SIEMENS

IP 252 Closed-loop control module and COMREG

(EWA 4NEB8110480-02)

Manual

4NES 811 0480 02

Release 03

for **6ES5252-5AB21**

Supplement to the IP 252 Manual,

- **Amendment/corrections to the IP 252 Manual,**

chapter	page	Amendment/corrections
4.5.2	4-7	However the following retentive data only can be entered in the STOP state of the IP:

SIEMENS

SIMATIC S5
IP 252 General-Purpose Closed-Loop Control Module

Operating Instructions Order No.: GWA 4NEB 811 0480 - 02b

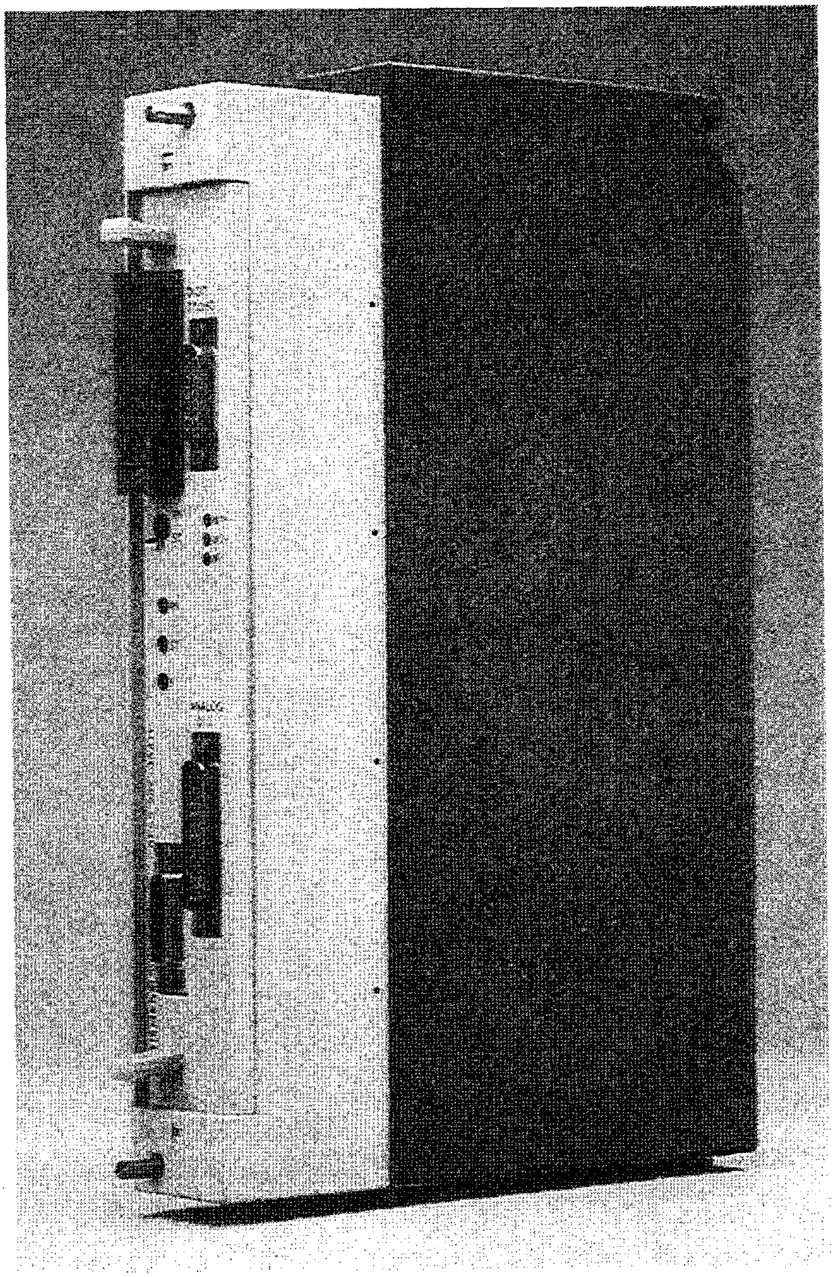


Fig. 1.1 General-Purpose Closed-Loop Control Module

1. Contents

Contents page

Contents Page

1. Overview

1.1 Using the module within the S5 System

The IP 252 module is a general-purpose closed-loop control module which can be configured for dedicated applications by inserting a memory submodule. The 252 intelligent I/O module can be inserted into the subracks of the U range of programmable controllers (S5-115U, S5-135U with R processor and S5-150U). It can be used with these programmable controllers as a part of the SIMATIC S5 system.
Used in this way, it can be networked via a CP communications processor to a central operator communication and monitoring system (e. g. CP 526, DIMOS) or via another CP to a higher level bus.
Configuration, parameter assignment and also start-up can be carried out using the PG 615/635/675/685 and 695 programmers in conjunction with the COM 252 or COM REG closed-loop control oriented operating systems. The programmers provide easy-to-use menus for these tasks.

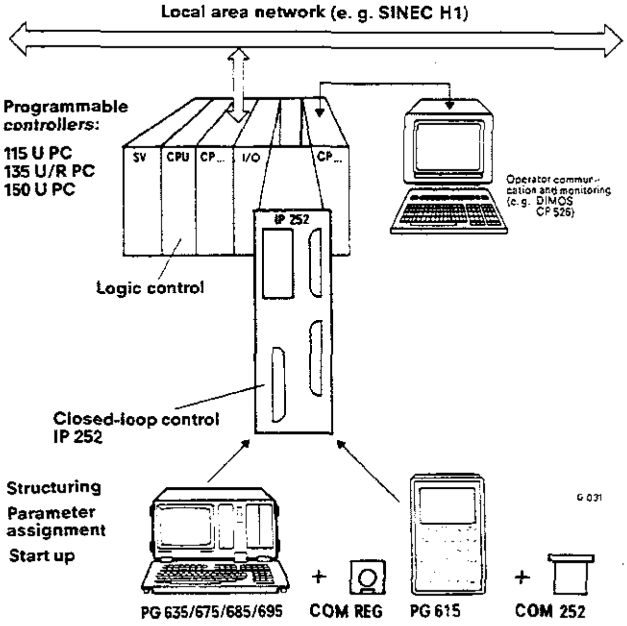


Fig. 1.2

The software interface between the logic program and the closed-loop control program is handled by a function block (FB). The data to be transferred between the CPU and the IP are defined in this block.

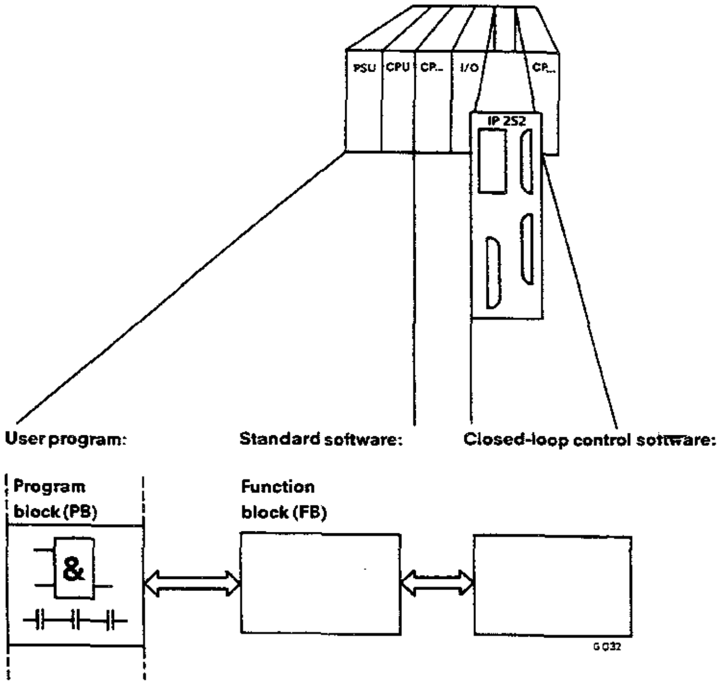


Fig. 1.3

1.2 Description of the Configuring Principle

The IP 252 is a closed-loop control module which can be configured for dedicated tasks by inserting a memory submodule into it. The available solutions for dedicated tasks are referred to in the following pages as controller structures. These structures consist of individual functions such as speed controller, ramp-function generator, etc., which are connected up to form controllers for specific tasks as required. There are two memory submodules available with the following controller configuration:

1. Drive controller structure and standard controller structure [DR/SR]

MLFB No.: 6ES5 374-0AA11

2. Expanded drive controller structure with self-setting and standard controller structure [DRS/SR]

MLFB No.: 6ES5 374-0AB11

Before starting up a control loop, the configuring data for the closed-loop controllers must be selected by closing appropriate software switches during a configuring data programming cycle.

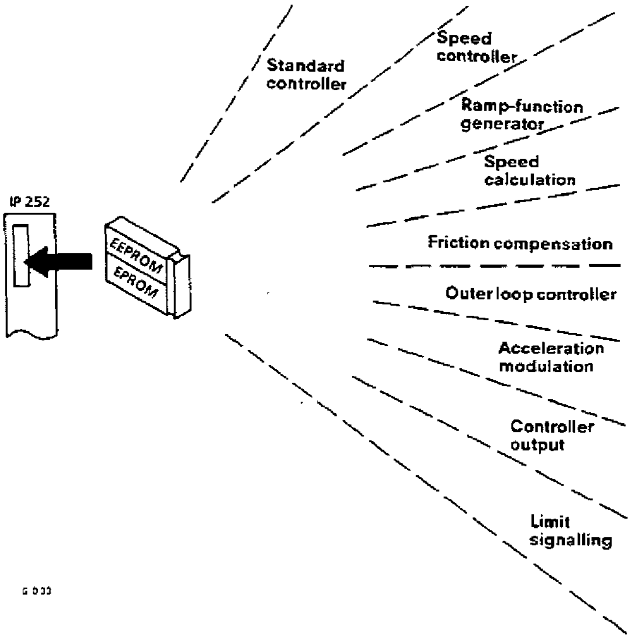


Fig. 1.4

2.1.1 Application

Digital closed-loop control systems are growing in significance alongside programmable controllers in the field of automation. For this reason, the IP 252 general purpose closed-loop control module was developed for use in fast closed-loop control applications. It can be used with the U range of programmable controllers (S5-115U, S5-135U/R processor and S5-150U). The IP 252 is one of a range of independent processor modules, which are modules that carry out their functions autonomously without using main CPU resources to any appreciable extent.
The closed-loop control module is available in compact design, so that it can be inserted in the S5-135U and S5-150U programmable controllers. For use in the S5-115U programmable controller, the IP 252 must be inserted into an adapter casing.

2.1.2 Principle of operation

2.1.2.1 General

The IP 252 interface processor module is used for solving fast closed-loop control tasks in the SIMATIC S5 automation system. It can execute up to eight control loops in parallel without using any CPU resources. With this module, much faster control loops can be processed by the SIMATIC system. The IP 252 cuts the shortest sampling time for other products from the previous figure of 100 ms down to 4 ms, which makes fast closed-loop controls such as in drive controls possible.
If more control loops have to be processed than can be executed by one module – the number of executable controllers per module depends on the requirements which are placed on the sampling time and the range of functions of the control system – then several IP 252 modules can be operated in one central controller. The number of closed-loop control modules which can be used in the various programmable controllers differs. Four IP 252 modules can be inserted in either the S5-135U or S5-150U programmable controller. In the S5-115U PC, the maximum number depends on various factors. If the S5-115U is operated without fans, then two IP 252 modules can be used, with fans four are possible.
The IP 252 module has eight analog inputs and eight analog outputs as well as an input for an incremental speed sensor. If additional analog inputs and outputs are required, analog modules can be used. The IP 240 module provides further digital pulse inputs. Up to two digital tachogenerators, whose pulse trains can be conditioned by the IP 240 to produce an actual speed value, can be connected.
As a special case when used in the S5-115U, the IP 252 can access the analog input/output modules in the same subrack directly without going via the CPU. If one wants to make use of this special case, then the number of IP 252 modules which can be used in the central controller even with fans is limited to three.
The IP 252 is a general purpose closed-loop control module which is configured for certain tasks by inserting a memory submodule. Special solutions for any dedicated tasks are referred to below as structures.

Fig. 2.1 shows the IP 252 used as a drive controller. The CPU of the programmable controller carries out the sequential and logic control and the IP 252 carries out the closed-loop drive control. The output signal from the control module has a range of −10 ... +10V. This signal represents the current setpoint for the external current controller, which is housed together with the power section in a separate unit (e. g. SIMOREG).

For operator communication and monitoring of the controller, the user has available to him the 615/635/675/685 and 695 programmers with the corresponding COMREG software. User-friendly configuration and parameter assignment of the universal IP 252 closed-loop control module is possible with these programmers.
Standard function blocks are available for transferring the following data between the control module and the S5 central processor:

- Start/stop commands
- Setpoints
- Binary variables

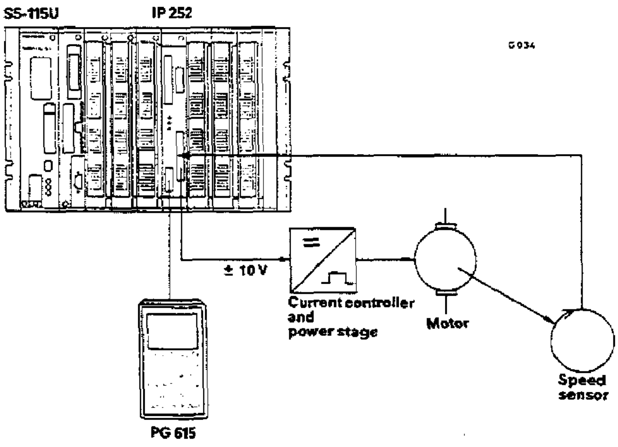


Fig. 2.1 Drive controller with S5-115U

2.1.2.2 Hardware architecture of the IP 252

The closed-loop controller is a double-width module in double Eurocard format. It consists of an analog and a digital card. The block diagram is shown in Fig. 2.2.

The closed-loop controller and its associated functions are executed by the 16-bit 80186 microprocessor. The processor section has an interface for a memory submodule, which can be plugged in at the front. The submodule is a mixed memory type with 32K bytes EPROM and 8K bytes EEPROM). The closed-loop controller structures, i. e. the firmware of the controller, are stored in the EPROM of this submodule. The configuring data entered during the configuration and parameter assignment cycle with the programmer are stored in the EEPROM of the memory submodule.

The processor section contains its own programmer interface for connecting up the programmer. Other interfaces connect the digital section with the backplane bus and the analog section.

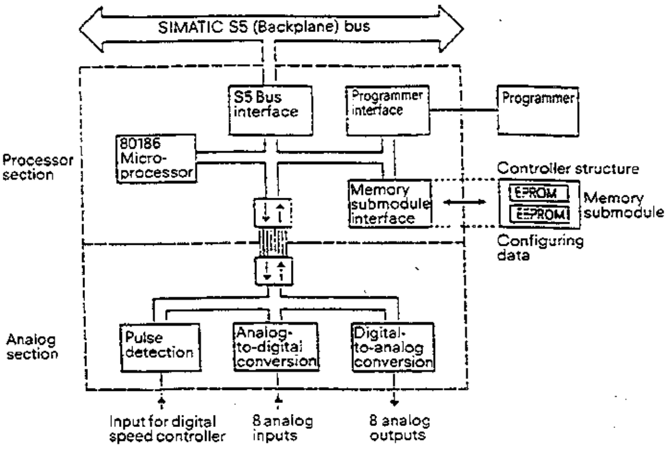


Fig. 2.2 Block diagram of the IP 252

The analog input/output section contains eight analog inputs and eight analog outputs. A 25-pin Cannon connector in the front panel is used for connecting up the input/output lines via a mating plug-in terminal box. The incoming and outgoing wires can be connected up to the screw terminals in the terminal box. Each of the eight analog inputs can be supplied with +/−10V from a signal source. Higher voltages should be reduced to +/−10V using an external actual value conditioning circuit. The first input is an exception as it can accept a maximum input voltage of 200 V, which is then reduced to +/−10V in the terminal box. This input can be used for instance for connecting up an analog tacho-generator (see Section 2.1.3.1.5). The inputs are equipped with suppression networks for protection against current and voltage spikes and against overvoltages (up to +/−24V).

The eight analog outputs have a voltage range of +/−10V at a maximum current of 5 mA. In order to protect against static discharges the outputs are equipped with suppression networks.

When using the IP 252 as a drive or position controller, an additional input for connecting a digital tacho-generator is available in the module. The tacho-generator is connected up via a 15-pin Cannon connector (see Section 2.1.3.1.3).

2.1.3 Construction

The module is a compact type and therefore can be plugged into the S5-135U and S5-150U programmable controllers. When using the S5-115U, the IP 252 must be inserted into an adapter casing.
A fan is generally not required when using the IP 252 controller module.

The front panel contains a receptacle for the memory submodule (X3), a 15-pin socket for connecting up a digital tacho-generator (X4), a serial interface for connecting up a programmer (X5), a 25-pin socket for connecting up the analog inputs and outputs via the terminal box (X6) and various control and indicating elements (operating mode switch for RUN/STOP, LEDs for operating mode indication and measuring sockets).
Backplane bus connectors (X1, X2) are located at the back of the module for connecting up to both backplane bus PCBs. The construction of the IP 252 is illustrated in Fig. 2.3.

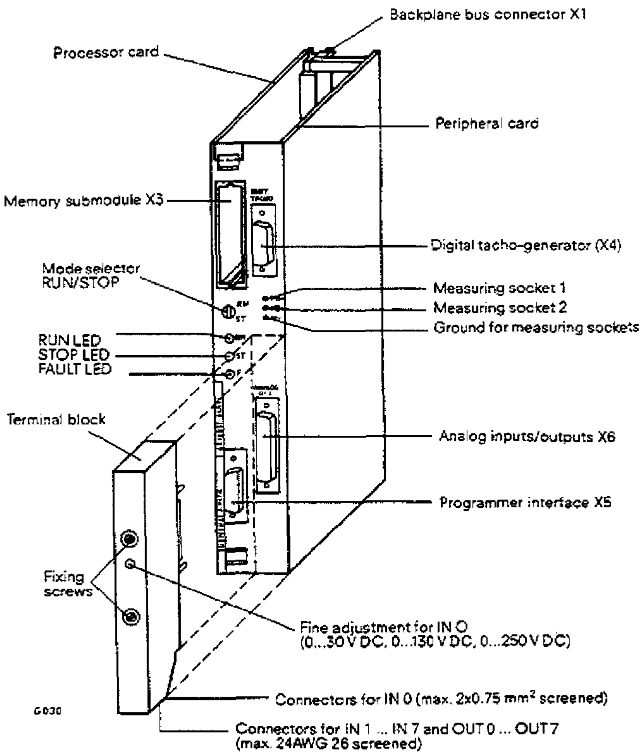

Backplane bus connector X1
Processor card
Peripheral card
Memory submodule X3
Digital tacho-generator (X4)
Mode selector RUN/STOP
Measuring socket 1
Measuring socket 2
Ground for measuring sockets
RUN LED
STOP LED
FAULT LED
Terminal block
Analog inputs/outputs X6
Programmer interface X5
Fixing screws
Fine adjustment for IN O (0...30 V DC, 0...130 V DC, 0...250 V DC)
Connectors for IN 0 (max. 2x0.75 mm² screened)
G030
Connectors for IN 1 ... IN 7 and OUT 0 ... OUT 7 (max. 24AWG 26 screened)

Fig. 2.3 Construction of the IP 252

2.1.3.1 Interface assignments

In the following sections, the interfaces of the IP 252 are described in detail. These are:

– Backplane bus connectors	(X1, X2)
– User memory	(X3)
– Interface for connecting up an incremental encoder	(X4)
– Serial interface for the programmer	(X5)
– Analog inputs/outputs	(X6)

2.1.3.1.1 Bus connectors X1, X2

Both 48-pin backplane bus connectors of the 2 series form the interface between the IP 252 and the SIMATIC S5 (backplane) bus. The signals comply with the "S5-bus specification"

Backplane bus connector 1

	d	b	z
2	+5,2V	M	+5V
4	UBATT		
6	ADB12	ADB0	RESET
8	ADB13	ADB1	$\overline{MEMR}$
10	ADB14	ADB2	$\overline{MEMW}$
12	ADB15	ADB3	$\overline{RDY}$
14	$\overline{IRA}$	ADB4	DB0
16		ADB5	DB1
18		ADB6	DB2
20		ADB7	DB3
22		ADB8	DB4
24		ADB9	DB5
26		ADB10	DB6
28		ADB11	DB7
30		BASP	
32		M	

Backplane bus connector 2

	d	b	z
2		M	+5V
4			
6			
8			
10			
12			
14			$\overline{NAU}$
16			$\overline{BAU}$
18			$\overline{HOLDAX}$
20			$\overline{HOLD}$
22	$\overline{T*DSn}$		
24			
26		R*DSn	
28			
30		M24V	M24V
32		M	+24V

Fig. 2.4 Pin assignment of the bus connectors X1 and X2

2.1.3.1.2 Memory submodule X3

This interface (48-pin DIN 41612 connector, range c short version) is used for the memory submodule shown in Fig. 2.5. This module contains the controller structures in the form of firmware in a 32K bytes EPROM and the configuring data (such as structure switches, controller parameters etc.) in an 8K bytes EEPROM.

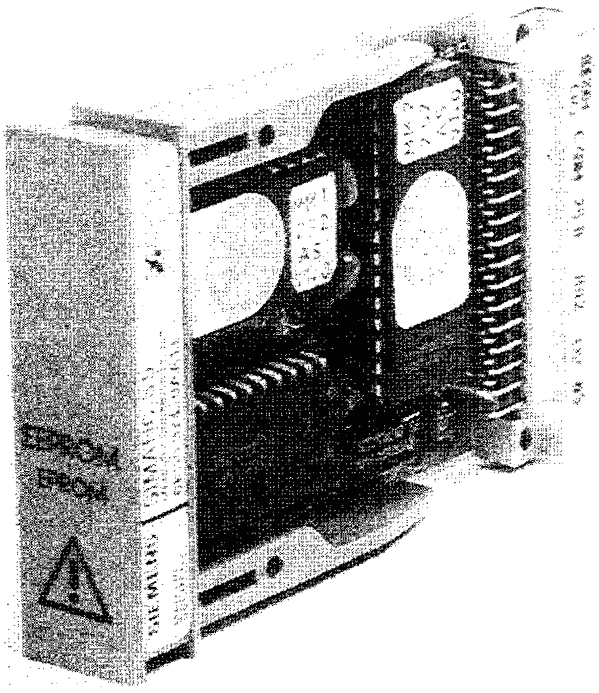


Fig. 2.5 Memory submodule

	c	b	a
1	A13	M	+5V
2	A 1	A 2	A 3
3	A 4	A 5	A 6
4	A 7	A 8	A 9
5	A10	A11	A12
6	A14	A15	$\overline{RD}$
7	$\overline{AWR}$	D 8	D 9
8	D10	D11	D12
9	D13	D14	D15
10	D 0	D 1	D 2
11	D 3	D 4	D 5
12	D 6	D 7	K 1
13	$\overline{CS1}$		K 2
14	$\overline{CS2}$	$\overline{CS4}$	K 3
15		PSW$\overline{busy}$	K 4
16	+5V	M	K 5

Fig. 2.6 Pin assignment X3

2.1.3.1.3 Digital tacho-generator input X4

If required (e. g. for speed control), it is possible to connect up an incremental encoder (digital tacho-generator) via a 15-pin socket to the pulse detection circuit of the IP 252. The utilization of the pulse acquisition module is projected during configuring with the programmer (PG 615 or PG 675). The exact assignment of the interface for connecting up the incremental encoder is shown in Fig. 2.7.

Sensors providing two pulse trains displaced by 90°, a reference track and the relevant inverse signals can be connected.

1	A	Track A
2	M5V	Internal ground
3	/B	Track /B
4	R	Reference track
5	+5V	
6		
7		
8		
9	/A	Track /A
10	B	Track B
11	M5V	Internal ground
12	/R	Reference track /R
13		
14	+5V	
15	/W	Warning track

Fig. 2.7 Interface for RS 422 incremental encoder

2.1.3.1.4 PG interface X5

The 15-pin socket assignment shown in detail in Fig. 2.8 is the interface between the IP 252 and the programmer.

1	MEXT	External ground
2	TTY IN−	Current input
3	+5.2V	
4	+24V	
5	Ground	Internal ground
6	TTY OUT+	Current output
7	TTY OUT−	Current output
8	MEXT	External ground
9	TTY IN+	Current input
10	M 24V	Earth for 24V
11	20 mA	Current source for transmitter
12	Ground	Internal ground
13	20 mA	Current source for receiver
14	+5.2V	
15	Ground	Internal ground

Fig. 2.8 Programmer interface

2.1.3.1.5 Analog inputs/outputs

Up to eight analog input and eight analog output signals can be connected via the terminal box (see Fig. 2.9) to the 25-pin socket on the controller module. Each of the eight inputs (IN 0+ . . . IN 7+) contains its own ground connections (IN 0− . . . IN 7−) whereas the eight analog outputs (OUT 0+ . . . OUT 7+) are connected to the ground of the IP 252 (M5V).
The analog inputs and outputs are normalized to 10V = 100%. The actual speed value from the analog speed controller can be adjusted to 10V. The coarse adjustment is carried out using jumpers on the terminal block and the fine adjustment using a multi-turn potentiometer, which can be accessed from the outside of the terminal box. The maximum permissible tacho-generator voltage therefore lies in the range 0 . . . 200 V DC depending on jumpers A . . . F.
Table 2.1 shows the relationship between the jumpers and the maximum permissible tacho voltages.

Tacho voltage	Inserted jumpers	Fine adjustment width	Filter time constant
0 . . . 10V	E	/	300 µs
0 . . . 30V	D,F	R8	1.5 ms
0 . . . 70V	C,F	R8	1.5 ms
0 . . . 130V	B,F	R8	1.5 ms
0 . . . 200V	A,F	R8	1.5 ms

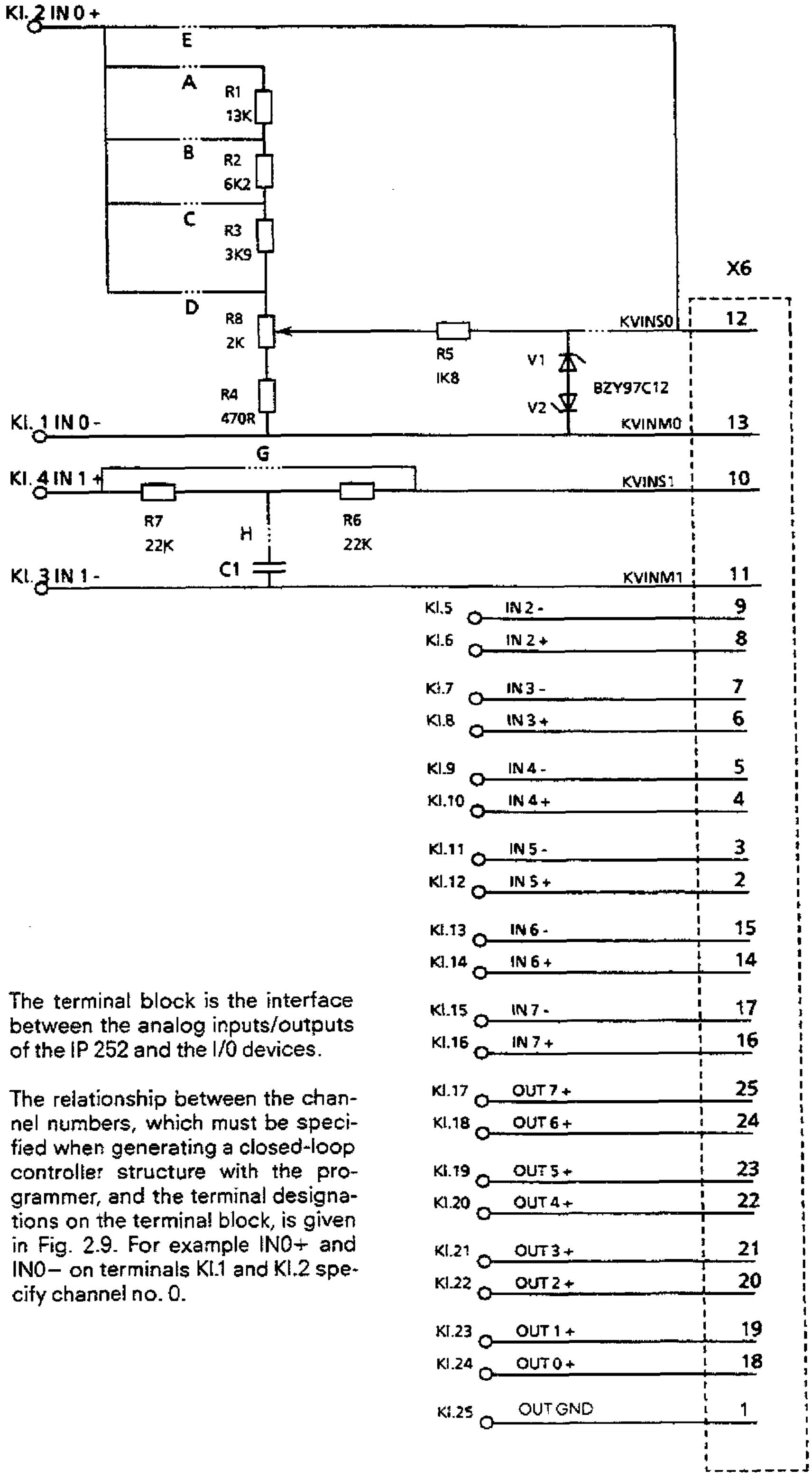
Table 2.1 Adjustment of the encoder voltage on the terminal block

The input impedance and therefore the smoothing time constant of the actual speed value detection circuit is therefore dependent on the jumper configuration. The standard configuration is with jumpers A and F inserted.

2. Instructions for the IP 252

2.1 Description

The actual armature current detection should be carried out via terminals Kl.3 and Kl.4, since it is possible to effectively smooth out the harmonic components at these terminals. Jumper G removed and jumper H inserted produces a smoothing time constant TGL = 10 ms.
All the other analog inputs have a smoothing time constant of 300 μs.



The terminal block is the interface between the analog inputs/outputs of the IP 252 and the I/0 devices.

The relationship between the channel numbers, which must be specified when generating a closed-loop controller structure with the programmer, and the terminal designations on the terminal block, is given in Fig. 2.9. For example IN0+ and IN0− on terminals Kl.1 and Kl.2 specify channel no. 0.

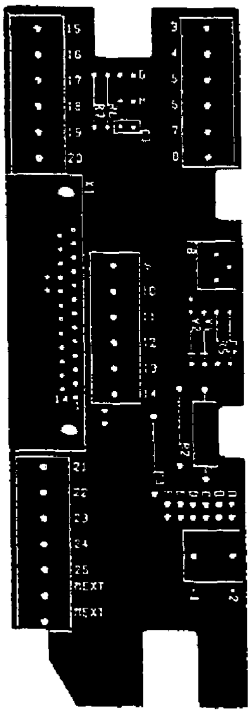


Fig. 2.9 Circuit diagram of the terminal block

2.1.3.1.6 Measuring sockets (M1, M2, M−)

The two measuring sockets M1 and M2 with the corresponding ground wires M− permit the analog measurement and recording of any two selectable variables (e. g. controller deviation and manipulated variable). The assignment of the measuring socket to the required variables is possible at any time during operation with the programmer. The measuring socket to be used must be specified during the configuring run during structure configuration.

2.1.4 Recommendations for installation and start-up

The following measures are recommended for protecting the IP 252 against electrical and magnetic interference via the analog inputs/outputs:
- All signal sources and loads must be connected via shielded cables.
- The leads, including their shielding, must be connected to a terminal block.
- A shielded, multi-core cable runs from the terminal block to the terminal block of the IP 252
  The cable for the actual speed value (200 V max.) should be run externally.
- The cable shields must be connected to the ground of the programmable controller via the terminal block.
- The shields of the analog input/output cables must be connected radially to the central grounding point **in the immediate vicinity of the terminal block.**

In the case of the S5-135U and S5-150U programmable controllers, the IP 252 closed-loop controller module is plugged into a suitable mounting location which connects it to the backplane bus. When used in the S5-115U programmable controller, the IP 252 must be inserted into an adapter casing, which is then attached to the subrack of the S5-115U.

To avoid erroneous addressing of the module, an interface block number should be assigned to the IP 252 in the SYSID function immediately after "power on" which is used to address the module from the CPU in all subsequent operations.

After switching the power supply of the programmable controller "on", initially both red LEDs on the IP 252 light up and the self-test on the module is initiated. After successful completion of the self-test routine the fault LED extinguishes; the module waits in the STOP state.

The IP 252 can be switched to the RUN state by moving the mode selector switch from the "STOP" position to the "RUN" position.

If the fault LED does not extinguish after the self-test, then the programmer (e. g. PG 615) can be used for determining the cause of fault (see Section 4.5).

If the actual speed value is to be acquired via an analog tachogenerator, then the tacho voltage must be initially normalized to the +/−10V rated voltage with the voltage divider in the terminal box (see Section 2.1.3.1.5).

When the module is connected up to the programmable controller and the inputs and outputs, then the individual control loops which are to be executed in the IP 252 can be configured. This means that the required structure and parameters are entered using a programmer (see Sections 6 and 7).

2.1.5 Technical specifications

2.1.5.1 Environmental conditions

Degree of protection		:	IP 20
Permissible ambient temperature		:	0 to 55 °C
Transport and storage temperature		:	−40 to 85 °C
Humidity rating F (DIN 40040)		:	< 75% humidity, average annual value for <35 °C, no condensation
Mechanical stress		:	Can be mounted on fixed equipment not free of vibrations
– Vibration	IEC 68-2-26	:	10 . . . 57 Hz 0.15 mm 57 . . . 500 Hz 2 g
– Shock	IEC 68-2-27	:	30g/18ms, semi-sinusoidal

2.1.5.2 Mechanical specifications

Printed circuit board format	Double Eurocard format 160 x 233 mm
Front panel width	40.4 mm
Adapter capsule	(42.5 x 177 x 201) mm
Weight	
Backplane bus connectors (ES 902, series 2, 48-pin)	2
Front panel connector (socket, D-Sub, 15-pin)	2
Front panel connector (socket, D-Sub, 25-pin)	1
Operating mode switch RUN/STOP	
LED display elements	3

RN (RUN)
ST (STOP)
F (FAULT)

2.1.5.3 Electrical specifications

Dissipation		:	12.9 W max.
Microprocessor		:	iAPx 80186
Processor clock		:	8 MHz
Memory			
Module EPROM		:	2 x 8K bytes
Memory submodule EPROM		:	2 x 32K bytes
Module RAM		:	2 x 8K bytes (backup)
Memory submodule EEPROM		:	1 x 8K bytes

Analog section

Analog inputs			
Input signal range		:	± 10 V
Saturated range		:	± 11.25 V
Number of inputs		:	8
Input resistance, channels 0-3 and 7		:	> 10 M
channels 4-6		:	1 M
Input filter time constant		:	0.3 ms
Digital signal representation		:	11 bits with additional sign bit
Conversion mode		:	stepwise approximation
Conversion time		:	30 us
Conversion time for 8 inputs with command execution cycles		:	560 us
Permissible voltage between input and central ground point (destruction limit)		:	max. 24 V or 75 V for max. 1 ms and 1 : 20 duty cycle
Permissible voltage between (+) input and (−) input (destruction limit)		:	max. ± 35 V
Permissible voltage between reference potential of a non-floating encoder and central ground		:	max. ± 1 V
Basic error limits	± 10 V	:	± 0.06 % ± 1 LSB
Operating error limits (0 °C to 55 °C)		:	± 0.17 % ± 1 LSB

Analog outputs

Output voltage range		:	± 10 V
Number of outputs		:	8
Burden, channels 0 − 6		:	≥ 3.3 K
channel 7		:	≥ 0.5 K
Digital signal representation		:	11 bits with additional sign bit
Short-circuit protection		:	Yes
Short-circuit current, channels 0 − 6		:	approx. 25 mA
channel 7		:	approx. 35 mA
Reference voltage of the analog output signals		:	Module ground (low resistance connection to subrack)
Basic error limits	± 10 V	:	± 0.05 % ± 1 LSB
Operating error limits (0 °C to 55 °C)		:	± 0.15 % ± 1 LSB
Cable length		:	max. 200 m (screened)
Supply voltage (serial interface)		:	24 V
Rated value		:	20 V − 30 V
Supply voltage (logic)		:	+ 5 V
Rated value		:	4.75 V − 5.25 V
Supply voltage (PG 615)		:	+ 5.2 V
Rated value		:	4.95 V − 5.45 V
Current consumption	+ 5 V	:	max. 2.3 A
	+ 24 V	:	max. 60 mA
Module width (1 SPS = 15.24 mm)		:	8/3 SPS (≙ 2 mounting locations)

Pulse input

Measurement input type		:	incremental
Counter range		:	0 to 32767
Input voltage for the tracks		:	TTL levels from line drivers, type SN 55114
Supply voltage for the encoder		:	+ 5 V
Input frequency		:	max. 200 kHz
Operating modes		:	2 pulse trains, 90° shift, 1 zero pulse

3. Brief Programming Instructions

3.1 The Configuring Principle

These brief programming instructions describe the generation and start-up of control loops with the IP 252 closed-loop control module. Familiarity with the operation of the programmers used is assumed. The various input options (off-line/on-line) are not described further.
The PG 615, equipped with the special operating system for the IP 252:
COM 252 automatically displays the menu after switching on the power supply: "Default: bus access Y/N" (see Section 6.2.1). After answering this question and pressing the execute key, the basic menu is displayed where, for example, the operating modes "input", "Output", and "Controller test" can be selected.
If the PG 615 is connected to the IP via a PG cable, then the PG is supplied with +5.2 V when the IP is operated from an S5-115U PC. If an S5-135 U PC or an S5-150 U PC is used, an external power supply (+5.2 V) is required.

If a PG 635/675/685/695 programmmer is used, the **COM REG** diskette is required.
The programming package for generating control-loops with the IP 252 is then called up with: **S5**
After the COM REG package has been selected with the aid of the cursor, and soft key (function key) F1 is pressed, a menu with defaults is displayed. After pressing the "Finished" soft key, the basic menu appears in which the operating modes "Input" etc. can be called up using the soft keys.

3.1 The configuring principle

The programming and observation of a control-loop is carried out in 8 steps using the programmer:

1) **Selection of the controller structure and assignment of a control loop number**
The following structures are available
   - DR (drive controller see, Fig. 9.1)
   - SR (standard controller see, Fig. 9.2)
   - DRS (expanded drive controller structure with self-setting, see Figure 9.3)

   The control loop to be generated with the selected controller structure is assigned a number from 1 . . . 8. This means that up to 8 drive and/or standard controllers can be operated in parallel on an IP 252.

2) **Selection of all required functions**
The **functions** of a control loop (e. g. ramp-function generator, PID controller etc.) are selected by closing configuring switches. This occurs in the **"configuration run"**. A configuring switch can only be modified in the "Input" and "Output" modes using the programmer.

3) **Selection of the sampling time**
The selection of the sampling time is always a compromise between a quasi-continuous assumption for the control loop on the one hand and the processor loading on the other.
Longer sampling times reduce the processing load on the processor of the IP 252 and allow the parallel operation of more control loops with one IP 252. However this also causes a slight degradation of the control system in terms of dynamic response and re-tuning of the controlling parameters to a specified performance criterion (e. g. max. 5% overshoot for set-point changes) may be required.
Recommendation for the selection of the sampling time:
In order to use the well known analog assumptions for digital control loops (e. g. for selecting the controller parameters according to the symmetrical optimum principle), the sampling time cannot be too long.
Experience shows that a sampling time of approximately 1/10 of the time constant $T_{RK,\,dom}$, which determines the step response of the **closed control-loop,** produces a controller response comparable with an analog control loop:

$$T_A \leq \frac{1}{10} T_{RK,\,dom}$$

The shortest sampling time T_A = 4 msec loads the processor of the IP 252 to such an extent that only one drive or one standard control loop is possible without overloading the processor.
If such an overloading of the processor occurs (for instance through the quasi-parallel operation of two drive controllers with T_A = 4 msec **or** 2 controllers with T_A = 8 msec **and** 1 controller with T_A = 4 msec) the operating system of the IP 252 automatically increases the sampling time temporarily to the next higher value. This ensures trouble-free further operation of the control loops even in extreme cases.
The processor loading is displayed (in %) on the screen, as soon as the entry of the sampling time is concluded.

The following sampling times can be specified: T_A = 4/8/16/32/64/128/256/512 msec, 1/2/4/8/16/32 sec.

3. Brief Programming Instructions

3.1 The Configuring Principle

4) Selection of the controller response
The following Yes/No questions have to be answered:

I) If the control loop is not executed, then the outputs are at "0": Yes/No
"Yes" means that a disabled control loop has zero as its manipulated variable (m. v.).
"No" means that, as soon as a control loop is disabled, the last calculated manipulated variable continues to be output. The enabling or disabling of a control loop is carried out with the programmer using the "Special functions" menu in the sub-menu "Operating mode" (Instruction Manual: Section 6.2.6.1).
This question should only be answered with "No" in applications where a ramping or a crossing of a limit value by the controlled variable (e. g. speed or temperature) is not possible or does not lead to damage. (For detailed description see Instruction Manual, Section 6.2.2.6)

II) Automatic warm restart after "Power on" required: Yes/No
This question determines whether after a power failure of any duration, the IP 252 should automatically enter the "Run" mode after the power has returned and continue with the processing of the control loops. This assumes that the IP 252 was in the RUN mode before the power failure.

If "No" is selected, this control loop is no longer executed after a power failure regardless of the previous state, the control loop is disabled.

Furthermore, if this question is answered with "Yes", then question III must also be answered.
(Detailed description see Instruction Manual, Sections 4.7 and 6.2.2.6).

III) The warm restart criterion is considered: Yes/No
The warm restart criterion refers its decision criterion to the control deviation x_D before and after the power failure. As a guide to the duration of the interruption, the following start criterion is used:

$$|x_{D,\,new} - x_{D,\,old}| < 0.25 * |w_{old}|$$

where:
$x_{D,\,new}$ is the control deviation **after** the power failure
$x_{D,\,old}$ is the control deviation **before** the power failure
w_{old} is the setpoint **before** the power failure

If the question was answered with "Yes" and the criterion is fulfilled, then the conclusion is drawn that the interruption is only of short duration as the actual value has not distanced itself too far from the setpoint. In this case the old previous values are used for the calculation (e. g. manipulated variable) and the control loop is executed.
In the other case ($|x_{D,\,new} - x_{D,\,old}| > 0.25 * |w_{old}|$) the previous values of all functions are reset and the control loops are then executed further. This case corresponds to a "cold start" of the controller.
(Detailed description see Instruction Manual, Sections 4.7 and 6.2.2.6).

If this question was answered with "No", then a cold restart of the controller is always carried out, provided that warm restart was selected and the module was in the "RUN" mode before the power failure.

5) Specification of dimensions for dimensioned variables (only for the standard controller structure)
Limiting values, setpoint upper limits etc. of the standard controller configuration can be assigned any desired dimension. This dimension consists of max. 6 ASCII characters.
The range limits must then be entered in dimensioned absolute values e. g.:

0% = 10.50 (dimension)
100.00% = 68.42 (dimension)

Note: The number of digits after the decimal point must be the same for both values.

The values entered for 0% and 100% determine the coordinates of a straight line. In this way the range of values for −100% ... 0 ... +100% of the dimensioned variable is specified.
(For detailed description see Instruction Manual, Sections 4.4.3 and 6.2.2.7).

6) Assigning parameters to the selected branches and functions
All selected functions and branches of the controller configuration must be assigned the required parameters by making corresponding entries on the programmer.

Parameters are for instance the controller amplification K_p, smoothing time constants, as well as analog input/output channels and measuring points within the controller structure (e. g. setpoint to ramp-function generator).

Input formats on the PG:
– Time formats (e. g. controller integral-action time T_N)
The units msec, sec or h. min are selected by pressing a soft key and then the numerical value is entered.
The following time ranges can be selected on the programmer:
0.1 ... 999.9 msec
0.001 ... 9999. sec
00.01 ... 59.59 h.min
– Percentage values (e. g. setpoint)
The input/output is carried out using fixed decimal point.
Input range: ± 0.01% ... ± 100.00%
Output range: ± 0.01% ... ± 200.00%
The number range of ± 100.00% corresponds to a voltage range of ± 10 V at the analog inputs/outputs. (For detailed description, see Instruction Manual, Section 4.4).

All parameters, except for input/output channels, can be modified not only in the "Input" and "Output" operating modes but also in "Controller test". Therefore one can intervene in a running control loop, which maskes for example the tuning of the control loop or the entry of a new manipulated variable limit possible.

The **assignment of analog channel numbers** to the A/D or D/A converters shown in the controller structure diagrams (Fig. 9.1 to Fig. 9.3) is carried out as follows:

For instance, in Fig. 9.1 (drive controller structure), DAC 2 of branch 1 is assigned to channel no. 3 corresponding to the wiring of the terminal block.

This determines in this example that the controller output (manipulated variable) is available via terminals 21 (+) and 25 (ground) in the terminal block (see Table 3.1).

Terminals	Analog inputs (ADC)
Term. 2 Term. 1	+ – Input channel no. 0
Term. 4 Term. 3	+ – Input channel no. 1
Term. 6 Term. 5	+ – Input channel no. 2
Term. 8 Term. 7	+ – Input channel no. 3
Term. 10 Term. 9	+ – Input channel no. 4
Term. 12 Term. 11	+ – Input channel no. 5
Term. 14 Term. 13	+ – Input channel no. 6
Term. 16 Term. 15	+ – Input channel no. 7

Terminals	Analog outputs (DAC)
Term. 24 Term. 25	+ – Output channel no. 0
Term. 23 Term. 25	+ – Output channel no. 1
Term. 22 Term. 25	+ – Output channel no. 2
Term. 21 Term. 25	+ – Output channel no. 3
Term. 20 Term. 25	+ – Output channel no. 4
Term. 19 Term. 25	+ – Output channel no. 5
Term. 18 Term. 25	+ – Output channel no. 6
Term. 17 Term. 25	+ – Output channel no. 7

Table 3.1 Relationship between the input/output channel nos. for which parameters have to be assigned and the terminals in the terminal block

If more than 8 ADCs or more than 8 DACs are required per IP 252, then it is possible to access external DACs and ADCs via **direct bus access** in the S5-115U.
(For detailed description see Instruction Manual, Sections 2.1.3.1.5 and 4.9).

7) Enabling of control-loops

Before a control loop can be started up, it must be enabled in the PG operating mode "Special functions" in the sub-menu "Operating mode".

Note regarding control loop enable:

Basically two different meanings are attached to 'Controller enable'.

- 'Controller enable' within a control loop:
  In the drive controller in each of the branches 5 and 9 there is a control algorithm which can only be executed if the corresponding controller enable bit is active. This bit can be made active in the PG mode "Controller test", where the branch (5 or 9) is selected and the RF bit is set to 1 via the PG.
- 'Control-loop enable' or enabling of a programmed control loop.
  'Control loop' in this context means the controller structure selected by the user with all configuring data and parameter assignments.

Before a control loop, which has been assigned a control loop no. between 1 . . . 8, can start control operation in the PG operating mode "Controller test", it must first be enabled for execution.

3. Brief Programming Instructions

3.1 The Configuring Principle

The enabling is carried out in the PG operating mode "Special functions" in the submenu "Operating mode".

Example:
Operating mode on the PG 615:

	R1	R2	R3	R4	R5	R6	R7	R8
ENABLE	N	J	N	J	–	–	–	–

This example illustrates the following:

1. Of the 8 possible control loops, those with numbers 1, 2, 3 and 4 are already configured. Which structure (drive or standard controller) is selected **cannot** be seen from this menu.
2. The control loops 2 and 4 are enabled, i. e. they are executed if the IP 252 is in the "RUN" state. Control loops 1 and 3 are disabled, i. e. they are **not** executed.

The enabling of the control loop can also be carried out via the PC.

8) Start up of a control loop ("Controller test")

After steps 1 – 7 have been carried out, the control loop can be started up. For this purpose the IP 252 is brought to the RUN state using the PG **or** using the operating mode selector. Starting from the basic menu of the PG, the function "Test" or "Controller test" is called up. Then the control loop no. is requested. After this it is possible to call up the branches of the DR or SR structure which have been configured and assigned parameters. Only then can the enable bits, such as, for example, the controller enable bit RF in branch 5 of the DR structure, be set. The controller algorithm in branch 5 only begins execution when RF = 1. This bit can be set or reset either from the PC or from the PG.

The modification of a bit, relay or constant during controller test is carried out by
first pressing the key ↦ in the PG 615 or
the **"Force" soft key** in the PG 635/675/685 and 695.
The cursor begins to blink and the modification of bits, relays and constants is possible.

A controller structure must therefore be

- configured,
- assigned parameters,
- enabled in the PG operating mode "Special functions", and
- the corresponding enable bits must be activated in the PG operating mode "Controller test". The last two functions can also be carried out from the PC.

Only ther. :s the selected controller structure able to control a process (e. g. electric drive).

3.2.1 System configuration for this example

PG 675 programmer
S5 115 U programmable controller
CR 700-2 subrack
Modules from left to right:
6ES5 951-7LD11, power supply, max. 15 A
6ES5 942-7UA11, CPU, version 2, default: NR
6ES5 252-3AA11 IP with DR/SR memory submodule (6ES5 374-0AA11)
6ES5 451-7LA11 digital output module
6ES5 430-7LA11 digital input module

Converter equipment and motor:
4-quadrant static converter equipment
10V current setpoint (actual value) corresponds to an armature current of 24A
The nominal motor current is 15A; analog actual speed sensor

3.2.2 Requirements to be met by open-loop control and closed-loop control systems

- Speed control of the motor, current setpoint generation
- Ramp function generator with "Manual" function (with the "Faster" and "Slower" keys)
- Temperature monitoring of the motor with shutdown at excess temperature (motor coasts to a standstill)
- Movement with auxiliary speeds "Setting-up forward" and "Setting-up reverse"; "Setting-up forward" is also used as the base speed of the drive
- Braking at "Stop"
- Generation of the warning, pause and enable time when switching on the drive
- Switching on the motor field and the motor fan, if installed
- Driving the warning horn
- Driving the main contactor
- Generating the controller enable
- Driving the control lamps for overload and enable time
- Output of two velocity limit values to the input/output modules
- Assigning the current setpoint to measuring socket 1 of the IP, and the actual speed to measuring socket 2.

3.2.3 Preparation of the static converter and motor

- Connect the static converter and the motor
- Optimize current controller (close the main contactor and bridge the controller enable)
- Wire the current setpoint and the actual current to the IP, connect the tachogenerator (see Fig. 3.1).

3.2 Example for Operating a DC Motor wit the IP 252

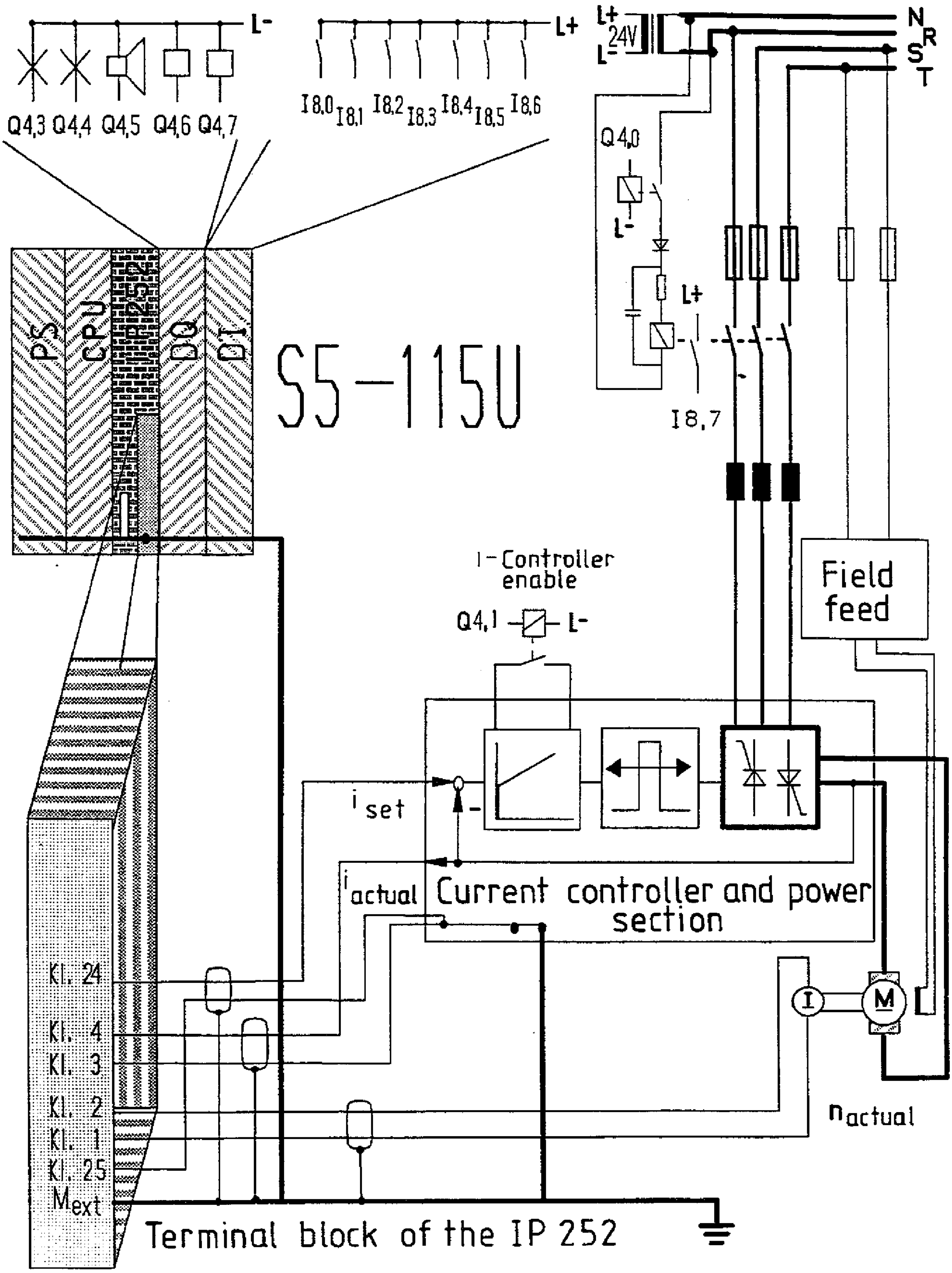


Fig. 3.1 System configuration

3.2.4 Preparation of the S5 control

- Plug the S5 modules and termination connector into the rack.
- Select the voltage on the power supply module, inserting the back-up battery if applicable.
- Ground the rack and connect the supply voltage.
- Wire the inputs and outputs.
- Remove the "G" jumper on the terminal block of the IP and insert the "H" jumper; the "A, B, C, D, E, F" jumpers must also be inserted – depending on the tachogenerator used.
- Attach the terminal block to the IP 252, plug in the user submodule, and set the mode selector switch to "STOP".
- Switch on the controller and execute an Overall Reset (hold the switch on the CPU in the "OR" position and move the Run/Stop switch twice from the ST position to the RN position).
- Switch the controller to "RUN" mode.

3.2.5 Programming the IP 252

- Plug in the connecting cable between the programmer and the IP 252 and switch on the programmer; insert the "PCP/M Operating System" diskette in drive 0 and the CEFU diskette (Section 3.2.9) in drive 1.
- The operating system answers with "**A** >". You can call up the S5-DOS system with "**B:S5** <CR>".
- Remove the "PCP/M" diskette, insert the "COM REG" diskette (Section 3.2.9) and press function key <F7>.
- "S5-DOS" answers with the available program package. On pressing <F1> ("Package") the module menu appears. Press key "IP 252" and you are now in the defaults form.
- In the "DEFAULTS FORM" the operating modes "ON LINE" and "IP 252 WITHOUT BUS ACCESS" are selected with <F8> and <F3>. <F8> takes you to the main menu.
- On pressing <F7> "INFO" and <F4> "SYSID MODULE", page no. **5** is entered. <CR> and <F7> "READY" brings you back to the main menu.
- Now all old controller data of the module must be deleted. To do so, press <F5> "DELETE" and <F4> "DELETE MODULE". *is inserted as the controller number. The job is terminated with <CR>.
- <F1> "INPUT" is now pressed and the module is selected with <F4>.
- <F1> determines that a drive controller is to be programmed.
- Next, the loop number is determined. **1** is entered and confirmend with <CR>.
- Now the controller structure is entered. The required branches are selected with **1.** See printout: "1. Configuring switch".
- Configuration is terminated with <F7> "READY".
- The sampling time is now selected. **4 ms** is entered with <F2> "INPUT" and the time is confirmed with <CR>. After pressing <F7> "READY", the "Controller action" form appears.
- The questions are answered with <F1> "YES" and <F3> "NO" as follows:
  When the controller is not being processed, all outputs are set to 0: **YES**
  Automatic warm restart after power up: **YES**
  The warm restart condition is valid: **NO**
  This is also terminated with <F7>.
- Nothing is entered in the next form. Pressing <F7>7 "READY" again brings you to parameter assignment.
- The branches selected during configuration are now called up in sequence and initialized. After entering the branch number **1** and terminating with <CR>, the form of branch 1 "Controller output" appears. The individual parameters can be found in the program printont under "5. Parameters".
- <CR> must be pressed every time a parameter is entered. When the last parameter of a branch is entered, the message "End of list reached" appears. The next branch is called up with the "Enter" key.
- After the last branch has been entered, a list of all branches used appears. <F7> "READY" must now be pressed. This transfers the controller block to the module.
  The "ABORT" key takes you back to the main menu.

3.2 Example for Operating a DC Motor with the IP 252

3.2.6 Testing the controller block

- Closing the main contactor and bypassing the controller enable (current controller).
- Switch the IP 252 to "RUN" mode.
- Press <F6> "SPECIAL FUNCTIONS" and the <F7> "CONTROLLER PROCESSING". Then enable controller 1 for processing with <F1> "YES". The "ENTER" key brings you back to the main menu.
- Press <F8> "TEST" and enter controller number **1**; <CR> takes you to the branch menu.
- Branch **5** is selected and terminated with <CR>.
- Now press <F2> „FORCE". Set the "Controller enable" parameter from **0** to **1** and confirm with <CR>. **Important note:** the drive may already have started to rotate slowly.
- Now press the "ENTER" key three times. The following parameters must be changed in branch 8:
  "Setpoint enable" **1**
  "ADC/Key" in **1**
  A constant setpoint of **30%** must also be entered. <F2> "FORCE" must be pressed before every change to a parameter and every entry must be confirmed with <CR>.
- The drive should now run with 30% of its nominal speed. The speed is adjusted with the spindle potentiometer on the terminal block of the IP 252.
- The speed controller can now be optimized by disabling and enabling the set-up speed setpoint. For connecting a recorder, the current setpoint is available at measuring socket 1 and the actual speed at measuring socket 2.
- Branch 6 is called up using <F8>. Now set the "Set-up speed enable" parameter to **1** and then reset it to **0** again.
  To change the controller parameters between step changes in the setpoint, branch 5 must be selected with <F8>. The proportional coefficient can be changed here and the integral action time can be entered.
- The speed of the motor with the setpoint of 100%, and the operating mode "Setting-up reverse" (creep speed branch 7) should now be checked.
- At the end of the test, set the controller enable in branch 5, the two parameters in branch 8 and all setpoints to 0. Remove the jumpers for the main contactor and the controller enable of the current controller.

3.2.7 Entering the control program

- Connect the interface cable from the IP 252 to the CPU and switch the IP 252 to "STOP".
- Change the operating system in the programmer and execute a cold restart with the keylock switch.
- Now transfer the FB244, FB245, FB247, FB248 and FB249 function blocks (data handling blocks) from the PC to diskette. FB100 (FB:STEU) must also be transferred to this diskette.
- Now write the program onto the diskette (see printout).
- Then transfer all block types individually to the PC. When transferring the function blocks, error message 70 appears and the programmer aborts the transfer (because the data handling blocks are already in the S5-115U). However, all the other function blocks have been transferred before the abort.

3.2.8 Information about the control program

- Blocks used
  OB 1, 21, 22;
  PB 1, 2, 3;
  FB 96, 97, 98, 99, 100, 244, 245, 247, 248, 249; (with the S5 115U)
  FB 96, 97, 98, 99, 100, 120, 121, 123, 124, 125; (with the S5 135U, R processor)
  FB 96, 97, 98, 99, 100, 180, 181, 183, 184, 185; (with the S5 150U)
  DB 10, 11;

- Inputs

I 8.0	"0" corresponds to STOP (fail-safe)
I 8.1	Faster
I 8.2	Slower
I 8.3	Setting-up forward
I 8.4	Setting-up reverse
I 8.5	Acknowledgement overload
I 8.6	Warning
I 8.7	Acknowledgement "Main contactor on"

- Outputs

Q 4.0	Main contactor on
Q 4.1	Controller enable
Q 4.2	Field and fan on
Q 4.3	Enable lamp
Q 4.4	Overload display
Q 4.5	Warning horn
Q 4.6	Limit monitor 6% of max. speed
Q 4.7	Limit monitor 10% of max. speed

- Timers
  T 10 to T 17

- Flags
  0.0, 0.1, 31.1, 31.2,
  FB 30, 112, 124,
  FW 100 to 110, 114 to 118 and 200 to 213

- Parameter assignment errors are not evaluated by the program.

3.2.9 Generating a "COM REG S5-DOS" work diskette

"COM REG"

Make a back-up copy of the "COM REG" diskette.

"CEFU diskette"

The central functions (CEFU) are located in several files.
Find the CEFU diskette which contains the following files:

- S5.CMD
- S5KDS02X.CMD
- S5WX000H.CMD
- S5WX001H.CMD
- S5WX100H.CMD
- S5XXM01X.DAT
- S5XXM02X.DAT
- S5XXM03X.DAT

In addition to the blocks printed out below, FB100 (FB:STEU) and the data handling blocks for the S5 115U (excepting FB 246 and FB 248) are used. These data handling blocks are integrated in the operating system of the CPU. The data blocks used are not listed.

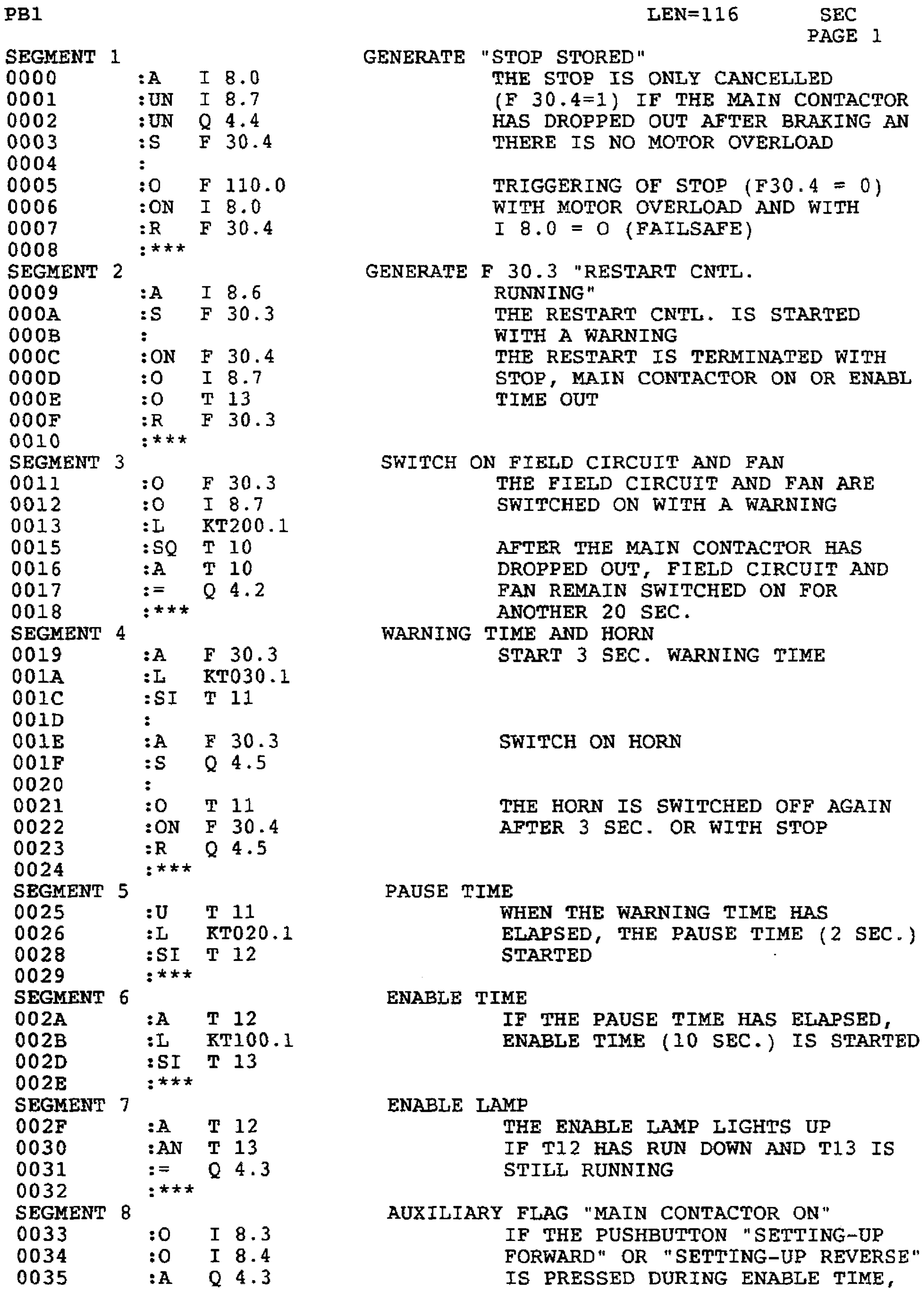
DB10, length 20 words
DB11, length 20 words.

```
OB1                                                    LEN=23      SEC
                                                                  PAGE 1
SEGMENT 1
0000       :A   F 0.0                GENERATION OF RLO FLAG "0"
0001       :R   F 0.0
0002       :AN  F 0.1                GENERATION OF RLO FLAG "1"
0003       :S   F 0.1
0004       :
0005       :A   F 30.0               COLD RESTART AT F 30.0 = 1
0006       :JC  FB98                 => IP 252 MUST BE STARTED
0007 NAME  :STP=>RUN
0008       :
0009       :A  F 30.1                POWER FAILURE AT F30.1 = 1
000A       :JC FB96                  => SET IP 252 TO INITIAL STATUS
000B NAME  :GRUNDST.
000C       :
000D       :JU PB1                   RESTART CONTROL,FLAGS FOR FB 100
000E       :JU PB2                   CALL FB 100
000F       :JU PB3                   ASSIGNMENT OF FLAGS -> OUTPUTS
0010       :***
SEGMENT 2
0011       :BE
--------------------------------------------------------------------
```

```
OB21                                                   LEN=35      SEC
                                                                  PAGE 1
SEGMENT 1                   COLD RESTART
0000       :A   F 0.0                GENERATE RLO FLAG "0"
0001       :R   F 0.0
0002       :AN  F 0.1                GENERATE RLO FLAG "1"
0003       :S   F 0.1
0004       :
0005       :AN  F 30.0               CODE: NO POWER FAILURE
0006       :S   F 30.0               (F 30.0 = 1) FOR FB99
0007       :
0008       :JU  FB99                 IP 252 SYNCHRONISATION
0009 NAME  :SZNC:IPS
000A       :
000B       :R   F 0.1                RLO = 1
000C       :S   F 30.6               F 30.6 = 1 => JOBS FOR IP
000D       :                         INHIBIT 252 (FB98 EXECUTES
000E       :                         BEFORE THE IP JOBS)
000F       :R   F 30.1               CODE: NO POWER FAILURE
0010       :                         (F 30.1 = 0) FOR OB 1
```

```
0011        :R    F 30.2                RESET AUXILIARY FLAG
0012        :                           MAIN CONTACTOR
0013        :R    T 14                  RESET DROP-OUT DELAY
0014        :                           MAIN CONTACTOR
0015        :R    F 30.3                RESET "RESTART CNTL. RUNNING"
0016        :R    F 107.3               RESET CONTROLLER ENABLE
0017        :A    F 0.0                 T17 IS PROCESSED HERE ONCE
0018        :L    KT010.1               WITH RLO = 0 BEFORE STARTING
0019        :SI   T 17                  IN FB 98
001B        :***
SEGMENT 2
001C        :BE
```

```
OB22                                                   LEN=29     SEC
                                                                  PAGE 1
SEGMENT 1                         AUTOM. WARM RESTART AFTER POWER FAILURE
0000        :A    F 0.0                 GENERATE RLO FLAG "0"
0001        :R    F 0.0
0002        :AN   F 0.1                 GENERATE RLO FLAG "1"
0003        :S    F 0.1
0004        :
0005        :A    F 30.0                CODE: POWER FAILURE
0006        :R    F 30.0                (F 30.0 = 0) FOR FB 99
0007        :
0008        :JU   FB99                  IP 252 SYNCHRONISATION
0009 NAME   :SYNC:IPS
000A        :
000B        :A    F 0.1                 RLO = 1
000C        :S    F 30.6                F 30.6 = 1 => JOBS FOR THE IP
000D        :                            INHIBIT 252 (FB 96 EXECUTES
000E        :                           BEFORE THE IP JOBS)
000F        :S    F 30.1                CODE: POWER FAILURE
0010        :                           (F 30.1 = 1) FOR OB1
0011        :R    F 30.2                RESET AUXILIARY FLAG
0012        :                           "MAIN CONTACTOR ON"
0013        :R    T 14                  RESET DROP-OUT DELAY
0014        :                           MAIN CONTACTOR
0015        :R    F 30.3                RESET "RESTART CNTL. RUNNING"
0016        :***
SEGMENT 2
0017        :BE
```



```
PB1                                                 LEN=116      SEC
                                                                PAGE 1
SEGMENT 1                     GENERATE "STOP STORED"
0000       :A    I 8.0                THE STOP IS ONLY CANCELLED
0001       :UN   I 8.7                (F 30.4=1) IF THE MAIN CONTACTOR
0002       :UN   Q 4.4                HAS DROPPED OUT AFTER BRAKING AN
0003       :S    F 30.4               THERE IS NO MOTOR OVERLOAD
0004       :
0005       :O    F 110.0              TRIGGERING OF STOP (F30.4 = 0)
0006       :ON   I 8.0                WITH MOTOR OVERLOAD AND WITH
0007       :R    F 30.4               I 8.0 = 0 (FAILSAFE)
0008       :***
SEGMENT 2                     GENERATE F 30.3 "RESTART CNTL.
0009       :A    I 8.6                RUNNING"
000A       :S    F 30.3               THE RESTART CNTL. IS STARTED
000B       :                          WITH A WARNING
000C       :ON   F 30.4               THE RESTART IS TERMINATED WITH
000D       :O    I 8.7                STOP, MAIN CONTACTOR ON OR ENABL
000E       :O    T 13                 TIME OUT
000F       :R    F 30.3
0010       :***
SEGMENT 3                     SWITCH ON FIELD CIRCUIT AND FAN
0011       :O    F 30.3               THE FIELD CIRCUIT AND FAN ARE
0012       :O    I 8.7                SWITCHED ON WITH A WARNING
0013       :L    KT200.1
0015       :SQ   T 10                 AFTER THE MAIN CONTACTOR HAS
0016       :A    T 10                 DROPPED OUT, FIELD CIRCUIT AND
0017       :=    Q 4.2                FAN REMAIN SWITCHED ON FOR
0018       :***                       ANOTHER 20 SEC.
SEGMENT 4                     WARNING TIME AND HORN
0019       :A    F 30.3               START 3 SEC. WARNING TIME
001A       :L    KT030.1
001C       :SI   T 11
001D       :
001E       :A    F 30.3               SWITCH ON HORN
001F       :S    Q 4.5
0020       :
0021       :O    T 11                 THE HORN IS SWITCHED OFF AGAIN
0022       :ON   F 30.4               AFTER 3 SEC. OR WITH STOP
0023       :R    Q 4.5
0024       :***
SEGMENT 5                     PAUSE TIME
0025       :U    T 11                 WHEN THE WARNING TIME HAS
0026       :L    KT020.1              ELAPSED, THE PAUSE TIME (2 SEC.)
0028       :SI   T 12                 STARTED
0029       :***
SEGMENT 6                     ENABLE TIME
002A       :A    T 12                 IF THE PAUSE TIME HAS ELAPSED,
002B       :L    KT100.1              ENABLE TIME (10 SEC.) IS STARTED
002D       :SI   T 13
002E       :***
SEGMENT 7                     ENABLE LAMP
002F       :A    T 12                 THE ENABLE LAMP LIGHTS UP
0030       :AN   T 13                 IF T12 HAS RUN DOWN AND T13 IS
0031       :=    Q 4.3                STILL RUNNING
0032       :***
SEGMENT 8                     AUXILIARY FLAG "MAIN CONTACTOR ON"
0033       :O    I 8.3                IF THE PUSHBUTTON "SETTING-UP
0034       :O    I 8.4                FORWARD" OR "SETTING-UP REVERSE"
0035       :A    Q 4.3                IS PRESSED DURING ENABLE TIME,
PB1                                                    LEN=116      SEC
                                                                  PAGE 2
0036       :S    F 30.2                  F30.2 WILL BE SET
0037       :
0038       :AN   F 107.3                 F30.2 IS RESET WITH STOP AND
0039       :AN   F 30.4                  WITH CONTROLLER ENABLE INACTIVE
003A       :R    F 30.2
003B       :***
SEGMENT  9                      MAIN CONTACTOR ON/OFF
003C       :A    F 30.2                  AUXILIARY FLAG "MAIN CONTACTOR
003D       :L    KT050.0                 ON" 0.5 SEC. DROP-OUT DELAY OF
003F       :SQ   T 14                    THE MAIN CONTACTOR AFTER CON-
0040       :A    T 14                    TROLLER ENABLE OFF
0041       :=    Q 4.0
0042       :***
SEGMENT  10                     CONTROLLER ENABLE
0043       :A    F 30.2                  THE CONTROLLER ENABLE IS TRANS-
0044       :A    I 8.7                   MITTED TO THE IP 252 IF THE MAIN
0045       :A    F 30.4                  SWITCH IS ON, THE ACKNOWLEDGE-
0046       :S    F 107.3                 MENT SIGNAL IS PRESENT AND THERE
0047       :                             IS NO STOP
0048       :AN   F 30.4                  THE CONTROLLER ENABLE IS
0049       :AN   F 109.2                 SWITCHED OFF WITH STOP AND N ACT
004A       :O    F 110.0                 < 1% N MAX. OR ON MOTOR OVERLOAD
004B       :R    F 107.3
004C       :
004D       :A    F 107.3                 Q 4.1 CONTROLLER ENABLE FOR
004E       :=    F 4.1                   CURRENT CONTROL
004F       :***
SEGMENT  11                     BREAKE ENABLE
0050       :AN   F 30.4                  THE BREAKE SETPOINT IS ENABLED
0051       :AN   A 4.4                   WITH STOP AND IF THERE IS NO
0052       :=    F 106.6                 OVERLOAD
0053       :***
SEGMENT  12                     SETTING-UP FORWARD
0054       :A    I 8.3                   "SETTING-UP FORWARD" IS INTER-
0055       :A    F 30.2                  LOCKED WITH THE MAIN CONTACTOR
0056       :AN   F 106.4                 AND "SETTING-UP REVERSE"
0057       :S    F 106.5
0058       :
0059       :R    F 30.4                  THE SETPOINT IS SWITCHED OFF
005A       :R    F 106.5                 AGAIN WITH STOP
005B       :***
SEGMENT  13                              "SETTING-UP BACK" IS INTERLOCKED
005C       :A    I 8.4                   WITH THE MAIN CONTACTOR AND
005D       :A    F 30.2                  WITH "SETTING-UP FORWARD"
005E       :AN   F 106.5
005F       :S    F 106.4
0060       :
0061       :AN   F 30.4                  THE SETPOINT IS SWITCHED OFF
0062       :R    F 106.4                 AGAIN WITH STOP
0063       :***
SEGMENT  14                     FASTER
0064       :A    I 8.1                   IF "SETTING-UP FORWARD" IS
0065       :A    F 106.5                 ACTIVE AND IF N SETPOINT OF
0066       :AN   F 111.0                 BRANCH 8 IS NOT YET GREATER THAN
0067       :=    F 107.2                 96% OF N MAX. (4% FROM BRANCH 6)
0068       :***                          "FASTER" IS ENABLED
0069       :A    I 8.2                   IF "SETTING-UP FORWARD" IS ACTIV
006A       :A    F 106.5                 AND IF N SETPOINT OF BRANCH 8 >
```

```
PB1                                                      LEN=116       SEC
                                                                      PAGE 3
SEGMENT 15                     SLOWER
006B        :A    F 111.1                "SLOWER" IS ENABLED
006C        :=    F 107.1
006D        :***
SEGMENT 16
006E        :BE
```

```
PB2                                                      LEN=26        SEC
                                                                      PAGE 1
SEGMENT 1                       CALL FB100
0000        :A    F 30.6                 F30.6 = 1, JOBS TO IP 252
0001        :BEC                         INHIBITED
0002        :L    KB1                    1 - DATA TRAFFIC PC <-> IP,
0003        :T    MB112                  CONTROLLER NUMBER 1
0004        :JU   FB100                  DRIVE CONTROLLER COMMUNICATION
0005 NAME   :STEU:ANT
0006 DBNR   :     DB11                   DB FOR INTERNAL USE, 12 DW,
0007 SSNR   :     KF+5                   PAGE NR. 5
0008 RENR   :     MB112                  JOB AND CONTROLLER NUMBER
0009 VAR8   :     MW100                  SPEED SETPOINT (VAR 8.1)
000A VAR9   :     MW102                  SETPOINT (VAR 9.1)
000B VAR3   :     MW104                  INITIAL DIAMETER (VAR 3.1)
000C DE0    :     MB106                  RELAYS UND BITS (VAR 3.1)
000D DE1    :     MB107                  RELAYS UND BITS (VAR 3.1)
000E DE2    :     MB108                  RELAYS UND BITS (VAR 3.1)
000F DA0    :     MB109                  MESSAGE BITS OF THE IP
0010 DA1    :     MB110                  MESSAGE BITS OF THE IP
0011 DA2    :     MB111                  MESSAGE BITS OF THE IP
0012 PAFE   :     F 31.2                 PARAMETER ASSIGNMENT ERROR, 1
0013        :***                         => ERROR
SEGMENT 2
0014        :BE
```

```
PB3                                                      LEN=18       SEC
                                                                     PAGE 1
SEGMENT 1                     OVERLOAD FLAG
0000       :A    F 110.0            SET FLAG
0001       :S    Q 4.4
0002       :AN   M 110.0            ACKNOWLEDGEMENT CAN BE MADE IF
0003       :AN   M 109.2            THE OVERLOAD NO LONGER EXISTS
0004       :U    I 8.5              AND IF THE MOTOR IS AT STANDSTIL
0005       :R    Q 4.4
0006       :***
SEGMENT 2                     LIMIT VALUES TO INPUT/OUTPUT MODULES
0007       :A    F 109.0            LIMIT VALUE 6% N MAX.
0008       :=    Q 4.6
0009       :A    F 109.1            LIMIT VALUE 6% N MAX.
000A       :=    Q 4.7
000B       :***
SEGMENT 3
000C       :BE


FB96                                                     LEN=47       SEC
                                                                     PAGE 1
SEGMENT 1                     CNTL. NO. 1 THE IP IN INITIAL STATUS
NAME :GRUNDST.

0005       :L    KB21               21 DATA TRAFFIC CPU -> IP,
0006       :T    MB112                 CONTROLLER NUMBER 1
0007       :
0008       :L    KM00000000 00000000 ALL RELAYS AND BITS HAVE
000A       :T    FW100              "0" DEFAULT
000B       :T    FW102
000C       :T    FW104
000D       :T    FW106
000E       :T    FW108
000F       :T    FW110
0010       :JU   FB100              DRIVE CONTROLLER COMMUNICATION
0011 NAME  :STEU:ANT
0012 DBNR  :     DB10               DB FOR INTERNAL USE, 12 DW
0013 SSNR  :     KF+5               PAGE NR.5
0014 RENR  :     FB112              JOB AND CONTROLLER NUMBER
0015 VAR8  :     FW100              SPEED SETPOINT (VAR 8.1)
0016 VAR9  :     FW102              SETPOINT (VAR 9.1)
0017 VAR3  :     FW104              INITIAL DIAMETER (VAR 3.1)
0018 DE0   :     FB106              RELAYS UND BITS
0019 DE1   :     FB107              RELAYS UND BITS
001A DE2   :     FB108              RELAYS UND BITS
001B DA0   :     FB109              MESSAGE BITS OF THE IP
001C DA1   :     FB110              MESSAGE BITS OF THE IP
001D DA2   :     FB111              MESSAGE BITS OF THE IP
001E PAFE  :     F 31.1             PARAM. ASSIGNM. ERRORS, 1=> ERRO
001F       :A    F 212.0            BIT 0 OF THE PAFE BYTE OF THE
0020       :                        FB: CNTL.-INTERNAL "SEND" IS
0021       :                        USED HERE. 1 => JOB HAS NOT YET
0022       :                        RUN (E.G. DUE TO IP OVERLOAD),
0023       :                        0 => NO ERROR.
0024       :JC   =M001              IF THE JOB HAS BEEN PROCESSED,
0025       :R    F 30.1             FB96 IS NO LONGER PROCESSED AND
0026       :R    F 30.6             THE IP IS READY TO PROCESS  OTHE
0027 M001  :BE                      JOBS.
```

```
FB98                                                     LEN=33       SEC
                                                                     PAGE 1
SEGMENT 1                    IP 252 FROM STOP TO RUN
NAME :STP=>RUN

0005        :A   F 0.1                    RLO = 1
0006        :JU  FB244
0007 NAME :SEND
0008 SSNR :      KY0,5                    0 DIRECT INITIALISED, 5 PAGE
0009 A-NR :      KY0,20                   NR. 0.2 TASK NO. FOR SEND 20
000A ANZW :      FW114                    DISPLAY WORD
000B QTYP :      K5NN                     NN - NO DATA
000C DBNR :      KY0,0                    IRRELEVANT
000D QANF :      KF+0                     IRRELEVANT
000E QLAE :      KF+0                     IRRELEVANT
000F PAFE :      FB121                    ERROR DISPLAY
0010        :
0011        :A   F 0.1                    RLO = 1
0012        :L   KT010.1                  1 SEC. WAITING TIME AFTER STOP
0014        :SI  T 17                     => RUN
0015        :
0016        :A   T 17                     IF THE PULSE TIMER HAS RUN DOWN,
0017        :JC  =M001                    IS NO LONGER PROCESSED AND THE
0018        :R   F 30.0                   IP IS READY TO PROCESS JOBS
0019        :R   F 30.6
001A F001 :***
SEGMENT 2
001B        :BE
```

```
FB99                                                     LEN=29       SEC
                                                                     PAGE 1
SEGMENT 1                    SYNCHRONISATION OF THE IP 252 INTERFACE
NAME :SYNC:IPS

0005        :A   F 30.0                   THERE WAS A POWER FAILURE AT
0006        :JC  =M001                    F 30.0 = 0
0007        :                             => 2 SEC. WAITING TIME BEFORE
0008        :L   KT020.1                  SYNCHRONISATION OF THE IP 252
000A        :A   F 0.0                    T 15 IS PROCESSED ONCE BEFORE
000B        :SI  T 15                     STARTING WITH RLO = 0
000C        :A   F 0.1
000D        :SI  T 15                     STARTING T 15
000E F002 :A     T 15                     2 SEC. TIME LOOP, SCAN TIME
000F        :JC  =M002                    MONITOR IS INOPERATIVE IN OB22.
0010        :                             SYNCHRONISE INTERFACE WITH PAGE
0011 F001 :JUA FB249                      NR. 5
0012 NAME :SYNCHRON
0013 SSNR :      KY0,5                    0 DIRECT PARAMETER ASSIGNMENT,
0014 BLGR :      KY0,6                    5 PAGE NR.0,6 BLOCK SIZE 512
0015 PAFE :      FB120                    BYTES ERROR FLAG
0016        :***
SEGMENT 2
0017        :BE
```

3.4 Application Example for S5 135U, R Processor

The FB 100 (FB:STEU) and the data handling blocks for the S5 135U, R processor (without FB 122 and FB 124), are used as well as the blocks printed out. These data handling blocks are integrated in the operating system of the CPU, but they can only be called up if their headers have previously been loaded into the CPU from the FB:STEU diskette. The following data blocks are used but not listed

DB 10, length 20 words
DB 11, length 20 words.

```
OB1                                                    LEN=23       SEC
                                                                  PAGE 1
SEGMENT 1
0000       :A    F 0.0                   GENERATE RLO FLAG "0"
0001       :R    F 0.0
0002       :AN   F 0.1                   GENERATE RLO FLAG "1"
0003       :S    F 0.1
0004       :                             THERE WAS A COLD RESTART OR A
0005       :A    F 30.0                  MANUAL WARM RESTART AT F 30.0=1
0006       :JC   FB98                    => IP 252 MUST BE STARTED
0007 NAME  :STP=>RUN
0008       :
0009       :A    F 30.1                  THERE WAS A POWER FAILURE AT
000A       :JC   FB96                    F 30.1 =1
000B NAME  :GRUNDST.                     => SET IP 252 TO INITIAL STATE
000C       :
000D       :JU   PB1                     RESTART CONTROL, FLAG F. FB 100
000E       :JU   PB2                     CALL FB 100
000F       :JU   PB3                     ASSIGN FLAGS => OUTPUTS
0010       :***
SEGMENT 2
0011       :BE
--------------------------------------------------------------------
```

```
OB20                                                   LAE=20       SEC
                                                                  PAGE    1
SEGMENT 1                        MANUAL COLD RESTART
0000       :UN   F 0.1                   GENERATE RLO FLAG "1"
0001       :S    F 0.1
0002       :
0003       :UN   F 30.0                  ID: NO POWER FAILURE
0004       :S    F 30.0                  (F 30.0 = 1) FOR FB 99
0005       :
0006       :JU   FB99                    IP 252 SYNCHRONISATION
0007 NAME  :SYNC:IPS
0008       :
0009       :A    F 0.1                   RLO = 1
000A       :S    F 30.6                  F 30.6 = 1 => INHIBIT JOBS TO
000B       :                             IP 252 (FB 98 IS EXECUTED BEFORE
000C       :                             THE IP JOBS)
000D       :***
SEGMENT 2
000E       :BE
```

```
OB21                                                  LEN=35        SEC
                                                                    PAGE    1
SEGMENT 1                          MANUAL WARM RESTART
0000        :A    M 0.0                    GENERATE RLO FLAG "0"
0001        :R    M 0.0
0002        :AN   M 0.1                    GENERATE RLO FLAG "1"
0003        :S    M 0.1
0004        :
0005        :AN   M 30.0                   ID: NO POWER FAILURE
0006        :S    M 30.0                   (F 30.0 = 1) FOR FB 99
0007        :
0008        :JU FB99                       IP 252 SYNCHRONISATION
0009 NAME   :SYNC:IPS
000A        :
000B        :A    F 0.1                    RLO = 1
000C        :S    F 30.6                   F 30.6 = 1 => INHIBIT JOBS TO
000D        :                              IP 252 (FB 98 EXECUTES BEFORE
000E        :                              THE IP JOBS)
000F        :R    F 30.1                   ID: NO POWER FAILURE
0010        :                              (F 30.1 = 0) FOR OB 1
0011        :R    F 30.2                   RESET AUXILIARY FLAG "MAIN
0012        :                              CONTACTOR" ON"
0013        :R    T 14                     RESET DROP-OUT DELAY MAIN
0014        :                              CONTACTOR
0015        :R    F 30.3                   RESET "RESTART CNTL. RUNNING"
0016        :R    F 107.3                  RESET CONTROLLER ENABLE
0017        :
0018         :A     F  0.0                 T 17 IS PROCESSED  ONCE  WITH
0019        :L    KT010.1                  RLO = 0 BEFORE STARTING IN THE
001B        :SD   T 17                     FB 98
001C        :BE
--------------------------------------------------------------------------
```

```
OB22                                                  LEN=29        SEC
                                                                    PAGE    1
SEGMENT 1                          AUTOM. WARM RESTART AFTER POWER FAILURE
0000        :A    F 0.0                    GENERATE RLO FLAG "0"
0001        :R    F 0.0
0002        :AN   F 0.1                    GENERATE RLO FLAG "1"
0003        :S    F 0.1
0004        :
0005        :A    F 30.0                   ID: POWER FAILURE
0006        :R    F 30.0                   (F 30.0 = 0) FOR FB 99
0007        :
0008        :JU FB99                       IP 252 SYNCHRONISATION
0009 NAME   :SYNC:IPS
000A        :
000B        :A    F 0.1                    RLO = 1
000C        :S    F 30.6                   F 30.6 = 1 => INHIBIT JOBS TO
000D        :                              IP 252 (FB 96 EXECUTES BEFORE
000E        :                              THE IP JOBS)
000F        :S    F 30.1                   ID: POWER FAILURE
0010        :                              (F 30.1 = 1) FOR OB 1
0011        :R    F 30.2                   RESET AUXILIARY FLAG "MAIN
0012        :                              CONTACTOR ON"
0013        :R    T 14                     RESET "DROP-OUT DELAY MAIN
0014        :                              CONTACTOR
0015        :R    F 30.3                   RESET "RESTART CNTL. RUNNING"
0016        :BE
```

3.4 Application Example for S5 135U, R Processor

```
PB1                                                     LEN=116      SEC
                                                                     PAGE    1
SEGMENT 1                       GENERATION OF "STORED STOP"
0000         :A    I 8.0                  THE STOP IS ONLY CANCELLED
0001         :AN   I 8.7                  (F 30.4=1), IF THE MAIN
0002         :AN   Q 4.4                  CONTACTOR HAS DROPPED OUT AFTER
0003         :S    F  30.4                BRAKING AND IF THERE IS NO MOTOR
0004         :                            OVERLOAD
0005         :O    F 110.0                STOP TRIGGERED (F 30.4 = 0) WITH
0006         :ON   I 8.0                  MOTOR OVERLOAD AND WITH I 8.0
0007         :R    F 30.4                 = 0 (FAILSAFE)
0008         :***
SEGMENT 2                       GENERATE 30.3 "RESTART CNTL. RUNNING"
0009         :A    I 8.6                  THE RESTART CNTL. IS STARTED WIT
000A         :S    F 30.3                 A WARNING
000B         :
000C         :ON   F 30.4                 THE RESTART IS TERMINATED WITH
000D          :O     I   8.7              STOP, MAIN CONTACTOR ON OR
000E         :O    T 13                   ENABLE TIME ELAPSED
000F         :R    F 30.3
0010         :***
SEGMENT 3                       SWITCH ON FIELD CIRCUIT AND FAN
0011         :O    F 30.3                 THE FIELD CIRCUIT AND FAN ARE
0012         :O    I 8.7                  SWITCHED ON WITH A WARNING
0013         :L    KT200.1
0015         :SF   T 10                   FIELD CIRCUIT AND FAN REMAIN
0016         :A    T 10                   SWITCHED ON FOR 20 SEC. AFTER
0017         :=    Q 4.2                  THE MAIN CONTACTOR HAS DROPPED
0018         :***                         OUT
SEGMENT 4                       WARNING TIME AND HORN
0019         :A    F 30.3                 START 3 SEC. WARNING TIME
001A         :L    KT030.1
001C         :SI   T 11
001D         :
001E         :A    F 30.3                 SWITCH ON HORN
001F         :S    Q 4.5
0020         :
0021         :O    T 11                   THE HORN IS SWITCHED OFF AGAIN
0022         :ON   F 30.4                 AFTER 30 SEC. OR WITH STOP
0023         :R    Q 4.5
0024         :***
SEGMENT 5                       PAUSE TIME
0025         :A    T 11                   THE PAUSE TIME (2 SEC.) IS
0026         :L    KT020.1                STARTED WHEN THE WARNING TIME
0028         :SI   T 12                   HAS ELAPSED
0029         :***
SEGMENT 6                       ENABLE TIME
002A         :A    T 12                   THE ENABLE TIME (10 SEC.) IS
002B         :L    KT100.1                STARTED WHEN THE PAUSE TIME
002D         :SI   T 13                   HAS ELAPSED
002E         :***
SEGMENT 7                       ENABLE LAMPPE
002F         :A    T 12                   THE ENABLE LAMP LIGHTS UP, IF
0030         :AN   T 13                   T12 HAS RUN DOWN AND IF T 13
0031         :=    Q 4.3                  IS STILL RUNNING
0032         :***
SEGMENT 8                       AUXILIARY FLAG "MAIN CONTACTOR ON"
0033         :O    I 8.3                  IF THE "SETTING-UP FORWARD"
0034         :O    I 8.4                  PUSHBUTTON OR THE "SETTING-UP
0035         :A    Q 4.3                  REVERSE" PUSHBUTTON IS PRESSED
```

```
PB1                                                 LEN=116       SEC
                                                                  PAGE    2
0036         :S    F 30.2                     F 30.2 IS SET
0037         :
0038         :AN   F 107.3                    F 30.2 IS RESET WITH STOP AND
0039         :AN   F 30.4                     CONTROLLER ENABLE INACTIVE
003A         :R    F 30.2
003B         :***
SEGMENT  9                           MAIN CONTACTOR ON/OFF
003C          :A    F 30.2                    AUX. FLAG "MAIN CONTACTOR ON"
003D         :L    KT050.0                    0.5 SEC. DROP-OUT DELAY OF
003F         :SF   T 14                       THE MAIN CONTACTOR AFTER CON-
0040         :A    T 14                       TROLLER ENABLE OFF
0041         :=    Q 4.0
0042         :***
SEGMENT  10                          CONTROLLER ENABLE
0043         :A    F 30.2                     IF THE MAIN SWITCH IS ON, THE
0044         :A    E 8.7                      ACKNOWLEDGEMENT IS PRESENT AND
0045         :A    F 30.4                     THERE IS NO STOP, THE CONTROLLER
0046         :S    F 107.3                    ENABLE IS TRANSMITTED TO THE IP
0047         :
0048          :AN    F  30.4                  THE CONTROLLER ENABLE IS
0049         :AN   F 109.2                    SWITCHED OFF WITH STOP AND WITH
004A         :O    F 110.0                    N ACT < 1% N MAX. OR ON MOTOR
004B         :R    F 107.3                    OVERLOAD
004C         :
004D         :A    F 107.3                    Q 4.1 CONTROLLER ENABLE FOR
004E         :=    Q 4.1                      CURRENT CONTROL
004F         :***
SEGMENT  11                          BRAKE ENABLE
0050         :AN   F 30.4                     THE BRAKE SETPOINT IS ENABLED
0051         :AN   Q 4.4                      WITH STOP AND NO OVERLOAD
0052         :=    F 106.6
0053         :***
SEGMENT  12                          SETTING-UP FORWARD
0054         :A    I 8.3                      "SETTING-UP FORWARD" IS INTER-
0055         :A    F 30.2                     LOCKED WITH THE MAIN CONTACTOR
0056         :AN   F 106.4                    AND WITH "SETTING-UP REVERSE"
0057         :S    F 106.5
0058         :
0059         :AN   F 30.4                     THE SETPOINT IS SWITCHED OFF
005A         :R    F 106.5                    AGAIN WITH STOP
005B         :***
SEGMENT  13
005C         :A    I 8.4                      "SETTING-UP BACK" IS INTER-
005D         :A    F 30.2                     LOCKED WITH THE MAIN CONTACTOR
005E         :AN   F 106.5                    "SETTING-UP FORWARD"
005F         :S    F 106.4
0060         :
0061         :AN   F 30.4                     THE SETPOINT IS SWITCHED OFF
0062         :R    F 106.4                    AGAIN WITH STOP
0063         :***
SEGMENT  14                          FASTER
0064         :A    I 8.1                      IF "SETTING-UP FORWARD" IS PRE-
0065         :A    F 106.5                    SENT AND N SETPOINT OF BRANCH 8
0066         :AN   F 111.0                    IS NOT YET GREATER THAN MAX. 96%
0067         :=    F 107.2                    OF N MAX. (4% FROM BRANCH 6),
0068         :***                             "FASTER" IS ENABLED
0069         :A    I 8.2                      IF "SETTING-UP FORWARD" IS PRE-
006A         :A     F 106.5                   SENT AND SETPOINT N OF BRANCH
```

```
PB1                                                     LEN=116      SEC
                                                                     PAGE    3
SEGMENT 15                          SLOWER
006B        :A    F 111.1                    8 < 0, "SLOWER" IS ENABLED
006C        :=    F 107.1
006D        :***
SEGMENT 16
006E        :BE
```

```
PB2                                                     LEN=26       SEC
                                                                     PAGE    1
SEGMENT 1                           CALL FB 100
0000        :A    M 30.6                     F30.6 = 1, TASKS TO IP 252
0001        :BEC                             DISABLED
0002        :L    KB1                        1 - DATA TRAFFIC PC <-> IP,
0003        :T    FB112                      CONTROLLER NUMBER 1
0004        :JU FB100                        DRIVE CONTROLLER COMMUNICATION
0005 NAME   :STEU:ANT
0006 DBNR   :     DB11                       DB FOR INTERNAL USE, 12 DW,
0007 SSNR   :     KF+5                       PAGE NR. 5
0008 RENR   :     FB112                      JOB AND CONTROLLER NUMBER
0009 VAR8   :     FW100                      SPEED SETPOINT (VAR 8.1)
000A VAR9   :     FW102                      SETPOINT (VAR 9.1)
000B VAR3   :     FW104                      INITIAL DIAMETER (VAR 3.1)
000C DE0    :     FB106                      RELAYS AND BITS
000D DE1    :     FB107                      RELAYS AND BITS
000E DE2    :     FB108                      RELAYS AND BITS
000F DA0    :     FB109                      MESSAGE BITS OF THE IP
0010 DA1    :     FB110                      MESSAGE BITS OF THE IP
0011 DA2    :     FB111                      MESSAGE BITS OF THE IP
0012 PAFE   :     F 31.2                     PARAMETER ASSIGNMENT ERROR,
0013        :***                             1 => ERROR
SEGMENT 2
0014        :BE
```

```
PB3                                                   LEN=18        SEC
                                                                   PAGE    1
SEGMENT 1                          OVERLOAD DISPLAY
0000       :A    F 110.0                    SET DISPLAY
0001       :S    Q 4.4
0002       :AN   F 110.0                    IF THE OVERLOAD NO LONGER EXISTS
0003       :AN   F 109.2                    AND THE MOTOR IS AT STANDSTILL,
0004       :A    I 8.5                      ACKNOWLEDGEMENT CAN BE MADE
0005       :R    Q 4.4
0006       :***
SEGMENT 2                          LIMIT VALUES TO THE I/O VALUES
0007       :A    F 109.0                    LIMIT VALUE 6% N MAX.
0008       :=    Q 4.6
0009       :A    F 109.1                    LIMIT VALUE 10% N MAX.
000A       :=    Q 4.7
000B       :BE
```

```
FB96                                                  LEN=47        SEC
                                                                   PAGE    1
SEGMENT  1                         CNTL. NO.1 OF THE IP 252 IN INITIAL STATE
NAME :GRUNDST.

0005       :L    KB21                       21 DATA TRAFFIC PC -> IP, CON-
0006       :T    FB112                         TROLLER NUMBER 1
0007       :
0008       :L    KM00000000 00000000        ALL RELAYS AND BITS HAVE "0"
000A       :T    FW100                      DEFAULT
000B       :T    FW102
000C       :T    FW104
000D       :T    FW106
000E       :T    FW108
000F       :T    FW110
0010       :JU   FB100                      DRIVE CONTROLLER COMMUNICATION
0011 NAME  :STEU:ANT
0012 DBNR  :     DB10                       DB FOR INTERNAL USE, 12 DW
0013 SSNR  :     KF+5                       PAGE NR. 5
0014 RENR  :     FB112                      JOB AND CONTROLLER NR.
0015 VAR8  :     FW100                      SPEED SETPOINT (VAR 8.1)
0016 VAR9  :     FW102                      SETPOINT (VAR 9.1)
0017 VAR3  :     FW104                      INITIAL DIAMETER (VAR 3.1)
0018 DE0   :     FB106                      RELAYS AND BITS
0019 DE1   :     FB107                      RELAYS AND BITS
001A DE2   :     FB108                      RELAYS AND BITS
001B DA0   :     FB109                      MESSAGE BITS OF THE IP
001C DA1   :     FB110                      MESSAGE BITS OF THE IP
001D DA2   :     FB111                      MESSAGE BITS OF THE IP
001E PAFE  :     F 31.1                     PARAMETER ASSIGNMENT ERROR,
001F       :                                1 => ERROR
0020       :A     F 212.0                   BIT 0 OF THE PAFE BYTE OF THE
0021       :                                FB: INTERNAL "SEND" IS USED
0022       :                                HERE. 1 => JOB HAS NOT YET PRO-
0023       :                                CESSED (E.G. DUE TO IP OVER-
0024       :                                LOAD), 0 => NO ERROR.
0025       :JC   =F001                      IF THE JOB HAS BEEN PROCESSED,
0026       :R    F 30.1                     THE FB96 IS NO LONGER PROCESSED
0027       :R    F 30.6                     AND THE IP IS READY TO PROCESS
0028 M001  :BE                              OTHER TASKS.
```

3.4 Application Example for S5 135U, R Processor

```
FB98                                                     LEN=33       SEC
                                                                      PAGE    1
SEGMENT 1                    IP 252 FROM STOP TO RUN
NAME :STP=>RUN

0005        :A    F 0.1              RLO = 1
0006        :JU   FB120
0007 NAME   :SEND
0008 SSNR   :     KY0,5              0 DIR.PARAM.ASSIGNM.,5 PAGE NR.
0009 A-NR   :     KY0,20             0,20 - JOB NR. FOR SEND 20
000A ANZW   :     MW114              JOB STATUS WORD
000B QTYP   :     KCNN               NN - NO DATA
000C DBNR   :     KY0,0              IRRELEVANT
000D QANF   :     KF+0               IRRELEVANT
000E QLAE   :     KF+0               IRRELEVANT
000F PAFE   :     MB121              ERROR FLAG
0010        :
0011        :A    F 0.1              RLO = 1
0012        :L    KT010.1            1 SEC. WAITING TIME AFTER STOP
0014        :SE   T 17               => RUN
0015        :
0016        :AN   T 17               IF THE DELAY TIME HAS ELAPSED,
0017        :JC   =M002              THE FB98 IS NO LONGER PROCESSED
0018        :R    F 30.0             AND THE IP IS READY TO PROCESS
0019        :R    F 30.6             JOBS
001A M002   :***
SEGMENT 2
001B        :BE
```

```
FB99                                                     LEN=29       SEC
                                                                      PAGE    1
SEGMENT 1                    SYNCHRONISATION OF THE IP INTERFACE
NAME :SYNC:IPS

0005        :A    M 30.0             THERE WAS A POWER FAILURE AT
0006        :JC   =F001              F 30.0 = 0 => 2 SEC. WAITING
0007        :                        TIME BEFORE SYNCHRONISATION
0008        :L    KT020.1            OF THE IP 252
000A        :A    F 0.0              T 15 IS PROCESSED ONCE WITH
000B        :SI   T 15               RLO = 0 BEFORE STARTING
000C        :A    F 0.1
000D        :SI   T 15               STARTING T 15
000E M002   :A    T 15               2 SEC TIME LOOP, SCAN TIME
000F        :JC   =F002              MONITOR IS INOPERATIVE IN OB22.
0010        :                        SYNCHRONISE INTERFACE WITH PAGE
0011 M001   :JU   FB125              NR. 5
0012 NAME   :SYNCHRON
0013 SSNR   :     KY0,5              0 DIR.PARAM.ASSIGNM., 5 PAGE NR.
0014 BLGR   :     KY0,6              0.6 - BLOCK SIZE 512 BYTES
0015 PAFE   :     MB120              ERROR FLAG
0016        :***
NETZWERK 2
0017        :BE
```

In addition to the blocks below, FB100 (FB:STEU) and the data handling blocks for the S5-150U (excepting FB182, FB183 and FB186) are used. These data handling blocks must be ordered separately on diskette, if required. The following data blocks used are also not listed:

DB10, length 20 words
DB11, length 20 words.

```
OB1                                                   LEN=23       SEC
                                                                   PAGE    1
SEGMENT  1
0000        :A    F 0.0                 GENERATION OF RLO FLAG "0"
0001        :R    F 0.0
0002        :AN   F 0.1                 GENERATION OF RLO FLAG "1"
0003        :S    F 0.1
0004        :                           COLD RESTART AT F 30.0 = 1
0005        :A    F 30.0                => IP 252 MUST BE STARTED
0006        :JC   FB98
0007 NAME   :STP=>RUN
0008        :
0009        :A    F 30.1                POWER FAILURE AT F30.1 = 1
000A        :JC   FB96                  => SET IP 252 TO INITIAL STATUS
000B NAME   :GRUNDST.
000C        :
000D        :JU   PB1                   RESTART CONTROL, FLAGS FOR FB100
000E        :JU   PB2                   CALL FB 100
000F        :JU   PB3                   ASSIGNMENT OF FLAGS -> OUTPUTS
0010        :***
SEGMENT  2
0011        :BE
----------------------------------------------------------------------
```

```
OB20                                                  LEN=20       SEC
                                                                   PAGE    1
SEGMENT  1                      MANUAL COLD RESTART
0000        :AN   F 0.1                 GENERATE RLO FLAG "1"
0001        :S    F 0.1
0002        :
0003        :AN   F 30.0                IDENT. NO POWER FAILURE
0004        :S    F 30.0                (F 30.0 = 1) FOR FB99
0005        :
0006        :JU   FB99                  IP 252 SYNCHRONISATION
0007 NAME   :SYNC:IPS
0008        :
0009        :A    F 0.1                 RLO = 1
000A        :S    F 30.6                F 30.6 = 1 => INHABIT JOBS TO
000B        :                           IP 252 (FB98 IS RUN BEFORE
000C        :                           IP JOBS)
000D        :***
SEGMENT  2
000E        :BE
```

```
OB21                                                    LEN=35       SEC
                                                                     PAGE    1
SEGMENT 1                          MANUAL COLD RESTART
0000         :A    F 0.0                   GENERATE RLO FLAG "0"
0001         :R    F 0.0
0002         :AN   F 0.1                   GENERATE RLO FALG "1"
0003         :S    F 0.1
0004         :
0005         :AN   F 30.0                  IDENT: NO POWER FAILURE
0006         :S    F 30.0                  (F 30.0 = 1) FOR FB99
0007         :
0008         :JU   FB99                    IP 252 SYNCHRONISATION
0009 NAME    :SYNC:IPS
000A         :
000B         :A    F 0.1                   RLO = 1
000C         :S    F 30.6                  F 30.6 = 1 => JOBS FOR IP
000D         :                             252 INHIBIT (FB 98 EXECUTES
000E         :                             BEFORE THE IP JOBS)
000F         :R    F 30.1                  IDENT: POWER FAILURE
0010         :                             (F 30.1 = 0) FOR OB1
0011         :R    F 30.2                  RESET AUXILIARY FLAG
0012         :                             "MAIN CONTACTOR ON"
0013         :R    T 14                    RESET DROP-OUT DELAY
0014         :                             MAIN CONTACTOR
0015         :R    F 30.3                  RESET "RESTART CNTL. RUNNING"
0016         :R    F 107.3                 RESET CONTROLLER ENABLE
0017         :
0018         :A    F 0.0                   T 17 IS PROCESSED HERE
0019         :L    KT010.1                 ONCE WITH RLO = 0 BEFORE
001B         :SI   T 17                    STARTING IN FB 98
001C         :BE
--------------------------------------------------------------------------------
OB22                                                    LEN=29       SEC
                                                                     PAGE    1
SEGMENT 1                          AUTOM. WARM START AFTER POWER FAILURE
0000         :A    F 0.0                   GENERATE RLO FLAG "0"
0001         :R    F 0.0
0002         :AN   F 0.1                   GENERATE RLO FLAG "1"
0003         :S    F 0.1
0004         :
0005         :A    F 30.0                  IDENT: POWER FAILURE
0006         :R    F 30.0                  (F 30.0 = 0) FOR FB99
0007         :
0008         :JU   FB99                    IP 252 SYNCHRONISATION
0009 NAME    :SYNC:IPS
000A         :
000B         :A    F 0.1                   RLO = 1
000C         :S    F 30.6                  F 30.6 = 1 => JOBS FOR THE IP
000D         :                             252 INHIBIT (FB 96 EXECUTES
000E         :                             BEFORE THE IP JOBS)
000F         :S    F 30.1                  IDENT: POWER FAILURE
0010         :                             (F 30.1 = 1) FOR OB1
0011         :R    F 30.2                  RESET AUXILIARY FLAG
0012         :                             "MAIN CONTACTOR ON"
0013         :R    T 14                    RESET DROP-OUT DELAY
0014         :                             MAIN CONTACTOR
0015         :R    F 30.3                  RESET "RESTART CNTL. RUNNING"
0016         :BE
```

```
PB1                                                    LEN=116        SEC
                                                                      PAGE    1
SEGMENT 1                          GENERATE "STOP STORED"
0000       :A     I 8.0                     THE STOP IS ONLY CANCELLED
0001       :AN    I 8.7                     (F 30.4=1), IF MAIN CONTACTOR
0002       :AN    Q 4.4                     HAS DROPPED OUT AFTER BRAKING
0003       :S     F 30.4                    AND THERE IS NO MOTOR OVERLOAD
0004       :
0005       :O     F 110.0                   TRIGGERING OF STOP (F30.4 = 0)
0006       :ON    I 8.0                     WITH MOTOR OVERLOAD AND WITH
0007       :R     F 30.4                    I 8.0 = 0 (FAILSAFE)
0008       :***
SEGMENT 2                          GENERATE F 30.3 "RESET CNTL. RUNNING"
0009       :A     I 8.6                     THE RESTART CNTL. IS STARTED
000A       :S     F 30.3                    WITH A WARNING
000B       :
000C       :ON    F 30.4                    THE RESTART IS TERMINATED WITH
000D       :O     I 8.7                     STOP, MAIN CONTACTOR ON OR
000E       :O     T 13                      ENABLE TIME OUT
000F       :R     F 30.3
0010       :***
SEGMENT 3                          SWITCH ON FIELD CIRCUIT, AND FAN
0011       :O     F 30.3                    THE FIELD CIRCUIT AND FAN ARE
0012       :O     I 8.7                     SWITCHED ON WITH A WARNING
0013       :L     KT200.1
0015       :SQ    T 10                      AFTER THE MAIN CONTACTOR HAS
0016       :A     T 10                      DROPPED OUT, FIELD CIRCUIT AND
0017       :=     Q 4.2                     FAN REMAIN SWITCHED ON FOR
0018       :***                             20 SEC.
SEGMENT 4                          WARNING TIME AND HORN
0019       :A     F 30.3                    START 3 SEC. WARNING TIME
001A       :L     KT030.1
001C       :SI    T 11
001D       :
001E       :A     F 30.3                    SWITCH ON HORN
001F       :S     Q 4.5
0020       :
0021       :O     T 11                      THE HORN IS SWITCHED OFF AGAIN
0022       :ON    F 30.4                    AFTER 3 SEC. OR WITH STOP
0023       :R     Q 4.5
0024       :***
SEGMENT 5                          PAUSE TIME
0025       :A     T 11                      WHEN THE WARNING TIME HAS
0026       :L     KT020.1                   ELAPSED, THE PAUSE TIME (2 SEC.)
0028       :SI    T 12                      IS STARTED
0029       :***
SEGMENT 6                          ENABLE TIME
002A       :A     T 12                      IF THE PAUSE TIME HAS ELAPSED,
002B       :L     KT100.1                   THE ENABLE TIME (10 SEC.) IS
002D       :SI    T 13                      STARTED
002E       :***
SEGMENT 7                          ENABLE LAMP
002F       :A     T 12                      THE ENABLE LAMP LIGHTS UP
0030       :AN    T 13                      IF T12 HAS RUN DOWN AND T13 IS
0031       :=     Q 4.3                     STILL RUNNING
0032       :***
SEGMENT 8                          AUXILIARY FLAG "MAIN CONTACTOR ON"
0033       :O     I 8.3                     IF THE PUSHBUTTON "SETTING-UP
0034       :O     I 8.4                     FORWARD" OR "SETTING-UP REVERSE"
0035       :A     Q 4.3                     IS PRESSED DURING ENABLE TIME,
PB1                                                       LEN=116       SEC
                                                                     PAGE    2
0036        :S    F 30.2                    F30.2 WILL BE SET
0037        :
0038        :AN   F 107.3                   F30.2 IS RESET WITH STOP AND
0039        :AN   F 30.4                    WITH CONTROLLER ENABLE
003A        :R    F 30.2                    INACTIVE
003B        :***
SEGMENT 9                          MAIN CONTACTOR ON/OFF
003C       :A    F 30.2                    AUXILIARY FLAG "MAIN CONTACTOR
003D       :L    KT050.0                   ON" 0.5 SEC. DROP-OUT DELAY OF
003F        :SQ   T 14                      THE MAIN CONTACTOR AFTER
0040        :A    T 14                      CONTROLLER ENABLE OFF
0041        :=    Q 4.0
0042        :***
SEGMENT 10                         CONTROLLER ENABLE
0043        :A    F 30.2                    THE CONTROLLER ENABLE IS TRANS-
0044        :A    I 8.7                     MITTED TO THE IP 252 IF THE MAIN
0045        :A    F 30.4                    SWITCH IS ON, THE ACKNOWLEDGE-
0046        :S    F 107.3                   MENT SIGNAL IS PRESENT AND THERE
0047        :                               IS NO STOP
0048        :AN   F  30.4                   THE CONTROLLER ENABLE IS
0049        :AN   F 109.2                   SWITCHED OFF WITH STOP AND N ACT
004A        :O    F 110.0                   > 1% N MAX. OR ON MOTOR OVERLOAD
004B        :R    F 107.3
004C        :
004D        :A    F 107.3                   Q 4.1 CONTROLLER ENABLE FOR
004E        :=    Q 4.1                     CURRENT CONTROL
004F        :***
SEGMENT 11                         BRAKE ENABLE
0050        :AN   F 30.4                    THE BRAKE ENABLE SETPOINT IS
0051        :AN   Q 4.4                     ENABLED WITH STOP AND IF THERE
0052        :=    F 106.6                   IS NO OVERLOAD
0053        :***
SEGMENT 12                         SETTING-UP FORWARD
0054        :A    I 8.3                     "SETTING-UP FORWARD" IS INTER-
0055        :A    F 30.2                    LOCKED WITH THE MAIN CONTACTOR
0056        :AN   F 106.4                   "SETTING-UP REVERSE"
0057        :S    F 106.5
0058        :
0059        :AN   F 30.4                    THE SETPOINT IS SWITCHED OFF
005A        :R    F 106.5                   AGAIN WITH STOP
005B        :***
SEGMENT 13
005C        :A    I 8.4                     "SETTING-UP BACK" IS INTERLOCKED
005D        :A    F 30.2                    WITH THE MAIN CONTACTOR AND
005E        :AN   F 106.5                   "SETTING-UP FORWARD"
005F        :S    F 106.4
0060        :
0061        :AN   F 30.4                    THE SETPOINT IS SWITCHED OFF
0062        :R    F 106.4                   AGAIN WITH STOP
0063        :***
SEGMENT 14                         FASTER
0064        :A    I 8.1                     IF "SETTING-UP FORWARD" IS
0065        :A    F 106.5                   ACTIVE AND IF N SETPOINT OF
0066        :AN   F 111.0                   BRANCH 8 IS NOT YET GREATER THAN
0067        :=    F 107.2                   96% OF N MAX. (4% FROM BRANCH
0068        :***                            6), "FASTER" IS ENABLED
0069        :A    I 8.2                     IF "SETTING-UP FORWARD" IS
006A        :A    F 106.5                   ACTIVE AND IF N SETPOINT OF
```

```
PB1                                                      LEN=116      SEC
                                                                      PAGE    3
SEGMENT 15                          SLOWER
006B       :A    F 111.1                     BRANCH 8 > 0, "SLOWER" IS
006C       :=    F 107.1                     ENABLED
006D       :***
SEGMENT 16
006E       :BE
```

```
PB2                                                      LEN=26       SEC
                                                                      PAGE    1
SEGMENT 1                           CALL FB100
0000       :A    M 30.6                      F30.6 = 1, JOBS TO IP 252 IN-
0001       :BEC                              HIBITED
0002       :L    KB1                         1 - DATA TRAFFIC PC <-> IP, CON-
0003       :T    FB112                       TROLLER NUMBER 1
0004       :JU   FB100                       DRIVE CONTROLLERR COMMUNICATION
0005 NAME  :STEU:ANT
0006 DBNR  :     DB11                        DB FOR INTERNAL USE, 12 DW,
0007 SSNR  :     KF+5                        PAGE NR. 5
0008 RENR  :     FB112                       JOB AND CONTROLLER NUMBER
0009 VAR8  :     FW100                       SPEED SETPOINT (VAR 8.1)
000A VAR9  :     FW102                       SETPOINT (VAR 9.1)
000B VAR3  :     FW104                       INITIAL DIAMETER (VAR 3.1)
000C DE0   :     FB106                       RELAYS AND BITS
000D DE1   :     FB107                       RELAYS AND BITS
000E DE2   :     FB108                       RELAYS AND BITS
000F DA0   :     FB109                       MESSAGE BITS OF THE IP
0010 DA1   :     FB110                       MESSAGE BITS OF THE IP
0011 DA2   :     FB111                       MESSAGE BITS OF THE IP
0012 PAFE  :     F 31.2                      PARAMETER ASSIGNMENT ERROR,
0013       :***                              1 => ERROR
SEGMENT 2
0014       :BE
```

```
PB3                                                        LEN=18        SEC
                                                                        PAGE    1
SEGMENT 1                      OVERLOAD DISPLAY
0000         :A    F 110.0             SET DISPLAY
0001         :S    Q 4.4
0002         :AN   F 110.0             ACKNOWLEDGEMENT CAN BE MADE IF
0003         :AN   F 109.2             THE OVERLOAD NO LONGER EXISTS
0004         :A    I 8.5               AND IF THE MOTOR IS AT STAND-
0005         :R    Q 4.4               STILL
0006         :***
SEGMENT 2                      LIMIT VALUES TO INPUT/OUTPUT MODULES
0007         :A    F 109.0             LIMIT VALUE 6% N MAX.
0008         :=    Q 4.6
0009         :A    F 109.1             LIMIT VALUE 10% N MAX.
000A         :=    Q 4.7
000B         :BE
```

```
FB96                                                       LEN=47        SEC
                                                                        PAGE    1
SEGMENT 1                      CNTL. NO. 1 THE IP IN INITIAL STATUS
NAME :GRUNDST.

0005         :L    KB21                21 DATA TRAFFIC  CPU -> IP,
0006         :T    MB112                  CONTROLLER NUMBER 1
0007         :
0008         :L    KM00000000 00000000 ALL RELAYS AND BITS HAVE "0"
000A         :T    FW100               DEFAULT
000B         :T    FW102
000C         :T    FW104
000D         :T    FW106
000E         :T    FW108
000F         :T    FW110
0010         :JU   FB100               DRIVE CONTROLLER COMMUNICATION
0011 NAME    :STEU:ANT
0012 DBNR    :     DB10                DB FOR INTERNAL USE, 12 DW
0013 SSNR    :     KF+5                PAGE NR. 5
0014 RENR    :     FB112               JOB AND CONTROLLER NUMBER
0015 VAR8    :     FW100               SPEED SETPOINT (VAR 8.1)
0016 VAR9    :     FW102               SETPOINT (VAR 9.1)
0017 VAR3    :     FW104               INITIAL DIAMETER (VAR 3.1)
0018 DE0     :     FB106               RELAYS AND BITS
0019 DE1     :     FB107               RELAYS AND BITS
001A DE2     :     FB108               RELAYS AND BITS
001B DA0     :     FB109               MESSAGE BITS OF THE IP
001C DA1     :     FB110               MESSAGE BITS OF THE IP
001D DA2     :     FB111               MESSAGE BITS OF THE IP
001E PAFE    :     F 31.1              PARAMETER ASSIGNMENT ERRORS,
001F         :                         1 => ERROR
0020         :A    F 253.0             BIT 0 OF THE PAFE BYTE OF THE
0021         :                         FB: CNTL.-INTERNAL "SEND" IS
0022         :                         USED HERE. 1 => JOB HAS NOT YET
0023         :                         RUN (E.G. DUE TO IP OVERLOAD),
0024         :                         0 => NO ERROR.
0025         :JC   =N001               IF THE JOB HAS BEEN PROCESSED,
0026         :R    F 30.1              FB96 IS NO LONGER PROCESSED
0027         :R    F 30.6              AND THE IP IS READY TO PROCESS
0028 M001    :BE                       OTHER JOBS.
```

```
FB98                                                        LEN=33        SEC
                                                                          PAGE    1
SEGMENT 1                      IP 252 FROM STOP TO RUN
NAME :STP=>RUN

0005          :A    F 0.1                RLO = 1
0006          :JU   FB180
0007 NAME :SEND
0008 SSNR :     KY0,5                    0 DIRECT INITIALISED, 5 PAGE
0009 A-NR :     KY0,20                   NR. 0.2 TASK NO. FOR SEND 20
000A ANZW :     FW114                    DISPLAY WORD
000B QTYP :     KSNN                     NN - NO DATA
000C DBNR :     KY0,0                    IRRELEVANT
000D QANF :     KF+0                     IRRELEVANT
000E QLAE :     KF+0                     IRRELEVANT
000F PAFE :     FB121                    ERROR DISPLAY
0010          :
0011          :A    F 0.1                RLO = 1
0012          :L    KT010.1              1 SEC. WAITING TIME AFTER STOP
0014          :SI   T 17                 => RUN
0015          :
0016          :AN   T 17                 IF THE PULSE TIMER HAS RUN
0017          :JC   =M002                DOWN, FB98 IS NO LONGER PRO-
0018          :R    F 30.0               CESSED AND THE IP IS READY TO
0019          :R    F 30.6               PROCESS JOBS.
001A M002 :***
SEGMENT 2
001B          :BE
```

```
FB99                                                        LEN=29        SEC
                                                                          PAGE    1
SEGMENT 1                      SYNCHRONISATION OF THE IP 252 INTERFACE
NAME :SYNC:IPS

0005          :A    F 30.0               THERE WAS A POWER FAILURE AT
0006          :JC   =M001                F 30.0 = 0
0007          :                          => 2 SEC. WAITING TIME BEFORE
0008          :L    KT020.1              SYNCHRONISATION OF THE IP 252
000A          :A    F 0.0                T 15 IS PROCESSED ONCE BEFORE
000B          :SI   T 15                 STARTING WITH RLO = 0
000C          :A    F 0.1
000D          :SI   T 15                 STARTING T 15
000E M002 :A    T 15                     2 SEC. TIME LOOP, SCAN TIME
000F          :JC   =M002                MONITOR IS INOPERATIVE IN OB22.
0010          :                          SYNCHRONISE INTERFACE WITH PAGE
0011 M001 :JU   FB185                    NR. 5
0012 NAME :SYNCHRON
0013 SSNR :     KY0,5                    0 DIR.PARAM.ASSIGNM., 5 PAGE NR.
0014 BLGR :     KY0,6                    0,6 BLOCK SIZE 512 BYTES
0015 PAFE :     FB120                    ERROR DISPLAY
0016          ::***
SEGMENT 2
0017          :BE
5.1.3         STEP 5 - Example for PB:STEU
```

4. Programming Instructions

4.1 Configuration Overview

The IP 252 is a closed-loop control module which can be adjusted to specialised applications by plugging in a memory submodule. The task-specific solutions suggested are referred to in the following as controller structures. These structures consist of individual functions, e. g. speed controller, ramp function generator etc., which can be connected together to form task-specific controllers. The currently available controller structure spectrum is contained in two different memory submodules:

1. Memory submodule DR/SR **6ES5 374-0AA11**.
   This submodule contains the structures "Drive controller" (Section 4.10) and "Standard controller" (Section 4.11).

2. Memory submodule DRS/SR **6ES5 374-0AB11**.
   This submodule contains the expanded "Drive controller structure with self-setting" (Section 4.12) and the slightly modified structure "Standard controller" (Section 4.11).

   In addition to the self-setting feature, the DRS structure has been expanded by the following functions:

   – Interlink capability of the control loops, also with the SR structure.

   – Free assignment of measuring sockets

   – Function expansions of the DRS controller structure
     ● In the ramp function generator
     ● In the diameter calculator
     ● In the primary controller
     ● In field current measurement
     ● Arithmetic operations

Two of these functions, which apply to both structures of the "DRS/SR" submodule, are briefly dealt with in the following:

a) Free assignment of measuring sockets

Both measuring sockets on the frontplate of the IP 252 module are used for displaying two measured values. Which measured values (control deviation, manipulated variable etc.) are to be displayed within which control loops (1 to 8) must be defined in the user submodule with the structures

DR/SR in the configuration phase. Later modifications can only be made in stop mode of the module.
In contrast to this, the measuring sockets for the
DRS/SR user submodule must be assigned to the desired measuring points immediately the controller is tested; in other words, while the process is running:
The operator interface of the COM REG packages also offers the "Measuring sockets" function as well as the "Controller test" function. In the "Measuring sockets" function, you can assign the socket 1 (DAC channel no. 5) and the socket 2 (DAC channel no. 6) in menu-driven mode to any measuring point of the controller structure (controllers nos. 1 to 8). These assignments can be changed at any time.
The measuring sockets can only be activated if the analog output channels 5 and 6 have not been otherwise assigned.

b) Interlink capability of the control loops

The user submodule with the "DRS/SR" structures supports the interlinking of control loops 1 to 8 to form master and slave controllers. Wherever an **ADC n** is indicated in Sections 8.2 and 8.3 of the configuration documentation, the following parameters may be entered:

eg. ADC 6 =	0 to 7	Internal ADC channels
	128 to 254	Backplane bus addresses of the S5 analog input/output modules: only possible with the S5-115U
	R No.MP No.	**R No.** is the controller number 1 to 8 and **MP No.** the number of a measuring point of this controller sturcture.

It is now possible, for example, to transmit the processed actual value of controller no. 2 as a setpoint to controller no. 3. The following value is now entered in the input field of ADC 6 (of branch 8 in controller no. 3) using the programmer:

ADC 6   2.12

4.2 Maximum Number of Control Loops on the IP 252

The operating system of the IP can supervise a **maximum of 8 control loops.** Each control loop is assigned a sampling time by the user. **The minimum sampling time is 4 ms, the maximum 32 s.**

Each control loop uses up a certain percentage of the CPU resources of the IP 252. The total sum of resources used by the controllers should not exceed 100% of the CPU capacity.

How many percentage points a control loop uses up depends on the following influencing factors:

- Choice of structure (drive controller, . . .)
- Choice of sampling time (4 ms, 8 ms, . . .)
- Choice of branches (limit monitor, . . .) within the structure
- Choice of functions (ramp function generator, . . .) within a branch

The PG displays the percentage loading of the CPU in order to provide an estimate of the CPU loading of the IP. The table included in the Appendix (Section 9) states to what extent (in %) each individual function loads the processor, given a sampling time of 4 ms. These data are however only a **rough** guide. **Exact** information as to whether all controllers in the IP can run without time problems is generated by the IP itself as follows:
If the FAULT lamp (Section 4.4) does **not** light up in the RUN state of the IP, then the loading is under 100%.
Illumination means momentary overloading. This can happen for instance when the PG or S5-CPU accesses the IP frequently.
Overloading is detected by the operating system and "smoothed out" (see Section 4.4).

Overloading causes timing conflicts in the control loops of the IP. This means that the control loops **cannot** be processed at the sampling times specified by the user via the PG. In this case the operating system of the IP **automatically** lengthens the sampling time by 4 ms. This lengthening continues until the time conflict has ended. After this the control loops operate with the sampling times specified by the user.
The operating system can cope with **any** overload situation. The IP can be operated via the PG or PC under all circumstances.

In the case of a **permanent** as opposed to a temporary overloading, the operating system permanently lengthens the sampling times of all control loops. This indicates that the user has selected sampling times which are too small and thus overloaded the IP.

Note:

The selected control loop sampling time is not valid for all branches of the structure
Branches such as the speed controller (branch 5, AR) are processed with the set sampling time T_A, whereas the limit signal monitor is only processed during every eighth sampling interval ($8 \cdot T_A$).
This relationship is represented in Sections 8 and 9 in the upper half of the diagram with "T_A, $2 \cdot T_A$ and $8 \cdot T_A$".

The IP recognizes the following number formats:

- Time values
- Percentage values
- Dimensioned variables
- Dimensionless variables

4.3.1 Time values

The ranges which can be displayed on the PG are:

0.1	to	999.9	ms	(milliseconds)
0.001	to	9999.	s	(seconds)
00.01	to	59.59	h.m	(hours.minutes)

4.3.2 Percentage values

The input/output is carried out with **fixed** decimal point.

Input range:	± 0.01% to ± 100.00%
Output range:	± 0.01% to ± 200.00%

The number range of ± 100% corresponds to a voltage range of ± 10 V.

4.3.3 Dimensioned variables

It is possible to input and output a dimensioned variable (e. g. setpoint for a temperature controller). For this the PG requests the following information:

- 0% = ?
- 100% = ?
- ASCII = ?

The values entered for 0% and 100% define a straight line. This specifies the value range for the dimensioned variable.

The example in Fig. 4.2 illustrates this. A temperature value is to be controlled. The user knows that the occurring temperature value varies in the range + 3,0 °C to – 2,0 °C. The setpoint and the actual values are to be input and output in °C. The following must be entered on the PG:

			Input at PG
– 0%	=	0.5	
– 100%	=	3.0	
– ASCII	=	DEG C	(maximum 6 characters)

The 0% value corresponds to the middle of the possible temperature range, the 100% value to the maximum value.
After these specifications the dimension of temperature can be specified directly (e. g. 2.01 °C).
Measuring point displays are then also converted to the temperature range (e. g. – 3.00 °C). The output range in this example lies between + 5.50 °C and – 4.50 °C.

4.3 Input/Output Formats of the IP 252

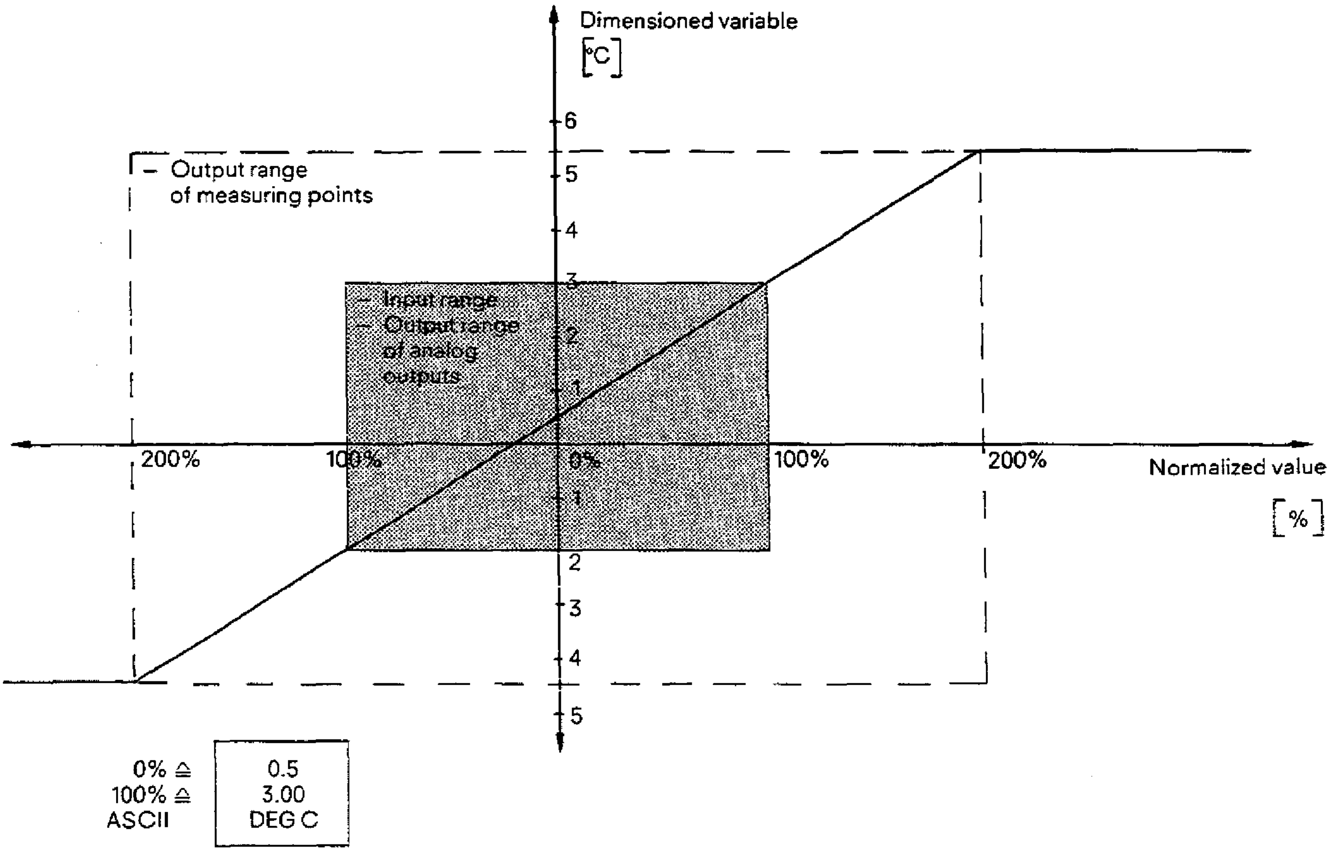


Fig. 4.2 Example of dimensioned input/output via the PG

Notes on the correct selection of the 0% and 100% specification:

- Permissible range for the (0% / 100%) specification

± 1	to	± 10000
± 0.1	to	± 1000.0
± 0.01	to	± 100.00
± 0.001	to	± 10.000
± 0.0001	to	± 1.0000
± .00001	to	± .00000

- The permissible combinations for the (0% / 100%) specification:
  After the 0% **and** the 100% values have been entered in the PG, the PG checks whether this **pair of values** is permissible. Only those pairs of values are permissible which make sense from the accuracy consideration and for which the specification of the 100% value is larger than the 0% value.

  The checking of the accuracy is carried out according to the following procedure:
  - Determination of the position of the decimal point for 0% and 100% values: K_1, K_2
  - Multiplication of the 0% and the 100% values by 10^x, where x is the larger of the two numbers K_1, K_2.
  - If the magnitude of both results of the multiplications $\leqq$ 10000 then the (0% / 100%) pair of values is sensible and permissible.

Example 1:

$0\% = 0.1 \quad K_1 = 1$ $100\% = 12345 \quad K_2 = 0$	1. Determine position of decimal point
$0.1 \cdot 10^1 = 1$ $12345 \cdot 10^1 = 123450$	2. Multiplication with 10^x

Result: The (0%/100%) pair of values is **not** permissible!

Example 2:

$0\% = 0.01 \quad K_1 = 2$ $100\% = 10 \quad K_2 = 0$	1. Determine position of decimal point
$0.01 \cdot 10^2 = 1$ $10 \cdot 10^2 = 1000$	2. Multiplication with 10^x

Result: The (0%/100%) pair of values is permissible!
The following inputs/outputs are possible via the PG:
0.01 0.9 0.95 1 1.2 1.06 . . .

4.3.4 Dimensionless variables

There are dimensionless variables **with** and **without** a decimal point:

- Variables without decimal points have a range of 0 to ± 32767.
- Variables with decimal points always contain two digits after the decimal point and have a range of ± 00.01 to ± 99.99.

4.4 Meaning of the LEDs on the Front Panel of the Module

Combinations:	**Meaning:**
○ RUN ⊗ STOP ○ FAULT	The module is in the STOP mode (see Section 4.9)
⊗ RUN ○ STOP ○ FAULT	The module is in the RUN mode (see Section 4.9)
○ RUN ⊗ STOP ⊗ FAULT	Both lamps light up **immediately** after the module power has been switched on. If no faults are present, the fault lamp extinguishes after a few seconds. This means that after switching the power on, the diagnostic routines of the module could not detect any faults. If the fault lamp (FAULT) does not extinguish, then the module is defective.
⊗ RUN ○ STOP ⊗ FAULT	The loading of the module is partially too high; i. e. during those periods when the fault lamp lights up (momentarily), there are timing problems in the closed-loop controllers **(see Section 4.2).** The following alternative remedies are available: – Increase the sampling time of a control loop – Delete a control loop – Disable a control loop – Switch individual functions off – Switch individual branches off – Limit the communication with the S5-CPU or the PG

Symbols:	
○	Lamp **extinguished**
⊗	Lamp illuminated

4.5.1 Retentive/non-retentive data

The memory submodule used in the IP 252 contains memory (EEPROM) which retains data when the voltage is switched off. The controller parameters for a maximum of 8 control loops are stored there.
These variables are listed in **Table 4.1** for each individual control loop. The controller parameters stored in the EEPROM are known as "retentive" data. In contrast to this sort of data there is also "non-retentive" data, which is listed in **Table 4.2.** Non-rentention data is **not** stored in the EEPROM and are lost during a power failure, if no back-up battery is available.

The storage of controller parameters in the memory submodule is carried out **fully automatically** by the IP 252, **without** the user having to worry about it. The principle is explained briefly in Section **4.5.2.**

Table 4.1: Retentive data of a control loop (see also Sections 4.10.7, 4.11.7 and 4.12.8 data words 0 to 167)

- Type of structure (drive controller, standard controller, . . .)
- Sampling time of the control loop
- Dimension specifications
- Structuring of the control loop (state of the structure switches)
- Addresses of the analog controller inputs "ADC 1, . . ., ADC 8"
- Addresses of the analog controller outputs "DAC 1, . . ., DAC 8"
- Constant of the control loop "KON X.Y"
- Assignment of the measuring points to the measuring sockets
- Assignment of the measuring points to the limit monitors

Table 4.2 NON-retentive data of a control loop (see also Sections 4.10.7, 4.11.7 and 4.12.8 data words 168 to 255)

- Variable "VAR X.Y"
- Contents of analog inputs/outputs
- Binary inputs/output values "BIT X.Y"
- Relay states "REL X.Y"
- Measuring point values "MP X"
- Past values of functions (smoothing, PID, . . .)

4.5.2 Principle of data retention (see Fig. 4.2)

A workspace memory (RAM) is located in the IP, in which all the controller data is stored. This data can be subdivided into:

- retentive data (see Table 4.1)
- non-retentive data (see Table 4.2)

Retentive data can be modified with CPU/CP and PGs (Fig. 4.3, 1 and 2). However the following retentive data cannot be entered in the STOP state of the IP:

- Structure type
- Sampling time
- Dimensions
- Structure switches
- Addresses for analog inputs/outputs

The remainder of the retentive data of Table 4.1 can also be modified in the RUN state of the IP.

Each input via the CPU/CP or PG is stored initially in the RAM of the IP. The operating system of the IP continuously compares the controller data of the module (RAM) with the controller data in the memory submodule (EEPROM). If a value differs then it is automatically updated in the memory submodule (Fig. 4.2, 3).

Note:
If random data are transferred cyclically from the S5 CPU to the IP 252 (e. g. KON10.1, KON5.KP etc.), it may not be desirable to dump these data on EEPROM. If this is the case, use of a special job no. during data transfer will prevent these data being dumped in the EEPROM of the user submodule. The reason for using this method for data transfer is that the EEPROM can survive only a limited number of write cycles (updating).
This mode (Section 5.2.3.2) is only possible with the submodule "Expanded drive controller structure with self-setting and standard controller structure (DRS/SR)" (MLFB 6ES5 374-0AB11).

After a user input via the CPU/CP or PG, there is a certain interval of time during which the retentive data in the memory submodule is updated. If a power failure does **not** occur during this (short) interval of time, then the description given under "Case 1" applies. If a power failure occurs during this interval of time, then the description under "Case 2" applies.

4.5 Data Retention in the Memory Submodule

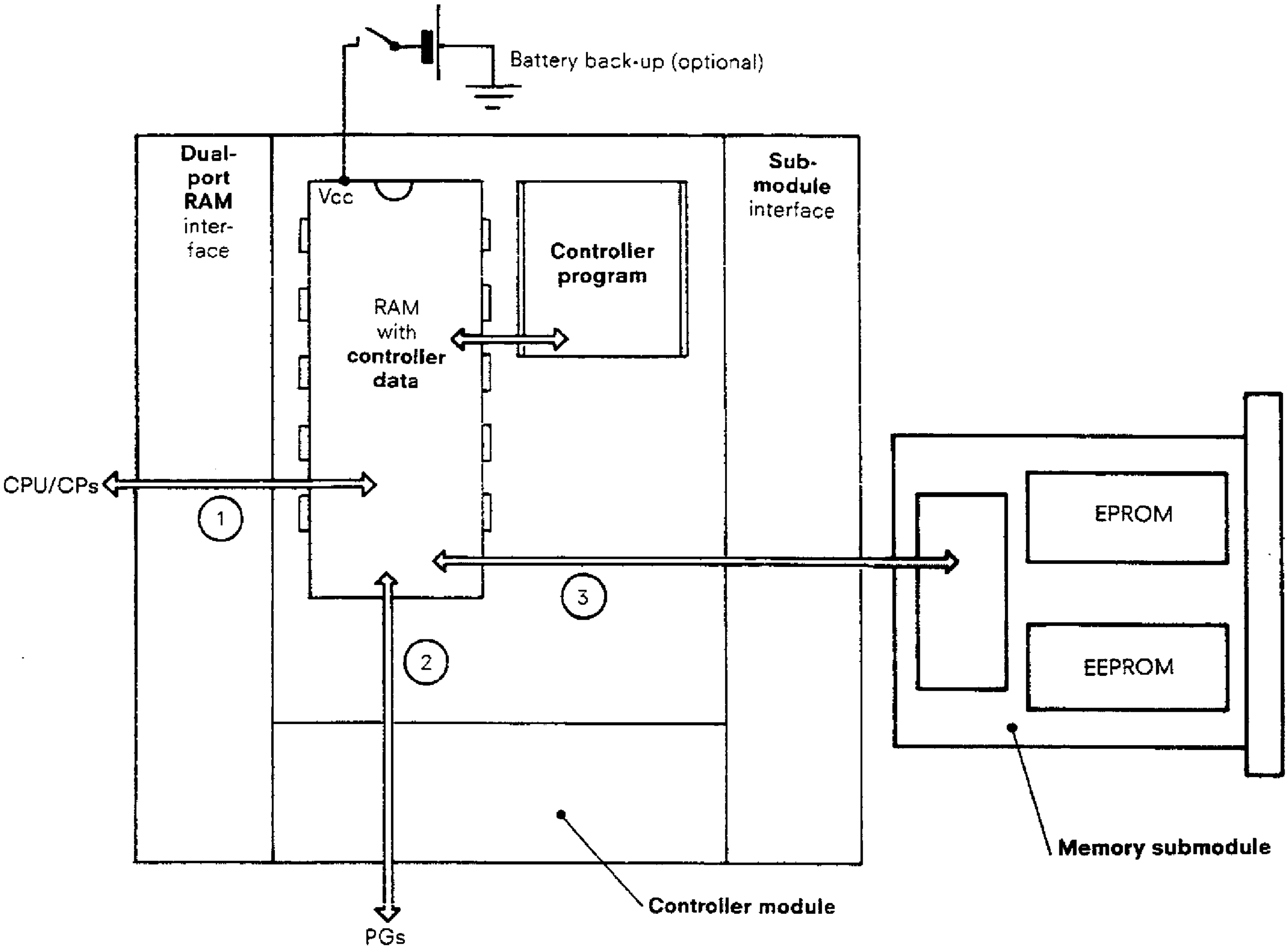


Fig. 4.2 Data retention in the 252 IP

Case 1: NO power failure during the updating of the EEPROMs

The EEPROM of the memory module contains all the latest data required for the control loops according to Table 4.1.

Case 2: Power failure during the updating of the EEPROMs

In this case one must differentiate between whether the RAM of the IP is backed up or not. A battery in the power supply of the programmable controller is used for supplying the back-up voltage.

The RAM is supplied by a backup battery:

After the restoration of power, the EEPROM contains the most recent data for all the control loops as listed in Table 4.1. **After** power restoration there is no difference to case 1.

The RAM is not backed up:

After restoration of power, the EEPROM contains the most recent data listed in Table 4.1 for all control loops except for those whose updating was interrupted by the power failure. The data of the control loop during which the power failure occured has the same state in the EEPROM as **before** the last modification.

Comment to case 2:

If the memory submodule is pulled out with the IP supply voltage switched **"off"**, then it is **not** important whether RAM is backed up or not. The contents of the EEPROM are as follows:
The data for all control loops except for the one during which the power failure occurred, are the most recent.
The data of the control loop during which the power failure occured, has the same state as before the last modification.

4.6 Start-up Behaviour of the IP 252 (response to "power on")

4.6.1 Treatment of the controller data after "power on"

After switching the power "on", the operating system checks the IP for the presence of a user memory submodule. If no submodule is present or a submodule with the **wrong identification** (≠ 28) is present, then the IP remains in the STOP mode. The IP can be accessed via the PG even when **no** submodule is plugged in!

If a **valid** memory submodule is plugged in, then the following **two** cases must be considered:

Case 1:

Assumption: The IP is powered up and the power fails. The submodule remains plugged in and the power is again restored.

Consequence: The controller data in the RAM of the IP and the memory submodule are **identical.** How current the data are, as compared to the last modification by the user, is described in Section 4.6.2.

Case 2:

Assumption: The IP is powered up and the power fails. The submodule is removed when the power is "off" and **another submodule with valid data** is plugged in. Then the power is restored.

Consequence: In the following cases the controller data is copied from the memory submodule into the RAM of the IP:
- No battery is present
  OR
- The IP was in the STOP mode before "power off"
  OR
- The stop switch of the IP was switched to stop in the unpowered state.

Note to case 2:

If the user wants to load **new controller data** into the IP, then the IP must be switched "off", the new memory submodule plugged in, the STOP switch moved to the STOP position and the power switched "on" again.

4.6.2 Start-up behaviour of the control loops after "power on" (Fig. 4.3)

After powering up, the IP goes into the RUN mode (green RUN LED lights up) or into the STOP mode (red STOP LED lights up).

The STOP mode is entered under the following conditions:

- No battery is available OR
- The switch on the IP is in the STOP position OR
- The IP was in the STOP mode before power failure OR
- The power failure indication is not set

Before reaching the STOP mode, the controller data from the EEPROM of the memory submodule is copied to the RAM on the module. Also all the previous values, bits, relays and variables of the control loops are erased.

The RUN mode is entered under the following conditions:

- Battery is available AND
- The switch on the IP is in the RUN position AND
- The IP was in the RUN mode before power failure AND
- The power failure bit is set AND
- The S5-CPU switches the BASP signal inactive i. e. the CPU is in the RUN mode

There are various ways of influencing the start-up response of a control loop from the PG. The following statements assume that the IP automatically goes to the RUN mode after "power on". The PG can be used for setting in each control loop whether **warm restart** is desired and in that case whether the **warm restart criterion** should be used.

4.6 Start-up Behaviour of the IP 252 (response to "power on")

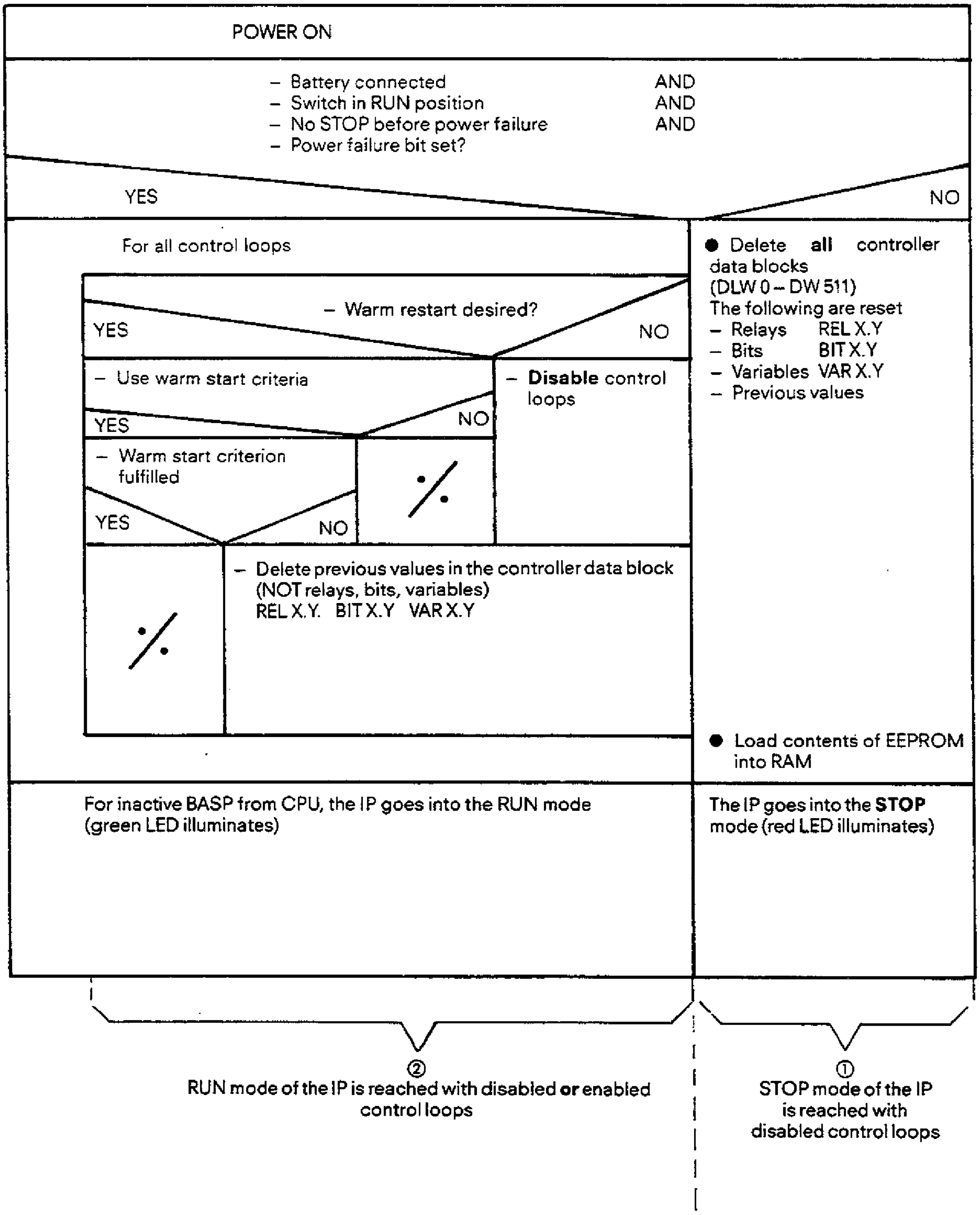

POWER ON
– Battery connected AND
– Switch in RUN position AND
– No STOP before power failure AND
– Power failure bit set?
YES
NO
For all control loops
– Warm restart desired?
YES
NO
– Use warm start criteria
YES
NO
– Disable control loops
– Warm start criterion fulfilled
YES
NO
./.
./.
– Delete previous values in the controller data block (NOT relays, bits, variables) REL X.Y. BIT X.Y VAR X.Y
● Delete all controller data blocks (DLW 0 – DW 511)
The following are reset
– Relays REL X.Y
– Bits BIT X.Y
– Variables VAR X.Y
– Previous values
● Load contents of EEPROM into RAM
For inactive BASP from CPU, the IP goes into the RUN mode (green LED illuminates)
The IP goes into the STOP mode (red LED illuminates)
②
RUN mode of the IP is reached with disabled or enabled control loops
①
STOP mode of the IP is reached with disabled control loops

Fig. 4.3 Start-up behaviour of the IP 252 after "power on"

The warm restart criterion is:

The actual values **before** and **after** power failure should not differ in magnitude by more than 25% of the actual value **before** the power failure.

$$| \text{actual value}_{\text{after NAU}} - \text{actual value}_{\text{before NAU}} | \leq | 0.25 \times \text{actual value}_{\text{before NAU}} |$$

If **no** warm restart is required, the operating system disables all control loops and resets the previous values in the corresponding controller data blocks, i. e. the IP goes into the RUN mode with disabled control loops. These control loops can be enabled from the S5-CPU via a command, which is transmitted by data handling blocks. The enabling is carried out individually for each control loop ("Controller cold restart").

Now the case is considered where the user has selected warm restart behaviour via the PG. If the warm restart criterion is then **not** used, then all previous values of the control loops are reset. The IP goes into the RUN mode and the control loops which were enabled before **"power off"** remain enabled and begin to operate from the start up mode ("Controller cold restart").

When the warm restart criterion is used, the operating system of the IP checks whether the criterion is fulfilled. If it is **not** fulfilled, then all the previous values of the control loops are reset. The IP goes into the RUN mode and the control loops which were enabled before **"power off"** remain enabled and begin to operate from the start up ("Controller cold restart").

If the warm restart criterion is fulfilled, **no** previous values are erased. The IP goes into the RUN mode and the control loops which were enabled before **"power off"** remain enabled and begin to operate again from the point at which they were interrupted by **"power off"** ("Controller warm restart").

Summary:

Controller cold restart means that the control loops begin to operate from the restart after switching the power on. This means that all the previous values of these control loops are reset.

Controller warm restart means that the control loops continue to operate with the old values after switching the power on. These values correspond to the state at the instant of the power failure. Several conditions must be fulfilled before any of the (maximum 8) control loops can carry out a warm restart.

The following applies for the IP 252:

- The RAM of the IP is backed up by a battery
- The IP is in the RUN mode at the instant of the power failure.

The following applies to the control loops:

- Warm restart is selected and the warm restart criterion is fulfilled.

The following applies to the S5-CPU:

- The CPU is in the RUN mode

4.7 Enabling/Disabling of the Control Loops with the Programmer

Individual control loops can be enabled or disabled via the PG from the "Operating mode" menu. This is possible in the RUN and in the STOP mode of the IP.
The command acts immediately in the RUN mode of the IP. If the command is given in the STOP mode of the IP, then it operates only when the IP goes to the RUN mode.

Example:

The following is entered during the STOP mode of the IP:

	R1	R2	R3	R4	R5	R6	R7	R8
ENABLE	N	Y	N	Y	–	–	–	-

When the IP subsequently goes into the RUN mode, the following happens:
Control loops 2, 4 are enabled, i. e. they are processed
Control loops 1, 3 are disabled, i. e. they are **not** processed

Note:
If, during configuration of the control loops, the programmer query "Warm restart after power failure" is answered with 'No', the relevant control loops R1 to R8 will be disabled at power recover. Re-enabling must then be effected from the programmer or the S5-CPU.

4.7.1 Disabling of a control loop in the RUN mode of the IP

If a control loop is disabled by the programmer in the "Controller processing" form (or "Mode" form in the case of the PG 615), this means **no** calculation is carried out for this control loop.
The response of the **analog outputs** assigned to this disabled control loop can be selected by the user. There is a menu for this purpose on the PG. There are two options for selection:

Option 1: the **analog outputs** remain in the state they had at disabling.
Option 2: the **analog outputs** are reset, i. e. 0V is output.

If the user selects option 2, then in addition all measuring points and previous values of the control loop are reset.

4.7.2 Enabling a control loop in the RUN mode of the IP

The reaction of a control loop to being enabled depends on its past history.

Pre-history 1: The control loop was enabled during RUN of the IP and then disabled. When the control loop is again enabled, then two cases must be differentiated:

Case 1: The analog outputs of the control loop have retained the last value while the control loop is disabled. In this case, a check is made as to whether a warm restart of the controller is possible. If the warm restart criterion is fulfilled, then the control loop continues with the last values, which it had when it was disabled. The warm restart criterion is (as in Section 4.6): The actual value **before disabling** and the actual value **after enabling** should not differ in magnitude by more than 25% of the actual value before disabling.

If the warm restart criterion is **not** fulfilled, then a cold restart of the controller is carried out, i. e. all previous values of the control loop are reset.

Case 2: The analog outputs of the control loop were reset while the control loop is disabled (outputs at 0 V).
This always requires a cold restart of the control loop as a consequence. This means that the previous values of the control loop are reset.

Pre-history 2: The control loop was never enabled in the RUN mode of the IP. In this case enabling always leads to a cold restart of the control loop.

4.8 RUN/STOP Mode of the Module

Both modes STOP and RUN of the IP can be selected via the switch on the module, via the PG or via the S5-CPU. The switch has the top priority. If for instance the RUN mode was selected via the PG and the switch was set to the STOP position, then the IP always goes to the STOP mode.

A transition from the STOP mode to the RUN mode caused by the **PG,** CPU or **switch always** triggers a **cold start** (Section 4.7.2). This means that all previous values, bits, variables and relays are reset. The control loop enabling however remains uninfluenced!

4.8.1 RUN mode

The following characteristics apply to the RUN mode:

- The analog outputs of the control loops are active.
- Individual control loops can be enabled or disabled.
- Enabled control loops are executed.
- Communication with the PG is possible.
- Communication with the S5-CPU is possible.
- Controller parameters are **automatically** saved on the EEPROM of the memory submodule.
- Constants, relays, bits, variables and measuring point assignments of the control loops can be modified.
- The structuring of a control loop is not allowed.

The IP can reach the RUN state in various ways.
After "power on" the IP goes automatically into RUN, if the conditions of Section 4.6.2 are fulfilled:

If the IP is in the STOP mode, then there are various ways of going to RUN. It is assumed that a memory submodule with a valid identifier is inserted, and the S5-CPU is in the RUN mode. These ways are:

- The switch is moved to the RUN mode
  OR
- The PG gives the RUN command and the switch is in the RUN mode
  OR
- The S5-CPU gives the RUN command and the switch is in the RUN mode

4.8.2 STOP mode

The following characteristics apply to the STOP mode:

- All analog outputs of the module are connected to module earth via relays.
- Individual control loops can be enabled and disabled. Enabled controllers are not executed.
- Communication with the PG is possible.
- Communication with the S5-CPU is possible.
- Controller parameters are **automatically** saved on the EEPROM of the memory submodule.
- Constants, variables and measuring point assignments can be modified; this does not apply to bits and relays.
- The structuring of a control loop is not allowed.

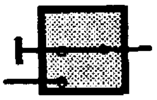
The STOP mode of the IP is reached by various ways.
After **"power on"** the IP goes into STOP, if the conditions described in Section 4.6.2 are fulfilled.

The IP goes from the RUN mode into the STOP mode, due to the following:

- The S5-CPU goes to STOP (BASP active)
  OR
- The switch on the IP is set to STOP
  OR
- The voltage monitoring of the module signals a fault
  OR
- The PG gives a STOP command
  OR
- A hardware fault occurs
  OR
- The S5-CPU gives the STOP command
  OR
- The watchdog is triggered
  OR
- An access is made to a defective or missing analog module.

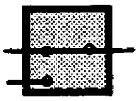
4.9 Explanation of the Symbols used in the Configuring Sheets (Section 8)

The basis of the description of the controller structures are the **configuring sheets** (Section 8) for these controller structures. The symbols and abbreviations used are described below.



Main structure switch (configuring bit) for branch 13:

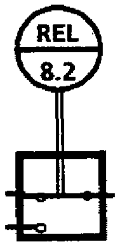
The switch (St 13) is used for selecting branches within a controller structure. The user determines via the programmer if the branch is to be executed or not.



Structure switch 1 in branch 8:

The switch (S 8.1) determines the signal flow **within** a branch. The switch position is only scanned by the PG if the corresponding branch is selected.

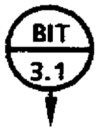
Note regarding the main structure switches. Modification of the switch position is only possible in the STOP state of the IP. The PG must be in the "Structuring" mode.



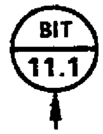
Relay 2 in branch 8:

The term relay (REL 8.2) is used to identify switches which can be modified in the RUN state of the control loop, i. e. during the time the IP is processing control loops, the signals in a control loop can be interrupted, switched through or switched over.

The relays are influenced by the control program of the CPU and from the PG.

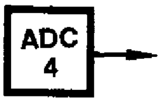


Binary (input) value 1 in branch 3:

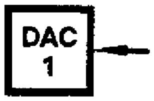


Binary (output) value 1 in branch 11:

The control loop recognises binary input variables and binary output variables. The states of the input bits (0/1) can be modified in the RUN state of the IP both from PG and also from the control program of the CPU. Binary output variables (0/1) are transferred to the control program of the CPU from the IP. They can be simultaneously observed with the PG.



Analog input 4 of the controller structure (analog-to-digital converter)



Analog output 1 of the controller structure (digital-to-analog converter)

Each controller structure has a certain number of analog input/output variables (ADC 1, ADC 2, . . . or DAC 1, DAC 2, . . .). The assignment of these inputs/outputs to the connected signal lines of the IP or the analog modules is carried out with the PG. This is only possible in the STOP state of the IP.

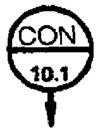
The following inputs are possible via the PG:

0, . . ., 7 The analog input/output variables are processed **in the IP** and are connected to channel numbers 0, . . ., 7 at the terminal block. (Section 2.1.3.1.5)

128, . . ., 254 The analog input/output variables are processed in the **analog module.** The S5 addresses are in the range F080H to F0FFH. This is the peripheral range **without** process image.

Addressing is slot-coded. Address "128" corresponds to an analog input or output module in the slot next to the CPU and the second slot is then coded with "160" (= 128 + 32). The **two's complement** must be set as the format and sampling is performed cyclically.

The IP 252 can **only** access analog modules when used in the 115U-CPU. Depending on the CPU version only a limited number of IPs can access analog modules:

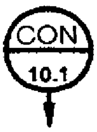


CPU	Number
944	3
941 to 942 B	1
otherwise	0

The following input is also possible in the case of user submodules with the structures "DRS/SR", wherever an **ADCn** is indicated in Sections 8.2 and 8.3 of the configuration documentation:

R No. MP No. **R No.** is the controller number 1 to 8 and
M No. is the number of a measuring point of this controller structure.

This makes it possible to assign, for example, the processed actual value of controller No. 2 to controller No. 3 as a setpoint. The following value is entered by the programmer in the entry field of ADC 6 (of branch 8 in controller No. 3): ADC 6 2.12.

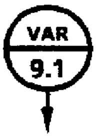


Constant value 1 in branch 10

The following numerical values can be input via the PG in the **STOP and the RUN** state of the IP:

- Timers (e. g. ramp-up time = 20 s)
- Percentage values (e. g. setpoint = 50.05%)
- Dimensioned variables (e. g. setpoint = 300.5 rev/min)
- Dimensionless variables (e. g. proportional value = 10.01)

(refer to **Section 4.4** for available possible input formats)



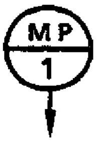
Variable value 1 in branch 9

Setpoints can be input not only as analog signals but also as numerical values. These numerical values can be generated both by the PG and also by the control program of the CPU. If these numerical values are generated by the S5-CPU, then they are identified with "VAR". Variable values can be entered in the **STOP and the RUN** state of the IP.

The following values can be input:

- Percentage values (e. g. speed setpoint = 10.83%)
- Dimensioned variables (e. g. temperature setpoint = 1024°C)

(refer to **Section 4.4** for available input formats)



Measuring point 1 of the controller structure

A series of measuring points are distributed over each controller structure. These measuring points can be used to observe the most important signals of the control loop.

Measuring points are
- Percentage values
  OR
- Dimensioned variables

In the **RUN state of the IP** it is possible to assign **any** desired measuring points to limit monitors or measuring sockets with the PG. A recorder can be connected to the measuring sockets (on the front panel of the IP) and the signal can be recorded. Crossing of upper or lower limits by signals can be monitored with the limit monitors.

Note regarding the switch position for relays and function switches:

The position drawn in the configuring sheets is always the default position. A switch position can only be changed by an action on the part of the user:

- For structure switches, a branch or a function must be selected with the PG (=1).
- For relays, the corresponding bit must be **active** ("1"). This is possible using "Force" on the PG during the "Controller test" mode or via the S5-CPU.

4.10 Description of the Drive Controller Structure (DR)

The structure contains all functions required for controlling a drive, except for the current controller and the power stage. This means that depending on the requirements of the user, a **speed control system** (e. g. for mills, turbines) or a **velocity control system** (e. g. for paper machines, winders and foil machines) can be implemented.

The drive controller structure (Fig. 9.1) consists basically of **two cascaded closed-loop controllers.** Parameters can be assigned to each of the controllers of P, PI, PD or PID response. The **outer loop controller** (9) is used e. g. for position control, tension control or pressure control. One should mention at this stage that the numbers in brackets correspond to the branch number ((5) ≙ branch 5). A velocity control loop or a speed control loop can be implemented using the **inner loop controller** (5).

Upon a request by the CPU of the programmable controller, the closed-loop controller structure can be switched over to "direct tension control". The output of the inner loop controller (5) is then switched to limit the outer loop controller (9). The output of the outer loop controller (9) generates the manipulated variable (current setpoint).

4.10.1 Outer loop controller (9)

The **setpoint** (e. g. position setpoint) is input either via an A/D converter, or via the programmer or the CPU of the programmable controller. The **actual value** (e. g. actual position value) is sensed by an A/D converter. The **controller output** can be reduced in proportion to the actual speed value. This is used for speed-dependent adaptive control in foil machines.

4.10.2 Inner loop controller (5)

The following **setpoint sources** can be programmed:

- 1st channel: Output of the outer loop controller (9)
- 2nd channel: Setting up speed (6)
- 3rd channel: Inching speed (7)
- 4th channel: Armature current dependent component (11)
  This component is used e. g. in conveyor belts and continuous casting processes (load regulation).
- 5th channel: Main setpoint (speed or velocity setpoint (8)).
  This setpoint is input either via an A/D converter, via the programmer or via the programmable controller CPU. The acquired setpoints can be processed by a **ramp function generator** and/or a **smoothing module.**
  The ramp function generator module produces a ramp output from a step function at its input. This is required for instance during start up processes.
  The smoothing module is used for "smoothing" the setpoint.
  The control loop can be tuned to optimum disturbance response. Selection of a suitable smoothing time constant produces an optimum response to setpoint changes.

The **actual value** (10) (actual speed value) can be input either as a **tacho voltage** via the A/D converter or via a **counter input.** A **smoothing module** is used for suppressing any resonances. In addition, the high frequency disturbances to which the controller cannot respond are kept away from the PID module (10).
The **display function** (10) provides a steady display of the actual speed value via a measuring instrument connected to the D/A converter.

In the case of the speed control loop, the actual speed value (10) is used directly in the inner loop (speed) controller (5). If a velocity control is required, the current velocity is calculated from the actual speed value (3 a) and transmitted to the inner loop (velocity controller) as an actual velocity value.

The **controller output,** optionally evaluated with a factor (4), forms the main component of the current setpoint. This evaluation of the controller output produces a loop gain, as required e. g. during the field weakening operation of motors.

4.10.3 Current setpoint

The current setpoint which is generated by the IP 252 as a ± 10 V voltage at the D/A converter consists of the following:

- 1st channel: Main current setpoint (5)
- 2nd channel: Friction compensation (2)
- 3rd channel: Acceleration compensation (3 b); is used in velocity controllers (e. g. reeling and unwinding operations)
- 4th channel: Braking current modulation (1 b)
  Instead of the summed output (1 a), an actual speed dependent braking current can be output as the manipulated variable.

Before the current setpoint is output as the manipulated variable, it can be converted and limited (1 b).

4.10.4 Additional functions

- Two **user connected** limit monitors (12), (13):
  Each of the limit monitors can be assigned to any desired signal (measuring point) of the controller structure. The limit monitors contain 6 stages, which are specified via the programmers. The results of the limit monitors (overshoot or undershoot) are evaluated by the logic control program of the S5 central controller.

- Four **pre-assigned** limit monitors:
  These limit monitors support the operator communication and control concept of the compact controller structures. The results of the monitors are used for instance by the CP 526 communications processors as inputs for the standard displays on the VDUs.
  The limit monitors monitor setpoints and actual values of the outer loop (9) and the inner loop (5) controllers.
  The danger and the warning limits are specified via the programmer in the planning stage.

- **Thermal monitoring** of the motor (11):
  Using the actual armature current a thermal monitoring of the motor is possible. If one of the switching limits specified by the programmer is reached this is communicated to the logic control program.

- Two **user assigned** measuring sockets (14, 15)
  Two measuring sockets are located on the front panel of the controller module. Any desired signals (measuring points) of the controller can be measured at these measuring sockets. The programmer is used to assign a particular signal to a particular measuring socket.

4.10.5 Detailed description of the drive controller structure

The following description refers to the configuring sheets (Section 8) for the drive controller structure. The symbols used here are explained in Section 4.9.

The three overview pages of Section 8 show all the branches of the drive controller structure. The shading in branches 1, 5, and 10 of the drive controller structure means that these branches **cannot** be switched off. These branches are always active! The precise representation of the structure can be found in Section 9 (Fig. 9.1) of the Appendix.

4.10.5.1 Branch 1: Controller output/current setpoint

Function:

The current setpoint (manipulated variable) is generated and output via an analog output channel. The current setpoint can be inverted with structure switch S 1.1.
The limiting stage limits the current setpoint to values, which are specified by the user via the PG. The upper and lower limiting values are detected in **branch 5** (Section 4.10.5.5) by the PG. If the current setpoint crosses the limits, then this is taken into account in the inner loop controller (PID module) in **branch 5;** i. e. the corresponding overflow bits are set and the I component of the PID controller is disabled as long as an overflow bit is set.

Relay REL 1.1 is available for braking action. If the relay is active, then DAC2 outputs the current setpoint, which is linearly dependent on the instantaneous actual speed value. MP12 is multiplied by (−100) and by the constant CON1.1, with REL1.1 active. This means that 0% is output as the current setpoint when 0 speed is reached.

Input variables:

– Current setpoint component	from **branch 2**
– Current setpoint component	from **branch 3**
– Main current setpoint	from **branch 5**

Braking compensation:

– CON1.1	The constant influences the magnitude of the braking current
– MP12	Actual speed from **branch 10**
– REL1.1	When active, the motor is braked to standstill.

Output variables:

– DAC2	Current setpoint (manipulated variable) **after** limiting.
– MP 6	Magnitude of the braking current. The actual speed value, multiplied by the constant CON1.1 and (−100) is the braking current.
– MP 9	Current setpoint before limiting

4.10.5.2 Branch 2: Friction

Function:

This branch can be activated with relay REL 2.1 for compensating friction (stiction) forces. In order that the correct polarity of these current setpoint components is maintained even when the direction of rotation changes, the constant 2.1 is multiplied with the **sign** of the speed setpoint.

Input variables:

– CON2.1	The constant specifies the magnitude of the current setpoint component.
– REL2.1	When active, the current setpoint component is enabled.
– MP14	Speed setpoint from branch 8

Output variables:

– The output from **branch 2** is connected to the summation point of **branch 1.**

4.10.5.3 Branch 3: Acceleration compensation and diameter calculator

This branch consists of two sections, which are used for operating axel-driven upcoilers and downcoilers.

Functions:

a) Acceleration compensation, branch 3b
If rotating masses are accelerated (decelerated) an acceleration (deceleration) torque is required from the electric drive. If the rotating mass is connected by a web of material to a drive with a different mechanical time constant, this can produce fluctuations in tension in the web during acceleration or deceleration. To minimize these fluctuation, the drive is supplied with a current setpoint component dependent on the acceleration torque.
The speed setpoint from branch 5 is differentiated for this purpose. The result is acceleration. This is multiplied with the constant KON 3.1 and applied to branch 1 as acceleration current.

b) Diameter calculator, branch 3a.
A primary requirement in upcoiling and downcoiling is that the web material is kept at a suitable tension. The IP 252 does this by means of velocity control (speed control) with primary tension control. With this "direct tension control" (actual tension measurement via tension load cells or dancer roll), the tension is controlled with branch 9. If there is a dancer roll, the primary controller functions as a position controller. The tension is determined by the weight of the dancer roll or the load applied to it.
The actual speed is matched to the coil diameter in branch 3a. Excitation during the coiling operation can be influenced via measuring point MP 15, which is then routed to a DAC via a measuring socket (branch 14 or 15). A precondition for coiling control is that the web speed be set by the driven machine.

Function sequence in the case of downcoiling

If the coil diameter decreases, the speed controller tries at first to maintain the speed since its input signals remain constant. This increases the web tension. The tension controller or position controller makes the appropriate adjustment and the speed is increased. This also increases the product n x d (MP 16). At the input to the summator in branch 3a, n x d is greater than the master reference voltage V_L at MP 14 and at this point the integrator runs from the set initial diameter (MP 15) downwards until the product n x d is again equal to V_L.
The actual value n x d for branch 5 is therefore smaller and so the drive is "faster". The correction value of the primary controller is decreased. During the coiling operation, n is therefore greater and d smaller; n x d always remains equal to V_L! Branch 3a functions similarly in the case of upcoiling with the difference that, in this operation, the integrator functions upwards from a small initial diameter.
It is important that the new initial diameter be set at the beginning of a coiling operation (e. g. by the CPU control program). The level of the master reference voltage (MP 14) at max. production speed depends on the coiling ratio.

Example:

Diameter of empty mandrel	200 mm = 22.2%
Diameter of full coil	900 mm = 100%
Diameter ratio	= 4.5%
Max. master reference voltage	= 22.2%

The master reference voltage can be influenced by means of the constant CON 8.2 in branch 8.
The diameter (MP 15) is only deleted in the STOP mode of the IP 252.
In the case of a warm restart after power failure, the old value is retained if the IP RAM has battery back-up.

Input variables
Acceleration compensation, branch 3b
– CON3.1 The constant determines the influence on the current setpoint
– MP 14 Velocity setpoint from branch 8
Diameter calculator, branch 3a
MP 12 Actual speed from branch 10
– VAR 3.1 The diameter of a newly mounted coil must be entered here. The IP 252 calculates the current diameter in the case of up and down coiling, starting from this diameter.
– REL 3.1 This relay influences the output of the integrator. When the relay is inactive, the currently calculated diameter is at the integrator output. When active, the output of the integrator is set to the value of variable 3.1. The diameter can be set again at any time.
– BIT 3.1 If the bit is "0", the integrator is disabled. The last diameter calculated remains at the output. If the bit is set to "1", the integrator begins to work again from the last diameter calculated.

Output variables
Acceleration output, branch 3b:
– MP 7 Magnitude of the current setpoint component
Diameter calculator, branch 3a:
– MP 15 Current diameter of the coil
– MP 16 Velocity value (to the summator in branch 5).

4.10.5.4 Branch 4: Loop gain

Function:

The output of the inner control loop in branch 5 is evaluated and gives the main component of the current setpoint. Depending on the position of structure switch S4.1 various arithmetic operations can be carried out:

S4.1 inactive: (division in branch 5)

The signal (field current) input through an analog input channel is transmitted to a function generator and multipied with the constant CON4.1. The characteristic cannot be changed on the IP and is described in Section 4.10.6.5. This characteristic gives the approximate relationship between the field current and the magnetic flux of the D. C. motor. The shape of the characteristic is selected to fit a majority of the most commonly used motors (see Section 4.10.6.5).

S4.1 active: (multiplication in branch 5)

In the case of velocity control, the actual diameter calculated in **branch 3** (MP15) is multiplied with the constant CON 4.1.
The result of this product is multiplied with the output variable of the control algorithm.

Input variables:

– ADC5	Field current
– CON4.1	The constant determines the influence of the arithmetic operation
– MP15	Actual diameter from branch 3

Output variables:

– MP8	Operation on the controller output in branch 5

4.10.5.5 Branch 5: Speed controller/velocity controller

Branch 5 (and also branch 9) contains a relay (REL 5/9), which is only active in a special application ("Direct tension control"). Section 4.10.5.16 is devoted to this application. Therefore in the description below this relay is assumed to be inactive.

Function:

The instantaneous control deviation is determined in the summation stage. It is calculated from the difference between the setpoint and the actual value (see page 2 on branch 5 in Section 8.1). The setpoint consists of the outputs of branches 6, 7, 8, 9 **and** 11, the actual value is the output of branch 3 **or** 10. If the actual value comes from branch 3, then it is a velocity control system otherwise it is a speed control system.

The setpoint and the actual value are each monitored by a preassigned limit monitor. The function of this monitor is described in **Section 4.10.6.1.**

If the relay REL5.1 is inactive, then the output of the summation stage goes to the PID controller. For commissioning purposes the relay can be made active. Then the constant CON5.1 goes to the PID controller input.

The PID controller can be assigned P, PD, PID or PI control action by setting various parameters to zero:

TN = 0	I component not active
TV = 0	D component not active

Both the limits CON5.B+ and CON5.B– limit the manipulated variable in **branch 1.** If the manipulated variable in **branch 1** crosses one of the limit values, then the corresponding bits BIT5.UE+ and BIT5.UE– of branch 5 are set.
The PID controller in branch 5 then disables its integrator. This prevents "wind up" of the integrator.

The output of the PID controller is operated on by the output of branch 4, if branch 4 was selected. If branch 4 was not structured then no operation is carried out, the controller output is connected to branch 1 without modification.
Evaluation: Multiplication if S4.1 = 1
Division if S4.1 = 0

The output of branch 5 is the main component of the current setpoint.

Input variables:

PID controller module:

– CON5.KP	Proportional value	} influence the behaviour of the PID controller
– CON5.TN	Integrating time	
– CON5.TV	Differentiating time	
– CON5.B+	The constant determines the upper limit for the limiting in **branch 1.**	
– CON5.B–	The constant determines the lower limit for the limiting in **branch 1.**	
– BIT5.RF	The bit disables or enables the PID controller. The controller is enabled, when the bit is active. When disabled, the controller produces 0% of its output and resets its internal memory.	

Setpoint limit monitor:

– CON5.SOG	Upper limit
– CON5.SUG	Lower limit

Actual value limit monitor:

- CON5.OW Upper warning limit
- CON5.UW Lower warning limit
- CON5.OG Upper danger limit
- CON5.UG Lower danger limit

Miscellaneous:

- CON5.1 When relay REL5.1 is active, the constant works on the input of the PID controller. (Start-up value).
- REL5.1 When the relay is active, it switches the constant CON5.1 to the PID controller input.
- REL5/9 With this relay, one can switch over to „Direct tension control" (see Section 4.10.5.16).

Output variables:

PID controller module:

- BIT5.UE+ This bit is active if the manipulated variable (MP9) in branch 1 crosses the upper limit CON5.B+ (in branch 1). The integrator in the PID controller is then frozen.
- BIT5.UE– This bit is active if the manipulated variable in branch 1 crosses the lower limit CON5.B– (in branch 1). The integrator in PID controller is then frozen.

Setpoint limit monitor

- BIT5.SOG The bit is active if the setpoint crosses the upper limit.
- BIT5.SUG The bit is active if the setpoint crosses the lower limit.

Actual value limit monitor

- BIT5.OW The bit is active if the actual value crosses the upper warning limit.
- BIT5.UW The bit is active if the actual value crosses the lower warning limit.
- BIT5.OG The bit is active if the actual value crosses the upper danger limit.
- BIT5.UG The bit is active if the actual value crosses the lower danger limit.

Miscellaneous:

- MP10 Main current setpoint (input of the summation stage in branch 1)
- MP11 Input of the PID controller (control deviation)

Note:

The bits BIT5.SOG to BIT5.SUG are not evaluated by the standard function block FB:FORCE (Section 5.1).

4.10.5.6 Branch 6: Setting-up speed

Function:

When relay REL6.1 is active, the constant CON6.1 is switched to the summation stage in branch 5.

Input variables:

- CON6.1 Constant used as the setting-up speed setpoint
- REL6.1 Relay used to switch the constant CON6.1 to the speed controller, branch 5 (control deviation).

Output variables:

- The result of branch 6 is connected to the summation stage in branch 5.

4.10.5.7 Branch 7: Inching speed

Function:

If relay REL7.1 is active, then the constant CON7.1 is switched to the summation stage in branch 5.

Input variables:

- CON7.1 Constant used as the inching speed setpoint.
- REL7.1 Relay used to switch the constant CON7.1 to the speed controller, branch 5 (control deviation).

Output variables:

- The result of branch 7 is connected to the input of the summation stage in branch 5.

4.10.5.8 Branch 8: Speed/velocity setpoint

Function:

The branch generates the main setpoint for the inner loop controller in branch 5.
Relay REL8.3 is used to select whether the setpoint is an **analog** or a **digital** input. In the case of an analog input (REL8.3 inactive) the IP inputs the value via ADC6.
In the case of a digital input (REL8.3 active) relay REL8.1 can be used to decide whether the setpoint comes from the PG (CON8.1) or from the logic control program of the S5-CPU (VAR8.1).

Further processing of the setpoint is only carried out if relay REL8.2 is active. The setpoint can be enabled or disabled with the relay.

The setpoint input via ADC or VAR8.1/CON8.1 can be transmitted via a ramp-function generator or a smoothing block or via both simultaneously. The structure switches S8.1 and S8.2 determine which block is selected.

The processed setpoint (MP17) is multiplied by the constant CON8.2 and then transmitted to branch 5.
If structure switch S8.3 is active, then the processed setpoint (MP17) is output via an analog output channel (DAC5).

The ramp-function generator block and the smoothing block are described in detail in Section 4.10.6.

Input variables:

Setpoint input:

- ADC6 For analog setpoint input, the signal is input via ADC6.
- REL8.1 The source for the digital setpoint is selected by the relay. If the relay is inactive, the value comes from the PG (CON8.1).
- REL8.3 The relay determines whether the setpoint input is analog (relay REL8.3 inactive) or digital (relay REL8.3 active).
- REL8.2 When active, the relay allows the setpoint to be processed further.
- CON8.1 For digital setpoint input (REL8.3 active) and with relay REL8.1 inactive, the PG is the source of the setpoint (CON8.1).
- VAR8.1 For digital setpoint input (REL8.3 active) and with relay REL8.1 active, the logic control program of the S5-CPU is the source of the setpoint.
- CON8.2 Multiplication of the processed setpoint by a constant.

Ramp-function generator:

- CON8.TR Ramp-down time
- CON8.TH Ramp-up time
- CON8.ZUW Increment

see Section 4.10.6.3

- BIT8.HOE Increase bit
- BIT8.TIE Decease bit
- BIT8.LOE Reset

- MP12/16 Actual speed/velocity

Smoothing block:

- CON8.TVZ Delay time see Section 4.10.6.2

Output variables:

- MP14 Magnitude of the setpoint **after** optional processing by the ramp-function generator block and/or the smoothing module. This value is transmitted to the summation stage in branch 5.
- MP17 Magnitude of the setpoint directly after being input.
- DAC5 For active structure switch S8.3, the processed setpoint is output to an analog output.

4.10.5.9 Branch 9: Outer loop (primary) controller

Branch 9 (and also branch 5) contains a relay REL 5/9, which is only active in a special application ("Direct tension control"). Section 4.10.5.16 is devoted to this application. Therefore in the description below this relay is assumed to be inactive.

Function:

The control deviation is determined in the summation stage. The actual value is input via ADC1. The setpoint can be input either as an analog variable (S9.2 inactive) or digital variable (S9.2 active). For digital setpoint input, the state of relay REL9.1 determines whether this value comes from the S5-CPU (VAR9.1) or from the programmer (CON9.1).
The setpoint and the actual value are each monitored by a preassigned and non-optional limit monitor (see page 2 on branch 9 in Section 8.1). The operation of both these limit monitors is described in **Section 4.10.6.1.**

The control deviation (output of the summation stage) is used as the input by the PID controller.
The PID controller can be assigned, P, PD, PID or PI control action by setting various parameters to zero:
TN = 0 I component not active
TV = 0 D component not active

The controller output is limited by CON 9.B+ and CON 9.B− and then multiplied before it reaches the summation stage of branch 5. The type of this evaluation can vary:
multiplication by a constant is possible via the PG value CON 9.2. However, it is also possible to make the operation proportional to the instantaneous speed value (MP 12 from branch 10).
If the signal reaches the limit, the relevant bit, BIT9.U+ or BIT9.U−, will be set. The PID controller then disables the integrator. In this way "wind up" of the integrator is prevented.

Input variables:

Setpoint input:

- ADC2 Setpoint input if **analog** setpoint input mode was selected (S9.2 inactive) during structuring.
- REL9.1 The source for the **digital** setpoint is selected by the relay. If the relay is inactive, the value comes from the PG.
- CON9.1 For digital setpoint input and with relay REL9.1 inactive, the PG is the source of the setpoint (CON9.1).
- VAR9.1 For digital setpoint input and with relay REL9.1 active, the S5-CPU is the source of the setpoint (VAR9.1).

Actual value input:

- ADC1 The actual value is always input as an analog variable.

PID controller:

- CON9.KP Proportional gain
- CON9.TN Integral-action time
- CON9.TV Derivative-action time
- CON9.B+ The constant determines the **upper** limit for the limiting.
- CON9.B− The constant determines the **lower** limit for the limiting.
- BIT9.RF The bit enables or disables the PID controller. The controller is enabled if the bit is active. In the disabled state, the controller outputs 0% and resets its internal memory.

Setpoint limit monitor:

- CON9.SOGL Upper limit
- CON9.SUGL Lower limit

Actual value limit monitor:

- CON9.OWL Upper warning limit
- CON9.UWL Lower warning limit
- CON9.OGL Upper danger level
- CON9.UGL Lower danger level

Multiplication of the controller output:

- CON9.2 This value is multiplied with the controller output if structure switch S9.3 is active.
- MP12 The controller output is multiplied with the **actual speed value** input in branch 10 if structure switch S9.3 is inactive.

Miscellaneous:

- REL5/9 This relay can be used for switching over to "Direct tension control".

Output variables:

PID controller:

- BIT9.UE+ The bit is set when the output of the PID controller crosses the upper limit CON9.B+. The integrator in the PID controller is then frozen.
- BIT9.UE− The bit is active when the output of the PID controller crosses the lower limit CON9.B−. The integrator in the PID controller is then frozen.

Setpoint limit monitors:

- BIT9.SOG The bit is active when the setpoint crosses the upper limit.
- BIT9.SUG The bit is active when the setpoint crosses the lower limit.

Actual value limit monitors:

- BIT9.OW The bit is active when the actual value crosses the upper warning limit.
- BIT9.UW The bit is active when the actual value crosses the lower warning limit.
- BIT9.OG The bit is active when the actual value crosses the upper danger limit.
- BIT9.UG The bit is active when the actual value crosses lower danger limit.

Miscellaneous:

- MP1 Actual value of the outer loop controller
- MP2 Setpoint of the outer loop controller
- MP3 Control deviation of the outer loop controller
- MP4 Input of the summation stage in branch 5

Note:

The bits BIT9.SOG to BIT9.SUG are not evaluated by the standard function block FB:FORCE (Section 5).

4.10.5.10 Branch 10: Actual speed value

Function:

The actual speed value can be input via an analog input channel (ADC3) as a tacho voltage or via the pulse detection input as a pulse sequence. If required, the smoothing block can be used to smooth the actual value. Then the signal is multiplied by a constant (CON10.1). If relay REL10.1 is inactive, the result of the multiplication in the case of a speed control system goes to branch 5, in the case of velocity control to branch 3.
For display purposes the actual speed value (MP12) is processed further. It is multiplied by a constant (CON10.3), then transmitted via the display block and output via the analog output channel DAC1.

If relay REL10.1 is active, the constant CON10.2 goes to branch 3 or branch 5.
Relay REL10.1 is used during start up.

The display and smoothing blocks are described in Section 4.10.6.4.

Input variables:

- CON10.1 The constant is used for normalizing the actual speed value.
- CON10.2 This value can be input for commissioning purposes via relay 10.1.
- CON10.3 The constant is used for calibrating the display via DAC1.
- CON10.4 Rated speed in revolutions per second.
- CON10.5 The number of index lines divided by 100. Both constants CON10.4 and CON10.5 are used for calibrating the digital actual speed value input. At rated speed the block outputs 100%. (Example: CON10.5; 5 ≙ 500 index lines).
- CON10.TVZ Input variable of the smoothing block, see Section 4.10.6.2.
- ADC3 Address of the analog input channel used for sensing the tacho voltage
- DAC1 Address of the analog output channel used for displaying the actual speed value.
- REL10.1 When active, this relay activates constant CON10.2.

Output variables:

- MP12 This is the **processed** actual speed value.
  It is effective at the input of either branch 3 or branch 5. In addition the value can be output via an analog output channel.

4.10.5.11 Branch 11: Actual armature current value

Function:

The actual value of the armature current is input via ADC4. It should be routed via the input terminals 3 and 4 (channel 1) since actual value filtering is possible in the terminal block. The actual current value is used for thermal monitoring of the machine and/or for injection in the summator in branch 5.
If applied to the summator in branch 5, the actual current value is used, for example, for characteristic manipulation or, in the case of voltage controll, for (I x R) compensation. A signed actual current value is required in the case of a 4-quadrant drive. The influence of the actual current value can be influenced by constant CON11.3.
Using the armature current, a thermal monitoring of the motor is possible (S11.2 active). For this purpose the armature current is substituted in an equation. This equation generates the approximate temperature response of the armature winding. When the limiting value is reached (CON11.1), bit 11.1 becomes active.
A more detailed description of the equation is given in Section 4.10.6.6.

Input variables:

Thermal monitoring:

- CON11.1 The constant gives the value from which the thermal monitor sets bit 11.1.
- CON11.2 The constant is a characteristic of the motor. It is a criterion for how quickly the motor warms up.

Miscellaneous:

- CON11.3 The constant is multiplied by the armature current when S11.1 is active.
- ADC4 Address of the analog input channel used for the actual armature current.

Output variables:

- BIT11.1 This bit is set, when the thermal monitor has reached the limit CON11.1. When the bit is set, the maximum permitted heating of the armature has been reached.
- MP5 The actual armature current value after multiplication by constant CON11.3. This value is used as the input of the summation stage in branch 5.
- MP13 Actual armature current value input via ADC4.

4.10.5.12 Branch 12: Limit monitor 1

Function:

The limit monitor monitors the value at any desired measuring point. A maximum of **six** limits can be used. The no. of the monitored measuring point can be modified in the RUN mode of the IP at any time.
The function is described in detail in **Section 4.10.6.7.**

Input variables:

- MPNO. No. of the measuring point to be monitored (1 ... 17)
- CON12.1
- CON12.2
- CON12.3 Maximum of 6 limit values
- CON12.4
- CON12.5
- CON12.6
- CON12.7 Number of limiting values

Output variables:

- BIT12.1
- BIT12.2
- BIT12.3 Maximum of 6 output bits
- BIT12.4
- BIT12.5
- BIT12.6

4.10.5.13 Branch 13: Limit monitor 2

Function:

The limit monitor monitors the value at any desired measuring point. A maximum of **six** limits can be used. The no. of the monitored measuring point can be modified in the RUN mode of the IP at any time.
The function is described in detail in Section **4.10.6.7.**

Input variables:

– MP NO	No. of the measuring point to be monitored (1 ... 17)
– CON13.1 – CON13.2 – CON13.3 – CON13.4 – CON13.5 – CON13.6	Maximum of 6 limit values
– CON13.7	Number of limiting values

Output variables:

– BIT13.1 – BIT13.2 – BIT13.3 – BIT13.4 – BIT13.5 – BIT13.6	Maximum of 6 output bits

4.10.5.14 Branch 14: Measuring socket 1

Function:

The value of any desired measuring point can be output via an analog output channel. The no. of the measuring point can be modified any time during the RUN mode of the IP.

Input variables:

– MP NO	No. of the measuring point, which is to be recorded (1 ... 17)
– DAC3	Address of the analog output channel at which the value of the measuring point is to be output. Measuring socket 1 is permanently connected to the DAC channel 5.

4.10.5.15 Branch 15: Measuring socket 2

Function:

The value of any desired measuring point can be output via an analog output channel. The no. of the measuring point can be modified any time during the RUN mode of the IP.

Input variables:

– MP NO	No. of the measuring point, which is to be recorded (1 ... 17)
– DAC4	Address of the analog output channel at which the value of the measuring point is to be output. Measuring socket 2 is permanently connected to the DAC channel 6.

4.10.5.16 Special case: Direct tension control

In the case of a velocity control system (branch 3 active), one can switch over to „Direct tension control". Switchover is carried out by relay REL 5/9 from the control program of the S5-CPU.

When relay REL 5/9 is active the following occurs:

- Measuring point MP10 of the velocity controller in branch 5 is used by the outer loop controller in branch 9 either as the upper **or** lower limit. The state of the structure switch S9.1 determines whether the lower or upper limit is specified by MP10.
- Measuring point MP4 of the outer loop controller in branch 9 becomes the input of branch 1. MP4 is therefore the main component of the current setpoint.

This is illustrated by **Fig. 4.4.** This shows the case where the **lower** limit of the controller from branch 9 is determined by the controller in branch 5 (S9.1 inactive). The upper limit is then the constant CON9.B+, which was specified via the PG.
When structure switch S9.1 is active, then the **upper** limit of the controller from branch 9 is determined by the controller in branch 5. The lower limit is then CON9.B−, which was specified via the PG.

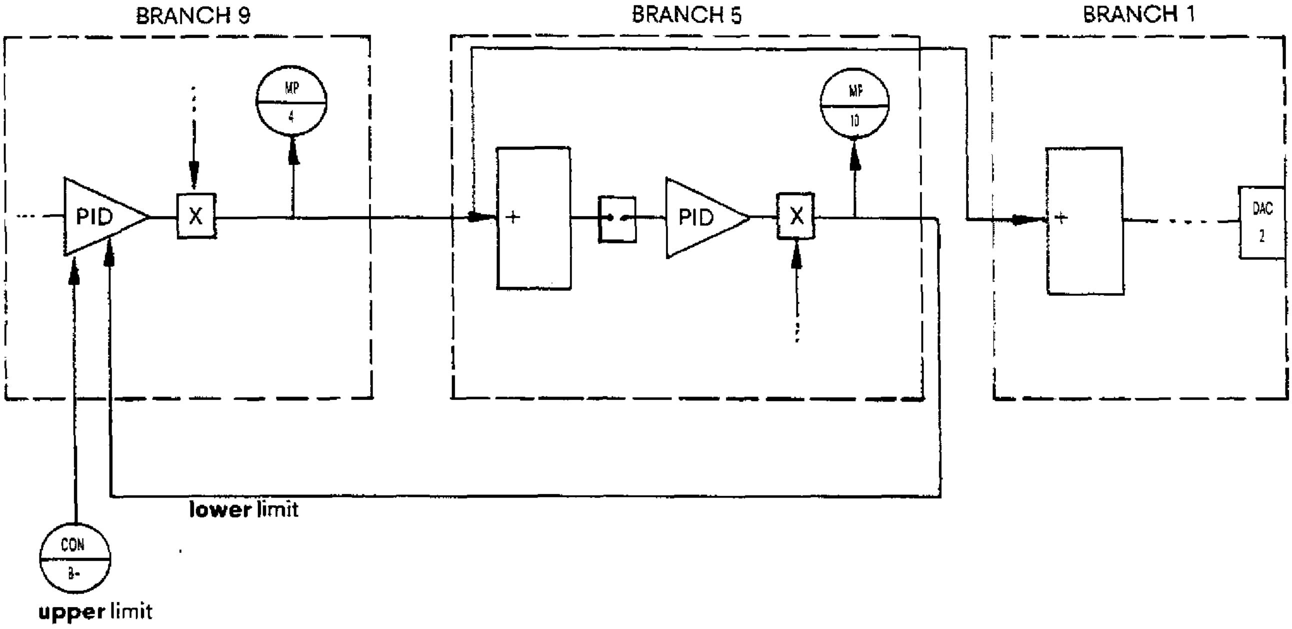


Fig. 4.4 Direct tension control (relay 5/9 active)

Example: S9.1 inactive

4.10.6 Functions of the drive controller

4.10.6.1 Pre-assigned limit monitors in branches 5 and 9

The results of these limit monitors are used by a CP 526 for display purposes. The output bits **cannot** be read from the standard FB used with the logic program (Section 5.1).

Function of the actual value limit monitor:

Four limits can be specified via the PG:
- Upper warning limit
- Lower warning limit
- Upper danger limit
- Lower danger limit

Each of these limits is assigned a bit. If a signal **crosses** the **upper** warning/danger limit, then the "Upper warning/danger limit crossed" bits are set. In all other cases they are reset. When the signal crosses the **lower** warning/danger limit, then the "Lower warning/danger limit crossed" bits are set. In all other cases they are reset.

Function of the setpoint limiting monitor:

Two limits can be specified via the PG:
- Upper limit
- Lower limit

Both limits are assigned two bits. When the **upper** limit is **crossed** the "Upper limit crossed" bit is set, otherwise it remains reset. When the **lower** limit is crossed, the "Lower limit crossed" bit is set, otherwise it is reset (Fig. 4.5).

Example: Setpoint limit monitor

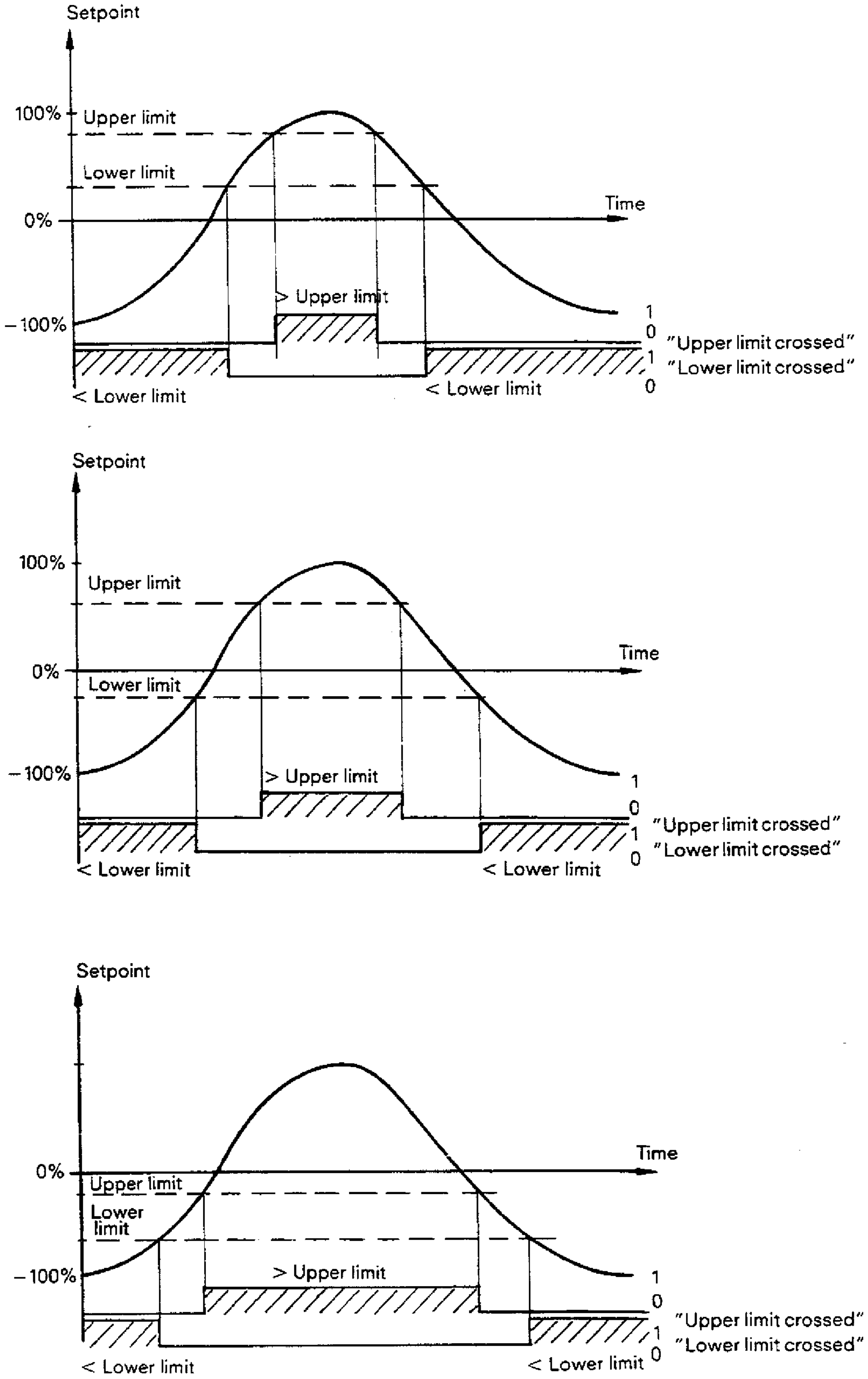


Fig. 4.5 Method of operation of the pre-assigned limit monitor

4.10.6.2 Filter (see Fig. 4.6)

Function:

The filter smoothes an analog variable using a **first** order delay function.

Explanation of function parameters

Type of variable	Symbol	Description	Number format	Setting range
Parameter	TVZ	Filter time constant	Time	4 ms to 99hrs 59min

Explanation of function input/output variables

Type of variable	Symbol	Description	Number format	Setting range
Input variable	X (t)	Submodule input variable to be filtered	variable-dependent	–100% to +100%
Output variable	Y (t)	Filtered submodule output variable	variable-dependent	– 100% to +100%

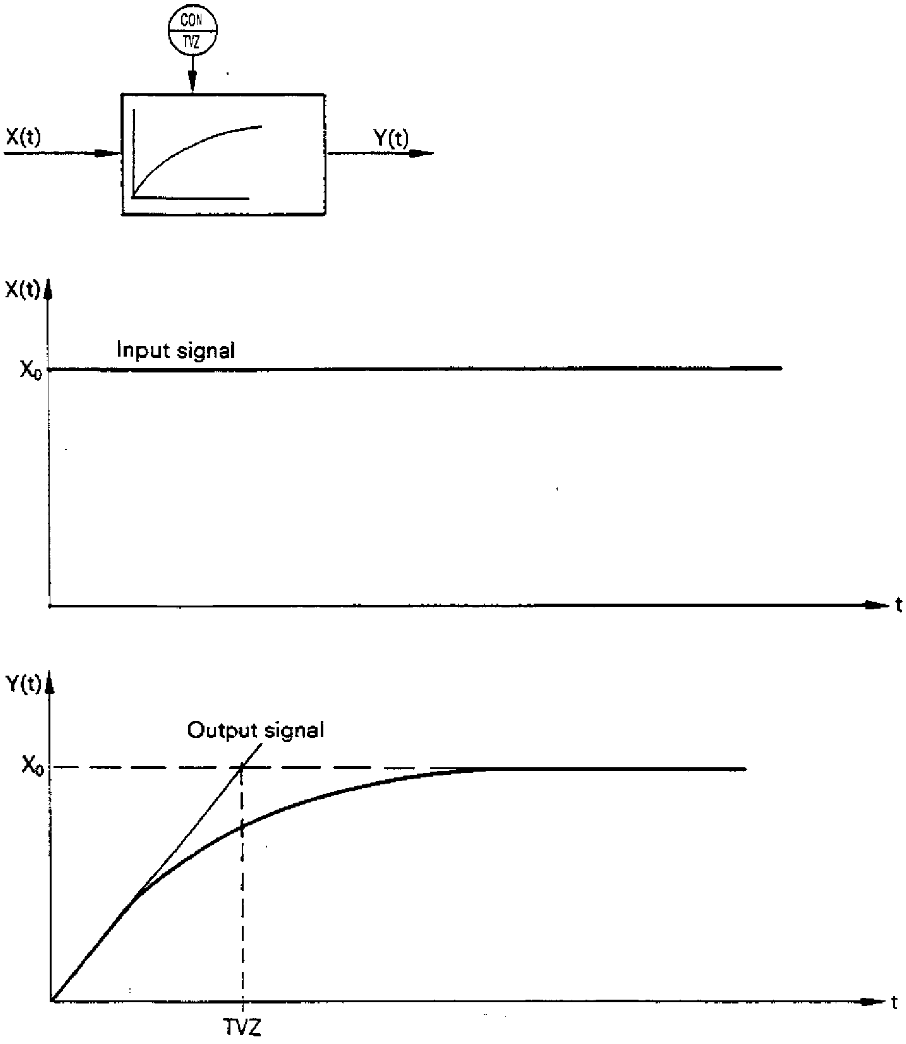


Fig. 4.6 Filter

4.10.6.3 Ramp-function generator

Function: (Fig. 4.7)

The ramp-function generator produces a **ramp** as the output signal y(t) from an input step change x(t).

- The **slope** of the **positive ramps** is determined by the constants (ZUW, TH) and of the **negative ramps** by the constants (ZUW, TR).
  Positive ramps are where the output value y(t) changes towards **increasing** speed (±100%). Negative ramps are where y(t) changes towards **decreasing** speed (±0%).

  The constant ZUW (increment) specifies the percentage value which is reached after expiry of the negative (TR) or positive (TH) ramp times, when a 100% step is connected to the input of the ramp-function generator.

  In Fig. 4.7 (diagrams 1 to 4) several examples are included. They illustrate the influence of the constants ZUW, TR and TH.

- The ramp-function generator **takes into account the actual value** (MPx). This guarantees the fastest possible tracking of the setpoint y(t) by the actual value i(t). When **ramping down,** the actual value is taken into account, if it is less than the momentary ramp value calculated by the ramp-function generator. When **ramping up,** the actual value is taken into account if it is greater than the momentary ramp value calculated by the ramp-function generator. This procedure is explained in Fig. 4.8 (diagrams 1 to 5).

- Fig. 4.9 shows how the ramp-function generator behaves if the input signal is changed **before** the output signal has reached its final value.
  The actual value is also taken into account here.

Explanation of function parameters and binary variables

Type of variable	Symbol	Description	Number format	Setting range
Parameter	CON TH CON TR CON ZUW	Ramp-up time Ramp-down time Ordinates of the ramp-function generator, i. e. the ramp value achieved in the time TH or TR at 100% input step change (thus determining the ramp slope)	Time Time variable-dependent	0.1 ms to 99hrs 59min 0.1 ms to 99hrs 59min 0 to +100%
Binary input signals	BIT HOE BIT TIE BIT LOE	Higher bit, BH = 1 starts rising ramp Lower bit, BL = 1 starts falling ramp Delete bit, BD = 1 effects switch from manual to automatic mode	Bit Bit Bit	0/1 0/1 0/1

Explanation of function input/output variables

Type of variable	Symbol	Description	Number format	Value range

Input variables	X(t)
	i(t)
		Current setpoint
		Current actual value (MP12 or MP16)
			variable-dependent
			variable-dependent
				−100% to +100%
				−100% to +100%

Output variable	Y(t)	Output value (ramp value)	variable-dependent	−100% to +100%

4.10 Description of the Drive Controller Structure (DR)

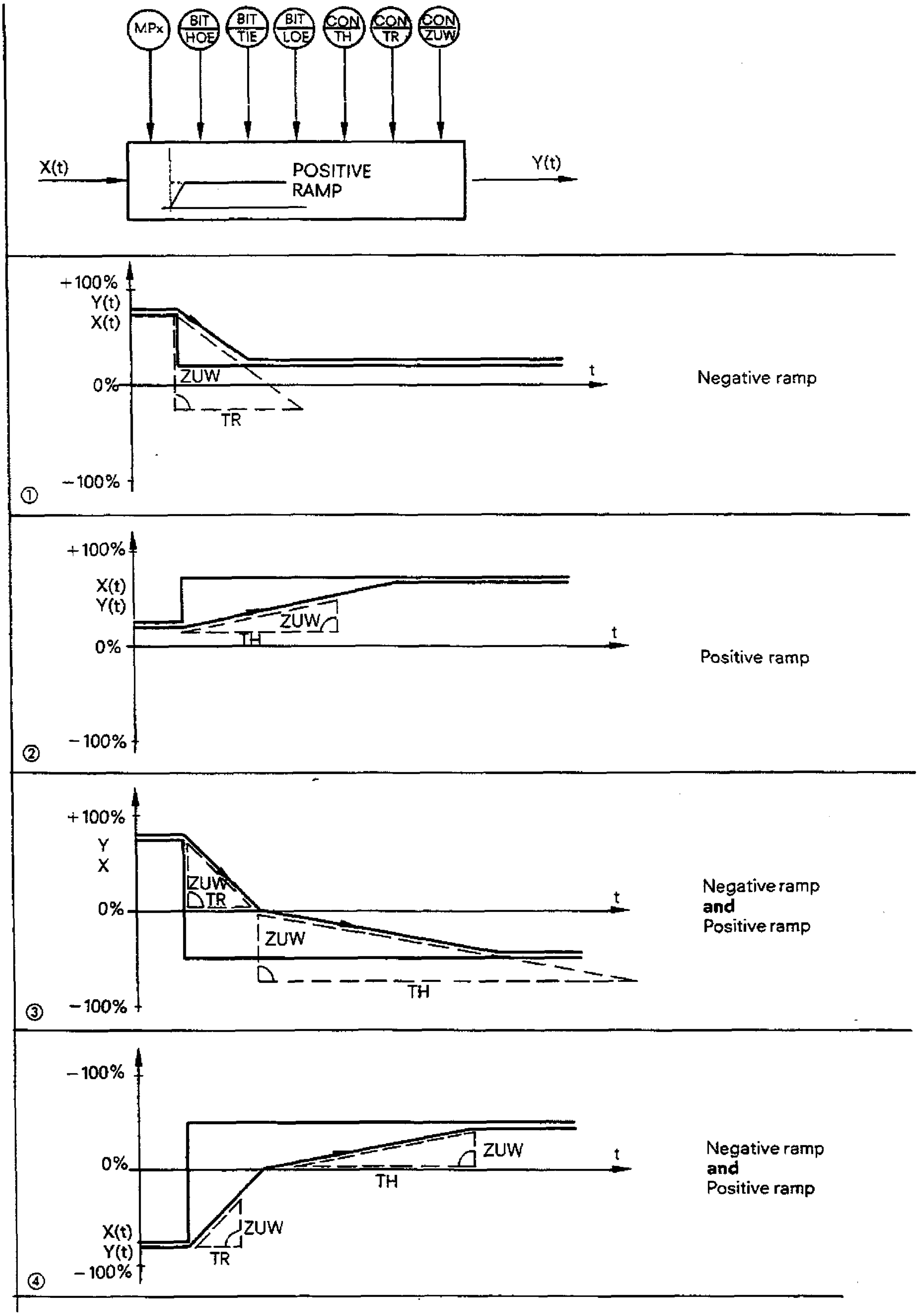
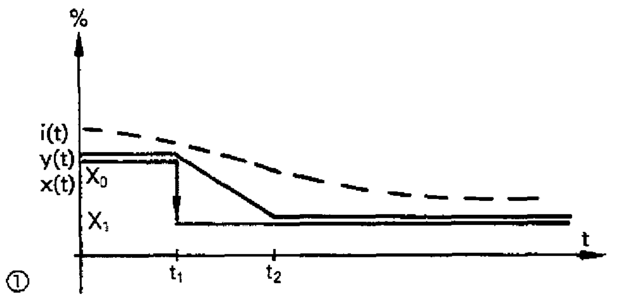
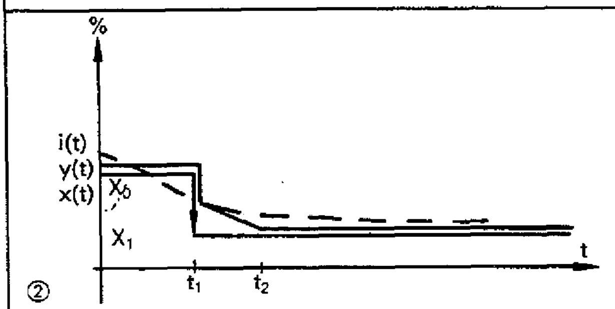


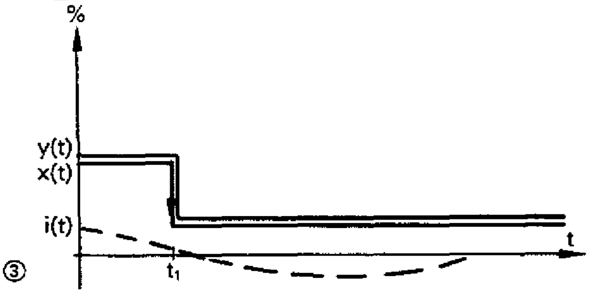
Fig. 4.7 Ramp-function generator for drive controller
Assumption: Actual value referencing not sensible!



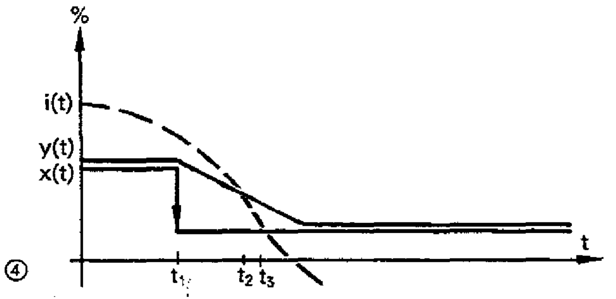
The actual value is larger than the ramp y(t).
==> **No** actual value referencing



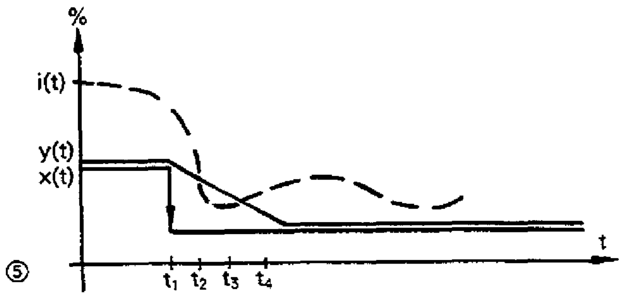
At instant t_1, the actual value is between x_o and x_1
==> Actual value referencing



At instant t_1, the actual value is below x_1
==> Actual value referencing



At instant t_2, the actual value intersects the ramp y(t)
==> No actual value referencing



The actual value sinks below the ramp value at t_2 and begins to increase again at t_3-
==> No actual value referencing

Fig. 4.8 Ramp-function generator actual value referencing

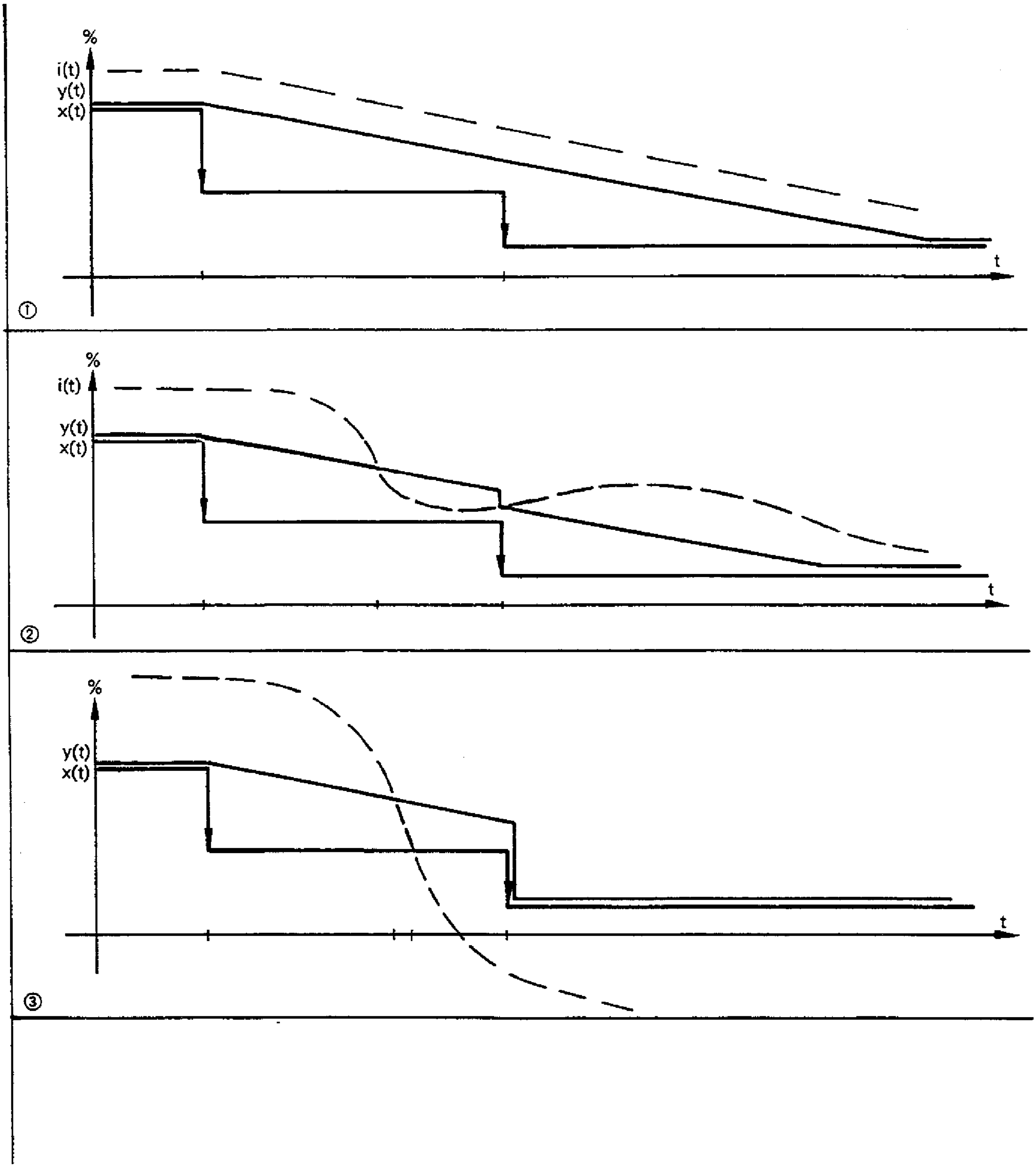


Fig. 4.9 Ramp-function generator
Changing the input before the output has reached its final value

- The ramp-function generator has three binary input signals with which the output y(t) can be influenced (independently of the input x(t)).
  - If the HOE bit is active, then the output y(t) ramps to the +100% limit. The actual value is **not** taken into account (MPx).
  - If the TIE bit is active, then the output ramps to the −100% limit. The actual value is **not** taken into account.
  - If the HOE and TIE bits are both active simultaneously, then the output remains at the last value;
    i. e. no ramp is generated
  - If the LOE bit is active, a change of mode is made from manual to automatic (i. e., the setpoint is approached via the preset parameters T_H, T_R an ZUW), as long as the HOE and TIE bits are inactive.
    The actual value is taken into account in this case.
    Resetting of the bit causes the output y(t) to ramp to the input value x(t). The actual value is also taken into account here.
  - The HOE and TIE bits have priority over the LOE bit.

The function of the bits is illustrated in Fig. 4.10 (diagrams 1 to 2).

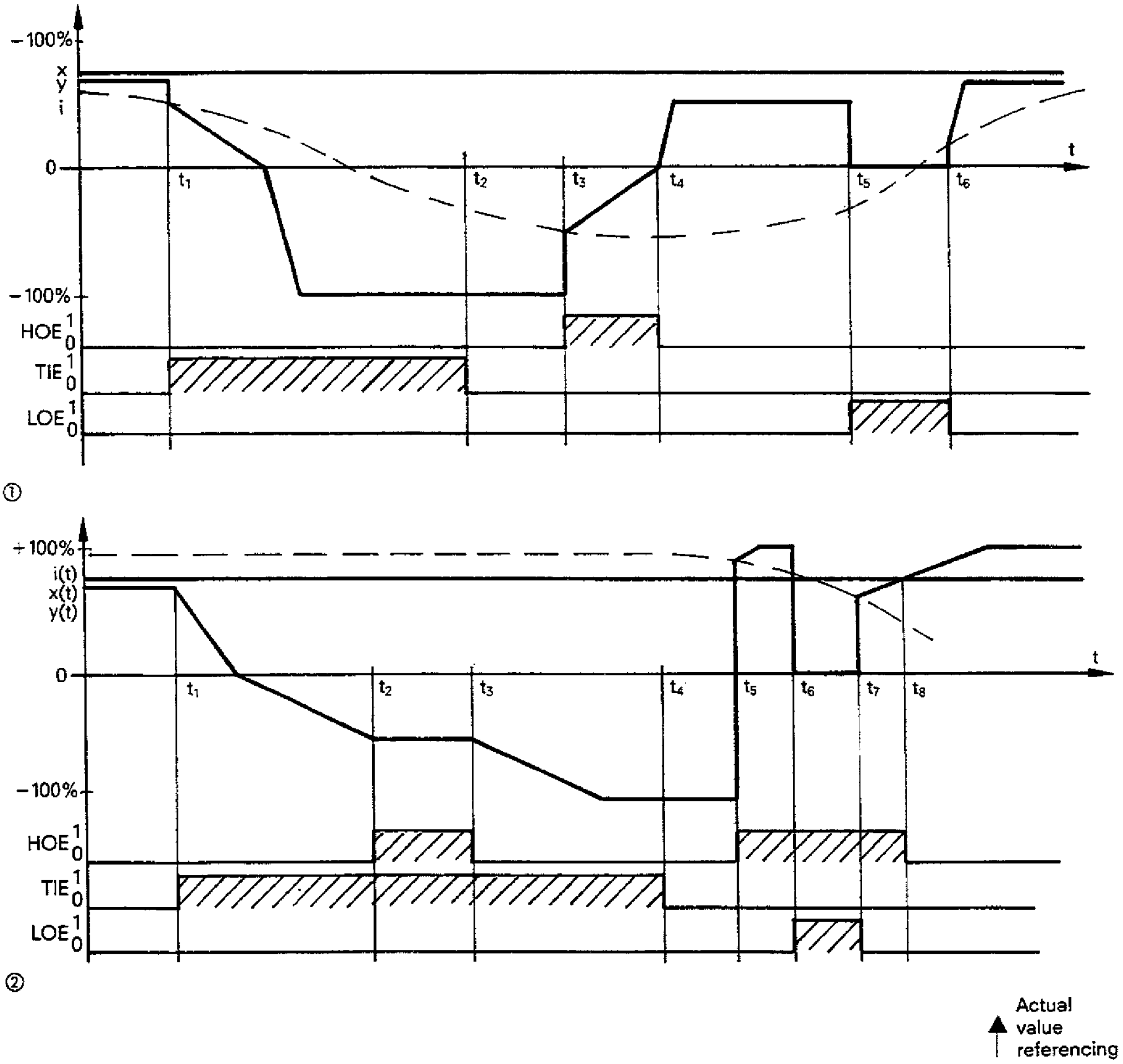


Bild 4.10 Ramp-function generator
Function of HOE, TIE and LOE bits

4.10.6.4 Display

Function:

The display function provides a non-flickering display of the actual speed value.
The input signal to the display is output as a **rounded** signal.

4.10.6.5 Characteristic curve

Function:

The characteristic curve stage transforms an analog input variable x (field current) into an analog output variable y.
The function y = f(x) used has the following characteristics:

– Linear range

$y \geqq 0$ for $0 \leqq x \leqq 100\%$

$y = 0$ for $-100\% \leqq x \leqq 0\%$

$y = 3/2\,x$ for $0 \leqq x \leqq \frac{100}{3}\,\%$

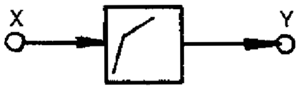
– Parabolic region

$y = -\frac{9}{800}(x-100)^2 + 100$ for $\frac{100}{3}\% \leqq x = \leqq 100\%$

The curve is shown in Fig. 4.11.
The curve is also called **the normalized excitation curve.** It represents the relationship between the field current and the flux of a d. c. motor. The curve is an **approximation** which is valid for most d. c. motor types.

4.10 Description of the Drive Controller Structure (DR)

Value table:



Field current x	Flux y
0%	0%
10%	15%
20%	30%
30%	45%
33¹/₃%	50%
40%	59,5%
50%	72%
60%	82%
70%	90%
80%	95,5%
90%	99%
100%	100%

Linear approximation $y = \frac{3}{2}x$

Parabolic approximation $y = -\frac{9}{800}(x - 100)^2 + 100$

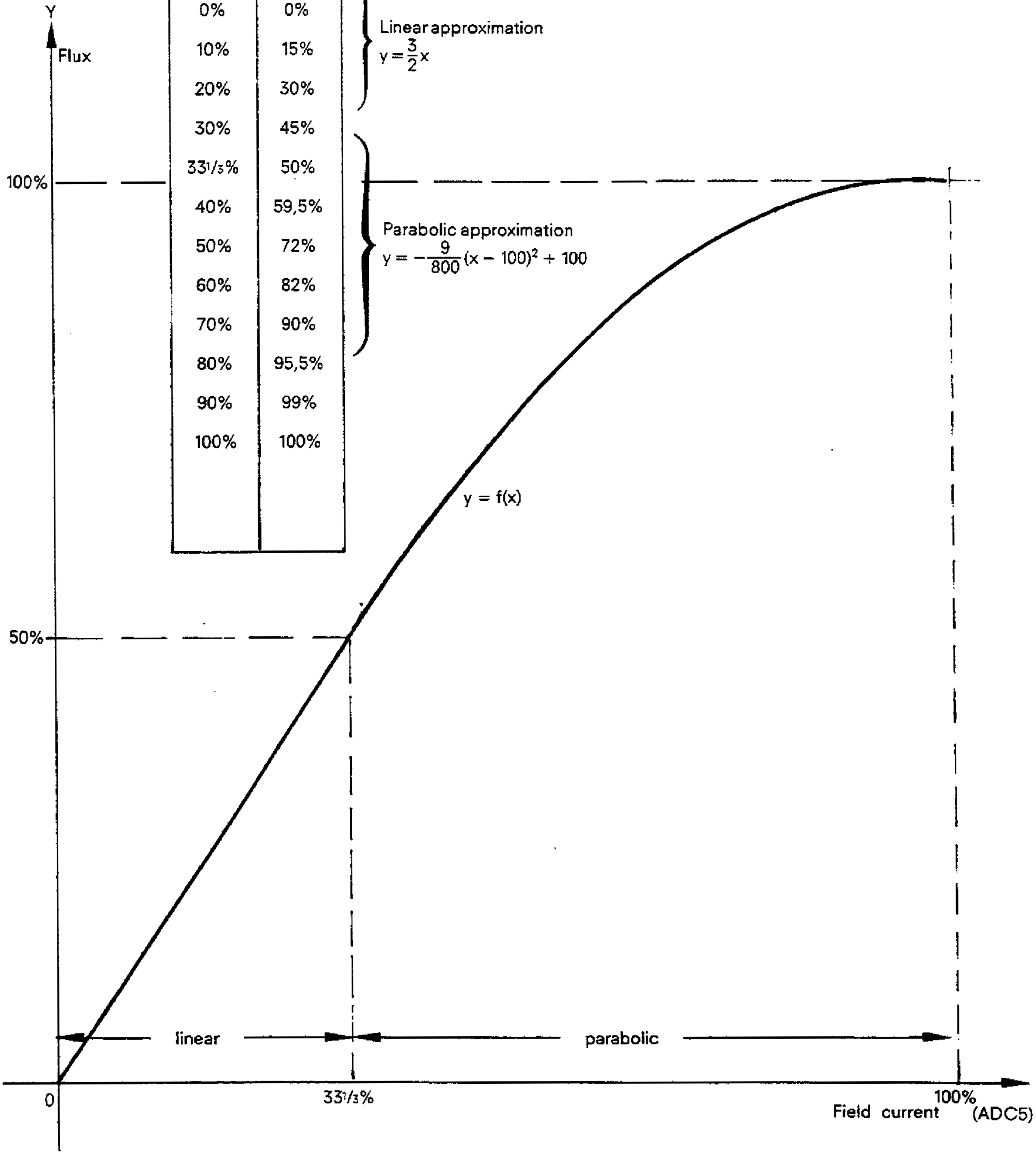


Fig. 4.11 Normalized excitation curve

4.10.6.6 Thermal monitoring

When current flows through an electric machine, the temperature rise can be described approximately using the e function. This "thermal image" is used to regulate the temperature rise in the machine in a calculation involving the armature current and the constant CON 11.2 (thermal time constant) according to the following equation

$$\text{Temperature rise} = i^2_{\text{armature}} \cdot (1 - e^{-\frac{t}{T}}).$$

If the permissible temperature limit (temperature rise) is exceeded, bit 11.1 is set. The temperature limit is given with the constant CON 11.1. A temperature limit is selected such that under operation with nominal current the temperature limit is never quite reached (or theoretically would be only after an infinite period). Cooling is expressed by the equation $i^2 \cdot e^{-\frac{t}{T}}$

Example:

Nominal thyristor current = 500 A ≙ 10 V I_{IST} ≙ 100%

Nominal motor current = 400 A ≙ 8 V I_{IST} ≙ 80%

Thermal time constant: 30 min (CON 11.2)

Temperature rise curve with nominal current:

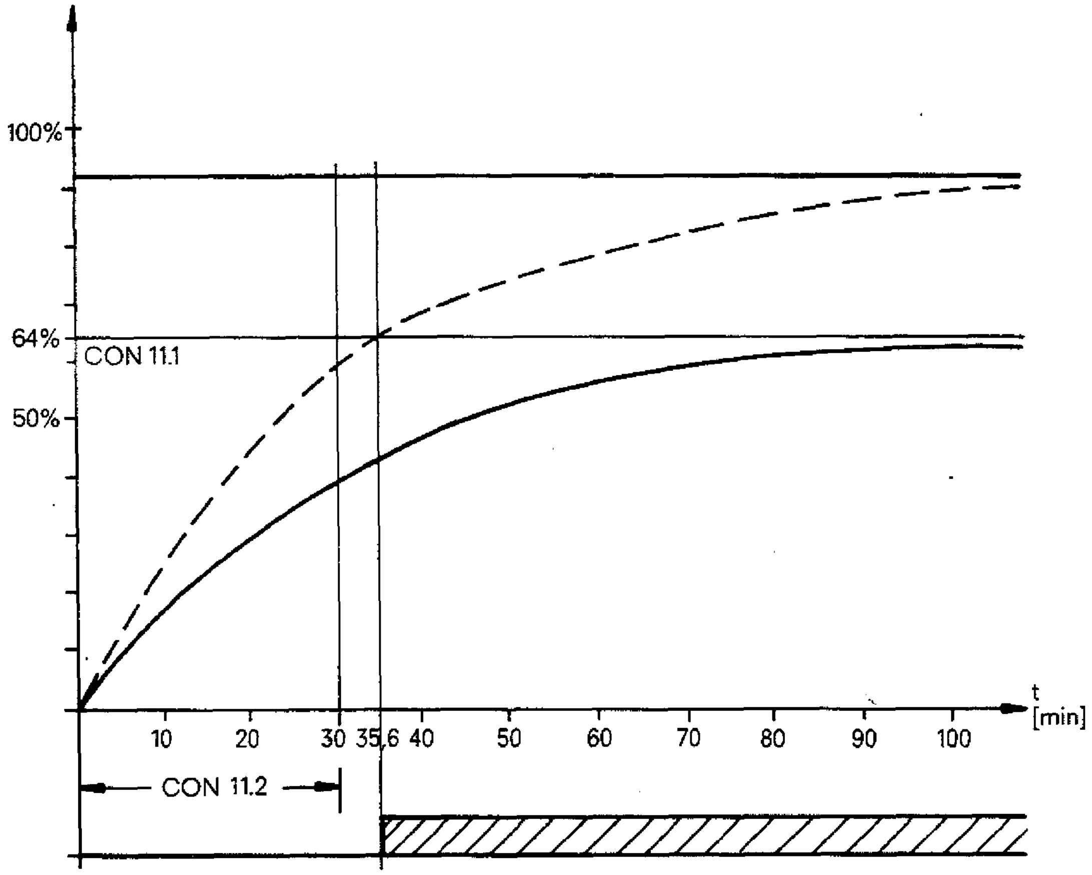
$$\text{Temp. rise} = i_N^2 \times (1\text{-exp} - \frac{t}{30\,\text{min}}) = \frac{80 \cdot 80}{100}\,\%\,(1\text{-exp} - \frac{t}{30\,\text{min}}) = 64\,\%\,(1\text{-exp} - \frac{t}{30\,\text{min}})$$

Temperature rise curve at, e. g., 1.2 I_N = 480 A (≙ 96%)

$$\text{Temp. rise} = 92.16\,\%\,(1\text{-e} - \frac{t}{30\,\text{min}})$$

It can be seen from Fig. 4.12 that, when operating with 1.2 x I_N, bit 11.1 is set after approximately 36 minutes. The temperature rise value is only reset when the module is in STOP status. If the IP RAM has battery backup, the old value will be retained on "restart after power failure".

"Heating" of the armature winding



$$\boxed{i^2 \cdot (1 - e^{\frac{-t}{x}})}$$

Heating equation

i Armature current
x Thermal time constant
t Time

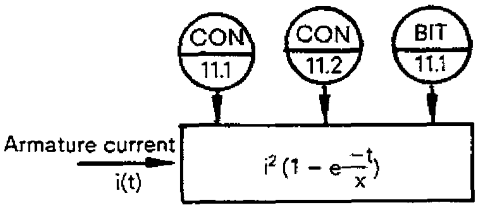


Fig. 4.12 Thermal monitoring

4.10.6.7 Limit monitor

Function: (Fig. 4.13)

The value of a measuring point MPx is checked against six limit values GW(i).
If for positive limit values MPx > GW(i)
or for negative limit values MPx < GW(i),
then the corresponding limit value bit B(i) is set.

- $GW(i) \geqq 0$: $MPx \leqq GW(i) — B(i) = 0$
  $MPx > GW(i) — B(i) = 1$
  for $1 \leqq i \leqq N$
- $GW(i) < 0$: $MPx \geqq GW(i) — B(i) = 0$
  $MPx < GW(i) — B(i) = 1$

- The number N of limit values is defined by:
  $1 \leqq N \leqq 6$

- Unused limit value bits are set to zero:
  $B(i) = 0$ for $i > N$

Explanation of function parameters:

Type of variable	Symbol	Description	Number format	Setting range
Parameter	CON 12.7 (or 13.7)	Number of preset limit values	no unit	1 to 6
	CON 12.1 (or 13.1)	Limit value 1	variable-dependent (or %)	−100% to +100%
	:	:	:	:
	:	:	:	:
	CON 12.6 (or 13.6)	Limit value 6	:	:

Explanation of function input/output variables:

Type of variable	Symbol	Description	Number format	Value range
Input variable	Xe	Input value to be tested	variable-dependent (or %)	−100% to +100%
Binary output signals	Bit 12.1 (or 13.1)	Limit value bit 1	Bit	0/1
	:	:	:	:
	:	:	:	:
	Bit 12.6 (or 13.6)	Limit value bit 6	Bit	0/1

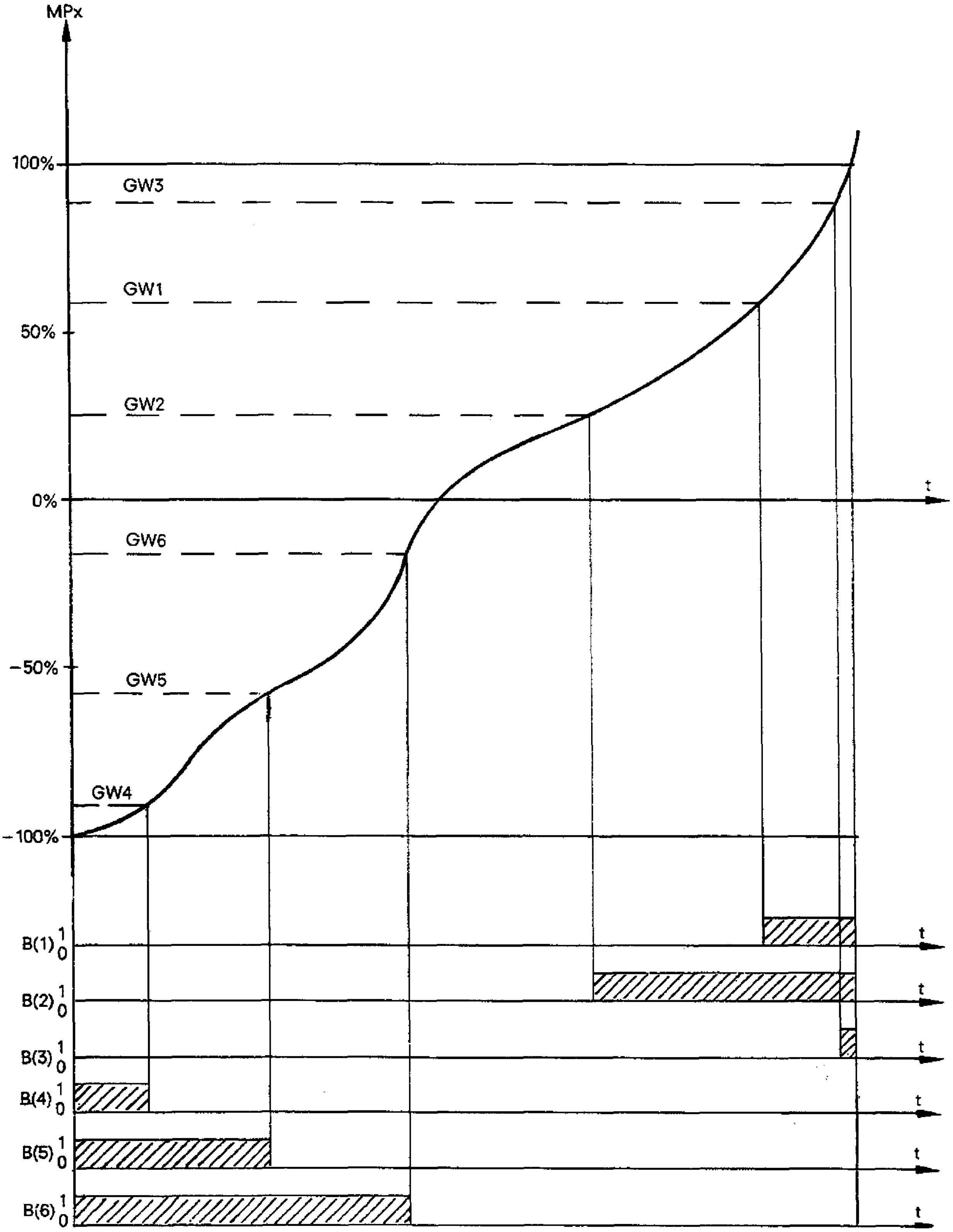


Fig. 4.13 Limit monitor of the drive controller structure

4.10.7 Data block of the drive controller (DR)

The data block contains all the data of the **DR** controller structure. If the contents of these data words have to be read or overwritten by the CPU, access to these internal IP 252 data can be effected with the help of data handling blocks (Section 5.2).

```
                                                                                                          Data
                                                                                                           word
                                                                                                          address
          15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0       I
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+      V
        I     Configuration code (DRIVE: 101.)                                                          I  DW  0
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I     Version number                                                                            I  DW  1
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Status word                                                                               I  DW  2
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Error form word                                                                           I  DW  3
  BESY- +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  CODE  I     Error form word                                                                           I  DW  4
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I                                                                                               I  DW  5
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I                                                                                               I  DW  6
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     OCM word                                                                                  I  DW  7
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I     Sampling time /2.5 ms (32 BIT-OCM)                                                        I  DW  8
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW  9
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
SamplingI      Sampling time of the fastest branch  (16 BIT-OCM)     Time value                         I  DW 10
  time  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                            Time format                        I  DW 11
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I     Minimum pulse duration /2.5 ms (FPKT)                  Time value                         I  DW 12
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                            Time format                        I  DW 13
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I     Minimum pulse duration (16 BIT-OCM)                    Time value                         I  DW 14
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I     Time format                                            Time format                        I  DW 15
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I     Multiplier (16 BIT-OCM)      = Sampling time/smallest basic sampling time                 I  DW 16
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 17
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 18
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 19
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 20
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 21
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 22
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

4.10 Description of the Drive Controller Structure (DR)

```
                                                                                                          Data
                                                                                                          word
                                                                                                         address
          15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0      I
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+    V
        I                                                                                               I  DW 23
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 24
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 25
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 26
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 27
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 28
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 29
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 30
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 31
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 32
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 33
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 34
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Configu-I     ST(0)                                                                                     I  DW 35
 ring   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
switch  I     ST(1)                                                                                     I  DW 36
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 1I     Standardization acceleration value  CON 1.1                                               I  DW 37
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 38
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 39
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Controller gain                     CON 5.KP                                              I  DW 40
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I                                                                                               I  DW 41
    I   +-----+-----+-----+-----+-----+--- -+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Integral action time                CON 5.TN                                              I  DW 42
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     DIM 5.TN                                                                                  I  DW 43
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 5I     Derivative action time              CON 5.TV                                              I  DW 44
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     DIM 5.TV                                                                                  I  DW 45
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Upper manipulated variable limit    CON 5.B+                                              I  DW 46
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Lower manipulated variable limit    CON 5.B-                                              I  DW 47
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                                                                                            Data
                                                                                                            word
                                                                                                           Address
           15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0        I
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+       V
   I    I                                                                                               I  DW 48
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 49
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Start-up value BRANCH 5             CON 5.1                                               I  DW 50
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Filter time constant                CON 10.TVZ                                            I  DW 51
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     DIM 10.TVZ                                                                                I  DW 52
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 10I    Matching                      CON 10.1                                                    I  DW 53
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Start-up value BRANCH 10      CON 10.2                                                    I  DW 54
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Setpoint                      CON  9.1                                                    I  DW 55
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Controller gain               CON  9.KP                                                   I  DW 56
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch  9I                                                                                              I  DW 57
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Integral action time          CON  9.TN                                                   I  DW 58
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     DIM 9.TN                                                                                  I  DW 59
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Derivative action time        CON  9.TV                                                   I  DW 60
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     DIM 9.TV                                                                                  I  DW 61
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Upper limit                   CON  9.B+                                                   I  DW 62
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Lower limit                   CON  9.B-                                                   I  DW 63
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 64
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 65
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Scaler constant               CON  9.2                                                    I  DW 66
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 11I    Matching armature current     CON 11.3                                                    I  DW 67
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch  2I    Friction value                CON  2.1                                                    I  DW 68
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 3bI    Standardization acceleration  CON  3.1                                                    I  DW 69
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch  4I    Standardization flux          CON  4.1                                                    I  DW 70
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch  6I    Setting-up speed              CON  6.1                                                    I  DW 71
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch  7I    Creep speed                   CON  7.1                                                    I  DW 72
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Setpoint                      CON  8.1                                                    I  DW 73
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                                                                                Data
                                                                                                word
                                                                                               Address
          15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0      I
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+    V
       I I     Acceleration time         CON  8.TH                                                    I DW 74
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     DIM 8.TH                                                                               I DW 75
Branch  8+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     Deceleration time         CON  8.TR                                                    I DW 76
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     DIM 8.TR                                                                               I DW 77
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     Ordinates after time has elapsed CON 8. ZUW                                            I DW 78
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     Filter time constant      CON  8.TVZ                                                   I DW 79
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     DIM 8.TVZ                                                                              I DW 80
 --------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 10I     Calibration display       CON 10.3                                                     I DW 81
 --------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     Upper response threshold  CON 11.1                                                     I DW 82
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 11I     Time constant             CON 11.2                                                     I DW 83
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     DIM 11.2                                                                               I DW 84
 --------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     M1: Number of limits      CON 12.1                                                     I DW 85
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     M1: Limit 1               CON 12.2                                                     I DW 86
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 12I     M1: Limit 2               CON 12.3                                                     I DW 87
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     M1: Limit 3               CON 12.4                                                     I DW 88
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     M1: Limit 4               CON 12.5                                                     I DW 89
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     M1: Limit 5               CON 12.6                                                     I DW 90
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     M1: Limit 6               CON 12.7                                                     I DW 91
 --------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     M2: Number of limits      CON 13.1                                                     I DW 92
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     M2: Limit 1               CON 13.2                                                     I DW 93
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     M2: Limit 2               CON 13.3                                                     I DW 94
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 13I     M2: Limit 3               CON 13.4                                                     I DW 95
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     M2: Limit 4               CON 13.5                                                     I DW 96
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     M2: Limit 5               CON 13.6                                                     I DW 97
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     M2: Limit 6               CON 13.7                                                     I DW 98
 --------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I I     Position setpoint upper limit CON  9.SOG                                               I DW 99
       I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                                                                               Data
                                                                                               word
                                                                                               Address
          15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0      I
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+      V
      I  I    Position setpoint lower limit       CON  9.SUG                                           I  DW 100
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  Fixed  I    Position setpoint upper warning limit CON  9.OW                                          I  DW 101
   M in  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 9 I    Actual position lower warning limit  CON  9.UW                                           I  DW 102
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    Upper danger limit                  CON  9.OG                                            I  DW 103
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    Lower danger limit                  CON  9.UG                                            I  DW 104
---------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    Speed setpoint upper limit          CON  5.SOG                                           I  DW 105
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    Lower limit                         CON  5.SUG                                           I  DW 106
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    Actual speed upper warning limit    CON  5.OW                                            I  DW 107
  Fixed  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+     V
   M in  I    Actual speed lower warning limit    CON  5.UW                                            I  DW 108
Branch 5 +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    Actual speed upper danger limit     CON  5.OG                                            I  DW 109
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    Actual speed lower danger limit     CON  5.UG                                            I  DW 110
---------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 8 I    Setpoint scaler                     CON  8.2                                             I  DW 111
---------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 10I    Rated speed in rev/min              CON 10.4                                             I  DW 112
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    Sensor number/100                   CON 10.5                                             I  DW 113
---------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         I                                                                                             I  DW 114
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         I                                                                                             I  DW 115
---------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    Measuring socket 1   Measuring point number                                              I  DW 116
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
MeasuringI    Measuring socket 2   Measuring point number                                              I  DW 117
  point  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 number  I    Limit monitor 1      Measuring point number                                              I  DW 118
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    Limit monitor 2      Measuring point number                                              I  DW 119
---------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    ADC 1 address        Actual position                                                     I  DW 120
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    ADC 2 address        Position setpoint                                                   I  DW 121
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    ADC 3 address        Actual speed                                                        I  DW 122
  Input  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    ad-  I    ADC 4 address        Actual armature current                                             I  DW 123
 dresses +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    ADC 5 address        Field current                                                       I  DW 124
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I    ADC 6 address        Speed setpoint                                                      I  DW 125
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

4. Programming Instructions

4.10 Description of the Drive Controller Structure (DR)

```
                                                                                                   Data
                                                                                                   word
                                                                                                   address
          15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0     I
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+   V
   I    I                                                                                               I  DW 126
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 127
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 128
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 129
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 130
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Address of digital counter    Actual speed                                                I  DW 131
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 132
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 133
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 134
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 135
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 136
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 137
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 138
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 139
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 140
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 141
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 142
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 143
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     DAC 1 address     Actual speed display                                                    I  DW 144
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     DAC 2 address     Current setpoint                                                        I  DW 145
 Output +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  ad-   I     DAC 5 address     Master setpoint                                                         I  DW 146
dresses +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 147
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 148
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 149
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 150
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 151
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                                                                                            Data
                                                                                                            word
                                                                                                           address
           15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0       I
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+     V
    I    I                                                                                               I  DW 152
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 153
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I    DAC 3 address     Measuring socket 1                                                       I  DW 154
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I    DAC 4 address     Measuring socket 2                                                       I  DW 155
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 156
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 157
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 158
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 159
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 160
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 161
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 162
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 163
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 164
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 165
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 166
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 167
---------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I    ADC 1 contents                                                                             I  DW 168
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I    ADC 2 contents                                                                             I  DW 169
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I    ADC 3 contents                                                                             I  DW 170
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I    ADC 4 contents                                                                             I  DW 171
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I    ADC 5 contents                                                                             I  DW 172
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I    ADC 6 contents                                                                             I  DW 173
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Contents I                                                                                               I  DW 174
  of the +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  inputs I                                                                                               I  DW 175
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 176
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 177
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

4. Programming Instructions

4.10 Description of the Drive Controller Structure (DR)

```
                                                                                         Data
                                                                                         word
                                                                                        address
          15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0       I
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+    V
  I   I                                                                                              I  DW 178
  I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  I   I     Value of digital counter                                                                 I  DW 179
------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 Bit  I     Bit variable word 1     (Inputs)                                                         I  DW 180
variables+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  I   I     Bit variable word 2     (Inputs)                                                         I  DW 181
------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I                                                                                              I  DW 182
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I                                                                                              I  DW 183
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I                                                                                              I  DW 184
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I                                                                                              I  DW 185
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I                                                                                              I  DW 186
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I                                                                                              I  DW 187
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I                                                                                              I  DW 188
------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I  I     Speed setpoint         VAR 8.1                                                           I  DW 189
 Vari- +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 ables I    Position setpoint      VAR 9.1                                                           I  DW 190
   I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I  I     Variable initial value (diameter)   VAR 3.1                                              I  DW 191
------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I  I     Controller name:   1st Byte             I     Controller name:   2nd Byte                I  DW 192
 Fields +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   for I    Controller name:   3rd Byte             I     Controller name:   4th Byte                I  DW 193
 local +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 opera- I   Controller name:   5th Byte             I     Controller name:   6th Byte                I  DW 194
  tor-  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 process I  Controller name:   7th Byte             I     Controller name:   8th Byte                I  DW 195
 communi-+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 cation I   Area name:         1st Byte             I     Area name:         2nd Byte                I  DW 196
   and  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 visuali-I  Area name:         3rd Byte             I     Area name:         4th Byte                I  DW 197
 zation +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I  I     Area name:         5th Byte             I     Area name:         6th Byte                I  DW 198
   I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I  I     Area name:         7th Byte             I     Area name:         8th Byte                I  DW 199
------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I                                                                                              I  DW 200
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I                                                                                              I  DW 201
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I                                                                                              I  DW 202
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I                                                                                              I  DW 203
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                                                                                            Data
                                                                                                            word
                                                                                                          address
           15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0       I
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+     V
        I                                                                                               I  DW 204
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 205
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 206
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I  DW 207
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    DAC 1 contents    Display                                                                  I  DW 208
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    DAC 2 contents    Manipulated variable (current setpoint)                                  I  DW 209
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    DAC 5 contents    Master setpoint                                                          I  DW 210
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 211
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 212
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 213
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 214
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 215
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+     V
ContentsI                                                                                               I  DW 216
 of the +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  out-  I                                                                                               I  DW 217
  puts  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    DAC 3 contents         Measuring socket 1                                                  I  DW 218
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    DAC 4 contents         Measuring socket 2                                                  I  DW 219
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    Bit variable word 1    Outputs                                                             I  DW 220
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    Bit variable word 2    Outputs                                                             I  DW 221
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 222
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 223
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 224
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 225
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 226
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 227
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 228
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I                                                                                               I  DW 229
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

4.10 Description of the Drive Controller Structure (DR)

```
                                                                                       Data
                                                                                       word
                                                                                      address
          15   14   13   12   11   10    9    8    7    6    5    4    3    2    1    0     I
        +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+   V
     I  I                                                                               I DW 230
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I                                                                               I DW 231
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 1    Actual value of the primary controller                I DW 232
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 2    Setpoint of the primary controller                    I DW 233
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 3    Control deviation of the primary controller           I DW 234
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 4    Correction value of the primary controller            I DW 235
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 5    Correction value of the armature current              I DW 236
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 6    Deceleration current                                  I DW 237
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 7    Acceleration compensation                             I DW 238
Contents+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  of the I   Measuring point 8    Flux PHI                                              I DW 239
measur-+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
    ing I   Measuring point 9    Current setpoint                                      I DW 240
  point +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 10   Control of output of the secondary controller         I DW 241
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 11   Control deviation of the secondary controller         I DW 242
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 12   Actual speed                                          I DW 243
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 13   Actual armature current                               I DW 244
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 14   Setpoint after ramp generator                         I DW 245
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 15   Diameter                                              I DW 246
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 16   Velocity                                              I DW 247
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I   Measuring point 17   Setpoint before ramp generator                        I DW 248
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
        I                                                                               I DW 249
        +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
        I                                                                               I DW 250
        +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
        I                                                                               I DW 251
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I Acknowledgement word for speed controller                                    I DW 252
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
 Status I Status word for speed controller                                             I DW 253
  bytes +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
    for I Acknowledgement word for position controller                                 I DW 254
    OCM +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I Status word for position controller                                          I DW 255
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
```

Controller Mangement

```
  15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
!     I     I     I     I     I     I     I     I     I     I     I     I     I     I     I RBV I  DW 7
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

Controller management area RBV = 0 : Controller is not processed
= 1 : Controller is processed

Configuring Switches

```
          15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
ST (0)  I S1.1I ST2 I ST4 IS11.1I ST11I S9.3I S9.2I ST9 I ST6 I ST7 I S8.2I S8.1I     I ST8 IS10.1I ST3 I  DW 35
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
ST (1)  I S4.1IS10.2IS10.3IS11.2I ST13I ST12I ST15I ST14I     I     I     I     I     I     I     I S8.3I  DW 36
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

	Abbreviation	Branch	Meaning
DW35:	S 1.1	01	Inversion
	ST 2	02	Friction
	ST 3	03	Actual velocity
	ST 4	04	Loop gain
	ST 6	06	Setting-up speed
	ST 7	07	Creep speed
	ST 8	08	Speed setpoint
	S 8.1	08	Ramp-function generator
	S 8.2	08	Filter
	ST 9	09	Position controller
	ST 9.1	09	Limit selection B+/B−
	S 9.2	09	Position setpoint selection
	S 9.3	09	Scaler selection
	S 10.1	10	Actual speed subswitch
	ST 11	11	Armature current
	S 11.1	11	Injection
DW36:	S 4.1	04	Injection
	S 8.3	08	Setpoint sequence
	S 10.2	10	Filter
	S 10.3	10	Zoom display
	S 11.2	11	Thermal monitoring
	ST 12	12	Limit monitor 1
	ST 13	13	Limit monitor 2
	ST 14	14	Measuring socket 1
	ST 15	15	Measuring socket 2

4.10 Description of the Drive Controller Structure (DR)

Input bit variables

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Range 5 (12)	BIT 3.1	REL 1.1	REL 6.1	REL 7.1	REL 3.1	REL 8.2	REL 8.1	REL 9.1	REL 2.1	REL 5.1	REL 5/9	BIT 9.RF	BIT 5.RF	BIT HOE	BIT TIE	BIT LOE	DW 180
Range 5(13)							REL 10,1	REL 8.3									DW 181

	Abbreviation	Branch	Meaning
DW 180:	REL 1.1	01	Deceleration enable
	REL 2.1	02	Friction enable
	REL 3.1	3a	Initial value switch for integrator
	BIT 3.1	3a	Integrator enable
	REL 5.1	05	Enable start-up speed controller
	BIT 5.RF	05	Controller enable speed controller
	REL 5/9	05,09	Direct tension control (transfer)
	REL 6.1	06	Setting-up speed
	REL 7.1	07	Creep speed
	REL 8.1	08	Setpoint switch (speed)
	REL 8.2	08	Setpoint enable (speed)
	BIT LOE	08	Reset ramp-function generator
	BIT TIE	08	Low ramp-function generator
	BIT HOE	08	High ramp-function generator
	REL 9.1	09	Setpoint switch (position)
	REL 9.RF	09	Controller enable position controller
DW 181:	REL 8.3	8	Setpoint switch: analog/dig. setpoint
	REL 10.1	10	Enable start-up value

Output bit variables

```
  15      14      13      12      11      10      9       8       7       6       5       4       3       2       1       0
+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+
I BIT    BIT     GM      GM      GM      GM      GM      GM     I                                                       BIT I  DW 220
I9UE-L  9UE+L   12.6    12.5    12.4    12.3    12.2    12.1    I                                                      11.1 I
+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------++
I BIT    BIT     BIT     BIT     BIT     BIT     BIT     BIT    I                                                           I  DW 221
I5UE-   5UE+    13.6    13.5    13.4    13.3    13.2    13.1    I                                                           I
+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+-------+
```

	Abbreviation	Branch	Meaning		
DW220:	BIT 12.1	12	Response	Limit 1	Limit monitor 1
	BIT 12.2	12	Response	Limit 2	Limit monitor 1
	BIT 12.3	12	Response	Limit 3	Limit monitor 1
	BIT 12.4	12	Response	Limit 4	Limit monitor 1
	BIT 12.5	12	Response	Limit 5	Limit monitor 1
	BIT 12.6	12	Response	Limit 6	Limit monitor 1
	BIT 9UE−L	09	Lower limit position controller		
	BIT 9UE+L	09	Upper limit position controller		
	BIT 11.1	11	Thermal alarm		
DW221:	BIT 13.1	13	Response	Limit 1	Limit monitor 2
	BIT 13.2	13	Response	Limit 2	Limit monitor 2
	BIT 13.3	13	Response	Limit 3	Limit monitor 2
	BIT 13.4	13	Response	Limit 4	Limit monitor 2
	BIT 13.5	13	Response	Limit 5	Limit monitor 2
	BIT 13.6	13	Response	Limit 6	Limit monitor 2
	BIT 5UE−	5	Lower limit speed controller		
	BIT 5UE−	5	Upper limit speed controller		

4.10 Description of the Drive Controller Structure (DR)

Status word for the speed controller

```
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|                                               | YOGD| YUGD| SOGD| SUGD| IOWD| IUWD| IOGD| IUGD|  DW 253
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

YOGD : = 1 ===> Upper limit of manipulated variable exceeded
YUGD : = 1 ===> Lower limit of manipulated variable exceeded

SOGD : = 1 ===> Speed setpoint exceeding upper limit
SUGD : = 1 ===> Speed setpoint exceeding lower limit

IOWD : = 1 ===> Actual speed exceeding upper warning value
IUWD : = 1 ===> Actual speed exceeding lower warning value

IOGD : = 1 ===> Actual speed exceeding upper danger value
IUGD : = 1 ===> Actual speed exceeding lower danger value

Status word for position controller

```
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|                                               | YOGL| YUGL| SOGL| SUGL| IOWL| IUWL| IOGL| IUGL|  DW 255
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

YOGL : = 1 ===> Upper manipulated variable limit of position controller exceeded
YUGL : = 1 ===> Lower manipulated variable limit of position controller exceeded

SOGL : = 1 ===> Position setpoint exceeding upper limit
SUGL : = 1 ===> Position setpoint exceeding lower limit

IOWL : = 1 ===> Actual position exceeding upper warning value
IUWL : = 1 ===> Actual position exceeding lower warning value

IOGL : = 1 ===> Actual position exceeding upper danger value
IUGL : = 1 ===> Actual position exceeding lower danger value

4.11 Description of the Standard Controller Structure (SR)

The controller structure referred to as the "Standard controller" is designed for simple tasks with single-loop controls. It can be used, for example, in temperature, pressure, position, flow, and other "standard" control systems.
The result calculated by the controller algorithm can be output in various forms:

- Continuous signal
- "On" – "Off" signal
- Pulse signal

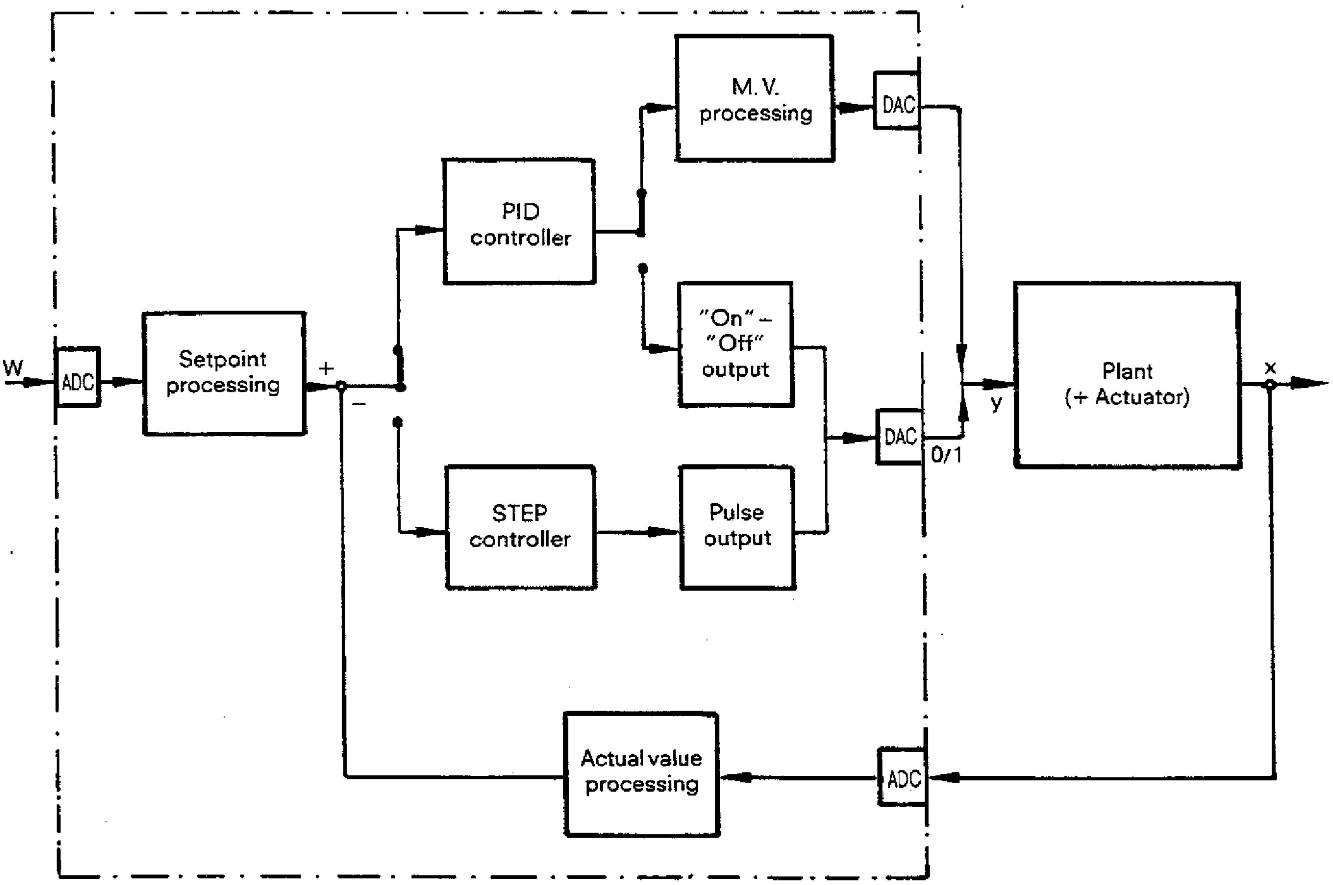


Fig. 4.14 Block diagram of the standard controller

As can be seen from the block diagram in Fig. 4.14, the standard controller basically offers an option between two different types of controllers:

- a continuous PID controller
- a step controller

Both types are based on a PID algorithm. The parameters of the controller make it possible to assign P, PI, PD or PID control action to each controller. The output response is also determined by the parameters assigned.

4.11.1 Controller and controller output

The step controller with a pulse generator module produces control pulses for driving an integral-action actuator. The PID controller has an option where the calculated manipulated variable can be either output directly via an analog output to the process actuator or alternatively converted to an equivalent "on" – "off" signal when using a switching actuator.
In the case of a continuous controller, the user also has the possibility of selecting a standard or extended controller by providing additional amplification in the proportional component, a separate D input, disturbance variable compensation and optional limiting of the correction rate.

4.11 Description of the Standard Controller Structure (SR)

4.11.2 Setpoint branch

The setpoint can be input from the CPU or from an A/D converter. It is also possible to specify a setpoint sequence consisting of a maximum of ten corner points via the PG. The following functions are available in the setpoint branch:

- Ramp function generator
- Filter stage.

4.11.3 Actual-value branch

The actual value can be input using either an analog or a digital input. The actual value branch can contain the following, depending on the user requirements:

- Plausibility checking
- Averaging function
- Function generator for signal linearization.

The functions are described in detail in Section 4.12.

4.11.4 Additional functions

- Two **user-connected** limit monitors:
  Each of the limit monitors can be assigned to any desired signal (measuring point) of the controller structure. The limit monitors contain 6 stages, which are specified via the programmer. The results of the limit monitors (overshoot or undershoot) are evaluated by the logic control program of the S5 central controller.

- Two **pre-assigned** limit monitors:
  These limit monitors support the operator communication and control concept of the standard controller structure. The results of the monitors are used for instance by the CP 525/CP 526 communications processors as inputs for the standard displays on the VDUs.
  The limit monitors monitor setpoints and actual values of the control loop.
  The danger and the warning limits are specified via the programmer during the initialization phase.

- Two **user-assigned** measuring sockets:
  Two measuring sockets are located on the front panel of the controller module. Any desired signals (measuring points) of the controller can be measured at these measuring sockets. The programmer is used to assign a particular signal to a particular measuring socket.

4.11.5 Detailed description of the standard controller structure

The following description refers to the configuring sheets (Section 8.2; standard controller structure). The symbols used are explained in Section 4.9.

All branches of this structure are shown on the cover page of the configuring sheets of the standard controller structure.
In contrast to the drive controller structure, all controller functions and outputs here are included in branch 1.
A detailed block diagram of the standard controller structure is included in Section 9 (Fig 9.2).

4.11.5.1 Branch 1.1: Continuous controller (standard)

Function:

The input variable of this branch is the control difference which is generated in branch 3. This control difference is converted into a controller result using a PID algorithm. The result is then converted into a manipulated variable in branch 1.3 or 1.4.
The PID controller can be assigned P, PD, PID or PI control action by setting various parameters to zero:

TN = 0	I component not active
TV = 0	D component not active

By switching relay REL1.1.1 on, the controller can be switched over to manual operation. This relay can be switched either from the PG or from the S5-CPU. Whether the manual value comes from the PG (CON HA) or from another A/D converter is determined by switch S1.1.1.
If the controller is switched over from automatic to manual operation (REL1.1.1 active), then the manipulated variable is changed exponentially from the instantaneous value to the specified value, which leads to a bumpless switch-over.
The manipulated variable (MP4) calculated by the algorithm is compared with the control limits B+ and B−. If these limits are crossed, then an overflow bit is set (bit UE+ or UE−). If the manipulated variable returns to within the specified limits, then the previously set bit is reset.
These bits can be read by the CPU, as can all bit variables.
The setting of the overflow bits also leads to the freezing of the integral component, so that a "wind up" of the integrator is prevented.

Input variables:

- CON KP   Proportional value }
- CON TN   Integral-action time } influence the behaviour of the PID controller
- CON TV   Derivative-action time }
- CON B+   The constant determines the upper limit of the limiting in branch 1.1.
- CON B−   The constant determines the lower limit of the limiting in branch 1.1.
- BIT RF   This bit disables or enables the controller. The controller is enabled if the bit is active. In the disabled state the controller outputs 0% and deletes the internal memory.
- CON HA   Constant input value for manual input

Output variables:

- BIT UE+   The bit becomes active when the controller output signal (MP4) crosses the upper limit (CON UE+). The integrator is frozen as long as the bit is active.
- BIT UE−   The bit is active when the controller output signal (MP4) crosses the lower limit (CON UE−). The integrator is frozen as long as the bit is active.
- MP3   Input signal of the controller algorithm
- MP4   Output signal of the controller algorithm
- MP10   Input signal of the manual input
- ADC 5   Analog manual input

4.11.5.2 Branch 1.2: Continuous controller (enhanced)

Function:

The enhanced version of the continuous controller offers several advantages described below in addition to the features described in Section 4.11.5.1.

- User specifiable additional amplification R in the proportional component
  Due to the parallel structure of the PID algorithm, it is possible to disable each component separately. Therefore – in contrast to the standard version – it is possible to disable the proportional amplification. In this way the controller can have a P, I, D, PI, PD or PID response.

- Separate D input
  A separate D component can be connected to the PID controller via structure switch S1.2.3. This D component is input via an A/D converter and can be observed at measuring point MP11.
  This additional D component allows the user to utilize an auxiliary variable for differentiating changes in the control variable. This is very useful for example where long sampling times do not allow satisfactory differentiation of the actual control variable.

- Ideal or real PID controller
  The IR bit can be utilized by the user to determine whether the control algorithm should emulate the behaviour of an ideal or a real PID controller.
  An ideal PID controller only contains a P, D, and I component while a real PID controller contains an additional delay in the D component. The delay time used in this algorithm corresponds to the selected sampling time.

- Disturbance variable input
  With structure switch S1.2.2, the user can structure A/D converter ADC4 as an input for a disturbance variable compensation. If this is so structured, then the calculated manipulated variable can be modulated with a known measurable disturbance variable via relay REL1.2.2.

- Holding the manipulated variable constant
  By setting bit ST it is possible to make the manipulated increment equal to zero independently of the control difference. This makes it possible to hold the manipulated variable constant.
  This function is essential for instance during the opening up of a cascaded control loop.

- Limiting the rate of change of the manipulated variable
  Using constants A+ and A–, it is possible to limit the variation in the control variable between two successive sampling points. This limiting results in a compulsory limiting of the rate of change of the manipulated variable.
  This limiting can be disabled by setting A+ and A– to ±100%.

Input variables:

- CON KP Proportional value
- CON TN Integral-action time } influence the behaviour of the PID controller
- CON TV Derivative-action time
- CON B+ The constant determines the upper limit of the limiting in branch 1.2.
- CON B– The constant determines the lower limit of the limiting in branch 1.2.
- CON HA Constant input value for manual input.
- BIT RF This bit disables or enables the controller.
  The controller is enabled if the bit is active. In the disabled state the controller outputs 0% and deletes the internal memory.
- CON A+ The constant determines the upper limit of the change in the manipulated variable.
- CON A– The constant determines the lower limit of the change in manipulated variable.
- CON R With this variable the user can specify an amplification which only influences the P component of the controller.
- BIT IR This bit allows the user to choose between a real and an ideal PID controller.
- BIT ST Bit for disabling manipulated variable changes.
  If the bit is active, then the manipulated variable increment is set to 0 and the manipulated variable therefore held constant.
- ADC 3 Input for separate D component
- ADC 4 Input for the disturbance variable
- ADC 5 Input for the manual control variable

Output variables:

– BITUE+	The bit becomes active, when the controller output signal (MP4) crosses the upper limit (CON UE+). The integrator is frozen as long as the bit is active.
– BITUE–	The bit is active, when the controller output signal (MP4) crosses the lower limit (CON UE–). The integrator is frozen as long as the bit is active.
– MP4	Controller output signal
– MP3	Input signal to the control algorithm
– MP10	Input signal to the manual input
– MP11	Input signal to the separate D input
– MP12	Input signal to the disturbance variable input

4.11.5.3 Branch 1.3: Continuous output

Function:

This output branch is selected via structure switch ST3 (= 0). It outputs the controller output signal calculated in branch 1.1 or 1.2 continuously. Matching to the actuator is possible. This matching allows both the slope and the offset to be corrected. The specification of the matching values is carried out by selecting parameters of the linear equation:

$$Y = a \cdot x + b,$$

where

a	is the slope (CON VER)
b	is the offset (CON OFF)
x	is the controller output signal
Y	is the manipulated variable.

Whether the actuator matching is carried out or not is determined by switch S1.3.1. If this switch is in the 1 position, then the matching is carried out.
The control (manipulated variable) signal can be observed at measuring point MP5 and is output via D/A converter DAC1.

Input variables:

- Controller output signals from branch 1.1 or 1.2
- CON VER The slope of the actuator matching can be set with this signal
- CON OFF This constant is used for selecting the offset

Output variables:

– MP5	Continuous control (manipulated) signal
– DAC1	Output for the control (manipulated) signal

4.11.5.4 Branch 1.4: "On" – "Off" output

Function:

The second output branch, the "on" – "off" output branch, is used for the implementation of two and three-step controllers within this controller structure.
For this purpose the controller output signal from branch 1.1 or 1.2 is transformed into an "on" – "off" signal with a minimum pulse length of 4 ms. The sampling time for this controller is a multiple of the minimum pulse length.

$$TA = n \cdot Tmin \qquad \text{with } n = 1,2,....$$

An analog output is required for a two-step controller. The three-step controller requires two analog outputs. The analog outputs are used in this application as digital outputs.
The positive pulse of the two-step controller corresponds to a +10V signal at the corresponding analog output.
If the analog outputs DAC1 and DAC2 are selected for the three-step controller, then the following signals are generated

```
DAC1 =  0V and DAC2 =  0V   ==>  manipulated signal     0%
DAC1 = 10V and DAC2 =  0V   ==>  manipulated signal +100%
DAC1 =  0V and DAC2 = 10V   ==>  manipulated signal –100%
```

The second output of the three-step controller is connected via switch S1.4.1, i. e. when this switch is inactive, the output branch has a two-step response.
The constant CON ASW is used for assigning the hysteresis parameter which makes it possible to prevent high frequency switching of the actuator during small oscillations of the manipulated variable around the steady state position. The threshold can be assigned a value between 0% and 50%.
A second influencing factor affecting the controller behaviour (only for three-step controllers) is the matching factor. This value which can be assigned a parameter, allows the controller intervention for positive and negative ranges to be different. With this it is possible for example to implement a heating/cooling control loop with different control interventions for the heating and cooling cycles. This matching factor (APF) can be entered in the range between 0 to 99.99, where the value APF = 1 corresponds to a weighting of 1:1.

4.11 Description of the Standard Controller Structure (SR)

Input variables:

- Controller output signal from branch 1.1 or 1.2
- CONTMIN Minimum pulse duration of the "on" – "off" output, adjustable between 4 ms and 32 sec.
- CON ASW Threshold value of the "on" – "off" function, adjustable in the range between 0% to 50%. This value determines the hysteresis range of the stage.
- CON APF Matching factor for weighting the control interventions in positive and negative control ranges, where the value 1 corresponds to intervention without weighting.
  This factor is adjustable in the range between 0 to 99.99.

Output variables:

- BIT PP This bit is always set during the time a positive pulse is output.
- BIT NP This bit is always set during the time a negative pulse is output.
- MP6 Output signal of the "on" – "off" function.
- MP7 Output signal of the "on" – "off" function, only active in case this output is selected for the three-step controller.
- DAC 1 Output of this function for both the two and three-step controller
- DAC 2 Output of this function used for the three-step controller, if this was structured with switch S1.4.1

4.11.5.5 Branch 1.5: Step controller with pulse output

Function:

The step controller with pulse output implemented here is a digital three-step controller. It is used for controlling actuators with integral response (e. g.: valves, dampers and flaps). In order to prevent high frequency oscillations of the actuators due to small control deviations, a dead band with hysteresis is connected before the PID algorithm. This dead band can be made separately inactive for the I component, which leads to optimum protection of the actuator and prevents a continuous control deviation.
In contrast to the "on" – "off" output, here the change in the manipulated variable is output to the pulse generator instead of the manipulated variable. The pulse generator converts the manipulated variable change (dYk) to a pulse duration (Tk).

$$Tk = TM \cdot dYk$$

The input range for the actuator travel time (TM) is between 0.1 ms and 59.59 h.min.
In order to limit the switching frequency, a minimum pulse duration (Tmin) must be specified. From this viewpoint, the pulse length can also be represented as a multiple of the minimum pulse duration Tmin.

$$Tk = x \cdot Tmin$$

The output signal from the pulse generator stage is output as in branch 1.4 via two D/A converters.

It is also possible to structure a manual input for this controller branch using switch S1.5.1. The manual branch can be activated via relay REL1.5.1 if required. The manual value can be specified in two ways, either via an A/D converter or by entering this value via the programmer. In this step controller, the manual value has a different meaning to the normal case due to the way it is processed. Here the manual value does not operate as a manipulated variable change but instead as a rate of change.

Note: A further method of operating the step controller in manual mode (two switches 'actuator open/closed') is demonstrated in Sections 4.11.6.12 and 5.2.3.1.

Input variables:

- MP3 Control difference from branch 3
- CON KP Proportional value
- CON TN Integral-action time } influence the behaviour of the PID controller
- CON TV Derivative-action time
- CON TMIN Minimum pulse duration, must be specified in order to limit the switching frequency
- CON TM Actuator travel time; it can be adjusted in the range between 0.1 ms to 59.59 h. min.
- CON AN Triggering threshold for the input hysteresis
- CON AB Release threshold for the input hysteresis
- CON HA Constant input value for manual input
- BIT RF This disables or enables the controller.
  The controller is enabled if the bit is active. In the disabled state the controller outputs 0% and deletes the internal memory.
- BIT HAI This "manual input inactive" bit, when inactive (bit = 0), causes the manipulated variable to become zero.
- BIT TOT "BIT TOT" determines whether the dead band is active for the integral component or not. When the bit is active (BIT TOT = 1) the dead band is inactive.
- BIT BA Both these bits provide information to the pulse generator as to whether the actuator is in one of its end
- BIT BZ positions. If "BIT BA" = 1, then the actuator has reached its final OPEN position, whereas "BIT BZ" = 1 signals that the actuator has reached its final CLOSED position. This information can be communicated to the pulse generator stage either from the PG or from the CPU.
- MP10 Input signal of the manual input
- ADC 5 Input for manual control variable

Output variables:

- MP6 Output signal of the pulse generator
- MP7 Output signal of the pulse generator
- DAC 1 Pulse generator output for "positive" pulses
- DAC 2 Pulse generator output for "negative" pulses
- BITAUF
- BITZU

  These bits signal the direction of motion of the actuator. If "BIT AUF" is set, this indicates for instance that the valve is just opening, whereas if "BIT ZU" is set it is just closing. If both these bits are not set, then the actuator is in a steady state.

4.11.5.6 Branch 2: Actual-value branch

Function:

This branch provides several other options of processing the actual value signal apart from just sensing.
The actual value can be input in analog form or as a pulse signal. The type of input signal is specified by the user via switch S2.1. The signal can be observed at the measuring point MP8.
Using the plausibility check, the input value can be checked to ascertain whether it matches the three previous measured values. For this purpose switch S2.2 must be set to 1 and the constant CON ZUL must be selected, which specifies by how much the actual current value can deviate from the calculated value during this time. The current actual value is calculated as an extrapolation of the three previous values.
The user can connect an averaging stage in the actual value branch using switch S2.3. This stage can be used as protection against interference voltages. However the user should take into account that the exact actual value can also be falsified (averaged) by considering the previous values.
The averaging is carried out according to the equation:

$$Xa = (Xe + 7 \cdot Xv) / 8$$

In this equation

Xe is the actual value
Xv is the previous average value
Xa is the current average value

Apart from the functions described above it is possible in the actual value branch to linearize the actual value using an optional function generator. This linearization function is enabled via switch S2.4. When specifying the curve for the function generator up to ten equi-distant extrapolation nodes can be specified.
The values to be specified are

Number of extrapolation nodes
The first abscissa value X (1)
Distance to the next extrapolation nodes (DX)
N ordinate values

At the output of the actual value branch, switchover to a start up actual value is possible via relay REL2.3. This value can be input via the programmer.
The actual value output from this actual value branch, which is used for calculating the control difference, can be observed at measuring point MP9.

Input variables:

- ADC2 The actual value to be controlled, which can also be input as an incremental input (S2.1 = 1). In the case of incremental actual value sensors, standardization is carried out to 100% for rated signal in the following steps:
  - configure and initialize SR structure with polygon in the actual value branch. The polygon first implements the function y = x.
  - After manual acceleration of the actual value to, for example, 10% of the nominal value, the actual value measured by the IP 252 can be read in the controller test at MP 8. If this is, for example, 4%, the polygon must implement a straight-line equation according to $y = \frac{10\%}{4\%} \cdot x = 2.5\,x$.
- CON ZUL Permissible deviation of the actual value from the calculated expected value
- CON N Number of extrapolation nodes in the function generator
- CON STA Starting value of the extrapolation nodes (abscissa value)
- CON SCH Interval between neighbouring extrapolation nodes
- CON 01..10 Ordinate values of the extrapolation nodes 1...10
- CON INB Commissioning actual value

Output variables:

- MP9 Processed actual value used for calculating the control deviation
- MP8 Actual value as input

4.11.5.7 Branch 3: Setpoint branch

Function:

This setpoint branch provides various options for specifying the setpoint and processing the setpoint after being input.
The user can use switch S3.1 to decide whether the setpoint is entered as an analog value via the A/D converter ADC 1 or digitally. The digital value can be input from the CPU or from the PG! For input from the PG it is possible to specify a setpoint sequence of up to ten points, where the number of extrapolation nodes (N), a maximum of ten setpoints (SW(i)) and the interval time (TI) must be specified. Bit 3.1 determine whether the extrapolation nodes describe a staircase or linear curve.
The selected setpoint which can be observed at measuring point MP1, can now be processed using a ramp-function generator and/ or a smoothing stage. Switch S3.2 shorts out the ramp-function generator when it is inactive (0), and switch S3.3 shorts out the smoothing stage when it is inactive.
The ramp-function generator transforms step setpoint changes into ramping signals, which then can be smoothed by the smoothing stage. Apart from the already known ramp-functions parameters such as positive and negative ramping times, an additional constant must be specified for the ramp-function generator. This constant is known as the increment and corresponds to the amplitude which the ramp-function generator generates at its output after the positive or negative ramping time has expired when a step signal of 100% is connected to its input.
In addition the higher, lower and reset bits are provided as is already known in analog ramp-function generator pushbuttons.
The smoothing time is the only parameter of the smoothing stage.
Via relay REL3.2 it is possible to disable the complete setpoint branch.
The control difference is generated at the output of the setpoint branch, which subtracts the actual value processed in branch 2 from the setpoint processed in branch 3 and outputs this to the controller. The processed setpoint is available at measuring point MP2, and the calculated control difference at measuring point MP3.

Input variables:

- ADC 1 Input for the analog setpoint
- VAR 3.1 Setpoint from the CPU
- CON N Number of extrapolation nodes for the setpoint sequence
- CON TI Distance between neighbouring extrapolation nodes
- CON SOL (i) Setpoints 1...10
- CON TH Ramp-up time of the ramp-function generator
- CON TR Ramp-down time of the ramp-function generator
- CON ZUW Increment constant: measure of the amplitude, which the ramp-function generator output reaches for a 100% step at the input within the ramp-up or ramp-down times.
- CON TVZ Delay time constant of the smoothing stage
- BIT 3.1 This bit determines whether the extrapolation nodes are treated as a staircase function of interpolated linearly. Bit 3.1 = 1: linear; = 0: staircase function
- BIT HOE With this bit the setpoint can be shifted to the +100% limit, regardless of the current setpoint.
- BIT TIE With this bit the setpoint can be shifted to the −100% limit, regardless of the current setpoint.
- BIT LOE When this bit is set, automatic mode is resumed. The HOE and TIE bits have priority over the LOE bit.

Output variables:

- MP1 Input signal of the setpoint branch
- MP2 Output signal of the setpoint branch
- MP3 Calculated control difference

4.11.5.8 Branch 4: Limit monitor 1

Function:

The limit monitor monitors the value of any desired measuring point of this control loop. A maximum of six limiting values can be specified. The no. of the monitored measuring point can be changed any time during the RUN mode of the IP.
The function is described in Section 4.16.6 in more detail.

Input variables:

- MP-No. No. of the measuring point to be monitored 1...12)
- CON 4.1
- CON 4.2
- CON 4.3 max. 6 limiting values
- CON 4.4 (see Section 4.11.6.6)
- CON 4.5
- CON 4.6
- CON 4.7 Number of limiting values

Output variables:

- BIT 4.1
- BIT 4.2
- BIT 4.3 maximum 6 output bits for signalling
- BIT 4.4 "limit value reached"
- BIT 4.5
- BIT 4.6

4.11.5.9 Branch 5: Limit monitor 2

Function:

The limit monitor monitors the value of any desired measuring point of this control loop. A maximum of six limiting values can be specified. The no. of the monitored measuring point can be changed any time during the RUN mode of the IP.
The function is described in Section 4.16.6 in more detail.

Input variables:

- MP-No. No. of the measuring point to be monitored (1...12)
- CON 5.1
- CON 5.2
- CON 5.3 max. 6 limiting values
- CON 5.4 (see Section 4.11.6.6)
- CON 5.5
- CON 5.6
- CON 5.7 Number of limiting values

Output variables:

- BIT 5.1
- BIT 5.2
- BIT 5.3 maximum 6 output bits for signalling
- BIT 5.4 "limit value reached"
- BIT 5.5
- BIT 5.6

4.11.5.10 Branch 6: Measuring socket 1

Function:

The value of any measuring point of the control loop can be connected via an output channel to measuring socket 1. The no. of the measuring socket can be changed at any time during the RUN mode of the IP.

Input variables:

- MP-No. No. of the measuring point which is connected to measuring socket 1 (1...12).

Output variables:

- DAC 3 Address of the analog output channel to which the measuring point value is output.
  Measuring socket 1 is wired to output channel 5. Measuring socket 1 is used for the output of a random measuring point to analog output channels 0 to 7.

4.11.5.11 Branch 7: Measuring socket 2

Function:

The value of any measuring point of the control loop can be connected via an analog output channel to measuring socket 2. The no. of the measuring socket can be changed at any time during the RUN mode of the IP.

Input variables:

- MP No. No. of the measuring point which is connected to measuring socket 1 (1...12).

Output variables:

- DAC 4 Address of the analog output channel to which the measuring point value is output.
  Measuring socket 2 is wired to output channel 6 in the case of the DR/SR submodule. Measuring socket 2 (and also measuring socket 1) of the DRS/SR submodule are used to output a random measuring point to analog output channels 0 to 7, since global assignment of the measuring sockets takes place in the case of this submodule, (see Section 4.1).

4.11.6 Functions of the standard controller

4.11.6.1 Preassigned limit monitors in branches 2 and 3

The results of these limit monitors are used by a CP 526 for display purposes. The output bits **cannot** be read from the standard FB used with the logic program (Section 4.14).

Function of the actual value limit monitor:

Four limits can be specified via the PG:
- Upper warning limit
- Lower warning limit
- Upper danger limit
- Lower danger limit

Each of these limits is assigned a bit. If a signal **crosses** the **upper** warning/danger limits, then the "upper warning/danger limits crossed" bits are set. In all other cases they are reset. When the signal crosses the **lower** warning/danger limits, then the "lower warning/danger limits crossed" bits are set. In all other cases they are reset.

Function of the setpoint limiting monitor:

Two limits can be specified via the PG:
- Upper limit
- Lower limit

Both the limits are assigned two bits. When the **upper** limit is **crossed** the "upper limit crossed" bit is set, otherwise it remains reset. When the **lower** limit is crossed, the "lower limit crossed" bit is set, otherwise it is reset (Fig. 4.15).

4.11 Description of the Standard Controller Structure (SR)

Example: setpoint limit monitor

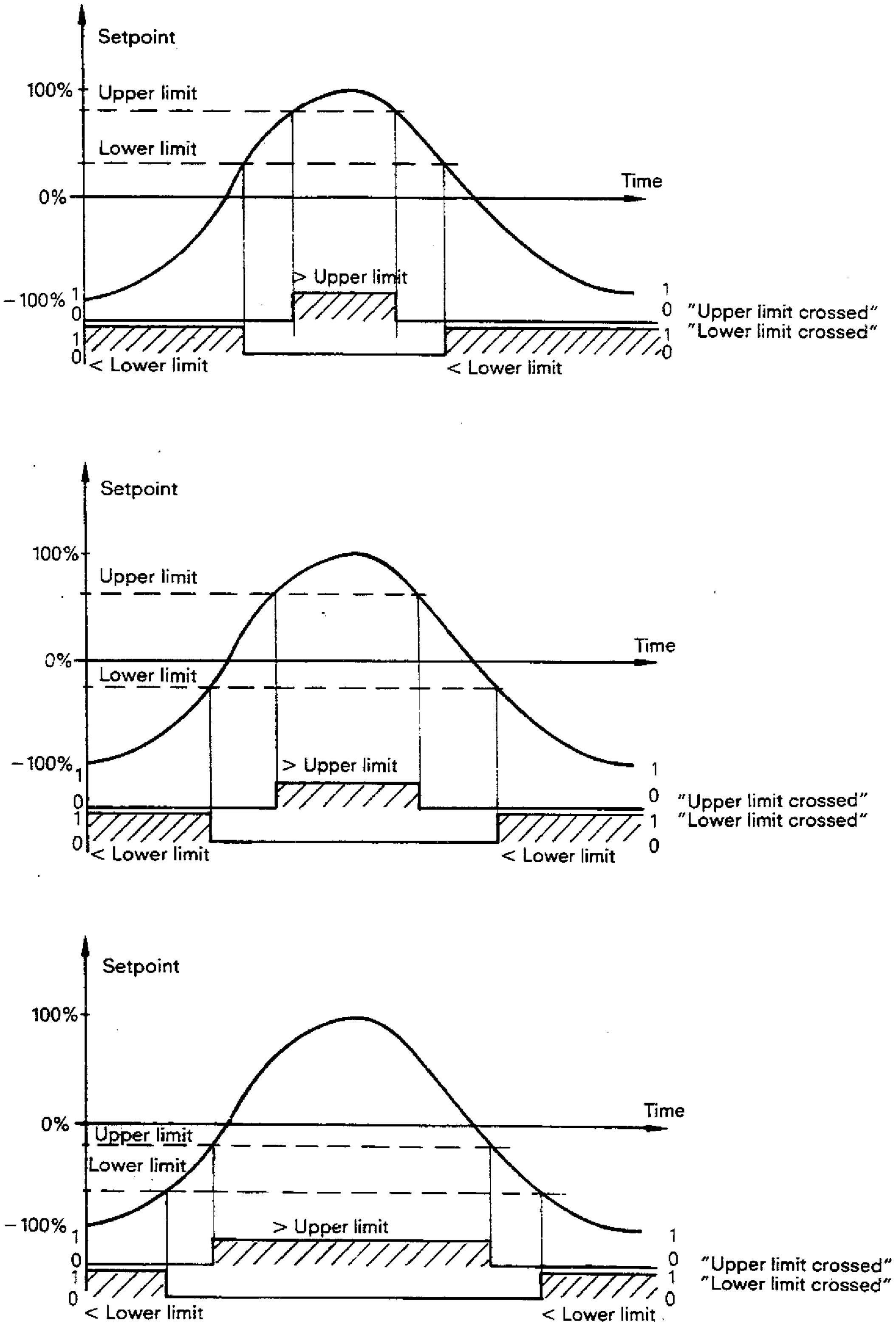


Fig. 4.15 Method of operation of the pre-assigned limit monitor

i.2 Setpoint sequence

:tion description:

mpling time (TA) driven setpoint sequence Xa(t) is generated from i = 1,...,10 setpoint interpolation nodes CON SOL (1),..., ↓ SOL (i).

options are available:

aircase waveform:

t 3.1 = 0 is set, the output variable Xa is equal to the last setpoint CON SOL (I) until the period between 2 successive setpoints N TI (> TA) has expired. Then, for the duration CON TI of the next period, Xa = CON SOL (I+1) is output (Fig. 4.16).

near interpolated waveform:

it 3.1 = 1, then linear interpolation is carried out between successive setpoints (Fig. 4.17).

etpoint generated in this way is continued cyclically after the expiry of the period TPER = N · CON.
:onstant setpoint Xa = CON SOL (1) is output in case N = 1, regardless of the values of CON TI and bit 3.1.

:strictions:

ɔit 3.1 = 1 (case "linear interpolation") the following additional assumptions are made:

* CON TI = P · TA , P = positive integer.
* P <= 32767.

ɘtween the setpoints CON SOL (I) and CON SOL (I+1), a linear approximation given by the straight line equation is always used:

Xa (M·TA) = [CON SOL (I+1) − CON SOL (I)] · M/P + CON SOL (I) , M <= P,

/here M*TA is the time since the last setpoint CON SOL (I).

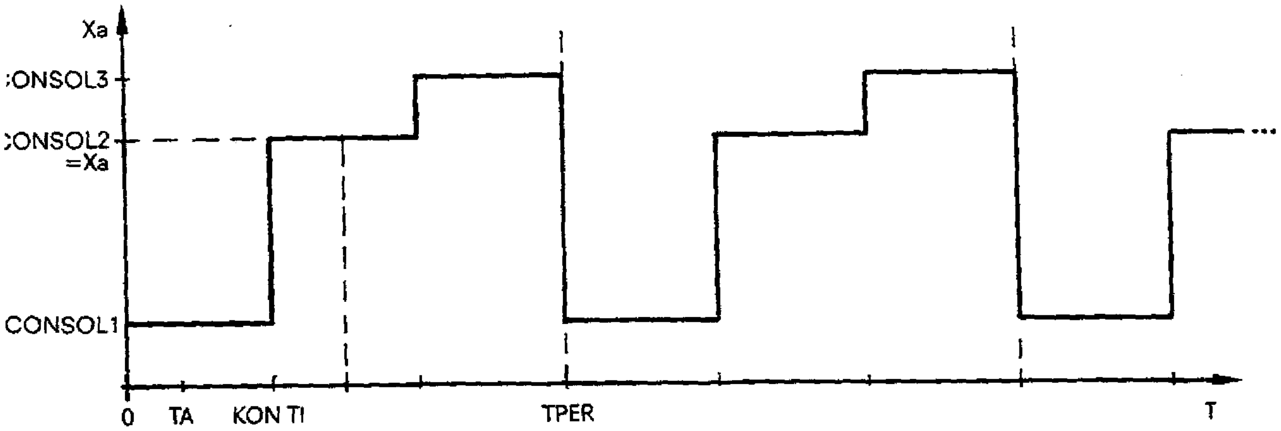


Fig. 4.16 Staircase waveform setpoint sequence (Example N=3)

4.11 Description of the Standard Controller Structure (SR)

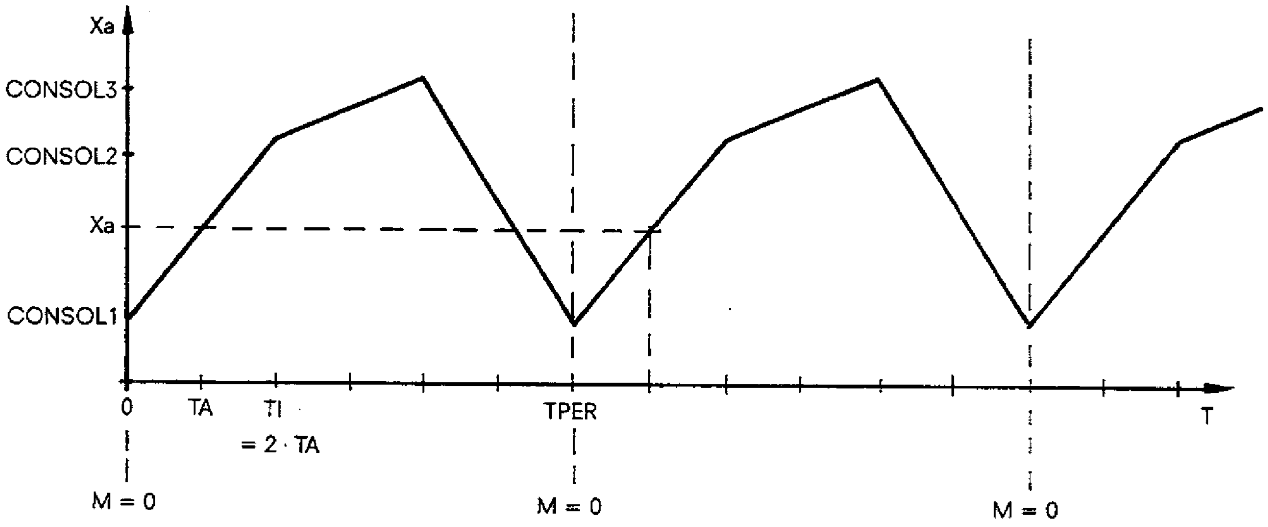


Fig. 4.17 Linearly interpolated waveform setpoint sequence (Example N=3)

Symbol:

```
                              CON
                   CON TI  TA  SOL   N        Bit 3.1
                      I    I    I    I           I
                      I    I    I    I           I
                      I    I    I    I           I
                 +----+----+----+----+-----------+--+
                 I                                  I
                 I                                  I
                 I                                  I
T  --------->    I      SETPOINT SEQUENCE           I---------->  Xa
                 I                                  I
                 I                                  I
                 I                                  I
                 +----------------------------------+
```

Fig. 4.18 Symbol of the setpoint sequence stage

Description of function parameters and binary variables:

Type of variable	Symbol	Description	Number format	Numerical range
Parameter	N	Number of setpoints	undimen.	1 ... 10
	CON SOL (1)	Setpoint 1	variable-dependent	−100% ... +100%
	: :	: :	:	: :
	CON SOL (10)	Setpoint 10	variable-dependent	−100% ... +100%
	CON TI	Interval time	Time	4ms ... 99h 59min
	TA	Sampling time	Time	4ms ... 99h 59min
Binary input variable	Bit 3.1	= 0 : Staircase waveform = 1 : Linearly interpolated waveform	Bit	0/1

Description of function input and output variables:

Type of variable	Symbol	Description	Number format	Value range
Input variable	T	Time	Time	0.1 ms ... 99 h 59min
Output variable	Xa	Setpoint sequence	variable-dependent	−100% ... +100%

4.11.6.3 Function generator

Function description:

A function described in a table is used to generate a function value Xa = F(Xe) from a given abscissa value Xe within the interval X(1) ≤ Xe ≤ X (N) using linear interpolation.

The function can be defined by N = 1,...,10 pairs of values [(X)I, F(I)], where the N abscissa values X(1),....,X(N) define a strictly monotonous curve starting with the abscissa value of the first interpolation node CON STA and with a period of CON SCH between the interpolation nodes, i. e.:

$X(1) \leq X(2) \leq \ldots \leq X(N).$

Therefore the abscissa values are equidistant.

The corresponding ordinate values should be specified in the sequence CON (1), CON (2),..., CON (N).

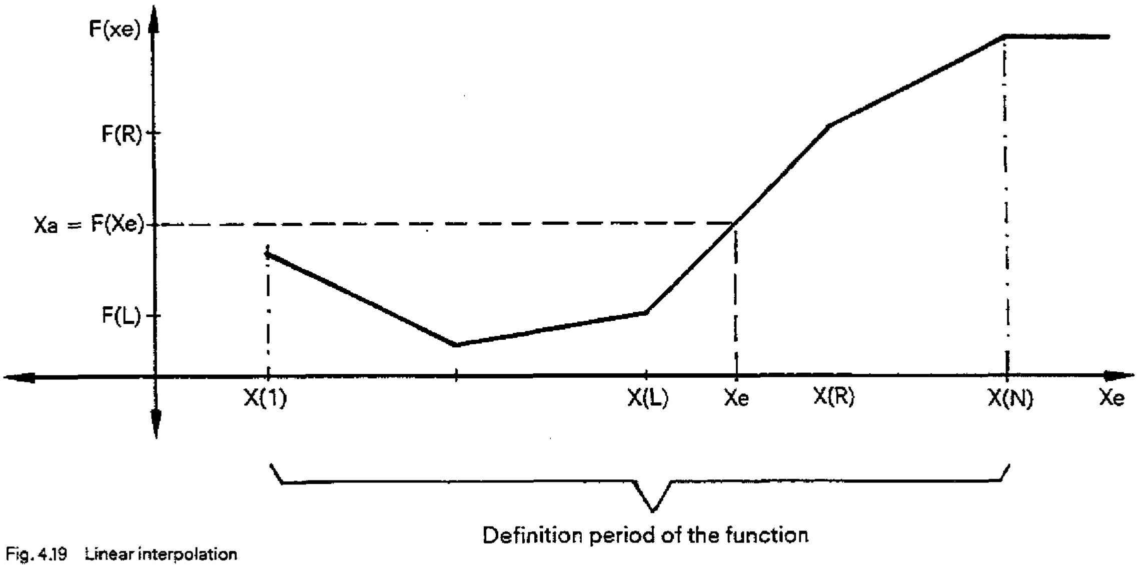


Fig. 4.19 Linear interpolation

Procedure:

A given value Xe is compared successively with the selected abscissa values, until the abscissa values X(L) and X(R) of the neighbouring table interpolation nodes are found. Then the function value is calculated according to the straight line equation:

$$\boxed{F(Xe) = \frac{F(R) - F(L)}{X(R) - X(L)} (Xe - X(L)) + F(L)}$$

Note:
Due to its use as a setpoint, the function value outside the defined interval is defined as follows:

- * Xa = F(1) for Xe < X (1),
- * Xa = F(N) for Xe > X (N).

Symbol:

```
                          N  CON STA  CON SCH  CON(1),...,CON(N)
                          I       I        I       I
                          I       I        I       I
                          I       I        I       I
                     +----+-------+--------+-------+----+
                     I                                  I
                     I                                  I
                     I                                  I
Xe      ---------->  I        FUNCTION GENERATOR        I---------->  Xa
                     I                                  I
                     I                                  I
                     I                                  I
                     +----------------------------------+
```

Fig. 4.20 Symbol of the function generator

Description of the function parameters:

Type of variable	Symbol	Description	Number format	Numerical range
Parameter	N	Number of equi-distant nodes	no unit	1 ... 10
	CON STA	Abscissa value of the first nodes	variable-dependent	−100% ... +100%
	CON SCH	Distance between neighbouring nodes	variable-dependent	−100% ... +100%
	CON(1)	Ordinate value of the first node	variable-dependent	−100% ... +100%
	⋮	⋮	⋮	
	CON (10)	Ordinate value of the tenth corner point	variable-dependent	−100% ... +100%

Description of the function input and output variables:

Type of variable	Symbol	Description	Number format	Value range
Input variable	Xe	Abscissa value	variable-dependent	−100% ... +100%
Output variable	Xa	Linearly interpolated function value	variable-dependent	−100% ... +100%

4.11.6.4 Averaging

Function description:

The new averaged output value Xa is generated from the input value Xe (i. e. actual value), which may be falsified (due to "ripple"), using the old (averaged) output value X_V, as follows:

$$\boxed{Xa = \frac{1}{8}(Xe + 7 \cdot X_V)}$$

Note: The averaging may falsify correct values!

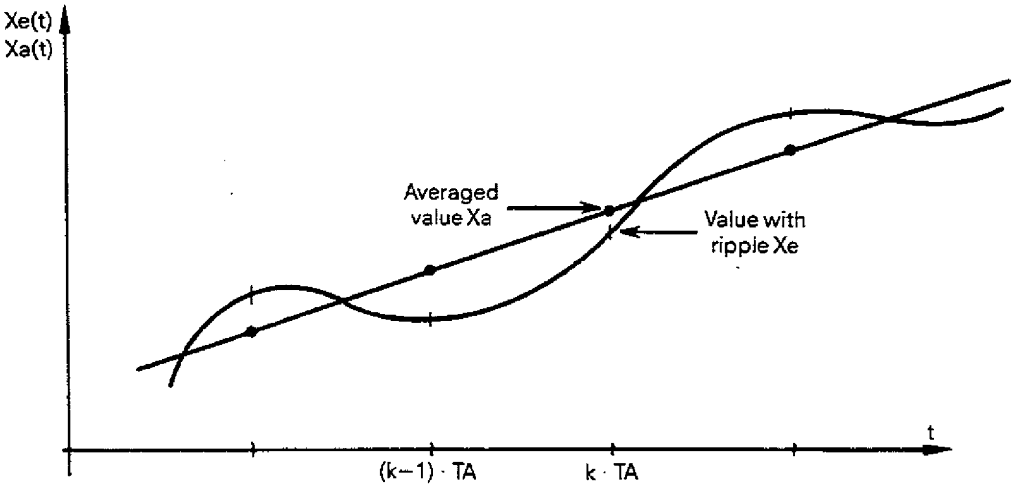


Fig. 4.21 Suppression of measurement ripple by averaging

Block symbol:

```
                +--------------------+
                |                    |
                |                    |
                |                    |
Xe   ---------->|     AVERAGING      |----------> Xa
                |                    |
                |                    |
                |                    |
                +--------------------+
```

Fig. 4.22 Symbol of the averaging function

The block has no parameters.

Description of the block input and output variables:

Type of variable	Symbol	Description	Number format	Numerical range
Input variable	Xe	Input value (with ripple)	variable-dependent	−100% ... +100%
Output variable	Xa	Averaged output value	variable-dependent	−100% ... +100%

In addition the previous value X_V is stored in the block. However this value is not accessible to the user.

4.11.6.5 Plausibility check

Function description:

Any interference which causes a difference between two consecutive sampled values Xek1, Xek to be greater than a specified (physically meaningful) value CON ZUL is suppressed.

The current output value Xak is calculated as follows:

(1) $\mathrm{Xak} = \mathrm{Xek} \quad \text{for} \quad |\mathrm{Xek}-\mathrm{Xak1}| \leq \mathrm{CON\ ZUL},$

(2) $$\mathrm{Xak} = \mathrm{Xak1} + \frac{(\mathrm{Xak1}-\mathrm{Xak2}) + (\mathrm{Xak2}-\mathrm{Xak3})}{2} =$$

$$= \frac{3}{2}\ \mathrm{Xak1} - \frac{1}{2}\mathrm{Xak\,3} \quad \text{for} \quad |\mathrm{Xek}-\mathrm{Xak1}| > \mathrm{CON\ ZUL}.$$

4.11 Description of the Standard Controller Structure (SR)

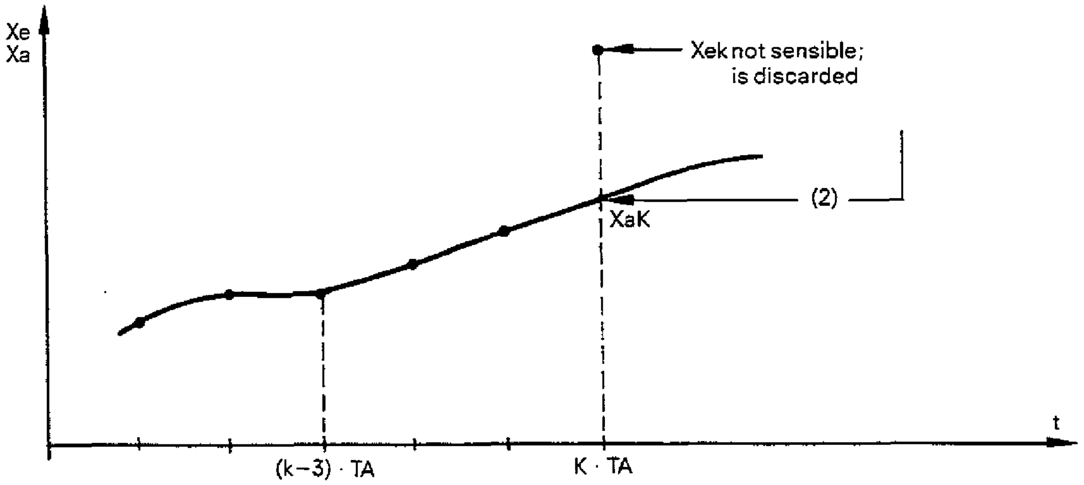


Fig. 4.23 Method of operation of the plausibility check

If the difference is > CON ZUL for longer than 2 sampling periods, then the input value is interpreted as being permissible and the output value is changed to the input value according to an expotential function.

==> Permissible values are not falsified by the plausibility checking (different to averaging action)!

Symbol:

```
                          KON ZUL
                             |
                             |
                             |
                 +-----------+-----------+
                 |                       |
                 |                       |
                 |                       |
Xek  ---------->|      PLAUSIBILITY     |----------> Xak
                 |         CHECK         |
                 |                       |
                 |                       |
                 +-----------------------+
```

Fig. 4.24 Symbol of the plausibility checking stage

Description of the function parameter:

Type of variable	Symbol	Description	Number format	Numerical range
Parameter	CON ZUL	Magnitude of the maximum permissible difference between two successive sampling values	variable-dependent	0 ... +100%

Description of the function input and output variables:

Type of variable	Symbol	Description	Number format	Numerical range
Input variable	Xek	Input value	variable-dependent	−100% ... +100%
Output variabie	Xak	Output value	variable-dependent	−100% ... +100%

Note:
The minimum pulse duration T_{min} can only be changed in the "Input" and "Output" modes, **but not in the controller test.**

4.11.6.6 Limit monitor

Function description:

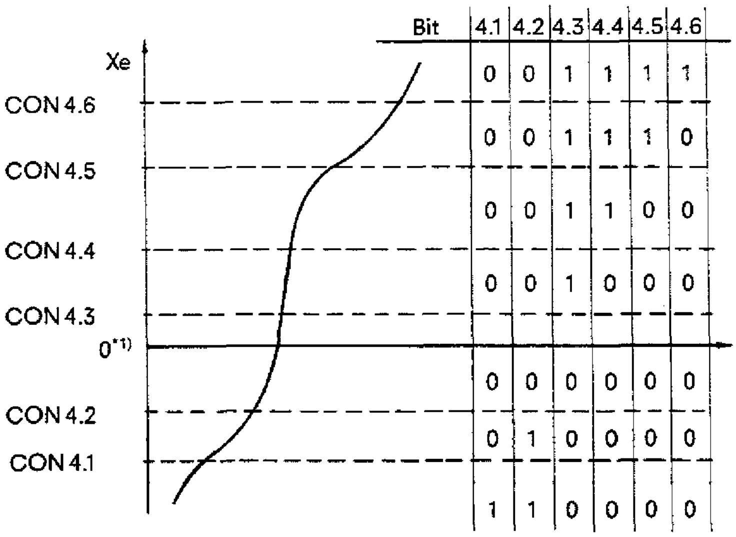
An input value MP NR is checked against up to 6 limit values
CON 4.1 (or 5.1) to CON 4.6 (or 5.6). (No hysteresis!)
No given sequence of limiting values is assumed.
If limiting values are crossed, then N bits are set, i. e. bits 4.1,...,4.6 (or 5.1,...,5.6):

Case 0: N=0 (trivial case, should be discarded at the PG)
No checking of Xe is necessary. For safety reasons all bits Bit(i) are reset.

Case 1: $1 \leq N \leq 6$
The bits of the specified limit values are set, if a positive value or a negative value is crossed:

$$\begin{array}{ll} CON4.i \geq 0: & Xe \leq CON4.i \implies Bit4.i := 0, \\ & Xe > CON4.i \implies Bit4.i := 1, \\ CON4.i < 0: & Xe \geq CON4.i \implies Bit4.i := 0, \\ & Xe < CON4.i \implies Bit4.i := 1, \\ & i = 1, \ldots, N. \end{array}$$

==> For N < 6 due to safety reasons, the 6-N not required bits are set to 0:
$Bit4.(N+1) = \ldots = Bit4.(6) = 0.$
N is specified by the constant CON 4.7 (or CON 5.7).



Bit	4.1	4.2	4.3	4.4	4.5	4.6
	0	0	1	1	1	1
	0	0	1	1	1	0
	0	0	1	1	0	0
	0	0	1	0	0	0
	0	0	0	0	0	0
	0	1	0	0	0	0
	1	1	0	0	0	0

Fig. 4.25 Method of operation of the limit monitor for the maximum case N = 6 (with ascending sequence of limit values)

Symbol:

```
                  CON 4.7
                  (or 5.7)   CON 4.1   CON 4.6 (or CON 5.1...CON 5.6)
                     I          I            I
                     I          I            I
                     I          I            I
               +-----+----------+------------+---+
               I                                 I-----------> Bit 4.1
               I                                 I              (or 5.1)
               I                                 I       :        :
MP NR ---------> I          LIMIT MONITOR          I       :        :
               I                                 I       :        :
               I                                 I              Bit 4.6
               I                                 I-----------> (or 5.6)
               +---------------------------------+
```

Fig. 4.26 Symbol of the limit monitor

Description of the function parameters:

Type of variable	Symbol	Description	Number format	Numerical range
Parameter	CON 4.7 (or 5.7)	Number of specified limit values	no unit	1 ... 6
	CON 4.1 (or 5.1)	Limit 1	variable-dependent (or %)	−100% ... +100%
	:	:	:	:
	CON 4.6 (or 5.6)	Limit 6	:	:

Description of the function input and output variables:

Type of variable	Symbol	Description	Number format	Value range
Input variable	Xe	Monitored input value	variable-dependent (or %)	−100% ... +100%
Binary output signals	Bit 4.1 (or 5.1)	Limit value bit 1	Bit	0/1
	:	:	:	:
	Bit 4.6 (or 5.6)	Limit value bit 6	Bit	0/1

4.11.6.7 Ramp-function generator

Function description:

The ramp-function generator produces an output signal Xa which **ramps** up to the required setpoint W after a setpoint jump at its input.

* The ramp begins e. g. at the current actual value XS of the controller (see "Actual value referencing") and ramps with the specified slope to the upper or lower **setpoint** W.

* If the setpoint is changed after it has been reached (ramp value is equal to setpoint), then the ramp is continued with the current valid slope from the current ramp value, except when the actual value is between the ramp value and the setpoint. In this case the ramp starts from the actual value.

* If the setpoint changes before it is reached, then the ramp is started again from the current actual value or from the last ramp value.

* In addition it is possible by pressing the **"higher" pushbutton,** i. e. by setting input bit BIT HOE = 1, to ramp past the setpoint W up to the maximum 100% setpoint, or correspondingly by pressing the **"lower" pushbutton,**" i. e. by setting input bit BIT TIE = 1, to ramp to the minimum −100% setpoint.
  As long as the "higher" **or** "lower" pushbutton is pressed, then the ramp-function generator ramps with the specified slope. When the pushbutton is no longer pressed then the current momentary ramp value is frozen till a pushbutton is pressed again.

* The "higher" pushbutton always causes the ramp to go to more positive values, that is in the positive range with the "higher" slope and in the negative range with the "lower" slope.
  Similarly the "lower" pushbutton always causes the ramp to go to more negative values, that is in the positive range with the "lower" slope and in the negative range with the "higher" slope.

* When **both** pushbuttons are pressed at the same time the ramp value remains constant.

* When the **reset switch** is activated (input bit BIT LOE) the following occurs: When the LOE bit is set, the ramp-function generator is switched from setpoint manual mode to automatic (i. e., the setpoint is approached via the preset parameters T_H, T_R and ZUW), provided the HOE and TIE bits are set.

* The "higher"/"lower" pushbuttons have priority over the LOE bit.

* If the setpoint W changes when the "higher" or "lower" pushbutton is pressed, then the new setpoint is targeted only after the pushbutton has been released and the reset switch has been pressed.

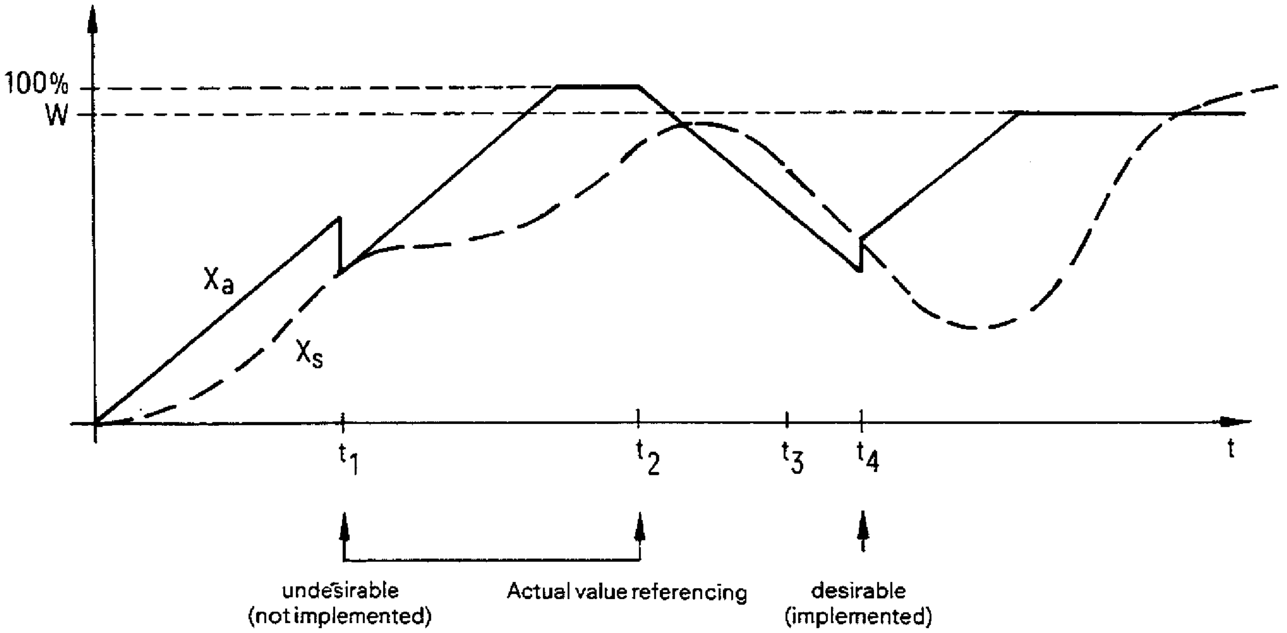
Actual value referencing:

The main function of the ramp-function generator is to smoothen setpoint jumps and to travel to setpoint at a predefined rate of change.

With the aim of reaching the setpoint as quickly as possible, the **actual value can only be used sensibly in certain cases** as a ramp starting point after any **switch-over** ("reset", setpoint change):

- The switch-over causes a **positive ramp**:
  ==> Actual value referencing sensible in cases where XS > Xa.
- The switch-over causes a **negative ramp**:
  ==> Actual value referencing sensible in cases where XS < Xa.

Otherwise starting the ramp at the current actual value leads to an unnecessary jump in the ramp value which is the effective setpoint and causes the ramp value to target the setpoint **after a delay**, see Fig. 4.27.



t1 : "Higher" pushbutton pressed
t2 : "Lower" pushbutton pressed
t3 : Bits active (HOE bit = TIE = LOE = 0)
t4 : Reset pushbutton

Fig. 4.27 Actual value referencing in the ramp-function generator during "switch-over"

In practice another operating state can occur, which makes actual value referencing necessary: i. e. **power failure.** If, for example, during a very slow heating process which must be ramped up during one hour, the power supply fails after half an hour for a long period of time, then the actual value sinks far below the last ramp value.
On power restoration, the ramp should be continued at the current actual value and not at the last ramp value. Otherwise the sudden large control deviation causes excessive heating ("overshoot").

For this purpose the ramp-function generator must be able to detect a power failure, since none of the "switch-overs" mentioned occurs. A central power fault bit does not solve the problem, as in this case a controller with a sampling time of 10 minutes may only be executed 10 minutes after power restoration, i. e. it could only then determine that a power failure has occurred. For other controllers with shorter sampling times, however, this bit must be reset much sooner, otherwise they would always react to that bit.

For this purpose the actual value referencing is implemented in the following way: After power return the previous values of the setpoint and the ramp-function generator are reset. Since W <> W_{old} = 0, actual value referencing takes place compulsorily for the next execution of the function. Therefore, after a power failure, the ramp starts at zero or, if valid, at the current actual value.

4.11 Description of the Standard Controller Structure (SR)

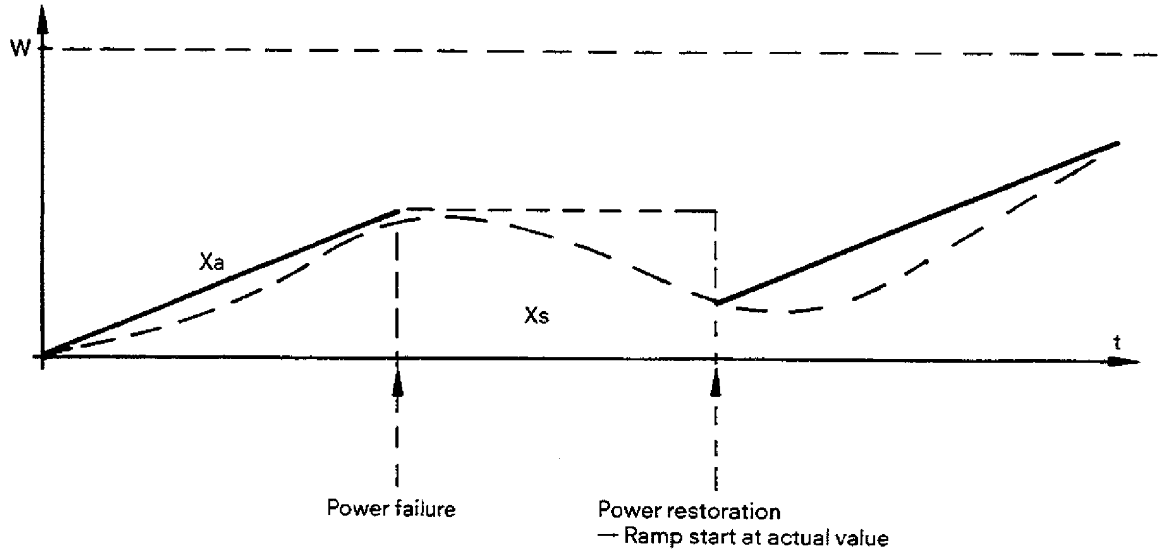


Fig. 4.28 Actual value referencing in the ramp-function generator after power failure

Symbol:

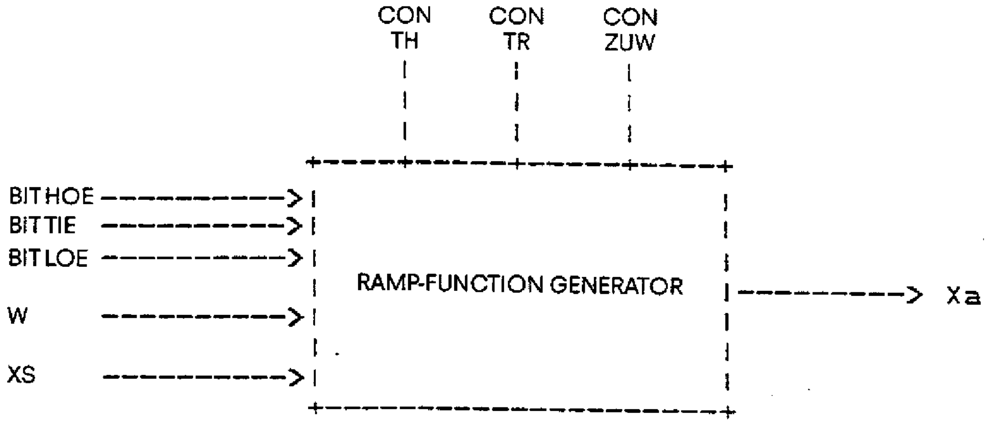


Fig. 4.29 Symbol of the ramp-function generator

Description of the function parameters and binary variables:

Type of variable	Symbol	Description	Number format	Numerical range
Parameter	CON TH CON TR CON ZUW	Positive ramp time Negative ramp time Ordinate of the ramp-function generator value, i. e. the ramp value traversed during the time TH or TR (therefore determines the ramp slope)	Time Time variable-dependent	0.1 ms ... 99h 59min 0.1 ms ... 99h 59min 0 ... +100%
Binary input signals	BIT HOE BIT TIE BIT LOE	"Higher" bit, BH = 1 causes positive ramp "Lower" bit, BT = 1 causes negative ramp Reset bit, BL = 1 causes matching of the ramp value to the setpoint if the HOE and TIE bits are set.	Bit Bit Bit	0/1 0/1 0/1

Description of the parameters:

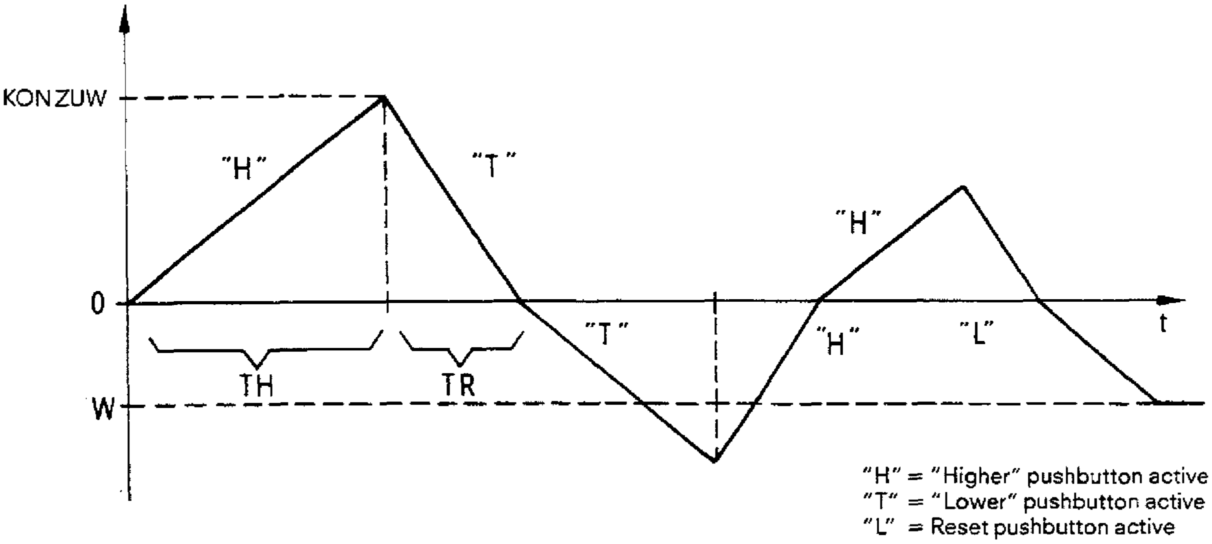

KON ZUW
0
W
"H"
"T"
"H"
"T"
"H"
"L"
TH
TR
t
"H" = "Higher" pushbutton active
"T" = "Lower" pushbutton active
"L" = Reset pushbutton active

Fig. 4.30 Relationship between the ramp-function generator user parameters TH, TR, ZUW and the effect of the "higher" and "lower" pushbuttons.

Description of the function input and output variables:

Type of variable	Symbol	Description	Number format	Value range
Input variables	W	Current setpoint	variable-dependent	−100% ... +100%
	XS	Current actual value	variable-dependent	−100% ... +100%
Output variable	Xa	Output value (ramp value)	variable-dependent	−100% ... +100%

4.11.7.8 Filter

Function description:

For filtering an analog variable Xe, a first-order delay stage **(VZ1 stage)** is available with the transfer function:

$$\frac{Xa\,(s)}{Xw\,(s)} = \frac{1}{1 + TVZ \cdot s}$$

Procedure:
In order to implement a discrete filter, the time domain representation is transferred into integral notation

$$Xa\,(t) + TVZ \cdot Xa\,(t) = Xe\,(t)$$

$$\int_0^t XA(v)\,dv + TVZ \cdot Xa = \int_0^t Xe\,(v)\,dv.$$

If the trapezoidal approximation is used for both integrals t = k·TA and t = (k−1)TA and the resulting two equations are subtracted from one another, then the solution for output variable Xak gives the following equation at the sampling time t = k·TA:

$$Xak = \frac{2 \cdot TVZ - TA}{2 \cdot TVZ + TA}\,Xak\,1 + \frac{TA}{2 \cdot TVZ + TA}\,(Xek + Xek\,1).$$

One arrives at the same result, when s = (2/TA) (z−1)/(z+1) is substituted into the complex transfer function and the inverse z-transformation is carried out.
If one uses the less accurate rectangle approximation for integrating Xe, then one obtains the same basic iterative equation used in FB 97 in Catalog ST 56.

$$Xak = \underbrace{\frac{2 \cdot TVZ - TA}{2 \cdot TVZ + TA}}_{KG}\,(Xak1 - Xek1) + Xek1.$$

This form which only requires one block parameter is also used here in order to prevent the dead time in the Xe sampling, with the following modification:

$$\boxed{Xak = KG\,(Xak1 - Xek) + Xek}$$

Symbol:

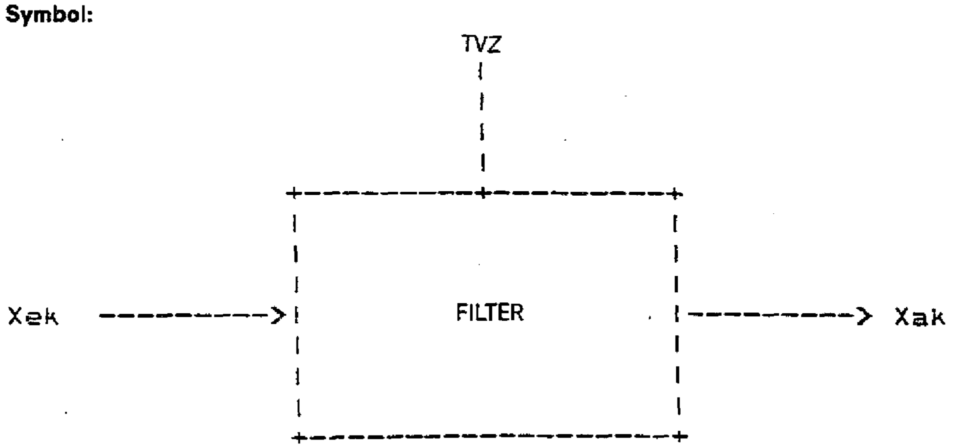


Fig. 4.31 Symbol of the smoothing

Description of the function parameters:

Type of variable	Symbol	Description	Number format	Numerical range
Parameter	TVZ	Filter time constant	Time	4 ms ... 99h 59min

Description of the function input and output variables:

Type of variable	Symbol	Description	Number format	Numerical range
Input variable	Xek	Function input variable to be filtered	variable-dependent	–100% ... +100%
Output variable	Xak	Filtered function output variable	variable-dependent	–100% ... +100%

in addition the following variables are present in the block, which however cannot be accessed by the user:

*** Parameter:** KG = (2*TVZ–TA) / (2*TVZ+TA)
= smoothing factor,
TVZ = filter time constant,
TA = sampling time

*** Previous values:** Xak1 Previous output value
((k–1) th sampling value)

4.11.6.9 PID controller

Function description:

The equation for the relationship between the control deviation x_w (t) and the manipulated variable y(t) of the continuous PID controller in the time domain is given by:

$$y = Kp\,(x_w + 1/TN \cdot \int_0^t x_w\,(v)dv + TV \cdot x_w),$$

This equation is emulated by a quasi-continuous PID controller where a manipulated variable increment dYk is calculated from the control deviation XWk using the PID velocity algorithm. The manipulated variable Yk is output as the sum of the previously generated increments.
The switch-over between various operating modes is carried out via binary signals B1 – B7.

Procedure:

A parallel structure is implemented (see Fig. 4.32) where the factor R, the integral-action time TN and the derivative-action time TV can be adjusted separately. In addition the proportional factor of Kp can be entered as a parameter which influences all 3 parallel branches.

PID velocity algorithm (with trapezoidal integration):

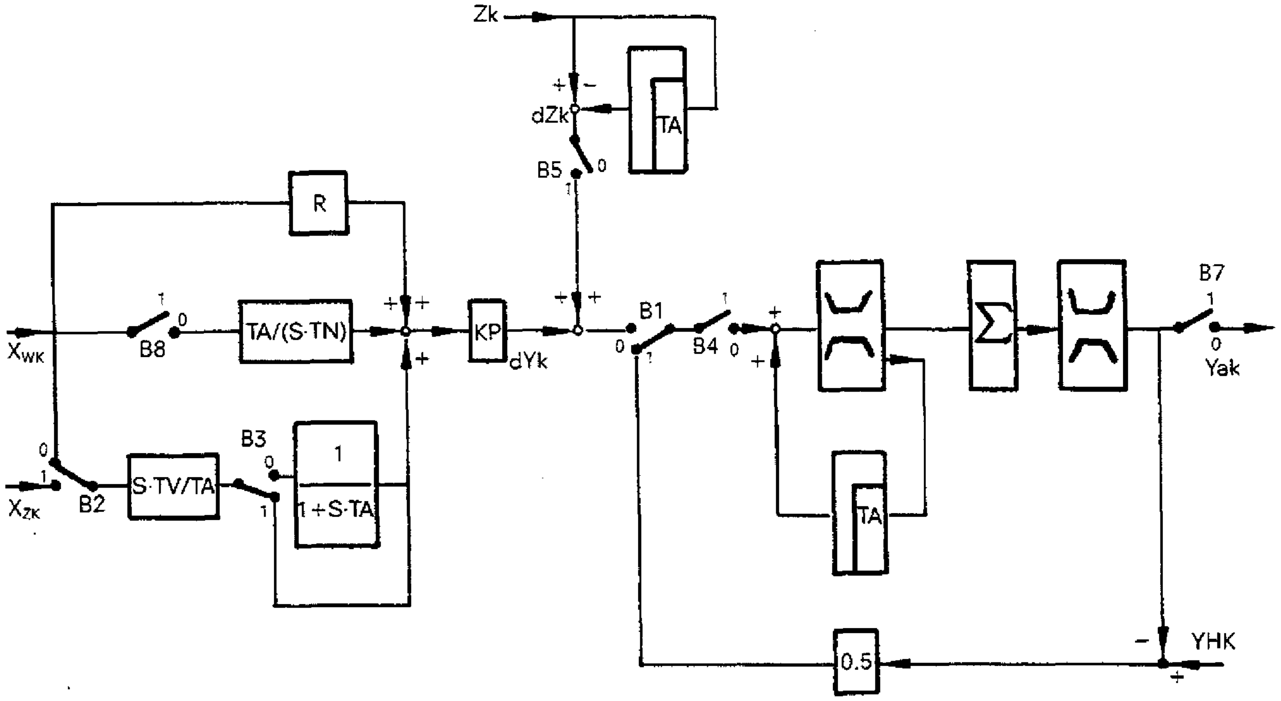
$$\boxed{dYk = Kp \cdot [\,R \cdot (XWk - XWk\,1) + (XWk + XWk\,1) \cdot TA/(TN \cdot 2) + Dk\,]}$$

where

$$Dk = 0.5 \cdot [\,TV/TA \cdot \quad (XWk - XWk\,1) - (XWk\,1 - XWk\,2) \quad + Dk\,1\,].$$

Here Kp, TN, TV are the actual PID controller parameters. The trapezoidal integration was selected since it gives a more exact representation of the continuous integration when used in a PI controller.
To switch off one of the controller branches the corresponding parameter (R, TN, TV) is set to zero. Setting **TN = 0** causes the **I component to be switched off** which is not explicit in the quotient TA/TN.

4.11 Description of the Standard Controller Structure (SR)



PID controller

(HA)	B1	: 1 = Automatic, 0 = manual operation
(S 1.2.3)	B2	: 1 = Separate D input, 0 = XWk as D input
(BIT IR)	B3	: 1 = Ideal, 0 = real PID controller
(BIT ST)	B4	: 1 = Hold m. v. constant, 0 = not constant
(S 1.2.2)	B5	: 1 = Disturbance variable modulation, 0 = none
(ST2)	B6	: 1 = Standard version, 0 = extended version (not marked here)
(BIT RF)	B7	: 1 = Controller disabled, 0 = enabled
	B8	: 1 = Switch for prevention of integral wind up (only used by program)

XWk	: Control deviation
XZk	: Separate D input
Zk	: Disturbance variable
dYk	: Calculated m. v. increment
Yk	: Output m. v.
YHk	: Manual input
TA	: Sampling time

Fig. 4.32 Structure of the PID controller

Fig. 4.32 shows the structure of the PID controller with the switch-over options for the operating modes which are described in detail below.
Basically one can choose between a **standard version** (ST2 = 1) and an **extended version** (ST2 = 0) of the controller. The simpler standard version has the following differences over the more general extended version:

- R = 1 (not a parameter, i. e. the P component cannot be switched off)
- A+ and A− not parameters, i. e. rate of change of manipulated variable limiting is not possible
- S 1.2.3 = 0, i. e. no separate D input XZk
- BIT IR = 0, i. e. D component is always delayed
- BIT ST = 0, i. e. the manipulated variable cannot be held constant
- S 1.2.2 = 0, i. e. no disturbance variable compensation is possible

The upgraded version of the controller has the following functions:

- One can switch over to **manual operation** (signal HA). The manipulated variable is then matched to the adjusted manual value YHk according to an exponential function.
- The input for the D component can be selected from either the control deviation XWk or a **separate input variable** XZk (signal S1.2.3).
- The D component can be calculated with or without **delay** (signal BIT IR) corresponding to a real or ideal PID controller.
- The m. v. increment can be set to zero independently of the control difference so that the **manipulated variable** is held **constant**. This is used e. g. for the opening up of a cascaded control loop (signal BIT ST).
- In order to compensate for a measurable interference signal Zk as early as possible, the interference signal can be added as an increment dZK to the calculated manipulated variable increment for **disturbance variable compensation** (signal S1.2.2). The measured interference signal must be inverted before being input to the controller, otherwise, without inversion, it would be added to the manipulated variable.
- During **operating mode switch-overs** no unpredictable manipulated variable jumps can occur due to the precautions which have been taken in the program and the internal velocity algorithm used, especially in the case of manual/automatic switch-overs. A control difference set during manual operation will only be controlled to zero by the I component after switching over to automatic.
  In a controller without an I component, however, a control deviation set during manual operation is retained after switching over to automatic operation.
- The rate of change of the manipulated variable, i. e. the manipulated variable increment, can be limited with A+ and A– which is useful for a slow actuator. The portion cut off by the **limiting** is stored and to prevent any information from being lost is added to the value at the next sampling period. The resulting increment is then again subject to limiting.
- The manipulated variable can also be limited using the parameters B+ and B–.
- When the manipulated variable limit is reached, the I component is switched off to **prevent integrator wind up**.
- If the manipulated variable crosses the limit, the **overflow bit** UE+ or UE– is set.
- BIT RF represents a **controller enable signal**. If this signal is 0, then the manipulated variable is output as zero, regardless of the state of the controller inputs. If the signal becomes 1, then the controller reacts with a manipulated variable jump at the output (caused mainly by the D and P components) corresponding to the instantaneous control difference, as if a setpoint jump had occurred at the input.
  This allows the controller to be enabled and disabled on-line.

Symbol:

```
                        Parameter and control bits

                     I   I   I   I           I   I   I   I
                     I   I   I   I   : : :   I   I   I   I
                     I   I   I   I           I   I   I   I
                   ++--+---+---+---+---+---+---+---+---+-++
XWk  ------------> I                                     I ------------> Yk
                   I                                     I
YHk  ------------> I                                     I
                   I           PID controller            I ------------> UE+
XZk  ------------> I                                     I
                   I                                     I
Zk   ------------> I                                     I ------------> UE-
                   +-------------------------------------+
```

Fig. 4.33 Symbol of the PID controller

4. Programming Instructions

4.11 Description of the Standard Controller Structure (SR)

Description of the function parameters and binary variables:

Type of variable	Symbol	Description	Number format	Numerical range
Parameter	Kp	Proportional constant, the sign determines the direction of control action: + same direction of change in setpoint and m. v. − opposite direction of change	no unit	−99.99 ... +99.99
	R	Separate R factor (usually 1), the P component can be disabled by R=0	no unit	−99.99 ... +99.99
	TN	Integral-action time, the I component can be disabled by TN=0	Time	0.1ms ... 99h 59m
	TV	Derivative-action time, the D component can be disabled by TV=0	Time	0.1ms ... 99h 59m
	B+	Upper limit of output Yk	%	−100% ... +100%
	B−	Lower limit of output Yk (B−<B+)	%	−100% ... +100%
	A+	Upper m. v. rate limit (A+ > 0)	%	0% ... +100%
	A−	Lower m. v. rate limit (A− < 0)	%	−100% ... 0%
Binary control signals	S. 1.2.1	1 = Manual operation 0 = Automatic operation	Bit	0/1
	S 1.2.3	1 = Separate D input 0 = XWk as D input (can only be modified in STOP)	Bit	0/1
	BIT IR	1 = Ideal PID controller, D comp. without delay 0 = Real PID controller, D comp. with delay	Bit	0/1
	BIT ST	1 = Hold m. v. constant independently of the outputs 0 = Do not hold constant	Bit	0/1
	S. 1.2.2	1 = Disturbance variable connected to controller 0 = No disturbance variable	Bit	0/1
	ST2	1 = Standard version 0 = Upgraded version (can only be modified during STOP)	Bit	0/1
	BIT RF	1 = Controller enabled 0 = Controller disabled	Bit	0/1

The parameters TN and TV are converted into the parameters TI = TA / TN and TD = TV / TA; these variables are stored in specific data areas for that block.

Description of the function input and output variables:

Type of variable	Symbol	Description	Number format	Value range
Input variables	XWk	= Wk − Xk = setpoint − actual value = control deviation	variable dependent	−200% ... +200%
	YHk	Manual input. During switch-over from automatic to manual, the m. v. is matched according to an exponential function. This prevents step changes in the m. v.	%	−100% ... +100%
	XZk	Separate D variable input	variable dependent	−100% ... +100%
	Zk	Disturbance variable input	%	−100% ... +100%
Output variables	Yk	M. v. output	%	−100% ... +100%
Binary output variables	UE+	1 = Indication positive limit reached	Bit	0/1
	UE−	1 = Indication negative limit reached	Bit	0/1

4.11.6.10 "On" – "Off" output

Function description:

A pulse generator stage with "on" – "off" characteristic for converting a calculated quasi-continuous control signal Yk into binary output signals for **2 or 3-step** controllers is implemented.

The manipulated variable is set to +100% (for 2-step output) or +100% or −100% (for 3-step output) only for the part of the sampling time corresponding to the calculated manipulated variable $|Yk| \leq 100\%$. As for the pulse generator stage of the step controller the pulse duration cannot be less than the minimum duration Tmin. Therefore the following equation also applies here:

$TA = n \cdot Tmin, n = 1, 2, 3, \ldots$.

Procedure:

The function input variable is the value calculated by the PID algorithm and limited to ± 100% i. e. the **manipulated variable** Yk.

During the first call of the "on" – "off" output function when the manipulated variable Yk is calculated, it is first compared with the **threshold value** ASW = 0%, ..., 50%:

* If $|Yk| < ASW$, no pulse is generated.
* If $|Yk| > 100\% - ASW$, a pulse of the maximum length TA is generated, i. e. the number of individual pulses is TA/Tmin.
* If the range $ASW \leq |Yk| \leq 100\% - ASW$, a total pulse duration (proportional to the m. v. Yk) or number of individual pulses of minimum pulse duration Tmin is given by:

$$ANZ = Yk \cdot TA/Tmin$$

as in the "Step controller" (TA instead of TM) function.

A negative value of ANZ always means negative pulses, which however can only be output with a three-step output stage.

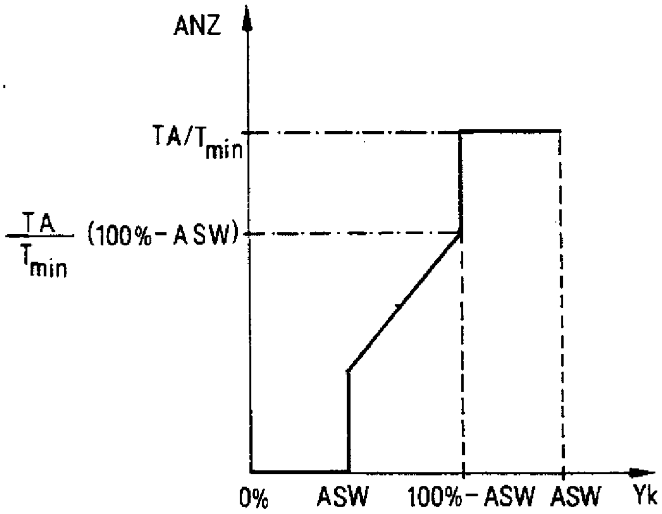


Fig. 4.34 Influence of the threshold value ASW on the number of pulses ANZ for a manipulated variable Yk

If only a two-step output is configured this means that only one analog output (DAC) is used, which is assigned to the positive pulse. In this case the heating can only be switched on (DAC1 = 10V) or off (DAC1 = 0V).
With a three-step output however, again in the case of temperature control, 3 control states can be implemented:

-DAC 1 = 0V, DAC 2 = 0V ==> OFF
-DAC 1 = 10V, DAC 2 = 0V ==> HEAT
-DAC 1 = 0V, DAC 2 = 10V ==> COOL

In order to prevent possible stronger control interventions on the cooling side as compared to the heating, a heat/cool factor or general **matching factor** APF = 0, ..., 99.99 can be used in the three-step controller.
Consider an example where 10 seconds of heating increases the temperature by 2 degrees whereas 10 seconds of cooling reduces the temperature by 4 degrees. Therefore the heating effect is only half as powerful as the cooling. Due to the matching factor APF = 0.5, the analog output assigned to the cooling is only set to 1 for a period half as long as originally determined by the value ANZ.

Please note the threshold value for the cooling output must be reduced by the same factor!

4.11 Description of the Standard Controller Structure (SR)

Generalization:

By definition, the matching factor refers to the analog output DAC2. If the value range of APF is extended to values >1, in order to include the possibility of larger control interventions for heating as compared to cooling for example, then the effect of the matching factor APF > 0 is defined as follows:

* **APF < 1:** The total pulse duration determined by ANZ at the output DAC2 is shortened by the factor APF.
* **APF > 1:** The total pulse duration determined by ANZ at the binary output DAC1 is shortened by the factor 1/APF.

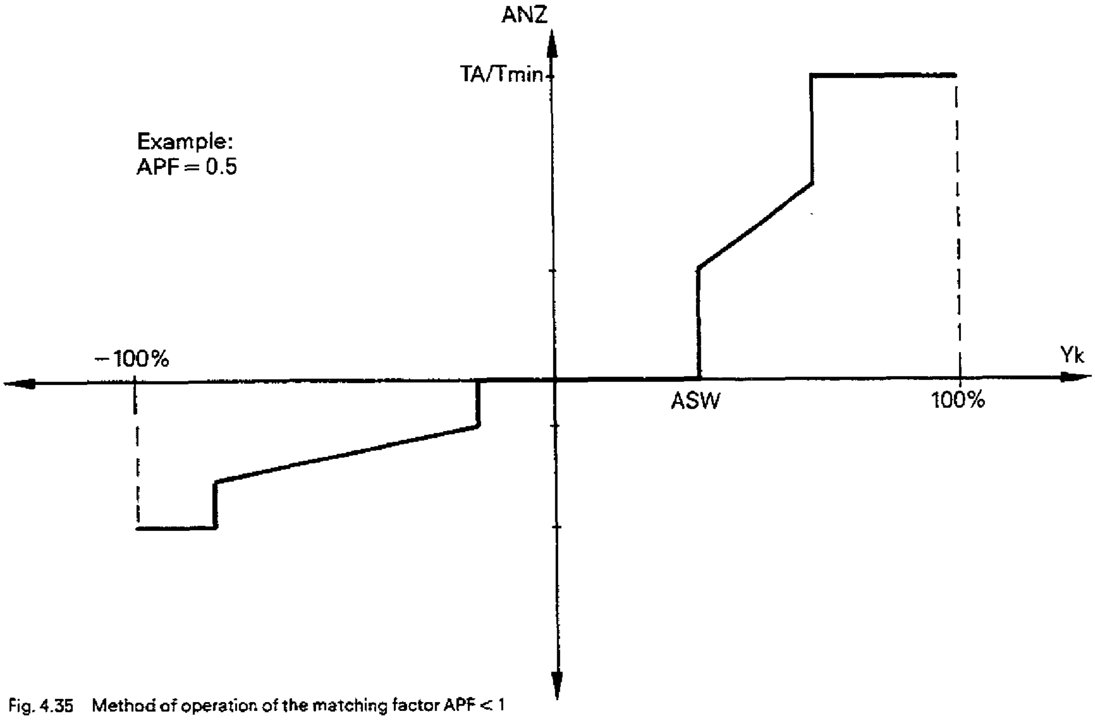


Fig. 4.35 Method of operation of the matching factor APF < 1

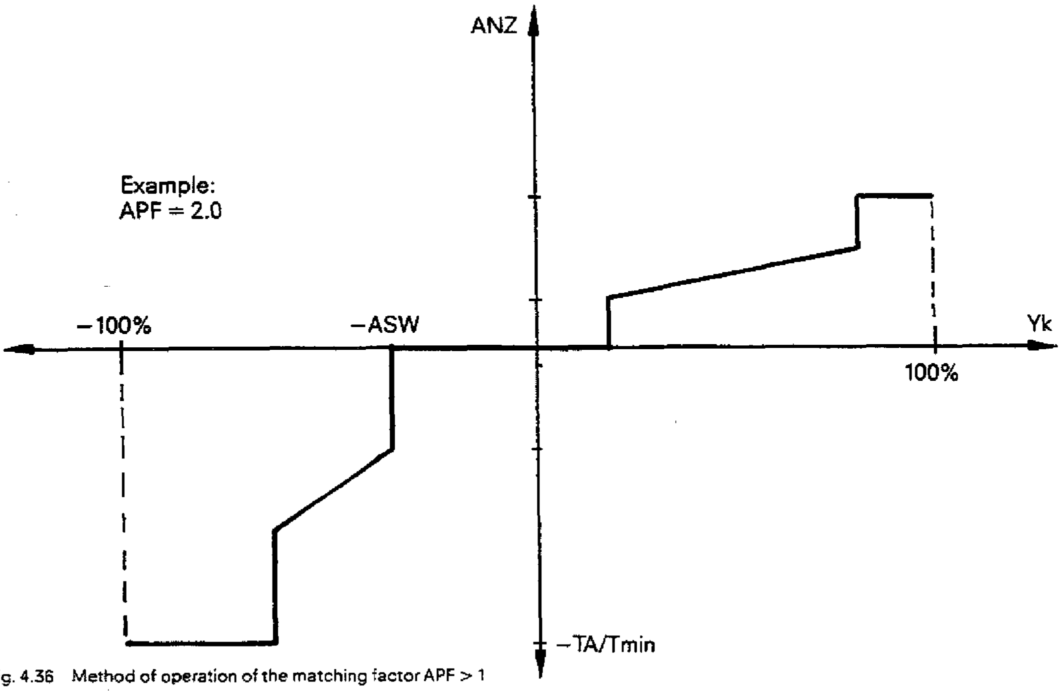


Fig. 4.36 Method of operation of the matching factor APF > 1

After the value ANZ is calculated during the first execution of the block, it is then only evaluated and, if required, updated during subsequent executions of the block till the next execution of the controller. The analog outputs DAC1 and DAC2 are set according to the current value of ANZ.

Notes:

- A value (e. g. remainder after updating) I ANZ I < 1 is lost.
- In contrast to the step controller, a controller with "on" – "off" output generates pulses during the steady state of the manipulated variable Yk.

Symbol:

```
                     S 1.4.1     ASW      APF
                        I         I        I
                        I         I        I
                        I         I        I
                   +----+---------+--------+----+
                   I                            I
                   I                            I
                   I                            I---------> DAC 1
Yk      ---------> I    "ON" - "OFF" OUTPUT     I
                   I                            I---------> DAC 2
                   I                            I
                   I                            I
                   +----------------------------+
```

Fig. 4.37 Symbol of the "on" – "off" output

Description of the function parameters:

Type of variable	Symbol	Description	Number format	Numerical range
Parameter	ASW	Threshold value (0%, ..., 50%) * No control pulse for IYkI < ASW * Control pulse of a maximum duration TA for IYkI > 100% – ASW	%	0% ... 50%
	APF	Matching factor: takes into account different intervention of the two binary outputs	no unit	0 ... 99.99

Description of the function input and output variables:

Type of variable	Symbol	Description	Number format	Value range
Input variable	Yk	M. v. output of PID controller module	%	–200% ... +200%
Output variable	DAC 1 DAC 2	Positive pulse Negative pulse	% %	0% / 100% 0% / 100%
Binary input variable	S 1.4.1	= 0 : two-step output = 1 : three-step output	Bit	0/1

In addition, the following variable is present in the function, but not accessible to the user:

ANZ At function start: the number of pulses to be output with duration Tmin is calculated during the first execution. At the end of the function: number of pulses not yet output.

Note:
The minimum pulse duration T_{min} can only be changed in the "Input" and "Output" operating modes, **not in the controller test.**

4.11.6.11 Step controller

Function description:

The step controller is a digital controller with three-step action, which only operates in the plants with **motorized integral actuators** (e. g. vanes, flaps and other positioning equipment).

The step controller constructed using analog components such as a three-step stage with hysteresis and delayed feedback is implemented here as a series circuit of three function blocks:

* Dead band with hysteresis, * PID velocity algorithm * Pulse generator stage	} step controller

Procedure:

The control difference XWek goes first through a **dead band stage with hysteresis,** in order to filter out small control deviations and to protect the actuator. A positive or negative analog value XWek can be suppressed in a symmetrical predefined range around the zero point.

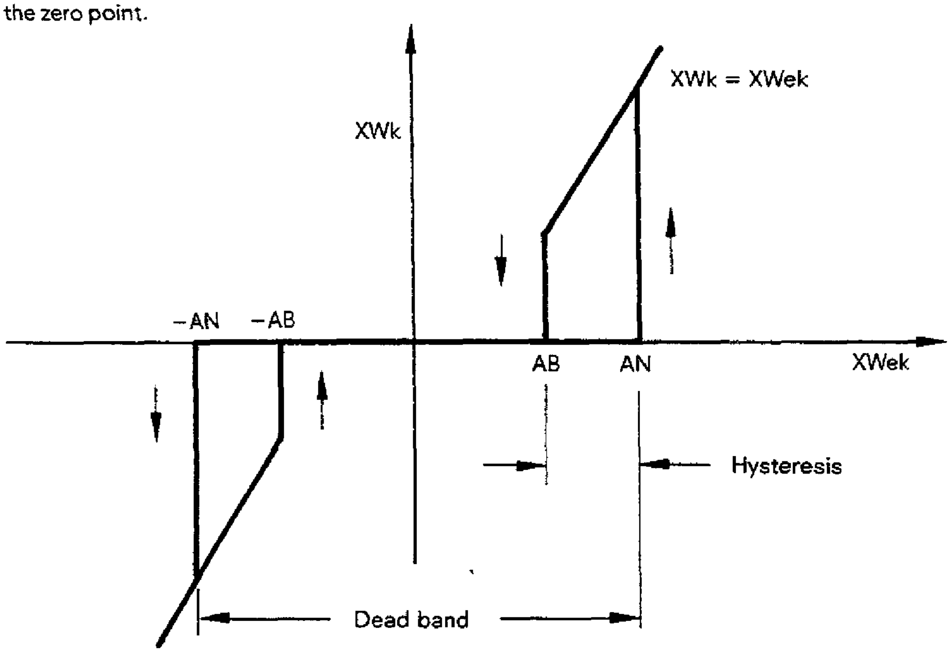


Fig. 4.38 Dead band with hysteresis

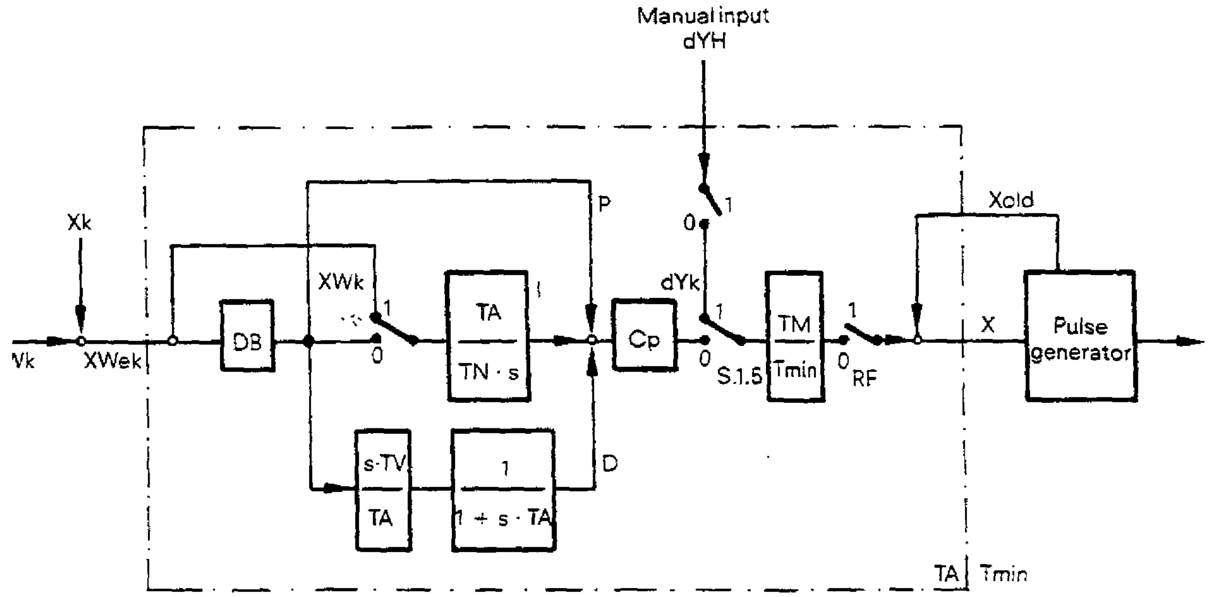
The limits at which the output value XWk is set to 0 or equal to the input value XWek (hysteresis) can be selected with the parameters AN and AB.

A manipulated value increment dYk is calculated from the output variable XWk of the dead band stage using the **PID velocity algorithm:**

$$\boxed{dYk = K_p \cdot [(XWk - XWk\,1) + (XWk + XWk\,1) \cdot TA/\,(2 \cdot TN) + Dk\,]}$$

where

$$Dk = 0.5 \cdot [\,TV/TA \cdot \quad (XWk - XWk\,1) - (XWk\,1 - XWk\,2) \quad + Dk\,1\,].$$



STEP CONTROLLER

Cp	= Proportional constant, TN = integral-action time, TV = derivative time
TA	= Controller sampling time, Tmin = minimum pulse duration
TM	= Actuator positioning time
Wk	= Setpoint, Xk = actual value
XWk	= Control deviation after dead band, XWek: before dead band
X	= Number of single pulses of duration Tmin to be output
S 1.5.1	= Automatic operation (= 0), manual operation (= 1)
BITRF	= Controller enabled (= 1), disabled (= 0)
BITTOT	= Dead band active for I comp. (= 0), inactive (= 1)
BITHAI	= Manual input active (= 1), inactive (= 0)

Fig. 4.39 Structure of the step controller

Here Kp, TN, TV are the control parameters of the PID algorithm. Normally TV = 0 is selected as a parameter, i. e. only a PI algorithm is selected, since a step controller is normally only used in slow plants with slow acting actuators.

In the **pulse generator**, the pulse duration proportional to the size of the manipulated variable increment dYk is calculated and transformed into a corresponding number of binary control signals + 1 (clockwise rotation), − 1 (anticlockwise rotation) or 0 (standstill) for controlling the actuator drive.
The relationship between the pulse duration Tk and the manipulated variable increment dYk is given in Fig. 4.40:

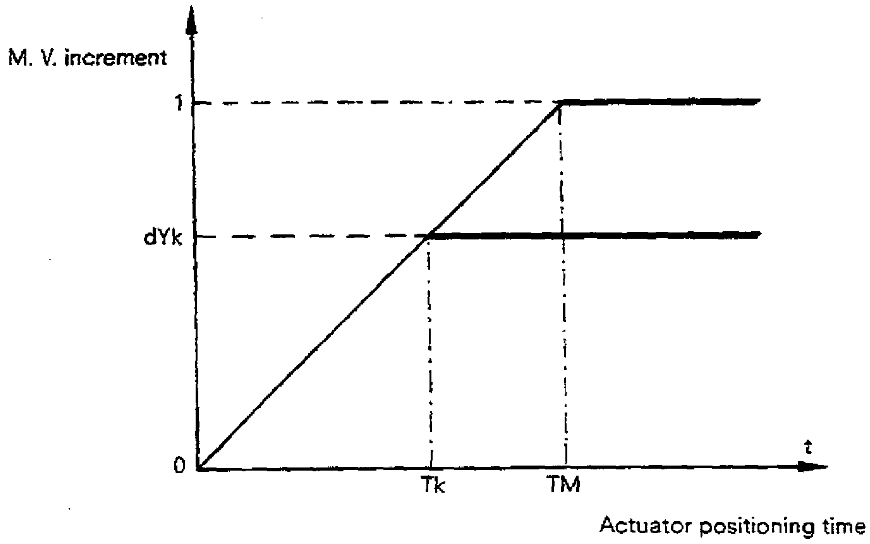


Fig. 4.40 Response of an actuator drive to a pulse of amplitude 1 and duration Tk or TM

4.11 Description of the Standard Controller Structure (SR)

The pulse duration Tk assigned to a manipulated variable increment dYk is therefore given by

$$Tk = TM \cdot dYk .$$

In order to limit the switching frequency, a minimum pulse duration Tmin must be specified. In this way the pulse length Tk can be represented as a multiple of the minimum pulse duration Tmin:

$$Tk = X \cdot Tmin .$$

The number of individual pulses of length Tmin to be output as a result of a calculated manipulated variable increment dYk is therefore

$$\boxed{X = (TM/Tmin) \cdot dYk} .$$

Since there is a possibility that all X pulses cannot be cutput during the time TA (sampling time of the PID algorithm), the value X calculated at the time k·TA must be added to the remaining value X.
The new value X is then transmitted to the pulse generator stage.

For |X| < 1 the minimum pulse duration Tmin is not reached, therefore no pulses are output.
For |X| ≥ 1 the pulse generator stage outputs a pulse of length Tmin each time it is called and decrements the magnitude of X by 1 until |X| < 1.

After switching over from automatic to manual (switch S1.5.1), a manual value dYH can be entered via a **manual input.** A number of control pulses corresponding to this manual value is calculated per sampling period, which is then processed further during automatic operation of the pulse generator. The manual value is actually only operational if HAI is set (manual input active). With the help of this bit however it is possible to bring an actuator under manual operation to a predefined position (without the bit HAI the actuator would travel into the limits without stopping for a fixed manual value <> 0).

Precautions have been taken which prevent longer pulses being generated when switching over to automatic operation. A control deviation set under manual operation is therefore only controlled to zero via the I component.

In automatic operation it is also possible to make the dead band inactive for the I component using the software switch TOT, i. e. to calculate the I component with the actual control deviation XWek.

Bit RF represents the **controller enable signal.** If this signal is 0, then no pulses are output regardless of the state of the controller input. If the signal is set to 1 then the controller reacts with a number of pulses which corresponds to the current control deviation. In this way the controller can be enabled and disabeld on-line.

Symbol:

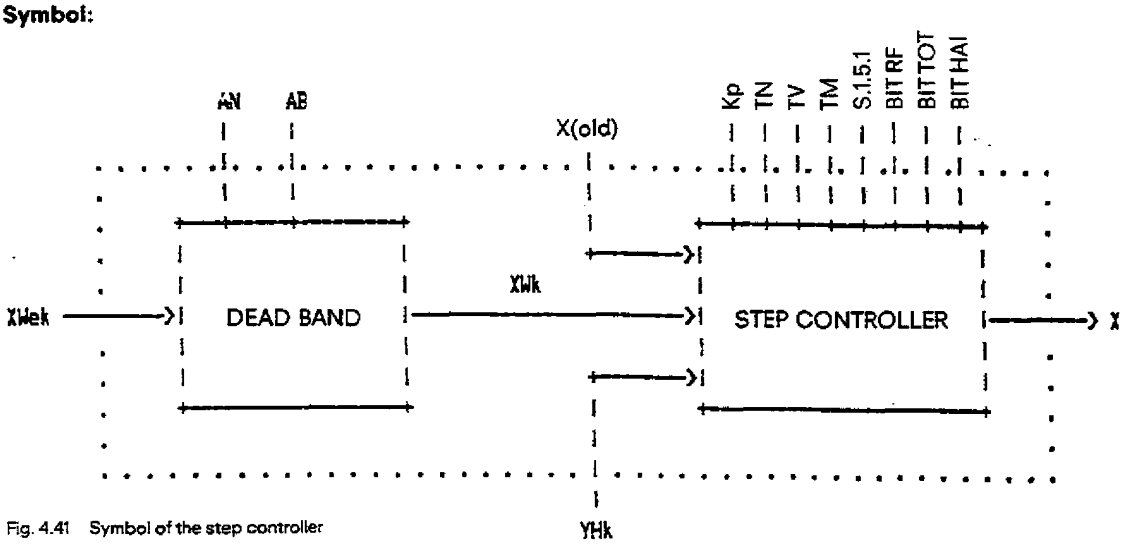


Fig. 4.41 Symbol of the step controller

Note:
The minimum pulse duration T_{min} can only be changed in the "Input" and "Output" modes, **not in the controller test.**

Description of the function parameters and binary input variables:

Type of variable	Symbol	Description	Number format	Numerical range
Parameter	Kp	Proportional constant; the sign determines the direction of control action: + same direction of change in setpoint and m. v. – opposite direction of change in setpoint and m. v.	no unit	–99.99 ... +99.99
	TN	Integral-action time; the I component can be disabled by TN = 0	Time	0.1 ms ... 99h 59m
	TV	Derivative-action time; the I component can be disabled by TV = 0	Time	0.1 ms ... 99h 59m
	TM	Positioning time of integrating final control element e. g. actuator	Time	0.1 ms ... 99h 59m
	AN	Trigger threshold of dead band	variable-dependent	–100% ... +100%
	AB	Release threshold of dead band	variable-dependent	–100% ... +100%
Binary input signals	S.1.5.1	1 = Manual operation, 0 = automatic operation	Bit	0/1
	BITTOT	1 = Dead-band inactive for integral component 0 = Dead-band active for integral component	Bit	0/1
	BITRF	1 = Controller disabled 0 = Controller enabled	Bit	0/1
	BITHAI	1 = Manual value active, 0 = inactive	Bit	0/1

The sampling time TA and the minimum pulse duration Tmin are also required for the step controller. These values however cannot be considered as block parameters, but as global variables of the control loop specified once only which may also be evaluated by the system program.

The user parameters TN and TV are converted into the internal parameters TI = TA/TN and TD = TV/TA.
Similarly Kp is converted into the parameters K = Kp · TM/Tmin. These converted variables are in the data area specific to the block.

Description of the function input and output variables:

Type of variable	Symbol	Description	Number format	Value range
Input variable	XWek	= Wk–Xk = control deviation is generated from the setpoint and actual value before calling up the module	variable-dependent	–200% ... +200%
	XHk	Manual input	%	–100% ... +100%
	X	Initially contains number of pulses of duration Tmin not yet output	no unit	
Output variable	X	At program end contains number of pulses still to be output	no unit	

In addition the following variables are present, which are not accessible to the user:

XWek1	previous control deviation before the dead band
XWk	control deviation after the dead band
XWk1	previous control deviation after the dead band ((k-1) th sampling period)
Dk1	previous D component

4.11.6.12 Pulse generator for the step controller

Function description:

The **pulse generator function** converts the manipulated variable pulse duration (or to be more exact: the number X of pulses of minimum duration Tmin with sign corresponding to the pulse direction) calculated by the step controller function in the k-th sampling period into 2 analog signals for DAC 1 and DAC 2 for controlling an **integral-action actuator:**

* |X| < 1 ==> DAC1 = 0 , DAC2 = 0 ("standstill")

* X ≥ 1 ==> DAC1 = 10V, DAC2 = 0 ("open")

* X < –1 ==> DAC1 = 0 , DAC2 = 10V ("close").

When these signals are output the analog outputs remain set for the time specified by the total pulse duration |X| · Tmin.

One should consider the following:

- The **minimum pulse duration Tmin should be smaller than the sampling period TA** of the control loop in order to achieve maximum control accuracy, where
  TA = n · Tmin, n = 1, 2, 3, ... and thus also Tmin < TA < TM.
  Within the sampling period TA, up to n pulses with the minimum duration Tmin can be output **consecutively.** This means that the pulse generator program is processed within the time TA exactly n times.
- For |X| < 1 the minimum pulse duration Tmin is not yet reached, therefore no pulses are output. The value X however is not lost, it is added in the next sampling period to the new value X.
- For |X| ≥ 1 the pulse generator produces a pulse of duration Tmin at the corresponding output each time it is called and decrements the magnitude of X by 1.
- If the controller program has calculated a total pulse duration |X| · Tmin > TA, then not all X pulses can be output during the sampling period TA. Therefore the number of remaining pulses is stored and is added in the next sampling period to the new value X.
- For active acknowledgement BA = 1 ("final OPEN position reached") the DAC1 output is disabled; similarly for active acknowledgement BZ = 1 ("final CLOSED position reached"), the DAC 2 output is disabled in order to prevent the actuator from being damaged by overdriving. The acknowledgement signal from the PC is transferred to the IP 252 via a standard FB (Section 5).

Example: n = TA/Tmin = 4 , X = 3.7

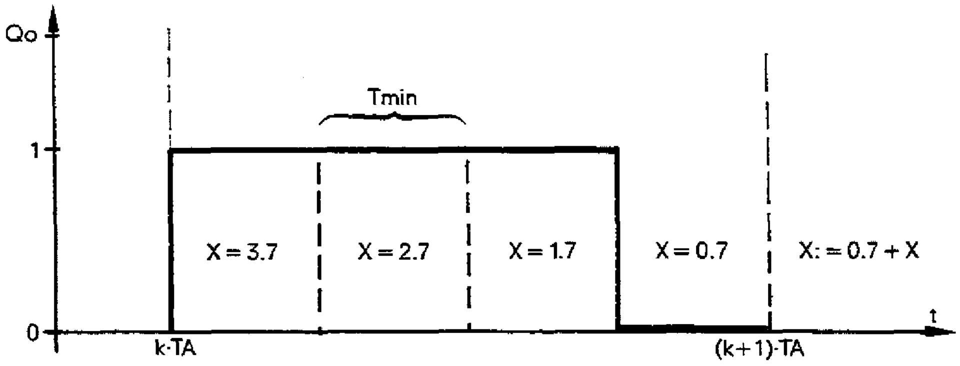


Fig. 4.42 Example of pulse generation

Symbol:

```
             +--------------------+
             |                    |
             |                    |
             |                    |----------> DAC 1
X  ---------->|   PULSE GENERATOR  |
             |                    |----------> DAC 2
BA ---------->|                    |
BZ ---------->|                    |
             +--------------------+
```

Fig. 4.43 Symbol of the pulse generator stage

Description of the function parameters and binary input variables:

Type of variable	Symbol	Description	Number format	Numerical range
Binary input variables	BA	Acknowledgement bit: End position OPEN reached	Bit	0/1
	BZ	Acknowledgement bit: End position CLOSED reached	Bit	0/1

Description of the function input and output variables:

Type of variable	Symbol	Description	Number format	Value range
Input variable	X	Initially contains number of pulses of duration Tmin not yet output	no unit	
Output variables	X	At program end: contains number of pulses still to be output	no unit	
	DAC 1	Positive pulse	%	0% / 100%
	DAC 2	Negative pulse	%	0% / 100%

Note: The following, additional method of operating the step controller manually is **not** illustrated in Figure 4.43:

The puls generator has two additional binary inputs, the "Actuator open" and "Actuator closed" keys. The functions of both keys are transferred via the S5 CPU to the IP 252. Neither of these keys is accessible in the COM REG programmer software or in the standard function block FB:STEU:STD in Section 5.1.2.

In contrast to manual mode with constant manual value (CON HA), the output of the step controller is controlled **direct** here:

BIT 1.5.HAZ = 1 --> Manual mode "Actuator closed"
BIT 1.5.HAA = 1 --> Manual mode "Actuator open"

For this type of manual mode, the following bits must be set:

BIT 1.5.RF = 1 (to controller enable)
BIT 1.5.1 = 1 (to manual mode)
BIT 1.5.HAI = 0 (to manual value "CON HA" non-active).

In section 5.2.3.1 there is a description of the transfer of both "HAZ" and "HAA" keys from the STEP 5 program in the CPU to the IP 252.

4.11.7 Data block of the standard controller (SR)

The data block contains all the data of the **SR** controller structure. If the contents of these data words have to be read or overwritten by the CPU, these internal IP 252 data can be accessed with the help of data handling blocks (Section 5.2).

```
                                                                                                      Data
                                                                                                      word
                                                                                                     address
                                                                                                        |
          15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0        V
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |        Additional code (for PG and IP  252)   (STANDARD 102)                                  |  DW  0
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |        Version number                                                                         |  DW  1
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+--------
   ^    |        Status flag word                                                                       |  DW  2
   |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 BESY-  |        Error word                                                                       | AZF |  DW  3
 CODES  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   |    |        Error form word                                                                  | MAZF|  DW  4
   |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   |    |      ( still free )                                                                           |  DW  5
   |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   |    |      ( still free )                                                                           |  DW  6
   |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   v    |        B/B flag display word                                                                  |  DW  7
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+--------
        |        Sampling time TA in 2.5 ms units (for RAV)            (HW)                             |  DW  8
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |      ( 32 bits fixed-point)                                  (LW)                             |  DW  9
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |        Sampling time TA (16 bits fixed-point)                                                 |  DW 10
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |        Time format code for TA                                                                |  DW 11
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |      Minimum pulse duration Tmin in 2.5 ms units (vor RAV)   (HW)                             |  DW 12
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |      ( 32-bit-Festpunkt )                                    (LW)                             |  DW 13
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |        Minimum pulse duration Tmin (16 bits fixed-point)                                      |  DW 14
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |        Time format code for Tmin                                                              |  DW 15
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |        Multiplier for IP 252 (16 bit fixed-point)                                             |  DW 16
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+--------
   ^    |      6 bytes ASCII string                                                                     |  DW 17
   D    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    |              for the selectable phys. unit                                                    |  DW 18
   M    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   E    |                      of the standard controller                                               |  DW 19
   N    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   S    |      Minimum range (0% value)           (with unit)                                           |  DW 20
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   O    |      Maximum range (= 100% value)       (with unit)                                           |  DW 21
   N    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   v    |      Decimal point code (= number of decimal places)                                          |  DW 22
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+--------
```

```
                                                                                        Data
                                                                                        word
                                                                                       address
                                                                                          |
                                                                                          |
          15   14   13   12   11   10    9    8    7    6    5    4    3    2    1    0     V
-------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
Config-|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  DW  23
 uring +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
switches|                                     |    |    |    |    |    |    |    |    |  DW  24
-------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+--------
   ^   |       Number N (= 1-10) of the equidistant interpolation points of the polygon (w/o unit)  |  DW  25
   |   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   |   |       Abscissa value X1 of the 1st interpolation point      (w. unit)          |  DW  26
   |   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   |   |       Interval DX between neighbouring interpolation points  (w. unit)          |  DW  27
   |   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   |   |       Ordinate value F1 of the 1st interpolation point      (w. unit)          |  DW  28
   |   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   P   |       Ordinate value F2 of the 2nd interpolation point      (w. unit)          |  DW  29
   O   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   L   |       Ordinate value F3 of the 3rd interpolation point      (w. unit)          |  DW  30
   Y   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   G   |       Ordinate value F4 of the 4th interpolation point      (w. unit)          |  DW  31
   O   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   N   |       Ordinate value F5 of the 5th interpolation point      (w. unit)          |  DW  32
   Z   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   U   |       Ordinate value F6 of the 6th interpolation point      (w. unit)          |  DW  33
   G   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   |   |       Ordinate value F7 of the 7th interpolation point      (w. unit)          |  DW  34
   |   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   |   |       Ordinate vlaue F8 of the 8th interpolation point      (w. unit)          |  DW  35
   |   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   |   |       Ordinate value F9 of the 9th interpolation point      (w. unit)          |  DW  36
   |   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   V   |       Ordinate value F10 of the 10th interpolation point    (w. unit)          |  DW  37
-------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+--------
   ^   |       Number NSW (=1-10) of the setpoints of the submodule 'set point sequence' (w/o unit) |  DW  38
   |   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   |   |      Interval time TINT                                                        |  DW  39
   |   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   |   |      Time format code for TINT                                                 |  DW  40
   |   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   |   |      1. Setpoint  SW1             (w. unit)                                    |  DW  41
   |   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   |   |      2. Setpoint  SW2             (w. unit)                                    |  DW  42
   S   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   E   |      3. Setpoint  SW3             (w. unit)                                    |  DW  43
   T   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   P   |      4. Setpoint  SW4             (w. unit)                                    |  DW  44
   O   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   I   |      5. Setpoint  SW5             (w. unit)                                    |  DW  45
   N   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   T   |      6. Setpoint  SW6             (w. unit)                                    |  DW  46
   |   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   |   |      7. Setpoint  SW7             (w. unit)                                    |  DW  47
   |   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
                                                                                              Data
                                                                                              word
                                                                                              address
                                                                                                 |
         15    14    13    12    11    10    9     8     7     6     5     4     3     2     1     0       v
  |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  |    |     8. Setpoint  SW8               (w. unit)                                                  | DW  48
  |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  |    |     9. Setpoint  SW9               (w. unit)                                                  | DW  49
  |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  v    |    10. Setpoint SW10               (w. unit)                                                  | DW  50
-------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+--------
  ^    |     Ramp-up time TH of the ramp generators                                                    | DW  51
  |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 RAMP  |     Time format code for TH                                                                   | DW  52
GENER- +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 ATOR  |     Ramp-down time TR of the ramp generator                                                   | DW  53
  |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  |    |     Time format code for TR                                                                   | DW  54
  |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  v    |     CON ZUW (ordinates after ramp-up time is out, with unit)                                  | DW  55
-------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+--------
 FIL-  |      Filter time constant TVZ                                                                 | DW  56
 TER   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  |    |     Time format code for TVZ                                                                  | DW  57
-------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+--------
  PK   |     Max. permissible difference dXzul of the validity check (w. unit))                        | DW  58
-------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+--------
  ^    |     Number N1 of limit values of the 1st limit monitor      (w/o unit)                        | DW  59
  |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  |    |     1st limit value of the 1st limit monitor (w. unit or %)                                   | DW  60
       +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  1.   |     2nd limit value of the 1st limit monitor (w. unit or %)                                   | DW  61
LIMIT  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
MONI-  |     3rd limit value of the 1st limit monitor (w. unit or %)                                   | DW  62
 TOR   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       |     4th limit value of the 1st limit monitor (w. unit or %)                                   | DW  63
  |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  |    |     5th limit value of the 1st limit monitor (w. unit or %)                                   | DW  64
  |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  v    |     6th limit value of the 1st limit monitor (w. unit or %)                                   | DW  65
-------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+--------
  ^    |     Number N2 of limit values of the 2nd limit monitor (w/o unit)                             | DW  66
  |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  |    |     1st limit value of the 2nd limit monitor (w. unit or %)                                   | DW  67
  |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       |     2nd limit value of the 2nd limit monitor (w. unit or %)                                   | DW  68
  2.   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
LIMIT  |     3rd limit value of the 2nd limit monitor (w. unit or %)                                   | DW  69
MONI-  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 TOR   |     4th limit value of the 2nd limit monitor (w. unit or %)                                   | DW  70
  |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  |    |     5th limit value of the 2nd limit monitor (w. unit or %)                                   | DW  71
  |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  v    |     6th limit value of the 2nd limit monitor (w. unit or %)                                   | DW  72
-------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+--------
  ^    |     Proportional coefficient KP of the PID controller  (w/o unit)                             | DW  73
  |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                                                                                      Data
                                                                                                      word
                                                                                                      address
                                                                                                        |
       15    14    13    12    11    10    9     8     7     6     5     4     3     2     1     0      V
 |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 |     |     Separate selectable gain R of the P component (for extended version) (without unit)   | DW 74
 P     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 I     |     Integral action time TN of the PID controller                                         | DW 75
 D     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       |     Time format code for TN                                                               | DW 76
 C     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 O     |     Derivative action time TV of the PID controller                                       | DW 77
 N     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 T     |     Time format code for TV                                                               | DW 78
 R     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 O     |     Upper manipulated variable limit B+       (%)                                         | DW 79
 L     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 L     |     Lower manipulated variable limit B-       (%)                                         | DW 80
 E     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 R     |     Upper manipulated speed limit A+          (%)                                         | DW 81
 |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 v     |     Lower manipulated variable limit A-       (%)                                         | DW 82
-------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-------
 ^     |     Proportional coefficient KP of the step controller         (without unit)             | DW 83
 S     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 T     |     Integral action time TN of the step controller                                        | DW 84
 E     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 P     |     Time format code for TN                                                               | DW 85
       +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 C     |     Derivative action time TV of the step controller                                      | DW 86
 O     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 N     |     Time format code for TV                                                               | DW 87
 T     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 R     |     Final control element operating time TM                                               | DW 88
 O     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 L     |     Time format code for TM                                                               | DW 89
 L     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 E     |     Upper response threshold AN of the step controller dead zone        (w. unit)         | DW 90
 R     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 v     |     Lower response threshold AB of the step controller dead zone        (w. unit)         | DW 91
-------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-------
PULSE  |     Upper response threshold ASW of the pulse-pause output          (%)                   | DW 92
PAUSE  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
OUTPUT |     Interface factor APF of the pulse-pause output   (w/o unit)                           | DW 93
-------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-------
 ^     |     Start-up value of the actual value branch      (w. unit)                              | DW 94
 |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       |     PG value of the manual input for PID or step controller  (%)                          | DW 95
Exter- +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
nal    |     Factor for final control element interface KON VER (w/o unit)                         | DW 96
con-   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
stants |     External constant for final control element interface KON VER  (%)                    | DW 97
 |     |-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 |     |     Setpoint upper limit                (w/o unit)                                        | DW 98
 |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 |     |     Setpoint lower limit                (w/o unit)                                        | DW 99
 !     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

4.11 Description of the Standard Controller Structure (SR)

```
                                                                                                 Data
                                                                                                 word
                                                                                                address
                                                                                                   |
       15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0     V
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |       Upper warning limit of the actual value       (with unit)                             | DW 100
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |       Lower warning unit of the actual value       (with unit)                              | DW 101
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |       Upper danger limit of the actual value    (with unit)                                 | DW 102
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |       Lower danger limit of the actual value       (with unit)                              | DW 103
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |                                                                                             | DW 104
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |                                                                                             | DW 105
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |                                                                                             | DW 106
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |                                                                                             | DW 107
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |                                                                                             | DW 108
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |                                                                                             | DW 109
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |                                                                                             | DW 110
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |                                                                                             | DW 111
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |                                                                                             | DW 112
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |                                                                                             | DW 113
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |                                                                                             | DW 114
|     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
V     |                                                                                             | DW 115
------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-------
      |       Measuring point No. for measuring socket 1                                            | DW 116
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |       Measuring point No. for measuring socket 2                                            | DW 117
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |       Measuring point No. for limit monitor 1                                               | DW 118
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |       Measuring point No. for limit monitor 2                                               | DW 119
------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-------
  ^   |       A d d r e s s  of the PII of the setpoint input (ADC 1)                               | DW 120
  |   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |       A d d r e s s  of the PII of the actual value input (ADC 2)                           | DW 121
Ad-   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
dresses|      A d d r e s s  of the PII of the sparate D input    (ADC 3)                           | DW 122
of the +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
PII   |       A d d r e s s  of the PII of the disturbance input (ADC 4)                            | DW 123
of the +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
in-   |       A d d r e s s  of the PII of the manual input  (ADU 5)                                | DW 124
puts  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |                                                                                             | DW 125
  |   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                                                                     Data
                                                                                     word
                                                                                    address
                                                                                       |
        15    14    13    12    11    10    9     8     7     6     5     4     3     2     1     0        V
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 |    |                                                                                               |  DW 126
 |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 |    |                                                                                               |  DW 127
 |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 |    |                                                                                               |  DW 128
 |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 |    |                                                                                               |  DW 129
 |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 |    |                                                                                               |  DW 130
 |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 V    |      A d d r e s s  of the counter input                                                      |  DW 131
------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-------
      |      A d d r e s s  of the PII of the input bit variable word                                 |  DW 132
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |                                                                                               |  DW 133
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |                                                                                               |  DW 134
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |                                                                                               |  DW 135
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |                                                                                               |  DW 136
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |                                                                                               |  DW 137
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |                                                                                               |  DW 138
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |                                                                                               |  DW 139
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |                                                                                               |  DW 140
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |                                                                                               |  DW 141
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      |                                                                                               |  DW 143
------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-------
  ^   |      A d d r e s s  of the PIQ of the control output DAC 1                                    |  DW 144
  |   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  |   |      A d d r e s s  of the PIQ of the control output DAC 2                                    |  DW 145
  |   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  |   |                                                                                               |  DW 146
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Ad-   |                                                                                               |  DW 147
dresses+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
of the |                                                                                              |  DW 148
PIQ   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
of the |                                                                                              |  DW 149
out-  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
puts  |                                                                                               |  DW 150
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  |   |                                                                                               |  DW 151
  |   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

4.11 Description of the Standard Controller Structure (SR)

```
                                                                                                              Data
                                                                                                              word
                                                                                                             address
                                                                                                                |
            15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0        v
          +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |     |                                                                                               |  DW 152
    |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |     |                                                                                               |  DW 153
    |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |     |      A d d r e s s   of the PIQ of the 1st measuring socket  (DAC 3)                          |  DW 154
    |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    v     |      A d d r e s s   of the PIQ of the 2nd measuring socket (DAC 4)                           |  DW 155
----------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+--------
          |      A d d r e s s   of the PIQ of the output bit variable word                               |  DW 156
          +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
          |                                                                                               |  DW 157
          +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
          |                                                                                               |  DW 158
          +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
          |                                                                                               |  DW 159
----------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |     |   Controller name:   1st byte                 |    Controller name:   2nd byte                |  DW 160
  Fields  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   for    |   Controller name:   3rd byte                 |    Controller name:   4th byte                |  DW 161
  local   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
operator- |   Controller name:   5th byte                 |    Controller name:   6th byte                |  DW 162
 process  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 communi- |   Controller name:   7th byte                 |    Controller name:   8th byte                |  DW 163
  cation  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   and    |   Range name:        1st byte                 |    Range name:        2nd byte                |  DW 164
 visuali- +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  sation  |   Range name:        3rd byte                 |    Range name:        4th byte                |  DW 165
 for the  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  DR/SR   | - Range name:        5th byte                 |    Range name:        6th byte                |  DW 166
   sub-   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  module  |   Range name:        7th byte                 |    Range name:        8th byte                |  DW 167
----------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    ^     |       V a l u e   of the PII of the setpoint input (ADC 1)                                    |  DW 168
    |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |     |       V a l u e   of the PII of the actual value input (ADC 2)                                |  DW 169
   PII    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  of the  |       V a l u e   of the PII of the seperate D input (ADC 3)                                  |  DW 170
  inputs  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |     |       V a l u e   of the PII of the disturbance input (ADC 4)                                 |  DW 171
    |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |     |       V a l u e   of the PII of the manual input (ADC 5)                                      |  DW 172
    |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |     |                                                                                               |  DW 173
    |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |     |                                                                                               |  DW 174
    |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |     |                                                                                               |  DW 175
    |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |     |                                                                                               |  DW 176
    |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |     |                                                                                               |  DW 177
    |     +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                                                                                        Data
                                                                                                        word
                                                                                                      address
                                                                                                         |
          15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0    V
   |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   |    |                                                                                               | DW 178
   |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   v    |      V a l u e  of the counter input                                                          | DW 179
--------+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+--------
        |      PII of the input bit variable word  (relays and bits) se below for meaning               | DW 180
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |                                                                                               | DW 181
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |                                                                                               | DW 182
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |                                                                                               | DW 183
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |                                                                                               | DW 184
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |                                                                                               | DW 185
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |                                                                                               | DW 186
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |                                                                                               | DW 187
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |                                                                                               | DW 188
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |                                                                                               | DW 189
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |                                                                                               | DW 190
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |       V a l u e  of the 'VC setpoint variable'                                                | DW 191
--------+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+
   |    |  Controller name:   1st byte                 |  Controller name:   2nd byte                 | DW 192
 Fields +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   for  |  Controller name:   3rd byte                 |  Controller name:   4th byte                 | DW 193
 local  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
operator|  Controller name:   5th byte                 |  Controller name:   6th byte                 | DW 194
process +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
communi-|  Controller name:   7th byte                 |  Controller name:   8th byte                 | DW 195
 cation +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   and  |  Range name:        1st byte                 |  Range name:        2nd byte                 | DW 196
visuali-+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 sation |  Range name:        3rd byte                 |  Range name:        4th byte                 | DW 197
for the +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 DR/SR  |  Range name:        5th byte                 |  Range name:        6th byte                 | DW 198
  sub-  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 module |  Range name:        7th byte                 |  Range name:        8th byte                 | DW 199
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |                                                                                               | DW 200
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |                                                                                               | DW 201
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |                                                                                               | DW 202
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        |                                                                                               | DW 203
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

4.11 Description of the Standard Controller Structure (SR)

```
                                                                                                         Data
                                                                                                         word
                                                                                                        address
                                                                                                           |
           15    14    13    12    11    10    9     8     7     6     5     4     3     2     1     0      V
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         |                                                                                               | DW 204
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         |                                                                                               | DW 205
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         |                                                                                               | DW 206
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         |                                                                                               | DW 207
---------+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+--------
    ^    |      V a l u e  of the PIQ of the control output DAC 1                                        | DW 208
    |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |    |      V a l u e  of the PIQ of the control output DAC 2                                        | DW 209
    |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |    |                                                                                               | DW 210
    |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |    |                                                                                               | DW 211
    |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   PIQ   |                                                                                               | DW 212
  of the +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 outputs |                                                                                               | DW 213
    |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |    |                                                                                               | DW 214
    |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |    |                                                                                               | DW 215
    |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |    |                                                                                               | DW 216
    |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |    |                                                                                               | DW 217
    |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    |    |      V a l u e  of the PIQ of measuring socket 1  (DAC 3)                                     | DW 218
    |    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    V    |      V a l u e  of the PIQ of measuring socket 2  (DAC 4)                                     | DW 219
---------+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+--------
         |      PIQ of the output bit variable 1 (limits etc.) See below for meaning                     | DW 220
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         |                                                                                               | DW 221
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         |                                                                                               | DW 222
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         |                                                                                               | DW 223
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         |                                                                                               | DW 224
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         |                                                                                               | DW 225
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         |                                                                                               | DW 226
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         |                                                                                               | DW 227
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         |                                                                                               | DW 228
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         |                                                                                               | DW 229
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                                                              Data
                                                                              word
                                                                             address
                                                                                |
   15   14   13   12   11   10    9    8    7    6    5    4    3    2    1    0    V
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |                                                                               | DW 230
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |                                                                               | DW 231
--+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+------
  |      V a l u e  of measuring point  MP 1    (with unit)                       | DW 232
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |      V a l u e  of measuring point  MP 2    (with unit)                       | DW 233
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |      V a l u e  of measuring point  MP 3    (with unit)                       | DW 234
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |      V a l u e  of measuring point  MP 4         (%)                          | DW 235
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |      V a l u e  of measuring point  MP 5         (%)                          | DW 236
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |      V a l u e  of measuring point  MP 6         (%)                          | DW 237
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |      V a l u e  of measuring point  MP 7         (%)                          | DW 238
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |      V a l u e  of measuring point  MP 8    (with unit)                       | DW 239
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |      V a l u e  of measuring point  MP 9    (with unit)                       | DW 240
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |      V a l u e  of measuring point  MP 10        (%)                          | DW 241
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |      V a l u e  of measuring point  MP 11   (with unit)                       | DW 242
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |      V a l u e  of measuring point  MP 12        (%)                          | DW 243
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |                                                                               | DW 244
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |                                                                               | DW 245
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |                                                                               | DW 246
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |                                                                               | DW 247
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |                                                                               | DW 248
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |                                                                               | DW 249
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |                                                                               | DW 250
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |                                                                               | DW 251
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |                                                                               | DW 252
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |                                                                               | DW 253
  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  |                                                                               | DW 254
--+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+------
Status |                                   | YOG | YUG | SOG | SUG | OW | UW | OG | UG | DW 255
 word  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
```

4.11 Description of the Standard Controller Structure (SR)

Controller management:

```
                                                                                                   Data
                                                                                                   word
                                                                                                  address
                                                                                                     |
                                                                                                     |
                                                                                                     V
  15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | RBV |  DW  7
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

Controller management bit RBV = 0 : Controller not being processed
RBV = 1 : Controller being processed

```
   +---> only for R processor of the PC 135U             +---> S2.4
   |                                                     |
   |     +---> S 1.4.1                                   |     +---> S2.3
   |     |                                               |     |
   |     |     +---> S1.3.1                              |     |     +---> S2.2
   |     |     |          /S1.1.1                        |     |     |
   |     |     |     +--->- S1.2.1                       |     |     |     +---> S2.1
   |     |     |     |    \S1.5.1                        |     |     |     |
  15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |     |     |     |     |     |     |     |     |     |     |     |     | ST 3| ST 2| ST 1|  DW 23
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                 |     |     |     |
                                 |     |     |     +---> S3.1
                                 |     |     |
                                 |     |     +---> S3.2
                                 |     |
                                 |     +---> S1.2.3
                                 |
                                 +---> S1.2.2

  15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|     |     |     |     |     |     |     |     |     |     |     | S21 | ST 7| ST 6| ST 5| ST 4|  DW 24
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                                                     |
                                                                     +---> Bit 3.1
```

Bit variables of the PII:

```
                                                                                                   Data
                                                                                                   word
                                                                                                  address
                                                                                                      |
                                                                                                      v
                                                                    'Pulse         'Ramp-up
                                                                   converter'      generator'
                                                                   submodule       submodule
                                                                   ____^____    ________^_______
                                                  RL3   RL2   RL1  /         \ /               \
  15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| RF  |STOER| INO |IDRE |AH/AH|TOTI | SRF | HAI |INBET|SZFR |SOLL | BA  | BZ  | HOE | TIE | LOE |  DW 180
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   |    RL5     |     |   |RL4|   |      |     |     'Step
   |     |      |     |   |    +---+-----+-----+---> controller'
   |     |      |     |   |                          submodule
   +-----+------+-----+---+---> 'PID controller'
                                submodule
```

Bit variables in the PIQ:

```
                                               'PID controller'      'Limit monitor 1'
                                                  submodule              submodule
                                                  ___/\___      _______________/\_______________
                                                 /         \  /                                  \
  15  . 14    13    12    11    10     9     8     7     6     5     4     3     2     1     0
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|QP/QO|QN/QS|GW2_6|GW2_5|GW2_4|GW2_3|GW2_2|GW2_1| NUE | PUE |GW1_6|GW1_5|GW1_4|GW1_3|GW1_2|GW1_1|  DW 220
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 |  |  |  | \________________  ________________/
 |  |  |  |                  \/
 |  |  |  |   'Limit monitor 2' submodule
 |  |  |  |
 |  +--|--+---> 'Pulse converter' submodule
 |     |
 +-----+---> 'Pulse-pause output' submodule
```

Status word of the controller

```
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|                                               | YOG | YUG | SOG | SUG | OW  | UW  | OG  | UG  |  DW 255
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

The **status word** created for the compact controller signalling system contains bit information on the "hard-wired" limit monitors.

4.11 Description of the Standard Controller Structure (SR)

Meaning of the bit variables in the process input/output image:

Bit variables in the PII area can be changed **by the user** at any time during operation (via STEP 5, PG).

They can be divided into
* Structure relays, which enable certain structure changes during operation
* Internal control bits.

Bit or binary variables in the PIQ area indicate specific signal statuses of the controller. They can only be changed **from the structure program.**

HOE : "Higher" bit of the "ramp-function generator":
0 = No effect
1 = Ramp with positive slope.

TIE : "Lower" bit of the "ramp-function generator":
0 = No effect
1 = Ramp with negative slope.

LOE : "Delete" bit of the "ramp-function generator":
0 ===> 1 : Return from manual mode to automatic mode if HOE = 0 = TIE
1 ===> 0 : No effect

BA : "Acknowledge" bit of the "Pulse generator":
0 = Final position OPEN not reached
1 = Final position OPEN reached.

BZ : "Acknowledge" bit of the "Pulse generator":
0 = Final position CLOSED not reached
1 = Final position CLOSED reached.

RL1 – RL3 : Structure relay (cf. standard controller structure!)

SETPOINT (RL1) : Setpoint selection bit:
0 = PC setpoint effective
1 = "Setpoint sequence" effective.

SZFR (RL2) : Setpoint branch enable bit:
0 = Setpoint branch on
1 = Setpoint branch off.

INBET (RL3) : Actual value branch startup bit:
0 = Actual value branch on
1 = Actual value branch off
Startup value effective.

HAI : "Manual value active/inactive" bit of the step controller
0 = Manual value inactive, i. e. no pulse output
(final control element standstill)
1 = Manual value active, i. e. pulse output with a frequency corresponding to the manual value
(final control element run).

SRF : Enable bit of the "Step controller":
0 = Controller disabled, i. e. zero output.
1 = Controller enabled, i. e. output of the calculated value.

TOTI : Switch for selecting the input variable for the I component of the "Step controller":
0 = Dead zone for the I component effective.
1 = Dead zone for the I component ineffective.

AH (RL4) : Automatic/manual transfer in the case of the "PID controller" or "Step controller":
0 = Automatic mode
1 = Manual mode.

IDRE : Change from ideal to real "PID controller":
0 = Real
1 = Ideal PID.

INO : Bit for setting the control increment to zero in the case of the "PID controller":
0 = No effect
1 = Control increment is set to zero or manipulated variable is kept constant.

STOER (RL5) : Disturbance variable injection in the case of the "PID controller":
0 = Ignored
1 = Effective, i. e. disturbance variable increment is added to calculated control increment.

RF : Enable bit of the "PID controller":
0 = Controller disabled, i. e. zero output
(past values are set to zero, no manipulated value calculation).
1 = Controller enabled, i. e. output of the calculated value.

GW1_1 - GW1_6 : Limit bits of the 'Limit monitor 1' submodule:
GW2_1 - GW2_6 : Limit bits of the 'Limit monitor 2' submodule:
0 = Relevant limit not exceeded
1 = Relevant limit exceeded.

NUE : Bit for lower limit of the manipulated variable in th
of the 'PID controller' submodule:
0 = not exceeded
1 = exceeded.

PUE : Bit for the upper limit of the control variable in th
of the 'PID controller' submodule:
0 = not exceeded
1 = exceeded.

QO : Binary output "Open" of the 'Pulse converter' submodu
0/1

QS : Binary output "Close" of the 'Pulse converter' submod
0/1

QP : Binary output "Positive pulse" in the case of the
'Pulse-pause output' submodule: 0/1

QN : Binary output "Negative pulse" in the case of the
'Pulse-pause output' submodule: 0/1

YOG := PUE in the PID controller with continuous control out
= BA in the step controller
YUG := NUE in the PID controller with continuous control out
= BZ in the step controller

SOG := 1 ---> Setpoint exceeded upper limit (otherwise 0).
SUG := 1 ---> Setpoint exceeded lower limit (").

OW := 1 ---> Actual value exceeded upper warning limit ("
UW := 1 ---> Actual value exceeded lower warning limit ("

OG := 1 ---> Actual value exceeded upper danger limit (")
UG := 1 ---> Actual value exceeded lower danger limit (")

4.12 Description of the Drive Controller Structure with Self-Optimization (DRS)

The structure contains all functions required for controlling a drive, except for the current controller and the power stage. This means that depending on the requirements of the user, a **speed control system** (e. g. for mills, turbines) or a **velocity control system** (e. g. for paper machines, foil machines) can be implemented.

The drive controller structure (Fig. 9.1) consists basically of **two cascaded closed-loop controllers.** Parameters can be assigned to each of the controllers of P, PI, PD or PID response. The **outer loop controller** (9) is used e. g. for position control, tension control or pressure control. One should mention at this stage that the numbers in brackets correspond to the branch no. ((5) ≙ branch 5). A velocity control loop or a speed control loop can be implemented using the **inner loop controller** (5).

The "DRS" structure on memory submodule 6ES5 374-0AB11 is a further development of the drive controller structure ("DR") described in Section 4.10. The **Self-setting of drive controllers** function (16) and the facility for performing mathematical operations (17) are both new developments. In addition, the eight possible control loops of the IP 252 are user-configurable (Section 4.12.2).

4.12.1 Outer loop controller (9)

The **setpoint** (e. g. position setpoint) is input either via an A/D converter, or via the programmer or the CPU of the programmable controller. The **actual value** (e. g. actual position value) is sensed by an A/D converter. The **controller output** can be reduced in proportion to the actual speed value. This is used for speed-dependent adaptive control in foil machines.

4.12.2 Inner loop controller (5)

The following **setpoint sources** can be programmed:

- 1st channel: Output of the outer loop controller (9)
- 2nd channel: Setting-up speed (6)
- 3rd channel: Inching speed (7)
- 4th channel: Armature current dependent component (11)
  This component is used e. g. in conveyor belts and continuous casting processes (load regulation).
- 5th channel: Main setpoint (speed or velocity setpoint (8)).
  This setpoint is input either via an A/D converter, via the programmer or via the programmable controller CPU. The acquired setpoints can be processed by a **ramp-function generator** and/or a **smoothing module.**
  The ramp-function generator module produces a ramp output from a step function at its input. This is required for instance during start up processes.
  The smoothing module is used for "smoothing" the setpoint.
  The control loop can be tuned to optimum disturbance response. Selection of a suitable smoothing time constant produces an optimum response to setpoint changes.

The **actual value** (10) (actual speed value) can be input either as a **tacho voltage** via the A/D converter or via a **counter input.** A **smoothing module** is used for suppressing any resonances. In addition, the high frequency disturbances to which the controller cannot respond are kept away from the PID module (10).
The **display function** (10) permits amplification and display of the alternating component of the actual speed value via a measuring instrument connected to the D/A converter.

In the case of the speed control loop, the actual speed value (10) is used directly in the inner loop (speed) controller (5). If a velocity control is required, the current velocity is calculated from the actual speed value (3) and transmitted to the inner loop (velocity) controller as an actual velocity value.

The **controller output,** optionally evaluated with a factor (4), forms the main component of the current setpoint. This evaluation of the controller output produces a loop gain, as required e. g. during the field weakening operation of motors.

4.12.3 Current setpoint

The current setpoint which is generated by the IP 252 as a ± 10 V voltage at the D/A converter consists of the following:

- 1st channel: Main current setpoint (5)
- 2nd channel: Friction compensation (2)
- 3rd channel: Acceleration compensation (12); is used in velocity controllers (e. g. reeling and unwinding operations)
- 4th channel: Braking current modulation (1 b)
  Instead of the summed output (1 a), an actual speed dependent braking current can be output as the manipulated variable.

Before the current setpoint is output as the manipulated variable, it can be converted and limited (1 b).

4.12.4 Additional functions

- Two **user connected** limit monitors (12), (13):
  Each of the limit monitors can be assigned to any desired signal (measuring point) of the controller structure. The limit monitors contain 6 stages, which are specified via the programmers. The results of the limit monitors (overshoot or undershoot) are evaluated by the logic control program of the S5 central controller.
- Four **pre-assigned** limit monitors:
  These limit monitors support the operator communication and control concept of the compact controller structures. The results of the monitors are used for instance by the CP 526 communications processors as inputs for the standard displays on the VDUs.
  The limit monitors monitor setpoints and actual values of the outer loop (9) and the inner loop (5) controllers.
  The danger and the warning limits are specified via the programmer in the planning stage.
- **Thermal monitoring** of the motor (11):
  Using the actual armature current a thermal monitoring of the motor is possible. If one of the switching limits specified by the programmer is reached this is communicated to the logic control program.
- Free assignment of the measuring sockets[1]
- User configurability of the control loops[2]
- Internal branch function expansions in the branches
  - 3: Peripheral velocity
  - 4: Loop gain (field current monitoring)
  - 8: Setpoint branch (ramp-function generator and actual value referencing)
  - 9: Primary controller (actual value processing and controller output)
  - 10: Actual value branch (digital actual value capture with IP 240)
  - 11: Actual armature current (temperature display)
  - 12: Acceleration compensation (decoupled from branch 3)
- New branches in the "DRS" structure
  - Branch 15: Analog measuring point output
  - Branch 16: Arithmetic
  - Branch 17: Self-optimization of the speed controller

The functions listed under "1)" and "2)" apply to both structures of the "DRS/SR" block and, therefore, also to the standard controller structure:

1) Free assignment of the measuring sockets
Both measuring sockets on the frontplate of the IP 252 module are used for displaying two measured values. Which measured values (e. g. control deviation, manipulated variable, etc.) are to be displayed within which control loops (1 to 8) is to be defined at the configuration stage in the memory submodule with the **DR/SR** structures.
Later changes can only be undertaken with the module in the STOP mode.
With the **DRS/SR** memory submodule, on the other hand, the measuring sockets must be assigned to the desired measuring points during controller test, i. e. while the process is running:
For this purpose, the operator interface of the COM REG packages offers the "Measuring sockets" function as well as the "Controller test" function. With the "Measuring sockets" function you can assign MB1 (DAC channel No. 5) and MB2 (DAC channel No. 6) menu-driven to any measuring point of the controller structure from controller Nos. 1 to 8. These assignments can be changed at any time. The measuring sockets may only be activated if analog output channels Nos. 5 and 6 are not otherwise assigned!

2) Configurability of the control loops
The memory submodule with the "DRS/SR" structures supports the configuring of control loops 1 to 8 to master and slave controllers. Wherever an **ADCn** is indicated in Sections 8.2 and 8.3 of the configuration documentation, the following parameters can be entered:

e. g. ADC 6 =	0 to 7	IP 252 – internal ADC channels
	128 to 254	Backplane bus addresses of the S5 analog I/0 modules: only possible with the S5 115U.
	R No. MP No.	The **R No.** is the controller No. 1 to 8, and the **MP No.** is the No. of the measuring point of this controller structure.

It is thus possible to transfer, for example, the processed actual value of controller no. 2 to controller no. 3 as the setpoint. If both controllers have the "DRS" structure, the following inputs are required:

The following value is entered, using the programmer, in the entry field of ADC 6 (of branch 8 in controller no. 3):

ADC 6 2.12

If controller no. 2 is a drive controller (DRS) and controller no. 3 is a standard controller (SR),
the following value is entered, using the programmer, in the entry field of ADC 1 (of branch 3 in controller no. 3):

ADC 1 2.12

4.12.5 Detailed description of the drive controller structure (DRS)

The following description refers to the **configuring sheets** (Section 8.3) for the drive controller structure. The symbols used here are explained in Section 4.9.

The overview pages of Section 8 show all the branches of the drive controller structure. The shading in branches 1, 5, and 10 of the drive controller structure means that these branches **cannot** be switched off. These branches are always active! Exact representation of the structures can be found in the Appendix in Section 9 (Fig. 9.3).

4.12.5.1 Branch 1: Controller output/current setpoint

Function:

The current setpoint (manipulated variable) is generated and output via an analog output channel. The current setpoint can be inverted with structure switch S1.1.
The limiting stage limits the current setpoint to values, which are specified by the user via the PG. The upper and lower limiting values are detected in **branch 5** (Section 4.12.5.5) by the PG. If the current setpoint crosses the limits, then this is taken into account in the inner loop controller (PID module) in **branch 5;** i. e. the corresponding overflow bits are set and the I component of the PID controller is disabled as long as an overflow bit is set.

Relay REL 1.1 is available for braking action. If the relay is active, then DAC2 outputs the current setpoint, which is linearly dependent on the instantaneous actual speed value. This means that 0% is output as the current setpoint when 0 speed is reached.

Input variables:

– Current setpoint component	from **branch 2**
– Current setpoint component	from **branch 3**
– Main current setpoint	from **branch 5**

Braking compensation:

– CON1.1	The constant influences the magnitude of the braking current
– MP12	Actual speed from **branch 10**
– REL1.1	When active, the motor is braked to standstill.

Output variables:

– DAC2	Current setpoint (manipulated variable) **after** limiting
– MP6	Magnitude of the braking current The actual speed value, multiplied by the constant CON1.1 and (–100) is the braking current.
– MP9	Current setpoint before limiting

4.12.5.2 Branch 2: Friction

Function:

This branch can be activated with relay REL 2.1 for compensating friction (stiction) forces. In order that the correct polarity of these current setpoint components is maintained even when the direction of rotation changes, the constant 2.1 is multiplied with **the sign** of the speed setpoint (MP14 from branch 8).

Input variables:

– CON2.1	The constant specifies the magnitude of the current setpoint component
– REL2.1	When active, the current setpoint component is enabled
– MP20	Summated setpoint from branch 5

Output variables:

– The output from **branch 2** is connected to the summation point of **branch 1.**

4.12.5.3 Branch 3: Peripheral velocity (diameter calculator)

This branch is required for operating axle-driven upcoilers and downcoilers.

Function:

A velocity control system operates with a velocity setpoint. Accordingly, the actual value must also be available as a velocity. In **branch 3**, therefore, the actual speed (MP12) measured in branch 10 is used for calculating the velocity of the web material.
The actual value of MP12 of branch 10 is measured in branch 3 while the setpoint is being read in via ADC7. Under normal conditions, ADC7 will be switched to measuring socket 14 of its own controller number. It is also possible to obtain the primary setpoint from an analog web tachometer.
The difference between actual velocity and velocity setpoint is calculated and the resultant signal routed to the deadband filter. Only signals greater than the preset value CON 3.1 pass the deadband filter. The resulting signal is multiplied with the sign of the rotational speed value and intergrated overtime if the integrator has been enabled (bit 3.1 active). The integration period is set with CON3.TID according to requirements. A value for CON3.TID of approximately 10 s for thin sheeting and paper, and approximately 60 s for stip metal roughly 1 mm thick, can be used as a rule of thumb when working with normal web velocities.
The result is the calculated diameter of the reel. If this calculated value falls below a minimum diameter (CON3.DUG), the preset lower diameter limit CON3.DUG is used. The diameter calculated in this way (MP15) is multiplied with the actual rotational speed (MP12) to give the web velocity (MP16).

The control program of the S5-CPU provides the desired initial diameter at VAR3.1, which is accepted by the integrator of branch 3 if relay 3.2 is active.

The diameter calculator has four operating modes:

I) The master reference voltage from the tacho is positive
   1. Downcoiling with positive revs (clockwise)
      The calculated diameter (MP15) is within the range
      $0\% < d \leq 100\%$
      Meaningful entries for the constants CON3.DUG and VAR3.1 lie within the positive value range
      $0\% < x \leq 100\%$
   2. Downcoiling with negative revs (anti-clockwise)
      The calculated diameter (MP15) is within the range
      $-100\% \leq d < 0\%$
      Meaningful entries for the constants CON3.DUG and VAR3.1 lie within the positive value range
      $-100\% \leq x < 0\%$

II) The master reference voltage from the tacho is negative
   3. Upcoiling with positive revs (clockwise). This corresponds to "1) 2." above.
   4. Upcoiling with negative revs (anti-clockwise). This corresponds to "1) 1" above.

A primary requirement in upcoiling and downcoiling is that the web material be kept at a suitable tension throughout the whole coiling operation. The IP does this by means of velocity control (speed control) with primary ("direct") tension control. Tension is controlled with branch 9 (actual tension measurement via tension load cell or dancer roll).
If there is a dancer roll available, the primary controller functions as a position controller. Tension is determined by the weight of the dancer roll or the weight applied to it.
The actual rotational speed is matched to the coil diameter in branch 3. Excitation during the coiling operation can be influenced via measuring point MP15, whose signal is then routed to a DAC via the measuring socket (branch 15). A presondition for coiling control is that web velocity be determined by the driven machine.

Function sequence during downcoiling

If the coil diameter decreases, the speed controller will at first attempt to maintain the speed since its input signals remain constant. This leads to an increase in web tension. The tension controller or position controller makes the appropriate adjustment and the speed is increased. This also increases the product n x d (MP16). At the input to the summator in branch 3a, n x d is greater than the master reference voltage V_L at MP14 and at this point the integrator runs from the set initial diameter (MP15) downwards until the product n x d is again equal to V_L.
The actual value n x d for branch 5 is therefore smaller and so the driver is "faster". The correction value of the primary controller is decreased. During the coiling operation, n is therefore greater and d smaller; with the difference that, in this operation, the integrator functions upwards from a small initial diameter.
It is important that the new initial diameter be set at the beginning of a coiling operation (e. g. by the CPU control program). The level of the master reference voltage (MP14) at max. production speed depends on the coiling ratio.

Example:

Diameter of empty mandrel	200 mm = 22.2%
Diameter of full reel	900 mm = 100%
Diameter ratio	= 4.5%
Max. master reference voltage	= 22.2%

The master reference voltage can be influenced by means of the constant CON 8.2 in branch 8.
The diameter (MP 15) is only reset in the STOP mode of the IP 252. In the case of a warm restart after power failure, the old value is retained if the IP RAM has battery back-up.

Input variables:
Acceleration compensation, branch 3b

–ADC7	Channel for feeding in the velocity setpoint (primary setpoint).
–MP12	Actual speed from branch 10.

- CON3.1 Constant for setting a threshold value for the difference between velocity setpoint and actual velocity
- CON3.TID Integration time constant of the diameter calculator
- CON3.DUG Lower limit of roll diameter
- VAR3.1 The variable gives the diameter of a newly inserted reel. The IP uses this diameter to calculate the current actual diameter during upcoiling and downcoiling.
- REL3.2 This relay influences the output of the integrator. When the relay is inactive, the current diameter is always available at the integrator output. When the relay is active, the integrator is set to the value of variable 3.1. The diameter can be reset at any time.
- BIT3.1 If this bit is "0", the integrator is disabled. The output retains the last calculated diameter. If the bit is set to "1", the integrator starts to work again from the last calculated diameter.

Output variables:

- MP15 Actual diameter of the reel.
- MP16 Velocity (to summator in branch 5).

4.12.5.4 Branch 4: Loop gain

Function:

The output of the inner control loop in branch 5 is evaluated and gives the main component of the current setpoint. Depending on the position of structure switch S4.1 various arithmetic operations can be carried out:

S4.1 inactive: (division in branch 5)

The signal (field current) input through an analog input channel is multiplied with the constant CON 4.1 for standardization and displayed with limit indicators at measuring point MP18 for possible further processing. If S4.2 is inactive, the signal is transmitted via a characteristic. The characterisitic cannot be changed and is described in Section 4.12.6.5. This characteristic gives the approximate relationship between the field current and the magnetic flux of the d. c. motor. The shape of the characteristic is selected to fit a majority of the most commonly used motors (see Section 4.12.6.5)

S4.1 active: (multiplication in branch 5)

In the case of velocity control, the actual diameter calculated in **branch 3** (MP15) is entered. In both cases (S4.1 active/inactive), the signal entered can be matched to offset and gain via a straight-line equation (S4.3 active). Only if relay 4.1 is inactive will the value calculated in this way reach branch 5. If REL4.1 is active, a constant loop gain can be given for start-up purposes using CON4.2 (format: −100% to +100%). Depending on the position of the structure switch S4.1, either an increase (S4.1 inactive) or a decrease (S4.1 active) in loop gain is produced.

Input variables:

- ADC5 Field current
- CON4.1 The constant is used for standardizing the field current (format −99.99 to +99.99)
- CON4.2 The constant determines the influence of the evaluation
- CON4.VER Gain factor of the interface (format: −99.99 to 99.99)
- CON4.OFF Offset of the interface (straight-line equation y = x* CON9.VER + CON9.OFF)
- MP15 Actual diameter from branch 3

Output variables:

- MP8 Operation on the controller output in branch 5
- MP18 Measured and standardized field current

4.12.5.5 Branch 5: Speed controller/velocity controller

Function:

The instantaneous control deviation is determined in the summation stage. It is calculated from the difference between the setpoint and the actual value (see page 2 of branch 5 in Section 8.3). The setpoint consists of the outputs of branches 5, 6, 7, 8, 9 **and** 11, the actual value is the output of branch 3 **or** 10. If the actual value comes from branch 3, then it is a velocity control system, otherwise it is a speed control system.

The setpoint and the actual value are each monitored by a preassigned limit monitor. The function of this monitor is described in **Section 4.12.6.1.**

Relay 5.1 can be made active for start-up purposes. Then the constant CON5.1 acts on the PID controller input as an additional setpoint component.

The PID controller can be assigned P, PD, PID or PI control action by setting various parameters to zero:

TN = 0 I component not active
TV = 0 D component not active

Both the limits CON5.B+ and CON5.B− limit the manipulated variable in **branch 1.** If the manipulated variable in **branch 1** crosses one of the limit values, then the corresponding bits BIT5.UE+ and BIT5.UE− of branch 5 are set.
The PID controller in branch 5 then disables its integrator. This prevents "wind up" of the integrator.

The output of the PID controller is operated on by the output of branch 4, if branch 4 was selected. If branch 4 was not structured then no operation is carried out, the controller output is connected to branch 1 without modification.
Evaluation: Multiplication if S4.1 = 1
Division if S4.1 = 0

The output of branch 5 is the main component of the current setpoint.

Input variables:

PID controller module:

- CON5.KP Proportional value
- CON5.TN Integral-action time
- CON5.TV Derivative-action time

} influence the behaviour of the PID controller

- CON5.B+ The constant determines the upper limit for the limiting in **branch 1.**
- CON5.B− The constant determines the lower limit for the limiting in **branch 1.**
- BIT5.RF The bit disables or enables the PID controller. The controller is enabled, when the bit is active. When disabled, the controller produces 0% of its output and resets its internal memory.

Setpoint limit monitor:

- CON5.SOG Upper limit
- CON5.SUG Lower limit

Actual value limit monitor:

- CON5.OW Upper warning limit
- CON5.UW Lower warning limit
- CON5.OG Upper danger limit
- CON5.UG Lower danger limit

Miscellaneous:

- CON5.1 When relay REL5.1 is active, the constant CON5.1 works on the input of the PID controller as an additional setpoint component (start-up value).
- REL5.1 When the relay is active, it switches the constant CON5.1 to the summator.
- REL5/9 With this relay, one can switch over to „Direct tension control" (see Section 4.10.5.16).

Output variables:

PID controller module:

- BIT5.UE+ This bit is active if the manipulated variable (MP9) in branch 1 crosses the upper limit CON5.B+ (in branch 1). The integrator in the PID controller is then frozen.
- BIT5.UE− This bit is active if the manipulated variable in branch 1 crosses the lower limit CON5.B− (in branch 1). The integrator in PID controller is then frozen.

Setpoint limit monitor

- BIT5.SOG The bit is active if the setpoint crosses the upper limit.
- BIT5.SUG The bit is active if the setpoint crosses the lower limit.

Actual value limit monitor

- BIT5.OW The bit is active if the actual value crosses the upper warning limit.
- BIT5.UW The bit is active if the actual value crosses the lower warning limit.
- BIT5.OG The bit is active if the actual value crosses the upper danger limit.
- BIT5.UG The bit is active if the actual value crosses the lower danger limit.

Miscellaneous:

- MP10 Main current setpoint (input of the summation stage in branch 1)
- MP11 Input of the PID controller (control deviation)
- MP16/12 Actual velocity or actual speed summated setpoint
- MP20 Summated setpoint

Note: The bits BIT5.SOG to BIT5.SUG are not evaluated by the standard function blocks FB:STEU (Section 5).

4.12.5.6 Branch 6: Setting-up speed

Function:

When relay REL6.1 is active, the constant CON6.1 is switched to the summation stage in branch 5.

Input variables:

- CON6.1 Constant used as the setting-up speed setpoint
- REL6.1 Relay used to switch the constant CON6.1 to the speed controller, branch 5 (control deviation).

Output variables:

- The result of branch 6 is connected to the summation stage in branch 5.

4.12.5.7 Branch 7: Inching speed

Function:

If relay REL7.1 is active, then the constant CON7.1 is switched to the summator stage in branch 5.

Input variables:

- CON7.1 Constant used as the inching speed setpoint.
- REL7.1 Relay used to switch the constant CON7.1 to the speed controller, branch 5 (control deviation).

Output variables:

- The result of branch 7 is connected to the input of the summator stage in branch 5.

4.12.5.8 Branch 8: Speed/velocity setpoint

Function:

The branch generates the main setpoint for the inner loop controller in branch 5.
Relay REL8.3 is used to select whether the setpoint is an **analog** or a **digital** input. In the case of an analog input (REL8.3 inactive) the IP inputs the value via ADC6.
In the case of a digital input (REL8.3 active) relay REL8.1 can be used to decide whether the setpoint comes from the PG (CON8.1) or from the logic control program of the S5-CPU (VAR8.1).

Further processing of the setpoint is only carried out if relay REL8.2 is active. The setpoint can be enabled or disabled with the relay.

The setpoint input via ADC or VAR8.1/CON8.1 can be transmitted via a ramp-function generator or a smoothing block or via both simultaneously. The configuring switches S8.1 and S8.2 determine which block is selected.

The setpoint (MP17) is previously multiplied with the constant CON8.2.

Whether the ramp-function generator block is to reference the actual value from branch 10 or 3 can be decided using configuring switch S8.3.

The ramp-function generator block and the filter block are described in detail in Section 4.15.

Input variables:

Setpoint input:

- ADC6 For analog setpoint input, the signal is input via ADC6.
- REL8.1 The source for the digital setpoint is selected by the relay. If the relay is inactive, the value comes from the PG (CON8.1).
- REL8.2 When active, the relay allows the setpoint to be processed further.
- REL8.3 The relay determines whether the setpoint input is analog (relay REL8.3 inactive) or digital (relay REL8.3 active).
- REL8.4 If relay 8.4 is active, branch 8 operates in isolated mode. The setpoint at MP14 is then not transmitted to branch 5.
- CON8.1 For digital setpoint input (REL8.3 active) and with relay REL8.1 inactive, the PG is the source of the setpoint (CON8.1).
- VAR8.1 For digital setpoint input (REL8.3 active) and with relay REL8.1 active, the logic control program of the S5-CPU is the source of the setpoint.
- CON8.2 Multiplication of the processed setpoint by a constant.

Ramp-function generator:

- CON8.TR Ramp-down time
- CON8.TH Ramp-up time
- CON8.ZUW Increment

see Section 4.12.6.3

- BIT8.HOE "Higher" bit
- BIT8.TIE "Lower" bit
- BIT8.AUT Automatic mode bit
- BIT8.NUL Move setpoint slowly to zero percent
- MP12/16 Actual speed or actual velocity

Filter block:

- CON8.TVZ Delay time see Section 4.12.6.2

Output variables:

- MP14 Magnitude of the setpoint **after** optional processing by the ramp-function generator block and/or the filter module. This value is transmitted to the summation stage in branch 5.
- MP17 Magnitude of the setpoint directly after being input.

4.12.5.9 Branch 9: Outer loop controller

Function:

The control deviation is determined in the summator. The actual value is input via ADC1. If required, the actual value can be matched to offset and gain via a straight-line equation (S9.1 active) and/or transmitted via a filter function (S9.4 active). The setpoint can be input either as an analog variable (S9.2 inactive) or digital variable (S9.2 active). For digital setpoint input, the state of relay REL9.2 determines whether this value comes from the S5-CPU (VAR9.1) or from the programmer (CON9.1).
The setpoint and the actual value are each monitored by a preassigned and non-optional limit monitor (see page 2 of branch 9 in Section 8.3). The operation of both these limit monitors is described in **Section 4.12.6.1.**

The control deviation (output of the summation stage) is used as the input by the PID controller.
The PID controller can be assigned, P, PD, PID or PI control action by setting various parameters to zero:

TN = 0	I component not active
TV = 0	D component not active

The controller output is limited by CON9.B+ and CON9.B− and then multiplied before it arrives at the summation stage of branch 5. Various types of multiplication are available:
Multiplication by a constant is possible via the PG value CON9.2. However it is also possible to make the operation proportional to the instantaneous actual speed value (MP 12 from branch 10) multiplied by CON9.2.

In case the signal crosses the limit, the corresponding bit BIT9.U+ or BIT9.U− is set. The PID controller then disables the integrator. In this way "wind up" of the integrator is prevented.

Input variables:

Setpoint input:

– ADC2	Setpoint input if **analog** setpoint input mode was selected (S9.2 inactive) during structuring.
– REL9.1	The source for the **digital** setpoint is selected by the relay. If the relay is inactive, the value comes from the PG.
– CON9.1	For digital setpoint input and with relay REL9.1 inactive, the PG is the source of the setpoint (CON9.1).
– VAR9.1	For digital setpoint input and with relay REL9.1 active, the S5-CPU is the source of the setpoint (VAR9.1).

Actual value input:

– ADC1	The actual value is always input as an analog variable.
– CON9.VER	Gain factor of the interface (format: −99.99 to 99.99)
– CON9.OFF	Offset of the interface (even equation y = x ∗ CON9.VER + CON9.OFF)
– CON9.TVZ	Input variable of the filter block, see Section 4.12.6.2

PID controller:

– CON9.KP	Proportional gain
– CON9.TN	Integral-action time
– CON9.TV	Derivative-action time
– CON9.B+	The constant determines the **upper** limit for the limiting.
– CON9.B−	The constant determines the **lower** limit for the limiting.
– BIT9.RF	The bit enables or disables the PID controller. The controller is enabled if the bit is active. In the disabled state, the controller outputs 0% and resets its internal memory.

Setpoint limit monitor:

– CON9.SOGL	Upper limit
– CON9.SUGL	Lower limit

Actual value limit monitor:

– CON9.IOWL	Upper warning limit
– CON9.IUWL	Lower warning limit
– CON9.IOGL	Upper danger level
– CON9.IUGL	Lower danger level

Weighting of the controller output:

– CON9.2	This value is multiplied with the controller output if structure switch S9.3 is active. (CON9.2 = −99.99 to +99.99)
– MP12	The controller output is multiplied with the **actual speed value** input in branch 10, and with CON9.2, if structure switch S9.3 is inactive.

Output variables:

PID controller:

- BIT9.UE+ The bit is set when the output of the PID controller crosses the upper limit CON9.B+. The integrator in the PID controller is then frozen.
- BIT9.UE– The bit is active when the output of the PID controller crosses the lower limit CON9.B–. The integrator in the PID controller is then frozen.

Setpoint limit monitors:

- BIT9.SOG The bit is active when the setpoint crosses the upper limit.
- BIT9.SUG The bit is active when the setpoint crosses the lower limit.

Actual value limit monitors:

- BIT9.OW The bit is active when the actual value crosses the upper warning limit.
- BIT9.UW The bit is active when the actual value crosses the lower warning limit.
- BIT9.OG The bit is active when the actual value crosses the upper danger limit.
- BIT9.UG The bit is active when the actual value crosses lower danger limit.

Miscellaneous:

- MP1 Actual value of the outer loop controller
- MP2 Setpoint of the outer loop controller
- MP3 Control deviation of the outer loop controller
- MP4 Input of the summator in branch 5

Note: The bits BIT9.SOG to BIT9.SUG are not evaluated by the standard function block (Section 4.13).

4.12.5.10 Branch 10: Actual speed value

Function:

The actual speed value can be input via an analog input channel (ADC3) as a tacho voltage or via the pulse detection input as a pulse sequence. If required, the filter block can be used to smooth the actual value. Then the signal is multiplied by a constant (CON10.1). If relay REL10.1 is inactive, the result of the multiplication in the case of a speed control system goes to branch 5, in the case of velocity control to branch 3.
If the actual value is obtained in the form of a pulse train (S10.1 = 1), a decision must be made, using S10.4, whether to use single-channel internal pulse acquisition or one channel (1 or 2) of the external **IP 240** input/output module.

- For internal pulse acquisition, a digital tachometer is connected to the 25-way Cannon connector on the frontplate of the IP 252.
- If the IP 240 external counter module is used for digital actual value acquisition (S10.4 = 1), the slot-coded I/0 address (128 to 252) and the channel no. (1 or 2) must be specified as well as the sensor pulses per rev/100 and the nominal speed in rev/s. An IP 252 can access several IP 240s. **However,** only one IP 252 can access both channels of an IP 240!
  This backplane bus access is only possible in the S5-115U programmable controller, with the IP 252 connected directly adjacent to the CPU (see also Section 4.9).

For display purposes the actual speed value (MP12) is processed further. It is multiplied by a constant (CON10.3), then transmitted via the display block and output via the analog output channel DAC1.

If relay REL10.1 is active, the constant CON10.2 goes to branch 3 or branch 5.
Relay REL10.1 is used during start up.

The display and filter blocks are described in Section 4.12.6.4.

Input variables:

- CON10.1 The constant is used for normalizing the actual speed value.
- CON10.2 This value can be input for commissioning purposes via relay 10.1.
- CON10.3 The constant is used for calibrating the display via DAC1.
- CON10.4 Rated speed in revolutions per second.
- CON10.5 The number of index lines divided by 100. Both constants CON10.4 and CON10.5 are used for calibrating the digital actual speed value input. At rated speed the block outputs 100% (example: CON10.5 = 5 ≙ 500 index lines).
- CON10.TVZ Input variable of the smoothing block, see Section 4.12.6.2.
- ADC3 Address of the analog input channel used for sensing the tacho voltage.
- DAC1 Address of the analog output channel used for displaying the actual speed value.
- REL10.1 When active, this relay activates constant CON10.2.
- ADR.K Address of the external IP 240 counter module and channel no.

Output variables:

- MP12 This is the **processed** actual speed value.
  It is either the input of branch 3 or branch 5. In addition the value can be output via an analog output channel.
- MP21 Actual value display

4.12.5.11 Branch 11: Actual armature current value

Function:

The actual value of the armature current is input via ADC4. It should be routed via input terminals 3 and 4 (channel 1) since actual value filtering is possible here in the terminal block.
Using the armature current, a thermal monitoring of the motor is possible (S11.2 active). For this purpose the armature current is substituted in an equation. This equation generates the approximate temperature response of the armature winding. When the limiting value is reached (CON11.1), bit 11.1 becomes active.
A more detailed description of the equation is given in section 4.15.6.

Input variables:

Thermal monitoring:

- CON11.1 The constant gives the value from which the thermal monitor sets bit 11.1.
- CON11.2 The constant is a characteristic of the motor. It is a criterion for how quickly the motor warms up.

Miscellaneous:

- CON11.3 The constant is multiplied by the armature current when S11.1 is active.
- ADC4 Address of the analog input channel used for the actual armature current.

Output variables:

- BIT11.1 This bit is set, when the thermal monitor has reached the limit CON11.1. When the bit is set, the maximum permitted heating of the armature has been reached.
- MP5 The actual armature current value after multiplication by constant CON11.3. This value is used as the input of the summation stage in branch 5.
- MP13 Actual armature current value input via ADC4.
- MP19 Instantaneous temperature

4.12.5.12 Branch 12: Acceleration compensation

Function:
If rotating masses are accelerated (decelerated), an acceleration (deceleration) torque must be developed by the electric drive. If the rotating mass is connected by a web to a drive with a different mechanical time constant, this can produce variations in tension in the web during acceleration or deceleration. To minimize these variations, the drive is given a current setpoint component dependent on the acceleration torque.
The speed setpoint from branch 5 is differentiated for this purpose. The result is acceleration. It is multiplied with the constant CON3.1 and transmitted to branch 1 as acceleration current.

Input variables
- CON3.1 The constant determines the influence on the current setpoint
- MP20 Velocity setpoint from branch 5

Output variables
- MP7 Size of the current setpoint components

4.12.5.13 Branch 13: Limit monitor 1

Function:

The limit monitor monitors the value at any desired measuring point. A maximum of **six** limits can be used. The no. of the monitored measuring point can be modified in the RUN mode of the IP at any time.
The function is described in detail in **Section 4.12.6.7.**

Input variables:

- MP No. No. of the measuring point to be monitored (1 ... 29)
- CON13.1
- CON13.2
- CON13.3
- CON13.4
- CON13.5
- CON13.6

} maximum of 6 limit values

- CON13.7 Number of limiting values

Output variables:

- BIT13.1
- BIT13.2
- BIT13.3
- BIT13.4
- BIT13.5
- BIT13.6

} maximum of 6 output bits

4.12.5.14 Branch 14: Limit monitor 2

Function:

The limit monitor monitors the value at any desired measuring point. A maximum of **six** limits can be used. The no. of the monitored measuring point can be modified in the RUN mode of the IP at any time.
The function is described in detail in **Section 4.12.6.7.**

Input variables:

– MP No.	No. of the measuring point to be monitored (1 ... 29)
– CON14.1	maximum of 6 limit values
– CON14.2	
– CON14.3	
– CON14.4	
– CON14.5	
– CON14.6	
– CON14.7	Number of limiting values

Output variables:

– BIT14.1	maximum of 6 output bits
– BIT14.2	
– BIT14.3	
– BIT14.4	
– BIT14.5	
– BIT14.6	

4.12.5.15 Branch 15: Measuring socket

Function:

The value of any desired measuring point can be output via an analog output channel. The no. of the measuring point can be modified any time during the RUN mode of the IP.

Input variables

– MPNR	No. of the measuring point to be output (1 to 29)
– REL15.1	When activated, the relay releases the selected measuring point for further processing.
– CON15.1	Multiplication of the MP value with −99.99 to +99.99
– CON15.TVZ	Filter time constant (see Section 4.12.6.2)
– DAC3	Analog output channel at which the value of the measuring point is to be output.

Output variables

– MP22	Value output at DAC 3

4.12.5.16 Branch 16: Arithmetic

Functions:

The "Arithmetic" branch offers the facility of gating signals logically. The signal may come from various sources, depending on how the ADC has been initialized:

1.) The ADC is initialized with a channel no. 0 to 7 (internal IP 252 converter) or 128 to 254 (external analog input modules in the case of the S5-115U).

2.) The ADC is initialized with the controller no. and measuring point no. of a controller 1 to 8 of the IP 252.
A signal is supplied which is at a random measuring point of random controller 1 to 8 of this IP 252.

3.) The ADC is **not** initialized.
In this case, a value can be supplied by the S5 CPU via the data handling function (see Section 5.2.3.2).

If branch 16 (ST 16 = 1) is configured, each of the eight functions of addition, subtraction, multiplication, division, absolute value generation, reciprocal value generation, conversion and comparison can be selected exactly once per controller 1 to 8 of the "DRS" structure. The operations can be nested. This means, for example, that two signals can first be multiplied and the result can be subtracted from a third signal etc. In order to avoid unnecessary dead times here, please note that the operations are processed by the IP 252 in the order detailed above. If the results of branch 16 of other controller nos. are used, the following also applies here: controllers 1 to 8 are executed chronologically (i. e. controller 1 first).

The **precision of the arithmetic operations** is determined by the format of the input signal and the result. The format is 16-bit fixed point two's complement with a value range of -16384 to +16383 (correspondig to -100% to +100%).

The results of the operations are displayed at one measuring point each for further processing. This measuring point can be read in by other branches of controllers 1 to 8 wherever an **ADC channel** has been initialized with "Controller no. and measuring point no.".

The **Comparator** implements a special function (S16.8 active):

One of the signals detailed in 1.) to 3.), e. g. the result of the subtraction in MP 24, is available at ADC 19 and if relay 16.1 is energized, is routed to a comparator with hysteresis. Depending on the parameters of this comparator (upper and lower response threshold of the Schmitt trigger), signal status "0" (not yet triggered) or signal status "1" (triggered) is generated. This result can be inverted if required (S16.9 = 1), and is then flagged at BIT16.1. The result ("0" or "1") is simultaneously routed to an arbitrary input bit or relay of branch 1 to 17 **of this controller.** This is dore by specifying the relevant branch and bit no. If S16.8 is active, the position of REL16.1 will decide whether the bit specified in the particular branch is influenced by the programmer or the S5 CPU (REL16.1 inactive) on the one hand, or by the result of the comparison (REL16.1 active) on the other. The upper and lower response thresholds of the Schmitt trigger can be entered in the format −100% to + 100%. Meaningful entries are in the range 0 ≤ AB ≤ AN ≤ 100%. Negative entries from CON16.AN and CON16.AB are treated as positive entries by the IP 252.

Input variables

– ADC 8	Channel 1 of the addition
– ADC 9	Channel 2 of the addition
– ADC10	Channel 1 of the subtraction
– ADC11	Channel 2 of the subtraction
– ADC12	Channel 1 of the multiplication
– ADC13	Channel 2 of the multiplication
– ADC14	Channel 1 of the division
– ADC15	Channel 2 of the division
– ADC16	Input channel of the absolute value generation
– ADC17	Input channel for generating the reciprocal value
– ADC18	Input channel for conversion (multiplication with [–1])
– ADC19	Input channel of the comparator
– CON AN	Upper response threshold of the Schmitt trigger
– CON AB	Lower response threshold of the Schmitt trigger
– REL16.1	Comparator enable
– Z.B	Branch and bit no. of affected by the comparison result

Output variables

– MP23	Result of the addition
– MP23	Result of the subtraction
– MP23	Result of the multiplication
– MP23	Result of the division
– MP23	Absolute value of the input variable
– MP23	Reciprocal value of the input variable
– MP23	Input variable multiplied by [–1]
– BIT16.1	Result

4.12.5.17 Branch 17: Self-optimization

Optimization of the speed controller is a problem when starting up drive control systems.

A procedure based on the guidelines of the symmetrical optimum is available here for the self-setting of speed controllers. This procedure first determines the parameters of a PI controller K_P and T_N and of a setpoint filter. The parameters found are post-optimized to the **desired target response** by simulation in the IP 252 and subjected to thorough final testing.
The desired **target response** (transient response or overshoot) can be varied with the help of a presettable parameter.

A precise description of the self-setting feature can be found in Section 4.12.7.3.

4.12.6 Functions of the drive controller

4.12.6.1 Pre-assigned limit monitors in branches 5 and 9

The results of these limit monitors are used by a CP 526 for display purposes. The output bits **cannot** be read from the standard FB used with the logic program (Section 5.1).

Function of the actual value limit monitor:

Four limits can be specified via the PG:

- Upper warning limit
- Lower warning limit
- Upper danger limit
- Lower danger limit

Each of these limits is assigned a bit. If a signal **crosses** the **upper** warning/danger limits, then the "upper warning/danger limits crossed" bits are set. In all other cases they are reset. When the signal crosses the **lower** warning/danger limits, then the "lower warning/danger limits crossed" bits are set. In all other cases they are reset.

Function of the setpoint limiting monitor:

Two limits can be specified via the PG:

- Upper limit
- Lower limit

Both limits are assigned two bits. When the **upper** limit is **crossed** the "upper limit crossed" bit is set, otherwise it remains reset. When the **lower** limit is crossed, the "lower limit crossed" bit is set, otherwise it is reset (Fig. 4.44).

Example: Setpoint limit monitor

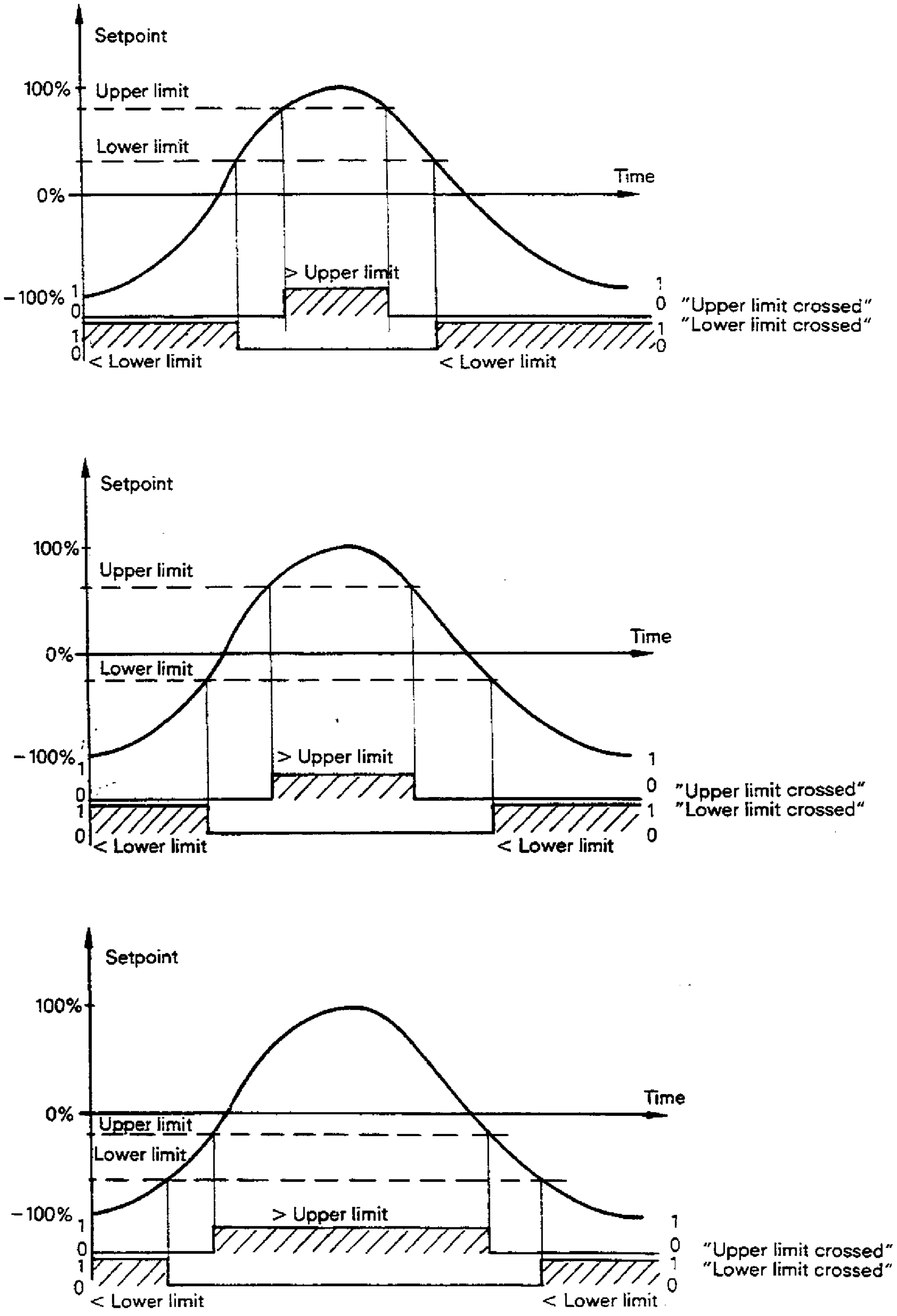


Fig. 4.44 Method of operation of the pre-assigned limit monitor

4.12.6.2 Filter block (see Fig. 4.6)

Function:

The filter smoothes an analog variable using a **first** order delay function.

Explanation of function parameters:

Type of variable	Symbol	Description	Number format	Setting range
Parameter	TVZ	Filter time constant	Time	4 ms to 99h 59min

Explanation of function input/output variables:

Type of variable	Symbol	Description	Number format	Setting range
Input variable	X (t)	Function input variable to be filtered	variable-dependent	–100% to +100%
Output variable	Y (t)	Filtered function output variable	variable-dependent	–100% to +100%

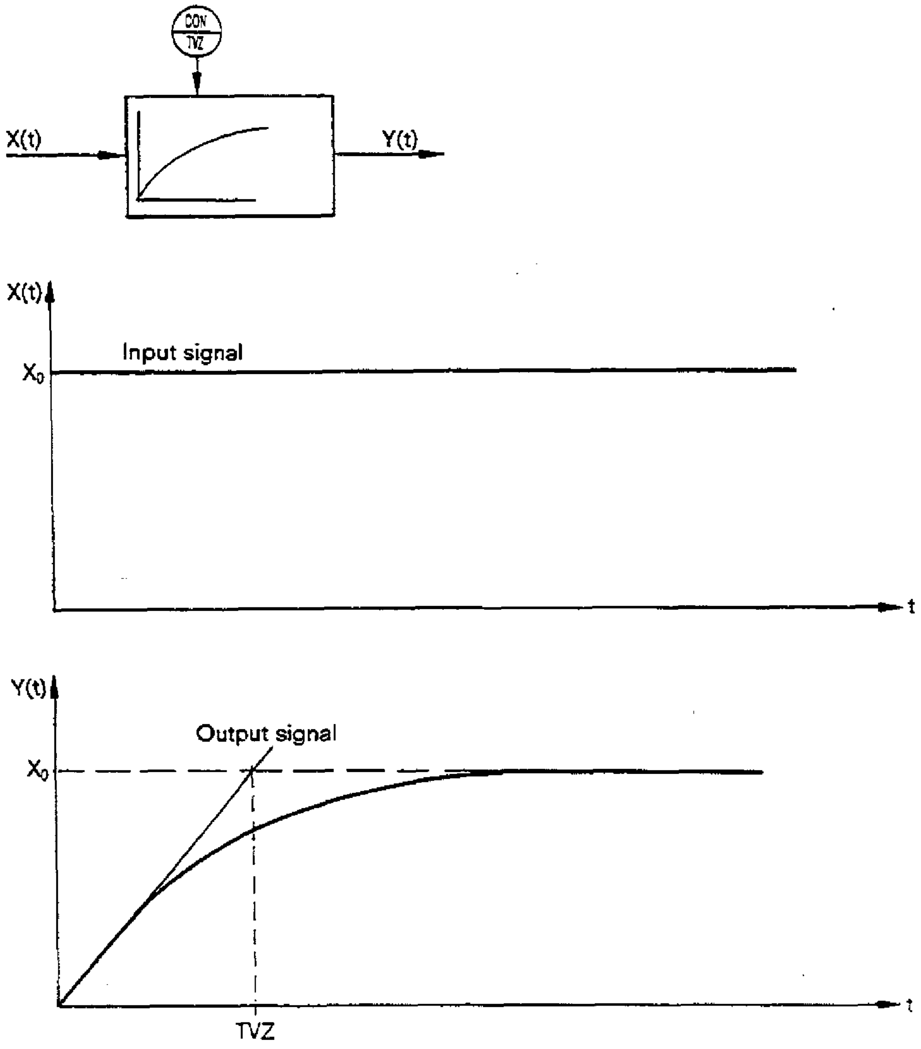


Fig. 4.7 Filter function

12.6.3 Ramp-function generator

nction: (Fig. 4.46)

e ramp-function generator produces a **ramp** as the output signal y(t) from an input step change x(t).

The **slope** of the **positive ramps** is determined by the constants (ZUW, TH) and of the **negative ramps** by the constants (ZUW, TR).
Positive ramps are where the output value y(t) changes towards **increasing** speed (±100%). Negative ramps are where y(t) changes towards **decreasing** speed (±0%).

The constant ZUW (increment) specifies the percentage value which is reached after expiry of the negative (TR) or positive (TH) ramp times, when a 100% step is connected to the input of the ramp-function generator.

In Fig. 4.46 (diagrams 1 to 4) several examples are included. They illustrate the influence of the constants ZUW, TR and TH.

- The ramp-function generator **takes into account the actual value** when S8.3 is active. This guarantees the fastest possible trakking of the setpoint y(t) by the actual value i(t). When **ramping down,** the actual value is taken into account, if it is less than the momentary ramp value calculated by the ramp-function generator. When **ramping up,** the actual value is taken into account if it is greater than the momentary ramp value calculated by the ramp-function generator. This procedure is explained in Fig. 4.47 (diagrams 1 to 5).

- Fig. 4.48 shows how the ramp-function generator behaves if the input signal is changed **before** the output signal has reached its final value.
  The actual value is also taken into account here.

Explanation of the function parameters and the binary variables:

Type of variable	Symbol	Description	Number format	Setting range
Parameter	KONTH	Ramp-up time	Time	0.1 ms to 99h 59min
	KONTR	Ramp-down time	Time	0.1 ms to 99h 59min
	KONZUW	Ordinate of the ramp-function generator value, i. e. the ramp value reached in the time TH or TR with 100% input step change (thus determining ramp slope)	variable-dependent	0 to +100%
Binary input signals	BITHOE	"Higher" bit, BH = 1 causes rising ramp.	Bit	0/1
	BITTIE	"Lower" bit, BT = 1 causes falling ramp.	Bit	0/1
	BITAUT	Automatic bit, BL = 1 causes switch from manual to automatic mode	Bit	0/1
	BITNUL	Zero bit, NUL = 1 brings the setpoint down to 0%		

Explanation of the function input/output variables:

Type of variable	Symbol	Description	Number format	Setting range
Input variables	X(t)	Current setpoint	variable-dependent	−100% to +100%
	i(t)	Current actual value (MP12 or MP16)	variable-dependent	−100% to +100%
Output variable	Y(t)	Output value (ramp value)	variable-dependent	−100% to +100%

4.12 Description of the Drive Controller Structure with Self-Optimization (DRS)

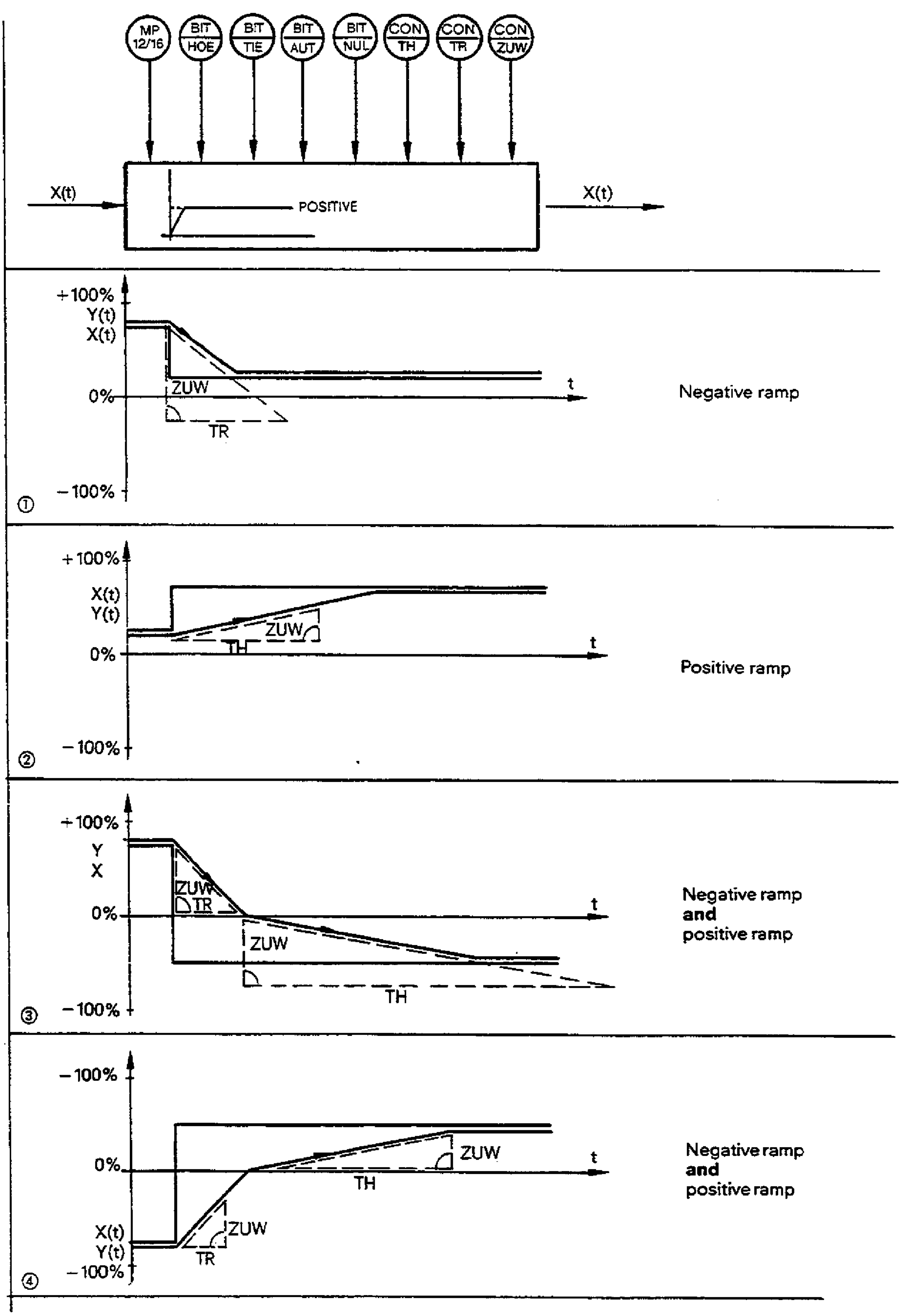


Fig. 4.46 Ramp-function generator for drive controller
Assumption: Actual value referencing not sensible or S8.3 = 0!

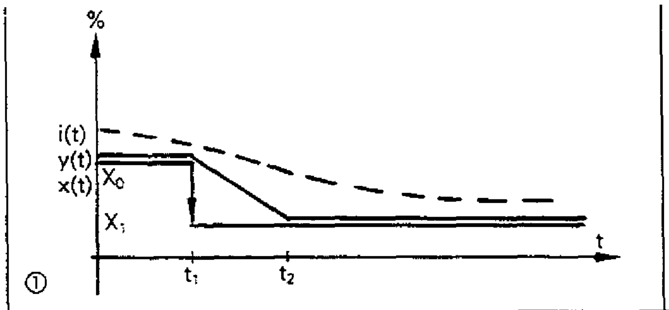
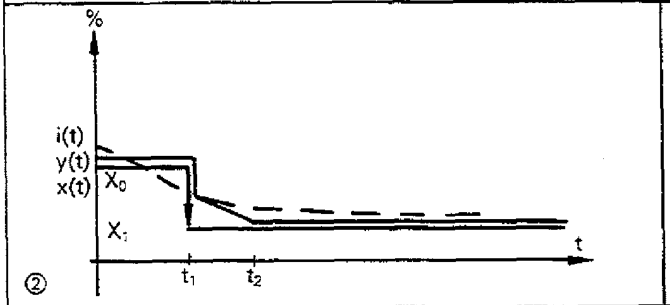
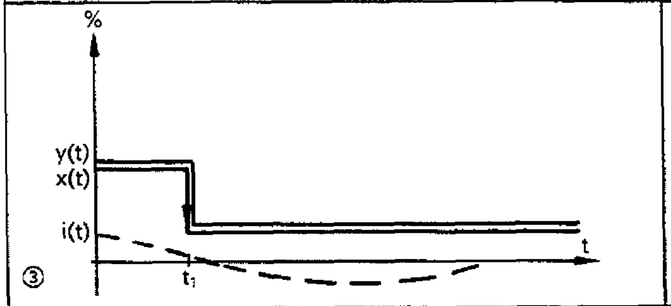
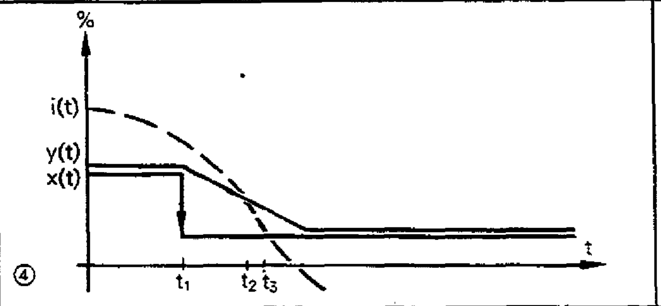
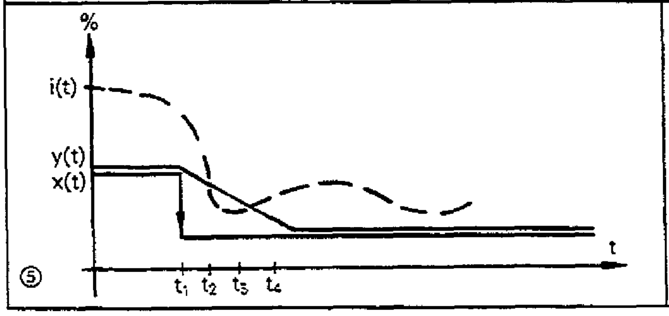
	The actual value is larger than the ramp y(t). ==> **No** actual value referencing
	At instant t_1, the actual value is between x_0 and x_1 ==> Actual value referencing
	At instant t_1, the actual value is below x_1 ==> Actual value referencing
	At instant t_2, the actual value intersects the ramp y(t) ==> No actual value referencing
	The actual value sinks below the ramp value at t_2 ==> No actual value referencing

Fig. 4.47 Ramp-function generator
Assumption: Actual value referencing

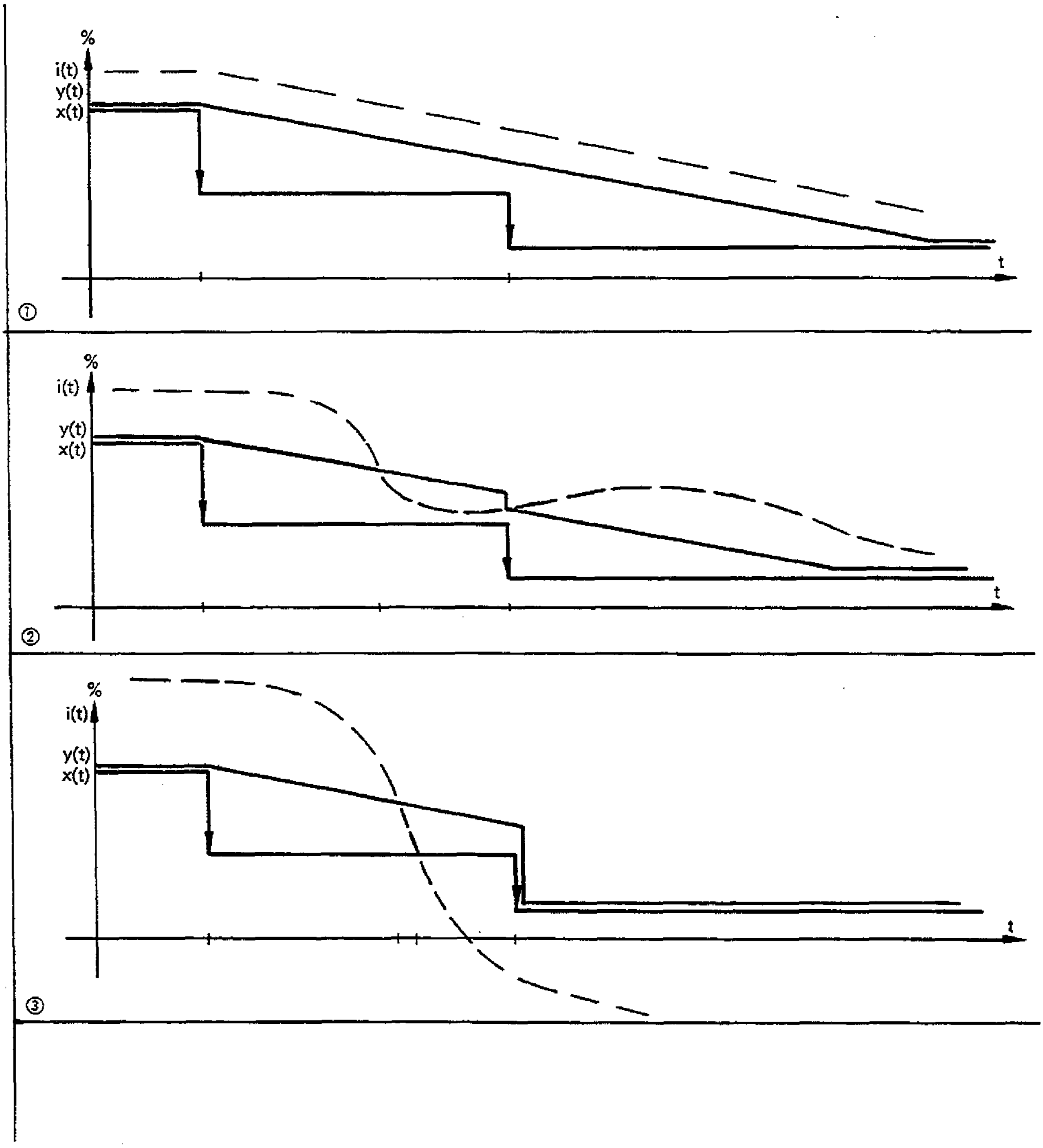


Fig. 4.48 Ramp-function generator
Changing the input before the output has reached its final value, S8.3 = 1 is assumed

- The ramp-function generator has four binary input signals with which the output y(t) can be influenced (independently of the input x(t)).
- If the HOE bit is active, then the output y(t) ramps to the +100% limit. The actual value is **not** taken into account (MPx).
- If the TIE bit is active, then the output ramps to the −100% limit. The actual value is **not** taken into account.
- If the HOE and TIE bits are both active simultaneously, then the output remains at the last value;
  i. e. no ramp is generated
- If the AUT bit is active, a change is made from manual to automatic mode (i. e. the setpoint is approached via the preset parameters T_H, T_R and ZUW) provided the HOE and TIE bits are inactive.
  Here,the actual value is taken into account if S8.3 is active.
- The HOE and TIE bits have priority over the LOE bit.
- The NUL bit has the highest priority. If it is active, the 0% setpoint is immediately approached at the preset ramp rate of rise. The actual value is not taken into account.

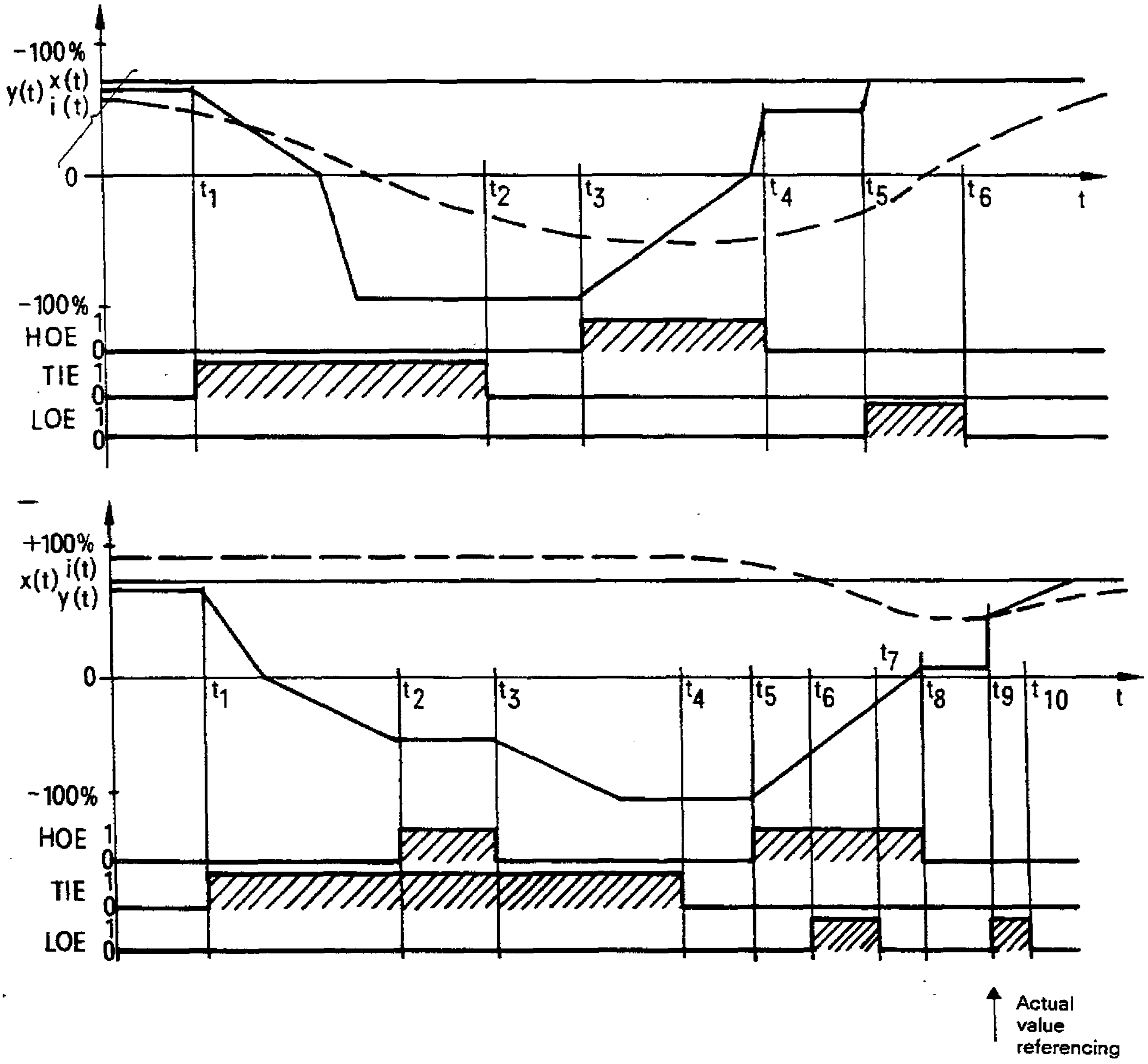


Fig. 4.49 Ramp-function generator
Function of HOE, TIE and AUT bits

4.12.6.4 Display

Function:

When active, this function diplays only the lower eight bits of the actual speed value.

4.12.6.5 Characteristic curve

Function:

The characteristic curve stage transforms an analog input variable x (field current) into an analog output variable y.
The function y = f(x) used has the following characteristics:

– Linear range

$y \geqq 0$ for $0 \leqq x \leqq 100\%$

$y = 0$ for $-100\% \leqq x \leqq 0\%$

$y = 3/2\,x$ for $0 \leqq x \leqq \frac{100}{3}\,\%$

– Parabolic region

$y = -\frac{9}{800}(x-100)^2 + 100$ for $\frac{100}{3}\% \leqq x = \leqq 100\%$

The curve is shown in Fig. 4.50.
The curve is also called the **normalized excitation curve.** It represents the relationship between the field current and the flux of a d. c. motor. The curve is an **approximation** which is valid for most d. c. motor types.

4.12 Description of the Drive Controller Structure with Self-Optimization (DRS)

Value table:

Field current x	Flux y
0%	0%
10%	15%
20%	30%
30%	45%
33⅓%	50%
40%	59,5%
50%	72%
60%	82%
70%	90%
80%	95,5%
90%	99%
100%	100%

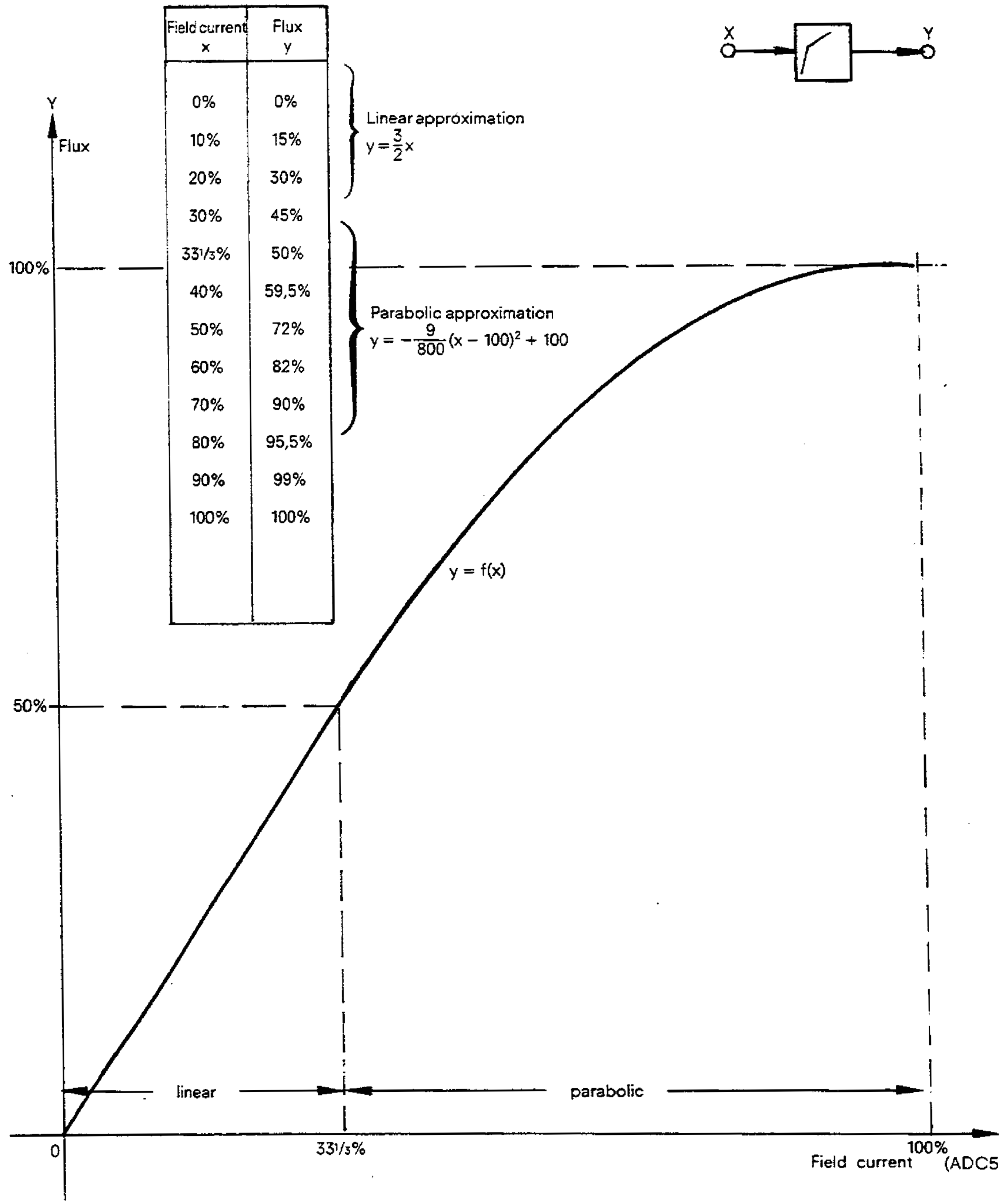


Fig. 4.50 Normalized excitation curve

4.12.6.6 Thermal monitoring

When current flows through an electrical machine, the temperature rise can be described approximately by the e function. This "thermal image" is used to regulate the temperature rise in the machine in a calculation involving the armature current and the constant KON11.2 (thermal time constant) according to the following equation

Temperature rise = $i^2_{armature} \cdot (1 - e^{-\frac{t}{T}})$.

If the permissible temperature limit (temperature : MP19) is exceeded, bit 11.1 is set. The temperature limit is specified with the constant CON11.1. A temperature limit is selected such, that under operating with nominal current, the temperature limit is never quite reached (or theoretically would be only after an infinite period). Cooling is expressed by the equation $i^2 \cdot e^{-\frac{t}{T}}$.

Example:

Nominal thyristor current	= 500 A ≙ 10 V I_{IST} ≙ 100%
Nominal motor current	= 400 A ≙ 8 V I_{IST} ≙ 80%

Thermal time constant: 30 min (CON 11.2)

Temperature rise curve with nominal current:

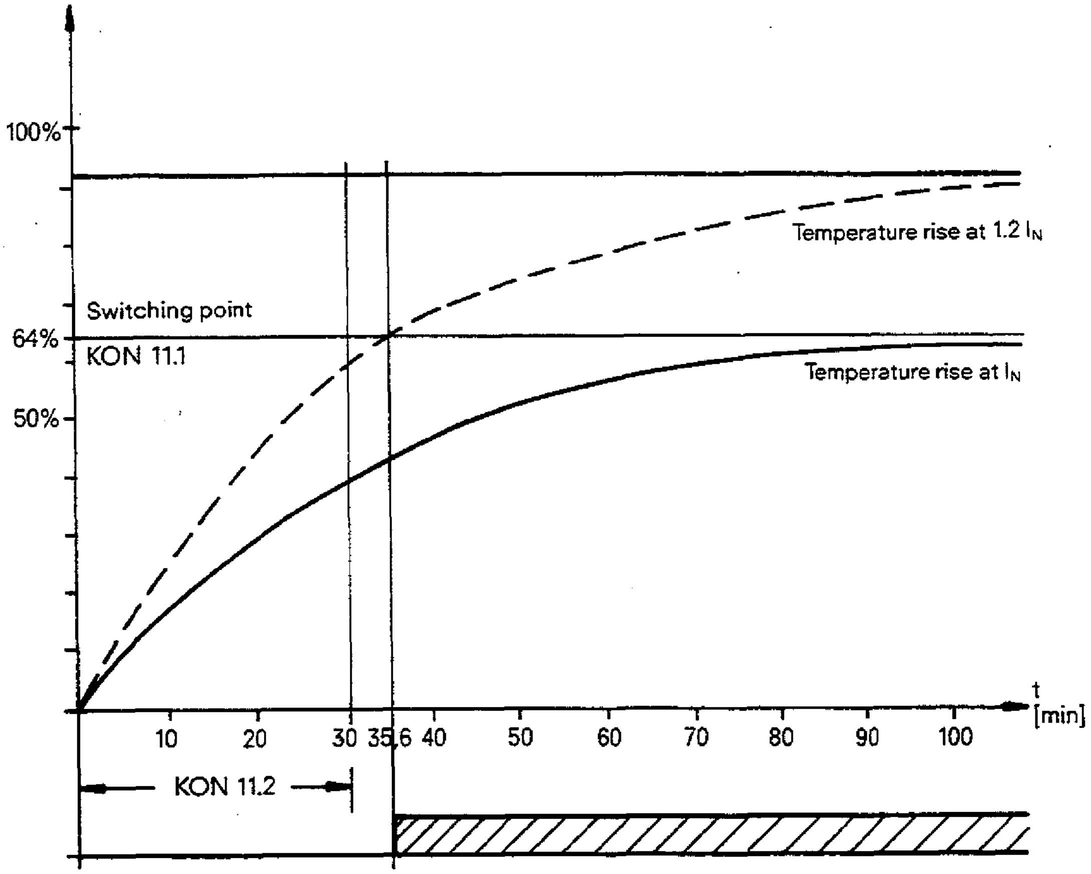
Temp. rise = $i_N^2 \times (1\text{-exp} - \frac{t}{30\,\text{min}}) = \frac{80 \cdot 80}{100}\% \; (1\text{-exp} - \frac{t}{30\,\text{min}}) = 64\,\% \; (1\text{-exp} - \frac{t}{30\,\text{min}})$

Temperature rise curve at, e. g., 1.2 I_N = 480 A (= 96%)

Temp. rise = $92.16\,\% \; (1\text{-e} - \frac{t}{30\,\text{min}})$

It can be seen from Fig. 4.51 that, when operating with 1.2 x I_N, bit 11.1 is set after approximately 36 minutes. The temperature rise value is only reset when the module is in STOP mode. If the IP RAM has battery backup, the old value will be retained on restart after power failure.

Temperature rise of the armature winding



$$i^2 \cdot (1 - e^{-\frac{t}{x}})$$

Temperature rise equation

i Armature current
x Thermal time constant CON11.2
t Time

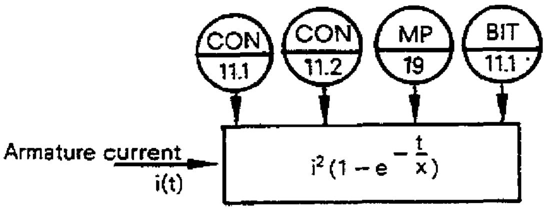


Fig. 4.51 Thermal monitoring

4.12.6.7 Limit monitor

Function: (Fig. 4.52)

The value of a measuring point MPx is checked against six limit values GW(i).
If for positive limit values MPx > GW(i)
or for negative limit values MPx < GW(i),
then the corresponding limit value bit B(i) is set.

- Limit (i) $\geqq$ 0: MPx $\leqq$ Limit (i) — B(i) = 0
  MPx > Limit (i) — B(i) = 1
  for 1 $\leqq$ i $\leqq$ N
- Limit (i) < 0: MPx $\geqq$ Limit (i) — B(i) = 0
  MPx < Limit (i) — B(i) = 1
- The number N of limit values is defined by:
  1 $\leqq$ N $\leqq$ 6
- Unused limit value bits are set to zero:
  B(i) = 0 for i > N

Explanation of function parameters:

Type of variable	Symbol	Description	Number format	Setting range
Parameter	CON 13.7 (or 14.7) CON 13.1 (or 14.1) : : CON 13.6 (or 14.6)	Number of preset limit values Limit value 1 : : Limit value 6	no unit variable-dependent (or %) : :	1 to 6 −100% to +100% : :

Explanation of function input/output variables:

Type of variable	Symbol	Description	Number format	Value range
Input variable	Xe	Input value to be checked	variable-dependent (or %)	−100% to +100%
Binary output signals	Bit 13.1 (or 14.1) : : Bit 13.6 (or 14.6)	Limit value bit 1 : : Limit value bit 6	Bit : : Bit	0/1 : : 0/1

4.12 Description of the Drive Controller Structure with Self-Optimization (DRS)

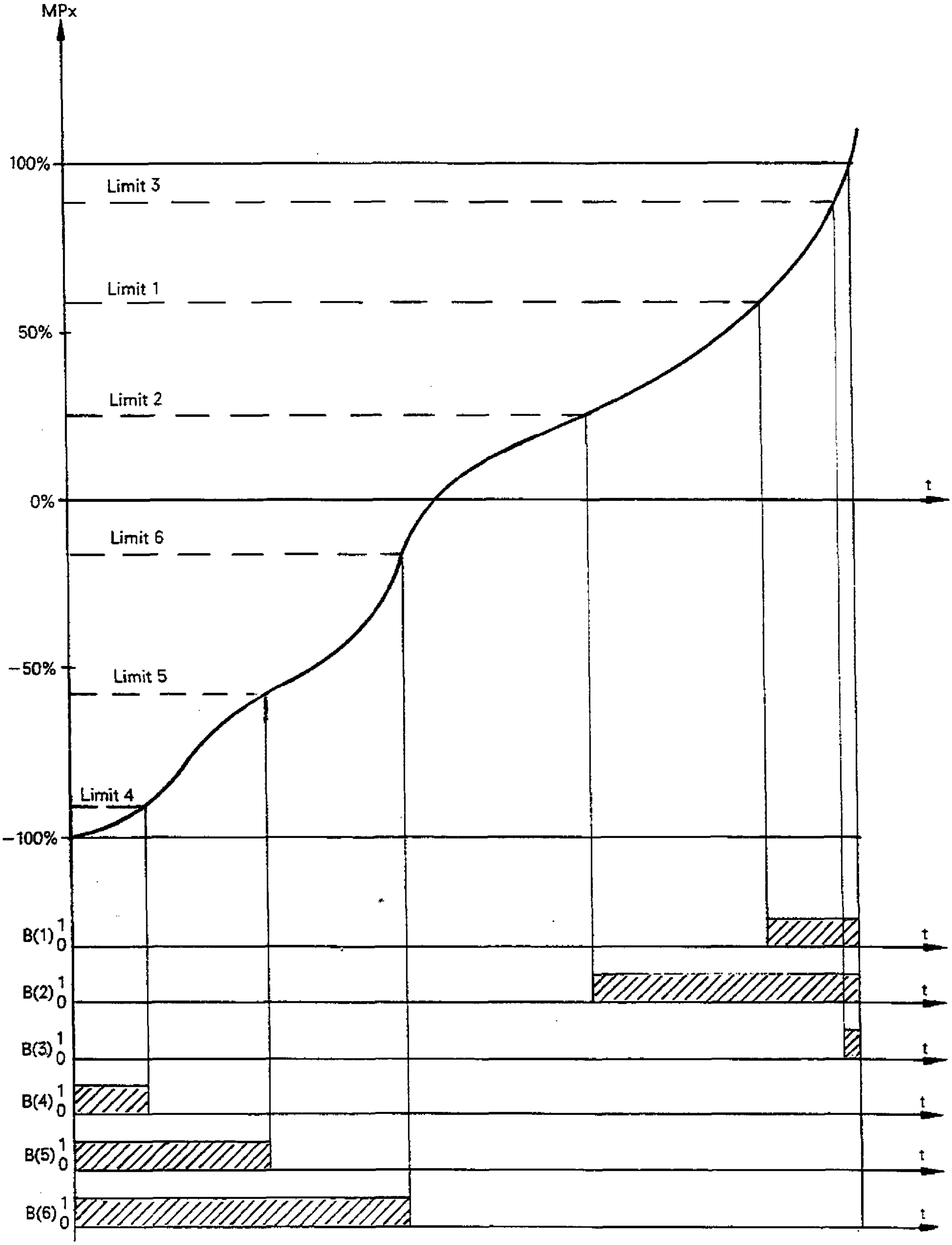


Fig. 4.52 Limit monitor of the drive controller structure

4.12.7 Speed controller self-optimization

A large number of applications of the **DRS** drive controller structure of the IP 252 (various coiling mechanisms, centrifuges, calenders and hoists) have more or less rigid mechanical conditions in the speed loop and display a relatively simple unified basic structure.
For applications of this type, the structure has been equipped with a start-up procedure for the speed controller. In conjunction with the on-line adaptation of the drive controller structure (see branch 4: Influencing the loop gain), the procedure can also be used for controlled drive systems with variable moments of inertia.
The controller parameters can be determined in this way without lengthy trail and error, whereby only limit data for the protection of the motor and the machine need be specified as input variables for optimization. The dynamics of the controller setting can be influenced with the help of a further parameter.
This section is concerned with the principle and operation of the procedure and the preconditions for its use.

4.12.7.1 Performance range and area of application

The procedure is suitable for use in the speed control of DC shunt-wound motors with secondary current control loop corresponding to Figs. 4.61 and 4.62.

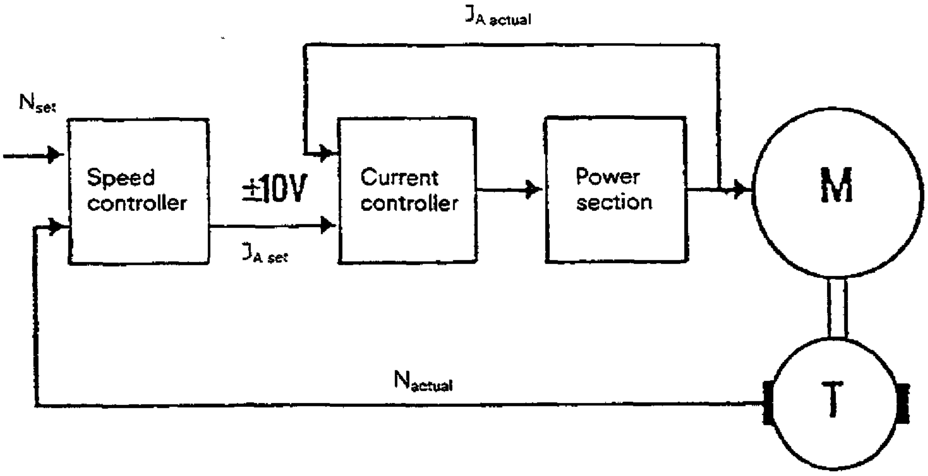


Fig. 4.61 Drive control system

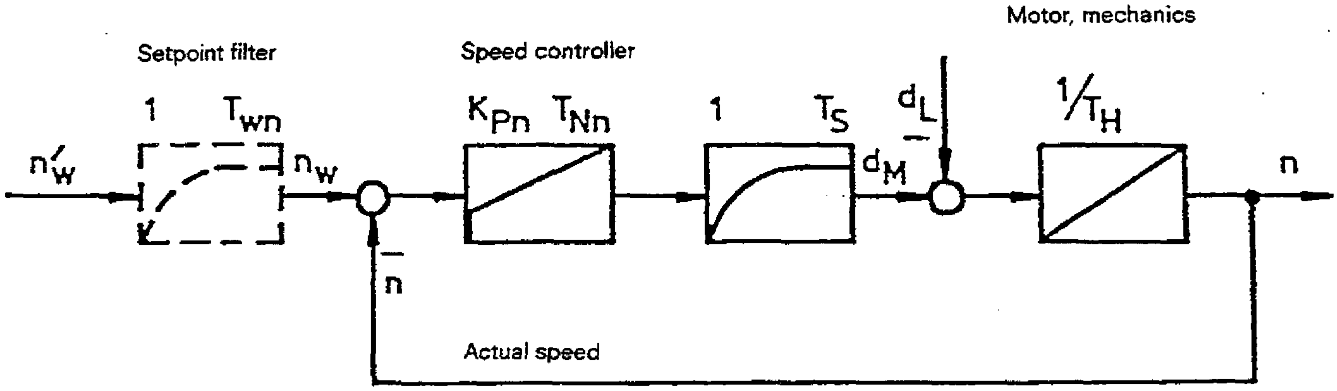


Fig. 4.62 Simplified block diagram of the speed control loop with secondary current controller and filter element (rigid mechanics)

4.12 Description of the Drive Controller Structure with Self-Optimization (DRS)

The gain and integral action time for the speed controller are to be found in the preconditions outlined below, as well as (if configured) the time constant for a PT_1 element, through which the setpoint of branch 8 is supplied.
4 ms or 8 ms can be selected as the sampling time of the speed controller. For greater sampling times, Section 4.12.7.5 contains appropriate conversion formulas.
The values of the constants and the position of the configuring switch set by the user are taken into account, insofar as these have an influence on the system.

Control and monitoring functions

The self-optimizing procedure consists of an **identification phase,** in which the behaviour of the controlled system is determined by acceleration attempts, and an **optimization phase,** in which the control parameters are determined from the measuring signals acquired.
Control of the individual steps of the procedure and avoidance of impermissible machine states are the task of the **sequence control**, which is also a component of the DRS structure. During the acceleration test runs in the identification phase, any exceeding of a speed limit (armature current dependent) is prevented and, if required, adherence to position limits is ensured. The parameters established in the self-optimizing procedure are subjected to a validity check, based on simulation of the controller behaviour in the IP 252 and comparison with a reference model, before they are presented to the user. It is also possible, after finishing the optimization run, to represent the target response and the simulated response of the closed loop control using a programmer with graphics capability and the appropriate software (COM REG GRAPHICS, see Section 7).

4.12.7.2 Preconditions for use

This section describes the preconditions for use of the procedure.

Current controller, static converter

The characteristics of the system consisting of static converter motor must be largely independent of the operating point throughout the useful speed range. This assumes converter sets in inverse-parallel connection with or without circulating current, and adaptation of the curent controller to the response of the armature loop modified in pulsating-current operation.
Torque reversal must be possible. The current control loop should exhibit no more than 10% overshoot for optimum results, which is usually the case. When using single-phase static converters in conjunction with very short mechanical acceleration times, it is necessary to use anticipatory EMF control (standard with all SIMOREG devices).

Motor and mechanics

It must be permissible to accelerate the system to be identified with constant torque.

The load and the speed sensor must be connected to the driven machine as rigidly as possible and with minimum backlash. Consequently, a suitable, programmable filter must be configured by the user and a correspondingly slow response for optimization must be set. The lowest mechanical natural frequency of the system must at all costs be clearly higher than the limiting frequency of the current control loop and the actual value acquisition system. During the identification process the load torques must be kept approximately constant.
The rotating mass and the accelerated mass must be maintained at a constant level, as must the field current. Strong speed-dependent load torques, as for example an unusually high friction torque or fluctuating external load torques, are not detected in the identification phase and can therefore lead to incorrect results.

Changes in the plant or controlled system parameters in on-line operation

The controller setting for constant plant (controlled system) parameters is made with the control loop open. However, in many drive systems, these parameters change in the course of operation.
The on-line adaptation capability of the **DRS** structure or parameter-insensitive optimization of the control loop permit the use of the self-setting function also in field weakening operation or in the case of a variable rotating mass during coiling operations (Section 4.12.7.3).

Parameter range

The acceleration time of the motor with the driven machine connected must be under 4 seconds for numerical reasons. Mechanical transients must have decayed at the latest after 400 ms at a sampling time of 4 ms or 800 ms at a sampling time of 8 ms.

Permissible loading of the IP 252

When using automatic self-start up, no more than two controllers can be programmed on the IP 252 due to restricted memory space. Controllers 1 and 2 are permitted. Otherwise, the self-setting routine cannot be called. If an impermissible controller no. is used, the relevant error message is stored in the IP 252.
The sampling time of the speed controller can be selected at 4 ms or 8 ms. During the identification and optimisation process of a control loop, the IP can service no other controllers. Updating of the measuring sockets is not possible. Old values may be displayed under certain circumstances in the "Controller test" function of the COM packages.

The setting procedure

By measuring the reaction of the drive system to sudden changes in excitation under constant load conditions the setting procedure used obtains a non-parametrical description of the response of the controlled system in the form of the step-function response, which implicitly contains all the parameters important for controller setting, such as the small time constants and the system order. This presupposes that, during the identification process, the friction can be neglected and external load torques remain constant.
On the basis of this model, a robust controller setting is determined, the dynamic response of which can be adapted to the mechanical conditions by the user. The setting determined is then tested by simulation in the IP 252.
The identification process for the speed system must be carried out at constant field and with a constant rotational mass.

4.12 Description of the Drive Controller Structure with Self-Optimization (DRS)

The required parameters are obtained in the following steps:

a) Determination of a **constant** external load torque and deceleration

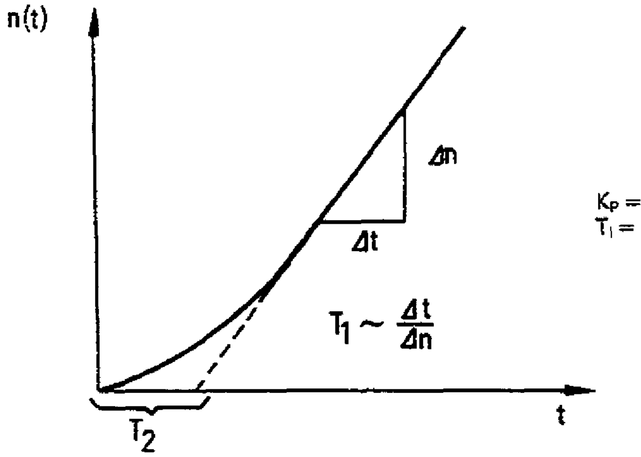
By adjusting the drive to zero speed with the help of a **PI controller** carefully set by the user, an external load torque, which can have a possible effect on the drive, is approximately determined. The controller parameters required for this measurement are non-critical. However, they influence the duration of the measuring operation.
No start parameters need be entered if there is no load torque acting on the motor during the identification process.
Deceleration of the motor is then performed by a **P controller** the gain of which is adapted to the mass moment of inertia during the acceleration phase, in order to shorten this phase as much as possible. The max. deceleration current is determined by the manipulated variable limits "CON5.B+" and "CON5.B–" from branch 5.

b) Determination of the speed step-function response

The system is then accelerated by inputting a constant current setpoint whereby a constant external load torque corresponding to the result from (a) is compensated. The measurement is repeated 16 times in order to suppress measurement noise. If impermissible speeds are reached when doing this, the motor is immediately braked and the process is repeated with lower current setpoints, if it is meaningful to do so. The same applies on exceeding of position limits calculated from the position limits entered by the user, allowing for the braking distance. If the acceleration time is over 1 sec., 32 measurements are executed.
The measurement duration is 400 ms for 4 ms sampling time or 800 ms for 8 ms sampling time. The acceleration characteristics determined over 16 or 32 measurements on the output side of the actual value filter block can be displayed on a programmer with graphics capability or with "COM REG GRAPHIK" software.
A subsequent low-pass filter will produce an initial criterion for the use of the procedure:

The step-function response measured must have approximately IT1 behaviour (Fig. 4.63). If no steady state has been reached, the procedure is aborted with the appropriate error message, since it is then assumed that it cannot be used for one of the following reasons:

- Poorly damped natural oscillations in the controlled system
- Non-compensated EMF influence in the armature circuit
- Changing load conditions during the identification process
- System parameters not constant during the identification process



$$K_P = T_1 \cdot \mathrm{CON17.DV} / (2 \cdot T_2)$$
$$T_I = 4 \cdot T_2 / (\mathrm{CON17.DV})^2$$

Fig. 4.63 Step response of the IT1 element and relevant control parameters for a PI controller set to double ratios (double ratio factor = CON17.DV/2)

c) Calculation of the parameters for the speed controller and setpoint filter

The response of the closed control loop is then tuned to a target function, corresponding to the **double ratio specification,** by means of an optimization procedure using the values determined from the controlled system parameters (Fig. 4.63). The target behaviour can be varied by a parameter, to be set by the user, between the limit case of the "Symmetrical optimum" (double ratio factor = 0.5 or CON17.DV = 100%) and a setting which is infinitely insensitive to parameter variations and mechanical inadequacies of the controlled system at the cost of dynamic response (double ratio factor less than 0.5). A robust controller setting provides the default for this parameter. Depending on the result obtained, this value can be changed empirically towards a slower or more dynamic controller setting (prior to a subsequent optimization run, if necessary). Any dead time due to the discrete processing can be taken into account in the course of the optimization process. The time constant for a configured setpoint filter is obtained direct from the integral action time. Should the target function prove to be insufficiently approachable during simulation in the IP 252, especially if the parameters in Fig. 4.63 are used, the preconditions are obviously not met and the procedure will be aborted with the relevant error message.
The relationship between setting time and the CON17.DV parameter can be seen from Fig. 4.64.

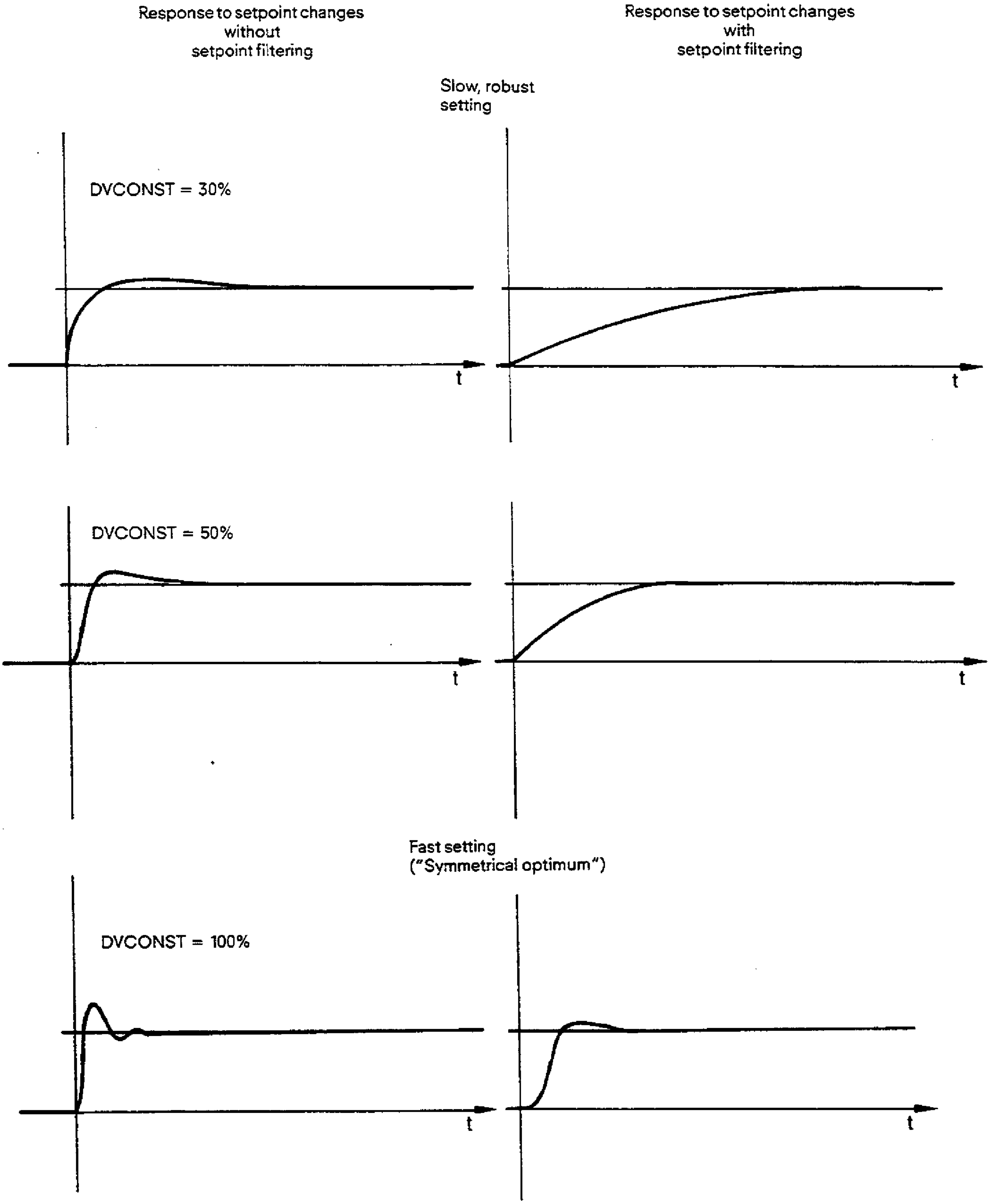


Fig. 4.64 Target behaviour of the self-setting feature for different values of CON17.DV and the influence of setpoint filtering.

4.12.7.3 Speed controller self-optimization in the DRS structure

In addition to the parameters of branch 17, there are also a number of external data of the controller structure, that have an influence on the optimisation process.

- The controller structure must be operated without direct backplane bus access.
- The controller sampling time can be selected at 4 ms and 8 ms.

Constants and configuring switches with influence on optimisation

Branch 1, Controller output:
S1.1 "Conversion"

Branch 4, Adaptation of the loop gain:
At the "Diameter injection" position of switch S 4.1, the initial diameter VAR 3.1 entered before the optimisation run is taken into account.

Branch 5, Speed controller:
KP, TN as initial values, if the shaft is to be identified under load and these values are entered and are not equal to 0.
Upper and lower control limits "CON5.B+" and "CON5.B−" determine the max. acceleration current in the identification phase.

Branch 9, Primary controller:
CON9.IOWL, CON9.IUWL (upper/lower warning limit for actual position) are required, if position monitoring during the acceleration phase is needed.

Branch 10, Actual speed acquisition:
CON10.1, actual value weighting

S 10.1, filter block

CON10.TVZ, if the filter element is selected

S 10.1: analog/digital sensor

On-line adaptation of the parameters found by self-setting

The output variables of branch 3 and 4 can be used to adapt the gain of the speed control loop to field weakening operation or in the event of variable moment of inertia in the case of velocity control. If the conditions listed in the following are satisfied, the setting found by self-start up will also be suitable for these cases.

Field weakening operation

The loss of gain caused by the weakening of the field current can be determined approximately in adaptation branch 4 of the DRS structure via the flux characteristic and can then be used for correcting the loop gain.
The gain is automatically and correctly adapted by branch 4 (flux calculation position) if the identification process is carried out at rated field current.

Variable rotating mass in the case of coiling operations

To adapt the controller setting to the diameter-dependent system gain of the controlled system, it must be made correspondingly robust by defining its target behaviour accordingly.
The weighting of the speed with the diameter estimated in branch 3 of the controller structure gives a proportional growth of the controller gain which acts against the loop gain decreasing with increasing diameter. Where the rotating mass of the coil has a strong influence on the total inertia, this effect can be further amplified with the help of branch 4 "Diameter injection" (or, additionally, with the help of branch 16 "Arithmetic"), in order to achieve a dynamic controller setting.

If, however the load influence on the mechanical inertia is small – for example, as a result of high motor inertia or a gear reduction – control of gain should not be dependent on diameter. In this case, branch 16 may equally well be used.

In order to obtain the fluctuation width of the total gain, several optimization runs are required.

The reaction of the controller to the extreme values of the moment of inertia should in any case be monitored by the user.

Identification must be carried out at full coil diameter. The initial diameter value must be set accordingly (integrator enable disabled) in branch 3 (peripheral velocity). Any diameter-dependent field current control must similarly be set to the coil diameter with which the control system is identified.

Diameter signal injection by branch 3 increases controller gain proportionally to the diameter. Optimization must, however, take place in the direction of a robust controller behaviour, since no complete compensation of the changed system gain can be achieved.

Suitable guide values for the "CON17.DV" parameter can be obtained as per Fig. 4.64. The behaviour of the controller at full and empty coil must be checked by the user, since the control simulation covers only those system conditions existing during the identification procedure. If there is a tendency to oscillation, the CON 17.DV double ratio factor must be further reduced and re-optimized.

Setpoint entry

A filter element can be configured in setpoint branch 8 of the **DRS** drive structure. By using this block, the overshoot in response to sudden changes in the setpoint can be reduced from 50% to less than 5% without affecting the controller response. However, this increases the rise time (Fig. 4.64). Natural oscillations in this system are less markedly excited by step changes in the setpoint.

Operator interface for speed controller self-optimization of the DRS structure with COM REG

The operator interface of the branch for self-optimization on startup is described in this Section. Section 4.12.7.4 contains an application example.

1. Notes on configuring and initializing the controller structure:

The self-optimization on startup function constitutes branch No. 17 of the **DRS** drive controller structure. In the configuring run, configuring switch ST 17 must therefore be set to 1. The controller structure must be operated without direct backplane bus access. The controller sampling time can be selected at 4 ms or 8 ms. In the "Programming of selected branches" function, the following inputs are possible:

a) Monitoring of the commutation characteristic (for protecting the motor during speed system identification):

		Value range	Dimension
Maximum permissible armature current	Imax1:	−100 to +100	%
At speed	N1:	−100 to +100	%
Maximum permissible armature current	Imax2:	−100 to +100	%
At speed	N2:	−100 to +100	%
Maximum permissible armature current	Imax3:	−100 to +100	%
At speed	N3:	−100 to +100	%

4.12 Description of the Drive Controller Structure with Self-Optimization (DRS)

Explanation:

The permissible speed as a function of the current can be obtained from the commutation characteristic represented here by the input of up to three value pairs – speed Nx, armature current Ix – (approximation in the IP 252 by linear interpolation corresponding to Fig. 4.65).

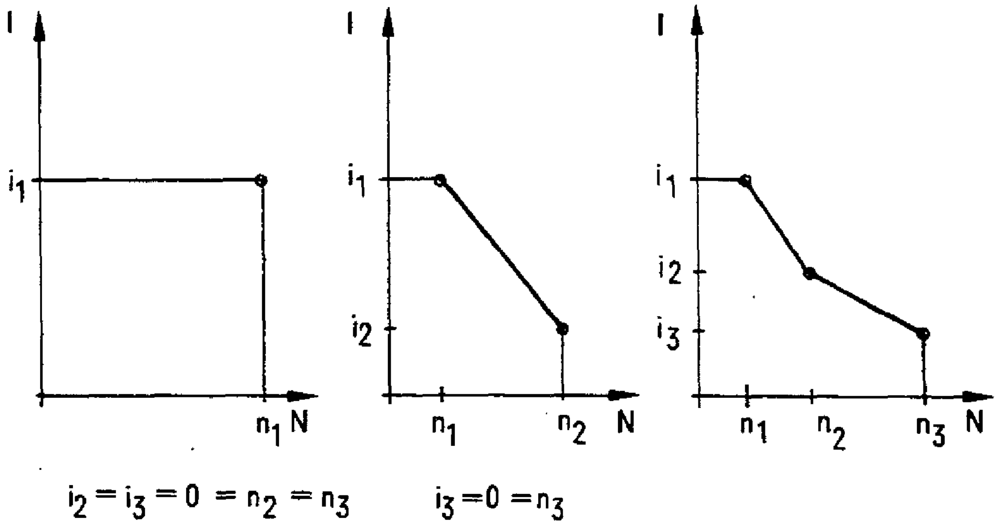


Fig. 4.65 Possible value pairs of the commutation characteristic

2. Notes on startup (controller test) of the controller structure:

In branch 17 the following appears

	Value range	Dimension
Monitoring of position limits? :	0/1	
Sudden setpoint changes in pos. direction? :	0/1	
Sudden setpoint changes in neg. direction? :	0/1	
Double ratio factor KON17.DV :	+5 to +100	%
Self-optimizing enable :	0/1	
Controller gain KP :	−99.99 to 99.99	
Integral action time TN :	0 to 99h 59 min	t
Filter time constant TVZ :	0 to 99h 59 min	t
Accept determined values? :	0/1	
Maximum permissible armature current Imax1:	−100 to +100	%
at speed N1:	−100 to +100	%
Maximum permissible armature current Imax2:	−100 to +100	%
at speed N2:	−100 to +100	%
Maximum permissible armature current Imax3:	−100 to +100	%
at speed N3:	−100 to +100	%

Explanation:

- Monitoring of position limits during the identification phase:
  If the switch is on, the permissible traversing range must be defined by entering a positive upper limit and a negative lower limit: in branch 9 (primary controller) these are represented by the parameters "CON9.IOWL (upper warning limit, actual position)" or "CON9.IUWL (lower warning limit, actual position)".
- Setting the direction of acceleration:
  Depending on the switch position, the machine is accelerated using positive, negative or alternating armature current. For the sake of precision, both current directions should be enabled where possible.

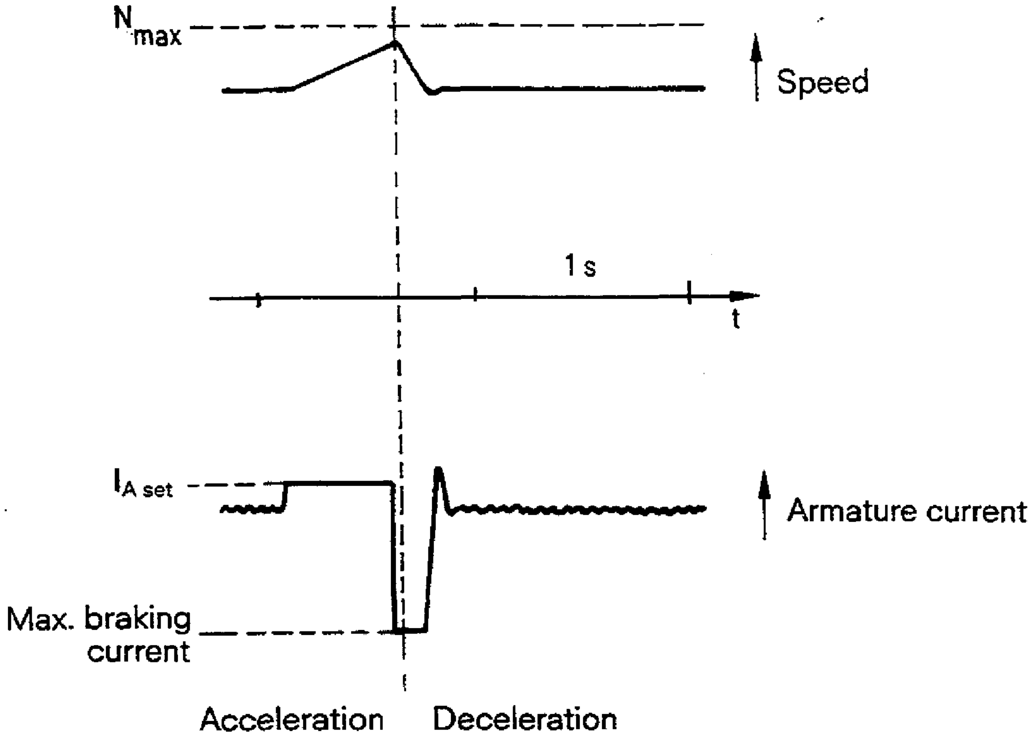


Fig. 4.66 Variation in speed and armature current during the identification procedure of the speed controller system. The operation is repeated 16 or 32 times.

- The parameter CON17.DV influences the dynamic response of the controller setting found. It can be set at 5% or 100%, in which case the default is 50%. Values of "CON17.DV" < 100% lead to an insensitive controller setting, to the detriment of the dynamic response. In this way, the controller setting can be adapted to, for example, mechanical backlash, tacho ripple or changing system parameters.
- Start of self-optimization on startup
  Switch (4) is reset by the operating system after completion of the optimization run or after power failure.
  Resetting of this bit aborts the optimization run.
- When the optimization has been successfully completed, the controller parameters found are displayed.
- By setting this switch or bit, the speed controller (branch 5) accepts the displayed parameters KP and TN. The filter time constant TVZ found is accepted by branch 8, provided branch 8 has been configured with a filter element. If there is no filter element in branch 8 of the controller structure generated, CON17.TVZ is displayed with "0". This pushbutton is then reset automatically.

4.12.7.4 Self-optimization messages

The optimization run is made visible to the user by the flashing green RUN LED and the error LED in order to call attention to limited operating system functions (overload).
The status of the optimization run can be monitored by the S5 CPU (Section 5.2) and using the programmer with COM REG from the "Errors" submenu, which is reached from "Info" in the main menu.

The following status messages are possible:

- No. 75: "Prepare self-optimization"
  - System capability and controller configuration check
  - Initialization of programs; bring machine to standstill
- No. 76: "Self-optimization active"
  - Code for the speed controller optimization run
- No. 77: "Self-optimization successfully completed"
  - The parameters displayed in branch 17 can be accepted.
- No. 78: "Structure or parameter assignment error"
  - The controller structure contains bus accesses
  - Traversing range wrongly entered (upper limit must be positive, lower limit negative)
  - Both acceleration directions disabled
- No. 79: "Impermissible controller no."
  - Controllers with impermissible controller nos. (> 2) or more than two controllers have been configured
  - A second controller structure has not been disabled
- No. 80: "Sampling time too large"
  - A sampling time greater than 8ms has been selected
- No. 81: "Load torque too high"
  - The external load torque is too high to be compensated for by the armature current setpoint prescribed by the commutation characteristic.
- No. 83: "Controlled system unsuitable"
  - The system response measured does not correspond to the reference model and self-optimization cannot then be used.
    Reasons: – Overshoot of the current controller greater than approx. 40%
    – K_P greater than 100
    – Required controller response cannot be achieved with the given arrangement
- No. 84: "Optimization unsuccessful" (parameters could not be calculated)
  - The validity check in the last phase of self-optimization was not passed
    Reasons: – Overshoot of the current controller greater than approx. 40%
    – K_P greater than 100
    – Required controller response cannot be achieved with the given arrangement
- No. 85: "Abort by PG/PC"
  - Message via software stop in the case of abort

Application example

It is assumed that speed controllers no. 1 and no. 2 have been configured on the IP 252. The speed loop of controller no. 1 is to be optimized for a drive with fixed system parameters (Fig. 4.61). The following sequence then applies:

- Move controller 2 to stop; lock the shaft mechanically, if necessary, since this controller will not be processed by controller no. 1 during the startup run.
- If the motor is under **constant** load during the identification procedure, the speed controller (branch 5) must be set with "conservative" start parameters (e. g. KP = 1, TN = 500ms) and enabled with setpoint 0, so that the shaft can be kept still when the mechanical lock is cancelled. All other branches of controller 1 are disabled (i. e. the relevant relays are set to "0"). If no external load torque is acting on the motor during the identification process, pre-initialization can be dispensed with.
- Call branch 17 (speed controller setting) in the "Controller test" function for controller No. 1 and – if this has not already been done – enter suitable value pairs for the commutation characteristic, according to the manufacturer's recommendations.
- Preselect one or both acceleration directions, depending on the operating conditions of the driven machine.
- Select the desired controller dynamic response with "CON17.DV", retain this in the case of unknown mechanical conditions e. g. default (CON17.DV = 50%) and, depending on the success of the optimization run, repeat with changed "CON17.DV".
- If necessary, release mechanical brake (the shaft is now held by the controller).
- Enable self-optimization. The speed controller system is now identified by making step changes in the armature current setpoint; field current and load must remain constant. See Section 4.12.7.3. for procedure in the case of variable field or moment of inertia).
- Read the self-optimization message in the COM REG "Info", "Errors" function on completion of the optimization run.
  In the case of successful completion of optimization, the parameters found will be displayed and can be transferred to the controller.
- Accelerate controller 2 again
- The basic optimization of the speed loop has now been found for controller 1, and this will be used as a reference point for further startup procedures.

4.12.7.5 Projecting the parameters found to greater sampling times

The self-optimization function of the IP 252 can only be run if the sampling time has been set at 4 or 8 ms. If it is desired to operate the controller later with greater sampling times, the desired sampling time can be projected using the formulae outlined below. In doing so, please note the following:

a) Increasing the sampling time will always lead to deterioration of the dynamic response of the controller.
b) The sampling time of the digital controller should be ten times smaller than the dominating time constant of the controlled system.

$$T_{N,new} = T_{N,old} + \frac{6(T_{A,new} - T_{A,old})}{x^2}$$

$$K_{P,new} = K_{P,old} \cdot \frac{T_{N,old} \cdot x^2}{T_{N,old} \cdot x^2 + 6(T_{A,new} - T_{A,old})}$$

$$T_{VZ,new} = T_{VZ,old} + \frac{6(T_{A,new} - T_{A,old})}{x^2}$$

where $x = \frac{\text{CON17.DV}}{100\%}$ with $0.05 \leq x \leq 1$

4.12 Description of the Drive Controller Structure with Self-Optimization (DRS)

Self-optimization

The influence of the control parameters K_p and T_n on the response of the controller loop is illustrated in Fig. 4.67:

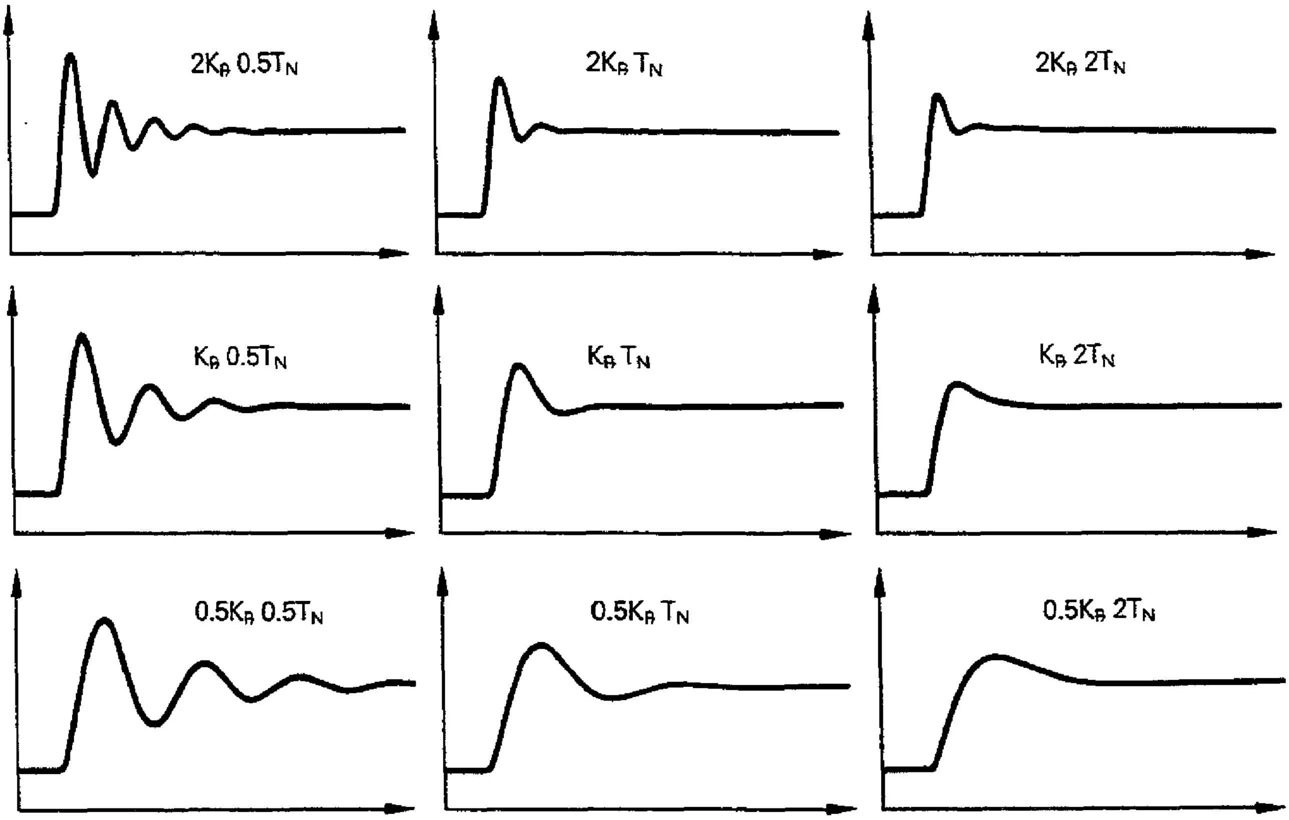


Fig. 4.67 Maladjustment to the symmetrical optimum

K_p and T_n represent the controller parameters set to according to the symmetrical optimum (see centre of diagram). Any change to these parameters by the factor "1/2" or "2" leads to the response illustrated. It is a precondition in these cases that the sampling time of the digital control loop must be small compared with the dominating time constant of the closed control loop.

4.12.8 Data block of the drive controller with self-optimization (DRS)

The data block supplied contains all data of the DRS controller structure. If the contents of these data words are to be read or overwritten by the CPU, they can be accessed with the help of data handling blocks (Section 5.2).

```
                                                                                                          Data
                                                                                                          word
                                                                                                        address
           15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0      I
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+    V
        I     Configuration    (DRIVE with self-optimization: 105.)                                     I DW  0
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I     Version number                                                                            I DW  1
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Status word                                                                               I DW  2
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Error word                                                                                I DW  3
  BESY  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  CODE  I     Error word                                                                                I DW  4
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I                                                                                               I DW  5
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I                                                                                               I DW  6
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     OCM status word                                                                           I DW  7
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I     Sampling time 2.5 ms (32BIT-FPKT)                                                         I DW  8
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                                                               I DW  9
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
SamplingI     Sampling time of the fastest branch (16-BIT-FPKT)      Time value                         I DW 10
  time  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                            Time format                        I DW 11
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I     Minimum pulse duration /2.5 ms (FXPT)                  Time value                         I DW 12
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I                                                            Time format                        I DW 13
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I     Minimum pulse duration (16 bits FXPT)                  Time value                         I DW 14
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I     Time format                                            Time format                        I DW 15
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I     Multiplicator (16 bits FXPT)  - Sampling time/smallest basic sampling time                I DW 16
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Speed N1                                                                                  I DW 17
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Commutation current Imax (N1)                                                             I DW 18
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch  I     Speed N2                                                                                  I DW 19
17      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Commutation current Imax (N2)                                                             I DW 20
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Speed N3                                                                                  I DW 21
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Commutation current Imax (N3)                                                             I DW 22
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

4.12 Description of the Drive Controller Structure with Self-Optimization (DRS)

```
                                                                                          Data
                                                                                          word
                                                                                          address
          15   14   13   12   11   10    9    8    7    6    5    4    3    2    1    0     I
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
    I   I    Upper response threshold        CON 16.AN                                  I  DW 23
Branch  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
16      I    Lower response threshold        CON 16.AB                                  I  DW 24
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
   I    I    Controller gain KP of the self-optimization                                I  DW 25
Branch  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
17 I    I    Integral action time TN of the self-optimization                           I  DW 26
    I   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
    I   I    Time format code for TN of the self-optimization                           I  DW 27
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
Branch 9 I   Gain                            CON 9.VER                                  I  DW 28
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
    I   I    Double ratio constant           CON 17.DV                                  I  DW 29
    I   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
Branch  I    Filter time constant TVZ of the self-optimization                          I  DW 30
17      +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
    I   I    Time format code for TVZ of the self-optimization                          I  DW 31
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
    I   I    Fast value                      CON 3.1                                    I  DW 32
Branch 3 +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
    I   I    Minimum diameter                CON 3.DUG                                  I  DW 33
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
    I   I    ST(-1)                                                                     I  DW 34
Structure+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
  switch I   ST(0)                                                                      I  DW 35
    I   +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
    I   I    ST(1)                                                                      I  DW 36
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
Branch 1 I   Standardization, deceleration   CON 1.1                                    I  DW 37
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
        I                                                                               I  DW 38
        +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
        I                                                                               I  DW 39
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
Branch 5 I   Controller gain                 CON 5.KP                                   I  DW 40
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
Branch 4 I   Startup loop gain               CON 4.2                                    I  DW 41
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I    Integral action time            CON 5.TN                                   I  DW 42
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I    DIM 5.TN                                                                   I  DW 43
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
Branch 5 I   Derivative action time          CON 5.TV                                   I  DW 44
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I    DIM 5.TV                                                                   I  DW 45
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I    Upper manipulated variable limit   CON 5.B+                                I  DW 46
     I  +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
     I  I    Lower manipulated variable limit   CON 5.B-                                I  DW 47
--------+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
                                                                                   Daten-
                                                                                    Wort-
                                                                                   Adresse
           15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0      I
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Gain                              CON 4.VER                                             I  DW 48
Branch 4 +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Offset                            CON 4.OFF                                             I  DW 49
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 5 I    Startup value BRANCH 5            CON 5.1                                               I  DW 50
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Filter time constant              CON 10.TVZ                                            I  DW 51
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     DIM 10.TVZ                                                                              I  DW 52
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 10I    Interface                   CON 10.1                                                    I  DW 53
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Startup value BRANCH 10     CON 10.2                                                    I  DW 54
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Setpoint                    CON  9.1                                                    I  DW 55
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Controller gain             CON  9.KP                                                   I  DW 56
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 9 I    Offset                      CON  9.OFF                                                  I  DW 57
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Integral action time        CON  9.TN                                                   I  DW 58
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     DIM 9.TN                                                                                I  DW 59
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Derivative action time      CON  9.TV                                                   I  DW 60
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     DIM 9.TV                                                                                I  DW 61
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Upper limit                 CON  9.B+                                                   I  DW 62
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Lower limit                 CON  9.B-                                                   I  DW 63
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Filter time constant        CON  9.TVZ                                                  I  DW 64
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     DIM 9.TVZ                                                                               I  DW 65
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Constant factor             CON  9.2                                                    I  DW 66
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 11I    Interface armature current  CON 11.3                                                    I  DW 67
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 2 I    Friction value              CON  2.1                                                    I  DW 68
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 12I    Standardization acceleration  CON 12.1                                                  I  DW 69
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 4 I    Standardization field current CON  4.1                                                  I  DW 70
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 6 I    Setting-up speed            CON  6.1                                                    I  DW 71
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 7 I    Creep speed                 CON  7.1                                                    I  DW 72
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I   I     Setpoint                    CON  8.1                                                    I  DW 73
    I   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

4.12 Description of the Drive Controller Structure with Self-Optimization (DRS)

```
                                                                                                           Data
                                                                                                           word
                                                                                                          address
           15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0      I
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+  V
      I  I     Ramp-up time                  CON  8.TH                                                   I  DW 74
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     DIM 8.TH                                                                                  I  DW 75
Branch  8+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     Ramp-up time                  CON  8.TR                                                   I  DW 76
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     DIM 8.TR                                                                                  I  DW 77
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     Ordinate after time elapsed   CON  8.ZUW                                                  I  DW 78
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     Filter time constant          CON  8.TVZ                                                  I  DW 79
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     DIM 8.TVZ                                                                                 I  DW 80
---------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 10I     Calibration display           CON 10.3                                                    I  DW 81
---------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     Upper response threshold      CON 11.1                                                    I  DW 82
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 11I     Time constant                 CON 11.2                                                    I  DW 83
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I. I     DIM 11.2                                                                                  I  DW 84
---------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     GWM1: Number of limits        CON 13.7                                                    I  DW 85
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     GWM1: Limit 1                 CON 13.1                                                    I  DW 86
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 13I     GWM1: Limit 2                .CON 13.2                                                    I  DW 87
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     GWM1: Limit 3                 CON 13.3                                                    I  DW 88
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     GWM1: Limit 4                 CON 13.4                                                    I  DW 89
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     GWM1: Limit 5                 CON 13.5                                                    I  DW 90
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     GWM1: Limit 6                 CON 13.6                                                    I  DW 91
---------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     GWM2: Number of limits        CON 14.7                                                    I  DW 92
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     GWM2: Limit 1                 CON 14.1                                                    I  DW 93
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     GWM2: Limit 2                 CON 14.2                                                    I  DW 94
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 14I     GWM2: Limit 3                 CON 14.3                                                    I  DW 95
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     GWM2: Limit 4                 CON 14.4                                                    I  DW 96
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     GWM2: Limit 5                 CON 14.5                                                    I  DW 97
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     GWM2: Limit 6                 CON 14.6                                                    I  DW 98
---------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      I  I     Position setpoint upper limit CON  9.SOG                                                  I  DW 99
      I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                                                                              Daten-
                                                                                              Wort-
                                                                                              Adresse
          15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0    I
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+   V
   I    I    Position setpoint lower limit          CON  9.SUG                                       I  DW 100
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 Fixed  I    Position setpoint upper warning limit  CON  9.OW                                        I  DW 101
 LM in  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
branch 9 I   Position setpoint lower warning limit  CON  9.UW                                        I  DW 102
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    Upper danger limit                     CON  9.OG                                        I  DW 103
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    Lower danger limit                     CON  9.UG                                        I  DW 104
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    Speed setpoint upper limit             CON  5.SOG                                       I  DW 105
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    Lower limit                            CON  5.SUG                                       I  DW 106
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    Actual speed upper warning limit       CON  5.OW                                        I  DW 107
 Fixed  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 LM in  I    Actual speed lower warning limit       CON  5.UW                                        I  DW 108
branch 5 +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    Actual speed upper danger limit        CON  5.OG                                        I  DW 109
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    Actual speed lower danger limit        CON  5.UG                                        I  DW 110
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 8 I   Setpoint scaler                        CON  8.2                                         I  DW 111
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 10I   Rated speed in rps                     CON 10.4                                         I  DW 112
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    Sensor number /100                     CON 10.5                                         I  DW 113
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    Integration time constant              CON  3.TID                                       I  DW 114
Branch 3 +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    DIM 3.TID                                                                               I  DW 115
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 15I   Measuring point output   Measuring point no.                                            I  DW 116
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 16I   Address of the arithmetic comparator                                                    I  DW 117
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 Measu-  I   Limit monitor 1       Measuring point no.                                               I  DW 118
  ring   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
point no.I   Limit monitor 2       Measuring point no.                                               I  DW 119
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    ADC 1 address         Actual position                                                   I  DW 120
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    ADC 2 address         Position setpoint                                                 I  DW 121
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 Input  I    ADC 3 address         Actual speed                                                      I  DW 122
  ad-   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
dresses I    ADC 4 address         Actual armature current                                           I  DW 123
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    ADC 5 address         Field current                                                     I  DW 124
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I    ADC 6 address         Speed setpoint                                                    I  DW 125
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

4.12 Description of the Drive Controller Structure with Self-Optimization (DRS)

```
                                                                                                    Data
                                                                                                    word
                                                                                                   address
        15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0     I
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+   V
    I  I     ADC 7-address       Setpoint for coil computer in branch 3                               I  DW 126
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     ADC 8-address       Addition                                                             I  DW 127
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     ADC 9-address       Addition                                                             I  DW 128
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     ADC10-address       Subtraction                                                          I  DW 129
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     ADC11-address       Subtraction                                                          I  DW 130
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     Pulse capture address        Acutal speed                                                I  DW 131
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     ADC12-address       Multiplication                                                       I  DW 132
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     ADC13-address       Multiplication                                                       I  DW 133
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     ADC14-address       Division                                                             I  DW 134
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     ADC15-address       Division                                                             I  DW 135
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     ADC16-address       Absolute value generation                                            I  DW 136
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     ADC17-address       Reciprocal value generator                                           I  DW 137
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     ADC18-address       Multiplication with (-1)                                             I  DW 138
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     ADC19-address       Input for comparator with switched output                            I  DW 139
-------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I                                                                                              I  DW 140
-------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     Scaling                       CON 15.1                                                   I  DW 141
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Branch 15I     Filter time constant          CON 15.TVZ                                                 I  DW 142
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I     DIM 15.TVZ                                                                               I  DW 143
-------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 Output I     DAU 1-address     Actual speed display                                                  I  DW 144
 ad-   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 dressesI     DAU 2-address     Current setpoint                                                      I  DW 145
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I      DAU 3-address     Measuring point output                                                I  DW 146
-------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       I                                                                                              I  DW 147
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I                                                                                              I  DW 148
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I                                                                                              I  DW 149
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I                                                                                              I  DW 150
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I  I                                                                                              I  DW 151
    I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                                                                                            Data
                                                                                                            word
                                                                                                           address
           15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0       I
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+      V
    I    I                                                                                               I  DW 152
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 153
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 154
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 155
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 156
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 157
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 158
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I                                                                                               I  DW 159
---------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I   Controller name:  1st byte                  I   Controller name:  2nd byte                  I  DW 160
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  Fields I   Controller name:  3rd byte                  I   Controller name:  4th byte                  I  DW 161
   for   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   local I   Controller name:  5th byte                  I   Controller name:  6th byte                  I  DW 162
operator-+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 process I   Controller name:  7th byte                  I   Controller name:  8th byte                  I  DW 163
 communi-+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  cation I   Range name:       1st byte                  I   Range name:       2nd byte                  I  DW 164
   and   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 visuali-I   Range name:       3rd byte                  I   Range name:       4th byte                  I  DW 165
  zation +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I   Range name:       5th byte                  I   Range name:       6th byte                  I  DW 166
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I   Range name:       7th byte                  I   Range name:       8th byte                  I  DW 167
=========+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+========
    I    I   ADC 1-Contents                                                                              I  DW 168
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I   ADC 2-Contents                                                                              I  DW 169
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I   ADC 3-Contents                                                                              I  DW 170
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I   ADC 4-Contents                                                                              I  DW 171
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I   ADC 5-Contents                                                                              I  DW 172
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I   ADC 6-Contents                                                                              I  DW 173
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   Con-  I   ADC 7-Contents                                                                              I  DW 174
  tents  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 of the  I   ADC 8-Contents                                                                              I  DW 175
 inputs  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I   ADC 9-Contents                                                                              I  DW 176
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    I    I   ADC10-Contents                                                                              I  DW 177
    I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

4.12 Description of the Drive Controller Structure with Self-Optimization (DRS)

```
                                                                                                      Data
                                                                                                      word
                                                                                                     address
          15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0      I
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+   V
   I    I     ADC11-Contents                                                                          I  DW 178
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Value of digital counter                                                                I  DW 179
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 Bit    I     Bit variable word 1     (Inputs)                                                        I  DW 180
 varia- +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 bles   I     Bit variable word 2     (Inputs)                                                        I  DW 181
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     ADC 12, contents                                                                        I  DW 182 !
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     ADC 13, contents                                                                        I  DW 183
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     ADC 14, contents                                                                        I  DW 184
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 Cont-  I     ADC 15, contents                                                                        I  DW 185
 tents  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 of the I     ADC 16, contents                                                                        I  DW 186
 inputs +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----I
   I    I     ADC 17, contents                                                                        I  DW 187
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     ADC 18, contents                                                                        I  DW 188
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Speed setpoint          VAR 8.1                                                         I  DW 189
 Varia--+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 bles   I     Position setpoint       VAR 9.1                                                         I  DW 190
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     Variable start value (diameter)     VAR 3.1                                             I  DW 191
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I     ADC 19, contents                                                                        I  DW 192
--------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 193
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 194
Internal+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   IP   I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 195
working +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  area  I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 196
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 197
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 198
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 199
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 200
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 201
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 202
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   I    I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 203
   I    +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                                                                                            Data
                                                                                                            word
                                                                                                           address
            15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0      I
          +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+   V
        I I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 204
        I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 205
        I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 206
        I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 207
----------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
   Con- I I     DAC 1 contents    Display                                                                 I  DW 208
  tents I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
  of theI I     DAC 2 contents    Manipulated variable (current setpoint)                                 I  DW 209
 outputsI +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I     DAC 3 contents    Measuring point output                    (formerly DW218)              I  DW 210
----------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 211
        I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 212
        I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 213
        I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 214
  Internal+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        IP I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 215
  working +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      area I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 216
        I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 217
        I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 218
        I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 219
----------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       Bit I     Bit variable word 1     Outputs                                                           I  DW 220
 variables+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I     Bit variable word 2     Outputs                                                           I  DW 221
----------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX I  DW 222
----------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I     Measuring point 1    Actual value primary controller                                      I  DW 223
        I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I     Measuring point 2    Setpoint primary controller                                          I  DW 224
        I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I     Measuring point 3    Controller deviation primary controller                              I  DW 225
  Contents+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
    of the I     Measuring point 4    Controller value primary controller                                  I  DW 226
  measur- +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
       ing I     Measuring point 5    Correction value armature current                                    I  DW 227
   points +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I     Measuring point 6    Brake current                                                        I  DW 228
        I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I     Measuring point 7    Acceleration compensation                                            I  DW 229
        I +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        I I     Measuring point 8    Flux PHI                                                             I  DW 230
```

4.12 Description of the Drive Controller Structure with Self-Optimization (DRS)

```
                                                                                                      Data
                                                                                                      word
                                                                                                      address
                 15   14   13   12   11   10    9    8    7    6    5    4    3    2    1    0         I
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+   V
             I  I    Measuring point  9   Current setpoint                                            I  DW 231
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 10   Controller output secondary controller                      I  DW 232
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 11   Controller deviation secondary controller                   I  DW 233
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 12   Actual speed                                                I  DW 234
I  I     Measuring point-13---Actual-armature-current--+-----+-----+-----+-----+-----+-----+-----+-I--DW-235-+-----+
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 14   Setpoint after ramp generator                               I  DW 236
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 15   Diameter                                                    I  DW 237
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      ContentsI      Measuring point 16   Velocity                                                    I  DW 238
        of the  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        measu-  I    Measuring point 17   Setpoint before ramp generator                              I  DW 239
           red  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         point  I    Measuring point 18   Field current                                               I  DW 240
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 19   Temperature                                                 I  DW 241
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 20   Sum setpoint                                                I  DW 242
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 21   Actual speed display                                        I  DW 243
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 22   Measured point output                                       I  DW 244
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 23   Sum                                                         I  DW 245
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 24   Difference                                                  I  DW 246
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 25   Product                                                     I  DW 247
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 26   Quotient                                                    I  DW 248
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 27   Absolute value                                              I  DW 249
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 28   Reciprocal value                                            I  DW 250
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I    Measuring point 29   *(-1)                                                       I  DW 251
      ----------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I Acknowledgement word for speed controller                                           I  DW 252
             I  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        Status  I Status word for speed controller                                                    I  DW 253
         bytes  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
           for  I Acknowledgement word for position controller                                        I  DW 254
           B&B  +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
             I  I Status word for position controller                                                 I  DW 255
      ----------+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
                                                                                            Data
                                        Controller management                               word
                                                                                           address
     15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0    I
   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+  V
   I                                                                                         RBV I  DW  7
   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

```
Controller management bit RBV = 0 : Controller is not processed
                              = 1 : Controller is processed
```

```
                                                                                              Data
                                          Configuring switch                                  word
                                                                                             address
          15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0     I
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+  V
ST (-1) I ST16 S16.1 S16.2 S16.3 S16.4 S16.5 S16.6 S16.7 S16.8 S16.9                                   I DW 34
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
ST (0)  I S1.1  ST2   ST4  S11.1  ST11  S9.3  S9.2  ST9   ST6   ST7   S8.2  S8.1  S8.3  ST8  S10.1  ST3 I DW 35
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
ST (1)  I S4.1 S10.2 S10.3 S11.2  ST14  ST13        ST15  ST17  S4.3 ST12  S15.1 S10.4  S9.1  S9.4  S4.2I DW 36
        +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

	Abbreviation	Branch	Meaning
DW 34:	ST 16	16	Arithmetic
	S 16.1	16	Sum
	S 16.2	16	Difference
	S 16.3	16	Product
	S 16.4	16	Division
	S 16.5	16	Absolute value
	S 16.6	16	Reciprocal value
	S 16.7	16	*(-1)
	S 16.8	16	Comparator
	S 16.9	16	Invert result of comparison
DW 35:	S 1.1	01	Inversion
	ST 2	02	Friction
	ST 3	03	Actual velocity
	ST 4	04	Loop gain
	ST 6	06	Setting-up speed
	ST 7	07	Creep speed
	ST 8	08	Speed setpoint
	S 8.1	08	Ramp generator
	S 8.2	08	Filter
	S 8.3	08	Actual value allignment
	ST 9	09	Position controller
	S 9.2	09	Position setpoint selection
	S 9.3	09	Scaler selection
	S 10.1	10	Actual speed subswitch
	ST 11	11	Armature current
	S 11.1	11	Injection

DW 36:	S 4.1	04	Diameter compensation
	S 4.2	04	Field current monitoring
	S 4.3	04	Conditionning
	S 9.1	09	Actual value correction
	S 9.4	09	Filter
	S 10.2	10	Filter
	S 10.3	10	"Expanded scale"
	S 10.4	10	External pulse input
	S 11.2	11	Thermal monitoring
	ST 12	12	Acceleration output
	ST 13	13	Limit value monitor 1
	ST 14	14	Limit value monitor 2
	ST 15	15	Measuring point output
	S 15.1	15	Filterng
	ST 17	17	Speed controller self-optimization

Input bit variables

```
                                                                                                     Data
                                                                                                     word
                                                                                                    address
  15    14    13    12    11    10    9     8     7     6     5     4     3     2     1     0          I
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+      V
I BIT   REL   REL   REL   REL   REL   REL   REL   REL   REL   REL   BIT   BIT   BIT   BIT   BIT I   DW 180
I 3.1   1.1   6.1   7.1   3.2   8.2   8.1   9.1   2.1   5.2   4.1   9.1   5.1   8.5   8.6   8.7 I
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
I REL   BIT   REL   REL               REL   REL   BIT   BIT   BIT   BIT   BIT                   I   DW 181
I 8.4   8.8   15.1  16.1              10.1  8.3   17.1  17.2  17.3  17.4  17.5                  I
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

	Abbreviation	Branch	Meaning
DW 180 :	REL 1.1	01	Brake enable
	REL 2.1	02	Friction enable
	BIT 3.1	03	Integration enable
	REL 3.2	03	Initial value switch for integrator
	REL 4.1	04	Enable startup
	BIT 5.1.RF	05	Controller enable speed controller
	REL 5.2	05	Enable startup speed controller
	REL 6.1	06	Setting-up speed
	REL 7.1	07	Creep speed
	REL 8.1	08	Setpoint switch (speed)
	REL 8.2	08	Setpoint enable (speed)
	BIT 8.5.HOE	08	High ramp-up generator
	BIT 8.6.TIE	08	Low ramp-up generator
	BIT 8.7.AUT	08	Automatic -"-
	BIT 9.1.RF	09	Controller enable position controller
	REL 9.2	09	Setpoint switch (position)
DW 181 :	REL 8.3	08	Setpoint switch: analog/digital setpo
	REL 8.4	08	Isolated mode
	BIT 8.8.NUL	08	Ramp-up generator: output zero
	REL 10.1	10	Enable startup value
	REL 15.1	15	Measuring point output
	REL 16.1	16	Comparator enable
	BIT 17.1.POS	17	Enable positive acceleration directio
	BIT 17.2.NEG	17	Enable negative acceleration directio
	BIT 17.3.LAG	17	Position monitoring ?
	BIT 17.4.OPT	17	Start speed controller self-setting
	BIT 17.5.UEB	17	Transfer of parameters

4.12 Description of the Drive Controller Structure with Self-Optimization (DRS)

Output bit variables

```
                                                                                                  Data
                                                                                                  word
                                                                                                 address
  15    14    13    12    11    10     9     8     7     6     5     4     3     2     1     0       I
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+    V
I BIT   BIT   GM    GM    GM    GM    GM    GM  I                                   BIT   BIT I  DW 220
I9UE-L 9UE+L 13.6  13.5  13.4  13.3  13.2  13.1 I                                  16.1  11.1 I
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----++
I BIT   BIT   BIT   BIT   BIT   BIT   BIT   BIT I                                               I  DW 221
I5UE-  5UE+  14.6  14.5  14.4  14.3  14.2  14.1 I                                               I
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

	Abbreviation	Branch	Meaning
DW220:	BIT 9UE-L	09	Lower limit position controller
	BIT 9UE+L	09	Upper limit position controller
	BIT 11.1	11	Thermal interrup
	BIT 13.1	13	Response Limit 1 Limit monitor 1
	BIT 13.2	13	-"- -"- 2 -"-
	BIT 13.3	13	-"- -"- 3 -"-
	BIT 13.4	13	-"- -"- 4 -"-
	BIT 13.5	13	-"- -"- 5 -"-
	BIT 13.6	13	-"- -"- 6 -"-
	BIT 16.1	16	Result of comparison
DW221 :	BIT 5UE-	5	Lower limit speed controller
	BIT 5UE+	5	Upper limit speed controller
	BIT 14.1	14	Response Limit 1 Limit monitor 2
	BIT 14.2	14	-"- -"- 2 -"-
	BIT 14.3	14	-"- -"- 3 -"-
	BIT 14.4	14	-"- -"- 4 -"-
	BIT 14.5	14	-"- -"- 5 -"-
	BIT 14.6	14	-"- -"- 6 -"-

Status word for speed controller

```
                                                                                                  Data
                                                                                                  word
                                                                                                 address
                                                                                                    I
                                                                                                    I
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+   V
I                                                YOGD  YUSD  SOGD  SUGD  IOWD  IUWD  IOGD  IUGDI  DW 253
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

YOGD: = 1 ---> Upper control limit exceeded
YUGD: = 1 ---> Lower control limit exceeded

SOGD: = 1 ---> Speed setpoint exceeding upper limit
SUGD: = 1 ---> Speed setpoint exceeding lower limit

IOWD: = 1 ---> Actual speed exceeding upper warning limit
IUWD: = 1 ---> Actual speed exceeding lower warning limit

IOGD: = 1 ---> Actual speed exceeding upper danger limit
IUGD: = 1 ---> Actual speed exceeding upper danger limit

Status word position controller

```
                                                                                                  Daten-
                                                                                                   Wort-
                                                                                                  Adresse
                                                                                                    I
                                                                                                    I
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+   V
I                                                YOGL  YUGL  SOGL  SUGL  IOWL  IUWL  IOGL  IUGLI  DW 255
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

YOGL : = 1 ---> Upper control limit of the position controller
YUGL : = 1 ---> Lower control limit of the position controller

SOGL : = 1 ---> Position setpoint exceeding upper limit
SUGL : = 1 ---> Position setpoint exceeding lower limit

IOWL : = 1 ---> Actual position exceeding upper warning limit
IUWL : = 1 ---> Actual position exceeding lower warning limit

IOGL : = 1 ---> Actual position exceeding upper danger limit
IUGL : = 1 ---> Actual position exceeding lower danger limit

5. S5-CPU <——> IP 252 Communications

The IP 252 intelligent input/output module is capable of exchanging data with the control CPU via the backplane bus.

For this purpose, the CPU <——>IP 252 connection must be established on both sides of the interface.

- On the IP 252 this is done by assigning a page no. 0 to 254. Using the "COM REG" or "COM 252" operating system (Sections 6 and 7), the page no. can be entered in the "Info" function in the "SYSID" submenu. This page no. is also referred to as the interface no. "SSNR".
- The connection to the IP 252 on the CPU side is established by the data handling blocks, which are called in the STEP 5 user program and initialized with the relevant SSNR.

The standard function block **FB:STEU,** which calls the data handling blocks internally, is described in Section 5.1. This FB:STEU is used for high-speed data exchange of defined data. Knowledge of the data handling blocks is not required for their use.

Expanded means of communication (exchange of random parameters between the CPU and IP 252) are described in Section 5.2. In these cases, the data handling blocks are used direct. In Section 5.2.7 there are relevant examples to accompany all the possibilities described.

Note:
1) The data handling blocks (standard FBs) must be ordered separately for the S5 135U (R processor) and S5 150U programmable controllers. In the case of the S5 115U, they are part of the operating system.
2) Section 5 describes the methods of communication between the IP 252 and the S5 CPU. Here also, a distinction is made at certain points between the
   DR/SR user submodule (MLFB: 6ES5 374-0AA11 or 0AA13)
   or **DRS/SR** user submodule (MLFB: 6ES5 374-0AB11)
   The text and examples are marked accordingly.

5.1 Standard function block FB:STEU

The FB:STEU is a standard FB for data exchange between the S5 CPU and the IP 252. There is a STEP 5 standard FB for each of the controller structures available on the IP 252, i. e. "Drive controller (DR)" or "Drive controller with self-setting (DRS)" and "Standard controller (SR)":

DR und DRS	: FB100 (Name: STEU:ANT)
SR	: FB101 (Name: STEU:STD)

The function blocks FB 100 and FB 101 implement the following functions:

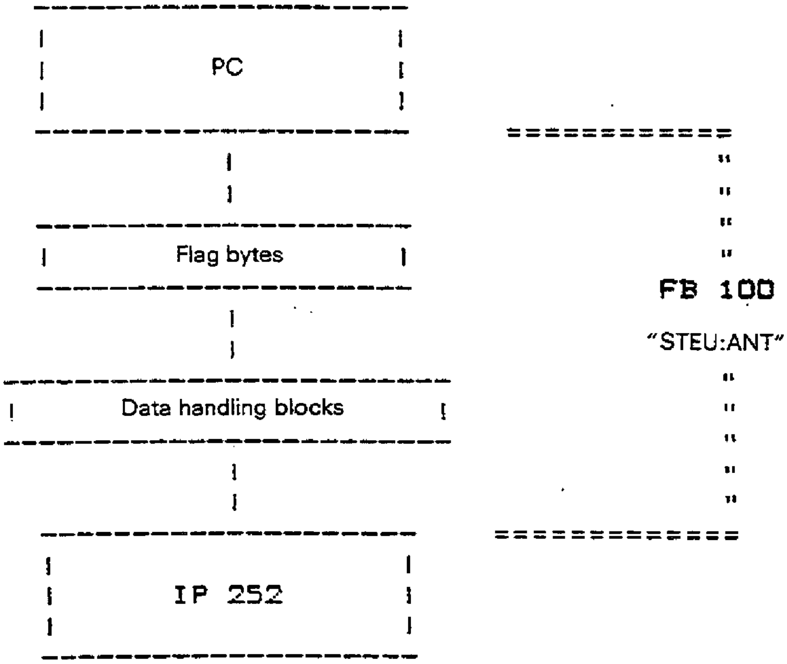
- Transfer of setpoints to the IP 252 closed-loop control module
- Enabling or disabling of the controller branches and the structure branches
- Setting of overflow identifiers
- Recognition of limits
- Recognition of parameter assignment errors

5. S5-CPU <——> IP 252 Communications

5.1 Standard Function Block FB:STEU/FB 100

5.1.1 Function block for drive controller structure FB:STEU:ANT

Overview



Function description:

As shown in thc overview, communication between the PC and the IP 252 in drive control systems is carried out by function block "STEU:ANT". This function block is used for exchanging the most important parameters.

Flag bytes are used as the transfer area for the data to be transmitted or received.

During the actual data transmission/reception, the data handling blocks which consist of standard function blocks are called up specifically in the "STEU:ANT" function block and carry out the data transmission via a dual-port RAM interface (*). These data handling blocks need not be initialized by the user.

Functions:

FB:STEU:ANT

- Transfer setpoints to the IP 252
- Enabling and disabling of controllers and structure branches
- Enabling and disabling of setpoints and actual values
- Transfer of overflow identifier bits
- Detection of limiting values
- Detection of incorrect parameter assignment

(*) Communication interface of the IP 252 for the CPU (1K – address range with 8-bit data width).

Calling up the function block

Graphical representation:

```
  FB  100
       --------------------------------
---I  DBNR                            I
   I                           PAFE   I---
---I  SSNR                            I
   I                                  I
---I  RENR                            I
   I                                  I
---I  VAR8                            I
   I                                  I
---I  VAR9                            I
   I                                  I
---I  VAR3                            I
   I                                  I
---I  DE  0                    DA  0  I---
   I                                  I
---I  DE  1                    DA  1  I---
   I                                  I
---I  DE  2                    DA  2  I---
       --------------------------------
```

List representation:

```
       :JU FB 100
NAME   :STEU:ANT
DBNR   :
SSNR   :   KF
RENR   :
VAR8   :
VAR9   :
VAR3   :
DE0    :
DE1    :
DE2    :
DA0    :
DA1    :
DA2    :
PAFE   :
```

Description of the parameters

Name	Type	Data	Description	Note
DBNR	B	—	Data block no.	DW0-12 used, after that data transfer area
SSNR	D	KF	Interface no.	Page no. set on the IP
RENR	I	BY	Controller no.	8 controller nos. and task assigment
VAR8	I	W	Speed setpoint	Branch 8 of the structure
VAR9	I	W	Position setpoint	Branch 9 of the structure
VAR3	I	W	Starting value circumferential speed	Branch 3 of the structure
DE0	I	BY	"Relay 0" of the structure	—
DE1	I	BY	"Relay 1" of the structure	—
DE2	I	BY	"Relay 2" of the structure	—
DA0	Q	BY	"Relay 3" of the structure	—
DA1	Q	BY	"Relay 4" of the structure	—
DA2	Q	BY	"Relay 5" of the structure	—
PAFE	Q	BI	Parameter fault	—

Parameter assignment

```
DBNR  —  DB3-DB255
SSNR  —  KF=0-254
RENR  —  BY
             KF=  1-  8 Data transfer/reception   PC<->IP
             KF= 11-  8 Data transfer             IP==>PC
             KF= 21-28 Data transfer              PC==>IP
VAR8  —  W        (FW, DW etc.)        KF=+-10000
VAR9  —  W          "   "              KF=+-10000
VAR3  —  W          "   "              KF=+-10000
```

NOTE: During the "transmit" job (data transfer) the assignment of the outputs DA0, DA1, DA2 is irrelevant.

During the "receive" job (data reception) the assignment of the inputs VAR8, VAR9, VAR3, DE0, DE1, DE2 is irrelevant.

5.1 Standard Function Block FB:STEU/FB100

DE 0 — "Relay 0" of the structure

Bit	7	6	5	4	3	2	1	0	
Structure Branch	Bit 3.1	Rel 1.1	Rel 6.1	Rel 7.1	Rel 3.1	Rel 8.2	Rel 8.1	Rel 9.1	for the DR structure *
Structure Branch	Bit 3.1	Rel 1.1	Rel 6.1	Rel 7.1	Rel 3.2	Rel 8.2	Rel 8.1	Rel 9.1	for the DRS structure **

Rel 9.1 Setpoint selector outer loop controller
0 – specified from PG
1 – specified from PC

Rel 8.1 Setpoint selector speed controller
0 – specified from PG
1 – specified from PC

Rel 8.2 Setpoint enable speed
0 – disabled
1 – enabled

Rel 3.1* Starting value for integrator
or 1 – specified from PG
Rel 3.2** TO – calculated value

Rel 7.1 Inching speed enable
0 – disable
1 – enable

Rel 6.1 Setting up speed enable
0 – disable
1 – enable

Rel 1.1 Braking enable
0 – no braking
1 – braking

Bit 3.1 Enable integrator
0 – no integration
1 – integration

DE 1 — "Relay 1" of the structure

Bit	7	6	5	4	3	2	1	0	
Structure Branch	Rel 2.1	Rel 5.1	Rel 5/9	Bit 9.RF	Bit 5.RF	Bit 8.HOE	Bit 8.TIE	Bit 8.LOE	for the DR structure *
Structure Branch	Rel 2.1	Rel 5.2	Rel 4.1	Bit 9.1RF	Bit 5.1RF	Bit 8.5HOE	Bit 8.6TIE	Bit 8.7AUT	for the DRS structure **

Bit 8.LOE* Ramp-function generator reset
or 0 – inoperational
Bit 8.7 AUT** 1 – operational

Bit 8.TIE* "Lower" ramp-function generator
or 0 – inoperational
Bit 8.6 TIE** 1 – operational

Bit 8.HOE* "Higher" ramp-function generator
or 0 – inoperational
Bit 8.5 HOE** 1 – operational

Bit 5.RF* Speed controller enable
or 0 – disabled
Bit 5.1 RF** 1 – enabled

Bit 9.RF* Outer loop controller enable
or 0 – disabled
Bit 9.1 RF** 1 – enabled

Rel 5/9 Switch-over to direct tension control (branch 5)
0 – speed control
1 – tension control

Rel 4.1 Loop gain
0 – structure-dependent
1 – start-up loop gain

Rel 5.1* Start-up enable
or 0 – structure-dependent
Rel 5.2** 1 – specified from PC

Rel 2.1 Friction enable
0 – disabled
1 – enabled

DE 2 — "Relay 2" of the structure

Bit	7	6	5	4	3	2	1	0	
Structure Branch	0	0	0	0	0	0	Rel 10.1	Rel 8.3	for the DR structure *
Structure Branch	Rel 8.4	Bit 8.8NUL	Rel 15.1	Rel 16.1	0	0	Rel 10.1	Rel 8.3	for the DRS structure **

Rel 8.3 ADC/specification
0 – setpoint specified by ADC
1 – setpoint specified by PG/PC

Rel 10.1 Actual speed value selector
0 – structure-dependent
1 – specified from programmer

Rel 16.1 Comparison function enable
0 – comparator inhibited
1 – comparator enabled

Rel 15.1 Enabling of the measuring point output
0 – inhibited
1 – free

Bit 8.8 NUL "Setpoint to 0%" ramp-function generator
0 – ineffective
1 – effective

Bit 8.4 Isolated operation
0 – setpoint of branch 8 transmitted at branch 5
1 – isolated operation for branch 8

DA 0 — "Relay 3" of the structure

Bit	7	6	5	4	3	2	1	0	
Structure Branch	Bit 9.UE-	Bit 9.UE+	Bit 12.6	Bit 12.5	Bit 12.4	Bit 12.3	Bit 12.2	Bit 12.1	for the DR structure *
Structure Branch	Bit 9UE-	Bit 9.UE+	Bit 13.6	Bit 13.5	Bit 13.4	Bit 13.3	Bit 13.2	Bit 13.1	for the DRS structure **

Bit 12.1 to bit 12.6 on the AR and bits 13.1 to 13.6 on the DRS are the limit monitor bits of limit monitor 1 (GWM 1)

When the bit is set, the corresponding limit value from branch 12 of the structure has triggered.

Bit 9.UE+ Upper limit position controller
0 – no overflow
1 – overflow

Bit 9.UE– Lower limit position controller
0 – no overflow
1 – overflow

DA 1 — "Relay 4" of the structure

Bit	7	6	5	4	3	2	1	0	
Structure Branch	0	0	0	0	0	0	0	Bit 11.1	for the DR structure *
Structure Branch	0	0	0	0	0	0	Bit 16.1	Bit 11.1	for the DRS structure **

Bit 11.1 When the bit is set, the thermal annunciator in branch 11 of the structure has triggered.
Bit 16.1 flags the result of the comparison function in branch 16.

DA 2 — "Relay 5" of the structure

Bit	7	6	5	4	3	2	1	0	
Structure Branch	Bit 5.UE-	Bit 5.UE+	Bit 13.6	Bit 13.5	Bit 13.4	Bit 13.3	Bit 13.2	Bit 13.1	for the DR structure *
Structure Branch	Bit 5.UE-	Bit 5.UE+	Bit 14.6	Bit 14.5	Bit 14.4	Bit 14.3	Bit 14.2	Bit 14.1	for the DRS structure **

Bit 13.1 to bit 13.6 are the limit monitor bits of limit monitor 2 (GWM 2)

When the bit is set, the corresponding limit value from branch 13 of the structure has triggered.

Bit 5.UE+ Upper limit speed controller
0 – no overflow
1 – overflow

Bit 5.UE– Lower limit speed controller
0 – no overflow
1 – overflow

PAFE — Parameter error
When the bit is set, the execution of the function block is discontinued.

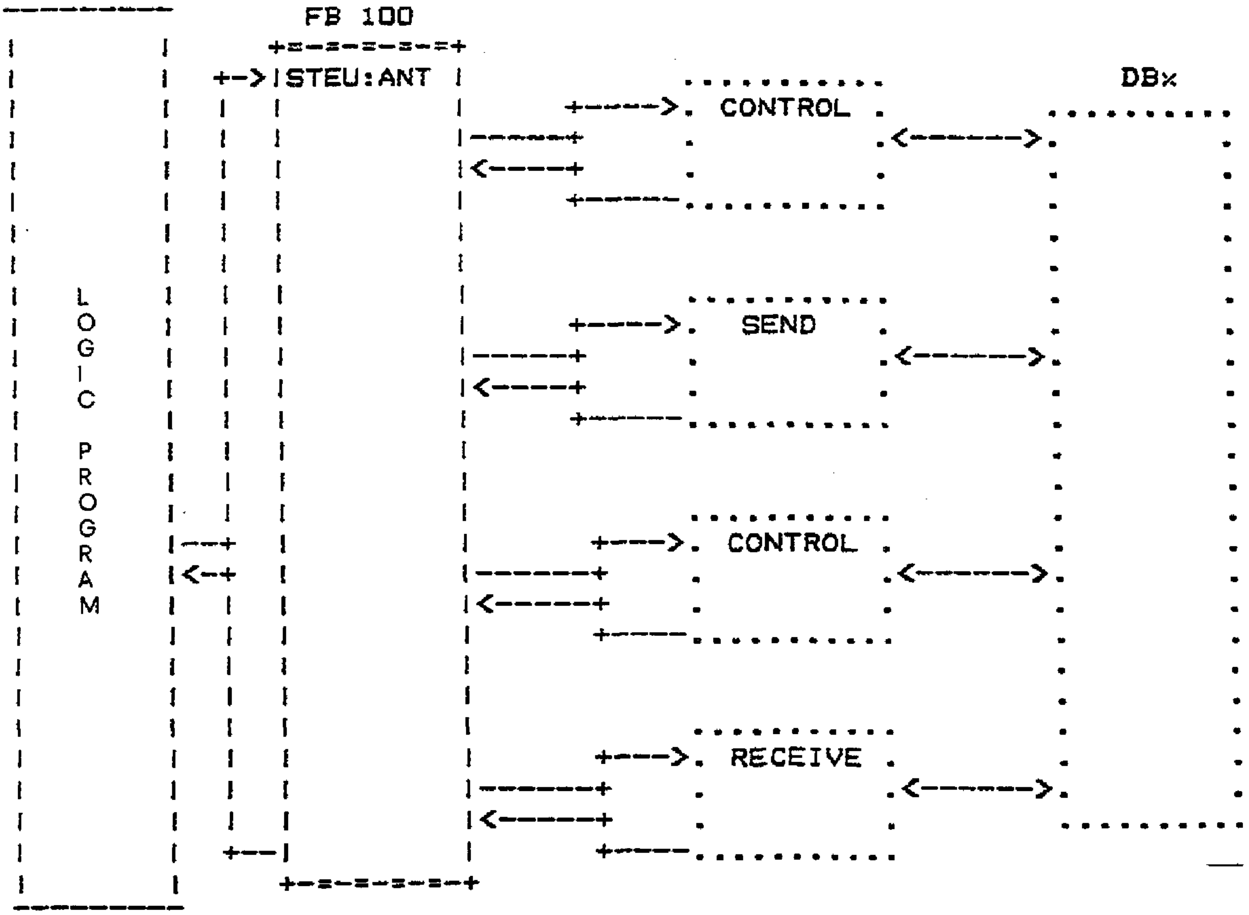
Conditions

The data block specified at input "DBNR" (DB No. 3 . . . 255, length at least 12DW, free for user from DW13) must be present in the memory of the programmable controller. The page frame No. must be selected on the IP 252 **before start-up** via a programmer. Selection via the "Info" function, submenu "SYSID".
If one wants to observe the task execution ("TRANSMIT" or "RECEIVE" data), this is possible via the corresponding status word (ANZW) or the error byte (PAFE) of the data handling blocks. See "Technical Specifications"!

5. S5-CPU <——> Communications

5.1 Standard Function Block FB:STEU/FB100

Program structure



Start-up

Procedure:

- Select the transfer block no. on the corresponding IP 252 with the programmer using the "COMREG" or "COM 252" operating system.
- Structure and assign parameters to the required control loop
- Transfer FB:STEU:ANT from PG to PC (with the S5 135U, R-processor, blocks FB 120, FB 121 and FB 123 must also be transferred)
- Insert an absolute call to FB:STEU:ANT in organization block OB 1.

Technical specifications of FB100 (STEU:ANT)

	S5 115U	S5 135U (R processor)	S5 150U
Library No.	P71200-S1100-A-1	P71200-S9100-A-1	P71200-S4100-A-0
Block length	221 words	224 words	222 words
Call length	21 words	21 words	21 words
Execution time:			
Data "SEND"	941 : 18.5 ms 942 : 11.5 ms 943 : 8.0 ms	approx. 4.2 ms	approx. 4 ms
Data "RECEIVE"	941 : 14.5 ms 942 : 10.0 ms 943 : 6.5 ms	approx. 3.8 ms	approx. 3.7 ms
Data "SEND" and "RECEIVE"	941 : 25.0 ms 942 : 17.5 ms 943 : 12.0 ms	approx. 6.5 ms	approx. 5.6 ms
Function blocks called			
Data handling block "SEND"	244	120	180
Data handling block "RECEIVE"	245	121	181
Data handling block "CONTROL"	247	123	184
Flags, timers, counters used			
"Send" job	FB200 to FB208	FB200 to FB208	FB243 to FB253
"Receive" job	FB209 to FB211	FB209 to FB211	FB197 to FB199 FB254 to FB255
Data handling blocks	FB212 FB213	FB212 FB213	FB200 to FB242
Monitoring the job sequence:			
ANZW job "SEND"	DW8 in the D-DB	DW8 in the D-DB	DW8 in the D-DB
job "RECEIVE"	DW10 in the D-DB	DW10 in the D-DB	DW10 in the D-DB
PAFE job "SEND"	FB212	FB212	FB253
job "RECEIVE"	FB213	FB213	FB255
Nesting depth	1	1	1

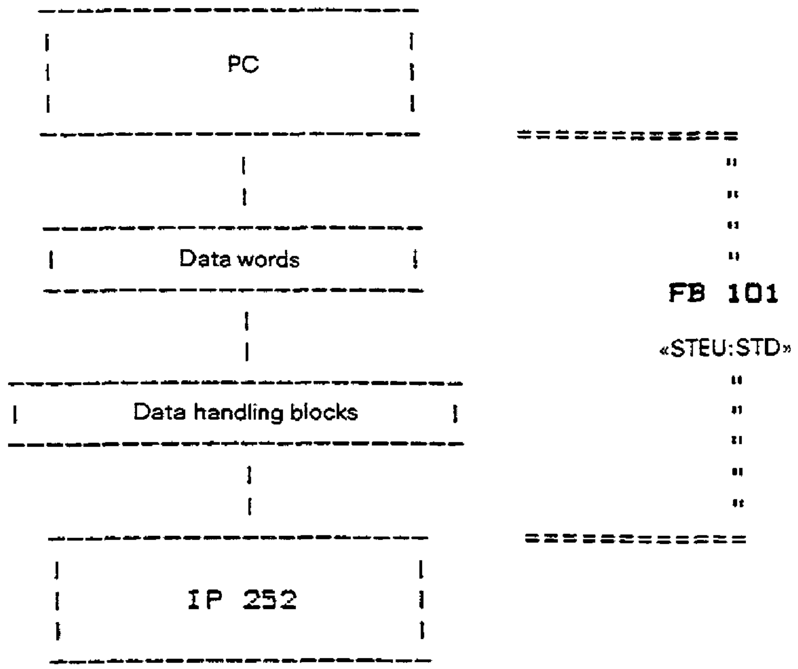
Details on ANZW and PAFE can be found, if required, in the data handling block specifications.

5. S5-CPU <——> IP 252 Communications

5.1 Standard Functions Block FB:STEU/FB 101

5.1.2 Function block for standard controller structure FB:STEU:STD

Overview



Function description:

As shown in the overview, communication between the PC and the IP 252 in standard control systems, is carried out by function block "STEU:STD". This function block is used for data communication in both directions in the "Standard" controller structure.

Flag bytes are used as the transfer area for the data to be transmitted or received.

During the actual data transmission/reception, the data handling blocks which consist of standard function blocks are called up specifically in the "STEU:STD" function block and carry out the data transmission via a dual-port RAM interface (✱).

Functions:

FB:STEU:STD

- Transfer setpoints to the IP 252
- Enabling and disabling of controllers and structure branches
- Enabling and disabling of setpoints and actual values
- Transfer of overflow identifier bits
- Detection of limiting values
- Detection of incorrect parameter assignment

(✱) Communication interface of the IP 252 for the CPU (1K – address range with 8 bit data width).

Calling up the function block

Graphical representation:

```
 FB  101
    ---------------------------
---I  DBNR                    I
   I                    PAFE  I---
---I  SSNR                    I
   I                          I
---I  RENR                    I
   I                          I
---I  VAR3                    I
   I                          I
---I  DE  0             DA  0 I---
   I                          I
---I  DE  1             DA  1 I---
    ---------------------------
```

List representation:

```
      :JU FB 101
NAME  : STEU:STD
DBNR  :
SSNR  :     KF
RENR  :
VAR3  :
DE 0  :
DE 1  :
DA 0  :
DA 1  :
PAFE  :
```

Description of the parameters

Name	Data	Type	Description	Note
DBNR	B	—	Data block no.	DW0-12 used, after that data transfer area
SSNR	D	KF	Interface no.	Page no. set on the IP
RENR	I	BY	Controller no.	8 controller nos. and task assignment
VAR3	I	W	Setpoint	Setpoint branch
DE 0	I	BY	"Relay 0" of the structure	—
DE 1	I	BY	"Relay 1" of the structure	—
DA 0	Q	BY	"Relay 2" of the structure	—
DA 1	Q	BY	"Relay 3" of the structure	—
PAFE	Q	BI	Parameter error	—

Parameter assignment

DBNR — DB 3 – DB 255
SSNR — KF = 0 – 254
RENR — BY
KF = 1 – 8 Data transfer/reception PC <–> IP
KF = 11 – 18 Data transfer IP ==> PC
KF = 21 – 28 Data transfer PC ==> IP
VAR3 — W (FW, DW etc.) KF = + – 10000

NOTE: During the "transmit" job (data transfer) the assignment of the outputs DA0, and DA1 is irrelevant.
During the "receive" job (data reception) the assignment of the inputs VAR 3, DE0 and DE1 is irrelevant.

DE 0 — "Relay 0" of the structure

Bit	7	6	5	4	3	2	1	0
Structure	Bit	Rel	Bit	Bit	Rel	Bit	Bit	Bit
Branch	1.1.RF 1.2.RF	1.2.1	1.2.ST	1.2.IR	1.1.1 1.2.2 1.5.1	1.5.TOT	1.5.RF	1.5.HAI

Bit 1.5.HAI Manual input of the "step-action controller" function
1 – manual input active
0 – manual input inactive

Bit 1.5.RF Enable bit of the "step-action controller" function
1 – enable controller, i. e. calculated value is output
0 – controller disabled, i. e. zero is output

Bit 1.5.TOT Switch for selecting the input variables for the I component in the "step-action controller" function
1 – dead band for the I component inactive
0 – dead band for the I component active

5.1 Standard Function Block FB:STEU/FB 101

Rel 1.1.1 Rel 1.2.1 Rel 1.5.1 — Automatic/manual operation switch-over in the "PID-controller" or "step-action controller" function
0 – automatic operation
1 – manual operation

Bit 1.2.IR — Switch-over between ideal and real "PID controller"
0 – real PID
1 – ideal PID

Bit 1.2.ST — Bit for setting the manipulated variable increment in the "PID controller" function to zero
0 – no effect
1 – manipulated variable increment is set to zero or the manipulated variable is held constant

Rel 1.2.2 — Disturbance variable injection in the "PID controller" function
0 – not operational
1 – operational, i. e. disturbance variable increment is added to the calculated manipulated variable increment.

Bit 1.1.RF Bit 1.2.RF — Enable bit of the "PID controller" function
1 – enable controller, i. e. calculated value is output
0 – disable controller, i. e. zero is output

DE 1 — "Relay 1" of the structure

Bit	7	6	5	4	3	2	1	0
Structure Branch	Rel 2.3	Rel 3.2	Rel 3.1	Bit 1.5.BA	Bit 1.5.BZ	Bit 3.HOE	Bit 3.TIE	Bit 3.LOE

Bit 3.LOE — "Reset" bit of the "ramp-function generator" function
0 – no effect
1 – reset, i. e. set the output value to zero and for 1/0 transition ramp to the last setpoint

Bit 3.TIE — "Lower" bit of the "ramp-function generator" function
0 – no effect
1 – output of ramp-function generator negative (– 100%)

Bit 3.HOE — "Higher" bit of the "ramp-function generator" function
0 – no effect
1 – output of ramp-function generator positiv (+ 100%)

Bit 1.5.BZ — Acknowledgement bit of the "pulse generator" function
0 – final CLOSED position not reached
1 – final CLOSED position reached

Bit 1.5.BA — Acknowledgement bit of the "pulse generator" function
0 – final OPEN position not reached
1 – final OPEN position reached

Rel 3.1 — Setpoint selection
0 – PC setpoint operational
1 – "setpoint sequence" function operational

Rel 3.2 — Setpoint enable
1 – setpoint branch enabled
0 – setpoint branch disabled

Rel 2.3 — Start-up enable
0 – actual value branch enabled
1 – actual value at start-up operational

DA 0 —— "Relay 2" of the structure

Bit	7	6	5	4	3	2	1	0
Stucture	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit
Branch	1.4.PP	1.4.NP	5.6	5.5	5.4	5.3	5.2	5.1
	1.5.OPEN	1.5.CLOSED						

Bit 5.1– Limit value bit of the "limit monitor 2" function
Bit 5.6 0 – corresponding limit value not violated
1 – corresponding limit value violated

Bit 1.5.AUF Binary output "open" of the "pulse generator" function 0/1

Bit 1.5.ZU Binary output "close" of the "pulse generator" function 0/1

Bit 1.4.PP Binary output "positive pulse" of the "on" – "off" output function 0/1

Bit 1.4.NP Binary output "negative pulse" of the "on" – "off" output function 0/1

DA 1 — "Relay 3" of the structure

Bit	7	6	5	4	3	2	1	0
Structure	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit
Branch	1.1.UE–	1.1.UE+	4.6	4.5	4.4	4.3	4.2	4.1
	1.2.UE–	1.2.UE+						

Bit 4.1– Limit value bits of the "limit monitor 1" function
Bit 4.6 0 – corresponding limit value not violated
1 – corresponding limit value violated

Bit 1.1.UE+ Bit for upper limit of the manipulated variable in the "PID controller" function
Bit 1.2.UE+ 0 – not crossed
1 – crossed

Bit 1.1.UE– Bit for lower limit of the manipulated variable in the "PID controller" function
Bit 1.2.UE– 0 – not crossed
1 – crossed

PAFE — Parameter assignment error
If the bit is set the execution of the function block is discontinued.

Conditions

The data block specified at input "DBNR" (DB no. 3 . . . 255, length at least 12DW, free for user from DW13) must be present in the memory of the programmable controller. The page no. must be selected on the IP 252 **before start-up** via a programmer. Selection via the "Enquiry" function, submenu "SYSID".
If one wants to observe the job execution ("TRANSMIT" or "RECEIVE" data), this is possible via the corresponding condition code word (ANZW) or the error byte (PAFE) of the data handling blocks. See "Technical Specifications"!

5. S5-CPU <——> IP 252 Communications

5.1 Standard Function Block FB:STEU/FB 101

Program structure

```
---------       FB 101
I       I     +=-=-=-=-=+
I       I  +->ISTEU:STD I          ...........           DBx
I       I  I  I         I     +--->. CONTROL .       ..........
I       I  I  I         I-----+    .         .<----->.        .
I       I  I  I         I<----+    .         .       .        .
I       I  I  I         I     +----...........       .        .
I       I  I  I         I                            .        .
I  L    I  I  I         I                            .        .
I  O    I  I  I         I          ...........       .        .
I  G    I  I  I         I     +--->.  SEND   .       .        .
I  I    I  I  I         I-----+    .         .<----->.        .
I  C    I  I  I         I<----+    .         .       .        .
I  P    I  I  I         I     +----...........       .        .
I  R    I  I  I         I                            .        .
I  O    I  I  I         I                            .        .
I  G    I  I  I         I          ...........       .        .
I  R    I--+  I         I     +--->. CONTROL .       .        .
I  A    I<-+  I         I-----+    .         .<----->.        .
I  M    I  I  I         I<----+    .         .       .        .
I       I  I  I         I     +----...........       .        .
I       I  I  I         I                            .        .
I       I  I  I         I                            .        .
I       I  I  I         I          ...........       .        .
I       I  I  I         I     +--->. RECEIVE .       .        .
I       I  I  I         I-----+    .         .<----->.        .
I       I  I  I         I<----+    .         .       ..........
I       I  +--I         I     +----...........
I       I     +=-=-=-=-=+
---------
```

Start-up

Procedure:

- Select the page no. on the corresponding IP 252 with the programmer using the "COMREG" or "COM 252" operating system.

  Structure and assign parameters to the required control loop

- Transfer FB:STEU:STD from PG to PC (with S5 135U, R-processor, blocks FB 120, FB 121 and FB 123 must also be transferred).
- Select data block in the PC (DB3 . . . . . 255, length at least 12 DW, remainder free for user)
- Insert an absolute call to FB:STEU:STD in organization block OB1.

Technical specifications of FB101 (STEU:STD)

	S5-115U	S5-135U (R-processor)	S5-150U
Library No.	P71200-S1101-A-1	P71200-S9101-A-1	P71200-S4101-A-0
Block length	179 words	183 words	182 words
Call length	17 words	17 words	17 words
Execution time:			
Data "SEND"	941 : 15.0 ms 942 : 10.0 ms 943 : 6.5 ms	approx. 3.9 ms	approx. 3.8 ms
Data "RECEIVE"	941 : 13.0 ms 942 : 9.5 ms 943 : 6.0 ms	approx. 3.7 ms	approx. 3.6 ms
Data "SEND" and "RECEIVE"	941 : 21.0 ms 942 : 15.5 ms 943 : 10.5 ms	approx. 5.6 ms	approx. 5.4 ms
Function blocks called			
Data handling block "SEND"	244	120	180
Data handling block "RECEIVE"	245	121	181
Data handling block "CONTROL"	247	123	184
Flags, timers, counters used			
"Send" job	FB200 to MF203	FB200 to FB203	FB243 to FB250
"Receive" job	FB204 to MF205	FB204 to FB205	FB198 to FB199 FB251 to FB252
Data handling blocks	FB206 FB207	FB206 FB207	FB200 to FB242
Monitoring the job sequence:			
ANZW job "SEND"	DW8	DW8	DW8
job "RECEIVE"	DW10	DW10	DW10
PAFE job "SEND"	FB206	FB206	FB250
job "RECEIVE"	FB207	FB207	FB252
Nesting depth	1	1	1

Details on ANZW and PAFE can be found, if required, in the data handling block specifications.

5. S5-CPU <——> IP 252 Communications

5.1 Standard function block FB:STEU/FB 101

The following example describes initialization of the FB:STEU. PB 100 standard function block for the drive controller structure (DR an DRS) an FB 101 for the standard controller. Flag words are used in the first example, and in the other example, data words of a block are used. Error recognition is valid for the S5-115U only. The FB:STEU for the S5-135U/150U reserves other flag bytes which can be found in the tables in Sections 5.2.1 and 5.2.2, if required.

```
FB2                                                   LEN=138

SEGMENT 1
NAME :FORCE

0005        :A     F 30.6           WAITING TIME FROM FB6 ACTIVE ?
0006        :BEC                    END IF YES.
0007        :L     KF-2233          KF-2233 = -22,33 % AS THE SETPOINT
0009        :T     FW122            TO BE TRANSFERRED TO THE IP 252
000A        :
000B        :L     KH0608           THE FOLLOWING BITS AND RELAYS
000D        :T     FW128            ARE SET AS A RESULT:
000E        :L     KB1                1.) BIT5.RF (CONTROLLER ENABLE)
000F        :T     FB130              2.) REL 8.1 (SETPOINT FROM PC)
0010        :                         3.) REL 8.2 (SETPOINT ENABLE)
0011        :                         4.) SETPOINT NOT FROM ADC 6,
0012        :                             BUT PROGRAMMED
0013        :
0014        :L     KB6              "6" TO FB 34 (=RENR), I.E. SEND
0015        :T     FB34             AND RECEIVE DATA AT CONTROLLER
0016        :                       NO 6 OF THE IP 252.
0017        :                        THE FOLLOWING APPLIES IN GENERAL
0018        :                        FOR RENR:
0019        :                       MB34 =  1 ...  8 : AG <--- IP252
001A        :                            = 11 ... 18 : AG ---> IP252
001B        :                            = 21 ... 28 : AG ---> IP252
001C        :                       FB:STEU.ANT FOR THE DRIVE CON-
001D        :                       TROLLER STRUCTURE OF THE IP 252.
001E        :                       THIS FUNCTION BLOCK SENDS/RECEIVES
001F        :                       DATA AND CONTROL/MESSAGE BITS
0020        :
0021        :
0022        :JU    FB100
0023 NAME   :STEU:ANT
0024 DBNR   :      DB41             DATA DB FOR INTERNAL USE (1)
0025 SSNR   :      KF+4             PAGE NO. OF THE IP
0026 RENR   :      FB34             JOB AND CONTROLLER NO    (2)
0027 VAR8   :      FW122            VAR8 -> SETPOINT VAR 8.1 OF THE DR
0028 VAR9   :      FW124            VAR9 -> POSITION SETPOINT VAR 9.1
0029 VAR3   :      FW126            VAR3 -> VAR. START VALUE VAR 3.1
002A DE0    :      FB128            >
002B DE1    :      FB129            > > RELAYS AND BITS OF THE DR
002C DE2    :      FB130            >              STRUCTURE
002D DA0    :      FB131            >
002E DA1    :      FB132            > > MESSAGE BITS OF THE DR
002F DA2    :      FB133            >              STRUCTURE
0030 PAFE   :      F 30.4           BIT IS SET IF E.G.
0031        :                       VAR8 > KF+10000  (= 100.00%)
0032        :                            < KF-10000  (=-100.00%)
```

```
FB2                                                     LEN=138
0033       :
0034       :                            ADDITIONAL EXPLANATION:
0035       :                              (1 THE DATA DB IS USED BY FB100
0036       :                                 FROM DW0 TO DW12.
0037       :                              IF DATA WORDS OR DATA BYTES ARE
0038       :                              USED INSTEAD OF FLAG WORDS OR
0039       :                              FLAG BYTES, THE DATA DB AB DW 13
003A       :                              SPECIFIED SHOULD BE USED (AND
003B       :                              EXTENDED ACCORDINGLY). THIS
003C       :                              DB NO. SHOULD THEN BE OPENED
003D       :                              BEFORE CALLING THE FB100.
003E       :                              (WITH "A DBXY")
003F       :
0040       :
0041       :
0042       :                             (2) IN THE CASE OF RENR, A FLAG
0043       :                                BYTE IS SPECIFIED HERE, THE
0044       :                              CONTENTS OF WHICH DECIDE WHICH
0045       :                              CONTROLLER NO. (1 TO 8) OF THE
0046       :                              IP IS TO BE ACCESSED WITH THE
0047       :                              PAGE NO. SPECIFIED, AND WHICH OF
0048       :                              THE FOLLOWING IS TO BE DONE:
0049       :                               A) DATA FROM PC --> IP 252
004A       :                               B) DATA FROM IP 252 --> PC
004B       :                               C) BOTH
004C       :
004D       :O    F 30.4                 INITIALIZATION ERROR ?
004E       :O    F 212.0                SEND ERROR (FROM PC TO THE
004F       :                            IP 252 ?
0050       :O    F 213.0                RECEIVE ERROR (PC<-IP)
0051       :
0052       :JC   =M001                  JUMP, IF YES
0053       :JU   =M002
0054       :
0055 M001  :                            ERROR HANDLING: E.G.
0056       :L    KB2                    MOVE NO. OF THE FB IN WHICH THE
0057       :T    FB5                    ERROR OCCURRED TO FB5
0058       :                            (FLAG BYTE 5)
0059       :
```

```
FB2                                                                    LEN=138

005A          :
005B          :
005C          :
005D  M002    :                          EXAMPLE FOR FB:STEU.STD
005E          :                          WITHOUT USING FLAG AREAS
005F          :                          (EXCEPTION: INTERNAL FLAG
0060          :                          AREAS AND PAFE BYTE)
0061          :
0062          :Q    DB42                 OPEN DB42, SINCE IT IS ALSO
0063          :                          USED HERE FOR ASSIGNING
0064          :                          PARAMETERS TO FB101.
0065          :
0066          :L    KF+5577              KF+5577 = +55.77 % AS THE SET-
0068          :T    DW13                 POINT TO BE TRANSFERRED TO THE IP
0069          :
006A          :L    KH8040               AS A RESULT, THE FOLLOWING RELAYS
006C          :T    DW14                 ARE SET ON THE STANDARD STRUCTURE:
006D          :                            1.) BIT RF  (CONTROLLER ENABLE)
006E          :                            2.) REL 3.2 (SETPOINT ENABLE)
006F          :
0070          :L    KB23                 SEND TO CONTROLLER NO. 3
0071          :T    FB35
0072          :
0073          :JU   FB101
0074  NAME    :STEU:STD
0075  DBNR    :     DB42                 DB FOR INTERNAL AND EXTERNAL USE
0076  SSNR    :     KF+3                 PAGE NO. OF THE IP
0077  RENR    :     FB35                 JOB AND CONTROLLER NO.
0078  VAR3    :     DW13                 DW13 IN DB42 CONTAINS SETPOINT
0079  DE0     :     DL14                 LEFT-HAND BYTE OF DW14
007A  DE1     :     DR14                 RIGHT-HAND BYTE OF DW14
007B  DA0     :     DL15
007C  DA1     :     DR15
007D  PAFE    :     F 30.5
007E          :                          ERROR OCCURED ?
007F          :O    F 30.5               INITIALIZATION ERROR ?
0080          :O    F 206.0              SEND ERROR ?
0081          :O    F 207.0              RECEIVE ERROR ?
0082          :
0083          :                          SEE ABOVE FOR ERROR HANDLING !
0084          :BE
```

:ommunication between the controllers and the S5-CPU takes place either with the help of the FB:STEU or direct via the **data ıandling blocks.** The S5-CPU can both exchange **data** with the controllers and issue **commands** to the IP 252.

f the FB:STEU only is used, data exchange will be restricted. In Section 5.2, all methods of data exchange between the IP 252 and he CPU are explained and are illustrated in Section 5.2.7 using STEP 5 programming examples.

The principles of data exchange between the IP/CP and the CPU:

The interface between the CPU and the IP/CP must generally be "synchronized" at the beginning, i. e. in the restart organization blocks of the CPU. The IP 252 does not require this synchronization internally. The IP 252 interface or the dual-port RAM should, however, be synchronized for the following reason:

> After a power failure or a CPU error arising from the program, resumption of data exchange after a warm restart or cold restart of the CPU cannot be guaranteed without synchronization of the IP 252.

In the example FBs in Section 5.2.7, the IP 252 is synchronized as soon as the organization blocks OB20, OB21 and OB22 have been called. In these OBs the example FB99 is called in each case for synchronization of the three interfaces (i. e. in the following example: three IP 252s with the page Nos. 2, 3 and 4). There is an explanation in FB99 of the waiting times before and after synchronization which are required for restarting the IP 252.

Note:

When **exchanging data between a CPU and several IP 252s** in an S5 environment, the page nos. (interface nos.) of the IPs must not be identical, as this would result in a bus short-circuit. Exception: page no. 255, since the S5-CPU only has to "read" this page no. but does not have to "write" it.

At the initial startup of the IP 252, page no. 255 is set for the above reasons. If it is now desired to transfer data between the CPU and the IP 252, a page no. 0 to 254 must be set for this purpose in the IP 252.
This is done with COM REG or COM 252 by calling the "SYSID" function in the submenu of the "Info" form. The IP 252 can now be accessed by the data handling block of the CPU via the page no. (interface no.) set in this way.

The STEP 5 programming examples detailed in Section 5.2.7 apply to the S5 115U programmable controller. For the S5 135U (R processor) and the S5 150U the "Call nos." of the data handling blocks must be changed according to the following table:

Data handling blocks	FB No. in the S5 115 U	FB No. in the S5 135 U (R)	FB No. in the S5 150 U
SEND	244	120	180
RECEIVE	245	121	181
FETCH	246	122	182
CONTROL	247	123	184
RESET	248	124	183
SYNCHRON	249	125	185

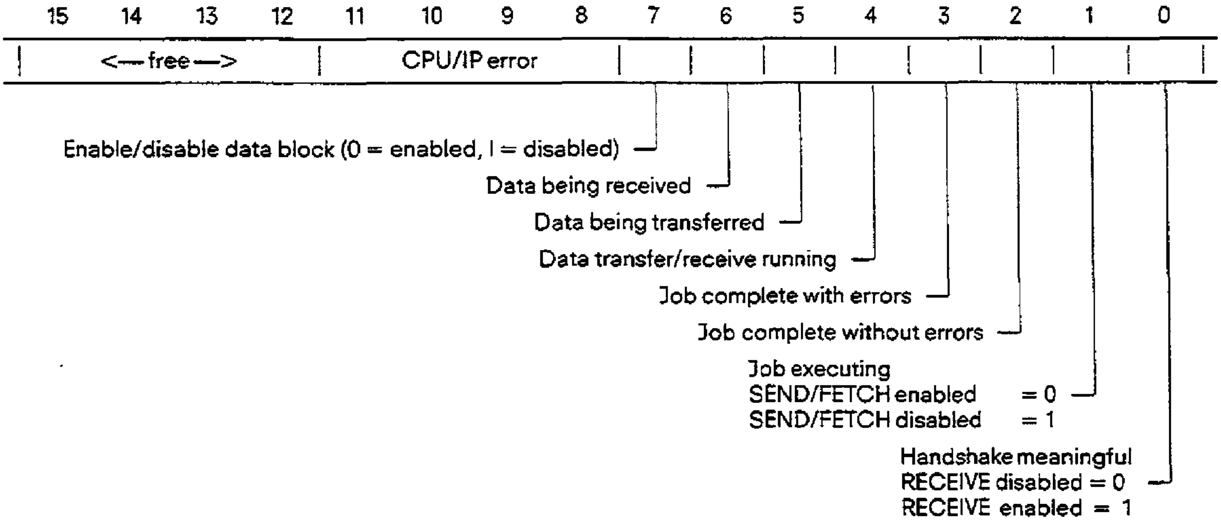
Note on data exchange in multiprocessor mode in the case of the S5 135U:

- Communication between one or several IP 252s and **several R processors** is possible, as outlined in the examples in Section 5.2.7. Several R processors may not access an IP 252 with one and the same job no. In doing so, each interface may be synchronized by only one (random) R processor.

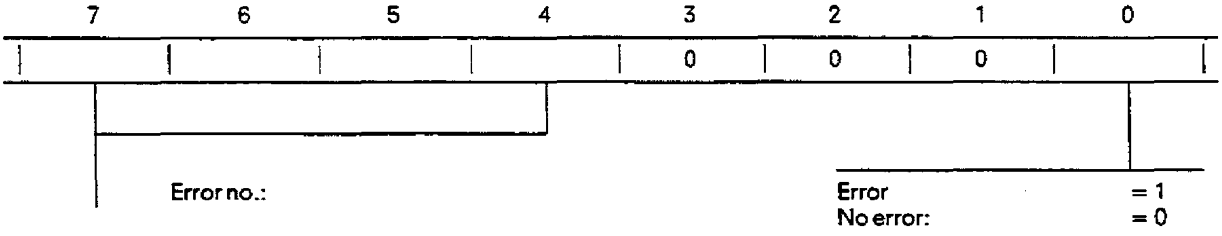
5.2 Use of the Data Handling Blocks of the S5-CPU

The data handling blocks of the S5-115U, S5-135U with R processor and S5-150U programmable controllers called in the examples enable the user to monitor correct execution of the job in progress and respond to errors:

The job status word **(ANZW)** of the data handling block flags the job status to the user.



Structure of the parameter assignment error byte **"PAFE"**:



0 No error
1–4 Source/destination parameter
  1 Range wrong
  2 DB or DX do not exist
  3 Range too small
  4 Range does not exist
5 Job status word wrong
6 No. not assigned
7 Interface (p. no.) does not exist
8 Interface not ready
9 Interface overloaded
A Interface reserved by other CPU
B Illegal job no.
C Interface does not respond at the correct time
E Other errors in the data handling block, such as
  – missing data block call in the case of indirect assignment of the parameters SSNR, A Nr., ANZW

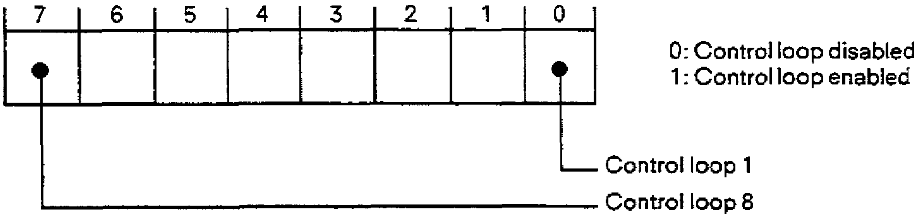
Further details can be found in the descriptions of relevant data handling blocks.

5.2.1 Command: Control loop enable/disable

This command is used for enabling or disabling of control loops on the IP. This command has the same effect as the enable/disable command from the **PG** (PG menu: "Operating mode").

Calling up in the logic control program of the S5-CPU:
- SEND 10 (with data)
  SEND 10 transfers a byte to the IP.

The byte has the following format:



See example FB3 in Section 5.2.7

5.2.2 Command: RUN/STOP mode of the module

With this command the IP can be set to the STOP mode or to the RUN mode.
The command has the same effect as operating the **switch** on the IP or selecting the RUN/STOP command from the **PG** (PG menu: "Operating mode").

Calling up in the logic control program of the S5-CPU:
- SEND 19 (without data): module STOP
- SEND 20 (without data): module RUN
  The parameters for the source type must be specified as "NN".

See examples FB6 and FB7 in Section 5.2.7.

5.2.3 Data exchange with the control loops

5.2.3.1 High-speed data exchange of defined data

The "SEND 11 to 18" and "RECEIVE 11 to 18" jobs enable high-speed exchange of defined data between the CPU and the IP 252. The length of time between initiating the job in the CPU and using the parameters on the IP 252 is independent of the loading of the processor in the IP 252.

The jobs correspond exactly to those used in FB:STEU (Section 5.1).

Direction S5-CPU to IP:

The data handling blocks "SEND 11 to 18" transfer data to the controllers 1 to 8.
Depending on the structure of the controller on the IP (drive controller or standard controller) either 9 bytes or 4 bytes are transferred. The meaning of the data bytes is given in Fig. 5.2.

Direction IP to S5-CPU:

The data handling blocks "RECEIVE 11 to 18" transfer data from the controllers 1 to 8.
Depending on the structure of the controllers on the IP (drive controller or standard controller) either 2 bytes or 3 bytes are received. The meaning of the data bytes is given in Fig. 5.1.

The data handling blocks "SEND 11 to 18" and "RECEIVE 11 to 18" are included in the user-friendly standard function blocks
FB:STEU/FB 100 for drive controllers
FB:STEU/FB 101 for standard controllers.

While the number of bytes transferred is fixed in the FB:STEU, it is possible in the example FBs 4 and 5 to send or receive only 1, 2 etc. data words or bytes.

Data from a drive controller:

7	6	5	4	3	2	1	0	BYTE
BIT 9.UE-	BIT 9.UE+	BIT 12.6	BIT 12.5	BIT 12.4	BIT 12.3	BIT 12.2	BIT 12.1	0
							BIT 11.1	1
BIT 5.UE-	BIT 5.UE+	BIT 13.6	BIT 13.5	BIT 13.4	BIT 13.3	BIT 13.2	BIT 13.1	2

↓ Increasing addresses

Data from a standard controller:

7	6	5	4	3	2	1	0	BYTE
BIT 1.4.PP 1.5.AUF	BIT 1.4.NP 1.5.ZU	BIT 5.6	BIT 5.5	BIT 5.4	BIT 5.3	BIT 5.2	BIT 5.1	0
BIT 1.1.UE- 1.2.UE-	BIT 1.1.UE+ 1.2.UE+	BIT 4.6	BIT 4.5	BIT 4.4	BIT 4.3	BIT 4.2	BIT 4.1	1

↓ Increasing addresses

Fig. 5.1 "RECEIVE 11 to 18" (IP 252 ——> S5-CPU)

Data sent to a drive controller:

7	6	5	4	3	2	1	0	BYTE
VAR 8.1							HIGH	0
							LOW	1
VAR 9.1							HIGH	2
							LOW	3
VAR 3.1							HIGH	4
							LOW	5
BIT 3.1	REL 1.1	REL 6.1	REL 7.1	REL 3.1	REL 8.2	REL 8.1	REL 9.1	6
REL 2.1	REL 5.1	REL 5/9	BIT 9.RF	BIT 5.RF	BIT 8.HOE	BIT 8.TIE	BIT 8.LOE	7
						REL 10.1	REL 8.3	8

Increasing addresses

Data sent to a standard controller:

7	6	5	4	3	2	1	0	BYTE
VAR 3.1							HIGH	0
							LOW	1
BIT 1.1.RF 1.2.RF	REL 1.2.2	BIT 1.2.ST	BIT 1.2.IR	REL 1.1.1 1.2.1 1.5.1	BIT 1.5.TOT	BIT 1.5.RF	BIT 1.5.HAI	2
REL 2.3	REL 3.2	REL 3.1	BIT 1.5.BA	BIT 1.5.BZ	BIT 3.HOE	BIT 3.TIE	BIT 3.LOE	3
						BIT 1.5.HAA	BIT 1.5.HAZ	4

Increasing addresses

Note: Both these bits (pushbuttons)
HAA: Manual input "Open", and
HAZ: Manual input "Close"
can be transferred to the IP 252 only with "SEND 11 to 18" (Section 4.11.6.12).

Fig. 5.2 "SEND 11 to 18" (S5-CPU — IP)

See examples FB4 and FB5 in Section 5.2.7

5.2.3.2 Exchange of random control loop data

The previous subsections of Section 5 have described the exchange of a number of defined control loop data.
This subsection will demonstrate how transfer of random controller structure data can be implemented. The data which can be transferred between the IP 252 and the CPU are listed in Sections 4.10.7 (DR), 4.11.7 (SR) and 4.12.8 (DRS). The following description refers to these controller data blocks.

The following procedure is required for programming data transfer:

1) Select the desired constant or desired bit etc. from the configuration documentation in Section 8 or 9.
2) Search for the selected values in Sections 4.10.7, 4.11.7 and 4.12.8 (controller data blocks). In doing so, each value of the controller structure must be assigned a DW No. in the controller DB.
3) This DW No. and the corresponding controller no. (1 to 8) are stored in a CPU DB as source/destination parameters.
4) By specifying a page no. when calling the data handling block, the desired values are then clearly assigned.

Note: The data handling blocks described here run on the IP 252 with lower priority. Depending on the IP 252 processor load, this can result in relatively large dead times between job allocation on the CPU side and the time at which the transferred parameters come into effect (up to several seconds).

Receiving random control loop data of the IP 252

Random data of the control loop are transferred to a CPU DB with the "RECEIVE ALL" job. The data handling block "FETCH" determines which data are transferred from which controller.

Only the "FETCH21" job is permissible for the **DS/SR** user submodule (MLFB: 6ES5 374-0AA11). This job, initialized with the "READ/WRITE" data handling function, transfers the source and destination parameters to the IP 252, so that in any subsequent "SEND ALL" the desired data will be transferred to a CPU DB.

The "FETCH21" job prepares data transfer according to the illustration below, i. e.:
1) The source (IP 252) ignores the initial address and the length of the data block. The IP 252 always presents the data of a control loop starting with the first data word (DWO).
2) Only meaningful data are transferred. The areas DW120 to DW179 and DW200 to DW219 are not transferred, since only internal IP values are stored here.

See example FB 12 in Section 5.2.7.

If the **DRS/SR** user submodule (MLFB: 6ES5 374-0AB11) is used, the "FETCH23" job is available as well as the above-mentioned "FETCH21" job.
Use of this job permits the user to give the initial address and the length not only on the destination side (CPU) but also on the source side (IP 252). All controller block data, including internal IP values, can be transferred here. Special care must be taken that the amount of data transferred in one cycle does not exceed 224 data words, since the length of the dual-port RAM is limited to 224 data words.

See example FB13 in Section 5.2.7.

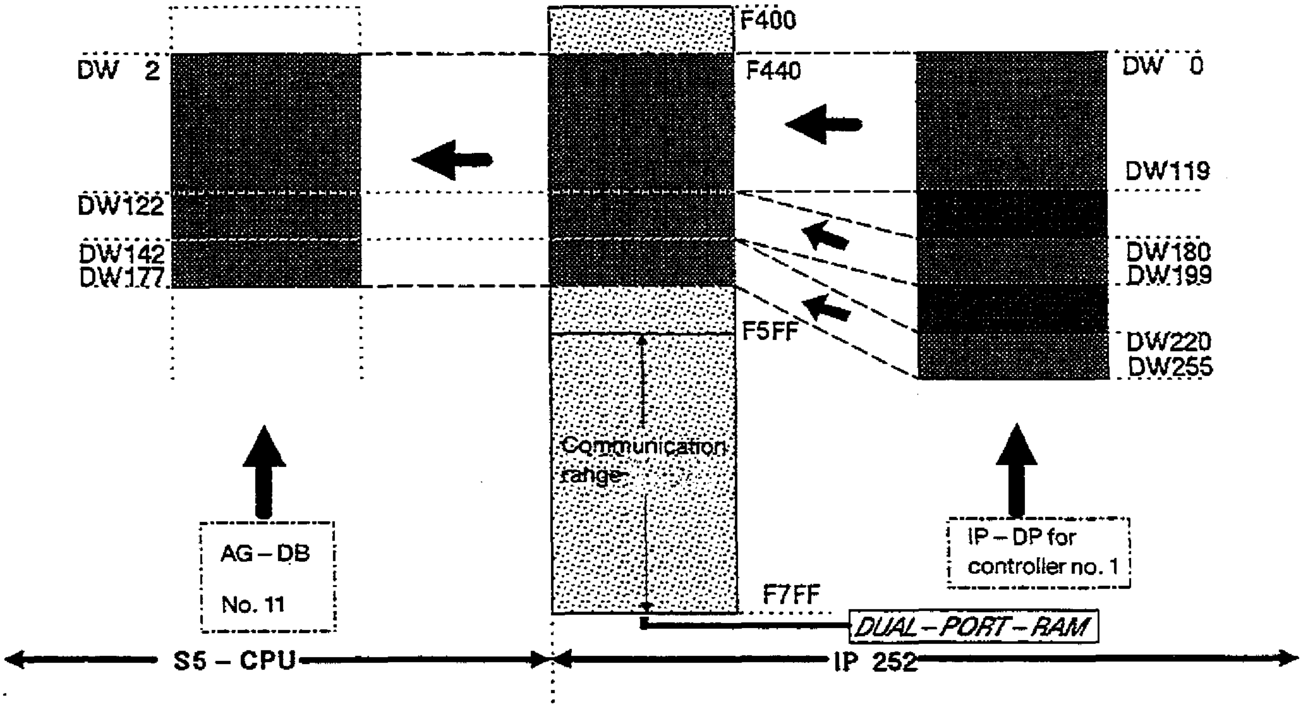


Fig. 5.3

Sending random data to a control loop of the IP 252

In the example FBs 10 and 11 of Section 5.2.7, two data words from CPU DB9 are transferred to the data block of controller no. 1. The parameters for the source (CPU DB9, DW5 and 6) and the destination (controller DB1, DW105 and DW106) are sent to the IP 252 by "SEND21" using the READ/WRITE function. If controller no. 1 is a drive controller (DR/DRS), the data word has the following meaning (see Sections 4.10.7 and 4.12.8):
 DW105: Setpoint, upper danger limit of the speed controller (SOGD)
or DW106: Setpoint, lower danger limit of the speed controller (SUGD)

If controller no. 1 of the IP 252 had been a standard controller (SR), transfer of data words 105 and 106 would have had no effect since, according to Section 4.11.7, these are not assigned.

According to Section 4, data words 105 and 106 belong to the group of "retentive data" in the IP 252. Retentive data of a controller structure are constants, configuring switches (bits), DAC/ADC addresses and page nos. etc. In the user submodule they are stored automatically in EEPROM along with the DR/SR structures of the IP 252. Since the EEPROM only has an operating life of >10.000 write cycles, such a mode may not send data cyclically to the IP 252.

5.2 Use of the Data Handling Blocks of the S5-CPU

If a cyclic change of retentive controller data is required, the user submodule with the DRS/SR structures (MLFB: 6ES5 374-0AB11) must be used. This submodule permits a choice between "Data dump desired/not desired" by using the following job numbers:

> If it is desired to dump the data on EEPROM, job "SEND21" must be used (example FB10). If otherwise retentive data are not to be dumped, job "SEND22" must be used (example FB11).

If the user submodule with the DR/SR structures (MLFB: 6ES5 374-0AA1) is used, only "SEND21" with subsequent "SEND ALL" may be called (example FB10). Cyclic transfer of retentive data to the IP 252 is then not possible, since the EEPROM will have been destroyed after a relatively short time.

The following figure illustrates data transfer from the CPU DB via the dual-port RAM to the controller DB of the IP 252. It can be seen from this figure that the data range in the dual-port RAM of the IP 252 permits the transfer of a maximum of 224 words. Transfer of all controller DBs would therefore have to be executed in block mode.

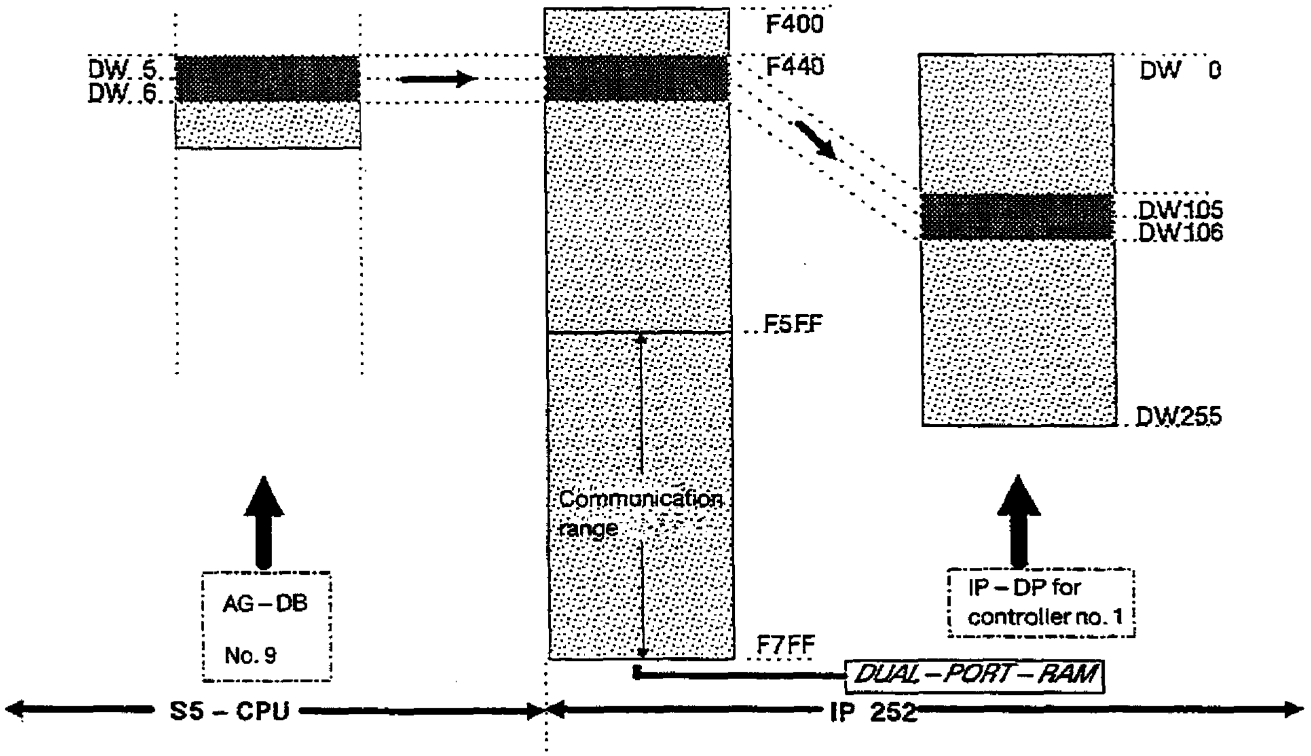


Fig. 5.4

Note: If data words DW 168 to 173 in the case of DR
DW 168 to 172 in the case of SR
or DW 168 to 178, 182 to 188 and 192 in the case of DRS
are to be transferred from the S5-CPU to the IP 252, the "high" byte and the "low" byte should be exchanged by the STEP 5 user program.
The following applies for the format of these ADC contents:
−100% to 0% to +100%
corresponds to −16384 to 0 to +16383 in fixed-point format.

5.2.4 IP 252 Fault diagnostics by the CPU control program

The following messages are transferred from the IP 252 to the CPU control program for diagnostics:

Fault No. (decimal)	Text on PG	Fault caused by	Response of the IP 252
00.	No fault in IP	Initial state: "No fault in IP 252"	-
11.	Hardware	Time-out (not analog module)	"Stop"
12.	Hardware	Checksum of EEPROMs incorrect	"Stop"
13.	Hardware	Result of offset correction: Deviation of a DAC > 7LSB	"Stop"
14.	Hardware	Fault in hardware test program: RAM	"Stop"
15.	Hardware	Fault in hardware test program: MUART	"Stop"
20.	Watchdog	Time-out	"Stop"
21.	Direct access	S5 bus not enabled by S5-CPU	"Stop"
22.	Analog section	Wire break at digital input (digital tachogenerator)	"Stop"
23.	Analog section	Power failure in analog section	"Stop"
30.	PC at stop	BASP active	"Stop"
31.	Submodule fault	Wrong or no submodule in IP 252	"Stop"
50.	Analog module	Time-out or wire break in analog module	"Stop"
51.	Overload	IP 252 overloaded (timing conflict)	LED "F" flashing
70.	Stop switch	Stop switch on IP 252 set to "Stop"	"Stop"
71.	Software stop	Stop of IP 252 (initiated by command from PG or CPU)	"Stop"
The following messages apply only to the **DRS** structure			
75.	Prepare SE	Prepare self-optimization	None
76.	SO active	Self-optimization active	None
77.	SO successfully completed	Self-optimization successfully completed	None
78.	CONFIG./PAR. error	Configuring/parameter-assignment error	None
79.	Impermissible CNTL. No.	Impermissible controller number (only no. 1 or 2 are permissible)	None
80.	Sampling time too large	Sampling time too large (only TA = 4 or 8 ms permissible)	None
81.	Moment of inertia too high	Moment of inertia too high	None
83.	Unsuitable system	Unsuitable system (procedure cannot be used)	None
84.	Unsuccessful optimization	Parameters could not be calculated (unsuccessful optimization)	None
85.	Abort by PG/PC	Abort by programmer	None
86.	S5 communications error	S5 communications error with the IP 240	None
87.	S5 wire break	Wire break on the IP 240 module	None

All the messages listed above are recognized by the IP 252 operating system and can be

1. interrogated with the help of COM 252 for the PG 615 (or COM REG for PG 635/675/685/695) via the "Info" function in the "Errors" submenu and
2. fetched by the CPU via RECEIVE 200 from a specified RAM area of the IP 252 (dual-port RAM).
   The error is reset again via RESET 200. Furthermore, any error entered once will be automatically reset when the module changes from STOP to RUN. CONTROL 200 can be used to determine whether a new error has been entered by the IP 252, and whether it is meanningful to call RECEIVE 200.

Generally, only the first message to appear will be entered. Exceptions are nos. 51 an 75 to 85: However, these messages are overwritten by all subsequent messages!

See example FB8 in Section 5.2.7

5.2 Use of the Data Handling Blocks of the S5-CPU

5.2.5 System identification and system status (SYSID and SYSTAT)

In the first section of the example FB9, the SYSID area (SYSID = system identification) is read with the help of RECEIVE 223 from the dual-port RAM of the IP 252 with the page no. specified. The SYSID area is limited to a maximum length of 100 data words. The data are stored in ASCII code.

This SYSID area, which is also similar in other CPs and IPs, has the following structure in the IP 252:

Byte No.	ASCII characters (examples)	General description
Bytes 0 to 5	**0AA11<CR>** or 0AB11<CR>	Submodule order code
Bytes 6 to 13	**IP-252<CR>**	Module description
Bytes 14 to 21	**V 1.2 B<CR>**	Module FW version
Byte 22	**<CR>**	
Bytes 23 to 31	**15.10.87<CR>**	Date
Bytes 32 to 38	**<CR>** to **<CR>**	7 blank lines
Bytes 39 to 42	**255<CR>**	Page no.
Bytes 43 to 44	**<CR> <CR>**	2 blank lines
Bytes 45 to 52	**V 1.2 M<CR>**	MM-FW version
Bytes 53 to 199	–	not assigned

In the second section of the example FB9, the SYSTAT area (SYSTAT = system status) is read with the help of RECEIVE 221 from the dual-port RAM of the IP 252 with the page no. specified:

This SYSTAT area, which is also similar in other CPs and IPs, has the following structure:

Byte No.	Meaning
Byte 0	1 H : IP at STOP / 2H : IP at RUN
Byte 1	2H —> IP has no additional battery back-up
Byte 2	Irrelevant
Byte 3	Irrelevant
Byte 4	Irrelevant
Byte 5	Error message of the IP
Byte 6	00H (i. e.: no additional information in the IP 252)

The second method of error diagnostics by the S5-CPU is to receive byte 5 of the SYSTAT range specifically (see Section 5.2.4).

See example FB9 in Section 5.2.7.

5.2.6 Recording and transferring the measured values of a control loop in the IP 252 (oscilloscope function)

The IP 252 has a memory in which measured values can be recorded. Three different measured values can be stored in parallel in the RAM of the IP 252 for each of the 150 sampling points. The oscilloscope function is only important if it desired to display the meared values on CRT systems. Using an operator keyboard, for example, a step change can be made in the setpoint for a control loop and the resulting transfer function/change in manipulated variable etc. can be displayed on the screen.

a) Sending the parameters of the oscilloscope function from the CPU to the IP 252

It is now possible to inform the IP 252, via the CPU control program, which measuring points of the selected controller structure (DR/SR/DRS) are to be recorded, e. g. MP 12 of controller no. 1 (actual speed of the drive controller structure DR and DRS) and when the recording is to begin:

- Either via a trigger condition (e. g. "Value of the first measuring point exceeds 5%")
- Or immediately after the parameters of the oscilloscope function have been transferred by means of "SEND 30", i. e. without a trigger condition.

The values of the oscilloscope function for initialization are transferred to the IP 252 in the order listed below (see also example FB14 in Section 5.2.7):

DW No.	Example	General meaning
DW 0	KF = **17** Setpoint in the case of DR and DRS	1st measuring point no. ("00" not permissible)
DW 1	KF = **14** Processed setpoint in the case of DR and DRS	2nd measuring point no. ("00": no recording)
DW 2	KF = **8** Actual value in the case of SR	2nd measuring point no. ("00": no recording)
DW 3	KF = **144** (=[1−1] · 1034 + 144)	([Controller no. of the 1st MP] − 1) · 1034 + 144
DW 4	KF = **144** (=[1−1] · 1034 + 144)	([Controller no. of the 2nd MP] − 1) · 1034 + 144
DW 5	KF = **1178** (=[2−1] · 1034 + 144)	([Controller no. of the 3rd MP] − 1) · 1034 + 144
DW 6	KF = **164** (≙ +1%)	Trigger lever (−100% to + 100%) ≙ −16384 to + 16383
DW 7	KF = **1** (No expansion)	Expansion factor k (see "Notes")

DW 8	KM = **0000 00yz 0000 000x**	Trigger edge: x = 0 : positive edge
		x = 1 : negative edge
		Trigger: yz = 01 : without trigger condititon
		yz = 10 : with trigger condition

DW 9	KF = **0** (No delay)	Delay factor n (see "Notes")

Notes:

- The trigger condition refers to the measuring point no. in DW 0
- The bit "with/without trigger condition" is deleted at the beginning of the recording
- Expansion factor : k = 1 to 9999
  i. e. "every k-th sampling point is recorded"
  Delay factor : n = 0 to 999
  i. e. "recording begins after n sampling intervals"

5.2 Use of the Data Handling Blocks of the S5-CPU

The **recording interval** is obtained from the two values "expansion factor" and "delay factor" with the sampling time T_A
–> Start after beginning of recording:
$k \cdot n \cdot T_A$ (ms) = ... (ms)
–> End after beginning of recording:
Recording duration + delay time
$k \cdot 150 \cdot T_A$ (ms) + $k \cdot n \cdot T_A$ (ms) = ... (ms)

b) Transferring oscilloscope function parameters in the IP 252 to a DB of the CPU.

"RECEIVE30" is used for transferring trace data which already exist in the IP 252 (see above for order).

c) Receiving measured data of the oscilloscope function in the CPU

"CONTROL31" is used to check whether all measured values of the oscilloscope function exist in the IP 252. "FETCH23" is called to prepare the data transfer, and, in doing so, it sends th source/destination parameters to the IP 252. In the example FB15, all data recorded by the oscilloscope function (450 data words) are transferred to three CPU DBs. The actual transfer of data is executed with "RECEIVE ALL". In example FB15, each group of 150 data words of a measuring point are transferred three times to a CPU DB.

5.2.7 STEP 5-Examples of IP 252 <——> S5-CPU data traffic

```
OB1                                                         LEN=12

SEGMENT 1
0000        :A    F 100.0
0001        :R    F 100.0            RLO = 0  -  FLAG
0002        :AN   F 100.1            UNCONDITIONALLY REQUIRED:
0003        :S    F 100.1            RLO = 1  -  FLAG
0004        :JU   FB2                E.G.: CALL "FB2"
0005 NAME :FORCE
0006        :BE

---------------------------------------------------------------------

OB20                                                        LEN=12

SEGMENT 1
0000        :AN   F 30.0             30.0=1 CODE: NO POWER FAILURE
0001        :S    F 30.0             (IS REQUIRED IN FB99)
0002        :A    F 30.1             30.1=0 CODE: COLD RESTART
0003        :R    F 30.1
0004        :JU   FB99               FB FOR SYNCHRONIZING THE IPS
0005 NAME :SYNC:IPS
0006        :BE

---------------------------------------------------------------------

OB21                                                        LEN=22

SEGMENT 1
0000        :AN   F 30.0             30.0=1 CODE: NO POWER FAILURE
0001        :S    F 30.0             (IS REQUIRED IN FB99)
0002        :AN   F 30.1             30.1=1 CODE: WARM RESTART
0003        :S    F 30.1             (THIS FLAG IS USED IN THE EXAMPLE
0004        :                         FB6 AND CAN BE USED FOR THE
0005        :                               S5-135U AND S5-150U
0006        :                         TO ENABLE THE JOB "SEND20"
0007        :                        (SET THE IP 252 TO RUN) ONLY IF
0008        :                        THE INPUTS/OUTPUTS ARE BEING PRO-
0009        :                        CESSED AGAIN, I.E. AFTER THE
000A        :                        PC CYCLE PREVIOUSLY INTERRUPTED BY
000B        :                        THE CPU STOP HAS BEEN PROCESSED TO
000C        :                        TO THE END.
000D        :
000E        :JU   FB99               FB FOR SYNCHRONIZING THE IPS
000F NAME :SYNC:IPS
0010        :BE

---------------------------------------------------------------------

OB22                                                        LEN=10

SEGMENT 1
0000        :A    F 30.0
0001        :R    F 30.0             30.0=0: CODE: "POWER FAILURE"
0002        :JU   FB99               THEREFORE: IN FB99 FIRST 2 SECS
0003 NAME :SYNC:IPS
0004        :BE                      WAITING. FB2
```

```
FB3                                                          LEN=65

SEGMENT 1
NAME :STRUK-FR

0005      :                      EXAMPLE OF DISABLING/ENABLING
0006      :                      CONTROLLER LOOPS OF THE IP 252
0007      :A    F 30.6           WAITING TIME FROM FB6 ACTIVE ?
0008      :BEB                   IF YES, END.
0009      :L    KB255
000A      :T    FB82             KM=1111 1111 DH.: ALL 8 CON-
000B      :                      TROLLERS ARE ENABLED.
000C      :A    F 100.1          SET RLO=1
000D      :JU   FB244            THE IP WITH PAGE NUMBER 2 IS
000E NAME :SEND                  TRANSFERRED TO THE "CONFIGURING
000F SSNR :     KY0,2            ENABLE BYTE"
0010 A-NR :     KY0,10
0011 ANZW :     FW70
0012 QTYP :     KSFB
0013 DBNR :     KY0,0            IRRELEVANT, SINCE Q TYPE: F BYTE
0014 QANF :     KF+82            FLAG BYTE 82 IS THE SOURCE
0015 QLAE :     KF+1             (ONLY 1 BYTE)
0016 PAFE :     FB67
0017      :L    KB1              KM=0000 0001, I.E. ENABLE ONLY
0018      :T    FB83             CONTR. NO 1 OF THE IP WITH THE PAGE
0019      :                      NO 3 (DISABLE CONTR. NOS 2 TO 8)
001A      :A    F 100.1          SET RLO=1
001B      :JU   FB244
001C NAME :SEND
001D SSNR :     KY0,3
001E A-NR :     KY0,10
001F ANZW :     FW74
0020 QTYP :     KSFB
0021 DBNR :     KY0,0            IRRELEVANT
0022 QANF :     KF+83            FB83
0023 QLAE :     KF+1             ONLY 1 FB
0024 PAFE :     FB68
0025      :L    KB3              KM=0000 0011, I.E. ENABLE ONLY CON-
0026      :T    FB83             TROLLER NO. 1 AND 2 OF THE IP WITH
0027      :                      PAGE NUMBER 4 (DISABLE 3 TO 8)
0028      :
0029      :A    F 100.1          SET RLO=1
002A      :JU   FB244
002B NAME :SEND
002C SSNR :     KY0,4
002D A-NR :     KY0,10
002E ANZW :     FW78
002F QTYP :     KSFB
0030 DBNR :     KY0,0            IRRELEVANT
0031 QANF :     KF+83
0032 QLAE :     KF+1
0033 PAFE :     FB69
0034      :O    F 67.0           ANY ERRORS IN TRANSMISSION ?
0035      :O    F 68.0
0036      :O    F 69.0
0037      :JC   =M001            IF YES, JUMP.
0038      :BEA
0039 M001 :L    KB3              ERROR HANDLING: E.G.
003A      :T    FB5              TRANSFER NUMBER OF THE FB, IN
003B      :BE                    WHICH THE ERROR APPEARED, TO FB5
```

```
FB4                                                     LEN=82

SEGMENT 1
NAME :FORCE 1                             JOBS FOR THE IP 252

0005       :                              IN THIS EXAMPLE DATA ARE SENT FROM
0006       :                              FLAG WORD 106 AND FW108 OF THE CPU
0007       :                              TO THE IP 252.
0008       :
0009       :                              PAGE NUMBER 4 IS SET ON THE IP 252,
000A       :                              THE JOB GOES TO CONTROLLER NUMBER
000B       :                              2 (SEE JOB NO. 0.12)
000C       :
000D       :                              (JOB NUMBERS  0.11 TO 0.18
000E       :                               CORRESPOND TO THE CONTROLLER
000F       :                               NUMBERS 1 TO 8)
0010       :
0011       :L    KF+1234                  SET 12.34% AS THE SETPOINT BEFORE
0013       :T    FW106                    "SEND" IS CALLED, THE FLAG BYTES
0014       :                              USED (HERE FB106 TO FB109) MUST
0015       :                              BE INITIALIZED.
0016       :
0017       :
0018       :JU   FB244                    TRANSMITTING DATA FROM THE IP 252
0019 NAME  :SEND
001A SSNR  :     KY0,4                    PAGE NUMBER OF THE IP (HERE: 4)
001B A-NR  :     KY0,12                   JOB NUMBER 12, I.E. TO R-NO. 2
001C ANZW  :     FW100                    JOB STATUS WORD IS FW100 AND FW102
001D QTYP  :     KSFB                     THE DATA ARE FROM FBS
001E DBNR  :     KY0,0                       IRRELEVANT, SINCE FLAG BYTES
001F QANF  :     KF+106                   THE DATA FROM FB106 BEGIN HERE:
0020 QLAE  :     KF+4                    4 FB, I.E. 2 WORDS
0021 PAFE  :     FB104
0022       :
0023       :                              DEPENDING ON THE CONTROLLER
0024       :                              STRUCTURE USED FOLLOWING DIVISION
0025       :                              WILL RESULT:
0026       :
0027       :                               1. CONTROLLER NUMBER 2 OF THE
0028       :                                IP 252 HAS "DRIVE" STRUCTURE
0029       :                               I.E.:
002A       :                              FW100: ANZW,    SEND12
002B       :                              FW102: ANZW+1,  SEND12
002C       :                              FB104: PAFE,    SEND12
002D       :                              FB105:      FREE
002E       :                              FW106: VAR 8.1 OF THE IP 252
002F       :                              FW108: VAR 9.1 OF THE IP 252
0030       :                               ---------------------------------
0031       :                               IN THE EXAMPLE ONLY VAR 8.1 AND
0032       :                               VAR 9.1 WERE TRANSMITTED TO THE
0033       :                               IP 252.
0034       :                               IN ORDER TO ALSO TRANSMIT THE
0035       :                               FOLLOWING VALUES TO THE IP, THE
0036       :                               'QLAE' PARAMETER MUST BE SET TO
0037       :                               BETWEEN "6" AND "9"
0038       :
0039       :                              FW110: VAR 3.1 OF THE IP 252
003A       :                              FB112: DE0 (BITS AND RELAYS V: AR)
003B       :                              FB113: DE1 (BITS AND RELAYS V: AR)
003C       :                              FB114: DE2 (BITS AND RELAYS V: AR)
```

```
FB4                                                        LEN=82

003D      :                                  -------------------------------
003E      :
003F      :                                   2. CONTROLLER NO. 2 OF THE IP 252
0040      :                                      IS A STANDARD CONTROLLER
0041      :                                   I.E.:
0042      :                                  FW100: ANZW,    SEND12
0043      :                                  FW102: ANZW+1, SEND12
0044      :                                  FB104: PAPE,    SEND12
0045      :                                  FB105:        FREE
0046      :                                  FW106: VAR 3.1 OF THE IP 252
0047      :                                  FB108: DE0 (BITS AND RELAYS V: SR)
0048      :                                  FB109: DE1 (BITS AND RELAYS V: SR)
0049      :                                   IN ORDER TO SEND ONLY VAR 3.1,
004A      :                                   THE PARAMETER "QLAE" MUST BE SET
004B      :                                   TO "QLAE = 2"' (2 BYTES)
004C      :BE
```

```
FB5                                                     LEN=64

SEGMENT 1
NAME :FORCE1                        JOBS FOR THE IP 252

0005       :                        IN THIS EXAMPLE DATA IS TRANS-
0006       :                        MITTED FROM THE IP 252 TO DATA
0007       :                        WORDS IN DB41.
0008       :                        PAGE NUMBER 4 IS SET ON THE IP 252,
0009       :                        THE JOB GOES TO CONTROLLER NUMBER 2
000A       :                        (S. A-NR: 0.12)
000B       :                        (JOB NUMBER A-NR: 0.11 TO 0.18 COR-
000C       :                        RESPOND TO CONTROLLER NUMBERS
000D       :                        1 TO 8)
000E       :O    DB41               OPEN DB41
000F       :JU   FB245              RECEIVE DATA FROM THE IP 252
0010 NAME :RECEIVE
0011 SSNR :      KY0,4              PAGE NUMBER OF THE IP (HERE: 4)
0012 A-NR :      KY0,12             JOB NO. 12, I.E. FROM CONTR. NO.2
0013 ANZW :      DW1                DW1 AND DW2 FOR DISPLAY WORDS
0014 ZTYP :      KCDB               DESTINATION PARAMETERS TO DB
0015 DBNR :      KY0,41             LIKEWISE DB41
0016 ZANF :      KF+3               ASSIGN FROM DW3
0017 ZLAE :      KF+1               RECEIVE 1 WORD
0018 PAFE :      FB100                PARAMETER ASSIGNMENT ERROR BYTE
0019       :                        DB41 MUST HAVE A MINIMUM LENGTH OF
001A       :                        4 DATA WORDS IN THIS EXAMPLE:
001B       :
001C       :                        DEPENDING ON THE CONTROLLER STRUC-
001D       :                        TURE USED, THE FOLLOWING DIVISION
001E       :                        WILL RESULT:
001F       :                         1. CONTROLLER NUMBER 2 OF THE
0020       :                          IP 252 HAS "DRIVE" STRUCTURE
0021       :                         THEREFORE:
0022       :                        FB100: PAFE, RECEIVE12
0023       :                        DB41:
0024       :                        DW1: ANZW,    RECEIVE12
0025       :                        DW2: ANZW+1, RECEIVE12
0026       :                        DL3: DA0 (LIMITS)
0027       :                        DR3: DA1 (LIMITS)
0028       :                        ----------------------------------
0029       :                         ONLY DA0 AND DA1 WERE RECEIVED
002A       :                         FROM THE IP 252 IN THE EXAMPLE
002B       :                         IN ORDER TO ALSO RECEIVE DA2 FROM
002C       :                         THE IP, "ZLAE" MUST BE SET TO "2".
002D       :                         IN THIS CASE 1 BYTE (DR4), WHICH
002E       :                         IS IRRELEVANT, WOULD THEN ALSO
002F       :                         BE TRANSFERRED.
0030       :
0031       :                        ----------------------------------
0032       :                         2. CONTROLLER NO. 2 OF THE IP 252
0033       :                            IS A "STANDARD CONTROLLER"
0034       :                         THEREFORE:
0035       :                        FB100: PAFE, RECEIVE12
0036       :                        DB41:
0037       :                        DW1: ANZW,    RECEIVE12
0038       :                        DW2: ANZW+1, RECEIVE12
0039       :                        DL3: DA0 (LIMITS)
003A       :BE                      DR3: DA1 (LIMITS)
```

```
FB6                                                            LEN=110

SEGMENT 1
NAME :STP->RUN

0005       :                          THIS EXAMPLE TAKES THE IPS WITH
0006       :                          THE PAGE NUMBERS 2, 3 AND 4 FROM
0007       :                          "STOP" TO "RUN" IF THE PC IS AT
0008       :                          RUN AND IF THE RUN/STOP SWITCHES
0009       :                          OF THE IPS ARE AT THE RUN
000A       :                          POSITION.
000B       :
000C       :A    F 30.1
000D       :JC   =ENDE                IF A MANUAL WARM RESTART IS EXE-
000E       :                          CUTED AND IF THE "IPS TO RUN" JOB
000F       :                          IS TO BE EXECUTED FIRST, I.E. IM-
0010       :                          MEDIATELY, IT MUST BE NOTED THAT
0011       :                          THE PREVIOUSLY INTERRUPTED PC
0012       :                          CYCLE MUST FIRST BE PROCESSED TO
0013       :                          THE END, WITHOUT REFERENCING THE
0014       :                          I/OS.
0015       :
0016       :
0017       :                          THIS MEANS THAT THE IP 252 CAN
0018       :                          ONLY BE SET TO RUN WHEN THIS PC
0019       :                          CYCLE HAS BEEN PROCESSED.
001A       :                          THEREFORE, THE FLAG USED FOR THIS
001B       :                          PURPOSE IS INTERROGATED.
001C       :
001D       :A    F 30.7               MODULES ALREADY IN RUN?
001E       :JC   =M001                I.E.: JOB FINISHED?
001F       :AN   F 30.7
0020       :S    F 30.7               SET THE CODE FOR THE FIRST RUN.
0021       :S    F 30.6               THIS FLAG SHOULD BE INTERROGATED
0022       :                          BY THE USER, TO ESTABLISH WHETHER
0023       :                          OR NOT THE REQUIRED WAITING TIME
0024       :                          AFTER A "STOP-->RUN" OF THE IP 252
0025       :                          HAS ELAPSED:
0026       :                            F 30.6 = 0 ==> RUN
0027       :                            F 30.6 = 1 ==> WAIT WITH
0028       :                                           FURTHER JOBS
0029       :
002A       :U    M 100.1              SET RLO=1
002B       :SPA FB244                 IP WITH PAGE NUMBER 2 TO "RUN"
002C NAME  :SEND
002D SSNR  :     KY0,2
002E A-NR  :     KY0,20               "JOB NO. 20" FOR "RUN"
002F ANZW  :     FW54
0030 QTYP  :     KSNN                 "NN", I.E. NO DATA
0031 DBNR  :     KY0,0                     IRRELEVANT
0032 QANF  :     KF+0                  NO DATA
0031 DBNR  :     KY0,0                     IRRELEVANT
0032 QANF  :     KF+0                          "
0033 QLAE  :     KF+0                          "
0034 PAFE  :     FB64
0035       :A    F 100.1              SET RLO=1
0036       :JU   FB244                IP WITH PAGE NUMBER 3 TO "RUN"
0037 NAME  :SEND
0038 SSNR  :     KY0,3
0039 A-NR  :     KY0,20
```

```
FB6                                                         LEN=110

003A ANZW :     FW58
003B QTYP :     KSNN
003C DBNR :     KY0,0
003D QANF :     KF+0
003E QLAE :     KF+0
003F PAFE :     FB65
0040      :A    F 100.1               SET RLO=1
0041      :JU   FB244                 IP WITH PAGE NUMBER 4 TO "RUN"
0042 NAME :SEND
0043 SSNR :     KY0,4
0044 A-NR :     KY0,20
0045 ANZW :     FW62
0046 QTYP :     KSNN
0047 DBNR :     KY0,0
0048 QANF :     KF+0
0049 QLAE :     KF+0
004A PAFE :     FB66
004B      :
004C M001 :AN   F 30.5
004D      :L    KT002.2               WAIT 2 SECONDS AFTER STOP -> RUN
004F      :SI   T 5                   TILL THE IPS ARE READY FOR OTHER
0050      :A    T 5                   JOBS
0051      :=    F 30.5
0052      :AN   T 5
0053      :JC   =M002                 JUMP IF THE TIMER HAS NOT YET RUN
0054      :A    F 30.7
0055      :R    F 30.6                JOB: IPS FROM STOP -> RUN ALREADY
0056      :                           RUN
0057      :
0058      :R    F 30.7                =0, I.E. IPS READY FOR FURTHER
0059      :                           JOBS
005A      :
005B M002 :O    F 64.0                ERRORS IN TRANSMISSION?
005C      :O    F 65.0
005D      :O    F 66.0
005E      :JC   =M003                 IF YES, JUMP
005F      :BEA
0060 M003 :                           ERROR HANDLING: E.G. TRANSFER
0061      :L    KB6                   NUMBER OF THE FB IN WHICH THE
0062      :T    FB5                   ERROR OCURRED TO MB5
0063      :BEA
0064      :
0065 ENDE :A    F 30.1                RESET THE FLAG FOR MANUAL WARM
0066      :R    F 30.1                RESTART
0067      :S    F 30.6                DISABLE ALL OTHER JOBS TO THE IP
0068      :BE
```

```
FB7                                                        LEN=58

SEGMENT 1
NAME :RUN->STP

0005        :                           THIS EXAMPLE TAKES THE IPS WITH THE
0006        :                           PAGE NUMBERS 2, 3 AND 4 FROM RUN
0007        :                           MODE TO STOP MODE
0008        :
0009        :A    F 30.6                WAITING TIME FROM FB6 ACTIVE ?
000A        :BEB                        IF YES, END.
000B        :A    F 100.1               SET RLO=1
000C        :JU   FB244                 IP WITH PAGE NUMBER 2 TO "STOP"
000D NAME :SEND
000E SSNR :       KY0,2
000F A-NR :       KY0,19                "JOB NO. 19" FOR "STOP"
0010 ANZW :       FW42
0011 QTYP :       KSNN                  "NN", I.E. NO DATA
0012 DBNR :       KY0,0                      IRRELEVANT
0013 QANF :       KF+0                           "
0014 QLAE :       KF+0                           "
0015 PAFE :       FB39
0016        :A    F 100.1               SET RLO=1
0017        :JU   FB244                 IP WITH PAGE NUMBER 3 TO "STOP"
0018 NAME :SEND
0019 SSNR :       KY0,3
001A A-NR :       KY0,19
001B ANZW :       FW46
001C QTYP :       KCNN
001D DBNR :       KY0,0
001E QANF :       KF+0
001F QLAE :       KF+0
0020 PAFE :       FB40
0021        :A    F 100.1               SET RLO=1
0022        :JU   FB244                 IP WITH PAGE NUMBER 4 TO "STOP"
0023 NAME :SEND
0024 SSNR :       KY0,4
0025 A-NR :       KY0,19
0026 ANZW :       FW50
0027 QTYP :       KSNN
0028 DBNR :       KY0,0
0029 QANF :       KF+0
002A QLAE :       KF+0
002B PAFE :       FB41
002C        :O    F 39.0                ERRORS IN TRANSMISSION?
002D        :O    F 40.0
002E        :O    F 41.0
002F        :JC   =M001                 IF YES, JUMP.
0030        :BEA
0031 M001 :                             ERROR HANDLING: E.G. TRANSFER
0032        :L    KB7                   NUMBER OF THE FB IN WHICH THE
0033        :T    FB5                   ERROR OCCURED TO FB5
0034        :BE
```

```
FB8                                                        LEN=63

SEGMENT 1
NAME :IP-ERROR

0005      :                          IN THIS EXAMPLE AN ERROR REPORTED
0006      :                          BY THE IP 252 WITH PAGE NUMBER 4
0007      :                          IS FETCHED FROM THE DPR OF THE IP
0008      :                          AND TRANSFERRED TO THE CPU.
0009      :
000A      :                          (FOR DIAGNOSING SOFTWARE AND HARD-
000B      :                           WARE ERRORS AS WELL AS FOR MESSAGE
000C      :                           MONITORING)
000D      :                          THE REPORTED ERROR IS STORED IN
000E      :                          THIS EXAMPLE IN FB110
000F      :
0010      :A    F 30.6               WAITING TIME FROM FB6 ACTIVE?
0011      :BEB                       IF YES, END.
0012      :
0013      :                          "RLO" FOR "CONTROL" IRRELEVANT
0014      :JU   FB247                NEW ERROR ON THE IP 252
0015 NAME :CONTROL
0016 SSNR :     KY0,4                REPORTED ?
0017 A-NR :     KY0,200
0018 ANZW :     FW88                 FW88 = FB88 AND FB89
0019 PAFE :     FB97
001A      :                          IF NEW ERROR:
001B      :AN   F 89.0               F 89.0 OF THE ANZW = 1 !!
001C      :JC   =M001
001D      :A    F 100.1              SET RLO=1 (NOT REQUIRED AT THIS
001E      :                          POSITION, SINCE "JC =M001" SETS
001F      :                          THE RLO TO "1")
0020      :JU   FB245                EVALUATION IF NEW ERROR
0021 NAME :RECEIVE
0022 SSNR :     KY0,4                RECEIVE ERROR WITH RECEIVE 200
0023 A-NR :     KY0,200
0024 ANZW :     FW92
0025 ZTYP :     KSFB
0026 DBNR :     KY0,0
0027 ZANF :     KF+110               FB110 = ERROR NUMBER OF THE IP
0028 ZLAE :     KF+1
0029 PAFE :     FB98
002A      :A    F 100.1              SET RLO=1
002B      :JU   FB248                RESET ERROR AGAIN WITH RESET 200
002C NAME :RESET
002D SSNR :     KY0,4
002E A-NR :     KY0,200
002F PAFE :     FB99
0030 M001 :O    F 96.0               ERRROS IN TRANSMISSION ?
0031      :O    F 97.0
0032      :O    F 98.0
0033      :O    F 99.0
0034      :JU   =M002                IF YES, JUMP.
0035      :BEA
0036 M002 :                          ERROR HANDLING: E.G. TRANSFER
0037      :L    KB8                  NUMBER OF THE FB IN WHICH THE
0038      :T    FB5                  ERROR OCCURRED TO FB5
0039      :BE
```

```
FB9                                                     LEN=57

SEGMENT 1
NAME :STATUS                          SYSID / SYSTAT - INFORMATION

0005       :                          IN THIS EXAMPLE, THE SYSID AREA
0006       :                          (SYSTEM IDENTIFICATION AREA) OF
0007       :                          THE IP IS READ FIRST BY MEANS OF
0008       :                          "RECEIVE 223"
0009       :
000A       :                          THEN "RECEIVE 221" READS THE SYSTAT
000B       :                          AREA (SYSTEM STATUS AREA) OF THE IP
000C       :                          WITH PAGE NUMBER 4
000D       :
000E       :
000F       :A    F 30.6               WAITING TIME FROM FB6 ACTIVE ?
0010       :BEB                       IF YES, END.
0011       :
0012       :A    F 100.1              SET RLO=1
0013       :
0014       :JU   FB245                RECEIVE - 221
0015 NAME  :RECEIVE
0016 SSNR  :     KY0,4                RECEIVE THE SYSID OF THE IP 252
0017 A-NR  :     KY0,223              WITH PAGE NUMBER 4 AND STORE IN
0018 ANZW  :     FW84                 THE AREA FB112 TO FB164
0019 ZTYP  :     KCMB
001A DBNR  :     KY0,0                IRRELEVANT, SINCE ZTYP: FB
001B ZANF  :     KF+112               STORE FROM FB112
001C ZLAE  :     KF+53                LENGTH OF THE IP 252 - SYSID IN
001D PAFE  :     FB96                 BYTES
001E       :
001F       :A    F 100.1              SET RLO=1
0020       :
0021       :JU   FB245
0022 NAME  :RECEIVE
0023 SSNR  :     KY0,4
0024 A-NR  :     KY0,221              RECEIVE SYSTAT WITH RECEIVE 221
0025 ANZW  :     FW84
0026 ZTYP  :     KCMB
0027 DBNR  :     KY0,0                IRRELEVANT, SINCE ZTYP: FB
0028 ZANF  :     KF+102               STORE FROM FB 102
0029 ZLAE  :     KF+7                 LENGTH OF THE IP 252 - SYSTAT
002A PAFE  :     FB96
002B       :
002C M001  :A    F 96.0               ERRORS IN TRANSMISSION ?
002D       :
002E       :JC   =M002                IF YES, JUMP.
002F       :BEA
0030 M002  :                          ERROR HANDLING: E.G. TRANSFER
0031       :L    KB9                  NUMBER OF THE FB, IN WHICH THE
0032       :T    FB5                  ERROR OCCURRED TO FB5
0033       :BE
```

```
FB10                                                     LEN=66

SEGMENT 1
NAME :S-ALL

0005        :                    PROGRAMMING EXAMPLE OF TRANSFER OF
0006        :                    DATA (HERE: SOG AND SUG OF THE
0007        :                    DRIVE CONTROLLER STRUCTURE) TO THE
0008        :                    CONTROLLER NUMBER 1 OF THE IP WITH
0009        :                    PAGE NUMBER 4
000A        :                    IMPORTANT!
000B        :                     THE TRANSFERRED DATA CAUSE THE
000C        :                     IP 252 TO DUMP ALL RETENTIVE DATA
000D        :                     IN THE EEPROM OF THE USER SUB-
000E        :                     MODULE.
000F        :                     THIS MEANS THAT THIS JOB MAY NOT
0010        :                     EXECUTE CYCLIC MODIFICATION OF
0011        :                     RETENTIVE DATA:
0012        :Q    DB9            DB9 AS SOURCE
0013        :L    KF+123         TRANSFER KF+0123 = + 1.23 % AS
0015        :T    DW5            SETPOINT UPPER LIMIT (SOG)
0016        :L    KF-1234        TRANSFER KF-1234 = -12.34 % AS
0018        :T    DW6            SETPOINT LOWER LIMIT (SUG)
0019        :
001A        :A    F 100.1        TO GENERATE RLO=1
001B        :                    "SEND 21" IN PREPARATION OF
001C        :JU   FB244          "SEND ALL"
001D NAME   :SEND
001E SSNR   :     KY0,4          TO IP WITH PAGE NUMBER 4
001F A-NR   :     KY0,21         A-NO. 21
0020 ANZW   :     FW10
0021 QTYP   :     KCRW           "RW", THEREFORE DB10 CONTAINS THE
0022 DBNR   :     KY0,10         S/D PARAMETERS FOR THE FOLLOWING
0023 QANF   :     KF+8           "SEND ALL" START. ADDR. IN DB10
0024 QLAE   :     KF+0           IRRELEVANT, SINCE THERE ARE ALWAYS
0025 PAFE   :     FB18           8 DW (RW)
0026        :                    "SEND ALL" (JOB-NO. 0.0) TRANSFERS
0027        :                    DATA FROM THE SOURCE SPECIFIED IN
0028        :                    DB10 (HERE: DB9, DW5 AND DW6) TO
0029        :                    THE DESTINATION (SPECIFIED IN DB10
002A        :                    BY DW12 TO DW15 (HERE: CONTROLLER
002B        :JU   FB244          NUMBER 1)
002C NAME   :SEND
002D SSNR   :     KY0,4
002E A-NR   :     KY0,0
002F ANZW   :     FW14
0030 QTYP   :     KCNN           "NN", I.E. NO DATA IN THE BLOCK
0031 DBNR   :     KY0,0                IRRELEVANT
0032 QANF   :     KF+0                     "
0033 QLAE   :     KF+0                     "
0034 PAFE   :     FB19
0035        :O    F 18.0         ERRORS IN TRANSMISSION?
0036        :O    F 19.0
0037        :JC   =M001          IF YES, JUMP.
0038        :BEA
0039 M001   :                    ERROR HANDLING: E.G. TRANSFER
003A        :L    KB10           NUMBER OF THE FB IN WHICH THE
003B        :T    FB5            ERROR OCCURRED TO FB5
003C        :BE
```

```
FB11                                                    LEN=67

SEGMENT 1
NAME :S-ALL-*                            ONLY FOR THE DRS/SR STRUCTURE

0005       :                             PROGRAMMING EXAMPLE OF TRANSFERRING
0006       :                             DATA (HERE: SOG AND SUG OF THE
0007       :                             DRIVE CONTROLLER STURCTURE DRS)
0008       :
0009       :                             TO CONTR. NO. 1 WITH PAGE NO. 4
000A       :                             IMPORTANT !
000B       :                              THE DATA TRANSFERRED DO NOT CAUSE
000C       :                              ANY SAVING OF DATA (WHETHER RE-
000D       :                              TENTIVE OR NOT) IN THE EEPROM
000E       :                              OF THE USER SUBMODULE.
000F       :
0010       :                              THIS JOB (A-NO. 22) MAY MODIFY
0011       :                              ANY DATA OF THE DRS/SR STRUCTURE
0012       :                              CYCLICALLY.
0013       :                              HOWEVER, AFTER A POWER FAILURE,
0014       :                              THE OLD VALUES (STORED ON EEPROM)
0015       :                              FIRST BECOME THE CURRENT VALUES
0016       :                              AGAIN.
0017       :A    DB9                     DB9 AS SOURCE
0018       :L    KF+123                  TRANSFER KF+0123 = + 1.23 % AS
001A       :T    DW5                     SETPOINT UPPER LIMIT (SOG)
001B       :L    KF-1234                 TRANSFER KF-1234 = -12.34 % AS
001D       :T    DW6                     SETPOINT LOWER LIMIT (SUG)
001E       :U    M 100.1                 TO GENERATE RLO=1
001F       :                             "SEND 22" IN PREPARATION FOR
0020       :SPA FB244                    "SEND ALL"
0021 NAME  :SEND
0022 SSNR  :     KY0,4                   TO THE IP WITH PAGE NUMBER 4
0023 A-NR  :     KY0,22                  JOB NO. 22
0024 ANZW  :     MW10
0025 QTYP  :     KCRW                    "RW", THEREFORE DB10 CONTAINS THE
0026 DBNR  :     KY0,10                  S/D PARAMETERS FOR THE FOLLOWING
0027 QANF  :     KF+8                    "SEND ALL" IN DB10
0028 QLAE  :     KF+0                    IRRELEVANT, SINCE THERE ARE ALWAYS
0029 PAFE  :     MB18                    8 DW (RW) "SEND ALL" (JOB NO. 0.0)
002A       :                             TRANSFERS DATA FROM THE SOURCE SPE-
002B       :                             CIFIED IN DB10 (HERE: DB9, DW5 AND
002C       :                             DW6) TO THE DESTINATION (SPECIFIED
002D       :SPA FB244                    IN DW10 BY DW12 TO DW15) (HERE CON-
002E NAME  :SEND                         TROLLER NUMBER 1)
002F SSNR  :     KY0,4
0030 A-NR  :     KY0,0
0031 ANZW  :     MW14                    FETCH DATA WITH "SEND ALL"
0032 QTYP  :     KCNN                    "NN", I.E. NO DATA IN BLOCK
0033 DBNR  :     KY0,0                           IRRELEVANT
0034 QANF  :     KF+0                            IRRELEVANT
0035 QLAE  :     KF+0                                "
0036 PAFE  :     MB19                              PAFE
0037       :O    M 18.0                  ERRORS IN TRANSMISSION ?
0038       :O    M 19.0
0039       :SPB =M001                    IF YES, JUMP.
003A       :BEA                          ERROR HANDLING: E.G. TRANSFER
003B M001  :L    KB11                    NUMBER OF THE FB IN WHICH THE
003C       :T    MB5                     ERROR OCCURRED TO FB5
003D       :BE
```

```
FB12                                                        LEN=58

SEGMENT 1
NAME :R-ALL

0005        :                          PROGRAMMING EXAMPLE OF RECEIVING
0006        :                          DATA FROM CONTROLLER NUMBER 1 OF
0007        :                          THE IP WITH PAGE NUMBER 4
0008        :                          (ALL AVAILABLE DATA, I.E. A TOTAL
0009        :                           OF 176 DATA WORDS, ARE LOADED
000A        :                           INTO DB11 OF THE BC)
000B        :
000C        :                          <SEE ALSO: DB11>
000D        :
000E        :A    F 100.1              TO GENERATE RLO=1
000F        :                          "FETCH 21" IN PREPARATION FOR
0010        :JU   FB246                "RECEIVE ALL"
0011 NAME   :FETCH
0012 SSNR   :     KY0,4                TO THE IP WITH PAGE NUMBER 4
0013 A-NR   :     KY0,21
0014 ANZW   :     FW20
0015 ZTYP   :     KCRW                 "RW", THEREF. DB10 CONTAINS THE S/D
0016 DBNR   :     KY0,10               PARAMETERS FOR THE FOLLOWING "SEND
0017 ZANF   :     KF+17                ALL" STRT. ADDR. THE PARAM. IN DB10
0018 ZLAE   :     KF+0                 IRRELEVANT, SINCE THERE ARE ALWAYS
0019 PAFE   :     FB28                 8 DW
001A        :
001B        :                          "RECEIVE ALL" (JOB NO. 0.0) TRANS-
001C        :                          FERS DATA FROM THE SOURCE SPECIFIED
001D        :                          IN DB10 (HERE: CONTROLLER NUMBER 1
001E        :                          OF THE IP 252 WITH PAGE NUMBER 4 TO
001F        :                          THE DESTINATION (SPECIFIED IN DB10
0020        :                          BY DW17.DW24) (HERE: PC-DB-NO. 11)
0021        :
0022        :JU   FB245
0023 NAME   :RECEIVE
0024 SSNR   :     KY0,4
0025 A-NR   :     KY0,0
0026 ANZW   :     FW24
0027 ZTYP   :     KCNN
0028 DBNR   :     KY0,0                IRRELEVANT, SINCE "NN"
0029 ZANF   :     KF+0                      "
002A ZLAE   :     KF+0                      "
002B PAFE   :     FB29
002C        :
002D        :O    F 28.0               ERRORS IN TRANSMISSION ?
002E        :O    F 29.0
002F        :JC   =M001                IF YES, JUMP.
0030        :BEA
0031 M001   :                          ERROR HANDLING: E.G. TRANSFER
0032        :L    KB12                 NUMBER OF THE FB IN WHICH THE
0033        :T    FB5                  ERROR OCCURRED TO FB5
0034        :BE
```

```
FB13                                                  LEN=58

SEGMENT 1
NAME :R-ALL-*                               ONLY FOR THE DRS/SR STRUCTURE

0005       :                                PROGRAMMING EXAMPLE OF RECEIVING
0006       :                                DATA FROM CONTROLLER NUMBER 1 OF
0007       :                                THE IP WITH PAGE NUMBER 4
0008       :                                IN CONTRAST TO THE EXAMPLE FB12,
0009       :                                IT IS POSSIBLE HERE FOR AN ASSIGNED
000A       :                                DATA BLOCK TO BE RECEIVED BY THE
000B       :                                IP. (A DATA SET OF THE CONTROLLER
000C       :                                 IN THE IP IS TRANSFERRED TO DB11
000D       :                                 OF THE CPU)
000E       :                                <SEE ALSO: DB11>
000F       :
0010       :A    F 100.1                    TO GENERATE RLO=1
0011       :                                "FETCH 23" IN PREPARATION FOR
0012       :JU   FB246                      "RECEIVE ALL"
0013 NAME  :FETCH
0014 SSNR  :     KY0,4                      TO IP WITH PAGE NUMBER 4
0015 A-NR  :     KY0,23
0016 ANZW  :     FW20
0017 ZTYP  :     KCRW                       "RW", THEREF. DB10 CONTAINS THE S/D
0018 DBNR  :     KY0,10                     PARAM. FOR THE FOLLOW. "SEND ALL"
0019 ZANF  :     KF+26                      STRT. ADDR. OF THE PARAM. IN DB10
001A ZLAE  :     KF+0                       IRRELEVANT, SINCE THERE ARE ALWAYS
001B PAFE  :     FB28                       8 DW
001C       :                                "RECEIVE ALL" (JOB NO. 0.0) TRANS-
001D       :                                FERS DATA FROM THE SOURCE SPECIFIED
001E       :                                IN DB10 (HERE: CONTROLLER NUMBER
001F       :                                1 OF THE IP 252 WITH PAGE NUMBER 4
0020       :                                TO THE DESTINATION (SPECIFIED IN
0021       :                                DB10 BY DW26.DW33) (HERE:
0022       :                                PC-DB-NO. 11)
0023       :JU   FB245
0024 NAME  :RECEIVE
0025 SSNR  :     KY0,4
0026 A-NR  :     KY0,0
0027 ANZW  :     FW24
0028 ZTYP  :     KCNN
0029 DBNR  :     KY0,0                      IRRELEVANT, SINCE "NN"
002A ZANF  :     KF+0                             "
002B ZLAE  :     KF+0                             "
002C PAFE  :     FB29
002D       :O    F 28.0                     ERRORS IN TRANSMISSION ?
002E       :O    F 29.0
002F       :JC   =M001                      IF YES, JUMP.
0030       :BEA
0031 M001  :                                ERROR HANDLING: E.G. TRANSFER
0032       :L    KB13                       NUMBER OF THE FB IN WHICH THE
0033       :T    FB5                        ERROR OCCURRED TO FB5
0034       :BE
```

```
FB13                                                  LEN=58

SEGMENT 1
NAME :R-ALL-*                            ONLY FOR THE DRS/SR STRUCTURE

0005        :                            PROGRAMMING EXAMPLE OF RECEIVING
0006        :                            DATA FROM CONTROLLER NUMBER 1 OF
0007        :                            THE IP WITH PAGE NUMBER 4
0008        :                            IN CONTRAST TO THE EXAMPLE FB12,
0009        :                            IT IS POSSIBLE HERE FOR AN ASSIGNED
000A        :                            DATA BLOCK TO BE RECEIVED BY THE
000B        :                            IP. (A DATA SET OF THE CONTROLLER
000C        :                             IN THE IP IS TRANSFERRED TO DB11
000D        :                             OF THE CPU)
000E        :                            <SEE ALSO: DB11>
000F        :
0010        :A    F 100.1                TO GENERATE RLO=1
0011        :                            "FETCH 23" IN PREPARATION FOR
0012        :JU   FB246                  "RECEIVE ALL"
0013 NAME   :FETCH
0014 SSNR   :     KY0,4                  TO IP WITH PAGE NUMBER 4
0015 A-NR   :     KY0,23
0016 ANZW   :     FW20
0017 ZTYP   :     KCRW                   "RW", THEREF. DB10 CONTAINS THE S/D
0018 DBNR   :     KY0,10                 PARAM. FOR THE FOLLOW. "SEND ALL"
0019 ZANF   :     KF+26                  STRT. ADDR. OF THE PARAM. IN DB10
001A ZLAE   :     KF+0                   IRRELEVANT, SINCE THERE ARE ALWAYS
001B PAFE   :     FB28                   8 DW
001C        :                            "RECEIVE ALL" (JOB NO. 0.0) TRANS-
001D        :                            FERS DATA FROM THE SOURCE SPECIFIED
001E        :                            IN DB10 (HERE: CONTROLLER NUMBER
001F        :                            1 OF THE IP 252 WITH PAGE NUMBER 4
0020        :                            TO THE DESTINATION (SPECIFIED IN
0021        :                            DB10 BY DW26.DW33) (HERE:
0022        :                            PC-DB-NO. 11)
0023        :JU   FB245
0024 NAME   :RECEIVE
0025 SSNR   :     KY0,4
0026 A-NR   :     KY0,0
0027 ANZW   :     FW24
0028 ZTYP   :     KCNN
0029 DBNR   :     KY0,0                  IRRELEVANT, SINCE "NN"
002A ZANF   :     KF+0                         "
002B ZLAE   :     KF+0                         "
002C PAFE   :     FB29
002D        :O    F 28.0                 ERRORS IN TRANSMISSION ?
002E        :O    F 29.0
002F        :JC   =M001                  IF YES, JUMP.
0030        :BEA
0031 M001   :                            ERROR HANDLING: E.G. TRANSFER
0032        :L    KB13                   NUMBER OF THE FB IN WHICH THE
0033        :T    FB5                    ERROR OCCURRED TO FB5
0034        :BE
```

```
FB14                                                  LEN=45

SEGMENT 1
NAME :TRACE-ON                    ONLY FOR THE DRS/SR STRUCTURE

0005      :                       "SEND30" IS USED FOR TRANSFER AND
0006      :                       ACTIVATION OF THE TEST FUNCTION ON
0007      :                       THE IP 252
0008      :JU  FB244
0009 NAME :SEND
000A SSNR :    KY0,4              PAGE NUMBER 4
000B A-NR :    KY0,30             JOB NUMBER FOR TEST FUNCTION
000C ANZW :    FW10
000D QTYP :    KSDB
000E DBNR :    KY0,14             DB14 CONTAINS THE TEST PARAMETERS
000F QANF :    KF+0               FROM DW0
0010 QLAE :    KF+10                LENGTH 10 DW
0011 PAFE :    FB18
0012      :
0013      :                       ===============================
0014      :
0015      :                       WITH "RECEIVE30" TEST PARAMETERS
0016      :                       OF THE IP 252 WHICH HAVE ALREADY
0017      :                       BEEN SET CAN BE LOADED INTO A DB
0018      :                       OF THE CPU.
0019      :                       THESE PARAMETERS, ALREADY PRESENT
001A      :                       IN THE IP, ORIGINATE EITHER IN THE
001B      :                       "COM REG GRAPHICS" INITIALISATION
001C      :                       SOFTWARE OR IN A "SEND30" OF THE
001D      :JU  FB245              CPU
001E NAME :RECEIVE
001F SSNR :    KY0,4              PAGE NUMBER 4
0020 A-NR :    KY0,30             JOB NUMBER 30 FOR "TEST"
0021 ANZW :    FW14
0022 ZTYP :    KCDB               STORE THE DATA IN DB
0023 DBNR :    KY0,14             DBNO. 14
0024 ZANF :    KF+0               FROM STARTING ADDRESS 0
0025 ZLAE :    KF+10
0026 PAFE :    FB19
0027      :BE
```

```
FB15                                                       LEN=119

SEMGENT 1
NAME :TRACE-DA                        ONLY FOR THE DRS/SR STRUCTURE

0005        :                         PROGRAMMING EXAMPLE OF RECEIVING
0006        :                         TEST DATA FROM THE IP 252 WITH
0007        :                         PAGE NUMBER 4
0008        :                         (ALL AVAILABLE DATA, I.E. 3 x 150
0009        :                          DATA WORDS, ARE LOADED INTO THE
000A        :                          DATA BLOCKS
000B        :                          DB15: VALUES OF THE 1ST MEASUR.PT.
000C        :                          DB16: VALUES OF THE 2ND MEASUR.PT.
000D        :                          DB17: VALUES OF THE 3RD MEASUR.PT.
000E        :
000F        :                         <DB10 FROM DB35 IS USED FOR
0010        :                          ADDRESSING THE SOURCE/DESTINATION
0011        :                          PARAMETERS>
0012        :
0013        :                         THE FOLLOWING "CONTROL31" CHECKS
0014        :                         WHETHER OR NOT THE TRACE DATA ON
0015        :                         THE IP HAVE BEEN RECORDED.
0016        :JU  FB247
0017 NAME   :CONTROL
0018 SSNR   :     KY0,4
0019 A-NR   :     KY0,31
001A ANZW   :     FW8                 MW8 = 0 -> NO DATA PRESENT
001B PAFE   :     FB6                 MW8 = 1 -> DATA PRESENT!
001C        :
001D        :AN  F 8.0                RECEPTION OF TRACE DATA MEANINGFUL?
001E        :BEB                      IF NO, END.
001F        :L   KB0                  PRESET FB50 AS INTERNAL COUNTER
0020        :T   FB50
0021        :
0022        :                         INITIATE FIRST DATA BLOCK TRANSFER
0023        :                            TO DB15
0024        :Q   DB10                 DB FOR S/D PARAMETERS
0025        :L   KCDB                 SOURCE IS DB NO. 31 OF THE IP 252
0027        :T   DW35                 <- STRT. ADDR. OF THE S/D PARAM.
0028        :L   KF+31                IP DB NO. FOR TEST DATA DB
002A        :T   DW36
002B        :L   KF+1                 STRT. ADDRESS OF THE 1ST BLOCK IN
002D        :T   DW37                 THE IP DB NO. 31
002E        :L   KF+150               LENGTH (OR NUMBER OF DATA)
0030        :T   DW38
0031        :
0032        :L   KSDB                 THE DESTINATION IS DB15 IN THE CPU
0034        :T   DW39
0035        :L   KF+15                DB NO.
0037        :T   DW40
0038        :L   KF+1                 STRT. ADDRESS IN DB 15 (HERE: 1)
003A        :T   DW41
003B        :L   KF+150               LENGTH (NUMBER OF DATA)
003D        :T   DW42
003E        :
003F ANF    :A   F 100.1              FOR GENERATING RLO=1
0040        :                         "FETCH 21" IN PREPARATIO FOR
0041        :JU  FB246                "RECEIVE ALL"
0042 NAME   :FETCH
0043 SSNR   :     KY0,4               TO IP WITH PAGE NUMBER 4
```

```
FB99                                                  LEN=66

SEGMENT 1
NAME :SYNC:IPS

0005      :A   F 30.0                FLAG TO INDICATE POWER FAILURE
0006      :JC  =M001                 F 30.0 = 0 IN THE EVENT OF POWER
0007      :                          FAILURE (SEE OB 20 TO OB 22)
0008      :L   KT002.2               APPROX. 2 SECS WAITING TIME IN THE
000A      :A   F 35.0                EVENT OF POWER FAILURE
000B      :SI  T 1
000C      :AN  F 35.0
000D      :SI  T 1
000E M003 :A   T 1
000F      :JC  =M003
0010      :                          SYNCHRONIZE INTERFACE WITH PAGE
0011 M001 :JU  FB249                 NUMBER 2
0012 NAME :SYNCHRON
0013 SSNR :    KY0,2
0014 BLGR :    KY0,6                 IP 252 ONLY RECOGNIZES BLGR: 6
0015 PAFE :    FB36
0016      :
0017      :O   F 1.1                 FOR GENERATING
0018      :ON  F 1.1                         RLO = 1
0019      :JU  FB249
001A NAME :SYNCHRON                  SYNCHRONIZE SS NO. 3
001B SSNR :    KY0,3
001C BLGR :    KY0,6
001D PAFE :    FB37
001E      :
001F      :O   F 1.1                 FOR GENERATING
0020      :ON  F 1.1                         RLO = 1
0021      :JU  FB249
0022 NAME :SYNCHRON
0023 SSNR :    KY0,4                 SYNCHRONIZE SS NO. 4
0024 BLGR :    KY0,6
0025 PAFE :    FB38
0026      :R   F 30.6                RESET FLAG FOR WAITING TIME IN
0027      :                          FB6.
0028      :O   F 36.0                ERRORS IN SYNCHRONISATION ?
0029      :O   F 37.0
002A      :O   F 38.0
002B      :JC  =M009                 IF YES, JUMP.
002C      :BEA
002D M009 :                          ERROR HANDLING: E.G. TRANSFER
002E      :L   KB99                  NUMBER OF THE "RESTART FB" TO FB5
002F      :T   FB5                   AND ERRORS IN PAGE NUMBER 2 ?
0030      :AN  F 36.0
0031      :JC  =M010                 IF NO, JUMP.
0032      :L   KB2                   TRANSF. PAGE NO. IN WHICH THE ERROR
0033      :T   FB4                   OCCURRED TO FB4
0034 M010 :AN  F 37.0                ERRORS IN PAGE NUMBER 3 ?
0035      :JC  =M011
0036      :L   KB3
0037      :T   FB4
0038 M011 :AN  F 38.0                ERRORS IN PAGE NUMBER 4 ?
0039      :BEB                       NOTE: IN THIS EXAMPLE THE LATEST
003A      :L   KB4                   ERROR OVERWRITES ALL PREVIOUS
003B      :T   FB4                   ERRORS !
003C      :BE
```

```
DB9                                   LEN=12
              0 :     KH= 0000;
              1 :     KH= 0000;
              2 :     KH= 0000;
              3 :     KH= 0000;
              4 :     KH= 0000;
              5 :     KF= +00123;
              6 :     KF= -01234;
```

```
DB10                                  LEN=46
  0 :    KH= 0000;
  1 :    KH= 0000;
  2 :    KH= 0000;
  3 :    KH= 0000;
  4 :    KH= 0000;
  5 :    KH= 0000;
  6 :    KH= 0000;
  7 :    KH= 0000;
  8 :    KS= DB      KS DB ==> CPU-DB-NR. 9      !         !
  9 :    KF= +00009; NO. 9                       ! SOURCE :!
 10 :    KF= +00005; STRT. ADDRESS IN DB 9       !   CPU   ! to
 11 :    KF= +00002; LENGTH IN WORDS ____________!_________! FB10
 12 :    KS= DB      KS DB ==> DB-NO. 1 (C-NO.1) !         ! and
 13 :    KF= +00001; NO. 1                       ! DESTIN.:! FB11
 14 :    KF= +00105; STRT. ADDRESS IN R DB NO. 1 ! IP 252  !
 15 :    KF= +00002; LENGTH IN WORDS             !         !
 16 :    KH= 0000;   ==>========== here: free =============!=====
 17 :    KS= DB      KS DB ==> DB NO. 1 (C-NO.1) !         !
 18 :    KF= +00001; NR. 1                       ! SOURCE :!
 19 :    KH= 0000;   IRRELEVANT                  ! IP 252  ! to
 20 :    KH= 0000;   IRRELEVANT _________________!_________! FB12
 21 :    KS= DB      KS DB ==> CPU DB NO. 11     !         !
 22 :    KF= +00011; NO. 11T                     ! DESTIN.:!
 23 :    KF= +00002; STRT. ADDRESS IN DB 11      !   CPU   !
 24 :    KF= +00176; LENGTH IN WORDS             !         !
 25 :    KH= 0000;   ==>========== here: free =============!=====
 26 :    KS= DB      KS DB ==> DB NO. 1 (C-NO.1) !         !
 27 :    KF= +00001; NO. 1                       ! SOURCE :!
 28 :    KF= +00110; STRT. ADDRESS IN R DB NO. 1 ! IP 252  ! to
 29 :    KF= +00010; NUMBER OF DATA WORDS _______!_________! FB12
 30 :    KS= DB      KS DB ==> CPU DB NO. 11     !         !
 31 :    KF= +00011; NO. 11T                     ! DESTIN.:!
 32 :    KF= +00180; STRT. ADDRESS IN DB 11      !   CPU   !
 33 :    KF= +00010; LENGTH IN WORDS             !         !
 34 :    KH= 0000;   ==>========== here: free ===================
 35 :    KH= 0000;   +----------------------------+
 36 :    KH= 0000;   !                            !
 37 :    KH= 0000;   ! Area of the source/destin- !
 38 :    KH= 0000;   ! ation parameters for FB15  !
 39 :    KH= 0000;   !                            !
 40 :    KH= 0000;   !                            !
 41 :    KH= 0000;   !                            !
 42 :    KH= 0000;   +----------------------------+
```

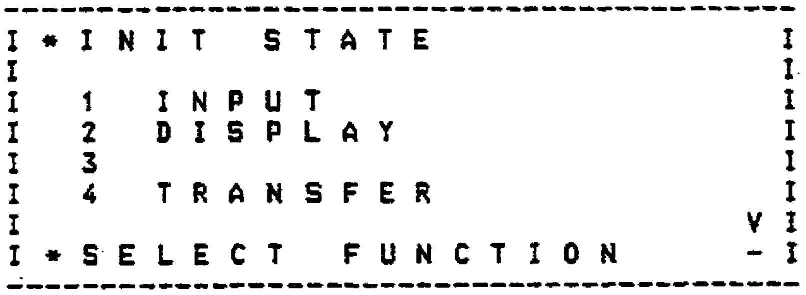
6.1 General

The IP 252 closed-loop control module can be configured and assigned parameters with the PG 615 and PG 635/675/685/695 programmers. User-friendly menu-driven prompts help the user during operation.
In this section the operator communication of the PG 615 is described and input formats which may occur are also described.

Note:
The PG 615 programmer with the IP-specific "COM 252" initialization software can only be used if the memory submodule 6ES5 374-0AA11 is used on the IP 252.

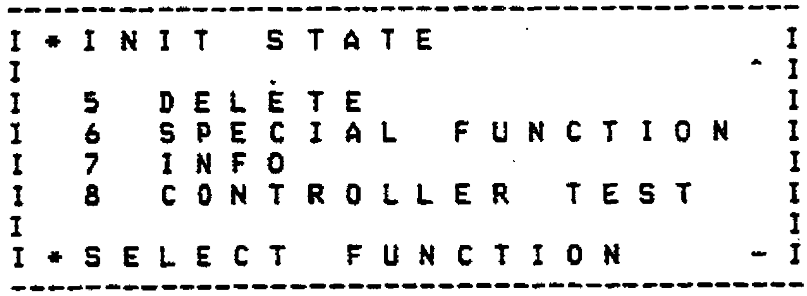
6.1.1 Selection procedure

Starting from the main menu (see Fig. 6.1) in which all functions available to the user are listed, the corresponding sub-menus (functions) can be selected by directly entering the call number shown in the main menu. Except for the branch selection menu, for which two digits can be entered and which is therefore provided with a separate input field, an enter key is not required and the selected sub-menu is called up directly after entry of the number.
If a menu is longer than four lines, it can be scrolled upwards and downwards using the cursor keys. In all cases where the menu display field can be scrolled, this is indicated on the right hand border of the display with the corresponding direction.



```
----------------------------------------
I * I N I T   S T A T E              I
I                                    I
I   1   I N P U T                    I
I   2   D I S P L A Y                I
I   3                                I
I   4   T R A N S F E R              I
I                                  V I
I * S E L E C T   F U N C T I O N  - I
----------------------------------------
```

Fig. 6.1 a: Main menu before scrolling



```
----------------------------------------
I * I N I T   S T A T E              I
I                                  ^ I
I   5   D E L E T E                  I
I   6   S P E C I A L   F U N C T I O N   I
I   7   I N F O                      I
I   8   C O N T R O L L E R   T E S T    I
I                                    I
I * S E L E C T   F U N C T I O N  - I
----------------------------------------
```

Fig. 6.1 b: Main menu after scrolling several times

6.1 General

6.1.2 Parameter input/output

6.1.2.1 Subfield editor for input/output

Input: The input is left justified on entry in the input field. During input the first character deletes the original contents of the subfield. The cursor can be positioned anywhere within the input field with the cursor keys. After an entry is made, the subfield can only be exited by pressing the subfield enter key. After entering several data items in an input field, they must be entered using the global enter key.
Fig. 6.2 shows an example of data input before transferring the braking current normalization value with the subfield enter key, Fig. 6.3 shows this after the subfield enter key has been pressed.

```
-----------------------------------------
I * I N P   P 6 I   C 1   S 1           I
I                                       I
I S T A . I   D C L       1 . 1     %   I
I A D R   D A C 2                 7     I
I                                       I
I                                       I
I                                       I
I * P A R .   B R A N C H   0 1       + I
-----------------------------------------
```

Fig. 6.2 Left justified input

Output: Data is output right justified, i. e. each subfield is represented on the right after subfield enter key has been pressed.

```
-----------------------------------------
I * I N P   P 6 I   C 1   S 1           I
I                                       I
I S T A . I   D C L             1 . 1 % I
I A D R   D A C 2                 7     I
I                                       I
I                                       I
I                                       I
I * P A R .   B R A N C H   0 1       + I
-----------------------------------------
```

Fig. 6.3 Right justified output

Sign: In signed parameters, the sign appears in a special sign position. Positive signs are suppressed during output.

6.1.2.2 Types of parameters

	Dim.	Sign	Digits	Decimal point	Range
Bit value	–	–	1	–	0/1
Integer value					
Number, MP number	–	–	2	–	var.
Address	–	–	3	–	var.
Constants	–	yes	6	2	+/– 99.99
Percent values	%	yes	7	2	+/– 100.00
Time values	ms	–	5	0/1	0.1 – 9999
	s	–	5	0-3	0.001 – 9999
	hm	–	5	2	00.01 – 59.59

6.1.2.3 Input formats

1. Integer constants

VZZ.ZZ	VZZ.Z	VZZ
VZ.ZZ	VZ.Z	VZ

2. Percentage

V100.00	V100.0	V100
VZZ.ZZ	VZZ.Z	VZZ
VZ.ZZ	VZ.Z	VZ

3. Milliseconds

ZZZZ	ZZZ	ZZ	Z
ZZZ.Z	ZZ.Z	Z.Z	

4. Seconds

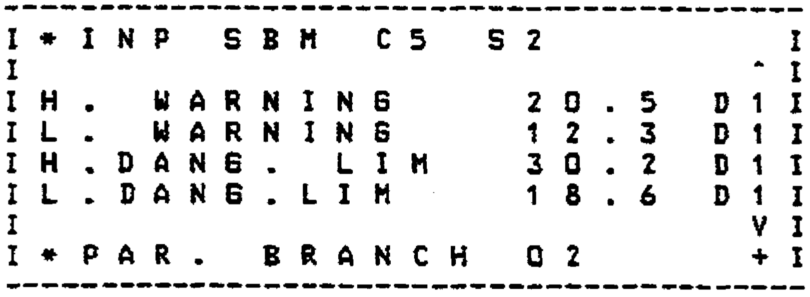
ZZZZ	ZZZ	ZZ	Z
Z.ZZZ	Z.ZZ	Z.Z	
ZZ.ZZ	ZZ.Z		
ZZZ.Z			

5. Hours

HH.MM	H.MM

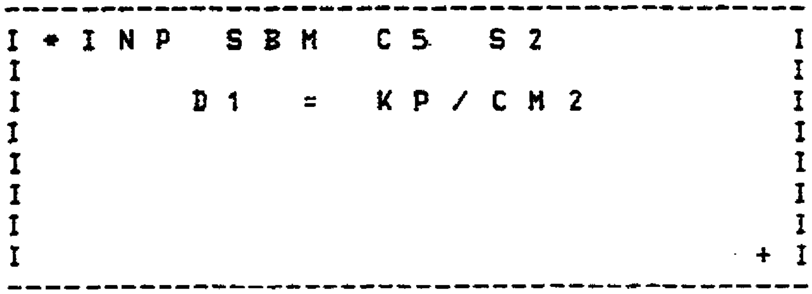
6.1.2.4 Parameters with physical units

In some structures (e. g. standard controller) it is possible for the user to input and observe setpoint values, actual values and limit values as well as polygon interpolation points and variables with physical units. Depending on the complexity of the structure, up to 4 different dimensions or physical units can occur simultaneously. For each of the 4 dimensions the user can specify an ASCII string with a maximum of 6 characters and also the characteristic line used to convert dimension values into a percentage representation used internally by the processor.
Since the unit field is only two characters long, the six characters long ASCII string cannot be output after the subfield. Instead of this a number (D1 to D4) is output. With the "OTHER" key the ASCII strings of all current units can be displayed on the screen. By pressing any other key the original display is restored to the screen. Figs. 6.4 and 6.5 show an example for this. In Fig. 6.4 an example of an input is shown which uses the physical D1. By pressing the "OTHER" key the representation is displayed as shown in Fig. 6.5.



```
--------------------------------------------
I * INP  SBM  C5  S2                      I
I                                       ^ I
I H.  WARNING      20.5     D1 I
I L.  WARNING      12.3     D1 I
I H.DANG.  LIM     30.2     D1 I
I L.DANG.LIM       18.6     D1 I
I                               V I
I * PAR.  BRANCH   02           + I
--------------------------------------------
```

Fig. 6.4 Encoded physical unit display during parameter input



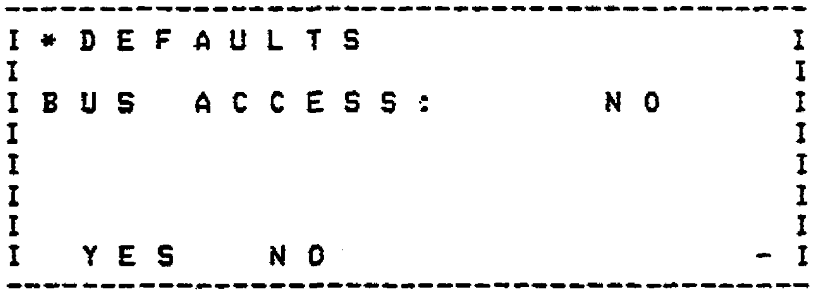
```
--------------------------------------------
I * INP  SBM  C5  S2                      I
I                                         I
I       D1  =  KP/CM2                     I
I                                         I
I                                         I
I                                         I
I                                         I
I                                       + I
--------------------------------------------
```

Fig. 6.5 Physical unit display after "OTHER": key

6.2 PG (Programmer) Functions

6.2.1 Start-up

After switching the power on, the COM 252 executes a short self-diagnostic test and then goes immediately into the default routine. Here the defaults form is displayed on the screen (see Fig. 6.6), which the user can acknowledge with the Break key or modify with the function keys. After modification, the defaults must also be acknowledged before the main menu is displayed. This main menu is shown in Fig. 6.1.
The main menu corresponds to the base state to which the user can return from any point by single or repeated activation of the Break key. From this main menu he can go into the required function by entering the calling number of the function.



```
----------------------------------------
I * D E F A U L T S                    I
I                                      I
I B U S   A C C E S S :       N O      I
I                                      I
I                                      I
I                                      I
I                                      I
I  Y E S     N O                     - I
----------------------------------------
```

Fig. 6.6 Default menu

6.2.2 Input

The term "input" refers to all steps required for fully specifying a control loop with the COM 252/615. In order to prevent any steps being overlooked during the first input procedure, the PG guides the user linearly, i. e. on a path without branches, through all input functions.

Input sequence:

Selection of the target device
I
Input of the control loop no.
I
Structure selection
I
Structuring
I
Input of the sampling time
I
Selecting the stop behaviour
I
Determining the dimensions
I
Parameter assignment of the branches

6.2.2.1 Selection of the target device

After selection, the input function checks the programmer initially for a controller block in the PG. If this is the case, the delete menu appears on the screen (see Fig. 6.7), and the user must decide whether this block is to be deleted or not.

```
---------------------------------------
I * I N P                             I
I                                     I
I B L O C K                           I
I A V A I L A B L E   I N   P G       I
I                                     I
I E R A S E   ?                       I
I                                     I
I   Y E S     N O                   + I
---------------------------------------
```

Bild 6.7 Delete menu

After the user has decided to delete the block by entering "1", the input menu appears on the PG as shown in Fig. 6.8.

```
---------------------------------------
I * I N P U T                         I
I                                     I
I   1   P G                           I
I   2   I P 2 5 2                     I
I   3   S U B M O D U L E             I
I                                     I
I                                     I
I * S E L E C T   F U N C T I O N   - I
---------------------------------------
```

Fig. 6.8 Input menu

By entering a number (1 – 3) the user determines where the controller block generated in the subsequent step is to be stored. If the user selects input into the IP 252 controller module or into the submodule, the PG fetches the necessary text and description lists from the selected target device. However, if the block is to be stored in the PG, then the user must first specify whether on-line or off-line operation is required. During this, the user is guided by the "Select operating mode" menu shown in Fig. 6.9. Depending on this input, the list source is displayed in the top menu display line.

```
---------------------------------------
I * I N P   P G                       I
I                                     I
I   1   O N L I N E                   I
I   2   O F F L I N E                 I
I                                     I
I                                     I
I                                     I
I * S E L E C T   M O D E           - I
---------------------------------------
```

Fig. 6.9 Selection of operating mode

6.2.2.2 Input of control loop number

The next step of the input procedure is the input of the controller number, which is necessary so that the IP 252 can process eight control loops simultaneously. For this purpose, the PG displays the menu shown in Fig. 6.10.

```
-----------------------------------------
I * I N P    P G M                      I
I                                       I
I                                       I
I   C O N T R O L L E R   NO  .   2     I
I   ( 1 - 8 )                           I
I                                       I
I                                       I
I                                     - I
-----------------------------------------
```

Fig. 6.10 Input of controller number

The input of the control loop number must be concluded with the subfield or global enter key, where controller numbers smaller than 1 or greater than 8 are neglected.
The letter which is displayed in the first line of the dislplay directly after "PG" (M in Fig. 6.10) indicates whether the memory submodule or the IP 252 is used as the list source.

6.2.2.3 Configuration or structure selection

After the control loop numbers have been selected, the configuration of the control loop must be selected. This is normally determined by the application.
The programmer shows the user at this point the maximum 4 controller structures available in the memory submodule. If there are less than 4 structures, then the list is filled up with lines (see Fig. 6.11).

```
-----------------------------------------
I * I N P    P G M    C 2               I
I                                       I
I   1    D R I V E                      I
I   2    S T A N D A R D                I
I   3    - - -                          I
I   4    - - -                          I
I                                       I
I * S E L E C T    C O N F I G U R .    I
-----------------------------------------
```

Fig. 6.11 Configuration selection menu

6.2.2.4 Configuring

Configuring means the setting of software switches (configuring bits), which are embedded between permanently assigned branches, according to the application. This means that the switches of necessary branches are closed (= 1) and those of unnecessary branches are left open.
The configuring or structure switches function both as "on"/"off" and also selector switches.
For "on"/"off" switches, "0" means "No" and "1" means "Yes". Selector switches are identified by a "/" in the text and select between two alternative sub-branches. "0" in this case is the first alternative and "1" is the second.
The structure switches are hierarchically organized and assigned to corresponding levels. This organization can be recognized by the indentation of the corresponding lower level structure switch designations in the configuring menu.
For a better overview, the user prompting is configured in such a way that sub-functions of a not selected branch, i. e. a branch set to "0", are skipped over during structuring or configuring, so that they do not appear in the corresponding menu displays. The structure switches are displayed according to branches. If the cursor is at the last position of a structure branch, then after entering the subfield entry key the structure switches of the next branch are displayed. If the cursor moves upwards past the main structure switch, the structure switches of the previous branch are displayed.
Positioning within the display is carried out with the help of the cursor-up and cursor-down keys. The selection of the branch to be used is carried out by setting to "0" or "1" and subsequent pressing of the subfield enter key. As an example Figs. 6.12 and 6.13 illustrate two cases where a selector is set to "0" and then "1".

```
-----------------------------------------
I * I N P   P G M   C 2   S 2          I
I                                      I
I L O O P   C O N T R O L L E R      1 I
I   C O N T / S T E P                O I
I     S T A N D A R D / U P G R A D  O I
I       M . P G / A D C              O I
I                                    V I
I * C O N F I G . B R O 1            + I
-----------------------------------------
```

Fig. 6.12 Configuring the controller output: continuous controller

```
-----------------------------------------
I * I N P   P G M   C 2   S 2          I
I                                      I
I L O O P   C O N T R O L L E R      1 I
I   C O N T / S T E P                1 I
I     P G   K E Y / A D C            O I
I                                      I
I                                    V I
I * C O N F I G . B R O 1            + I
-----------------------------------------
```

Fig. 6.13 Configuring the controller output: step controller

The selector switches shown in this example switch between the two alternatives "continuous controller output" and "step controller output". In Fig. 6.12 continuous output is selected, in which case the programmer displays the sub-functions of this branch, e. g. standard/enhanced and H.PG/ADC. (The meaning of the abbreviations used in the menus is described in the appendix of this section). In Fig. 6.13 the selector switch is set to "1", i. e. the output functions as a step controller output and the programmer displays the sub-functions of the "step controller output" branch, H.PG/ADC.

```
-----------------------------------------
I * I N P   P G M   C 1   S 1          I
I                                    ^ I
I S E T   R E V / M I N              O I
I                                      I
I                                      I
I                                      I
I                                    V I
I * C O N F I G . B R O 8            + I
-----------------------------------------
```

Fig. 6.14 Setpoint branch not selected

If a branch is not selected, then its sub-functions remain invisible to the user and are only listed when the branch is selected in the display of the PG. This is illustrated in Figs. 6.14 and 6.15 using the example of a speed setpoint.

```
-----------------------------------------
I * I N P   P G M   C 1   S 1          I
I                                    ^ I
I S E T   R E V / M I N              1 I
I   R A M P   G E N E R A T O R      O I
I   S M O O T H I N G                O I
I   S E T P .   S E Q U E N C E      O I
I                                    V I
I * C O N F I G . B R O 8            + I
-----------------------------------------
```

Fig. 6.15 Setpoint branch selected

6.2.2.5 Input of sampling time

After the structure of the controller has been selected in the last step, the required sampling time is input in this step. One should note that only times which can be expressed as powers of two between 4 ms and 32 s can be selected.
The processor loading caused by this control loop on the IP 252 is also calculated in this menu depending on the structure and sampling time.
Figs. 6.16 and 6.17 show the sampling time menu.

```
----------------------------------------------
I*INP  PGM  C1  S1                           I
I                                            I
ITA  =  0.1*TIME  CONST.                     I
I                                            I
I  SAMPL.TIME  TA          4MS               I
I  IP  LOAD  C1            85%               I
I                                            I
ISTOR  PAR   TA>                           + I
----------------------------------------------
```

Fig. 6.16 Sampling time menu with default setting

```
----------------------------------------------
I*INP  PGM  C1  S1                           I
I                                            I
ITA  =  0.1*TIME  CONST.                     I
I                                            I
I  SAMPL.TIME  TA          8MS               I
I  IP  LOAD  C1            42%               I
I                                            I
ISTOR  PAR   TA>     TA<                   + I
----------------------------------------------
```

Fig. 6.17 Sampling time menu after changing the time

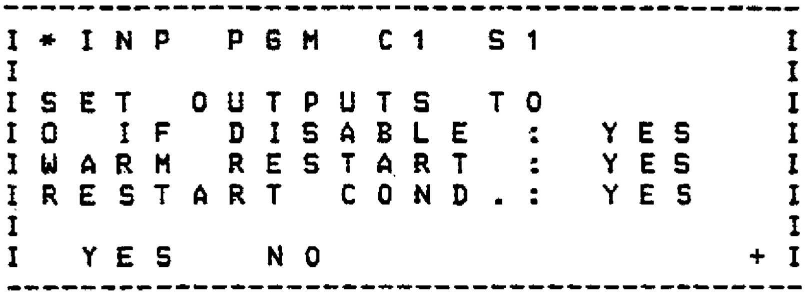
In the sampling time menu one is initially reminded of the rule of thumb that the sampling time should be approximately 10% of the dominant plant time constant. The input line for the sampling time with a default value of 4 ms is located under this reminder. The line below the sampling time shows the processor loading of the selected control loop. The last line of the display shows the assignment of the numerical keys as function keys. In Fig. 6.16 "1" is used for the function "ABSP", "2" for the function "PAR" and "3" for the function "TA>". "ABSP" is used for aborting the storage of previously entered data and returning to the basic menu. Pressing the "PAR" or the ENTER key takes the operator to the next function, i. e. "programming stop behaviour". The "3" key is assigned the function "TA>" which increases the sampling time in steps (in powers of 2). After changing the sampling time (TA> 4 ms) the function "TA<" then appears in the menu and is assigned to key "4". With the "4" key it is possible to reduce the sampling time shown on the display. **Whether the controller is stable at the selected sampling time remains within the responsibility of the user. Similarly, it is his responsibility when changing the sampling time to also adjust the controller parameters accordingly.**

6.2.2.6 Selecting the stop behaviour

At this point the behaviour of the outputs must be determined separately for each controller if the control structure is inhibited. Two alternatives are available here: either the outputs are set to zero or they remain in the state in which they were last. In the second line of this menu the user is asked whether the control loop should carry out an automatic warm restart after a power failure. Below this is the option of taking the warm restart condition into account. This condition states that the magnitude of the difference between the control deviation before the power failure and after the restoration of the power should be not greater than 25% of the setpoint value before the power failure. With this last option the user can determine which of the following occurs:

- no warm restart
- conditional warm restart
- unconditional warm restart.

These decisions have defaults of YES and can be changed by pressing "1" or "2". In this case, "1" means "YES" and "2" means "NO". These inputs must be concluded by pressing the ENTER key.
Fig. 6.18 shows the menu for determining the stop behaviour.

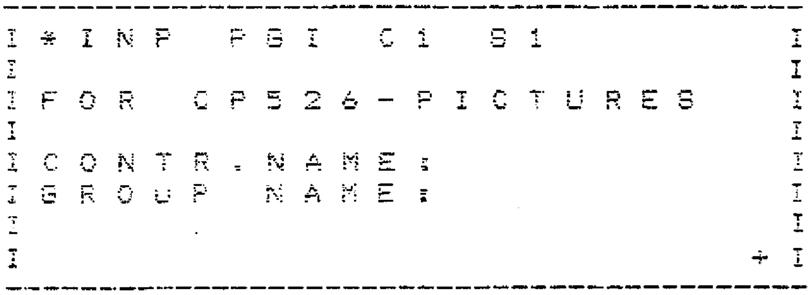


```
--------------------------------------------------
I * I N P   P G M   C 1   S 1                    I
I                                                I
I S E T   O U T P U T S   T O                    I
I O   I F   D I S A B L E   :     Y E S          I
I W A R M   R E S T A R T   :     Y E S          I
I R E S T A R T   C O N D . :     Y E S          I
I                                                I
I   Y E S     N O                              + I
--------------------------------------------------
```

Fig. 6.18 Determining the stop response

6.2.2.7 Definition of controller names and area names

After the stop behaviour has been defined and acknowledged with the ENTER key , the menu "Input for CP 526 displays" appears. Here, each controller 1 to 8 can be assigned a controller name and an area name consisting of up to eight characters. Only numbers are acceptable as input with COM 252, but any ASCII characters are acceptable when using the COM REG programmer software.



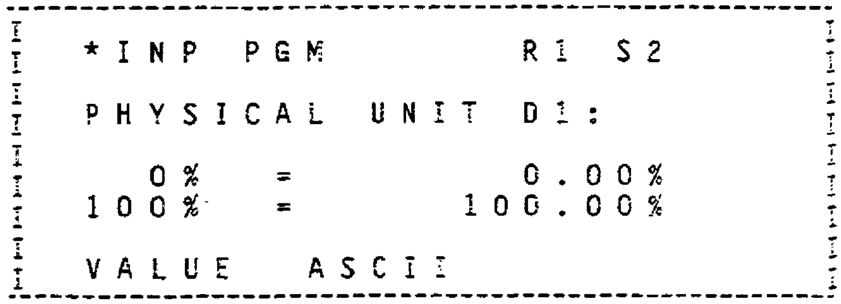
```
--------------------------------------------------
I * I N P   P G I   C 1   S 1                    I
I                                                I
I F O R   C P 5 2 6 - P I C T U R E S            I
I                                                I
I C O N T R . N A M E :                          I
I G R O U P   N A M E :                          I
I                                                I
I                                              + I
--------------------------------------------------
```

Fig. 6.19 CP 526 interface

Note:
An entry in this screen form is not relevant for the control. Such an entry is only meaningful for controller manipulation and monitoring with the CP 526. The ASCII characters entered can then be displayed on the CP screen.

6.2.2.8 Determining the physical units

If parameters with physical units appear in the selected structure, the user can determine the ASCII string and characteristic of the units before beginning the assignment of parameters. In the default state the 6 characters of the ASCII string contain "%", "0" is used for the 0% value and "100.00" for the 100% value. If other units are present, this is indicated by the scrolling arrow in the base units menu (see Fig. 6.20). They can also be displayed by pressing the corresponding cursor keys (not with the DR/DRS structures).



```
*INP PGM          R1  S2

PHYSICAL   UNIT   D1:

  0%   =          0.00%
100%   =        100.00%

VALUE    ASCII
```

Fig. 6.20 Base units menu

From the base units menu the characteristic or ASCII input can be called up via softkeys.

6.2.2.8.1 Characteristic input

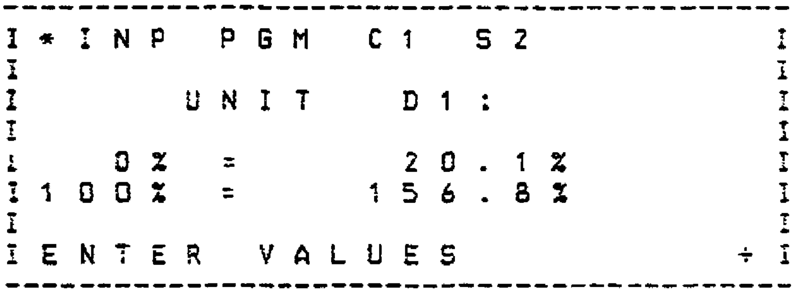
The 0% and 100% values can be input with the decimal point at any position. However, the pure numerical value must lie in the range +/−10000.

When accepting the entered value only a check for correct syntax is carried out. Only after the ENTER key is pressed is a check made as to whether the characteristic can be determined from both nodes entered.

The prerequisites for this are:

1. The characteristic has a positive slope, i. e. the 100% value is greater than the 0% value.
2. The value with the smaller number of digits after the decimal point can be normalized to the number of digits after the decimal point of the other value without exceeding 10000 in magnitude.

An example for an acceptable input is shown in Fig. 6.21.

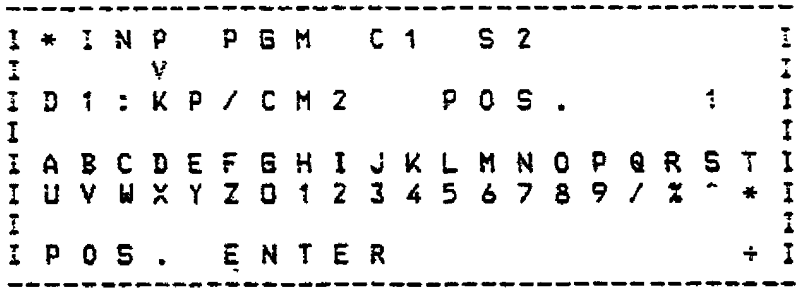


```
-----------------------------------------
I * I N P   P G M   C 1   S 2           I
I                                       I
I        U N I T    D 1 :               I
I                                       I
I     0 %   =        2 0 . 1 %          I
I 1 0 0 %   =      1 5 6 . 8 %          I
I                                       I
I E N T E R   V A L U E S             + I
-----------------------------------------
```

Fig. 6.21 Characteristic input for the physical units

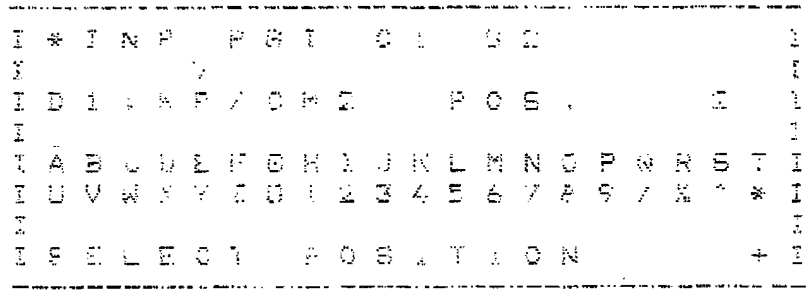
5.2.2.8.2 ASCII string input

Since no ASCII keyboard is provided, the maximum 6 characters long ASCII string must be entered by positioning the cursor on an ASCII table menu. If only one single character has to be modified, then any position in the string can be directly selected. Otherwise input automatically begins with the first position and moves on to the next position after entry.
Figs. 6.22 and 6 23 show an example with a physical unit input "D1; KP/CM2", an ASCII table menu and a menu for selecting the position in the string.



```
-----------------------------------------
I * I N P   P G M   C 1   S 2           I
I       V                               I
I D 1 : K P / C M 2     P O S .     1   I
I                                       I
I A B C D E F G H I J K L M N O P Q R S T I
I U V W X Y Z 0 1 2 3 4 5 6 7 8 9 / % ^ * I
I                                       I
I P O S .   E N T E R                 + I
-----------------------------------------
```

Fig. 6.22 ASCII tab e menu

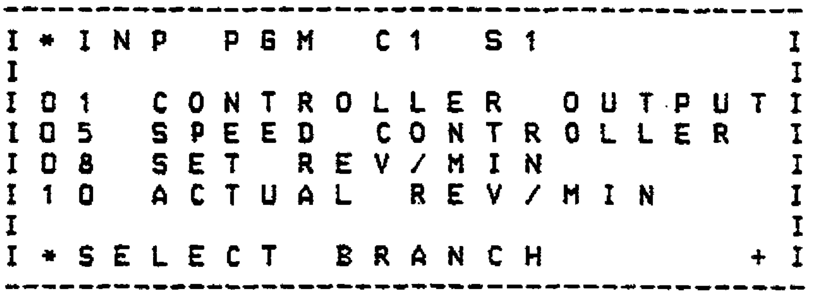


```
-----------------------------------------
I * I N P   P G M   C 1   S 2           I
I       V                               I
I D 1 : K P / C M 2     P O S .     2   I
I                                       I
I A B C D E F G H I J K L M N O P Q R S T I
I U V W X Y Z 0 1 2 3 4 5 6 7 8 9 / % ^ * I
I                                       I
I S E L E C T   P O S I T I O N       + I
-----------------------------------------
```

Fig. 6.23 Position selection

6.2.2.9 Assigning parameters

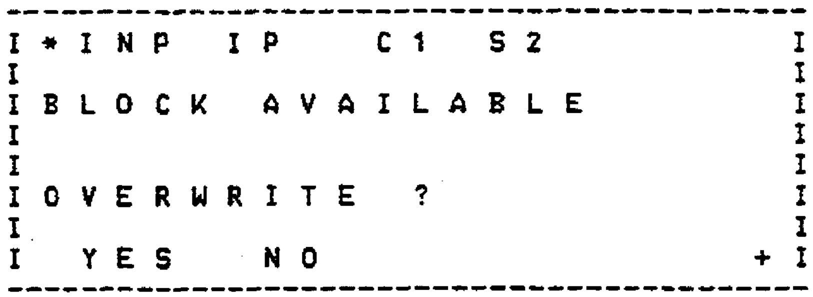
In the last step of the input procedure, the parameters of the previously configured controllers must be input. At this point the programmer displays only the subfunctions for parameter assignment which have been activated in the previous configuring step. During parameter assignment the PG shows the user a list of the selected subfunctions, where each subfunction has a selection number which corresponds to the branch number (see Fig. 6.24). Using the selection number, the user can subsequently call up the parameter list for assigning parameters to the subfunctions.



```
------------------------------------------
I* INP  PGM  C1  S1                      I
I                                        I
I01  CONTROLLER  OUTPUT                  I
I05  SPEED  CONTROLLER                   I
I08  SET  REV/MIN                        I
I10  ACTUAL  REV/MIN                     I
I                                        I
I* SELECT  BRANCH                       +I
------------------------------------------
```

Fig. 6.24 Overview of the selected branches

The parameter list only displays the parameters of the selected branches and subbranches.
Each input must be concluded with the subfield ENTER key, whereas the completion of the branch parameter assignment must be concluded with the Enter key. After this, the parameter list for the next branch appears until all branches have been assigned parameters. Then the branch list appears again on the PG. If no further parameter is to be modified, the previously entered data can be stored by pressing the ENTER key again. If a data record is already present in the target device under the specified controller number, then the menu shown in the Fig. 6.25 appears on the PG.



```
------------------------------------------
I* INP  IP  C1  S2                       I
I                                        I
IBLOCK  AVAILABLE                        I
I                                        I
I                                        I
IOVERWRITE  ?                            I
I                                        I
I  YES  NO                              +I
------------------------------------------
```

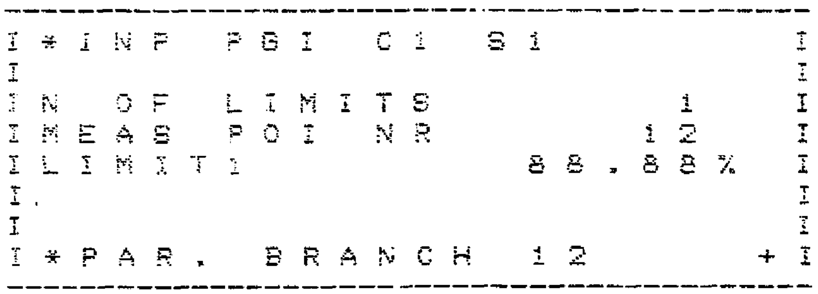
Fig. 6.25 Delete Yes / No

In this step the user must decide whether the old or the newly entered parameter sets are to be used further.

Special cases:

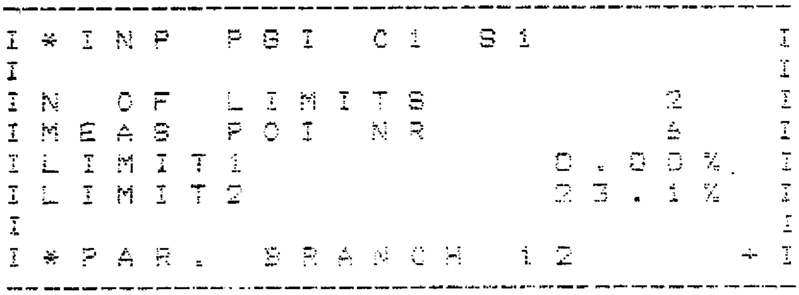
1. Limit monitor

The limit monitors are designed for a maximum of 6 steps. For operation with fewer stages the user must select the number of limits to be monitored in the first menu input line. The limit value menu changes accordingly and the PG requests the limit values in the same menu. The physical units of the entered limit values are determined by those of the monitored measuring point.



```
------------------------------------------
I* INP  PGI  C1  S1                      I
I                                        I
IN OF  LIMITS                   1        I
IMEAS  POI  NR                 12        I
ILIMIT1                   88.88%         I
I                                        I
I                                        I
I* PAR.  BRANCH  12                     +I
------------------------------------------
```

Fig. 6.26 Limit monitor with 1 limit value

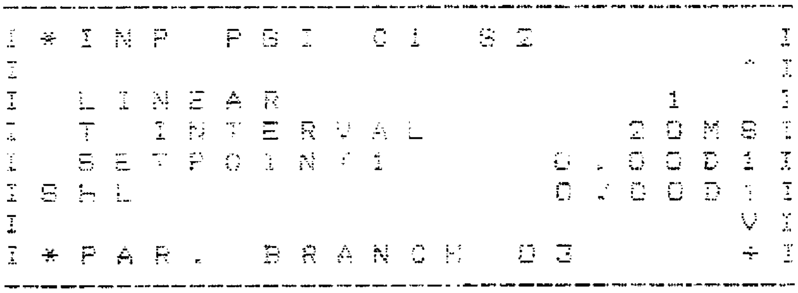


```
I * I N P   P G I   C 1   S 1             I
I                                         I
I N   O F   L I M I T S             2     I
I M E A S   P O I   N R             4     I
I L I M I T 1                 0 . 0 0 %.  I
I L I M I T 2                 2 3 . 1 %   I
I                                         I
I * P A R .   B R A N C H   1 2         + I
```

Fig. 6.27 Limit monitor with 2 limit values

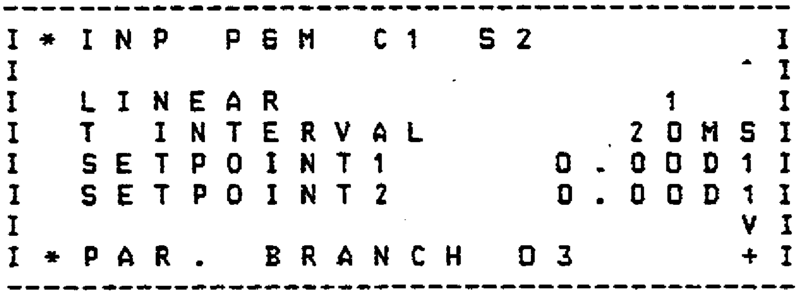
2. Function generator and setpoint sequence

In the function generator and setpoint sequence, the number of vertices (interpolation and extrapolation nodes) can be selected optionally between 1 and 10. The parameter assignment menu is generated according to the number selected.



```
I * I N P   P G I   C 1   S 2             I
I                                       ^ I
I   L I N E A R                     1     I
I   T   I N T E R V A L           2 0 M S I
I   S E T P O I N T 1         0 . 0 0 D 1 I
I S H L                       0 . 0 0 D 1 I
I                                       V I
I * P A R .   B R A N C H   0 3         + I
```

Fig. 6.28 Setpoint sequence



```
I * I N P   P G M   C 1   S 2             I
I                                       ^ I
I   L I N E A R                     1     I
I   T   I N T E R V A L           2 0 M S I
I   S E T P O I N T 1         0 . 0 0 D 1 I
I   S E T P O I N T 2         0 . 0 0 D 1 I
I                                       V I
I * P A R .   B R A N C H   0 3         + I
```

Fig. 6.29 Setpoint sequence with 2 interpolation nodes

Apart from the number of interpolation nodes, the user must also select the distance between nodes by specifying the interval time (T-interv).
In addition, the user can decide whether the interpolation between the nodes should be linear or according to a staircase waveform. This is specified by "1" or "0", which is entered after the input field "LINEAR".

6.2.3 Output

If the user has selected the output function by entering the selection number "2" in the basic menu, the output menu shown in Fig. 6.30 is displayed on the screen.

```
----------------------------------------
I * D I S P L A Y                      I
I                                      I
I   1   P G                            I
I   2   I P 2 5 2                      I
I   3   S U B M O D U L E              I
I   4   P R I N T E R                  I
I                                      I
I * S E L E C T   F U N C T I O N    ÷ I
----------------------------------------
```

Fig. 6.30 Display menu

Using the selection numbers listed in this menu, the user must select the source device from which the controller data blocks are to be output. After selecting the source device, the menu shown in Fig. 6.31 prompts for selection of the listed data to be output.

```
----------------------------------------
I * O U T   I P     C 1   S 2          I
I                                      I
I   1   C O N F I G U R I N G          I
I   2   S A M P L I N G   T I M E      I
I   3   P A R A M .   A S S I G N .    I
I   4   R E S T A R T   C H A R .      I
I                                    V I
I                                    ÷ I
----------------------------------------
```

Fig. 6.31 Function selection output

In contrast to the rigid user guidance during incut, various operational procedures can be selected individually during output. After each operational step the program returns to this output menu. The BREAK or ENTER key branches from this menu to the storage prompts.

IMPORTANT NOTE:

When assigning parameters the selected dimensions are displayed initially and can be changed as during input.
Please note that modification of the characteristic does not cause the values previously entered for that physical unit to be changed, so that it is possible for values which are outside the input range to be present.
Example:

Old node : 0% = 0 kp/cm
100% = 300.0 kp/cm
Input : 270.0 kp/cm
New node : 0% = 0 kp/cm
100% = 100.0 kp/cm

The value 270.0 remains as entered but now, instead of being converted by the IP to 90%, it is converted to a completely random modulo value since the inner limit has been exceeded.

==>The user must take full responsibility for modifications of the dimensional characterisitic during output.

6.2.3.1 Output printer

Entering "4" as the selection number in the output menu displays the print menu. This menu shown in Fig. 6.32 again offers the user various functions. From this menu it is possible to select the source device for the data to be printed. Selection of "1" displays the printer parameters on the PG screen.

```
----------------------------------------
I *PRINTER  OUTPUT                     I
I                                      I
I  1  PRINT  PARAMETER                 I
I  2  PG                               I
I  3  IP252                            I
I  4  SUBMODULE                        I
I                                      I
I *SELECT  FUNCTION                  + I
----------------------------------------
```

Fig. 6.32 Print menu

6.2.3.1.1 Printer parameters

In the "Print parameters" menu (see Fig. 6.33) all parameters required for connecting up to various types of printer are grouped together.

```
----------------------------------------
I *PRINT  PARAMETERS                   I
I  BAUD  RATE     :    600             I
I  MAX.NUM.LIN.:        72             I
I  WAIT  T.A.  CR:    005              I
I  WAIT  T.A.  LF:    010              I
I  BUSY  SIGNAL  :    NO               I
I  TITLE  BLOCK  :    NO               I
I  150   300   600    1200             I
----------------------------------------
```

Fig. 6.33 Print parameters

In the last display line the selection numbers "1" to "4" are assigned values for selecting the baud rate.

6.2.3.1.2 Print PG

After selecting "Print PG" by entering "2" no further sub-menu appears, except for the prompt for source of the list, as in "Input PG". "Print PG" documents the current control loop in the PG. The documentation is printed in the following sequence: structure switch positions, sampling time, resulting processor loading and finally the parameters of the individual branches (see Section 6.5).

6.2.3.1.3 Print IP 252 / submodule

After selecting the "Print IP 252" or "Print submodule" function, the user has three alternatives (see menu "Print IP" Fig. 6.34).

Parameter list:

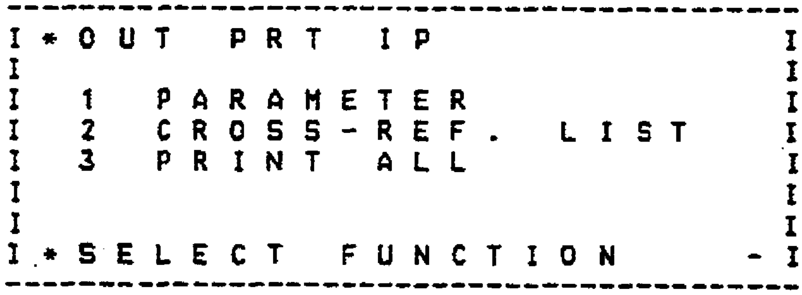
The parameter list documents a controller with structure switches, sampling time and branch parameters as in "Output PG" (see Section 6.5.).

Cross reference list:

The cross reference list documents the calling list of all inputs and outputs used in all the control loops so that multiple assignments can be detected and the wiring can be documented.

Complete printout:

The complete printout is a combination of the parameter list of all controllers available on the IP 252 or submodule and the cross reference list.



```
-----------------------------------------
I * OUT  PRT  IP                        I
I                                       I
I   1  PARAMETER                        I
I   2  CROSS-REF.  LIST                 I
I   3  PRINT  ALL                       I
I                                       I
I                                       I
I * SELECT  FUNCTION                  - I
-----------------------------------------
```

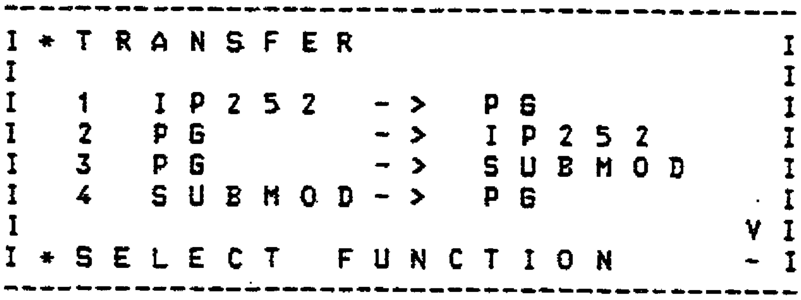
Fig. 6.34 "Print IP"

6.2.4 Transfer

The user selects this function by "4" in the base menu and can then select the source and destination of the transfer operation. The control loop parameters are transferred between the PG and the IP 252/submodule packed in a data block (DB). Each control loop is assigned a fixed DB number which however remains invisible to the user.

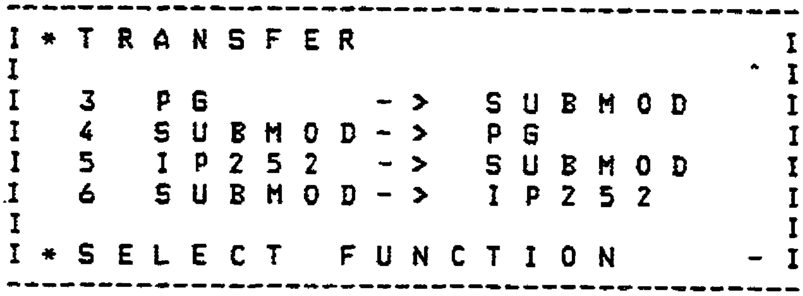
If the control loop is transferred to the IP 252 or submodule, which is already present at the destination, then the user is prompted as to whether he wants to overwrite the previous control loop. The same prompt occurs if transfer is carried out to the PG and a control loop data block is present there.

Two possible transfer menus are illustrated in Figs. 6.35 and 6.36.



```
-----------------------------------------
I * TRANSFER                            I
I                                       I
I   1  IP252    ->  PG                  I
I   2  PG       ->  IP252               I
I   3  PG       ->  SUBMOD              I
I   4  SUBMOD   ->  PG                  I
I                                     V I
I * SELECT  FUNCTION                  - I
-----------------------------------------
```

Fig. 6.35 Transfer menu before scrolling

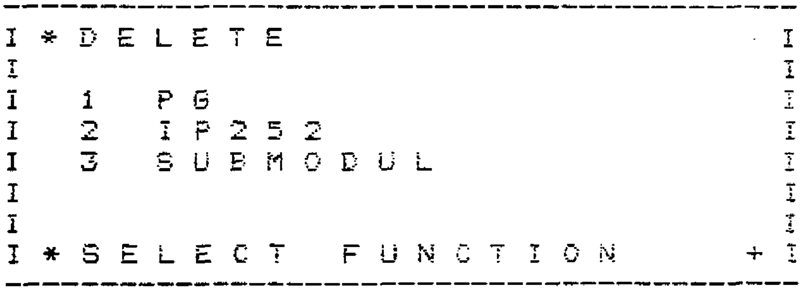


```
-----------------------------------------
I * TRANSFER                            I
I                                     ^ I
I   3  PG       ->  SUBMOD              I
I   4  SUBMOD   ->  PG                  I
I   5  IP252    ->  SUBMOD              I
I   6  SUBMOD   ->  IP252               I
I                                       I
I * SELECT  FUNCTION                  - I
-----------------------------------------
```

Fig. 6.36 Transfer menu after scrolling twice

6.2.5 Delete

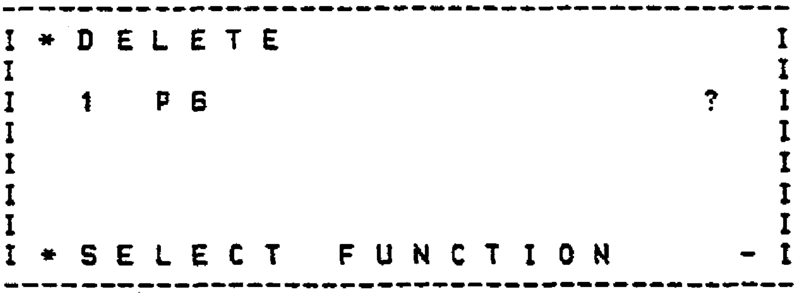
This Delete function can be selected by the user by entering the number "5". After this, the Delete menu shown in Fig. 6.37 appears on the PG display.



```
----------------------------------------
I * D E L E T E                        I
I                                      I
I    1    P G                          I
I    2    I P 2 5 2                    I
I    3    S U B M O D U L              I
I                                      I
I                                      I
I * S E L E C T   F U N C T I O N    + I
----------------------------------------
```

Fig. 6.37 Delete menu

After selecting "Delete IP 252" or "Delete submodule" the user is prompted by the PG to enter the number of the control loop to be deleted. In "Delete PG" the lines "2 Delete IP 252" and "3 Delete submodule" are displayed and in line 3 after the "1 Delete PG" a question mark is displayed (see Fig. 6.38). This question mark is a safety prompt and should be acknowledged by entering "1".



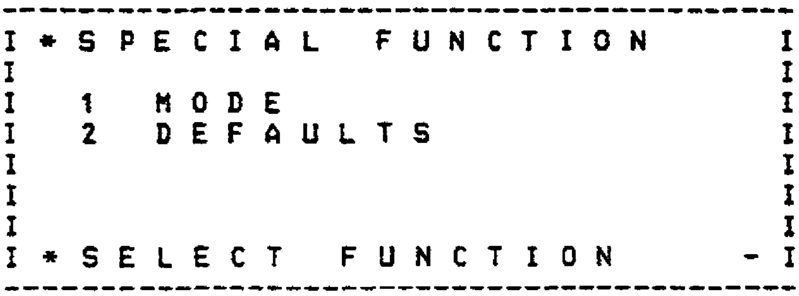
```
----------------------------------------
I * D E L E T E                        I
I                                      I
I    1    P G                     ?    I
I                                      I
I                                      I
I                                      I
I                                      I
I * S E L E C T   F U N C T I O N    - I
----------------------------------------
```

Fig. 6.38 Safety prompt: Delete PG

If "Delete submodule" and "Delete IP" are selected, the user is prompted by the PG to enter the number of the control loop to be deleted.

6.2.6 Special functions

The menu "Special functions" can be called up by the user by selecting the number "6". The menu which appears on the PG display is shown in Fig. 6.39.



```
----------------------------------------
I * S P E C I A L   F U N C T I O N    I
I                                      I
I    1    M O D E                      I
I    2    D E F A U L T S              I
I                                      I
I                                      I
I                                      I
I * S E L E C T   F U N C T I O N    - I
----------------------------------------
```

Fig. 6.39 Special functions menu

As described in the previous sections, one enters into the "Operating mode" or "Defaults" menu by entering the corresponding selection number.

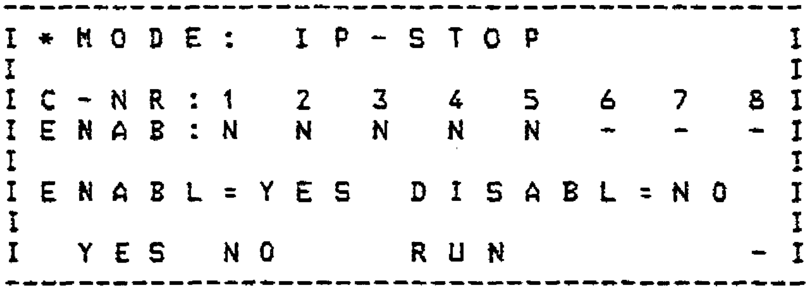
6.2 PG (Programmer) Functions

6.2.6.1 Operating mode

The "Operating mode" menu controls both the general IP module RUN/STOP as well as the selective control loop enable. The operating mode menu is shown in Fig. 6.40.
In the last line of the display the decimal keypad of the PG is assigned the following functions:

1 = YES 2 = NO 3 = RUN/STOP

The upper line shows the current module state whereas both lines underneath show whether the eight control loops in the IP modules are enabled or disabled.



```
---------------------------------------------
I * MODE:   IP-STOP                         I
I                                           I
I C-NR: 1   2   3   4   5   6   7   8       I
I ENAB: N   N   N   N   N   -   -   -       I
I                                           I
I ENABL=YES   DISABL=NO                     I
I                                           I
I  YES   NO       RUN                     - I
---------------------------------------------
```

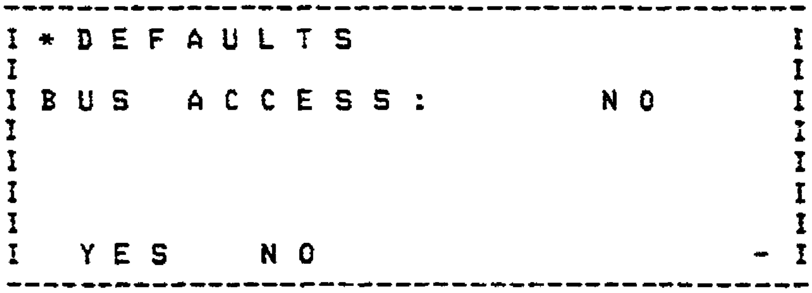
Fig. 6.40 Operating mode menu

After entering a selection number, a question mark appears after the selected function appears (e. g. RUN). This prompts the user to enter the selection number a second time. This safety check reduces the probability of incorrect operation.
If the module is in the STOP by software initiation, then it can be put in the RUN state by entering "3" twice in succession. The message text in the display changes from RUN to STOP. STOP appears in the last display line above the "3", i. e. the selection number "3" is assigned to another function.
In order to enable or disable one particular control loop the user must position the cursor to the point below the control loop number. Then he can change the enable/disable state of the particular control loop by pressing the selection number twice. The line which contains the message "ENAB" gives information about the current state of the particular controller, where **Y** stands for enabled and **N** for disabled or not used.

6.2.6.2 Defaults

The Defaults menu (see Fig. 6.41) is restricted to the prompts bus access YES or NO.
Bus access means in this case that the IP 252 not only uses the internal ADCs and DACs but also accesses the extended peripherals of the S5 bus. This has an effect on the syntax checking for the address assignments of the ADCs and DACs. Without bus access only the internal addresses 0 to 7 are possible, with bus access however the addresses 128 to 254 are possible.

This "direct bus access" is only possible with the PC 115 U!



```
---------------------------------------------
I * DEFAULTS                                I
I                                           I
I BUS  ACCESS:              NO              I
I                                           I
I                                           I
I                                           I
I                                           I
I  YES     NO                             - I
---------------------------------------------
```

Fig. 6.41 Defaults menu

6.2.7 Information

This menu is called by selecting number "7" as shown in Fig. 6.42.

```
----------------------------------------
I *INFO                               I
I                                     I
I  1  CONTROLLER LIST                 I
I  2  SYSID                           I
I  3  ERROR                           I
I  4  PROCESSOR LOAD                  I
I                                     I
I *SELECT FUNCTION                   +I
----------------------------------------
```

Fig. 6.42 Information menu

6.2.7.1 Controller list

In this list the available control loops in the IP 252 and the submodule are listed. For each control loop the structure name and version number is displayed.
After selecting the controller list the menu shown in Fig. 6.43 appears in which the user must enter the operating mode (online/offline). This influences whether the IP 252 or the submodule is used in the lower submodule receptacle of the PG 615 as the source device for the list. Fig. 6.44 shows the actual controller list appearing after selection.

```
----------------------------------------
I *CONTROLLER LIST                    I
I                                     I
I  1  ONLINE                          I
I  2  OFFLINE                         I
I                                     I
I                                     I
I                                     I
I *SELECT MODE                       +I
----------------------------------------
```

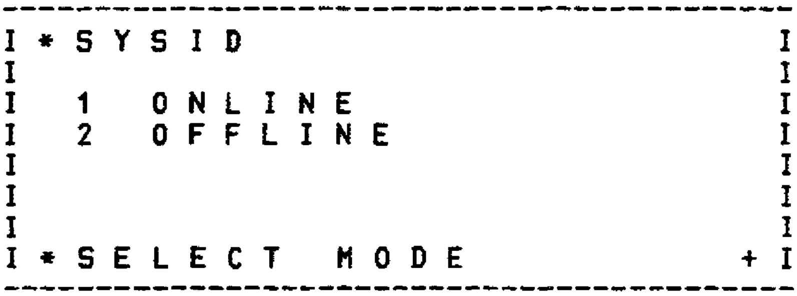
Fig. 6.43 Controller list / source selection

```
----------------------------------------
I *C  LIST  SUBMODUL                  I
I                                     I
I R1  STANDARD           1.0          I
I R2  DRIVE              1.0          I
I R3  DRIVE              1.0          I
I R4  DRIVE              1.0          I
I                                    VI
I                                    -I
----------------------------------------
```

Fig. 6.44 Controller list

6.2.7.2 SYSID

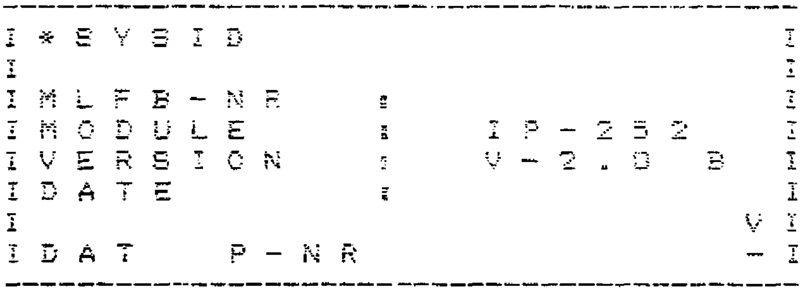
This function was introduced so that the system CPU could access its IPs (intelligent I/Os) and CPs (communications processors' and read the version number, the date of generation and the module designation for diagnostic purposes. If the "SYSID" functior is called up under the "Information" function, then the menu shown below in Fig. 6.45 is displayed.



```
--------------------------------------------
I * SYSID                                 I
I                                         I
I   1   ONLINE                            I
I   2   OFFLINE                           I
I                                         I
I                                         I
I                                         I
I * SELECT   MODE                       + I
--------------------------------------------
```

Fig. 6.45 SYSID base menu

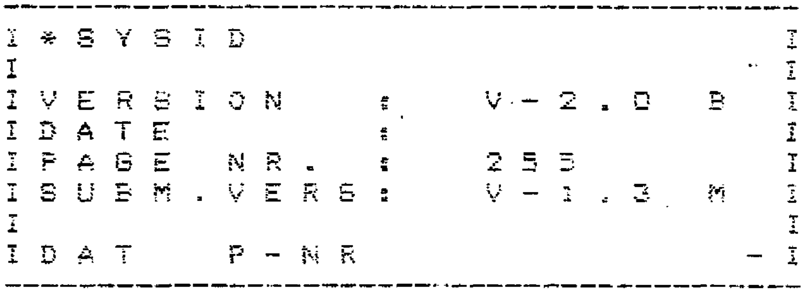
In this menu the user must decide whether he wants to work online or offline. Next, the actual SYSID mask, which is shown in Fig 6.46, is displayed.



```
--------------------------------------------
I * SYSID                                 I
I                                         I
I MLFB-NR       :                         I
I MODULE        :     IP-252              I
I VERSION       :     V-2.0   B           I
I DATE          :                         I
I                                       V I
I DAT   P-NR                            - I
--------------------------------------------
```

Fig. 6.46 SYSID menu

Only the date is to be entered by the user in this screen form. The page number and the submodule version, in this case V1.3M, are displayed after scrolling down twice.

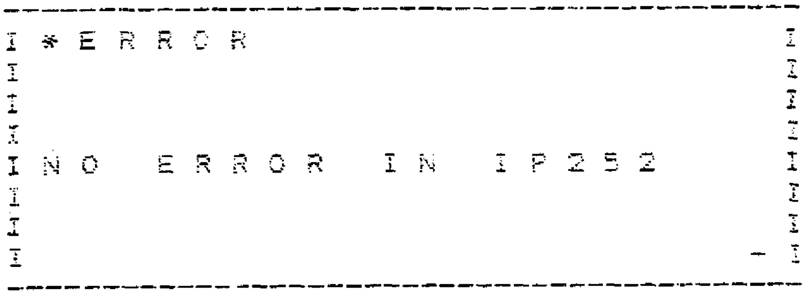


```
--------------------------------------------
I * SYSID                                 I
I                                         I
I VERSION       :     V-2.0   B           I
I DATE          :                         I
I PAGE   NR.    :     253                 I
I SUBM.VERS     :     V-1.3   M           I
I                                         I
I DAT   P-NR                            - I
--------------------------------------------
```

Fig. 6.47 Second part of the SYSID menu

6.2.7.3 Faults/errors

This function enables error/fault diagnostics if, for example, the IP will not enter the RUN mode.
Under normal conditions – no error – the following menu will be displayed:



```
----------------------------------------------------------------
I * E R R O R                                                 I
I                                                             I
I                                                             I
I                                                             I
I N O   E R R O R   I N   I P 2 5 2                           I
I                                                             I
I                                                             I
I                                                           - I
----------------------------------------------------------------
```

Fig. 6.48 Error form

The following messages are transferred from the IP 252 to the CPU control program for diagnostics purposes:

Errornumber decimal	Text on PG 615	Error caused by	Reaction of IP to error
00.	No error on IP	Basic status: "No error on IP 252"	–
11.	Hardware	Time-out (not analog module)	"Stop"
12.	Hardware	Checksum of EPROMs incorrect	"Stop"
13.	Hardware	Result of offset correction: Deviation of a DAC > 7 LSB	"Stop"
14.	Hardware	Error in hardware diagnostics program: RAM	"Stop"
15.	Hardware	Error in hardware diagnostics program: MUART	"Stop"
20.	Watchdog	Time-out	"Stop"
21.	Direct access	S5 bus not enabled by S5-CPU	"Stop"
22.	Analog section	Wire breakage at digital input (digital tacho)	"Stop"
23.	Analog section	Power failure in analog section	"Stop"
30.	PC on Stop	BASP activ	"Stop"
31.	Submodul	Wrong or no submodule in IP 252	"Stop"
50.	Analog module	Time-out or wire breakage in analog module	"Stop"
51.	Overload	IP 252 overloaded (timing conflict)	LED "F" flashing
70.	RUN / STOP switch	RUN / STOP switch on IP 252 set to "Stop"	"Stop"
71.	Software stop	Stop of IP 252 initiated by command from PG or PC	"Stop"

All the messages listed above are recognized by the IP 252 operating system and can be

1. scanned with the help of COM 252 for the PG 615 or COM REG for the PG 635/675/685/695 via the "Info" function in the "Errors" submenu, and
2. fetched via RECEIVE 200 from a specific RAM area of the IP 252 (the dual-port RAM) by the CPU. The error bit in question is then reset via RESET 200. An error bit, once entered, will be automatically reset when the module goes from "STOP —> RUN". CONTROL 200 can be used to determine whether a new error bit has been entered by the IP 252, and therefore whether it is meaningful or not to call up a RECEIVE 200.

Generally, only the first message received is entered. The numbers 51 and 75 to 85 are exceptions: these messages are overwritten by all subsequent messages!

6.2.7.4 Processor loading

After selecting the "Processor loading" function, the menu shown in Fig. 6.49 appears. In this menu one decides whether online or offline operation is required. After this the actual control loop loading menu containing information about the individual control loops is displayed.
This function displays the processor loading caused by the individual control loops in the IP 252 or submodule on the processor of the IP 252 (depending on the selection online / offline). The total loading is given in the last line.

```
-------------------------------------------
I * P R O C E S S O R   L O A D          I
I                                        I
I   1   O N L I N E                      I
I   2   O F F L I N E                    I
I                                        I
I                                        I
I                                        I
I * S E L E C T   M O D E              - I
-------------------------------------------
```

Fig. 6.49 Controller loading / source selection

```
-------------------------------------------
I * P R O C . L O A D  S U B M O D       I
I                                        I
I   C O N T R O L L E R  1    5 5   %   I
I   C O N T R O L L E R  2    2 7   %   I
I   C O N T R O L L E R  3    1 3   %   I
I   C O N T R O L L E R  4    1 3   %   I
I                                    V  I
I   T O T A L   L O A D  =  1 0 8   %   I
-------------------------------------------
```

Fig. 6.50 Controller loading

6.2.8 Controller test

The controller test function is selected by entering the selection number "8". It is used for operator communication and monitoring of the controller under online operation. In addition to the input and display of parameters, the controller test is also used for displaying bit variables (e. g. branch enable bits or limit value identifier bits), input values (e. g. PC setpoints) or intermediate variables (referred to as measuring points). All values are updated several times per second by the IP 252.

Forcing during controller test (↦ key)

The cursor is not visible during the status display. If a parameter is to be modified in the RUN mode, the cyclic status request is interrupted by the FORCE key. The last display is frozen and the cursor appears in the first forceable field or in the last forced field in this screen. If no forceable field is available in the current screen, the PG searches for the first forceable field after the current screen. If no field is found, the old screen remains displayed and a corresponding fault message appears and the status is again cyclically requested. Otherwise the display scrolls until the first forceable field found appears on the display.
In the "Force" mode, the cursor can be moved upwards or downwards with the cursor keys as during parameter assignment with the restriction that positioning is only possible on forceable fields. If no forceable field is available in the direction of the cursor key, a fault message appears and cyclic updating is again started (cursor disappears).
If a parameter on which the cursor was positioned is to be changed, the desired value is input and the subfield ENTER key is pressed. The PG then transmits the new value to the IP 252, interrupts the forcing mode and returns to the status display mode.

Values which cannot be forced:

- ✻ Addresses
- ✻ Measuring points
- ✻ Number of limit values
- ✻ Interpolation/extrapolation node and setpoint numbers

When selecting the following parameters, there may be conflicts with the outer loop controller since it also accesses the same memory locations via the dual-port mechanism:

- ✻ PC setpoints
- ✻ PC enable bits

ADR	Address
ADC	Analog-to-digital converter
ANQ	Analog output
BR01	Branch 01
C1	Controller 1
C LIST	Controller list
C NO	Controller number
CONT	Continuous-action controller
CR.W.TIME	Waiting time after carriage return
D1	Dimension 1
DAT	Date
DAC	Digital-to-analog converter
DLM	Danger limit
ENAB	Enable
HH.MM	Input format for hours/minutes
INP	Input
IP	Intelligent I/O module (IP is often used as an abbreviation for IP 252 in this manual)
IP-LOAD C1	IP loading due to controller 1
L	Lower
LF.W.TIME	Waiting time after line feed
LMV	Limiting value
MAX.LINES	Maximum number of lines
MOD	Submodule
M.PG	Manual value PG (manipulated variable for manual intervention)
MS	Milliseconds
MS.PT-NO	Measuring point number
NORM DECEL	Normalization of the decelerating current
OPM	Operating mode
OUT	Output
PAR	Parameter assignment
PAR.AS	Parameter assignment
PLNT-CONST	Plant time constant
P-NO	Page number
PRI	Printer output
PROC.LOAD	Processor loading
POSN	Position (in dimension designation)
S	Seconds
S1	Structure 1 (drive controller DR)
S2	Structure 2 (standard controller DR)
S3	Structure 3 (drive controller with self-setting DRS)
SEC	Seconds
STEP	Step controller
STOR	Store
STRUC	Structuring (configuring)
SYSID	System identification
T INTERV	Interval time
TLD	Total loading
TS	Sampling time
TS>	Increasing sampling time
TS<	Decreasing sampling time
U	Upper
WARNG	Warning limit
WR	Warm restart
X^1 LM	Limit monitor

6.4 Error messages on the PG 615

Hardware messages

NO.	ERROR	REMEDY
02	External RAM error	Replace PG
03	Internal RAM error	Replace PG
04	Buffer overflow	Repeat function
05	Parity error	Repeat function
06	Wire break	Repeat function
07	Time expired	Repeat function or disconnect PG connector temporarily
08	Unknown	Repeat function; if required disconnect PG connector temporarily
22	Incorrect operating mode	Select correct operating mode; then repeat function
30	Block not available	
33	Usart fault	Repeat function; if required exchange PC or interface
44	Unknown message	Repeat function
50	Wrong key	Press right key
51	Unknown command	Enter right command
53	Key-operated switch	Key switch must be on II position
60	No information DB	
61	No description and text lists	
62	Range cannot be represented uniformly	
63	Branch not available	
64	Conclude subfield	↧ key
65	Description list error	Enter controller once again (configure and assign parameters); it is not functioning properly as it has been generated on the basis of an obsolete description list
66	No parameter in branch	
67	Inadmissible number of steps/minimum pulse duration	
68	No value in the direction of the arrow / on the page can be forced	
69	Unknown measuring point	
72	Address not allowed	
73	Parameter overflow	Enter command with the correct parameter
85	Parameter cannot be forced	Acknowledge
87	Data in the selected format cannot be represented	Change format
91	Submodule programming error	Delete controller and re-enter/ replace submodule
92	Wrong submodule inserted	Identify submodule correctly
93	No space on the submodule	
95	No submodule inserted	

```
PRINT PG     CONTR.: 02     CONFIGUR.: DRIVE     VERSION: 0.2     PAGE 01

1. Configuring bits (structure switches):

Branch 01:   Controller output          1
              Conversion                0
Branch 02:   Friction                   1
Branch 03:   Periph. vel+accel          1
Branch 04:   Increase loop gain         1
              Inject dia. signal        1
Branch 05:   Speed controller           1
Branch 06:   Set-up speed               1
Branch 07:   Creep speed                1
Branch 08:   Set rev/min                1
              Ramp-function generator   1
              Filter                    1
              Setpoint sequence         1
Branch 09:   Primary controller         1
              B+/B-                     1
              ADC/Input                 1
              N act/PG scaler           1

Branch 10:   Actual rev/min             1
              Analog/pulse              1
              Filter                    1
              Zoom display              1
Branch 11:   Act. armature current      1
              Signal injection          1
              Thermal monitor           1
Branch 12:   Limit monitor 1            1
Branch 13:   Limit monitor 2            1
Branch 14:   Meas. socket 1             1
Branch 15:   Meas. socket 2             1

2. Sampling time/IP252 load:

Sampl. time:     4 ms
IP252 load:      105%
```

```
PRINT PG     CONTR.: 01     CONFIGUR.: DRIVE     VERSION: 0.2

3. Controller parameters:

Branch 01:  Controller output    NORM BRKG            0.00%
                                 ADR DAC 2               1
Branch 02:  Friction             FRICTION             0.00%
Branch 03:  Periph. vel + accel  STA. I ACCL          0.00%
Branch 04:  Increase loop gain   STA. I LOOP          0.00%
                                 INJECT DIA. SIGNAL
Branch 05:  Speed controller     KP                  10.00
                                 TN                   200MS
                                 TV                      0S
                                 HIGH LIMIT         100.00%
                                 LOW LIMIT         -100.00%
                                 IOWD                 0.00%
                                 IUWD                 0.00%
                                 IOGD                 0.00%
                                 IUGD                 0.00%
                                 SOGD                 0.00%
                                 SUGD                 0.00%
                                 START-UP SETP        0.00%
Branch 06:  Set-up speed         REV/MIN              5.00%
Branch 07:  Creep speed          REV/MIN             10.00%
Branch 08:  Set rev/min          CONST SETP          22.00%
                                 SETP SECT          100.00%
                                 ADR ADC6                2
                                 RAMP GENERATOR
                                   TH                   10S
                                   TR                   15S
                                   INCREASE         100.00%
                                   FILTER
                                   TVZ                 20MS
                                   SETPOINT SEQUENCE
                                   ADR DAC5              1
Branch 09:  Primary controller   B+/B-
                                   ADC/KEY IN
                                   CONST SETP         0.00%
                                   ADR ADC1              3
                                   KP                 5.00
                                   TN                    0S
                                   TV                    0S
                                   HIGH LIMIT        20.00%

                                   LOW LIMIT        -20.00%
                                   IOWL               0.00%
                                   IUWL               0.00%
                                   IOGL               0.00%
                                   IUGL               0.00%
                                   SOGL               0.00%
                                   SUGL               0.00%
                                   NACT/PG SCALER
                                   SCALER CONST      80.00%
Branch 10:  Actual rev/min       ANALOG/PULSE
                                   REV/SEC           30.00
                                   ST/100             5.00
                                   FILTER
                                   TVZ                  20MS
                                   ZOOM DISPLAY
                                   STAND ACT        100.00%
                                   CAL DISPL          0.00%
                                   ADR DAC1
                                   START-UP ACT.      0.00%
Branch 11:  Act armature curr    ADR ADC4                1
                                 SIGNAL INJECTION
                                   STA. I ARM       100.00%
                                   THERM MONITOR
                                   THERM CONST       1.10HM
                                   THERM LIM.        89.00%
Branch 12:  Limit monitor 1      NO. OF LIMITS           2
                                 MS. PT NO.             12
                                 LIMIT 1              1.00%
                                 LIMIT 2             -1.00%
Branch 13:  Limit monitor 2      NO. OF LIMITS           1
                                 MS. PT NO.             14
                                 LIMIT 1             80.00%
Branch 14:  Meas socket 1        MS. PT NO.             14
                                 ADR DAC 3               5
Branch 15:  Meas socket 2        MS. PT NO.             12
                                 ADR DAC4                6
```

6.5 Output : Print PG

```
PRINT PG     CONTR.: 01     CONFIGUR.: STANDARD     VERSION: 0.3     PAGE: 01

1. Configuring bits (structure switches):

Branch 01:   Controller output     1              Branch 02:   Actual value          1
               Cont/step           0                             ADC/PULSE           0
               M. PG/ADC           0                             Validity check      0
               Standard/upgraded   1                             Averaging           0
                 Sep.d-comp. input 0                             Polygon             1
                 Disturbance inp.  0              Branch 03:   Setpoint              1
                 M.PG/ADC          0                             ADC/input           1
                 M.PG/ADC          0                             Ramp generator      0
               Cont/"on"/"off"     1                             Smoothing           0
                 2/3-step contr.   0              Branch 04:   Limit monitor 1       1
                 Conditioning      0              Branch 05:   Limit monitor 2       0
                                                  Branch 06:   Meas. socket 1        0
                                                  Branch 07:   Meas. socket 2        0


2. Sampling time/IP 252 load

Sampl. time:     4 ms
IP252 load:      65%
```

```
PRINT PG     CONTR.: 01     CONFIGUR.: STANDARD     VERSION: 0.3     PAGE 02

3. Controller parameters:

Branch 01:   Controller output   CONT/STEP
                                 STANDARD/                                                 POLYGON
                                 UPGRADED                                                  NR. VERTICES         1
                                 M. PG ADC                                                 START VAL.      10.00%
                                   CONST. MAN          22%                                 CORNER           2.00%
                                   H. LIMIT        100.00%                                 ORDINATE 1      20.00%
                                   L. LIMIT       -100.00%                                 START-UP ACT     0.00%
                                   KP                 5.00    Branch 03:   Setpoint       ADC INPUT
                                   TN                   1S                                 NR. SETP.            2
                                   TV                   0S                                 LINEAR               1
                                   CONT/"ON"/"OFF"       1                                 T INTERVAL          0S
                                   TMIN                4MS                                 SETPOINT 1      20.00%
                                   ADF               1.00%                                 SETPOINT 2       0.00%
                                   RSP              10.00%                                 SHL              0.00%
                                   2/3 STEP CONTR.       1                                 SLL              0.00%
                                   ADR DAC1              0    Branch 04:   Limit monitor 1 NR. LIMTS            1
Branch 02:   Actual value        ADC/PULSE                                                 MEAS PT NO.          4
                                   ADR ADC2              0                                 LIMIT VAL. 1    22.00%
                                   H. WARNING        0.00%
                                   L. WARNING        0.00%
                                   H. DANG. LIM      0.00%
                                   L. DANG. LIM      0.00%
```

SIEMENS

COM REG
Programmer-Software

User's Guide Order No. C79000-B8576-C388-02

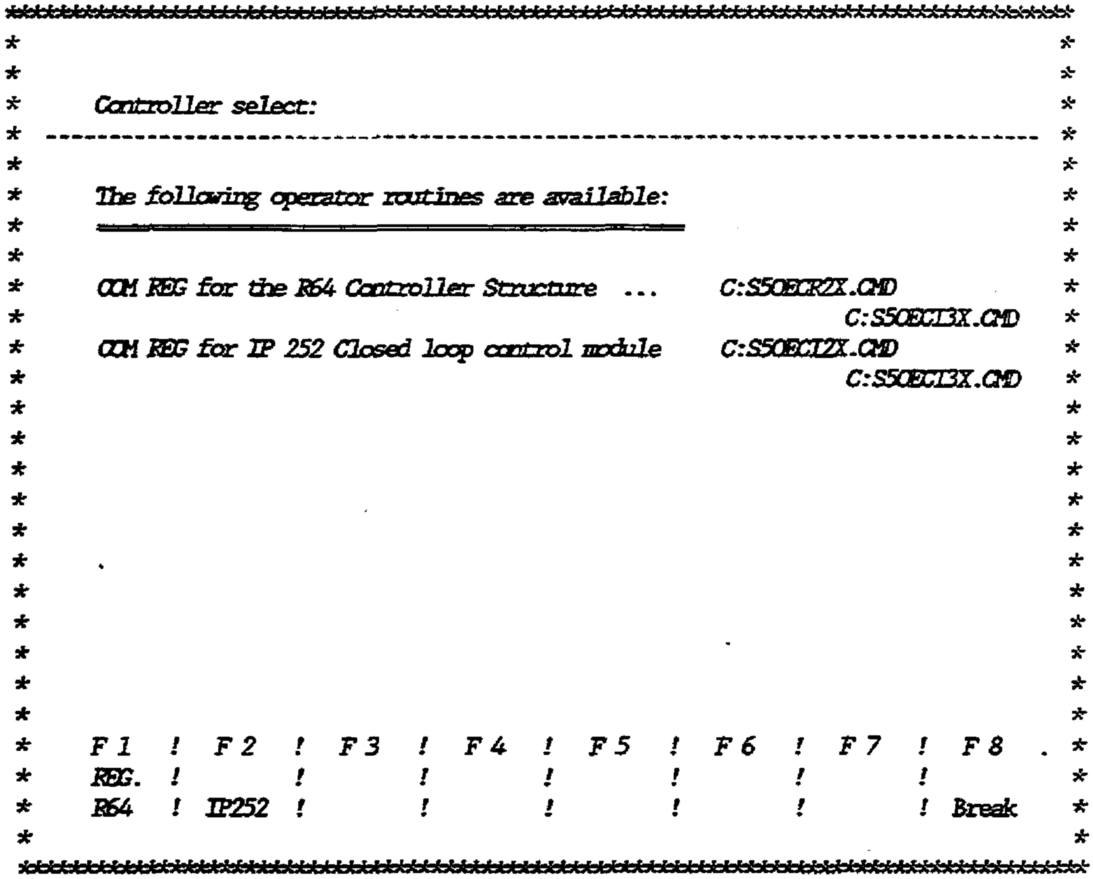
TABLE OF CONTENTS

3 General Notes

3.1 Structure of the Masks

As in other SIMATIC S5 operator areas, the dialog between the user and COM REG is executed exclusively by means of masks. All the masks are structured basically the same:
- two headlines with information on the selected function and the block which is being processed
- 19 lines of working area
- three lines of function key menu for selecting functions and controlling the parameter input.

This structure is illustrated in the "Controller selection" mask. This mask appears immediately after selecting "COM REG" by means of the <F1> / <Package> key. All existing COM REG packages are displayed.



```
Controller select:
---------------------------------------------------------------------------

The following operator routines are available:
==============================================

COM REG for the R64 Controller Structure  ...    C:S5OECR2X.CMD
                                                        C:S5OECI3X.CMD
COM REG for IP 252 Closed loop control module    C:S5OECI2X.CMD
                                                        C:S5OECI3X.CMD

F1   !  F2   !  F3  !  F4  !  F5  !  F6  !  F7  !  F8
REG. !       !      !      !      !      !      !
R64  ! IP252 !      !      !      !      !      ! Break
```

In the "Controller selection" mask the user chooses the controller he wishes to work with using the COM software. For this purpose, the function keys offer the following options:

<F1> Controller structure R64
<F2> Closed-loop controller IP 252
<F8> Break

The assignment of the function keys <F1> to <F7> in the mask shown above depends on the existing packages.

After a module has been selected the preset mask is displayed.

To exit COM REG press the break key <F8>. Then the command interpreter is loaded which will display again all available packages. To exit S5-DOS press the function key <F8>. This command must be confirmed by activating the <Enter> key.

3.2 Selecting Functions

COM REG is operated by means of the alphanumeric keyboard, the cursor keys, the eight function keys, the <Break> key, the <Enter> key, and the <Hard copy> key. All other STEP5 specific keys are ineffective.

When you press an ineffective key the message "BLOCKED KEY" is displayed; afterwards you can correct the input. Keyboard entries are closed by pressing the <Carriage return>. After that the user is prompted to enter further data or, the next menu is automatically displayed.

COM REG is structured hierarchically, i. e. there are different levels on which the program may run. The upper level is the main menu. When the user selects a function from the main menu (for example output) a new menu is displayed from which the data that is to be output may be selected. When the user selects, for example, "PARAMETER" the third level is entered. The following diagram shows this in detail:

```
Main menu              Output                   Parameter output
---------              ------                   ----------------

Input                  +- Structuring
                       |
Output ----------------+- Scan time
                       |
Transfer               +- Response              +- Controller
                       |                        |
Delete                 +- Phys. dimension       +- Actual value
                       |                        |
Special functions      +- Parameter ------------+- Setpoint value
                                                |
Information                                     +- Test socket
                                                |
Test                                            +- Digital peripheral
```

Normally a function is closed by pressing the function key <F7> (Ready); then the program returns to the next higher level.
The entries or changes made are stored. When a function is cancelled by pressing <F8> the program returns to the next higher level without storing the entries or the changes.
As with other operator areas the <Break> key and the <Carriage return> are effective under COM REG. Often the <Break> key functions the same as <F8> and the <Enter> key functions in the same way as <F7>.
When the hardcopy key is pressed the screen contents may be output at any time via a connected printed.

3.3 Entry Fields

You enter data into the entry fields by means of the alphanumeric keyboard and close the entries by pressing the <Enter> key.
Before pressing this key you can move the cursor within the entry field and correct wrong entries.
Before you start to enter data into the entry field the cursor is positioned in the leftmost position of the field. When the entry field is blank, data can be entered left-justified. After you have pressed the <Enter> key COM REG displays the entry right-justified. When the entry field is not blank you can enter data in one of two ways:

- You enter the new value left-justified. Since the previous entry is still displayed, right-justified, it is not overwritten completely. A blank must follow the last character of the new entry so that COM REG can recognize it. After pressing the <Enter> key COM REG accepts the new value and displays it right-justified. In the following example the value "10.5" should be replaced by "9.5". (Blanks are represented by "_")

Before the entry is made:	"_10.5"
Before pressing the <Enter> key:	"9.5_5"
After pressing the <Enter> key:	"__9.5"

- You overwrite the old value with the new one in such a way that the position of the decimal point is maintained, i. e. the new value is entered right-justified. The advantage of this method is that only those characters that really have to be changed are entered. In the previous example "10" is overwritten with "_9".

Before the entry is made:	"_10.5"
Before pressing the <Enter> key:	"__9.5"
After pressing the <Enter> key:	"__9.5"

When you wish to enter parameters of different time units or data types COM REG offers possible time units such as ms, s, hm or different data types such as IFW, XW, PW, FW in the function key menu, during completion of the entry field. The default unit can be changed by means of the appropriate function key before pressing the <Enter> key.

3.4 Types of Parameters and their Input Formats

There are different types of parameters under COM REG and for each type of parameter only particular input formats are allowed. In the following table all types of parameter are listed:

Type of Parameter	Dimension	Sign	Decimal places	Range
Controller no.	–	no	0	1 – 8
DB no.	–	no	0	2 - 255
FB no.	–	no	0	0 – 255
Bit value	–	no	0	0/1
Address	–	no	0	0 – 254
Fixed point	–	yes	2	+/–100.00
Percent value	%	yes	2	+/–100.00
Times	ms	no	1 0	0.0 – 999.9 0 – 9999
	sec	no	3 2 1 0	0.000 – 9.999 0.00 – 99.99 0.0 – 999.9 0 – 9999
	hm	no	2	0.00 – 59.59
Determination of physical dimension	6 optional characters	yes	4 3 2 1 0	0.0000 – 1.0000 0.000 – 10.000 0.00 – 100.00 0.0 – 1000.0 0 – 10000
Dimension–dependent parameter	6 optional characters	yes	as determ. above	format determined above

Dimension–dependent parameters are parameters with the same unit as the values to be controlled, for example the setpoint value, the error signal, the setpoint value error limits, the processed actual value. For further information see chapter 4, section "Input/Entering a standard controller/Input characteristic".

3.5 Recommendations for the Procedure

You can project a controller by means of COM REG according to the steps described below:

- Enter the controller structure and parameters into a program file.
- Create the controller list (only for controller structure R64)
- Transfer the data blocks (and possibly the function blocks) from the program file to the module.
- Online test of the controller; optimize the parameters.
- Change the structure with "Output", if required, and test it again.
- Store the tested controller data block in the program file.
- Program the data blocks in EPROMs, if required.
- For documentation, print the controller structure and parameters.

3.5.1 Entering a Controller

In order to structure a controller the "INPUT"-function is selected from the main menu by pressing function key <F1>. In order not to lose any data, in the event of interference, it is advisable to initially enter controller data blocks into a file and not send them directly to the module. When you enter data COM REG guides you with masks so that you can enter the data in a suitable order:

- structuring
- determining the sampling time [1]
- determining the controller response
- determining the physical dimension
- parameterizing the branches and modules that were switched on during structuring

When a controller is being entered no values are preset by COM REG in order to avoid unintended controller functions being activated. For an appropriate parameterization of controller structure R64 it is necessary to enter values >< 0 for the following parameters:

- Scan time [1]
- Time base of the controller list
- Upper limit (of the controller)
- Lower limit (of the controller)
- Positive increment limit
- Negative increment limit
- Adjustment factor on a continuous controller with pulse/pause output
- Gain of the actuator adjustment
- Minimum pulse duration on a step or continuous controller with pulse/pause output
- Number of vertices of the polygon curve
- Distance between the vertices of the polygon curve
- Number of setpoints of the setpoint sequence
- Filter time constant
- Increase at the ramp-function generator
- Number of limit values of the limit monitors
- Measuring point number for limit monitors and test sockets

[1] Here, 'sampling time' and 'scan time' have the same meaning

3.5.2 Creating the Controller List (only for R64)

The system program of the processor must be informed in the reserved data block DB2 in which sequence each controller is called. Therefore, after the creation of the data blocks, each of which contains a controller structure, the controller list must be created by COM REG.

3.5.3 Transfer to the Module

In order to be able to test the controller the data block should be transferred from the file to the module using the function <F4> "TRANSFER". When working with controller structure R64 the function block (FB102) and the controller list (DB2) must be transferred along with the data block in which the controller structure is stored.

3.5.4 Online Test of the Controller

After starting the PC the controller can be tested by means of the function <F8> "TEST". It is recommended to ensure that the controller receives the correct values from the input module by selecting a test point table where the different test point values are visible at a glance.

You can optimize the parameters online during the controller test by overwriting the current parameter using the function "FORCE".

3.5.5 Changing the Structure

Since only the parameters may be changed during test you have to exit the test and select the function <F2> "OUTPUT" in order to change the structure. It is reasonable to change the data blocks at the module (in STOP state) since it is there that the parameter changes, resulting from test, will be accepted, in contrary to the data block on file. After a structure has been changed the processor must be restarted. The user may now change the masks completed by "INPUT". In contrary to input, the user won't have to follow the complete sequence of masks, but may select directly the masks to be changed. The "Test" and "Change" steps are repeated until the desired controller characteristics are obtained.

3.5.6 Transferring to a File

After the test all data blocks that have been changed should be saved in the file using the function <F4> "TRANSFER".

3.5.7 Programming the EPROMs

When you work with the IP252, COM REG offers the possibility to program the created data blocks into EPROMs using the function <F4> "TRANSFER". When using the "controller structure R64" the programming of EPROMs is only possible using the STEP5 program package.

3.5.8 Documentation

After you have finished projecting the controller, the structures and parameters should be printed. To do this, select <F8> "PRINT OUTPUT" using the <F2> key. In addition to the parameters, a cross reference list with the input/output modules used by each controller can be printed.

3.6 Possible Sources of Errors

This section attempts to list all possible problems and sources of errors so that you may avoid them after having studied this section.

- If there are notes on the delivered program version at the beginning of this manual, please pay attention to the remarks given!

- A valid filename should be preset when blocks are to be read from or written onto floppy/hard disk. The valid form of a filename is: "X:YZZZZZST.S5D" where "X" is a valid drive name (e. g. "A"), "Y" is a capital letter and "Z" a capital letter or a digit.
  When you do not enter a filename or when you enter one incorrectly COM REG cancels the access to the floppy/hard disk and displays the message "ERROR EXTERNAL STORAGE". If this error occurs when you are writing a data block this block can be saved because the data is still in the "programmer" medium, although the input medium "FILE" was selected. You can save this data block from the programmer by transferring it into a valid file by means of the function "TRANSFER".

- When you work with the controller structure R64 and the IP252 you should store the data block for both devices in different files so that they are not mixed unintentionally!

- After disconnecting and reconnecting the cable between PG and PC, when a power failure on the PC occurs, or following a cold restart of the R-Processor a transfer error occurs that is detected during the next communication between PG and PC. COM REG then cancels the transfer and displays the message "PC <-> PG TRANSFER ERROR". When the cancelled function is called again the connection may be established.

- In order to increase data security each data block is almost always simultaneously sent to the PG storage as you process a data block (input, output, transfer). It is this PG storage that always contains the last data block processed, even if it

was input to the module or into a file.
When you cancel the input or output function unintentionally the PG storage retains the data block until you work on a different one; therefore the block can be saved by transferring it from the PG to the module or the file.

- The input function offers "PG" as the target for a data block. Because of the characteristics of the PG storage mentioned above this data block is overwritten without warning when you work on another DB. Therefore you are advised against selecting the PG as destination for input!

- When you cancel the function "OUTPUT" (except "OUTPUT/PARAMETER") not only the output of the mask but also output of the complete data block is cancelled with the result that all other changes (e. g. parameters) are lost. This block can only be saved by means of the PG storage mentioned above.

- The encoding switch of the printer PT88 should be set as it was when the printer was delivered, i. e. all switches "ON".

  Note: An incorrect printout indicates that the parity of the printer interface is not set correctly.

3.7 Checklist for Troubleshooting

The following list contains the most frequent causes of the most important possible user errors, from call of COM REG to controller test.

PCs are highly complex, high performance devices where many functions must run correctly at the same time, in particular in the multitasking mode, in order to realize the required action. The large number of available functions may lead to a large number of possible operator errors. It is therefore reasonable to restrict the troubleshooting of particularly stubborn and apparently inexplicable faults to the necessary modules and functions. Experience has shown that faults are not necessarily found in the function where they appear but in a different one.

COM REG cannot be started

- Does the floppy/hard disk contain all tools and drivers required?
- Were all tools and drivers taken from the same ZEFU package?
- Does the floppy/hard disk contain all COM REG files?
- Were all COM REG files taken from the same COM REG package?

You cannot exit a COM REG mask

- Is there still a wrong entry in the input field (e. g. entry of time base or determination of input characteristic)?
- Is it possible to leave the mask by pressing the <Break> key or the <Enter> key?
- Is the keyboard locked with the key switch?

Problems when working with the program file

- Is the name of the default program file in the correct format?
- Is there enough space on the floppy/hard disk?
- Is the attribute of the selected program file "Read only"?
- Is the selected program file stored in a different user area? (User areas can read files with the attribute "SYS" from user 0 but cannot write into them)
- Is the disk formatted?
- Is the disk drive closed?

Problem when accessing the module

- Is the default of COM REG "Online"?
- Is the PC supplied with power?
- Is the module plugged in?
- Is the cable connection between the PC and the PG correct?
- Is the connection cable servicable?
- Are the correct S5DOS drivers used?

The following module-specific notes refer to the controller structure R64:

Following cold restart, the processor does not enter the RUN mode

- For multiprocessing: Is there a valid DB1?
- For multiprocessing: Is the coordinator installed? Are all jumpers set correctly? Is the correct mode set?
- Is the controller function block missing?
- Is a data block that was entered in the controller list missing?
- Do all accessed input/output modules exist? (Print out cross reference list!)
- Is the correct base address set for all modules?
- Do all modules receive the enable and supply voltage required?
- Are the modules plugged in correctly?

Chapter 5 in which the controller structure R64 is described gives information on how controller faults (and acknowledgement delay on controllers) can be identified and evaluated.

The processor is in the 'RUN' mode but the controller does not function correctly. Then refer to the following checklist:

- After any transfer/change on the module a restart must be carried out
- The controller must be entered in the controller list
- The controller must be enabled (see Special functions/Controller processing)
- If you entered an address in digital inputs: Was this entry supplied with meaningful values (by STEP5 programs, CP, or switch)? E.g., flagwords must be filled with values by the CP or the STEP5 program, special switches connected with I/O modules. Special attention is to be paid to the position of the bit values for "Inhibit controller", "Final position ON achieved", "Final position OFF achieved", "Manual operation", and "Maintain regulating variable constant".
- The bits mentioned above could have been set in test.
- Are all parameters preset with meaningful values? (see chapter "Entering a controller")
- The address of an ADC (DAC) may not be maintained in a switched off branch. (You should activate the appropriate branch using the structure switch to check it!)
- Do the input/output modules work correctly? Were they parameterized for the correct range?
- Do the input/output modules work with the correct data format? (Negative values must be represented in two's complement!)
- Does a STEP5 program describe an incorrect data word in the controller data block?

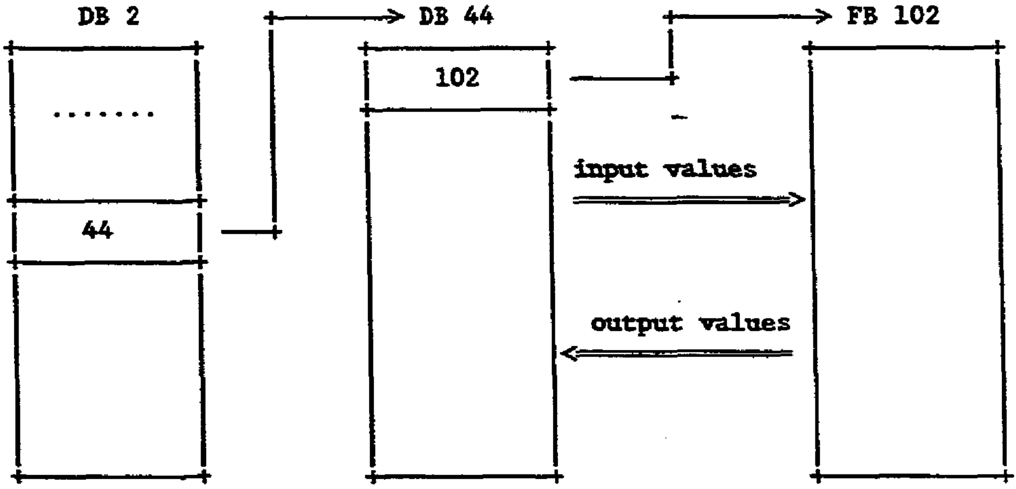
Values entered during the test are not accepted or overwritten

- Not all parameters may be changed during the test!
- Were the parameters entered in the correct format?
- Was an input made with the addressing for the digital inputs? Then the digital inputs cannot be controlled during the test!

4 Projecting the Controller Structure R64

4.1 Processing the Controller FB

The processor executing the control process is a word processing control processor that recognizes the common STEP5 functions and organization blocks (OB1, OB13, etc.).
Only when data block DB2 (controller list) containing usable data is available, following restart, will the time-controlled call-up cycle of the controllers be started by the system program.
Each controller is represented by a data block. The system program receives information from the controller list as to which controller is called with which scan time. When calling, the appropriate data block is selected. In data word 0 the number of the function block, which contains the control algorithm (e.g. 102 for the controller structure R64) is entered. This function block which is called by the system program processes the projected controller structure using the data in the data block. During this procedure all input values (setpoint, actual value etc.) can be taken from the data block. The computed output values (e.g. regulating variable) are stored in the data block. The process image (takes input values from the peripheral to the data block and output values from the data block to the peripheral) is produced by the system program, if there is an address given in the appropriate parameters. The input/output values can also be supplied by a STEP5 program. In this case no addresses may be allocated with the respective parameters so that the system program does not execute a process image for these parameters. The function block that contains the controller struc-ture must exist only once for all controllers because all controller specific data is stored in the data block.



Those times not marked for controller processing are available to the STEP5 program. During these times, optional STEP5 programs may run to process input and output values of controllers. Thus multi-loop control systems may be created.

The higher the processor load, i. e. the more controllers that are entered in the controller list, the longer the cycle time of the STEP5 program. The STEP5 programs run asynchronically compared with the controllers.

The following blocks must be available in order to enable a control procedure:

- DB 2	controller list
- DB x	a controller data block ($3 \leq x \leq 255$)
- FB 102	function block with the control algorithm

Since a STEP5 program always runs in the background (idle cycle if no program was input) the operating system executes the process image for the digital peripherals (PB 0 ... PB 127). When the control procedure uses input/output devices whose addresses are less than 128, the process image of the STEP5 program overwrites their process images. In order to avoid this a DB 1 that does not assign input or output to the STEP5 program should be entered in the processor. In order to execute a control procedure without STEP5 software and without any knowledge of STEP5, a "dummy DB1" which prevents the cyclic STEP5 program from accessing peripheral addresses < 128 is delivered together with the controller structure R64.

Note: - The file "REGR64ST.S5D" contains the control algorithm as function block FB102. When you already use an FB102 on your system you can assign another block number to the delivered one using COM REG or "LAD CSF STL". You should enter this new name in the controller data block.

- **All changes to the structure and the controller list are transferred correctly only when the processor is restarted. Controllers must not be changed using the function "OUTPUT", during processing! Only those changes that the function "TEST" offers are permitted. Before changing the structure the processor must be brought to the "STOP" mode in order to accept the changes afterwards by means of the function "RESTART".**

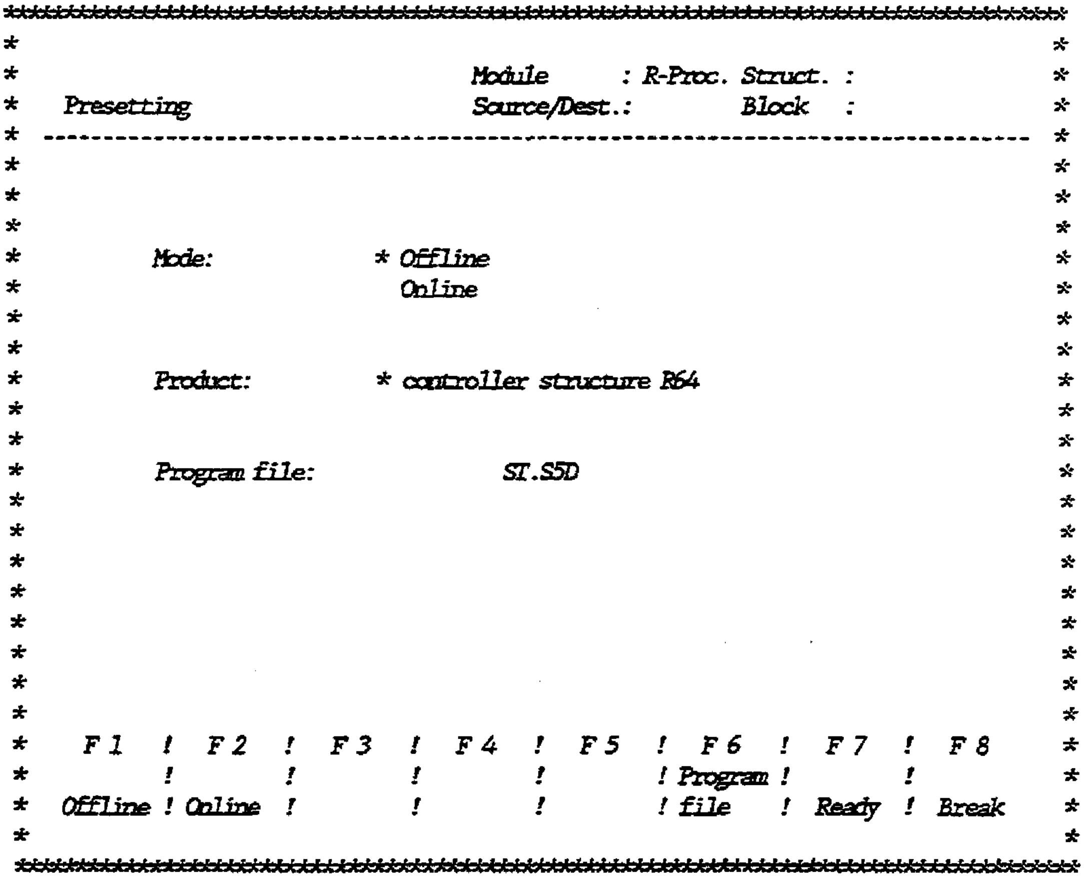
- In the following sections the processor is also called "module" following the conventions of COM REG.

You can find more detailed information on the processor and its system program in the User's Guide for the processor and in the description of the controller structure R64.

Please pay particular attention to the application example given in the controller structure R64 description and to the explanation of all terms used by COM REG!

4.2 Preset

After S5DOS is started and COM REG is selected (see section "Starting COM REG") COM REG displays the preset mask.



```
******************************************************************************
*                                                                            *
*                                 Module      : R-Proc. Struct. :            *
*  Presetting                     Source/Dest.:         Block   :            *
* -------------------------------------------------------------------------- *
*                                                                            *
*                                                                            *
*                                                                            *
*        Mode:           * Offline                                           *
*                          Online                                            *
*                                                                            *
*                                                                            *
*        Product:        * controller structure R64                          *
*                                                                            *
*                                                                            *
*        Program file:              ST.S5D                                   *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*    F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8     *
*          !        !        !        !        ! Program !       !           *
*  Offline ! Online !        !        !        ! file    ! Ready ! Break     *
*                                                                            *
******************************************************************************
```

Select the operating mode and the program file from the Preset mask.

- "ONLINE" means that the PG can communicate directly with the module. You can select this operating mode only when the module is ready to operate and when it is connected with the PG. In the online mode, controllers can be projected directly to the module.
  If no PC is provided, the controller data blocks can be created using COM REG and stored in a program file. In this case, you should select the operating mode "OFFLINE".

- COM REG can store data and function blocks in a program file. All following accesses to external storage (floppy or hard disk) refer to the blocks in the specified program file. You can enter the program file name after you have pressed the <F6> key. The format of the filename is "X:YZZZZZST.S5D" where "X" is the drive name (e. g. "A:", "B:", or "C:"), "Y" is an upper case and "Z" an upper case letter or a digit. The name should have the number of characters specified above, otherwise it is filled with "@". The entry is completed with <CR>.

Example: "B:KILN02ST.STD"
The name of the program file should refer to the project. In the specified program file, STEP5 DB, FB and controller DB and FB can be stored together.

By pressing the function key <F7> you can exit the preset mask and enter the main menu. To return to the module selection press <F8>.

4.3 Main Menu

```
*****************************************************************************
*                                                                           *
*                             Module       : R-Proc. Struct. :              *
*  F U N C T I O N - S E L E C T   Source/Dest.:      Block   :              *
*  ------------------------------------------------------------------------ *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*    F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8    *
*          !         !        !        !        !Special !        !         *
*   Input  ! Output  !  Test  !Transfer ! Delete !function !  Info  !  Break  *
*                                                                           *
*****************************************************************************
```

The main menu is the highest mask level of COM REG. From there you can select the following functions:

INPUT .	- enter the controller data blocks - enter the controller list
OUTPUT	- change the existing controller data blocks - change the existing controller list - print the controller structure - print the cross reference list
TEST	- test controllers online: starting-up, operating, monitoring and changing the parameters
TRANSFER	- transfer the data blocks and function blocks between the module (programmable controller), program file and block memory of the PG
DELETE	- delete data and function blocks in the module and program file - delete the program file and all blocks within
SPECIAL FUNCTIONS	- cold restart of the processor - warm restart of the processor - stop the processor - compress the data blocks in the processor

- change the presetting
- controller processing

INFO

- list of contents of all control loops on the module, program file or submodule
- SYSID module
- SYSID submodule (frame number, version)

4.4 Input

Using the function "INPUT" you can project controllers by creating a controller data block. Additionally a controller list (DB2) can be created using the function "INPUT".

After selection of the function "INPUT" by pressing the function key <F1> the main menu offers the possible destinations where entries may be stored automatically:

<F1> program file
<F4> module
<F5> programmer (PG)

Note: - It is advisable, even in online mode, that the entries are stored in the program file first and then transferred to the module so that in the case of disturbances at the PC (e. g. unintentional removal of the module etc.), the data is still available.

- You should never enter the data directly into the PG because its data block storage can only hold one block, as described by STEP5. The block stored in the PG is lost without warning when you work on the next one (e. g. input, output, transfer).

In the following mask input of a controller data block and a controller list is offered:

<F1> controller data block
<F8> controller list

It is only realistic to create a controller list after the creation of all controller data blocks. Following the input of a controller data block or the controller list, described below, the mask is displayed again so that you can make further entries.

The function "INPUT" is terminated by pressing the Break key!

Note: If COM REG realizes that an entered data block already exists on the specified destination medium the following question is displayed: "OVERWRITE EXISTING DATA BLOCK? (Y/N)". If you do not wish to overwrite the existing data block, you can save the newly created one. It still exists in the PG memory even though you specified the program file or the module as destination. In order to save the new data block enter "N" and copy the data block from the PG to the program file or to the module by means of the function "Transfer". The data block number may also be changed during this procedure.

4.4.1 Entering a Controller DB

The first step on entering a controller DB consists of specifying a data block number between 3 and 255. A controller DB entry is generally carried out in a linear way, i. e. all inputs are requested one after the other, without branching, in the form of masks. Entries are offered in the following order:

- entry of structure
- entry of scan time
- entry of controller behaviour
- entry of function block number
- entry of controller and area name for CP526
- definition of dimensions and numerical range
- parameterization of selected branches

Note: Parameterization offers only those branches and modules that have been selected during the preceding structuring operation. If you realize during parameterization that you have forgotten a module when structuring the controller, exit the input and change the structure using "OUTPUT", in order to be able to parameterize the desired module.

4.4.1.1 Controller Structuring

After entering the data block number the structuring mask is displayed. By means of the structuring function, you can establish an individually required controller structure by setting the structure-switches. Based on the given primary structure you can activate specific controller branches.

The structure-switches have the functions of either on/off or change-over switches. The switches can only be set by entering "0" or "1". In case of on/off switches (e. g. "ramp-function generator"), entry of "1" causes the module to be activated. When entering "0" the module remains switched off. Changeover switches are marked in the text by a slash "/" (e. g. "continuous/step"), where one of two selections is possible: "0" for the alternative preceeding the slash or "1" for the alternative following the slash.

```
*****************************************************************************
*                                                                           *
*  Input                       Module      : R-Proc. Struct. : Control.     *
*  S T R U C T U R I N G       Source/Dest.: File    Block   : DB  003      *
*  -----------------------------------------------------------------------  *
*                                                                           *
*                                                                           *
*    1: Controller                  1          2: Actual value        1     *
*     Continuous/Step               0           Validity check        0     *
*       Manual value PG/ADC         0           Filter actual value   0     *
*       Analog/Digital output       0           Polygon curve         0     *
*       Standard/Upgraded           0                                       *
*         Separate D-input          0                                       *
*         Interference input        0                                       *
*         Manual value PG/ADC       0                                       *
*         Manual value PG/ADC       0                                       *
*       Cont./mark-space            0                                       *
*         2-/3 Point controller     0                                       *
*           Anal./Dig. output       0                                       *
*           Anal./Dig. output       0                                       *
*         Actuator adjustment       0                                       *
*                                                                           *
*                                                                           *
*                                                                           *
*   F 1  !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7  !  F 8             *
*        !       !       ! Scroll ! Scroll !      !       !                 *
*        !       !       ! up    ! down  ! Help  ! Ready ! Break            *
*                                                                           *
*****************************************************************************
```

After each entry of "0" or "1" the cursor shows the next logical switch, i. e. only switches of branches that have been activated can be moved. Thus, you are spared unnecessary and confusing entries. If you select, for example, the continuous controller "standard" by '0' the cursor will never point to the item 'interference input' since the latter is optional only for the upgraded controller.

The cursor may also be moved to the respective switches using the four cursor keys. Since the list of switches is longer than the available space, the list can be scrolled up or down using the function keys <F4> and <F5>.

Notes:
- If the switch indicated by the cursor position is preset to "0" and you do not wish to change it, you are nevertheless recommended to enter "0". As a result, the cursor is positioned to the next logical switch by the program. Entering the digits one or zero exclusively prevents you from actuating a switch several times or not at all. If you move the cursor using the cursor keys you do this without prompting from the program!

- The change-over switches "Manual Value PG/ADC" and "Analog/Digital Output" are given several times in the list for reasons of program structure. However, COM REG sets the cursor to the respective switch only once, depending on the specified structure.

- The branches "Controller", "Actual Value" and "Digital Addresses" cannot be switched off, thus they are present in each controller.

- When structuring you can only set structure-switches, digital inputs may not be set. Relays can be controlled during online test only.

In order to show the relationships between the structuring mask and the switches of the controller block diagram, a list with the corresponding assignments is provided in the description of the controller structure R64 (chapter 3, Tables).

Structuring operations are terminated by pressing the function key <F7> after which the next entry mask is displayed. Entry can be cancelled by pressing <F8>; all preceding entries are lost.

Note: If the entry is not cancelled during structuring but at a later point in time, COM REG attempts to store the data block along with previous entries at the destination medium! Only if a data block with the same number exists the question "Block x overwrite (Y/N)" is displayed.

4.4.1.2 Scan Time

The "scan time" mask enables you to enter individual scan times for each controller.
The scan time is the period of time in which the input values (actual value, setpoint, etc.) are read in once and the output values (e. g. manipulated variable, limit) are evaluated and output to the process.

```
*************************************************************************************
*                                                                                   *
*   Input                            Module      : R-Proc. Struct. : Control.       *
*   S C A N - T I M E                Source/Dest.: File    Block   : DB  003        *
*  -------------------------------------------------------------------------------  *
*                                                                                   *
*                                                                                   *
*                                                                                   *
*          Comment :     For the quasi-continuous controller design the             *
*                        recommended scanning time value is 10% of the              *
*                        dominating time constant of the controlled                 *
*                        system.                                                    *
*                        The scanning time for the R-Proc. is a multiple            *
*                        of 10 ms and may not be less than 20 ms.                   *
*                                                                                   *
*                                                                                   *
*          Scan time:           100 ms                                              *
*                                                                                   *
*                                                                                   *
*                                                                                   *
*                                                                                   *
*                                                                                   *
*                                                                                   *
*                                                                                   *
*    F 1  !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7  !  F 8                    *
*         !       !       !       !       !       !       !                         *
*         !  Input !      !       !       !       !  Ready !  Break                 *
*                                                                                   *
*************************************************************************************
```

The scan time may be entered after pressing the function key <F2>. The notes on the sequence of keys during entry, given in the section "Input fields" should be observed. The following points are important for the numerical value:

- In the quasi-continuous controller outline, the recommended scan time value amounts to 10% of the dominating time constant of the system to be controlled.

- The scan time must be an integer multiple of 10 ms, i.e. each at least 20 ms.

- For step controllers and continuous controllers with pulse/ pause output, the scan time must be an integer multiple of the minimum puls duration.

- A processor can process a maximum of eight different scan times.

- The smaller the scan time the higher the processor load. Therefore, fewer controllers can be processed at the same time. In other words the cycle time of a STEP5 program in the background is becoming longer.

- In the controller list which is to be entered later, the maximum common divisor of the scan times of all continuous controllers must be entered as time base. If an unusual value is specified for the scan time it should either be corrected later, or the time base should be selected to be unnecessarily

small causing an increased processor load and STEP5 programs to be processed more slowly.
(It is not possible, for example, to enter a controller with a scan time of 30 ms and another with a scan time of 50 ms into the controller list at the same time; the maximum common divisor is 10 ms while the minimum time base must be 20 ms.)

- After changing the scan time the controller DB in DB2 must be switched off, then on again. Then, a cold restart is to be executed for the processor.
  (Further information can be found in the description of the controller list and the controller structure R64.)

Use function key <F7> to terminate entry of scan time and step to the next entry mask. Entry may be cancelled by pressing <F8>; the data block is then created.

4.4.1.3 Controller Behaviour and FB Number

This mask requires four entries. The cursor may be moved by use of the keys <cursor up> and <cursor down>. Yes/no entries are to be made by means of the function keys <F1> and <F3>. The function block number should be entered via the keyboard and terminated by pressing the <Carriage Return>.

```
*******************************************************************************
*                                                                             *
*  Input                             Module      : R-Proc. Struct. : Control. *
*                                    Source/Dest.: File    Block   : DB  003  *
* --------------------------------------------------------------------------- *
*                                                                             *
*                                                                             *
*    Cntl.-Behaviour:                                                         *
*    ----------------                                                         *
*        If the cntl. is not operational                                      *
*        the outputs are set on zero:                  Yes                    *
*                                                                             *
*        The updating of the controller output                                *
*        follows immed. the controller operation:      No                     *
*                                                                             *
*        Match format to measuring range 4 - 20 mA                            *
*        (for modules without matching):               No                     *
*                                                                             *
*    Input of FB-Number:                                                      *
*    -------------------                                                      *
*        The controller structure R64 is in FB:          0                    *
*                                                                             *
*                                                                             *
*                                                                             *
*    F 1   !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7  !  F 8             *
*          !       !       !       !       !       !       !                  *
*    Yes   !       !  No   !       !       !       ! Ready !  Break           *
*                                                                             *
*******************************************************************************
```

With the PG you can switch on and off individual controllers during operation without influencing the other controllers (Special functions/controller enable). For this status and for the "STOP" status of the processor you can specify, with the first entry, if in case of a controller stop all outputs of the controller should be set to zero or if they are to remain in the same states as before the controller stop.

By means of the second entry, you may specify whether the controller output is to be updated immediately following the controller processing, or time controlled, i. e. together with the controller input.
In the first case, dead time is short but not constant due to a variable program execution time. In the second case, dead time is constant but of the same length as the scan time. This entry is relevant for those controlled systems where the time constant is about the same duration as the scan time. You then have to decide which entry to select, depending on the controlled system.

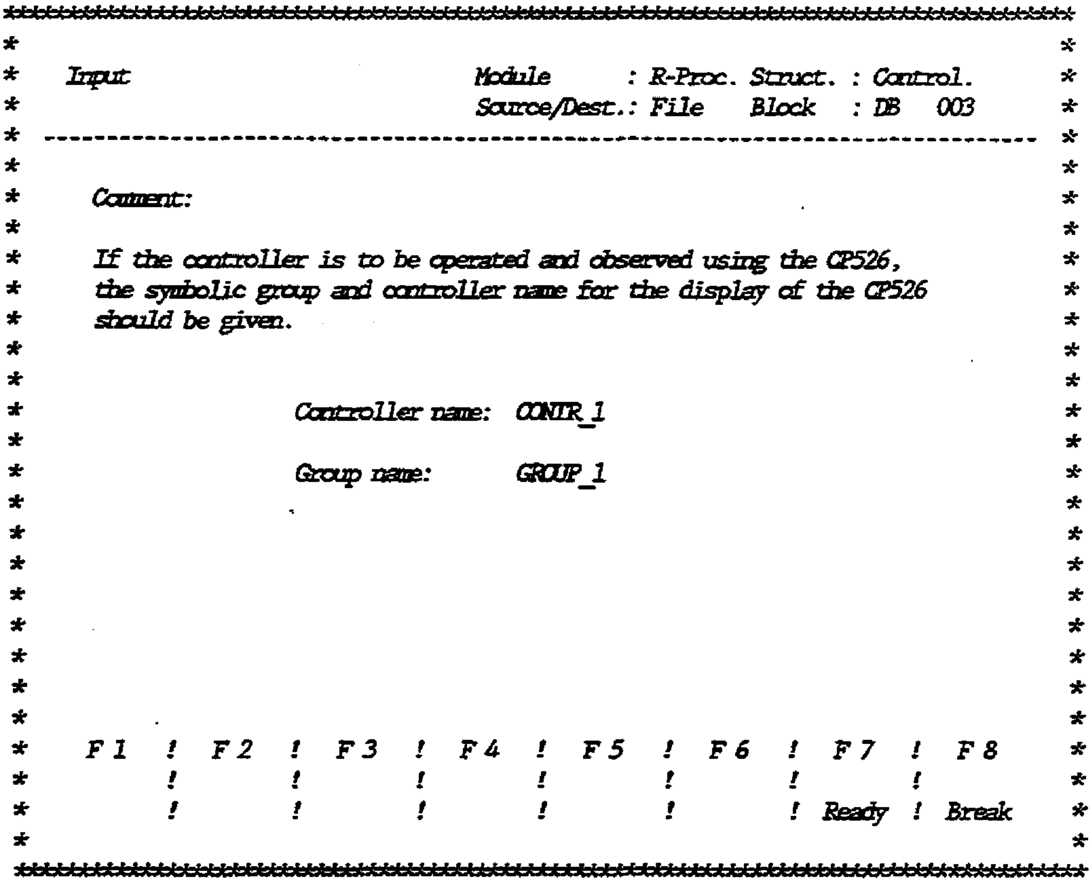
With the analog input modules 6ES5-460-4U and 6ES5-465-4U, the

measuring range 4 ... 20 mA is not mapped to 0 ... 100%, but to 25 (1000H) ... 125% (5000H).
You may select a suitable adaptation via the controller. 25% are then subtracted from all ADC input values of this controller.

Entering the function block number informs the processor which function block contains the control algorithm. Therefore this entry is mandatory. (The controller structure R64 is supplied with the function block number 102.)

Press the function key <F7> to terminate this entry and step on to the next entry mask. Entry can be cancelled by use of <F8>; the data block is then created.

4.4.1.4 CP526 Adaptation



```
*****************************************************************************
*                                                                           *
*   Input                       Module      : R-Proc. Struct. : Control.    *
*                               Source/Dest.: File    Block   : DB   003    *
* ------------------------------------------------------------------------- *
*                                                                           *
*    Comment:                                                               *
*                                                                           *
*    If the controller is to be operated and observed using the CP526,     *
*    the symbolic group and controller name for the display of the CP526   *
*    should be given.                                                       *
*                                                                           *
*                                                                           *
*                    Controller name:  CONTR_1                              *
*                                                                           *
*                    Group name:       GROUP_1                              *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*   F 1  !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7  !  F 8            *
*        !       !       !       !       !       !       !                  *
*        !       !       !       !       !       ! Ready ! Break            *
*                                                                           *
*****************************************************************************
```

This mask should be completed only if you wish to operate and monitor the controller using CP526.
Entries for controller and area name are used for display building of CP526 and they are stored in the data words 192 .. 199 of the data block. The entry comprises of eight characters maximum; letters, digits, spaces and underscores ("_") are allowed.

Press the function key <F7> to conclude the entry and go on to the next entry mask. The entry may be cancelled by pressing <F8>; the data block is then created.

4.4.1.5 Input Characteristic

Analog input/output modules work with normalized signals, e. g. with 4..20 mA for the analog part and with the range of values of 0000h...4000h on the digital part. With a temperature of 300 ° C a transducer provides a current of 12 mA. The analog input module transforms this current into a hexadecimal value, e. g. 2000h. This is the value that the controller structure R64 receives from the analog input. In order to work with COM REG using the actual numerical values and units you should tell the controller by means of this mask how to interpret the hexadecimal value of 2000h, i. e. the characteristic of the input range should be determined.

The controller structure R64 assumes that the input/output modules represent the positive range of values of 0..100% as digital value of 0000h..4000h. Negative values are expected in two's complement (for 4...20 mA = 1000U...5000U see chapter 4.4.1.3).

Three entries are required in order to specify the characteristic:

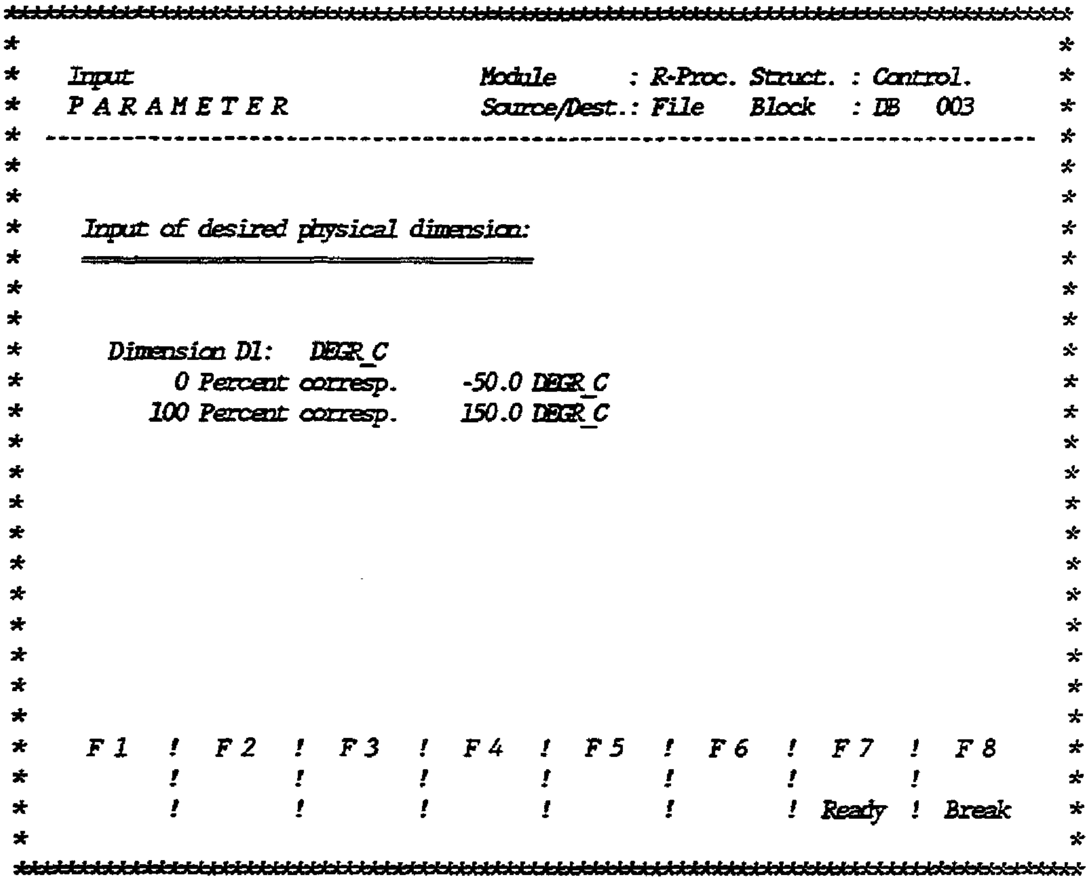
- physical dimension (6 characters maximum)
- numerical value of the controlled condition to be provided 0 % (=0000h) by the controller in the data format
- numerical value of the controlled condition to be provided 100 % (=4000h) by the controller in the data format

Notes: Many analog input/output modules have a resolution of 2048 units. On the digital part the modules work with 16-bit-words where the three least significant bits are not evaluated or set, i. e. the units that correspond to the analog value are shifted 3 bits to the left (multiplied by 8). Therefore, for a resolution of 2048 units, on the digital part is represented by 16384, corresponding to 4000h.

Example 1:	range of actual value:	-50	..	150 Degr_C
	transducer provides	4	..	20 mA
	analog input provides	0000h	..	4000h
		0	..	2048 units
	controller interprets	0 %	..	100 %

During the work with COM REG, in the initial position the following entries (in italics) apply:

Dimension D1 : *Degr_C*
0 Percent corresp. *-50.0* Degr_C
100 Percent corresp. *150.0* Degr_C



```
******************************************************************************
*                                                                            *
*   Input                        Module      : R-Proc. Struct. : Control.    *
*   P A R A M E T E R            Source/Dest.: File    Block   : DB   003    *
* -------------------------------------------------------------------------- *
*                                                                            *
*                                                                            *
*    Input of desired physical dimension:                                    *
*    ====================================                                    *
*                                                                            *
*                                                                            *
*      Dimension D1:    DEGR_C                                               *
*            0 Percent corresp.      -50.0 DEGR_C                            *
*          100 Percent corresp.      150.0 DEGR_C                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*   F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8      *
*         !        !        !        !        !        !        !           *
*         !        !        !        !        !        !  Ready !  Break    *
*                                                                            *
******************************************************************************
```

Both input values that specify the characteristic of the input range determine the number of decimal places with which all dimension-dependent parameters are input and output. The following values apply for the valid input range:

0.0000 - 1.0000
0.000 - 10.000
0.00 - 100.00
0.0 - 1000.0
0 - 10000

The five formats, shown above, have the maximum resolution, i. e. the greatest possible number of decimal places. The user may ignore a part of the resolution by specifying less decimal places than permitted for this format. For example 1, the entry of -50..150 Degr_C would also be correct. Since most of the analog input modules can also process negative current and voltages the input range in example 1 is -250..150 Degr_C.

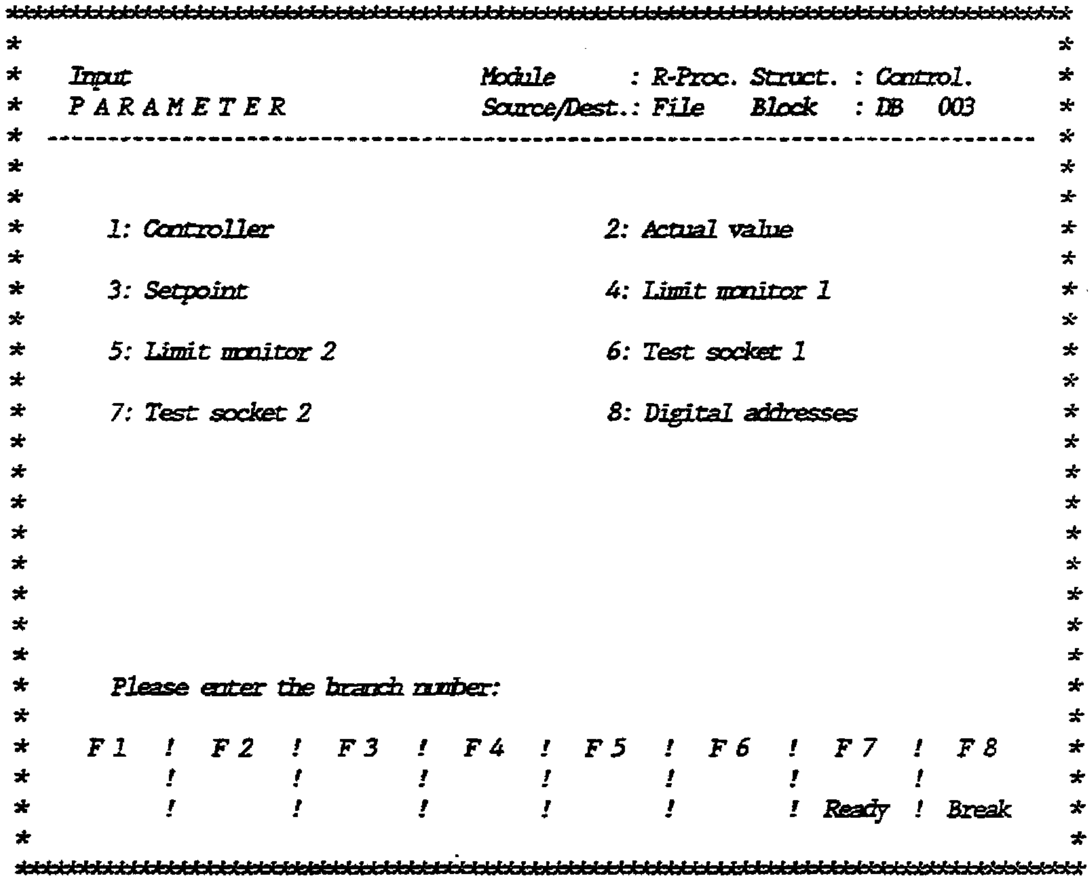
Note: - The algorithm specified in the input characteristic, with which the controller is to process the input/output, is valid for all dimension dependent parameters. Therefore, all input/output modules should have the same data format.

- When a digit whose format is not mentioned in the list above, is entered for the 0 % or 100 % values, the entry cannot be completed by <CR>, <F7>, <F8>, the <Enter> key or the <Break> key. Only after correction of the format is further processing possible.

- **For all further entries of dimension dependent parameters the format described must be kept. On the other hand, the format or the numbers of decimal places cannot be modified after the entry of the parameters without modifying all dimension dependent parameters!**

By pressing the function key <F7> the entry is completed and the next input mask is displayed. You can break the input procedure by pressing <F8>; then the data block is filed.

4.4.1.6 Parameter Input



```
*****************************************************************************
*                                                                           *
*  Input                       Module      : R-Proc. Struct. : Control.     *
*  P A R A M E T E R           Source/Dest.: File    Block   : DB  003      *
*  -----------------------------------------------------------------------  *
*                                                                           *
*                                                                           *
*     1: Controller                         2: Actual value                 *
*                                                                           *
*     3: Setpoint                           4: Limit monitor 1              *
*                                                                           *
*     5: Limit monitor 2                    6: Test socket 1                *
*                                                                           *
*     7: Test socket 2                      8: Digital addresses            *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*     Please enter the branch number:                                       *
*                                                                           *
*   F 1  !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7  !  F 8             *
*        !       !       !       !       !       !       !                  *
*        !       !       !       !       !       ! Ready ! Break            *
*                                                                           *
*****************************************************************************
```

The first mask of the parameter input contains a list of all active branches and their numbers. Since you can select the branch you wish to parameterize first, the linearity of the input in the function "Parameter input" is interrupted. This is realized by the independence of the input for the parameterizing of the controller branches, i. e. the order of input is unimportant. This program structure enables the user to modify a branch that is already parameterized, without leaving the function "Parameter input".
The controller branch to be parameterized is selected exceptionally by entering its number by means of the alphanumeric keyboard and then pressing the <Carriage Return>. This procedure enables COM REG to also process controllers with more than eight (= number or function keys) branches.

You can exit the branch selection menu by pressing the function key <F7>. The data block entered is stored at the specified destination medium.

For parameter input, note the following:

- When you make the first parameter input you always should select branch 1 first, COM REG then guides you (function key <F7> must be activated) through all branches. Only when you wish to enter modifications should you directly select the branch to be modified.

- For several parameters no input may be required (e. g. the danger limit of the actual value need not be entered when the corresponding bit is not evaluated). Under particular circumstances complete controller branches can be jumped without input (e. g. the branch digital address when neither digital input or digital output is intended).

- In addition to the input fields the masks also contain output fields that show the selections made when structuring. The cursor can be moved to the input fields only by using the keys <cursor up> and <cursor down>. When parameters are entered the procedure recommended in the section "Input fields" is to be considered.

- Since several parameter lists need more space than provided on the screen, these lists should be scrolled up or down (automatically) while the user completes them. Pressing the function keys <F5> "Scroll down" and <F6> "Scroll up" has the same effect. In order to show the end of a list the message "List end is reached !" is displayed when the last entry is transferred. This message must not be interpreted as an error message referring to the last entry!

- When an entry is made in the address of an ADC, DAC, DO or DI (i. e. input/output module) the corresponding parameter (e. g. actual value, setpoint, digital input, etc.) is described when the controller is operated by the system program creating the process profile. **When input values are not supplied by the input modules but by the CP or the PG to be tested (e. g. digital inputs) no entry must be made in the corresponding address of the input/output module otherwise the specified value is overwritten by the process profile.** (The default provides "PW" for each address. An entry is only accepted if this abbreviation (resp. "IFW", "FW", "XW") is followed by a number. Entries may be deleted by overwriting this number with three blanks.

In the following sections the peculiarities of each controller branch are briefly discussed.

4.4.1.7 Controller Branch

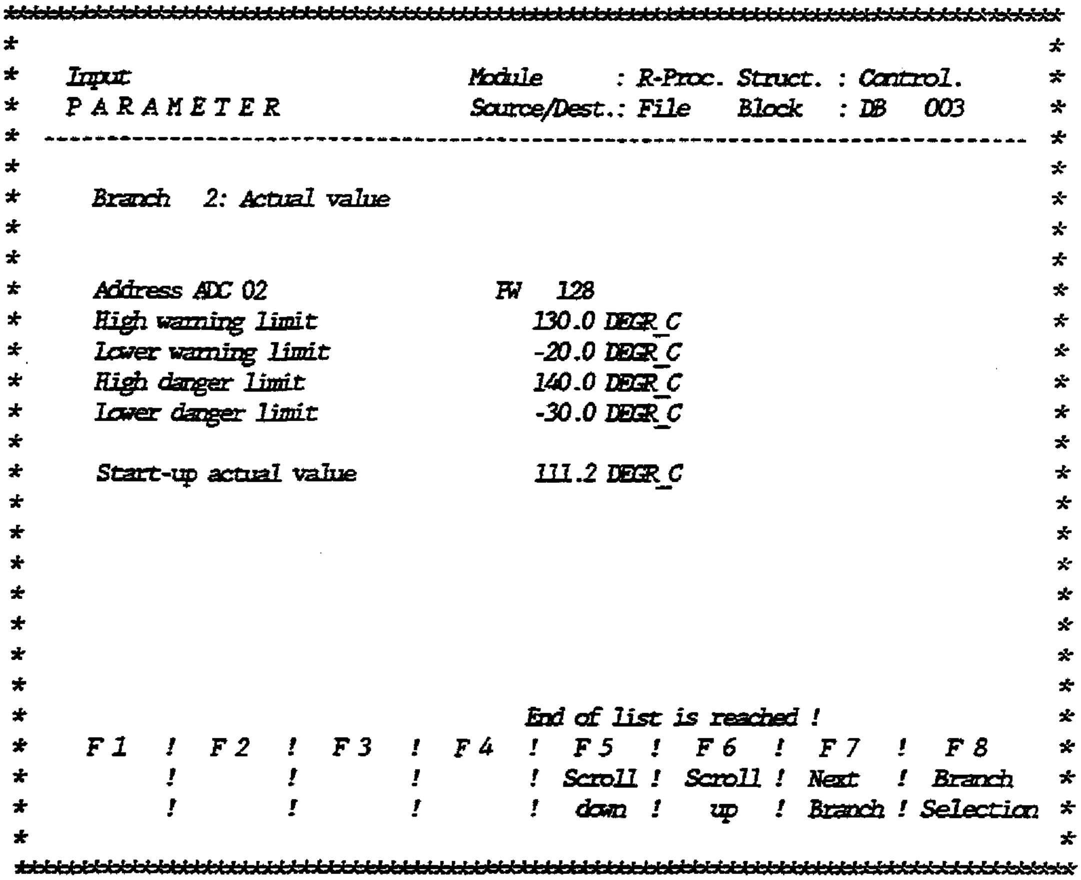
```
********************************************************************************
*                                                                              *
*  Input                        Module      : R-Proc. Struct. : Control.       *
*  P A R A M E T E R            Source/Dest.: File    Block   : DB   003       *
* ---------------------------------------------------------------------------- *
*                                                                              *
*    Branch   1: Controller                                                    *
*                                                                              *
*                                                                              *
*    Continuous/Step                  0                                        *
*      Standard/Upgraded              0                                        *
*        Manual value PG/ADC          0                                        *
*          Constant man. value    30.00 %                                      *
*                                                                              *
*        High limit              100.00 %                                      *
*        Lower limit            -100.00 %                                      *
*        Proportional value        1.23                                        *
*        Integral action time     2.123 sec                                    *
*        Derivative action time       0 sec                                    *
*                                                                              *
*      Cont./mark-space               0                                        *
*                                                                              *
*                                                                              *
*                                                                              *
*    F 1   !  F 2   !  F 3   !  F 4  !  F 5   !  F 6   !  F 7   !  F 8       *
*  Milli-  !        ! Hours  !       ! Scroll ! Scroll ! Next   ! Branch      *
*  seconds ! Seconds ! Minutes !     !  down  !   up   ! Branch ! Selection   *
*                                                                              *
********************************************************************************
```

In order to put a continuous controller into operation, the values entered for parameters "High limit" and "Lower limit" must not equal zero, otherwise the regulating variable is limited to zero.

The same is valid for the parameters "POS increment limit" and "NEG increment limit" of the upgraded controller, i. e. the values should not be zero.

If an actuator adjustment is projected the gain may not be zero.

4.4.1.8 Actual Value Branch

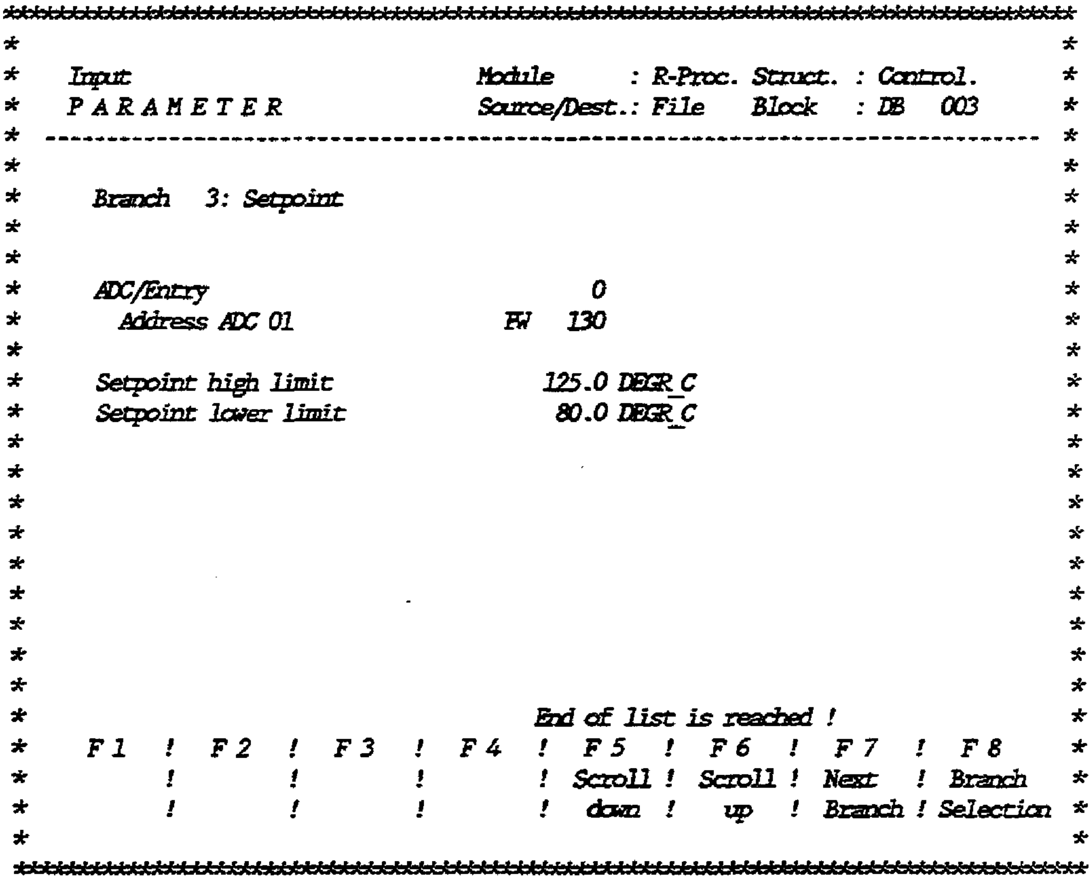


```
*******************************************************************************
*                                                                             *
*  Input                       Module       : R-Proc. Struct. : Control.     *
*  P A R A M E T E R           Source/Dest.: File   Block   : DB   003       *
*  -------------------------------------------------------------------------  *
*                                                                             *
*     Branch   2: Actual value                                                *
*                                                                             *
*                                                                             *
*     Address ADC 02                FW   128                                  *
*     High warning limit               130.0 DEGR_C                           *
*     Lower warning limit              -20.0 DEGR_C                           *
*     High danger limit                140.0 DEGR_C                           *
*     Lower danger limit               -30.0 DEGR_C                           *
*                                                                             *
*     Start-up actual value            111.2 DEGR_C                           *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                   End of list is reached !                  *
*    F 1  !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7   !  F 8            *
*         !       !       !       ! Scroll ! Scroll ! Next   ! Branch         *
*         !       !       !       !  down  !   up   ! Branch ! Selection      *
*                                                                             *
*******************************************************************************
```

The parameters for the warning limit and the danger limit need not be entered if the corresponding bits in the digital output word are not evaluated.

If a polygon curve was entered during structuring the number of vertices in the mask for the parameterizing of the actual value branch is preset with zero. Only when a number between one and ten is entered will the corresponding number of lines be displayed, which is required for parameterizing the ordinal values of the polygon curve. Although COM REG would accept the default number of zero vertices, this number is illogical; it must be set to a value between one and ten.

4.4.1.9 Setpoint Branch



```
*****************************************************************************
*                                                                           *
*   Input                           Module      : R-Proc. Struct. : Control.  *
*   P A R A M E T E R               Source/Dest.: File    Block   : DB   003  *
* ------------------------------------------------------------------------- *
*                                                                           *
*     Branch   3: Setpoint                                                  *
*                                                                           *
*                                                                           *
*     ADC/Entry                                 0                           *
*       Address ADC 01                  FW    130                           *
*                                                                           *
*     Setpoint high limit                  125.0 DEGR_C                     *
*     Setpoint lower limit                  80.0 DEGR_C                     *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                       End of list is reached !            *
*    F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8     *
*          !        !        !        ! Scroll ! Scroll !  Next  ! Branch   *
*          !        !        !        !  down  !   up   ! Branch ! Selection *
*                                                                           *
*****************************************************************************
```

The parameters "Setpoint high limit" and "Setpoint lower limit" do not limit the setpoint but a bit is set in the digital output word when these limits are exceeded. When these bits are not evaluated these parameters need not be entered.

When a setpoint sequence was entered during structuring the default number of setpoints in the mask for the parameterizing of the setpoint branch is zero. Only when a number between one and ten is entered will the corresponding number of lines be displayed, which is required for parameterizing the setpoints of the setpoint sequence. Although COM REG would accept the default number of zero setpoints, this number is illogical; it must be set to a value between one and ten.

Note: When the structure key S8 is set to "1", i. e. when the setpoint is specified by a STEP5 program or the setpoint sequence, and a module address was entered in the address of ADC1, the specified input module should exist, although the values are not used.

4.4.1.10 Limit Monitor Branch

```
*******************************************************************************
*                                                                             *
*  Input                       Module       : R-Proc. Struct. : Control.      *
*  P A R A M E T E R           Source/Dest.: File    Block    : DB   003      *
* --------------------------------------------------------------------------- *
*                                                                             *
*    Branch    4: Limit monitor 1                                             *
*                                                                             *
*                                                                             *
*    Number of limit values              6                                    *
*    Measuring point number              8                                    *
*    Limit 01                        105.0 DEGR_C                             *
*    Limit 02                        110.0 DEGR_C                             *
*    Limit 03                        115.0 DEGR_C                             *
*    Limit 04                        120.0 DEGR_C                             *
*    Limit 05                        125.0 DEGR_C                             *
*    Limit 06                        130.0 DEGR_C                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                    End of list is reached !                 *
*   F 1  !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7  !  F 8               *
*        !       !       !       ! Scroll ! Scroll ! Next   ! Branch          *
*        !       !       !       !  down  !   up   ! Branch ! Selection       *
*                                                                             *
*******************************************************************************
```

The number of limit values is preset to zero; it may be increased to 6 maximum. All limit values of the limit monitor branch refer to the same measuring point. When a positive or negative limit value is violated, the corresponding bit of the digital output word is set. The limit monitors can only refer to active measuring points.

4.4.1.11 Test Socket

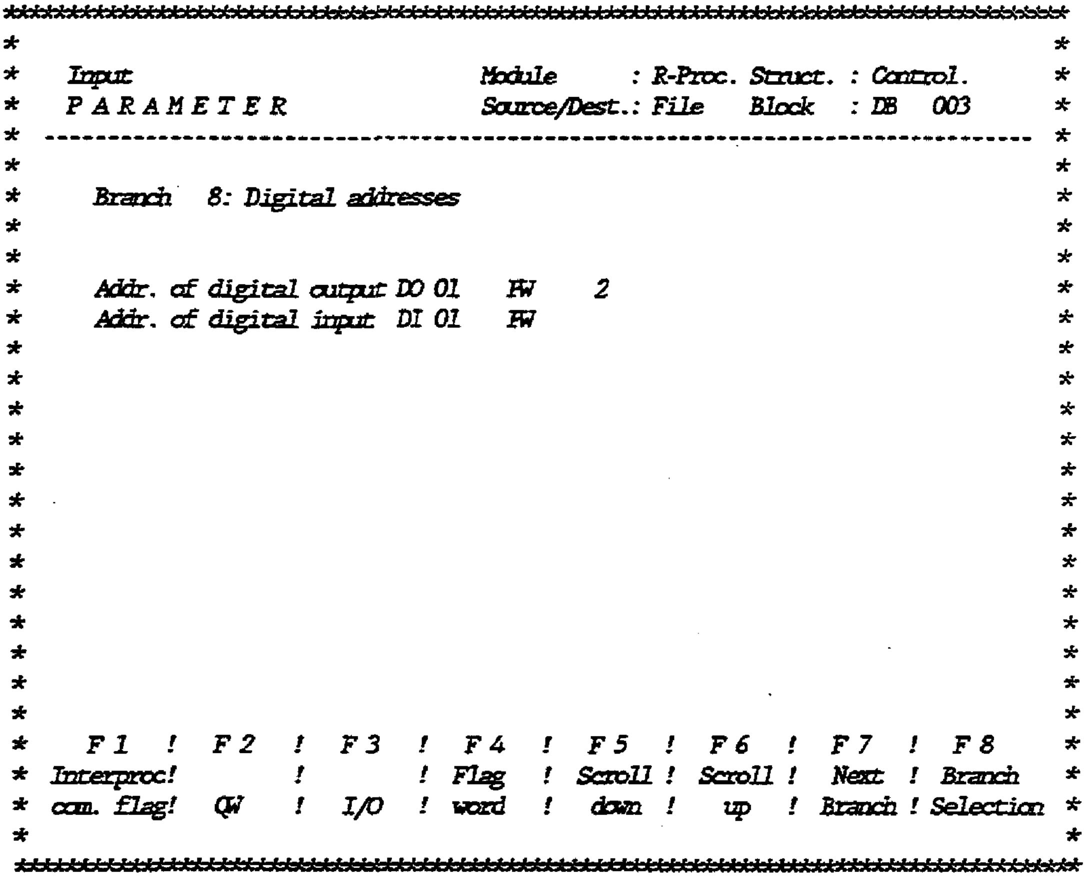
```
*******************************************************************************
*                                                                             *
*   Input                             Module       : R-Proc. Struct. : Control. *
*   P A R A M E T E R   I N P U T     Source/Dest.: File    Block   : DB  003  *
* --------------------------------------------------------------------------- *
*                                                                             *
*     Branch   6: Test socket 1                                               *
*                                                                             *
*                                                                             *
*     Measuring point number                3                                 *
*     Address DAC 03                FW   194                                  *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*   F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8      *
* Interproc!       !        ! Flag   ! Scroll ! Scroll ! Next   ! Branch     *
* com. flag!  QW   !  I/O   ! word   !  down  !   up   ! Branch ! Selection  *
*                                                                             *
*******************************************************************************
```

The test sockets enable the user to output internal controller values to external recording instruments. By means of the simultaneous output of the read setpoint and the processed setpoint on a recorder, the functions of all modules of the setpoint branch may be checked (the same refers to the actual value branch).

In contrary to the ADC address, the measuring point number can be modified online during the test.

Note: Before a test socket can be switched off using the structure key, the address of the ADC should be overwritten with blanks; otherwise, the system program attempts to output the contents of the measuring point to the ADC. This means that the ADC should exist physically, else the processor passes into the STOP state signalling a controller fault (see chapter 5, description of controller structure R64.

4.4.1.12 Digital Addresses



```
******************************************************************************
*                                                                            *
*   Input                       Module      : R-Proc. Struct. : Control.     *
*   P A R A M E T E R           Source/Dest.: File    Block   : DB  003      *
* -------------------------------------------------------------------------- *
*                                                                            *
*     Branch  8: Digital addresses                                           *
*                                                                            *
*                                                                            *
*     Addr. of digital output DO 01   FW     2                               *
*     Addr. of digital input  DI 01   FW                                     *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*   F 1  !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7  !  F 8     *
* Interproc!       !       ! Flag  ! Scroll ! Scroll !  Next  ! Branch    *
* com. flag!  QW   !  I/O  ! word  !  down  !   up   ! Branch ! Selection *
*                                                                            *
******************************************************************************
```

The description of controller structure R64 shows that the controller has a digital output word (DO) and a digital input word (DI).

The output word output out the statuses of the limit monitor and in particular the status of the step controller outputs ("Open" and "Close") and the continuous controller with Pulse/Pause output. When the regulating variable is to be output digitally the address of a digital output module should be entered into the mask.

Use one of the following options to control the digital inputs, for instance, the signals "End position open reached", "End position closed reached", "Inhibit controller", "Dead zone effective", "Upper", "Lower", "Delete" etc.:

- When the address of a digital input module is entered for the input "Address DI 01" the digital input word is read in automatically by the operating system and stored in the particular data word.

- When a (interprocessor communication) flag is entered for the input "Address DI 01" the input word may be specified by a STEP5 program or by a CP where the defined flag is described.

- The digital input word can also be specified directly by a STEP5 program where the data word 180 in the controller data block is described.

- The bit values of the digital input word may be controlled by the PG during test.

In the last two cases data should not be entered under any circumstances for the input "Address DI 01" since the digital input word is overwritten by the operating system when the process image is created.

Important Note:

- **The digital input word contains many important bit values. When one of these bit values is in an incorrect status the controller cannot continue running (e. g. the bit "Inhibit controller").**

- **When the user makes an entry in the address for the digital input the specified address, respectively the specified flag should supply a defined value.**

- **When the user makes an entry in the address for the digital input the relays cannot be controlled during test!**

4.4.2 Input of the Controller List

```
******************************************************************************
*                                                                            *
*   Input                      Module       : R-Proc. Struct. :              *
*   Controller list            Source/Dest.: File   Block   : DB   002       *
* -------------------------------------------------------------------------- *
*                                                                            *
*     Time base :      50 ms                                                 *
*                                                                            *
*     The Scan times of the columns are:                                     *
*                                                                            *
*   100 ms | 150 ms |   0 s  |   0 s  |   0 s  |   0 s  |   0 s  |   0 s    *
* ==========================================================================*
*     DB   |   DB   |   DB   |   DB   |   DB   |   DB   |   DB   |   DB     *
* ---------+--------+--------+--------+--------+--------+--------+---------- *
*      3   |    4   |        |        |        |        |        |          *
*          |        |        |        |        |        |        |          *
*     ---  |        |        |        |        |        |        |          *
*     ---  |   ---  |        |        |        |        |        |          *
*     ---  |   ---  |        |        |        |        |        |          *
*     ---  |   ---  |        |        |        |        |        |          *
*     ---  |   ---  |        |        |        |        |        |          *
*     ---  |   ---  |        |        |        |        |        |          *
*                                                                            *
*                                                                            *
*    F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8     *
*          !        !        !        !        !        !        !          *
*  Enter DB !Remove DB!Time base!       !        !        ! Ready  !  Break   *
*                                                                            *
******************************************************************************
```

The entries in the controller list determine the calling sequence of the controllers.

The controller list shows clearly the method of working and the loading of the processor:

The processor is able to manage a maximum of 8 different scan times, corresponding to the eight columns of the controller list. The processor processes the columns one after the other selecting only one controller per column, then stepping on to the next column. The time which passes after one controller of a column is processed until the next one in the same column is processed, is called time base which is to be entered into the head of the mask. When the time base, for example, is 100 ms the processor should process a controller every 25 ms when there are 4 lists; when there are 8 lists, a controller of a list should be processed every 12.5 ms. Since the processing time of a controller is 2.5 ms maximum, 22.5 ms or 10 ms respectively, are available for the processor to execute a STEP5 program between two controller processes, in the example above.

When, for this example, a list is processed every 100 ms it may contain a controller with a scan time of 100 ms. When the scan time of the controller of this column is 200 ms it should be called in every second column. Therefore, this column may contain two controllers with a scan time of 200 ms each. The number of controllers per column is derived from the quotients of the controller scan time of the column and the time base. The number of controllers, however, is limited to 8 since storage, not time, is restricted. All scan times (minimum pulse duration) of the projected controllers (see description below) should be an integer multiple of the time base so that the quotient is an integer. The maximum common divisor of all scan times (minimum pulse duration) should therefore be entered for the time base.

If a column does not contain any controllers or if the maximum number of controllers per column is not reached the operating system detects this and may possibly execute an existing STEP5 program instead of a controller.

For step and continuous controllers with a pulse/pause output the regulating variable is converted into the number of pulses. In order to output a pulse with the length of the parameterized minimum pulse duration the controller structure R64 should be called at least once during the minimum pulse duration to enable the bit of the digital controller output to be set or reset. This is why the minimum pulse duration is decisive for entry of step and continuous controllers with pulse/pause outputs into the controller list.

When the controller list is processed the time base is to be entered first. The following two conditions should be met:

- It should be a multiple of 10 ms, at least 20 ms.
- It should be the maximum common divisor of the scan times (respectively the minimum pulse duration) of the controller to be processed. When a smaller scan time is selected the processor loading increases because of unnecessary administration work.

It is only possible to leave the entry field when a valid time base was entered. The function keys are assigned the following:

<F1>	Enter DB
<F2>	Remove DB
<F3>	Time base
<F7>	Ready
<F8>	Break

In order to enter the controllers into the controller list, press the function key <F1>, enter the data block number, and conclude the input by pressing <Carriage Return>. In order to simplify the entry COM REG does not return to the previous menu but requires the entry of a new data block number. This input loop may be broken by pressing the <Break> key.

After the data block number is entered the program reads the scan time (minimum pulse duration) from the particular data block of the selected destination medium and attempts to enter the controller into the controller list. During this procedure the existing columns with the same scan time are filled before a new column is opened. If the scan time (minimum pulse duration) is not a multiple of the time base the controller cannot be entered and the time base or the scan time (minimum pulse duration) must be modified. The removal of individual controllers from the controller list is also carried out in form of a loop that is to be terminated by pressing the <Break> key.

After the function key <F3> is pressed the time base may be modified. However, the new value is only accepted if it is an integer divisor of all controllers contained in the list. The value is not deleted before a valid value is entered. If there is no further value, which meets all conditions for the time base, the old value should be entered again so that the user can leave the input field. If the modification was successful the controller list is updated.

The input of the controller list may be terminated by pressing <F7>; the DB2 that was created is stored. By pressing <F8> the input is terminated; the entries are lost.

4.5 Output

By means of the function "Output" an already existing controller data block or the controller list may be checked, amended or corrected. Additionally all controller data and a cross reference list may be printed out using a print function. The only difference between the functions "Input" and "Output" is that, in contrary to the rigid operator prompting in the input function, the mask the user wishes to complete may be directly selected in the output function.

After "Output" is selected from the main menu the user may select the medium on which the data block to be processed is stored. The print function may be branched to from this menu.

<F1>	Program file
<F4>	Module
<F5>	Programmer (PG)
<F8>	Print

After the medium is selected and the data block number is entered the mask selection menu is displayed. When data block two is selected the controller list may be processed. The controller list is output the same way as it was input.

The following description applies to controller data blocks, not to the controller list.

```
*************************************************************************
*                                                                       *
*   Output                       Module      : R-Proc. Struct. : Control.  *
*                                Source/Dest.: File    Block   : DB  003   *
* ------------------------------------------------------------------- *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*                                                                       *
*    F 1   !  F 2   !  F 3   !  F 4   !  F 5   !   F 6   !  F 7   !   F 8    *
*  Struc-  ! Sample !  BESY  !Physical ! Initial-!         ! Store  !          *
*  turing  ! time   !Parameter!Dimension! ization !         ! Cntl.  !  Break   *
*                                                                       *
*************************************************************************
```

When the user presses function key <F1>, <F2>, or <F4>, the associated mask is displayed and may be directly completed; however, when function key <F3> is pressed, another menu is displayed, from which the user may select the masks, controller response/FB number or CP526 adaptation. When function key <F5> is pressed, the menu displayed for the controller branch selection is the same as for input displayed.

When the masks are terminated by pressing <F7> "Ready" COM REG returns to the mask shown above. When a mask is terminated by pressing <F8> "Break" the user leaves not only the processing of the mask but also the complete output of the data block. The program returns to that level where the user is requested to enter the data block number. In order to save changes already made, the data block which is in PG block memory may be transferred to the module or program file by means of the function "TRANSFER".

When the user leaves the output menu by pressing <F7> "Store controller", COM REG overwrites the old data block with the new one once the prompt "Block x overwrite (Y/N) ?" is answered. If this prompt is answered with "N" or if the output menu is left by pressing <F8> "Break" the modified data block can still be saved from the PG memory.

Note: - When a structure switch is modified by means of the function "OUTPUT", COM REG changes this switch only, not the parameters that become invalid by this procedure. For example, when the polygon curve is switched off with the corresponding structure switch the parameters for the polygon curve are maintained in the data block so that it need not be entered again when the polygon curve is reactivated. Another consequence is that the ADC address is still stored in the data block after the test socket was switched off with the structure switch or after the setpoint was transferred from the ADC to the setpoint sequence. As already described, this existing address input requests the system program to read cyclically the particular variable of the input module. This means that the input module must exist although the variable read is not evaluated. **Therefore the address of each ADC or DAC should be overwritten with blanks before the branch with the ADC (DAC) is switched off by means of a structure switch! After the address was switched off with the structure switch it cannot be deleted because it is no longer offered for parameterizing!**

- When the format or the number of decimal places is modified during entry of the input characteristic, all dimension dependent parameters are falsified by the decimal power that corresponds to the modification to the number of decimal places, i. e. all dimension-dependent parameters should be entered again.

Example:		
	0% corresponds to	0.00 V
	100% corresponds to	10.00 V
	Setpoint upper limit	1.23 V

After the format of the input characteristic was modified to one decimal place the upper limit of the setpoint is falsified.

0 % corresponds to	0.0 V
100 % corresponds to	10.0 V
Setpoint high limit	12.3 V

As described above, the function "OUTPUT" also contains the option to print out the controller data entered. After the function "Print" is selected by pressing function key <F8> of the first output menu the following functions are offered:

<F2>	Print a controller data block
<F5>	Print all
<F6>	Print cross reference list
<F8>	Break

After being selected all three functions request information on which medium (program file/module) the data to be printed is to be read. When only one controller data block is to be printed the block number should be entered. Of course, a printer ready to run should be connected to the module. When the "SIEMENS PT88" printer is used, all DIL switches should be set to "ON".

The cross reference list looks like this:

```
******************************************************************************************
*                                                                                        *
*    Analog Inputs:                                                                      *
*                                                                                        *
*                         PW  128      DB 003       ADC 2                                *
*                         PW  130      DB 003       ADC 1                                *
*                         PW  132      DB 004       ADC 2                                *
*                         PW  134      DB 004       ADC 1                                *
*                                                                                        *
*                                                                                        *
*    Analog Outputs:                                                                     *
*                                                                                        *
*                                      DB 004       DAC 1                                *
*                         PW  192      DB 003       DAC 1                                *
*                                                                                        *
*                                                                                        *
*    Digital Inputs:                                                                     *
*                                                                                        *
*                         PW    4      DB 003       DI  1                                *
*                         PW    6      DB 004       DI  1                                *
*                                                                                        *
*                                                                                        *
*                                                                                        *
*    Digital Outputs:                                                                    *
*                                                                                        *
*                         PW    0      DB 003       DO  1                                *
*                         PW    2      DB 004       DO  1                                *
*                                                                                        *
******************************************************************************************
```

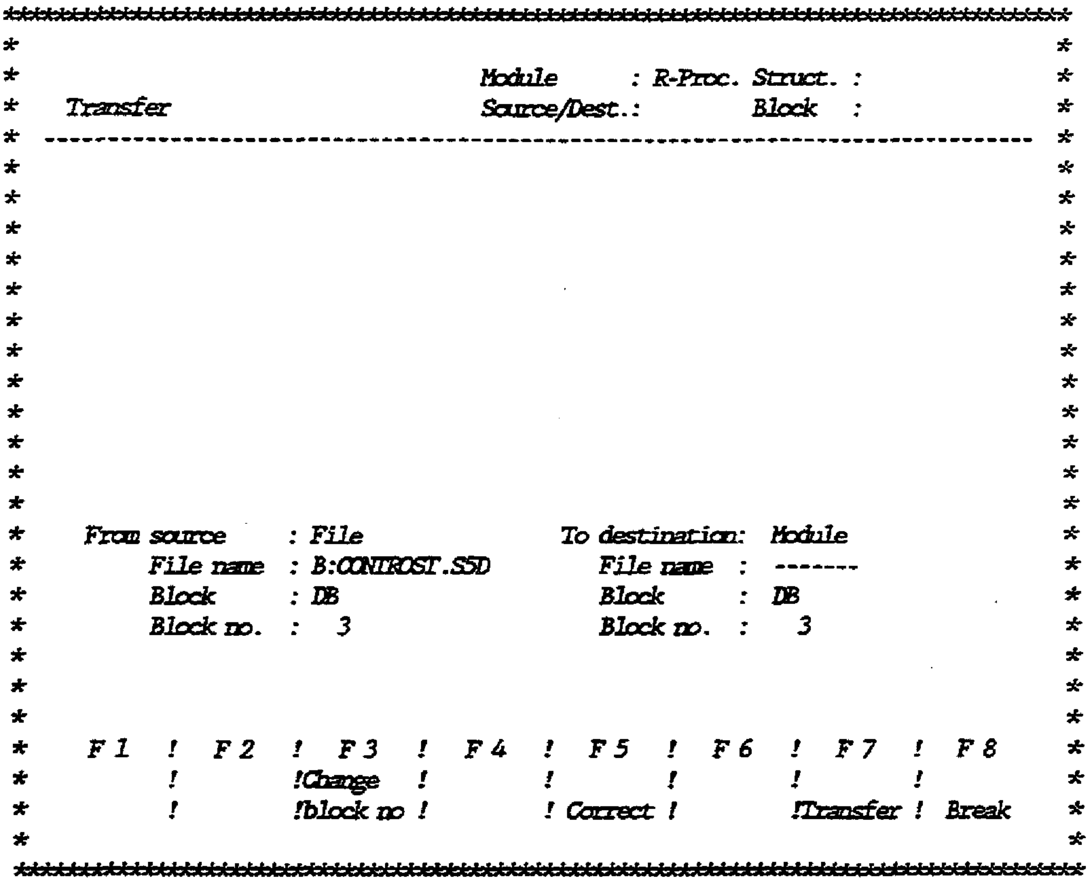
The cross reference list shows the controllers and the input/output module types and the required addresses, whether addresses are accessed twice, and the channel of modules not yet assigned.

When the function "Print all" is selected the controller list and all controllers entered are printed. The representation of the controller data corresponds to the representation of the controller input.

When the function "Print a controller data block" is selected one single controller may be printed.

4.6 Transfer

By means of the function "Transfer" any (i. e. also STEP5) data and function blocks may be transferred between the media "program file", "module", and "PG".



```
*******************************************************************************
*                                                                             *
*                                   Module      : R-Proc. Struct. :           *
*  Transfer                         Source/Dest.:         Block   :           *
*  -------------------------------------------------------------------------- *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*   From source    : File              To destination: Module                 *
*        File name : B:CONTROST.S5D        File name  : -------               *
*        Block     : DB                    Block      : DB                    *
*        Block no. :   3                   Block no.  :   3                   *
*                                                                             *
*                                                                             *
*                                                                             *
*   F 1  !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7  !  F 8               *
*        !       !Change !       !       !       !       !                    *
*        !       !block no !     ! Correct !     !Transfer ! Break            *
*                                                                             *
*******************************************************************************
```

In order to transfer data the source medium should be selected by pressing the corresponding function key. When the program file is selected as source the name of the preset program file is displayed automatically. Afterwards the user specifies the block type (DB or FB) to be transferred by pressing function key <F1> or <F2>. If all blocks of the selected type are to be transferred, function key <F1> should be pressed in place of the entry of a block number; otherwise the block number must be entered. The destination medium may also be selected by means of the function keys. When the program file was selected as destination, the name of the destination file may be entered according to the conventions described in section "Presetting". The destination file may be identical to the source file. This is only useful when the block number is modified during the transfer procedure. When the user wishes to change the block number, function key <F3> "Change block no." should be pressed and the new number entered.
When all entries are correct the function key <F7> "Transfer" may be pressed. The entries may only be corrected after <F5> is pressed. The cursor is moved over each input line which may then be corrected or acknowledged by means of <Carriage Return>.
The input may be terminated at any time by pressing function key <F8>.

Notes:

- "PG" is the term for the block memory of the programmer. It may contain only one block and is overwritten each time a new block is created.
- When blocks are transferred from the program file to the module they are initially stored in the plug-in RAM module of the processor. When this storage is occupied other data blocks, except function blocks, may be stored in the data block storage of the processor. Therefore, it is advisable to transfer the function block(s) first to the module.
- When no more blocks can be transferred to the module because there is not enough free memory the function "Compress PC" may possibly provide the memory required.

4.7 Delete

By means of the function "Delete" single data and function blocks, or the complete program file may be deleted. After the function is called the function key menu offers the following:

```
******************************************************************************
*                                                                            *
*                                         Module      : R-Proc. Struct. :    *
*   Delete                                Source/Dest.:         Block   :    *
*  ------------------------------------------------------------------------  *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*    F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8     *
*   Delete ! Delete !        ! Delete !        !        !        !           *
*   file   !prog.file!       ! module !        !        !        !  Break    *
*                                                                            *
******************************************************************************
```

<F1> Delete single blocks from the program file
<F2> Delete the complete program file
<F4> Delete single blocks from the module
<F8> Break

When single blocks are to be deleted, the block type (DB or FB) and the block number should be selected by pressing function key <F1> or <F2>. When a program file is to be deleted, the name of this file should be entered. By means of this function not only the preset program file may be deleted but also each program file in the current user area of the user's disk (hard disk).

The function "Delete" may be terminated at any time by pressing the <Break> key.

4.8 Special Functions

After the "Special functions" key is pressed the following menu is displayed:

```
**************************************************************************************
*                                                                                    *
*                                      Module       : R-Proc. Struct. :              *
*   Special functions                  Source/Dest.:          Block   :              *
* ---------------------------------------------------------------------------------- *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*    F 1   !  F 2   !  F 3   !  F 4   !  F 5    !  F 6   !  F 7    !  F 8    *
*    Cold  !  Warm  !        !        !  PC     !        !Controll.!           *
*  restart ! restart !       !  Stop  !compress ! Preset !process. !  Break    *
*                                                                                    *
**************************************************************************************
```

Each function, except "Preset" may be called if an operational processor is connected to the PG and if "Online" was selected when COM REG was preset.

- "Cold restart" has the same function as the manual restart of the R-Processor. "Cold restart" causes a new interpretation of the controller list and the acceptance of the modifications of the controller structure or modifications of the number of controllers. The cold restart deletes all internal controller variables (e. g. a large integral-action componenent which was created on the basis of a long-range controller deviation). The cold restart of the PG can be executed only if the operating mode switch of the processor is set to "RUN".

- The "Warm restart" causes the processor to continue the cycle with all previous values after it was stopped by means of "Stop". A warm restart may be executed only if the operating mode switch of the processor is set to "RUN".

- "STOP" will interrupt the running processor. The processor sets the digital output modules to zero by using the "command output inhibit" ('BASP') signal.

- When blocks are deleted from the processor the storage contains gaps that cannot be used because new blocks transferred are always stored after the already allocated storage. The function "Compress PC" compresses the blocks in the processor so that the gaps disappear and the continuous free storage increases. "Compress PC" may be called during operation.

- <F6> calls the presetting mask described in the chapter "Presetting". By means of this function the program filename may be changed for example.

- The function "Controller processing" enables or disables each controller of the module. <F1> (Yes) enables, <F2> (No) disables the controller. The cursor may be moved to each controller by means of the cursor keys. The response of each disabled controller regarding the outputs may be determined for each controller when the mask "Controller response" is completed.

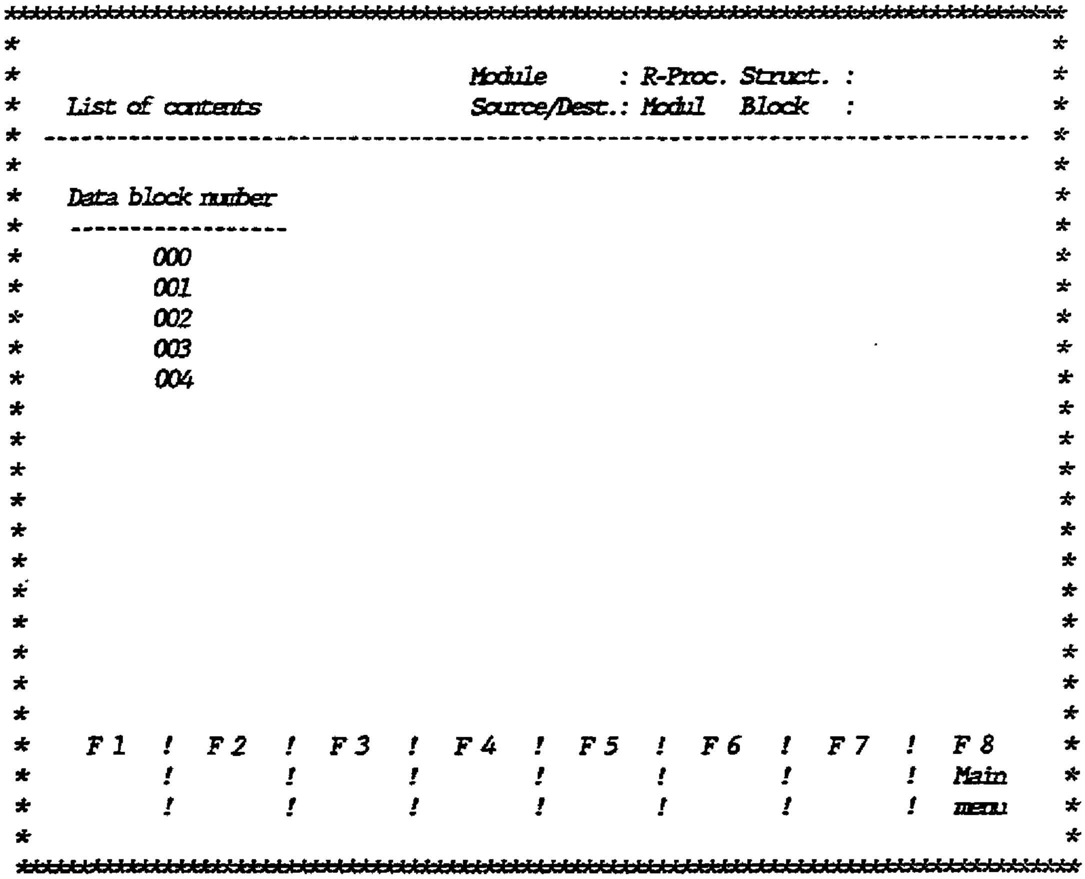
  Note: Only those controllers that were entered in the controller list may be enabled or disabled. The function "Controller processing" may be called only if the processor contains a correct controller list.

The user may exit the menu "Special functions" without an entry being made by pressing the <Break> key.

4.9 Information

When the function "Info" is called, the list of contents referring to data and function blocks of the preset program file or the module is displayed. For purchased function blocks the library number is displayed in addition to the block number.

After "Info" is called the user selects - after pressing <F2> - between program file by pressing <F1> and module by pressing <F4>. The block type is then to be specified by pressing the function keys <F1> and <F2>.



```
*****************************************************************************
*                                                                           *
*                                    Module      : R-Proc. Struct. :        *
*  List of contents                  Source/Dest.: Modul   Block   :        *
* ------------------------------------------------------------------------- *
*                                                                           *
*  Data block number                                                        *
*  -----------------                                                        *
*       000                                                                 *
*       001                                                                 *
*       002                                                                 *
*       003                                                                 *
*       004                                                                 *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*   F 1  !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7  !  F 8            *
*        !       !       !       !       !       !       !  Main           *
*        !       !       !       !       !       !       !  menu           *
*                                                                           *
*****************************************************************************
```

The function "Info" may be exited at any time by pressing the <Break> key.

Note: Not only the blocks created using COM REG are displayed but all blocks contained on the selected medium.

4.10 Test

The controller test enables the user to test operating and monitoring of the controllers in online mode (operating mode of the module: "RUN"). This function enables the user to

- start-up the system
- control the digital inputs
- change and optimize the parameters
- obtain an overview of all important controller statuses.

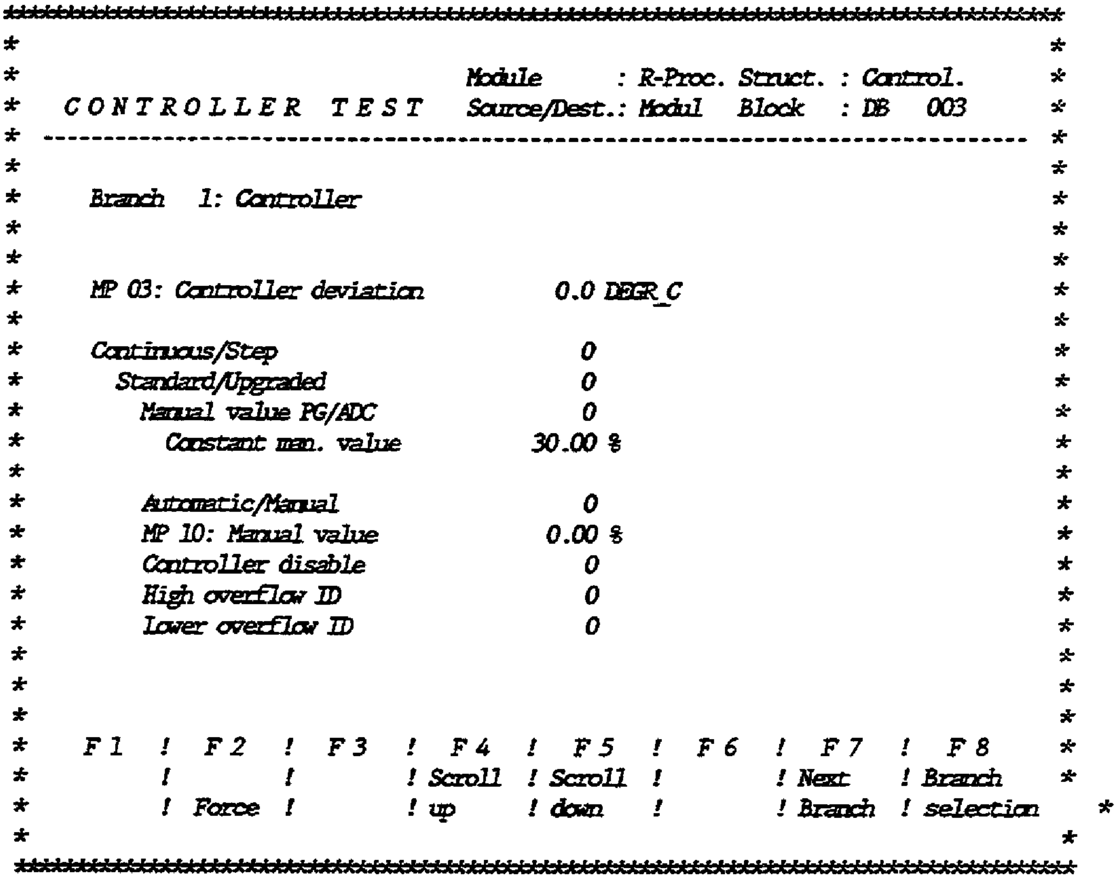
In addition to the correctable parameters the different masks also display the structure switch position, the input values, the averaging (measuring points), and the output values.

Each value is requested several times per second from the module and updated on the screen.

After the function "Test" is selected and the data block number of the controller to be tested is entered, the branch selection mask is displayed. This mask contains only the active branches as in the parameter input. In addition, a start-up branch and a measuring point table are available.

After the branch number is entered all data of the selected controller branch is displayed and permanently updated on the screen:

Note: The measuring points of the limit monitors can also be changed in test operation. If you want to change measuring points of different dimensions (example: MP4 regulating variable given as %, MP1 actual value dimension dependent), it may be necessary to re-enter the limit values in order to obtain a correct indication of the limit monitor bits.



```
********************************************************************************
*                                                                              *
*                               Module      : R-Proc. Struct. : Control.       *
*  C O N T R O L L E R  T E S T  Source/Dest.: Modul  Block   : DB  003        *
* -------------------------------------------------------------------------- *
*                                                                              *
*    Branch   1: Controller                                                    *
*                                                                              *
*                                                                              *
*    MP 03: Controller deviation          0.0 DEGR_C                           *
*                                                                              *
*    Continuous/Step                       0                                   *
*      Standard/Upgraded                   0                                   *
*        Manual value PG/ADC               0                                   *
*          Constant man. value         30.00 %                                 *
*                                                                              *
*        Automatic/Manual                  0                                   *
*        MP 10: Manual value            0.00 %                                 *
*        Controller disable                0                                   *
*        High overflow ID                  0                                   *
*        Lower overflow ID                 0                                   *
*                                                                              *
*                                                                              *
*                                                                              *
*   F 1  !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7  !  F 8               *
*        !       !       ! Scroll ! Scroll !      ! Next  ! Branch             *
*        ! Force !       ! up     ! down   !      ! Branch ! selection           *
*                                                                              *
********************************************************************************
```

During the status display the function keys are assigned the following:

<F2> Force
<F4> Scroll up
<F5> Scroll down
<F7> Next branch
<F8> Branch selection

When the list requires more space on the screen than is available the display may be scrolled up (<F4>) or scrolled down (<F5>). The next branch is selected by pressing <F7>; when the user presses <F8> he is led back to the menu for branch selection.

After the function key <F2> is pressed the cyclical status display is frozen on the screen and the cursor may be moved by means of the cursor keys to the input field required. As soon as the new parameter value is enterd and the <Carriage Return> is pressed the new value is sent to the module by the PG and shown in the new cyclical status display. Since the value displayed comes from the module, it is confirmed that the module has accepted the value.
The following variables may not be controlled and thus must be changed by means of the function "Output":

- structure switch
- addresses
- number of limits
- number of vertices of the polygon curve
- number of setpoints for the setpoint sequence

The measuring point table is the most important aid for providing an overview of all important controller data. It supplies the following information:

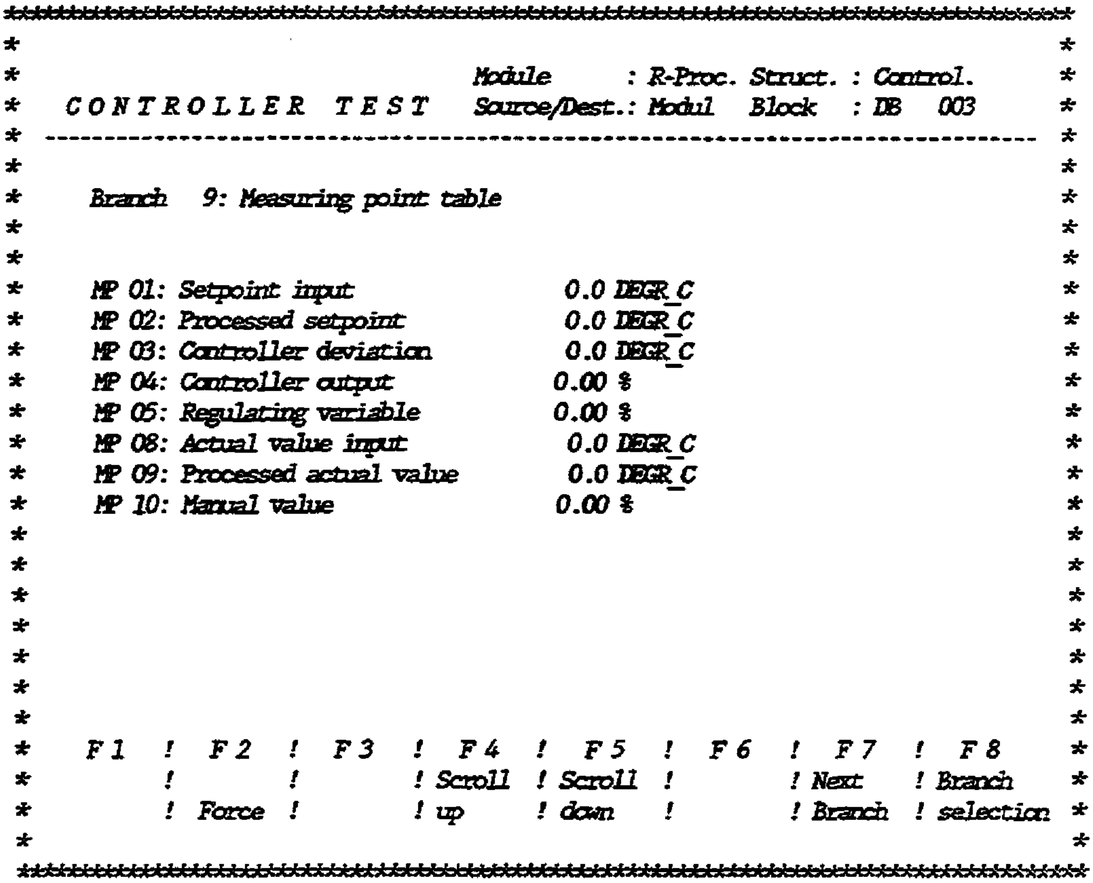
- Do the input modules supply the correct values?

- Do the output modules output the correct values?

- Does the controller run? (the modified setpoint or actual value should be displayed at latest after the scan time)

- By comparing the fed and processed actual value (setpoint) the function of the processing modules may be tested in the corresponding branches.

- Are the controller parameters correct, does the controller output the expected regulating variable?

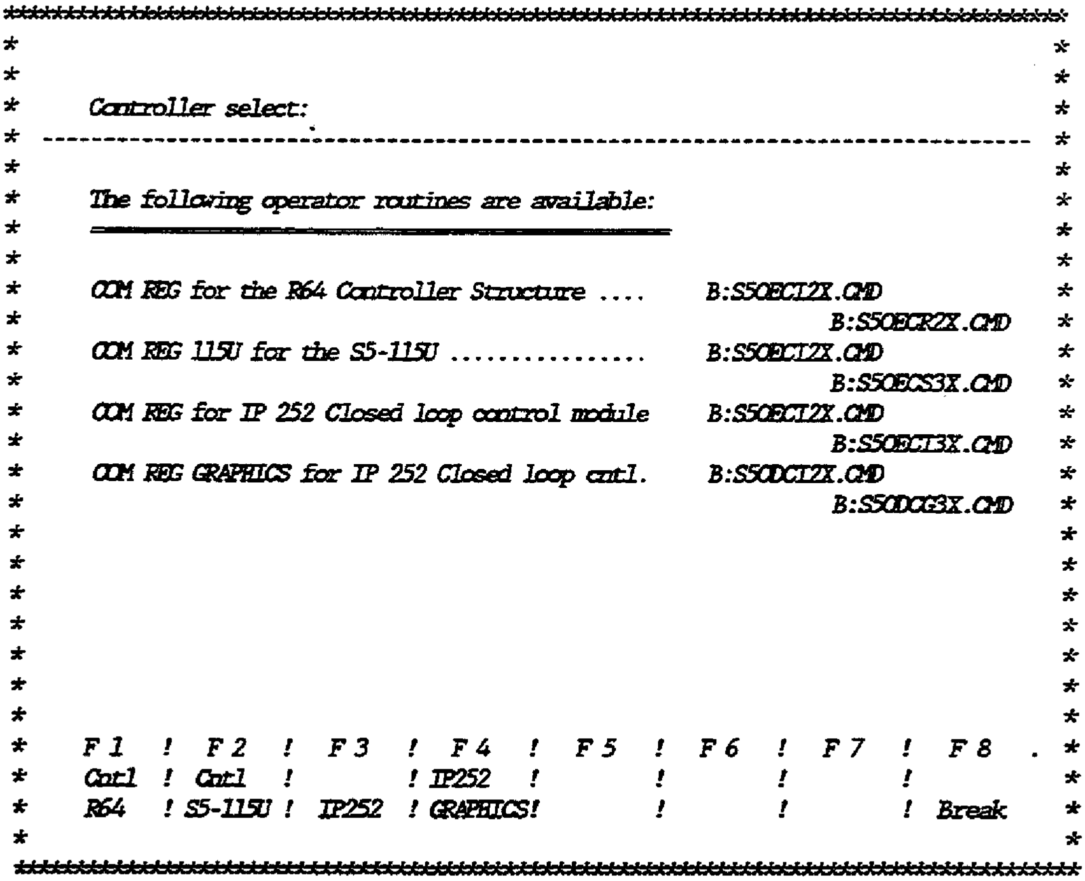


```
******************************************************************************
*                                                                            *
*                                Module       : R-Proc. Struct. : Control.   *
*  CONTROLLER TEST               Source/Dest.: Modul  Block   : DB  003      *
* -------------------------------------------------------------------------- *
*                                                                            *
*    Branch   9: Measuring point table                                       *
*                                                                            *
*                                                                            *
*    MP 01: Setpoint input               0.0 DEGR_C                          *
*    MP 02: Processed setpoint           0.0 DEGR_C                          *
*    MP 03: Controller deviation         0.0 DEGR_C                          *
*    MP 04: Controller output           0.00 %                               *
*    MP 05: Regulating variable         0.00 %                               *
*    MP 08: Actual value input           0.0 DEGR_C                          *
*    MP 09: Processed actual value       0.0 DEGR_C                          *
*    MP 10: Manual value                0.00 %                               *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*    F1  !  F2   !  F3  !  F4    !  F5    !  F6   !  F7    !  F8         *
*        !       !      ! Scroll ! Scroll !       ! Next   ! Branch      *
*        ! Force !      ! up     ! down   !       ! Branch ! selection   *
*                                                                            *
******************************************************************************
```

Note: When a data block is transferred from the module to the program file after test, the positions of the digital inputs are also transferred.

5 Projecting Controller Structures for IP252

The previous chapters (COM REG) described how COM-software is loaded and how the user steps from loading to the point where he may decide whether to use the COM REG software to operate either the R64 controller of the PC S5-135U or the controller device IP252. The controller selection menu is now displayed.



```
********************************************************************************
*                                                                              *
*                                                                              *
*    Controller select:                                                        *
* ---------------------------------------------------------------------------  *
*                                                                              *
*    The following operator routines are available:                          *
*    ================================================                          *
*                                                                              *
*    COM REG for the R64 Controller Structure ....     B:S5OECI2X.CMD          *
*                                                              B:S5OECR2X.CMD  *
*    COM REG 115U for the S5-115U ...............      B:S5OECI2X.CMD          *
*                                                              B:S5OECS3X.CMD  *
*    COM REG for IP 252 Closed loop control module     B:S5OECI2X.CMD          *
*                                                              B:S5OECI3X.CMD  *
*    COM REG GRAPHICS for IP 252 Closed loop cntl.     B:S5ODCI2X.CMD          *
*                                                              B:S5ODCG3X.CMD  *
*                                                                              *
*                                                                              *
*                                                                              *
*                                                                              *
*                                                                              *
*                                                                              *
*                                                                              *
*   F 1  !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8   .    *
*   Cntl ! Cntl   !        ! IP252  !        !        !        !             *
*   R64  ! S5-115U !  IP252 ! GRAPHICS!       !        !        ! Break       *
*                                                                              *
********************************************************************************
```

Fig. 5.1 Controller selection

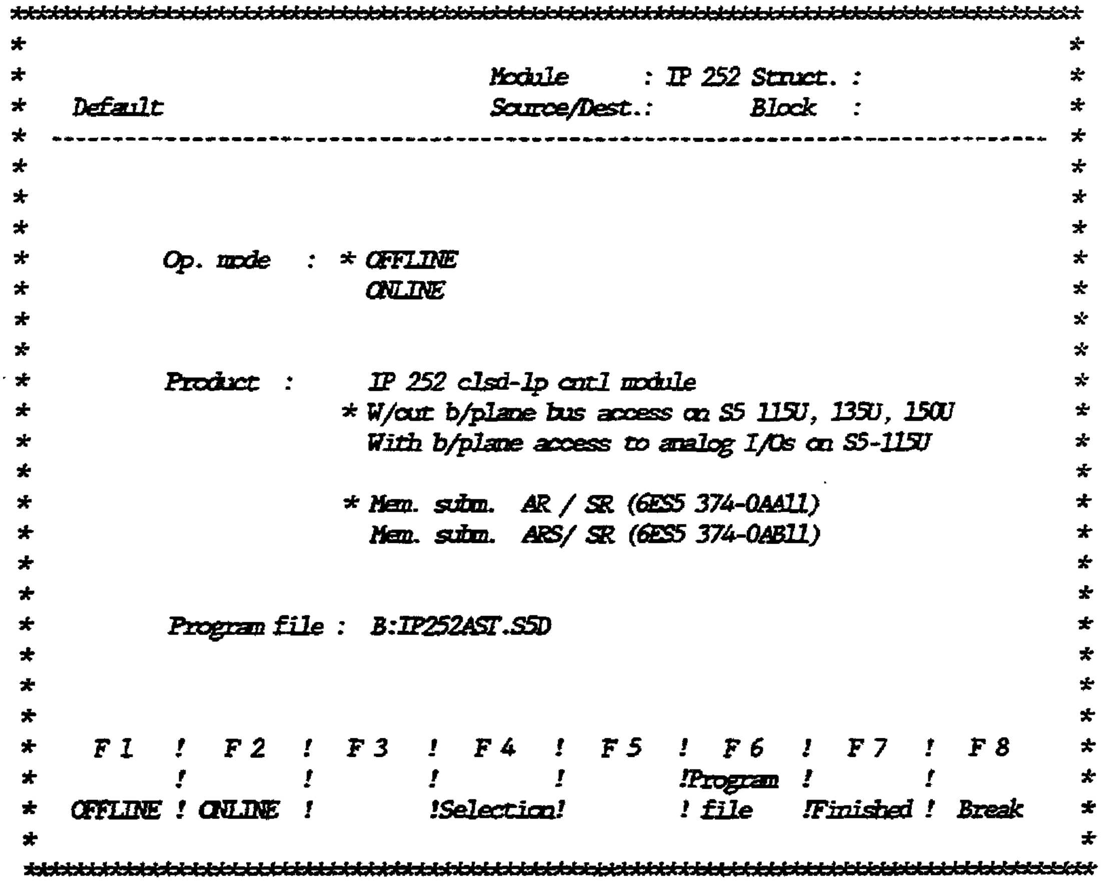
In the controller selection the user specifies the module he wishes to operate using the COM software. The function keys offer the following options:

<F1> : Controller structure R64
<F2> : Control on CPU S5-115U
<F3> : Closed-loop control module IP252

<F4> : Closed-loop control module IP252 with graphic parameterization software
<F8> : Break

The assignment of the function keys <F1> to <F7> of the mask shown above depends on the existing packages.

After the controller selection the presetting menu is displayed.



```
*******************************************************************************
*                                                                             *
*                                 Module      : IP 252 Struct. :              *
*  Default                        Source/Dest.:        Block   :              *
*  -------------------------------------------------------------------------  *
*                                                                             *
*                                                                             *
*                                                                             *
*         Op. mode   :  * OFFLINE                                             *
*                         ONLINE                                              *
*                                                                             *
*                                                                             *
*         Product  :      IP 252 clsd-lp cntl module                          *
*                       * W/out b/plane bus access on S5 115U, 135U, 150U     *
*                         With b/plane access to analog I/Os on S5-115U       *
*                                                                             *
*                       * Mem. subm.  AR / SR (6ES5 374-0AA11)                *
*                         Mem. subm.  ARS/ SR (6ES5 374-0AB11)                *
*                                                                             *
*                                                                             *
*         Program file :  B:IP252AST.S5D                                      *
*                                                                             *
*                                                                             *
*                                                                             *
*   F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8        *
*         !        !        !        !        !Program !        !             *
*  OFFLINE ! ONLINE !        !Selection!       ! file   !Finished !  Break     *
*                                                                             *
*******************************************************************************
```

Fig. 5.2 Presetting menu

This menu is structured the same as all other menus of this COM package and is an example of the principle structure of menus. The structure consists of a header area, foot area, and inbetween the particular input and output field.

In the left part of the header area, the function to be executed is displayed (e. g. presetting, input, etc.) The right part of this area contains information about entries already made. This information is: "Module:", "Source/Dest.:", "Struct.", and "Block:". "Module:" gives information about whether the user has selected the controller structure R64 or the IP252. "Source/Dest." shows from where the output data was read or where the input data is stored. The following entries are possible: program file, submodule, module or PG. In the foot area the function keys are assigned the corresponding functions; the particular inputs and outputs are made in the area between header and foot area.

The presetting has the following defaults:

Operating mode: Offline
Module: : IP252 in S5-115U, -135U, -150U without access to
backplane bus
AR/SR memory submodule

In the presetting the user specifies how to operate the module with this COM software. The function keys offer the following options:

<F1> : OFFLINE
<F2> : ONLINE
<F4> : Selection
<F6> : Program file
<F7> : Finished
<F8> : Break

The operating mode depends on whether the user wishes to work offline first, i. e. programming into the PG, the submodule or the disk, or whether he wishes to program directly to the module (ONLINE).

The functions IP252 with or without bus access refer to the direct bus access. The direct bus access means that the IP252 is not restricted to its eight analog inputs/outputs but that it can additionally use the analog peripherals of the central controller. In this case the IP252 behaves as a co-processor and leaves the bus administration to the CPU. However, the bus can be accessed only in the S5-115U programmable controller.

The user submodule which contains the structures "ARS/SR" supports the connection of control loops 1 to 8 with *master and servo controllers*. Wherever you find **ADC n** in the documentation on projecting (chapters 8.2 und 8.3, manual IP252) you can enter the following parameters:

e.g. ADC 6 =	0 ... 7	internal ADC channels
	128 ... 254	backplane bus addresses of the PC S5 analog peripherals: for PC S5-115U only
	C-no./MP-no.	**C-no.** here means the controller numbers 1 to 8 and **MP-no.** the measuring point number of this controller structure

It is thus possible to assign, for example, the processed actual value from controller no. 2 to controller no. 3 as a setpoint value. The following value is entered via the PG into the entry field of ADC 6 (of branch 8 of controller no.3):

ADC 6 PW 2.12

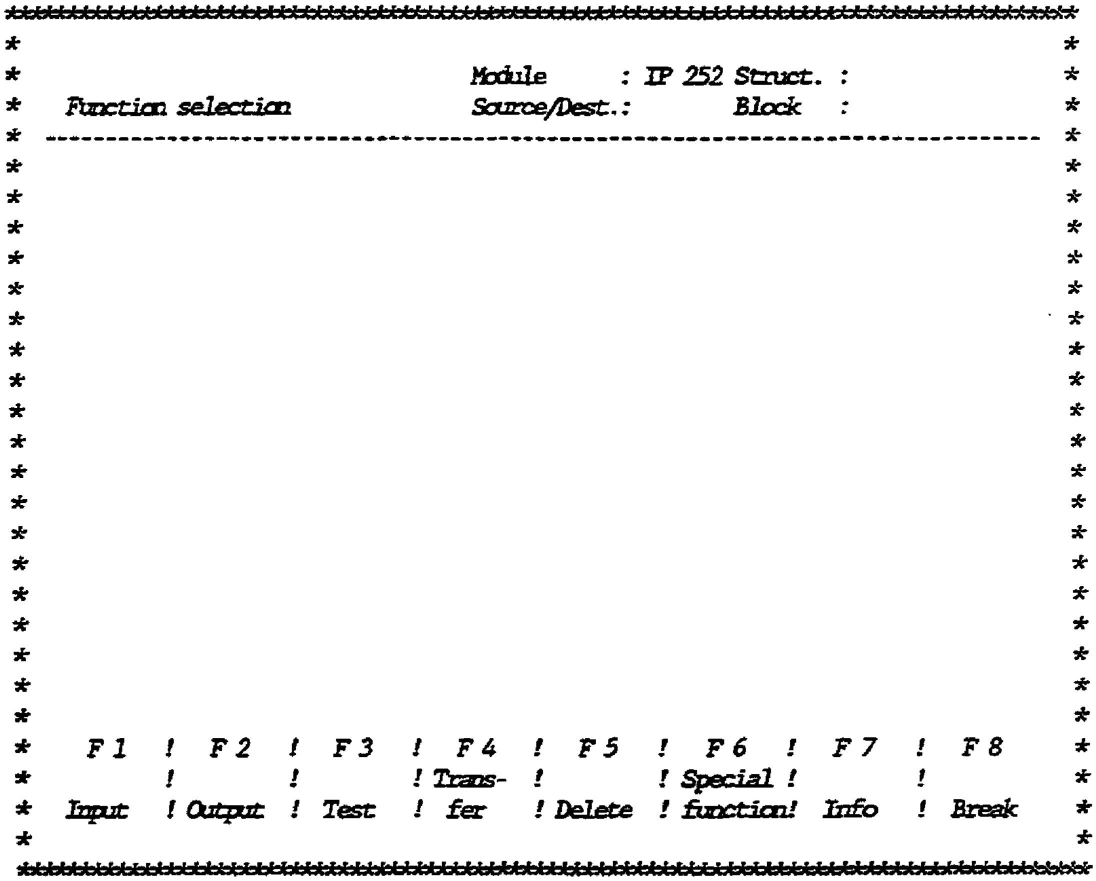
Use the <F4> function key to carry out these presettings.

For the description of the following masks a standard controller with memory submodule AR/SR is taken as an example.

When the <F7> key is pressed the main menu is displayed.

5.1 Main Menu

The main menu is the starting mask for all functions; the user can reach it from each position of the program by pressing the Break key once or several times.



```
*********************************************************************************
*                                                                               *
*                                 Module      : IP 252 Struct. :               *
*   Function selection            Source/Dest.:        Block   :               *
*  ---------------------------------------------------------------------------  *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*                                                                               *
*    F 1   !   F 2   !   F 3   !   F 4   !   F 5   !   F 6   !   F 7   !   F 8  *
*          !         !         ! Trans-  !         ! Special !         !        *
*   Input  ! Output  !  Test   !  fer    ! Delete  ! function!  Info   ! Break  *
*                                                                               *
*********************************************************************************
```

Fig. 5.3 Main menu

Starting from this main menu, the user steps to the sub-menus by pressing the respective function key. The selectable functions are:

<F1> : Input	(see chapter 5.2)
<F2> : Output	(see chapter 5.3)
<F3> : Test	(see chapter 5.8)
<F4> : Transfer	(see chapter 5.4)
<F5> : Delete	(see chapter 5.5)
<F6> : Special functions	(see chapter 5.6)
<F7> : Info	(see chapter 5.7)
<F8> : Break	

5.2 Input

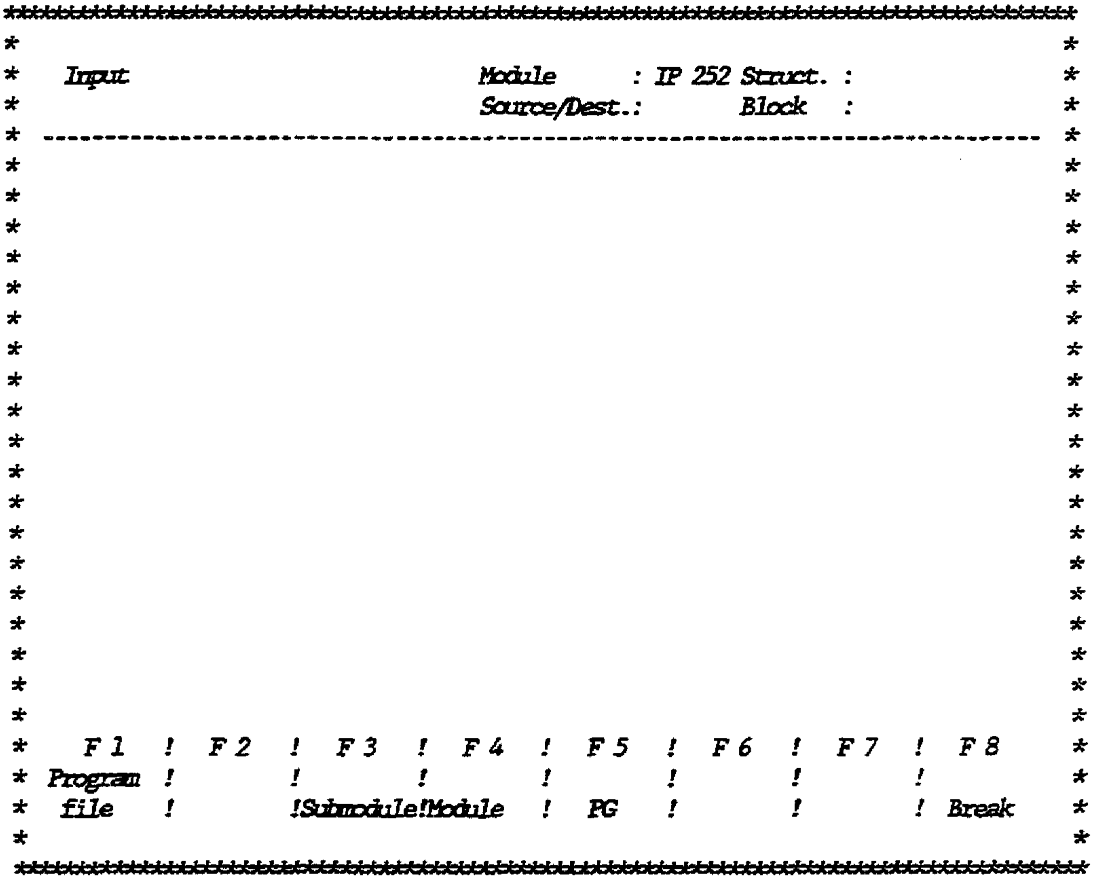
The term "Input" describes each step for specifying the control loop. In order no step is omitted during the initial input the PG leads the user in a linear manner, i. e. without branches, through all input functions.

```
Input sequence:   Select the destination medium
                                I
                                I
                  Enter the control loop number
                                I
                                I
                       Select the structure
                                I
                                I
                            Structure
                                I
                                I
                        Enter the scan time
                                I
                                I
                   Specify the Stop behaviour
                                I
                                I
                      Specify the dimension
                                I
                                I
                    Parameterize the branches
```

After the input function is selected the PG replies by displaying the menu in figure 5.3.

This menu requests the input of the medium where the data to be input should be stored. This information is entered into the field "Source/Dest.:" in the header area. The following entries are permitted:

<F1> : Program file
<F2> : ----
<F3> : Submodule
<F4> : Module
<F5> : Programmer
<F6> : ----
<F7> : ----
<F8> : Break



```
**************************************************************************************
*                                                                                    *
*   Input                          Module       : IP 252 Struct. :                   *
*                                  Source/Dest.:        Block    :                   *
* -------------------------------------------------------------------------------    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*    F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8    *
* Program  !        !        !        !        !        !        !          *
*  file    !        !Submodule!Module !  PG    !        !        ! Break    *
*                                                                                    *
**************************************************************************************
```

Fig. 5.4 Menu for destination input

After the destination is selected the controller structure is selected in the same way. The function keys are assigned the following:

<F1> Standard controller
<F2> Drive controller
<F8> Break

At this stage the PG requests the control loop number. Since IP252 is able to process up to eight control loops, the entry 1..8 is permitted. Thus the data entered in the following procedure is allocated to a specific control loop.

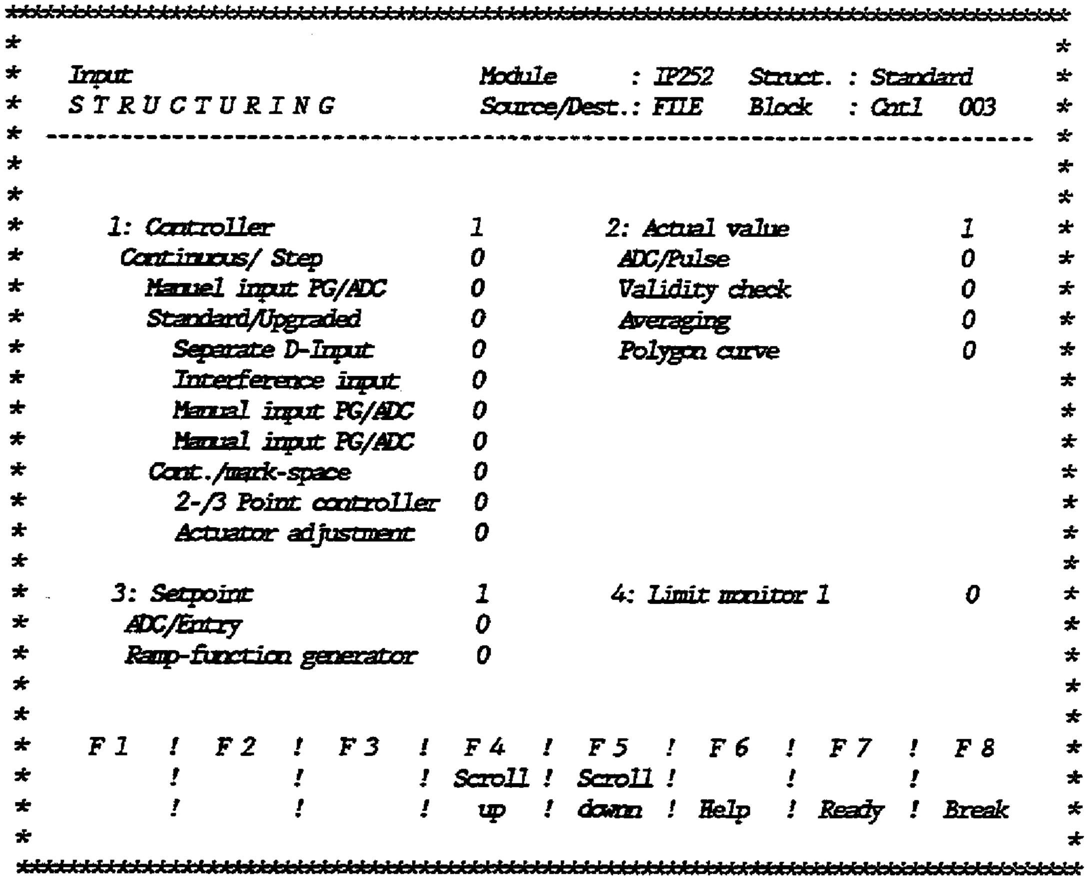
Each entry made appears in the right part of the header area. When the user has entered the control loop number and transferred it by pressing the Return key, the structuring mask (figure 5.5) is displayed.

5.2.1 Structuring

Structuring means that the software switches that exist between the permanently assigned branches, are set according to the application. That means that the switches of the branches required are closed (=1) and those of the branches not required are open (=0).

The structuring switches may function as on-off switches as well as changeover switches. For on-off switches "0" means No and "1" means Yes. Changeover switches are marked with a slash "/" in the text and are used to select one of two sub-branches. "0" is assigned to the first and "1" to the second alternative.

The structuring switches are subordinated hierarchically and assigned to corresponding levels. These divisions are indicated by the indentations of the particular subordinate structure switch terms in the structuring mask.



```
******************************************************************************
*                                                                            *
*  Input                       Module      : IP252   Struct. : Standard      *
*  STRUCTURING                 Source/Dest.: FILE    Block   : Cntl   003    *
*  ------------------------------------------------------------------------  *
*                                                                            *
*                                                                            *
*    1: Controller              1          2: Actual value           1       *
*     Continuous/ Step          0           ADC/Pulse                0       *
*       Manuel input PG/ADC     0           Validity check           0       *
*       Standard/Upgraded       0           Averaging                0       *
*         Seperate D-Input      0           Polygon curve            0       *
*         Interference input    0                                            *
*         Manual input PG/ADC   0                                            *
*         Manual input PG/ADC   0                                            *
*       Cont./mark-space        0                                            *
*         2-/3 Point controller 0                                            *
*         Actuator adjustment   0                                            *
*                                                                            *
*    3: Setpoint                1          4: Limit monitor 1        0       *
*     ADC/Entry                 0                                            *
*     Ramp-function generator   0                                            *
*                                                                            *
*                                                                            *
*   F1  !  F2  !  F3  !  F4   !  F5   !  F6  !  F7   !  F8                   *
*       !      !      ! Scroll ! Scroll !      !       !                     *
*       !      !      !  up   !  down !  Help !  Ready !  Break              *
*                                                                            *
******************************************************************************
```

Fig. 5.4 Structuring mask

Since not all the structure switches of a controller structure can be displayed at a time, the contents of the screen may be scrolled up or down.
These functions can be executed by pressing the function keys <F4> or <F5>. The function key <F5> is assigned the function

Help; by pressing <F7> the entries made are transferred, by means of <F8> the processing of the mask is terminated and the main menu is displayed.

<F4> : Scroll up
<F5> : Scroll down
<F6> : Help
<F7> : Ready
<F8> : Break

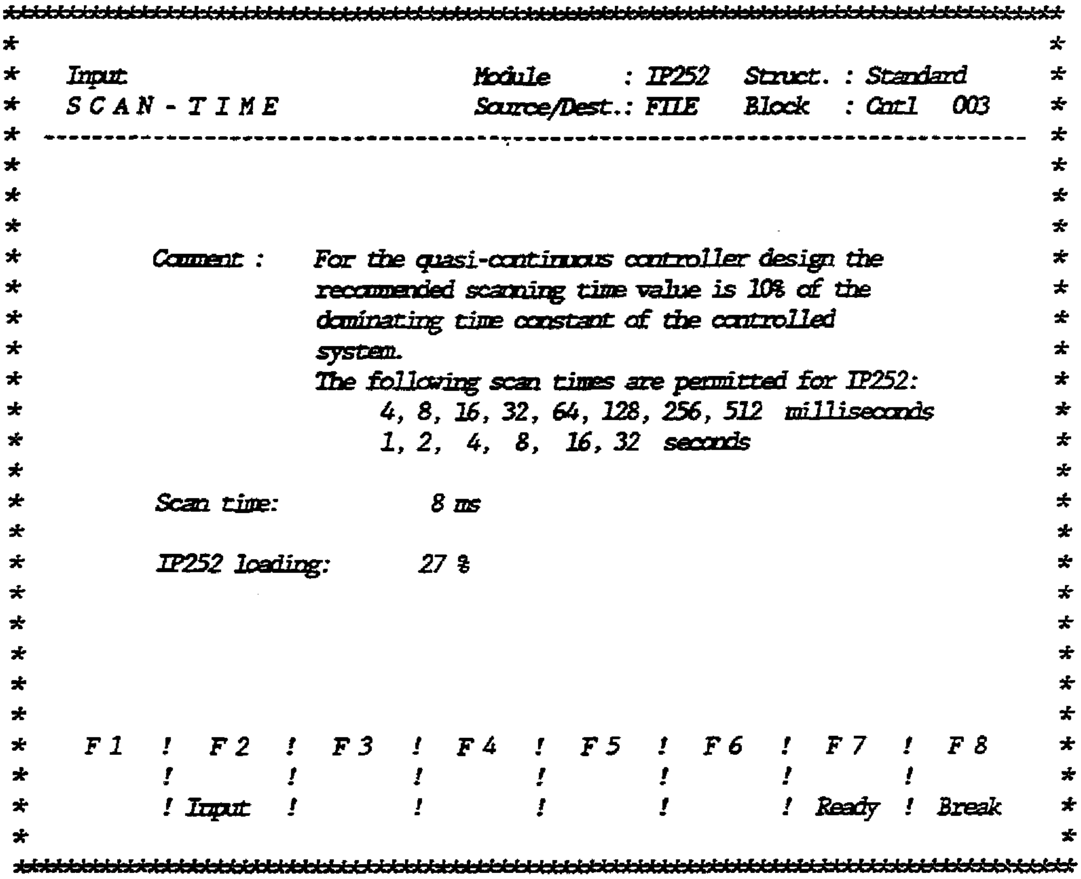
The cursor is moved on the screen by means of the cursor keys. The user structures the branches and subbranches by entering a "1". The branches not selected are suppressed.

As soon as the branches are set the user has defined the final control loop structure. When he is satisfied with it he may terminate the projection by pressing the function key <F7> (Ready).

5.2.2 Entering the Scan Time

After the controller structure is defined in the last step, the scan time is entered. The user should note that the scan time may only be a two's square value between 4 ms and 32 sec.

In the mask shown in figure 5.5, a rough formula is offered for selecting the scan time; the possible range is indicated. Below, the set or the default scan time is displayed (default is always TA = 4ms). In the bottom line the PG provides information on the processor loading according to the selected scan time, for the structure selected for the control loop. The unit is percent (%), 100 % indicates complete loading of the processor.



```
*******************************************************************************
*                                                                             *
*  Input                       Module      : IP252   Struct. : Standard       *
*  S C A N - T I M E           Source/Dest.: FILE    Block   : Cntl   003     *
*  -------------------------------------------------------------------------  *
*                                                                             *
*                                                                             *
*                                                                             *
*        Comment :    For the quasi-continuous controller design the          *
*                     recommended scanning time value is 10% of the           *
*                     dominating time constant of the controlled              *
*                     system.                                                 *
*                     The following scan times are permitted for IP252:       *
*                          4, 8, 16, 32, 64, 128, 256, 512  milliseconds      *
*                          1, 2,  4,  8,  16, 32  seconds                     *
*                                                                             *
*        Scan time:            8 ms                                           *
*                                                                             *
*        IP252 loading:       27 %                                            *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*   F 1  !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7  !  F 8               *
*        !       !       !       !       !       !       !                    *
*        ! Input !       !       !       !       ! Ready ! Break              *
*                                                                             *
*******************************************************************************
```

Fig. 5.6 Scan time menu

The menu offers the following function keys:

<F2> : Input
<F7> : Ready
<F8> : Break

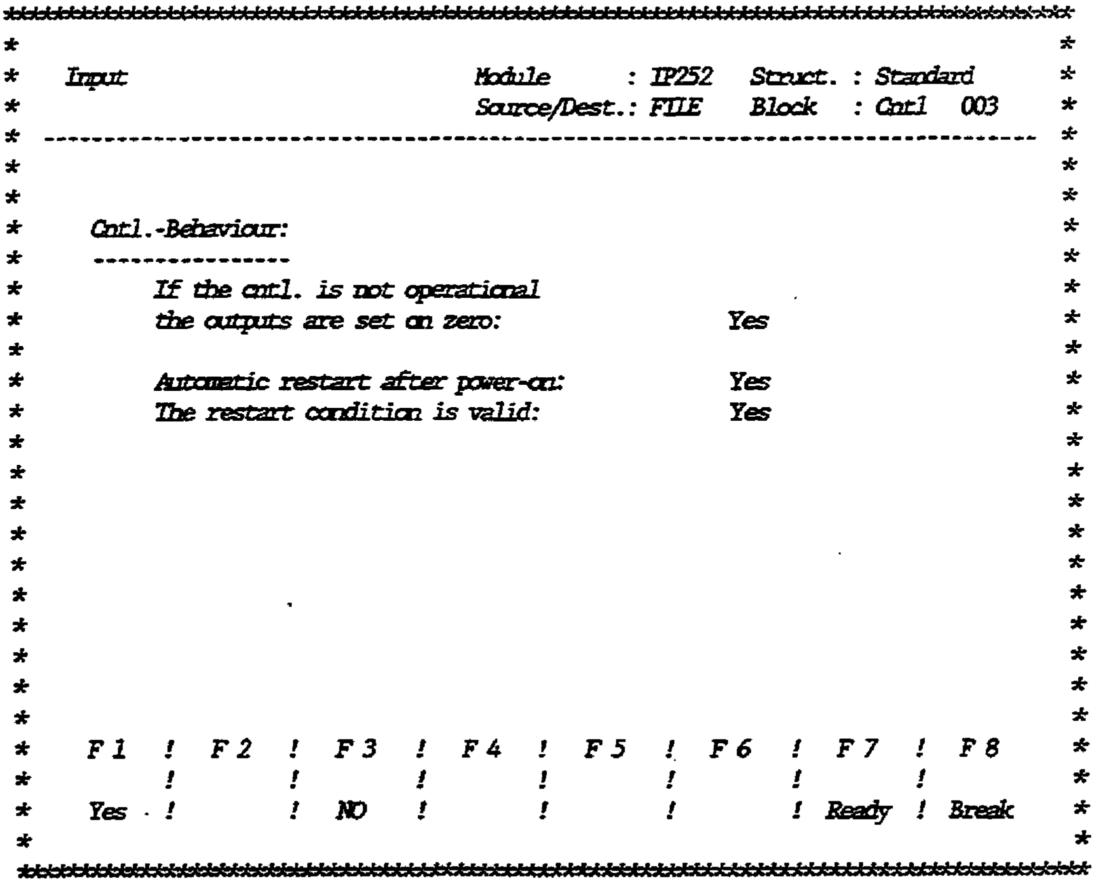
By pressing function key <F2> the default scan time can be modified. The keys <F7> and <F8> are assigned the same functions as in the previous menus.

To which extent the controller works stably with the scan time selected is the responsibility of the user. He is also responsible for the adaptation of controller parameters to the modified scan time.
When function key <F7> is pressed the mask for setting the controller behaviour (see figure 5.7) is displayed.

5.2.3 Controller Behaviour

In this menu the user specifies the controller behaviour in the case of a controller stop (e. g. when power failure occurs). For such a case three entries are necessary respectively three questions have to be answered. The default is "Yes" in all cases.

a) Should the controller outputs be set to "0" when the control loop is not executed?
b) Should the system restart, automatically, with resumption of power supply?
c) Is a restart condition to be observed when the system is started automatically (for a detailed description of this condition see sections 3.1 and 4.7)?



```
*****************************************************************************************
*                                                                                       *
*  Input                            Module       : IP252   Struct. : Standard           *
*                                   Source/Dest.: FILE     Block   : Cntl   003         *
*  -----------------------------------------------------------------------------------  *
*                                                                                       *
*                                                                                       *
*    Cntl.-Behaviour:                                                                   *
*    ----------------                                                                   *
*        If the cntl. is not operational                                                *
*        the outputs are set on zero:                 Yes                               *
*                                                                                       *
*        Automatic restart after power-on:            Yes                               *
*        The restart condition is valid:              Yes                               *
*                                                                                       *
*                                                                                       *
*                                                                                       *
*                                                                                       *
*                                                                                       *
*                                                                                       *
*                                                                                       *
*                                                                                       *
*                                                                                       *
*                                                                                       *
*    F 1   !   F 2   !   F 3   !   F 4   !   F 5   !   F 6   !   F 7   !   F 8          *
*          !         !         !         !         !         !         !                *
*    Yes   !         !   NO    !         !         !         !  Ready  !  Break         *
*                                                                                       *
*****************************************************************************************
```

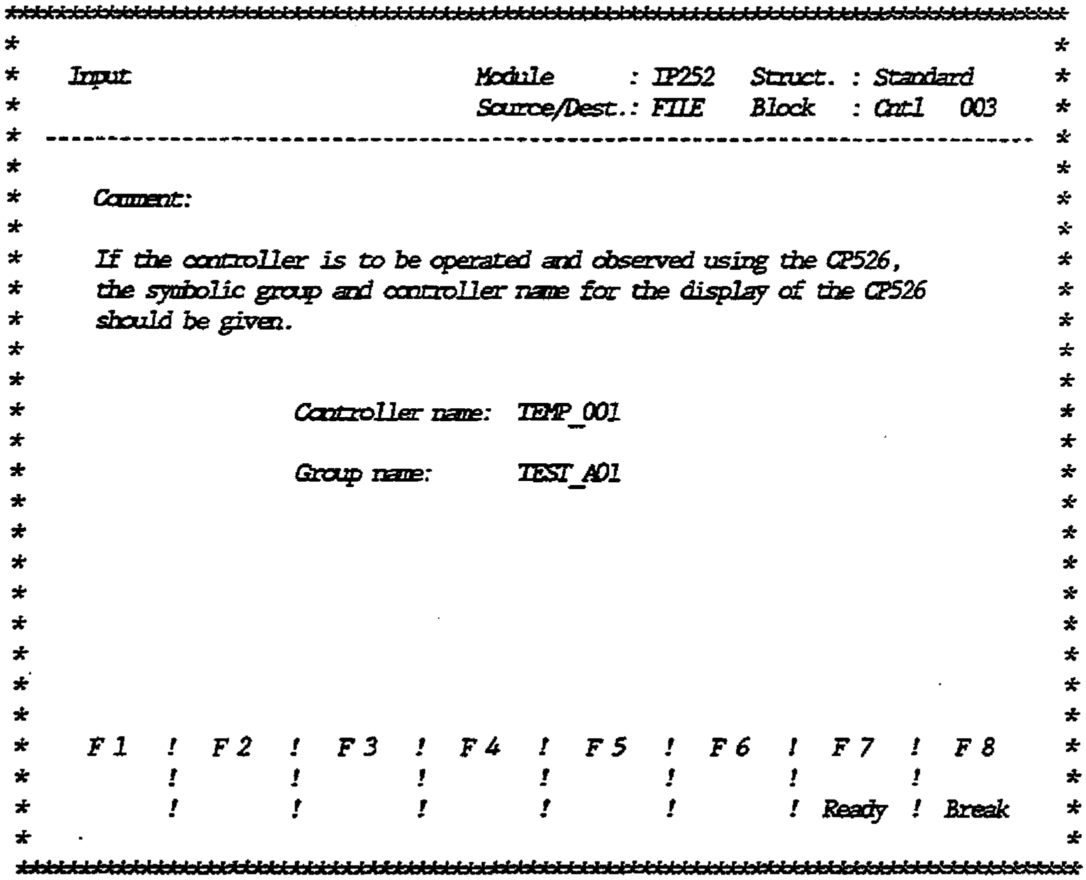
Fig. 5.7 Setting the controller behaviour

The displayed responses may be changed by pressing function key <F1> or <F3>. The function keys are assigned the following:

<F1> : Yes
<F3> : No
<F7> : Ready
<F8> : Break

5.2.4 Specifying the Controller Name and Area Name

After specifying the controller behaviour and pressing the "Ready" key <F7> each controller (No. 1 to 8) of the IP252 can be assigned a **controller name** and **area name** comprising each not more than 8 ASCII characters. Input in this mask, however, is useful only if controllers of the IP252 are to be operated and monitored via a CP526 or a similar device.



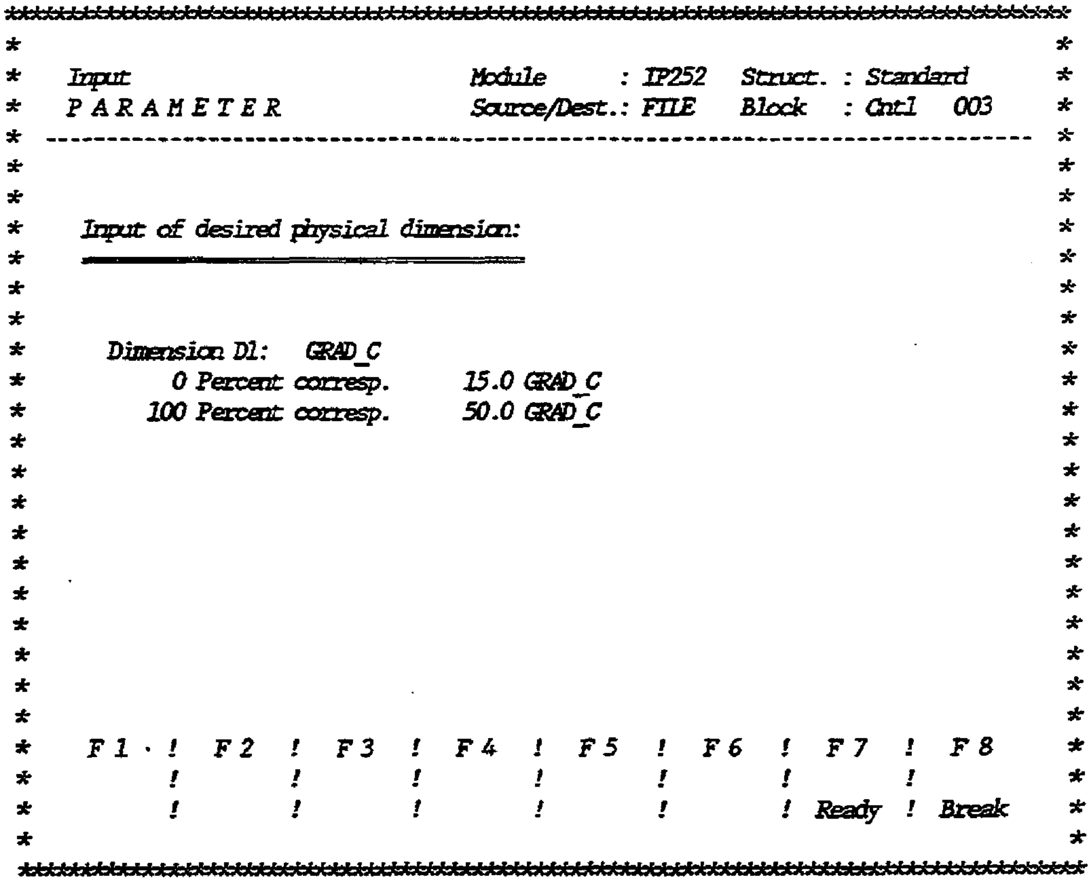
```
Input                              Module      : IP252   Struct. : Standard
                                   Source/Dest.: FILE    Block   : Cntl  003
-----------------------------------------------------------------------------

  Comment:

  If the controller is to be operated and observed using the CP526,
  the symbolic group and controller name for the display of the CP526
  should be given.


                 Controller name:  TEMP_001

                 Group name:       TEST_A01








 F1  !  F2  !  F3  !  F4  !  F5  !  F6  !  F7  !  F8
     !      !      !      !      !      !      !
     !      !      !      !      !      ! Ready ! Break
```

Fig. 5.8 Adaptation to CP526

At this stage, note that there is a difference between standard controllers and drive controllers. With the drive controller, activating the <F7> key will lead directly to the parameter assignment, whereas the standard controller still requests an intermediate step.
In this intermediate step, the dimension and characteristic is specified.

5.2.5 Specifying the Dimension

When the standard structure contains values with physical dimensions the user may specify an ASCII string and a characteristic of the dimension before parameterization. The default ASCII string with 6 characters contains "%"; the 0% value contains "0", and the 100% value contains "100".
The specification of the dimension consists of entering
- the ASCII string,
- the characteristic.
The menu for these entries is shown in figure 5.9.



```
Input                         Module      : IP252   Struct. : Standard
PARAMETER                     Source/Dest.: FILE    Block   : Cntl   003
---------------------------------------------------------------------------


 Input of desired physical dimension:



   Dimension D1:   GRAD_C
       0 Percent corresp.      15.0 GRAD_C
     100 Percent corresp.      50.0 GRAD_C










 F1 ! F2  !  F3  !  F4  !  F5  !  F6  !  F7   !  F8
    !     !      !      !      !      !       !
    !     !      !      !      !      ! Ready ! Break
```

Fig. 5.9 Input of the physical dimension

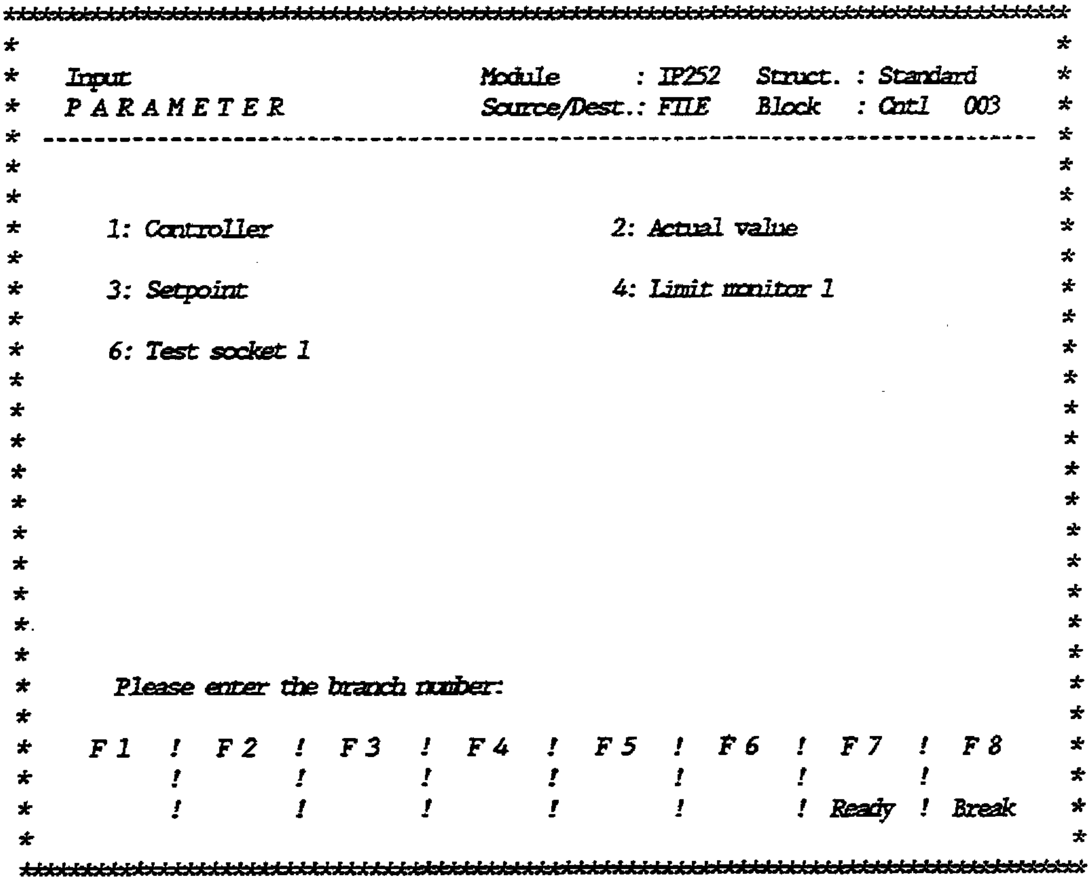
In the first line of the menu "Dimension D1" the user may enter the dimension necessary for the control loop, with an ASCII string up to 6 characters long if the default "%" does not match. Afterwards the cursor jumps to the next line and the % sign in the characteristic lines is replaced by the dimension entered. Then the "0 %" value and the "100 %" value are assigned a numerical value.

When these values are entered the PG checks whether the decimal places are identical and whether the characteristic entered is positive, i. e. whether the 0% value is less than the 100% value (see section 4.4.3).

5.2.6 Parameter Input

The last step of the input is to enter the parameters of the last structured controller. Here the PG offers only those subfunctions (branches) activated in the previous structuring mode, for parameterizing.

The parameterizing starts with the PG displaying a list of the connected branches where each branch is assigned a selection number, which is identical to the branch number (see figure 5.10). By means of the selection number the user may call the parameter list of the subfunctions to be parameterized. After the selection number is entered the branch selection is terminated by pressing the <Enter> key.



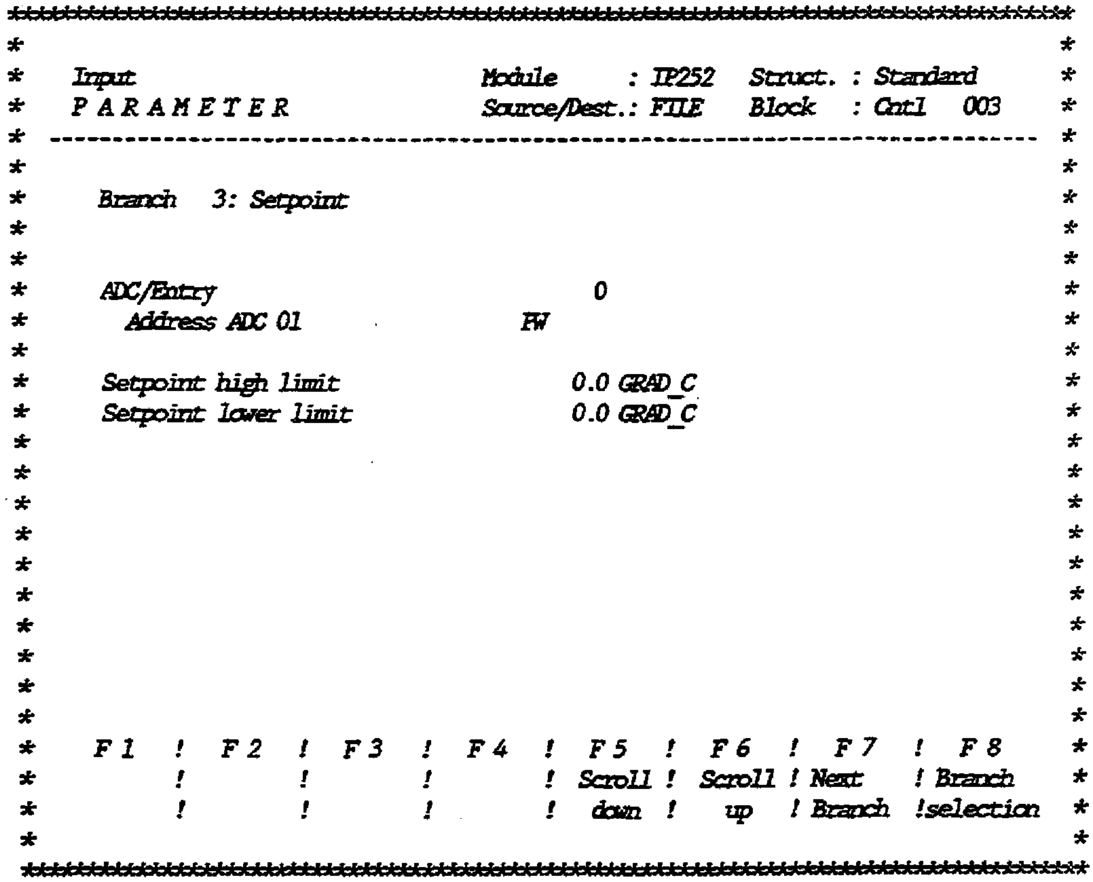
```
  Input                       Module      : IP252   Struct. : Standard
  PARAMETER                   Source/Dest.: FILE    Block   : Cntl  003
  ---------------------------------------------------------------------


     1: Controller                      2: Actual value

     3: Setpoint                        4: Limit monitor 1

     6: Test socket 1











     Please enter the branch number:

   F1  !  F2  !  F3  !  F4  !  F5  !  F6  !  F7    !  F8
       !      !      !      !      !      !        !
       !      !      !      !      !      !  Ready !  Break
```

Fig. 5.10 Parameter input/Branch overview

After a branch is selected the corresponding parameter list is displayed. Only the parameters of the selected subbranches are displayed.

After the branches are parameterized each entry should be terminated by pressing <Carriage Return>, whereas the complete parameter list of each branch is terminated by pressing the

<Enter> key. Then the parameter list of the next branch is displayed until all branches are parameterized. Figure 5.11 shows the parameters of branch 3 of the standard controller when the memory submodule ARS/SR is used.



```
*******************************************************************************
*                                                                             *
*   Input                         Module      : IP252   Struct. : Standard    *
*   P A R A M E T E R             Source/Dest.: FILE    Block   : Cntl   003  *
* --------------------------------------------------------------------------- *
*                                                                             *
*    Branch   3: Setpoint                                                     *
*                                                                             *
*                                                                             *
*    ADC/Entry                            0                                   *
*      Address ADC 01                FW                                       *
*                                                                             *
*    Setpoint high limit                0.0 GRAD_C                            *
*    Setpoint lower limit               0.0 GRAD_C                            *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*    F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8       *
*          !        !        !        ! Scroll ! Scroll ! Next   ! Branch     *
*          !        !        !        !  down  !   up   ! Branch !selection   *
*                                                                             *
*******************************************************************************
```

Fig. 5.11 Parameter input

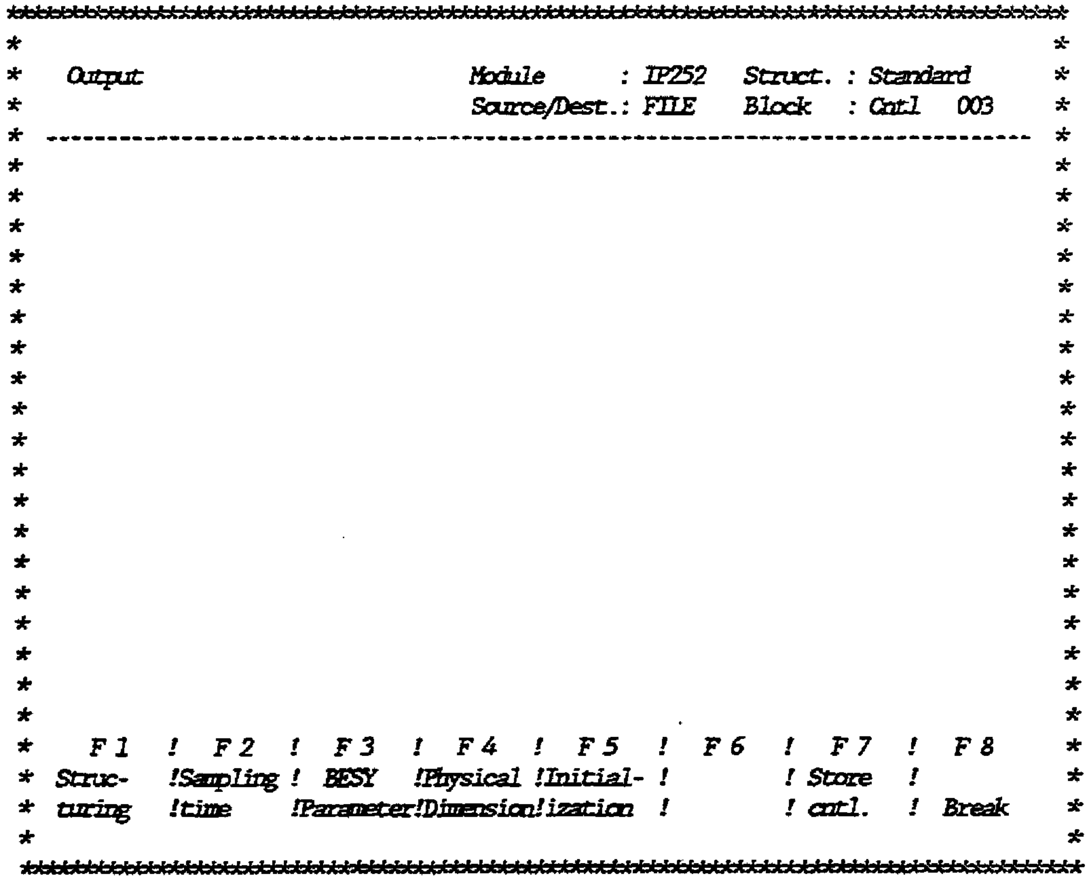
Following this procedure the PG redisplays the list of all activated branches. This enables the user to correct the entries later. When all the values are modified the <F7> key is pressed and the data, entered so far, is transferred. When the destination device already contains a data set with the same controller number the programmer displays a menu which prompts the user whether the data set stored in the PG may be deleted.

The user must answer the prompt "Controller x overwrite (Y/N)". He does this by pressing the function key "Yes" or "No". When "Yes" is pressed the data set just entered is stored and the data set in the destination medium is overwritten; when "No" is pressed the new data set is lost.

5.3 Output

When the user selects the function "Output" in the main menu by pressing function key <F2> the output menu as shown in figure 5.12 is displayed after entry of the destination medium and the control loop number. By means of this function an already existing control block may be checked, amended or corrected.

Contrary to the linear prompting during input, the desired masks may directly be selected in the output function. The screen masks "STRUCTURING", "SCAN TIME", "CONTROLLER BEHAVIOUR", "PHYSICAL DIMENSION", and "PARAMETERIZING" are handled in the output function as described in the previous section.
After each step the program returns to the output menu. If the <Break> key or the <Enter> key is pressed this menu is left and the saving dialog started.



```
*******************************************************************************
*                                                                             *
*  Output                          Module      : IP252   Struct. : Standard   *
*                                  Source/Dest.: FILE    Block   : Cntl  003  *
*  -------------------------------------------------------------------------  *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*                                                                             *
*   F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8       *
*  Struc-  !Sampling !  BESY   !Physical !Initial- !        ! Store  !          *
*  turing  !time     !Parameter!Dimension!ization  !        ! cntl.  !  Break   *
*                                                                             *
*******************************************************************************
```

Fig. 5.12 Output menu

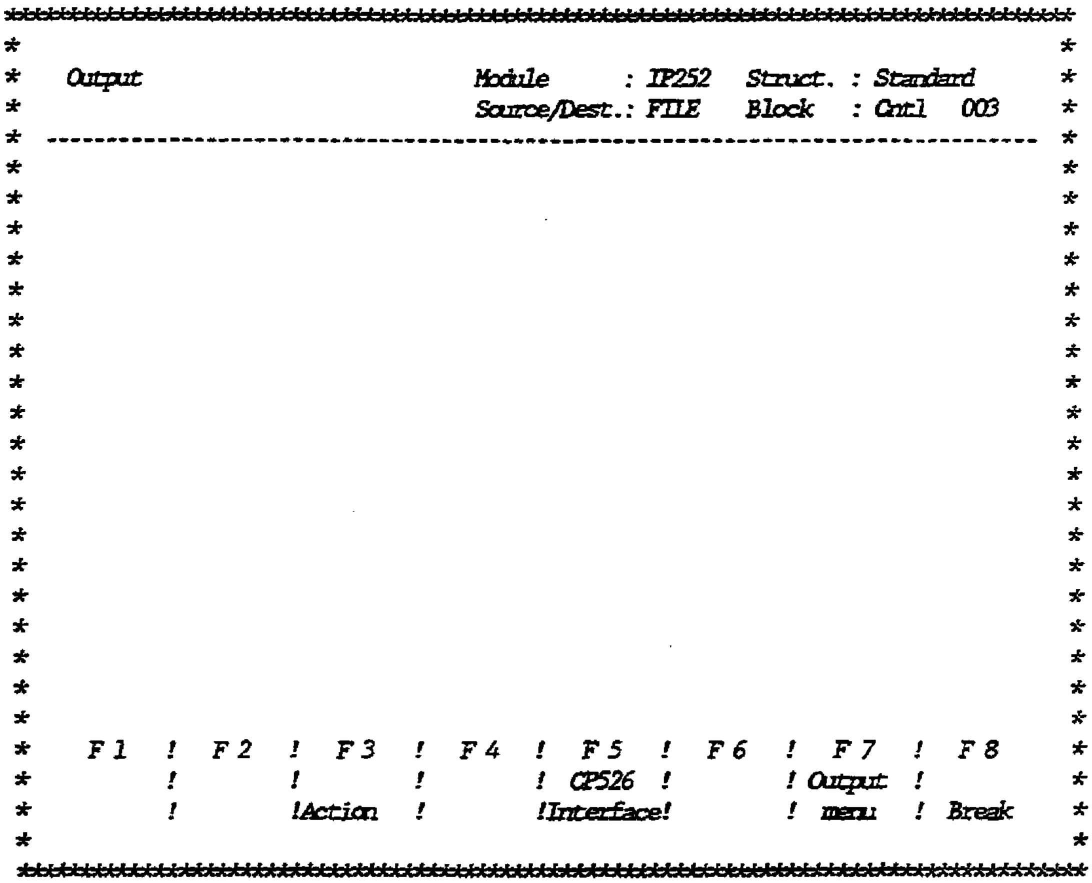
In the submenu to

<F3> BESY parameter

the softkeys

<F3> Behaviour
<F4> Adaptation to CP526

are displayed (see also figures 5.7 and 5.8).



```
*****************************************************************************
*                                                                           *
*   Output                     Module       : IP252    Struct. : Standard   *
*                              Source/Dest.: FILE     Block   : Cntl   003  *
*  -----------------------------------------------------------------------  *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*   F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8     *
*         !        !        !        !  CP526 !        ! Output !          *
*         !        !Action  !        !Interface!       !  menu  !  Break   *
*                                                                           *
*****************************************************************************
```

Fig. 5.13 Submenu to function "BESY parameter"

CAUTION:
When the controller is parameterized the set dimension is, if necessary, displayed initially and may be modified in the output function. The user should note that the modification of the characteristic does not cause another check of the values previously entered. After the characterstic is modified the new values may exceed the input range and lead to undefined states.

The user is completely responsible for the modification of the dimension characteristic in the output!

When the user presses function key <F2> in the main menu the output mode is called. When at this stage the "Print" function key is pressed, the "Print" menu shown in figure 5.14 is displayed.

In this menu the user may select the following printouts:

<F2> : Print block
<F5> : Print all
<F6> : Cross reference list
<F8> : Break

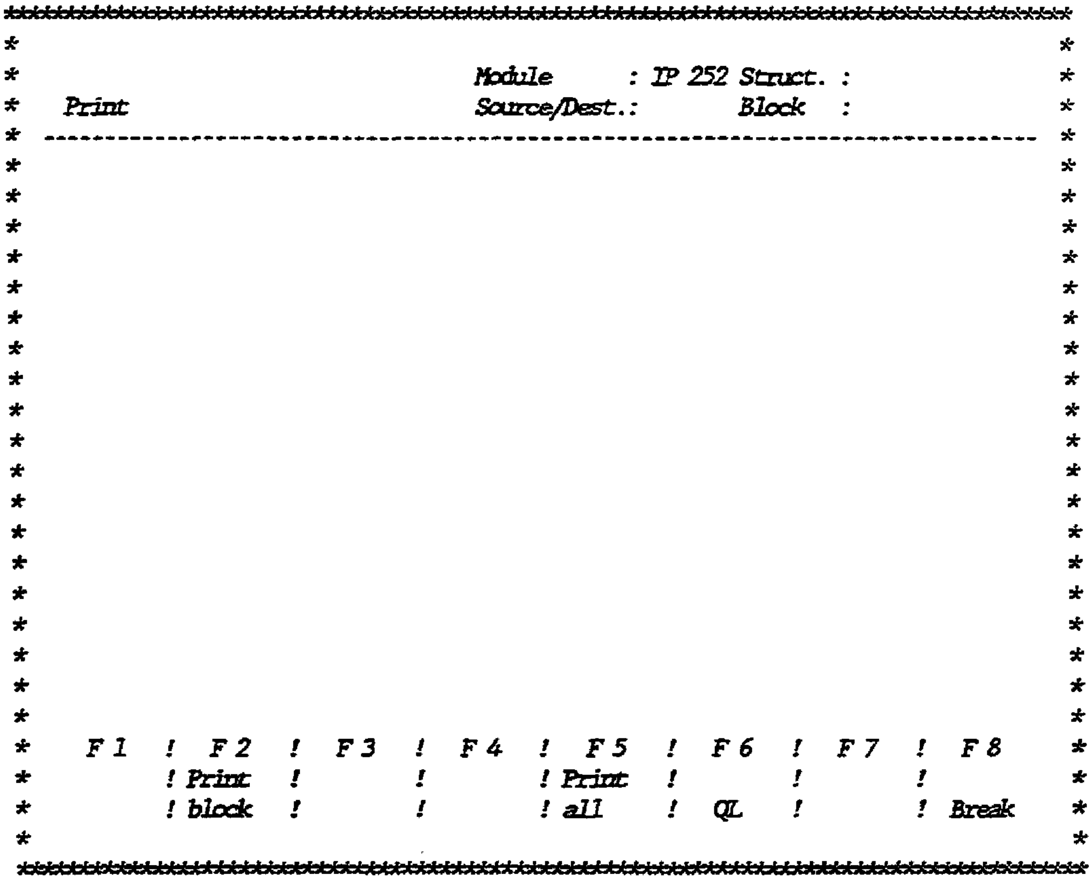
The cross reference list contains a list of all inputs and outputs used for each control loop. This documents the interconnection and multiple allocations may be avoided.

With the function "Print block" the controller structures, scan time and all parameters are printed for one selected control loop.

With the function "Print all" the cross reference list, controller structure, scan time and all parameters of all control loops are printed.

After the program is selected the input of the source medium is requested; when the function "Print block" is selected, the control loop number should also be entered.

When the <Break> key is pressed the user returns to the main menu.



```
                                  Module      : IP 252 Struct. :
  Print                           Source/Dest.:        Block   :
 ------------------------------------------------------------------------------

  F1  !  F2    !  F3  !  F4  !  F5    !  F6  !  F7  !  F8
      ! Print  !      !      ! Print  !      !      !
      ! block  !      !      ! all    !  QL  !      ! Break
```

Fig. 5.14 Print menu

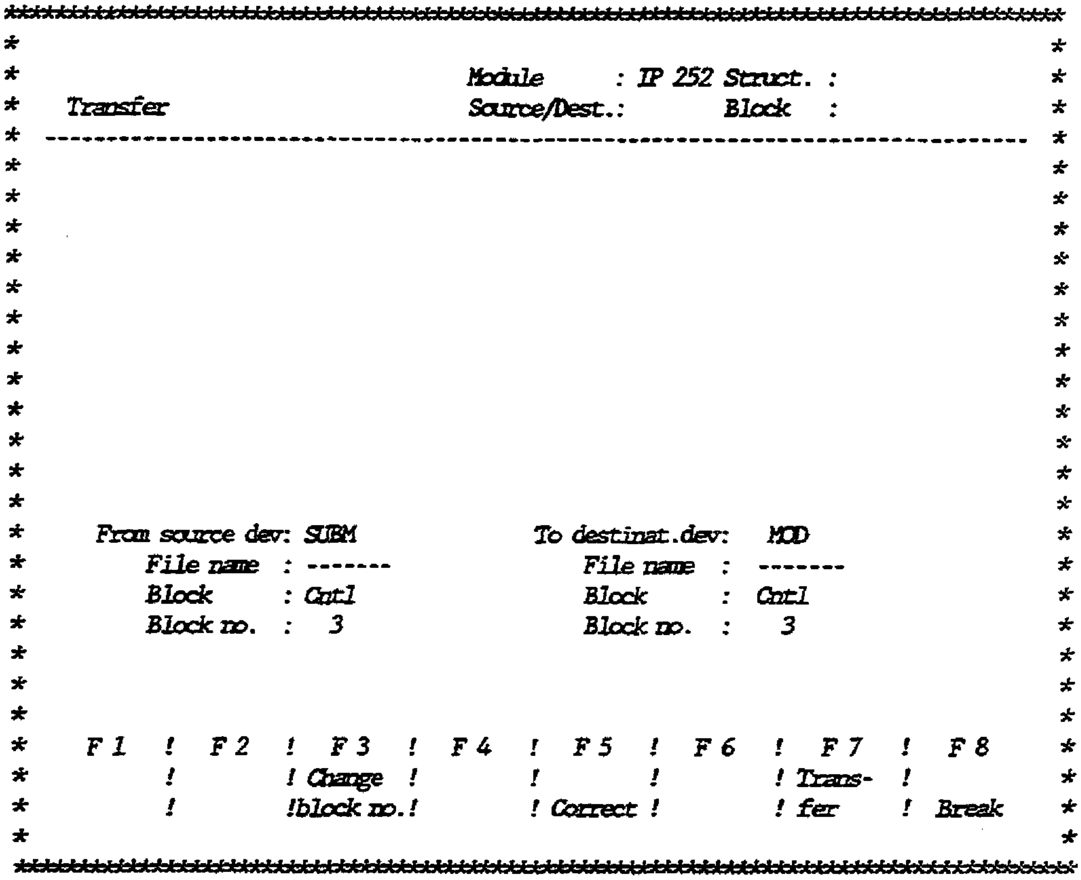
5.4 Transfer

With the function "Transfer" the blocks are transferred to the individual media; however, only one block can be transferred at a time.
When the function key <F4> is pressed in the main menu, the user is prompted to enter the source and the destination medium. The function keys are assigned the following:

<F1> : Program file
<F3> : Submodule
<F4> : Module
<F5> : PG
<F8> : Break

The user should additionally enter the block (parameter set) that is to be transferred. When an asterisk (*) is entered all blocks are transferred.
Afterwards the PG displays the menu shown in figure 5.15 where the function keys are assigned the following:

<F3> : Change block number
<F5> : Correct
<F7> : Transfer
<F8> : Break



```
  Transfer                     Module       : IP 252 Struct. :
                               Source/Dest.:        Block   :
 ------------------------------------------------------------------------












     From source dev: SUBM               To destinat.dev:   MOD
          File name  : -------              File name  :  -------
          Block      : Cntl                 Block      :  Cntl
          Block no.  :   3                  Block no.  :    3



     F 1  !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7  !  F 8
          !       ! Change !      !       !       ! Trans- !
          !       !block no.!     ! Correct !     ! fer    !  Break
```

Fig. 5.15 Menu for block transfer

<F3> Change block number	This function enables the user to change the block numbers. The input of the new numbers is to be terminated by pressing <Carriage Return>.
<F5> Correct	This function enables the user to correct incorrect entries. When for example the data set is to be transferred not to the selected device (medium) but to another one the user may change this entry by means of this function.
<F7> Transfer	This function enables the transfer in the selected manner. If a block with the same number is already stored in the destination device (medium) the user is prompted "Overwrite module? (Y/N)".
<F8> Break	This function terminates the function without transferring the data.

5.5 Delete

The user may call the Delete function by pressing function key <F5> in the main menu. Then the PG displays the Delete menu shown in figure 5.16.

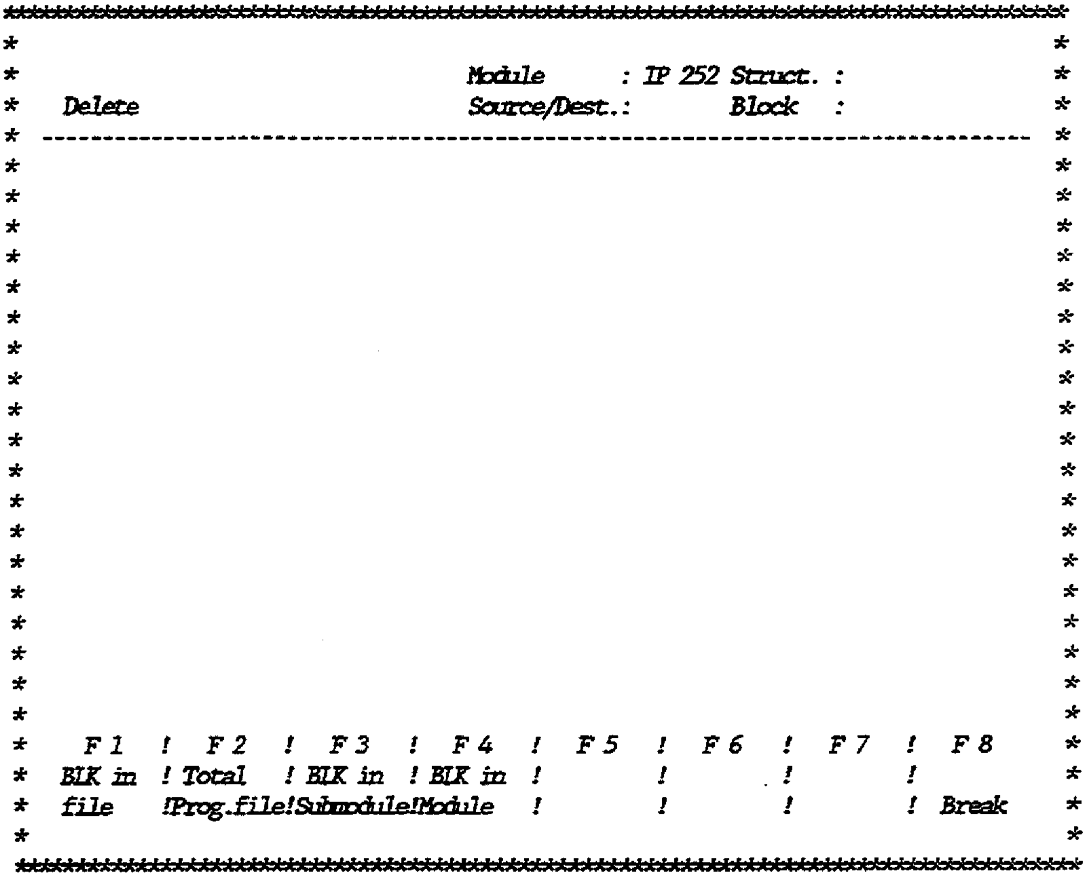
The following delete functions can also be called up by function keys:

<F1> Delete block from file
An individual block of the activated program file may be deleted.

<F3> Delete block from submodule
Individual controller data sets may be deleted from the memory module. When an asterisk (*) is entered instead of a controller number all controllers of this memory module are deleted.

<F4> Delete block from module
Individual controller data sets may be deleted from the module. When an asterisk (*) is entered instead of a controller number, all controllers are deleted from the module.

<F8> Delete complete prog. file
A program file is deleted completely from the disk or the Winchester. Thus all blocks are deleted from this file.



```
******************************************************************************
*                                                                            *
*                                 Module      : IP 252 Struct. :             *
*  Delete                         Source/Dest.:       Block    :             *
* -------------------------------------------------------------------------- *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*                                                                            *
*   F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8     *
*  BlK in ! Total  ! BlK in ! BlK in !        !        !        !           *
*  file   !Prog.file!Submodule!Module !        !        !        ! Break     *
*                                                                            *
******************************************************************************
```

Fig. 5.16 Delete menu

5.6 Special Functions

The special functions which the user selects from the main menu by pressing <F6> offer the following:

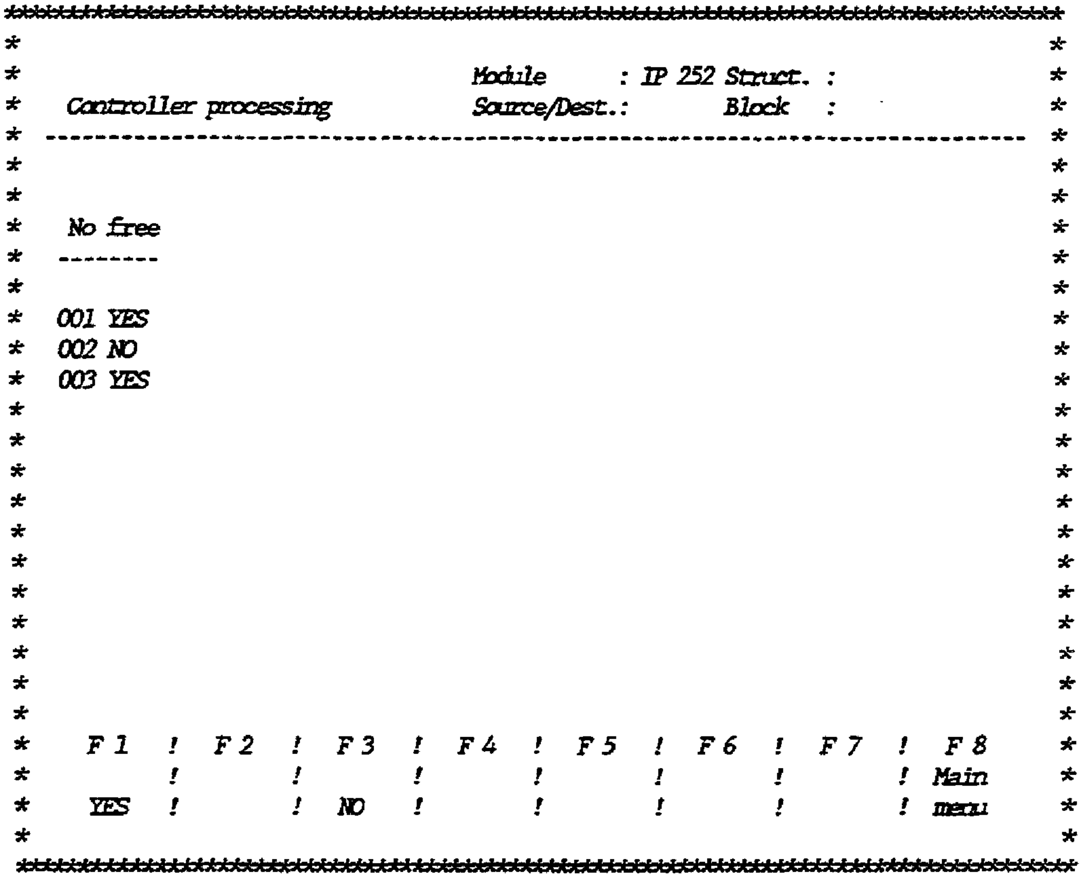
<F1> Start
This function that only runs online, sets the operating mode "Run" for the module.

<F4> Stop
This function that only runs online, sets the operating mode "Stop" for the module.

<F6> Preset
From this menu that is shown in figure 5.2, the operating mode and the program file may be selected. When the operating mode is prompted the user should enter, offline, if programmer and programmable controller are not connected.
The user is offered two alternatives when operating the IP252:
- "IP252 without bus access" (<F3>)
- "IP252 with bus access" (<F4>).

The term "with bus access" respectively "without bus access" means that the IP252 may behave like a co-processor; if "with bus access" is selected the IP252 may access the peripheral, plugged into the same central processor, without increasing the CPU loading. This direct bus access is described in detail in section 4 and is restricted to the IP252 in the S5-115U.
The controller blocks may be stored together in a program file on an external storage medium. The file name is optional; the user should enter it into this presetting mask, to inform the program. The filename consists of 6 characters maximum; when it is smaller, the remaining places are filled with "@" signs. When no drive is selected the default drive is assumed.

<F7> Controller processing
Using this function which runs only online, the user is able to individually enable or disable the control loops of the module. This is shown in the menu in figure 5.17.



```
*****************************************************************************
*                                                                           *
*                                Module       : IP 252 Struct. :            *
*   Controller processing        Source/Dest.:         Block   :            *
*  ----------------------------------------------------------------------   *
*                                                                           *
*                                                                           *
*   No free                                                                 *
*  --------                                                                 *
*                                                                           *
*  001 YES                                                                  *
*  002 NO                                                                   *
*  003 YES                                                                  *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*                                                                           *
*    F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8     *
*          !        !        !        !        !        !        ! Main     *
*    YES   !        !  NO    !        !        !        !        ! menu     *
*                                                                           *
*****************************************************************************
```

Fig. 5.17 Controller processing menu

The cursor may be moved to the individual control loops in this menu. The function keys are assigned the following:

<F1> Yes
The control loop on which the cursor is positioned is enabled.

<F3> No
The control loop on which the cursor is positioned is disabled.

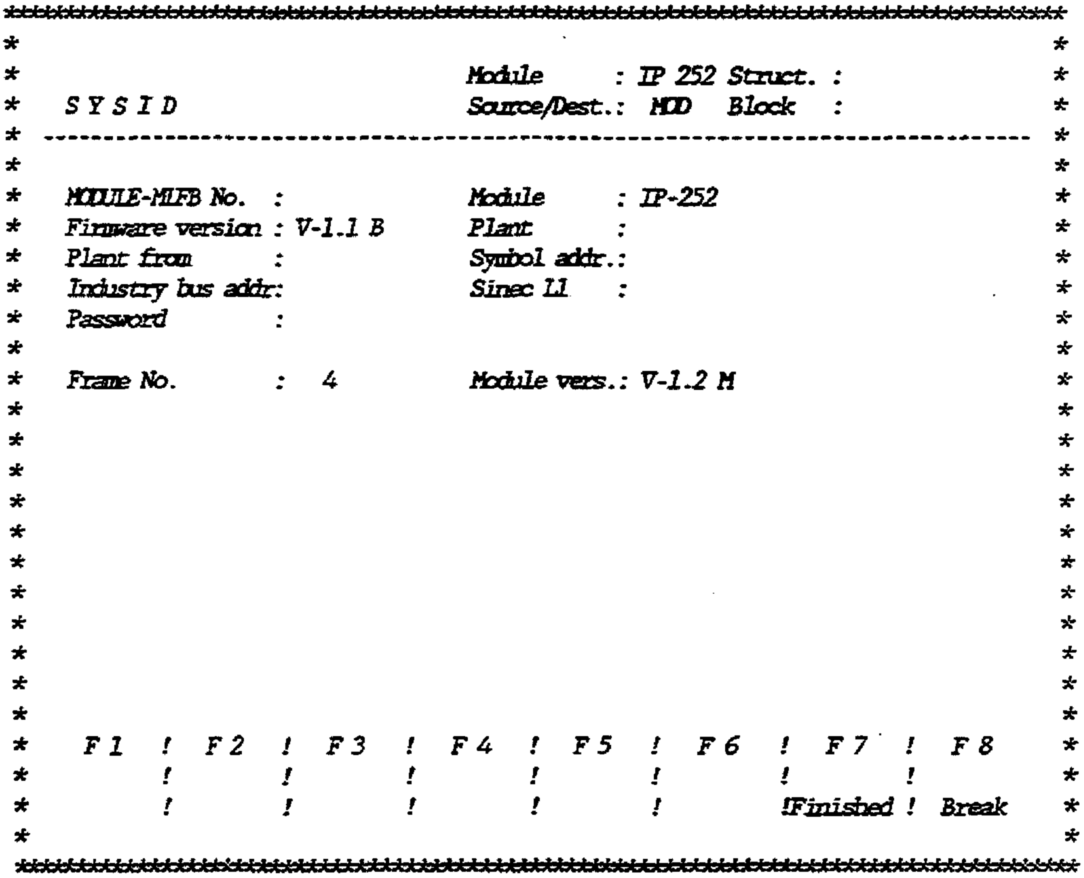
<F8> Main menu
When this function key is pressed the main menu is displayed.

5.7 Information Functions on the IP252

When the user presses the function key <F7> in the main menu the menu "Information" is displayed. The function keys are assigned the following:

<F2> Directory:
After the source device is selected, the programmer supplies a list of contents of all control loops of this medium. In addition to the control loop number the structure, the version number, and the processor loading are displayed.

<F4> SYSID Module:
<F5> SYSID Submodule:
These functions that lead to the menu shown in figure 5.18 inform the user about the plant to be controlled, the module, the submodule, the version number of the firmware, and the bus addresses.
Input is possible in the fields
"Plant from : date" and
"Frame no.: x" (x = 0 to 254).
These functions were introduced in order to enable the CPU of a programmable controller to operate its IPs and CPs and in order to read the data described above for diagnostic purposes.



```
**************************************************************************************
*                                                                                    *
*                                   Module       : IP 252 Struct. :                  *
*   S Y S I D                       Source/Dest.:  MD   Block    :                   *
* ---------------------------------------------------------------------------------- *
*                                                                                    *
*   MODULE-MLFB No.  :              Module       : IP-252                            *
*   Firmware version : V-1.1 B      Plant        :                                   *
*   Plant from       :              Symbol addr.:                                    *
*   Industry bus addr:              Sinec L1     :                                   *
*   Password         :                                                               *
*                                                                                    *
*   Frame No.        :   4          Module vers.: V-1.2 M                            *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*                                                                                    *
*    F 1  !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7  !  F 8                     *
*         !       !       !       !       !       !       !                          *
*         !       !       !       !       !       !Finished !  Break                 *
*                                                                                    *
**************************************************************************************
```

Fig. 5.18 SYSID menu

IP252 - Error diagnosis

<F6> IP252 fault
When a fault occurs in the IP252 this function displays an error message containing error number and description. Only one error message is displayed at a time, even if several errors should have occured. See figure 5.19 for the error messages.

When the "Info" function in the submenu "Error" is activated IP252 outputs the following messages for error diagnosis. The preceding fault numbers are stored as error code in the dual-port RAM (see also chapter 5, manual IP252).

Error code (decimal)	Text displayed at the PG	Error description	Reaction of IP
00.	No error	Normal state: "No error in IP252"	-
11.	Hardware	Timeout (except analog module)	"STOP"
12.	Hardware	Ckecksum of EPROMs is not valid	"STOP"
13.	Hardware	Offset check: deviation of a DAC >7LSB	"STOP"
14.	Hardware	Error in hardware test program: RAM	"STOP"
15.	Hardware	Error in hardware test program: MUART	"STOP"
20.	Watchdog	Monitoring time elapsed	"STOP"
21.	Dir. bus access	S5 bus is not enabled by S5 CPU	"STOP"
22.	Wire break at digital input	Open circuit at digital input (digital tacho)	"STOP" "STOP"
23.	Error in analog sec.	Voltage supply of analog sec. has failed	"STOP"
30.	PC STOP	Inhibit command output (BASP) is active	"STOP"
31.	Subm. error	Wrong/no submodule in IP252	"STOP"
50.	Error in analog module	Timeout or open circuit in analog module	"STOP"
51.	Overload	IP 252 overloaded (time conflict)	LED "F" flashing
70.	STOP switch	STOP switch of IP 252 in STOP position	"STOP"
71.	Software STOP	Stop of IP 252 (caused by PG or CPU)	"STOP"

The following messages only apply for the ARS structure

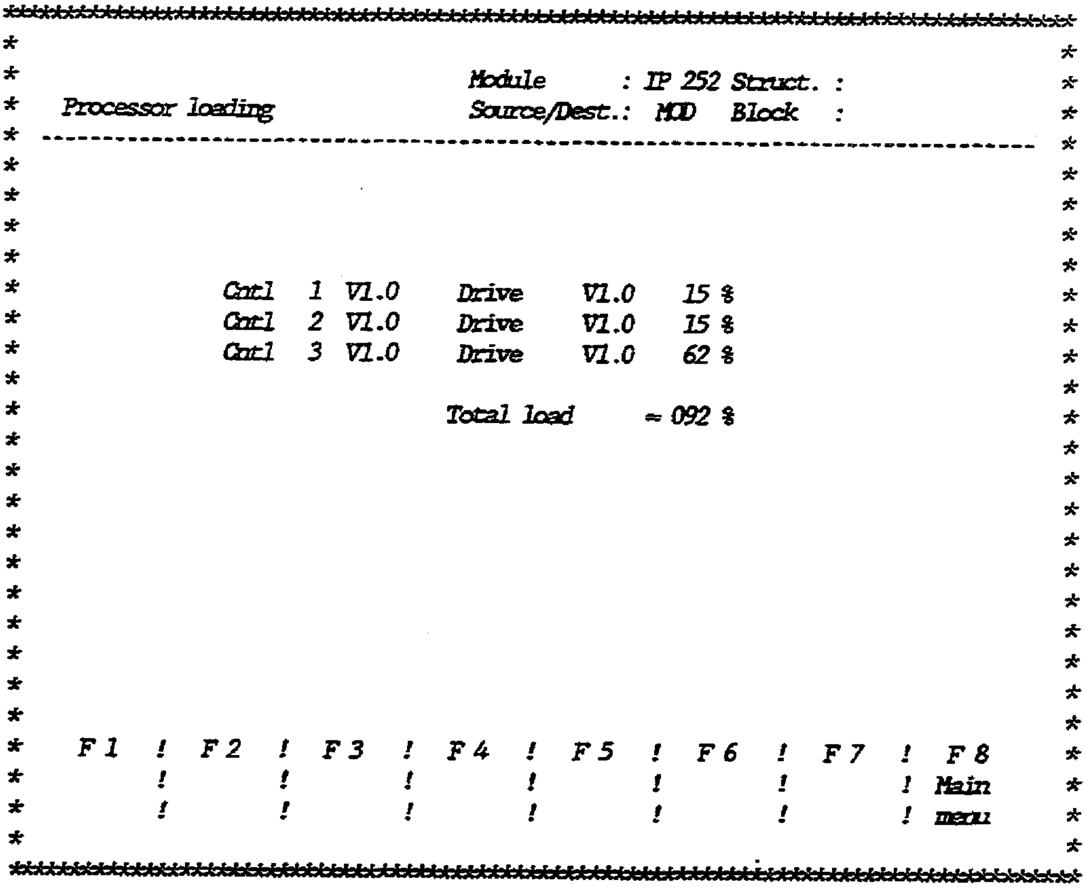
75.	Prepare self-setting		none
76.	Self-setting active		none
77.	Self-setting successfully terminated		none
78.	Structuring/ initializing error		none
79.	Invalid cntl number	Invalid controller no. (no. 1 or 2 only)	none
80.	Samp. time too long	Sampling time too long (TA=4 or 8 ms only)	none
81.	Load torque too high		none
83.	Unsuitable	Illegal procedure	none
84.	Optimization failed	Parameters could not been calculated	none
85.	Break by PG/PC	Break caused by programmer	none
86.	S5 communication error	S5 communication error with IP 240	none
87.	S5 wire break	Open circuit in IP 240 module	none

Fig. 5.19 Error messages of IP252 for error diagnosis

All messages listed above are recognized by the operating system of the IP252 and can also be fetched by the CPU from a specific RAM area of the IP252 (dual-port RAM) by means of RECEIVE 200. A fault entry will automatically be deleted when the module passes from "STOP" to "RUN".

Normally only the message which has been signalled first is entered. Message numbers 51 and 75 to 85 are an exception to this rule: These messages are overwritten by each following one!

<F7> Processor loading:
After the source device is entered this function supplies a list of all control loops together with the version number, a controller structure, the description list, and the processor loading of each control loop (IP252 loading). The total load of the individual modules must not exceed the 100% limit. See figure 5.20 for processor loading.



```
  Processor loading              Module      : IP 252 Struct. :
                                 Source/Dest.: MOD  Block    :
 ---------------------------------------------------------------------------



              Cntl  1 V1.0    Drive     V1.0    15 %
              Cntl  2 V1.0    Drive     V1.0    15 %
              Cntl  3 V1.0    Drive     V1.0    62 %

                             Total load       = 092 %











    F 1   !  F 2   !  F 3   !  F 4   !  F 5   !  F 6   !  F 7   !  F 8
          !        !        !        !        !        !        !  Main
          !        !        !        !        !        !        !  menu
```

Fig. 5.20 Processor loading

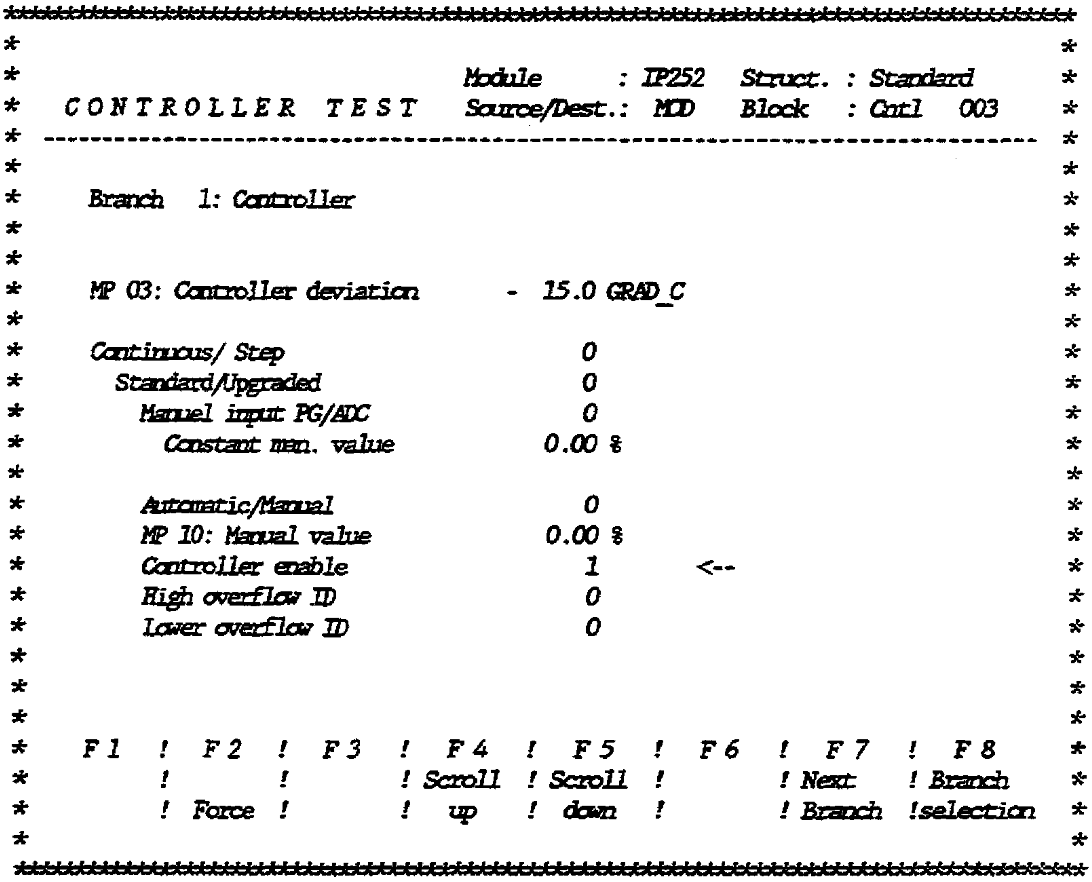
5.8 Controller Test

The controller test function which the user calls by pressing function key <F3> in the main menu, enables the user to operate and monitor the controller in online mode; in addition to the input and the display of parameters (in control mode) the controller test shows actual bit values (e. g. enabling branches or limit value identification), input values (e. g. PC setpoints) or intermediate results of the algorithm (so-called measuring points). All values are requested and updated by the IP252 several times per second.

This function is suitable, in particular, for the starting-up procedure, error diagnosis and optimization of control loops.

After the user has selected the function "Test" (<F3>) and entered the control loop number, the branch selection menu is displayed which is identical to the branch overview shown in figure 5.10. In addition to the branches offered for parameterization, there are the two functions "Measuring point table" and "Starting-up" in the control test. Within the individual branches, bit values and switch positions are displayed in addition to the data displayed for parameterization. After the user has selected a branch, a mask is displayed as shown in figure 5.21, for example.

<u>Note:</u> The measuring points of the limit monitors can also be changed in test operation. If you wish to change measuring points of different dimensions (example: MP4 regulating variable given as %, MP1 actual value is dimension-dependent), it is necessary to re-enter the limit values in order to obtain a correct indication of the limit monitor bits.



```
***********************************************************************************
*                                                                                 *
*                                   Module       : IP252   Struct. : Standard     *
*  C O N T R O L L E R   T E S T    Source/Dest.: MD      Block   : Cntl   003    *
* ------------------------------------------------------------------------------- *
*                                                                                 *
*    Branch   1: Controller                                                      *
*                                                                                 *
*                                                                                 *
*    MP 03: Controller deviation       -  15.0 GRAD_C                             *
*                                                                                 *
*    Continuous/ Step                       0                                     *
*      Standard/Upgraded                    0                                     *
*        Manuel input PG/ADC                0                                     *
*          Constant man. value           0.00 %                                   *
*                                                                                 *
*        Automatic/Manual                   0                                     *
*        MP 10: Manual value             0.00 %                                   *
*        Controller enable                  1        <--                          *
*        High overflow ID                   0                                     *
*        Lower overflow ID                  0                                     *
*                                                                                 *
*                                                                                 *
*                                                                                 *
*   F 1  !  F 2  !  F 3  !  F 4  !  F 5  !  F 6  !  F 7  !  F 8                   *
*        !       !       ! Scroll ! Scroll !      ! Next   ! Branch               *
*        ! Force !       !  up    !  down  !      ! Branch !selection             *
*                                                                                 *
***********************************************************************************
```

Fig. 5.21 Controller test menu

During this controller test the user may change each value except the structure switches. These changes should be made by means of the "Force" mode.

Controlling in the controller test

During the normal controller test the cursor is not visible. If the user wishes to modify a parameter during RUN he may initiate it by pressing the "Force" key. The result is that the cyclical status request is terminated and the last display is frozen. Then the cursor appears on the first field that can be accessed with the "Force" key respectively on the field that was accessed last in this section. In the "Force" mode, the cursor control is the same as in parameterization mode, except that the cursor can only be moved to "accessible" fields.

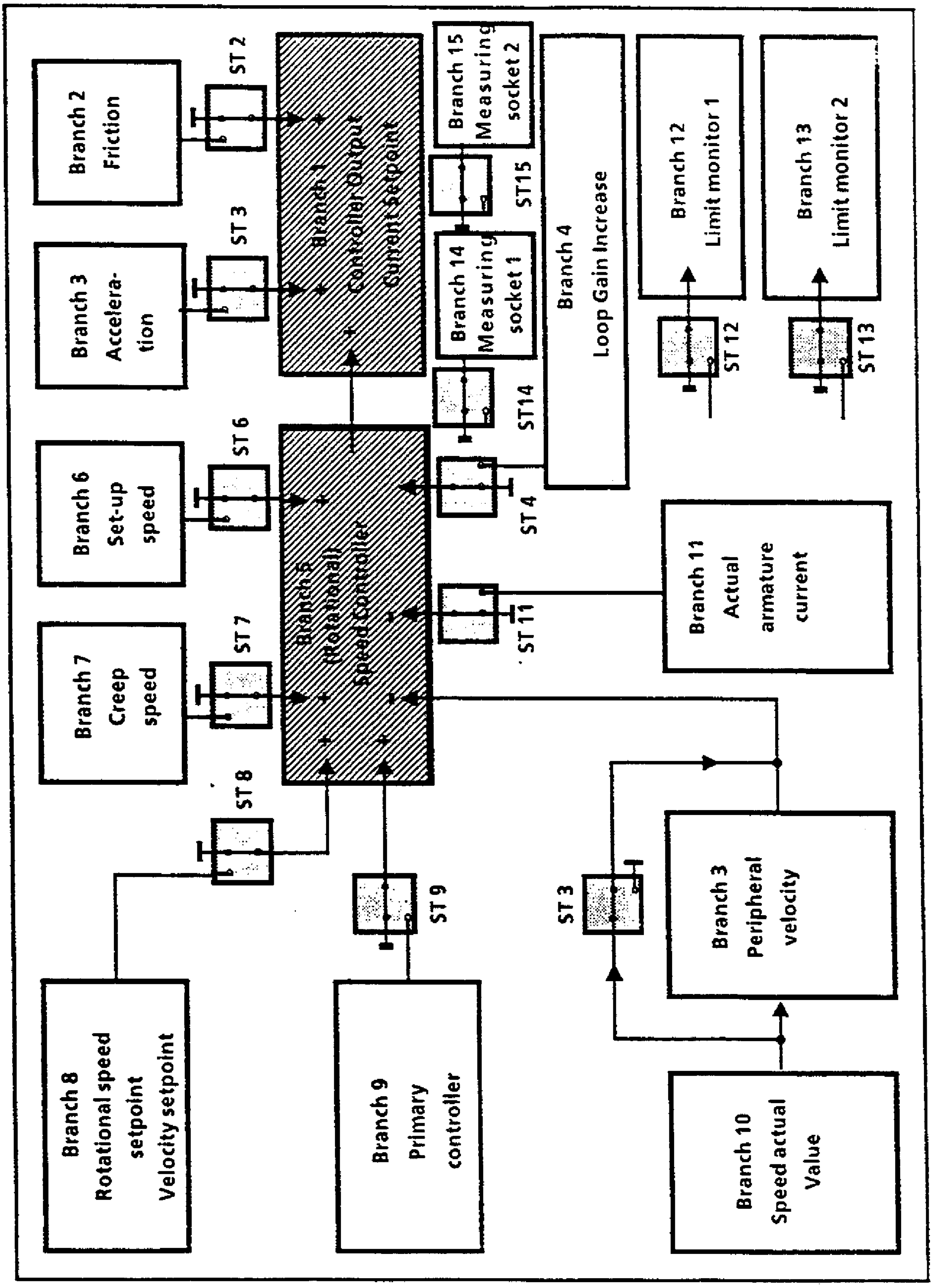
When a parameter, on which the cursor is to be moved, should be changed the existing value is overwritten by the new one and the entry is terminated by pressing the Return key. The PG transfers this new value immediately to the IP252, cancels the control mode and returns to the cyclical status output.

Non-controllable values: addresses
measuring points
number of limit values
number of vertices/setpoints

The following parameters may cause conflicts in the overlayed control of the IP252 since these parameters also may access the same lines via dual-port-RAM operation:

PC setpoints
PC enabling

Configuration sheet: Drive controller


Branch 2 Friction
ST 2
Branch 1 Controller Output Current Setpoint
Branch 15 Measuring socket 2
ST15
Branch 14 Measuring socket 1
ST14
Branch 4 Loop Gain Increase
Branch 12 Limit monitor 1
ST 12
Branch 13 Limit monitor 2
ST 13
Branch 3 Accelera- tion
ST 3
Branch 6 Set-up speed
ST 6
Branch 5 (Rotational) Speed Controller
ST 4
Branch 11 Actual armature current
ST 11
Branch 7 Creep speed
ST 7
ST 8
ST 9
ST 3
Branch 3 Peripheral velocity
Branch 8 Rotational speed setpoint Velocity setpoint
Branch 9 Primary controller
Branch 10 Speed actual Value
+
-

Controller No:

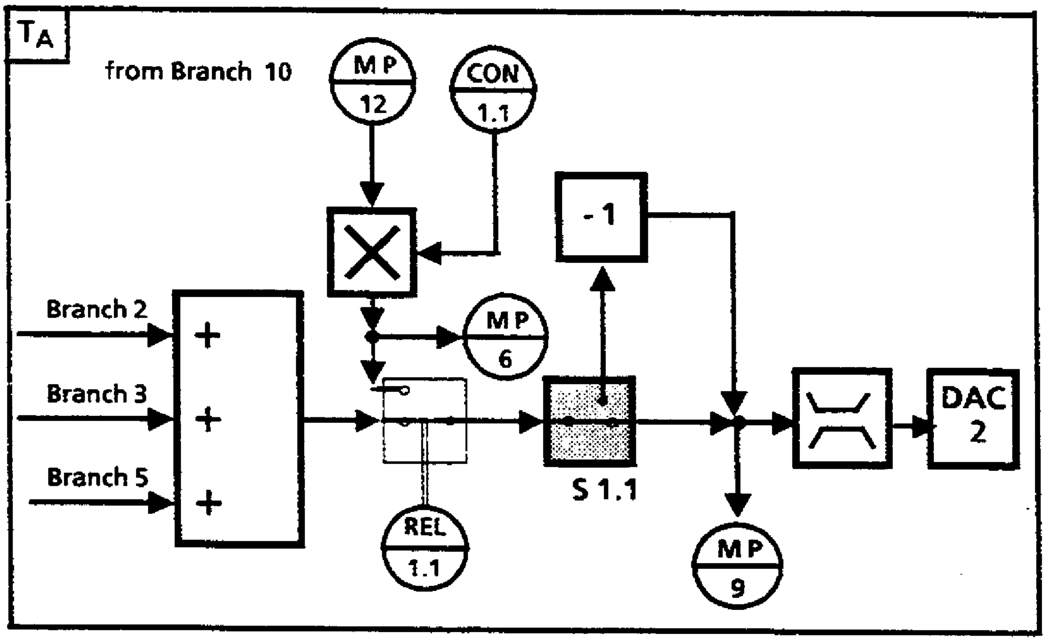
Module No:

Plant:

Date:

Handled by:

BRANCH 1: CONTROLLER OUTPUT
CURRENT SETPOINT

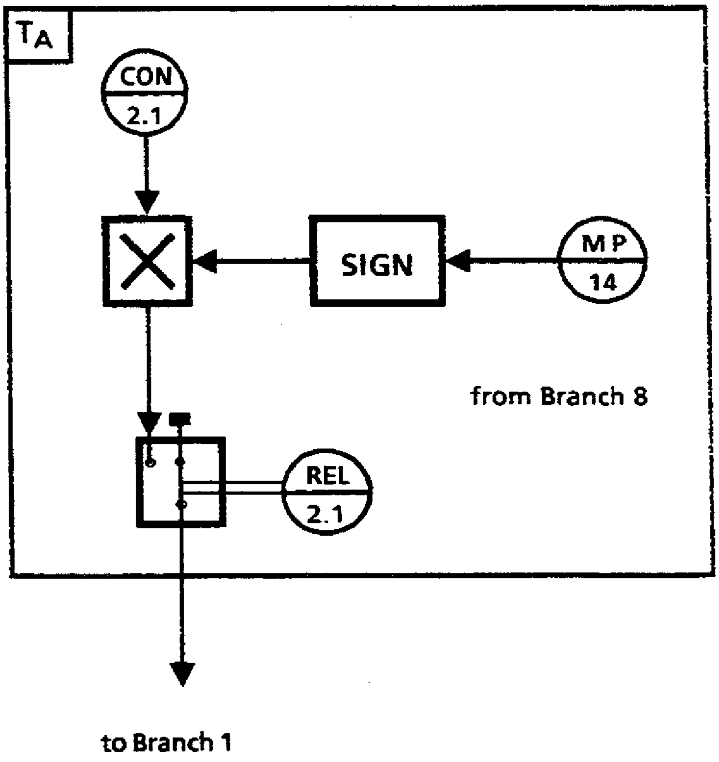


		Description	Value	Phys. unit
S 1.1	Structure Selector CONVERSION			
CON 1.1		SCALing DeCeLeration Value	□	%
DAC 2		ADdRess	□	
REL 1.1		BREAK ENABLE		
MP 6	I BR	Deceleration current		
MP 9	I SOL	Current setpoint		
MP 12	N-ACT	Actual speed		

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 2: FRICTION



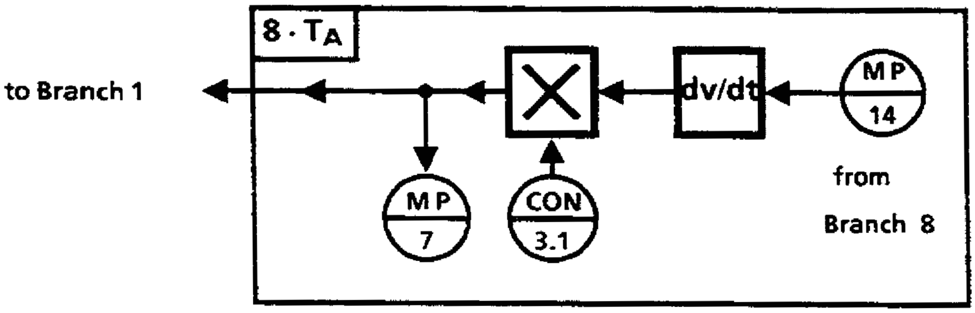
	Description	Value	Phys. unit
CON 2.1	FRICTION value	□	%
REL 2 .1	FRICTION ENABle		
MP 14	N-SET Setpoint after ramp generator		%

Controller No:
Module No:
Plant:

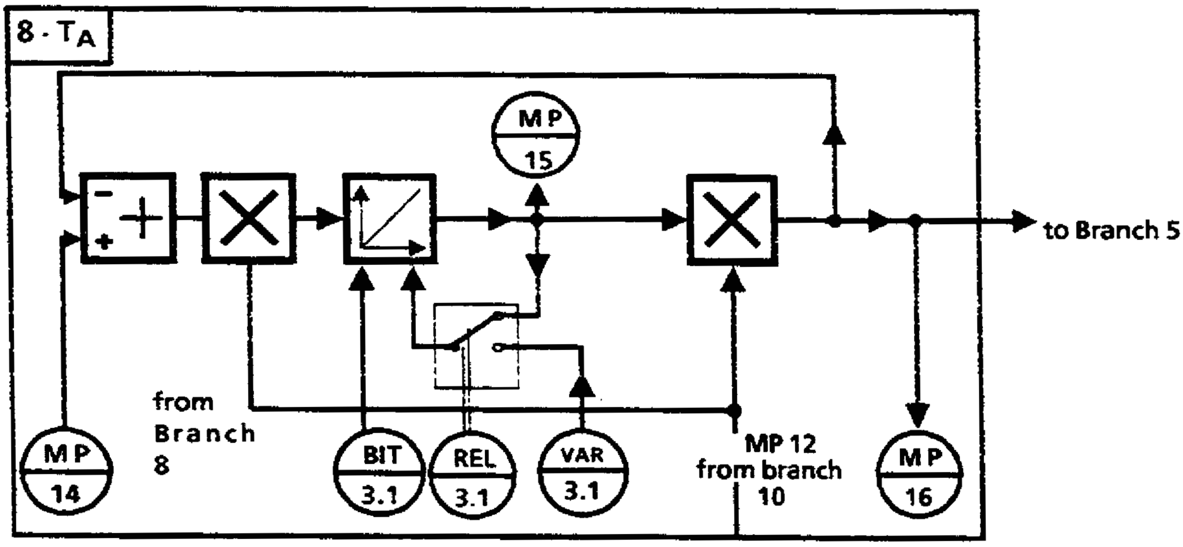
Date:
Handled by:

BRANCH 3: PERIPHERAL VELOCITY AND ACCELERATION

Acceleration



Peripheral velocity

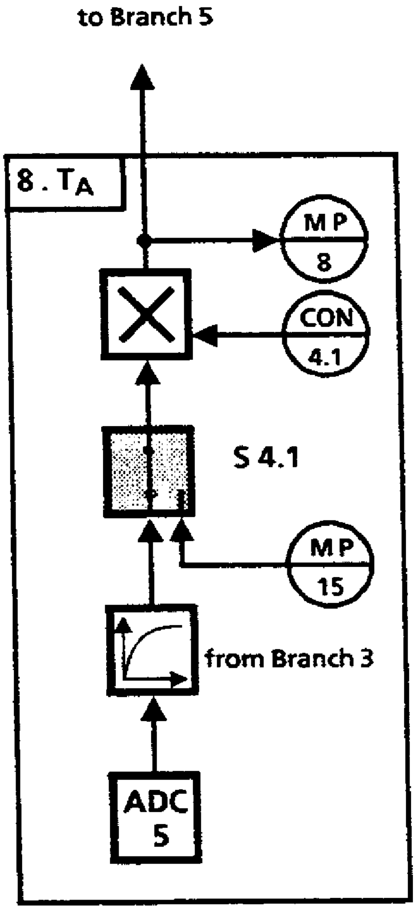


		Description	Value	Phys. unit
CON 3.1		SCALing ACCeLeration	□	%
BIT 3.1		INTegrater ENABle		
REL 3.1		SET Start VALue		
VAR 3.1		INITIal DIAMeter		
MP 7	DVDT	Acceleration		%
MP 12	N-ACT	Actual speed		%
MP 14	N-SET	Setpoint after ramp generator		%
MP 15	D	Diameter		%
MP 16	V-ACT	Actual speed		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 4: LOOP GAIN



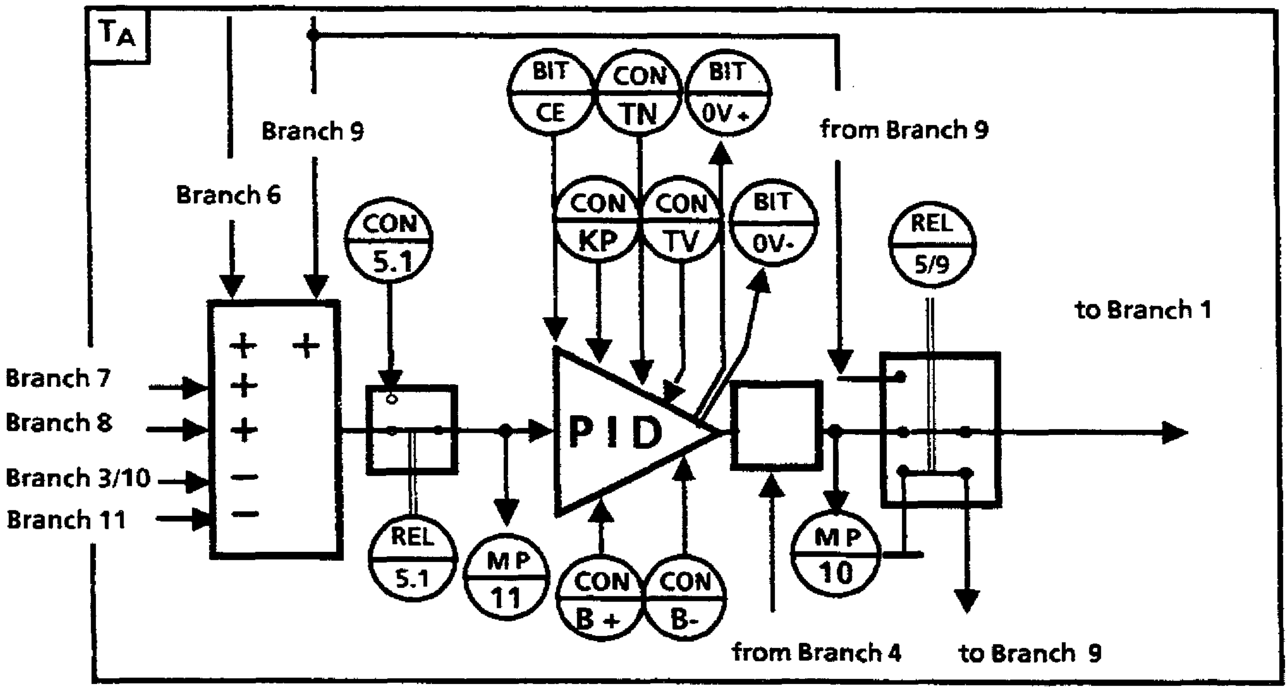
	Description	Value	Phys. unit
S 4.1	Structure selector INJECT DIAmeter SIGNAL		
CON 4.1	SCALing LOOP amplification		%
ADC 5	ADdRess		
MP 8	K Gain		%
MP 15	D Diameter		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 5: VELOCITY CONTROLLER SPEED CONTROLLER

Page 1



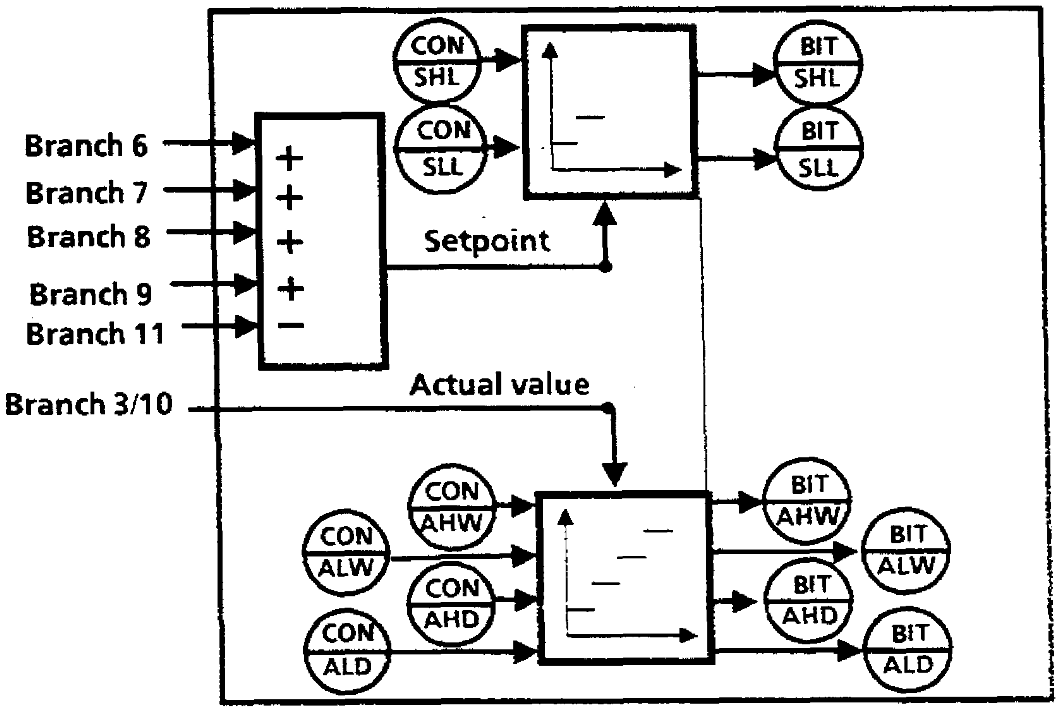
	Description	Value	Phys. unit
CON5.1	STart-UP SETPoint	□	%
CON5.KP	Proportional value	□	
CON5.TN	Integral-action time	□	□
CON5.TV	Derivative-action time	□	□
CON5.B +	Controller HIGH LIMIT	□	%
CON5.B-	Controller LOW LIMIT	□	%
BIT5.CE	CONTRoller ENABle		
BIT5.OV +	High OVER FLOW (identifier)		
BIT5.OV-	Low OVER FLOW (identifier)		
REL 5.1	STart-UP DerivatioN ENable		
REL 5/9	DIRect TENSion CONTRol		
MP10	I*1 controller output		%
MP11	DN-ACT control deviation		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 5: (ROTATIONAL) SPEED CONTROLLER

Page 2



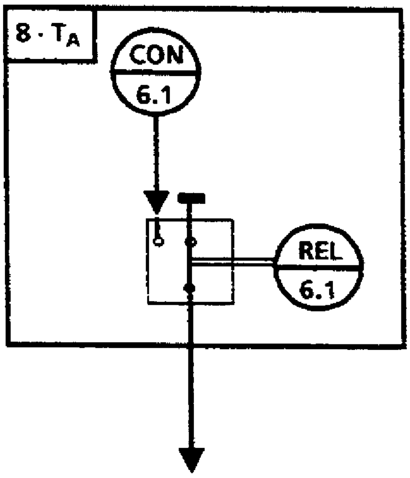
	Description	Value	Phys. unit
CON 5.SHL	Setpoint High Limit, Speed controller		%
CON 5.SLL	Setpoint Low Limit, Speed controller		%
CON 5.AHW	Actual value High Warning limit, Speed controller		%
CON 5.ALW	Actual value Low Warning limit, Speed controller		%
CON 5.AHD	Actual value High Danger limit, Speed controller		%
CON 5.ALD	Actual value Low Danger limit, Speed controller		%

BIT 5.SHL	SHLS VIOLated
BIT 5.SLL	SLLS VIOLated
BIT 5AHW	AHWS VIOLated
BIT 5.ALW	ALWS VIOLated
BIT 5.AHD	AHDS VIOLated
BIT 5.ALD	ALDS VIOLated

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 6: SET-UP SPEED



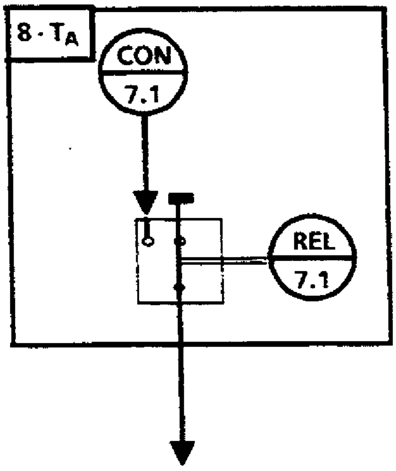
to Branch 5

	Description	Value	Phys. unit
CON 6.1	Set-UP SPEED	□	%
REL 6.1	SET-up Speed ENABle		

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 7: CREEP SPEED



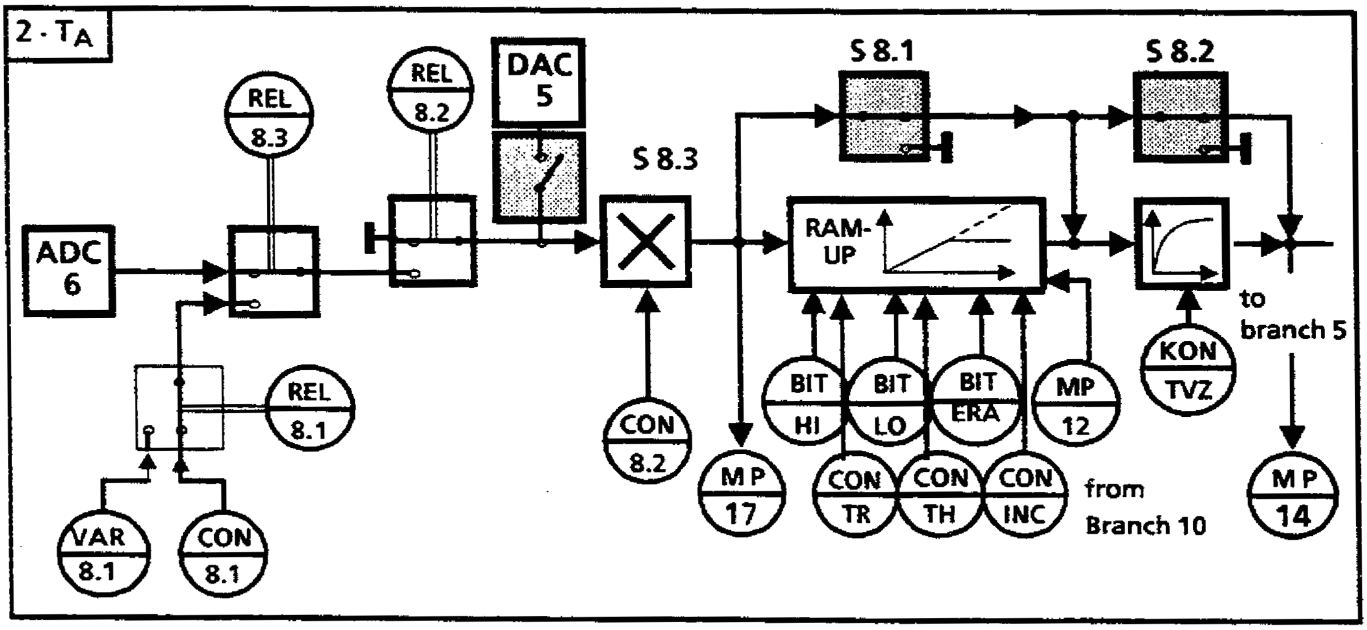
to Branch 5

	Description	Value	Phys. unit
CON 7.1	Creep SPEED		%
REL 7.1	CREEP speed ENABle		

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 8: (ROTATIONAL) SPEED SETPOINT, VELOCITY SETPOINT



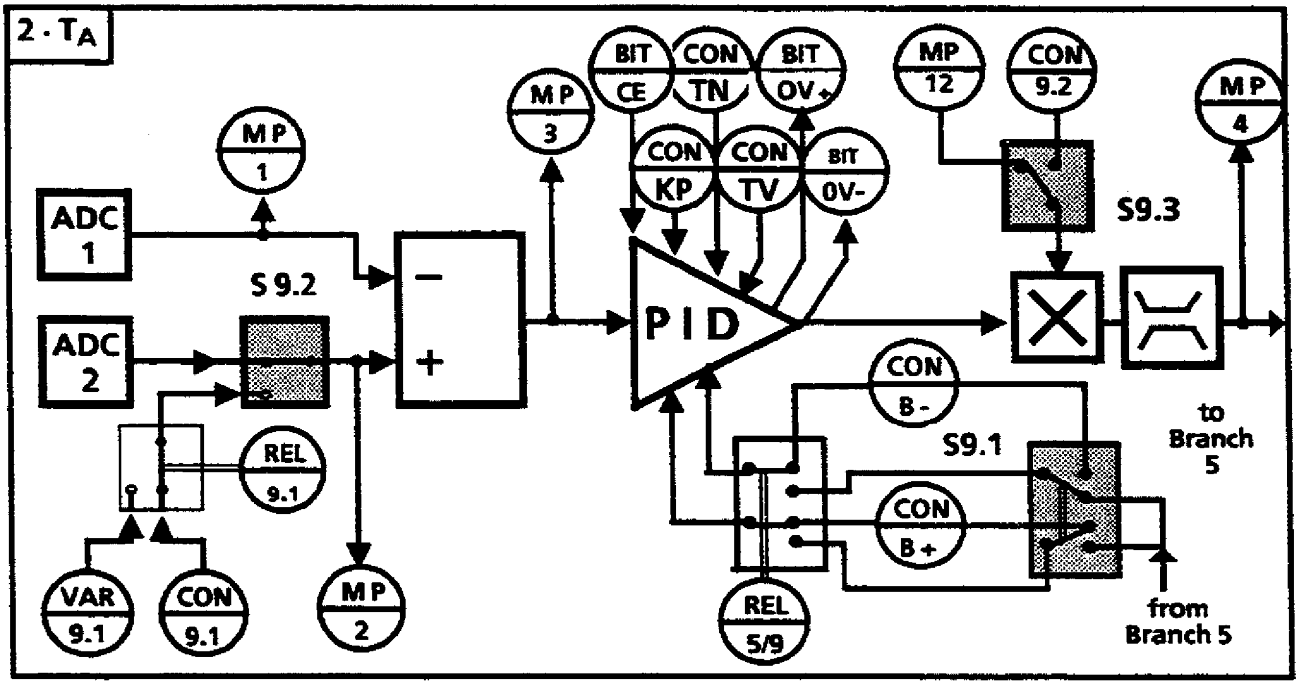
	Description	Value	Phys. unit
S 8.1	Struct. sel. RAMP GENERATOR		
S 8.2	Struct. sel. SMOOTHING		
S 8.3	Struct. sel. SETPoint SEQUENCE		
CON8.1	CONSTant SETPoint		%
CON8.2	SETPoint SCALER		%
CON8.TR	Ramp-down time		
CON8.TH	Ramp-up time		
CON8.INC	INCREASE		%
CON8.TZV	Smoothing time constant		
ADC 6	ADdRess		
DAC 5	ADdRess		
BIT 8.hi	HIGHER		
BIT 8.LO	LOWER		
BIT 8.ERA	ERASE		
REL 8.1	PG/PC-SETPoint		
REL 8.2	SETpoint ENABLE		
REL 8.3	ADC/INPUT		
VAR 8.1	VARiable SETPoint		%
MP 12 N-ACT	Actual speed		%
MP14 N-SET	Setpoint after ramp generator		%
MP 17 N-SET	Setpoint before ramp generator		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 9: PRIMARY CONTROLLER

Page 1



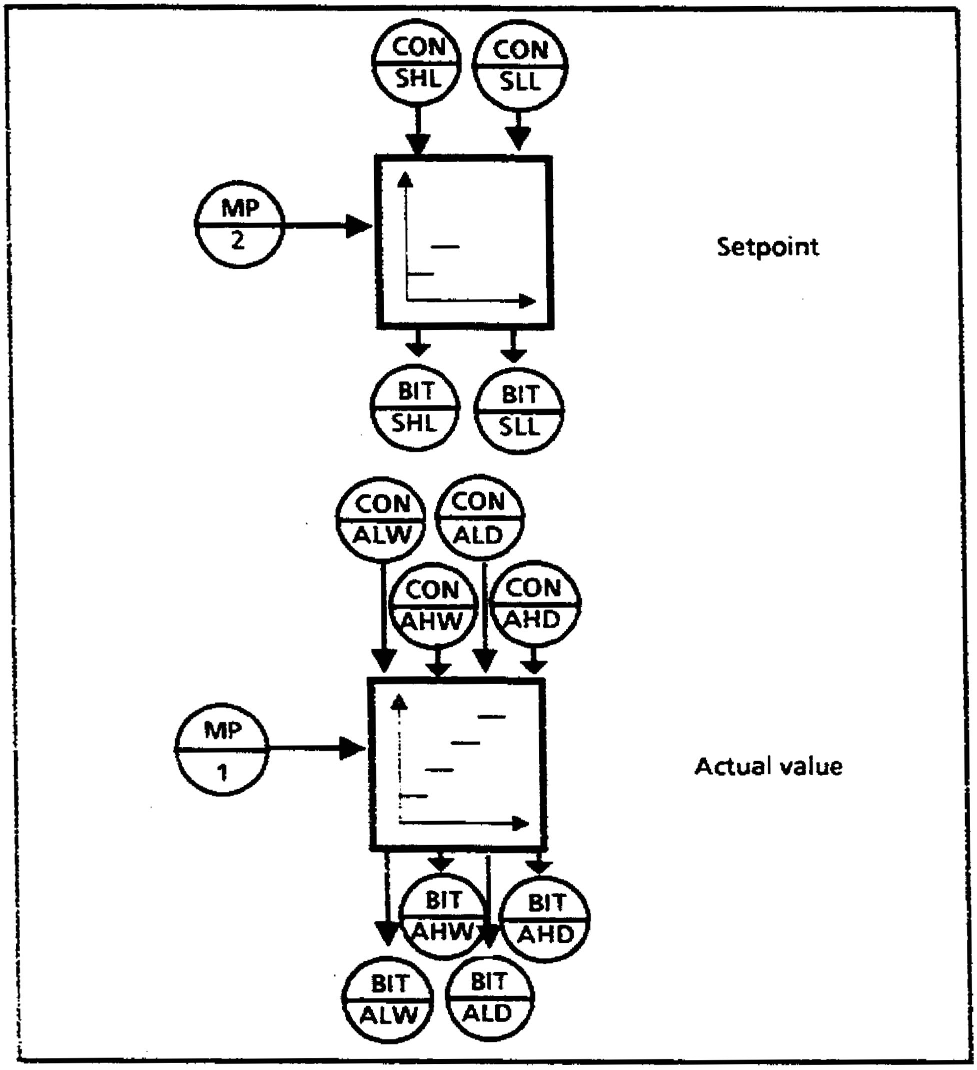
	Description	Value	Phys. unit
S9.1	Struct. sel. Limit choice B+/B-		
S9.2	Struct. sel. Setpoint selection ADC/INPUT		
S9.3	Struct. sel. multiplier select N-ACT/PG SCALER		
CON9.1	CONSTant SETPoint		%
CON9.2	SCALer CONST.		%
CON9.KP	Proportional value		
CON9.TN	Intergral-action time		
CON9.TV	Derivative-action time		
CON9.B+	Controller HIGH LIMIT		%
BON9.B-	Controller LOW LIMIT		%
ADC1	ADdRess		
ADC2	ADdRess		
BIT9.CE	CONTRoller ENABle		
BIT9.OV+	High OVERFLOW (identifier)		
BIT9.OV-	Low OVERFLOW (identifier)		
REL9.1	VARiable SETPoint		
REL5/9	DIRect TENSion CONTRol		
VAR9.1	VARiable SETPoint		%
MP1 ACTUAL	Actual value at controller		%
MP2 SET	Setpoint at controller		%
MP3 DIFF	Deviation at controller		%
MP4 CORR	Correction value at controller		%
MP12 N-ACT	Actual speed		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 9: SETPOINT/ACTUAL VALUE MONITORING

Page 2

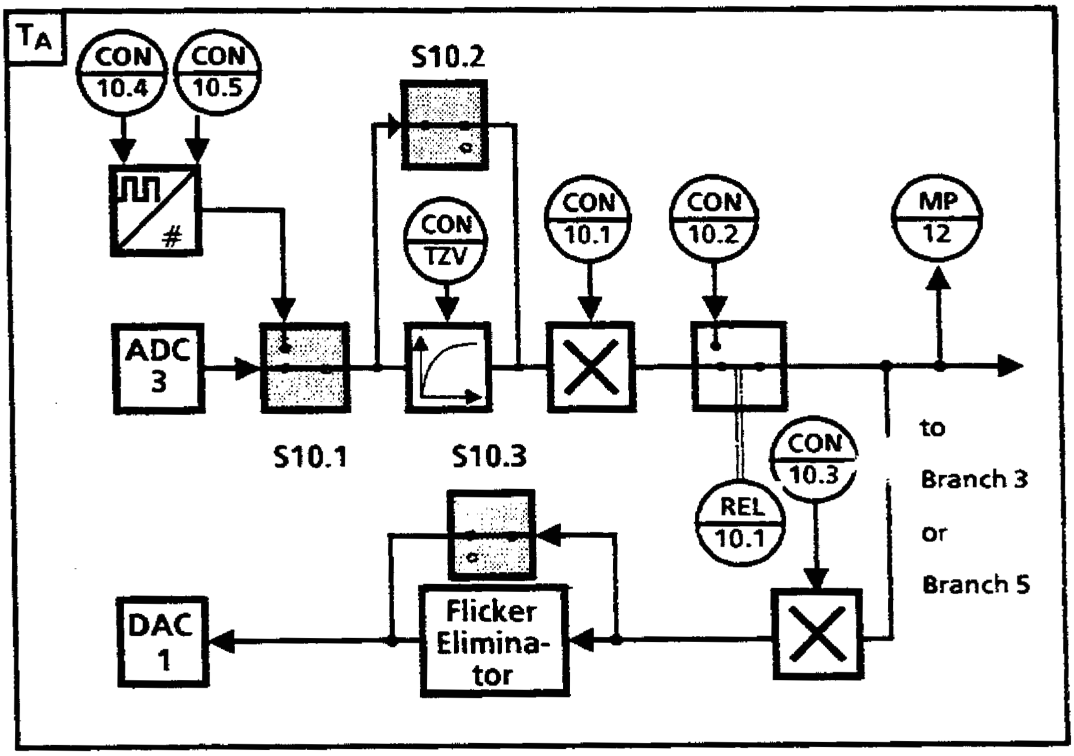


	Description	Value	Phys. unit
CON9.SHL	Setpoint High Limit, Position controller		%
CON9.SLL	Setpoint Low Limit, Position controller		%
CON9.AHW	Actual value High Warning limit, Position controller		%
CON9.ALW	Actual value Low Warning limit, Position controller		%
CON9.AHD	Actual value High Danger limit, Position controller		%
CON9.ALD	Actual value Low Danger limit, Position controller		%
BIT9.SHL	SHILP VIOLated		
BIT9.SLL	ALIP VIOLated		
BIT9.AHW	AHWP VIOLated		
BIT9.ALW	ALWP VIOLated		
BIT9.AHD	HDP VIOLated		
BIT9.ALD	ALDP VIOLated		
MP1 ACTUAL	Actual value at controller		%
MP2 N-ACT	Setpoint at controller		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 10: SPEED ACTUAL VALUE

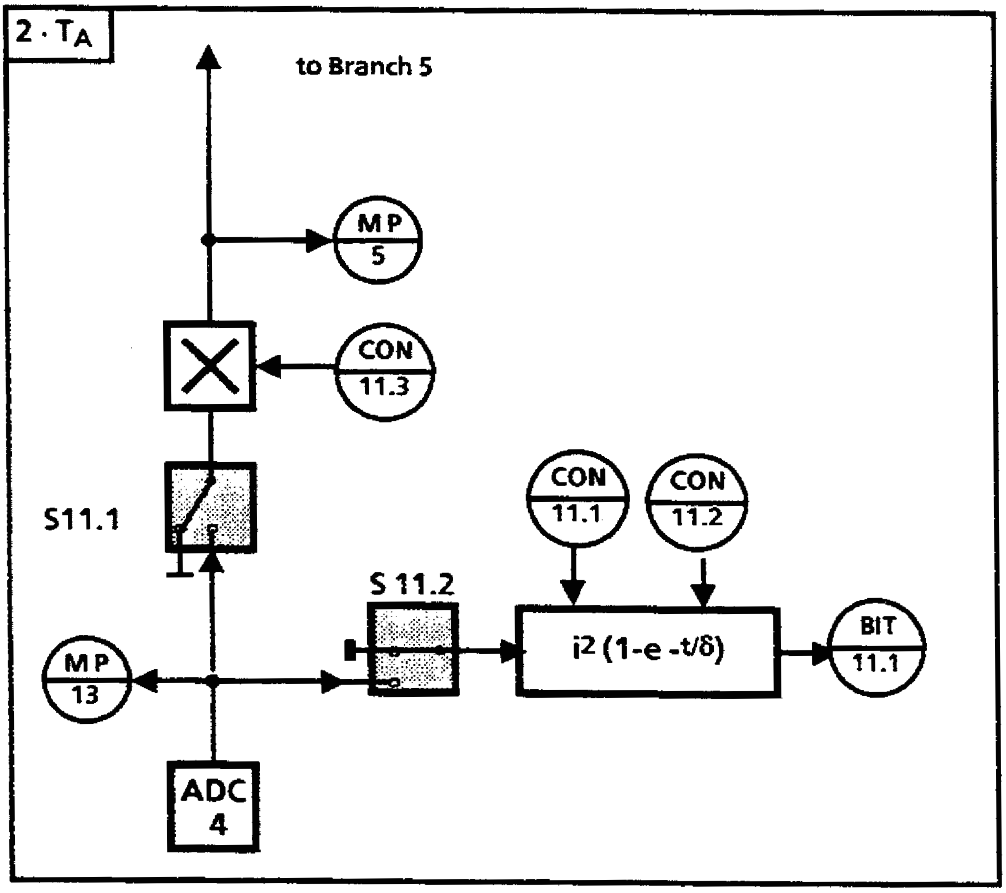


	Description	Value	Phys. unit
S 10.1	Struct. sel. actual value ANALOG/PULSE sensor		
S 10.2	SMOOTHING		
S 10.3	EXPAND (flicker eliminator)		
CON10.1	ACTual SCALing speed		%
CON10.2	STart-UP ACTual value		%
CON10.3	CALibration DISPlay		%
CON 10.4	Rated speed REV/SEC		%
CON 10.5	Line numbers/100 (NC/100)		%
CON10.TVZ	Smoothing time constant		
ADC 3	ADdRess		
DAC 1	ADdRess		
REL 10.1	Start-up ACTual ENABle		
MP 12 N-ACT	Actual speed		%

Controller No:
Module No:
Plant:

Date:
Handled by:

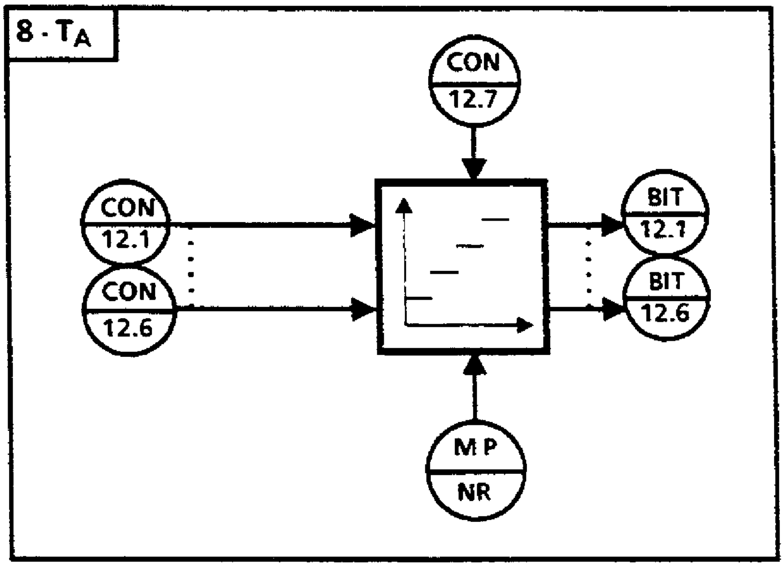
BRANCH 11: ACTUAL ARMATURE CURRENT



		Description	Value	Phys. unit
S 11.1		Struct. sel. THERMal MONITORing		
S 11.2		Struct. sel. Armature CURRent INJECTION		
CON 11.1		THERMal LIMit		%
CON 11.2		THERMAL CONSTant		
CON 11.3		SCALing ARMature current		%
ADC 4		ADdRess		
BIT 11.1		THERMal ALARM		
MP 5	I*R	Correction value at actual current		%
MP13	I-ACT	Actual armature current		%

Controller No: Date:
Module No: Handled by:
Plant:

BRANCH 12: LIMIT MONITOR 1



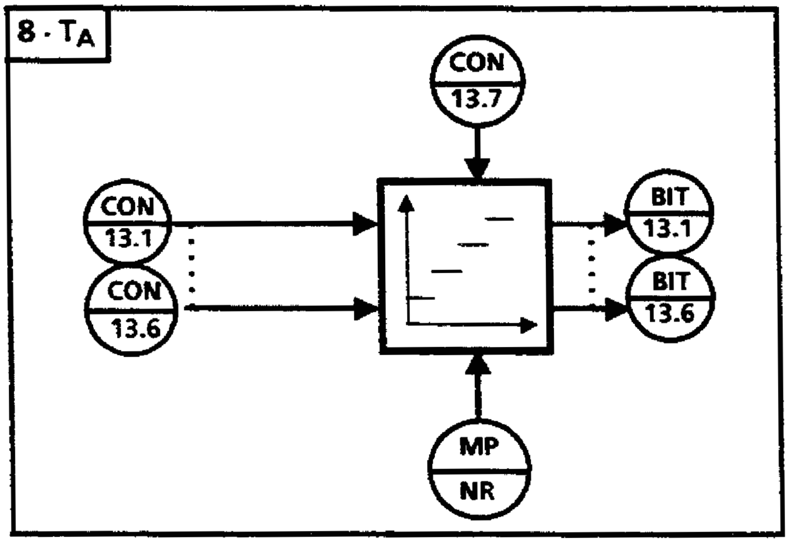
	Description	Value	Phys. unit
MP NR	MEASuring POInt NumbeR		
CON 12.1	LIMIT 1		%
CON 12.2	LIMIT 2		%
CON 12.3	LIMIT 3		%
CON 12:4	LIMIT 4		%
CON 12.5	LIMIT 5		%
CON 12.6	LIMIT 6		%
CON 12.7	Number OF LIMITS		

BIT	12.1	LIMIT IDENTifier 1
BIT	12.2	LIMIT IDENTifier 2
BIT	12.3	LIMIT IDENTifier 3
BIT	12.4	LIMIT IDENTifier 4
BIT	12.5	LIMIT IDENTifier 5
BIT	12.6	LIMIT IDENTifier 6

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 13: LIMIT MONITOR 2



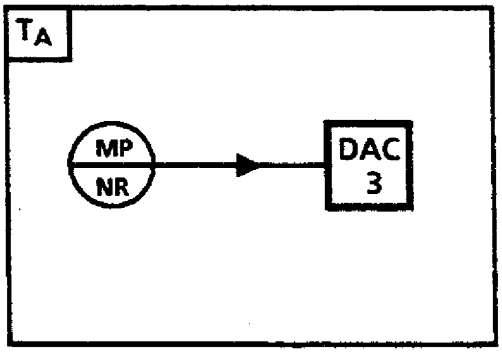
	Description	Value	Phys. unit
MP NR	MEASuring POInt NumbeR		
CON 13.1	LIMIT 1		%
CON 13.2	LIMIT 2		%
CON 13.3	LIMIT 3		%
CON 13.4	LIMIT 4		%
CON 13.5	LIMIT 5		%
CON 13.6	LIMIT 6		%
CON 13.7	Number OF LIMITS		

BIT 13.1	LIMIT IDENTifier 1
BIT 13.2	LIMIT IDENTifier 2
BIT 13.3	LIMIT IDENTifier 3
BIT 13.4	LIMIT IDENTifier 4
BIT 13.5	LIMIT IDENTifier 5
BIT 13.6	LIMIT IDENTifier 6

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 14: MEASURING SOCKET 1

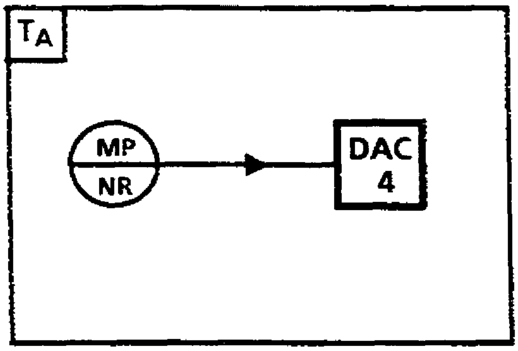


	Description	Value	Phys. unit
MP NR	MEAS. POInt NumbeR		
DAC 3	ADdRess		

Controller No:
Module No:
Plant.

Date:
Handled by:

BRANCH 15: MEASURING SOCKET 2

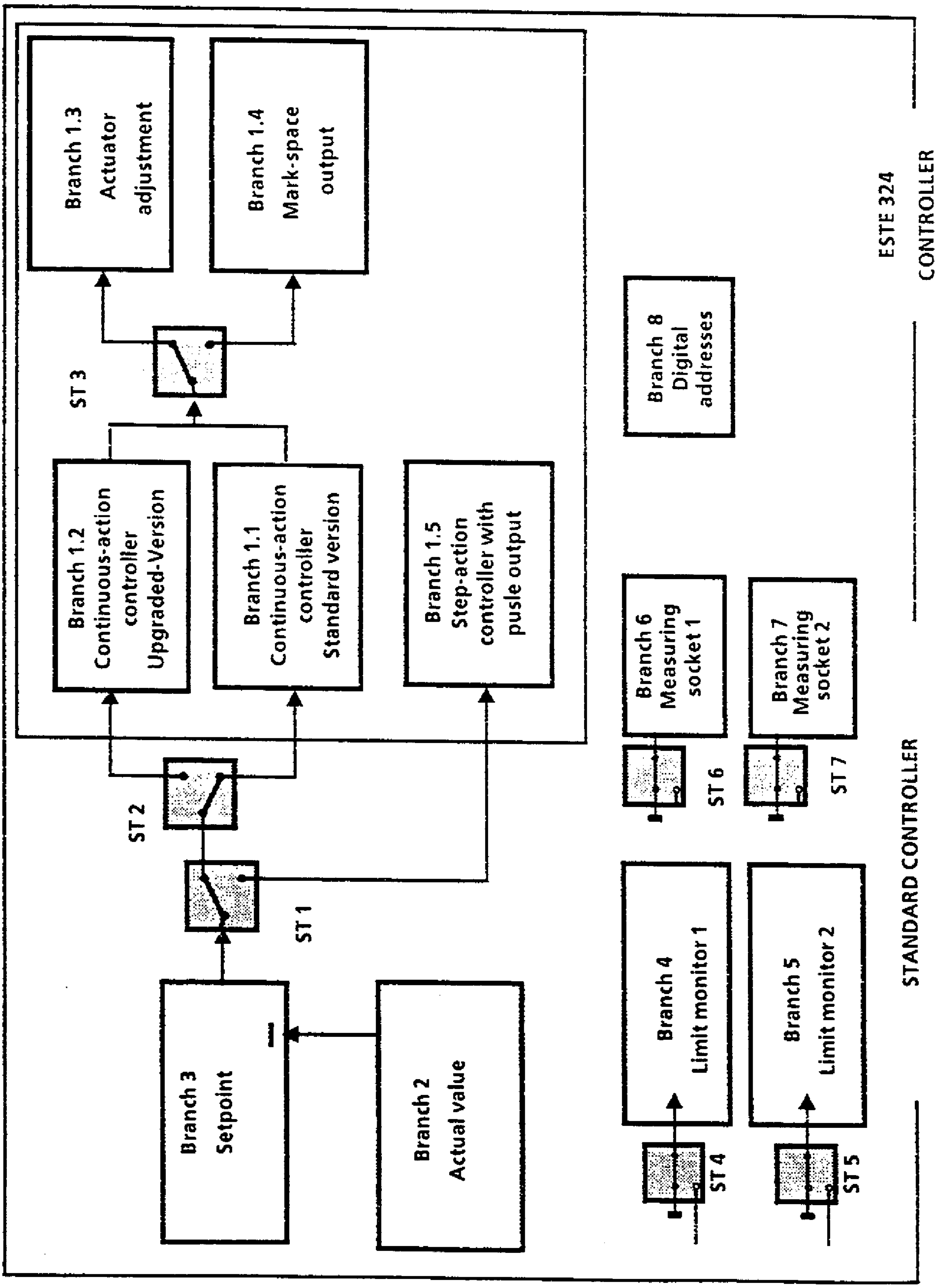


	Description	Value	Phys. unit
MP NR	MEAS. POInt NumbeR		
DAC 4	ADdRess		

Controller No:
Module No:
Plant:

Date:
Handled by:

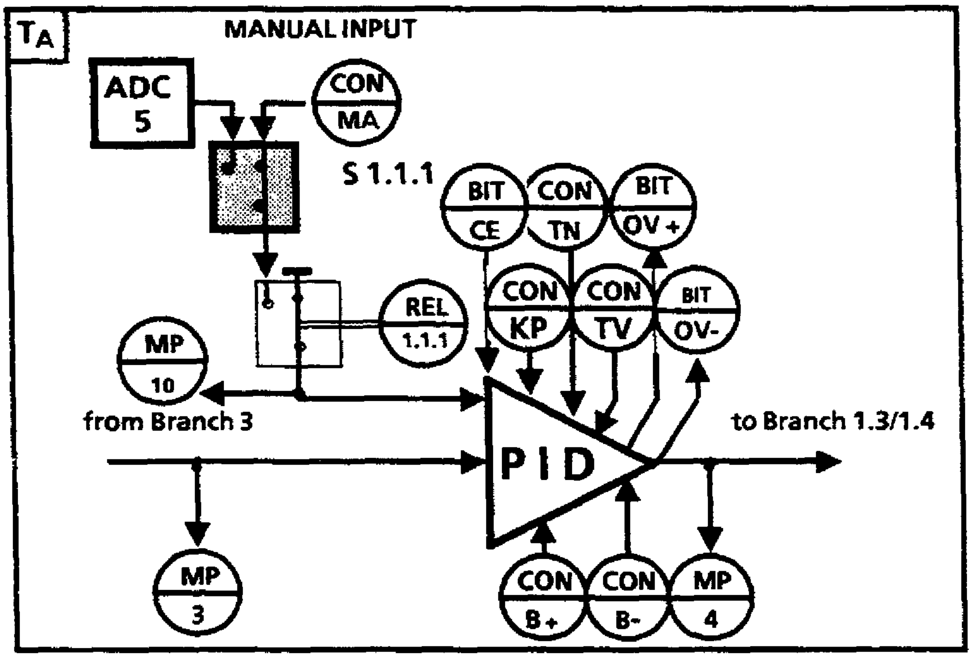
Configuration sheet: Standard controller



Controller No:
Module No:
Plant:

Date:
Handled by:

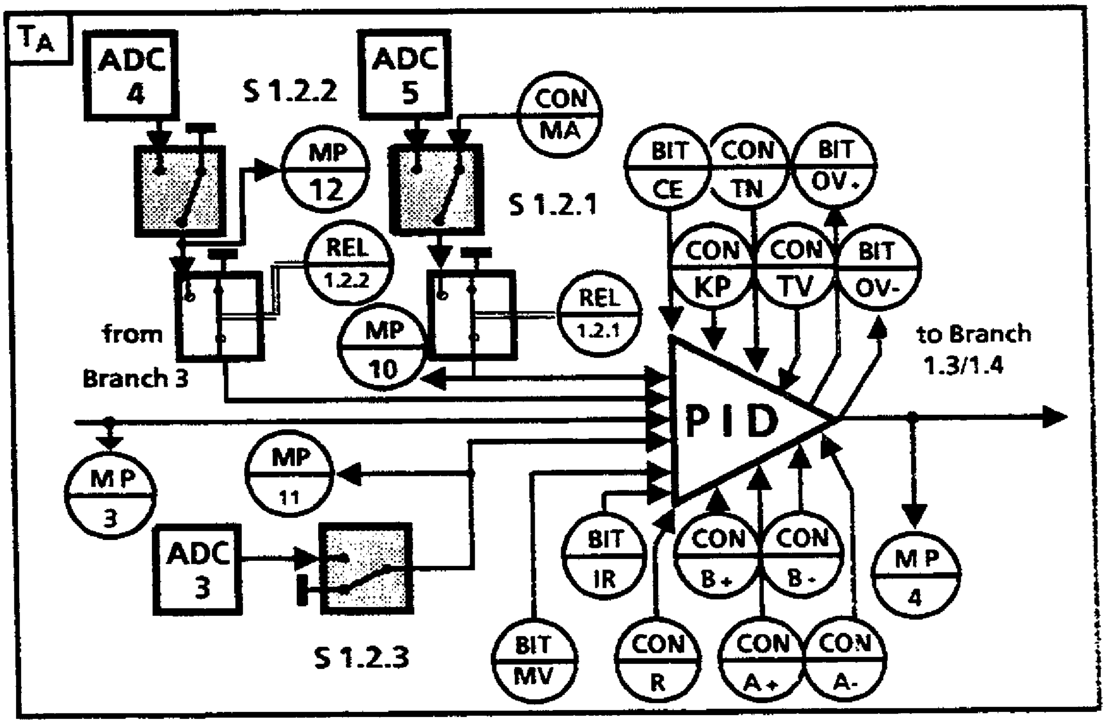
BRANCHE 1.1 : CONTINUOUS-ACTION CONTROLLER (STANDARD-VERSION)



	Description	Value	Phys. unit
S1.1.1	Struct. sel. Manual input	PG/ADC	
CON 1.1.MA	CONSTant MANual value		%
CON 1.1.KP	Proportional value		
CON 1.1.TN	Integral-action time		
CON 1.1.TV	Derivative-action time		
CON 1.1.B +	Controller High LIMIT		%
CON 1.1.B -	Controller Low LIMIT		%
ADC 5	ADdRess		
REL1.1.1	AUTOmatic/MANUAL (mode)		
BIT 1.1.CE	CONTRoller ENABle		
BIT 1.1.OV +	High OVERFLOW (identifier)		
BIT 1.1.OV -	Low OVERFLOW (identifier)		
MP 3	Deviation		
MP 4	Controller output		%
MP 10	Manual value		%

Controller No: Date:
Module No: Handled by:
Plant:

BRANCH 1.2: CONTINUOUS-ACTION CONTROLLER (UPGRADED VERSION)

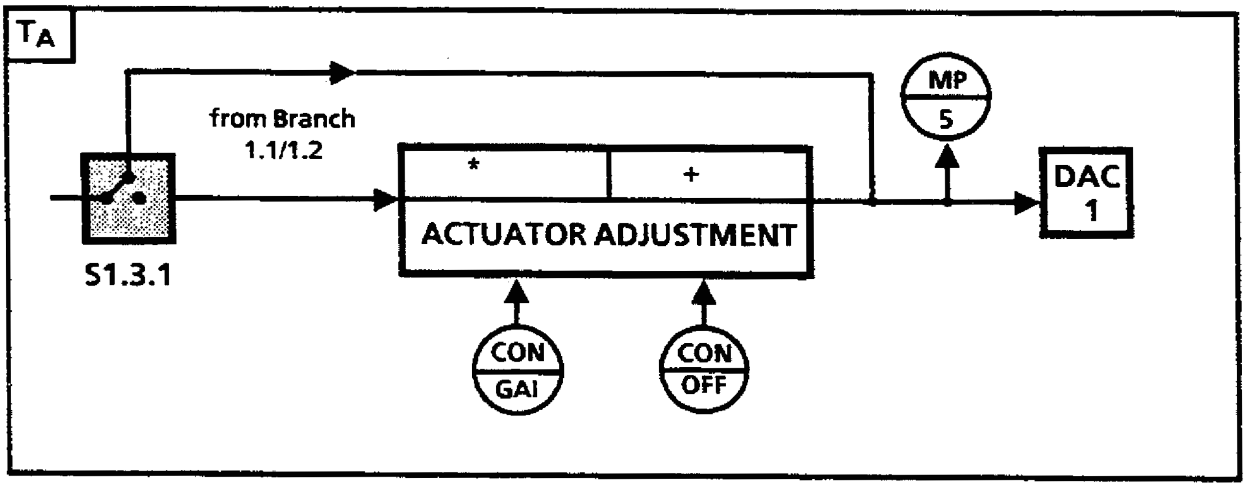


	Description	Value	Phys. unit
S1.2.1	Manual input	PG/ADC	
S1.2.2	Struct. sel. DISTURBANCe INPut		
S1.2.3	SEPARate D-INPUT		
CON 1.2.MA	CONSTant MANual value		%
CON 1.2.KP	Proportional value		
CON 1.2.R	Additional gain		
CON 1.2.N	Integral-action time		
CON 1.2.TV	Derivative-action time		
CON 1.2.A +	Positive increment limit		%
CON 1.2.A -	Negative increment limit		%
CON 1.2.B +	Controller High LIMIT		%
CON 1.2.B-	Controller Low LIMIT		%
ADC 3	ADdRess		
ADC 4	ADdRess		
ADC 5	ADdRess		
BIT 1.2.CE	CONTRoller ENABle		
BIT 1.2.MV	CONstant MANIPulated VARiable		
BIT 1.2.IR	Real/ideal PID controller		
BIT 1.2.OV +	High OVERFLOW (identifier)		
BIT 1.2.OV -	Low OVERFLOW (identifier)		
REL 1.2.1	DISTURBance ENABle		
REL 1.2.2	AUTOmatic/MANUAL (mode)		
MP 3	Deviation		
MP 4	Controller output		
MP 11	Separate D-input		
MP 12	Disturbance input		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 1.3: ACTUATOR ADJUSTMENT

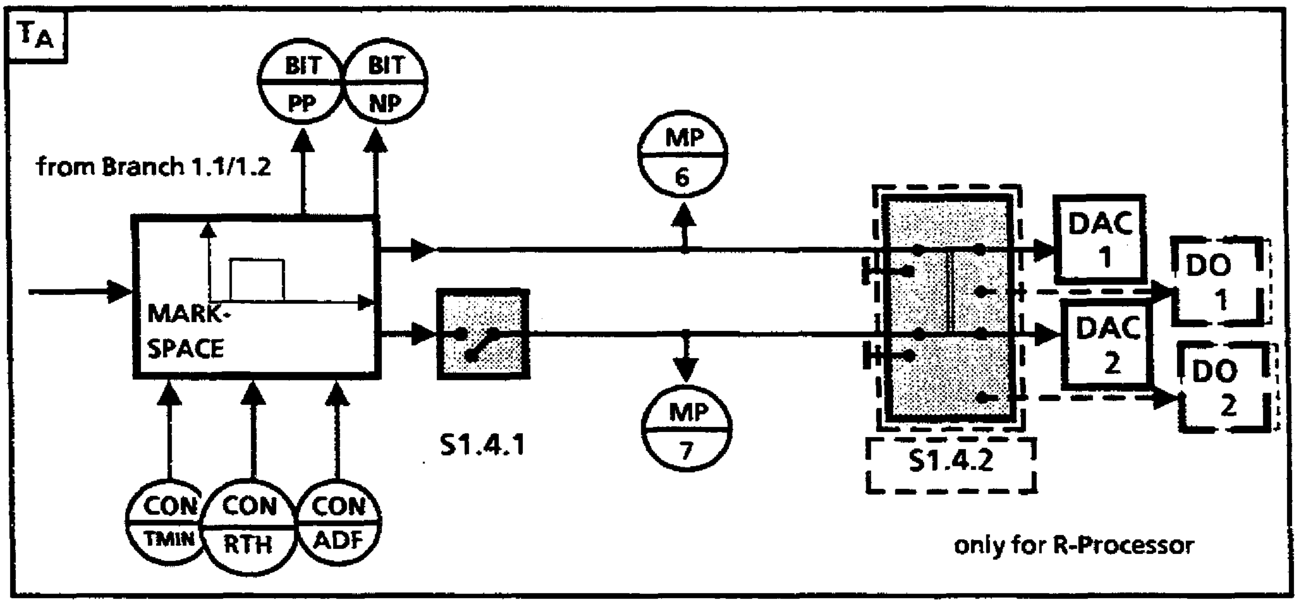


	Description	Value	Phys. unit
S 1.3.1	Struct. sel ACTUATOR ADJustment		
CON1.3.GAI	GAIN	□	
CON1.3.OFF	OFFSET	□	%
DAC 1	ADdRess	□	
MP5	Manipulated variable		

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH1.4: MARK-SPACE OUTPUT

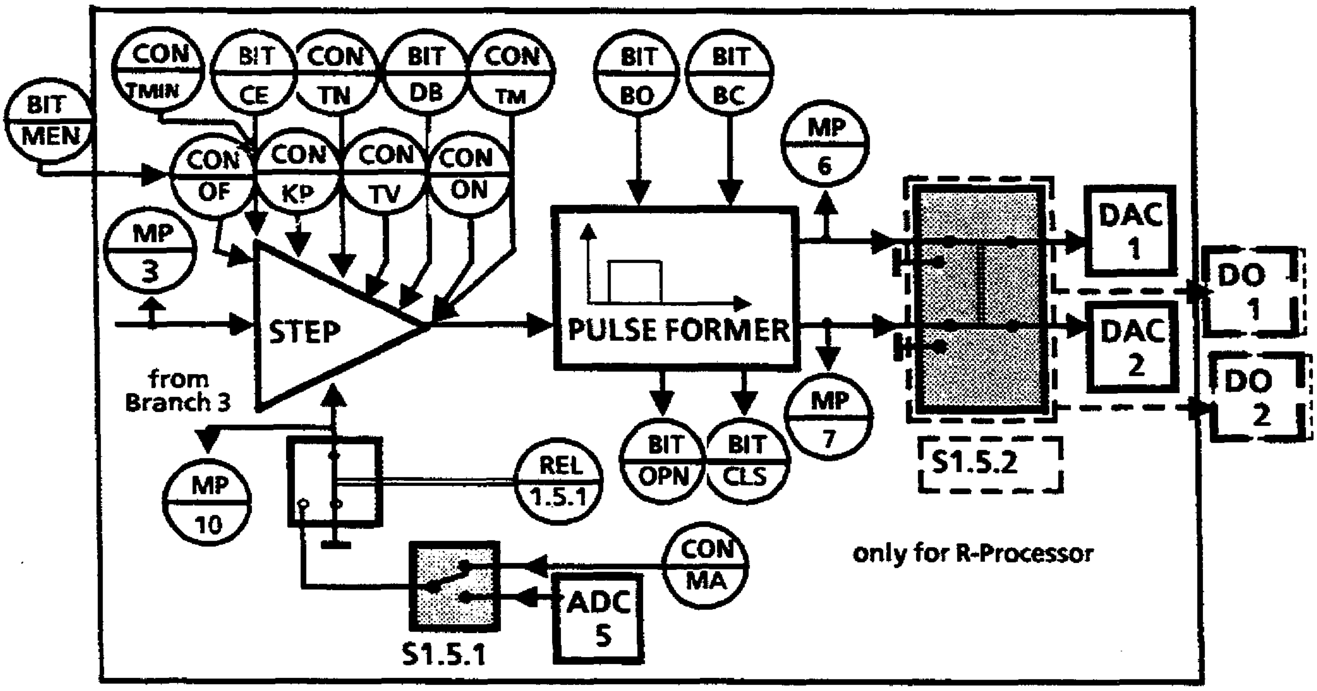


	Description	Value	Phys. unit
S1.4.1	Struct. sel. 2/3-POInt CONTRoller		
S1.4.2	ANAlog/DIGItalloutput		... only for R-Processor
CON 1.4.TMIN	Minimal Pulse duration TMIN	□	□
CON 1.4.RTH	Response THreshold	□	%
CON 1.4.ADF	ADaptation Factor	□	
DAC1	ADdRess	□	
DAC 2	ADdRess	□	
DO 1	ADdRess	□	...only for R-Processor
DO 2	ADdRess	□	
BIT 1.4.PP	POSitive PULSE		
BIT 1.4.NP	NEGative PULSE		
MP 6	Positive mv output		
MP 7	Negative mv output		

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 1.5: STEP-ACTION CONTROLLER WITH PULSE OUTPUT



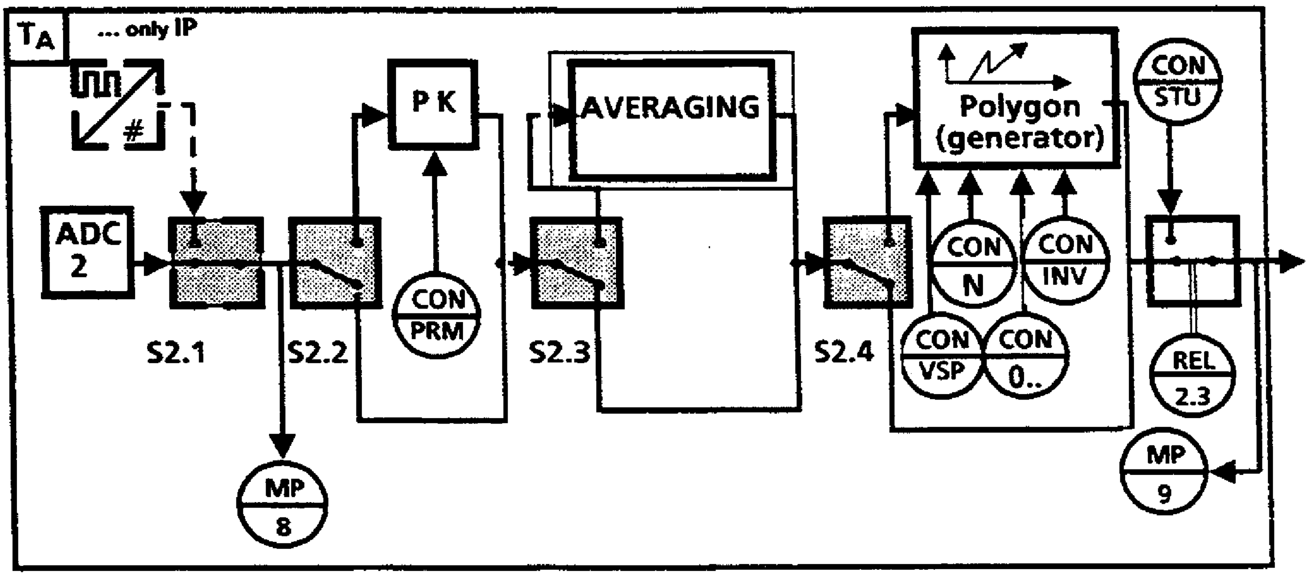
	Description	Value	Phys. unit
S1.5.1	Struct. sel. Manual input PG/ADC		
S1.5.2	ANAlog/DIGItAl output		... only for R-Processor
CON 1.5.MA	CONSTant MANual value		%
CON 1.5.KP	Proportional value		
CON 1.5.TN	Integral-action time		
CON 1.5.TV	Derivative-action time		
CON 1.5.TM	ACTUATOR runtime		
CON 1.5.ON	ON THRESHold		
CON 1.5.OF	OFF THRESHold		
CON 1.5.TMIN	Minimal pulse duration TMIN		
ADC 5	ADdRess		
DAC 1	ADdRess		
DAC 2	ADdRess		
DO 1	ADdRess		
DA 2	ADdRess		... only for R Processor
REL 1.5.1	AUTOmatic/MANUAL (mode)		
BIT 1.5.CE	CONTRoller ENABle		
BIT 1.5.DB	Dead Band ACTIVE		
BIT 1.5.BC	Position OPEN REACHED		
BIT 1.5.BZ	Position CLOSED REACHED		
BIT 1.5.OPN	OPEN		
BIT 1.5.CLS	CLOSE		
BIT 1.5.MEN	MANUAL ENABle		
MP 3	Deviation		
MP 6	Positive mv output		
MP 7	Negative mv output		
MP 10	Manual value		

Controller No·
Module No:
Plant:

Date:
Handled by:

BRANCH 2: ACTUAL VALUE BRANCH

Page 1



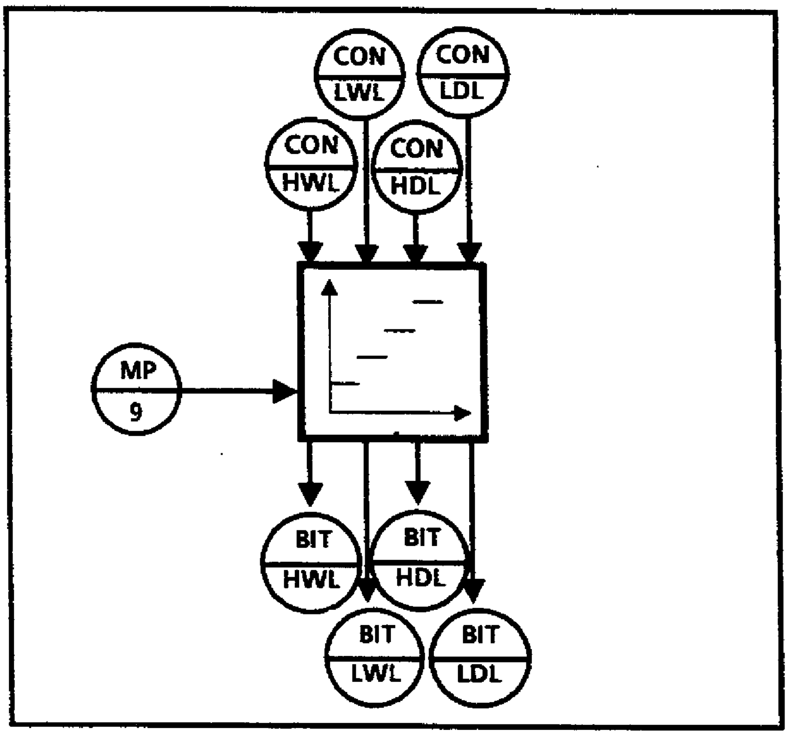
	Description	Value	Phys. unit
S 2.1	Struct. sel ADC/PULSE		
S 2.2	Struct. sel. VALIDITY CHECK		
S 2.3	Struct. sel. AVERAGING		
S 2.4	Struct. sel. POLYGON (generator)		
CON2.PRM	MAX. Permiss. DIFFerence		
CON2.N	NUMB. of VERTICES		
CON2.INV	START VALue		
CON2.VSP	VERTex SPAcing		
CON2.O1	ORDINATE 1		
CON2.O2	ORDINATE 2		
CON2.O3	ORDINATE 3		
CON2.O4	ORDINATE 4		
CON2.O5	ORDINATE 5		
CON2.O6	ORDINATE 6		
CON2.O7	ORDINATE 7		
CON2.O8	ORDINATE 8		
CON2.09	ORDINATE 9		
CON2.10	ORDINATE 10		
CON2.STU	ACTual Start-up value		
ADC 2	ADDRESS		
REL2.3	Start-UP ENABle		
MP8	Actual fed value		
MP9	Processed actual value		

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 2: ACTUAL VALUE MONITORING

Page 2



	Description	Value	Phys. unit
CON 2.HWL	High WARNING limit		
CON 2.LWL	Low WARNING limit		
CON 2.HDL	High DANGer LIMit		
CON 2.LDL	Low DANGer LIMit		

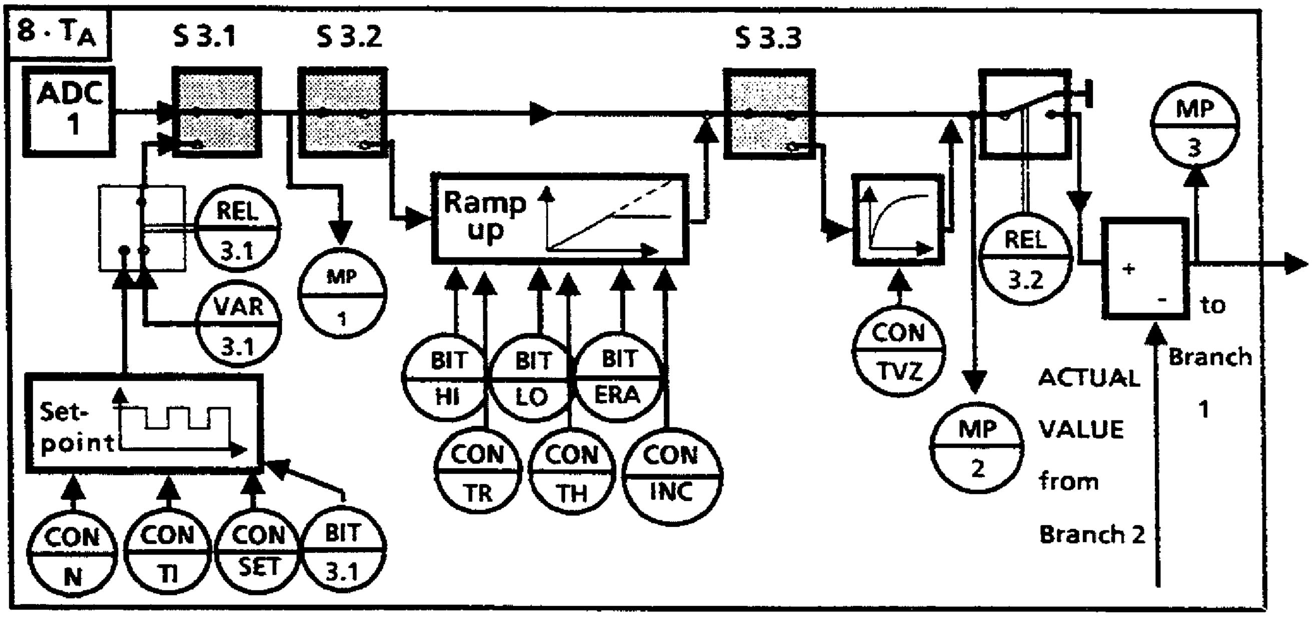
BIT 2.HWL	HWL VIOLated
BIT 2.LWL	LWL VIOLated
BIT 2.HDL	HDL VIOLated
BIT 2.LDL	LDL VIOLated
MP 9	Processed actual value

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 3 : SETPOINT BRANCH

Page 1

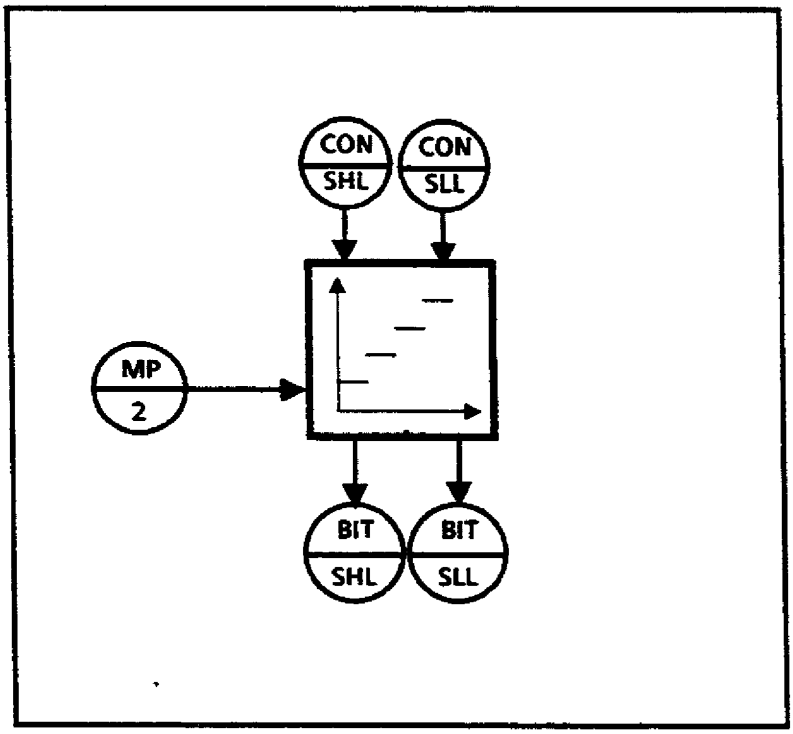


	Description	Value	Phys. unit
S 3.1	Struct. sel. ADC/INPUT		
S 3.2	Struct. sel. RAMP GENERATOR		
S 3.3	Struct. sel. SMOOTHING		
CON3.N	NUMBER OF SETPOINTS		
CON3.TI	INTERVAL time		
CON3.SET 1	SETPOINT 1		
CON3.SET 2	SETPOINT 2		
CON3.SET 3	SETPOINT 3		
CON3.SET 4	SETPOINT 4		
CON3.SET 5	SETPOINT 5		
CON3.SET 6	SETPOINT 6		
CON3.SET 7	SETPOINT 7		
CON3.SET 8	SETPOINT 8		
CON3.SET 9	SETPOINT 9		
CON3.SET10	SETPOINT 10		
CON3.TR	Ramp-down time		
CON3.TH	Ramp-up time		
CON3.INC	INCREASE		
CON3.TVZ	Smoothing time constant		
ADC 1	ADdRess		
REL3.1	PC-setpoint/SETPoint SEQUence		
REL3.2	SETPoint ENABle		
VAR3.1	SETPoint FRom PC		
BIT 3.HI	HIGHER		
BIT 3.LO	LOWER		
BIT 3.ERA	ERASE		
BIT 3.1	LINEAR (rectangular/interpol)		
MP1	Fed SetPoint		
MP2	Processed SetPoint		
MP3	Deviation		

Controller No: Date:
Module No: Handled by:
Plant:

BRANCH 3: SETPOINT MONITORING

Page 2

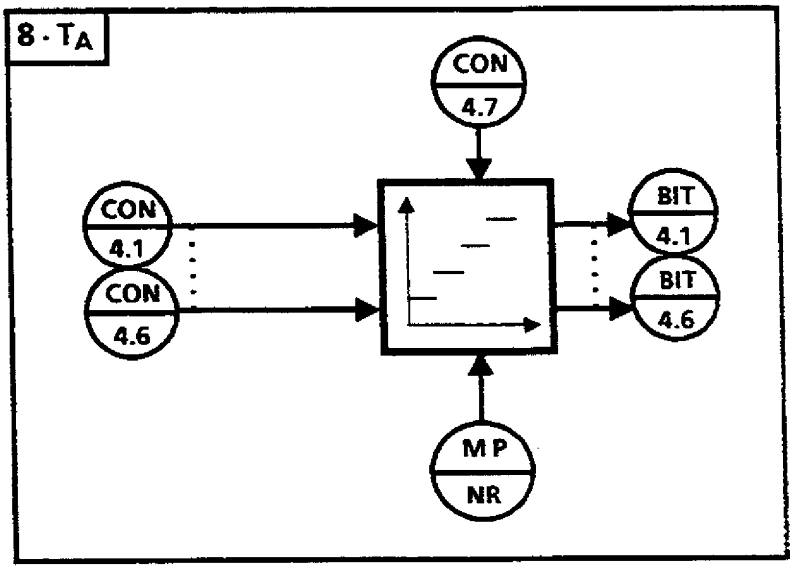


	Description	Value	Phys. unit
CON 3.SHL	Setpoint high limit		
CON 3.SLL	Setpoint low limit		
BIT 3.SHL	SHL VIOLated		
BIT 3.SLL	SLL VIOLated		
MP 2	Processed Setpoint		

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 4: LIMIT MONITOR 1



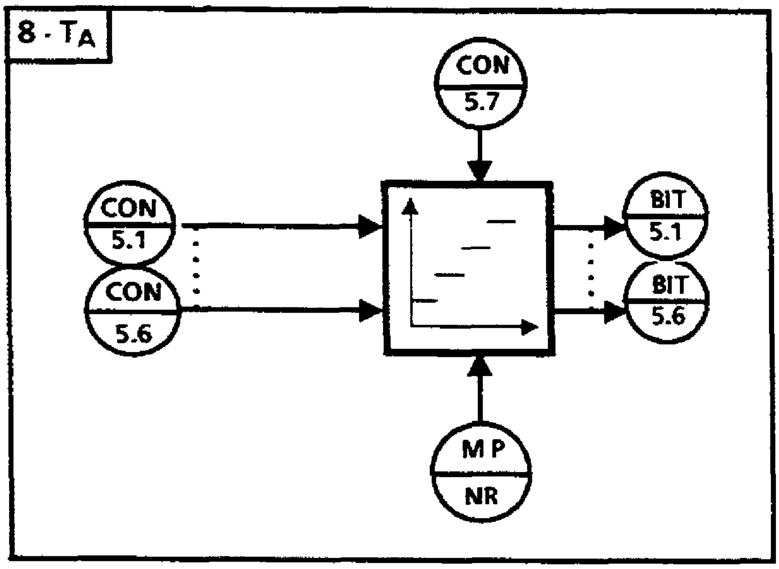
	Description	Value	Phys. unit
MP NR	MEASuring POInt NumbeR		
CON 4.1	LIMIT 1		
CON 4.2	LIMIT 2		
CON 4.3	LIMIT 3		
CON 4.4	LIMIT 4		
CON 4.5	LIMIT 5		
CON 4.6	LIMIT 6		
CON 4.7	Number OF LIMITS		

BIT 4.1	LIMIT IDENTifier 1
BIT 4.2	LIMIT IDENTifier 2
BIT 4.3	LIMIT IDENTifier 3
BIT 4.4	LIMIT IDENTifier 4
BIT 4.5	LIMIT IDENTifier 5
BIT 4.6	LIMIT IDENTifier 6

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 5: LIMIT MONITOR 2

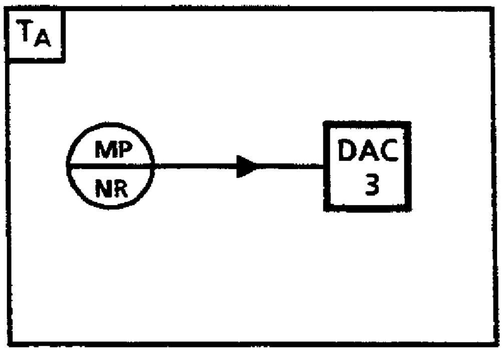


	Description	Value	Phys. unit
MP NR	MEASuring POInt NumbeR		
CON 5.1	LIMIT 1		
CON 5.2	LIMIT 2		
CON 5.3	LIMIT 3		
CON 5.4	LIMIT 4		
CON 5.5	LIMIT 5		
CON 5.6	LIMIT 6		
CON 5.7	Number OF LIMITS		
BIT 5.1	LIMIT IDENTifier 1		
BIT 5.2	LIMIT IDENTifier 2		
BIT 5.3	LIMIT IDENTifier 3		
BIT 5.4	LIMIT IDENTifier 4		
BIT 5.5	LIMIT IDENTifier 5		
BIT 5.6	LIMIT IDENTifier 6		

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 6: MEASURING SOCKET 1

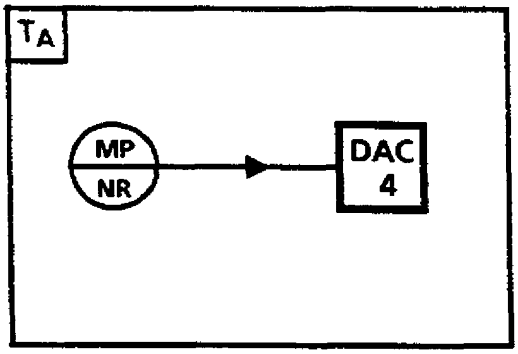


	Description	Value	Phys. unit
MP NR	MEAS. POInt NumbeR		
DAC 3	ADdRess		

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 7: MEASURING SOCKET 2

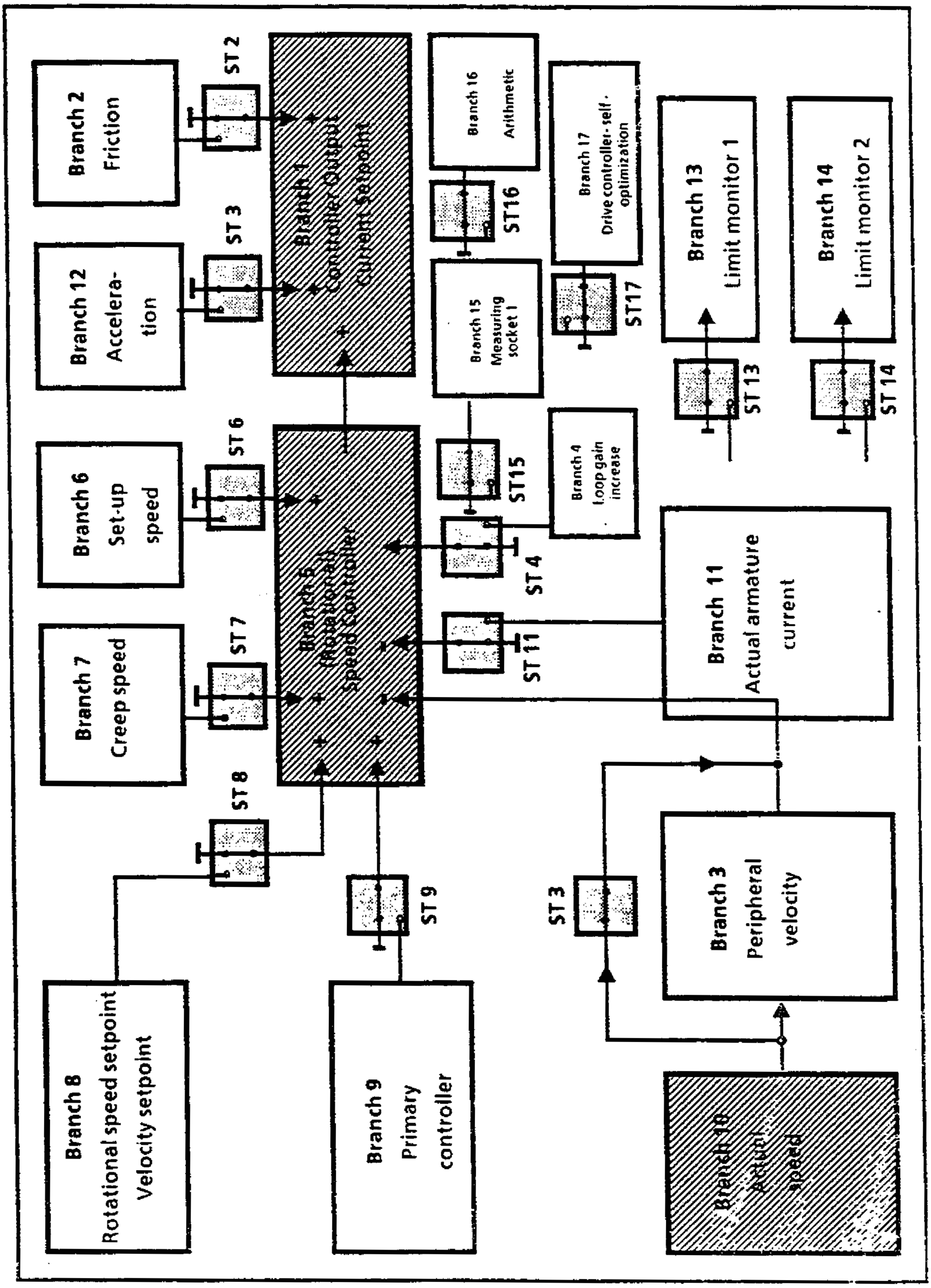


	Description	Value	Phys. unit
MP NR	MEAS. POInt NumbeR		
DAC 4	ADdRess		

Controller No:
Module No:
Plant:

Date:
Handled by:

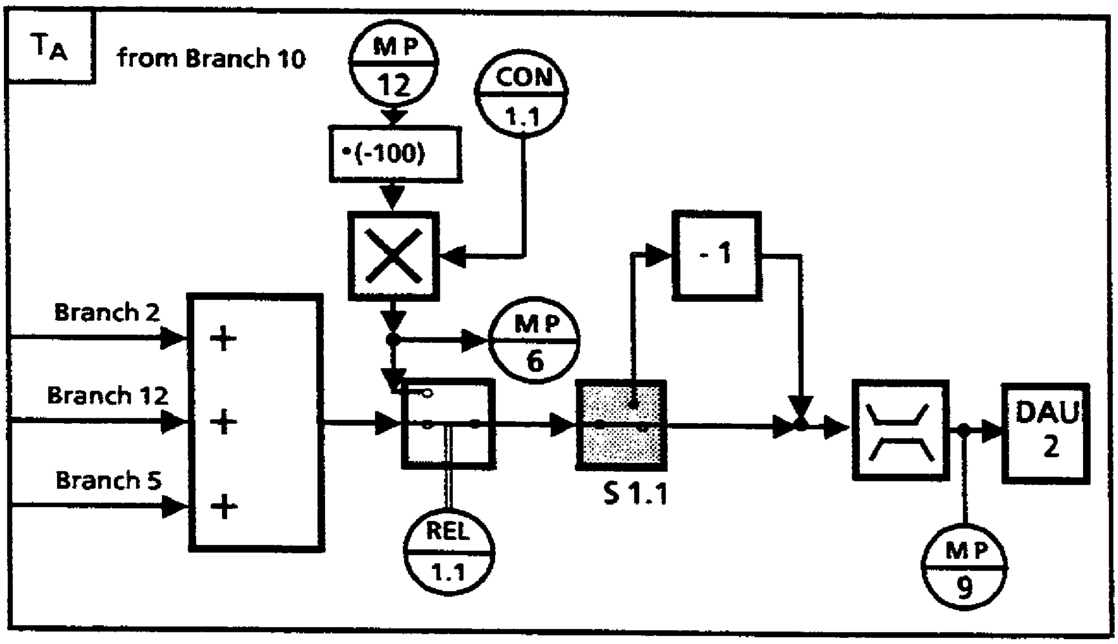
Configuration sheet: Drive controller with self-optimization



Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 1: CONTROLLER OUTPUT
CURRENT SETPOINT

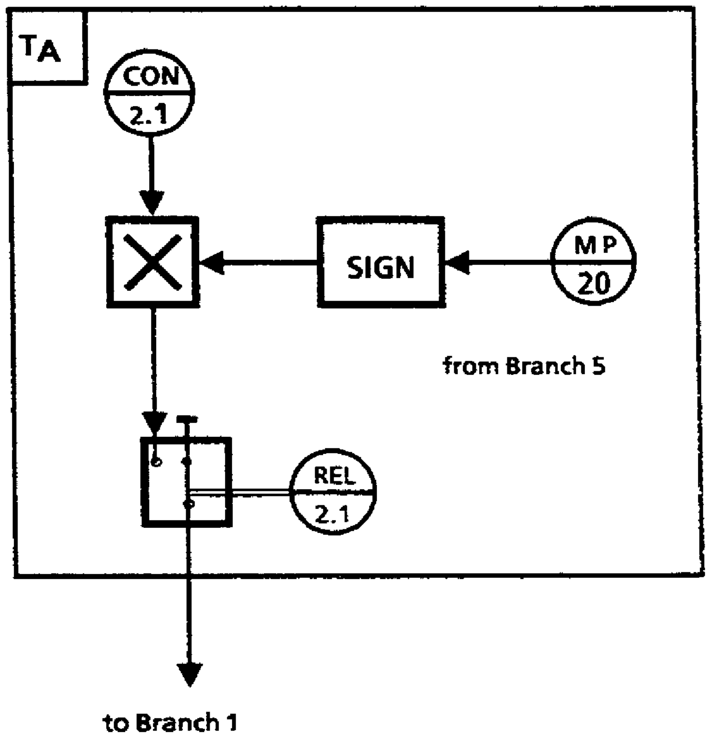


	Description	Value	Phys. unit
S 1.1	Conversion structure switch		
CON 1.1	Standardization deceleration value	□	%
DAU 2	Address	□	
REL 1.1	Break enable		%
MP 6	Deceleration current		%
MP 9	Current setpoint		%
MP 12	Actual speed		

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 2: FRICTION



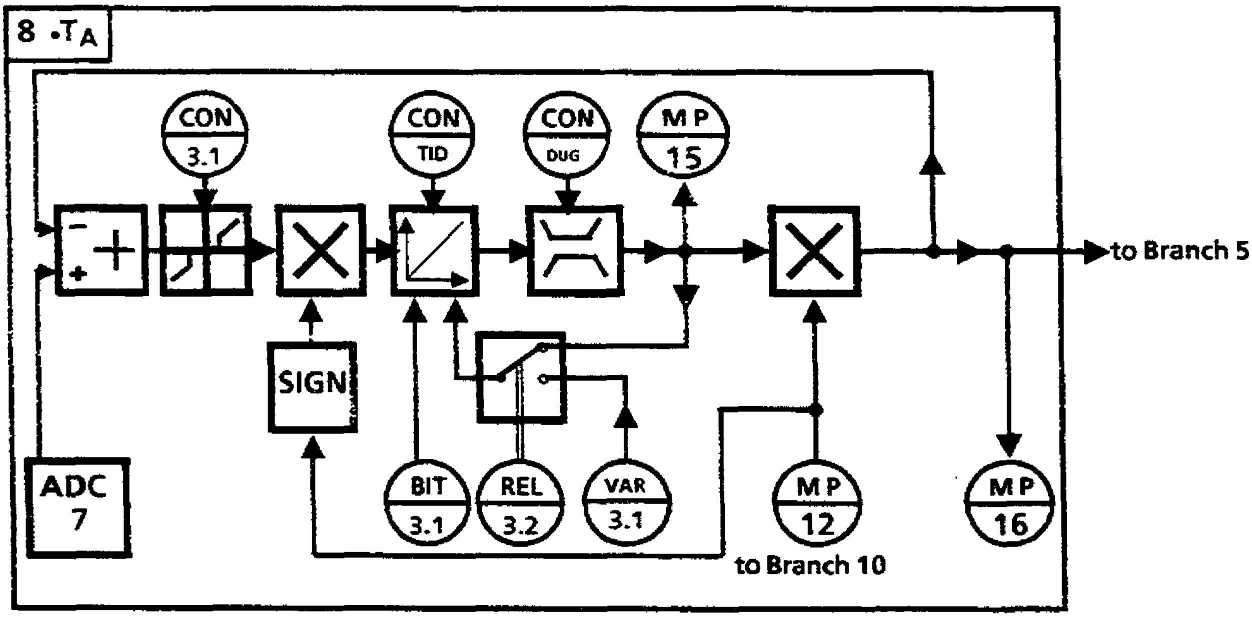
	Description	Value	Phys. unit
CON 2.1	Friction	□	%
REL 2.1	Friction enable		
MP 20	Summated setpoint		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 3: PERIPHERAL VELOCITY

Peripheral velocity

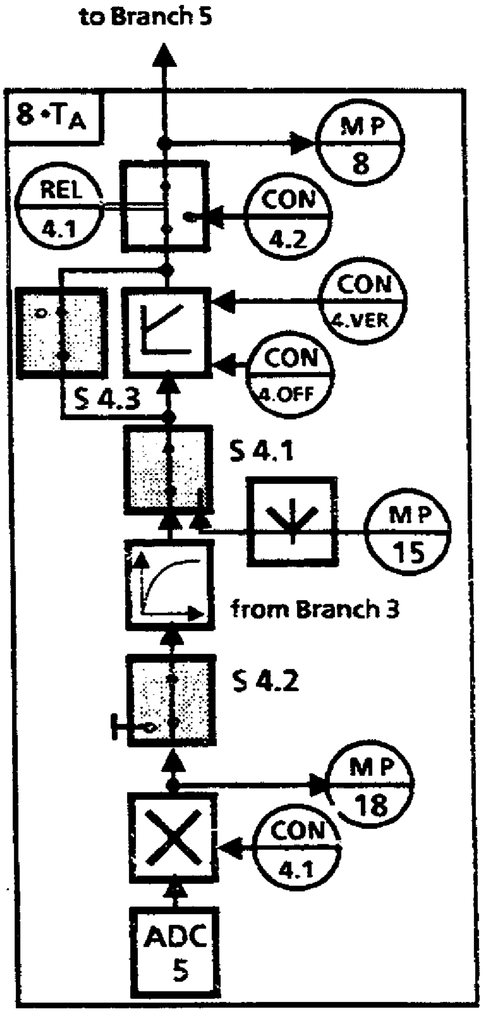


CON 3.1	Treshold value		%
CON 3.DUG	Diameter, lower limit		%
CON 3.TID	Integral action time constant		
ADC 7	Address		
BIT 3.1	Integrator enable		
REL 3.2	Set start value		
VAR 3.1	Initial diameter		%
MP 7	Acceleration		%
MP 12	Actual speed		%
MP 15	Diameter		%
MP 16	Actua! speed		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 4: LOOP GAIN INCREASE



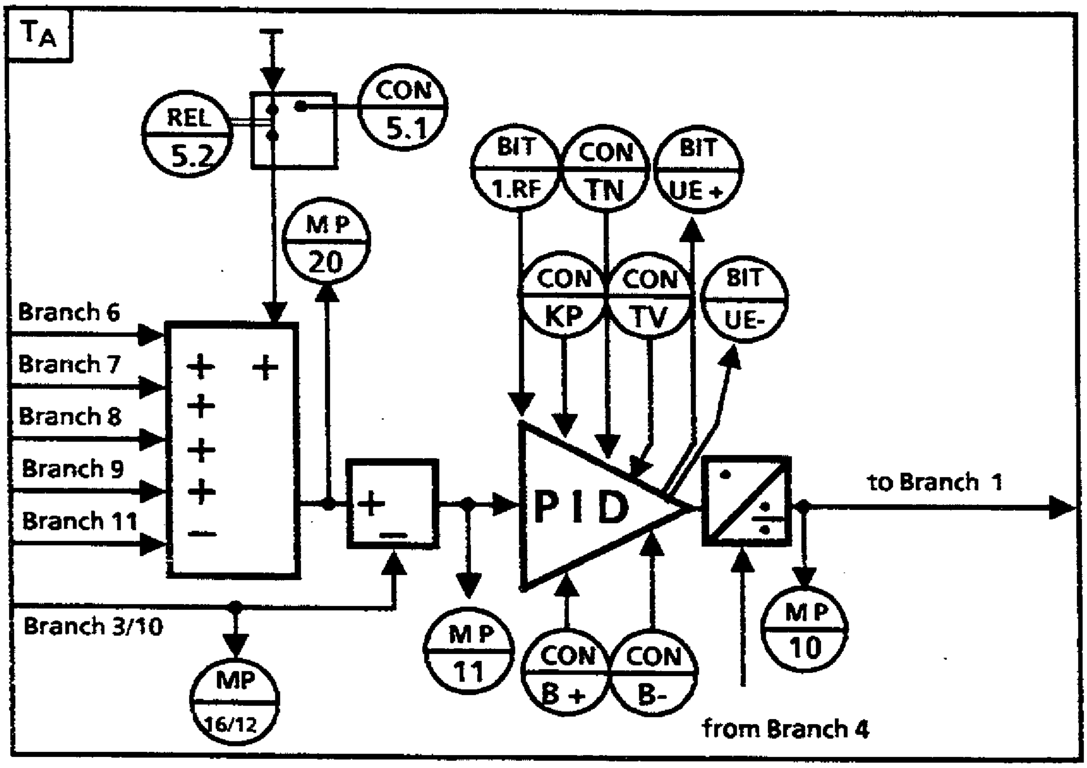
	Description	Value	Phys. unit
S 4.1	Structure selector inject diameter signal		
S 4.2	Field current monitor		
S 4.3	Interface		
CON 4.1	Standardization field current		
CON 4.2	Start-up loop gain		%
CON 4.VER	Gain		
CON 4.OFF	Offset		%
ADC 5	Address		
REL 4.1	Start-up relay		
MP 8	Gain		%
MP 15	Diameter		%
MP 18	Field current		%

Controller No.:
Module No:
Plant:

Date.
Handled by:

BRANCH 5: VELOCITY CONTROLLER SPEED CONTROLLER

Page 1



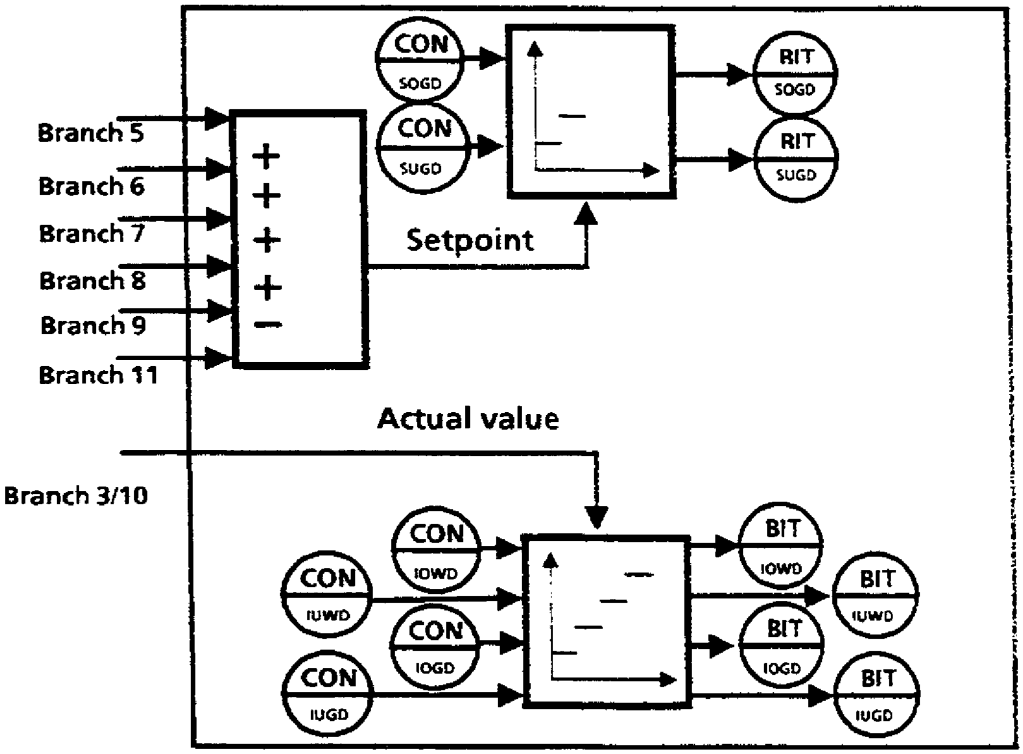
	Description	Value	Phys. unit
CON5.1	Start-up setpoint	□	%
CON5.KP	Proportional value	□	
CON5.TN	Integral-action time	□	□
CON5.TV	Derivative-action time	□	□
CON5.B +	Controller high limit	□	%
CON5.B-	Controller low limit	□	%
BIT5.1.RF	Controller enable		
BIT5.UE +	High overflow		
BIT5.UE-	Low overflow		
REL 5.2	Start-up setpoint enable		
MP10	Controller output		%
MP11	Controller deviation		%
MP12/16	Actual speed / velocity		%
MP20	Summated setpoint		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 5: (ROTATIONAL) SPEED CONTROLLER

Page 2



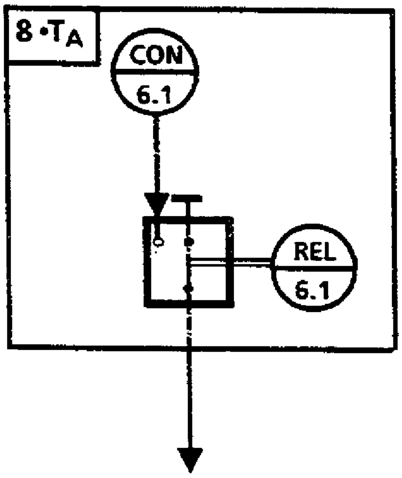
	Description	Value	Phys. unit
CON 5.SOGD	Setpoint high limit, speed controller		%
CON 5.SUGD	Setpoint low limit, speed controller		%
CON 5.IOWD	Actual value high warning limit, speed controller		%
CON 5.IUWD	Actual value low warning limit, speed controller		%
CON 5.IOGD	Actual value high danger limit, speed controller		%
CON 5.IUGD	Actual value low danger limit, speed controller		%

BIT 5.SOGD	SHLS violated
BIT 5.SUGD	SLLS violated
BIT 5.IOWD	AHWS violated
BIT 5.IUWD	ALWS violated
BIT 5.IOGD	AHDS violated
BIT 5.IUGD	ALDS violated

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 6: SET-UP SPEED



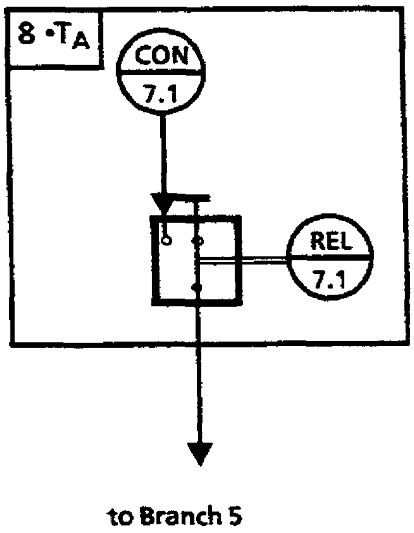
to Branch 5

	Description	Value	Phys. unit
CON 6.1	Set-up speed	□	%
REL 6.1	Set-up speed enable		

Controller No:
Module No:
Plant:

Date.
Handled by:

BRANCH 7: CREEP SPEED

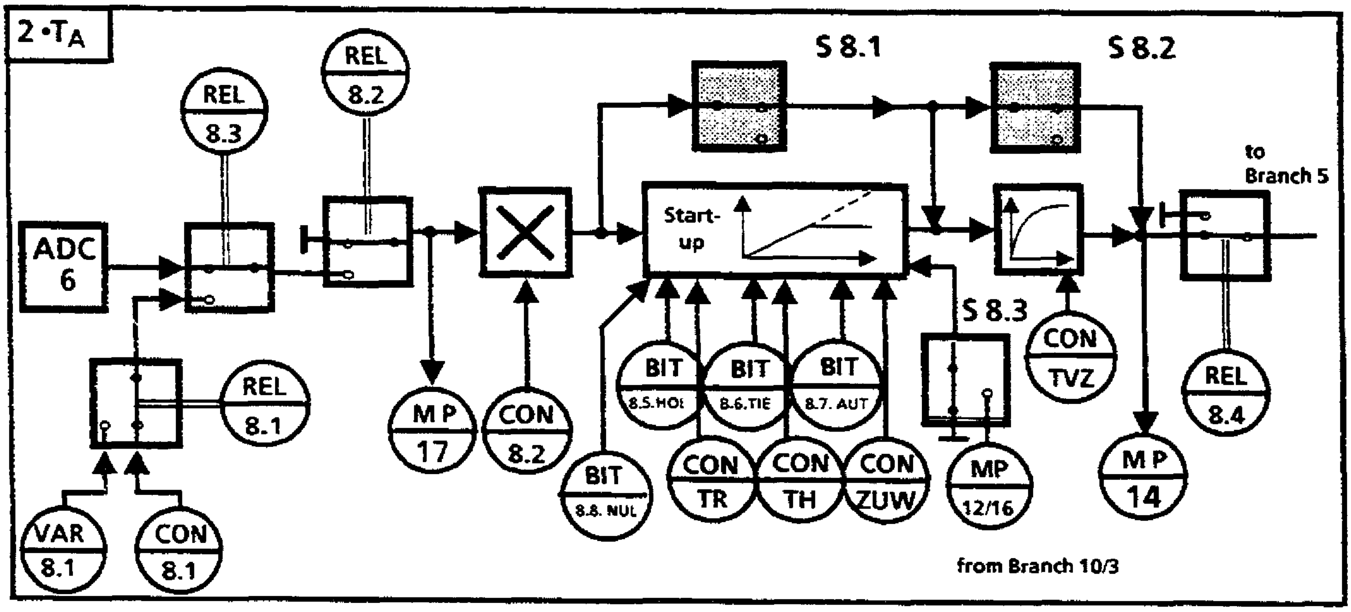


	Description	Value	Phys. unit
CON 7.1	Creep speed	□	%
REL 7.1	Creep speed enable		

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 8: (ROTATIONAL) SPEED SETPOINT, VELOCITY SETPOINT



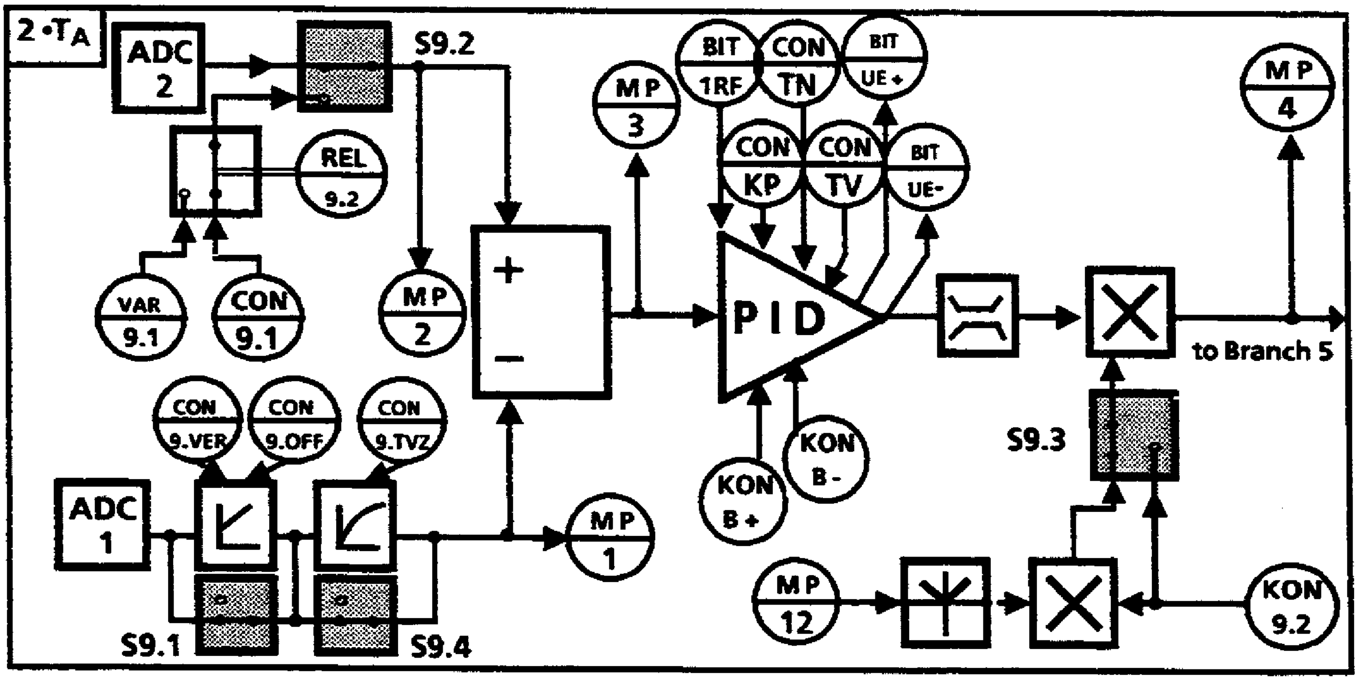
	Description	Value	Phys. unit
S 8.1	Struct. sel. RAMP GENERATOR		
S 8.2	Struct. sel. SMOOTHING		
S 8.3	Struct. sel. SETPOINT SEQUENCE		
CON8.1	Constant setpoint		%
CON8.2	Setpc .scaler		%
CON8.TR	Ramp-down time		
CON 8.TH	Ramp-up time		
CON 8.ZUW	Increase		%
CON8.TVZ	Smoothing time constant		
ADC 6	Address		
BIT 8.5 HOE	Higher		
BIT 8.6TIE	Lower		
BIT 8.7 AUT	Automation mode		
BIT 8.8 NUL	Move setpoint to 0 %		
REL 8.1	PG/PC-setpoint		
REL 8.2	Setpoint enable		
REL 8.3	ADC / input		
REL 8.4	Isolated mode		
VAR 8.1	Variable setpoint		%
MP 12	Actual speed		%
MP 14	Setpoint after ramp generator		%
MP 17	Setpoint before ramp generator		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 9: PRIMARY CONTROLLER

Page 1



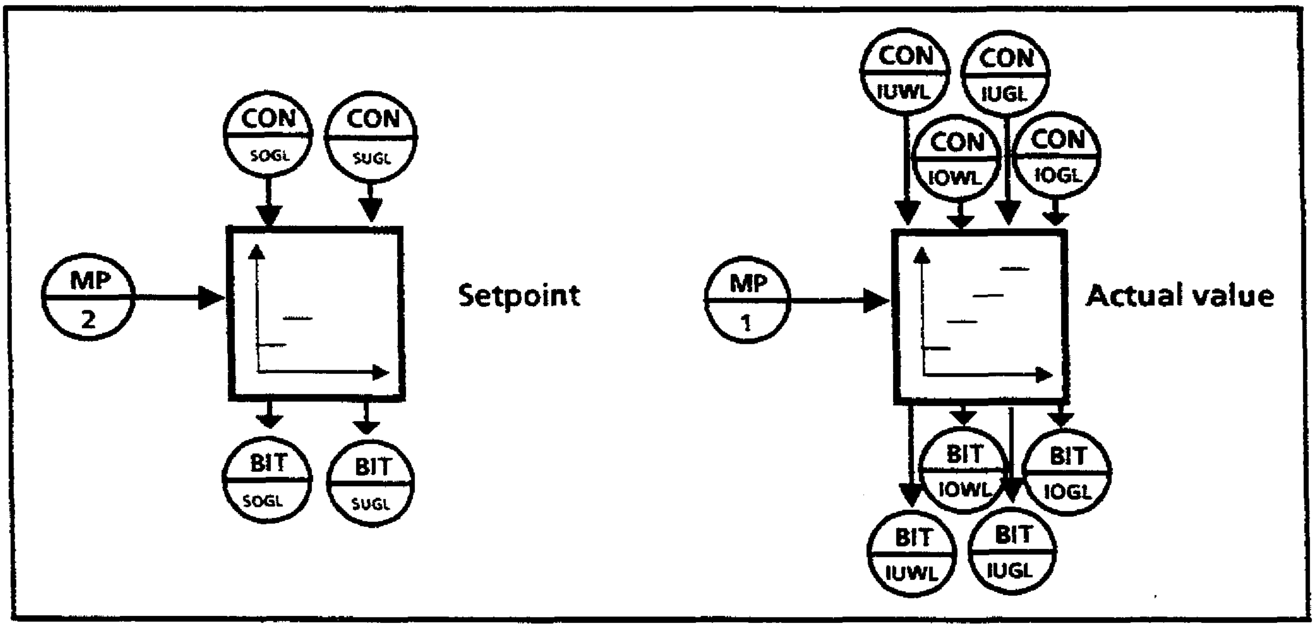
	Description	Value	Phys. unit
S9.1	Interface structure switch		
S9.2	Struct. sel. setpoint selection ADC/INPUT		
S9.3	Struct. sel. multiplier select. N-ACT/PG SCALER		
S9.4	Filter structure switch		
CON 9.1	Constant setpoint		%
CON 9.2	Constant factor		
CON 9.KP	Proportional value		
CON 9.TN	Integral-action time		
CON 9.TV	Derivative-action time		
CON 9.B +	Controller high limit		%
CON 9.B-	Controller low limit		%
CON 9.VER	Gain		
CON 9.OFF	Offset		%
CON 9.TVZ	Filter time constant		
ADC 1	Address		
ADC 2	Address		
BIT 9.1 RF	Controller enable		
BIT 9.UE +	High overflow (identifier)		
BIT 9.UE-	Low overflow (identifier)		
REL 9.2	Variable setpoint		
VAR 9.1	Variable setpoint		%
MP 1	Actual value at controller		%
MP 2	Setpoint at controller		%
MP 3	Deviation at controller		%
MP 4	Correction value at controller		%
MP12	Actual speed		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 9: SETPOINT/ACTUAL VALUE MONITORING

Page 2

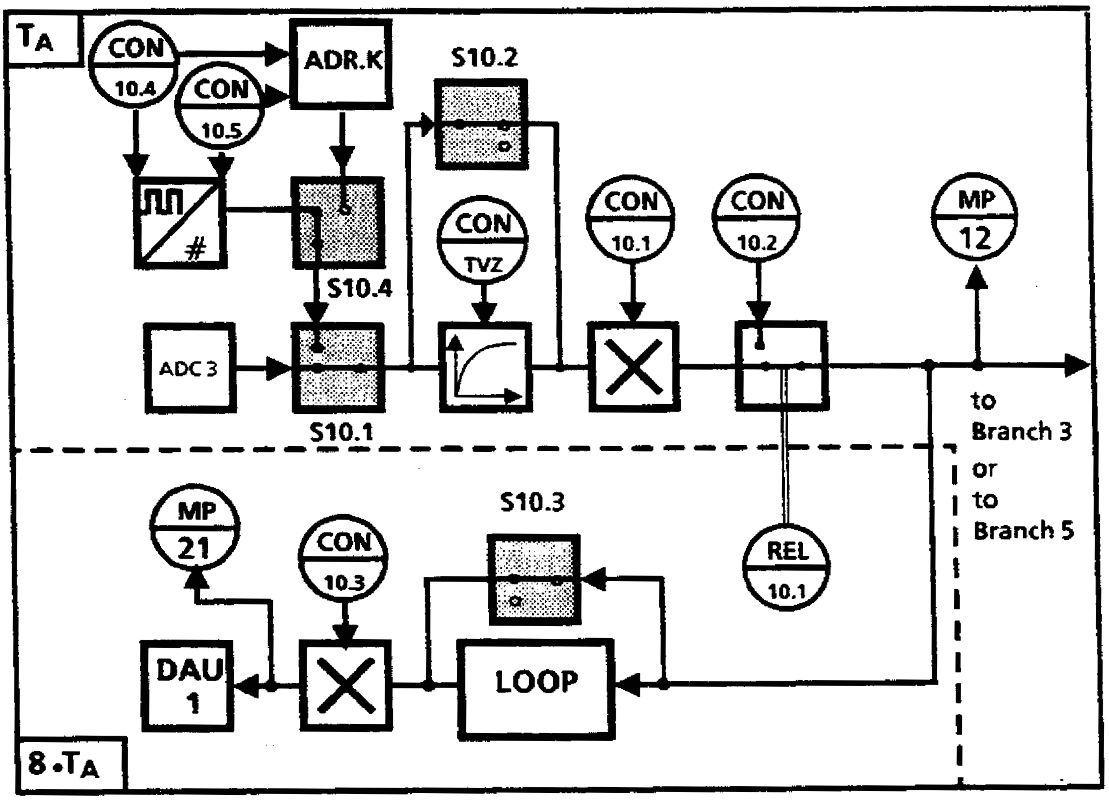


	Description	Unit	Phys. unit
KON 9.SOGL	Setpoint high limit, position controller		%
KON 9.SUGL	Setpoint low limit, position controller		%
KON 9.IOWL	Actual value high warning limit, position controller		%
KON 9.IUWL	Actual value low warning limit, position controller		%
KON 9.IOGL	Actual value high danger limit, position controller		%
KON 9.IUGL	Actual value low danger limit, position controller		%
BIT 9.SOGL	SHILP violated		
BIT 9.SUGL	ALIP violated		
BIT 9.IOWL	AHWP violated		
BIT 9.IUWL	ALWP violated		
BIT 9.IOGL	HDP violated		
BIT 9.IUGL	ALDP violated		
MP 1	Actual value at controller		%
MP 2	Setpoint at controller		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 10: ACTUAL ARMATURE CURRENT

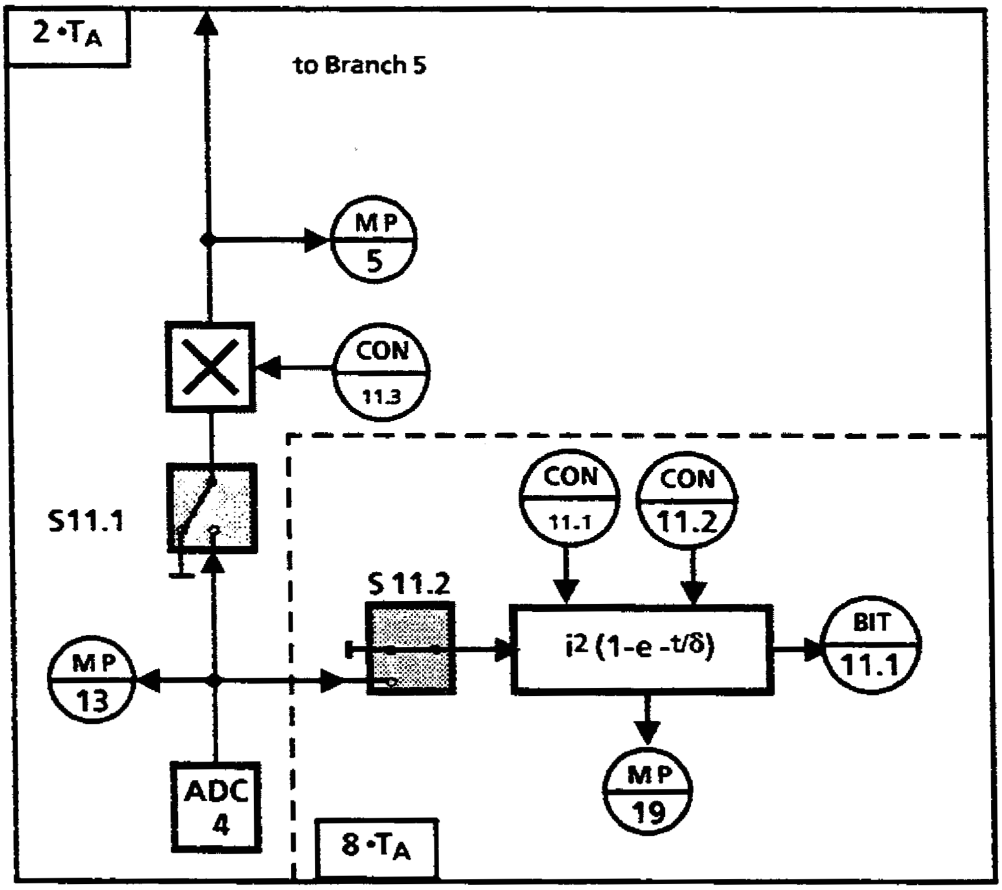


	Description	Value	Phys. unit
S 10.1	Struct. sel. actual value ANALOG/PULSE sensor		
S 10.2	Smoothing		
S 10.3	EXPAND (flicker eliminator)		
S 10.4	Structure selector internal pulse capture/ external IP 240 counter module		
CON10.1	Scaling speed actual value		
CON10.2	Actual start-up value		%
CON10.3	Calibration display		%
CON 10.4	Rated speed rev/sec		
CON 10.5	Line numbers/100 (NC/100)		
CON10.TVZ	Smoothing time constant		
ADCC 3	Address		
DAU 1	Address		
ADR.K	I/O address Channel No. of the IP 240		
REL 10.1	Actual start-up value enable		
MP 12	Speed actual value		%
MP 21	Actual speed display		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 11: ACTUAL ARMATURE CURRENT

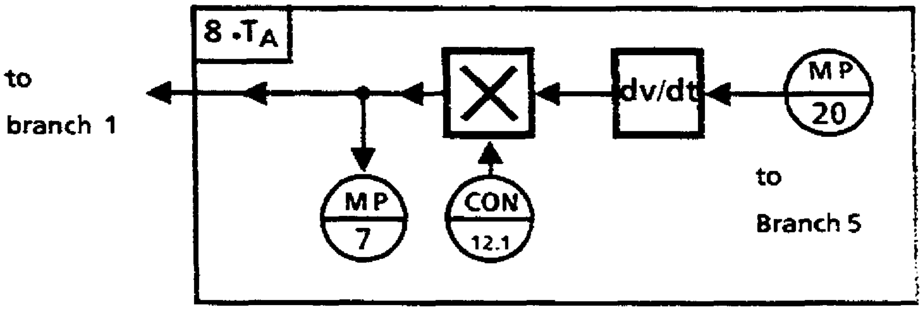


	Description	Value	Phys. unit
S 11.1	Struct. sel. thermal monitoring		
S 11.2	Struct. sel. armature current injection		
KON 11.1	Thermal limit	□	%
KON 11.2	Thermal constant	□	□
KON 11.3	Standardization armature current	□	%
ADU 4	Address	□	
BIT 11.1	Thermal interrupt		
MP 5	Correction value at actual current		%
MP13	Actual armature current		%
MP19	Temperature		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 12: ACCELERATION COMPENSATION

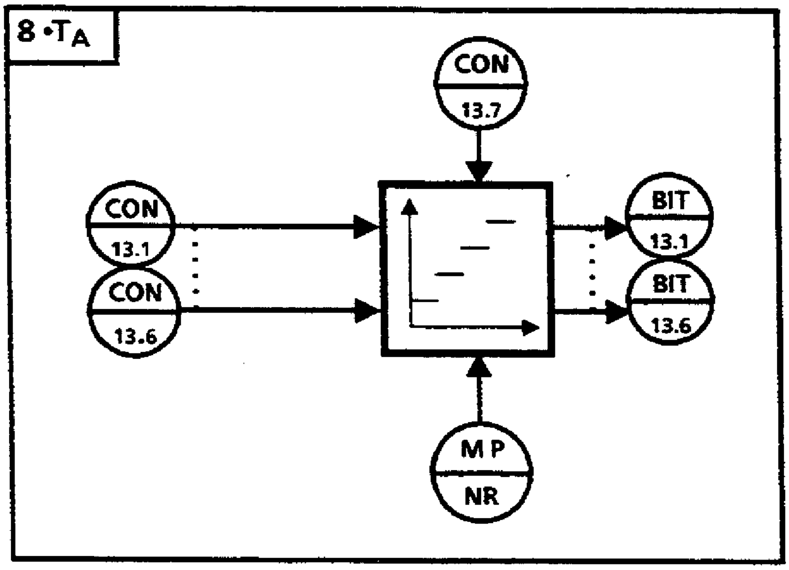


	Description	Value	Phys. unit
KON 12.1	Acceleration standardization	□	
MP 7	Acceleration		%
MP 20	Summated setpoint		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 13: LIMIT MONITOR 1

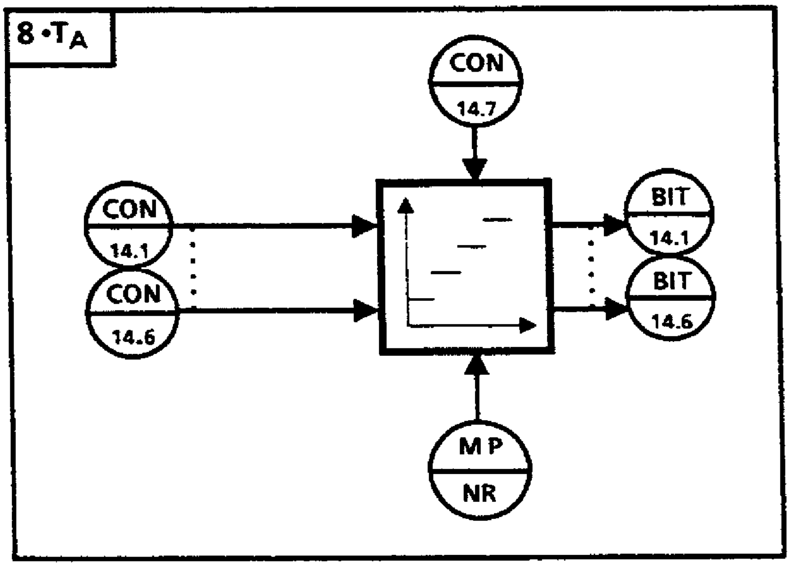


	Description	Value	Phys. unit
MP NR	Measuring point number		
CON 13.1	Limit 1		%
CON 13.2	Limit 2		%
CON 13.3	Limit 3		%
CON 13.4	Limit 4		%
CON 13.5	Limit 5		%
CON 13.6	Limit 6		%
CON 13.7	Number of limits		
BIT 13.1	Limit identifier 1		
BIT 13.2	Limit identifier 2		
BIT 13.3	Limit identifier 3		
BIT 13.4	Limit identifier 4		
BIT 13.5	Limit identifier 5		
BIT 13.6	Limit identifier 6		

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 14: LIMIT MONITOR 2

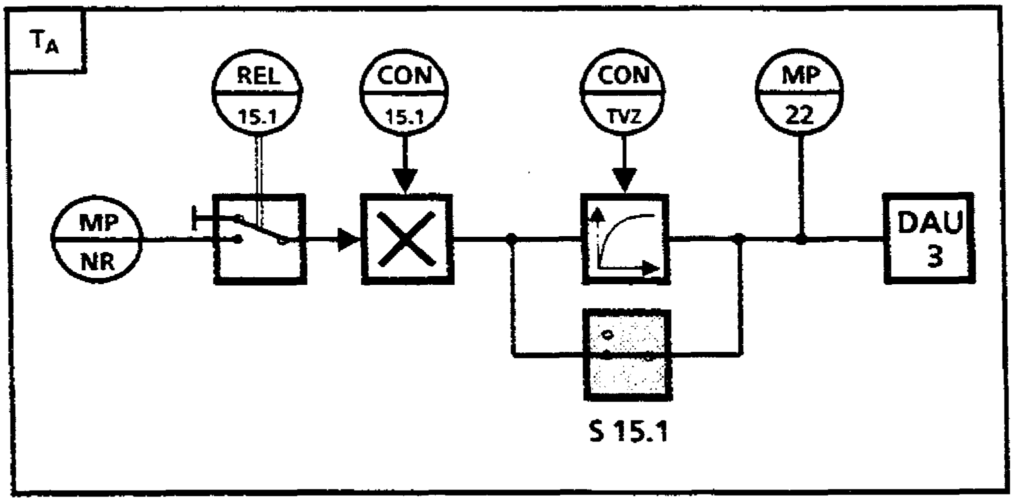


	Description	Value	Phys. value
MP NR	Measuring point number		
CON 14.1	Limit 1		%
CON 14.2	Limit 2		%
CON 14.3	Limit 3		%
CON 14.4	Limit 4		%
CON 14.5	Limit 5		%
CON 14.6	Limit 6		%
CON 14.7	Number of limits		
BIT 14.1	Limit identifier 1		
BIT 14.2	Limit identifier 2		
BIT 14.3	Limit identifier 3		
BIT 14.4	Limit identifier 4		
BIT 14.5	Limit identifier 5		
BIT 14.6	Limit identifier 6		

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 15: MEASURING POINT OUTPUT

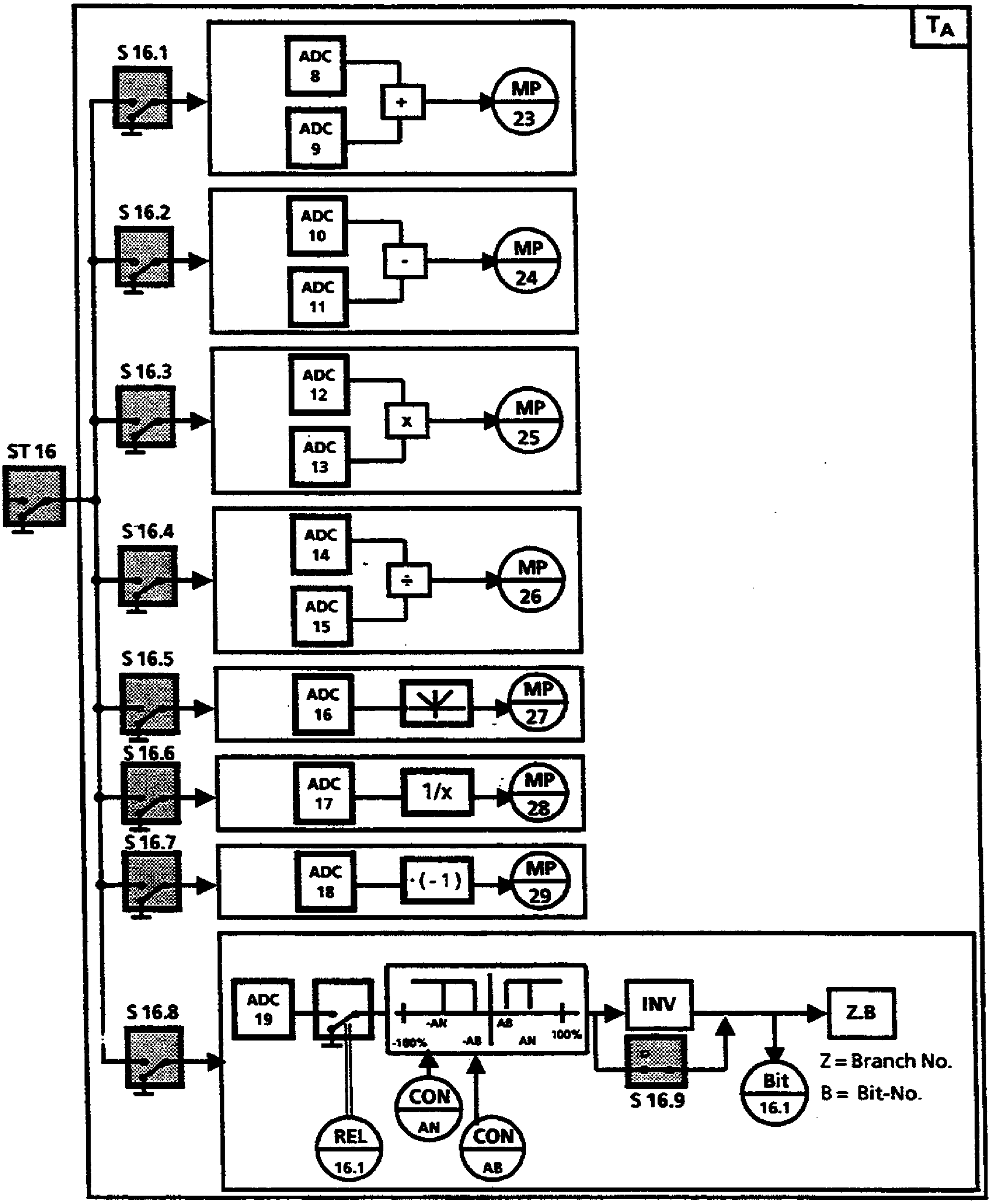


	Description	Value	Phys. unit
S 15.1	Smoothing		
MP NR	Measuring point number		
CON15.1	Standardization		
CON15.TVZ	Smoothing constant		
DAU 3	Address		
REL 15.1	Measuring point enable		
MP22	Measuring point output		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 16: ARITHMETIC



Controller No:

Module No:

Plant:

Date:

Handled by:

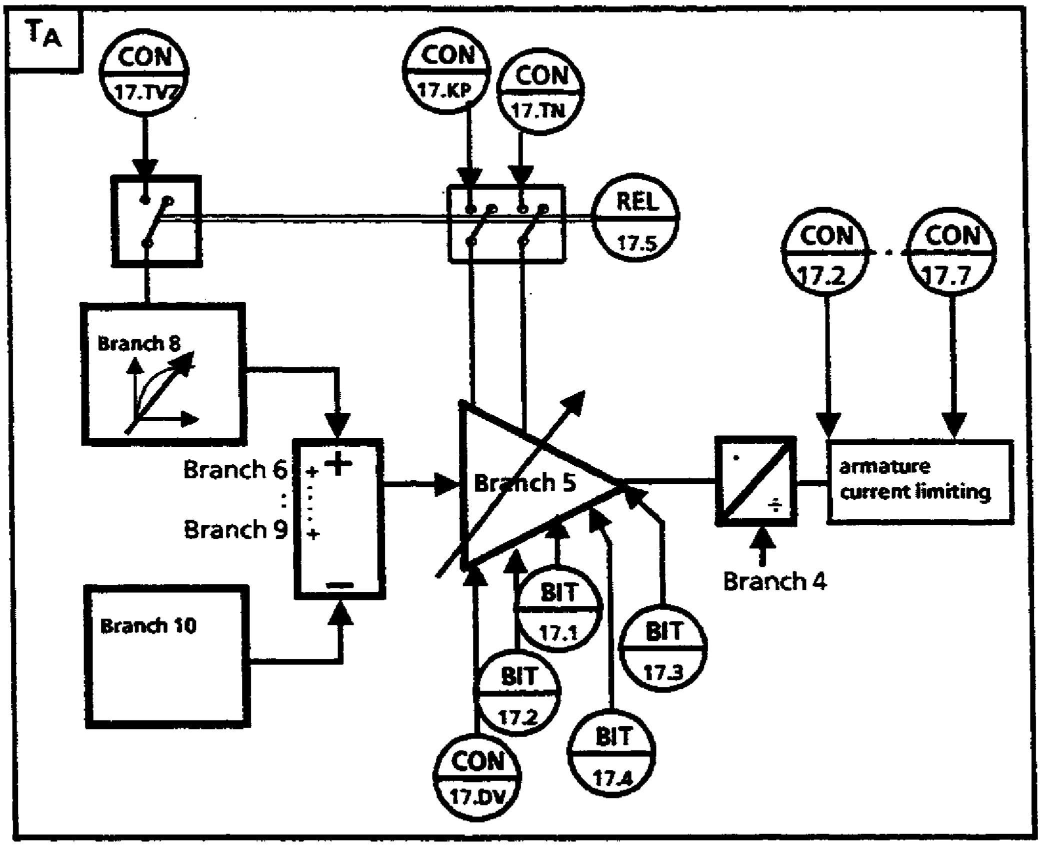
BRANCH 16: ARITHMETIC (Parameter)

	Description	Value	Phys. unit
S 16.1	Forming the sum		
S 16.2	Summated setpoint		
S 16.3	Forming the product		
S 16.4	Forming the quotient		
S 16.5	Forming the unsigned value		
S 16.6	Forming the reciprocal value		
S 16.7	Conversion		
S 16.8	Comparator		
S 16.9	Conversion		
CON 16.AN	Upper response threshold		%
CON 16.AB	Lower response threshold		%
ADC 8	Address		
ADC 9	Address		
ADC 10	Address		
ADC 11	Address		
ADC 12	Address		
ADC 13	Address		
ADC 14	Address		
ADC 15	Address		
ADC 16	Address		
ADC 17	Address		
ADC 18	Address		
ADC 19	Address		
REL 16.1	Switch enable		
BIT 16.1	Switch result		
Z.B	Branch/bit-number		
MP 23	Summated value		%
MP 24	Difference value		%
MP 25	Product value		%
MP 26	Quotient value		%
MP 27	Unsigned value		%
MP 28	Reciprocal value		%
MP 29	Converted value		%

Controller No:
Module No:
Plant:

Date:
Handled by:

BRANCH 17: SELF SETTING



	Discription	Value	Phys. unit
CON17.DV	Double ratio factor		%
CON17.2	Maximum permissible armature current I max. 1		%
CON17.3	at speed N1		%
CON17.4	Maximum permissible armature current I max. 2		%
CON17.5	at speed N2		%
CON17.6	Maximum permissible armature current I max. 3		%
CON17.7	at speed N3		%

BIT17.1.POS	Setpoint step changes in positive direction?
BIT17.2.NEG	Setpoint step changes in negative direction?
BIT17.3.LAG	Position limit monitoring enable?
BIT17.4.OPT	Self-optimization
REL17.5.UEB	Accept calculated value?
CON17.KP	Controller gain KP
CON17.TN	Integral action time TN
CON17.TVZ	Filter time constant TVZ

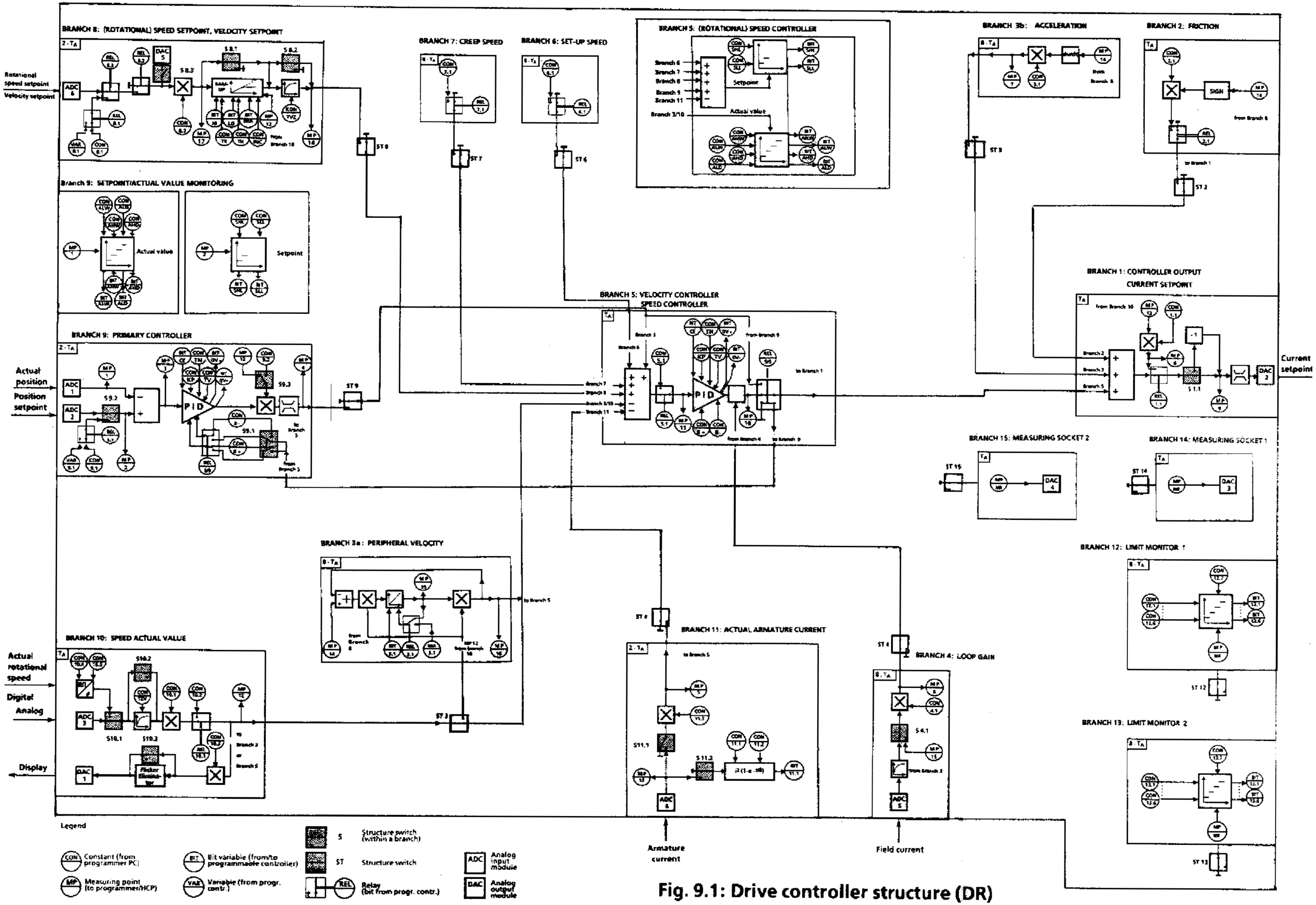
Controller No:

Module No:

Plant:

Date:

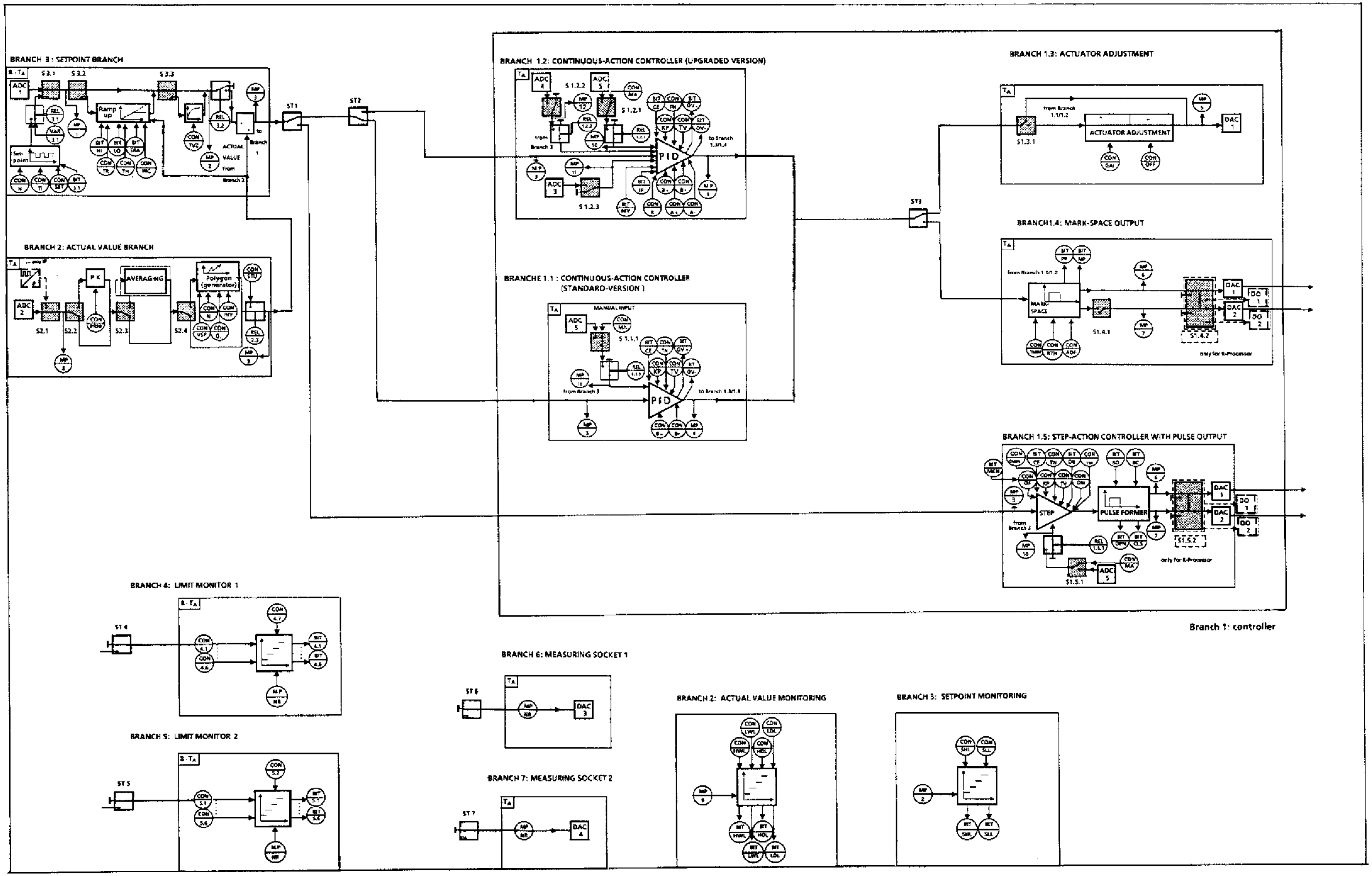
Handled by:



BRANCH 8: (ROTATIONAL) SPEED SETPOINT, VELOCITY SETPOINT
Rotational speed setpoint
Velocity setpoint
Branch 9: SETPOINT/ACTUAL VALUE MONITORING
Actual value
Setpoint
BRANCH 9: PRIMARY CONTROLLER
Actual position
Position setpoint
P I D
BRANCH 7: CREEP SPEED
BRANCH 6: SET-UP SPEED
BRANCH 5: (ROTATIONAL) SPEED CONTROLLER
Setpoint
Actual value
BRANCH 5: VELOCITY CONTROLLER
SPEED CONTROLLER
BRANCH 3b: ACCELERATION
BRANCH 2: FRICTION
SIGN
BRANCH 1: CONTROLLER OUTPUT
CURRENT SETPOINT
Current setpoint
BRANCH 15: MEASURING SOCKET 2
BRANCH 14: MEASURING SOCKET 1
BRANCH 12: LIMIT MONITOR 1
BRANCH 13: LIMIT MONITOR 2
BRANCH 3a: PERIPHERAL VELOCITY
BRANCH 10: SPEED ACTUAL VALUE
Actual rotational speed
Digital
Analog
Display
Flicker Eliminator
BRANCH 11: ACTUAL ARMATURE CURRENT
Armature current
BRANCH 4: LOOP GAIN
Field current
ST 1
ST 2
ST 3
ST 4
ST 6
ST 7
ST 8
ST 9
ST 12
ST 13
ST 14
ST 15
Legend
CON Constant (from programmer PC)
MP Measuring point (to programmer/HCP)
BIT Bit variable (from/to programmable controller)
VAR Variable (from progr. contr.)
S Structure switch (within a branch)
ST Structure switch
REL Relay (bit from progr. contr.)
ADC Analog input module
DAC Analog output module

Fig. 9.1: Drive controller structure (DR)

9.1



Legend

CON Constant (from programmer PC)

MP Measuring point (to programmer/HCP)

BIT Bit variable (from/to programmable controller)

VAR Variable (from progr. contr.)

▨ S Structure switch (within a branch)

▨ ST Structure switch

REL Relay (bit from progr. contr.)

ADC Analog input module

DAC Analog output module

Fig. 9.2: Standard controller structure (SR)

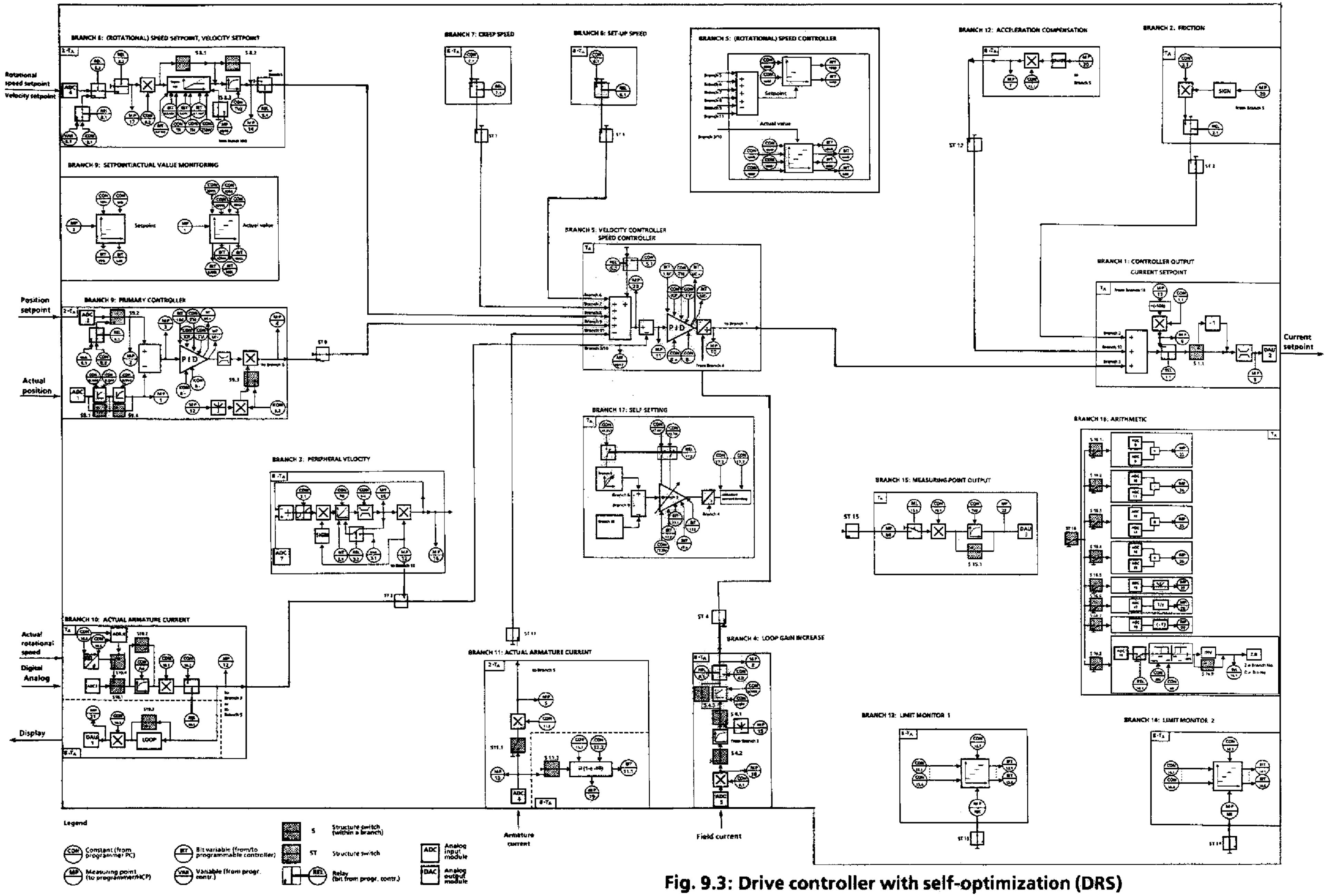
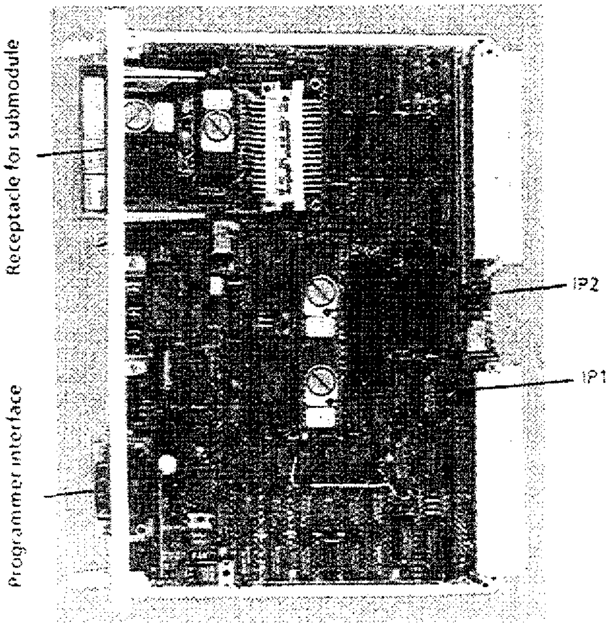
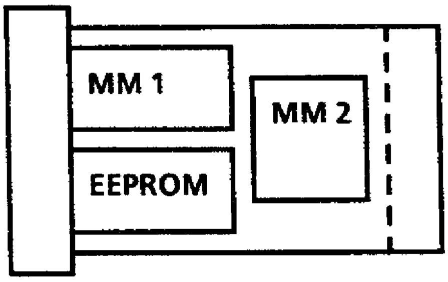
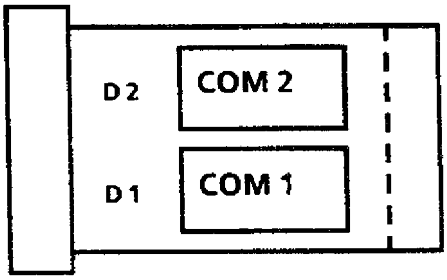

BRANCH 8: (ROTATIONAL) SPEED SETPOINT, VELOCITY SETPOINT
Rotational speed setpoint
Velocity setpoint
BRANCH 9: SETPOINT/ACTUAL VALUE MONITORING
Setpoint
Actual value
BRANCH 9: PRIMARY CONTROLLER
Position setpoint
Actual position
BRANCH 7: CREEP SPEED
BRANCH 6: SET-UP SPEED
BRANCH 5: (ROTATIONAL) SPEED CONTROLLER
BRANCH 12: ACCELERATION COMPENSATION
BRANCH 2: FRICTION
BRANCH 5: VELOCITY CONTROLLER SPEED CONTROLLER
BRANCH 1: CONTROLLER OUTPUT CURRENT SETPOINT
Current setpoint
BRANCH 3: PERIPHERAL VELOCITY
BRANCH 17: SELF SETTING
BRANCH 15: MEASURING POINT OUTPUT
BRANCH 16: ARITHMETIC
BRANCH 10: ACTUAL ARMATURE CURRENT
Actual rotational speed
Digital
Analog
Display
BRANCH 11: ACTUAL ARMATURE CURRENT
Armature current
BRANCH 4: LOOP GAIN INCREASE
Field current
BRANCH 13: LIMIT MONITOR 1
BRANCH 14: LIMIT MONITOR 2
Legend
CON Constant (from programmer PC)
MP Measuring point (to programmer/HCP)
BIT Bit variable (from/to programmable controller)
VAR Variable (from progr. contr.)
S Structure switch (within a branch)
ST Structure switch
REL Relay (bit from progr. contr.)
ADC Analog input module
DAC Analog output module

Fig. 9.3: Drive controller with self-optimization (DRS)

9.4 Firmware-Overview

EPROMs for IP 252

	Location	Label	Module
Operating system on IP 252	D 4	IP 1 252 V x.z	IP 252 processor card  Receptacle for submodule Programmer interface IP2 IP1
	D 3	IP 2 252 V x.z	
Operating system on mixed-memory submodule	D 2	MM 1 252 AS V y.z	
	D 3	MM 2 252 AS V y.z	
COM 252 / 615	D 1	COM 1 252 AS V x.y	
	D 2	COM 2 252 AS V x.y	

A: Drive controller structure
S : Standard controller structure

9.5 Abbreviations

ADU	Analog/digital converter
BASP	Command output disable
CP	Communications processor
CPU	Central processing unit
DAC	Digital/analog converter
DIMOS	Diagnostic and Monitoring System
DR	Drive controller
DRS	Drive controller with self-optimization
FB	Function block
IF	Interface
IP	Intelligent I/O module
KON	Delay time constant (= TVZ)
KP	Proportional gain
LM	Limit monitor
µs	Microseconds
PB	Program block
PC	Programmable controller
PG	Programmer
S5-DOS	S5 Disk Operating System
SR	Standard controller
TN	Integral-action time
TS	Sampling time
TV	Derivative-action time
TVZ	Smoothing time constant (= KON)

9.6 Controller loading of the IP 252

The following list states the approximate percentage loading imposed on the processor by each branch at a given sampling time of 4 ms. The percentage values given are halved when the sampling time is doubled (8ms). It is intended as a guideline for the user in ascertaining the maximum number of control loops he can implement on the IP 252 for his particular purpose.
COM 252/COM REG initialization software gives the current total percentage loading of the processor in the "Processor loading" submenu of the "Info" function. If this value is less than 100%, the sampling time T_A of the control loops is automatically extended by 4ms. This extension applies until the time discrepancy has been eliminated. In this way, the operating system of the IP 252 can control all overloads and, in this case, can still be operated via the programmer or the S5-CPU.

Drive controller

Branch	1: Controller output	*
	a) Without conversion	
	b) With conversion	
Branch	2: Friction	*
Branch	3: Circumferential velocity and acceleration	5%
Branch	4: Loop gain	
	a) With field current measurement	5%
	b) With injection of diameter signal	1%
Branch	5: Speed controller	*
Branch	6: Setting-up speed	cannot be measured
Branch	7: Inching speed	cannot be measured
Branch	8: Speed setpoint	
	a) Branch without ramp-function generator and smoothing stage	7,5%
	b) Ramp-function generator	1%
	c) Smoothing stage	1%
Branch	9: Outer loop controller	
	a) Position setpoint from PC	8%
	b) Position setpoint from ADC	10%
Branch	10: Actual speed value	
	a) Branch without smoothing stage and expanded scale	*
	b) Smoothing stage	1%
	c) Expanded scale	**
Branch	11: Actual armature current value	4%
Branch	12: Limit monitor 1	1%
Branch	13: Limit monitor 2	1%
Branch	14: Measuring socket 1	3%
Branch	15: Measuring socket 2	3%

Standard controller

Branch	1: Controller	
	a) Step controller with analog output	54%
	b) Continous-action controller without controller output	48%
	c) Additional features of extended version of the continous-action controller, without separate D input and without disturbance input	5%
	d) Separate D input	5%
	e) Disturbance input	5%
	f) "On"-"Off" output with digital output	7,5%
	g) "On"-"Off" output (two-step output)	5%
Branch	2: Actual value	
	a) Branch without function generator, averaging and plausibility checking	***
	b) Function generator	1,5%
	c) Averaging	**
	d) Plausibility checking	0,5%
Branch	3: Setpoint	
	a) Branch without ramp-function generator and without smoothing stage	1,5%
	b) Ramp-function generator	1%
	c) Smoothing stage	0,5%
	d) Setpoint sequence	0,5%
Branch	4: Limit monitor 1	1%
Branch	5: Limit monitor 2	1%
Branch	6: Measuring socket 1	3%
Branch	7: Measuring socket 2	3%

* This load is part of the base load of the drive controller; with a sampling time of 4 ms 55%.
** These loads are negligible.
*** The loads of these branches are accounted for in the base load specified for branch 1a) and branch 1b).

9.7 Controller loading of the IP 252

Drive controller with self-optimization (DRS)

((Text folgt))