Profibus Radio Modem

– Software-Version 1.12 –

G_76330-A

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Contents

Contents

1 General Device Description

The radio modem G_76330-A is used for wireless, asynchronous transmission of data (simplex operation). It is a data communication equipment (DCE), communicating with a data terminal equipment (DTE) via a defined interface.

The modem offers several options concering housing, interfaces, power supply and software so that it is possible to guarantee an optimal, customized adaption to the user's hardware and/or software (DTE).

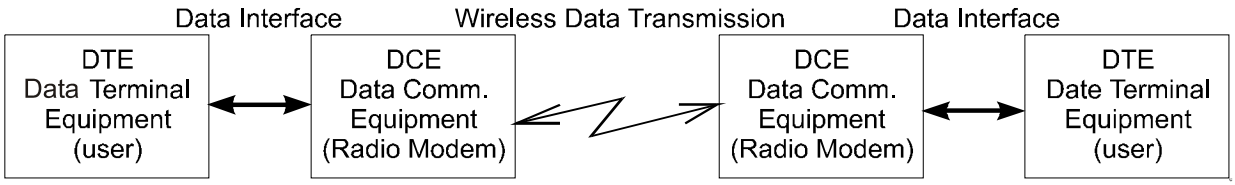


Figure 1 Schematic System Structure

2 Basic Information

At the time this manual was printed, the following symbols and marks were used in all Götting KG documentations:

- For security advices, the following symbols stand for different degrees of danger and importance:

NOTE!

ATTENTION!

WARNING!

- Further information or advices are indicated as follows:

TIP!

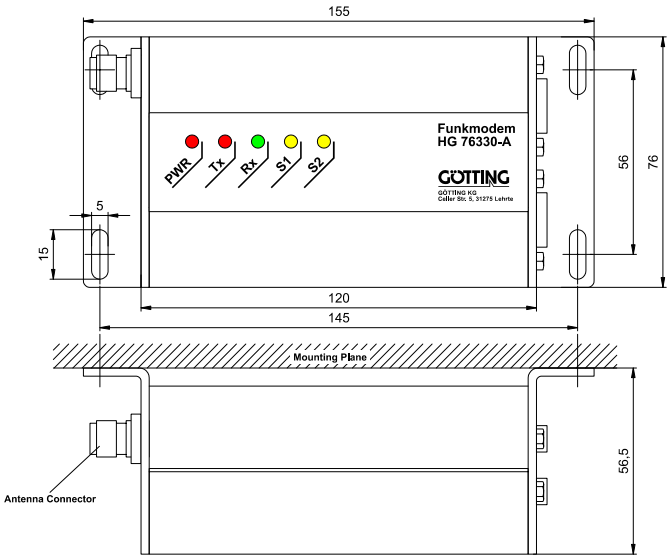
- Program texts and variables are indicated through the use of the `Script Courier`.
- Whenever the pressing of letter keys is required for program entries, the required Letter Keys are indicated as such (for any programs of Götting KG small and capital letters are equally valid).
- Sections, drawings and tables are subsequential numbers throughout the complete document. In addition, each documents includes a list of contents showing the page numbers following the front. If a document exceeds 10 pages, it also has a drawings list and a list of tables on the last few pages. If required, in case a document is correspondingly long and complex, a index is added in the back.
- Each document shows a small table including meta information, such as deveopler, author, revision and date of issue, on the front page. The information regarding revision and date of issue are also included in the bottom line on each page of the document. This way it is possible to clear identify the source document for each bit of information.
- Online version (PDF) and printed handbook are always generated from the same source. Due to the consequent use of Adobe FrameMaker for these documentations, it is possible to use the cross hints and content entries (including page numbers of the index) of the PDF file for automatical transfer to the corresponding content.

3 Hardware

3.1 Mounting the Radio Modem

The radio modem is either available in a flange casing or in a casing for installation on a mounting bar. The flange casing will be screwed directly to a suitable underground through four mounting drillings. The casing for installation on the mounting bar has a preparatory installation to fix it onto the bars.

Flange Casing



Casing for Mounting Bar

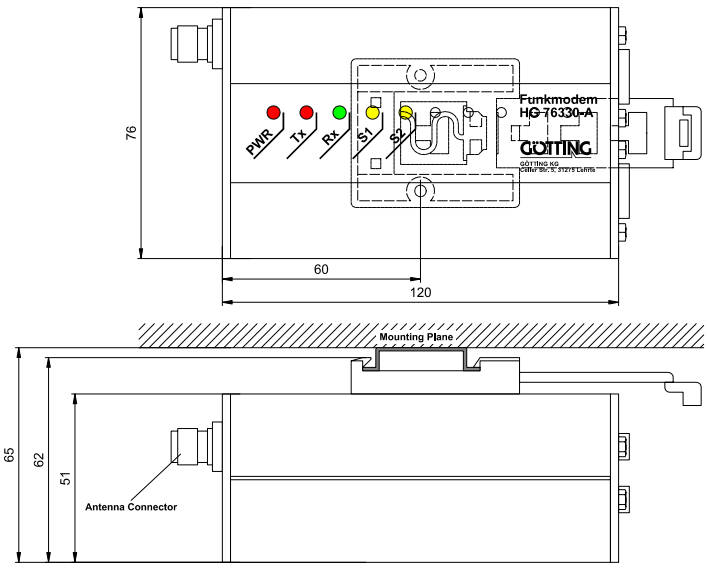


Figure 2 Comparison: Flange casing <–> casing for mounting bar (with housing dimensions)

3.2 Front Panel Elements

LEDs:

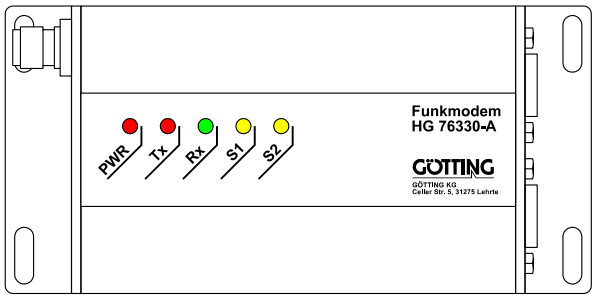


Figure 3 Front panel elements G_76330-A

Red LED PWR: Device ready to operate

Red LED TX: The device transmits data via radio

Green LED RX: The device receives data via radio

Yellow LED S1: Stand-by or error status

Yellow LED S2: Profibus is in data exchange

Interfaces:

BNC / TNC socket antenna:
Connector for antenna with an antenna input impedance of 50 Ohm

2 x 9-pin Sub-D: Connection of data line (RS 323, Profibus)

1 x 3-pin Sub-D: Connection for power supply

3.3 High Frequency Data Transmission Cable

In order to minimize signal loss the antenna feeding line should be as short as possible. The attenuation should be below one decibel at a frequency of 500 MHz (note instructions of cable particulars!).

Suitable cables and antennas may be purchased from us!

Standard Cable:

RG 58 U (50 Ohm)	ø 4,95 mm	Attenuation 0,4 dB/m (f = 480 MHz)
RG 213 U (50 Ohm)	ø 10,3 mm	Attenuation 0,1 dB/m (f = 480 MHz)

3.4 Power Supply

Power is supplied either through the 25-pin Sub-D socket or a 3-pin Sub-D connector depending on the version ordered. The modem is generally equipped with an integrated isolated DC / DC converter. Two different input voltage ranges from 9 to 36 V or from 18 to 72 are available.

Input Voltage Range	Power Assumption (Transceiver 500 mW)	Current Assumption during Transmission	Potentially Separated	Ordering Information
+9 V to +36 V	5,3 Watt	600 to 150 mA	X	24 V
+18 V to +72 V	5,3 Watt	300 to 75 mA	X	48 V

Table 1 Power supply versions available

3.5 Current Consumption

Operating Mode	Current Consumption [mA] at V_S = 24 Volt
Normal Operation (no input signal)	86
Normal Operation (with input signal)	< 90
Transmit Mode (RL = 50 Ohm)	160
Transmit Mode (RL <> 50 Ohm)	< 180

Table 2 Current consumption related to the possible operation modes

3.6 Hex Rotating Switch

Two hex rotating switches on the radio modem board enable setting the Profibus address. The hex rotating switches are only accessible after opening the radio modem's casing. Additionally it is possible to overwrite the profibus adress in the configuration menu (please refer to section 4.2.12.3 auf Seite 26). **Only personnel authorized by Götting KG is allowed to change settings - otherwise the warranty claim will expire.**

3.7 Interfaces

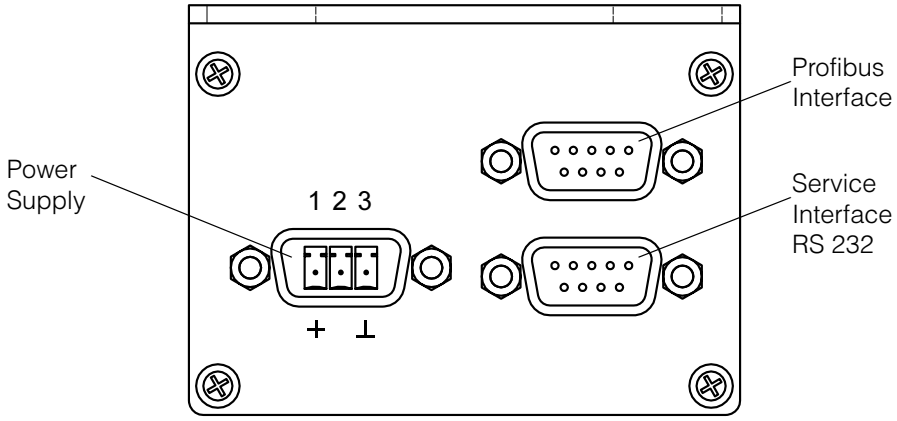


Figure 4 Interfaces

3.7.1 RS 232 Interface

The RS 232 (V.24; integrated within the modem) is a standardized voltage interface operating bit serially and asynchronously with one startbit and one or two stopp bits. A logical One corresponds to a voltage range between -3 V and -15 V, a logical Zero to a voltage between +3 V and +15 V. The range between -3 V and +3 V is undefined. The data transfer rate is maximal 19200 baud according to DIN. The rate depends on the applied software . This interface is not potential- free / isolated. Subsequently the specified signals of the RS 232 interface are explained:

Function within the Modem	Standardized Identification
Read data from DTE (Input)	TXD
Output data to DTE (Output)	RXD
Signal Ground	SG

Table 3 RS 232 signals implemented within the modem

3.7.2 Profibus Interface

The Profibus interface corresponds to the DIN 19245. This is an RS 485 interface. As a plug connector suitable profibus-plugs of type 9-pin Sub-D with integrated, switchable terminating resistor should be applied.

3.8 Pin Allocations

Pin	RS 232	Profibus	Voltage Supply
1			$+U_B$
2	TxD[a]		Supply Ground
3	RxD[b]	Line B	Supply Ground
4		RTS	
5	Signal GND	Signal GND	
6		+5 V	
7			
8		Line A	
9			

Table 4 Pin Allocation of Sub-D connector

a. TxD: Radio Modem Output
b. RxD: Radio Modem Input

3.9 Transceiver

The data edited by the microprocessor and the corresponding implemented program will be transmitted wireless over a longer distance via the transceiver module integrated into the modem. In terms of frequency there are again several options.

The frequencies are available in the ISM- frequency band from 433.15 MHz to 434.75 MHz in a 25 kHz- pattern. Additionally it is possible to supply devices for the so called ABIN-bands at 456 MHz and 466 MHz. Furthermore there are also several country specific frequency ranges (also refer to section 7 „Appendix – Frequency Allocations“ auf Seite 36).

The radio device has been approved by the appropriate authority BZT. GMSK (9.600 baud) is applied as a modulation method:

- GMSK (Gaussian Minimum Shift Keying) Special Phase Shift Keying
- In this modulation process the phase of the carrier wave is connected to the data signal and is screened with a special filter.

3.10 Available Versions of System G_76330-A

Power Supply	Casing	Frequency HF	Interface	Software
Independent of software			**Only in combination with suitable Software**	
24 V* 48 V	Mounting bar (HS) Flange (FL) *)	433.10 MHz ... 434.475 MHz *) ... 434.75 MHz 456.21 MHz 456.25 MHz 456.33 MHz 466.21 MHz 466.25 MHz 466.33 MHz Other frequencies upon request	PROFIBUS-DP *)	HG 39730_CP *)
*) Default				

Table 5 Overview of different complete systems HG 76300-A

When ordering, please advise your choice for each category!

E.g.: G_76330-A / 24V / FL / 434,475 MHz / PROFIBUS-DP / HG39730_CP

4 Software

4.1 Versions

We are prepared to develop customized hardware and software versions upon request. So far the following software versions are available:

Software	Application (described on..)	Accompanying Hardware
HG 39730_CP	Profibus-radio modem (page 12)	• 1 main station • 127 mobile participants • PROFIBUS-DP-interface • 19200 baud service-interface • 9600 baud radio transmission

Table 6 Software Versions

4.2 Software for the Communication between a Main Station and Several Participants HG 39730_CP

4.2.1 Introduction

The data exchange between Data Communication Equipment (DCE) G_76330-A and the corresponding Data Terminal Equipment (DTE) will be effected via PROFIBUS-DP. Dou to the internal data link identical to radio modems HG 76100/HG 76300 with procedure 3964R it is possible for the systems to intercommunicate.

The radio modem is a PROFIBUS slave. The communication profile complies with DIN 19245 / EN 50170. The adjusted baud rate is determined automatically. The GSD- File, required for the system's configuration, will be generated by a program (refer to section 4.3 on page 32).

For setting the devices' parameters a terminal-compliant service interface is available. The parameters are 19200 baud, 8 data bits, 1 stop bit, no parity and Xon/Xoff- flow control.

The HF- transmission rate is 9600 baud.

4.2.2 Function of LEDs during Switch-on Period

When switching on the radio modem, the Rx-LED and Tx-LED have the following control functions:

Tx-LED	Rx-LED	S1-LED	Function
●	●	O	Radio modem not connected
●	●	⊕	RAM- error (Program stops)
●	●	⊕	Initialization error radio modem (radio module (program continues after 5-fachem flashes)
O	●	⊕	Reading error EEPROM (programme continues after 3 flashes)
● = LED permanently on, O = LED off, ⊕ = LED flashes			

Table 7 Function of LEDs during switch-on period

4.2.3 Profibus Address / Switch Function

Two hex rotating switches on the radio modem board enable setting the Profibus address. The hex rotating switches are only accessible after opening of the radio modem's casing, **which must be done by Götting personnel**. Additionally it is possible to overwrite the Profibus adress in the configuration menu (please refer to section 4.2.12.3 on page 26).

4.2.4 Device Adresses

Control block $A2_{hex}$ (see 4.2.8.3 on page 20) or the service menu enable setting a fixed address for each device. The following configurations are possible:

Set Device Address	Able to transmit packets, whose address is	Able to receive packets, whose adress is
0 (installation)	any	
1... 127 (vehicle)	device's own address or zero	

Table 8 Setting of device adresses

4.2.5 Data Buffer

The profibus data buffer is 200 byte.

4.2.6 Profibus Telegram Structure

The data bytes of one telegram include one sequence number, one fill character, the participants and a maximum of 197 byte user data.

As the data is permanently available, while only modified data should be transmitted by radio, sequence numbers are applied in order to identify updated data. Transmittance and reception require separated sequence number circuits. The radio modem transmits a telegram if

- the sequence number was modified or
- the address was changed

During the reception of data and the following output via Profibus, the sequence number will be incremented for each new telegram.

4.2.6.1 Data Telegrams

Data telegrams transmitted by or received from the Profibus master have the following configuration of data bytes:

Sequence Number – Sequence number of the current telegram (0 to FF_{hex})

Fill Character – During transmission any, on reception always zero

Address – Participant address (0 to $7F_{hex}$)

Data – User data (0 to FF_{hex})

4.2.6.2 Acknowledgement Packets

During transmission to radio adresses from 1 to $7F_{hex}$ acknowledgement packets are generated by the radio modem and transferred to the twin device. Positive and negative acknowledgements are distinguished.

A positve acknowledgement is output if the wireless data transmission was successful. A telegram with three data bytes and without any user data will be generated:

Sequence Number – Sequence number of the current telegram (0 to FF_{hex})

FF_{hex} – Identification of the positive acknowledgement

Adresse – Participant address

If the wireless data transmission was interrupted or a data block was not transferred to the twin device, the transferred data block will be transmitted together with the status message (fill character) as a negative acknowledgement. The following acknowledgement packets are possible:

01	No acknowledgement received via radio
02	- 3964R: Timeout after first STX - Profibus: Profibus not ready for operation
03	- 3964R: Timeout on second STX (**Initialization conflict**) - Profibus: Old profibus data not yet transferred
04	- 3964R: Another character than DLE was received after the first or second STX - Profibus: Timeout in operation mode with handshake
05	3964R: NAK received during data output
06	3964R: Interference effect (except NAK) received during data output
07	3964R: Another character than DLE was received after the block check character (BCC)
08	3964R: Timeout after block check character (BCC)
80_{hex}	3964R: Standby over
FF_{hex}	Positive acknowledgement

Table 9 Overview acknowledgement packets

4.2.6.3 Control Packets

If procedure 3964R receives data packets with addresses higher $7F_{hex}$ these addresses will be interpreted as a control command. The data block must have the following format:

Sequence Number – Telegram sequence number

Fill Character – Any value

Control Command – 80_{hex} to FF_{hex}

Data – Value to be transmitted

Transfer of a numerical value may be effected in decimal or hexadecimal format. This value must always be ASCII coded. Hexadecimal values are to be identified by leading „X“ (58_{hex}) or „x“ (78_{hex}) . In both cases leading zeros are permissable.

Example: Value = **5**: <35_{hex}>;

<30_{hex}, 30_{hex}, 30_{hex}, 35_{hex}>;

<58_{hex}, 35_{hex}>;

<58_{hex}, 30_{hex}, 35_{hex}>

Example: Value = **30**: <33_{hex}, 30_{hex}>;

<30_{hex}, 33_{hex}, 30_{hex}>;

<78_{hex}, 31_{hex}, 45_{hex}>;

<58_{hex}, 30_{hex}, 30_{hex}, 31_{hex}, 45_{hex}>

Transferring alphabetical texts has to be left justified and additional following characters are allowed.

Example: Value = **0FF**: <$4F_{hex}$, 46_{hex}, 46_{hex}>;

<$4F_{hex}$, 46_{hex}, 46_{hex}, 41_{hex}, 42_{hex}, 43_{hex}>

For some control packets the modem returns numerical values. They are decimal ASCII coded.

Example: Value = **173**: <31_{hex}, 37_{hex}, 33_{hex}>

4.2.6.4 Back Up / Data Protection

The complete data traffic between the modem and the PLC-software shall be saved so that no telegrams will get lost. Thus the modem requires the relevant information whether a transmitted telegram to the profibus has reached the PLC-user program. Only now the profibus may transmit a new telegram.

Reception sequence number or transmission sequence number included in the first byte of the data block identify the timeliness of the data.

If the modem receives a wireless telegram - either new data or an acknowledgement packet - the `E-sequence number` will be incremented and the datablock will be transmitted to the profibus. If the datablock has reached the PLC-user program, the `E-sequence number` will be copied to the dummy byte of the current transmission data block (second byte of transmission data block). As the data block is transmitted permanently via the Profibus it is transferred to the Profibus input buffer of the radio modem. Taking the `E-sequence number` as a basis the radio modem recognizes the reception of the data block through the PLC-user program and is able to transfer a new data block to the Profibus.

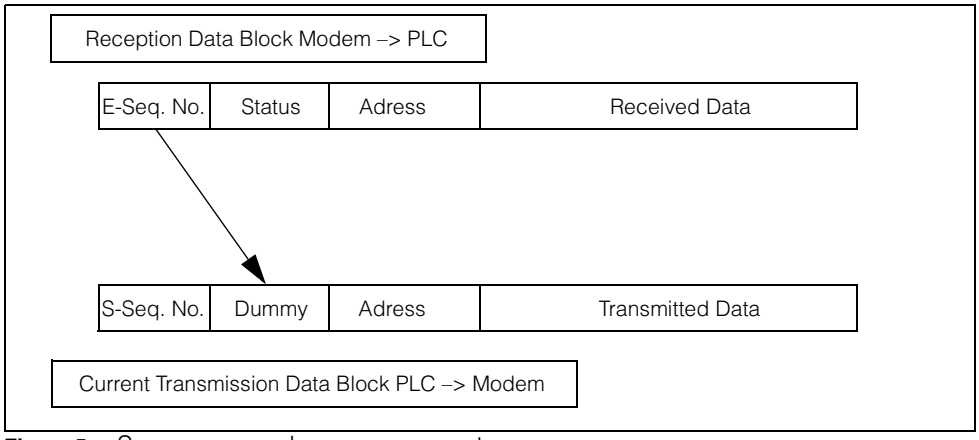


Figure 5 Sequence number management

It is not necessary that the transmission data block is a new data block; i.e. the sequence number does not have to be modified. Using the `E-sequence number`, integrated in the received transmission data block, the modem identifies the receipt of the latest telegram independently. The transmission data block will not be transmitted wirelessly until the `S-sequence number` has changed as well. A simultaneous increase of `S-sequence number` and ecceptance of the `E-sequence number` must be avoided.

Should the modem not receive an acknowledgement from the PLC-user program within a defined time interval, an acknowledgement with status 04 will be returned. The defined time interval is adjustable via the serial interface under

Profibus Parameters -> Handshake Timeout

and is adjustable between 30 and 1000 ms. A value of `0` completely deactivates this function in order to remain system-compatible with older software versions not having implied this function.

4.2.7 Implemented Control Commands

Describing control characters the values in parenthesis have the following meaning:

Adr.	Functions	per.	Def.	Range Value
81	Changing number of transmission retries of wireless communication	X	6	1 - 11
82	Changing number of transmission retries 3946R	X	5	1 - 255
83	Changing characer reply time 3946R	X	30	5 - 2000
84	Changing character reply time of wireless communication	X	5	1 - 30
85	Changing carrier rise time	X	10	3 - 30
86	Changing acknowledgement delay time 3946R	X	30	5 - 2000
87	Changing number of output retries 3946R-acknowledgement	X	255	0 - 254, 255
88	Changing acknowledgement delay time broadcast	X	30	0 - 2000
8a	Permanently setting frequency	X	0	0 - 255
8b	Temporarily setting frequency			0 - 255
8c	Setting RSSI threshold according to measured RSSI value	X		RSSI
8d	Setting repetition time for indicating telegram	X	0	0 - 9999
a0	Reading current adress			
a1	Reading DIP switch - Bit 0 to Bit 3 = Hex-switch SW1 - Bit 4 to Bit 7 = Hex-switch SW2			
a2	Changing current address	X	1	0 - 127

Table 10 Implemented Control Commands (part 1 of 3)

Adr.	Functions	per.	Def.	Range Value
a3	Changing address for lower boundary of range	X	1	1 - 127
a4	Changing address for upper boundary of range	X	127	1 - 127
a5	Reading current lower address			
a6	Reading current upper address			
a7	Clearing address			1 - 127
a8	Blocking address			1 - 127
a9	Clearing or blocking all addresses			ON, on, OFF, off
aa	Reading binary clearing table			
ab	Reading acknowledgement delay time broadcast			
b0	Reading field intensity in AD parts			
b3	Reading field intensity in dBm			
b5	Reading current number of antennas			
b6	Reading current transmission retries of wireless communication			
b7	Reading current transmission retries 3964			
b8	Reading current character reply time 3964			
b9	Reading current character reply time of wireless communication			
ba	Reading current carrier rise time			
bb	Reading current acknowledgement delay time 3964			
bc	Reading current acknowledgement delay time 3964			
bd	Reading current frequency			
be	Reading value for RSSI- threshold			
bf	Reading current repitition time for indicating telegrams			
c0	Reading error status (refer to Table 11 on page 21)			

Table 10 Implemented Control Commands (part 2 of 3)

Adr.	Functions	per.	Def.	Range Value
c1	Reading version number of modem G_76330-A			
c2	Resetting parameter	X		DEF, def
c3	Reading system status		0	always 0
c4	(De)activate or read switch-on message	X	OFF	ON,on, OFF, off
c5	Multiplexer mode		OFF	ON,on, OFF off
c6	Reading version number of transceiver module HG 75430			
c7	Reading version number of Flash-Loader			

Table 10 Implemented Control Commands (part 3 of 3)

The program checks all transferred values and ignores them in case of error. Any adjustable parameters are automatically and permanently saved in an EEPROM if overwritten.

If the execution of a control command requires communication with the internal transceiver is faulty, this is indicated by error code 5 (LED flashes 5 times, bit 5 (xx1x xxxx) of the error status is set).

4.2.8 Description of Various Important Control Commands

4.2.8.1 Control Block for Reading Current Addresses

The active address is the one under which it is currently possible to address the modem via the wireless connection. The modem answers the control block with the address $A0_{hex}$ with its current address decimal ASCII coded.

Address of the output block is again $A0_{hex}$. Versions 1.4B and higher provide a non volatile memory (EEPROM), in which the current address is stored; i.e. the address is saved when switching off the device and can be retrieved when it is switched on again.

4.2.8.2 Control Block for Reading Out the adjusted Hex-Address

The adjusted address is the one being preset on the rotary hex switch. The Hex switch setting is only read when the modem is switched on.

A control block using adress $A1_{hex}$ causes the modem to return its set hex address in ASCII decimally coded.

Output and input address are identical.

4.2.8.3 Control Block for Changing the Current Address

A control block using address $A2_{hex}$ enables setting a new current adress. The address `zero` will only be accepted if the modem is fitted with RAM.

The modem is then re-intialized. All alterable parameters will be preserved. The status of the standby function remains in its current state.

4.2.8.4 Control Block for Activating the Relais Function

A control block of address 90_{hex} is able to either switch off the standby function by sending an ASCII coded block „ON“ or „on“ or switch it on by sending „OFF“ or „off“ in the same way.

4.2.8.5 Control Block for Reading and Changing Various Time Values

83_{hex}, 86_{hex}, $b8_{hex}$ und bb_{hex} enable reading and setting character reply time and acknowledgement delay time. This is essential for the communication with some PLC (Programmable Logic Control) or self-made 3964R-drivers, since here time values might be larger than the values preset and thus unnecessary repetitions and delays may occur.

4.2.8.6 Control Block for Reading the Error Status

The modem answers a control block with address $C0_{hex}$ with a three digit decimal ASCII coded number between `0` and `255`. In the binary coded version each set bit represents a certain error.

If error status zero is output no error was detected. The reading procedure sets status to zero.

Error Description	Status Bit	Action
RAM defective	———	S2-LED flashes permanently
Watchdog-Timeout	Bit 0	Reset
EEPROM defective	Bit 3	S2-LED flashes three times

Table 11 Control block values while reading the error status

4.2.8.7 Control Block for Reading Version Number

A control block with address $C1_{hex}$ is answered by the modem with an ASCII coded string, which indicates the software version number. Address $C6_{hex}$ reads out the transceiver software version.

4.2.8.8 Control Block for Restoring Preset Values

Control block $C2_{hex}$ enables restoring the factory set values for all parameters except for the current address

4.2.9 Radio Transmission

4.2.9.1 Addressed Transmission

User data transferred by the profibus will be analyzed by the superior program. Following the identification of a valid adress it will be verified whether or not the RF channel is currently used for transmission. Should there be no radio transmission the carrier will be switched on and after the programmable carrier rise time (6 to 30 msec) transmission will be started.

Once the radio transmission is completed, the carrier is switched off after a waiting period of 6 msec. Subsequently an acknowledgement is expected within the acknowledgement delay time (carrier rise time -6 msec). This acknowledgement includes a status byte indicating whether or not data transmission was successful. From this information an acknowledgement will be generated and transmitted to the twin device.

If the acknowledgement delay time passes without any reaction or the received acknowledgement is invalid, following a waiting period of t_W the radio transmission procedure desribed above will be repeated for a programmable number of 1 to 11 retries. A repitition corresponds to transmission retry -1.

In case the RF channel is busy the modem reexamines radio operation after a waiting period of t_W. This procedure is repeated until the RF channel is free and transmission can be carried out. Only the real transmission is recognized as a transmission attempt.

$$t_W = 2^V \times t_R$$

- t_W: Waiting period
- V: Random numbers between 1 and 5
- t_R: Carrier rise time (6 to 30 msec)

During waiting period t_w the receiver will be monitored and a recognized data packet will be received. In case the telegram is assigned for this user it will be output. Then the waiting period will be continued.

Should all transmission attempts fail, this information will be transferred to the twin device by a corresponding acknowledgement.

4.2.9.2 Broadcast Transmission

Broadcast transmission is possible from the main radio station as well as from each individual modem by activating user address `zero`.

Once address zero was recognized it is checked whether the RF channel is currently used for radio transmission. If not, the carrier will be switched on and after the programmable carrier rise time (6 to 30 msec) radio transmission will be started. Once radio transmission has been completed, the carrier is switched off after a waiting period of 6 msec.

If the RF channel is busy the modem reexamines radio operation after a waiting period of t_W. This procedure will be repeated until the RF channel is free and radio transmission can be carried out.

During the waiting period t_W the receiver will be monitored and a recognized data packet will be received. In case the telegram is assigned for this user it will be output. Then the waiting period will be continued.

There is no acknowledgement output to the twin device.

4.2.9.3 Indicating Telegrams

An indicating telegram can be transmitted by users in adjustable periods. This telegram will be output at the central station and has the following configuration: dummy (0x00), participant's address. Using this telegram automatic log-in from another fixed station (automatic handover) is possible in multiplex operation (several fixed stations) even if there is currently no normal data transfer.

4.2.10 Radio Reception

4.2.10.1 Reception of Adressed Data Packets

Once a radio signal has been detected the data packet is received up to its address. If the adress is valid the data packet is received up to its end and the data is stored in a buffer. The last character represents the check sum which is compared to the check sum internally calculated. If these check sums are not identical, the data packet will be chopped.

If the check sum is correct the carrier will be switched on, time measurement for the programmable carrier rise time (6 to 30 msec) will be started and the sequence number of the telegramm will be controlled.

Should the sequence number be different to the one received previously the data packet will be output. A status byte indicating whether or not the output was successful will be returned. It will be included in the acknowledgement packet.

Should the sequence number be identical to the one received last there is a data packet duplication and the status byte of the previous transaction is included in the acknowledgement packet.

Once the carrier rise time has passed, the acknowledgement is being transmitted. When this process is completed the carrier will be switched off after a waiting period of 6 msec.

4.2.10.2 Main Station transmits Broadcast Packets

Once a radio signal has been detected the data packet is received up to its address. If the address is zero the packet will be received up to the telegram's end and the data are stored in a buffer. The very last character indicates the check sum and will be compared with the internally calculated check sum. If these check sums are not identical be the acknowledgement will be chopped. If the check sums are identical the telegram will be output.

4.2.10.3 Participants send Broadcast Telegram

Any participant is able to transmit data packets to address `zero` independently from the current address as it is possible in the central. No acknowledgement is expected.

The participant temporarily becomes the main station even though he is not able to send data directly to defined participants.

4.2.11 Data Packet Structure (not visible for the User)

4.2.11.1 Data Packets

Due to the fact that the structure of the data telegrams is closely related to the telegram's structure of procedure3964R, it is not necessary that the telegram length is known at the beginning of a transmission. Thus the transmission can be interrupted at any time.

Data packets recieved and / or transmitted wireless are constructed as follows:

Packet Section	Assigned Values
Sequence Number	80_{hex} to FF_{hex}
Address	Participant's Address (0 to $7F_{hex}$)
Data	User data (0 to 1024 Byte plus 1 Byte per DLE)
DLE	Control character 10_{hex}
ETX	Control character 03_{hex}
Check Sum	CRC-16 over the complete telegram

Table 12 Structure of Data packets

4.2.11.2 Acknowledgemet Packets

Acknowledgement packets received and / or transmitted wireless are constructed as follows:

Packet Section	Assigned Values
Address	Participant's address (1 to $7F_{hex}$)
Status	Status of data output (0 to 2 to 8)
Check Sum	CRC-16 over address and status

Table 13 Structure of acknowledgement packets

4.2.11.3 Block Numbering

In order to avoid a duplication of acknoweledgement telegrams during internal repetitions, each telegram will be provided with a sequence number. Having activated the modem, the sequence number of the first telegram to be sent is 80_{hex}. For every following telegram the sequence number will be increased by one up to value FF_{hex}. FF_{hex} is followed by value 81_{hex}. Value 80_{hex} will not be reached.

As the radio main station is the only modem being able to communicate addressed with all users, a separated number circuit for each participant is required.

4.2.11.4 CRC Back up

During transmission a CRC test method, operating table-oriented and indicating the following parameters will be applied:

- 16 Bit CRC
- Polynom 1021_{hex}
- Initalization value $FFFF_{hex}$

4.2.12 Service Interface

The service interface is used for setting the parameters and allows further system analysis. For this specified use a terminal program with ANSI emulation has to be connected with the service interface. The interface's settings are predefined and are 19,200 baud, no parity, 8 data bits, 1 stop bit with Xon/Xoff flow control.

Pressing the space bar it enables outputting the current display again. If a submenu is opened and no further input effected within the following 10 minutes, this function is terminated and the program returns to the main menu.

4.2.12.1 Main Menu

Having started the system the main menu will be output. From here several features can be selected.

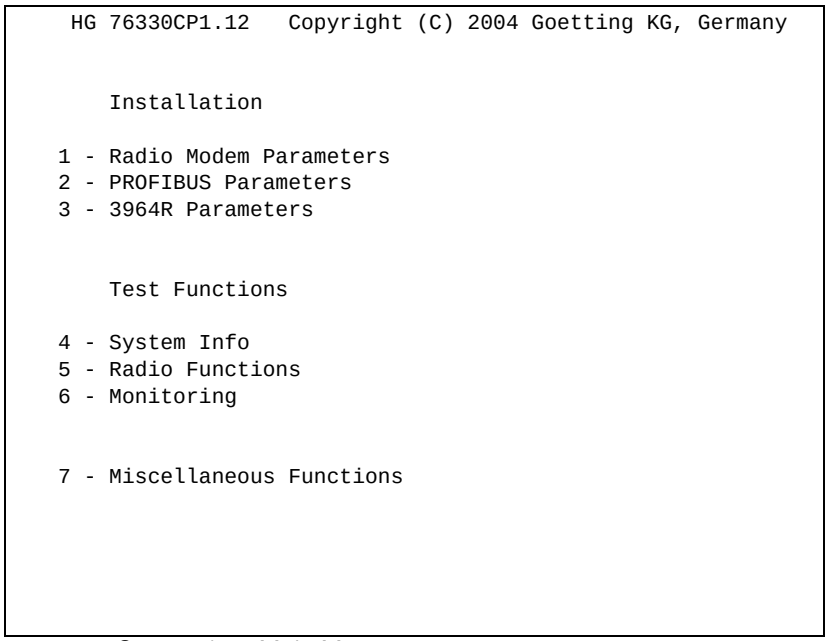


Figure 6 Screenshot: Main Menu

4.2.12.2 Radio Modem Parameters

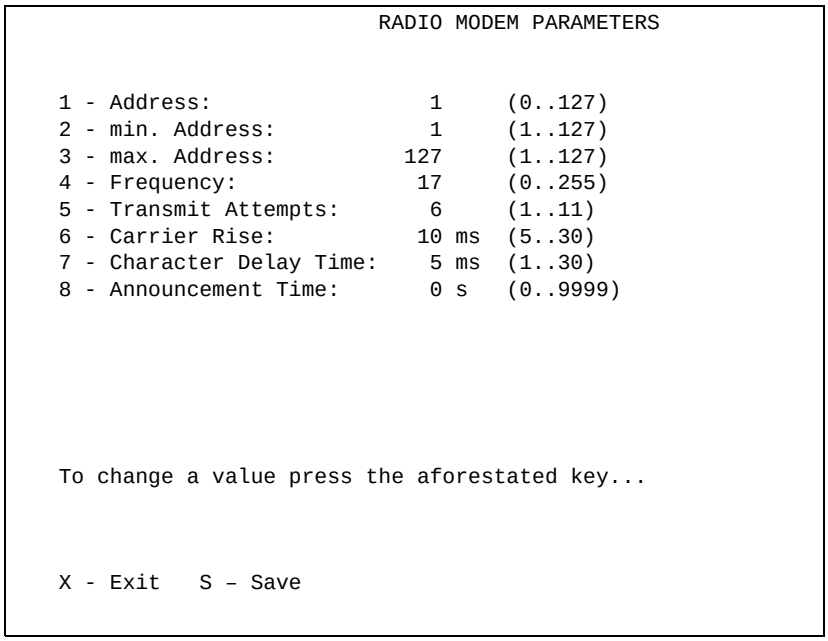


Figure 7 Screenshot: Radio Modem Parameters

1. Address: Radio address
2. Min. Address: Lower radio address for range
3. Max. Address: Upper radio address for range
4. Frequency: Radio channel
5. Transmit Attempts: Transmit attempt radio
6. Carrier Rise: Carrier Rise Time
7. Character Delay Time: Character Delay Time Radio
8. Announcement Time: Interval for indicating telegram (see section 3.2.9.3 on page 22). Value `0` terminates this function.

4.2.12.3 Profibus Parameters

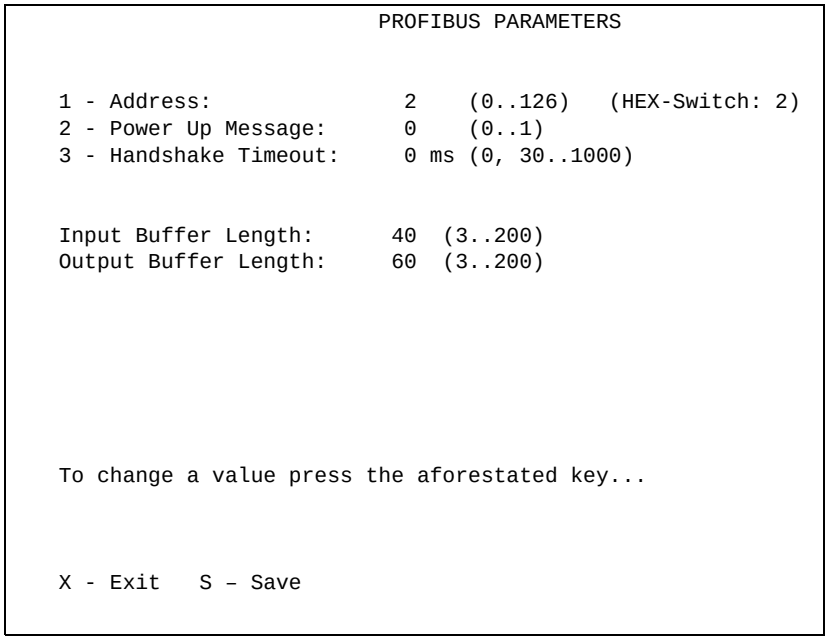


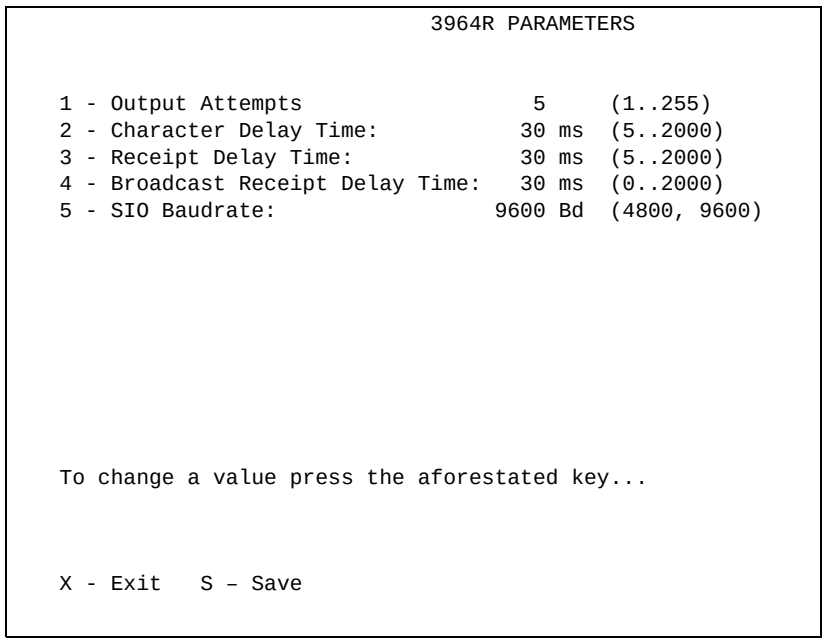
Figure 8 Screenshot: Profibus Parameters

1. Address: Profibus address
   Enables overwriting the setting of the Hex rotary switch. If the position of the Hex rotary switch is changed, the switch value will be re-imported after the next switch-on.
2. Power Up Message: Turn on message
   The power up message always lasts 14 bytes and is specified as follows (the version number 1.12 is certainly variable)
   `Sequence Number 0x00 0xC4 76330CP1.12`
3. If the modem receives no acknowledgement from the SPS user program within an adjustable time period, an acknowledgement telegram with status 04 will be returned. This time period can be adjusted between 30 and 1000 ms. A value of `0` deactivates this function completely, in order to remain system-compatible to older software versions not having implemented this function.

4.2.12.4 3964R Parameters

Enables setting 3964R parameters for the twin devices for calculating timeouts and repetition times correctly.

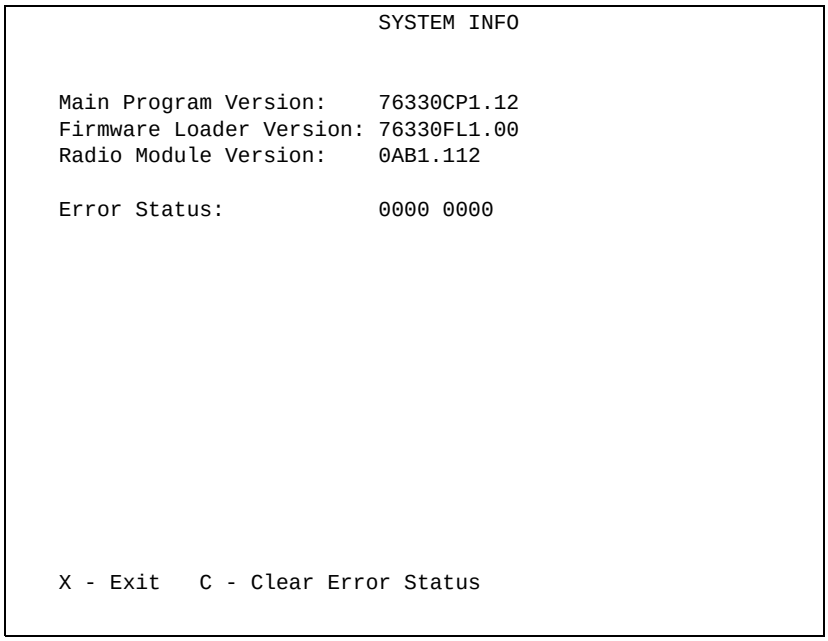
Figure 9 Screenshot: 3964R Parameters



1. Output Attempts: 3964R Output attempts data telegrams 3964R
2. Character Delay Time: 3964R Character delay time
3. Receipt Delay Time: 3964R Acknowoledgement delay time
4. Broadcast Receipt Delay Time: 3964R acknowledgement delay time during broadcast
5. SIO Baudrate: Baud rate of the 3964R interface

4.2.12.5 System Info

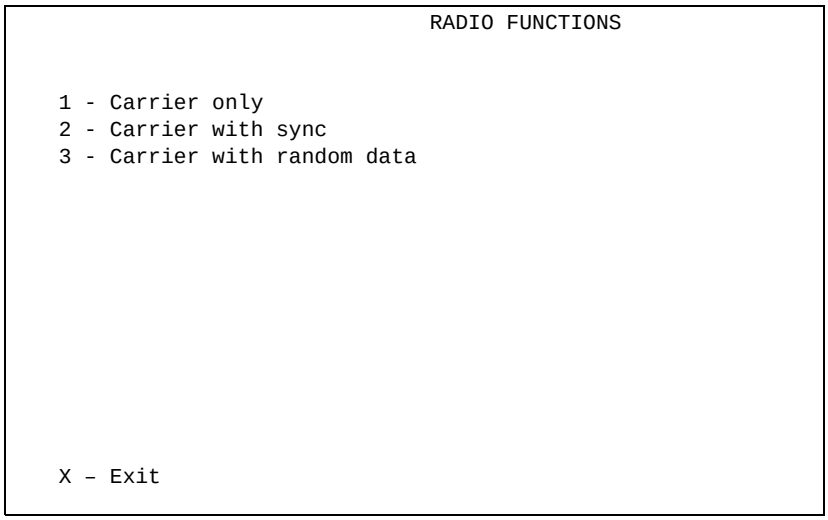
Figure 10 Screenshot: System Info



- Main Program Version: Version number of the main program
- Firmware Loader Version: Version number firmware-loading program
- Radio Module Version: Version number radio modul
- Error Status: Error status bit coded (refer to Tabelle 11 auf Seite 21)

4.2.12.6 Radio Functions

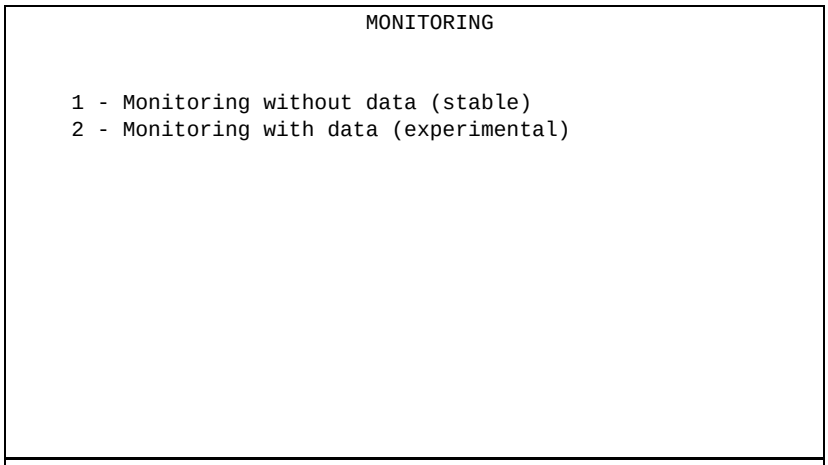
Figure 11 Screenshot: Radio Functions



Here several testfunctions for the radio modem can be selected. Executing these functions the radio channel will be occupied and during this time no radio communication can be realized.

4.2.12.7 Monitoring

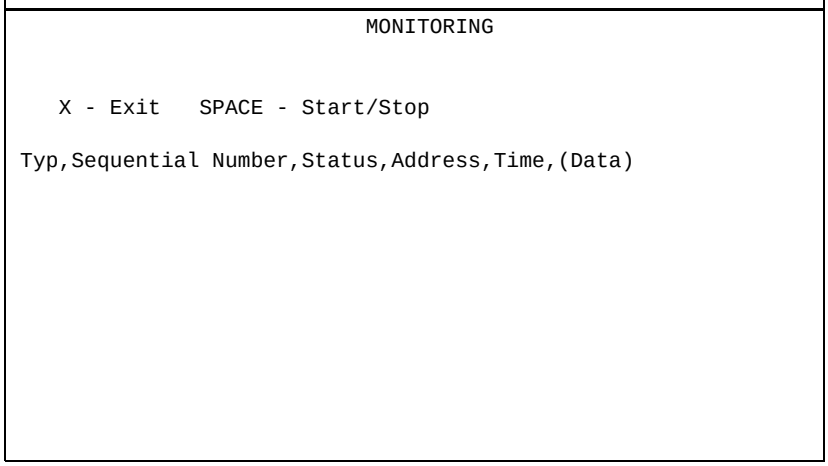
Figure 12 Screenshot: Monitoring



Output of monitor information

1. User data will not be output.
2. User data will be output (Timing problems might occur, so that the user data indicated might not be the latest available data)

Figure 13 Screenshot: Setup of monitoring display during output of data



Start / Stop with space key

Analysis data can be output via the serial RS 232 interface - not used in normal operation.

- Current transmission sequence number, status and address, time
- Current reception sequence number, status and address of data telegrams, time
- Current reception sequence number, status and address of acknowledgement telegram, time

After activation the data will be output - according to the example - permanently ASCII coded in the following order: telegram mode, sequence number, status, address and time. Each data telegram will be terminated with Carriage Return and Line Feed. It is possible to record data using a terminal program for subsequent evaluation. For the analysis with MS Excel the data should have the ending CSV and can then directly be imported into to Excel.

The interface parameters are 19200, 8, N, 1, XON / XOFF

Data Block	Signification	
T,170,132,005,0000000160	Transmits telegram 170 to vehicle 5	
Q,133,255,005,0000000255	Acknowledgement to transmission telegram 170 of vehicle 5	Importing the E-Seq. no. as acknowledgement S-Seq. no. remains unchanged
T,170,133,005,0000000280	Transmit telegram 170 to vehicle 5, telegram is not transmitted	
R,134,000,005,0000000370	Receive telegramm 134 from vehicle 5	Importing the E-Seq. no. as acknowledgement
T,170,134,005,0000000500	Transmit telegram 170 to vehicle 5, telegram is not transmitted	Importing the E-Seq. no. as acknowledgement
R,135,000,002,0000000550	Receive telegram 135 from vehicle 2	S-Seq. no. is incremented
T,171,135,002,0000000600	Transmit telegram 171 to vehicle 2, telegram is transmitted	
Q,136,255,002,000000700	Acknowledgement for transmission telegram 171 from vehicle 2	Importing the E-Seq. no. as acknowledgement
T,171,136,002,0000000720	Transmit telegram 171 to vehicle 2, telegram is not transmitted	
R,137,000,005,000001010	Receive telegram 137 from vehicle 5	

Table 14 Data telegram examples in monitoring mode

Optionally it is possible to output user data. However this function is not completely data consistent, as there exists only one data buffer which can be overwritten asynchronously by the Profibus during output. This is due to the length of time the output of data via the serial interface requires.

- Acknowledgement and reception telegrams (Q and R) will be output directly after reception / when they are transferred to the profibus.
- Transmission telegrams (T) will be output if the transmission sequence number is changed or the status value output.
- The time is a value with a resolution of 1 msec indicating the time since the device was switched on.

4.2.12.8 Miscellaneous Functions

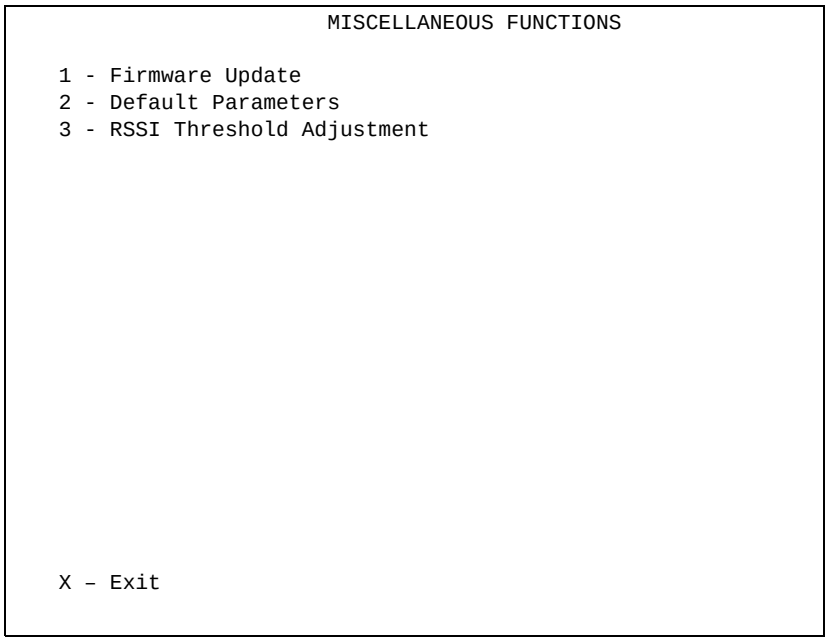


Figure 14 Screenshot: Miscellaneous Functions

1. Firmware Update: Using this sub menu a new program version can be loaded. If the following security query is acknowledged, the program memory will be deleted!
2. Default Parameters: Enables resetting all parameters to the factory set.
3. RSSI Threshold Adjustment: Adjustment of RSSI- threshold. Password protection!

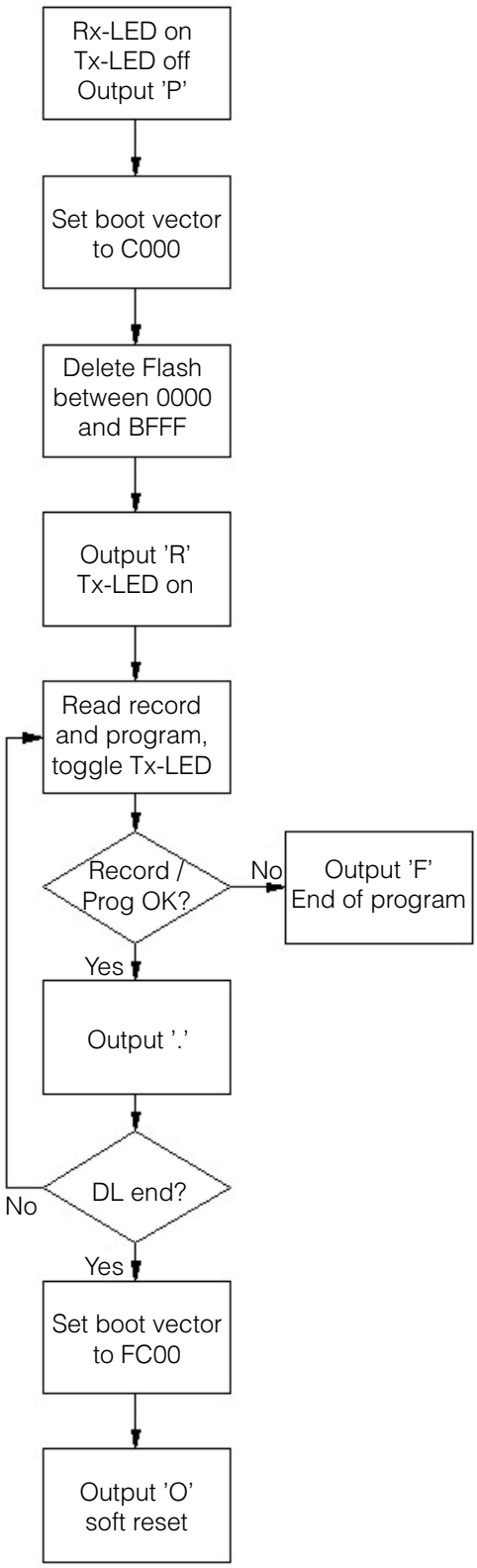
4.2.13 Firmware-Update

Figure 15 Simplified programming routine firmware update software HG 39730_CP as timing diagram

After starting the function for firmware update in the service menu the new firmware file has to be loaded in Intel Hex-format. The file has to be send as an ASCII- upload from a terminal program. It is essential to use flow control Xon/Xoff. Each record will be programmed directly after reception. The following characters will be output for monitoring purposes:

'P'	Start of program routine
'R'	Ready for reception
'.'	Record received without error and programmed.
'F'	Error during transmission or programming.
'O'	Download and programming successfully completed.

On the right you will find the simplified program routine described as a flow diagram.



4.3 GSD-File

The Windows program GSD-Config is used for the generation of an individual GSD-file. You will find this program under search term `76330` in our FTP/Download area with the following address: http://www.goetting.de/en/download/start.html.The name of the ZIP-archive including this program is G_76330-A_GSD-CFG_Vxx.zip (whereas xx depends on the current version number).

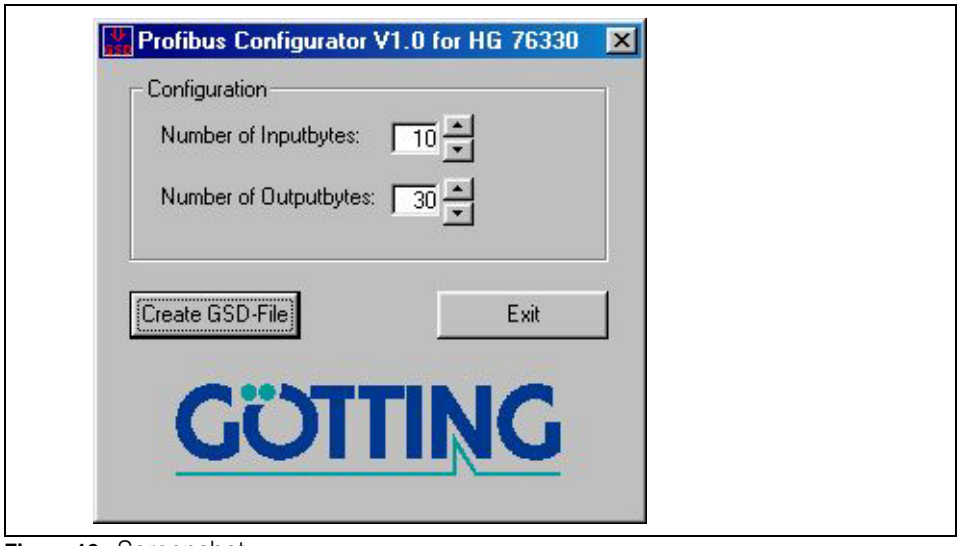


Figure 16 Screenshot

The amount of input- and output bytes to be transmitted can be set. It has to be noted that the first 3 bytes are used as a communication interface between the radio modem and the PLC, and are the minimum requirement. The following data is transmitted via the radio link. It is possible to generate such a file using button `Create GSD-File`. Path and file name can be selected through the opening dialogue. `Exit` terminates the program without generating a GSD-file.

5 Accessories

In addition to the standard accessories like antennas, cables, connectors, etc. further components for the extension or completion of the system are available. The devices described below (wall cabinet and interface multiplexer) are able to communicate with the Profibus radio modem via the radio link, but do not offer a Profibus interface themselves.

5.1 Wall Cabinet with Power Supply (HG 76110)

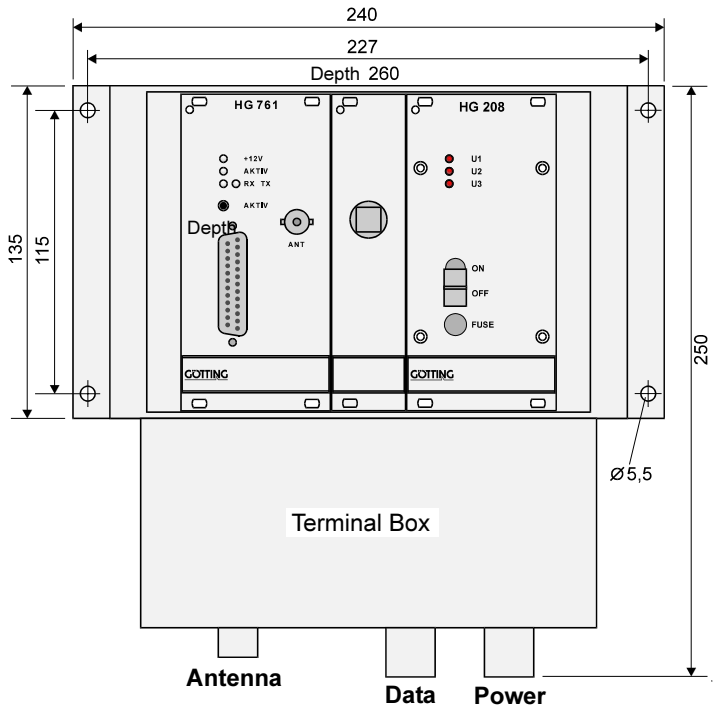


Figure 17 Front View of the Wall Cabinet

5.2 Interface Multiplexer HG 04330

It is possible to supply the interface multiplexer separately as software for a PC or as a complete installation including a PC. The PC can have up to 8 serial interfaces with FIFO blocks 16550. The PC communicates with the host via a serial interface. Up to three fixed radio stations can be connected to the other interfaces. Thus it is possible to cover a broad range by radio or smaller ranges with several frequencies accordingly. This enables a high number of participants to communicate. The software includes automatic handover (transfer) of mobile participants between the fixed radio stations. Cyclical (cycle time adjustable), short indicating telegrams practice this inscribing and cancelling even without data transmission. These processes can be monitored on the PC screen.

Optionally the PC can be fitted with an ethernet card for controlling the radio system through an already existing Ethernet. Then up to eight fixed stations can be triggered. You will find an exemplary illustration of the Multiplex and Handover operation in section 6.2 „Measuring Point Management, Automation, Logistics, PDA“ auf Seite 35.

6 Applications

The following few paragraphs show examples for selected possible applications:

6.1 Simple Point-to-Point Data Transmission or Bus Topology with Master-Slave-Operation

In this application the radio modems almost used as a replacement for a wire connection (see Figure 18). Data transmission is only possible in one direction. It is done in simplex operation and transparent, except for the handshaking. You have to pay attention to the fact that any radio modem, that is located within the range of the transmitting modem will output the received data.

ATTENTION! Radio operation by itself is **not** a full replacement for cable connection! Errors which have to be detected by a superior protocol might occur.

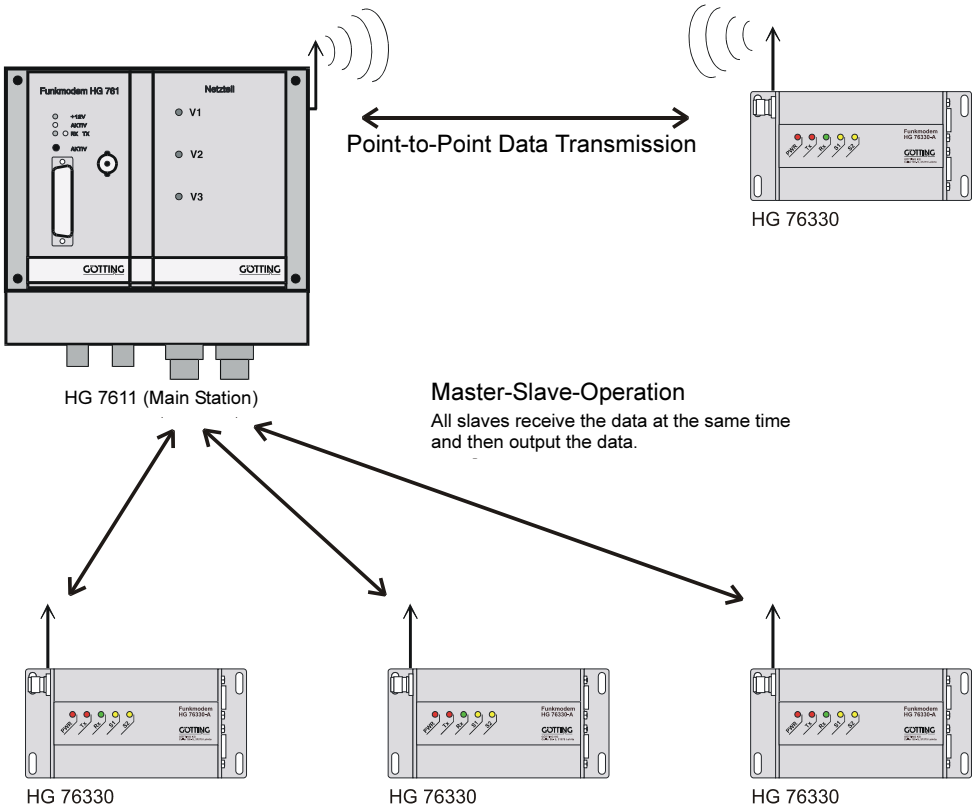
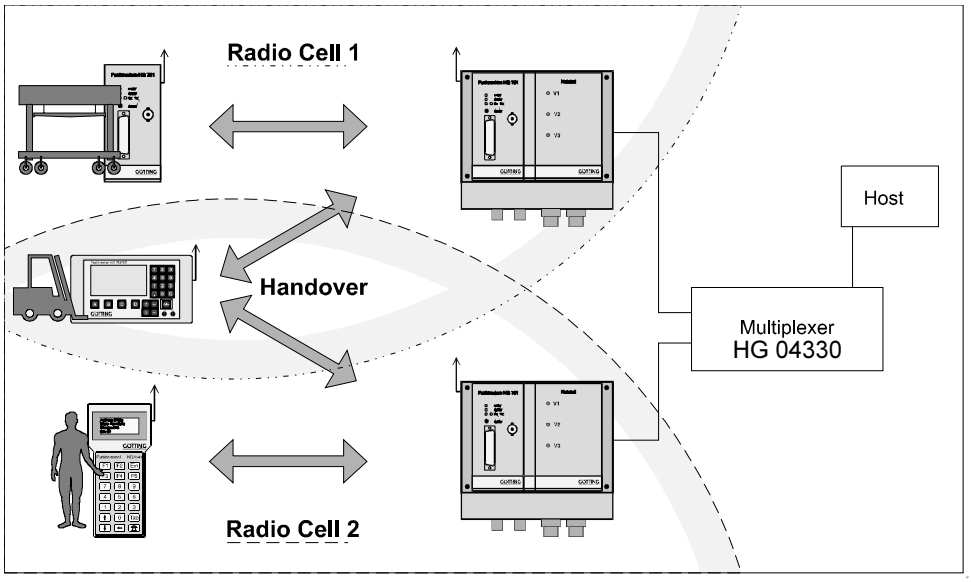


Figure 18 Simple Point to Point data transmission and bus topology with Master- Slave Operation

6.2 Measuring Point Management, Automation, Logistics, PDA

1. Data transmission from and to separate measuring points.
   In this application several participants (measuring points) are intialized and polled from one main station. The device adress of the central radio modem is set to 0 while the adresses of the participants are in the range of 1 to 20.
   At the beginning of a measuring cycle the main station activates a synchronous start of the measurements of all participants using a broadcast telegram. Then the main station polls each participant separately and – if necessary – changes its configuration. Finally all participants are deactivated by another broadcast telegram.

2. Automatic control engineering and storaging logistics including product data acquisiton (PDA).
   The compatibility of the radio interface enables a simultanous wireless data communication to the vehicles, operating terminals on forklift trucks and hand-held terminals. It is possible to manage up to 127 participants within one network. Using a multiplexer for the connection of several fixed stations an extension of the system for covering larger areas is feasible.



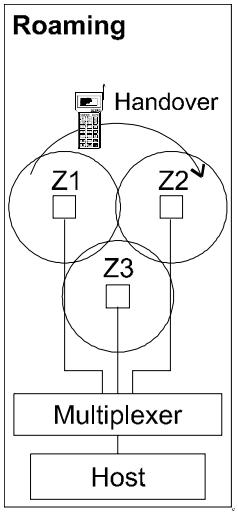


Figure 19 Interface Multiplexer / Handover-Prinzip

It is possible to use interface multiplexer HG 04330 which is included in the accessories for multiplex (also refer to section 5.2 auf Seite 33). It enables forming radio cells and handover operation.

7 Appendix – Frequency Allocations

A Frequency Range 1 (ISM Range)

S0-Register	Frequency [MHz]	S0-Register	Frequency [MHz]
0	433.150	32	433.975
1	433.175	33	434.000
2	433.200	34	434.025
3	433.225	35	434.050
4	433.250	36	434.075
5	433.275	37	434.100
6	433.300	38	434.125
7	433.325	39	434.150
8	433.350	40	434.175
9	433.375	41	434.200
10	433.400	42	434.225
11	433.425	43	434.250
12	433.450	44	434.275
13	433.475	45	434.300
14	433.500	46	434.325
15	433.525	47	434.350
16	433.550	48	434.375
17	433.575	49	434.400
18	433.600	50	434.425
19	433.625	51	434.450
20	433.650	52	434.475
21	433.675	53	434.500
22	433.700	54	434.525
23	433.725	55	434.550
24	433.750	56	434.575
25	433.775	57	434.600

Table 15 Frequency Range 1 (ISM Range) (part 1 of 2)

S0-Register	Frequency [MHz]	S0-Register	Frequency [MHz]
26	433.800	58	434.625
27	433.825	59	434.650
28	433.850	60	434.675
29	433.875	61	434.700
30	433.900	62	434.725
31	433.950	63	434.750

Table 15 Frequency Range 1 (ISM Range) (part 2 of 2)

B Frequency Range 1 (ABIN Range)

S0-Register	Frequency [MHz]	S0-Register	Frequency [MHz]
253	456.170	10	456.300
254	456.180	11	456.310
255	456.190	12	456.320
0	456.200	13	456.330
1	456.210	14	456.340
2	456.220	15	456.350
3	456.230	16	456.360
4	456.240	17	456.370
5	456.250	18	456.380
6	456.260	19	456.390
7	456.270	20	456.400
8	456.280	21	456.410
9	456.290		

Table 16 Frequency Range 1 (ABIN Range)

C Frequency Range 2 (Brazil)

414.000 to 415.975 MHz in 0.025 MHz-pattern. The SO-register is calculated according to the following formula (a value from 0 to 79 is allowed).

$$f(S0) = (414 + S0 \times 0.025)\ \text{MHz with } 0 \leq S0 \leq 79$$

D Frequency Range 3 (ABIN Range)

S0-Register	Frequency [MHz]	S0-Register	Frequency [MHz]
253	466.170	10	466.300
254	466.180	11	466.310
255	466.190	12	466.320
0	466.200	13	466.330
1	466.210	14	466.340
2	466.220	15	466.350
3	466.230	16	466.360
4	466.240	17	466.370
5	466.250	18	466.380
6	466.260	19	466.390
7	466.270	20	466.400
8	466.280	21	466.410
9	466.290		

Table 17 Frequency Range 3 (ABIN range)

E Frequency Range 4 (Great Britain)

458.500 to 458.950 MHz in 0.025 MHz pattern. The S0-register is calculated according to the following formula (a value from 0 to 79 is allowed)

$$f(S0) = (458 + S0 \times 0.025)\ \text{MHz with } 0 \leq S0 \leq 79$$

8 List of Figures

9 List of Tables

10 Index

11 Copyright and Terms of Liability

11.1 Copyright

This manual is protected by copyright. All rights reserved. Violations are subject to penal legislation of the Copyright.

11.2 Exclusion of Liability

Any information given is to be understood as system description only, but is not to be taken as guaranteed features. Any values are reference values. The product characteristics are only valid if the systems are used according to the description.

This instruction manual has been drawn up to the best of our knowledge. Installation, setup and operation of the device will be on the customer's own risk. Liability for consequential defects is excluded. We reserve the right for changes encouraging technical improvements. We also reserve the right to change the contents of this manual without having to give notice to any third party.

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