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**APPLICATION EXAMPLE** 

Redundant process data transmission with the SIMATIC PN/PN Coupler, driver library, and SIMATIC PCS 7

PCS 7 V9.1



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# 1 Introduction

### **1.1 Overview**

Since the PCS 7 Version 9.0 SP2 Update Collection 1, the SIMATIC PN/PN Coupler can be used to exchange process data between two automation systems. The PCS 7 library "PCS 7 PN/PN PN/MF Coupler Software" (9LA1110-6CG20-0AA0) which is used in this application example can be used for PCS 7 V9.3 or higher.

Given two fault-tolerant programmable controllers, a singular SIMATIC PN/PN Coupler represents a single point of failure. In this case it is recommended to redundantly design the SIMATIC PN/PN Coupler as shown in <u>Figure 1-1</u> to ensure fault-tolerant exchange of process data.



In this application example you will learn how process data are exchanged redundantly via two separate SIMATIC PN/PN Couplers, and which technical specifications must be considered.

Figure 1-1

### **1.2** Principle of operation

The PN/PN Coupler is one way of exchanging data over the fieldbus. One advantage is the galvanic isolation between the X1 and X2 interfaces. The isolation is required to guarantee I-Device functionalities. A PN/PN Coupler is the only approved method of communicating between two CPUs with the fieldbus The X1 and X2 ports represent two separate PROFINET devices, each of which can be connected with S2 system redundancy (possible with firmware version V4.2 onward).

A PN/PN Coupler maintains constant communication with the connected IO controllers. If data has already been made available for reading on one side of the interfaces, the data will be deleted at the start of the cycle. Transmission only occurs when both sides of the Coupler communicate with the IO controllers.

With S2 system redundancy, 988 BYTE input data and 988 BYTE output data can be communicated. It is not possible to saturate the complete address range of 1000 BYTES, since 12 BYTES are required for internal communication between the X1 and X2 ports. Accordingly, the configuration used in this application example allows for 196 analog data records to be transmitted.





To safeguard the single point of failure in redundant process data exchange between the two fault-tolerant controllers "AS\_A" and "AS\_B", two separate SIMATIC PN/PN Couplers, "Coupler 1" and "Coupler 2", are utilized (Figure 1-2). The analog value signal generated in "AS\_A" is sent to both Couplers by an output module in the "AS\_A" CFC. The Couplers send the signals to a CFC chart in "AS\_B". This is accomplished through processing of the redundant values, whereby the signal with the signal status "Good" / the defined master signal is always the signal that is used. The light blue arrows in Figure 1-2 show data value transmission via both Couplers from "AS\_A" to "AS\_B". The purple arrows show how data are sent from "AS\_B" to "AS\_A" according to the same principle. IO data are continuously updated via the process image of the inputs and outputs.

### **1.3 Used components**

The following hardware and software components were used to create this application example:

Table 1-1

Components	Quantity	ltem number	Note
SIMATIC PN/PN Coupler	2	6ES7158-3AD10-0XA0	Firmware version 4.2.1
SIMATIC PCS 7 CPU410-5H	4	6ES7410-5HX08-0AB0	Firmware version 8.2.2
PCS 7 PN/PN PN/MF Coupler Software	1	9LA1110-6CG20-0AA0	Lib_PCS7_PNPN_Coupler_V11

#### **Document creation**

Screenshots were taken with PCS 7 V9.1.

#### Applicability

This document is valid for SIMATIC PCS 7 V9.1.

# 2 Hardware integration and symbol table

### 2.1 Hardware integration of the PN/PN Coupler

# 2.1.1 Hardware configuration of the PN/PN Coupler in AS\_A

1. Open the hardware configuration of PC station A in the component view.



2. Integrate two X1 PN/PN Couplers into your PROFINET system from the side navigation pane. To do this, drag and drop a PN/PN Coupler to a "PN-IO-X8" interface. Since both interfaces need to be in the same network, a connection is automatically created between the interfaces and the Couplers.

Note

It is important that the hardware is based on the correct GSDML file. In case of the wrong GSDML file, the driver wizard does not proceed with the call up of the diagnostic blocks and interconnections of the parameter. The supported GSDML files can be found in the <u>manual</u> of "PCS 7 PN/PN PN/MF Coupler Software" Library.





3. To transmit 196 data records, 8 modules must be added to the configuration of the PN/PN Couplers from the navigation pane. Integrate them into the modules listed.

Steckplatz	Baugruppe	Bestellnummer	E-Adresse	A-Adresse	Diagnoseadresse	Kommentar	Zugriff
0	🚡 coupler1X1	6ES7 158-3AD10-0XA0	1	1	16332*		voll
X7	FN-10-01				16331*		srt#
X1 F1 R	Fort 1 R.145	6ES7 193-64F100-04A0			16334*		sn#
X1 F2 R	Fort 2 R/45	6ES7 193-64F100-04A0			16333*		1/21/
1	INPUT + DS		10001250				voll
2	INPUT + DS		12511501				voll
3	INPUT + DS		15021752				voll
4	INPUT + DS		17531987				voll
5	OUTPUT			10001249			voll
6	OUTPUT			12511500			voll
7	OUTPUT			15021751			voll
3	OUTPUT			17531986			voll
9							
10							
11							
12							
13							
14							
15							
16							

Figure 2-3 "Coupler1X1" hardware configuration

4. Adapt the input and output addresses to match the modules you inserted. To do this, double-click on the modules and change to the "Addresses" tab. The corresponding addresses can be found in Figure 2-3.

Figure 2-4

Properties	s - INPUT + DS -	(R-/S4)			×
	Add				
General	Addresses				1
Input	Address	Length:	Process Image:		
Start	1753	235	PIP 5	-	
End:	1987	12000	111.5	-	

- 5. Open the device settings of the Coupler and enter the desired device names in the "General" tab. Here we enter the name "Coupler1X1".
  - Figure 2-5

Short Description:	PN-PN-Coupler				
	Coupler of two PROFINET networks, IP20; PROFINET interface and 2 ports; X1 [left side); FW update via bus; port diagnostics; I&M functionality; IRT and prioritized startup; shared functionality; MRP; firmware V4.2				
Order No./ Firmware:	6ES7 158-3AD10-0XA0 / V4.2				
amily:	Gateway				
Device Name:	coupler1X1				
Node in PROFINET	IO System				
Derfer Nurter					
Device Number:	9 PROFINET IO system (100)				
IP Address:	9 PROFINET IO system (100) 172.17.1.9 Ethemet				
IP Address:	PROFINET IO system (100)      172.17.1.9      Ethemet      s. via IO Controller				
IP Address:	9         PROFINET ID system (100)           172.17.1.9         Ethemet           ss via IO Controller         Ethemet				
IP Address: IP Address: IP Address: Comment:	9         PROFINET 10 system (100)           172.17.19         Ethemet           ss via ID Controller				
IP Address: IP Address: IP Address: Comment:	9         PROFINET 10 system (100)           172.17.19         Ethemet           10 Controller         State 10 Controller	~			
IP Address: IP Address: IP Address Comment:	9         PROFINET ID system (100)           172.17.19         Bhemet           ss via ID Controller	<			
IP Address: IP Address: IP Address Comment:	9         PROFINET ID system (100)           172.17.1.9         Ethemet           ss via 10 Controller         Statemet	< >			
IP Address: IP Address: IP Address: Comment:	9         PROFINET ID system (100)           172,17.1.9         Ethemet           ss via ID Controller	< >			

- 6. In the "General" tab, modify the PROFINET device address of the X1 Coupler. It must be the same between the hardware configuration of AS\_A and the configuration of AS\_B, the X2 Coupler.
- 7. Open the "Ethernet..." sub-tab in the "General" tab, then modify the IP address of the Coupler. This view also allows you to change the network assignment.

Figure	2-6
Figure	2-0

•				
perties - coupler1X1				>
ieneral dentification	Coupling   GSDML Export   F	Redundancy   Shared   /	Access	
Short Description:	PN-PN-Coupler			
	Coupler of two PROFINET n (left side); FW update via bu prioritized startup; shared fur	etworks, IP20; PROFINE s; port diagnostics; I&M fu actionality; MRP; firmware	T interface and 2 port inctionality; IRT and V4.2	s; X1 🔨
Order No./ Firmware:	6ES7 158-3AD10-0XA0 / V4	4.2		
Family:	Gateway			
Device Name:	coupler1X1			
Node in PROFINET I	O System			
Device Number:	9 🗸	PROFINET IO system	(100)	
IP Address:	172.17.1.9	Ethernet		
Assian IP Addres	s via IO. Controller			_
IP address:	17217719	-Gateway		< ->
Subnet mask:	255.255.0.0	C Use router Address:		Help
Subnet:				
			New	
not networked Plant Bus (Part of: Plant bus CP Field bus	Mant bus)	_	Properties Delete	e (
not networked Plant bus (Part of: Plant bus CP Field bus	Plant bus)		Properties Delete	

- 8. Close the tab by clicking "OK" when you are done.
- 9. Click "OK" to close the object properties.

10. In order to compile the hardware configuration, the H parameters of the CPU must be recalculated. Open the object properties of the master CPU and change to the "H parameters" tab. Open the "Calculate..." sub-tab.

HW Konfig - [41	I0_A (Konfiguration) AS_A]		
Station Bearb	eiten Einfügen Zielsystem	nsicht Extras Fenster Hilfe	
) 🚘 🛼 🖬 🛯	4   45   Ba 🗈   🏟 🏫	E 28 M	
		1	
(0) UR2AL	.U-H		
1	PS 407 10A		
ļ	-	Figenschaften - CPU 410-5H - (R0/S3)	
3	CPU 410-5H A		
	110.02	Allgemein Anlauf Zyklus / Taktmerker Remanenz Spe	shar   Alarma
IF1	H Sync module	Uhrzeitalarme Weckalarme Diagnose / Uhr Schutz	H-Parameter
IF2	H Sync module		
X5	PN-IO-X5-A	Parameter zum erweiterten CPU- Lest	
X5 P1 R	Port 1	Testzykluszeit [min]:	
X5 P2 R	Port 2	Reaktion auf RAM/PAA-Vergleichsfehler: FEHLERSUCHE	•
×8	PN-IO-X8-A	A feltan der Reserve	
X8 P1 R	Port 1		
X8 P2 R	Port 2	Maximale Anzahl der Versuche: 10	
5	CP 443-1	Weckalarm-OB mit Sonderbehandlung: 0	
X1	PN-IO	Watezeit zwischen zwei Versuchen [s]:	
XIPIR	Port 1		
XTP2R	Port 2	Uberwachungszeiten	
	·	Maximale Zykluszeitverlängerung [ms]:	
_		Maximale Kommunikationsverzögerung [ms]: 3200 E	Berechnen
		Maximala Scarrad für Bright itaklassen > 15 (ma): 800	has been also also
(1) UR2A	LU-H		Werte verwen-
		Minimale Peripheriehaltezeit (ms): 30	den
1	PS 407 TUA	Particularly Detribute	
	CPU 410-5H B	Redundante renpiene	2
12	CF0 410-SH B	Datenbaustein-Nr.: 1 und 2	<u>د</u>
3		Passivierungsverhalten : Kanalgranular	<b>T</b>
3			
3			

11. Change the figures to fit your user program. Recalculate the parameters. Click the "Recalculate" button. Then click on "OK" to close the sub-menu.

Figure 2-8	
Aufdaten der Reserve: Berechnen der Überwachungszeiten	×
Angaben zum Anwenderprogramm	
Zeitabstand des höchstprioren Weckalarm bzw. des Weckalarm mit Sonderbehandlung [ms]:	
Laufzeit des betreffenden Weckalarms [ms]:	0
Arbeitsspeicherbelegung aller Datenbausteine im Anwenderprogramm (KByte):	1024
√Vorgaben aus dem Prozeβ (Sicherheitszeiten)	
Kritischste F-SM - Überwachungszeit [ms]:	keine F-SM
Im DP- Mastersystem:	
F-Baugruppen hinter Y-Link berechnen	
Neu berechnen	
Berechnete Überwachungszeiten	
Maximale Zykluszeitverlängerung [ms]:	
Maximale Kommunikationsverzögerung [ms]:	
Maximale Sperrzeit für Prioritätsklassen > 15 [ms]:	
Minimale Peripheriehaltezeit [ms]:	
OK Abbrecher	n Hilfe

12. Click "OK" to close the object properties.

13. Perform Steps 3 through 12 again for your redundant Coupler. Refer to Figure 2-9 for the appropriate modules, input and output addresses, and the device name "Coupler2X1".

<b>(</b>	(10) coupler2×1						
Slot	Module	Order Number	I Address	Q Address	Diagnostic Address	Comment	Access
0	a coupler2X1	6ES7 158-3AD10-0XA0	1		16328*		Full
X7	FN-ID-01				16327*		Full
X1 F1 R	Fort 1 R/45	6ES7 193-64F00-04A0			16330*		Full
X1 F2 R	🚦 Port 2 R/45	6ES7 193-64F00-04A0			16329*		Full
1	INPUT + DS		20002250				Full
2	INPUT + DS		22512501				Full
3	INPUT + DS		25022752				Full
4	INPUT + DS		27532987				Full
5	OUTPUT			20002249			Full
6	OUTPUT			22512500			Full
7	OUTPUT			25022751			Full
8	OUTPUT			27532986			Full
9							
10							
11							
12							
13							
14							
15							
16							

Figure 2-9 "Coupler2X1" hardware configuration

14. Save and compile the hardware configuration.

Figure 2-10

0ł	HW Konf	ig - [SIM/	ATIC	H Station_A	A (Konfigurati	ion) S7P	ro_1_Prj]		
0 <sup>0</sup> 0	Station	Bearbeit	ten	Einfügen	Zielsystem	Ansicht	Extras	Fenster	Hilfe
	I 🗃 🔓		8	& 6	📩 🛍	🔁 🗖	‱   ▶?		

# 2.1.2 Hardware integration of the PN/PN Coupler in AS\_B

Integration of the PN/PN Coupler into the hardware configuration of AS\_B works in much the same way as the integration into the HW Config of AS\_A (see 2.1.1 Hardware configuration of the PN/PN Coupler in AS\_A). This chapter describes the points where the configuration differs.

1. Integrate two PN/PN Couplers as described in Steps 1 and 2 in chapter <u>2.1.1</u> Hardware configuration of the PN/PN Coupler in AS\_A. Drag and drop 2 X2 PN/PN Couplers (instead of X1) into your PROFINET system.



2. Parameterize the Couplers as described in Steps 3 through 14 in chapter <u>2.1.1</u> Hardware configuration of the PN/PN Coupler in AS\_A. Refer to the Figure 2-12 and Figure 2-13 for the correct modules and input and output addresses of the Couplers.

Note

It is important that the hardware is based on the correct GSDML file. In case of the wrong GSDML file, the driver wizard does not proceed with the call up of the diagnostic blocks and interconnections of the parameter. The supported GSDML files can be found in the <u>manual</u> of "PCS 7 PN/PN PN/MF Coupler Software" Library.

(9	) coupler1X2							
Slot	Module	Order Number	I Address	Q Address	Diagnostic Address	Comment	Access	
0	🚡 coupler1X	2 6ES7 158-3AD10	-OXAO		16359*		Full	
X2	FN-10-02				16358*		Full	
X2F1 R	🚦 Port 1 R.145	6ES7 193-64R00-04	WO		16361*		Full	
X2F2R	🚦 Port 2 R/45	6ES7 193-64/R00-04	WO		16380*		Full	
1	🚺 OUTPUT			10001249			Full	
2	🚺 OUTPUT			12511500			Full	
3	🚺 OUTPUT			15021751			Full	
4	🚺 OUTPUT			17531986			Full	
5	🚺 INPUT + DS		10001250				Full	
6	🚺 INPUT + DS		12511501				Full	
7	🚺 INPUT + DS		15021752				Full	
8	🚺 INPUT + DS		17531987				Full	
9								
10								
11								
12								
13								
14								
15								
16								

Figure 2-12 "Coupler1X2" hardware configuration

Slot allocation from one IO device to the other IO device (coupling partner) must be done on a 1-to-1 basis (e.g. slot 3 left bus side = slot 3 right bus side).

Steckplatz		Baugruppe	Bestellnummer		E-Adr	esse	A-Adresse			
0	ī	coupler1X1	6ES7 158-3AD10-0X	cao	1					
X7		FN-ID-01								
XTFTR		Port 1 RJ45	6ES7 193-64R00-04A0	,						
X1 F2 R		Port 2 RJ45	6ES7 193-64R00-04A0	,						
1		INPUT + DS			1000	1250	)			
2		INPUT + DS			1251	1501	1			
3		INPUT + DS			1502	1752	2			
4		INPUT + DS			1753	1987	7			
5		OUTPUT		_			10001249			
6		OUTPUT					12511500			
7		OUTPUT					15021751			
8		OUTPUT					17531986			
				Slot			Module	Order Number	I Address	Q Address
				0		it i	coupler1X2	6ES7 158-3AD10-0XAL	1	
				X2			FN-10-02			
				1.22	F1 R		Port 1 R/45	6L 7 193-64R00-04A0		
				X2	F2R		Port 2 R/45	6ES; 193-64/R00-0440		
				1			OUTPUT			10001249
				2			OUTPUT			12511500
				3			OUTPUT			15021751
				4		I	OUTPUT			17531986
				5			INPUT + DS		10001250	
				6			INPUT + DS		12511501	
				7			INPLIT + DS		1502 1752	
				1			INPLIT + DS		1753 1987	
				<u> </u>			141 01 + 05		11351307	J

Figure 2-13 "Coupler2X2" hardware configuration

Note

(1	0)	coupler2X2						
Slot		Module	Order Number	I Address	Q Address	Diagnostic Address	Comment	Access
0	ī	coupler2X2	6ES7 158-3AD10-0XA0			16355*		Full
X2		FN-10-02				16354*		Full
X2F1 R		Port 1 R.145	6ES7 193-64R00-04A0			16357*		Full
X2F2R		Port 2 R/45	6ES7 193-64R00-04A0			16356*		Full
1		OUTPUT			20002249			Full
2		OUTPUT			22512500			Full
3		OUTPUT			25022751			Full
4		OUTPUT			27532986			Full
5		INPUT + DS		20002250				Full
6		INPUT + DS		22512501				Full
7		INPUT + DS		25022752				Full
8		INPUT + DS		27532987				Full
9								
10								
11								
12								
13								
14								
15								
16								

### 2.2 Symbol table

The symbol table contains symbols for communicating with the hardware. The input and output addresses listed for the Coupler modules in chapter 2.1 must be in the symbol table. These addresses are necessary for communication between the CPUs via the Coupler. They contain all transmitted signals. The symbol table must have the same input and output addresses on the PLCs that are communicating. The symbol table should be configured in the same manner as with an ordinary distributed I/O system.

### 2.2.1 Configure the symbol table

1. Open the symbol table for AS\_A in the component view.

Figure	2-1	4

🔁 RedPNPNCoupler (Component	View) D:\PCS7_projec	ts\PN_PN\RedPNPNCoupler	\RedPNPNC
	Object name	Symbolic name	Туре
E AS_A	Sources		Source folder
⊟- <b>∰</b> 410_A	Blocks		Block Folder Offline
	🙉 Charts		Chart folder
	🖨 Symbols		Symbol table
E 410 CP 443.1			
⊞ <b>H</b> CP 443-1(1)			
⊕			
🖨 🎒 AS_B			
Ė-∰ 410_B			
🕀 🔛 CPU 410-5H A			
⊡			
En Shared Declarations			
E-005			
E-m Lib			
Sources			
Blocks			
🕞 🖓 Charts			
⊕ Bhared Declarations			

2. Instance the input and output addresses of the redundant Couplers (see Table 2-1).

#### Table 2-1

Sym bol	Data type	Address range	Steps	Comment
PVIn_	REAL	ID 10001978	1000;	Process value input (Coupler 1)
XXX			10051978	
PVInS	REAL	ID 20002978	2000;	Process value input (Coupler 2)
L_xxx			20051978	
STIn_	BYTE	IB 10001982	1004;	Status byte of the input data records
XXX			10091982	- Last BYTE of a PVIn_xxx (REAL) -> 5. BYTE
STInS	BYTE	IB 20002982	2004;20092	Status byte of the input data records (device)
L_xxx			982	- Last BYTE of a PVInSI_xxx (REAL) -> 5. BYTE
STSLx	BYTE	IB 1250;1501;	-	Status bytes of the Coupler modules (INPUT + <b>DR</b> )
_X1		1752;1987		<ul> <li>Last byte of the respective address range</li> </ul>
STSLx	BYTE	IB 2250;2501;	-	Status bytes of the Coupler modules (INPUT + <b>DR</b> ) (device)
_X2		2752;2987		<ul> <li>Last byte of the respective address range</li> </ul>
PVOu	REAL	QD	1000;	Process value output
t_xxx		10001978	10051978	
PVOu	REAL	QD	2000;	Process value output (device)
tSL_x		20002978	20051978	
XX				
STOut	BYTE	QB	1004;	Status byte of the output data records
_xxx		10001982	10091982	<ul> <li>Last BYTE of a PVOut_xxx (REAL) -&gt; 5. BYTE</li> </ul>
STOut	BYTE	QB	2004;	Status byte of the output data records (device)
SL_xx		20002982	20092982	- Last BYTE of a PVOutSI_xxx (REAL) -> 5. BYTE
х				

3. Copy the inserted input and output addresses into the symbol table of AS\_B.

# 3 Library

This chapter explains the templates of the "PCS 7 PN/PN PN/MF Coupler Software" Library (9LA1110-6CG20-0AA0) which are used in this application example. The Diagnostic blocks

Figure 3-1

Tmpl\_PnPnDiln\_red Tmpl\_PnPnDiln\_red\_ST Tmpl\_PnPnDiOu\_red Tmpl\_PnPnDiOu\_red\_ST Tmpl\_PnPnlAnIn\_red Tmpl\_PnPnlAnIn\_red\_ST Tmpl PnPnIAnOu red Tmpl\_PnPnlAnOu\_red\_ST Tmpl\_PnPnRAnIn\_red Tmpl\_PnPnRAnIn\_red\_ST 🕞 Tmpl\_PnPnRAnOu\_red Tmpl PnPnRAnOu red ST Tmpl\_PnPnWoln\_red Tmpl\_PnPnWoln\_red\_ST 🕞 Tmpl\_PnPnWoOu\_red Tmpl\_PnPnWoOu\_red\_ST

Figure 3-2

🚰 FB6005	PnPnDiln
🚰 FB6006	PnPnDiOu
🚰 FB6008	PnPnBAnIn
🚰 FB6009	PnPnRAnOu
🚰 FB6011	PnPnWoln
🚰 FB6012	PnPnWoOu
🚰 FB6013	PnPnlAnIn
🚰 FB6014	PnPnlAnOu
<table-of-contents> FB6020</table-of-contents>	PnPnMod
🚰 FC1500	PnPnDilnSel
🚰 FC1501	PnPnWolnSel
🚰 FC1502	PnPnAnInSel
🚰 FC1503	PnPnRedDi02
🚰 FC1504	PnPnRedWo02
🚰 FC1505	PnPnRedAn02

As shown in <u>Figure 3-1</u> and <u>Figure 3-2</u>, the library contains many other blocks and templates. For other applications there are also blocks for the data type Integer and Word and Templates which handles the quality information with a bit instead of a byte. General the Status information via process image is an option that can be used or not used to save data space at the Coupler.

Note

More information can be found in the manual of "PCS 7 PN/PN PN/MF Coupler Software" Library.

### 3.1 Tmpl\_PnPnRAnIn\_red\_ST

The "Tmpl\_PnPnRAnIn\_red\_ST" template describes the redundant data transmission of analog input values in "REAL" format with the "PnPnRAnIn" and the "PnPnRedAn02" block. All necessary diagnostic blocks are automatically called up and interconnected at the Charts beginning with "@".



The "PV\_In" of the two "PnPnRAnIn" blocks (analog input driver real) process the redundantly transmitted analog values of the Couplers. The "ST\_In" of the two "PnPnRAnIn" blocks read the corresponding signal status. The "PnPnRedAn02" (Selection of two redundant analog values) block evaluates the best of the two redundant signals based on "In1.ST" resp. "In2.ST". The best signal with the corresponding signals "Bad", "OosAct", "MS\_Req" MS\_dev" is given out at the output parameters of the "PnPnRedAn02".

Figure 3-4

ompile program			
Compile Charts as Prog	gram		
CPU:	CPU 410-5H		
Program name:	410_A\CPU 410-	5H A\Prog_A\	
Scope			
Entire program			
C Changes only			
Generate module	drivers	Block Driver Sett	ings
Generate SCL so	urce		

#### Figure 3-5



Thanks to the "Generate module drivers" functionality, as is customary in PCS 7, all necessary diagnostic blocks are automatically called up and interconnected. At the "PnPnRAnIn" block, the input parameter "ST\_In", "MS", "Mode", "DataXchg", "DataXchg1", and" MS\_Xchg" will be interconnected with the corresponding module diagnostic block resp. address of the process image.

#### Parameters of "PnPnRAnIn"

"SelQB" ist set to 0 and "SelST" is set to 1 because the evaluation of the signals status is done by the input parameter "ST\_IN"

"Feature.Bit25" and "Feature.Bit26" are set to 0. These Bits can be used for "Bit Swap" and "Byte swap" if the coupled PLC have different data formats, like little Endian and Big Endian. The "Feature.Bit27" is set to 0. "Feature.Bit28" allows for evaluation of the signal status at the output "Bad". "Feature.Bit29" and "Feature.Bit30" is set to 0.

Note

A detailed description for the blocks "PnPnRAnIn" and "PnPnRedAn02" can be found in the <u>manual</u> of "PCS 7 PN/PN PN/MF Coupler Software" Library.

### 3.2 Tmpl\_PnPnRAnOu\_red\_ST

The "Tmpl\_PnPnRAnOu\_red\_ST" template describes the redundant data transmission of analog output values in "REAL" format with the "PnPnRAnOu" block.



The "PV\_Out" of the two "PnPnRAnOu" blocks (analog output driver real) process the analog value which must be transmitted redundantly by the Couplers. The "ST\_Out" of the two "PnPnRAnOu" blocks write the corresponding signal status to the process image. The "PnPnAnInSel" (select one out of two analog values real) block is a placeholder for a block that gives out an analog value.

Figure 3-7			
Compile program			×
Compile Charts as Program			
CPU: Program name:	CPU 410-5H 410_A\CPU 410-5H	H A\Prog_A\	
Scope © Entire program © Changes only			
Generate module driv	ers	Block Driver Set	tings
ок		Cancel	Help



Thanks to the "Generate module drivers" functionality, as is customary in PCS 7, all necessary diagnostic blocks are automatically called up and interconnected. At the "PnPnRAnOu" block, the output parameter "ST\_Out" and the input parameter "MS", "Mode", "DataXchg", "DataXchg1", and "MS\_Xchg" will be interconnected with the corresponding module diagnostic block resp. address of the process image.

#### Parameters of "PnPnRAnOu"

"Feature.Bit25" and "Feature.Bit26" are set to 0. These Bits can be used for "Bit Swap" and "Byte swap" if the coupled PLC have different data formats like little Endian and Big Endian. The standard Feature Bits "Feature.Bit27", "Feature.Bit31" are set to 0 and "Feature.Bit30" is set to 1.

Note

A detailed description for the blocks "PnPnRAnOu" and "PnPnAnInSel" can be found in the <u>manual</u> of "PCS 7 PN/PN PN/MF Coupler Software" Library.

### 3.3 Tmpl\_PnPnDiIn\_red\_ST

The "Tmpl\_PnPnRDiln\_red\_ST" template describes the redundant data transmission of digital input values with the "PnPnDiln" and the "PnPnRedDi02" block.



The "PV\_In" of the two "PnPnRDiIn" blocks (digital input driver bit) process the redundantly transmitted digital values of the Couplers. The "ST\_In" of the two "PnPnRDiIn" blocks read the corresponding signal status. The "PnPnRedDiO2" block (selection of two redundant digital values) evaluates the best of the two redundant signals based on In1.ST resp. In2.ST. The best signal with the corresponding signals "Bad", "OosAct", "MS\_Req" and "MS\_dev" is given out at the output parameters of the "PnPnRedDiO2".

Figure 3-10

Compile program	×
Compile Charte as Program	
Comple Chars as Program	
CPU: CPU 410-5H	
. Program name: 410_A\CPU 410-5H A\Prog_A\	
Scope	_
• Entire program	
C Changes only	
Generate module drivers Block Driver Settings	
Generate SCL source	
OK Cancel Hel	p



Thanks to the "Generate module drivers" functionality, as is customary in PCS 7, all necessary diagnostic blocks are automatically called up and interconnected. At the "PnPnDiln" block, the input parameter "ST\_In", "MS", "Mode", "DataXchg", "DataXchg1", and "MS\_Xchg" will be interconnected with the corresponding module diagnostic block resp. address of the process image.

#### Parameters of "PnPnDiIn"

"SelQB" is set to 0 and "SelST" is set to 1 because the evaluation of the signals status is done by the input parameter "ST\_IN"

"Feature.Bit27" is set to 0. "Feature.Bit28" allows for evaluation of the signal status at the output "Bad". "Feature.Bit29" and "Feature.Bit30" is set to 0.

Note

A detailed description for the blocks "PnPnDiln" and "PnPnRedDi02" can be found in the <u>manual</u> of "PCS 7 PN/PN PN/MF Coupler Software" Library.

### 3.4 Tmpl\_PnPnDiOu\_red\_ST

The "Tmpl\_PnPnRDiOu\_red\_ST" template describes the redundant data transmission of digital output values with the "PnPnDiOu" block.



The "PV\_Out" of the two "PnPnDiOu" blocks (digital output driver bit) process the ditial value which must be transmitted redundantly by the Couplers. The "ST\_Out" of the two "PnPnDiOu" blocks write the corresponding signal status to the process image. The "And04" block (Logical AND with 4 inputs) is a placeholder for a block that gives out a digital value.



Compile program			×
Compile Charts as Prog	gram		
CPU:	CPU 410-5H		
Program name:	410_A\CPU 410-5H	H A\Prog_A\	
Scope			
<ul> <li>Entire program</li> </ul>			
C Changes only			
Generate module	drivers	Block Driver Settings	
Generate SCL so	urce		-
		Court 1	
UK		Cancel He	P

#### Figure 3-14



Thanks to the "Generate module drivers" functionality, as is customary in PCS 7, all necessary diagnostic blocks are automatically called up and interconnected. At the "PnPnDiOu" block, the output parameters "ST\_Out" and the input parameter "MS", "Mode", "DataXchg", "DataXchg1", and "MS\_Xchg" will be interconnected with the corresponding module diagnostic block resp. address of the process image.

#### Parameters of "PnPnRAnOu"

The standard Feature Bits "Feature.Bit27", "Feature.Bit31" are set to 0 and "Feature.Bit30" is set to 1.

A detailed description for the blocks "PnPnRAnOu" and "PnPnAnInSel" can be found in the <u>manual</u> of "PCS 7 PN/PN PN/MF Coupler Software" Library.

### 3.5 Diagnostic in the @-Charts

In the charts beginning with "@" all necessary diagnostic blocks are automatically called up and interconnected. This happens by compiling the program with the option "Generate module drivers".

#### Figure 3-15



The "PnPNMod" handles the proceeds of the diagnostic for each module of the PN/PN. The interconnection on the lefthand side guides to higher level diagnostic blocks e.g., "OB\_DIAG1\_PN", "SUBNET\_PN" and "OB\_BEGIN\_HPN". The dialog status at the input parameter "DS" taken from the input byte "DS" of the Coupler. The interconnections on the right-hand side guide to the channel blocks e.g., "PnPnRAnIn", "PnPnRAnOu", "PnPnDiIn" and "PnPnDiOu".

# 4 Test charts

### 4.1 TestValueSiS

Figure 4-1



The CFC "TestValueSiS" is employed for the following applications:

- Generating a process value
- Comparing a sent and received process value
- Simulating process values
- Process value monitoring
- Monitoring of transmission speed
- Displaying the maximum transmission time
- Simulating signal states

### 4.1.1 CFC Chart Partition A/Sheet 1

Figure 4-2



In CFC Chart Partition A/Sheet 1, a process value is generated which increments cyclically from 10 to 1000 in increments of one. Once 1000 is reached, the process value automatically resets to 10. APL standard blocks are used (CompAn02, Add04, SelA02In). The process value is combined with a generated signal status using a "StruAnOu" APL block (see

The "Out" output of the "SimVal" is connected to the "PV\_In" input of the two "PnPnRAnOu" blocks (Logical AND with 4 inputs) in Tmpl\_PnPnRAnOu\_red\_ST 3.2 in order to use the generated process value.

### 4.1.2 CFC Chart Partition A/Sheet 2





In CFC Chart Partition A/Sheet 2, the received process value (sent via the Coupler) from Tmpl\_PnPnRAnIn\_red\_ST <u>0</u> is compared to the generated process value. The value calculated from this operation is used on <u>CFC Chart Partition A/Sheet</u> <u>4</u> to compute the transmission speed (multiplication by 100 ms). The maximum transmission speed is set using a selector block, "Max\_Val", and likewise computed with a factor of 100 ms on <u>CFC Chart Partition A/Sheet 4</u>. It is possible to reset this value in the OS with an "OpDiO1" control block ("SiS ResetMaxVal").

### 4.1.3 CFC Chart Partition A/Sheet 3

Figure 4-4



In CFC Chart Partition A/Sheet 3, it is possible to change the signal status of the generated process value. The signal status of the process value generated in <u>CFC Chart Partition A/Sheet 1</u> is converted to a REAL with the help of APL standard blocks. It can be modified on the OS by "OpDiO1" blocks ("SiSModSigStBad", "SiSModSigStSim"). The status can be simulated for three states:

- 16#80 > Good
- 16#00 > "Bad" Signal
- 16#60 > Simulation
- The simulated signal status is converted to a Word.

### 4.1.4 CFC Chart Partition A/Sheet 4



In CFC Chart Partition A/Sheet 4, the process value is displayed on the OS using monitoring blocks ("MonAnS").

- "SiS SimValIn" > current generated process value (see <u>CFC Chart Partition A/Sheet 1</u>)
- "SiS MaxTimeDelay" > maximum transmission time (see <u>CFC Chart Partition A/Sheet 2</u>)
- "SiS TimeDelay" > transmission time (see CFC Chart Partition A/Sheet 2)

### 4.2 TestValueBPCS

Figure 4-6

	Menitorium of Imput VV BRCRupium	
	800 8 su//si	
	Hold Own	
Test Reference and ST(1, 11) 1	Analog a 2/3	
Out Output of heat analog value	100.0- PC.5ptca PC.5pt-	
	6-PU_bate Config	
Tap1_PaPaRaIn_red_ST(A, 1)\2		
Bad 148ad process value		
	1	
	1	
	1	
	4	

In the CFC "TestValueBPCS", the current process value being sent is displayed on the OS with a monitoring block. The "Out" output of the "PnPnRedAn02" ("Input") block of a BPCSCoupler is interconnected with the "PV" input of the monitoring block. The "CSF" input is interconnected with the "Bad" output of the "PnPnRedAn02" block to display an external error.

### 4.3 OS display

In the OS, the test charts "TestValueSiS" and "TestValueBPCS" are shown on a screen.

Figure 4-7



# 5 Appendix

### 5.1 Service and support

#### Industry Customer Support for PCS 7 PN/PN PN/MF Coupler Software

Do you have any questions or need assistance regarding the driver library?

Please contact:

function.blocks.industry@siemens.com

#### **Industry Online Support**

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs, application examples and videos – all information is accessible with just a few mouse clicks:

support.industry.siemens.com

#### **Technical Support**

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers

- ranging from basic support to individual support contracts. Please send queries to Technical Support via Web form:

siemens.com/SupportRequest

#### SITRAIN – Digital Industry Academy

We support you with our globally available training courses for industry with practical experience, innovative learning methods and a concept that's tailored to the customer's specific needs.

For more information on our offered trainings and courses, as well as their locations and dates, refer to our web page:

siemens.com/sitrain

#### Service offer

Our range of services includes the following:

- Spare parts services
- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts

You can find detailed information on our range of services in SiePortal: https://sieportal.siemens.com/en-ww/home

#### Industry Online Support app

You will receive optimum support wherever you are with the "Siemens Industry Online Support" app. The app is available for iOS and Android:

support.industry.siemens.com/cs/ww/en/sc/2067

### 5.2 Industry Mall



The Siemens Industry Mall is the platform on which the entire siemens Industry product portfolio is accessible. From the selection of products to the order and the delivery tracking, the Industry Mall enables the complete purchasing processing - directly and independently of time and location:

mall.industry.siemens.com

### Links and literature 5.3

Table 5-1

Nr.	Thema
\1\	Siemens Industry Online Support
	https://support.industry.siemens.com
121	Link to this entry page of this application example
	https://support.industry.siemens.com/cs/ww/de/view/109824283
131	

### **Change documentation** 5.4

Table 5-2

Version	Date	Modifications
V1.0	09/2023	First version