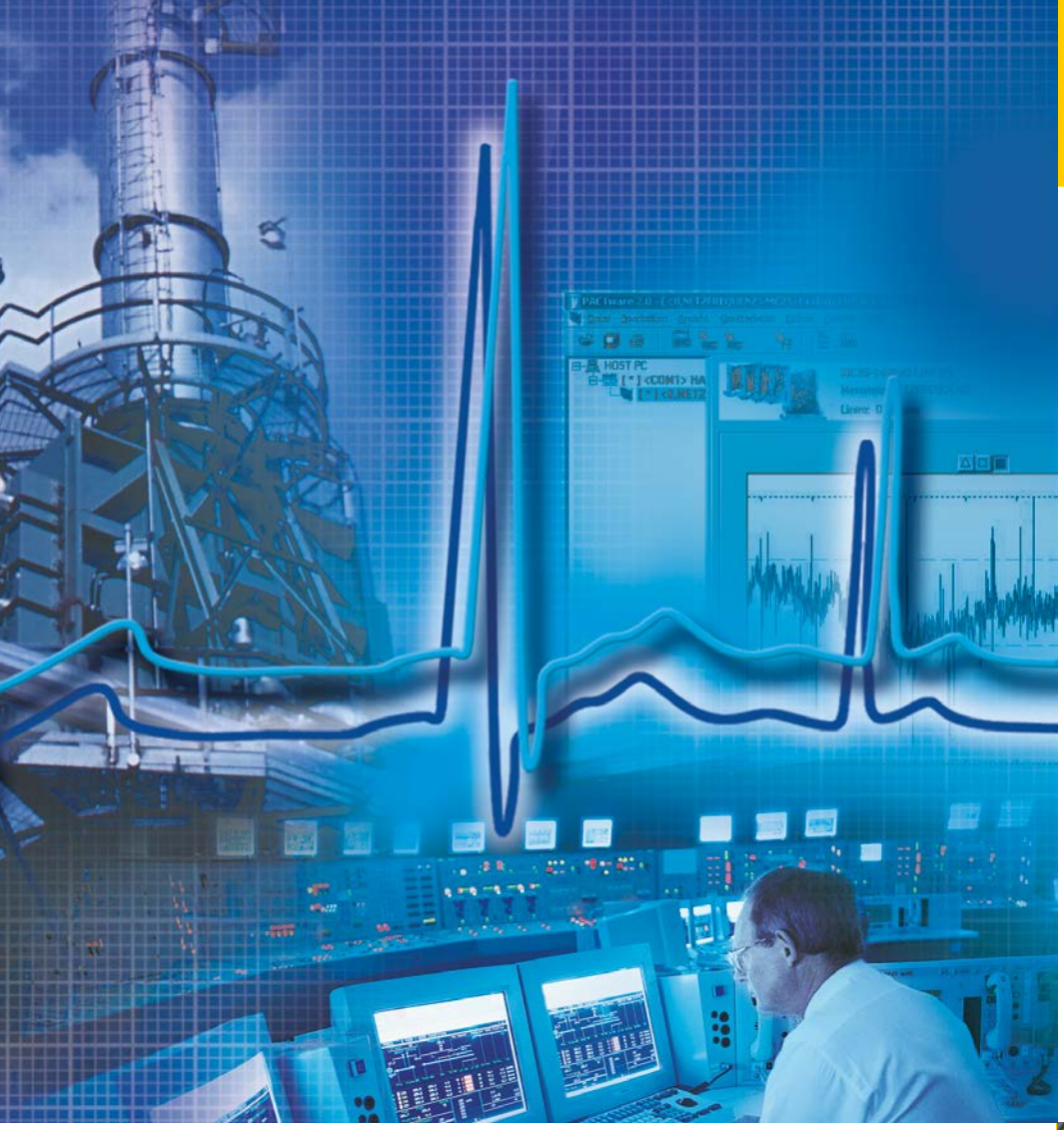


TURCK

Industrial Automation

excom® – REMOTE I/O

INTEGRATION TURCK EXCOM® IN EMERSON DELTA V (M-SERIES)

GETTING STARTED

Sense it! Connect it! Bus it! Solve it!

Content

1 Introduction

1.1 About this manual

This document is designed to help users in the configuration of the excom® gateway and the associated I/O modules in the DeltaV control system. It is assumed for this that the excom® hardware is already properly installed. Please refer to the appropriate excom® manuals for any questions relating to the wiring diagrams, the gateway and/or the redundancy of the power supply. The user must know the specific arrangement of the I/O modules and the PROFIBUS addressing. The PROFIBUS GSD file for the excom® system must also be available. This document is based on the use of the DeltaV System V12 and the TURCK excom® system with the GDP-IS/FW2.x.x gateway.

1.2 Explanation of symbols

The following symbols are used in this manual:

NOTE
Indicates tips, recommendations and important information. The notes contain information, particular operating steps that facilitate work and possibly help to avoid additional work resulting from incorrect procedures

1.3 Associated documents

Besides this document the following material can be found in the TURCK product database:
excom® – Remote I/O for intrinsically safe circuits, D301266
excom® – Remote I/O for non intrinsically safe circuits, D301268
All applicable national and international certificates for the TURCK devices are available on the Internet (www.turck.com).

2 Parameters and I/O mapping of the excom® modules

2.1 GSD-based integration

GSD files describe the entire configuration scope and the communication properties of a PROFIBUS station. The file describes properties such as transmission speeds, time response, configuration data, parameters, diagnostic data etc. in the form of keywords. The relevant configuration software of the host systems interprets the GSD files and normally represents the configuration and parameter data of the stations in text form. An *excom®* station can be assigned by module or by channel.

The GSD file T203FF9F.GS? is required in order to integrate the excom® system in the control system. The last letter in the file name extension "?" denotes the country language of the file.

Name of the GSD file	Language
T203FF9F.GSD	English
T203FF9F.GSG	German

Table 1: Example of possible GSD files of the GDP-IS excom® gateway

Module	Type	Configuration	Data volume	
			Input data	Output data
GDP…	GDP-…	Standard gateway	-	-
	GDP-… C	Standard gateway + cyclic data	1 word	1 word
DM80...	DM80...	Bidirectional DM80... without status	1 byte	1 byte
	DM80... S	Bidirectional DM80... with status	2 bytes	1 byte
	DM80... 8I	DM80... only as input module without status	1 byte	0 byte
	DM80...S 8I	DM80... only as input module with status	2 bytes	0 byte
DO40...	DO40...	Digital output module without status	0 byte	1 byte
DO80…	DO80…	Digital output module without status	0 byte	1 byte
DI40...	DI40...	Digital input module with status	1 byte	0 byte
DI80…	DI80…	Digital input module with status	1 byte	0 byte
DF20...	DF20... P	Counter module	8 bytes	2 bytes
	DF20 ... F	Frequency module	8 bytes	2 bytes
AIH40...	AIH40...	Analog input (active) without cyclic HART® data	4 words	-
	AIH40... 1H	Analog input (active) with 1 cyclic HART® variable	6 words	-
	AIH40... 4H	Analog input (active) with 4 cyclic HART® variables	12 words	-
	AIH40... 8H	Analog input (active) with 8 cyclic HART® variables	20 words	-
AIH41...	AIH41...	Analog input (passive) without cyclic HART® data	4 words	-
	AIH41... 1H	Analog input (passive) with 1 cyclic HART® variable	6 words	-
	AIH41... 4H	Analog input (passive) with 4 cyclic HART® variables	12 words	-
	AIH41... 8H	Analog input (passive) with 8 cyclic HART® variables	20 words	-
AOH40...	AOH40...	Analog output without cyclic HART® data	0 words	-
	AOH40... 1H	Analog output with 1 cyclic HART® variable	2 words	4 words
	AOH40... 4H	Analog output with 4 cyclic HART® variables	8 words	4 words
	AOH40... 8H	Analog output with 8 cyclic HART® variables	16 words	4 words
AI40...	AI40...	Analog input (active/passive) with status	4 words	-
AI41...	AI41...	Analog input (passive) with status	4 words	-
AI43...	AI43...	Analog input for resistance measurement (passive) with status	4 words	-
AO40...	AO40...	Analog output (active)	4 words	-
TI40...	TI40... R	Input module for resistance elements	4 words	-
	TI40... T	Input module for thermocouples	4 words	-

Table 2: The I/O data column shows the different data volume of the particular configuration.

NOTE
The module hardware is the same in spite of the different configuration. The behavior of the module is only affected by the Hardware Manager via the controller and the control system.

2.2 GDP-… gateway

The GDP-IS *excom*® gateway is an intrinsically safe gateway for PROFIBUS-DPV1. The gateway manages the connection of the *excom*® stations to the higher-level fieldbus system and handles the entire data traffic. The gateway also supplies the entire range diagnostics information right through to channel-based diagnostics. Manufacturer specific error codes are also generated. This includes for example HART® communication errors, power supply faults, engineering faults, as well as information concerning simulations, internal communication, redundancy switching etc.
The configuration and parameter setting stored in the gateway is still available in the event of a PROFIBUS failure. If an I/O module has to be replaced, the new module is assigned parameters immediately.
There are three different internal cycle times for the I/O modules. The digital I/O modules are scanned every 5 ms, the analog modules every 20 ms and the secondary HART® variables every 80 ms. These scan times are constant irrespective of the number of configured and fitted modules.

The gateway has two important configurations:

Variant	Description	Input data	Output data
GDP-…	Communication interface, PROFIBUS DPV1	-	-
GDP-… C	Communication interface, PROFIBUS DPV1, with cyclic data.	1 word	1 word

Table 3: Configuration and cyclic data - GDP-IS

In the GDP-…C configuration, the gateway provides one input and one output data word. The input data word and the output data word are used as status and control registers of the gateway. These status descriptions are used in order to indicate the current “active” and “passive” gateways in the event of a redundancy switchover. The input word also provides the status of the power supply units.

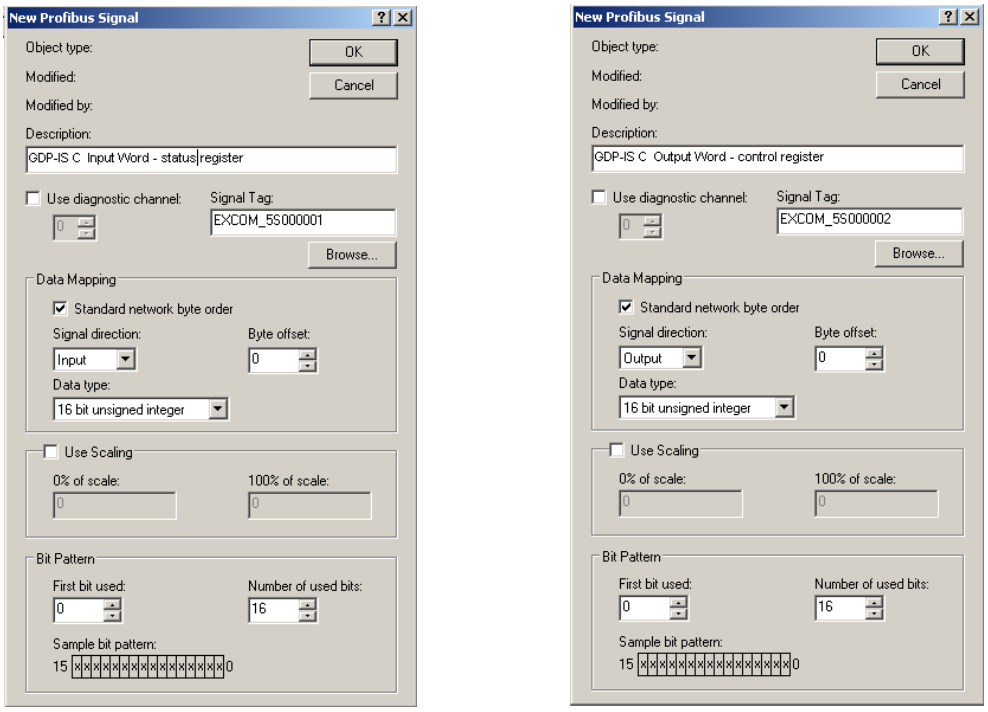


Figure 1: Channel definition of GDP...

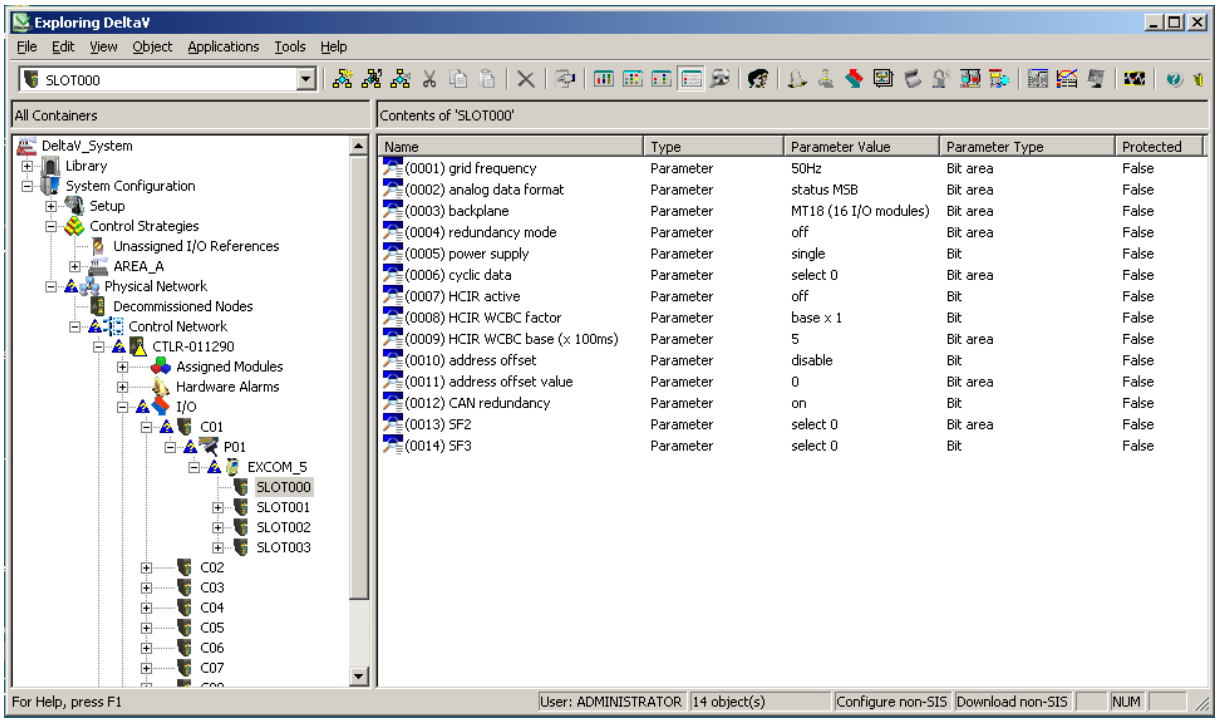


Figure 2: Parameters of GDP… Slot 000

The following table describes all available settings of the GDP-IS gateway. The parameter settings in **bold type** are the default settings.

Parameter	Setting	Description
Backplane	MT9 / **MT18 /** MT24	Set size of used termination unit. The communication interface communicates only with specified number of I/O modules, beginning with slot 1. MT9 up to 8 I/O modules MT18 up to 16 I/O modules MT24 up to 24 I/O modules
Analog data format	**State MSB**	Channel status is mapped to the MSB of the Unsigned16 value. All configured analog input modules are affected by this setting
	State LSB	Channel status is mapped to the LSB of the Unsigned16 value. All configured analog input modules are affected by this setting
	No state	No Channel status is embedded in the analog value. All configured analog input modules are affected by this setting
Grid frequency	**50 Hz** / 60 Hz	An additional filtering eliminates the influence of mains frequency in the analog to digital conversion of the analog input modules.
Redundancy mode	**off**	The gateway does not support redundancy.
	Line redundancy	Gateway and network are redundant. The primary gateways communicate with the configured PROFIBUS address. The backup is polled by the master with the virtual address given by the parameter “address offset” + configured address. Note that assigning the virtual address to any configured slave in the relevant PROFIBUS network is not allowed.

	mode 2	Reserved
	System redundancy	Gateway and network are redundant and communicating with two independent masters. Both gateways are configured and parameterized in the same manner and the same address
address offset	1...124 (Default: **0**)	Specifies the address offset for the backup gateway in line redundancy.
power supply	**Single**	No power supply supervision.
	Redundant	Power supply supervision.
HCIR active	**off** / on	Enables configuration in run. **Note:** This bit has to be set by the master before the HCIR sequence starts
HCIR WCBC factor	**base x1 /** base x16	Factor to generate the maximum time of re-configuration The entered time constant "HCIR WCBC base …" can be multiplied by the entered factor.
HCIR WCBC base (x 100 ms)	0…63 (Default:**5**)	Determines the basis of the re-configuration time Worst Case Bus Cycle. Timeout for monitoring the online re-configuration (HCIR). If the PROFIBUS master supports HCIR, these parameters are set automatically.
cyclic data	Selection **0**	The default value of this parameter is 0 and must not be changed. This parameter is only available for GDP with cyclic data (GDP-IS C)..
	Selection 1 Selection 2 Selection 3	For future use For future use For future use
can redundancy	**on** / off	Activate the redundancy of the internal communication with the I/O modules.
SF2		For future use
SF3		For future use

Table 4: GDP-… parameter settings

2.3 DM80...

The DM80... I/O module is used to connect NAMUR sensors (DIN EN 60947-5-6) and actuators. If mechanical contacts are connected a suitable resistance circuit (WM1, Ident no. 0912101) must be implemented when wire break or short circuit monitoring is activated.

The behavior of the inputs/outputs is set via the PROFIBUS-DP master. Possible parameters are switching behavior, input delay, substitute value strategy, wire break and short circuit monitoring. The user can also define whether an input or an output is provided at the corresponding connection point. Configurations of 8 inputs/0 outputs, 6 inputs/2 outputs right up to 0 inputs/8 outputs are possible (via GSD file, mode 2). This makes it possible to optimally adapt the system to the application environment at hand.

NOTE
When connecting the field devices bear in mind that all inputs/outputs are connected to a common potential.

There are 4 different ways of configuring the DM80... in the GSD file.
The following table shows an overview of the different supporting functions of the module.

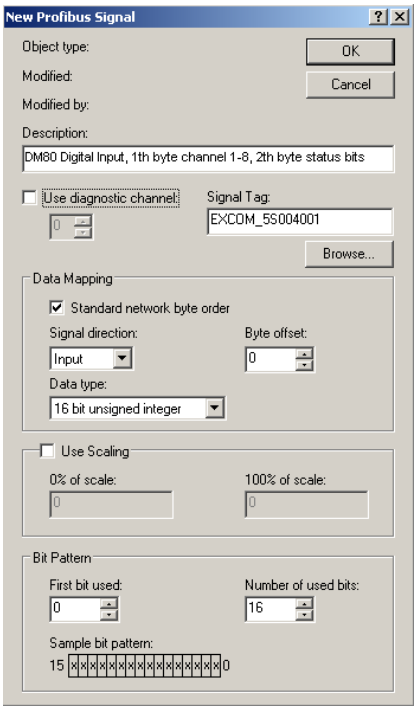
Variant	Description	Input data	Output data
DM80...	Groups of two channels can be either parameterized as input or as output. No signal status is delivered.	1 byte	1 byte
DM80... S	Groups of two channels can be either parameterized as input or as output. A signal status is delivered in the second byte for every input and output channel.	1 signal byte + 1 status byte	1 byte
DM80... 8I	All 8 channels are parameterized fixed as inputs. Therefore no output data is consumed.	1 byte	
DM80... S 8I	All 8 channels are parameterized fixed as inputs. Therefore no output data is consumed. A signal status is delivered in the second byte for every input channel.	1 signal byte + 1 status byte	

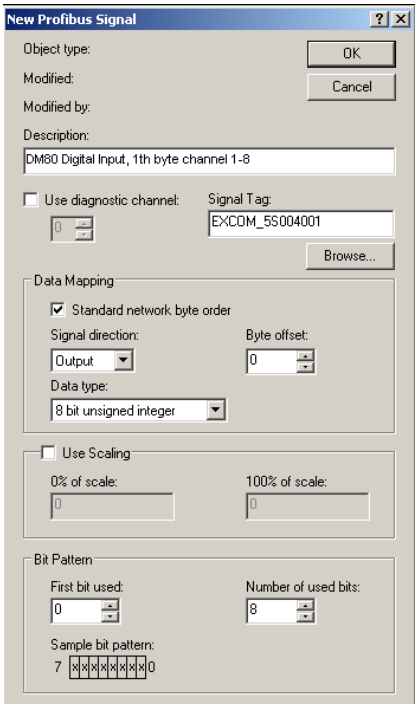
Table 5: Configuration and cyclic data

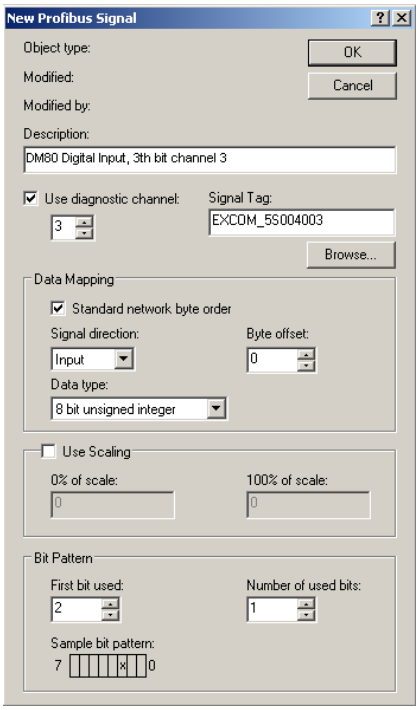
Data byte (1st input byte)							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Ch. 8	Ch. 7	Ch. 6	Ch. 5	Ch. 4	Ch. 3	Ch. 2	Ch. 1
Status byte (2nd input byte) optional by using the extra "S" of the configuration							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Ch. 8	Ch. 7	Ch. 6	Ch. 5	Ch. 4	Ch. 3	Ch. 2	Ch. 1

Output byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Ch. 8	Ch. 7	Ch. 6	Ch. 5	Ch. 4	Ch. 3	Ch. 2	Ch. 1

Table 6: Data mapping of DM80...







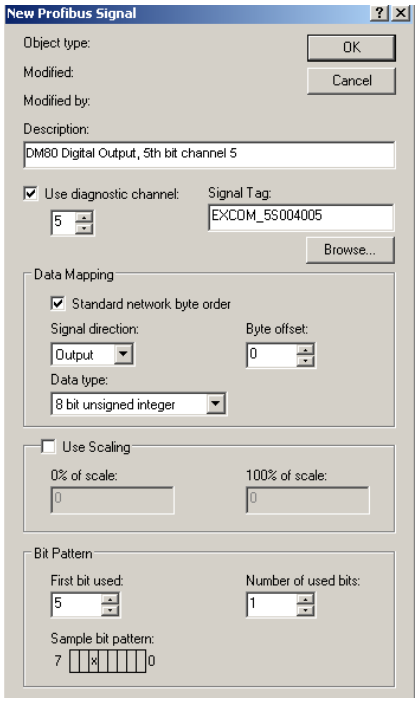


Figure 3: Channel definition of DM80...

The module is always parameterized for 2 channels.

Parameter	Settings	Description
short circuit detection	**on** / off	A short circuit of the field cables is monitored. In the event of a short circuit the channel LED of the module becomes red. Monitoring by the output signals is only available during channel outputs "high" signal.
open line detection	**on** / off	An open line of the field cables is monitored. In the event of an open line the channel LED of the module becomes red. Monitoring by the output signals is only available during channel outputs "high" signal.
failsafe mode	**min.** / max. / last valid value	Either 'min.' or 'max.' or 'last valid value' can be selected.
direction	**Input**	The group of channels (1/2, 3/4, 5/6, 7/8) works as inputs. The variants DM80... S and DM80... S 8I deliver a status for these channels.
	Output	The group of channels (1/2, 3/4, 5/6, 7/8) works as outputs. The status information is also transmitted.
polarity	**normal/** inverted	Channel signal sent/receive by fieldbus master is normal or inverted by the module.
damping	**off** / 10 ms / 20 ms / 50 ms /	The input takes the new value, if the level of the field terminal does not change in between the specific time..
Channel 1	**on** / off	If channel 1 is not used, it can be deactivated to suppress any diagnosis.
… … … …	**…/…**	Channel 2 up to channel 7 analog to channel 1
Channel 8	**on /** off	If channel 8 is not used, it can be deactivated to suppress any diagnosis.

Table 7: Parameters of DM80...

2.4 DF20...

The DF20... is an *excom*® module with 2 function blocks that either measure frequencies up to 4 kHz or count pulses. Two different configurations in the GSD file or the DTM define the operating mode in which the module is to be run. **DF20... F** stands for the configuration as a frequency module and **DF20... P** for the configuration as a pulse counter.

The two function blocks are marked A and B in the following. The assigned signal cables are called A1...A4 and B1...B4.

Variant	Description	Input byte	Output byte
DF20... F	The two function blocks are configured as frequency input A. The signal status is delivered in the first byte for every channel.	8 bytes	2 bytes
DF20... P	The two function blocks are configured as counter input A. The signal status is delivered in the first byte for every channel.	8 bytes	2 bytes

Table 8: Configuration and data rates

2.4.1 DF20... F

In this configuration the module provides a double word with measured value and status for each function block. The untreated value is in the LONG INTEGER format with a resolution of 0.1 mHz per digit. The status bits must be masked out for the conversion to Hz, and the untreated value converted to REAL must be divided by 10,000. This results in a fixed decimal point value with 4 decimal places.

Byte 1	Bit	7	6	5	4	3	2	1	0
	Significance	2^{31}	2^{30}	2^{29}	2^{28}	2^{27}	2^{26}	2^{25}	2^{24}
	Meaning	I	0	Sign	Measured value				
Byte 2	Bit	7	6	5	4	3	2	1	0
	Significance	2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}
	Meaning	Measured value							
Byte 3	Bit	7	6	5	4	3	2	1	0
	Significance	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}
	Meaning	Measured value							
bytes4	Bit	7	6	5	4	3	2	1	0
	Significance	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
	Meaning	Measured value							

Table 9: Data mapping of the DF20... F, Data type is Long INTEGER

S Measured value status
0 = valid measured value
1 = invalid measured value

VZ Sign
0 = measured value positive
1 = measured value negative

An input for detecting the rotation direction is also provided as well as the measuring input. The rotation direction is evaluated statically or dynamically depending on the parameters set via the host system. With the static evaluation of the input signal “logical 0” means forward rotation and “logical 1” reverse rotation. With dynamic evaluation the rotation direction, detection is implemented via the phase location between the measuring input and the input for rotation direction detection. The following schematic diagram shows the operating principle:

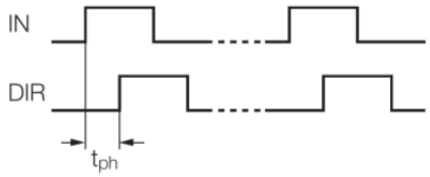


Figure 4: Dynamic rotation direction detection IN leading

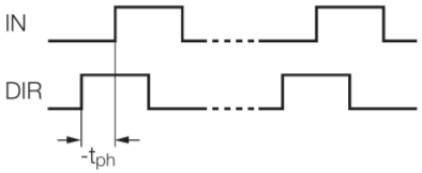


Figure 5: Dynamic rotation direction detection IN reactive

The rotation direction detection can also be set from the host system. This then makes the DIR input inactive. The control byte of the DF20... F has the following assignment:

Output byte 1 for function block A							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	UP/ DOWN	-	-	-
Output byte 2 for function block B							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	UP/ DOWN	-	-	-

Table 10: Control output byte 1 and 2 of the DF20... F

0 = positive frequency
1 = negative frequency

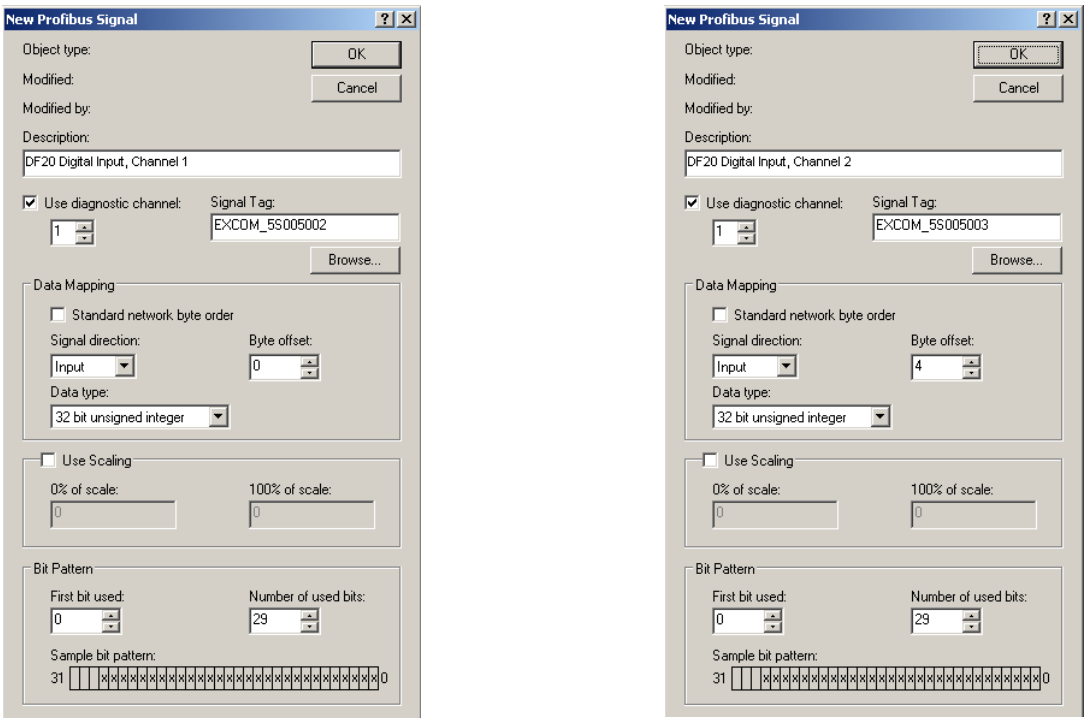


Figure 6: Channel definition - DF20 Channel 1 and 2

Parameter

As also with other *excom*® modules, channel-based programming (to the function block) is possible in mode 2. As this not only involves physical channels but primarily function blocks, the 2 function blocks provided are called A and B. The associated physical channels are each called A1...A4 and B1...B4.

Name	Value	Meaning
line monitoring	**on**	Wire-break/short-circuit monitoring of corresponding signal line active
	off	Wire-break/short-circuit monitoring of corresponding signal line inactive
failsafe mode input	**min. value**	The input value of the corresponding function block is 0
	max. value	The input value of the corresponding function block is 1
	last valid value	The input value of the corresponding function block retains the last valid value 1
failsafe mode output	**min. value**	The output value of the corresponding function block is 0
	max. value	The output value of the corresponding function block is 1
	last valid value	The output value of the corresponding function block retains the last valid value 1
direction detection	**count up (f < 4 kHz)**	Rotation detection direction permanently set to forwards
	host controlled (f < 4 kHz)	The rotation direction is set via the UP/DOWN control bit to forward/reverse. This flag is part of the control byte
	field controlled (f < 4 kHz)	The rotation direction is controlled via the direction detection input on the channel 3 and channel 4 (static evaluation)
	field controlled (auto, f < 1.25 kHz)	The rotation direction is monitored via the two measuring inputs on the channel 3 and channel 4 (dynamic evaluation)
cycle time	**< 300 ms (0.1% resolution)**	At a signal frequency of 4 kHz one measuring cycle is approx. 300 ms This results in an accuracy of 0.1%
	< 50 ms (1% resolution)	At a signal frequency of 4 kHz one measuring cycle is approx. 50 ms This results in an accuracy of 1%
damping control inputs	**off**	No additional attenuation of input signals
	50 ms	50 ms attenuation
average	**off**	The rotational speed is derived from one scanning interval
	4 values	The rotational speed is derived from four, eight or sixteen scanning intervals (floating average)
	8 values	
	16 values	
polarity	**normal**	No inversion of the effective signal direction
	inversion	Inversion of effective signal direction

Table 11: Parameters of DF20... F

Substitute values and validity of the measured values

Unlike other *excom*® modules, not all signals on the DF20... are routed through directly but undergo internal preprocessing. As a result, the substitute values of these signals are not output but a derivative of the resulting function. For example, if the Last valid value substitution strategy is set, the substitute value of the frequency is set to “zero” if wire break or short circuit are present at the frequency input. This substitution value is set as the fault can occur at any time during measuring.

The following substitution values are formed according to the fault and the parameters set:

Error	Parameter substitute value of input	Substitute value
Wire-break or short-circuit on A1...A4 or B1...B4	Min. value	16# 80 00 00 00
	Max. value	16# 9F FF FF FF
	Last valid value	16# 80 00 00 00
Module removed	Min. value	16# 80 00 00 00
	Max. value	16# 9F FF FF FF
	Last valid value	16# 8x xx xx xx

Table 12: Substitute values

Substitute values of the output only refer to the output of rotation direction detection if the setting of the parameter value is “host controlled (f < 4 kHz)”. The output then takes on the set substitute value.

The channel-specific error codes of diagnostics output from the DF20... F according to EN 50170 are shown in the following table

NOTE
The channel number supplied for channel-specific diagnostics corresponds to the LED number on the front and not to the otherwise normal contact assignment.

LED	Meaning
1	Counter input Function block A
2	Count direction (I/O) Function block A
3	Counter controller (I/O) Function block A
4	Reset (I/O) Function block A
5	Counter input Function block B
6	Count direction (I/O) Function block B
7	Counter controller (I/O) Function block B
8	Reset (I/O) Function block B

Table 13: Channel-specific error codes of diagnostics according to EN 50170

2.4.2 DF20 ... P

In this configuration the module provides a double word with counter value and status for each function block. The untreated value has the following format

Byte 0	Bit	7	6	5	4	3	2	1	0
	Significance	2^{31}	2^{30}	2^{29}	2^{28}	2^{27}	2^{26}	2^{25}	2^{24}
	Meaning	I	OV	Sign	Counter value				
bytes1	Bit	7	6	5	4	3	2	1	0
	Significance	2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}
	Meaning	Counter value							
bytes2	Bit	7	6	5	4	3	2	1	0
	Significance	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}
	Meaning	Counter value							
Byte 3	Bit	7	6	5	4	3	2	1	0
	Significance	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
	Meaning	Counter value							

Table 14: Data mapping of DF20... F, Data type Long INTEGER

Untreated value format of the DF20... F for function block A. The same applies to function block B in byte 4...7.

S Measured value status
0 = valid measured value
1 = invalid measured value

OV = Overflow bit
0 = No overflow
1 = Overflow

Sign
0 = measured value positive
1 = measured value negative

An input for detecting the rotation direction is also provided as well as the measuring input. The rotation direction is evaluated statically or dynamically depending on the parameters set via the host system. With the static evaluation of the input signal “logical 0” means up counting and “logical 1” down counting. With dynamic evaluation the rotation direction detection is implemented using the phase location between the measuring input and the input for rotation direction detection. The following schematic diagram shows the operating principle:

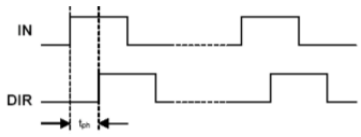


Figure 7: Dynamic detection of counting direction: IN leading

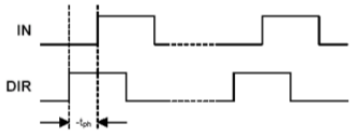


Figure 8: Dynamic detection of counting direction: IN reactive

The counting direction detection can also be set from the host system. This then makes the DIR input inactive. The control byte of the DF20... P has the following assignment:

Byte 1 for function block A							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	UP/ DOWN	RST OV	MRS	RST
Byte 2 for function block B							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	UP/ DOWN	RST OV	MRS	RST

Table 15: Control output byte 1 and 2 of the DF20... P

UP/DOWN count direction
0 = Up
1 = Down

RST OV Reset of overflow bit OV
0 = Overflow bit enabled
1 = Overflow bit reset

MRS With host controller, the counter is enabled
0 = Counter disabled
1 = Counter enabled

RST Counter reset
0 = Counter enabled
1 = Counter reset and disabled

Parameter

As also with other *excom*® modules, channel-based programming is possible. As this not only involves physical channels but primarily function blocks, the 2 function blocks provided are called A and B. The associated physical channels are each called A1...A4 and B1...B4.

Name	Value	Meaning
A1...A4: B1...B4: Line monitoring	**on**	Wire-break/short-circuit monitoring active on all 8 channels
	off	Wire-break/short-circuit monitoring inactive on all 8 channels
A/B: Substitute value input	**min. value**	The input value of the corresponding function block takes on the value 0.
	max. value	The input value of the corresponding function block takes on the value 1.
	Last valid value	The input value of the corresponding function block retains the last valid value 1.
A/B: Substitute value output	**min. value**	The output value of the corresponding function block takes on the value 0.
	max. value	The output value of the corresponding function block takes on the value 1.
	Last valid value	The output value of the corresponding function block retains the last valid value 1.
A/B: Count direction detection	**Up** **(f < 4 kHz)**	Count direction detection permanently set to "Up"
	Host controlled (f < 4 kHz)	Count direction detection is set to up/down via the UP/DOWN control bit
	Terminal (f < 4 kHz)	Count direction is detected via the direction input (static evaluation)
	Terminal (auto, f < 1.25 kHz)	Count direction is detected via the direction input (dynamic evaluation)
A/B: Reset counter	**Host controlled**	RST bit
	Terminal	RST input
A/B: Debounce of the control inputs	**off**	No additional damping of the input signals
	50 ms	50 ms damping
A/B: Edge counting	**positive**	only positive edges are counted
	positive + negative	Positive and negative edges are counted
A/B: Gate time	**Host controlled**	Counter enable via MRS bit
	Terminal	Counter enable via MRS input
A/B: Measuring range	0...100 Hz	For future function expansions in the module.
	0...1 kHz	
	0...4 kHz	
A1...A4: B1...B4: Polarity	**normal**	No reverse inversion of the signal
	Inverted	Reverse inversion of the signal

Table 16: Parameters of DF20... P

2.5 DI40...

The DI40... is a 4-channel, digital input module for connecting NAMUR sensors (DIN EN 60947-5-6) or mechanical contacts. If mechanical contacts are connected a suitable resistance circuit (WM1, Ident no. 0912101) must be implemented when wire break or short circuit monitoring is activated.

NOTE
All channels are galvanically isolated from each other.

The DI40... has the following configuration:

Variant	Description	Input data	Output data
DI40...	Digital input, 4 channels, NAMUR sensors, with status.	1 byte	-

Table 17: Configuration and cyclic data of DI40...

The DI40... input module operates solely as an input card with an additional status bit for each channel. When a status message is present, the status bit of the corresponding channel is set to 1 in the input byte (Bit 5... Bit 8). A short circuit or a wire break are the possible reasons for setting the bit.

Data byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status ch.4	Status ch.2	Status ch.1	Status ch.1	ch. 4	ch. 3	ch. 2	ch. 1

Table 18: Data mapping of DI40...

The parameters are set for each channel.

Parameter	Setting	Description
short detect	**on** off	A short circuit of the field cables is monitored. In the event of a short circuit the channel LED of the module becomes red. Monitoring by the output signals is only available during
open line detect	**on** off	An open line of the field cables is monitored. In the event of an open line the channel LED of the module becomes red. Monitoring by the output signals is only available during
failsafe mode	**min value** max value last valid	Either 'min value' or 'max value' or 'last valid value' can be selected.
polarity	**normal** inverted	The module can optionally invert the input signal.
damping	**off** 10 ms 20 ms 50 ms	The signal takes the new value, if the level on the field terminals does not change within the set time.

Table 19: Parameters of DI40...

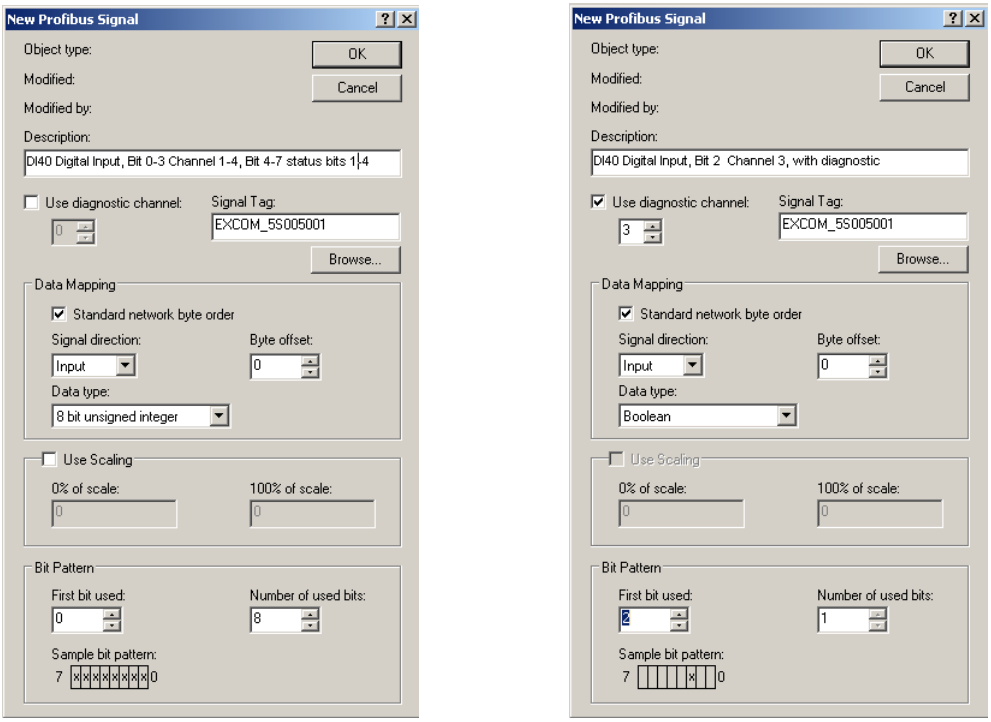


Figure 9: Channel definition of DI40...

2.6 DI80...

The DI80… digital input module is used for connecting eight 3-wire PNP/NPN sensors (IEC 61131, Type 3). The sensors are not fed via the module but via an auxiliary supply with reverse polarity protection, which is externally supplied separately for channels 1…4 (group 1) and 5…8 (group 2) via the terminals. The signal bounce monitoring detects and indicates any abnormal signal patterns in the process, e.g. frequent oscillation of the input signal between 0 and 1. The occurrence of these signal patterns is an indication of faulty transmitters or unstable process conditions.

The DI80... has the following configuration:

Variant	Description	Input data	Output data
DI80...	Digital input, 8 channels, 3-wire PNP/NPN sensors, with status	1 byte	-

Table 20: Configuration and data rates

Data byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Ch. 8	Ch. 7	Ch. 6	Ch. 5	Ch. 4	Ch. 3	Ch. 2	Ch. 1
Status Ch. 8	Status Ch. 7	Status Ch. 6	Status Ch. 5	Status Ch. 4	Status Ch. 3	Status Ch. 2	Status Ch. 1

Table 21: Data mapping of the DI80…

Parameter name	Value	Description
Short circuit monitoring	**on** off	Activating or deactivating the channel short circuit monitoring. In the event of a short circuit, the corresponding channel LED is lit red. The output signal can only be monitored if the output is activated.
Wire break monitoring	**on** off	Activating or deactivating the channel wire break monitoring. In the event of a wire break, the corresponding channel LED is lit red.
Substitute value strategy	**min. value** max. value of last valid value	Depending on the parameter setting for each channel, either the minimum, the maximum or the last valid value is set as a substitute value.
Polarity	**normal** inverted	Activation or deactivation of the inversion of the input signal
Current flow direction	**PNP** NPN	Selection of the sensor type (either PNP or NPN)
Bounce monitoring	**off** 10 ms 20 ms 50 ms	Activation of the additional bounce monitoring of the input signals to prevent a diagnostics overload in the event of loose contacts.
Bounce time window	**off** 0.5 s 1 s 2 s	Signal bounce is detected within the selected monitoring time window.
Number of signal changes	**2** 4 8 16	Number of signal changes within the monitoring time window to detect signal bounce

Table 22: Parameters of the DI80…

2.7 DO40...

The DO40... output module is used to connect intrinsically safe actuators such as valves or display elements. An actuator can be connected to each channel. Depending on the selection, each channel is provided with two intrinsically safe circuits with different control data.

The values for valve actuation are provided in the load curve. Refer to the certificates of the valve manufacturer for the permissible limit values. For example, the following variants are possible:

- 24 V/6 mA
- 18 V/25 mA
- 15 V/35 mA
- 12 V/45 mA

NOTE
All channels are galvanically isolated from each other.

Variant	Description	Cyclic input	Cyclic output
DO40...	Digital Output, 4 channels, IS. Valve. No signal status is delivered.	-	1 byte

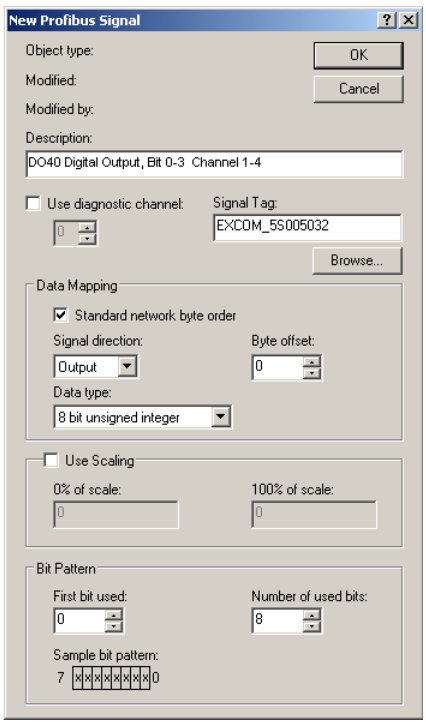
Table 23: Configuration and cyclic data of DO40...

Data byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	Ch. 4	Ch. 3	Ch. 2	Ch. 1

Table 24: Data mapping of DO40...

Parameter	Setting	Description
short detect	**On / off**	A short circuit of the field cables is monitored. In the event of a short circuit the channel LED of the module becomes red. Monitoring by the output signals is only available if the output is set to one.
open line detect	**on / off**	An open line of the field cables is monitored. In the event of an open line the channel LED of the module becomes red. Monitoring by the output signals is only available during channel outputs "high" signal.
failsafe mode	**min. value / max. value / last valid value**	Either 'min.' or 'max.' or 'last valid value' can be selected.
polarity	**Normal / inverted**	Output signal sent by fieldbus master is inverted by the module.

Table 25: Parameters of DO40...



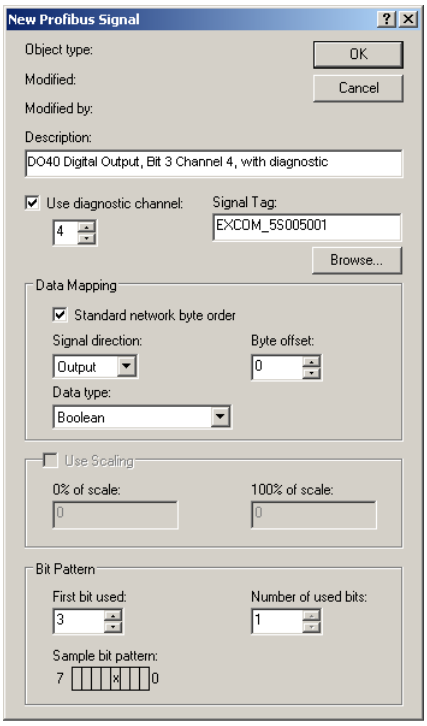


Figure 10: Channel definition of DO40...

2.8 DO80...

The DO80... digital output module is used to connect eight 24 VDC actuators such as valves or indication elements with 0.5 A. The actuators are not fed via the module but via an auxiliary supply with reverse polarity protection, which is externally supplied separately for channels 1…4 (group 1) and 5…8 (group 2) via the terminals. The parallel switching of the outputs within a group is possible in order to increase the load.

The behavior of the outputs is set via the PROFIBUS-DP master. Possible parameters are input delay, substitute value strategy, wire break and short circuit monitoring and short circuit behavior.

In the event of a short circuit the outputs are set to latching or non-latching short circuit protection.

Variant	Description	Input data	Output data
DO80...	Digital output, 8 channels, valves, no channel status	-	1 byte

Table 26: Configuration and data rates of the DO80...

Data byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Ch. 8	Ch. 7	Ch. 6	Ch. 5	Ch. 4	Ch. 3	Ch. 2	Ch. 1

Table 27: Data mapping of the DO80….

Parameter name	Value	Description
Short circuit monitoring	**on** off	The short circuit monitoring is activated or deactivated for each channel. In the event of a short circuit, the corresponding channel LED is lit red. The monitoring is only possible if the output signal is “high”.
Wire break monitoring	**on** off	The wire break monitoring is activated or deactivated for each channel. In the event of a wire break, the corresponding channel LED is lit red. The monitoring is only possible if the output signal is “high”.
Substitute value strategy	**min. value** max. value / last valid value	Depending on the parameter setting, the minimum, the maximum or the last valid value is set.
Polarity	**normal** inverted	Activation or deactivation of the inversion of the signal
Short-circuit current	**non-latching** latching	The short circuit can be set to non-latching or latching.

Table 28: Parameters of the DO80….

2.9 AI40...

The AI40... input module is used for connecting 2-wire measuring transducers (active input = feeding / sensor passive) or 4-wire measuring transducers (passive input = not feeding / sensor active).
The setting of parameters, such as for wire-break monitoring, short circuit monitoring, substitute value strategy etc. is carried out by channel and only initiated by the master.
A 14-bit resolution is used, i.e. the analog value of 0...21 mA is digitized to a number between 0 and 16383. For a simpler representation, the digitized value is spread to between 0...21000 and transferred to the host system.

2.9.1 HART® capability

HART®-enabled actuators can be connected to the module. This enables parameter setting via an approved modem directly at the connection level on the backplane.
HART® capability means on the AI40… that it is possible to connect directly to the terminals of the transmitter using an FSK modem. (the relevant burden is inverted in the module.)

The AI40... has the following configuration.

Variant	Description	Cyclic input	Cyclic output
AI40...	Analog input, 4 channels, 0/4..21 mA, active	4 words	-

Table 29: Configuration and cyclic data for AI40...

2.9.2 Configuration and data rates

The AI40... input module operates solely as an input card with an additional status bit for each channel. When a status message is present, the status bit of the corresponding channel is set to 1 in the input word (depending on representation, bit 16 or bit 1). The status bit is set if an error occurs that triggers a diagnostics signal.

The analog value of 0...21 mA is converted to a 15-bit number with a resolution of 1 µA/digit and sent to the host system. Depending on the gateway parameter selected, the status bit incorporated in the process data is included left-justified, right-justified or not at all.

<table>
<tr><th></th><th colspan="16">Data word</th></tr>
<tr><th></th><th>Bit 15</th><th>Bit 14</th><th>Bit 13</th><th>Bit 12</th><th>Bit 11</th><th>Bit 10</th><th>Bit 9</th><th>Bit 8</th><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>MSB</td><td>Status</td><td colspan="15">Bit position of the measured value (0 .. 2100 corresponds to 0 to 21 mA)</td></tr>
<tr><td>LSB</td><td colspan="15">Bit position of the measured value (0 .. 21000 corresponds to 0 to 21 mA</td><td>Status</td></tr>
<tr><td>No status</td><td>-</td><td colspan="15">Bit position of the measured value (0 .. 21000 corresponds to 0 to 21 mA</td></tr>
</table>

Table 30: Data mapping for AI40...

Word	Meaning
1	Channel 1 process value 0/4 – 20 mA in µA
2	Channel 2 process value 0/4 – 20 mA in µA
3	Channel 3 process value 0/4 – 20 mA in µA
4	Channel 4 process value 0/4 – 20 mA in µA

Table 31: Complete data mapping of the module

Parameter	Setting	Description
Range	0..20 mA	The channel works in the range 0…20 mA. Underrange diagnostics is disabled.
	4..20 mA	The channel works in the range 4...20 mA. Overrange and underrange diagnostics according to NAMUR is activated.
Damping	off…29.2 s	Time constant of a PT1 filter.
Short detection	**on** / off	A short circuit of the field device cables is monitored. In the event of a short circuit the channel LED of the module becomes red.
Open line detection	**on** / off	An open line of the field device cables is monitored. In the event of a short circuit the channel LED of the module becomes red.
Failsafe value	**Min. value** / Max. value / Last valid value	Either min value or max value or last valid value can be entered. Max value is 21 mA, min value depends on the selected range: It is 0 mA for a value of 0..20 mA and 3.6 mA for a value of 4..20 mA.
Connection	**active** / passive	This parameter should be set to the used operation mode active or passive. When used as active short circuit and a line break is monitored. When operated as passive module only a line fault can be detected.

Table 32: Parameters for AI40...

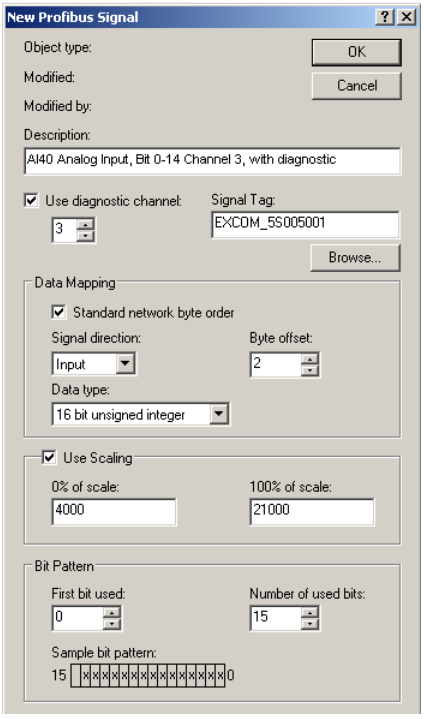


Figure 11: Channel definition of AI40...

2.10 AI41...

The AI41... input module is used for connecting 4-wire measuring transducers (passive input = not feeding / sensor active). All four channels are each provided with a current input for 0 to 21mA and a voltage input for 0 to 10 V. Peripheral devices can be connected as required.

The parameter settings such as for wire-break monitoring, short circuit monitoring, substitute value strategy etc. are carried out by channel and only initiated by the master. A 14-bit resolution is used, i.e. the analog value of 0...21 mA is digitized to a number between 0 and 16383. For a simpler representation, the digitized value is spread to between 0...21000 and transferred to the host system. The value 0...10 V is transferred as a digital value 0...10000

2.10.1 HART® capability

HART®-enabled actuators can be connected to the module. This enables parameter setting via an approved modem directly at the connection level on the backplane. HART® capability means on the AI41… that it is possible to connect directly to the terminals of the transmitter using an FSK modem. (the relevant burden is inverted in the module.)

The AI41... has the following configuration.

Variant	Description	Input data	Output data
AI41...	Analog input, 4 channels, 0/4..20 mA, active/passive	4 words	-

Table 33: Configuration and cyclic data for AI41...

The AI41... module operates solely as an input card with an additional status bit for each channel. When a status message is present, the status bit of the corresponding channel is set to 1 in the input word (depending on representation, bit 16 or bit 1). The status bit is set if an error occurs that triggers a diagnostics signal.

	Data word															
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
MSB	Status	Bit position of the measured value (0 .. 21000 corresponds to 0 to 21 mA)														
LSB	Bit position of the measured value (0 .. 21000 corresponds to 0 to 20 mA															Status
No status	-	Bit position of the measured value (0 .. 21000 corresponds to 0 to 21 mA														
MSB	Status	Bit position of the measured value (0 .. 10000 corresponds to 0 to 10 V)														
LSB	Bit position of the measured value (0 .. 10000 corresponds to 0 to 10 V)															Status
No status	-	Bit position of the measured value (0 .. 10000 corresponds to 0 to 10 V)														

Table 34: Data mapping for AI41...

Word	Meaning
1	Channel 1 process value 0/4 – 20 mA in µA or 0-10V in µV
2	Channel 2 process value 0/4 – 20 mA in µA or 0-10V in µV
3	Channel 3 process value 0/4 – 20 mA in µA or 0-10V in µV
4	Channel 4 process value 0/4 – 20 mA in µA or 0-10V in µV

Table 35: Complete data mapping of the AI41...

Parameter	Setting	Description
line monitoring	off/ **on**	An open line of the field device cables is monitored. In the event of a short circuit the channel LED of the module becomes red.
failsafe value	**min. value** / max. value / last valid value	Either 0 mA or 3.6 mA or 22 mA or last valid value can be entered. The values 0 mA and 3.6 mA value depend on the selected range: It is 0 mA for a value of 0...20 mA and 3.6 mA for a value of 4..20 mA.
range	0…10 V/ **2…10 V/** 0…20 mA/ 4…20 mA	The channel works in the range 0…20mA or 4…20mA. Substitute values depend on the selected range; 0 to 20 mA →min: 0 mA, max: 22 mA 4 to 20 mA→min: 3.6 mA, max: 22 mA 0 to 10 V → min: 0 V, max: 10.5 V 2 to 10 V →min: 1.8 V, max: 10.5
filter (PT1)	off/ **0.1 s**/ 2.6 s/ 29.2 s	Time constant of a PT1 filter.

Table 36: Parameters for AI41...

2.11 AI43...

The AI43... analog input module is used for connecting potentiometers in 3-wire or 4-wire circuits. When using 3-wire potentiometers, a jumper must be set at the terminals on the backplane. Resistance measurements, i.e. the evaluation of potentiometers with a 2-wire connection, are not possible.
The module has four channels for scanning 3-wire or 4-wire potentiometers. The channels are galvanically isolated from each other and from the power supply and also the internal bus.
Each potentiometer input is monitored for wire breaks. Any interruption in a single connection line, as well as any combination of breaks on the four connection lines of an input are reliably detected. A short circuit monitoring is not carried out. After a cable fault has occurred, the set substitute value is output immediately and the Invalid bit of the output value is set. This state is retained until the measured values are valid.
A 14-bit resolution is used. For a simpler representation, 0...100% is converted to the digitized value 0...10000 (depending on the set measuring range) and transmitted to the host system.

The AI43... has the following configuration.

Variant	Description	Cyclic input	Cyclic output
AI43...	Analog input, 4 K, potentiometers	2 bytes	-

Table 37: Configuration and cyclic data for AI43...

2.11.1 Configuration and data rates

The AI43... module operates solely as an input card with an additional status bit for each channel. When a status message is present, the status bit of the corresponding channel is set to 1 in the input word (depending on representation, bit 16 or bit 1). The status bit is set if an error occurs that triggers a diagnostics signal.
The analog value of 0...100 % is converted to a 15-bit number with a resolution of 0.1% digit and sent to the host system. Depending on the gateway parameter selected, the status bit incorporated in the process data is included left-justified, right-justified or not at all.

	Data word															
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
MSB	Status	Bit position of the measured value (0 ... 10000 corresponds to 0 to 100%)														
LSB	Bit position of the measured value (0 … 10000 corresponds to 0 to 100%)															Status
No status	-	Bit position of the measured value (0 … 10000 corresponds to 0 to 100%)														

Table 38: Data mapping for AI43...

Word	Meaning
1	Channel 1 process value 0 … 10000 corresponds to 0 to 100%
2	Channel 2 process value 0 … 10000 corresponds to 0 to 100 %
3	Channel 3 process value 0 … 10000 corresponds to 0 to 100 %
4	Channel 4 process value 0 … 10000 corresponds to 0 to 100 %

Table 39: Complete data mapping of the AI43...

Parameter	Setting	Description
Damping	off **0,1 s** 2,6 s 29,2 s	Time constant of a PT1 filter. 100ms is the default value.
Open line detection	**on** / off	An open line of the field device cable is monitored. In the event of an open circuit the channel LED of the module becomes red.
Failsafe value	**min. value** / max value / last valid/ value"	Either min value or max value or last valid value can be entered.

Table 40: Parameters for AI43...

2.12 AO40...

The AO40... output module is used to connect intrinsically safe actuators such as control valves or process displays. A 13-bit resolution is used, i.e. the analog value of 0...21 mA is represented as a number between 0 and 8191. The host system operates with the value range from 0...21000 to ensure simpler handling. This untreated value is reduced by the AO40A... to the 13-bit resolution.

2.12.1 HART® capability

HART®-enabled actuators can be connected to the module. This enables parameter setting via an approved modem directly at the connection level on the backplane. HART® capability means on the AO40… that it is possible to connect directly to the terminals of the transmitter using an FSK modem. (the relevant burden is inverted in the module.)

2.12.2 Configuration and data rates

The AO40... module operates solely as an output card. The analog value of 0...21 mA is converted to a 15-bit number with a resolution of 1 µA/digit and sent to the host system.

Variant	Description	Input data	Output data
AO40...	Analog output, 4 channels, 0/4..21 mA	4 words	-

Table 41: Configuration and cyclic data for AI40...

The individual bits of the output word, e.g. the first channel, are assigned according to the following table:

Data word															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Bit position of the measured value (0 .. 21000 corresponds to 0 to 21 mA)															

Table 42: Data mapping for AO40...

Word	Meaning
1	Channel 1 process value 0/4 – 20 mA in µA
2	Channel 1 process value 0/4 – 20 mA in µA
3	Channel 1 process value 0/4 – 20 mA in µA
4	Channel 1 process value 0/4 – 20 mA in µA

Table 43: Complete data mapping of the AO40...

Parameter	Setting	Description
short circuit detection	**on** / off	A short circuit of the field cables is monitored. In the event of a short circuit the channel LED of the module becomes red.
open line detection	**on** / off	An open line of the field cables is monitored. In the event of a short circuit the channel LED of the module becomes red.
range	0..20 mA / **4..20 mA**	The channel works in the range 0…20 mA or 4-20 mA. 0 to 20 mA →min: 0 mA, max: 22 mA 4 to 20 mA→min: 3.6 mA, max: 22 mA 0 to 10 V → min: 0 V, max: 10.5 V 2 to 10 V →min: 1.8 V, max: 10.5
failsafe value	**Min. value** / Max. value / Last valid value	Either min value or max value or last valid value can be entered. Max value is 22 mA, min value depends on the selected range: It is 0 mA for a value of 0...20 mA and 3.6 mA for a value of 4…20 mA.

Table 44: Parameters for AO40...

2.13 AIH40...

The AIH40... analog input modules of the *excom*® system are intrinsically safe modules for connecting up to four transmitters. The AIH40... input module is used for connecting 2-wire measuring transducers (active input = feeding / sensor passive).

NOTE
The inputs are not galvanically isolated from each other. When connecting the field devices, bear in mind that all inputs are connected to a common chassis potential.

A 14-bit resolution is used, i.e. the analog value of 0...21 mA is digitized to a number between 0 and 16383. For a simpler representation, the digitized value is converted to a resolution of 1 µA/digit and transferred to the host system.

2.13.1 HART® capability of the modules

HART® enabled sensors which communicate directly with the integrated HART® controller can be connected to the module. Up to 8 HART® variables (maximum 4 per channel) can be read via the cyclical user data traffic of the PROFIBUS-DP network. The bidirectional variable exchange between the host system and HART® transmitter is implemented with PROFIBUS-DPV1 services.

2.13.2 Configuration and data rates

The AIH40... module operates solely as an input card with an additional status bit for each channel. When a status message is present, the status bit of the corresponding channel is set to 1 in the input byte (Bit 16). The status bit is set if an error occurs that triggers a diagnostics signal. Different data rates are possible, depending on the configuration.

The following configurations are possible:

Variant	Description	Input data	Output data
AIH40...	Analog input, 4 channels, 0/4..20 mA, active HART®	4 words	-
AIH40... 1H	Analog input, 4 channels, 4..20 mA, active HART®, 1 cyclic HART® variable	6 words	-
AIH40... 4H	Analog input, 4 channels, 4..20 mA, active HART®, 4 cyclic HART® variables	12 words	-
AIH40... 8H	Analog input, 4 channels, 4..20 mA, active HART®, 8 cyclic HART® variables	20 words	-

Table 45: Configuration and cyclic data for AIH40...

	Data word															
	Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 0
MSB	Status	Bit position of the measured value (0 ... 20000 corresponds to 0 to 20mA)														
LSB	Bit position of the measured value (0 … 20000 corresponds to 0 to 20mA)															Status
No status	-	Bit position of the measured value (0 … 20000 corresponds to 0 to 20mA)														

Table 46: Data mapping for AIH40...

Note: In the event of an error, the module supplies an error message via the status bit of the data telegram, depending on the measuring range set (0 to 20 mA, 4 to 20 mA).

Word	Meaning	
1	Channel 1 process value 0/4 – 20 mA in µA	
2	Channel 2 process value 0/4 – 20 mA in µA	
3	Channel 3 process value 0/4 – 20 mA in µA	
4	Channel 4 process value 0/4 – 20 mA in µA	
5 – 6	1st HART® side variable	AIH40... 1H
7 – 8	2nd HART® side variable	AIH40... 4H
9 – 10	3rd HART® side variable	
11 – 12	4th HART® side variable	
13 – 14	5th HART® side variable	AIH40... 8H
15 – 16	6th HART® side variable	
17 – 18	7th HART® side variable	
19 – 20	8th HART® side variable	

Table 47: Data mapping from the complete module

Parameter	Setting	Description
short circuit detection	**On** /Off	Short-circuit monitoring is set on a channel basis
Open line detection	**On** /Off	Wire break monitoring is set on a channel basis
failsafe mode	**Min. value** / Max. value / Last valid value	**min. value:** 0 mA or 3.6 mA **max. value:** 21 mA **last valid value:** The last valid measurement value. The substitute value "min value" depends on the selected measurement range: It is 0 mA for a value of 0...20 mA and 3.6 mA for a value of 4...20 mA. Substitute value produced in the event of a module or gateway fault.
HART® status / range	0…20mA / off / 4…20mA / **on / 4…20mA**	**0…20mA:** The measurement range is 0…20mA **off / 4…20mA:** The HART® status error from the field device is suppressed. The measurement range is 4...20 mA. **on / 4…20mA:** The HART® status error from the field device is not suppressed. The measurement range is 4...20mA When error code 31 is sent by the HART® device, the HART® values are not valid - there is an error in the HART® communication. The channel works in the range of 0…20 mA or 4…20 mA. The HART® status polling, cyclic HART® variables and non-cyclic HART® communication via a HART® DTM requires a range setting of 4…20 mA. If select additional HART® variables, e.g. "AIH40... 4H" and 8H, then the range is fixed on 4…20mA. There can be several reasons for the HART® status flag. It is the diagnostic channel and of a HART® device. For example, if the measuring range of a device is changed, the change flag appears and the HART® controller of the related excom module produces a channel diagnostic. The excom send two different HART® error codes to the DCS. The error code 30 (HART® status error) and error code 31 (HART® error). When error code 30 will send by the HART® device, the HART® variables are valid - only there is information that the status of the device have an error (or is changed by an parameterization tool, e.g. FDT/DTM communication).

Filter (PT1)	**off** / 0.1s / 2.6s / 29.2 s	Software filter for average value formation of the input signals
HART® variable	Primary / **secondary 1** / secondary 2 / secondary 3 / secondary 4	Determination of the HART® side variables which should be read from a HART® field device
HART® var. of channel	**ch. 1** / ch. 2 / ch. 3 / ch. 4	Definition of the AIH40... input channel to which the HART® field device is connected
Ch.1… ch.4 : SV1… SV4	**off** / on	Activation of the HART® side variable SV1…SV4 of the AIH40... input channel K1… K4 to which the HART® field device is connected

Table 48: Parameters for AIH40...

2.14 AIH41...

The analog input modules of the *excom*® system are intrinsically safe modules for connecting up to four transmitters. The AIH41... input module is used for connecting 4-wire measuring transducers (passive input = not feeding / sensor active).

NOTE
The inputs are not galvanically isolated from each other. When connecting the field devices bear in mind that all inputs are connected to a common chassis potential.

A 14-bit resolution is used, i.e. the analog value of 0...21 mA is digitized to a number between 0 and 16383. For a simpler representation, the digitized value is converted to a resolution of 1 µA/digit and transferred to the host system.

2.14.1 HART® capability of the modules

HART® enabled sensors which communicate directly with the integrated HART® controller can be connected to the module. Up to 8 HART® variables (maximum 4 per channel) can be read via the cyclical user data traffic of the PROFIBUS-DP network. The bidirectional variable exchange between the host system and HART® transmitter is implemented with PROFIBUS-DPV1 services.

2.14.2 Configuration and data rates

The AIH41... module operates solely as an input card with an additional status bit for each channel. When a status message is present, the status bit of the corresponding channel is set to 1 in the input byte (Bit 16). The status bit is set if an error occurs that triggers a diagnostics signal.

Different data rates are possible, depending on the configuration.

The following configurations are possible:

Variant	Description	Cyclic input	Cyclic output
AIH41...	Analog input, 4 channels, 0/4…20 mA, passive HART®	4 words	-
AIH41... 1H	Analog input, 4 channels, 4…20 mA, passive HART®, 1 cyclic HART® variable	6 words	-
AIH41... 4H	Analog input, 4 channels, 4…20 mA, passive HART®, 4 cyclic HART® variables	12 words	-
AIH41... 8H	Analog input, 4 channels, 4…20 mA, passive HART®, 8 cyclic HART® variables	20 words	-

Table 49: Configuration and cyclic data for AIH41...

The individual bits of the input word, e.g. the first channel, are assigned according to the following table:

	Data word															
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
MSB	Status	Bit position of the measured value (0 ... 20000 corresponds to 0 to 20mA)														
LSB	Bit position of the measured value (0 … 20000 corresponds to 0 to 20mA)															Status
No status	-	Bit position of the measured value (0 … 20000 corresponds to 0 to 20mA)														

Table 50: Data mapping for AIH41...

Note
In the event of an error, the module supplies an error message via the status bit of the data telegram, depending on the measuring range set (0 to 20 mA, 4 to 20 mA).

Word	Meaning	
1	Channel 1 process value 0/4 – 20 mA in µA	
2	Channel 2 process value 0/4 – 20 mA in µA	
3	Channel 3 process value 0/4 – 20 mA in µA	
4	Channel 4 process value 0/4 – 20 mA in µA	
5 – 6	1st HART® side variable	AIH41... 1H
7 – 8	2nd HART® side variable	AIH41... 4H
9 – 10	3rd HART® side variable	
11 – 12	4th HART® side variable	
13 – 14	5th HART® side variable	AIH41... 8H
15 – 16	6th HART® side variable	
17 – 18	7th HART® side variable	
19 – 20	8th HART® side variable	

Table 51: Data mapping from the complete module

Parameter	Setting	Description
Line monitoring	**On** / Off	Short-circuit or line break monitoring is set on a channel basis
Failsafe mode	**Min. value** / Max. value / Last valid value	**min. value**: 0 mA or 3.6 mA max. value: 21 mA **last valid value:** The last valid measurement value. The substitute value “min value” is depend on the selected measurement range: It is 0 mA for a value of 0...20 mA and 3.6 mA for a value of 4...20 mA. Substitute value produced in the event of a module or gateway fault
HART® status / range	0…20 mA / off / 4…20mA **on / 4…20mA**	0…20mA: The measurement range is 0…20mA off / 4…20mA: The HART® status error from the field device is suppressed. The measurement range is 4...20mA. on / 4…20mA: The HART® status error from the field device is not suppressed. The measurement range is 4...20 mA. The channel works in the range 0…20 mA or 4…20 mA. The HART® status polling, cyclic HART® variables and non-cyclic HART® communication via a HART® DTM requires a range setting of 4…20 mA. If select additional HART® variables, e.g. “AIH40... 1H”, then the range is fixed on 4…20 mA. There can be several reasons for the HART® status flag. It is the diagnostic channel and of a HART® device. For example, if the measuring range of a device is changed, the change flag appears and the HART® controller of the related excom module produces a channel diagnostic. The excom send two different HART® error codes to the DCS. The error code 30 (HART® status error) and error code 31 (HART® error). When error code 30 will send by the HART® device, the HART® variables are valid - only there is information that the status of the device have an error (or is changed by an parameterization tool, e.g. FDT/DTM communication). When error code 31 is sent by the HART® device, the HART® values are not valid - there is an error in the HART® communication.
Filter (PT1)	**off** / 0.1 s / 2.6 s / 29.2 s	Software filter for average value formation of the input signals
HART® variable	Primary / **secondary 1** / secondary 2 / secondary 3 / secondary 4	Determination of the HART® side variables which should be read from a HART® field device

HART® var. of channel	**ch. 1** / ch. 2 / ch. 3 / ch. 4	Definition of the AIH40... input channel to which the HART® field device is connected
Ch.1… ch.4 : SV1… SV4	**off** / on	Activation of the HART® side variable SV1…SV4 of the AIH40... input channel K1… K4 to which the HART® field device is connected

Table 52: Parameters for AIH41...

2.15 AOH40...

The AOH40... output module is used to connect intrinsically safe actuators such as valves or process displays.

NOTE
The channels are not galvanically isolated from each other. All outputs are connected to a common chassis potential.

2.15.1 HART® capability

HART®-enabled actuators can be connected to the module. The actuators then communicate directly with the integrated HART® controller integrated in the module.

2.15.2 Configuration and data rates

The AOH40... module operates solely as an output card. The analog value of 0...21 mA is converted to a 15-bit number with a resolution of 1 µA/digit and sent to the host system. Different data rates are possible, depending on the configuration.

The following configurations are possible:

Variant	Description	Cyclic input	Cyclic output
AOH41...	Analog input, 4 channels, 0/4..20 mA, passive HART®	-	4 words
AOH41... 1H	Analog input, 4 channels, 4..20 mA, passive HART®, 1 cyclic HART®° variable	2 words	4 words
AOH41... 4H	Analog input, 4 channels, 4..20 mA, passive HART®, 4 cyclic HART®° variables	8 words	4 words
AOH41... 8H	Analog input, 4 channels, 4..20 mA, passive HART®, 8 cyclic HART®° variables	16 words	4 words

Table 53: Configuration and Cyclic Data for AOH40...

The individual bits of the output word, e.g. the first channel, are assigned according to the following table:

	Data word															
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
MSB	Status	Bit position of the measured value (0 ... 20000 corresponds to 0 to 20 mA)														
LSB	Bit position of the measured value (0 … 20000 corresponds to 0 to 20 mA)															Status
No status	-	Bit position of the measured value (0 … 20000 corresponds to 0 to 20 mA)														

Table 54: Data mapping for AOH40...

Word Output	Word Input	Meaning	
1	-	Channel 1 process value 0/4 – 20 mA in µA	
2	-	Channel 2 process value 0/4 – 20 mA in µA	
3	-	Channel 3 process value 0/4 – 20 mA in µA	
4	-	Channel 4 process value 0/4 – 20 mA in µA	
	1 - 2	1st HART® side variable	AIH41... 1H
	2 – 3	2nd HART® side variable	AIH41... 4H
	4 – 5	3rd HART® side variable	
	6 – 7	4th HART® side variable	
	8 – 9	5th HART® side variable	AIH41... 8H
	10 - 11	6th HART® side variable	
	12 – 13	7th HART® side variable	
	14 - 15	8th HART® side variable	

Table 55: Complete data mapping

Parameter	Setting	Description
Short-circuit monitoring	**On** / Off	Short-circuit monitoring is set on a channel basis
Wire break monitoring	**On** / Off	Wire break monitoring is set on a channel basis
Substitute value strategy	**Min. value** Max. value Last valid value	Either min value or max value or last valid value can be entered. Max value is 22 mA, min value depends on the selected range: It is 0 mA for a value of 0...20 mA and 3.6 mA for a value of 4…20 mA.
HART® status / measuring range	0…20 mA / Off / 4…20 mA **On / 4…20 mA**	When error code 30 will send by the HART® device, the HART® variables are valid - only there is information that the status of the device have an error (or is changed by an parameterization tool, e.g. FDT/DTM communication). **0…20mA:** The measurement range is 0…20 mA **off / 4…20mA:** The HART® status error from the field device is suppressed. The measurement range is 4...20 mA. **on / 4…20mA:** The HART® status error from the field device is not suppressed. The measurement range is 4...20 mA When error code 31 is sent by the HART® device, the HART® values are not valid - there is an error in the HART® communication. The channel works in the range of 0…20 mA or 4…20 mA. The HART® status polling, cyclic HART® variables and non-cyclic HART® communication via a HART® DTM requires a range setting of 4…20 mA. If select additional HART® variables, e.g. “AOH40... 4H” and 8H, then the range is fixed on 4…20mA. There can be several reasons for the HART® status flag. It is the diagnostic channel and of a HART® device. For example, if the measuring range of a device is changed, the change flag appears and the HART® controller of the related excom module produces a channel diagnostic. The excom send two different HART® error codes to the DCS. The error code 30 (HART® status error) and error code 31 (HART® error). When error code 30 will send by the HART® device, the HART® variables are valid - only there is information that the status of the device have an error (or is changed by an parameterization tool, e.g. FDT/DTM communication).
HART® variable	Primary, **secondary 1**, secondary 2, secondary 3, secondary 4	Determination of the HART® side variables which should be read from a HART® field device

HART® variable of channel	**Channel 1**, channel 2, channel 3, channel 4	Definition of the AIH40... input channel to which the HART® field device is connected
K1… K4 : SV1… SV4	**Off** / On	Activation of the HART® side variable SV1…SV4 of the AOH40... input channel K1… K4 to which the HART® field device is connected

Table 56: Parameters for the AOH40...

2.16 TI40...

The TI40... temperature module is used for connecting 2-, 3- and 4-wire type Pt100, Pt200, Pt400, Pt1000, Ni100 and Cu100 resistance thermometers as well as for connecting type B, E, D, J, K, L, N, R, S, T and U thermocouples. The module can also be used for measuring extra low voltages (-75...+75 mV, -1,2...+1,2 V) and for resistance measurements (0...30 Ω, 0...300 Ω, 0...3 kΩ).

2.16.1 Cable compensation and cold junction compensation

Cable compensation increases the measuring accuracy with resistance thermometers. Measuring with resistance thermometers is possible if the **TI40... R** module type was configured.
The cable compensation for 2-wire temperature resistors can be carried out by entering fixed resistance values when the parameters are set. The cold junction compensation increases the measuring accuracy with thermocouples. Measuring with thermocouples is possible if the **TI40... T** module type was configured. The type of cold junction compensation can be defined with the parameter for all channels.

2.16.2 Configuration and data rates

The TI40... module operates solely as an input card with an additional status bit for each channel. When a status message is present, the status bit of the corresponding channel is set to 1 in the input byte (Bit 16). The status bit is set if an error occurs that triggers a diagnostics signal.
A 16-bit resolution is used, i.e. the analog value is represented as a number between 0 and 65536. The temperature value is displayed as a value in units of 1/10 Kelvin. An offset of 273.15 must be included for the conversion to °C.

Variant	Description	Input data	Output data
TI40... R	Analog input, 4 channels, active, Pt100, Pt200, Pt400, Pt1000, Ni100 and Cu100, 0...3 kΩ, 2-wire/3-wire/4-wire, HART®	2 bytes	-
TI40... T	Analog input, 4 channels, active, Thermocouple type B, E, D, J, K, L, N, R, S, T U and mV	2 bytes	-

Table 57: Configuration and cyclic data for TI40...

The individual bits of the input word, e.g. the first channel, are assigned according to the following table:

	Data word															
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
MSB	Status	Bit position of the measured value (0 .. 30000 corresponds to 0 to 3000 K)														
LSB	Bit position of the measured value (0 .. 30000 corresponds to 0 to 3000 K)															Status
No status	-	Bit position of the measured value (0 .. 30000 corresponds to 0 to 3000 K)														

Table 58: Data mapping

Parameter	Setting	Description
Sensor type (values for TI4 R)	**PT100 (IEC 751)** PT200 (IEC 751) PT400 (IEC 751) PT1000 (IEC 751) PT100 (JIS) PT1000 (JIS) PT100 (SAMA) PT1000 (SAMA) PT100 (Ghost) NI100 CU100 0…30 Ohm 0…300 Ohm 0…3 kOhm	The sensor characteristic used for linearization with thermo resistors.
Sensor type (values for TI4 T)	**Type B** Type E Type J Type K Type L Type N Type R Type S Type T Type U Type C Type D Type L (Ghost) U [-75..+75mV] U [-1.2..+1.2V]	The sensor characteristic used for linearization with thermo couples.
connection (only available for variant TI4 R)	2 wire, 0...7.5 Ohms	The sensor is connected with 2 wires. The wire resistance is between 0 and 7.5 Ohms.
	2 wire, 8...15 Ohms	The sensor is connected with 2 wires. The wire resistance is between 8 and 15 Ohms.
	3 wire **4 wire**	The sensor is connected with 3 or 4 wires.
cold junction temp. (only available for variant TI4 T)	no CJC internal CJC **PT100 on terminal** external CJC	The type of compensation that should be used with thermocouples.
Damping	**off**...25 s	Time constant of a PT1 block. If the channel is used for HART® communication this parameter should be adjusted to 100 ms.
Short circuit detection (only available for variant TI4 R)	Off / **on**	A short circuit of the field cables is monitored. In the event of a short circuit the channel LED of the module becomes red.
Open line	Off /**on**	An open line of the field cables is monitored. In the event of a

detection		short circuit the channel LED of the module becomes red.
Failsafe value	**Min. value**/ max. value/ last valid value	Either min value or max value or last valid value can be entered. Min value is 0 K (-273.15 °C), Max value is 3276.70 K (3003.55 °C).
fix junc temp.	**0**…70C°	Comparison temperature detected by external thermocouple

Table 59: Parameters of TI40…

2.17 TI41...

The TI40... temperature module is used for connecting 2-, 3- and 4-wire type Pt100, Ni100 and Cu100 resistance thermometers.

2.17.1 Cable compensation

Cable compensation increases the measuring accuracy with resistance thermometers. The cable compensation for 2-wire temperature resistors can be carried out by entering fixed resistance values when the parameters are set.

2.17.2 Configuration and data rates

The TI40... module operates solely as an input card with an additional status bit for each channel. When a status message is present, the status bit of the corresponding channel is set to 1 in the input byte (Bit 16). The status bit is set if an error occurs that triggers a diagnostics signal.
A 16-bit resolution is used, i.e. the analog value is represented as a number between 0 and 65536. The temperature value is displayed as a value in units of 1/10 Kelvin. An offset of 273.15 must be included for the conversion to °C.

Variant	Description	Input data	Output data
TI41... R	Analog input, 4 channels, active, Pt100, Ni100 and Cu100, 2-wire/3-wire/4-wire	2 bytes	-

Table 60: Configuration and cyclic data for TI40...

The individual bits of the input word, e.g. the first channel, are assigned according to the following table:

	Data word															
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
MSB	Status	Bit position of the measured value (0 .. 30000 corresponds to 0 to 3000 K)														
LSB	Bit position of the measured value (0 .. 30000 corresponds to 0 to 3000 K)															Status
No status	-	Bit position of the measured value (0 .. 30000 corresponds to 0 to 3000 K)														

Table 61: Data mapping

Parameter	Setting	Description
Sensor type	**Pt100 (IEC 751)** Pt100 (JIS) Pt100 (SAMA) Pt100 (Ghost) Ni100 Cu100	The sensor characteristic used for linearization with thermo resistors.
connection (only available for variant TI4 R)	2 wire, 0...7.5 Ohms	The sensor is connected with 2 wires. The wire resistance is between 0 and 7.5 Ohms.
	2 wire, 8...15 Ohms	The sensor is connected with 2 wires. The wire resistance is between 8 and 15 Ohms.
	3 wire **4 wire**	The sensor is connected with 3 or 4 wires.
Short circuit detection	Off / **on**	A short circuit of the field cables is monitored. In the event of a short circuit the channel LED of the module becomes red.
Open line detection	Off /**on**	An open line of the field cables is monitored. In the event of a short circuit the channel LED of the module becomes red.
Failsafe value	**Min. value**/ max. value/ last valid value	Either min value or max value or last valid value can be entered. Min value is 0 K (-273.15 °C), Max value is 3276.70 K (3003.55 °C).

Table 62: Parameters of TI41…

2.18 DO60-R...

The 6-channel relay module DO60R-N is used to connect actuators such as valves or display elements. The outputs are designed as dead relay contacts for higher switching capacities and can be configured as NO and NC contacts:

2 x changeover contacts (Channel 1 and 2) and 4 x NO contacts (Channel 3 to 6)

Note
All channels are galvanically isolated from each other.

Channels 3/4 and 5/6 can be switched as changeover contacts via the PROFIBUS-DP master. Only an external bridge on the terminals is needed for this. One actuator can be connected to each channel.

2.18.1 Configuration and data volume

The output module DO60R-N operates as a true output card. Compared to the other digital cards, the module does not have an additional status bit. The 6 channels are assigned to Bit 0...5 of the output byte. Bits 6...7 are not assigned.

Variant	Description	Input data	Output data
DO60-R...	Digital output, 6 channels, passive	-	1 byte

Table 63: Configuration and data volume of DO60-R...

Data byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

Table 64: Data mapping of DO60-R...

Parameter	Setting	Description
Failsafe value	**Min. value**/ max. value/ last valid value	Either min value or max value or last valid value can be entered.
Polarity	**normal /** inverted	Activation or deactivation of the signal inversion.
Relay configuration Channel 3 + 4 or rather 5 + 6	**2 x NO contacts** 1 x changeover contact	The outputs, as dead relay contacts, can be configured as NO or changeover contacts.

Table 65: Parameters of DO60-R…

3 Example for integration of excom® in DeltaV

In the first step a new PROFIBUS device is added in DeltaV Explorer. This requires the prior installation of the GSD files.

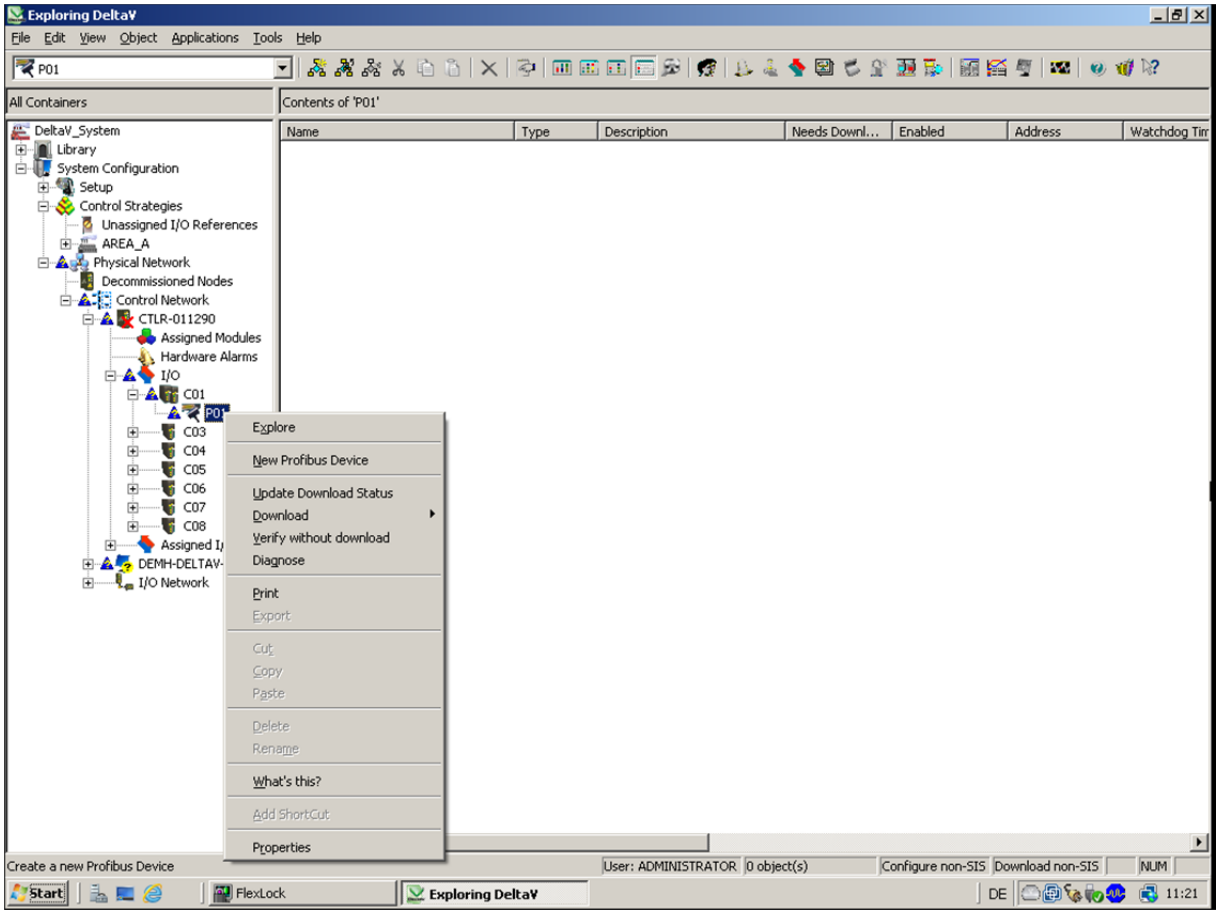


Figure 12: step 1

In the second step select a suitable TURCK device.

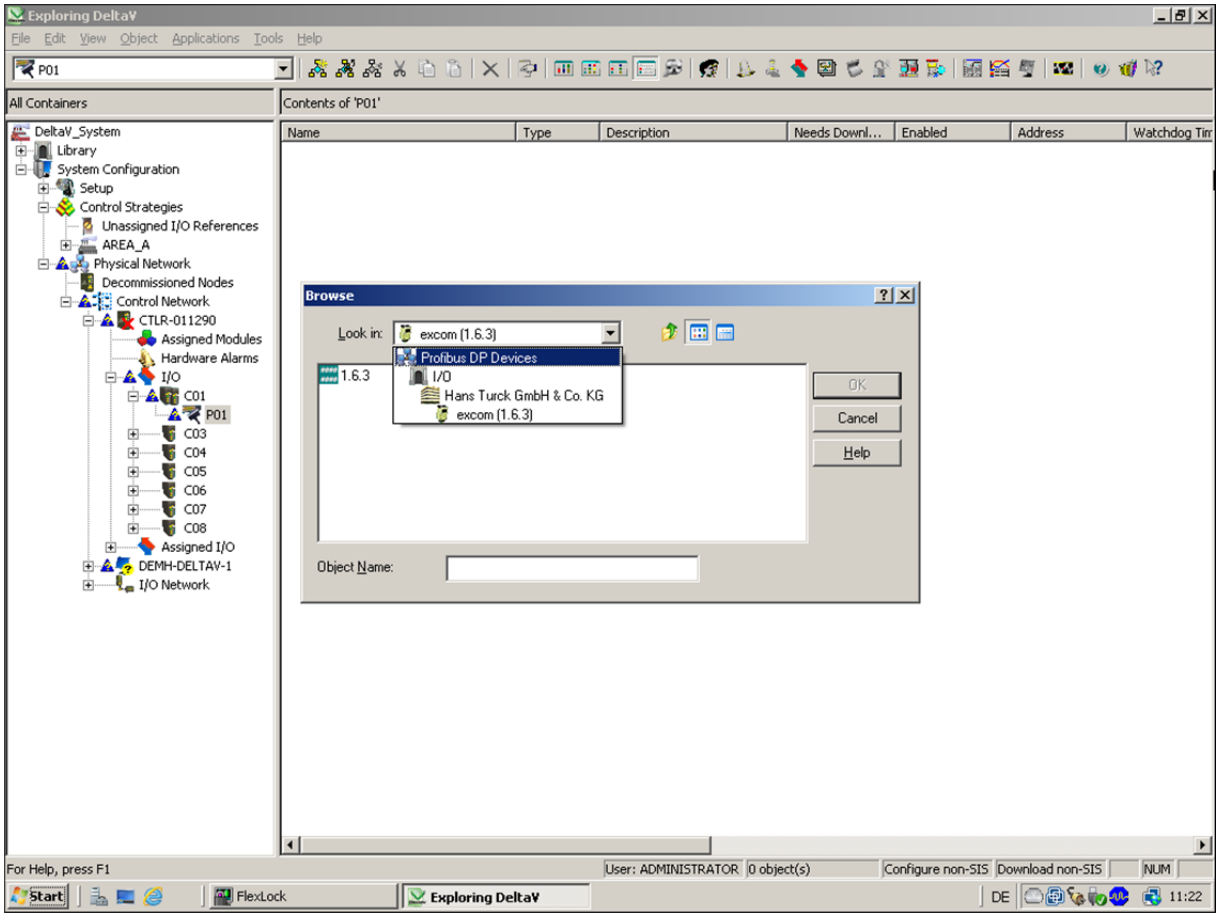


Figure 13: step 2

In step 3 the device is provided with a unique name.

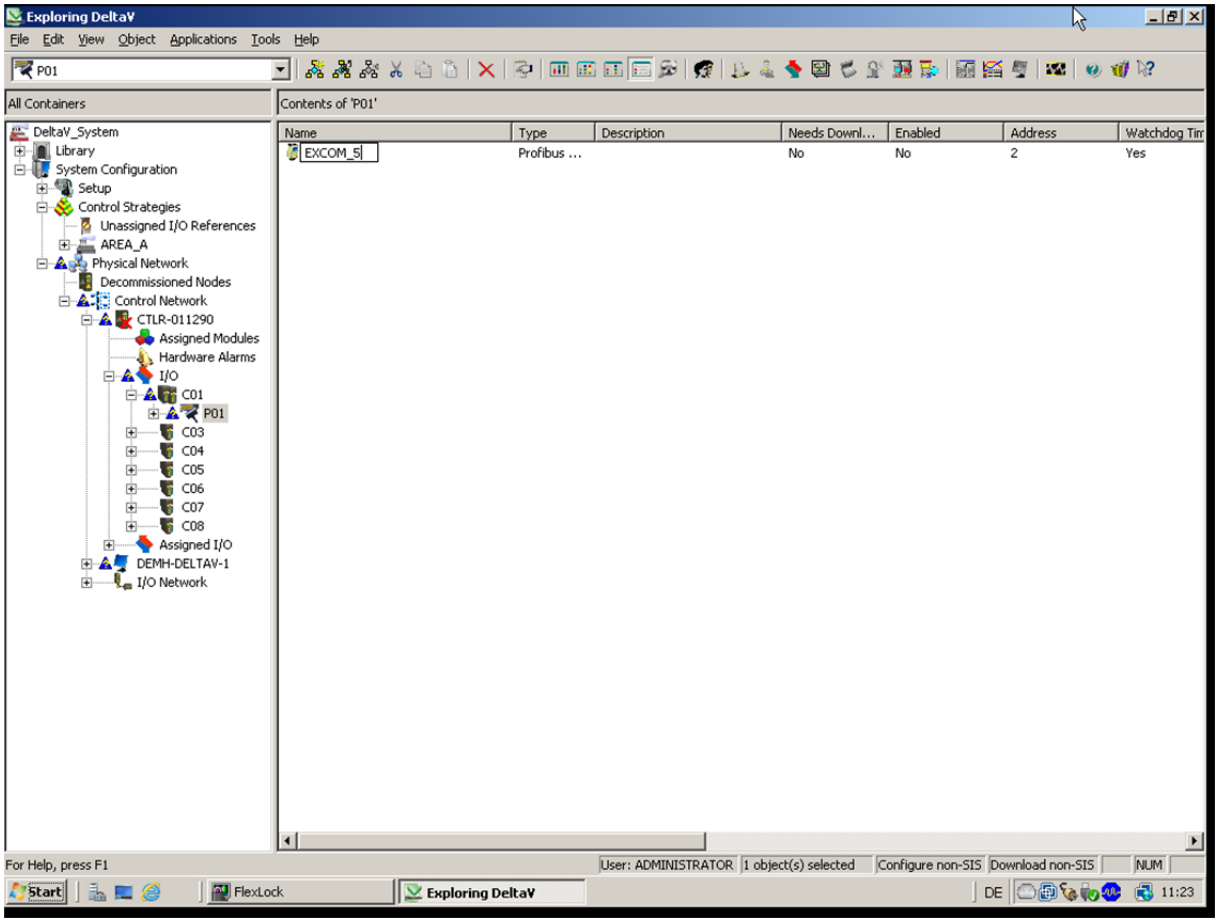


Figure 14: step 3

The modules are then added.

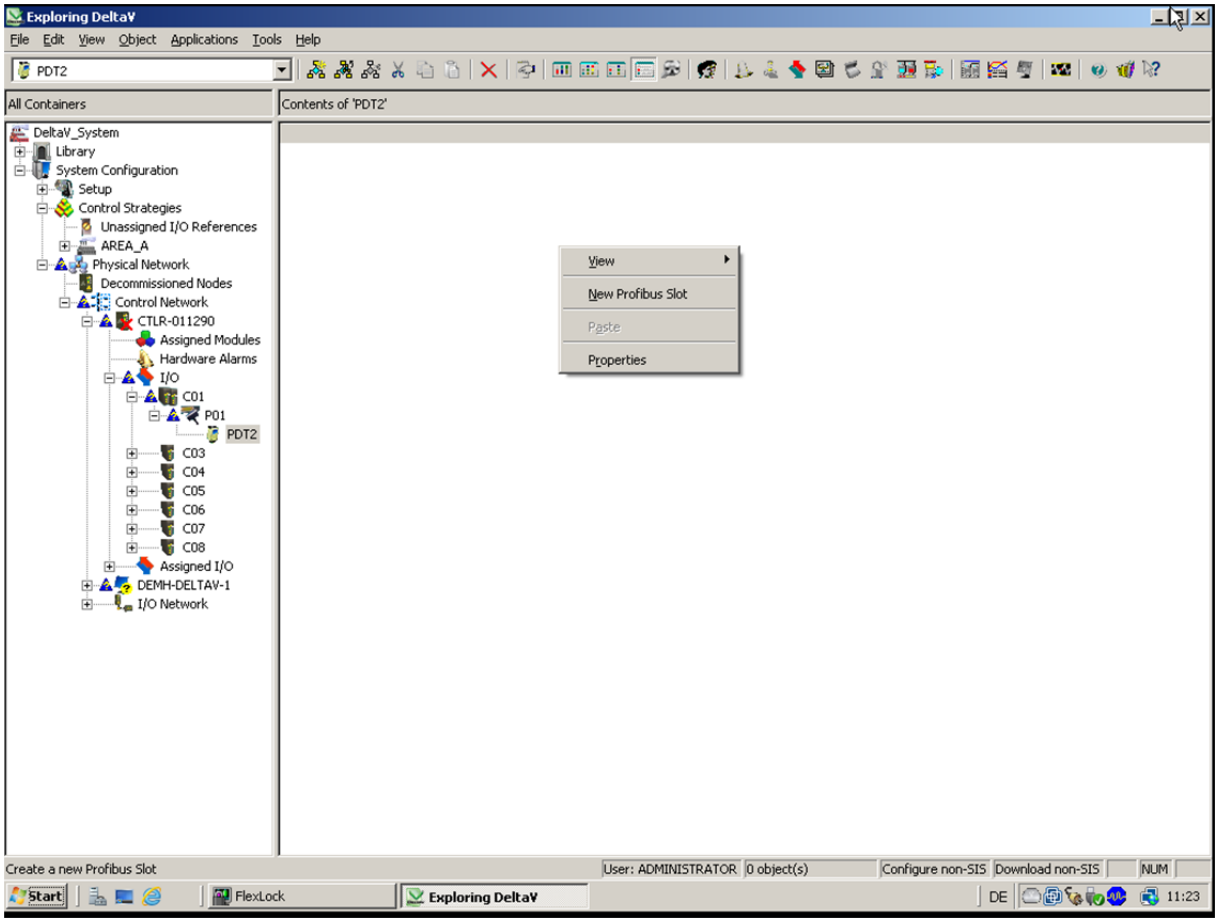


Figure 15: step 4

In step 5 and 6 the devices are fitted in the rack in a fixed order.

Only one gateway must be added here.

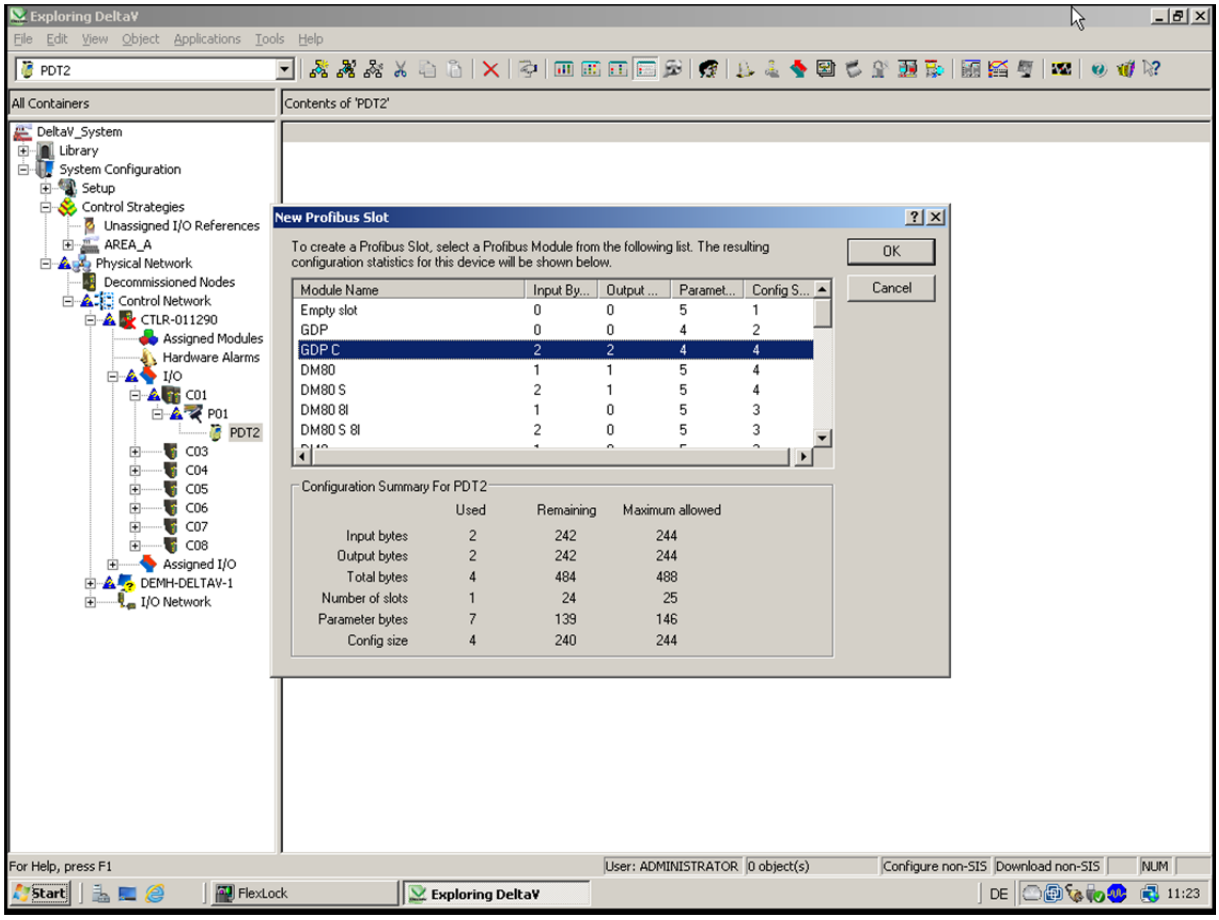
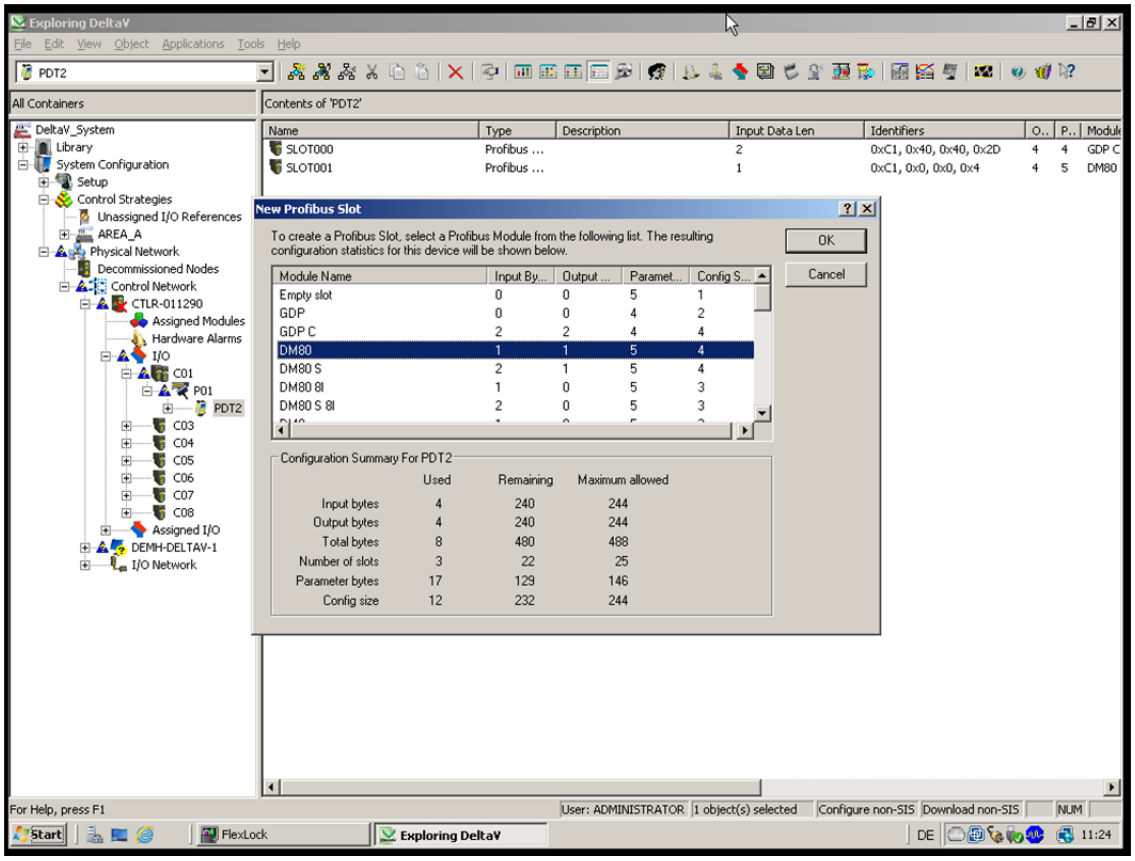


Figure 16: step 5



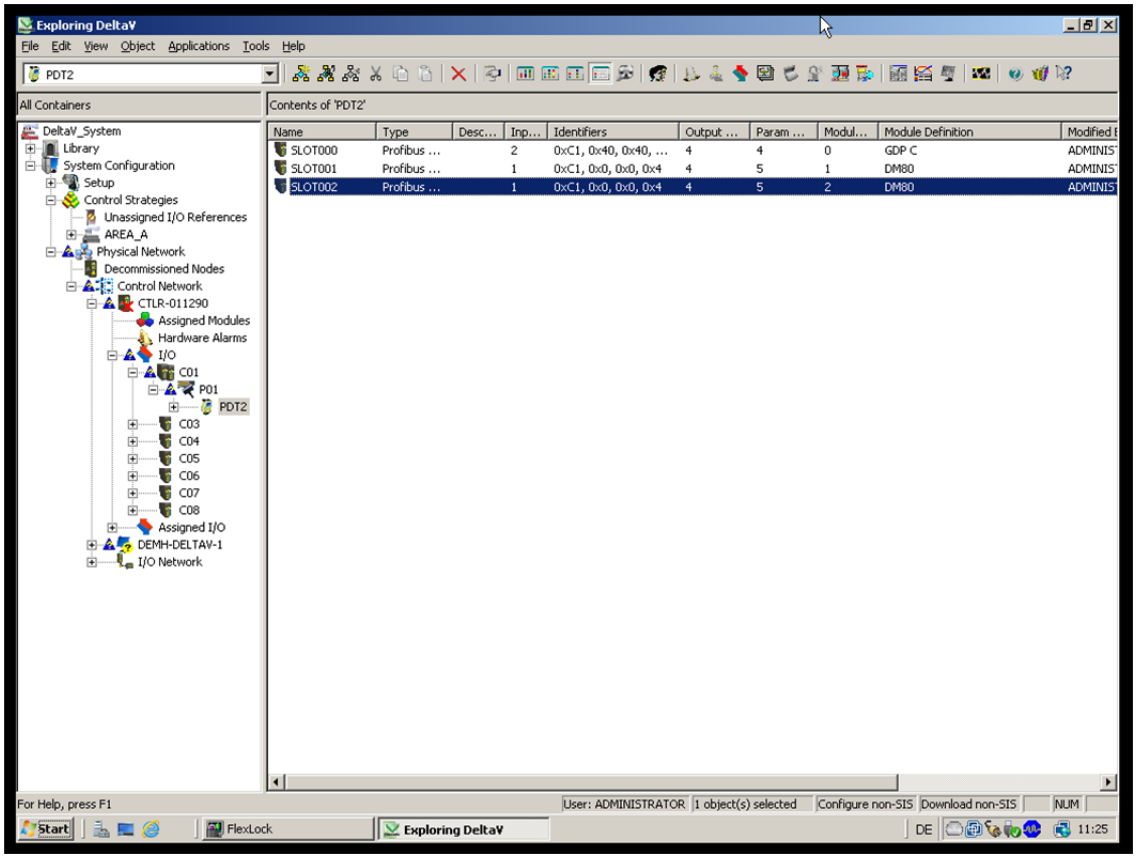


Figure 17: step 6

The module parameters are then set.

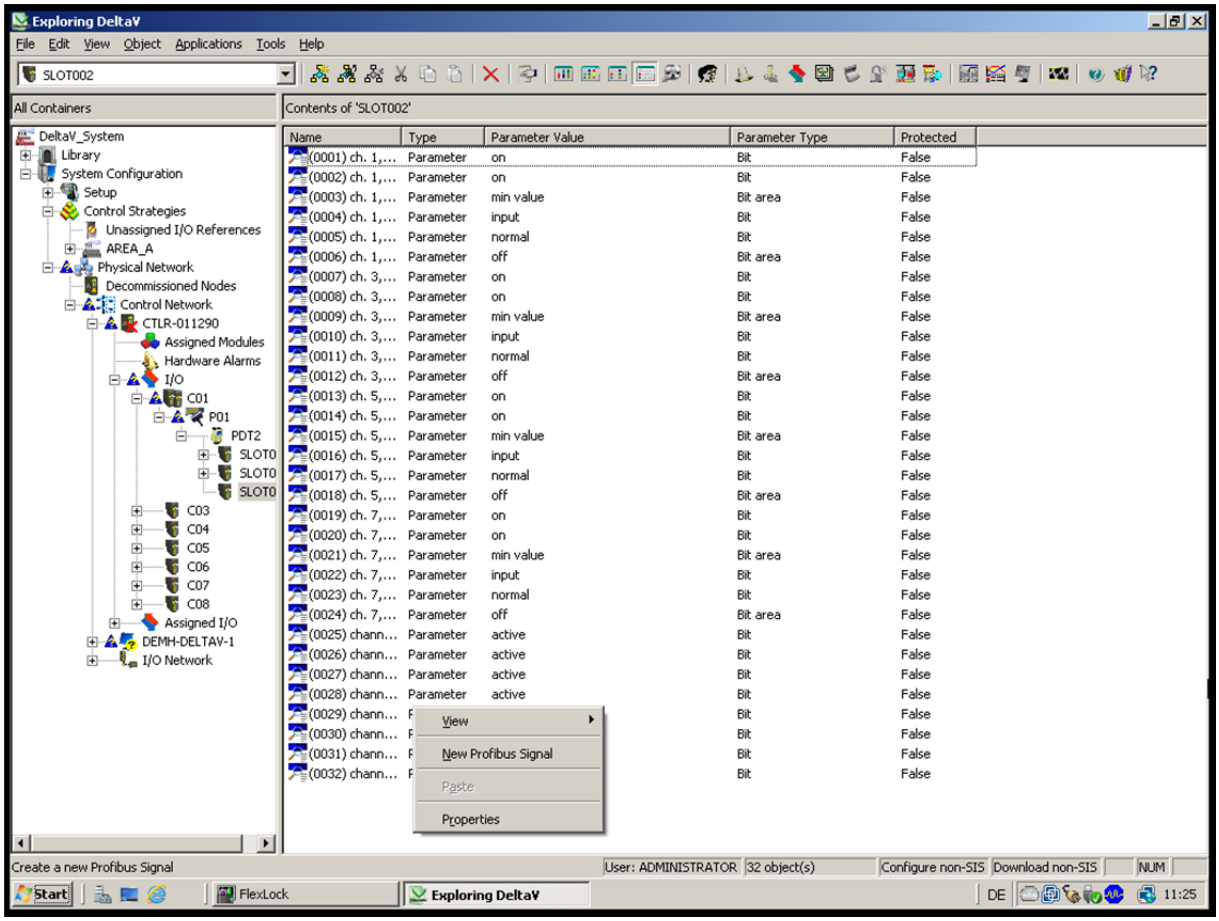


Figure 18: step 7

Definition of a PROFIBUS signal for the individual modules.

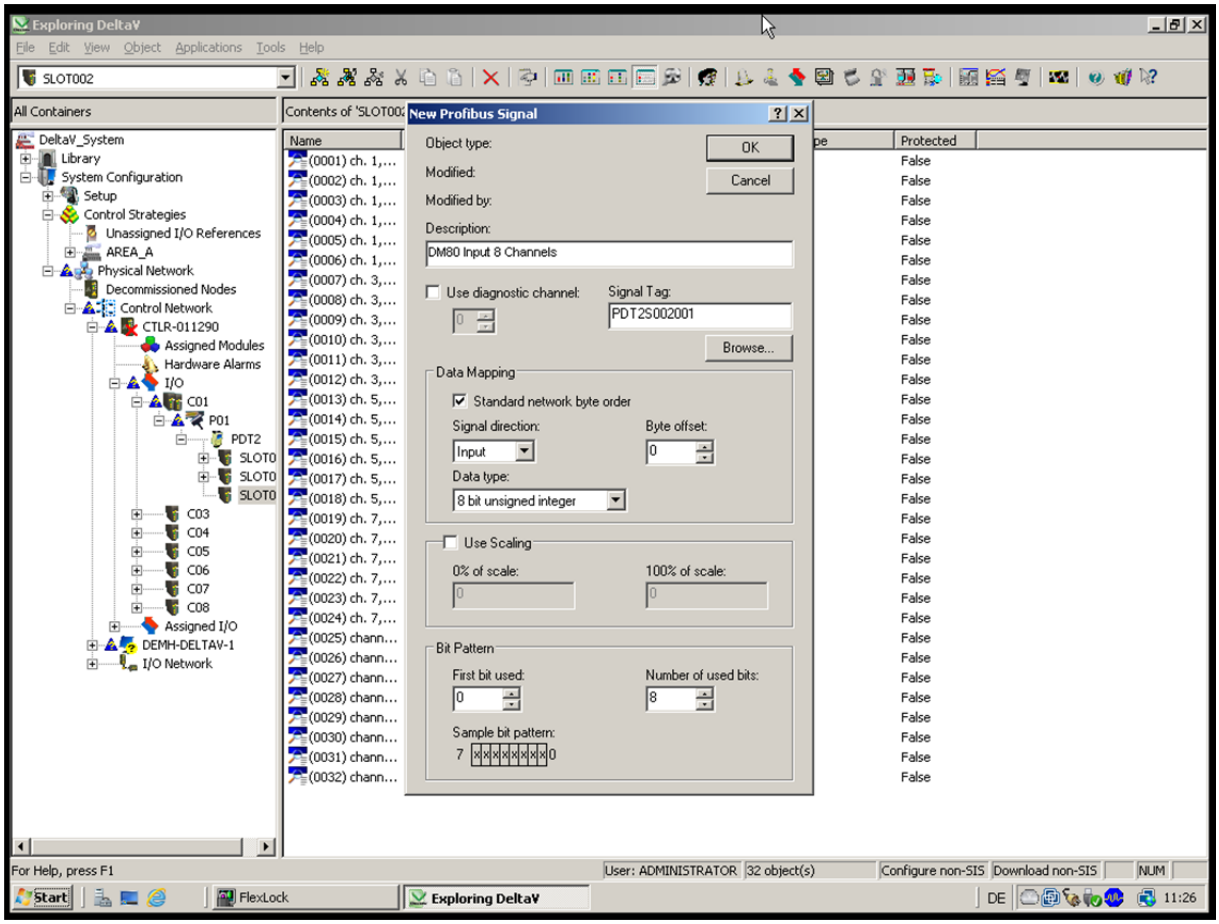


Figure 19: step 8

The signal tree is adjusted in this step.

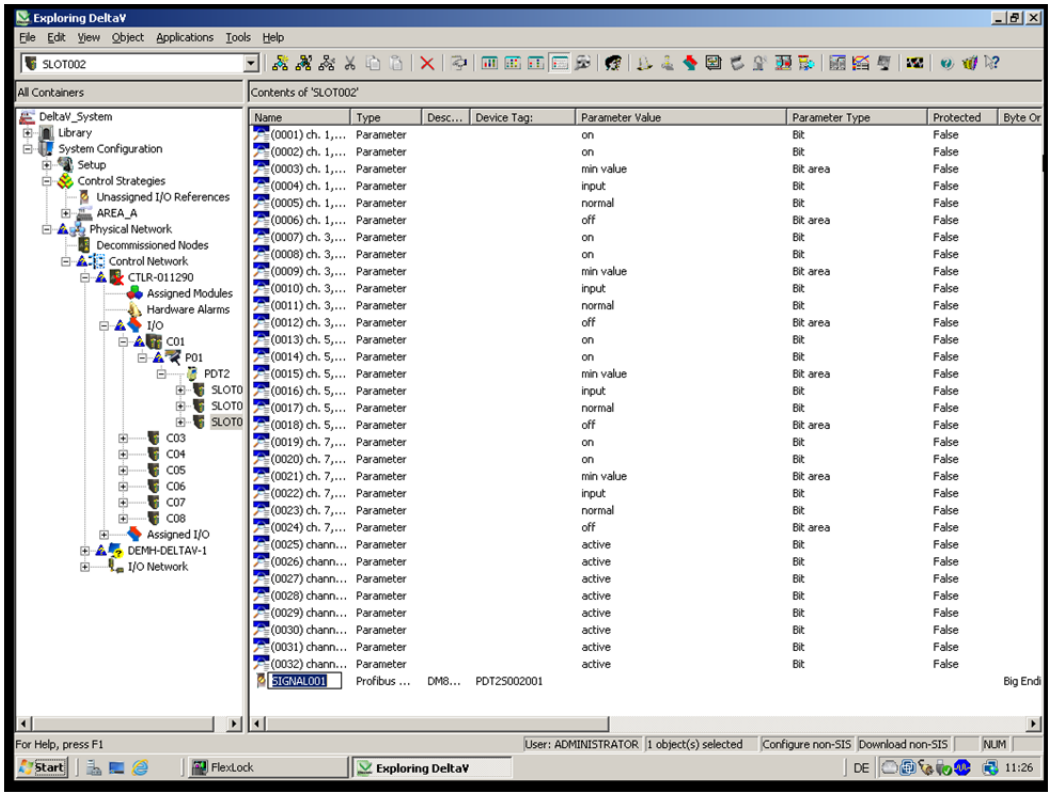


Figure 20: step 9

Figure 21 shows the complete configuration.

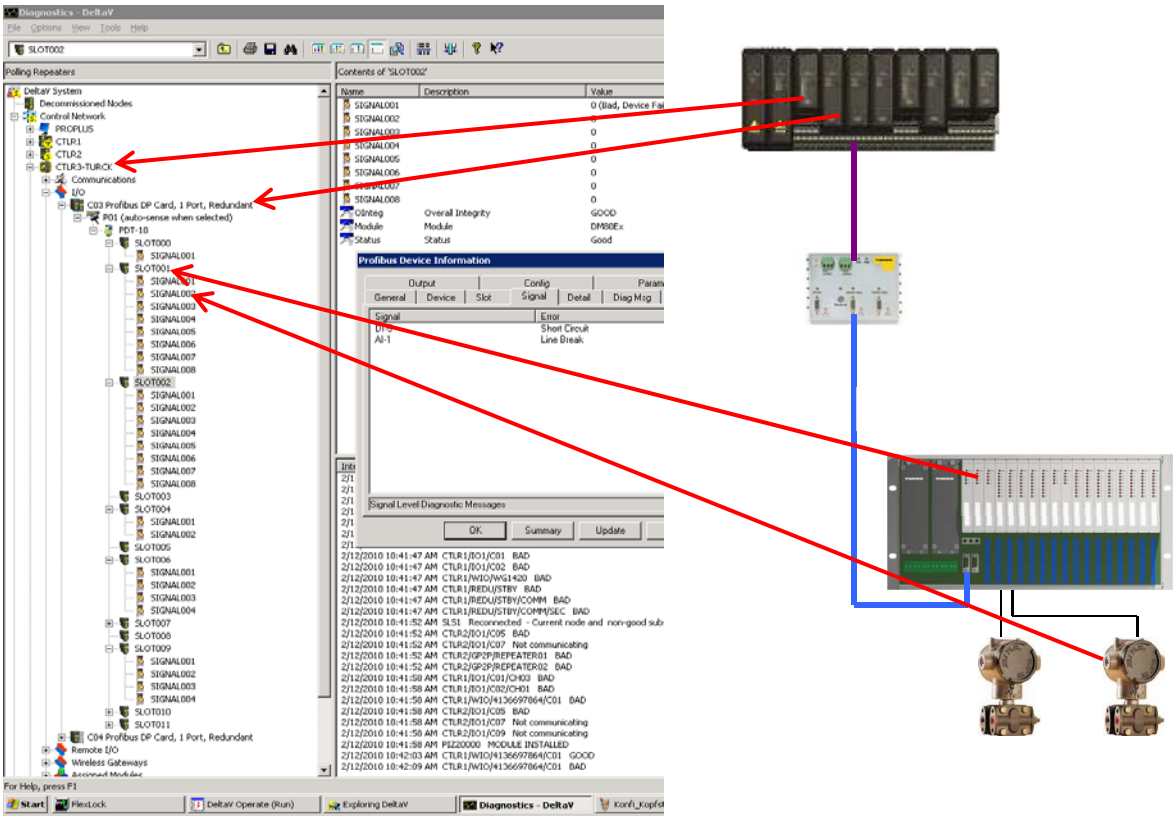


Figure 21: Complete configuration

4 Redundancy strategies with PROFIBUS-DP

4.1 Gateway redundancy (simple line redundancy)

The use of two gateways (and two bus lines) enables communication to be ensured even if a gateway or a bus line fails. If a gateway fails, communication is switched to the other gateway.

NOTE
When replacing a faulty gateway, bear in mind that the new device must have the same firmware and hardware status as the redundant gateway in all cases!

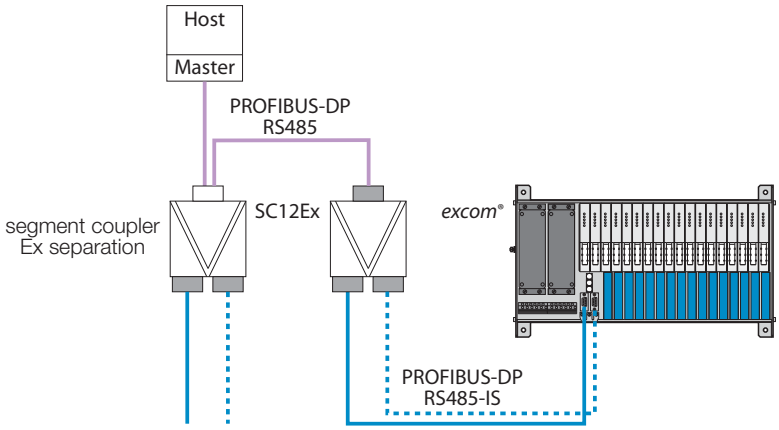


Figure 22: Gateway redundancy

Gateway redundancy is a simple redundancy function of the excom® system which is neither parameterized nor visible in the master. The switchover between the gateways is automatic.

4.2 Example of gateway redundancy

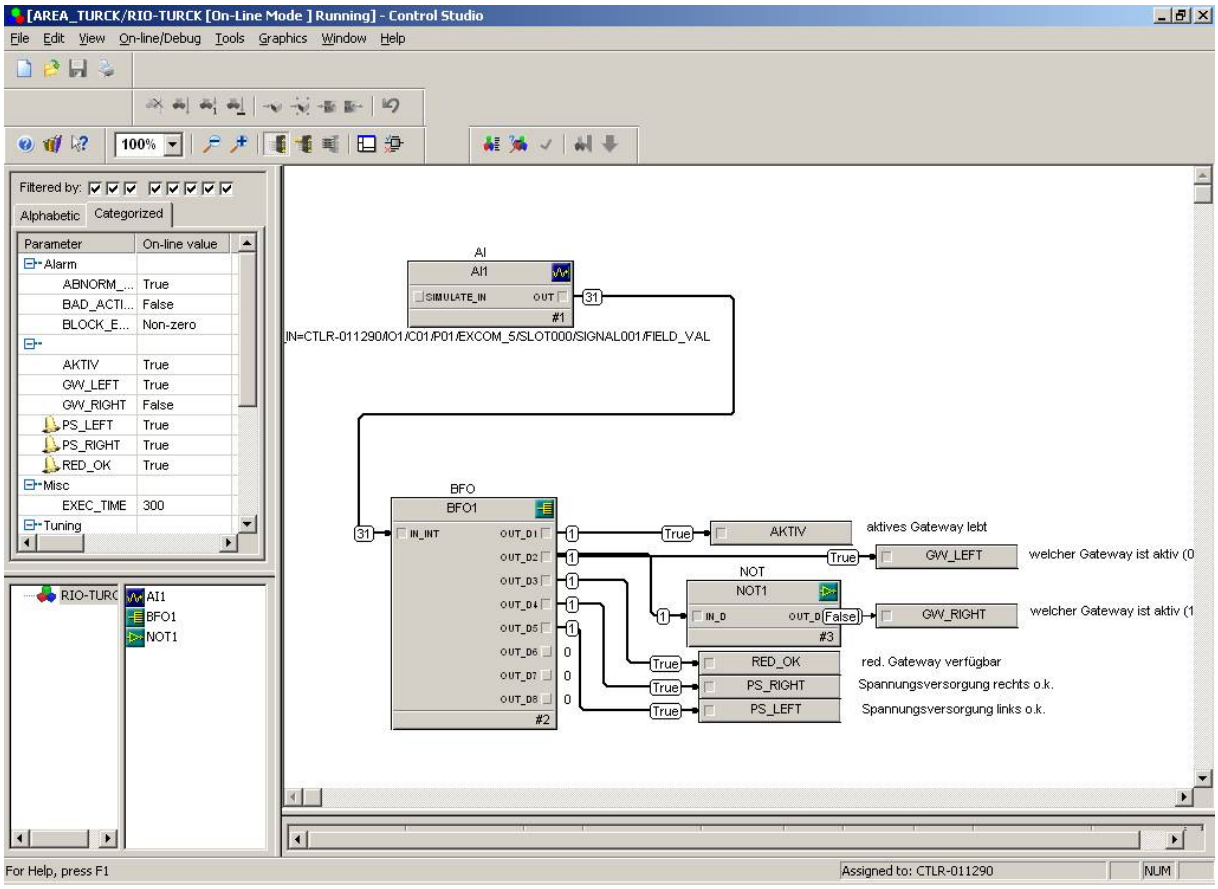


Figure 23: Gateway redundancy

4.3 Line redundancy

Line redundancy increases availability with a minimum of effort. Line redundancy can be implemented only in an active master. A second redundant master can be installed for hot standby operation. In line redundancy the bus line is split close to the master into two redundant bus lines. This is implemented through the use of two segment couplers or an SC12Ex. The excom® station must incorporate two gateways for this purpose. Each gateway is then connected to one of the two redundant bus lines. One of the two gateways is activated whilst the other is switched to standby.

NOTE
When replacing a faulty gateway, bear in mind that the new device must have the same firmware and hardware status as the redundant gateway in all cases!

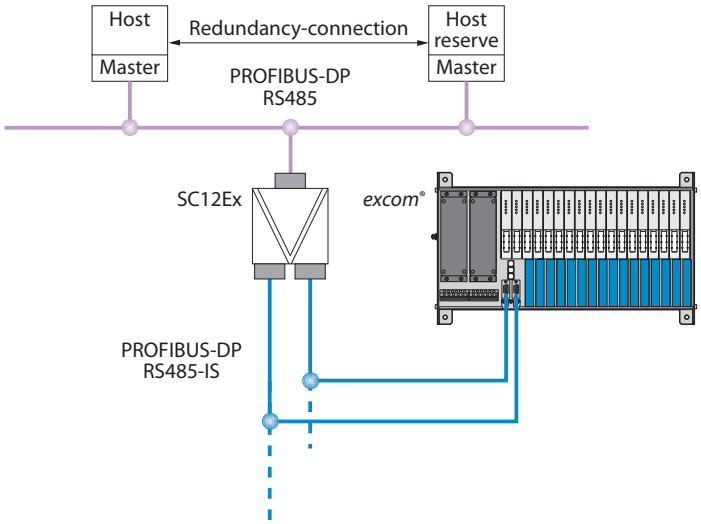


Figure 24: Line redundancy

Line redundancy is set in the master. The standby gateway responds to FDL telegrams and is thus visible to the master. The switchover can be initiated by the master as well as independently via the gateways.

If the Address offset parameter is activated (“on”) and an address offset value not equal to “0” is entered, the redundant gateway receives an excom internal virtual bus address (base address of the excom® station + address offset value).

With the set virtual bus address, the redundant gateway responds to the polling of all unconfigured slaves of the network via the PROFIBUS master and sends a receipt acknowledgment.

This receipt acknowledgement checks the readiness to communicate of the redundant gateway.

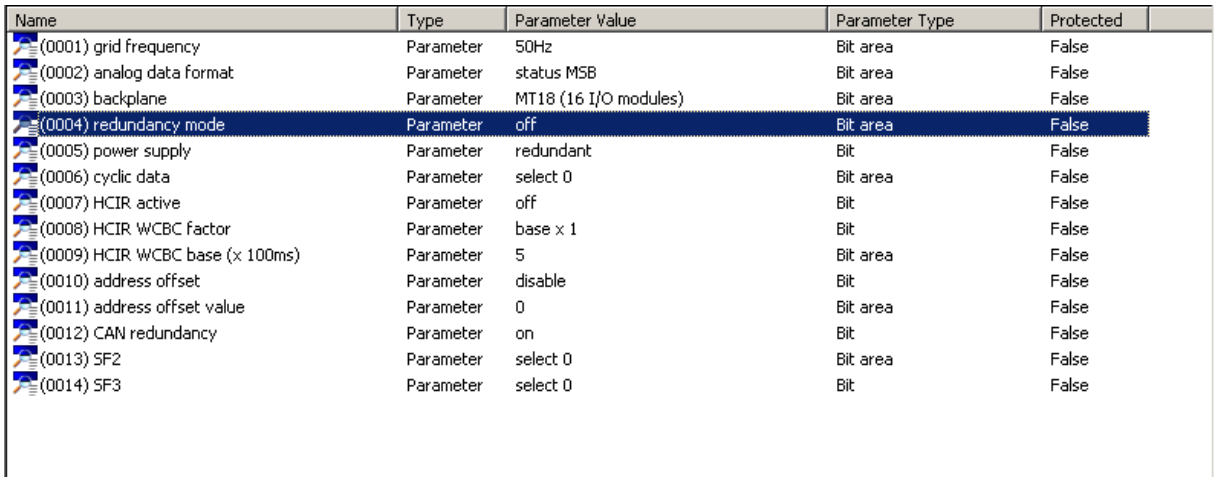
4.3.1 Parameter setting of the excom® with line redundancy

Redundancy for excom® is set via the Redundancy mode, Address offset and Address offset value gateway parameters.

4.3.2 Redundancy mode “off”

If the Redundancy mode parameter is deactivated (“off”), excom® operates in line redundancy without monitoring. If the communication between the master and the primary gateway is interrupted, the redundant gateway of the excom® station takes over communication (gateway redundancy).

NOTE
During the switchover the communication capability of the redundant gateway is not checked. No additional diagnostics are generated.

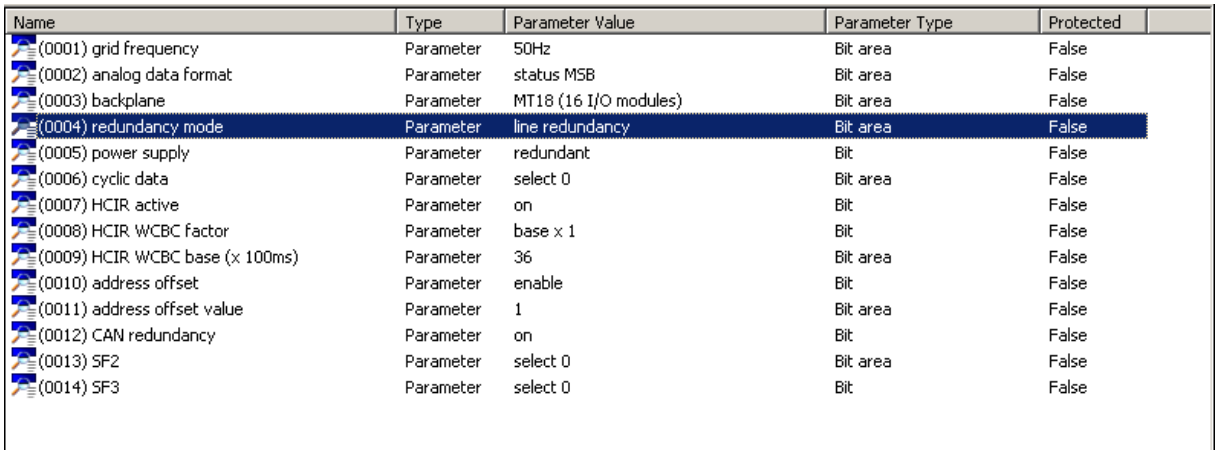


Name	Type	Parameter Value	Parameter Type	Protected
(0001) grid frequency	Parameter	50Hz	Bit area	False
(0002) analog data format	Parameter	status MSB	Bit area	False
(0003) backplane	Parameter	MT18 (16 I/O modules)	Bit area	False
(0004) redundancy mode	Parameter	off	Bit area	False
(0005) power supply	Parameter	redundant	Bit	False
(0006) cyclic data	Parameter	select 0	Bit area	False
(0007) HCIR active	Parameter	off	Bit	False
(0008) HCIR WCBC factor	Parameter	base x 1	Bit	False
(0009) HCIR WCBC base (x 100ms)	Parameter	5	Bit area	False
(0010) address offset	Parameter	disable	Bit	False
(0011) address offset value	Parameter	0	Bit area	False
(0012) CAN redundancy	Parameter	on	Bit	False
(0013) SF2	Parameter	select 0	Bit area	False
(0014) SF3	Parameter	select 0	Bit	False

Figure 25: Redundancy parameter – Line redundancy off

4.3.3 Line redundancy mode

If the Redundancy mode parameter is set for Line redundancy, excom® also operates in line redundancy mode. If the communication between the master and the primary gateway is interrupted, the redundant gateway of the excom® station takes over communication. However, in this case the communication capability of the redundant gateway is checked. If the Address offset parameter is activated (“on”) and an address offset value not equal to “0” is entered, the redundant gateway receives an excom®-internal virtual bus address (base address of the excom® station + Address offset value). With the set virtual bus address, the redundant gateway responds to the polling of all unconfigured slaves of the network via the PROFIBUS master and sends a receipt acknowledgment. This receipt acknowledgement checks the readiness to communicate of the redundant gateway.



Name	Type	Parameter Value	Parameter Type	Protected
(0001) grid frequency	Parameter	50Hz	Bit area	False
(0002) analog data format	Parameter	status MSB	Bit area	False
(0003) backplane	Parameter	MT18 (16 I/O modules)	Bit area	False
(0004) redundancy mode	Parameter	line redundancy	Bit area	False
(0005) power supply	Parameter	redundant	Bit	False
(0006) cyclic data	Parameter	select 0	Bit area	False
(0007) HCIR active	Parameter	on	Bit	False
(0008) HCIR WCBC factor	Parameter	base x 1	Bit	False
(0009) HCIR WCBC base (x 100ms)	Parameter	36	Bit area	False
(0010) address offset	Parameter	enable	Bit	False
(0011) address offset value	Parameter	1	Bit area	False
(0012) CAN redundancy	Parameter	on	Bit	False
(0013) SF2	Parameter	select 0	Bit area	False
(0014) SF3	Parameter	select 0	Bit	False

Figure 26: Redundancy parameter – Line redundancy

4.3.4 Redundancy status with Line redundancy on

The different redundancy states, i.e. normal operation or fault situation are indicated via the status diagnostics, the channel-specific diagnostics (slot 0, channel 0) and the LEDs of the two gateways.

The following events may occur:

Active gateway	Passive gateway	Error code (active gateway)	Description
PRIO-LED off	PRIO-LED flashes for a short time	27	**R_SWITCH_OVER:** The redundancy switchover has been executed (reset after 10 s).
PRIO-LED flashes	-	28	**R_GW_MISSING:** The redundant gateway is missing.
PRIO-LED flashes	PDP-LED red	29	**R_NOT_READY:** The redundant gateway is not ready.
PRIO-LED flashes	PDP-LED red	30	**R_GW_ERROR:** The redundant gateway is present but an error has occurred.
PRIO-LED flashes	PDP-LED red	31	**R_NO_DP:** The redundant gateway does not have any PROFIBUS communication. This may be due to: HSA (Highest Station Address) too low, physical connection fault etc.

Table 66: Redundancy status

4.4 Redundancy monitoring

If it is configured in the control system as “GDP-IS C”, the gateway is provided with an input word as well as an output word for monitoring redundancy. The input word describes the current status of the gateway; the output word is used for forcing a redundancy switchover. This information can be used to monitor redundancy with a user-defined logic in the control system. For example, the logic can be defined so that in the event of an intentional or unintentional switchover the process values of the inputs and/or outputs from the I/O modules are freezed for a defined time.

4.5 Input word for the current status of the gateway

The status of the current gateway is stored in the input word. If line redundancy is configured, Only the active gateway sends its status. If system redundancy is configured, both gateways send their status to the respective PROFIBUS masters.

Input word															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Not used											PSD status left	PSD status right	Red. GDP status	Slot	active/ passive

Bit 0	Bit 1	Meaning	Description
0	0	Gateway in the right-hand slot is passive	Bit 0: Shows the status of the active gateway. 0 = passive 1 = active Only with system redundancy: With simple redundancy this bit is always set to 1 if the active gateway exchanges data with the master. Bit 1: Indicates the slot of the active gateway 0 = Gateway is in the right-hand slot 1 = Gateway is in the left-hand slot
0	1	Gateway in the right-hand slot is active	
1	0	Gateway in the left-hand slot is passive	
1	1	Gateway in the left-hand slot is active	

Bit 2	Meaning	Description
0	Redundant gateway not available	Shows the status of the redundant gateway. 0 = Redundant gateway not available
1	Redundant gateway available	

Bit 3	Meaning	Description
0	Right-hand power supply unit failed	Shows the status of the right-hand power supply unit or module 0: Right-hand power supply unit or module failed 1: Right-hand power supply unit or module o.k. If the gateway parameter for the redundant power supply is not set, this bit is always set to 1.
1	Right-hand power supply unit or module ok	

Bit 4	Meaning	Description
0	Left-hand power supply unit or module failed	Shows the status of the left-hand power supply unit or module 0: Left-hand power supply unit or module failed 1: Left-hand power supply unit or module ok If the gateway parameter for the redundant power supply is not set, this bit is always set to 1.

4.6 Output word for forcing a redundancy switchover

Bits 0-2 control the redundancy switchover. The redundancy switchover only responds if bits 0 and 1 change status 11 –> 01 or 11 –> 10. Bit 2 determines the response to an edge change.
If Bit 2 = 0, a redundancy switchover is initiated irrespective of the position of the gateways
If Bit 2 = 1, either the left-hand or the right-hand gateway is activated selectively. Bit 2 can be used statically
An evaluation is carried out with each edge change.

Output word															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Not used													Control bits	Control bits for edge change	

Bit 2	Bit 1 Bit 0 edge change	Meaning
0	11→01	Receiver is the passive gateway. The passive gateway requests control from the active gateway and becomes active.
0	11→10	Receiver is the active gateway. The active gateway gives control to the passive gateway and becomes passive.
1	11→01	Receiver is the left-hand gateway. The left-hand gateway requests control from the right-hand gateway and becomes active.
1	11→10	Receiver is the right-hand gateway. The right-hand gateway requests control from the left-hand gateway and becomes active.

5 Reconfiguration during operation (HCIR/CIR)

Sometimes the reference configuration has to be reconfigured. If possible this must be carried out without any adverse effects on the connected sensors and actuators. The reconfiguration during operation is called HCIR (HCIR = Hot Configuration in Run). This allows the unrestricted operation of unaffected I/O modules during the reconfiguration process.

For this, excom® generates a new Check_Cfg Telegram during operation. The Data Exchange operating state is stopped for a short time in accordance with the PROFIBUS definition until the Data Exchange state is restored. During this absence of telegrams the outputs retain their last valid value. However, this requires the reconfiguration to be completed properly otherwise the outputs take on their set substitute values. The excom® system is therefore fully HCIR compatible.

NOTE
HCIR is naturally only possible with the excom® remote I/O system if the master also supports HCIR. The DeltaV system is suitable for HCIR. To prevent the occurrence of errors or alarms during the reconfiguration, the inputs must also be latched momentarily. The DeltaV system has this feature.

5.1 Configuration (adding modules)

Acyclic data exchange is used for PROFIBUS configurations, and this generally provides a new I/O mapping in the PROFIBUS master. This interruption in data transmission for the configuration is designed so that the operation of the installation is not disturbed. The PROFIBUS master must naturally also be HCIR-capable. The parameters required for the description are provided in the GSD file.

5.2 HCIR with excom®

HCIR is started with excom® via the **leave-master** command. The **UNLOCK** bit in the **prm_command** telegram is set. If the appropriate parameters for HCIR are selected in the GDP… gateway, the **leave-master** command is executed for starting the HCIR timer. The outputs are kept in the **last valid value** state and do not switch to **fail save** until no reconfiguration was possible after the HCIR timer has elapsed. Otherwise excom® will start up jolt-free with the new configuration.

Regardless of whether the newly configured modules are physically present already or not. As with line redundancy, the PROFIBUS master does not receive any input data from excom® for the time up to the restart. This momentary loss of input data must be managed by the master application.

The HCIR parameters have the following meaning:

HCIR active	**off**/ on	Activation of the online configuration **NOTE:** This bit must be set by the master before the HCIR sequence is started.
HCIR WCBC factor	**Base x 1 /** Base x16	Factor for generating the maximum switchover time between old and new configuration. The configuration change can be carried out by replacing modules (hot swapping) and configuration expansion (configuration in run) during operation. During the switchover time the outputs are held at the current value. The set HCIR WCBC … base is multiplied with this factor.
HCIR WCBC base (x 100ms)	0…63 (default value: **5**)	Sets the base for the switchover time. This parameter is automatically set if the PROFIBUS master supports HCIR.

6 Diagnostics with excom®

6.1 GDP… gateway

6.1.1 PROFIBUS errors

LED	Behavior	Possible cause of error
Status	green	No communication with PROFIBUS excom® address incorrect Double assignment to PROFIBUS stations Bus termination not present Cabling faulty
CAN	yellow	
PDP	red	
PRIO (redundancy status)	yellow	
Config	off	

6.1.2 No internal communication

LED	Behavior	Possible cause of error
Status	green	No internal communication No modules fitted Module causing a fault on the internal communication bus
CAN	red	
PDP	yellow	
PRIO (redundancy status)	yellow	
Config	Red flashing	

6.1.3 Configuration error

LED	Behavior	Possible cause of error
Status	green	No modules fitted Module at incorrect position Modules not fitted correctly in rack Modules not parameterized
CAN	yellow	
PDP	yellow	
PRIO (redundancy status)	yellow	
Config	red flashing	

6.2 Digital modules

LED	Behavior	Meaning
Status	off	No power supply
	red flashing	Module is not configured for this slot.
	green	Correct operation
	green flashing	The module was not yet configured by the gateway and is waiting for configuration data.
	fast green flashing	Module is configured but the master is not supplying any output data.
Channel	off	Channel not active (not switched)
	yellow	Channel switched/active.
	red	Channel error (wire break, short circuit) – channel diagnostics present.

6.3 Analog modules

LED	Behavior	Meaning
Status	off	No power supply
	red flashing	Module is not configured for this slot.
	green	Correct operation
	green flashing	The module was not yet configured by the gateway and is waiting for configuration data.
Channel	off	No channel error
	red	Channel error (wire break, short circuit) – channel diagnostics present.

7 Error codes with excom®

7.1 Standard error codes

Code	Meaning
0	reserved
1	Short circuit
2	Undervoltage
3	Overvoltage
4	Overload
5	Overtemperature
6	Wire break
7	Upper limit value exceeded + overflow (U < 1.8 V, I < 3.6 mA)
8	Lower limit value undershot + underflow (U > 10.5 V, I > 21 mA)
9	Error
10 …15	reserved
16 …31	Manufacturer specific (excom®)

7.2 Manufacturer specific gateway error codes

Code	Meaning
16	ROM error
17	RAM error
18	EEPROM error
19	Startup after cold start
20	Different configuration (with redundancy)
21	Different firmware (with redundancy)
22	Malfunction of internal bus (CAN error)
23	Malfunction of internal bus (passive) (CAN error)
24	Error in power supply unit or module 1
25	Error in power supply unit or module 2
26	Startup after watchdog reset
27	Redundancy switchover executed
28	Redundant gateway missing
29	Redundant gateway not ready
30	Redundant gateway has an error
31	Redundant gateway does not have PROFIBUS-DP communication

7.3 Manufacturer specific error codes for the excom® I/O modules

Code	Meaning
19	Module type (reference configuration) unknown
20	Module type (reference configuration) unknown
21	Reserved
22	Module type (reference configuration) unknown
23 … 29	Reserved
30	HART® status error
31	HART® communication error

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