4 PROFIBUS-PA interface

4.1 Overview

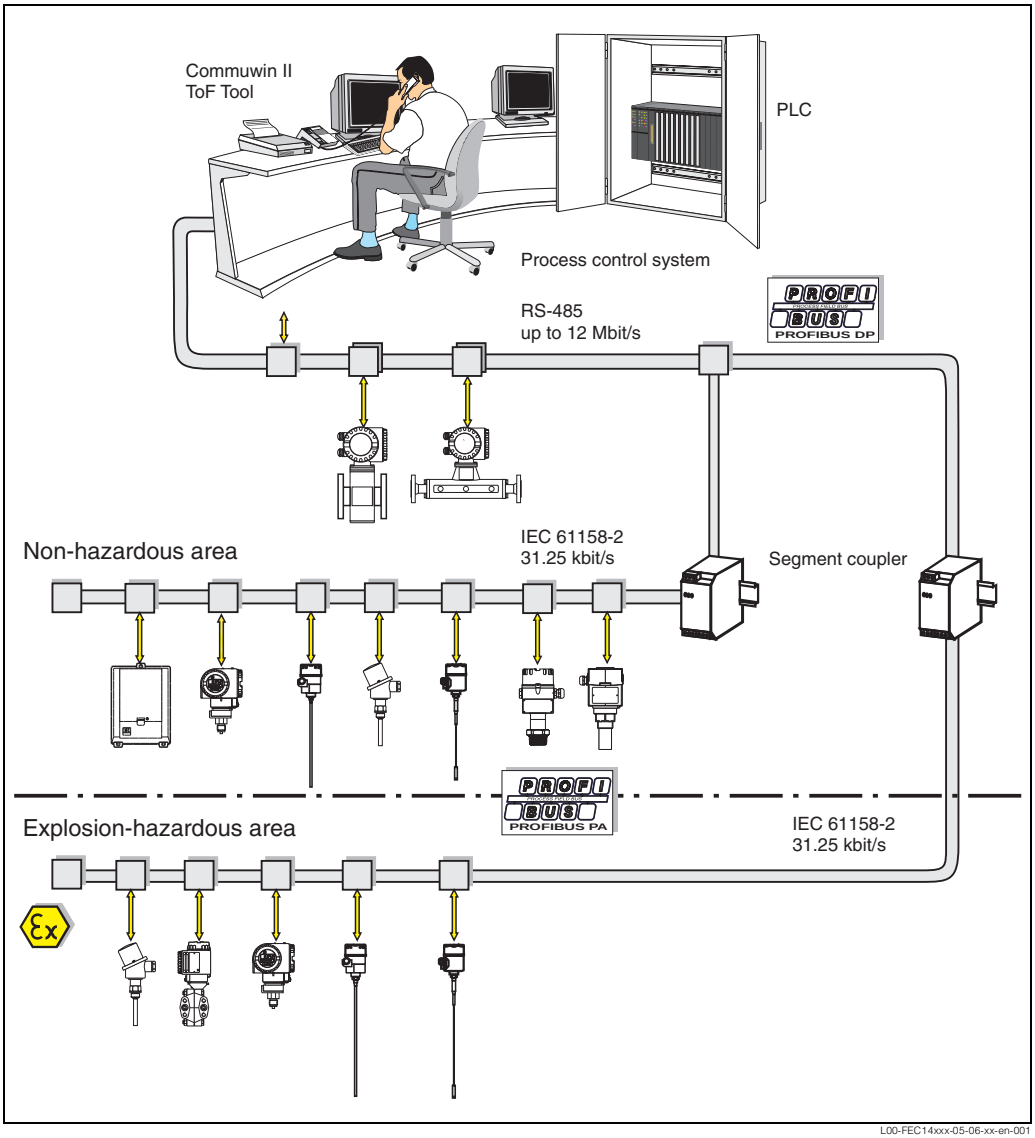


Fig. 4: PROFIBUS DP/ PA principle of operation

Note!
Additional planning instructions for PROFIBUS PA can be found in the Operating Instructions BA 198F/00/en, "PROFIBUS DP/ PA: Guidelines for planning and commissioning".

4.2 Setting the device address

An address must be assigned to each PROFIBUS PA device. The process control system only recognises the device when the address is set correctly.

- Valid device addresses are inside the range of 0 to 126. All devices are supplied from the factory with the software address 126.
- In a PROFIBUS PA network, each address may be assigned only once.
  For further information, please refer to the Operating Instructions BA 198F.

The factory-set address 126 can be used for functional testing of the device and for connecting to a PROFIBUS PA network in operation.
Subsequently, this address must be changed to be able to include additional devices.

There are two ways to assign the FEC 14 the device address:

- Via software with the aid of an operating program (DP Class 2 master, e.g. Commuwin II) or
- Locally via DIP switches. The DIP switches are located behind the display on the electronic insert.

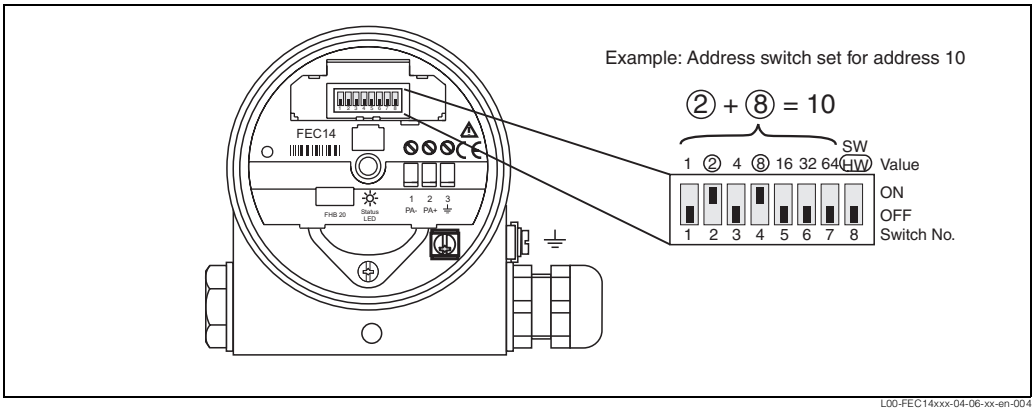


Fig. 5: Setting the device address via address switches

Setting the address mode

Setting the address mode via switch 8:

- ON = Software addressing takes place via the bus system (factory setting) (SW)
- OFF = Hardware addressing takes place at the device via DIP switches 1...7 (HW)

Hardware addressing

Proceed as follows to set a hardware address:

1. Set DIP switch 8 to OFF.
2. Set address as per table with DIP switches 1 to 7.
3. An address change takes effect after 10 seconds.

Switch No.	1	2	3	4	5	6	7
At the factory in position "ON"	1	2	4	8	16	32	64
At the factory in position "OFF"	0	0	0	0	0	0	0

Software addressing

Please refer to the Operating Instructions BA 198F for information on addressing the device using software.

4.3 Device Master Files and type files (GSD)

A Device Master File (GSD) contains a description of the properties of a PROFIBUS PA device, e.g. which data transmission rate is supported by the device or which digital information in which format the PLC receives from the device. The GSD files also have bitmap files. These files are used to display the measuring points in image form.
The Device Master File and the corresponding bitmaps are required to plan a PROFIBUS network.

Each device receives an ID number from the PROFIBUS User Organisation (PNO). The name of the Device Master File (GSD) is derived from this. For Endress+Hauser, this ID number always starts with "15XX", where "XX" stands for the device name.

Name of device	ID No.:	GSD	Type file	Bitmaps
FEC 14 Multicap	153A (hex)	EH3x153A.gsd	EH3153Ax.200	EH153A_d.bmp EH153A_n.bmp EH153A_s.bmp

The GSD files for all Endress+Hauser devices can be acquired as follows:

- INTERNET:
  Endress+Hauser ➠ http://www.endress.com
  Then: ➠ Products ➠ Process Solutions ➠ PROFIBUS ➠ GSD files
  PNO ➠ http://www.PROFIBUS.com (GSD library)
- On a CD-ROM directly from Endress+Hauser: Order No. 56003894

Note!
The PNO makes a general data base file with the name PA_x9700.gsd available for devices with an Analog Output Block. This file supports the transmission of the main measured value. Transmission of a second measured value (2nd Cyclic Value) or a Display Value is not supported. With FHB 20 local operation, the universal profile must be selected via the matrix field V6H0.

Working with GSD files

The GSD files must be loaded to a specific subdirectory of the PROFIBUS DP configuration software of your PLC.

- For example, GSD files and bitmaps which are located in the "Extended" directory are used for the configuration software STEP7 of the Siemens S7-300/400 PLC family.
- x.200 files and bitmaps which are located in the "Typdat5x" directory are used for the configuration software COM ET200 with Siemens S5.
- GSD files located in the "Standard" directory are for PLCs which only support the "Identifier Byte" (0x94) and not the "Identifier Format".
  These are for use e.g. with an Allen-Bradley PLC5.

Please refer to the Operating Instructions BA 198F for exact information on the directories to which the GSD files should be saved.

4.4 Cyclic data exchange (Data_Exchange)

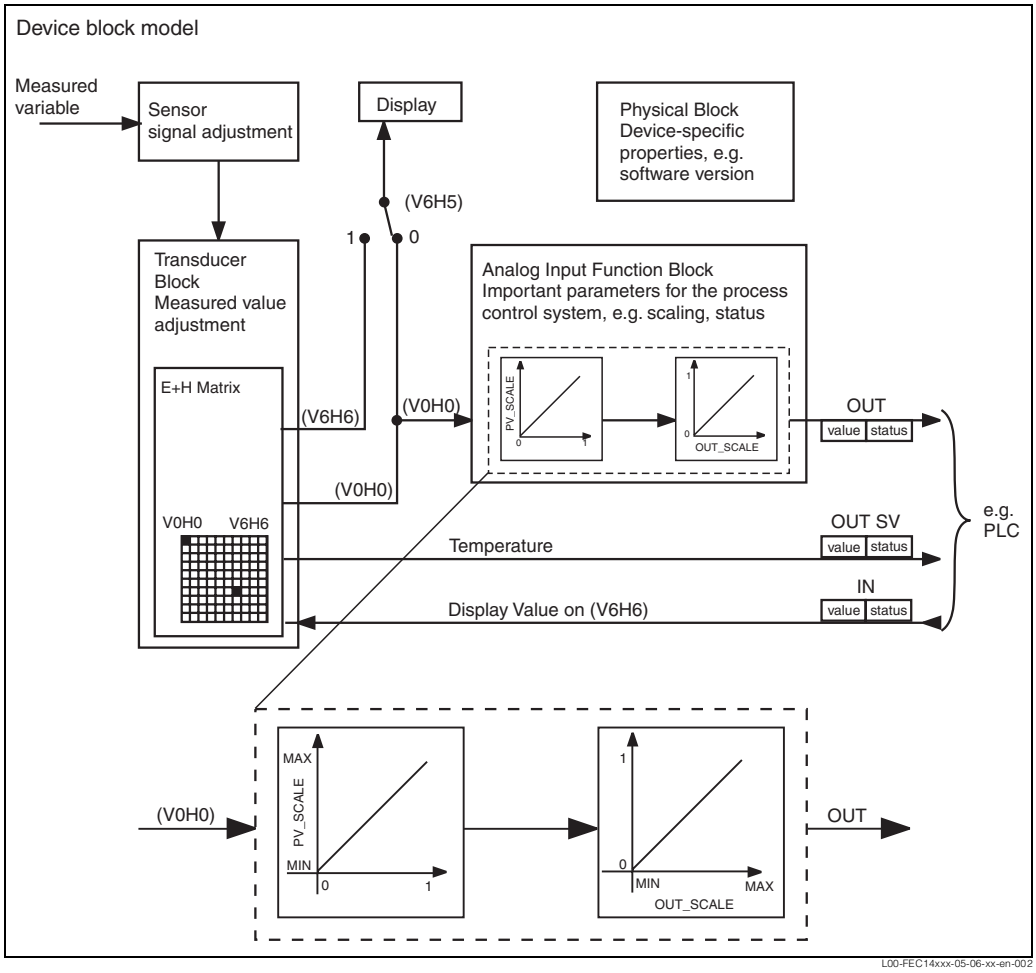


Fig. 6: Block model for FEC 14 with PROFIBUS PA Profile 3.0. The data in brackets indicate the matrix position on the local display

Block model

Fig. 6 shows the block model of an FEC 14. The main measured value V0H0 is transferred from the Transducer Block to the Analog Input Block. The measured value is scaled here and limit values are added before being made available as the OUT variable to the PLC in cyclic data communication. A value and the related status is transmitted with the OUT variable.
The local display and the matrix field V0H0 display the same value as standard. However, a cyclic output value (Display Value) from a PLC can also be made available to the local display. For this purpose, the matrix field V6H5 in Commuwin II or the local display must be set to "Display Value" (or 1).

The FEC 14 can also output the electronics temperature to the PLC.

Configuration

Data exchange must be configured via a network design tool.

1. Use the network design tool for your PLC and add the FEC 14 to the network. Make sure that the assigned address matches with the set device address.
2. Select FEC 14 and start the configuration program:
   Four options appear: – "Main Process Value", "2nd Cyclic Value", "Display Value" and "FREE PLACE"

3. Select "Main Process Value". If no value other than the "Main Process Value" is required, close the configuration window, otherwise
4. Select "2nd Cyclic Value" or "FREE PLACE" (= deactivate function) and select "Display Value" or "FREE PLACE" (= function deactivated).
   Then close the configuration window.
5. To display a cyclic output value (Display Value) on the local display, set V6H5 = "Display Value" (or 1).
6. Data exchange is now configured for this FEC 14 device.

FEC 14 ➠ PLC (input data)

With the Data_Exchange service, a PLC can read input data from the FEC 14 in the form of a response telegram. The cyclic data telegram has the following structure:

Index Input data	Data	Access	Data format/remarks
0, 1, 2, 3	Main measured value Level or volume	Read	32 bit floating point number (IEEE-754)
4	Status code for main measured value	Read	See status codes
5, 6, 7, 8	Second value: Temperature Electronic insert	Read	32 bit floating point number (IEEE-754)
9	Status code for second value	Read	See status codes
* This value displays the temperature measured value of the electronic insert. The temperature measured value is used for compensation purposes.			

PLC ➠ FEC 14 (output data)

The output data from the PLC to the local display have the following structure:

Index Input data	Data	Access	Data format/remarks
0, 1, 2, 3	Display value	Write	32 bit floating point number (IEEE-754)
4	Status code	Write	See status codes for second value

Status codes

The FEC 14 supports the following status codes for the main measured value and the second value:
C:\astoria\EDITEXP\BA261FDE_chapter_sui7v.sgm:97:0:E: notation "TIF" for entity "BA164D01" undefined

Status code	Device status	Meaning	Main measured value	Second measured value
52 Hex	GOOD	Sensor conversion not accurate	X	
1C	BAD	Out of Service	X	
80 Hex	GOOD	OK	X	X
84 Hex	GOOD	Active block alarm (Static Revision has been increased)	X	
89 Hex	GOOD	LOW_LIM (alarm active)	X	
8A Hex	GOOD	HI_LIM (alarm active)	X	
8D Hex	GOOD	LOW_LOW_LIM (alarm active)	X	
8E Hex	GOOD	HI_HI_LIM (alarm active)	X	

4.5 Acyclic data exchange

With the acyclic service, you can access the device parameters in the Physical Block, Transducer Block and Analog Input Block. Fig. 7 and 8 show block models of the Transducer Block and Analog Input Block.
Please refer to the Operating Instructions BA 198F for further information on device management, standard parameters and the Physical Block.

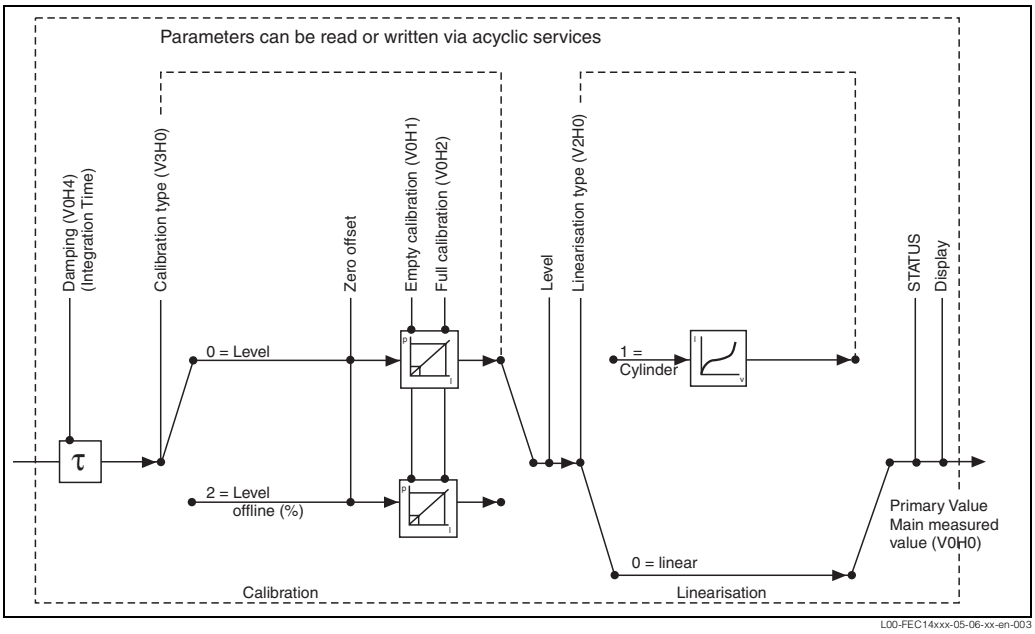


Fig. 7: Diagram for the Transducer Block FEC 14. The parameter names correspond to the names in the slot/index list. Parameters with information on a matrix position (in brackets) can also be accessed using Commuwin II or local operation.

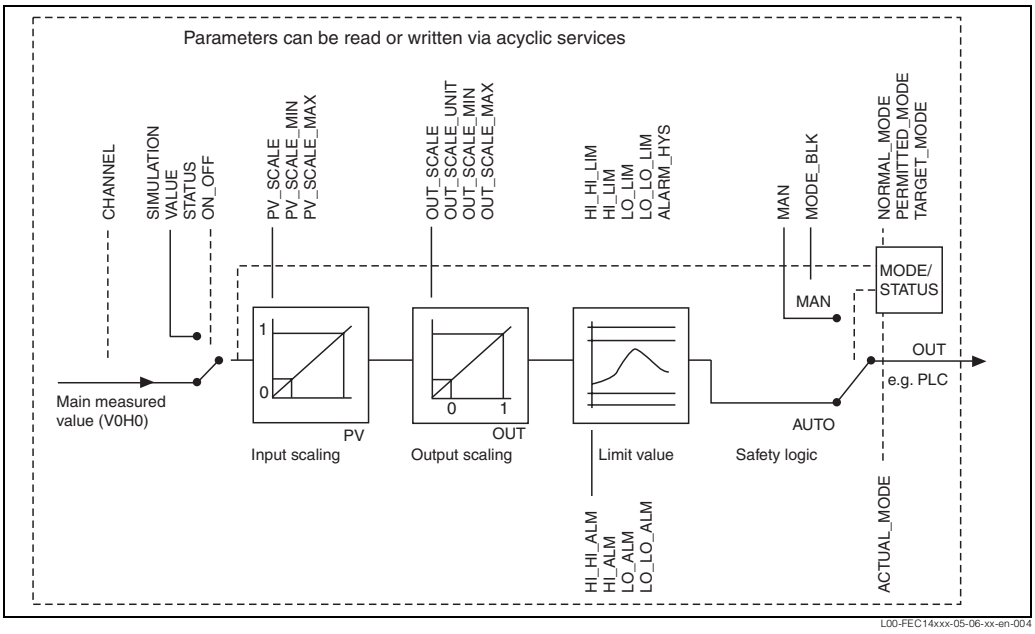


Fig. 8: Diagram for the Analog Input Block FEC 14

Slot/index table

The device parameters are listed in the table below. You can access the parameters using the slot and index numbers. The Analog Input Block, Transducer Block and Physical Block contain standard parameters, block parameters and manufacturer-specific parameters.

4.5.1 Analog Input Block

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
Standard parameters								
Block Data		1	16	20	DS-32*	X		constant
Static revision		1	17	2	UNSIGNED16	X		non-vol.
Device tag		1	18	32	OSTRING	X	X	static
Strategy		1	19	2	UNSIGNED16	X	X	static
Alert key		1	20	1	UNSIGNED8	X	X	static
Target Mode		1	21	1	UNSIGNED8	X	X	static
Mode		1	22	3	DS-37*	X		dynamic non-vol. constant
Alarm summary		1	23	8	DS-42*	X		dynamic
Batch		1	24	10	DS-67*	X	X	static
Gap		1	25					
Block parameters								
Out	V6H2 (value) V6H3 (status)	1	26	5	DS-33*	X		dynamic
PV Scale		1	27	8	Array of FLOAT	X	X	static
Out Scale		1	28	11	DS-36*	X	X	static
Linearisation type		1	29	1	UNSIGNED8	X	X	static
Channel		1	30	2	UNSIGNED16	X	X	static
Gap		1	31					
PV Ftime		1	32	4	FLOAT	X	X	non-vol.
Fail safe type		1	33	Not supported				
Fail safe value		1	34	Not supported				
Alarm Hysteresis		1	35	4	FLOAT	X	X	static
Gap		1	36					
HI HI Limit		1	37	4	FLOAT	X	X	static
Gap		1	38					
HI Limit		1	39	4	FLOAT	X	X	static
Gap		1	40					
LO Limit		1	41	4	FLOAT	X	X	static
Gap		1	42					
LO LO Limit		1	43	4	FLOAT	X	X	static
Gap		1	44-45					
HI HI Alarm		1	46	16	DS-39*	X		dynamic
HI Alarm		1	47	16	DS-39*	X		dynamic
LO Alarm		1	48	16	DS-39*	X		dynamic
LO LO Alarm		1	49	16	DS-39*	X		dynamic
Simulate		1	50	6	DS-51*	X	X	non-vol.
Out unit text		1	51	Not supported				

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
Gap reserved		1	52-60					
Gap		1	61-65					

4.5.2 Physical Block

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
Standard parameters								
Block Data		0	16	20	DS-32*	X		constant
Static revision		0	17	2	UNSIGNED16	X		non-vol.
Device tag	VAH0	0	18	32	OSTRING	X	X	static
Strategy		0	19	2	UNSIGNED16	X	X	static
Alert key		0	20	1	UNSIGNED8	X	X	static
Target mode		0	21	1	UNSIGNED8	X	X	static
Mode		0	22	3		X		dynamic non-vol. constant
Alarm summary		0	23	8		X		dynamic
Block parameters								
Software revision		0	24	16	OSTRING	X		constant
Hardware revision		0	25	16	OSTRING	X		constant
Device manufacturer ID		0	26	2	UNSIGNED16	X		constant
Device ID		0	27	16	OSTRING	X		constant
Device serial number		0	28	16	OSTRING	X		constant
Diagnosis		0	29	4	OSTRING	X		dynamic
Diagnosis extension		0	30	6	OSTRING	X		dynamic
Diagnosis mask		0	31	4	OSTRING	X		constant
Diagnosis mask ext.		0	32	6	OSTRING	X		constant
Device certification		0	33	32	OSTRING	X	X	constant
Security locking	V9H9	0	34	2	UNSIGNED16	X	X	non-vol.
Factory reset	V9H5	0	35	2	UNSIGNED16		X	non-vol.
Descriptor		0	36	32	OSTRING	X	X	static
Device message		0	37	32	OSTRING	X	X	static
Device instal. date		0	38	8	OSTRING	X	X	static
Gap reserved		0	39					
Ident number select	V6H0	0	40	1	UNSIGNED8	X	X	static
HW write protection		0	41	1	UNSIGNED8	X	X	dynamic
Gap reserved		0	42-48					
Gap		0	49-53					
E+H parameters								
error code	V9H0	0	54	2	UNSIGNED16	X		dynamic
last error code	V9H1	0	55	2	UNSIGNED16	X	X	dynamic
Up Down features		0	56	1	OSTRING	X		constant

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
Gap		0	57-58					
Bus address	V9H4	0	59	1	UNSIGNED8	X		dynamic
Device SW No.	V9H3	0	60	2	UNSIGNED16	X		dynamic
Set unit to bus	V6H1	0	61	1	UNSIGNED8	X	X	static
Input value	V6H6	0	62	6	FLOAT+U8+ U8	X		dynamic
Select Main value	V6H5	0	63	1	UNSIGNED8	X	X	dynamic
PA profile revision	V6H7	0	64	16	OSTRING	X		constant
Clear last error code		0	65	1	UNSIGNED8	X	X	dynamic
Ident Number		0	66	2	UNSIGNED16	X		static
Gap		0	67-69					
View_1_PB		0	70	17	OSTRING	X		dynamic non-vol. constant

4.5.3 View_1 parameters

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
View_1 Physical Block		0	70	17	OSTRING	X		dynamic non-vol. constant
View_1 Transducer Block		1	134	22	OSTRING	X		dynamic non-vol. constant
View_1 Analog Input Block		1	64	18	OSTRING	X		dynamic non-vol. constant

4.5.4 Transducer Block

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
Standard parameters								
Block data		1	69	20	DS-32	X		constant
Static revision		1	70	2	UNSIGNED16	X		non-vol.
Device tag		1	71	32	OSTRING	X	X	static
Strategy		1	72	2	UNSIGNED16	X	X	static
Alert key		1	73	1	UNSIGNED8	X	X	static
Target mode		1	74	1	UNSIGNED8	X	X	static
Mode_BLK		1	75	3	DS-37	X		dynamic
Alarm summary		1	76	8	DS-42	X		dynamic
Block parameters								
Primary_Value	V0H0	1	77	5	DS-32	X		dynamic
Primary_Value_Unit	V3H8	1	78	2	UNSIGNED16	X	X	static
Level		1	79	4	FLOAT	X		dynamic
Level_Unit		1	80	2	UNSIGNED16	X	X	static
Sensor_Value	V0H8	1	81	4	FLOAT	X		dynamic
Sensor_Value_Unit		1	82	2	UNSIGNED16	X	X	non-vol.
Sensor_Value_1		1	83	5	DS-33	X		dynamic
Sensor_Value_1_Unit		1	84	2	UNSIGNED16	X	X	static
Sensor_Value_2		1	85	5	DS-33	X		dynamic
Sensor_Value_2_Unit		1	86	2	UNSIGNED16	X	X	static
Sensor_Offset		1	87	4	FLOAT	X	X	static
CAL-Type	V3H0	1	88	1	UNSIGNED8	X	X	static
CAL-Point_LO	V0H5	1	89	4	FLOAT	X	X	static
CAL-Point_HI	V0H6	1	90	4	FLOAT	X	X	static
Level_LO	V0H1	1	91	4	FLOAT	X	X	static
Level_HI	V0H2	1	92	4	FLOAT	X	X	static
Level_Offset		1	93	4	FLOAT	X	X	static
Lin_Type	V2H0	1	94	1	UNSIGNED8	X	X	static
Lin_Diameter		1	95	Not supported				
Lin_Volume		1	96	Not supported				
Sensor_High_Limit		1	97	4	FLOAT	X		constant
Sensor_Low_Limit		1	98	4	FLOAT	X		constant
Max Sensor Value		1	99	4	FLOAT	X	X	non-vol.
Min Sensor Value		1	100	4	FLOAT	X	X	non-vol.
Temperature	V7H1	1	101	4	FLOAT	X		dynamic
Temperatur_Unit	V3H9	1	102	1	UNSIGNED16	X	X	static
Max_Temperature	V7H3	1	103	4	FLOAT	X	X	non-vol.
Min_Temperature	V7H2	1	104	4	FLOAT	X	X	non-vol.
Linearisation Parameter		1	105-111	Not supported				
Reserved		1	112-121					

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
E+H parameters								
Gap		1	122	4				
Sensor_Range	V7H0	1	123	4	FLOAT	X		non-vol.
Gap		1	124-125					
Empty calibration	V3H1	1	126	4	FLOAT	X	X	static
System_Start_Counter		1	127	4	FLOAT	X		non-vol.
Full calibration	V3H2	1	128	4	FLOAT	X	X	static
View_1_TB		1	129	22	OSTRING	X		dynamic non-vol. constant

1.6 Data format

IEEE 754 format

The measured value is transmitted as an IEEE-754 floating point number, where

Measured value = $(-1)^{Sign} \times 2^{E-127} \times (1+F)$

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Sign	Exponent (E)								Fraction (F)						
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}
Fraction (F)															
2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}	2^{-13}	2^{-14}	2^{-15}	2^{-16}	2^{-17}	2^{-18}	2^{-19}	2^{-20}	2^{-21}	2^{-22}	2^{-23}

Example
40 F0 00 00 hex = 0**100 0000 1**111 0000 0000 0000 0000 0000 binary value

$= (-1)^0 \times 2^{(129-127)} \times (1 + 2^{-1} + 2^{-2} + 2^{-3})$

$= 1 \times 2^2 \times (1 + 0.5 + 0.25 + 0.125)$

$= 1 \times 4 \times 1.875$

$= 7.5$

Note!
- Not all programmable logical controllers support the IEEE-754 format. A conversion module then has to be used or written.
- It may also be necessary to change the byte sequence (byte swapping routine) depending on the type of data management employed in the PLC (master) (most-significant byte or low-significant byte).

Data strings

Some data types, e.g. DS-36, are marked with an asterisk in the slot/index table (Pages 17-21). These are data strings that are structured along the PROFIBUS PA Specification Part 1, Version 3.0. They comprise several elements that are addressed via the slot, index and subindex, as shown in the following two examples:

Data strings

Some data types, e.g. DS-36, are marked with an asterisk in the slot/index table (Pages 17-21). These are data strings that are structured along the PROFIBUS PA Specification Part 1, Version 3.0. They comprise several elements that are addressed via the slot, index and subindex, as shown in the following two examples:

Parameter type	Slot	Index	Element	Sub-index	Type	Size
DS-33	1	26	OUT Value	1	FLOAT	4
			OUT Status	5	UNSIGNED8	1

Parameter type	Slot	Index	Element	Sub-index	Type	Size
DS-36	1	28	OUT Scale Max.	1	FLOAT	4
			OUT Scale Min.	5	FLOAT	4
			OUT Scale Unit		UNSIGNED8	1
			OUT Scale DP (decimal point)		INTEGER8	1

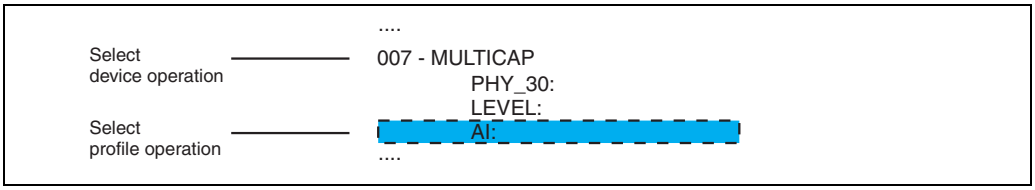
4.7 Configuration of parameter profiles

You can access the block parameters by means of a PROFIBUS DP Class 2 master such as Commuwin II. Commuwin II runs on an IBM-compatible PC or laptop.
The computer must be equipped with a PROFIBUS interface, i.e. PROFIBOARD for PCs and PROFICARD for laptops. During system integration, the computer is logged-on as a Class 2 master. For further information, please refer to the Operating Instructions BA 124F "Commuwin II".

Operation

The PA-DPV1 server must be installed for operation.
You can then establish the connection to Commuwin II via the PA-DPV1 server.

- Create a live list with "Tags"



- E+H device operation is selected by clicking the device designation, such as FEC 14 here.
- Select the profile operation by clicking the appropriate tag, e.g. AI: = Analog Input Block, or by selecting the associated device profile in the graphic operation.
- The device is then configured in the Device menu.

Device menu

The Device menu in Commuwin II offers two types of operation:
"Matrix operation" and "Graphic operation".

- In the case of matrix operation, the device or profile parameters are loaded in a matrix. You can change a parameter when the appropriate matrix field has been selected.
- With graphical operation, the operation sequence is represented in a series of images with parameters. For profile operation, the graphics Diagnosis, Scaling, Simulation and Block are of interest.

Output scaling

The FEC 14 local display and the digital output can be scaled independently of one another.

Digital output value (OUT Value)
= Display value of the local display
You have the following options to make the digital output and the display output the same value:

– Set the values for the lower and upper limit of PV Scale and OUT Scale as equal in the Analog Input Block;
PV Scale min = OUT Scale min and PV Scale max = OUT Scale max.
Please refer also to Section 4.5, "Slot/index table" and Section 13.2 "Matrix Analog Input Block (AI transmitter)"
– Scale the limits of PV Scale and OUT Scale in Commuwin II in the graphic mode, see graphic below.

Digital output value (OUT Value)
= Display value of the local display
You have the following options if you require an output value with a different scale for your PLC:

– Set the values for the lower and upper limit for PV Scale and OUT Scale in the Analog Input Block as required. See Fig. 7 Page 16 or
– Scale the limits of PV Scale and OUT Scale in Commuwin II in the graphic mode, see graphic below.

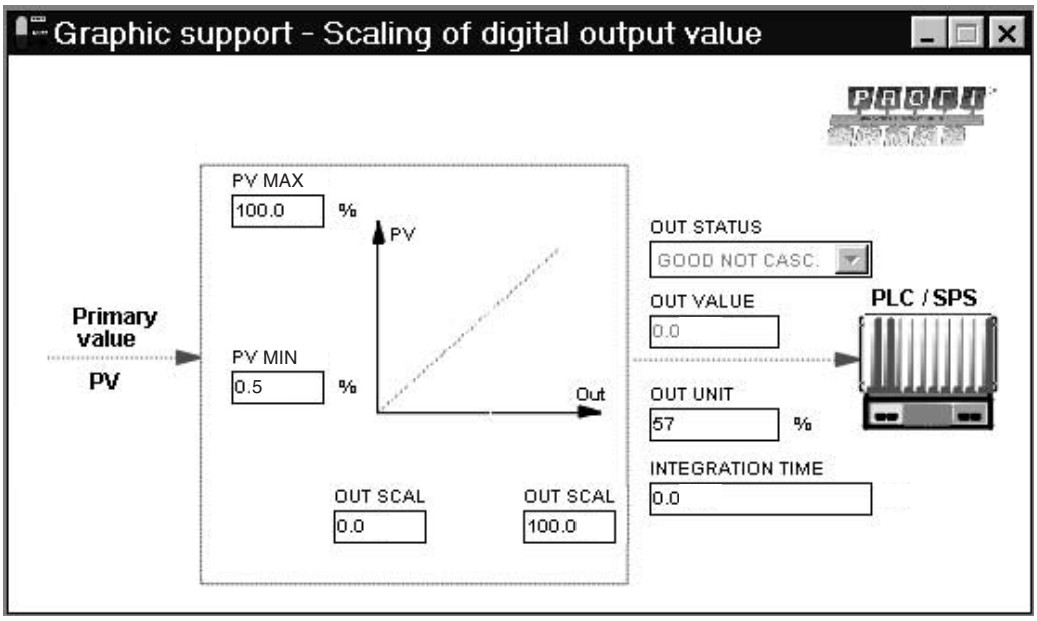


Fig. 9: OUT Value scaling using graphic operation in Commuwin II