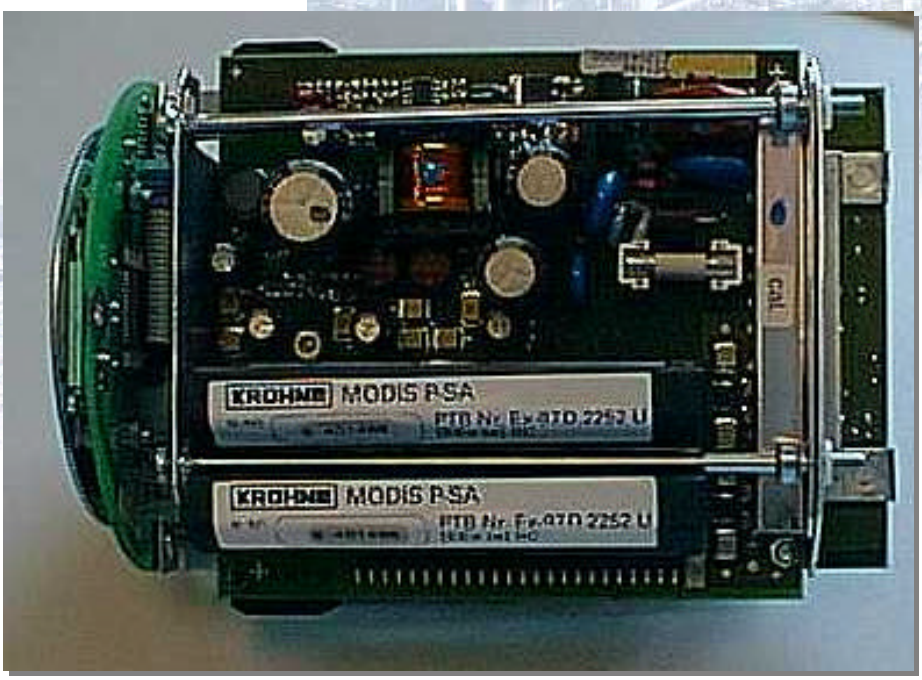
Addendum to Operating and Instruction Manual For Modis Converters

MFC 081/085i



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Ex Versions

1. Description

These versions of the converter are suitable for installation in a hazardous area where intrinsically safe outputs are required.

This converter has passive outputs, which also has the benefit of utilizing the multi-drop feature of HART®. The outputs are galvanically separated from each other.
Please ensure that you know which converter options you have, to use the correct wiring diagram.

2. Output Options

The following output options are available:

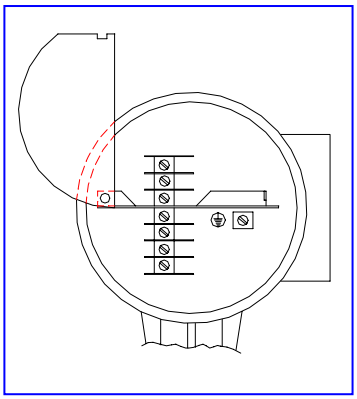
G.	1 x 4 -20mA and 1 x Pulse output
H.	1 x 4 -20mA and 1 x Status output
K.	1 x 4 -20mA and 1 x Control input
L.	2 x 4-20 mA
M.	1 x 4-20mA and PROFIBUS PA
N.	1 x 4-20mA and Foundation Fieldbus (pending)

Note: HART® is available on the first current output in all cases except options M and N.

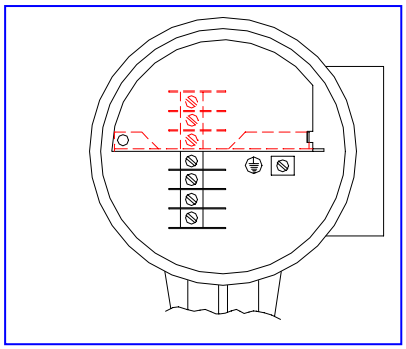
Wiring the Converter:

Note:
Supply compartment is separated from output terminals

Wiring the Power Supply:



Slide the cover to the left to
Expose the power terminals.

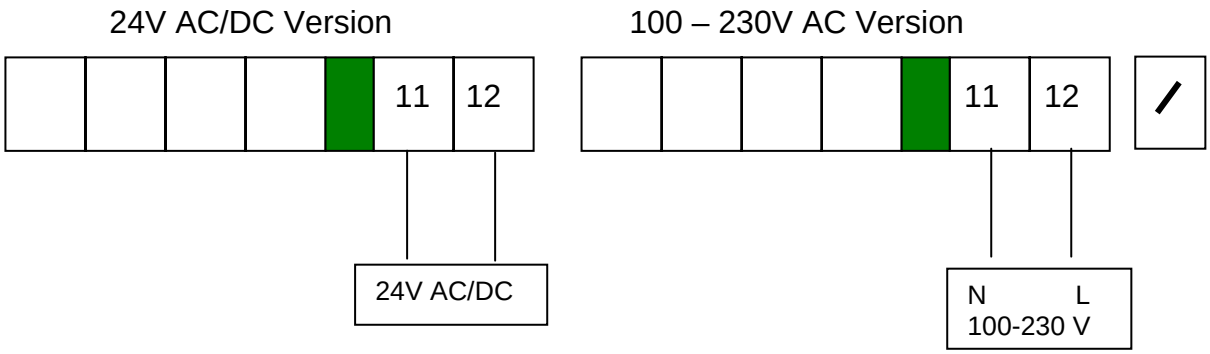


Power supply terminals
covered.

3. Power Supplies:

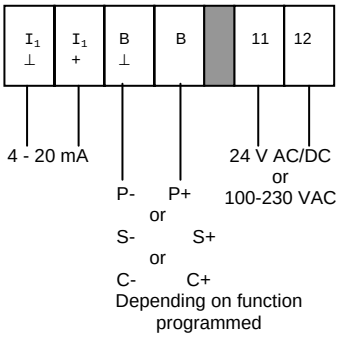
The converter is available in two options:

A. 24 V AC/DC Switched mode supply
B. 100/230 V AC

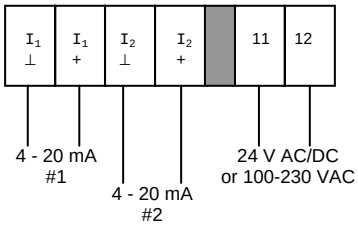


4. Output Wiring:

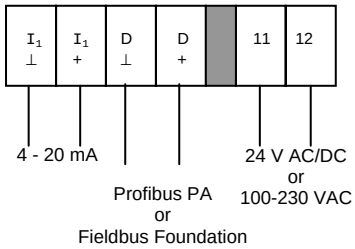
Option G, H, K



Option L



Option M, N



Non-Ex Versions

5. Description:

This version of converter is similar to the existing Modis converter range but has no Ex approvals.
It has been introduced to provide the options of Profibus PA, Foundation Fieldbus (planned) and galvanically isolated outputs for non-Ex environments such as food and pharmaceutical applications.

6. Available Versions:

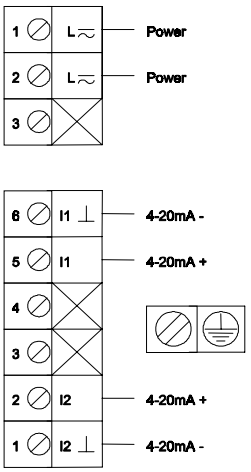
L 2 x 4-20mA passive output (freely programmable). HART protocol on first output. Both outputs galvanically separated from each other and the power supply.
M 1 x 4-20mA passive output (freely programmable) and 1 x Profibus PA passive output (HART protocol not available). Both outputs galvanically separated from each other and the power supply.
N Like M, but 1x Fieldbus Foundation passive output (pending)

Supply Voltage:

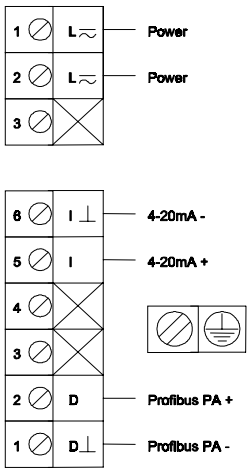
These converters are available with the same two voltage options:
24V AC/DC
100 – 230 V AC

7. Terminal Connections:

Option L



Option M, N



Programming:

All programming and functions remain as for standard converters as described in the main instruction manual.

Communication Options

Two options are planned for this converter. PROFIBUS PA is available with Foundation Fieldbus to follow.

8. Supplementary Instructions for PROFIBUS PA

1. General

These Instructions are supplementary to the “Installation and Operating Instructions MFM 4085 K / F or MFM2081/3081 K/F“. The details given there, in particular the Safety Information, are valid and should be observed. These Supplementary Instructions provide only additional information for device Operation and connection to a PROFIBUS-PA Fieldbus.

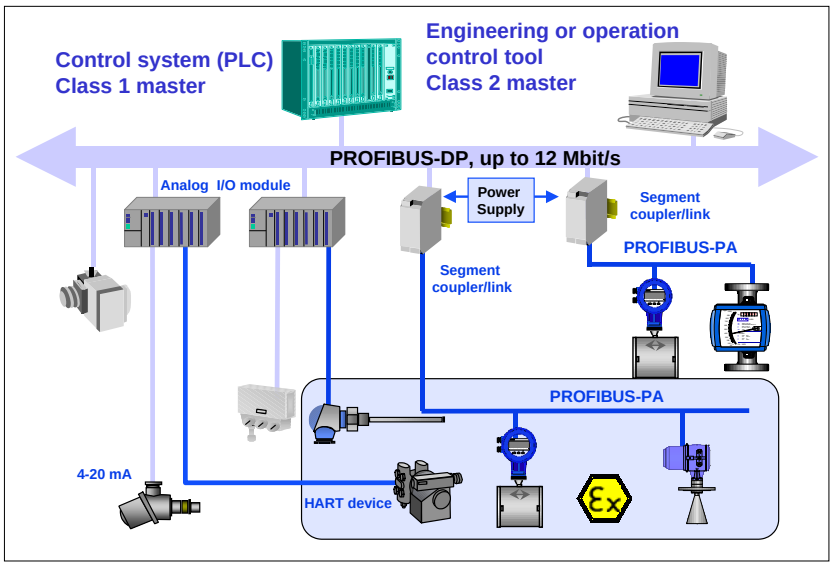
Items included with supply

In addition to the standard scope of supply, these Supplementary Instructions for the MFM 4085 K / F i and MFM 2081/3081 K / F i with PROFIBUS-PA interface, plus a diskette with all available GSD files for KROHNE devices.

Software history

Issued	Signal converter		Instructions	
month/ year	Hardware	Firmware	Device	User program
05/99	PROFIBUS-PA Module	4.10/PRE990528		
06/99	PROFIBUS-PA Module	4.15/PRE990618		
11/99	PROFIBUS-PA Module	4.12/991126		

2. Technical Specifications



The above diagram shows a typical instrumentation with PROFIBUS-PA devices in hazardous and non-hazardous locations, including connection of conventional devices (e.g. with 4-20mA signals) to the PROFIBUS-PA.

The PROFIBUS-PA is normally connected to a segment coupler, which, among other things, carries out conversion to the PROFIBUS-DP. Here, it needs to be noted in particular that the segment coupler is normally set to a fixed baud rate on the DP side.
Further information on the planning and Operation of PROFIBUS-PA networks is to be found in the KROHNE brochure “PROFIBUS-PA networks”.

2.1 GSD File

All available GSD files of KROHNE devices – including those of the MFC 081 i or 085 i, of course - are supplied together with each device. The GSD contains information that is needed for project planning of the PROFIBUS-DP/PA communication network. The relevant data files must be loaded into the project planning system/master system before start-up of the bus system.
For example, the following applies to COMET 200 or COM PROFIBUS from Siemens:

- all GSD files (*.GSD) into the directory of the GSD files, e.g. *\GSD
- all BMP files (*.BMP) into the directory of the bit maps, e.g. *\BITMAPS

In STEP7, the GSD file is automatically copied into the respective directory with “install new GSD” (in the HW-Config Menu: EXTRAS). After that, the bit map must be copied into the directory *\SIEMENS\STEP7\S7data\Nsbmp. Following “catalogue updating” the device can be placed in the project. This will then enable the cyclic communication (measured values and status).

The MFC 081/085 i are supporting the entire PROFIBUS-PA profile V 3.0. All devices have two ident-no. and two GSD files. Ident-no. “F701” belongs to the GSD file KROHF701.GSD and includes the complete functionality of the mass flow meter. The use of the manufacturer independent Ident-no. “9742” (GSD file “PA_9742.GSD”) allows the user an interchange with other mass flow devices from other manufacturers.

PA_9742.GSD

The limited functionality of the GSD file includes four function blocks:
Mass flow rate, density, temperature and mass flow totalizer.

You need the PA_9742 to use this functionality. Before this, the communication has to be projected and it has to be switched from “full functionality” to “interchangeable basic configuration” by using a Master Class 2 Tool (IDENT_NUMBER_SELECTOR: Slot 0, Index 40 change byte value from 1 to 0). After this has been done, the device has to be projected by using PA _9742.

KROHF701.GSD

KROHNE delivers the GSD with the entire device functionality, which is listed below:

Block Number	Standard-Configuration	KROHF701.GSD Ident-No. F701	Address of the “channel parameter”
1	Mass Flow	AI-FB	ØxØ115
2	Density	AI-FB	ØxØ119
3	Temperature	AI-FB	ØxØ11D
4	Mass Totalizer	Totalizer-FB	ØxØ115
5	Volume Flow	AI-FB	ØxØ111
6	Percentage Mass or ° Brix	AI-FB	ØxØ139
7	Solid Flow	AI-FB	ØxØ141
8	Volume Totalizer	Totalizer-FB	ØxØ111

AI = Analog Input Function Block
FB = Function Block

Important Notes:

1. To project the PROFIBUS communication network, you have to allocate each of the blocks to a function. On the PC-S7 from Siemens, this will be done with the Tool HW-Config. It offers the functions which are described as follows:

2. It is possible to program an “empty block” on each block number. This means, that for this block no data are transmitted in the cyclic data telegram.

3. There is NO Al block allowed on block position 4 and 8! Only totalizer block is here allowed! That means the function “Analog Input (AI) is not possible. Beside the totalizer functions is only the “empty block” allowed.

4. There is a choice between 4 different totalizer functions, which can be allocated to the blocks 4 and/or 8. The meaning of the cyclic data transfer (Totalizer and Status) does always correspond the meaning in section Meaning of the Measuring- and Status Messages. The four functions are defined as follows:

Function “Totalizer”	cyclic transfer of the totalizer with status to the master
Function “TOT_SetTot”	cyclic transfer of the totalizer with status to the master + cyclic control data from master to the device via the Bytes SetTot
Function “TOT_Mode_Tot”	cyclic transfer of the totalizer with status to the master + cyclic control data from master to the device via the Bytes ModeTot
Function “TOT_SetTot_ModeTot”	cyclic transfer of the totalizer with status to the master + cyclic control data from master to the device via the Bytes SetTot and after that ModeTot

Both, the Byte SetTot and ModeTot are beeing sent cyclicly from Master to the device, by inserting these bytes as output datas to the PLC configurator. The meaning of the control bytes are as follows:

SetTot

SetTot =0:	Totalizer is totalizing. If the value of SetTot changes from “1” or “2” to “0” the totalizer starts from the actual (0 or Preset value).
SetTot =1:	Totalizer will be reset to 0 and stays there until SetTot is switched to 0.
SetTot =2:	Totalizer is set to the value of PresetTot. PresetTot can be written via a acyclic master (totalizer in block 4 = Slot 4 Index 32; totalizer in block 8 Index 32).
SetTot > 2:	Is not allowed

ModeTot

ModeTot = 0	totalizer totalizes positive and negative values.
ModeTot = 1	totalizes only positive values.
ModeTot = 2	totalizes only negative values.
ModeTot = 3	totalizer is stopped, no totalization happens.
ModeTot >3	is not allowed

5. The standard block configuration can be changed, e.g. that density will be transferred in block 1 instead of block 2. To do this, customer has to use a user tool, which can change the “channel parameter” under the relative index 14, for totalizer function blocks under index 12. In the above listed table, we have listed in the column “ Address of the “channel parameter” the value, which you have to program in the channel parameter of the function blocks.
6. Does the device include the options “volume concentration” or “° Baumé”, ° Brix and NaOH, these values can be programmed via the channel parameters on a Al function block. The value of the corresponding function block (relative Index 14) has to be programmed 0x0135 for volume concentration or 0x013D for ° Baumé.

2.2 PROFIBUS-PA Profile

The MFC 081/085 i supports the PROFIBUS-PA Profile Version 3.0. Additionally, all relevant parameters in the device are offered via the PROFIBUS-PA interface. The MFC 081/ 085 *i* defines the following blocks:

- Six blocks Analog Input (AI): mass flow, density, temperature, volume flow, percentage mass and solid flow. Optional volume concentration and ° Baumé can be provided.
- Two totalizer function blocks (TOT): totalized mass and totalized volume. As an option, the solids can be totalized.
- One transducer block for Coriolis mass flow devices.
  This block provides the parameters and functions defined in Profile 3.0, as well attached are the values, which are not defined by the profile.
- One physical block.
  This block contains the parameters defined in Profile 3.0.

2.3 Meaning of the Measuring- and Status Messages

By implementing devices in the PROFIBUS-Master by using the GSD, it is possible to indicate, which measuring and totalizer messages will be transferred over the PROFIBUS. To each values a status will be added. First, the 4 value byte (Float Format to IEEE Standard 754 Short Real Number) and then 1 status Byte will be transferred. That means that each measuring or totalizing value is described with 5 byte and transmitted one after the other according to the sequence which was projected over the GSD. If 4 function blocks have been projected, 20 byte will be transmitted.
First an example of the float format:

Byte n								Byte n+1								Byte n+2								Byte n+3							
Bit7	Bit6							Bit7	Bit6							Bit7								Bit7							
VZ	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}	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}
	Exponent							Mantisse								Mantisse								Mantisse							

Example: 40 F0 00 00 (hex) = 0100 0000 1111 0000 0000 0000 0000 0000 (binary)

Formula: $Value = (-1)^{VZ} * 2^{(Exponent - 127)} * (1 + Mantisse)$
$Value = (-1)^{0} * 2^{(129 - 127)} * (1 + 2^{-1} + 2^{-2} + 2^{-3})$
$Value = 1 * 4 * (1 + 0,5 + 0,25 + 0,125)$
$Value = 7,5$

The meaning of the status (unsigned integer) you will find in following table:

Quality		**Quality-Substatus**				**Limits**		
Gr	Gr	QS	QS	QS	QS	Qu	Qu	
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
0	0							= bad
0	1							= uncertain
1	0							= good (Non Cascade)
1	1							= good (Cascade) - not supported

Status = bad								
0	0	0	0	0	0			= non-specific
0	0	0	0	0	1			= configuration error
0	0	0	0	1	0			= not connected
0	0	0	0	1	1			= device failure
0	0	0	1	0	0			= sensor failure
0	0	0	1	0	1			= no communication (last usable value)
0	0	0	1	1	0			= no communication (no usable value)
0	0	0	1	1	1			= out of service
Status = uncertain								

0	1	0	0	0	0			= non-specific
0	1	0	0	0	1			= last usable value
0	1	0	0	1	0			= substitute-set
0	1	0	0	1	1			= initial value
0	1	0	1	0	0			= sensor conversion not accurate
0	1	0	1	0	1			= engineering unit violation (unit not in the valid set)
0	1	0	1	1	0			= sub-normal
0	1	0	1	1	1			= configuration error
0	1	1	0	0	0			= simulated value
0	1	1	0	0	1			= sensor calibration

Status = good (Non-Cascade)								
1	0	0	0	0	0			= ok
1	0	0	0	0	1			= update event
1	0	0	0	1	0			= active advisory alarm (priority < 8)
1	0	0	0	1	1			= active critical alarm (priority > 8)
1	0	0	1	0	0			= unacknowledged update event
1	0	0	1	0	1			= unacknowledged advisory alarm
1	0	0	1	1	0			= unacknowledged critical alarm
1	0	1	0	0	0			= initiate fail safe
1	0	1	0	0	1			= maintenance required

Status = Limits								
						0	0	= ok
						0	1	= low limited
						1	0	= high limited
						1	1	= constant

Please test the first two (Quality) to check the quality of the measuring value:

Good (non Cascade)	measuring value is ok and can be used
Uncertain	the measuring value can be used, although the accuracy is not confirmed (e. g. measuring value is frozen or A/D-value is outside of the valid range)
Bad	the measuring value is not acceptable and cannot be used for further processing.
Good (Cascade)	will not be supported, because it is not applicable for the device

Diagnosis

If the internal diagnostic detects a error, additional information will be transmitted in the Master. The meaning of this information are described in the GSD-file under UNIT_DIAG_BIT(i).

3. Connection of Instruments on the PROFIBUS-PA system

3.1 Interconnection of devices in hazardous locations

We recommend that a PROFIBUS-PA network in the hazardous location be projected in accordance with PTB’s FISCO model (see KROHNE brochure “PROFIBUS-PA networks”). In that case, all connected electrical components (including the bus termination) must be approved in conformity with the FISCO model.

3.2 Bus cable

The statements given in the FISCO model apply only provided the bus cable used meets the following specifications: R´=15...150 Ohm/km; L´=0.4...1 mH/km; C´=80...200 nF/km.

3.3 Shielding and grounding

For optimum electromagnetic compatibility of systems it is extremely important that the system components, and particularly the bus cables connecting the components, be shielded and that such shields - if possible - form an unbroken cover, electrically speaking.
Hence it follows that, for use in non-hazardous duty systems , the cable shield should be grounded as often as possible.
In “Ex“ systems with adequate equipotential bonding in the hazardous and non-hazardous location along the entire Fieldbus installation, multiple grounding of the shield is also of advantage.

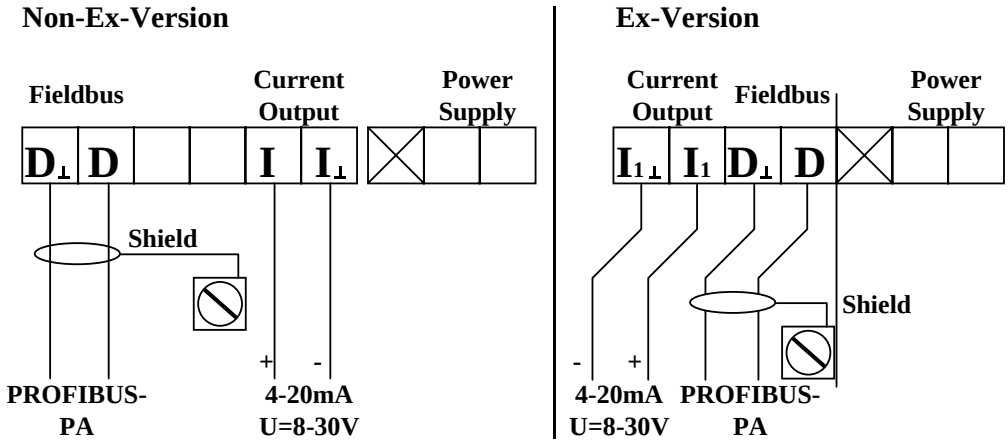
Note: The use of twisted and shielded cables is strongly recommended, otherwise EMC protection of the mass flow meter cannot be assured.

3.4 PROFIBUS-PA connection

Connect the bus cable as shown in the figure.

- Connect the cable cores to terminals D and D• .
- Polarity reversal will not have any effect.
- The cable shield should be connected with minimum length to the FE functional ground.
- The equipotential bonding conductor must be connected to the device by connecting it to FE functional ground

PROFIBUS-PA with current output:



4. Menu Settings for PROFIBUS-PA

The following settings need to be made for Operation of the MFC 081/ 85 i on a PROFIBUS-PA network. Note, that the address can be set over the communication service “Set slave address” from the master.

Function (Fct.)	Description
3.8.4 LOCATION	**Tag name setting** (measuring point no.) max. 10 characters Characters assignable to each place: A-Z 0-9 or "_" (blank character)
3.11.0	Text, measuring-point tag (max. 10 characters) Characters assignable to each place: A-Z 0-9 or "_" (blank character)
3.11.1 PROTOCOL	• PROFI PA
3.11.2 ADDRESS	Set address Range: 00-126 for PROFIBUS-PA (default 126)
3.11.3 BAUD RATE	BLOCKED

5. Technical Data

Hardware		Software	
Physical	to IEC 61158-2 and the FISCO model	GSD	GSD file supplied on diskette
Bus characteristic	9... 30 V; 0.3 A max.; 4.2 W max.	Device profile	complete implementation of Profile B, V3.0
Base current	10 mA.	Function blocks	Function blocks (listed units=default units) mass flow [kg/s] density [kg/l] temperature [°K] mass totalizer [kg] volume flow [m3/h] percentage mass [%sol/wt] or °Brix [degBrix] solid flow [kg/s] volume totalizer [m3]
FDE	yes: separate fault disconnection electronics provided.	Optional	Percentage volume [%vol] ° Baumé [degBaum hv]
Fault current	6 mA; (fault current = max. continuous current – base current).	Address range	0-126, default 126,
Starting current	lower than the base current	Operator control	local display and operator interface at device.
“Ex“ approval	EEx ia IIC T6 or EEx ib IIC/IIB T6 in conformity with the FISCO model	SAP’s	1; the number of Service Access Points is typically equal of the number of master class 2 tools
Connection	independent of polarity		

	Ex	Non-Ex
Supply voltage	24 V AC/DC (Switch mode power supply) U_N = 24 V DC +30% / -25%, 5W U_N = 24 V AC +10% / -15%, 5W 100 V AC...230 V AC + 10% / 15%, 10 V A	24 V AC/DC (Switch mode power supply) U_N = 24 V DC +30% / -25%, 5W U_N = 24 V AC +10% / -15%, 5W 100 V AC...230 V AC + 10% / 15%, 10 V A
Fuse rating	I_N <= 1.25 A	I_N <= 1.25 A
Outputs / inputs	Module dependant	Module dependant
Current output (IS)		
Function	All operating data programmable galvanically isolated from supply, CPU and other outputs. Passive (Current sink, EX*i*)	All operating data programmable galvanically isolated from supply, CPU and other outputs. Passive.
Current	4 – 20 mA	4 – 20 mA
Linearity	0.05% (reference 20 mA at 25°C)	0.05% (reference 20 mA at 25°C)
Temperature drift	<= 100 ppm/°K (Typical 30ppm/°K)	<= 100 ppm/°K (Typical 30ppm/°K)
Load	$\frac{U_S - 8V}{22\ mA}$ (U_S = external supply voltage)	$\frac{U_S - 8V}{22\ mA}$ (U_S = external supply voltage)
Supply	8 – 30 V	8 – 30 V
	Connect ONLY to certified IS circuits with the maximum values: Ui = 30V, Ii = 250mA, Pi = 1W	
Pulse output (IS)		**Not available**
Function	All operating data programmable galvanically isolated from supply, CPU and other outputs.	
Operation	Passive, loop-powered	
External supply voltage	6 – 30V DC	
Current	Maximum 110 mA / 6 – 30 V DC I high <= 900 µA (30 V) I high <= 200 µA (8 V)	
Saturation voltage	≤2V @ I = 110mA	
Frequency	≤ 1300Hz	
	Connect ONLY to certified IS circuits with the maximum values: Ui = 30V, Ii = 250mA, Pi = 1W	
Status output		**Not available**
Function	All operating data programmable galvanically isolated from supply, CPU and other outputs.	
Operation	Passive, loop-powered	
External supply voltage	6 – 30V DC	
Current	≤ 110 mA I high <= 900 µA (30 V) I high <= 200 µA (8 V)	
	Connect ONLY to certified IS circuits with the maximum values: Ui = 30V, Ii = 250mA, Pi = 1W	

	Ex	Non-Ex
Control input (IS)		**Not available**
Function	All operating data programmable galvanically isolated from supply, CPU and other outputs.	
Operation	Passive, loop-powered	
External supply voltage	7 – 30V DC	
Current	≤ 4.5 mA	
Control signals	7-30V DC for HIGH 0-2V or open terminals for LOW	
	Connect ONLY to certified IS circuits with the maximum values: Ui = 30V, Ii = 250mA, Pi = 1W	
PROFIBUS PA		
Hardware	See table above	See table above
Software	See table above	See table above
Fieldbus Foundation (IS)	Pending	Pending
Hardware	Designed to ISA and IEC 1158-2 physical layer. Standards applicable to type 121 device profile. Connection: polarity independent Connect ONLY to certified IS circuits according to the FISCO model with the maximum values: Ui = 30V, Ii = 250mA, Pi = 1W	Designed to ISA and IEC 1158-2 physical layer. Standards applicable to type 121 device profile. Connection: polarity independent Bus data: 9V – 32V; 11mA typical
Ambient Temperature	-20 to 65°C	-20 to 65°C