



H250 M40 ESK4 Supplementary instructions

Signal converter for variable-area flowmeters

Description of PROFIBUS interface

The documentation is only complete when used in combination with the relevant documentation of the flowmeter.



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1.1 Installation

If the ESK4 Device Description is not already installed on the PDM System a so called Device Install ESK4 PROFIBUS-PA PDM is needed (available as download from KROHNE 'Download Center' on the internet or on CD-ROM from KROHNE). For installing the DD with the Device Install refer to the "PDM Manual" section: "Integrating Devices". Please read also the "readme.txt", which is also contained in the Device Install.

1.2 Scope of the document

These instructions are supplementary to the standard product documentation of the signal converter. The details described herein, in particular the safety information, are valid and shall be adhered to. The present supplementary instructions provide additional information for the device when it is connected to a PROFIBUS network.



INFORMATION!

The information in this document only contains the data applicable to the PROFIBUS module. The technical data in the signal converter Handbook is valid in its current version, provided that it is not rendered invalid or replaced by these supplementary instructions.

1.3 Scope of delivery

A device for PROFIBUS communication is supplied with:
Supplementary instructions for the PROFIBUS PA interface (this document)

2.1 Software history

Issued	Signal converter		Application program		System integration		
Mth./year	Hardware	Firmware	Hardware	Software	Driver	Version	Model name
07/12	PROFIBUS PA module Ident. No. 4000769602	V2.1.x / 120717	Simatic PCS7 or other SPS of other manufact.	HW Config	GSD (device specific)	KR014531.GSD	ESK4-PA
				or other Software of other SPS manufact.	GSD (profile specific)	PA139740.GSD	Flow 1 AI 1 TOT (Phy MBP)
			Laptop / PC	PDM (≥ 6.0 SP5)	DD (Ident.-No.)		
				Pactware	DTM ≥		

2.2 Device overview

The ESK4-PA transmitter has a modular design. It consists of the following components:

- ESK4-Basic module
- ESK4-PA module

The ESK4-Basic module performs the measuring while the ESK4-PA module provides communication technology and power supply for both modules.

Depending on the factory calibration and the assembled sensor the ESK4-PA transmitter can be used to perform flow or level measurement.

The ESK4-PA transmitter has a MBP interface (Manchester coded, bus powered) to connect the device to a PROFIBUS PA network. The software supports the PROFIBUS PA Profile 3.02. Both, cyclic services towards a control system (e.g. PLC) as well as acyclic services for operating with engineering tools (e.g. DD/DTM based tools) are supported.

The PROFIBUS station address can be set via a hardware switch or via PROFIBUS services.

2.3 PROFIBUS PA Profile implementation

The PROFIBUS PA Profile 3.02 defines standardized parameters and functions for PROFIBUS devices used for process control. It describes a PROFIBUS device as a function block application, i.e. parameters and functions are grouped into different blocks. In the ESK4-PA transmitter the following blocks are implemented:

Block	Usage
1 Physical Block (PB)	contains identification and diagnosis parameters of the device
1 Flow Transducer Block (TB-Flow)	contains parameters and functions to control the flow measurement
1 Level Transducer Block (TB-Level)	contains parameters and functions to control the level measurement
1 Analog Input Function Block (AI-FB)	contains parameters and functions to control the measuring output; provides the measuring value(s)
2 Totalizer Function Blocks (Tot-FB)	contains parameters and functions to control/provide the counter value(s)

The Analog Input Function Block and the Totalizer Function Blocks provide the data interface towards a process control system (e.g. a PLC); i.e. their input/output data can be read/written by the control system. In a PROFIBUS network this is done via cyclic communication services.

From the PROFIBUS point of view the ESK4-PA transmitter is designed as a modular device with three slots. While the Analog Input Function Block is assigned (as virtual module) to slot 1 the Totalizer Function Blocks are assigned (as virtual modules) to slot 2 and 3. This assignment is fixed and cannot be modified by the user. Nevertheless the measuring data for each Function Block is selectable according to the following tables:

Device calibrated for Volume Flow

Slot	Module type	Measuring data ①
1	AI-FB	Volume flowrate (Default setting) Mass flowrate Board temperature
2	Totalizer-FB	Totalized volume flowrate (Default setting) Totalized mass flowrate
3	Totalizer-FB	Totalized volume flowrate Totalized mass flowrate (Default setting)

① Selection of measuring data can be changed by modifying the channel parameter via acyclic PROFIBUS services.

The calibration units are used as default units.

Device calibrated for Mass Flow

Slot	Module type	Measuring data ①
1	AI-FB	Volume flowrate Mass flowrate (Default setting) Board temperature
2	Totalizer-FB	Totalized volume flowrate Totalized mass flowrate (Default setting)
3	Totalizer-FB	Totalized volume flowrate (Default setting) Totalized mass flowrate

① Selection of measuring data can be changed by modifying the channel parameter via acyclic PROFIBUS services.

The calibration units are used as default units.

Device calibrated for Level

Slot	Module type	Measuring data ①
1	AI-FB	Level (Default setting) Board temperature
2	Totalizer-FB ②	Totalized volume flowrate (Default setting) Totalized mass flowrate
3	Totalizer-FB ②	Totalized volume flowrate Totalized mass flowrate (Default setting)

① Selection of measuring data can be changed by modifying the channel parameter via acyclic PROFIBUS services.

② Totalizing is not active if the device is calibrated for level measurement.

The default unit for level is [%]. Calibration unit is used as default unit for board temperature.

2.4 Technical data

Hardware

Type	PROFIBUS MBP interface according to IEC 61158-2 with 31.25 kbit/s; voltage mode (MBP = Manchester Coded Bus Powered)
Polarity	Independent of polarity at electrical connection
Base current	16 mA
FDE	Separate fault disconnection electronics provided (FDE = Fault Disconnection Electronics)
Max. error current	23 mA
Start current after 10ms	Lower than base current

Electrical connections

Device power supply	Bus powered 9...32 VDC - not intrinsically safe
	Bus powered 9...24 VDC - intrinsically safe
Basic current	16 mA
Maximum error current	23 mA
Start current after 10 ms	lower than basic current
Polarity sensitivity	No
Minimum cycle time	250 ms

Software

Supported GSD	KR014531.GSD PA139740.GSD PA139700.GSD KR0HF201.GSD YP01F201.GSD	
Device profile	PROFIBUS PA Profile V3.02; conformance class B, compact	
Address setting	Default:	126
	Hardware switch:	0...126/selection via PROFIBUS service Set_Slave_Add.
	PROFIBUS service Set_Slave_Add:	0...125
	Factory_Reset=2712:	126
Write protection	Password and/or hardware switch	
SAP's	2× MS1 SAPs – acyclic interface to PLC	
	3× MS2 SAPs – the number of MS2 Service Access Points is typically equal to the maximum number of master class 2 tools	
Function blocks	1 Physical Block 1 Flow Transducer Block (Variable area) 1 Level Transducer Block 1 Analog Input Function Block 2 Totalizer Function Blocks	

3.1 Topology of a PROFIBUS PA network

The following diagram shows a typical network configuration with PROFIBUS PA devices in hazardous and non-hazardous areas, as well as the connection of conventional non-PROFIBUS devices (e.g. with 4 ... 20 mA signals) to a PROFIBUS network.

The PROFIBUS PA segment is connected to a segment coupler which, among other things, provides the conversion to the PROFIBUS DP bus line. In addition it provides the power supply for bus-powered PROFIBUS PA devices. Refer to the instruction manual of the segment coupler concerning the DP bus parameters, e.g. the supported baud rates.

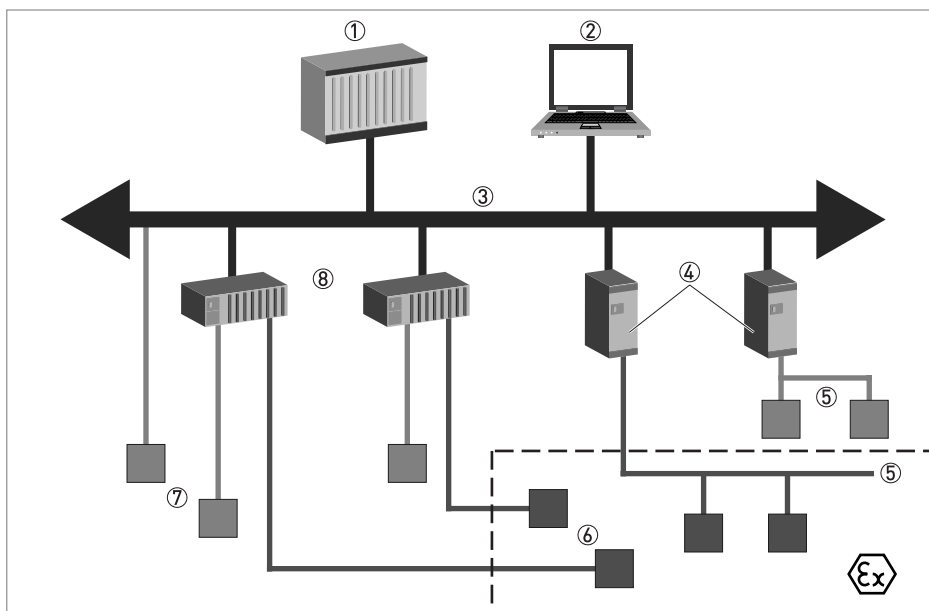


Figure 3-1: PROFIBUS PA network

- ① Control system (PLC); class 1 master
- ② Engineering or operation control tool; class 2 master
- ③ PROFIBUS DP network with max. 12 Mbit/s
- ④ PROFIBUS PA segment coupler DP / PA
- ⑤ PROFIBUS PA network with 31.25 kbit/s
- ⑥ HART® device
- ⑦ More devices with 4...20 mA
- ⑧ Analogue I/O module

Refer also to the PROFIBUS PA User and Installation Guideline (Version 2.2, February 2003 PNO Order No. 2.092).

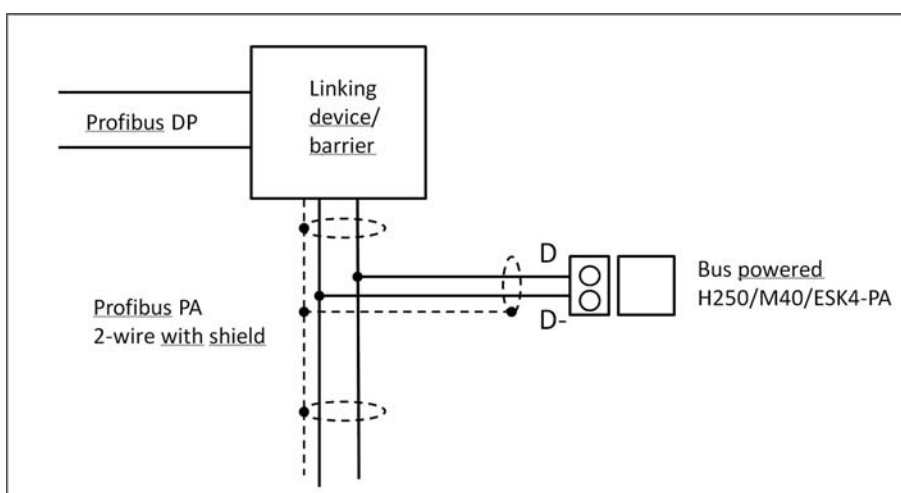
3.2 Electrical connection for signal converter

Bus cable - Shielding and grounding

The statements of the FISCO model only apply if the used bus cable meets the required specifications.

In order to ensure optimum electromagnetic compatibility of systems it is important that the system components, and in particular the bus cables, are shielded. These shields must have as few gaps as possible.

Polarity reversal has no effect on the function. The cable shield should be connected with minimum length to the functional ground FE.



ESK4-PA

- 2-wire bus powered
- Protected against reverse polarity
- Foundation Fieldbus
- Bus supply voltage 9...32 VDC
- Nominal current 16mA

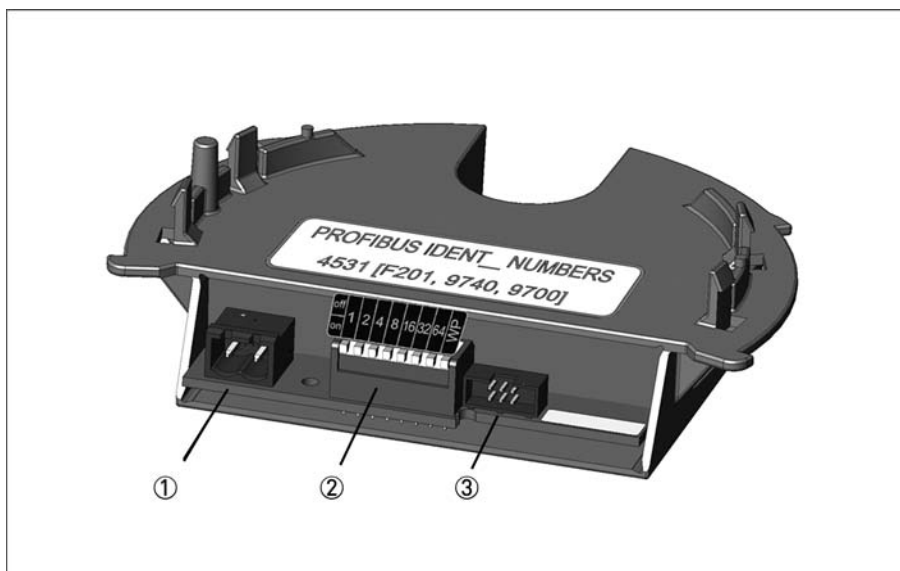


DANGER!

The signal converter must be properly grounded to avoid personnel shock hazard. All directions, operating data and connection diagrams do not apply to devices used in hazardous areas; in such cases, read the special Ex instructions without fail!

4.1 Hardware settings

A hardware switch is available at the ESK4-PA module to set the PROFIBUS station address as well as to activate a hardware write protection. It is realized by a switch with 8 separate switches.



- ① Power supply D / D-
- ② Hardware switch
- ③ Connection to basic module

Function	Value (off)	Value (on)	Label
Write protection	disabled	enabled	WP
Station address	+ 64	+ 0	64
	+ 32	+ 0	32
	+ 16	+ 0	16
	+ 8	+ 0	8
	+ 4	+ 0	4
	+ 2	+ 0	2
	+ 1	+ 0	1

The actual station address is calculated by adding the corresponding values shown in the diagram above. Each value depends on the setting of its corresponding switch. Default setting for each switch is “off”; i.e. write protection is disabled and station address set to an invalid value (127).

According to the PROFIBUS PA Profile 3.02 the following rules are considered in conjunction with the hardware switch:

Hardware write protection:

- If hardware write protection is enabled acyclic write access via PROFIBUS is refused to all parameters. Only index parameters remain writeable which are required to specify an entry within a table which shall be read. In addition the FI_Index remains writeable to read I&M data via the Call service.
- Hardware write protection is ignored if a password is entered to enable write access to service and/or production parameters. This will provide a comfortable write access to parameters without modifying user settings.
- Controlling the totalizers via cyclic services (i.e. via data exchange) remains possible even if hardware write protection is enabled. The corresponding parameters might be modified via these services.
- Changing the station address via Set_Slave_Add service remains available even if hardware write protection is enabled.
- Automatic Ident. Number adaptation via Set_Slave_Add service or SetPrm service remains available even if hardware write protection is enabled.
- Selection of classic/condensed status via Set_Prm service remains available even if hardware write protection is enabled. The corresponding parameter(s) might be modified via this service.

Station address

- If the hardware switch provides a valid station address (≤ 125) this address is used by the device. The Set_Slave_Add service is ignored. Automatic Ident. Number adaptation is not possible via Set_Slave_Add service in this case. Physical block parameter FACTORY_RESET code 2712 (reset station address to its default value) is rejected.
- If the hardware switch provides an invalid address (> 125) the switch is ignored by the device. The Set_Slave_Add service is accepted. Physical block parameter FACTORY_RESET code 2712 (reset station address to its default value) is accepted even if No_add_Cfg flag is set.
- If the hardware switch is shifted from an invalid address to a valid address the device takes over the selected hardware address. The flag No_Add_Chg will be set. Its former setting is ignored.
- If the hardware switch is shifted from a valid address to an invalid address the device takes over the default address 126. The flag No_Add_Chg will be cleared.
- The station address can be modified via the hardware switch even if the device is write protected (via hardware write protection and/or password protection).

4.2 GSD files

The GSD file contains information that will be needed for configuration of the PROFIBUS DP communication network. Supplementary files (e.g. _____.bmp and _____.dib) contain icons which will represent the PROFIBUS devices in the view of the bus configuration system/master system. The files must be loaded into the configuration program before. Follow the instructions in the manual of the host supplier when installing GSD file and supplementary files.

The GSD files of all KROHNE devices with PROFIBUS PA interface are available at the KROHNE internet site for download.

**INFORMATION!**

If it is supported by the host configuration tool the device entry for the ESK4-PA transmitter will be located within the slave family "PROFIBUS PA".

4.3 Ident. Number selector

Within a PROFIBUS network the type of a PROFIBUS slave is identified by its Ident. Number which is unique for this slave type. The ESK4-PA transmitter supports different Ident. Numbers. Therefore it can be installed for different use cases. When the Ident. Number is changed the behaviour of the device concerning the cyclic data transfer is changed; i.e. the maximum number of transferred measuring values and/or the length and content of the diagnosis information will be different. The user can select the required Ident. Number by an engineering tool (e.g. DD/DTM). The Ident. Number is set via the parameter IDENT_NUMBER_SELECTOR.

The following settings are supported by the ESK4-PA transmitter:

- Automatic adaptation mode (factory setting)
- Manufacturer specific Ident. Number (4531hex)
- Profile specific Ident. Number (9740hex)
- Profile specific Ident. Number (9700hex)
- Compatibility mode (ESK3-PA: F201hex)
- Compatibility mode (Profile: 9740hex)

Automatic adaptation mode (factory setting)

If the parameter IDENT_NUMBER_SELECTOR is set to this mode the device will select its operation mode during start-up of the cyclic data transfer according to the used GSD file. The active Ident. Number is set to one of the settings described below. If the IDENT_NUMBER_SELECTOR is changed to this mode the current Ident. Number is not changed until the cyclic data transfer is (re-)started.



INFORMATION!

Depending on the components in the PROFIBUS network the automatic adaptation might fail. The active Ident. Number has to be selected by the user via an engineering tool in this case. The parameter IDENT_NUMBER_SELECTOR has to be set to a fixed Ident. Number.

Manufacturer specific Ident. Number (4531hex)

This setting provides complete functionality of the ESK4-PA transmitter. All Functions Blocks (1 AI-FB, 2 Tot-FBs) are available for cyclic data transfer. Device specific diagnosis information is transferred in addition to the Profile diagnosis.

Cyclic layout:

Slot	Function Block	Valid GSD Modules
1	AI-FB	Empty Module AI: Out
2	Totalizer-FB ①	Empty Module TOT (Id.F.): Total TOT (Id.F.): SetTot + Total TOT (Id.F.): ModeTot + Total TOT (Id.F.): SetTot+ModeTot+Total TOT (Id.F.): SetTot TOT (Id.F.): ModeTot TOT (Id.F.): SetTot + ModeTot
3	Totalizer-FB ①	

① Totalizing is stopped if the ESK4-PA transmitter is calibrated for level measurement.

GSD file KR014531.GSD is required in this mode. This file might be used for all types of PROFIBUS DP/PA segment couplers.

**INFORMATION!**

If another GSD file is used in the PROFIBUS master system the cyclic data transfer cannot be established in this setting.

Profile specific Ident. Number (9740hex)

This setting is accepted only if the ESK4-PA transmitter is calibrated for flow measurement. Functionality is reduced to the requirements which are mandatory in the PA Profile; i.e. 1 AI-FB and 1 Tot-FB are available for cyclic data transfer only. Device specific diagnosis information is not available via cyclic PROFIBUS services. Nevertheless this behaviour will improve interchangeability between devices of different vendors because only functions are available which are provided by all PROFIBUS PA variable area flowmeters. Exchange is possible without modifying the configuration of the control system.

Cyclic layout:

Slot	Function Block	Valid GSD Modules
1	AI-FB	EMPTY_MODULE AI
2	Totalizer-FB	EMPTY_MODULE TOTAL SETTOT_TOTAL SETTOT_MODETOT_TOTAL

GSD file PA139740.GSD is required in this mode. This file is provided by PROFIBUS International (see www.profibus.com). This file might be used for all types of PROFIBUS DP/PA segment couplers. Take care that "Condensed Status" is not supported by this file.

**INFORMATION!**

If another GSD file is used in the PROFIBUS master system the cyclic data transfer cannot be established in this setting.

Profile specific Ident. Number (9700hex)

This setting is accepted only if the ESK4-PA transmitter is calibrated for level measurement. Functionality is reduced to the requirements which are mandatory in the PA Profile; i.e. 1 AI-FB is available for cyclic data transfer only. Device specific diagnosis information is not available via cyclic PROFIBUS services. Nevertheless this behaviour will improve interchangeability between devices of different vendors because only functions are available which are provided by all PROFIBUS PA level devices. Exchange is possible without modifying the configuration of the control system.

Cyclic layout:

Slot	Function Block	Valid GSD Modules
1	AI-FB	Analog Input (AI) short Analog Input (AI) long

GSD file PA139700.GSD is required in this mode. This file is provided by PROFIBUS International (see www.profibus.com). This file might be used for all types of PROFIBUS DP/PA segment couplers. Take care that "Condensed Status" is not supported by this file.

**INFORMATION!**

If another GSD file is used in the PROFIBUS master system the cyclic data transfer cannot be established in this setting.

Compatibility mode (ESK3-PA: F201hex)

This setting supports a compatibility mode concerning the cyclic data transfer (cyclic measurement values and diagnosis) if the ESK4-PA transmitter shall be used for replacement of an ESK3-PA transmitter. The ESK4-PA transmitter emulates the cyclic behaviour of the ESK3-PA transmitter. Status and diagnosis are restricted to the capabilities of this transmitter. Therefore it is usually not necessary to modify the configuration of the control system if it is configured for operation with an ESK3-PA transmitter.

Cyclic layout:

Slot	Function Block	Valid GSD Modules
1	AI-FB	EMPTY_MODULE Analog Input (AI)
2	Totalizer-FB ①	EMPTY_MODULE Totalizer (Ext.) SETTOT_TOTAL (Ext.) SETTOT_MODETOT_TOTAL (Ext.)
3	Totalizer-FB ①	

① Totalizing is stopped if the ESK4-PA transmitter is calibrated for level measurement.

GSD file KROHF201.GSD is required in this mode. If the ESK4-PA transmitter is connected to a Pepperl+Fuchs PROFIBUS DP/PA segment coupler SK2 or SK3 the GSD file YP01F201.GSD shall be used. Take care that "Condensed Status" is not supported in this mode for compatibility reasons.

**INFORMATION!**

If another GSD file is used in the PROFIBUS master system the cyclic data transfer cannot be established in this setting.

**INFORMATION!**

The `IDENT_NUMBER_SELECTOR` changes the behaviour of the ESK4-PA transmitter from the communication point of view. In addition it might be necessary to set additional parameters to suitable values in order to adapt the measuring behaviour to ESK3-PA.

**INFORMATION!**

Although the cyclic behaviour of the ESK3-PA is emulated by the ESK4-PA transmitter the acyclic behaviour is not changed. Therefore a DD/DTM for ESK4-PA has to be used to set parameters/read measuring values and diagnosis even if the compatibility mode is active. Extended diagnosis information is still available on this way.

Compatibility mode (Profile: 9740hex)

This setting supports a compatibility mode concerning the cyclic data transfer (cyclic measurement values and diagnosis) if the ESK4-PA transmitter shall be used for replacement of an ESK3-PA transmitter while the ESK3-PA was operating in Profile specific mode. The ESK4-PA transmitter emulates the cyclic behaviour of the ESK3-PA transmitter. Status and diagnosis are restricted to the capabilities of this transmitter. Therefore it is usually not necessary to modify the configuration of the control system if it is configured for operation with an ESK3-PA transmitter.

Cyclic layout:

Slot	Function Block	Valid GSD Modules
1	AI-FB	EMPTY_MODULE AI
2	Totalizer-FB ①	EMPTY_MODULE TOTAL SETTOT_TOTAL SETTOT_MODETOT_TOTAL

① Totalizing is stopped if the ESK4-PA transmitter is calibrated for level measurement.

GSD file PA139740.GSD is required in this mode. This file is provided by PROFIBUS International (see www.profibus.com). This file might be used for all types of PROFIBUS DP/PA segment couplers. Take care that "Condensed Status" is not supported by this file.

**INFORMATION!**

If another GSD file is used in the PROFIBUS master system the cyclic data transfer cannot be established in this setting.

**INFORMATION!**

The `IDENT_NUMBER_SELECTOR` changes the behaviour of the ESK4-PA transmitter from the communication point of view. In addition it might be necessary to set additional parameters suitable values in order to adapt the measuring behaviour to ESK3-PA.

**INFORMATION!**

Although the cyclic behaviour of the ESK3-PA is emulated by the ESK4-PA transmitter the acyclic behaviour is not changed. Therefore a DD/DTM for ESK4-PA has to be used to set parameters/read measuring values and diagnosis even if the compatibility mode is active. Extended diagnosis information is still available on this way.

**INFORMATION!**

This operation mode cannot be entered via the Automatic adaptation mode (see above).

4.4 Summary

The following table shows a summary of the supported combinations:

Calibration	Ident. Number Selector	Ident. Number	GSD File	Status
Flow	Automatic adaptation mode	4531	KR014531.GSD	classic condensed
		9740	PA139740.GSD ①	classic
		F201	KROHF201.GSD YP01F201.GSD	classic
Level	Automatic adaptation mode	4531	KR014531.GSD	classic condensed
		9700	PA139700.GSD ①	classic
		F201	KROHF201.GSD YP01F201.GSD	classic
Flow/Level	Manufacturer specific Ident. Number (4531hex)	4531	KR014531.GSD	classic condensed
Flow	Profile specific Ident. Number (9740hex)	9740	PA139740.GSD ①	classic
Level	Profile specific Ident. Number (9700hex)	9700	PA139700.GSD ①	classic
Flow/Level	Compatibility mode (ESK3-PA: F201hex)	F201	KROHF201.GSD YP01F201.GSD	classic
Flow/Level	Compatibility mode (Profile: 9740hex)	9740	PA139740.GSD ①	classic

① This file is provided by PROFIBUS International (see www.profibus.com)

4.5 Configuration of cyclic data transfer

During network configuration the user has to select which function block input/output data shall be transferred between the PROFIBUS master and the PROFIBUS slave. The GSD file described above contains several types of modules for this purpose. During configuration a module has to be assigned to each slot of the device in order to select which data has to be transferred for the corresponding function blocks. The cyclic layout (see section Ident. Number selector) shows which module types are valid for each slot. The order of transmission of the data always remains the same. If an "Empty Module" is assigned to a slot no data will be sent for the corresponding function block and all function block data following this empty module will move up one position.

4.6 Cyclic data

In a PROFIBUS network cyclic data is described from the point of view of the master. Therefore input data is transferred from the slave to the master while output data is transferred from the master to the slave.

4.6.1 Input data

Input data is transferred from the ESK4-PA transmitter to the master for the measuring value and the totalizer values. The format is the same for both. If input data transfer is configured 5 bytes are transferred for the corresponding slot:

- 4 byte float value (Float Format according to IEEE Standard 754 Short Real Number)
- 1 byte status value

Float value

The following example describes the format of the float value according to IEEE Standard 754 Short Real Number:

Float format

Byte n								Byte n+1							
Bit7	Bit6							Bit7	Bit6						
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}
Exponent								Mantissa							

Byte n+2								Byte n+3							
Bit7								Bit7							
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}
Mantissa								Mantissa							

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

Formula:

$$\begin{aligned} \text{value} &= (-1)^{\text{VZ}} * 2^{(\text{Exponent} - 127)} * (1 + \text{Mantissa}) \\ \text{value} &= (-1)^0 * 2^{(129 - 127)} * (1 + 2^{-1} + 2^{-2} + 2^{-3}) \\ \text{value} &= 1 * 4 * (1 + 0.5 + 0.25 + 0.125) \\ \text{value} &= 7.5 \end{aligned}$$

Status value

The ESK4-PA PROFIBUS interface supports the PROFIBUS-PA Profile Version 3.02. In this Profile the Condensed Status and Diagnosis has replaced by default the Classic Status and Diagnosis of the PROFIBUS-PA Profile Version 3.0. The Condensed Status and Diagnosis has been created to make diagnostic events more obvious and to allow predictive and preventive maintenance. Nevertheless Classic Status and Diagnosis is still available for ESK4-PA transmitters. It is implemented for backwards compatibility to "older" devices or PLC systems which do not support Condensed Status and Diagnosis. The device may be switched between "Condensed Status and Diagnosis" and "Classic Status and Diagnosis"

- automatically during start-up of the cyclic data transfer by setting the parameter PRM_COND within the Set_Prm service data.
- using an engineering tool (e.g. DD/DTM) to write the parameter COND_STATUS_DIAG (slot 0, index 43).

Coding for both parameters is:

- 0: Classic Status
- 1: Condensed Status (factory setting)



INFORMATION!

The parameter COND_STATUS_DIAG cannot be modified directly if cyclic data transfer is active. Nevertheless it is reset to the factory setting if a reset to default data is requested by an engineering tool.

The coding of the status value depends on the active status and diagnosis mode. It is described in the following tables.

Condensed Status

The Condensed Status codes have been defined to allow easier decoding of the information provided by the PROFIBUS devices. The coding is shown in the 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

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	0	0	0	0	0	0	= non-specific (not provided by the device)
0	0	1	0	0	0	1	1	= passivated (diagnostic alerts inhibited)
0	0	1	0	0	1	x	x	= maintenance alarm, more diagnosis available
0	0	1	0	1	0	x	x	= process related, no maintenance
0	0	1	1	1	1	x	x	= function check / local override; value not usable

Status = uncertain

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	1	0	0	1	0	x	x	= substitute set
0	1	0	0	1	1	1	1	= initial value
0	1	1	0	1	0	x	x	= maintenance demanded
0	1	1	1	0	0	1	1	= simulated value, start
0	1	1	1	0	1	1	1	= simulated value, end
0	1	1	1	1	0	x	x	= process related, no maintenance

Status = good (Non Cascade)

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	
1	0	0	0	0	0	x	x	= ok
1	0	0	0	0	1	x	x	= update event
1	0	0	0	1	0	x	x	= advisory alarm
1	0	0	0	1	1	x	x	= critical alarm
1	0	1	0	0	0	x	x	= initiate fail safe (not provided by ESK4-PA)
1	0	1	0	0	1	x	x	= maintenance required
1	0	1	0	1	0	x	x	= maintenance demanded
1	0	1	1	1	1	x	x	= function check

Status = Limits

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

Check the first two quality bits in order to get the quality information of the measurement value:

- **Good (Non Cascade):** function block output value is ok and can be used without restrictions
- **Good (Cascade):** will not be supported, because it is not applicable for the device
- **Uncertain:** function block output value can be used but the accuracy can not be guaranteed (e.g. function block outputs value has been frozen or A/D converter is saturated or out of range)
- **Bad:** function block output value is bad - don't use it for process control!

The "Quality-Substatus" and "Limit" bits will be used for further diagnostics or limit checking.



INFORMATION!

The status should be monitored because a number will be transmitted even if the status of the measurement value is bad or uncertain. This is the only way to check the quality of the transmitted measurement values.

Classic Status

The Classic Status is implemented to provide compatibility to systems which are not configured for Condensed Status. The coding is shown in the 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

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	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

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	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

Status = good (Non Cascade)

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	
1	0	0	0	0	0			= ok
1	0	0	0	0	1			= update event
1	0	0	0	1	0			= active advisory alarm
1	0	0	0	1	1			= active critical alarm
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

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

Check the first two quality bits in order to get the quality information of the measurement value:

- **Good (Non Cascade):** function block output value is ok and can be used without restrictions
- **Good (Cascade):** will not be supported, because it is not applicable for the device

- **Uncertain:** function block output value can be used but the accuracy can not be guaranteed (e.g. function block outputs value has been frozen or A/D converter is saturated or out of range)
- **Bad:** function block output value is bad - don't use it for process control!

The "Quality-Substatus" and "Limit" bits will be used for further diagnostics or limit checking.



INFORMATION!

The status should be monitored because a number will be transmitted even if the status of the measurement value is bad or uncertain. This is the only way to check the quality of the transmitted measurement values.

4.6.2 Output data

Output data is transferred from the master to the ESK4-PA transmitter to control the totalizers. Behaviour and coding is described by the following tables.

Module types (defined in GSD):

Total	cyclic transfer of the totalizer value with status to the master (no output data)
SetTot + Total	cyclic transfer of the totalizer value with status to the master + cyclic control data from master to the slave via the parameter SetTot
ModeTot + Total	cyclic transfer of the totalizer value with status to the master + cyclic control data from master to the slave via the parameter ModeTot
SetTot + ModeTot + Total	cyclic transfer of the totalizer value with status to the master + cyclic control data from master to the slave via the parameters SetTot and ModeTot (in this order)
SetTot	cyclic control data from master to the slave via the parameter SetTot
ModeTot	cyclic control data from master to the slave via the parameter ModeTot
SetTot + ModeTot	cyclic control data from master to the slave via the parameters SetTot and ModeTot (in this order)

Coding of SetTot

SetTot = 0	Totalizer is totalizing
SetTot = 1	Totalizer is reset to 0.0 and remains at this value until SetTot is reset to 0. If the value of SetTot changes from "1" to "0" the totalizer starts counting from 0.0.
SetTot = 2	Totalizer is set to the value defined by PresetTot. PresetTot can be written via an acyclic service (totalizer in slot 2: Slot 2, Index 32; totalizer in slot 3: Slot 3, Index 32). If the value of SetTot changes from "2" to "0" the totalizer starts counting from the current value defined by PresetTot.
Other values are not accepted for SetTot. Values are ignored; totalizer remains in its last valid setting.	

Coding of ModeTot

ModeTot = 0	True arithmetic integration of the incoming rate values.
ModeTot = 1	Totalization of positive incoming rate values only.
ModeTot = 2	Totalization of negative incoming rate values only.
ModeTot = 3	Totalizer is stopped, no totalization is done.
ModeTot = 248	All incoming rates will be handled as positive values; i.e. negative input values will be multiplied with "-1.0".
ModeTot = 249	All incoming rates will be handled as negative values; i.e. positive input values will be multiplied with "-1.0".
Other values are not accepted for ModeTot. Values are ignored; totalizer remains in its last valid setting.	



INFORMATION!

Take care that SetTot and ModeTot are level sensitive parameters; e.g. if SetTot is changed from '0' to '1' the totalizer is reset and stopped. It will not start counting before SetTot is reset to '0' via the control system or an engineering tool. It is not reset by the ESK4-PA transmitter itself.

4.7 Diagnosis

The ESK4-PA transmitter performs internal self-tests. The results are provided as detailed diagnosis information according to PA Profile 3.02. This diagnosis information is available via several parameters and can be read by an engineering tool (e.g. DD/DTM). In addition the diagnosis information is transferred via cyclic services towards the control system (e.g. PLC).

Diagnosis is bitwise coded. Therefore it is possible to report more than one indication simultaneously. The GSD file contains a text for each diagnosis bit in order to provide a text message in the control system. The references are defined by the UNIT_DIAG_BIT(i) entries. They show which bit is set to indicate a special diagnosis event.

The amount and content of the diagnosis information depends on the device configuration. The active Ident. Number and the selected status and diagnosis mode will influence diagnosis propagation. The following tables show the diagnosis events which are reported for different settings. The bit number is equal to the counting within the GSD file. It represents the position in the device-related diagnostic field of the Slave_Diag service.

Diagnosis to control system in case of

- Manufacturer specific Ident. Number (4531hex)
- Profile specific Ident. Number (9740hex)
- Profile specific Ident. Number (9700hex)

Bit Number	supported	Description	Remedy
16	yes	Error appears	-
17	yes	Error disappears	-
24	①	Hardware failure electronics	Restart the device. If the error occurs again: send the device back to the manufacturer with an indication of the error.
27	①	Electronic temperature too high	Electronic temperature below -40°C or above +85°C. Comply with the application limits with regard to temperature of the medium and ambient temperature. If the process conditions are within the specified limits: send the device back to the manufacturer with an indication of the error.
28	①	Memory error	Reset the device to Factory/Default settings. If the error occurs again: send the device back to the manufacturer with an indication of the error.
29	①	Measurement failure	Check process conditions (Flow/Level, Temperature). If the process conditions are within the specified limits: send the device back to the manufacturer with an indication of the error.
34	①	Configuration invalid	Reset the device to Factory/Default settings. If the error occurs again: send the device back to the manufacturer with an indication of the error.
35	yes	Restart	Device is restarted because of power-up or warmstart request. In case of unexpected restart: send the device back to the manufacturer with an indication of the error.
36	yes	Coldstart	Device is reset to its Factory/Default settings because of a user request or exchange of the basic module (serial number is changed). Recover user specific parameter settings.
37	yes	Maintenance required	Linearization or temperature compensation is not operating correct. See for detailed failure message or send the device back to the manufacturer with an indication of the error.
39	yes	Ident_Number violation	Ident. Number Selector was modified while cyclic data transfer was active. To clear this message perform one of the following actions: <ul style="list-style-type: none"> • Reset Ident. Number Selector to its former setting • Stop cyclic data transfer • Restart the device
40	②	Maintenance alarm	Check detailed diagnosis. Restart the device. If the error occurs again: send the device back to the manufacturer with an indication of the error.
42	②	Function check	Simulation is active. Disable simulation to clear this message.
43	②	Invalid process condition	Check process conditions (Flow/Level, Temperature). If the process conditions are within the specified limits: send the device back to the manufacturer with an indication of the error.
55	yes	Extension available	Refer to detailed diagnosis in bits 56 to 103.
56	③	SE – ROM error	Restart the device. If the error occurs again: send the device back to the manufacturer with an indication of the error.
57	③	SE – FRAM error	Restart the device. If the error occurs again: send the device back to the manufacturer with an indication of the error.
58	③	SE – Memory corruption detected	Restart the device; if the error occurs again the device must be sent back to the manufacturer with an indication of the error.

59	③	SE – Crystal failure	The device must be sent back to the manufacturer with an indication of the error.
60	③	SE – Invalid reference voltage	
61	③	SE – Sensor A failure	
62	③	SE – Sensor B failure	
63	③	SE – Temperature sensor failure	
64	③	SE – Communication failed	
65	③	SE – Temperature out of range	Electronic temperature below -40°C or above +85°C. Comply with the application limits with regard to temperature of the medium and ambient temperature. If the process conditions are within the specified limits: send the device back to the manufacturer with an indication of the error.
66	③	SE – PV out of upper limit	PV larger than 150% of the calibrated range. Reduce flow/level. If the process conditions are within the specified limits: send the device back to the manufacturer with an indication of the error.
67	③	SE – No pre-linearization	Activate linearization or carry it out again (HART® communication and linearization software are required; the original calibration values must be known), or send the device back to the manufacturer for linearization.
68	③	SE – No temperature compensation	The device, together with an indication of the error, must be sent back to the manufacturer for checking.
69	③	SE – No output linearization	Activate linearization or carry it out again (HART® communication and linearization software are required; the original calibration values must be known), or send the device back to the manufacturer for linearization.
70	③	SE – Temperature out of limits	Electronic temperature below -45°C or above +125°C. Comply with the application limits with regard to temperature of the medium and ambient temperature. If process conditions are within the specified limits: send the device back to the manufacturer with an indication of the error.
72	③	SE not connected	Check connection between basic module and PROFIBUS module. If the error remains: send the device back to the manufacturer with an indication of the error.
76	③	SE parameter update error	Incompatible combination between basic module and PROFIBUS module: send the device back to the manufacturer with an indication of the error.
77	③	SE not supported	
78	③	SE power supply failure	Restart the device. If the error occurs again: send the device back to the manufacturer with an indication of the error.
79	③	SE – PV out of range	PV larger than 110% of the calibrated range. Reduce flow/level.
94	③	PA – Runtime data failure	Reset the device to Factory/Default settings. If the error occurs again: send the device back to the manufacturer with an indication of the error.
95	③	PA – Runtime execution failure	
96	③	PA – CPU board failure	Restart the device. If the error occurs again: send the device back to the manufacturer with an indication of the error.
97	③	PA – CPU ROM failure	
98	③	PA – CPU RAM failure	
99	③	PA – Ext. RAM failure	
101	③	PA – SPC4-2 failure	
102	③	PA – FRAM device failure	
103	③	PA – FRAM data failure	Reset the device to Factory/Default settings. If the error occurs again: send the device back to the manufacturer with an indication of the error.

① Indication is supported if Classic Diagnosis is active only.

② Indication is supported if Condensed Diagnosis is active only.

③ Indication is supported in cyclic diagnosis only if Ident. Number 4531hex is active. Nevertheless it is available always via acyclic access [e.g. by using DD/DTM].

Diagnosis to control system in case of

- Compatibility mode (ESK3-PA: F201hex),
- Compatibility mode (Profile: 9740hex):

Bit Number	supported	Description	Remedy
16	yes	Error appears	-
17	yes	Error disappears	-
24	yes	Hardware failure electronics	Restart the device. Reset the device to Factory/Default settings. Check connection between basic module and PROFIBUS module. If the error occurs again: send the device back to the manufacturer with an indication of the error.
28	yes	Memory error	Reset the device to Factory/Default settings. If the error occurs again: send the device back to the manufacturer with an indication of the error.
29	yes	Measurement failure	Refer to detailed diagnosis in bits 56 to 73. If no further information is available: send the device back to the manufacturer with an indication of the error.
35	yes	Restart	Device is restarted because of power-up or warmstart request. In case of unexpected restart: send the device back to the manufacturer with an indication of the error.
36	yes	Coldstart	Device is reset to its Factory/Default settings because of a user request or exchange of the basic module (serial number is changed). Recover user specific parameter settings.
39	yes	Ident_Number violation	Ident. Number Selector was modified while cyclic data transfer was active. To clear this message perform one of the following actions <ul style="list-style-type: none"> • Reset Ident. Number Selector to its former setting • Stop cyclic data transfer • Restart the device
55	yes	Extension available	Refer to detailed diagnosis in bits 56 to 73
56	①	IRAM Error	Restart the device. If the error occurs again: send the device back to the manufacturer with an indication of the error.
57	①	XRAM error	
58	①	ROM error	
59	①	SPC4 Error	
60	①	ADC Error	Check environment conditions. If they are within the specified limits: send the device back to the manufacturer with an indication of the error.
61	①	EEPROM Error	Restart the device. If the error occurs again: send the device back to the manufacturer with an indication of the error.
62	①	FRAM Error	Reset the device to Factory/Default settings. If the error occurs again: send the device back to the manufacturer with an indication of the error.
64	①	No ADC ZeroCal	Activate linearization or carry it out again (HART® communication and linearization software are required; the original calibration values must be known), or send the device back to the manufacturer for linearization.
65	①	No ADC FullCal	

66	①	No ADC TempCal	The device, together with an indication of the error, must be sent back to the manufacturer for checking.
67	①	No ProcessCal	Activate linearization or carry it out again (HART® communication and linearization software are required; the original calibration values must be known), or send the device back to the manufacturer for linearization.

① Indication is supported in cyclic diagnosis only if Ident. Number F201hex is active.



KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature assemblies
- Pressure transmitters
- Analysis products
- Products and systems for the oil & gas industry
- Measuring systems for the marine industry

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