BA268F/00/en 02.03 Part No. 52017696

PROCESS AUTOMATION

Manual

KFD2-HMM-16

HART Multiplexer Master

PEPPERL+FUCHS

Table of contents

Part No.: 109143, Date of issue 29.11.2000

Part No.: 109143, Date of issue 29.11.2000

1 Introduction

1.1 Explanation of the symbols used in the manual

Warning

This symbol warns of danger. If the instruction given in this warning is not heeded the result could be the injury or death of personnel and/or the severe damage or destruction of equipment.


Attention

This symbol advises of a possible failure. If the instruction given in this warning is not heeded, the device and any plant or systems connected to it could develop a fault or even fail completely.


Note

This symbol indicates important information.

1.2 Aim of the manual

This manual should enable the user to install the HART multiplexer master, to commission it and to maintain it. It provides all the information required on status and fault messages and also provides a guide to fault diagnosis and rectification.


Note

In addition, the manual provides an introduction to HART communication. For additional information, the attention of the user is directed to the bibliography in the appendix and to other literature on the subject, including the publications of the HART Communication Foundation (www.hartcomm.org).

Where reference to the bibliography is made in this manual it is indicated thus: /3/.

The appendix also explains many terms and abbreviations used in this manual.

1.3 Intended use

The HART multiplexer master **KFD2-HMM-16** provides full HART access to up to 256 field devices and hence operation with the conventional 4m A.. .2 0mA current loops. It thus acts as a transparent gateway between the service station (PC, or process control system) and the transmitters.

The multiplexer can be used within Zone 2 hazardous areas or in the safe area. Power is provided by a 24 V (nominal voltage) DC power supply. Connection to the process control system or PC is via an R S485 interface.

Warning

It should be stressed that the HART multiplexer master KFD2-HMM-16 is approved for use in zone 2 and therefore may not be used in zone 0 or 1 hazardous areas. If the equipment is used in conjunction with intrinsically safe or associated apparatus, then this use must take place in front of the Ex-barrier (e. g. transmitter power supply device).

*Reference should be made to the statement of conformity contained in **TÜV 00 ATEX 1547 X**.*

Part No.: 109143, Date of issue 29.11.2000

1.4 Responsibilities of the user

In order to avoid damage, incorrect operation and equipment failures, the user must make himself acquainted with the equipment and must have read and understood the manual before undertaking its installation and commissioning.

Repairs to the device must only be undertaken by specialist personnel and in compliance with the relevant regulations.
We strongly recommend that repairs are undertaken by the manufacturer. No guarantee claims will be accepted by Pepperl+Fuchs GmbH resulting from improper repair work.

1.5 Marking

The following identification is affixed to the KFD2-HMM-16 multiplexer:
Pepperl+Fuchs GmbH
D-68307 Mannheim

KFD2-HMM-16

TÜV 00 ATEX 1547 X II 3G EEx n A II T4

Part No.: 109143, Date of issue 29.11.2000

2 Product description

2.1 HART multiplexer master

2.1.1 Delivery package

Included in the delivery package of the device are:

- One device KFD2-HMM-16
- One product supplement (manual, data sheet, installation instruction)

2.1.2 Accessories/Product family

In addition to the HART multiplexer master, the following items from the HART multiplexer system family of products are available from Pepperl+Fuchs:

- KFD0-HMS-16, HART multiplexer slave, for extending the HART channels
- KSD2-HC, HART RPI control module, for connecting the HART multiplexer to the RPI product family
- K-HM14, cable master ↔ slave, for connecting the master with the slaves
- FI-***, HART flexible interface, handover interface of the analogue signals between transmitter, multiplexer and PLC/DCS (control system specific)
- MB-***, motherboard, carrier board for Ex-isolator module
- K-HM26, cable master/slave ↔ FI-***/MB-***, for connection of master/slave with flexible interface FI-*** or motherboard MB-***, respectively
- Interface converter RS 485 ↔ RS 232 (Telebyte Model No. 285), converter RS 485 ↔ RS 232, Pepperl+Fuchs order code: Telebyte Model 285M

Note

The complete product family is described in the Pepperl+Fuchs product catalogues. Please refer to the ordering instructions detailed in the catalogues.

2.1.3 Description of the hardware

The HART multiplexer can operate up to 256 analogue transmitters. The built-in slave unit operates the first 16 loops, and a maximum of a further 15 KFD0-HMS-16 slaves can be connected.

The external connections are shown in Figure 2.1 and Figure 2.2.

The power supply (2 4 VDC nominal voltage) is provided via the power rail or terminals 17 and18. The optional slave units or the RPI control module are connected with the master via a 14-core flat cable (K-HM14). Its connector is placed on the same housing side as the terminals for the R S485 interface and the voltage supply. The analogue signals for each unit are connected separately via a 26-core cable. 16 leads are provided for the HART signals of the analogue instrument circuits, the other 10 are connected to ground. The minimum load resistance of the analogue instrument circuits is 2 30Ω (min. load resistance in accordance with the HART specification), the max. load resistance is 5 0 0Ω. Load resistances of up to 1000 Ω are possible, however, resistance values greater than 500 Ω can interfere with the HART communication. The connector for these connections is located on the top of the housing. A process control system or a PC can be connected via a RS485 interface (terminals 13, 14 and 15). Up to 31 KFD2-HMM-16 can be operated on one RS 485 interface. Terminals 19, 20 and 21 can be used to connect additional stations to the R S485 interface. The DIP-switch on the housing front is for the setting of the R S485 address and the baud rate.

Part No.: 109143, Date of issue 29.11.2000

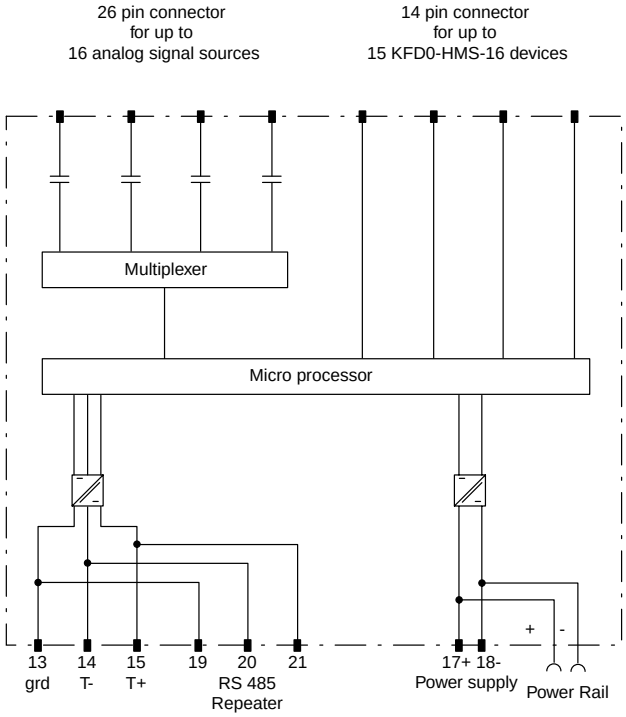


Figure 2.1: Block diagramm KFD2-HMM-16

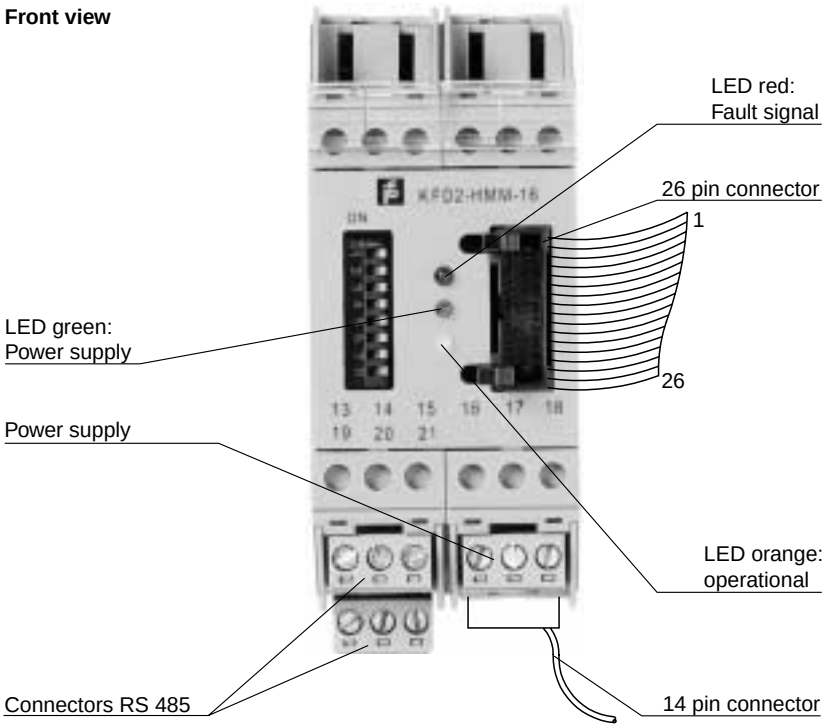


Figure 2.2: Location of the plug connectors and controls and the indicators of the KFD2-HMM-16

Part No.: 109143, Date of issue 29.11.2000

2.1.4 Galvanic isolation

The voltage supply, the analogue signals and the RS 485 interface are galvanically separated. This galvanic isolation is achieved through the use of transformers and opto couplers.

For the direct current components, the individual HART channels are isolated by means of capacitors. Thus the 4 mA ... 20 mA signal is not affected.

The connected current repeaters are galvanically interconnected unilaterally through the common ground connection of the analogue signals.
If the galvanic isolation is to be properly maintained, the individual ground cables must be isolated by capacitors. Suitable FI and MB boards can be supplied by Pepperl+Fuchs for this purpose.

Notwithstanding the common ground connection of the analogue signals from the masters/slaves, the galvanic isolation of the current repeaters is secured if

- FI and MB boards are used, which are fitted with capacitors.
- KFD2-STC4-Ex1 or KFD2-STC4-Ex2 Ex isolation modules are used as current repeaters.

2.1.5 Cabling for the analogue signals

The individual I/O components of the HART product family are connected by a single 26-pin system plug connector for the connection of the individual current repeaters (for plug pin assignmentsee section 6.2). Pepperl+Fuchs provide specially developed connector units (HART interfaces type FI-***) for this purpose. As required, the connection to these units can be via a system cable or even by means of conventional screwconnections. If the current repeaters are mounted on a motherboard (MB-***), the connection is made directly from the board to the multiplexer via a flat cable type K-HM26.

The control system is connected via a system specific connector of the motherboard or the Flex-interface. Flex-interfaces with screw terminals are available for the purpose of individual wiring.

2.1.6 Device function

*The software functions described in this section are normally integrated into the operating software for the servicing station, i.e. the functions are **not** generally (de-)activated via the described HART commands. In contrast the operating software uses functions (menu commands) to control these procedures. However the basic HART commands are described as well, because the functions may be named different in the various operating softwares and the basic function may not be obvious. Information on the supported commands can be found in section 6.1.*

Channel number

The HART multiplexer master KFD2-HMM-16 provides 16 channels for the connection of "smart“ transmitters or control devices, which support digital communication in accordance with the HART specification. A maximum of 15 additional KFD0-HMS-16 slaves can be connected, each of which in turn support 16 channels. Thus in a full assembly, a loop of 256 channels can be achieved with just one master. When using the multiplexer master with the RPI product family, no slave units are necessary. On RPI, communication takes place via the power rail.

Multiplexer table (module table)

The multiplexer master and the connected multiplexer slaves must be designated as 'available' in a multiplexer table (command 157). Only those modules defined as 'available' in this table are used in the communication process. The multiplexer table consists of 16 bit, one for each possible multiplexer address (default: module 0 (master) and 1 activated).

Part No.: 109143, Date of issue 29.11.2000

Interface

In this way, the multiplexer master acts as a transparent gateway between the service station (typically a PC with suitable software, see section 2.3.2) and the field devices. The service station is able to communicate with up to 31 multiplexer master via up to 38400 baud R S485 connection. Because each master is able to communicate with 256 field devices, up to 7936 field devices are controlable over a singl e RS485 interface.

HART

As a digital communication system for servicing and configuration purposes, the HART protocol is supported by many field devices with conventional analogu e 4m A. . .2 0mA current loops. The HART signal is thus modulated on the analogue current as an FSK signal (see section 2.2). The modulator/demodulator circuitry (Modem) required for this is integrated in the multiplexer. Only one HART transmitter can be connected at each multiplexer HART connection (no "multidrop“ functionality).

Special procedures in respect to HART communication:

- On the host side (RS 485) always the long frame address is used (except for command 0).
- On the field devices side, either the short address or the long frame address is used, depending on necessity.
- The operating modes "Primary Master“ and "Secondary Master" and the corresponding time responses are supported on the field device side.
- On the host side, only the commands 0 ... 3 and 1 1. . .13 are accepted from the secondary host. Other commands are not accepted/are ignored.
- Commands to connected field devices are only accepted by the primary host.
- Extended messages and messages in the Burst Mode are recognised and used, but not generated by the multiplexer itself.
- An answer buffer is available for a delayed message response. This can be used to intermediately store a message, the command for which requires a long execution time.

Loop construction/REBUILD (Software function)

On power-up, the device searches the multiplexers in the multiplexer table for the connected HART field devices (commands 0 and 4[1]) and generates the internally required access tables. This function can also be carried out by the connected service station, as is necessary, for example, in communication with newly connected HART field devices. The duration of this function depends on the number of connected multiplexer slaves and HART field devices and also on the type of loop search (see command 153) and the permissible number of message repeats. With 16 HART devices (e.g. by using only one master without slaves) the duration is between 1 5s and 3 0s. The number of permissible message repeats is set to "2" in the factory setting and the loop search type to "single analogue".

During the REBUILD phase, only certain read commands are accepted from the service station (commands 0, 1, 2, 3, 11, 12, 13, 48, and 129). All other commands are followed by the response "Busy" (Code 32, see section 5.3.2), until the REBUILD phase ends.

Cyclic data interrogation/SCAN (software function)

The multiplexer can read cyclic data from up to 31 transmitters. In this case the SCAN option must be set for the transmitter (command 137) and the SCAN function activated in the multiplexer (command 149, function 1). Which data is transferred is determined by the "SCAN command" option (command 147).

If the SCAN function is activated, the transmitters, on which the SCAN option is activated are regularly chekked for data. In this case, the SCAN command is executed, with which one or more variables are read from the transmitter. If a field device does not respond, it is designated as having "disappeared" (see command 129), but it remains in the search list (i. e., it is searched for again on the next run sequence). If a device has disappeared, but responds correctly on the next search command, it is then listed as "appeared". If, instead of this, another device has answered, then the status "mismatched" is assigned.

1. Command 4 is additionally used on transmitters which only support the old HART specifications up to 4.

Part No.: 109143, Date of issue 29.11.2000

Variation on the SCAN function (special SCAN function)

The multiplexer offers in addition a second SCAN function. With this special SCAN function (command 149, function 2) an additional parameter is used, which defines the minimum length of the expected number of data bytes. This can be different for each current loop, but must be set for each current loop that is to be scanned.

The SCAN function itself takes place as above, however, the response of the transmitter is compared with the expected data length. If the length of the response is less than the set minimum data length, the answer is rejected. If the minimum length is 0, the answer is always saved.

Delay on channel change/Loop switch delay (software function when used with RPI)

If the HART multiplexer is used with the RPI HART control module KSD2-HC, a pause time must be inserted when the multiplexer channel is changed. This pause time is necessary, since the RPI HART control module has to monitor the communication channel of the multiplexer and recognise the channel change. This pause time can be set by means of command 161.

All the functions at a glance

The following list gives all the functions once again at a glance:

- 16 channels, extendable to 256 channels by the connection of up to 15 KFD0-HMS-16 slaves.
- Up to 7936 loops per interface
- Automatic search of all existing HART field devices (REBUILD)
- Facility for self-standing cyclic interrogation of the HART variables (SCAN)
- Acts as a primary or secondary master
- Fast RS 485 interface (multidrop) with up to 38400 baud
- Integrated Modem
- Removable terminals
- Supply via power rail
- Approval for zone 2

2.1.7 Start-up sequence

Following connection of the power supply, the device executes an initialisation procedure with self test. The function is indicated by a flashing green LED, any errors detected are indicated by a red LED. Next a search is made of the multiplexers in the multiplexer table (command 157) for available HART compatible field devices (REBUILD). This function is indicated by a flashing orange LED. The REBUILD function can also be started via the service station, e. g. in order to include connected transmitters in the communication process during the operating phase. The duration of this function is dependent on the number of connected transmitters, multiplexer slaves and message repeats in the case of errors, or if an interrogation has not been answered. The factory setting for the number of repeats is "2". The search duration for this lies between approx. 30 s and several minutes (full structure).

In addition, transient data are set to their pre-setting. Non-volatile stored data are retained. see section 2.1.10.

2.1.8 Operation

The multiplexer master KFD2-HMM-16 also functions as a HART device (see also section 2.1.10). However, due to the incorporation into the operating software of the service station (see section 2.3.3), this remains concealed from the user. The HART commands that are supported by the multiplexer can be found in section 6.1.

For HART communication with the transmitters, the commands of the service station are passed through without modifications.

Part No.: 109143, Date of issue 29.11.2000

2.1.9 LED indicators

The device has three LEDs, located on the front of the housing.

The meaning of these LEDs is given in the following table:

Colour	Meaning
Red	*Error indications (detected during the initialisation phase)*
Green	*Operating indications*
Orange	*HART communication with a field device*

Note

During the initialisation phase, the green LED flashes, the other two are off.

During the REBUILD function, the green LED is ON and the orange flashes.

If all three LEDs flash one after the other, the DIP switch 1 (test) is in the "ON" position. Set the switch to "OFF“ and repeat the commissioning.

2.1.10 Device parameter, parameterisation

For the identification and programming of the multiplexer master, this contains - as do other HART field devices - specific parameters that are in the non-volatile memory. The following list shows these parameters and how the programming must be carried out.

- Unambiguous device identification (see commands 0, 11)
  The device identification provides information about the device (type, type-ID, serial number and revision numbers) and the manufacturer and cannot be changed.
- Message (see commands 12 and 17)
  An arbitrary 32 character long item of text can be stored in the device under this parameter.
- Tag, description and date (see commands 13 and 18)
  A tag (8 characters), description (16 characters) and a date, can be saved under these parameters.
- The number of preambles in message responses (see command 59)
  This parameter is used to establish how many preambles are inserted in message responses. The pre-setting is 4, the setting range is 2 ... 20.
- Number of message repeats (retry) (see commands 144 and 145)
  The number of message repeats can be separately set for the repeats in the case of communication errors and for the response code "Busy" (see section 5.3.2).
  The range of adjustment is 0.. .11 repeats. In the case of communication errors, the pre-setting is 2, in the case of the response code "Busy" it is 0.
- SCAN command (see section 2.1.6 and commands 146 and 147)
  Of the available SCAN parameters, only the SCAN command is stored by non-volatile means. It signifies which HART command (1, 2 or 3) is to be sent to the transmitter as the SCAN command.
- Master type (primary or secondary master) (see command 151)
  This controls the priority for access to the HART field devices. A primary master always initiates a connection with a field device. A secondary master initiates a connection to a field device through an arbitration function (i.e. only when the primary master does not achieve access). The pre-setting of the multiplexer is "Primary Master". A typical example of a secondary master is a hand-held operating device.
- Loop type search (command 153)
  At present, the multiplexer does not support a multidrop with HART, i. e. only one HART field device is connected to each HART channel. With loop construction (REBUILD, see above)the connected field devices are either always searched on the short address 0 ("single analogue"), or, in preparation for multidrop, on the short addresses 0 ... 15, in which the first one found is addressed ("single unknown").
- Module table (see section 2.1.6 and command 157)
- Delay time on channel change (loop-switch delay) (see section 2.1.6 and command 161)

Part No.: 109143, Date of issue 29.11.2000

2.1.11 Connection to the service station (PC, DCS/Process control system)

The connection to the service station or to the control system is made via a multidrop able RS 485 interface. The baud rate of this interface can be set to 9600, 19200 or 38400 baud via the DIP switches 2 and 3 (see section 2.1.12). The device address for the communication via RS 485 is set by the DIP switches 4 to 8 (see section 2.1.12).

When setting the address, care should be taken to ensure that no address is assigned more than once, since this can lead to communication errors or even communication failure.

The adjusted baud rate must comply with the service station.

2.1.12 DIP switch settings

8 DIP switches are located on the top of the device. DIP switch 1 is used by the manufacturer for testing the device and must therefore always be set to "OFF".

DIP switch	1	Meaning
Setting	*OFF*	*Normal status (LED test de-activated)*
	ON	*LED test activated; all three LEDs flash one after the other*

DIP switches 2 and 3 determine the baud rate of the RS 485 interface.

DIP switch	2	3	Meaning
Setting	*OFF*	*OFF*	*9600 Baud*
	OFF	*ON*	*19200 Baud*
	ON	*OFF*	*38400 Baud*
	ON	*ON*	*Not permitted*

DIP switches 4 to 8 determine the RS485 address. A value is assigned to each of the individual DIP switches for this purpose. The resulting address is given by the addition of the set values.

DIP switch	4	5	6	7	8	Meaning
Setting	*ON*					*Value 16*
		ON				*Value 8*
			ON			*Value 4*
				ON		*Value 2*
					ON	*Value 1*
Example:	*OFF*	*ON*	*ON*	*OFF*	*ON*	*address = 8 + 4 + 1 = 13*

To accept the values set on the DIP switches, the device must be isolated briefly from power supply.

Condition on delivery

DIP switch	1	2	3	4	5	6	7	8	Meaning
Setting	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*	*OFF*	*Manufacturer test de-activated* *Baud rate 9600 baud* *RS 485 address 0*

The address 0 is set on the device when delivered. Care should be taken that no address is assigned more than once.

Part No.: 109143, Date of issue 29.11.2000

2.1.13 Connection and Connection Assignment of RS 485

Connector assignment of the removable terminals:

Terminal	Description	Meaning
13, 19	*Screen*	*Cable screening*
14, 20	*RxD/TxD + (RS 485 B)*	*RS 485 differential signal*
15, 21	*RxD/TxD - (R S485 A)*	

Note

If the screen is grounded, the grounding should only be connected to one end of the cable, in order to avoid equipotential bonding currents. However, in all cases, existing guidelines and regulations must be observed.

Attention

To connect a standard PC with a R S232 interface an interface converter R S485 to R S232 is required. A converter that has been tested and recommended by Pepperl+Fuchs is manufactured by Telebyte (Telebyte Model No. 285). This can be obtained from Pepperl+Fuchs under the part number "Telebyte Model 285M".

In accordance with the RS 485 specification up to 32 stations ("multidrop") can be connected to a up to 1200 m cable (for data rates less than 100 kBaud). Pepperl+Fuchs recommends that this length of cable is not exceeded. Even though problems seldom occur at these data rates, screened twisted two-wire cabling should be used.

In addition a terminating resistor should be connected to each end of the R S485 cable. If the multiplexer master is such a device, i. e. the RS 485 cable ends here and is not routed to other devices, then the second available connection terminal for the RS 485 can be used for the connection of a terminating resistance. The terminating resistor terminates the cables with its characteristic impedance. At minimal baud rates and with short lengths of cable, in practice quite often no terminating resistors are used. If communication errors arise, or if these are to be positively excluded from the outset, terminating resistors typically of 120 Ω ... 220 Ω should be used. Such can, for example, be connected between terminals 20 and 21.

Note

If an interface converter is used, a terminating resistor should be connected to the converter and another to the other end of the cable.

Part No.: 109143, Date of issue 29.11.2000

2.2 Description of the HART communication

The HART[1] protocol is supported by many conventional 4 mA ... 20 mA field devices, which thus enable digital communication for configuration and servicing purposes. Many device parameters and also the measured values themselves can thus be digitally transferred to and from the device. This digital communication runs in parallel with th e 4m A. . .2 0mA signal on the same cable. This is possible through a current modulation, which is superimposed on the user signal.

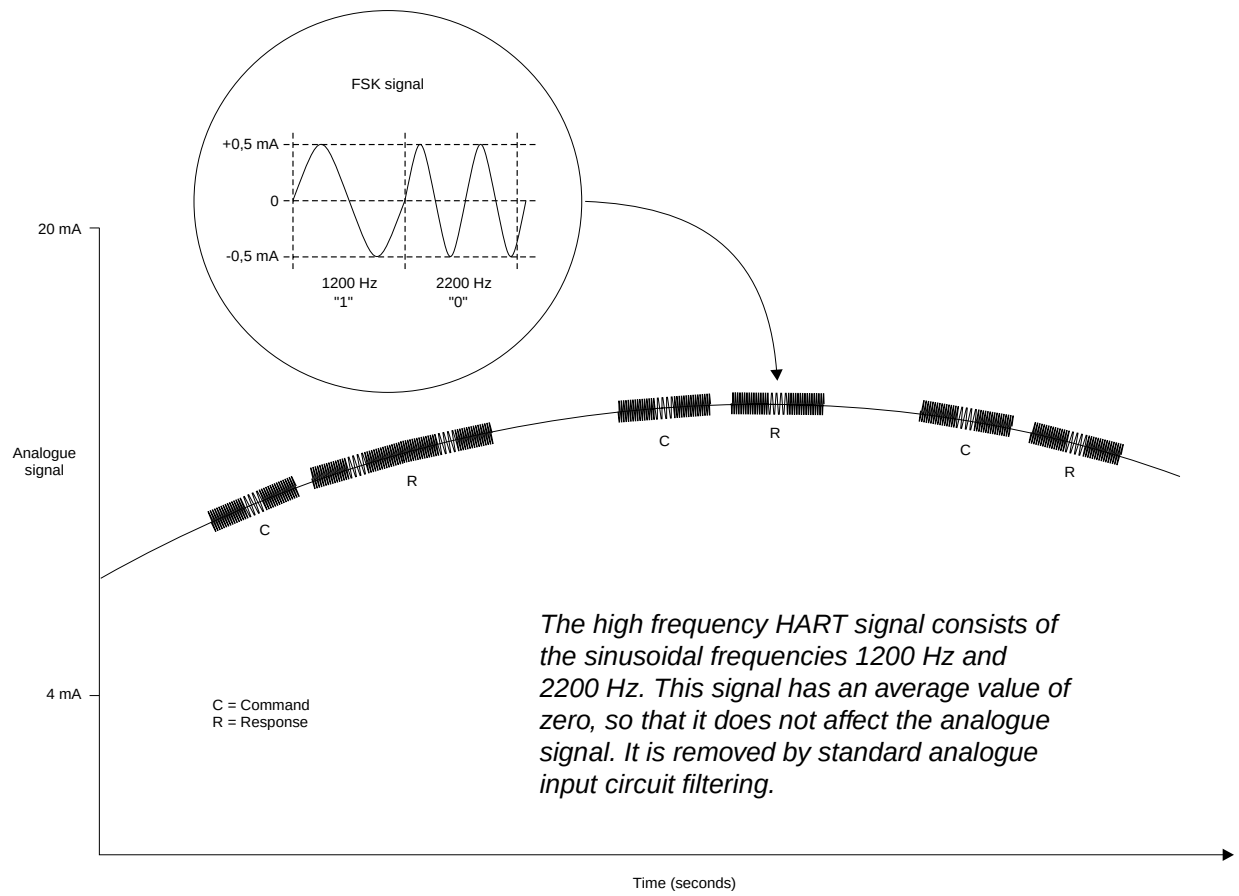


Figure 2.3: The modulated HART-Signal

HART is a master-slave protocol: a field device does only respond when requested (except in "Burst mode"). The message duration is several hundred milliseconds, so that between two and three messages can be transferred per second.

On HART, there are three groups of commands:

- The "Universal" commands; these must be supported by all field devices;
- the "Common practice" commands; these are pre-defined commands, suitable for many field devices, which, if they are supported by the device, must be implemented in the pre-defined form;
- device-specific commands; these are commands, which are particularly suitable for this field device.

The HART multiplexer contains commands in all three groups. Details of the supported commands are given in section 6.1.

1. HART = Highway Addressable Remote Transducer

Part No.: 109143, Date of issue 29.11.2000

2.3 System construction

2.3.1 System description

In process engineering plants, there are many field devices distributed over a large area. The characteristic values of these field devices must be monitored, for example, in the context of ISO 9000 and recorded and adapted to changes in process parameters.

The HART multiplex system from Pepperl+Fuchs enables online communication between a PC and "smart" field devices that support the HART protocol.

Smart transmitters and intelligent valve positioners enable information such as measurement range, tag number, ID number and manufacturer to be stored in the field device itself. Access to these data is usually obtained using a handheld terminal. This means, that when changes to information are required, connection to the field device must be carried out "By hand".

When specific data has to be recorded in the context of quality assurance - in accordance with ISO 9000 - this means that there is an increased demand on the process control system or the DCS. For example, the data has to be cyclically interrogated and then stored by the system in a database.

The HART multiplex system from Pepperl+Fuchs provides the coupling between the PC and the intelligent "HART-capable" field devices. All access to the field device takes place in parallel with the transfer of the 4 mA ... 20 mA measuring signal and therefore has no affect on the processing of measured values by the process control system.

The system thus provides a subordinate service interface. It is also possible to obtain measured values through the HART multiplex system. On field devices, which are installed in hazardous areas, the coupling takes place on the safe area side of the current repeaters.

Pepperl+Fuchs can supply the appropriate KFD2-STC4-Ex1/KFD2-STC4-Ex2 smart current repeaters and KFD2-SCD-Ex1.32, KFD2-SCD-Ex1.LK smart isolated transformers. Similarly, the HART multiplex system can also be connected to other smart Ex-isolation stages. This means that existing systems can be expanded very easily, thus taking full advantage of the HART communication system.

The system comprises a max. of 31 HART multiplexer masters, which are connected to the PC via a RS 485 interface. Each HART multiplexer master can control up to 15 HART multiplexer slaves. Each multiplexer, irrespective of master or slave, can connect up to 16 transmitters.

Thus one PC can be used to address up to 7936 field devices for the exchange of data. Operation using a handheld terminal also remains possible, since the HART protocol accepts 2 masters in one system, i. e. PC and handheld terminal.

2.3.2 Service station

Besides the control system a PC is frequently used as the service station, with which the parameter functions or data logging functions can be carried out. Operating programs for the PC are available from various manufacturers (see section 2.3.3) to provide the necessary back-up for this purpose.

However, in some cases the communication is provided by a process control system via a RS 485 interface direct (via the HART multiplexer) to the field devices without a connected service station. But the low speed of the HART communication imposes limitations on this method of operation.

2.3.3 Integration in the operating software (Asset Management Systems)

The full potential of the HART multiplexer System is realised through integration in modern Asset Management Systems such as PACTware (open source), SIMATIC PDM (Siemens), AMS (Fisher-Rousemount), Cornerstone (Applied System Technologies) and Valve Manager (Neles Automation). These operating tools combine the device functions of the multiplexer in the form of menu commands in a unified interface providing a very convenient method of operation. The presentation and description of the functions in the individual operating tools can be very different, however; thus a generally applicable presentation is not possible here.

Note

Information on the configuration, parameter assignment, operation and diagnostics options of the multiplexer is provided in the documentation accompanying the various operating tools.

Part No.: 109143, Date of issue 29.11.2000

PACTware

PACTware™ is the first open source Process Automation Configuration Tool with an open FDT interface (Field Device Tool). For the first time this enables all field buses and field devices in a system, independent of the manufacturer, to be configured and assigned parameters using a single engineering tool.

Representative example on the basis of PACTware

The PACTware user interface is divided into two parts: The project tree is located in the left part; the data and input fields being represented in the right.

The system structure is represented in the project tree. Above the HART multiplexer there is a HART driver and above that a host system (PC). All the connected multiplexer slaves are to be found under the HART multiplexer master and also the internal one that is indicated as having the slave address 0.

Under these slave units there are the HART-compatible field devices.

2.3.4 System construction with and without multiplexer slaves

In a system structure without multiplexer slaves, only one multiplexer master is used. The arrangement is restricted to 16 HART channels. With two to three messages per second, the system cycle time can be up to one minute.

In a system structure with multiplexer slaves, one multiplexer master and up to 15 slaves are used. The number of channels per slave is extended by 16, so that in the fully-developed structure 256 HART channels are available. With two to three messages per second, the system cycle time is several minutes.

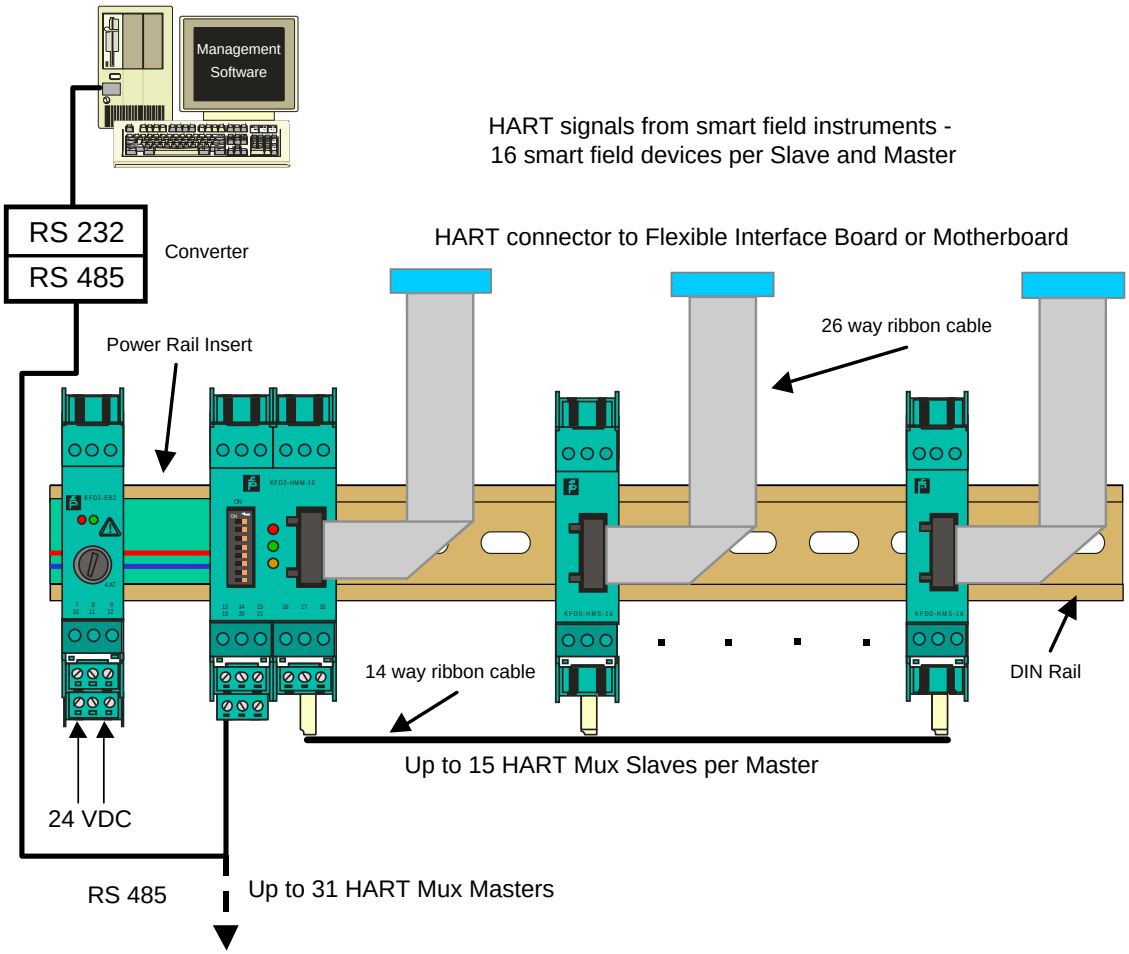


Figure 2.4: Multiplexer system structure

The connection between the field devices and the control system is the same in both cases and can take place via motherboards or Flex-Interfaces (see section 2.3.5 and 2.3.6).

Part No.: 109143, Date of issue 29.11.2000

2.3.5 System structure with Flex-interface solutions

For general purpose applications, Pepperl+Fuchs offers Flex-interfaces in various versions. The HART connection for one multiplexer is common to all versions. The connections for the maximum of 16 field devices are provided as screw terminals or in the form of Pepperl+Fuchs system connectors for cable tree installation. The connections for the control system are likewise either provided as screw terminals or as control system-specific connectors. Such a system is presented in Figure 2.5.

The distinguishing characteristics of the FI-*** in detail:

- Power feed option (also redundant), switchable for each individual module.
- Fuses
- 250 Ω resistance
- Control system-specific connector (also redundant)
- Screw terminals/System connector

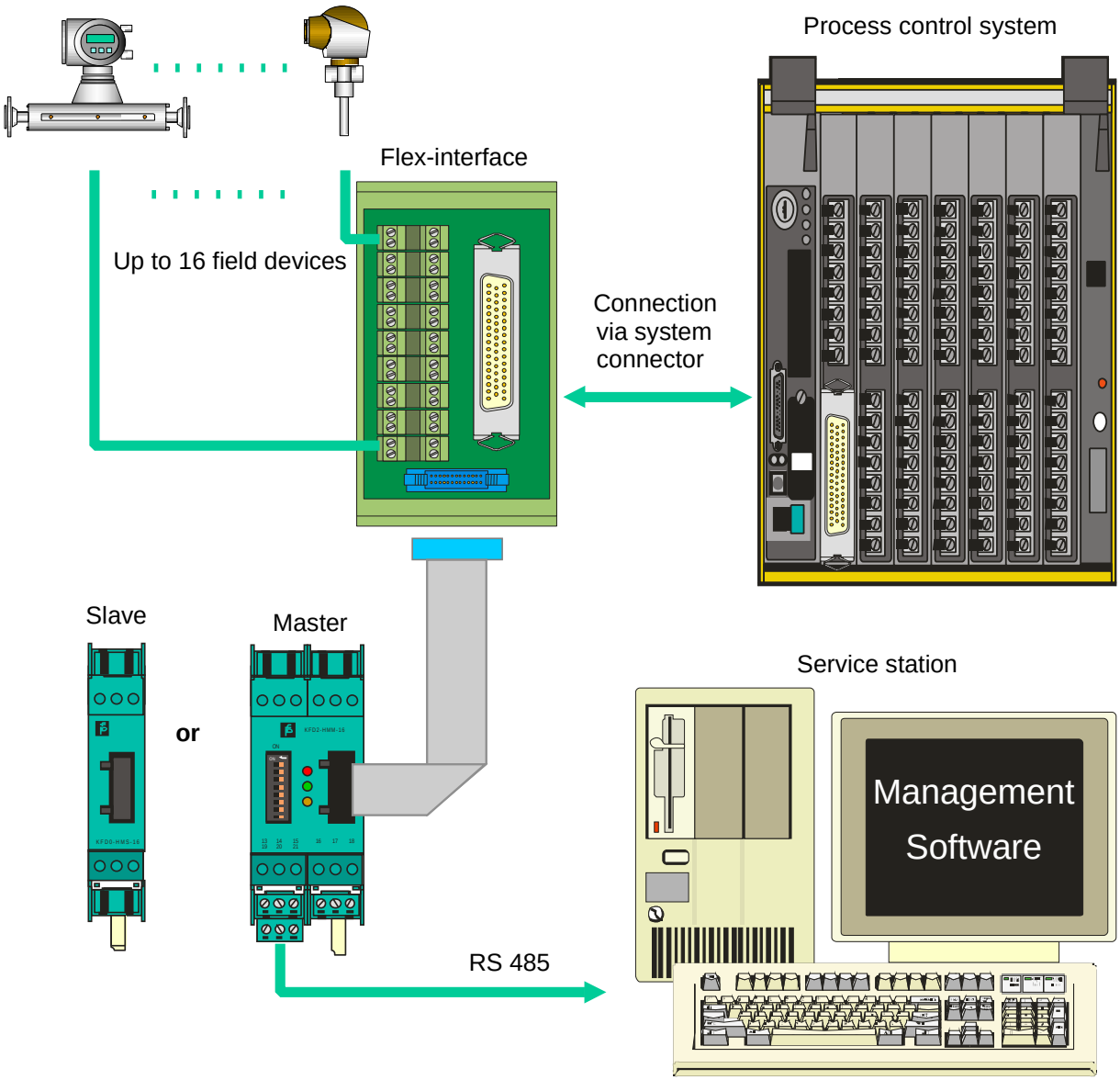


Figure 2.5: System with Flex-interface

Part No.: 109143, Date of issue 29.11.2000

2.3.6 Structure with motherboard solutions

For applications in hazardous areas, motherboard solutions are employed. Motherboards serve as carriers for Ex-isolation modules, such as current repeaters and isolated transformers and have connections both for power supply, one or more HART system connectors suitable for the family of multiplexer devices and a control system-specific connector for direct connection to the control system. Such a system is shown in Figure 2.6.

The distinguishing characteristics of the MB-*** in detail:

- Power feed (also redundant) with fuses and LEDs
- 250 Ω resistance
- Control system-specific connector (also redundant)
- Control system-specific arrangement of the Ex-isolation modules (Number and type)

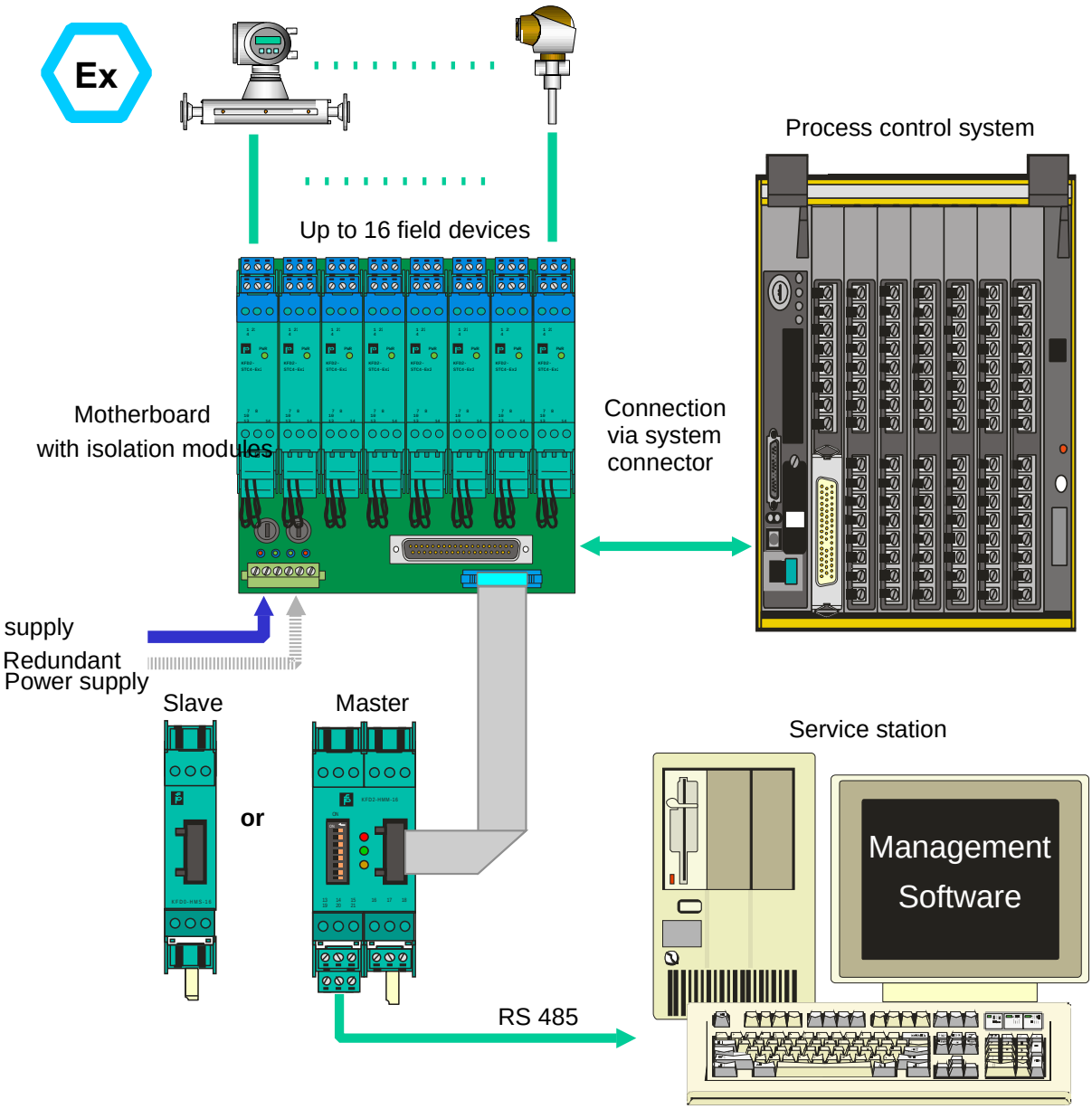


Figure 2.6: System with motherboard

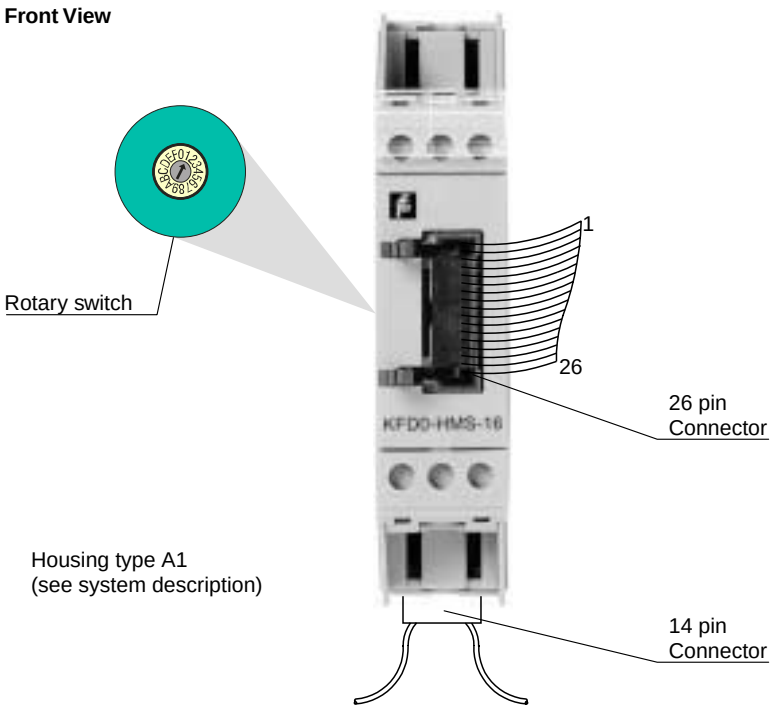
Part No.: 109143, Date of issue 29.11.2000

2.4 HART Multiplexer Slave

The HART multiplexer slave is supplied from the HART multiplexer master via the 14-core flat cable. The contacting of the flat cable is provided via IDC connectors, so that the cable can be tapped at any position. By this means, the power supply and data cables are looped on from station to station. The address 1 ... 15 is set via a 16-step rotary switch. Address 0 is reserved for the multiplexer master and must therefore not be used. If a number of slaves are operated on the KFD2-HMM-16, different addresses must be assigned. The sequence therefore plays no role in this.

The analogue signals are fed via a 26 core flat cable into the KFD0-HMS-16. 16 of these are intended for the HART signal of the analogue instrument circuit (the remaining 10 are to ground) (for the assignment, see section 6.2).

The minimum load resistance of the analogue measuring circuit is 23 0Ω (minimum load impedance in accordance with HART specification), the maximum resistive load being 500 Ω. Load resistances of up to 1000 Ω are possible, however, resistance values greater than 50 0Ω can interfere with the HART communication.



2.5 Slave connection

HART multiplexer masters and slaves must be connected together via a separate K-HM14 flat cable.

The length of cable required should be stated when ordering. Hence the wiring of the HART multiplexer is significantly simplified and the danger of wiring faults is excluded.

Part No.: 109143, Date of issue 29.11.2000

3 Installation

3.1 Storage and transportation

For storage and transportation, the multiplexer must be protected from shock loading and dampness by means of suitable packaging. Optimum protection is afforded by the original packaging.

In addition, the permissible ambient conditions must prevail (see datasheet).

3.2 Unpacking

Make sure that the multiplexer is undamaged. Damages should be reported to the mail or forwarding agent as well as the supplier.

The consignment should be in compliance with the order and shipment documents. Check the following items:

- Quantity supplied
- Device type and version in accordance with the type plate
- Accessories (manual, etc.)

Keep the original packing if the device is to be stored and shipped at a later date.

3.3 Installation

The installation options are described in the accompanying product information about the K-System, KFD series.

3.4 Electrical connection

3.4.1 General notes for connection

Warning

Work on live installations and electrical connections must only be carried out by appropriately trained personnel.

When connecting the RS 485, reference should be made to the instructions in section 2.1.13 .

3.4.2 Location of electrical connections

The power supply (24 V DC nominal voltage) is provided via the power rail or terminals 1 7(+) and1 8(-). The device is protected against reverse polarity by means of a protection diode.

The connection of a higher level control unit (PLC, PC) is achieved via an RS 485 interface on terminals 13, 14 and 15. The RS 485 bus is looped through to terminals 19, 20 and 21. In this way, the three terminals can be used alternatively, or simultaneously, (for the connection of other devices with R S485, or for the connection of a terminating resistor). If a standard PC with an RS 232 interface is to be used, an interface converter is required (see section 2.1.2).

The connection of the KFDO-HMS-16 HART Multiplexer slaves is via the 14 pin plug connector on the side of the device.

The analogue HART signals are connected to the current repeaters via the 26 pin plug connector on the front of the device.

Part No.: 109143, Date of issue 29.11.2000

3.4.3 Note on electromagnetic compatability (EMC)

The device is intended for use in electrically conductive and earthed control cabinets. Leads that are fed into the control cabinet should be screened and the screen should be connected with the control cabinet at the point of entry, preferably directly in the cable gland. Unscreened leads in the control cabinet (e.g. power supply leads) should be fed via filters.

3.5 Dismantling, packaging and disposal

When dismantling the device, keep it in the original packaging for future use.

Note

The multiplexer should eventually be disposed of in accordance with national regulations on disposal / recycling.

The device does not contain batteries which would have to be separately disposed of.

Part No.: 109143, Date of issue 29.11.2000

4 Commissioning

4.1 Commissioning check list

The commissioning of the Multiplexer Master is summarised in the following check list. You should follow the list through in sequence, actions that have already been carried out can be skipped. The steps required for commissioning the multiplexer refer to the section in which the respective procedure is described in detail.

The usual commissioning procedure is as follows:

Installation

- Installation of the field devices
- Selection and connection of the motherboard and Flex-Interface (see also section 2.3.5 and 2.3.6)
- Selection and connection of the isolating modules
- Connection of the process control system
- Connection of the Multiplexer Masters and Slaves (see section 2.3.5 and 2.3.6)
- Connection of the Service Station. If necessary, install the interface converters.
  Set up the RS 485 address and set the baudrate(see section 2.1.12)
  Caution: Note the polarity of the R S485 connection (see section 2.1.13).

Note

The device must be disconnected briefly from the power supply in order to accept the values set on the DIP switches.

Operation

- Wait for the start-up sequence to finish (see section 2.1.7)
- Start the parameter assignment (see section 2.1.10), in particular, establish the position of the multiplexers that are being used in the module table (see section 2.1.6)
- Carry out the loop construction (REBUILD, see section 2.1.6)
- Activate the SCAN function, if required (see section 2.1.6)

4.2 Data access to the connected transmitters

The way in which data access to the connected field devices can take place depends on the operator tool that is being used.

In general, however, the field devices are to be found in a project tree under the HART Multiplexer Slaves (the master integrates the slave unit on slave address 0), where device data, parameters and diagnostics can be accessed via menu functions. A project tree of this type is described in section 2.3.3.

The data, parameters and diagnostic windows accommodate data for the underlying HART commands, which differ considerably, depending on the field device.

Only the "Universal" commands and general response codes have the same functions on all devices, so that information relating to the devices themselves, as well as the process values and several items of diagnostic information can be represented in a consistent manner.

Part No.: 109143, Date of issue 29.11.2000

5 Diagnosis and Fault Elimination

5.1 General

This section provides operating instructions to be used if faults occur and describes the possible causes of such faults.

Note

Faults and failures are signalled via the following means:
- *LEDs (see section 2.1.9 and 5.2)*
- *Status/response code (see section 5.3)*
- *Extended device status (see section 5.4)*

5.2 LEDs

The following fault conditions can occur during the initialisation phase after start-up:

Red	Green	Orange	Cause	Corrective action
Off	*Off*	*Off*	• *No power supply available* • *LED(s) defect*	• *Check power supply* • *Select DIP switch 1, isolate power supply briefly; LEDs flash one after the other*
On	*On*	*On*	*Fault in device hardware (CPU, ROM)*	*Send device to Pepperl+Fuchs for repair.*
On	*Off*	*Off*	*Fault in device hardware (CPU, ROM)*	*Send device to Pepperl+Fuchs for repair.*
On	*On*	*Off*	• *Fault in device hardware (CPU, RAM)* • *Device parameter assignment incorrect (Parameter Loop Switch Delay, Command 161)*	• *Send device to Pepperl+Fuchs for repair.* • *Parameterise device again. If this is not successful, the device must be sent to Pepperl+Fuchs for repair.*

5.3 Status/Response code (Response code)

5.3.1 General

Two status bytes, also referred to as the "Response code“ are contained in every message from a field device. These contain three types of information: Communication errors, command responses and the device status. Depending on bit 7, the first two types are contained in the first status byte. The device status is always transferred in the second byte.

5.3.2 Structure of the first byte

If bit 7 is set (1), the first status byte contains a summary of the communication errors. This information is coded bit by bit.

If bit 7 is cleared (0), the first status byte contains a summary of the command responses. This information is numbered consecutively and not coded bit by bit.

Communication error

This byte contains information concerning the reception of a message.

The individual bits indicate a detected error, which has resulted in non-acceptance of the message. Thus neither can a response be given to the message. It is necessary to repeat the command, to check the connections, to use the terminating resistors or to reduce the baud rate.

Part No.: 109143, Issue date 29.11.2000

Bit								Meaning
7	6	5	4	3	2	1	0	
1								*Communication error, if bit 7 = 1; coded bit by bit*
1	*1*							*Parity error*
1		*1*						*Overrun error*
1			*1*					*Message error*
1				*1*				*Checksum error*
1					*0*			*Always 0 (reserved)*
1						*1*		*Input buffer overrun*
1							*1*	*(undefined)*

Note

Details can be found in /1/.

Command responses

The first byte contains information relating to the execution of a command. The command-specific response code thus documents the execution of the command.

In contrast to the communication error, the command responses are not coded bit by bit, but are numbered consecutively from 0 to 127.

Of the command responses signalled by the multiplexer, two instances are warnings (codes 8 and 31), in which the processing of the command is continued. In the other cases, errors are indicated, that means that the initiating command could not be correctly executed. Here, the remedy is given by the meaning of the code.

Note

All the codes that occur on the HART system are described in /1/.

The following response codes can occur on the multiplexer:

Code	Description	Meaning	Can occur with commands ...
2	*Invalid selection*	*The selected code/index is not permissible.*	*147, 149, 151, 153*
3	*The parameter value was too large*		*59, 129, 155*
4	*The parameter value was too small*		*59*
5	*Too few data bytes received*	*The message has no error, but it contains fewer bytes than expected for the execution of the command.*	*17, 18, 59, 129 ... 141, 145, 147, 149, 151, 153, 154, 155, 157*
8	*Warning*	*Here (132): Preamble length not within range 5 ... 20 and has been set to 5 or 20.*	*132*
9	*1st parameter too large*	*The first of the two parameters is too large.*	*145*
11	*2nd parameter too large*	*The second of the two parameters is too large.*	*145*
16	*Access restricted*	*The command has been ignored, since the current device status does not permit the command to be carried out correctly.*	*6, 17, 18, 38, 41, 42, 48, 59, 106, 128 ... 157*

Part No.: 109143, Issue date 29.11.2000

Code	Description	Meaning	Can occur with commands ...
17	*Too many items requested*		*131, 132, 133, 135 ... 141, 154*
31	*Warning*	*Here (137): SCAN value has not been changed, since it is identical.*	*137*
32	*Busy*	*The device is executing a function, which cannot be interrupted by this command.*	*6, 17, 18, 38, 41, 42, 59, 106, 128, 130 ... 157*
64	*Command not implemented*	*The command does not exist and therefore cannot be executed. This error message is also output if an error occurs that cannot be accurately specified by the device.*	*Almost all*
65	*Not specified*	*Parameter not in the permissible range.*	*132, 137*

5.3.3 Device status (structure of the second byte)

If a communication error is indicated in the first byte (bit 7 = "1"), the second byte described here has no significance (always 0).

In the other case, it contains the status of the field device in full, i.e. independent of commands.

The individual bits have the following meaning:

Bit	Description	Meaning	Corrective action
7	*Error function of the field device (malfunction)*	*Hardware fault. The extended device status may provide further information (see section 5.4).*	• *Read extended device status (section 5.4)* • *Check LEDs (section 5.2)* • *Re-parameterise device*
6	*Configuration changed (Configuration changed)*	*A write command has been executed.*	*This bit can be cleared by command 38.*
5	*Start-up sequence is running*	*The power supply has been connected or a reset has been activated. Transient data are reset to the preset values.*	*Wait for the start-up sequence, then parameterise the device.*
4	*Extended device status available*	*Further status messages are available and can be called up; see section 5.4.*	*Read extended device status (section 5.4)*
3	*Analogue output current fixed (primary variable)*	*The primary variable is fixed at the requested value and no longer follows the process.*	*Always 1 (Has no function on the multiplexer, since there is no analogue output)*
2	*Analogue output current has reached its limit (primary variable)*	*The primary variable lies outside its limit value and therefore no longer corresponds to the process value.*	*Always 0 (Has no function on the multiplexer)*
1	*Variables (not the primary one) outside the range*	*The values detected by the sensor (not for the primary variable) lie outside the operating range. The extended device status may yield additional information (see section 5.4).*	*Always 0 (Has no function on the multiplexer)*
0	*Primary variable outside the range*	*The measured value detected by the sensor lies outside the operating range.*	*Always 0 (Has no function on the multiplexer)*

Part No.: 109143, Issue date 29.11.2000

5.4 Extended device status

The extended device status can be called up via command 48. It provides five bytes of information, which are thematically arranged:

1st byte: Operation in progress

The byte indicates which operation is in progress. The information is coded bit by bit. The coding is shown in the following table:

Bit	Operation in progress	Meaning
7	*Reset*	*Start-up sequence running and must be completed*
6	*REBUILD*	*REBUILD function is running and must be completed*
5	*Internal EEPROM write function*	*Switching off the power supply can result in loss of the parameter assignment*
4	*SCAN*	*SCAN function is running and must be completed*
3	*Self test (command 41)*	*The device self test is executed (as when the power supply is switched on); if no error occurs, the "Malfunction" status message (see section 5.3.3) clears (if it is set)*
2 ... 0	*Reserved*	*Reserved.*

2nd byte: Hardware fault

This byte, which is also bit by bit coded, indicates any hardware faults that have been found. Hardware faults are only detected during the initialisation sequence after the power supply has been switched on.

Bit	Detected hardware fault	Meaning/Remedial action
7	*Current loop*	*OR logic operation on all detected hardware faults in the current loops. Check the transmitter and its cabling, then execute REBUILD.*
6	*ROM error*	*Send device to Pepperl+Fuchs for repair*
5	*EEPROM error*	*Send device to Pepperl+Fuchs for repair*
4 ... 0	*Reserved*	*Reserved*

3rd byte: SCAN error

The byte indicates an OR logic operation for all errors that have been detected during the SCAN function.

Example: If a field device has been detected as having "Disappeared" and another as "Mismatched", then these two bits are set simultaneously.

The bit by bit coded information is shown in the following table:

Bit	State	Meaning	Corrective action
7	*Reserved*	*Reserved*	
6	*Searching*	*Transmitter is searched for (due to having disappeared)*	• *Check cabling* • *Check transmitter*
5	*Disappeared*	*Transmitter no longer responds*	
4	*Appeared*	*Transmitter responds again*	*Check cabling*
3	*Mismatched*	*Despite this, another transmitter has responded*	*Transmitter has been exchanged for another type. Check type, rebuild loop.*
2 ... 0	*Reserved*	*Reserved*	

Part No.: 109143, Issue date 29.11.2000

6 Appendix

6.1 Supported commands

The following tables show the HART commands supported by the multiplexer, ordered by the three groups "Universal", "Common-practice" and "Device specific" commands (see also section 2.2). The read commands are caracterised by 🕮 and the write commands by ✍.

The "Universal" and "Common-practice" commands are described in detail in /1/. In this section only the functions are explained, not the data structure of the lower layer of the HART protocol.

"Universal" commands:

Command		Action	Meaning
0	🕮	*Read unique identifier*	*12 bytes device identifier are given in the response.*
1	🕮	*Read HART variables (process values)*	*Commands are only supported for compatibility purposes and are without any meaning. Used with transmitters (e.g. SCAN function) they have the following meanings:* *1: Read primary variable* *2: Read primary variable as current (in mA) and percent of range* *3: Read primary variable as current (in mA) and four (predefined) dynamic variables*
2	🕮		
3	🕮		
6	✍	*Write polling address*	*This command is never accepted and the messages "Access restricted" or "Busy" (see section 5.3.2) will be returned.*
11	🕮	*Read unique identifier associated with tag*	*A response will contain 12 bytes device identifier, if the given tag complies to the tag of the multiplexer.*
12	🕮	*Read "Message"*	*Read the 32 digit message (see also 17).*
13	🕮	*Read tag, description and date*	*Read the 8 digit tag, the 16 digit description and the date.*
17	✍	*Write "Message"*	*Write the 32 digit message (see also 12).*
18	✍	*Write tag, description and date*	*Write the 8 digit tag, the 16 digit description and the date.*

Part No.: 109143, Date of issue 29.11.2000

"Common-practice" commands:

Command		Action	Meaning
38	✍	*Reset "Configuration changed" flag*	*Reset the "Configuration changed" response code, see section 5.3.3.*
41	✍	*Perform device self test*	*Initiates the self test function in the device (as during power up); if no error occurs the response code "malfunction" (see section 5.3.3) is cleared (if set).*
42	✍	*Perform device reset*	*Immediately after the response the microprocessor of the device will be reset.*
48	🕮	*Read additional device status*	*See section 5.4.*
59	✍	*Write number of the response preambles*	*The number of preambles insert in response telegrams can vary from 2 to 20. Default setting is 4.*
106	✍	*Delete all delayed responses pending for the host*	*All pending response telegrams are deleted. Because only one response buffer exists, the buffer is always deleted (independent from the initiating host) in accordance with the specification.*

"Device specific" commands:

Command		Action	Meaning
128	🕮	*Read parameterisation of the multiplexer*	*The actual parameterisation is read out of the multiplexer.*
129	🕮	*Read loop status*	*With this command the status of the current loop can be read out. The following information is supplied:* • *Hardware fault* • *Rebuild running for this loop* • *SCAN activated for this loop* • *Searching transmitter (due to "disappeared")* • *Transmitter not responding ("disappeared")* • *Transmitter responding again ("appeared")* • *An other transmitter responded instead ("mismatched")*
130	🕮	*Read transmitter list (max. 49 entries, beginning with the given index)*	*The long frame addresses of up to 49 transmitters are returned beginning at the given index.*
131	🕮	*Read static data of up to 22 transmitters*	*For the given long frame addresses the function returns the following transmitter data:* • *Current loop number (0. ..15)* • *Polling address* • *Supported HART revision* • *Minimum count of required preambles (5 ... 20)*
132	✍	*Write static data of up to 22 transmitters*	*Write static data (see 131). Values out of the range 5 ... 20 will be set to 5 or 20, respectively.*
133	✍	*Remove transmitter from transmitter list (max. 35 at the same time)*	*Transmitters with the given long frame addresses will be removed from the transmitter list (and the SCAN list).*
134	🕮	*Read SCAN list (max. 49 entries, beginning with the given index)*	*The long frame addresses of up to 49 transmitters are returned beginning at the given index.*
135	🕮	*Read dynamic data of up to 7 transmitters*	*For the given long frame addresses the function returns the following transmitter data:* • *the selected SCAN command* • *long frame address* • *HART data*
136	🕮	*Read SCAN status of up to 31 transmitters*	*For the given long frame addresses, this command returns the SCAN status of the transmitters (0=SCAN disabled, 1=SCAN enabled)*

Part No.: 109143, Date of issue 29.11.2000

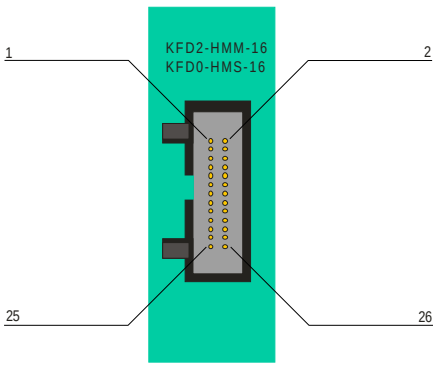
Command		Action	Meaning
137	✍	Write SCAN status of up to 31 transmitters	For the given long frame addresses, this command sets the SCAN status of the transmitters (0=disable SCAN, 1=enable SCAN)
138	🕮	Read cumulative responses of up to 27 transmitters	This command returns the OR-combination of communication errors and status response bits.
139	✍	Reset cumulative responses of up to 35 transmitters	This command resets the cumulative responses.
140	🕮	Read transmitter counts of tries and failures of up to 16 transmitters	Communication statistic that contains the number of commands sent to the transmitter and the number of commands that failed.
141	✍	Reset transmitter counts of tries and failures of up to 16 transmitters	Reset the communication statistic.
142	🕮	Read counts of host communications	Communication statistic concerning the multiplexer.
143	✍	Reset counts of host communications	Reset the communication statistic.
144	🕮	Read retry limits	Retries in case of "Busy": 0 ... 11 (default is 0); Retries in case of communication errors: 0 ... 11 (default is 2).
145	✍	Write retry limits	
146	🕮	Read the selected SCAN command	During SCAN the HART commands 1, 2 or 3 (see above) can be executed.
147	✍	Select SCAN command	
148	🕮	Read SCAN status	With these commands the status of the SCAN function is set or read, respectively (see section 2.1.6). 0: SCAN function disabled (default after power-up) 1: Normal SCAN function activated 2: Special SCAN function activated (see 158, 159)
149	✍	Write SCAN status	
150	🕮	Read master type (gender)	1 = Primary master (default), 0 = Secondary master.
151	✍	Write master type (gender)	
152	🕮	Read loop search type	The loop search type defines the polling address(es) for a transmitter that did not respond during several requests (disappeared) is searched (see also command 129). 0: Single transmitter, 4 mA ... 20 mA (single analogue)(only polling address 0) (default) 1: Single transmitter, unknown (single unknown) (first one of the polling addresses 0 to 15) **Note**: The search procedure without any connected transmitters is 16 times longer because all 16 polling addresses are checked! 2: Reserved for multidrop
153	✍	Write search type	
154	✍	"Rebuild" up to 83 loops	see section 2.1.6.
155	✍	Pass through host command to transmitter and transmitter response to host	By this any command can be passed to a field device and the response can be evaluated - without any modification by the multiplexer.
156	🕮	Read multiplexer table (module table) (16 multiplexers)	This command returns the multiplexer table (see 157).
157	✍	Write multiplexer table (module table) (16 multiplexers)	This is to select which of the multiplexers (master and 15 slaves) are connected (2 bytes, bit coded).

Part No.: 109143, Date of issue 29.11.2000

Command		Action	Meaning
158	🕮	*Read special SCAN parameters*	*For the given loop the actual special parameters and, if available, the transmitter data are returned. These are:* • *Loop number* • *Error flag (0=OK, 1=special SCAN not activated)* • *Polling address (always 0, no multidrop)* • *Threshold data length for special SCAN* • *Selected SCAN command* • *Long frame address* • *Number of available data bytes* • *The data bytes itself (if any)*
159	✍	*Write special SCAN parameters*	*For the given current loop and polling address (has to be 0) the threshold data length (0 ... 62) and the SCAN command to be used can be written.*
160	🕮	*Read loop switch delay*	*When the multiplexer switches the communication channel (loop 0 ... 255) it can insert a delay time (0 ms ... 300 ms) before any HART commands are sent to the loop. This is necessary when using the multiplexer together with the RPI product family of Pepperl+Fuchs.*
161	✍	*Write loop switch delay*	

6.2 Terminal assignment of the 26 pin connector with analogue HART signals

Pin	Signal	Pin	Signal
1	*Analogue ground*	*14*	*Analogue ground*
2	*Analogue ground*	*15*	*Analogue ground*
3	*Analogue ground*	*16*	*HART channel 9*
4	*Analogue ground*	*17*	*HART channel 10*
5	*Analogue ground*	*18*	*HART channel 11*
6	*HART channel 1*	*19*	*HART channel 12*
7	*HART channel 2*	*20*	*HART channel 13*
8	*HART channel 3*	*21*	*HART channel 14*
9	*HART channel 4*	*22*	*HART channel 15*
10	*HART channel 5*	*23*	*HART channel 16*
11	*HART channel 6*	*24*	*Analogue ground*
12	*HART channel 7*	*25*	*Analogue ground*
13	*HART channel 8*	*26*	*Analogue ground*



Part No.: 109143, Date of issue 29.11.2000

6.3 Literature

/1/ *HART Communication Foundation:*
HART - SMART Communications Protocol Specification
HCF SPEC-11, Revision 5.9
www.hartcomm.org

/2/ *HART Communication Foundation:*
HART Application Guide
HCF LIT 34
www.hartcomm.org

/3/ *Romilly Bowden, Fisher-Rosemount:*
HART- A technical Overview, August 1997
Fisher-Rosemount

6.4 Glossary

Address
In communications technology, the address of a device is used to identify that device, so that messages can be delivered correctly. HART uses two forms of addressing: a polling address in the range 0 to 15, and a unique identifier (long frame format address) of 38 bits. The polling address 0 is reserved for 4m A. . .2 0mA analogue transmitters in→point-to-point networks, polling addresses 1 ... 15 for transmitters in →multidrop networks.

Broadcast Mode
→Burst Mode

Burst Mode
A communication mode in which a master device instructs slave devices to continiously broadcast process values (e. g. the →primary variable) until the master instructs it to stop. The multiplexer recognizes and supports this mode, but itself does not instruct field devices to use this mode.

FSK
Abbrev. for Frequency Shift Keying. Method of coding the two digital signals "0" and "1" with two different frequencies.

HART
Abbrev. for Highway Addressable Remote Transducer. Used to describe communications that complies to the HART specification. HART is a →master-slave system.

Host
Higher layer system, e. g. service station, PC oder process control system.

Long frame address
→Address

Master
A device (e. g. the process control system) in a →master-slave system that initiates all transactions and commands.

Master-slave system
A communication system in which all message transactions and commands are always initiated by a →master device and →slave devices only respond to requests received.

Part No.: 109143, Date of issue 29.11.2000

Multidrop

In contrast to →point-to-point, more than two (field) devices are connected together to one segment (pair of wires) in a multidrop system. To correspond to each singe device it must have a unique →address. Because communication can only be established to one field device, cycle times are increasing proportional to the number of field devices. In HART multidrop operation the current through each field device is fixed at 4 mA to allow parallel operation of more than one device (up to 15 devices are possible).

Multimaster

HART allows connection of two masters, a primary and a secondary master. A high level station is configured as primary master, usually this is the process control system or the main service station. A lower level station is configured as secondary master, this may be a hand terminal or a service station. The difference between primary and secondary master is the priority of the bus access: the primary master has a higher priority than the secondary master. Messages sent by the masters are characterised by a master bit, so that the masters can recognise which responses are intended for them.

Point-to-point

In a point-to-point communcation system, only two communicating devices are connected together to one segment (pair of wires). A point-to-point system is for example the master-slave system multiplexer-field device.

Polling address

→Address

Primary master

→Multimaster

Primary variable

Process value measured by a field device. The unit depends on the used HART command (see commands 1, 2 and 3). The primary variable of a pressure sensor could contain for example the measured process pressure in the unit "bar".

Secondary master

→Multimaster

Secondary variable

Additional value (measured in the prozess) of a field device (up to four additional values are supported by HART). This variable can only be read by HART command 3.

Slave

A device (e. g. transmitter or valve) in a →master-slave system that receives commands from a →master device. A slave is not able to initiate a transaction.

"Smart" field device

Microprocessor-based device that can be programmed, has memory, is capable of performing calculations and self-diagnostics and reporting faults, and can be communicated with from a remote location.

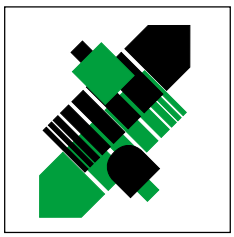
Tag

Unique tag (designation of the control engineering point) of the field device within the process plant.

Part No.: 109143, Date of issue 29.11.2000

Part No.: 109143, Date of issue 29.11.2000

One Company, Two Divisions.



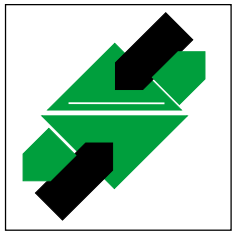
Factory Automation Division

Product Range

- Digital and analogue sensors
- in different technologies
  - Inductive and capacitive sensors
  - Magnetic sensors
  - Ultrasonic sensors
  - Photoelectric sensors
- Incremental and absolute rotary encoders
- Counters and control equipment
- Identification Systems
- AS-Interface

Areas of Application

- Machine engineering
- Conveyor or transport
- Packaging and bottling
- Automotive industry



Process Automation Division

Product Range

- Signal conditioners
- Intrinsically safe interface modules
- Remote Process Interface (RPI)
- Intrinsically safe field bus solutions
- Level control sensors
- Process measuring and control systems engineering at the interface level
- Intrinsic safety training

Areas of Application

- Chemical industry
- Industrial and community sewage
- Oil, gas and petrochemical industry
- PLC and process control systems
- Engineering companies for process systems

Service Area

Worldwide sales, customer service and consultation via competent and reliable Pepperl+Fuchs associates ensure that you can contact us wherever or whenever you need us. We have subsidiaries worldwide for your convenience.

The Pepperl+Fuchs Group

USA Headquarters
Pepperl+Fuchs Inc. • 1600 Enterprise Parkway
Twinsburg, Ohio 44087 • Cleveland-USA
Tel. (330) 4 25 35 55 • Fax (330) 4 25 4607
e-mail: sales@us.pepperl-fuchs.com

Asia Pacific Headquarters
Pepperl+Fuchs Pte Ltd. • P+F Building
18 Ayer Rajah Crescent • Singapore 139942
Tel. (65) 7 79 90 91 • Fax (65) 8 73 16 37
e-mail: sales@sg.pepperl-fuchs.com

Worldwide Headquarters
Pepperl+Fuchs GmbH • Königsberger Allee 87
68307 Mannheim • Germany
Tel. +49 621 7 76-0 • Fax +49 621 7 76-10 00
http://www.pepperl-fuchs.com
e-mail: pa-info@de.pepperl-fuchs.com

PEPPERL+FUCHS