# MACX MCR-S-MUX

## HART multiplexer

Data sheet
103246_en_01
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## 1 Description

The MACX MCR-S-MUX HART multiplexer is used for the digital connection of up to 32 HART-capable field devices to a PC.

HART field devices are connected in point-to-point mode via a HART connection board and communicate with the HART multiplexer via the HART protocol. These HART signals are superimposed on the analog standardized signals (4 ... 20 mA) of the process variables.

The HART multiplexer communicates with a connected PC via an RS-485 bus.

The configuration and diagnostics of the connected HART field devices are implemented by the HART/OPC server or standard software tools, such as Cornerstone, AMS (Version 6.2 or later), PDM, PRM, FieldCare or PACTware.

**Conformance**

The MACX MCR-S-MUX HART multiplexer meets the following standards and directives:

– Directive 94/9/EC
– EN 61326
– VDE 0110
– HART Field Communication Protocol Rev. 6.0

⚠ **WARNING: Risk of electric shock**
Observe the safety notes on page 4.

ℹ Make sure you always use the latest documentation.
It can be downloaded at www.phoenixcontact.net/catalog.

# 2 Table of contents

# 3 Ordering data

## HART multiplexer

| Description | Type | Order No. | Pcs. / Pkt. |
|---|---|---|---|
| HART multiplexer, 32-channel, including two 14-wire flat-ribbon cables | MACX MCR-S-MUX | 2865599 | 1 |

## Accessories

| Description | Type | Order No. | Pcs. / Pkt. |
|---|---|---|---|
| The HART transfer board is used to operate the MACX MCR-S-MUX HART multiplexer. The signals from the HART-capable signal converters are applied to the terminal strip of the transfer board where they are then transmitted to the multiplexer via an FLK. | MACX MCR-S-MUX-TB | 2308124 | 1 |
| Interface converter, for conversion from RS-232 to RS-422 and RS-485, with electrical isolation, 2 channels, DIN-rail mountable | PSM-ME-RS232/RS485-P | 2744416 | 1 |
| Repeater, for electrical isolation and increasing the range in RS-485 2-wire bus systems, 3-way isolation, DIN-rail mountable (required if there are more than 32 multiplexers on one interface) | PSM-ME-RS485/RS485-P | 2744429 | 1 |
| Ex-i motherboard for accommodating 16 x PI-Ex supply, input or output isolating amplifier modules. With interface for connecting to HART multiplexer and D-SUB pin strip for connecting the analog signals to the control system level. | PI-EX-MB-S/16-01-2/D-SUB | 2865214 | 1 |
| FL COMSERVER BASIC..., serial devices server to convert a serial RS-232/422/485 interface to Ethernet, supports TCP, UDP applications, incl. CD-ROM with Com Port Redirector Software and user documentation (PDF). | FL COMSERVER BASIC 232/422/485 | 2313478 | 1 |

ℹ️ Only use original accessories and original replacement parts from Phoenix Contact.

# 4 Technical data

### Field device interface (HART)

| | |
|---|---|
| Channels | 16 or 32; can be set via a switch |
| Connection method | Flat-ribbon cable, 14-pos. (included) |
| Signal | HART FSK |
| HART specification | HART Field Communication Protocol Rev. 6.0 (backwards compatible up to Rev. 4.0); FSK Physical Layer Specification (Rev. 8.1) |
| Data transmission indicator | 2 yellow "Tx" and "Rx" LEDs: "HART" |
| Error indicator | Red "ERR" LED (flashes in the event of an error on the HART bus) |

### RS-485 interface

| | |
|---|---|
| Connection method | 9-pos. D-SUB socket |
| Signal | RS-485 |
| Data flow control/protocols | Compatible with OPC HART server, AMS, PDM, and PRM |
| Number of HART multiplexers per bus segment | 31, maximum |
| Address setting | 0 ... 127; via rotary switch on the front |
| Data rate | 9600/19200/38400/57600 [bps]; via rotary switch on the front |
| Transmission length | ≤ 1200 m |
| Indicator | 2 yellow "Tx" and "Rx" LEDs: "RS-485" |

### General data

| | |
|---|---|
| Supply voltage range | 20 V DC ... 30 V DC |
| Nominal supply voltage | 24 V DC |
| Current consumption | 55 mA |
| Power consumption | 1.35 W |
| Operating voltage indicator | Green "PWR" LED |
| Undervoltage monitoring | Yes (no faulty module/output states) |

### General data [...]

| | |
|---|---|
| Electrical isolation of HART signal/RS-485 | 350 V AC |
| Electrical isolation of HART signals from one another | 100 V DC (capacitive) |
| Electrical isolation of HART signal/supply | 350 V AC |
| Electrical isolation of RS-485/supply | 350 V AC |
| Error monitoring | Processor error: "PWR" LED flashes; HART communication error: "ERR" LED flashes |
| Width x height x length | 35.2 x 99 x 114.5 mm |

### Ambient conditions

| | |
|---|---|
| Ambient temperature (operation) | -20°C ... 60°C |
| Ambient temperature (storage/transport) | -40°C ... 80°C |
| Humidity | ≤ 95% (no condensation) |

### Conformance/approvals

| | |
|---|---|
| Conformance | CE-compliant |

## 5    Block diagram
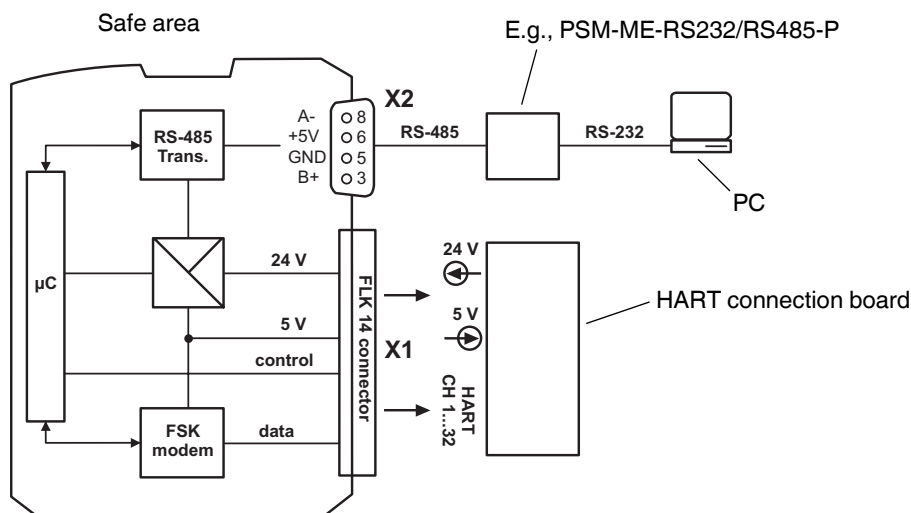


## 6    Safety notes

**WARNING: Risk of electric shock**

Please observe the following notes during installation and operation:

– Observe all national assembly and installation regulations (e.g., EN 60079-14), national safety and accident prevention regulations, generally recognized technical regulations, as well as the safety notes in the operating instructions.

– Install the HART multiplexer outside potentially explosive areas.

– Use the module for its intended purpose, i.e., only for its approved application (see page 1).

– Incorrect or improper use or failure to observe the notes in the operating instructions invalidates the warranty.

– Modifications and changes to the module are not permitted.

– The module must only be installed and operated when in an undamaged, dry, and clean state.

# 7    Structure
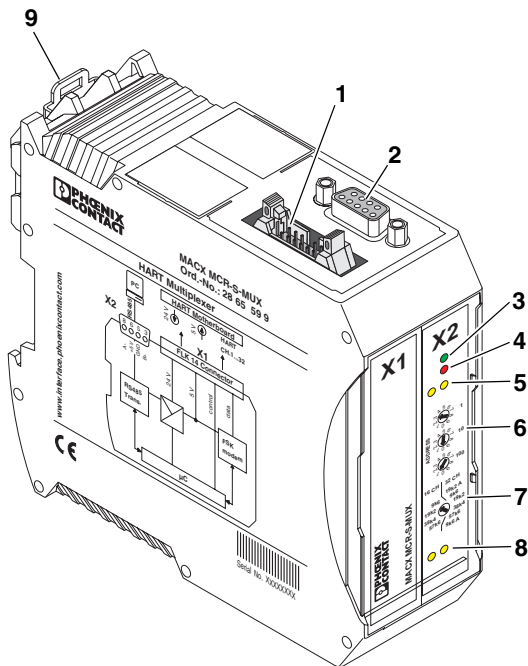


1    FLK connection
2    D-SUB connection
3    "PWR" LED, power
4    "ERR" LED, error
5    "HART-Tx"/"HART-Rx" LEDs, data transmission
6    Rotary switch for RS-485 address
7    Rotary switch for number of channels and transmission speed
8    "RS485-Tx"/"RS485-Rx" LEDs
9    Universal snap-on foot for EN DIN rails

# 8    Power supply

The HART multiplexer is supplied with power by the HART connection board, e.g.,MACX MCR-S-MUX-TB, which is connected via the 14-pos. flat-ribbon cable.

# 9    Installation
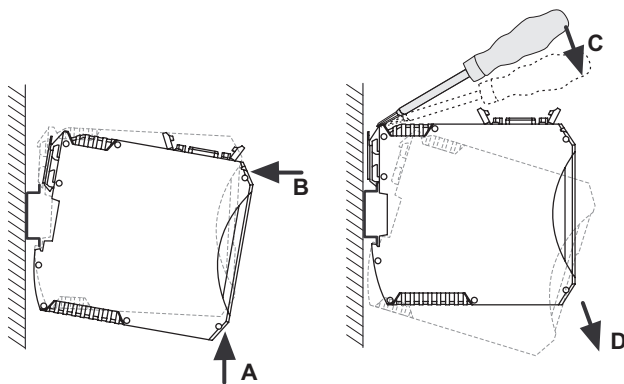


⚠ **WARNING: Danger if installed incorrectly**

Install the HART multiplexer outside potentially explosive areas.

The assignment of the connection terminal blocks is shown in the block diagram. The module can be snapped onto all 35 mm DIN rails according to EN 60715.

• Push the module onto the DIN rail from below (A). Push the module from the front toward the mounting surface until it engages with a click (B).

• Pull the base latch up using a screwdriver, needle-nose pliers or similar (C). Pull the top edge of the module away from the mounting surface and pull the module diagonally downward away from the DIN rail (D).

# 10 Settings

## 10.1 RS-485 address

Each HART multiplexer that is installed is assigned an address. This is set directly on the front of the multiplexer.

| ℹ️ | Please note that the setting is not indicated by the slot for the screwdriver, but by a small slot on the edge of the rotary switch. |



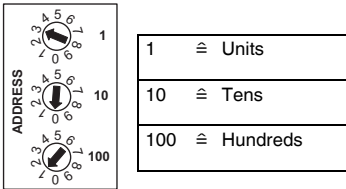| 1 | ≙ | Units |
| 10 | ≙ | Tens |
| 100 | ≙ | Hundreds |

Figure 1     Rotary switches

Example: Address 103

## 10.2 Number of channels/transmission speed

The number of channels and transmission speed are set in the same way.



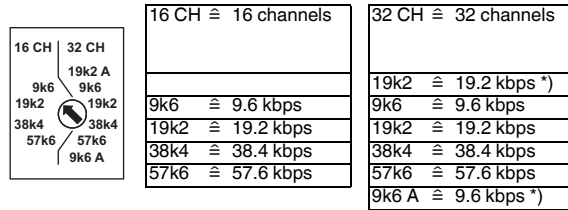| 16 CH ≙ 16 channels | 32 CH ≙ 32 channels |
| --- | --- |
| | 19k2 ≙ 19.2 kbps *) |
| 9k6 ≙ 9.6 kbps | 9k6 ≙ 9.6 kbps |
| 19k2 ≙ 19.2 kbps | 19k2 ≙ 19.2 kbps |
| 38k4 ≙ 38.4 kbps | 38k4 ≙ 38.4 kbps |
| 57k6 ≙ 57.6 kbps | 57k6 ≙ 57.6 kbps |
| | 9k6 A ≙ 9.6 kbps *) |

Figure 2     Rotary switch

Example: 16 channels, 9600 bps

*) Select these settings ("19k2 A", "9k6 A") when connecting the HART multiplexer to PRM (ARCOM protocol).

Select the "9k6" setting when operating the HART multiplexer with AMS (Version 6.2).

| ℹ️ | Settings are only applied after a software reset or module restart. |

# 11 Startup

## 11.1 Starting the HART multiplexer

- Connect the flat-ribbon cable (supplied as standard with the module) to the HART connection board, e.g., MACX MCR-S-MUX-TB.
- Connect the HART connection board, e.g., MACX MCR-S-MUX-TB, to the 24 V DC supply voltage.

The HART multiplexer scans all 32 channels (default setting) for connected HART field devices (CMD 0).

## 11.2 LED indicators on startup

(See also "Troubleshooting" on page 15)

| Des. | Color | Indicator | |
|------|-------|-----------|---|
| PWR | Green | Steady light: | Supply voltage present, operation OK |
| | | Flashing: | Module error; switch module off/on again |
| HART-Tx | Yellow | Flashing briefly: | Request to field device |
| HART-Rx | Yellow | Flashing briefly: | Confirmation from field device; communication OK |
| ERR | Red | Flashing briefly: | No confirmation from field device |

## 11.3 Communication with field devices

ℹ️ An RS-485 bus is not required for communication with field devices.

Once scanning is complete, the HART multiplexer establishes communication with the HART field devices that are found.

The "HART-Tx" and "HART-Rx" LEDs light up alternately.

If no field devices are found when the HART multiplexer is started, both LEDs remain off.

If modules are added later, they must be located and added using the PC software (e.g., in Cornerstone using "Learn" or "Add instrument").

HART communication is only possible if the control circuit resistance is between 230 Ω and 600 Ω. An additional resistor may be required. 250 Ω is sufficient in most cases.

# 12 Operating states

## LED indicators

| Des. | Color | Indicator | |
|------|-------|-----------|---|
| PWR | Green | Steady light: | Supply voltage present, operation OK |
| HART-Tx HART-Rx | Yellow | Lit alternately: | Communication with HART field devices OK |
| RS485-Rx RS485-Tx | Yellow | Lit alternately: | Communication with the PC via the RS-485 interface OK |

# 13 Connection examples

Various connection boards and transmission options are available for connecting the field devices to the HART multiplexer.

If one board is not sufficient, the connection board can be extended with a second board.

> **i** For a detailed description of the installation of the HART multiplexer and additional information, please refer to the user manual at www.phoenixcontact.net/catalog.

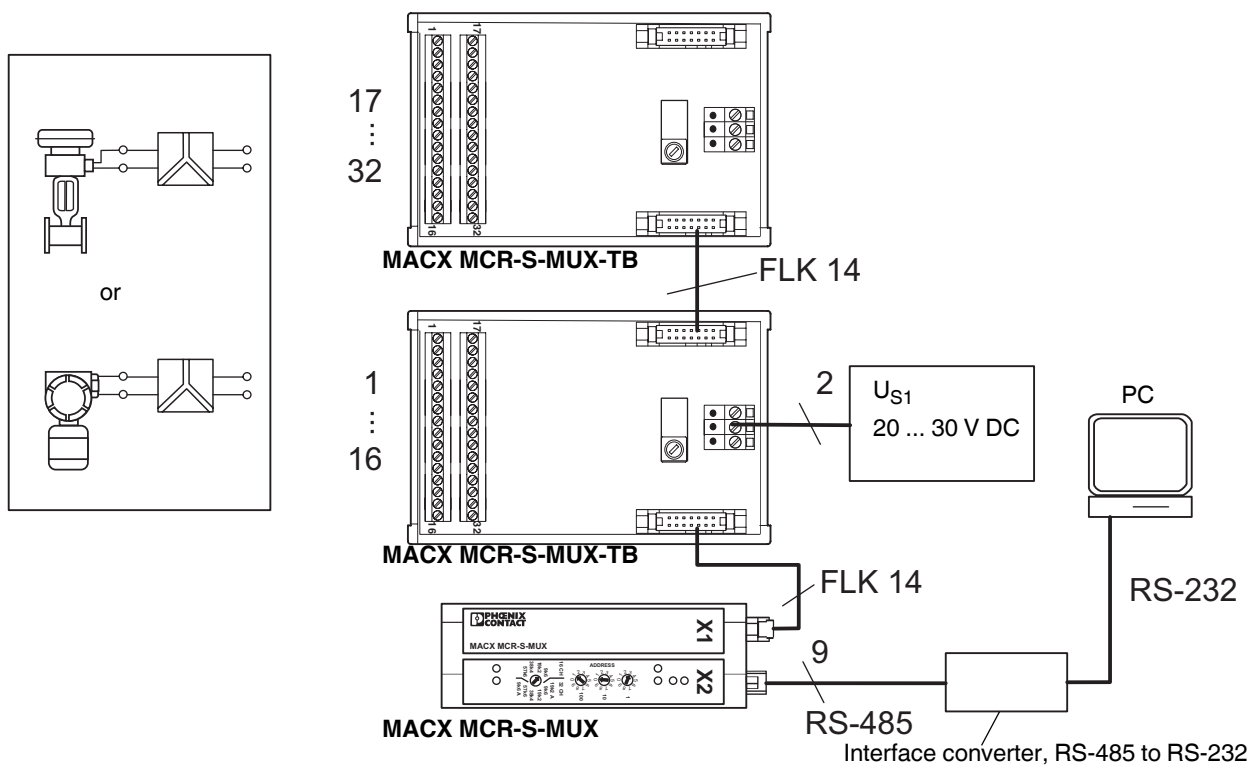## 13.1 Example 1 - HART multiplexer with connection board and interface converter



Figure 3    MACX MCR-S-MUX HART multiplexer with MACX MCR-S-MUX-TB connection board and interface converter

The following components are required:

– **Field device**

HART-capable

Ex-certified, if necessary

– **Signal converter**

HART-penetrable

Ex-certified, if necessary, for explosion protection through energy limitation (EX-i) of the circuit for the field device. For example, a repeater power supply that supplies the field device and forwards the process signal (4 ... 20 mA) with electrical isolation to a controller.

– If required, a suitable **terminal block** in order to route the signal to the connection board.

– **HART connection board**

Here, a maximum of 16 channels are connected per board. An FLK plug can be used to extend this to 32 channels by adding a board.

– **HART multiplexer**

Accepts the HART signal, which was previously decoupled capacitively, and forwards it via an RS-485 interface.

A maximum of 32 field devices in succession can therefore communicate bidirectionally via a HART multiplexer.

The flat-ribbon cable for connection to the connection board is supplied as standard.

– **Interface converter**, RS-485 to RS-232

– If necessary, a **resistor** for the signal cable

A termination resistor may be required in the signal cable. According to the HART specification, a resistance value of between 230 and 600 Ω is required for the transmission of the HART signal.

– **Power supply**

The converter, connection board, signal converter, and, if necessary, the field device must be supplied with 24 V.

**Software**

The following may be required:

– **Standard software tools**, such as Cornerstone, AMS (Version 6.2 or later), PDM, PRM, FieldCare or PACTware

– **HART OPC server** (HCF server - the program can be purchased from the HCF (HART Communication Foundation))

### 13.2 Example 2 - HART multiplexer with connection board and FL COMSERVER

The HART multiplexer organizes bidirectional data exchange between a maximum of 32 field devices and a separate PC or controller.
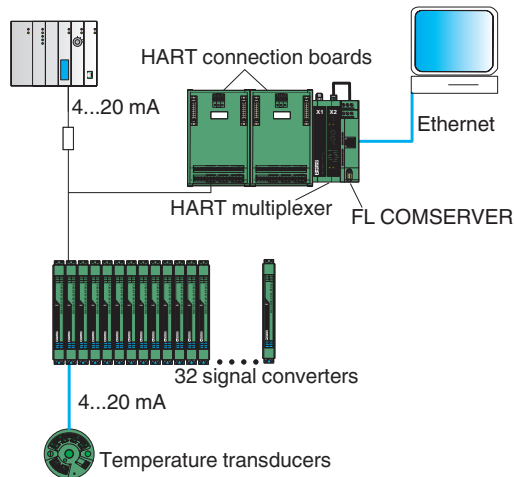


Figure 4    MACX MCR-S-MUX HART multiplexer with MACX MCR-S-MUX-TB connection board and FL COMSERVER

The following components are required:

– **Field device**
  HART-capable
  Ex-certified, if necessary

– **Signal converter**
  HART-penetrable
  Ex-certified, if necessary, for explosion protection through energy limitation (EX-i) of the circuit for the field device. For example, a repeater power supply that supplies the field device and forwards the process signal (4 ... 20 mA) with electrical isolation to a controller.

– If required, a suitable **terminal block** in order to route the signal to the connection board.

– **HART connection board**
  Here, a maximum of 16 channels are connected per board. An FLK plug can be used to extend this to 32 channels by adding a board.

– **HART multiplexer**
  Accepts the HART signal, which was previously decoupled capacitively, and forwards it via an RS-485 interface.
  A maximum of 32 field devices in succession can therefore communicate bidirectionally via a HART multiplexer.
  The flat-ribbon cable for connection to the connection board is supplied as standard.

– **FL COMSERVER**
  Has an RJ45 interface for the Ethernet connection.

– **Ethernet cable**

– If necessary, a **resistor** for the signal cable
  A termination resistor may be required in the signal cable. According to the HART specification, a resistance value of between 230 and 600 Ω is required for the transmission of the HART signal.

– **Power supply**
  The converter, connection board, signal converter, and, if necessary, the field device must be supplied with 24 V.

**Software**

The following may be required:

–   **CommPort Redirector** (Version 2.2/3 in the example)

    The CommPort Redirector program, which is supplied as standard with the FL COMSERVER, provides a virtual COM port on the PC, because the HART OPC server expects a COM interface.

    Version 2.2/3 can be used up to Windows XP. Version 4.3 is available for Windows XP or later.

–   **Browser** for configuring the FL COMSERVER

–   **Standard software tools**, such as Cornerstone, AMS (Version 6.2 or later), PDM, PRM, FieldCare or PACTware

–   **HART OPC server** (HCF server - the program can be purchased from the HCF (HART Communication Foundation))

### 13.3 Example 3 - Several HART multiplexer with connection board and FL COMSERVER

Several HART multiplexer can be connected in parallel so that, in theory, up to 4000 channels can be visualized on a PC via the interface.
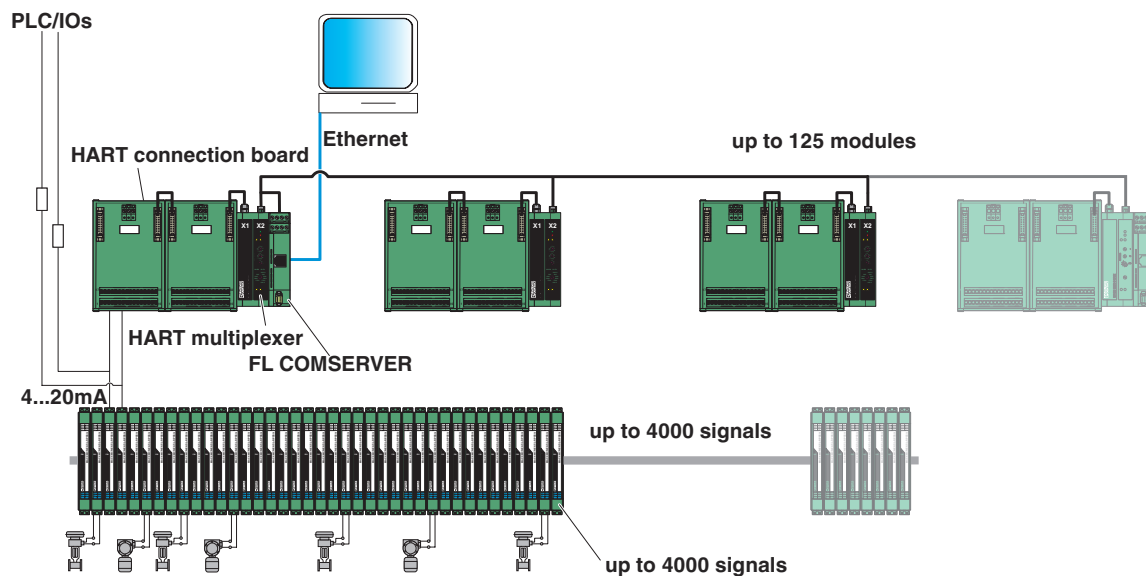


Figure 5    Several MACX MCR-S-MUX HART multiplexer with MACX MCR-S-MUX-TB connection board and FL COMSERVER

### 13.4    Example 4 - HART multiplexer with motherboard and interface converter or FL COMSERVER
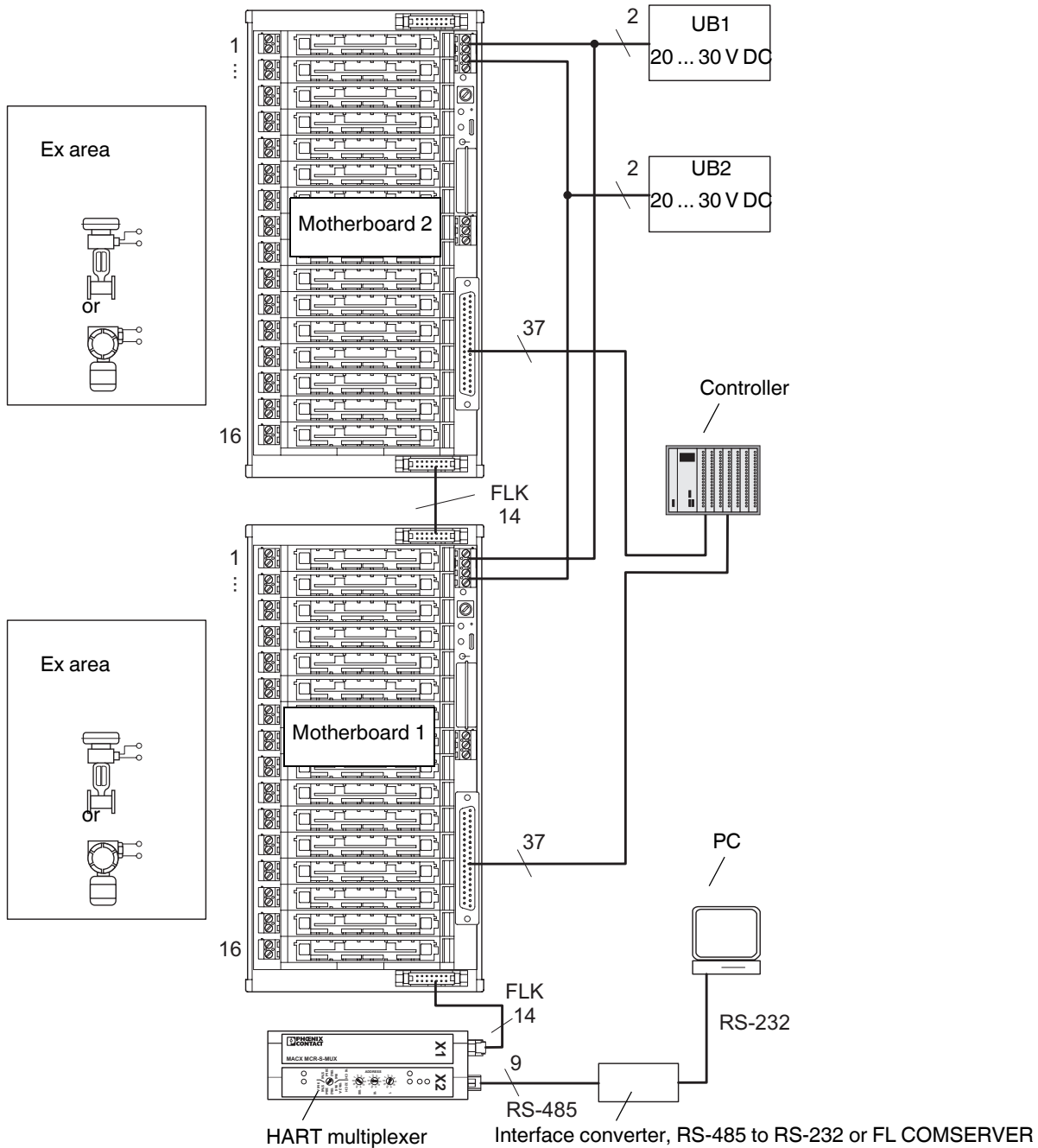


Figure 6      MACX MCR-S-MUX HART multiplexer with two PI-EX-MB-S/16-01-2/D-SUB (2 x 16 channels) HART connection boards and PSM-ME-RS232/RS485-P interface converter or FL COMSERVER

The following components are required:

– **Field device**

  HART-capable

  Ex-certified, if necessary

– **Signal converter**

  HART-penetrable

  Ex-certified, if necessary, for explosion protection through energy limitation (EX-i) of the circuit for the field device. For example, a repeater power supply that supplies the field device and forwards the process signal (4 ... 20 mA) with electrical isolation to a controller.

– If required, a suitable **terminal block** in order to route the signal to the connection board.

– **HART connection board**, PI-EX-MB-S/16-01-2/D-SUB

  Here, a maximum of 16 channels are connected per board. An FLK plug can be used to extend this to 32 channels by adding a board.

– **HART multiplexer**

  Accepts the HART signal, which was previously decoupled capacitively, and forwards it via an RS-485 interface.

  A maximum of 32 field devices in succession can therefore communicate bidirectionally via a HART multiplexer.

  The flat-ribbon cable for connection to the connection board is supplied as standard.

– **Interface converter**, RS-485 to RS-232 or FL COMSERVER

– **Ethernet cable** (for FL COMSERVER only)

– If necessary, a **resistor** for the signal cable

  A termination resistor may be required in the signal cable. According to the HART specification, a resistance value of between 230 and 600 Ω is required for the transmission of the HART signal.

– **Power supply**

  The converter, connection board, signal converter, and, if necessary, the field device must be supplied with 24 V.

– **Software**, see "Software" on page 11

# 14 Repair and maintenance

We recommend that you only allow us to repair our modules. In exceptional cases, repairs can also be made by another approved body.

The modules are maintenance free.

**Troubleshooting**

| Error detection | Possible error cause | Error removal |
|---|---|---|
| "PWR" LED off | Auxiliary voltage failure or module fuse faulty | Check auxiliary voltage supply.<br><br>If fuse is faulty, return the module for repair. |
| "PWR" LED flashing | Internal module error | Switch module off/on. If LED keeps flashing, return the module for repair. |
| "ERR" LED flashes briefly | No HART field device found | Connect HART field device and check connection. |
| "HART" LEDs off | No HART field device found | Connect HART field device and check connection. |
| "RS485" LEDs off | No RS-485 bus connected.<br>RS-485 interface not active. | Connect RS-485 interface and check connection. |

If the approaches described prove unsuccessful, please contact our nearest sales center. For a quick response, make sure you have the following information to hand:

– Type and serial number
– Purchase data
– Error description
– Application (especially input/output circuit)