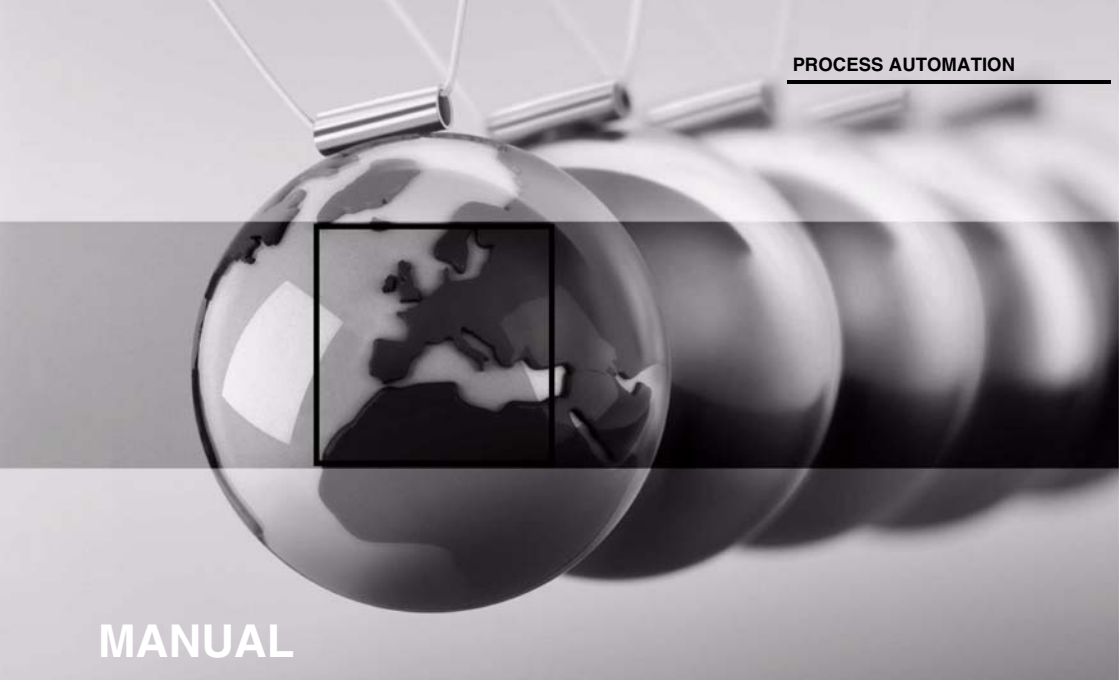

MANUAL

TEMPERATURE MULTI INPUT DEVICE

TM-I

FOUNDATION

PEPPERL+FUCHS

PROTECTING YOUR PROCESS

With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

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11/2008 132328

11/2008 132328

1 Validity of these instruction manual/manual

Pepperl+Fuchs offers three different types of Temperature Multi Input Devices:

- F2D0-TI-Ex8.FF.*:* in a IP 67 housing for panel mounting.
- RD0-TI-Ex8.FF.* for mounting on a 35-mm DIN rail in accordance with EN 50 022.

This manual applies to all types.

The manufacturer of the product, Pepperl+Fuchs GmbH in D-68301 Mannheim, has a certified quality assurance program in accordance with ISO 9001.

ISO**9001**

Note

A corresponding declaration of conformity may be requested from the manufacturer.

2 Symbols used

Warning

This symbol warns of a danger.
In the event the warning is ignored, the consequences may range from personal injury to death or from damage to equipment to destruction.

Attention

This symbol warns of a possible fault.
Failure to observe the instructions given in this warning may result in the device and any facilities or systems connected to it developing a fault or even failing completely.

Note

This symbol draws your attention to important information.

11/2008 132328

3 Introduction

This manual describes the Pepperl+Fuchs FOUNDATION Fieldbus version of the Temperature Multi Input Device (TM-I Device) for universal temperature measurement, voltage and resistance input.

This manual shall allow the user to install, start, parameterize and operate the Pepperl+Fuchs TM-I Device. In addition it provides all necessary information about status/ error messages, device safety and monitoring functions as well as fault diagnosis and fault elimination.

Capter 6 provides in-depth information about configuration of the Pepperl+Fuchs device specific transducer blocks since they contain device and manufacturer specific functionality. The Resource, AI and MAI blocks and their use are documented by the control system.

The manual assumes the user has technical knowledge and experience in the areas of FOUNDATION Fieldbus, explosion protection, as well as planning, projecting and installing FOUNDATION Fieldbus systems. It does not provide an introduction to FOUNDATION Fieldbus or explosion protection for inexperienced users. Please refer to other information sources if required.

11/2008 132328

4 Instruction Manual

These instructions apply in conjunction with the respective data sheets and EC-type-examination certificate. You can access the documents at www.pepperl-fuchs.com.

Warning

The operator of the system bears the responsibility in terms of planning, mounting, commissioning, operation and maintenance, especially in conjunction with applications in hazardous areas.

4.1 Intended Use

The 8 channel TM-I Device transfers signals from resistance temperature measuring sensors (RTD's), thermocouples, resistance and millivolt signals via FOUNDATION Fieldbus. Each channel could be configured independently.

The TM-I Device can be used for FOUNDATION Fieldbus H1 bus that use the physical layout in accordance with IEC 61158-2/ISA-S50.02-1992.

The TM-I Device may be installed in category 2G (Zone 1) or category 3G (Zone 2) of a hazardous area.

For category 2G (Zone 1) applications the type of protection is "Intrinsic Safety". The associated field devices could operate in a category 1G (Zone 0) or category 1D (Zone 20) location.

For category 3G (Zone 2) applications the type of protection is EEx nA. The TM-I Device could be connected to non-intrinsically safe H1 segment. Independent of the type of protection of the H1 bus the inputs remains intrinsically safe.

The EC-Type Examination certificate and the data sheet are considered as an integral part of this instruction manual. The data sheet contains the electrical data of the EC-Type Examination certificate.

Warning

TM-I Device*s that are operated in general electrical systems must not thereafter be operated in electrical systems that are connected in hazardous areas.*

Laws and/or regulations governing the use or intended usage goal must be observed.

TM-I Devices are only approved for proper professional usage in accordance with the intended purposes. Improper handling will void any claim made under the warranty and any manufacturer's liability.

Warning

Protection of operating personnel and the system is not ensured if the module is not ***used in accordance with its intended purpose.***

The device can only be operated by trained professionals in accordance with the available instruction manual.

11/2008 132328

4.2 Marking

TM-I Devices are identified by:

F2D0-TI-Ex8.FF.*:*	RD0-TI-Ex8.FF.*
Pepperl + Fuchs	Pepperl + Fuchs
68301 Mannheim, Germany	68301 Mannheim, Germay
F2D0-TI-Ex8.FF.*:*	RD0-TI-Ex8.FF.*:*
PTB 03 ATEX 2237 Ex II 2 (1G/D) Ex ia IIC T4 Ex II (1) GD [Ex ia] IIC Ex II 3 G Ex ic IIC T4 Ex II (3) GD [Ex ic] IIC	
PTB 03 ATEX 2238 X Ex II 3 G Ex nA II T4 Ex II 3 G Ex nL II T4 Ex II (3) G [Ex nL] IIC	

Table 4.1: Marking of the Temperature Multi Input Device

4.3 Ambient Conditions

For the ambient temperature range, please refer to the respective data sheet.

4.4 Mounting and Dismounting

Mounting, dismounting, installation and commissioning must only be performed by specialist who are trained specifically for this purpose.

Recognized rules of the technology and setup requirements must be maintained during mounting and dismounting. Especially for tasks on electrical systems, special safety requirements must be observed. Special attention must be paid to the following points:

1. Has the TM-I Device been installed in accordance with specifications?

2. Is the TM-I Device free of damage?

3. Is IP protection ensured?

4. Are the screws tightened securely?

Plastic cable glands must be protected against mechanical force.

The Device has to be protected against electro static charge.

4.4.1 Mounting and Dismounting of F2D0-TI-Ex8.FF.*:*

F2D0-TI-Ex8.FF.*.*

The housing of TM-I Device F2D0-TI-Ex8.FF.*:* reaches the degree of protection IP67. It is intended for panel mounting. 2 screws with a diameter of 6 mm should be used for mounting. The mounting material should be selected according to the nature of the sub-surface (the wall). When selecting mounting material, care must be taken that it will ensure a secure fastening.

11/2008 132328

4.4.2 Mounting and Dismounting of RD0-TI-Ex8.FF.*

TM-I Device RD0-TI-Ex8.FF.* is designed for mounting on a 35-mm DIN rail in accordance with EN 50 022 and must be protected against electro static discharge.

The Device must be mounted inside a housing that corresponds to at least degree of protection

- IP20 in accordance with IEC 60529 for category 2G (Zone 1) application. The housing must be suitable for this application.
- IP54 in accordance with IEC 60529 for category 3G (Zone 2) application. The housing must be suitable for this application.

Housings of light alloy must not contain more then 6% of magnesium in total weight.

Plastic housing must be designed in accordance with IEC 60079-0 or need to be protected against electro static charge.

4.5 Installation and Commissioning

The Temperature Multiplexer meets the requirements of the Foundation Fieldbus physical layer profile 111 and 511 as well as the requirements for non IS fieldbus segments in acc. with IEC 61158-2/ISA-S50.02-1992.

The TM-I Device has to be installed according to its designation in Zones 1 or 2.

11/2008 132328

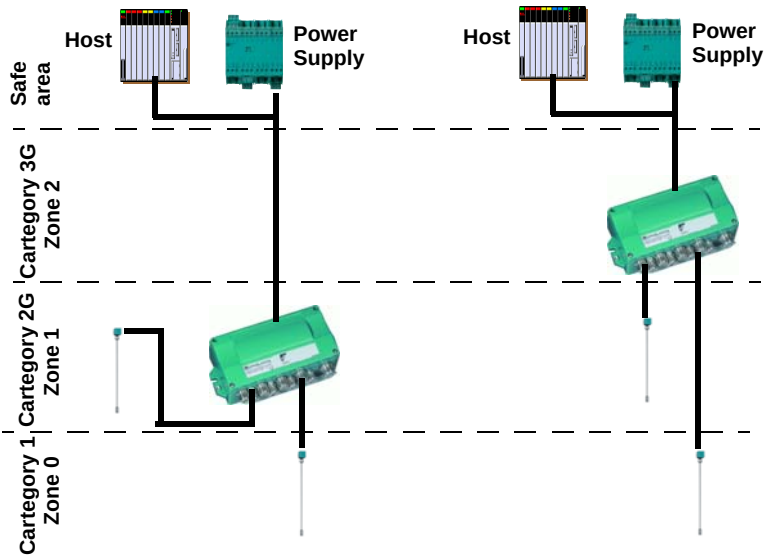


Figure 4.1: Possibilities of installation

In Zone 1 the fieldbus must be intrinsically safe in accordance with the FISCO or Entity model. Is the TM-I Device mounted in Zone 2 it is not required to have an intrinsically safe fieldbus. In this case the TM-I Device works as an associated apparatus.

Warning

The EC-type-examination certificate or the statement of conformity must be observed. *It is especially important to maintain any „special conditions“ that may be indicated.*

4.5.1 Installation in Category 2G (Zone 1)

If the TM-I Device is installed in Zone 1 environments, the fieldbus has to be powered intrinsically safe. A suitable fieldbus power supply has to be certified according to the Entity or the FISCO model (IEC 60079 part 27). For the marking of the TM-I Device please refer to Table 4.1 on page 6.

When using intrinsically safe analog input circuits in the Dust Ex Area 'D' only appropriate certificated field devices must be connected.

When installing intrinsically safe fieldbus segments, EN 60079-14/IEC 60079-14 must be observed. For the interconnection of intrinsic safe field devices with the TM-I Device the maximum values in the meaning of explosion protection must be observed. Only the certified analogue inputs are allowed, depending on the type of explosion protection, to be installed in a category 1 (Zone 0) area.

For the Federal Republic of Germany, the „National Foreword“ of DIN EN 60079-14/VDE 0165 Part 1 must also be observed.

11/2008 132328

4.5.2 Installation in Category 3G (Zone 2) and safe areas

The TM-I Device could be installed in a category 3G (Zone 2) location.

In Zone 2 environment or safe areas the TM-I Device is normally powered by a non intrinsically safe fieldbus power supply.

Only devices which are suitable for use in hazardous areas, category 3G (Zone 2) and for the conditions at the place of installation must be installed in category 3G (Zone 2; see declaration of conformity or statement of conformity)

The sensors connected to the inputs could be located

- in a category 3G (Zone 2) location
- in a category 1G (Zone 0) or 2G (Zone 1) location or
- in a category 1D (Zone 20) or 2D (Zone 21) location.

STOP
Warning

A segregation between the bus terminals and the input terminals is required. To segregate the terminals of the fieldbus to the terminals of the sensor inputs the segregation plate which is delivered with the TM-I Device has to be installed on to the housing (see figure 4.2)

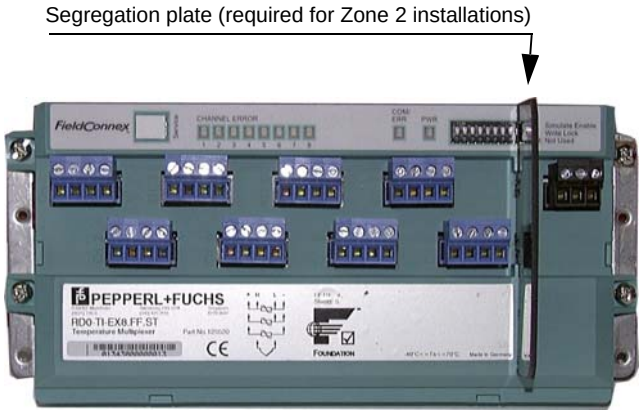


Figure 4.2: Zone 2 installation

When connecting intrinsically safe field devices to the TM-I Device the respective peak values as defined by explosion protection (proof of intrinsic safety) have to be observed.

In Zone 2 the connection and disconnection of the internal terminal connectors as well as the closing of circuits while the power is on is only permissible for reasons of in-

11/2008 132328

stallation, maintenance or repair.

Note

The coincidence of an explosive atmosphere with installation, maintenance or repair in Zone 2 is considered to be unlikely.

If a F2D0-TI-Ex8.FF.*:* with external connectors for the H1 bus mounted at the housing is in use, these connectors are allowed to be connected or disconnected only if the H1 bus segment is **not** powered.

Only intrinsically safe analogue input circuits must be carried in Zone 1 or Zone 2 depending on the ignition protection class.

Sensors mounted in a category 1D (Zone 20) or 2D (Zone 21) location

When using intrinsically safe analogue input circuits in the Dust Ex Area 'D' only appropriate certificated field devices must be connected.

4.5.3 Use as Intrinsically Safe Apparatus

The current supply circuit in category 2G (Zone 1) must be intrinsically safe ia or ib.

The current supply circuit in category 3G (Zone 2) must be intrinsically safe ia, ib or ic.

Only intrinsically safe analogue input current circuits must be carried in Zone 0 or Zone 1 depending on ignition protection class.

When using intrinsically safe analogue input circuits in the Dust Ex Area 'D' only appropriate certificated field devices must be connected.

For interconnection of intrinsically safe field devices with the TM-I device take into account the respective maximum values in the sense of explosion protection (proof of intrinsically safety).

4.5.4 Use as Associated Apparatus

Only intrinsically safe analogue input current circuits must be carried in Zone 0, Zone 1 or Zone 2 depending on ignition protection class.

When using intrinsically safe analogue input circuits in the Dust Ex Area 'D' only appropriate certificated field devices must be connected.

For interconnection of intrinsically safe field devices with the TM-I device take into account the respective maximum values in the sense of explosion protection (proof of intrinsically safety).

4.5.5 Use as non-arcing Apparatus "nA"

Only devices which are suitable for use in hazardous areas, category 3G (Zone 2) and for the conditions at the place of installation must be installed in category 3G (Zone 2; see declaration of conformity or statement of conformity)

Only intrinsically safe analogue input current circuits must be carried in Zone 0, Zone 1 or Zone 2 depending on ignition protection class.

When using intrinsically safe analogue input circuits in the Dust Ex Area 'D' only appropriate certificated field devices must be connected.

For interconnection of intrinsically safe field devices with the TM-I device take into account the respective maximum values in the sense of explosion protection (proof of

11/2008 132328

intrinsically safety).

In Zone 2 the connection and disconnection of the internal terminal connectors as well as the closing of circuits while the power is on is only permissible for reasons of installation, maintenance or repair.

Note

The coincidence of an explosive atmosphere with installation, maintenance or repair in Zone 2 is considered to be unlikely.

4.5.6 Commissioning the TM-I Device

When installing intrinsically safe fieldbus segments, EN 60079-14/IEC 60079-14 must be observed. For the Federal Republic of Germany, the "National Foreword“ of DIN EN 60079-14/VDE 0165 Part 1 must also be observed.

The DIP-switches for configuration can be activated even during operation.

The following identifying values must be observed when connecting fieldbus transmission lines:

- The insulating length of the wire is 9 mm.
- Wire cross-section 0.2 mm² to 2.5 mm² or AWG 24 to 14.
- If a cable, consisting of fine wire is in use, the ends of the leads must be protected (e. g. with core cable ends).
- Tightening torque of the screw terminals (if present) 0.4... 0.5 Nm.
- If a Thermocouple is connected to the terminals H and L of the TM-I Device, it is not allowed to connect something to the terminals + and -.
- A fieldbus transmission line with an insulation voltage between the bus line and shield of at least 500 V must be used for intrinsically safe fieldbus segments.
- The serial interface (see figure 4.3) is for parameterization only. It fulfills the type of protection EEx ia IIC/IIB resp. EEx ib IIC/IIB with the following values:
  - U_O = 7.2 V
  - I_O = 29.1 mA
  - P_O = 52,38 mW
  - L_i = 0
  - C_i = 0
  - Characteristic curve: linear
  - Only for connection of intrinsically safe circuits
  - U_i = 5 V

Tasks for parameterization via the serial interface must only be performed by specialists who are specially trained and authorized by Pepperl+Fuchs.

11/2008 132328

4.5.7 Installation and Commissioning of RD0-TI-Ex8.FF.*

TM-I Device RD0-TI-Ex8.FF.*·* is mounted on a DIN rail in accordance with EN 50 022.

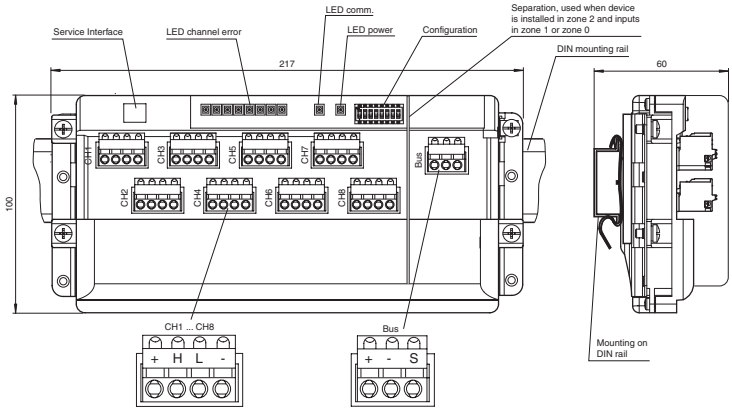


Figure 4.3: Dimensions and pinout of RD0-TI-Ex8.FF.*·*

4.5.8 Installation and Commissioning of F2D0-TI-Ex8.FF.*.*

Tightening torques of the screwed connection of cable glands:
The tightening torques of cap nuts depends on the type cable used and must therefore be determined by the user. The cap nuts must be securely tightened. Tightening the cap nuts too tight can have a negative effect on the protection method. The following figures should be taken as a rough guides:

Type	Cap nut	Lower part
F2D0-TI-Ex8.FF.*·*.CG	2.5 Nm	3.75 Nm
F2D0-TI-Ex8.FF.*·*.CGB	4.17 Nm	6.25 Nm
F2D0-TI-Ex8.FF.*·*.CGS	4.17 Nm	6.25 Nm
F2D0-TI-Ex8.FF.*·*.CGAB	22 Nm	28 Nm

11/2008 132328

Only permanently laid cables and lines must be inserted into the cable glands. For the permissible cable diameters, please refer to the respective data sheet. The operator must provide an appropriate strain-relief clamp (for example with a suitable cable clamp). The mounting notes in chapter 4.4.1 must be observed.

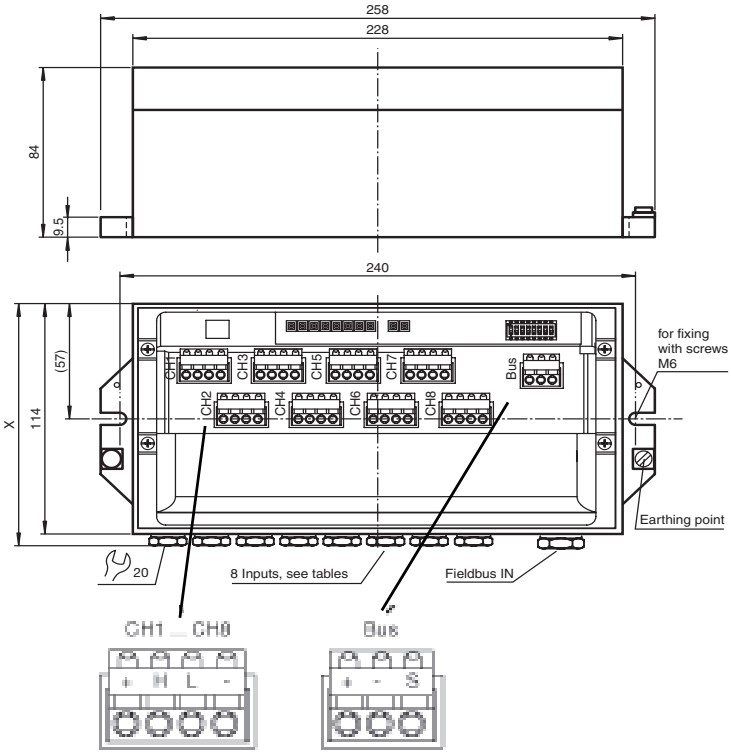


Figure 4.4: Dimensions and pinout of F2D0-TI-Ex8.FF.*:*

Cable glands that are not in use must be closed off with a corresponding plug or replaced by an appropriate screw plug. The required degree of protection (e. g. IP66) must be observed.

The ambient temperature range can be restricted by the stop plug.

Attention

For examples of stop plugs and screw plugs, please refer to the respective data sheets.

For metal housings in hazardous areas, a suitable potential equalization in accordance with EN 60 079 is required. A grounding screw is provided on the housing for

11/2008 132328

this purpose. The connection must be designed to prevent lossening and must be protected against corrosion. Protection against corrosion can also be achieved by using tinned cable plates, for example

Before closing the cover, a visual inspection must be performed to ensure that there are no visible signs of damage on the cover seal. In the event of damage, the seal must be replaced by an original seal.

The screws on the cover should be tightened with a torque of 2.5 Nm.

11/2008 132328

4.6 Handling of the Cable Glands

4.6.1 Handling F*D0-TI-Ex8.FF.CG Cable Glands

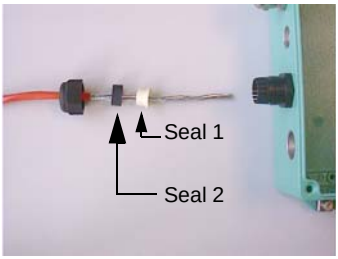
1. Strip the insulation of the cable up to about 120 mm

Step 1

2. Loosen the cap nuts from the TM-I Device and push it onto the cable. Remove the seals from the TM-I Device as well and push them onto the cable. The following table will indicate when Seal 1 should be used and when it is not required:

Type	Terminal area [mm]	Seal 1
M16 x 1.5	5 - 10	No
M20 x 1.5	5 - 8	Yes
M20 x 1.5	8 - 13	No

Seal 2 must always be used!

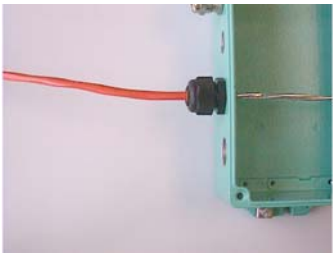


Step 2

3. Push the seals that are used far enough over the cable so that the covering extends about 5 mm beyond the seal.

4. Insert the cable with the seals into the cable gland of the TM-I Device. Then tighten the cap nut. The tightening torques of cap nuts depends on the cable typeis used and must therefore be determined by the user. As a rough guide for the FieldBarrier of type F*D0-TI-Ex8.FF.CG you may use 2.5 Nm for the cap nut and 3.75 Nm for the lower part.

Step 3



Step 4

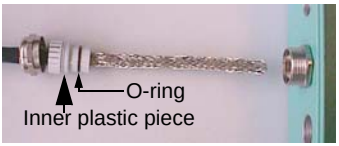
11/2008 132328

4.6.2 Handling the F*D0-TI-Ex8.FF.CGB and F*D0-TI-Ex8.FF.CGS Cable Gland

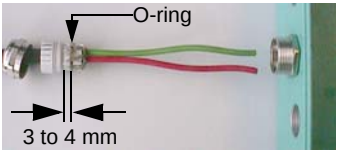
1. Strip the insulation of the cable up to about 120 mm
2. Loosen the cap nuts from the TM-I Device and push it onto the cable.
3. Remove the seals from the inside plastic part as well and push them onto the cable.
   Move the inside plastic part far enough over the cable that the covering is completely surrounded by the seal.
   The covering must not stand out over the end of the plastic inner part.
4. Pull the shield over the inside plastic part and shorten it to the correct length. The shield should protrude about 3 to 4 mm beyond the O-ring.
5. Insert the cable with the inside plastic part into the lower part of the cable gland.
6. Then tighten the cap nut.
   The tightening torques of cap nuts depends on the cable typeis used and must therefore be determined by the user.
   As rough guides for FieldBarrier type F*D0-TI-Ex8.FF.CGS you may use 4.17 Nm for the cap nut and 6.25 Nm for the lower part.

Step 1

Step 2



Step 3



Step 4

Step 5

Step 6

11/2008 132328

4.7 Grounding and Shielding of the TM-I Device

If the shield of the fieldbus transmission line is grounded for reasons related to EMC, the appropriate sections of the FOUN DATION Fieldbus Application Guide 31.35 bit/s Intrinsically Safe Systems must always be observed.

The terminal S of the intrinsically safe fieldbus segment is

- in case of using the F2-version connected internally to the housing. The housing should be connected to the potential equalization.

The housing of the F2-version must be connected to the potential equalization in case of Category 2G (Zone 1) applications.

- in case of using the R version connected internally to the DIN rail. The DIN rail should be connected to the cabinet and the cabinet should be connected to the potential equalization.

Depending on this the shield is automatically connected to the potential equalization.

4.8 Repair and maintenance

The transmission behavior of the TM-I Device is stable even over long periods of time. There is thus no need for regular adjustments or similar tasks. Maintenance is therefore not required.

4.9 Fault elimination

TM-I Devices that are operated in connection with hazardous areas must not be modified. If there is a defect, the TM-I Device must always be replaced.

Defective housing parts (for example cover seals) must be replaced only by original parts. For detailed information please refer to the respective data sheet.

Tasks for eliminating malfunctions must only be performed by specialists who are specially trained and authorized for the task.

4.10 Disposal

Disposal of the packaging and TM-I Device must only take place in accordance with the requirements of the country in which the TM-I Device is installed.

The TM-I Device does not contain any batteries that must be disposed of separately from the TM-I Device.

11/2008 132328

5 Installation

5.1 Electrical Connection

5.1.1 Sensors

Five types of sensors can be connected to each channel according to the following scheme:

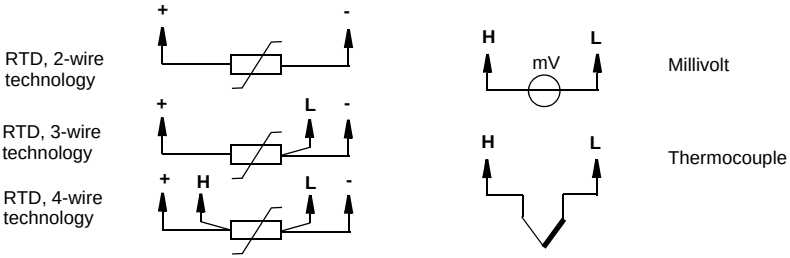


Figure 5.1: Sensor connection

5.1.2 Fieldbus and Shield Connection

The TM-I Device provides a connector for the fieldbus cable. The device itself can operate in both polarities. As not all FOUNDATION Fieldbus devices support polarity independent operation, it is recommended to wire all field devices in a consistent way.

5.2 DIP Switches

The device has eight DIP switches. Only DIP switch 1 and 2 are in use:

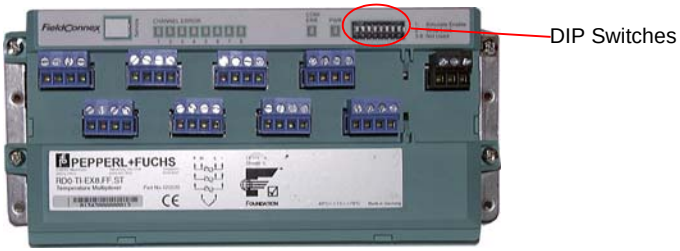


Figure 5.2: DIP Switches

Switch 1: **Simulation ON/OFF**. With activated simulation, the sensor input transferred from the transducer block to the function block can be set by the control system independent from the hardware input of an input channel. For safety reasons, it is recommended to set the switch to OFF for normal operation.

Switch 2: **Hardware write protection ON/OFF**. Parameterization of the device via the bus is no longer possible when write protection is activated (setting ON).

11/2008 132328

6 Configuration

6.1 Introduction

The Pepperl+Fuchs Temperature Multi Input Device contains a resource block (like any FOUNDATION Fieldbus Device), 9 transducer blocks (8 sensor and one concentrator block) and 9 standard FOUNDATION Fieldbus function blocks (8 AI and one MAI block).

The **sensor transducer blocks** provide connection to the sensor hardware and the possibility to configure the eight temperature sensors that can be connected to the device.

The **concentrator transducer block** provides convenient access to the most important configuration options of all sensors as well as Device Description (DD) methods for easy configuration of the device. This will increase the productivity at configuration time. Additionally, it provides the device's body temperature and EMC filter settings. It allows to view the values and diagnostics information of all channels at the same time.

The **Analog Input (AI) blocks** are conform to the FOUNDATION Fieldbus specification and can be used to build a FOUNDATION Fieldbus application and provides temperature/voltage/resistance value depends on the configuration.

The **Multiple Analog Input (MAI) block** is conform to the FOUNDATION Fieldbus specification and provides all eight sensor values in one block. Limits handling and alarms are not implemented in this block. Also, the block consumes only one execution time so the FOUNDATION Fieldbus schedule time can be reduced. This block is convenient if e.g. the device is used for monitoring purposes because it is very easy to project and do not require configuration. Additionally, there is only one block to configure instead of 8.

6.2 Block Interaction and Channel Mapping

Transducer blocks provide a measurement value to AI and MAI blocks. The connection between the blocks is configured via the „Channel“ parameter of the AI block which chooses the sensor block to get the process data from.

Number	Selected sensor	Usable by
1	*Sensor 1*	*AI*
2	*Sensor 2*	*AI*
3	*Sensor 3*	*AI*
4	*Sensor 4*	*AI*
5	*Sensor 5*	*AI*
6	*Sensor 6*	*AI*
7	*Sensor 7*	*AI*
8	*Sensor 8*	*AI*
9	*Sensor 1 to 8*	*MAI*
10	*Body temperature*	*AI*

Table 6.1: Channel Mapping

11/2008 132328

In addition to the measurement value, status information is conveyed to the AI and MAI block which can be used to determine the measurement value's quality. For more information, see chapter 7.1

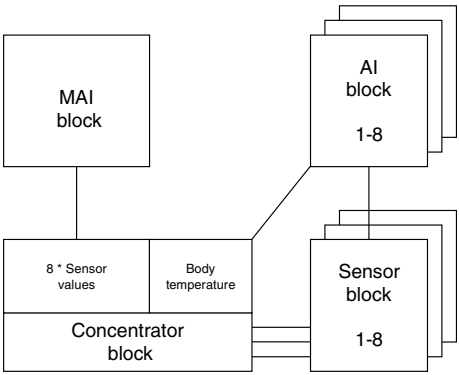


Figure 6.1: Block interaction

6.3 Identification, Device ID, PD Tag

Each FOUNDATION Fieldbus device has a unique device ID. The Pepperl+Fuchs TM-I Device device ID is structured as follows:

Manufacturer	Type	Serial number
502B46	0003	12345678901234

The device ID "502B460003-12345678901234" contains the manufacturer identification "502B46" for Pepperl+Fuchs and the type "0003" for Temperature Multiplexer. The first two fields are the same for all Temperature Multi Input Device *-TI-Ex8.*.*. The serial number is unique for each device, thus a differentiation can be made via the serial number if several Temperature Multiplexers are connected to one FF-H1 segment. The serial number is also provided on the type label

- on the upper right side (RD0...)
- on the inner left side of the housing.

The PD tag contains as default a cleartext identification for the device and the last nine characters of the serial number, e.g. „P+F TM-I Device 123456789".

6.4 Getting Started

Step 1 Integration of DD and capability file on the configuration tool of the host system

To parameterize the Temperature Multiplexer in the online mode the as-

11/2008 132328

sociated device description (DD) must be imported in the engineering tool used. For offline parameterization a capability file is available. Unless the manufacturer of the control system has made integration, you will find the necessary files on the Internet at the P+F website.

Please consult the control system's manual for instructions on how to import the files.

Step 2 Physical connection to the fieldbus, address assignment

Connect the fieldbus to the appropriate terminals of the device. If a power supply is connected, the device boots up and the LEDs show a kind of „progress bar“. In the following the green power LED is on, the sensor error LEDs are off. The COM LED is flashing until communication with a link master is established.

Upon delivery, the device is configured to address 248. Most control systems automatically change the address after startup, so no user action is required. Please refer to the control system's manual.

Step 3 Commissioning

First, the transducer blocks need to be configured. This can be accomplished in two ways:

- Executing the DD methods of the sensor or concentrator block. The user is guided through the setup process
- By hand via the parameters described in the following sections.

Second, the AI/MAI blocks are configured according to the application's needs.

Third, a schedule for the complete application is built and downloaded to all involved devices. For a more detailed TM-I Device configuration description, please refer to the following sections.

6.5 Sensor Block Configuration

Note

The concentrator and sensor block contains DD methods for convenient and fast sensor configuration.

6.5.1 Measurement Data Flow

Figure 6.2 „Measurement data flow“ shows the internal data flow in the sensor block and illustrates the block parameters' influence on measurement. These parameters

11/2008 132328

are explained in detail in the following sections.

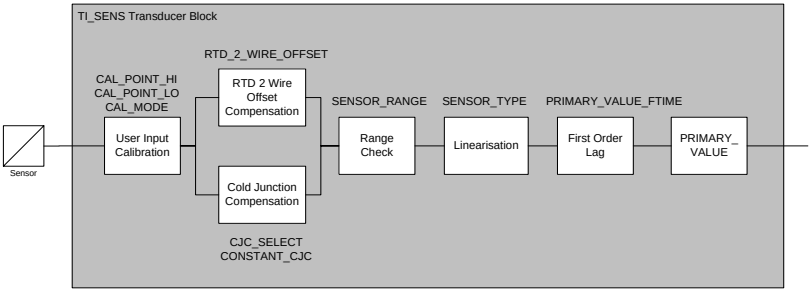


Figure 6.2: Measurement dataflow

6.5.2 Sensor Type

The type of the sensor attached to the corresponding connector can be configured via the *„Sensor Type“* parameter. The device supports Thermocouples, RTD's and bare voltage or resistance measurement. For a list of supported sensors, please refer to the data sheet of the device.

6.5.3 Sensor Wiring and Wire Resistance

For resistive sensors, a wiring method can be chosen by the *„Sensor Connection“* parameter.

A maximum value of 50 Ω is allowed for the resistance of a sensor wire.

If 2-wire connection is chosen, it is possible to supply a constant wire resistance value that is subtracted from the measured resistance via the *„RTD 2 Wiring Resistance“* parameter. For all other sensor connection methods, the parameter is ignored. Allowed value range is 0 to 100 Ω.

For voltage based sensors, the *„Sensor Connection“* parameter is ignored (and thus will not produce a configuration error if it is set to another value than 2-wire).

6.5.4 Measurement Unit

It is possible to select between several units for *„Primary Value.Value“* via the *„Sensor Range.Units Index“* parameter. If an invalid unit is chosen for the sensor (e.g. „mV“ for a resistance based sensor), the *„Configuration error“* bit is set in the *„BLOCK_ERR“* parameter.

6.5.5 Filtering

The *„Primary Value.Value“* can be filtered by a first order lag. The filter time is selectable between 0 s and 255 s via the *„Primary Value Filtertime“* parameter. A value of 0 s disables filtering.

6.5.6 Sensor Diagnosis

It is possible to enable sensor monitoring for each sensor via the "Sensor Diagnostics" parameter. If the sensor diagnosis indicates an sensor error, this will be reported in the "BLOCK_ERR", "Sensor status" and "Transducer error" parameter. The "Primary Value.Status" will be set to BAD.

The default adjustment is sensor diagnosis enabled. Pepperl+Fuchs recommends to use the sensor diagnosis for normal operation.

11/2008 132328

6.5.7 Cold Junction Compensation

Thermocouple temperature sensors require cold-junction compensation for accurate measurement. The Pepperl+Fuchs TM-I Device supports two methods of CJC compensation:

- **Internal**: The cold junction temperature measured by a built-in temperature sensors is used for compensation. This is the recommended method.
- **Constant**: The user can define a constant cold junction temperature that is used for compensation.

The two methods can be selected via the *"CJC select"* parameter. If it is set to *"Constant"*, the TM-I Device uses the value in *"CJC Constant"* for compensation, the unit is the same as for the *"Primary Value.Value"* parameter, which is specified by the *"Sensor Range.Units Index"* parameter. If the unit is changed, the "CJC Constant" value is automatically converted to the new unit.

6.5.8 User Calibration

It is possible to perform a user calibration of the device. User calibrated measurement can be enabled by writing *"Calibration on"* to the *"Calibration Mode"* parameter.

A user calibration is done by executing the following steps:

1. Select sensor type, wiring and sensor diagnosis. It may be necessary to turn off sensor diagnosis if the device is connected to a calibration source that interferes with the sensor monitoring.
2. Write *"Execute user calibration"* to *"Calibration Mode"* parameter.
3. The unit used for calibration can be read from *"Calibration Units"* parameter.
4. Wait until *"Calibration state"* reads *"Wait first calibration point"*.
5. Connect first resistor / apply first calibration voltage. Please note that the limits that can be read from *"Calibration highest/lowest Point Limit"* have to be taken into account.
6. Write the first calibration value to *"Calibration Highest/Lowest Point"* depending on the applied physical value.
7. Wait until *"Calibration state"* reads *"Wait HI/LO Calibration Point"* depending on whether high or low point was calibrated first.
8. Connect second resistor / apply second calibration voltage. Please note that the limits that can be read from *"Calibration highest/lowest Point Limit"* and *"Calibration Minimum Span"* have to be taken into account.
9. Write the second calibration value to *"Calibration Highest/Lowest Point"* depending on the point that was calibrated first. Note that it is not possible to write two times to the same parameter during the same calibration procedure to prevent errors.
10. *"Calibration state"* now reads *"OK"*.
11. Enable user calibrated measurement by writing *"Calibration On"* to *"User calibration"* parameter.

If *"Calibration state"* reads *"Failure"* during calibration, the following errors may have happened:

11/2008 132328

- Sensor diagnosis is enabled and a sensor error was detected
- A higher value was written to *"Calibration Lowest Point"* than to *"Calibration Highest Point"*.
- Calibration span was too small (see parameter *"Calibration Minimum Span"* during calibration)
- Values higher / lower than specified in *"Calibration highest/lowest Point Limit"* were applied

Note

Pepperl+Fuchs recommends not to use the user calibration feature, the device is delivered with a suitable factory calibration.

6.5.9 Non-functional Parameters

The device offers several non-functional parameters (parameters that do not affect the device's operation in any kind) to store additional information. These parameters are:

- *"Primary Value Type"*
- *"Sensor Serial No."*
- *"Sensor Calibration Method"*
- *"Sensor Calibration Location"*
- *"Sensor Calibration Date"*
- *"Sensor Calibration Who"*
- *"Calibration Location"*
- *"Calibration Date"*
- *"Calibration Who"*

6.5.10 Block Mode

Sensor block support two modes: OOS (out-of-service) and AUTO. In OOS mode, measurement is disabled and the sensor can be configured and/or calibrated. In AUTO mode, measurement is enabled, all functional parameters except *"Sensor Diagnostics"* are write protected.

6.6 Concentrator Block Configuration

The concentrator block provides a summary view for the most important sensor configuration parameters of each sensor block. These parameters are simply mapped to their corresponding counterparts in the sensor blocks. The write protection of the parameters depends on the sensor block's target block mode.

6.6.1 Body Temperature

The device's body temperature can be read from the *"Body Temperature"* parameter. It is possible to configure the temperature unit via the *"Body Temperature Unit"* parameter.

Please note that it is possible to map body temperature to an AI block (see chapter 6.2).

11/2008 132328

6.6.2 EMC Filter

Measurement values are filtered internally with a 50 Hz or 60 Hz filter to suppress EMC disturbance by that frequency. The filter can be configured via the *"ASIC Rejection"* parameter.

Note

Pepperl+Fuchs recommends to configure the filter in accordance to the countries' power supply system frequency.

6.6.3 Block Mode

The block mode supports two modes of operation: OOS (out-of-service) and AUTO.

In OOS mode, the body temperature status is always BAD and the body temperature unit can be configured.

In AUTO mode, body temperature status is GOOD.

Note

Note that the concentrator block mode does not affect write protection of the sensor parameters since they solely depend on the sensor block's target block mode.

6.7 AI and MAI Block Configuration

The AI and MAI blocks are standard FOUNDATION Fieldbus block types. Please refer to the FOUNDATION Fieldbus standard for configuration information. The channel map can be found in chapter 6.2.

11/2008 132328

7 Operation

7.1 Primary Value Status

The primary value of the sensor blocks can have the following status:

- **Good (NC)-Non specific**
- **Good (NC)-Active Block Alarm**
- **Good (NC)-Unacknowledged Block Alarm**
- **Bad-Sensor Failure**: The sensor value exceeds the values defined by Primary Value. A sensor range or sensor error (wiring error, lead breakage) is detected for the sensor inputs. The substatus *"Hi-limited"* or *"Low-limited"* define in which direction the sensor's range has been exceeded. The substatus *"Not limited"* indicates a sensor error.
- **Bad-Device Error**: The internal diagnosis of the device detected a hardware fault.
- **Bad-OOS**: The actual mode of the block is OOS

7.2 Body Temperature Status

The body temperature status in the Concentrator block is BAD if the block is in OOS mode. In AUTO mode, the value is always GOOD as long as there is no self-diagnosis error detected.

7.3 Device Self-diagnosis

The Pepperl+Fuchs TM-I Device continuously monitors its internal hardware and body temperature. If an error occurs, the status of all Primary Values switches over to BAD and the *"Device needs maintenance now"* bit in the *"BLOCK_ERR"* error parameter of the resource block is set which will generate an alarm.

7.4 Alarms

If an error occurs, the corresponding transducer block issues a block alarm (*"BLOCK_ALM"*). It is a summary alarm for all alarms of this block and is asserted as long as the fault is still valid. To get information about the reason for the block alarm, read the following parameters and refer to chapter 8 for remedy:

- *"BLOCK_ERR"*
- *"Transducer error"*

If the control system supports alarms, the *"Alarm occur"* and *"Alarm clear"* conditions are conveyed through the bus to the system.

Since this mechanism is not supported by all control systems, the Pepperl+Fuchs TM-I Device supports another method for error detection: All errors are shown in the *"BLOCK_ERR"* parameter of the transducer block. Usually, this parameter is cyclically read by the control system. For a list of errors reported by *"BLOCK_ERR"*, please refer to chapter 8.

11/2008 132328

Note

If the control system does not support alarms, the option "Reports" in the "FEATURES_SEL" parameter of the resource block should be deactivated.

11/2008 132328

8 Error Detection and Problem Remedy

8.1 LED Indications

The Temperature Multiplexer provides 8 sensor input specific red LEDs to indicate the status of the related sensor input channels. The status of the bus power is provided by a green LED, the communication status by a red LED. The LEDs are located on the upper side of the device.

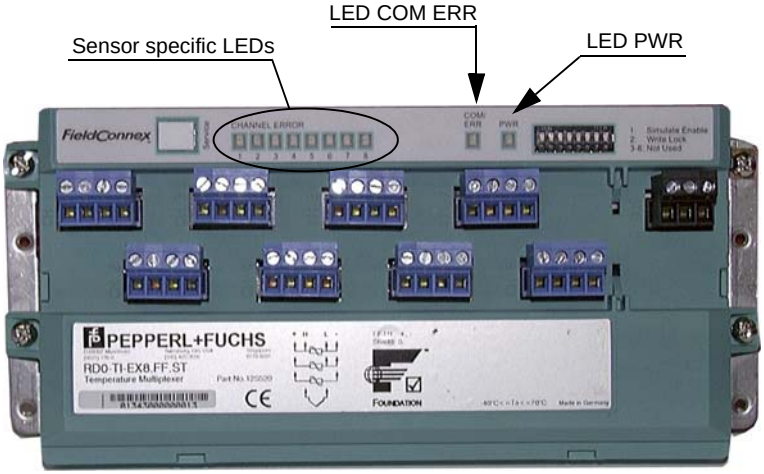


Figure 8.1: TM-I Device LEDs

Led	States	Cause	Remedy
PWR (green)	OFF	No power supply	• Check power supply • Check fieldbus cable wiring
	ON permanently	Power available	-
COM (red)	OFF	Communication active	-
	ON permanently	Hardware error	Send device to Pepperl+Fuchs for repair
	ON flashing	No communication Communication errors	• Check LAS • Check wiring
Sensor (red) (Channel 1…8)	OFF	No sensor errors detected	-
	ON flashing	Sensor error (Over- / underrange, wiring error, leadbreakage)	Check sensor wiring. For more detailed information refer to diagnostic messages in the corresponding sensor transducer block

Table 8.1: LED indications

11/2008 132328

8.2 Resource Block

Problem		Remedy	
Parameter	**Message**	**Cause**	**Procedure**
BLOCK_ERR	Lost Static Data	The parameterization data stored in the device were faulty and replaced by default settings	Repeat parameterization. If this error occurs repeatedly, send the device to Pepperl+Fuchs for repair
	Device needs Maintenance now	Hardware error	Send device to Pepperl+Fuchs for repair
	Simulate active	Simulation allowed by setting the switch 1	Check whether simulation shall be allowed
	OOS	The target mode of the block is OOS	Set block to "Auto" mode
RS_STATE	Online	No error	-
	Stand-by	The target mode of the block is OOS	Set block into "Auto" mode

Table 8.2: Resource Block Errors

8.3 Sensor Block

Problem		Remedy	
Parameter	**Message**	**Cause**	**Procedure**
BLOCK_ERR	Block Configuration Error	• "Sensor Type" is set to "Undefined" • "Sensor Range.Unit" is set to a value not supported by sensor (e.g. "mV" for a resistance based sensor) • User calibration is turned on at "Calibration Mode", but "Calibration State" shows no valid user calibration exists	Correct parameterization
	Input failure	Several	see Table 8.4: Common Sensor Block Problems below
	OOS	The target mode of the block is OOS	Set block to "Auto" mode

11/2008 132328

Problem		Remedy	
Transducer Error (XD_ERROR)	Configuration Error	See above at "BLOCK_ERR"	See above at "BLOCK_ERR"
	I/O failure	The sensor value exceeds the HI or LO sensor limits	see Table 8.4: Common Sensor Block Problems below
	Lead Breakage / Sensor connection error	Sensor wiring fault	see Table 8.4: Common Sensor Block Problems below
Sensor Status	Sensor connection error	See "Transducer Error	See "Transducer Error"
	Overrange	Sensor high measurement limit exceeded	see Table 8.4: Common Sensor Block Problems below
	Underrange	Sensor low measurement limit exceeded	see Table 8.4: Common Sensor Block Problems below

Table 8.3: Sensor Block Errors

11/2008 132328

Problem	Remedy	
	Cause	**Procedure**
Block does not leave OOS mode	A configuration error is reported	Clear configuration error cause. See above
	Resource block is in OOS mode	Set Resource block to AUTO mode
Sensor failure	Sensor error (Overrange, underrange, leadbreakage)	• Check wiring • Use sensor with a greater input range
	Wrong sensor type selected	Configure correct sensor type
	RTD3 / RTD4 wires mixed up	Check cabling, see chapter 5.1.1
Wrong measurement values	Thermocouple polarity reversed	Check thermocouple polarity
Unable to write to parameters	Write protection is enabled	Set write protection DIP switch to OFF. see chapter 5.2
	Block is in AUTO mode	Set "MODE_BLK.Target" to "OOS"

Table 8.4: Common Sensor Block Problems

8.4 Concentrator Block

Problem		Remedy	
Parameter	**Message**	**Cause**	**Procedure**
BLOCK_ERR	Body temperature out of range	Devices' body temperature is too high / too low	• Choose another mounting location • Adjust mounting locations' ambient temperature
	OOS	The target mode of the block is OOS	Set block to "Auto" mode
Transducer error (XD_ERROR)	Body temperature out of range	See "BLOCK_ERR	See "BLOCK_ERR"

Table 8.5: Concentrator Block Errors

11/2008 132328

Problem	Remedy	
	Cause	**Procedure**
Block does not leave OOS mode	Resource block is in OOS mode	Set Resource block to AUTO mode
Unable to write to parameters	Write protection is enabled	Set write protection DIP switch to OFF (see chapter 5.2)
	Corresponding sensor block is in AUTO mode	Set sensor block to OOS mode
	Block is in AUTO mode	Set "MODE_BLK.Target" to "OOS"

Table 8.6: Common Concentrator Problems

8.5 AI Function Blocks

Problem		Remedy	
Parameter	**Message**	**Cause**	**Procedure**
BLOCK_ERR	Block Configuration Error	The channel parameter contains an invalid value.	Set valid value (see chapter 6.2).
		The function block does not have a schedule downloaded	Include block into application and download schedule to device
		"L_TYPE" parameter is set to an incorrect value	Set "L_TYPE" to correct value
	Input failure	Transducer block reports BAD "Primary Value.Status"	Check transducer block diagnostics (see Table 8.3)
	Simulate active	Simulation for block is activated	Check simulation activation
	Out-of-service	Actual block mode is OOS	Choose suitable target mode·Check block configuration

Table 8.7: AI Function Block Errors

11/2008 132328

Problem	Remedy	
	Cause	**Procedure**
Function block does not leave OOS mode	A "BLOCK_ERR" is reported	Clear block error cause
	The function block does not have a schedule downloaded	Include block into application and download schedule to device
	Resource block is in OOS mode	Set Resource block to AUTO mode
OUT does not show transducer block value	Simulation activated	Disable simulation
Simulation does not activate	Simulation DIP switch set to OFF	Set simulation DIP switch to ON (see chapter 5.2).
Unable to write to parameters	Write protection is enabled	Set write protection DIP switch to OFF (see chapter 5.2).
	Block is in AUTO mode	Set "MODE_BLK.Target" to "OOS"

Table 8.8: Common AI Block Problems

8.6 MAI Function Block

Problem		Remedy	
Parameter	**Message**	**Cause**	**Procedure**
BLOCK_ERR	Block ConfigurationError	The channel parameter contains an invalid value.	Set valid value (see chapter 6.2)
		The function block does not have a schedule downloaded	Include block into application and download to device

Table 8.9: MAI Function Block Errors

11/2008 132328

Problem	Remedy	
	Cause	**Procedure**
Function block does not leave OOS mode	A "BLOCK_ERR" is reported	Clear block error cause. See above
	Resource block is in OOS mode	Set Resource block to AUTO mode
	The function block does not have a schedule downloaded	Include block into application and download schedule to device
Unable to write to parameters	Write protection is enabled	Set write protection DIP switch to OFF (see chapter 5.2).
	Block is in AUTO mode	Set "MODE_BLK.Target" to "OOS"

Table 8.10: Common MAI Problems

11/2008 132328

8.7 Diagnostic Summary

The following chapter shows a summary of the diagnostic features the TM-I Device will provide and the way they are reported.

Diagnostic Alarm	Description	Alarm indication
Communication Failure	H1 segment communication is not established	LED
EEPROM Failure	The device configuration data base is corrupted	RB Alarm, RB BLOCK_ERR
Program Storage Failure	The devices firmware is corrupted	LED
Memory Failure	The memory inside the device is defective	LED
Body Temperature too high/low	The body temperature of the device exceeds it's specification	RB Alarm, Concentrator BLOCK_ERR
Resource Block is in Out of Service Mode	The actual mode of the RB is OOS	RB Alarm, RB BLOCK_ERR
Block is in Out of Service Mode	The actual mode of the block is OOS. This is the same for all function and transducer blocks	Block Alarm, BLOCK_ERR
Block Configuration Error	One or more parameters of the block contain invalid or conflicting values. This is the same for all function and transducer blocks.	Block Alarm, BLOCK_ERR
Sensor error (wiring, lead break)	A cable of the sensor is broken, incorrect sensor wiring.	Block Alarm, BLOCK_ERR of all TBs
Sensor Over / Under Range	Measured sensor value exceeds its high or low range limit.	Block Alarm, BLOCK_ERR of all TBs
Simulation active	The Simulation is enabled for a function block.	Block Alarm, BLOCK_ERR of all FBs
Device HW Failure (ADC, CJC measurement etc.)	The device detected an internal HW failure at the measurement unit.	Block Alarm, BLOCK_ERR of RB, status of affected values, LED

Table 8.11: Device diagnostic summary

11/2008 132328

9 Block Descriptions

9.1 Resource Block (RB)

Rel. Index	Parameter	Description
01	ST_REV	The revision level of the static data associated with the resource block. The revision value will be incremented each time a static parameter value in the block is changed.
02	TAG_DESC	The user description of the intended application of the block.
03	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
04	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
05	MODE_BLK	The actual, target, permitted, and normal modes of the block:· • **Target**: The mode to "go to" • **Actual**: The mode the "block is currently in" • **Permitted**: Allowed modes that target may take on • **Normal**: Most common mode for actual
06	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string so that multiple errors may be shown. Supported values:· • **Simulate Active**: Hardware switch is set to simulation possible • **Lost Static Data**: The database used for storing the NV parameters within the device is corrupt • **Device Needs Maintenance Now**: The hardware of the device failed in some way (e.g. body temperature too high) • **Out Of Service**: The RB is in Mode OOS
07	RS_STATE	State of the resource block application state machine.
08	TEST_RW	Read/Write test parameter. Used only for conformance testing.
09	DD_RESOURCE	String identifying the tag of the resource that contains the device description for this resource.
10	MANUFAC_ID	Manufacturer identification number - used by an interface device to locate the DD file for the resource. Pepperl+Fuchs ID is 0x502B46.
11	DEV_TYPE	Manufacturer's model number associated with the resource - used by interface devices to locate the DD file for the resource. The P+F TI Mux is device type 3.
12	DEV_REV	Manufacturer revision number associated with the resource - used by an interface device to locate the DD file for the resource.
13	DD_REV	Revision of the DD associated with the resource - used by an interface device to locate the DD file for the resource.
14	GRANT_DENY	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block.
15	HARD_TYPES	The types of hardware available as channel numbers. Only scalar types are supported.
16	RESART	Allows a manual restart to be initiated. Several degrees of restart are possible: 1. **Run** - nominal state when not restarting 2. **Restart resource** - not used 3. **Restart with defaults** - set parameters to default values 4. **Restart processor** - does a warm restart of CPU
17	FEATURES	Used to show supported resource block options.

11/2008 132328

Rel. Index	Parameter	Description
18	FEATURES_SEL	Used to select resource block options. Supported values: • **Unicode**: Tells host to use Unicode for string values • **Reports**: Enables alarms, must be set for alarming to work • **Hardware Lock**: Hardware write locking enabled but not active. WRITE_LOCK follows the status of the security switch
19	CYCLE_TYPE	Identifies the block execution methods available for this resource. Supported values: • **Schedule** • **Completion of Block execution**
20	CYCLE_SEL	Used to select the block execution method for this resource. Supported values: • **Scheduled**: Blocks are only executed based on the schedule in FB_START_LIST. • **Block Execution**: A block may be executed by linking to another blocks completion.
21	MIN_CYCLE_T	Time duration of the shortest cycle interval of which the resource is capable.The Pepperl+Fuchs TM-I Device supports 100 ms.
22	MEMORY_SIZE	Available configuration memory in the empty resource.
23	NV_CYCLE_T	Interval between writing copies of NV parameters to non-volatile memory. Zero means none.
24	FREE_SPACE	Percent of memory available for further configuration. Not supported by Pepperl+Fuchs TM-I Device.
25	FREE_TIME	Percent of the block processing time that is free to process additional blocks. Not supported by Pepperl+Fuchs TM-I Device.
26	SHED_RCAS	Time duration at which to give up on computer writes to function block RCas locations.
27	SHED_ROUT	Time duration at which to give up on computer writes to function block ROut locations.
28	FAULT_STATE	ondition set by loss of communication to an output block, failure promoted to an output block or a physical contact. When a fault state condition is set, the output function blocks will perform their FSTATE actions. The P+F TI Mux does not support output blocks.
29	SET_FSTATE	Allows the fault state condition to be manually initialed by selecting Set. The P+F TI Mux does not support this function.
30	CLR_FSTATE	Writing a Clear to this parameter will clear the device fault state if any field condition has cleared. The P+F TI Mux does not support this function.
31	MAX_NOTIFY	Maximum number of unconfirmed alert notifications messages possible. This number cannot be changed. The P+F TI Mux supports a maximum of 42.
32	LIM_NOTUIFY	Maximum number of unconfirmed alert notification messages allowed. P+F TI Mux supports a maximum of 42.
33	CONTIRM_TIME	The minimum time between retries of alert reports. Retries shall not happen when parameter is set to 0.
34	WRITE_LOCK	If set, no writes from anywhere are allowed, except to clear WRITE_LOCK. Block inputs will continue to be updated.
35	UPDATE_EVT	This alert is generated by any change to the static data.
36	BLOCL_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the ALARM_STATE subcode.
37	ALARM_SUM	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
38	ACK_OPTION	Selection of whether alarms associated with the function block will be automatically acknowledged.
39	WRITE_PRI	Priority of the alarm generated by clearing the write lock.

11/2008 132328

Rel. Index	Parameter	Description
40	WRITE_ALM	This alert is generated if the write lock parameter is cleared.
41	ITK_VER	Major revision number of the Interoperability Test Case used to register the device with the Fieldbus FOUNDATION.
42	SERIAL_NUM	Unit specific serial number to identify production and release information. Set by manufacturer.
43	SW_REV	The software revision of the firmware within the device.

Table 9.1: Resource Block parameter list

9.2 Analog Input Function Block (AI)

Rel. Index	Parameter	Units	Description
01	ST_REV		The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
02	TAG_DESC		The user description of the intended application of the block.
03	STRATEGY		The strategy field can be used to identify a grouping of blocks. This data is not checked or processed by the block.
04	ALERT_KEY		The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
05	MODE_BLK		The actual, target, permitted, and normal modes of the block. • **Actual**: The mode the "block is currently in" • **Target**: The mode to "go to" • **Permitted**: Allowed modes that target may take on • **Normal**: Most common mode for target
06	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
07	PV	EU of XD_SCALE	The primary analog process variable used in block execution.
08	OUT	EU of OUT_SCALE or XD_SCALE if in direct L_TYPE	The primary analog block output value and status.
09	SIMULATE		A data structure that contains the current transducer output value and status, the simulated transducer value and status, and the enable/disable bit.
10	XD_SCALE		A data structure that contains the high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with the channel input value.
11	OUT_SCALE		A data structure that contains the high and low scale values, engineering units code, and number of digits to the right of the decimal point displaying the OUT parameter.
12	GRANT_DENY		Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device.
13	IO_OPTS		Allows the selection of input/output options used to alter the input block processing (PV).

11/2008 132328

Rel. Index	Parameter	Units	Description
14	STATUS_OPTS		Allows selecting options for status handling and processing. The following options are supported in the AI block: • **Propagate fault forward** • **Uncertain if limited** • **Bad if limited** • **Uncertain if manual mode**
15	CHANNEL		The CHANNEL value is the number of the physical input (transducer output) that is used as input for the function block. Supported values: • 1-8: physical input from Channel 1 to Channel 8 • 10: physical input from Concentrator block which is the internal device temperature
16	L_TYPE		Determines whether the field value is used directly (Direct), is converted linearly (Indirect), or is converted with the square root (Indirect Square Root).
17	LOW_CUT	%	If percentage value of transducer input fails below this value, then PV is set to 0
18	PV_FTIME	Seconds	Time constant of the first-order filter for the PV. It is the time required for a 63% change in the PV or OUT value. Used for filtering the response time.
19	FIELD_VAL	%	The value (in percent of the PV range) and status from the transducer block or from the simulated input before signal characterization.
20	UPDATE_EVT		This alert is generated by any change to the static data.
21	BLOCK_ALM		The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
22	ALARM_SUM		The current alert status, unacknowledged states, and disabled states of the alarm associated with the function block.
23	ACK_OPTION		Used to set auto acknowledgment of alarms.
24	ALARM_HYS	%	Span, expressed in percent of the PV span, in which a PV must return before an alarm condition is cleared.
25	HI_HI_PRI		The priority of the HI-HI alarm.
26	HI_HI_LIM	EU of PV_SCALE	The setting for the alarm limit used to detect the HI-HI alarm condition.
27	HI_PRI		The priority of the HI alarm.
28	HI_LIM	EU of PV_SCALE	The setting for the alarm limit used to detect the HI alarm condition.
29	LO_PRI		The priority of the LO alarm.
30	LO_LIM	EU of PV_SCALE	The setting for the alarm limit used to detect the LO alarm condition.
31	LO_LO_PRI		The priority of the LO-LO alarm.
32	LO_LO_LIM	LO_LO_PRI	The setting for the alarm limit used to detect the LO-LO alarm condition.
33	HI_HI_ALM		The HI-HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.

11/2008 132328

Rel. Index	Parameter	Units	Description
34	HI_ALM		The HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
35	LO_ALM		The LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
36	LO_LO_ALM		The LO-LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.

Table 9.2: Analog Input Function Block (AI) Parameter List

9.3 Multiple Analog Input Function Block (MAI)

Rel. Index	Parameter	Units	Description
1	ST_REV		The revision level of the static data associated with the input selector block. The revision value will be incremented each time a static parameter value in the block is changed.
2	TAG_DESC		The user description of the intended application of the block.
3	STRATEGY		The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	ALERT_KEY		The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	MODE_BLK		The actual, target, permitted, and normal modes of the block. • **Actual**: The mode the "block is currently in" • **Target**: The mode to "go to" • **Permitted**: Allowed modes that target may take on • **Normal**: Most common mode for target
6	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	CHANNEL		Allows for custom channel setting. Valid values: • 0: Uninitialized • 9: Physical channels 1 to 8 will be set to the corresponding sensors
8 -15	OUT_(1-8)	EU of OUT_SCALE	The block output value and status.
16	UPDATE_EVT		This alert is generated by any change to the static data.
17	BLOCK_ALM		he block alarm is used for all configuration, hardware connection feature, or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block may be reported without clearing the Active status, if the subcode has changed.

Table 9.3: MAI Parameter List

9.4 TI_SENS Sensor Blocks (TIS)

The properties column lists parameter properties:

- S: Static (a write access to this parameter increments ST_REV)
- W: Parameter is writeable
- OOS: Parameter is writeable in OOS mode only
- SP: Special (see description column)

11/2008 132328

- NF: non-functional parameter (does not change block behaviour).

Since all parameters can be read, this is not explicitly stated.

Rel. Index	Parameter	Properties	Description
01	ST_REV		The revision level of the static data associated with the input selector block. The revision value will be incremented each time a static parameter value in the block is changed.
02	TAG_DESC	S, W, NF	The user description of the intended application of the block.
03	STRATEGY	S, W, NF	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
04	ALERT_KEY	S, W, NF	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
05	MODE_BLK	S, W	The actual, target, permitted, and normal modes of the block. • **Actual**: The mode the "block is currently in" • **Target**: The mode to "go to" • **Permitted**: Allowed modes that target may take on • **Normal**: Most common mode for target
06	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown. Supported values: • Block Configuration Error: Target block mode is different than OOS and one of the following conditions is true: - Sensor type is set to undefined - "Sensor Range.Unit" is set to a value not supported by sensor (e.g. "mV" for a resistance based sensor) - User calibration is turned on at "Calibration Mode", but Calibration State shows no valid user calibration exists • Input Failure: "Primary Value.Status" is BAD, but not BAD/OOS • Out-of-Service: Actual mode of the block is OOS
07	UPDATE_EVT		This alert is generated by any change to the static data
08	BLOCK_ALM		The block alarm is used for all configuration, hardware connection feature, or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter.
09	Transducer Error (XD_ERROR)		Stores the actual transducer block error with the highest priority. Supported values: • Configuration Error: A block configuration error exists. See "BLOCK_ERR" for details • I/O Failure: The sensor value exceeds the HI or LO sensor Limits • Sensor Connection Error: Sensor cabling error detected
10	Prinary Value Type	S, W, NF	Defines the type of the Primary Value. The following values are valid: • Process temperature • Non-process temperature • mV • Ohm
11	Primary Value		The value and status of the sensor input (see chapter 7.1).
12	Primary Value Filter-time	S, OOS	Time constant in seconds of a first order lag filter applied to "*Primary value*". Valid values are 0 to 255 s. A value of 0 disables filtering.

11/2008 132328

Rel. Index	Parameter	Properties	Description
13	Sensor Type	S, OOS	Type of the attached sensor. For a list of supported sensors, see datasheet.If "*Sensor Type*" is written some other parameters will be set automatically for convenience: • If voltage mode or a TC is selected, "SENSOR_CONNECTION" is set to 2-wire • If voltage mode is selected, Primary Value unit is set to mV • If resistance input is selected the Primary Value unit is set to Ohm • If a TC or RTD sensor is selected and the Primary Value Unit is mV or Ohm it is set to °C
14	Sensor Range	S, OOS	Defines the absolute maximum ends of the sensor range, the units of those limits and the number of digits to the right of the decimal point to be used to display these values. Supported units: mV, Ohm, °C, °F, K, °R
15	Sensor Connection	S, OOS	Number of wires used to connect the sensor. This parameter is only honored if a resistance-based sensor is configured. Supported values: • Two wires • Three wires • Four wires
16	Sensor Diagnostics	S, W	Enables sensor diagnosis.
17	Sensor Status		Shows failures of the attached sensor, it is a bit string so multiple errors can be shown. Supported values: • Sensor connection error • Over range: The measured value is too high for current sensor • Under range: The measured value is too low for current sensor
18	Sensor Serial No.	S, W, NF	The serial number of the attached sensor.
19	Sensor Calibration Method	S, W, NF	Last calibration method used for the attached sensor: • Factory trim standard calibration • User trim standard calibration • Factory trim special calibration • User trim special calibration • Other
20	Sensor Calibration Location	S, W, NF	Shows location of the last calibration for the attached sensor.
21	Sensor Calibration Data	S, W, NF	Shows date of the last calibration for the attached sensor.
22	Sensor Calibration Who	S, W, NF	Shows name of person responsible for the last calibration for the attached sensor.
23	RTD 2 Wire Resistance	S, OOS	Specifies an offset subtracted from the measured resistance if a two-wire RTD or Ohm sensor is attached. The value is specified as a positive floating point number.
24	CJC Select	S, OOS	Selects the method used to do a CJC: • **Internal**: use the internally measured value • **Constant**: use the value of parameter "Constant CJC"
25	CJC Constant	S, OOS	Value used for CJ compensation if "CJC select" is set to Constant. Uses the Unit of "Sensor Range.Units Index". The value is converted automatically if "Sensor Range.Units Index" is changed.
26	Calibration Highest Point	S, SP	Upper value for calibration of the input. Writeable only during calibration.
27	Calibration Lowest Point	S, SP	Lower value for calibration of the input. Writeable only during calibration.
28	Calibration Highest Point Limit		Highest value allowed to calibrate the input.

11/2008 132328

Rel. Index	Parameter	Properties	Description
29	Calibration Lowest Point Limit		Lowest value allowed to calibrate the input.
30	Calibration Minimum Span		Minimum allowed difference between "Calibration Highest Point" and "Calibration Lowest Point".
31	Calibration Units		Unit used to calibrate the input. It is set automatically if a calibration starts. Valid values: mV and Ohm
32	Calibration Mode	S, OOS	Stipulates the validity of user calibration and turns the calibration mode on for the input • **User calibration off** • **User calibration on**: A calibration error ("Calibration State" reads "Failure") will be reported as a block configuration error so the block will not switch to AUTO mode. • **Execute user calibration**
33	Calibration State		Shows the state of the user calibration for the input. Supported values: • **Not initialized**: No user calibration was carry out yet. It's not possible to turn on the user calibration • **Executing**: A user calibration is being started • **OK**: A valid user calibration was executed • **Failure**: A failure happened during the last user calibration. The values are invalid. It's not possible to turn on the user-calibrated measurement. The block will report a configuration error if "Calibration Mode" is set to "User calibration on". • **Wait first**: Device is waiting for write on "Calibration Highest Point" or "Calibration Lowest Point" as first calibration point • **Wait second HI**: Device is waiting for write on " Calibration Highest Point " as second calibration point • **Wait second LO**: Device is waiting for write on " Calibration Lowest Point " as second calibration point • **Sampling HI**: Device is measuring HI calibration value. • **Sampling LO**: Device is measuring LO calibration value
34	Calibration Location	S, W, NF	Shows location of the last calibration for the input.
35	Calibration Date	S, W, NF	Shows date of the last calibration for the input.
36	Calibration Who	S, W, NF	Shows name of person responsible for the last calibration for the input.

Table 9.4: TI_SENS Block Parameter List

9.5 Concentrator Block (TIC)

The properties column lists parameter properties:

- S: Static (a write access to this parameter increments ST_REV);
- W: Parameter is writeable;
- OOS: Parameter is writeable in OOS mode only;
- SP: Special (see description column);
- NF: non-functional parameter (does not change block behaviour).

Since all parameters can be read, this is not explicitly stated.

Rel. Index	Parameter	Properties	Description
01	ST_REV		The revision level of the static data associated with the input selector block. The revision value will be incremented each time a static parameter value in the block is changed.
02	TAG_DESC	S, W, NF	The user description of the intended application of the block.

11/2008 132328

Rel. Index	Parameter	Properties	Description
03	STRATEGY	S, W, NF	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
04	ALERT_KEY	S, W, NF	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
05	MODE_BLK	S, W	The actual, target, permitted, and normal modes of the block. • Actual: The mode the "block is currently in" • Target: The mode to "go to" • Permitted: Allowed modes that target may take on • Normal: Most common mode for target
06	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown. Supported values: • 15: Out-of-Service = Actual Mode of the Block is OOS • 129: Body temperature too high or too low
07	UPDATE_EVT		This alert is generated by any change to the static data.
08	BLOCK_ALM		The block alarm is used for all configuration, hardware connection feature, or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block may be reported without clearing the Active status, if the subcode has changed.
09	Transducer Error (XD_ERROR)		Stores the actual transducer block error wit the highest priority.Supported values: • 129: Body temperature too high or too low
10	Block Mode Channel 1	S, W	Mode block of sensor input 1.
11	Primary Value		The value and status of sensor input 1.
12	Primary Value Filter-time Channel 1	S, SP	The damping value for sensor input 1. Parameter is writeable if corresponding sensor block is in OOS mode.
13	Sensor Unit Channel 1	S, SP	The unit used for sensor input 1. Parameter is writeable if corresponding sensor block is in OOS mode.
14	Sensor Type Channel 1	S, SP	The type of sensor input 1. Parameter is writeable if corresponding sensor block is in OOS mode.
15	Sensor Connection Channel 1	S, SP	The connection type of sensor input 1. Parameter is writeable if corresponding sensor block is in OOS mode.
16	Sensor Diagnostics Channel 1	S, W	Allows to enable/disable the sensor diagnosis for sensor 1.
18 - 73	The sensor specific values above are repeated for the sensor inputs 2 - 8 • 18 - 24 channel 2 • 25 - 31 channel 3 • 32 - 38 channel 3 • 39 - 45 channel 4 • 46 - 52 channel 5 • 53 - 59 channel 6 • 60 - 66 channel 7 • 67 - 73 channel 8		
74	Body Temperature		Value and status of the body temperature.
75	Body Temperature Unit	S, OOS	The unit used to display body temperature. Valid units: °C, °F, °R, K
76	ASIC Rejection	S, W	Used to set the electrical noise filter depending on the power line frequency of the installation. Valid values are 50Hz and 60Hz.
77	Status Summary		Overview of the sensor status of all sensors. The parameter is a bit string, so multiple errors can be displayed.Supported values: "Bad sensor 1" to "Bad sensor 8"

Table 9.5: Concentrator Block Parameter List

11/2008 132328

10 List of Tables

11/2008 132328

11 List of Figures

11/2008 132328

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