PMA Prozeß- und Maschinen-Automation GmbH

Digital indicator Digital 280-1

Digital 280-1 MODBUS

Interfacedescription

MODBUS-protocol

9499 040 70111

Valid from: 02/2005

Explanation of symbols:

General information

General warning

Caution: ESD-sensitive components

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Content

1 General

We thank you for purchasing a device from the *BluePort*® product range. This document describes the implementation and operation of the MODBUS interface used with the Digital indicator Dig 280-1 which will be called 'device' in the rest of this document.

Devices with a MODBUS interface permit the transmission of process data, parameters, and configuration data. Electrical connections are made at the base of the device in the channel of the top-hat DIN rail. The serial communication interface provides a simple link to superordinate PLCs, visualization tools, etc.

An additional interface that is always fitted in the device's front panel is the BluePort® (PC) interface. This interface is not bussable, and serves for a direct connection with the BlueControl® software package that runs on a PC or laptop. Communication is done according to the master/slave principle. The device is always operated as a slave.

The most important characteristics and physical/electrical properties of the bus connection are:

- **Network topology**
  linear bus, possible with bus termination at both ends (see below).
- **Transmission media**
  screened and twisted 2-wire copper leads
- **Lead lengths (without repeater)**
  A maximum lead length of 1000 m should not be exceeded.
- **Transmission speeds**
  The following transmission speeds are supported:
  2400 … 38400 bits/s
- **Physical interface**
  RS 485 with bus connections in the top-hat rail; connections made on site.
- **Address range**
  1 ... 247
  (32 devices in one segment. Expandable to 247 with repeaters.)

1.1 References

Further information on the MODBUS-Protokoll:

[1] MODBUS Specifications
- MODBUS application Protocol Specification V1,1
- MODBUS over serial line specification and implementation guide V1.1
- http://www.modbus.org

Further information on RS 485:

[2] ANSI/TIA/EIA-485-A

Additional documentation for Dig 280-1 devices:

[3] Digital indicator Dig 280-1
- Data sheet Dig 280-1 9498 737 46813
- Operating instructions Dig 280-1 9499 040 67311

2 Commissioning the interface

Instrument field bus connection is via the pins of connector B on the rear, via flat-pin connectors or via screw terminals dependent on version.
Construction of suitable cables must be done by the user.

2.1 Mounting hints

If possible, the place of installation should be exempt of vibration, aggressive media (e.g. acid, lye), liquid, dust or aerosol.

The unit may be operated only in environments for which it is suitable due to its protection type.

The housing ventilation slots must not be covered.

In plants where transient voltage peaks are susceptible to occur, the instruments must be equipped with additional protective filters or voltage limiters!

Caution! The instrument contains electrostatically sensitive components.

Please, follow the instructions given in the safety hints.

2.2 Electrical connections

The electrical connection of the interface can be done as two-wire RS 485, as well as four-wire RS 485 (often called RS 422).

2.2.1 RS 485 version (two-wire)

The bus is build as RS 485 - two-wire cable with common ground main.
All the participants of an RS 485 bus are connected in parallel to the signals 'Data A' and 'Data B'.

The meaning of the data line terms are defined in the unit as follows:

- for signal 1 (off) Data A is positive to Data B
- for signal 0 (on) Data A is negative to Data B

The terms Data A and Data B are reverse to A und B defined in [2] .

For the purpose of limiting ground current loops, signal ground (GND) can be grounded at one point via a resistor 'RGND' (100 ohms, ¼ watt).

Association of terms for the two-wire-MODBUS definition according to [1]:

Definition MODBUS	according to unit
D1	Data A
D0	Data B
Common	RGND

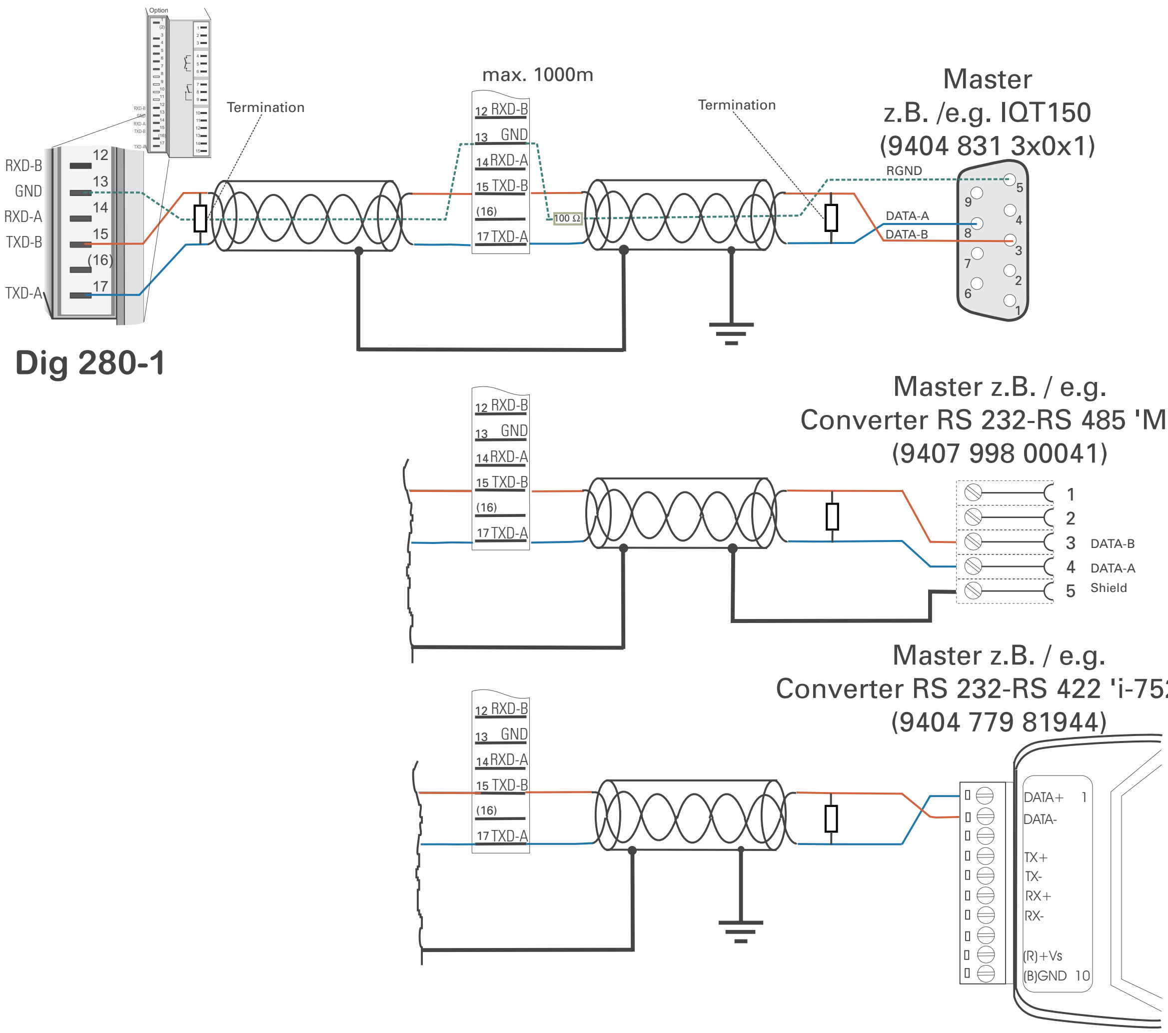
Notes:

❶ Terminating resistors between Data A and B at the cable ends (see 2.2.3 below)
❷ Screening (see 2.2.2 below)
❸ GND lead (see Fig. 6)

dig280-1		IQT 150		M-4		ADAM-4520-D	
Signal	Terminal	Signal	Terminal	Signal	Terminal	Signal	Terminal
TXD-B	15	DATA-B	3	TXD-A	3	DATA -	
TXD-A	17	DATA-A	8	TXD-B	4	DATA+	
GND	13	RGND	5	Shield	5		

There are various possibilities for cable entry of the RS 485.

Fig. 1 : connection example four-wire RS 485 (RS 422)



2.2.2 RS 422 version (four-wire - RS 485)

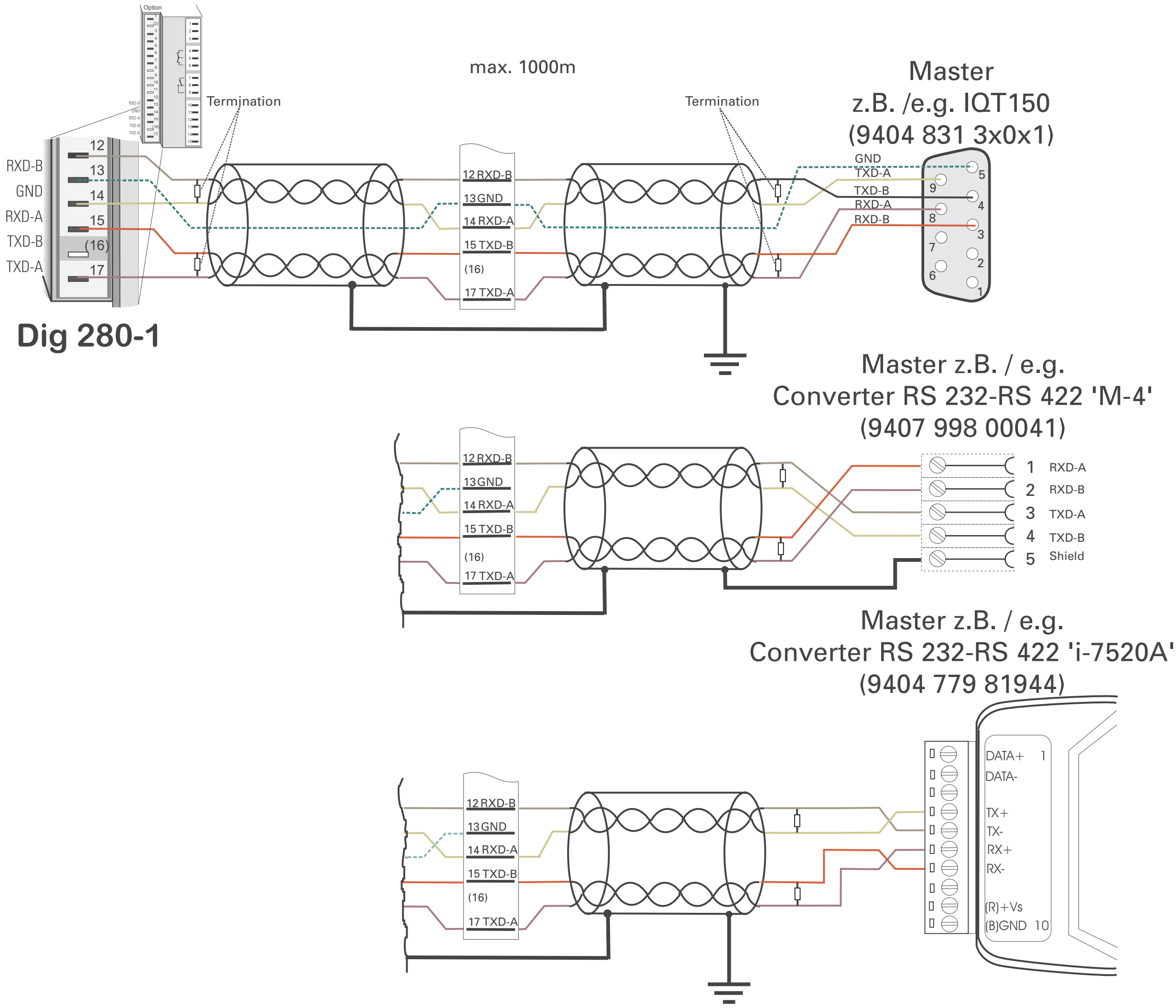
The RS 422 bus is of the RS 485 four-wire type with two pairs of conductors and a common ground.
The data on the master wire pair (RXD) are received only by the slaves. The data on the slave wire pair (TXD) are received only by the master.
Allocation of descriptions for the four-wire MODBUS definition according to [1]:

Description MODBUS	correspondence in the instrument
TXD1	RXD-A
TXD0	RXD-B
RXD1	TXD-A
RXD0	TXD-B
Common	GND

dig280-1		IQT 150		M-4		ADAM-4520-A	
Signal	Terminal	Signal	Terminal	Signal	Terminal	Signal	Terminal
TXD-B	15	RXD-B	3	RXD-A	1	RX-	
TXD-A	17	RXD-A	8	RXD-B	2	RX+	
RXD-B	12	TXD-B	4	TXD-A	3	TX-	
RXD-A	14	TXD-A	9	TXD-B	4	TX+	
GND	13	GND	5	Shield	5		

The following cable connection methods are possible.

Fig. 2 connection example RS 485



2.2.3 Cable installation

Depending on each application, suitable cables are to be used for the bus. When installing the cables, all relevant regulations and safety codes (e.g. VDE 0100) must be observed:

- Cable runs inside buildings (inside and outside of control cabinets)
- Cable runs outside buildings
- Potential balancing conductors
- Screening of cables
- Measures against electrical interference
- Length of spur lines

In particular, the following points must be considered:

- The RS 485 bus technology used here permits up to 32 devices in a segment to be connected to one bus cable. Several segments can be coupled by means of repeaters.
- The bus topology is to be designed as a line with up to 1000 m length per segment. Extensions by means of repeaters are permitted.
- The bus cable is to be taken from device to device (daisy chaining), i.e. not star connected.
- If possible, spur lines should be avoided, in order to prevent reflections and the associated disturbances in communication.
- The general notes on interference-free wiring of signal and bus leads are to be observed (see Operating notes “EMC – General information’ (9407 047 09118)).
- To increase signal transmission reliability, we recommend using screened, twisted pairs for the bus leads.

2.2.4 Screening

The type of screening is determined primarily by the nature of the expected interference.

- For the suppression of electrical fields, one end of the screened cable must be grounded. This should always be done as the first measure.
- Interference due to alternating magnetic fields can only be suppressed, if the screened cable is grounded at both ends. However, this can lead to ground current earth loops: galvanic disturbance along the reference potential lead can interfere with the useful signal, and the screening effect is reduced.
- If several devices are linked to a single bus, the screen must be connected at each device, e.g. by means of screen clamps.
- The bus screen must be connected to a central PE point, using short, low-impedance connections with a large surface, e.g. by means of screen clamps.

2.2.5 Terminating resistors

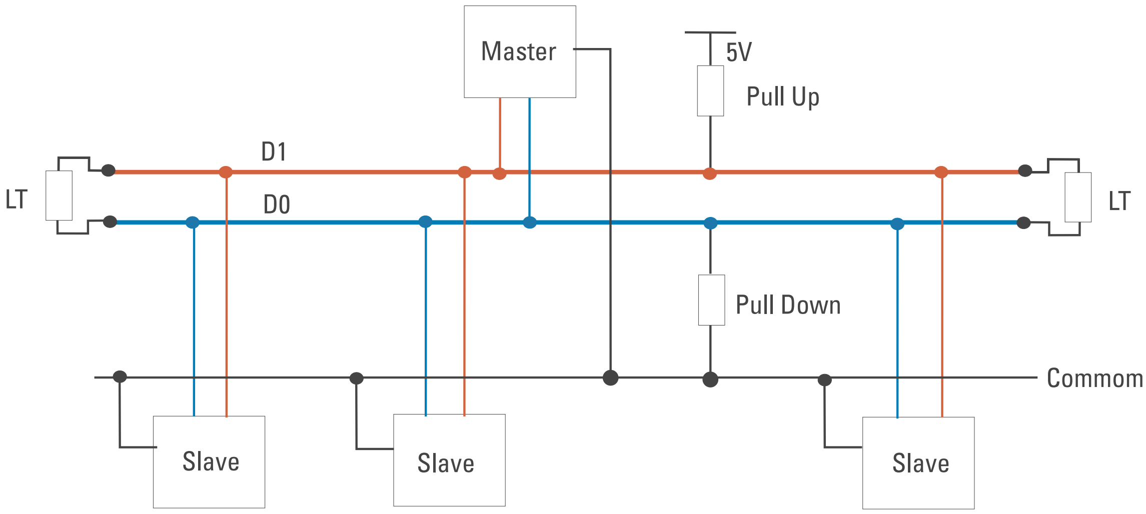
The widespread US Standard EIA RS 485 recommends fitting terminating resistors at each end of the bus cable. Terminating resistors usually have a value of approx. 120 ohms, and are connected in parallel between the data lines A and B (depending on the cable impedance; for details, see the cable manufacturer’s data sheet). Their purpose is to eliminate reflections at the end of the leads, thus obtaining a good transmission quality. Termination becomes more important, the higher the transmission speed is, and the longer the bus leads are.

However, if no signals are applied to the bus, it must be ensured that the signal levels are clearly defined. This done by means of pull-up and pull-down resistors between +5V or GND, and the drivers. Together with the bus terminating resistor, this forms a voltage divider. Moreover, it must be ensured that there is a voltage difference of at least ±200mV between the data lines A and B, as seen by the receiver.

ⓘ Normally, an external voltage source is provided.

Fig. 6 shows the device connections as recommended by the MODBUS User Organization [1].

Fig. 3 Recommended connections



With four-wire connection (RS 422), each wire pair corresponds to the drawing above.

If no external voltage source is available, and if there are only a few participants on the bus (e.g. only a master and a slave device), and the transmission speed is low (e.g. 9600 bits/s), the lead lengths are short, and terminating resistors have been fitted, it is possible that the minimum signal level cannot be reached. This will cause disturbances in signal transmission.

Therefore, if only a few PMA devices are connected, we recommend the following procedure before fitting terminating resistors:

Baudrate	Lead length	No. of PMA devices	Terminating resistor
≤ 9600 Bist/s	≤ 1000 m	< 8	no
19200 Bit/s	≤ 500 m	< 8	no
38400 Bit/s	≤ 250 m	< 8	no
beliebig		≥ 8	useful
			other cases: try out

If less than 8 PMA devices are connected to a bus with the above maximum lead lengths, no terminating resistors should be fitted.

Note: If additional devices from other manufacturers are connected to the bus, no general recommendations are possible – this means: trial and error!

2.2.6 Installation notes

- Measurement and data leads should be kept separate from control leads and power cables.
- Twisted and screened cables should be used to connect sensor. The screen must be grounded.
- Connected contactors, relays, motors, etc. should be fitted with RC snubber circuits in accordance with manufacturer specifications.
- The device must not be installed near powerful electrical or electromagnetic fields.

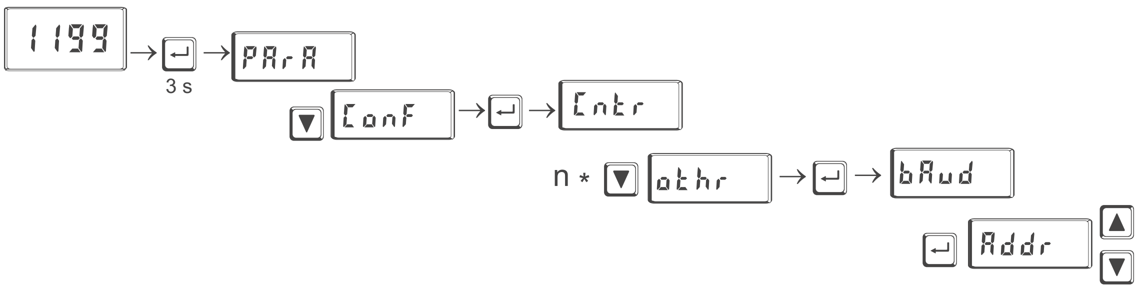
- The device is not certified for installation in explosion-hazarded areas.
- Incorrect electrical connections can result in severe damage to the device.
- Please observe all safety instructions.

2.3 Bus settings

2.3.1 Bus address

The participant address of a device connected to a bus must be adjusted by one of the following means:
- the Engineering Tool BlueControl® using the menu item Othr/Addr
- or via the device's front panel (see below)

Fig. 4 Setting a bus address



Every device connected to a bus must have a different, unique address.

Please regard: When allocating the unit's addresses don't give the same address to two units. In this case a strange behaviour of the whole bus becomes possible and the busmaster will not be able to communicate with the connected slave-units.

2.3.2 Transmission parameters

The transmission parameters of all devices linked to a bus must have the same settings.

Baudrate (bAud)
The baudrate is the measure of data transmission speed. The devices support the following transmission speeds:
- 38000 bits/s
- 19200 bits/s
- 9600 bits/s
- 4800 bits/s
- 2400 bits/s

Parity / Stop bit (PrtY)
The parity bit is used to check whether an individual fault has occurred within a byte during transmission.

The device supports:

- **even parity**
- **odd parity**
- **no parity**

With even parity, the parity bit is adjusted so that the sum of the set bits in the 8 data bits and the parity bit result in an even number. Conversely, the same applies for uneven parity.

If a parity error is detected upon receipt of a message, the receiving device will not generate an answer.

Other parameters are:

- 8 data bits
- 1 start bit
- 1 stop bit
  1 or 2 stop bits can be selected when adjusting 'no parity'.

The max. length of a message may not exceed 256 bytes.

2.4 System layout

Please observe the guidelines and notes provided by the manufacturer of the master device regarding the layout of a communication system.

2.4.1 Minimum configuration of a MODBUS installation

A MODBUS installation consists of not less than the following components:

- a bus master, which controls the data traffic
- one or more slave participants, which provide data upon demand by the master
- the transmission media, consisting of the bus cable and bus connectors to link the individual participants, plus a bus segment (or several, which are connected by means of repeaters).

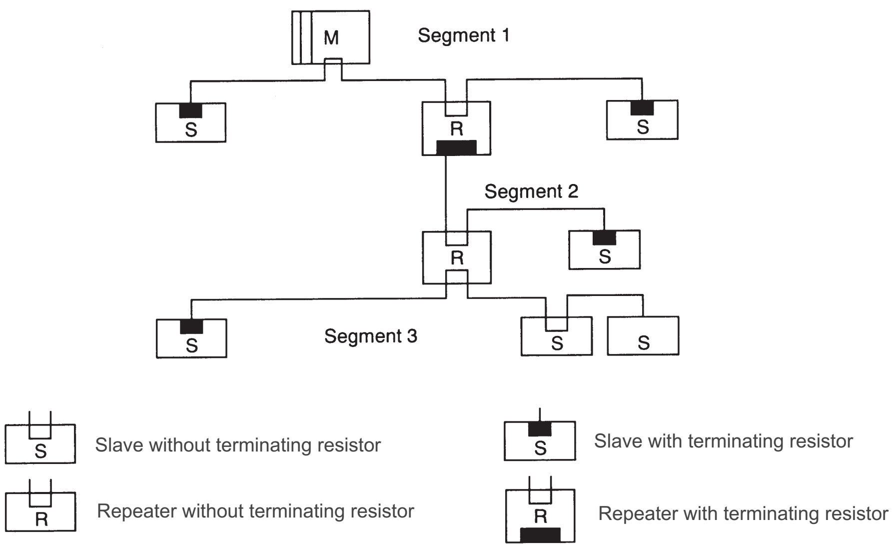
2.4.2 Maximum configuration of a MODBUS installation

A bus segment consists of max. 32 field units (active and passive). The greatest number of slave participants that can be operated by one MODBUS master via several segments, is determined by the internal memory structure of the master. Therefore, you should know the specifications of the master when planning a MODBUS installation.
The bus cable can be opened at any point in order to add another participant by means of a bus connector. At the end of a segment, the bus cable can be extended up to the total permissible length for a segment. The permissible length of a bus segment depends on the selected transmission speed, which in turn is determined mainly by plant layout (length of each segment, distributed inputs/outputs) and the required scan cycles for individual participants. All participants connected to the bus must be configured for the same transmission speed (bit rate).

MODBUS devices must be connected in a line structure.

If more than 32 participants are required, or larger distances than the permissible length of one segment are needed, the MODBUS installation can be extended by means of repeaters.

Fig. 5 structure

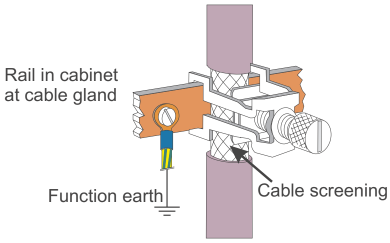


A fully configured MODBUS installation may contain max. 247 participants with the address range 1...247. Every installed repeater reduces the max. number of participants with a segment. Repeaters are passive participants and do not require a MODBUS address. However, its input circuit represents an additional load in the segment due to the current consumption of the bus driver. Nonetheless, a repeater has no influence on the total number of participants connected to the bus. The maximum number of series-connected repeaters can differ, depending on the manufacturer. Therefore, you should ask the manufacturer about possible limitations when planning a MODBUS installation.

2.4.3 Wiring inside buildings

The following wiring hints apply for twisted-pair cables with screen. The cable screen serves to improve overall electromagnetic compatibility.

Fig. 6 Screen connection



Depending on requirements, the one or both ends of the cable screen must be connected to a central earth point (PE) by means of low-impedance connections with a large surface, e.g. screen clamps. When installing a repeater or field unit in a control cabinet, the cable screen should be connected to an earth rail mounted as close as possible to the cable entry into the cabinet.

The screen must be taken right up to the field unit, where it is to be connected to the conductive housing and/or the metal connector. Hereby, it must be ensured that the device housing (and possibly the control cabinet in which the device is installed), are held at equal ground potential by means of low-impedance connections with a large surface. Connecting a screen to a lacquered or painted surface is useless. By observing these measures, high-frequency interference will be grounded reliably via the cable screens. Should external interference voltages still reach the data lines, the voltage potential will be raised symmetrically on both lines, so that in general, no destructive voltage differences can arise. Normally, a shift of the ground potential by several volts will not have an effect on reliable data transmission. If higher voltages are to be expected, a potential balancing conductor with a minimum cross-section of 10 mm^2 should be installed parallel to the bus cable, with connections to the reference ground of every field unit. In case of extreme interference, the bus cable can be installed in a metal conduit or channel. The conduit tube or the channel must be earthed at regular distances.

The bus cable must always be installed with a minimum separation of 20 cm from other cables carrying voltages above 60 V. Similarly, the bus cable must be run separately from telephone lines, as well as from cables leading into explosion-hazarded areas. In these cases, we recommend installing the bus cable in a separate cable tray or channel.

Cable trays or channels should always be made of conductive materials, and must be earthed at regular distances. Bus cables should not be subjected to any mechanical strains or obvious risks of damage. If this cannot be ensured, suitable measures must be undertaken, such as installation in conduit.

Floating installation:
If the installation must be floating (no earth connection) for certain reasons, the device reference ground must only have a high-impedance connection to earth (e.g. an RC combination). The system will then find its own earth potential. When connecting repeaters for the purpose of linking two bus segments, a floating installation is recommended, to prevent possible potential differences being transferred from one segment to the next.

3 Bus protocol

3.1 Composition of a transmission byte

Originally, the MODBUS protocol was defined for the communication between a supervisory system and the Modicon® PLC. It used a master/slave structure, in which only one device (master) is able to initiate data transactions (queries). The query message from the master is answered (response) by other devices (slaves), which supply the requested data. Moreover, the master can address a specific slave via its MODBUS address, or address all connected slaves by means of a general message (broadcast).
The MODBUS protocol determines the transmission formats for the query and the response. Function codes define the actions to be executed by the slaves.
Within the device, the MODBUS protocol uses the RTU (remote terminal unit) mode, i.e. every transmitted byte of a message contains two hexadecimal characters (0...9, A...F).

The composition of a byte in the RTU-protocol is as follows:

Start bit	8 data bits	Parity/Stop bit	Stop bit

3.2 General message frame

The message is read into a data buffer with a defined maximum length. Longer messages are not accepted, i.e. the device does not answer.

The message consist of the following elements:

Device address	Function code	Data field	CRC	End of frame detection
1 byte	1 byte	N * 1 bytes	2 bytes	

- Device address (Addr)
  The device address is used for identification. Device addresses can be assigned in the range of 1...127.
  The device address '0' is reserved for 'Broadcast' messages to all slaves. A broadcast message can be transmitted e.g. with a write instruction that is then executed by all the slaves on the bus. Because all the slaves execute the instruction, no response messages are generated.

- Function code
  The function code defines the transaction type in a message. The MODBUS specification defines more than 17 different function codes. Supported codes are described in Section 3.6. „Function codes".

- Data field
  The data field contains the detailed specifications of the transaction defined by the function code. The length of the data field depends on the function code.

- CRC
  As a further means of fault detection (in addition to parity bit detection) a 16-bit cyclical redundancy check (CRC) is performed. The CRC code ensures that communication errors are detected. For additional information, see Section 3.2.1. "CRC".

- End of frame detection
  The end of a message is defined by a period of 3,5 characters, during which no data transfer occurs. For additional information, see Section 3.2.2. „End of frame detection"

Further information is given in the documents named in **[1]** or under http://www.modbus.org.

3.2.1 CRC

The CRC is a 16-bit value that is attached to the message. It serves to determine whether a transmitted message has been received without errors. Together with the parity check, this should detect all possible communication errors.

If a parity fault is detected during reading, no response message will be generated.

The algorithm for generating a CRC is as follows:

① Load CRC register with FFFFhex.
② Exclusive OR the first transmit/receive byte with the low-order byte of the CRC register, putting the result into the CRC register, zero-filling the MSB.
③ Shift the CRC register one bit to the right.
④ If the expelled bit is a '0' repeat step 3.
If the expelled bit is a '1', exclusive OR the CRC register with value A001hex.
⑤ Repeat steps 3 and 4 for the other 7 data bits.
⑥ Repeat steps 2 to 5 for all further transmit/receive bytes.
⑦ Attach the result of the CRC register to the message (low-order byte first, then the high-order byte).
When checking a received message, the CRC register will return '0', when the message including the CRC is processed.

3.2.2 End of frame detection

The end of a message (frame) is defined as a silence period of 3.5 characters on the MODBUS.
A slave may not start its response, and a master may not start a new transmission before this time has elapsed.

However, the evaluation of a message may begin, if a silence period of more than 1.5 characters occurs on the MODBUS. But the response may not start before 3,5 characters of silence.

3.3 Transmission principles

Two transmission modes are used with MODBUS:

- **Unicast mode**
- **Broadcast mode**

In the Unicast mode, the master addresses an individual device, which processes the received message and generates a response. The device address can be 1...247. Messages always consist of a query (request) and an answer (response). If no response is read within a defined time, a timeout error is generated.

In the Broadcast mode, the master sends a write instruction (request) to all participants on the bus, but no responses are generated. The address '0' is reserved for broadcast messages.

3.4 Response delay (dELY)

Some devices require a certain period to switch from transmit to receive. The adjusted delay is added to the silent period of 3,5 characters at the end of a message, before a response is generated. The delay is set in ms.

3.5 Modem operation (C.dEL)

The end of frame detection of a received MODBUS message can be increased by the period 'C.del'. This time is needed e.g. for transmission via a modem, if messages cannot be transmitted continuously (synchronous operation). The delay is set in ms.

3.6 Function codes

Function codes serve to execute instructions. The device supports the following function codes:

Function code hex	dez	Description	Explanation
0x03	3	Read Holding (Output) Register	Reading of process data, parameters, and configuration data
0x04	4	Read Input Register	Reading of process data, parameters, and configuration data
0x06	6	Preset Single Register (Output)	Wordwise writing of a value (process value, parameter, or configuration data)
0x08	8	Diagnostics	Reading the MODBUS diagnostic register
0x10	16	Preset Multiple Register (Output)	Wordwise writing of several values (process data, parameter or configuration data)

The behaviour of function codes 3 and 4 is identical.
The following sections show various examples of message composition.

3.6.1 Reading several values

Messages with function codes 3 or 4 are used for (wordwise) reading of process data, parameters or configuration data. For reading 'Float' type data, 2 values must be requested for each datum.

The composition of a read message is as follows:
Request:

Field name	Value (hex)	Explanation
Address	11	Address 17
Function	03 or 04	Reading process data, parameters or configuration data
Start address High Start address Low	02 8A	Starting address 650
No. of values	00 02	2 datums (2 words)
CRC	CRC-Byte1 CRC-Byte2	

Response:

Field name	Value (hex)	Explanation
Address	11	Address 17
Function	03 oder 04	Reading process data, parameters or configuration data
No. of bytes	04	4 data bytes are transmitted
Word 1	00 DE	Process data, parameters or configuration data. Address 650= 222
Word 2	01 4D	Process data, parameters or configuration data. Address 651= 333
CRC	CRC-byte1 CRC-byte2	

A broadcast message is not possible for function codes 3 and 4.

If the first addressed value is not defined, an error message "ILLEGAL DATA ADDRESS" is generated. If no further data are defined in the areas to be read following the first value, these areas will be entered with the value "NOT DEFINED VALUE". This enables areas with gaps to be to be read in a message.

3.6.2 Writing a single value

Messages with function code 6 are used for (wordwise) writing of process data, parameters or configuration data as integers. This function is not suitable for writing 'Float' type data.

The composition of a write message is as follows:
Request:

Field name	Value (hex)	Explanation
Address	11	Address 17
Function	06	Writing a single value (process data, parameter or configuration)
Write address High Write address Low	02 8A	Write address 650
Value	00 7B	Preset value = 123
CRC	CRC-byte1 CRC-byte2	

Response:

Field name	Value (hex)	Explanation
Address	11	Address 17
Function	06	Writing a single datum (process data, parameter or configuration)
Write address High Write address Low	02 8A	Write address 650
Value	00 7B	Preset value = 123
CRC	CRC-Byte1 CRC-Byte2	

If everything is correct, the response message corresponds exactly to the default.

The devices can also receive this message as a broadcast with the address '0'.

A default value in the 'Real' data format is not possible, as only 2 bytes can be transmitted as value.

If a value is outside the adjustable range, the error message "ILLEGAL DATA VALUE" is generated. The datum remains unchanged. Also if the datum cannot be written (e.g. configuration data, and the device is online), an error message "ILLEGAL DATA VALUE" is generated.

3.7 Writing several values

Messages with function code 16 are used for (wordwise) writing of process data, parameters or configuration data. For writing ‘Float’ type data, 2 values must be transmitted for each datum.

The composition of a write message is as follows:
Request:

Field name	Value (hex)	Explanation
Address	11	Address 17
Function	10	Writing several process values, parameters or configuration data
Start address High Start address Low	02 8A	Write address 650
No. of values	00 02	2 values
No. of bytes	04	4 data bytes are transmitted
Word 1	00 DE	Process value, parameters or configuration data. Address 650 = 222
Word 2	01 4D	Process value, parameters or configuration data. Address 651 = 333
CRC	CRC byte1 CRC byte2	

Response:

Field name	Value (hex)	Explanation
Address	11	Address 17
Function	10	Writing several process values, parameters or configuration data
Start address High Start address Low	02 8A	Write address 650
No. of values	00 02	2 process values, parameters or configuration data
CRC	CRC byte1 CRC byte2	

The devices can also receive this message as a broadcast with the address ‘0’.

If the first value is not defined, an error message ”ILLEGAL DATA ADDRESS” is generated.
If the first value cannot be written (e.g. configuration data, and the device is online), an error message ”ILLEGAL DATA VALUE” is generated.

If no further data are defined or cannot be written in the specified areas following the first value, these areas will be skipped. The data in these locations remains unchanged. This enables areas with gaps, or that are currently not writable, to be changed with a message. No error message is generated.

If a value is outside the adjustable range, the error message ”ILLEGAL DATA VALUE” is generated. Subsequent data are not evaluated. Previously accepted correct data are active.

3.8 Error record

An error record is generated, if a message is received correctly, but message interpretation or the modification of a datum is not possible.

If a transmission error is detected, no response is generated. The master must retransmit the message.

Detected transmission errors are:

- Parity fault
- Framing error (no stop bit received)
- Overrun error (receiving buffer has overflowed or data could not be retrieved quickly enough from the UART)
- CRC error

The composition of the error record is as follows:

Field name	Value	Explanation
Address	11	Address 17
Function	90	Error record for the message 'Writing several parameters or configuration data'. Composition: 80_{hex} + function code
Error code	02	ILLEGAL DATA ADDRESS
CRC	CRC byte1 CRC byte2	

In the 'Function' field, the most significant bit is set.
The error code is transmitted in the subsequent byte.

3.8.1 Error codes

The following error codes are defined:

Code	Name	Explanation
01	ILLEGAL FUNCTION	The received function code is not defined in the device.
02	ILLEGAL DATA ADDRESS	The received address is not defined in the device, or the value may not be written (read only). If several data are read simultaneously (function codes 01, 03, 04) or written simultaneously (function codes 0F, 10), this error is only generated if the first datum is not defined.
03	ILLEGAL DATA VALUE	The received value is outside the adjusted limits or it cannot be written at present (device is not in the configuration mode). If several data are written simultaneously (function codes 0F, 10), this error is only generated if the first datum cannot be written.
04	SLAVE DEVICE FAILURE	More values are requested than permitted by the transmission buffer.

Other error codes specified in the MODBUS protocol are not supported.

3.9 Diagnosis

By means of the diagnosis message, the device can be prompted to send check messages, go into operational states, output counter values or to reset the counters.
This message can never be sent as a broadcast message.

The following functions have been defined:

Code	Explanation
0x00	Return transmission of the received message
0x01	Restart of communication (terminates the Listen Only mode)
0x02	Return transmission of the diagnosis register
0x04	Change to the Listen Only mode
0x0A	Delete the counter and reset the diagnosis register
0x0B	Return transmission of the message counter (all messages on the bus)
0x0C	Reset of the counter for faulty message transmissions to this slave (parity or CRC error)
0x0D	Return transmission of the counter for messages answered with error code
0x0E	Return transmission of the message counter for this slave
0x0F	Return transmission of the counter for unanswered messages
0x10	Return transmission of the counter for messages answered with NAK
0x11	Return transmission of the counter for messages answered with Busy
0x12	Return transmission of the counter for too long messages
0x40	Return transmission of the parity error counter
0x41	Return transmission of the framing error counter (stop bit not detected)
0x42	Return transmission of the counter for full buffer (message longer than receiving buffer)

- Request in the Integer format:
  If the setting for Integer with decimals (most significant 3 bits) is used for the address, the counter contents will be transmitted in accordance with the necessary conversion factor.

- Request in the Float format:
  If the setting for Float (most significant 3 bits are 010) is used for the address, the counter contents will be transmitted in the IEEE format. The largest value is 65535, because the counters in the device are designed as word counters.
  In the Float format, a 4-byte data field is returned with a request for counter contents. In all other cases, a 2-byte data field is returned.

When switching into the Listen mode (0x04) and at restart after the device has changed into the Listen mode, no response is generated.
If a restart diagnosis message is received while the device is not in the Listen mode, the device generates a response.

A diagnosis message is composed as follows:

Request:

Field name	Value	Explanation
Address	11	Address 17
Function	08	Diagnosis message
Sub-function High Sub-function Low	00 YY	Sub-function code
Data field	Byte 1 Byte 2	Further data definitions
CRC	CRC byte1 CRC byte2	

3.9.1 Return transmission of the received message (0x00)

The message serves as a check whether communication is operational.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 00	2 bytes of any content	Return transmission of the received datum

3.9.2 Restart of communication (terminates the Listen Only mode) (0x01)

The slave is instructed to initialize its interface, and to delete the event counters. In addition, the device is instructed to exit the Listen Only mode. If the device already is in the Listen Only mode, no response is generated.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 01	00 00	00 00

3.9.3 Return transmission of the diagnosis register (0x02)

The slave sends its 16-bit diagnosis register to the master. The data contained in this register are freely definable. For example, the information could be: EEPROM faulty, LED defective, etc.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 02	00 00	Contents of the diagnosis register

3.9.4 Change to the Listen Only mode (0x04)

The slave is instructed not to execute or answer any messages addressed to it. The device can only return to normal operation by means of the diagnosis message ‘Sub-function 00 01’ or by means of a new power up.

The function serves to disable a module that is behaving erratically on the MODBUS, so that the bus can continue operations. The device does not generate a response after receiving this message.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 04	00 00	No response

3.9.5 Delete the counter and reset the diagnosis register (0x0A)

The slave is instructed to delete the contents of its event counter and to reset the diagnosis register.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 0A	00 00	00 00

3.9.6 Return transmission of the message counter (0x0B)

The slave is instructed to return the value of its message counter.
The counter contains the sum of all messages, which the slave has recorded on the bus. This count includes all the messages transmitted by the master and the other slaves. The count does not include the response messages of this slave.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 0B	00 00	Message counter

3.9.7 Return transmission of the counter for faulty message transmissions

The slave is instructed to return the value of its counter for faulty message transmissions.
The counter contains the sum of all messages addressed to the slave, in which an error was detected. Hereby, the faults can be CRC or parity errors.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 0C	00 00	Contents of counter for faulty message transmissions

3.9.8 Return transmission of the counter for messages answered with error code

The slave is instructed to return the value of its counter for the messages answered with error code. The counter contains the sum of all messages addressed to the slave, and which were answered with an error code.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 0D	00 00	Contents of counter for messages answered with an error code

3.9.9 Return transmission of the message counter for this slave

The slave is instructed to return the value of its counter for messages to this slave.
The counter contains the sum of all messages addressed to the slave.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 0E	00 00	Contents of counter for messages addressed to this slave

3.9.10 Return transmission of the counter for unanswered messages

The slave is instructed to return the value of its counter for unanswered messages.
The counter contains the sum of all messages addressed to the slave, which were not answered because of internal events or detected errors.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 0F	00 00	Contents of counter for unanswered messages

3.9.11 Return transmission of the counter for messages answered with NAK (0x10)

The slave is instructed to return the value of its counter for messages answered with NAK.
The counter contains the sum of all messages addressed to the slave, which were answered with NAK.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 10	00 00	Contents of counter for messages answered with NAK

3.9.12 Return transmission of the counter for messages answered with Busy (0x11)

The slave is instructed to return the value of its counter for messages answered with Busy.
The counter contains the sum of all messages addressed to the slave, which were answered with Busy.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 12	00 00	Contents of counter for messages answered with Busy

3.9.13 Return transmission of the parity error counter (0x40)

The slave is instructed to return the value of its counter for parity errors.
The counter contains the sum of all messages addressed to the slave, in which a parity error was detected.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 40	00 00	Contents of counter for the number of parity errors

3.9.14 Return transmission of the framing error counter (0x41)

The slave is instructed to return the value of its counter for the number of framing errors.
The counter contains the sum of all messages addressed to the slave, in which a framing error was detected. A framing error occurs, if the stop bit at the end of a byte is not detected.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 41	00 00	Contents of counter for the number of framing errors

3.9.15 Return transmission of the counter for too long messages

The slave is instructed to return the value of its counter for too long messages.
The counter contains the sum of all messages addressed to the slave, which caused an overflow of the receiving buffer, or if the data were not retrieved from the UART quickly enough.
Definition of the received and returned data:

Sub-function	Received data field	Transmitted data field
00 42	00 00	Counter for too long messages

4 MODBUS addresses, address areas, and address formats

4.1 Area definitions

The address is coded in 2 bytes. The most significant 3 bits determine the data transmission format.
The following formats are available for *rail line* devices:

- **Integer**
- **Integer with 1 decimal**
- **(Float acc. to IEEE)**

Address area hex	dez.	Data transfer format	Smallest transferable value	Largest transferable value	Resolution
0x0000 ... 0x1FFF	0 ... 8191	Integer without decimals	-30000	+32000	+/- 1
0x2000 ... 0x3FFF	8192 ... 16383	Integer with 1 decimal	-3000.0	+3200.0	+/- 0.1
0x4000 ... 0x7FFF	16384...32767	Float (IEEE format)	-1.0 E+037	+1.0 E+037	+/-1.4E-045

For integer numbers with and without decimals, the value range -30000 to +32000 is transmitted via the interface. Scaling with the factor 1 or 10 must be carried out by the transmitting device as well as by the receiving device.

- Values are transmitted in the Motorola format (big endian).
- The relevant areas are grouped for process data, parameter and configuration data reading and writing.
- Multiple definition of process data in different groups is possible.

4.2 Special values

The following special values are defined for transmission in the integer format:

- -31000 Sensor fault
  This value is returned for data that do not represent a meaningful value due to a sensor fault.

- -32000 Switch-off value
  The function is disabled.

- -32500 Undefined value
  The device returns this value, if a datum is not defined within the requested range („NOT DEFINED VALUE“).

- -32768 Corresponds to 0x8000 hex.
  The value to be transmitted lies outside the transferable integer value range.

The following special values are defined for transmission in the Float format:

- -1.5E37 This datum is not defined.
  The device returns this value, if a datum is not defined within the requested range.

4.3 Composition of the address tables

In the address tables shown in Section 5, the addresses for every parameter of the corresponding data format are specified in decimal values.
The tables are structured as follows:

Name	R/W	Address	Integer	Real	Type	Value/off	Description
		base 1dP					

- Name — Description of the datum
- R/W — permitted type of access: R = read, W = write
- Address integer — Address for integer values
- base — Integer without decimals
- 1 dP — Integer with 1 decimal
- Real — Floating point number / Float (IEEE format)
- Type — internal data type
- Value/off — permissible value range, switch-off value available
- Description — Explanations

4.4 Internal data types

The following data types are assigned to data used in the device:

- Float
  Floating point number
  Value range: -1999 ... -0.001, 0, 0.001 ... 9999
- INT
  Positive whole integer number
  Value range: 0 ... 65535
  Exception: Switch-off value '-32000'
- Text
  Text string consisting of n characters, currently defined n = 5
  Permissible characters: 20H...7FH
- Long
  Positive whole Long number
  Value range: 0 … 99999
- Enum
  Selection value

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6 Address tables

The following sections describe the address tables for:

- **Digital indicator Dig 280-1**

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ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Fnc.1	r/w	base 1dP 2dP 3dP	5063 13255 21447 29639	42894	Enum	*Enum_Func1*	function 1 = process value processing. The process value can be assigned directly to an input value, but it can also be computed from the comparison of two input values. For this, various formulas are provided for the user, e.g. the difference or the ratio of the two input values.

0	no function
1	Tare function
2	sample & hold
3	O2 measurement

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Fnc.2	r/w	base 1dP 2dP 3dP	5064 13256 21448 29640	42896	Enum	*Enum_Func2*	function 2

0	indicator
1	controller

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
C.Fnc	r/w	base 1dP 2dP 3dP	5050 13242 21434 29626	42868	Enum	*Enum_CFnc*	Control behaviour (algorithm) referred to output value: e.g. 2- or 3-point controller, signaller, 3-point stepping control.

0	on/off controller or signaller with one output. The on/off controller or signaller switches if the process value drifts from the setpoint more than the hysteresis.
1	PID control, e.g. heating, with one output: Switched as a digital output (2-point) or used as an analog output (continuous). PID controllers respond quickly to changes of the control deviation, and typically do not exhibit any permanent control offset.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
C.Act	r/w	base 1dP 2dP 3dP	5052 13244 21436 29628	42872	Enum	*Enum_CAct*	Operating sense of the controller. Inverse operation (e.g. heating) means increased heat input when the process value falls. Direct operation (e.g. cooling) means increased heat input when the process value increases.

0	Inverse or opposed-sense response, e.g. heating. The controller output is increased with a falling process value, and decreased with a rising process value.
1	Direct or same-sense response, e.g. cooling. The controller output is increased with a rising process value, and decreased with a falling process value.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
rnG.L	r/w	base 1dP 2dP 3dP	5059 13251 21443 29635	42886	Float	-19999...9999 ☐	Lower limit for the controller's operating range. The control range is independent of the measurement range. Reducing the control range will increase the sensitivity of the self-tuning process.
rnG.H	r/w	base 1dP 2dP 3dP	5060 13252 21444 29636	42888	Float	-19999...9999 ☐	Upper limit for the controller's operating range. The control range is independent of the measurement range. Reducing the control range will increase the sensitivity of the self-tuning process.

1 Func

PArA

Name	r/w	Adr.	Integer	real	Typ	Value/off		Description
tEmP	r/w	base 1dP 2dP 3dP	5021 13213 21405 29597	42810	Float	0...99999	☐	Constant sensor temperature. With O2 measurement, the actual oxygen content is derived from the constant sensor temperature and the EMF (electromotive force in volts) generated by the sensor.Note: A constant sensor temperature is only ensured with heated lambda sensors.
Pb1	r/w	base 1dP 2dP 3dP	5000 13192 21384 29576	42768	Float	1...99999	☐	Proportional band 1 (heating) in engineering unit, e.g. °C. Pb defines the relationship between controller output and control deviation. The smaller Pb is, the stronger is the control action for a given control deviation. If Pb is too large or too small, the control loop will oscillate (hunting).
ti1	r/w	base 1dP 2dP 3dP	5002 13194 21386 29578	42772	Float	1...99999	☑	Integral action time 1 (heating) [s]. Ti is the time constant of the integral portion. The smaller Ti is, the faster is the response of the integral action. Ti too small: Control tends to oscillate. Ti too large: Control is sluggish and needs a long time to line out.
td1	r/w	base 1dP 2dP 3dP	5004 13196 21388 29580	42776	Float	1...99999	☑	Derivative action time 1 (heating) [s], second parameter set. Td is the time constant of the derivative portion. The faster the process value changes, and the larger the value of Td is, the stronger will be the derivative action. Td too small: Very little derivative action. Td too large: Control tends to oscillate.
t1	r/w	base 1dP 2dP 3dP	5006 13198 21390 29582	42780	Float	0,4...99999	☐	Minimum duty cycle 1 (heating) [s]. With the standard duty cycle converter, the shortest pulse duration is 1/4 x t1. If the duty cycle is not to be optimized, this must be entered in the configuration. (Default: Optimization of the duty cycle during self-tuning, but also if the output value is less than 5%).
SH	r/w	base 1dP 2dP 3dP	5014 13206 21398 29590	42796	Float	0...99999	☐	Neutral zone, or switching difference of the signaller [engineering unit].Too small: unnecessarily high switching frequency.Too large: reduced controller sensitivity.With 3-point controllers this slows down the direct transition from heating to cooling. With 3-point stepping controllers, it reduces the switching operations of the actuator around setpoint.
Y.Lo	r/w	base 1dP 2dP 3dP	5018 13210 21402 29594	42804	Float	-105...105	☐	Lower output limit [%] The range is depedant of the type of controller: 2 point controller: 0...ymax+1 3 point controller: -105 ymax-1
Y.Hi	r/w	base 1dP 2dP 3dP	5019 13211 21403 29595	42806	Float	-105...105	☐	Upper output limit [%] The range is ymin+1 105
Y2	r/w	base 1dP 2dP 3dP	5017 13209 21401 29593	42802	Float	-100...100	☐	Second positioning value [%]. Activated Y2 = positioner control. Caution: The parameter 'positioning output Y2' must not be confused with the controller output Y2!
Y.0	r/w	base 1dP 2dP 3dP	5020 13212 21404 29596	42808	Float	-105...105	☐	Offset for die positioning value [%]. This is added to the controller output, and has the most effect with P and PD controllers. (With PID controllers, the effect is compensated by the integral action.) With a control deviation = 0, the P controller generates a control output Y0.

1 Func

PArA

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
SP.LO	r/w	base 1dP 2dP 3dP	3100 11292 19484 27676	38968	Float	-19999...9999	☐	Lower setpoint limit. The setpoint is raised to this value automatically, if a lower setpoint is adjusted. BUT: The (safety) setpoint W2 is not restricted by the setpoint limits! The setpoint reserve for the step function is 10% of SPHi - SPLo.
SP.Hi	r/w	base 1dP 2dP 3dP	3101 11293 19485 27677	38970	Float	-19999...9999	☐	Upper setpoint limit. The setpoint is reduced to this value automatically, if a higher setpoint is adjusted. BUT: The (safety) setpoint W2 is not restricted by the setpoint limits! The setpoint reserve for the step function is 10% of SPHi - SPLo.

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
C.InP	r	base 1dP 2dP 3dP	5102 13294 21486 29678	42972	Float	-19999...9999	☐	process value
In.Hi	r	base 1dP 2dP 3dP	5106 13298 21490 29682	42980	Float	-19999...9999	☐	maximum value
In.Lo	r	base 1dP 2dP 3dP	5105 13297 21489 29681	42978	Float	-19999...9999	☐	minimum value

1 Func

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
St.Cntr	r	base 1dP 2dP 3dP	5100 13292 21484 29676	42968	Int	0...65535	☐	Status informations of the controller.f.e. switching signals, controller off or informations about selftuning. The controller sratus shows the actual adjustments of the controller.

Bit 0: Switching signal heating: 0: off 1: on
Bit 1: Switching signal cooling: 0: off 1: on
Bit 2: Sensor error 0: ok 1: error
Bit 3: Controlsignal: Manual/automatic
0: automatic 1: manual
Bit 4: Controlsignal: Y2
0: Y2 not activ 1: Y2 activ
Bit 5: Controlsignal: Ext. setting of outputsignal
0: not activ 1: activ
Bit 6: Controlsignal: Controller off
0: contr. on 1: contr. off
Bit 7: Controlsignal:The activ parameter set
0: parameterset 1
1: parameterset 2
Bit 8: Loopalarm
0: no alarm
1: alarm
Bit 9: Soft start function
0: not activ
1: activ
Bit 10: Rate to setpoint
0: not activ
1: activ
Bit 11: Not used
Bit 12-15: Internal functional statuses (operating state)
0 0 0 0 Automatic
0 0 0 1 Selftuning is running
0 0 1 0 Selftuning faulty
(Waiting for operator signal)
0 0 1 1 Sensor error
0 1 0 0 Not used
0 1 0 1 Manual
0 1 1 1 Not used
1 0 0 0 Manual, with external presetting of the outputsignal
1 0 0 1 Outputs switched off (neutral)
1 0 1 0 Abortion of the selftuning (by control- or error-signal)

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
diFF	r	base 1dP 2dP 3dP	5104 13296 21488 29680	42976	Float	-19999...99999	☐	Control deviation, is defined as process value minus setpoint. Positive Xw means that the process value is above the setpoint. A small control deviation indicates precise control.
Tu1	r	base 1dP 2dP 3dP	5141 13333 21525 29717	43050	Float	0...99999	☐	'Heating' delay time of the loop. Tu is calculated by the self-tuning function: It is the time delay before the process reacts significantly. In effect, Tu is a dead time that is determined by the reaction of the process to a change of the control output. It is used for defining controller action.
Ypid	r	base 1dP 2dP 3dP	5103 13295 21487 29679	42974	Float	-120...120	☐	Output value Ypid is the output signal determined by the controller, and from which the switching pulses for the digital and analog control outputs are calculated. Ypid is also available as an analog signal. e.g. for visualization.

1 Func

Signal

Name	r/w	Adr.	Integer	real	Typ	Value/off		Description
Ada.St	r/w	base 1dP 2dP 3dP	5150 13342 21534 29726	43068	Enum	*Enum_AdaStart*		Starting / stopping the self-tuning function.After the start signal, the controller waits until the process reaches a stable condition (PIR) before it starts the self-tuning process. Self-tuning can be aborted manually at any time. After a successful self-tuning attempt, the controller automatically resumes normal operation.
						0		'Stop' will abort the self-tuning process, and the controller returns to normal operation with the previous parameter settings.
						1		Start of the self-tuning process is possible during manual or automatic controller operation.
SP.EF	r	base 1dP 2dP 3dP	5101 13293 21485 29677	42970	Float	-19999...9999 0	☐	Effective setpoint. The value reached at the end of setpoint processing, after taking W2, external setpoint, gradient, boost function, programmer settings, start-up function, and limit functions into account. Comparison with the effective process value leads to the control deviation, from which the necessary controller response is derived.
St.Tune	r	base 1dP 2dP 3dP	5140 13332 21524 29716	43048	Int	0...65535	☐	Status information during self-tuning, e.g. the actual condition, and possible results, warnings, and error messages.
								Bit 0 Process lined out; 0 = No; 1 = Yes Bit 1 Operating mode 'Self-tuning controller; 0 = Off; 1 = On Bit 2 Result of controller self-tuning; 0 = OK; 1 = Fault Bit 3 - 7 Not used Bit 8 - 11 Result of the 'heating' attempt 0 0 0 0 No message / Attempt still running 0 0 0 1 Successful 0 0 1 0 Successful, with risk of exceeded setpoint 0 0 1 1 Error: Wrong operating sense 0 1 0 0 Error: No response from process 0 1 0 1 Error: Turning point too low 0 1 1 0 Error: Risk of exceeded setpoint 0 1 1 1 Error: Step output too small 1 0 0 0 Error: Setpoint reserve too small Bit 12 - 15 Result of 'cooling' attempt (same as heating attempt)
Opt.Stat	r	base 1dP 2dP 3dP	5149 13341 21533 29725	43066	Int	0...65535	☑	Internal status of self-tuning. Status of automatic function when using step response and pulse response procedure.
Vmax1	r	base 1dP 2dP 3dP	5142 13334 21526 29718	43052	Float	0...99999	☐	Max. rate of change for 'heating', i.e. the fastest process value increase during self-tuning. Vmax is calculated by the self-tuning function, and is determined by the reaction of the process to a change of the control output. It is used for defining controller action.
Kp1	r	base 1dP 2dP 3dP	5143 13335 21527 29719	43054	Float	0...99999	☐	Process gain for 'heating'. For control loops with self-regulation, process gain is the ratio determined by the change of the control output and the resulting permanent change of the process value. Kp is calculated by the self-tuning function, and is used for defining controller action.

1 Func

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Msg1	r	base	5144	43056	Enum	*Enum_Msg*	The result of self-tuning for 'heating' indicates whether self-tuning was successful, and with what result.
		1dP	13336				
		2dP	21528				
		3dP	29720				

0	No message / Tuning attempt still running
1	Self-tuning has been completed successfully. The new parameters are valid.
2	Self-tuning was successful, but with a warning. The new parameters are valid. Note: Self-tuning was aborted due to the risk of an exceeded setpoint, but useful parameters were determined. Possibly repeat the attempt with an increased setpoint reserve.
3	The process reacts in the wrong direction. Possible remedy: Reconfigure the controller (inverse <-> direct). Check the controller output sense (inverse <-> direct).
4	No response from the process. Perhaps the control loop is open. Possible remedy: Check sensor, connections, and process.
5	The process value turning point of the step response is too low. Possible remedy: Increase the permitted step output range, i.e. increase the parameter Y.Hi ('heating') or reduce the parameter Y.Lo ('cooling').
6	Self-tuning was aborted due to the risk of an exceeded setpoint. No useful parameters were determined. Possible remedy: Repeat the attempt with an increased setpoint reserve.
7	The step output change is not large enough (minimum change > 5 %). Possible remedy: Increase the permitted step output range, i.e. increase the parameter Y.Hi ('heating') or reduce the parameter Y.Lo ('cooling').
8	The controller is waiting. Setpoint reserve must be given before generating the step output change. Acknowledgment of this error message leads to switch-over to automatic mode. If self-tuning shall be continued, change set-point, change process value, or decrease set-point range.

2 InP

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
S.tYP	r/w	base 1dP 2dP 3dP	1150 9342 17534 25726	35068	Enum	*Enum_StYP*	Sensor type selection. For sensors with signals of resistance transducer, current or voltage measuring, scaling can be adjusted

0	thermocouple type L (-100...900°C), Fe-CuNi DIN Fahrenheit: -148...1652°F
1	thermocouple type J (-100...1200°C), Fe-CuNi Fahrenheit: -148...2192°F
2	thermocouple type K (-100...1350°C), NiCr-Ni Fahrenheit: -148...2462°F
3	thermocouple type N (-100...1300°C), Nicrosil-Nisil Fahrenheit: -148...2372°F
4	thermocouple type S (0...1760°C), PtRh-Pt10% Fahrenheit: 32...3200°F
5	thermocouple type R (0...1760°C), PtRh-Pt13% Fahrenheit: 32...3200°F
6	thermocouple type T (-200...400°C), Cu-CuNi Fahrenheit: -328...752°F
7	thermocouple type C (0...2315°C), W5%Re-W26%Re Fahrenheit: 32...4199°F
8	thermocouple type D (0...2315°C), W3%Re-W25%Re Fahrenheit: 32...4199°F
9	thermocouple type E (-100...1000°C), NiCr-CuNi Fahrenheit: -148...1832°F
10	thermocouple type B (0/400...1820°C), PtRh-Pt6% Fahrenheit: 32/752...3308°F
18	Special thermocouple with a linearization characteristic selectable by the user. This enables non-linear signals to be simulated or linearized.
20	Pt100 (-200.0 ... 100.0(150.0)°C) Measuring range up to 150°C at reduced lead resistance. Fahrenheit: -328...212(302) °F
21	Pt100 (-200.0 ... 850,0 °C) Fahrenheit: -328...1562 °F
22	Pt 1000 (-200.0...850.0 °C) Fahrenheit: -328...1562 °F
23	Special : 0...4500 Ohms. For KTY 11-6 with preset special linearization (-50...150 °C or -58...302 °F).
24	Special 0...450 Ohm
30	Current : 0...20 mA / 4...20 mA
40	0...10V / 2...10V
41	Special -2.5...115 mV
42	Special : -25...1150 mV
43	Special : -25...90 mV
44	Special : -500...500 mV
45	Special : -5...5 V
50	potentiometer 0...160 Ohm
51	potentiometer 0...450 Ohm
52	potentiometer 0...1600 Ohm

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
S.Lin	r/w	base 1dP 2dP 3dP	1151 9343 17535 25727	35070	Enum	*Enum_SLin*	Linearization (not adjustable for all sensor types S.tYP). Special linearization. The linearization table can be created with the Engineering Tool. The default characteristic is for KTY 11-6 temperature sensors.

0	No special linearization.
1	Special linearization. Definition of the linearization table is possible with the Engineering Tool. The default setting is the characteristic of the KTY 11-6 temperature sensor.

2 InP

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Corr	r/w	base	160	33088	Enum	*Enum_Corr*	Measured value correction / scaling
		1dP	8352				
		2dP	16544				
		3dP	24736				

0	Without scaling
1	The offset correction (in the CAL Level) can be done on-line in the process. If InL shows the lower input value of the scaling point, then OuL must be adjusted to the corresponding display value. Adjustments are made via the front panel keys of the device only.
2	2-point correction (in CAL-Level) ist possible offline via process value transmitter or on-line in the process. Set process value for the upper and lower scaling point and confirm as input value InL or InH, then set the belonging displayed value OuL and OuH. The settings are done via the front of the device.
3	Scaling (at PArA-level). The input values for the upper (InL, OuL) and lower scaling point (InH. OuH) are visible at the parameter level. Adjustment is made via front operation or the engineering tool.

PArA

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
InL	r/w	base	1100	34968	Float	-19999...9999	☐	Input value of the lower scaling point. Depending on sensor type, the input value can be scaled to the required display value in the Parameter Level. The display of the input value of the lower scaling point (e.g. 4 mA) is done using the corresponding electrical value.
		1dP	9292					
		2dP	17484					
		3dP	25676					
OuL	r/w	base	1101	34970	Float	-19999...9999	☐	Display value of the lower scaling point. Depending on sensor type, the input value can be scaled to the required display value in the Parameter Level. The operator can change the display value of the lower scaling point, e.g. 4 mA is displayed as 2 [pH].
		1dP	9293					
		2dP	17485					
		3dP	25677					
InH	r/w	base	1102	34972	Float	-19999...9999	☐	Input value of the upper scaling point. Depending on sensor type, the input value can be scaled to the required display value in the Parameter Level. The display of the input value of the upper scaling point (e.g. 20 mA) is done using the corresponding electrical value.
		1dP	9294					
		2dP	17486					
		3dP	25678					
OuH	r/w	base	1103	34974	Float	-19999...9999	☐	Display value of the upper scaling point. Depending on sensor type, the input value can be scaled to the required display value in the Parameter Level. The operator can change the display value of the upper scaling point, e.g. 20 mA is displayed as 12 [pH].
		1dP	9295					
		2dP	17487					
		3dP	25679					
t.F	r/w	base	1104	34976	Float	0...100	☐	Filter time constant [s]. Every input is fitted with a digital (software) low-pass filter for suppressing process-related disturbances on the input leads. Higher filter settings improve the suppression, but increase the delay of the input signals.
		1dP	9296					
		2dP	17488					
		3dP	25680					
b.F	r/w	base	1105	34978	Float	0...99999	☐	The filter bandwidth is used in a 1st order mathematical filter. The filter bandwidth is the adjustable tolerance around the measured value within which the filter is active. Measurement value changes in excess of the adjusted bandwidth are not filtered.
		1dP	9297					
		2dP	17489					
		3dP	25681					
E.tc	r/w	base	1106	34980	Float	0...100	☑	External temperature compensation (temperature at the junction of thermocouple/copper lead with external temperature compensation).
		1dP	9298					
		2dP	17490					
		3dP	25682					

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
InP.r	r	base	1170	35108	Float	-19999...9999	☐	Measurement value before the measurement value correction (unprocessed).
		1dP	9362					
		2dP	17554					
		3dP	25746					
Fail	r	base	1171	35110	Enum	*Enum_InpFail*		Input circuit fault: faulty or incorrectly connected sensor.
		1dP	9363					
		2dP	17555					
		3dP	25747					

0	no error
1	sensor break
2	Incorrect polarity at input.
4	Short circuit at input.

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
InP	r	base	1172	35112	Float	-19999...9999	☐	Measurement value after the measurement value correction (e.g. with offset or 2-point correction, and scaling).
		1dP	9364					
		2dP	17556					
		3dP	25748					
F.Inp	r/w	base	1180	35128	Float	-19999...9999	☐	Forcing the value for an analog input INP. Forcing involves the external operation of an input. The instrument takes over the value at this input like a measurement value (preset value for inputs from a superordinate system, e.g. for a function test.)
		1dP	9372					
		2dP	17564					
		3dP	25756					

3 Lim

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Fnc.1	r/w	base	2150	37068	Enum	*Enum_Fcn*	Activation and adjustment of the limit value alarm (e.g. for input circuit monitoring), e.g. with/without storage.
		1dP	10342				
		2dP	18534				
		3dP	26726				

0	No limit value monitoring.
1	measured value monitoring. The alarm signal is generated, if the limit is exceeded. If the measured value is within the limits (including hysteresis) again, this alarm signal is resetted.
2	Measured value monitoring + alarm status latch. An alarm signal is generated, if the limit is exceeded. A latched alarm signal remains latched until it is manually resetted.
3	Signal monitoring for rate of change (per minute).
4	Signal monitoring for rate of change (per minute) + storage of the alarm status.

3 Lim

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Src.1	r/w	base	2151	37070	Enum	*Enum_Src*	Source for limit value. Selection of which value is to be monitored.
		1dP	10343				
		2dP	18535				
		3dP	26727				

0	Process value = absolute alarm
1	control deviation xw (process value - set-point) = relative alarm Note: Monitoring with the effective set-point Weff. For example using a ramp it is the changing set-point, not the target set-point of the ramp.
2	Control deviation Xw (= relative alarm) with suppression during start-up and setpoint changes. Limit value monitoring is continued as soon as the control deviation comes within the alarm limits again, at the latest after 10 * Tn.
3	Measured value of the analog input INP1.
6	effective set-point Weff. For example the ramp-function changes the effective set-point untill it matches the internal (target) set-point.
7	correcting variable y (controller output)
11	Control deviation Xw (= relative alarm) with suppression during start-up and setpoint change. Limit value monitoring is continued as soon as the control deviation comes within the alarm limits again.

PArA

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
L.1	r/w	base	2100	36968	Float	-19999...99999	☑	Lower limit value. The alarm is triggered if the value falls below the limit, and is reset with lower limit value plus hysteresis.
		1dP	10292					
		2dP	18484					
		3dP	26676					
H.1	r/w	base	2101	36970	Float	-19999...99999	☑	Upper limit value. The alarm is triggered if the value rises above the limit, and is reset with upper lower limit value plus hysteresis.
		1dP	10293					
		2dP	18485					
		3dP	26677					
HYS.1	r/w	base	2102	36972	Float	0...99999	☐	Hysteresis of the limit value. Switching difference for upper and lower limit value. The limit value must change by this amount (rise above upper limit or fall below lower limit) before the limit value alarm is reset.
		1dP	10294					
		2dP	18486					
		3dP	26678					
dEL.1	r/w	base	2103	36974	Float	0...99999	☐	Delayed alarm of a limit value. The alarm is only triggered after the defined delay time. It is only indicated, and possibly stored, if it is still present after the delay time has elapsed.
		1dP	10295					
		2dP	18487					
		3dP	26679					

3 Lim

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
St.Lim	r	base	2170	37108	Enum	*Enum_LimStatus*	Limit value status: No alarm present or stored.
		1dP	10362				
		2dP	18554				
		3dP	26746				

0	no alarm
1	latched alarm
2	A limit value has been exceeded.

4 Lim2

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Fnc.2	r/w	base	2250	37268	Enum	*Enum_Fcn*	Activation and adjustment of the limit value alarm (e.g. for input circuit monitoring), e.g. with/without storage.
		1dP	10442				
		2dP	18634				
		3dP	26826				

0	No limit value monitoring.
1	measured value monitoring. The alarm signal is generated, if the limit is exceeded. If the measured value is within the limits (including hysteresis) again, this alarm signal is resetted.
2	Measured value monitoring + alarm status latch. An alarm signal is generated, if the limit is exceeded. A latched alarm signal remains latched until it is manually resetted.
3	Signal monitoring for rate of change (per minute).
4	Signal monitoring for rate of change (per minute) + storage of the alarm status.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Src.2	r/w	base	2251	37270	Enum	*Enum_Src*	Source for limit value. Selection of which value is to be monitored.
		1dP	10443				
		2dP	18635				
		3dP	26827				

0	Process value = absolute alarm
1	control deviation xw (process value - set-point) = relative alarm Note: Monitoring with the effective set-point Weff. For example using a ramp it is the changing set-point, not the target set-point of the ramp.
2	Control deviation Xw (= relative alarm) with suppression during start-up and setpoint changes. Limit value monitoring is continued as soon as the control deviation comes within the alarm limits again, at the latest after 10 * Tn.
3	Measured value of the analog input INP1.
6	effective set-point Weff. For example the ramp-function changes the effective set-point untill it matches the internal (target) set-point.
7	correcting variable y (controller output)
11	Control deviation Xw (= relative alarm) with suppression during start-up and setpoint change. Limit value monitoring is continued as soon as the control deviation comes within the alarm limits again.

4 Lim2

PArA

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
L.2	r/w	base 1dP 2dP 3dP	2200 10392 18584 26776	37168	Float	-19999...99990	☑	Lower limit value. The alarm is triggered if the value falls below the limit, and is reset with lower limit value plus hysteresis.
H.2	r/w	base 1dP 2dP 3dP	2201 10393 18585 26777	37170	Float	-19999...99990	☑	Upper limit value. The alarm is triggered if the value rises above the limit, and is reset with upper lower limit value plus hysteresis.
HYS.2	r/w	base 1dP 2dP 3dP	2202 10394 18586 26778	37172	Float	0...99999	☐	Hysteresis of the limit value. Switching difference for upper and lower limit value. The limit value must change by this amount (rise above upper limit or fall below lower limit) before the limit value alarm is reset.
dEL.2	r/w	base 1dP 2dP 3dP	2203 10395 18587 26779	37174	Float	0...99999	☐	Delayed alarm of a limit value. The alarm is only triggered after the defined delay time. It is only indicated, and possibly stored, if it is still present after the delay time has elapsed.

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
St.Lim	r	base 1dP 2dP 3dP	2270 10462 18654 26846	37308	Enum	*Enum_LimStatus*	Limit value status: No alarm present or stored.

0	no alarm
1	latched alarm
2	A limit value has been exceeded.

5 Lim3

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Fnc.3	r/w	base 1dP 2dP 3dP	2350 10542 18734 26926	37468	Enum	*Enum_Fcn*	Activation and adjustment of the limit value alarm (e.g. for input circuit monitoring), e.g. with/without storage.

0	No limit value monitoring.
1	measured value monitoring. The alarm signal is generated, if the limit is exceeded. If the measured value is within the limits (including hysteresis) again, this alarm signal is resetted.
2	Measured value monitoring + alarm status latch. An alarm signal is generated, if the limit is exceeded. A latched alarm signal remains latched until it is manually resetted.
3	Signal monitoring for rate of change (per minute).
4	Signal monitoring for rate of change (per minute) + storage of the alarm status.

5 Lim3

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Src.3	r/w	base 1dP 2dP 3dP	2351 10543 18735 26927	37470	Enum	*Enum_Src*	Source for limit value. Selection of which value is to be monitored.

0	Process value = absolute alarm
1	control deviation xw (process value - set-point) = relative alarm Note: Monitoring with the effective set-point Weff. For example using a ramp it is the changing set-point, not the target set-point of the ramp.
2	Control deviation Xw (= relative alarm) with suppression during start-up and setpoint changes. Limit value monitoring is continued as soon as the control deviation comes within the alarm limits again, at the latest after 10 * Tn.
3	Measured value of the analog input INP1.
6	effective set-point Weff. For example the ramp-function changes the effective set-point untill it matches the internal (target) set-point.
7	correcting variable y (controller output)
11	Control deviation Xw (= relative alarm) with suppression during start-up and setpoint change. Limit value monitoring is continued as soon as the control deviation comes within the alarm limits again.

PArA

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
dEL.3	r/w	base 1dP 2dP 3dP	2303 10495 18687 26879	37374	Float	0...99999	☐	Delayed alarm of a limit value. The alarm is only triggered after the defined delay time. It is only indicated, and possibly stored, if it is still present after the delay time has elapsed.
L.3	r/w	base 1dP 2dP 3dP	2300 10492 18684 26876	37368	Float	-19999...99999	☑	Lower limit value. The alarm is triggered if the value falls below the limit, and is reset with lower limit value plus hysteresis.
H.3	r/w	base 1dP 2dP 3dP	2301 10493 18685 26877	37370	Float	-19999...99999	☑	Upper limit value. The alarm is triggered if the value rises above the limit, and is reset with upper lower limit value plus hysteresis.
HYS.3	r/w	base 1dP 2dP 3dP	2302 10494 18686 26878	37372	Float	0...99999	☐	Hysteresis of the limit value. Switching difference for upper and lower limit value. The limit value must change by this amount (rise above upper limit or fall below lower limit) before the limit value alarm is reset.

5 Lim3

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
St.Lim	r	base	2370	37508	Enum	*Enum_LimStatus*	Limit value status: No alarm present or stored.
		1dP	10562				
		2dP	18754				
		3dP	26946				

0	no alarm
1	latched alarm
2	A limit value has been exceeded.

6 LOGI

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
L_r	r/w	base	1051	34870	Enum	*Enum_dInP1*	Local / remote switchover (Remote: Adjustment of all values via the front panel is blocked).
		1dP	9243				
		2dP	17435				
		3dP	25627				

0	no function (switch-over via interface is possible)
1	always active
2	Digital Input DI1 switches
3	DI2 switches (only visible with OPTION)
4	DI3 switches (only visible with OPTION)

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Err.r	r/w	base	1052	34872	Enum	*Enum_dInP4*	Source of the control signal for resetting all stored entries in the error list (the list contains all error messages and alarms). If an alarm is still present, i.e. the source of trouble has not been remedied, stored alarms cannot be acknowledged (reset).
		1dP	9244				
		2dP	17436				
		3dP	25628				

0	no function (switch-over via interface is possible)
2	Digital Input DI1 switches
3	DI2 switches (only visible with OPTION)
4	DI3 switches (only visible with OPTION)
5	F-key switches.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
tArA	r/w	base	1053	34874	Enum	*Enum_dInP4*	Signal source for activating the 'Tare' function
		1dP	9245				
		2dP	17437				
		3dP	25629				

0	no function (switch-over via interface is possible)
2	Digital Input DI1 switches
3	DI2 switches (only visible with OPTION)
4	DI3 switches (only visible with OPTION)
5	F-key switches.

6 LOGI

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
HOLd	r/w	base	1054	34876	Enum	*Enum_dInP4*	Signal source for activating the Sample&hold function
		1dP	9246				
		2dP	17438				
		3dP	25630				

0	no function (switch-over via interface is possible)
2	Digital Input DI1 switches
3	DI2 switches (only visible with OPTION)
4	DI3 switches (only visible with OPTION)
5	F-key switches.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
rES.L	r/w	base	1055	34878	Enum	*Enum_dInP4*	Signal source for aktivating the function Reset of minimum value
		1dP	9247				
		2dP	17439				
		3dP	25631				

0	no function (switch-over via interface is possible)
2	Digital Input DI1 switches
3	DI2 switches (only visible with OPTION)
4	DI3 switches (only visible with OPTION)
5	F-key switches.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
rES.H	r/w	base	1056	34880	Enum	*Enum_dInP4*	Signal source for activating the function Reset of maximum value
		1dP	9248				
		2dP	17440				
		3dP	25632				

0	no function (switch-over via interface is possible)
2	Digital Input DI1 switches
3	DI2 switches (only visible with OPTION)
4	DI3 switches (only visible with OPTION)
5	F-key switches.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
di.Fn	r/w	base	1050	34868	Enum	*Enum_diFn*	Function of digital inputs (valid for all inputs)
		1dP	9242				
		2dP	17434				
		3dP	25626				

0	Basic setting 'Off': A permanent positive signal switches this function 'On', which is connected to the digital input. Removal of the signal switches the function 'Off' again.
1	Basic setting 'On': A permanent positive signal switches this function 'Off', which is connected to the digital input. Removal of the signal switches the function 'On' again.
2	Push-button function. Basic setting 'Off'. Only positive signals are effective. The first positive signal switches 'On'. Removal of the signal is necessary before the next positive signal can switch 'Off'.

6 LOGI

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
St.Di	r	base 1dP 2dP 3dP	1070 9262 17454 25646	34908	Mask	0...7	☐	Status of the digital inputs or of push-buttons (binary coded).
						Bit 0 Input 1 Bit 1 Input 2 Bit 2 Input 3 Bit 8 Status of 'F' key Bit 9 Status of 'A/M' key Bit 10 Status of 'Sel' key Bit 11 Status of 'Down' key Bit 12 Status of 'Up' key Bit 13 Status of 'Loc' key		
L-R	r/w	base 1dP 2dP 3dP	1080 9272 17464 25656	34928	Int	0...1	☐	Remote operation. Remote means that all values can only be adjusted via the interface. Adjustments via the front panel are blocked.
Err.r	r/w	base 1dP 2dP 3dP	1081 9273 17465 25657	34930	Int	0...1	☐	Signal for resetting the entire error list. The error list contains all errors that are reported, e.g. device faults and limit values. It also contains queued as well as stored errors after their correction. The reset acknowledges all errors, whereby queued errors will reappear after the next error detection (measurement).
tArA	r/w	base 1dP 2dP 3dP	1082 9274 17466 25658	34932	Int	0...1	☐	The positiv signal (=1) activates the tare function. Switching on the tare function sets the instantaneous input value to zero and measurement is continued with this offset. By switching off the tare function, the actual measurement value is displayed again.
HOLd	r/w	base 1dP 2dP 3dP	1083 9275 17467 25659	34934	Int	0...1	☐	The positiv signal (=1) activates the hold function. With the sample & hold function activated, the measured value is held on the display. After de-activating the sample & hold function, the actual measurement value is displayed again.
rES.L	r/w	base 1dP 2dP 3dP	1084 9276 17468 25660	34936	Int	0...1	☐	Reset of minimum value. The positiv signal (=1) resets the minimum value.
rES.H	r/w	base 1dP 2dP 3dP	1085 9277 17469 25661	34938	Int	0...1	☐	Reset of maximum value. The positiv signal (=1) resets the maximum value.
F.Di	r/w	base 1dP 2dP 3dP	1094 9286 17478 25670	34956	Mask	0...7	☐	Forcing of digital inputs. Forcing involves the external operation of at least one input. The instrument takes over this input value (preset value for inputs from a superordinate system, e.g. for a function test.)
						Bit 0 Forcing of digital input 1 Bit 1 Forcing of digital input 2 Bit 2 Forcing of digital input 3 Bit 3 Forcing of digital input 4 Bit 4 Forcing of digital input 5		

7 ohnE

PArA

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
Conf	r/w	base 1dP 2dP 3dP	1 8193 16385 24577	32770	Int	0...2	☐	Start/Stop and abortion of the configuration mode 0 = End of configuration 1 = Start of configuration 2 = Abort configuration

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
UPD	r/w	base 1dP 2dP 3dP	95 8287 16479 24671	32958	Enum	*Enum_Aenderungsflag*		Status message indicating that parameter / configuration have been changed via the front panel.

0	No change via the front panel keys.
1	A change has been made via the front panel keys, which must be processed.

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
Hw.Opt	r	base 1dP 2dP 3dP	200 8392 16584 24776	33168	Int	0...65535	☑	
Sw.Op	r	base 1dP 2dP 3dP	201 8393 16585 24777	33170	Int	0...255	☐	Software version XY Major and Minor Release (e.g. 21 = Version 2.1). The software version specifies the firmware in the unit. For the correct interaction of E-Tool and device, it must match the operating version (OpVersion) in the E-Tool.
Bed.V	r	base 1dP 2dP 3dP	202 8394 16586 24778	33172	Int	0...255	☐	Operating version (numeric value). For the correct interaction of E-Tool and device, the software version and operating version must match.
Unit	r	base 1dP 2dP 3dP	203 8395 16587 24779	33174	Int	0...255	☐	Identification of the device.
S.Vers	r	base 1dP 2dP 3dP	204 8396 16588 24780	33176	Int	100...255	☐	The sub-version number is given as an additional index for precise definition of software version.

7 ohnE

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
St.Ala	r	base	250	33268	Mask	0...0	☐	Alarm status: Bit-wise coded status of the individual alarms, e.g. exceeded limit value or Loop.
		1dP	8442					
		2dP	16634					
		3dP	24826					

Bit 0 Existing/stored exceeded limit 1
Bit 1 Existing/stored exceeded limit 2
Bit 2 Existing/stored exceeded limit 3
Bit 3 Not used
Bit 4 Existing/stored loop alarm
Bit 5 Existing/stored heating current alarm
Bit 6 Existing/stored SSR alarm
Bit 7 Not used
Bit 8 Existing exceeded limit 1
Bit 9 Existing exceeded limit 2
Bit 10 Existing exceeded limit 3
Bit 11 Not used
Bit 12 Existing loop alarm
Bit 13 Existing heating current alarm
Bit 14 Existing SSR alarm
Bit 15 Not used

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
St.Do	r	base	251	33270	Mask	0...0	☐	Status of the digital outputs Bit 0 digital output 1 Bit 1 digital output 2 Bit 2 digital output 3 Bit 3 digital output 4 Bit 4 digital output 5 Bit 5 digital output 6
		1dP	8443					
		2dP	16635					
		3dP	24827					
St.Ain	r	base	252	33272	Mask	0...0	☐	Bit-coded status of the analog input (fault, e.g. short circuit)
		1dP	8444					
		2dP	16636					
		3dP	24828					

Bit 0 Break at Input 1
Bit 1 Reversed polarity at Input 1
Bit 2 Short circuit at Input 1
Bit 3 Not used
Bit 4 Break at Input 2
Bit 5 Reversed polarity at Input 2
Bit 6 Short-circuit at Input 2
Bit 7 Not used
Bit 8 Break at Input 3 (only KS 90)
Bit 9 Reversed polarity at Input 3 (only KS 90)
Bit 10 Short-circuit at Input 3 (only KS 90)
Bit 11 Not used

7 ohnE

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
St.Di	r	base	253	33274	Mask	0...0	☐	Status of the digital inputs or of push-buttons (binary coded).
		1dP	8445					
		2dP	16637					
		3dP	24829					
								Bit 0 Input 1 Bit 1 Input 2 Bit 2 Input 3 Bit 8 Status of 'F' key Bit 9 Status of 'A/M' key Bit 10 Status of 'Sel' key Bit 11 Status of 'Down' key Bit 12 Status of 'Up' key Bit 13 Status of 'Loc' key
F.Di	r/w	base	303	33374	Mask	0...0	☐	Forcing of digital inputs. Forcing involves the external operation of at least one input. The instrument takes over this input value (preset value for inputs from a superordinate system, e.g. for a function test.)
		1dP	8495					
		2dP	16687					
		3dP	24879					
								Bit 0 Forcing of digital input 1 Bit 1 Forcing of digital input 2 Bit 2 Forcing of digital input 3 Bit 3 Forcing of digital input 4 Bit 4 Forcing of digital input 5
F.Do	r/w	base	304	33376	Mask	0...0	☐	Forcing of digital outputs. Forcing involves the external operation of at least one output. The instrument has no influence on this output (use of free outputs by superordinate system).
		1dP	8496					
		2dP	16688					
		3dP	24880					

8 ohnE1

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
InP	r	base	232	33232	Float	-19999...9999 0	☐	Measurement value after the measurement value correction (e.g. with offset or 2-point correction, and scaling).
		1dP	8424					
		2dP	16616					
		3dP	24808					
InP.r	r	base	240	33248	Float	-19999...9999 0	☐	Measurement value before the measurement value correction (unprocessed).
		1dP	8432					
		2dP	16624					
		3dP	24816					
F.Inp	r/w	base	300	33368	Float	-19999...9999 0	☐	Forcing the value for an analog input INP. Forcing involves the external operation of an input. The instrument takes over the value at this input like a measurement value (preset value for inputs from a superordinate system, e.g. for a function test.)
		1dP	8492					
		2dP	16684					
		3dP	24876					

9 ohnE3

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
F.Out1	r/w	base	305	33378	Float	0...120	☐	Forcing value of the analog output. Forcing involves the external operation of an output, i.e. the instrument has no influence on this output. (Used for the operation of free outputs e.g. by a supervisory PLC.)
		1dP	8497					
		2dP	16689					
		3dP	24881					

10 othr

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
bAud	r/w	base	180	33128	Enum	*Enum_Baud*		Bit rate of the interface (only visible with OPTION). The bit rate determines the transmission speed.
		1dP	8372					
		2dP	16564					
		3dP	24756					

0	2400 Baud
1	4800 Baud
2	9600 Baud
3	19200 Baud
4	38.400 bits/s

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
Addr	r/w	base	181	33130	Int	1...247	☐	Address on the interface (only visible with OPTION)
		1dP	8373					
		2dP	16565					
		3dP	24757					
PrtY	r/w	base	182	33132	Enum	*Enum_Parity*		Parity of data on the interface (only visible with OPTION). Simple possibility of checking that transferred data is correct.
		1dP	8374					
		2dP	16566					
		3dP	24758					

0	No parity, with 2 stop bits.
1	even parity
2	odd parity
3	no parity (1 stop bit)

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
dELY	r/w	base	183	33134	Int	0...200	☐	Response delay [ms] (only visible with OPTION). Additional delay time before the received message may be answered on the Modbus. (Might be necessary, if the same line is used for transmit/receive.)
		1dP	8375					
		2dP	16567					
		3dP	24759					
Unit	r/w	base	170	33108	Enum	*Enum_Unit*		Physical unit (temperature), f.e.°C
		1dP	8362					
		2dP	16554					
		3dP	24746					

0	without unit
1	°C
2	°F

10 othr

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
dP	r/w	base	171	33110	Enum	*Enum_dP5*	Decimal point (max. no of decimals). Format of the measured value display.
		1dP	8363				
		2dP	16555				
		3dP	24747				

0	No decimal values
1	1 decimal value
2	2 decimal values
3	3 decimal values
4	4 decimal values

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
dISP	r/w	base	172	33112	Enum	*Enum_diSP5*	Format of the measured value display, in digits. In order to ensure a steady display, the value of the last displayed digit is defined by a multiple of the total selected number of display digits.Example with a resolution of 2 decimals:The measured value '1.234' is displayed as 1.23; with a 2-digit display it is 1.24; with a 5-digit display it is 1.25, and with 10 digits it is 1.20.
		1dP	8364				
		2dP	16556				
		3dP	24748				

1	Full display resolution.
2	Display resolution = 2 digits
3	Display resolution = 5 digits
4	Display resolution = 10 digits
5	Display resolution = 20 digits
6	Display resolution = 50 digits
7	Display resolution = 100 digits

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
C.dEL	r/w	base	184	33136	Int	0...200 ☐	For both interfaces, Modbus only. Additional acceptable delay time between 2 received bytes, before "end of message" is assumed. This time is needed if data is not transmitted continousely by the modem.
		1dP	8376				
		2dP	16568				
		3dP	24760				
FrEq	r/w	base	150	33068	Enum	*Enum_FrEq*	Switchover of the applied mains frequency 50 / 60 Hz, thereby better adaptation of the input filter for hum suppression.
		1dP	8342				
		2dP	16534				
		3dP	24726				

0	Mains frequency is 50 Hz.
1	Mains frequency is 60 Hz.

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
E.1	r/w	base	210	33188	Enum	*Defect*	Err 1 (internal error) Contact Service.
		1dP	8402				
		2dP	16594				
		3dP	24786				

0	No fault exists (Reset).
2	The device is defective.

10 othr

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
E.2	r/w	base 1dP 2dP 3dP	211 8403 16595 24787	33190	Enum	*Problem*	Err 2 (internal error, resettable) (As a process value via fieldbus interface not writable!)

0	No fault,	resetting possible (Reset).
1	A fault has occurred and has been stored.	

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
FbF.1	r/w	base 1dP 2dP 3dP	212 8404 16596 24788	33192	Enum	*Break*	Sensor break at input INP1. Typical causes and suggested remedies: Sensor fault: replace INP1 sensor. Wiring fault: check connections of INP1. (As a process value via fieldbus interface not writable!)

0	No fault,	resetting of the sensor break alarm possible (Reset).
1	The sensor fault alarm has been triggered and stored; the fault is no longer present. The operator must acknowledge the error message in order to delete it from the error list.	
2	Sensor break: The sensor is defective or there is a wiring fault.	

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Sht.1	r/w	base 1dP 2dP 3dP	213 8405 16597 24789	33194	Enum	*Short*	Short circuit at input INP1. Typical causes and suggested remedies: Sensor fault: replace INP1 sensor. Wiring fault: check connections of INP1. (As a process value via fieldbus interface not writable!)

0	No fault,	resetting of the short-circuit alarm possible (Reset).
1	A short-circuit fault has occurred and has been stored.	

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
POL.1	r/w	base 1dP 2dP 3dP	214 8406 16598 24790	33196	Enum	*Polarity*	Incorrect polarity at input INP1. Suggested remedy: reverse the polarity at INP1. (As a process value via fieldbus interface not writable!)

0	No fault, resetting of the incorrect polarity alarm possible (Reset).
1	An incorrect polarity fault has occurred and has been stored.
2	Incorrect polarity. The wiring of the input circuit is not correct.

10 othr

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
AdA.H	r/w	base 1dP 2dP 3dP	221 8413 16605 24797	33210	Enum	*Tune*	Error message from "heating" self-tuning and reason for aborted tuning attempt. Hints for trouble-shooting: Check operating sense of actuator. Is the loop closed? Is there an output limit? Adapt the setpoint. Increase step output for Yopt. (As a process value via fieldbus interface not writable!)

0	no error
3	Process responds in the wrong direction. Possible remedy: Check the output signal sense (inverse <-> direct), and re-configure the controller if necessary (inverse <-> direct).
4	No response from the process. Perhaps the control loop is open. Possible remedy: Check sensor, connections, and process.
5	The process value turning point of the step response is too low. Possible remedy: Increase the permitted step output range, i.e. increase the parameter Y.Hi ('heating') or reduce the parameter Y.Lo ('cooling').
6	Self-tuning was aborted due to the risk of an exceeded setpoint. Possible remedy: Repeat the attempt with an increased setpoint reserve.
7	The step output change is not large enough (minimum change > 5 %). Possible remedy: Increase the permitted step output range, i.e. increase the parameter Y.Hi ('heating') or reduce the parameter Y.Lo ('cooling').
8	Setpoint reserve must be given before generating the step output change. Possible remedy: decrease set-point range, change set-point, or change process value.
9	The pulse response attempt has failed. No useful parameters were determined. Perhaps the control loop is open. Possible remedy: Check sensor, connections, and process.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
AdA.C	r/w	base 1dP 2dP 3dP	222 8414 16606 24798	33212	Enum	*Tune*	Error message from "cooling" self-tuning and reason for aborted tuning attempt. Hints for trouble-shooting: Check operating sense of actuator. Is the loop closed? Is there an output limit? Adapt the setpoint. Increase step output for Yopt. (As a process value via fieldbus interface not writable!)

0	no error
3	Process responds in the wrong direction. Possible remedy: Check the output signal sense (inverse <-> direct), and re-configure the controller if necessary (inverse <-> direct).
4	No response from the process. Perhaps the control loop is open. Possible remedy: Check sensor, connections, and process.
5	The process value turning point of the step response is too low. Possible remedy: Increase the permitted step output range, i.e. increase the parameter Y.Hi ('heating') or reduce the parameter Y.Lo ('cooling').
6	Self-tuning was aborted due to the risk of an exceeded setpoint. Possible remedy: Repeat the attempt with an increased setpoint reserve.
7	The step output change is not large enough (minimum change > 5 %). Possible remedy: Increase the permitted step output range, i.e. increase the parameter Y.Hi ('heating') or reduce the parameter Y.Lo ('cooling').
8	Setpoint reserve must be given before generating the step output change. Possible remedy: decrease set-point range, change set-point, or change process value.
9	The pulse response attempt has failed. No useful parameters were determined. Perhaps the control loop is open. Possible remedy: Check sensor, connections, and process.

10 othr

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Lim.1	r/w	base	223	33214	Enum	*Limit*	Limit value 1 exceeded. Hint for trouble-shooting: check the process. (As a process value via fieldbus interface not writable!)
		1dP	8415				
		2dP	16607				
		3dP	24799				

0	No fault,	resetting of the limit value alarm possible (Reset).
1	The limit value has been exceeded, and the fault has been stored.	
2	The limit value has been exceeded; the monitored (measurement) value is outside the set limits.	

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Lim.2	r/w	base	224	33216	Enum	*Limit*	Limit value 2 exceeded. Hint for trouble-shooting: check the process. (As a process value via fieldbus interface not writable!)
		1dP	8416				
		2dP	16608				
		3dP	24800				

0	No fault,	resetting of the limit value alarm possible (Reset).
1	The limit value has been exceeded, and the fault has been stored.	
2	The limit value has been exceeded; the monitored (measurement) value is outside the set limits.	

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Lim.3	r/w	base	225	33218	Enum	*Limit*	Limit value 3 exceeded. Hint for trouble-shooting: check the process. (As a process value via fieldbus interface not writable!)
		1dP	8417				
		2dP	16609				
		3dP	24801				

0	No fault,	resetting of the limit value alarm possible (Reset).
1	The limit value has been exceeded, and the fault has been stored.	
2	The limit value has been exceeded; the monitored (measurement) value is outside the set limits.	

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
InF.1	r/w	base	226	33220	Enum	*Time*	Message from the operating hours counter that the preset no. of hours for this maintenance period has been reached. The op-hours counter for the maintenance period is reset when this message is acknowledged. Counting the operating hours is used for preventive maintenance. - Acknowledge the error to reset it. (As a process value via fieldbus interface not writable!)
		1dP	8418				
		2dP	16610				
		3dP	24802				

0	No signal,	resetting of the time limit signal possible (Reset).
1	Operating hours - limit value (maintenance period) reached: please acknowledge.	

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
InF.2	r/w	base	227	33222	Enum	*Switch*	Message from the switching cycle counter that the preset no. of switch cycles for this maintenance period has been reached. The cycle counter for the maintenance period is reset when this message is acknowledged. Counting the switching cycles is used for preventive maintenance. - Acknowledge the error to reset it. (As a process value via fieldbus interface not writable!)
		1dP	8419				
		2dP	16611				
		3dP	24803				

0	No error message, resetting of the switching cycle counter possible (Reset).
1	Set limit of the switching cycle counter (maintenance period) has been reached: please acknowledge.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
E.4	r/w	base	228	33224	Enum	*Problem*	Hardware fault.Cause: Code number and hardware are not identical. Remedy: Contact Service. (As a process value via fieldbus interface not writable!)
		1dP	8420				
		2dP	16612				
		3dP	24804				

0	No fault,	resetting possible (Reset).
1	A fault has occurred and has been stored.	

11 Out.1

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
O.Act	r/w	base 1dP 2dP 3dP	4150 12342 20534 28726	41068	Enum	*Enum_OAct*	Operating sense of the switching output. Direct: Active function (e.g. limit value) switches the output ON; Inverse: Active function (e.g. limit value) switches the output OFF.
						0	direct / normally open
						1	inverse / normally closed
Y.1	r/w	base 1dP 2dP 3dP	4151 12343 20535 28727	41070	Enum	*Enum_Y1*	Output function: Controller output Y1
						0	not active
						1	This output provides the controller output Y1.
Lim.1	r/w	base 1dP 2dP 3dP	4153 12345 20537 28729	41074	Enum	*Enum_Lim1*	Output function: Signal limit 1
						0	not active
						1	The output is activated by an alarm from limit value 1.
Lim.2	r/w	base 1dP 2dP 3dP	4154 12346 20538 28730	41076	Enum	*Enum_Lim2*	Output function: Signal limit 2
						0	not active
						1	The output is activated by an alarm from limit value 2.
Lim.3	r/w	base 1dP 2dP 3dP	4155 12347 20539 28731	41078	Enum	*Enum_Lim3*	Output function: Signal limit 3
						0	not active
						1	The output is activated by an alarm from limit value 3.
FAi.1	r/w	base 1dP 2dP 3dP	4162 12354 20546 28738	41092	Enum	*Enum_FAi1*	Output function: Signal INP1 fault. The fail signal is generated, if a fault occurs at the analog Input INP1.
						0	not active
						1	The output sends the error message 'INP1 fault'.

11 Out.1

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Out1	r	base 1dP 2dP 3dP	4180 12372 20564 28756	41128	Enum	*Enum_Ausgang*	Status of the digital output

0	off
1	on

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
F.Do1	r/w	base 1dP 2dP 3dP	4181 12373 20565 28757	41130	Enum	*Enum_Ausgang*	Forcing of this digital output. Forcing involves the external operation of an output. The instrument has no influence on this output (use of free outputs by superordinate system).

0	off
1	on

12 Out.2

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
O.Act	r/w	base 1dP 2dP 3dP	4250 12442 20634 28826	41268	Enum	*Enum_OAct*	Operating sense of the switching output. Direct: Active function (e.g. limit value) switches the output ON; Inverse: Active function (e.g. limit value) switches the output OFF.

0	direct / normally open
1	inverse / normally closed

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Y.1	r/w	base 1dP 2dP 3dP	4251 12443 20635 28827	41270	Enum	*Enum_Y1*	Output function: Controller output Y1

0	not active
1	This output provides the controller output Y1.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Lim.1	r/w	base 1dP 2dP 3dP	4253 12445 20637 28829	41274	Enum	*Enum_Lim1*	Output function: Signal limit 1

0	not active
1	The output is activated by an alarm from limit value 1.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Lim.2	r/w	base 1dP 2dP 3dP	4254 12446 20638 28830	41276	Enum	*Enum_Lim2*	Output function: Signal limit 2

0	not active
1	The output is activated by an alarm from limit value 2.

12 Out.2

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Lim.3	r/w	base	4255	41278	Enum	Enum_Lim3	Output function: Signal limit 3
		1dP	12447				
		2dP	20639				
		3dP	28831				

0	not active
1	The output is activated by an alarm from limit value 3.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
FAi.1	r/w	base	4262	41292	Enum	Enum_FAi1	Output function: Signal INP1 fault. The fail signal is generated, if a fault occurs at the analog Input INP1.
		1dP	12454				
		2dP	20646				
		3dP	28838				

0	not active
1	The output sends the error message 'INP1 fault'.

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Out2	r	base	4280	41328	Enum	Enum_Ausgang	Status of the digital output
		1dP	12472				
		2dP	20664				
		3dP	28856				

0	off
1	on

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
F.Do2	r/w	base	4281	41330	Enum	Enum_Ausgang	Forcing of this digital output. Forcing involves the external operation of an output. The instrument has no influence on this output (use of free outputs by superordinate system).
		1dP	12473				
		2dP	20665				
		3dP	28857				

0	off
1	on

13 Out.3

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
O.tYP	r/w	base	4370	41508	Enum	Enum_OtYP	Signal type selection OUT
		1dP	12562				
		2dP	20754				
		3dP	28946				

0	Relay / logic
1	0 ... 20 mA continuous
2	4 ... 20 mA continuous
3	0...10 V continuous
4	2...10 V continuous
5	transmitter supply

13 Out.3

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
O.Act	r/w	base 1dP 2dP 3dP	4350 12542 20734 28926	41468	Enum	*Enum_OAct*	Operating sense of the switching output. Direct: Active function (e.g. limit value) switches the output ON; Inverse: Active function (e.g. limit value) switches the output OFF.

0	direct / normally open
1	inverse / normally closed

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Y.1	r/w	base 1dP 2dP 3dP	4351 12543 20735 28927	41470	Enum	*Enum_Y1*	Output function: Controller output Y1

0	not active
1	This output provides the controller output Y1.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Lim.1	r/w	base 1dP 2dP 3dP	4353 12545 20737 28929	41474	Enum	*Enum_Lim1*	Output function: Signal limit 1

0	not active
1	The output is activated by an alarm from limit value 1.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Lim.2	r/w	base 1dP 2dP 3dP	4354 12546 20738 28930	41476	Enum	*Enum_Lim2*	Output function: Signal limit 2

0	not active
1	The output is activated by an alarm from limit value 2.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Lim.3	r/w	base 1dP 2dP 3dP	4355 12547 20739 28931	41478	Enum	*Enum_Lim3*	Output function: Signal limit 3

0	not active
1	The output is activated by an alarm from limit value 3.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
FAi.1	r/w	base 1dP 2dP 3dP	4362 12554 20746 28938	41492	Enum	*Enum_FAi1*	Output function: Signal INP1 fault. The fail signal is generated, if a fault occurs at the analog Input INP1.

0	not active
1	The output sends the error message 'INP1 fault'.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Out.0	r/w	base 1dP 2dP 3dP	4371 12563 20755 28947	41510	Float	-19999...9999 ☐	Lower scaling limit of the analog output (corresponds to 0%). If current and voltage signals are used as output values, the display can be scaled to the output value in the Parameter Level. The output value of the lower scaling point is indicated in the respective electrical unit (mA / V).

13 Out.3

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Out.1	r/w	base 1dP 2dP 3dP	4372 12564 20756 28948	41512	Float	-19999...99990 ☐	Upper scaling limit of the analog output (corresponds to 100%). If current and voltage signals are used as output values, the display can be scaled to the output value in the Parameter Level. The output value of the upper scaling point is indicated in the respective electrical unit (mA / V).
O.Src	r/w	base 1dP 2dP 3dP	4373 12565 20757 28949	41514	Enum	*Enum_OSrc*	Signal source of the analog output (visible not with all output signal types O.TYP).

0	not used
1	Controller output y1 (continuous)
3	process value
4	The effective setpoint Weff, which is used for control. Example: The gradient changes the effective setpoint until it reaches the internal (target) setpoint.
5	control deviation xw (process value - set-point)= relative alarm Note: Monitoring with the effective set-point Weff. For example using a ramp it is the changing set-point, not the target set-point of the ramp.

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
O.FAI	r/w	base 1dP 2dP 3dP	4374 12566 20758 28950	41516	Enum	*Enum_OFail*	fail behaviour

0	upscale
1	downscale

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
Out1	r	base 1dP 2dP 3dP	4380 12572 20764 28956	41528	Enum	*Enum_Ausgang*	Status of the digital output

0	off
1	on

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
F.Do1	r/w	base 1dP 2dP 3dP	4381 12573 20765 28957	41530	Enum	*Enum_Ausgang*	Forcing of this digital output. Forcing involves the external operation of an output. The instrument has no influence on this output (use of free outputs by superordinate system).

0	off
1	on

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
F.Out1	r/w	base 1dP 2dP 3dP	4382 12574 20766 28958	41532	Float	0...120 ☐	Forcing value of the analog output. Forcing involves the external operation of an output, i.e. the instrument has no influence on this output. (Used for the operation of free outputs e.g. by a supervisory PLC.)

14 SEtP

Signal

Name	r/w	Adr. Integer		real	Typ	Value/off		Description
SP.EF	r	base 1dP 2dP 3dP	3170 11362 19554 27746	39108	Float	-19999...9999 0	☐	Effective setpoint. The value reached at the end of setpoint processing, after taking W2, external setpoint, gradient, boost function, programmer settings, start-up function, and limit functions into account. Comparison with the effective process value leads to the control deviation, from which the necessary controller response is derived.
SP	r/w	base 1dP 2dP 3dP	3180 11372 19564 27756	39128	Float	-19999...9999 0	☐	Setpoint for the interface (without the additional function 'Controller off'). SetpInterface acts on the internal setpoint before the setpoint processing stage. Note: The value in RAM is always updated. To protect the EEPROM, storage of the value in the EEPROM is timed (at least one value per half hour).

15 Tool

ConF

Name	r/w	Adr. Integer		real	Typ	Value/off	Description
U.LinT	r/w	base 1dP 2dP 3dP	634 8826 17018 25210	34036	Enum	*Enum_Unit*	Engineering unit of linearization table (temperature).

0	without unit
1	°C
2	°F

9499-040-70111

Subject to alterations without notice
Änderungen vorbehalten
Sous réserve de toutes modifications

P.O.B. 310 229, D-34058 Kassel, Germany
Printed in Germany 9499-040-70111 (02/2005)

A4, unibind, SW-Druck, 80g[2] weiß