Data Sheet
10/11-3.20 EN

Temperature Transmitter TEU421, TEU421-Ex

intelligent, four-wire

- **Input/sensor connection**
  - Resistance thermometers (2-, 3-, 4-wire circuit)
  - Thermocouples without, with internal/external reference junction)
  - Resistance remote signalling unit
  - Ω-, mV-, mA-, V sensors
- **Output**
  - 0/4...20 mA
  - 0...10 V
- **Digital interface for communication**
  - LKS (lokal communication interface, parameter setting at the factory)
  - FSK (remote parameter setting, bus operation)
- **Digital, low-drift measured-value processing**
- **19“ plug-in card with 4T mounting width**
- **Surface-mounting case IP 20**
- **Field enclosure IP 65**
- **1 or 2 channels**
- **Continuous sensor and self-monitoring**
- **Default value strategy in the event of faults**
- **1 or 2 relay outputs for fault or alarm value signalling**
- **Explosion protection**
  - intrinsically safe [EEx ia] IIC bzw. [EEx ib] IIC
- **Elektromagnetic compatibility (EMC)**
  - General interference immunity to NAMUR recommendation
- **Test socket for the output**
- **Electrical isolation**



HART® FIELD COMMUNICATIONS PROTOCOL

Technical data

Function and system design

The temperature transmitter transforms the singal coming from the sensor into a load-independent direct current or voltage signal.

The input signals are led to the measuring point selector switch MUX via the input protection circuit. The standard input variables (mV, Ω, V, mA) are matched to the input voltage range of the aplifier by means of a filter network..

The pulse-width modulator PWM converts the voltage coming from the amplifier into a pulse-pause ratio. Correction values for the zero and slope are determined from the test measurements (zero and reference voltage) and are stored. The (sensor) break monitoring checks the sensor impedance for a maximum value. The CPU fulfils serveral tasks.

Routines
- of the monitoring (dead man, watchdog),
- of the A/D converter (read-in, validity check, ...),
- of the communication (read, write),
- of the measured value processing (linearization, damping, ...)

are called up one after the other.

The ROM contains the firmware of the transmitter.

The EEPROM contains all user-specific parameter setting data (e. g. measuring range, linearization, tag number, etc.). The EEPROM also contains data concerning the transmitter only, e. g. deviations from the reference voltage or the serial number.

In addition, 3 LEDs and 2 relays can be activated.

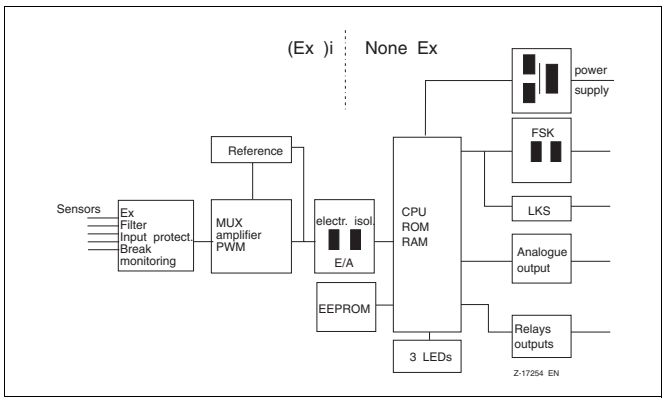


Bild 1: Functional diagram

Electrical power is supplied via a transformer with an electrically isolated output voltage.

For communicating with the PC either
- the LKS interface (3 V CMOS) or
- the FSK interface (electrically isolated) is used.

Via an A/D and a U/I converter the signal is made available to the analog output.

Functions modules

The function modules shown are configured via the Device Management Tool DSV4xx (SMART VISION) depending on the measuring tast. Im Device data window the „readable variables“ are displayed.

Measured value processing

Measuring range adjustment (measuring circuit, sensor selection); sensor break monitoring (break, short circuit), reference junction measurement for the internal reference junction temperature.

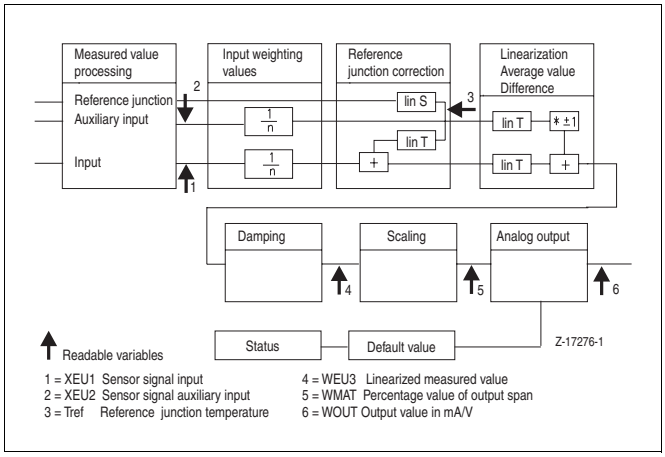


Bild 2: Function modules

Input weighting

Generation of average value in case of interconnecting several sensors at one input. Generation of sensor characteristics with the same basic data (e. g. Pt 1000 on the basis of the Pt 100 characteristics – 10 × Pt 100).

Reference junction correction

Correction of the measured value with the internal/external reference junction value in case of measuring with thermocouples.

Linearization/average value/difference

to standardized of customized characteristics (max. 32 tie-points); average and difference value generation of input and auxiliary input. The characteristics of the standardized sensors are stored in the transmitter.

Damping

Filter with 1st order delay.

Scalling

Lower-range value and upper-range value.

Analog output

Adjustment of the output signal for current/voltage, underranging/overranging, behaviour in case of a sensor/apparatus fault.

Binary signals

(Not shown in the figure). Aissignment LED 1+2, binary output 1+2 for signalling of sensor fault, apparatus fault, alarm value

Input

Measuring types

Single: 1 sensor at input
Average value: 1 sensor at input and 1 sensor at auxillary input
orr 2...10 sensors in serie at input
Difference: 1 sensor at input and 1 s at auxillary input
(Average value, difference only for Ω -, mV sources)

Measuring circuit (MK) combinations – can be switched over

	Full modulation	Min. span
MK 41	0...391 Ω –8...+120 mV	6.7 Ω 2 mV
MK 42	0...3250 Ω –8...+120 mV	58 Ω 2 mV
MK 44	–0.8...+12 V	0.5 V
MK 45	–1.6...+24 mA	1 mA

Measuring range

Can be parameterized

Measuring current

MK 41: approx. 0.29 mA
MK 42: approx. 35 µA

Input resistance

MK 44: 100 kΩ
MK 45: 5 Ω

Overload limit[1)]

Thermocouple, mV measurement (MK 41/42):
–0.5...+3.5 V
Resistance thermometer and resistance measurement
(MK 41, MK 42):
Open or short-circuited input permitted
Voltage measurement (MK 44):
–50...+100 V
Current measurement (MK 45):
–100...100 mA

Sensor monitoring

mV measurement:
Break: response threshold > 1.5 MΩ
or gradient < -3 mV/s / gradient > +3 mV/s
or < -8mV / > +120 mV

Ω measurement

Response thresh. in case of sensor break: MK 41: > 391 Ω
MK 42: > 3250 Ω
Response threshold in case of short circuit: < 5 Ω

Line resistance

(R_m = measuring resistance; R_L = line resistance of one wire)
2 wire circuit:
10 Ω max. for both wires
For MK 41 (average value, difference):
$R_{m1} + (2R_{L1}) + R_{m2} + (2R_{L2}) < 415\ \Omega$
3 wire ciruit:
10 Ω max. per wire
4 wire circuit:
50 Ω max. per wireje Ader
For MK 41: $(R_m + R_L) < 415\ \Omega$

Internal reference junction

Separate input for Pt 100 in 2-wire circuit

[1)] Observe EC-Type-Examination certificate for TEU 421-Ex

Linearization

on the basis of DIN IEC standard characteristics
Resistance thermometers Pt 100, Ni 100
(Extended to e. g. Pt 1000, Ni 50, by means of weighting
Pt 100, Ni 100)
Thermocouples of type B, E, J, K, L, N, R, S, T, U
or customized (32 tiepoints max.)

Max. permitted potential

230 V AC[1)]

Output

Output signal (direct/reserve action)

0/4...20 mA (open output permitted)
Load ≤ 750 Ω (test jack not active)[2)]
≤ 750 Ω (test jack active – standard)
0...10 V (short-circuit proof)
Load > 10 kΩ

Residual ripple

≤ 0,5 %

Max. permitted potential

50 V AC

Full modulation range (can be parameterized)

Underranging: –0.2...0/4 mA (test jack not active)[2)]
–0.1...0/4 mA (test jack active)
–0.1...0 V
Overranging: 20...23.6 mA
20...22 mA (for a load ≥ 600 Ω or
2 binary output)
10...11.8 V
10...11 V (for 2 binary outputs)

Output behaviour in the even of a fault

Fault: Sensor fault or Sensor/apparatus fault
Underranging (= adjusted underranging)
Overranging (= adjusted overranging)
Default value (parameterizable –0.2...23.6 mA, –0.1...11.8 V)[3)]
Hold last valid value

Binary outputs

1 or 2 relays with changeover contact

Switching capacity

P_{max} = 10 W, 10 VA, cosφ ≥ 0.7

Switching current

$I_{UC\ max.}$ = 0.5 A

Switching voltage

$U_{UC\ max.}$ = 50 V

Damping

Filter with 1st order delay (t = 0 s; 0.9...100 s)

Adjusted time constant τ	Response time T
0 s	typisch 0.8 s (max. 1 s)
0.9 s	ca. 2.7 s
1 s	ca. 3.3 s
1.5 s	ca. 5.8 s
2 s	ca. 8.2 s
> 5 s	1 + 4.6 × τ

[2)] Test jack bridged
[3)] Can also be parameterized via the adjusted modulation range
(e. g. for over-/underranging signal)

Interfaces

Local communication interface (LKS)
For parameter setting at the factory
(Power supply from PC)

Frequency Shift Keying (FSK)
For remote parameter setting and bus operation

Data format
HART protokoll

Power supply

Voltage
24 V UC
115 V AC
230 V AC (can be switched over to 24 V UC)[1)]

Alternating voltage
–15 %...+ 10 %, 48...62 Hz

Direct voltage
18...33 V

Residual ripple
≤ 20 % within tolerance range

Power consumption
24 V UC: approx. 1.2 W, 1.5 VA
115 V AC: approx. 2 W, 5 VA
230 V AC: approx. 2 W, 8 VA

Characteristics at rated conditions (acc. to IEC 770)

(MW = measured value; K1, K2, K3 see table)
(Examples of calculation, see Data Sheet 11-1.02 EN)

Measuring deviation (referred to set span)
0.1 % × MW + 0.1 % + K1
Additional error for internal reference junction: 0.25 K
Additional error MK 44, MK 45: 0.1 % × MV

	K1	K2	K3
Ω (MK 41)	80 mΩ	20 mΩ	10 mΩ
Ω (MK 42)	0.75 Ω	0.2 Ω	0.09 Ω
mV (MK 41/42)	10 µV	5 µV	2 µV
V (MK 44)	1 mV	0.5 mV	0.2 mV
mA (MK 45)	2 µA	1 µA	0.4 µA
Resistance thermometer (MK 41)	0.25 K	0.05 K	0.063 K
Resistance thermometer (MK 42)	0.25 K	0.05 K	0.1 K
Thermocouple > –150 °C, except for Type B (MK 41/MK 42)	10 µV[2)]+0.2 K	10 µV[2)] or 0.2 K (larger value applies)	2 µV[2)]
Thermocouple Type E, K, N, T –250...–150 °C Type B > 300 °C (MK 41/MK 42)	10 µV[2)]+0.6 K	10 µV[2)] or 0.6 K (larger value applies)	2 µV[2)]

[1)] Compliance with NAMUR guideline on mains interruption only applies to 230 V AC
[2)] Use temperature corresponding to the slope of 10 µV or 2 µV

Non-conformity (contained in measuring deviation)
0.1 % + K2

Effects

Ambient temperature (referred to set span)
(0.05 % × MV + 0.05 % + K3)/10 K
In case of internal reference junction additionally 0.1 K / 10 K

Power supply (referred to set span)
< 0.05 % with 10 % voltage change
< 0.05 % with 48...62 Hz frequency change

Effects in the output (referred to output span)
With current ≤ 0.1 % in load range 0...700 Ω
With voltage ≤ 0.1 % of 10 kΩ..∞

Parasitic voltage in the input (referred to set span)
50 Hz symmetrical
< 0.5 % with $U_{stör(ss)}$ = 0.3 × span (τ = 0 s)
(increased residual ripple)
< 0.5 % with $U_{stör(ss)}$ = 4 × span (τ ≥ 0.9 s)
50 Hz asymmetrical (up to $U_{eff.}$ = 250 V)
< 0.006 % × full modulation/span (τ ≥ 0.9 s)
< 0.05 % × full modulation/span (τ = 0 s)

DC component of fault voltage (up to U = 250 V)
< 0.006 % × full modulation/span (τ ≥ 0.9 s)
< 0,.5 % × full modulation/span (τ = 0 s)

Time behavior

Response time (damping not active)
Typically 0.8 s (1 s max.)

Electromagnetic compatibility (EMC)

acc. to DIN EN 61326

General interference immunity to NAMUR recommendation for:
– Mains supply tolerances
– Mains interruption (max. 1 relay active)

General and safety characteristics

Environment conditions

Climatic category
JSF to DIN 40040

Ambient temperature
–10...±20...+70 °C

Permitted ambient temperature of an equipped 19“ subrack with 4T module width
≤ 60 °C

Transportation and storage temperature:
–25...+85 °C

Relative humidity
≤ 75 %

Condensation
None

Mechanical stress

Tested to DIN IEC 68 Teil 2-27 and 68 Teil 2-6

Transport
Shock: 30 g/18 ms

During operation
Vibration:
2g/± 0.15 mm/5...150 Hz/3 × 5 cycles
2g/± 10 mm/1...35 Hz/3 × 1 cycle

Connections, housing, mounting

Electrical connections	32-pole blade connector to DIN IEC 41612, design D or F
Degree of protection to DIN 40050	IP 00
Class of protection to IEC 1010-1 (correspond to DIN EN 61010-1 and DIN VDE 0411 part 1)	I
Degree of contamination	II
Overvoltage category	II input/output; III mains
Test voltage to IEC 1010-1 (correspond to DIN EN 61010-1 and DIN VDE 0411 part 1)	Mains against inp./output 3.71 kV[1)] Input against output 3.71 kV Output against each other 0.75 kV Input/output/mains against protective conductor 1.5 kV
Material	Polycarbonate GR
Colour	RAL 7032
Position	Front panel vertical
Weight	Approx. 0.6 kg

[1)] Disconnect Y capacitors

Explosion protection

EC-Type-Examination certificate

single channel: PTB 04 ATEX 2062
two channel: PTB 04 ATEX 2064

Input circuit

Type of protection intrinsic safety
TEU 421-Ex.A: ⟨Ex⟩ II (1) GD [EEx ia] IIC / IIB or
TEU 421-Ex.B: ⟨Ex⟩ II (2) GD [EEx ib] IIC / IIB

Ambient temperature

19“ plug-in card: +70 °C max.
Surface-mounting case IP20: +55 °C max. (only single channel)

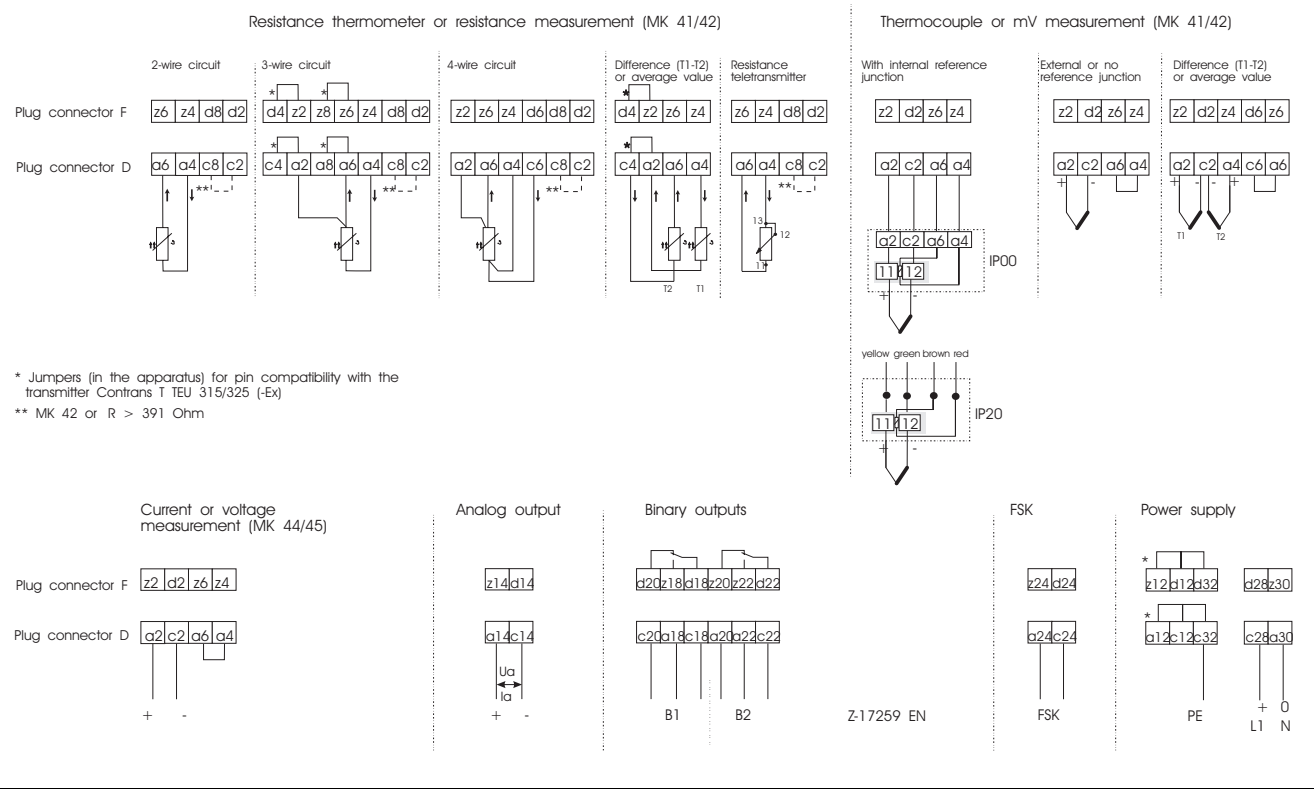
Mounting

Outside the hazardous area

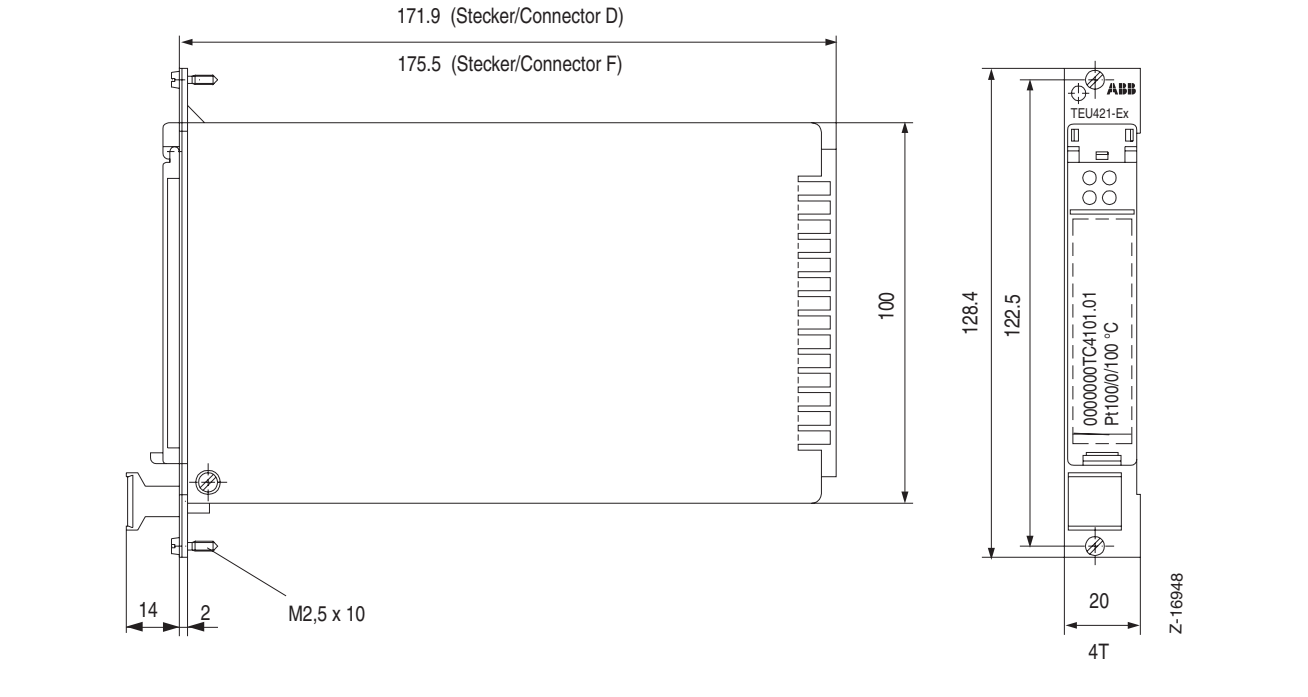
For maximum values and permitted connection data of the transmitter see Table

Maximum values of the transmitter	**Resistance measurement**		**Thermocouple-measurement**	
	Ex. A	**Ex. B**	**Ex. A**	**Ex. B**
R	1056 Ω	1056 Ω	1056 Ω	1056 Ω
U_O	8.9 V	8.9 V	8.9 V	8.9 V
I_K	23.9 mA	23.9 mA	23.9 mA	23.9 mA
P	160 mW	160 mW	160mW	160 mW
L_i	330 µH	500 µH	330 µH	500 µH
C_i	397 nF	500 nF	397 nF	500 nF
Perm. L_a } II B	2.1 mH	49,9 mH	see EC-Type-Examination certificate	
Perm. C_a } II B	2320 nF	69.5 µF		
Perm. L_a } II C	1.6 mH	49.9 mH		
Perm. C_a } II C	295 nF	6.5 µF		

Connection diagrams (single channel)



Dimensional drawings (dimensions in mm)



Ordering information

													Code		
Temperature Transmitter TEU421, TEU421-Ex				**V11421A-**											
Explosion protection															
None					1										
Input [EEx ib]					2										
Input [EEx ia]				1)	3										
Model															
19" plug-in card, single channel	with blade connector type D					1									
	with blade connector type F					3									
19" plug-in card, two channel	with blade connector type D					4									
	with blade connector type F					5									
Surface-mounting case IP 20	with 19" plug-in card, blade connector type D, single channel, screw terminals					6									
Surface-mounting case IP 20	with 19" plug-in card, blade connector type F, single channel, screw terminals					7									
Input (measuring circuit combination MK)															
MK 41/42	Temperature measurement/resistance teletransmitter measurement						1								
MK 44	Voltage measurement			1) 3)			4								
MK 45	Current measurement			1) 3)			5								
Output															
0/4...20 mA								1							
0...10 V						1)		2							
Binary signals															
None									0						
1 binary output with relay (two-channel: 1 relay per channel)									1						
2 binary outputs with relay							1)		2						
Interface															
LKS/non-HART (lokal communication interface) for parameter setting at the factory										1					
FSK/HART (frequency shift keying) for remote parameter setting and bus operation							1)			4					
Power supply															
230 V AC	(can be switched over to 24 V UC)								1)		1				
115 V AC									1)		3				
24 V UC											5				

Additional ordering information

					Code		
Reference junction							
IP 20,	version	1	for connection soldered	1)	512		
		2	wire-wrap 1 mm x 1 mm	1)	513		
		3	Maxi-Termi-Point 2.4 x 0.8 mm	1)	514		
IP 00, on terminal board					515		
Pt 100 for reference junction (2 pcs.)				2)	516		
Field enclosure, IP 65			(1 or 2 channel, with or without reference junction, according to sensor type)	3)	541		
customized parameter setting (enclose questionnaire for each unit/channel)					681		
Operating instruction	(specify total quantity required, 1 copy without extra charge)						
	German (no specification for 1 copy)				Z2D		
	English (always state Code-No.)				Z2E		
	French (always state Code-No.)				Z2F		

1) single channel only
2) two channel only
3) not for Ex type

Accessories

	Catalog No.	Code		
LKS adapter (local communication interface)	see Data Sheet 10/63-6.71 EN			
FSK modem with connection cable	see Data Sheet 10/63-6.71 EN			
Parameter setting program DSV4xx (SMART VISION)	see Data Sheet 10/63-1.20 EN			
Reference junctions				
IP 20, version 1 for soldered connection	345827			
IP 20, version 2 for wire-wrap connection 1 mm x 1 mm	345828			
IP 20, version 3 for maxi-termi-point 2.4 x 0.8 mm	345829			
IP 00, on terminal board	343685			
Pt 100 for reference junction	745402			
Module with 1 relay output	345825			
Module with 2 relay outputs	345826			
Set of resistors for changing the measuring circuit combinations	345838			

Standard parameters

Measuring circuit combination	**MK 41/42**	**MK 44**	**MK 45**
Tag number	-/-	-/-	-/-
Measuring point description	-/-	-/-	-/-
Bus address	00000:00	00000:00	00000:00
Type of measurement	single	single	single
Sensor	Pt 100/3-wire circuit	V-linear	mA-linear
Measuring range	0...100 °C	0...10 V	0...20 mA
Output	4...20 mA	4...20 mA	4...20 mA
Underranging value	3.6 mA	3.6 mA	3.6 mA
Overranging value	22 mA	22 mA	22 mA
Output behaviour in case of sensor error	overranging	-	-
Damping	0.90 s	0.90 s	0.90 s
LED1/binary output 1			
Assignment	sensor error	Alarm value	Alarm value
Behaviour	-	min.	min.
Circuit	Operating current	Operating current	Operating current
Switch point	-	0 V	0 mA
LED2/binary output 2			
Assignment	Alarm value	Alarm value	Alarm value
Behaviour	max.	max.	max.
Circuit	Operating current	Operating current	Operating current
Switch point	100 °C	10 V	20 mA

Information for customer-specific parameter-setting (Code No 681)

Temperature measurement with resistance thermometer or thermocouple

Sensor	Thermocuople type	B ☐ E ☐ J ☐ K ☐ L ☐ N ☐ R ☐ S ☐ T ☐ U ☐	V21 V15 V13 V16 V14 V17 V18 V19 V11 V12
	Other type	☐	V22 Enclose linearization table (maximum 32 tie points)
	Reference junction internal	☐	V26 external ☐ with temperat. ☐,☐ V27 without ☐ V25
	Resistance thermometer	Pt 100 ☐	V31 Ni 100 ☐ V32
	Other type	☐	V33 Enclose linearization table (maximum 32 tie points)
	Sensor circuit	2-L ☐	V35 3-L ☐ V36 4-L ☐ V37
	Resistance teletransm.	0…3250 ohms ☐	V41 Current -1,6…24 mA 2) ☐ V43 Voltage -0,8…12V 2) ☐ V42
Measuring range	Start (quote value)	☐☐☐☐,☐☐☐	V51 End ☐☐☐☐,☐☐☐ V52
	Unit (s. measuring range)	°C ☐	V55 K ☐ V56 °F ☐ V57 RK ☐ V58 other ☐ V59
Output	Current output	0…20 mA ☐	V61 4…20 mA ☐ V62
	Action for	Sensor and device error 1) ☐	V72 Sensor error 1) ☐ V71
	Overranging	☐ underranging	V76 Hold last valid input value ☐ V78
	Default value	☐☐☐☐,☐☐☐	V79

Binary output1	Sensor fault signaling 1)	☐	V81 Signaling of sensor and unit fault 1) ☐ V82
LED 1	or alarm value signaling 1)	☐	*Behaviour* max. ☐ V85 min. ☐ V86
			Switch point ☐☐☐☐,☐☐☐ V87
Binary output 2 2)	Sensor fault signaling 1)	☐	V91 Signaling of sensor and unit fault 1) ☐ V92
LED 1	or alarm value signaling 1)	☐	*Behaviour* max. ☐ V95 min. ☐ V96
			Switch point ☐☐☐☐,☐☐☐ V97

Additional information (if required)

Measuring point number (max. 32 characters) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ V01

1 - single (1 Sensor at input)	☐ V04
3 - Average Value (☐☐ Sensors in series at input)	☐ V06
4 - Average value (1 Sensor each at input and auxiliary input)	☐ V07
5 - Difference (1 sensor each at input [+] and aux. input [-])	☐ V08

Damping	Time constant	☐☐,☐ s	V68
Output	Reverse-action charactersitic	☐	V65 direct-action characteristic ☐ V64

Input fields: ☐ = check ☐ = enter data

1) not for current and voltage measurement
2) single channel only

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