TEU 211, TEU 211-Ex

Two-wire transmitter for temperature, rail mounting

Operating Manual 42/11-42 EN Rev. 1.0

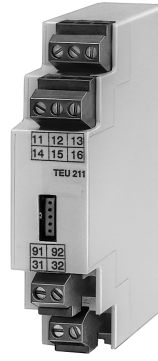

ABB Automation

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Important Instructions for Your Safety!
Please read and observe!

Correct and safe operation of TEU 211 (-Ex) calls for appropriate transportation and storage, expert installation and commissioning as well as correct operation and meticulous maintenance.

Only those persons conversant with the installation, commissioning, operation and maintenance of similar apparatuses and who posses the necessary qualifications are allowed to work on the apparatus.

Please make a note of
- the contents of this Operating Manual,
- the safety regulations affixed to the apparatus,
- the safety regulations pertaining to the installation and operation of electrical systems as well as
- the directives and guidelines on explosion protection.

The user must ensure that units connected to the transmitter fulfil the appropriate requirements of the accident prevention regulations VBG4.

The directives, norms and guidelines mentioned in this Operating Manual are applicable in the Federal Republic of Germany. When using the apparatus in other countries, please observe the national regulations prevailing in the respective country.

This apparatus has been constructed and tested according to DIN EN 61 010 part 1/VDE 0411 part 1, "Safety regulations for electrical measuring, controlling, regulating and laboratory instruments" and has been supplied in a safe condition. In order to retain this condition and to ensure safe operation, the safety instructions in this Operating Manual bearing the headline "Caution" must be observed. Otherwise, persons can be endangered and the apparatus itself as well as other equipment and facilities can be damaged.

If the information in this Operating Manual should prove to be insufficient in any point, the Hartmann & Braun Service Department will be delighted to give you more information.

Short description

The Transmitter TEU 211 (-Ex) is used to measure temperature and other process variables. It converts the input variable into a load-independent direct current 4...20 mA.

The transmitter is supplied with:
- standard parameters or
- customized parameters

Installation and Commissioning

Rating plate inscription

Explanation of symbols:


Protective insulation (DIN 30 600)


Input (DIN 30 600)

Output (DIN 30 600)


Internal reference junction (DIN 30 600)


Electrical power (DIN 30 600)


Observe Operating Manual! (DIN 30 600)


Type-tested electrical apparatus (DIN 40 012)


Measured value constant (DIN 30 600)
hold last valid value


Measured value rising (DIN 30 600) overranging

Measured value falling (DIN 30 600) underranging


Default value

LKS interface

2 L/w/f Two-wire circuit/wire/fils
3 L/w/f Three-wire circuit/wire/fils
4 L/w/f Four-wire circuit/wire/fils

1. Mounting location

Operating position	as required
Ambient temperature	−10 . . . +70 °C for TEU 211 −10 . . . +55 °C for TEU 211-Ex
Condensation	none
Degree of protection	IP 20

Transmitter **TEU 211-Ex** is to be mounted outside the hazardous area.

2. Mounting the unit

(see Fig. 1)

⚠ Caution

When mounting the transmitter TEU 211-Ex bear in mind the directives governing electrical systems in hazardous areas (ElexV), the regulations pertaining to the installation of electrical systems in hazardous areas (DIN VDE 0165/2.91) and the certificate of conformity PTB Nr. Ex-95.D.2018

Transmitters in surface-mounting case, degree of protection IP 20, are mounted on a top-hat rail with snap-on fixing.

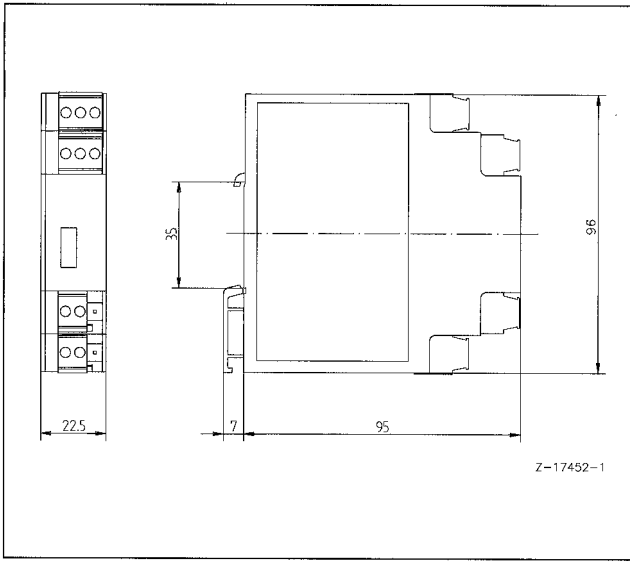

Fig. 1 Dimensional drawing (dimensions in mm)

3. Connecting

(see Fig. 2)

⚠ Caution

Safe isolation from circuits hazardous to touch is only guaranteed if the units connected meet the requirements to VDE 0106 T. 101 (basic requirements for safe isolation).

For safe isolation, lay instrument lines separately from circuits hazardous to touch or provide additional insulation.

If, for functional reasons, the intrinsically safe current circuit has to be earthed through connection to the potential equalization, it may only be earthed at one point.

When a unit with a certified intrinsically safe input circuit is connected to the TEU 211-Ex evidence of the intrinsic safety of the interconnection must be provided to DIN VDE 0165/2.91.

When selecting the line material and laying the measuring circuits and supply lines, requirements to DIN VDE 0100 must be respected.
Intrinsically safe terminals are marked light blue.

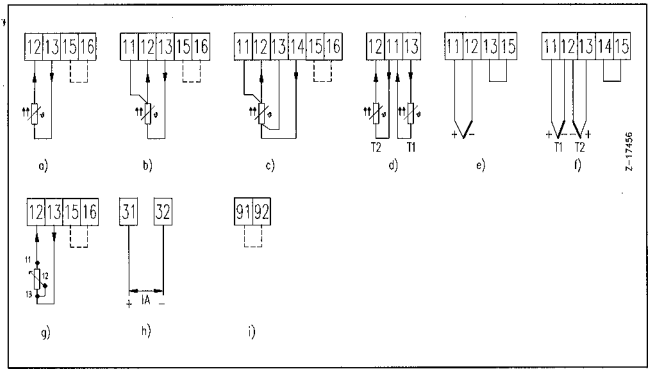

Fig. 2 Connection diagram

a) Resistance thermometer or resistance measurement in 2-wire circuit[1]
b) Resistance thermometer or resistance measurement in 3-wire circuit[1]
c) Resistance thermometer or resistance measurement in 4-wire circuit[1, 2]
d) Resistance thermometer or resistance measurement in 2-wire circuit with difference (T1 - T2) or mean value
e) Thermocouple or voltage measurement
f) Thermocouple or voltage measurement with difference (T1 - T2) or mean value
g) Resistance teletransmitter measurement in 2-wire circuit[1]
h) Output signal current or supply voltage
i) Write protection with closed jumper

1 For resistance measurement with R > 391 Ω plug jumper terminal 15 - 16.

2 In the case of open-circuit monitoring for 4-wire circuit jumper Br 3 must be open (see Fig. 4).

4. Line balancing

Line balancing is necessary for:
- Resistance thermometer or resistance measurement in 2-wire circuit,
- Resistance teletransmitter measurement.

Line balancing is not required for:
- Resistance thermometer or resistance measurement in 3-wire circuit

  Note
  If the line resistances are not the same for each conductor, the line can be balanced via PC software IBIS.

- Resistance thermometer or resistance measurement in 4-wire circuit.

Line balancing:
- **with PC software IBIS**
  Select menu branch: Device data / Expert / Unit / Adjustment / Line balancing.

- **On the unit without PC**
  1. Short-circuit sensor on site.
  2. Close jumper terminals 11 and 15.
  3. Wait for 30 seconds.
  4. Open jumper terminals 11 and 15.
  5. Connect sensor.

5. Adjustment

Transmitter TEU 211 (-Ex) is delivered fully adjusted. Adjustments must be only made if highest accurary is required (vernier adjustment for the lower-range and upper-range value).

Adjustment instructions are given in PC software IBIS.

Additional aids:
- Precision transmitter (for input)
- Measuring instrument (for output).

Operation

The transmitter is operated via the PC software IBIS. The following interfaces are available, for the communication between the PC and the transmitter:

LKS interface

(LKS = local communication interface)
(see Fig. 3)

⚠ Caution

Potential separation is necessary with the LKS interface if the output is electrically connected to earth[1].

Equipment:
- PC with PC software IBIS - application TEU 211
- LKS adapter

Both off-line and on-line communication are possible with transmitters with the LKS interface.

off-line communication
- Transmitter not operational

Note
The transmitter can be parameterized without power supply.

on-line communication
- Transmitter operational.

1 For TEU 211-Ex observe Certificate of Conformity

Write protection

This unit is protected against accidental inversion of parameters as soon as terminals 91, 92 are jumpered.

Note:
Jumper with isolated wire jumper.

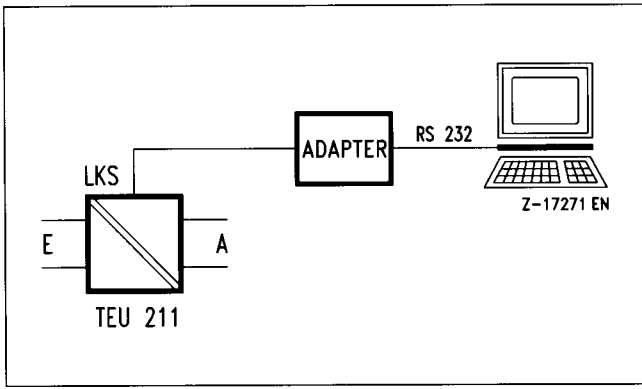

Fig. 3 PC communication with LKS interface and LKS adapter

PC requirements

(Minimum requirements)

– PC:	IBM compatible PC, XT, AT
– Working memory:	≧ 640 KB RAM
– Disk drive:	3½″ (1.44 MB)
– Monitor:	Monochrome or colour
– Graphics card:	CGA, EGA, VGA
– Interfaces:	1x serial: RS 232C 1x parallel: for printer connection (optional)
– Operating system:	MS DOS 3.2 or higher

Device data

The transmitter is supplied with:
- standard parameters (see Table) or
- customized parameters.

Measuring circuit combination	MC 41	MC 42
Number of measuring point	–/–	–/–
Measuring point description	–/–	–/–
Bus address	0000 : 00	0000 : 00
Type of measurement	simple	simple
Sensor	Pt 100 / 3-wire circuit	resistance tele-transmitter / 2-wire circuit
Measuring range	0 . . . 100 °C	0 . . . 1000 Ω
Output	4 . . . 20 mA	4 . . . 20 mA
Underranging / Overranging	3.6 . . . 22 mA	3.6 . . . 22 mA
Output behaviour in the event of sensor fault	overranging	overranging
Damping / Time constant	0.9 s up to software version 3 0.5 s as from software version 4	

Table 1 Standard parameters

Conversion

The transmitter can be modified to perform another measuring task i.e: the measuring circuit combinations can be changed.

Changing the measuring circuit combinations

(see Fig. 2)

⚠ Caution

The catalogue number (P...) on the rating plate gives the hardware configuration. This number is also stored in the transmitter. When changing the measuring circuit combination, which also necessitates a change of the Catalogue Number, this must be stored in the transmitter using the IBIS PC software. No validity check is carried out for this modification.

Jumper 15 - 16 open:
MC 41, resistance thermometer, thermocouple or resistance measurement $< 391\ \Omega$

Jumper 15 - 16 closed:
MC 42, resistance measurement, upper-range value $> 391\ \Omega$

Open-circuit monitoring

(see Fig. 4)

When converting jumper Br3, open-circuit monitoring with 2, 3 and 4-wire circuit can be activated as follows:

- Jumper Br3 open: open-circuit monitoring with resistance measurement in 4-wire circuit;
- Jumper Br3 closed: open-circuit monitoring with 2 or 3-wire circuit.

Maintenance

⚠ Caution!

Workcan be carried out on an explosion-protection apparatus by any electrician or in any workshop. However, the apparatus must be checked and certified by an expert before putting it into operation. This is not necessary if the work has been carried out by the manufacturer's authorized personnel.

Before beginning work on the instrument, the safety measures pertaining to the explosion protection must absolutely be borne in mind.

Before any maintenence or replacement of parts the unit must be disconnected from all voltage sources if it is necessary to open the apparatus.

Whenever it is likely that protection has been impaired, the unit shall be made inoperative and be secured against any unintended operation.

It must be assumed that the protection has been impaired when the unit

- **shows visible signs of damage**
- **no longer functions**
- **has been stored for long periods under unfavourable conditions**
- **has been subjected to adverse transport conditions.**

The transmitter TEU 211 (-Ex) does not require any maintenance. In the event of errors, first check the power supply or the transmitter and its connection lines. PC software IBIS offers further possibilities of diagnostics (e.g. status information for different modules) and adjustment.

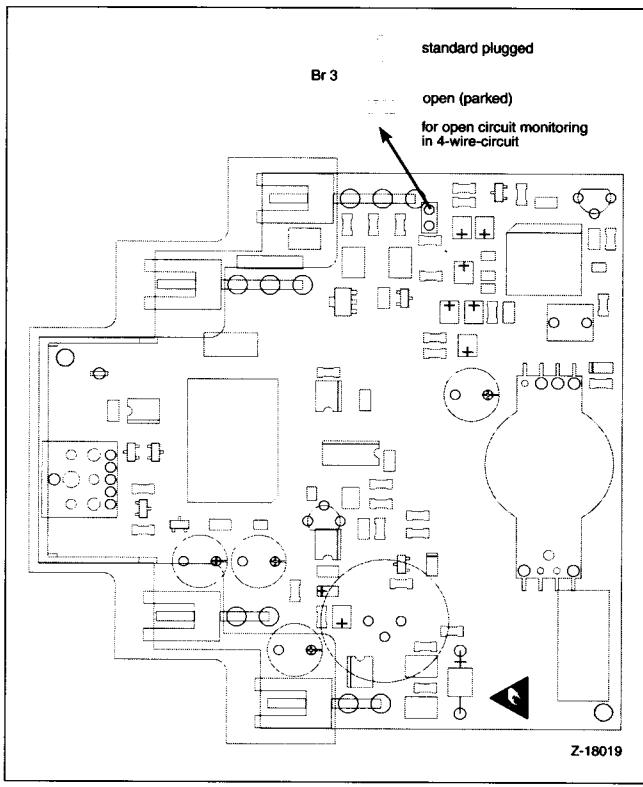

Fig. 4 Open-circuit monitoring

Appendix

Description

(see Fig. 5)

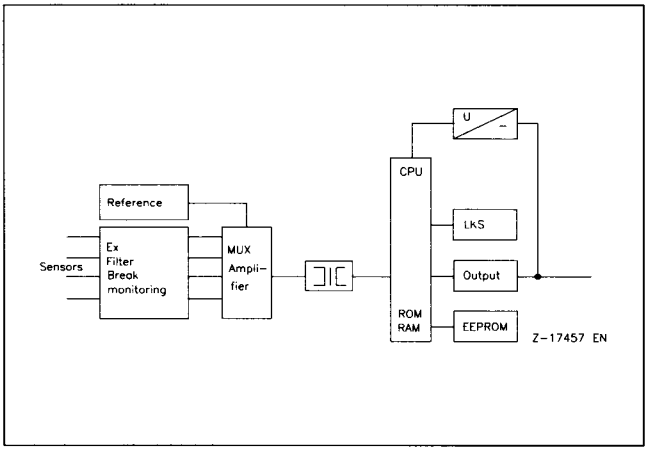

Fig. 5 Functional diagram

The input signals are routed via the **input protection circuit to the measuring point selector switch MUX.** The input variables (mV, Ω) are adapted to the input voltage range of the amplifier by means of a filter network. The input signal is routed via the MUX, amplifier, A/D converter and electrical isolation to the CPU.

The (sensor-) **break monitoring** checks the sensor impedance for maximum value. **Power supply** and signal transmission is carried out via the output current with an electrically isolated DC/DC converter. A version without electrical isolation is also available. The CPU processes successively self-monitoring, analogue values and communication.

ROM contains operating data, firmware and fixed linearization tables. The **EEPROM** contains user-specific parameter setting data.

Communication with PC is possible via **LKS** interface.

Functional modules

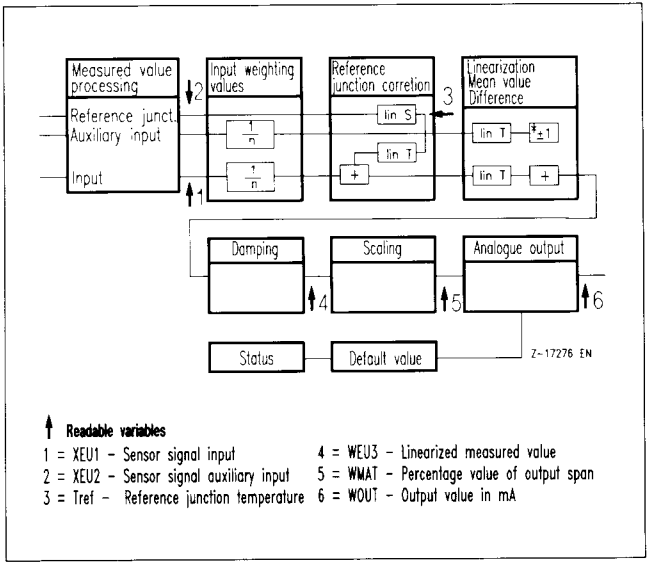

Fig. 6 Functional modules

Measured value processing

Measuring range setting (measuring circuit and sensor selection)
Sensor monitoring (break, short circuit)
Reference junction measurement for the internal reference junction

Input weighting

Mean value formation when interconnecting several sensors at one input. Simulation of sensor characteristics with same basic data (e.g. Pt 1000 from Pt 100 characteristics – 10 x Pt 100)

Reference junction compensation

Correction of measured value by the value of the internal / external reference junction for thermocouple measurements.

Linearization / mean value / difference

Acc. to standardized or customer-specific characteristics (max. 32 tiepoints); formation of mean value, difference at input and auxiliary input. Mean value, difference at input and auxiliary input.

Damping

Filter with 1st order delay
(τ = 0; 0.9...100 s up to software version 3)
(τ = 0; 0.5...100 s as from software version 4)

Scaling

Lower limit and upper limit range.

Analogue output

Underranging / Overranging
Output action in the event of a sensor fault and an instrument fault
Default value

Technical data

Input

Resistance thermometer in
2-, 3- and 4-wire circuit

Thermocouples
Without/with internal or external reference junction

Resistance teletransmitter

Ω-, kΩ, mV sources

Measurement

Simple:	1 sensor at input
Mean value:	1 sensor at input and 1 sensor at auxiliary input or 2...10 sensors in series at input
Difference:	1 sensor at input and 1 sensor at auxiliary input

(Mean value and difference only for mV transmitter and Ω transmitter, MC 41 in 2-wire circuit)

Measuring range: Ω: $R_{m1} + 2R_{L1} + R_{m2} + 2R_{L2} < 415$
Pt 100: $(T1 + T2)_{max} < 500$ °C
Ni 100: $(T1 + T2)_{max} < 250$ °C

Measuring circuit combinations MC

Measuring circuit combination	Full modulation span	Minimum span
MC 41	0. . .391 Ω –8. . .+120 mV	6.7 Ω 2 mV
MC 42	0. . .3250 Ω –8. . .+120 mV	58 Ω 2 mV

Measuring range
can be parameterized

Input current
approx. 70 nA with mV or thermocouple measurement

Measuring current
MC 41: approx. 0.29 mA
MC 42: approx. 35 µA

Overload limit [1]

Thermocouple/mV measurement (MC 41/MC 42)
−0.5...+3.5 V
Resistance thermometer and resistance measurement (MC 41/MC 42)
Open or short-circuit input permitted.

(Sensor)break monitoring

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

Ω measurement

Response threshold for sensor break:	MC 41 > 391 Ω
	MC 42 > 3250 Ω
Response threshold for short-circuits:	< 5 Ω

Line resistance

(R_m - measuring resistance; R_L- Line resistance of a conductor)

2-wire circuit ($2R_L \leqq 10$ Ω):
with MC 41 (mean value/difference):
$R_{m1} + 2R_{L1} + R_{m2} + 2R_{L2} < 415$ Ω

3-wire circuit
0...10 Ω per conductor

4-wire circuit
0...50 Ω per conductor
with MC 41: $R_m + R_L < 415$ Ω

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1 For TEU 211-Ex observe Certificate of Conformity

Internal reference junction
Built-in Pt 100 in 2-wire circuit

Linearization
As per DIN IEC standardized characteristics
Resistance thermometers: Pt 100, Ni 100
Thermocouple type B, E, J, K, L, N, R, S, T, U or customer specific (max. 32 tie points)

Input weighting
n = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
(for resistance measurement additionally n = 0.5 e.g. for Pt 50)

Output

Output signal (rising/falling)
4...20 mA

Supply via DC voltage source
(I_K < 130 mA)

Supply voltage
11.5...42 V for TEU 211
11.5...42 V for TEU 211-Ex
13.5...42 V without electrical isolation

Current output
4... 20 mA

Power consumption
P_{max} < 1.0 W

Max. load

$$R = \frac{U_S - 11.5\ V}{I_{a\,max.}}$$ with electrical isolation

$$R = \frac{U_S - 13.5\ V}{I_{a\,max.}}$$ without electrical isolation

$I_{a\,max}$ = max. current parameterized
U_S = supply voltage

Admissible residual ripple of the supply voltage
1 V (peak-peak) < 120 Hz, additional residual ripple of the output signal 0.2 % (peak-peak)

Residual ripple of the output signal
< 0.5 % (peak-peak)

Modulation range (parameterizable)
Underranging
< 3 mA (< 3.3 mA elevated residual ripple)

Overranging
20...23.6 mA, can be parameterized

Output behaviour in case of error
Fault: sensor error or sensor/device error
Underride (underride set)
Override (override set)
Default value (parameterizable 3...23.6 mA)[1]
Maintain the last valid value

Damping
Filter with first order delay
($\tau = 0$; 0.9...100 s up to software version 3)
($\tau = 0$; 0.5...100 s as from software version 4)

time constant set τ	Response time T (up to software version 3)	Response time T (as from software version 4)
0 2	typ. 0.8 max. 1 s	
0.5 s	-	approx. 1.8 s
0.9 s	approx. 2.7 s	approx. 3.7 s
1 s	approx. 3.3 s	approx. 4.2 s
1.5 s	approx. 5.8 s	approx. 6.5 s
2 s	approx. 8.2 s	approx. 8.8 s
>5 s	$1 + 4.6 \cdot \tau$	

Interfaces

Local communication interface LKS
for workshop parameterization (power supplied from PC)

Data format
HART protocol

1 Parameter setting is also possible via the set control range (e.g. for override/underride signal)

Characteristics under nominal conditions

(to DIN IEC 770)

Measuring deviation[1] (MV = Measured value)
0.1 % · MV + 0.1 % + K1
Additional error for internal reference junction: 0.25 K

Nonlinearity (contained within the measuring deviation)
0.1 % + K2

Examples for calculation
see Data Sheet 11–1.02 EN Configuring aids

Constants	K1	K2	K3
Ω (MC 41)	80 mΩ	20 mΩ	10 mΩ
Ω (MC 42)	0.75 Ω	0.2 Ω	0.09 Ω
mV (MC 41/MC 42)	10 µV	5 µV	2 µV
Resistance thermometer (MC 41)	0.25 K	0.05 K	0.063 K
Resistance thermometer (MC 42)	0.25 K	0.05 K	0.1 K
Thermocouple > – 150 °C except type B (MC 41/ MC 42)	10 μV^2+0.2 K	10 μV^2 or 0.2 K (greater value holds)	2 μV^2
Thermocouple type E, K, N, T – 250. . .– 150 °C Type B > 300 °C (MC 41/MC 42)	10 μV^2+0.6 K	10 μV^2 or 0.6 K (greater value holds)	2 μV^2

Variations

Ambient temperature[1]
(0.05 % · MV + 0.05 % + K3) / 10 K
with an internal reference junction additionally 0.1 K / 10 K

Power supply[1]
< 0.05 % / 10 V voltage variation

Parasitic voltage in input[1]
50 Hz symmetrical
< 0.5 % with U_{para} (peak-peak) = 0.3 · span ($\tau = 0$ s)
(elevated residual ripple)
< 0.5 % with Upara (peak-peak) = 4 · span[4]

50 Hz asymmetrical (to $U_{eff} = 50$ V)[3]
< 0.006 % · full modulation / span[4]
< 0.05 % · full modulation / span ($\tau = 0$ s)

DC component of fault voltage (to UDC = 50 V)[3]
< 0.006 % · full modulation / span[4]
< 0.05 % · full modulation / span ($\tau = 0$ s)

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1 Referred to the span set.
2 Insert temperature value which corresponds to the slope of 10 µV or 2 µV at the measurement point.
3 Only with electrical isolation.
4 up to software version 3 ($\tau \geq 0.9$ s)
as from software version 4 ($\tau \geq 0.5$ s)

Transient response

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

Electromagnetic compatibility

General interference immunity based on NAMUR recommendation for:

- Inrush current limitation
- Transient overvoltage
- Discharge of static electricity
- Electromagnetic fields

General and safety data

Climatic capabilities

Climatic category
3K3 to DIN IEC 721-3-3
2K2 to DIN IEC 721-3-2

Ambient temperature
-10...+20...+70 °C for TEU 211
-10...+20...+55 °C for TEU 211-Ex

Transportation and storage temperature
-25...+90 °C

Relative humidity
≦ 75 %

Condensation
none

Mechanical stress

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

During transportation
Shock 30g / 18 ms / 18 Shocks

During operation
Vibration 2g / 0.15 mm / 5...150 Hz / 3 x 5 Cycles
2g / 10 mm / 1...35 Hz / 3 x 1 Cycle

Connection, case, mounting

Electrical connections
Screw terminals for 1.5 mm^2 incl. thimbles

Degree of protection to EN 60 529/DIN VDE 0470 part 1
IP 20

Class of protection to DIN EN 61 010 part 1/VDE 0411 part 1
II for version with electrical isolation
III for version without electrical isolation

Degree of contamination[1]
2

Overvoltage category[1]
II

Test voltage to VDE 110 Part 1-2
$U_{eff} = 4$ kV

Material
Polycarbonate

Colour
RAL 7032

Operating position
as required

Weight
approx. 120 g

Explosion protection

Manufacturer's code
49/11-54 Ex

Certificate of conformity
PTB Nr. Ex-95.D.2018

Ambient temperature
+ 55 °C

1 only with electrical isolation

Mounting
outside the hazardous area

Input circuit, type of protection "intrinsic safety"
EEx ib IIC; EEx ib IIB
Max. values:
$U = 8.9$ V; $I = 22$ mA;
$R = 1500\ \Omega$; $P = 142$ mW

For further data see certificat of conformity.

Packing instructions

If the original packing is no longer available, the transmitter TEU 211 (-Ex) must be wrapped in an insulating air foil or corrugated board and packed in a sufficiently large crate lined with shock absorbing material (foamed material or similar). The amount of cushioning must be adapted to the weight of the unit and to the mode of transport. The crate must be labelled "Fragile".

For overseas shipment the unit must additionally be sealed airtight in 0.2 mm thick polyethylene together with a desiccant (e.g. silica gel). The quantity of the desiccant must correspond to the packing volume and the probable duration of transportation (at least 3 months). Furthermore, for this type of shipment the crate should be lined with a double layer of kraft paper.

Subject to technical changes.

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Subject to technical changes.
Printed in the Fed. Rep. of Germany
42/11-42 EN Rev. 1.0
Edition 11.00