TEU 411, TEU 411-Ex

Four-wire transmitter for temperature and other process variables

Operating Manual 42/11-35 EN Rev. 1.0

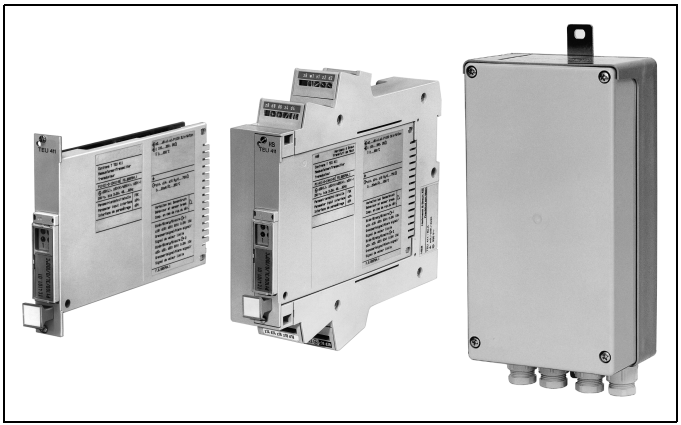

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Table of contents

Important instructions. It is imperative that they may be read and observed

Correct and safe operation of the transmitter TEU 411, TEU 411-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 and operation of similar instruments and who possess the necessary qualifications are allowed to work on the instrument. They must be familiar with the contents of this Operating Manual and observe the safety instructions governing the installation and operation of electrical systems.

This apparatus has been designed and tested in accordance with DIN VDE 0411, Part 1 (based on IEC Publication 348), "Safety Requirements for Electronic Measuring Apparatus", and has been supplied in a safe condition. The safety instructions in this Operating Manual bearing the headline "Caution" must be observed in order to retain the apparatus in a safe condition and to ensure safe operation. Noncompliance with the safety instructions can result in bodily injuries or in damage to the instrument itself or to other instruments and facilities.

Should the information in this Operating Manual prove to be insufficient in any point, please consult your Technical Branch Office, or a branch or representative of Hartmann & Braun.

The industrial standards and regulations (e.g. DIN, VDE, VDI) as well as the directives, specifications and requirements governing explosion protection (ElexV, EX-RL, VDE, DIN EN) referred to in this Operating Manual are applicable in the Federal Republic of Germany. When using this device outside the Federal German jurisdiction, the relevant specifications, standards and regulations applicable in the country where the device is used must be observed.

Application and description

The Transmitter TEU 411, TEU 411-Ex is used to measure temperature and other process variables. It converts the input variable into a load-independent direct current (0/4...20 mA) or into a direct voltage (0...10 V).

The following designs are available:
- 19" plug-in card,
- Surface-mounting case IP 20,
- Field case IP 54 (but not with explosion protection).

The transmitter is supplied with customized or standard parameters.

1 Mounting and connecting

1.1 Basic supply

The following items are supplied with Transmitter TEU 411, TEU 411-Ex:
1 Test connector (for 19" plug-in card and surface-mounting case IP 20)
1 Rating plate bearing no inscription.

1.2 Mounting location

Design	19"plug-in card	Surface-mounting case IP 20	Field case IP 54
Mounting orientation	Vertical	Vertical	Cable glands facing downwards
Ambient temperature	-10...+20 ...+70 °C	-10...+20 ...+55 °C	-25...+20 ...+55 °C
Condensation	None	None	Permissible

The input circuit of Transmitter **TEU 411-Ex** has been approved for type of protection "intrinsic safety" [EEx ib] IIC or [EEx ia] IIC. The input circuit can be installed in hazardous areas bearing in mind the Certificate of Conformity (see Technical data). Since only the input circuit features intrinsic safety, Transmitter **TEU 411-Ex** must be installed outside the hazardous area.

1.3 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 energy (DIN 30 600)


Observe Operating Manual (DIN 30 600)


Type-tested electrical apparatus (DIN 40 012)


Measured value constant (DIN 30 600)
– pass on value


Measured value increasing (DIN 30 600)
– overdrive


Measured value decreasing (DIN 30 600)
– underdrive

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

1.4 Mounting

Caution

When mounting the transmitter TEU 411-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 No. Ex-91.C.2121 X).

1.4.1 19″ plug-in card

(see Fig. 1)

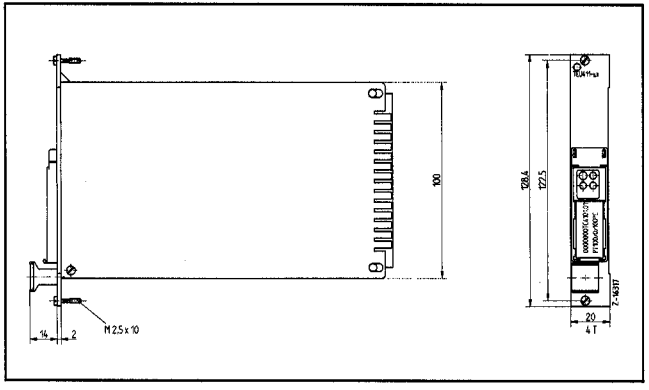

Fig. 1 Dimensional drawing 19″ plug-in card (dimensions in mm)

1.4.2 Codes on the plug connectors design D and F

(see Figs. 2 and 3)

No other card may be fitted into the slot intended for a 19" plug-in card in the explosion-protection version. To ensure this, codes are marked on the plug connectors. The slot in the 19" subrack must be adapted to this coding.

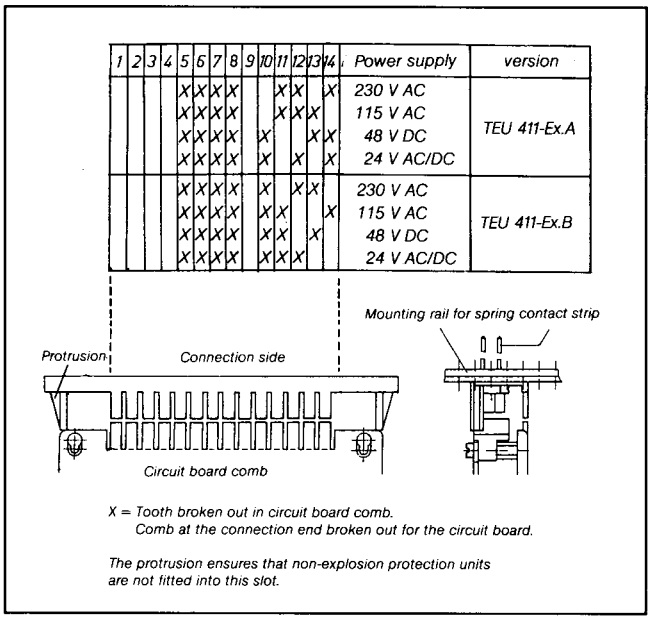

Fig. 2 Plug connector design D
Coding with protrusion and circuit board comb

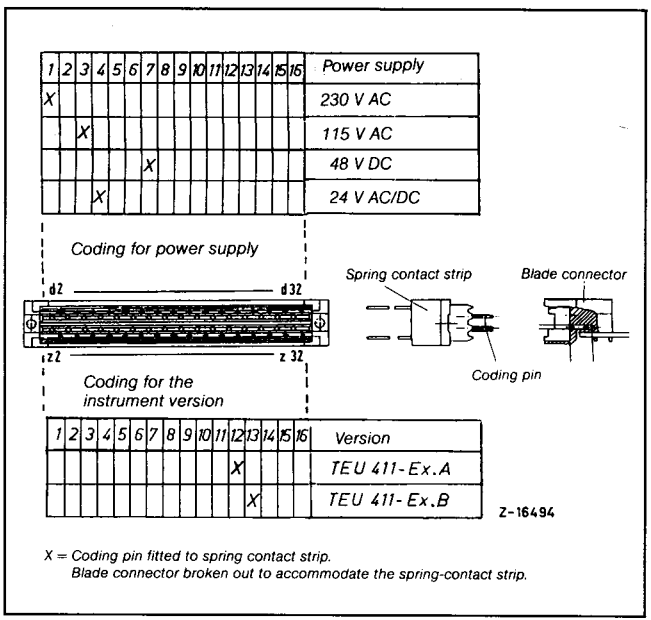

Fig. 3 Plug connector design F
Coding with coding pin

The 19″ plug-in card has a width of 4T, hence up to 21 transmitters can be installed in a single 19″ subrack. Observe the permissible ambient temperature.

■ Mounting the 19″ plug-in card:

Fit the 19″ plug-in card into the slot on the 19″ subrack and secure it with two screws.

19″ plug-in cards for bus operation

Parameters must be defined for each 19″ plug-in card before the next card can be fitted.

Internal reference junction (see Figs. 4 and 5).

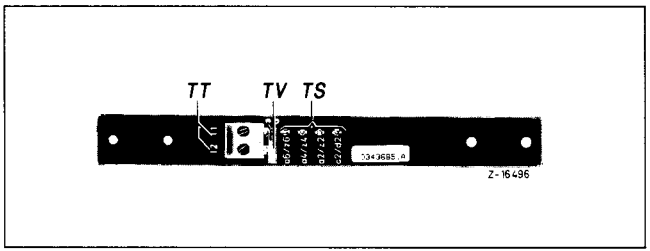

Fig. 4 Internal reference junction IP 00 mounted on connection plate
TS Spring contact strip connection
TT Thermocouple connection
TV Internal reference junction (Pt 100)

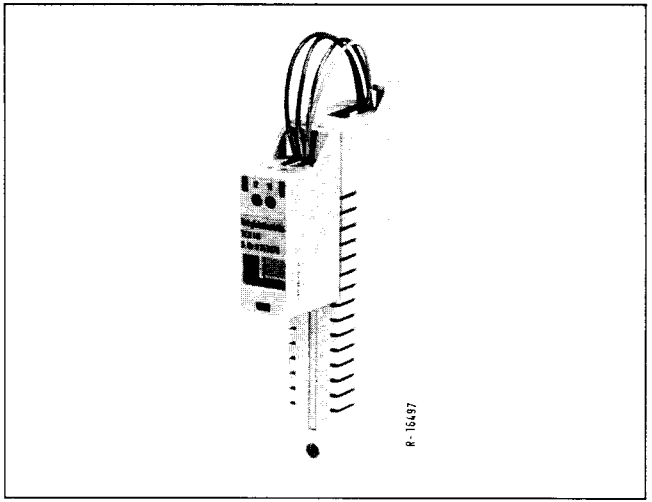

Fig. 5 Internal reference junction IP 20 mounted on cover flap

1.4.3 Surface-mounting case IP 20

(see Fig. 6)

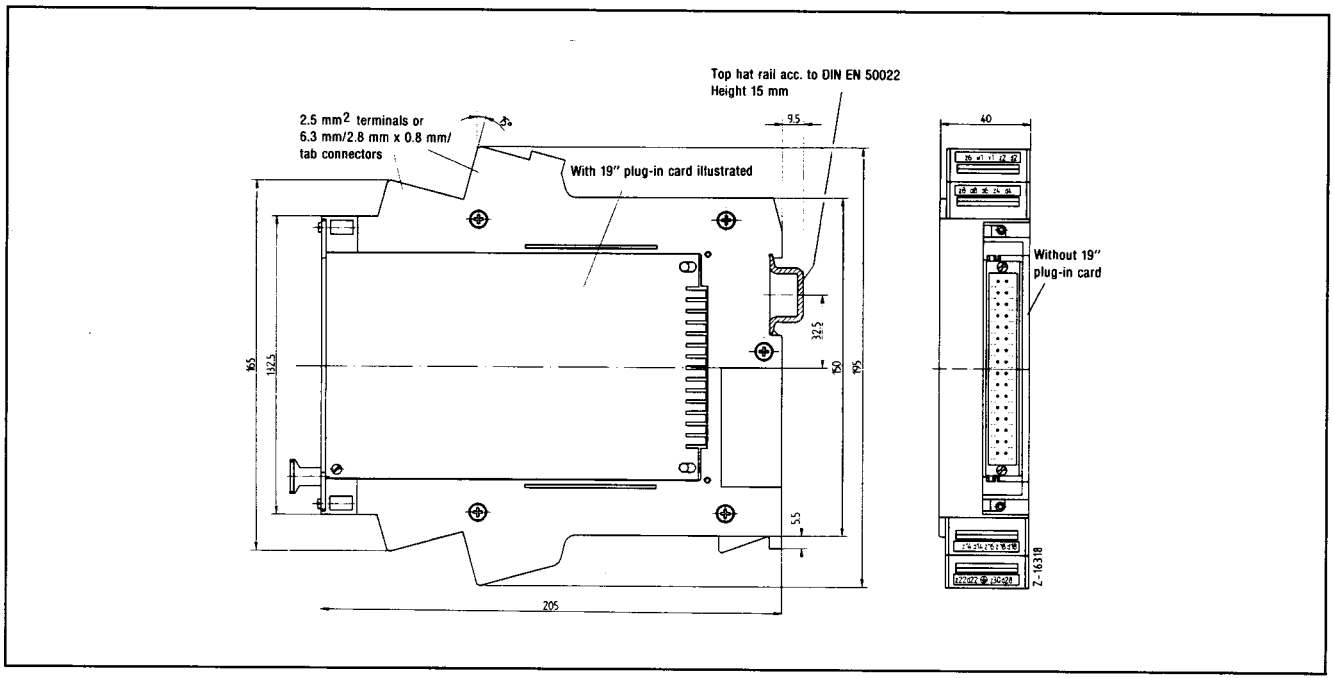

Fig. 6 Dimensional drawing of surface-mounting case IP 20 (dimensions in mm)

Mounting permitted only on horizontal top hat rail acc. to DIN EN 50 022.

■ Engage surface-mounting case IP 20 in top-hat rail.

Use plug connector design F in the 19" plug-in card explosion-protection version and plug connector design D in the non-explosion-protection version.
The internal reference junction has been incorporated at the connection level (terminals v1, w1).

1.4.4 Field case IP 54 (only without explosion-protection)

(see Fig. 7)

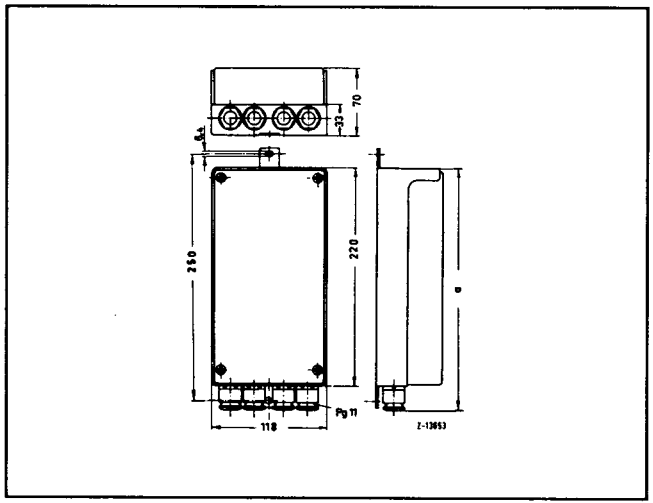

Fig. 7 Dimensional drawing of the field case IP 54 (dimensions in mm)

- Screw case tightly to the mounting wall so that the cable glands are facing downwards.

The internal reference junction is fitted on the motherboard behind the terminal strip.

1.5 Connecting

(see Figs. 8.1 and 8.2)

Caution

Before any other connection is made the protective ground terminal shall be connected to a protective conductor.

Any interruption of the protective conductor inside or outside the apparatus or disconnection of the protective ground terminal is likely to make the apparatus dangerous. Intentional interruption is prohibited.

Provision must be made for an all-pole switch-off facility within the mains supply line. This switch-off facility can also be used for a group of instruments if the respective facility features the necessary voltage and current ratings.

If an apparatus with a certified intrinsically safe output circuit is connected to the intrinsically safe input circuit of Transmitter TEU 411-Ex, proof must be furnished acc. to DIN VDE 0165/2.91 for the intrinsic safety of the interconnection.

If for functional reasons the intrinsically safe circuit must be grounded because of the connection to the potential equalization, it must only be grounded at a single point.

When selecting the lead material as well as when installing and connecting the measured and output signal lines local requirements such as DIN VDE 0100 are to be observed. With explosion-protection version DIN VDE 0165/2.91 must be observed in addition.

FSK bus – parallel switching (max. 21 units) of the connections (Fig. 8.2, pos. r).

1.5.1 19" plug-in card

Wire the spring contact strips mounted in the 19" subrack acc. to the connection diagram.

1.5.2 Surface-mounting case IP 20

Connection:

- Screw terminals
  Provide thimbles for the wire (max. cross-section 2.5 mm^2) and secure it in the screw terminal.
- Tab connectors
  Provide insulating sleeves for the wire and tab connectors (6.3 mm x 0.8 mm or 2.8 mm x 0.8 mm) and fit on.

Caution

Provide insulating sleeves for the tab connectors so that the protection against electric shocks is guaranteed (degree of protection IP 20).

1.5.3 Field case IP 54

Caution

When the apparatus is connected to its supply, terminals may be live, and the opening of the covers or removal of parts (except those to which access can be gained by hand) is likely to expose live parts.

1. Remove case cover.
2. Route the cable through the cable gland.
3. Tighten cable glands.
4. Connect cable to the terminal strip.

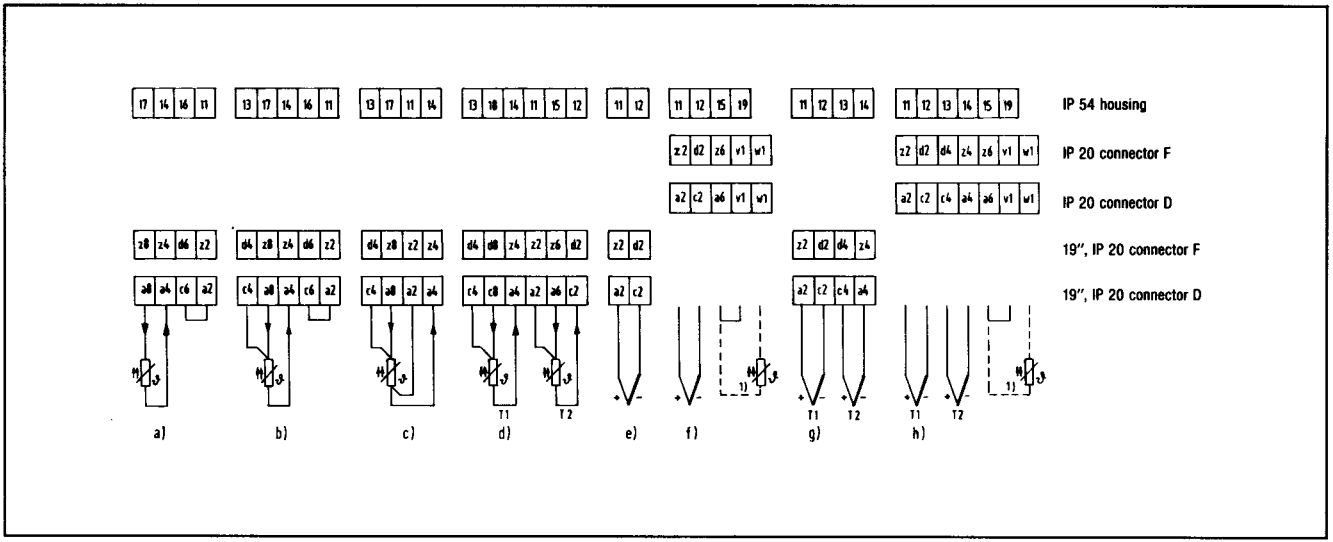

Fig. 8.1 Connection diagram

a) Resistance thermometer or resistance measurement in 2-wire circuit

b) Resistance thermometer or resistance measurement in 3-wire circuit

c) Resistance thermometer or resistance measurement in 4-wire circuit

d) Resistance thermometer or resistance measurement in 3-wire circuit with sum, difference or mean value

e) Thermocouple or voltage measurement

f) Thermocouple or voltage measurement with internal reference junction (19" plug-in card: see Fig. 8.2)

g) Thermocouple or voltage measurement with sum, difference or mean value

h) Thermocouple or voltage measurement with sum, difference or mean value with internal reference junction (19" plug-in card: See Fig. 8.2)

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1) Pt 100 retrofitted

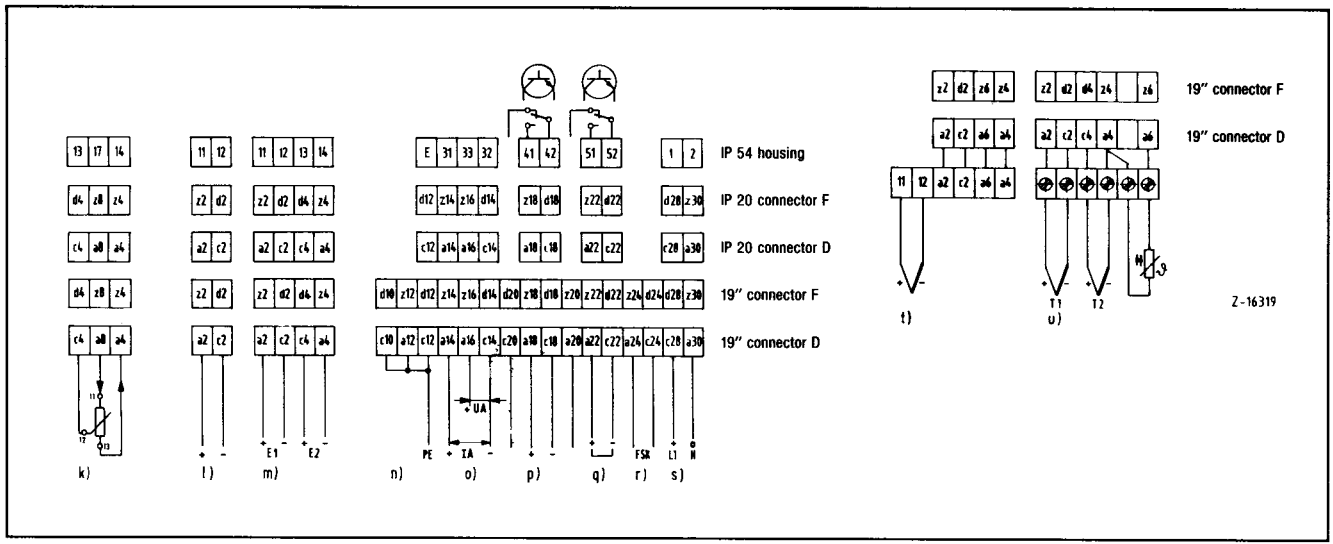

Fig. 8.2 Connection diagram

k) Resistance teletransmitter measurement (line balancing only for connections 14, a4 and z4)

l) Current and voltage measurement

m) Current and voltage measurement with sum, difference or mean value

n) Protective conductor (only with Ex version)

o) Output signal current or voltage

p) Binary output 1

q) Binary output 2 or binary input

r) FSK connection

s) Power supply

t) Thermocouple or voltage measurement with internal reference junction (for 19" plug-in card)

u) Expansion facility for thermocouple or voltage measurement with sum, difference or mean value with internal reference junction – not included in the basic supply.

2 Commissioning

Caution

Before switching on the apparatus make sure it is set to the voltage of the power supply.

When the apparatus is connected to its supply, terminals may be live, and the opening of the covers or removal of parts (except those to which access can be gained by hand) is likely to expose live parts.

Switch on the power supply. The green LED indicates that the apparatus is ready for operation. In the 19" plug-in card or in the surface-mounting case IP 20 the green LED is located on the front panel. In the field case IP 54 the green LED is visible only after removing the case lid.

Signals of the green LED:

OFF	– Power supply switched off
ON	– Power supply switched on
Flashing slowly:	– Internal fault (instrument fault)
	– Basic alignment
	– Configuration
Flashing quickly:	– External fault: Sensor break
	Sensor short circuit
	Line break or
	short circuit at output

2.1 Line balancing

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

Line balancing not required for:
- Resistance thermometer or resistance measurement in 3-wire circuit (provided that the line resistances are the same in each conductor).
- Resistance thermometer or resistance measurement in 4-wire circuit,
- If the line balancing was taken into consideration at the time of configuration.

Note:
In the surface-mounting case IP 20 with internal reference junction (terminals v1, w1) the internal line of the plug receptacle leading to the Pt 100 must be balanced.

Line balancing:

- **with the program CONTRANS**
  Select menu branch: Service/Adjustment/**Line balancing;**

- **with the test connector or the plug-in jumper**
  Test connector (19″ plug-in card and surface-mounting case IP 20)
  Plug-in jumper (field case IP 54)

Line balancing procedure:

Short-circuit all the connection lines on the sensor as well as the connections on the surface-mounting case IP 20 (terminals a6/z6 and w1) before line balancing.

1. Insert test connector / plug-in jumper into *jack* / jumper 111 (see Figs. 9 and 10).
   LED1 and *LED2* flash simultaneously.

2. Remove and plug-in test connector / plug-in jumper.
   LED1 and *LED2* flash alternatively, *green LED* flashes slowly.
   After approx. 10 s, *LED1* and *LED2* flash simultaneously, and the *green LED* is in the operating state.

3. Remove and plug in test connector / plug-in jumper.
   LED1, LED2 and the *green LED* are in the operating state.

4. Remove test connector / plug-in jumper.

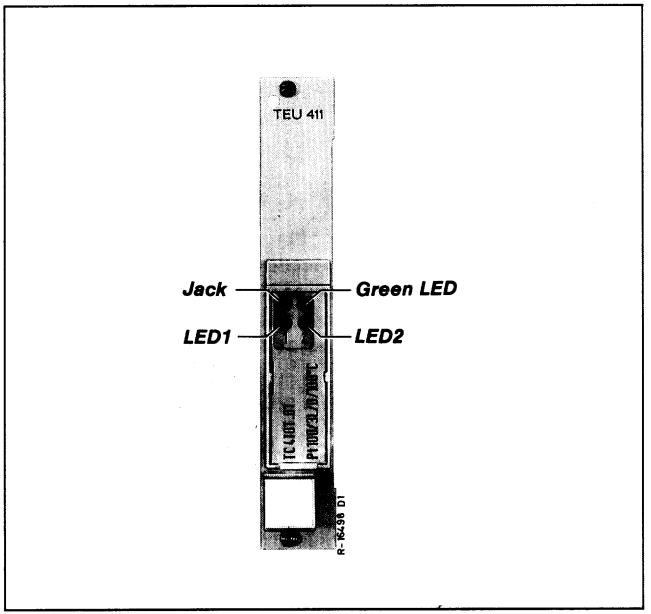

Fig. 9 Front view of 19″ plug-in card, surface-mounting case IP 20

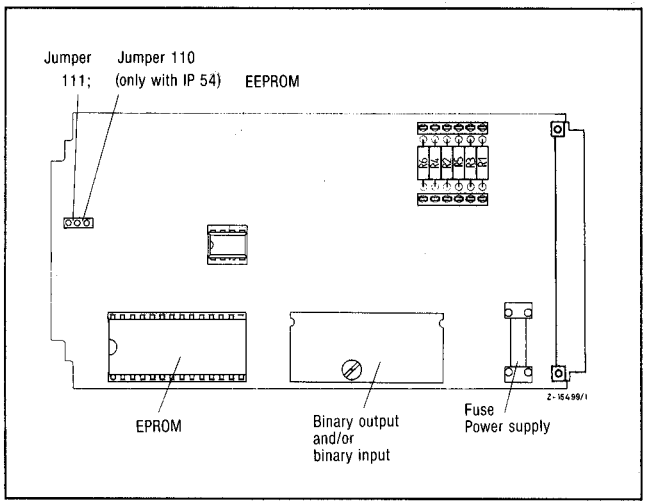

Fig. 10 Motherboard (component side)
Plug-in jumper in the operating state fitted to jumper 110 (park position)

2.2 Adjustment

Transmitter TEU 411, 411-Ex is delivered fully adjusted. Adjustments must be only made:
- if the measuring circuit combinations have been changed,
- for vernier adjustment for the lower-range and upper-range value,
- if the line resistances of the three-wire circuit are not equal.

Adjustment instructions are given in the program CONTRANS.

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

3 Configuration and parameter definition

Transmitter TEU 411, TEU 411-Ex is configured if the transmitter is to be adapted to a new measurement task.

Transmitter TEU 411, TEU 411-Ex is parameterized if the transmitter values are to be changed. Incorrect entries are detected by the software with the latter issuing a request for correction.

A PC of the following design is required for configuration and parameter definition of the transmitter:

- Personal computer: IBM XT or AT. (run-capability is generally possible but not guaranteed on compatible PCs).
- Hard disk: Min. 20 MB
- RAM: Min. 512 MB
- Diskette storage: 3 ½" 720 KB or 3 ½" 1.44 MB
  5 ¼" 360 KB or 5¼" 1.2 MB
- Screen: Monochrome, color with LC display
- Graphics card: CGA, EGA, VGA, Hercules
- Interfaces: 1x serial: RS 232 C for connecting TEU 411
  1x parallel: for printer connection (option)
- Operating system: DOS Version 3.0 or more recent

The program CONTRANS is available for configuration and parameter definition. The program is self-explanatory. The following are required to set the operating data:

- Transmitter ready for operation
- PC
- RS 232 C interface or FSK modem with connecting cable

The coupling between transmitter and PC is illustrated in the following Figs.:

- Fig. 11: for transmitter (19" plug-in card, surface-mounting case IP 20 and field case IP 54) with RS 232 C interface or FSK interface,
- Fig. 12: for transmitter (IP 54 field case) with FSK connection at output,
- Fig. 13: for transmitter (19" plug-in card) with FSK bus. The input and output signal functions of the transmitters are not affected and remain electrically isolated.

Caution:

The coupling "transmitter – PC" must be effected in the field case IP 54 only by an electrical expert (case is opened).

With RS 232 C interface, potential separation must be effected if the output is grounded.

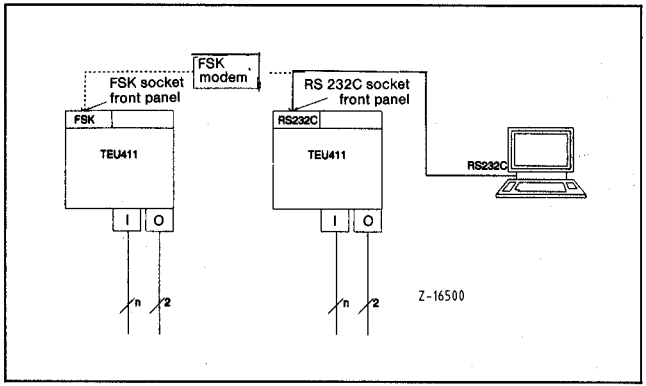

Fig. 11 Transmitter with RS 232 C or FSK interface

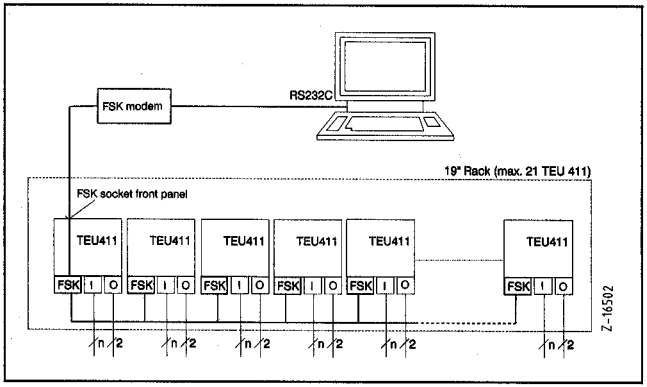

Fig. 13 Transmitter with FSK bus

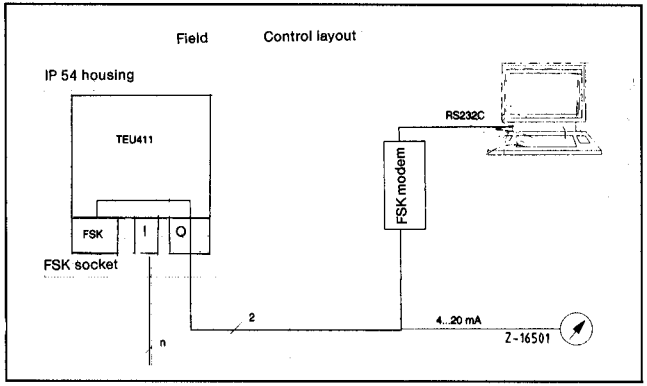

Fig. 12 Transmitter with FSK connection at output

3.1 Parameters

The parameters defined for the transmitter are:
- customized parameters,
- standard parameters (see table).

A bus address must be provided for the 19″ plug-in cards on the FSK bus. This address is set with the program CONTRANS, menu branch "Service" or "Configuration". The bus address must be > 00:00. Further instructions are given in the program CONTRANS, menu branch "Help".

Measuring circuit combination	MC 41	MC 42	MC 44	MC 45
Measurement type	Simple	Simple	Simple	Simple
Sensor	Pt 100 / 3-wire	–	–	–
Measuring range	0...100 °C	0...1000 Ω	0...10 V	0...20 mA
2nd measuring range	0...100 °C	0...1000 Ω	0...10 V	0...20 mA
Output	0...20 mA	0...20 mA	0...20 mA	0...20 mA
Underdrive/ Overdrive range	–0.4...22 mA	–0.4...22 mA	–0.4...22 mA	–0.4...22 mA
Output action in the event of sensor fault	Overdrive	Overdrive	Overdrive	Overdrive
Output action in the event of instrument fault	Preserve last valid value	Preserve last valid value	Preserve last valid value	Preserve last valid value
Damping/ time constant	0.00 s	0.00 s	0.00 s	0.00 s
Slave pointer	Max.	Max.	Max.	Max.

Measuring circuit combination	MC 41	MC 42	MC 44	MC 45
LED1 / assignment	Alarm value WMAT	Alarm value WMAT	Alarm value WMAT	Alarm value WMAT
LED1 / action	Min.	Min.	Min.	Min.
LED1 / switching operation	Operating current	Operating current	Operating current	Operating current
LED1 / switch point	0 %	0 %	0 %	0 %
LED1 / hysteresis	1 %	1 %	1 %	1 %
LED2 / assignment	Alarm value WMAT	Alarm value WMAT	Alarm value WMAT	Alarm value WMAT
LED2 / action	Max.	Max.	Max.	Max.
LED2 / switching operation	Operating current	Operating current	Operating current	Operating current
LED2 / switch point	100 %	100 %	100 %	100 %
LED2 / hysteresis	1 %	1 %	1 %	1 %
Binary output 1 / assignment	Instrument/ output fault	Instrument/ output fault	Instrument/ output fault	Instrument/ output fault
Binary output 1 / switching operation	Operating current	Operating current	Operating current	Operating current
Binary output 2 / assignment	Sensor fault	Sensor fault	—	—
Binary output 2 / switching operation	Operating current	Operating current	—	—

3.2 Changing the measuring circuit combinations

MC	jumper 9	jumper 9A	jumper 9B	R1/R2	R3/R4	R5/R6
MC 41	closed	closed	closed	–	–	–
MC 42	open	closed	closed	–	–	–
MC 44	closed	open	open	–	475 kΩ	6,19 kΩ
MC 45	closed	open	open	10 Ω	100 Ω	50 Ω

Resolder or remove the resistors or jumpers acc. to this table and to Figs. 14 and 15. All resistors are metal-film resistors of DIN size 0207, tolerance ± 0,1% and TK = 15.

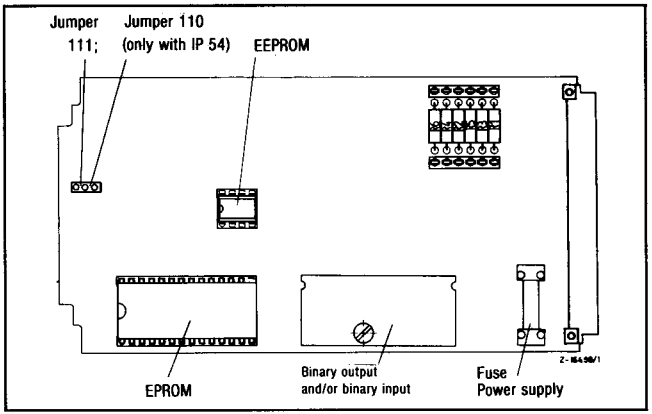

Fig. 14 Motherboard (component side)
Plug-in jumper is fitted in the operating state on jumper 110 (park position)

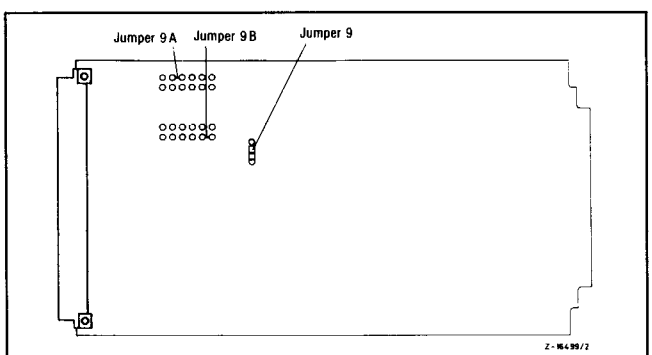

Fig. 15 Motherboard (soldered side)
Position for change of measuring circuit

4 Maintenance

Caution

Work can 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 placing it in operation. This is not necessary if the work has been carried out by the manufacturer's authorized personnel.

The apparatus shall be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair.

Capacitors inside the apparatus may still be charged even if the apparatus has been disconnected from all voltage sources.

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

It must be assumed that the protection has been impaired when
- **the apparatus has visible signs of damage;**
- **the apparatus no longer functions;**
- **the apparatus has been stored in unfavorable conditions for a long time;**
- **the apparatus has been subjected to adverse transport conditions.**

Transmitter TEU 411, TEU 411-Ex requires no maintenance. In the event of faults, check first the power supply or the sensor and its supply lines as well as the output circuit for the cause of the fault.

The fuse for the power supply is located on the motherboard (see Fig. 10). Only the following fuses may be used:

Power supply	Fuse ratings
V AC/DC = 24 V	M 0.4C
V DC = 48/60 V	M 0.2C
V AC/DC = 115 V	M 0.1C
V AC/DC = 230 V	M 0.08C

Caution

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short-circuiting of fuse-holder are prohibited.

The test instrument "Kompavi 10" (Catalog No. 35511-4-0854592) is recommended for testing the functions of the apparatus. The program CONTRANS offers other test facilities in the menu branch "Service".

Appendix

Description

(see Fig. 16)

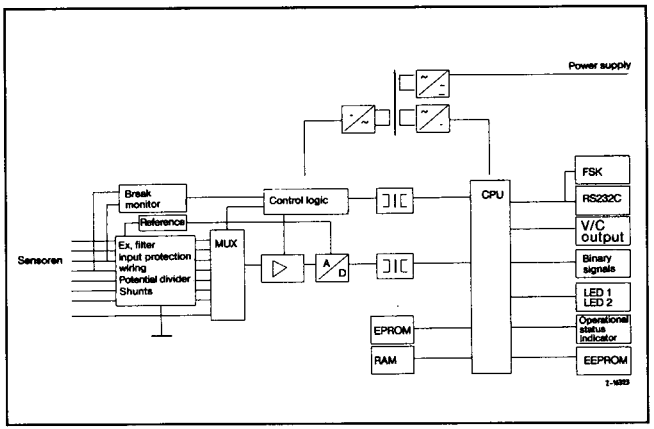

Fig. 16 Functional diagram

The input signals are routed via the **input protection circuit** to the **measuring point selector switch MUX.** The standard input variables (mV, Ω, mA, V) 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 **control logic** activates the MUX and amplifier.

The sensor **break monitoring** checks the sensor impedance for a maximum value. The **power supply** consists of a clocked direct voltage converter with two electrically isolated output voltages. The **RAM** is a working memory containing the important operational data.

The plug-in **EPROM** contains the transmitter's firmware. The plug-in **EEPROM** contains the parameter definition data.

Note:
The EEPROM can be replaced, a corresponding EEPROM can be ordered acc. to Data Sheet 10/11-3.10 EN.

Caution

The power supply must be switched off when removing the EEPROM. Ensure that the EEPROM is installed in the correct direction.

The **RS 232 C** interface and **FSK** interface permit communication with the PC.

Function modules

The function modules are described in the program CONTRANS.

They can be set to either "active" or "inactive", their order remaining unchanged.

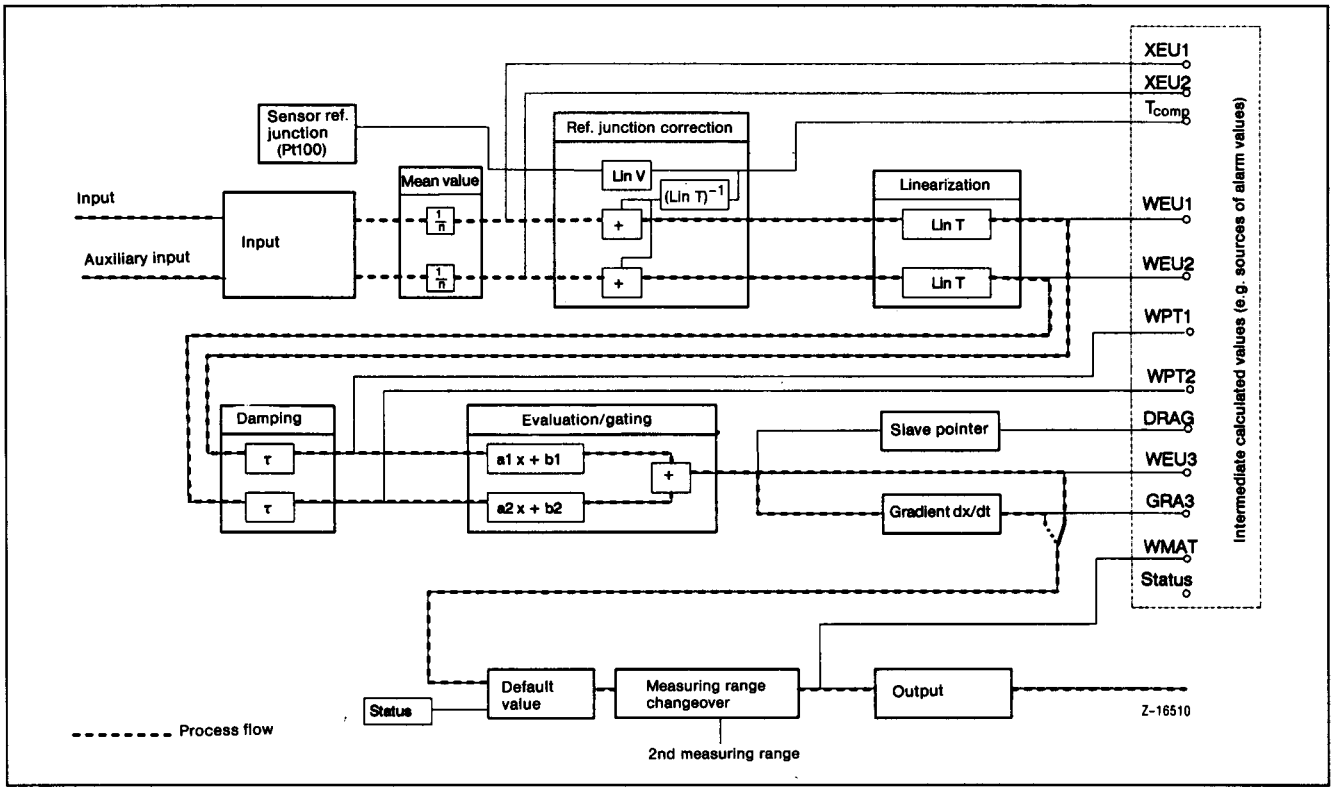

Fig. 17 Function modules

Input

Measuring range setting (by measuring circuit and sensor selection)
Sensor monitoring (break, short circuit)
Reference junction measurement for the internal reference junction
Sensor limits
Line resistance and series resistance of the sensor

Mean value

Mean value calculation on interconnecting several sensors

Reference junction correction

By means of internal or external reference junction

Linearization

Based on standardized curves or customized (max. 64 checkpoints)

Damping

Filter with delay of 1st order (time constant 0... 999.99 s)

Evaluation / Gating

Evaluation / correction can be set separately for the input and auxiliary input. Gating for input and auxiliary input can be parameterized:

None
Mean value
Sum
Difference
Slave pointer min./max.

Gradient

Measured value gradient illustrated at the output

Default value

Default value strategy in the event of an instrument fault

Measuring range changeover

Changeover between two measuring ranges via optional binary input

Output

Measuring range scaling
Output signal: Current, voltage
Signal range adjustment
Underdrive/overdrive range
Output action in the event of a sensor fault or instrument fault

Binary signals

(not illustrated in the figure)
LED1, LED2, binary output 1, binary output 2

Possible assignment
- Not active
- Sensor fault
- Instrument/output fault
- Alarm value

Alarm value setting
- Switch point
- Hysteresis
- Action (min./max.)
- Switching operation (operating/quiescent current)

Alarm value monitoring
- Sensor signal input – XEU1
- Sensor signal auxiliary input – XEU2
- Reference junction correction – Tcomp
- Linearized input – WEU1
- Linearized auxiliary input – WEU2
- Input after damping – WPT1
- Auxiliary input after damping WPT2
- Evaluated / gated measured value – WEU 3
- Gradient of the measured value – GRA3
- Percentage value of the output span – WMAT

Technical data

Input

One input and one auxiliary input

Max. potentials permitted
Analog inputs: V AC = 230 V
Binary input: V AC = 50 V

Measurement types

1 – Simple – 1 sensor at input

2 – Gradient – 1 sensor at input

3 – Mean value – 2...255 sensors in series at input

4 – Mean value – 1 sensor at input
– 1 sensor at auxiliary input

5 – Difference – 1 sensor at input
– 1 sensor at auxiliary input

6 – Sum – 1 sensor at input
– 1 sensor at auxiliary input

Input 0...390 Ω (resistance thermometer)

Measurement types
1, 2, 3, 4, 5 and 6

Sensors
Pt 100 (DIN IEC 751)
Ni 100 (DIN 43 760)
Other resistive pickups

Span
3...390 Ω (with measurement type 2: min. span = 10 Ω/s)

Lower-range value
0...387 Ω

Upper-range value
390 Ω

Measuring range
Can be parameterized

Measuring current
Approx. 0.5 mA

Sensor circuit
Two, three and four-wire circuit
(only three-wire circuit with measurement types 4, 5 and 6)

Max. line resistance
20 Ω/conductor with max. span

(sensor) break monitoring
Response threshold approx. 1 kΩ

Line balancing
Can be parameterized or via
test connector (19" plug-in card / IP 20 surface-mounting case)
Plug-in jumper (IP 54 field case)

Input –8... +56 mV (thermocouples)

Measurement types
1, 2, 3, 4, 5 and 6

Sensors

Type B: Pt30Rh-Pt6Rh	(DIN IEC 584)
Type E: NiCr-CuNi	(DIN IEC 584)
Type J: Fe-CuNi	(DIN IEC 584)
Type K: NiCr-Ni	(DIN IEC 584)
Type L: Fe-CuNi	(DIN 43 710)
Type N: NiCrSi-NiSi	(DIN IEC 584)
Type R: Pt13Rh-Pt	(DIN IEC 584)
Type S: Pt10Rh-Pt	(DIN IEC 584)
Type T: Cu-CuNi	(DIN IEC 584)
Type U: Cu-CuNi	(DIN 43 710)

Other thermoelectric voltage sources

Span
1...64 mV (with measurement type 2: min. span = 2 mV/s)

Lower-range value
–8... + 55 mV

Upper-range value
56 mV

Measuring range
Can be parameterized

Input current
≦ 10 nA

Temperature compensation
Internal (Pt 100)
External

(sensor) break monitoring
Response threshold approx. 1 kΩ
Max. source resistance < 700 Ω

Input –28... +200 mV (thermocouples)

Measurement types
1, 2, 3, 4, 5 and 6

Sensors

Type B: Pt30Rh-Pt6Rh	(DIN IEC 584)
Type E: NiCr-CuNi	(DIN IEC 584)
Type J: Fe-CuNi	(DIN IEC 584)
Type K: NiCr-Ni	(DIN IEC 584)
Type L: Fe-CuNi	(DIN 43 710)
Type N: NiCrSi-NiSi	(DIN IEC 584)
Type R: Pt13Rh-Pt	(DIN IEC 584)
Type S: Pt10Rh-Pt	(DIN IEC 584)
Type T: Cu-CuNi	(DIN IEC 584)
Type U: Cu-CuNi	(DIN 43 710)

Other thermoelectric voltage sources

Span
3.5...228 mV (with measurement type 2: min. span = 7 mV/s)

Lower-range value
–28... + 196.5 mV

Upper-range value
200 mV

Measuring range
Can be parameterized

Input current
≦ 10 nA

Temperature compensation
Internal (Pt 100)
External

(sensor) break monitoring
Response threshold approx. 1 kΩ
Max. source resistance < 700 Ω

Input 0...5 kΩ (resistance thermometer)

Measurement types
1, 2 and 3

Sensors
Resistance teletransmitters
Other resistive pickups

Span
0.1...5 kΩ (with measurement type 2: min. span = 200 Ω/s)

Lower-range value
0... 4.9 kΩ

Upper-range value
5 kΩ

Measuring range
Can be parameterized

Measurement current
Approx. 50 µA

Sensor circuit
Two-wire circuit

Line balancing
Can be parameterized or via
test connector (19" plug-in card / IP 20 surface-mounting case)
Plug-in jumper (IP 54 field case)

Input -2.3...+16 V (voltage sources)

Measurement types
1, 2, 3, 4, 5 and 6

Sensors
Voltage sources

Span
0.3...18.3 V (with measurement type 2: min. span = 0.6 V/s)

Lower-range value
-2.3... + 15.7 V

Upper-range value
16 V

Measuring range
Can be parameterized

Input resistance
> 470 kΩ

Input –10...+70 mA (current sources)

Measurement types
1, 2, 3, 4, 5 and 6

Sensors
Current sources

Span
1.25...80 mA (with measurement type 2: min. span=2.5 mA/s)

Lower-range value
– 10...+ 68.75 mA

Upper-range value
70 mA

Measuring range
Can be parameterized

Input resistance
< 10 Ω

Binary input (measuring range changeover)

Connection: Floating contact
Measuring range 1: Contact closed (R < 3 kΩ)
Measuring range 2: Contact open (R > 100 kΩ)

Assignment of the inputs to the measuring circuit combinations:

Inputs	MC 41	MC 42	MC 44	MC 45
0...390 Ω	X	–	–	–
–8...+56 mV	X	X	–	–
–28...+200 mV	X	X	–	–
0...5 kΩ	–	X	–	–
–2.3...+16 V	–	–	X	–
–10...+70 mA	–	–	–	X

Output

Max. permissible potential
V AC = 50 V

Analog

Output	0/4...20 mA	0...10 V
Output span	4...20 mA	2...10 V
Lower range value	0...16 mA	0...8 V
Upper-range value	20 mA	10 V
Underdrive/ overdrive	−0.4...+22 mA	−0.2...+11 V
Load	≦ 750 Ω (IP 54 with FSK ≧ 250 Ω) Open-circuit-proof	≧ 2 kΩ Short-circuit-proof
Output monitoring	Open circuit > 0.1 mA	Short circuit > 0.1 V
Residual ripple	≧ 0.5 %	≧ 0.5 %
Output range	Can be parameterized (falling characteristic can be set by specifying lower-range and upper-range value)	
Resolution	> 15 bits (max. output span)	

Binary
Relay with NO or changeover contacts
Switching capacity $P_{max.}$ = 10 W, 10 VA; cos φ ≧ 0.7
Switching current C AC/DC $_{max.}$ = 0.5 A
Switching voltage V AC/DC $_{max.}$ = 50 V

Transistors / optoelectronics couplers
Switching voltage V DC = 24 V
Switching current V $DC_{max.}$ = 33 V
$C_{max.}$ = 100 mA
Voltage drop < 3 V (switch closed)

Interfaces

RS 232 C or
FSK acc. to HART specifications

Response time

Measurement types 1, 2 and 3
Typically 350 ms, max. 500 ms
For input 0...390 Ω
Three-wire circuit: Typically 700 ms, max. 1000 ms
Four-wire circuit: Typically 450 ms, max. 650 ms

Measurement types 4, 5 and 6
Typically 450 ms, max. 650 ms
For input 0...390 Ω
Three-wire circuit: Typically 1200 ms, max. 1600 ms

Filter

1st order 0...999.99 (can be parameterized)

Characteristic

64 checkpoints (can be parameterized)

Power supply

Versions

Non-explosion protection	V AC/DC	= 24 V, 115 V and 230 V
	V DC	= 48/60 V
Explosion-protection	V AC/DC	= 24 V
	V AC	= 115 V and 230 V
	V DC	= 48 V

Direct voltage
± 25 %; with V DC = 24 V: 18...33 V

Residual ripple
≦ 20 % within the tolerance range

Alternating voltage
−15 ... 10 %; 48...62 Hz

Power consumption
Approx. 3.2 W

Features under nominal conditions acc. to IEC 770

Measurement deviation
Referred to Ω, mV, V, mA and °C with resistance thermometer
0.2 % · measured value + 0.02 % · max. span
Additional measurement deviation with internal reference junction 0.8 K;
1 k (for surface-mounting case IP 0 without balancing)

Characteristic deviation
Referred to Ω, mV, V and mA
0.05 % · span + 0.005 % · max. span

Influences

Ambient temperature
Referred to mV
(0.07 % · measured value + 0.001 % · max. span)/10 K
Additionally with internal reference junction
0.1 K / 10 K

Referred to Ω, V and mA
(0.1 % · measured value + 0.001 % · max. span)/10 K

Power supply
Referred to Ω, mV, V and mA
< 0.01 % · measured value / 10 % · voltage change
< 0.01 % · measured value with 48...62 Hz change in frequency

Parasitic voltage at the input
Referred to Ω, mV, V and mA

50 Hz symmetrical	< 0.1 % · measured value with 3 · measured value
50 Hz asymmetrical	< 0.006 % · max. span
To V_{rms} = 250 V	< 0.006 % · max. span
To V DC = 250 V	

Influences at the output
With current < 0.1 % in the load range 0...750 Ω
With voltage < 0.1 % of 2 kΩ...∞

Electromagnetic compatibility
General interference immunity based on NAMUR recommendation for:
- Mains supply tolerances
- Mains interruption for power supply V AC/DC = 230 V
- Inrush current limitation for alternating voltage power supply units
- Transient overvoltages
- Discharge of static electricity
- Electromagnetic fields

General and safety data

Climatic capabilities

Design	19"plug-in card	Surface-mounting case IP 20	Field case IP 54
Climatic class	JSF	JVF	HVD
Ambient temperature	−10...+20 ...+70 °C	−10...+20 ...+55 °C	−25...+20 ...+55 °C
Transportation and storage temperature	−40...+85 °C	−40...+85 °C	−40...+85 °C
Relative atmospheric humidity	≦ 75 %	≦ 75 %	≦ 80 %
Condensation	None	None	Permissible

Permissible ambient temperature of an equipped 19" subrack
with 4 T spacing ≦ 55 °C
with 5 T spacing ≦ 65 °C
(5 T spacing = 4 T spacing + 1 T width between the units)

Mechanical stress capabilities

Testing

Acc. to DIN IEC 68 Part 2-27 and
Acc. to DIN IEC 68 Part 2-6

During transportation
Shocks 30 g/18 ms

During operation
Vibration 2 g/± 0.15 mm / 5...150 Hz;
Vibration 2 g/± 10 mm / 1...35 Hz

Seismic stress capabilities

Strong to very strong earthquakes based on Draft DIN IEC 50A(CO) 179

Connection, case and mounting

Design	19" plug-in card	Surface-mounting case IP 20	Field case IP 54
Electrical connections	32-pole blade connector strip acc. to DIN 41612 Design D or F	Screw terminals for 2.5 mm² including thimbles or tab connectors 6.3 mm with insulating sleeves	Screw terminals for 2.5 mm² including thimbles
Degree of protection acc. to 40050	IP 00	IP 20	IP 54
Class of protection acc. to VDE 0411 IEC 348	I	II I with explosion-protection	II
Degree of contamination [1]	2 (only with explosion-protection version)		
Overvoltage category [1]	III for power supply V AC/DC = 24 V V DC = 48/60 V II for power supply V AC/DC = 115/230 V II for input and output circuit		

1 DIN VDE 0110 Part 1/2 of 01.89 applies for the non-explosion-protection version

Connection, case and mounting

Design	19″ plug-in card	Surface-mounting case IP 20	Field case IP 54
Tested acc. to to DIN VDE 0411	Mains against input/output 4 kV (remove Y capacitors) Input against output 4 kV		
Material	Glass-fibre-reinforced polycarbonate		
Colour	RAL 7032		
Mounting orientation	Vertical		Cable glands facing downwards
Weight	Approx. 0.6 kg	Approx. 1.0 kg	2.0 kg

Explosion protection

Manufacturer's code
49/11-44 Ex

Certificate of conformity,
PTB No. Ex-91.C.2121 X

Input circuit
Type of protection intrinsic safety
[EEx ia] IIC or
[EEx ib] IIC

Ambient temperature
Max. + 70 °C

Mounting
Outside the hazardous area

Maximum transmitter values
$V_o = 7$ V; $C_k = 15$ mA; $P = 0.06$ W;
$L_i = 0.5$ mH; $C_i = 500$ nF

Connection data permitted
See Certificate of Conformity

Packing instructions

If the original packing is no longer available, the Transmitter TEU 411, TEU 411-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) for the transportation. The amount of cushioning must be adapted to the weight of the unit and to the mode of transport. The crate must be labeled "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.

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