TEU 704, TEU 704-Ex

Transmitters
two-wire, for temperature and
direct current variables

Operating manual

42/11-20 EN

Rev. 04

ABB

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Safety Notes

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 present Operating Manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the apparatus in safe condition.

- 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 covers or removal of parts is likely to expose live parts.
- The apparatus shall be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair.
- Any adjustment, maintenance and repair of the opened apparatus under voltage shall be avoided as far as possible and, if inevitable, shall be carried out by a person who is aware of the hazard involved.
- 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.

TECHNICAL DESCRIPTION

1 Application

The transmitter TEU 704, TEU 704-Ex is suitable for DC voltage, DC current and resistance measurements (e.g. temperature measurements with thermocouples or resistance thermometers). It converts the input variable into a load-independent 4...20 mA DC current signal.

The type of measurement can be set with solder links and the measuring range with resistors. The transmitter can easily be mounted on pipes or on walls close to the point of measurement.

2 Technical data according to VDI/VDE 2191

Application		Measuring circuit
for mV transmitters and thermocouples with external or internal reference junction with or without start-of-range displacement		
	linear with voltage	751
	linear with temperature	752.1–4
mV difference or temperature difference with 2 thermocouples		
	linear with voltage	753
Resistance thermometer		
Two-wire circuit	linear with resistance	771
	linear with temperature for Pt 100 IEC	772
Three-wire circuit	linear with resistance	773
	linear with temperature for Pt 100 IEC	774
2 resistance thermometers in temperature difference circuit		778
Current measurement with or without start-of-range displacement in summation or differentiation circuit (2 current inputs)		781 782
Resistance teletransmitter		791

Input

(for standard measuring ranges see Data Sheet 11–1.00 EN)

Setting limits	Span	Lower-range value
Measuring circuit 751,		
752, 753	1...100 mV	−13...+150 mV
771, 773	3.2...250 Ω	10...320 Ω
772, 774	10...230 Ω	20...320 Ω
778	3.2...40 Ω	$T_1 = T_2$
791	20...1000 Ω	0...270 Ω
781	0.01...100 mA	
781	lower-range value depending on span −6.5 ...+100 mA (for 1.75...100 mA) −0.245 ...+5.66 mA (for 65 µA...1.75 mA) −0.036 ...+0.85 mA (for 10...65 µA)	
782	ΔI 200 µA...50 mA	

Table 1

The lower-range value and the span can be set by changing fixed resistors.

Permissible source resistance or line resistance

Measuring circuit 751,752	
753	up to 1 kΩ/mV without balancing (with break monitoring max. 10 Ω/mV)
771,772	for two-wire circuit 10 Ω balancing resistor provided internally
773,774	for three-wire circuit up to 10 Ω without balancing (the same resistance of line conductors is necessary)
778	line resistance balancing with zero point potentiometer
781	> 1000 × input resistance
791	10 Ω balancing resistor provided internally

Overload limit[1]			
Voltage	−0.7 V or 1.1 A +2.7 V or 0.29 A		
Resistance	open circuit input is permitted		
Current	1:100 for < 5 mA 1: 10 for ≧ 5 mA 1: 5 for ≧ 50 mA		
Input resistance	MK 751, 752, 753		
for voltage measurement	> 1 MΩ		
for current measurement	Measuring circuit 781		Measuring circuit 782
	> 50 mA	1 Ω	
	1.75...50 mA:	2 Ω	$\frac{100\ mV}{I_{1,2}}$
	65 µA...1.75 mA:	53 Ω	
	10 µA...65 µA:	353 Ω	

Measuring circuit options

Thermocouple break monitoring		Thermometer and wire break monitoring
Measuring circuit capacitance	Any[1]	Any[1]
Permissible measuring circuit resistance	10 Ω/mV	0...1000 Ω
Output signal rising or falling		

Table 2

Digital indicator (LCD)

Extent of display 0 ± 1999 3½digit
Figures 25 mm high, visible through window in case lid
Decimal point can be freely selected
Voltage drop at 20 mA: ≦ 1.2 V

Display range for measuring ranges with zero displacement (span = display upper-range value − display lower-range value)

Display lower value (NP)	Span
min. max	
(−0.55... +0.82) x span	≧ 1100 digits
(−1.2 ... +1.85) x span	600...1099 digits
(−2.2 ... +3.54) x span	300... 599 digits
(−2.6 ... +7.33) x span	150... 299 digits

Overflow — Display only figure "1"

[1] For TEU 704-Ex note certificate of conformity

Output

Output signal	4...20 mA load-independent DC
Supply	from DC voltage source
Terminal voltage	$U_{min.} = 12$ V (13 V for TEU 704-Ex with electrical isolation and digital display) $U_{max.} = 36$ V (26 V for TEU 704-Ex)
Current drain	4...20 mA
Permissible load	$R_a = \frac{U_s - U_{min.}}{0.02}$ (Ω); where U_s = supply voltage
Permissible residual ripple of supply voltage	1.5 V (peak to peak < 120 Hz of $U_{min.} - U_{max.}$)
Residual ripple of output signal	< 1% (peak to peak)
Limit of output current[1]	Version without electrical isolation < 27 mA Version with electrical isolation < 36 mA
Underranging	Limitation of output current between 2...4 mA

Mechanical capabilities

Tested to	DIN IEC 68 Part 2-6, 2-27
In operation	
Impact	50g/11 ms
Continuous impact	25g/6 ms/1000 per axis
Vibration	2.5g/±0.17 mm/5...150 Hz 5g/±0.4 mm/5...55 Hz
Seismic capability class	II based on DIN 40046 Part 55
Vibration	1g/5...35 Hz

Environmental capabilities

H&B climate group according to WN 120-005	3
Application class according to DIN 40040	HSD
Ambient temperature[1]	-25...+70°C -20...+70°C (with Display)
Transportation and storage temperature	-30...+80°C
Relative humidity, annual average	≦ 80%
Condensation	permissible
Degree of protection according to DIN 40050	IP54 or IP65

[1] For TEU 704-Ex note certificate of conformity
[2] Relative to output voltage
[3] With lower-range value ≧ -50°C
[4] < 0.8% for type E with lower-range value ≦ 200°C
[5] < 1.5% for type R, S with lower-range value ≦ 400°C
[6] For lower-range value ≧ 800°C
[7] The curve is divided into 4 equidistant sections, which are parallel to the Y-axis. The max. error is the distance between the curve and the straight lines, which are formed by the intersection of curve/cutting line
[8] With internal reference junction, temperature compensation is required between reference junction and terminals

Case and mounting

Electrical connections	Screw terminals for max. 1.5 mm²
Material	Glass-fibre reinforced polyester
Color	TEU 704-Ex black RAL 9011 TEU 704 gray RAL 7032
Operating orientation	cable glands downwards
Weight	approx. 1 kg
Imprint on the rating plate	in German, English, French
Class of protection according to VDE 0411 or IEC 348	
Insulation group according to VDE 0110	C
Test voltage according to VDE 0411	For version with electrical isolation input with respect to output 1.5 kV
Radio interference level according to VDE 0875	N

Features in steady-state condition under nominal conditions

Basic shape of characteristic	linear		
Characteristic coincidence at limit point setting			
Measurement error	< ± 0.5%[2] (0,25% as "option" Digital display < ± 0.2% ± 1 digit with internal reference junction add. 0.5 K		
Non-linearity	Measuring circuit	752.1...3[1]	Type J, K, E < 0.4%[3][4] Type L, T < 0.6%[3] Type R, S, U < 0.65%[3][5] Type B < 0.7%[6]
		752.4	Depending on shape of curve[7]
		778	< 0.3%
		772, 774	< 0.2% for temperatures > 0°C
	all other measuring circuits < 0.2%		

Nominal conditions

Ambient temperature	18...28°C
Permissible temperature change during measurement	2 K
Supply voltage	$U_{min.}...U_{max.}$
Load	≦ $R_{a\,max.}$
Heating up time	≦ 5 seconds (without internal reference junction)[8]

Features in steady-state condition with deviation from nominal conditions

Effect of ambient temperature	≦ 0.2 %[1] / 10 K at zero ≦ 0.1 %[1] / 10 K over span Additional error with built-in reference junction compensation about 0.3 °C / 10 K with Pt 100 IEC for spans < 50 K: 0.05 °C / 10 K Digital indicator < 0.1 % / 10 K on 2000 digits
Effect of supply voltage	< 0.1 %[1] between $U_{min.}$ and $U_{max.}$

Effects on input

Parasitic voltage effect of a symmetrical 50 Hz AC voltage	< 0.1 %	within output range 5...100 % with 2 x span increased residual ripple
unsymmetrical 50 Hz AC voltage	< 0.1 %	up to max. 60 V_{rms}
unsymmetrical DC voltage	< 0.1 %	up to max. 60 V
Effect of radio frequency (interference)	< 0.3 %	at 27...460 MHz 1 W transmission power 0.5 m from aerial

Effects on output

Effect of load	< 0.05 %	in load range
Effect of voltage	< 0.1 %	per 60 V (with electrical isolation)

Time behavior (dynamic behavior)

Jump from 10 % to 90 %, residual error ± 1 %, aperiodic setting

	mV, mA measurement	Ω measurement
Setting time (Ta)	$\approx \frac{20\ mV}{\Delta U\ (mV)} \cdot 100\ ms$	$\approx \frac{100\ \Omega}{\Delta R\ (\Omega)} \cdot 100\ ms$
Recovery time after interruption of measuring circuit	$\approx \frac{20\ mV}{\Delta U\ (mV)} \cdot 0.5\ s$	$\approx \frac{100\ \Omega}{\Delta R\ (\Omega)} \cdot 0.5\ s$

Table 3

Long time effect < 0.2 % / year

Explosion protection

Manufacturers identification code	49/11–41 Ex
Type test certificate	PTB No. Ex-87.B.2037
Type of protection	Intrinsic safety "i"
Marking	EEx ib IIC T5/T6 or EEx ib [ia] II CT5/T6
Temperature class	T6 at ambient temperatures up to + 50 °C T5 at ambient temperatures up to + 65 °C

Mounting of transmitter in the case of all TEU 704-Ex types within zones 1 and 2 or outside the hazardous areas.

Mounting of the intrinsically safe measuring circuit in zone 0 for types TEU 704-Ex.A and D together with a suitable measuring transmitter can be certified by a Test Authority.

Type key	Electrical isolation	Measuring circuit: Type of protection	Measuring circuit: Transmitter connection
TEU 704-Ex.A	built in	EEx ia II C	active transmitter measuring circuits 751, 752.1...4 753, 781
TEU 704-Ex.B	built in	EEx ib II C	
TEU 704-Ex.C -Ex.G	not built in	EEx ib II C	
TEU 704-Ex.D	built in	EEx ia II C	passive transmitter measuring circuits 771, 772, 773, 774, 778, 791
TEU 704-Ex.E	built in	EEx ib II C	
TEU 704-Ex.F -Ex.H	not built in	EEx ib II C	

Table 4

Supply and signal current circuit	Type of protection intrinsic safety EEx ib II C only for connection to certified intrinsically safe circuits with the following maximum values: U = 26 V I = 35 mA P = 0.6 W
Effective internal inductance	≦ 60 µH
Effective internal capacitance	≦ 2 nF
Measuring current circuit	type of protection intrinsic safety (see Table 4)

Maximum values of transmitter

Type TEU 704-Ex.A
-Ex.B U = 12.5 V I = 9 mA P = 28 mW
-Ex.C
-Ex.G

For maximum permissible La and Ca see Certificate of Conformity.

Type TEU 704-Ex.D
-Ex.E U = 12.5 V I = 15 mA P = 47 mW
-Ex.F
-Ex.H

Maximum permissible	TEU 704-Ex.D	TEU 704-Ex.E, F, H
La		
Ca		

[1] Referred to the output span

3 Mode of operation

3.1 General principle of operation

The input signal is supplied to the amplifier (2) via the input circuit (1) determining the type of measurement and measuring range and is converted into a load-independent DC current in the output stage (3). This flows via the electrical isolation stage and the negative feedback resistor RK, on which it produces a voltage drop, which is fed to the input. The output current changes until the difference between the input voltage and the feedback voltage is nearly zero. The constant voltage source (5) supplies the components with a stabilized voltage.

In the version without electrical isolation, the constant voltage source (5) and the output stage (3) are connected directly to the output terminals.

The isolating stage consists of the prestabilization (9), the multivibrator with transistor chopper (8), the isolating transformer (7) and the rectifier (6).

The current is supplied via the output line by the basic current of 4 mA, on which a current up to 20 mA proportional to the measured variable builds up. The output current or the measured variable can be read off on the built-in digital indicator (10). With the linearization module (11) an output signal linear with temperature is produced when measuring with thermocouples. For measurements with resistance thermometers, linearization is effected with the supply current of the Pt 100 DIN IEC 751. If the measuring circuit is interrupted, the output signal is controlled by the line break monitoring device (4) so that the lower or upper range value is exceeded.

3.2 Applied circuits

Matching to type of measurement and span is done by soldered links and resistors. In principle all measuring circuits can be implemented. A measuring circuit number 7... is assigned to each type of measurement.

The measuring range of each measuring circuit is roughly balanced by fitting resistors and is exactly balanced by the built-in potentiometers.

Measuring circuits 751, 752, 753

DC voltages in the mV range are converted by the compensation method into output signals proportional to the input value. For measuring circuits 751 and 753, the output variable is linear with voltage and for measuring circuit 752, the output variable is linear with temperature. The measuring circuit 752 is suitable mainly for linearizing thermocouple voltages.

A copper coil is soldered in for internal reference junction compensation.

Measuring circuits 771, 772

These measuring circuits are suitable for connection to resistance thermometers Pt100 IEC in two-wire circuit. One can decide by wiring (solder link) whether the output current is to be proportional to the change of resistance or to the change of temperature.

The linearization (measuring circuit 772) is effected by the Pt100 measuring current dependent on the amplifier control. The measuring current passing through the resistance thermometer is about 0.7 mA.

Measuring circuits 773, 774

The measuring circuits 773, 774 are provided for the connection of resistance thermometers Pt100 IEC in three-wire circuit. One can decide by wiring whether the output current is to be proportional to the change of resistance or to the change of temperature. Linearization (measuring circuit 774) is done in the same way as for measuring circuit 772. The measuring current is about 0.7 mA.

Measuring circuit 778

The measuring circuit 778 is intended for differential temperature measurement with 2 resistance thermometers. The two thermometers supplied with current form "half a bridge", where the difference in resistance is amplified and transformed into a linearized output signal over the working range.

Measuring circuit 781, 782

For current measurement, the input current to be measured is switched to a shunt and thus led back to a voltage measurement.

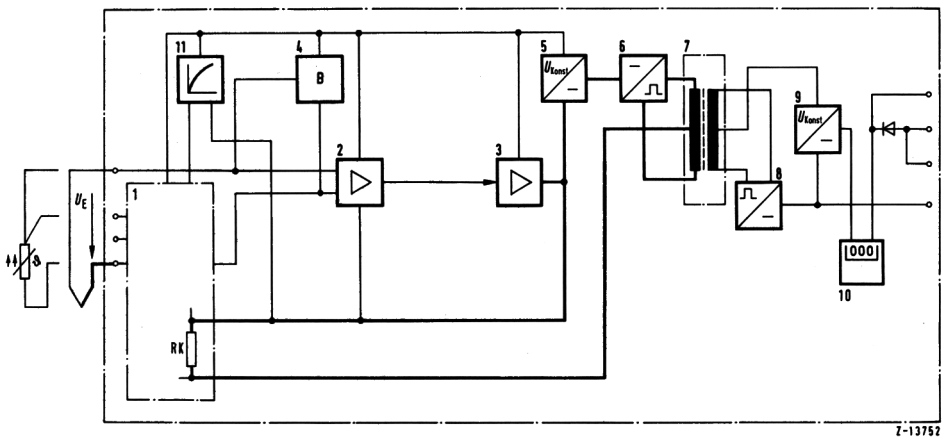


Fig. 1 Block diagram of TEU 704 with electrical isolation

1 Input circuit
2 Amplifier
3 Output stage
4 Line break monitoring
5 Constant voltage source
6 Rectifier
7 Isolating transformer
8 Multivibrator with transistor chopper
9 Prestabilization
10 Digital display
11 Linearization device

Measuring circuit 791

The resistance teletransmitters are supplied by a highly resistive series resistor.

The measuring voltage produced at the teletransmitter, depending on position, is tapped between the minus connection of the bridge circuit (ground) and the slider, and converted into a proportional output signal. As only the minus line 52–11 (teletransmitter start – see also wiring diagram) produces a voltage drop, which falsifies the reading, a balancing resistor of 10 Ω (internal) is required for this teletransmitter circuit. Due to the high internal resistance of the measuring circuit 791 and the input amplifier, the resistance of cores 51–12 (teletransmitter tap) and 53–13 (end of teletransmitter) is not included in the result.

4 Construction

The complete electronics is accommodated in a robust plastic case. After slackening 4 screws, the plug-in electronics can be taken out of the case. The connection plate with the terminals and the connected wires remains in the case.

With the non-plug-in version, the electronics with the terminals are situated on a motherboard which, after undoing the fixing screws and the connected wires, can be taken out of the case.

The electronics is solidly connected to the case by four screws. The modules' chopper amplifier, electrical isolation and linearization are situated on the back of the motherboard.

The optional field indicator as digital indicator (figures 25 mm high) is mounted on the equipment side and can be swung open.

The transmitter TEU 704 is accommodated in a grey (RAL 7032) plastic case and the TEU 704 Ex in a black (RAL 9011) plastic case, made of glass-fibre reinforced polyester. Fig. 2 shows the position of the components which determine the type of measurement and the measured variable. The potentiometers for the fine setting of the start of the range and the span are the same in all versions.

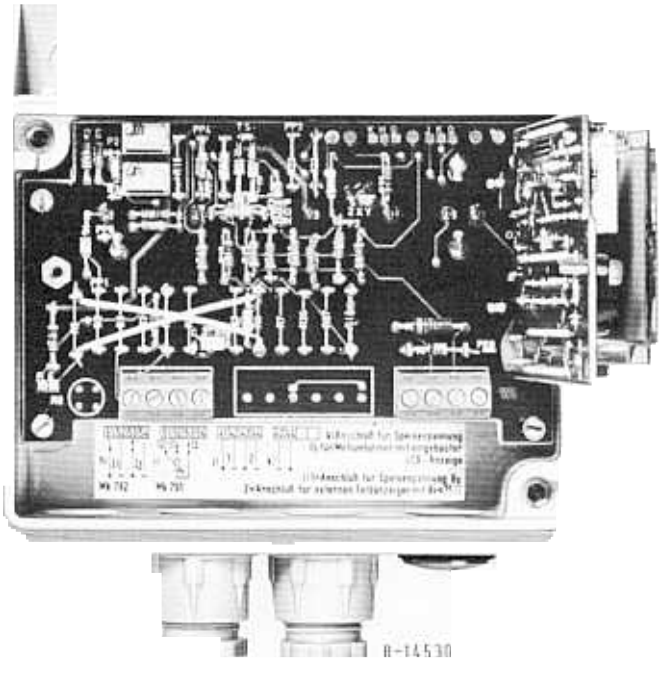


Fig. 2 Motherboard with components (non-plug-in version)

OPERATING INSTRUCTIONS

5 Instructions for mounting and connection

5.1 Mounting the unit

The case is of degree of protection IP 54 or IP 65 and is suitable for pipe and wall mounting in the field. It must be fixed on the projecting strap (for fixing hole spacing see Fig. 7), so that the cable glands point downwards. After removing the case lid, the electrical connections on the terminals can be made with wires up to 1.5 mm².

5.2 Installing the measuring and output signal leads

The requirements of DIN VDE 0100 must be met in the choice of lead material and laying of the measurement and output signal leads. VDE 0165 must also be followed for the explosion protected version.

5.3 Connection diagrams and key

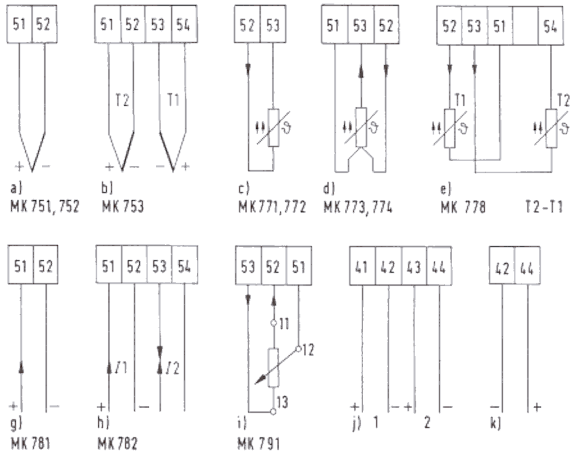


Fig. 3 Connection diagrams

MK measuring circuit.

a) Thermoelectric voltage and mV measurement with and without reference junction correction.
b) Differential temperature measurement with 2 thermocouples.
c) Temperature measurement with resistance thermometer Pt100 two-wire circuit, internal compensation for line resistance.
d) Temperature measurement with resistance thermometer Pt100 three-wire circuit.
e) Differential resistance measurement T2 – T1, balancing of line resistance with zero potentiometer.
g) µA, mA measurement.
h) Current summation or difference measurement with $I_1 \pm I_2$
i) Resistance teletransmitter measurement, internal line resistance balancing (11 start of teletransmitter, 12 teletransmitter tap, 13 end of teletransmitter).
j) 1 = connection of supply voltage for transmitter without built-in digital indicator
   2 = connection for external field indicator with $R_i < 15\ \Omega$.
k) Connection of supply voltage for transmitter with built-in digital indicator.

Key according to DIN 45140 Part 2

Contrans T Transmitter TEU 704

Marking of connection / Terminal layout

DIN 45140 Part 1	on instrument	Graphical symbol/ description	Technical data
31 32	41 42	+ – **I Output**	Supply voltage 12 ≤ Us ≤ 36 V 4 ... 20 mA See Fig. 3 j
31 34	42 44	– + **I Output**	Supply voltage 13 ≤ Us ≤ 36 V See Fig. 3 k
33 34	43 44	+ – **I Output**	Ri < 15 Ω See Fig. 3 j
11 12	51 52	+ – Thermocouple	Thermocouple or mV
11 12 13 14	51 52 53 54	+ – – +	Differential Circuit
12 13	52 53	3 4	Pt 100 IEC Two-wire circuit
11 13 12	51 53 52	3 4	Pt 100 IEC Three-wire circuit
11 12	51 52	3 4	Differential resistance measurement
13 14	53 54	3 4	
11 12 13	51 52 53		Resistance teletransmitter
11 12	51 52	+ – Current input	Current input
11 12 13 14	51 52 53 54	+ – – + Current input for summation or difference measurement	Current input for summation or difference measurement

Table 5

5.4 Imprint on the rating plate

The symbols used on the rating plate have the following meanings:

Transmitter (DIN 30600/ISO 7000)

Transmitter with electrical isolation (DIN 19227 Part 2)

Input (DIN 30600/IEC 417)

Output (DIN 30600/IEC 417)

Reference point (DIN 30600/ISO 7000)
Depending on the version means reference junction or lead balancing

Power supply – electrical energy (DIN 30600/ISO 7000)

Protective isolation symbol (DIN 40014)

Warning sign: Follow the operating manual

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

6 Commissioning

If a two-way radio is used for communication during commissioning, it must have a transmission power of ≦1 W at a minimum distance of 1 m from the transmitter.

6.1 Switching on the unit

After switching on the supply voltage, the unit will be operative. The input and output data of the transmitter can be seen on the rating plate.

Setting of the potentiometers may be done also with uninsulated tools. In normal working conditions, the input and output are open circuit-proof and shortcircuit-proof.

6.2 Balancing the measuring leads

Lead balancing is not necessary for thermocouples and for detectors in the mV and mA range. However, the maximum source resistance given in the "Technical data" must be observed.

For resistance thermometers in a three-wire circuit, no lead balancing is required if the resistances of the leads are equal up to 10 Ω/core. However, it is pointed out that, particularly for low resistance ranges (ΔR < 15 Ω), unequal lead resistances can lead to considerable zero point errors. Small asymmetries (< 2.5 Ω) can be compensated for by the zero potentiometer P2.

In the two-wire circuit and the differential temperature measurement with resistance thermometers, and when connecting resistance teletransmitters, lead balancing is necessary.

Lead balancing can be done as follows:

a) With the built-in lead balancing resistor.
The lead balancing resistor is available on the motherboard. It consists of fixed resistors R42, R43 and R44 for coarse balancing and the zero potentiometer P2 for fine balancing. The bridge A–B, A–C, C–D and D–B must be replugged for coarse balancing.

The following resistances are assigned to the plug-in jumper:

A – B	0 Ω
B – D	2.67 Ω
C – D	5.48 Ω
A – C	7.42 Ω

b) With the potentiometer for the start of measurement.

6.2.1 Lead balancing for two-wire circuit MK 771, 772

The unit must be switched off and the resistance thermometer short-circuited for lead balancing.

The test resistor must be connected into the line.

Switch on the unit and read the indicated resistance and temperature value.

This will normally not agree with the value given on the test resistor.

With the unit switched on, adjust the lead balancing resistor or the zero potentiometer P2 until the required indication is reached.

By replugging the plug-in jumper, the lead balancing resistor can be changed coarsely in 4 steps.

Switch off the unit, disconnect test resistor and remove short-circuit on resistance thermometer.

6.2.2 Lead balancing for differential temperature measurement MK 778

The lead balancing for a differential temperature measurement with resistance thermometers requires 2 test resistors.

Note! For unsymmetrical lead resistances, the lead balancing can be made with the zero potentiometer P2.

6.2.3 Lead balancing for resistance teletransmitter MK 791

For measurements with resistance teletransmitters, the teletransmitter is set to its initial value. Instead of the teletransmitter, a test resistor of the initial value can be connected to teletransmitter terminals 11 and 13, where terminals 12 and 13 are short-circuited (see section 5.3).

Balancing must be done as described in section 6.2.1.

6.3 Measuring circuit option: measuring circuit break monitoring

6.3.1 Thermocouple break monitoring (A)

In order to obtain a defined output signal, on interruption of the measuring leads or the thermocouple, a "thermocouple break monitor" is built into the transmitter. It consists of a resistor, connected to the supply voltage and which can be switched to the input of the amplifier. On interruption of the measuring circuit, the voltage drop at this resistor causes the amplifier output to rise or to fall.

6.3.2 Thermometer and wire break monitoring (B)

In order to obtain a defined output signal on interruption of the resistance thermometer or of the measuring leads, a break monitor is built into the transmitter.

It is situated at the input of the amplifier and consists of a transistor and two resistors.

If the voltage at the resistance thermometer rises above 3 V due to an open circuit, the transistor conducts, and a voltage appears at the input of the amplifier, which produces a rising or a falling output signal.

The device described in section 6.3.1 is used to monitor the 3rd conductor.

6.3.3 Change of direction of action (rising / falling)

The action of the amplifier in producing a falling or a rising output signal is decided by solder links and resistors on the motherboard, and can be changed there, as shown in Table 6. After a change, the transmitter must be recalibrated (see section 7).

MK Version for measured circuit	Measuring accessory none	With output signal	
		rising	falling
A 751, 753, 752.x		N – O	O – P
B 771, 772		X – Z	X – Y
B 773, 774	R1 = 3.9 kΩ	O – N Z – X R1 = 0 Ω	O – P X – Y R1 = 3.9 kΩ
B 778	Solder link Br 10 closed	X – Z	X – Z
B 791		O – N Z – X	O – P X – Y

Table 6 Resistors and bridge wiring of measuring circuit break monitoring

6.4 Internal reference junction compensation

For measurements with thermocouples, the reference junction compensation can also be done in the transmitter.

The reference junction compensation consists of a copper coil, and is soldered directly next to the input terminals.

The internal reference junction compensation is designed for 20 °C, and can be used for different types of couples.

6.4.1 Retrofitting the reference junction compensation

If a transmitter is converted to a measuring circuit with internal reference junction compensation, the reference junction can be ordered from the Works under Cat. No. 11 004-4-0371 549. The reference junction can only be fitted if the four screws of the motherboard are loosened (see section 7).

7 Change of function or of measuring range

The information required for changes to the measurement type, measuring ranges or functions is part of the conversion instructions "TEUKON 7" which can be ordered from the manufacturer. The conversion instructions comprise a software program for calculating the resistors, which are to be replaced, and for assignment of the bridges (see spare parts list).

The program operates under operating system MS-DOS for IBM Personal computers or compatibles.

8 Balancing the field indicator

The following equipment is required to adjust the field indicator: Constant current source, screwdriver and soldering iron. This work must be done in accordance with the mounting and commissioning instructions.

The PCB of the field indicator is screwed to the plastic hinges of the motherboard and can be folded back after slackening one screw (see Fig. 4).

The IC 7126 is plugged into the appropriate IC socket. The appropriate precautions must be taken when dealing with MOS circuits.

The field indicator is connected to the soldered joints U and V of the motherboard by two stranded wires.

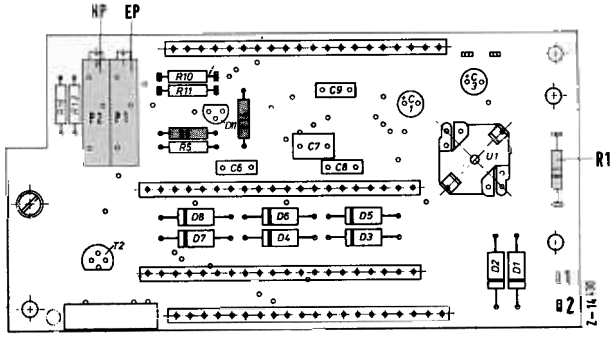


Fig. 4 PCB of field indicator

8.1 Defining the extent of indication

The extent of indication (span) must be at least 150 digits, regardless of the position of the decimal point. The largest possible extent of indication should always be selected. No decimal point is required if the top value of indication is ≧ 200.

		Display
COM 1-2-3	without DP	000 ... 1999
COM 2-3	DP-1	00.0 ... 199.9
COM 1- 3	DP-2	0.00 ... 19.99
COM 1-2	DP-3	.000 ... 1.999

Table 7 Bridge assignment for decimal point (DP) on field indicator (see fig. 5)

The resistor R1 (see Fig. 4) and the solder links to be made must be taken from Table 8.

The solder links and the associated setting ranges are selected so that there is a minimal effect of the zero potentiometer for the required range:

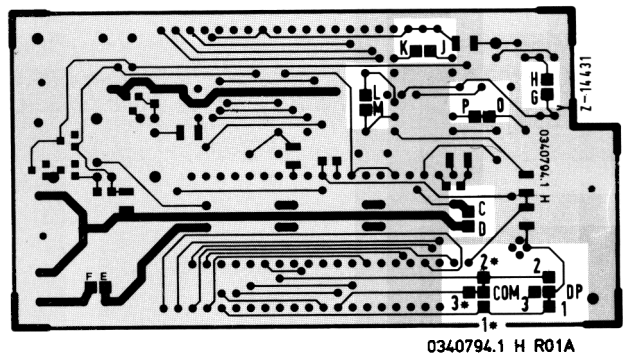
Solder links and resistances depending on the range of measurement are determined as follows:

a) Fit bridges for decimal point depending on extent of indication
b) Fit R1 according to span to be indicated
c) Determine ratio NP/SP for suppressed ranges or NP/MBE for raised ranges and fit the solder links and resistors shown in the appropriate column (see table 8).

R1 (Ω)	Extent of indication Digit	NP suppression NP/SP	NP suppression NP/SP	NP suppression NP/SP	NP suppression NP/SP
1.5	150 - 299	–	-2.6 ... -0.8	-1.1 ... -0.8	-0.8 ... 0.22
3.3	300 - 599	-2.2 ... -1.1	-1.1 ... -0.38	-0.38 ... -0.22	-0.22 ... 0.22
6.2	600 - 1099	-1.2 ... 0.45	-0.45 ... -0.09	-0.09 ... -0.018	-0.018 ... 0.22
11.0	1100 - 1999	-0.55 ... -0.15	-0.15 ... +0.25	–	-0.022 ... 0.031*
Solder links or mini-Melf [1] via solder links		J-K G-H L-M	J-K G-H L-M with 26.7 kΩ mini-Melf [1] bridged	J-K with 20 kΩ mini-Melf [1] bridged	J-K [2] only R1 = 11 Ω bridged

R1 (Ω)	Extent of indication Digit	NP raised NP/MBE	NP raised NP/MBE	NP raised NP/MBE	NP raised NP/MBE
1.5	150 ... 299	0.18 ... 0.61	0.61 ... 0.82	0.82 ... 0.88	–
3.3	300 ... 599	0.18 ... 0.45	0.45 ... 0.69	0.69 ... 0.79	–
6.2	600 ... 1099	0.18 ... 0.36	0.36 ... 0.52	–	0.52 ... 0.65
11.0	1100 ... 1999	0.17 ... 0.30	0.30 ... 0.46	–	0.41 ... 0.55
Solder links or mini-Melf [1] via solder links		G-H	G-H with 6.8 kΩ and L-M with 26.7 kΩ mini-Melf [1] bridged, open 0-P and fit R15 = 5.1 kΩ with mini-Melf [1]	G-H L-M with mini-Melf [1] 26.7 kΩ bridged, open 0-P and fit R15 = 10 kΩ as mini-Melf [1]	G-H L-M

Table 8 Extent of indication
NP zero point
MBE upper-range value
SP span



0340794.1 H R01A

Fig. 5 PCB of field indicator (soldered side)

Example 1 Extent of indication 800 °C ... 1600 °C ≙ 4 ... 20 mA
R1 = 6.2 Ω (span 800 digits)
NP/MBE = 800/1600 = 0.5
according to column 2 (NP raised 0.36 ... 0.52) mini-Melf across G-H with 6.8 kΩ and L-M bridged by mini-Melf with 26.7 kΩ.
Open 0-P and fit R15 as mini-Melf of 5.1 kΩ.

Example 2 Extent of indication 0.80 ... 3.2 bar ≙ 4 ... 20 mA
Decimal point COM 1-3; DP-2
R1 = 1.5 Ω (span 240 digits)
NP/MBE = 0.8/3.2 = 0.25
according to column 1 (NP raised 0.15 ... 0.61) G-H

Example 3 Extent of indication -30.0 ... +20.0 mA ≙ 4 ... 20 mA
Decimal point COM 2-3; DP-1
R1 = 3.3 Ω (span 500 digits)
NP/SP = -30/50 = -0.6
according to column 2
(NP suppression -2.6 ... - 1.1)
Bridge J-K and G- H, Bridge L-M with 26.7 kΩ mini-Melf.

[1] Mini-Melf can be ordered (see list of spare parts)
[2] Specification refers only to the range marked with *

8.2 Adjustment procedure

One pole of the connection to the motherboard of the transmitter must be interrupted and the constant current source connected to solder pins **1** and **2** (see Fig. 4). The positive pole of the current source must be connected to "**2**" and the negative pole to "**1**".

The required display lower-range value is set on the digital indicator using the zero potentiometer (P2) and a value of 4 mA. With a current input of 20 mA from the constant current source, the display upper-range on the digital indicator is set using the span potentiometer (P1).

This procedure must be repeated several times. Disconnect the constant current source and solder wire **1** to **U** and wire **2** to **V**.

9 Explosion protected versions

The TEU 704-Ex is approved for type of protection intrinsic safety EEx ib IIC T5/T6 or EEx ib [ia] IIC T5/T6. It can be installed without limitation by explosion groups in hazardous areas of zones 1 and 2 up to an ambient temperature of 65/50 °C.

When mounting the TEU 704-Ex, the ordinance for electrical equipment in hazardous areas (ElexV), the regulations for installing electrical equipment in hazardous area workshops (VDE 0165) and the Certificate of Conformity must be observed.

The TEU 704-Ex must be supplied by a certified intrinsically safe circuit, reference EEx ib IIC or (Ex) i G5. Fig. 6 shows applications for the transmitter with and without electrical isolation.

If an instrument with a certified intrinsically safe output circuit is connected to the intrinsically safe input circuit of the transmitter, the intrinsic safety of the current circuits has to be maintained in this combination. Some admissible combinations are given in the certificat of conformity PTB No. Ex 87.B.2037. This has to be attested according to VDE 0165/9.83. If for functional reasons the intrinsically safe circuit has to be grounded by connection to the equipotential bonding, the earthing may only be done at one, but arbitrary place. The equipotential bonding must then be present over the whole area of the intrinsically safe circuit.

Work on explosion protected equipment may be done by any one or in any workshop; however, the equipment must be checked and certified by an expert before recommissioning. This is not required if work has been done by the authorized staff of the equipment manufacturer. The repairer must furnish appropriate identification.

After a repair has been done, the date and reference (H&B Certificate No.) of the repairer must be attached to the repaired equipment. Work involving changing the measuring range is excepted from these conditions.

This may be done by the operator's skilled staff, where the conditions of section 7 must be observed. One should take care that damage to or shortcircuiting of resistors or other components must always be avoided. Covers should be used when soldering.

10 Trouble-shooting

If faults occur, the cause should first be sought at the source and its incoming leads. This can be done for voltage measurements by testing for a through circuit and checking the measuring voltage with a suitable measuring instrument (e.g. a portable compensator). Then check the indication circuit by connecting the ammeter in. For resistance measurements, the resistance to be measured must be simulated and the correctness of the current checked at the output of the transmitter.

If the incoming and outgoing circuits of the transmitter are in order, the fault must be sought in the transmitter electronics. This fault can be remedied using the wiring diagram and by replacing electronic units.

11 Maintenance

The TEU 704 transmitter requires no routine maintenance.

12 Packing instructions

If the original packing is no longer available, then the transmitter must be packed for transport protected against shock, in a sufficiently large box with shock-absorbing material (e.g. excelsior, spun rubber etc.) If excelsior is used, the layer should be at least 10 cm thick on each side. The instrument should first be wrapped in paper.

For overseas transport, the transmitter must also be welded airtight in polyethylene foil at least 0.2 mm thick, with a desiccant (e.g. silica gel). With this type of transport, the transport container must be lined with a layer of double bitumen paper on the inside.

This packing instruction also applies for equipment returned to the manufacturer (change of calibration, repair).

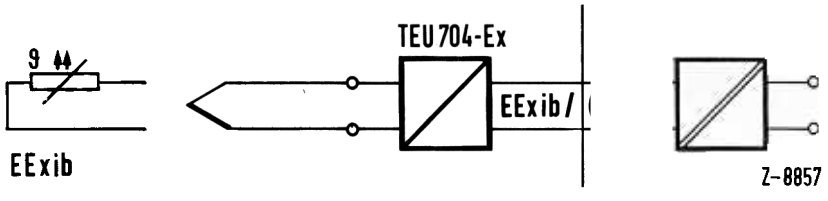


Fig. 6 Example for application of transmitter without electrical isolation

13 Spare parts list

The following components of the transmitters TEU 704 and TEU 704-Ex can be obtained from the Spare Parts Service Department of the manufacturer by giving the designation and catalogue number.

For spare parts orders or complaints of any kind, the equipment number stated on the nameplate should always be quoted.

Designation	Cat. No.
Equipment lid, grey, with window	11004-4-0341392
Case, black, with window	11004-4-0367274
Mounting bracket 2"	11004-4-0367583
Pipe clamp 2"	11005-4-0367584
Cable gland Pg 11	94372-4-0839748
Cable gland Pg 11, Ex	94671-4-0839774
Chopper amplifier [1]	11004-4-0365490
Chopper amplifier [2]	11004-4-0365489
Chopper amplifier Ex [1]	11004-4-0365492
Chopper amplifier Ex [2]	11004-4-0365491
Electrical isolation	11004-4-0340465
Electrical isolation Ex	11004-4-0340376
Digital indicator	11004-4-0367856
Connection plate	11004-4-0340749
Internal reference junction 20 °C	11004-4-0371549
Mini-Melf resistors	11004-4-0365123
Software for transposing measuring tasks	
TEUKON 7	
5¼" diskette in German	11095-0-1100000
5¼" diskette in English	11095-0-2100000
5½" diskette in German	11095-0-1200000
5½" diskette in English	11095-0-2200000

[1] For transmitter without electrical isolation
[2] For transmitter with electrical isolation

Note

All spare parts sales are handled by means of EDP. Thus, the catalog designation (≙ object) on the order confirmation, shipping papers and invoice are subject to the laws of automatic data processing. Verbal deviations are possible in the paperwork of the manufacturer.

The Catalog No. is the sole criterion!

14 Dimensional drawings

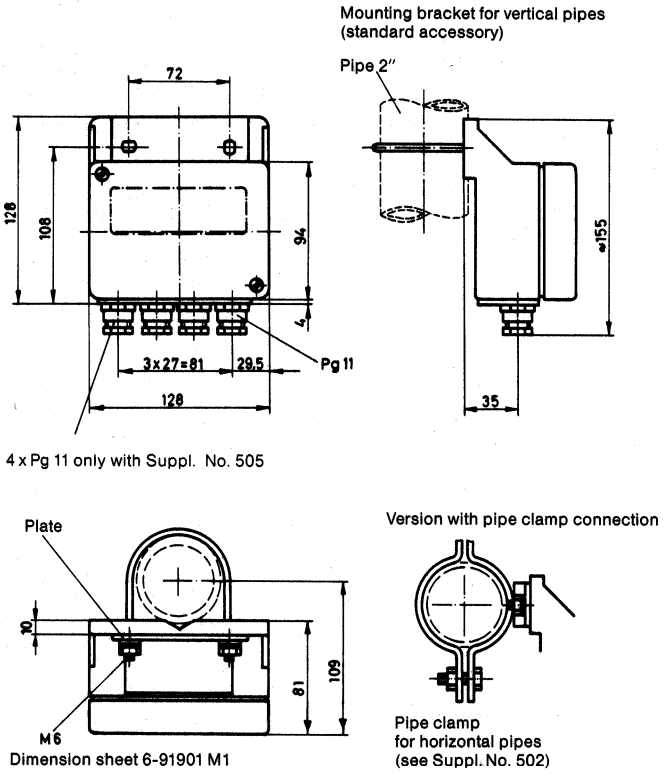


Fig. 7 Dimensional drawings and examples of mounting

15 Circuit diagrams

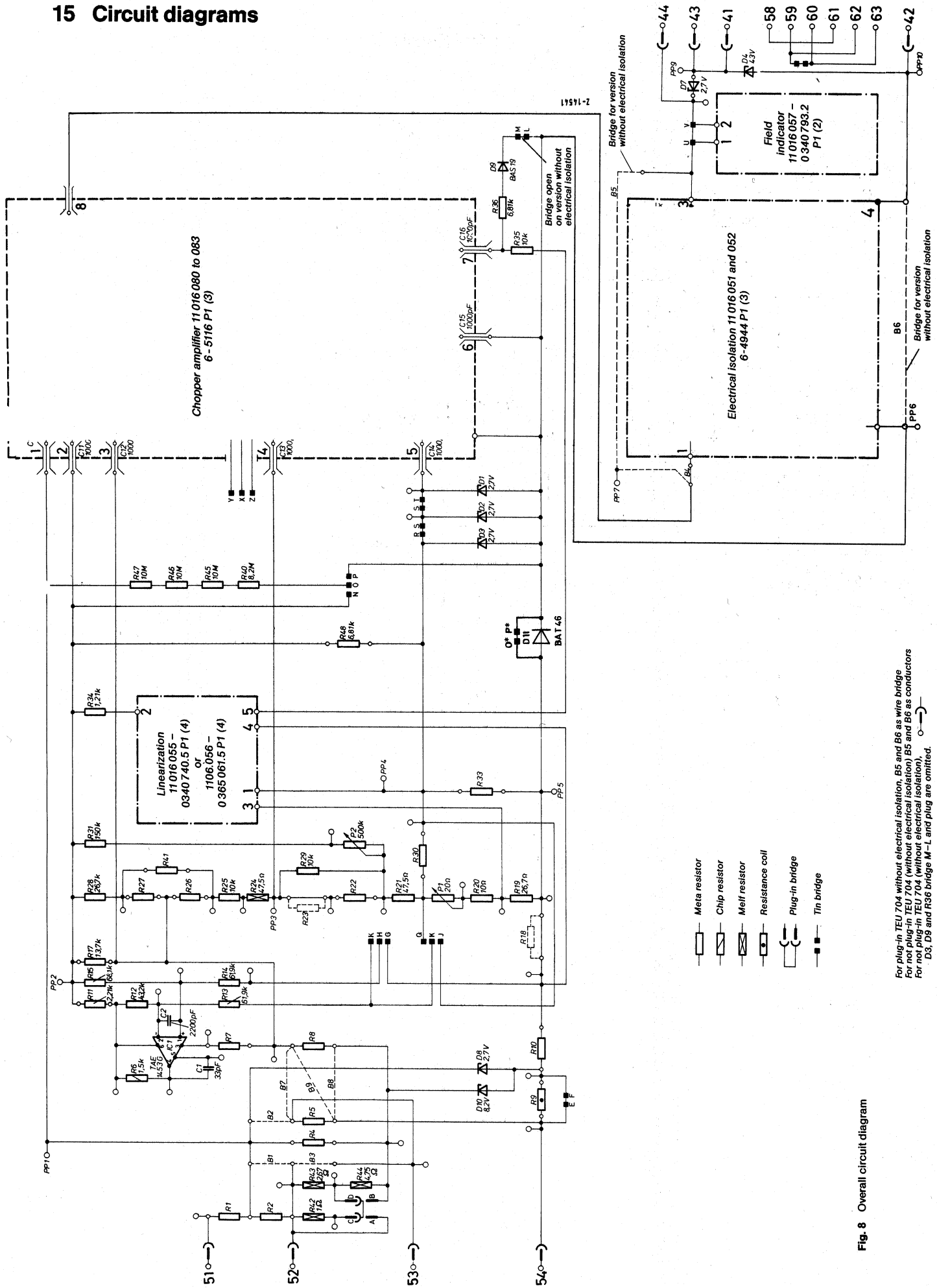


Fig. 8 Overall circuit diagram

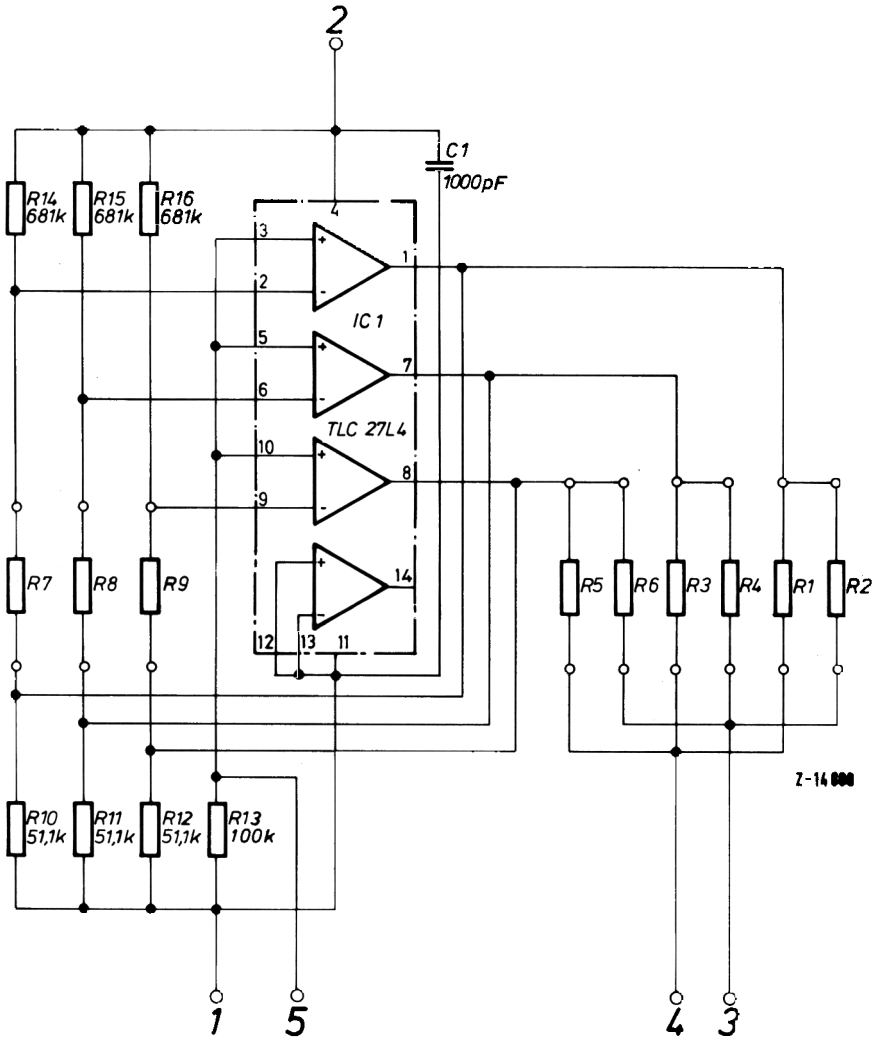


Fig. 9 Linearization device

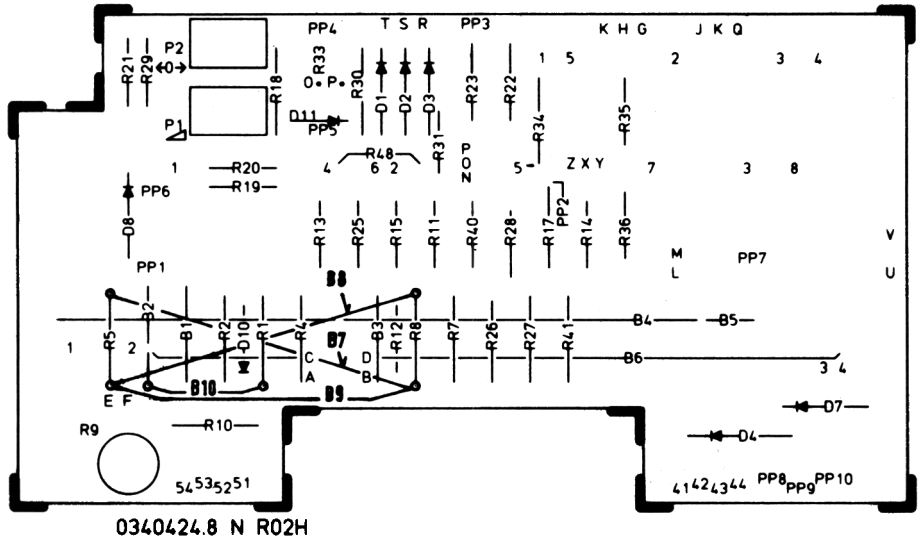


Fig. 10 Layout of the resistors and bridges determining the function and the type of measurement in plug-in version

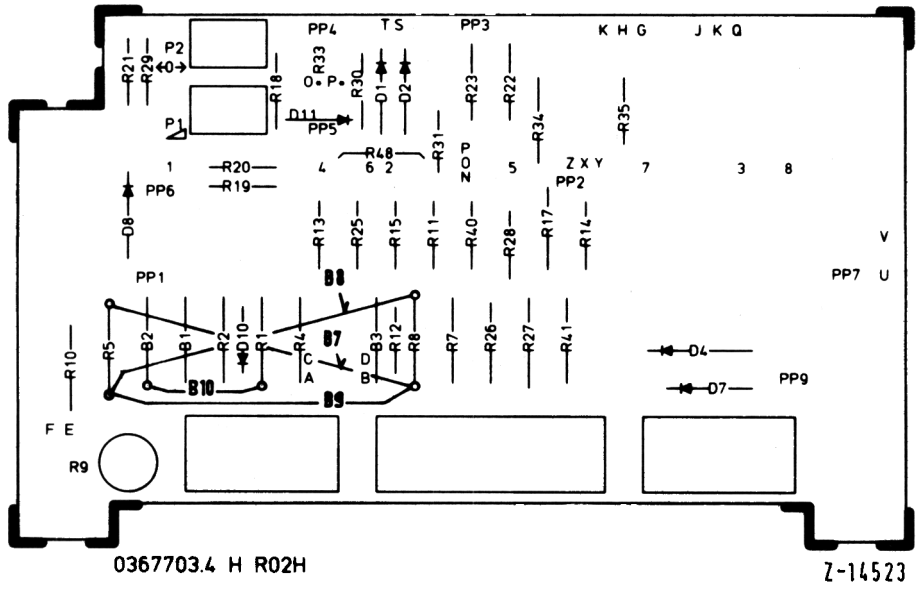


Fig. 11 Layout of the resistors and bridges determining the function and the type of measurement in not plug-in version

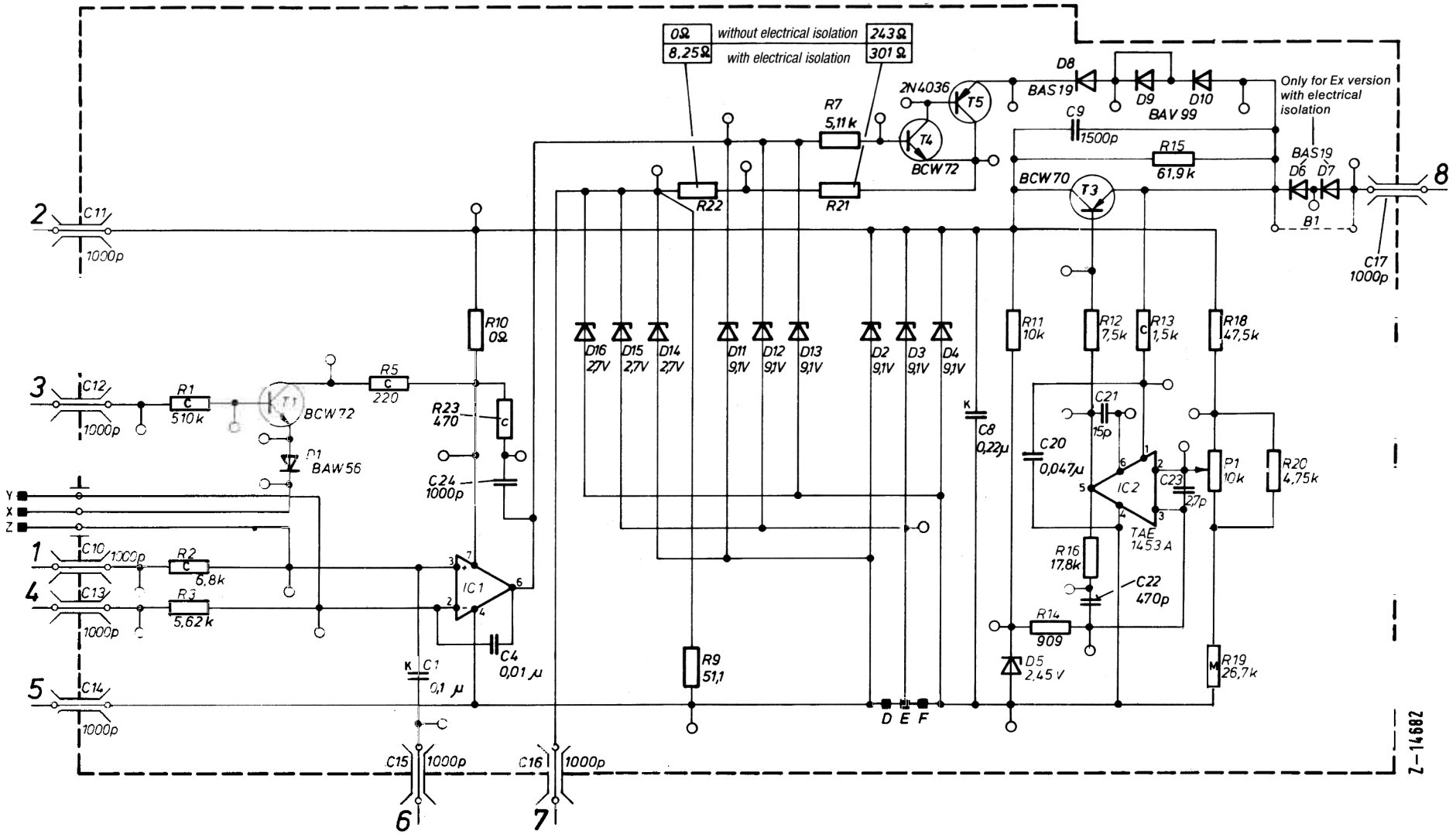
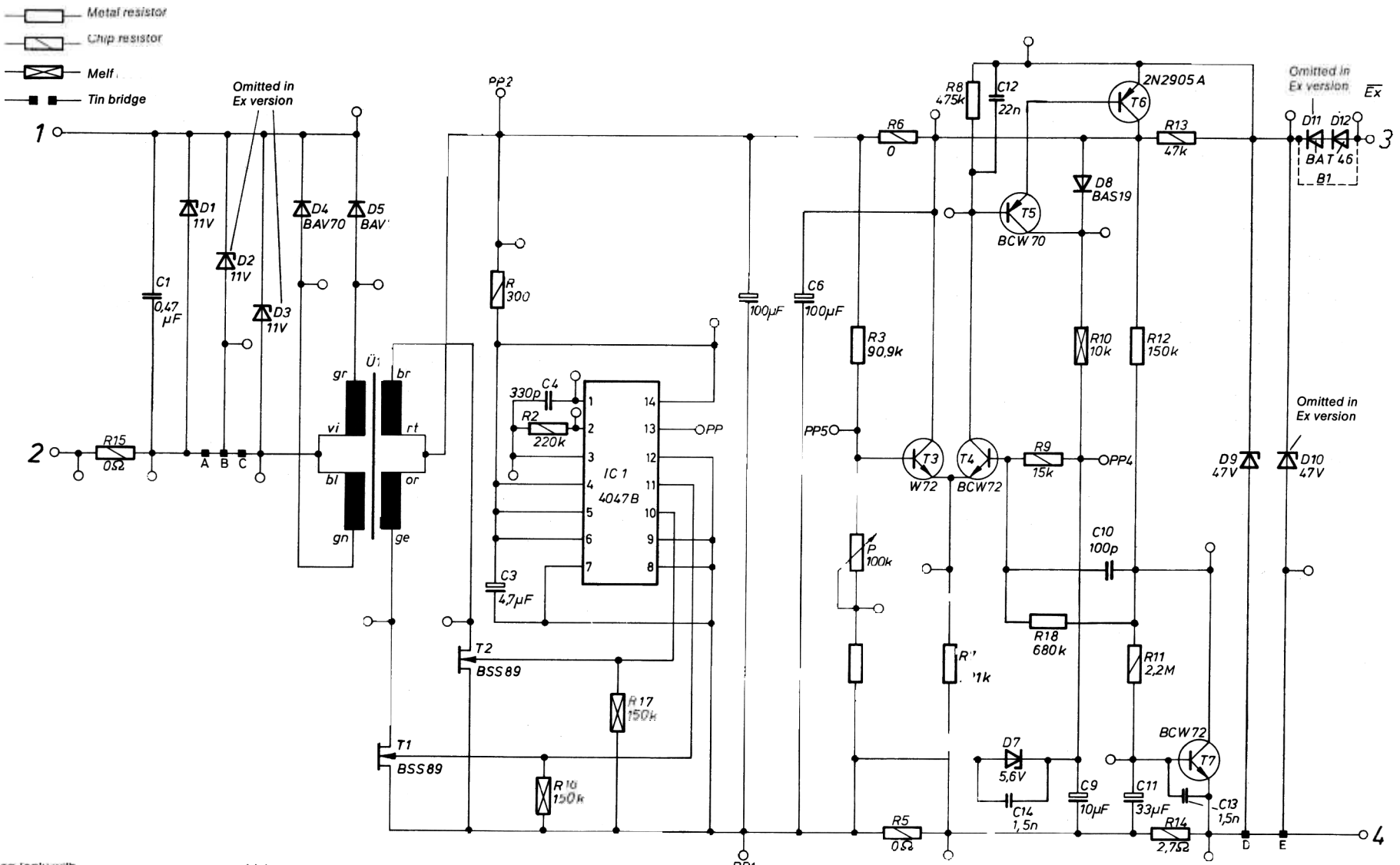


Fig. 12 Chopper amplifier



17 **Fig.** lectrical isolation (only with ible)

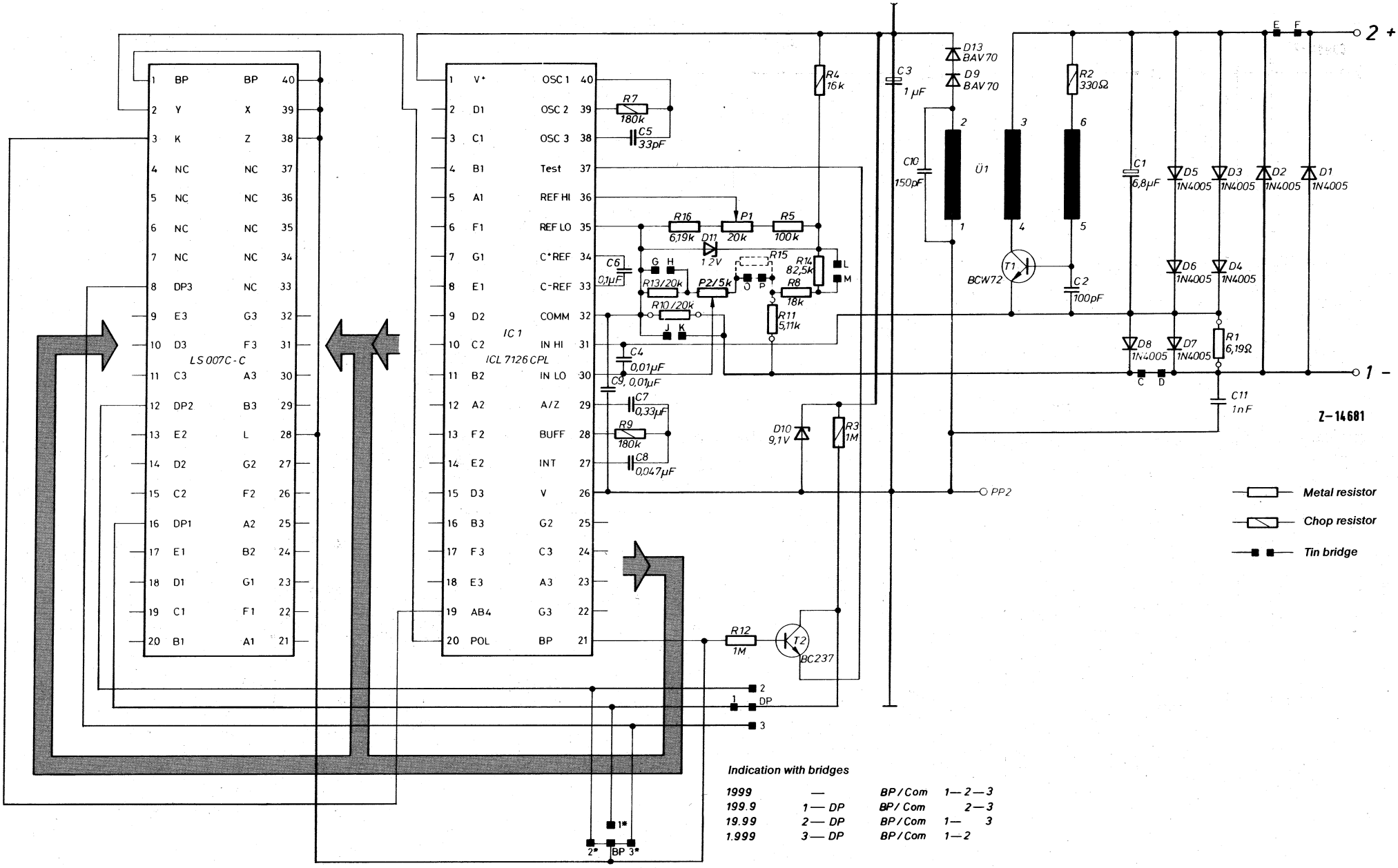


Fig. 14 Field indicator

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