Service manual

TEMAX-3

Temperature transducers

4189340017D

TEMAX-3.4B

- *2 wire transducer for remote monitoring of 2, 3 or 4 temperatures*
- *Read-out of highest output*
- *Plug-in PCB's*

DEIF A/S

DEIF A/S
Frisenborgvej 33, DK-7800 Skive
Denmark

Tel.: +45 9614 9614
Fax: +45 9614 9615
E-mail: deif@deif.com

Available types

TYPE	TEMAX-3.2B	TEMAX-3.3B	TEMAX-3.4B
For sensors	2 Pt100Ω sensors	3 Pt100Ω sensors	4 Pt100Ω sensors

Introduction

TEMAX-3 is intended for monitoring of 2 to 4 temperatures. TEMAX-3.2 and TEMAX-3.3 may later on at our factory be upgraded to 3 or 4 measuring points (type TEMAX-3.3 and TEMAX-3.4 respectively). The temperature transducers type TEMAX-3 are CE classified for residential, commercial and light industry plus industrial environment.

Application

TEMAX-3 is applied to monitor inputs from 2, 3 or 4 Pt100Ω resistance sensors, indicating the highest temperature on its built-in 240° indicating instrument.

Operating principle

TEMAX-3 is a 2 wire transducer with an output signal of 4...20mA.

The term "2-wire transducer" refers only to the output signal as the power for the electronics is transmitted through the two output wires and not by means of a separate auxiliary voltage (4 wire principle). TEMAX-3 is placed near the measuring points and the two output wires carry the power to supply the electronics as well as the output signal.

The output current can be considered as two components: a constant 4mA for the amplifier etc. of the transducer and a variable signal of 0...16mA, which changes proportionally to the measured input signal. The input signal corresponds to the output 4...20mA.

Indicating instruments, recorders, controllers etc. can be connected as shown in series with the output circuit and the supply voltage.

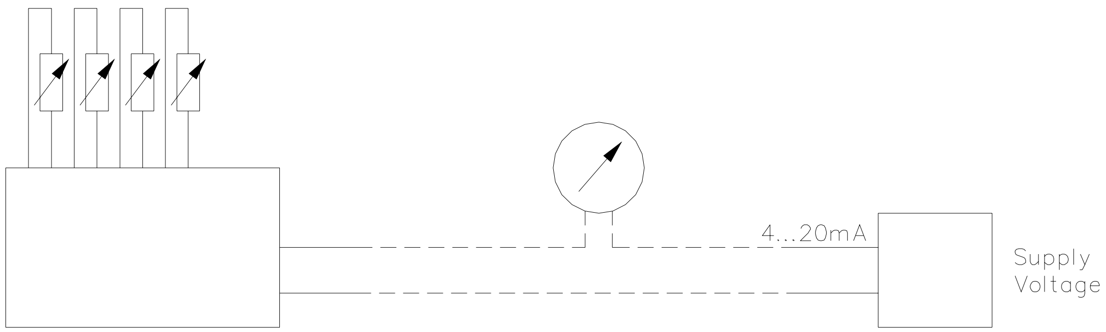


Fig. 1

The output current is proportional to the temperature and independent of varying supply voltage, lead resistance and load within the specified limits.

The 2, 3 or 4 temperatures are measured by means of Pt100Ω sensors connected in 2 wire couplings. Each sensor forms part of a wheatstone bridge, whose diagonal voltage is amplified by an operational amplifier.

The 2, 3 or 4 amplifier outputs are compared and the signal representing the highest temperature is selected. This signal controls an output amplifier which converts the signal into the 4...20mA constant current output.

Output under fault conditions

If one of the sensors or its leads is/are broken, TEMAX-3 will give an output higher than 20mA (max. 32mA).

In this case there will be no temperature measurement but a clear indication of fault.

If one of the sensors or the input leads is/are short-circuited, the other measurements remain unaffected but no typical change of the output signal will occur. However, such faults are not typical. Pt100Ω sensors are very reliable, and if they do fail, it is usually caused by physical damage resulting in an open circuit condition.

A short-circuit fault can only be detected by periodical activation of the push-buttons. At the actual point the meter will indicate less than 0°C.

Installation

In order to fully utilize the 2-wire system, the transducer should be placed near the measuring points.

The Pt100Ω sensors are connected to the TEMAX-3 in "2-wire couplings". The resistance in the sensor leads is in series with the Pt100Ω sensor, and an error would consequently occur, if not allowed for. To avoid this error, the TEMAX-3 is adjusted to a fixed resistance of 0.35Ω for each sensor.

The mentioned 0.35Ω corresponds to 2 x 15m - 1.5mm² or 2 x 10m - 1.0mm² wires, etc.

In order to simplify the TEMAX-3, it is not provided with variable lead compensations and check resistors. The lead resistance should be as close as possible to the mentioned 0.35Ω to ensure highest achievable accuracy.

Deviations from the 0.35 will cause an error of +1°C per +0.38 , without recalibration.

Mechanical construction

The transducer is housed in a polycarbonate case (to IP65, i.e. protected against water jets) with a transparent cover and 4 watertight push-buttons.

The case is fitted with 5 PG9 cable glands and has an internal terminal block for connection of up to 4mm² wires.

All electrical components are protected against mechanical damage and dust by means of the thermoplastic case with plug-in PCB's and a metal cover plate.

The transducer is furthermore equipped with a built-in indicating instrument, 48 x 48mm with 240° scale.

Electrical construction

TEMAX-3 consists of a base board plus 4-6 plug-in PCB's, which are individually calibrated, facilitating service and repair in the event of faulty function:

- Amplifiers for the Pt100Ω sensors (2-4 PCB's), (PCB A)
- Voltage supply and output amplifier (1 PCB), (PCB B)
- Built-in push-button function (1 PCB), (PCB C)

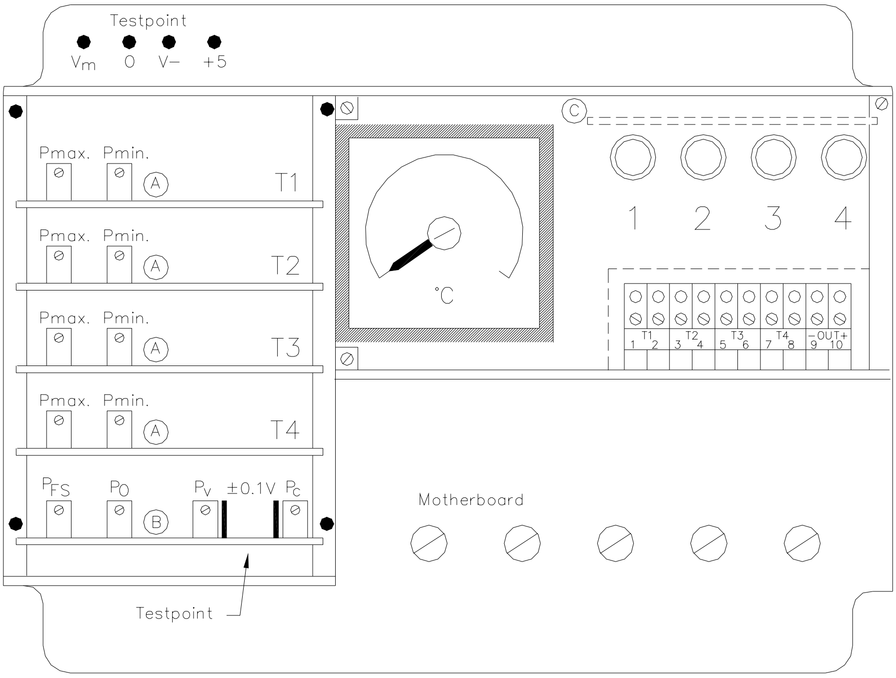


Fig. 2

Bridge amplifiers, (A) Boards

See diagram No. 4157200140 (page 8 and 9).

Standard range: 0-150°C, temperature linear. Ry = 0.35Ω

Number of PCB's: 4 pcs. in TEMAX-3/4
3 pcs. in TEMAX-3/3
2 pcs. in TEMAX 3/2

These boards are interchangeable and can be used in all three TEMAX-3 versions.

The Pt-100Ω bulb and R_2 form the left part of a wheatstone bridge and R_3 + R_4 the right part. The sensor is connected from 0 (common) and through a zenerprotected double RC-filter to the non-inverting input (pin 3) of a low-power operational amplifier (N101). The output (pin 6) passes the BE-junction of a PNP-transistor (V102), which in this application functions as a diode only. The output is voltage divided and feed back to the inverting input (pin 2) and the right side of the bridge.

P_{min} balances the bridge and the amplification is adjusted by means of P_{max}. The bridge is sourced by a stabilized and compensated voltage (approx. 5V) supplied by PCB (B).

The positive outputs of the 2, 3 or 4 "Bridge Amplifiers" are connected in parallel (V_M). The amplifier with the highest output, corresponding to the higest temperature will reverse bias the BE-diode in the other output transistor circuits and block the associated amplifiers. Because the BE-diode is inside the feed back loop, the selection of the higest input is effectuated with an accuracy higher than 0.3%.

Voltage supply/output amplifier, (B) Board

See diagram No. 4157200140 (page 8 and 9).
1 pcs for all types.

The positive output (V_M) representing the higest temperature is inverted by an inverting amplifier (N203) with an amplification factor of -1 x.

N202 and an output transistor, 2N1711 (V207), control the output current of 4...20mA. The output current emits a voltage drop across the resistors named R_{max} (R221//R222), which by the operational amplifier N202 is compared with the signal from N203. When V_M is 131mV, P_O (R215) is adjusted until I_O is 4mA.

R_{MAX} determinates the amplication rate of the output amplifier, and I_O is fine adjusted to 20.00mA at V_M = 736mV by means of PFS (R210).

At overranging the output current is limited to 32mA by a current-limiting circuit in the collector of the output transistor.

The reference diode 1N4567 (V201), is fed by a FET-current source 2N4393 (V203), adjusted by means of P_C (R201) until a voltage of 0.1V is emitted across a 182Ω (R202) resistor, corresponding to a current of 0.555mA. The 0.5mA is flowing in the reference diode and the 0.055mA in the parallel connected voltage divider (R203+R205+R206). The voltage from P_V (R205) controls the operational amplifier, which is buffered by a "voltage follower" BC546B (V204). The emitter voltage is voltage divided and passed to the inverting input (pin 2) of N201. The bottom of this voltage divider (R207+R223) is connected to the negative output of N203, which follows the higest temperature.

The stabilized voltage that supplies the bridge, is adjusted to 5.000V by means of P_V at T_{min} (0°C). When the higest temperature increases, this voltage will increase as well, in such a way that it compensates for the decrease in the Pt-100Ω bulb sensitivity (Ω /°C) at increasing temperature.

Selector switch board (C)

See diagram No. 4157200140 (page 8 and 9).

Number of switches: 2, 3 or 4.

Each bridge amplifier is sourced by a voltage follower coupled transistor BC546B (V301, V302, V303, V304), which is held ON during normal operation. When one of the push-buttons is activated, the other transistors are turned OFF by the changeover switch connecting the other bases to the negative supply voltage (V-). This voltage is emitted as a voltage drop across the zener diode ZTE1.5 by the 4...20mA output current.

This PCB is provided with a diode, IN4007 (V305), to ensure reverse polarity protection of the electronics in case of reversed supply voltage.

Service of TEMAX-3

See diagram No. 4157200140 (pages 8 and 9) and drawing "Component Location" (PCB A and PCB B, page 7).

If a TEMAX-3 is replaced by another complete unit intended for a higher number of inputs, the unused inputs are shorted in the terminal block.

If repair work has to be carried out on a TEMAX-3, recalibration is needed.

Recalibration:
If the repair work has been limited to the (A) Board only, recalibration of the (B) Board is not necessary.
$R_0 = Pt_{min} + Ry = 100.35\Omega$, if $T_{min} = 0°C$
$R_{150} = Pt_{max} + Ry = 157.67\Omega$, if $T_{max} = 150°C$

Recalibration procedure

Calibration equipment:
1 off Precision resistance box.
Resolution: ≤0.1Ω . Error: ≤0.05Ω .
2 off DVM. Accuracy at DC: ≤0.2% ±1 digit.
1 off Power Supply. Approx. 24V, minimum 40mA.

The left cover plate is removed. See fig. 2 for location of trimpots and test points.

1) The resistance box substitutes T_1, directly connected to the terminals 1-2 in the TEMAX-3.
2) Connect a DVM to the test points marked ±0.1V on the top of the (B) Board.
3) Connect a DVM (range: 20.00mA) and the voltage supply according to fig. 3.
4) Set the resistance box to R_O (100.35Ω).
5) Adjust P_C on the (B) Board until the DVM, connected to the test points, reads 100 ±2mV.
6) Connect the same DVM to the test points 0 and +5V on the top of the "Mother Board" above the internal case.
7) Press the pushbutton T_1 (S301) at steps 8-10-11-13-14.
8) Adjust the trimpot P_V until the DVM reads 5.00V.
9) Connect the same DVM to the test points marked 0 and V_M on the top of the "Mother Board".
10) Adjust P_{min} on the upper (A) Board until the DVM reads 131mV.
11) Adjust P_0 on the (B) Board until the output current is 4.00mA.
12) Set the resistance box to R_{150}. (157.67Ω).
13) Adjust P_{max} on the upper (A) Board until V_M is 736mV.
14) Adjust P_{FS} on the (B) Board until the output current is 20.00mA.
15) Connect the resistance box to T_2 (S302), terminals 3-4.
16) Set the box to R_0.
17) Repeat the calibration procedure for the other (A) Boards in a similar way but DO NOT recalibrate the trimpots on the (B) Board.

°C	0	10	20	30	40	50	60	70	80	90	100	Ω/GRD 1)
0	100.00	103.90	107.79	111.67	115.54	119.40	123.24	127.07	130.89	134.70	138.50	0.385
100	138.50	142.28	146.06	149.82	153.57	157.32	161.04	164.76	168.47	172.16	175.84	0.373
200	175.84	179.51	183.17	186.82	190.46	194.08	197.70	201.30	204.88	208.46	212.03	0.361
300	212.03	215.58	219.13	222.66	226.18	229.69	233.19	236.67	240.15	243.61	247.06	0.350
400	247.06	250.50	253.93	257.34	260.75	264.14	267.52	270.89	274.25	277.60	280.93	0.338
500	280.93	284.26	287.57	290.87	294.16	297.43	300.70	303.95	307.20	310.43	313.65	0.327
600	313.65	316.86	320.05	323.24	326.41	329.57	332.72	335.86	338.99	342.10	345.21	0.315
700	345.21	348.30	351.38	354.45	357.51	357.51	363.59	366.61	369.62	372.62	375.61	0.304
800	375.61	378.59	381.55	384.50	387.45	390.38	–	–	–	–	–	0.295

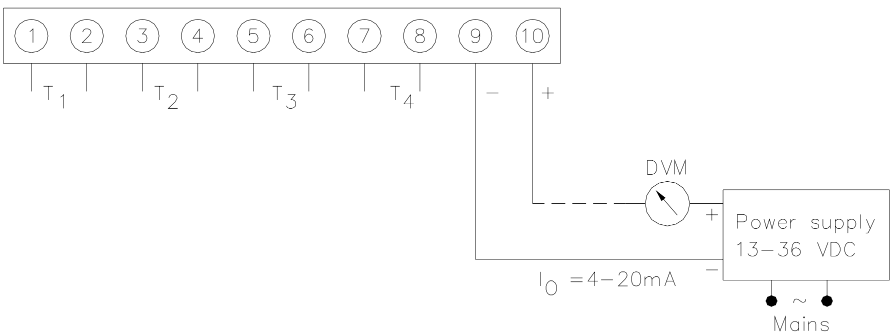
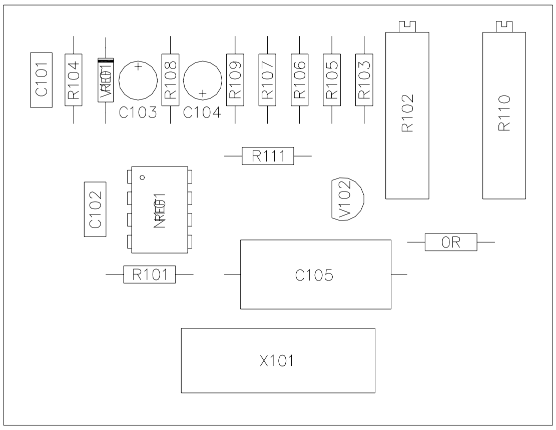
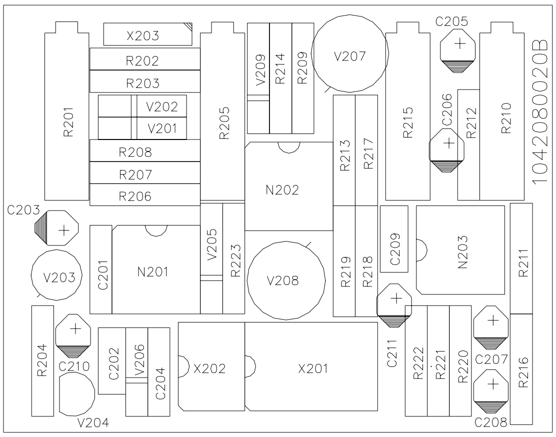


Fig. 3



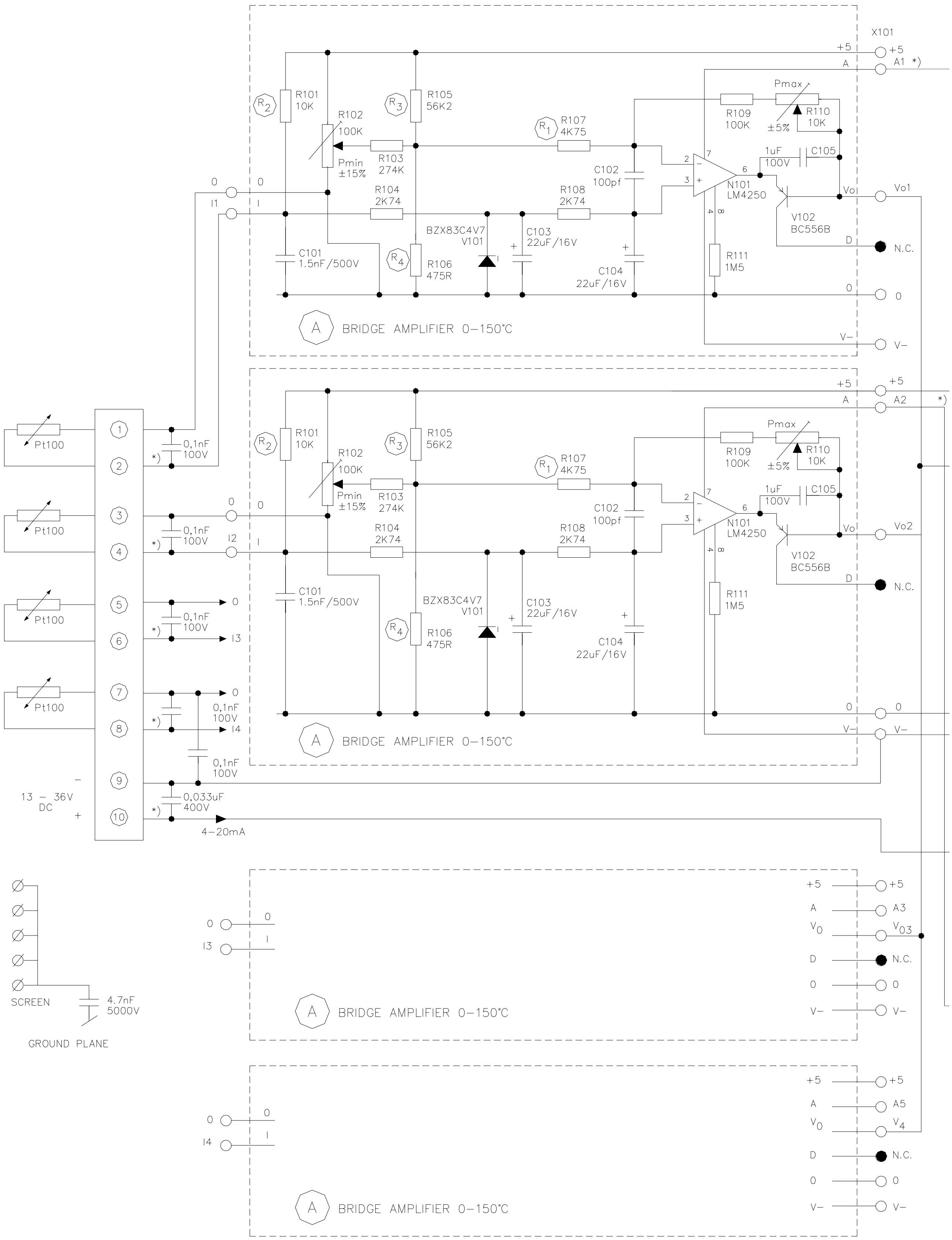
PCB A



PCB B

General technical specifications

Temperature:	-10...55°C (nominal) -25...70°C (operating) -40...70°C (storage).
Temperature drift:	Max. 0.2% per 10°C.
Test voltage:	2000V AC - 50Hz - 1 min. between mounting plate and input/output. 500V AC - 50Hz - 1 min. between inner screen and input/output.
Climate:	Class HSE, to DIN 40040.
EMC:	To EN 50081-1/2, EN 50082-1/2, SS4361503 (PL4) and IEC 255-22-1 (class 3).
Protection:	Case: IP65, to IEC 529 and EN 60529.
Materials:	Case: light grey polycarbonate. With 5 PG9 glands and internal terminal block.
Connections:	Cable diametre: 4...10mm. Wire diametre: max. 4mm². Extra terminals are provided for looping of any screens from the input/output cables.
Mounting:	For base mounting. Position as required, however, vertical mounting recommended to reduce any ingress of liquid and dust etc. via the cable glands.


X101
+5
A1 *)
A2
R101
10K
R102
100K
R103
274K
R104
2K74
R105
56K2
R106
475R
R107
4K75
R108
2K74
R109
100K
R110
10K
R111
1M5
Pmax
Pmin
±15%
±5%
C101
1.5nF/500V
C102
100pf
C103
22uF/16V
C104
22uF/16V
C105
1uF
100V
BZX83C4V7
V101
N101
LM4250
V102
BC556B
Vo1
Vo2
N.C.
V−
BRIDGE AMPLIFIER 0−150°C
Pt100
0,1nF
100V
0,033uF
400V
13 − 36V
DC
4−20mA
A3
A5
SCREEN
4.7nF
5000V
GROUND PLANE

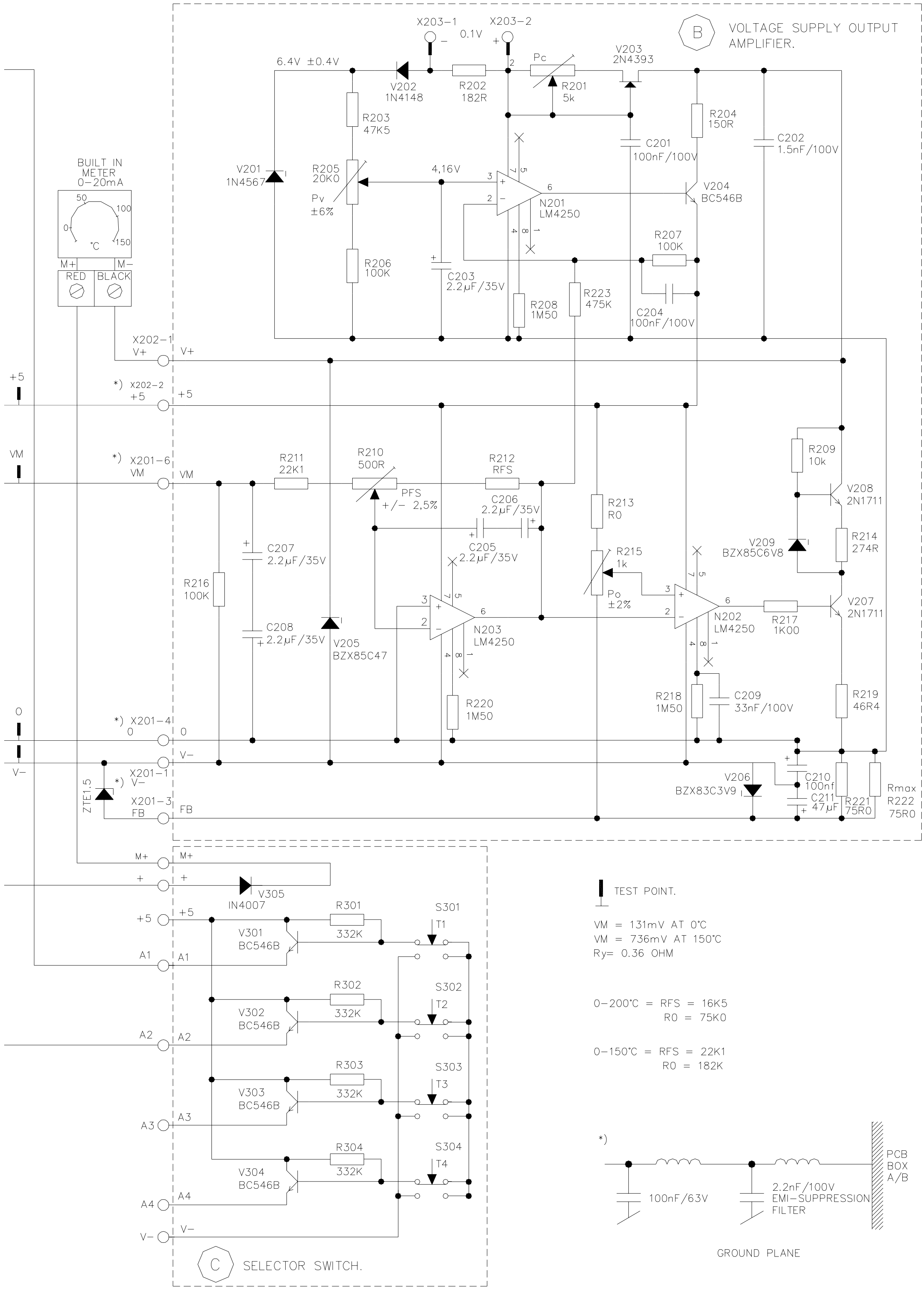


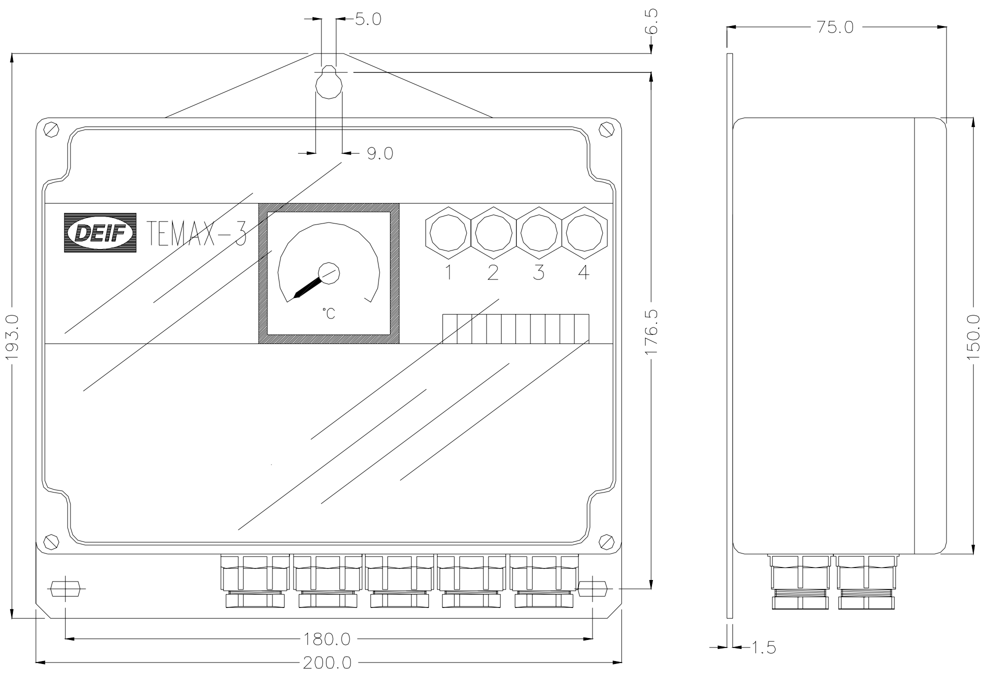
Diagram 4157200140

Technical specifications

Measuring range:	0...150°C or 0...200°C (other ranges on request).
Temperature sensor:	Pt100Ω , 2 wire
Lead compensation:	Adjusted for lead resistance 0.35Ω , corresponding to a pair of 15m - 1.5mm² or 10m - 1mm² copper connecting leads.
Lead compensation resistance:	None
Maximum continuous overload:	Max. 36V DC (refers to all inputs and output).
Output:	4...20mA constant current. The temperature of any input can be read on the built-in instrument.
Maximum output:	32mA on extended input (e.g. open circuit or disconnected sensor).
Auxiliary voltage (V_S):	13...36V DC at 0.1 V_{pp} ripple. 14...36V DC at 2 V_{pp} ripple.
Ripple on output:	Max. 0.5% pp at $V_R \leq 0.1V_{pp}$ (10...400Hz). Max. 1.5% $_{PP}$ if $V_R \leq 2$ V_{PP} (10...400Hz). V_R = ripple on V_S.
Output non-linearity:	Max. 0.1%.
Accuracy:	Class 1.0 (1%) ±0.5°C (-10...<u>15...30</u>...55°C), to IEC 688 and EN 60688.
Comparison accuracy:	0.5°C.
Max. ripple (V_R):	5 V_{pp}.
Load on output (R_L):	Depends on the aux. voltage V_S: Max. $R_L = \frac{V_S - (0.5\ V_R + 13)}{0.02}$ (OHMS)
Aux. voltage influence:	Max. 0.1% from 13...36V DC at $0.1V_{pp}$ ripple.
Response time:	Ca. 1 sec. for 100% change of input, ca. 2.5 secs on initial energisation (for deviation 0.5%).

Dimensions

All dimensions in mm



Weight: Ca. 1.200 kgs
TEMAX-3.4 (TEMAX-3.3, TEMAX-3.2)