Vacuum Pumps | Instrumentation | Fittings and Valves

LEYBOLD

LEYBOLD VACUUM

GA 09.216 / 2.02

TTR 211 S; TTR 211 S2
TTR 211 NPT
TTR 216 S

THERMOVAC Transmitter

Cat. No.
157 30; 164 30
157 32;
157 31

Operating Instructions

Leybold Service
If equipment is returned to LEYBOLD, indicate whether the equipment is free of substances damaging to health or whether it is contaminated. If it is contaminated also indicate the nature of the hazard. LEYBOLD must return any equipment without a Declaration of Contamination to the sender's address.

General Remarks
We reserve the right to alter the design or any data given in these Operating Instructions. The illustrations are not binding.

Contents

GA 09.216/2.02 - 02/96

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1 Description

1.1 General

The THERMOVAC transmitter TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S is supplied ready for operation. Even so, we recommend to read these Operating Instructions with care so as to ensure optimum operating conditions right from the start.

These Operating Instructions contain important information on the functions, installation, start-up, operation and troubleshooting of the THERMOVAC transmitters TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S.

Important remarks concerning operational safety and protection are emphazised as follows:

Warning

Indicates procedures that must be strictly observed to prevent hazards to persons.

Caution

Indicates procedures that must strictly be observed to prevent damage to, or destruction of the TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S.

Note
Indicates special technical requirements that the user must comply with.

The references to diagrams, e.g. (4/1), consist of the Fig. No. and the item No. in that order.

Unpack the TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S immediately after delivery, even if it is to be installed at a later date.

Examine the packaging for any external damage.

Completely remove all packaging materials.

Note
Retain the shipping container and the packaging materials in the event of complaints about damage.

Check that the TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S is complete (see Section 1.4).

Carefully examine the TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S visually.

If any damage is discovered, report it immediately to the forwarding agent and insurer. If the damaged part has to be replaced, please get in touch with the orders department.

1.1.1 Purpose

The THERMOVAC transmitters TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S are compact active pressure converters housing a Pirani measurement system as well as the corresponding operating electronics.

They are particularly well suited for integration into systems and offer a measurement range of $5 \cdot 10^{-4}$ to 1000 mbar.

The transmitter is connected directly to the vacuum system through its DN 16 KF or 1/8" NPT flange.

The electrical connection is provided through a screened 8-way FCC 68 connector.

Moreover, the technical data as published in Section 1.2 must be observed.

1.2 Technical Data

1.2.1 General Data

Measurement range	$5 \cdot 10^{-4}$ to $1 \cdot 10^{3}$ mbar
Measurement uncertainty	
Deviation from the characteristic	
± 20 % in the range from $1 \cdot 10^{-3}$ to $1 \cdot 10^{-2}$ mbar	
± 15 % in the range from $1 \cdot 10^{-2}$ to 30 mbar	
± 50 % in the range from 30 to 1000 mbar	
Average temperature coefficient of the output span	< 1 % / K of the displayed value
Reproducibility	< 5 % of the displayed value
Measurement principle	thermal conductivity according to Pirani
Supply voltage	14.5 to 36 V DC; typ. 24 V DC Ripple ≤ 2 V_{pp} in the range from 17 to 32 V
Power consumption	< 2 W
Protection	IP 40
Electrical connection	8-way FCC 68 socket with screen
Cable length	100 m max. (dia. 0.14 mm^2)
Flammability	UL 94 - V2

CE

- Electrical safety: DIN EN 61 010, Part 1, corresponding to VDE 0411 Part 1, bzw. IEC 1010-1
- Emission of interferences: EN 50081, Part 1, Limit B
- Immunity to interferences: EN 50082, Part 2, Level III

1.2.2 Measurement System

Measurement system	exchangeable
Filament	tungsten (TTR 211 S, TTR 211 S2, TTR 211 NPT) or platinum (TTR 216 S)
Flange connection	DN 16 KF or 1/8" NPT
Degassing temperature	80 °C max. at the flange
Dead volume	11 cm^3 approx.

Materials in contact with the medium

TTR 211 S / 211 S2	aluminium, nickel-plated steel, VACON, tungsten, CrNi 8020; glass, epoxy cement
TTR 211 NPT	stainless steel, tungsten, glass VACON, CrNi 8020, epoxy cement
TTR 216 S	stainless steel, CrNi, Al_2O_3 ceramics, NiFe, Mo, Ni, platinum

Overpressure tolerance

TTR 211 S / 211 S2; TTR 211 NPT	3 bar abs.
TTR 216 S	10 bar abs.

1.2.3 Signal Output

Signal output	0 to 10.6 V
Permissible load resistance	$R_a \geq 10$ kOhm
Measurement signal	1.9 V to 10 V; corresponding to $5 \cdot 10^{-4}$ to $1 \cdot 10^{3}$ mbar logarithmic, 1.286 V per decade
Status signal	broken filament 10.5 V

1.2.4 Switching Threshold

Switching threshold 1	normally open relay contact
Switching threshold 2 (TTR 211 S2)	changeover relay contact
Adjustment range	about $1 \cdot 10^{-3}$ to 500 mbar

Hysteresis: about + 30 % of the adjusted pressure value

Contact rating 1	60 V; 0.5 A DC
Contact rating 2	60 V; 0.5 A DC 250 V; 3 A AC
Error status	open contact or rest position for broken filament or switched off supply voltage

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1.2.5 Control Input

Input resistance	$R_E \approx 100$ kOhm approx. (see Fig. 3 and Section 2.2.5)
Chart recorder output switchover	
Measurement signal output	$U_E \approx 11$ to 12 V or open input
Switching threshold adjustment	$U_E \approx 0$ to 1 V

1.2.6 Status Display

Operation (power)	
Switching threshold (not activated)	two-colour LED shining orange
Switching threshold (activated)	two-colour LED shining green

1.2.7 Monitor Output

3.5 mm jack socket for accessing the measurement signal and switching threshold setting (see Section 2.2.4).

1.2.8 Mechanical Data

Dimensions (WxHxD) in mm	
for TTR 211 S / 211 S2; TTR 216 S	73 x 106 x 56
for TTR 211 NPT	73 x 121 x 56
Weight	200 g approx.

1.2.9 Ambient Conditions

Storage temperature range	- 20 °C to + 70 °C
Climatic rating KWF to DIN 40040	
Operating temperature	10 °C to 50 °C
Max. rel. humidity on 30 days per year, non-condensing	95 %

1.3 Technical Description

The THERMOVAC utilizes the thermal conductivity of gases for the purpose of vacuum pressure measurement (Pirani principle). The temperature of the filament which is used is maintained at a constant level by an electronic control circuit. Thus the sensor may respond quickly to any pressure changes. The specially designed temperature compensation circuitry significantly improves temperature stability of the measured pressures in the useful measurement range from $5 \cdot 10^{-4}$ mbar to atmospheric pressure. An internal voltage regulator permits operation off a wide supply voltage range with low requirements ($2\ V_{pp}$ ripple).

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The built-in trigger level is easily adjustable over a range from $1 \cdot 10^{-3}$ to 500 mbar. The switching function is available through a relay contact. A LED is provided for indication of the switching function.

The TTR 211 S2 is equipped with an additional switching threshold which is accessible through an additional set of relay contacts.

The TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S supplies a logarithmic output of the vacuum pressure by means of a voltage signal ranging from 1.9 to 10 V which can easily be subjected to further processing. A control signal may also be applied to read out the current threshold setting via the signal output.

The threshold setting may also be checked through an additional monitor output where a voltmeter may be connected, for example. The measurement signal is also continuously available at this output for testing purposes.

The low impedance output amplifier permits the connection of long cable runs.

Faults in the sensor, such as a broken filament, for example can be detected at the signal output by way of a status message. In the event of a fault, the switching threshold relay is returned to its rest position.

1.4 Equipment

1.4.1 Supplied Equipment

	Cat. No.
THERMOVAC transmitter TTR 211 S	157 30
THERMOVAC transmitter TTR 211 S2	164 30
THERMOVAC transmitter TTR 211 NPT	157 32
THERMOVAC transmitter TTR 216 S	157 31
Operating Instructions	GA 09.216
Jack plug (3.5 mm)	

1.4.2 Accessories

	Cat. No.
Replacement sensing cell for TTR 211 S	157 75
Replacement sensing cell for TTR 211 S2	157 75
Replacement sensing cell for TTR 211 NPT	896 34
Replacement sensing cell for TTR 216 S	157 77
10 m long connection cable with two FCC 68 plugs, screened	157 33
FCC 68 plug / screw terminal adapter fitted on top hat rail for cabinet installation	in preparation
DN 10/16 KF clamping ring	183 41
DN 16 KF (Al) centering ring	183 26

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For overpressure operation and degassing (TTR 216 S only):

Ultra sealing disc (3 pcs.)	883 75
Clamping ring for ultra sealing discs	882 75

2 Operation

Check the technical data first to see whether the transmitter is suited for your particular application.

2.1 Installation of the TTR 211 S; TTR 211 S2; TTR 211 NPT; TTR 216 S

The THERMOVAC transmitters TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S should preferably be mounted flange down. Inclined installation is possible but the horizontal orientation must not be exceeded.

Flange up installation is not permissible because under such circumstances condensate may collect in the TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S. This will either adversely affect the measurements, or the transmitter may possibly be damaged.

The THERMOVAC transmitter is equipped with a DN 16 KF or a 1/8" NPT connection flange which is used to connect the transmitter to the mating connection flange on a vacuum system with the aid of a centering ring and a clamping ring.

For the dimensional drawing, see Fig. 1.

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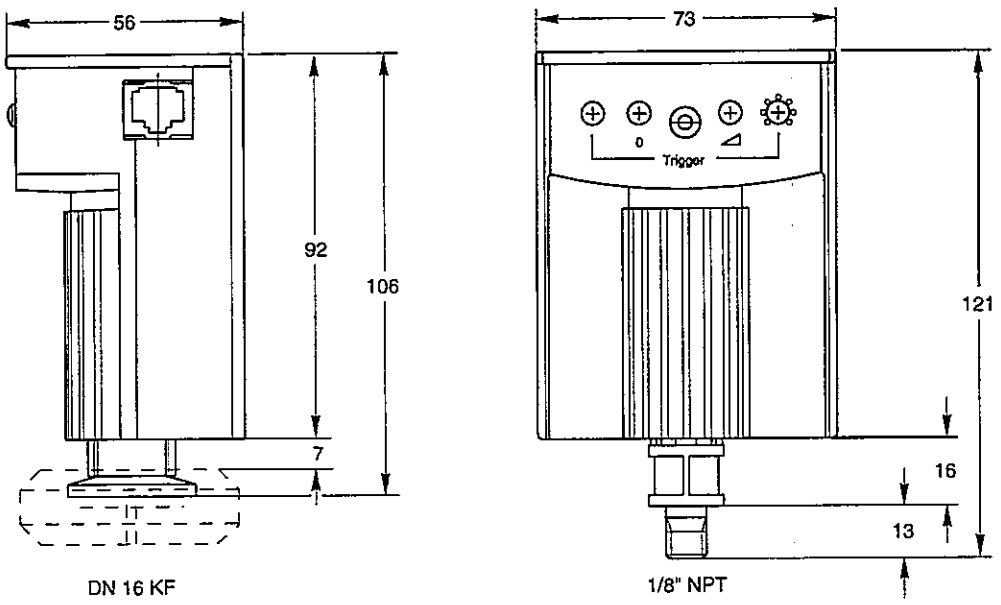

Fig. 1 Dimensional drawing for TTR 211 S and TTR 211 NPT

2.2 Electrical Connection

The electrical connection for the THERMOVAC transmitters is provided through an 8-way FCC 68 connector which links the transmitter to the corresponding operating unit.

The pinout is given in Fig. 2.

Pin	Signal	Designation on the rear
Pin 1	Supply voltage 14.5 V to 36 V DC	+ 24 V DC
Pin 2	0 V supply; used as the ground reference for the supply and control signal voltages.	COMMON
Pin 3	Pressure dependant logarithmic signal output	SIGN 0 - 10 V
Pin 4	„TM transmitter" identification code (27 kOhm)	IDENT
Pin 5	Signal ground (used only for the pressure signal)	SIGN COM
Pin 6	Switch contact 1	TRG
Pin 7	Chart recorder switchover (control input)	SIGN CTRL
Pin 8	Switch contact 2	TRG

Note
Signal ground (pin 5) and power supply ground (pin 2) are internally linked by a 10 Ohm resistor. For this also refer to the block diagram of Fig. 3.

Two examples of how to connect the TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S are given in Annex 2.

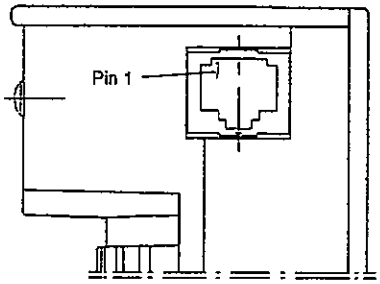

Fig. 2 Connection socket

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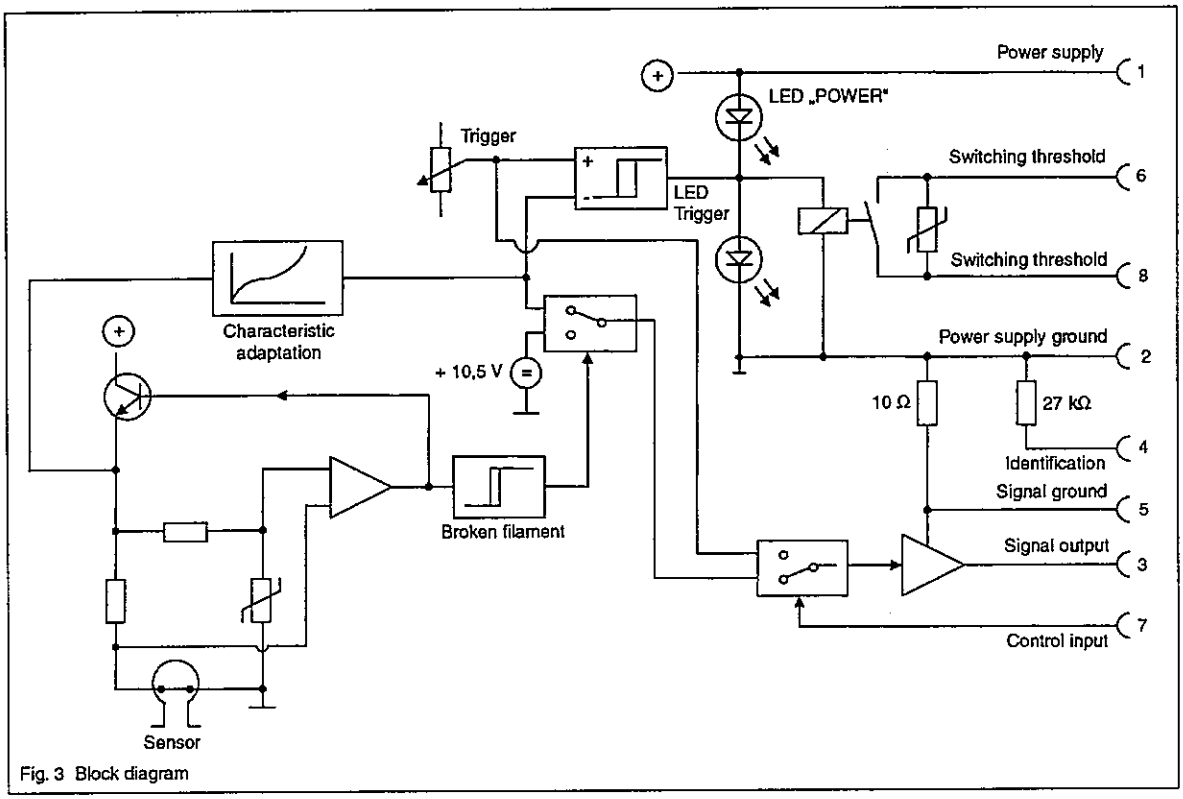


Fig. 3 Block diagram

2.2.1 Power Supply

Warning

The THERMOVAC transmitter TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S may only be connected to supply units or measuring instruments which meet the requirements of mains isolated extra-low voltages (PELV) and VDE 0100.

The THERMOVAC transmitter TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S is capable of operating off supply voltages ranging from 14.5 V to 36 V (regulated) or 17 to 32 V supplies with a max. ripple of $\leq 2\ V_{pp}$. A supply voltage of 24 V DC is recommended.

The power supply must be connected to Pin 1 (+) and Pin 2 (power supply ground).

2.2.2 Measurement Signal Output

The TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S supplies a defined output signal ranging from 1.9 V to 10 V at Pin 3 with reference to Pin 5 which is signal ground. In the case of a broken filament the signal is raised to a level of about 10.5 V. Via the measurement signal output it is also possible to directly switch the high tension on and off automatically in a PTR 225 / PTR 237 PENNING transmitter. This occurs at a pressure of about $5 \cdot 10^{-3}$ mbar. For this also refer to Table 1 in Annex 1.

Table 1 has been included to clarify the relationship between the output voltage and the pressure.

Note

The measurement signal provided by the THERMOVAC transmitter depends on the type of gas. The values stated in Table 1 apply to nitrogen and air. For other gases, corresponding correction factors must be used which are available from LEYBOLD upon request.

2.2.3 Switching Threshold

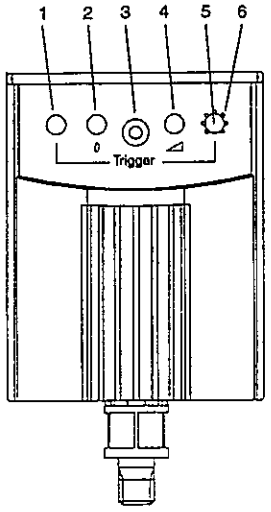
The built-in switching threshold can be adjusted by means of potentiometer (4/5) or (5/2) in the range between $1 \cdot 10^{-3}$ to 500 mbar.

To adjust the switching threshold, remove the cap and adjust this potentiometer to the desired value by using a screwdriver.

To check the setting you may connect a voltmeter to the monitor output (4/3) or (5/1) (see Section 2.2.4 and Table 1 in the Annex), or you may switch over the chart recorder output (see Section 2.2.5).

Note

In the access path to the potentiometer marking dots (4/6) are provided as a visual aid. The distance between two marking dots approximately corresponds to one decade of pressure.



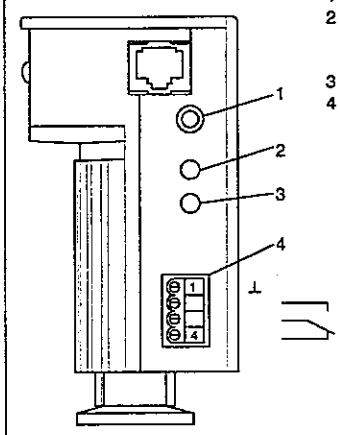
Key to Fig. 4

1 Two-colour LED
orange: operation (power)
green: switching threshold has been activated
2 Potentiometer for Zero alignment
3 Monitor output (3.5 mm jack socket)
4 Potentiometer for full scale alignment
5 Potentiometer for adjustment of the switching threshold
6 Marking dots

Fig. 4 THERMOVAC transmitter TR 211 NPT - front view

The switching threshold function is available through a floating relay contact (normally open) at Pin 6 and Pin 8. The switching action is indicated by a LED (4/1) which changes its colour from „orange" to „green" when the pressure drops below the adjusted threshold.

The second switching threshold is available at the electrical connection (5/4) by means of a floating changeover contact. When active, LED (5/3) comes on.



Key to Fig. 5

1 Monitor output
2 Potentiometer for adjustment of the switching threshold
3 LED (green)
4 Connection plug
Pin 1 Ground
Pin 2 Normally open
Pin 3 Center contact
Pin 4 Normally closed

Fig. 5 THERMOVAC transmitter TTR 211 S2

2.2.4 Monitor Output

The monitor output (4/3) or (5/1) is accessible through a 3.5 mm jack socket so that the measurement signal and the trigger setting may be measured. The stereo jack plug which is included with the instrument may be used to connect a voltmeter, for example. For this also refer to Fig. 6.

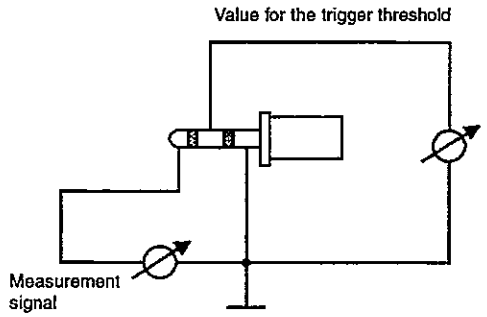


Fig. 6 Jack plug for the monitor output

2.2.5 Switching over the Chart Recorder Output

By applying a control voltage to Pin 7 it is possible to switchover the chart recorder output for outputting the voltage for the switching threshold setting.

Pin 2 must be used as the reference potential.

The chart recorder output is switched over for outputting the switching threshold voltage either by linking pins 7 and 2 or by applying a voltage ranging between 0 and 1 V to Pin 7.

The measurement signal is output through the chart recorder output when there is no link between pins 7 and 2 (open input) or by applying a voltage ranging between 11 and 12 V to Pin 7.

2.2.6 Identification

For the purpose of identifying the type of connected transmitter and the pressure range, the THERMOVAC transmitter is equipped with an identification resistor (R = 27 kOhm) between Pin 4 and Pin 2. This resistor may be sensed by connected operating or control units so that these can automatically adapt.

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2.3 Start-up

Connect the THERMOVAC transmitter TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S according to Section 2.1 and 2.2.

2.3.1 Operation

Apply a supply voltage of 14.5 to 36 V to the transmitter (see Section 2.2.1).

LED (4/1) lights up in an orange colour.
Now the transmitter is ready to make measurements.

Status message:
LED lights up in an orange colour (green/red):
- The switching threshold has not been activated.

LED lights up in a green colour:
- The switching threshold has been activated according to its pre-set value.

2.3.2 Measurement System Status Indication

Proper operation is indicated by the presence of a pressure dependant output signal for the pressure range from about $5 \cdot 10^{-4}$ mbar right up to the upper range limit of 1000 mbar.

In the case of a broken filament the measurement signal is raised to 10.5 V and the relay contact is returned to its rest position (open).

2.4 Troubleshooting

LED off.
Possible cause: Supply voltage is missing.

The measurement signal is always greater than 10 V even when the pressure is considerably lower than 10^3 mbar.
Possible cause: Broken filament.
Remedy: Exchange the sensing cell.
For this refer to Section 3.3.2.

At atmospheric pressure (system vented) the measurement signal level is not correct.
Possible cause: Misalignment.
Remedy: Align the transmitter.
For this refer to Section 3.3.3.

The measurement signal level deviates from 1.9 V although the pressure is below $5 \cdot 10^{-4}$ mbar.
Possible cause: Misalignment.
Remedy: Align the transmitter.
For this refer to Section 3.3.3.

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3 Maintenance

3.1 LEYBOLD Service

If equipment is returned to LEYBOLD, indicate whether the equipment free of substances damaging to health or whether it is contaminated. If it is contaminated also indicate the nature of the hazard. For this you must use a form which has been prepared by us which we will provide upon request.

A copy of this form is reproduced at the end of these Operating Instructions: „Declaration of Contamination of Vacuum Instruments and Components".

Please attach this form to the equipment or enclose it with the equipment.

This Declaration of Contamination is required to meet German Law and to protect our personnel.

LEYBOLD must return any equipment without a „Declaration of Contamination" to the sender's address.

3.2 The Operating Electronics

The electronics assembly of the THERMOVAC transmitters TTR 211 S, TTR 211 S2, TTR 211 NPT and TTR 216 S does not require any maintenance.

3.3 The Sensing Cell

3.3.1 Cleaning the Sensing Cell

The sensing cell is preferably cleaned by using organic solvents (petrolether, ether or similar).

Note
The cleaning agent CCl_4 is not suitable for cleaning the TTR 211 S / 211 S2 or the TTR 211 NPT where the feedthrough is glued in place. The adhesive used will not resist exposure to CCl_4 for a longer period of time.

The sensing cell must not be cleaned by mechanical means (like brushes, for example) since this will damage the sensitive filament. The cleaning agent should be injected into the sensing cell by means of a syringe and left there for some time. **Do not shake!**

After the cleaning agent has been poured out, rinse once or twice again. It is possible that the measurements made in the range below 10^{-2} mbar with be to high for a short while.

After having cleaned and let the sensing cell to dry, evacuate it down to a pressure of under $5 \cdot 10^{-4}$ mbar. The measurement output signal must then drop to below

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Key to Fig. 7
1 Housing
2 Catches
3 Lid
4 Inlay panel
5 Slots

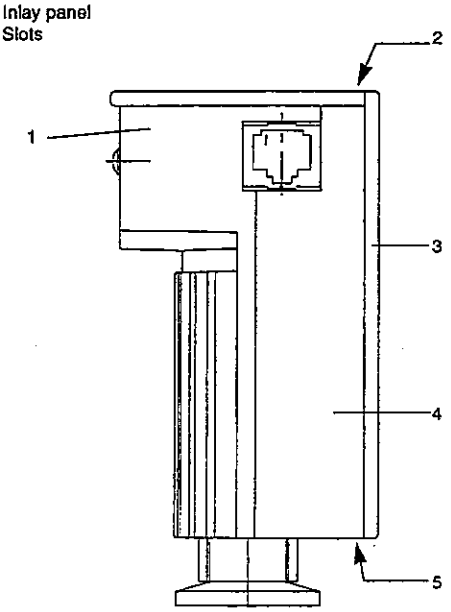

Fig. 7 Side view of the TTR 211 S

$5 \cdot 10^{-4}$ mbar. If this is not the case, you must realign the transmitter; see Section 3.3.3.

3.3.2 Exchanging the Sensing Cell

In order to exchange the sensing cell (in the event of a broken filament or a contaminated sensor) it is required to open the housing first.

Note
In lid (7/3) there are catches which must engage in the slots (7/5) of the housing so that the housing sections are firmly attached.

- To open the lid (7/3) use a screwdriver to press the catches (7/5) in their slots back, and pull off the lid. Disengage the lid from the upper catches (7/2).
- Pull the inlay plate (7/4) out.
- Pull out the electronics assembly together with the sensing cell from the housing.
- Pull the sensing cell off from the electronics assembly.
- Exchange the sensing cell.

Note
- When reassembling sensing cell and electronics assembly, polarity of the pins on the sensing cell will not have to be observed.

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- When reassembling the transmitter make sure that the rubber compression piece for the temperature sensor is present, the insulation disk has been placed on the cell and that the insulating plate between electronics and upper housing section is in place.

To reassemble proceed in the reverse order as for disassembly.

The transmitter electronics must be aligned to take account of the new sensing cell. See Section 3.3.3.

3.3.3 Alignment of the Sensing Cell

Ageing and contamination of the filament will impair accuracy of the pressure readings obtained. For this reason it is recommended to align the transmitter as required or after having exchanged the sensing cell.

The alignment process is run as follows:
Remove the cap for potentiometers (4/2) and (4/4) from the housing.

Connect a voltmeter set to the 0 to 10 V range to the monitor output (4/3).

Vent the vacuum system and adjust the potentiometer (4/4) for full scale alignment so that the voltmeter reads 10 V.

Next evacuate the vacuum system down to a pressure below $5 \cdot 10^{-4}$ mbar and adjust the Zero alignment potentiometer (4/2) so that the voltmeter reads 1.9 V.

Vent the vacuum system and check full scale alignment once more. Any possibly present deviation must be corrected through potentiometer (4/4) for full scale alignment.

If is was necessary to correct full scale alignment, the Zero alignment should be repeated.

After the alignment process has been completed put the caps (4/2) and (4/4) back in place.

4 Spare Parts List

	Ref. No.
Housing, complete with lid and inlay panel	200 61 598
Cap	200 27 544
Compression rubber piece	200 28 397
Replacement sensing cell for TTR 211 S / TTR 211 S2 (DN 16 KF)	157 75
Replacement sensing cell for TTR 211 NPT (1/8" NPT)	896 34
Replacement sensing cell for TTR 216 S (DN 16 KF)	157 77

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Annex 1

Table 1 Relationship between output voltage and pressure

U (Out) [V]	Pressure [mbar]	U (Out) [V]	Pressure [mbar]	U (Out) [V]	Pressure [mbar]	U (Out) [V]	Pressure [mbar]
1.9	5.00E-04	4.1	2.58E-02	6.3	1.32E+00	8.5	6.81E+01
2	5.99E-04	4.2	3.08E-02	6.4	1.58E+00	8.6	8.15E+01
2.1	7.17E-04	4.3	3.69E-02	6.5	1.90E+00	8.7	9.75E+01
2.2	8.57E-04	4.4	4.41E-02	6.6	2.27E+00	8.8	1.17E+02
2.3	1.03E-03	4.5	5.27E-02	6.7	2.71E+00	8.9	1.39E+02
2.4	1.23E-03	4.6	6.31E-02	6.8	3.24E+00	9	1.67E+02
2.5	1.47E-03	4.7	7.54E-02	6.9	3.88E+00	9.1	2.00E+02
2.6	1.75E-03	4.8	9.02E-02	7	4.64E+00	9.2	2.39E+02
2.7	2.10E-03	4.9	1.08E-01	7.1	5.55E+00	9.3	2.85E+02
2.8	2.51E-03	5	1.29E-01	7.2	6.64E+00	9.4	3.41E+02
2.9	3.00E-03	5.1	1.54E-01	7.3	7.94E+00	9.5	4.08E+02
3	3.59E-03	5.2	1.85E-01	7.4	9.50E+00	9.6	4.89E+02
3.1	4.30E-03	5.3	2.21E-01	7.5	1.14E+01	9.7	5.84E+02
3.2	5.14E-03	5.4	2.64E-01	7.6	1.36E+01	9.8	6.99E+02
3.3	6.15E-03	5.5	3.16E-01	7.7	1.63E+01	9.9	8.36E+02
3.4	7.35E-03	5.6	3.78E-01	7.8	1.94E+01	10	1.00E+03
3.5	8.80E-03	5.7	4.52E-01	7.9	2.33E+01		
3.6	1.05E-02	5.8	5.41E-01	8	2.78E+01		
3.7	1.26E-02	5.9	6.47E-01	8.1	3.33E+01		
3.8	1.51E-02	6	7.74E-01	8.2	3.98E+01		
3.9	1.80E-02	6.1	9.26E-01	8.3	4.76E+01		
4	2.15E-02	6.2	1.11E+00	8.4	5.70E+01		

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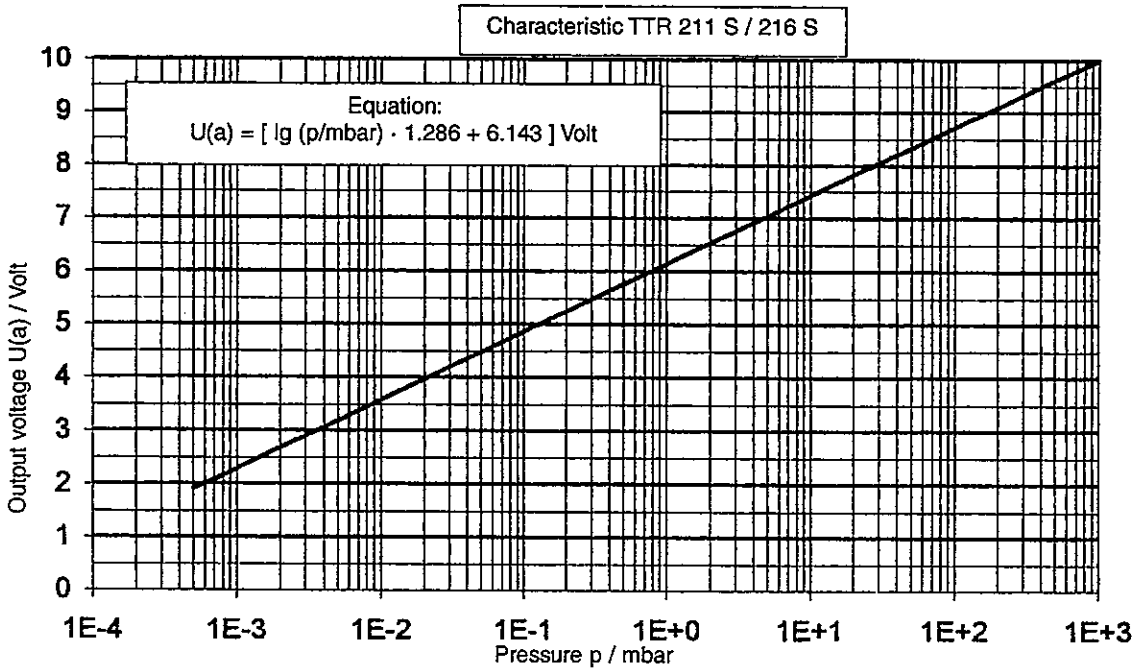
Characteristic TTR 211 S / 216 S
Equation:
U(a) = [lg (p/mbar) · 1.286 + 6.143] Volt
Output voltage U(a) / Volt
10
9
8
7
6
5
4
3
2
1
0
1E-4
1E-3
1E-2
1E-1
1E+0
1E+1
1E+2
1E+3
Pressure p / mbar

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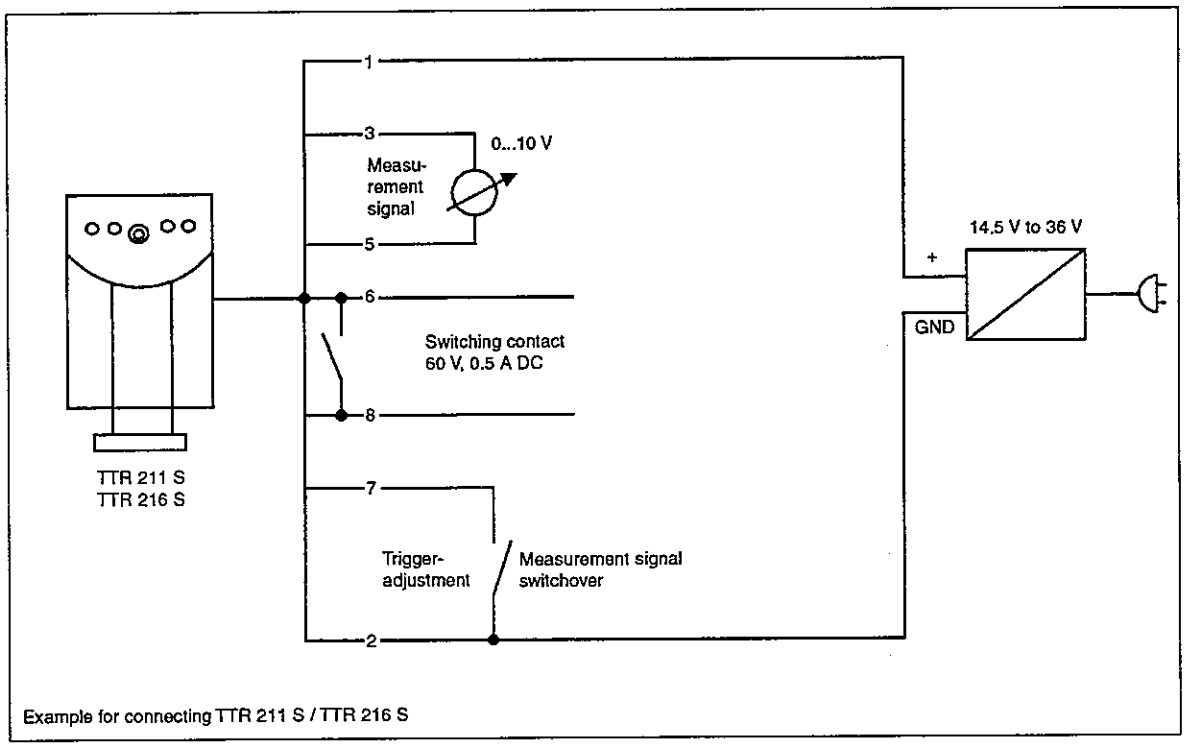
Annex 2



Example for connecting TTR 211 S / TTR 216 S

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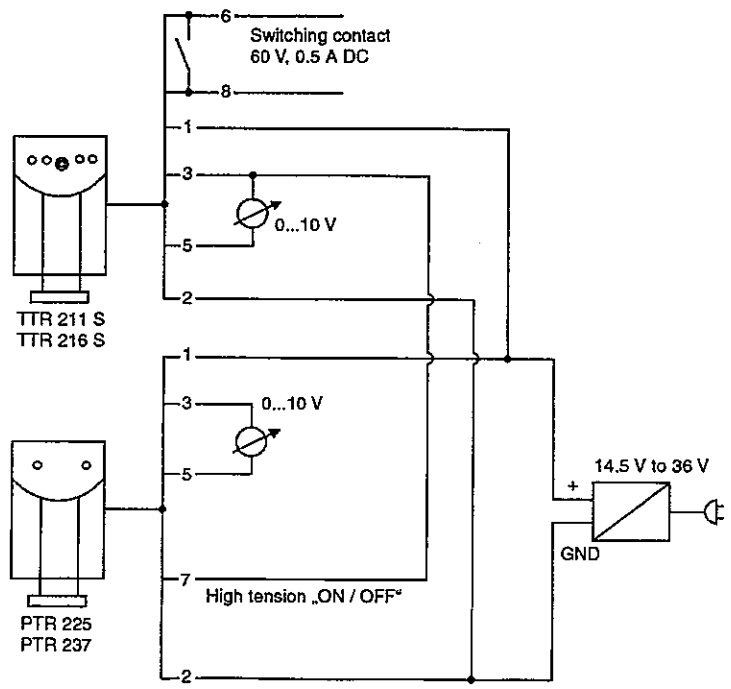

Example for connecting the TTR 211 S / TTR 216 S and PTR 225 / PTR 237

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