

PRESSURE TRANSDUCER TP-140D(R)

Operation Manual
PLA140.202.011.000 RE



This Manual provides information for service personnel how to perform installation, commissioning and maintenance of the wireless Pressure Transducer TP-140D(R) (hereinafter referred to as the TP-140D(R)).

The TP-140D(R) exploitation is allowed to be used by personnel who has studied this manual, set of exploitation documentation and passed safety training.

The TP-140D(R) is intended for pressure measurement in pipes / hydraulic lines and transmit measured values data over the radio channel in digital form to the controller for registration and visualization. This device is made as part of the DEL-150 Drilling and Well Workover Monitoring System (hereinafter referred to as the DEL-150).

Scope of application is explosive zones of premises and outdoor facilities according to Ex-marking. The TP-140D(R) is manufactured in accordance with the requirements of ISO 9001:2015.

In order to exclude the possibility of mechanical damage, violation of electroplating and paint coatings, the rules of storage and transportation of the device should be observed. When studying the rules of operation, it is also necessary to be guided by the technical description and operating instructions of the DEL-150 System.

The TP-140D(R) (see Fig. 1) consists of a cylindrical steel body (2) with a built-in strain gauge bridge. There are a printed circuit board with electronic mounting elements, a data transmission radio module, an internal battery power supply unit and a signal transducer inside enclosure. The signal transducer (1) is made of a radiotransparent material. The sensor has a connecting threaded fitting M20x1.5 as a default size (3). The PS-150(RK) Signal Transducer is required to establish wireless communication between the TP-140D(R) sensor and the MU-150 / MU-150E / MK-140 unit of the DEL-150 System.

1. Technical Characteristics

Name of parameter	Value
Measurement capacity, MPa	40/60/100
Accuracy, %FS	±1.5
Power supply from the battery, VDC	3.6
Power consumption, max., Wt	0.05
Power supply for the PS-150(RK) Signal Transducer, VDC	15
Max. distance for stable wireless communication, m	15
Ex marking, ATEX	II2GExibIAT3Gb
Ex marking, EAC	1ExibIIBT4Gb
Ingress protection	IP66
Ambient temperature range, °C	-45...+65
Dimensions, mm	Ø60 x 152
Weight, max., kg	1
Battery runtime, min., months	12
Service life, min., years	8



Figure 1. The TP-140D(R) components

2. Explosion Safety During Operation

Explosion protection is provided by an intrinsically safe electrical circuit ("i" type of explosion protection).

3. Requirements for Keeping Equipment Specifications that Cause its Explosion Safety

During operation, it is forbidden to break the seals and open the TP-140D(R) enclosure.

When the MU-150 / MU-150E / MK-140 unit of the DEL-150 System is switched on, it is forbidden to connect and disconnect cables, power cable and grounding conductors. In case of malfunctions, it is necessary to turn off the MU-150 / MU-150E / MK-140 unit and disconnect the power cable from the power source. Then replace the faulty PS-150(RK) Signal Transducer if required with a serviceable one by connecting it according to the documentation (operation manual for the DEL-150).

During operation, check the condition of communication cables periodically. If a violation of the protective layer on the cable lines is detected, replace the damaged cable immediately.

Do not allow sealing violations. If a damage is detected, replace the faulty equipment.

Ensuring explosion safety during operation is according to the safety regulations, applicable to the equipment with which (or as part of which) the equipment is used.



ATTENTION!!! During operation, it is necessary to monitor the equipment status and its cables. In case of any mechanical damage of the equipment or any of the cables connected, further operation is strictly prohibited!

4. Installation



NOTIFICATION. Installation and further commissioning of the equipment should be carried out only by qualified specialists.

Before installing the TP-140D(R), it is necessary to make sure that:

- Basic dimensions at the processing facilities correspond to the dimensions of the TP-140D(R) and PS-150(RK) (see Fig. 2, 3);
- Fixing bolts and screws are present;
- There is no damage of the connector insulation;
- There is no external damage of the components;
- There is no damage of the insulation of the signal cable.

Disregard of this instruction may lead to a serious failure of the TP-140D(R).

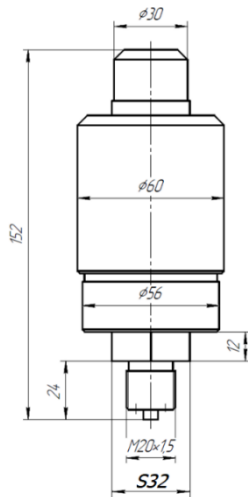


Figure 2. Overall dimensions of the TP-140D(R) Pressure Transducer

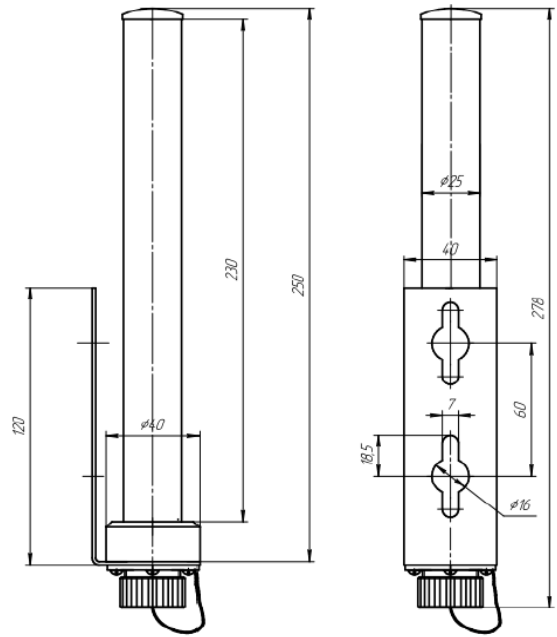
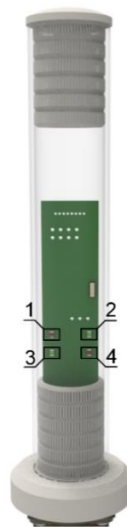


Figure 3. Overall dimensions of the PS-150(RK) Signal Transducer

The TP-140D(R) sensor is installed on the pipe / hydraulic line via M20x1.5 adapter / tee made according to the size of the Customer's equipment and using a phase separator if necessary. The phase separator is required in case of pressure measurement of aggressive, highly viscous, contaminated, solidifying liquids. The phase separator is not included in the sensor's shipment package by default.

The installation location should provide convenient conditions for maintenance and disassembly of the sensor. The TP-140D(R) communicates with the MU-150 / MU-150E / MK-140 unit of the DEL-150 System via the PS-150(RK) Signal Transducer. The PS-150(RK) is connected by a signal cable to the MU-150 / MU-150E / MK-140 unit and is installed at a distance of no more than 15 meters in line of sight from the TP-140D(R). PS-150(RK) is made in a transparent enclosure, which allows to see four LEDs located on the board when the transducer works (see Fig. 4).



1. **TxD** – wireless data sending to the sensor;
2. **RS-485** – data exchanging by RS-485;
3. **RxD** – wireless data exchanging;
4. **Fault** – software error

Figure 4. The PS-150(RK) view

Installation is carried out in the following order:

1. Make sure that there is no pressure in the pipe / hydraulic line;
2. Make sure that the sealing surfaces of the TP-140D(R) transducer and the measuring point are clean and undamaged;
3. Fix the Pressure Transducer at the installation point with a wrench (32 mm) for the hexagon of the fitting (see Fig. 1, Item 3). The tightening force should not exceed 50 N*m (see Fig. 5):

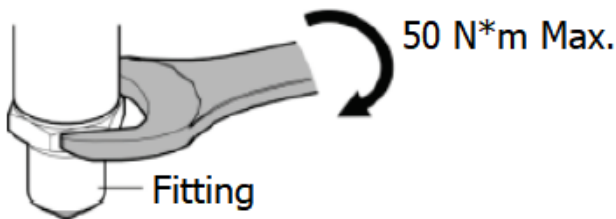


Figure 5. The TP-140D(R) installation



ATTENTION!!! In order to avoid damage of the Pressure Transducer, it is forbidden to force to its body during installation/disassembly (see Fig. 1, Item 2). The force should be applied ONLY to the hexagon of the fitting (see Fig. 1, Item 3).

4. Mount the PS-150(RK) transducer;
5. Connect the commutation cable (see Fig. 6) with the PS-150 (RK);
6. Run and connect the commutation cable to the MU-150 / MU-150E / MK-140 unit of the DEL-150 System through cable channels or places not exposed to mechanical action.

5. External Electrical Connections Installation

Connecting the PS-150(RK) to the MU-150 / MU-150E / MK-140 units of the DEL-150 System, use the SHR20/SHR20 universal commutation cable from the supplied package (see Fig. 6).

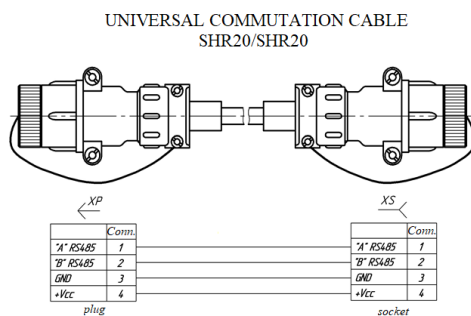


Figure 6. SHR20/SHR20 universal commutation cable

The cable from the PS-150(RK) is connected to any of the connectors of the MU-150 / MU-150E / MK-140 units marked "RS-485" / "Sensor" (see Fig. 7).

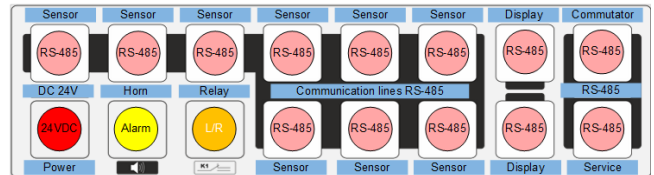


Figure 7. The MU-150 / MU-150E / MK-140 unit's connectors "RS-485" / "Sensor" for the PS-150(RK) connection

6. The TP-140D(R) Functional Test

For functional test of the TP-140D(R) it is necessary to connect the PS-150(RK) to MU-150 / MU-150E / MK-140 unit, to supply power and to make sure that the required parameter (e.g. MUD PRESS.IN) is displayed on the MU-150 / MU-150E EL screen (see Fig. 8).



Figure 8. Readings on the Control Module display in operating mode

There are two operating modes for TP-140D(R):

1. "Active" (LED on the TP-140D(R) flashes synchronously with LED #2 on Fig. 4);
2. "Standby" (LED on the TP-140D(R) flashes 1 time per 3 seconds).

7. Readings Issues

If the connection with the TP-140D(R) is lost, the following symbols are displayed opposite the parameter (e.g. MUD PRESS.IN) on the MU-150 / MU-150E EL screen:

Malfunction	Possible Reason	Troubleshooting
Symbols "----"	<ul style="list-style-type: none"> • The commutation cable is damaged; • The PS-150(RK) outage 	<ul style="list-style-type: none"> • Checking of the integrity of the commutation cable; • Reconnection of the PS-150(RK) cable to the free connector of the MU-150 / MU-150E / MK-140 marked "RS-485" / "Sensor"; • Replacement of the PS-150(RK)

Symbols "???"	<ul style="list-style-type: none"> The TP-140D(R) sensor's battery is discharged (no light indication); Distance from the PS-150(RK) to the TP-140D(R) is more than 15 m.; The TP-140D(R) outage 	<ul style="list-style-type: none"> Battery replacement; Adjustment of the distance between the PS-150(RK) and the TP-140D(R); Replacement of the TP-140D(R)
Parameter is absent	<ul style="list-style-type: none"> The commutation cable is damaged; The PS-150(RK) outage; The MU-150 / MU-150E / MK-140 unit's PCB RS-485 outage; Sensor address is not correct 	<ul style="list-style-type: none"> Checking of the integrity of the commutation cable; Reconnection of the PS-150(RK) cable to the free connector of the MU-150 / MU-150E / MK-140 marked "RS-485" / "Sensor"; Checking sensor address according to the DEL-150 System Operation Manual

8. Setting of the TP-140D(R)

When the sensor installation is completed, it is necessary to turn on the MU-150 Control Module and to enter the setting mode using the MU-150's keyboard (see Fig. 9).

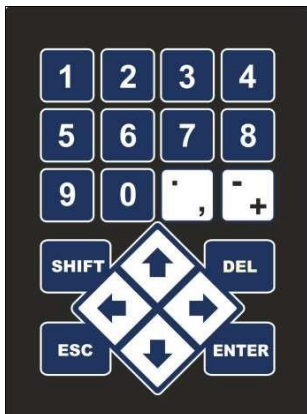


Figure 9. The MU-150 Control Module keyboard

Proceed in the following order to reach out required parameter:

1. Unblock the keyboard by pressing **SHIFT** + **ENTER** simultaneously;




2. Enter OPERATING PARAMETERS menu by pressing

SHIFT + **3** simultaneously;

3. Use  ,  and **ENTER** to select required parameter. To return to the previous menu, use **ESC**.

8.1. Setting of MUD PRESS.IN Parameter




The mud system pressure associated parameter is MUD PRESS.IN and it can be controlled by the TP-140D(R). Its address in the Modbus network is 17 (dec).

	MUD PRESS.IN DRILLING TONGS + HYDRAULIC TONGS + ROTARY TORQUE
Set the required maximum value	MUD PRESS.IN,AT MAX 0200.0 SET ZERO 000.0 4 mA 00.000 20 mA 00.000
In case of zeroing is required press  + 	MUD PRESS.IN,AT MAX 0200.0 SET ZERO 000.0 4 mA 00.000 20 mA 00.000
Calibrate 4 mA and 20 mA values for the sensors with related analogue output if any	MUD PRESS.IN,AT MAX 0200.0 SET ZERO 000.0 4 mA 00.000 20 mA 00.000

8.2. Setting of HT PRESSURE Parameter


The hydraulic tong pressure associated parameter is HT PRESSURE and it can be controlled by the TP-140D(R). Its address in the Modbus network is 16 (dec).

	MUD PRESS.IN DRILLING TONGS + HYDRAULIC TONGS + ROTARY TORQUE
--------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------

	<p style="color: red; text-align: center;">HT PRESSURE</p> <p style="color: green; text-align: center;">HT TORQUE(P)</p> <p style="color: green; text-align: center;">HT RPS</p> <p style="color: green; text-align: center;">HT(2)PRESSURE</p>
<p>Set the required maximum value</p>	<p style="color: green; text-align: center;">HT PRESSURE,AT</p> <p style="color: red; text-align: center;">MAX 0050.0</p> <p style="color: green; text-align: center;">SET ZERO 000.0</p> <p style="color: green; text-align: center;">4 mA 00.000</p> <p style="color: green; text-align: center;">20 mA 00.000</p>
<p>In case of zeroing is required press</p> <p> + </p> <p>on the associated row</p>	<p style="color: green; text-align: center;">HT PRESSURE,AT</p> <p style="color: green; text-align: center;">MAX 0050.0</p> <p style="color: red; text-align: center;">SET ZERO 000.0</p> <p style="color: green; text-align: center;">4 mA 00.000</p> <p style="color: green; text-align: center;">20 mA 00.000</p>

8.3. Setting of ROTARY TORQUE Parameter

The rotary torque associated parameter is ROTARY TORQUE and it can be controlled by the TP-140D(R). Its address in the Modbus network is 18 (dec).

	<p style="color: red; text-align: center;">ROTARY TORQUE</p> <p style="color: green; text-align: center;">ROTARY RPM</p> <p style="color: green; text-align: center;">TRIP VELOCITY</p> <p style="color: green; text-align: center;">BLOCK HEIGHT</p> <p style="color: green; text-align: center;">HOLE DEPTH</p>
<p>Set the required maximum and minimum value, factor and units of measurement.</p> <p>Turn on values inversion if required.</p> <p>Calibrate 4 mA and 20 mA values for the sensors with related analogue output if any</p>	<p style="color: green; text-align: center;">ROTARY TORQUE,kN*m</p> <p style="color: red; text-align: center;">MAX 98.000</p> <p style="color: green; text-align: center;">MIN -----</p> <p style="color: green; text-align: center;">ZERO 00.00</p> <p style="color: green; text-align: center;">FACTOR 1.00000</p> <p style="color: green; text-align: center;">INV.VALUE OFF</p> <p style="color: green; text-align: center;">4mA 00.000</p> <p style="color: green; text-align: center;">20mA 196.13</p> <p style="color: green; text-align: center;">UNITS kN*m</p>

9. List of Critical Failures and Possible Issues in Maintenance Leading to Equipment Failures and Actions to Prevent these Failures (troubleshooting)

Incorrect power supply can lead to equipment failure. The failure can be recognized by LED indication absence of the TP-140D(R) and PS-150(RK).

Incorrect set maximum values for parameters can lead to incorrect operation of the external controlled equipment if the

maximum level for the controlled parameter is exceeded.

A short circuit or a break circuit in the power and communication lines of the sensor, may cause loss of communication with the sensor with the following failures: lack of parameter data, symbols "???" or "----" instead of parameter data, lack of data on other parameters.

In case of failure of the sensor or Control Module, it is necessary to check the equipment technical condition according to the Clause #8 of this Operation Manual. If troubleshooting did not lead to proper operation, it is necessary to stop operation and replace with obviously serviceable equipment. Defective equipment should be sent for repair to the manufacturer or to the specialized authorized service center.

In case of failures that can lead to emergency situations, it is necessary to replace the equipment that has failed. If necessary, disable additional external devices.

10. Maintenance Procedure

Maintenance is carried out in the following order:

1. Cleaning the sensor's enclosure from contamination;
2. Checking the safety of seals (if available);
3. Checking the presence and strength of the mounting components;
4. Cleaning of connectors and terminals from contamination;
5. Checking for the absence of visible mechanical damages;
6. Replacement and (or) repair of damaged cable products;
7. Replacement of damaged connectors.

The contacts of the connector should be washed with an alcohol-gasoline mixture (need 3 ml.) using a soft brush. Connectors after cleaning and drying should be treated with Vaseline or similar lubricant. It is recommended to treat the threads on the connectors with graphite grease.



NOTIFICATION. Absence of maintenance records in the passport (section "Maintenance Records") ENTAILS VIOLATION OF THE OPERATION RULES, and the manufacturer has the right to withdraw from warranty obligations

11. Limit Conditions Parameters

In case of severe mechanical damage, leakproofness violations, seals violations, heating of parts to unacceptable temperatures, supply of unacceptable currents and voltages, change of calibration data, further use is unacceptable or impractical, or restoration of its serviceable or operable condition is impossible or impractical.

12. Marking and Packaging

The TP-140D(R)'s nameplate includes the following components (see Fig.10):

1. Trademark or name of manufacturer;
2. Part number;
3. Name and model;
4. Serial number;
5. Manufacturing year;
6. Explosion protection marking together with certificate

- number;
7. Technical characteristics.

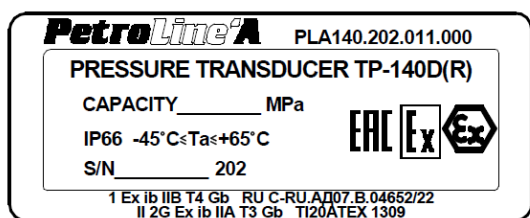


Figure 10. Example of the TP-140D(R) marking

Other data required by regulatory and technical documentation may also be reflected on the nameplate.

Boxes made of plywood with metal handles for carrying are used to transport the TP-140D(R) as part of the DEL-150 System.

13. List of Components

Full completeness is indicated in the passport for equipment released by manufacturer.

14. Repair

Repair of the TP-140D(R) is carried out at the manufacturer or at a specialized authorized service center.



NOTIFICATION. Absence of repair records in the passport (section "Repair Records") ENTAILS VIOLATION OF THE OPERATION RULES, and the manufacturer has the right to withdraw from warranty obligations

15. Storage

The equipment requires careful handling, storage in dry, clean rooms with a constant temperature from +10°C to +35°C as an optimum range and a relative humidity of no more than 80%. Daily temperature fluctuations should not exceed 5°C.

The long-term storage requires conservation, according to the requirements of the equipment conservation instructions. The equipment arriving at the warehouses in the manufacturer's containers are not unpacked, packed on flat pallets and stacked or in the cells of the racks.

Factory-sealed devices are not allowed to be opened in warehouses.

Small devices and devices arriving in individual packaging are stored in box pallets with installation in a stack.

Devices and components without individual packaging should be stored in shelving cells no more than 3 rows in height with the use of cushioning materials between them.

Small devices and products arriving without packaging can be stored in small-cell racks and cabinets, while devices or products of the same type should be stored in one cell.



NOTIFICATION. Absence of storage records in the passport (section "Storage Records") ENTAILS VIOLATION OF THE OPERATION RULES, and the manufacturer has the right to withdraw from warranty obligations

16. Transportation

Transportation of the equipment is allowed by all types of closed transport. The TP-140D(R) in a package for transportation allows the impact of transport shaking with an acceleration of 30 m/s² with a frequency of 100 beats per minute or 1500 beats with that acceleration.

17. Disposal

The TP-140D(R) is disposed of in accordance with the requirements and norms applicable in the oil and gas industry.

18. Warranty Obligations

The warranty period is 12 months from the date of sale.

A full description of the warranty obligations is described in the equipment passport.

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