

2023



DEL-150
Drilling and Well Workover
Monitoring System
Operation Manual

PLA150.000.100.100 RE



Rev. 2.01

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1. DESCRIPTION AND WORK

1.1. DEL-150 Description and Work

1.1.1. Purpose

Drilling and Well Workover Monitoring System (hereinafter the EDR) DEL-150 is designed to control the parameters of technological operations during all types of drilling, workover and underground repair of wells, exploration drilling in the oil and gas industry in areas with a temperate and cold climate on drilling and repair plants of all types.

Usage of the system: explosive areas of rooms and outdoor installations in accordance with the EX-marking GOST IEC 60079-14: 2013 regulating the use of electrical equipment located in the hazardous area and connected by intrinsically safe external circuits with electrical devices installed outside the hazardous area. EDR DEL-150 meets the requirements of TR TS 012/2011 "On the safety of equipment for work in explosive atmospheres."

The explosion protection of composite components of EDR DEL-150 is ensured by meeting the requirements of the standards: GOST 31610.0-2014 (IEC 60079-0:2011) «Explosive environments. Part 0. Equipment. General requirements»;

– GOST 31610.11-2014 (IEC 60079-11:2011) «Explosive environments. Part 11. Equipment with explosion protection «intrinsically safe electrical circuit "i"»;

– GOST IEC 60079-1: 2013) Equipment with protection type «flameproof enclosures "d"».

Description of explosion protection: the components of EDR DEL-150 are made in steel hermetic enclosures with connectors and have, along the line of intrinsically safe power supply, two series-connected, non-damaging diodes at the entrance. Intrinsic safety barriers are installed in MU-150 and MK-140 (RS-485 repeater).

Table 1. EDR DEL-150 Ex-marking

Name	Ex-marking	Ingress protection)	Ambient temperature range, °C
MU-150 Control Module	[Ex ib Gb]IIA	IP54	from -45 to +65
MK-140 Commutation Module	[Ex ib Gb]IIA	IP54	from -45 to +65
DN-130, DN-130V Load Sensor	1Ex ib IIA T3 Gb	IP65	from -45 to +65
ДCM-140 Rotary Tongue Torque Sensor	1Ex db IIA T6 Gb	IP65	from -45 to +65
DPS-140 Position and Velocity Sensor	1Ex ib IIA T3 Gb	IP65	from -45 to +65
DTE-140 Digital Temperature Sensor	1Ex ib IIA T3 Gb	IP65	from -45 to +65
DPR-140 Mud Density Sensor	1Ex ib IIA T3 Gb	IP65	from -45 to +65
IVR-140 Mud Return Indicator	1Ex ib IIA T3 Gb	IP65	from -45 to +65
MI-140, MI-140S Display Module	1Ex ib IIAT3 Gb	IP65	from -45 to +65
TP-140D and TP-140D(M) Pressure Transducer	1Ex ib IIA T3 Gb	IP65	from -45 to +65
PS-150 Signal Transducer	1Ex ib IIA T3 Gb	IP65	from -45 to +65

1.1.2. Technical Characteristics

Table 2. DEL-150 Main technical characteristics and parameters

Item	Technical characteristics	Value
1	Electric power source parameters of control module: • Voltage range, V • Max power, W	18...27 12
2	Electric power source parameters of commutation module: • Voltage range, V • Max power, W	18...27 12
3	Rated digital output sensor voltage 1Ex ib IIAT3 Gb , V	12,6
4	Rated indicator output sensor voltage ([Ex ib Gb] IIA) , V	12,6
5	Number of supported connectors to one Control Module or commutation module, pieces.	14
6	Number of supported commutation modules by a cable, pieces	1 и более
7	Number of supported commutation modules by a radiochannel, pieces	1 и более
8	Max RS-485 with digital sensors, m	20 и более
9	Max channel connection radius with commutation module, m	300
10	Operating temperature range, °C	-45 ... +65
11	Storage temperature, °C	-45 ... +65
12	Calibration interval, months	12
13	Quantity of modem sim-cards, piece	2
14	Channel interface with computer and outer digital devices	RS-485
15	Communication protocol	ModBus ASCII
16	Measuring range of pulling unit on hook, κN (ts)	Rig's specification
17	Internal memory capacity, GB:	4 and more
18	Memory module capacity, measurings	200
19	Segments of display indicators, pieces	4
20	Max acceptable basic percentage error, %	95
21	Relative humidity at +25 °C, %, no more	98
22	Average lifecycle, years	8
23*	Max acceptable basic percentage error of load measuring (guy line load), %.	3

* Error value while guy line load increasing 0,5%.

1.1.3. Configuration

At DEL-150 system, a modular principle of architecture is applied. EDR DEL-150 consists of modules of four main types:

- Control module / commutation;
- Display module;
- Sensors / indicators;
- Signal transducers.

This provides the possibility of kitting the device in accordance with the selected number of monitored and recorded parameters. Configuration options differ from each other in the number and composition of devices, the length of communication cables.

Basic configuration DEL-150 consists of:

- 1) MU-150 – Control Module with memory removable module and built –in modem GSM;
- 2) DN-130 – load sensor on line;
- 3) MI-140 (MI-140S) – digital display module or point digital one;
- 4) BP-137 – power unit with cable or power cable;
- 5) Sound signaling (alarm);
- 6) Remote console (button station).

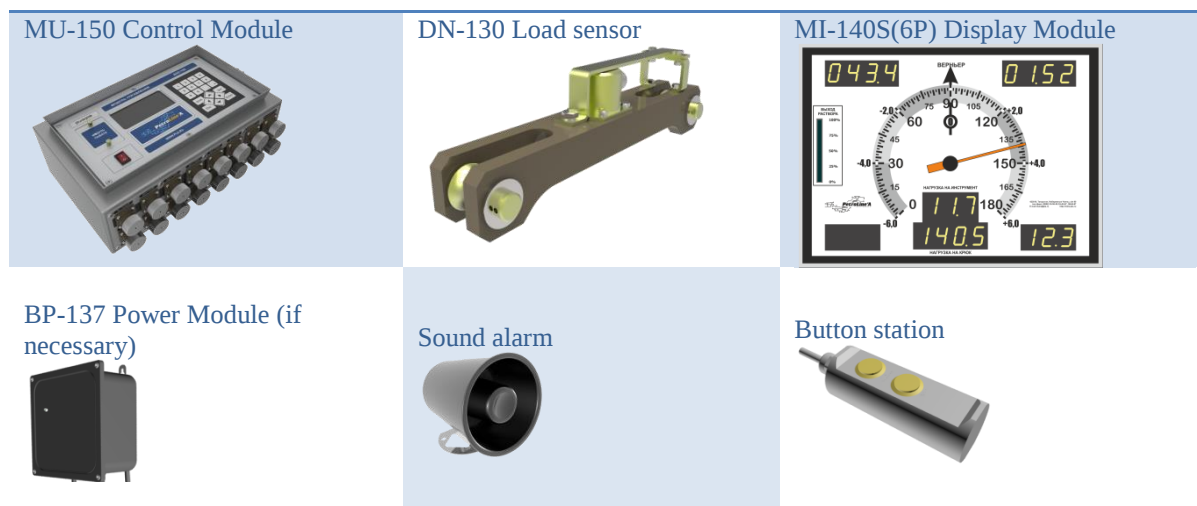


Figure 1. Example of base set

Set can consist of additional sensors:

- TP-140D – pressure transducers and its modifications;
- DN-130V – inline load sensor and its modifications;
- DCM -140 – rotary torque sensor and its modifications;
- DPS-140 – speed sensor and its modifications;
- DTE-140 – ambient temperature sensor and its modifications for measuring liquid temperature;
- DPR-140 – mud density sensors;
- IVR-140 – mud return indicator;
- U-150 – ultrasonic level sensors.

Display Units:

- MI-140(P1) – digital display module and its modifications;
- MI-140(4P) – pointer digital display module on 4 parameters;
- MI-140(6P)E – pointer digital display module on 6 parameters;
- MI-140(P4) – display module with setting parameters and its modifications;
- Industry panel computer.

Extension Units:

- MK-140 – commutation module and its modifications;
- MK-140(GAS) – commutation module and its modifications;
- KBS-485 – wireless communication unit with personal computer (alternative to cable line)
- KBS (RF 868 MHz) – wireless communication unit with commutation module (alternative to cable line)
- WiFi-bridge – antenna set for connection to Ethernet;
- KDD-140 – discrete data input controller;
- PS-150 – signal transducer and its modifications;

and etc.



EDR DEL-150 can work simultaneously with Video Registration system DEL-150V. Software enables to synchronize video registration archive data and measuring.

Table 3. Overall dimensions, weight of sensors and units

Item	Name	Dimensions, mm	Weight, kg
1	MU-150 Control Module	362×250×130	4,7
2	MK-140 Commutation Module	362×250×130	4,0-7,0
3	DN-130 Load Sensor Ø35 -38	540×140×100	15,5
4	DN-130 Load Sensor Ø28 -32	500×127×88	10,54
5	DN-130 Load Sensor Ø22 -25	420×124×83	7,36
6	DN-130 Load Sensor Ø16 -18	310×111×70	4,4

Item	Name	Dimensions, mm	Weight, kg
7	DN-130 Load Sensor	215Ø80	3,8
8	DN-130 Load Sensor (R)	300Ø102	5
9	DVN-140 Vertical Load Sensor	55×Ø98	3
10	DPS-140(A) Speed Sensor	110×Ø60	1,3
10.1	DPS-140(P) Speed Sensor	52×Ø150	1,5
11	DCM-140(R) Rotary Torque Sensor	Ø230×103*	10
12	DCM-140C Rotary Torque Sensor	420×230×280	42
13	TP-140D Pressure Transducer	106×Ø45	0,5
14	TP-140D (M) Pressure Transducer	100×Ø90	1,8
15	IVR-140 Mud Return Indicator	410×Ø90	3,5
16	DTE-140 Temperature Sensor (ambient temperature)	100×Ø35	0,52
17	DTE-140 Temperature Sensor (liquid)	250(500)×Ø35	0,84...
18	MI-140(P1), (P2), (P3), (PU) Display Module	250×190×60	1,6
19	MI-140(4P), MI-140(6P)E Display Module	400×320×60**	3,5
20	MI-140(P4) Display Module	550×200×60	3
21	MI-140(P8) Display Module	550×320×60	5
22	MI-140(P9) Display Module	430×440×60	6
23	MI-140(P12) Display Module	550×440×60	7,4
24	WiFi-bridge antenna		
25	RF-868MHz remote active antenna	220×Ø30	0.3
26	PS-150(R) Signal Transducer	150×Ø30	0,2
27	KBS-485 Wireless communication unit	400×Ø90	1,18
28	Device approved by USB-port	60×64×117	0,04
29	Audible alarm (siren)	106×Ø90	0,7
30	USB-RS485 Converter	60×64×117	0,04

* there are more than 20 dimensions type;

**height of enclosure portion is 30 mm.



Manufacturer leaves the right itself to amend architecture and complex layout, which do not affect technical parameters with correction of operation manual.

Sensors

Sensors which are put on the State register of measuring equipment are used in EDR complex.

Table 4. List of sensors

Sensor name	Abbreviation
Load sensor on a line	DN-130
Inline load sensors	DN-130V
Pressure Transducers	TP-140D, TP-140D(M)
Ultrasonic level sensors	U-150
Gas Analyzer	GSV-1

Verification and calibration of Load Sensors DN-130, DN-130V, Pressure Transducer TP-140D, TP-140D (M), Gas Analyzers GSV-1 are performed at the manufacturer or other accredited enterprise. Calibration interval is 12 months.

The calibration and adjustment of U-150 Level gauge is carried out at the factory or another accredited enterprise. Calibration interval is 24 months.

According to the results of sensors calibration, standardization and certification bodies issue a “certificate of verification” of the established sample.

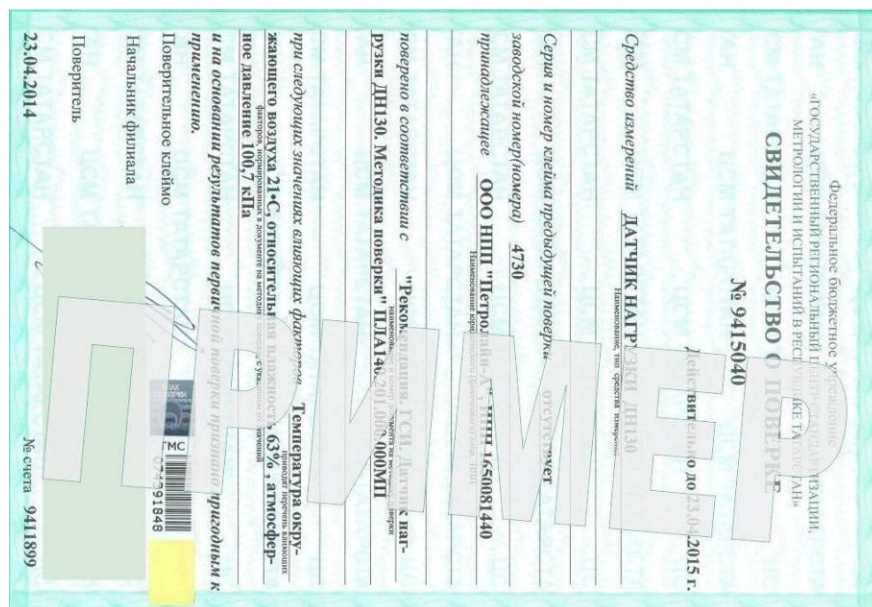


Figure 2 – Certificate of calibration.

Cabling

For the manufacture of communication cables to connect devices in the system, cable products of foreign and domestic production are used which are made of high-quality materials.

A cable is used which includes:

- copper wire strands;
 - core insulation based on thermoplastic elastomer;
 - outer enclosure of special polyurethane;
- This cable has, as a rule, high performance:
- increased mechanical resistance;
 - high frost resistance;
 - resistance to hydrolysis;
 - resistance to acids and alkalis.



In application to operational manual desoldering wiring schemes and cable seals used in DEL-150 system.

1.1.4. Topology and Operation

EDR DEL-150 is a system of digital devices interconnected by a cable communication line. In some cases, the cable line can be replaced by radiochannel. The system uses the ModBus ASCII protocol and RS-485 interface. Each digital device in the system has a non-volatile memory in which the calibration and identification information of the device is stored. For example, for load sensor DN-130 it is:

- Sensor address on the RS-485 bus;
- Serial number;
- Date of calibration;
- Calibration table.

Sensor identification information is stored and transmitted along with measurement information. The software "Monitoring of drilling and repair of wells" allows you to view all the information received.

All measurement data is stored in the internal memory of the control module. The amount of internal memory of Control Module is measured by the number of measurements stored in it. Measurement in EDR system is information per day or part of it from the moment the "reference parameters" change, or the settings affecting the correct display of graphs (for example: changes made during parameter setting, for which it is not possible to form a continuous line diagram).



Capacity of internal storage is 200 measuring.

Control module simultaneously records the saved measurements to removable media "memory module" during the period the memory module is in the Control Module compartment. Record of archival data is made on request.



Information capacity is confined to memory module (from 4 to 8 Gb).



Copying data procedure on memory module is described in chapter «Operating instructions with memory module».

EDR DEL-150 ensures:

- registration of data of line load (tension force), its dynamics and duration;
- data logging of connected sensors and signal transducers;
- display of values by measured parameters on digital and pointer-digital indicators;
- ability to connect current sensors;
- sound alarm function when 95% of the set maximum load (weight) on hook is reached;
- function of the sound (light and sound) alarm at the achievement of the established limit values of the monitored parameters;
- function of giving the blocking signal to the actuator when 100% of the set maximum value of the monitored parameter is reached (line load, mud pressure, rotor torque, etc.);
- function of recording data on controlled values in the electronic memory module and in the internal memory of MU-150 control module;
- function of transmitting the registered data by radio, wired, GSM communications, Ethernet;
- ability of setting to work in GSM;
- ability of setting to work in Ethernet;
- data recording for all measured technological parameters in an external removable memory module;
- use "Vernier" mode for example the mode in which the pointer display module switches to displaying hook load on an additional scale;
- use of the "drill" mode (bit load) during drilling operations;
- function of the choice of system calculation;
- ability of setting of reference parameters (well, pad and etc.);
- ability of setting of operating parameters (max and min allowed parameter values) and pulling units parameters;
- ability of choosing a parameter for indication on Control Module display
- ability of connection of MK-140 commutation module for sensor extension configuration;

Data on all monitored parameters, if there are appropriate connections, are simultaneously stored in the databases created by the Drilling and Well Workover Monitoring software:

- At enterprise server;
- At customer server;
- At master PC/ engineer and others.

List of EDR DEL-150 Controlled Parameters

EDR DEL-150 enables to control the following parameters if there are necessary devices:

- Hook load (Ts, κN);
- Bit load (Ts, κN);
- Rotary torque (Ts·m, κN·m);
- Rotary rpm (rpm);
- Top drive torque (Ts·m, κN·m);
- Top drive rpm (rpm);
- Mud inlet pressure (atm, MPa);
- Hydraulic tong torque pressure (atm, MPa)
- Tripping rate (m/s);
- Hook block position over rotary table (m);
- Measured depth (m);
- Bit position (m);
- Rate of penetration (m/sec);
- Tong torque (Ts·m, κN·m);
- Tong torque by pressure (Ts·m, κN·m);
- Pump rode strokes (strokes/min);
- Mud inlet rate (l/sec);
- Mud volume (m³);
- Total mud volume (m³);
- Inlet mud temperature (°C);
- Outlet mud temperature (°C);
- Ambient temperature (°C);
- Gas concentration (%LFL, mg/m³);
- Mud density (g/sm³);
- Velocity sensor (m/sec);
- And other.



The Drilling and Well Workover Monitoring Software allows selection of measuring units independently

Table 5. Units of measurements

Measuring items	1	2	3	4	5
Load and force	Ts	κN	lb		
Torque	Ts·m	κN·m	lb·ft		
Length	m	ft			
Line speed 1	m/s	ft/s			
Line speed 2	m/h	ft/h			
Density	gr/sm ³	lb/gal			
Pressure	atm	MPa	kgs/sm ²	bar	psi
Temperature	°C	°F			
Fuel volume	l	gal			
Volume	m ³	bbl			
Volume consumption	l/s	l/min	gal/s	gal/m	

Figure 3. Window of settings of measure units

The list of monitored parameters depends on the composition of EDR and can be expanded by connecting additional sensors and signal transducers. The increase in the number of controlled parameters, as a rule, is available if there are free outputs for connection and the relevance of Control Module software.



Software update procedure is described further.



Addition of new parameters which are absent in the system requires additional approval.

Parameters and Sensors

Parameter existence depends on sensor availability in DEL-150 system.

Table 6. List of parameters

PARAMETER	REDUCTION	SENSOR	ALTERNATIVES	
Hook load	LOAD	DN130	DN130B40	
Bit load	BIT LOAD	DN130	DN130B40	
Tong load	MT LOAD	DN130		
Guy line load	GUY LINE	DN130B(R)	DN130(R)	
Tong torque	TONG TORQUE	DN130V	DN130	
Tong torque 1	TONG TORQUE 1	DN130V	DN130	
Tong torque 2	TONG TORQUE 2	DN130V	DN130	
Tripping rate	T.RATE	DPS-140(P)	DPS-140(A)	KDD-140+VBI
Travelling block position	TB POSITION	DPS-140		
Hydraulic tong pressure	HT PRESSURE	TP-140D		
Tong torque pressure	TT PRESSURE	TP-140D(VBI)+VBI	TP-140D	
Inlet mud pressure	MUD PRESS.IN	TP-140D(M)	TP-140D	
Rotor torque pressure	ROTOR TORQUE [D]	TP-140D		
Outlet mud pressure	MUD PRESS.OUT	TP-140D		
Ambient temperature	TEMPERATURE	DTE-140		
Inlet mud temperature	TEMPER.IN	DTE-140G	TP-140D(M)	
Outlet mud pressure	TEMPER.OUT	DT-140G	TP-140D(M)	
Mud return	MUD OUTPUT	IVR-140	U-150	
Rotary Torque	ROTOR TORQUE	DCM-140(R)	DCM-140C	DN130V(C)
Rotor rpm	ROTOR RPM	DCM-140(R)	DCM-140C	DN130V(C)
Fuel level	FUEL LEVEL1	PS-140(LLS)+		
Fuel level	FUEL LEVEL 2	PS-140(LLS)+		
Fuel level	FUEL LEVEL 3	PS-140(LLS)+		
Fuel level	FUEL LEVEL 4	PS-140(LLS)+		
Mud density	MUD DENSITY 1	DPR-140		
Mud density	MUD DENSITY 2	DPR-140		
Mud density	MUD DENSITY 3	DPR-140		
Mud density	MUD DENSITY 4	DPR-140		
Pump consumption	FLOW RATE 1	KDD-140+VBI		
Pump consumption	FLOW RATE 2	KDD-140+VBI		

Pump consumption	FLOW RATE 3	KDD-140+VBI		
Pump consumption	FLOW RATE 4	KDD-140+VBI		
Gas content	GAS-1	GSV	(4-20 mA)	
Gas content	GAS-2	GSV	(4-20 mA)	
Gas content	GAS-3	GSV	(4-20 mA)	
Gas content	GAS-4	GSV	(4-20 mA)	
Gas content	GAS-5	GSV	(4-20 mA)	
Gas content	GAS-6	GSV	(4-20 mA)	
Gas content	GAS-7	GSV	(4-20 mA)	
Gas content	GAS-8	GSV	(4-20 mA)	
Gas content	GAS-9	GSV	(4-20 mA)	
Gas content	GAS-10	GSV	(4-20 mA)	
Gas content	GAS-11	GSV	(4-20 mA)	
Gas content	GAS-12	GSV	(4-20 mA)	
Gas content	GAS-13	GSV	(4-20 mA)	
Gas content	GAS-14	GSV	(4-20 mA)	
Gas content	GAS-15	GSV	(4-20 mA)	
Gas content	GAS-16	GSV	(4-20 mA)	
Mud level/Volume	MUD LEVEL 1	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 2	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 3	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 4	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 5	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 6	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 7	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 8	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 9	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 10	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 11	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 12	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 13	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 14	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 15	U-150	(4-20 mA)	
Mud level/Volume	MUD LEVEL 16	U-150	(4-20 mA)	

Below is a list of addresses of the corresponding parameters with an abbreviation of sensors displayed in the Control Module menu for the “CONNECTED DEVICES” and addresses on the RS-485 bus.

Table 7. List of addresses

№	Recording on MU-150	dec	Connected Sensors
1	DN130	002	Load sensor
2	DN130C	003	Torque load sensor
3	DN130V	004	Inline torque load sensor
4	DPS(VBI)	005	Tripping rate VBI sensor
5	DPS-140(A/E)	006	Rate sensor with encoder or tripping rate/position sensor with absolute encoder
6	DN130V(KT)	007	Load sensor (coiled tubing)
7	KVDS-140	009	Table lift sensor
8*	DN130V	011	Inline torque load sensor 2
9*	DN130V	012	Inline torque load sensor 3
10	TP-140D(HT)	016	Hydraulic tong pressure sensor
11	TP-140D(IN)	017	Inlet mud pressure sensor
12	TP-140D(RP)	018	Rotor pressure sensor
13	TP-140D	019	Tong pressure sensor (with coefficient)
14	TP-140D(OUT)	020	Outlet mud pressure sensor
15	DTE-140	023	Ambient temperature sensor
16	DTE-140(IN)	024	Inlet mud pressure sensor
17	DTE-140(OUT)	025	Outlet mud pressure sensor
18	IVR-140	026	Mud return sensor

19	CONSUMPTION(420)	028	Flowmeter (4-20)
20	DPR-140(1)	030	Inlet mud density sensor
21	DPR-140(2)	031	Outlet mud density sensor
22	PG-1(C)	038	Level sensor 1 (digital)
23	PG-2(C)	039	Level sensor 2 (digital)
24	PG-3(C)	040	Level sensor 3 (digital)
25	PG-4(C)	041	Level sensor 4 (digital)
26	PG-5(C)	042	Level sensor 5 (digital)
27	PG-6(C)	043	Level sensor 6 (digital)
28	PG-7(C)	044	Level sensor 7 (digital)
29	PG-8(C)	045	Level sensor 8 (digital)
30	KDD-140(N)	052	KDD-140 DEL-140
31	KDD-150(N)	054	KDD-140 DEL-150
32	KDD-150(N)2	055	KDD-1402 ДЭЛ-150
33	GAS1-8	056	Gases (8 channels)
34	LEVEL PG1-8	064	Levels (8 channels)
35	FUEL LEVEL	072	Fuel level (4 channels)
36	TD TORQUE 420	075	Top Drive Torque (4-20)
37	TD RPM 420	076	Top Drive RPM(4-20)
38	R.TORQUE 420	078	Rotor torque (4-20)
39	R.RPM 420	079	Rotor rpm (4-20)
40	BLOCK-D	080	Drawworks block
41	BLOCK-R	081	Rotor block
42	BLOCK-P	082	Pump block
43	DCM-140C	93	Torque sensor for chain drive
36	DCM-140	94	Torque sensor for shaft drive
37	MI(CONSOLE)1	128	Display Module with driller's console 1
38	MI(CONSOLE)2	129	Display Module with driller's console 2
39	MI(CONSOLE)3	130	Display Module with driller's console 3
40	MI(CONSOLE)4	131	Display Module with driller's console 4
41	MI-1	132	Display Module 1
42	MI-2	133	Display Module 2
43	MI-3	134	Display Module 3
44	MI-4	135	Display Module 4
45	MI-5	136	Display Module 5
46	MI-6	137	Display Module 6
47	MI-7	138	Display Module 7
48	MI-8	139	Display Module 8
49	PS-150(4C)	140	PS-150(4K) 4 channels Signal Transducer
50	PS-150(4C)2	141	PS-150(4K) 4 channels Signal Transducer

* * additional addresses for sensors used on similar keys within one complex.

In the future, the list may be updated in connection with the appearance of new positions.

Connection of Digital Devices

Connection of digital devices (sensors, display modules, signal transducers) is made via universal communication channel to Control Module connectors.

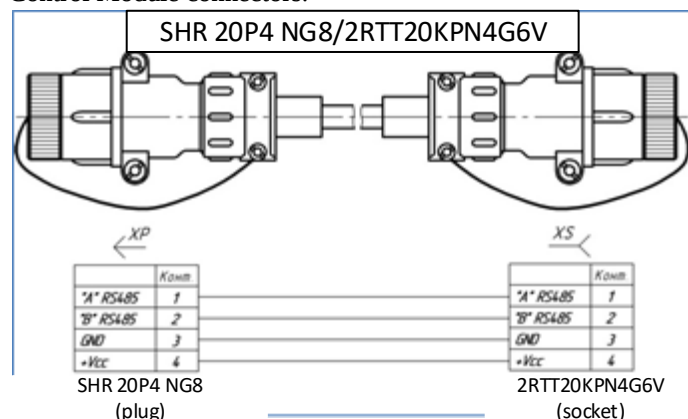


Figure 4. Universal communication channel (RS-485)

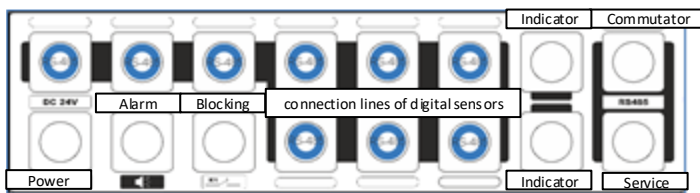


Figure 5. Connection points of digital sensors

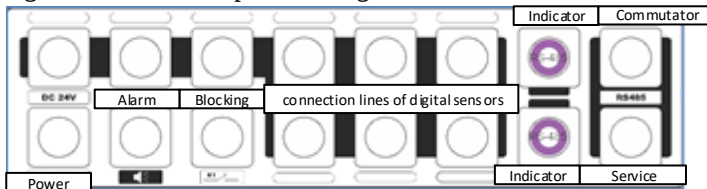


Figure 6. Connection points of display module

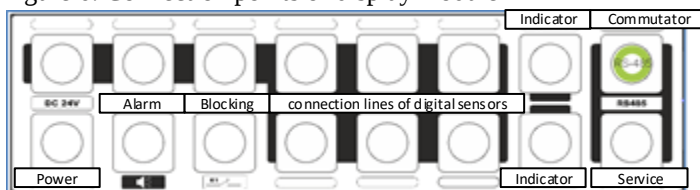


Figure 7. Connection points of commutation modules

To connect the commutation module with the same connectors with or without a screen the cable is used.

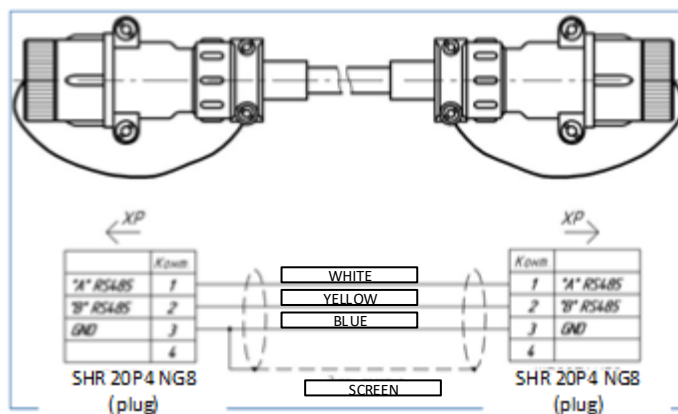


Figure 8. Channel cable of Control Module with commutation module

Connection «power source», «alarm», «blockings», «service»

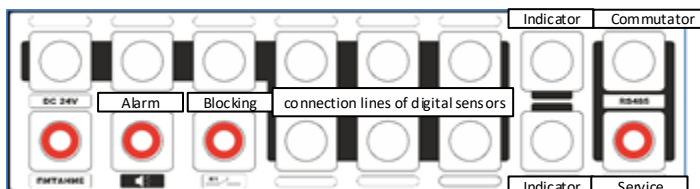


Figure 9. Connection points of «power source», «alarm», «blockings», «service»

To connect power source from rig accumulator battery power source cable is used.

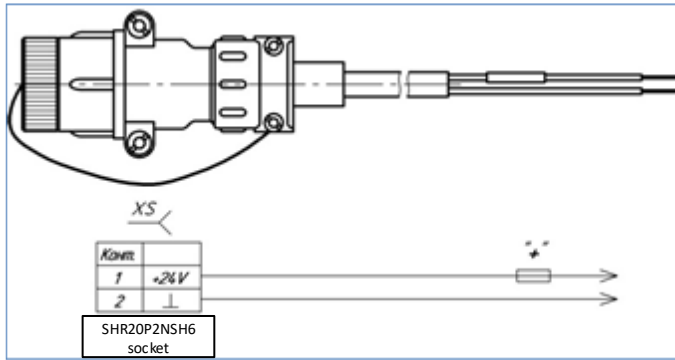


Figure 10. Power source cable

Sound alarm together with a cable are connected at alarm connection point

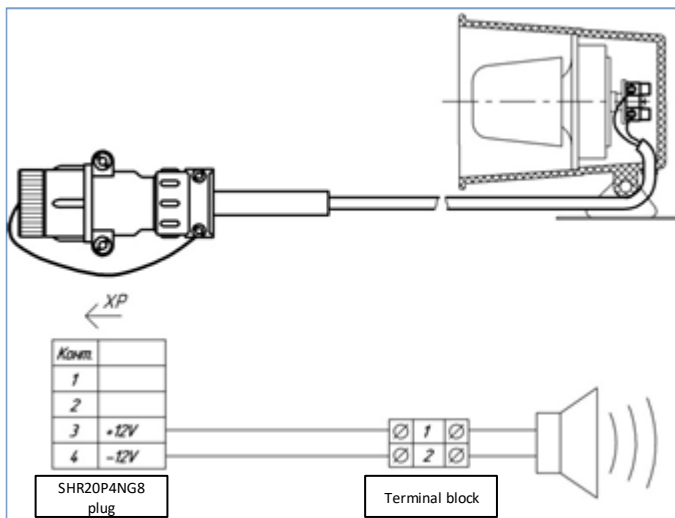
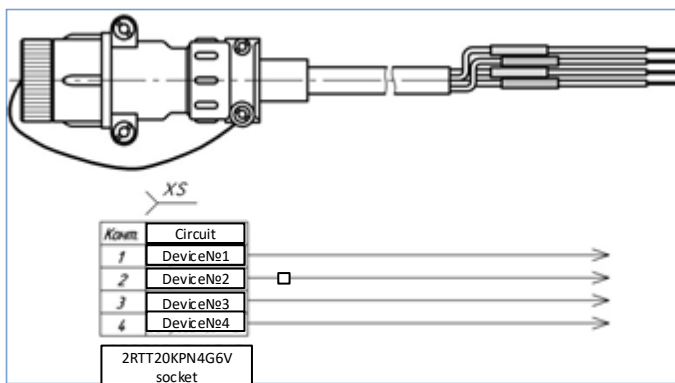


Figure 11. Alarm with a cable

To connect to the actuators 2 or 4-wire cable blocking is applied to sustain a signal to the blocking.



Circuit

Figure 12. Blocking cable (4 wire cable)

1.1.5. Relay Blocking Operation (till 2016).

A relay with normally closed contacts is used to feed a signal to an executive device for blocking drawworks or another mechanism.



While the relay is not “worked”, the contacts are closed; the current passes directly, as through a normal wire. When the relay is triggered, the contacts are opened, the circuit is broken, the current stops flowing. This type of contact is normally closed (NC).

Thus, the relay contacts are at open state in three cases:

1. When the parameter value exceeds the tolerable limits;

- 2. In the absence of the required parameter;
- 3. When the instrument is turned off.

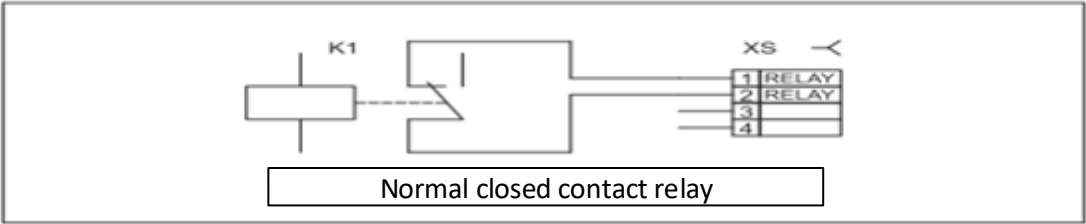


Figure 13 Relay blocking layout

These blocking boards have two relays and can work with two executive devices. To send a signal to the executive devices for blocking a drawworks or another mechanism, boards with a relay with the possibility of switching the operation mode are used.

Placement of connectors, installation and adjustment of the blocking module is made at the request of the customer during the assembly and preparation of EDR for shipment. By default, the Control Module comes with one output to drawworks blocking, the relay contacts are normally closed.

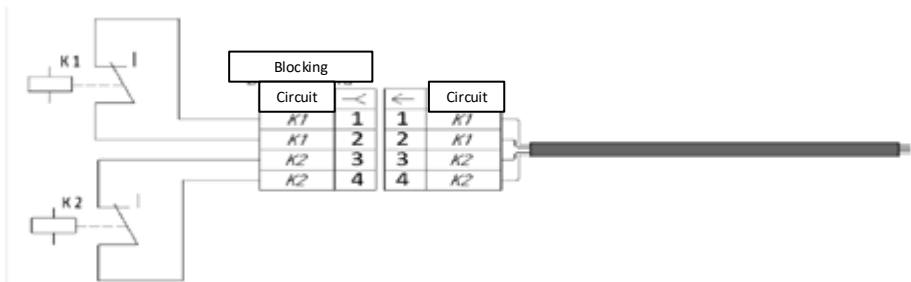


Figure 14. Connection for one connector

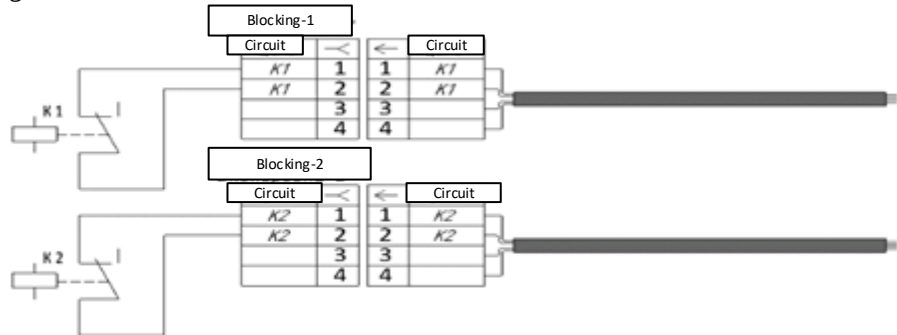


Figure 15. Connection for one connector.

Table 8. Relay blocking type

	Sensor is on	Sensor is off	By a signal
Normally closed			
Normally open			

Connection to Terminal Blocks on a Blocking Board.

The blocking module shows six terminals for connecting the blocking connectors.

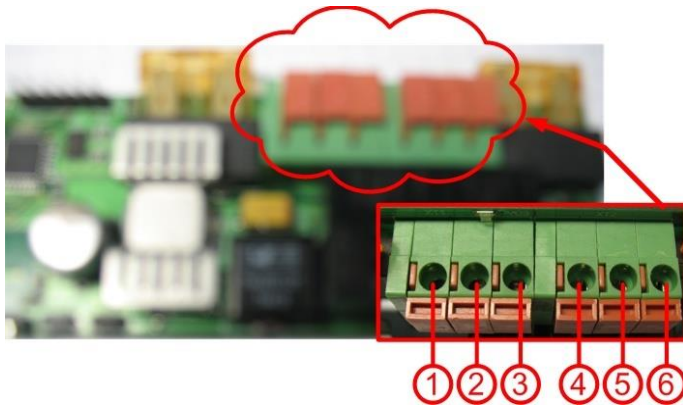


Figure 16. Terminal blocks on a blocking board

1. Normal open contact 1;
2. General 1;
3. Normal closed contact 1;
4. Normal open contact 2;
5. General 2;
6. Normal closed contact 2.

Max carry current	2 A
Max commutating voltage	24 W



Attention! Do not connect a blocking cable to sources exceeding relay characteristics.



Only drawworks «blocking» exists at base modification of EDR.

To work with other devices, you must have a corresponding connector on the Control Module or the communication module. The connection is made by a “blocking cable” through a standard connector with a signature, for example: “L”, “R”, “N”, etc. on the connector strip.

Upon request, signals of two “blockings” can be output on a single connector.

Acronyms	Address on RS-bus	Acronyms at menu Connected devices	Designation	Parameter
K1 (L)	80	BLOCK[L]	Signal on drawworks blocking	HOOK LOAD
K2 (R)	81	BLOCK[R]	Signal on rotor blocking	TORQUE ROTOR
K3 (N)	82	BLOCK[N]	Signal on pump blocking	PUMP FLOW RATE
K5 (G)	83	BLOCK[G]	Signal on exceeding gas concentration	GASES
K4 (K)	84	BLOCK[KI]	Signal on tong blocking	TONG TORQUE LOAD
K5 (O)	85	BLOCK[O]	Signal on drawworks blocking	GUY LINES
K6 (KM)	86	BLOCK[KIM]	Signal on tong blocking	TONG TORQUE
K7 (KG)	87	BLOCK[KIG]	Signal on tong blocking	TONG HYDRAULIC PRESSURE
K8 (A)	88	BLOCK[AKB]	Signal on tong blocking	AUTOMATIC TONG TORQUE
K9 (VP)	89	BLOCK[SVP]	Signal on top drive blocking	TOP DRIVE SYSTEM TORQUE
K10 (G2)	90	BLOCK[G-2]	Signal on exceeding gas concentration	
K11 (U)	92	BLOCK[U]	Signal on exceeding gas concentration block by level gauges readings	



Figure 17. Signs of connectors

To set the blocking signal, it is necessary to set the value in the corresponding parameter window in the “MAX” line and, or “MIN” (for example: load-on-hook), to confirm the Set point, a signal will be given to the corresponding blocking relay.

HOOK LOAD,Ts	
Max	150.0
Coeff	8.0
HOOK LOAD,Ts	6.0

Figure 18. Window example of set parameter "HOOK LOAD"



To disconnect a signal it is necessary to delete the value at line «MAX» and «MIN» by pressing  on keyboard, after that a symbol "-----" appears

1.1.6. Sound Alarming

An audible signal (alarm) is a complete device with an alarm generation circuit that is activated when the supply voltage is applied upon a command from the blocking module. The audio signal device (alarm) is made in industrial design and is installed outside the hazardous area.



Figure 19 – Sound signal (alarm)



Notification: alarm is switched on when 95 % of parameter threshold is reached.

1.1.7. Measuring Tools and Instrumentation

In the process of installation, commissioning and operation, no special measuring instruments are required.

For installation and maintenance of DEL-150, the standard tools of Control Measuring Parameters specialist and an electrician are used.

A set of tools of a specialist can include: a hammer, a set of wrenches or single keys, a mounting knife, a set of screwdrivers, pliers, side-cutters, a belt for tools, a cutter, a clamping tool, a screwdriver-probe, insulation strippers, crimping pliers, electrical tape, drill bit, drill hole, bit set, soldering iron, multimeter.

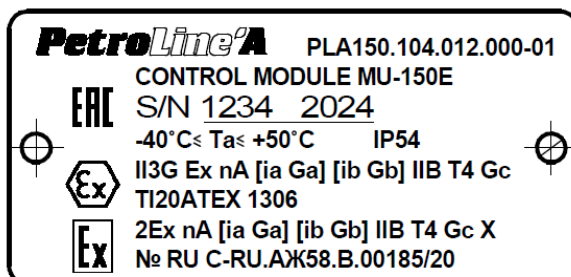
In the process of operation of EDR for reconfiguration of the display module, RS-485 converter with a service cable may be needed.

1.1.8. Marking and Sealing

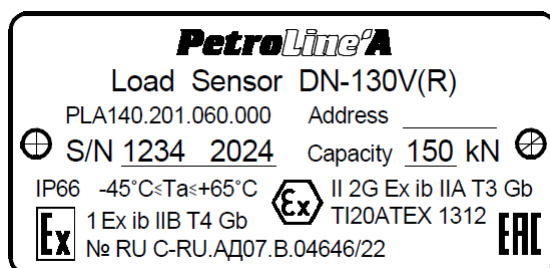
Marking applied to enclosures of the components of the electronic dynamometer DEL-150 includes the following data:

1. The trademark or the name of the manufacturer;
2. Type of product;
3. Serial number and year of issue;
4. Ex marking of;
5. Special sign of explosion safety;
6. The range of ambient temperature during operation;
7. The name of the certification body and the number of the certificate of compliance.

Other data required by regulatory and technical documentation, which the manufacturer should reflect on the label, could also be used.



Picture 20 – Example of marking of the Control Module



Picture 21 – Example of marking of a sensor

The device enclosures containing electronic circuits and electromechanical links are sealed in order to prevent unauthorized use. Repairs are carried out by the manufacturer or by the accredited service center, which is delegated to repair.



Picture 22 – Sealing examples

1.1.9. Packaging

For DEL-150 transportation it is used durable boxes made of plywood with metal carrying handles. Four basic size boxes are supplied, but if necessary, the size and type of packaging can be changed due to the specific delivery conditions.

Table 9. Transportation boxes

Item	Name	Dimensions, mm	Weight, kg
1	Big load transfer case	740×300×420	8,9
2	Small load transfer case	680×300×350	7,4
3	Load transfer case for MI-140S	460×460×340	5,5
4	Load transfer case for DCM-140C	450×380×280	6

2. OPERATION

2.1. Operational Constraints

EDR DEL-150 is operated by personnel who have completed the present instruction, passed the appropriate safety instructions on the site and have the necessary equipment to work in hazardous areas.

When operating the complex, it is necessary to guide:

- the regulations of the "Rules for operation of electrical installations";
- "Safety Rules in Oil and Gas Industry", approved by Gosgortech Supervision of Russia in accordance with the Federal Law "On Industrial Safety of Dangerous Production Facilities";
- current industry safety regulations;
- requirements of this manual.



Attention! In case of mechanical damage of EDR DEL-150 devices and communication cables between them in hazardous area, the further operation of the products is strictly prohibited.

- Modules in DEL-150 complex must be securely fastened and grounded in order to ensure reliable contact on the «weight» of the lifting unit.
- During operation, it is prohibited to tear the seals and open the covers of the devices included in EDR.
- When the power is turned on, it is prohibited to connect and disconnect the connectors of connecting cables, power cable and grounding wires.
- In case of failure detection, it is necessary to turn off the device, disconnect the power cable from the power source. Then replace the faulty device with a working one, having connected it according to the documentation. After replacement, check the reliability of the connections and grounding of the buildings to the weight of the lift.
- During the operation, check periodically the condition of the communication cables. When detecting a breach of the protective layer on the cable lines, immediately turn off the power supply and replace the damaged cable.
- Do not disrupt sealing devices. When detecting faults, turn off the power supply and replace the faulty device.
- When detecting mechanical damage, dismount the defective device and repair it.
-



Attention! The absence of marks on the operation in the specification booklet (section "Movement of the product during operation") ATTRIBUTES THE OPERATION RULES, and the manufacturer has the right to waive the warranty.



Attention! When performing welding works on a lifting installation, it is necessary to disconnect the device from the network.

- Before installation, inspect the devices that are part of the complex in the absence of external damage, cracks, chips, pay attention to the presence of explosion-proof marking, the condition of the connectors of connecting cables.
- Installation, disassembly, connection and preparation for work of EDR DEL-150 should be performed only with the disconnected power supply.

2.2. DEL-150 Preparing to Usage

2.2.1. External Check Scope of Works

An external examination includes a check:

- states of contacts, flexible connections and outputs;
- availability of mounting bolts and nuts;
- strength ratios;
- ease of movement and the absence of jams and distortions in the moving system;
- states of the choke supplying the measured medium to the sensible element of the pressure sensors, level, state of the cable leads into the sensors of their sealants;
- condition of cable entries and terminal boxes;
- tightness of the mounting bolts of sensors, indicators and other devices;
- integrity of keyboards, signal LEDs, displays, glass surfaces;
- integrity of the painting panels, cabinets, appliances, sensors.

2.2.2. Rules and Sequence of Readiness Checking for Usage

- When connecting to AC 220 V, check integrity of the socket or the terminal connection.
- When connecting to 24 V AFDX, check the charge status of the battery pack.
- Check the reliability of the connection of all connectors on the Control Module and the communication module, as well as connectors and terminal connections of sensors and other devices of the system.
- If there is a built-in GSM modem, check the presence of SIM cards (check indoors, to prevent moisture and active substances from entering the front panel of the control module), and the presence of a GSM antenna in the Control Module connection

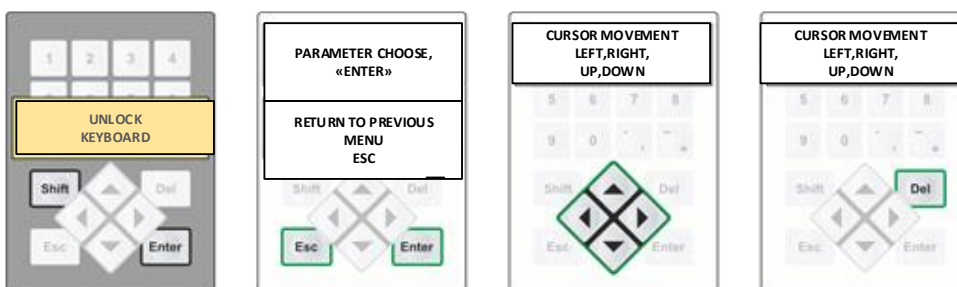
2.2.3. Settings

- Enable DEL-150 by pressing keys on the front panel of MU-150;
- If MK-140 is equipped with one or several models, the Control module must be turned on after all communication modules are turned on.



Figure 23 – Control Module physical configuration.

- After loading Control Module (Control Module can work without a memory module), the device is ready for operation;
- After the first activation, edit the required parameters:
 - o reference parameters;
 - o maximum values;
 - o coefficients;
 - o carry out the update of the required parameters;
- After moving to edit the reference parameters;
- After changing the fixtures, replacing and adding sensors, check and, if necessary, edit the operating parameters;
- If you have a GSM modem and use the data transfer function, check the GPRS settings;
- If you have Ethernet module and use a network connection, check the Ethernet settings;
- The settings should be carried out according to the information set out on the cover of Control Module and “MU-150 Control Module operation manual setting”.



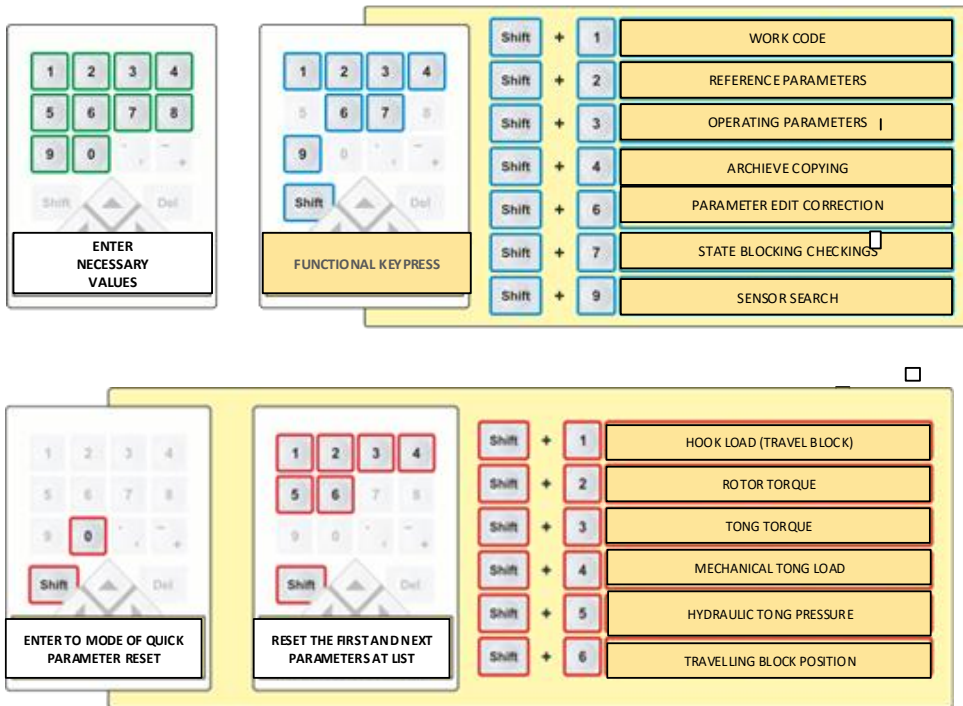


Figure 24. Sealings which are inner side of Control Module cover.

2.2.4. Blocking Checking



Caution! Blocking checking should be carried out only during the works provided for by the regulations for the technical inspection and adjustment of instrumentation!



Caution! Exclude unauthorized shutdown, activating of technological equipment!

- Check that the blocking cable is connected correctly;
- Switch on control module;
- Go to "blocking test mode"
- In the window of "blocking status", select the required lines;

```
BLOCKING STATE
BLOCK-L [080] --
BLOCK-R [081] SB
BLOCK-N [082] --
```

- «BLOCK-L» - drawworks blocking;
- «BLOCK-R» - rotor blocking;
- «BLOCK-N» - pump blocking;
- «A» - alarms are in active state by exceeding set parameter;
- «B» - blocking relay is in active state by exceeding set parameter.



Notification: alarm is switched on when 95 % of parameter threshold is reached.

- Simultaneously press buttons on the keyboard



```
BLOCKING CHECKING
SCANNING IS STOPPED
BLOCKING IS ON
```



When a blocking is triggered in the "block check mode", the polling of all devices is disabled.

- After termination of a checking «checking is terminated» line is flashed on, polling is recommenced

BLOCKING CHECKING
SCANNING IS STOPPED
BLOCKING IS ON
CHECKING IS FINISHED

- Enter in «operating mode».

2.2.5. Installation

- MU-150 Control Module and MK-140 Communication Module should be located outside Ex zone, on a suitable for this, vertical surface, at the height of for setting up the device;
- The memory compartment on the front panel of Control Module should be closed with two captive screws;
- The lid of Control Module after entering the settings must be closed on the latch;
- The display module, one or several, must be mounted on the platform in the field of view of the auditor without blocking the view of the working area, at the level and at the distance of which it is necessary to perceive information.



The second connector of the display module is assigned to connect the button station.

- Sensors are placed according to the information contained in the manual for the operation of individual devices and applications with wiring diagrams;
- Sensors and devices from third-party manufacturers are installed according to the manufacturer's documentation.

2.2.6. Connection of the 3rd Party Equipment

- Interconnection with analogue sensors 4-20 mA.

To work with analogue sensors on the cross-board of Control Module boards are mounted which allow to make this connection. Connectors are made out of the corresponding inscription.

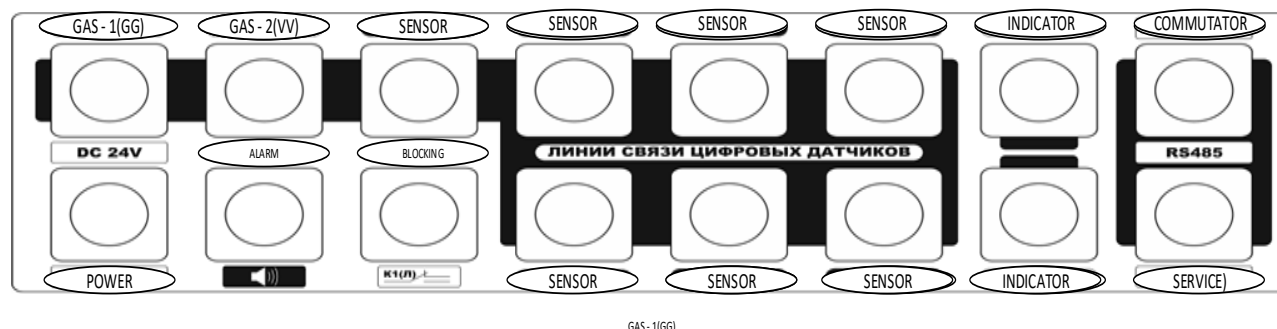


Figure 25 – Control module connectors signing (Commutation Module).

- Interconnection with VBI-M30 induction sensor

To work with inductive sensors, an external KDD-140 single-channel external device for measuring the speed of lifting and two-channel for counting the revolutions of pumps or stocks of rods is provided. KDD-140 connects to Control Module with a universal communication cable.



Figure 26 – KDD-140

- Interaction with capacitive fuel level sensors

To work with sensors fuel level with two-channels PS-150 signal converter (LLS) is used. The signal converter is connected to Control Module in a standard RS-485 connector.



Figure 27 – PS-150 (LLS)

– Interaction with ACS

To deliver data as analogue signal for third-party systems, PS-140 four-channel signal converter (4K) is used, allowing to set four parameters from a single transducer at a choice.



Figure 28 – PS-140 (4K)

To provide measurement data of the Control Module via the network connection at the facility, the EDR system provides an integrated Ethernet module with an RJ-45 connector on the building of the Control Module



Figure 29 - RJ-45 connector at Control Module enclosure

- Interaction with a signal splitter 4 ... 20mA

The signal splitter is designed to convert and branch out signals from various sensors. The input signal is converted and branched into two output signals, unified by current (0 ... 20 mA, 4 ... 20 mA) or voltage (0 ... 5 V, 0 ... 10 V).



Figure 30. SENECA Z170REG

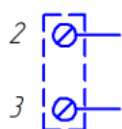
Table 10. Layout connections

Active outputs

	Input	Output 1	Output 2
Type	4...20 mA	4...20 mA	4...20 mA
Layout			
Settings	SW1 : 00010101 ; SW2 : 11110111		

Passive outputs

	Input	Output 1	Output 2
Type	4...20 mA	4...20 mA	4...20 mA
Layout			
Settings	SW1 : 00010101 ; SW2 : 11111111		



Splitter requires voltage from 10 to 40 W D/C or from 19 to 28 W A/C.

Electric power supply polarity connection is of no matter.

2.2.7. Modbus Protocol Description

DEL-140E / DEL-150 Control Module provides a second RS485 service port (Service 2), designated for communication with third-party automation systems. Service 2 can work in the following modes: Mode 1 - MODBUS SLAVE. In this mode, the Control Module is a slave device on the MODBUS bus, the broadcast address is 0xFF, the mode is 57600:8:N:1. The MODBUS command is a group reading registers - 0x03.

Table 11. Information registers

Register		Description	Example, hex	
dec	hex			
11	x000B	Device address on the MODBUS bus	x00CE	
12	x000C	Serial number of the Control Module	x2710	
13	x000D	Version of built-in software in BCD format HIBYTE – major part LOBYTE – minor part	x1001	v. 10.01
14	x000E	Day and month in BCD format HIBYTE – day LOBYTE – month	x0407	4 th of July
15	x000F	Year in BCD format	x2019	2019 year
16	x0010	Hours, minutes in BCD format	x1211	12:11
17	x0011	Seconds in BCD format HIBYTE – reserved LOBYTE – seconds	x0043	43 seconds

Table 12. Register range with extended parameters information

	255	x00FF	Quantity of measured parameters at this moment		x0005	
List of registers for the 1st parameter	256	x0100	ID– identifier of the parameter 1		x0101	
	257	x0101	HIWORD	MAX – set maximum for a parameter. Interpreted as int32_t (character four-byte integer). Value 0x80000000 (INT32_MIN) means that maximum is absent.	x0000	25000
	258	x0102	LOWORD		x61A8	
	259	x0103	HIWORD	MIN – set minimum for a parameter. Interpreted as int32_t (character four-byte integer). Value 0x80000000 (INT32_MIN) means that minimum is absent.	xFFFF	-1
	260	x0104	LOWORD		xFFFF	
	261	x0105	FLAGS – Parameter’s flag: x0001 -MBSLAVE_MEASPARAMDESC_FLAG_ERROR. Error, measured value is not valid (sensor is out of order, cable breakdown with a sensor and etc.). x0002 - MBSLAVE_MEASPARAMDESC_FLAG_NOVALID. Measured value is not valid (warming of a measuring element, the primary transducer is off.) x0004 - MBSLAVE_MEASPARAMDESC_FLAG_OFF. Measured value is not valid, at current mode a parameter is not used.			
	262	x0106	HIWORD	VALUE – measured parameter value. Interpreted as int32_t (character four-byte integer).		
	263	x0107	LOWORD			
	264	x0108	RESERVED - reserved.			
	265	x0109				
List of registers for the 2nd parameter	266	x010A	ID– identifier of the parameter 2			
	267	x010B	...	...		
	268	x010C	...			
	269	x010D	...	...		
	270	x010E	...			
	271	x010F	...			
	272	x0110	...	...		
	273	x0111	...			
	274	x0112	...			
	275	x0113				
		...	...	...		...
List of registers for the n parameter	256+ (n*10)	...	ID– identifier of the parameter n			
	256 + (n*10)+1	...	...	...		
	256 + (n*10)+2	...	...			
	256 + (n*10)+3	...	...	...		
	256 + (n*10)+4	...	...			

	256 + (n*10)+5	...	...		
	256 + (n*10)+6	...	...	...	
	256 + (n*10)+7	...	...		
	256 + (n*10)+8	...	...		
	256 + (n*10)+9	...			
	256+ (n+1)*10	...	xFFFF		xFFFF
	256+ (n+1)*10 +1	...	xFFFF		xFFFF
	256+ (n+1)*10 +2	...	xFFFF		xFFFF
	256+ (n+1)*10 +3	...	xFFFF		xFFFF
	256+ (n+1)*10 +4	...	xFFFF		xFFFF
	256+ (n+1)*10 +5	...	xFFFF		xFFFF
	256+ (n+1)*10 +6	...	xFFFF		xFFFF
	256+ (n+1)*10 +7	...	xFFFF		xFFFF
	256+ (n+1)*10 +8	...	xFFFF		xFFFF
		256+ (n+1)*10 +9	...	xFFFF	

Table 13. Register range with reduced parameters information

	4095	xFFF	Quantity of registered parameters at this moment		x0005
Reduced registers list for parameter 1	4096	x1000	ID – identifier of the parameter 1		x0101
	4097	x1001	HIWORD	VALUE – measured parameter value. Interpreted as int32_t (character four-byte integer). Value 0x80000000 (INT32_MIN) means, that parameter is off or sensor error or primary transducer is not connected.	
	4098	x1002	LOWORD		
Reduced registers list for parameter 2	4099	x1003	ID – identifier of the parameter 2		x0112
	4100	x1004	HIWORD	VALUE - измеренное значение параметра. Interpreted as int32_t (character four-byte integer). Value 0x80000000 (INT32_MIN) means, that parameter is off or sensor error or primary transducer is not connected.	
	4101	x1005	LOWORD		
	...	...	...	...	

Reduced registers list for parameter n	4096 + (n*3)	...	ID- parameter identifier n		
	4096 + (n*3)+1	...	HIWORD		
	4096 + (n*3)+2	...	LOWORD		
	4096 + (n+1)*3	...	xFFFF		xFFFF
	4096 + (n+1)*3 +1	...	xFFFF		xFFFF
	4096 + (n+1)*3 +2	...	xFFFF		xFFFF

Table 14. MODBUS instruction of register group reading 0x10.

Register 143 (0x008F) is available for writing as a command register.

Recording value (decimal)	Actions
1	Turn on / off DRILL mode. If DRILL mode was turned off, the recording of the value 1 will turn it on, if it was turned on, it will be turned off. You can monitor the current state of DRILL mode by reading the parameter value with ID 0x0112.
2	Turn on / off VERNER mode. If VERNER mode was turned off, the recording of the value 2 will turn it on, if it was turned on, it will be turned off. You can monitor the current state VERNER mode by reading the parameter value with ID 0x0101.
4	Zeroing of traveling block position.

Instructions for reading ranges of registers.

To read ranges of registers with extended information, you should focus on register 255 (0x00FF), which contains information on the number of parameters measured at the time of receiving the actual data frame.

The range of extended registers contains sequences of 10 registers, always starts with 256 (0x0100) and, according to Table 12, contains all information about the parameter, its identifier, set maximum and minimum values, parameter status flag (error, invalid measurement, status), measured value, and reserved part. The number of ranges to be read is in the 255 register. For example, if the number 13 is in register 255, it means that 13 parameters are currently being measured (not necessarily 1 sensor is equal to 1 parameter) and 13 * 10 registers should be read, starting from 256 to 395 = (256 + (13*10) + 9), the following registers will return 65535 (0xFFFF).

In the first register of each ten (256 + (n*10)) the parameter identifier is found (Table 15), this parameter can change with a change in the number of parameters, that is, if a parameter is added or decreased, the register map will be rebuilt and, for example, there will be a new identifier in the 3rd ten. In other words, it is NECESSARY to decrypt the register map at each request to the Control Module.

For example, before the sensor is turned off, you receive the following identifiers:

- in 256 (0x0100) register there is an identifier 0x0100;
- the 266 (0x010A) register contains the identifier 0x0101;
- the 276 (0x0114) register contains the identifier 0x0112;
- the 286 (0x010E) register contains the identifier 0x0104;
- the 296 (0x0128) register contains the identifier 0x0114.

After disconnecting the sensor, the register map will be rebuilt and the 256 register will return a DIFFERENT identifier, respectively, the measured value and its state will be for the new parameter:

- the 256 (0x0100) register contains the identifier 0x0104;
- the 266 (0x010A) register contains the identifier, 0x0114;
- the 276 (0x0114) register contains the identifier, 0x0118;
- the 286 (0x010E) register contains the identifier, 0x011A;
- the 296 (0x0128) register contains the identifier, 0x011C.

The similar situation for a reduced range of registers starting from 4096 register.

Information on the measured value, the set maximum and minimum are in 2 registers in a row, they should be interpreted as int32, for example:

- HIWORD is in register 262, 0xFFFF;
- LOWORD is in register 263, 0xFFFB.

Interpretation of 0xFFFFFFFBB or decimal -5. The resulting number should be multiplied by the unit of measurement of the parameter, for example, if the 256 register returned 0x0102 (HT PRESSURE), the measured value should be multiplied by 0.1 (-5 * 0.1 = -0.5 atmospheres in the hydraulic tong system).

Table 15. UOM used in the data transferring

Item			UOM	Parameter Name in the Control Module	Description
	dec	hex			
1		x0100	1 kgf	HOOK LOAD	Hook load
2		x0101		VERNIER	Hook Load in Vernier mode
3		x0102	0.1 at	HT PRESSURE	Hydraulic tong pressure
4		x0104	0.1 at	MUD PRESS.IN	Inlet mud pressure
5		x0105	0.1 at	MUD PRESS.IN2	Inlet mud pressure 2
6		x0106	0.1 °C	TEMPERATURE	Ambient temperature
7		x0108	0.1 °C	MUD TEMP.OUT	Outlet mud temperature
8		x010A	0.1 °C	MUD TEMP.IN	Inlet mud temperature
9		x010C	0.1 m/s	T.VELOCITY	Tripping Velocity
10		x010E	1 %	MUD OUTPUT	Mud output %
11		x0112	1 kgf	WOB	Bit load
12		x0114	*	GAS-1	GAS 1
13		x0118	*	GAS-2	GAS 2
14		x011A	*	GAS-3	GAS 3
15		x011C	*	GAS-4	GAS 4
16		x011E	*	GAS-5	GAS 5
17		x0120	*	GAS-6	GAS 6
18		x0122	*	GAS-7	GAS 7
19		x0124	*	GAS-8	GAS 8
20		x0115	*	GAS-9	GAS 9
21		x0119	*	GAS-10	GAS 10

Item	\		UOM	Parameter Name in the Control Module	Description
	dec	hex			
22		x011B	*	GAS-111	GAS 11
23		x011D	*	GAS-12	GAS 12
24		x011F	*	GAS-13	GAS 13
25		x0121	*	GAS-14	GAS 14
26		x0123	*	GAS-15	GAS 15
27		x0125	*	GAS-16	GAS 16
28		x0128	0.01 m ³	MUD VOLUME1	Mud level (volume) 1
29		x012A	0.01 m ³	MUD VOLUME2	Mud level (volume) 2
30		x012C	0.01 m ³	MUD VOLUME3	Mud level (volume) 3
31		x012E	0.01 m ³	MUD VOLUME4	Mud level (volume) 4
32		x0130	0.01 m ³	MUD VOLUME5	Mud level (volume) 5
33		x0132	0.01 m ³	MUD VOLUME6	Mud level (volume) 6
34		x0134	0.01 m ³	MUD VOLUME7	Mud level (volume) 7
35		x0136	0.01 m ³	MUD VOLUME8	Mud level (volume) 8
36		x0129	0.01 m ³	MUD VOLUME9	Mud level (volume) 9
37		x012B	0.01 m ³	MUD VOLUME10	Mud level (volume) 10
38		x012D	0.01 m ³	MUD VOLUME11	Mud level (volume) 11
39		x012F	0.01 m ³	MUD VOLUME12	Mud level (volume) 12
40		x0131	0.01 m ³	MUD VOLUME13	Mud level (volume) 13
41		x0133	0.01 m ³	MUD VOLUME14	Mud level (volume) 14
42		x0135	0.01 m ³	MUD VOLUME15	Mud level (volume) 15
43		x0137	0.01 m ³	MUD VOLUME16	Mud level (volume) 16
44		x0138	0.01 l/s	PUMP FLOW1	Pump flow rate 1
45		x0139	0.01 spm	PUMP SPM1	Pump spm 1
46		x013A	0.01 l/s	PUMP FLOW2	Pump flow rate 2
47		x013B	0.01 spm	PUMP SPM2	Pump spm 2
48		x013C	0.01 l/s	PUMP FLOW3	Pump flow rate 3
49		x013D	0.01 spm	PUMP SPM3	Pump spm 3
50		x013E	0.01 l/s	PUMP FLOW4	Pump flow rate 4
51		x013F	0.01 spm	PUMP SPM4	Pump spm 4
52		x0140	0.01 l/s	PUMP FLOW5	Pump flow rate 5

Item			UOM	Parameter Name in the Control Module	Description
	dec	hex			
53		x0141	0.01 spm	PUMP SPM5	Pump spm 5
54		x0142	0.01 l/s	PUMP FLOW6	Pump flow rate 6
55		x0143	0.01 spm	PUMP SPM6	Pump spm 6
56		x0144	0.01 l/s	PUMP FLOW7	Pump flow rate 7
57		x0145	0.01 l/s	PUMP FLOW8	Pump flow rate 8
58		x0147	0.01 l/s	SUM FLOW	Total pump flow rate
59		x014A	0.01 kgf*m	ROTARY TORQUE	Rotary torque
60		x014C	1 rpm	ROTARY RPM	Rotary rpm
61		x014E	0.1 m	BLOCK HEIGHT	Travelling block position
62		x014F	0.001 m	HOLE DEPTH	Bottomhole depth
63		x0150	0.1 ts	TONG LINEPULL	Easy tong pull force
64		x0151	0.01 kgf*m	AKB TORQUE	AKB-4 tong torque
65		x0152	0.01 kgf*m	TONGS TORQUE	Easy tong torque
66		x0153	0.01 kgf*m	HT TORQUE(P)	Hydraulic tong torque
67		x0154	0.01 l/s	MUD FLOW IN	Pump flow rate from flow sensor
68		x0156	0.001 g/sm ³	MUD DENSITY	Mud density
69		x0157	0.001 g/sm ³	MUD DENSITY3	Mud density 3
70		x0158	0.001 g/sm ³	MUD DENSITY2	Mud density 2
71		x0159	0.001 g/sm ³	MUD DENSITY4	Mud density 4
72		x015A	1 kgf*m	TD TORQUE	Top Drive Torque
73		x015C	1 rpm	TD RPM	Top Drive rpm
74		x015E	0.1 l	FUEL LEVEL1	Fuel level 1
75		x0160	0.1 l	FUEL LEVEL2	Fuel level 2
76		x0162	0.1 l	FUEL LEVEL3	Fuel level 3
77		x0164	0.1 l	FUEL LEVEL4	Fuel level 4
78		x0166	0.1 l	FUEL LEVEL5	Fuel level 5
79		x0168	0.1 l	FUEL LEVEL6	Fuel level 6
80		x016A	0.1 l	FUEL LEVEL7	Fuel level 7
81		x016C	0.1 l	FUEL LEVEL8	Fuel level 8
82		x016E		ROTORT.LIFT	Rig floor height
83		x0170	0.01 kgf*m	TONGS TORQUE 2	Tong torque 2
84		x0172	0.01 kgf*m	TONGS TORQUE 3	Tong torque 3

Item	\		UOM	Parameter Name in the Control Module	Description
	dec	hex			
85		x0174	0.1 m/s	WIND SPEED	Wind speed
86		x0178	0.01 m ³	MUD VOL.SUM	Total mud volume
87		x0179	0.01 m ³	MUD VOL.SUM2	Total mud volume2
88		x017C	0,1 m/h	ROP	ROP
89		x0180	0.1 at	SKR PRESS.	Pressure in the Mud Monitoring System
90		x0181	0.1 °C	SKR TEMPER.	Temperature in the Mud Monitoring System
91		x0182	0.01 l/s	SKR FLOW RATE	Flow rate in the Mud Monitoring System
92		x0183	0.001 m ³	SKR TOT.FLOW	Total flow in the Mud Monitoring System
93		x0184	0.001 g/sm ³	SKR DENSITY	Density in the Mud Monitoring System
94		x0190	1 kgf	HOOK LOAD2	Hook load 2
95		x0192	0.001 m	BIT POSITION	Bit position
96		x0194	1 kgf	GUY-LINE1	Guy-line load 1
97		x0196	1 kgf	GUY-LINE2	Guy-line load 2
98		x0198	1 kgf	GUY-LINE3	Guy-line load 3
99		x019A	1 kgf	GUY-LINE4	Guy-line load 4
100		x019B	1 kgf	GUY-LINE5	Guy-line load 5
101		x019C	1 kgf	GUY-LINE6	Guy-line load 6
102		x019D	1 kgf	GUY-LINE7	Guy-line load 7
103		x019E	1 kgf	GUY-LINE8	Guy-line load 8
104		x01A0	0.1 at	HT(2)PRESSURE	Hydraulic tong pressure 2
105		x01A2	0.1 at	MUD PRESS.OUT	Outlet mud pressure
106		x01AC	*	GAS-17	GAS 17
107		x01AE	*	GAS-18	GAS 18
108		x01B0	*	GAS-19	GAS 19
109		x01B2	*	GAS-20	GAS 20
110		x01B4	*	GAS-21	GAS 21
111		x01B6	*	GAS-22	GAS 22
112		x01B8	*	GAS-23	GAS 23
113		x01BA	*	GAS-24	GAS 24
114		x01BC	*	GAS-25	GAS 25
115		x01BE	*	GAS-26	GAS 26

Item			UOM	Parameter Name in the Control Module	Description
	dec	hex			
116		x01C0	*	GAS-27	GAS 27
117		x01C2	*	GAS-28	GAS 28
118		x01C4	*	GAS-29	GAS 29
119		x01C6	*	GAS-30	GAS 30
120		x01C8	*	GAS-31	GAS 31
121		x01CA	*	GAS-32	GAS 32
122		x01CC	0.001 g/sm ³	MUD DENSITY5	Mud density 5
123		x01CE	0.001 g/sm ³	MUD DENSITY6	Mud density 6
124		x01D0	0.001 g/sm ³	MUD DENSITY7	Mud density 7
125		x01D2	0.001 g/sm ³	MUD DENSITY8	Mud density 8
126		x01D4	0.1 at	MUD PRESS.IN3	Inlet mud pressure 3
127		x01DA	0.1 at	MUD PRESS.IN4	Inlet mud pressure 4
128		x01DC	0.01 rpm	HT RPS	Hydraulic tong rpm
129		x01DE	0.01 °	RIG TILT	Rig's must tilt
130		x01E0	0.01 °	RIG PITCH	Rig's must pitch
131		x01E2	0.001 m	RIG OFFSET	Rig's must offset
132		x01E4		HT GEAR	Hydraulic tong gear
133		x01E6	0.1 °C	HT TEMP	Hydraulic tong temperature
134		x01E8	0.01 °	INC-1 TILT	Inclinometer 1 tilt
135		x01EA	0.01 °	INC-1 PITCH	Inclinometer 1 pitch
136		x01EB	0.01 °	INC-2 TILT	Inclinometer 2 tilt
137		x01EE	0.01 °	INC-2 PITCH	Inclinometer 2 pitch
138		x01F0	1 kgf	GUY-LINE9	Guy-line load 9
139		x01F2	1 kgf	GUY-LINE10	Guy-line load 10
140		x01F4	1 kgf	GUY-LINE11	Guy-line load 11
141		x01F6	1 kgf	GUY-LINE12	Guy-line load 12
142		x01F8	1 kgf	GUY-LINE13	Guy-line load 13
143		x01FA	1 kgf	GUY-LINE14	Guy-line load 14
144		x01FC	1 kgf	GUY-LINE15	Guy-line load 15
145		x01FE	1 kgf	GUY-LINE16	Guy-line load 16
146		x0200	1 kgf	FULL HOOK LOAD	Full hook load
147		x0202	0.1 h	HT WORKING TIME	Hydraulic tong operation time

Item			UOM	Parameter Name in the Control Module	Description
	dec	hex			
148		x0204	0.1 at	HT PRESSURE2	Hydraulic tong pressure 2
149		x0206	0.01 tf*km	ROPE WEAR	Drill line wearing
150		x021C	0.1 at	HT PRESSURE3	Hydraulic tong pressure 3
151		x021E	0.1 at	HT PRESSURE4	Hydraulic tong pressure 4
152		x0220	0.1 at	PREVENT.PRESS.	BOP pressure
153		x0222		DIGITAL IN1	Digital input 1
154		x0223		DIGITAL IN2	Digital input 2
155		x0224		DIGITAL IN3	Digital input 3
156		x0225		DIGITAL IN4	Digital input 4
157		x022A	0.01 kgf*m	HT(2)TORQUE(P)	Hydraulic tong torque 2
158		x0232		SPIDER STATE	Spider status
159		x0233	0.01 m ³	MUD VOLUME17	Mud level (volume) 17
160		x0234	0.01 m ³	MUD VOLUME18	Mud level (volume) 18
161		x0235	0.01 m ³	MUD VOLUME19	Mud level (volume) 19
162		x0236	0.01 m ³	MUD VOLUME20	Mud level (volume) 20
163		x0237	0.01 m ³	MUD VOLUME21	Mud level (volume) 21
164		x0238	0.01 m ³	MUD VOLUME22	Mud level (volume) 22
165		x0239	0.01 m ³	MUD VOLUME23	Mud level (volume) 23
166		x023A	0.01 m ³	MUD VOLUME24	Mud level (volume) 24
167		x023B	0.1 m/s	AVG.WIND SPD	Wind speed average
168		x023C	0.1 m/s	WIND GUST	Wind gust
169		x023D	0.1 °C	MUD TEMP.IN2	Inlet mud temperature 2
170		x023E	0.1 °C	MUD TEMP.IN3	Inlet mud temperature 3
171		x023F	0.1 °C	MUD TEMP.IN4	Inlet mud temperature 4
172		x0240	0.1 °C	MUD TEMP.IN5	Inlet mud temperature 5

* units of measurement depend on the type of gas. To determine the units of measurement in which the Control Module transmits readings, it is necessary to look at the 1st reserved register, in which the measured value is transmitted and displayed on the Control Module display. For example, in the 264 (0x0108) extended range register, the value is 0x0102, where the first part (01) is the unit of measurement according to:

0 – 0.001 %LEL;
1 – 0.001 mg/m³;
2 – 0.001 %vol. fraction

and the second (02) part is not involved in any way. Only the first part should be read. In the example given, 0x0102 is measured in mg/m³.

2.2.8. Switching on and Testing

After completing the installation and connecting the power cable to the mobile power supply system of the mobile power unit or connecting the power supply unit to the AC power supply system, it is necessary to make the first switch on Device switch on:

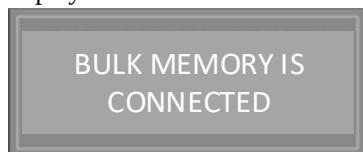


After pressing the key on the front panel of control module, the boot starts.;

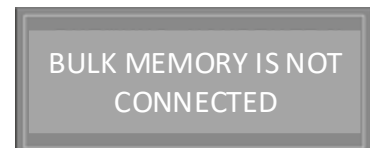
The boot continues for 18-20 seconds, then at MU-150 display appears:



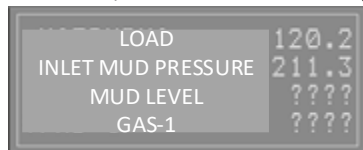
At the end of the boot-up, an external drive (memory module) is connected, as evidenced by the following inscription on the display of the control module



Или



After that, the Control Module goes into working mode and the line by line parameters are reflected:



???? – malfunction or absence of the primary transducer (analogue sensor)

---- - loss of communication with sensor.

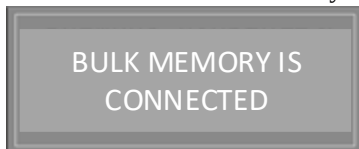
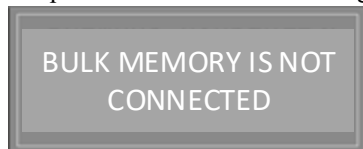
2.2.9. Memory Module

DEL-150 memory module is used to store, record and copy measurements. Control module can work with or without a memory module. Control module has its own internal memory. Memory module is installed in a special compartment with a double-screw cover.



Figure 31. Memory module compartment, memory module, joint box

At the start of control module, a message appears: “External storage device is connected” with a memory module in the compartment and “External storage disconnected” with no memory module in the compartment.



Measurements in the memory module are recorded from the time it is installed in Control Module and the compartment cover is closed. If you need to measure the control module, it can be copied to the module pressing simultaneously at Control Module



Select the necessary period and press

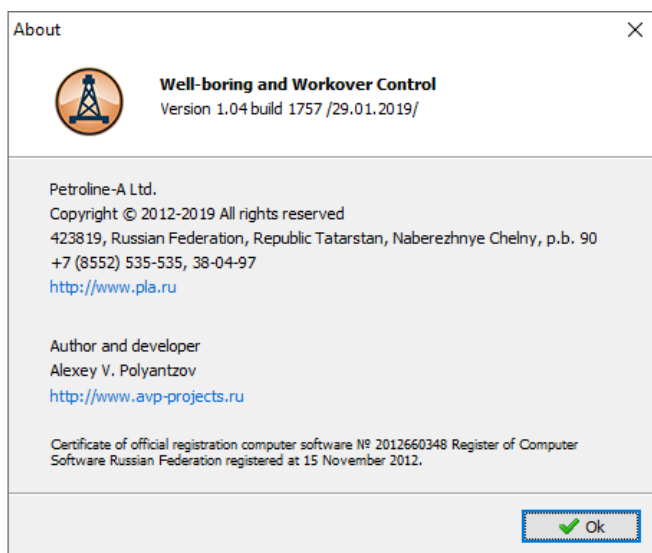
FOR 2 DAYS FOR A WEEK FOR A MONTH FOR A PERIOD...	DATA COPY 100% OPERATION IS OVER
--	---



Data copy on Control Module is made if storage device lid is covered.

The memory capacity of Control Module is measured by the number of measurements and is equal to 200 measurements. Further recording occurs at the place of the earliest by date.

For work with measurements “Drilling and well workover monitoring” programme is used. Software version and contact information are shown in window. The window opens after pressing the “about the program” button in “help” menu of “Drilling and well workover monitoring” programme.



2.2.10. Software Update

Connect the memory module to the computer using DEL-150SD interface (in the dark gray enclosure).



Figure 32. USB interface DEL-150SD with memory module

- Unpack in the root folder of memory module firmware firmware.fwc from the archive firmware_Vxxxx.zip.
- Install a memory module, close the cover. Press SHIFT + 1 on the keyboard, turn on the device. The software installation process begins.

- After the end of the process, messages on the need to reset the settings to the factory settings may appear on the display of control module.



Attention! After the software update is completed, it is necessary to check ALL instrument settings (ho weight, hoist coefficient, well, pad, etc.)

2.2.11. GSM Module Settings

GPRS (General Packet Radio Service - "Public Packet Radio Communication") is an add-on to GSM mobile communication technology that implements packet data. GPRS allows the user of the cellular network to exchange data with other GSM devices and with external networks, including the Internet. GPRS implies billing based on the amount of information transmitted / received.

To work in GSM network, the following components are required:

- Built-in GSM modem (standard);
- GSM antenna (standard);
- Sim card (single or double) with connected data transfer
- Server with a "white" address on the Internet.

"White IP Address" is also known as the "External IP Address", "Real IP Address" or "Direct IP Address". Each computer on the network is assigned an IP address, this address uniquely identifies the computer on the network and allows it to communicate with the rest of the network participants.

The following information is required to configure the modem:

- Server address (white IP address);
- GPRS mobile operator settings:
 - o APN NAME;
 - o APN USER;
 - o APN PASS.

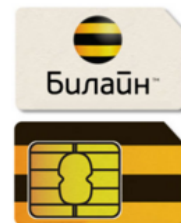
For example:

Билайн / Beeline Россия (GPRS/EDGE)

Обычная SIM-карта "Билайн"

Обычная SIM-карта приобретается в салонах связи. За балансом обычной SIM-карты следит сам пользователь.

- o APN: internet.beeline.ru
- o Username: beeline
- o Password: beeline



or

- o APN: m2m.beeline.ru
- o Username: beeline
- o Password: beeline

МТС / MTS Россия (GPRS/EDGE)

Обычная SIM-карта "МТС"

- o APN: internet.mts.ru
- o Username: mts
- o Password: mts



SIM-карта "МТС m2m" (Телематика)

Данная SIM-карта используется в системах навигации, мониторинга и других системах. SIM картами "МТС m2m" обычно комплектуется оборудование, приобретаемое вместе с подключением к сети. Баланс SIM-карты "МТС m2m" пополняется автоматически при оплате услуг GPShome.ru.

- o APN: m2m.msk
- o Username: mts
- o Password: mts



There are two ways to configure a modem:

- from the keypad of the Control Module (main);
- Remote connection (auxiliary).

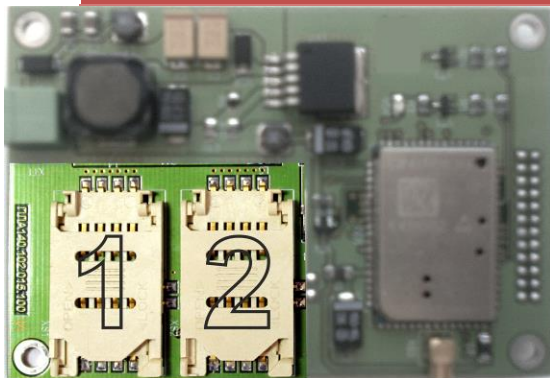
Method 1. Modem setting is made in the following way (also see «DEL-150 Operation Manual»):

- Switch on the device;

- Press button **ENTER** on Control Module keyboard;
 - Transfer to line «SYSTEM PARAMETERS»;
 - Press button **ENTER** on Control Module keyboard;
 - Transfer to line «GPRS settings»;
 - Press button **ENTER** on Control Module keyboard;
 - At line «GPRS» switch value «On» by pressing button **ENTER**;
 - At line «SIM PRIORITY» enter the value «1» if it is necessary to set the priority of the first sim card;
 - Make afterwards the settings of the GPRS mobile operator for the first and second sim-cards;
 - After finishing of editing the listed parameters press button **ESC** for storage;
 - Transfer to «SERVER ADDRESS»;
 - Press button **ENTER** on Control Module keyboard;
 - Enter consequently activity indexes and server names (for switching on and switching over the alphabet use the buttons combination **SHIFT** **ENTER** after finishing of editing of all lines press two times on Control Module button **ENTER** for saving;
 - READY;
 - To return in operating mode press **ESC** on Control Module keyboard;
- To check the connection with a server can be made by route «main menu» → «SYSTEM CONDITION» → «DATA TRANSFER» at line «TRANSFERED 1» and «TRANSFERED 2». Quantity of transferred information is reflected in kilobytes.
- Method 2. Software is described at operation manual for electron dynamometers DEL-140, DEL-150 «Drilling and well workover monitor».



Attention: A double-sim modem is used to minimize manipulations with sim-cards in areas where the coverage areas of two mobile operators are interspersed. Only a single SIM card is active during the transfer process. The modem is switched, if necessary, by analyzing the signal level and by the priority of manual setting.



Picture 33. GSM-modem board.

2.2.12. Ethernet Module Settings

To work in a network it is necessary to have the following components:

- Ethernet – module (built-in);
- Wi-Fi bridge with a cable set (if Wi-Fi is available in the field) ;
- A cable set (if local network is available in the field).

There are the most simple layout connections of Control Module and PC in the field showed below.

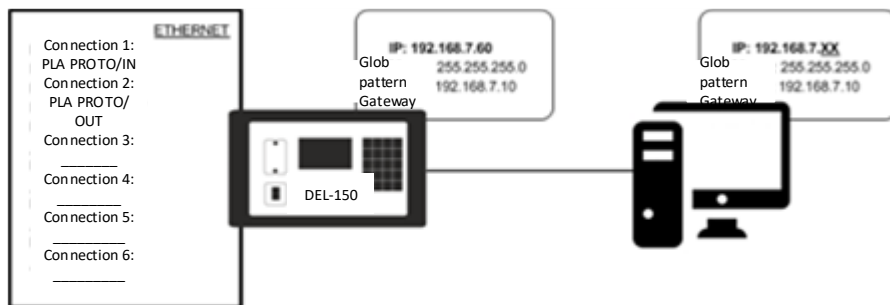


Figure 34. Layout 1

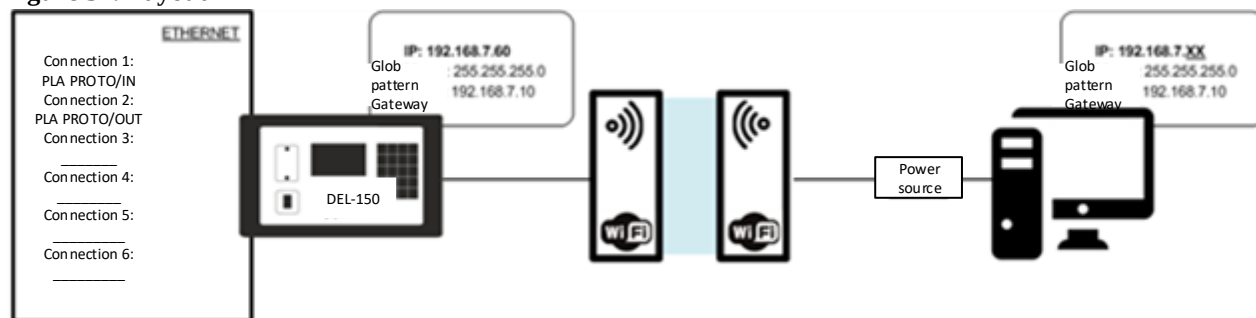


Figure 35. Layout 2

Connection is made by network cable YT-RJ45/RJ45 or RJ45/RJ45:

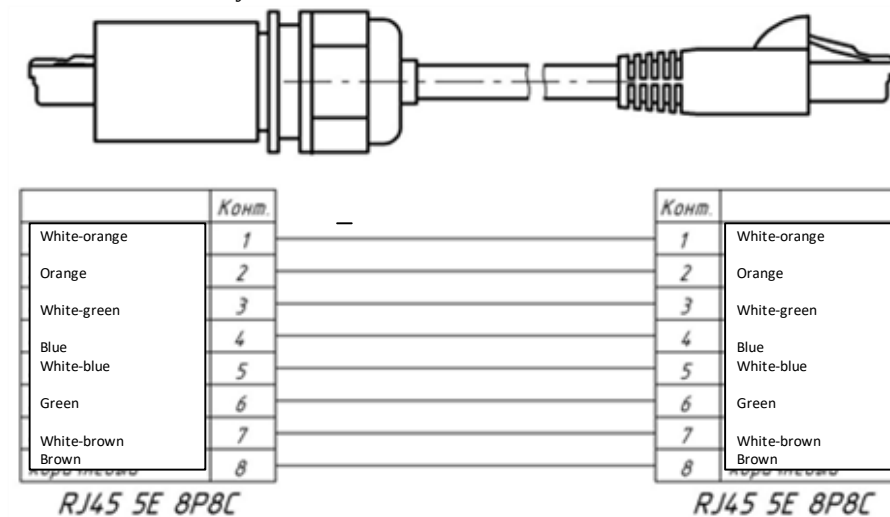


Figure 36. Channel cable YT-RJ45/RJ45

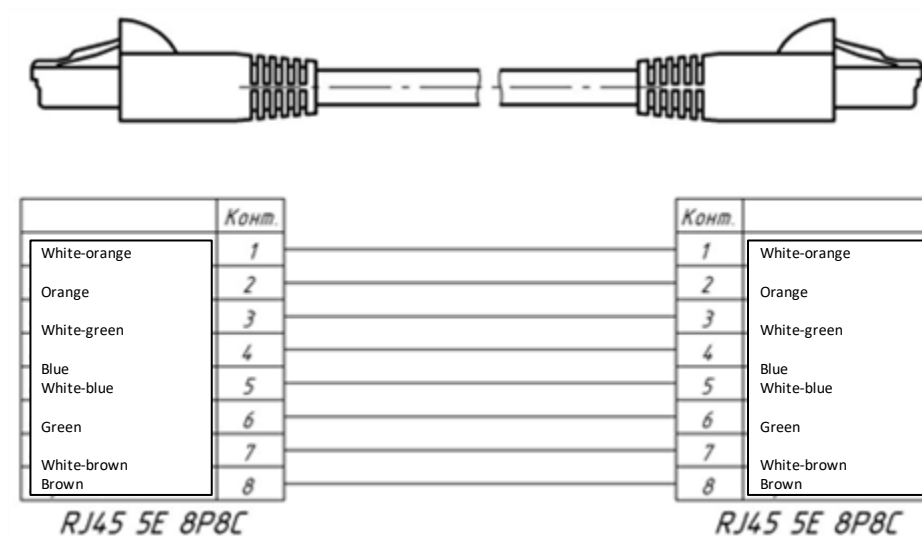


Figure 37. Channel cable RJ45/RJ45

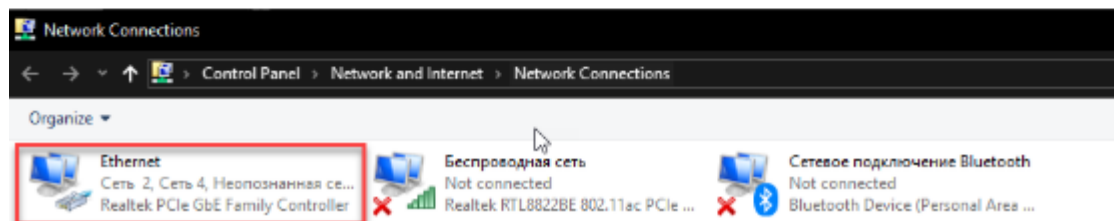
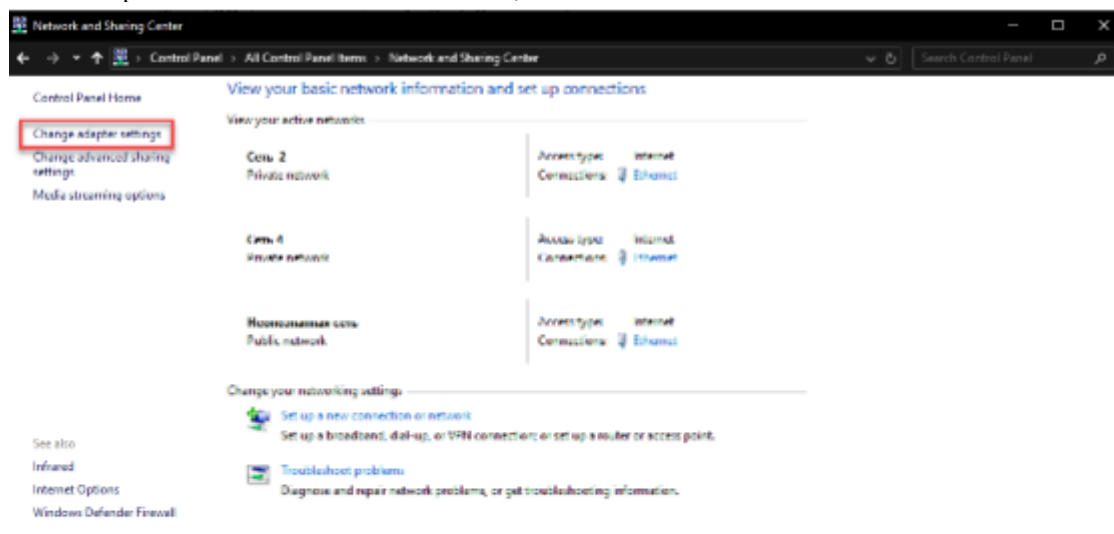
To set Control Module it is necessary to make the following instructions:

- Switch on the device;
- Press button  on Control Module keyboard;
- Transfer to the line «SYSTEM PARAMETERS»;
- Press button  on Control Module keyboard;
- Transfer to the line «ETHERNET SETTING»;
- Press button  on Control Module keyboard;
- At opened window check the match of Control Module settings to network settings at the field:
 - o IP-ADDRESS;
 - o GLOB PATTERN;
 - o GATEWAY;
- Transfer line «CONNECTION»;
- Press button  on Control Module keyboard;
- At opened list create 2 connections (in TCP and out TCP):
 - o I TCP, PLA PROTO, PORT 17999;
 - o Out TCP with PC parameters where connection is held:

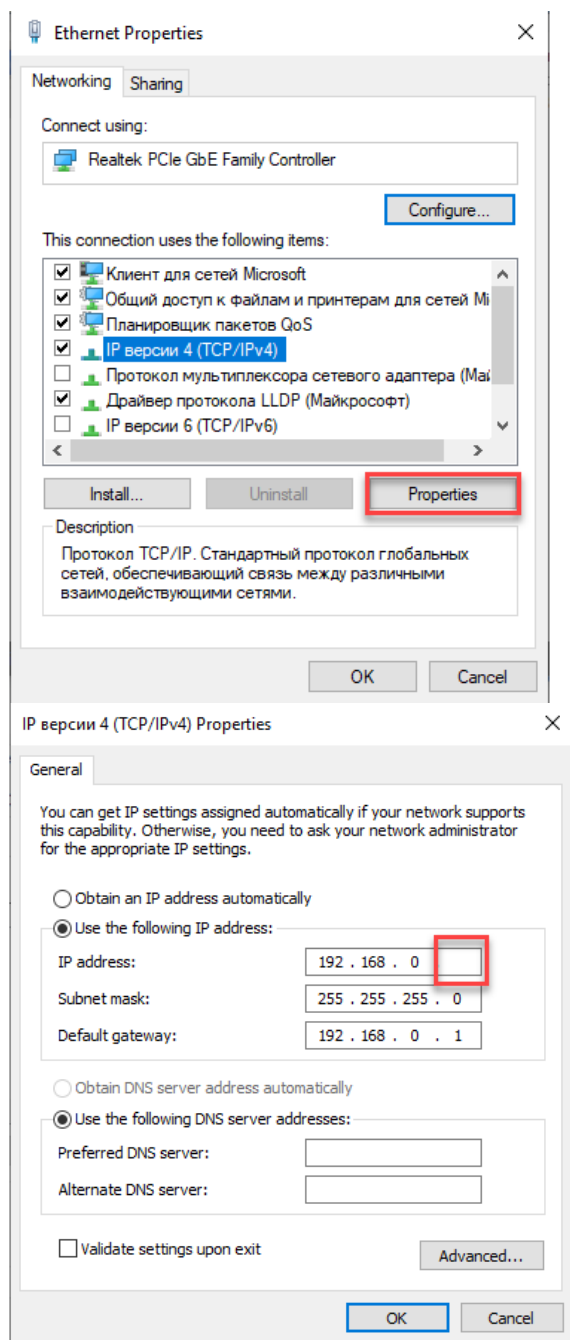
- IP-ADDRESS;
- GLOB PATTERN;
- GATEWAY;

To set PC it is necessary to make the following instructions:

- Open network center and broad access;



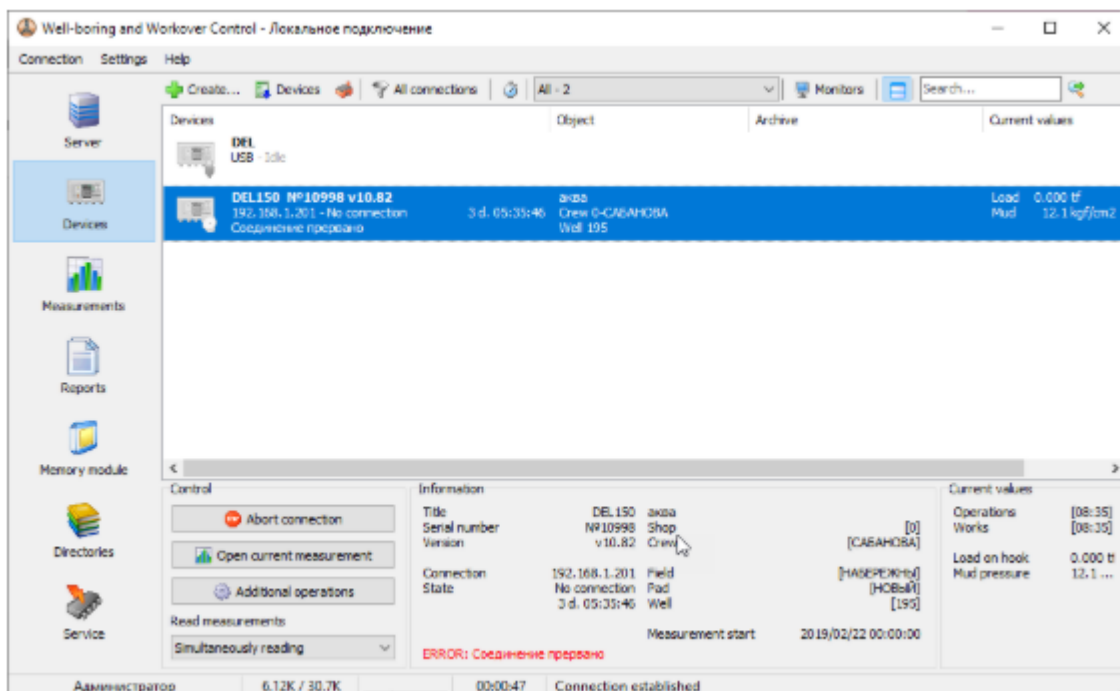
- Open adapter parameters for checking;
- Open connection properties by a local network;
- Open TCP/IPv4 properties and check settings;



Control Module and PC must be at one sub network and their addresses must not match with other device addresses of this network..

If all settings are correct, then:

- At tab «Devices» of programme «Drilling and well workover» a line with a new setting will appear automatically;



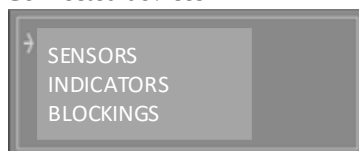
– At Control Module display at the created line PLA/OUT digits will appear (information volume in kilobytes) reflecting of a data transfer process.

2.3. DEL-150 Usage

2.3.1. Connected Devices to the Control Module

There is availability to observe a list of connected devices. List contains redundant devices (sensors, blocking boards, indicators) and address on bus RS-485 (table 6).

Connected devices



Sensors

→ DN 130	002
TP 140 DM IN	017
GAS 1	056
↕ LEVEL 1	064

Indicators

→ MI (CONSOLE) 1	128
MI (CONSOLE) 2	129
MI 1	132
↕ MI 4	135

Blockings

BLOCKING STATE	
→ BLOCK L	[080] - -
BLOCK R	[081] SB
BLOCK N	[082] -

2.3.2. Troubleshooting

A group of DEL-150 malfunctions:

1. Cable malfunction;
2. Antenna malfunction;
3. Sensor malfunction;
4. Display module malfunction;
5. «RS-485» board malfunction at crotchboard.
6. Control module malfunction;
7. Power Supply Module malfunction;
8. Ill configured device;
9. RS-485 converter malfunction;
10. Interface device malfunction;
11. Interfere between antenna.

Table 16. Troubleshooting

№	Malfunction appearance	Group	Instructions order
1	In the list of parameters on the display Control Module there is no corresponding inscription	1, 2, 3, 5, 6	1.1. Replace a cable; 1.2. Start sensor search. 2.1. Replace an antenna; 2.2. Start sensor search. 3.1. Replace the sensor; 3.2. Start sensor search. 5.1. Switch sensor to other connector MU or MK 5.2. Start sensor search. 6.1. Replace MU or MK. 6.2. Run and enter settings.
2	In the list of parameters on the display Control Module opposite the parameter inscription is displayed «???»	malfunction or absence of primary transducer (analogue sensor)	1.1. Replace a cable 1.2. Start sensor search. 2.1. Replace an antenna; 2.2. Start sensor search. 3.1. Replace the sensor; 3.2. Start sensor search.
3	In the list of parameters on the display Control Module opposite the parameter inscription is displayed «----»	1, 11, 2, 3, 5, 6	1.1. Replace the cable; 1.2. Start sensor search. 11.1 Eliminate interferences or re-install antenna 11.2 Start sensor search. 2.1. Replace an antenna; 2.2. Start sensor search. 3.1. Replace the sensor; 3.2. Start sensor search. 5.1. Switch sensor to other connector MU or MK 5.2. Start sensor search. 6.1. Replace MU or MK. 6.2. Start and enter settings.
4	Replacing the sensor cable did not lead to a positive result.	2, 3, 5, 6	2.1. Replace an antenna; 2.2. Start sensor search. 3.1. Replace the sensor; 3.2. Start sensor search. 5.1. Switch sensor to other connector MU or MK 5.2. Start sensor search. 6.1. Replace MU or MK. 6.2. Start and enter settings.
5	Replacing antenna did not lead to a positive result.	3, 5, 6	3.1. Replace the sensor; 3.2. Start sensor search. 5.1. Switch sensor to other connector MU or MK 5.2. Start sensor search. 6.1. Replace MU or MK. 6.2. Start and enter settings.
6	Switching the sensor did not lead to a positive result.	5, 6	5.1. Switch sensor to other connector MU or MK 5.2. Start sensor search. 6.1. Replace MU or MK. 6.2. Start and enter settings.
7	Sensor replacement did not lead to a positive result.	6	6.1. Replace MU or MK. 6.2. Start and enter settings.

№	Malfunction appearance	Group	Instructions order
8	On the display module there are indications of all sensors, on the display Control Module all parameters are normal	1, 4, 5, 6	1.1. Replace the cable; 1.2. Start sensor search. 4.1. Replace indicator; 4.2. Start sensor search 5.1. Switch the indicator to the other connector MU or MK 5.2. Start sensor search. 6.1. Replace MU or MK. 6.2. Start and enter settings.
9	On the display module, there is no sensor reading, on the display of Control Module parameters are normal.	8, 4	8.1. Reconfigure indicator; 8.3. Check the address of the device; 8.2. Start sensor search. 4.1. Replace indicator; 4.2. Start sensor search.
10	A message appeared on the display of control module. «APPPANIC!»	6	6.0. Address to customer care.
11	Invalid sensor reading	8, 3	8.1. Recheck parameter settings. 3.1. Replace the sensor; 3.2. Start sensor search
12	No connection with PC	8, 11, 2, 9	8.1 Check connection settings; 8.2. Set the connection. 8.3. Reconfigure antenna. 8.4. Set the connection. 11.1 Eliminate interferences or re-install antenna 11.2 Start sensor search. 2.1. Replace an antenna; 2.2. Set the connection. 9.1. Replace the converter; 9.2. Set the connection.
13	No data at server	**no connection, enough means, 8, 2	** check the signal level. ** recharge account. 8.1 Check connection settings; 8.2. Set the connection. 2.1. Check the integrity of the connector or change the antenna; 2.2. Set the connection.
14	No connection with commutation module	1, 11, 2, 5	1.1. Replace the cable; 1.2. Start sensor search. 11.1 Eliminate interferences or re-install antenna 11.2 Start sensor search. 2.1. Replace the antenna; 2.2. Start sensor search. 5.1. Switch sensor to other connector MU or MK 5.2. Start search sensor

2.3.3. Operation Modes

There are five DEL-150 type modes:

- Start mode;
- Operating mode;
- Parameter edit mode;
- Additional sensor sampling mode;
- Blocking checking mode;
- Data copy mode.

2.3.4. Changing the Operation Mode Procedure

- Transfer from «start mode» in «operating mode» is made automatically;
- Transfer from «operating mode» in «parameter edit mode» is made by pressing at Control Module button .
- Return is made by pressing button .
- Return from «operating mode» to «sensor scanning» is made by pressing combination of buttons  .
- Exit from «sensor scanning mode» is held automatically after scanning termination;
- Transfer from «operating mode» to «blocking checking mode» is made in sequence order by pressing buttons;
 ,  ,  ,  ,  ,  , .
- Transfer from «blocking checking mode» to «operating mode» is made by pressing buttons on Control Module keyboard:  ,  ,  , .
- From «operating mode» to «data copy mode» is made by simultaneous pressing on buttons  .

2.3.5. Switch Off Procedure

After completing the work to turn off the device, you must press the key (Fig. 7) on the front panel of control module. Before removing and (or) moving, disconnect the Control Module from the power supply. Inspection should be carried out in accordance with clause 2.2.3 of this manual.

2.3.6. Emergency Cases

In case of failures that can lead to emergency situations, it is necessary to replace the failed device. If necessary, disable additional devices that control non-technical-logical parameters.

In all cases not described in this manual, follow the Federal norms and rules in the field of industrial safety «Safety rules in the oil and gas industry».

3. MAINTENANCE

3.1. DEL-150 Maintenance

3.1.1. General Information

Maintenance is divided into:

- monthly maintenance;
- periodic maintenance, performed after working off a certain time, and after the move (before installation).

3.1.2. Daily Maintenance

The list of these works includes:

- check the status and control of the instrument;
- checking and monitoring the parameters of DEL-150;
- prompt action on the replacement of damaged components with the registration of acts;
- check the switch on of blocking signals;
- registration in a form using the forms recommended by the manufacturer of all recorded deviations, failures, work performed and other information.

3.1.3. Safety Measures

While operating the complex it is necessary to follow Operation Manual:

- chapter 3.4 "Electrical installations in hazardous areas" PEEP;
- the current rules of electrical installation devices;
- this operation manual (OM) and other normative documents, acting on the enterprise.

During operation, it is prohibited to open all devices included in EDR DEL-140.

Works should be carried out as necessary, but at least once a month.

3.1.4. Maintenance Procedure

Technical maintenance should be carried out in the following order:

1. Cleaning the contamination of the sensors and indicators enclosures;
2. Checking the safety of seals;
3. Cleaning the glass surfaces of the indicators;
4. Check the availability and strength of the installation of fasteners;
5. Cleaning from contamination of connectors and contact groups;
6. Check for visible mechanical damage;
7. Replacement and / or repair of damaged cable products;
8. Replacing damaged sensors, indicators and other devices and components.

Wash the connector MU 150 Control Module with an alcohol-gasoline mixture (0.5 ml) using a soft brush;

Wash the contacts with alcohol-gasoline mixture (need 3 ml) with a soft brush.

After cleaning and drying the connectors should be treated with vaselene type KV-3 / 10E.



The absence of marks for maintenance in the Formular (section "Technical maintenance account") IS A SUBJECT TO A VIOLATION OF OPERATION RULES, and the manufacturer has the right to disclaim the warranty.

3.1.5. Work Capacity Checking

- Switch on the device;
- Check the list of connected devices;
- Check, edit the reference parameters;
- Check, edit the operating parameters;
- Check the operation of blockings and alarms;
- Check the operation of indicators;

If GSM modem is available

- Check the antenna presence;

- Check the integrity of the antenna connector;
- Check the availability of SIM cards;
- Check the modem settings;

If there is a commutation module

- Check the list of devices connected to the commutation module;

If communication antenna and PC are available

- Check the communication quality;
- Check PC settings;
- Switch off, switch on the Control Module, check the entered settings.

4. STORAGE

The entire nomenclature requires careful handling, storage in dry, clean rooms with a constant temperature. The optimal storage conditions are considered to be from 10 to 35 ° C, the relative air humidity is no more than 80%. The precise temperature fluctuations should not exceed 5 ° C.

Devices that are stored in warehouses in the packaging of the manufacturer are not unpacked, are packed in flat containers and put in a stack or in a slot including racks.

The devices sealed by the factory are not allowed to be opened in warehouses.

Small devices and devices, which are placed in an individual package, are placed in storage in boxes with a stack.

Devices and components without individual packing should be stored in the slots including racks in no more than 3 rows in height with the use of sealing materials between them.

Small devices and products delivered without packaging can be stored in small-slot racks and cabinets, while devices or products of a single type must be stored in a single cell.



The absence of marks for maintenance in the Formular (section "Storage") IS A SUBJECT TO A VIOLATION OF OPERATION RULES, and the manufacturer has the right to disclaim the warranty.

5. TRANSPORTATION

Complex transportation in packaged form is supplied with all types of closed transport. Electronic dynamometer DEL-150 in package for transportation permits the impact of transport shaking with an acceleration of 30 m/s^2 with impact frequency of 100 per minute or 1500 impact frequency with that acceleration.

6. DISPOSAL

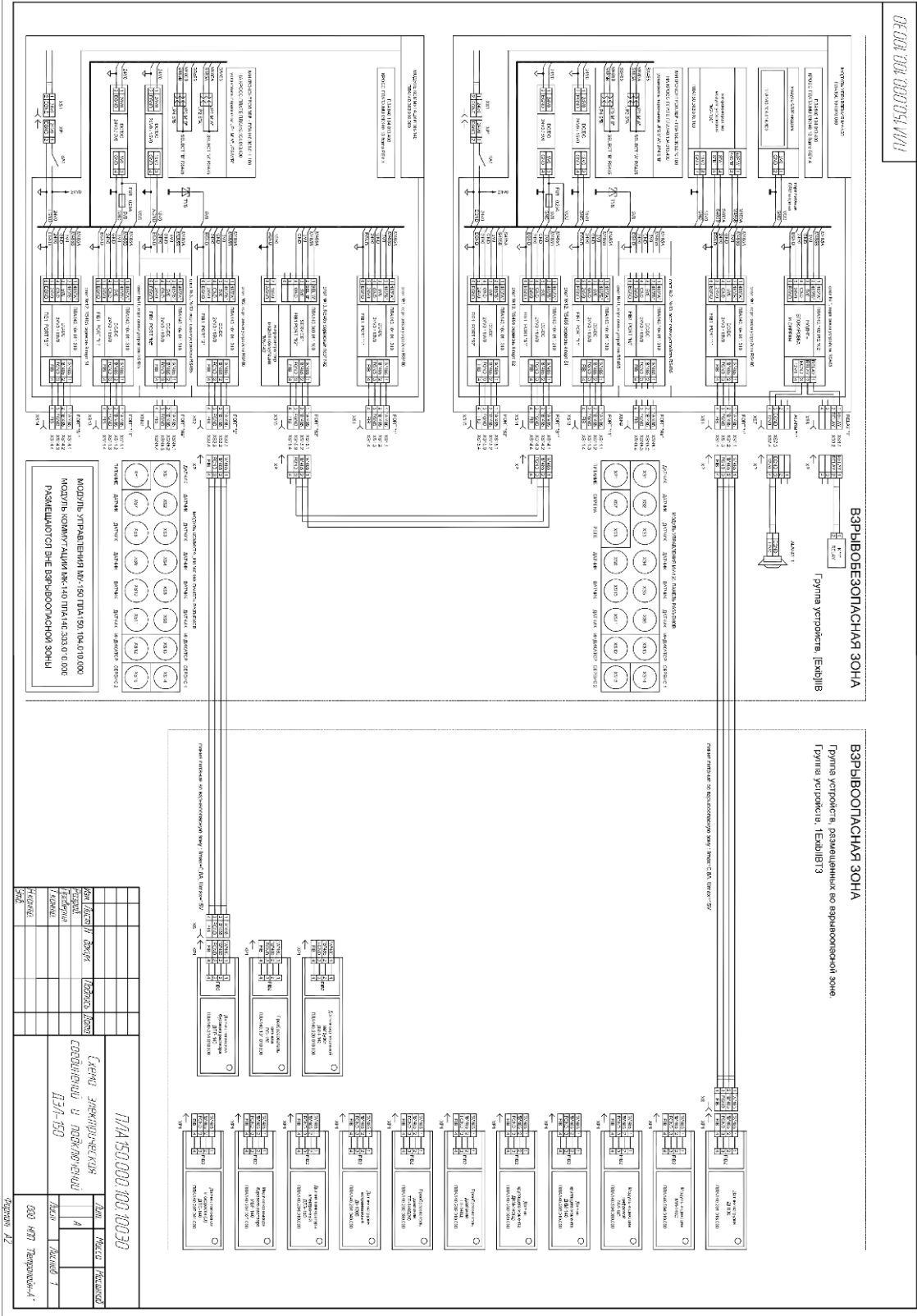
Products are not disposed along with normal municipal waste, but collected and disposed of separately;

Private waste collection and recycling systems, established by state laws must be used. It is also possible to return the waste equipment to the distributor when purchasing a new equipment.

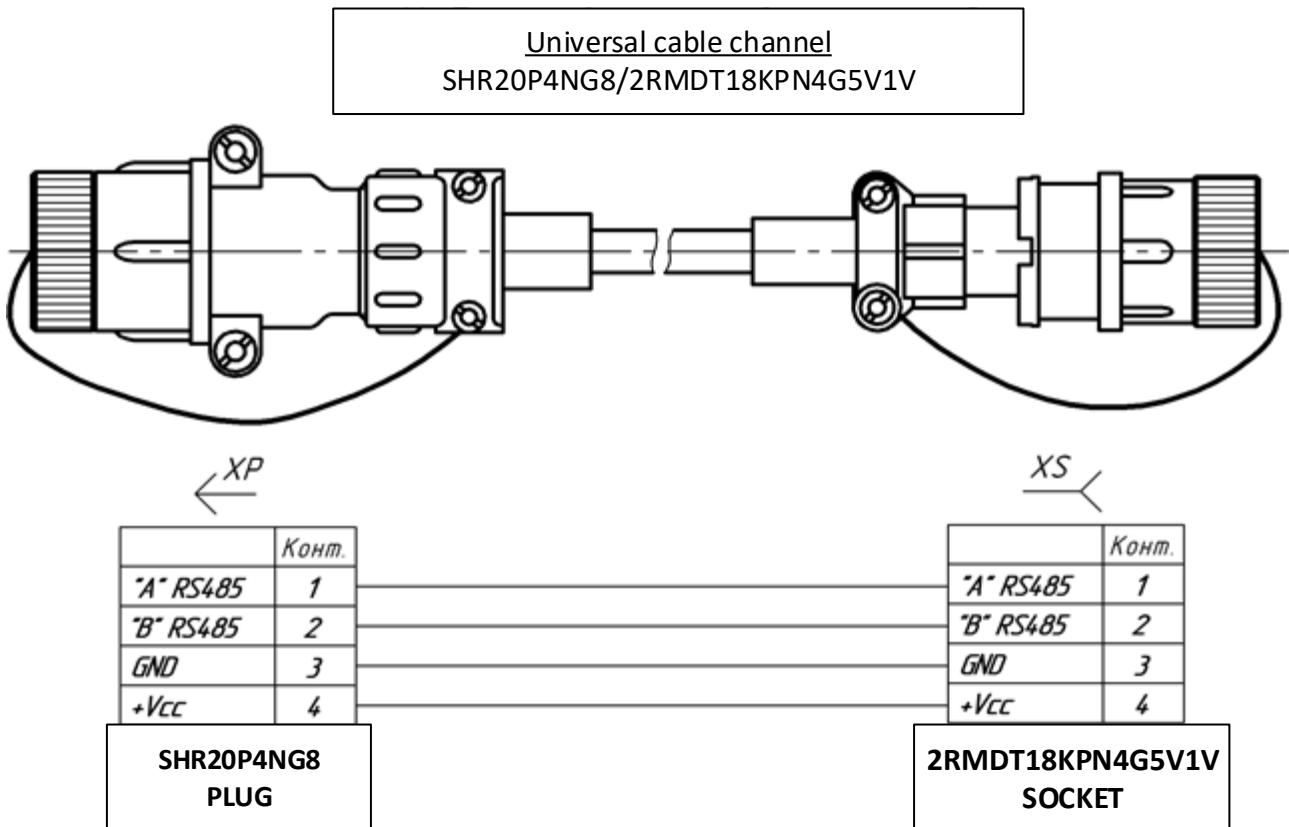
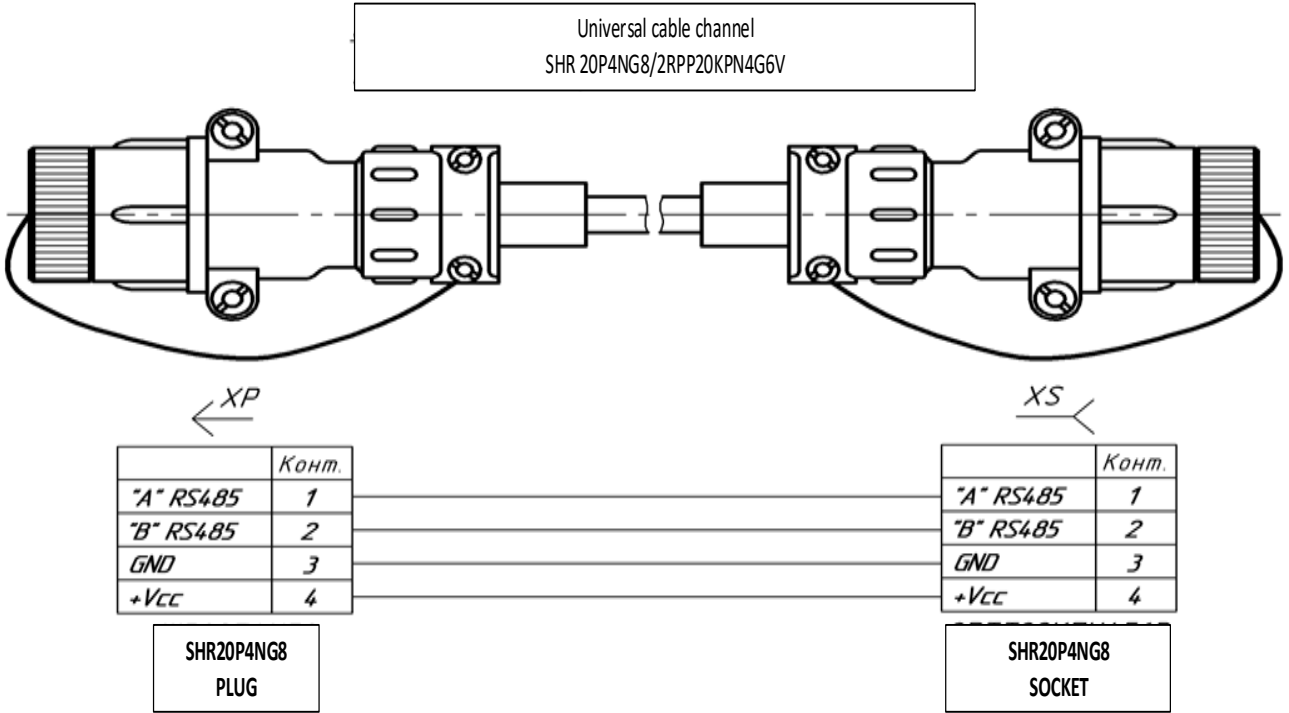
The product may contain substances hazardous to animal health: improper operation or disposal of the product may damage human health and the environment;

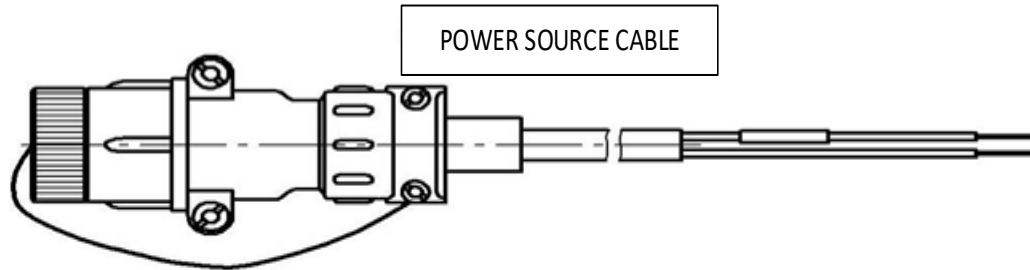
The punishment for illegal utilization of production waste of electrical and electronic products is established by the state authorities supervising the disposal of waste.

Appendix 1. DEL-150's Device connection layout



Appendix 2. Cable desoldering layout

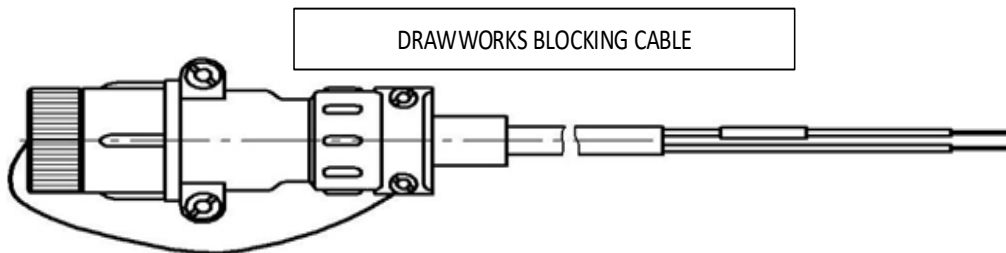




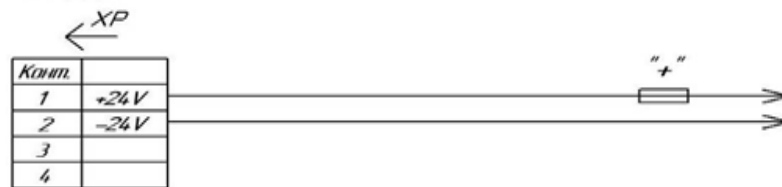
POWER SOURCE CABLE



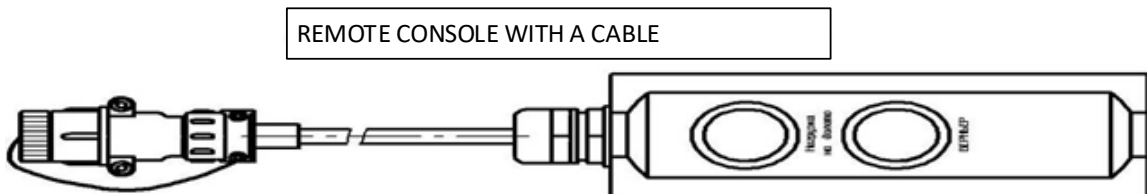
SHR20P2N6SH6
(SOCKET)



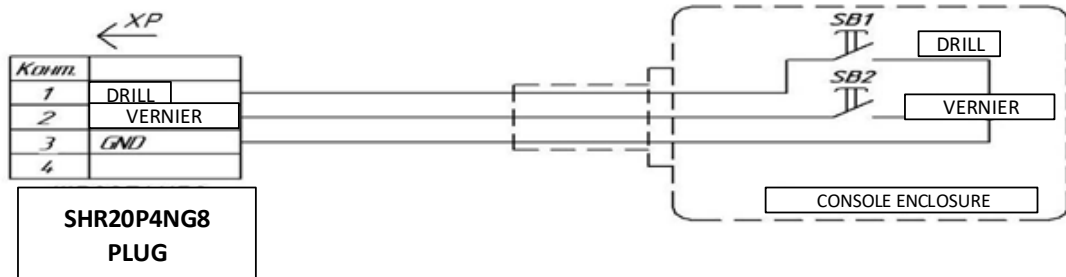
DRAWWORKS BLOCKING CABLE



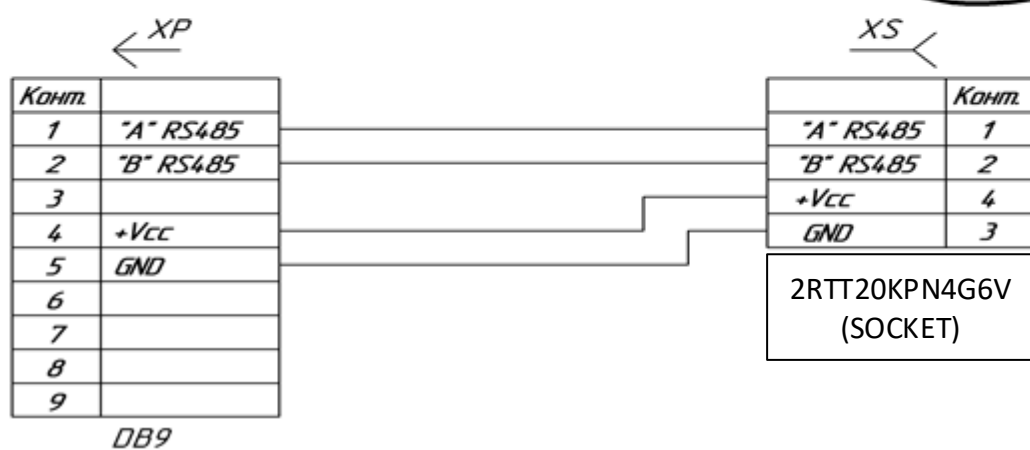
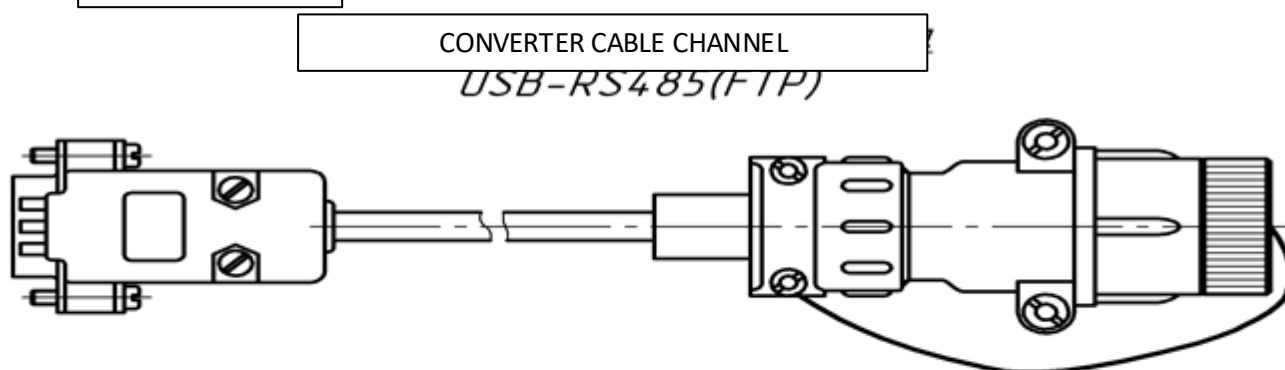
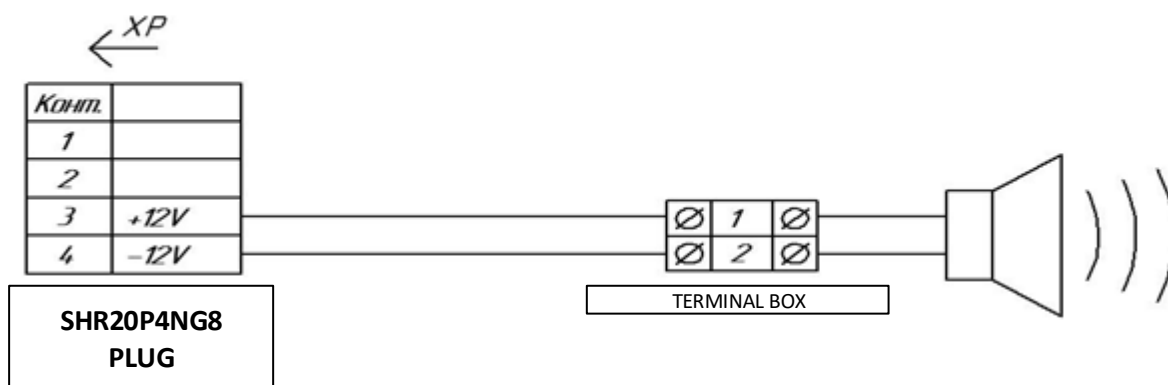
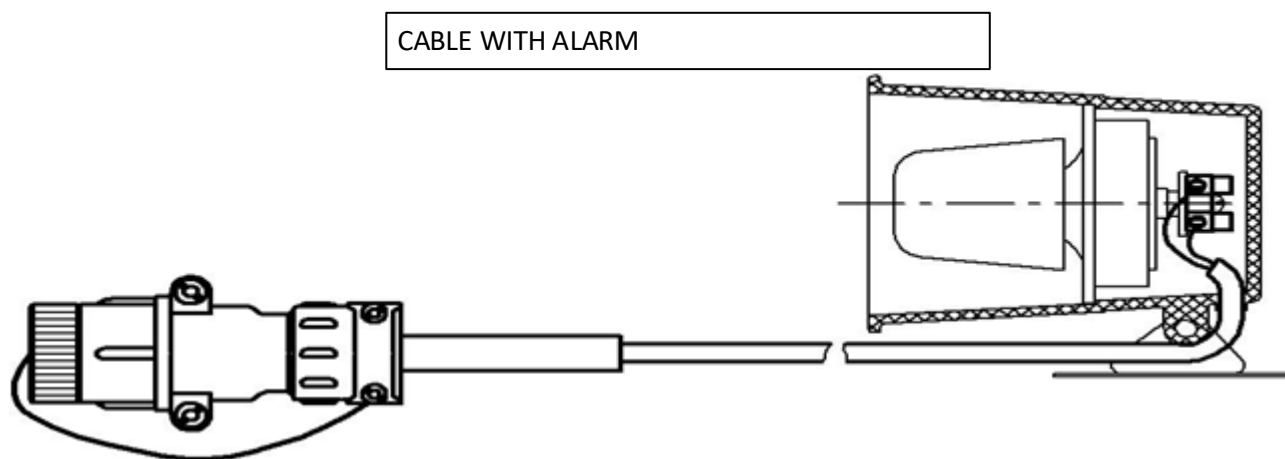
SHR20P4NG8
PLUG

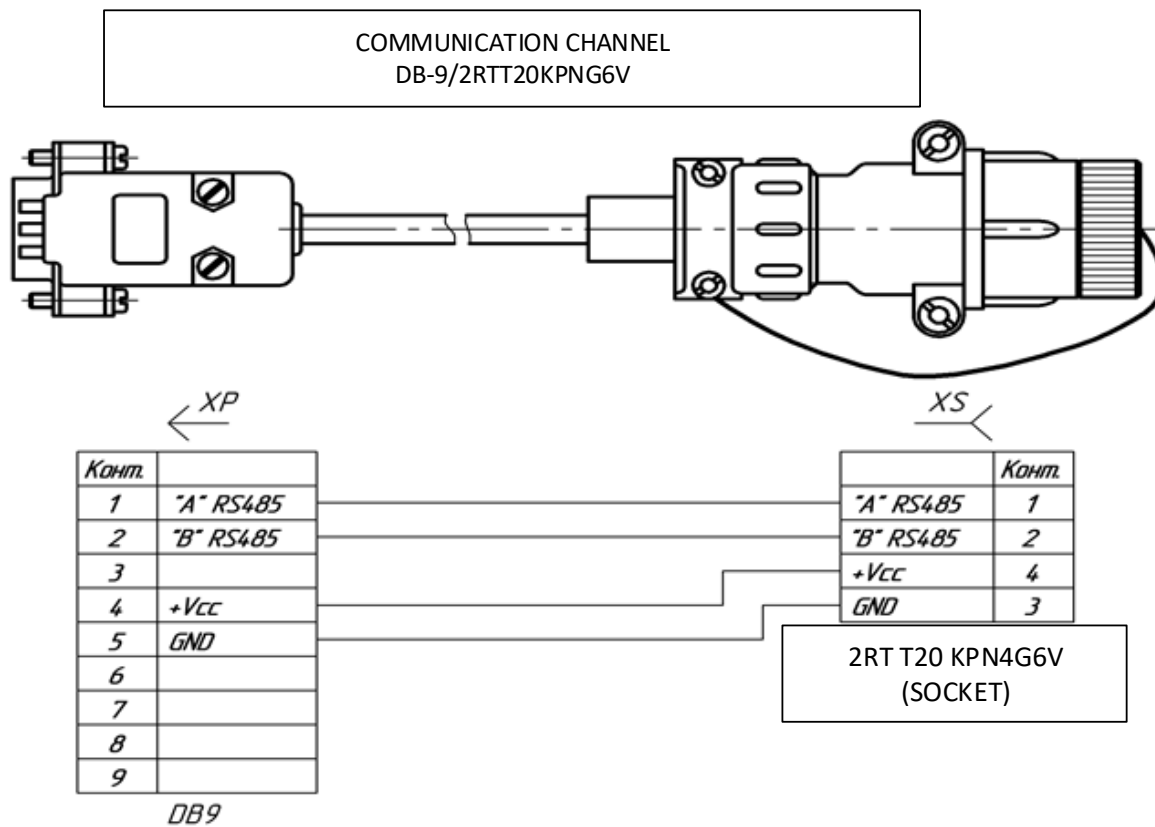
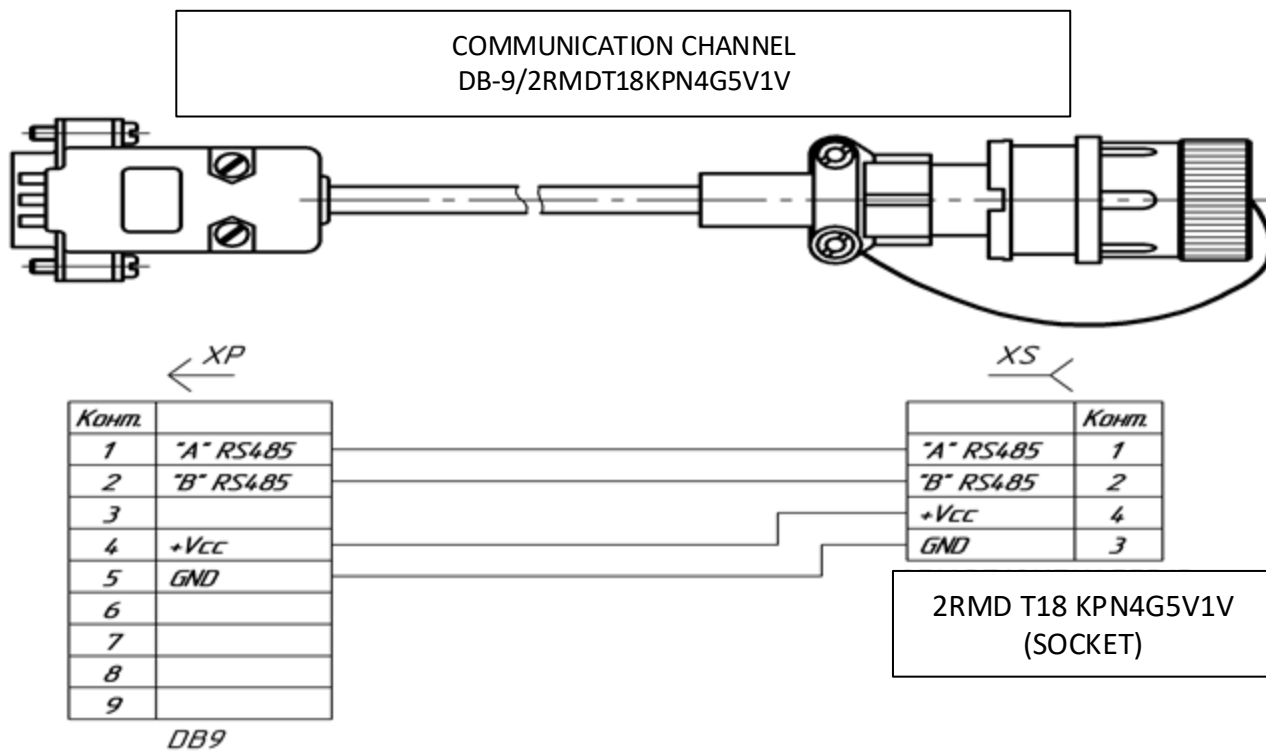


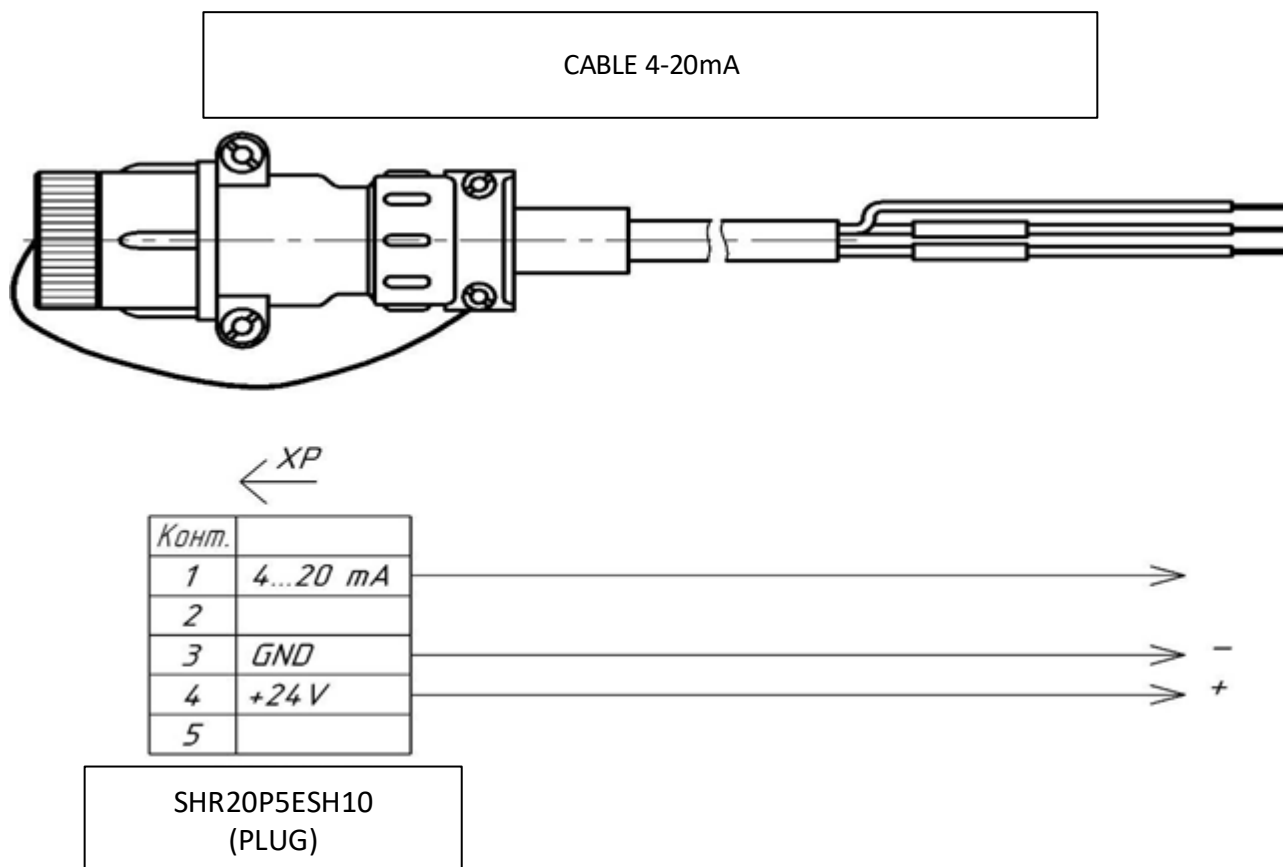
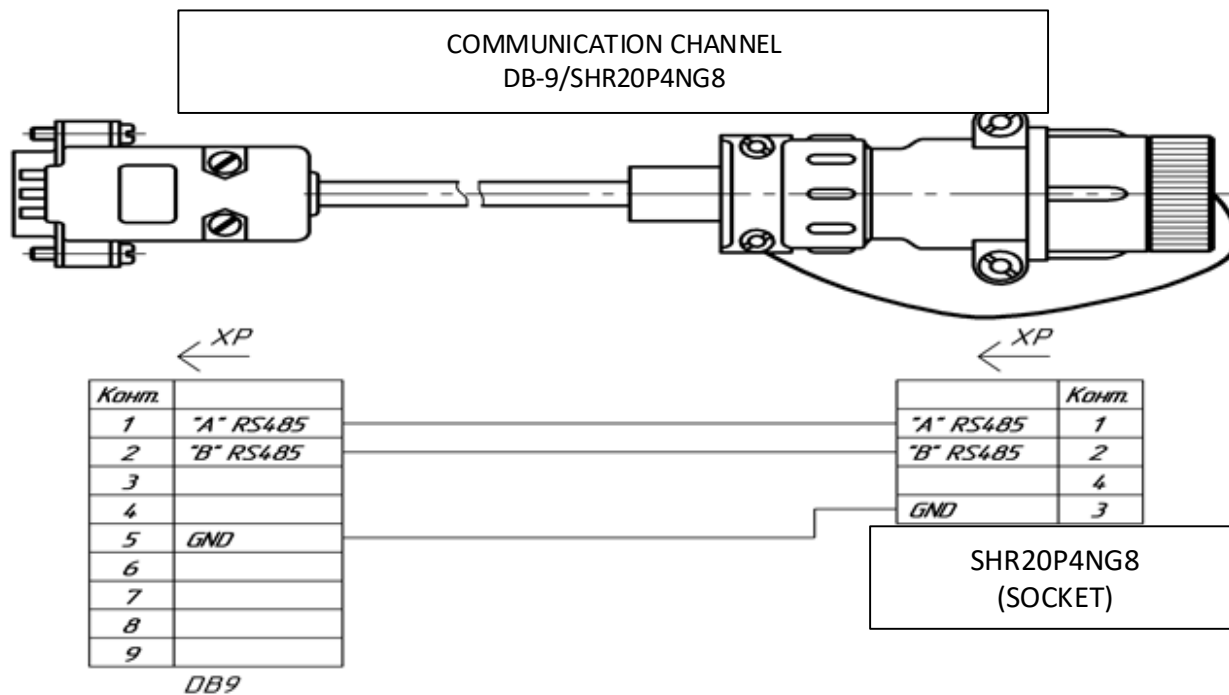
REMOTE CONSOLE WITH A CABLE



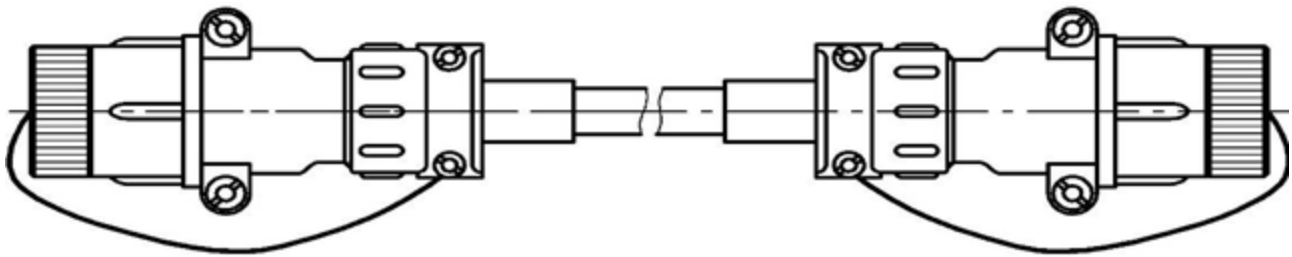
SHR20P4NG8
PLUG







GAS ANALYZER CABLE



XP

Конт.	
1	4...20 mA
2	
3	GND
4	+Vcc
5	

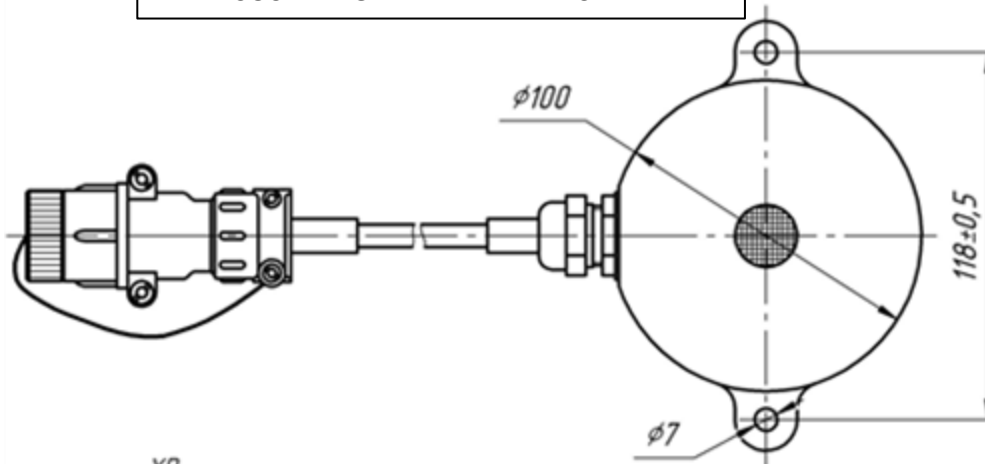
SHR20P5ESH10
(PLUG)

XS

	Конт.
4...20 mA	1
+Vcc	2
GND	3

SHR20R3ESH7

SOUND LIGHT ALARM WITH CABLE



XP

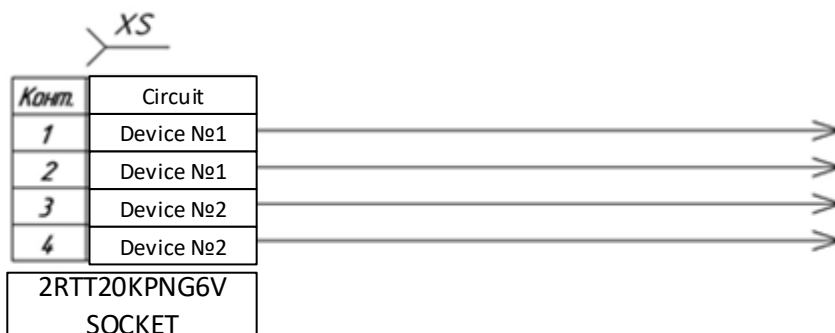
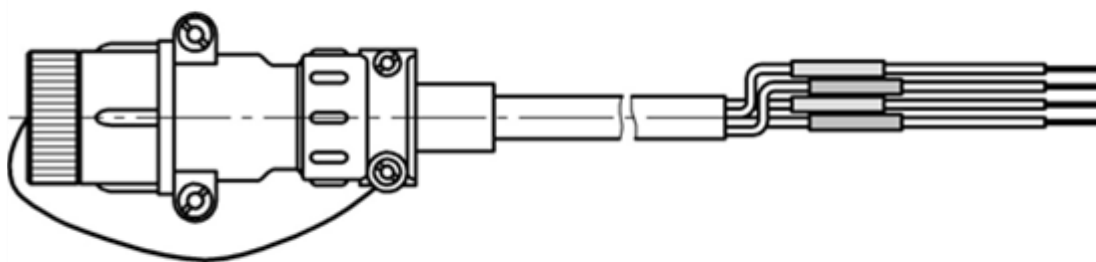
	Цепь
1	
2	
3	+12V
4	GND

SHR20P4NG8
(PLUG)

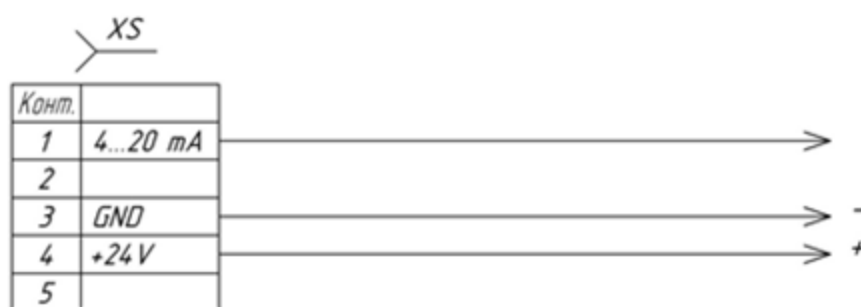
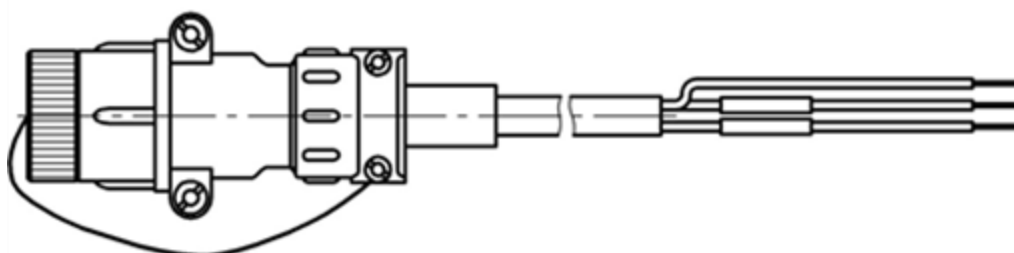
	Цепь
3	+12V
4	GND

SOUND LIGHT
ALARM

4 WIRED BLOCKING CABLE (SOCKET)



CABLE 4-20 mA (socket SHR20P5NSH10)



SHR20P5NSH10
(PLUG)