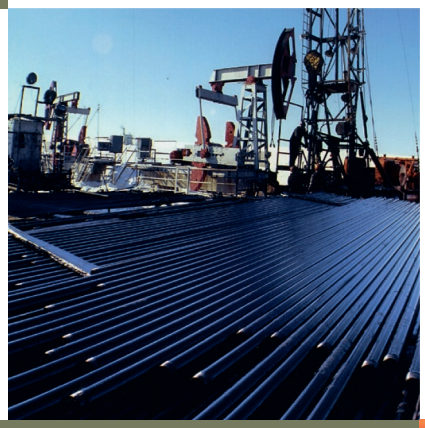
IRZ



PRODUCT CATALOGUE

IRZ TEK

oil.irz.ru

IZHEVSKIY RADIOZAVOD (IRZ)

FUEL & POWER

Oilfield electronic equipment, control and data acquisition systems, power converters for electric vehicles

AEROSPACE & DEFENCE

Space-related electronics for on-board and ground segments, telemetry systems, visual control systems, communication systems, navigation equipment, mobile robotic systems

RAILWAYS

Railway automatics and safety systems, railway traffic control systems, train control and monitoring systems

TELECOM

Radio communication and data transmission systems

PRODUCTION

Printed circuit boards, surface mounting

TESTING CENTER

Certification tests of electronic components, electronic equipment tests, check-out equipment

MACHINING

High precision mechanical parts production, assembly and integration of end products

IRZ TEK is one of the leaders of the Russian oilfield electronics market.

IRZ TEK produces:

- downhole monitoring systems;
- downhole anti-scaling systems;
- dual completion systems;
- geophysical monitoring systems;
- fiber-optic monitoring system;
- check-out systems for oilfield electronic equipment;
- drives for surface and submersible motors;
- software for well monitoring and equipment diagnostic systems;
- oil production automated control systems.

IRZ TEK maintains a consistent customer-oriented policy guaranteeing customers product development according to their requirements, technical support at the stage of commissioning, timely service maintenance and repair, as well as training of service companies personnel to work with electronic equipment.

Due to high engineering potential, advanced production facilities and reliability of the equipment produced, IRZ TEK demonstrates stable development and is constantly expanding its products range. IRZ TEK secures 40% market share for downhole monitoring systems and 20% for variable frequency drives in Russia.

Equipment of IRZ TEK is operated by leading oil producing and service companies in Russia and outside - in Kazakhstan, Azerbaijan, Tadjikistan, China, Indonesia, India, Egypt and South Sudan.

IRZ TMS DOWNHOLE MONITORING SYSTEM
FOR SEVERE ENVIRONMENTAL CONDITIONS

Intended use: monitoring and performance optimization of electrical submersible pump units (ESP systems) operated with high-voltage submersible electric motors (SEM), in conditions of high level of interferences, at the depth of up to 6,000 meters, at the formation fluid temperatures of up to 150 °C (for special versions - up to 180 °C with ability to sustain short-time overheating up to 200 °C).

System components:
- downhole sensor (DHS);
- TMS-E5 surface acquisition board or ASPT surface read-out panel;
- depending on the version, motor base - motor adapter for connecting downhole sensor to motor.

TMS-E5

BP-103M3
downhole sensor

Monitored parameters:
- pump intake pressure;
- motor oil pressure;
- motor oil temperature;
- formation fluid temperature;
- motor stator winding temperature;
- motor vibrations;
- power cable and motor insulation resistance.

Using IRZ TMS with ESP control systems ensures:
- protection and optimization of ESP system operation;
- automatic regulation of a fluid level in the well;
- data acquisition for hydrodynamic tests of a well.

Operation principle:

The downhole sensor is connected to the bottom of a motor either directly or with the help of a motor adapter (cross-over) supplied individually for the specific type of the motor. TMS-E5 surface acquisition board is installed inside of a variable frequency drive. Readings come from the downhole sensor via the motor power cable, the data is processed by the surface acquisition board, and then transferred to a variable frequency drive.

Advantages:

- high voltage protection at the short-circuit in power cable or motor of up to 5000 V;
- reliable data transfer at the transformer Y-point voltage up to 1000 V;
- pump intake pressure sensors are in direct contact with fluid;
- intake pressure measurement with the resolution of 0.1 psi;
- equipment can be reinstated using repair kits with no need for re-calibration;
- stable data reception at low insulation resistance of the "transformer - power cable - motor" line up to 5 kOhm;
- compatibility with variable frequency drives of all Russian manufacturers;
- a series of downhole sensor versions designed for motors with diameter from 70 mm to 185 mm;
- downhole monitoring system versions designed according to the technical requirements of Lukoil, Surgutneftegaz, and Rosneft.

Options:

- built-in display;
- USB-archive in TMS-E5;
- receiving, displaying, and transmitting real-time parameters via GSM-link to customer's server, displaying real-time parameters and VFD operation history, building charts, generating reports in MS Excel and WellView formats;
- using backup battery for building pressure recovery curve when power supply is interrupted;
- compatibility with motor built-in thermocouple (J- or K-type);
- relay and analog outputs for connection to outdated types of variable frequency drives.

Specification	Value
Supply voltage	160-300 V
Downhole data scanning interval	20 seconds (optionally: 1 time per 5 seconds/intake pressure, once per 30 seconds for other parameters)
Operating temperature range surface acquisition board downhole sensor	 -60…+60 °C 0…+150 °C (optionally up to +180 °C)
Temperature measuring range motor stator winding motor oil temperature formation fluid temperature	 0…+250 °C 0…+250 °C 0…+150 °C
Pressure measuring range	0-356/569/3560/5690/8534 psi
Pressure measuring resolution	0.1 psi
Measurement error	0.25 %/0.5 % depending on the version
Motor vibrations measurement range	from 0g to 5g
Controller communication interfaces	RS-232, RS-485

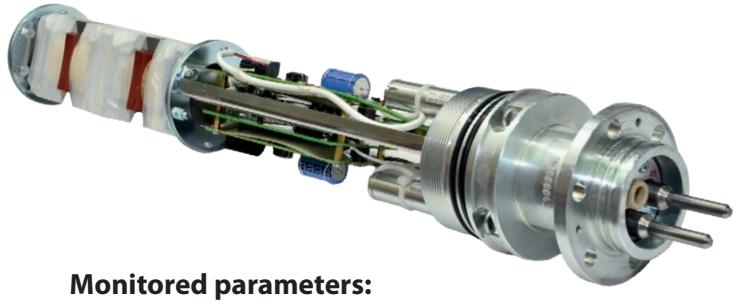
IRZ TMS-M3N DOWNHOLE MONITORING SYSTEM
WITH COLD BACKUP OF ELECTRONICS

Intended use: control and optimization of ESP systems operation in wells with tough requirements for reliability and accuracy of readings. The downhole sensor has dual backup of all electronic modules. The set of backup electronics is activated automatically or by the command from the surface unit when the master set fails.

System components:
- BP-103M3N downhole sensor;
- TMS-E5 surface acquisition board or ASPT surface read-out panel;
- depending on the version, motor adapter to connect downhole sensor with the motor.

TMS-E5

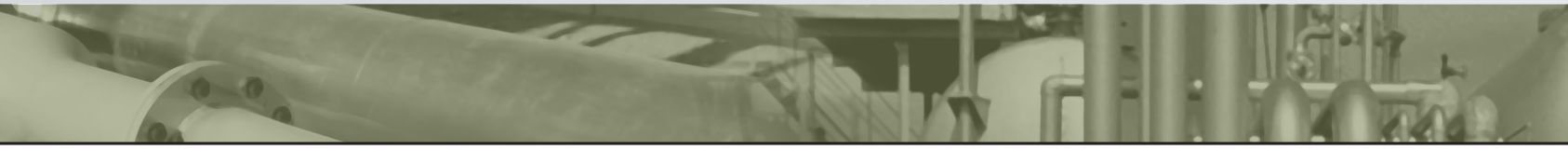
BP-103M3N



Operation principle:
The downhole sensor is connected to the bottom of a motor either directly or with the help of a motor adapter (cross-over) supplied individually for the specific type of the motor. The TMS-E5 surface acquisition board is designed for installation inside the variable speed drive. Readings come from the downhole sensor via the motor power cable, the data is processed by the surface acquisition board, and then transferred to a variable frequency drives.

Monitored parameters:
- pump intake pressure;
- motor oil temperature;
- formation fluid temperature;
- motor stator winding temperature;
- motor vibrations;
- power cable and motor insulation resistance.

Using IRZ TMS-M3N with ESP control systems ensures:
- protection and optimization of ESP system operation;
- automatic regulation of desired wellbore fluid level;
- collecting data for well testing.



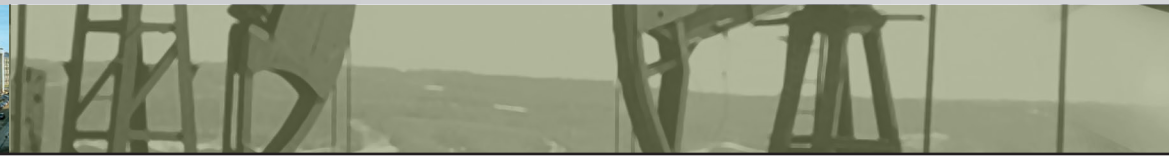
Advantages:

- The downhole sensor comprises two independent sets of electronics - the "master" and the "slave" set. If the master set of electronics fails, the system switches to the slave set automatically.
  The operator can switch to the slave set manually.
- control of measurement accuracy by comparing the readings of two independent systems and detection of errors associated with partial failure of components;
- measurement of intake pressure with the resolution of 0.1 psi;
- data is transferred to an external device via RS-232 RS-485 interface using the IRZ TMS2 data exchange protocol;
- stable data reception at low insulation resistance of the "transformer - power cable - motor" line up to 10 kOhm;
- readings update - not less than once per 40 s;
- customized versions compliant to the technical requirements of Lukoil, Surgutneftegaz, Rosneft.

Options:

- USB-archive in TMS-E5;
- receiving, displaying, and transmitting real-time parameters via GSM-link to customer's server, displaying real-time parameters and VFD operation history, building charts, generating reports in MS Excel and WellView formats.

Specification	Value
Supply voltage	160-300 V
Downhole data scanning interval	up to 30 s
Operating temperatures range of the surface readout unit	-60…+60 °C
Temperature measuring range motor stator winding motor oil formation fluid	 0 … +250 °C 0 … +250 °C 0 … +150 °C
Pressure measuring range	0 - 356/569/3560/5690/8534 psi depending on the version
Pressure measuring resolution	0.1 psi
Measurement error	0.25%/0.5% depending on the version
Motor vibrations measurement range	from 0g to 5g
Controller communication interfaces	RS-232, RS-485
Overall dimensions TMS-E5 BP-103M3N	 210x250x160 mm Ø 103x755 mm



IRZ TMS DOWNHOLE MONITORING SYSTEM IDENTIFICATION CODE

IRZ TMS -X(1) -X(2) -X(3) -X(4) -X(5) -X(6) -X(7) -X(8) -X(9) -X(10) CVIA.465625.015

1 - The diameter and manufacturer of the motor, to which the downhole unit will be connected through the adapter, are in accordance with Table 1

Table 1

Versions	Description
-	Without motor adapter
70	Downhole monitoring system for motors Ø70 mm
81	Downhole monitoring system for motors Ø81 mm
95	Downhole monitoring system for motors Ø95 mm
103	Downhole monitoring system for motors Ø103 mm of ALNAS and ALMAZ
103B	Downhole monitoring system for Ø103 mm motors of BORETS and NOVOMET
114	Downhole monitoring system for motors Ø114 mm
117	Downhole monitoring system for motors Ø117 mm
130	Downhole monitoring system for motors Ø130 mm
185	Downhole monitoring system for motors Ø185 mm

2 - downhole sensor version according to table 2

Table 2

Versions	Description
M3	BP-103M3 downhole sensors series, compatible with TMS-E5-01 and TMS-E6-01 surface acquisition boards
M32	BP-103M3 downhole sensors series, maximum operation temperature is 180 °C. The system is compatible with TMS-E5-01 surface acquisition board
70M3	BP-81M3 downhole sensors series, compatible with TMS-E5-01 surface acquisition board, outer diameter is Ø70 mm
81M3	BP-81M3 downhole sensors series, compatible with TMS-E5-01 surface acquisition board, outer diameter is Ø81 mm
6M3	BP-116M3 downhole sensor series, designed for non-Russian motors, compatible with TMS-E5-01 and TMS-E6-01 surface acquisition boards
M3V	BP-103M3V downhole sensor series, compliant to Surgutneftegaz technical requirements, compatible with TMS-E5V-21 surface acquisition board
6M3K	BP-116M3K downhole sensor series designed for export to Kazakhstan, compatible with TMS-E5-01 and TMS-E6-01 surface acquisition boards
PR	BP-117PR downhole sensor series with thru shaft, compatible with TMS-E5-01 and TMS-E6-01 surface acquisition boards
PRD	BP-117PRD downhole sensor series with thru shaft, compatible with TMS-E6-01 surface acquisition board, compatible with SAKMAR system manufactured by NPF "Geofizika".
M3R	BP-103M3R downhole sensor series, compliant to Rosneft technical requirements, compatible with TMS-E5-01P surface acquisition board
M3R2	BP-103M3R2 downhole sensor series, compliant to Rosneft technical requirements, maximum operating temperature is 170 °C, compatible with TMS-E5-01P surface acquisition board

Table 2 continuation

Versions	Description
M3S	BP-103M3S downhole sensor series, compliant to Surgutneftegaz technical requirements, compatible with TMS-E5V-21 surface acquisition board
M3S2	BP-103M3S downhole sensor series, compliant to Surgutneftegaz technical requirements, maximum operating temperature is 160 °C, compatible with TMS-E5V-21 surface acquisition board
117M3L	BP-117M3L downhole sensor series, compliant to Lukoil technical requirements, compatible with TMS-E5-01L surface acquisition board, designed for motors Ø117 mm
M3L	BP-103M3L downhole sensor series, compliant to Lukoil technical requirements, compatible with TMS-E5-01L surface acquisition board, designed for motors Ø103 mm
117M3L2	BP-117M3L2 downhole sensor series, compliant to Lukoil technical requirements, maximum operating temperature is 180°C, compatible with TMS-E5-01L surface acquisition board
M3N	BP-103M3N downhole sensor series, dual backup design of all electronics, compatible with TMS-E5-01 and TMS-E5-02 surface acquisition boards
M3N2	BP-103M3N2 downhole sensor series, dual backup design of all electronics, maximum operating temperature is 160°C, compatible with TMS-E5-01 and TMS-E5-02 surface acquisition boards
M3N3	BP-103M3N3 downhole sensor series, dual backup design of all electronics, maximum operating temperature is 180°C, compatible with TMS-E5-01 and TMS-E5-02 surface acquisition boards

3– The maximum allowable pressure, accuracy, resolution, units of measurement, and data exchange protocol are given in Table 3

Table 3

Versions	Description
600/400/320/ 250/40/25	Units of measurement are kgf/cm², the maximum allowable pressure is selected from the specified values, resolution is 0.01 kgf/cm², and the data transfer protocol is IRZ TMS2*
60MPa/40MPa/32 MPa/25MPa/4MPa/ 2.5MPa	Units of measurement are MPa, the maximum allowable pressure is selected from the specified values, resolution is 0.001 MPa, and the data transfer protocol is Lukoil/Rosneft/Surgutneftergaz*
None/, 05/.025	Limit of the full-scale error (from upper range limit) is 1% / 0.5% / 0.25% respectively

Example: 600.05 – the measurement limit is 600 kgf/cm², communication protocol is IRZ TMS2*, the error of pressure measurement is 0.5%;
40MPa – the measurement limit is 40 MPa, data transfer protocol is Lukoil/Rosneft/ Surgutneftegaz*, the error of pressure measurement is 1%;
2.5,025 MPa – the measurement limit is 2.5 MPa, data transfer protocol is Lukoil/Rosneft/ Surgutneftegaz*, the error of pressure measurement is 0.25%.

*determines the data transfer between the surface readout unit and variable frequency drive, and between downhole sensor and surface readout unit

4– The availability of motor vibrations sensor is specified according to Table 4

Table 4

Versions	Description
-	No sensor
V2	Vibrations sensors along X, Y, and Z axes

5 – The availability of temperature sensor is according to Table 5

Table 5

Versions	Description
T2	Oil temperature sensor (external) and formation fluid temperature sensor
T2M	Oil temperature sensor (built-in) and formation fluid temperature sensor

6 – The availability of corrosion resistant coating of downhole unit is according to Table 6

Table 6

Versions	Description
-	Downhole sensor zinc coating - C9.hr
K	Downhole sensor corrosion resistant coating – high-speed plasma spraying
Kn	Downhole sensors made of stainless (corrosion-resistant) non-coated steel
K2	Downhole sensor corrosion resistant coating – monel plasma spraying

7 – Base view is according to Table 7

Table 7

Versions	Description
-	Base with internal thread for Ø60 mm tubing connection
N1	Base with external thread for Ø73 mm tubing connection
N2	Base with external thread for Ø60 mm tubing connection
N3	Base with internal thread for Ø73 mm tubing connection
N0	Base without tubing thread
N4	Base with internal inch thread 2-3/8-8RD
P10	Flange connection for M10 pins on a 98 mm bore diameter, shaft is made with straight-sided splines according to GOST 1139-80
E10	Flange connection for M10 pins on a 98 mm bore diameter, shaft is made with involute splines according to GOST 6033-80
P12	Flange connection for M12 pins on a 98 mm bore diameter, shaft is made with straight-sided splines according to GOST 1139-80
E12	Flange connection for M12 pins on a 98 mm bore diameter, shaft is made with involute splines according to GOST 6033-80

8 – Version of TMS surface readout unit is according to Table 8

Table 8

Versions	Description
-	No surface readout unit
E5	TMS-E5-01 surface acquisition board
E501R	TMS-E5-01R surface acquisition board
E5M	TMS-E5M surface acquisition board
E5V	TMS-E5V-21 surface acquisition board
E6	TMS-E6-01 surface acquisition board

9 – Serial number of design
Indicates design version

10 – Additional information, not mandatory
May include data exchange protocol, maximum operating temperature, additional set of installation accessories, availability of additional permits, etc.

Examples of reference designation when ordering IRZ TMS downhole monitoring system:

IRZ TMS-117-M3-600-V2-T2-E5-33 CVIA.465625.015

Downhole monitoring system designed for connection to the motor with a diameter of 117 mm. The system delivery set includes: BP-103M3 downhole sensor with operational pressure measurement up to 8534 psi, pressure measurement resolution of 0.1 psi reduced total error of pressure measurement of ±1%, data transfer protocol IRZ TMS 2 (determines the data exchange between the downhole sensor and VFD, and between downhole sensor and surface readout unit), vibrations sensors along X, Y and Z axis, motor oil and intake fluid temperature sensor, TMS-E5-01 surface acquisition board version 33.

BP-103M3 REPAIR KIT

Intended use: overhaul and restoring repair of IRZ downhole sensors upgrade of outdated downhole sensors manufactured since 2012 year according to valid requirements of oil companies.

Advantages:

- contains a full set of PCBs, calibrated sensors and connection adapters;
- less expensive than brand new downhole sensor;
- compliant to current protocols;
- updated circuitry design;
- allows an overhaul repair of downhole sensors of other manufacturers by installing the IRZ electronics in the old housing;
- compliant to technical requirements of Rosneft, Lukoil, and Surgutneftegaz oil companies.

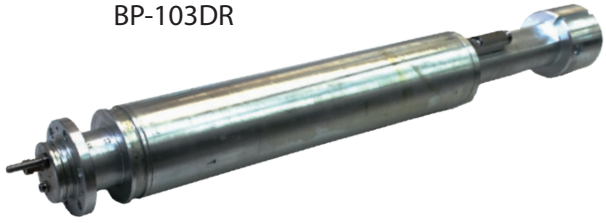
Specification	Value
Supply voltage	160-300 V
Downhole data scanning interval	up to 30 s
Operating temperature range surface acquisition board downhole sensor	 -60…+60 °C 0…+150 °C
Temperature measuring range motor stator winding motor oil formation fluid	 0…+250 °C 0…+250 °C 0…+150 °C
Pressure measuring range	0 - 356/569/3560/5690/8534 psi depending on the version
Pressure measuring resolution	0.1 psi
Measurement error	0.5 %
Motor vibrations measurement range	from 0g to 5g
Controller communication interfaces	RS-232, RS-485
Overall dimensions	Ø84x300 mm or Ø70x400 mm

IRZ TMS-R DOWNHOLE MONITORING SYSTEM WITH FLOW METER

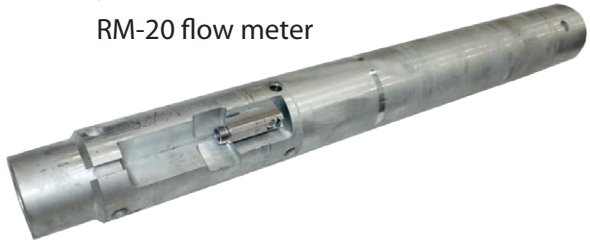
Intended use: measurement of pressure, temperature and flow rate of fluid at the ESP discharge.

System components:
- BP-103DR downhole sensor;
- RM-20 flow meter;
- TMS-E5 surface acquisition board;
- motor adapter (crossover);
- cable in KST-2 tube for RM-20 connection to the downhole sensor;
- protectolizers for protection of geophysical cable;
- cable winding device in the tube.

BP-103DR



RM-20 flow meter

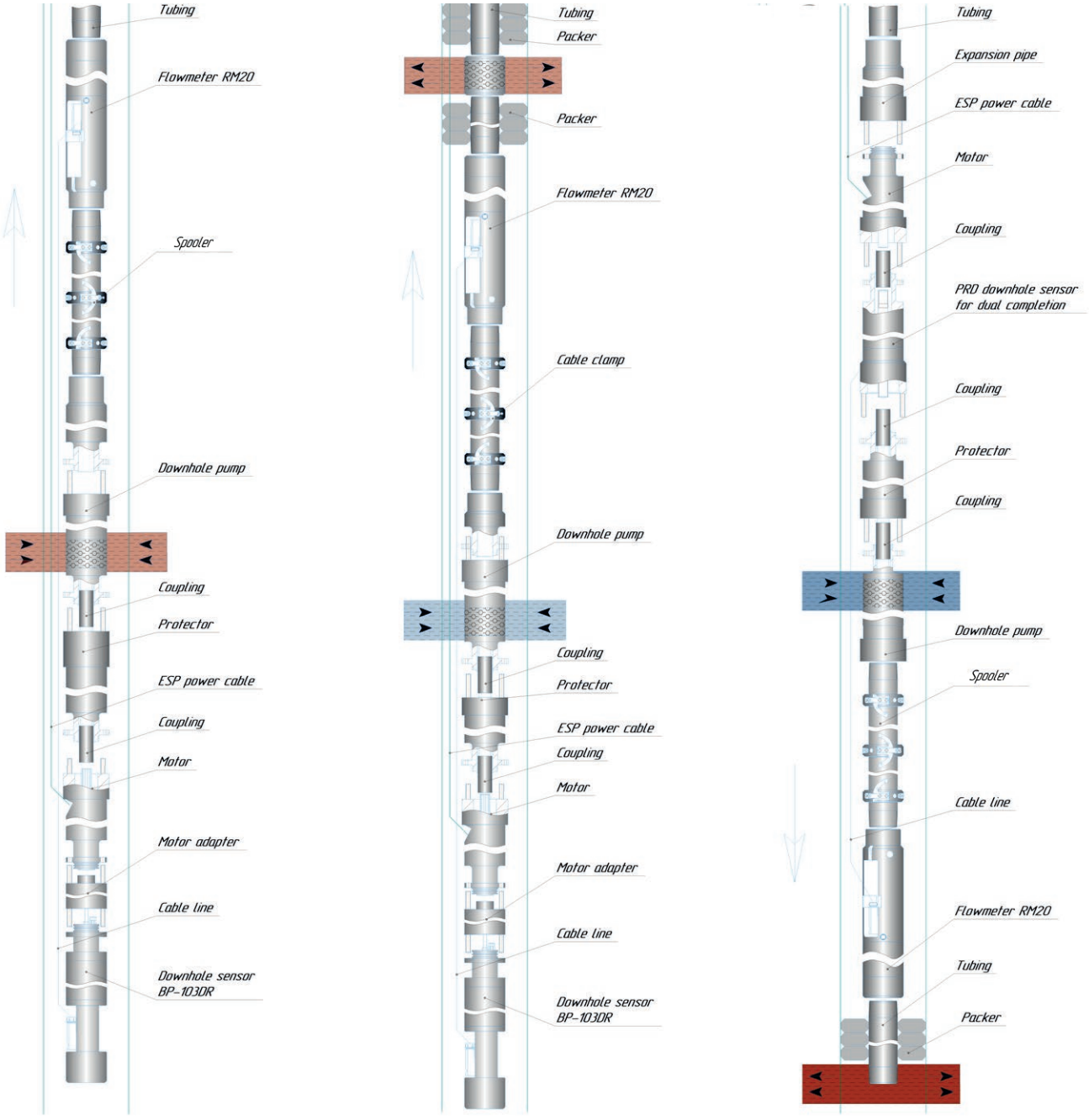


Monitored parameters:
- pump intake pressure;
- motor oil temperature;
- formation fluid flow rate;
- formation fluid temperature;
- motor vibrations;
- power cable and motor insulation resistance.

Features:
Variety of design options for production and intrawell pumping systems, both for "upward" and "downward" layouts;
1a – version for production;
1b – version for intrawell pumping from lower layer to upper;
1c – version for intrawell pumping from upper layer to lower layer using downhole sensor version with thru shaft.
To implement any of the layouts, only one cable is required in a tube in the setting zone of ESP.

Using IRZ TMS with ESP control systems ensures:
- protection and optimization of ESP system operation;
- automatic regulation of a fluid level in the well;
- data acquisition for hydrodynamic tests of a well.

Operation principle:
IRZ TMS-R system is completed with an additional downhole unit that measures the flow rate, pressure and temperature of the fluid passing through the unit. The flow meter is a vortex-type measurement tool. Comparing with spinner-type flow meters, the vortex-type meter has no moving parts and has a wide measurement range of production flow rates.



a) **b)** **c)**

Layout systems: a) IRZ TMS-R1 for oil production; b) IRZ-TMS-R1 for intrawell pumping; c) IRZ TMS-R2 for intrawell pumping with downhole sensor and thru shaft.

MAIN OPERATING PARAMETERS OF THE SYSTEM	
Allowable vibration	50 m/s^2
Operating temperature range	0…+150 °C
Fluid pressure at the pump discharge	up to 7112 psi
Setting depth	up to 5,000 m
Motor secondary voltage	up to 4,000 V
Overall dimensions RM-20 BP-103DR	 103x900 mm 103x930 mm
Weight RM-20 BP-103DR	 <40 kg <30 kg
MONITORED PARAMETERS	
Range of measured production rates	20-200/100-1,000 m^3/day
Relative error limit of flow rate measurement	5 %
Temperature measuring range pump discharge pump intake motor oil temperature motor windings temperature	 0…+150 °C 0…+150 °C 0…+250 °C 0…+250 °C
Reduced overall error of temperature measurement	2 %
Range of pressure measurement pump discharge pump intake motor oil pressure	 0-8534 psi 3560/4551/8534 psi 3560/4551/8534 psi
Reduced overall error of pressure measurement	1 % / 0.5 %
Range of three-axis vibration measurement at the setting point of downhole sensor at the setting point of flow meter	 0-50 m/s 0-50 m/s
Reduced overall error of vibration measurement	5 %

IRZ TMS-BV1.1 DOWNHOLE MONITORING SYSTEM WITH COLD BACKUP OF ALL ELECTRONIC COMPONENTS AND HYDRAULIC CONTROL LINE FOR PRESSURE MEASUREMENT AT ESP DISCHARGE

Intended use: monitoring and optimization of ESP systems operation, as well as measuring pump discharge pressure via hydraulic control line.

System components:

- BP-95MT5 downhole sensor;
- TMS-E5 or ASPT surface readout unit;
- Threaded d-sub or flanged d-sub;
- hydraulic control line;
- choke.

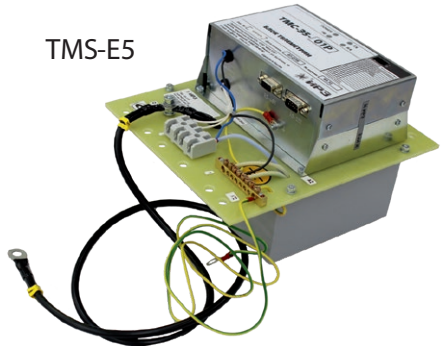
BP-95MT5

Flanged d-sub with hydraulic line

Monitored parameters:

- pump intake pressure;
- pump discharge pressure;
- motor oil pressure;
- motor oil temperature;
- formation fluid temperature;
- motor stator winding temperature;
- motor vibrations;
- power cable and motor insulation resistance.

TMS-E5

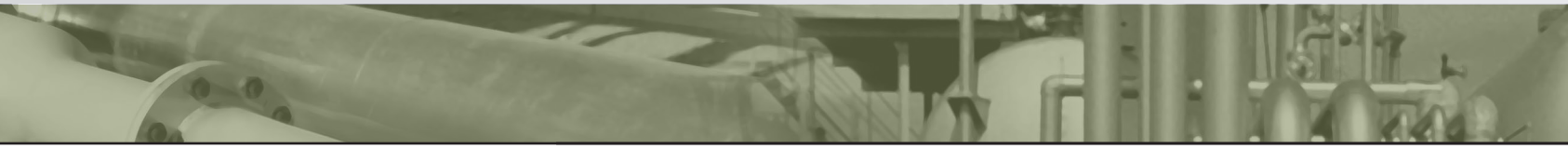


Operation principle:

Downhole sensor is mounted directly to motor base or via motor crossover or adapter which is supplied individually for a specific motor type. Discharge pressure is measured at the input of the downhole sensor via thick-wall hydraulic tube and flanged d-sub. The TMS-E5 surface acquisition board is designed for installation inside the variable speed drive. Readings from the downhole sensor are transmitted through the motor power cable, processed by the surface readout unit, and then transmitted to the variable frequency drive.

Using IRZ TMS-BV1.1 with ESP control systems ensures:

- protection and optimization of ESP systems operation;
- automatic regulation of desired wellbore fluid level;
- data acquisition for hydrodynamic tests the well.



Advantages:

- pump discharge pressure measurement;
- downhole sensor is designed with cold backup of all electronic components: two downhole sensors are incorporated in one housing - one is functioning, the second is activated manually or automatically in case the first one fails;
- measurement accuracy is controlled by comparing the readings of two independent sensors and detecting errors associated with partial failure of electronic components;
- pump intake pressure measurement with the resolution of 0.1 psi;
- stable readings reception at low insulation resistance of the "step-up transformer - cable - motor" line down to 10 kOhm;
- data exchange is performed via RS-232 or RS-485 interface using the IRZ TMS2 data exchange protocol;
- monitored parameters update time - not less than once in 30 s;
- intake pressure readings update time - not less than once in 5 s;
- compliant to the requirements and standards of international companies.

Specification	Value
Supply voltage	160 - 300 V
Downhole data scanning interval	up to 30 s
Operating temperature range surface acquisition board downhole sensor	 from minus 60 to +60 °C 0…+150 °C
Temperature measuring range motor stator winding motor oil formation fluid	 0…+250 °C 0…+250 °C 0…+150 °C
Range of formation fluid pressure measurement	0-356/569/3560/5690/8534 psi depending on the version
Formation fluid pressure measurement resolution	0.1 psi
Measurement error	0.5 %
Motor vibrations measurement range	from 0g to 5g
Controller communication interfaces	RS-232, RS-485
Range of pressure measurement at pump discharge	from 0 to 0-356/569/3560/5690/8534 psi depending on the version
Resolution of pressure measurement at pump discharge	0.1 psi
Overall dimensions surface acquisition board downhole sensor	 210x250x160 mm Ø 95x755

Additional options:

- measurement of cable leakage current;
- autonomous operation with batteries up to 12 hours;
- connection of a GSM-modem for remote monitoring of parameters, viewing the history of VFD operation and plotting graphs and reports in MS Excel and WellView formats;
- the surface acquisition board can be equipped with graphic display;
- the sensor can be connected to the step-up transformer which is not equipped with a Y-point;
- relay outputs and/or up to 8 analog inputs of TMS can be used for settings and motor protections adjustments as well as for connecting TMS to any variable frequency drive including non-Russian and old versions drives;
- VFD history archive of up to 150 days of operation can be viewed and downloaded to a USB-drive.

IRZ TMS-MAGMA-28-400-230-K-E5M

HIGH-TEMPERATURE PERMANENT DOWNHOLE MONITORING SYSTEM FOR PCP AND SRP SYSTEMS

Intended use: measurement of temperature and pressure of the environment inside tubing and annulus, designed for usage in extreme temperatures (up to 230 °C) at the depth up to 3,000 meters.

System components:

- BP-28VT downhole sensor;
- TMS-E5M surface acquisition board;
- M-117-NKT73 mandrel.

BP-28VT with mandrel and clamp

TMS-E5M

Specification	Value
Rated power	40 W
Range of formation fluid pressure measurement	0-8534 psi
Range of formation fluid temperature measurement	0…+230 °C
Resolution of pressure measurement	0.15 psi
Reduced overall error of pressure measurement	1 %
Resolution of temperature measurement	0.01 °C
Reduced overall error of temperature measurement	1.5%

Monitored parameters:

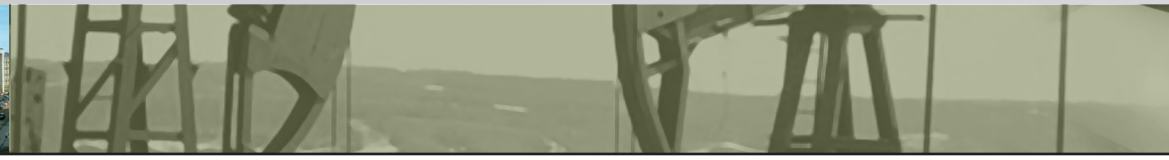
- formation fluid temperature;
- formation fluid pressure;
- pressure and temperature at the pump discharge.

Operation principle:

Downhole sensor is installed at the pump discharge and connected to high-temperature geophysical cable or ESP power cable which are going to wellhead and then connected to surface readout unit.

Benefits:

- operation in high-temperature environment – up to +230 °C;
- high resolution of temperature and pressure measurement;
- easy installation;
- effective at a depth of 3,000 m;
- automatic regulation of a given wellbore fluid dynamic level.



IRZ TMS-MAGMA-117-40-200-K-E5VT

HIGH-TEMPERATURE DOWNHOLE MONITORING SYSTEM

Intended use: measurement and transfer of intake pressure, motor oil temperature, intake temperature, power cable and motor insulation resistance readings during oil production in wells with high operation temperatures (up to 200 °C).

System components:

- TMS-E5-VT surface acquisition board;
- BP-103VT downhole sensor.

Options:

- connection of a GSM-modem for remote monitoring of parameters, viewing the history of VFD operation and plotting graphs and reports in MS Excel and WellView formats;
- easy data downloading to USB-drive.

BP-103VT

TMS-E5-VT

Operation principle:

The downhole sensor is connected to the motor base either directly or through a motor adapter supplied individually for the specific type of the motor. The TMS-E5-VT surface acquisition board is designed for installation inside the variable speed drive. Readings come from the downhole sensor via the motor power cable, the data is processed by the surface acquisition board, and then transferred to an external device (variable frequency drive).

Benefits:

- operation in high-temperature environment – up to +200 °C;
- high resolution of temperature and pressure measurement;
- downhole sensor can be operated at a depth of up to 3,000 m;
- archiving data on the history of VFD operation at least for 30 days.

Specification	Value
Supply voltage	120-400 V
Supply voltage frequency	50±1 Hz / 60±1 Hz
Power consumption	40 W
Operating temperature range	-60...+60 °C
AC current consumption	40 mA
Allowed vibration	100 m/s^2
Allowed formation fluid pressure	up to 4551 psi
Range of pressure measurement	0-4551 psi
Range of formation fluid temperature measurement	0…+200 °C
Range of motor oil temperature measurement	from 0 to +200 °C
Reduced overall error of pressure measurement	0.5 % / 1 %
Pressure measurement resolution	0.1 psi
Temperature measurement resolution	0.1 °C
Reduced overall error of the rest parameters measurement	1.5 %
Running depth	up to 3,000 m
Controller communication interfaces	RS-232 or RS-485

IRZ TMS-ORD1 DOWNHOLE MONITORING SYSTEM FOR DUAL COMPLETION

Intended use: real-time monitoring of multilayer objects development in wells equipped with ESP systems. The system provides preliminary processing, visualization and interpretation of well information, as well as remote monitoring of the ESP system operation.

System components:

- downhole geophysical modules like SAKMAR-5D-ECN;
- BP-103D1 downhole sensor;
- ASPT surface panel.

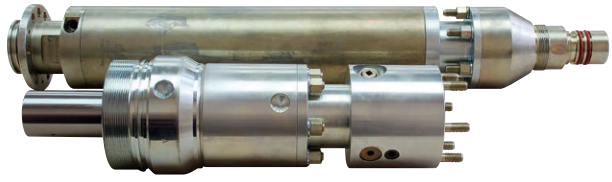
Monitored parameters:

- pump intake pressure;
- motor oil temperature;
- formation fluid temperature;
- motor stator winding temperature;
- motor vibrations;
- insulation resistance between power cable and motor;
- geophysical information on each layer; pressure, temperature, flow rate, water cut.

ASPT surface panel

SAKMAR

BP–103D

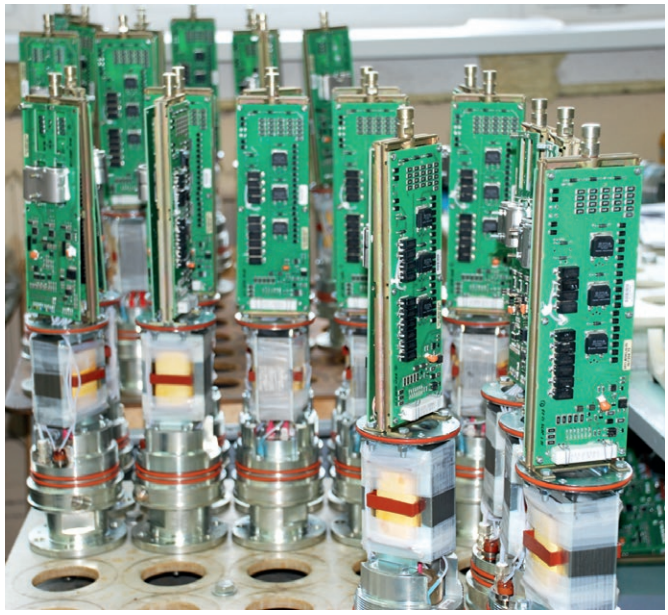


Using IRZ TMS-ORD1 with ESP control systems ensures:

- protection and optimization of ESP system operation;
- automatic regulation of desired wellbore fluid level;
- collecting data for well testing.

Operation principle:

The development of multilayer objects in wells is monitored using standard ESP power cable for transmitting geophysical, hydrodynamic, and production data from downhole sensor and multi-parameter measuring modules installed below the ESP. BP-103D downhole sensor with gauges and acquisition unit for receiving data from geophysical module is mounted to the motor base with the help of motor adapter (crossover). Bottom end of BP-103D is equipped with a standard connector for connecting to a geophysical cable. ASPT surface panel is installed outside the VFD of any manufacturer and does not require modification of the VFD. Readings from downhole sensor and multi-parameter measuring modules are transferred through the ESP power cable digitally without distortion to an operator's workplace via GSM-modem, to the VFD and remote control system upon request via RS-232 or RS-485 interface, as well as to USB-drive. The data is accumulated in the memory of the surface readout unit. The memory size ensures data archiving for a period of 30 days at the maximum speed of scanning the gauges. The modules are verified at the factory during production and once a year by an accredited center of standardization and metrology when lifting the pumping unit.



Advantages:

- real-time monitoring of multilayer objects development;
- hydrodynamic tests in shut-in wells when shutting down or changing the operating mode of the electric pump without stopping the ESP system;
- real-time monitoring and control of the ESP system operation mode;
- in case of areal application of the ORD1 technology – remote control of oilfield development, remote monitoring and control of the equipment installed at the oilfield;
- monitoring real-time parameters, VFD operation history, plotting the graphs and generating reports in MS Excel and WellView formats.

Specification	Value
BP and ASPT	
Operating temperature	
downhole sensor	0…+150 °C
surface acquisition board	-60…+60 °C
Temperature measuring range	
motor stator windings	0…+250 °C
motor oil	0…+250 °C
formation fluid	0…+150 °C
Range of pressure measurement	0-8534 psi
Resolution of pressure measurement	0.1 psi
Motor vibrations measurement range	0g-5g
Controller communication interfaces	RS-232, RS-485
SAKMAR-5D-ECN	
Operating temperatures range of the downhole equipment	0…+120 °C
Temperature measuring range	0…+120 °C
Resolution of temperature measurement	0.005 °C
Range of pressure measurement	0-5690 psi
Resolution of pressure measurement	0.004 psi
Flow rate measurement range	from 0.4 to 29 m3/h
Humidity indication range	0-100 %
Pressure sensor	
Pressure measurement range	0-8534 psi
Resolution	0.1 psi
Instrumental error	0.2 %
Instrument drift	1
Temperature sensor	
Ambient temperature measurement range	0…+150 °C
Temperature measurement resolution	0.03 °C
Instrumental error	0.2 %
Motor oil temperature measurement range	0…+250 °C
Resolution	0.01 °C
Instrumental error	0.2 %
Vibration sensor	
Vibration measurement range	0g-5g
Resolution	0.01g
Instrumental error	1
Sensor scanning interval	60 s

IRZ TMS-ORD2 DOWNHOLE MONITORING SYSTEM FOR DUAL COMPLETION

Intended use: oil production monitoring of dual completion wells with two layers and with a pumping system that consist of downhole motor and two pumps according to the "ESP-MOTOR-ESP" layout.

System components:

- TMS-E6 or ASPT surface readout unit;
- BP-117PRD downhole sensor;
- SAKMAR-4D-ECN geophysical unit.

TMS-E6

BP-117PRD

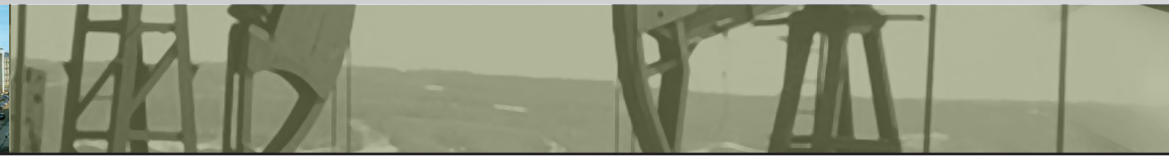
SAKMAR

Monitored parameters:

- pump intake pressure;
- motor oil temperature;
- formation fluid temperature;
- upper formation fluid temperature;
- motor vibrations;
- insulation resistance between power cable and motor;
- intake pressure of the bottom pump;
- lower formation fluid water cut;
- lower layer production rate.

Using IRZ TMS-ORD2 with ESP control systems ensures:

- protection and optimization of ESP system operation;
- automatic regulation of a fluid level in the well;
- data acquisition for hydrodynamic tests of a well.



Operation principle:

TMS-E6 powers the BP-117PRD downhole sensor through the motor power cable.

BP-117PRD has a thru shaft and is installed between the motor and bottom seal. The SAKMAR geophysical module is connected via a geophysical cable at the bottom pump intake and measures pressure, temperature, water cut, and flow rate of the lower layer.

Advantages:

- downhole sensor system has protection against high voltage up to 3000 V;
- compatibility with all VFDs of Russian manufacturers;
- readings update interval is no less than once per 40 s;
- dual string production of two layers in a single-lift layout with minimum changes to a typical ESP.

Specification	Value
Downhole sensor	
Supply voltage	160-300 V
Downhole data scanning interval	20 s
Operating temperature range TMS-E6 BP-117PRD	 minus 60...+60 °C 0…+150 °C
Temperature measuring range motor oil formation fluid	 0…+250 °C 0…+150 °C
Range of pressure measurement	0 - 3560/4551/8534 psi depending on the version
Resolution of pressure measurement	from 0.1 psi
Measurement error	0.5% or 1% depending on the model
Motor vibrations measurement range	from 0g to 5g
Controller communication interfaces	RS-232, RS-485
Overall dimensions TMS-E6 BP-117PRD	 210x250x160 mm Ø 117x1000
SAKMAR 4D-ECN	
Operating temperatures range of the downhole equipment	0…+120 °C
Temperature measuring range	0…+120 °C
Resolution of temperature measurement	0.005 °C
Range of pressure measurement	0-5690 psi
Resolution of pressure measurement	0.004 psi
Flow rate measurement range	from 0.4 to 29 m3/h
Humidity indication range	0-100 %

IRZ TMS-ORD3 DOWNHOLE MONITORING SYSTEM FOR DUAL COMPLETION

Intended use: dual string production in wells equipped with SRP or PCP systems. Joint development with SPF Packer LLC.

System components:
- ASPT-ASTI surface panel;
- BV-46K downhole unit.

ASPT-ASTI

BV-46K

The use of IRZ TMS-ORD3 ensures:
- deactivation (activation) of bottom reservoir;
- intake choke restriction from bottom reservoir for creation of individual pressure sink on bottom reservoir;
- solenoid control from the surface unit without sucker-rod pump deactivation;
- increase of oil production efficiency.

Operation principle:
The system with a solenoid is installed below the pump for choke restriction of bottom reservoir and connected to high-temperature geophysical cable or ESP power cable going to the wellhead and then connected to the surface unit.

Monitored parameters:
- temperature of upper and bottom reservoirs;
- solenoid location;
- pressure of top and bottom reservoirs.

Advantages:
- provides dual production from two layers in a single-lift layout without changes to a typical SRP or PCP systems layout.

Specification	Value
Operating temperature	0…+100 °C
Rated power of the electric valve drive	0-400 W
Range of formation fluid pressure measurement	356 psi
Range of formation fluid temperature measurement	0…+150 °C
Resolution of pressure measurement	0.1 psi
Reduced overall error of pressure measurement	1 %
Resolution of temperature measurement	0.01 °C

IRZ TMS-ORD4 DOWNHOLE MONITORING SYSTEM FOR DUAL COMPLETION

Intended use: dual production from two reservoirs in the wells equipped with a single ESP system, and hermetic separation or choke restriction of one of the layers without motor deactivation. Joint development with SPF Packer LLC. The system is optimal for wells with a distance between the layers not less than 4 meters, with the diameter of the production tubing not less than 140 mm, the temperature of the formation fluid up to 100 °C, with a production rate of isolated reservoir up to 30% of total production rate.

System components:

- BP-103DI downhole sensor with motor adapter;
- KPUE-102 electric valve;
- IRZ-512-18-400-ORD4 upgraded variable frequency drive or ASPT autonomous surface panel;
- packer equipment depending on the type of the well.

BP-103DI

KPUE-102

Specification	Value
BP-103DI downhole sensor	
Intake pressure	0-4551 (0-8534) psi
Pump intake temperature	0…+150 °C
Motor oil temperature	15…+200 °C
Radial vibration	from 0g to 5g
KPUE-102 electric valve	
Pressure of the isolated reservoir	0-4551 (0-8534) psi
Temperature of the isolated reservoir	0…+150 °C
Valve position	0 - 100 %

Monitored parameters:

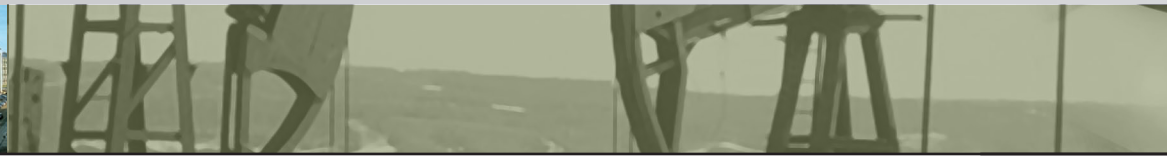
- main reservoir production rate – according to Group Metering Station, production rate of isolated reservoir – by calculation;
- pressure build-up curves;
- reservoir pressure;
- reservoir water cut percentage: main reservoir – by test, isolated reservoir – by calculation;
- ESP intake pressure;
- motor temperature;
- motor intake temperature;
- pressure under valve.

Advantages:

- valve is controlled through the downhole sensor (geophysical cable from the wellhead and additional surface equipment is not required);
- flange connection is used between motor and electric valve (geophysical cable is not required);
- electric valve is controlled through the VFD menu without motor deactivation;
- data from electric valve is recorded to main VFD archive and displayed in communication program along with main real-time parameters;
- compliance with the requirements of the Federal Service for Environmental, Technological, and Nuclear Supervision for multi-reservoir production;
- optimal production rates from both reservoirs;
- dual production is carried out using typical ESP systems.

Operation principle:

Surface readout unit powers the downhole sensor and electric valve through motor power cable which is used for data exchange as well. Downhole sensor is connected to the motor Y-point and electric valve is installed under the downhole sensor and controls the inflow rate from bottom reservoir by command from the surface unit.



IRZ TMS-ORD5 DOWNHOLE MONITORING SYSTEM FOR DUAL COMPLETION

Intended use: dual production from two-layer wells with the help of one electric motor and two pumps systems with a controlled valve for choke restriction of bottom reservoir. The system is used in case of a large pressure drop between the reservoirs (more than 285 psi) or the difference in the injectability of the reservoirs is 50 m^3/day and more, or in other cases when the IRZ TMS-ORD4 system is not applicable. Joint development with SPF Packer LLC.

System components:

- ASPT-KPUE2 surface panel;
- BV-92UK downhole unit;
- BP-117PRK downhole sensor;
- UK-10 cable laying device;
- KS2 cable;
- PNG-5U protectolizers (2 pcs).

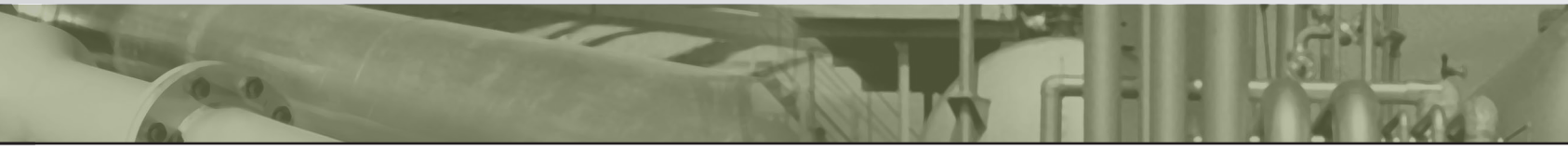
Monitored parameters:

- pump intake pressure;
- motor oil temperature;
- formation fluid temperature;
- motor vibrations;
- bottom-hole pressure of each reservoir separately;
- pressure build-up curves;
- separate measuring of the fow rate of each reservoir through the Group Metering Station (GMS).

ASPT surface panel

BV-92UK

BP-117PRK



Operation principle:
Surface readout unit powers the downhole sensor and electric valve through motor power cable which is used for data exchange as well. Downhole sensor is connected to the motor Y-point. BP-117PRK has a thru shaft and is installed between the motor and lower seal. Electric valve is installed under lower pump and connected via a geophysical cable, the valve controls the inflow rate from the lower reservoir by command from the surface unit.

Advantages:
- lower reservoir can be deactivated (activated);
- electric valve is controlled from surface unit while motor is running;
- producing the formation fluid from lower reservoir under conditions when the pressure of the lower reservoir is less than the pressure of the upper reservoir;
- ensuring full production of reserves from the well drainage area;
- reducing the cost of oil production and increasing profitability of the well.

Specification	Value
Operating temperature	0…+120 °C
Rated power of the electric valve drive	25 W
Range of pressure measurement formation fluid motor oil	 0-4551 psi 0-5690 psi
Temperature measuring range formation fluid motor oil	 0…+150 °C 0…+250 °C
Range of motor vibrations measurement in the frequency range from 0 to 70 Hz	0-40 m/s^2
Resolution of pressure measurement	0.1 psi
Reduced overall error of pressure measurement	1 %
Resolution of temperature measurement	0.01 °C
Reduced overall error of temperature and vibration measurement	2 %

ORZ1 DOWNHOLE MONITORING SYSTEM

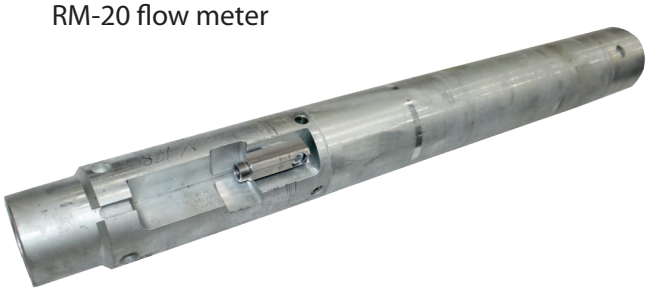
Intended use: monitoring of the injection volume into each reservoir for production wells with dual water injection into two production formations. Joint development with SPF Packer LLC.

System components:

- ASPT-KV-ORZ surface panel;
- fitting;
- RM-20 flow meter.

ASPT surface panel

RM-20 flow meter



Monitored parameters:

- formation fluid pressure;
- formation fluid temperature;
- injection fluid temperature;
- injected water volume.

Operation principle:

The measuring module is installed below the fitting that regulates the injection into the upper and lower reservoirs. The module is connected to a high-temperature geophysical cable, or, as an option, it can be connected via the ESP power cable. The cable goes through the wellhead feedthrough to the surface unit.

Advantages:

- water can be injected into several production reservoirs through one well;
- injected water volume and reservoir pressure are measured in real-time mode;
- cost reduction for the development and operation of the water flooding patterns in oilfields.

Specification	Value
Operating temperature	0…+100 °C
Rated power of the electric valve drive	25 W
Range of formation fluid pressure measurement	0-4551 psi
Range of formation fluid temperature measurement	0…+150 °C
Range of measured production rates	20-200 m^3/day
Resolution of pressure measurement	0.1 psi
Reduced overall error of pressure measurement	1 %
Resolution of temperature measurement	0.01 °C
Reduced overall error of temperature measurement	2 %
Resolution of production rate measurement	0.01 m^3/day
Reduced overall error of production rate measurement	5 %

ORZ2 AND ORZ3 DOWNHOLE MONITORING SYSTEMS

Intended use: maintenance of reservoir pressure during production of wells with dual water injection into several production formations. Joint development with SPF Packer LLC.

System components:

ORZ2

- ASPT-KV-ORZ surface panel;
- BV-98EP downhole units - 2 pcs;
- RM-20 flow meter;
- KLS2-83GF communication cable.

ORZ3

- ASPT-KV-ORZ surface panel;
- BV-98EP downhole units - 3 pcs;
- RM-20 flow meter – 2 pcs;
- KLS2-83GF communication cable.

Specification	Value
Operating temperature	0…+100 °C
Rated power of the electric valve drive	25 W
Range of formation fluid pressure measurement	0-4551 psi
Range of formation fluid temperature measurement	0…+150 °C
Range of measured production rates	20-200 m^3/day
Resolution of pressure measurement	0.1 psi
Reduced overall error of pressure measurement	1 %
Resolution of temperature measurement	0.01 °C
Reduced overall error of temperature measurement	2 %
Resolution of production rate measurement	0.01 m^3/day
Reduced overall error of production rate measurement	5 %

Monitored parameters:

- formation fluid pressure;
- formation fluid temperature;
- injection fluid temperature;
- injected water volume;
- position of each valve.

Operation principle:

The electric valve regulates water injection for each reservoir, the flow meters measure the injection volume for each reservoir. The equipment is connected via the ESP power cable.

Advantages:

- water can be injected into several production reservoirs through one well;
- regulation of water injection in each reservoir separately;
- electric valves are controlled from the surface panel in real-time mode;
- injected water volume and reservoir pressure are measured in real-time mode;
- cost reduction for the construction and operation of the water flooding patterns in oilfields.

VERSION DESIGNATION OF IRZ TMS-XXX DOWNHOLE MONITORING SYSTEMS

IRZ TMS -X 1 -X 2 -X 3 -X 4 -X 5 -X 6 -X/X 7 -X 8 -X 9 -X 10 CVIA.465625.015

Downhole monitoring system "IRZ TMS-XXX" special version (XXX is an alphanumeric designation of downhole unit subtype), depending on the version, the system is intended for:

- measurement of pressure and temperature of formation fluid in the setting zone of downhole sensor;
- motor oil or motor windings temperature measurement;
- motor vibration measurement;
- insulation resistance monitoring of the "step-up transformer - power cable - motor" line;
- measurement of volumetric flow rate of the fluid in the setting zone of of the downhole unit;
- measurement of the fluid temperature in the setting zone of the downhole unit;
- measurement of the fluid pressure in the setting zone of the downhole unit;
- measurement of the volumetric flow rate of the fluid in the setting zone of the downhole unit;
- control and position detection of the downhole electric valve;
- measurement of pressure and temperature of formation fluid below downhole electric valve;
- connection of additional geophysical equipment.

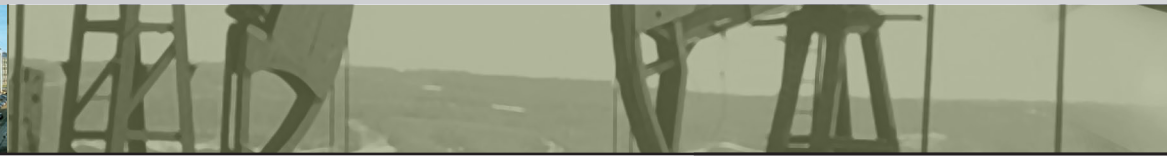
IRZ TMS downhole monitoring system, depending on the version, includes:

- surface acquisition board installed inside the VFD or autonomous surface panel;
- motor adapter (crossover);
- downhole sensor connected to the ESP motor base with the help of motor adapter;
- downhole unit (one or more).

1 – downhole monitoring system specialized intended use is defined according to Table 9

Table 9

Versions	Description
ORD1	Downhole monitoring system for dual completion with ESP unit equipped with BP-103D1 downhole sensor and SAKMAR geophysical module
ORD2	Downhole monitoring system for dual completion with the "ESP-MOTOR-ESP" dual pump layout equipped with BP-117PRD downhole sensor and SAKMAR geophysical module
ORD3	Downhole monitoring system for dual completion with SRP/PCP systems equipped with KP24UE electric valve produced by SPF Packer LLC
ORD4	Downhole monitoring system for dual completion with ESP system equipped with BP-103DI downhole sensor and BV-103EP downhole unit for installation in KPUE electric valve produced by SPF Packer LLC
ORD4.1	Downhole monitoring system for dual completion with ESP system equipped with BP-103DZI downhole sensor in a shield, flow meter and three BV-103EP downhole units for installation in KPUE electric valve produced by SPF Packer LLC
ORD5	Downhole monitoring system for dual completion with the "ESP-MOTOR-ESP" layout based on BP-117PRK downhole sensor and BV-92UK downhole unit for installation in KPUE electric valve produced by SPF Packer LLC
ORD4+ORD2	Downhole monitoring system for dual completion with ESP system equipped with BP-103DI downhole sensor, SAKMAR geophysical module and BV-103EP downhole unit for installation in KPUE electric valve produced by SPF Packer LLC
ORZ1	Dual water injection system for two reservoirs comprised of the downhole flow meter for systems with the fitting
ORZ2	Dual water injection system for two reservoirs comprised of two KPUE electric valves produced by SPF Packer LLC and downhole flow meter for lower reservoir
ORZ3	Dual injection system for three reservoirs comprised of three KPUE electric valves produced by SPF Packer LLC and two downhole flow meters
BV1	Downhole monitoring system with a function of pressure and temperature measurement at the pump discharge, connected through a geophysical cable
BV1.1	Downhole monitoring system with a function of discharge pressure measurement, connected through a hydraulic control line
BV1.2	Downhole monitoring system with a function of pressure and temperature measurement at the pump discharge, connected through the cable shileded with stainless steel tube
BV2	Downhole monitoring system with a function of additional pressure and temperature measurement at a given distance, below the setting point of downhole sensor, connected through a geophysical cable
R1	Downhole monitoring system with a function of pressure, temperature and volumetric flow rate measurement at the pump discharge. Bottom-to-top pumping, flow meter at the pump discharge
R2	Downhole monitoring system with a function of pressure, temperature and volumetric flow rate measurement at the pump discharge. Top-to-bottom pumping, flow meter at the pump discharge, downhole unit with thru shaft
R3	Downhole monitoring system with a function of pressure, temperature and volumetric flow rate measurement at the pump discharge. Bottom-to-top pumping, equipment is shielded, flow meter is connected to the downhole sensor bottom without cable
SHGN	Downhole monitoring system for SRP or PCP system
MAGMA	High temperature downhole monitoring system



2 – downhole equipment diameter or motor diameter are defined according to Table 10

Table 10

Versions	Description
-	Without motor adapter
28	Downhole monitoring system for SRP
70	Downhole monitoring system for motors Ø70 mm
81	Downhole monitoring system for motors Ø81 mm
95	Downhole monitoring system for motors Ø95 mm
103	Downhole monitoring system for motors Ø103 mm of ALNAS and ALMAZ
103B	Downhole monitoring system for Ø103 mm motors of BORETS and NOVOMET
114	Downhole monitoring system for motors Ø114 mm
117	Downhole monitoring system for motors Ø117 mm
130	Downhole monitoring system for motors Ø130 mm
185	Downhole monitoring system for motors Ø185 mm

3 – maximum allowable pressure, accuracy, resolution, units of measurement, and communication protocol are defined according to Table 11

Table 11

Versions	Description
600/400/320/ 250/160/40/25	Units of measurement are kgf/cm², the maximum allowable pressure is selected from the specified values, resolution is 0.01 kgf/ cm², and the communication protocol is IRZ TMS2*
60MPa/40MPa/32MPa/ 25MPa/4MPa/2.5MPa	Units of measurement are MPa, the maximum allowable pressure is selected from the specified values, resolution is 0.001 MPa, and the communication protocol is Lukoil/Rosneft/Surgutneftergaz*
None/.05/0.25	Limit of the full-scale error (from upper range limit) is 1% / 0.5% / 0.25% respectively
-	Default value - 400 kgf/cm², communication protocol is IRZ TMS2*
Example: 600.05 – the measurement limit is 600 kgf/cm², communication protocol is IRZ TMS2*, the error of pressure measurement is 0.5%; 40MPa – the measurement limit is 40 MPa, communication protocol is Lukoil/Rosneft/ Surgutneftegaz*. The error of pressure measurement is 1%; 32.025MPa – the measurement limit is 32MPa, communication protocol is Lukoil/Rosneft/ Surgutneftegaz*. The error of pressure measurement is 0.25% *determines data exchange between the downhole sensor and surface readout unit	

4 – maximum operating temperature is according to Table 12

Table 12

Versions	Description
-	Default version for 120 °C
100 °C	Maximum operating temperature is 100 °C
150 °C	Maximum operating temperature is 150 °C
160 °C	Maximum operating temperature is 160 °C
170 °C	Maximum operating temperature is 170 °C
180 °C	Maximum operating temperature is 180 °C
200 °C	Maximum operating temperature is 200 °C
230 °C	Maximum operating temperature is 230 °C
Maximum operating temperature is determined by the downhole unit, with the lowest temperature tolerance in the assembly	

5 – availability of corrosion-resistant coating is to be defined in accordance with Table 13

Table 13

Versions	Description
-	Downhole sensor zinc coating - C9.hr
K	Corrosion-resistant coating of downhole sensor – high-speed plasma spraying
Kn	Downhole sensors made of stainless steel (corrosion-resistant) without coating
K2	Corrosion-resistant downhole sensor coating – monel plasma spraying coating

6 – surface unit version is to be specified according to Table 14

Table 14

Versions	Description
-	No surface readout unit
E5	TMS-E5 surface acquisition board
E5M	TMS-E5M surface acquisition board
E5VT	TMS-E5-VT surface acquisition board
E6	TMS-E6-01 surface acquisition board
E6IP25	TMS-E6-01 + IP25 surface acquisition board
ASPTORD	ASPT-ORD surface panel
ASPTORD25	ASPT-ORD25 surface panel
ASPTKPUE	ASPT-KPUE2 surface panel
ASPTKVORZ	ASPT-KV-ORZ surface panel
ASPT/S	TMS-E5-ASPT surface acquisition board
ASTI	ASPT-ASTI surface panel

7 – daily production rate measurement range, m^3/day, is to be specified according to Table 15

Table 15

Versions	Description
-	None
20/200	20/200 m^3/day
50/500	50/500 m^3/day

8 – drive (if included in delivery package) to be specified according to Table 16

Table 16

Description as indicated	Digital symbols – drive current	Letter symbols – drive type	Additional options indicated in brackets
Versions	250 A	PrP (switchboard)	M (GPRS-modem)
	400 A	PIP - soft starter	IP54
	630 A	A (frequency regulation for induction motor)	
	800 A	B1 (permanent magnet motor)	
		B2 (hybrid drive for PM and induction motors)	
Examples: 250A(M) – 250A variable frequency drive for induction motor with GPRS-modem. 400V2 – Hybrid variable frequency drive for 400A. 250PrP(IP54) – soft starter with IP54 cabinet.			

9 – compliance with oil companies' specifications as per Table 17

Table 17

Versions	Description
-	No specific requirements
P6	Compliance with unified technical requirements of Rosneft where digit indicates requirements version.
L2016	Compliance with unified technical requirements of Lukoil where digit indicates requirements version.
C27.01	Compliance with unified technical requirements of SurgutNefteGaz where digit indicates requirements version.

10 – Identification number of design version
ID number indicates design version (determined by main downhole unit).

11 – Additional information – other
Length, type and number of communication cables, data exchange protocol, maximum operating temperature, additional set of mounting parts, etc. Additional parameters to be indicated via slash (for example: cable 15 m/BP NZ/BV NZN1 – communication cable for downhole sensor connection. Downhole sensor with box thread NKT73. Discharge sub with NKT73 box thread on the top, with NKT73 pin thread on the bottom. IN126 – delivery set includes choke for connection to three-phase step-up transformers without y-point in secondary winding).

Designation examples:

IRZ TMS-MAGMA-117-40-200°C-K-E5VT-55

High-temperature monitoring system for 117 mm motor. Maximum measured pressure 569 psi, maximum operating temperature 200°C, corrosion proof coating, TMS-E5-VT surface acquisition board, design version 55.

IRZ TMS-SRP-28-600.05-150°C-E5M-38.04

SRP monitoring system with 28 mm downhole sensor. Maximum measured pressure 8534 psi, pressure measurement tolerance 0.5%, maximum operating temperature 150°C, TMS-E5M surface acquisition board. Design version 38.04.

IRZ TMS-ORD5-117-400.05-100°C-ASPTKPUE-34-cable 15 m

Monitoring system for ORD dual completion systems with ESP including BP-103DI downhole sensor and BV-103EP downhole unit for installation into Paker's KPUE electric valve and connection to 117 mm motors. Maximum measured pressure 5690 psi, pressure measuring tolerance 0.5%, maximum operating temperature 100°C, ASPT-KPUE surface panel, design version 34, delivery set includes 15 m cable.

IRZ TMS-KVANT+

FIBER-OPTIC MONITORING SYSTEM

IRZ-501-95 drive

Fiber-optic surface cable

System components:

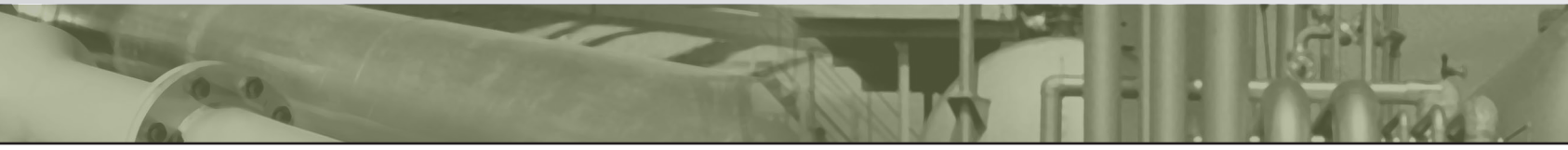
- IRZ-501-95 drive;
- fiber-optic armored sensing cable;
- fiber-optic surface cable;
- set of assembling parts;
- software for temperature profile visualization.

In addition, the system ensures effective well monitoring including:

- determining ranges of fluid inflow/injection;
- determining downhole fluid level and perforation intervals;
- determining fluid flow outside casing;
- monitoring ESP units thermal conditions;
- monitoring thermal profile of gas wells;
- identifying non-optimal heating processes and environment parameters;
- monitoring temperature profiles in injection and producing wells for high viscosity oil production using steam assisted gravity drainage (SAGD) method.

Options:

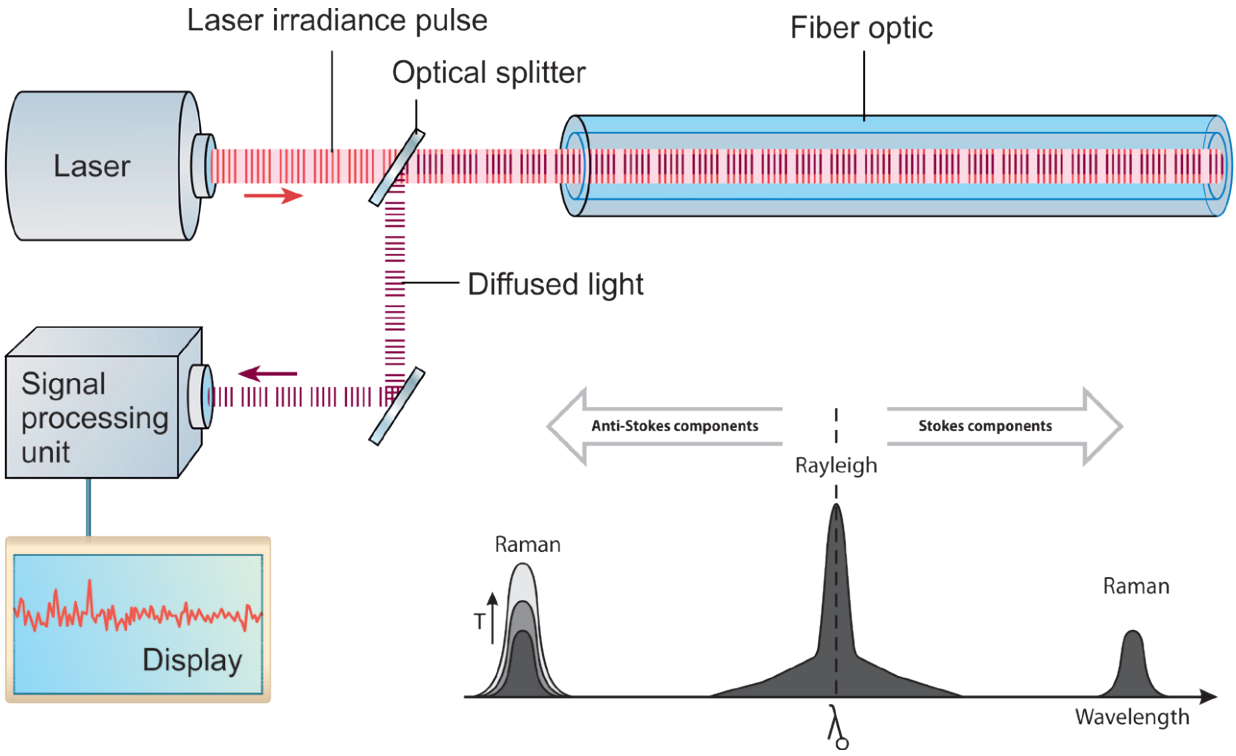
- VFD unit of UHL1 climatic version (operates within the temperature range from - 60 °C to +50 °C so that there is no need in a skid with heating and ventilation systems);
- displaying actual parameters on the VFD controller screen; transmitting these parameters to the customer's server via GSM channel;
- storing actual parameters and easy download to a USB drive;
- vizualization software to display temperature log as curves, and to make csv, xml, jpeg, and png reports;
- storing temperature logs as a database in a local network or in Internet.

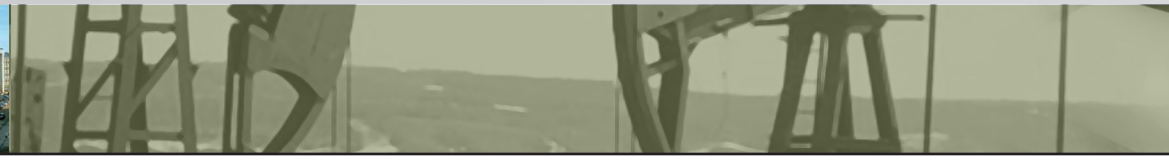


Operation principle:

Operation principle of the IRZ TMS-Kvant+ system is based on the Raman Effect, i.e. on combinational scattering arising from inelastic scattering of input light photons in the scattering medium where atoms of molecules are thermally oscillating at low frequency. Optical recorder located in VFD generates laser emission which propagates along the fiber optic cable and scatters in it. As a result, the scattering spectrum gains additional frequencies with magnitude depending on the scattering medium temperature.

Temperature of the fiber optic cable is determined based on analysis of the back scatter curves. Optical fiber inside armored cable is the detecting element of the system which directly senses the environment temperature. Sheaths of the cable protect the optical fiber against mechanical stresses and adverse conditions of medium.





Advantages:

- simultaneous temperature sensing accross the entire length of the cable forming continuous temperature profile of the analyzed medium at any given moment;
- the fiber optic cable sensor withstands electromagnetic effects and ensures full explosion and fire safety;
- the VFD unit is able to transmit temperature logs via standard Ethernet TCP/IP and RS485 Modbus RTU channels, as well as via GPRS-modem;
- VFD analyzes temperature logs and issues commands to executive components should temperature readings fall beyond the limits, which significantly increases equipment run-life and decreases failure risks;
- the system is certified as a temperature measuring tool.

Specification	Value
Temperature measuring range	-55...+300 °C
Temperature measurement resolution	0.01 °C
Measurement interval	1.63 °C / 0.25 m
Type of optic fiber	single-mode
Measuring channel length	up to 6000 m
Number of optic measuring channels	1, 4*
Period of one measurement	1, 3, 5, 10, 15 min
VFD input voltage	220±40 V (50±1 Hz)
VFD auxiliary circuits voltage	24 V
Period of VFD autonomous operation at ambient temperature from -30 to +50 °C	minimum 4 hours
Enclosure	IP43 / IP54*
Operating temperature range	-60…+50 °C*
Data communication interfaces	USB-port, Ethernet-port (RJ-45), RS-485, GPRS-modem
Number of optic fibers in a sensor cable	1-4*
Operating temperature range of the cable sensor	-55…+300 °C
Cable sensor outer diameter	7.4 mm*
Cable sensor tensile strength	30 kN*

* varies depending on modification

PILOT-1 ANTI SCALING SYSTEM

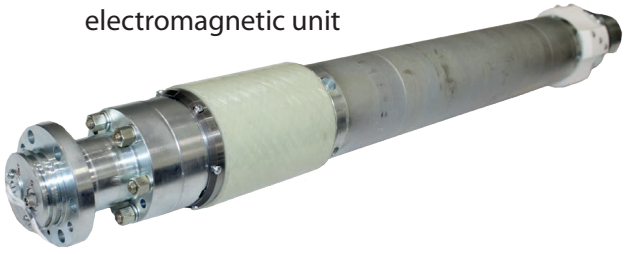
Intended use: treating well fluid during ESP operation in order to decrease or eliminate scale formation on outer and inner surfaces of downhole equipment.

The system consists of:

- downhole electromagnetic unit with a protective centralizer;
- BP-103DMT downhole sensor;
- TMS-E5 surface acquisition board;
- OP-117-02 motor base.

TMS-E5

Downhole electromagnetic unit



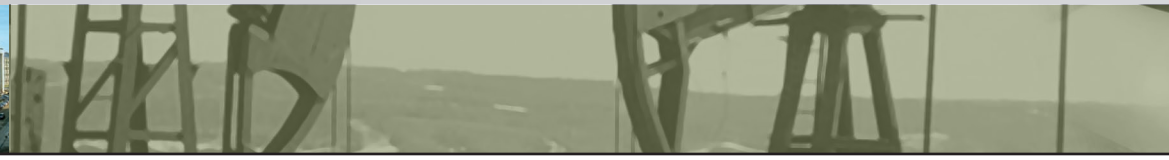
PILOT-1 system

Ensures:

- prevention of scale deposition on downhole equipment;
- increase in well production rate;
- protection and optimization of ESP system operation;
- automatic regulation of desired wellbore fluid level;
- collecting data for well testing.

Operation principle:

Pilot-1 is designed on the basis of a patented technology of treating well fluid. Influence of AC electromagnetic field results in active formation of fine salt crystals with modified structure in fluid; when the crystals with modified structure are lifted to the surface, scale is not deposited on downhole equipment. The effect is along the entire wellbore, from the bottom hole to the wellhead.



Advantages:

- high efficiency of scaling protection during entire run-life of ESP unit proved by field trials in Lukoil and Rosneft oilfields;
- quick payback ;
- 2 times increase of mean time between failures (MTBF);
- simple and easy to implement and operate;
- transferring system performance parameters to the VFD controller;
- increase of fluid production by 20% due to ESP optimized operation and decrease of fluid viscosity;
- analysis of managed wells using REPOS ALPS software;
- compatibility with all Russian VFDs;
- the system can be used in autonomous and remote locations;
- no need for additional installation and maintenance; works for acid treatments, selecting and supplying chemicals.

Specification	Value
Supply voltage	160 - 300 V
Downhole data scanning interval	up to 30 s
Operating temperature range surface acquisition board downhole sensor downhole electromagnetic unit	 –60...+60 °C 0...+150 °C 0...+120 °C / 0...+150 °C*
Temperature measuring range motor stator winding motor oil formation fluid	 0…+250 °C 0…+250 °C 0…+150 °C
Range of formation fluid pressure measurement	0-356/569/3560/5690/8534 psi
Formation fluid pressure measurement resolution	0.1 psi
Measurement error	0.5/1* %
Motor vibrations measurement range	from 0g to 5g
Controller communication interfaces	RS-232, RS-485
Overall dimensions surface acquisition board downhole electromagnetic unit downhole sensor	 210x250x160 mm Ø 117 x 1048 Ø 103 x 747

* depending on modification

DK IRZ TMS
DIAGNOSTIC UNIT

Intended use: autonomous check of BP-103M3 downhole sensor and TMS-E5 surface acquisition board functioning in fields and workshops.

Monitored parameters:
- current frame number;
- motor oil pressure;
- motor oil temperature;
- formation fluid temperature;
- motor stator winding temperature;
- motor vibrations;
- insulation resistance between power cable and motor;
- sensors conditions.

Advantages:
- allows checking functions of downhole sensors when the motor is running without shutdown of the drive;
- power source - internal battery;
- plastic case for easy use in oilfields.

DK IRZ TMS

IMBP DOWNHOLE SENSOR
SIMULATOR

Intended use: checking functioning of the TMS-E5 surface acquisition board by simulation of connection to the BP-103M3 downhole sensor.

IMBP downhole sensor simulator ensures:
- check of TMS-E5 surface acquisition board functioning;
- check of TMS-E5 board insulation monitoring device functioning;
- configuring corresponding drive controller inputs;
- check of controller's algorithms of response to changes in data readings;
- check of algorithms of response to decrease of insulation resistance of the "transformer - cable - motor" system.

Downhole sensor SIMULATOR

ST-BP-M MONITORING SYSTEMS' DOWNHOLE AND SURFACE UNITS TEST BENCH

Intended use: checking health of downhole sensors made by IRZ TEK, Elekton, Borets, NIS, Schlumberger etc. at incoming inspection or prior to assembly with motor, prior to repeated use, assessment of tools accuracy and correct operation.

The system consists of the following items:

- vibration table with downhole sensor fixture;
- control cabinet;
- operator's workplace (with surface units test area);
- 60 MPa hydraulic unit;
- downhole sensors thermal chamber with 60 MPa hydraulic lines;
- high-pressure chamber for downhole sensors leak testing;
- workplace for units weighing;
- set of interconnecting cables;
- set of hydraulic fittings for connection to sensors made by various vendors;.

Specification	Value
Supply voltage	380 V
Frequency	50 Hz
Duty cycle	100 %
Overall dimensions (sequential installation)	11000 x 2200 x 2000 mm
Weight	1500 kg

With the bench, service companies can evaluate parameters of repaired (inspected) downhole monitoring systems for compliance with:

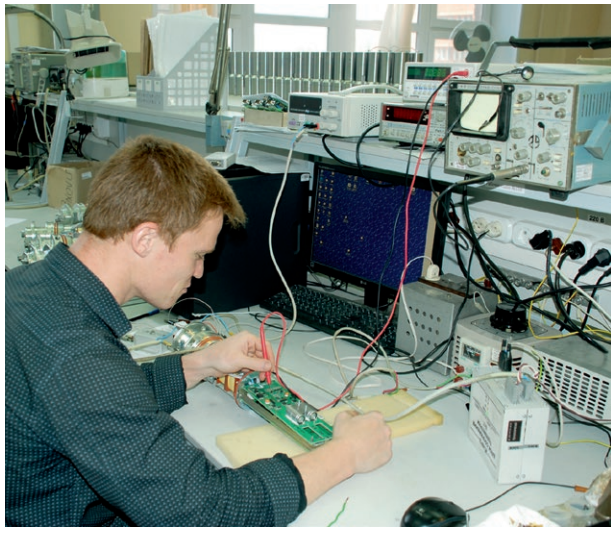
- technical requirements of the oil operator to downhole monitoring system repair;
- design and process documentation of the manufacturer or service company;
- manufacturer's specifications for this type of products.

Advantages:

Simultaneous testing of up to eight downhole sensors in the thermal chamber, one downhole sensor in the high-pressure chamber and one sensor on the vibration table, as well as one surface unit using the IMBP downhole sensor simulator and plug resistance.

Operation principle:

The bench is used for testing downhole and surface units of downhole monitoring systems by measuring, reading, and comparing measured values with reference values, and automatic generation of test reports.



Maximum simulated conditions when testing downhole sensors	Value
Ambient pressure	60 MPa
Motor oil pressure	60 MPa
Downhole sensor leak test pressure	60 MPa
Ambient and oil temperature	170 °C
Vibration	60 m/s^2
Insulation resistance test voltage	2.5 kV

IRZ-200 SWITCHBOARD FOR ESP

Intended use: control, parameters monitoring and protection of motors with power capacity from 3 to 250 kW.

Ensures:

- manual or automatic control mode;
- continuous monitoring of electric circuit parameters, 3-phase currents and insulation resistance in the "transformer - power cable - motor" system, defining of voltage and current unbalance, power factor, load factor, energy consumption, and runtime;
- connecting to surface readout units made by various manufacturers;
- record of monitored parameters and causes of motor shutdowns in real time and saving the logs even in case of power interruptions;
- equipment protection in emergencies caused by failures in power system and downhole motor system;
- automatic restart when parameters return to the operating range.

The drive allows connecting:

- of units to the 220V 10A socket on the switchboard operator's panel;
- to well pad telemechanics (normally closed or open contacts);
- to a SCADA-system via RS-232 or RS-485 interfaces, Modbus RTU protocol;
- of a GPRS-modem with option for data output in the Internet;

Advantages:

- small size and weight; the drive can be transported in a light vehicle or carried by two persons.

Specification	Value
Supply voltage	190-520 V
Power of the connected motor	3-250 kW
Range of motor operation current (measured on the transformer primary winding and recalculated into motor actual operating current)	0-2000 A
Range of monitoring insulation resistance of the "transformer-cable-motor" system	0-10000 kOhm
Range of monitoring backspin frequency	1-50 Hz
Error of measuring current, resistance, rotation frequency, and accuracy of time settings	2 %
Error of monitoring insulation resistance	5 %
Operating temperatures	-60…+50 °C
Enclosure	IP43 (or IP54)

- easy operation and maintenance;
- easy connection;
- graphic liquid-crystal display;
- data logs download on a USB-drive;
- software updating without motor shutdown;
- compliance with requirements of oil companies and GOST R 51321.1;
- bus-type design of the power part of the drive for drives with current from 250 A;
- option to install a power meter registered in the National Register of Measuring Instruments.

Models	Rated current	Overall dimensions	Weight
IRZ-200-25*	25 A	1755 x 795 x 635 mm	180 kg*
IRZ-201-160**	160 A	1215 x 540 x 365 mm	60 kg
IRZ-201-250	250 A	1680 x 780 x 630 mm	150 kg
IRZ-202-400	400 A	1680 x 780 x 630 mm	155 kg
IRZ-202-400**	400 A	950 x 585 x 370 mm	75 kg
IRZ-203-630	630 A	1680 x 780 x 630 mm	245 kg

* Drives with built-in output isolation transformer to monitor and control a membrane pump unit
** Portable switchboard

IRZ–500 VARIABLE FREQUENCY DRIVE
FOR ESP WITH PERMANENT MAGNET AND INDUCTION MOTORS

Intended use: VFD ensures control, parameters monitoring and protection of permanent magnet and induction submersible electric motors with power ranging from 5 to 400 kW, enabling motor soft start, deceleration and speed regulation.

Advantages:

- compliant with EAC and CE;
- can be used with various types of PMMs and induction electric motors;
- versatility when selecting surface equipment;
- low price increase comparing to standard VFDs for induction motors;
- smart control modes;
- voltage harmonic factor at VFD output in induction mode within 5% thanks to built-in sine filter;
- change of VFD control modes by changing settings in the controller of the drive;
- VFD allows for connection of geophysical systems, including dual completion applications;
- maintaining PMM efficiency ;
- VFD can be used with progressive cavity pumps;
- the drive allows for connecting of monitoring systems made by different manufacturers;
- data logs can be downloaded on a USB-drive;
- service modes: start of stuck ESP, gas lock removal, deposits removal, voltage optimisation, and PID regulation;
- software updating without motor shutdown;
- LCD for data display;
- compliance with requirements of oil companies and GOST R 51321.1;
- option to install a power meter registered in the National Register of Measuring Instruments.

Ensures:

- manual or automatic control mode;
- motor soft start, deceleration, and frequency regulation;
- continuous monitoring of electric circuit parameters, 3-phase currents and insulation resistance in the "transformer - cable - motor" system;
- evaluation of voltage and current unbalance, power factor, load factor, consumed power, and runtime;
- equipment protection in emergencies caused by failures in power system and ESP unit;
- minimization of motor shutdowns by proper forecasting and automatic response to various operation deviations in wellbore or on wellhead;
- automatic restart when parameters return back to the operating range;
- record of monitored parameters and causes of motor shutdowns in real time and saving the logs even in case of power interruptions;
- automatic maintaining preset level of formation pressure by regulation of motor rotation frequency;
- automatic update of maintained setpoint to ensure production at the level close to the well potential;
- automatic transition from the intermittent to continuous cycle and vice versa under certain conditions.

The drive allows connecting:

- to well pad telemechanics (normally closed or open contacts);
- to a SCADA-system via RS-232 or RS-485 interfaces, Modbus RTU protocol;
- of a GPRS-modem with option for data output in the Internet.

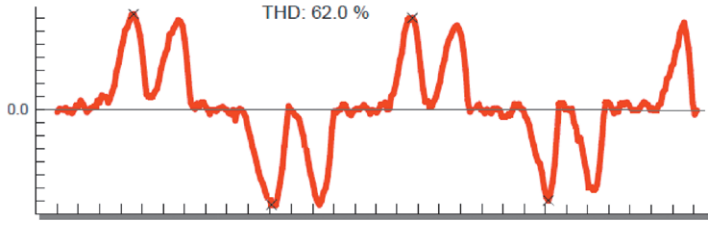
Specification	Value
Supply voltage	190-520 V / 330-560 V*
Power of the connected motor	5-400 kW
Frequency regulation range induction motor permanent magnet motor	 0.5-100 Hz 15-550 Hz
Range of monitoring motor operating current	0-2000 A
Range of monitoring insulation resistance of the "transformer-cable-motor" system	0-10000 kOhm
Range of monitoring backspin frequency	1-50 Hz
Error of measuring current, resistance, rotation frequency, and accuracy of time settings	2 %
Error of monitoring insulation resistance	5 %
Operating temperatures	-60…+50 °C
Enclosure	IP43 (or IP54)

* for export supplies

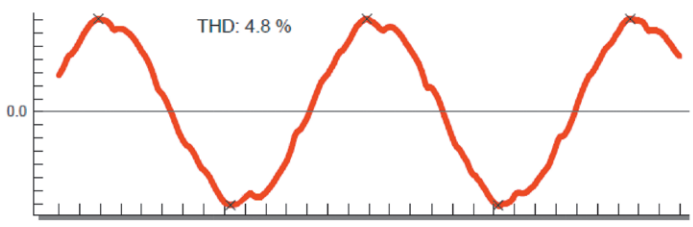
Options:

- input harmonics filter or active front end to maintain THDV and THDI at VFD input within 5 % in accordance with IEEE-519-2014;
- automatic switching from operation of motor with inverter to operation of motor directly from the power supply network and back without ESP interruption (option of inverter and sine filter by-pass for starting stuck ESP and energy saving when operating at a frequency equal to supply voltage frequency);
- maintaining ESP operation at power loss down to 0 V within 100 ms;
- 12 or 18 pulse rectification circuit to reduce current harmonics at VFD input.

Optional input filter allows for reduction of current THD to 5%.



Without input harmonics filter



With input harmonics filter (or active front end)

	Models	Drive rated current	Overall dimensions	Weight
For induction motors	IRZ-510-25*	25 A	1675x780x870 mm	275 kg
	IRZ-510-60	60 A		275 kg
	IRZ-510-100	100 A		254 kg
	IRZ-511-250	250 A	1725x940x970 mm	330 kg
	IRZ-512-400	400 A		330 kg
	IRZ-513-630	630 A	2060x1150x1275 mm	620 kg
	IRZ-514-800	800 A		655 kg
	IRZ-515-1000	1000 A	2265x1350x1330 mm	950 kg
	IRZ-516-1200	1200 A	2265x2300x1330 mm	1270 kg
	IRZ-517-1400	1400 A		1290 kg
	IRZ-518-1600	1600 A		1310 kg
For induction motors and PMM	IRZ-540-25*	25 A	1675x780x870 mm	285 kg
	IRZ-540-100	100 A		265 kg
	IRZ-541-250	250 A	1725x940x970 mm	340 kg
	IRZ-542-400	400 A		340 kg
	IRZ-543-630	630 A	2060x1150x1275 mm	630 kg
	IRZ-544-800	800 A		665 kg
	IRZ-545-1000	1000 A	2265x1350x1330 mm	960 kg
	IRZ-546-1200	1200 A	2265x2300x1330 mm	1280 kg
	IRZ-547-1400	1400 A		1300 kg
	IRZ-548-1600	1600 A		1320 kg
	IRZ-544-800**	800 A	2300x1910x1580 mm	1500 kg
For PMM	IRZ-551-160	160 A	1675x780x870 mm	260 kg
	IRZ-551-250	250 A	1725x940x970 mm	335 kg
	IRZ-552-400	400 A		335 kg
	IRZ-553-630	630 A	2060x1150x1275 mm	625 kg
	IRZ-554-800	800 A		660 kg
	IRZ-555-1000	1000 A	2265x1350x1330 mm	960 kg

* with built-in isolation output transformer to monitor and control membrane pump unit
** with active front end

IRZ-700 SOFT STARTER FOR ESP

Intended use: control, parameters monitoring and protection of motors with power capacity from 14 to 400 kW enabling soft start and stop

Ensures:

- four start modes: current increase, current limiting, push mode at high torque, and direct start;
- two stop modes: soft stop and run-down stop (stop without braking);
- manual or automatic control mode;
- continuous monitoring of electric circuit parameters, 3-phase currents and insulation resistance in the "transformer - cable - motor" system;
- evaluation of voltage and current unbalance, power factor, load factor, consumed power, and runtime;
- connecting to surface readout units made by various manufacturers;
- record of monitored parameters and causes of motor shutdowns in real time and saving the logs even in case of power interruptions
- equipment protection in emergencies caused by failures in power system and downhole motor system;
- automatic restart when parameters return to the operating range.

The drive allows connecting:

- of devices to the 220 V 10 A socket on the drive operator's panel;
- of devices to the 380 V socket of the drive at phase current up to 60 A;
- to well pad telemechanics (normally closed or open contacts);
- to a SCADA-system via RS-232 or RS-485 interfaces, Modbus RTU protocol;
- of a GPRS-modem with option for data output in the Internet.

Advantages:

- variety of start and stop modes of the drive;
- small sizes and weight;
- easy operation and maintenance;
- easy connection;
- liquid-crystal display;
- logs download to a USB-drive;
- software updating without motor shutdown;
- compliance with requirements of oil companies and GOST R 51321.1-2007;
- bus-type design of power parts in all drive models;
- option to install a power meter registered in the National Register of Measuring Instruments.

Specification	Value
Supply voltage	190-520 V
Power of the connected motor	14-400 kW
Range of monitoring motor operation current (measured on the transformer primary winding and recalculated into motor actual operating current)	0-2000 A
Range of monitoring insulation resistance of the "transformer-cable-motor" system	0-10000 kOhm
Range of monitoring backspin frequency	1-50 Hz
Error of measuring current, resistance, rotation frequency, and accuracy of time settings	2 %
Error of monitoring insulation resistance	5 %
Operating temperatures	-60…+50 °C
Enclosure	IP43 (or IP54)

Models	Drive rated current	Overall dimensions	Weight
IRZ-721-160	160 A	1755 x 795 x 635 mm	160 kg
IRZ-721-250	250 A		170 kg
IRZ-722-400	400 A		185 kg
IRZ-723-630	630 A		190 kg
IRZ-724-800	800 A		200 kg
IRZ-725-1000	1000 A		240 kg

IRZ-410 VARIABLE FREQUENCY DRIVE
FOR SRP AND PCP

Intended use: VFD ensures control, parameters monitoring and protection of electric motors of sucker-rod pump / progressive cavity pump systems with power ranging from 5 to 75 kW, enabling motor soft start, deceleration and frequency regulation.

Specification	Value
Supply voltage	190-520 V
Power of the connected motor	5-75 kW
Range of motor rotation frequency regulation induction motor permanent magnet motor	0-2000 A 0.5-100 Hz (optionally up to 300 Hz) 15-300 Hz
Frequency regulation step	0.1 Hz
Error of measuring current, resistance, rotation frequency, and accuracy of time settings	2 %
Operating temperatures	-60…+50 °C
Enclosure	IP54 (or IP66)

Ensures:
- manual or automatic control mode;
- soft start and stop;
- reduction of energy consumption;
- regulation of electric motor rotor speed;
- rocking at heavy start;
- continuous monitoring of electric circuit voltage, phase sequence, and three-phase currents;
- defining voltage and current unbalance, SRP unit unbalance, power factor, load factor, power consumption, and runlife;
- record of monitored parameters and causes of motor shutdowns in real time and saving the logs even in case of power interruptions;
- minimization of emergency shutdowns and increase in production rate due to automatic regulation of pumping frequency;
- equipment protection in emergencies caused by failures in power system and SRP / PCP systems;
- automatic restart when parameters return to the operating range.

The drive allows connecting:
- to well pad telemechanics (normally closed or open contacts);
- to a SCADA-system via RS-232 or RS-485 interfaces, Modbus RTU protocol;
- of GPRS-modem for data output in the Internet;
- of a wireless or wired dynagraph;
- of wellhead pressure and temperature gauges;
- of a motor temperature and vibration gauge.

Advantages:
- pumping frequency can be changed without replacing pulleys and motor interruption;
- the drive allows for connecting of monitoring systems made by different manufacturers;
- data logs can be saved to a USB-drive;
- graphic LCD;
- software updating without motor shutdown;
- load curves log up to 500 records;
- compliance with requirements of oil companies and GOST R 51321.1;
- option to install a power meter registered in the National Register of Measuring Instruments.

Options:
- input harmonics filter to ensure THDI and THDV at the drive's input within 5%;
- graphs and load curves can be displayed on the drive's controller;
- load curves can be plotted without use of a dynamometer;
- the drive can be operated with PMM;
- smart control modes defining pump fill factor, production rate, downhole and surface equipment loads, automatic adjustment for the maximum production rate and reducing hits of the plunger over fluid;
- optional IP66 enclosure.

Models	Drive rated current	Overall dimensions	Weight
IRZ-410-25	25 A	1300x905x350 mm	120 kg
IRZ-410-32	32 A		120 kg
IRZ-410-40	40 A		120 kg
IRZ-410-60	60 A		126 kg
IRZ-410-100	100 A		126 kg
IRZ-410-160	160 A	1720x940x970 mm	287 kg
IRZ-410-25*	25 A	1115x910x400 mm	90 kg
IRZ-410-32*	32 A		90 kg
IRZ-410-40*	40 A		95 kg
IRZ-410-60*	60 A		95 kg
IRZ-410-100*	100 A		95 kg

* Drive version in IP66 enclosure

IRZ-400 SWITCHBOARD FOR SUCKEER-ROD PUMPS

Intended use: parameters monitoring and protection of sucker-rod pump motors with power capacity from 5 to 75 kW.

Ensures:

- manual or automatic control mode;
- continuous monitoring of electric circuit voltage, phase sequence, and three-phase currents;
- evaluation of voltage and current unbalance, power factor, load factor, consumed power, and runtime;
- record of monitored parameters and causes of motor shutdowns in real time and saving the logs even in case of power interruptions;
- equipment protection in emergencies caused by failures in electric circuit and SRP unit;
- automatic restart when parameters return to the operating range.

Specification	Value
Supply voltage	190-520 V
Power of the connected motor	5-75 kW
Range of monitoring motor operating current	0-160 A
Error of measuring current, resistance, rotation frequency, and accuracy of time settings	2 %
Enclosure	IP54 (or IP66)
Operating temperatures	-60…+50 °C

The drive allows connecting:

- to well pad telemechanics (normally closed or open contacts);
- to a SCADA-system via RS-232 or RS-485 interfaces, Modbus RTU protocol;
- of a GPRS-modem with option for data output in the Internet.

Advantages:

- the drive allows for connecting of monitoring systems made by different manufacturers;
- possibility to connect a dynagraph;
- data logs can be downloaded to a USB-drive;
- graphic liquid-crystal display;
- software updating without SRP shutdown;
- load curves log up to 500 records;
- compliance with requirements of oil companies and GOST R 51321.1;
- option to install a power meter registered in the National Register of Measuring Instruments.

Options:

- graphs and load curves can be displayed on the drive's controller;
- load curves can be plotted without use of a dynamometer;
- smart control modes definition of pump fill factor, production rate, and downhole and surface equipment loads.

Models	Drive rated current	Overall dimensions	Weight
IRZ-400-40	40 A	740x465x380 mm	43 kg
IRZ-400-60	60 A		43 kg
IRZ-400-100	100 A		43 kg
IRZ-400-160	160 A		40 kg

IRZ-201-08-160 DRIVE FOR HEATING CABLE

Intended use: control, parameters monitoring and protection of heating cable in system of heating produced well fluid

The drive allows connecting:

- of units to the 220 V 10 A socket on the switchboard operator's panel;
- to well pad telemechanics (normally closed or open contacts);
- to a SCADA-system via RS-232 or RS-485 interfaces, Modbus RTU protocol;
- of GPRS-modem for data output in the Internet;
- of fluid temperature sensor installed at the wellhead.

Ensures:

- supply of direct (if rectifier is applied) and alternate current to the heating cable;
- continuous monitoring of electric circuit parameters, wellhead temperature, three-phase currents, operating current of the cable, and "transformer - rectifier - heating cable" system insulation resistance;
- definition of voltage and current unbalances, consumed power, and runtime;
- connecting to surface readout units made by various manufacturers;
- record of monitored parameters and causes of motor shutdowns in real time and saving the logs even in case of power interruptions;
- equipment protection in emergencies caused by failures in electric circuit and heating cable;
- automatic restart when parameters return to the operating range.

Specification	Value
Supply voltage	275-475 V
Range of measuring heating cable operating current (measured in the transformer primary winding and recalculated into actual operation current)	1-160 A
Range of monitoring insulation resistance of the "transformer - heating cable" system	0-10000 kOhm
Range of monitoring heating cable temperature	1-100 °C
Error of monitoring heating cable current, voltage, active power coefficient, and error of time setting	2 %
Error of monitoring insulation resistance	2-10 %
Overall dimensions drive rectifier	 1215x540x390 mm 740x566x293 mm
Weight drive rectifier	 60 kg 40 kg
Operating temperatures	-60…+50 °C
Enclosure	IP54

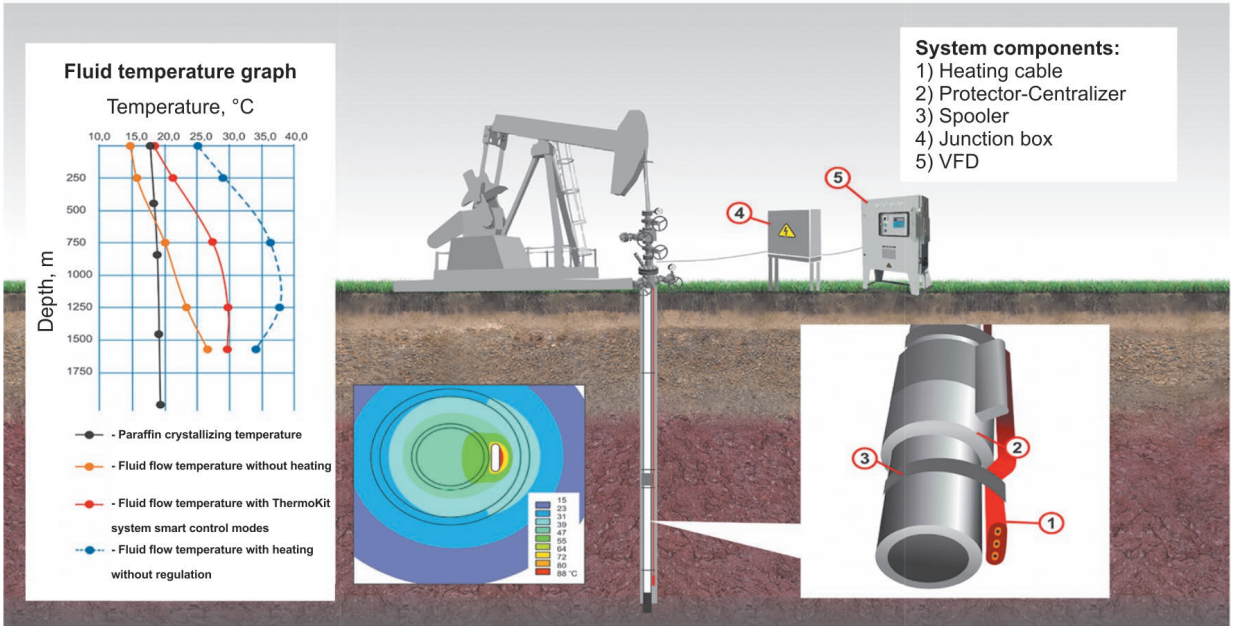
Advantages:

- energy savings up to 20% due to intelligent temperature maintenance at the wellhead using PID regulator;
- reliability and ease of maintenance due to simple design and use of components from serial VFDs for ESP;
- small sizes and weight; the drive can be transported in a light vehicle or carried by two persons;
- LCD display;
- data logs can be downloaded to a USB-drive;
- software updating (and drive's controller replacement) without interruption of well heating;
- compliance with requirements of oil companies and GOST R 51321.1;
- option to install a power meter registered in the National Register of Measuring Instruments.

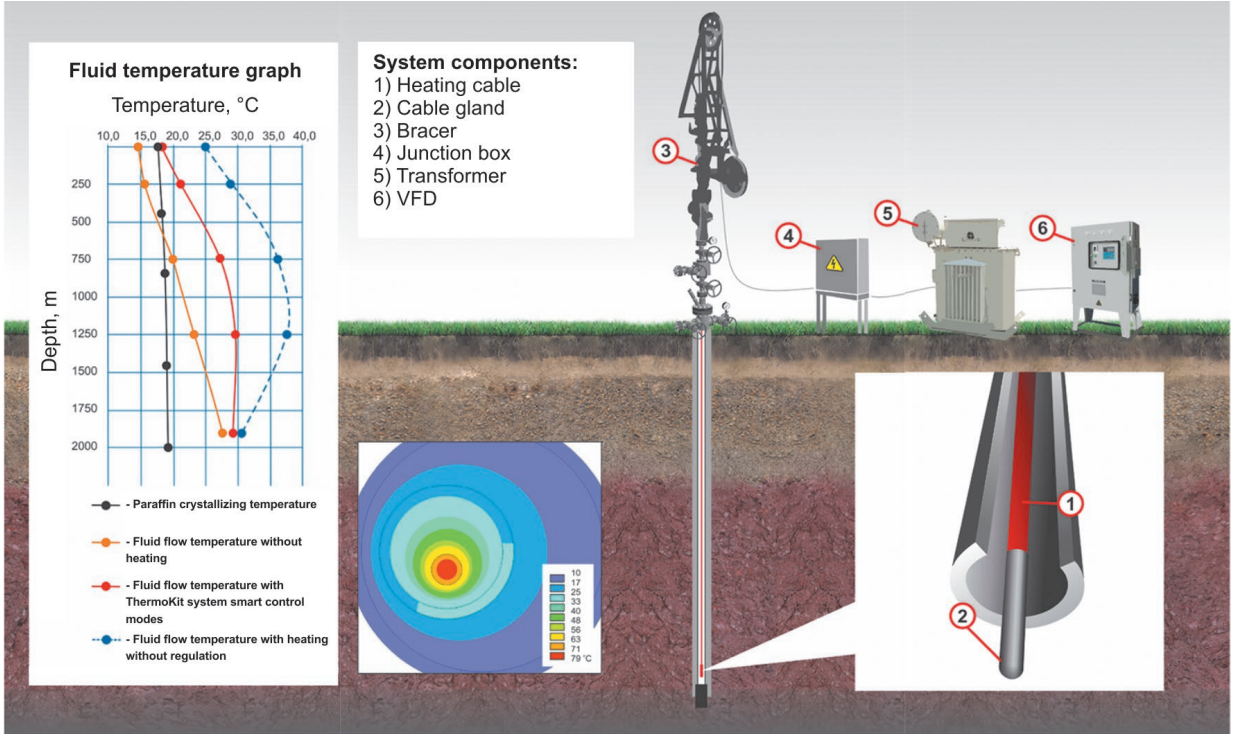
Options:

The unit can be equipped with a rectifier installed between the transformer and terminal box.

Automated heating cable system deployed on external surface of tubing

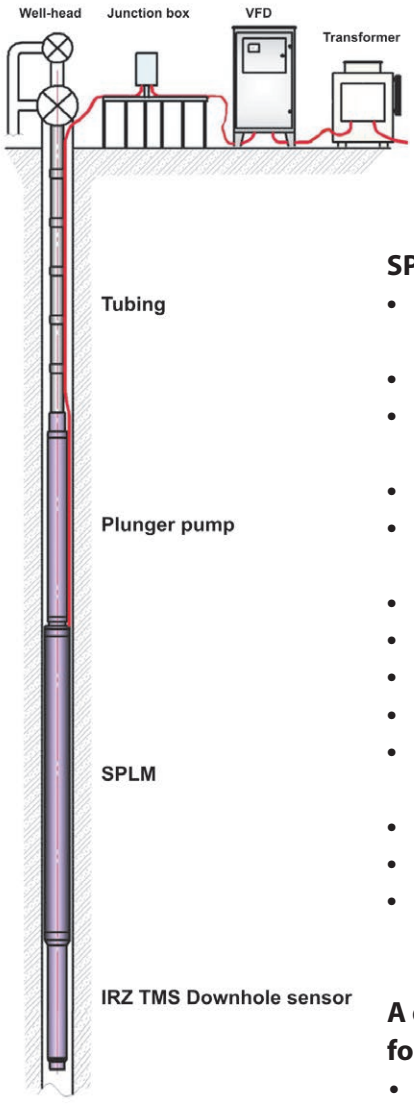


Automated heating cable system deployed inside the tubing



SPLM SUBMERSIBLE RECIPROCATING PUMP UNIT WITH LINEAR MOTOR

Intended use: monitoring of well parameters and control of equipment operation in horizontal, vertical, and deviated wells with production rate from 0.8 to 20 m³/day.



The system consists of the following units:

- IRZ-550 series VFD;
- downhole power cable;
- plunger pump;
- downhole linear motor;
- BP-103 downhole sensor.

SPLM benefits:

- use of SPLM eliminates problems associated with using rods, e.g. rods loosening, breakout, corrosion, as well as wear of rods and tubing;
- can be used in wells of any curvature, including deviated and horizontal wells;
- can operate in severe conditions with low permeability, in observation wells with low production rate;
- reduced maintenance costs;
- high efficiency - average efficiency is 60-90 % higher comparing to other pumping systems;
- simple installation and connection;
- stepless regulation of stroke length and number of strokes per minute;
- low power consumption - 30-80% less comparing to other pumping systems;
- resistance to high wellbore pressure (up to 30-60 MPa);
- resistance to high voltage (exposure to test voltage of 3300 V at 50 Hz and 200 °C for 1 minute);
- high insulation resistance (100 MOhm at 2500 V);
- the system allows for remote control;
- lifetime is up to 10 years.

A downhole sensor is installed at the motor bottom to monitor and transfer the following real-time parameters:

- pump intake pressure and temperature;
- motor temperature and vibrations;
- power cable and motor insulation resistance.

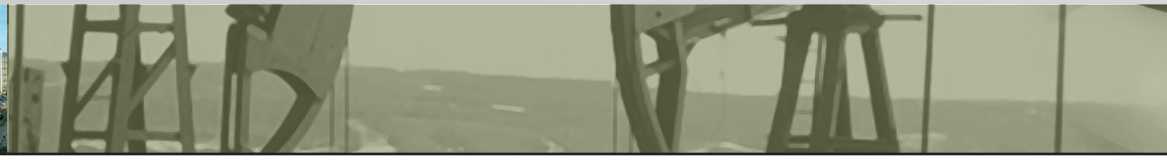
Specification	Value
Overall dimensions	Ø 117x9600 mm
Stator dimensions	Ø 117x6240 mm
Rotor stroke	1230 mm
Power	35 kW / 50 kW
Voltage	660 V / 1140 V
Maximum output current	30-80 A
Drive force	3 t /5.5 t
Pump flow rate range	0.5-30 m^3/day
Operating temperature	0…+150 °C
Static pressure in wellbore	0-30 MPa

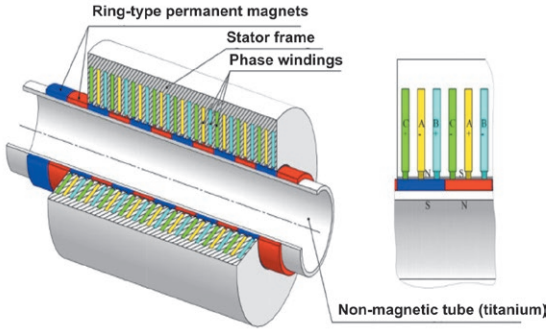
SPLM compared to ESP and SRP:
SPLM is a more economical, energy-efficient and environmentally friendly analogue of SRP unit. Moreover, SPLM can effictively replace ESP in wells with decreasing production rates without infrastructure adjustment.

	SRP	ESP	SPLM
Production rate	<30 m^3/day	>15 m^3/day	<30 m^3/day
Setting depth	<2000 m	<3000 m	<3000 m
Operation mode	continuous	periodic	continuous
Specific power consumption	20 kW/t	10 kW/t	8 kW/t
Wellhead foundation	required	not required	not required

LINEAR MOTOR

Operation principle:
The linear motor comprises a fixed round stator and a rod with permanent magnets. The stator consists of cylindrical three-phase winding coils that are connected in series and powered by a variable frequency drive. The stator coils generate a travelling magnetic field that induces electromotive force to move the magnetic slider, which pulls and pushes the plunger pump rod.





Criteria for selecting SPLM systems:

- flow rate from 4 to 30 m^3/day, low production rate wells;
- pump installation depth up to 3000 m;
- directional and deviated wells and wells with periodic injections where regulation of flow rate is required from time to time;
- limited electric power.

IRZ-550 VARIABLE FREQUENCY DRIVE

Intended use: VFD ensures control, parameters monitoring and protection of linear electric motors with power ranging from 15 to 80 kW, enabling motor speed regulation.

Ensures:

- manual or automatic control mode;
- reduction of energy consumption;
- linear motor rod speed regulation;
- continuous monitoring of electric circuit voltage, phase sequence, and three-phase currents;
- definition of voltage and current imbalances, power factor, fill factor, power consumption, and runtime;
- record of monitored parameters and causes of motor shutdowns in real time and saving the logs even in case of power interruptions;
- minimization of emergency shutdowns and increase in flow rate due to automatic regulation of rod speed;
- equipment protection in emergencies caused by failures in electric circuit and plunger pump system;
- automatic restart when parameters return to the operating range.

Options:

- input harmonics filter to ensure THDI and THDV at the VFD input within 5 %;
- smart control modes defining pump fill factor, production rate, automatic adjustment for the maximum production rate and reducing hits of the plunger over fluid;
- option to install a power meter registered in the National Register of Measuring Instruments.

The drive allows connecting:

- to oilfield telemechanics;
- to a SCADA-system via RS-232 or RS-485 interfaces, Modbus RTU protocol;
- of GPRS-modem for data output in the Internet;
- of wellhead pressure and temperature gauges.

Advantages:

- compliant with EAC and CE;
- the drive allows for connecting of monitoring systems made by different manufacturers;
- plotting downhole load curves;
- data logs can be downloaded to a USB-drive;
- software updating without motor shutdown;
- graphic LCD can display graphs and load curves;
- load curves log up to 500 records;
- compliance with requirements of oil companies and GOST R 51321.1.

Specification	Value
Supply voltage	380-1140 V depending on the model
Power of the connected motor	15-80 kW
Range of output voltage frequency regulation	1-70 Hz
Range of monitoring insulation resistance of the "transformer-cable-motor" system	0-10000 kOhm
Error of measuring current, resistance, rotation frequency, and accuracy of time settings	2 %
Error of monitoring insulation resistance	5 %
Operating temperatures	-60…+50 °C
Enclosure	IP43 (or IP54)

Models	Drive rated voltage	Drive rated current	Overall dimensions	Weight
IRZ-550-01-50	380-480 V	50 A	1675x780x870 mm	254 kg
IRZ-550-02-50	660 V	50 A		266 kg
IRZ-550-03-80	1140 V	80 A		275 kg

KDU IRZ DISPATCHING SYSTEM

Intended use: remote monitoring and control of equipment installed in the oil field in order to improve the technological process, reduce costs and increase oil production.

The system consists of the following units:

- top level, which includes software, InTouch or Trace Mode SCADA system, database, Web reports, operator's workstation, redundant communication channels, and server storage;
- middle level, which includes controllers, telemechanics units, and industrial communication facilities;
- bottom level, i.e. all kinds of discrete and analog sensors or sensors with unified protocol, as well as actuators (valves, solenoids, and pumps).

Operation principle:

The dispatching system has hierarchical three-level structure:

- the bottom level is formed by primary measuring transducers and actuators involved in the process, and local automation controllers (drives for ESP, SRP and controllers for group metering stations);
- the middle level is formed by IRZ-501 series process controllers, which receive information from sensors and primary transducers of the bottom level and transmit it to the central controller - an intermediate link in the system; it optimizes scanning of well pad facilities and transfers information to the control room via communication equipment;
- the top level is formed by operator's workstation and database server with installed software, which receive information on process parameters (pressure, temperature, flow rate), security alarm, and supply voltage. When the facility is deactivated, the operator receives a signal of a shutdown with interpretation of the shutdown cause. Data is archived in the database for analytical processing, and reports are provided via WEB interface.

Specification	Value
Maximum number of connected sites	10000
Communication range	≤ 100 km
Network protocols	MODBUS RTU, MODBUS TCP, DNP3

Ensures:
- control of valves, gates and pumps in manual or automatic mode;
- measurement of levels, pressures, vibrations, temperatures, etc.;
- measurement of flow rate, water cut and oil quality;
- control of any process parameters according to customer requirements.

Advantages:
- building a centralized system for data collection and control over remote sites (automated control system);
- flexible routing when sharing various communication equipment for data communication: radio modems in frequency range of 433-434 MHz, 146-174 MHz, GPRS modems, broadband access systems for high-speed data transmission over radio channel, connection to Ethernet networks, etc.;
- improving quality of the process and its safety by increasing the information support of process and operational personnel, reducing number of functions performed by process staff due to automation, and increasing responsiveness of personnel actions;
- decrease of oil losses and improvement of environmental situation at the facility;
- reducing probability of emergency situations;
- reduction of operational costs for oil production (transportation costs) due to timely and coordinated departure of repair crews during emergency shutdowns, and activation of wells after planned shutdowns.

SCADA FUNCTIONS FOR AUTOMATED SITES

A remote automated dispatching workstation can be arranged for remote monitoring of geographically distributed process groups of equipment. Ensuring:
- control of oil production processes at well pads in accordance with industrial safety requirements;
- archiving of real-time process information for each well pad for the purpose of subsequent use in analysis and reporting documentation.

The SCADA functions can be implemented at various oil and gas infrastructure facilities

SCADA system functions for ESP:
- real-time monitoring of motor parameters;
- remote control of ESP;
- monitoring of wellhead pressure.

SCADA system functions for SRP units:
- on-line control over SRP operation and parameters monitoring;
- quick access to load and current curves;
- monitoring of wellhead pressure.

SCADA system functions for a pipeline pumping station:
- monitoring pumps and motor operation parameters;
- monitoring tank levels;
- monitoring fluid pressure in intake and discharge lines of the pump;
- oil flow rate control;
- valves status control.

SCADA system functions for a group metering station (GMS):

- automatic and remote control over the well selector switch;
- monitoring pressure at GMS output;
- monitoring of well production rate;
- retransmission of process parameters and commands for ESP and SRP control to the operator's workstation;
- security alarms in GMS and instrumentation and automated control systems facility rooms;
- automatic scanning of slave units (wells) in background mode.

SCADA system functions for an oil treatment plant:

- autonomous maintenance of process mode in accordance with the requirements of process procedures;
- emergency prevention;
- protection against erroneous staff actions;
- diagnostics of equipment;
- automatic scanning and memorizing of main process parameters of monitored objects (pressures, levels, temperatures, etc.);
- reception and transmission of alarms in case of pre-emergency and emergency situations and events;
- remote control of process equipment operation (pumps, electric gate valves, solenoids, etc.) by operators;
- maintaining data archives on progress of processes, updates in parameters, as well as events and actions of personnel.

SCADA system functions for compressor pump stations:

- monitoring operation parameters of pumps and motor;
- monitoring tank levels;
- fluid pressure measurement at pump discharge;
- monitoring water flow rate;
- pump statuses control.

SCADA system functions for water distribution manifolds:

- monitoring oilfield water flow rate per each well;
- fluid pressure measurement at pump discharge.

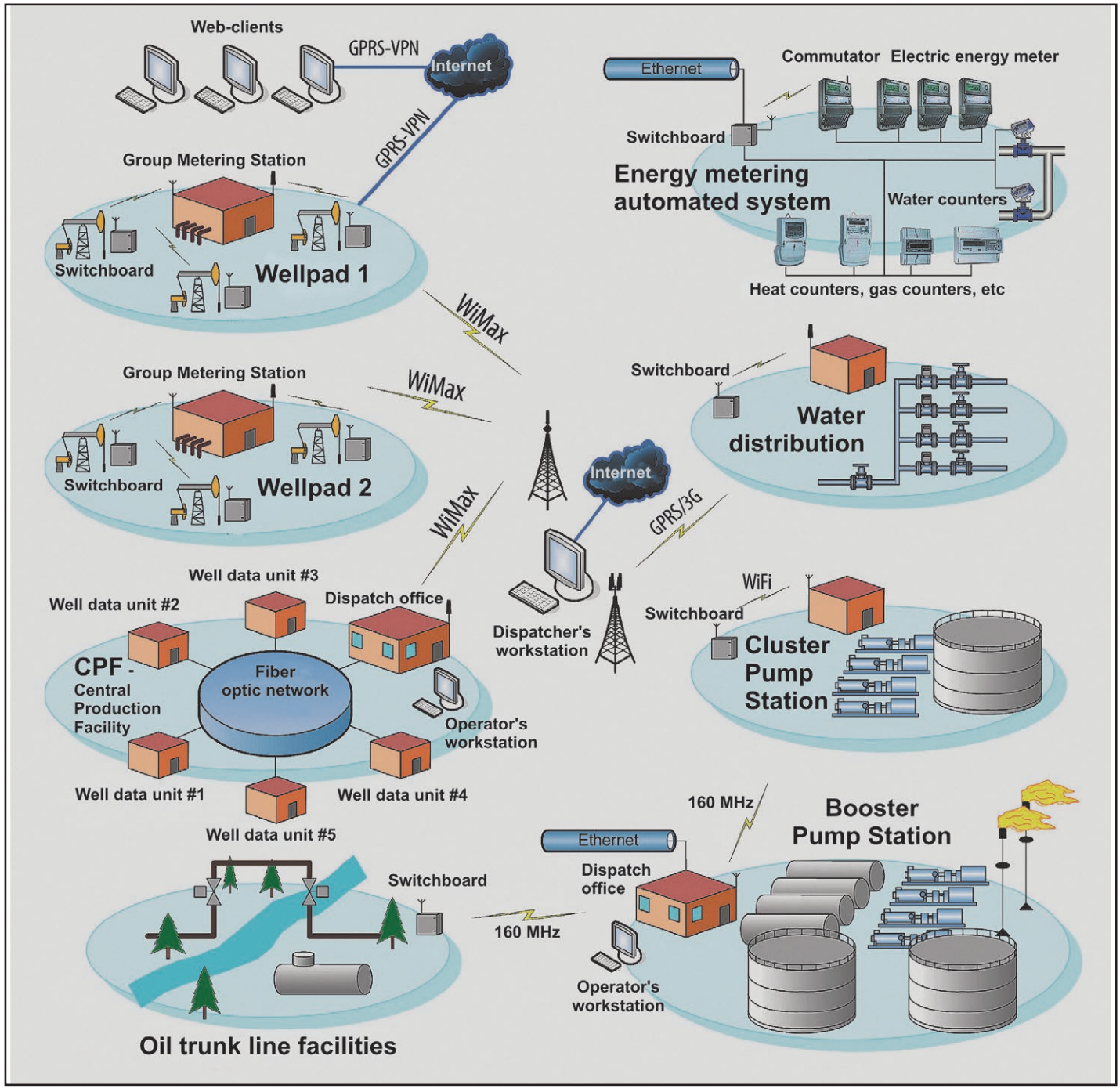
SCADA system functions for equipment energy efficiency control systems:

- automatic collecting and archiving data on consumed energy in water injection stations and wells;
- displaying up-to-date information on energy consumption and volume of pumped fluid for the compressor pump station and wells;
- preparing reports;
- determination of power equipment performance indicators to assess quality of ongoing energy saving measures.

SCADA system functions for chemical injection units:

- automatic control of chemicals injection (on operator's command);
- monitoring temperature, limit pressure, chemicals level in tanks, fire and security alarms, and gas level parameters;
- metering chemicals consumption;
- control of pumps, injection units, adjustment of unit operation parameters from a local console, and remotely from the control room;
- creating an archive of real-time parameters and making reports.

Summarized functional diagram of KDU IRZ



ST-IRZ-SAPSU TEST BENCH

Intended use: Automated testing of pump controllers to check compliance with technical requirements after overhaul, as well as at incoming inspection by the customer.

The system consists of:

- operator's workplace;
- control cabinet;
- ARM-ST-01 software;
- set of connecting cables and adapters.

ARM-ST-01 software ensures:

- reading and storing results of measurements;
- forming required signals;
- testing ESP drive in manual and automatic mode;
- presenting test results;
- storing history of operations in database.

Specification	Value
Range of phase voltage regulation	100…280 V
Range of frequency regulation	1…50 Hz
Output current	5; 25; 50 A
Load power factor	0.1-0.8
Fixed value of step-up transformer neutral wire resistance	51; 100; 300; 510; 1000; 2000; 4300; 7500; 9100 kOhm
Generated "dry contact" discrete signals	2 %
Generated "0..10 V / 4..20 mA" analog signals	2 %
Overall dimensions	2600x1300x2200 mm
Operating temperatures	+5...+40 °C
Enclosure	IP43

Main benefits:

- incoming inspection tests of drives for ESP, SRP, PCP and linear pumps with rated current up to 1000 A and with possibility to regulate the load in a wide range;
- testing drives' specific protective algorithms;
- calibration according to drive input signals;
- optional test bench version with reduced power consumption (up to 30 % of drive's nominal value);
- optional customized test bench manufactured according to customer's specifications.

ST-IRZ-SAPKSU TEST BENCH

Intended use: automated testing controllers to check compliance with the required algorithm of operation during incoming acceptance tests.

The system consists of:

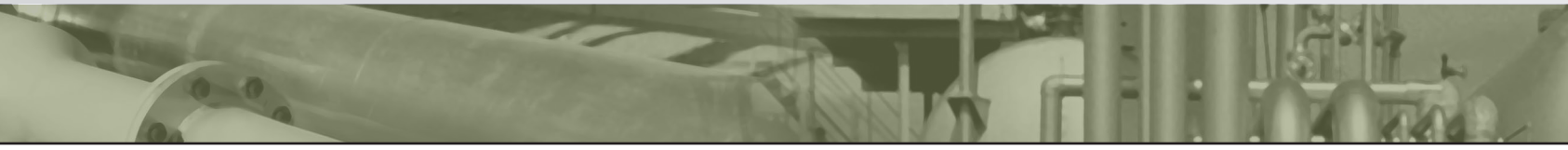
- operator's workplace;
- control cabinet;
- ARM-ST-02 software;
- set of connection cables and adapters for each type of controller.

The test bench ensures acceptance testing of the following controllers:

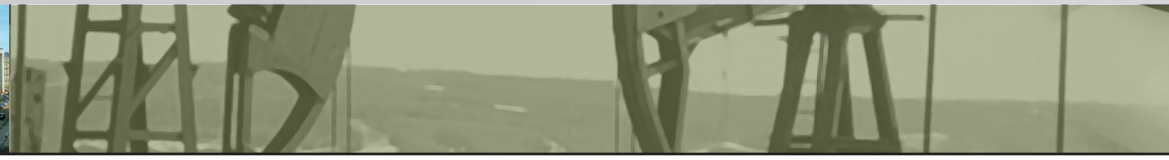
- KSU IRZ500, UKSU produced by IRZ TEK;
- Elekton 8, Elekton 9.1, Elekton 10 produced by ZAO "Elekton";
- Kaskad-2-200, Kaskad NT, Borets VD, Argus produced by LLC "Borets";
- other controllers upon customer's request.

ARM-ST-02 software ensures:

- reading and storing results of measurements;
- presenting test results;
- testing controllers in manual and automatic modes;
- presenting test results;
- storing history of operations in database.



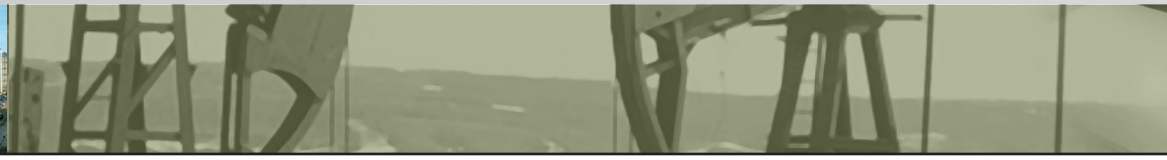
Specification		Value
System power parameters	Voltage	~ 220±10% V
	Power consumption	< 2000 VA
Power supply outputs of tested controllers	Regulation range	~ 66…286 V 15…30 V
	Number of outputs	3
Discrete output channels	Type	"dry contact"
	Number	10
Discrete input channels	Type	"24 V"
	Number	20
Analog input channels	Type	0-10 V 0-20 mA
	Number	10
Analog output channels	Type	0-10 V 0-20 mA
	Number	5
Channel for setting reference values of 3-phase voltages and currents with a given shape for checking measurement inputs of controllers	Channel parameters	2 ...50 Hz ~20…254 V 10 VA 0.05…12 A V 5 VA
	Number	1
Backspin value setting channel	Channel parameters	0...50 Hz ~0…5 V three-phase
	Number	1
Insulation resistance value setting channel	Nominal	51; 100; 300; 510; 1000; 2000; 4300; 7500; 9100 kOhm
	Number	1
Interface channels	Type	RS-485
	Number	4
	Type	RS-232
	Number	3
	Type	CAN
	Number	1
	Controllers communication protocols	Modbus RTU, 7.35
Dimensions	mm	2600x1300x2200



SALES GEOGRAPHY

AUTHORIZATIONS, CERTIFICATES AND PATENTS

Quality Management System of OOO "IRZ TEK" is certified for compliance with the requirements of ISO 9001:2015




СИСТЕМА ДОБРОВОЛЬНОЙ СЕРТИФИКАЦИИ ПРОДУКЦИИ И СИСТЕМ КАЧЕСТВА ПРЕДПРИЯТИЙ ОБОРОННЫХ ОТРАСЛЕЙ ПРОМЫШЛЕННОСТИ
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применительно к разработке, производству, реализации, монтажу и испытаниям продукции ВВТ по кодам ЕКПС в соответствии с приложением к данному сертификату
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ГОСТ Р ИСО 9001-2015, ГОСТ РВ 0015-002-2012, СРПП ВТ, Положений РК-98, РК-11, РК-11-КТ, ОСТ 134-1028-2012, ГОСТ Р ЕН 9100-2011
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НА ИЗОБРЕТЕНИЕ
№ 2509888
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№ 2533662
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№ 2571867
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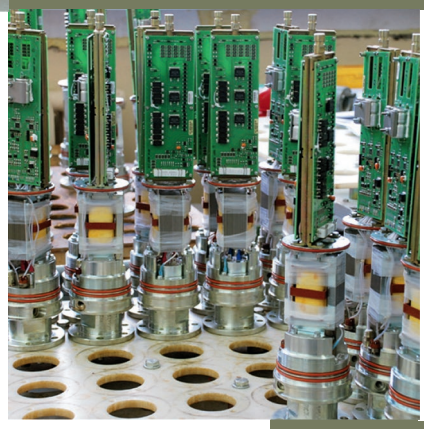
CONTENTS



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