Smart Tools for the Oil Industry

- DESIGN
- MANUFACTURE
- ASSEMBLING
- SERVICE
- SOFTWARE
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FOR MORE THAN 10 YEARS THE SOPHISTICATED ELECTRICAL SYSTEMS AND MICROPROCESSOR CONTROLLED ELECTRONIC DEVICES ENABLING OPTIMIZATION OF PROCESSES IN OIL PRODUCTION HAVE BEEN DEVELOPED, MANUFACTURED AND WIDELY PUT INTO OPERATION UNDER THE TRADE MARK OF ELEKTON.

At present Closed Joint Stock Company (CJSC) ELEKTON is one of the leading manufacturers of surface electrical equipment for oil production in Russia. Company’s production facilities areas exceed 16000 m² and total staff amounts about 500 employees. During last three years the production volume of the Company has been increasing for 50% annually. Our company’s focus is on the pursuit of innovating new technology, improving product quality and enhancing customer service. Dynamic development of the Company, aspiration for self-perfection, orientation toward world quality standards are among the reasons of dramatic sales growth of the Elekton’s production.

Long-term operation experience at Russia and CIS’s oilfields proved that as for reliability and functionality the ELEKTON’s equipment does not only yield to the best analogs of the world manufacturers but surpasses them in some parameters. The prices for our equipment allow successfully compete in the world market. The leading Russian oil companies, such as TNK-BP, YUKOS, LUKoil, Sibneft, Surgutneftegaz, Slavneft, Rosneft, Bashneft, Russneft are successfully running our equipment.

Our company is a designer and a production-run manufacturer of the switchboards Elekton-04 series with fixed speed drive. This equipment is intended to control and protect ESP motors with output current up to 1000 A. More than 13000 switchboards of this type are successfully running in oil companies.
For high-powered ESP motors (more than 140 kW) when starting current limitation is required, our company manufactured the switchboard Elekton-07 series with rated output current up to 1600 A with soft start of ESP unit.

CJSC ELEKTON is a developer and production-run manufacturer of switchboard Elekton-05 series with variable speed drive (output current up to 1800 A and rated output up to 1500 kVA) with soft start and variable speed drive of the ESP rotary unit. At present more than 3000 wells are equipped with Elekton-05 series switchboards.

The submersible telemetry system Elekton-TMS-2 has been developed and put into full-scale production by specialists of our company. Elekton-TMS-2 enables data acquisition on pressure at pumping unit intake (up to 60 MPa), insulance, rate of vibration speeding-up of ESP motor in radial and axial directions (0-30 m/sec²), temperature of ESP motor stator coil (up to 150°C) and temperature in any other part of motor (up to 300°C) by means of remote sensor.

Switchboard’s controller has RS-485 interface and standard Modbus protocol which enable data acquisition via telemechanics system and automates the oil production process. Oil production complex can be controlled through wire or cellular communications as well as radio channel or satellite communication (on base of CDMA technology via low-orbital satellites Globalstar).

Application of VSD switchboards jointly with downhole telemetry and telemechanics systems makes possible by means of selected program to optimize and coordinate downhole equipment’s operation with characteristics of bottomhole formation zone, as well as to diagnose, control and protect this equipment that enables to improve essentially oil production efficiency.

Lately, along with producing of microprocessor control drive, CJSC ELEKTON has developed and begun manufacturing new oil field equipment – Inserted Progressing Cavity Pumps, Starting Clutch for facilitation of ESP units’ start. CJSC ELEKTON has own testing workshop where produced equipment is being tested under power rating up to 1,5 MW.

Service centers of our company for warranty and after-sales services have been opened in many regions of ELEKTON’s equipment intensive application: Nizhnevartovsk, Nefteyugansk, Strezhevoy, Busuluk, Otradny, Noyabrsk. We ensure installation supervision, after-sales and warranty service, technical staff training.

IDEOLOGY OF CJSC ELEKTON CONSISTS IN INTEGRATED APPROACH TOWARDS AUTOMATION AND OPTIMIZATION OF OIL PRODUCTION PROCESS, IN INTENTION TO PRODUCE OIL FIELD EQUIPMENT TO BE COMPARED TO THE BEST WORLD MARKETS SAMPLES.
ELEKTON-04 Switchboards

ELEKTON-04-250 (400, 630, 800, 1000)

Elekton-04 Switchboards are designed for control and protection of the ESP motors.

Current measurement in Elekton-04 switchboards is carried out in step-up transformer primary circuit; results are being converted into motor operating current by controller with a special program. Due to such design the input of cables from secondary circuit of step-up transformer is eliminated, that enables to facilitate mounting noticeably and to increase operation safety.

Certificate of conformance PCCC RU.ME47.H00256.

FEATURES OF ELEKTON-04 SWITCHBOARDS

- Cables are connected in special section mounted on the cabinet’s back board upper part. Such design facilitates assembling of the switchboard on the multiple well platforms. This design is covered by several patents.
- 0,4 kV cable clamps provide connections up to 3 cables (with section 95 mm²) or up to 4 cables (with section 120 mm²) for each phase.
- Switchboard’s design is highly maintainable and has safe production service; system’s crucial components are easily substituted due to the plug-type connections application and engineering solution.
- Special sections for external devices connection unit are mounted on the cabinet’s back side of the switchboards as well as connection terminal of neutral point of the step-up transformer’s secondary coil. This design facilitates all external connections without opening the switchboard.
- There is a window on the switchboard cabinet’s front door, in front of the controller’s indicator lamps informing about switchboard’s status. Such design facilitates the control of the switchboard’s status without opening the door.

In Elekton-04M-250 (400) switchboard as opposed to Elekton-04-240 (400) switchboard, the power circuit’s flexible contactor has been substituted for copper bus. Elekton-04-240 (400) switchboard has been provided with a possibility of soft start device mounting.

MAIN TECHNICAL SPECIFICATIONS OF THE ELEKTON-04-250 (400, 630, 800, 1000) SWITCHBOARDS

<table>
<thead>
<tr>
<th>SPECIFICATIONS</th>
<th>VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating supply voltage, V</td>
<td>380/415/435, (50/60 Hz)</td>
</tr>
<tr>
<td>Supply voltage deviation from rated, %</td>
<td>-25 ... +25</td>
</tr>
<tr>
<td>Primary power circuit rated current, A, not more</td>
<td>250 (400, 630, 800, 1000)</td>
</tr>
<tr>
<td>Electric motor power, kW, not more</td>
<td>100 (160, 240, 320, 400)</td>
</tr>
<tr>
<td>Temperature range, °C</td>
<td>-60 ... +40</td>
</tr>
<tr>
<td>Protection rating</td>
<td>IP43</td>
</tr>
<tr>
<td>Switching unit</td>
<td>Contactor 250 A (400 A, 630 A, 800 A, 1000 A)</td>
</tr>
<tr>
<td>Switching unit control circuit</td>
<td>Controller Elekton-08</td>
</tr>
<tr>
<td>Overall dimensions, mm / weight, kg, not more</td>
<td></td>
</tr>
<tr>
<td>Elekton-04M-250 (400)</td>
<td>1735 x 700 x 520 / 110 (120)</td>
</tr>
<tr>
<td>Elekton-04-250 (400)</td>
<td>1735 x 800 x 640 / 155 (170)</td>
</tr>
<tr>
<td>Elekton-04-630</td>
<td>1735 x 850 x 752 / 210</td>
</tr>
<tr>
<td>Elekton-04-800 (1000)</td>
<td>1860 x 950 x 1000 / 370 (380)</td>
</tr>
</tbody>
</table>
Elektorn-05 Switchboards are designed to regulate speed rotation, optimize operation and protect the ESP motors.
Certificate of conformance РОСС RU.МЕ47.H00265.
Electromagnetic Compatibility Test report №232-041/IC EMC-02 Pl.

**AREA OF APPLICATION:**

- asynchronous electric motors of submersible pumps for oil recovery;
- ac converter-fed motors submersible pumps for oil recovery;
- asynchronous motors of common industrial modification – water intakes and water-supply, drives of screw pumps, smoke sucker and industrial ventilation.

**ELEKTON-05-32 (63, 160, 250, 400, 630, 800, 1000, 1200, 1600, 1800)**

Elektorn-05 Switchboards enables starting of pumping unit according to the specified program both manual and automatic mode. Possibility of technological parameter maintenance (frequency, current, pressure) by means of built-in PID-regulator.

**DESIGN PHILOSOPHY OF SWITCHBOARDS ELEKTON-05**

- Operation stability under power voltage jumping.
- Stabilization of output voltage in case of instability of mains supply.
- Built-in output filter for decrease of the mains voltage nonsinusoidal ratio on switchboards input.
- The high maintainability of the item.

**MAIN TECHNICAL SPECIFICATIONS OF ELEKTON-05-32 (63, 160, 250, 400, 630, 800, 1000, 1200, 1600, 1800) SWITCHBOARDS**

<table>
<thead>
<tr>
<th>SPECIFICATIONS</th>
<th>VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated supply voltage, V</td>
<td>380/415/435, (50/60 Hz)</td>
</tr>
<tr>
<td>Main supply voltage deviation, %</td>
<td>-25 ... +25</td>
</tr>
<tr>
<td>Rated current of the primary circuit, A, not more</td>
<td>32 63 160 250 400 630 800 1000 1200 1600 1800</td>
</tr>
<tr>
<td>Converter’s power rating, kVA</td>
<td>20 40 100 160 250 400 500 630 800 1000 1150</td>
</tr>
<tr>
<td>Temperature range, °C</td>
<td>-60 ... +50</td>
</tr>
<tr>
<td>Protection rating</td>
<td>IP43</td>
</tr>
<tr>
<td>Control scheme</td>
<td>Controller Elekton-09</td>
</tr>
<tr>
<td>Frequency variation range, Hz</td>
<td>3.5...70±0,1%</td>
</tr>
<tr>
<td>Overall dimensions, mm</td>
<td>1920х880х560 1735х856х800 1910х1186х1035 2400х1800х1600</td>
</tr>
<tr>
<td>Weight, kg, not more</td>
<td>155 170 300 330 350 750 780 800 850 1725 1725</td>
</tr>
</tbody>
</table>
ELEKTON-09 Controller for Switchboards of ELEKTON-05 Series

Functionally and constructively the controller is divided into 2 blocks: frequency converter control unit Elekton-09.2 and interfoce module Elekton-09.1.

**CONTROLLER PROVIDES THE FOLLOWING FUNCTIONS:**

- regulation of the electric motor’s rotation speed from built-in control panel;
- switchboard’s autorestart after the shutdown troubleshooting service;
- smooth electric motor’s acceleration with preset rate;
- electric motor rotation direction reversal;
- programmable frequency correction bursts to provide automatic putting the well into operating duty;
- electric motor gradual braking when voltage limit value increasing in dc link.
- automatic maintenance of the technological parameter value (pressure, temperature, level and so on) from 2 of the 8 analog inputs;
- data communication via one port RS-232 and two ports RS-485, connection to the telemechanics system for remote control and on-line control – start-up, shutdown, setpoints change;
- operation under field decay conditions if speeds of rotation exceed rated;
- possibility to vary characteristic U/F (for different types of loading) without switchboard’s shutdown;
- writing operating parameters of the switchboard (mains voltage, current, output frequency and so on) into controller memory and their fast view on the controller display directly;
- fixation in event log of the time of main supply switching off and on;
- setpoints changing registration in event log with indication of the data and time of the parameter’s value changing before and after, as well as the way of changing – remotely or by operator;
- recording in event log the course inhibiting the switchboard start;
- recording into event log the date and time of setpoints changing with indication of previous and new values;
- record into memory the meanings of the mains voltage values within adjustable periods, if it doesn’t allow the switchboard switching on;
- showing on controller display the protection name, which caused the switching off, with indication of remaining period of time (in minutes and seconds) before ESP motor switching off;
- automatic frequency changing up to preset value during preset period of time;
- 2 modes of wedging of ESP rotary unit:
  1. specified number of blows by increased voltage with specified output current frequency, in forward direction;
  2. specified number of blows by increased voltage with specified output current frequency, in different directions – «swinging».
- programming of analog inputs in any of 3 standards: 0-4 V, 0-10 V, 4-20 mA;
- password setting for exception of an unauthorized access of the switchboard programming, 8 users password indentification;
- possibility of frequency convertor’s operation in modes of pulse-width and 6-pulse modulations.
CONTROLLER ENABLES PROGRAMMING THE FOLLOWING MAIN PARAMETERS:

- manual and automatic mode;
- electric motor’s acceleration time;
- electric motor’s braking time;
- braking mode (running-out or frequency dynamic speed-down);
- initial direction of rotation;
- time of switchboard’s autorestarting after main supply restoration;
- time and rate of «jogging» when drive start-up occurs with increased starting moment;
- turndown of the controlled parameter;
- proportional, integral and differential coefficients during operation with PID-regulator, or range of the controlled parameter corresponding to the frequency adjustment range during parametric control;
- parameters of the curve U/F (specified by 4 points) for drive control under different loading conditions;
- maximum phases output currents for current protection;
- phase output current at which the acceleration speed limit algorithm starts running;
- maximum admissible current in dc link;
- current time clock set up.

THE MAIN FOLLOWING TYPES OF PROTECTION ARE PROVIDED BY CONTROLLER:

- main supply temporary overvoltage protection;
- external and internal short circuit current protection;
- programmable operation threshold of circuit voltage rise protection;
- programmable operation threshold of circuit voltage reduction protection;
- ESP asynchronous electric motors’ insulation reduction protection;
- transistor overheating or cooling air flow disappearance protection;
- overload current time-current protection;
- motor’s overheating time-current protection;
- underload protection.

CONTROLLER’S ADVANTAGE:

- reliable and steady to electric noise;
- up-to-date microprocessor is applied;
- reliable elemental base is applied;
- full galvanic isolation of power supply circuit;
- menu setpoints are grouped according to their functionalities;
- possibility to set up setpoints as default;
- informative enlargement of display by increasing displayed symbols – 4 lines of 20 symbols each;
- graphical display connection possibility;
- measuring of the mains voltage on the switchboard’s input allows to fix the reason of undervoltage in dc link (trouble of input rectifier or power circuit’s voltage derating);
- there is a possibility to create technologist’s individual menu;
- possible equipping of Elekton-08 (09) controllers with a function of information read-out to the USB Flash drive.
Output filters for Frequency Converters to Rated Current from 250 up to 1000 A

Output filter is intended for suppressing of high-frequency harmonics of the carrier frequency of 3-phase output voltage of variable speed drive switchboards. Output filter is attached between VSD switchboard and step-up three-phase transformer. Filter’s rated current circuit should be corresponding with rated output current of the switchboard.

**MAIN TECHNICAL FEATURES**

<table>
<thead>
<tr>
<th>Filter type</th>
<th>Rated operating current, A</th>
<th>Coefficient of distortion of sinusoidal curve of output voltage &amp; current with output filter</th>
<th>Dimensions, mm</th>
<th>Weight, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>K_U output</td>
<td>K_I output</td>
<td></td>
</tr>
<tr>
<td>Elekton-F-250</td>
<td>250</td>
<td></td>
<td></td>
<td>1588 x 804 x 925</td>
</tr>
<tr>
<td>Elekton-F-400</td>
<td>400</td>
<td></td>
<td></td>
<td>1588 x 804 x 925</td>
</tr>
<tr>
<td>Elekton-F-630</td>
<td>630</td>
<td></td>
<td>Not more than 5%</td>
<td>1835 x 1004 x 1105</td>
</tr>
<tr>
<td>Elekton-F-800</td>
<td>800</td>
<td></td>
<td></td>
<td>1835 x 1004 x 1105</td>
</tr>
<tr>
<td>Elekton-F-1000</td>
<td>1000</td>
<td></td>
<td></td>
<td>1094 x 1900 x 1235</td>
</tr>
</tbody>
</table>
THE RESULTS OF MEASUREMENT OF COEFFICIENT OF DISTORTION OF OUTPUT VOLTAGE $K_{U_{output}}$ AND CURRENT $K_{I_{output}}$ OF FREQUENCY CONVERTER ELEKTON-05-400

Switchboard ELEKTON-05 without output filter

Output voltage

Harmonic composition of output voltage

$K_{U_{output}} = 43.73\%$

Output current

Harmonic composition of output current

$K_{I_{output}} = 6.76\%$

Switchboard ELEKTON-05 with output filter

Output voltage

Harmonic composition of output voltage

$K_{U_{output}} = 2.55\%$

Output current

Harmonic composition of output current

$K_{I_{output}} = 0.58\%$
Submersible Telemetry System ELEKTON-TMS-2

Submersible Telemetry System ELEKTON-TMS-2 is intended to data logging and transmission to external devices of current values of:
- pressure on ESP unit’s intake;
- temperature of ESP motor oil;
- rate of vibration speeding-up of ESP motor along radial and axial directions.

THE SET OF SUBMERSIBLE TELEMETRY SYSTEM ELEKTON-TMS-2 CONSISTS OF:
- downhole unit Elekton-TMSP-2;
- connecting unit for docking to ES Motor;
- surface unit Elekton-TMSN-2.

Telemetry data from submersible unit are transmitted via ES Motor power cable, treated in surface unit and transmitted into controller. Data on insulance, pressure, vibration speeding-up and temperature values are stored in memory and induced on display of the switchboard’s controller Elekton and with the help of software could be examined in table or graphic mode on computer’s display or transmitted to the telematics system via interface the RS-485 (ModBus protocol).

Any surface unit TMSN-2 can operate with any downhole unit TMSP-2 without any additional settings.

Certificate of conformance POCC RU.TH02.B00662

**MAIN TECHNICAL SPECIFICATIONS ELEKTON-TMS-2**

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range:</td>
<td></td>
</tr>
<tr>
<td>• pressure, mPa</td>
<td>0 … 25; 32; 60</td>
</tr>
<tr>
<td>• downhole temperature sensor, °C</td>
<td>0 … +150</td>
</tr>
<tr>
<td>• temperature of remote sensor, °C</td>
<td>0 … +300</td>
</tr>
<tr>
<td>• vibration along X-Y, and Z axes, g</td>
<td>0 … 30</td>
</tr>
<tr>
<td>Operating temperature range:</td>
<td></td>
</tr>
<tr>
<td>• downhole unit, °C</td>
<td>0 … +150</td>
</tr>
<tr>
<td>• surface unit, °C</td>
<td>-60 … +40</td>
</tr>
<tr>
<td>Dimensions of downhole unit for ESP motor case diameter:</td>
<td></td>
</tr>
<tr>
<td>• 103 mm</td>
<td>Ø=90 mm, L=508,5 mm</td>
</tr>
<tr>
<td>• 117 and 130 mm</td>
<td>Ø=103 mm, L=486,5 mm</td>
</tr>
<tr>
<td>Overall dimensions of surface unit, mm</td>
<td>245 x 200 x 160</td>
</tr>
<tr>
<td>Weight of submersible unit, kg, not more</td>
<td>14</td>
</tr>
<tr>
<td>Weight of surface unit, kg, not more</td>
<td>6,5</td>
</tr>
</tbody>
</table>
Flowmeter ELEKTON-TMSR for Electric Submersible Motors

The flowmeter Elekton-TMSR is intended for measurement of discharge, pressure and temperature at ESP outlet. The flowmeter operates in conjunction with submersible telemetry system. Extra received parameters jointly with data on pressure and temperature at the pump suction allow to define technical condition and operating efficiency of the electric submersible rotary pump unit.

TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge, m³/day</td>
<td>800</td>
</tr>
<tr>
<td>Pressure, bar</td>
<td>up to 400</td>
</tr>
<tr>
<td>Temperature, °C</td>
<td>up to 250</td>
</tr>
<tr>
<td>Length, mm, not more</td>
<td>1200</td>
</tr>
<tr>
<td>Diameter, mm</td>
<td>103</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>not exceeding 28</td>
</tr>
</tbody>
</table>

1 – Elekton-TMSR
2 – Elekton - TMS-2
3 – Oil-well tubing
4 – ES Pump
5 – ES Motor
6 – Case

1 – Sensor
2 – Tube (for signal bunch)
3 – Flowmeter
4 – Head
5 – Input pressure seal
6 – Case
NOWADAYS THE INCREASED RATES OF THE OIL PRODUCTION VOLUMES AND THE URGENT REQUEST OF THE OIL COMPANIES TO REDUCE OPERATING COSTS HAVE GENERATED A NECESSITY OF CREATION OF THE SO-CALLED «SMART» WELL

The complex of above ground and downhole equipment, including VSD switchboard and telemetry system that allows the pump unit operating parameters’ data logging is usually called the «Smart» well. At the same time on the basis of logging information, according to the special algorithm, the switchboard controller should manage the pump unit operation with the purpose of assurance of the operating mode setting, for example, bottom-hole pressure supporting.

The complex in off-line mode enables to optimize and coordinate the operation of the downhole equipment with bottom-hole formation zone characteristics. The operating parameters of the pumping unit and the switchboard are stored in controller’s memory and can be performed in charts and plots, which facilitates the analysis of equipment operating. Besides, the designed new software, on the basis of logging data, makes creation of various databases simple.

The equipment complex «Smart» Well designed by CJSC ELEKTON contains the VSD switchboard, submersible telemetry system Elekton-TMSR, which enables pressure and temperature metering on the pump intake and discharge and also pump output (see graph).

The Elekton controller allows more detailed data representation of technical status conditions of the pump unit, operating efficiency of ESP motor, and also facilitates knowledge-based decision making. The controller enables data acquisition of such important field information as current yield and well production, bottom hole pressure and others; information, which can be get in other case only during hydrodynamic researches.
Low-orbital satellite
Globastar

**SYSTEM «ELEKTON-SK2»**

- Modem control unit
- Modem
- Radio station
- Server
- Internet
- Cluster modem
- Modem

**TELEMECHANICS SYSTEM OF THE FIELD**

- ESP motor with submersible unit of telemetry system Elekton-TMS-2

- R insulation
- T° of ESP motor oil
- P on the ESP pump intake
- ESP motor axial vibration
- ESP motor radial vibration
- Formation liquid T° on a pump discharge
- P on a pump discharge
- Formation liquid flow
ELEKTON-06 Switchboards for Deep-well Working Rod Pump and Beam Pumping Units

ELEKTON-06-100

The Switchboard Elekton-06-100 with switchboard Elekton-08 is assigned for control and protection of deep-well working rod pump, beam pumping unit and its drive – three-phase asynchronous motor with rated voltage 380 V and frequency 50 Hz;

Built-in controller of the switchboard Elekton-06 stores and represents on a liquid-crystalline display the information about rod pump and beam pumping units’ operation. Such information as: status of the unit; indication of the shutdown time and its cause; operating time from the moment of last start, or before start time in minutes and seconds; current parameters, setpoints and protections.

History, 10 dynamograms and wattmetergrams registered within time interval preset with setpoints are stored in the controller. There are input voltage, current and polish rod load protection set. Belts rupture protection.

Elekton-06 Switchboard has 3 analog user configured outputs, to which the stationary dynamograph and well head pressure sensor and other devices can be attached.

Switchboard can be connected to telemechanics system on ModBus protocol via built-in RS-485 interface. Operation data can be read out into a notebook or a compact data input/output unit for further analysis of operation and diagnostics of pumping unit.

Certificate of conformance Pocc RU. ME47.H00256.

ELEKTON-06 Switchboards for Deep-well Working Rod Pump and Beam Pumping Units

MAIN TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>SPECIFICATIONS</th>
<th>VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating supply voltage, V</td>
<td>380/415/435, (50/60 Hz)</td>
</tr>
<tr>
<td>Supply voltage deviation from rated, %</td>
<td>-25 ... +25</td>
</tr>
<tr>
<td>Primary power circuit rated current, A, not more</td>
<td>100</td>
</tr>
<tr>
<td>Electric motor power, kW, not more</td>
<td>55</td>
</tr>
<tr>
<td>Temperature range, °C</td>
<td>-60 ... +50</td>
</tr>
<tr>
<td>Protection rating</td>
<td>IP43</td>
</tr>
<tr>
<td>Switching unit</td>
<td>Contactor 100 A</td>
</tr>
<tr>
<td>Switching unit control circuit</td>
<td>Controller Elekton-08</td>
</tr>
<tr>
<td>External sensors' input signal standard</td>
<td>0-10 B; 4-20 mA</td>
</tr>
<tr>
<td>Interface</td>
<td>RS-485</td>
</tr>
</tbody>
</table>
| Information changing                  | • notebook
|                                       | • read-out unit BSI-03
|                                       | • telemechanics system, Modbus protocol     |
| Overall dimensions, mm                | 584 x 367 x 660                             |
| Weight, kg                            | 42                                          |
ELEKTON-07 Switchboards

ELEKTON-07-400 (630, 800, 1000, 1600)

Elekton-07 Switchboards are designed for control and protection of the ESP motors. The main difference of the Elekton-07 Switchboard is a thyristor soft start appliance.

Additionally to the standard algorithms (especially for large static moment cases) there have been added a quasi-frequency mode of motor launching to the soft start appliance of the Elekton-07. The soft start appliance enables to run the electric motor at low frequencies (12.5, 25 Hz discretely) within short period of time.

There is embedded interface RS-485 for connection with telemechanics system on Modbus protocol. Switchboard operating data are read out to the portable computer for further data processing and analysis.

Certificate of conformance РОСС RU. МЕ47.H00256.

SOFT START APPLIANCE ADJUSTMENT IS CARRIED OUT:

with the help of two setpoints:
• Starting current – 100% ... 500%
• Motor acceleration time – 0 ... 10 sec.

and starting mode selection:
• Soft start (for normal motor switching on);
• Jogging Start (for motor switching on, which requires increased starting moment, with further transition to the Soft Start Mode);
• Quasi-frequency mode (for motor switching on, which requires increased starting moment, with further transition to the Soft Start Mode);
• Full Start (for modes, which require direct motor switching on).

APPLICATION OF SOFT START APPLIANCE ALLOWS:
• to limit peak mechanical loads to the motor and mechanism;
• to limit start current;
• to exclude in some cases using the slip coupling and hydraulic clutch;
• to carry out contactor communication when there is no current.

MAIN TECHNICAL SPECIFICATIONS OF ELEKTON-07-400 (630, 800, 1000, 1600) SWITCHBOARDS

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating supply voltage, V</td>
<td>380/415/435, (50/60 Hz)</td>
</tr>
<tr>
<td>Main supply voltage deviation, %</td>
<td>-25 ... +20</td>
</tr>
<tr>
<td>Rated current, A, not more</td>
<td>400 (630, 800, 1000, 1600)</td>
</tr>
<tr>
<td>Electric motor power, kW</td>
<td>160 (240, 320, 400, 520)</td>
</tr>
<tr>
<td>Temperature range, °C</td>
<td>-60 ... +50</td>
</tr>
<tr>
<td>Protection rating</td>
<td>IP43</td>
</tr>
<tr>
<td>Overall dimensions, mm</td>
<td></td>
</tr>
<tr>
<td>• Elekton-07-400</td>
<td>1735 x 800 x 640</td>
</tr>
<tr>
<td>• Elekton-07-630</td>
<td>1735 x 850 x 725</td>
</tr>
<tr>
<td>• Elekton-07-800 (1000)</td>
<td>1860 x 950 x 1000</td>
</tr>
<tr>
<td>• Elekton-07-1600</td>
<td>1910 x 1186 x 1320</td>
</tr>
<tr>
<td>Weight, kg, not more</td>
<td>185 (235, 450, 460, 670)</td>
</tr>
</tbody>
</table>
ELEKTON-08 Switchboards

ELEKTON-08-250 (400)
Compact Elekton-08-250 (400) Switchboard is transformable, light weight, easy-to-use and transportable.
High-performance processor of the controller, which in complex with advanced communication facilities, provides the effective use of it in present and future telemechanics systems.

FEATURES OF THE ELEKTON-08 SWITCHBOARDS:
• compact design;
• high-performance processor;
• easy reprogramming via card connector;
• 2 interface RS-485;
• CAN interface bus;
• inside controller temperature indication;
• luminosity adjustment of LED, operating modes and indicator highlight.

MAIN TECHNICAL SPECIFICATIONS OF ELEKTON-08-250 (400) SWITCHBOARDS

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated supply voltage, Volt</td>
<td>380/415/435, (50/60 Hz)</td>
</tr>
<tr>
<td>Rated current, A</td>
<td>250 (400)</td>
</tr>
<tr>
<td>Main supply voltage deviation, %</td>
<td>-25 ... +20</td>
</tr>
<tr>
<td>Electric motor power, kW</td>
<td>100 (160)</td>
</tr>
<tr>
<td>Temperature rate, °C</td>
<td>-60 ... +50</td>
</tr>
<tr>
<td>Protection rating</td>
<td>IP43</td>
</tr>
<tr>
<td>Switching unit</td>
<td>Contactor 250 A (400 A)</td>
</tr>
<tr>
<td>Control scheme of the switching unit</td>
<td>Controller Elekton-08</td>
</tr>
<tr>
<td>Dimensions, mm</td>
<td></td>
</tr>
<tr>
<td>• in transit condition</td>
<td>1103 x 930 x 570</td>
</tr>
<tr>
<td>• in operating position</td>
<td>1823 x 930 x 570</td>
</tr>
<tr>
<td>Weight, kg, not more</td>
<td>140 (215)</td>
</tr>
</tbody>
</table>
ELEKTON-08 Controller for Switchboards of ELEKTON-04 (07, 08) Series

The controller of Elekton-08 Switchboards enables to automate the operation of ESP unit to the maximum and optimize the oil production process.

The Controller is mounted on the front panel of the Switchboard and has embedded alphanumeric liquid crystal two-line display with 16 symbols in each line. Large quantity of symbols enables to indicate massages not in code mode, but by full name, that makes information comprehensible and accessible for perception.

FEATURES

- Membrane keyboard application for setpoints input and function selection.
- Nonvolatile memory for data storage for a long period in case of power supply lack.
- Embedded interface RS-485 for connection with telemechanics system by Modbus protocol.
- Current parameters logging with four adjustable intervals.
- Highlight liquid crystal display (LCD) application.
- Reliable internal heating system and additional LC indicator heating.
- Keys of the controller are highlighted on the inside for usability in the dark.
- One program is used in Windows OS for data read-out, information processing, setpoints changing, and database management that enables to display and plot various parameters in tables and graphs for statistics.
- Easy adaptable to additional devices, such as downhole telemetry system and contact manometer.
- Controller reprogramming is carrying out without pump unit station.
Software

Windows-based software of CJSC ELEKTON has user-friendly and easy-to-use interface.

The program is assigned for data reading-out and processing from the controllers of Elekton series.

The program provides event logs, graphs and diagrams print functions as well as information storage into text file and its export to the Microsoft Excel format for further processing.

Stored information on submersible pumping unit operation from controller’s memory unit is read out into computer or data I/O unit BSI-03 for further control and processing.

Data flow diagram

Port RS-232 functions

Port RS-232 of Elektion Switchboard enables the following:

• to read out the event log in which the following data is sorted on date and time: line voltages, phase currents, load, insulation, pressure, temperature, power factor as well as switchboard’s launches and shutdowns with cause indication, setpoints changings with indication of previous and current values;
• to view the current switchboard’s state and parameters of its operation;
• to view and to change setpoints of the controller, which determine switchboard’s operating mode and its response to rated parameters deviation.
Directed Drilling Complex ELEKTON-KRNB

Stem assemblies are intended for directed hole drilling with calculated path in complicated mining and geological conditions. Elastic-framed centralizers as a part of the stem assemblies are used for the rock cutting tool's removal just in the center of a drilling hole section regardless to its actual diameter changing while drilling with both downhole motor and rotary method.

In addition to centralizers there are elastic-framed decentralizes, articulated couplings and drill collars for inclination angle increment.

- Thanks to optimal rigidity of the frame elastic support plates (patent of Russian Federation) the bore bit keeps in the center of the bore's cross-section when its chambering and when inclination angle changes that ensures accuracy of directed bore drilling.
- When bore is convergent the frame of the centralizer is decreased in diameter that reduces the stem assemblies' sticking.
- Elastic characteristics of elastic plates and lack of gaps between the frame and hole walls prevent the stem oscillation that facilitates borehole reaming and increasing of the stem's service life.

ROTARY DRILLING METHOD
1 - Stem assemblies for well's inclination angle increment
2 - Stem assemblies for bore's drilling direction stabilization
3 - Stem assemblies for directed drilling
4 - Rotary incliner

DOWNHOLE MOTOR DRILLING METHOD
5 - Stem assemblies for the well's inclination angle increment
6 - Stem assemblies for the bore drilling direction stabilization
7 - Stem assemblies for directed drilling
8 - Stem assemblies for specified well's inclination angle increment

ELASTIC-FRAMED COMPONENTS OF DIRECTED DRILLING COMPLEX ELEKTON

CKU-ZD – elastic-framed centralizer for downhole motor
CKU – elastic-framed centralizer
DKU-ZD – elastic-framed decentralizer for downhole motor
DKU – elastic-framed decentralizer
Progressing Cavity Pump VVN-54 is intended for high viscous and high gas factor oil recovery in marginal wells with minimum internal diameter of casing 122 mm.

Pumping Unit consists of inserted with oil-well tubing submersible fourpole ESP motor with borehole cable, starting clutch, seal section, base coupling and intake receptacle.

Progressing Cavity Pump (PCP) is inserted and hoisted through oil-well tubing with borehole cable of geodesic hoisting winch. The PCP consists of two working screw pairs (left and right), latching mechanism and spindle with axial and radial bearings. Rotation from spindle to screw pairs is transmitted via flexible shaft.

For ESP motor’s protection and pump system’s output adjustment the Elekton-05-63 Switchboard with variable speed drive is used.

### PUMPED-OUT FLUID PARAMETERS

- **Viscosity, cCT, not more**
  - 1000
- **Maximum temperature, °C**
  - 90
- **Concentration of solid particles in reservoir fluid, g/l, not more**
  - 1.0
- **Gas factor, m³/m³, not more**
  - 0.5
- **Concentration of hydrogen sulphide, %, not more**
  - 6

### TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil-well tubing diameter, not less</td>
<td>73</td>
</tr>
<tr>
<td>Base coupling diameter, mm</td>
<td>93</td>
</tr>
<tr>
<td>Maximum diameter of inserted PSP, mm</td>
<td>54</td>
</tr>
<tr>
<td>Pump capacity, m³/day</td>
<td>5…30</td>
</tr>
<tr>
<td>Pressure, MPa</td>
<td>10…15</td>
</tr>
<tr>
<td>Electric motor shaft’s rotating speed</td>
<td>800…1800</td>
</tr>
<tr>
<td>Electric motor power, kW</td>
<td>32</td>
</tr>
</tbody>
</table>

1 - Oil-well tubing  
2 - Power cable  
3 - Tubing anchor/packoff  
4 - Left  
5 - Right  
6 - Pump  
7 - Flexshaft  
8 - Spindle rod  
9 - Base coupling  
10 - Hydro-seal  
11 - Starting clutch  
12 - Submersible electric motor
Starting Clutch ELEKTON-MP 103 for Submersible Rotary and Progressive Cavity Electric Pumps

The Starting Clutch is intended for easing the start of the electric submersible motor in drives of the submersible rotary and progressive cavity pumps as well as to eliminate backspin of the electric submersible motor while being stopped because of check valve undersealing.

Starting Clutch is placed between hydro-seal and electric submersible motor. Design of the Clutch allows to reduce moment of resistance on the motor’s shaft during its start up to 9 times that reduces multiply the starting torque on the motor’s shaft (see graph) and consequently inrush currents.

MAIN TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated rotating speed of input shaft, rpm</td>
<td>up to 3000</td>
</tr>
<tr>
<td>Transmission ratio at the start moment</td>
<td>1...10</td>
</tr>
<tr>
<td>Transmission capacity, kW</td>
<td>up to 180</td>
</tr>
<tr>
<td>Warranty lifetime, hours (days)</td>
<td>17520 (730)</td>
</tr>
<tr>
<td>Ambient temperature, °C</td>
<td>up to 150</td>
</tr>
<tr>
<td>Dimensions, mm</td>
<td>Length – 1200 Diameter – 103</td>
</tr>
</tbody>
</table>

$M_p$ and $M_m$ – Torque on the pump shaft and ES motor respectively

t – ESP’s trigger time

Starting currents without starting clutch
Starting currents with starting clutch

t – ESP’s trigger time
Extension Cable

Extension cable with cable sleeve is intended for jointing of the mains supply power cable from surface equipment to ESP motor.

SPECIFICATIONS

- Length of cable extenders – 15, 20, 25, 30, 35, 40, 45, 50 m
- Type of cable – REDA LEAD
- Cable conductor section – 10, 13,3 and 16 mm²
- Rated operating voltage between phases – 4 kV
- Maximum admissible operating voltage – 4,8 kV
- Admissible temperature during trips – -40°C
- Maximum operating temperature – +220°C
- Formation liquid pressure – up to 35 MPa

Read-out Unit BSI-03

Read-out unit BSI-03 is assigned for read out and storage of the history via port RS-232 of the switchboards Elekton-04 (05, 06, 07, 08) controllers. It is used as a substitute for notebook.

For readout the unit is to be connected to the controller directly through RS-232 socket or with cable. In order to start readout the short-term pushing of the button should be done. The light indication of the unit, which consists of six highlighted diodes, informs an operator about the unit’s status:

- Power • Overrun • Read out
- Done • Wait • Error

BSI-03 enables to store 63 event logs, which are read out from controllers of switchboards Elekton-04 (05, 06, 07, 08). For further history analysis the unit should be connected to the computer via COM port and special communication program should be run. By clicking in toolbar on tab REGISTRATOR the list of read out data appears with indication of time, well and cluster number.

Overall dimensions: 100 x 73 x 15 mm, weight 0,1 kg.

The power supply of the BSI-03 is carried out from controller (the external power supply from compact power unit 9 V is required only for operating mode with computer).

THE SET OF THE BSI-03 UNIT CONSIST OF:

1. BSI-03 unit;
2. Operation manual;
3. Cables for connections of BSI-03 with controller or computer;
4. CD with communication program;
5. Network adapter.
Data I/O-unit BSIVP-01

Data I/O-unit BSIVP-01 is assigned for reading out and storage of the data from all devices with integrated memory produced by CJSC ELEKTON: switchboards, controllers, telemetry surface units, mains voltage recorder etc.

FUNCTIONAL CAPABILITIES

- Setpoints re-writing in case of controller’s changing (PC substitution).
- Communication control via RS-485.
- Indication of current parameters of telemetry surface unit.
- Viewing the stored event logs: switchboards type, cluster number, read-out date and so on.
- Graphical display with high resolution enables viewing the event logs and graphs without PC.

TECHNICAL SPECIFICATIONS

- Graphic display of 160 x 180 dots can show drawings, schedules and text information in 10 lines of 26 symbols each.
- Quantity of events stored into history – 320
- Extended memory for event logs – 10 Mbyte
- USB (mini B) socket for connection to computer
- RS-232 and RS-485 ports for connection to switchboards
- Dimensions: 170 x 75 x 25 mm
- Weight: 150 g.

Control and Read-out Unit by Radio Channel BUSIR-01

Control and read-out unit allows communication with switchboard by radio channel at a distance of 150 m.

The devise enables viewing of current parameters and setpoints, changing setpoints, reading-out of event log, switching on and of switchboard.
Interface Module ELEKTON-IM

Interface Module Elekton-IM is mounted jointly with the surface unit of submersible telemetry system Elekton-TMS-2 into switchboards which are not equipped with its own controller or into switchboards whose controllers couldn’t be connected directly to the surface unit of telemetry system.

Interface Module Elekton-IM is intended for indication of telemetry information, its storage in nonvolatile memory; for ESP motor’s proofing on the basis of collected telemetry data and preset settings, and also for individual adjustment of the surface unit of telemetry system Elekton-TMS.

Interface Module Elekton-IM is a controller with keyboard and LC display with two lines of 16 symbols, which represents the current status of telemetry information.

Nonvolatile memory of the Interface Module keeps the history which can be read out into PC via port RS-232 by means of universal communication program. There is possibility to read out information into the BSI-03 unit and Data I/O unit BSIVP-01, as well as from any controller of Elekton series.

There is a galvanic isolated port RS-485 for connection to telemechanics system.

Test Bench IS-01

Test Bench IS-01 is designed for examination of ESP motor’s operation in the following modes:

- low (high) voltage of mains supply;
- voltage (current) unbalance;
- raised (low) current load
- low insulation of «three phase step-up oil transformer – submersible cable – ESP motor».

The device enables to adjust smoothly the voltage supplied to the switchboard from 0 up to 425 V (separately in each of three phases), has main supply with smooth current adjustment within the range of from 0 up to 400 A. Operating mode is long-term. Embedded resistance box allows to check-up the insulation control device operation.

Overall dimensions of the unit 350 x 450 x 250 mm, weight 30 kg.
Test Bench IS-03

Test Bench IS-03 is designed for examination of operating efficiency of Elekton-08 switchboards' controllers in laboratory and field conditions. This device enables to control current parameters indications, restart delay count and controller’s protection response. Overall dimensions 180 x 260 x 70 mm, weight 3,0 kg. Power supply: AC 220 V network.

Contactors CEM

Electromagnetic contactors CEM is intended for application in electric drive control circuit with voltage up to 690 V of AC, frequency 50/60 Hz, application category AC-3 for remote start and stop of three-phase asynchronous electric motor with short-circuited rotor. Climatic version – U3.

MAIN TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Catalogue Number</th>
<th>Maximum operating current, A</th>
<th>Asynchronous motor power capability, kV</th>
<th>Control circuit</th>
<th>Overall dimensions, mm</th>
<th>Weight, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-inductive load AC 1</td>
<td>220 V 230 V 380 V 400 V 415 V 440 V 500 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEM-250</td>
<td>315</td>
<td>75 132 132 160</td>
<td>AC/DC</td>
<td>150 x 30 x 82</td>
<td>6,4</td>
</tr>
<tr>
<td>CEM-400</td>
<td>600</td>
<td>125 220 230 300</td>
<td>AC/DC</td>
<td>170 x 160 x 73</td>
<td>11,5</td>
</tr>
<tr>
<td>CEM-630</td>
<td>1000</td>
<td>220 375 400 425 480</td>
<td>AC/DC</td>
<td>170 x 200 x 91</td>
<td>18,0</td>
</tr>
</tbody>
</table>
Multi-channel Audio Logger digioLOG

Reliable standalone DSP based professional audio logging device with built-in storage and LAN support is intended for long-term standalone recording of the audio signals and communication sessions from various sources such as telephone lines, radio station, microphones.

ADVANTAGES
- Operating without computer
- Low power consumptions
- Accumulator connectivity
- Cooling fan absence, silent operation
- Fast access to the data
- Embedded long-term (for more than 1 year) audio-archive
- Internal flash disk
- Multi-purpose inputs with galvanic uncoupling and overvoltage protection
- Built-in DSP sound
- Full electronic control
- Easy scalability and integration to global net
- Real-time access and monitoring
- Internet connection
- Authorized access to stored information
- User firmware upgradeable

MAIN SUPPLY DURING RECORDING
Up to 5 W during simultaneous recording of all channels onto a hard disk and data access with 100 Mb.

SOFTWARE
Software for the operation with recorders DigioLog:
- digioView
- digioConfig

RANGE OF APPLICATION
Dispatching services of oil and gas industry, dispatching centers of gas and oil-refining companies, energy supply and energy distribution, railway transport, air transport, shipping, transport companies, for the notification of police and fire brigades, ambulance, control centers of Emergency Management Agency, police, civil defense and rescue services, banks and institutions security.

PERFORMANCE CAPABILITIES
- 4 multi-purpose galvanic uncoupling channels: telephone / linear / balanced / phantom 12V
- Hard disk 40 Gb and more
- Flash disk/buffer: 0.1...1 Gb (option)
- Sampling Rates 8, 16, 32 kHz
- High-resistance parallel connection to the line
- Signal/Noise Ratio: >80 dB
- ACD Resolution 24 Bits
- Preamplifier up to +46 dB
- Registration: ingoing, outgoing, dialing, automatic number detector, DTMF, Caller ID, fax
- Triggering Events: telephone line, VOX (voice activated), timer, by operator's command, external sensors, keyboard.
- Time synchronization
- Interfaces: RS-232, Ethernet 10/100 Mbit
- Performance:
  01 – two-colored status LED;
  02 – graphical LCD, control buttons;
  03 – graphical LCD, control buttons, IR remote, embedded loud speaker
- Independent adjustable dynamic range compressor
- Volume leveling of remote and near users
- Headphones output
- Compact dimensions: 105 x 130 x 44 mm
- Weight: 500 g
Sales geography of CJSC ELEKTON

RUSSIA
KAZAKHSTAN
UZBEKISTAN
UKRAINE
INDIA
LIBYA
INDONESIA
OMAN

ELEKTON IN RUSSIA
- Buzuluk
- Gubkinsky
- Izhevsk
- Kogalym
- Langepas
- Megion
- Narian-Mar
- Nefneugansk
- Nizhnevartovsk
- Novosibirsk
- Noyabrsk
- Nyagan
- Penza
- Pokachi
- Raduzhny
- Samara
- Saratov
- Strezhevoy
- Surgut
- Tomsk
- Tumen
- Ulianovsk
- Urai
- Usinsk

COMPANIES USING ELEKTON EQUIPMENT IN RUSSIA

TNK-BP
Yukos
Sibneft
LUKoil
Slavneft
Rosneft
Russneft
Bashneft
- TNK-Samotlorneftegaz
- TNK-Orenburgneft
- TNK-NNP
- TNK-Nyagan
- TNK-Saratovneftegaz
- Tumenneftegaz
- SP-Vanyeganneftegaz
- Sibneft-Noyabrskneftegaz
- Uganskneftegaz
- Tomskneft
- Samaraneftegaz
- Surgutneftegaz
- Slavneft-Megionneftegaz
- LUKoil-Western Siberia
- LUKoil-Komi
- NK-Rosneft-Purneftegaz
- Variegunnneftegaz
- Variegunnneft
- Udmurtnneft
- Zapadno-Malobalykskoe
- Ulianovskneft
- Penzanef
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We invite domestic and foreign firms, whose business is the oil production, to business cooperation on the mutually-beneficial basis