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product code for export supply

Approved
ДИВГ.421241.001 РЭ - ЛУ

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"For APS"

"DUGA-O" RECORDER

Operator's Manual

ДИВГ.421241.001 РЭ

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12 sheets
A4 format

This operator's manual (OM) is purposed for studying "Duga-O" recorder ДИВГ.421241.001 (further - Recorder) design, functioning principle, rules of mounting and operating.


Recorder's designs are protected by useful model patent № 49386 with priority of 31.05.2005.

1 Safety measures

1.1 Recorder may be mounted, maintained and operated only by qualified personnel trained for performing such works, who has studied operational documents for Recorder, passed safety training and has access authorization not lower than the third electrical safety qualification level.

Personnel is to be qualified by operating organization for the right of performing works in volume, which was stipulated in operational documents for Recorder.

1.2 Prior to switching on, it is necessary to inspect Recorder for the absence of external defects which may affect safety, such as contacts' deformation and corrosion, connectors' chipping and cracks of carrier socket connectors.

ATTENTION: PRIOR TO APPLICATION OF SUPPLY VOLTAGE OR ANY SIGNALS, AN EARTHING WIRE WITH SECTION AREA NOT LESS THAN 1.5 mm^2 IS TO BE CONNECTED TO THE RECORDER'S EARTH TERMINAL MARKED "  " !

1.3 Any inputs or outputs can be connected only when Recorder's supply is off.

1.4 When measuring resistance and checking Recorder's circuits insulation strength, it is necessary to observe safety rules regarding use of megohmmeters.

2 Purpose of product

2.1 "Duga-O" Recorder ДИВГ.421241.001 is designed for joint operation with fiber-optic sensors (FOS) and "DUGA-БЦ" unit as part of "DUGA-МТ" device ДИВГ.421453.002.

Recorder can be used in arcing protections of switchgears (s/g) without "DUGA-БЦ" unit, effecting on digital devices of relay protection and automatics (DDRPC), for example, relay protection microprocessor unit (RPMU) produced by Mehanotronika NTTs.

When using Recorder without "DUGA-БЦ" unit, it is necessary to take into account Recorder's outputs switching capacity (table 1).

Recorder performs conversion, transmission, storing and displaying signals from fiber-optic sensors when arcing faults occur, and also localization of arcing fault within the accuracy of a cubicle.

Recorder is designed for installation in switchgear cells 0.4-35 kV, including at atomic energy industry installations.

2.2 Recorder performs:

a) conversion of light signals into electric signals and forming signals of non-contact relay-controlled outputs;

b) forming signals of light signalling of arcing fault sensors actuation;

c) blocking of output signal in cases of prolonged gating of corresponding input;

d) storing signals, including the cases of control supply failure;

e) acknowledgement of signalling by button located on Recorder's front plate;

f) power circuits control and "Defect. ACR" signal forming.

2.3 Recorder's delivery complete set is shown in label ДИВГ.421241.001 ЭТ.

3 Technical characteristics

3.1 Recorder can be powered from a direct or rectified current source with rated voltage of 110 or 220 V, and also from alternating current source with frequency of (50 ± 5) Hz with effective rated voltage of 220 V. Supply voltage effective range is from 88 to 132 V (for voltage 110 V) and from 176 to 264 V (for voltage 220 V).

3.2 Rated power consumed by Recorder from control current source in all regims is not more than 1 W.

3.3 Recorder measures 115x116x62.2 mm (width x height x depth), its net weight is not more than 0.7 kg.

3.4 Recorder is produced for installation in unheated premises with operating range of temperature values from minus 40 to plus 55°C.

Other operation conditions:

a) relative air humidity up to 98% at a temperature of plus 25°C and lower temperatures without moisture condensation;

b) atmospheric pressure from 73.3 to 106.7 kPa (from 550 to 800 mm of mercury column);

c) height of equipment installation above sea level no more 2000m;

d) environment – unexplosive, not containing current-conducting dust, corrosive vapours and gases destroying insulation and metals;

d) installation place must be protected from splashes, water, oils, emulsions, and also from direct action of solar radiation.

3.5 Recorder endures earthquakes measuring 9 points on MSK-64 at the level of installation above zero mark up to 10 m according to GOST 17516.1-90.

3.6 Recorder endures, rated voltage applied to power supply circuits without break-down or overlap, and rime falls on Recorder and further melts.

3.7 Mechanical design group – M7 according to GOST 17516.1-90.

3.8 Recorder does not operate falsely due to collecting and supply of control current, and also as due to interruptions in supply of any duration with further restoration.

3.9 Recorder is not damaged:

- in case of voltage supply of control direct current of reverse polarity;

- in case of control current circuits fault to earth.

3.10 Recorder's time of availability for forming signals of light signalling after supply of control current – not more than 0.25 s.

3.11 Storage time for information about light indicators condition if power supply is lost – not less than 5 years.

3.12 Resistance of insulation between Recorder's output (contacts of 1-12 connector) and power supply input (contacts 13. 14 of connector), between, between supply input and Recorder case in cold condition¹⁾ constitutes:

a) not less than 100 mega ohm– in normal climatic conditions according to GOST 20.57.406-81;

b) not less than 1 mega ohm – at high humidity.

3.13 Recorder's insulation endures without break-down and overlapping between outputs (contacts 1-12 of connectors) and supply input (contacts 13. 14 of connector), between supply unput and Recorder case, between supply input and Recorder case in cold condition, at normal climatic conditions according to GOST 20.57.406-81:

- test voltage of alternating current of 2.0 kV (effective value) with frequency of (50 ± 1) Hz during 1 min;

- test impulse voltage of 5 kV in accordance with GOST P 50514-93 (three positive and three negative impulses).

3.14 Protection degree provided by Recorder's jacket, according to GOST 14254-96:

- IP65 – on the front plate;

- IP20 – on the connector;

- IP30 – the others.

3.15 Recorder performs its functions in conditions of electromagnetic interference:

a) nanosecond impulse interference according to GOST P 51317.4.4-99 (tests severity degree 3, operation quality criterion B), pulse amplitude of test oscillator output voltage in open-

¹⁾ Cold condition - Recorder is off and remained in normal climatic conditions for not less than 2 hours.

- circuit at repetition frequency of 5 kHz:
- in electric supply circuits 2 kV
 - in inputs/outputs circuits 1 kV;
 - b) electrostatic discharges according to GOST P 51317.4.2-99 (tests severity degree 3, operation quality criterion B), test voltage:
 - contact discharge 6 kV
 - air discharge 8 kV;
 - c) dynamic changes of supply voltage, amplitude of voltage dynamic changes, % of rated supply voltage:
 - voltage depression for 0.5 s 20
 - surge of voltage for not less than 2 s 20
 - voltage interruption for 0.5 s (for rated control supply voltage 220 V) (tests severity degree 4 according to GOST P 51317.4.11-99) 100

3.15 Recorder is referred to items non-repairable onsite. Recorder's average time-between-failures (T_{BF}) – not less than 18,000 hours. Recorder's average service life (T_{SL}) – not less than 15 years.

Recorder's characteristics and parameters are shown in table 1.

Table 1


Parameter or characteristic	Value
1 Signal inputs from FOS:	
a) number of inputs	4
b) operation threshold, lx	3000 ± 500
2 Outputs (non-contact relay):	
a) number of outputs	4 + 1*
b) current type	direct, alternating
b) commutation voltage, V, not more than	264
d) load current range, mA, not more than	100
3 "Defect. ACR" output:	
a) direct current commutation voltage range, V	24 - 264
b) fault current, A, not more than	2.50
c) release current under resistive-inductive load with time constant L/R 20 ms, A, not more than	0.15
*The fifth output duplicates the fourth	

3.17 Additional requirements if Recorder is supplied to atomic power station (APS).

3.17.1 By electromagnetic compatibility Recorder corresponds to the requirements of III group of modification of stability to interference according to GOST P 50746-2000, operation quality criterion B, types of action according to item 3.15.

3.17.2 Recorder corresponds to aseismic class II according to НП-031-01.

4 Design and operation

4.1 Four indicators with marking of corresponding sensor "1" – "4" (table 2) are arranged on Recorder's front plate (picture 1). "READY" indicator and "Acknowledgement" button are positioned below them (mnemonical representation "  ").

4.2 Recorder is fixed by the front plate with four screws.

4.3 A printed circuit board with radioelements and connectors for connection of external circuits and optic sensors is placed inside Recorder's jacket, and performs:

- conversion and transmission of input signals from sensors to outputs with adaptive duration and blocking of output signals;
- forming signals of light indication with "storing";

- acknowledgement of signals from the front plate button;
- galvanic isolation of output signals for their integration in "wired OR" circuit.

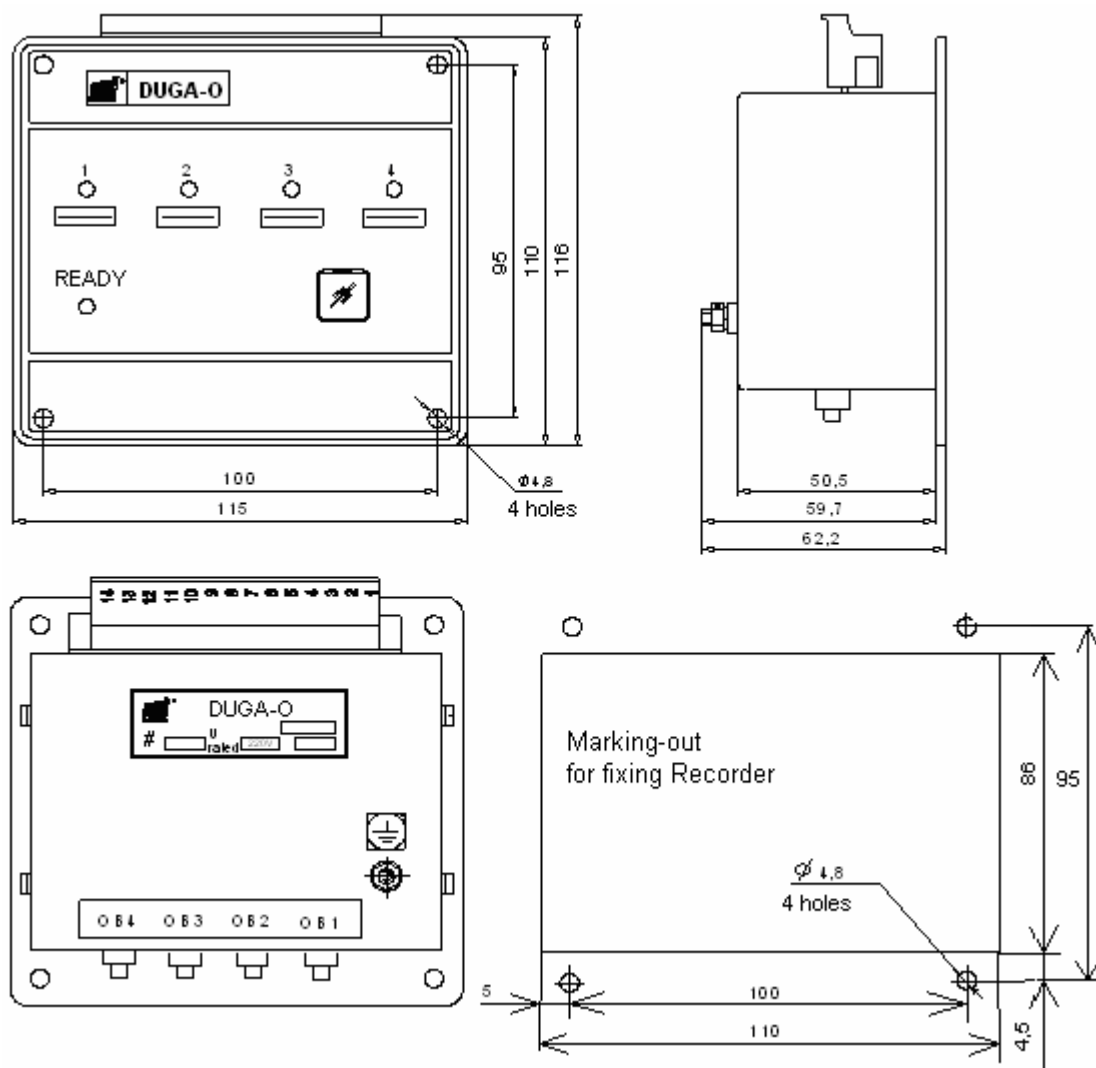
Table 2

Marking and colour	Indicator's purpose
READY Green	Recorder's operation indication Constant glow – Recorder is on and operable. Off – absence of power supply or Recorder is inoperable.
1; 2; 3; 4. Red	Signalling Off – no signal from sensor or signal is read and acknowledged. Constant glow – there is an unacknowledged signal from sensor. Flashing – signal from input is not removed.

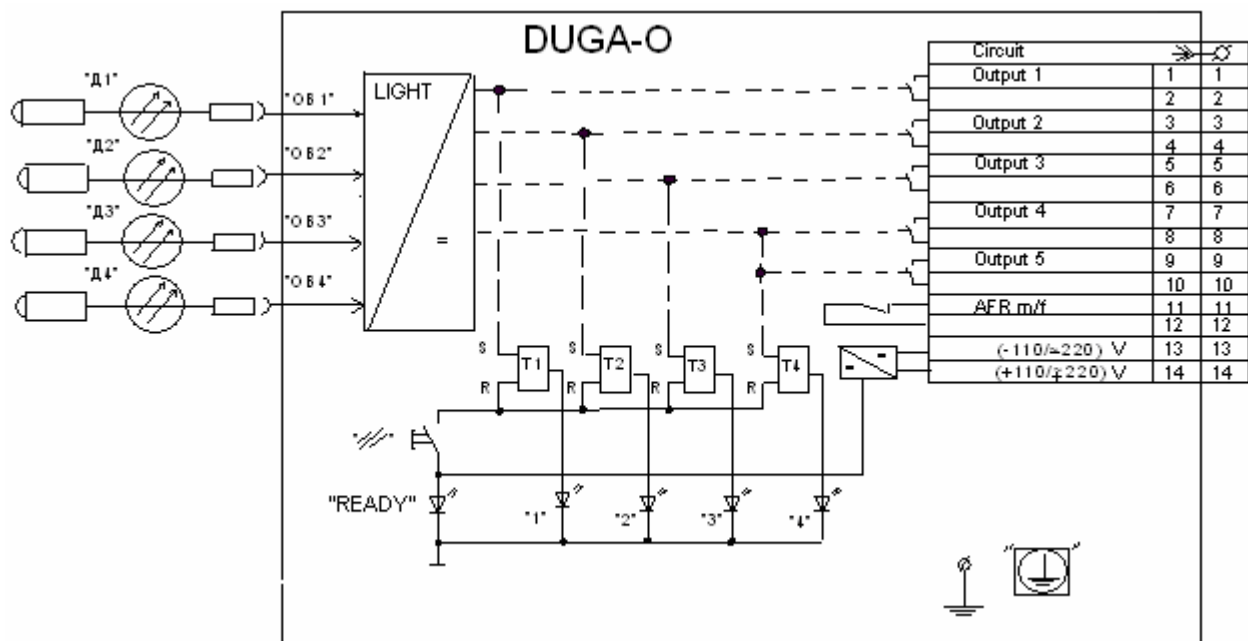
4.4 Source point and "Defect. ACR" relay with break contact are placed on the printed circuit board. "Defect. ACR" relay is closing contacts 11 and 12 in cases of control supply failure, Recorder's malfunction, and if input signal is longer than 1 s. Recorder's block diagram is shown in the picture 2.

4.5 An individual indicator corresponds to each Recorder's input. When there's a signal from a sensor, the corresponding indicator comes on. In cases of supply voltage failure and further recovery, light signalling remains. Below indicators, there is a field for insertion of designation of switchgear cubicle in which the sensor is installed.

4.6 Signals of light signalling are cleared by ACKNOWLEDGEMENT button.



Picture 1 – Recorder's overall, connecting and mounting dimensions



Picture 2 – Recorder's block diagram

4.7 Non-contact output signals duration (T_{OUT}) depending on input light signals duration (T_{IN}) is shown in table 3 and in picture 3.

Table 3

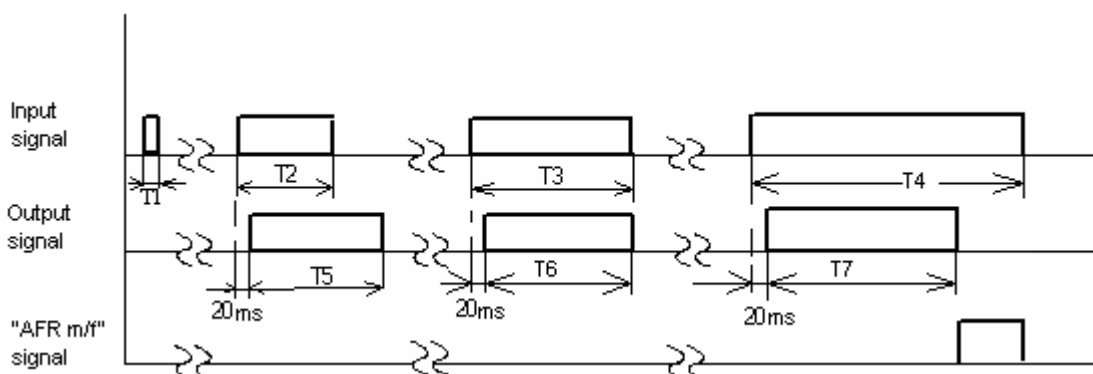
Signals duration	Value			
Input (T_{IN}), ms	T1 from 0 to (15 ± 5)	T2 from 20 to 300	T3 from 300 to 1000	T4 >1000
Output (T_{OUT}), ms	0	T5=300	T6 \approx T3	T7=1000

4.7.1 If input signal duration is equal to T1, there is no output signal.

4.7.2 If input signal duration is more than 1000 ms (T_4), "AFR m/f" signal is formed, and corresponding indicator changes into flashing mode with frequency of 2 Hz until input signal is cleared, and the output signal (T_7), corresponding to the input signal is blocked.

4.7.3 When input signal fails, "AFR m/f" signal is cleared and channels of output signals forming are reset.

4.7.4 Relative error in measuring signals duration not more than 20%.



Picture 3 – Time diagrams of output signals forming

5 External connections

5.1 Recorder's external connections are effected with electrical and optic connectors located on Recorder, in accordance with circuit diagram of connection (picture 4, where $\Delta 1 - \Delta 4$ are fiber-optic sensors of arcing faults, "OB1" – "OB4" are connectors for connecting sensors).

5.2 Connector (picture 5) is intended for connecting each contact to one conductor

with section from 0.35 to 2.5 mm².

6 Intended use

6.1 Unpack Recorder and check its completeness in accordance with Section 3 of Label ДИВГ. 421241.001 ЭТ.

6.2 Inspect Recorder, checking for:

- absence of mechanical damages and faults in covers;
- security of connector's mounting;
- availability and condition of marking on Recorder.

6.3 To connect conductors to the connector's cable part, unscrew screw 3 with a screwdriver of corresponding size (picture 5). Put conductor's end into the opened hole 2 and drive screw 3 right home. Pull the conductor to check its fastening.

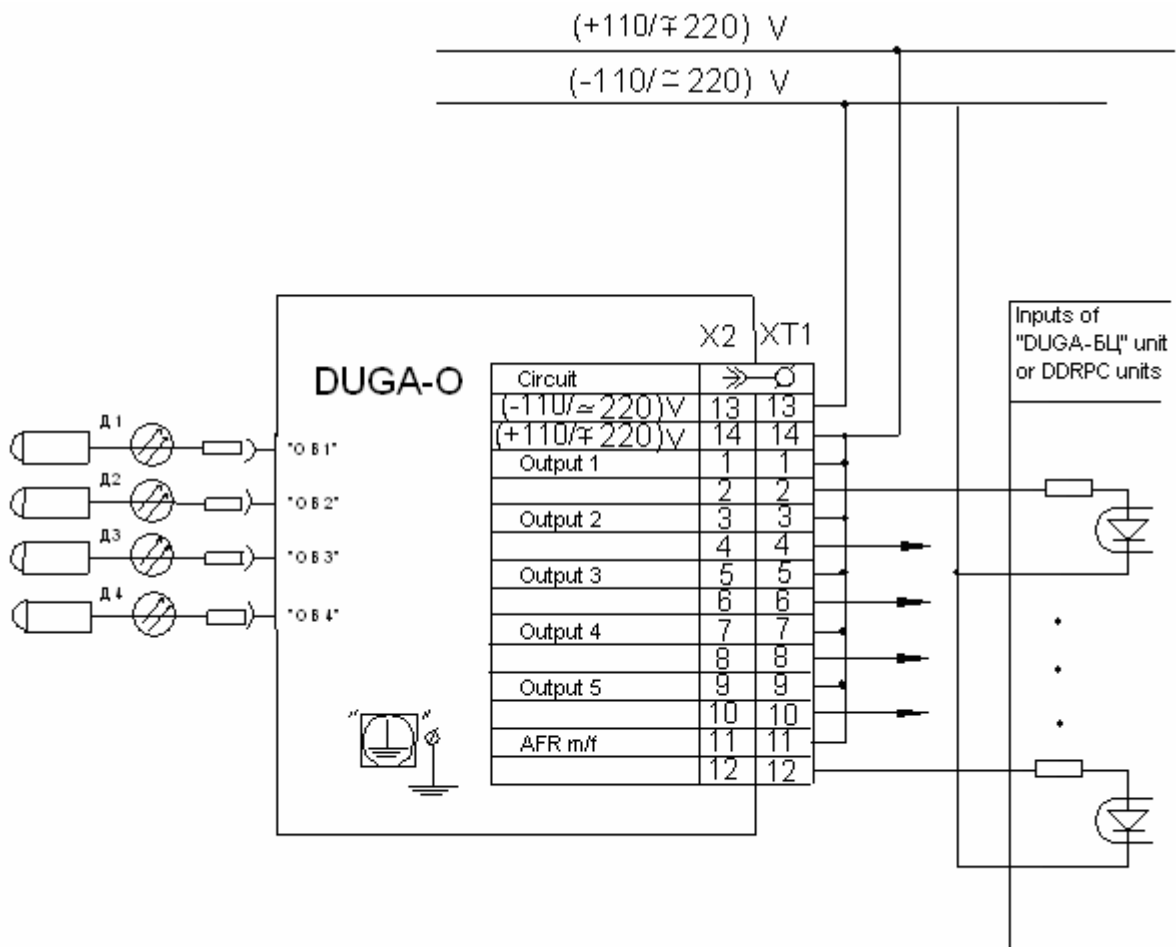
6.4 To connect two conductors to connector's contact, terminate their cores with one pin lug.

6.5 To take off connector's cable part, unscrew screws 1 and 4, fixing connector's cable part to the cell part. Pull first one end of connector's cable part, then the other end.

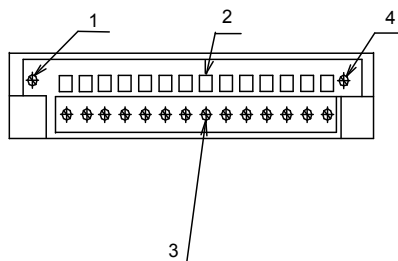
6.6 Earth Recorder with a wire of section not less than 1.5 mm², connected to the earth terminal with "⏏" marking, positioned on Recorder's rear side (see picture 1).

6.7 Prior to Recorder's first switching on, as well as during operation routine inspections, check electrical resistance and electrical strength of insulation between Recorder's circuits 1-14 and jacket (earth terminal "⏏") according to the circuit diagram of connection (see picture 4).

ATTENTION: RECORDER'S CONTROL AND CHECKING MUST BE CARRIED OUT IN NORMAL CLIMATIC CONDITIONS!



Picture 4 - circuit diagram of connection (example)



Picture 5 - Connector

6.8 Insulation resistance should be controlled with megohmmeter with test voltage not more than 2500 V. In normal climatic conditions, insulation resistance should not be less than 100 megohm.

6.9 Check correspondence of Recorder's external connections mounting to the Recorder's connection design circuit and circuit diagram of connection (see picture 4).

6.10 Switch on Recorder's power supply. Check Recorder's operability by "READY" indicator on Recorder's front plate and by absence of "AFR m/f" signal (contacts 11 and 12).

6.11 To check Recorder, apply a short (less than 1 s) light signal from arcing fault simulator successively to each FOS connected to Recorder's inputs, or apply a light signal from FOS simulator to each input "OB1" - "OB4".. In doing so, it is necessary to watch that light signaling appears on the indicator corresponding to this input.

When input light signal is read, watch that light signaling is preserved on Recorder's front plate. Switch off and after some minutes switch on again Recorder's power supply, and make sure that light signalling memory is stored. Light signalling is acknowledged by single pressing of ACKNOWLEDGEMENT button.

6.12 To check actuation of "AFR m/f" output relay, switch off control supply and control the changes of digital output condition with the help of multimeter set in ohmmeter mode, or make "prolonged gating": apply an input light signal with duration of more than 1 s. During the prolonged signal, watch flashing of indicator "1" - "4" corresponding to the input, to which the light signal is applied.

7 Maintenance

7.1 Maintenance can be carried out with periodicity determined by effective regulations and instructions of operating organization, regarding maintenance of switchgear cubicles.

7.2 During maintenance the following works should be performed:

- taking off dust and greasing from Recorder's external surfaces;
- connector's screws tightening and control of conductors' fastening;
- control of insulation resistance;
- control of earthing quality.

7.3 Dust and greasing are taken off from Recorder's external surfaces with unbleached calico moistened in ethyl alcohol GOST 17299-78 and wrung.

8 Routine repair

8.1 Faulty Recorder is replaced with operable.
Recorder's repair is performed by manufacturer.

9 Marking, packaging and sealing

9.1 Recorder's marking corresponds to the requirements of GOST 18620-86 and the set of design documentation (DD).


Marking application quality provides legibility for the whole life time period.

Recorder's front plate contains the following information:

- manufacturer's trade mark;
 - Recorder's code name;
 - symbols designating button purpose and indicators' numbers.
- Contacts numbers are stated on the connector.

Nameplate attached to the Recorder's rear side contains:

- manufacturer's trade mark;
- full code name (DUGA-O);
- serial number according to manufacturer's numbering system;
- year of production;
- product conformity sign (if any);
- rated supply voltage;
- inscription "For APS" (when supplied to atomic power stations).

"Earth" "  " sign is marked near terminal on Recorder's rear side, as well as

designation of connectors for connecting sensors.

9.2 Recorder is packed in a separate hermetically sealed polyethylene bag.

A bag with silica gel should be put into the polyethylene bag with Recorder.

9.3 Recorder and a set of operation documents are packed in a board box.

To improve transportation conditions for Recorder, empty spaces in package box are filled with packing paper or other material.

9.4 When packing Recorder, manufacturer must prepare a packing list in three copies.

One copy of the packing list must be placed inside the shipping container, the second must be stuck on the container, the third must be left in the manufacturer's quality control department (further - QCD).

Packing list must contain the following information:

- Recorder's full code name;
- Recorder's quantity;
- date of packing;
- signature of a person responsible for packing and QCD stamp.

9.5 Shipping container's marking corresponds to GOST 14192-96, set of design documentation and contains the following information:

- handling signs: "Keep from moisture", "Limitation on temperature";
- basic inscriptions: consignee, point of destination, quantity of packages in batch and consecutive number inside batch;
- additional inscriptions: consignor, point of departure;
- information inscriptions: package gross and net weight, package overall dimensions.

9.6 Sealing of Recorder is not provided for.

10 Transportation and storage

10.1 Packed Recorders must be transported in the following climatic conditions:

- ambient air temperature - from minus 40 to plus 60°C;
- relative air humidity at 25°C – up to 100%;
- atmospheric pressure - from 84.0 to 106.7 kPa (from 630 to 800 mm of mercury).

Packed Recorders can be transported by all types of roofed transportation means (in a roofed vehicle, closed wagon, ship hold, sealed heated airplane compartment).

Transportation by river or sea transportation means is effected upon agreement with consumer.

A box with packed Recorders should be securely fastened in transportation means, its stable position secured.

Transportation should be effected in accordance with carriage regulations effective for each transportation means.

10.2 Packed Recorders' storing conditions by supplier and consumer should correspond to the storage conditions 1(Л) of GOST 15150-69.

Free movement of packed Recorders and access to them should be provided in the storage.

Packed Recorders should be stored on a rack. And the distance should be ensured of not less than:

- 0.1 m between Recorders, walls and floor;
- 0.5 m between Recorders and storage's heating devices.

11. Environment protection

11.1 Use of Recorder requires no special measures on environment protection.

List of abbreviations

APS -	Atomic power station
RPMU -	Relay protection microprocessor unit
FOS -	Fiber-optic sensor
DD -	Design documentation
QCD -	Quality control department
AFR -	Arcing faults recorder
s/g -	Switchgear
OM -	Operator's manual
RPCDD -	Relay protection and control digital device

