



**ELECTRUM AV**

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MO14, MO15D

**OPTOELECTRONIC MODULES FOR DC COMMUTATION  
MO14, MO15D**

**USER'S MANUAL**



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## 1. APPLICATION AND PRODUCED MODULES

Optoelectronic modules for DC commutation (semiconductor optoelectronic normally opened unidirectional relay with low turn-on current) of types MO14 and MO15D are intended to use in automatics devices as a switching element with maximum peak voltage up to 1200 V and DC up to 400 A. The optoelectronic modules for DC commutation (hereinafter - modules) are represented with the following versions:

**MO14A** – a module based on MOSFET-transistor shunted with a reverse fast-recovery diode with control voltage 4...10 V.

**MO14B** – a module based on MOSFET-transistor shunted with a reverse fast-recovery diode with control voltage 10...30 V.

By the power switch types the modules MO14 are represented with the following versions (specified maximum permissible values of the currents and voltages):

Peak voltage 60 V with an amount of DC 10,20,40,60,80,120,200,240,300,400 A.

Peak voltage 100 V with an amount of DC 5,10,20,40,60,80,120,160,200,240,300,400 A.

Peak voltage 200 V with an amount of DC 5,10,20,40,60,80,120,160,200,240,300,400 A.

Peak voltage 250 V with an amount of DC 10,20,40,60,80,120,160,200,240 A.

**MO15DA** – a module based on IGBT-transistor shunted with a reverse fast-recovery diode with control voltage 4...10 V.

**MO15DB** – a module based on IGBT-transistor shunted with a reverse fast-recovery diode with control voltage 10...30 V.

By power switch types the module MO15D are represented with the following versions (specified maximum permissible values of the currents and voltages):

Peak voltage 600 V with an amount of DC 5,10,20,30,40,60,80,120,160,200,240,300 A.

Peak voltage 1200 V with an amount of DC 5,10,20,30,40,60,80,120,160,200,240,300 A.

Depending on the current and version the modules MO are produced in versions that are represented Table 1.1. The modules are produced only in the versions where at crossing the class line (peak voltage of power switch, maximum permissible one) of the module and the current column is specified the overall dimension corresponding to the version.

Table 1.1 – Produced modules MO14, MO15B and corresponding to them overall dimensions

Type	Class	Current, A												
		5	10	20	30	40	60	80	120	160	200	240	300	400
MO14	0,6		Fig.6.1	Fig.6.1		Fig.6.1	Fig.6.1	Fig.6.1	Fig.6.2		Fig.6.3	Fig.6.3	Fig.6.4	Fig.6.4
	1	Fig.6.1	Fig.6.1	Fig.6.1		Fig.6.1	Fig.6.1	Fig.6.1	Fig.6.2	Fig.6.2	Fig.6.3	Fig.6.3	Fig.6.4	Fig.6.4
	2	Fig.6.1	Fig.6.1	Fig.6.1		Fig.6.1	Fig.6.1	Fig.6.1	Fig.6.2	Fig.6.2	Fig.6.3	Fig.6.3	Fig.6.4	Fig.6.4
	2,5	Fig.6.1	Fig.6.1	Fig.6.1		Fig.6.1	Fig.6.1	Fig.6.2	Fig.6.2	Fig.6.2	Fig.6.3	Fig.6.3		
MO15D	6	Fig.6.1	Fig.6.1	Fig.6.1	Fig.6.1	Fig.6.1	Fig.6.1	Fig.6.2	Fig.6.2	Fig.6.2	Fig.6.3	Fig.6.3	Fig.6.4	
	12	Fig.6.1	Fig.6.1	Fig.6.1	Fig.6.1	Fig.6.1	Fig.6.1	Fig.6.2	Fig.6.2	Fig.6.2	Fig.6.3	Fig.6.3	Fig.6.4	

On Figure 1.1 shown modules name explanation.

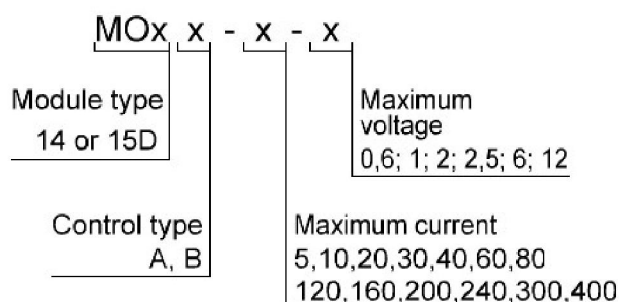


Figure 1.1 – Modules name explanation

For example, module MO15DA-80-12: a module with control voltage 4...10 V, with maximum permissible voltage of collector-emitter 1200 V and maximum DC 80 A.

## 2. GENERAL DESCRIPTION

Functional circuits combined with switching circuits of modules MO14 and MO15B are represented on Figures 2.1 - 2.4.

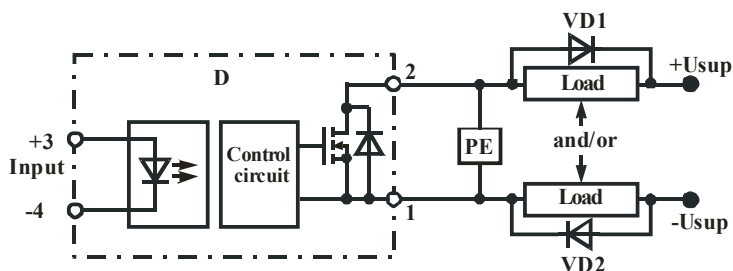


Figure 2.1 – Functional circuit of MO14 (Figure 6.1)

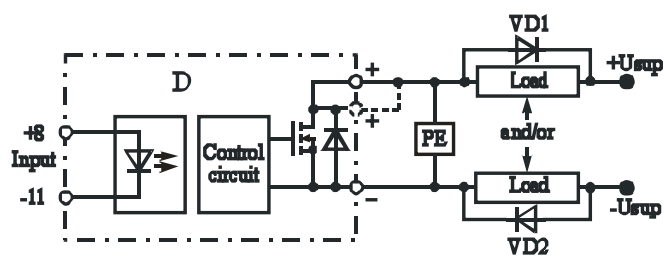


Figure 2.2 – Functional circuit of MO14 (Figure 6.2,3,4)

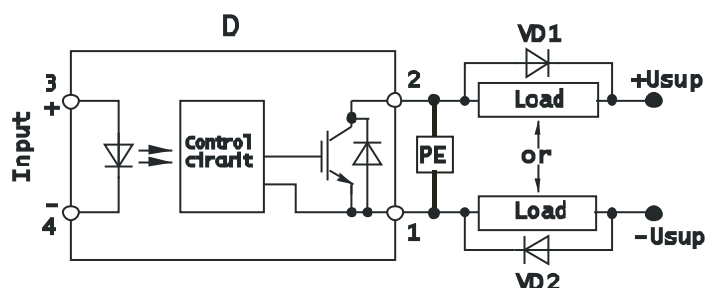


Figure 2.3 – Functional circuit of MO15D (Figure 6.1)

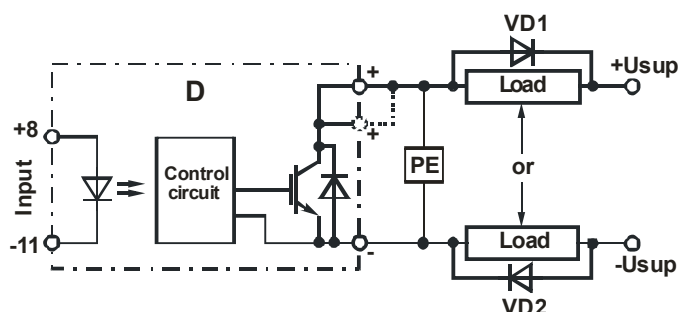


Figure 2.4 – Functional circuit of MO15D (Figure 6.2,3,4)

Where D – module; VD1,VD2 – diodes (are installed at inductive load); PE – protection element.

## 3. BASIC PARAMETERS

Basic parameters and maximum permissible parameters of the modules at temperature 25°C are shown in Tables 3.1 – 3.13.

Table 3.1 – Basic and maximum permissible control parameters of the modules MO14, MO15D

Class		0,6; 1; 2; 2,5			6,12	
Current, A		≤120	160, 200	240,300,400	≤200	240, 300
Parameter name, unit	Symbol					
Input current of ver. «A» at $U_{IH} = 4\text{ V}$ (max), mA	$I_{IN}$	7	15	20	7	15
Input current of ver. «A» at $U_{IH} = 10\text{ V}$ (max), mA		15	30	45	15	30
Input current of ver. «B» at $U_{IH} = 10\text{ V}$ (max), mA		10	20	30	10	20
Input current of ver. «B» at $U_{IH} = 30\text{ V}$ (max), mA		20	40	60	20	40
Switch-on voltage of ver. «A», V	$U_{IH}$	4...10				
Switch-on voltage of ver. «B», V		10...30				
Switch-off voltage of ver. «A», V	$U_{IL}$	-3.5...0.8				
Switch-off voltage of ver. «B», V		-3.5...0.8				
Input pulse voltage of ver. «A» (max), V	$U_{IP}$	30				
Input pulse voltage of ver. «B» (max), V		120				
On / off duration (max), ms	$t_{on/off}$	20 / 1				

Table 3.2 – Basic and maximum permissible parameters of modules of 0,6 class - up to 80 A

Parameter name, unit	Symbol	Current, A				
		10	20	40	60	80
Drain-source voltage (max), V	$V_{DSS}$	60				
Direct voltage of power circuit (max), V	$V_{DC}$	35				
Power circuit DC (max), A	$I_{DC}$	10	20	40	60	80
Pulse current of power circuit (max), A	$I_P$	30	60	120	180	240
Drain-source resistance in open state (max), m $\Omega$	$R_{DS(on)}$	60	28	12	3	6
Direct of voltage fall on reverse diode (max), V	$V_F$	1.3				
Leakage current of power switch (max), $\mu A$	$I_{DSS}$	50				
Junction temperature (max), $^{\circ}C$	$T_j$	150				
Junction-base thermal resistance (max), $^{\circ}C/W$	$R_{th(j-a)}$	2.7	1.6	1.0	0.7	0.5
Insulation strength, (DC), V	$V_{ISOL}$	1000				

Table 3.3 – Basic and maximum permissible parameters of modules of 0,6 class – up to 400 A

Parameter name, unit	Symbol	Current, A				
		120	200	240	300	400
Drain-source voltage (max), V	$V_{DSS}$	60				
Direct voltage of power circuit (max), V	$V_{DC}$	35				
Power circuit DC (max), A	$I_{DC}$	120	200	240	300	400
Pulse current of power circuit (max), A	$I_P$	360	600	720	900	1200
Drain-source resistance in open state (max), m $\Omega$	$R_{DS(on)}$	1.5	1.0	0.75	0.6	0.5
Direct voltage drop on reverse diode (max), V	$V_F$	1.3				
Leakage current of power switch (max), $\mu A$	$I_{DSS}$	200				
Junction temperature (max), $^{\circ}C$	$T_j$	150				
Junction-base thermal resistance (max), $^{\circ}C/W$	$R_{th(j-a)}$	0.35	0.25	0.2	0.15	0.12
Insulation strength, (DC), V	$V_{ISOL}$	1000				

Table 3.4 – Basic and maximum permissible parameters of modules of 1 class – up to 80 A

Parameter name, unit	Symbol	Current, A					
		5	10	20	40	60	80
Drain-source voltage (max), V	$V_{DSS}$	100					
Direct voltage of power circuit (max), V	$V_{DC}$	60					
Power circuit DC (max), A	$I_{DC}$	5	10	20	40	60	80
Pulse current of power circuit (max), A	$I_P$	15	30	60	120	180	240
Drain-source resistance in open state (max), m $\Omega$	$R_{DS(on)}$	200	120	55	27	20	14
Direct voltage fall on reverse diode (max), V	$V_F$	1.3					
Leakage current of power switch (max), $\mu A$	$I_{DSS}$	50					
Junction temperature (max), $^{\circ}C$	$T_j$	150					
Junction-base thermal resistance (max), $^{\circ}C/W$	$R_{th(j-a)}$	3.3	2.1	1.3	0.9	0.6	0.5
Insulation strength, (DC), V	$V_{ISOL}$	1000					

Table 3.5 – Basic and maximum permissible parameters of modules of 1 class – up to 400 A

Parameter name, unit	Symbol	Current, A					
		120	160	200	240	300	400
Drain-source (max), V	$V_{DSS}$	100					
Direct voltage of power circuit (max), V	$V_{DC}$	60					
Power circuit DC (max), A	$I_{DC}$	120	160	200	240	300	400
Pulse current of power circuit (max), A	$I_P$	360	480	600	720	900	1200
Drain-source in open state (max), m $\Omega$	$R_{DS(on)}$	8	6	5	4	2,5	1,8
Direct voltage fall on reverse diode (max), V	$V_F$	1.3					
Leakage current of power switch (max), $\mu$ A	$I_{DSS}$	200					
Junction temperature (max), $^{\circ}$ C	$T_j$	150					
Junction-base thermal resistance (max), $^{\circ}$ C/W	$R_{th(j-a)}$	0.3	0.23	0.18	0.16	0.15	0.12
Insulation strength, (DC), V	$V_{ISOL}$	1000					

Table 3.6 – Basic and maximum permissible parameters of modules of 2 class – up to 80 A

Parameter name, unit	Symbol	Current, A					
		5	10	20	40	60	80
Drain-source voltage (max), V	$V_{DSS}$	200					
Direct voltage of power circuit (max), V	$V_{DC}$	130					
Power circuit DC (max), A	$I_{DC}$	5	10	20	40	60	80
Pulse current of power circuit (max), A	$I_P$	15	30	60	120	180	240
Drain-source in open state (max), m $\Omega$	$R_{DS(on)}$	300	180	85	30	25	15
Direct voltage fall on reverse diode (max), V	$V_F$	1.3					
Leakage current of power switch (max), $\mu$ A	$I_{DSS}$	50					
Junction temperature (max), $^{\circ}$ C	$T_j$	150					
Junction-base thermal resistance (max), $^{\circ}$ C/W	$R_{th(j-a)}$	2.0	1.2	0.9	0.6	0.45	0.31
Insulation strength, (DC), V	$V_{ISOL}$	1000					

Table 3.7 – Basic and maximum permissible parameters of modules of 2 class – up to 400 A

Parameter name, unit	Symbol	Current, A					
		120	160	200	240	300	400
Drain-source voltage (max), V	$V_{DSS}$	200					
Direct voltage of power circuit (max), V	$V_{DC}$	130					
Power circuit DC (max), A	$I_{DC}$	120	160	200	240	300	400
Pulse current of power circuit (max), A	$I_P$	360	480	600	720	900	1200
Drain-source resistance in open state (max), m $\Omega$	$R_{DS(on)}$	9	7	5.5	4.5	3.5	2.8
Direct voltage fall on reverse diode (max), V	$V_F$	1.3					
Leakage current of power switch (max), $\mu$ A	$I_{DSS}$	200					
Junction temperature (max), $^{\circ}$ C	$T_j$	150					
Junction-base thermal resistance (max), $^{\circ}$ C/W	$R_{th(j-a)}$	0.25	0.18	0.14	0.12	0.09	0.07
Insulation strength, (DC), V	$V_{ISOL}$	1000					

Table 3.8 – Basic and maximum permissible parameters of modules of 2,5 class – up to 80 A

Parameter name, unit	Symbol	Current, A					
		5	10	20	40	60	80
Drain-source voltage (max), V	$V_{DSS}$	250					
Direct voltage of power circuit (max), V	$V_{DC}$	170					
Power circuit DC (max), A	$I_{DC}$	5	10	20	40	60	80
Pulse current of power circuit (max), A	$I_P$	15	30	60	120	180	240
Drain-source resistance in open state (max), m $\Omega$	$R_{DS(on)}$	280	140	75	30	25	15
Direct voltage fall on reverse diode (max), V	$V_F$	1.3					
Leakage current of power switch (max), $\mu$ A	$I_{DSS}$	50					
Junction temperature (max), $^{\circ}$ C	$T_j$	150					
Junction-base thermal resistance (max), $^{\circ}$ C/W	$R_{th(j-a)}$	1.0	0.8	0.6	0.5	0.26	0.2
Insulation strength, (DC), V	$V_{ISOL}$	1000					

Table 3.9 – Basic and maximum permissible parameters of modules of 2,5 class – up to 240 A

Parameter name, unit	Symbol	Current, A			
		120	160	200	240
Drain-source voltage (max), V	$V_{DSS}$	250			
Direct voltage of power circuit (max), V	$V_{DC}$	170			
Power circuit DC (max), A	$I_{DC}$	120	160	200	240
Pulse current of power circuit (max), A	$I_P$	360	480	600	720
Drain-source resistance in open state (max), m $\Omega$	$R_{DS(on)}$	10	7.5	6	5
Direct voltage fall on reverse diode (max), V	$V_F$	1.3			
Leakage current of power switch (max), $\mu$ A	$I_{DSS}$	200			
Junction temperature (max), $^{\circ}$ C	$T_j$	150			
Junction-base thermal resistance (max), $^{\circ}$ C/W	$R_{th(j-a)}$	0.17	0.13	0.1	0.09
Insulation strength, (DC), V	$V_{ISOL}$	1000			

Table 3.10 – Basic and maximum permissible parameters of modules of 6 class – up to 60 A

Parameter name, unit	Symbol	Current, A					
		5	10	20	30	40	60
Drain-source voltage (max), V	$V_{CES}$	600					
Direct voltage of power circuit (max), V	$V_{DC}$	350					
Power circuit DC (max), A	$I_{DC}$	5	10	20	30	40	60
Pulse current of power circuit (max), A	$I_P$	15	30	60	90	120	180
Drain-source resistance in open state (max), m $\Omega$	$V_{CE(on)}$	3.0					
Direct voltage fall on reverse diode (max), V	$V_F$	2.5					
Leakage current of power switch (max), $\mu$ A	$I_{CES}$	500					
Junction temperature (max), $^{\circ}$ C	$T_j$	150					
Junction-base thermal resistance (max), $^{\circ}$ C/W	$R_{th(j-a)}$	1.6	1.5	1.4	0.75	0.7	0.5
Insulation strength, (DC), V	$V_{ISOL}$	4000					

Table 3.11 – Basic and maximum permissible parameters of modules 6 class – up to 300 A

Parameter name, unit	Symbol	Current, A					
		80	120	160	200	240	300
Drain-source voltage (max), V	$V_{CES}$	600					
Direct voltage of power circuit (max), V	$V_{DC}$	350					
Power circuit DC (max), A	$I_{DC}$	80	120	160	200	240	300
Pulse current of power circuit (max), A	$I_P$	240	360	480	600	720	900
Drain-source resistance in open state (max), m $\Omega$	$V_{CE(on)}$	3.0					
Direct voltage fall on reverse diode (max), V	$V_F$	2.5					
Leakage current of power switch (max), $\mu$ A	$I_{CES}$	3000					
Junction temperature (max), $^{\circ}$ C	$T_j$	150					
Junction-base thermal resistance (max), $^{\circ}$ C/W	$R_{th(j-a)}$	0.25	0.18	0.13	0.11	0.09	0.07
Insulation strength, (DC), V	$V_{ISOL}$	4000					

Table 3.12 – Basic and maximum permissible parameters of modules of 12 class – up to 60 A

Parameter name, unit	Symbol	Current, A					
		5	10	20	30	40	60
Drain-source voltage (max), V	$V_{CES}$	1200					
Direct voltage of power circuit (max), V	$V_{DC}$	650					
Power circuit DC (max), A	$I_{DC}$	5	10	20	30	40	60
Pulse current of power circuit (max), A	$I_P$	15	30	60	90	120	180
Drain-source resistance in open state (max), m $\Omega$	$V_{CE(on)}$	3.0					
Direct voltage fall on reverse diode (max), V	$V_F$	2.5					
Leakage current of power switch (max), $\mu$ A	$I_{CES}$	500					
Junction temperature (max), $^{\circ}$ C	$T_j$	150					
Junction-base thermal resistance (max), $^{\circ}$ C/W	$R_{th(j-a)}$	2.3	1.4	0.8	0.6	0.5	0.4
Insulation strength, (DC), V	$V_{ISOL}$	4000					

Table 3.13 – Basic and maximum permissible parameters of modules of 12 class – up to 300 A

Parameter name, unit	Symbol	Current, A					
		80	120	160	200	240	300
Drain-source voltage (max), V	$V_{CES}$	1200					
Direct voltage of power circuit (max), V	$V_{DC}$	650					
Power circuit DC (max), A	$I_{DC}$	80	120	160	200	240	300
Pulse current of power circuit (max), A	$I_P$	240	360	480	600	720	900
Drain-source resistance in open state (max), m $\Omega$	$V_{CE(on)}$	3.0					
Direct voltage fall on reverse diode (max), V	$V_F$	2.5					
Leakage current of power switch (max), $\mu$ A	$I_{CES}$	3000					
Junction temperature (max), $^{\circ}$ C	$T_j$	150					
Junction-base thermal resistance (max), $^{\circ}$ C/W	$R_{th(j-a)}$	0.26	0.18	0.13	0.11	0.09	0.07
Insulation strength, (DC), V	$V_{ISOL}$	4000					



## 4. INSTRUCTIONS FOR USE

### General requirements

It is recommended to operate the module at operating value of the average current not more than 80% from specified one in the name of the module and the junction temperature not more than (70÷80)% from the maximum one.

It is not allowed to operate the module in modes at simultaneous influence of two or more maximum permissible values.

In the electric circuit of equipment with using of the modules should be provided the fast-speed protection against prohibitive overloads, SCs and commutating overloads.

### Module mounting

The module is mounted in the equipment to cooler (chassis, application housing, metal plates, etc.) in any orientation with screws M4 with torque  $(5\pm 0.5)$  N·m, with obligatory installation of flat and spring washers. The module should be located in such a way to protect it against additional heat from neighbor elements. The planes of cooler ribs should be oriented in the direction of air flow.

The contact area of the cooler should have roughness not more than  $2.5\ \mu\text{m}$  and flatness tolerance – not more than  $30\ \mu\text{m}$ . Cooler surface should not have any rough edges, honeycombs. There should not be extraneous particles between the module and cooler. To improve the heat balance the module installation to mounting area or cooler should be carried out by instrumentality of heat conducting pastes or having similar heat conducting properties.

When mounting, you should provide uniform pressure of module housing to cooler. For this purpose you should tighten all screws uniform in 2 – 4 steps by turns: first, located on one diagonal, then on the other one. When dismantling the module the screw tightening should be done in the reverse order.

Not earlier than in 3 hours after mounting the screws should be rotated to the end, keeping the prescribed torque, because the part of heat conducting paste under pressure will outflow and the fastening can fail.

You can mount the several modules without additional insulating spacer to one cooler, on condition that voltage between outputs of different modules will not exceed the minimum value of isolation breakdown voltage of each of them or when cooler is grounded.

### Connection to module

Electric wires and cables will be connected to power contacts of the module by means of screws M6 or M5 with torque  $(4 \pm 0.5)$  N·m or by means of bolts M8 or M10 with torque  $(5 \pm 0.5)$  N·m and the washers that are supplied in the package.

Power wires should be connected by means of connectors with corrosion-inhibiting cover, which are purified of foreign layers. When the screws (bolts) are tightened it is recommended to fasten the connection with paint. It is recommended to tighten screws (bolts) repeatedly in 8 days and in 6 weeks after the start of operating. Afterwards tightening should be controlled at least once a half year.

The controlling module outputs (gate and control source output) are intended for mounting by means of soldering or split connectors. Permissible number of module outputs' re-soldering during electronic (assembly) edit is three. Outputs soldering should be performed at temperature not higher than  $(235\pm 5)$  °C. Soldering duration is not longer than 3 sec.

Cores' section of external conductors and cables depending on nominal current are represented in Table 4.1.

Table 4.1 – Cores' section of external conductors and cables depending on current

Nominal current, A	Cores' section of external wires and cables, mm <sup>2</sup>	
	min	max
50	10	25
100	25	50
200	50	120
300	120	-
400	120	-

The controlling module outputs (gate and control source output) are intended for mounting by means of soldering or split connectors. Permissible number of module outputs' re-soldering during electronic (assembly) edit is three. Outputs soldering should be performed at temperature not higher than  $(235\pm 5)$  °C. Soldering duration is not longer than 3 sec.

When mounting and operating it is necessary to make protection measures against static electricity impact and overvoltage in gate circuit; on mounting personnel should use a ground band and grounded low-voltage soldering irons with transformer supply.

### Operation requirements

The module should be used under mechanical loads in accordance with Table 4.2.

Table 4.2 – Mechanical loads impact

External exposure factor	External exposure factor value
Sinusoidal vibration: - acceleration, $m/s^2$ (g); - frequency, Hz	150 (15) 0.5 - 100
Multiple-acting mechanic shock: - peak shock acceleration, $m/s^2$ (g); - shock acceleration duration, ms	40 (4) 50
Linear acceleration, $m/s^2$ (g)	5000 (500)

The module should be used under climatic loads in accordance with Table 4.3.

Table 4.3 – Climatic loads impact

Climatic factor	Climatic factor value
Reduced ambient temperature: - operating, °C; - maximum, °C	- 40 - 45
High ambient temperature: - operating, °C; - maximum, °C	+ 85 + 100
Relative humidity at temperature 35 °C without moisture condensation, %, max	98

### Safety requirements

1. Working with the module should only be performed by qualified personnel.
2. Do not touch the power terminals of the module when applying a voltage.
3. Do not connect or disconnect wires and connectors while the power to the circuit module is applying a voltage.
4. Do not touch the module radiator, if it is not grounded in and is applying a voltage on it.
5. Do not touch the cooler and the module housing during its operation, since their temperature can be very high.
6. Immediately turn off the power supply of the module if it discharges smoke, odor or abnormal noises, check if the module correctly connected.
7. It is not allowed to penetrate water and other liquids to the module.

### 5. RELIABILITY REQUIREMENTS

The manufacturer guarantees the quality of the module all the requirements of the passport if the consumer observes terms and conditions of storage, installation and operation, as well as guidance on the application specified in the user’s manual.

Operating warranty is two years from the acceptance date, in case of requalification – from the date of the requalification.

Reliability probability of the module for 25000 hours must be at least 0.95.

Gamma percentage life ( $T_\gamma$ ) of module at  $\gamma = 90\%$  in typical operation conditions should not be less than 50 000 hours within lifetime.

Gamma-percent service life of the modules, subject to cumulative operating time is not more than gamma-percent life, not less than 10 years, at  $\gamma = 90\%$ .

Gamma-percent storageability time of the modules, at  $\gamma = 90\%$  and storing – 10 years.

### 6. OVERALL AND CONNECTING DIMENSIONS

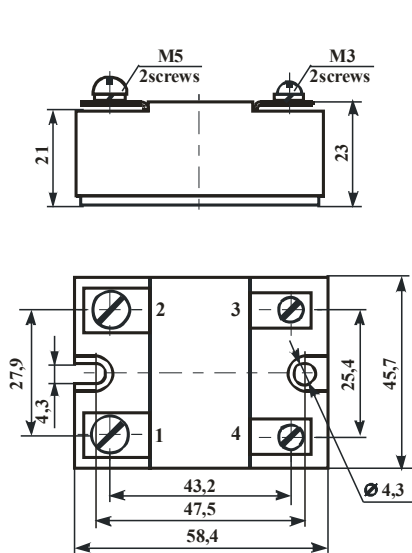


Figure 6.1 – Overall drawing of modules MO14, MO15D with maximum current up to 80 A

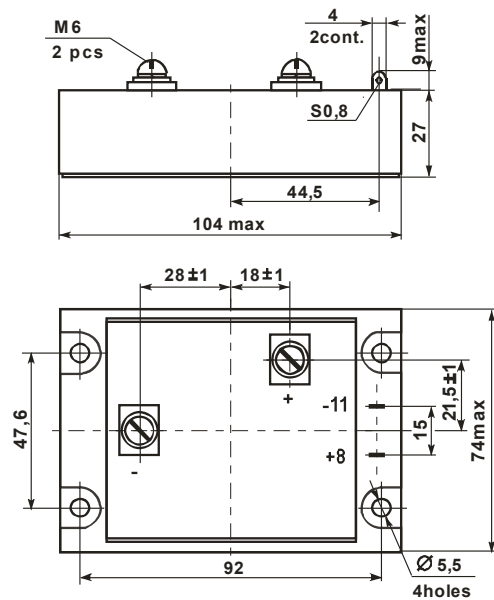


Figure 6.2 – Overall drawing of modules MO14, MO15D with maximum current up to 160 A

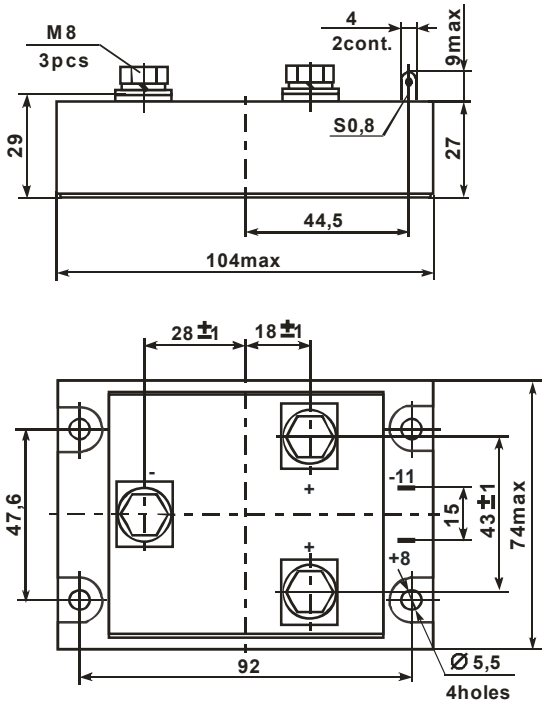


Figure 6.3 – Overall drawing of modules MO14, MO15D with maximum current up to 240 A

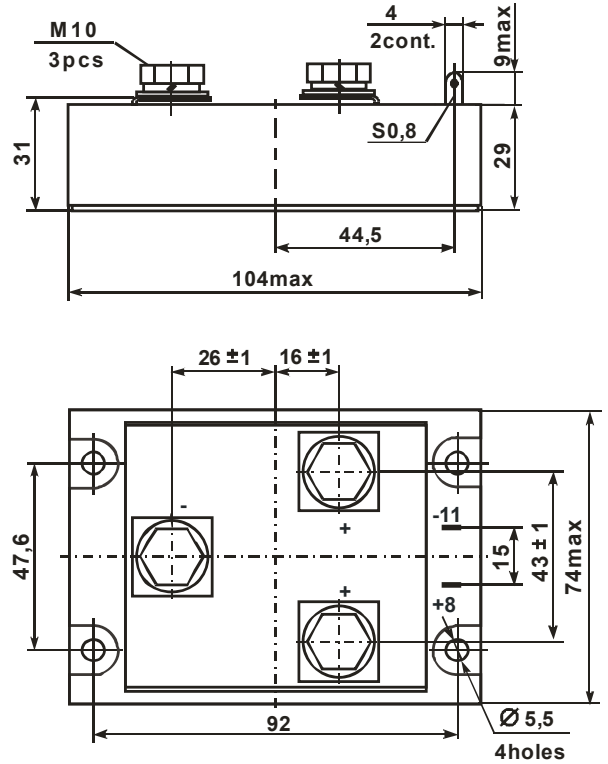


Figure 6.4 – Overall drawing of modules MO14, MO15D with maximum current up to 400 A

Precious metals are not contained.

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