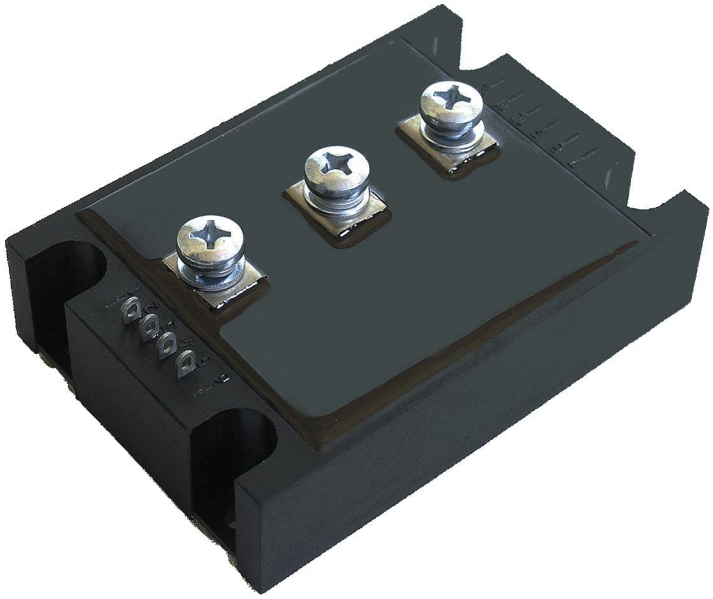
THYRISTOR MODULES WITH TRANSORMER ISOLATION
TM1

USER'S MANUAL



5 Naugorskoe highway, Orel, 302020, Russia Tel. +7(4862) 44-03-44, Fax +7(4862) 47-02-12
E-mail: mail@electrum-av.com

CONTENTS

1. APPLICATION AND PRODUCED MODULES

The thyristor modules with transformer isolation TM1 are intended to use them as switching elements of the controlled rectifiers, inverters, power controller for power loads of DC and AC with maximum peak voltage up to 1600 V and DC up to 250 A. The modules are intended to change the modules MO1 operating in equipment with high level of pulse surges.

The thyristor modules with transformer isolation (hereinafter - modules) are produced with a number of maximum average current 25,40,63,100,160,250 A, with peak voltage 1200 V, 1400 V, 1600 V.

In dependence on the current, the voltage and the version the modules are produced in designs that specified in Table 1.1.

Table 1.1 – Produced modules and corresponding to them overall dimensions

Type	**Maximum average current, A**					
	25	**40**	**63**	**100**	**160**	**250**
TM1	Fig. 6.1	Fig. 6.1	Fig. 6.1	Fig. 6.1	Fig. 6.2	Fig. 6.3

On Figure 1.1 is shown modules name explanation.

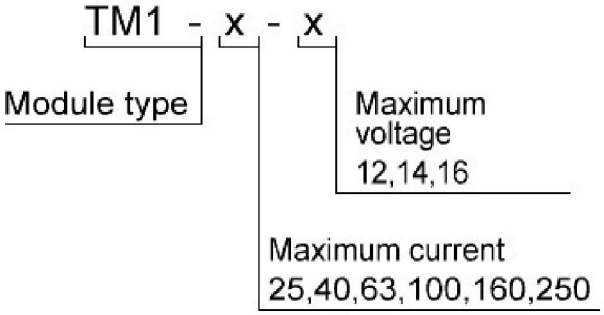
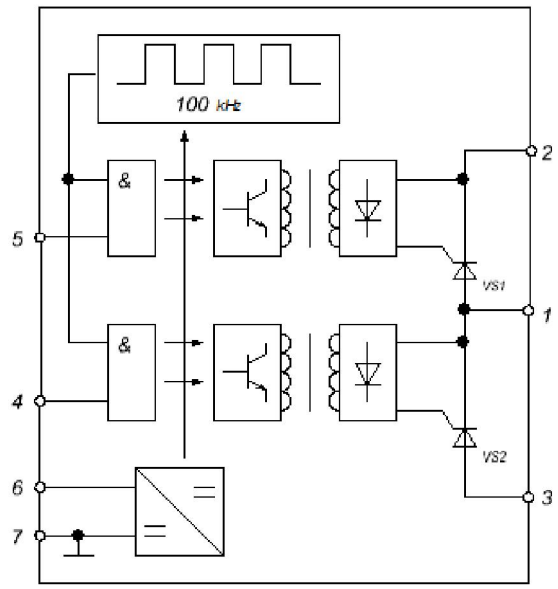


Figure 1.1 – Module name explanation

For example, a module TM1-100-12: a thyristor module with transformer isolation with maximum operating current 100 A and peak voltage 1200 V.

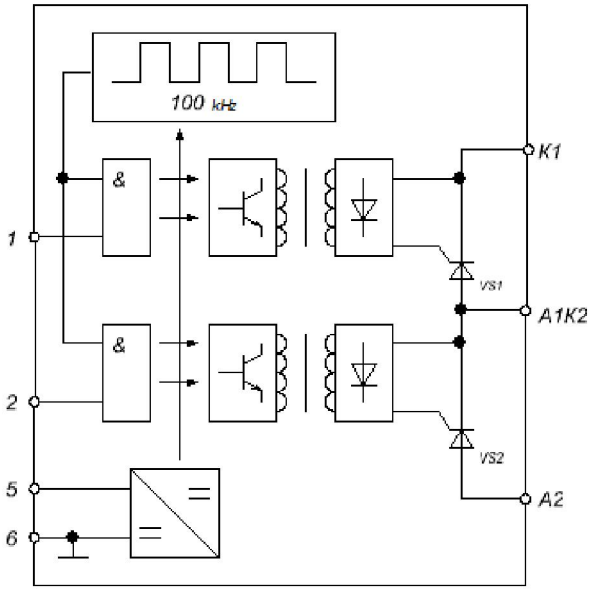
2. GENERAL DESCRIPTION

In dependence on the module type the electrical circuits of the modules are different; on Figures 2.1 and 2.2 are represented the variants of the modules circuits.



Outputs application	
1	Cathode VS2, anode VS1
2	Cathode VS1
3	Anode VS2
4	Control VS2
5	Control VS1
6	Supply
7	Ground

Figure 2.1 – Functional circuit of modules with average current up to 100 A (Figure 6.1)



Outputs application	
A1K2	Cathode VS2, anode VS1
K1	Cathode VS1
A2	Anode VS2
1	Control VS2
2	Control VS1
5	Supply
6	Ground

Figure 2.2 – Functional circuit of module with average current 160 A и 250 A (Figure 6.2,6.3)

3. BASIC PARAMETERS

Basic electrical parameters and maximum permissible modules' parameters at temperature 25^0C are shown in Tables 3.1 and 3.2.

Table 3.1 – Basic and maximum permissible parameters of modules control

Parameter name, Unit	**Symbol**	**Value**
Voltage supply, V	U_{CC}	13.5…27
Current consumption at U_{CC}=15 V (max), mA	I_{CC}	200
Current consumption at U_{CC}=24 V (max), mA		120
Control voltage corresponding to level «log.1», V (voltage corresponding to thyristor activation)	U_{IH}	5…15
Control voltage corresponding to level «log.0», V (voltage corresponding to thyristor turnoff)	U_{IL}	0…3.3
Current consumption on control input at U_{IN} = 15 V (max), mA	I_{IN}	10
Enable/disable time (max), ms	$t_{on/off}$	0.05/0.05

Table 3.2 – Basic and maximum permissible parameters of modules power circuits

Parameter name, Unit	**Symbol**	**Module maximum current, A**					
		25	**40**	**63**	**100**	**160**	**250**
Repetitive pulse voltage: reverse/in off-state (max), V for modules of 12-th class	V_{DRM} /V_{RRM}	±1200					
Repetitive pulse voltage: reverse/in off-state (max), V for modules of 14-th class		±1400					
Repetitive pulse voltage: reverse/in off-state (max), V for modules of 16-th class		±1600					
Commutating voltage (rms), V for modules of 12-th class (max)	$V_{O(RMS)}$	~ 430					
Commutating voltage (rms), V for modules of 14-th class (max)		~ 590					
Commutating voltage (rms), V for modules of 16-th class (max)		~ 750					
Average DC (max), A	$I_{T(AV)}$	25	40	63	100	160	250
Surge current in on-state, t = 10 ms (max), A	I_{TSM}	200	560	720	1250	3200	6000
Repetitive pulse current in off-state/reverse current (max), mA	I_{DRM} / I_{RRM}	1					
Pulse voltage in on-state at I= $I_{T(AV)}$ (max), V	V_{TM}	1.65					
Critical rate of current rise in on-state (max), A/μs	$(di_T/dt)_{crit}$	150					
Critical rate of voltage rise in off-state (max), V/μs	$(du_d/dt)_{crit}$	1000					
Junction-base of each thyristor thermal resistance (max), ºC/W	$R_{thjc\ t}$	0.8	0.7	0.55	0.3	0.22	0.15
Junction temperature (max), °C	T_J	125					
Insulation strength (AC, 50 Hz, 1 minute), V	V_{ISOL}	2500					

4. INSTRUCTIONS FOR USE

General requirements

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

It is not allowed operating the modules in modes at simultaneous impacting two or more maximum permissible parameters' values.

In the electrical circuit of the equipment with use of the modules should be provided a fast-recovery protection against overloads, SCs and commutating overloads.

Module mounting

The module is mounted in the equipment to cooler (chassis, application housing, metal plates that provide a thermal mode) in any orientation with screws M5 or M6 with torque (5±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 neighboring 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 μm and flatness tolerance– not more than 30 μm. 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 motions by turns: first, located on one diagonal, then on the other one. When disassembling the module the screw tightening should be done 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 install the several modules without additional insolating 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 the 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 ± 0.5) N·m or by bolts M8 or M10 with torque (5 ± 0.5) N·m and the washers that are supplied in the pack.

Power wires should be connected by means of connectors with corrosion-inhibiting cover, which are purified of foreign layers. When 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 commencement of operating. Afterwards tightening should be controlled at least once a half year.

The control module outputs are intended for mounting by means of soldering or with 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 °C. Soldering duration is not longer than 3 s.

When mounting and operating is necessary to make protection measures against static electricity impact; on mounting the personnel should use the ground bands and grounded low-voltage soldering irons with transformer supply.

Operating requirements

Module should be used under mechanical loads in accordance with Table 4.1.

Table 4.1 – 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 4.2.

Table 4.2 – 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. Don't touch the module's radiator if it is not grounded and it's applied a voltage.
5. Don't touch the cooler and the module's housing in time its operation thereby 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 penetrating water and other liquids to the module.

5. RELIABILITY REQUIREMENTS

The manufacturer guarantees the quality of the module to 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 2 years from the acceptance date, in the event of requalification – from the date of 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 no more than gamma-percent life, no less than10 years, when $\gamma = 90$ %.

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

6. OVERALL AND CONNECTING DIMENSIONS

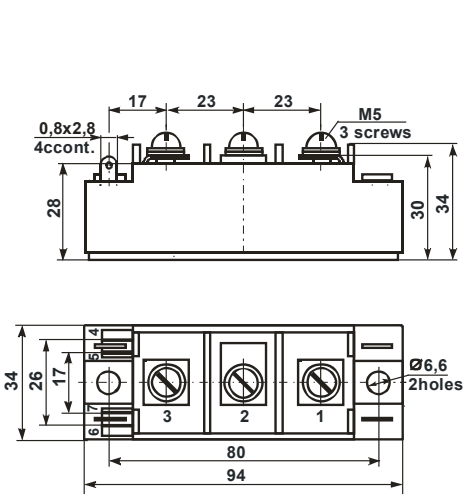


Figure 6.1 – Overall dimensions of modules TM1-25(40,63,100)-12(14,16)

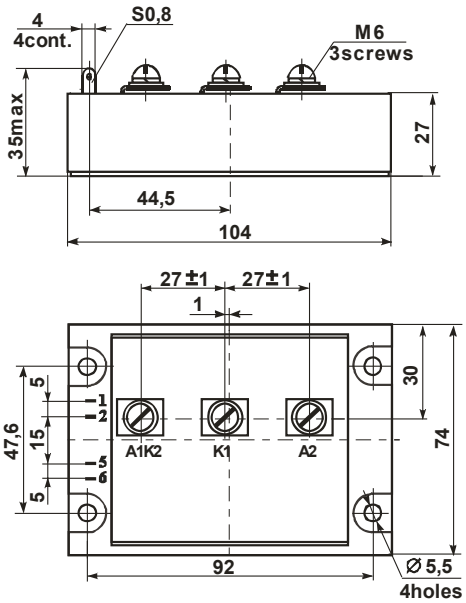


Figure 6.2 – Overall dimensions of modules TM1-160-12(14,16)

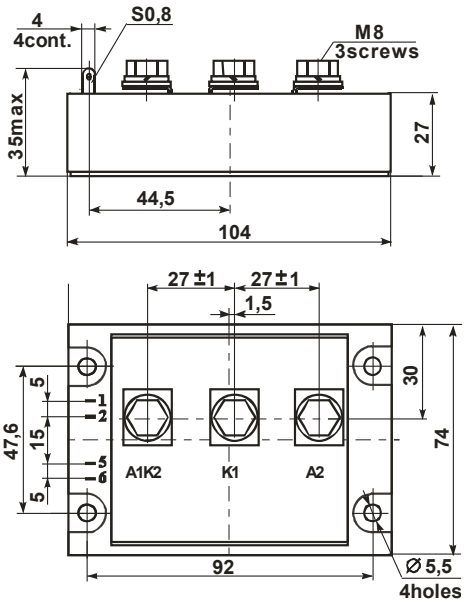


Figure 6.3 – Overall dimensions of modules TM1-250-12(14,16)

Precious metals are not contained.

5 Naugorskoe highway, Orel, 302020, Russia Tel. +7(4862) 44-03-44, Fax +7(4862) 47-02-12
E-mail: mail@electrum-av.com