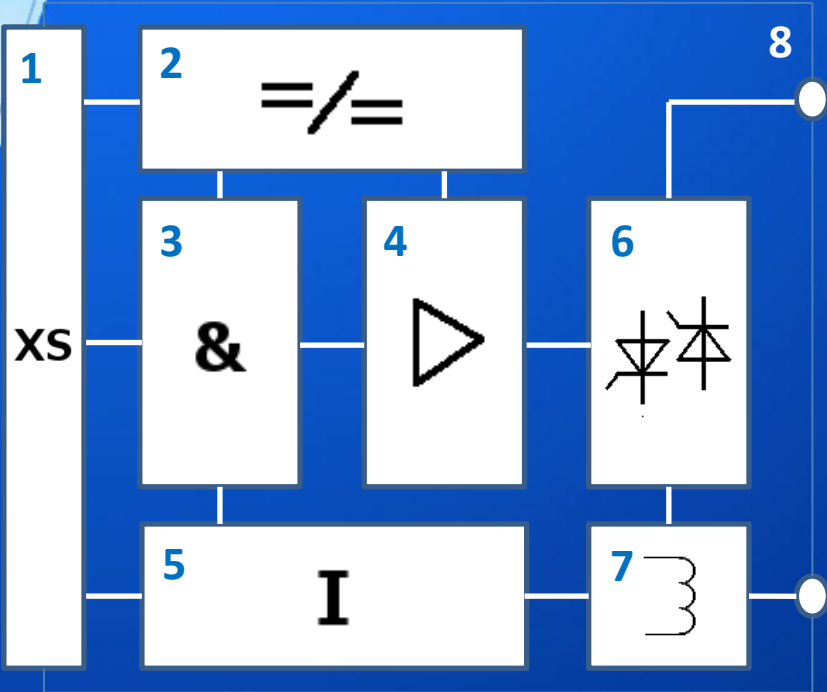


Electrum AV
Intelligent modules

Thyristor control by load

Thyristor power regulator



To create a typical thyristor power regulator we will need the following units:

- 1 – control interface
- 2 – DC/DC-converter
- 3 – controlling logic
- 4 – thyristors drivers
- 5 – current protection circuit
- 6 – power thyristors
- 7 – current sensor
- 8 – housing with power circuits

Or completed unit – module **M25**

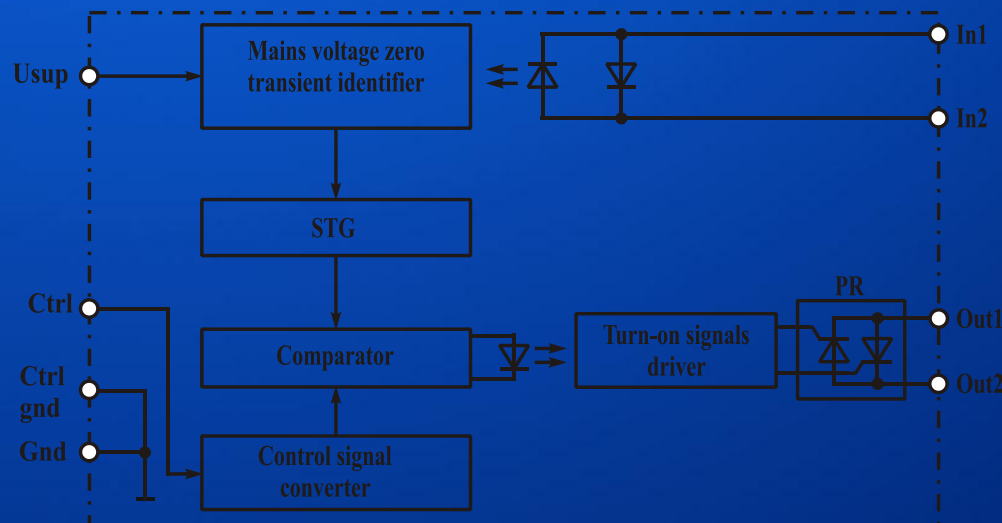
Module M25

Module of power regulator with current protection (M25T) and without current protection (M25M) is intended to adjust the power of active load and active-inductive one in AC nets with voltage 220/380V. In the modules M25 is used a phase method to adjust the power in load; at this method changing of load power is carried out by changing duration of pair on-state inverse-parallel thyristors during a relevant half-period of the net voltage. The power value is adjusted with emitting of the control signal having a standard form (0...5 V, 0...10 V, 4...20 mA, 0...5 mA, 0...20 mA); changing of the signal from minimum to maximum changes the output power value from 0 to 100%. In the module is there is galvanic isolation of control circuits and power circuits.

The module is maintains the following functions:

- commutation of alternating voltage;
- changing of output power by phase method;
- smooth start when switching on supply;
- protection against overcurrent (modules M25T);
- indication of current protection operation (modules M25T).

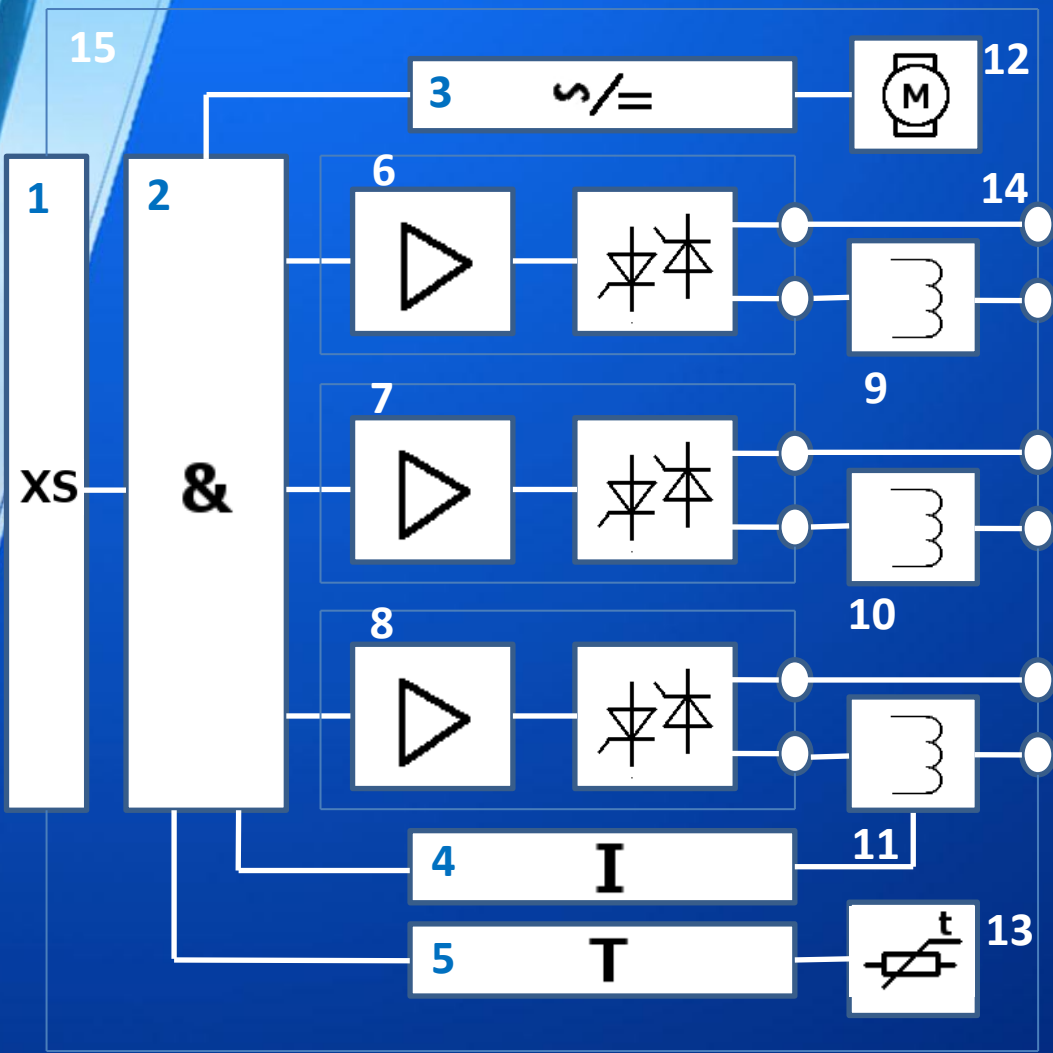
The modules are produced with an amount of maximum rms current 25,40,63,100,160,250 A, with peak voltage 1200 V.



Basic parameters

Parameter name, unit	Symbol	Maximum module current, A					
		25	40	63	100	160	250
Repetitive pulse voltage: reverse / in off-state (max), V	V_{DRM}/V_{RRM}	+1200					
Commutating voltage (rms), V	$V_{O(RMS)}$	~ 200...430					
Commutating current (rms), (max), A	$I_{O(RMS)}$	25	40	63	100	160	250
Surge current in on-state t=10 ms (max), A	I_{TSM}	200	300	750	1250	2000	3200
Repetitive pulse current: in off-state / reverse current (max), mA	I_{DRM}/I_{RRM}	±0.6					
Pulse voltage in on-state at $I = I_{O(RMS)}$ (max), V	V_{TM}	1.5					
Extreme current rise rate in on-state (max), A/μs	$(di_T/dt)_{crit}$	160					
Extreme voltage rise rate in off-state (max), V/μs	$(du_d/dt)_{crit}$	500					
Thermal junction-base resistance (max), °C/W	R_{thjc}	1	0.7	0.6	0.3	0.23	0.15
Protection operation current (typ.) for M25T, A	I_{CP}	35	56	89	141	226	353
Junction temperature (max), °C	T_J	125					
Electrical insulation strength of power circuits on housing (DC, 1 minute), V	V_{ISOL}	4000					

Completed power regulator



To create a completed thyristor power regulator we need the following units:

- 1 – control interface
 - 2 – controlling logic or spec. driver
 - 3 – AC/DC-converter
 - 4 – current protection circuit
 - 5 – temperature protection circuit
 - 6,7,8 – power modules of kind M25 or MO8
 - 9,10,11 – current sensors
 - 12 – fan for cooling
 - 13 – thermal resistor
 - 14 – power buses with mount structures
 - 15 – housing with cooler
- And also: protective elements (variable resistors), Indication elements, connectors wires, etc.

Or completed unit – TPR

Power regulators units

Single-phase thyristor power regulator (TPR1) and three-phase one (TPR3) is intended to adjust the power of active load and active-inductive one in the AC nets with voltage 220/380V. In the TPR has been used a phase method to adjust the power in load; at this method changing of load power is carried out by changing by duration of pair on-state inverse-parallel thyristors during a relevant half-period of the net voltage. The TPR is used in the automotive temperature regulation systems and other technological parameters.

The TPR operates together with control devices (third party manufacturer) having a DC standard analogue output signal. The value of the power is adjusted by applying the control signal having standard kind (0...5 V, 0...10 V, 4...20 mA, 0...5 mA, 0...20 mA); changing of the signal from minimum to maximum changes the output power value from 0 to 100%. In the TPR is maintained a galvanic isolation of control circuits and power circuits.

The TPR maintains the following functions:

- commutation of alternating voltage;
- changing of output power by phase method;
- smooth start when supplying power supply voltage;
- galvanic insulation of load circuits from signal circuits;
- protection against overload in load circuit;
- forming of status signal «Overload» (output – open collector);
- control of phase loss (for TPR3);
- forming of status signal «Loss» (output – open collector) (for TPR3);
- forming of voltage DC 24 V (for supplying of controlling device).

Product list of the units of thyristor power regulators are presented by the following versions:

TPR1 - are produced with an amount of maximum output rms current 25,40,63,100,160,250 A, with peak voltage 1200 V;

TPR3 - are produced with an amount of maximum output rms current 100,160,250 A (current of each phase), with peak voltage 1200 V;

TPR3-T - are produced with an amount of maximum output rms current of each phase 400,500,600,800,1000 A, with peak voltage 1200 V.

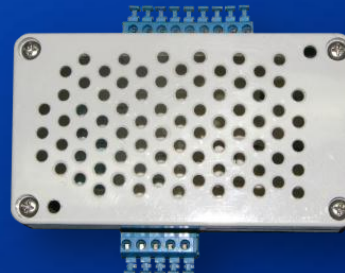
Units bases



Single-phase thyristor regulator TPR1 is made based on module of thyristor regulator M25



Three-phase thyristor regulator TPR3 is made based on optothyristor modules MO8 and dedicated power regulator driver 3phPRD



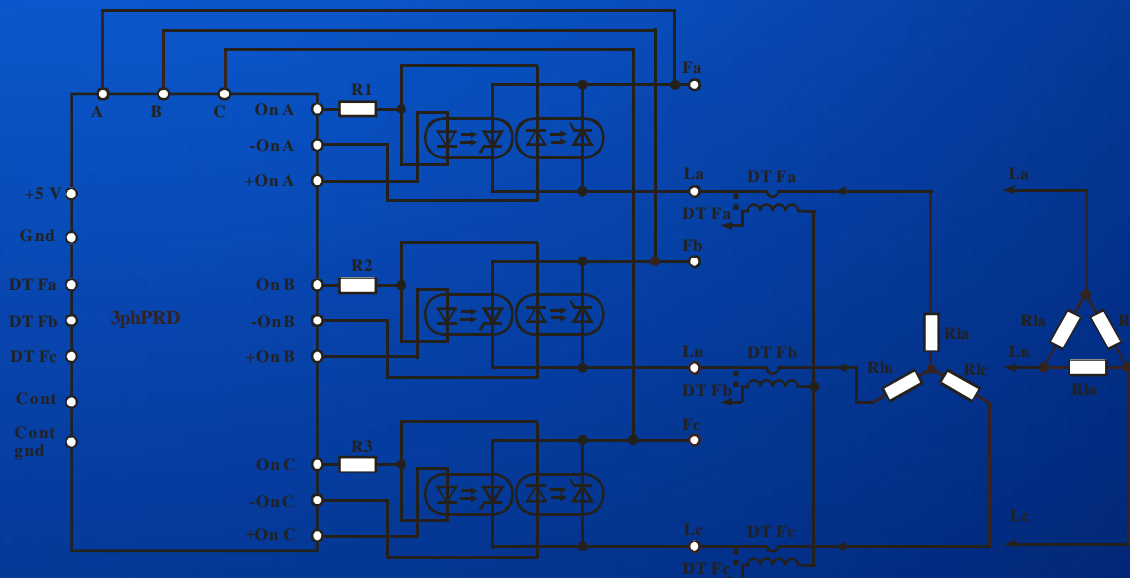
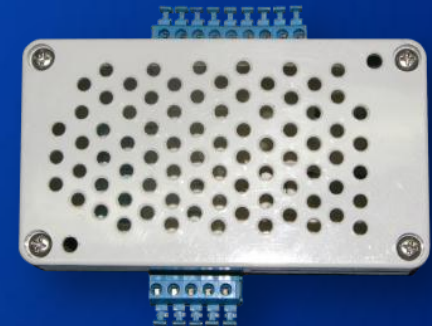
Driver 3phPRD

Three-phase power regulator driver 3phPRD is intended for controlling of thyristor module with three pairs of inverse-parallel thyristors with optoelectronic decoupling of kind MO26D, three thyristor modules with a pair of inverse-parallel thyristors with optoelectronic decoupling of kind MO8D or six opto thyristors and together with them it provides creation of three-phase power regulator.

The driver maintains the following functions:

- power thyristors control;
- output power changing by phase method;
- smooth start when switching on power supply;
- protection against current overload;
- indication of current protection operation.

In the driver there is galvanic insulation of control circuits and power circuits.



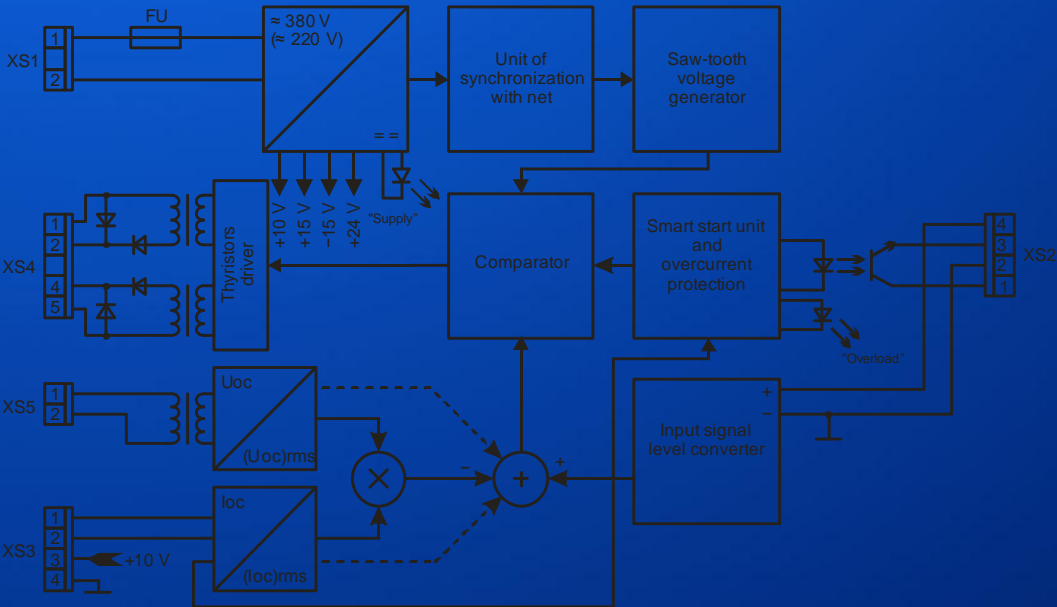
Driver PRD-FB

Power regulator driver with feedback PRD-FB is intended to operate in a power regulator of active and active-inductive loads in AC circuits with linear voltage 220 V or 380 V with frequency 50 Hz. In dependence on a version the driver allows performing stabilization on feedback by the following parameters:

- V – load voltage;
- V^2 – squared voltage on load;
- I – load current;
- I^2 – squared load current;
- $V \times I$ – load power.

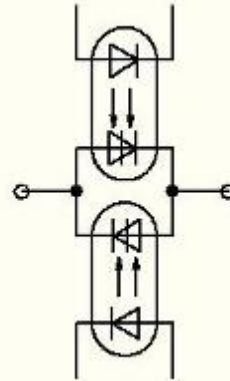
In the driver we used vertical-pulse power control method in the load, at which the change in load power is made by changing the duration of the on-state of a pair external thyristors switched in back-to-back during a respective half period of the mains voltage.

In the driver there is isolation of the control circuits and power circuits.



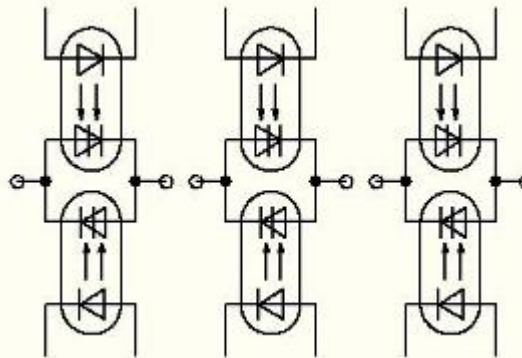
Opto thyristor modules

Module **MO8D** – a single-phase opto thyristor module.
The modules are produced with an amount of maximum average current 25,40,63,80,100,125,160,200,250 A, with peak voltage 1200 V or 1600 V.

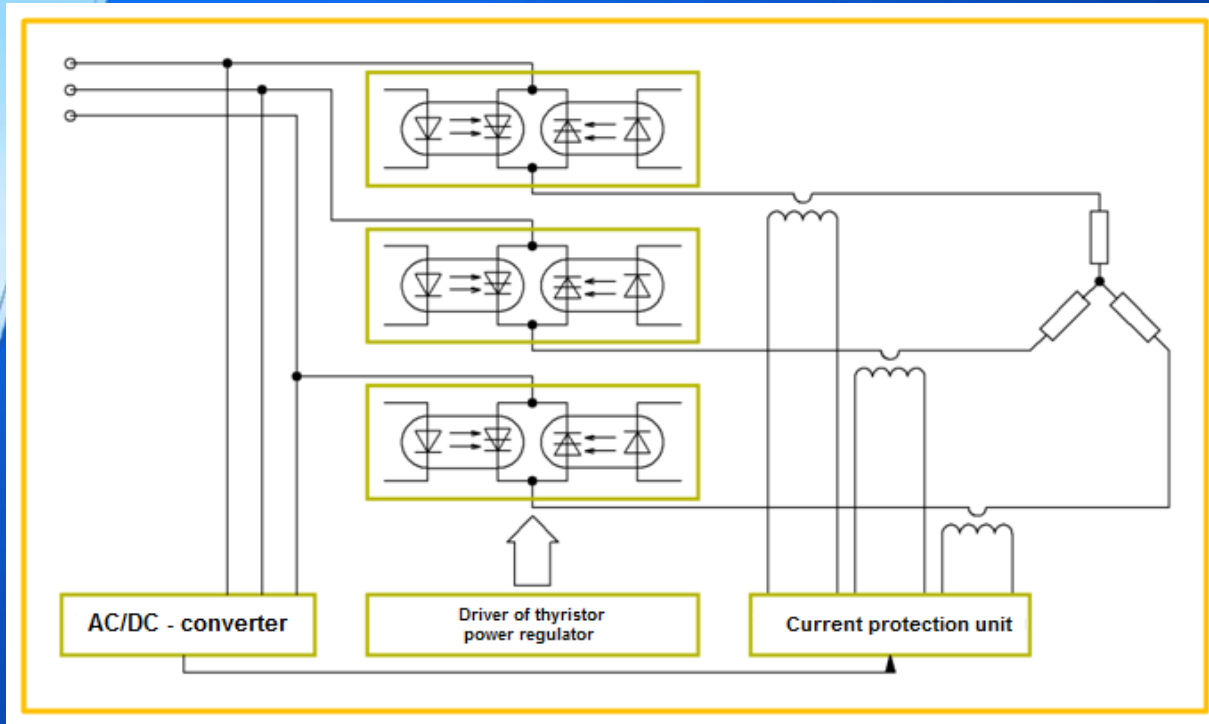


Module **MO26D** – three-phase opto thyristor module.

The modules are produced with an amount maximum average current 25,40,63,100 A, with peak voltage 1200 V or 1600 V.



Example of regulator assembly

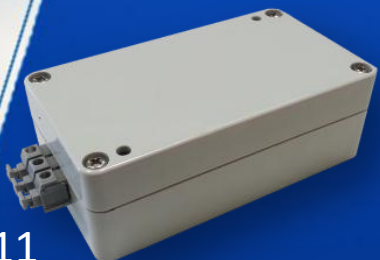


POWER MODULES –

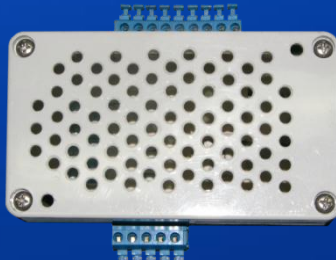
SINGLE-PHASE OPTO THYRISTOR MODULES MO8D



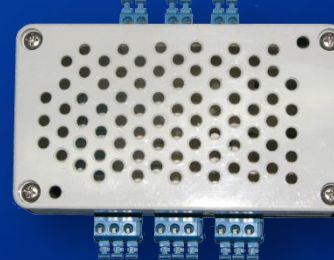
MIP 380-15



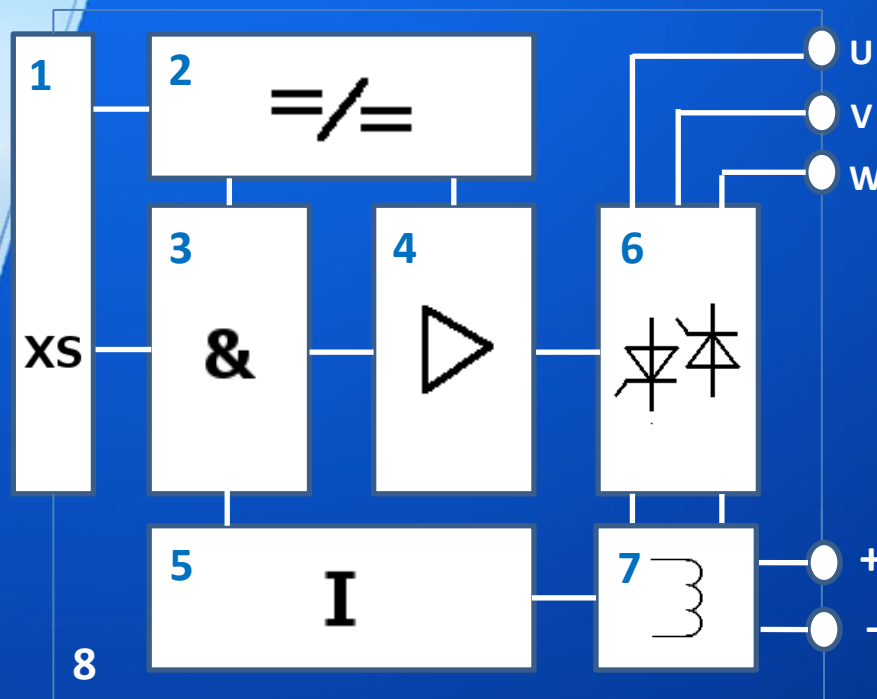
3phPRD



MPT-200MK



Thyristor rectifier



To create a typical thyristor rectifier we need the following units:

- 1 – control interface
- 2 – DC/DC-converter
- 3 – controlling logic
- 4 – thyristors drivers
- 5 – current protection circuit
- 6 – power rectifier bridge
- 7 – current sensors
- 8 – housing with power circuits

Or completed unit – module **MO30**

Module MO30

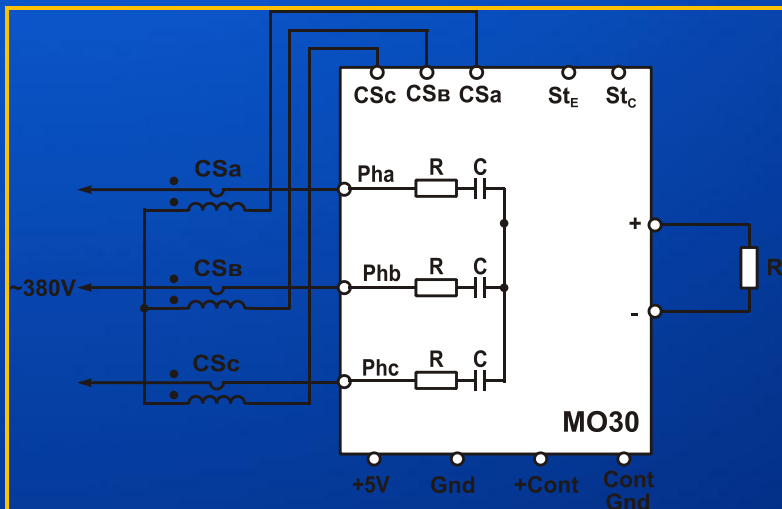
Module of three-phase (MO30) and single-phase (MO30.1) regulated rectifier is intended to form from three-phase (single-phase) net voltage 50 or 400 Hz rectified pulse voltage that regulated by phase method. The value of the voltage is regulated by triggering a control signal of standard kind (0...5 V, 0...10 V, 4...20 mA, 0...5 mA, 0...20 mA); changing of the signal from minimum to maximum changes the value of rms value of the direct voltage in the range from 0 to 100%.

In the module there is a galvanic isolation of control circuits and power circuits, also there is an inbuilt system of protection against overcurrent.

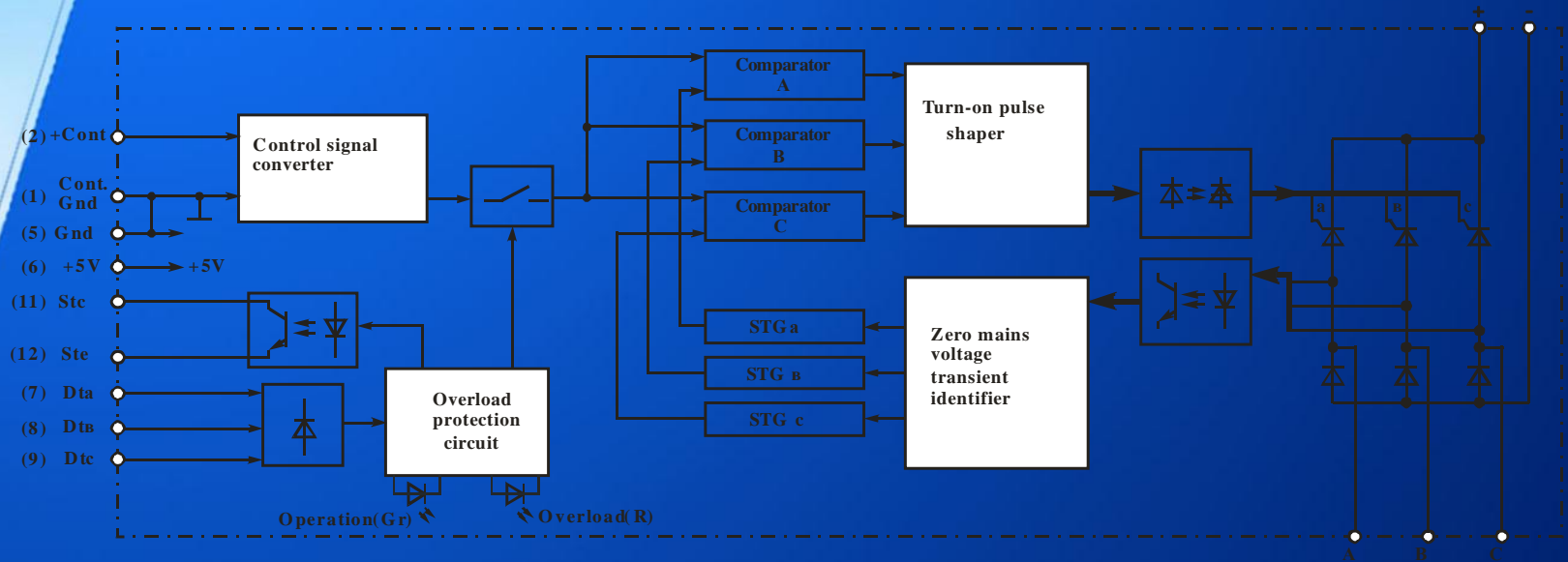
The module maintains the following functions:

- rectifying of alternating voltage;
- changing of direct voltage amplitude on input by phase method;
- smooth start when switching on supply;
- protection against overcurrent;
- indication of being supply voltage and of being current protection operation.

The modules are produced with an amount of maximum rms current 63,100,160,250 A, with peak voltage 1200 V.



Structural circuit of MO30



Drivers of thyristor rectifier

To create a thyristor regulated rectifier and diode-thyristor one can be used dedicated the drivers of series 3phCRD



Driver of diode-thyristor bridge
(thyristors in cathode group) 3phCRD



Driver of thyristor rectifier bridge
3phCRD-6-DIN



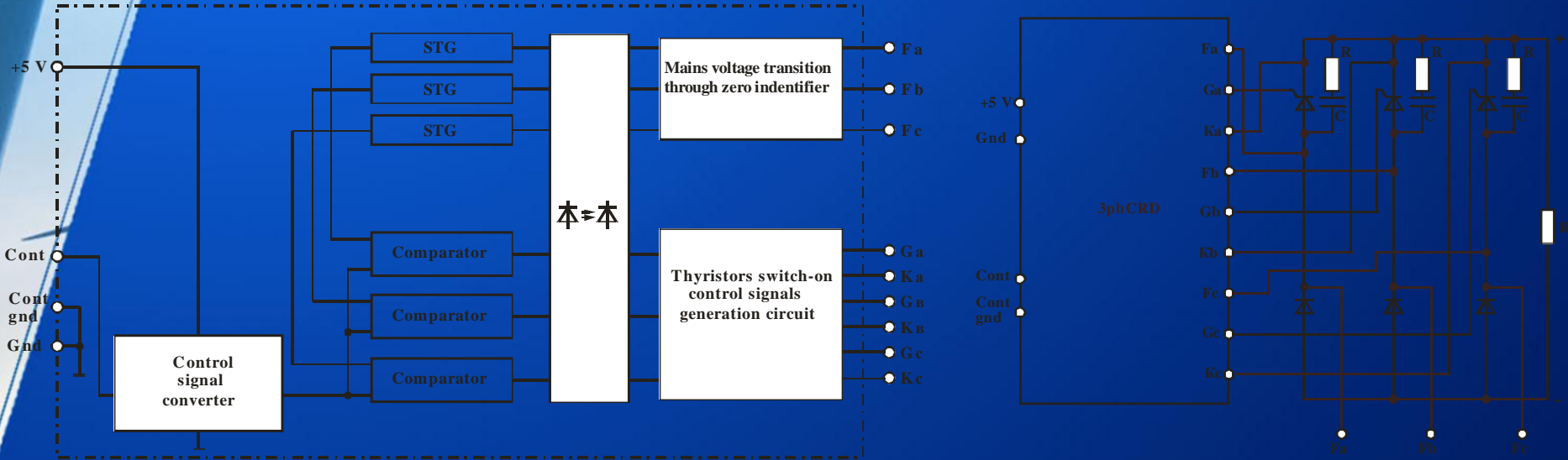
Driver 3phCRD

Three-phase controlled rectifier driver 3phCRD is intended for controlling by three-phase thyristor-diode bridge of kind M23 or by analogue bridge of kind M3 or another three-phase thyristor-diode bridge and in common with these bridges it allows constructing a three-phase controlled rectifier.

In the driver it is used the phase regulation method of rectified voltage, whereby effective value change of AC load voltage is performed by open state time changing of one of the connected thyristor during a half-cycle.

The voltage value is regulated by the control signal having a standard form (0 ... 5 V, 0 ... 10 V, 4 ... 20 mA, 0 ... 5 mA, 0 ... 20 mA), changing of the signal from minimum to maximum changes the output power value from 0 to 100%.

In the driver it is provided a galvanic isolating of control circuits and power circuits.



Driver 3phCRD-6-DIN

Three-phase thyristor rectifier 3phCRD-6-DIN is intended for controlling by power thyristor or thyristor drivers and allows creating a three-phase regulated rectifier for operation in three-phase AC circuit with frequency 50 Hz. The driver can be performed for creation of rectifiers for IGBT invertors supply with capability of smooth capacitor battery charging; rectifiers for capacitor battery charging; rectifiers for devices of cathode anticorrosive protection; rectifiers for supply DC drives, etc.

In the driver it is used a vertical-pulse regulation method of load voltage average value, whereby average value change is carried out by open state thyristor time changing during relevant a half-period of the net voltage.

In the driver it is provided galvanic insulation of control circuits and power circuits.

The driver maintains the following functions:

- power thyristors control;
- change of output power with phase method;
- smooth start at switching on power;
- protection against overcurrent;
- current protection operation indication;
- external or automatic reset of overcurrent mode.

By the types of output signals the drivers represented the following versions:

3phCRD-6 – driver with outputs designed for direct control of power thyristors;

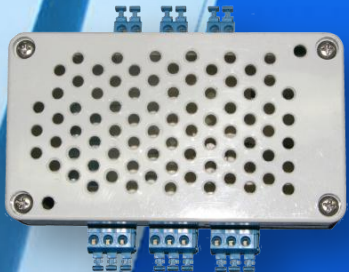
3phCRD-6.1 – driver with outputs designed to control the thyristor drivers on wire communication line;

3phCRD-6.2 – driver outputs designed to control the thyristor drivers by FOCL.

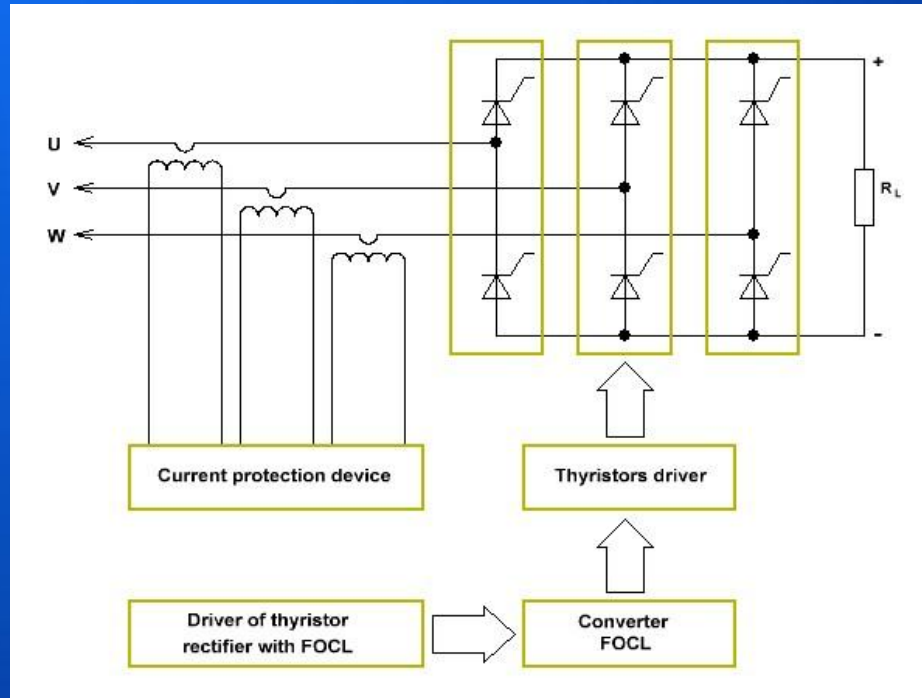
Basic and maximum permissible parameters of drivers' outputs

Parameter	Unit	Value	Driver
Output pulse current of control of built-in drivers at = 10 ms (max)	A	1	3phCRD-6
Output current of control at = 10 ms (max)	mA	12	3phCRD-6.1
Output voltage of open circuit of control outputs (max)	V	5	
Length wave used at transferring signal (typical)	nm	660	3phCRD-6.2
Signal transmission distance, (max)	m	25	

Example of rectifier assembly



PROTECTION DEVICE
MPT-200MK



THYRISTOR MODULE
M1 (3 PCS)



THYRISTORS DRIVER
TTMD-T3 (2 PCS)

OPTICAL CONVERTER OPTD
(2 PCS)

BRIDGE DRIVER
3phCRD-6.2-DIN



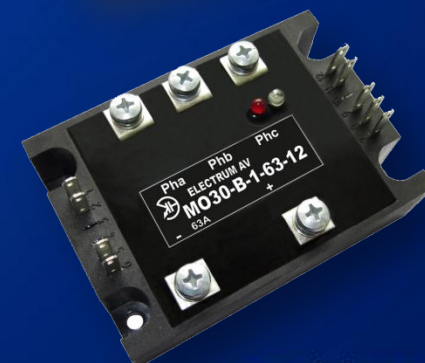
Optothyristor relay **MO8** in transformer substation



Module of power regulator **M25** in industrial dryer furnace



Module of regulated rectifier **MO30** in powerful stabilizer



A close-up, low-angle shot of a wind turbine's nacelle and blades against a clear blue sky. The turbine is positioned on the left side of the frame, with its blades extending towards the right. The background is a gradient of blue, transitioning from a lighter shade at the top to a darker shade at the bottom.

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