# THREE-PHASE CONTROLLED RECTIFIER DRIVERS
# 3phCRD -A1, 3phCRD -A2, 3phCRD -A3, 3phCRD -A4, 3phCRD -A5
# 3phCRD -B1, 3phCRD -B2, 3phCRD -B3, 3phCRD -B4, 3phCRD -B5
## TECHNICAL DESCRIPTION

Three-phase controlled rectifier driver 3phCRD (hereinafter – driver) is intended for controlling of three-phase thyristor-diode bridge M23 or of the analogue bridge of modules M3 or another three-phase thyristor-diode bridge and in common with these bridges it allows building a three-phase controlled rectifier. The driver provides galvanic isolation of control circuits and thyristor control circuits.

In the module 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 power frequency half-cycle.

Mode of operation and functional application of 3phCRD units are shown in Figure 1.

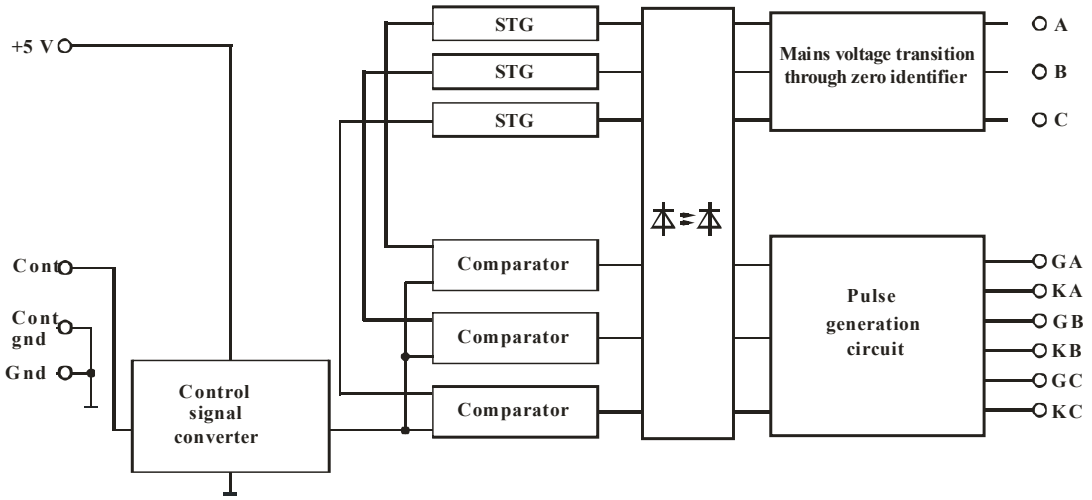



Figure 1 – 3phCRD functional circuit

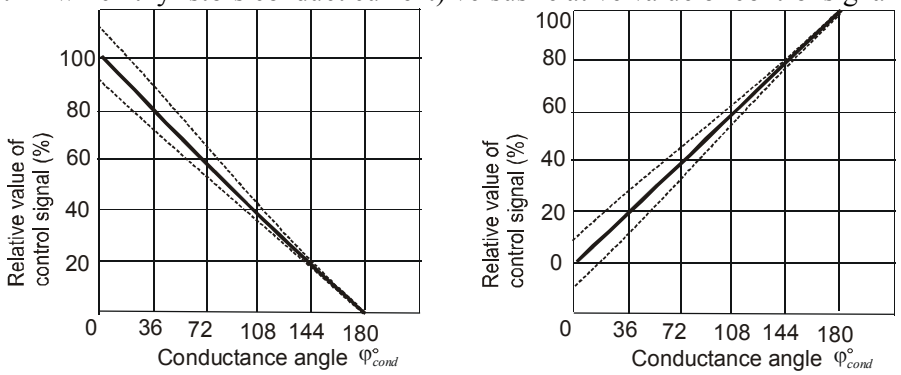
Voltage zero transient identifier (VZTI) forms pulses in time of voltage zero transient, which synchronize a saw-tooth generator (STG). In comparator (C) voltage STG and control signal voltage $U_{cont}$ are compared, received from the input signal converter circuit. When STG reaches the value $U_{cont}$, pulse of input thyristor connection is generated. Changing the control signal value, equality of STG and $U_{cont}$ is varied and, accordingly, the thyristor connection phase. Thereby you reach regulation the root-mean-square load voltage value.

Functional purpose of outputs is shown in Table 1.

Table 1 – Functional purpose of VZTI outputs

| Connector | Outputs number | Symbol | Purpose |
|---|---|---|---|
| XS1 | | A | Phase input A of AC power circuit |
| XS2 | | GA | Connection of controlled thyristor electrode |
| XS3 | | KA | Thyristor cathode connection |
| XS4 | | B | Phase input B of AC power circuit |
| XS5 | | GB | Connection of controlled thyristor electrode |
| XS6 | | KB | Thyristor cathode connection |
| XS7 | | C | Phase input C of AC power circuit |
| XS8 | | GC | Connection of controlled thyristor electrode |
| XS9 | | KC | Thyristor cathode connection |
| XS10 | 1 | Gnd (-5 V) | Ground «minus» of supply circuit |
| | 2 | +5 V | Supply voltage +5 V |
| | 3 | Cont.gnd | «Minus» of control signal |
| | 4 | Control | Control signal input |

Control signal converter, depending on 3phCRD version, transforms a control signal of five types (0…5 V; 0…10 V; 0…5 mA; 0…20 mA; 4…20 mA) into signal $U_{cont}$ for two types of control characteristics. Conductance angle of thyristors (time within which thyristors conduct current) versus relative value of control signal is shown in Figure 2.




A – 100% control signal corresponds to minimum root-mean-square load voltage value;
B– 100% control signal corresponds to maximum root-mean-square load voltage value.

Figure 2 – Types of control characteristics

Basic characteristic of input circuits are shown in Table 2. Basic characteristic of output circuits are represented in Table 3.

Table 2 – Basic characteristic of input circuits

| Characteristic name | | Unit | Types of input circuits | | | | | | | | | | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | A-1 | A-2 | A-3 | A-4 | A-5 | B-1 | B-2 | B-3 | B-4 | B-5 | |
| Basic electric characteristics | | | | | | | | | | | | | |
| 1 Current consumption, Ic, max | | mA | 50 | | | | | | | | | | Us = 5 V |
| 2 Control signal value corresponding to minimum root-mean-square load voltage value | | V | 5±0.5 | 10±1 | - | - | - | 0÷0.5 | 0÷1 | - | - | - | |
| | | mA | - | - | 20±2 | 5±0.5 | 20±2 | - | - | 4±0.4 | 0÷0.5 | 0÷2 | |
| 3 Control signal value corresponding to maximum root-mean-square load voltage value | | V | 0÷0.5 | 0÷1 | - | - | - | 5±0.5 | 10±1 | - | - | - | |
| | | mA | - | - | 4±0.4 | 0÷0.5 | 0÷2 | - | - | 20±2 | 5±0.5 | 20±2 | |
| 4 Control signal input circuit resistance, Rin | | kΩ | ≥10 | ≥10 | - | - | - | ≥10 | ≥10 | - | - | - | |
| 5 DC isolation voltage | | V | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 1 minute |
| Maximum permissible values of basis characteristic | | | | | | | | | | | | | |
| 1 Supply voltage, Us | min | V | 4,5 | | | | | | | | | | |
| | max | V | 5.5 | | | | | | | | | | |
| 2 Input voltage «Cont», Uin | max | V | 6 | 12 | 2 | 2 | 2 | 6 | 12 | 2 | 2 | 2 | |
| 3 Peak value of inputs «A», «B», «C», Uin.peak | max | V | 1200 | | | | | | | | | | tp = 10 ms |
| 4 Effective value of line voltage on inputs «A», «B», «C», Uin.lin | min | V | 50 | | | | | | | | | | |
| | max | | 500 | | | | | | | | | | |
| 5 Output current of control output | min | A | 1<br>10 | | | | | | | | | | tp = 1 ms<br>tp = 100 µs |

Table 3 – Maximum permissible values of output circuit parameters

| Characteristic name | Unit | Character-istic | Note |
|---|---|---|---|
| Operating temperature range, $T_{oper}$ | °C | -40…+80 | |

3phCRD drawing is shown in Figure 3.

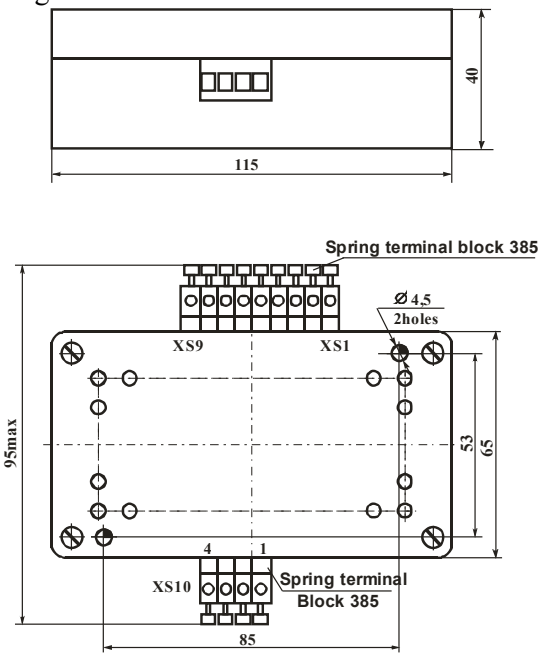



Figure 3 – 3phCRD drawing

Symbol scheme: $\frac{\text{3phCRD}}{1} - \frac{\text{A}}{2} - \frac{1}{3}$

1 Name of three-phase power regulator driver
2 Control characteristic:
A – 100% control signal corresponds to zero power;
B – 100% control signal corresponds to total power.
3 Control signal type:
1 - 0…5 V;
2 - 0…10 V;
3 - 4…20 mA;
4 - 0…5 mA;
5 - 0…20 mA.

**Application recommendations**

3phCRD connection circuit to load circuit is represented in Figures 4 – 6.

3phCRD should be mounted as close as possible to the controlled bridge, but not to the cooler, which it is located on. When mounting it is not permitted to run wires of the power line and controlled circuits in one bundle or common tube (package). Avoid loops in connecting wires of control and supply circuits. Connecting control wires for noise immunity providing should be made in a form of twisted pairs.

**Attention! When connecting the phase wires ensure strict phase interlacing in accordance with Figures 4, 5 and 6.**

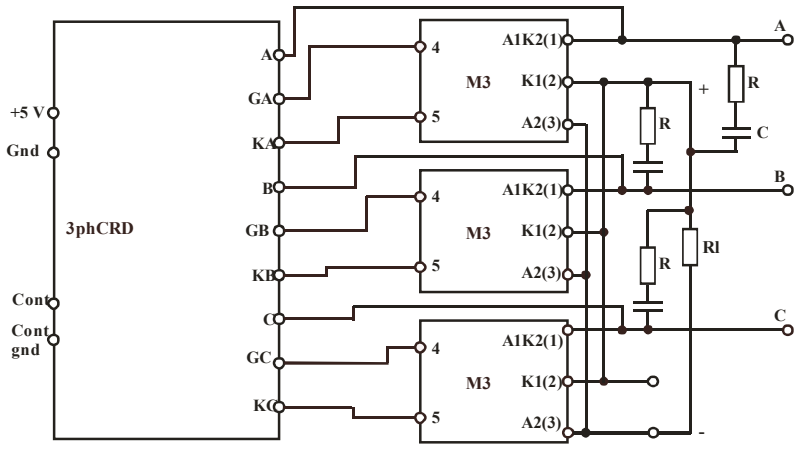



Figure 4 – 3phCRD connection circuit in common with three modules M3 to load

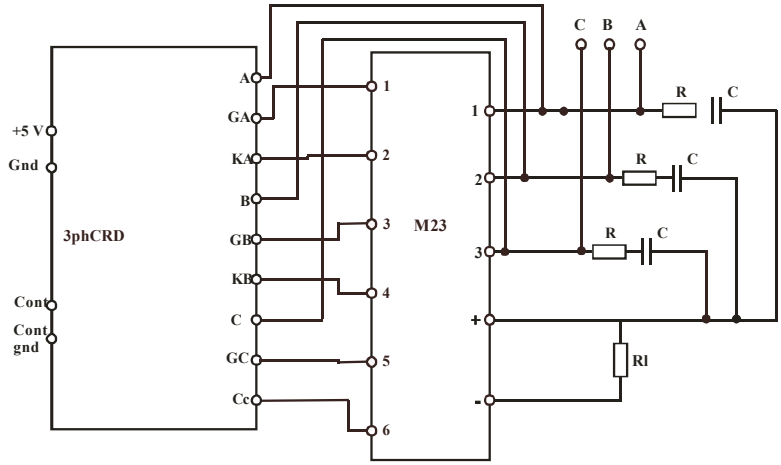



Figure 5 – 3phCRD connection circuit in common with bridge M23 to load

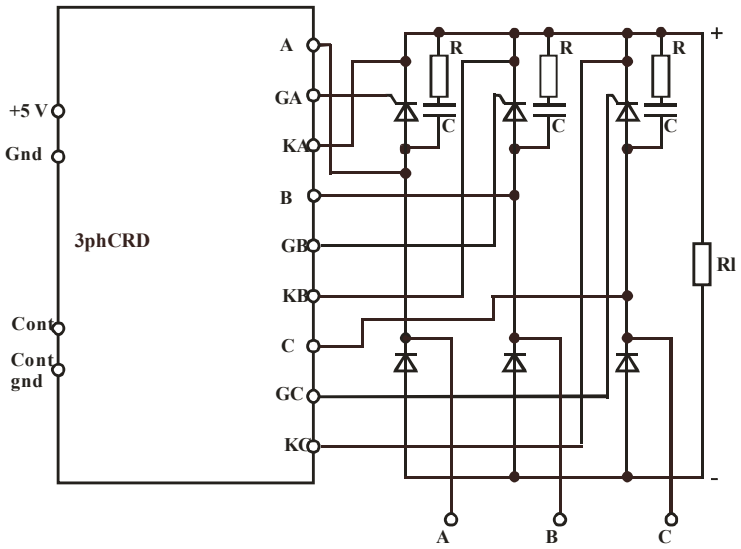



Figure 6 – 3phCRD connection circuit in common with other diode-thyristor modules

R = 10…27 Ω x 10 W
C = 0.33 μF x 1000 V

To improve the resistance to dU / dt it should be bridged the module RC with chains

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