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**02.07.2015**  
**PRD FB\_Rev2**

**PRD FB**  
**(Thyristor power regulator driver with feedback)**

**USER'S MANUAL**

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## PRD FB

### (Thyristor power regulator driver with feedback)

PRD FB is intended for operating composed of power regulator of active and active-inductive load in AC circuits 220V and 380 V, 50 Hz. In dependence of the version the driver allows realizing FB stabilization of the following characteristics:

- V – load voltage;
- $V^2$  – load voltage square;
- I – load currents;
- $I^2$  – load current square;
- $V \times I$  – load power.

The driver applies the vertically-pulse method for regulation of load power at which the change of load power is performed by changing of on-state duration of a pair of external thyristor that are connected opposite-parallel during the corresponding half-period of line voltage.

The structure driver circuit is shown at Figure 1.

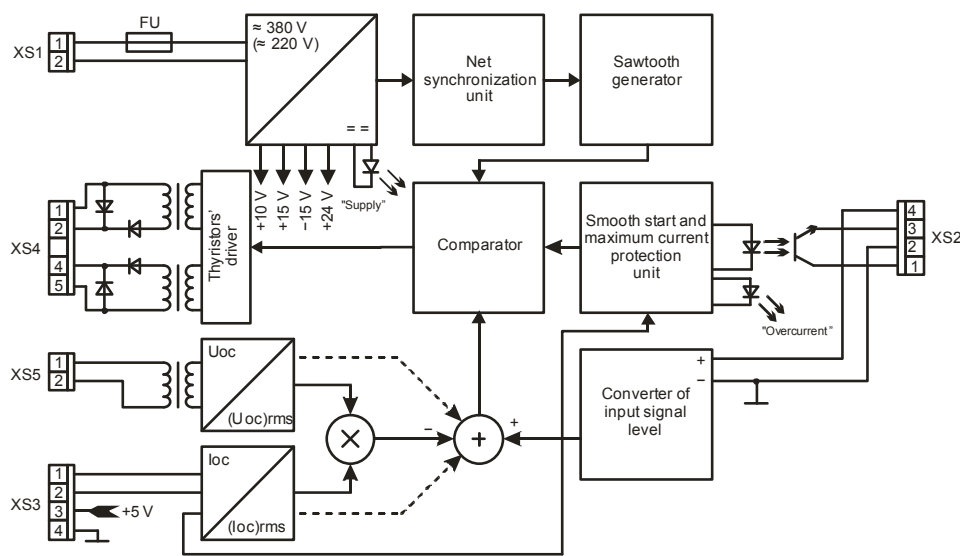


Figure 1 – Structure driver circuit

Network synchronization unit will form pulses during zero line voltage transient, the pulses synchronize sawtooth generator. The converter circuit of input signal is used for matching of operation signal of circuit with the standard analogue control signals (0...5 V, 0...10 V, 4...20 mA, 0...5 mA, 0...20 mA).

Feedback junction forms an error signal. The sawtooth generator and error signal will be compared in the comparator.

When comparison of sawtooth voltage and error signal the pulses of external power transistor will be generated in the thyristor driver.

Load power is regulated by means of control changing signal value.

PRD FB is provided for smooth start mode (500 ms) of power turn-on that is the reason for decrease of inrush current value when active-inductive load operation.

It is also provided with maximum-current overload protection. When achieving of instantaneous current value more than  $I_{com. rms}$  the corresponding junction removes load voltage, the status transistor will open. In 500 ms protection will be removed, status optocoupler transistor will be closed and smooth start is realized (smooth load voltage increase from zero to the value that is determined by control signal value).

If overload is not eliminated then the described before process will be continued until the malfunction is eliminated.

Under the PRD FB there is a 10-position switch (0-9) allowing a consumer setup the maximum value of operating current (when thyristors fully open) when putting PRD FB into operation, for this it's necessary to remove the cover and setup the switch to necessary position (when supplying to a consumer the switch setup to the position "0"). Current values are shown in Table 1.

Table 1 – Operating current values

|                    |    |    |    |    |    |    |    |    |    |    |
|--------------------|----|----|----|----|----|----|----|----|----|----|
| Switch position    | 0  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  |
| Maximum current, A | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 |

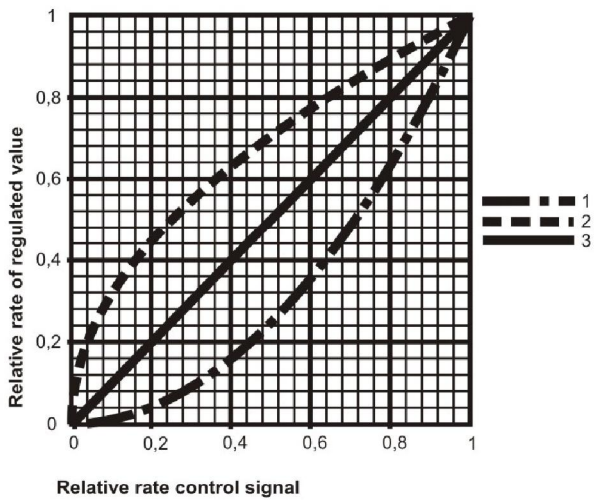
The permissible value of repetitive pulse off-state voltage of external power thyristors is 1200 V.

Control signal converter in dependence on the version will convert five types of control signal (0...5 V; 0...10 V; 0...5 mA; 0...20 mA; 4...20 mA) into the signal for two types of control characteristics.

The driver also contains output of stabilized voltage 10 V for manual mode drive. Adjusting characteristics of two types are shown at figures. Regulator feedback is intended for stabilizing of given value when the value of line voltage is changed within  $\pm 30\%$ .

- 1. V – load voltage stabilization (characteristic 3). Power allocated on linear load conforms to characteristic 1.
- 2.  $V^2$  – load power stabilization (characteristic 2). Power allocated on linear load conforms to characteristic 3.
- 3. I – load current stabilization (characteristic 3). Power allocated on linear load conforms to characteristic 1.
- 1.  $I^2$  – load power stabilization (characteristic 2). Power allocated on linear load conforms to characteristic 3.
- 3.  $V \times I$  – non-linear load power stabilization. For each point of adjusting characteristic the constancy of value  $V \times I$  is kept.

Forward regulation characteristic



Reverse regulation characteristic

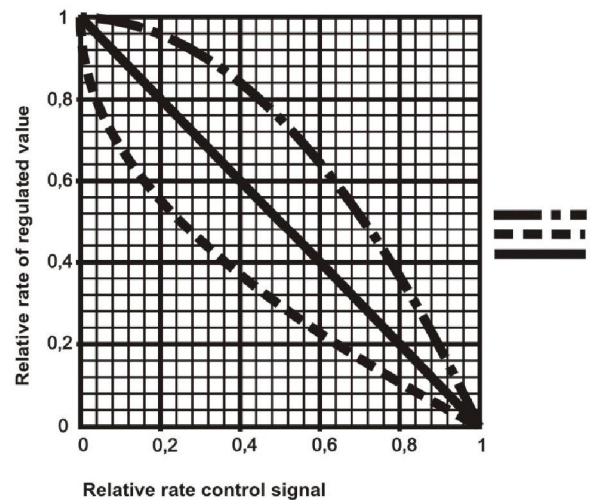


Figure 2 – Types of control characteristics

Connector functional area is shown in Table 1.

Table 2 – Connector functional area

| Connector | Output |  |
|-----------|--------|--|
| XS1       | 1      | Supply (ground)                          |
|           | 3      | ~ 220 V                                  |
|           | 5      | ~ 380 V                                  |
| XS2       | 1      | Optocoupler collector (current overload) |
|           | 2      | Control signal (-)                       |
|           | 3      | Optocoupler emitter (current overload)   |
|           | 4      | Control signal (+)                       |
| XS3       | 1      | Current transformer (current FB)         |
|           | 2      |  |
|           | 3      | Output 10 V (manual control) (+)         |
|           | 4      | Output 10 V (manual control) (-)         |
| XS4       | 1      | Thyristor control VS1 (cathode)          |
|           | 2      | Thyristor control VS1 (cont. electrode)  |
|           | 4      | Thyristor control VS2 (cont. electrode)  |
|           | 5      | Thyristor control VS2 (cathode)          |
| XS5       | 1      | Voltage feedback                         |
|           | 2      |  |

Basic characteristics of PRD FB are shown in Table 2.

Table 3 – Basic characteristics of PRD FB

| Parameter  | Unit | Kind and type of input circuit |            |            |           |            |           |            |            |           |            | Note                 |
|--|------|--------------------------------|------------|------------|-----------|------------|-----------|------------|------------|-----------|------------|----------------------|
|  |      | A-1                            | A-2        | A-3        | A-4       | A-5        | B-1       | B-2        | B-3        | B-4       | B-5        |                      |
| 1. Control signal value that corresponds to minimum power                | V    | 5<br>±0.5                      | 10<br>±1.0 | –          | –         | –          | 0<br>–0.5 | 0<br>–1.0  | –          | –         | –          |                      |
|  | mA   | –                              | –          | 20<br>±2.0 | 5<br>±0.5 | 20<br>±2.0 | –         | –          | 4<br>±0.4  | 0<br>–0.5 | 0<br>–2.0  |                      |
| 2. Control signal value that corresponds to maximum power                | V    | 0<br>–0.5                      | 0<br>–1.0  | –          | –         | –          | 5<br>±0.5 | 10<br>±1.0 | –          | –         | –          |                      |
|  | mA   | –                              | –          | 4<br>±0.4  | 0<br>–0.5 | 0<br>–2.0  | –         | –          | 20<br>±2.0 | 5<br>±0.5 | 20<br>±2.0 |                      |
| 3. Input resistance of control circuit                                   | k Ω  | 10.0                           | 10.0       | 0.06       | 0.2       | 0.05       | 10.0      | 10.0       | 0.06       | 0.2       | 0.05       |                      |
| 4. Power consumption   | W    | 15                             |            |            |           |            |           |            |            |           |            |                      |
| 5. Supply voltage  | V    | ~ 220<br>~ 380                 |            |            |           |            |           |            |            |           |            | ±10%                 |
| 6. FB voltage XS5  | V    | ~ 0...220<br>~ 0...380         |            |            |           |            |           |            |            |           |            | ±10%                 |
| 7. FB current XS3  | mA   | ~ 0...150                      |            |            |           |            |           |            |            |           |            |                      |
| 8. Current pulse amplitude of control thyristor                          | A    | 0.8 ÷ 1.2                      |            |            |           |            |           |            |            |           |            | R <sub>н</sub> = 1 Ω |
| 9. Pulse current rate of rise of thyristor control                       | A/μs | 1.2 ÷ 1.8                      |            |            |           |            |           |            |            |           |            | R <sub>н</sub> = 1 Ω |
| 11. Electric insulation strength of circuits: «XS1, XS4, XS5 – XS3, XS2» | kV   | 4                              |            |            |           |            |           |            |            |           |            | 1 minute             |
| 12. Operating temperature range  | °C   | – 40 ÷ + 85                    |            |            |           |            |           |            |            |           |            |                      |
| 13. Overall dimensions   | mm   | 171 × 152 × 55                 |            |            |           |            |           |            |            |           |            |                      |

The driver is made constructively in a square air-tight plastic housing. The overall drawing is shown at Figure 3.

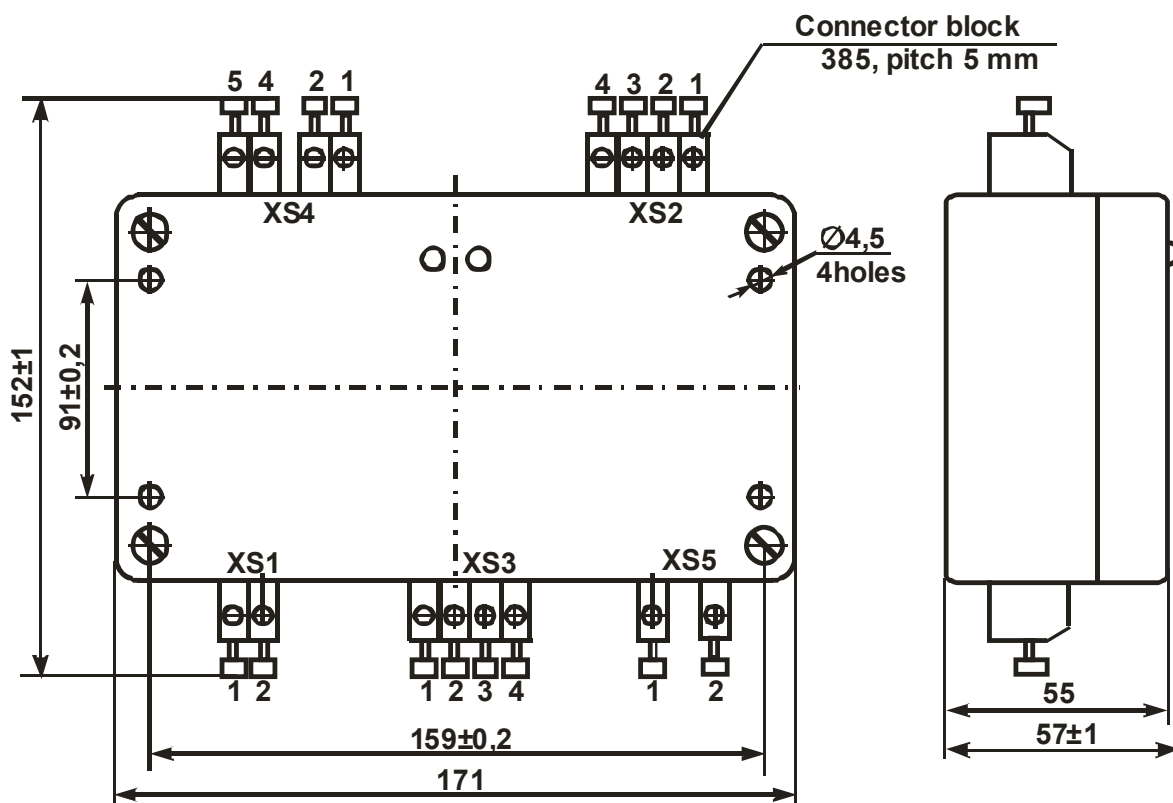


Figure 3 – Overall drawing

There are connectors on the side surfaces of the housing for connection of bonding wire connection.

Notation:

| <i>PRD</i> | <i>FB</i> | <i>B</i> | 3 | 5 | 220 |
|------------|-----------|----------|---|---|-----|
| 1          | 2         | 3        | 4 | 5 | 6   |

1 – PRD — thyristor power regulator driver;

2 – FB — with feedback;

3 – A — reverse adjusting characteristic;

B — forward adjusting characteristic;

4 – control signal type:

1 — 0...5 V;

2 — 0...10 V;

3 — 4...20 mA;

4 — 0...5 mA;

5 — 0...20 mA;

5 – FB type:

1 — V – Voltage FB;

2 —  $V^2$  – voltage square FB;

3 — I – current FB;

4 —  $I^2$  – current square FB

5 —  $V \times I$  – load power FB;

6 – driver operating voltage (~ 220 V or ~ 380 V).

Driver connection circuit is shown at Figures 4 – 6.

For FB version 3, 4, 5 the driver will be supplied by a current transformer CS 005.007-2 with transformation coefficient 1:2000.

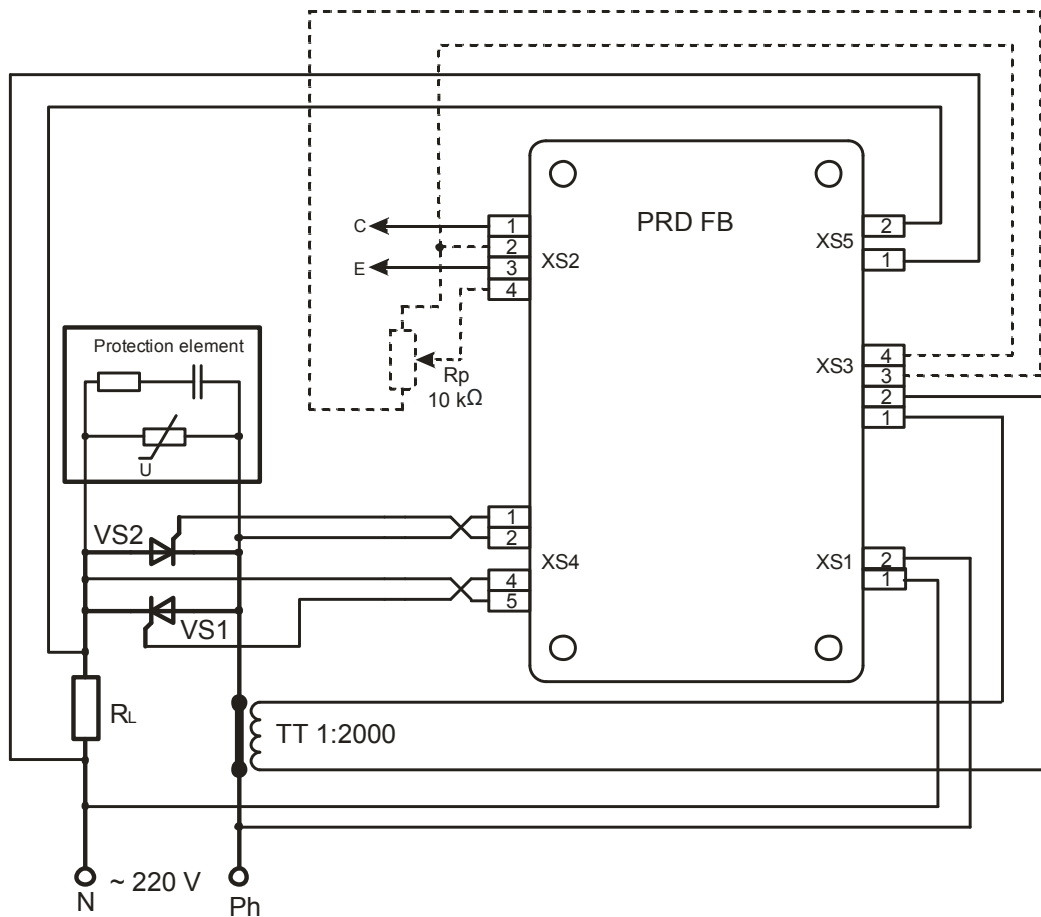


Figure 4 – Driver connection circuit with FB version 5 and network supply ~ 220 V

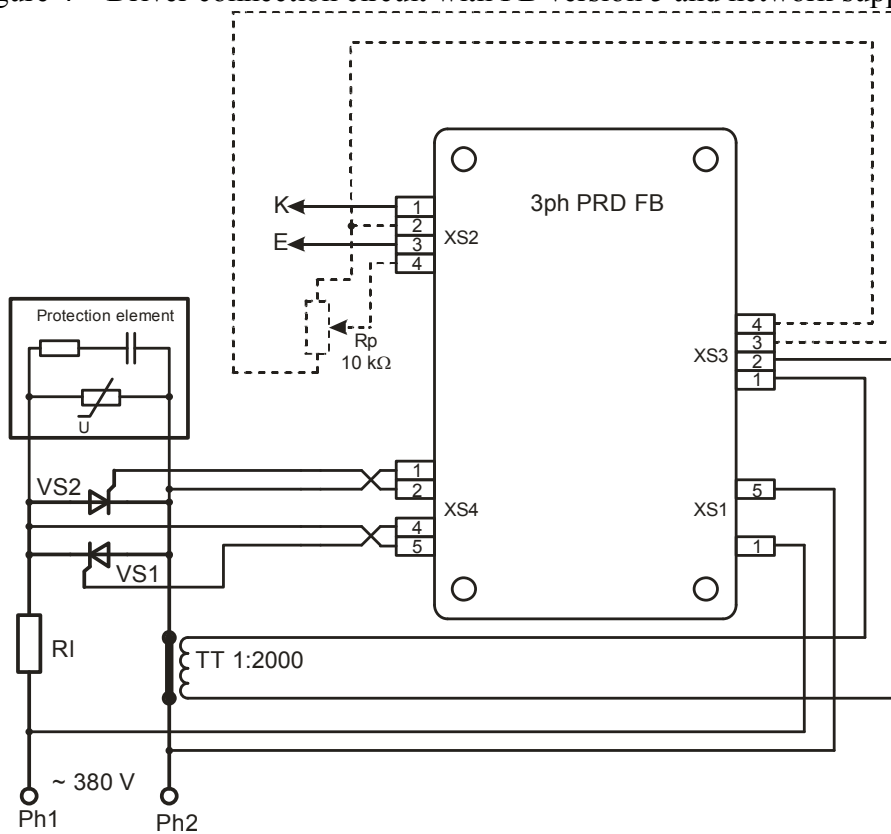


Figure 5 – Driver connection circuit with FB version 3, 4 and network supply ~ 380 V

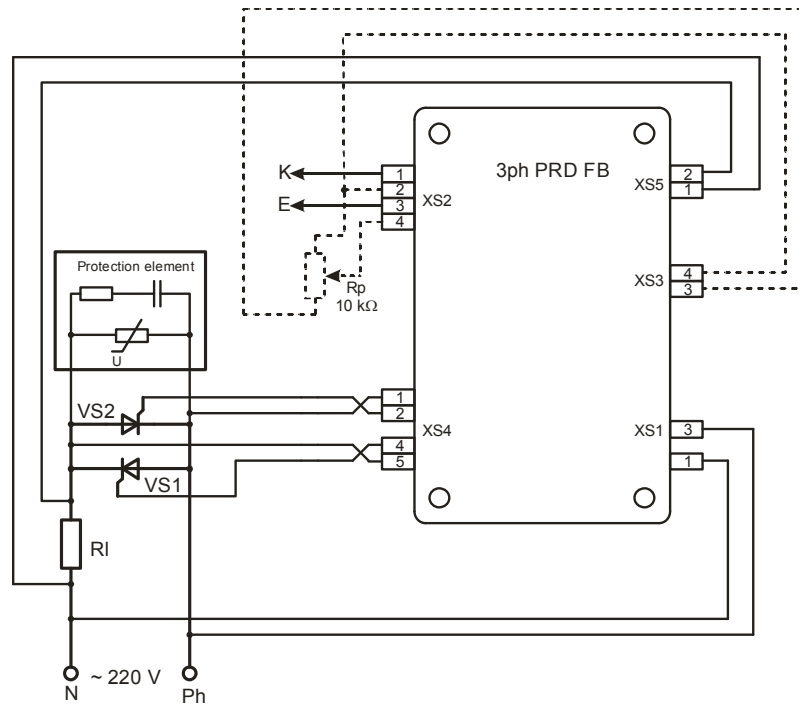


Figure 6 – Driver connection circuit with FB version 1, 2 and network supply ~ 220 V

### SUPPLY SET

- |                             |       |           |
|-----------------------------|-------|-----------|
| 1. Driver                   | _____ | _____ pcs |
| 2. Current sensor 1:2000±2% | _____ | _____ pcs |
| 3. User's manual            | _____ | _____ pcs |

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