POWER FACTOR CORRECTION

MRM - 12

Power factor regulators

Twelve®
electric

www.twelvee.com.pl

Introduction

Rational reactive power economy in an enterprise requires maintaining cosφ at the level specified in the energy solicitation contract. It results in minimisation of uncompensated reactive power costs. The MRM - 12 power factor regulator manufactured by Twelve Electric is a tool helpful in maintaining the correct power factor in three – phase LV and MV networks.

Construction

The MRM - 12 series of regulators is a family of modern, professional, digital devices for regulation of power factor, the cosφ. The microprocessor used allows intelligent control of reactive power regulation process and ensures high precision and sensitivity. Depending on the version, the regulator can control capacitor banks with low number of regulation stages (typical for small and medium businesses) or complex multi – stage power factor correction systems used in big industrial enterprises. It can be used also for regulation in networks burdened with capacitive reactive power, where control of a bank built from PFC reactors is required. The regulator is reliable and easy to install and operate. It is enclosed in a standard size casing flush mounted on a door or an internal panel.

Operation principles

The regulator cyclically, precisely measures the reactive power load in a network and analyses its characteristics. The measuring is carried out in a simplified Aron circuit basing on measurement of current in one phase, e.g. L1, and voltage in two remaining phases – L2 and L3 (see fig. 1 – 3). The measuring data is analysed by the microprocessor calculating actual reactive power intake and deciding on switching of consecutive stages of the capacitor bank in accordance with user – defined settings. The measuring circuit is highly sensitive, so the regulator works properly with CT currents from the order of 40 mA, allowing decent compensation with very low loads or an incorrectly sized current transformer. Regulation process can be adjusted to the characteristics and alteration dynamics of reactive power intake. This is thanks to the choice of three different measuring characteristics of the regulator, which increase its versatility and effectiveness. Data processing algorithms and measurement methods the regulator uses ensure correct operation with notable level of higher harmonic distortion in voltage and current (THDU≤8 % or THDI≤10 %). To reduce the number of switching processes that accompany frequent high – magnitude power fluctuations, the regulation proceeds with a preset response time. The MRM - 12 regulator allows presetting of three independent response speeds, separately for switching the capacitors on and off, and for additional disconnection in order to minimise the time of overcompensation when the characteristic of the load changes into capacitive. Wide range of response time presets allows using the regulator for power factor correction in systems with various dynamics of reactive power alterations, especially for rapidly changing loads with short reactive power intakes (e.g. 200ms), where fast electronic capacitor switches, e.g. the BŁT – 4, or special circuits for fast discharge of type DNE capacitors are in operation. Each MRM - 12 regulator has a factory preset time blockade of reconnection of a recently disconnected capacitor. It prevents switching a capacitor on before its complete discharge (assuming that the discharge circuit is operating properly). The blockade is disabled in the version for controlling thyristor switches. The blockade is disabled in the version for controlling thyristor switches. The regulator also allows setting of the level of uncompensated reactive power to desensitise the regulator to low magnitude reactive power intake changes that do not worsen the tgφ, but if included into the power factor correction process, they would increase the number of switchings and speed up the wear contactors and capacitors. In some cases, too high sensitiveness of a regulator to minor, but frequent alterations causes all of the capacitors to be discharging at the same time and, as a consequence, worsens power factor correction effectiveness. Another important feature of the MRM - 12 regulator is the possibility of using one of seven predefined operation modes. It facilitates power factor correction optimised for different load specifics and stepping of power of capacitors making the bank.

Types of regulators

The MRM - 12 power factor regulator is manufactured in a number of versions to meet different Customers' needs and expectations. Each version can have 4, 6, 9, 12 or 15 switching outputs. A standard regulator operates at 400 V. For individual orders we also make other nominal voltages: 100 V, 230 V, 500 V, and 660 V.

Versions of regulators

– basic: MRM - 12cs

digital cosφ indicator, current percent value indicator, manual operation mode, automatic blockade of undischarged capacitor reconnection, three response times programmable in wide range of presets, seven operation algorithms suiting different series of capacitors, fault indicator, active stages indicator.

– with time clock control: MRM - 12c

additional feature of time control. At a chosen time the regulator stops controlling the cosφ and disconnects the capacitors or switches on a predefined one. It also returns to automatic operation at a user – set time. This feature lets maintain "natural" cosine when necessary and allows power factor correction on slight power flows, e.g. in the night hours, when production lines are off, on external lighting or idle – running transformers.

– with dual current input: MRM - 12c/2xI – 1 or MRM - 12c/2xI – 2

standardly equipped with a controlling time clock, destined for working with two current transformers installed in two different sections of the supply. These regulators can be used in dual power supply systems or systems with reserve (dual), so in every place where there are two transformers working with an automatic transfer switch. Using the regulators with dual current inputs allows effective power factor correction not only during normal operation, but also when one of the transformers is disconnected.

The MRM - 12c/2xI – 1 regulator is destined for power factor correction in systems with known reserve (when one of the transformers is the main power supply, while the other one is the reserve switched on in case of the main transformer fault – see fig.2). The dual current input regulator conducts power factor correction on the main transformer and automatically switches the control over in case of connection and loading of the reserve transformer.

The MRM - 12c/2xI – 2 regulator finds its use in systems with hidden reserve (when two transformers work simultaneously – see fig.3). In case of voltage decay on one of the transformers, an automatic changeover system burdens the other transformer with the whole load. After that the regulator automatically becomes controlled by the signal from the operating transformer's supply section.

These features give solid economical effects as application of these regulators allows power factor correction with a single capacitor bank (MRM - 12c/2xI – 1) or with banks without hidden reserve, that is matching the load of a particular section (MRM - 12c/2xI – 2).

Usage advantages

A PFC system controlled by an MRM - 12 regulator effectively compensates reactive power to the level required by an energy supplier. Correct choice of individual stages and the total power of a bank, and adequate setting of the regulator ensure cosφ at the level of 0.98 without significant network overcompensation states. Thanks to that it is possible to reduce, or even completely eliminate the cost of reactive power consumption, if it is calculated basing upon the difference between the actual tgφ and tgφ specified in the contract with the energy distributor. The MRM - 12 regulator allows fully automatic, supervision – free power factor correction. It characterises with easy assembly and usage simplicity. It can be used as a replacement for older regulators without the need for modernisation of the capacitor bank. It is equipped with a set of indicators for monitoring of its condition. The built – in display shows real – time power factor (cosφ) to allow verification of the power factor correction effectiveness. Numerous programmable parameters ensure compatibility with different types of current transformers and steppings of capacitor banks, and give the possibility to optimise the PFC process in meet the specifics of a supply system and a load. Free Twelve Demo software helps to learn to program the regulator on a PC and to choose, and verify the settings to attain the best effectiveness of power factor correction with an actual load and a capacitor bank available.

Technical parameters

Voltage circuit:	
Nominal phase – to – phase voltage *(specify when ordering)*	**100, 230, 400, 500 V**
Voltage tolerance	**–10 % ÷ +15 %**
Nominal frequency	**50 Hz**
Power consumption	**15 VA**
Current circuit:	
Nominal current	**5 A**
Max. measured current	**6 A**
Min. measured current	**40 mA**
Power consumption	**2,5 VA**
Output circuit:	
Number of stages *(specify when ordering)*	**4⁰, 6⁰, 9⁰, 12⁰ or 15⁰**
Control voltage	**230 V**
Output load capacity:	**5 A at 250 V AC**
IP protection degree	**front: IP40; with special cover: IP54 terminals side: IP20**
Operating temperature:	**–15⁰C (version with heating) ÷ +50⁰C**
Accuracy class:	**1,5**
Regulation range:	
non – compensated reactive power %Q/n	**0 ÷ 150 %**
neutral zone Q/n	**0,01 ÷ 0,99**
cosφ	**0,3 ind. ÷ 0,7 poj.**
ind ON/OFF time, cap OFF time.	**1 ÷ 99 s step 1 s**
no. of control series	**7**
clock operation time without supply	**less than 6 months**
Indices/factors:	
power factor cosφ	**digital, four digits**
percentage of the current flowing through the current transformer	**digital, two digits**
current time	**hour and minute**
indication of steps switched on	**dioda LED**
Other:	
programming	**keypad**
connection	**2,5 mm² wire multi – contact connector**
weight	**<1,5 kg**
dimensions [mm]	**144x144x85 mm (DIN 43700)**
mounting cutout dimensions [mm]	**138x138 mm**

Standards:

PN – EN 5501; PN – EN 61000 – 4 – 2; PN – EN 61000 – 4 – 4;
PN – EN 61000 – 4 – 5; PN – EN 61000 – 4 – 6;
PN – EN 61000 – 4 – 8; PN – EN61000 – 4 – 11

Certificates:

Attestation no. 0964/NBR/08 issued by the Electrotechnical Institute.

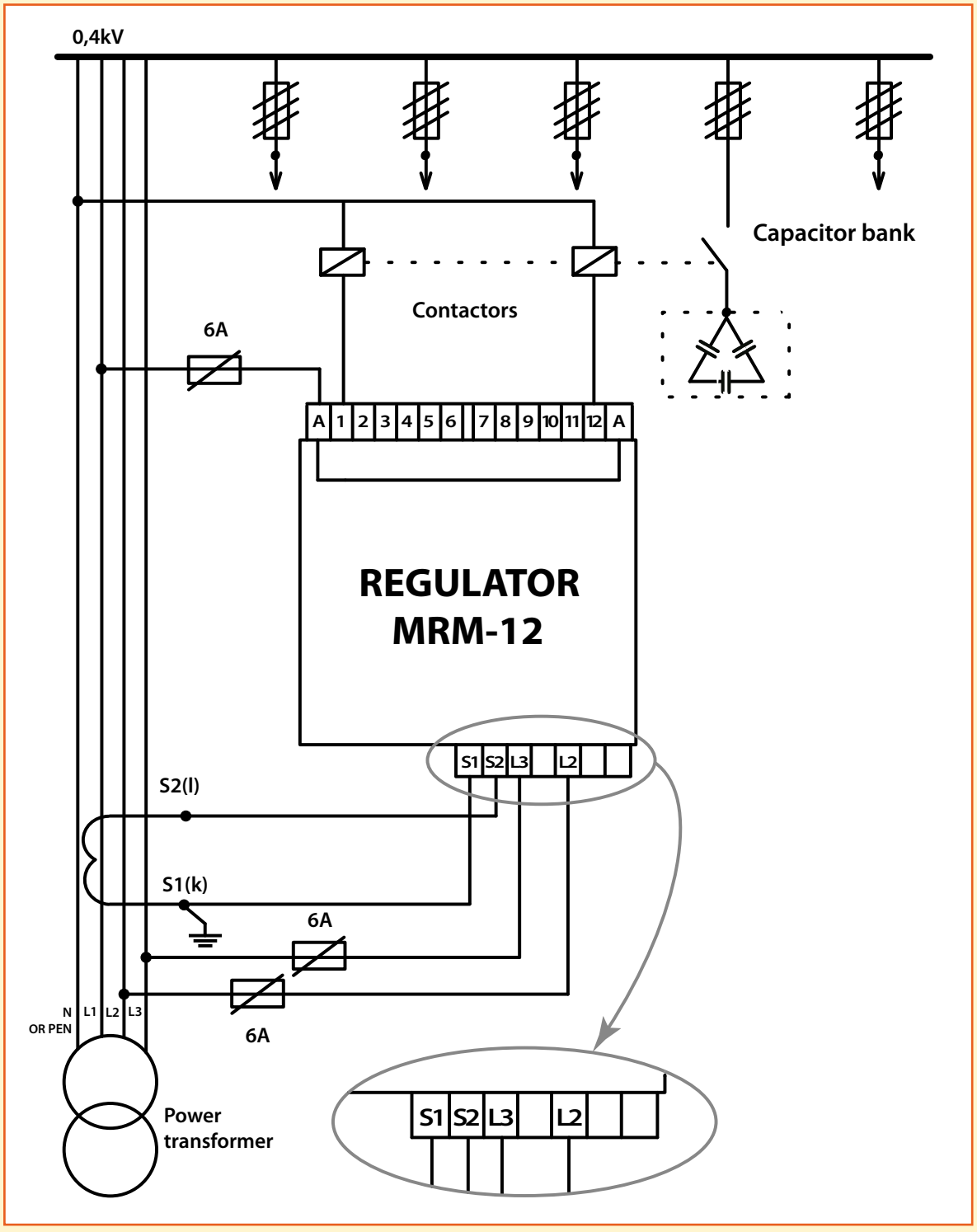

Fig.1. An MRM - 12 regulator connection schematic diagram.

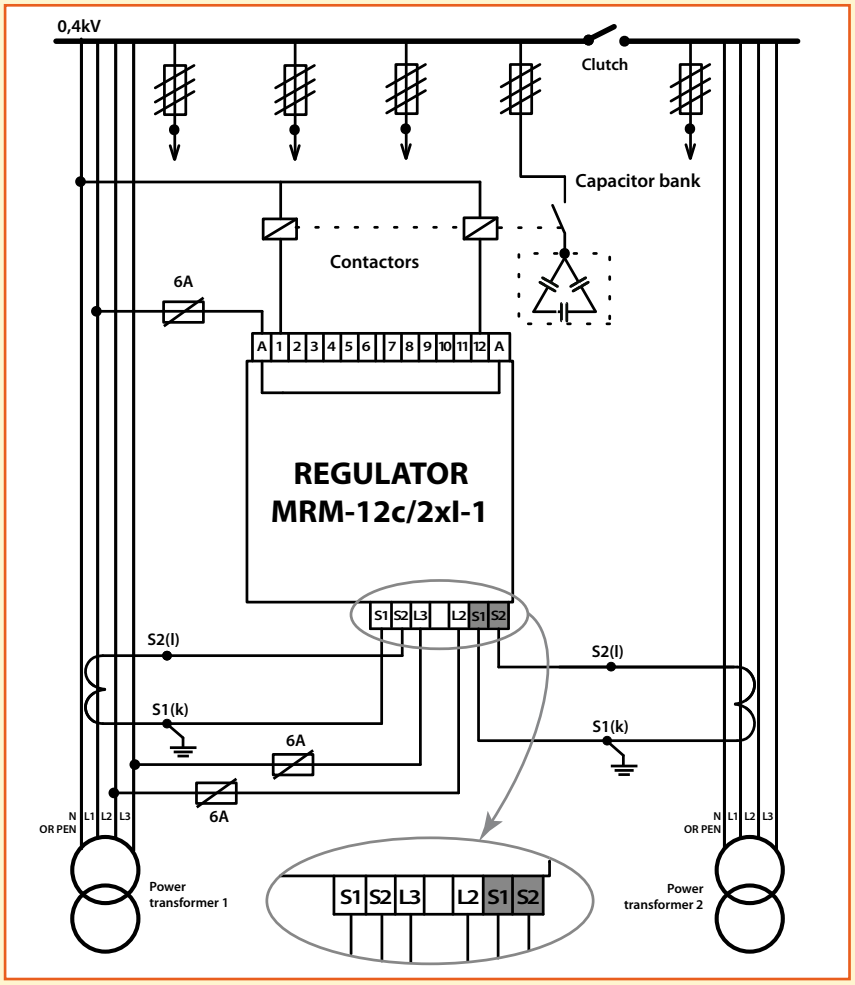

Fig.2. An MRM - 12c/2xI – 1 regulator connection schematic diagram.

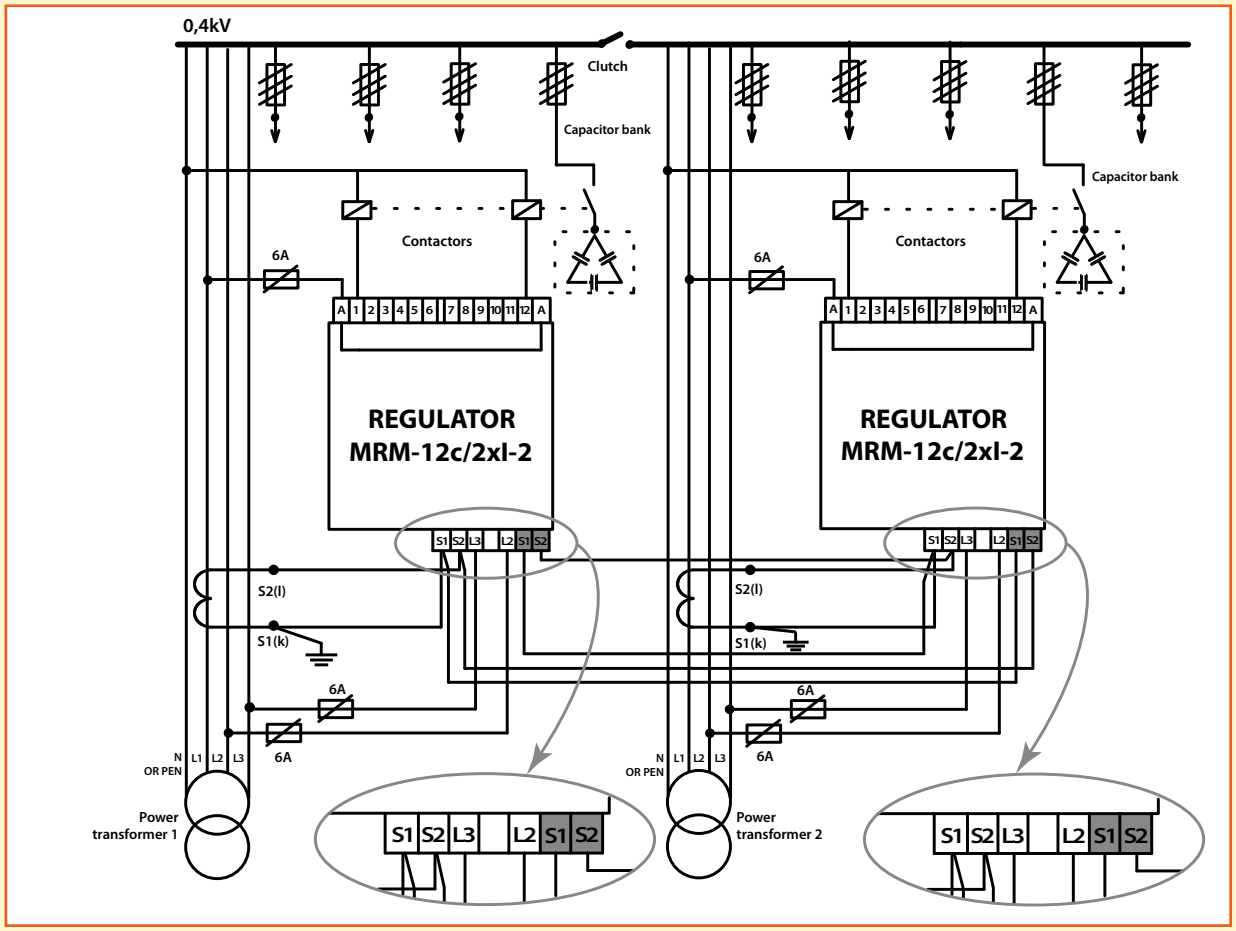

Fig.3. An MRM - 12c/2xI – 2 regulator connection schematic diagram.

TWELVE ELECTRIC'S OTHER OFFERS

POWER FACTOR CORRECTION

K.99/3
LV power capacitors

BK - T - 95
capacitor banks

DWD – 12
filtering reactors

IKT – 12
individual compensator

NETWORK QUALITY MONITORING

- **AS – *3plus***
  Network Parameters Analyser with graphical display

- **AS – *3mini***
  DIN – mounted Network Parameters Analyser

- **AS – *3energia***
  energy costs Analyser with elements of energy quality analysis

- **AS – *3diagnoza***
  porte Network Parameter Analysers with set of measuring clamps

- **AS – Multi 2002**
  system software for data transfer, visualisation, reports and alarms

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