

# POWER FACTOR CORRECTION

## IKT - 12

Individual compensator



## Introduction

Individual compensators find their use wherever power and characteristics of a single load differentiate it from the others. Such disproportions prevent efficient group power factor correction, which results in deviations from the solicited power factor. In many cases, to attain the  $\text{tg}\varphi$  required by a contract, individual compensation of a load is necessary. It mainly applies to systems with small number of loads installed, where reactive power intake is constant. Using individual compensators in such cases is technically and economically well founded. Adequate power of compensators allows effective compensation of asynchronous motors, especially those in high – power devices such as: compressors, vents, pumps; or operating with interruptions: lifts, cranes; as well as transformers working with no load. Individually adjusted compensators can be used to compensate asymmetrical power intake (lighting, two – phase welders). The economical effect of applying an individual compensator is obvious. In its simplest form it can be a cheap capacitor permanently connected to the supply terminals of a load to be compensated. When a load draws capacitive reactive energy, e.g. a long MV cable, it is possible to make a compensator from a reactor instead of capacitor. Because of personalised specifics of the product this catalogue does not contain its description. For the same reasons individual MV compensator has been omitted. Customers interested in this information are kindly advised to contact our sales department.

## Construction

Depending on build and application, individual compensators can be made in a number of versions. An essential part of each compensator is a three – phase power capacitor or a set of single – phase capacitors in one enclosure. Capacitors being the main part of the IKT – 12 compensator are made in the MKP technology, which means dry capacitors with polypropylene film dielectric and metallised conducting layer. Twelve Electric offers compensators in a variety of power, nominal voltage, IP protection degree, switching speed and auxiliary equipment. That allows matching a compensator to the characteristics and dynamics of the load. Our comprehensive offer allows choice of the most effective PFC systems and satisfies our Customers' technical requirements and expectations. It is possible to order a compensator with increased IP degree so it can be used as an idle – running transformer compensator working outdoors, e.g. in distribution stations.

## Operation principles

Individual compensation is synchronous work of a compensator and a load. Correct choice of a compensator reduces reactive power intake to the level, at which the compensator and the load are nearly a pure resistance. That decreases inductive reactive power consumption and its costs in effect. Capacitor is usually energised simultaneously with the compensated load. This process is individual in the meaning of time of work and intervals, and depends on the technological process a part of which is the load. Capacitor power – ups, supply voltages with different content of higher harmonics, various dynamics of switching processes, as well as many other factors have caused Twelve Electric's coverage of individual compensators to be extended and adjusted to Customers' unique requirements.

## Types of series IKT – 12 compensators

Variety of IKT – 12 individual compensators allows choice optimised for a particular load. The compensators can be divided by the kind of supply voltage or load into: single – , two – and three – phase. The last digit of product reference number represents the number of phases. There are also indoor and outdoor compensators, depending on the enclosure used. Other criteria are the compensator application and additional accessories. Twelve Electric's individual compensators come fitted with a contactor and time – relay circuit, a reactor, and a capacitor ( $U_n=440\text{ V}$ ). They also have an overvoltage protection eliminating the interferences caused by transient states during switching of the reactor – capacitor circuit.

### Individual compensators versions:

**The IKT – 12 / I compensator is destined for installation in networks with significant loads asymmetry. The most common application for this compensator is lighting systems without pre – fitted capacitors. The compensator is made from single – phase capacitors of power adequate to the load. The enclosure dimensions depend on the size of capacitors used. On a Customer's request we fit additional equipment, such as: a reactor, a contactor, signal lamps, etc. to improve the functionality.**

**The IKT – 12 / II is the basic version of an individual compensator built on a three – phase MKP power capacitor. This version is the cheapest option. Compensator power can be selected from the range from 0.5 kvar to 30 kvar. The capacitor is fitted with power supply terminals cover (plastic cap with cable glands) ensuring protection degree IP54. The compensator can be fitted in an arbitrary position by using the mounting bolt at the bottom of its cylindrical casing. This method allows easy installation using the compensated load's supporting structure. We can provide compensators with feeding wires of length and electrical parameters adjusted to particular needs.**

**The IKT – 12 / III individual compensator is equipped with a three – phase capacitor built from single – phase capacitors in shared metal enclosure. This way power of the compensator can be chosen from the range from 5 kvar to 75 kvar with resolution of 0.5 kvar (three phases). Aesthetic powder coated metal enclosure (440 x 480 x 350 mm; W x H x D) ensures IP54 protection degree. The compensator is easy to install. The terminals used simplify connection of feeding cables. Depending on a user's needs, operating conditions, supply voltage, and characteristics and dynamics of load alterations, the compensator can be fitted with additional equipment indicated by the following product codes**



**The IKT – 12 / III/SR compensator** is fitted with a type DNE fast discharge reactor. It uses a conventional contactor with soft switching system designed for switching capacity currents. The capacitor coupled with the discharge reactor provides discharge times of 1 second or more. This is a cheaper version of the IKT – 12 / III/D. The discharge speed offered, combined with low price makes it perfect for compensation of loads with dynamically changing reactive power intake.

**The IKT – 12 / III / Hr compensator** is fitted with a type DWD reactor for filtration of higher harmonics. It is designed for compensation of loads energised with distorted voltage (high THD). In this version, the compensator consists in a filtering reactor protecting the capacitor (connected in series) against harmful influence of higher harmonics. Feeding a capacitor with distorted voltage causes current flows above the permissible threshold and serious heat emission. Increased temperature degrades the dielectric, which can result in an avalanche self – healing in the capacitor, bringing loss of capacity and finally a breakdown of the whole compensator. The reactors working with capacitors are equipped with temperature sensors allowing automatic power disconnection in case of device overheating. Twelve Electric offers reactors with different attenuation coefficients for filtering of different orders of harmonics. The compensator in the Hr version is standardly equipped with capacitors adapted to work with filtering reactors (nominal voltage increased to 440 V).

**The IKT – 12 / III/R compensator** is fitted with an additional switch – fuse allowing maintenance and repair works on the compensator without disconnection of compensated load. This compensator is especially suitable for idle – running transformers. The fuses protect the capacitor against high currents (e.g. short – circuit), which is good for its lifetime, while the switch allows capacitor shut – down without need for disconnection of compensated load, e.g. a transformer.

**The IKT – 12 / III/L compensator** is fitted with phase failure signalisation system. In this version there are three LED's on the compensator's enclosure informing about decays of corresponding phases. Normally, these are single – colour lamps, but the compensator version with a switch – fuse or a contactor is fitted with two – colour lamps. Green indicates that the capacitor is energised properly, while red informs that the supply voltage is correct, but there is no voltage on the capacitor itself. It can mean that a fuse had melted, or, if it is the time – relay version, that the capacitor is discharging. No illumination at all means that there is a voltage decay in the supply network.

**The IKT – 12 / III/S compensator** is fitted with a contactor and a time relay. This kind of compensator is destined for compensation of loads that work with intervals shorter than 1 minute. The time relay protects an undischarged capacitor against reconnection. The delay time should be set at a few seconds more than the discharge time. The minimum delay is 1 minute as this is the time needed to discharge a capacitor through factory fitted resistors. Protection against energising the capacitor undischarged seriously increases its lifetime and keeps the load safe from electromagnetic interference. It also protects contactor contacts from sticking together. Using the time relay makes sense also when compensating motors with soft – start circuits. These circuits produce a big quantity of higher harmonics on startup that speeds up the capacitor wear. In this case the delay from the time relay allows energising the capacitor after startup, when the motor is at its normal power and rotational speed, and when THDU is at a safe level.

**The IKT – 12 / IV** is adapted to the needs of compensation of high – power asynchronous motors controlled by star – delta switches. The compensator is built from single – phase capacitors connected through contactors into a circuit ensuring adequate power both during (star) and after the startup (delta). Fig. 1 shows the electrical diagram of the compensator. It has metal enclosure with increased IP degree. It allows compensation of high – power motors from their startup.

**The IKT – 12 / III/D compensator** is fitted with a B&T – 4 thyristor switch and is destined for compensation of loads with very fast (0.5 s – 2 s) and short – lasting (max. 1 min.) reactive power alterations. Thanks to the thyristor switch it is possible to energise the capacitor anytime, even without discharging. The switching delay is only 0.2 seconds. Version D of the compensator is perfect for compensation of lift or crane motors, as well as loads with dynamically changing power intake, such as high – simultaneity groups of welders with high simultaneity factor.

### **Series IKT – 12 compensators usage advantages**

Twelve Electric's individual compensators are manufactured in a number of versions differing in the equipment and technical solutions applied. That allows easy choice of a compensator to suit unique needs, specifics of a compensated device and a user's financial limits. Availability of increased IP enclosures enables the compensator to work in difficult conditions, e.g. outdoors. The compensators are easy to install and operate. Durable capacitors and correctly chosen additions ensure long – lasting seamless operation. On individual request it is possible to order a compensator being a combination of selected versions, e.g.: a three – phase compensator with filtering

reactor, thyristor switch and indicator lamps. This compensator's ordering reference code would be: IKT – 12 / III/HR/D/L/3.

## Technical parameters

Technical parameters of individual compensators depend on the parameters of capacitors and technical solutions used. While choosing a compensator, the type of a load to be compensated has to be taken into account. The important parameters are: nominal power, reactive power alterations dynamics and either the measure of reactive power increments or power factor alterations range. In case of compensation of a three – phase motor it is necessary to determine its rotational speed. The choice of a compensator for electronically controlled devices should follow measurement of distortions in the supply network. Because of strong interference from power – electronic control systems resulting in damage to capacitors, the choice of a compensator should be made very carefully, especially for converter systems, for which the kind of filter used must be identified. For soft – start systems it is required to specify start – up parameters (the time needed for a motor to advance to the bypass mode) to allow adequate setting of the time relay. Precise description of fitting place and method allows more adequate choice of the compensator design, too (e.g.: specific IP degree or an additional switch – fuse).

Q [kvar]	Capacitance C [μF]			Nominal current In [A]		
	400 V	440 V	525 V	400 V	440 V	525 V
2,5	3x16,5	–	–	3x3,6	–	–
5,0	3x33,3	3x27,4	3x19,3	3x7,2	3x6,6	3x5,5
7,5	3x49,8	–	–	3x10,8	–	–
10,0	3x66,6	3x54,8	3x38,5	3x14,4	3x13,1	3x11,0
12,5	3x83,0	–	–	3x18,0	–	–
15,0	3x99,9	3x82,2	3x57,8	3x21,7	3x19,7	3x16,5
20,0	3x132,6	3x109,6	3x77,0	3x28,9	3x26,2	3x22,0
25,0	3x166,0	3x137,0	3x96,2	3x36,1	3x32,8	3x27,5
30,0	3x199,3	3x164,4	3x115,5	3x43,4	3x39,4	3x33,0

Table 1. IKT – 12 individual compensators parameters.

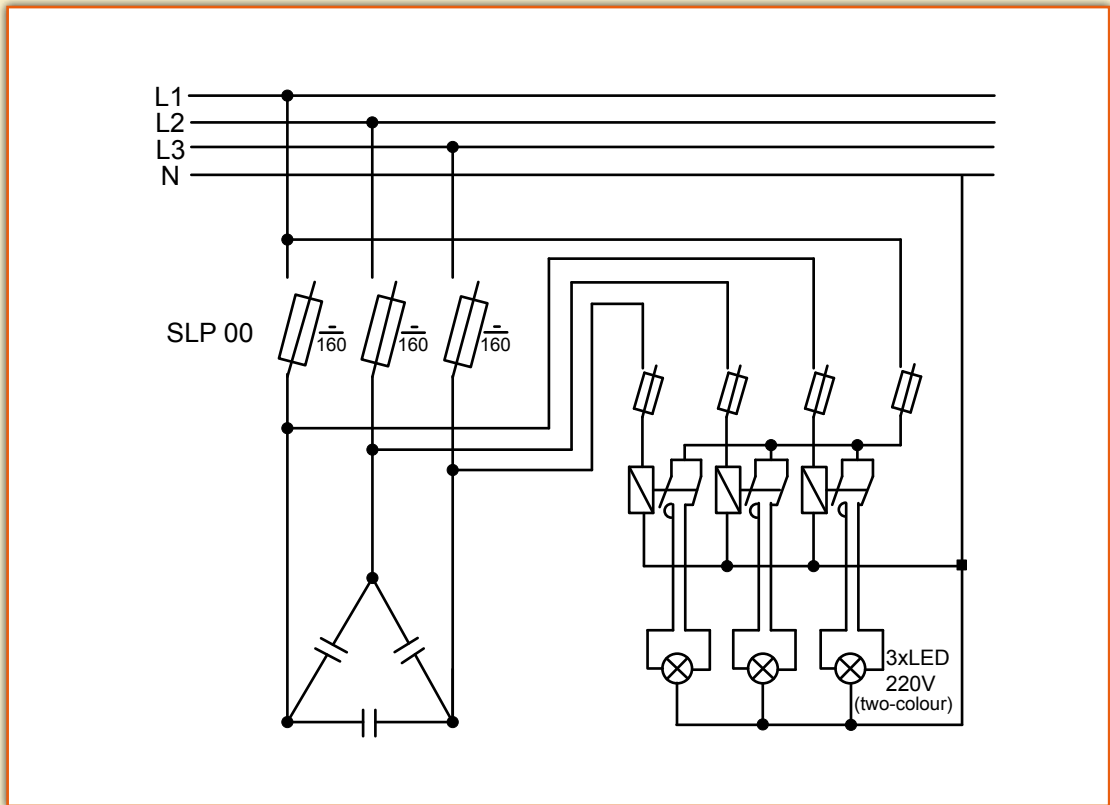


Fig. 1. IKT – 12 / III/L compensator connection schematic diagram.



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**Twelve Electric Sp. z o.o.**  
04 - 987 Warszawa, ul. Wał Miedzeszyński 162  
tel. +48 (22) 872 20 20, fax. +48 (22) 612 79 49  
skype: t12e\_1, t12e\_2, t12e\_3  
e - mail: [twelvee@twelvee.com.pl](mailto:twelvee@twelvee.com.pl)  
[www.twelvee.com.pl](http://www.twelvee.com.pl)