Brochure

Low voltage stepless compensator PQCR

PQCR is a solid state reactive power compensation solution with high reliability and low loss for dynamic and highly fluctuating loads. Designed with a small footprint, it contributes to reducing system losses and CO_2 footprint, as well as lower maintenance needs and enhance life of electrical installations

Contents

Instrument transformers

PQCR can be used for applications requiring instantaneous and stepless dynamic compensation for dynamic and unbalanced loads with response time of less than 1 cycle like:

- Inductive and capacitive loads
- Highly fluctuating loads
- Industrial loads fed by weak networks
- Three phase and single phase applications
- LV networks and MV networks with step-up transformers

Applications include:

- Automotive manufacturing plant
- Steel plants
- Rolling mills
- Traction loads
- Wind and solar farms
- Pulp and paper industries
- Crane operation facilities
- Cable capacitance compensation.

PQCR is the product with instantaneous and stepless reactive power compensation and load balancing facility for dynamic inductive and capacitive loads.

Stepless compensator PQCR

Unique features and benefits

Improved power quality

PQCR can compensate for dynamic reactive power and unbalanced loads in a fast and transient-free manner. It can compensate both inductive and capacitive behavior of the loads, thereby enhancing power quality in a truly superior way.

PQCR in combination with equal rated fixed filter banks doubles the dynamic range of the capacitive reactive power compensation capacity and reduces the Total Harmonic Distortion (THD).

Robust construction of components

PQCR consists of robust components, like -

- Latest generation IGBTs with high thermal capacity
- Better ripple current handling capacity of DC film capacitors increases the operating life
- Compact and robust IGBT stack with higher unbalancing capacity and reduced footprint

Compliance with utility regulations

PQCR enables compliance with stringent power quality regulations on power factor and THD. This helps customers avoid penalties imposed by utilities and / or refusal to connect installations to the grid. Rapid reactive power compensation also helps to maintain the voltage in the network.

Rapid, highly fluctuating reactive power demand compensation without risk of harmonic amplification

If the reactive power requirement fluctuates rapidly or is high, contactor switched capacitor banks cannot be used. This is due to limitation of number of operations that can be handled by contactors and the need to limit inrush current on the capacitors. If harmonic distortion is present in the network and if plain capacitor banks are used, excitation of resonance frequencies can occur leading to further harmonic voltage amplification. This causes failures in other loads connected to the same network. Also, the capacitor current stress may well go above the nominal rating. This typically leads to premature failing of the capacitors itself. PQCR compensates the reactive power requirement in a fast and stepless way and avoids switching transients.

Enhanced energy efficiency by reducing system losses

High power requirement at a very low power factor results in a high load current. High current results in additional losses (I2R losses) in supply cables and transformers which leads to inefficient operation of the plant. The customer faces an increased energy bill due to higher losses in the system. Moreover the energy losses because of reactive power present in the system may lead to excessive heating of various components which reduces the life expectancy of the electrical equipment. PQCR enhances energy efficiency by improving the power factor dynamically and thereby reduces these energy losses.

PQCR 440 V

PQCR 690 V single phase

Improving system usage

In thermally limited equipment, such as transformers or cables, PQCR allows a greater payload/usage of the same system. By furnishing the necessary magnetizing current through PQCR to induction motors and transformers, the current drawn from the power supply is reduced. Less current means less load on transformers and feeder circuits. If a system has an existing overload, because of reactive power, PQCR can eliminate it.

PQCR allows cost savings in infrastructure equipment like transformers, switchgear and cable, otherwise required to serve the additional loads.

Reduced maintenance needs and enhanced life of electrical installations

Poor power quality leads to inefficient running of installations, system down time and reduced equipment life and consequently high installation running costs. With PQCR the power quality of electrical installations is maintained and the installation lifetime can be optimized.

Easy installation, commissioning and operation with touchscreen human-machine interface (HMI)

PQCR is provided with a 7 inch touchscreen display which provides a versatile interactive interface to the users.

The simple organization of menus and sub-menus ensures ease in navigation. Minimal configuration set-up of the system parameters eases the commissioning process. The PQCR-Manager follows the TCP / IP communication protocol and can communicate externally over Ethernet/LAN port. All parameters, settings and measurements are accessible remotely.

Stepless compensator PQCR

Technology based on voltage source converters

PQCR is based on Voltage Source Converter (VSC) technology. VSC technology consists of Insulated Gate Bipolar Transistors (IGBT) as fully controlled power semiconductor devices.

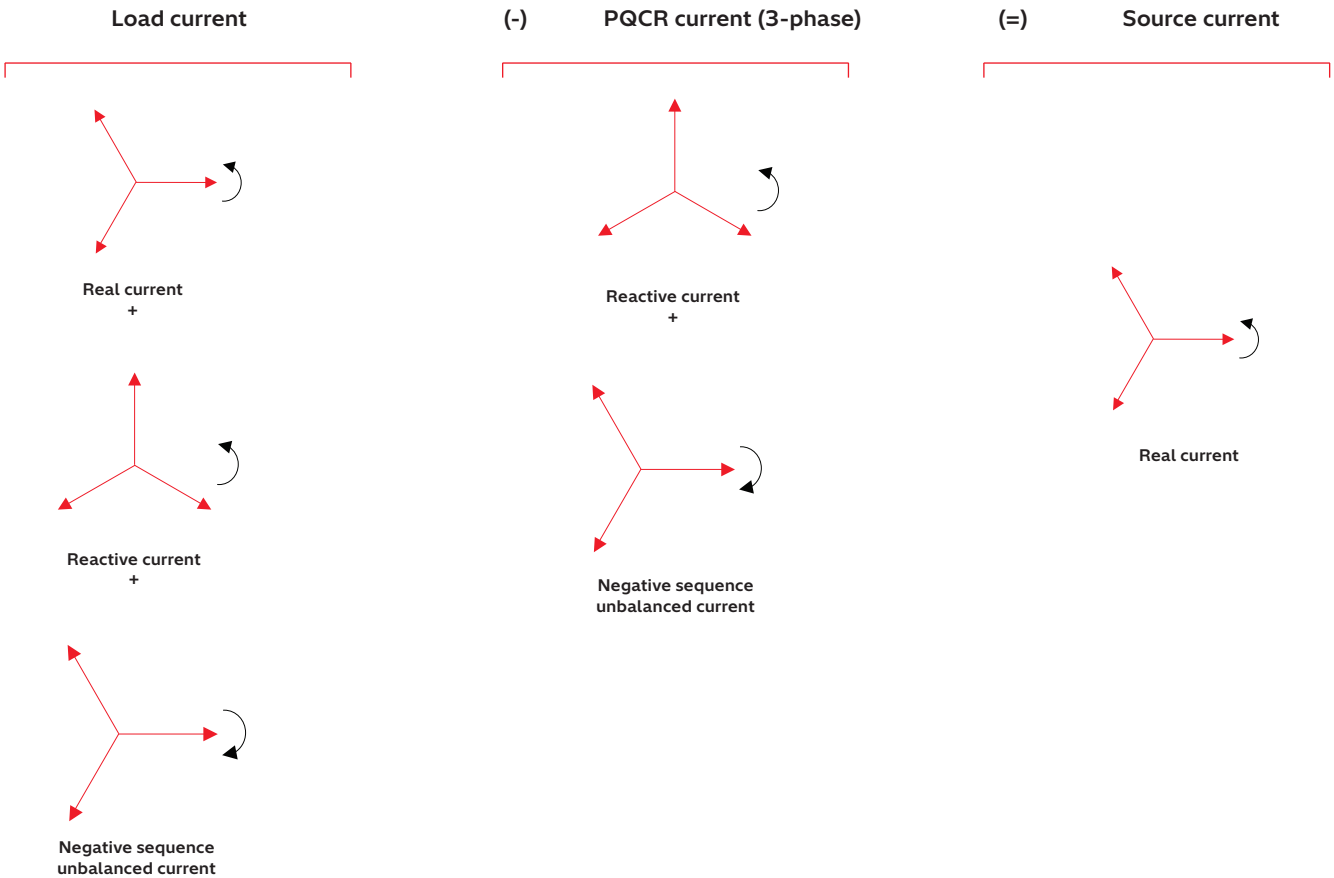
Major components like VSC converter, switchgear and controllers are designed in-house, meeting relevant international standards as well as ensuring consistency in quality.

The VSC produces single or three phase AC voltages from a DC source voltage. The VSC generated voltage is coupled to the supply voltage through a Pulse Width Modulation (PWM) reactor. By varying the magnitude of the AC terminal voltage of the VSC, reactive power exchange takes place between the VSC and the AC source. Further, PQCR generates appropriate magnitude of voltage at the AC terminal of the VSC to compensate for negative sequence current due to unbalanced loads.

Hence, the source is totally relieved from reactive current and negative sequence current (due to unbalanced loads). This results in a flow of balanced real current in all three phases in the source.

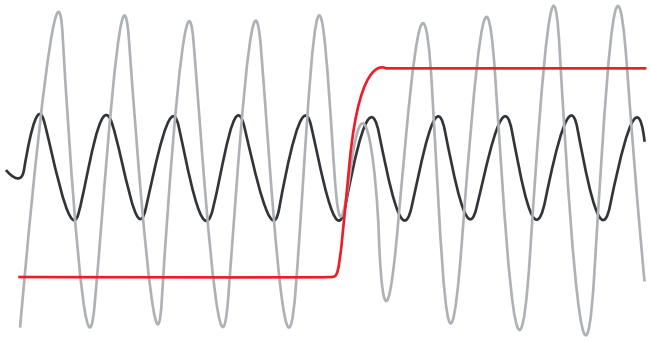
PQCR provides excellent steady state performance, instantaneous response (<1 power cycle) and has superior control characteristics, thanks to high speed Digital Signal Processor (DSP) technology.

Let's take an example of a typical welding load in an automobile factory. Arc welders draw high levels of current during their operating cycle, which is often only several seconds in duration. These high cycle-to-cycle currents cause high reactive power to be drawn from the supply resulting in a drop of the voltage at the transformer secondary and leading to failure or loss of productivity.



When PQCR is connected to the load, it compensates reactive power to support the arc welder and reduces reactive power demand upon the upstream electrical system. The system transformer does not see the massive demand for reactive current and does not experience significant voltage drops, and therefore the voltage remains stable.

The response time of PQCR is less than one power cycle of fundamental kvar compensation, ensuring accuracy and quality of the welding operation.



PQCR current

Source voltage

Step voltage

PQCR enhanced productivity and energy efficiency at Toyota Indus Motor Company, Karachi, Pakistan

PQCR

Technical specifications

Parameter	Unit	3 phase	1 phase (440 V)	1 phase (690 V)
Nominal voltage	V	380 - 440	380 - 440	585 - 690
Maximum kvar / unit	kvar	375	275	850
Maximum current / unit	A (rms)	520	665	1230
Maximum kvar support at voltage	V	415 - 440	415 - 440	650 - 690
Network frequency	Hz		50 / 60	
Response time	ms	<20	<20	<25
Number of parallel units		32	32	15
Communication features			Ethernet / LAN port [1]	
Programming manager			PQC Manager (Touchscreen graphical user interface)	
Target power factor			Programmable from 0.6 (inductive) to 0.6 (capacitive)	
Dimensions (without door and roof)	mm	900(W) x 900 (D) x 2000 (H)	900(W) x 900 (D) x 2000 (H)	1800(W) x 1200 (D) x 2000 (H)
Modes of operation				
Var compensation		Yes	Yes	Yes
Load unbalance compensation		Yes	NA	NA
Unbalance compensation range	%	50 to 100		
Environmental conditions				
Ambient temperature	°C		-5 to 40 °C	
Enclosure IP protection			IP30	
Relative humidity	%		0 - 95%	
Tests as per standard			IEC 61439 [2]	

1. PQCR has external communication features. Customer shall establish and maintain appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus program etc.) to protect PQCR, network system and its interfaces against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. Hiatchi Energy is not liable for damage and/ or losses related to such security breaches, any unauthorized access, intrusion leakage and/or theft of data or information

2. Tests performed as per IEC61439: heat run test / dielectric test / strength of material / ingress protection/ protective circuit/ clearance and creepage and mechanical operation.

Application example: Railways

Power quality solution helps Bulgarian railways ensure grid code compliance

The Bulgarian State Railways, founded in 1888, are among the oldest rail networks in Europe. Providing passenger and freight services, they cover more than 4,200 kilometers and connect diverse geographies – from the snow-capped Balkan mountains to the sunny Black Sea coast, from the bustling state capital Sofia to culture hub Plovdiv, and from Balkan Serbia to Mediterranean Greece.

Reactive power compensators from us, installed in five traction substations across Bulgaria have improved power quality across the rail network, bringing further benefits such as increased availability of the supply network, higher reliability and improved energy efficiency.

The National Railway Infrastructure Company (NRIC), responsible for the smooth operation and maintenance of this railway infrastructure and the electrical power that supports it, was facing power quality challenges across the network

Customer problem statement

Large varying non-linear loads are an inherent feature of electrical railway traction systems. Since the load changes dynamically and constantly, the traction power supply system draws a high amount of reactive power resulting in low power factor affecting power quality. Poor power quality is not only harmful to the traction system itself, but also prone to spreading through the supply grid and can cause disturbances to other users on the same grid. It also results in non-compliance to grid codes, leading to financial impact in the form of penalties.

Efficient, cost-effective solution from us

NRIC approached for a solution to its power quality challenge. After a detailed study of the various electrical parameters,Stepless reactive power compensators PQCR were installed in the traction substations.

The PQCR technology is used to provide reactive power support for grid-based supply networks. By installing this technology at various nodes across its electrical system, NRIC will experience improved power quality and better compliance to grid codes. Further benefits are accurate and precise compensation without the need for manual intervention, voltage stability and avoidance of penalties by the grid.