



GRIDCON[®] PFC

ACTIVELY CUT POWER COSTS
WITH PASSIVE SYSTEMS.

POWER QUALITY



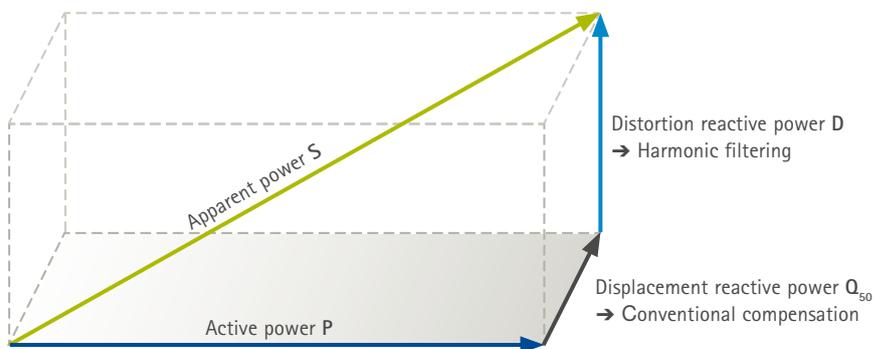
GRIDCON® PFC – ENHANCED POWER QUALITY. WHEREVER YOU WANT IT.



GRIDCON® PFC – PASSIVE FILTERS AND COMPENSATION SYSTEMS FROM MR.

The issue of reactive power is just as topical today as it was when electrification first took place. But compared with that time, the significance of harmonics in modern distribution grids has increased vastly. As a result, compensation systems and filters are subject to new requirements. Extensive know-how is indispensable to their dimensioning. With a comprehensive portfolio coupled with decades of experience, the experts at Maschinenfabrik Reinhausen (MR) are your partners of choice when it comes to voltage quality – experience counts.

The focus is increasingly on the efficiency of the energy supply. The GRIDCON® PFC product range from MR is used in the distribution grid. The passive systems for reactive power compensation and filtering harmonics can cut transmission losses and therefore energy costs. The Power Quality (PQ) division benefits from decades of experience and provides solutions at all voltage levels. Customers can benefit from the specialists' wealth of experience from numerous challenging projects. Over the years, the company has developed a system platform, paving the way for economic solutions and short delivery periods even for customized designs. MR's international experience ensures that all export processes run smoothly. Service work around the globe is a matter of course for PQ.



For decades, reactive power has been compensated for with capacitors – yet the challenges of modern distribution networks are varied and are changing. Frequency-controlled drives have an ever more important role to play in modern industrial plants – however the converters used to control them often feed harmonics back into the grid. These place new challenges on industrial plants.

Limit values have to be observed for harmonics. They also produce distortion reactive power which, relative to standard displacement reactive power (caused by the phase shift between current and voltage at 50 Hz), is placing more and more strain on the grids. Put briefly, the importance of conventional compensation is waning while that of harmonics is on the rise. Either way, the PQ team is highly familiar with all issues relating to voltage quality and is always the right contact.

MAXIMUM MODULARITY, MAXIMUM FLEXIBILITY.

GRIDCON® PFC – consistent modularity, zero-compromise safety.

Individual assemblies form the basis of MR's passive systems. They make up the platform for the systems' modular structure which provides various benefits, including simplification of service work and subsequent expansion or modification. Since the assemblies use common carriers, various technologies can be combined in one cabinet, making highly economical solutions possible. It is PQ's declared aim to fully meet all customer requests. The emphasis is on flexibility:

- Large systems available comprising several fields with continuous busbar and central feed-in
- Various climate concepts can be realized, from natural cooling to air conditioning units
- Experience with special solutions, e.g. inductive or two-phase compensation systems and hybrid solutions (such as dynamic + contactor-switched)
- Flexibility in the switch cabinet (dimensions, color, degree of protection up to IP 54, feed-in, on request even a version with protection from arc faults)

Capacitor contactors without compromise

Precharging preserves the capacitors when switching on, prevents the reactors producing a saturation effect, and reduces system perturbation

Reactor (on the rear)

Low-loss, sized for a high harmonic level as standard

Three-phase current capacitors

Low-loss and self-healing capacitors with integrated overpressure disconnectors

Discharge reactors as standard

Rapid discharge for effective personal protection, reduction in power loss on the capacitor

Short circuit protection

Should an error arise, a charged capacitor provides a source of DC voltage – fuses with a high rated voltage (≥ 690 V) guarantee the safe shutdown of capacitive fault currents and protect the assembly should a short-circuit arise

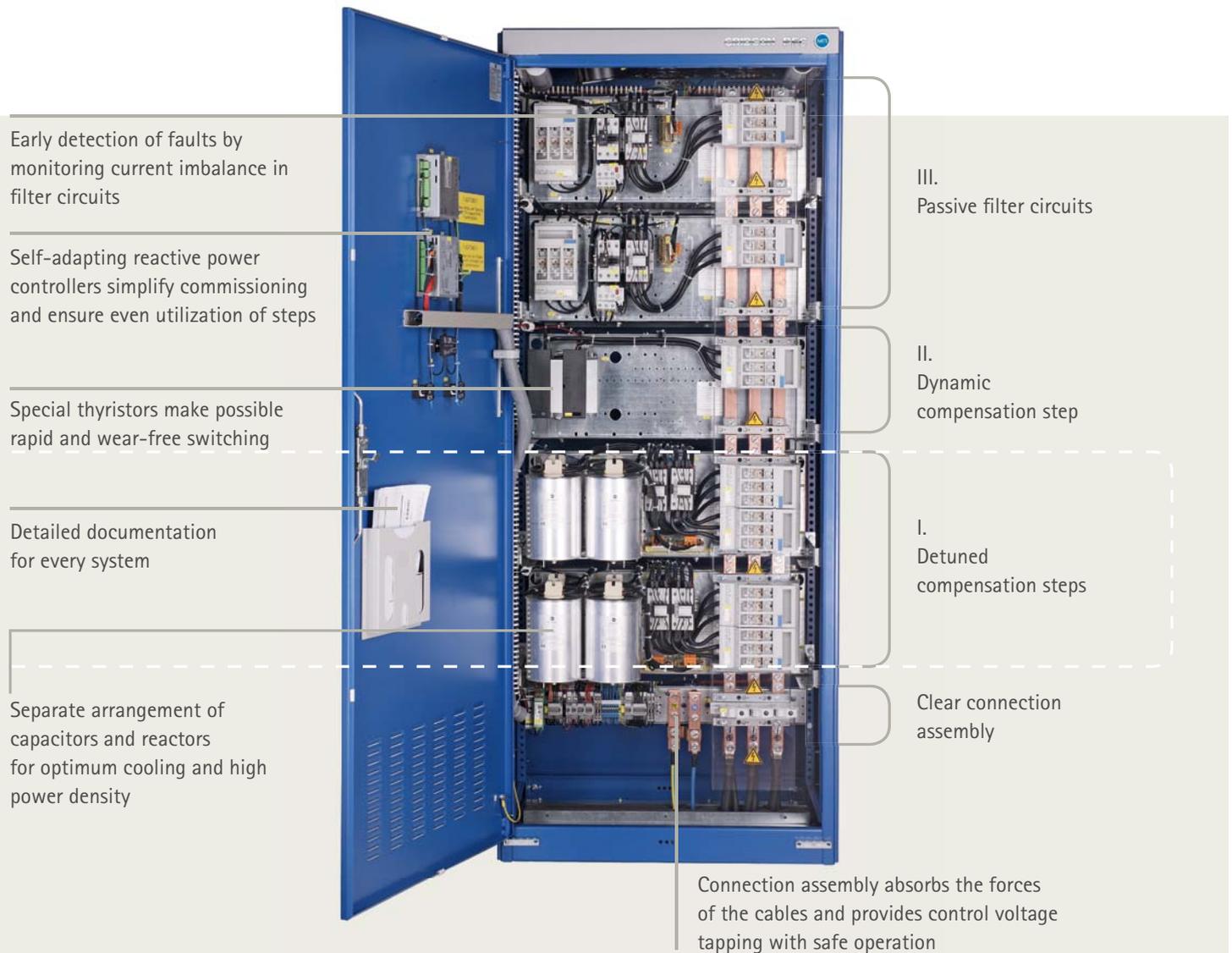


Safety.
Without any ifs or buts.

The name MR is synonymous with safety. Behind the PQ systems lies a very intelligent concept – to allow them to function smoothly under tough industrial conditions:

- Every step (assembly) is configured so that it can be individually monitored using HRC fuses with a maximum rated current of 125 A in order to restrict short-circuit currents
- Reactors are designed to be robust rather than low-cost
- Fuse holders or fuse switch disconnectors tested especially for capacitive loads prevent incorrect operation
- Use of discharge reactors as standard: Discharge of capacitors to less than 75 V in less than eight seconds
- Type-tested system concept – up to 500 kvar per cabinet with high detuning factor thermally tested

Can be combined on request – three functions in one cabinet by way of example



WHEN SPEED IS OF THE ESSENCE: DYNAMIC SYSTEMS.

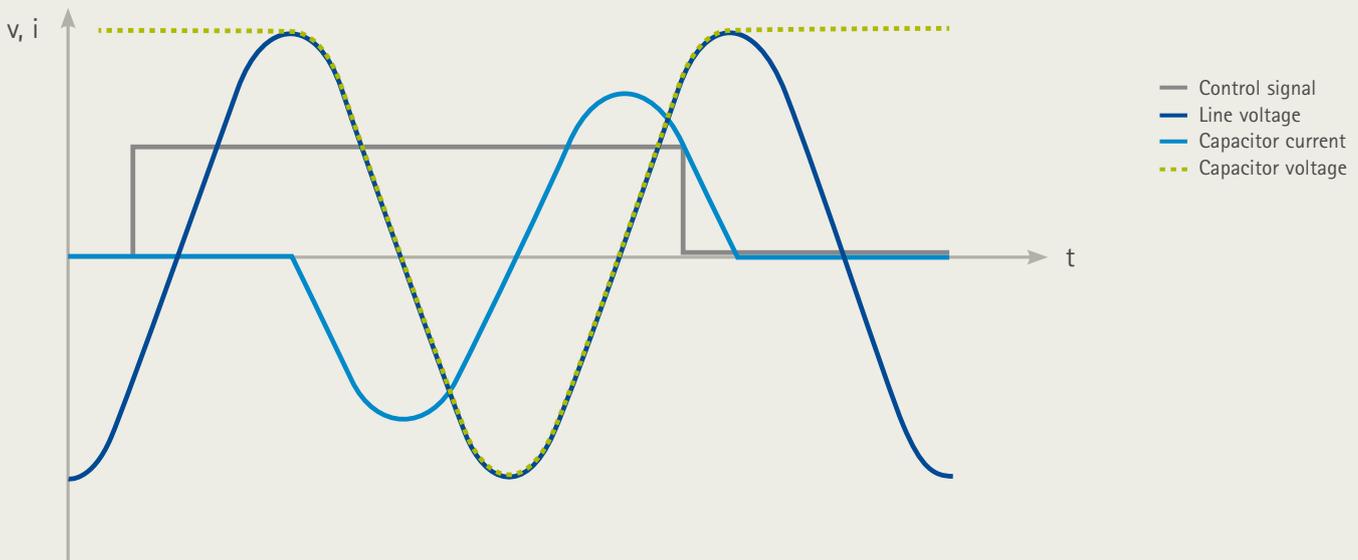
Gentle on the grid, gentle on the capacitor: By switching in the current's zero point, thyristor-controlled systems have virtually no wear. This preserves the capacitors and reduces system perturbation.

Dynamic systems

Sometimes speed is of the essence. For example, if compensation is to be provided for large crane drives or welding machines, contactor-switched compensation systems often respond too slowly. PQ's portfolio therefore also includes dynamic systems. The individual steps are switched with thyristors which respond within one mains period. Furthermore, before switching, the thyristors "wait" for the current to cross zero.

When a capacitor is activated, the system "watches" for the moment at which there is no difference in voltage with the grid. Peaks in current and the associated system perturbation are therefore avoided. Since high levels of current do not have to be interrupted with a mechanical contact, a thyristor operates with virtually no wear.

Combining conventional and dynamic capacitor steps allows highly economical solutions to be achieved. The steps for compensating for capacitive base load are switched with contactors and thyristors ensure compensation of dynamic processes.



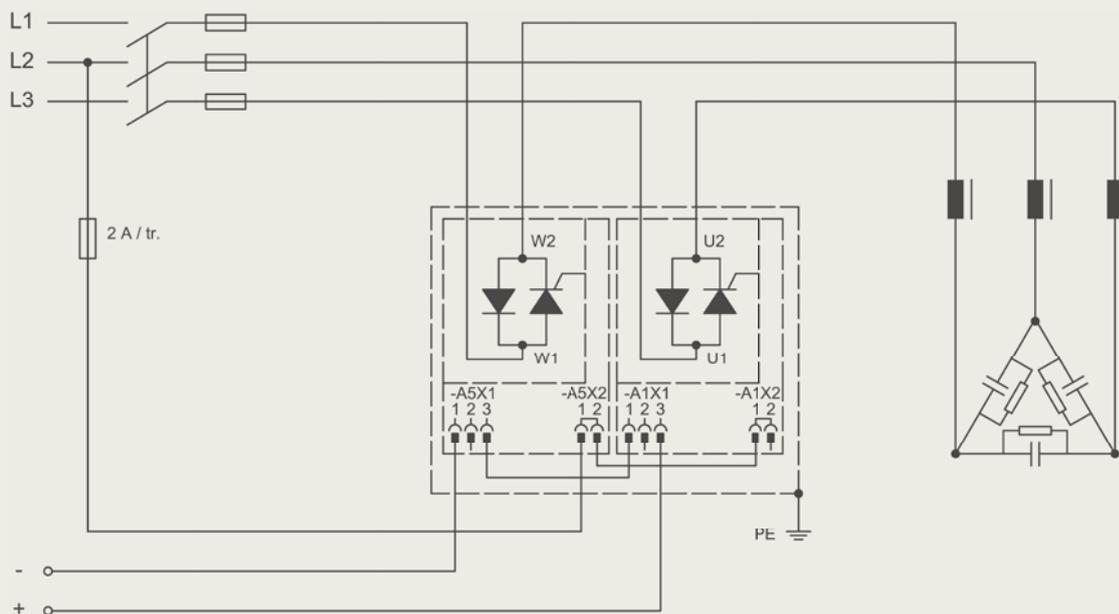


What is a thyristor?

A thyristor is an electrical component based on semi-conductor technology. Basically, thyristors are used as "controllable diodes". In their initial state, they are not conductive. They become conductive by means of a control impulse, known as the gate current. The thyro Cs from PQ are especially designed for switching capacitive loads and are available with various switching powers.

Typical applications:

- Crane systems / elevators
- Welding processes
- Press lines
- Test rigs
- Wind turbines

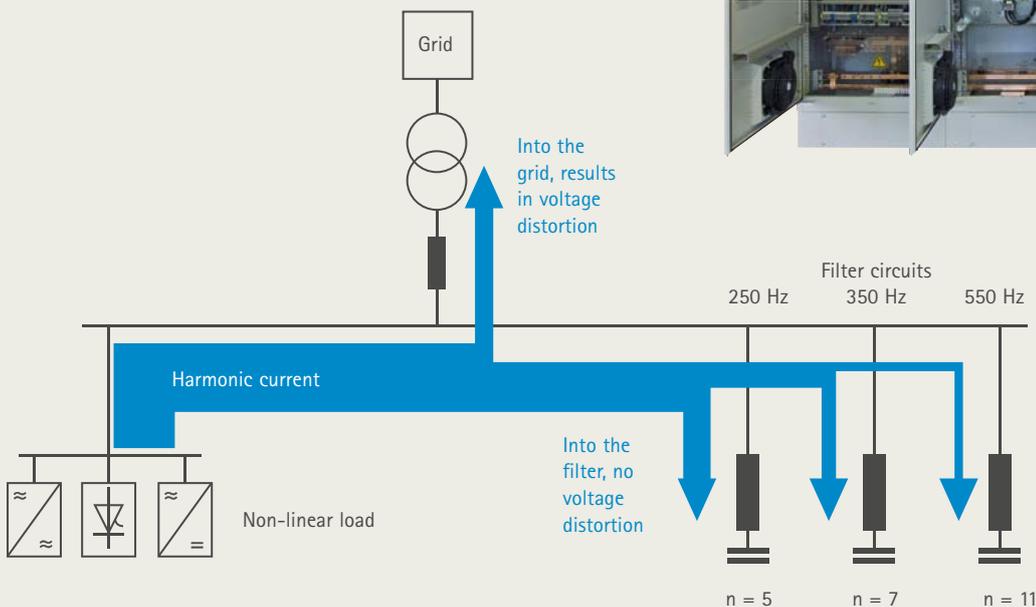


CLEAN GRIDS THANKS TO PASSIVE FILTERS.

Filter circuit systems are used in grids subject to high levels of harmonics. Here they do the job of compensating for inductive reactive power and at the same time improving the quality of the line voltage.

In addition to compensation systems, the passive range from PQ also includes tuned filter circuits. These are basically also reactors and capacitors connected in series. The difference lies in the detail: The resonance frequency of a passive filter is tuned to the frequency of a harmonic existing in the grid. For this frequency, the filter acts like a "low" resistance – harmonic currents are diverted to the filter. But this is exactly where passive filter circuits may present a risk because they are overloaded in the event of excess currents. For this reason, passive filter circuits have to be designed and monitored with great care – PQ therefore also produces passive filters following the philosophy of **consistent modularity and zero-compromise safety**.

- Splitting filter currents over several modules allows power to be adjusted to suit demand upon commissioning even if the conditions in the grid change
- The modular structure reliably limits fault currents through the use of small fuses
- The even distribution of current over the assemblies is monitored permanently – faults, such as those caused by components aging, can therefore be detected at an early stage



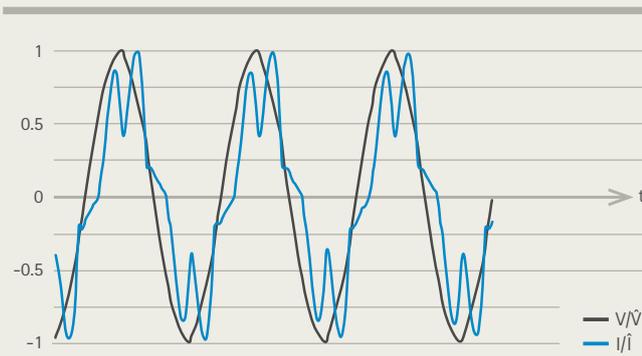
The right dimensioning is key

Passive filters can not only be overloaded if dimensioned incorrectly – they can also have a negative impact on the $\cos \varphi$ power factor because they represent a capacitive load for frequencies below the tuning frequency. This may result in an impermissible overcompensation and increase in voltage in the grid which in turn has to be inductively counter-compensated for as in the system shown. Neither of these issues applies to active filters because these function on the basis of a totally different principle. GRIDCON® ACF is the name given to active filters from MR. They are described in detail in a separate brochure.

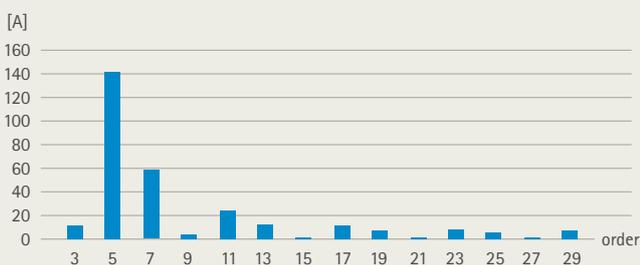
- Activating the filter steps in a staggered manner reduces system perturbation
- Both the temperature of the reactors and the temperature of the switch cabinet are monitored
- Monitoring of filter current – on request, also by a digital control unit with additional protection and display functions
- If a filter is matched to several harmonics, a locking circuit ensures safe operation of the entire system



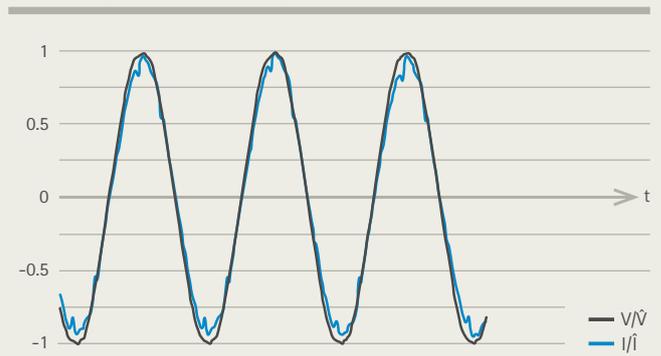
Oscilloscope current and voltage without filters



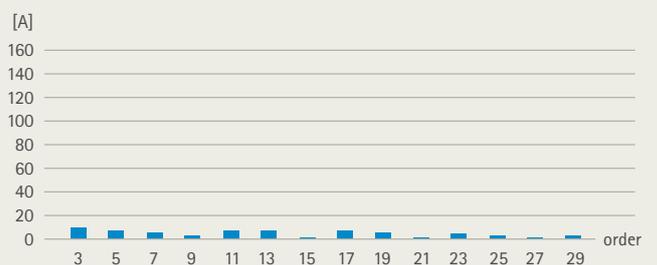
Effective harmonic currents without filters



Oscilloscope current and voltage with filters



Effective harmonic currents with filters



GRIDCON® PFC – UNIQUE EXPERTISE. EX FACTORY.



MORE POWER, MORE VALUE.

GRIDCON® PFC – Tailored passive systems.



Comprehensive product range

- Filters or compensation, central or decentralized, dynamic or conventional switching steps – PQ provides it all
- Optimized solutions through application know-how and experience in challenging projects
- Complete systems in freestanding cabinet design with various cooling concepts and also special customized designs



Flexible adaptation

- The system's modular concept simplifies subsequent assembly expansion or modification
- The combination of various functions, including active filters, makes possible particularly efficient and economical solutions
- Can be integrated in existing installations cable connection (from above or below) or busbar connection with circuit breaker panel possible



Maximum operational reliability

- Rapid discharge, fuses with high dielectric strength and specially tested load fuse breakers for effective personal protection
- Division of system power over several individually fused assemblies limits short-circuit currents in the event of error
- Protective concept has been proven over the years



Low life cycle costs

- Passive filters with multi-stage protection concept and early detection of faults
- Modular assembly concept makes demand-driven investments possible and reduces installation and service costs
- Space and money can be saved by the high power density of the compensation systems (up to 500 kvar per cabinet)
- High-quality and low-loss components as well as careful project planning ensure a long service life



Ease of service and operation

- Simple commissioning thanks to self-adapting reactive power controllers and detailed system documentation
- Their modular structure allows the systems to be maintained with ease and spare parts to be replaced at speed
- Expansion units can be easily retrofitted if the need for compensation grows

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THE POWER BEHIND POWER.

