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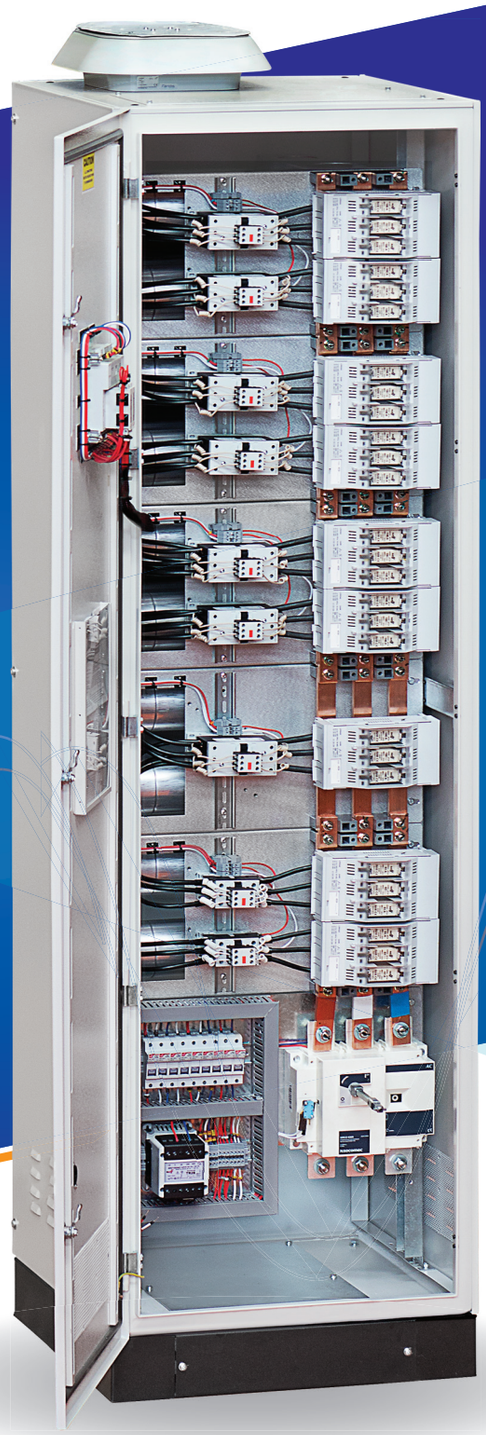
ElectroMechanica

REDUCE ELECTRICITY DEMAND COSTS

Power Factor Correction System



www.em.co.za

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INTRODUCTION

What is Power Factor?

Power factor is simply the ratio of “actual” power (active power) being used in a circuit, expressed in kilowatts (kW) to the power which is "apparently" being drawn from the mains, expressed in kilo volt amps (kVA)

To learn more about PF watch our video

Visit www.em.co.za/powerfactor

Electrical supply authorities have changed to kVA demand systems from the inefficient kW demand system. Consumers are now billed and penalised for their inefficient systems according to the apparent power being used. Consumers are now also penalised for plants with power factor below a pre-determined value.

Enhance the quality of your electrical distribution network through the implementation of Power Factor Correction and Power Quality solutions from EM.

For over three decades EM has been providing customers with solutions to increase energy efficiency, reduce maximum demand charges and substantially decease the cost of electricity.

Why you need Power Factor Correction?

Power Factor Correction is a mechanism to reduce operating costs associated with electricity consumption.

Disadvantages of Low Power Factor

- Increases energy cost since more current has to be transmitted, and this cost is directly billed to consumers on maximum demand kVA systems.
- Causes overloaded generators, transformers and distribution lines within a plant, resulting in greater voltage drops and power losses, all representing inefficiency and needless wear and tear on industrial electrical equipment.
- Reduces load handling capability of the plants electrical system.

Power Factor Advantages:

- Reduced kVA charges
- Improved plant efficiency
- Additional loads can be added to the system
- Reduced overloading of cables, transformers, switchgear, etc.
- Improved network voltage
- Improved starting torque of motors
- Reduced fuel requirements to generate power due to lower losses
- Compensates reactive power requirements in cogeneration installations.

Brands that form part of EM Power Factor Solutions:

Lovato electric · hager · DELTA · socomec Innovative Power Solutions · ELECTRONICON

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Power Factor Correction Calculator

The EM Power Factor Correction Calculator estimates your power factor correction requirements and calculates how your business will benefit from using our various solutions.

Try the EM Power Factor Correction Calculator.

Visit our website www.em.co.za/powerfactor

Substantiating Power Factor Correction Costs

This question can best be answered by an example:

Assuming a plant has a total load of 500 kW and a power factor (cosφ) of say 0.75 lagging. A typical supply authorities kVA demand charge is approximately R174.67 per kVA as in the case of Johannesburg (2019).

(kVA tariffs vary between different utility suppliers)

$$\frac{kW}{PF} = kVA : \frac{500\ kW}{0.75} = 666\ kVA$$

666 kVA @ R174.67 per kVA

= R116,330.22

By installing capacitors to improve power factor (cosφ) to 0.98 lagging new costs are;

$$\frac{500\ kW}{0.98} = 510\ kVA$$

510 kVA @ R174.67 per kVA

= R89 081.70

Potential monthly saving with PFC = R27 248.52
KVA Improves by 156 KVA

A complete system required to effect power factor from 0.75 to 0.98 (*as in above example*) would require a system of 350 kVAr which would cost approximately R110,000 (2019)

Power factor correction usually pays for itself well within 12 months of the initial purchase (*less than 5 months in above example*) and continues saving.

It therefore stands to reason that more significant savings can be anticipated with the ever increasing costs of electricity in the future.

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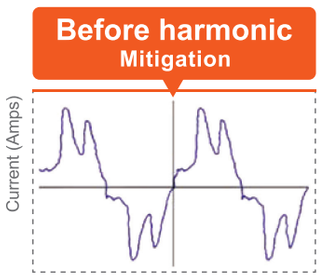
Harmonics

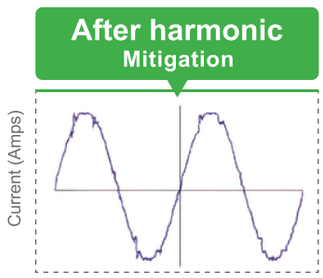
What causes Harmonics?

Normally, power system generators produce a clean sinusoidal voltage waveform at their terminals. A lot of modern electronic equipment generates sinusoidal current into the power system, which causes electrical harmonic pollution.

Modern equipment such as
- Variable Frequency Drives (VSD's)
- Battery Charges
- Switched-mode Power Supplies
- Inverters
- Uninterruptable Power Supplies (UPS's)
- LED lighting



Current oscillogram before filtration



Current oscillogram after filtration

Harmonics Solutions

It is important, therefore, to measure harmonic levels in the network and to install harmonic reactors when harmonics are above acceptable levels.

At EM we offer the following solutions:

- Modular and Floor Standing de-tuned reactor systems.
- Active Power Filter and Static VAR Generator

Power Quality Solutions

Excellent power quality reduces energy loss, extending equipment life and lowers costs. In contrast, poor power quality caused by harmonics distortion, reactive power, or non-linear loads, tends to lower power quality and reliability.

There are **Three Main Contributors** to low voltage and poor power quality problems:

- **Harmonic Pollution**
- **Reactive Power**
- **Load Imbalance**

Our Power Quality solution consists of the Active Power Filter (APF) and Static VAR Generator (SVG). Both provide an active compensation solution based on power electronics technology.

Delta's APF and SVG series feature a precise modular design, and filter capacity which can be expanded by adding modules according to requirements. It is easy to use at the design and maintenance stage for lower volume, flexible configuration, and convenient installation.

Static VAR Generator (SVG)

SVG rapidly and continuously compensate both inductive and capacitive reactive power, and correct load imbalance.

Modular (APF)

Same features as SVG and with harmonic mitigation. APF systems can be divided in modular or wall mounts systems. According to cable type, a modular APF can be divided into two types:

- Draw type modular APF *(hot-swappable)*
- Fixed type modular APF *(not hot-swappable)*

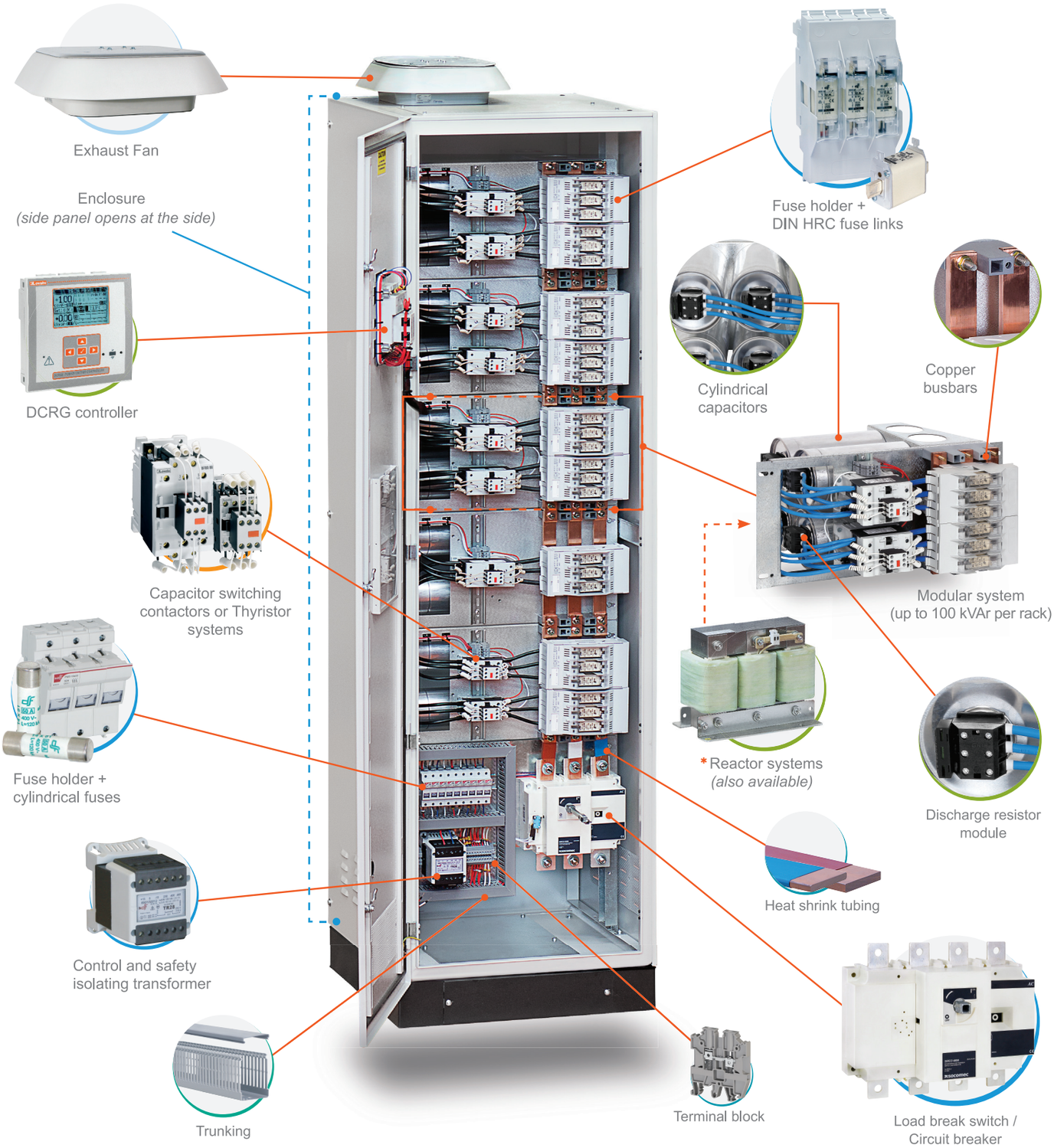
Benefits

- High Reliability
- High Adaptability
- Simple and Flexible Application
- Excellent Compensation Capability

Technical Assistance

Contact us for technical assistance and guidance on system selection.

* **Network analyser available for rental or purchase.**



ELECTRONICON®

MKPg-275 three-phase power capacitors, dry self-healing dielectric, gas filled (N2) protecting windings from environmental influences extending life expectancy, permitting mounting in any position.

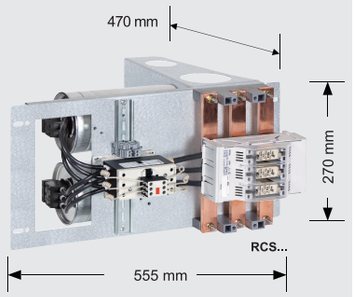
Lovato electric

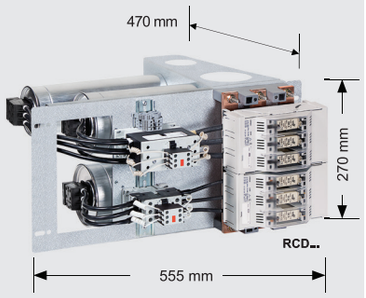
DCRG controllers

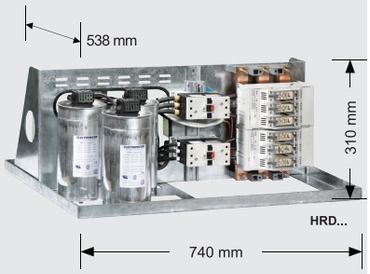
single and three-phase CT connection

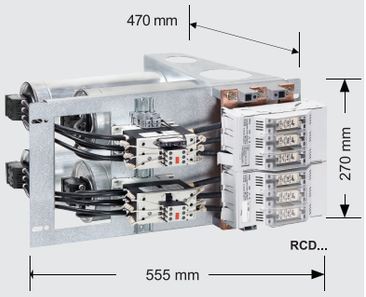
- Expansion slots for additional steps and or communication modules
- Advanced programmable I/O functions and user-definable alarms
- Capability to operate with several units interconnected in Master-Slave mode
- Quick CT programming function / Automatic identification of direction of CT current flow

PF Racks & Systems









RC series - Power Factor rack system

RC series power factor racks are designed for direct panel mounting onto vertical supports within floor standing electrical panels. RC series rack design incorporates the following:

- Sheet metal mounting frame for easy panel mounting
- Electronicon heavy duty "gas filled" cylindrical capacitors *(with integrated discharge resistors)*
- Special capacitor switching contactors 400 VAC coil *(230V on request)*
- Three-phase busbar mounted fuse holder with hinged fuse protection cover
- Suitably rated HRC fuses per phase of each capacitor bank
- Incorporated busbar, supports and inter-connecting busbar links

type	kvar at:			description	dimensions (mm)		
	400V	440V	480V		(H)	(W)	(D)
RC series - Rack system *(without harmonic reactors)*							
RCS01204	**12.5**	14	17	single step capacitor rack	270	555	470
RCS02504	**25**	28	34	single step capacitor rack	270	555	470
RCS05004	**50**	56	67	single step capacitor rack	270	555	470
RCD02524	**2 x 12.5**	2 x 14	2 x 17	double step capacitor rack	270	555	470
RCD05024	**2 x 25**	2 x 28	2 x 34	double step capacitor rack	270	555	470
RCD10024	**2 x 50**	2 x 56	2 x 68	double step capacitor rack	270	555	470
RCD03734	**12.5 + 25**	14 + 28	17 + 34	double step capacitor rack	270	555	470
RCD07534	**25 + 50**	28 + 56	34 + 67	double step capacitor rack	270	555	470
HR7 series - Racks (480V capacitors) with 7% de-tuned harmonic capacitor banks							
7% - 189 Hz De-tuned reactors *for networks with 5th and 7th Harmonics*							
HRS014074	**13.5**	15	18	single step capacitor + 7% reactor rack	310	740	538
HRS027074	**27**	30	36	single step capacitor + 7% reactor rack	310	740	538
HRS054074	**54**	60	72	single step capacitor + 7% reactor rack	310	740	538
HRD027274	**2 x 13.5**	2 x 15	2 x 18	double step capacitor + 7% reactor rack	310	740	538
HRD054274	**2 x 27**	2 x 30	2 x 36	double step capacitor + 7% reactor rack	310	740	538
HRD108274	**2 x 54**	2 x 60	2 x 72	double step capacitor + 7% reactor rack	310	740	538
HRD041374	**13.5 + 27**	15 + 30	18 + 36	double step capacitor + 7% reactor rack	310	740	538
HRD081374	**27 + 54**	30 + 60	36 + 72	double step capacitor + 7% reactor rack	310	740	538
HR14 Series - Racks (525V capacitors) with 14% de-tuned harmonic capacitor banks							
14% - 134 Hz De-tuned reactors *for networks with high levels of 3rd Harmonics*							
HRS013144	**13.5**	15	18	single step capacitor + 14% reactor rack	310	740	538
HRS027144	**27**	30	36	single step capacitor + 14% reactor rack	310	740	538
HRS054144	**54**	60	72	single step capacitor + 14% reactor rack	310	740	538
HRD027144	**2 x 13.5**	2 x 15	2 x 18	double step capacitor + 14% reactor rack	310	740	538
HRD054144	**2 x 27**	2 x 30	2 x 36	double step capacitor + 14% reactor rack	310	740	538
HRD040144	**13.5 + 27**	15 + 30	18 + 36	double step capacitor + 14% reactor rack	310	740	538
RC Series - 525V Rack system *(without harmonic reactors)*							
	525V	440V	400V				
RCS02005	**20**	14	11.5	single step capacitor rack	270	555	470
RCD04025	**2 x 20**	2 x 14	2 x 11.5	double step capacitor rack	270	555	470
RCD08025	**2 x 40**	2 x 28	2 x 23	double step capacitor rack	270	555	470
RCD06035	**20 + 40**	2 x 56	11.5 + 23	double step capacitor rack	270	555	470

Additional Accessories

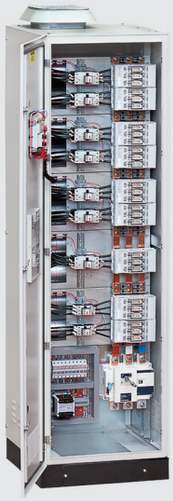
Remote Monitoring Devices

For remote monitoring and control of all electrical network parameters *(including harmonics)*, panel internal temperature, alarms, events and all setup parameters.

Software Solutions

Synergy is a remote control and supervision software for LOVATO Electric devices equipped with communication capabilities via serial ports, Ethernet or modem in a simple and reliable way. The supported protocols are Modbus-RTU, Modbus-ASCII and Modbus-TCP.

PF Racks & Systems



FMS...

FMS... *

type	kvar at:		steps (kvar) at 400V				expands to (kvar)	dimensions (mm)		
	400V	440V	12.5	25	50	100		(H)	(W)	(D)
FMS series - Floor standing complete power factor systems *(480V capacitors)*										
400V floor standing complete power factor systems										
FMS13804	**137.5**	165	1	1	2	–	475	2180	600	630
FMS17504	**175.0**	210	–	1	3	–	475	2180	600	630
FMS21304	**212.5**	255	1	2	3	–	475	2180	600	630
FMS23804	**237.5**	285	1	1	2	1	475	2180	600	630
FMS27504	**275.0**	330	–	1	3	1	475	2180	600	630
FMS31304	**312.5**	375	1	2	1	2	475	2180	600	630
FMS33804	**338.0**	390	1	1	2	2	475	2180	600	630
FMS37504	**375.0**	450	–	1	3	2	475	2180	600	630
FMS41304	**412.5**	480	1	2	3	2	475	2180	600	630
FMS43804	**437.5**	525	1	1	2	3	475	2180	600	630
FMS47504	**475.0**	570	–	1	1	4	–	2180	600	630
FMS53804*	**537.5**	645	1	1	2	4	950	2180	1200	630
FMS57504*	**575.0**	690	–	1	3	4	950	2180	1200	630
FMS63804*	**637.5**	765	1	1	2	5	950	2180	1200	630
FMS67504*	**675.0**	810	–	1	1	6	950	2180	1200	630
FMS73804*	**738.0**	870	–	1	2	6	950	2180	1200	630
FMS77504*	**775.0**	930	–	1	1	7	950	2180	1200	630
FMS83804*	**838.0**	990	1	1	2	7	950	2180	1200	630
FMS85004*	**850.0**	1020	–	2	2	7	950	2180	1200	630
FMS87504*	**875.0**	1050	–	1	3	7	950	2180	1200	630
FMS95004*	**950.0**	1140	–	2	2	8	–	2180	1200	630

type	kvar at:		steps (kvar) at 525V			expands to (kvar)	dimensions (mm)		
	525V	415V	20	40	80		(H)	(W)	(D)
525V floor standing complete power factor systems *(525V capacitors)*									
FMS14005	**140**	88	1	1	1	400	2180	600	630
FMS20005	**200**	126	2	2	1	400	2180	600	630
FMS22005	**220**	138	1	1	2	400	2180	600	630
FMS28005	**280**	176	2	2	2	400	2180	600	630
FMS30005	**300**	188	1	1	3	400	2180	600	630
FMS36005	**360**	228	2	2	3	400	2180	600	630
FMS38005	**380**	238	1	1	4	400	2180	600	630
FMS46005*	**460**	288	1	1	5	800	2180	1200	630
FMS52005*	**520**	326	2	2	5	800	2180	1200	630
FMS54005*	**540**	338	1	1	6	800	2180	1200	630
FMS62005*	**620**	388	1	1	7	800	2180	1200	630
FMS68005*	**680**	426	2	2	7	800	2180	1200	630
FMS70005*	**700**	438	1	1	8	800	2180	1200	630
FMS78005*	**780**	488	1	1	9	800	2180	1200	630
FMS80005*	**800**	500	–	–	10	–	2180	1200	630

* *Made up by combining two panels with one controller operating all capacitor banks*

Note: *Custom step configurations available on request*

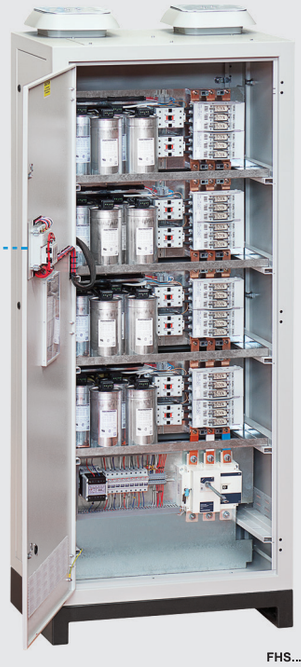
EM Solutions

We offer a complete range of components and equipment for Power Factor Correction and Power Quality Solutions:

- Single/double step modular racks designed for direct mounting
- Floor standing power factor systems
- PFC systems for 400 - 525V voltage networks
- Wall mount power factor systems
- Rack for floor standing systems with or without anti-harmonic de-tuned reactors
- Active Power Filters (APF)
- Static Var Generator (SVG)
- Fast switching thyristor based systems

PF Racks & Systems

DCRG 8 (Door Mount)



FHS...

FHS series - Floor standing power factor systems *(with anti-harmonic de-tuned capacitor banks)*

- For networks with THDU ≤6% and/or THDI ≤40%

Growing use of power electronic devices such as: variable speed drives, inverters, UPS systems, battery chargers, LED lighting etc. is causing increasing levels of harmonic distortion in electrical networks, often leading to problems with capacitor installations.

Installation of de-tuned (reactor-connected) capacitors designed to force the resonant frequency of the network below the frequency of the lowest harmonic present (usually the 5th), thereby ensuring no resonant circuit or amplification of harmonic currents. Such an installation also has a partial filtering effect, reducing the level of voltage distortion on the supply. De-tuned capacitors safer than non-de-tuned capacitors and future-proof for conditions of more and more deteriorating power quality in modern mains.

Complete ready-to-connect floor standing power factor system comprising:

- Mains isolator, door interlocking *(with early make/late break auxiliary contact)*
- High end reactive control relay DCRG 8 (incorporating digital display of all important network parameters)
- Configurable to monitor three voltage and current phases and provide accurate indication of:
  - Active, Apparent power as well as Active, Reactive, Apparent Energy monitoring
  - Current and Voltage Harmonics analysis (up to 31st harmonic)
  - Calendar-clock with backup reserve power
  - Event logging: alarms, setup, changes, etc. (internal memory stores last 250 events)
  - Internal panel temperature monitoring
- Expandable up to 4 expansion modules: additional steps, Analog I/O's, communication modules

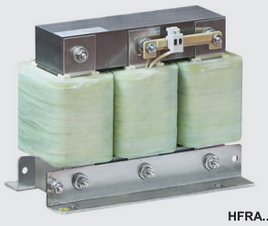
type	kvar at:		steps (kvar) at 400V				expands to (kvar)	dimensions (mm)		
	400V	440V	13.5	27	54	108		(H)	(W)	(D)
Anti-harmonic systems incorporating 7% de-tuned capacitor banks *(480V capacitors)*										
7% - 189 Hz De-tuned reactors *for networks with 3rd and 5th Harmonics*										
FHS122074	**122**	131	1	2	1	–	405	2280	900	600
FHS149074	**149**	161	1	1	2	–	405	2280	900	600
FHS176074	**176**	190	1	2	2	–	405	2280	900	600
FHS203074	**203**	219	1	1	3	–	405	2280	900	600
FHS239974	**230**	248	1	2	3	–	405	2280	900	600
FHS257074	**257**	277	1	1	2	1	405	2280	900	600
FHS297074	**297**	320	–	1	1	2	405	2280	900	600
FHS339074	**338**	364	1	2	1	2	405	2280	900	600
FHS365074	**365**	393	1	1	2	2	405	2280	900	600
FHS405074	**405**	436	–	1	1	3	–	2280	900	600
FHS446074*	**446**	481	1	2	1	3	864	2280	1800	600
FHS473074*	**473**	510	1	1	2	3	864	2280	1800	600
FHS513074*	**513**	553	–	1	1	4	864	2280	1800	600
FHS554074*	**554**	597	1	2	1	4	864	2280	1800	600
FHS621074*	**621**	669	–	1	1	5	864	2280	1800	600
FHS675074*	**675**	727	–	1	2	5	864	2280	1800	600
FHS729074*	**729**	786	–	1	1	6	864	2280	1800	600
FHS770074*	**770**	830	1	2	1	6	864	2280	1800	600
FHS837074*	**837**	902	–	1	1	7	864	2280	1800	600
FHS864074*	**864**	931	–	–	2	7	–	2280	1800	600
Anti-harmonic systems incorporating 14% de-tuned capacitor banks *(525V capacitors)*										
14% - 134 Hz De-tuned reactors *for networks with high levels of 3rd Harmonics*										
FHS095144	**95**	102	1	1	1	–	203	2280	900	600
FHS149144	**149**	161	1	1	2	–	203	2280	900	600
FHS203144	**203**	219	1	1	3	–	–	2280	900	600
FHS257144*	**257**	277	1	1	4	–	432	2280	1800	600
FHS311144*	**311**	335	1	1	5	–	432	2280	1800	600
FHS365144*	**365**	393	1	1	6	–	432	2280	1800	600
FHS419144*	**419**	452	1	1	7	–	432	2280	1800	600
FHS432144*	**432**	466	–	–	8	–	–	2280	1800	600
FHS473144**	**473**	510	1	1	8	–	648	2280	2700	600
FHS527144**	**527**	568	1	1	9	–	648	2280	2700	600
FHS581144**	**581**	626	1	1	10	–	648	2280	2700	600
FHS635144**	**635**	684	1	1	11	–	648	2280	2700	600
FHS648144**	**648**	698	–	–	12	–	–	2280	2700	600

* *Made up by combining two panels with one controller operating all capacitor banks*

** *Made up by combining three panels with one controller operating all capacitor banks*

PF Racks & Systems

WMS...



HFRA...

EXP1011

EXP1015 + CX03

WMS series - Wall mount power factor systems *(automatic)* *400/440V*

For applications with varying capacitor requirements. An automatic reactive controller monitors the network and only switches capacitor banks when required, avoiding potential over or under compensation in a network.

WMS series - Wall mount power factor systems (37 - 150 kvar - 400V)

Complete ready-to-install system comprising the following:

- Reverse-flow fan ventilated wall mount enclosure, bottom cable entry (top entry on request)
- Mains isolator, door interlocking (with early make / late break auxiliary)
- Heavy duty three phase capacitors (with internal discharge resistors)
- Reactive control relay **DCRL 5** (digital display of all important electrical network parameters)
- "Special" capacitor switching contactors incorporating limiting resistors
- HRC fuse protection (per capacitor bank)

WMS series - Wall mount complete power factor systems *(440V capacitors)*

type	kvar at:		steps (kvar) at 400V			expands to (kvar)	dimensions (mm)		
	400V	440V	12.5	25	50		(H)	(W)	(D)
WMS03704	**37.5**	45	1	1	–	87.5	700	600	300
WMS05004	**50.0**	60	2	1	–	87.5	700	600	300
WMS06204	**62.5**	75	1	2	–	87.5	700	600	300
WMS07504	**75.0**	90	2	2	–	87.5	700	600	300
WMS08704	**87.5**	105	1	3	–	–	700	600	300
WMS10004	**100.0**	120	2	1	1	150	700	900	300
WMS11204	**112.5**	135	1	2	1	150	700	900	300
WMS12504	**125.0**	150	2	2	1	150	700	900	300
WMS13704	**137.5**	165	1	1	2	150	700	900	300
WMS15004	**150.0**	180	–	2	2	–	700	900	300

De-tuned anti-harmonic reactors 400V, 50Hz

De-tuned reactors protect capacitors against harmonics, avoiding parallel resonance and amplification of harmonics flowing within the network.

- Insulation: F class insulation, 155°C
- Internal protection: Thermal cutout (125°C) incorporated (on centre phase)
- Reference standards: IEC/EN 60076-6, 61558-2-20

type	kvar at:		%	description	dimensions (mm)		
	400V	440V			(H)	(W)	(D)
7% - 189 Hz De-tuned reactors *for networks with 5th and 7th Harmonics*							
HFRA1207	**12.5**	15	7%	anti-harmonic reactors	215	210	120
HFRA2507	**25.0**	30	7%	anti-harmonic reactors	190	240	170
HFRA5007	**50.0**	60	7%	anti-harmonic reactors	240	300	180
14% - 134 Hz De-tuned reactors *for networks with high levels of 3rd Harmonics*							
HFRA1314	**13.5**	16	14%	anti-harmonic reactors	280	240	150
HFRA2714	**27.0**	32	14%	anti-harmonic reactors	250	330	220
HFRA5414	**54.0**	64	14%	anti-harmonic reactors	270	340	220

Remote monitoring of FM series systems

For remote monitoring and control of all electrical network parameters including harmonics, panel internal temperature, alarms, events and all setup parameters.

Communication modules simply plug-in to the controller and are automatically configured to offer various communication protocols.

EXP1011	opto-isolated	RS232 plug-in communication	expansion module
EXP1012	opto-isolated	RS485 plug-in communication	expansion module
EXP1013	opto-isolated	ETHERNET with web server function	expansion module
EXP1014	opto-isolated	Profibus-DP plug-in communication	expansion module

Plug-in GPRS/GSM modem automatically configures to the controller when mounted and once a data-enabled SIM card is installed the controller can send alarm or event SMS's or e-mails.

EXP1015	plug-in GPRS/GSM Modem for remote monitoring	expansion module for above
CX03	GSM/GPRS penta-band antenna (850/900/1800/1900/2100MHz)	

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