APFC PANEL RPC 9520

DPFC PANEL RPD 9520

AUTOMATIC POWER FACTOR CORRECTION PANEL

Member of CISQ Federation
RINA
ISO 9001:2008
Certified Quality System

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DYNAMIC POWER FACTOR CORRECTION PANEL

INTRODUCTION

Majority of the loads in the industries are highly inductive in nature such as induction motors, welding equipments, arc furnaces and fluorescent lightings. There may be a few resistive loads for heaters and incandescent bulbs. Very rarely industries may have capacitive loads such as synchronous motors. Net industrial load is highly inductive causing a lagging power factor. If this poor power factor is left uncorrected, the industry will require a high maximum demand from Electricity Board and also will suffer a penalty for poor power factor. These two factors of high kVA demand and penalty for poor factor will inflate the monthly Electricity Bill. Since Power Factor can be corrected to near unity there can be huge saving from the Electricity Bills. Standard practice is to connect power capacitors in the electrical network at appropriate places to compensate the inductive nature of the load.

BENEFITS OF POWER FACTOR IMPROVEMENT

- Substantial reduction in kVA demand and avoids penalty for low Power Factor
- Additional loads may be added for improved productivity without need for increased demand
- Considerable reduction of Transformer and line losses
- Reduction in voltage drop resulting in better system voltage regulation
- Reduction in maintenance, capital cost and longer life of distribution equipments due to lesser current in the system
- Reduction in voltage fluctuation and circuit reactance
- Reduction in reactive power demand from the supply system since PFC Panel compensates the reactive power of inductive loads
- Payback for the PF Panel is normally within 8-12 months

ICD SOLUTIONS FOR REACTIVE POWER COMPENSATION SYSTEM

- Calculated fixed capacitor banks with manual ON/OFF switch with or without de-tuned reactor
- Contactor switched Power Factor Correction Systems **(APFC)** - RPC 9520
- Thyristor switched Power Factor Correction Systems **(DPFC)** - RPD 9520
- Special type **DPFC Panel** to correct individual phases separately for unbalanced system either line to line or line to neutral - RPD9550

APFC Panel:

- Here automatic Power Factor correction takes place with respect to load requirements through PF Controller and contactor switching
- Use of Capacitor duty contactors limit the inrush current during switching and enhance the life of the capacitor

DPFC Panel:

- Power Factor correction takes place using fast PF controller and Thyristor Switching modules
- Most effective power factor correction takes place for fast fluctuating and dynamically varying loads

DPFC Panel for Unbalanced System:

- Here Power Factor Correction takes place by use of ultra fast PF Controller and Thyristor Modules for capacitor switching along with suitable de-tuned reactor
- Most suitable for 2 phase welding machines, furnace and unbalanced loads and compensation is possible even load is operated for few cycles

APPLICATIONS

- 1Ø and 3Ø Welding Equipments
- Wind Turbine Generators
- Robotic Machinery
- Steel Rolling Mills
- Elevators, Cranes, Presses
- IT Companies, Hospitals
- Water Treatment Plants
- Air-conditioning etc.

ADVANTAGES OF USING THYRISTOR SWITCHING MODULES

- Real time Power Factor correction is possible
- Thyristor switching ensures nearly zero current through capacitors during switching, avoiding system transients thus improving power quality
- Capacitor lifetime is very much extended
- Infinite number of switching operations since no mechanical moving contacts are involved
- Switching at zero voltage difference between Thyristor and Capacitor facilitates immediate re-connection of capacitor banks ensuring fast correction
- Fast response time of 5 - 20 ms. Cycle to cycle compensation is possible

HARMONICS

INTRODUCTION

Any device with non-linear operating characteristics, draw current from the source which does not follow the voltage wave form and introduce wave form distortion in current. These wave form distortion in current are called current harmonics. The harmonic current produced by the non linear loads flow through the system impedances and generate voltage harmonics

SOURCES OF HARMONICS

- Variable Speed AC/DC Drives, UPS Systems, Rectifiers
- SMPS, Static Converters, Thyristor controlled systems Frequency controlled Induction furnaces
- Arcing equipment, Arc furnaces, Welding, Lighting
- When saturation is reached in Transformers, Motors, Generators

PROBLEMS CREATED BY HARMONICS

- Reduced energy efficiency in the network
- Excessive Heating and failure of Capacitors, Fuses, Motors, Transformers, Cables, Switch gears and Lighting Ballast etc
- Nuisance Tripping of Circuit Breaker or frequent blowing of fuses
- Erroneous operation of control system equipments
- Damages to sensitive electronic equipments
- Communication interferences

PASSIVE HARMONIC FILTERS

When the harmonics present in the system is more, simple capacitor is not suitable for Power Factor improvement because,

- Capacitor reactance Xc decreases with the increase of frequency. Hence it offers low impedance for Harmonic frequencies. So even smaller amplitudes of the harmonic voltages result in higher currents through the capacitors which are detrimental to the capacitors and power system
- More critical is that the connected capacitors and the transformer inductance may cause a parallel resonant circuit. If this frequency matches the harmonic frequency, the resulting circuit amplifies the harmonics and lead to very high over voltage and over currents which is detrimental to the system
- Under these conditions de-tuned passive filter system of suitable tuning frequency is the solution for the improvement of Power Factor
- De-tuned capacitor banks consist of a series circuit of capacitor and a specific filter reactor. The resonance frequency of the de-tuned bank does not match close to any of the existing harmonic. It is normally lower than the lowest harmonic frequency present in the system, usually 5^{th} harmonic
- De-tuned system ensures no resonant condition and no amplification of harmonic currents
- De-tuned system ensures a partial harmonic filtering effect reducing the level of harmonic voltage distortion on the supply

TYPES OF PASSIVE HARMONIC FILTERS

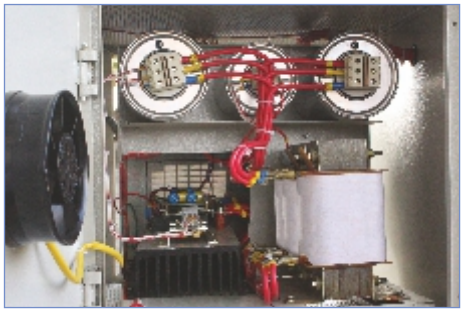
- Contactor switched De-tuned Harmonic Filter System RPC 9530
- Thyristor switched De-tuned Harmonic Filter System RPD 9530
- Tuned Harmonic Filter System

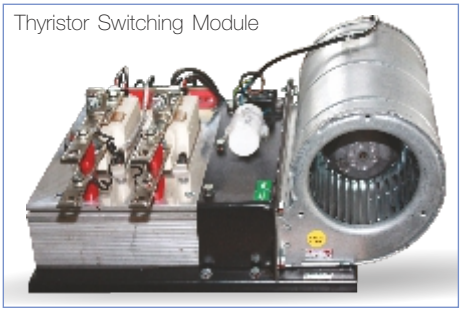
BENEFITS OF PASSIVE HARMONIC FILTER SYSTEMS

- Reduction of harmonic currents in the electrical network
- Eliminates resonance condition
- Improvement of True Power Factor
- Better voltage stability and regulation
- No derating of the transformers and motors due to harmonic losses
- Better utilisation of the electrical system
- Good life expectancy for all the electrical and electronic components
- Reduced downtime and hence higher productivity of the plant and system efficiency at its best
- Penalty by EB authorities for poor PF is avoided and hence reduced electricity bills

SELECTION GUIDE FOR PASSIVE HARMONIC FILTER SYSTEM

TYPES OF LOADS	Harmonic Level within IEEE 519 Standards	THDV>3% &<5% THDI>10% &<20%	THDV>5% THDI>20%
Steady Load	Fixed Capacitors	Fixed De-tuned Filter Banks	Fixed Tuned Filter Banks
Slow Varying Loads	APFC Systems RPC 9520	Contactor Switched with De-tuned Filter Banks RPC 9530	Variable Tuned Filter Banks
Fast Fluctuating Loads	DPFC Systems RPD 9520	Thyristor Switched with De-tuned Filter Banks RPD 9530	Active Harmonic Filter





Thyristor Switching Module

MAIN COMPONENTS OF DPFC

FAST PF CONTROLLER

It is a high end power factor controller suitable for switching the Thyristors. It accepts voltage and current signals, computes kVAr of the load, requirement of the compensation as per the set point and activates the Thyristor switching modules to switch IN/OUT the capacitor banks. A special logic is written in the software for selection of required compensation.

DYNAMIC SWITCHING MODULES

This module consists of an electronic card to see the Thyristor switch in a capacitor with minimum voltage so that the switching current is near zero. This prevents current and voltage transients during switching in and switching out of the capacitors in the system. Even with phase reversal this module functions normally. This module will switch OFF the capacitors during any phase failure condition.

POWER BLOCK

Power block consist of two Thyristors connected in antiparallel mode for use in AC system. Adequate dv/dt protection is provided by snubber circuit. Over current protection and isolation of the bank are achieved by upstream MCCB/Fuses. Thyristors are mounted on heat sinks with forced air cooling arrangements. Over temperature protection is provided.

CAPACITOR

Dry type - gas filled - self healing - low loss - metalised poly propylene (MPP) type capacitors confirming to IEC standards of reputed make are used. Depending on applications heavy duty capacitors suitable to operate in continuous voltages of 480 / 525V are used.

DE-TUNED REACTOR

Low loss, Low noise, High linearity aluminium or copper wound reactors of reputed make are used. It has high over loading capability to with stand harmonic currents and has over temperature protection feature.

STANDARD RATINGS	
Detuning Factor	Resonance Frequency
5.67%	210Hz
7%	189Hz
14%	134Hz

APPLICATIONS DPFC with De-tuned banks

- AC / DC Variable Frequency Drives
- Rectifiers used for battery charging applications
- Welding Machines and Furnace applications
- Offshore Oil and Gas Industries
- Shipping Industries
- Power Factor improvement for all kind of loads in the presence of harmonics

TECHNICAL SPECIFICATIONS

DETAILS	212.5 kVAr	350 kVAr	500 kVAr	750 kVAr
System Voltage	3 Ph 400V/415V/440V - 20% to 10%	3 Ph 400V/415V/440V - 20% to 10%	3 Ph 400V/415V/440V - 20% to 10%	3 Ph 400V/415V/440V - 20% to 10%
Frequency	50Hz +/-3%	50Hz + /- 3%	50Hz + /- 3%	50Hz + /- 3%
Capacitor	Heavy Duty Gas Filled MPP / APP	Heavy Duty Gas Filled MPP / APP	Heavy Duty Gas Filled MPP / APP	Heavy Duty Gas Filled MPP / APP
Reactor Winding	Aluminium / Copper	Aluminium / Copper	Aluminium / Copper	Aluminium / Copper
Reactor Impedance	5.67%/ 7%/ 14%	5.67%/ 7%/ 14%	5.67%/ 7%/ 14%	5.67%/ 7%/ 14%
Capacitor/Reactor - Make*	Reputed as per offered BOQ	Reputed as per offered BOQ	Reputed as per offered BOQ	Reputed as per offered BOQ
PF Controller - Make*	ICD	ICD	ICD	ICD
Switching Device	Thyristor / Capacitor duty contactor	Thyristor / Capacitor duty contactor	Thyristor / Capacitor duty contactor	Thyristor / Capacitor duty contactor
Operation Steps**	17 in Step of 12.5 kVAr	14 in Step of 25 kVAr	10 In Step of 50 kVAr	15 In Step of 50 kVAr
Capacitor Bank in KVAr**	3 x 50, 2 x 25 and 1 x 12.5	6 x 50,2 x 25	10 x 50	6 x 100, 3 x 50
Thyristor ratings for Capacitor Bank	Suitable rating as per CAP, Bank	Suitable rating as per CAP. Bank	Suitable rating as per CAP. Bank	Suitable rating as per CAP. Bank
Incomer Rating	400A MCCB	630A MCCB	1000A MCCB / ACB	1600A ACB
Switch Gear - Make*	Reputed as per offered BOQ	Reputed as per offered BOQ	Reputed as per offered BOQ	Reputed as per offered BOQ
Bank Protection	100A, 63A and 32A MCCB / FUSE	100A and 63A MCCB / FUSE	100A MCCB / FUSE	100A and 200A MCCB / FUSE
Protection when Voltage Sensing fails	Included in PFC	Included in PFC	Included in PFC	Included in PFC
Over Temperature Protection	Provided	Provided	Provided	Provided
Alarms with relay output	OC, OV, Over/Under Compensation	OC, OV, Over/Under Compensation	OC, OV, Over/Under Compensation	OC, OV, Over/Under Compensation
Tolerance in kVAr	8.75	17.5	35	35
Corrected PF	0.995	0.995	0.995	0.995
Auto Manual Selection	Through keypad in PFC	Through keypad in PFC	Through keypad in PFC	Through keypad in PFC
kVAr / Current meter for Capacitor	Optional - ICD Make	Optional - ICD Make	Optional - ICD Make	Optional - ICD Make
Parameter settings by keypad	Included	Included	Included	Included
Display of set / actual values	PF and kVAr	PF and kVAr	PF and kVAr	PF and kVAr
Panel Type	Cubicle / Compartmentalized	Cubicle / Compartmentalized	Cubicle / Compartmentalized	Cubicle / Compartmentalized
Panel Mounting	Floor Mounted	Floor Mounted	Floor Mounted	Floor Mounted
Panel Dimensions***	2100(H) x 800(W) x600(D) mm	2100(H) x 1300(W) x600(D) mm	2300(H) x 1500(W) x700(D) mm	2300(H) x 2500(W) x700(D) mm
Panel Temperature Rise	20° C above ambient	20° C above ambient	20° C above ambient	20° C above ambient
Ambient	45° C, Rh-90% @ 25° C	45° C, Rh-90% @ 25° C	45° C, Rh-90% @ 25° C	45° C, Rh-90% @ 25° C
Cooling type	Force Cooled	Force Cooled	Force Cooled	Force Cooled
Panel Enclosure Protection	As per IP42	As per IP42	As per IP42	As per IP42

Note: Alternate ratings also done depending on site study analysis and customer requirement
*For all these items refer to the respective product manuals for detailed specifications.
**Alternatively customers specifications can be adopted - 1:1:1:1 - 1:2:4:8
*** Panel Drawing submitted for Approval
Specifications are subject to change without prior notice due to continuous improvement in product development.

Services Provided In The Area Of Power Factor / Power Quality Improvement By ICD

- Load Flow studies, Harmonic studies and Power Quality studies are conducted at site
- Harmonics, Load Pattern, Single Line Diagram of the Network, Network Components are analyzed by our panel of experts to understand the problem accurately
- Based upon the type of application requirement and location, appropriate Power Factor / Harmonic Filter Solution of suitable rating is designed and proposed along with the payback and annual saving calculations
- Commissioning and Testing of ICD Power Factor / Harmonic Filter Systems
- The Performance of the Systems are monitored and validated to prove its impact after installation

Approximate Power Factor of different kind of loads:

- Induction Motor - 0.1 to 0.8 from no load to full load
- AC Drives - 0.95
- DC Drives - 0.1 to 0.8 depending upon the output voltage
- Fluorescent Light - 0.5
- Arc Welding Machines - 0.3 to 0.4
- Synchronous Motor - 0.8 lag to 0.8 lead depending upon the excitation
- Arc Furnace, Induction Heating - 0.85, Induction Furnace - 0.60

Exact kW/PF Rating will be available with the data sheet of the load

Please provide the following details along with enquiry:

- Full capacity in kW
- Average Power Factor of last 2 months
- Power Factor to be achieved
- Types of load steady and fluctuating like Motors, Welding, Cranes Press, Furnace, Rolling Mills, Forging, Stone Crusher, Cutting Machines etc.
- Total required kVAr for compensation and number of steps
- Whether field study required

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