

# TECHNICAL SPECIFICATION FOR 600V SCR SWITCHED FILTERED AUTOMATIC POWER FACTOR CORRECTION BANKS

## 1. Equipment Size / Ratings

System operating voltage (line-to-line): 600V, 3 phase, 60Hz. Capacitors shall be rated minimum 690V to protect against current and voltage overload due to harmonic distortion.

Total kVAr required at system voltage at present: 3600

Total kVAr required at system voltage for future: 3600

Total bank to be switched in 300 kVAr steps.

Master unit kVAr 1800 Slave unit kVAr 1800

Feeder Breaker included for Master and slave unit 2500Amp, 50 KAIC per bank

Switching speed required:        3 second response time Y 1 cycle response time

Target power factor selectable Y Target voltage selectable

## 2. Capacitors

Individual capacitors shall be CSA and UL approved, 3 phase, gas or oil filled under vacuum, and of a self-healing design utilizing a low loss metallized polypropylene film dielectric system with a pressure sensitive circuit interrupter. Metallized paper is not acceptable. Capacitor casing shall be of a seamless aluminum design. Electrical losses shall be less than 0.25w/kVAr. Dielectric fluid shall be high flash point, biodegradable, non-toxic and contain no PCB's. Capacitors shall include internal fusing for short circuit protection to 10kA, and include a grounding / mounting stud at the bottom of the capacitor cell for easy replacement.

Capacitors shall be rated for a minimum of 130% continuous current overload and 110% continuous voltage overload based on the 690 Volt rating of the capacitors. Individual capacitor cells shall not exceed 25 kVAr at the system voltage to keep replacement costs at a minimum.

Capacitors shall be suitable for -40°C to +60°C ambient temperature.

Dry type capacitors and / or capacitors without a pressure sensitive circuit interrupter are not acceptable.

## 3. Discharge Resistors

Adequate discharge resistors shall be provided for each capacitor cell to reduce the voltage to 50 Volts or less in one minute after disconnection of supply voltage.

## 4. Harmonic Filtering Reactors

Filter tuning frequency shall be 4.5 x 60 Hz (270 Hz).

Harmonic filtering reactors shall be three phase iron core complete with one "+" tap and one "-" tap per phase for field adjustment of inductance. Reactor insulation shall be rated at 220°C. The maximum temperature of the reactor at maximum continuous rms amperage shall be no higher than 145°C with a 45°C ambient. Reactor maximum continuous rms amperage shall be sized to match the maximum continuous rms amperage of the capacitors. The minimum reactor Q factor shall be 90.

Reactors shall be equipped with snap action thermostats which trip at 145°C and are wired to the associated step switching module which switches off and locks out the associated step for the overheated reactor. The power factor controller shall indicate which step has the overheated reactor.

## **5. SCR Switching Modules**

SCR switching modules shall be 2 phase and rated for capacitor switching duty. SCR switching modules shall have built in ventilation fans and heat sinks. The SCR's shall be capable of switching the maximum continuous rms amperage rating of the capacitors.

SCR controls shall be 120 Volt, 60 Hz and be equipped with alarm contact inputs to monitor reactor thermostat status.

## **6. SCR Switching Module Fusing**

3 semiconductor rated fuses shall be included for each SCR switching module. Fuses shall be rated for 600 Volts and have a minimum interrupting rating of 200 kA. Fuses shall be CSA approved and UL listed.

## **7. Digital Microprocessor Controller**

The digital microprocessor controller shall include the following features:

- a) adjustable target power factor and optional target voltage (both upper and lower limits for both targets) with selectable threshold to move from power factor to voltage control if target voltage control is required.
- b) standard and scan switching modes
- c) automatic or manual switching of SCR switching modules at zero crossing to prevent switching transients.
- d) switching ratios of 1:1:1:1, 1:2:2:2, 1:2:2:4
- e) capable of switching up to 12 steps for each switching ratio
- f) total acquisition time of 3 seconds for 3 second response time or total acquisition time of 1 cycle for 1 cycle response time.
- g) automatic determination of step quantity, kVAr per step, and if CT polarity and measurement phase angle is correct.
- h) measuring voltage range of 58 - 690 Volt without potential transformer
- i) displays capacitor step current and kVAr without having to use multipliers
- j) full digital metering system including kW, kVA, kVAr, Volts, Amps, Voltage Harmonics, Current Harmonics on both the mains and the capacitor bank.
- k) alarm relay for multiple functions.
- l) selection of activation or deactivation of individual alarms.
- m) no voltage release switches out all capacitors in case of interruption of supply voltage
- n) monitors and displays quantity of step on line.
- o) displays a fault when any step current is reduced below nominal values indicating a faulty step component.
- p) capable of communications via RS232 or RS485 using Modbus RTU protocol or ELCOM protocol
- q) 3 current inputs for remote and 2 current inputs for capacitor bank current transformers

## 8. Split Core Current Transformer

3 indoor rated split core current transformers of adequate size, ratio, and burden shall be supplied for remote mounting and 2 solid core current transformers of adequate size, ratio, and burden shall be supplied mounted in each capacitor bank for monitoring the capacitor bank amperages. Systems with master and slave configuration shall include a summation CT for the capacitor bank current transformers in the master unit.

Current transformers for remote mounting are to be supplied by the customer for systems with a distribution voltage greater than 600 Volts and systems with step up transformers.

## 9. Termination

A suitably sized three phase terminal block shall be provided for feeder termination. Ground terminals shall be provided for ground wire termination.

## 10. Enclosure

Enclosures shall be of at least the minimum gauge steel as required by code. Enclosures shall be suitable for the installation location. NEMA 1 enclosures shall be easily field changeable to NEMA 2, NEMA 3R, and NEMA 12. Thermostatically controlled ventilation shall be sized to maintain a maximum temperature of 45°C inside the enclosure at the extreme high ambient temperature.

NEMA 3R enclosures shall include thermostatically controlled anti-condensation heaters to maintain at least -20°C inside the enclosure based on the extreme low ambient temperature. Dripshields, air filters for dust, moisture, and vermin shall also be included for NEMA 3R enclosures. Dripshields and air filters for dust shall be included for NEMA 12 enclosures. Dripshields shall be included for NEMA 2 enclosures. The controller shall be semi-flush mounted on the door for NEMA 1 applications. The controller shall be mounted behind safety glass and the display visible for NEMA 2, NEMA 3R and NEMA 12 applications.

Adequately sized control transformer and control fuses shall be provided for all controls including heating and cooling.

All components must be suitably mounted to provide ease of replacement with front access only. All enclosure mounting hardware and framework shall be either galvanized steel or zinc plated steel for grounding continuity. Painted mounting hardware and framework with paint removed for grounding is not acceptable. All enclosure parts other than mounting hardware and framework shall be powder coated ASA 61 Grey.

The enclosure door shall have a lockable handle.

Enclosure rating required:   NEMA 1  

Minimum ambient  
temperature:   10°C    
Maximum  
ambient  
temperature:   35°C    
Feeder Cable Entry  
Location:   Top    
Feeder Cable  
Size:  
  5\*750 MCM per    
  bank per phase

## 11. Labelling

A "Wait one minute after disconnection from supply" label shall be located on the enclosure door. A "Wait five minutes after disconnection from supply" label shall be provided loose for the disconnecting device. Both labels shall be worded as per code requirements.

## 12. Testing

Testing shall be performed as per CSA and UL standards. All assemblies must bear a certification label for both Canadian and USA standards. A confirmation of the filter tuning frequencies must be performed prior to shipment.

## 13. Approved Manufacturers

Electrotek Ltd.

## 14. Step up Transformer

A step up transformer of adequate size shall be provided to allow connection of the 600 Volt capacitor banks to a higher voltage system. The step up transformer shall have little to no phase shift to allow direct connection of the power factor controller to the 600 Volt system without the use of potential transformers.

Step up transformer included	<u>Yes</u>
kVA rating of step up transformer (Minimum)	<u>4500</u>
Primary voltage of step up transformer (Ph-Ph)	<u>4160</u>
Secondary voltage of Step up transformer (Ph-Ph)	<u>600</u> (Ph-Ph)

## 15. Installation

Installation of step up transformer, capacitor banks, remote current transformers, all associated wiring, mounting, and placement of the step up transformer, capacitor banks, and current transformers is the customer's responsibility.

## 16. Commissioning

Commissioning of the system may be performed by customer supplied personnel with free telephone assistance from the factory. Factory trained technicians are available if required. Extra charges apply.