

CLASS 5860
REACTIVAR™ Power Factor Capacitors
AV6000 ANTI-RESONANT AUTOMATIC BANKS

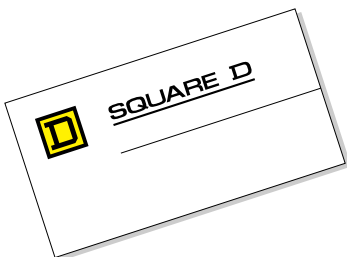
Square D's new REACTIVAR AV6000 Anti-resonant Automatic Power Factor Correction banks provide power factor correction in harmonic-rich environments.

- Power Factor Correction without the risk of harmonic resonance
- Heavy duty dry capacitors provide no risk of fluid leakage, no environmental pollution and no need for drip pans.
- Iron core reactors with thermal overload protection de-tune the network to prevent resonance.
- 100 kA current limiting fuse in each capacitor cell provides protection against both low and high current faults within the capacitor element.
- System may remove up to 50% of 5th harmonic.
- "MCC" style enclosures available up to 1200kVAR, 600V, Main lugs or main breaker.
- Advanced microprocessor controller reduces commissioning time by offering automatic C/K ratio selection, CT polarity retrieval, phase rotation retrieval and signalling of connection errors.
- 16 character alphanumeric LCD display on controller displays PF and connected steps, alarm conditions, load and reactive currents, voltage THD and more.
- Controls are viewable through a safety window.
- Attractive finish: Units constructed with removable 16 gauge steel panels over a welded 14 gauge steel frame. Indoor (Type 1) units finished in a medium-blue textured paint finish. ASA 61 and 49 available on request. Outdoor (Type 3R) units are painted ASA 61 as standard.
- Split core CT included as standard
- Built to CSA and UL Standards



The AV6000 Capacitive/Inductive Power Factor Correction system is designed to provide power factor correction in today's industrial networks which contain harmonic energies which would otherwise damage standard fixed or automatic capacitor banks.

The AV6000 anti-resonance capacitor bank includes custom designed iron core reactors in series with three phase capacitor modules. The series capacitor/reactor combination prevents resonance by tuning the network below the first dominant harmonic (usually the 5th, or 300hz). Since three phase networks typically have little or no harmonic current below the fifth, there is no energy available to resonate. In addition to providing power factor correction without the risk of resonance, the AV6000 may absorb up to 50% of the 5th harmonic current, depending upon network characteristics. This has the effect of reducing harmonic voltage distortion, thus improving overall network conditions



GROUPE SCHNEIDER

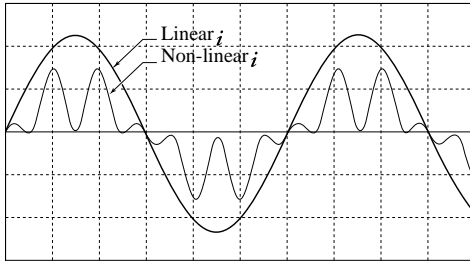


Fig. 1: Non-Linear Current

Harmonics and Standard Capacitors don't mix:

Harmonics are a natural by-product of non-linear loads such as drives (AC and DC), motor soft starters, welders, UPS systems, robotics and other electronic loads. Harmonics are higher-than-60Hz currents and voltages which are produced by these devices in response to the manner in which they draw current (see figure 1). As more and more non-linear loads are added to the electrical distribution system, the amount of harmonic current rises. Harmonics can cause serious problems to arise when standard fixed or automatic power factor correction capacitors are added to the network.

The problem:

There are two main concerns to consider when applying power factor correction capacitors. First, capacitors are a natural low impedance path for harmonic currents and will therefore absorb these energies. The increased capacitor current results in higher element temperature which negatively impacts the life of the capacitor. Also, because capacitors reduce the network impedance, capacitors can actually increase the level of harmonic current on the network. It's important to remember that while capacitors don't produce harmonic currents, they *can* magnify their effects. Furthermore, harmonic voltages present on the network create voltage stresses on the capacitor dielectric which can cause premature dielectric breakdown.

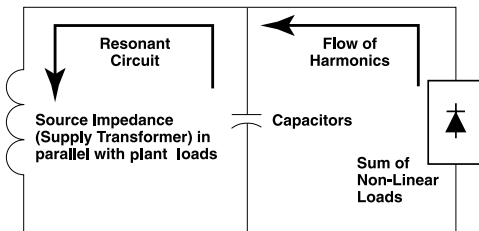


Fig. 2: Resonant Circuit Formed From Capacitor in Parallel with Source Impedance (Supply Transformer)

The second, and potentially more serious concern, is network resonance. When capacitors are added to the network, they set up a parallel resonance circuit between the capacitors and the system inductance's (see figure 2). Harmonic current components that are close to the parallel resonance point are magnified (see figure 3). The magnified currents can cause serious problems such as excessive voltage distortion, nuisance fuse operation, overvoltage trip of drives and insulation breakdown within motors, transformers and conductors.

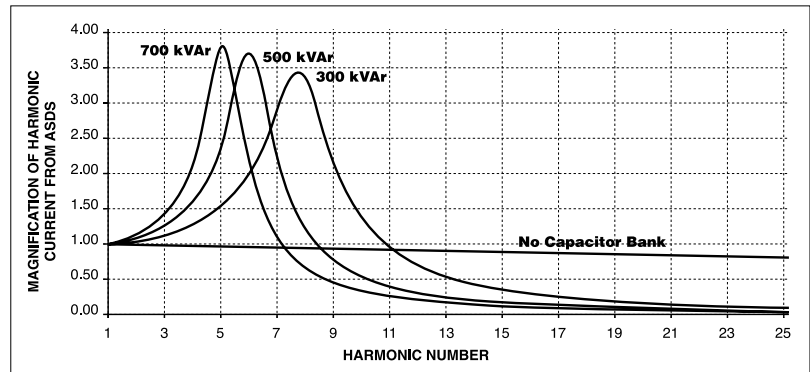


Fig. 3: Magnification of Harmonic Current When Standard Capacitors are Added to the Network

The solution:

The simplest method to accomplish power factor correction while maintaining harmonic control is to add an AV6000 anti-resonant capacitor bank. The AV6000 includes iron-core reactors in series with heavy duty capacitor elements. The series capacitor/reactor combination tunes the network below the first dominant harmonic (usually the 5th). Since most three phase networks contain little or no harmonic current below the 5th, there is no energy available to resonate. Figure 4 illustrates the effect of the AV6000 Anti-resonant bank on the harmonic currents. Note that there is a reduction in harmonic current amplification. In addition, because the impedance of the AV6000 is low near the fifth harmonic, it may actually absorb up to 50% of that current. This has the desirable effect of reducing overall voltage distortion.

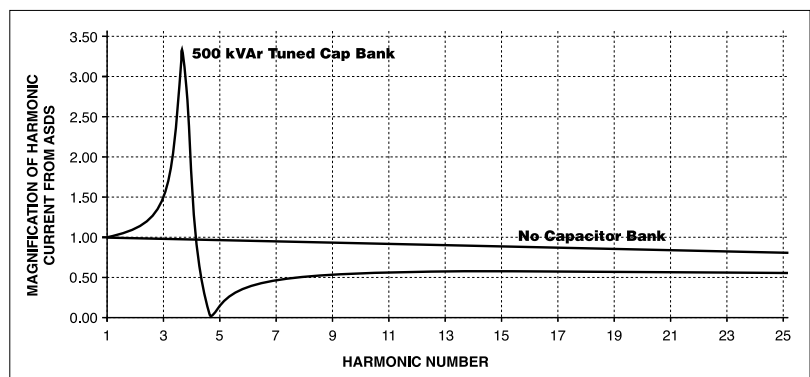


Fig. 4: Effect on Harmonic Current when Anti-resonant Capacitor Bank is Applied

When to apply an anti-resonant capacitor bank:

It is recommended that, if more than 15% of the load connected to the transformer is non-linear and power factor correction is desired, a de-tuned or anti-resonant bank should be applied. Below this value, a standard (i.e. non-filtered) capacitor bank can be safely applied. For example, if you have 2000 kW of connected load, of which 400 kW is variable speed drives (AC or DC), then the percent non-linear load is 20% (400/2000). Therefore, an AV6000 Anti-resonant bank is recommended.

Applying capacitors to a network which contains harmonics may warrant special considerations. We **highly recommend** that you contact the Square D/ Groupe Schneider Power Quality Correction Group for application assistance. Trained specialists are available to assess your conditions and make recommendations to ensure that the most effective solution is applied. Our specialists can provide telephone application assistance or arrange for a site visit to assess your needs. Solutions can include computer network simulation resulting in custom equipment. When calling for assistance, please have available the following:

- 12 months of utility billing information
- A single line diagram of the network showing nature of loads (e.g. 150 HP FVNR starters; 200 HP VFD; etc.)
- Transformer(s) kVA rating and percent impedance (%Z)
- Primary fault current level (if available)
- Primary & secondary voltages
- Location of utility metering
- Size and location of any existing capacitors

For technical assistance, please consult your nearest Square D/Groupe Schneider sales office.



Modular construction with safety in mind:

The AV6000 is constructed with free standing, modularized "MCC style" enclosures.

Capacitor blocks wired to HRC dead-front fuse holders and Telemecanique contactors are mounted on modular plates and wired to three phase iron core reactors. The entire assembly can be field installed, facilitating cost effective future expansion. AV6000 systems are constructed with up to 300 kVAR per section. For larger AV6000 systems, additional sections are added. Standard cubicle features includes:

- Finger-safe power and control wiring.
- Dead-front fuse holders.
- All copper bus, power and control wiring.
- Lockable two-point flush-mount door latching.
- Forced air ventilation controlled from a two stage temperature alarm. The first setpoint turns on the fan when the ambient rises above a preset level. The second setpoint automatically disconnects the bank to prevent damage. When the ambient returns to normal, the unit will return to normal operation.
- An attractive medium blue textured polyester paint (Indoor units). The textured paint finish resists dents and scratches and the standard blue color sets the equipment apart (ASA 49 & 61 grey available). Outdoor units are painted standard ASA 61.

Modularity and Performance



Iron Core Reactors are designed for the AV6000:

The iron core reactors employed in the AV6000 are custom designed and manufactured at our own factory under tight tolerances specifically for the AV6000.

- Reactors are constructed with an EI laminated low hysteresis iron core with precision controlled air gaps.
- Three phase windings consist of rectangular cross section, Class H insulated all-copper conductors.
- Entire reactor assembly is impregnated and baked with high temperature thermo-setting Epoxy resin to provide superior insulation levels.
- With any detuned bank, harmonic current overload is always a concern. The most effective way to protect the reactors is to monitor their temperature. For this reason, each reactor has a thermistor embedded in the center leg and wired to a Telemecanique thermistor relay. The system will shut down and annunciate should it overheat, usually as a result of excessive harmonic currents unaccounted for in the original specification. Automatic reset is standard.

Advanced controller offers user-friendly interface:

With its ergonomic design, the new Square D Varlogic power factor controller offers sophisticated electronic interface to facilitate ease of set-up, installation and control.



New advanced features make commissioning and operation simple:

- Automatic C/K ratio selection.
- Automatic CT polarity retrieval.
- Automatic phase rotation polarity detection.
- Manual operation with automatic return.
- Automatic no-voltage release and automatic staged reconnection.
- User-friendly menu-driven programming with 16 character alphanumeric LCD display
- Alarm relay and indication for: low power factor, hunting, abnormal PF, overcompensation, undervoltage, overvoltage, overcurrent, frequency not detected, high voltage THD, capacitor overload, low capacitor output and over temperature.
- Integral alphanumeric LCD display with graphical symbols includes display of: power factor, steps connected, period before switching, step configuration (auto, fixed, not used), step output status, real and reactive currents and THD Voltage.



Heavy duty Capacitor elements:

Merlin Gerlin Varplus M capacitors have a unique patented design that has been in service for over 10 years on several million elements around the world. Advances in materials and design provide reliability, safety and longevity unsurpassed in the industry:

- The HQ (High Quality) protection system provides protection against two types of end-of-life faults: High current faults are protected by an HRC cartridge fuse, low current faults are protected by a combination of the overpressure disconnect device and the HRC fuse.
- The self-healing metallized polypropylene film elements require no gas or liquid impregnation, thus they are completely environmentally safe.
- H Type cells used as standard are designed for the rigors of today's harmonic rich networks: Elements for 480V networks are rated 590V +10% overvoltage; Elements for 600 V networks are rated 690V +10% overvoltage.
- The unique cell design encapsulates the elements in a polyphenylene plastic housing mounted on a moulded polycarbonate plastic base. The plastic materials virtually eliminate the chances of ground faults originating from the cells. Furthermore, the design of the cells leads to better heat dissipation resulting in cooler operation and longer life.

AV6000 Selection and Dimensions

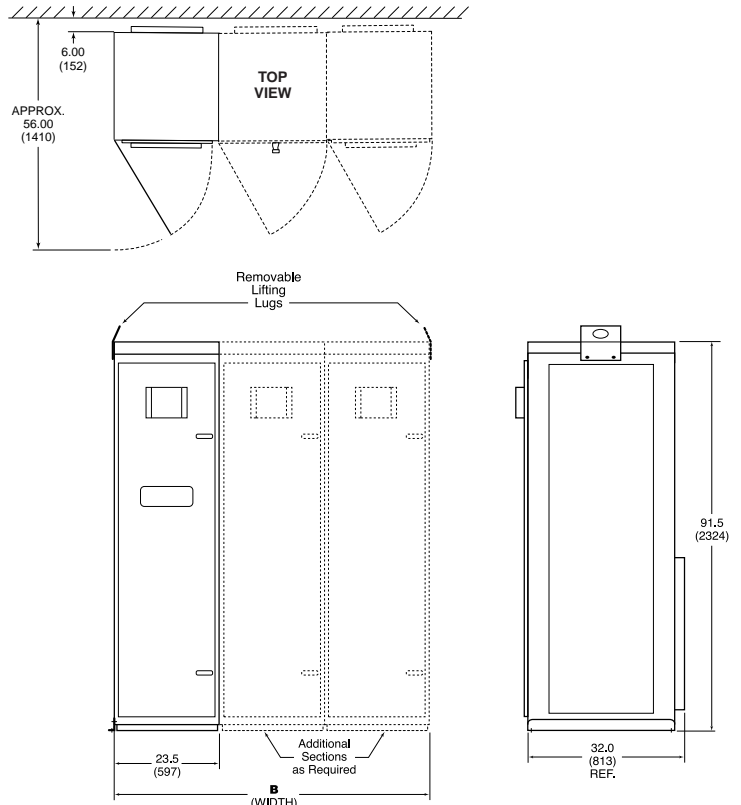
AV6000 Series			Main Lugsor Main Breaker				480 Volt 3 Phase/60Hz			Type 1 Enclosure		
kVAR Rating ■	Steps	kVAR per Step ■	Main Lugs		Standard Lugs Provided ■	Main Breaker		Standard Lugs Provided ■	Recommended Minimum Size Protection Rating* @ 480V		Recommended Minimum Cable Ampacity	
			Catalogue No.●	Encl.▼	(Qty x AWG)	Catalogue No.●	Encl.▼	(Qty x AWG)	Fuse	Breaker/Trip		
480V	(Qty x kVAR)	kVAR	Catalogue No.●	Encl.▼	(Qty x AWG)	Catalogue No.●	Encl.▼	(Qty x AWG)	Fuse	Breaker/Trip	135% Rated Current	
100	4x25	25	AV010046AV2N5N	4	2x1/0-2x350 MCM	BV010046AV2N4N	4	3x2/0-3x300 MCM	250	400/200	178	
150	3x50	50	AV015046AV5N5N	4	2x1/0-2x350 MCM	BV015046AV5N4N	4	3x2/0-3x300 MCM	400	400/300	267	
200	4x50	50	AV020046AV5N6N	4	2x1/0-2x500 MCM	BV020046AV5N4N	4	3x2/0-3x300 MCM	500	400/400	356	
250	1x50, 2x100	50	AV025046CV5N6N	4	2x1/0-2x500 MCM	BV025046CV5N6N	5	2x1/0-2x500 MCM	600	800/500	446	
300	2x50, 2x100	50	AV030046BV5N6N	4	2x1/0-2x500 MCM	BV030046BV5N6N	5	2x1/0-2x500 MCM	700	800/600	535	
350	1x50, 3x100	50	AV035046CV5N6N	5	2x1/0-2x500 MCM	BV035046CV5N6N	5	2x1/0-2x500 MCM	800	800/700	624	
400	4x100	100	AV040046AV8N6N	5	2x1/0-2x500 MCM	BV040046AV8N6N	5	2x1/0-2x500 MCM	900	800/800	713	
450	1x50, 4x100	50	AV045046CV5N6N	5	2x1/0-2x500 MCM	BV045046CV5N6N	5	2x1/0-2x500 MCM	1000	1200/900	802	
500	5x100	100	AV050046AV8N8N	5	4x1/0-4x500 MCM	BV050046AV8N8N	5	4x1/0-4x500 MCM	1100	1200/1000	891	
550	1x50, 5x100	50	AV055046CV5N8N	5	4x1/0-4x500 MCM	BV055046CV5N8N	6	4x1/0-4x500 MCM	1200	1200/1200	980	
600	6x100	100	AV060046AV8N8N	5	4x1/0-4x500 MCM	BV060046AV8N8N	6	4x1/0-4x500 MCM	1400	1200/1200	1069	

AV6000 Series			Main Lugsor Main Breaker				600 Volt 3 Phase/60Hz			Type 1 Enclosure		
kVAR Rating ■	Steps	kVAR per Step ■	Main Lugs		Standard Lugs Provided ■	Main Breaker		Standard Lugs Provided ■	Recommended Minimum Size Protection Rating* @ 600V		Recommended Minimum Cable Ampacity	
			Catalogue No.●	Encl.▼	(Qty x AWG)	Catalogue No.●	Encl.▼	(Qty x AWG)	Fuse	Breaker/Trip		
600V	(Qty x kVAR)	kVAR	Catalogue No.●	Encl.▼	(Qty x AWG)	Catalogue No.●	Encl.▼	(Qty x AWG)	Fuse	Breaker/Trip	135% Rated Current	
100	4x25	25	AV010066AV2N5N	4	2x1/0-2x350 MCM	BV010066AV2N4N	4	3x2/0-3x300 MCM	200	400/200	143	
150	3x50	50	AV015066AV5N5N	4	2x1/0-2x350 MCM	BV015066AV5N4N	4	3x2/0-3x300 MCM	300	400/250	214	
200	4x50	50	AV020066AV5N6N	4	2x1/0-2x500 MCM	BV020066AV5N4N	4	3x2/0-3x300 MCM	400	400/350	285	
250	1x50, 2x100	50	AV025066CV5N6N	4	2x1/0-2x500 MCM	BV025066CV5N6N	5	2x1/0-2x500 MCM	500	400/400	356	
300	2x50, 2x100	50	AV030066BV5N6N	4	2x1/0-2x500 MCM	BV030066BV5N6N	5	2x1/0-2x500 MCM	600	800/500	428	
350	1x50, 3x100	50	AV035066CV5N6N	5	2x1/0-2x500 MCM	BV035066CV5N6N	5	2x1/0-2x500 MCM	700	800/600	499	
400	4x100	100	AV040066AV8N6N	5	2x1/0-2x500 MCM	BV040066AV8N6N	5	2x1/0-2x500 MCM	700	800/700	570	
450	1x50, 4x100	50	AV045066CV5N6N	5	2x1/0-2x500 MCM	BV045066CV5N6N	5	2x1/0-2x500 MCM	800	800/800	642	
500	5x100	100	AV050066AV8N8N	5	4x1/0-4x500 MCM	BV050066AV8N8N	5	4x1/0-4x500 MCM	900	800/800	713	
550	1x50, 5x100	50	AV055066CV5N8N	5	4x1/0-4x500 MCM	BV055066CV5N8N	6	4x1/0-4x500 MCM	1000	1200/900	784	
600	6x100	100	AV060066AV8N8N	5	4x1/0-4x500 MCM	BV060066AV8N8N	6	4x1/0-4x500 MCM	1100	1200/1000	855	

- ◆ A single remote Current Transformer (included) must be located on the bus/cable at the main service entrance terminal compartment. **CT included in price. Specify CT ratio at time of order.**
- Top entry is standard. For alternate entry, consult your nearest Square D/Groupe Schneider sales office.
- ▼ For dimensions, see below.
- * Consult local Electrical Codes for proper sizing of Moulded Case Circuit Breakers and Disconnect Switches.
- ⊕ Type 3R enclosure available. Consult your nearest Square D/Groupe Schneider sales office.
- For additional sizes, ratings or options, please consult your nearest Square D/Groupe Schneider sales office.

Dimensions X				
Type	Encl.	Sections	Dimensions "B" (width)	
			IN	(mm)
AV6000	4	1	23.5	597
	5	2	47.0	1194
	6	3	70.5	1791

X Dimensions are approximate only. Do not use for construction. For actual dimensions, contact your local Square D/Groupe Schneider sales office.



Options and Wiring Diagram

Other products and services:

- REACTIVAR low voltage Fixed Capacitors
- AV4000 and AV5000 standard automatic capacitor banks for power factor correction in electrical networks which have less than 15% non-linear loads.
- AV7000 Harmonic filters for removal of harmonics
- Active (electronic) filters
- AV8000 and AV9000 Real Time Reactive Compensation banks and filters for highly transient loads.
- Medium voltage fixed and automatic switched banks up to 37 kV
- Medium voltage Real Time Reactive Compensation Banks up to 15 kV
- Engineering services such as:
 - Size and rating assistance
 - Harmonic analysis
 - Computer simulations
 - Commissioning
 - Service contracts

Consult your nearest Square D/Groupe Schneider sales office for pricing

Application Note:

It is imperative to ensure that no other capacitors (fixed or automatic) are connected to the same network as the AV6000 Anti-resonant Automatic Capacitor Bank. The components within the AV6000 are carefully chosen to avoid network resonance between the substation transformer and the AV6000 capacitor elements. Additional capacitors on the network will alter the characteristics of the AV6000, possibly leading to network resonance. The application of this product may warrant special consideration, please contact the Square D/Groupe Schneider Power Quality Correction Group, or your nearest Square D/Groupe Schneider field office for application assistance before sizing a unit.

Specifications are subject to change without notice.

VISIT OUR WEBSITE AT WWW.REACTIVAR.COM

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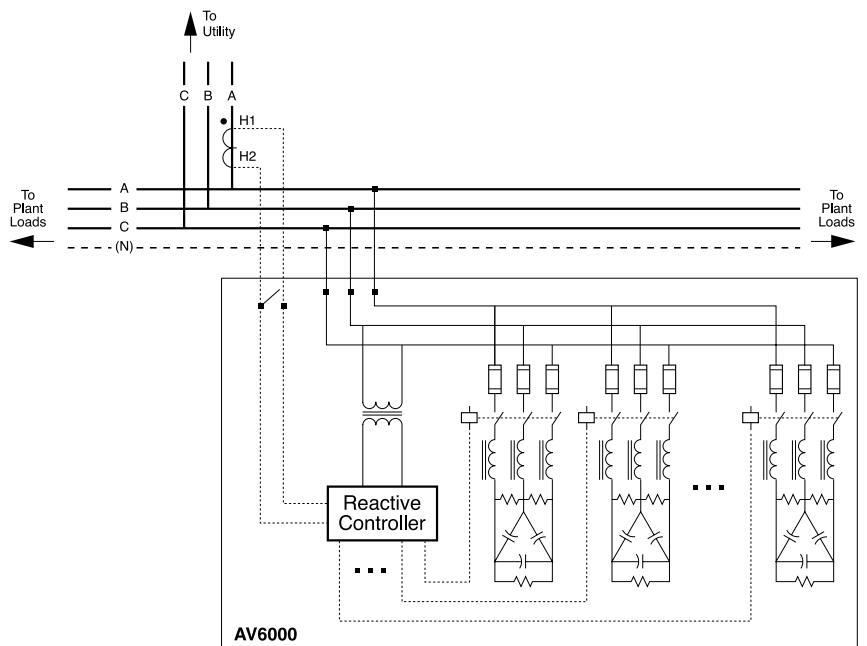
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Available Options

AV6000

Silver flashed copper bus, power and control wiring	■
Heavy duty capacitor elements	■
Iron core reactors with thermistor overload protection	■
Heavy duty control transformer w/ Class A ground fault protection	■
Finger safe control & power wiring	■
Advanced 12 step controller	■
C/W: Digital display incl. power factor meter	■
Capacitance loss each step	■
Automatic commissioning incl. auto C/K selection	■
Comprehensive alarms incl. voltage THD	■
Ambient overload protection	■
Split core CT	■
CT shorting block	■
Main lugs	■
Main breaker	○
Top entry	■
Bottom or side entry	○
Type 1 Enclosure (precaution blue standard)	■
Type 3R Enclosure (ASA 61 standard)	○
ASA 49 paint (Type 1 or 3R)	○
Powerlogic circuit monitor	○
Special control arrangements	○
Other voltages or frequencies	○
Other staging ratio's	○
Fixed stages	○
■ Standard feature	
○ Available option	

Wiring Diagram



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November, 1998