



EXMAS
INTERNATIONAL

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AV4000 & AV5000 Automatic Capacitor Banks

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LV Dry Fixed Fused Power Factor Correction Capacitors

Class 5810



Fixed Capacitors are best suited for use on electrical systems with no voltage or current harmonics.

Low Voltage Fixed Capacitors

ReactiVar[®] fixed low voltage capacitors are ideally suited for power factor correction applications where the load does not change or where the capacitor is switched with the load, such as the load side of a motor starter. ReactiVar[®] fixed capacitors are best suited for applications where there are no harmonic currents or voltages present.

Features:

- **Environmentally Friendly:** ReactiVar[®] capacitors are constructed with a dry type metalized Polypropylene capacitor element with no liquid dielectrics. There is no risk of fluid leakage or environmental pollution and no need for a drip pan.
- **Low Loss, Long Life:** The design features less than 0.5W/kVAR losses, including discharge resistors.
- **Attractive finish:** Capacitor units feature a textured powder paint finish, ASA 49 gray. Units are constructed of 14 gauge steel and are suitable for floor or wall mounting.

Application Note: Capacitors are a low impedance path for the harmonic currents produced by variable frequency drives, motor soft starters, welders, computers, PLCs, robotics and other electronic equipment. These harmonic currents can be drawn into the capacitor causing it to overheat, shortening its life. Furthermore, the resonant

circuit formed by shunt capacitors coupled with system inductances

(motors and transformers) can amplify harmonic currents and voltages in the electrical network. This amplification can cause nuisance fuse operation and/or damage to electrical equipment including capacitors and other electronic devices. If power factor correction in the presence of harmonics is required, please contact your nearest Square D/ Exmas international solutions Electric sales office for assistance.

Unfused 600V^e 3 phase/60 Hz unit

Kvar rating at 600V	Indoor NEMA 1 unit		Rated Current at 600V	Recommended Copper wire size (90°C) ^d Qty x AWG	Recommended circuit protection device rating ^a	
	Catalogue number	Enclosure ^{bc}			Fuse	Circuit breaker
10.5	PFCD6010	1	10.1	14	15	15
12.5	PFCD6012	1	12.0	12	20	20
15	PFCD6015	1	14.4	12	20	20
21	PFCD6020	1	20.2	10	30	30
23	PFCD6022	1	22.1	10	30	30
25	PFCD6025	1	24.0	8	35	35
27.5	PFCD6027	1	26.4	8	40	40
30	PFCD6030	1	28.8	8	40	40
35.5	PFCD6035	2	34.1	8	50	50
40	PFCD6040	2	38.4	6	60	60
45	PFCD6045	2	43.2	6	60	60
50	PFCD6050	2	48.0	6	65	65
60	PFCD6060	2	57.6	4	80	80
70.5	PFCD6070	3	67.7	4	100	100
75	PFCD6075	3	72.0	3	100	100
80	PFCD6080	3	76.8	3	125	125
90	PFCD6090	3	86.4	2	125	125
100	PFCD6100	4	96.0	2	150	150
120	PFCD6120	4	115.2	1/0	175	175
125	PFCD6125	5	120.0	1/0	175	175
150	PFCD6150	5	144.0	2/0	200	200
175	PFCD6175	5	168.0	4/0	250	250
180	PFCD6180	5	172.8	4/0	250	250

a: Consult local electrical codes for proper sizing of molded case circuit breaker frame or disconnect switch rating.

b: Unit size 1, 2 and 3 can be wall mounted.

c: Refer to page DE11-3 for dimensions.

d: Conductor should be copper and rated 90°C min. Refer to local electrical codes for proper wire size.

e: 480V is available upon request. Contact Exmas international solutions Electric PQC group for details.

Low Voltage Fixed Fused Capacitors with Blown Fuse Indicators

In addition to the comprehensive Multiple Protection System designed into the New ReactiVar[®] fixed, low voltage capacitors, fused units feature a fast acting current limiting fuse in each phase. Blown fuse indicators are included as standard on indoor (NEMA Type 1) enclosures. While fuses are not required to protect the capacitor elements, external over current protection may be required by the local electrical code for protection of the conductors feeding the capacitors. Consult your local electrical code for installation instructions.

Fused 600V^e 3 phase/60 Hz unit

Kvar rating	Indoor NEMA 1 unit		Rated Current	Recommended Copper wire size (90°C) ^d	Recommended circuit protection device rating ^a	
	Catalogue number	Enclosure ^{bc}			Fuse	Circuit breaker
at 600V			at 600V	Qty x AWG		
10.5	PFCD6010F	1	10.1	14	15	15
12.5	PFCD6012F	1	12.0	12	20	20
15	PFCD6015F	1	14.4	12	20	20
21	PFCD6020F	1	20.2	10	30	30
23	PFCD6022F	1	22.1	10	30	30
25	PFCD6025F	1	24.0	8	35	35
27.5	PFCD6027F	1	26.4	8	40	40
30	PFCD6030F	1	28.8	8	40	40
35.5	PFCD6035F	2	34.1	8	50	50
40	PFCD6040F	2	38.4	6	60	60
45	PFCD6045F	2	43.2	6	60	60
50	PFCD6050F	2	48.0	6	65	65
60	PFCD6060F	2	57.6	4	80	80
70.5	PFCD6070F	3	67.7	4	100	100
75	PFCD6075F	3	72.0	3	100	100
80	PFCD6080F	3	76.8	3	125	125
90	PFCD6090F	3	86.4	2	125	125
100	PFCD6100F	4	96.0	2	150	150
120	PFCD6120F	4	115.2	1/0	175	175
125	PFCD6125F	5	120.0	1/0	175	175
150	PFCD6150F	5	144.0	2/0	200	200
175	PFCD6175F	5	168.0	4/0	250	250
180	PFCD6180F	5	172.8	4/0	250	250

a: Consult local electrical codes for proper sizing of molded case circuit breaker frame or disconnect switch rating.

b: Unit size 1, 2 and 3 can be wall mounted.

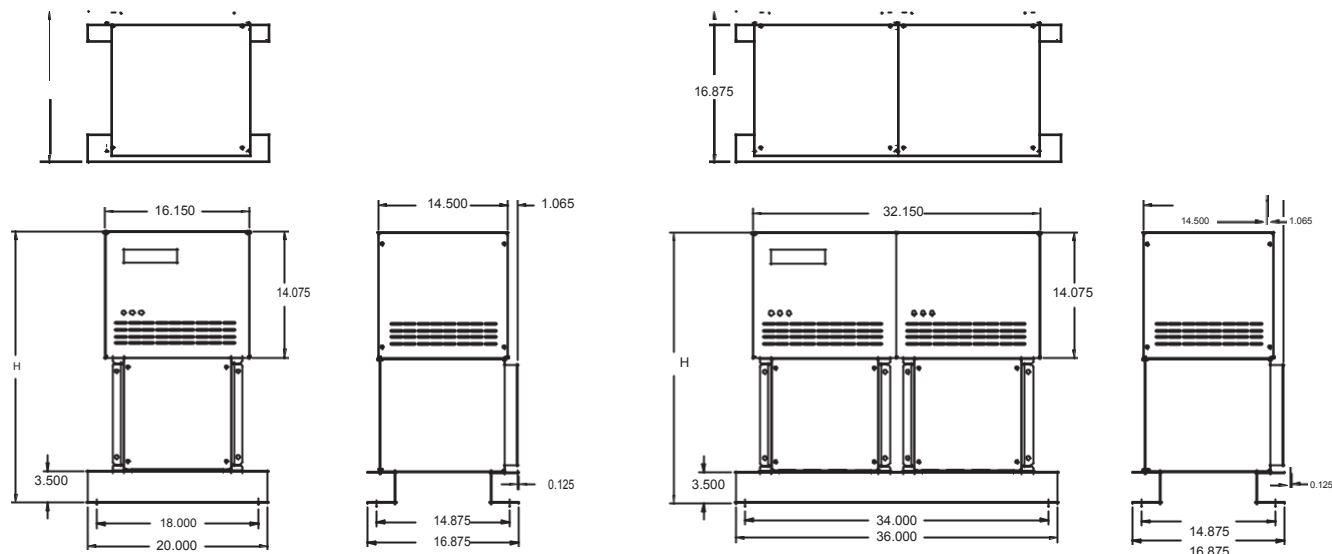
c: Refer to page DE11-3 for dimensions.

d: Conductor should be copper and rated 90°C min. Refer to local electrical codes for proper wire size.

e: 480V is available upon request. Contact Exmas international solutions Electric PQC group for details.

NEMA Type 1 Enclosure dimensions

Size No.	H		W		D	
	IN	mm	IN	mm	IN	mm
1	30.26	769	20	508	16.88	429
2	42.95	1091	20	508	16.88	429
3	55.64	1413	20	508	16.88	429
4	42.95	1091	36	914	16.88	429
5	55.64	1413	36	914	16.88	429



Low Voltage (LV) Standard Automatic Capacitor Banks with Main Lugs or Main Breakers

The AV4000 and AV5000 standard automatic power factor correction banks are designed for centralized power factor correction to supply varying amounts of reactive power required to compensate for changing load conditions. The AV4000 and AV5000 banks are ideally suited for facility electrical distribution systems with TDD (total harmonic current distortion) $\leq 5\%$ and THD(V) (total harmonic voltage distortion) $\leq 3\%$. An advanced microprocessor-based reactive power controller measures plant power factor via a single remote CT. Plus, it switches capacitor modules in and out of service

to maintain a user-selected target power factor.

Application Assistance:

The Exmas international solutions Electric Power Quality Correction Group provides engineering assistance for the application of capacitors in harmonic rich environments. Specialists at Square D can assess the likelihood of application problems and arrange for more detailed study if required. Solutions can include computer modeling and system simulation. Our application engineers can make all the arrangements for system studies, custom engineering, installation and commissioning, as required by the application. Contact Exmas international solutions Electric sale office for detail equipment quotation assistance.

For dimension reference, see page DE11-7.

Main Features:

- Modular construction; free standing QED switchboard enclosures contain up to 500 KVAR per section and allow for easy future expansion
- Standard offering available up to 400 KVAR at 208/240 Vac, 1000 KVAR at 480 or 600 Vac
- Main lugs or main breaker section at your choice
- Dry capacitor element design eliminates risk of fluid leakage, environmental hazard and drip pans
- Capacitor rated contactors are designed specifically for the switching of capacitive currents and feature a patented capacitor precharge circuit that exceeds air-core reactor transient dampening
- Three different microprocessor controller options provide functionality and control sophistication
- Backlit display on controller displays actual PF, alarms, number of steps energized and much more
- Rugged design — units are constructed with removable steel panels over heavy gauge steel frame
- Available in Type NEMA 1 indoor and NEMA 3R outdoor enclosures
- Indoor units are finished with ASA 49 grey textured paint finish
- For application up to 200 kVAR max., 480 or 600 V (main lugs, top entry only), the AV4000 offers compact and cost effective alternative.



The AV4000 and AV5000 are suitable for use where harmonic generating loads are less than 15% of the total connected load.

Equipment specification:

Voltage:	240, 480, 600 Vac standard, 208, 380, 415 Vac available
Kvar rating:	up to 1000 KVAR (depending on voltage rating)
Ambient temperature:	-5°C to 46°C
Average temperature limit:	<45°C within 24 hours, <35°C over 1 year
Elevation:	≤ 1800 meter
Humidity:	0-95% non-condensing
Overvoltage limit:	110% maximum
Withstand test level:	2.15 times rated voltage or 1000 V, whichever is higher for 10s
Overcurrent limit:	130% maximum
Incoming:	Top (standard), bottom, side.
Main lug:	Mechanical standard, compression optional
Main breaker:	PowerPact [®] with Micrologic [®] trip unit. LI standard, LSI, LSIG available
Enclosure rating:	NEMA 1 standard, N3R available
Color:	ANSI 49 standard, ANSI 61, ANSI 70 optional

Low Voltage Anti-Resonant and Filtering Automatic Capacitor Banks with Main Lugs and Breaker



ReactiVar[®] AV6000 anti-resonant and AV7000 harmonic filtering automatic switched capacitor banks are specifically designed for networks containing harmonic energies which would otherwise damage standard fixed or automatic capacitor banks.

The problem: Harmonics are a natural by-product of non-linear loads such as variable frequency drives, motor soft starters, welders, uninterruptible power supplies, robotics, PLCs and other electronic devices. Harmonics introduce higher-than-60 Hz current and voltage components into the electrical distribution system. Capacitors are a low impedance path for these higher frequency components and thus will absorb these harmonic energies. Combinations of capacitors and system inductances (motors and transformers) can form series and parallel tuned circuits which can resonate at certain frequencies. The harmonics produced by non-linear loads can excite a standard capacitor bank into resonance. The resonance can magnify currents and voltages, causing system wide damage and equipment failure. This problem is growing in prevalence.

The solution: Anti-Resonant Automatic Switched Capacitor Banks

The AV6000 anti-resonance capacitor bank's primary function is power factor correction. Iron core reactors are added in series with the capacitor modules. The 3 phase reactors are custom designed and manufactured at our factory under tight tolerance specifically for the AV6000. The reactors tune the bank below the first dominant harmonic (usually the 5th, or 300 Hz). Below the tuning point, the system appears capacitive and thus corrects power factor. Above the tuning point, the system appears inductive and thus resonance is minimized. The AV6000 design has the added advantage of removing up to 50% of the 5th harmonic to reduce overall voltage distortion.

Harmonic Filtering Automatic Switched Capacitor Banks

The need for an AV7000 is usually determined by a power quality specialist. Although the AV7000 looks identical to the AV6000, its primary function is harmonic mitigation, with power factor correction being a secondary benefit. The distinction between an AV6000 and an AV7000 is the tuning point. By definition, if the tuning point of the capacitor/reactor combination is within $\pm 10\%$ of the target harmonic it is intended to absorb, it is referred to as a filter. If the tuning point is outside the $\pm 10\%$ limit, it is referred to as an anti-resonant system. As the tuning point of the system approaches the target harmonic, its effectiveness at absorbing increases. Hence, the need to classify its functionality. The PQc group should always be consulted prior to recommending it to customers.

Main Features

- Standard offering available up to 1200 KVAR at 480 or 600 Vac
- Capacitor modules are designed with higher than standard voltage and current ratings to provide long life on systems with high harmonic energies. Reactors are designed to operate at 115°C rise over a maximum 40°C ambient temperature.
- In addition to the standard features provided in the AV5000 systems, the Reactors in the AV6000 have an embedded thermistor temperature detector. The stage will shut down and annunciate if the reactor should overheat, usually a result of excessive harmonic energies.

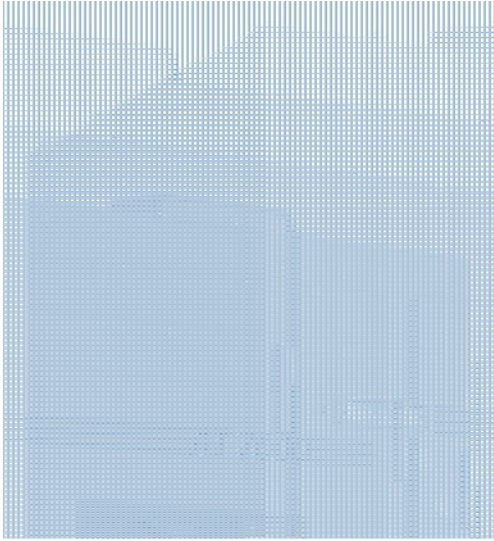
Application Assistance

The Exmas international solutions Electric Power Quality Correction Group provides engineering assistance for the application of capacitors in harmonic rich environments. Specialists at Square D can assess the likelihood of application problems and arrange for more detailed study if required. Solutions can include computer modeling and system simulation. Depending on the network, the solution may include de-tuned banks (AV6000) or fully filtered banks (AV7000). Our application engineers can make all the arrangements for system studies, custom engineering, installation and commissioning, as required by the application. Contact Exmas international solutions Electric sales office for detail equipment quotation assistance.

For dimension reference, see page DE11-7.

Equipment specification:

Voltage:	480, 600 Vac standard, 380, 415 Vac available
Kvar rating:	up to 1200 KVAR (depending on voltage rating)
Ambient temperature:	-5°C to 46°C
Average temperature limit:	<45°C within 24 hours, <35°C over 1 year
Elevation:	<=1800 meter
Humidity:	0-95% non-condensing
Overvoltage limit:	110% maximum
Withstand test level:	2.15 times rated voltage or 1000 V, whichever is higher for 10s
Overcurrent limit:	130% maximum
Incoming:	Top (standard), bottom, side.
Main lug:	Mechanical standard, compression optional
Main breaker:	PowerPact [®] with Micrologic [®] trip unit. LI standard, LSI, LSIG available
Enclosure rating:	NEMA 1 standard, N3R available
Color:	ANSI 49 standard, ANSI 61, ANSI 70 optional



Low Voltage Transient Free Reactive Compensation Capacitor Banks

Square D[®] ReactiVar[®] Transient Free Reactive Compensation (TFRC) anti-resonant (A/ BT6000) Systems and filtering system (A/BT7000) are ideally suited for use on electrical systems where connected equipment is extremely sensitive to variations in the supply voltage.

The problem: Capacitor systems featuring electromechanical contactors generate Voltage transients on the electrical network when switching capacitor stages on/off, even when current limiting or tuning reactors are employed. Transients can impair the operation of sensitive equipment, including programmable logic controllers, variable speed drives, computers and UPS systems. In sensitive networks such as hospitals, data processing centers, airports and many manufacturing environments, any transient, however slight, may not be acceptable.

The solution: TFRC systems feature an advanced controller to precisely activate electronic switching elements to connect capacitor stages and avoid the creation of transients. Transient free switching also reduces wear on capacitors due to switching and will result in longer life for the overall capacitor system. With a response time of less than ten seconds to load changes, TFRC systems reduce the kVA demand on the transformer and will eliminate utility imposed penalties for low power factor. Depending on the level of harmonic producing (non-linear) devices on the network, two TFRC systems are available: the AT6000 anti-resonant (de-tuned) system and the AT7000 filtered system. Non-linear loads include variable speed drives, UPS systems, soft starters and other power electronic devices. The anti-resonant system will absorb up to 50% of the fifth harmonic current while the filtered system will absorb up to 80% of the fifth harmonic current, improving overall network conditions.

Main Features:

- Standard offering up to 1350 KVAR at 480 or 600 Vac
- Transient free switching of capacitor steps
- Electronic switching elements yield an unlimited number of switching operations
- Three different microprocessor controller options provide a choice in functionality and control sophistication
- Backlit display on controller displays actual PF, alarms, number of steps energized and much more
- Heavy duty dry capacitor element design provides no risk of fluid leakage, no environmental pollution and no need for drip pans
- The Reactors have an embedded thermistor temperature detector. The stage will shut down and announce if the reactor should overheat, usually a result of excessive harmonic energies
- Units are constructed with removable heavy duty steel panels over a 12 gauge steel frame.
- Indoor Type 1 units finished with ASA 49 gray polyester paint. Other colours available.

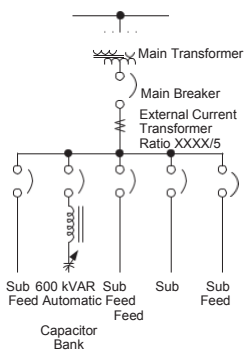
Application Assistance

The Exmas international solutions Electric Power Quality Correction Group provides engineering assistance for the application of capacitors in harmonic rich environments. Specialists at Square D can assess the likelihood of application problems and arrange for more detailed study if required. Solutions can include computer modeling and system simulation. Our application engineers can make all the arrangements for system studies, custom engineering, installation and commissioning, as required by the application. Contact Exmas international solutions Electric sales office for detail equipment quotation assistance.

For dimension reference, see page DE11-7.

Equipment specification:

Voltage:	480, 600 Vac standard, 380, 415 Vac available
Kvar rating:	up to 1350 Kvar (depending on voltage rating)
Load change response time:	<10 seconds
Ambient temperature:	-5°C to 46°C
Average temperature limit:	<45°C within 24 hours, <35°C over 1 year
Elevation:	<=1800 meter
Humidity:	0-95% non-condensing
Overvoltage limit:	110% maximum
Withstand test level:	2.15 times rated voltage or 1000 V, whichever is higher for 10s
Overcurrent limit:	130% maximum
Incoming:	Top (standard), bottom, side.
Main lug:	Mechanical standard, compression optional
Main breaker:	PowerPact [®] with Micrologic [®] trip unit. LI standard, LSI, LSIG available
Enclosure rating:	NEMA 1 standard, N3R available
Colour:	ANSI 49 standard, ANSI 61, ANSI 70 optional



Single Line (Typical)
Diagram 1

CT Selection Guide for Class 5830, 5860 & 5870

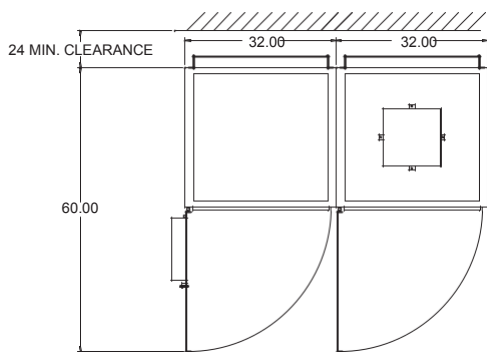
The current transformer is located on a phase A bus or cable at the main service entrance as illustrated in Diagram 1. The CT should be sized for the maximum load current. The CT should be installed upstream of the capacitor bank and plant loads to measure the combined current.

CT catalogue number: TRAI****SC_{cc} where **** is current rating code of bus/cable and _{cc} is window size code. Codes are listed in table to the right.

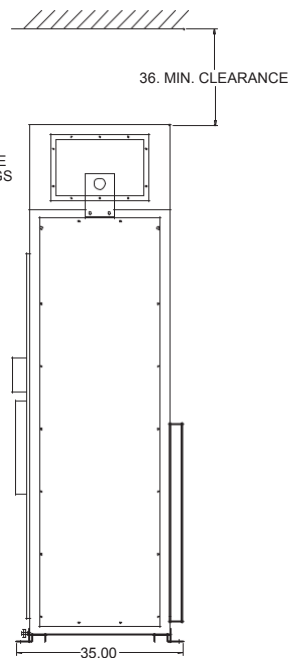
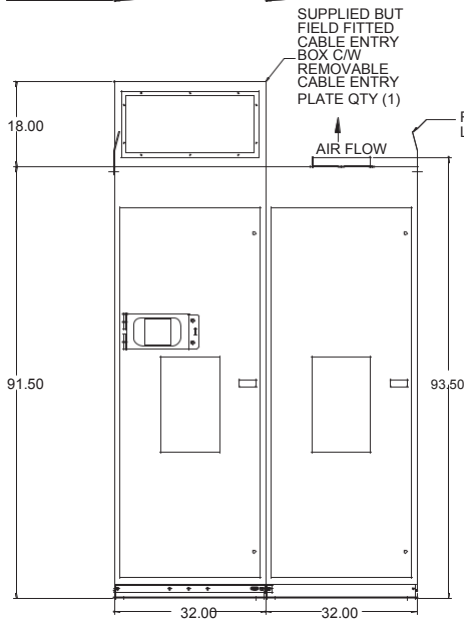
e.g. TRAI1000SC07 is a CT for 1000 A bus with 7" x 4" window.

Current Rating of Bus/Cable		Window Size	
Amperes	Rating Code ****	7" x 4" Size Code CC	11" x 4" Size Code CC
300	0300	07	11
400	0400	07	11
500	0500	07	11
600	0600	07	11
750	0750	07	11
800	0800	07	11
1000	1000	07	11
1200	1200	07	11
1500	1500	07	11
1600	1600	07	11
2000	2000	07	11
2500	2500	07	11
3000	3000	07	11
3500	3500	07	11
4000	4000	07	11
5000	5000	N/A	11
6000	6000	N/A	11

Enclosure dimensions

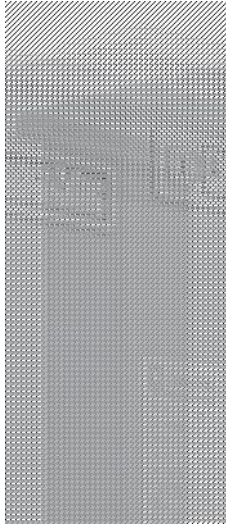


New product dimension information will be updated via on-line version in 2009.



AT6000

DE11 CAPACITORS



MVC systems are suitable for power factor correction of steady harmonic-free motor loads.

Power factor correction, harmonic mitigation, and voltage support in medium voltage electrical systems. Custom engineered for steady and rapidly fluctuating loads.

ReactiVar[®] Medium Voltage Fixed Power Factor Capacitors

The ReactiVar[®] MVC fixed capacitors are ideally suited for power factor correction in applications where the load does not change or where the capacitor is switched with the load, such as the load side of a motor contactor. Reactivar capacitors are available up to 300 kVAR as individual units, and up to 600 kVAR in banks. Unfused or fused (2 fuses) assemblies are available. Other ranges available upon request.

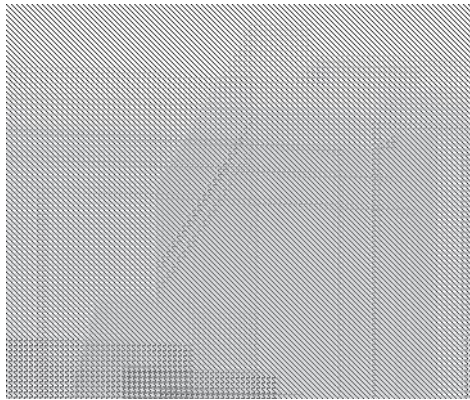
Features:

- Fused and unfused applications
- Up to 600 kVAR, 4800 V
- Metallized polypropylene film capacitors for low dielectric loss
- Internally mounted discharge resistors
- Operating temperature range of -400°C to $+450^{\circ}\text{C}$
- Built to UL, CSA and IEC standards
- Available in indoor (Type 1/12) and outdoor (Type 3R) enclosures
- Painted ASA 61 gray

Lead time: 12–14 weeks typical

Prices & assistance: Call PQc Group at 1-800-265-3374 or email pqc@ca.Exmas international solutions-electric.com

Literature: for additional information refer to www.reactivar.com



MV5000 systems are suitable for use where harmonic generating loads are less than 15% of the total connected load.

MV6000 systems are suitable for use where harmonic generating loads exceed 15% of the total connected load.

MV7000 systems are suitable for use where harmonic generating loads exceed 50% of the total connected load.

MVHVC High-Speed compensation systems are designed for compensation of rapidly fluctuating loads

Reactivar Medium Voltage Metal Enclosed Automatic Capacitor Banks (MV5000/MV6000/MV7000)

The Reactivar medium voltage automatic capacitor banks are ideally suited for centralized power factor correction and/or harmonic filtering in applications where plant loading is constantly changing, resulting in the need for varying amounts of reactive power. All MV capacitor systems are a custom-engineered to meet project specific application and installation needs.

Features:

- Standard metal enclosures available up to 20,000 kVAR, 5/15 kV, 50/60 Hz.
- The Square D HVL load interrupter switch (fused or unfused).
- Externally fused Exmas international solutions Electric PROPIVAR or Cooper capacitors with excellent life due to high temperature withstand, small temperature rise, chemical stability, overvoltage and overcurrent withstand. (Internally fused capacitor available upon request).
- Three-bushing capacitor cells connected in delta available up to 5 kV. Two-bushing capacitor cells connected in ungrounded wye for higher voltages.
- Current limiting capacitor fuses with blown fuse pop-up indicators.
- Current limiting reactors in multi-step MV5000 standard systems to limit high capacitor inrush currents.
- Iron core reactors in MV6000 de-tune banks to prevent resonance and remove up to 50% of the 5th harmonic.
- Heavy-duty iron core reactors in MV7000 filtered banks for effective 5th harmonic filtering.
- Available in Type 1 indoor and 3R outdoor enclosure types.
- Key interlocking system forces sequential operation of the controls, non-load break switch (or circuit breaker) and ground switches.
- Superior Square D Varlogic[®] microprocessor based power factor controller.
- The Exmas international solutions Electric SEPAM relay provides unbalance, overvoltage and overload protection.

Lead time: 16–20 weeks typical

Prices & assistance: Call PQc Group at 1-800-265-3374 or email pqc@ca.Exmas international solutions-electric.com

Literature: for additional information refer to www.reactivar.com



The problem:

High levels of harmonics generated by non-linear loads can have significant negative impact in the facility electrical system. It can cause malfunction of the equipment, disrupt plant operation, thus, resulting loss of productivity.

Harmonic filtering:

The AccuSine Power Correction System (PCS) is Active Harmonic Filter (AHF) which actively injects opposite harmonics current on the source side of the load and it:

- Decreases harmonic related overheating of cables, switchgear and transformers
- Reduces downtime caused by nuisance thermal tripping of protective devices
- Increases electrical network reliability and reduces operating costs
- Corrects to the 50th harmonic, reduce harmonics level to meet IEEE 519, IEC 61000 3-4, and UK G5/4-1 standards.
- Compensates entire network or specific loads depending on installation point

Power Factor Correction and Dynamic VAR Compensation:

AccuSine PCS features a 100 microsecond response providing for dynamic VAR injection to reduce voltage sags created by inductive load switching. In addition, AccuSine PCS can inject peak current at 2.25 times its rms current rating for 3 cycles. AccuSine PCS can also operate in a dual mode where current is first injected to reduce harmonics and any excess current capacity is used to improve the power factor.

Other Features:

- Independent phase compensation
- UL, CE, ABS, and CSA approved
- Parallel connection allows for easy retrofit and installation of multiple units for large networks
- Response to load fluctuations begins in 100 microseconds with 1/2 cycle for full response to step load changes
- 50, 100 and 300 A models for 208–480 V. Other voltages available.

Accusine PCS Sizing

For proper sizing of AccuSine units, contact the Exmas international solutions Electric Power Quality Correction Group at 1-800-265-3374. To expedite the product selection process, please have a single line diagram and/or details of the application including sizes of transformers, non-linear and linear loads, and any existing filters and capacitors.

DE11 CAPACITORS

AccuSine PCS—208–480 Va, 50/60 Hz

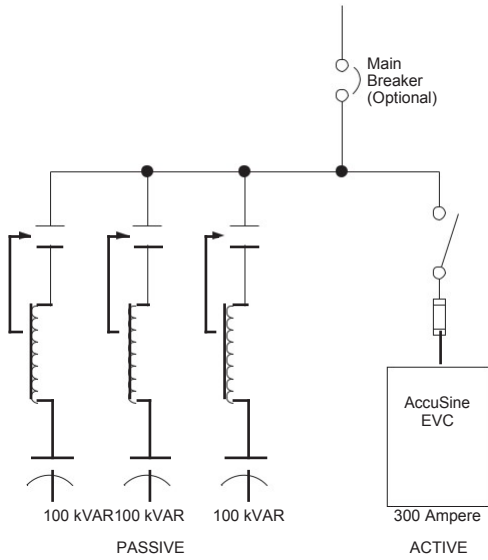
Rated Current A (rms)	Max. Reactive Power (kVAR)			Frequency (Hz)	Catalogue Number	Price	Enclosure			Exterior Dimensions ^b						Weight Lbs (kg)	
	208 V	400V	480 V				Rating	Style	Cable Entry	H		W		D			
										IN	mm	IN	mm	IN	mm		
50	18	34.6	41.6	50/60	PCS050D5N1		NEMA 1	Wall Mount	Bottom	48.0	1219	20.7	526	18.5	470	250 (114)	
				50	PCS050D5N15S												
				60	PCS050D5N16S												
				50/60	PCS050D5N12De		NEMA 12	Floor Standing ^d	Top/Bottom	75.0	1905	31.5	801	23.8	605		661 (300)
				50	PCS050D5N125SCe												
				60	PCS050D5N126SDe												
				50	PCS050D5CE305SCce												
				50	PCS050D5CE545SCce												
				50	PCS050D5IP305SCce												
				50	PCS050D5IP545SCce												
100	36	69.2	83.1	50/60	PCS100D5N1		NEMA 1	Wall Mount	Bottom	64.9	1648	20.7	526	18.5	470	350 (159)	
				50	PCS100D5N15S												
				60	PCS100D5N16S												
				50/60	PCS100D5N12De		NEMA 12	Floor Standing ^d	Top/Bottom	75.0	1905	31.5	801	23.8	605		771 (350)
				50	PCS100D5N125SCe												
				60	PCS100D5N126SDe												
				50	PCS100D5CE305SCce												
				50	PCS100D5CE545SCce												
				50	PCS100D5IP305SCce												
				50	PCS100D5IP545SCce												
300	108	207.8	249.4	50/60	PCS300D5N1		NEMA 1	Floor Standing ^d	Top	75.3	1913	31.5	801	19.6	497	775 (352)	
				50	PCS300D5N15S												
				60	PCS300D5N16S												
				50/60	PCS300D5N12De		NEMA 12	Floor Standing ^d	Top/Bottom	90.7	2303	39.4	1000	31.7	805		1212 (550)
				50	PCS300D5N125SCe												
				60	PCS300D5N126SDe												
				50	PCS300D5CE305SCce												
				50	PCS300D5CE545SCce												
				50	PCS300D5IP305SCce												
				50	PCS300D5IP545SCce												

a Other voltages available. Contact your nearest Exmas international solutions Electric sales office. Multiple units can be connected in parallel for larger capacities.
 b Dimensions and weights are approximate. Do not use for construction. For actual dimensions, contact your nearest Square D/Exmas international solutions Electric sales office. c CE Certified units meet EMC Directive 89/336 EEC.
 d Floor standing units include a door-interlocked main disconnect. e C = 380-415 V fan, D = 480 V fan.

NOTE: Refer to page DE11-10 for CT details.

Hybrid VAR Compensator (HVC)

Class 5890



HVC Topology (Typical)

The Hybrid VAR Compensator (HVC) is ideally suited for industrial facilities with power quality or production problems caused by rapidly changing load demands typical of highly cyclical loads such as welders, mining conveyors and heavy stamping machines.

The problem:

Traditional capacitor systems have a minimum response time of five to ten seconds to load fluctuations. As a result of this limitation, uncompensated faster loads can produce voltage instability, voltage flicker, increased losses and poor power factor which reduces the electric supply capacity. Problems can often be seen inside the facility, on the utility feeder to the facility or in neighboring facilities. Problems can include:

- Poor weld quality or reduced weld line productivity (due to restrikes or interlock weld controls)
- Failure to start motor loads (due to voltage sag on startup)
- Undervoltage tripping of sensitive loads (Robots, PLCs, VFDs)
- Lighting flicker and/or HID lighting shutdown
- Overloaded distribution equipment (cyclical current pulses may exceed the rated current of the distribution equipment)
- Poor power factor and associated utility demand charges
- High harmonic levels

Ultra-Fast Reactive Power Solution:

- The Hybrid VAR Compensator is ideally suited for power factor correction and voltage sag support in many applications where conventional systems are not suitable:
- One cycle (16.7 ms) or less for full response
- Infinite VAR resolution
- Compensates for large inductive inrush currents
- Transient free compensation
- Improves voltage regulation
- Reduces flicker

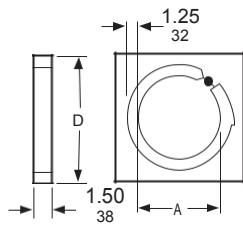
HVC systems can alleviate any of the problems created by cyclical loads that require large amounts of reactive power for short duration.

Unique, cost-effective construction:

HVC systems couple a detuned capacitor system (fixed, contactor or power electronic switched) with the Accusine[®] Electronic VAR Control (EVC) unit. The Accusine EVC is able to inject leading or lagging VARs to provide variable compensation over the operating rating. For example, coupling a 500 kVAR fixed detuned bank with a 300 A Accusine EVC yields an HVC that can provide reactive compensation between 250 kVAR and 750 kVAR.

Round Split-Core CT Selection

Three CTs required for networks with line-neutral loads. Two remote current transformers required for three phase loads. For installations requiring parallel connection of multiple Accusine for increased correction capacity, special considerations may be required. Contact the Square D Power Quality Correction Group for details.



Ampacity	Catalogue No.	Dimensions (IN)		Weight (lbs.)	Accuracy	Burden Capacity	Secondary Current
		A (ID)	D (OD)				
1000	CT1000SC	4.0	6.5	3.5	2%	10 VA	5 A
3000	CT3000SC	6.0	8.5	4.25	2%	45 VA	5 A
5000	CT5000SC	6.0	8.5	4.25	2%	45 VA	5 A

Rectangular CTs also available; contact PQc group.

PFC Selection for Individual Motors

Caution: Avoid placement of standard capacitors in the presence of power electronic loads or on systems where harmonic energies are excessive. Consult local Square D/Exmas international solutions Electric Sales Office for assistance as required.

- Select a capacitor kVAR size from Table 1 to match motor HP and speed. Select a capacitor catalogue number from DE11-2 & DE11-3 to match the kVAR selection and motor voltage. Capacitors selected from Table 1 correct motor PF to approximately 95%.
- Consult Square D/Exmas international solutions Electric Power Quality Correction Group for application of capacitors on motor frame types other than shown by Table 1.
- When capacitors are applied on the load side of the motor overloads, reduce the overload or relay size by the percent (%AR) in Table 1.
- When the motor is controlled by other than full voltage non-reversing across the line starters, locate the capacitor upstream from the controller. **Do not** apply capacitors on the load side of motor starters subject to reversing, inching, jogging or plugging, or that are multi-speed, open transition or solid state, or when the load may drive the motor such as with cranes and elevators.
- Caution is advised in oversizing capacitors when connected on the load side of the motor controller and left to discharge into the motor when turned off. Damaging self excitation voltages may occur if kVAR current is more than motor no-load current.

Suggested Capacitor Ratings (kVAR)

TABLE 1 – Low Voltage T-Frame NEMA Class B Induction Motors

Motor Rating (HP)	Nominal Motor Speed											
	3600 RPM		1800 RPM		1200 RPM		900 RPM		720 RPM		600 RPM	
	Capacitor Rating	% AR	Capacitor Rating	% AR	Capacitor Rating	% AR	Capacitor Rating	% AR	Capacitor Rating	% AR	Capacitor Rating	% AR
3	1.5	14	1.5	23	2.5	28	3	38	3	40	4	40
5	2	14	2.5	22	3	26	4	31	4	40	5	40
7.5	2.5	14	3	20	4	21	5	28	5	38	6	45
10	4	14	4	18	5	21	6	27	7.5	36	8	38
15	5	12	5	18	6	20	7.5	24	8	32	10	34
20	6	12	6	17	7.5	19	9	23	10	29	12	30
25	7.5	12	7.5	17	8	19	10	23	12	25	18	30
30	8	11	8	16	10	19	14	22	15	24	22	30
40	12	12	13	15	16	19	18	21	22.5	24	25	30
50	15	12	18	15	20	19	22.5	21	24	24	30	30
60	18	12	21	14	22.5	17	26	20	30	22	35	28
75	20	12	23	14	25	15	28	17	33	14	40	19
100	22.5	11	30	14	30	12	35	16	40	15	45	17
125	25	10	36	12	35	12	42	14	45	15	50	17
150	30	10	42	12	40	12	52.5	14	52.5	14	60	17
200	35	10	50	11	50	10	65	13	68	13	90	17
250	40	11	60	10	62.5	10	82	13	87.5	13	100	17
300	45	11	68	10	75	12	100	14	100	13	120	17
350	50	12	75	8	90	12	120	13	120	13	135	15
400	75	10	80	8	100	12	130	13	140	13	150	15
450	80	8	90	8	120	10	140	12	160	14	160	15
500	100	8	120	9	150	12	160	12	180	13	180	15

Please note: These tables are to be used for T-Frame NEMA class B induction motors only – Please contact the Square D/Exmas international solutions Electric Power Quality Correction Group for any other applications.

DE11 CAPACITORS

PFC Selection for System or Group Loads

Caution: Avoid placement of standard capacitors in the presence of power electronic loads or on systems where harmonic energies are excessive. Consult Square D/Exmas international solutions Electric for assistance as required.

Use the kW FACTOR TABLE to determine the capacitor kVAR size required to improve PF of a single load or entire power system. Actual power factor, peak kilowatt demand and desired PF is required. A calculation of each month's data for the year is recommended to determine the maximum kVAR required (consult utility company billing data or POWERLOGIC monitoring equipment).

Example: How much kVAR is required to correct an entire 600V system to a .90 power factor when the peak kilowatt demand was 620 kW at a .65 PF.

Use the formula: $kVAR = kW \times kW \text{ FACTOR}$

From the kW FACTOR table, find the FACTOR that applies to a system with an original PF of .65 and desired PF of .90. This FACTOR is read to be .685. Therefore:

$kVAR = 620 \times .685 = 425 \text{ kVAR}$

kW FACTOR TABLE

Original Power Factor	Desired Power Factor																
	.85	.86	.87	.88	.89	.90	.91	.92	.93	.94	.95	.96	.97	.98	.99	1.0	
.51	1.067	1.094	1.120	1.147	1.175	1.203	1.231	1.261	1.292	1.324	1.368	1.395	1.436	1.484	1.544	1.687	
.52	1.023	1.050	1.076	1.103	1.131	1.159	1.187	1.217	1.248	1.280	1.314	1.351	1.382	1.440	1.500	1.643	
.53	0.980	1.007	1.033	1.060	1.088	1.116	1.144	1.174	1.206	1.237	1.271	1.308	1.348	1.397	1.457	1.600	
.54	0.939	0.966	0.982	1.019	1.047	1.075	1.103	1.133	1.164	1.196	1.230	1.267	1.308	1.356	1.416	1.558	
.55	0.898	0.926	0.952	0.979	1.007	1.035	1.063	1.083	1.124	1.156	1.190	1.227	1.268	1.316	1.376	1.519	
.56	0.860	0.887	0.913	0.940	0.968	0.996	1.024	1.054	1.085	1.117	1.151	1.186	1.229	1.277	1.337	1.480	
.57	0.822	0.849	0.875	0.902	0.930	0.958	0.986	1.016	1.047	1.079	1.113	1.150	1.191	1.239	1.299	1.442	
.58	0.785	0.812	0.838	0.865	0.893	0.921	0.949	0.979	1.010	1.042	1.076	1.113	1.154	1.202	1.262	1.405	
.59	0.749	0.776	0.802	0.829	0.857	0.885	0.913	0.943	0.974	1.006	1.040	1.077	1.118	1.166	1.226	1.369	
.60	0.713	0.740	0.766	0.793	0.821	0.849	0.877	0.907	0.938	0.970	1.004	1.041	1.082	1.130	1.190	1.333	
.61	0.679	0.706	0.732	0.759	0.787	0.815	0.843	0.873	0.904	0.936	0.970	1.007	1.048	1.096	1.156	1.299	
.62	0.646	0.673	0.699	0.725	0.754	0.782	0.810	0.840	0.871	0.903	0.937	0.974	1.015	1.063	1.123	1.266	
.63	0.613	0.640	0.666	0.693	0.721	0.749	0.777	0.807	0.838	0.870	0.904	0.941	0.982	1.030	1.090	1.233	
.64	0.581	0.608	0.634	0.661	0.689	0.717	0.745	0.775	0.806	0.838	0.872	0.909	0.950	0.998	1.068	1.201	
.65	0.549	0.576	0.602	0.629	0.657	0.685	0.713	0.743	0.774	0.806	0.840	0.877	0.918	0.966	1.026	1.169	
.66	0.518	0.545	0.571	0.598	0.626	0.654	0.682	0.712	0.743	0.775	0.809	0.846	0.887	0.935	0.995	1.138	
.67	0.488	0.515	0.541	0.568	0.596	0.624	0.652	0.682	0.713	0.745	0.779	0.816	0.857	0.905	0.965	1.108	
.68	0.458	0.485	0.511	0.538	0.566	0.594	0.622	0.652	0.683	0.715	0.749	0.785	0.827	0.875	0.935	1.078	
.69	0.429	0.456	0.482	0.509	0.537	0.565	0.593	0.623	0.654	0.686	0.720	0.757	0.796	0.846	0.906	1.049	
.70	0.400	0.427	0.453	0.480	0.508	0.536	0.564	0.594	0.625	0.657	0.691	0.728	0.769	0.817	0.877	1.020	
.71	0.372	0.399	0.425	0.452	0.480	0.508	0.536	0.566	0.597	0.629	0.663	0.700	0.741	0.789	0.849	992	
.72	0.344	0.371	0.397	0.424	0.452	0.480	0.508	0.538	0.569	0.601	0.635	0.672	0.713	0.761	0.821	964	
.73	0.316	0.343	0.369	0.396	0.424	0.452	0.480	0.510	0.541	0.573	0.607	0.644	0.685	0.733	0.793	936	
.74	0.289	0.316	0.342	0.369	0.397	0.425	0.453	0.483	0.514	0.546	0.580	0.617	0.658	0.706	0.766	909	
.75	0.262	0.289	0.315	0.342	0.370	0.396	0.426	0.458	0.487	0.519	0.553	0.590	0.631	0.679	0.739	882	
.76	0.235	0.262	0.288	0.315	0.343	0.371	0.399	0.429	0.460	0.492	0.526	0.563	0.604	0.652	0.712	855	
.77	0.209	0.236	0.262	0.289	0.317	0.345	0.373	0.403	0.434	0.466	0.500	0.537	0.578	0.626	0.686	829	
.78	0.182	0.209	0.235	0.262	0.290	0.318	0.346	0.376	0.407	0.439	0.473	0.510	0.551	0.599	0.659	802	
.79	0.156	0.183	0.209	0.236	0.264	0.292	0.320	0.350	0.381	0.413	0.447	0.484	0.525	0.573	0.633	776	
.80	0.130	0.157	0.183	0.210	0.236	0.266	0.294	0.324	0.365	0.387	0.421	0.458	0.499	0.547	0.609	750	

ReactiVar[®] Dry Power Factor Correction Capacitors

Class 5810, 5830, 5860

When contacting the Power Quality Correction Group for application assistance, please have the following information available:

- Transformer(s) Size: _____ kVA (Note, indicate multiple transformers)
- Percent Impedance: _____ %Z
- Transformer Primary: _____ V
- Transformer Secondary: _____ V
- Primary Fault Current: _____ kA
- 12 months utility billing information
- Major Loads, **including existing capacitors** (fill in table below):

Feeder ID	Ampacity	Linear Loads (kVA)	Non-linear Loads
e.g.: Feeder 1	600 A	150 HP FVNR	50 HP VFD's
Feeder 2	800 A	450 HP FVNR	200 kW Welding
		100 A Lighting (HID)	
Feeder 3	1000 A	50 kVAR Capacitor	800 A Injection Molding

- Include a simple one-line diagram of the network indicating major loads:

It is usually necessary to measure the network when multiple substations are involved. The reason is that harmonic currents can flow from one substation to another in response to changes in the network impedance brought on by the installation of power factor capacitors. In cases such as this, contact the PQc group for assistance.

**Fax completed form to: Power Quality Correction Group
(905) 678-5979**

Your Name: _____

Job Name: _____ Q2C#: _____

Location: _____

Telephone: _____ Fax: _____