



Delta PQC Series Power Quality Solution

Active Power Filter (APF)

Static VAR Generator (SVG)

www.deltaww.com | www.deltapowersolutions.com

The power behind competitiveness



About Delta Group

Leading expert in power management and thermal management solutions

Delta, founded in 1971, is a global leader in switching power supplies and thermal management products with a thriving portfolio of smart energy-saving systems and solutions in the fields of industrial automation, building automation, telecom power, data center infrastructure, EV charging, renewable energy, energy storage and display, to nurture the development of smart manufacturing and sustainable cities. As a world-class corporate citizen guided by its mission statement, “To provide innovative, clean and energy-efficient solutions for a better tomorrow,” Delta leverages its core competence in high-efficiency power electronics and its CSR-embedded business model to address key environmental issues, such as climate change. Delta serves customers through its sales offices, R&D centers and manufacturing facilities spread over close to 200 locations across 5 continents.

Delta's Manufacturing

The Delta Group's operations are global in scale with 45 manufacturing facilities in Taiwan, China, Thailand, India, Mexico, Brazil and Slovakia. We also have 74 R&D centers across the globe and 171 sales offices on all 5 continents.



Delta's Green Business

Delta was nominated as one of the “Global Top 100 Low-Carbon Emission Enterprises” by the CNBC European Business Magazine.

Delta has won the “Corporate Social Responsibility Award and Honorary Award” from Global Views Magazine for four consecutive years.

Delta has won the “Corporate Citizenship Award” from Common Wealth Magazine for three consecutive years.

Delta Group’s mission statement, “To provide innovative, clean and energy-efficient solutions for a better tomorrow”, focuses on social responsibility and represents Delta’s confidence in putting advanced technology into practice on behalf of sustainability.

Delta Group’s president has said, “If Delta’s power efficiency is improved by just 1%, there can be fewer power plants in the world.”

Delta's Technology

Global Top 500 in Research and Development

Investing 5% of its annual operating revenues in R&D, Delta Group ranked No. 431 in a world ranking by the Department of Trade and Industry, United Kingdom.

The IEEE selects the three best theses every year to honor outstanding contributions to the academic fields of electrical and electronics engineering.

In September 2009, Delta’s thesis “Performance Evaluation of Bridgeless PFC Boost Rectifiers” stood out from 313 other theses and won the best thesis award issued by Prof. Deepak Divan, the IEEE Chairman, who presented the best thesis award to Milan M. Jovanovi, the manager of Delta’s R&D center in USA.



Power Quality and Harmonics

Power Quality Issues Overview

Power quality determines the suitability of electric power for consumer devices. There are three main contributors to low voltage and poor power quality problems:

- Harmonic Pollution causes extra stress on a power supply system and reduces reliability.
- Reactive Power loads the power supply system unnecessarily.
- Load Imbalance increases neutral current and neutral to earth voltage.

Harmonics

Normally, power system generators produce a clean sinusoidal voltage waveform at their terminals. However, a lot of modern electronic equipment such as VFDs, UPSs, LEDs, battery chargers, and other equipment powered by switched-mode power supply (SMPS) equipment, generates non-sinusoidal current injected into the power system, which causes electrical harmonic pollution.



Harmonics Standard

Based on “IEEE Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems” (IEEE std 519-2014) , the grid voltage distortion limits:

Bus Voltage V at PCC	Individual harmonics (%)	Total harmonics distortion THD (%)
$V \leq 1.0 \text{ kV}$	5.0	8.0
$1 \text{ kV} < V \leq 69 \text{ kV}$	3.0	5.0
$69 \text{ kV} < V \leq 161 \text{ kV}$	1.5	2.5
$161 \text{ kV} < V$	1.0	1.5

Current Distortion Limits for Systems Rated 120V through 69kV

Maximum Harmonic Current Distortion in Percent of I_L						
Individual Harmonic Order (Odd Harmonics)						
I_{SD}/I_L	$3 \leq h < 11$	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h < 50$	TDD
$< 20^*$	4.0	2.0	1.5	0.6	0.3	5.0
$20 < 50$	7.0	3.5	2.5	1.0	0.5	8.0
$50 < 100$	10.0	4.5	4.0	1.5	0.7	12.0
$100 < 1000$	12.0	5.5	5.0	2.0	1.0	15.0
> 1000	15.0	7.0	6.0	2.5	1.4	20.0

Even harmonics are limited to 25% of the odd harmonic limits above.

Current distortion that results in a DC offset, such as half-wave converters, are not allowed.

* All power generation equipment is limited to these values of current distortion, regardless of actual I_{SD}/I_L .

where

I_{SC} = maximum short-circuit current at PCC.

I_L = maximum demand load current (fundamental frequency component) at the PCC under normal load operating conditions.

Reactive Power

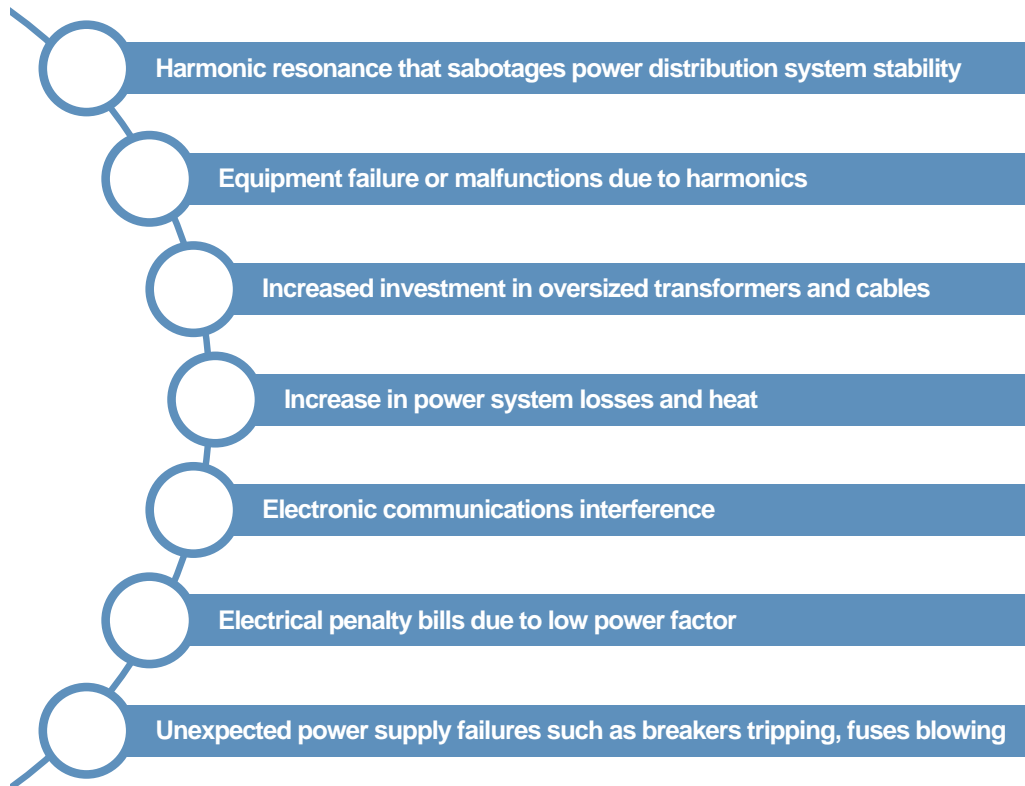
In most cases, reactive power is the power that magnetic equipment such as transformers, motors and relays, needs to produce magnetizing flux, which is inductive. In some cases, long distance power cables and some loads generate capacitive reactive power. Both inductive and capacitive reactive power will increase the apparent power (kVA), demanding larger transformers and cable size.

Load Imbalance

Every three-phase current can be divided into positive, negative and zero sequences. Negative and zero sequences cause load imbalance.

Power Quality Problems

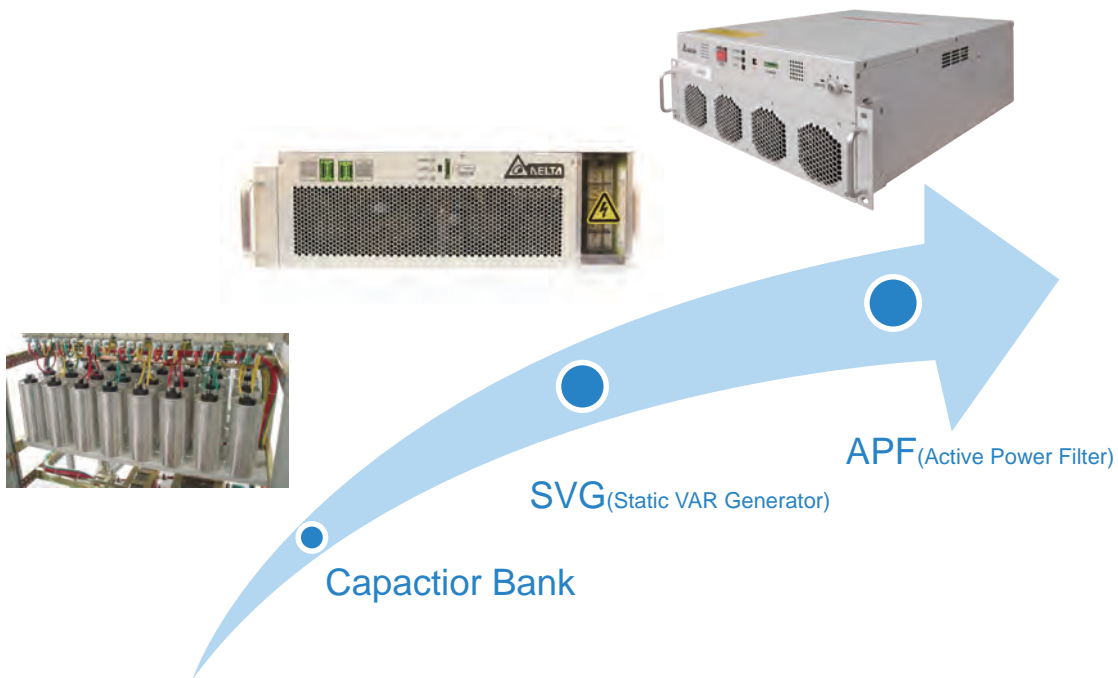
Poor Power Quality can be described as any event related to the electrical network that ultimately results in a financial loss. Possible consequences of poor Power Quality include:



Delta Power Quality Solution Evolution

Delta PQC series 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.

Compared with conventional passive compensation solutions such as capacitor banks, an active compensation solution improves the reliability and quality of the power distribution system.



Comparison between Capacitor Bank, SVG and APF

Item	Capacitor Bank	SVG	APF
Harmonic Filtering	Unavailable	Unavailable	Eliminate 2 nd ~50 th harmonics (selectable)
Reactive Power Compensation	Discretely compensate inductive reactive power only	Steplessly compensate both inductive and capacitive reactive power	Steplessly compensate both inductive and capacitive reactive power
Imbalance Correction	Unavailable	Available	Available
Response Speed	slow, can't track dynamic reactive power (20 ms ~ 5 s)	fast, can track dynamic reactive power (< 0.1 ms)	fast, can track dynamic harmonic & reactive loads (< 0.1 ms)
Harmonic Resonance Problem	Potential resonance between capacitor and transformer sabotages power system stability.	Active compensation technology avoids harmonic resonance from the principle.	Active compensation technology avoids harmonic resonance from the principle.
Output Ability	Actual output capacity is less than the rated capacity.	Actual output capacity is the same as rated capacity.	Actual output capacity is the same as rated capacity.

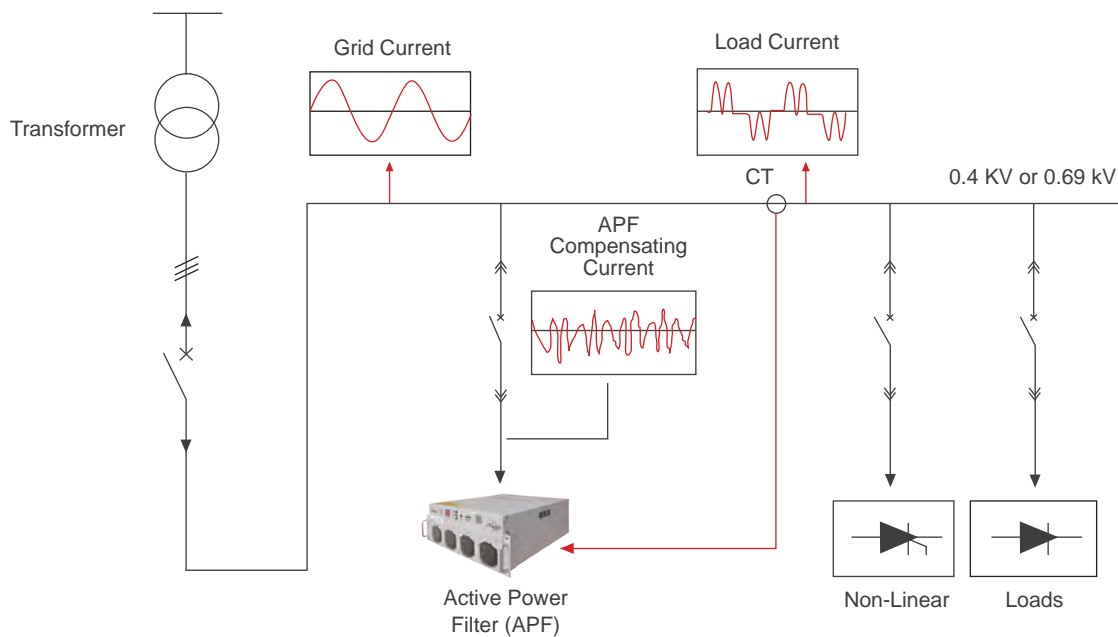
Delta PQC Series Active Power Filter (APF)

APF Principle

Delta's PQC Series APF is connected in parallel with non-linear loads, and uses one set of current transformers (CT) to detect the load current. It calculates each order harmonic current by FFT algorithms in its DSP microchips, and then generates a compensating current with the same amplitude but opposite phase angles to the detected harmonic current, which cancels out the original load harmonics.

The PQC series APF not only eliminates harmonic current from the load side, but it also mitigates harmonic voltage caused by harmonic currents. The APF system can also improve power factor (PF) and correct load imbalances in the power system.

Note: CT is a critical part of the APF system, and it can be purchased by users themselves, following Delta's suggestions on CT specification.



APF Structure

Delta PQC Series APF has a modular design, which adopted 3-level inverter topology with 12 pcs discrete IGBT and DC capacitor components. The Delta Active Power Filter system consists of one or several APF modules and a display. There are two types of displays, one is Touch Panel Human Machine Interface (HMI), which is touch-screen type, and the other one is non-touch-screen type, call Liquid Crystal Monitor (LCM).

Each APF module is an independent harmonic filtering system, and users can change the harmonic filtering system rating by adding or removing APF modules.

According to the mounting type, Delta PQC series APF can be divided into Modular APF (rack mounting) and wall-mounted APF.

APF Module and Cabinet Solutions

According to cable terminal type, a modular APF can be divided into two types:

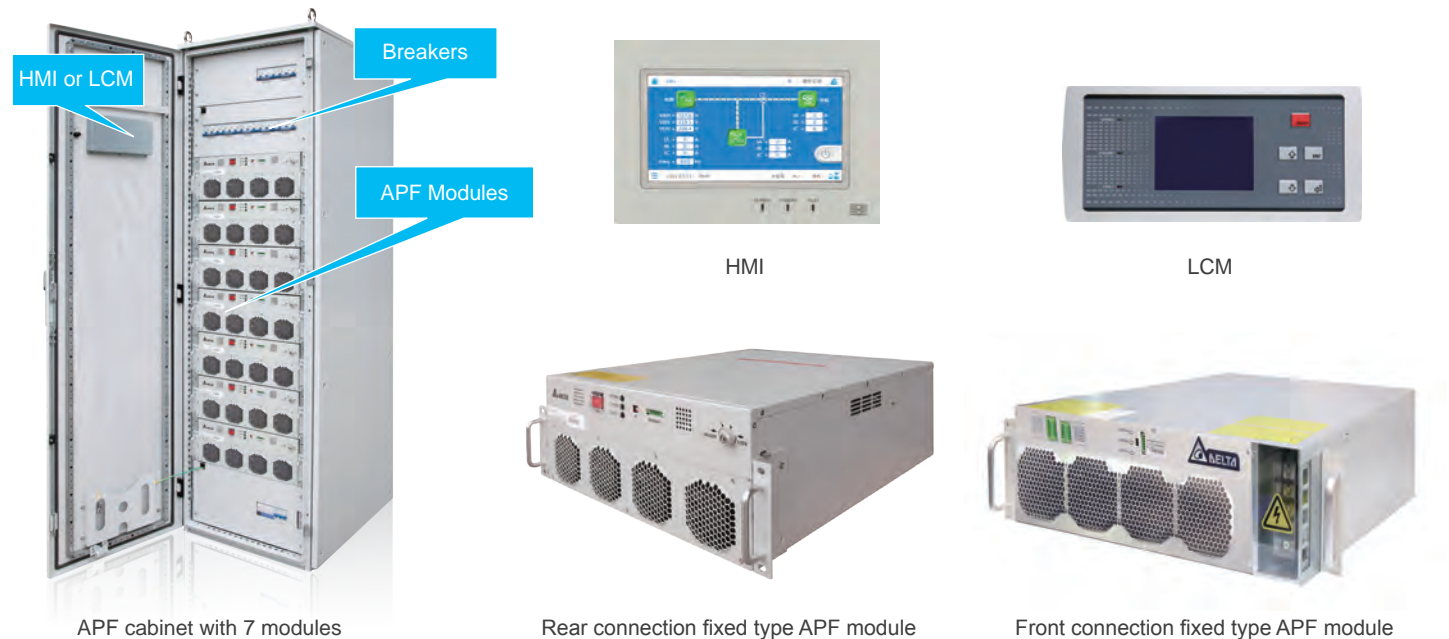
- Drawer type modular APF (hot-swappable)
- Fixed type modular APF (not hot-swappable)

Fixed type module contains front connection type module (Power cables and signal cables are fixed from front side) and Rear connection type module (Power cables and signal cables are fixed from rear side).

Control panel has two types:

- LCM • HMI

APF modules and a control panel can be embedded in Delta's standard APF cabinet or a customized cabinet. There are breakers, cable terminals and Surge Protection Device (SPD) in the APF cabinet. Delta can supply IP30, IP42, IP54 or customized solutions.



Wall-mounted APF Solutions

Delta's wall-mounted APF can be installed on a wall, which is suitable for low rating applications, and wall-mounted type HMI/LCM can be installed on the wall-mounted APF module, along with a mounting bracket to provide support and protection. Delta can supply IP30, IP42, IP54 or customized solutions.



APF Compensation Performance

Delta's PQC Series APF can perfectly mitigate harmonic current, and suppress harmonic voltage caused by the harmonic current. When the APF capacity is sufficient and background harmonic voltage is low, the APF ensures excellent compensation performance at full load condition, as below.

- THDu (Total Harmonic Distortion of Voltage) < 3%
- THDi (Total Harmonic Distortion of Current) < 5%
- PF (Power Factor) ≥ 0.99 (improves both leading and lagging PF)
- Neutral Current Attenuation Ratio ($\frac{I_{N(\text{Before})} - I_{N(\text{After})}}{I_{N(\text{Before})}}$) > 95%

Delta's PQC Series APF Actual Compensation Performance



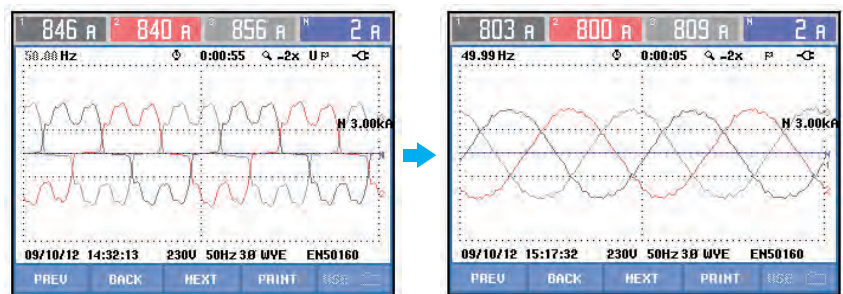
Application: Textile Industry

Non-linear Loads: Variable Frequency Drive (VFD).

Compensation Result: Current harmonic distortion (THDi) was reduced from 32.5% to 2.9%.

Current waveform and spectrum are recorded by Fluke 435, as below.

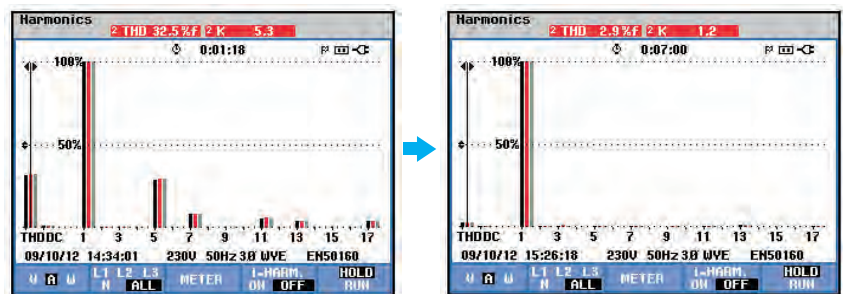
Current Waveform



BEFORE

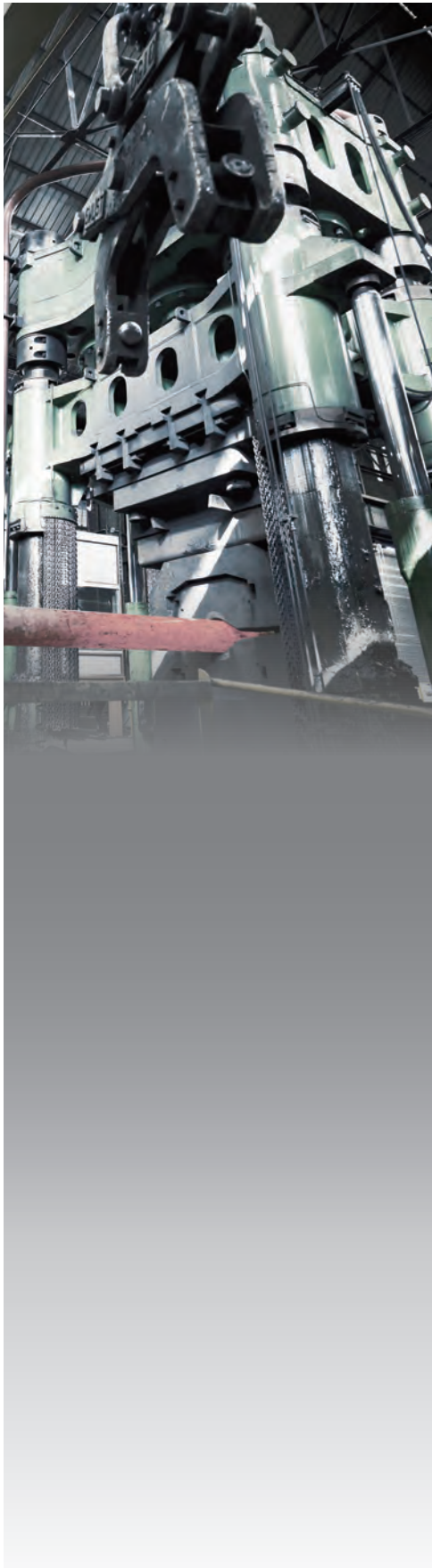
AFTER

Current Spectrum



BEFORE

AFTER



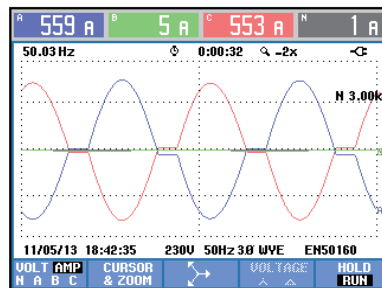
Application: Foundry Industry

Non-linear Loads: Electric Welder

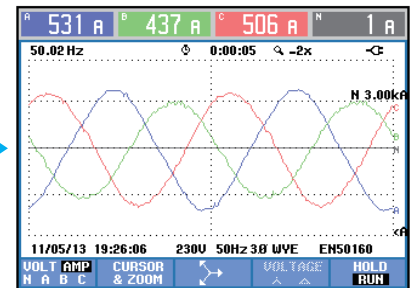
Compensation Result: Current harmonic distortion (THDi) was reduced from 70% to 4.4%, load imbalance was reduced from 102% to 6.1%.

Current waveform and spectrum are recorded by Fluke 435, as below.

Current Waveform



BEFORE



AFTER

Current Spectrum

HARMONICS TABLE				
	A	B	C	N
THD%f	70.0	16.6	69.3	49.0
H3%f	61.1	17.0	60.6	26.9
H5%f	16.9	5.0	16.7	16.3
H7%f	6.2	1.8	6.1	10.9
H9%f	6.0	1.8	6.0	8.8
H11%f	1.4	1.1	1.4	7.3
H13%f	3.0	0.6	3.0	6.1
H15%f	0.9	0.5	0.9	4.9

BEFORE

HARMONICS TABLE				
	A	B	C	N
THD%f	4.4	3.3	3.9	111.1
H3%f	3.1	1.5	2.2	43.0
H5%f	0.9	1.2	0.4	35.9
H7%f	0.3	1.1	0.5	18.1
H9%f	0.1	0.3	0.3	10.3
H11%f	0.5	0.2	0.4	9.0
H13%f	0.2	0.8	0.2	6.8
H15%f	0.2	0.4	0.3	8.3

AFTER

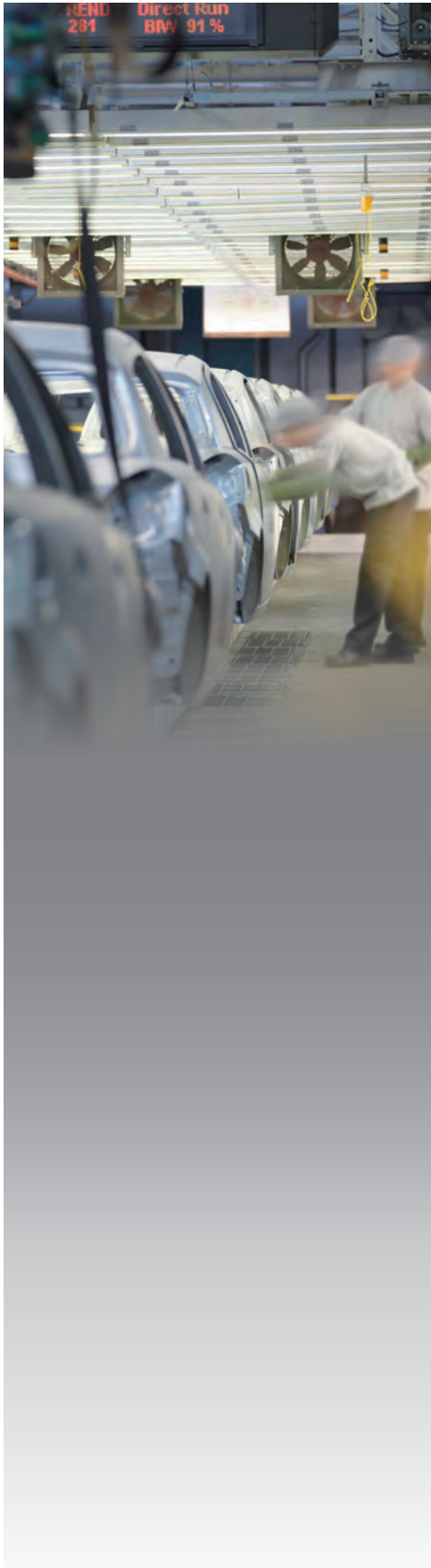
Load Unbalance

Unbalance				
	Unbal. (%)	Unbal. (%)	Unbal. (%)	Unbal. (%)
Unbal. (%)	0.9	0.0	102	0.5
Ufund	233.4	235.6	231.8	1.8
Hz	50.035			
φU(°)	0.0	-120.7	-240.9	-224.5
φI(°)	-106.3	-43.2	-285.7	-312.7
RIfund	552	8	551	0

BEFORE

Unbalance				
	Unbal. (%)	Unbal. (%)	Unbal. (%)	Unbal. (%)
Unbal. (%)	0.3	0.1	6.1	1.5
Ufund	234.1	234.2	233.1	1.9
Hz	50.034			
φU(°)	0.0	-120.3	-240.3	-221.9
φI(°)	-76.0	-199.0	-313.1	-90.6
RIfund	432	385	405	0

AFTER



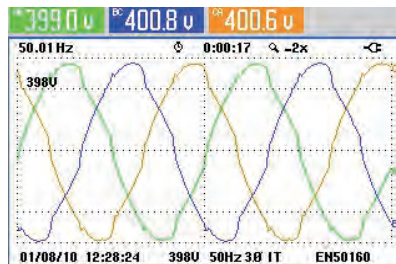
Application: Automobile Industry

Non-linear Loads: Thyristor driven heater

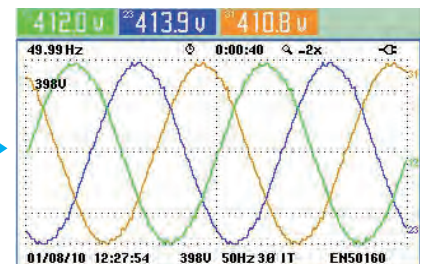
Compensation Result: Voltage harmonic distortion (THDu) was reduced from 5.5% to 1.3%.

Voltage waveform and spectrum are recorded by Fluke 435, as below.

Voltage Waveform



BEFORE



AFTER

Voltage Spectrum

HARMONICS TABLE			
Volt	FB	BC	CA
THD%	5.3	5.5	5.5
H3%	0.3	0.2	0.1
H5%	3.9	3.9	3.9
H7%	2.8	3.1	3.0
H9%	0.1	0.0	0.0
H11%	1.1	1.2	1.2
H13%	1.3	1.4	1.4
H15%	0.1	0.1	0.1
01/08/10 12:28:43 398U 50Hz 3Ø IT EN50160			

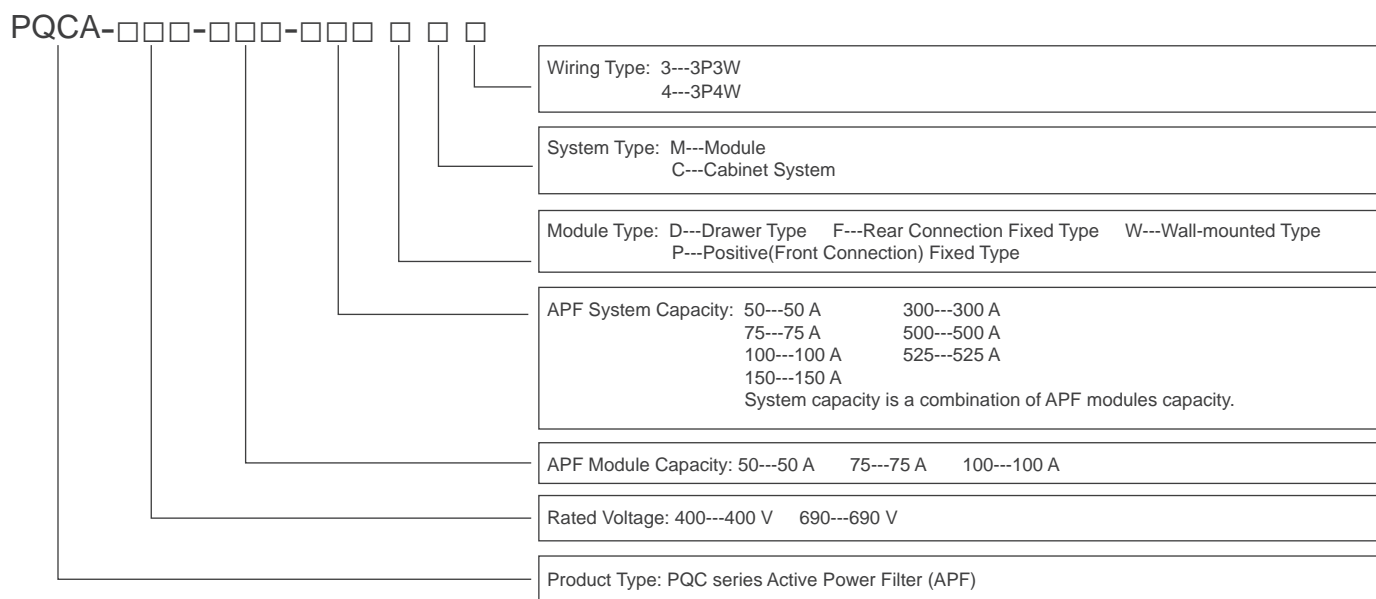
BEFORE

HARMONICS TABLE			
Volt	L12	L23	L31
THD%	1.3	1.3	1.2
H3%	0.2	0.2	0.1
H5%	0.5	0.3	0.4
H7%	0.2	0.3	0.2
H9%	0.1	0.0	0.1
H11%	0.4	0.3	0.2
H13%	0.1	0.2	0.1
H15%	0.0	0.0	0.0
01/08/10 02:18:05 398U 50Hz 3Ø IT EN50160			

AFTER

Delta PQC Series APF System Selection

PQC Series APF Naming Rule



Delta PQC Series APF Features

- Multifunctional: Harmonic, reactive power and imbalance compensation
- High harmonic filtering rate: Up to 98%
- Excellent reactive compensation: High speed, Precise ($-0.99 \leq \text{PF} \leq 0.99$), Step-less, Bi-directional (capacitive and inductance) compensation
- Excellent imbalance correction: Both negative and zero sequence, mitigates neutral current
- Wide input voltage & frequency range, adapts to tough electrical environments
- Low thermal loss ($\leq 3\%$ of rated APF kVA), efficiency $\geq 97\%$
- High stability: Infinite impedance to grid, avoids harmonic resonance problems
- Flexible application: Modular design, embedded in standard or customized cabinet
- Easy installation and maintenance: Plug-in installation for APF module replacement and expansion
- Wide capacity range: 50~700 A for a single cabinet, up 10 cabinets in parallel
- Wide working temperature:
 - 10~55°C temperature for Rear connection type, de-rating running from 50~55°C
 - 25~55°C temperature for Front connection type, de-rating running from 40~55°C
- Environmental adaptability: Withstand 15% voltage distortion, compatible with diesel generator
- Complete protection: Grid Over/Under voltage, APF over current, over temperature, and more. All faults are recorded in the event log, which is convenient for failure analysis

PQC Series APF Model

APF System Type	Structure	Model Name	APF Capacity	Dimension (WxDxH)	Weight (kg)
Independent Module System	Wall-mounted	PQCA-400-50-50WC4	50 A	440x176x593 mm	30
		PQCA-400-100-100WC3(4)	100 A	700x195x800 mm	75
	Drawer Type Modular	PQCA-400-50-50DM3(4)	50 A	440x522x174 mm	30
		PQCA-400-75-75DM3(4)	75 A	440x522x174mm	42
	Fixed Type Modular	PQCA-400-50-50FM3(4)	50 A	440x522x174 mm	30
		PQCA-400-75-75FM3(4)	75 A	440x522x174 mm	42
		PQCA-400-100-100PM3(4)	100 A	600x606x190 mm	53
		PQCA-400-100-100FM3(4)	100 A	600x725x220 mm	65
		PQCA-690-100-100FM3	100 A	605x761x270 mm	78
Cabinet System (Multiple Modules)	Fixed Type Cabinet	PQCA-400-50-100DC3(4)	100 A	600x800x2000 mm	275
		PQCA-400-75-150DC3(4)	150 A	600x800x2000 mm	295
		PQCA-400-75-225DC3(4)	225 A	600x800x2000 mm	350
		PQCA-400-75-525DC3(4)	525 A	600x800x2000 mm	570
		PQCA-400-50-100FC3(4)	100 A	600x800x2000 mm	255
		PQCA-400-75-150FC3(4)	150 A	600x800x2000 mm	275
		PQCA-400-100-200PC3(4)	200 A	800x1000x2000 mm	325
		PQCA-400-100-200FC3(4)	200 A	800x1000x2000 mm	350
		PQCA-400-75-225FC3(4)	225 A	600x800x2000 mm	320
		PQCA-400-100-300PC3(4)	300 A	800x1000x2000 mm	380
		PQCA-400-100-300FC3(4)	300 A	800x1000x2000 mm	415
		PQCA-400-75-375FC3(4)	375 A	600x800x2000 mm	410
		PQCA-400-100-400PC3(4)	400 A	800x1000x2000 mm	435
		PQCA-400-100-400FC3(4)	400 A	800x1000x2000 mm	480
		PQCA-400-100-500PC3(4)	500 A	800x1000x2000 mm	490
		PQCA-400-100-500FC3(4)	500 A	800x1000x2000 mm	545
		PQCA-690-100-300FC3	300 A	800x1000x2000 mm	460
		PQCA-690-100-400FC3	400 A	800x1000x2000 mm	540
		PQCA-690-100-500FC3	500 A	800x1000x2000 mm	620

Delta PQC Series APF Technical Specification

Electrical Specification	Rated Voltage	AC 400V		AC 690V
	Input Voltage Range	AC 308~456 V	AC 308~480 V	AC 384V~880 V
	Electric Connection	3P4W	3P3W	3P3W
	Rated Frequency	50(60) Hz $\pm 10\%$		
	Input Voltage THD Range	$\leq 15\%$		
	Rated Current per Module	50 A	75 A	100 A
	Rated Current per Cabinet	50~700 A (module combination)		100~500 A (module combination)
	Redundancy	Each module is an independent filtering system		
	Harmonic Elimination Range	2 nd ~ 50 th order (Selectable)		2 nd ~ 31 st order (Selectable)
	Harmonic Filtering Degree	0 ~ 100% programmable per harmonic in Ampere value		
	Harmonic Filtering Performance	Filter up to 98% harmonics at rated load, THDv < 3%, THDi < 5% after filtering (Precondition: The grid background THDv shall be less than 1% under no-load condition.)		
	Reactive Power Compensation Capability	Both inductive and capacitive reactive power		
	Reactive Power Compensation Performance	PF ≥ 0.99 after compensation (if the APF capacity is sufficient)		
	Imbalance Correction Capability	Mitigate negative and zero sequence		Mitigate negative sequence
	Full Response time	< 20 ms		
	Instant Response time	< 100 μ s		
	Thermal Loss	$\leq 3\%$ of APF rated capacity (kVA)		
	Output Current Limitation	Automatic (100% rated capacity)		
	Parallel Expansion(System)	Up to 10 Racks (7 modules per cabinet)		
	MTBF	> 100,000 hours		
Control Technology	Switching Frequency	60 kHz	30 kHz	30 kHz
	Controller	DSP control		
	Communication	Modbus RTU (RS-485), Modbus TCP/IP (Ethernet)		
Physical Specification	IP Grade of Cabinet	IP20, IP30, IP42, IP54 or customization		
	Cooling method	Intelligent forced air cooling		
	Noise Level	< 65 dB(A) @1m (Module)		< 70 dB(A) @1m (Module)
	Dust Filter	Optional		
	Dimension	Refer to APF Model table		
	Weight	Refer to APF Model table		
Environmental Requirement	Ambient Temperature	Rear connection type: -10~50°C with 100% capacity, de-rating running from 50~55°C Front connection type: -25~40°C with 100% capacity, de-rating running from 40~55°C		
	Relative Humidity	0~95% (No condensation)		
	Altitude	≤ 1000 m rated capacity, 1000~2000 m (derating 1% per 100 m)		

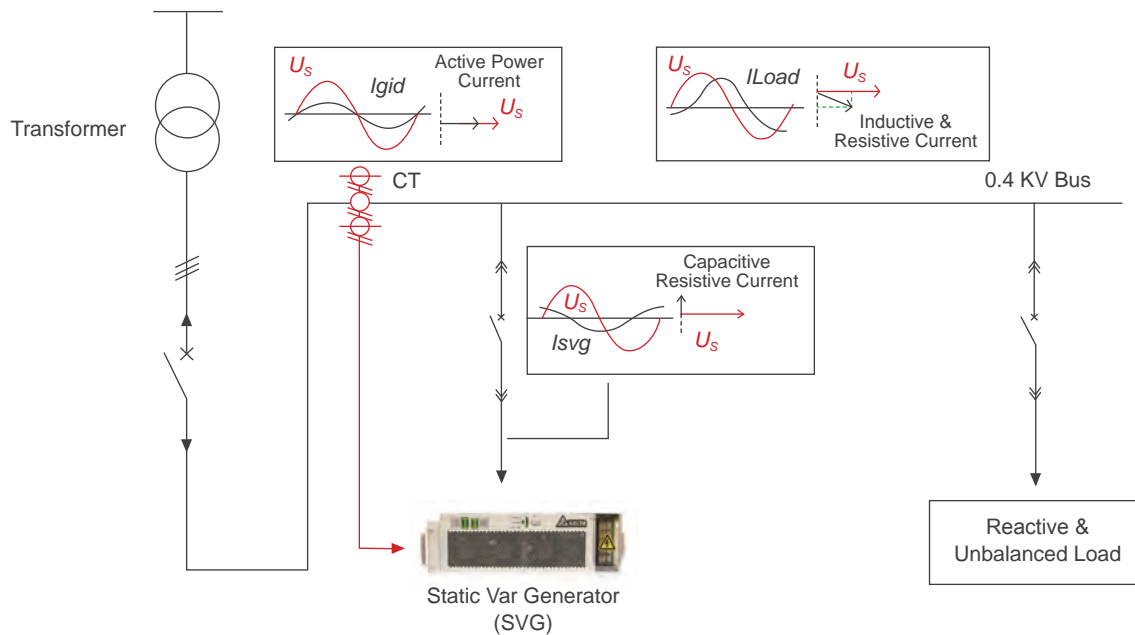
Delta PQC series Static Var Generator (SVG)

SVG Principle

The principle of the SVG is very similar to that of Active Power Filter, as demonstrated in the picture below. When the load is generating inductive or capacitive current, it makes load current lagging or leading the voltage. SVG detects the phase angle difference and generates leading or lagging current into the grid, making the phase angle of current almost the same as that of voltage on the transformer side, which means fundamental power factor is unit.

Delta's PQC series SVG is also capable of correcting load imbalance.

Note: CT is a critical part of the SVG system, and it can be purchased by users themselves, following Delta's suggestions on CT specification.



SVG Operating Mode	Waveform and Vector	Remark
No Load Mode	<p>SVG Outputs on Current</p> <p>(a) $U_i = U_s$</p>	$U_i = U_s$, $I_{svg} = 0$, SVG outputs no reactive current.
Capacitive Mode	<p>Leading Current</p> <p>(b) $U_i > U_s$</p>	$U_i > U_s$, I_{svg} is leading the voltage, and its amplitude is continuously adjustable.
Inductive Mode	<p>Lagging Current</p> <p>(c) $U_i < U_s$</p>	$U_i < U_s$, I_{svg} is lagging the voltage, and its amplitude is continuously adjustable.

SVG Structure

Delta PQC Series SVG is also in modular structure, which adopted 3-level inverter topology with 12 pcs discrete IGBT and DC capacitor components and the Delta SVG system consists of one or several SVG modules and a display. There are two types of displays, one is Touch Panel Human Machine Interface (HMI), which is touch-screen type, and the other one is non-touch-screen type, call Liquid Crystal Monitor (LCM).

SVG's HMI or LCM can be shared with Delta APF modules.

Each SVG module is an independent reactive power compensation system, and users can change the SVG rating by adding or removing SVG modules.

SVG Module and Cabinet Solutions

Fixed type modular SVG module contains Front connection type module (Power cables and Signal cables are fixed from Front side) and Rear connection type module (Power cables and Signal cables are fixed from rear side).

Control panel has two types:

- LCM
- HMI

SVG modules and a control panel can be embedded in Delta's standard APF cabinet or a customized cabinet. There are breakers, cable terminals and Surge Protection Device (SPD) in the SVG cabinet. Delta can supply IP30, IP42, IP54 or customized solutions.



SVG cabinet



Rear connection fixed type SVG module



Front connection fixed type SVG module

Wall-mounted SVG

Delta's Wall-mounted SVG can be installed on a wall, which is suitable for low rating applications, and wall-mounted type HMI/LCM can be installed on the wall-mounted SVG module, along with a mounting bracket to provide support and protection. Delta can supply IP30, IP42, IP54 or customized solutions.



Combined wall-mounted
IP30 50kvar SVG system



Integral wall-mounted
IP30 100kvar SVG system



Wall-mounted IP54 SVG system

SVG Compensation Performance

Delta's PQC Series SVG can rapidly and continuously compensate both inductive and capacitive reactive power, and correct load imbalance. With sufficient capacity, the SVG ensures excellent fundamental power factor improvement performance.

- Fundamental Power Factor ($\cos\phi$) ≥ 0.99 (improves both leading and lagging PF)

Delta's PQC Series SVG Actual Compensation Performance



Application: Harbor

Loads: Inductive Motors.

Compensation Results: Fundamental Power Factor (Cosφ) was improved from 0.82 to 0.99, current RMS value was reduced from 1335 A to 1116 A (around 16%).

Power and Energy were recorded by Fluke 435, as below.

Power and Energy

Power & Energy				
FUND	A	C	0:00:05	0:00:05
kW	254.8	253.6	256.3	764.8
kVA	307.8	310.9	313.4	932.1
kVAR	172.7	179.8	180.3	532.8
PF	0.81	0.80	0.80	0.81
Cosφ	0.83	0.82	0.82	
Arms	1335	1349	1362	
Urms	233.23	233.06	232.90	
09/19/12 14:21:26 230V 50Hz 3Φ WYE ENS0160				
PREV	BACK	NEXT	PRINT	ESC

BEFORE

Power & Energy				
FUND	A	C	0:00:04	0:00:04
kW	258.2	260.3	263.2	781.7
kVA	261.3	264.1	266.7	792.1
kVAR	40.2	44.7	43.2	128.1
PF	0.97	0.97	0.97	0.97
Cosφ	0.99	0.99	0.99	
Arms	1116	1128	1142	
Urms	236.72	236.68	236.49	
09/19/12 16:14:31 230V 50Hz 3Φ WYE ENS0160				
VOLTAGE	ENERGY	TREND	HOLD	RUN

AFTER



Application: Petrochemical Industry

Loads: Inductive Motors

Compensation Result: Fundamental Power Factor (Cosφ) was improved from 0.44 to 0.98, current RMS value was reduced from 2436 A to 1289 A (around 47%).

Power and Energy were recorded by Fluke 435, as below.

Power and Energy

Power & Energy				
FUND	L1	L2	L3	Total
kW	248.6	241.7	253.9	744.2
kVA	533.2	544.9	548.9	1627
kVAR	471.8	488.3	486.7	1447
PF	0.47	0.45	0.47	0.46
Cosφ	0.47	0.44	0.46	
Arms	2385	2418	2436	
Urms	223.80	225.55	225.48	
04/14/13 16:53:01 230V 50Hz 3Φ WYE ENS0160				
VOLTAGE	ENERGY	TREND	HOLD	RUN

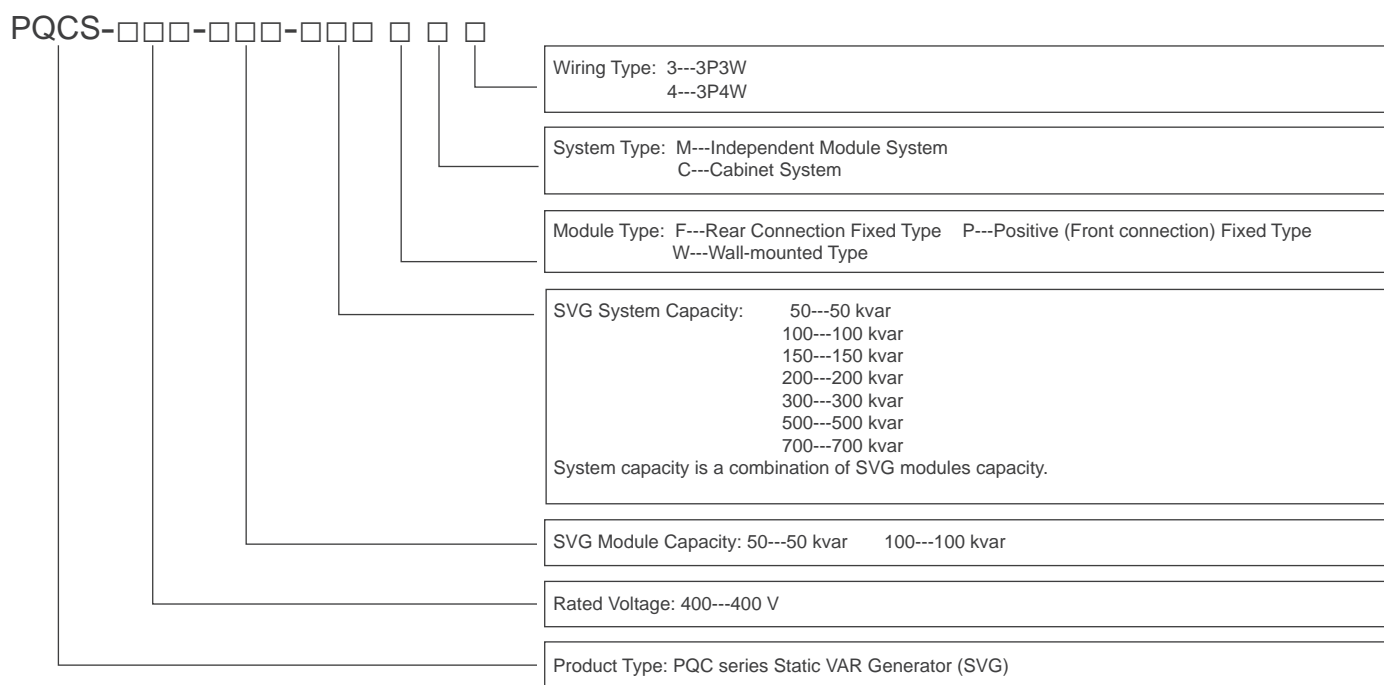
BEFORE

Power & Energy				
FUND	L1	L2	L3	Total
kW	273.2	276.2	282.8	832.3
kVA	281.5	283.1	290.4	854.9
kVAR	67.6	61.8	65.9	195.3
PF	0.97	0.97	0.97	0.97
Cosφ	0.97	0.98	0.97	
Arms	1251	1267	1289	
Urms	225.33	223.80	225.62	
04/17/13 00:40:05 230V 50Hz 3Φ WYE ENS0160				
VOLTAGE	ENERGY	TREND	HOLD	RUN

AFTER

Delta PQC Series SVG System Selection

PQC Series SVG Naming Rule



PQC Series SVG Model

SVG System Type	Structure	Model Name	SVG Capacity	Dimension (WxDxH)	Weight (kg)
Independent Module System	Wall-mounted	PQCS-400-50-50WC4	50 kVar	440×176×593 mm	30
		PQCS-400-100-100WC3(4)	100 kVar	700×195×800 mm	75
	Fixed Type Modular	PQCS-400-50-50FM3(4)	50 kVar	440×522×174 mm	30
		PQCS-400-100-100PM3(4)	100 kVar	600×606×190 mm	53
Cabinet System (Multiple Modules)	Fixed Type Cabinet	PQCS-400-50-100FC3(4)	100 kVar	600×800×2000 mm	255
		PQCS-400-50-150FC3(4)	150 kVar	600×800×2000 mm	290
		PQCS-400-50-200FC3(4)	200 kVar	600×800×2000 mm	325
		PQCS-400-50-250FC3(4)	250 kVar	600×800×2000 mm	360
		PQCS-400-50-300FC3(4)	300 kVar	600×800×2000 mm	395
		PQCS-400-50-350FC3(4)	350 kVar	600×800×2000 mm	430
		PQCS-400-100-200PC3(4)	200 kVar	800×1000×2000 mm	325
		PQCS-400-100-300PC3(4)	300 kVar	800×1000×2000 mm	380
		PQCS-400-100-400PC3(4)	400 kVar	800×1000×2000 mm	435
		PQCS-400-100-500PC3(4)	500 kVar	800×1000×2000 mm	490
		PQCS-400-100-600PC3(4)	600 kVar	800×1000×2000 mm	545
		PQCS-400-100-700PC3(4)	700 kVar	800×1000×2000 mm	600

Delta PQC Series SVG Features

- Multifunctional: Reactive power and imbalance compensation
- Excellent reactive compensation: High speed, Precise ($-0.99 \leq \cos\phi \leq 0.99$), Step-less, Bi-directional (capacitive and inductance) compensation
- Excellent imbalance correction: Both negative and zero sequence, mitigates neutral current
- Wide input voltage & frequency range, adapts to tough electrical environment
- Low thermal loss ($\leq 3\%$ of rated SVG capacity), efficiency $\geq 97\%$
- High stability: Infinite impedance to grid, avoids harmonic resonance problem
- Flexible application: Modular design, embedded in standard or customized cabinet
- Easy installation and maintenance: Easy installation for APF module replacement and expansion
- Wide capacity range: 50~700 kvar for a single cabinet, up to 10 cabinets in parallel
- Wide working temperature:
 - 10~55°C temperature for Rear connection type, de-rating running from 50~55°C
 - 25~55°C temperature for Front connection type, de-rating running from 40~55°C
- Environmental adaptability: Withstand 15% voltage distortion, compatible with diesel generators
- Complete protection: Grid over/under voltage, SVG over current, over temperature, and others. All faults recorded in event log, convenient for failure analysis



Delta PQC Series SVG Technical Specification

Electrical Specification	Rated Voltage	AC 400V	
	Input Voltage Range	AC 308~456 V	AC 308~480 V
	Electric Connection	3P4W	3P3W
	Rated Frequency	50(60) Hz $\pm 10\%$	
	Rated Capacity per Module	50 kvar / 100 kvar	
	Rated Current per Cabinet	50~700 kvar (module combination)	
	Redundancy	Each module is an independent reactive compensation system	
	Reactive Power Compensation Capability	Both inductive and capacitive reactive power	
	Reactive Power Compensation Performance	$\cos\phi \geq 0.99$ after compensation (if the SVG capacity is sufficient)	
	Imbalance Correction Capability	Mitigate negative and zero sequence	
	Full Response time	< 20 ms	
	Instant Response time	< 100 μ s	
	Thermal Loss	$\leq 3\%$ of SVG rated capacity	
	Output Current Limitation	Automatic (100% rated capacity)	
	Parallel Expansion(System)	Up to 10 Racks(7 modules per cabinet)	
	MTBF	> 100,000 hours	
Control Technology	Switching Frequency	30 kHz	
	Controller	DSP control	
	Communication	Modbus RTU (RS-485), Modbus TCP/IP (Ethernet)	
Physical Specification	IP Grade of Cabinet	IP20, IP30, IP42, IP54 or customization	
	Cooling method	Intelligent forced air cooling	
	Noise Level	< 65 dB(A) @1m (Module)	
	Dust Filter	Optional	
	Dimension	Refer to SVG Model table	
	Weight	Refer to SVG Model table	
Environmental Requirement	Ambient Temperature	Rear connection type: -10~50°C with 100% capacity, de-rating running from 50~55°C Front connection type: -25~40°C with 100% capacity, de-rating running from 40~55°C	
	Relative Humidity	0~95% (No condensation)	
	Altitude	≤ 1000 m rated capacity, 1000~2000 m(derating 1% per 100 m)	

Special Features of Delta Power Quality Solution

High Adaptability

- **Wider range of operating temperatures**

Delta PQC series APF & SVG can normally work from -10°C~ 55°C, which is suitable for most applications

- **Withstands extreme electrical condition**

Delta's PQC series APF & SVG can withstand severe harmonic distortion of voltage, they can work normally under conditions with THDu (total harmonic distortion of voltage) up to 15%

- **Compatible with diesel generators**

Simple and Flexible Application

- The Delta PQC series APF & SVG's modular structure makes it easy for installation, maintenance and capacity expansion.
- APF & SVG modules can be embedded in Delta's standard cabinets or third-party cabinets, making it possible to customize cabinets for special requirements.

Excellent Compensation Capability

- Delta's PQC series APF & SVG adopts 3-level inverter topology with 12 pcs discrete IGBT up to 60 kHz switching frequency, which provide excellent power quality compensation accuracy, response speed and output ability.

High Reliability

- Module redundancy technology
- Intelligent air cooling technology
- Top brand electronic components
- Advanced production technology



Delta's Manufacturing System is Certified by ISO 9001 and ISO 14001 Standards



IACQ Certificate of Hazardous Substance Process Management



The **PQC series APF** protects electrical equipment for a leading petrochemical company in Taiwan.



The **PQC series APF** protects the power distribution system of one of India's top three textile companies.



The **PQC series APF** boosts the power supply stability for a global automobile parts provider in India.



The **PQC series APF** protects the power distribution system from harmonics interference for the largest telecom company in India.



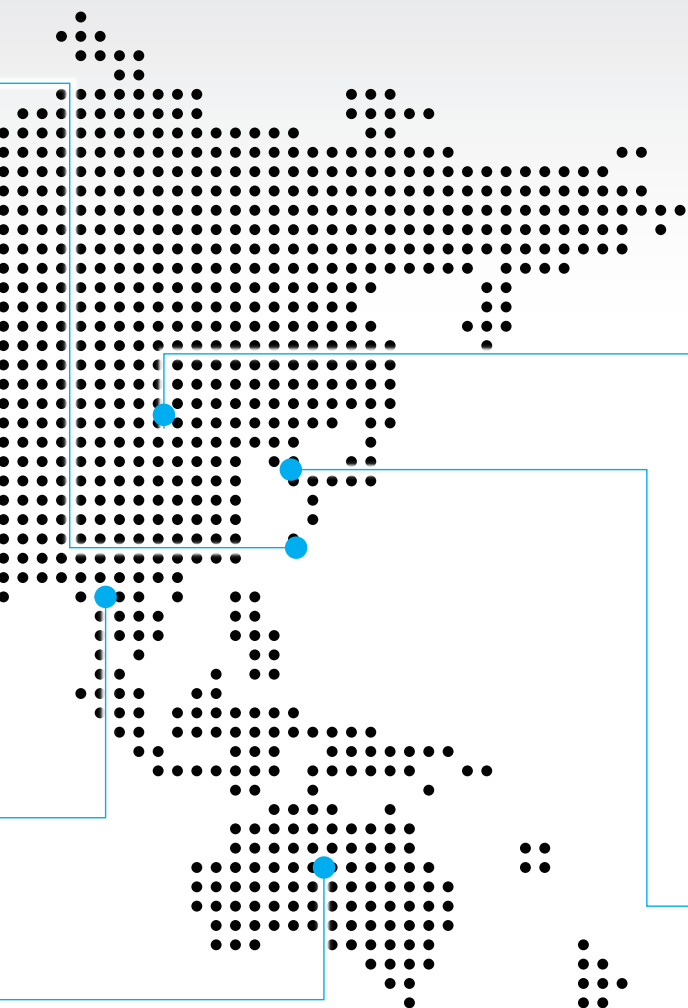
The **PQC series APF** helps to reduce the electricity bills for an international rubber & tire company in Thailand.



The **PQC series APF** protects the power distribution system for a public sports facility in Australia.



Critical Operations 24/7



The **PQC series APF** protects the power distribution system from harmonics for Asia's largest chemical fiber company in China.



The **PQC series APF** protects the power distribution system for a top petrochemical company in China



The **PQC series APF** boosts power supply stability for public metro system in three different cities of China.



The **PQC series APF** protects the power distribution system from harmonics interference for the largest telecom company in China.



The **PQC series APF** protects the power distribution system for a public water supply company in South Korea.



The **PQC series APF** boosts the power supply stability for an electronic components & battery material company in South Korea.

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