

Europe

Czech Republic

Delta Energy Systems (Czech Republic), spol.s r.o.
Perucka 2482/7
120 00 Praha 2
Czech Republic
T +420 272 019 330
F +420 271 751 799

Finland

Delta Energy Systems (Finland) Oy
Juvan teollisuuskatu 15
02921 Espoo
T +358 9 84966 0
F +358 9 84966 100

France

Delta Energy Systems (France) S.A.
ZI du bois Chaland 2 15 rue des Pyrenees,
Lisses
91056 Evry Cedex
T +33 1 69 77 82 60
F +33 1 64 97 05 77

Germany

Delta Energy Systems (Switzerland) AG
German Office
Coesterweg 45, D-59494 Soest
59494 Soest
T +49 2921 987 337
F +49 2921 987 396

Italy

Delta Energy Systems (Italy) S.R.L.
Piazza Grazioli 18
00186 Roma
T +39 06 699 41 209
F +39 06 699 42 293

The Netherlands

Deltronics Netherlands BV
Zandsteen 15
2132 MZ Hoofddorp
The Netherlands
T +31 20 655 0900
F +31 20 655 0999

Poland

Delta Energy Systems (Poland)
Sp. z o.o. 23 Poleczki Str.
02-822 Warsaw
T +48 22 335 26 00
F +48 22 335 26 01

Russia

Delta Energy Systems (Russia)
Vereyskaya Plaza II, office 503,
Vereyskaya str.17
121357 Moscow, Russia
T +7 495 644 32 40
F +7 495 644 32 41

Slovak Republic

DELTA ELECTRONICS (SLOVAKIA), s.r.o.
Botanická 25/A, SR-841 04 Bratislava,
T +421 (0)2 6541 1258
F +421 (0)2 6541 1283

Spain

Delta Energy Systems (Spain)
S.L. Calle Luis I
nº 60, Nave 1a, P.I. de Vallecas
28031 Madrid
T +34 91 223 74 20
F +34 91 332 90 38

Sweden

Delta Energy Systems (Sweden) AB
P.O.Box 3096
35033 Växjö
T +46 470 70 68 16
F +46 470 70 68 90

Switzerland

Delta Energy Systems (Switzerland) AG
Freiburgstrasse 251
3010 Bern-Bümpliz
T +41 31 998 53 11
F +41 31 998 54 85

Turkey

Delta Greentech Electronic San. Ltd.
Sti. Serifali Mevkii Barbaros Bulvari Söylesi Sok.
No: 19, K1, Y.Dudullu-Umraniye
34775 Istanbul
T +90 216 499 9910
F +90 216 499 8070

United Kingdom

Delta Electronics Europe Ltd.
1 Redwood Court
Peel Park, East Kilbride
G74 5PF
T +44 1355 588 888
F +44 1355 588 889

Americas

Argentina

Delta Greentech
Sarmiento 1889 5A
Buenos Aires
T +5411 4372 310

Brazil

Delta Energy Systems (Brazil) S/A
Rua Itapeva, Nº 26 - 3º andar
01332 000 - São Paulo - SP
T +55 11 3568 3874
F +55 11 3568 3865

Colombia

Delta Greentech
Calle 213 # 114-10 manzana 14 casa 25
Caminos de Arrayanes
T +57 1 673 4927
F +57 1 673 4927

Middle-East & Africa

South Africa

Delta Energy Systems MEA (Switzerland)
AG South Africa Representative Office
Unit 305B, Lougardia Building,
Cnr Embankment and Hendrik Verwoerd
Drive, Centurion, 0157, South Africa
T +27 12 663 2714
F +27 86 667 0469

Asia Pacific

China

Delta GreenTech (China) Co., Ltd.
No.238 Minxia Road, Pudong
P.R.C 201209 Shanghai
T +86 21 5863 5678
+86 21 5863 9595
F +86 21 5863 0003

India

Delta Power Solutions (India) Pvt. Ltd.
Plot No. 43, Sector-35, HSIIDC,
Gurgaon-122001, Haryana, India
T +91 124 4874 900
F +91 124 4874 945

Taiwan

Delta Electronics Inc.
39 Section 2, Huandong Road, Shanhua
Township
Tainan County 74144, Taiwan
T +886 6 505 6565
F +886 6 505 1919

Australia

Delta Energy Systems Australia Pty Ltd.
Unit 20-21, 45 Normanby Road, Notting
Hill VIC 3168, Australia
T +61 3 9543 3720
F +61 3 9544 0606

Thailand

Delta Electronics (Thailand) Public Co., Ltd.
909 Soi 9, Moo 4, E.P.Z., Bangpoo
Industrial Estate, Tambon Prakasa,
Amphur Muang-samutprakarn,
Samutprakarn Province 10280, Thailand
T +662 709-2800
F +662 709-2833

Singapore

Delta Electronics Int'l (Singapore) Pte Ltd.
4 Kaki Bukit Ave 1, #05-04, Singapore
417939
T +65 6747 5155
F +65 6744 9288



The power behind competitiveness

Delta PQC Series Power Quality Solution

Active Power Filter (APF)

Static VAR Generator (SVG)

About Delta Group

Delta Group is the world's leading provider of power management and thermal management solutions, as well as a major source for components, visual displays, industrial automation, networking products, and renewable energy solutions. Delta Group focuses on three main businesses: power electronics, energy management, and smart green life. Delta Group has sales offices worldwide and manufacturing plants in Taiwan, China, Thailand, Japan, Mexico, India, Brazil, and Europe.

As a global leader in power electronics, Delta's mission is, "To provide innovative, clean and energy-efficient solutions for a better tomorrow." Delta is committed to environmental protection and has implemented green, lead-free production and recycling and waste management programs for many years.

More information about Delta Group can be found at www.deltaww.com

Delta's Quality

Products - Delta's quality ensures customer satisfaction

Delta insists on the strictest quality control and management in various phases from development to manufacturing to ensure customer satisfaction by embracing the philosophy "Do things right the first time." Maintaining and exceeding the highest quality standards makes Delta the first-choice supplier of many world-leading enterprises.



Delta's Manufacturing

Delta in China has 23 R&D Centers with over 2,000 R&D engineers and 22 plants with a total manufacturing area of over 7,000,000 sq. ft. (680,000 m2).

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 519-2014) , the grid voltage distortion limits are:

Bus Voltage V at PCC	Individual harmonics (%)	Total harmonics distortion THD (%)
V ≤ 1.0kV	5.0	8.0
1kV < V ≤ 69kV	3.0	5.0
69kV < V ≤ 161kV	1.5	2.5
161kV < 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 _{sc} /I _L	3 ≤ h < 11	11 ≤ h < 17	17 ≤ h < 23	23 ≤ h < 35	35 ≤ 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_{sc}/I_L.

where
 I_{sc} = maximum short-circuit current at PCC.
 I_L = maximum demand load current (fundamental frequency component) at PCC.

Reactive Power

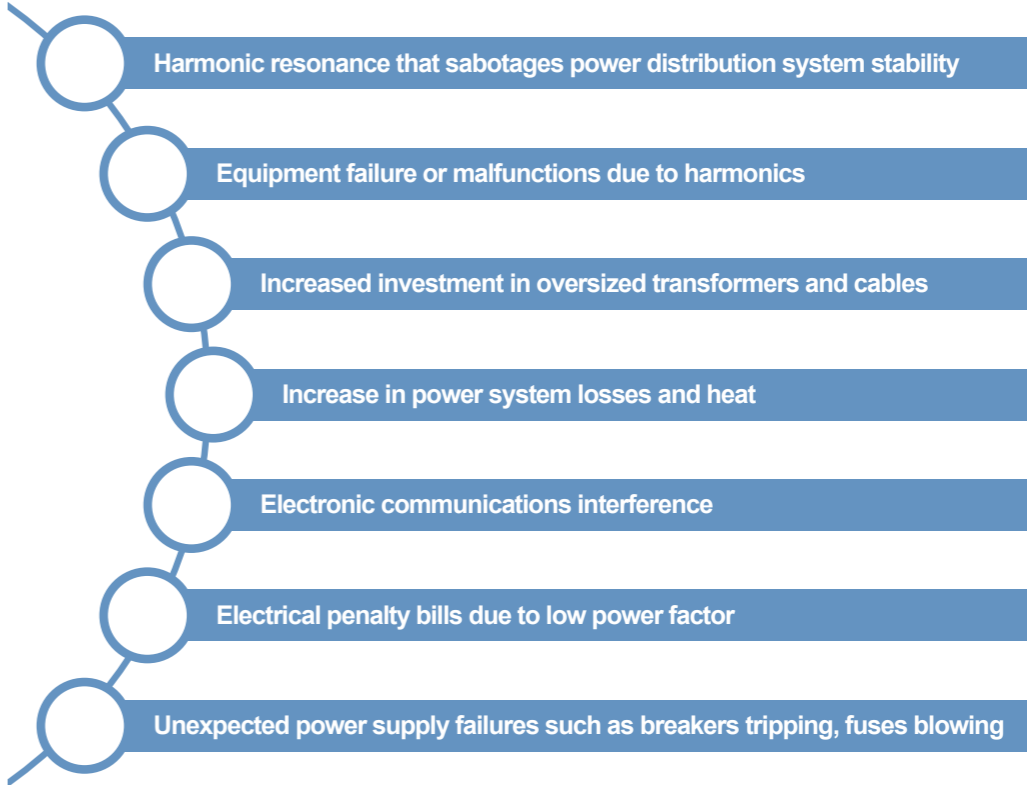
In most cases, reactive power is the power that magnetic equipment such as transformers, motors and relays, needs to produce magnetizing flux, which is inductive. In some cases, long distance power cables and some loads generate capacitive reactive power. Both inductive and capacitive reactive power 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

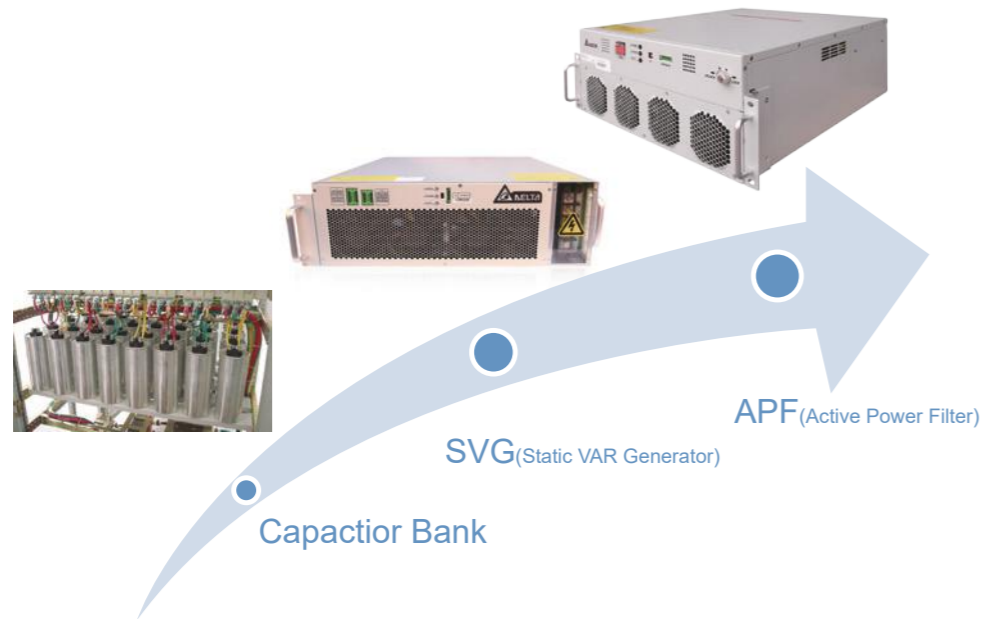
Poor Power Quality can be described as any event related to the electrical network that ultimately results in a financial loss. Possible consequences of poor Power Quality include:



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 2nd~50th 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 (20ms~5s)	fast, can track dynamic reactive power (<0.1ms)	fast, can track dynamic harmonic & reactive loads (<0.1ms)
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.

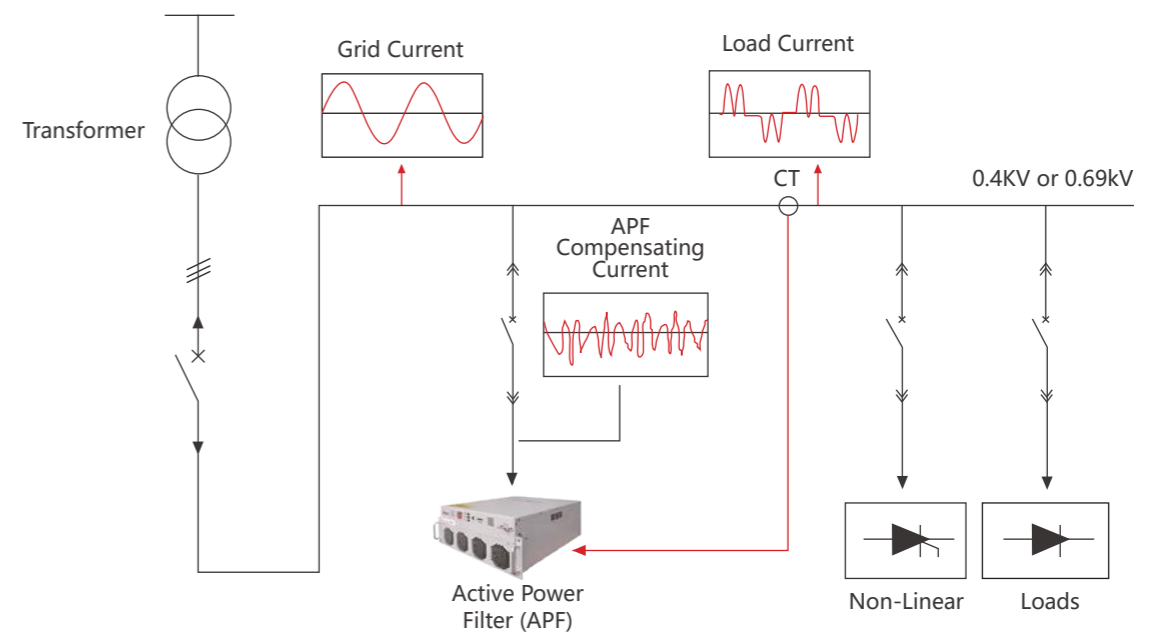
Delta PQC Series Active Power Filter (APF)

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. 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.

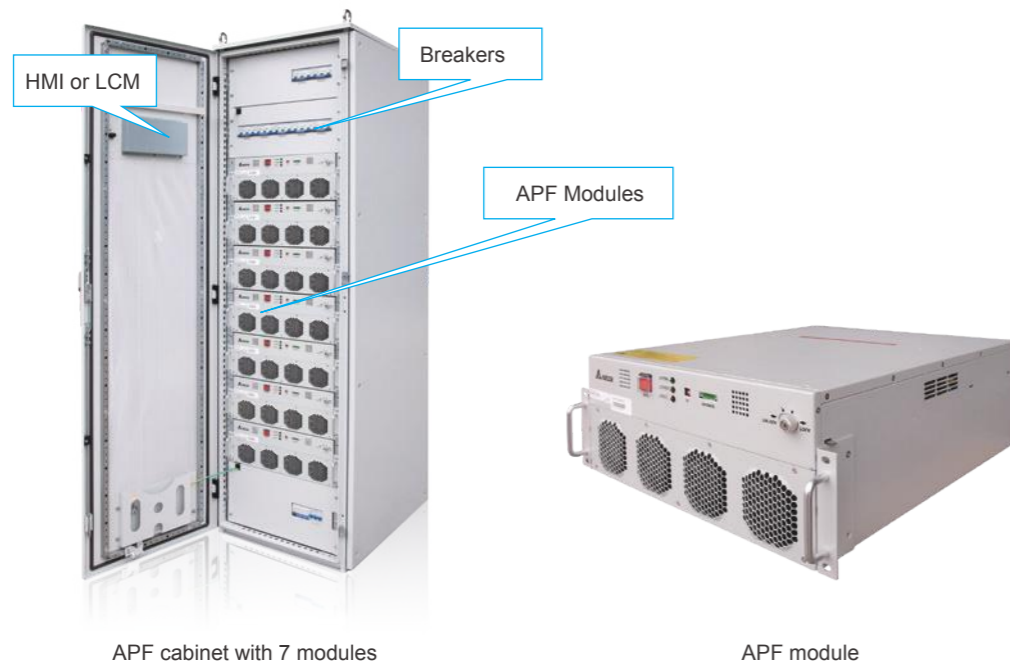
According to the mounting type, Delta PQC series APF can be divided into Modular APF (rack mounting) and Wall-mounted APF.

Modular APF

APF modules and HMI/ LCM 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.

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

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



APF cabinet with 7 modules

APF module

Wall-mounted APF

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.



Wall-mounted APF module

Wall-mounted APF with HMI and Bracket

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

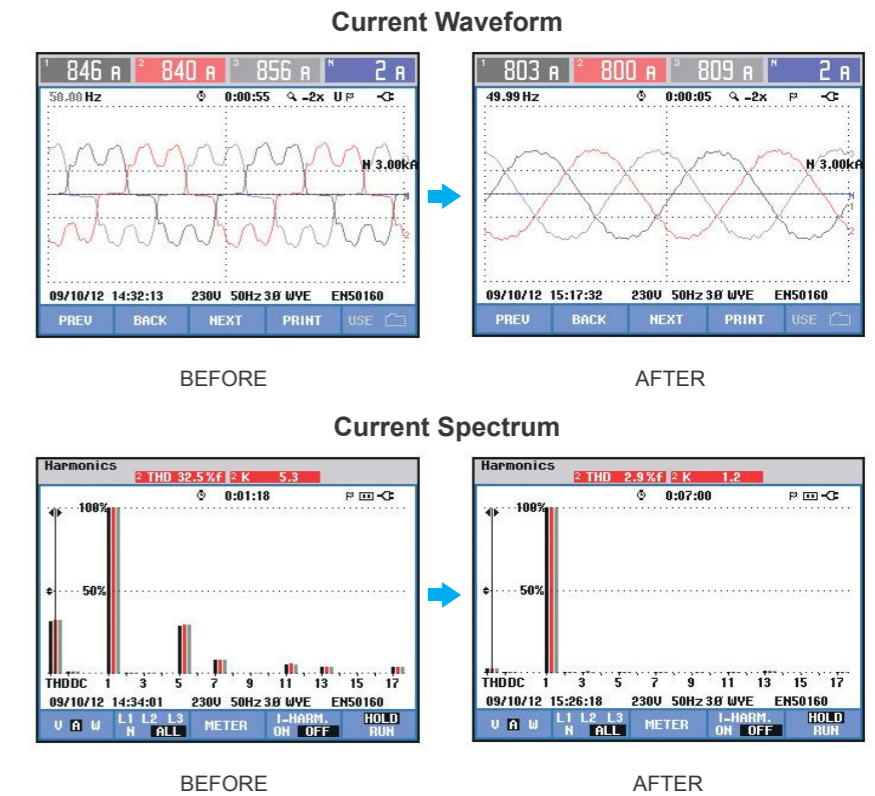


Application: Textile Industry

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.



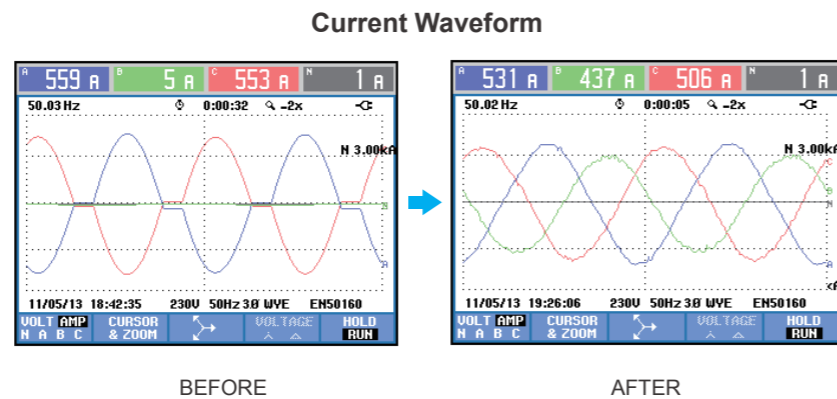


Application: Foundry Industry

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 Spectrum

HARMONICS TABLE				
Amp	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

AFTER

Load Unbalance

Unbalance				
Unbal.(%)	A	B	C	N
Unbal.(%)	0.9	0.0	102	0.5
Ufund	233.4	235.6	231.8	1.8
Hz	50.035			
∑U(°)	0.0	-120.7	-240.9	-224.5
∑R(°)	-106.3	-43.2	-285.7	-312.7
Rfund	552	8	551	0

BEFORE

AFTER

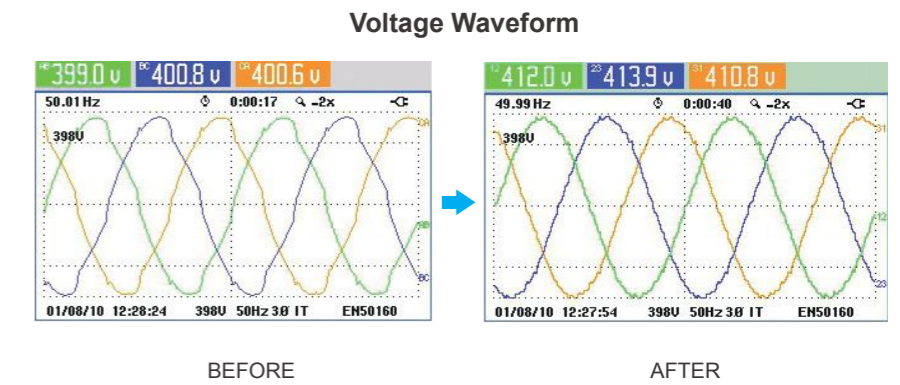


Application: Automobile Industry

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 Spectrum

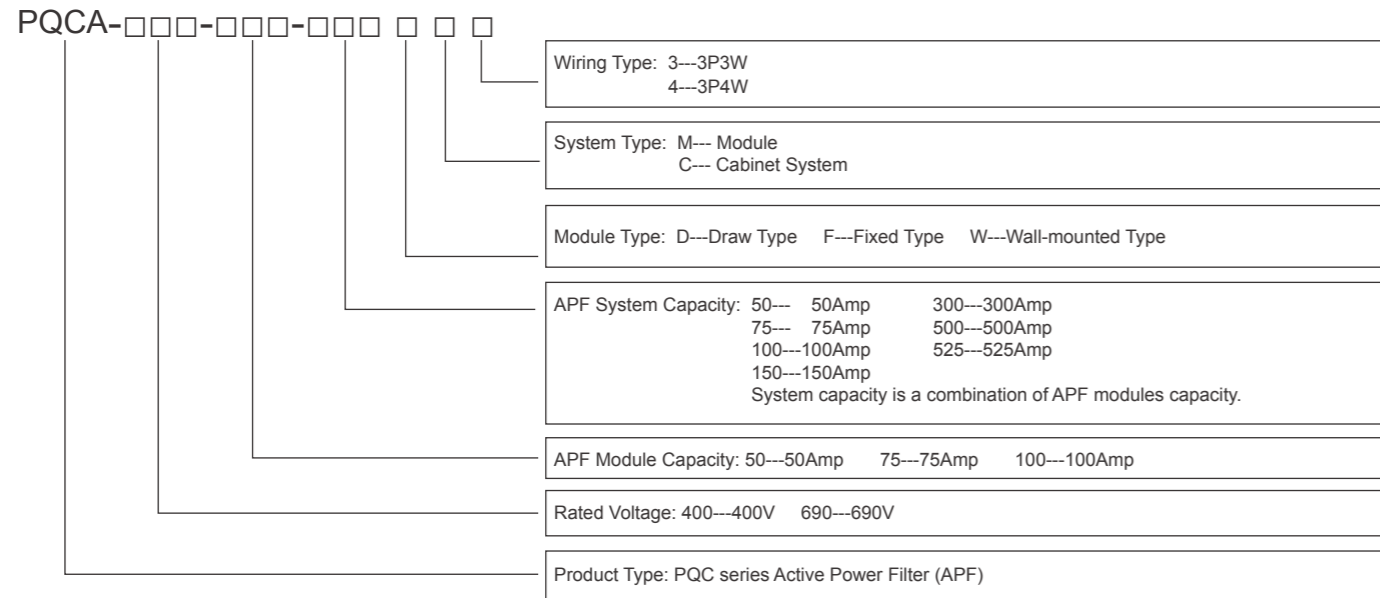
HARMONICS TABLE				
Voit	AB	BC	CA	U _P
THD% _r	5.3	5.5	5.5	
H3% _r	0.3	0.2	0.1	
H5% _r	3.9	3.9	3.9	
H7% _r	2.8	3.1	3.0	
H9% _r	0.1	0.0	0.0	
H11% _r	1.1	1.2	1.2	
H13% _r	1.3	1.4	1.4	
H15% _r	0.1	0.1	0.1	

BEFORE

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 ($-0.99 \leq PF \leq 0.99$), 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: 50A~525A for a single cabinet, up 10 cabinets in parallel
- Environmental adaptability: $-10 \sim 50^\circ\text{C}$ temperature, 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 (W×D×H)	Weight (kg)	
Independent Module System	Wall-mounted	PQCA-400-50-50-WM4	50A	440×174×600mm	30	
	Draw Type Modular	PQCA-400-50-50DM3(4)	50A	440×522×174mm	40	
		PQCA-400-75-75DM3(4)	75A	440×522×174mm	42	
	Fixed Type Modular	PQCA-400-50-50FM3(4)	50A	440×522×174mm	30	
		PQCA-400-75-75FM3(4)	75A	440×522×174mm	42	
		PQCA-400-100-100FM3(4)	100A	605×728.2×220mm	65	
PQCA-690-100-100FM3		100A	605×728.2×270mm	78		
Cabinet System (Multiple Modules)	Draw Type Cabinet	PQCA-400-50-50DC3(4)	50A	600×800×2000mm	208	
		PQCA-400-75-75DC3(4)	75A	600×800×2000mm	210	
		PQCA-400-75-150DC3(4)	150A	600×800×2000mm	260	
		PQCA-400-75-225DC3(4)	225A	600×800×2000mm	309	
		PQCA-400-75-300DC3(4)	300A	600×800×2000mm	359	
		PQCA-400-75-375DC3(4)	375A	600×800×2000mm	408	
		PQCA-400-75-450DC3(4)	450A	600×800×2000mm	458	
		PQCA-400-75-525DC3(4)	525A	600×800×2000mm	507	
		Fixed Type Cabinet	PQCA-400-50-50 FC3(4)	50A	600×800×2000mm	200
			PQCA-400-75-75FC3(4)	75A	600×800×2000mm	203
			PQCA-400-50-100FC3(4)	100A	600×800×2000mm	235
			PQCA-400-100-100FC3(4)	100A	800×1000×2000mm	265
	PQCA-400-50-150FC3(4)		150A	600×800×2000mm	270	
	PQCA-400-75-150FC3(4)		150A	600×800×2000mm	245	
	PQCA-400-50-200FC3(4)		200A	600×800×2000mm	320	
	PQCA-400-100-200FC3(4)		200A	800×1000×2000mm	330	
	PQCA-400-75-225FC3(4)		225A	600×800×2000mm	287	
	PQCA-400-50-250FC3(4)		250A	600×800×2000mm	360	
	PQCA-400-50-300FC3(4)		300A	600×800×2000mm	395	
	PQCA-400-100-300FC3(4)		300A	800×1000×2000mm	395	
	PQCA-400-50-350FC3(4)		350A	600×800×2000mm	430	
	PQCA-400-75-375FC3(4)		375A	600×800×2000mm	371	
	PQCA-400-100-400FC3(4)		400A	800×1000×2000mm	460	
	PQCA-400-75-450FC3(4)		450A	600×800×2000mm	413	
	PQCA-400-100-500FC3(4)		500A	800×1000×2000mm	522	
	PQCA-400-75-525FC3(4)		525A	600×800×2000mm	455	
	PQCA-690-100-100FC3	100A	800×1000×2000mm	280		
	PQCA-690-100-200FC3	200A	800×1000×2000mm	360		
	PQCA-690-100-300FC3	300A	800×1000×2000mm	440		
	PQCA-690-100-400FC3	400A	800×1000×2000mm	520		
PQCA-690-100-500FC3	500A	800×1000×2000mm	600			

Delta PQC Series APF Technical Specification

Electrical Specification	Rated Voltage	AC 400V	AC 690V		
	Input Voltage Range	AC 308V~480V	AC 432V~880V		
	Electric Connection	3P3W / 3P4W	3P3W		
	Rated Frequency	50(60)Hz ±10%			
	Input Voltage THD Range	≤15%			
	Rated Current per Module	50Amp	75Amp	100Amp	100Amp
	Rated Current per Cabinet	50~525Amp (module combination)		100~500Amp (module combination)	
	Redundancy	Each module is an independent filtering system			
	Harmonic Elimination Range	2rd ~ 50th order (Selectable)	2rd ~ 31st 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			
	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	<20ms			
	Instant Response time	<100us			
	Thermal Loss	≤3% of APF rated capacity (kVA)			
	Output Current Limitation	Automatic (100% rated capacity)			
	Parallel Expansion(System)	Up to 10 Racks(7 modules per cabinet)	Up to 10 Racks(5 modules per cabinet)		
	MTBF	>100,000 hours			
Control Technology	Switching Frequency	60kHz	30kHz	20kHz	
	Controller	DSP control			
	Communication	Modbus Protocol, RS232/485			
Physical Specification	Monitoring	PQC Monitor Software (Optional)			
	IP Grade of Cabinet	IP20, IP30 or customization			
	Cooling method	Intelligent forced air cooling			
	Noise Level	< 65dB(A) @1m (Module)	< 70dB(A) @1m (Module)		
	Dust Filter	Optional			
Environmental Requirement	Dimension	Refer to APF Model table			
	Weight	Refer to APF Model table			
	Ambient Temperature	-10~50°C with 100% capacity, de-rating running from 50~55°C			
	Relative Humidity	0~95%			
	Altitude	≤1000m rated capacity, 1000~2000m(derating 1% per 100m)			

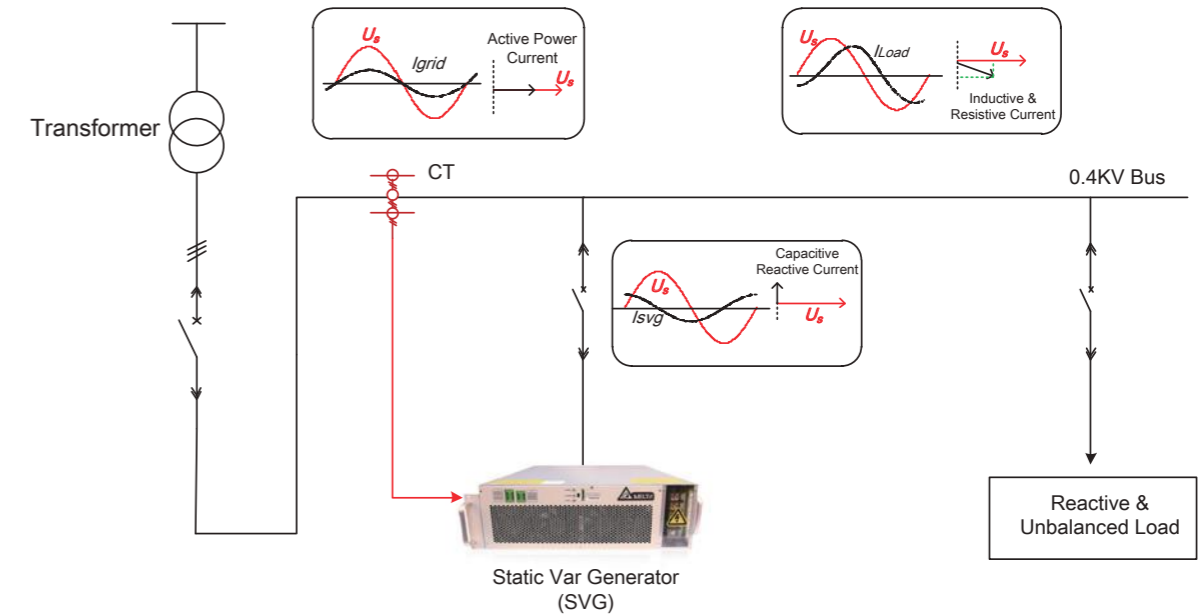
Delta PQC series Static Var Generator (SVG)

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>(a) $U_i = U_s$</p>	$U_i = U_s$, $I_{svg} = 0$, SVG outputs no reactive current.
Capacitive Mode	<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>(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, 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 modules and LCM panel can be embedded in Delta's standard SVG cabinet or in a customized cabinet. There are breakers, cable terminals and Surge Protection Device (SPD) in the SVG cabinet.



SVG Module



HMI



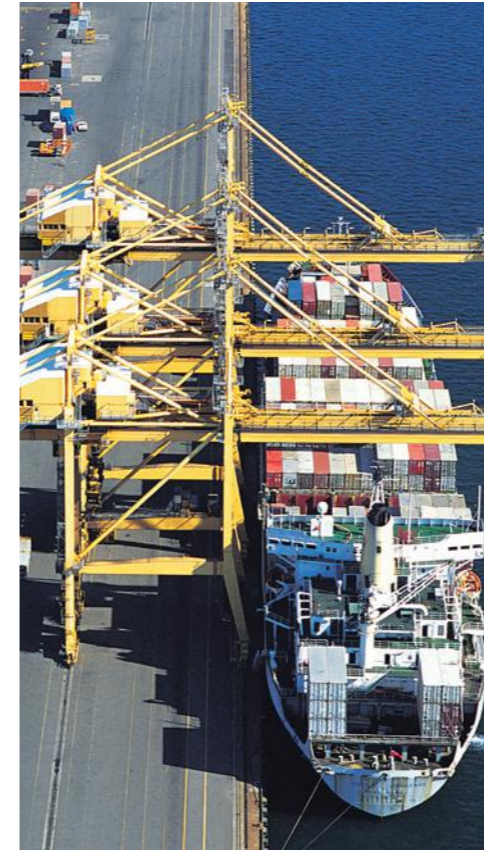
LCM

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 (Cosφ) ≥ 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 1335A to 1116A (around 16%).

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

Power and Energy

Power & Energy				
FUND	A	B	C	Total
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	
U _{rms}	233.23	233.06	232.90	

BEFORE

Power & Energy				
FUND	A	B	C	Total
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	
U _{rms}	236.72	236.68	236.49	

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 2436A to 1289A (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	
U _{rms}	223.80	225.55	225.48	

BEFORE

Power & Energy				
FUND	L1	L2	L3	Total
kW	273.2	276.2	292.8	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	
U _{rms}	225.33	223.80	225.62	

AFTER



Delta PQC Series SVG Technical Specification

Electrical Specification	Rated Voltage	AC 400V
	Input Voltage Range	AC 308V~480V
	Electric Connection	3P3W / 3P4W
	Rated Frequency	50(60)Hz ±10%
	Rated Capacity per Module	50kvar
	Rated Current per Cabinet	50~350kvar (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	Cosφ≥0.99 after compensation (if the SVG capacity is sufficient)
	Imbalance Correction Capability	Mitigate negative and zero sequence
	Full Response time	<20ms
	Instant Response time	<100us
	Thermal Loss	≤3% of SVG rated capacity
	Output Current Limitation	Automatic (100% rated capacity)
Control Technology	Parallel Expansion(System)	Up to 10 Racks(7 modules per cabinet)
	MTBF	>100,000 hours
	Switching Frequency	30kHz
	Controller	DSP control
Physical Specification	Communication	Modbus Protocol, RS232/485
	Monitoring	PQC Monitor Software (Optional)
	IP Grade of Cabinet	IP20, IP30 or customization
	Cooling method	Intelligent forced air cooling
	Noise Level	< 60dB(A) @1m (Module)
	Dust Filter	Optional
Environmental Requirement	Dimension	Refer to SVG Model table
	Weight	Refer to SVG Model table
	Ambient Temperature	-10~40°C with 100% capacity, de-rating running from 40~55°C
	Relative Humidity	0~95%
	Altitude	≤1000m rated capacity, 1000~2000m(derating 1% per 100m)

Special Features of Delta Power Quality Solution

High Adaptability

- **Wider range of operating temperatures**

Delta PQC series APF & SVG can normally work without any derating from -10°C~ 50°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 applies 3-level inverter topology and 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



2007~ 2008 Forbes Asia's Fabulous 50



2009 Frost & Sullivan Green Excellence Award for Corporate Leadership



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



IECQ 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.



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.