



The power behind competitiveness

Delta Power Quality Catalogue

Active Power Filter (APF)

Static VAR Generator (SVG)



www.onesmartfactory.com



About Delta

Corporate Mission

To provide innovative, clean, and energy-efficient solutions for a better tomorrow.

Delta was founded in 1971. Delta offers energy efficient power products, switching power supplies with efficiency over 90%, telecom power with up to 98%, and PV inverters with up to 98.8% efficiency. We have also developed the world's first server power supply certified as 80 Plus Titanium. We regularly invest over 8% of our annual sales revenues in R&D and have worldwide R&D facilities in China, Europe, India, Japan, Singapore, and the U.S.

Delta is a frequent recipient of international awards and related recognition for innovation, design, energy management and corporate social responsibility. Since 2011, Delta has been selected each year for the prestigious Dow Jones Sustainability™ World Index (DJSI World Index). In 2020, Delta was also recognized by CDP with two "A" leadership level ratings for its substantial contribution to climate change and water security issues.

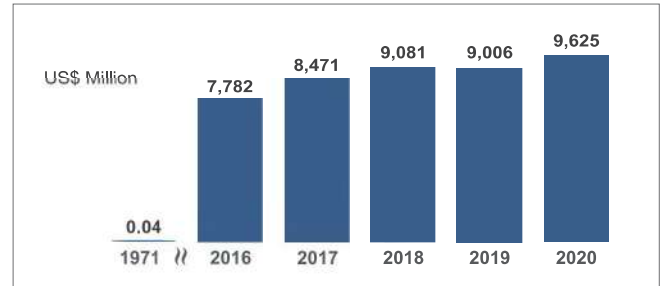
Delta continues to deliver strong and stable financial performance, achieving a compound annual growth rate of around 30.0% since 1971.



Bruce Cheng
Founder and
Honorary Chairman



Yancey Hai
Chairman

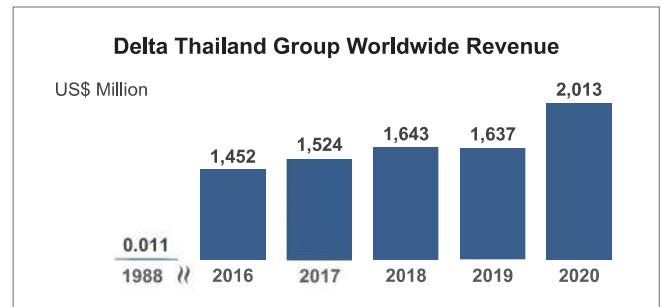


Delta Thailand Overview

- Founded in 1988
- Thailand's largest listed electronics manufacturer
- Business management center for Southeast Asia, India and Australia/ New Zealand markets
- Product development management center for Bangkok (Thailand), Soest/ Teningen (Germany), UK, USA, India, Singapore and Bucharest (Romania).
- Manufacturing management center to synergize advanced technologies and highly efficient production across manufacturing plants in Thailand, India, Slovakia and Myanmar.

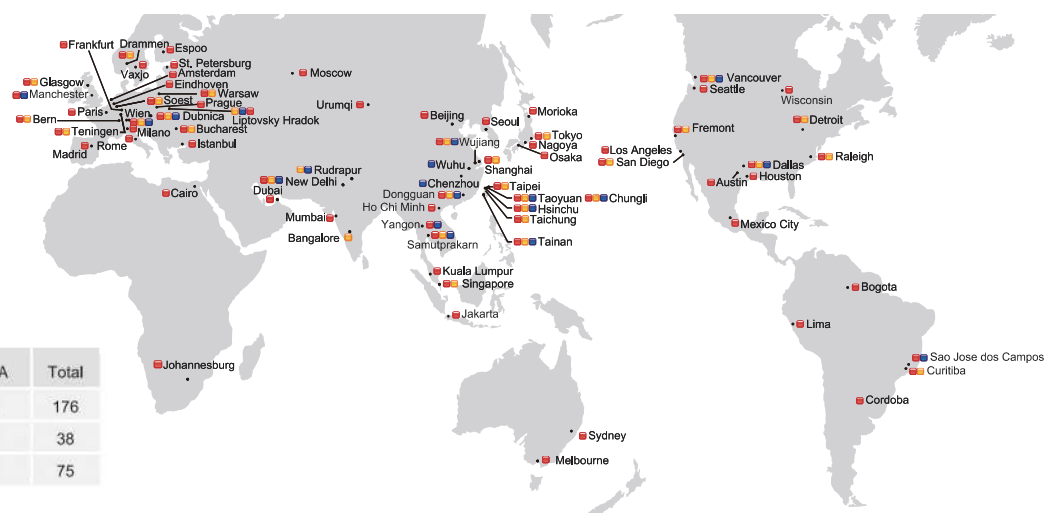


Chang Tsai-hsing (Jackie)
President



Global Operations

Delta Group has 176 sales offices, 38 plant sites, and 75 R&D centers with over 9,000 R&D engineers throughout the world.



| | Asia-Pacific | Americas | EMEA | Total |
|---------------|--------------|----------|------|-------|
| Sales Offices | 107 | 24 | 45 | 176 |
| Plant Sites | 31 | 4 | 3 | 38 |
| R&D Centers | 52 | 9 | 14 | 75 |

Business Categories

 Power Electronics

 Automation

 Infrastructure






















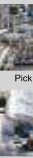






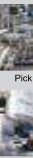






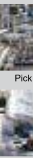
| | | | |
|---|---|--|---|
| <ul style="list-style-type: none"> • Components • Embedded Power • Fans & Thermal Management • Automotive Electronics | <ul style="list-style-type: none"> • Merchant & Mobile Power Innertek | <ul style="list-style-type: none"> • Industrial Automation • Building Automation | <ul style="list-style-type: none"> • ICT Infrastructure • Energy Infrastructure & Industrial Solutions vivitek |
|---|---|--|---|

Green Solutions

| | | | |
|---|--|---|--|
|  <p>Industrial Automation and Smart Manufacturing</p> |  <p>Building Automation</p> |  <p>Data Center</p> | <p>Delta provides integrated energy-saving solutions to build a better world for future generations.</p> |
|  <p>Telecom Energy</p> |  <p>Display and Monitoring</p> |  <p>Renewable Energy</p> | |

Industrial Automation and Smart Manufacturing

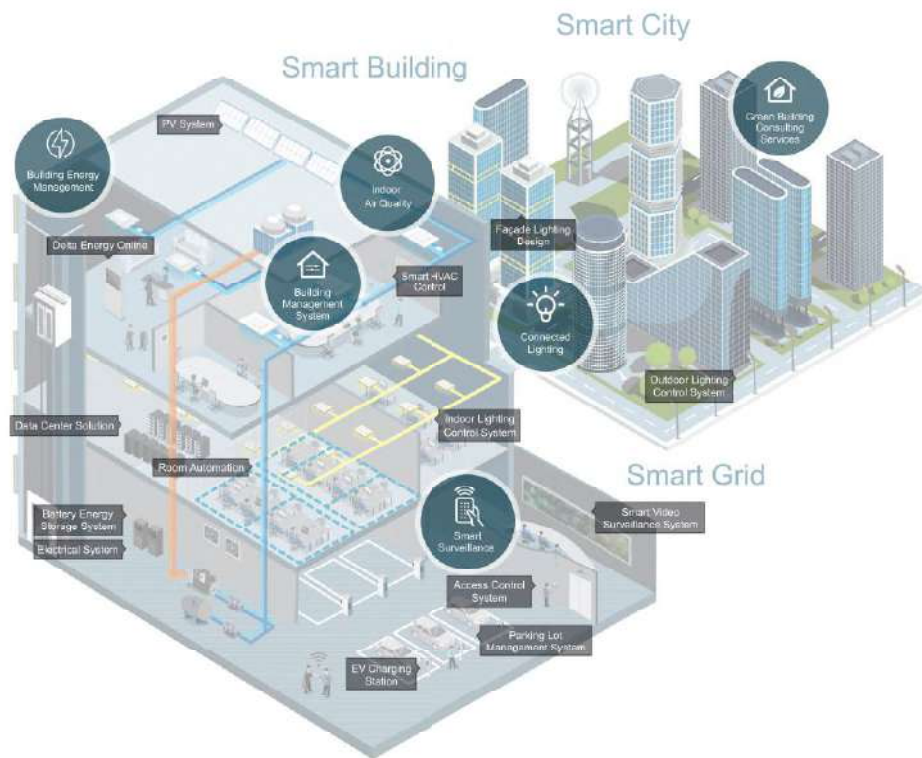
Industrial Automation Solution

| | | | | | | | | | | | | | | |
|--|---|---|--|--|--|---|--|--|--|--|---|---|--|---|
| <p>Data Analytics & Optimization</p> | <p>IIoT Cloud-based Platform </p> | | <p>Big Data Analysis </p> | | <p>Artificial Intelligence (Edge/Cloud) </p> | | <p>Modeling & Simulation </p> | | | | | | | |
| <p>Management</p> | <p>DIAMMP Manufacturing Management Platform</p> | | <p>DIAMES Manufacturing Execution System</p> | | <p>DIASPC Statistical Process Control</p> | | <p>DIAPMS Preventative Maintenance System</p> | | <p>DIAWMS Warehouse Management System</p> | | <p>DIAAMS Alarm Manage System</p> | | | |
| <p>Networking</p> | <p>IIoT Industrial Cloud Router </p> | | | <p>Ethernet Solution </p> | | | <p>Industrial Fieldbus Solution </p> | | | | | | | |
| <p>Control & Sensing</p> | <p>Integration Software - DIAStudio</p> | | | | | | | | | | | | | |
| | <p>PLC</p> | | <p>Motion Control</p> | | | <p>HMI</p> | | <p>Robot Controller</p> | | <p>Machine Vision System</p> | | <p>Sensor</p> | | <p>Meter & Measurement</p> |
| <p>Drives Motion Equipment</p> | <p>AC Motor Drive </p> | | | <p>Servo System (AC Servo Drive & Motor) </p> | | | <p>Planetary Gearbox </p> | | <p>Servo Press </p> | | <p>Industrial Robot </p> | | <p>Robot Workstation</p> <p>Pick & Place  Soldering </p> <p>Inspection  Screw Driving </p> | |
| | <p>PLC-Based Motion Controller </p> | | <p>CAD/CAM Computer-Aided Design/Manufacturing</p> | | | <p>CNC Controller </p> | | <p>PC-Based Motion Controller </p> | | <p>Motion Control Card </p> | | <p>Pressure Sensor </p> | | <p>Gas Flow Meter </p> |
| <p>Industrial PC </p> | | <p>DIAView Supervisory Control and Data Acquisition System (SCADA) </p> | | | <p>DIALink Equipment IoT Platform </p> | | <p>DIABCS Block Control System </p> | | <p>DIAMCS Material Control System </p> | | <p>DIA CPC CIM PC System </p> | | <p>DIAEnergy Industrial Energy Management System (IEMS) </p> | |
| <p>Encoder </p> | | <p>Temperature Controller </p> | | <p>Smart Sensor </p> | | <p>Power Meter </p> | | <p>Temperature Controller </p> | | <p>Encoder </p> | | <p>Temperature Controller </p> | | |

Building Automation

IoT-based Smart Building Solution

Delta's building solutions provide the best energy efficiency for a smart and sustainable building.

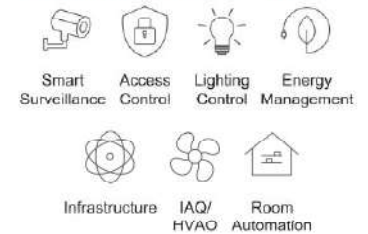


Our Products



Our Offerings

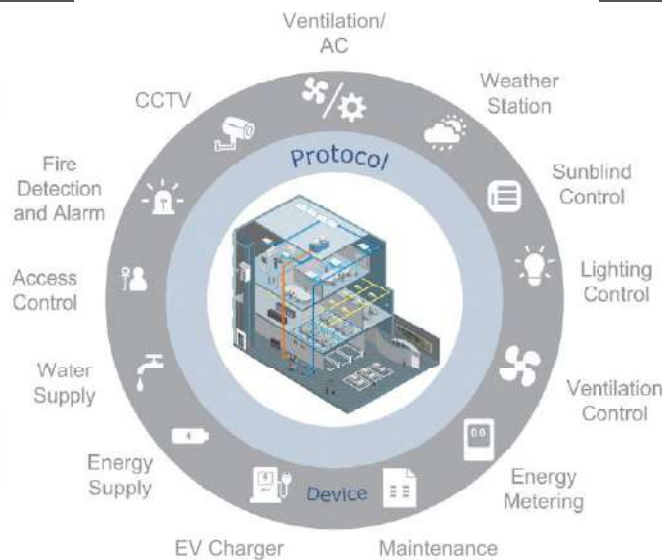
Various BA Product and Solution Packs



Our Practices

System Integration Services

HVAC



Surveillance

Lighting Control

Infrastructure

Room Control

Data Center



Display and Monitoring

Delta's visual display applications include projection and video wall solutions. Our projection solutions fulfill a wide range of professional applications, such as multimedia interaction, large-scale auto blending projection and 3D projection mapping. For control rooms and public information display systems, Delta offers innovative laser-light source DLP slim cubes video wall and LED display solutions integrated with DVCS (Distributive Vision Control Systems) for large area video walls.

High Performance Projector

Delta's high performance projectors include the world's first 8K projector. Our projectors can customize brightness with optimal lamp/ ballast selection. The projectors come with multiple optional lenses to meet versatile installation flexibility and featured with edge blending and warping capability. Delta also offers tailored colorimetry/contrast to meet home cinema or E-cinema requirement, and specialty design to meet simulator partners' requirements.

Multimedia Projector

As a leading professional design and manufacturing team, we offer total system solution service in commercial and multimedia projection display world.

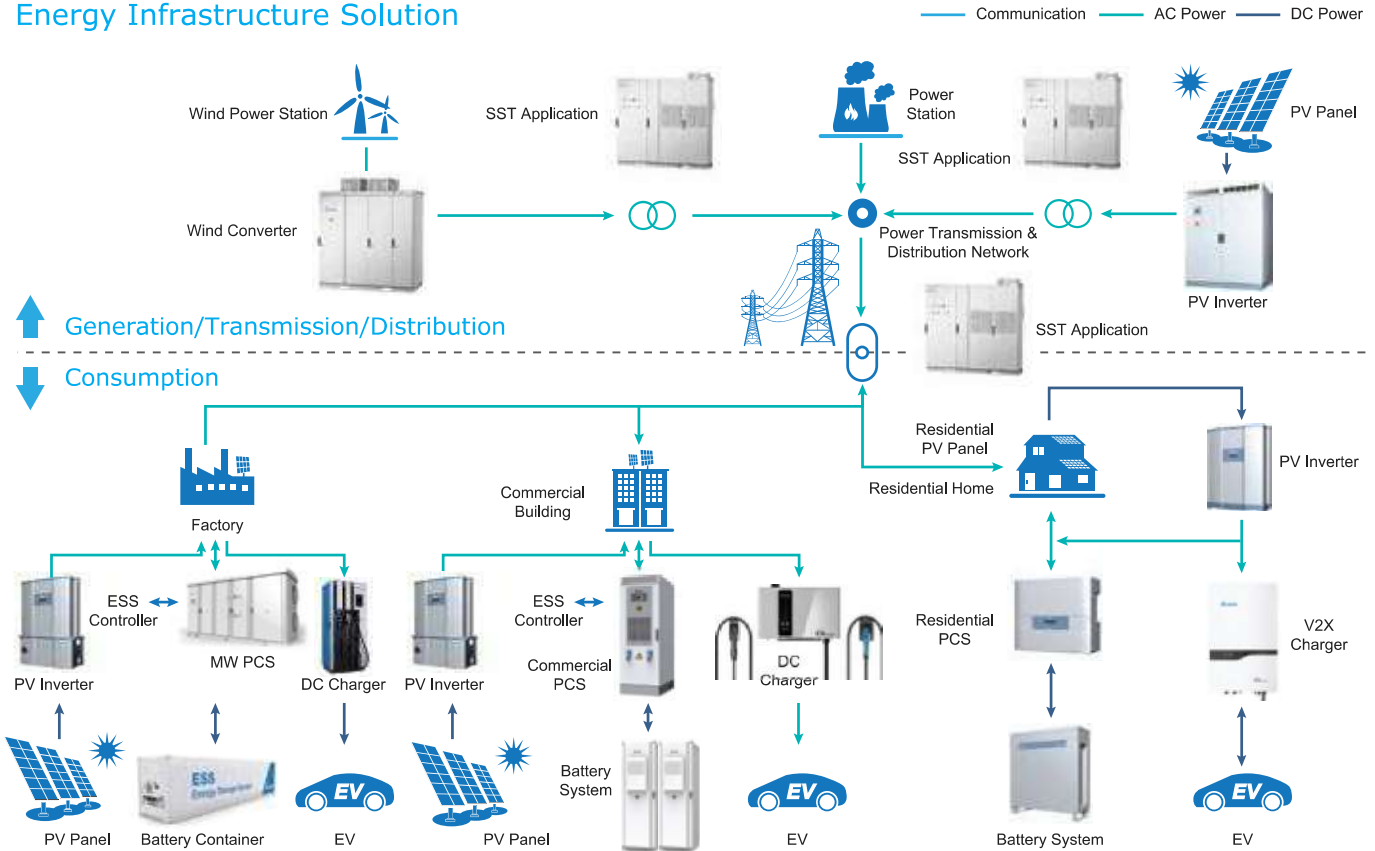
- Offer total system solution service in commercial and multimedia projection display world
- Projector designs to fulfill different kind of needs

DLP, LED and LCD Video Wall

- DLP; an extensive product portfolio with over 40 "off-the-shelf" products
- LCD; designed to deliver even the largest images with stunning clarity with its super-slim bezel
- LED; latest indoor LED products are high resolution LED display

Renewable Energy

Energy Infrastructure Solution



EV Charging

EV Charging Infrastructure Solution



- Scalable and customizable solution
- Optimize CapEX and OPEX to maximize charging efficiency and profitability
- Optimize energy efficiency with smart charging and energy allocation
- Reducing peak load impact on grid

| Management System | Energy Storage | Solar Inverter | EV Charger |
|--|--|---|--|
| <ul style="list-style-type: none"> • Manage multiple energy sources • Optimize energy consumption • Avoid overloading | <ul style="list-style-type: none"> • Peak shaving & load shift • Backup power • Bi-directional; demand-response enabled | <ul style="list-style-type: none"> • Provide clean energy • Integrate with energy storage & management system | <ul style="list-style-type: none"> • Supply electricity to EVs • Backup power for buildings <p>Specification</p> <ul style="list-style-type: none"> • AC Charger (7.4/ 11/ 22kW) • DC Charger (25/ 50/ 150kW) |

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.



2010
Panasonic Electric Networks
Certificate of Appreciation



2010
Cisco
Partner Collaboration
Excellence Award



2008
Fujitsu Siemens
Computers Preferred
Supplier Award



2008
Nokia Siemens
Outstanding Performance
Award



2007-2008
Fabulous 50
Award



2007
Intel
Supplier Achievement Award



2007
Rockwell
Outstanding Performance
Award



2005
Siemens Communications
Supplier of the Year Award



2004
Cisco
Supplier of the Year Award



2004
Microsoft
Vendor of the Year Award



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 (%) |
|-------------------------------------|--------------------------|------------------------------------|
| $V \leq 1.0\text{kV}$ | 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_{sc}/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_{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

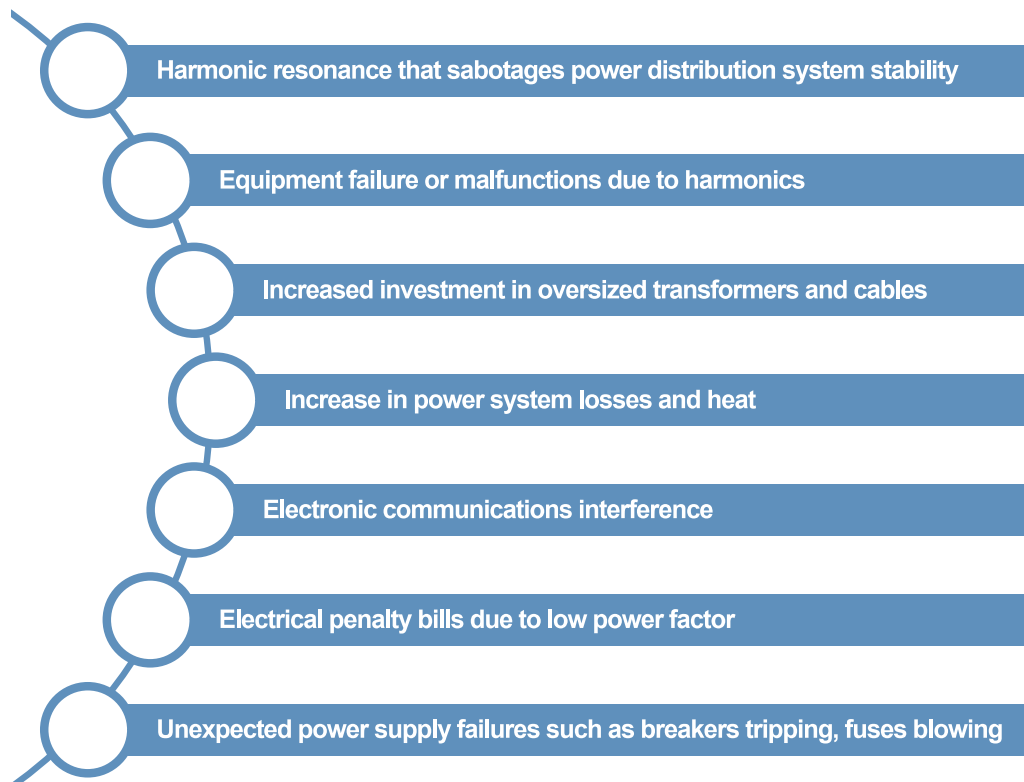
In most cases, reactive power is the power that magnetic equipment such as transformers, motors and relays, needs to produce magnetizing flux, which is inductive. In some cases, long distance power cables and some loads generate capacitive reactive power. Both inductive and capacitive reactive power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

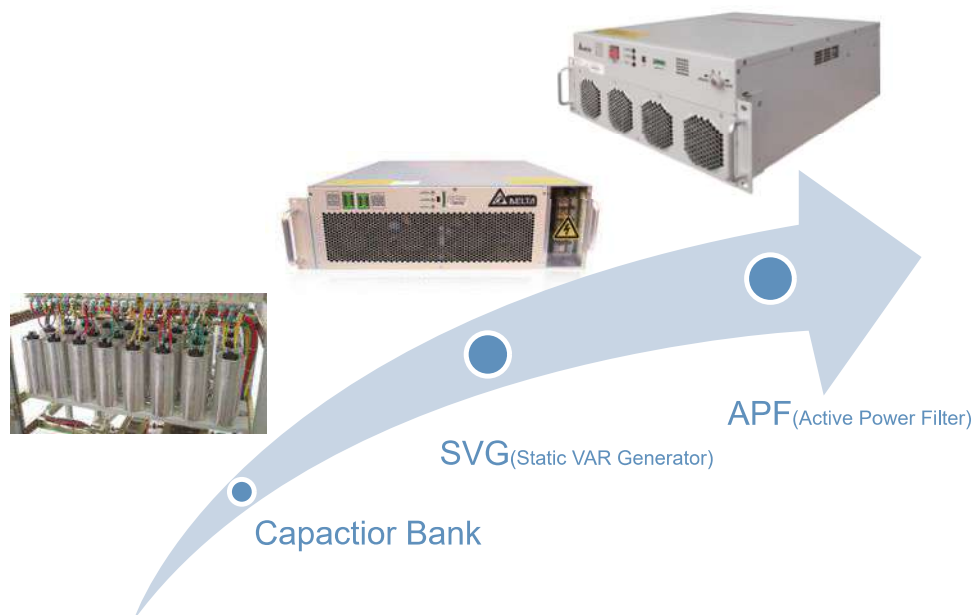
Poor Power Quality can be described as any event related to the electrical network that ultimately results in a financial loss. Possible consequences of poor Power Quality include:



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. |

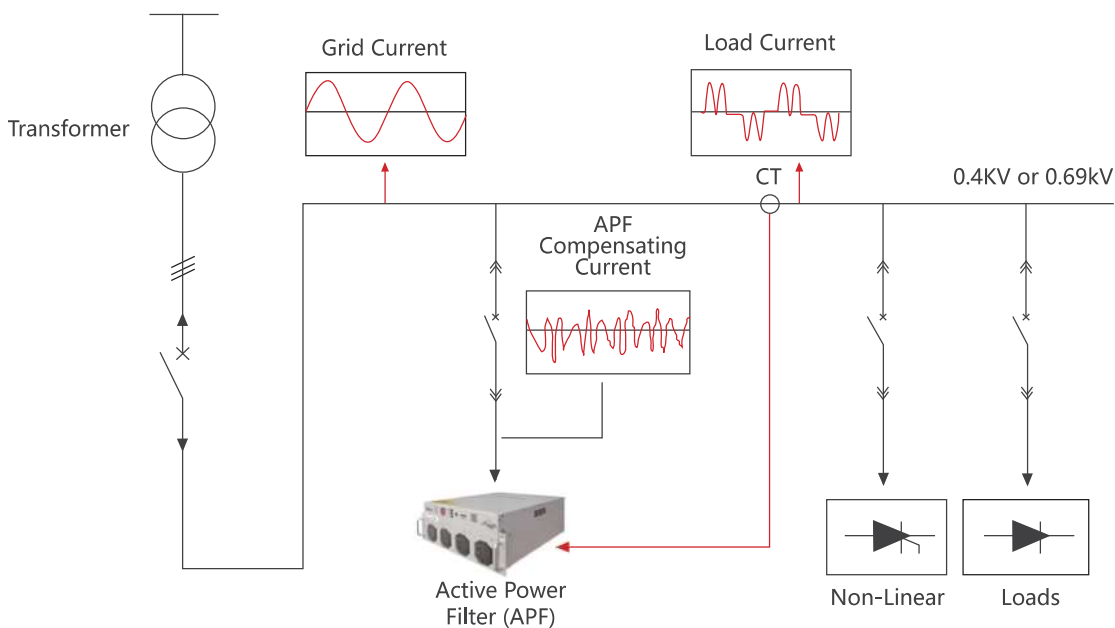
Delta PQC Series Active Power Filter (APF)

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.

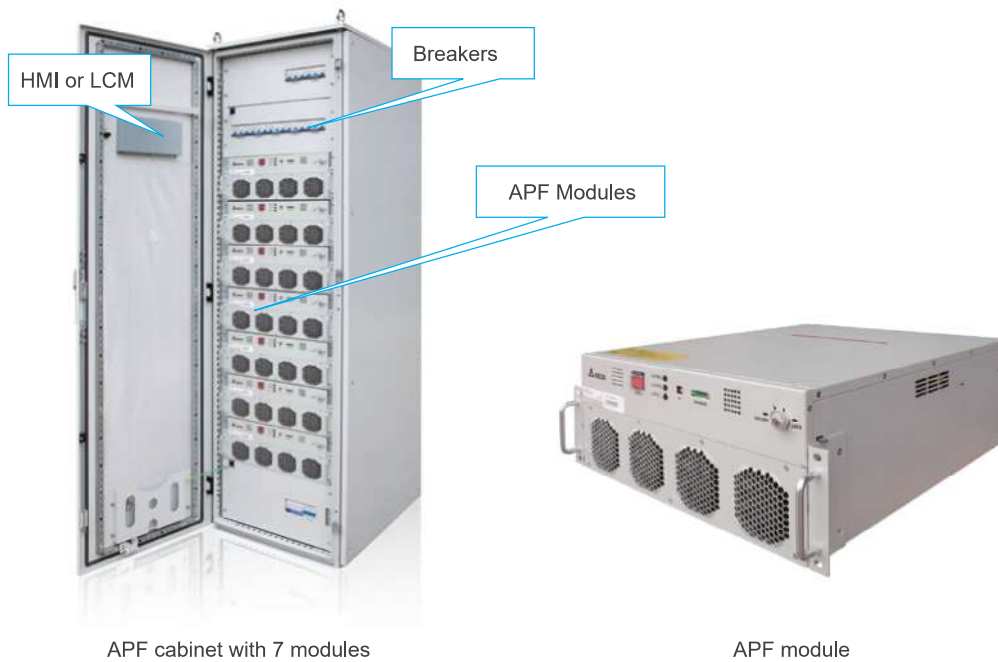
According to the mounting type, Delta PQC series APF can be divided into Modular APF (rack mounting) and Wall-mounted APF.

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



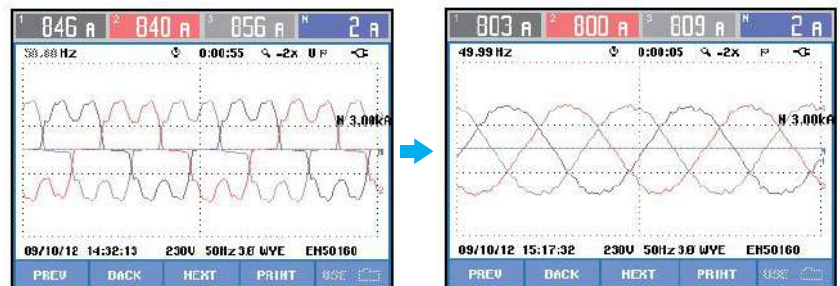
Application: Textile Industry

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.

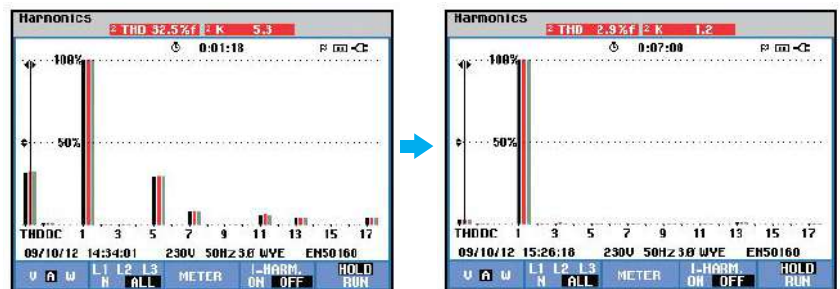
Current Waveform



BEFORE

AFTER

Current Spectrum



BEFORE

AFTER



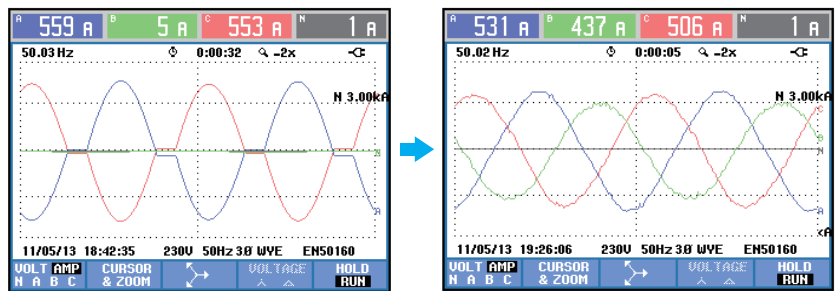
Application: Foundry Industry

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.

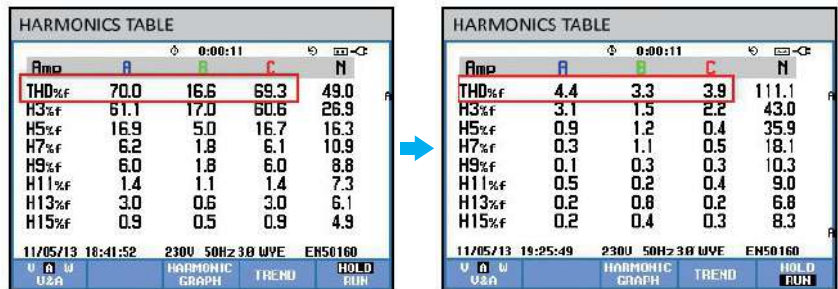
Current Waveform



BEFORE

AFTER

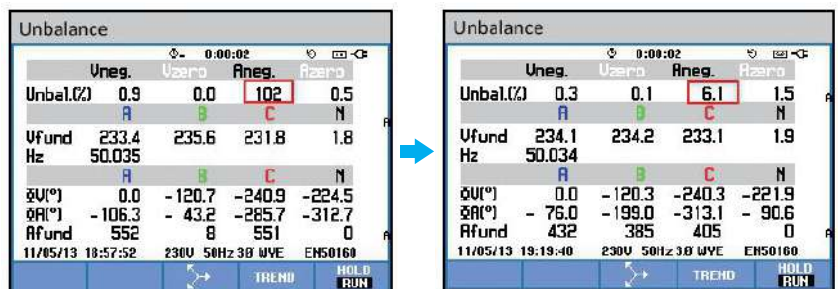
Current Spectrum



BEFORE

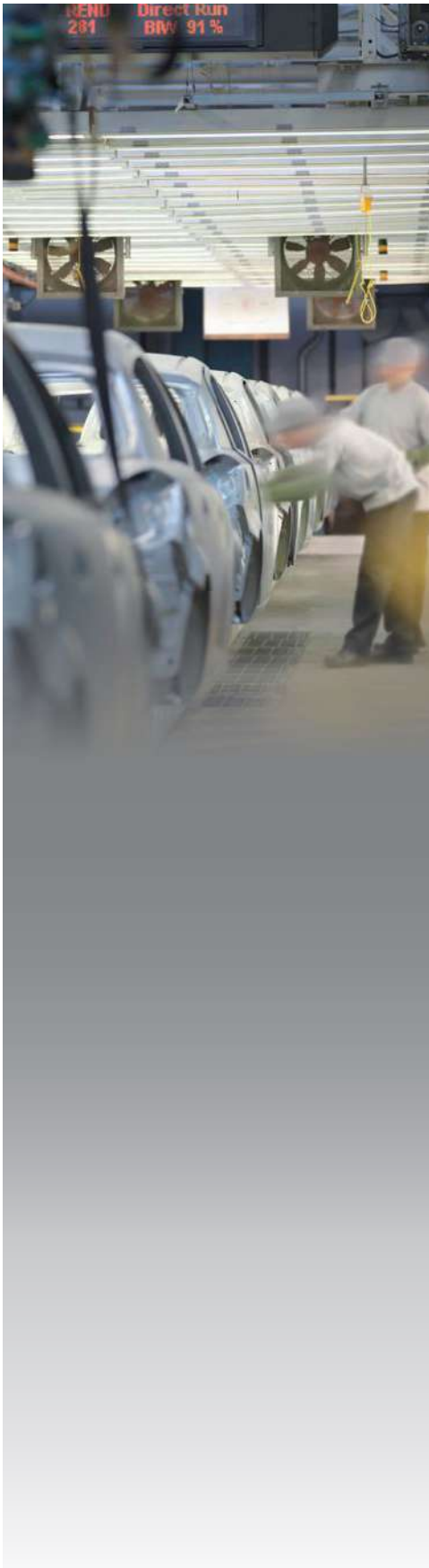
AFTER

Load Unbalance



BEFORE

AFTER



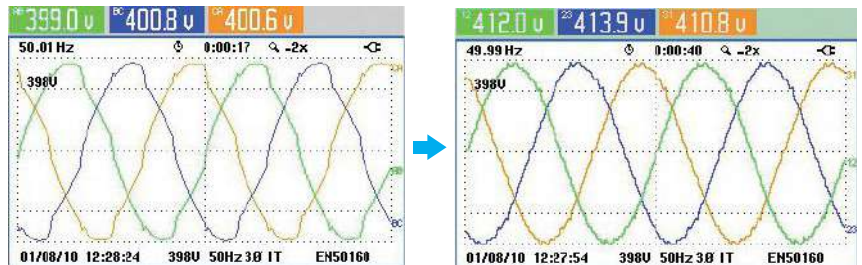
Application: Automobile Industry

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.

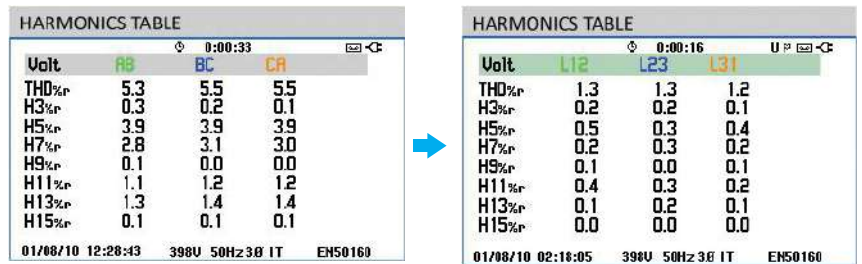
Voltage Waveform



BEFORE

AFTER

Voltage Spectrum

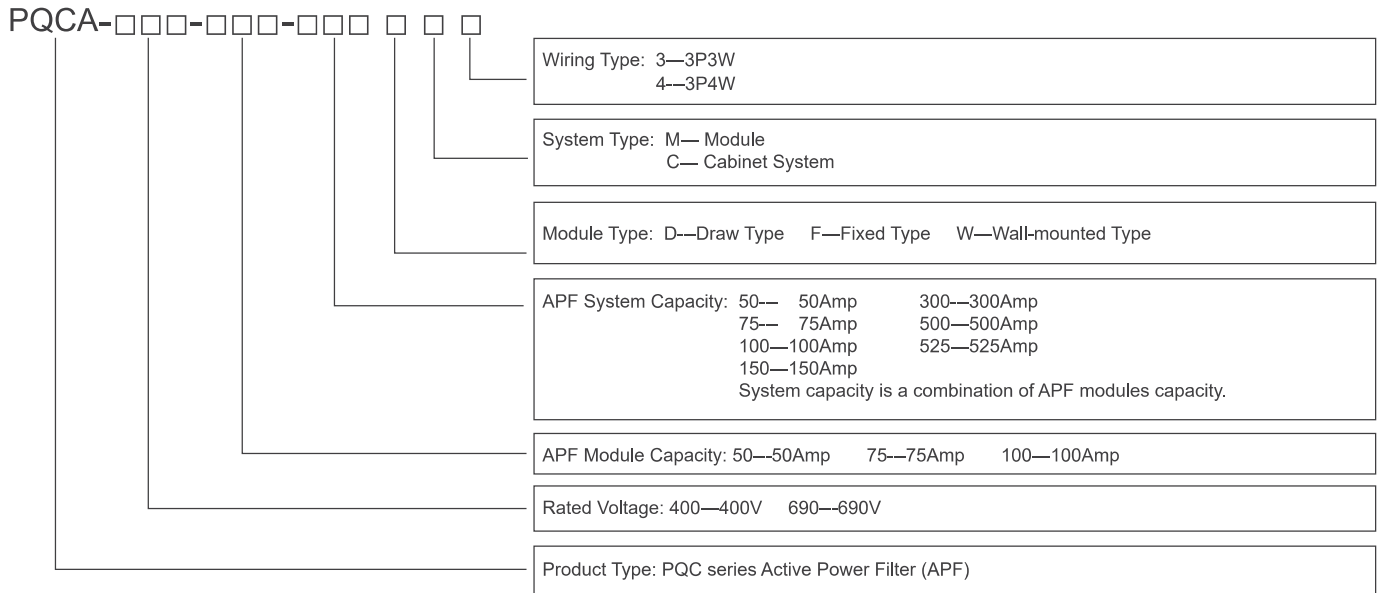


BEFORE

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 | | | |
| | Monitoring | PQC Monitor Software (Optional) | | | |
| Physical Specification | 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 | | | |
| | Dimension | Refer to APF Model table | | | |
| | Weight | Refer to APF Model table | | | |
| Environmental Requirement | 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) | | | |

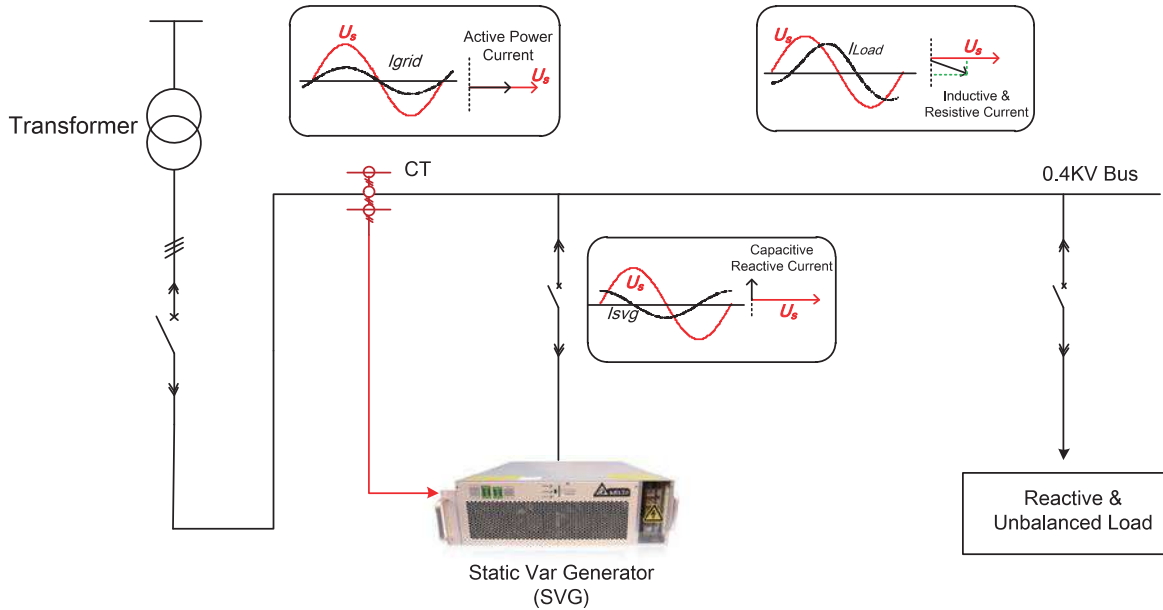
Delta PQC series Static Var Generator (SVG)

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>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, 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 ($\text{Cos}\phi$) ≥ 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 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 | |
| A rms | 1335 | 1349 | 1362 | |
| U rms 233.23 233.06 232.90 | | | | |
| 09/19/12 14:21:28 230V 50Hz 3Φ WVE ENS0160 | | | | |

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 | |
| A rms | 1116 | 1128 | 1142 | |
| U rms 236.72 236.68 236.49 | | | | |
| 09/19/12 16:14:31 230V 50Hz 3Φ WVE ENS0160 | | | | |

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 | |
| A rms | 2385 | 2418 | 2436 | |
| U rms 223.80 225.55 225.48 | | | | |
| 04/14/13 16:53:01 230V 50Hz 3Φ WVE ENS0160 | | | | |

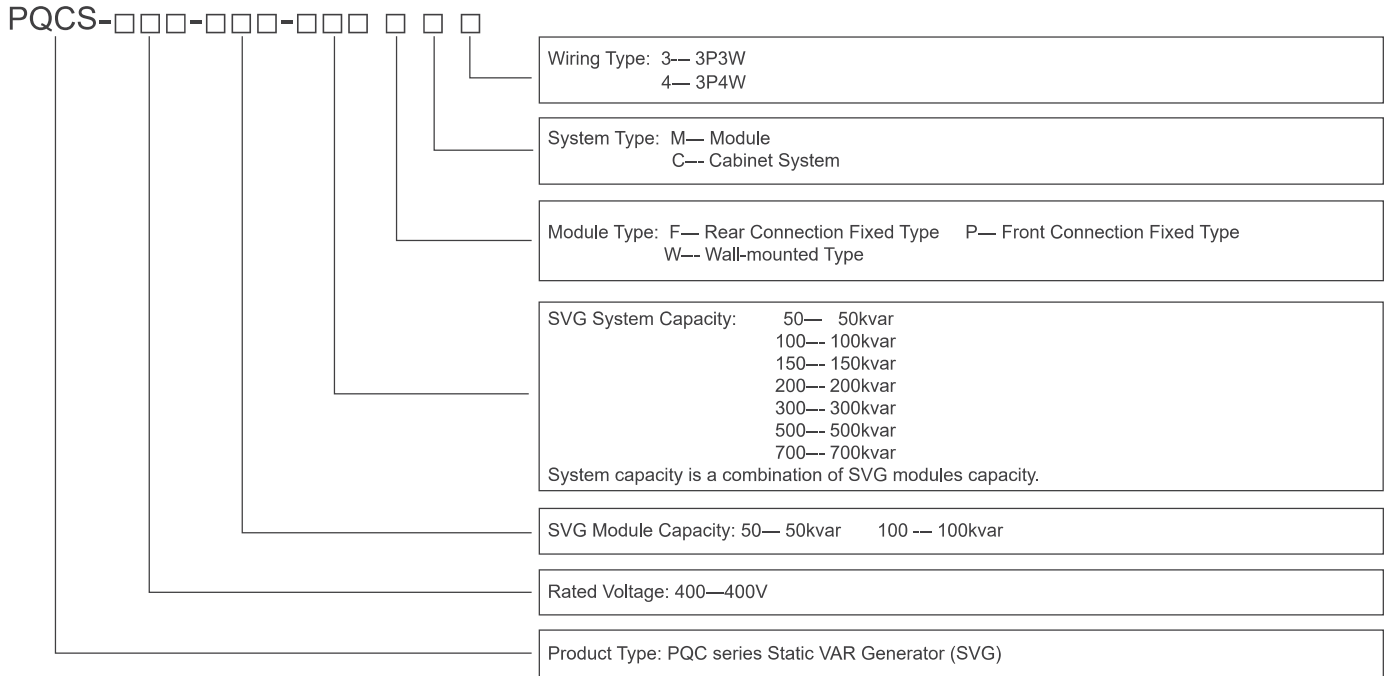
BEFORE

| 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 | |
| A rms | 1251 | 1267 | 1289 | |
| U rms 225.33 223.80 225.62 | | | | |
| 04/12/13 00:48:05 230V 50Hz 3Φ WVE ENS0160 | | | | |

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 (W×D×H) | Weight (kg) |
|-----------------------------------|--------------------|------------------------|--------------|-------------------|-------------|
| Independent Module System | Wall-mounted | PQCS-400-50-50WM4 | 50kvar | 440×174×600mm | 30 |
| | Fixed Type Modular | PQCS-400-50-50FM3(4) | 50kvar | 440×522×174mm | 30 |
| | | PQCS-400-100-100PM3(4) | 100kvar | 600×606×190mm | 57 |
| Cabinet System (Multiple Modules) | Fixed Type Cabinet | PQCS-400-50-50FC3(4) | 50kvar | 600×800×2000mm | 200 |
| | | PQCS-400-50-100FC3(4) | 100kvar | 600×800×2000mm | 240 |
| | | PQCS-400-50-150FC3(4) | 150kvar | 600×800×2000mm | 280 |
| | | PQCS-400-50-200FC3(4) | 200kvar | 600×800×2000mm | 320 |
| | | PQCS-400-50-250FC3(4) | 250kvar | 600×800×2000mm | 360 |
| | | PQCS-400-50-300FC3(4) | 300kvar | 600×800×2000mm | 400 |
| | | PQCS-400-50-350FC3(4) | 350kvar | 600×800×2000mm | 440 |
| | | PQCS-400-100-100PC3(4) | 100kvar | 800×1000×2000mm | 370 |
| | | PQCS-400-100-200PC3(4) | 200kvar | 800×1000×2000mm | 430 |
| | | PQCS-400-100-300PC3(4) | 300kvar | 800×1000×2000mm | 490 |
| | | PQCS-400-100-400PC3(4) | 400kvar | 800×1000×2000mm | 540 |
| | | PQCS-400-100-500PC3(4) | 500kvar | 800×1000×2000mm | 600 |
| | | PQCS-400-100-600PC3(4) | 600kvar | 800×1000×2200mm | 710 |
| | | PQCS-400-100-700PC3(4) | 700kvar | 800×1000×2200mm | 770 |

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: 50kvar~350kvar for a single cabinet, up to 10 cabinets in parallel
- Environmental adaptability: $-10 \sim 50^{\circ}\text{C}$ temperature, 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 308V~480V |
| | Electric Connection | 3P3W / 3P4W |
| | Rated Frequency | 50(60)Hz $\pm 10\%$ |
| | 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 | $\text{Cos}\phi \geq 0.99$ 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 | $\leq 3\%$ of SVG rated capacity |
| | Output Current Limitation | Automatic (100% rated capacity) |
| | Parallel Expansion(System) | Up to 10 Racks(7 modules per cabinet) |
| | Control Technology | MTBF |
| Switching Frequency | | 30kHz |
| 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 | < 60dB(A) @1m (Module) |
| | Dust Filter | Optional |
| | Dimension | Refer to SVG Model table |
| Environmental Requirement | 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 | $\leq 1000\text{m}$ 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.



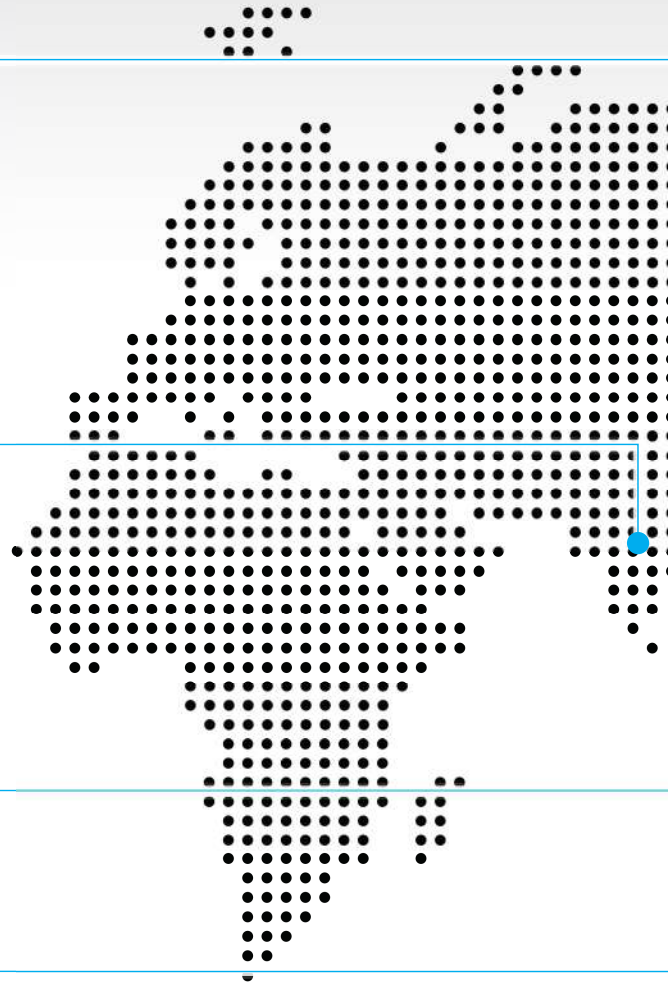
The **PQC series APF** protects the power distribution system from harmonics interference for the largest telecom company in India.



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.



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.



www.onesmartfactory.com



@onesmartfactory



Facebook

Bigphaisan Project Co.,Ltd

25/34-38 47-51, Sukhumvit Soi 27, Pak Nam, Mueang Samut Prakan District, Samut Prakan 10270

Tel : 02-755-2688 | Line : @onesmartfactory