



Automation for a Changing World

Delta Active Power Filter APF2000 Series



www.delta.com.tw/ia

 **DELTA**
Smarter. Greener. Together.

APF2000 - Advanced Power Quality Improvement Solution

Delta's Active Power Filter APF2000 is your key to a clean grid for more efficient production. It adopts the industry's highest standard 32-bit digital microprocessor to instantly compensate for all types of harmonics for ultimate power quality improvement.

The APF2000 is compact in design and provides flexible installation methods for users to efficiently manage their space. It is also mounted with Delta's 65,536-color TFT HMI for more realistic images and a vivid display. Delta's APF2000 is the best solution for harmonic distortion, voltage and current distortion, reactive power loss and load imbalances. Improve your power quality, lower energy loss and lower your maintenance costs with Delta's Active Power Filter APF2000.





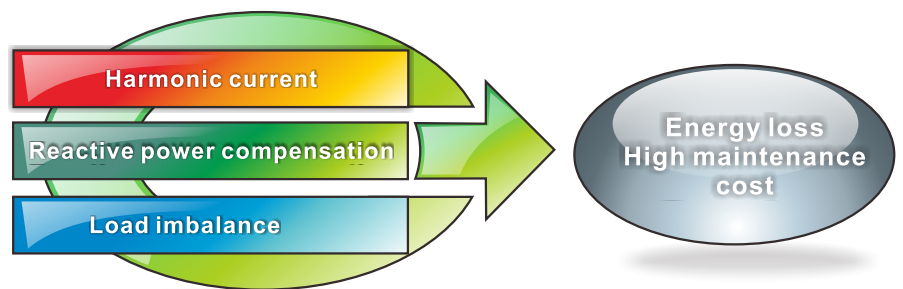


Overview of Power Quality Improvement

■ Power quality has a major influence on power efficiency

Today's automation equipment benefits us with greater convenience as well as cost savings from higher production efficiency. However, it can also bring significant wave distortion problems to the power grid that can lead to energy loss, increasing costs and many other power quality issues.

A clean and efficient power system normally generates a sinusoidal current waveform, but the electric equipment used in today's industrial automation industry generates non-sinusoidal currents that tend to cause many power quality problems. Voltage or current distortion, reactive power impact, and unbalanced loads, are common problems that lower power reliability and power efficiency and also increase operation costs. Major concerns in the industrial automation industry are how to improve power quality and how to manage power grids.



■ Harmonic interference increases operation cost

- Traditional reactive power compensation capacitance devices have a high chance of overloading that may burn out chips or create a fire hazard.
- High order harmonic distortion increases the possibility of heating up electric cables and copper bars which eventually wears off the insulation and shortens its lifespan.
- Excess harmonic peak voltage may break through the equipment's input module and decrease operation reliability.
- Excess harmonics may cause the malfunction of low and mid power systems and also interfere with the communication systems.
- Harmonic interferences would cause load imbalances which would lead to operation safety problems.
- A large amount of zero sequence current in the system causes neutral current to over-peak. In certain single phase load applications, neutral current might exceed phase line current and cause serious overload failure.

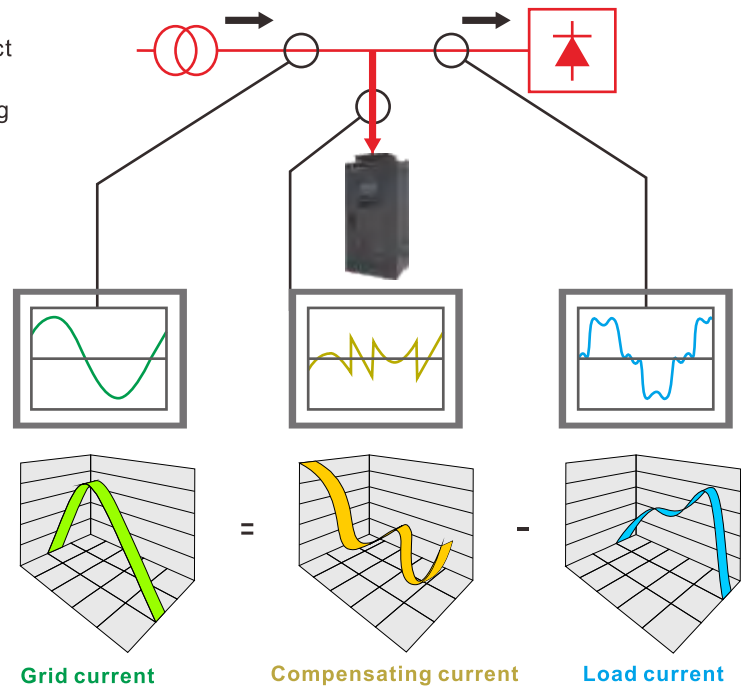


■ Reactive power compensation and load balance increases power efficiency

- Improves reactive power to meet the standard limit and avoid penalties.
- Increases power factor to improve power efficiency.
- 3-phase energy balancing to decrease energy waste.
- Lower system current avoids overheating of inverters, copper bars and cables.

Concept of Active Power Filter

Delta's Active Power Filter - APF2000 is a power filter device that can monitor load current and filter harmonics in real-time to maintain a clean line current. It monitors the load current in real-time using a current transformer and injects the exact opposite phase to the network of components that are to be filtered. It can also provide leading and lagging reactive current in real-time to improve the power factor and compensate reactive power.



Applications

- **Metallurgy and petrochemicals industries:**
rectifier, converter, rolling mill, electric arc furnace, medium frequency furnace, inverter
- **Chemical and electrolysis industries:** rectifier, calcium carbide furnace, electric soldering, inverter
- **Mechanical industries:** rectifier, rolling mill, inverter, electric arc equipment
- **Metal, paper, plastic processing and textile industries:**
rectifier, rolling mill, inverter, electric arc furnace, electric furnace
- **Transportation industries:**
the rectifier and the inverter of electric vehicles, electric motorcycles and metro systems
- **Automobile manufacturing industry:**
soldering equipment, car painting equipment, battery charger and inverter
- **Telecommunication, medical and construction industries:**
server station, EPS, UPE, converter, charger, inverter



APF2000 System Structure



■ APF Power Quality Improvement System

- 7" HMI TFT LCD 65536 Color (800 x 600)
- Real-time and continuous monitoring of grid data and 3-phase wave form
- 100 sets of error records
- Data logging and export
- USB Host and plug-in USB disk
- Supports SD card
- Ethernet monitoring and control

■ Optimized Ventilation Design

- Modular fan design
- Continuous variable transmission (CVT) fan
- Highly efficient heat pipe ventilation system

■ Hardware Modularized Design

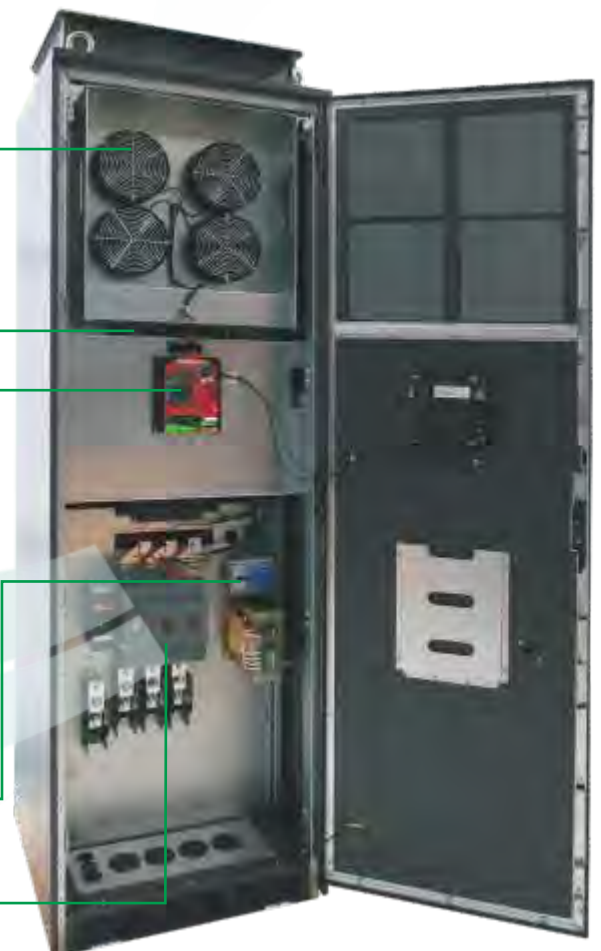
- Easy-to-assemble power factor module
- Digital signal integrated circuit board
- Plug-in capacitance module

■ Digital Signal Processing (DSP) Control

- Filter self diagnosis
- Intensified overloading protection
- Innovative PWM variation technology
- Multi-functional programmable digital input/output terminals

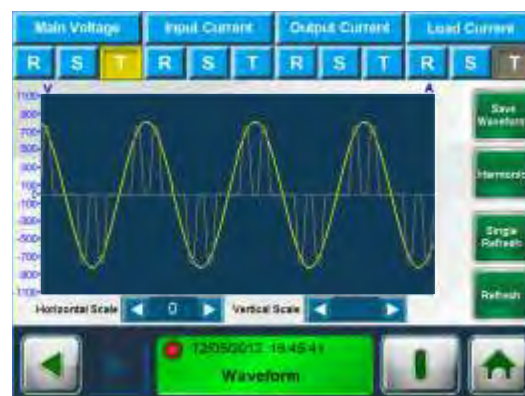
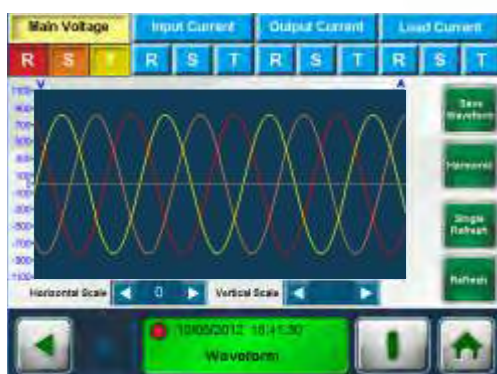
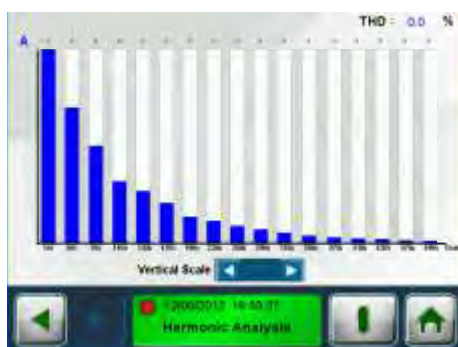
■ Built-in High Voltage Lightning Protection Module

■ Standard Power Input with Hardware Protection



*optional insulation fuse switch or non-fuse breaker

APF2000 Power Quality Improvement System



■ Quick Start Wizard

Quick and simple set up with one-press, easy installation step-by-step.



■ Data Logging

Records 9 sequential history data. Easy export to SD card or USB disk.



■ Waveform Display

Display and analyze up to 12 wave and harmonic forms synchronously and real-time monitoring of the power quality status.



■ System Setting

Communication type/Operating mode/Alarm level/Multi-functional output terminal.



■ Advanced Functions

Access control for different users and advanced settings for different applications.

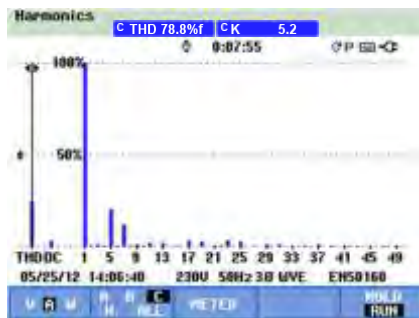


■ System Status

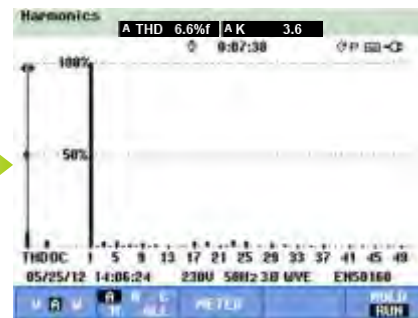
Review error/maintenance records. The system also has a self-diagnosis function to check basic settings and hardware.

APF2000 Product Features

 Excellent Filtering Result

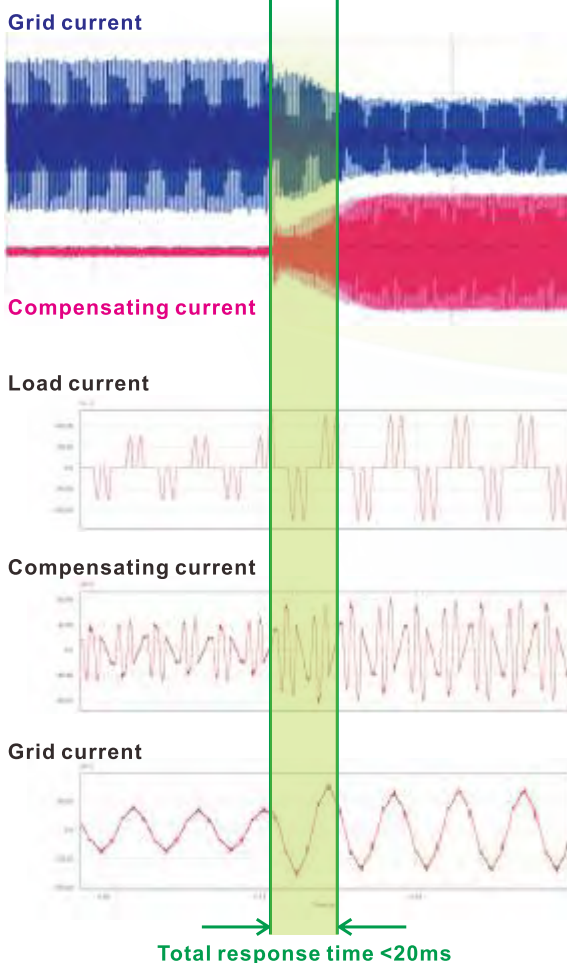


Total current distortion BEFORE compensation



Total current distortion AFTER compensation

Real-time Response and Current Compensation



Compensation to Current, Harmonics and Power Factor

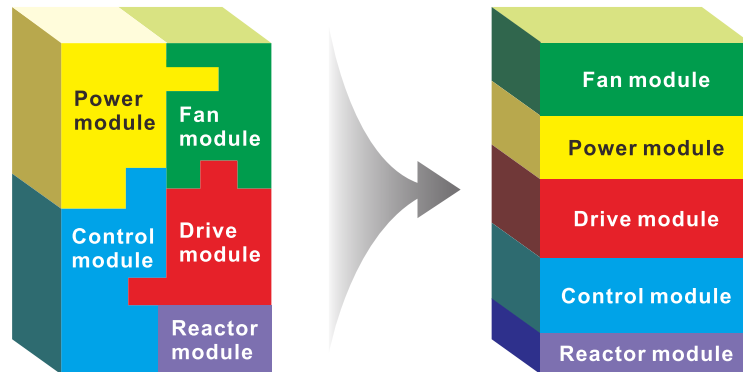
Function Mode	Harmonics Compensation	Reactive Power Compensation & Power Factor Correction	Load Balance
Harmonics & Power Factor	Yes	Yes	Yes
Harmonics	Yes	No	Yes
Power Factor	No	Yes	Yes

* Compensation priority: > > ; No Compensation:



Advanced Modular Design

- Safe, reliable, labor-saving



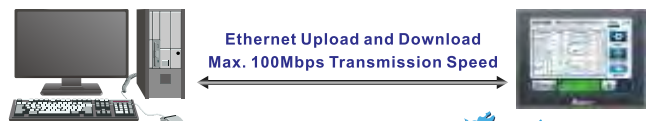
High-speed Network, Remote Monitoring and Control

- Provide diversified communication network and optional fieldbus card
- Built-in RS-485 protocol
- Advanced network functions

- MODBUS TCP



- * CANopen (DS301)

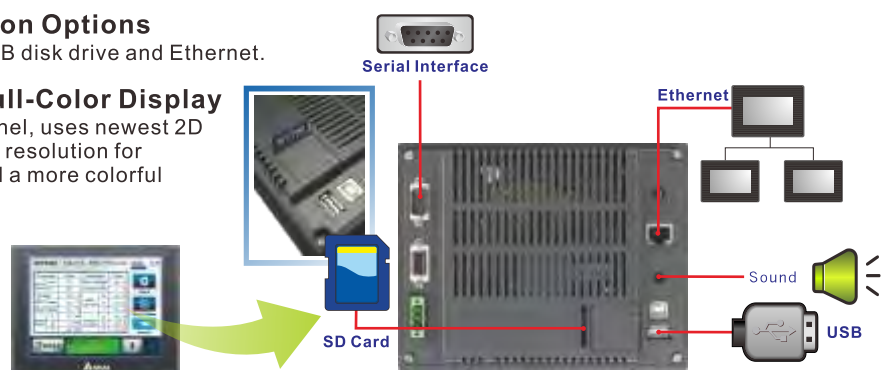


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Remote monitoring and control, no matter where you are.

Excellent Operation Interface

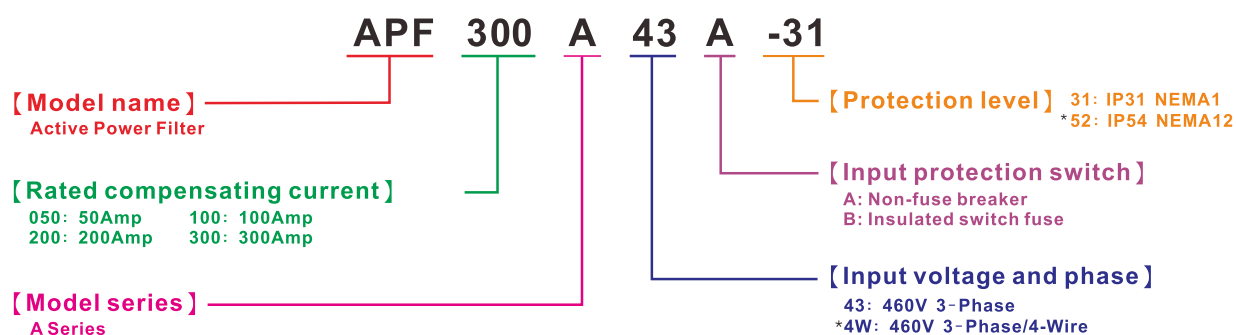
- Diversified Extension Options
Supports RS-232/485 USB disk drive and Ethernet.
- High Quality and Full-Color Display
65,536 color TFT LCD panel, uses newest 2D drawing technology. High resolution for more realistic images and a more colorful and vivid display.



Filter Comparison Chart

Characteristics	APF	LC Passive Filter	TSF Switching Passive Filter
System structure	Complex, high technology is required.	Simple	Complex
Operation & Maintenance	Easy-to-use Touch Panel	Very simple and convenient	Complex
Harmonic compensation	Compensate Up To 50th Order Harmonics	Only compensates certain order of harmonic	
Harmonic filtering effect	95% and above	Up To 50~80%, Corresponding to System Impedance	
Dynamic harmonics compensation	Strong compensation ability	No compensation	Only to certain order of harmonics
Harmonics filtering + reactive power compensation	Continuously outputs smooth and adjustable reactive power	Fixed reactive power output	Reactive power compensation for different order of harmonics
		Filtering and reactive power compensation action are inconsistent	
Characterisitic of reactive power compensation	Lagging Or Leading Reactive Power	Normally only output leading reactive power	
Unbalanced phase compensation	YES	N/A	Yes
Dynamic filtering responding speed	Fast (300μs~1ms)	N/A	Slow: ~100ms
Overloading	Auto current limit protection to prevent equipment from overload	No protection. Possible damage may occur when the amount of harmonic current exceeds the system rated capacity	
Analyze grid impedance before choosing model type	No need	YES. Verify the harmonic condition to prevent exaggeration	
Is filtering effect influenced by system impedance changing	NO	YES. At certain frequencies, the harmonic current resonance is expanding and may cause system overvoltage or overcurrent.	
Ability to suppress system resonance	YES	NO	
Capacity Expansion	YES. Via parallel connection	NO. Parallel or serial connection will impact the filtering effect and reactive power output capacity.	

Model Name



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Delta APF2000 Applications

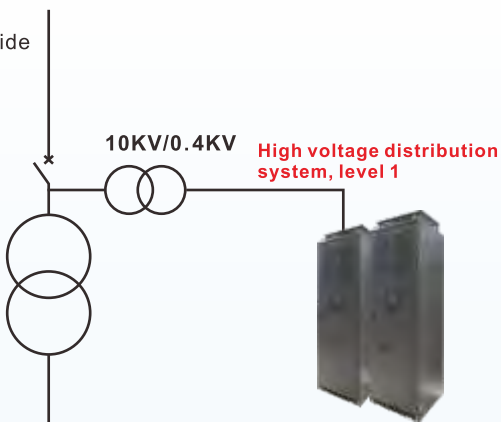
Concentrated control

- **APF input terminal:** 10KV at transformer input side
- **Product:** APF2000 series
- **Harmonic current improvement:**
THDI < 5% : THDU < 3%
- **Power factor:** > 0.96

Main electricity distribution system



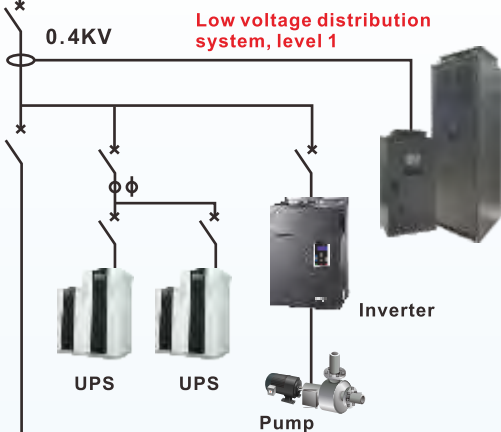
Transformer



Low pressure concentrated control

- **APF input terminal:** at transformer input side
- **Product:** APF2000 series
- **Harmonic current improvement:**
THDI < 5% : THDU < 3%
- **Power factor:** > 0.96

Low voltage distribution system



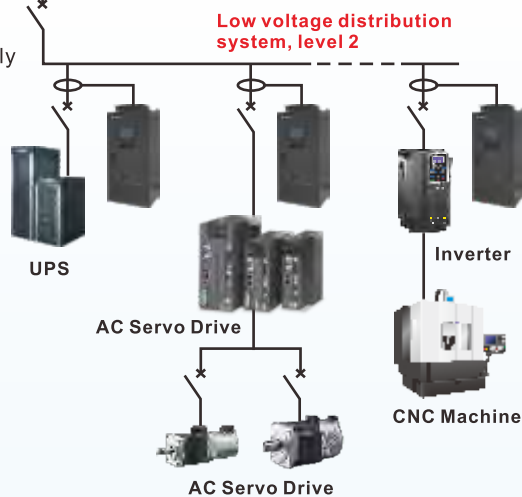
Area control

- **APF input terminal:** at a different area or floor, near AC main power switch
- **Product:** APF2000 series
- **Harmonic current improvement:**
THDI < 5% : THDU < 3%
- **Power factor:** > 0.96

Terminal control

- **APF input terminal:** install between the equipment and power supply
- **Product:** APF2000 series
- **Harmonic current improvement:**
THDI < 5% : THDU < 3%
- **Power factor:** > 0.96

Control room and power distribution system





Basic Specifications

Model		APF50A43X-31	APF100A43X-31	APF200A43X-31	APF300A43X-31
Rated Compensation Current		50A	100A	200A	300A
Rated Voltage		200V~480V			
Voltage Tolerance		-10%~+10%			
Grid Frequency		50Hz or 60Hz			
Frequency Tolerance		-5%~+5%			
Cooling Method		Force Air Cooling (Fan Cooling)			
Current Transformers Ratio (CT Ratio)		50 : 5 to 10,000 : 5			
Power Loss		<1500W	<2800W	<6000W	<9000W
Noise Level (ISO 7779)		63dBA	68dBA	70dBA	70dBA
Cable Entry		Bottom	Bottom	Bottom/Top	
Installation Method		Wall-mounted	Wall-mounted	Cabinet	
Dimensions (mm) Width x Height x Depth	A *1	370x590x311	423x1101x440	630x2130x656	
	B *1	370x590x345	445x1101x440	630x2130x680	
Weight (Kg)		50kg	90kg	350kg	370kg
Enclosure Rating		IP31(NEMA1)	IP31(NEMA1)		
Approvals		CE · UL · cUL · C-Tick			

【*1】 A=APFXXXA43A : B=APFXXXA43B

Technical Specifications

Step Response Time	<300μs
Total Response Time	<20ms
Carrier Frequency	15kHz
Harmonic Compensation	2nd to 50th harmonic
Harmonic Compensation Ratio	≥ 95%
Parallel Configuration	2~6 units
Human Machine Interface	65535 Colors 7" Touchscreen
Data Storage	USB Drive, SD Card
Communication Port	RJ45(Ethernet), D-Sub(RS-232), RJ45(RS-485)
Communication Protocol	MODBUS · MODBUS TCP *Optional: DeviceNet · PROFIBUS · CANopen

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Environment for Operation, Storage and Transportation

Environment Temperature	-10℃ ~ +45℃	
Installation Location	IEC60364-1/IEC60664-1 Pollution degree 2 · Indoor use only	
Surrounding Temperature	Storage / Transport	-25℃ ~ +70℃
	Non-condensation, non-frozen	
Rated Humidity	Operation	Max. 90%
	Storage / Transport	Max. 95%
	Non-condensation, non-frozen	
Atmosphere pressure	Operation / Storage	86 to 106 kPa
	Transport	70 to 106 kPa
Pollution Level	IEC60721-3-3	
	Operation	Class 3C2 ; Class 3S2
	Storage	Class 2C2 ; Class 2S2
	Transport	Class 1C2 ; Class 1S2
	Non-condensation, non-frozen	
Altitude	Operation	0-1000m : rated capacity usage 1000~3000m : when it goes above 1000m decrease 2% of rated current or lower 0.5 ℃ for every 200m increase in altitude.

DO NOT expose the Active Power Filter to harsh environments, such as dust, direct sunlight, corrosive/ inflammable gasses, humidity, liquid or vibrations. The salt in the air must be less than 0.01mg/cm² per year.

Regulation Standards

International Standards	
IEEE519-1992	IEC/EN61000-2-2
IEC/EN61000-3-12	IEC/EN61000-3-3
IEC/EN61000-3-4	IEC/EN61000-2-4
IEC/EN61000-3-2	TOR D2
G5/4	D-A-CH-CZ

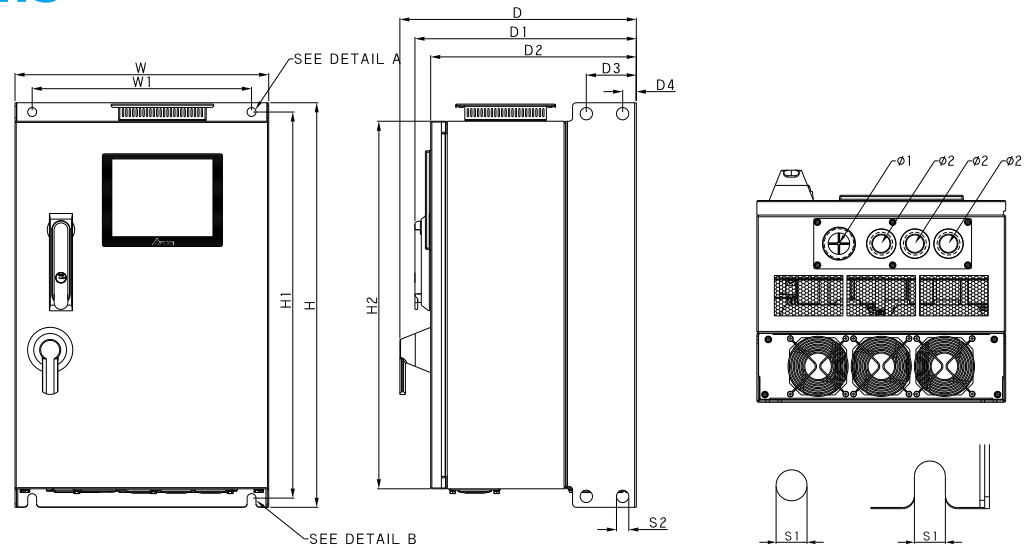
China National Standards
GB/T14549-93 (Quality of Electric Energy Supply Harmonics in Public Supply Network)
SD 126-84 Power System Harmonic Management Interim Provisions
Grid Adjustment Management Regulations

Dimensions

Frame A

MODEL

APF050A43A-31
APF050A43B-31

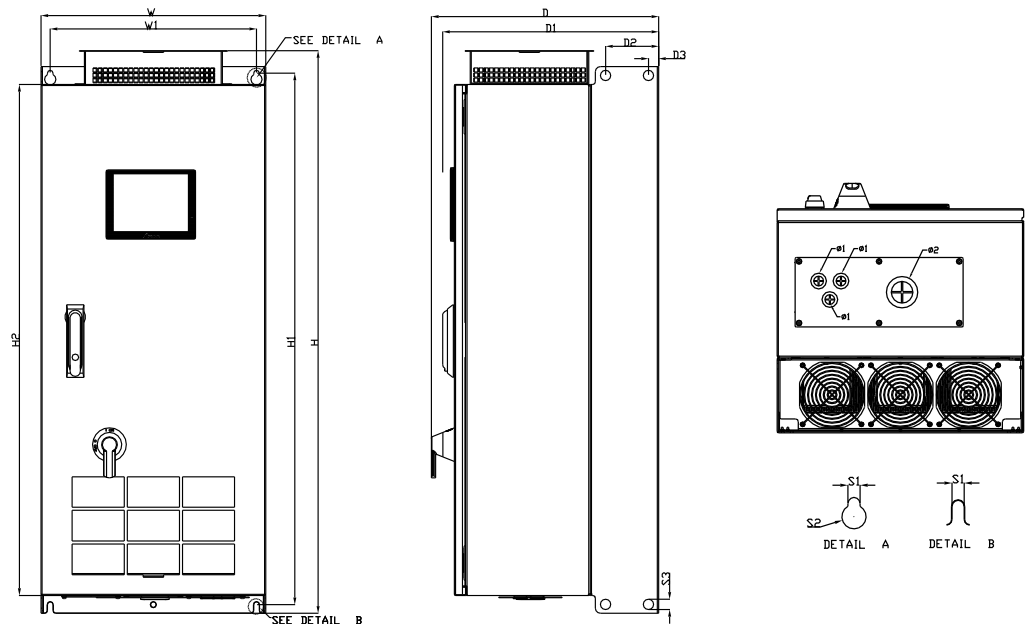


Frame		W	H	D	W1	H1	H2	D1	D2	D3	D4	S1	S2	Ø1	Ø2
APF050A43A-31	mm	370	590	-	320	563	536	323	300	73	20	13	18	44	34
	inch	14.57	23.23	-	12.60	22.17	21.10	12.72	11.81	2.87	0.79	0.51	0.71	1.73	1.34
Frame		W	H	D	W1	H1	H2	D1	D2	D3	D4	S1	S2	Ø1	Ø2
APF050A43B-31	mm	370	590	345	320	563	536	323	300	73	20	13	18	44	34
	inch	14.57	23.23	13.58	12.60	22.17	21.10	12.72	11.81	2.87	0.79	0.51	0.71	1.73	1.34

Frame B

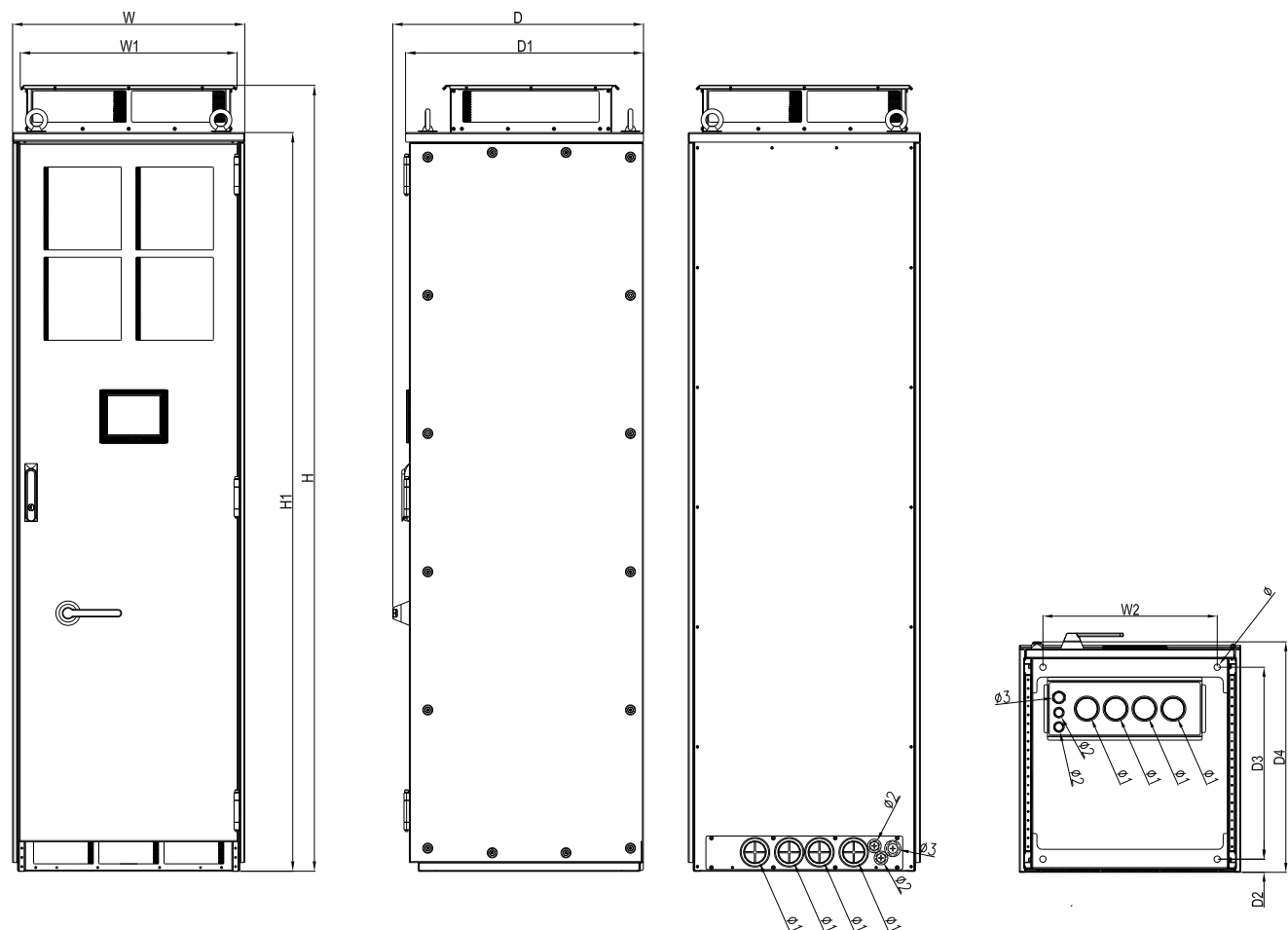
MODEL

APF100A43A-31
APF100A43B-31



Frame		W	H	D	W1	H1	H2	D1	D2	D3	S1	S2	S3	Ø1	Ø2
APF100A43A-31	mm	440	1101	-	404	1040	1000	423	104	20	11	22	20	22.2	50
	inch	17.32	43.35	-	15.91	40.94	39.37	16.65	4.09	0.79	0.43	0.87	0.79	0.87	1.97
Frame		W	H	D	W1	H1	H2	D1	D2	D3	S1	S2	S3	Ø1	Ø2
APF100A43B-31	mm	440	1101	445	404	1040	1000	423	104	20	11	22	20	22.2	50
	inch	17.32	43.35	17.52	15.91	40.94	39.37	16.65	4.09	0.79	0.43	0.87	0.79	0.87	1.97

Frame C



MODEL

APF200A43A-31
APF300A43A-31
APF200A43B-31
APF300A43B-31

Frame		W	H	D	W1	W2	H1	D1	D2	D3	D4
APF200A43A-31 APF300A43A-31	mm	630.0	2130	-	588.4	496.0	2000.0	645.6	37.4	546.0	656.0
	inch	24.80	83.86	-	23.16	19.53	78.74	25.42	1.47	21.50	25.83

Frame		Ø	Ø1	Ø2	Ø3
APF200A43A-31 APF300A43A-31	mm	18.0	61.0	28.0	34.0
	inch	0.71	2.40	1.10	1.34

Frame		W	H	D	W1	W2	H1	D1	D2	D3	D4
APF200A43B-31 APF300A43B-31	mm	630.0	2130	680.4	588.4	496.0	2000.0	645.6	37.4	546.0	656.0
	inch	24.80	83.86	26.79	23.16	19.53	78.74	25.42	1.47	21.50	25.83

Frame		Ø	Ø1	Ø2	Ø3
APF200A43B-31 APF300A43B-31	mm	18.0	61.0	28.0	34.0
	inch	0.71	2.40	1.10	1.34



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Industrial Automation Headquarters

Delta Electronics, Inc.

Taoyuan Technology Center
No.18, Xinglong Rd., Taoyuan City,
Taoyuan County 33068, Taiwan
TEL: 886-3-362-6301 / FAX: 886-3-371-6301

Asia

Delta Electronics (Jiangsu) Ltd.

Wujiang Plant 3
1688 Jiangxing East Road,
Wujiang Economic Development Zone
Wujiang City, Jiang Su Province,
People's Republic of China (Post code: 215200)
TEL: 86-512-6340-3008 / FAX: 86-769-6340-7290

Delta Greentech (China) Co., Ltd.

238 Min-Xia Road, Pudong District,
Shanghai, P.R.C.
Post code : 201209
TEL: 86-21-58635678 / FAX: 86-21-58630003

Delta Electronics (Japan), Inc.

Tokyo Office
2-1-14 Minato-ku Shibadaimon,
Tokyo 105-0012, Japan
TEL: 81-3-5733-1111 / FAX: 81-3-5733-1211

Delta Electronics (Korea), Inc.

1511, Byucksan Digital Valley 6-cha, Gasan-dong,
Geumcheon-gu, Seoul, Korea, 153-704
TEL: 82-2-515-5303 / FAX: 82-2-515-5302

Delta Electronics Int'l (S) Pte Ltd

4 Kaki Bukit Ave 1, #05-05, Singapore 417939
TEL: 65-6747-5155 / FAX: 65-6744-9228

Delta Electronics (India) Pvt. Ltd.

Plot No 43 Sector 35, HSIIDC
Gurgaon, PIN 122001, Haryana, India
TEL : 91-124-4874900 / FAX : 91-124-4874945

Americas

Delta Products Corporation (USA)

Raleigh Office
P.O. Box 12173, 5101 Davis Drive,
Research Triangle Park, NC 27709, U.S.A.
TEL: 1-919-767-3800 / FAX: 1-919-767-8080

Delta Greentech (Brasil) S.A

Sao Paulo Office
Rua Itapeva, 26 - 3º andar Edificio Itapeva One-Bela Vista
01332-000-São Paulo-SP-Brazil
TEL: +55 11 3568-3855 / FAX: +55 11 3568-3865

Europe

Deltronics (The Netherlands) B.V.

Eindhoven Office
De Witbogt 15, 5652 AG Eindhoven, The Netherlands
TEL: 31-40-2592850 / FAX: 31-40-2592851

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