

AHF / APF
(Active Harmonic Filter / Active Power Filter)
Harmonic Compensation solution and
SVG
(Static Var Generator)
Power Factor Correction Solution



APF Functions

APF

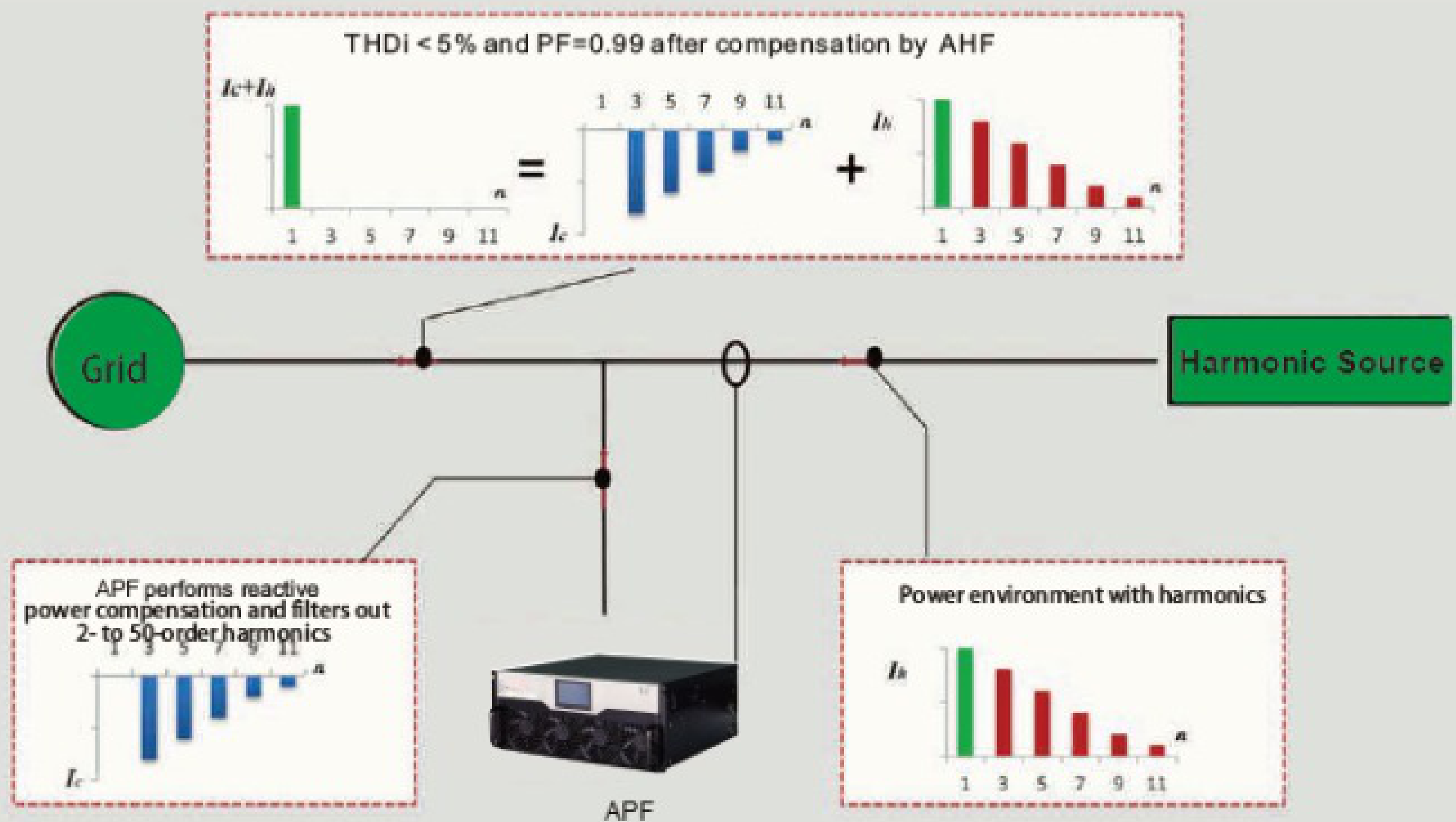
Meeting users' requirements:

- PF=0.99 and THDi < 5%
- Compensation for 2- to 50-order harmonics
- Capacitive and inductive reactive power compensation
- Three-phase unbalance compensation

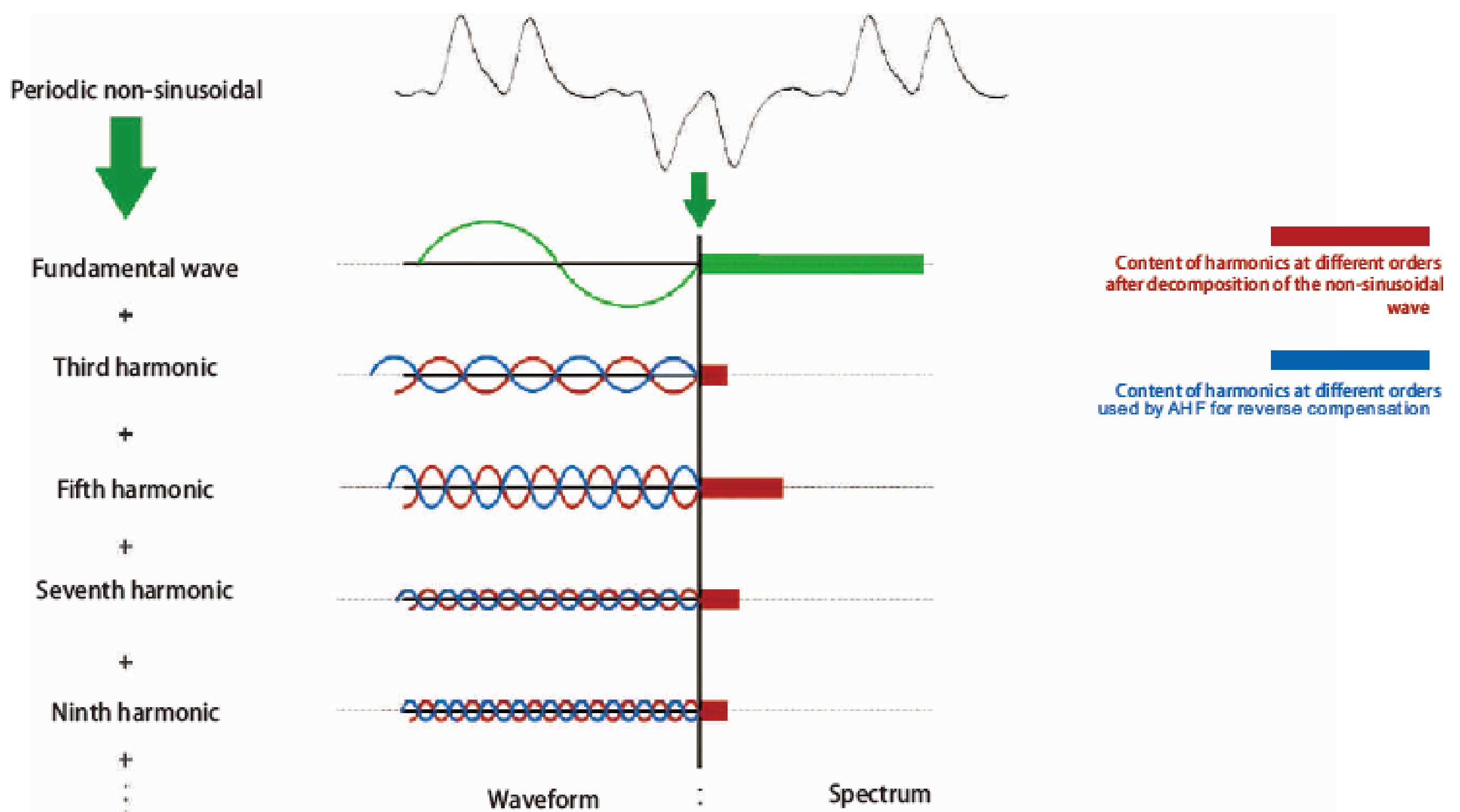


APF Operating Principle

APF checks the load current in real time through the external CT, performs computing through the internal DSP, and then extracts the harmonic components of the load current. After that, it sends the harmonic components to the internal IGBT through PWM signals to control the inverter to generate a current with a power equal to that of the harmonic and a direction reverse to that of the harmonic. Then, it injects the current into the compensation harmonic current to implement the filtering function.



Current at individual harmonic orders superposed onto the fundamental current to form non-sinusoidal waveform.



CAPF(Active Power Filter)

Mode description

C
A

APF
B

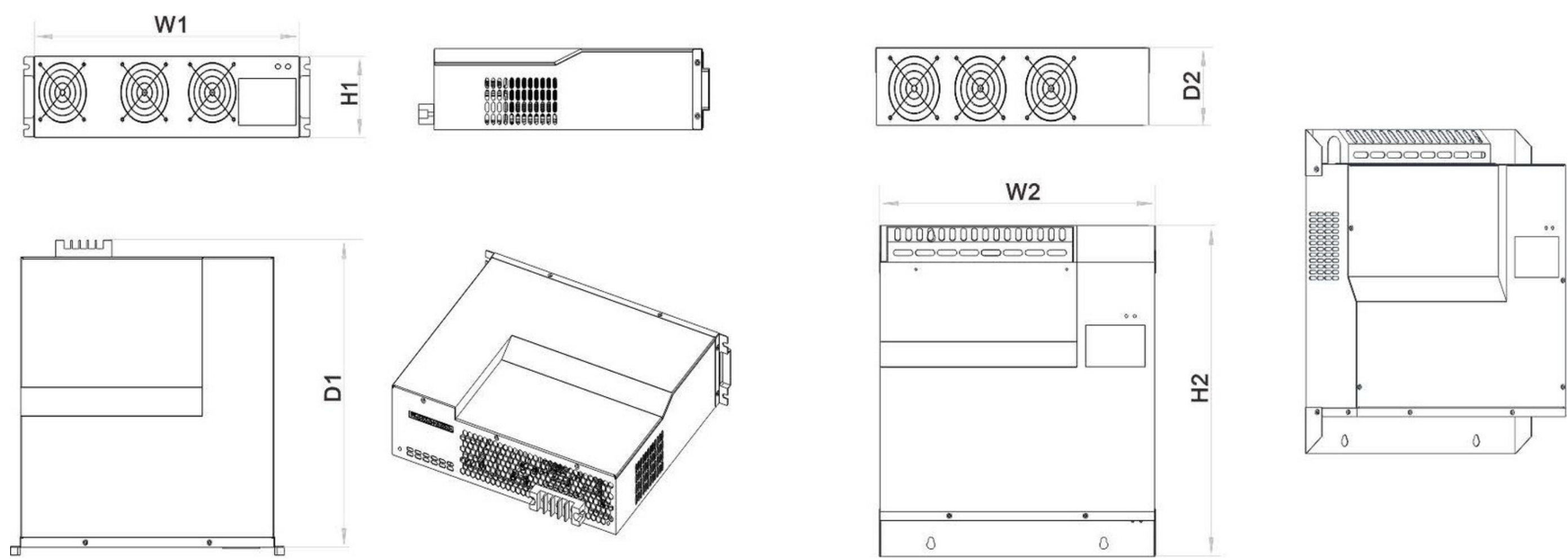
XXX
C

0.4
D

W
E

Serial number	
A	Company code :C
B	APF (Active Power Filter)
C	Compensation current : 30A/50A/75A/100A/150A
D	Voltage degree : 0.4KV (400V)
E	D:Rack mounted W:Wall mounted

Product structure



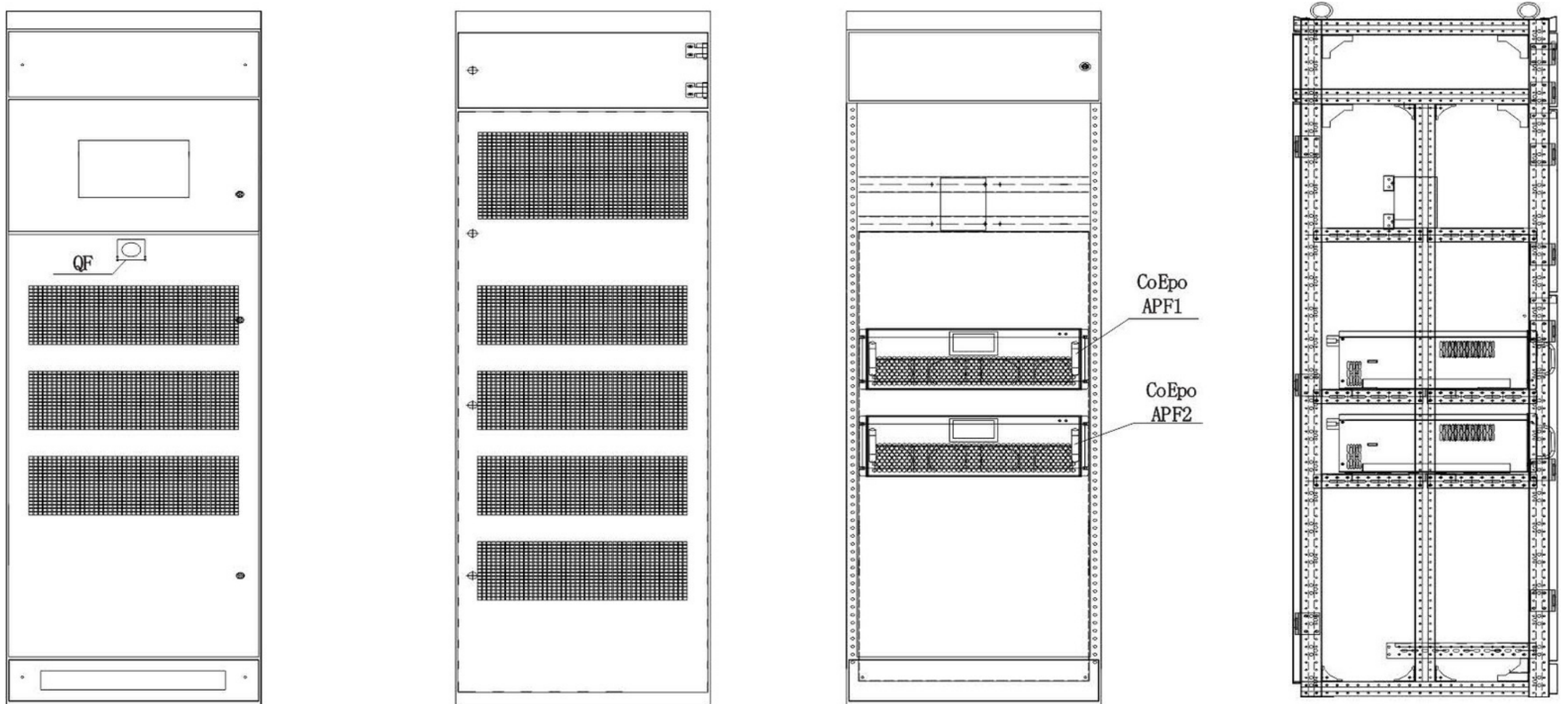
Rack Mounted

Wall Mounted

Installation	Rack Mounted			Wall Mounted		
Dimension(mm)	30A/50A	75A/100A	150A	30A/50A	75A/100A	150A
W	452.5	550.6	558	423	503	503
D	450	540	540	88	190	220
H	86	190	220	550	597	608

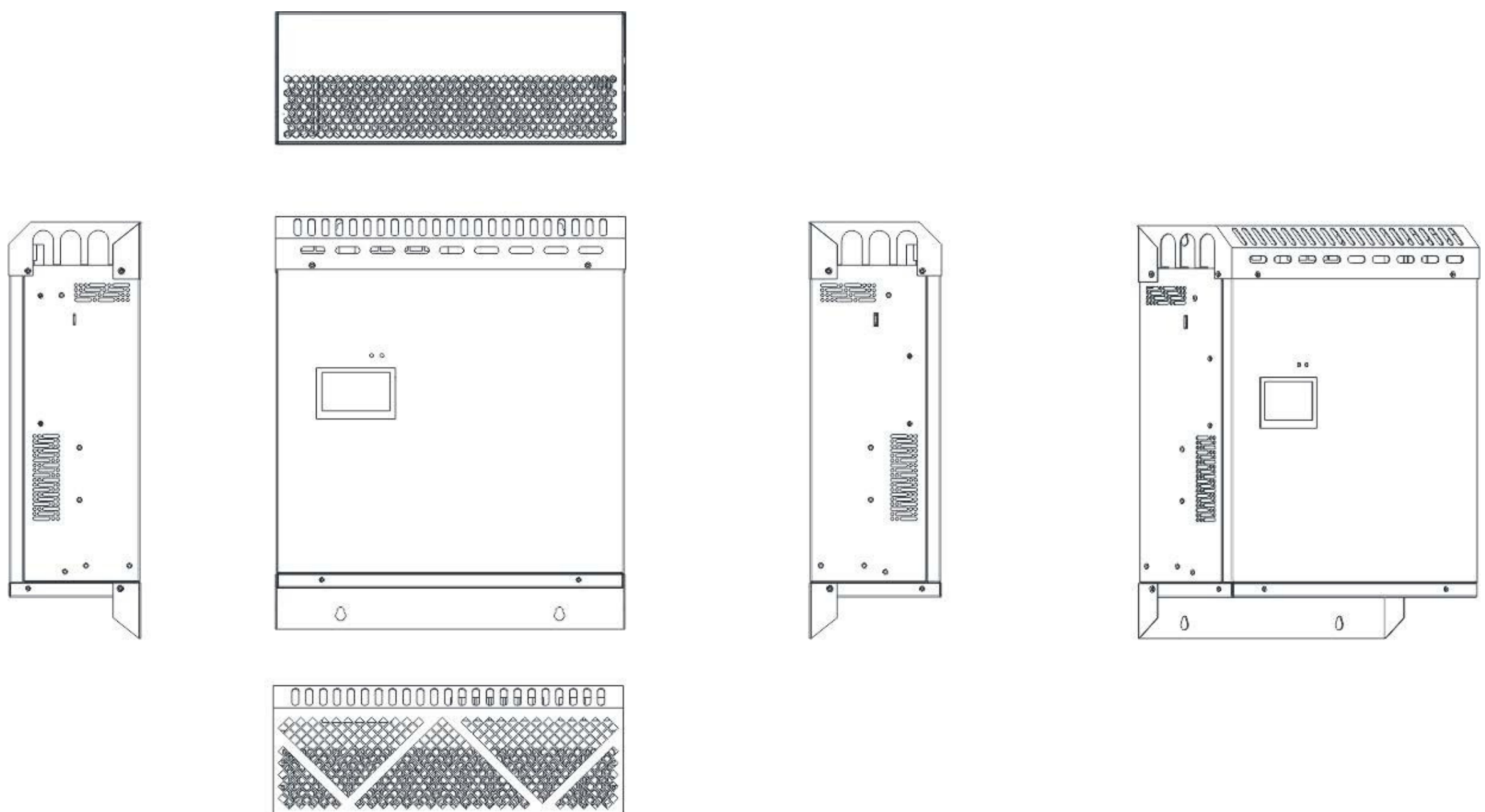
Installation mode

Support rack mount and wall mount two installation methods



Rack Mount Cabinet

Rack mounted, suitable for centralized treatment and local treatment. The maximum capacity of parallel cabinet is 750A. 7inch LCD touch screen is selected. It can be parallel with various types of distribution cabinets, which is convenient for installation



Wall Mount

Wall mounted installation is suitable for local treatment and other situations where the installation space is relatively tight. Single APF module wall mounted installation is flexible and convenient

APF Active Power Filter

Item	
Rated input	400V* (1±20%)
Power grid frequency	50Hz / 60Hz
Parallel operation	Unlimited
Overall efficiency	≥ 97%
Power grid structure	3P3W, 3P4W
CT	50/5 ~ 5000/5
Performance indicators	
Rated capacity	30A/50A/75A/100A/150A
Harmonic compensation	Available
Reactive power compensation	Available
Unbalance compensation	Available
Filtering range	2 to 50 orders
Filtering degree	Adjustable from 2 to 50
Filter performance	THDi<5%
Overall response time	<10ms
Target power factor	Adjustable from -1 to +1
Control algorithms	FFT, Intelligent and instantaneous reactive power
Switching frequency	20kHz
Noise level	<60dB
Communications and monitoring capabilities	
Communications ports	RS485 Communication And MODBUS -RTU Protocol
Communications protocols	TCP/IP, Modbus and TCP/IP
Module display interface	Touch screen
PC software	Optional
Protection functions	over-voltage protection, under-voltage protection, short-circuit protection, inverter bridge inverse protection, over-compensation protection and so on
Fault alarm	Available at most 500 alarm records
Monitoring	Independent monitoring and centralized monitoring
Mechanical properties	
Altitude	1% up 2000 m. Between 2000 m to 4000 m, according to GB/T3859.2, the power decreases by 1% for every additional 100 m.
Operating temperature	-10°C ~ +45°C
Relative humidity	5% to 95% non-condensing
Protection class	Ip20 (other IP classes are customizable.)

Note : 1. Customize service optional.
2. Product update without further notice.

Application notice

Harmonics compensation

Below design formulas just for designer refer

$$I_h = K \times I_N \times \frac{THD_i}{\sqrt{1+THD_i^2}} \quad (1)$$

Note: I_N ——— Equipment rated current
 K ——— Load rate
 THD_i ——— Load distortion rate

Industry standard capacity polling list

This list just for reference

Industry Transformer capacity/KVA	compensation capacity choice polling list					
	metro, airport tunnel	communication commercial building , bank	medicine industry	automobile manufacture shipping manufacture	Chemical industry Petroleum	Metallurgy industry
THDI distortion rate	15%	20%	25%	30%	35%	40%
200	50A	50A	100A	100A	100A	100A
250	50A	100A	100A	100A	150A	150A
315	100A	100A	150A	150A	150A	200A
400	100A	150A	150A	200A	200A	250A
500	100A	150A	200A	200A	250A	300A
630	150A	200A	250A	300A	350A	400A
800	200A	250A	300A	350A	450A	500A
1000	200A	300A	400A	450A	550A	600A
1250	300A	350A	450A	550A	650A	750A
1600	350A	500A	600A	700A	850A	950A
2000	450A	600A	750A	900A	1050 A	1200A
2500	550A	750A	900A	1150A	1300A	1500A

NOTE: APF capacity got from 80% load of transformer capacity

SVG Functions

SVG

Meeting users' requirements:

- $\cos\varphi=1.00$
- Capacitive and inductive reactive power compensation
- Three-phase unbalance compensation
- Harmonic Filtering

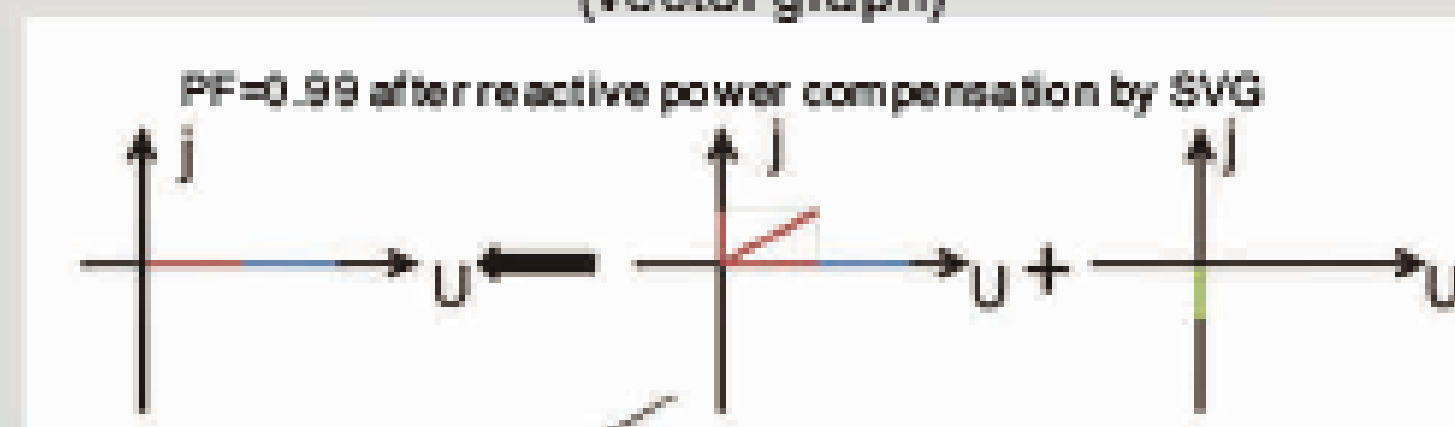


SVG Operating Principle

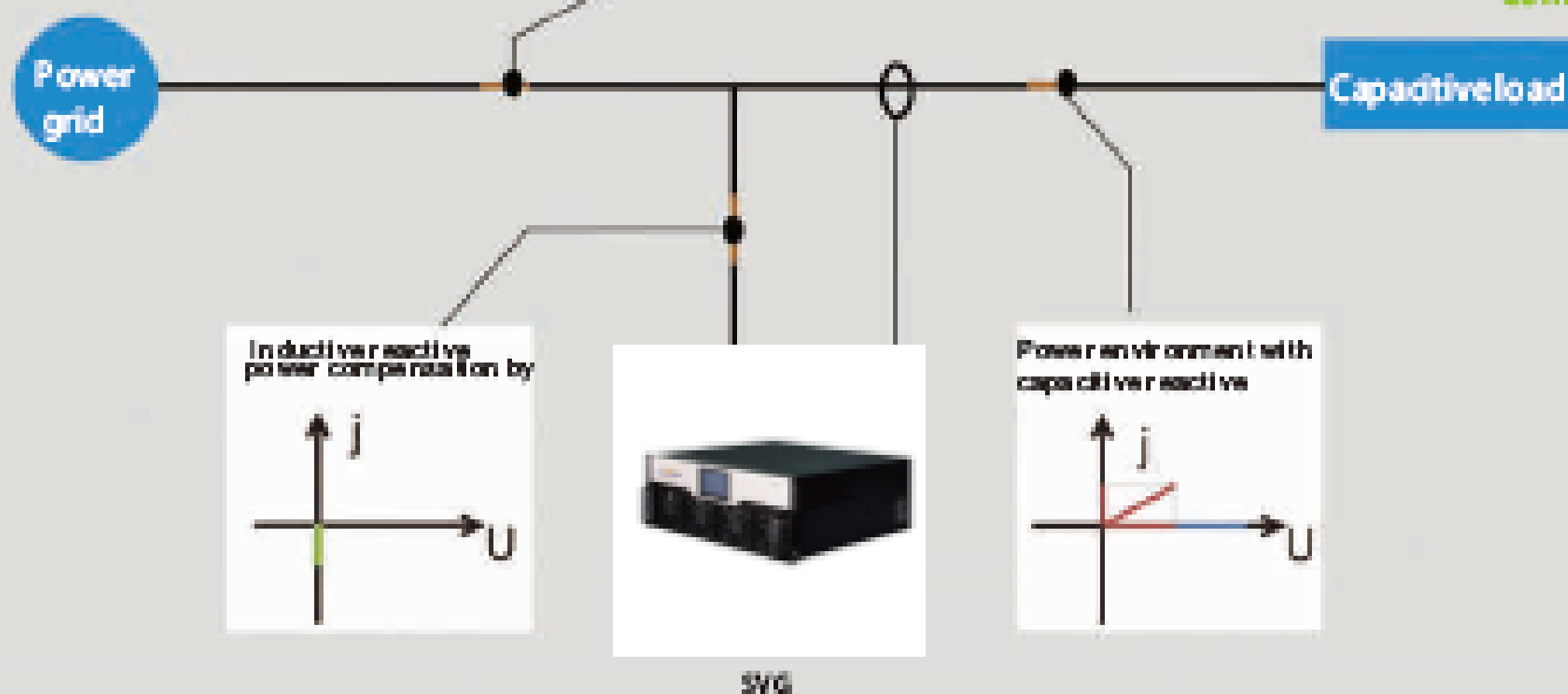
SVG checks the load current through the external CT and performs computing through the external DSP to analyze the reactive content of the load current. After that, it controls the PWM signal generator based on the settings to send control signals to the internal IGBT. In this way, it generates reactive compensation current to implement dynamic reactive power compensation.

SVG operating principle

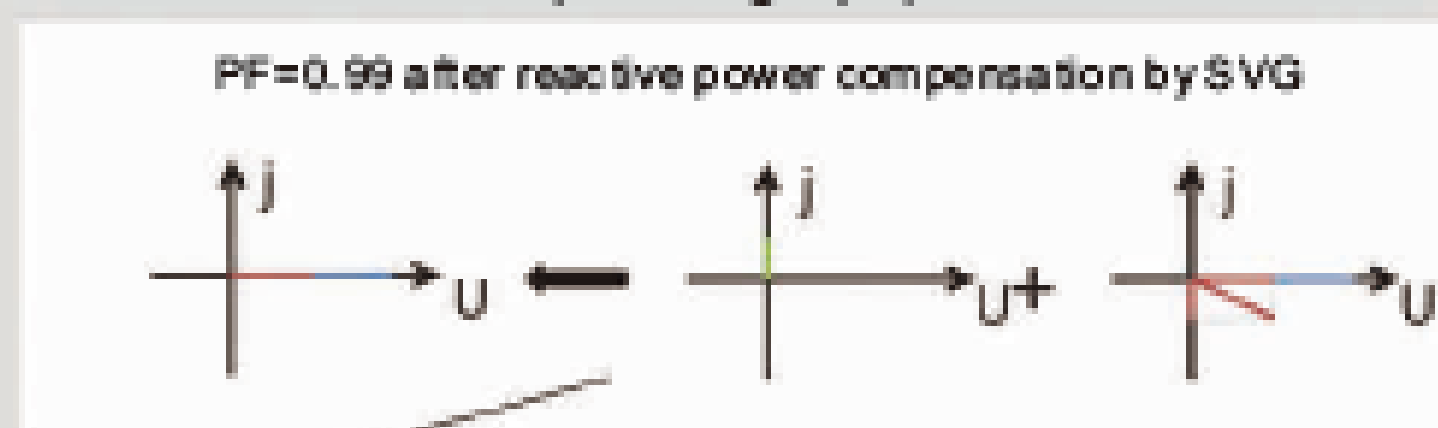
Capacitive reactive power compensation by SVG (vector graph)



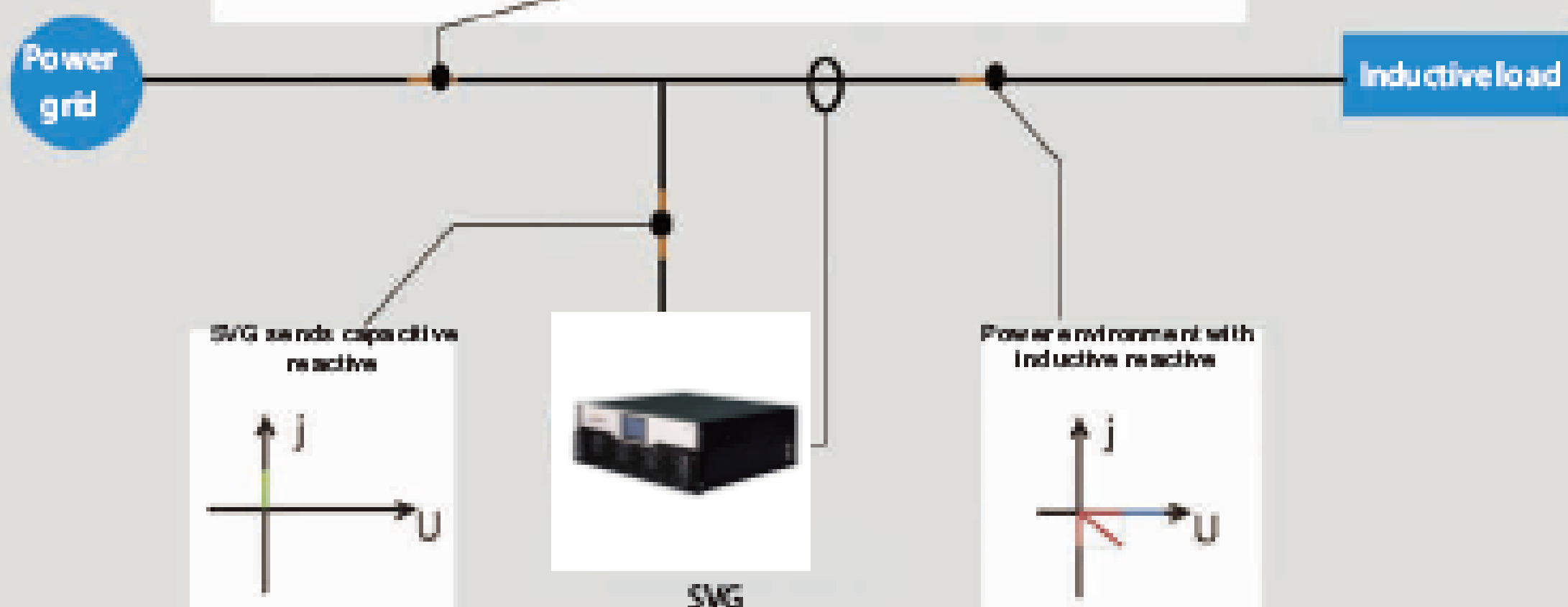
Current
Voltage
Compensation current



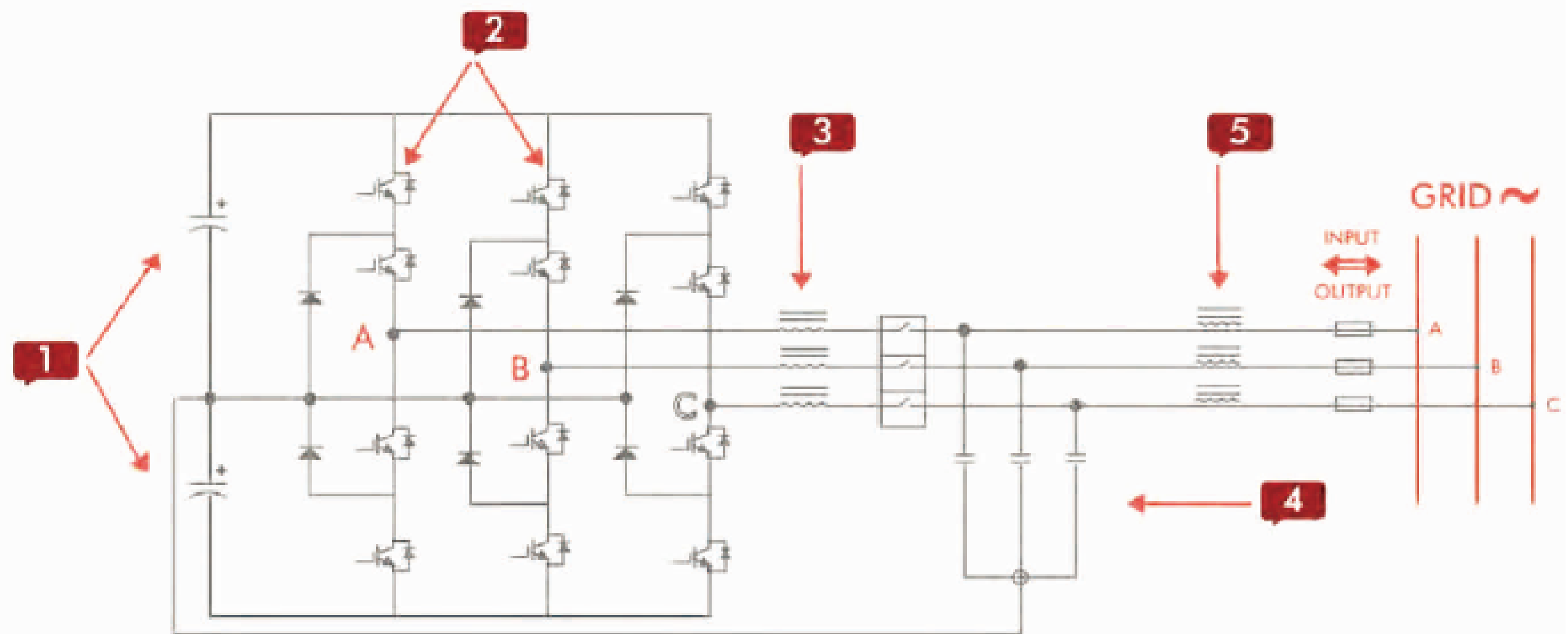
Inductive reactive power compensation by SVG (vector graph)



Current
Voltage
Compensation current



Understand How SVG Compensate Reactive Power

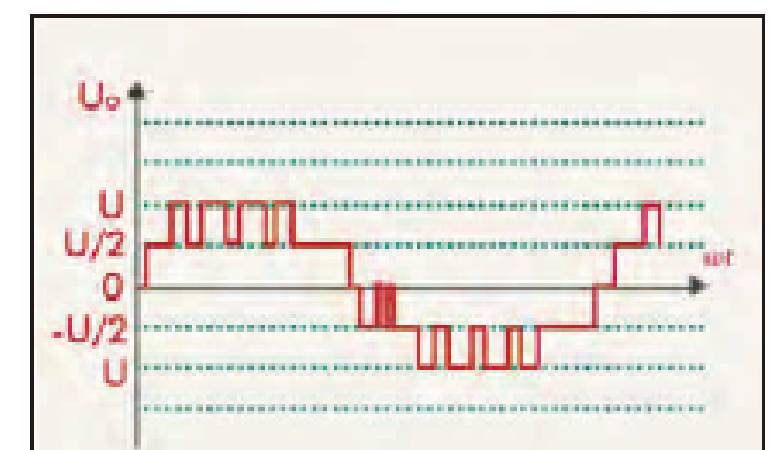


1 DC Bus Capacitor

DC bus capacitor, AC to DC rectifier storage

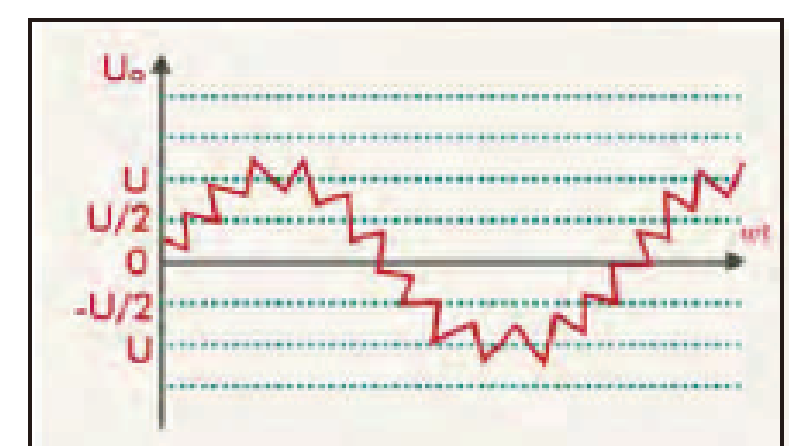
2 IGBT

Controlled by DSP software algorithm, IGBT on-off timing selection and length could control inverter to generate an accurate reactive power compensation current.



3 Inverter Induction

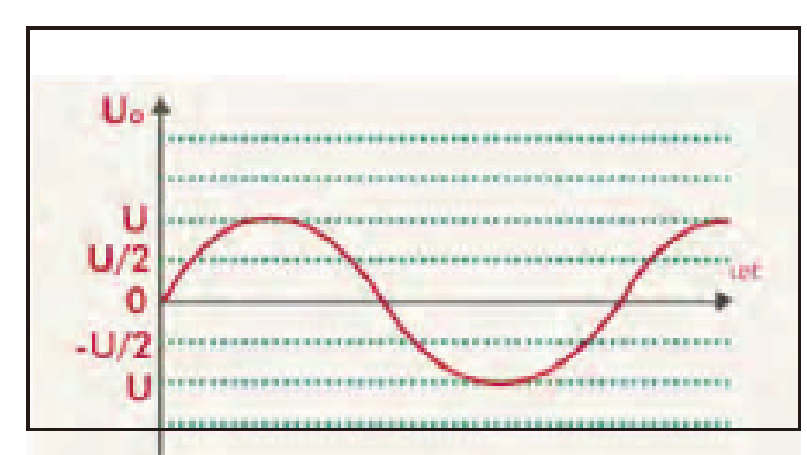
IGBT Compensating inductive reactive power or capacitive reactive power by controlling inverter induction to generate a capacitive current or inductive current to achieve bidirectional reactive power compensation



4 LC Filter Circuit

5 High Frequency Inductor

Both are for filtering. The combination of LC filter\ circuit and high frequency inductor are called LCL filter circuit



Substantial Improvement In Reactive Power Compensation Effect Made

Conventional Compensation Assemblies

Conventional compensation assemblies are component-based devices and they can be assembled freely. However, the capacitor group of TSC compensation assemblies work in the mode of group switching, and the reactive power output capacity is not presented in a sequential order. Therefore, it is impossible to adjust compensation capacity continuously, and it is difficult to strike a balance between the compensation capacity and the system reactive, which will lead to over-compensation or under-compensation, with power factor after compensation ranging between 0.8 and 0.9.

Conventional compensation assemblies take at least 20ms to perform compensation.

Conventional compensation assemblies make reactive power compensation mainly by adjusting reactance through silicon controlled regulator and several FC groups. However, resonant amplification may easily occur and therefore causes incidents.

Capacitors packed in conventional compensation assemblies offer reactive power. But the compensation is made only for inductive load and the compensation will not take effect if the system has capacitive current or current change between capacitive and inductive state.

Conventional compensation assemblies require large-capacity capacitor and reactor to serve as energy storage elements. Therefore, conventional compensation assemblies occupy large areas.

Conventional compensation assemblies rely on capacitors to provide capacitive reactive power. The output of reactive current is subject to the voltage of the grid, so the output of reactive current will be low if the voltage of the grid is at low level, which will cause compensation capacity to decline and lead to inadequate compensation.

Conventional compensation assemblies make frequent compensation to switching, thus having short service life of about 3 years and requiring frequent maintenance.

To have better compensation effect, conventional compensation assemblies require an installed capacity larger than compensation capacity.

CoEpo | SVG

SVG is designed by component concept and can make compensation for both capacitive and inductive loads, thus obtaining compensation effect with the level of PF 0.99 and avoiding over-compensation and under-compensation.

The complete response time of SVG is less than 15 ms and the dynamic response time is less than 50 μ s, making SVG a top pick for a fast-changing environment.

The capacitor that comes with the SVG does not require the installation of filter bank; therefore resonant amplification will not happen. In addition, as an active compensation device and a current source device adopting such cut-off component as IGBT, SVG wards off resonance from the perspective of mechanism, significantly improving completeness.

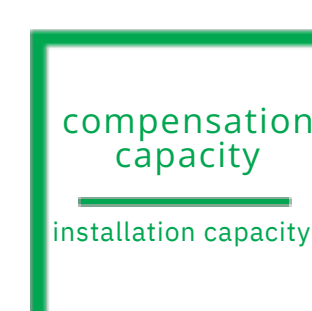
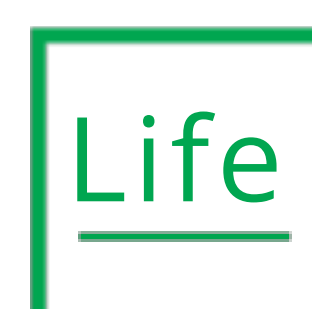
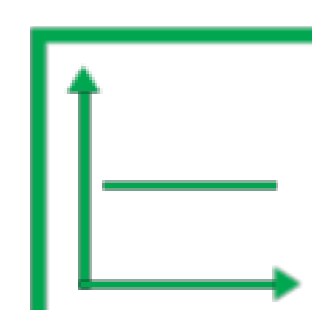
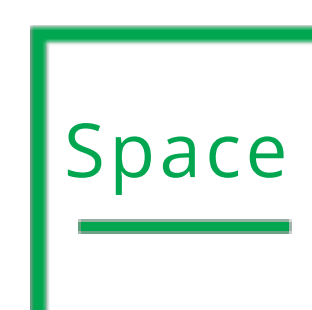
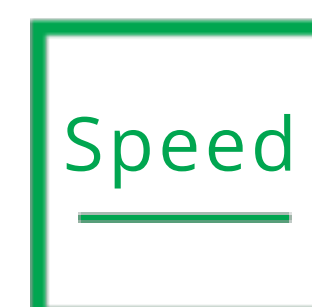
SVG can continuously adjust reactive power dynamically and bi-directionally (-1 to +1); that is to say, SVG can output reactive power constantly in both rated capacitive and rated inductive working conditions and it can make constant compensation in a wide range if combined with fixed capacitor.

SVG does not need large-capacity capacitor or reactor to serve as energy storage elements, and the area it occupies is just a half of that occupied by other types of dynamic compensation assemblies with the same capacity, or even a smaller area. Moreover, SVG adopts modular design and cabinet-type installation, which demands only a few efforts in engineering design and installation.

SVG is designed with active compensation circuit; therefore, the voltage of the grid has little influence on the compensation capacity. The output of reactive current matches the working condition even when the voltage of the power grid is low.

SVG has little self-loss and needs little maintenance, so chances of resonance over-voltage are pretty low. The service life lasts for over ten years (with an MTBF longer than 100,000 hours).

The compensation capacity of SVG is the same as the installed capacity. Therefore, for a given compensation effect, the capacity of SVG is 20% to 30% less than that of SVC.

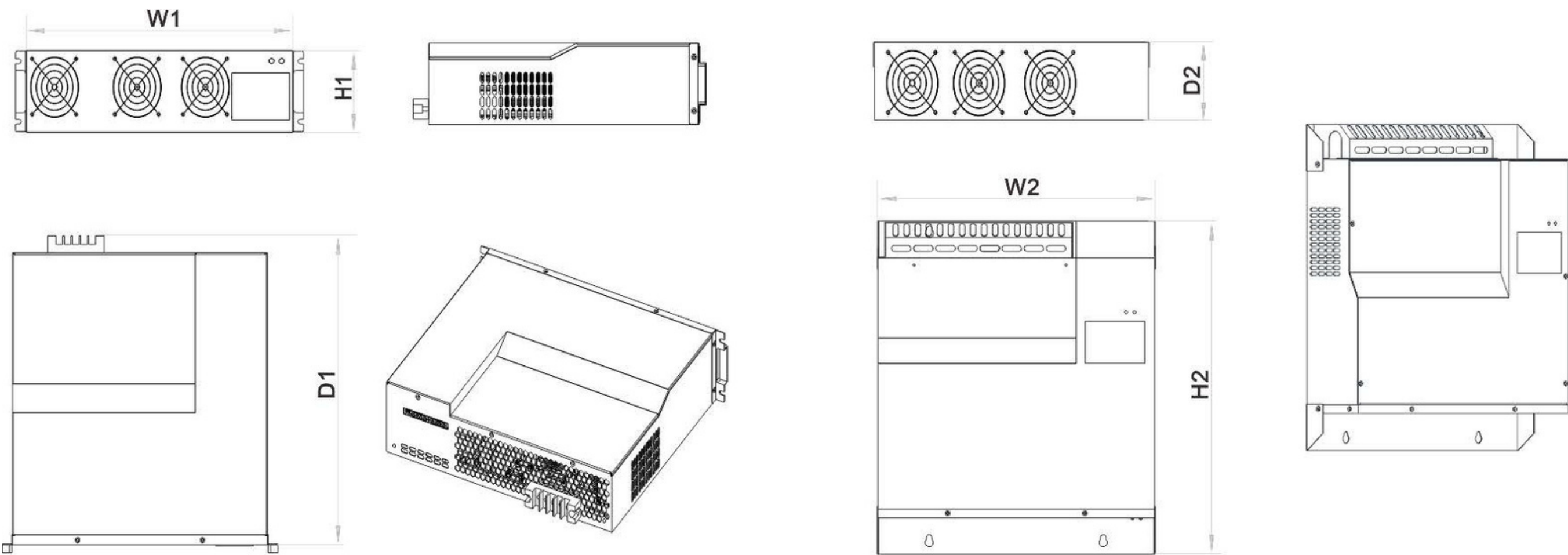


CSVG (Static Var Generator)

Mode description

C A	SVG B	XXX C	0.4 D	W E
Serial number				
A		Company code :C		
B		SVG (Static Var Generator)		
C		Compensation current : 30kvar/50kvar/75kvar/100kvar		
D		Voltage degree : 0.4KV (400V)		
E		D:Rack mounted W:Wall mounted		

Product structure



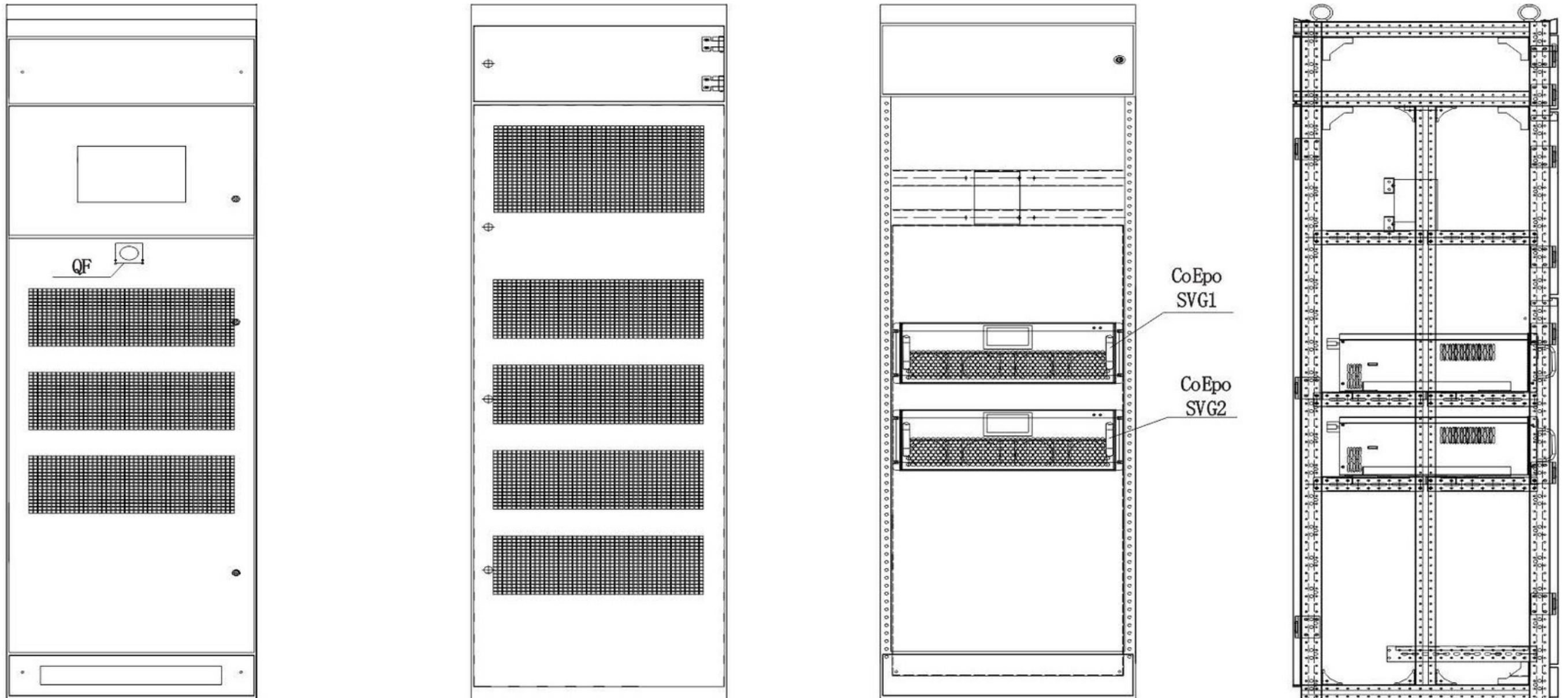
Rack Mounted

Wall Mounted

Installation	Rack Mounted				Wall Mounted		
Dimension(mm)	30kvar/50kvar		75kvar	100kvar	30kvar/50kvar		100kvar
W	452.5	472	550.6	558	423	503	503
D	450	540	540	540	88	122	220
H	86	122	190	220	550	558	608

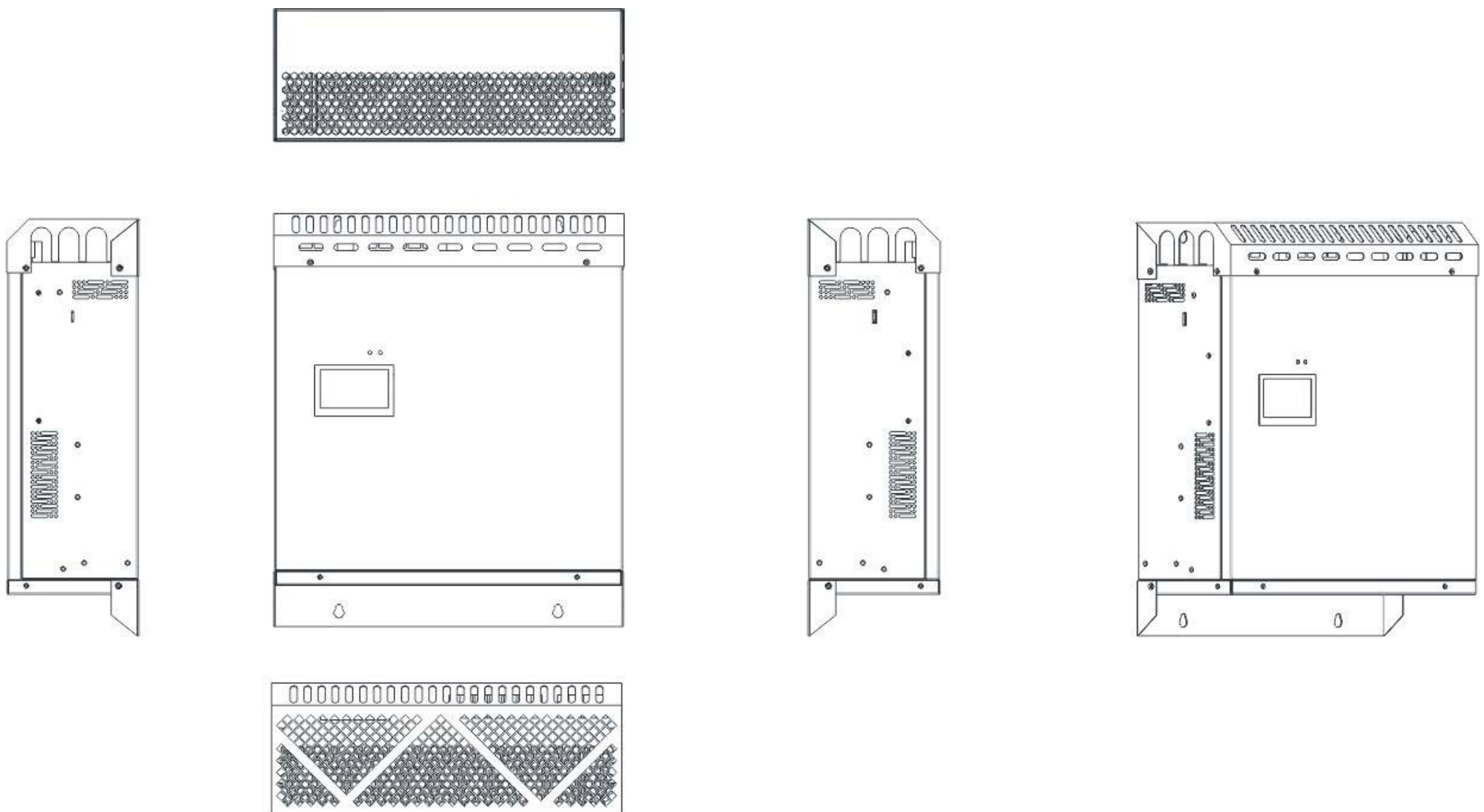
Installation mode

Support rack mount and wall mount two installation methods



Rack Mount Cabinet

Rack mounted, suitable for centralized treatment and local treatment. The maximum capacity of parallel cabinet is 500kvar. 7inch LCD touch screen is selected. It can be parallel with various types of distribution cabinets, which is convenient for installation



Wall Mount

Wall mounted installation is suitable for local treatment and other situations where the installation space is relatively tight. Single SVG module wall mounted installation is flexible and convenient

SVG Static var generator

Item		
System parameters		
Rated input line voltage	400V* (1±20%)	
Power grid frequency	50Hz/60Hz	
Parallel operation	Unlimited	
Overall efficiency	> 97%	
Power grid structure	3P3W/3P4W	
CT	150/5 ~ 5,000/5	
Performance indicators		
compensation capacity	30/50/75/100kvar	
Response time	< 10ms	
Target power factor	Adjustable from -1 to +1	
Cooling mode	Smart air cooling	
Noise level per module	< 65dB	
Communications and monitoring capabilities		
Communications ports	Rs485, CAN, and network port	
Communications protocols	Modbus and PMBus	
Alarm	Available	
Monitoring	Monitoring module, and optional centralized monitoring modules	
Environment requirement		
Altitude	2000 m. Between 2000 m to 4000 m, according to GB/T3859.2, the power decreases by 1% for every additional 100 m.	
Operating temperature	-10 ~ 40 °C	
Relative humidity	5% ~ 95% non-condensing	
Protection class	Ip20 (other IP classes are customizable.)	IP20

CSVG selection table

Transformer capacity (kVA)		315	630	800	1000	1250	1600	2000	2500
CSVG	Capacity	100	200	250	300	400	500	600	750
	mounting type	Cabinet	Cabinet	Cabinet	Cabinet	Cabinet	Cabinet	Cabinet	Cabinet
	Number of cabinets (parallel operation)	1	1	1	1	1	2	2	2

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