Digitized Automation for a Changing World

Delta Static Var Generator
SVG2000 Series

www.deltaww.com

DELTA

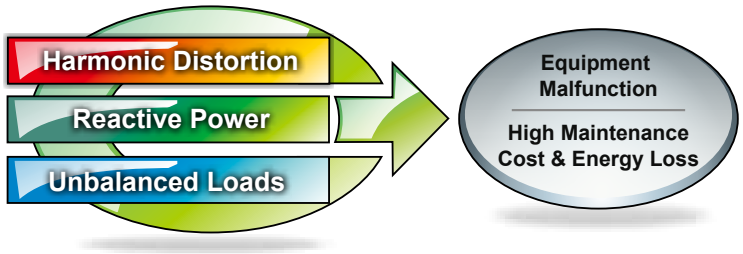
Smarter. Greener. Together.

Overview of Power Quality Improvement

Power Quality - the Major Influence on Power Efficiency

Modern power systems usually include multiple devices that require magnetic fields built from reactive power, such as motors, transformers and more. While these devices use active power, they consume reactive power as well, which results in an extremely low power factor.

Reactive power compensation has been an effective strategy widely applied in a variety of situations to solve low power factor and for efficient electricity consumption. However, conventional power compensation equipment can no longer sustain the power loads of modern power systems and may bring about system damage and low power factor that cause negative effects on electricity usage for enterprises.



Complex Electrical System Leads to Harmonic Current and Reactive Power

Electrical systems today are becoming more complex as manufacturers seek better performance and new technology innovation. Non-linear load equipment such as inverters, UPSs and rectifiers cause severe harmonic pollution while they are widely implemented in systems. When a large amount of harmonic current (such as reactive power) flows into a power system, it initiates resonance that damages the reactive power compensator. It may also interfere with the power system, causing errors and overheating power cables that may create a fire hazard. This is a critical factor that lowers the power quality and must be managed.

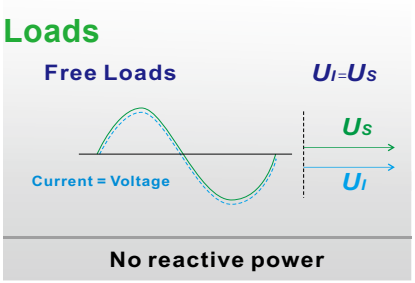
SVG2000 - Solution to Harmonic Suppression plus Reactive Power Compensation

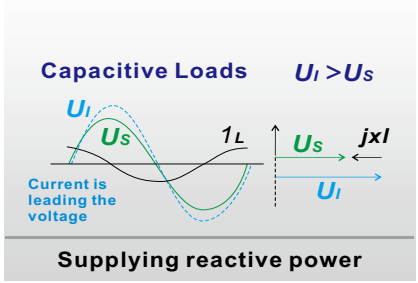
- Reduces harmonic distortion
- Balances non-linear loads
- Improves power usage efficiency
- Avoids penalties due to low power factor
- Stable power contributes to stable operation
- Lowers equipment maintenance cost

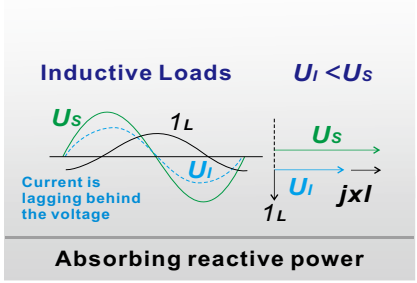
SVG2000 Operating Principle

SVG2000 Series is a voltage sourced converter (VSC). When connected to the grid in parallel with an inverter or a reactor, it can supply/absorb the required amount of reactive power (or harmonics) by controlling the output voltage and phases of AC current and therefore rapidly regulates the dynamic reactive power (i.e. harmonics compensation).

Loads



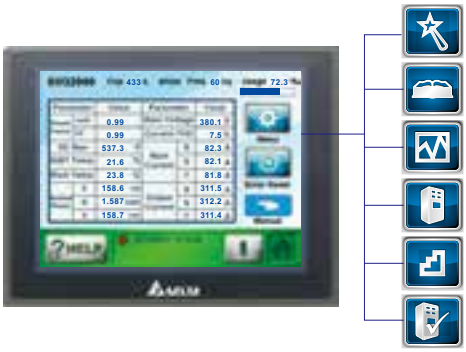




SVG2000 System Structure

Power Quality Improvement System

- 7" (800 x 600) TFT LCD 65,536 color touch panel
- Continuous monitoring and real-time display of power factor, current / voltage waveforms, and each order of harmonic parameters
- A maximum of 100 error logs
- Data logs export & management
- USB host for USB disks
- Supports SD cards for data logs storage
- Modbus communication protocol



Optimized Ventilation Design

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

Modular Design

- Easy-to-disassemble
- Digital-signal integrated circuit board
- Plug-in capacitance module

Digital Signal Processing (DSP) Control

- Self-diagnosis of harmonics filtering
- 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

SVG2000 Features

Power Factor Improvement

Continuously outputs and compensates reactive power to ensure the power factor remains above 0.99, and compensation performance is 1.2 times better than traditional compensators

Harmonic Suppression

Compensates the required amount of reactive current and achieves high order harmonics suppression in real time

Fast Response

Smart calculation capability provides fast analysis and response (cycle response time < 20 ms and dynamic response time < 500 µs)

Avoids Abnormal Low Voltage in Grid

The SVG2000 features current sources to effectively support the mains voltage after compensating reactive current.

Modular Design for Easy Maintenance

- No need for a huge amount of reactors and capacitors maintenance, saving installation space by 20~30%
- Modular design allows easy maintenance
- Special ventilation path avoids interference among modules and facilitates assembly with other products

High Operation Efficiency and Low Power Loss

Adopts the latest IGBT for high efficiency of more than 96% and low power consumption

High Reliability and Safety

Robust design for power systems eliminates resonance problems and harmonic current / voltage amplification extending component life cycles and protecting the system

Certified NEBS GR63 CORE (Zone 4) standard by Taiwan's National Center for Research on Earthquake Engineering

Excellent Operation Interface

- **Diversified extension options**
  Supports RS-232 / 422 / 485, USB disk drives and SD cards
- **High Quality and Full-Color Display**
  Adopts a 65,536-color TFT LCD panel with a 2D fast-drawing technology for higher resolution, more images, and a vivid and colorful display

Compensation to Current, Harmonics and Power Factor

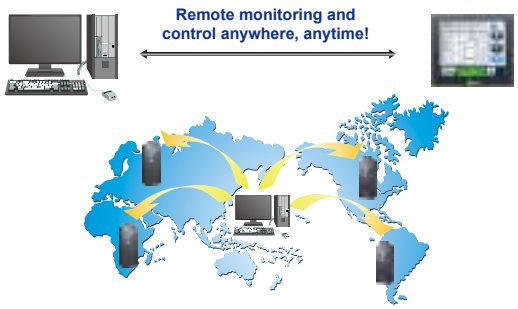
Features	Harmonics Compensation	Reactive Power Compensation	Note
Full Compensation	■	■	Enables the compensation function to compensate unbalanced loads under all operation modes*1
Harmonics Compensation	■		
Reactive Power Compensation		■	

Compensation priority: ■ > ■ ; No Compensation:

*1 Verified derating ratio for different unbalanced loads. Please contact Delta technical support or distributors in your region.

Communication & Remote Monitoring and Control

- **Built-in RS-485 (Modbus) protocol**
- **Remote monitoring and control**



Power Quality Improvement System

Quick Start Wizard

Step-by-step installation

Data Logging

9 sequential history logs and allows easy export to SD cards or USB disk drives as CSV files

Waveform Display

Synchronously displays and analyzes up to 12 waveforms & harmonics and real-time monitoring of power quality status

System Setting

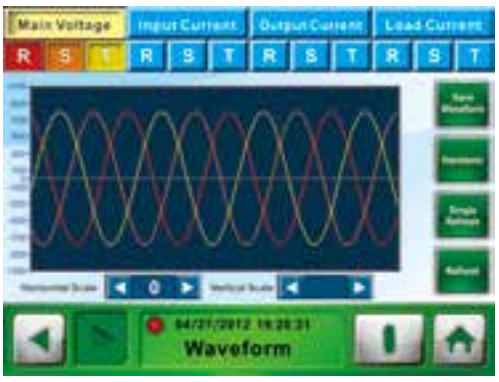
Communication type / Operating mode / Alarm level / Multi-functional output terminal

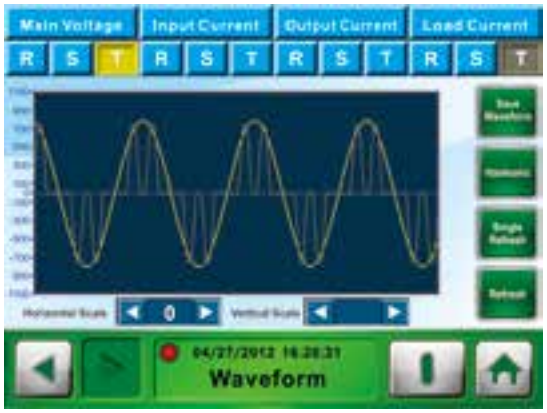
Advanced Functions

Access control for different users and advanced settings for different applications

System Status

Inquiries of anomalies / maintenance records and system self-diagnosis for general settings and hardware examination





Power Quality Improvement Facility & Technology General Comparison Chart

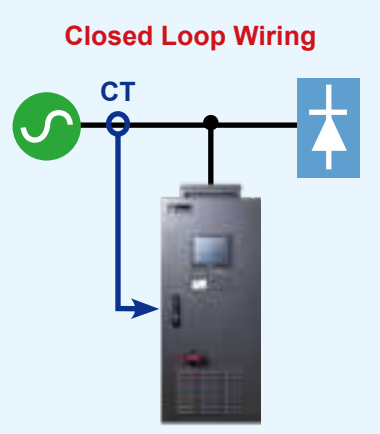
Items for Comparison	Passive Filter	Capacitor + Active Power Filter	Static Var Generator + Active Power Filter	Static Var Generator
	LC	SC+APF	SVG+APF	SVG
Function	Harmonic control and reactive power compensation			
Components	Capacitors and reactors	Capacitors and power electronic switch components	Two sets of power electronic switch components	High-voltage power electronic switch components
Operating	Compensates reactive power with capacitors and induces specific harmonics by impedance matching to filter single-order harmonics, and arranges multiple capacitors and inductors for each harmonic current	Compensates reactive power with capacitors and compensates harmonics with switch components	Compensates harmonic current and reactive power current with two power electronic devices	Compensates harmonic current and reactive power current with a power electronic device
Response Speed	Over 15 sec.	Reactive power compensation: over 15sec.; harmonics suppression: within 20 ms	Within 20 ms	
Reactive Power Compensation	Good compensation efficiency under steady loads and in low harmonic systems	Good compensation efficiency under steady loads	Good under all conditions	
Harmonics Suppression	Low efficiency and shortens facility lifespan	Harmonics suppression and filtering efficiency affected by capacitor switching	Good under all conditions	
Power Loss	Around ≤2.5%	Around ≤4.5%	Around ≤5%	Around ≤3%
Noise	Around 60 dB	Around 70 dB	Around 75 dB	Around 70 dB
Safety and Maintenance	Frequent damage to capacitors and high maintenance cost		Excellent	
Operation Reliability	Bad	Average	Excellent	
Dimensions (W x H x D mm)	1 (Reference standard)	1.2 ~ 1.5	1	0.7

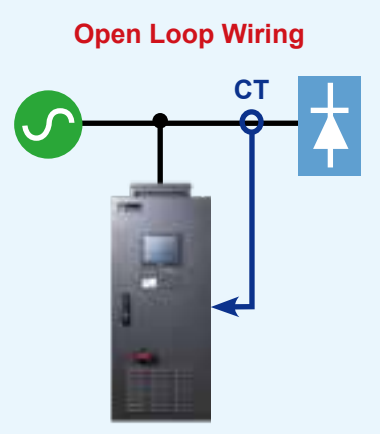
Open / Closed Loop Wiring

- Install a current transformer (CT) at both power side or load side to monitor harmonics or reactive power in real time
- For the highest response speed:
  Install a CT at the load side

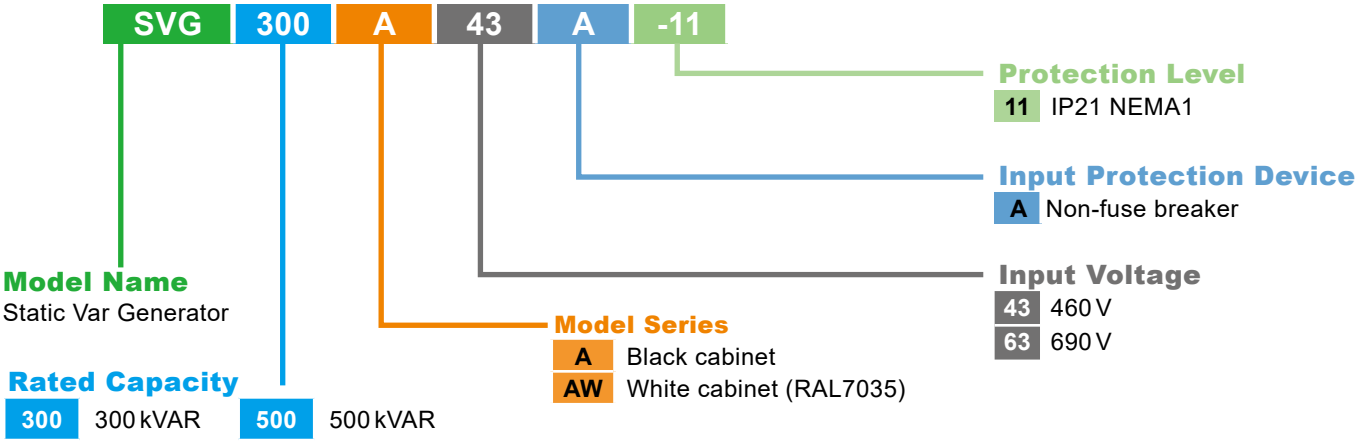
  For precise harmonic and reactive power compensation:
  Install a CT at the power side

*Multiple CTs connection in parallel is feasible for open-loop wiring only.





Model Name



Specifications

Frame	SVG300A43A-11	SVG500A43A-11	SVG300A63A-11	SVG500A63A-11
Rated Compensation Capacity (kVAR)[*1]	300	500	300	500
Rated Output Current (A)	433	720	290	420
Rated Voltage	200 ~ 480 V_{AC}		525 ~ 690 V_{AC}	
Voltage Tolerance	-10% ~ +10%			
Wiring	3-phases 3-wire[*2]			
Grid Frequency (Hz)	50 or 60			
Frequency Tolerance	-5% ~ +5%			
Carrier Frequency (kHz)	4			
Efficiency	96%			
Range of Reactive Power Compensation	-1~1, Leading (capacitive) or lagging (inductive) to target power factor			
Harmonic Filtering	5 / 7 / 11 / 13 order harmonics[*3]			
Step Response Time	< 500 µs			
Total Response Time	< 20 ms			
Operation Interface	7" HMI with 65,536 colors TFT LCD			
Data Storage	USB flash drives, SD cards			
Communication Port	D-Sub (RS-232), RJ45 (RS-485)			
Communication Protocols	Modbus, Modbus TCP			
Operation Temperature	-10~45℃			-10~40℃
Altitude	1,500 m: rated capacity usage 1,500 ~ 4,000 m: follows GB/T3859.2; when installed at a location above 1,500 m, decrease 1% of rated current for every 100 m increase in altitude			
Weight	650 kg	1,200 kg	650 kg	1,200 kg
Installation Method	Stand alone			
Wiring / Cable Entry	Cable entry from top and from bottom			
Cooling Method	Fan cooling			
Parallel Connection	2 ~ 6			
CT Range	50:5 ~ 10000:5			
Enclosure Rating	IP21			
Certifications	CE			

*1 SVGXXXA43A @ 400 V ; SVGXXXA63A @ 690 V
*2 Supports 3-phases 4-wire installation, no compensation to neutral point (N)
*3 30% rated current can be used for reactive power compensation

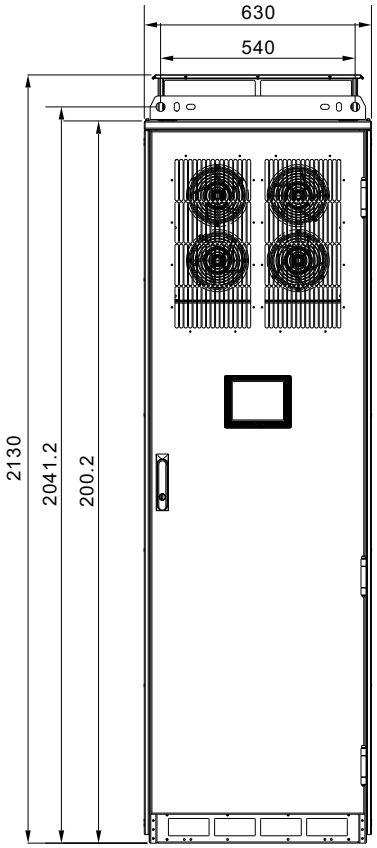
Dimensions

Frame A

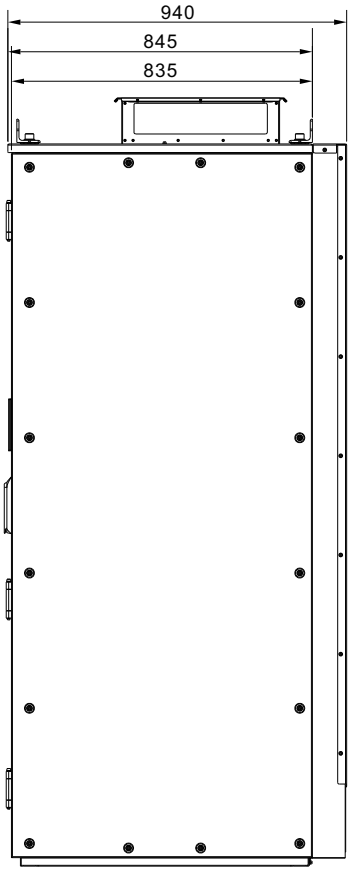
Model	
SVG300A43A-11	SVG300AW43A-11
SVG300A63A-11	SVG300AW63A-11

Unit: mm

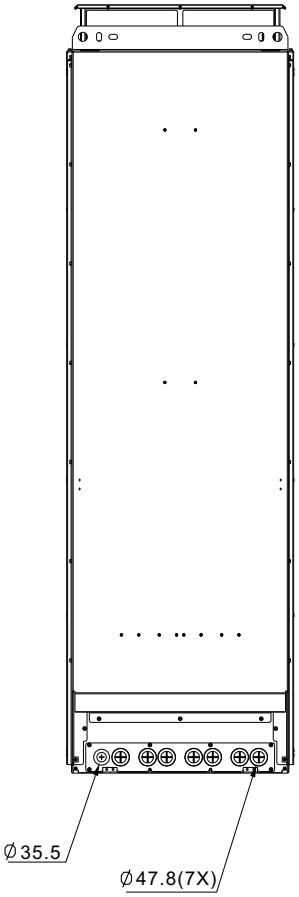
Front view



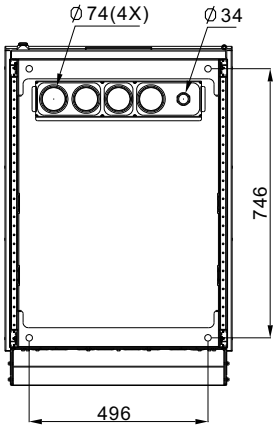
Side view



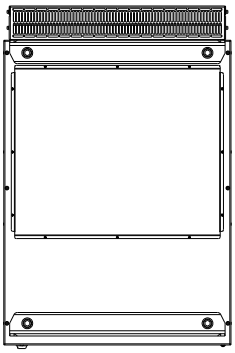
Back view



Bottom view



Top view

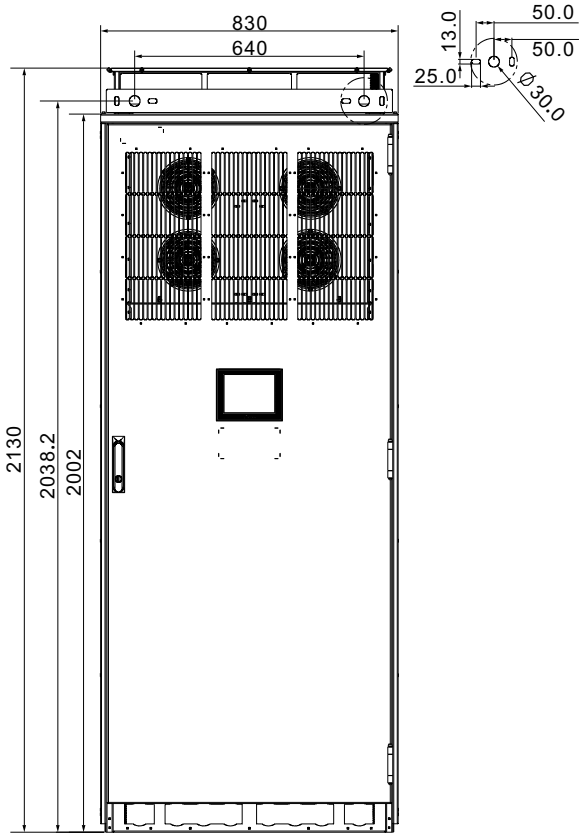


Frame B

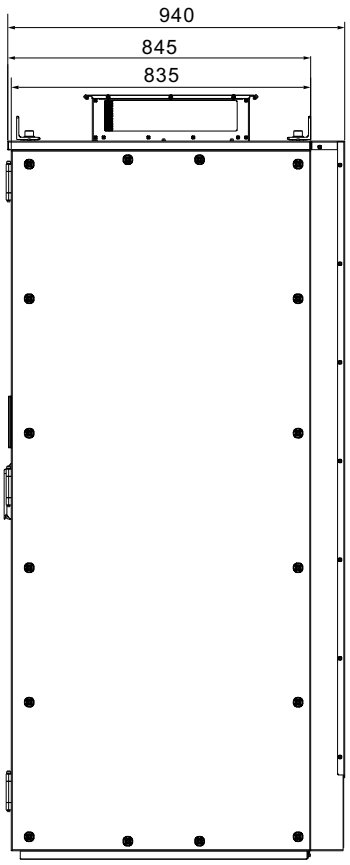
Model	
SVG500A43A-11	SVG500AW43A-11
SVG500A63A-11	SVG500AW63A-11

Unit: mm

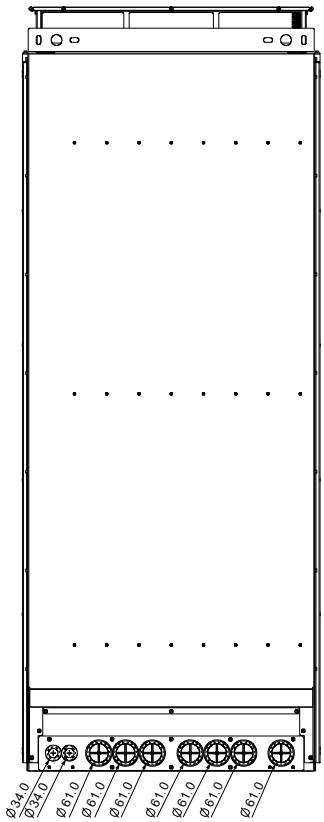
Front view



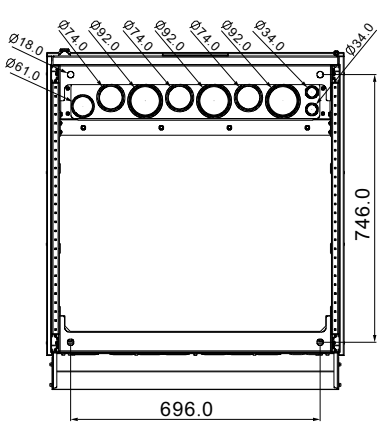
Side view



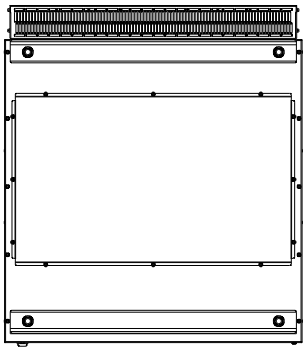
Back view



Bottom view



Top view



Accessories

▪ Current Transformer

Delta's Static VAR Generator requires 3 current transformers (CT), which use the rated frequency for standard transformers of 400 Hz (precision better than 1%); CT's rated output value must be 5A. Users can select a suitable CT from table 3-1 CT model selection to install.

▪ Notes on CT Model Selection:

(1) Be aware of the installation direction of CTs. The phase sequence of the CT detection signals (K, L) cannot be swapped, the Static VAR Generator must use 3 CTs in three-phase three-wire devices, installed separately in R-phase, S-phase, and T-phase. The arrows point towards load. The 3 CTs must be all in the same direction; any of the CTs fixed in a different direction will result in errors of current detection.

(2) The ratio of the rated primary/secondary current must be selected reasonably, the recommended primary current is 1.2-times (actual rated current).

(3) The primary/secondary isolation voltage is 0.66 V; select 5A as the secondary current.

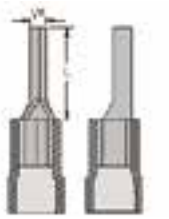
Mode	Current Ratio (A)*1	Primary Current (A)	Secondary Output Power (VA)	Accuracy	Dimension Code	Dimensions (L x W x D mm)	
CT-A0300	300/5	300	2.5	1%	A	Outer frame	115x110x46
						Inner frame	51x50x32
CT-A0600	600/5	600	5	1%	A	Outer frame	115x110x46
						Inner frame	51x50x32
CT-B0300	300/5	300	5	0.5%	A	Outer frame	155x110x46
						Inner frame	51x50x32
CT-B0600	600/5	600	5	0.5%	B	Outer frame	155x110x46
						Inner frame	90x50x32
CT-B0800	800/5	800	5	0.5%	B	Outer frame	155x110x46
						Inner frame	90x50x32
CT-B1000	1,000/5	1,000	5	0.5%	B	Outer frame	155x110x46
						Inner frame	90x50x32
CT-C0300	300/5	300	5	1%	C	Outer frame	186x110x46
						Inner frame	121x50x32
CT-C0500	500/5	500	5	0.5%	C	Outer frame	186x110x46
						Inner frame	121x50x32
CT-C0800	800/5	800	5	0.5%	C	Outer frame	186x110x46
						Inner frame	121x50x32
CT-C1000	1,000/5	1,000	5	0.5%	C	Outer frame	186x110x46
						Inner frame	121x50x32
CT-C1200	1,200/5	1,200	5	0.5%	C	Outer frame	186x110x46
						Inner frame	121x50x32
CT-C1500	1,500/5	1,500	5	0.5%	C	Outer frame	186x110x46
						Inner frame	121x50x32
CT-C1800	1,800/5	1,800	5	0.5%	C	Outer frame	186x110x46
						Inner frame	121x50x32
CT-C2500*2	2,500/5	2,500	5	0.5%	C	Outer frame	186x110x46
						Inner frame	121x50x32
CT-D1200	1,200/5	1,200	5	0.5%	D	Outer frame	226x130x46
						Inner frame	161x70x32
CT-D1500	1,500/5	1,500	5	0.5%	D	Outer frame	226x130x46
						Inner frame	161x70x32
CT-D1800	1,800/5	1,800	5	0.5%	D	Outer frame	226x130x46
						Inner frame	161x70x32
CT-D2000	2,000/5	2,000	5	0.5%	D	Outer frame	226x130x46
						Inner frame	161x70x32
CT-D3000	3,000/5	3,000	5	0.5%	D	Outer frame	226x130x46
						Inner frame	161x70x32

*1. When selecting CT's, pick the model with current closest to the actual primary current value (peak rms current). For example: select model CT-A0300 if the actual current is 280A. The same logic applies to the rest.

*2. All models are UL certified EXCEPT for the model CT-C2500.

▪ Current Transformer

(4) Crimp terminal connectors must be used for CT's terminal lines, and securely tightened K (S1), L (S2) terminal wires

Terminal:	K1 / L1 / K2 / L2 / K3 / L3			
Wire diameter	24 ~ 10 AWG			
Applicable terminal block (used with figure 3-1 position A)	Pin Insulated terminal		Blade Insulated terminal	
		W: 2.7 mm L: 14 mm		W: 2.8 mm L: 10 mm

(5) The CT cable length is limited; cables that are too long will cause the CT to decrease in accuracy.
(6) When you install multiple units in parallel, the length of each CT cable must be identical.

▪ CT Cable Selection

Wire Gauge (mm^2/AWG)	Impedance (Ω)	Cable Length (Meter/Feet)	Minimum Load Required by CT (VA)	Recommendation
4/#12	2.1	50/164	>6.3	10 VA
6/#10	3.4	50/164	>4.2	7.5 VA

▪ Range of Cable Length

The formula for the CT's fixed maximum load is: cable length (M) = [(VA)-1.25}/[25*(ohm/M)] (VA): 25*(ohm/M)* M+1.25; (ohm/M): impedance

Wire Gauge (mm^2/AWG)	Impedance (Ω)	Cable length (Meter/Feet)	Minimum Load Required by CT (VA)
6/#10	3.4	<44/147	5
6/#10	3.4	<73/243	7.5
6/#10	3.4	<102/340	10
6/#10	3.4	<161/537	15
6/#10	3.4	<338/1,127	30
4/#12	5.1	<29/97	5
4/#12	5.1	<49/163	7.5
4/#12	5.1	<68/227	10
4/#12	5.1	<107/357	15
4/#12	5.1	<225/750	30

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