Automation for a Changing World

Delta Static Var Generator
SVG2000 Series

www.deltaww.com

DELTA

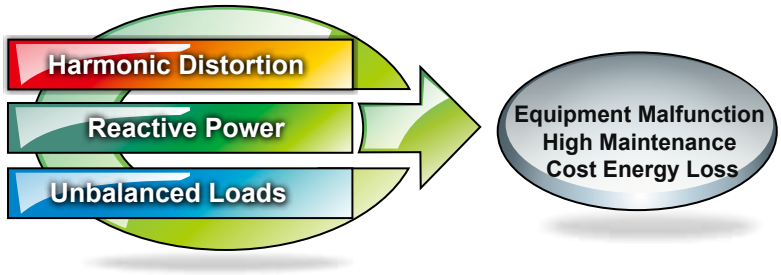
Smarter. Greener. Together.

Power Quality Overview

Power Quality - the Major Influence on Power Efficiency

Modern 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.



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 are commonly implemented to the system for smoother operation, causing significant harmonic distortion problems. When a large amount of harmonic current, such as reactive power, flows into the 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.

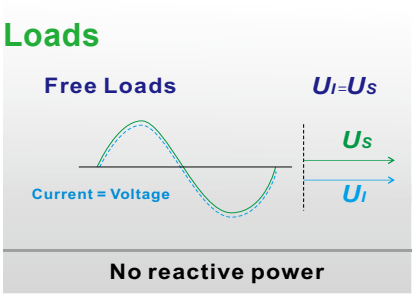
SVG2000 - Solution to Harmonic Suppression plus Reactive Power Compensation

- Reduces harmonic distortion
- Balances non-linear loads
- Improves power usage efficiency
- Avoids penalties due to low power factor
- Stable power provides stable operation

SVG2000 Operating Principle

SVG2000 Series is a voltage sourced converter (VSC). When connected parallel to the grid with an inverter or reactor, it is capable of supplying or absorbing accurate amounts of reactive power and regulating the dynamic reactive power in the system.

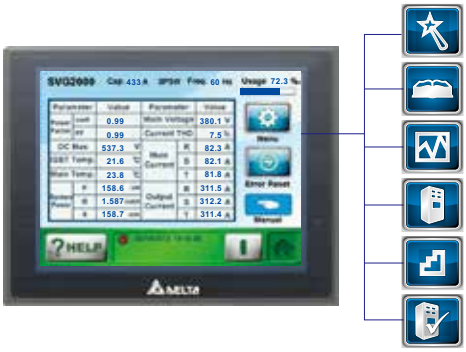
Loads



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
- 100 sets of error records
- Data logging and export
- USB Host and plug-in USB disk
- Supports SD card
- Supports monitoring and control via Ethernet



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

SVG2000 Features

Power Factor Improvement

Continuously outputs and compensates reactive power to assure 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

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

Avoids Abnormal Low Voltage in Grid

After compensating reactive current, the mains voltage can be effectively supported

Modular Design for Easy Maintenance

No need for a huge amount of reactors and capacitors, saving installation space by 20~30%; modular design allows easy maintenance; special ventilation path avoids interference for other products, easy to assemble

High Operation Efficiency and Low Power Loss

Adopts new electronic component design that provides efficiency of more than 96% and low power loss

High Reliability and Safety

Robust design for power systems eliminates resonance problems and amplified harmonic current / voltage, 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 Ethernet, RS-232 / 422 / 485, USB disk drives and SD cards
- **High Quality and Full-Color Display**
  Adopts 65,536 color TFT LCD panel with the newest 2D drawing technology to enhance resolution for more realistic images and a colorful, vivid display

Compensation to Current, Harmonics and Power Factor

Features	Harmonics Compensation	Reactive Power Compensation	Note
Full Compensation	■	■	Under all operation modes, the "Unbalanced Compensation" functions compensate unbalanced loads*1
Harmonic Compensation	■		
Reactive Power Compensation		■	

Compensation priority: ■ > ■ ; No Compensation:

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

High-speed Network, Remote Monitoring and Control

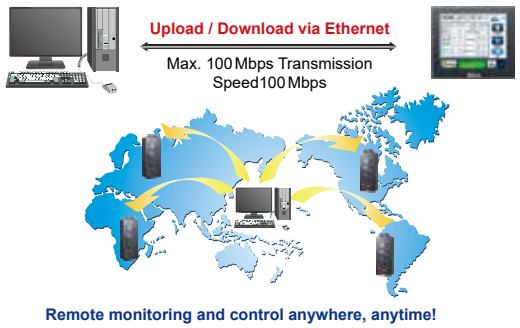
- **Built-in RS-485 protocol**
- **Provides diversified communication network and optional fieldbus card**

PROFIBUS

CANopen (DS301)

DeviceNet

MODBUS TCP

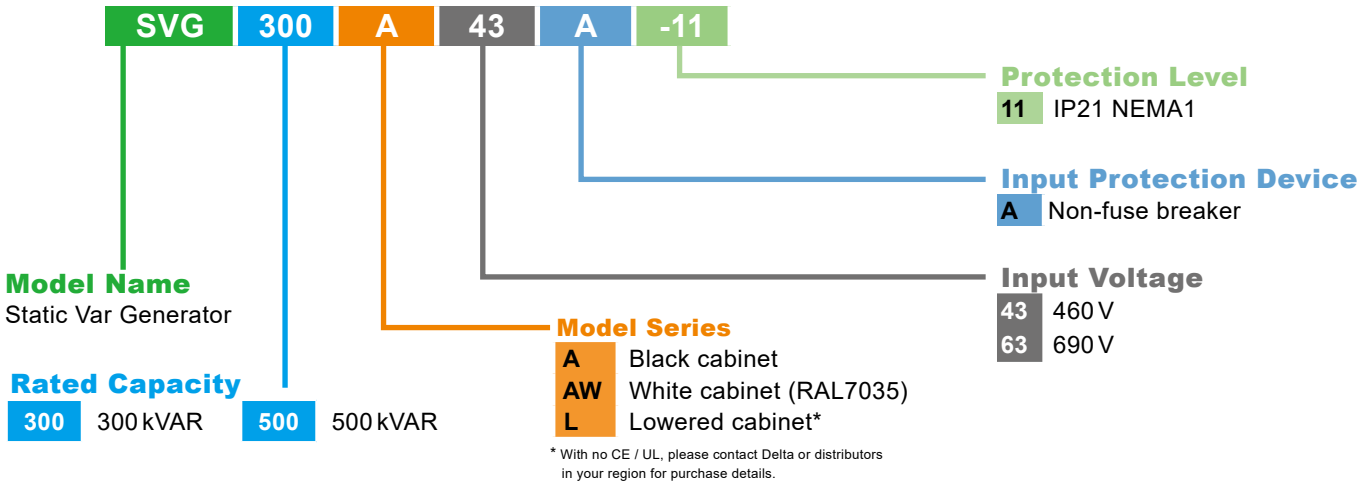


Remote monitoring and control anywhere, anytime!

Power Quality Improvement Facility and Technology General Comparison Chart

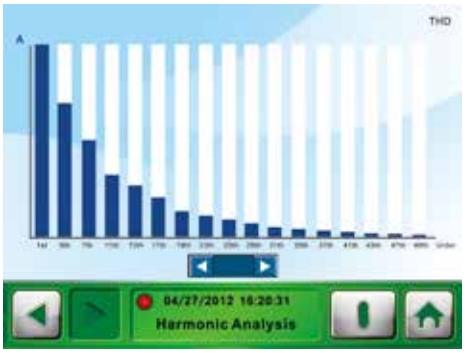
Items for Comparison	LC Passive Filter	FC+APF	SVG+APF	SVG+
Key Facilities	Capacitors and reactors	Capacitors and power electronic switch components	Two sets of power electronic switch components	High voltage power electronic switch components
Operating	Conducts reactive power compensation with capacitors; adjusts impedance to induce part of harmonics to realize single order harmonics filtering only	Conducts reactive power compensation with capacitors; compensates harmonics with switch components	Compensates harmonic current and reactive power current with two sets of power electronic devices	Compensates harmonic current and reactive power current with one set of power electronic devices
Response Speed	Over 15 sec	Reactive power compensation: over 15 sec; 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	Capacitors damage easily and require constant maintenance		Excellent	
Operation Reliability	Bad	Average	Excellent	
Dimensions (W x H x D mm)	1 (Reference standard)	1.2 ~ 1.5	1	0.7

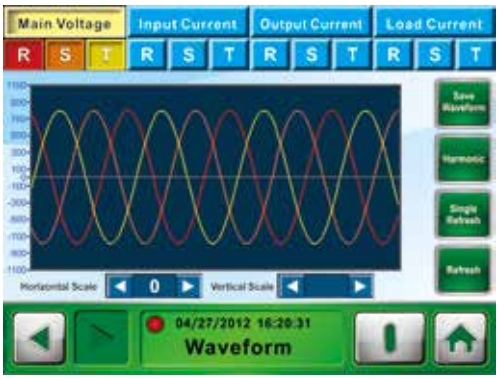
Model Name



* With no CE / UL, please contact Delta or distributors in your region for purchase details.

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 to export to SD card or USB disk

▪ Waveform Display

Synchronous display and analysis of up to 12 wave and harmonic forms and real-time monitoring of power quality status

▪ System Setting

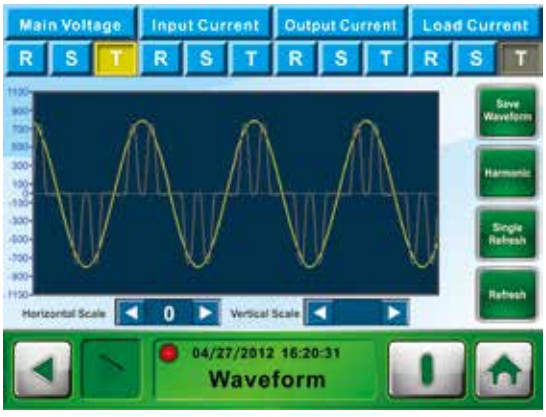
Communication type / Operating mode / Alarm level / Multi-functional output terminal

▪ Advanced Functions

Access control for different users and advanced settings for different applications

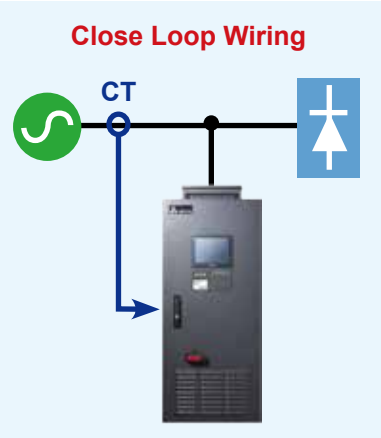
▪ System Status

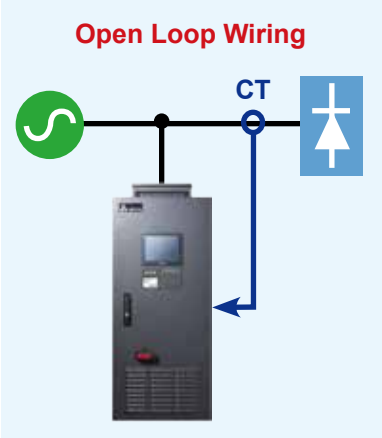
Error / Maintenance records review, and self-diagnosis function to check basic settings and hardware



Open / Close Loop Wiring

- Current transformer (CT) can be installed at both power side or load side to monitor real-time harmonics or reactive power
- CT installed at the load side for highest response speed; CT installed at the power side for precise harmonic and reactive power compensation





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	50 Hz or 60 Hz			
Frequency Tolerance	-5%~+5%			
Carrier Frequency (kHz)	4 kHz			
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			
Communication Interface	RS-485 and Ethernet			
Operation Interface	7" HMI TFT LCD 65536 color			
Data Storage	USB flash drive, SD card			
Communication Port	RJ45 (Ethernet), D-Sub (RS-232), RJ45 (RS-485)			
Communication Protocols	MODBUS, MODBUS TCP Optional: DeviceNet, PROFIBUS, CANopen			
Operation Temperature	-10~45℃	-10~45℃	-10~45℃	-10~40℃
Altitude	1500 m: rated capacity usage 1500~4000 m: follows GB/T3859.2. If installed at a location above 1500 m, decreases 1% of rated current for every 100 m increase in altitude.			
Weight	650 kg	1200 kg	650 kg	1200 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, UL, cUL, C-Tick			

*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

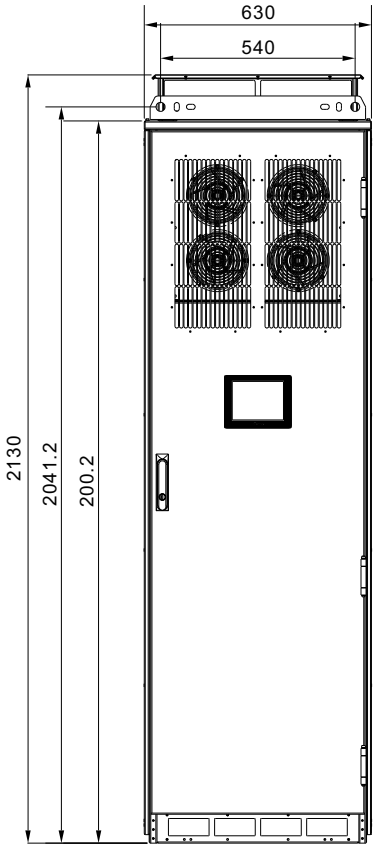
Dimensions

Frame A

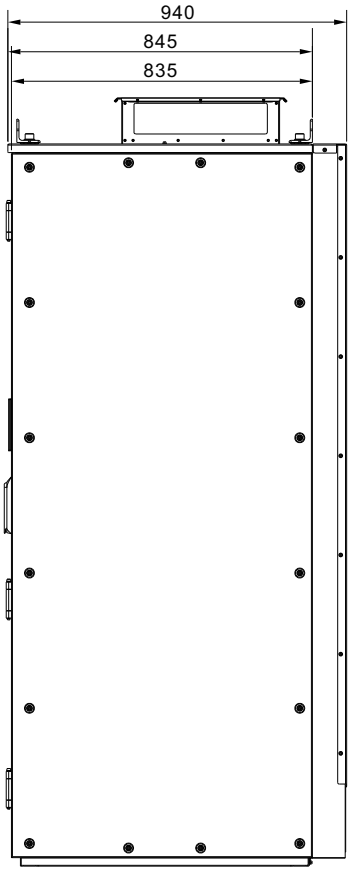
Model	
SVG300A43A-11	SVG300AW43A-11
SVG300A63A-11	SVG300AW63A-11

Unit: mm

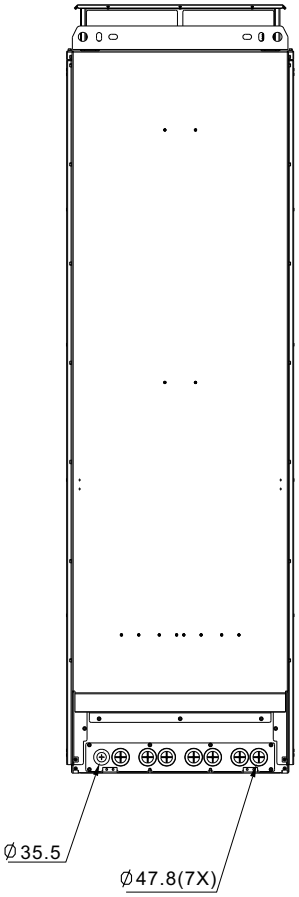
Front view



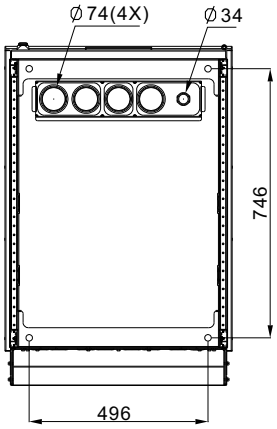
Side view



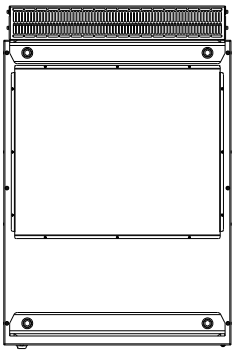
Back view



Bottom view



Top view

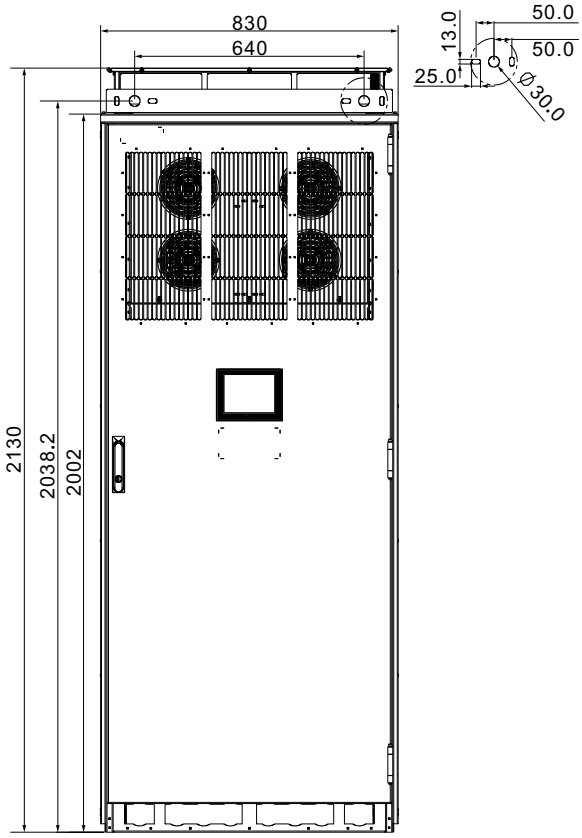


Frame B

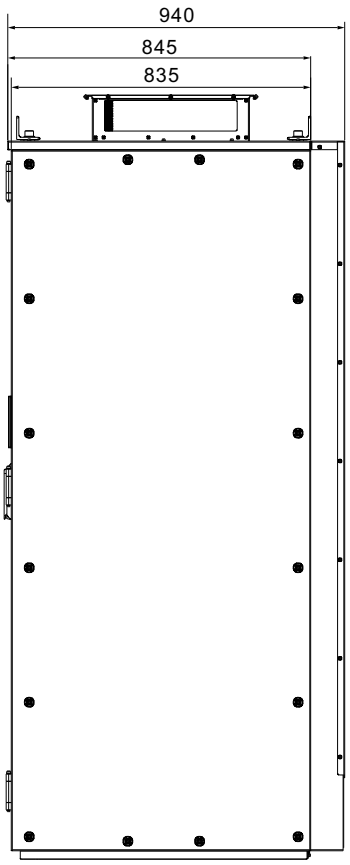
Model	
SVG500A43A-11	SVG500AW43A-11
SVG500A63A-11	SVG500AW63A-11

Unit: mm

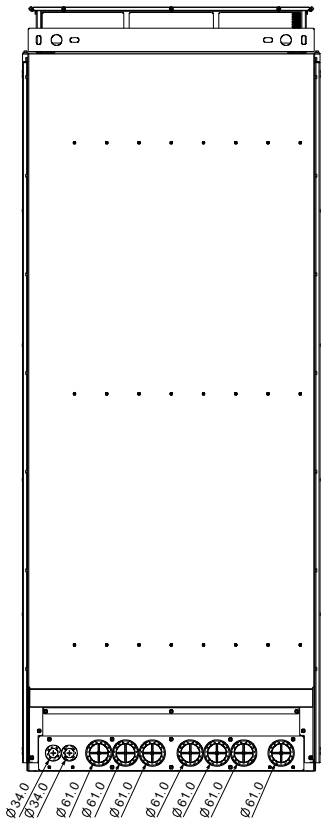
Front view



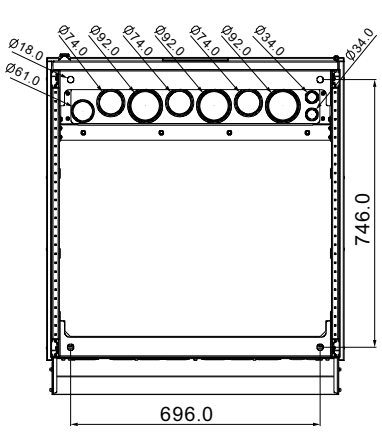
Side view



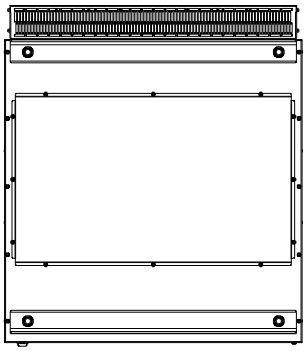
Back view



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 CT detection signals (K, L) cannot be swapped, the Static VAR Generator must use 3 CT's in three-phase three-wire devices, installed separately in R-phase, S-phase, and T-phase. The arrows point towards load. The 3 CT's must all be in the same direction, any fixed in the wrong direction will lead to errors in the detection of current values.

(2) The ratio of 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.

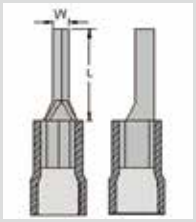
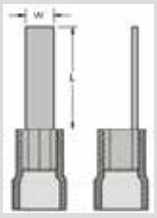
Mode	Current Ratio (A)*1	Primary Current (A)	Secondary Output Power (VA)	Accuracy	Dimension Code	Dimensions (L x W x D mm)	
CT-A0300	300A / 5A	300	2.5 VA	1%	A	Outer frame	115 x 110 x 46
						Inner frame	51 x 50 x 32
CT-A0600	600A / 5A	600	5 VA	1%	A	Outer frame	115 x 110 x 46
						Inner frame	51 x 50 x 32
CT-B0300	300A / 5A	300	5 VA	0.50%	A	Outer frame	155 x 110 x 46
						Inner frame	51 x 50 x 32
CT-B0600	600A / 5A	600	5 VA	0.50%	B	Outer frame	155 x 110 x 46
						Inner frame	90 x 50 x 32
CT-B0800	800A / 5A	800	5 VA	0.50%	B	Outer frame	155 x 110 x 46
						Inner frame	90 x 50 x 32
CT-B1000	1000A / 5A	1000	5 VA	0.50%	B	Outer frame	155 x 110 x 46
						Inner frame	90 x 50 x 32
CT-C0300	300A / 5A	300	5 VA	1%	C	Outer frame	186 x 110 x 46
						Inner frame	121 x 50 x 32
CT-C0500	500A / 5A	500	5 VA	0.50%	C	Outer frame	186 x 110 x 46
						Inner frame	121 x 50 x 32
CT-C0800	800A / 5A	800	5 VA	0.50%	C	Outer frame	186 x 110 x 46
						Inner frame	121 x 50 x 32
CT-C1000	1000A / 5A	1000	5 VA	0.50%	C	Outer frame	186 x 110 x 46
						Inner frame	121 x 50 x 32
CT-C1200	1200A / 5A	1200	5 VA	0.50%	C	Outer frame	186 x 110 x 46
						Inner frame	121 x 50 x 32
CT-C1500	1500A / 5A	1500	5 VA	0.50%	C	Outer frame	186 x 110 x 46
						Inner frame	121 x 50 x 32
CT-C1800	1800A / 5A	1800	5 VA	0.50%	C	Outer frame	186 x 110 x 46
						Inner frame	121 x 50 x 32
CT-C2500*2	2500A / 5A	2500	5 VA	0.50%	C	Outer frame	186 x 110 x 46
						Inner frame	121 x 50 x 32
CT-D1200	1200A / 5A	1200	5 VA	0.50%	D	Outer frame	226 x 130 x 46
						Inner frame	161 x 70 x 32
CT-D1500	1500A / 5A	1500	5 VA	0.50%	D	Outer frame	226 x 130 x 46
						Inner frame	161 x 70 x 32
CT-D1800	1800A / 5A	1800	5 VA	0.50%	D	Outer frame	226 x 130 x 46
						Inner frame	161 x 70 x 32
CT-D2000	2000A / 5A	2000	5 VA	0.50%	D	Outer frame	226 x 130 x 46
						Inner frame	161 x 70 x 32
CT-D3000	3000A / 5A	3000	5 VA	0.50%	D	Outer frame	226 x 130 x 46
						Inner frame	161 x 70 x 32

*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 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 wirings

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 installing multiple parallel units, the length of each CT cable must be identical.

▪ CT Cable Selection

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

▪ 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 (Meters/Feet)	Minimum Load Required by CT (VA)
6/#10	3.4	<44m/147	5
6/#10	3.4	<73m/243	7.5
6/#10	3.4	<102m/340	10
6/#10	3.4	<161m/537	15
6/#10	3.4	<338m/1127	30
4/#12	5.1	<29m/97	5
4/#12	5.1	<49m/163	7.5
4/#12	5.1	<68m/227	10
4/#12	5.1	<107m/357	15
4/#12	5.1	<225m/750	30

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