



**400 V**

**200 kvar- 400 kvar**

***HTSVG static var generator***

***( apply to low voltage distribution system )***

***Product details brochure***



## Introduction

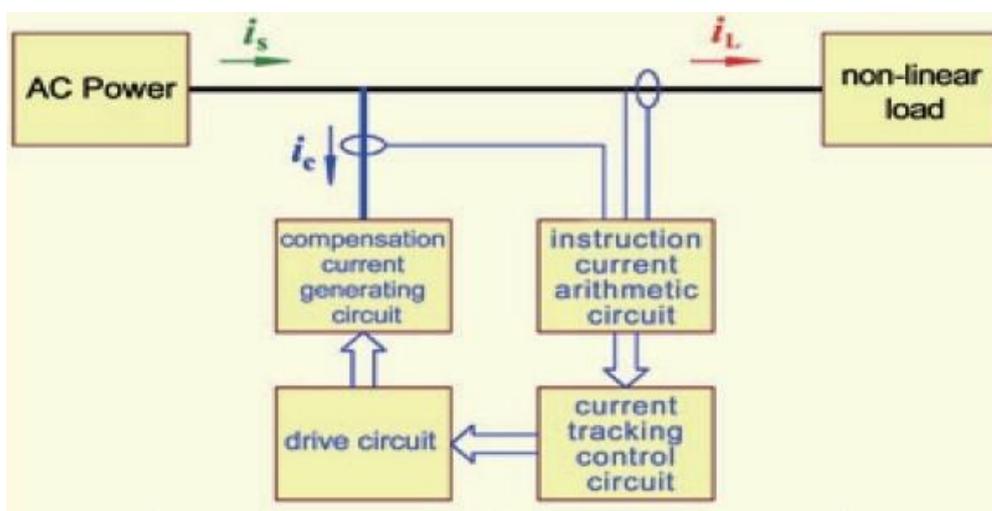
Hoteam HTSVG static var generator is a new active dynamic reactive power and harmonic compensation device with high cost performance. This device can do real-time tracking compensation to harmonic, reactive power which changes in both size and frequency and three phase unbalance, thus can provide fast dynamic reactive power compensation and harmonic filtering for power grid and electrical loads. It can effectively improve transit stability of power grid voltage, suppress busbar voltage flicker, compensate unbalanced loads, filter the harmonic and improve the power factor.

Hoteam HTSVG can be widely used in oil and chemistry, metallurgy, electricity, coal, electric railway, wind power plant that have impact loads and large-capacity motors.

## Working principle

SVG—Static Var Generator,( named SVG for short, also named STATCOM), is the representative of the latest technology in the reactive power compensation now, belongs to the important parts of flexible AC transmission system ( FACTS ). SVG is in parallel in the grid, which is equal to a controllable reactive current source, its reactive current changes along with the change of load reactive current, automatically compensate reactive power required by grid system and harmonic filtration, and realize dynamic stepless compensation to grid reactive power and harmonic.

HTSVG uses gate-controlled power electronic device ( such as IGBT ) to constitute self-commutation bridge type circuit, in parallel with grid by reactor, suitably adjust output voltage amplitude and phase at the AC side of bridge type circuit, or directly control its AC side current, then can make this circuit to absorb or generate required reactive current, to achieve the purpose of dynamic reactive power compensation.



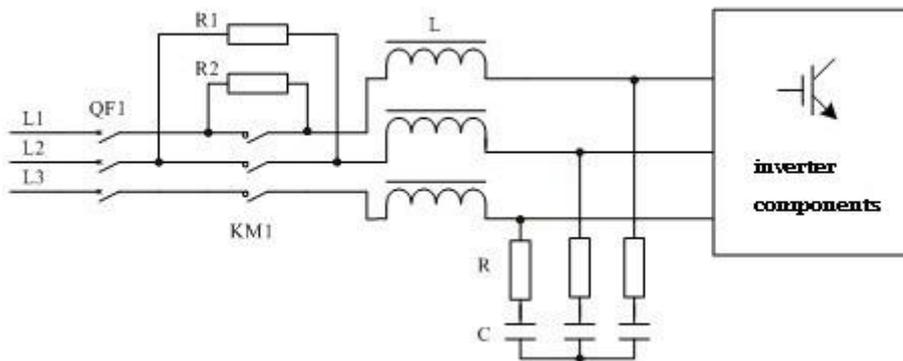
Picture 1 HTSVG working principle ( direct control type )

As shown in picture 1, SVG is constituted by instruction current arithmetic circuit and compensation current generating circuit. Instruction current arithmetic circuit real-time monitor load current, converse analog current signal into digital signal, send it to digital signal processor(DSP ) to process signal, extract the reactive current and harmonic current of fundamental wave to get the directive current, and follow the control and drive circuit through current, send out

drive pulse to compensation current generating circuit in the form of pulse width modulation(PWM ) , to drive IGBT or IPM power module, generate reverse and equivalent compensation current to inject into grid, thus can realize dynamic、fast、thoroughly manage the load reactive current and harmonic current.

### Device structure

Unit HTSVG device structure is as follows.



Picture 2 device structure diagram

### Main functions

**( 1 ) maintain receiving end voltage, strengthen system voltage stability**

For the load center, due to large capacity and no large reactive power as support, it is easy to cause grid voltage on the low side and voltage collapse accident. While SVG has fast reactive power adjustment ability, it can maintain load side voltage, to improve voltage stability of power supply system at load side.

**( 2 ) compensate system reactive power, improve power factor, reduce line loss, save energy and reduce cost**

A variety of loads in electricity system such as asynchronous motors、 electric arc furnace、 rolling mill and large capacity rectifying equipment and so on will need a large number of reactive power during working ; at the same time, transformer and line impedance in the power distribution grid will also generate some reactive power, that will reduce the system power factor.

For electric power system, load's low power factor will increase energy loss and voltage drop

of power supply line, which reduced voltage quality. Meanwhile, reactive power also cause the reduction of availability of power generation、 power distribtion、 power supply equipments ; for electric consumer, low power factor will increase electricity bill, increase production cost.

### **( 3 ) suppress voltage fluctuation and flicker**

The voltage fluctuation and flicker are mainly caused by load dramatic change. This change will cause current sharp fluctuation, cause the electric power grid voltage flicker. The typical loads that cause voltage flicker have electric arc furnace、 rolling mill、 electric locomotive and so on.

SVG can fast provide varying reactive current, to compensate voltage fluctuation and flicker caused by load changes.

At present, the best equipment to suppress voltage fluctuation and flicker is SVG.

### **( 4 ) filter the harmonics**

There are a large number of non-linear loads in power distribution grid such as inverter、 internal mixer、 elevator and arc furnance. They cause grid has a lot of harmoni , voltage/current waveform distortion, electrical equipment fault rate increase, distribution system loss increase, and even happen grid resonance which lead to trip accident. HTSVG can generate equivalent and reverse compensation current to filter harmonic, the maximum compensation capacity is 30% of device capacity.

### **( 5 ) suppress t hree phase unbalance**

Power distribution grid has many three phase unbalanced loads, such as electric locomotive traction loads and AC furnance. The three phase impedance unbalance of line, transformer and other distribution equipment will also cause voltage unbalance.

HTSVG can fast compensate negative current generated by unbalanced loads, always insure the three phase current to grid is balanced, greatly improve the quality of power supply.

## **Technical advantages**

SVG is the most advanced reactive power device at now. The compensation device based on voltage source type inverter has realized a qualitative leap of reactive power compensation mode. It

not longer use capacitance and inductance devices of large capacity, but through high-frequency switch of high-power electronic device to realized conversion of reactive energy. Technically speaking, HTSVG has the following advantages compared traditional reactive power compensation device :

**( 1 ) faster response speed**

SVG response time :  $\leq 10\text{ms}$ .

Traditional SVC response time :  $\geq 20\text{ms}$  ( if too fast, may cause oscillation of reactor and capacitor ) .

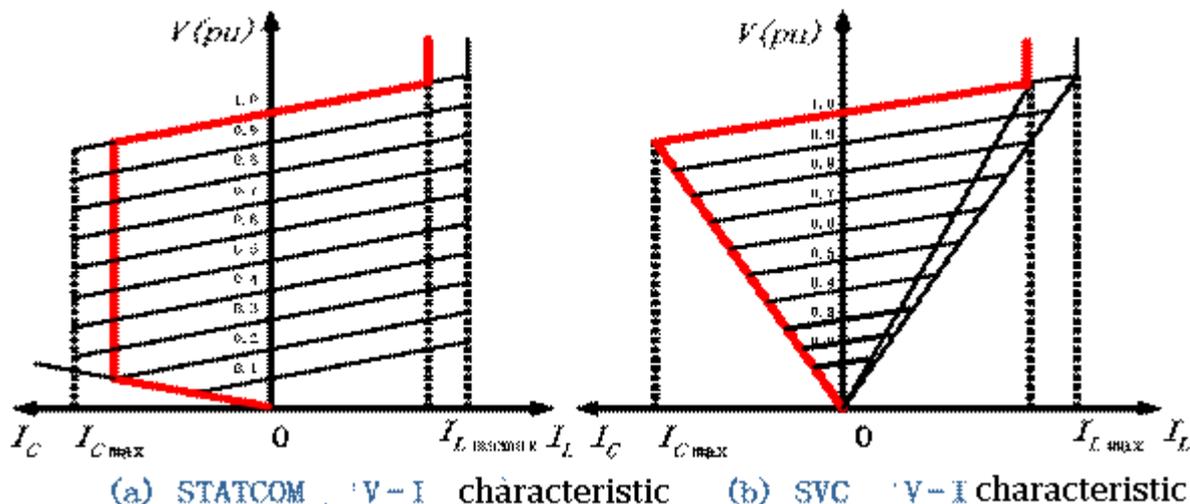
SVG can complete interconversion from rated capacitive reactive power to rated inductive power within a very short time, this incomparable response speed completely can be competent to the impact load compensation.

**( 2 ) stronger voltage flicker suppress ability**

The suppress of SVC on voltage flicker can be 2 : 1 at most, while SVG can be 5 : 1 or even higher. Being subject to the limitation of response speed, SVC's voltage flicker ability will not increase along with the increase of compensate capacity. But as SVG has faster response speed, increasing device capacity can continuously improve its voltage flicker suppress ability.

**( 3 ) wider operating range**

The output current of SVG is not depend on the voltage, performed as the characteristics of constant current source, can work among the ranges of rated inductive to rated capacitive, has wider operating range. While the nature of SVC is impedance compensation, the output current and voltage have linear relation. So when system voltage reduces, SVG can proved greater compensation capacity compared with the same capacity SVC, the characteristic of voltage and current are as follows,

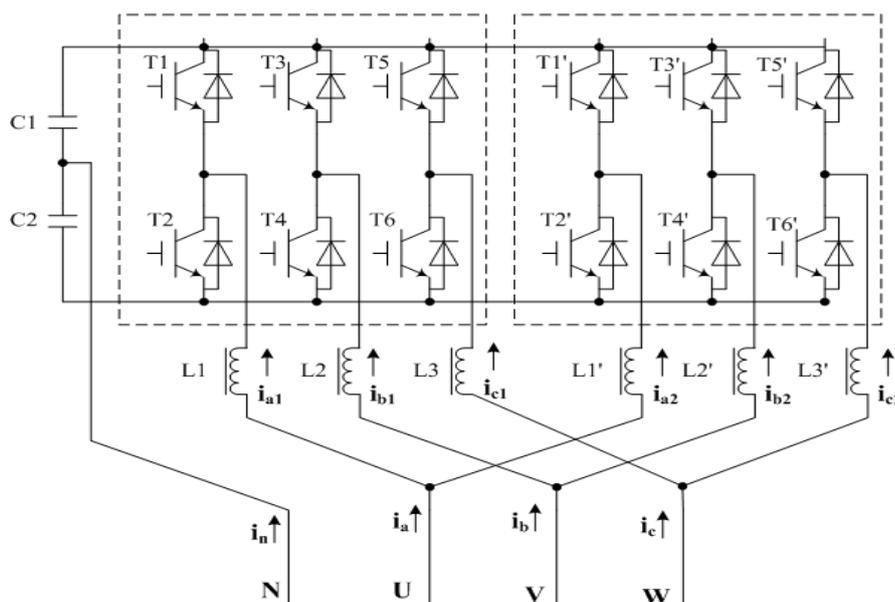


**( 4 ) diversified compensation function**

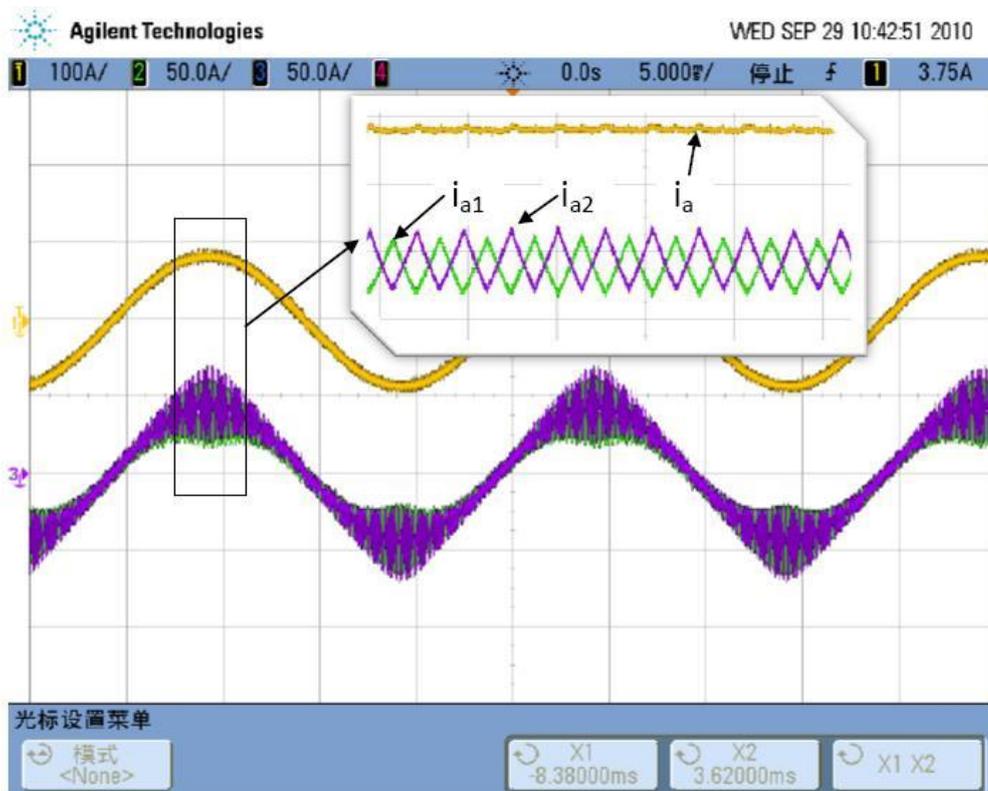
HTSVG not only has fast reactive power compensation functions, but also can compensate load harmonic current, negative-sequence current and other power quality problems based on user actual requirement.

**( 5 ) low switch ripple output characteristic**

HTSVG use two same three phase full bridge inverters in parallel, which improved equipment capacity ; and IGBT drive used PWM switch ripple cancellation technology which has our own patent, greatly reduced output ripple wave, circuit diagram as follows picture 4.



Picture 4 SVG inverter principle diagram



Picture 5 SVG inverter PWM switch stagger ripple wave cancellation technology

As shown in picture 5, the output current through PWM switch stagger technology, the ripple wave of output current  $i_a$  composited by  $i_{a1}$  and  $i_{a2}$  greatly reduced, the surplus ripply current was filtered by switch ripply wave filter.

**Technical paramters ( table 1 )**

model	HTSVG-□/□□□ Hoteam SVG
features	
	Apply to three phase three wire system, filter connect among three phases of grid, canfilter no-zero order harmonic, and compensate reactive power and unbalanced three phase.
Compensation capacity	20kvar ~ 400kvar(single cabinet, cabinet dimension see table 2)
<b>Input</b>	
Work voltage	0.4/0.69kV ±15%
Work frequency	50/60Hz±2%
<b>Performance index</b>	
Reactive power output range	Rated inductive to rated capacitive reactive, continuous adjustment
Reactive power output characteristics	Current source output
Compensation function	Power factor compensation、 voltage flicker suppress、 harmonic compensation、 load unbalanced compensation
Effective response time	Transient response<0.1ms, complete response≤10ms
Special	Switch ripply wave staggering technology, effectively reduce current ripply wave

technology	
Over load protection	Automatically limit at 100% rating output
efficiency	More than 97% when full load
CT requirement	3, 0.2 level and above, 5A at secondary side
Current detection mode	Field programmable source current detection or load current detection mode
<b>Display and port</b>	
language	English
model	7 or 10inch touch screen.
Communication port	RS-232 , RS-485 , TCP/IP
Communication protocol	MODBUS-RTU
Digital I/O	4 digital input, 2 digital output
<b>Product configuration</b>	
Unit operation	Allow
Multiple operation	5 sets in parallel at most
Protection level	IP3X ( please contact manufacturer for higher protection level )
Standard color	RAL7035, can be custom made
Device dimension	Up to detailed model
<b>Ambient condition</b>	
ambient	Indoor installation, clean ambient
Ambient temperature	- 10 ~ 40°C
Storage temperature	- 25 ~ 70°C
Relative humidity	Max 95%RH ( no condensation )
altitude	Not higher than 1000m(can be higher altitude by reducing capacity)

## Performance features

### Higher efficiency, lower loss

- Patented technology of ripple cancellation and stagger converter is characterized by high current tracing speed, small ripple and low loss ;

- Multi-DSP collaborative control can guarantee highly accurate control and high-speed computation ;

### More functions, more modes

- reactive power and harmonic integrated compensation, meet compensation requirement of series kind of power distribution system ;

- settable harmonic gradation compensation function ;

- balance compensation function, can balance load current among each phases ;

- RS-485、RS-232、TCP/IP port, standard MODBUS RTU communication protocol, and computer remote monitoring function.

**More stable, more reliable**

- Optical fiber drive can guarantee high security, reliability and anti-jamming capability ;

- Multi-protection, strict thermal design can ensure the secure and reliable operation of the system ;

- Advanced control algorithms, Adapt to all kinds of complicated field and stable operation ;

- Digital control, LCD working platform Chinese or English ;

- Self-diagnosis function ;

- Record of historical events function

**Higher power density, easier installation and maintenance**

- Modular design of controller and power module can guarantee high power density, and easy installation and maintenance ;

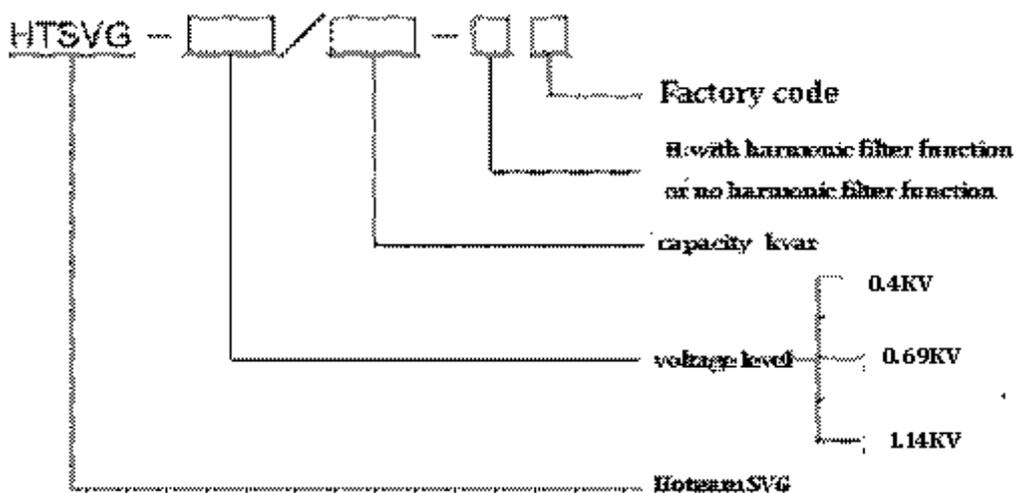
- It can conduct multi-machine parallel operation to satisfy various needs for compensation capacity ;

- Automatic current limiting will be conducted once output capacity is fully loaded, so it is free of the trouble in overloading ;

- Detection methods of source current and load current are optional for the convenience of field installation.

## Denomination method and specification model

### Denomination method



specification : for the SVG with filtering function, its maximum harmonic compensation capacity is 30% of device capacity.