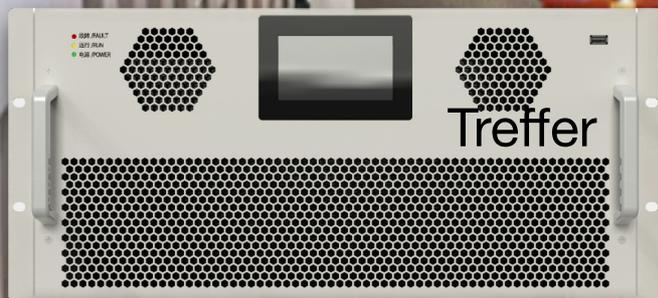
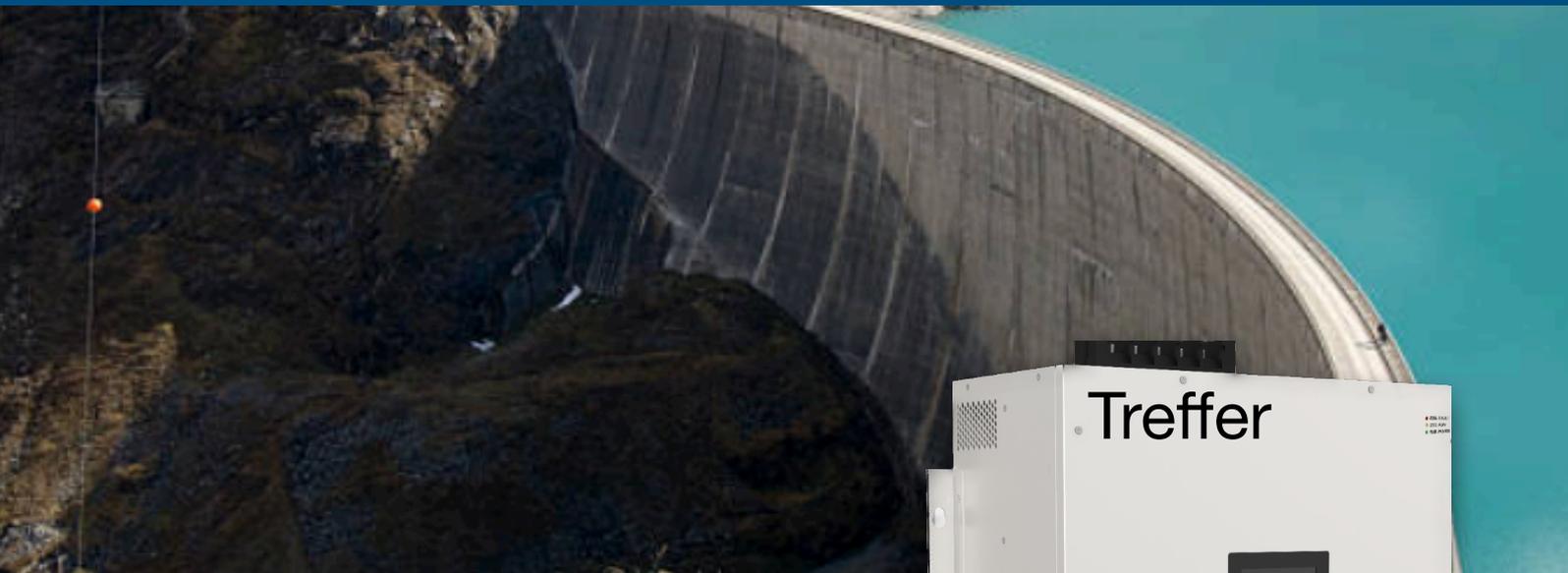


**ONE SOURCE FOR
POWER QUALITY SOLUTION**

Static Var Generator (SVG)

SVG Wall Mounted
SVG Rack Mounted



Treffer Power



THE EVOLUTION OF POWER FACTOR CORRECTION



Fixed Compensation



Contactor switching



IGBT switching



Thyristor switching

A REVOLUTIONARY NEW POWER FACTOR SYSTEM – STATIC VAR GENERATOR (SVG)

Automatic power factor correction equipment is broadly applied in IND industry to ensure the electrical network is utilised to its best capacity. The usual form of such power factor correction is an automatic controller that monitors one incoming phase to a plant and switches banks of capacitors to try and maintain a target power factor.

The problems with capacitor based automatic power factor correction are vast and varied. It is slow to react to load changes so the system is constantly in a state of over compensation or under compensation. In today's harmonic rich environments the capacitors suffer with overload. System resonance is a risk and the life expectancy of the system is reduced. Contactors regularly fail and overloaded capacitors leak, presenting a real fire risk.

Treffer SVG is an entirely new approach to power factor correction. The SVG utilises a high speed three level inverter that reacts to changes in reactive power, exchanging corrective reactive power into the system. Full correction is made in $3/4$ of a cycle. This rapid response provides stable accurate real-time power factor correction without the drawbacks of traditional based systems. The SVG can continuously adjust reactive power dynamically and bi-directionally (leading or lagging). There is no chance of system resonance and even under low voltage conditions SVG will provide full reactive power compensation. The Treffer SVG is 100% inverter based so there are no AC capacitors to fail.

THE PROS AND CONS OF A CONVENTIONAL CAPACITOR BASED SYSTEM VERSUS SVG

Capacitor based systems are based on "staging in" and "staging out" banks of fixed capacitance. This means the amount of correction is available only in multiples of the fixed banks resulting in over and under compensation.

Capacitor based systems are slow to respond. The power factor controller must be tuned to stop cycling of the "staging in" and "staging out" process. The delay is further increased by the time taken for the bank contactor to pull in.

Capacitor based systems can encounter resonance.

Conventional systems can only correct an inductive (lagging) load.

Conventional systems are manufactured by collectively installing blocking chokes, capacitors, and switching contactor into an enclosure. This takes up a large amount of switch room real estate.

The performance of power factor correction capacitors is greatly impacted by the grid voltage level. Low voltage on the grid results in poorer compensation performance from the capacitors.

Capacitor based systems require frequent switching of the stages to achieve correction for changing power factor thus resulting in a shortened service life, in some cases as low as 3 years.

PF
0.99

The SVG uses inverter technology to inject an infinitely variable amount of corrective reactive power. This ensures the power factor is always at set point with no over or under correction.

Speed
15 ms

The complete response time of the SVG is less than 15ms and the dynamic response time is less than 50µs. This makes the SVG perfect for sites with rapidly changing power factor.

Harmonic
Resonance

The SVG uses inverter technology so resonance is eliminated.

-1~1

The SVG can correct both an inductive (lagging) or capacitive (leading) load.

Space
Small

The inverter technology used in the SVG is very compact and typically requires less mounting area than a conventional system.

Life
100000h

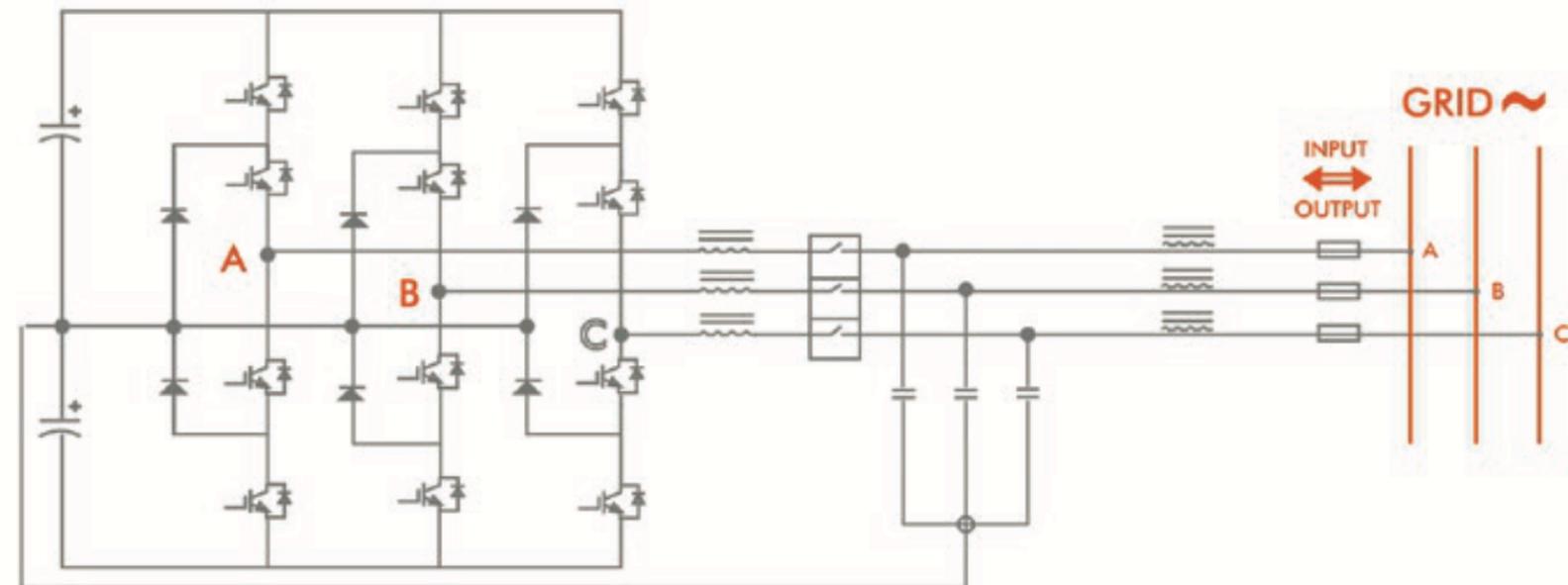
The SVG performance is virtually unaffected by low grid voltage levels.

Life
100000h

The SVG has low losses and needs little maintenance. The service life is expected to be greater than 10 years.

SVG Operating Principal

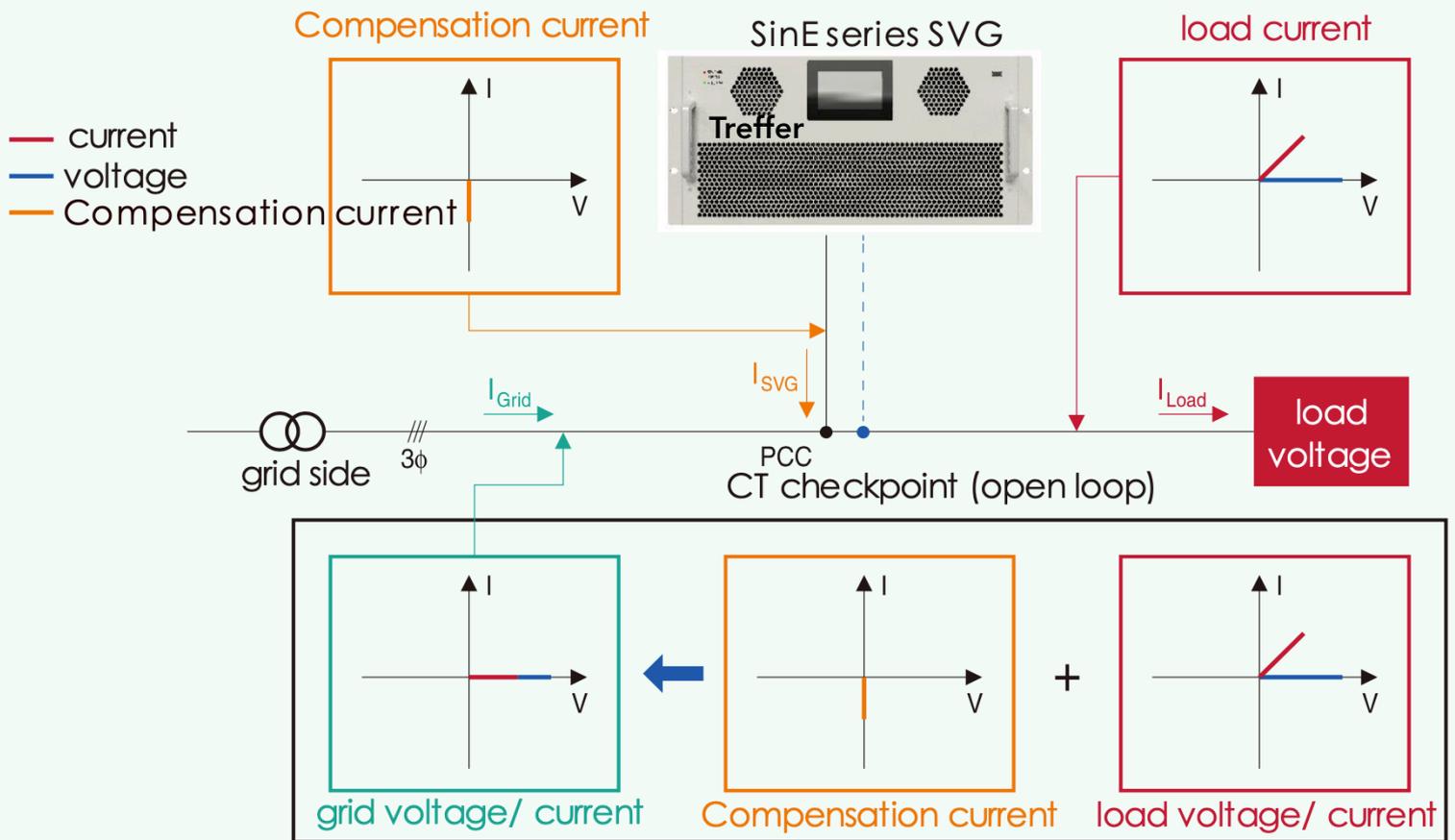
Load Current is Detected through external I_{ts} and fed to the internal DSP and CPU where an instantaneous Reactive Power algorithm separates the active power from the reactive Power. A compensating reactive power requirement is dynamically and accurately calculated and sent to the IGBT Control where a PWM signal is generated at a switching Frequency 20KHZ, A compensating capacitive reactive power Or inductive reactive power is controlled by manipulation of the DC bus voltage in comparison to the AC line Voltage , Thus A capacitive current or inductive current will flow, creating a Reactive power exchange with the network.



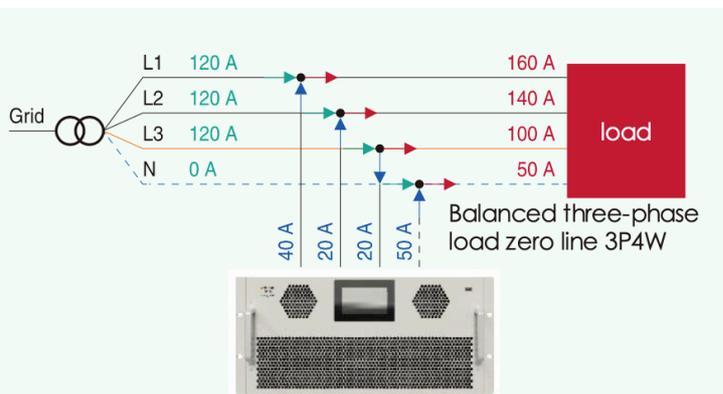
Innovative three level inverter circuit

Treffer Innovative Three level inverter is at heart of every SVG . The modular three level inverter utilise 12 IGBTs so reduces switching loss and permits higher switching speeds. The need for small filter components results in an ultra-compact Design with an improved waveform resulting in very low harmonic distortion and low Level of electromagnetic interference. The ultra-compact design permits modular Construction.

SVG Operating Principal



TREFFER SVG load balancing for 3P3W and 3P4W



Treffer SVG can balance load between phases and unloaded neutral wire for input voltage connection systems such as 3P3W and 3P4W. Therefore, it will be a perfect solution with applications having reactive power requirements along with unbalanced loads, which is the case with the electricity distribution in rural areas, some industrial applications and much more.

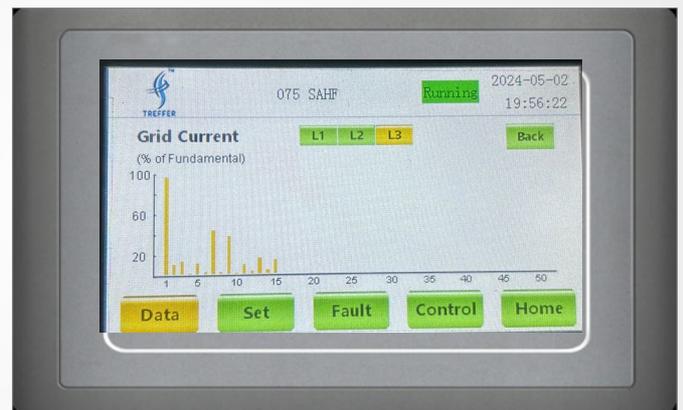
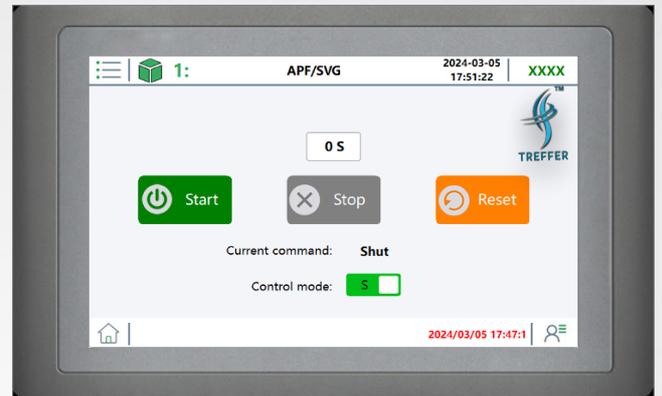
Technical data and Specification

Rated Voltage(V)	200	400	690	800
Grid voltage range	-20%~+20%	20%~+20%	-20%~+10%	-20%~850V
Individual module capacity (kVar)	25、 50、 75	20、 35、 50、 75、 100、 150	120	
Frequency	50/60Hz (-10%~+10%)			
Overall efficiency	>97.5%			
CT configuration	Closed or open loop (Open loop is recommended in case of parallel operation)			
Overall response time	<7.8ms			
Grid type	3P3W, 3P4W			
Overload capacity	110%-Continuous operation,120%-1min			
Circuit topology	3-level topology			
Switching frequency	20 kHz			
Modularity	Maximum 20 units can be combined			
Redundancy	Master/master or master/slave arrangement			
Typical power losses	< 2.5% (depending of the load)			
Target power factor	Adjustable from -1 to 1			
Harmonic compensation	Available			
Unbalance compensation	Available			
Display	1.8/4.3/7-inch HMI (Optional)			
Communication ports	RS485 Modbus (RTU)			
Noise level	< 69 dB (depending on the load and model)			
Altitude	Derating usage >2000m			
ambient temperature	Operating Temperature: -35°C~55°C, Derating usage above 55°C			
Humidity	Storage temperature: -45°C~70°C			
	5%~95%RH, non-condensing			
Protection class	IP20			
Design/Approvals	EN 62477-1(2012), EN 61439-1 (2011)			
EMC	EN/IEC 61000-6-4, Class A			

HMI Display

It has 7 inch Colour touch screen and can display power information, data and waveform before and after compensation.

SVG can control and monitor operating state of SVG and LC, as well as displaying the grid voltage, the grid current, frequency, $\cos\phi$, PF, THDU, THDI, active power, reactive power, apparent power, working condition of SVG and capacitors and other important parameters.



The picture-viewing functionality

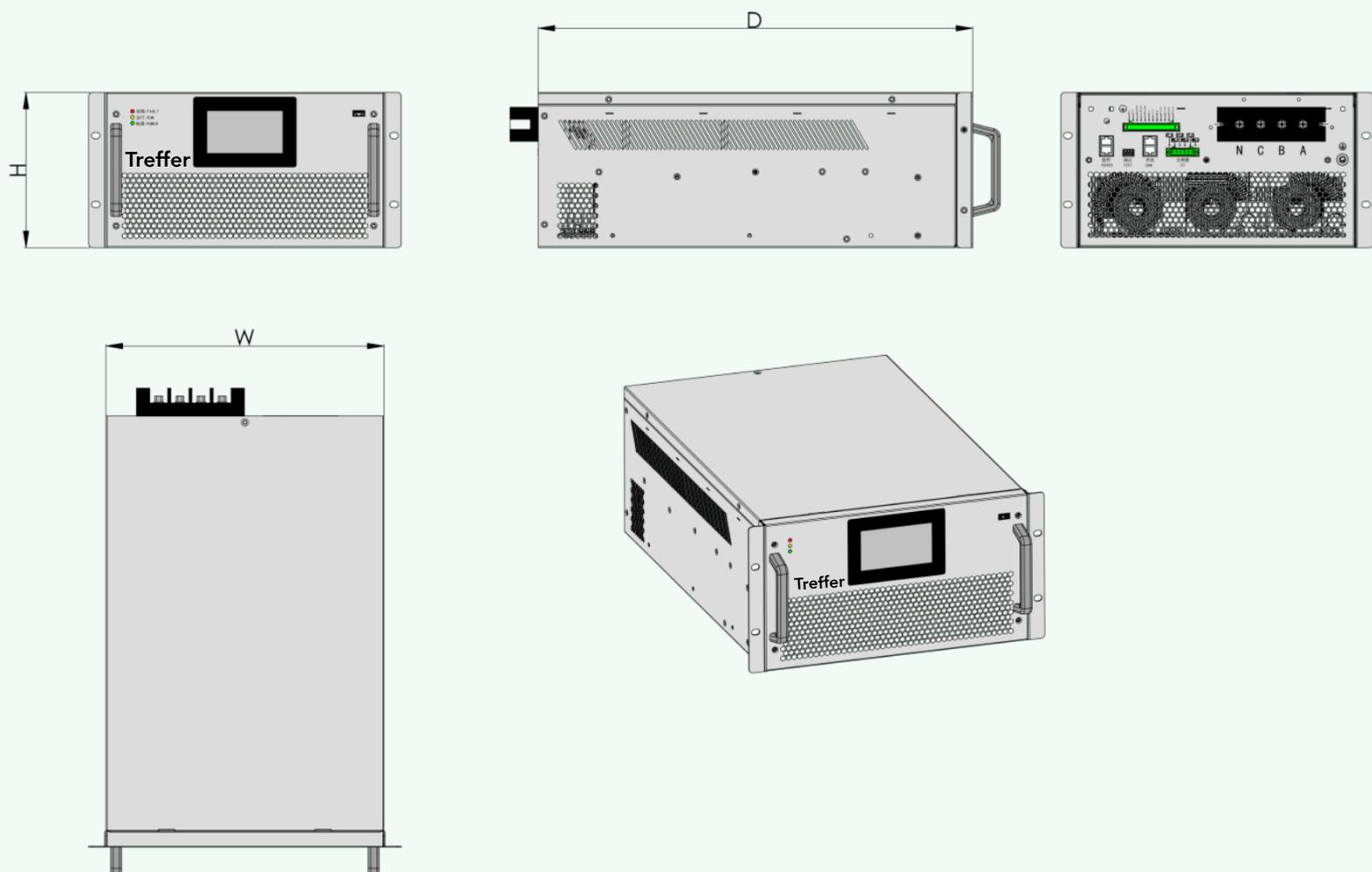
HMI can show images in real time on the screen, including waveform and spectrogram. When the screen displays the graph, operator can zoom in and out it to meet different requirement as needed.

Wave data: waveform of the grid voltage, waveform of the grid current, waveform of load current, waveform of offset current, frequency spectrum of the grid voltage, frequency spectrum of the grid current, frequency spectrum of load current.



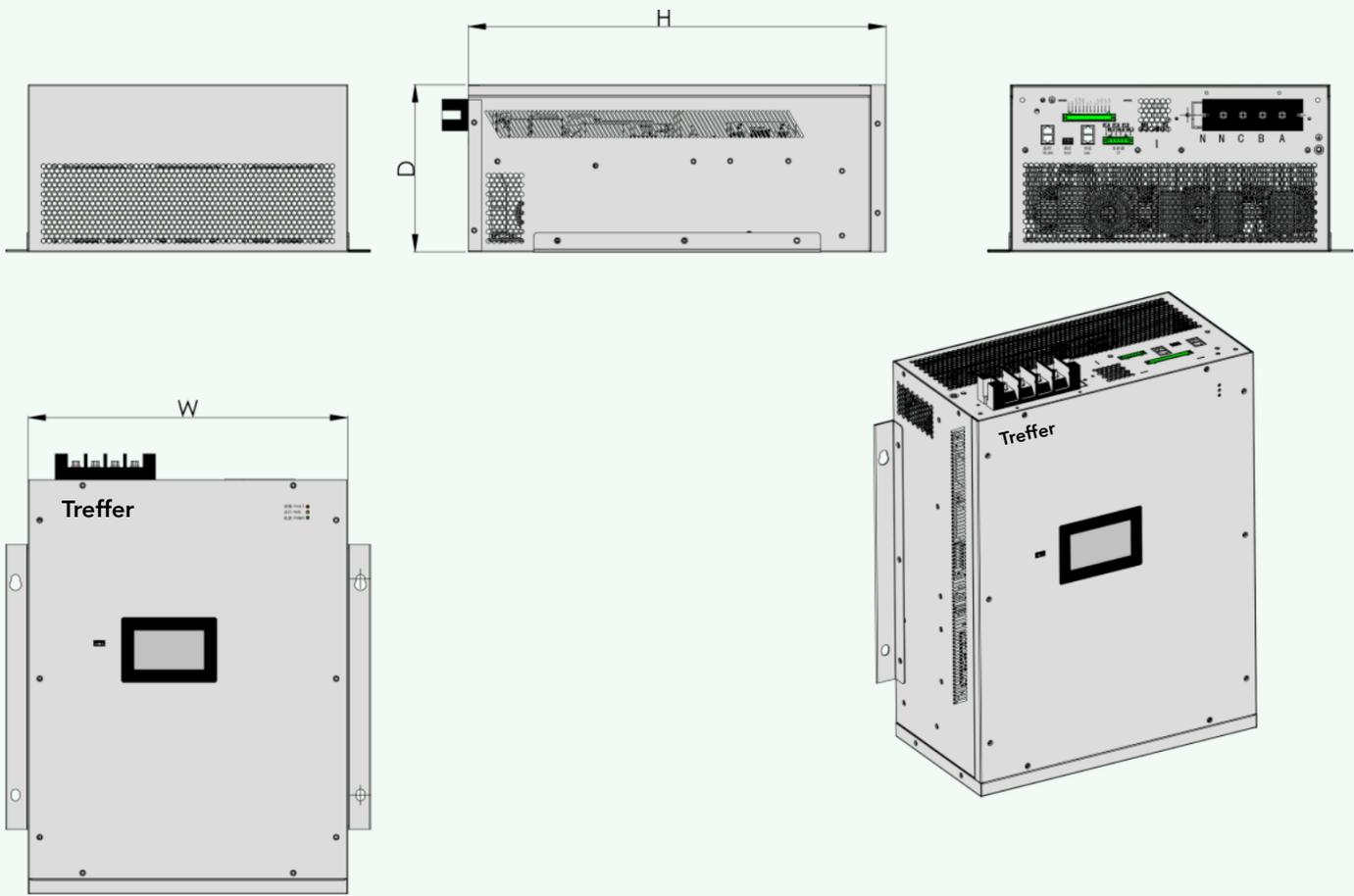
It is incorporated with 16 IO port to flexibly implement different integrated modes of SVG and LC. In manual switching mode, corresponding capacitor will connect or disconnect with a click of the white button below the capacitor.

Rack-mounted SVG module



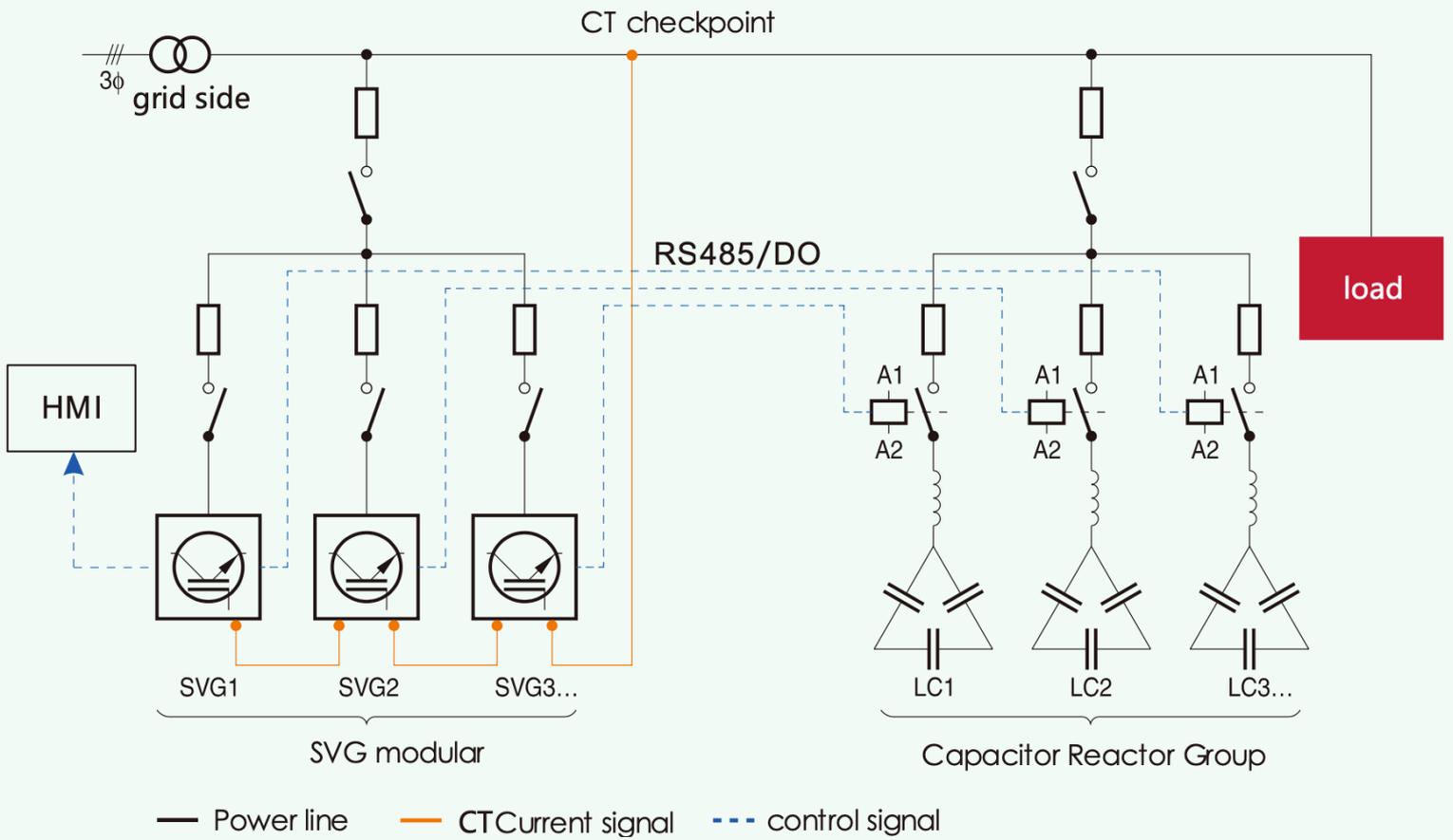
SVG modules		Approx. dimensions(W×D×H,mm)	Approx. weight(kg)
400V	35kVar	315*500*200	18.5
	50kVar	355*500*200	24.5
	75kVar	440*575*200	35
	100kVar	510*585*250	43.5
	150kVar	630*640*250	65
690V/800V	120kVa	525*626*250	55

Wall-mounted SVG module



SVG modules		Approx. dimensions(W×D×H,mm)	Approx. weight(kg)
400V	35kVar	315*200*500	22
	50kVar	355*200*520	27
	75kVar	440*232*575	38
	100kVar	510*250*585	47
	150kVar	630*250*640	68.5
690V/800V	120kVar	525*250*626	56

Hybrid Var compensation working principle



Comparison of capacitance compensation and hybrid var compensation

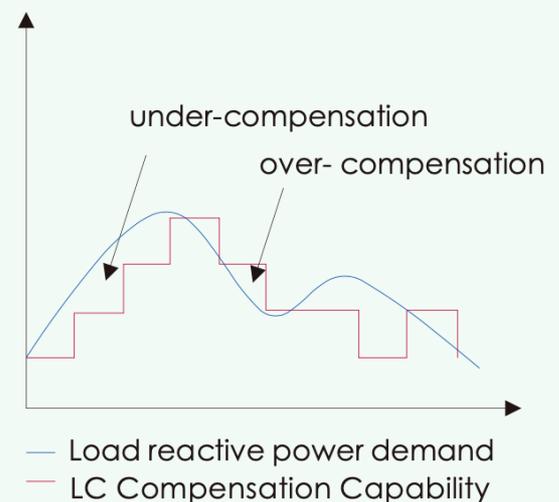
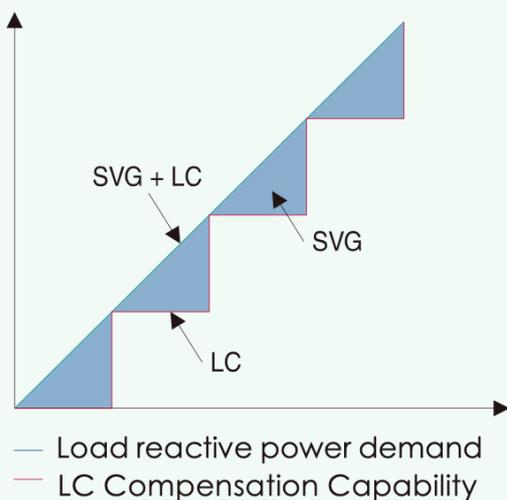
SVG+LC hybrid compensation

Capacitor reactor group realizes stepless switching compensation

- SVG module can cover all blind spots

Traditional capacitor reactive power compensation

- May lead to over- and under-compensation



Static Var compensation - Recommended tips

Cable cross-section and fuses

SVG Current	A/B/C (L1/L2/L3) mm ²	N mm ²	PE mm ²	Fuse A
35kVar	16	16	16	80
50kVar	25	25	16	125
75kVar	35	35	16	160
100kVar	50	50	25	250
150kVar	70	70	25	400

* It is recommended to use copper core wire;

CT

CT Ratio	50/5~10000/5. Choose according to 1.2~1.5 times of grid current, or choose according to transformer capacity		
CT cable	CT rated power	Conductor cross-sectional	Wire length m
	5VA	2.5	≤10
		4.0	10~20
	10VA	2.5	≤20
		4.0	20~40
	15VA	2.5	≤30
4.0		30~60	

*CT rated secondary power is greater than 1VA;

*CT accuracy is required to be above 0.5;

*The secondary side of the CT must be reliably grounded (only one end needs to be grounded);

*CT cable is recommended to use shielded twisted pair cable (RVVP)

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