



EnerVAR Active VAR Generator (AVG)

THE REVOLUTIONARY REACTIVE POWER GENERATOR UTILISING 3-LEVEL IGBT FOR POWER FACTOR CORRECTION

Key Features

- Modular and Scalable System Architecture.
- Various Voltage Available: 3Phase 208V/230V/400V/480V
- Using 3-Level IGBT to generate continuous reactive current, No moveable parts, not affected by Frequency & Impedance change.
- Step-less Reactive Compensation for 3-wire or 4-wire systems.
- Precise Compensation for both Leading and Lagging Power Factor.
- Built-in Active Harmonic Compensation Capability from 3rd to 13th orders. No risk of resonant with harmonic.

Powerful Performance

- Close / Open Loop Selectable Control.
- Ultra-fast response time from detection to complete correction in <10msec.
- Load balancing between phases and unload neutral wire.
- Programmable DSP control Reactive Power injection to desire value. No risk of under or over correction.

Expandable Capabilities

- True modular hot-swappable design, non-disruptive replacement without powering off the system.
- Unlimited parallel operation with same or different AVG ratings systems to meet various power demand without over sizing

User Friendly Human-Machine Interface

- HMI utilising 7inch Coloured LCD Touch Screen for advanced control and monitoring, complete with Modbus RTU and Ethernet TCP/IP communication.

Typical Application

- Hospitals, Data centers, Green Buildings, TV Stations.
- Chemical industry, Oil and gas, Steel plants.
- Water treatment plants, Automotive industry.



Designed & Engineered by:



Technical Data Sheet

Model	EnerVAR AVG			
Nominal Operating Voltage	208V	230V	400V	480V
Voltage Tolerance	+15%, -20%			+10%, -20%
Available Capacity Per Module*	25kVAR	30kVAR	55kVAR	65kVAR
Phase/Wires	3 phase 3 wires or 4 wires			3 phase 3 wires only
Nominal Frequency	50/60Hz \pm 5% (Auto Sensing)			
Weight, kG	~35kG / modules			
Parallel Operation	Unlimited, with same or different ratings.			
Reactive Power (Power Factor Correction) capability	Capable of both Inductive (lagging) & Capacitive (leading) reactive power compensation, programmable to achieve the desire targeted PF			
Harmonics Attenuation Capability	Up to 30% of rated capacity, Programmable From 3 rd to 13 th harmonic orders, typical attenuation ratio 10:1			
Load Balancing	Both phase to phases and phase to neutral			
CT Ratio	Programmable Primary Current: 200A~16000A Programmable Secondary Current: 1A/5A			
CT Location	Selectable Source Side: Close Loop Control Load Side: Open Loop Control			
Dynamic Response Time	<10ms			
Inrush Current	Less than rated current			
Maximum Heat Losses	\leq 3% at full capacity			
Communication Interfaces	USB, Ethernet (TCP/IP), RS-485 (Modbus RTU Protocol)			
Digital I/O	3 x Digital Outputs + 1 x Digital Input + 1 x EPO			
EMC Class Compliance	EN61000-6-4, EN55011, CISPR11, IEC61000-3-11, IEC61000-3-12, EN61000-6-2, EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, EN61000-4-8, EN61000-4-34			
Harmonics Reference Standards	EN 61000-3-4 , IEEE 519-1992			
Safety Standard	Complies to EN 62477-1			
Design Standard	According to EN 60146			
Operating Ambient Temperature	-10°C to 40°C (Up to 50°C with suitable derating)			
Operating Humidity	Maximum 95% RH; non-condensing			

*the current rating may be derated automatically depending on load conditions for ambient temperature higher than 40 degree C.

Frames Type Description	Frame Type 1	Frame Type 2	Frame Type 3
Install Up to total number of Power Module (PM)	4	6	8
Protection Index	IP 21, other IP rating available upon request		
Colour Code	RAL 9001, other colour available upon request		
Dimension (WxDxH), mm	600 x 900 x 1500	600 x 900 x 1950	600 x 1000 x 1950
Weigth, kg (exclude modules)	~150	~196	~200

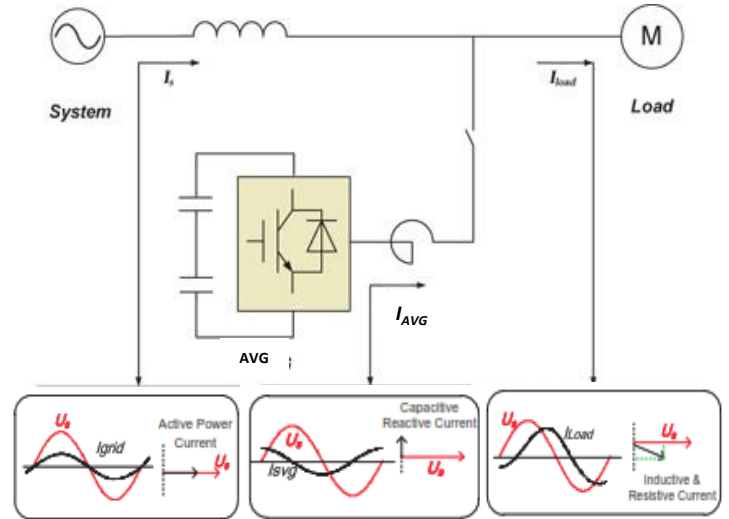
Operating Principle

The EnerVAR is a modular Active VAR generator (AVG), which utilizes a high speed three level inverter (IGBT) to control the reactive power flow of the system. The AVG detects the load current through the external CT and regulates the voltage by continuously absorbing or injecting the reactive power in the power system. The voltage and current waveform produced is almost sinusoidal, achieving a near unity power factor.

The switching frequency of the IGBTs provides extremely fast control resulting in very low electrical losses, less stress on the components, increasing the equipment lifetime.

The key functions of an AVG are:

- (1) Regulate Reactive Power : $\cos \phi = 1.00$
- (2) Compensate Current harmonics
- (3) Re-adjust unbalance current between phases
- (4) Treats Flickers

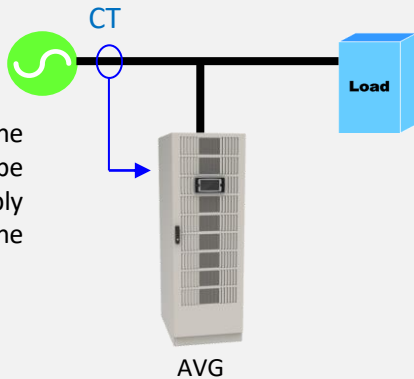


CT Installation

External auxiliary coupling current sensing transformers (CT) are the essential components in all power factor correction applications. The EnerVAR AVG is designed to have selective CT sensing configurations installed on Load Side or Source Side.

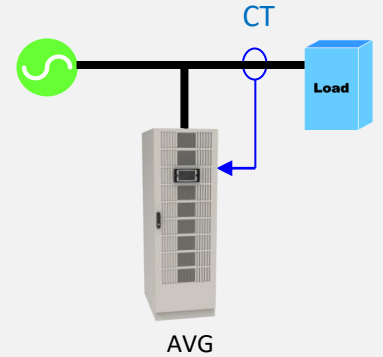
SOURCE SENSING

Source-sensing require the external auxiliary CT to be coupled at the input supply source common to both the AVG and the equipment.



LOAD SENSING

Load-sensing require the external auxiliary CT to be located nearest to the point of common coupling in the direction of the equipment.



Conventional Cap Bank Versus EnerVAR AVG

Cap Bank + Reactor	EnerVAR AVG
Use Passive components & Electro-mechanical Contactors	Utilize 3-level IGBT and other static components
Large Footprint	Compact Footprint
Sensitive to Frequency change, risk of capacitors becoming faulty	Use static semi-conductor (IGBT) for generating of reactive current, Not affected by Frequency change, No risk of resonant
Compensate only lagging PF	Able to compensate Leading and Lagging PF
Non-precise correction of PF, high risk of over correction depending on the no. of stages of capacitors used	Settable and precise correction to desire PF value. No risk of under or over correction.
Risk of Resonant with other passive or active harmonic compensating devices	Active compensation of 3 rd to 13 th order harmonics up to 30% of its capacity. No risk of resonant with harmonic
Slow dynamic respond time using contactors for switching, >40msec	Fast dynamic respond time from detection to complete correction in <10msec
Non hot-swappable. Full shutdown needed if any capacitor or reactor becomes faulty	True modular hot-swappable design, no shut down required to perform replacement
Requires further study to add on new harmonic filter to ensure compatibility and avoid resonant. Requires new set of CT and additional power cables for the new harmonic filter.	Easily added with AblereX active harmonic filter modules to increase harmonic current compensating capability. Able to share the same existing CT, enclosure and power cables.

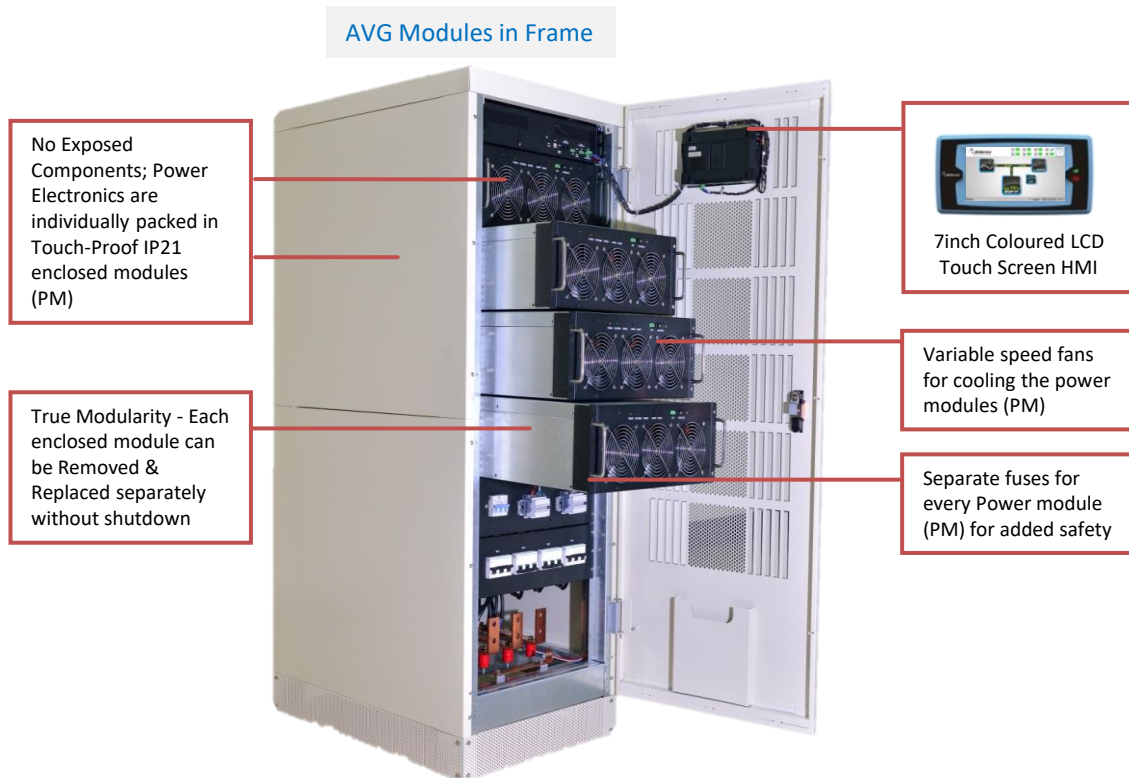
Modular & Scalable Architecture

Modularity principle: Maximum scope for extension

The compensation power electronics consisting 3-Level IGBT are housed in compact enclosed modules with speed controlled cooling fans for thermal dissipation. These rated AVG modules are equipped with live hot-plug connectors for ease of configuration and frame integration.

The compensation reactive power can be sized accordingly and gradually extended using additional AVG modules and frames. Standardizing the components ensures short delivery time and cost effectiveness.

The modular structure makes the EnerVAR AVG resilient to errors. Should a module fails, the other Modules continue to function until the error is rectified. Installation and maintenance are much easier with hot plug-in operation and front fan replacement. Reduced downtime with MTTR of less than 120 minutes.

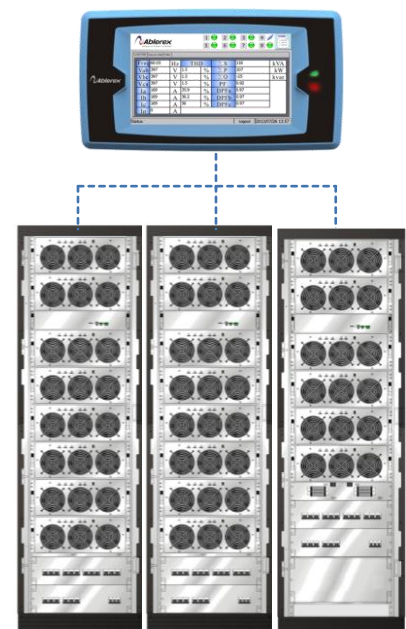


Expandable Capabilities:

Differently Rated AVG Systems can be wired in parallel

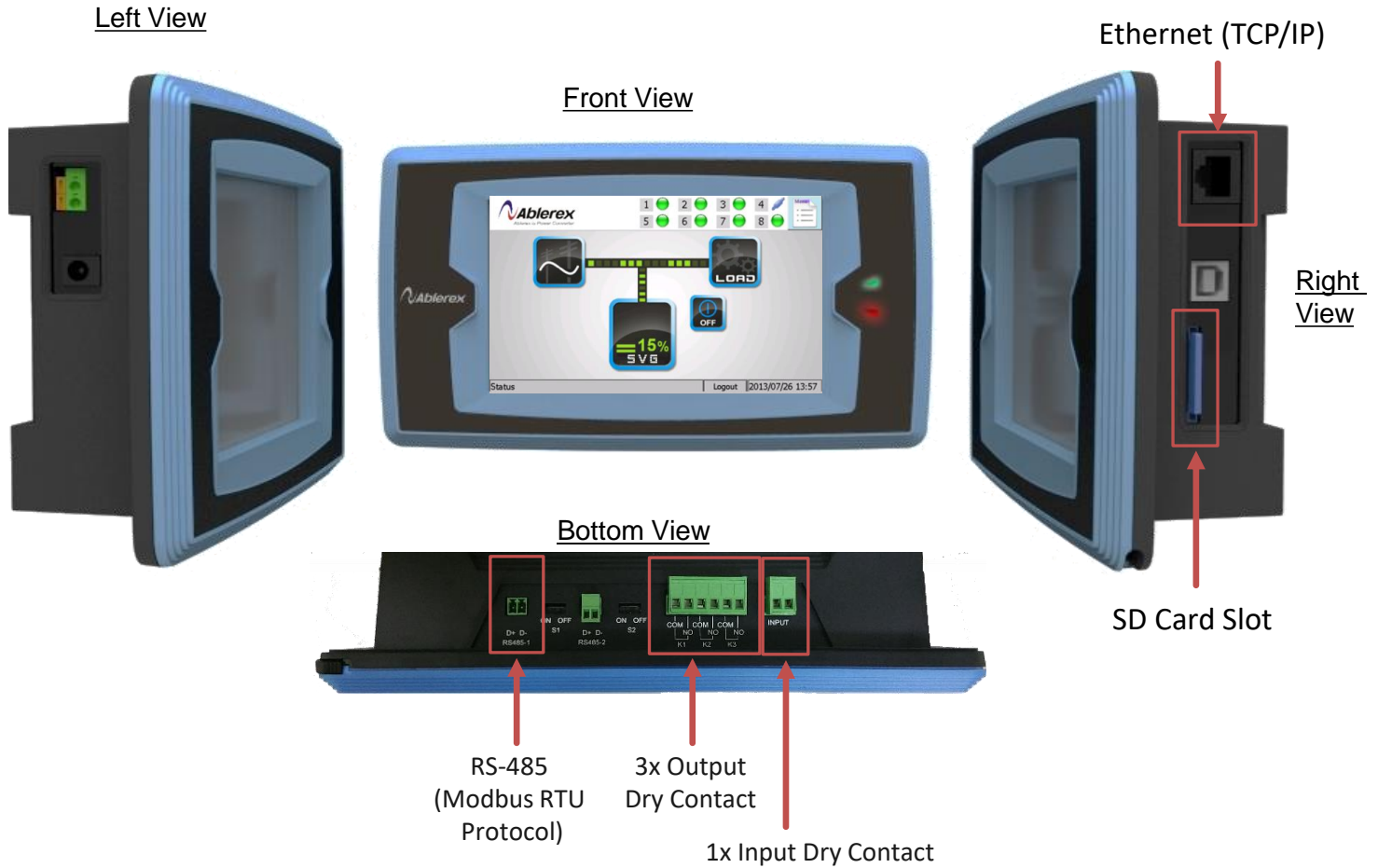
The frame system features a hot-swappable modular design, and modules are configured seamlessly in one frame. The frame system can be parallel and supplied accordingly to various application environment, and **differently Rated AVG Systems** can be applied in parallel according to requirements.

- Each Frame is complete with bus bar, hot-plug connectors, sliding rail kits and auto-power cut contacts for easy adds on or removal of power modules. No messy cabling needed.
- Different Frame size available for 4, 6 & 8 power modules to meet small to high power ratings
- Unlimited parallel operation to achieve any desire kVAR ratings.
- Enable Pay-As-You-Go; companies can save on buying large capacity from the beginning, but instead increase the KVAR rating gradually when demand increases.



Intuitive Human Machine Interface

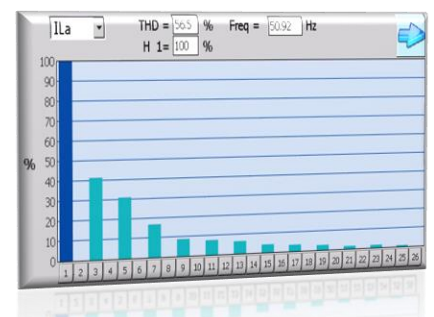
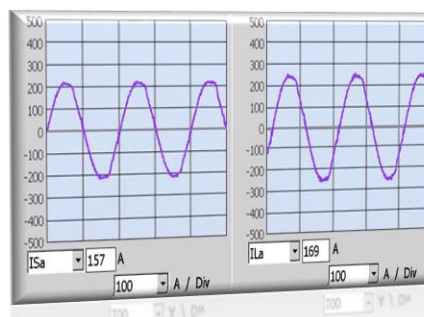
The EnerVAR AVG is equip with a 7inch Coloured LCD Touch Screen Human Machine Interface (HMI), providing direct control and access to all parameters, waveforms and spectrums for managing both EnerVAR AVG and system power quality.

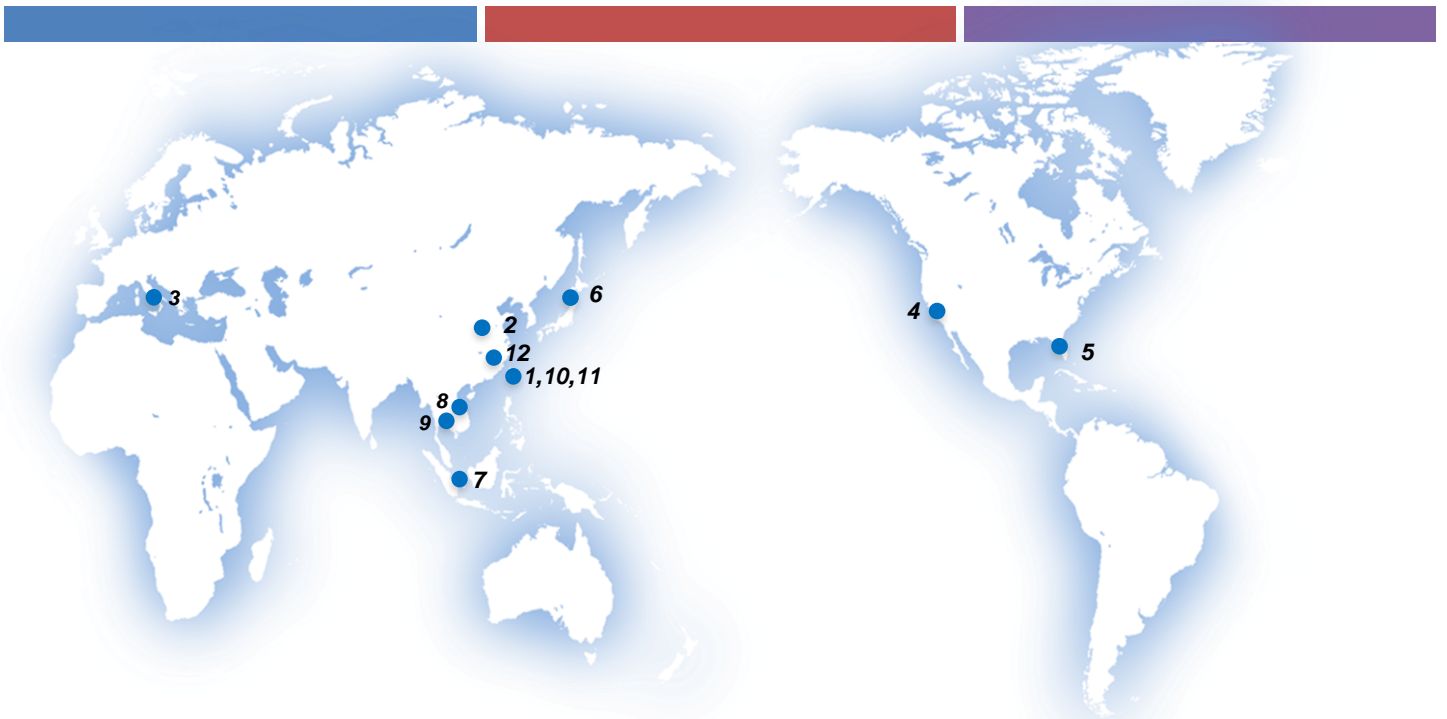


Benefits of the 7inch Coloured LCD Touch Screen includes:

- Display electrical parameters and functions without additional external devices.
- Clear menu structure and display data in both tables and diagrams.
- Simple programming of AVG function with input instruction.
- SD memory card records the system's operating statuses and event logs.
- Waveforms are display side by side for easy comparison.
- Intuitive operation and password protection.

Load Side	Source Side	Filter					
Freq	60.05	Hz	THD	ΣS	116		kVA
Vab	397	V	1.5	%	ΣP	107	kW
Vbc	397	V	1.5	%	ΣQ	-25	kvar
Vca	397	V	1.5	%	PF	0.92	
Ia	169	A	35.9	%	DPFa	0.97	
Ib	169	A	36.2	%	DPFb	0.97	
Ic	169	A	36	%	DPFc	0.97	
In	0	A					





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