

Hybrid Power Quality Solution

Real-Time Hybrid Reactive Power Compensation System with Extra Harmonic Filtration

As the use of non-linear loads grows among variety of industries, compensation systems for reactive energy and harmonic filtration are facing new challenges. On such loads, harmonic distortion increases due to the nature of non-linear loads without correlation to reactive energy. As a result, tuned filters integrated in capacitor banks might not be able to filter substantial amount of the distortion while the Power Factor is high. Therefore, a need for Hybrid solution raises.

Elspec's Hybrid solution is a unique combination between Elspec's reactive compensation system integrated with tuned filters, and an active harmonic filter. This combined system is the most efficient solution as it enables the compensation of the reactive energy and the harmonic distortion with extremely low losses.

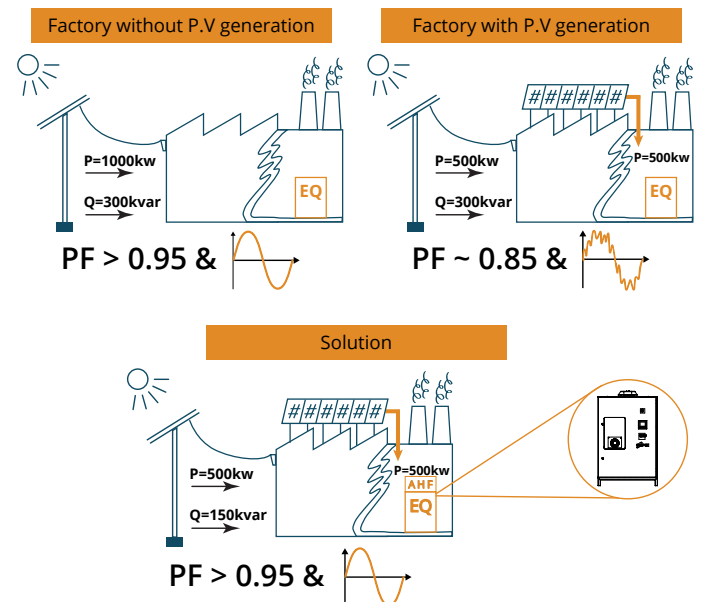
Our Hybrid solution offers all the advantages of the two existing technologies into a well performing solution - all in a single compact system.

Photovoltaic Example

Photovoltaic solar systems installed on rooftops are prevailing as an alternative source for electricity. As the use of Photovoltaic solar rooftops grows among the industry, new challenges for reactive energy compensation and harmonic filtration arise. Self-generation systems such as PV solar rooftops increase harmonics in the network as well as affecting the ratio between the active and reactive energies consumed from the grid and PV. This can substantially increase the chance for receiving penalties related to poor power factor and harmonics, despite the plant may already has a reactive power compensation system. Elspec's Hybrid solution combines between a reactive compensation system integrated with tuned filters, and an active harmonic filter. This combination enables the compensation of the reactive energy and the harmonic distortion in a single compact system.

How does it work?

In a plant which only connected to the grid, the power factor will be determined by the ratio between kW and the kVAr, both consumed from the utility. When a plant has PV rooftop, certain amount of the kW will be consumed from the PV source while all of the reactive energy still be consumed from the utility. This reduces the amount of the active energy consumed from the grid and thus has a negative effect on the power factor which may lead to penalties. Additionally, inverters from the PV system increase substantially the harmonics levels, mostly on THDv. Integrating an active harmonic filter with Elspec's power compensation system can solve both problems in a single efficient solution.

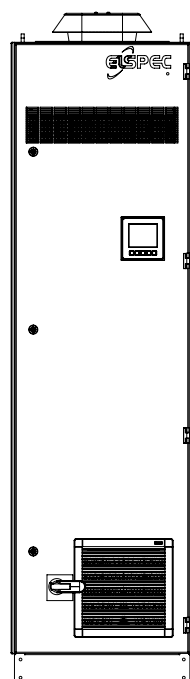


System Specifications

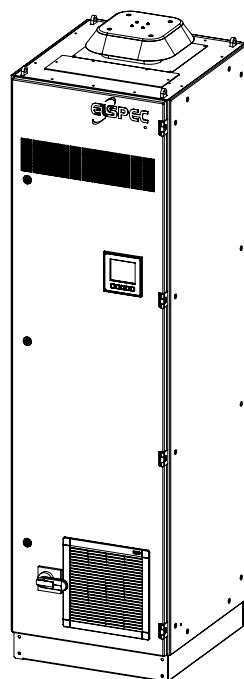
LV Equalizer System	System power	25kVAr to 3168kVAr
	Network voltage	208V to 690V
	Operational frequency	45-55Hz for 50Hz Network 55-65Hz for 60Hz Network
	Losses	208V – 690V: < 0.8%
	Communication	Isolated RS485 Up to 115k Baud Rate Protocol options: ELCOM (Elspec High-Speed communication protocol) ModBus/RTU (IEEE 754 Floating Point) Full remote control
Switching	Transient free operation	Power electronic switching designed to switch capacitor groups into the network without switching transients. Connection to the network during voltage zero-crossings, providing smooth connection of the groups.
Group Configurations	Number of groups	Up to 12 groups per controller
	Binary switching sequence	1:1:1 1:2:2 1:2:4 1:2:2:4 1:2:4:8
Acquisition Time	Full compensation within one network cycle	Up to 20ms for 50Hz network Up to 16ms for 60Hz network
Control Mode	Main ct installation location	Load only (open loop) Load + Capacitors (close loop)
	Network configuration	Single phase Three phases WYE/DELTA balanced Three phases WYE/DELTA unbalanced
Capacitors	Heavy duty capacitors	450V: 7.5um film thickness 550V: 10um film thickness 690V: 12um film thickness 800V: 14um film thickness
	Maximum ratings	Overcurrent: 4" Inrush current: 200"
Inductors	High power cooper inductors	Rated inductance and tolerance: -1.5% / +2.5% Insulation voltage: 8,000V
Operational Modes	Options	Manual Automatic Test Scan option: Can be used in Manual or Automatic modes. This option provides uniform utilization of the capacitor groups, which is carried out by transient free switching between engaged and non-engaged capacitor groups every few seconds in FIFO rotating sequence (First In First Out). Prevents overloading and overheating of the capacitors and inductors.
Display	Structure	Graphic, high contrast FSTN LCD 4.7", Black/White Long life LED backlight Antiglare coated polycarbonate window
	Functions	Menu driven operation Self-explained windows User friendly Easy installation via wizard
	Display Modes	Large Digit Screen – displays 9 numerical values Waveform Screen – displays wave shape together with wave form detailed information Harmonics Screen – displays complete harmonic spectrum, including each harmonic details (amplitude, percentage and phase shift).
Software	Upgrading methods	No Jumpers or switches Firmware can be upgraded by communication All parameters are software selectable, and stored in onboard Flash memory Easy, user-friendly firmware upgrade process Optional features can be enabled just by communication
PC Software	PQScada Sapphire Software	Complete System Remote Control Real Time measurements Time-Of-Use and Cost Allocation Harmonic & Waveform graphic and tabular display Comprehensive Data Logging, including triggers and set points Automatic analysis to international Power Quality standards, such as IEEE 519 (Harmonics standard) Easy Report Generation Exporting to word processor (such as Microsoft Word) and spreadsheets (such as Microsoft Excel) User Friendly on-line help, toolbars and hints Internet and Intranet operation Stand-alone or network versions, allowing intra-net and internet connectivity
Switching Module	Electronic switches	Rated voltage: 2400V/Peak Rated Current: 350Amp
	Cooling	Temperature controlled, forced air cooling system. Panel mounted Easy for Maintenance External air circulation (air does not pass through the cabinet) Long life, Ball bearings fan
	Low losses	400V: 0.35% (3.5W/kVAr) 690V: 0.25% (2.0W/kVAr)

Built in Power Quality Measurement System	Simultaneous measurement of the following sections	Mains (total of load and capacitor system) Load Capacitors (system) Combination of Mains, Load and Capacitors. For example, if reactive energy parameter is selected, the user can see the kVAR consumption by the Load , the connected kVAR by the Capacitor System and the result on the Mains .	
	Calculation method	True RMS measurements (up to 63rd harmonics) Based on FFT algorithm which is carried out cycle by cycle (128 samples per cycle)	
	Measured parameters	Frequency Phase Current Phase to phase Current* Phase Voltage Phase to Phase Voltage Active Power (kW) Reactive Power (kVAR) Apparent Power (kVA) Power Factor *Note: Unique feature: internal current of feeder transformer (delta secondary)	Common N, L1, L2, L3 L1-2, L2-3, L3-1 N, L1, L2, L3 L1-2, L2-3, L3-1 L1, L2, L3, Total L1, L2, L3, Total L1, L2, L3, Total L1, L2, L3, Total
	Thd, harmonic spectrum, and waveform analysis for	3 line current of Mains 3 line-line current of Mains 3 line current of Load 3 line-line current of Load 3 line current of Capacitors 3 Phase to Neutral voltage 3 line Phase to Phase voltages Neutral current Neutral voltage	DELTA, WYE DELTA DELTA, WYE DELTA DELTA, WYE DELTA, WYE WYE WYE WYE
	Energy	Active Energy (kWh) Reactive Energy (kVARh) Stores energy data every 15 minutes for previous	
	Power supply	230V, 50/60Hz	
Controller Specifications	Lcd display	Size: 94x76mm Resolution: Graphic 160x128 pixels Type: FSTN, LED backlight	
	Frequency	30 to 70 Hz	
	Power consumption	10VA	
	Operating temperature	-20 to +55°C	
	Communications	RS-485 communication port	
	Protocol	ELCOM (Elspec's protocol), Modbus/RTU	
	Alarm	Voltage free N.O. / N.C., relay, max 250 VAC / 2A	
	Protection class	IP 40	
	Dimensions	144x144x138mm	
	Weight	1.4 kg	
	Storage temperature	-25 to +70°C	
	Sensors	Three 5A current sensors for Mains/Load currents Two 5A current sensors for capacitors system current Four voltage sensors (up to 500V phase to ground)	
	User keys	Five soft touch buttons	
	Controller box standard	Electromagnetic compatibility: EN50081-2, EN50082-2, EN55011, EN61000-4-2/3/4/5, ENV50204, ENV50141 Safety standards: EN61010-1, EN50439-1	

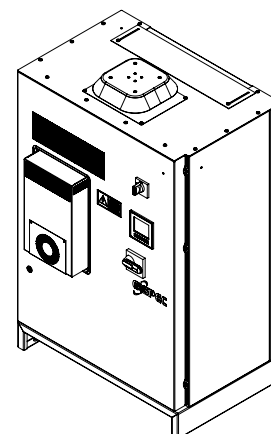
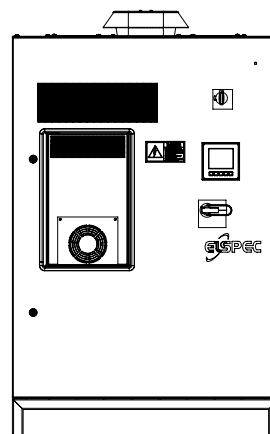
Mechanical drawings



2209X



1525X1020X757



Harmonic Filtration Specifications

Rated voltage (range)	200V (173-263V), 400V (228-456V)	480V (384-552V)
Individual module capacity	25, 35, 50, 60, 100, 150A	50, 75, 100A
Mains frequency	50/60Hz (range: 45-62Hz)	50/60Hz (range: 45-62Hz)
Neutral filtering capability	3 times the rated filter current (in case of 4 wire device)	3 times the rated filter current (in case of 4 wire device)
Harmonic current compensation range	2 nd to 50 th harmonic order or specified harmonics 0-110%	2 nd to 50 th harmonic order, or specified harmonics 0-110%
Rate of harmonic reduction	> 97% ₁	> 97% ₁
Typical power losses	< 3% (depending of the load)	< 3% (depending of the load)
Target power factor	Adjustable from -1 to 1	Adjustable from -1 to 1
Switching/control frequency	20kHz/20kHz	20kHz/20kHz
Reaction time	Approx. 50µs	Approx. 50µs
Overall response time	< 5ms	< 5ms
Harmonic compensation	Available	Available
Reactive power compensation	Available	Available
Unbalance compensation	Available	Available
Communication ports	RS485 and network port (RJ45)	RS485 and network port (RJ45)
Communication protocols	Modbus RTU, TCP/IP (Ethernet)	Modbus RTU, TCP/IP (Ethernet)
Fault alarm	Available, max. 500 alarm records	Available, max. 500 alarm records
Noise level	< 56dB upto 100A, < 65dB for 150A	< 65dB (depending on the model)
Protection functions	Overvoltage, undervoltage, short-circuit, inverter bridge inverse, overcompensation	Overvoltage, undervoltage, short-circuit, inverter bridge inverse, overcompensation
Operating temperature	-10 to +40°C (higher temperatures with derating)	-10 to +40°C (higher temperatures with derating)
Relative humidity	5-95%, non-condensation	5-95%, non-condensation
Cooling	75,115,222, 336,360L/sec (25-35,50-60,75-100, 150A)	359L/sec
Protection class	IP 20 according to IEC 529 (customizable)	IP 20 according to IEC 529 (customizable)
Panel color	RAL7035 light grey	RAL7035 light grey
Altitude	1500, 1500-4000m the power decreases by 1% for every additional 100m, according to GB/T3859.2	1500, 1500-4000m the power decreases by 1% for every additional 100m, according to GB/T3859.2
Qualifications	CE, IEEE 61000	CE, ETL (UL 508 and CSA C22.2 #2014), IEEE 61000
Compliance with standards	IEEE 519, ER G5/4	IEEE 519, ER G5/4

*AHF can be integrated with Elspec's existing system in a separate cabinet or in the same one depends on the available space.

Typical Applications

- Plants with Photovoltaic Solar systems installed on their rooftops
- Electric Vehicle Charging Stations
- Wind Turbines



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