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**ACTIVE POWER FILTER**

**LV**



**MADE IN ITALY**



**WWW.GRUPPOENERGIA.IT**

## INTRUDUCTION

Gruppo Energia Active Power Filters are used for harmonic mitigation, reactive power compensation, load balancing and neutral correction. They are fully compatible with both grid supply and backup generators. The ultra-fast response and the precise current compensation make our step-less GE-AFC3 filters effective, even on fast fluctuating and complex loads where traditional solutions fail to have any impact.

## FEATURES

- Harmonic compensation;
- Reactive compensation;
- Load balancing;
- Neutral compensation (optional);
- Unique Priority Selection feature for maximum flexibility and optimal capacity utilization.

## ADVANTAGES

- Ultra fast reaction time;
- Step-less and precise current compensation;
- Programmable and customizable;
- Compatible with diesel generator operation;
- Reduction in kVA and kVAh;
- Reduced trippings and electronic card failures;
- No more derating of diesel generators or transformers;
- No more heating of cables due to skin effect;
- No risk of resonance;
- No risk of transients;
- Easy to connect and disconnect (shunt operation);
- Auto fold-back feature, no risk of overloading;
- Fully compatible with future load expansion;
- Improved utilization of Electrical infrastructure.

## TYPICAL INSTALLATIONS

- Print industry;
- Process industry;
- Auto and welding parts;
- Steel plants, rolling mills and furnaces;
- Construction sites;
- Railway traction substations;
- Oil and gas sector;
- Renewable energy;
- IT industries;
- Textile industries;
- Commercial and residential complexes.

## TECHNOLOGY

- IGBT based static compensation technology;
- Advanced 32 bit DSP to analyze various network parameters;
- Ultra-fast sensing and advanced controlling algorithm that ensure step-less, precise instantaneous compensation;
- Hardware topology constantly controlled by the customizable algorithm in the DSP;
- Easily configurable and customizable. Ensures a perfect use of the available capacity in case of a complex load mix;
- Proven performance on fast fluctuating loads like welding;
- Proven performance on electric ARC furnace in steel.

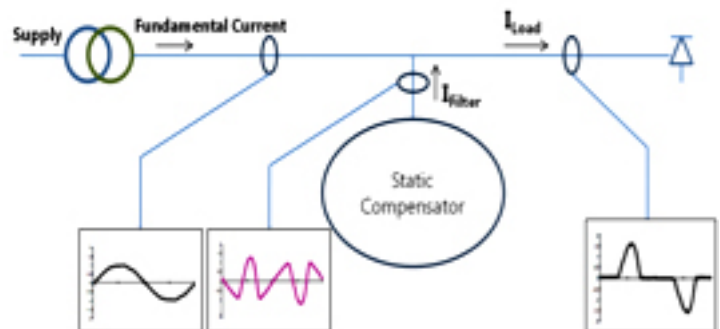
## OPERATING PRINCIPLE

Gruppo Energia Active Power Filters are based on Static Synchronous Compensation (StatCom) technology, which consists of an IGBT based inverter able to generate current waveform of any shape or size. The versatility of this technology makes it the only solution that can simultaneously correct all current related issues (reactive demand, harmonic distortions, high unbalance, high neutral current). Thanks to the advanced micro processor and fast switching of the IGBT inverter topology, we can achieve ultra fast reaction time of < 300 micro seconds.

A StatCom produces three-phase AC Voltage from a DC Bus using the Pulse Width Modulation (PWM) technique. The StatCom generated voltage is coupled to the source voltage (Grid/Generator) through a coupling reactor. By varying the magnitude of the AC terminal voltage of the StatCom, power exchange takes place between filter and the AC Source (Grid/Generator). If the magnitude of StatCom output voltage is more than the AC Source Voltage, current flows from the filter to the Supply. If the magnitude of StatCom output voltage is less than the AC Source Voltage, current flows from the supply voltage to the filter. If the amplitude of StatCom output voltage is equal to the AC Source voltage, no current flow takes place between Supply and StatCom and the filter is said to be in a floating state of operation. Thus, just by manipulating the voltage at the output terminal of the StatCom, the device can be programmed to generate current waveform of any shape, size or phase. A StatCom cannot generate/provide Active Power to the load.

Gruppo Energia Active Power Filters use an advanced DSP microprocessor, which analyses various network parameters and adjusts the output voltage of the StatCom. The ultra-fast sensing and advanced control algorithm ensures step-less correction and instantaneous compensation.

We can also implement priority settings based on the type of load. Thus, we can program the filter to perform Harmonic correction on first priority, Reactive correction on second priority, and Unbalance correction on third priority for a non linear drive-based load. This will ensure full harmonic compensation, near unity power factor and fully balanced load distribution.



## HARMONIC COMPENSATION

Harmonics are the currents or voltages with frequencies that are integral multiple of the fundamental (power) frequency. High harmonic distortions lead to switch-gear overloading, overheating of transformers, circuit breaker nuisance tripping, electronic card failure, voltage distortions and Diesel Generators Hunting. Gruppo Energia Active Power Filter perform step-less harmonic current compensation with an ultrafast reaction time of  $< 300 \mu s$ . This feature makes them effective, even in case of fast fluctuating loads.

Active Power Filter can be programmed to correct a single harmonic order or a combination of harmonic orders, without any change in the hardware at all. Moreover, the filter is connected in shunt so it is very easy to connect or disconnect from the load. Additionally, the filter is compatible with future load expansions (unlike traditional filters that need to be replaced if the load increases in the future).

## REACTIVE COMPENSATION

Power Factor is the ratio of True Power to the Apparent Power drawn by any load. Low power factor leads to increased transmission and distribution losses, increased electricity bills without increase in productivity, heating & hunting of diesel generators with increased fuel consumption.

Active Power Filters are capable of correcting both leading and lagging power factor situations. The ultra-fast response time, less than  $300 \mu s$ , of power filters makes them effective even with fast fluctuating loads where traditional solutions are ineffective. The reactive compensation is accurate and smooth without any risk of voltage transients or resonance.

Another important point is that Active Power Filter provides safe reactive compensation on diesel generator sets. This helps the customer use the full capacity of the generators, without any issues like alternator overheating or engine hunting. The customer can use fewer generators for a given load and realize significant savings in fuel consumption.

## LOAD BALANCING

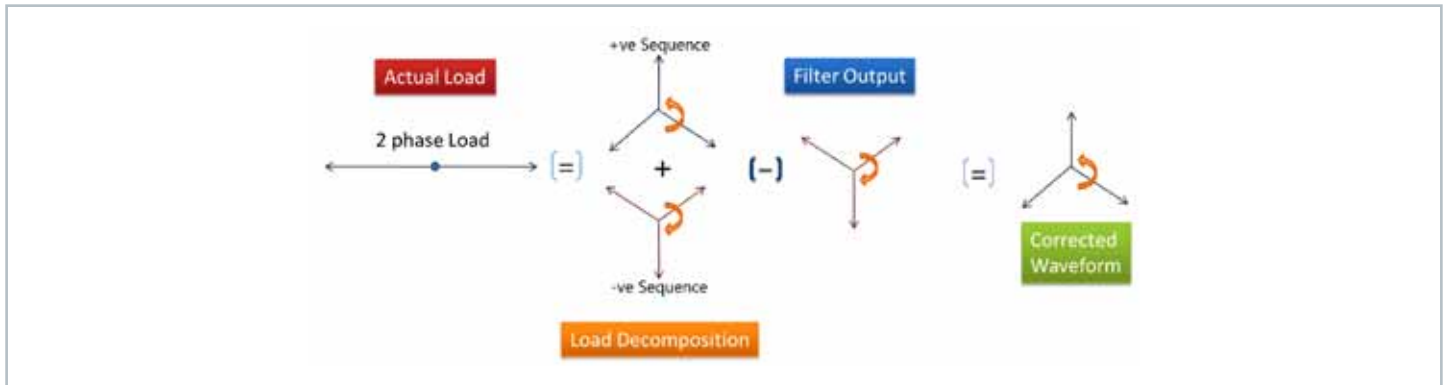
Distribution networks often have issues of uneven load distribution among the three phases. It is a very common phenomenon in industries with two phase loads. This results in overloading of the two phases of the source transformer and in the under utilization of the third phase. Consequently we assist to the pre-mature ageing of transformers, uneven voltage profile, overloading of switchgears and stress on generators. It is difficult to maintain good power factor on two phase loads.

A three phase power system is called balanced or symmetrical, if the three phase voltages and currents have the same amplitude and are phase shifted by  $120^\circ$  from one another. If any of these conditions is lacking, the system is called unbalanced or asymmetrical.

Any unbalanced three phase load can be viewed as a combination of a Positive Sequence (50Hz) current and a Negative Sequence ( $-50\text{Hz}$ ) current. Both Positive and Negative Sequence current components are independently balanced but when combined, result in unbalanced current distribution among the three phases. There are no passive solutions which can perform negative sequence compensation for load balancing. On the other hand, this can easily be achieved using the Active Power Filter! It can not only eliminate Negative Sequence current components to  $< 3\%$  but also perform reactive power correction to reduce the Positive Sequence current as well as maintain near unit reactive compensation.

The end result is a better use of existing electrical infrastructure, a significant reduction of energy bills and better voltage profile.

The diagram below shows a two phase load, this is the most severe case of unbalance in an industry. The current unbalance is  $\sim 100\%$ . The two phase current is decomposed into the Positive Sequence and the Negative Sequence current by the DSP micro controller. It then supplies the negative sequence current component so that the corrected waveform only has the Positive Sequence current left. The positive sequence current is perfectly balanced in the three phases. Thus, regardless of the type of load, the source only sees a balanced load leading to optimum capacity utilization.



## NEUTRAL COMPENSATION

High neutral Currents in any system are a result of the presence of homopolar components or zero sequence currents. Homopolar components have identical phase angles and only oscillate. Triple-N Harmonics add up in the neutral leg resulting in the overheating of the neutral conductor in 3-phase, 4-wire systems. High amount of neutral current can pose a serious fire risk.

The Active Power Filter (3P+1 wire typology) is able to correct high neutral current scenarios by completely eliminating the zero sequence currents.

Additionally, the filter can be programmed to perform unbalance, reactive and harmonic compensation to reduce the load on the transformer resulting in reduced risk of HT winding failure. Moreover, the filter by removing harmonic distortions, ensures that the voltage profile is improved resulting in elimination of equipment failures in the facility.

## AVAILABLE MODELS

- GE-AFC3 - Our 3P/4W model for typical harmonic loads;
- GE-AFC3 PLUS - Our Plus range, specially designed for extremely fast fluctuating loads like welding;
- GE-AFC4 - Our 4P/4W model. In addition to being able to do Harmonic, Reactive and Load Balancing like APF3, this model can also perform Neutral (zero sequence) compensation.

INPUT					
Model	GE-AFC3-415	GE-AFC4-415	GE-AFC3 PLUS 415	GE-AFC3-575	GE-AFC3-690
System connection	3P/4W	4P/4W	3P/4W	3P/4W	3P/4W
Compensation currents	From 25 A to 1000 A				
Voltage	415 V -15%/+10%		575 V -15%/+10%		690 V -15%/+10%
Frequency	50 Hz $\pm$ 5%				
FILTER					
Inverter technology	Two level	Two level	Three level	Multi level	Multi level
Harmonic range	from 2 to 21 or from 2 to 51				
Harmonic selection	Available				
Harmonic attenuation (at rated load)	> 96%	> 96%	> 98%	> 98%	> 98%
Power factor compensation	(+) / (-) 100%				
Load balancing	Negative sequence compensation possible (zero sequence with GE-AFC4-415 model)				
Reaction time	< 100 usec	< 100 usec	< 50 usec	< 50 usec	< 50 usec
Function selection (Harmonic filtering, Power Factor Correction, Load Balancing)	15 possible on-site priority selection settings for optimum capacity utilization				
Overload (peak value)	Up to 150% of rated peak (instantaneous)				
Current transformer: Primary	As per site load conditions. Recommended to be 125% of the expected peak load current				
Current transformer: Secondary	5 A				
Class and VA (recommended)	Class: 0,5 or better, Burden: 15VA or more				
Interface (communication)	MODBUS TCP, USB, Ethernet, SD-карта				
PHYSICAL CHARACTERISTICS					
Protection class	IP20 (higher on request)				
Cooling	Forced air cooling				
Overheating protection	Yes				
Cable entry	Top/Bottom (as per requirement)				
EXTERNAL CONDITIONS					
Ambient temperature	Up to 45 °C (55 °C with derating) with adequate ventilation				
Relative humidity	95% (non condensing)				
Maximum operating altitude	1000 m				
Acoustic noise at 1m	< 70 dB	< 70 dB	< 65 dB	< 65 dB	< 65 dB
USER INTERFACE					
Man Machine Interface	YES / LCD touch screen	YES / LCD touch screen	YES / LCD touch screen	YES / LCD touch screen	YES / LCD touch screen
STANDARDS					
CE, IEC 61000-4-7: 2009, RoHS Compliant					