

# AIM Active Harmonic Filters



**Real time active filtering of harmonics**



## Harmonics and Power Quality

The term Power Quality relates to the amplitude, frequency and distortion of the electrical supply. Whilst the utility provides a supply, which has the amplitude and the frequency within controlled limits, it is the consumer and his equipment that distorts both the voltage and current waveforms.

Prior to the proliferation of modern power electronics, most loads were linear, drawing a sinusoidal current following the supply voltage. However, nowadays the most common loads are non-linear, utilizing power that is not sinusoidal. Non-linear equipment use converters to transform AC power to DC power. The type of converter, the semiconductor and load characteristics dictate the current drawn by the source. Since the current drawn is not sinusoidal, harmonics are generated.

Harmonic Distortion, caused by non-linear loads on the supply network, results in currents in the system that are of a higher magnitude than expected and contain harmonic frequency components. The economic effects of these harmonics are shorter equipment life, reduced energy efficiency, and a susceptibility to nuisance tripping.

There are several common problems associated with harmonics:-

- Overheating of transformers, cables and motors
- Nuisance tripping of circuit breakers
- Over-stressing of PF correction capacitors
- Reduced current carrying capacity of cables due to skin effect
- Overloading of neutral conductors
- Zero crossing noise
- Voltage distortion
- Excitation of network resonance
- Problems caused when harmonic currents reach the supply - legislation problems.

## The Solution: AIM Active Harmonic Filter

A proven technology is now available to isolate harmonic current and protect the equipment on your power distribution system from damage due to harmonic voltage distortion.

By actively monitoring the non-linear current demanded by the load, the AIM Active Harmonic Filter (AHF) electronically generates an adaptive current waveform which matches the shape of the non-linear portion of the load current. By injecting this matching current into the bus in real time, the AHF stops the destructive current at the point of connection.

By this mode of cancellation, the AIM AHF provides the industry's best attenuation of harmonic currents.

The AHFs IGBT Converter Bridge reacts at micro-second speed to changes in the non-linear load current, allowing cancellation even as the high frequency harmonic components change.

The AHF is not affected by changes in the impedance in the system, nor will it react with other devices. The AHF will also not adversely affect the resonant points in the system.

The AHF has no series components allowing an easy-to-install connection. If greater capacity is required, the AHF has built-in circuitry to allow for simple paralleling. Paralleled systems are available for single point field connections.

## Unique Features

### AIM (Adaptive Injection Mode) Harmonic Filter

The AHFs electronic bridge draws leading reactive current from the power line, stores it in a DC capacitor bus, and delivers it back to the line as harmonic current, meeting the load's demand for non-linear current at the point of connection. The source delivers fundamental current.

### Industry's Best Harmonic Cancellation Device

Unlike a tuned filter, the AHF continuously measures the load's changing non-linear current and injects the required waveform to supply the load's harmonic current demand from the 2<sup>nd</sup> to the 51<sup>st</sup> harmonic.

### Easy to Apply

The AHF is a non-resonating, non-tuned device. It can be installed anywhere on the distribution system. A simple measurement to determine the magnitude of harmonic current is all that is needed. For new installations the equipment manufacturer or your AHF supplier can provide the required data.

### IGBT Bridge

The AHF's Class-D Switching Mode Current Source Amplifier uses Insulated Gate Bipolar Transistors. These are high frequency switched power electronic devices that allow high resolution and micro-second response to match the load's non-linear current waveform.

The AHF is connected parallel to the bus through a soft start circuit. When energized the AHF draws leading reactive current and the converter uses this to charge the internal DC Bus.

The current transformers on two of the phases measure the load current. An electronic "notch filter" rejects the fundamental frequency component and passes the "distortion current components" (harmonic as well as non-harmonic, transient and sub-harmonic components). Electronically controlled linear attenuators reduce the harmonic current signals to limit the AHFs harmonic current output to the unit's rated RMS value.

The amplifier control logic uses this signal to modulate current waveform which matches the non-fundamental current demanded by the non-linear load.

# Features



100Amp AIM AHF

## Adaptive Injection Mode (AIM)

Continuously monitors the load harmonic current spectrum and cancels it.

## Industry's Best Harmonic Cancellation Device

Superior non-linear current cancellation from the 2<sup>nd</sup> to 51<sup>st</sup> harmonic. Greatly reduces notching caused by SCR switching, diode rectification and other load generated transients.

## Parallel Connection

With no series components the AHF can be easily installed without major re-work. Current measurement is made with wide bandwidth current transformers (CTs). Energy consumption is low.

## Electronic VAR Current

In addition to harmonic cancellation current, the AHF electronically produces leading VAR current, aiding the improvement of system power factor without the negative effects of traditional power factor correction capacitors.

## Current Limited

The AHF unit is current limited and can work in any system without overload or damage, regardless of the magnitude of harmonic current demanded by the load.

## Safety and Access

The AHF's power sections are covered within the enclosure to LVD standards. Removable panels allow easy front access and clear view of major components.

## G5/4-1 & IEEE 519-1992

The AHF units are easily paralleled and can be sized to guarantee compliance with G5/4-1 and IEEE 519-1992 harmonic standards under most load conditions.

## Pictured 100Amp Model contains:

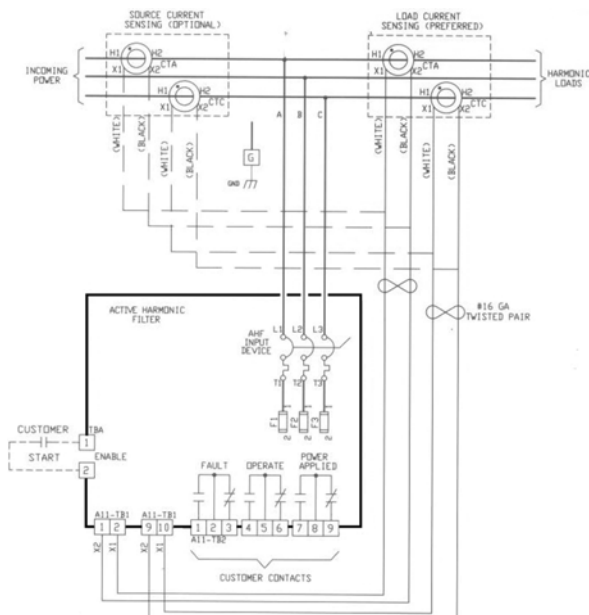
- MCS / Isolation Device
- Fast Acting/High Interrupting Fuses
- High Frequency / EMI/EMC Filter
- Soft Start Contactor Circuit
- IGBT Switching-Mode Power Stage
- DC Bus Capacitors
- AC Capacitor Reactive Current section

## Product Offering Summary

3-Wire models range between 25 and 300 amps (4-wire to 200 amps) with inputs of 208V through 600 VAC, 50Hz or 60Hz (690V Special build). Ring type Wide Bandwidth CTs are supplied as standard. Split core CTs are available upon request. AHFs can be paralleled using one set of CTs. All units are available as chassis or enclosed. Consult AIM for special enclosure requirements. All models include a control / display panel.

Chassis models include a control / display panel, 1m of ribbon cable, 2 CTs and 200k AIC Fuses. A moulded case disconnect switch is included with all enclosed models. A power quality analyser (PQA) with communications can be added at extra cost.

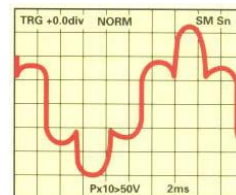
## Typical Connection Diagram



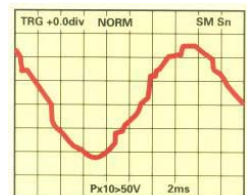
## AIM AHF Field Results - 100Amp

**Attenuation From the 2nd to 51st Harmonic**  
Typical results of the AHF during operation in parallel with SCR Bridge Rectifier non-linear load seen from Delta side of a Delta-Wye transformer.

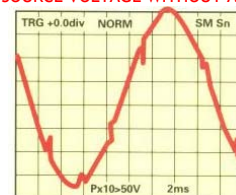
SOURCE CURRENT WITHOUT AHF



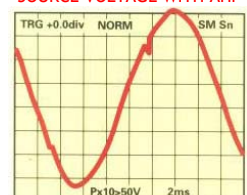
SOURCE CURRENT WITH AHF



SOURCE VOLTAGE WITHOUT AHF



SOURCE VOLTAGE WITH AHF



## Product Specifications

### Technical Data: 3Phase 3Wire & 4Wire Models. Voltage: 400V 50-60Hz \*

Type	Model	Harmonic Cancellation Phase Current	Harmonic Cancellation Neutral Current	Reactive Current	Corrective KVARs	Losses @ rated output	Dimensions H x W x D	Approx Weight
		(Arms)	(Arms)	(Arms)	(KVARs)	(kw)	(mm)	(Kg)
3W Chassis	3A025F5ACHXF	25	-	14	9.3	0.6	788 x 407 x 312	50
3W Wall Mount	3A025F5AE3MF	25	-	14	9.3	0.6	788 x 407 x 338	59
4W Chassis	4A025F5ACHXF	25	75	14	9.3	0.6	788 x 407 x 312	50
4W Wall Mount	4A025F5AE3MF	25	75	14	9.3	0.6	788 x 407 x 338	59
3W Chassis	3A050F5ACHXF	50	-	27	19	1.1	1220 x 407 x 312	79
3W Wall Mount	3A050F5AE3MF	50	-	27	19	1.1	1220 x 407 x 338	86
4W Chassis	4A050F5ACHXF	50	150	27	19	1.1	1220 x 407 x 312	79
4W Wall Mount	4A050F5AE3MF	50	150	27	19	1.1	1220 x 407 x 338	86
3W Chassis	3A100F5ACHXF	100	-	54	37	2.2	1473 x 500 x 381	170
3W Floor Mount	3A100F5AE2MF	100	-	54	37	2.2	2109 x 610 x 508	272
4W Chassis	4A100F5ACHXF	100	300	54	37	2.2	1473 x 500 x 381	180
4W Floor Mount	4A100F5AE2MF	100	300	54	37	2.2	2109 x 610 x 508	282
3W Chassis	3A150F5ACHXF	150	-	81	56	3.3	1473 x 699x381	190
3W Floor Mount	3A150F5AE2MF	150	-	81	56	3.3	2109 x 813 x 508	318
4W Chassis	4A150F5ACHXF	150	450	81	56	3.3	1473 x 699x381	190
4W Floor Mount	4A150F5AE2MF	150	450	81	56	3.3	2109 x 813 x 508	318
3W Chassis	3A200F5ACHXF	200	-	104	72	4.4	1473 x 1106 x 381	204
3W Floor Mount	3A200F5AE2MF	200	-	104	72	4.4	2109 x 1220 x 508	397
4W Chassis	4A200F5ACHXF	200	600	104	72	4.4	1473 x 1106 x 381	204
4W Floor Mount	4A200F5AE2MF	200	600	104	72	4.4	2109 x 1220 x 508	397
3W Chassis	3A300F5ACHXF	300	-	162	112	6.6	1897 x 1106 x 381	250
3W Floor Mount	3A300F5AE2MF	300	-	162	112	6.6	2109 x 1220 x 508	443

\* Other voltages 208V-600V available (standard). 100A-200A 690V available (special build)

\* AIM reserves the right to change the Technical Data in line with future developments. Please check with AIM at the point of ordering.

### General Specification

#### Input Voltage

- Nominal +6%, -14% steady state (+/- 10% at 208 VAC)
- Nominal +11%, -19% 20 minutes (+/- 15% at 208 VAC)
- Transient IEEE 587, class B

#### Input Frequency

- Nominal +/- 5%

#### Interrupting Capacity

- 200kA, fused

#### Initialisation Time

- 6 sec maximum

#### Peak Harmonic Current

- 3x nominal rms maximum rating

#### Reactive Current

- 85% electronically generated

#### Injected

#### Control & Indication

#### Panel

- Switch – On / Off / Reset
- Indicators – Power Applied
- Operate
- At Max. Capacity
- Fault
- Temp. Warning

#### Remote Indicator (relay output)

- Operate
- Fault
- Power Applied

#### Temperature

- 0° to 40°C operating, - 30° to 50°C storage

#### Humidity

- to 95%, non-condensing

#### Altitude

- to 1500 meters

#### MFBF

- 10.8 years

### Contact

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