

Active Harmonic Filter (AHF) Guide Specification

Harmonics Reduction, Power Factor correction and Imbalance Compensation

Section 1: GENERAL

1.1. SCOPE

- This specification defines the requirements for Active Harmonic Filter(s) (AHF) to meet electrical system requirements for harmonic current limits as defined in IEEE-519 – 2014. AHF counters the non linear load current by producing adaptive counter current to cancel out the harmonics produced by the load. The AHF shall provide harmonic mitigation, power factor correction and imbalance compensation.
- Any exceptions or deviations to this specification shall be indicated in writing and submitted with the bid.

1.2. STANDARDS

The AHF design is based on the following standards:

- A. UL 508 – 17th Edition [UL Standard for Industrial Control Equipment]
- B. CNL – CAN/CSA – C22.2 No. 14 – 2013 [Standard for Industrial Control Equipment]
- C. ANSI IEEE std 519-2014 [IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems]
- D. UL 508 [UL requirements for power conversion equipment]
- E. NEMA 1, IP20 [Type of enclosure]
- F. NEMA 250 – 2003 [Enclosures for Electrical Equipment (1000 Volts Max.)]

1.3. SUBMITTALS

- Shop drawings shall be provided for different sizes of AHF, consisting of enclosure outline drawings with overall dimensions along with standard catalog sheets stating voltages and current ratings accordingly.
- Standard catalog sheets shall be provided for the CT's proposed

1.4. WARRANTY

Warranty shall be provided for defective components for 18 months from the date of shipment or one year from the date of installation, whichever shall occur first.

Section 2: PRODUCT

2.1. MANUFACTURER

- The manufacturer of AHF(s) shall be Galt Electric – GAHF series, Eaton, or prior approved equal and shall be UL listed.
- Substitutions shall be submitted in writing three weeks prior to original bid date with supporting documentation indicating that the alternate manufacturer meets all aspects of the specification provided.

2.2. SYSTEM DESCRIPTION

A. GENERAL

1. System AHF filters are the devices which produce counter nonlinear current to mitigate harmonics produced by the nonlinear loads.
2. Active filter is suitable to connect in parallel whenever needed. Apart from the harmonic mitigation, the device shall also provide power factor correction and imbalance compensation.
3. A microprocessor-controlled power converter shall be a three-level design which optimizes performance and minimize heat losses.
4. AHF(s) shall be UL listed according to UL508

B. CONSTRUCTION

1. AHF(s) shall be provided in UL Type 1 wall mount enclosure or
2. Rack mount enclosure for AHF(s) are provided based on the application

C. APPLICATION DETAILS

1. THD_i performance shall be designed to provide not more than 3% when AHF is 50% or more loaded and all non-linear loads have 3% or larger input impedance.
2. TDD and THD_v performance shall be limited to not more than 5% of the load contribution at the location of AHF.
3. Power factor correction shall be more than 0.95 at the location of AHF.

D. PROTECTION

1. AHF shall be designed with a current limiting function for protection
2. AHF shall have automatic restart capability upon power loss return and fault resets

3. AHF(s) shall have over voltage protection and under voltage protection
- E. DISPLAY TERMINAL
1. AHF shall have a door mounted HMI (Human Machine Interface) with 4.3” touch screen.
 2. HMI shall provide an oscilloscope feature to display related parameters, mains voltage and current waveform, performance trend information for load, output reactive and harmonic currents, THDi, TDD and THDv.
 3. Diagnostic and performance checks, parameter adjustment and setup, event log check, external communications along with warning and error code checks with fault description can be performed using HMI.
- F. FUNCTION
1. AHF shall monitor the load current utilizing current transformers (CT’s) mounted on the AC lines for three phase loads.
 2. AHF shall analyze the load current for 2nd to the 50th harmonics and shall also determine the reactive current content representing displacement power factor.
 3. AHF shall provide for load balancing of AC line current for harmonic and reactive currents regardless of actual load distribution per phase.
 4. The units are designed such that unlimited AHF units may be installed in parallel and any one of the units can be selected for operation as master or slave, units that require dedicated master and slave units or power connections between unit DC buses shall not be acceptable.
 5. The remaining units shall automatically adjust the total output if one of the units goes offline, AHF units that turn off all units when one is taken offline are not acceptable.

2.3. RATINGS

A. SYSTEM PARAMETERS

- System voltages : 480V (80%-115%), 600V (70%-115%), 690V (70%-115%)
- System frequency : 45Hz – 62Hz
- Parallel capacity : Unlimited
- Efficiency : greater than 97%
- Wiring : 3P-4W; 3P-3W / Phase rotation insensitive
- CT ratios : 150:5 – 10,000:5

B. PERFORMANCE

- Rated capacity : 35A / 50A / 60A / 75A / 90A
- Filtering capacity : 2nd to 50th harmonics
- Cooling : Smart air-cooling (190 CFM fans*4)
- Noise : < 65dB at 1 meter from enclosure

C. COMMUNICATION

- Interface : RS485, Ethernet
- Protocol : Modbus, TCP/IP
- Monitoring : Centralized
- Failure alarms : Recording and reporting

D. ENVIRONMENT

- Altitude : ≤ 1500m (derating factor – 1% every 100m higher)
- Ambient temperature : -20°C – 40°C / -4°F – 104°F
- Storage temperature : -40°C – 70°C / -40°F – 158°F
- Relative humidity : < 95%, non-condensing

E. CONSTRUCTION

- Wall mount : NEMA 1
- Rack mount : IP20 (modular units)
- Wall mount dimensions : 19.8*10.0*25.5 inches
- Rack mount dimensions : 21.4*25.2*9.8 inches
- Weight : 145 lb.

2.4. ADDITIONAL FEATURES

AHF units shall have the following additional features:

- Real time intelligent Fast Fourier Transform algorithm – consistent reliable compensation, accurate analysis leading to precise compensation
- Circuit technology shall be 3 level (3 voltage levels – zero to peak in output voltage wave form; Much better sinusoidal output voltage and current)
- Graphic display – Door mounted HMI with 4.3” color touch screen, password protection enabled

- Maintenance free design
- Small foot print with unlimited paralleling capacity

2.5. CURRENT TRANSFORMERS

- AHF dedicated CTs shall be installed as per engineer design specification
- A minimum of two CTs per AHF location are required to be mount on phases A & B of the mains. If phase to neutral loads are connected on a 4-wire system, 3 CT's are required for the operation.
- Current transformers current ratings shall be according to full load current and the secondary current rating shall be 5 amperes.
- CTs provided with AHF shall be dedicated for AHF operation and are not shared with other system components

Section 3: EXECUTION

3.1. INSPECTION

The inspection of the AHFs is as follows:

- Verify if the site is ready to receive the AHF(s)
- Verify environment parameters for proper installation of the product and if it can be maintained after installation and the installation satisfies the manufacturer's specification accordingly
- Verify conditions such as surrounding space, adequate ambient temperature, relative cleanliness, humidity and proper accessibility are properly met before installation

3.2. INSTALLATION

The following conditions shall be verified for installation of the product:

- Installation shall be in compliance with the manufacturer's specification requirements, instructions and product drawings.
- Ensure if all required cables and connectors to interface with other equipment are provided along with AHF(s) and communication connections, wiring are in accordance with the manufacturer's specifications and NEC requirements.

3.3. START-UP

The following shall be met for the product startup:

- A factory certified technical service representative is required to review the contractor's installation and to commission the AHF. Certified report shall be provided upon successful testing of the equipment.
- Pre work check shall be performed to verify the installation according to manufacturer's checklist
- Equipment start up and performance measurements shall be taken to verify proper functioning of AHF(s)
- Harmonics check shall be performed before and after the installation.

3.4. TRAINING

A minimum of 4-hour customer training on AHF operation shall be provided by a factory trained technical representative including hands on training of the installed unit.