Equipment Specifications
Low Voltage
StacoSine®
Active Harmonic Filter

Open-Chassis and Enclosed Types

2-1-2010

1.0 General Description

This section contains the design standards, general equipment type and configuration, components, product description, warranty and installation requirements for harmonic mitigation and power factor correction, as provided by an active harmonic filter. Such equipment shall be utilized for the improvement of harmonic rich environments, along with the improvement of power factor, in AC electrical power systems.

The manufacturer shall have been engaged in the engineering and production of electrical power equipment for a minimum of ten years. The finished product shall be designed, assembled, tested and shipped as a complete system by the manufacturer. Equipment finished in any other manner is not acceptable.

2.0 System and Environment

Active filter equipment and systems shall be suitable for environments of either indoor or outdoor, intended as either stand-alone or integrated with other equipment, such as motor control centers, switchboards, switchgear and static switches, UPS or distributed generation. Equipment is intended for use with voltage classifications from 208 to 480vac. A step-up transformer shall be used for voltages above 480vac. Equipment shall be used on three phase, 3 wire and three phase 4 wire, grounded wye, ungrounded wye, or delta wire systems at 50hz or 60hz. Equipment is designed for reliable operation in ambient temperatures of 0 degrees C to 40 degrees C, up to 3250 feet (1000 meters) above sea level, with relative humidity of 95%. The finished StacoSine equipment shall be listed to UL508, c-UL.

3.0 Basic Equipment Type

The StacoSine active harmonic filter is an assembly intended to monitor the non-linear load and dynamically correct a wide spectrum of harmonic orders. Active filter technology shall utilize power electronics for its operation and functions such as switching, cancellation, injection, monitoring and controlling AC and DC power. Power semi-conductors shall switch the AC power to modulate and control output, which cancels detrimental harmonic and/or reactive currents. DC bus power shall provide storage for semiconductor switching. Semi-conductors shall have current limiting protection. A microprocessor shall provide control, monitoring and operational functions for the complete active harmonic filter apparatus.

When installed, the active filter shall provide ≤5% (Total Demand Distortion) TDD; ≤5% (Total Harmonic Distortion-Voltage) THDv; and specific power factor correction value at the load, where applicable, while not affecting the load in the form of a resonance condition. Corrected current distortion shall include all odd orders from the 3rd through the 51st harmonic order. Each harmonic order shall maintain a consistent and maximum level of performance.
A resonant condition occurring within the electrical power system between the active filter and the load shall not cause the active filter to stop functioning properly. Equipment which

cannot correct a wide harmonic spectrum and be capable to operate in a resonance condition to a minimum of the 51st harmonic order is not acceptable.

A constant, proportional value of power factor correction compensation shall be inherent in the design of the active filter, along with the capability to allow for the use of separate, additional power factor correction capacitor modules. Active filters shall operate in full compensation mode without shut-down, should additional loads be added (no overload). Heat loss (watts) shall be at a minimum. Active harmonic filter apparatus that derates harmonic cancellation performance when a power factor correction mode is operational is not acceptable. The expandable design of the active filter shall allow for additional (up to six) active filters to be installed in a parallel arrangement, and also allow use of existing active filters on the electrical system. Placement of the equipment shall be to mitigate single, or multiple loads, or a complete facility load. The active harmonic filter shall be installed at either the load or source location. Individual ampere ratings shall be provided at 25 ampere, 50 ampere, 100 ampere, 150 ampere, 200 ampere and 300 ampere.

The power electronics of the active filter shall be designed to operate well within the tolerance of the intended environment, utilize fan cooling and be properly ventilated. Power fuses (Class J), rated at 200kaic, shall be provided for protection of the power electronic IGBT (switched at 20 khz) modules. When initially energized, the active filter DC capacitor charge - soft start time shall be 10 seconds. Steady state at 100% step load (zero amperes to rated compensation amperes) shall be <40ms.

Equipment shall allow for wall mounting (to 50 amperes) and free-standing (100 amperes and above) configurations. Open-chassis type active filters shall be provided for use in “others” enclosure arrangements, such as motor control centers, switchboards/switchgear and supplementary power distribution equipment. In addition, and where multiple component integration is required, equipment shall provide incoming, active filter, capacitor, motor control, or switchgear sections, where applicable. Compartments or sections shall be segregated as required.

The active filter shall be available as a three wire apparatus. The active filter shall include two current transformers (CT’s), for connection during installation (phases A and C), for a three wire connection. Standard “split-core type” CT size shall be 2000:1, 20va, 400 hz, with <1ms transient response time to detect load current.

A DSP controller, with Discrete Fourier Transform (DFT) algorithm topology and analysis/calculate performance response time of minimum <20ms shall be provided. Controller shall allow for global or specific harmonic order settings (such as 3rd, 5th, 7th, 9th, 11th simultaneously). Controller shall be positioned on the front panel of the enclosure with display and keypad as part of the active filter system and shall be easily viewed. The graphic display shall be an LCD type, with multiple functions for operation and maintenance control, with 16 line and 40 character capability. Management and control access to the load, source and StacoSine data shall be provided to the user.

The display shall provide “man-machine” interface, and analyzer, operating data status and alarm information, while functioning, and allow the operator to utilize keypad/scrolling utilities. Parameters available for display, at a minimum shall include: Graphics display with wave form, measurements and spectrum data to the 31st order, four LED indicator and eight control/keypad utilities for On/Off, Reset (Alarm-Reset), Power “On” indicator, Filtering indicator, Full Correcting indicator, Error indicator, Confirmation (keypad), Direction Scrolling (keypad), Escape/Cancel (keypad). At a minimum, AC line voltage, total rms current, harmonic current, reactive current, output harmonic and reactive current of power correction shall be displayed values. A total of (5) five dry contacts (250vac/2amp) shall be provided for remote monitoring. Communications via RS 232 shall be provided as standard. Additional communications for RS 422, RS 485, USB, TCP/IP and Ethernet RJ45 shall be included where applicable. Open-chassis type active filters will provide display/DSP and cable separate for installation on front panel of enclosure. Controllers without capabilities as described above are not acceptable.

The active harmonic filter shall meet specific performance standards for harmonic mitigation, surge immunity, electromagnetic compatibility, design and safety:

IEEE519 / EN61000-3-4 Harmonic Mitigation Guidelines
IEEE587/ANSI C62.41/ EN61000-4-5 Surge Immunity
FCC Part 15 / EN55011 Electromagnetic compatibility
UL508, C-UL / EN60146 Safety/Design
EN50178 Vibration Testing, Safety/Design

4.0 Equipment Specifications and References

A. Low voltage power distribution equipment, motor control centers, switches switchboards, switchgear, static switches, fixed motor load and switched power factor correction capacitors and harmonic mitigation systems
B. Medium voltage switchgear, switches and static transfer switches
C. Medium voltage metal enclosed capacitors and harmonic filters
D. Engine-generator control, distributed generation systems, paralleling switchgear
E. Energy management and other power quality equipment and components

A. American National Standards Institute (ANSI)
B. Institute of Electrical and Electronic Engineers (IEEE)
C. National Electrical Manufacturers Association (NEMA)
D. Underwriters Laboratories, Inc (UL)
E. Canadian Standards Association (CSA)
F. International Electromechanical Commission (IEC)
G. European Standards (EN)
H. National Electric Code (NEC)

5.0 Submittals

Documentation for approval or reference shall be submitted in a CAD format. Common information, where applicable, shall include equipment plan view and outline dimensions, active filter sections, incoming locations, cable entry, main bus, fuse and active filter ratings, and where applicable capacitor ratings, mounting locations, and component technical descriptions.

6.0 Construction Guidelines

Equipment design shall follow the most recent applicable standards and guidelines and shall serve to meet the intended application requirements. Installation and operation of equipment is for general business, commercial, industrial, government and energy or utility service providers.

The enclosure assembly shall be from heavy gauge sheet steel, with wall mounted enclosure and freestanding enclosure construction of bolted design, to allow for ease of expansion, where applicable. Enclosures shall be finished with a texture and painted light gray, or other color as specified. The complete assembly shall be painted using electrostatically applied polyester powder coated paint, or a liquid enamel application, both, which provides for enhanced durability and extended protection. The open-chassis active filter rated 25 and 50 amperes shall provide a rugged sheet steel assembly; 100 through 300 amperes shall provide a rigid frame structure, with both types allowing for mounting in minimum 20” deep enclosures.

The finished enclosure shall provide both front and rear access via hinged doors or bolted, removable panels. Wall mounted enclosures shall allow for front access to internally mounted components. Doors shall be equipped with a latch-close system and include a key lockable feature, where applicable. Hardware shall be environmentally sound; either zinc plated or stainless steel, for optimum corrosion resistance. The entire assembly shall provide adequate personnel safety and component security. Cable entry shall be from the bottom with a grounding termination point included within the enclosure. A separate disconnect means may be required by NEC. Lifting lugs shall be provided for transport and to facilitate ease of installation of the finished equipment. Such removable lugs shall be located at the top of the equipment. Equipment manufactured in accordance to Staco Energy design.

Enclosures shall be rated as NEMA 1 or NEMA 12 (indoor) and NEMA 3R (outdoor). Where applicable, louvers shall be included for proper ventilation. For specific indoor or outdoor applications, aluminum mesh filters, fan(s) and heater(s)/thermostat(s) may be incorporated in the assembly. The design and construction integrity of the finished assembly shall allow for the equipment to be lifted, or slid into place. The “ready to ship” equipment shall meet stringent, applicable engineering and design standards and be neatly constructed and finished, meeting all Staco Energy quality and production control standards, prior to shipment.

7.0 Systems Integration

The active filter shall be compatible to allow other power quality related components and devices to be incorporated, allowing for maximum equipment provisions. Where applicable, the equipment shall be designed in such a manner for system and physical integration or match and line with new or existing power distribution equipment. The active filter itself shall be suitable for mounting in other power distribution or control equipment, where applicable. AC or DC variable frequency drive applications shall utilize a 3% (minimum impedance) line reactor/isolation transformer, where applicable.

8.0 Testing and Safety

The equipment shall be production tested, prior to shipment. This will include, at a minimum, mechanical functional operation, electrical functional operation, control wiring and circuit continuity, and polarity verification. Major electrical, electronic, and mechanical components and devices integral to the equipment shall include testing reports and technical information and other such data, where applicable.

A manual for the purpose of operation and maintenance instruction shall be included with the finished equipment.

The finished equipment shall include nameplates, labels, and other decals, providing applicable safety and general operation instruction. Such markings shall be visually accessible and conveniently located both internally and externally.

9.0 Equipment Documentation

The finished equipment shall be provided with design and construction documentation as a minimum:

- Physical dimension data, outline/plan elevation drawings, general component layout and technical information, weight and installation detail.
- Single line and three line drawings (where applicable)
- Control schematic and control program (where applicable)
- Component Bill of Materials
- Operations and Maintenance Instructions

10.0 Equipment Installation

Correct installation is required for proper performance and function of the StacoSine active filter. Physical inspection of equipment for damage is recommended, prior to any installation. Indoor storage for indoor and outdoor rated equipment should be in a clean, dry environment, and where recommended, may require removal of packaging materials. Outdoor storage of outdoor equipment shall require installation of any materials shipped for site assembly, such as fans and bus ducts and the mating of equipment shipping splits. Where recommended, packaging materials may be required to be removed.

Equipment includes removable lifting lugs, for transport and site installation handling. As a cautionary note, placement of the active filter shall be at a level and solid location, for correct operation.

National Electrical Code (NEC), electric utility company or service provider codes shall be adhered to during the installation. Electrical connections shall also be in compliance with required codes.

Installer/Contractor shall inspect and verify proper alignment, anchorage and ground, proper connections and tightness of connections, prior to any start-up functions.

Appropriate personnel shall start-up and operate equipment upon installation approval. This may also include use of portable measuring devices or analyzers to verify performance of the StacoSine active filter.

11.0 Equipment Warranty

The manufacturer shall provide its standard warranty for equipment of this type. The warranty shall provide for repair or replacement of the equipment, should it be found to be defective within twelve months from the date of being first energized, or eighteen months from date of shipment, or whichever occurs first.

Approved Manufacturer

The manufacturer of approval for the design, engineering, construction and testing of the StacoSine active filter equipment and systems shall be:

Staco Energy Products Co.
301 Gaddis Blvd.
Dayton, Ohio 45403
Telephone 937-253-1191 Fax 937-253-1723
www.stacoenergy.com