MYRON ♦ ZUCKER

ACTIVE HARMONIC FILTER GUIDE

TABLE OF CONTENTS

1. Scope

1.1. System

This specification describes the characteristics for a continuous duty Active Harmonic Filter designed to reduce total demand distortion (TDD) and total harmonic voltage distortion (THD (V)) to levels of <5%. The system will also be able to correct for linear displacement and to balance the incoming 3-phase current. Hereafter the Active Harmonic Filter shall be referred to as the system.

2. System Description

2.1. Applicable Standards

ANSI C62.41 (IEEE587) (standard for surge withstand capability)

ANSI IEEE Std. 519™-2014 (harmonic limits)

CSA 22.2, No. 14 (CSA requirements)

UL 508 (UL requirements for industrial control equipment)

2.2. Third Party Certification

The system shall have third party certification by Underwriters Laboratories (UL listing, USL and CNL)

2.3. System Operating Parameters

A. Input

1) Voltage: 480 V, ± 10%, 3-phase, 3 wire plus ground
2) Frequency: 60 Hz, ± 5 Hz

B. Performance

1) Limit the 2nd through the 50th order harmonic current to <5% TDD at each system installation point
2) Limit the voltage distortion THD (V) added to the facility electrical system to < or equal to 5% immediately to the line side of each system installation point.
3) Power Factor: Near unity each system installation point
4) Three-Phase line current balancing: ± 3% each system installation point
5) Crest Factor Capability: 3.0

(The system shall not correct for distortion caused by equipment installed upstream of the system installation point or for incoming utility voltage distortion. The system installation point shall be defined as the installation point for the system input wiring)

C. Overload protection

1) System output will be electronically current limited to 100% rms of system current rating.
2) Fuses will provide redundant overload protection. Fuses shall be rated at 200,000 AIC.

D. Current sensors

1) System shall utilize two current sensors (rated for 400 Hz) mounted on phases A and B to monitor line current drawn by the load(s). A third CT mounted on phase C is required if any single-phase loads are present.
2) Current sensors shall be rated at a minimum for the total rated rms current of the load at the system installation point and shall have an output current of 5 amperes.

E. Environmental

1) Ambient Operating Temperature: 0º C to 40º C

2) Humidity: 0 to 95% non-condensing
3) Storage Temperature: -20º C to 60º C
4) Altitude: Operating up to 1000 M (de-rated at higher altitudes)
5) System cooling: forced air

2.4. Operational Description

A. The system shall be designed to monitor incoming line current and instantaneously inject the required corrective current to effectively cancel the harmonic current produced by the load (or multiple loads) so that the harmonic current and voltage on the line side of the system installation point is less than 5% TDD and less than 5% THD (V).
B. The system shall have the capability to provide linear displacement power factor correction in addition to harmonic cancellation. The activation of this function shall be programmable by the user via the serial interface. When this function is activated the system will first perform harmonic cancellation and then use the remaining corrective current capacity to correct for linear displacement.
C. The system shall have the capability to provide three-phase line balancing. The system will balance the three phase line currents to within ± 3% on the line side of the system installation point. This function shall be performed simultaneously with the linear displacement power factor correction described above in paragraph 3.1.b.

2.5. Mechanical Design

A. Enclosure
1) The system shall be provided in a NEMA Type 1 enclosure
2) Systems provided in wall mountable enclosures shall also be available in a panel mount configuration for installation in motor control centers and switchgear panels.
3) Enclosed systems rated for 50 amps through 150 amps shall be supplied in wall mountable enclosures. Each enclosed wall mountable system shall include a door interlocked disconnect switch and lifting lugs to aid in installation.
4) Enclosed systems rated for 200 through 300 amps shall be supplied in a floor mount (free standing) enclosure. Each enclosed floor mount system shall include a door interlocked disconnect switch and shall be mounted on rails to facilitate lifting by pallet truck or forklift.

2.6. Customer Interface

A. Front Panel Interface
1) The system front panel shall incorporate 4.5” x 2.5” graphic LCD touch screen display
2) The system LCD touch screen display shall enable the user to view detailed power quality information, before and after the system installation point, so that the end user can evaluate the

effectiveness of the system. This detailed information shall include, but not be limited to, the following:

a) Line Voltage
b) Line Frequency
c) Line current (amps) before and after system installation point
d) Line TDD % before and after system installation point
e) Harmonic current (amps) before and after system installation point
f) Line Kilowatts (kW), Kilovolt amperes (kVA), and Power Factor (PF) before and after system installation point.

B. The operating status of the system (“ON” or “OFF”) shall be indicated towards the bottom of the LCD touch screen display on every display page.
   1) Additional status information such as: normal operation, max. Load, reduced power factor mode, low AC line, and warning or diagnostic messages shall be displayed directly below the “ON” or “OFF” status information.
   2) Miscellaneous system operating parameters shall also be viewable on the LCD touch screen display. These parameters shall include: system heat sink temperature, system PC board temperature, and system internal supply voltages.

C. The LCD touch screen display shall enable the user to perform the following system functions by touch the appropriate icons.
   1) Run
   2) Stop
   3) Menu (select)
   4) Set Parameters
      a) This function shall enable the user to view or change the user selectable system operating parameters.

D. Serial Communications Interface
   1) The system shall have a serial communications interface that can be accessed at the system front panel.
   2) The system serial interface shall enable the user to configure the selectable system parameters, collect system diagnostic information, collect current system operational data and collect historical system operational data.
   3) The system serial interface shall also enable the user to collect detailed power quality information, before and after the system installation point, so that the end user can evaluate the effectiveness of the system. This detailed information shall include, but not be limited to, the following:
      a) Line Voltage
      b) Line Frequency

c) Line current (amps) before and after system installation point
d) Line TDD % before and after system installation point
e) Harmonic current (amps) before and after system installation point
f) Line Kilowatts (kW), Kilovolt amperes (kVA), and Power Factor (PF) before and after system installation point.

E. Status Contacts

1) The system shall be equipped with three status relays for remote monitoring of the system. The relay contacts shall be rated for 1.0 amps at 24 VDC or 0.5 amps at 125 VAC. The first relay will be energized if the system is fully operational and correcting harmonics. The second relay will be energized if a diagnostic or warning condition is indicated. The third relay will be energized if the system is operating at maximum capacity.

3. System Function

3.1. Functional Description

A. The system shall incorporate a state of the art IGBT based inverter to draw energy from the line at some portion(s) of the 50/60 Hz cycle, store the energy at the capacitor bank of the system DC buss, and then deliver the stored energy at some other portion(s) of the cycle. The system will utilize digital signal processor technology to continuously monitor the incoming line current and instantaneously direct energy/current flow in and out of the inverter to effectively correct; harmonic distortion, linear phase displacement and to balance the incoming three-phase lines.

B. In order to monitor the incoming line current the system will utilize two current sensors mounted on phases A and B of the incoming line. A third current sensor shall be utilized on phase C if there are single phase loads present on the load side of the system installation point. Scaling for different size current sensors will be programmable via the serial interface.

C. If the amount of harmonic correction needed for an installation exceeds the maximum current rating of the largest single system available from the manufacturer, then multiple systems may be installed in parallel with each other to achieve the required amount of harmonic correction. Systems that are installed in parallel with each other will utilize the one set of current sensors to monitor the incoming line current. Up to six systems may be installed in parallel with each other.

D. The system shall use electronic current limiting technology for protection of the system in the case of an overload condition. In the case of an overload condition the system will electronically current limit its output to 100% of the maximum rms current capacity. The system will be designed to operate continuously while current limited at 100% of maximum rms current capacity.

E. In the case of a shutdown to due to AC line conditions, which are outside the specifications of the system, the system will be programmed to restart in a controlled manner once the AC conditions are within system specifications. The system shall be able to record the last 99 shutdown events that include AC line occurrences and/or fault conditions. This historical information shall be retrievable via the serial interface.

F. In the case of shutdown due to a fault condition the system will be programmed to attempt an auto restart and resume normal operation. During the occurrence of a sustained fault condition the unit will attempt a pre-programmed number of automatic restarts while extending the interval between each restart attempt. If the system completes the preprogrammed number of restarts and the fault condition still exists then the system will not attempt to restart until the system is attended to manually. The system shall be able to record the last 99 shutdown events that include AC line occurrences and/or fault conditions. This historical information shall be retrievable via the serial interface.