

SAMPLE BIDDING SPECIFICATIONS

HarmonicGuard® Passive (HGP) Harmonic Filter

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope

1. Provide all labor, materials, equipment and incidentals as shown on the DRAWINGS, specified and required to furnish and install the harmonic filter to limit harmonic voltage and current to acceptable levels as defined by IEEE Std 519-2014.
2. The harmonic filter shall be designed to filter all characteristic low frequency harmonics (5th, 7th, 11th, 13th, etc.), generated from three phase diode rectifier loads such as variable frequency drives (VFD), while improving the system power factor.
3. The harmonic filter shall be installed on the front end of the VFD as indicated on the Submittal Drawings.

1.02 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown and specified.

1. Voltage and current harmonic mitigation per IEEE-519-2014. The Point of Common Coupling (PCC) for all voltage and current harmonic calculations and measurements shall be at the input terminals of the harmonic filter in combination with the VFD. The filter supplier shall not be responsible for pre-existing voltage distortion caused by other harmonic sources.
2. The harmonic filter shall be UL 508A listed and labeled.
3. The filter shall have a labeled SCCR rating of 100kA per UL 508A. An SCCR rating of EXEMPT will not be accepted as a valid alternative.
4. The harmonic filter shall be warranted free from defects both in materials and in workmanship for a period of three years from the date of shipment, when applied in accordance with the manufacturer's recommended procedures.
5. The filter shall not adversely react with or resonate with the power system or attract harmonics from other sources.

1.03 SUBMITTALS

A. Submittal Drawings shall include the following information:

1. Outline dimensions and weight.

2. Customer connection and power wiring diagrams.
3. Complete technical product description.

1.04 ENVIRONMENTAL CONDITIONS

- A. The harmonic filter shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics or life.
 1. Operating Ambient Temperature: -40°C to 40°C.
 2. Operating Ambient Temperature for selected open chassis units: -40°C to 50°C.
 3. Storage Temperature: -40°C to 60°C.
 4. Relative Humidity: 0 to 95%, non-condensing.
 5. Altitude: Operating to 2000 meters (6600 ft).

1.05 WARRANTY

- A. The harmonic filter shall be warranted to be free of defects both in materials and in workmanship for a period of 3 years from the date of shipment.

1.06 PERFORMANCE REQUIREMENTS

A. Input Power

1. Voltage: ___ Volt, 3Ø, 3W
2. Frequency: __ Hz
3. The filter HP rating(s) shall be determined in accordance with the VFD schedule.

B. Output Performance

1. Harmonic Correction:
 - a) The Total Demand Distortion (TDD) of the current at the input terminals of the filter, in combination with the variable frequency drive, shall not exceed 5% THID at full rated load and given the filter is correctly applied.
 - b) The Total Harmonic Voltage Distortion (THVD) at the input terminals of the filter in combination with the variable frequency drive shall not exceed the limits defined in Table 10-2 of IEEE-519 (1992). The filter supplier shall not be responsible for pre-existing voltage distortion caused by other harmonic sources.
2. When the VFD is in bypass, the motor is connected across the line. In this line connected arrangement, the filter will improve the power factor by at least 0.05 for motors with poor power factor (<0.85).
3. The full load efficiency of the filter shall not be less than 97% for filters larger than 5 HP or less than 98.5% for filters larger than 25 HP.

4. The filter may produce a capacitive reactive power (KVAR) less than or equal to 40% of its HP rating over the full load range.
5. Voltage Regulation: The voltage regulation at the VFD terminals and attributable to the filter shall not exceed 5%. Filters with greater than 10% voltage drop, and/or filters that have capacitors in series with the VFD, are not acceptable.

PART 2 PRODUCT

2.01 GENERAL

- A. Voltage: ___ Volts, ___ Hz, 3 phase, 3 wire plus ground.
- B. Current Rating: Provide the rated current as indicated on the Submittal Drawings.
- C. Manufacturer:
 1. TCI, LLC
 2. (No substitutions)

2.02 HIGH PERFORMANCE CAPACITOR CELLS

- A. Capacitor cells shall have a voltage rating capable of handling nominal system voltage plus 10% continuously. Capacitor windings shall be metalized film construction consisting of aluminum-coated electrodes that are vacuum-deposited on polypropylene dielectric film. Dielectric material shall be low-loss (no more than 0.25 watts per kVAR). Capacitor cells themselves shall be rated to operate at a temperature of at least 65°C on the capacitor case. The capacitance tolerance shall be not more than ±10%. Capacitors shall be UL recognized.
- B. Liquid-filled capacitor cells shall be contained in hermetically sealed metal cans. Impregnate, if used, shall be biodegradable and not contain PCBs. Capacitor cells shall have a pressure-sensitive circuit interrupter which, in case of a hazardous internal pressure increase, will disconnect all three phases simultaneously.
- C. Individual capacitor cells, or groups of cells, shall be provided with a 3-phase discharge resistor network or individual resistors in the case of single-phase capacitors. The resistors shall be sized to reduce residual voltage to less than 50V within one minute of de-energization (NEC article 460-6).

2.03 INDUCTORS

- A. Both shunt circuit inductors and series line reactors shall be designed for harmonic filtering service and for slowing the rate of rapid current changes. The inductors shall be UL component-recognized or listed and shall be built to comply to UL 508. Construction shall be of copper wire-wound on magnetic steel cores. Inductors shall be three-phase. Series line reactors shall be sized appropriately for the total connected load. Design maximum temperature rise for inductors shall be 135°C on bobbin wound and 155°C on form wound devices at rated current.
- B. Windings shall consist of copper wire. Terminations shall be copper alloy ring lugs, UL-recognized terminal blocks, or solid copper bus. Sheet insulation shall be DuPont Nomex 410, IPT Cequin, or 3M ThermaVolt AR of the thickness as required for UL insulation systems.

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- C. Completed inductors shall be impregnated, using 100% solids epoxy resin. All insulation varnish systems shall be UL recognized and rated 180°C Class H, 200°C Class N, or 220°C Class R, 600V. Inductors shall be Hi-Pot tested (2,640V, 60 Hz, 1 second) line-to-line and line-to-ground.

WIRE

- D. Capacitor current-carrying wire shall consist of copper with thermoplastic insulation that is rated at 600V and for a minimum of 105°C. Wire shall be: NEC-rated, MTW, and UL style AWM. Control wire shall be copper wire that is rated at 600V for 90°C. Signal wire shall be multi-conductor jacketed wire that is rated for 300V at 80°C.

2.04 ENCLOSURE

- A. The harmonic filter shall be offered in an open panel, UL Type 1, or UL Type 3R enclosure.
- B. Enclosure shall have a hinged, lockable door cover for ease of scheduled inspection and maintenance.
- C. Freestanding units shall include lifting provisions by forklift truck and lifting lugs. Wall mount units weighing more than 80 pounds shall be equipped with a means of lifting, such as lifting lugs.
- D. All units shall be provided with a grounding lug.
- E. The paint shall be the manufacturer's standard type and color.

2.05 COMMUNICATIONS/CONTROLS

- A. The harmonic filter shall be equipped with communication capability and shall provide access, via serial communications, to real-time system performance data. This data shall be accessible via SCADA system interface and shall include:
 - 1. Filter input and output RMS Voltage
 - 2. Filter input and output RMS Current
 - 3. Filter Input Current THD
 - 4. Filter Input Voltage THD
 - 5. Input Displacement Power Factor
 - 6. Filter Contactor Status
 - 7. Non-Critical Faults including:
 - a) Over/Under input/output current
 - b) Over/under input/output voltage
 - c) Current and Voltage THD irregularities
 - d) Current imbalance
 - 8. Critical Faults including:

- a) Filter over/under current
 - b) Filter over/under voltage
 - c) Capacitor Failure
 - d) Contactor failure
 - e) Phase loss
 - f) Blown Fuse indication
- B. The harmonic filter shall have the ability to communicate over a standard industrial Ethernet or Modbus RTU communications network.
- C. The filter shall monitor system performance parameters without the use of current transformers.
- D. The harmonic filter shall provide local control to the filter contactor based on RMS load current, current THD/TDD, or displacement power factor, as measured at the filter input terminals.
- E. The filter control shall have the ability, via active control, to ensure that the filter does not contribute leadings VARs on to the power system.
- F. The harmonic filter shall be able to provide trend history data for RMS voltage, RMS current, current THD, voltage THD, and power factor as measured by the filter input and output terminals.
- G. Adjustable operational parameters shall be password protected.

2.06 DESIGN

- A. The harmonic filter shall suppress characteristic harmonics without the requirement to phase shift against other harmonic sources or without the need for individual tuning.
- B. The harmonic filter shall consist of inductive element(s) in series with the load and an inductive-capacitive network in shunt with the load. The shunt circuit shall be tuned to 4.7 times the fundamental frequency.
- C. The harmonic filter shunt circuit shall be protected by field replaceable fuses on each phase to ensure the VFD remains operational in the event of a capacitor over current or other condition causing the fuses to open. Fuses internal to the capacitor cell shall not be acceptable in lieu of field replaceable fuses.
- D. To control leading VARs on the power system or to enhance compatibility, the PQconnect connectivity option shall provide the disconnect means for the filter capacitors via active data monitoring and contactor control. 120V power shall be provided internal to the filter to power the contactor and PQconnect board.

PART 3 EXECUTION

3.01 TESTING

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[DATE]

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[PROJECT LOCATION]

- A. All reactors shall be functionally tested to verify inductance and the filter assembly shall be functionally tested for proper connections and wiring configuration.
- B. Every filter shall be tested at no load current at the manufacturing facility.
- C. Manufacturing facility shall have harmonic performance testing capability with VFD loads.

3.02 EXAMINATION

- A. Verify that location is ready to receive equipment.
- B. Verify that the building environment can be maintained within the service conditions required by the manufacturer of the harmonic filter.

3.03 INSTALLATION

- A. Installation shall be in compliance with all applicable local codes and all manufacturer requirements, instructions and drawings.

END OF SECTION