

SAMPLE BIDDING SPECIFICATIONS

KMG MotorGuard Sine Wave Filter

PART 1 GENERAL

1.01 SUMMARY

- A. The KMG Drive Output Sine Wave Filter (hereafter called a "KMG") shall contain a tuned circuit designed to remove PWM (Pulse Width Modulated) carrier frequency components generated by the output of a VFD (Variable Frequency Drive). The KMG is designed to reduce motor and cable heating, reduce motor noise, eliminate the problems associated with reflected wave, and improve motor life.
- B. KMG consists of inductive, capacitive, and resistive elements tuned to shunt frequencies at and above the target carrier frequency. The series reactor protects the capacitors as well as the VFD output IGBTs. The capacitor eliminates the dV/dt of the PWM wave (typically more than 50% vTHD) as it integrates the waveform resulting in a sine wave of voltage with about 5.0% total harmonic distortion (typical).
- C. The capacitors are internally self-protected and self-healing. Voltage drop at the filter output terminals shall not be more than 5% at rated conditions.

1.02 STANDARDS

- A. The KMG shall be designed in accordance with the applicable sections of the following documents.
 - 1. UL 508A
 - 2. CSA C22.2 No. 14
 - 3. Manufactured in the USA

1.03 SYSTEM DESCRIPTION

- A. The KMG described in this specification shall be used on a ____ V, 3-phase, variable frequency PWM VFD at fundamental frequencies ranging from 10 Hz to 80 Hz and carrier frequencies of no less than 2 kHz and no more than 16 kHz. The VFD shall be operated in scalar (V/Hz) mode only. The KMG shall be rated for the maximum continuous output current of the VFD. The industrial version of the KMG shall be cULus listed by Underwriter's Laboratories as an Industrial Control Panel under UL 508A. The General Purpose version of this filter shall be designed to comply with the requirements of UL 508.

1.04 SUBMITTALS

- A. Submittals shall include the following information:
 - 1. Outline dimensions and weight.
 - 2. Customer connection and power wiring diagrams.
 - 3. Complete technical product description.

1.05 ENVIRONMENTAL CONDITIONS

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

1.06 WARRANTY

- A. The KMG Drive Output Sine Wave Filter shall be warranted to be free of defects both in materials and in workmanship for a period of one year of useful service, not to exceed 18 months from the date of shipment.

PART 2 PRODUCT

2.01 MANUFACTURERS

- A. TCI, LLC
- B. (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 $\pm 10\%$. 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. The series tuning inductor shall be designed for high frequency filtering service and for slowing the rate of rapid current changes. The inductors shall be UL recognized components and shall be built to comply to UL 508. Construction shall be copper wire wound on magnetic steel cores. Inductors shall be three-phase and sized for the output current rating of the VFD. Design maximum temperature rise for inductors shall be 135°C on bobbin wound and 155°C on form wound devices at rated current.

- B. The core shall be made of laminated, magnetic steel (grade M50 or better). Brackets shall be ASTM structural steel or structural aluminum. Coils shall be wedged in place and the core locked in place using vertical ties or rods.
- C. 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.
- D. 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.
- E. Inductors shall be air-gapped to avoid control point saturation. Inductance shall be measured and shall be within $\pm 5\%$ of design value for the tuning inductor.

2.04 APPLICATION INTERFACE WITH THE VFD & MOTOR

- A. When used, distribution blocks shall be rated for copper wire and UL-recognized or listed.
- B. Lugs shall be one-piece construction of cold-forged, pure electrolytic copper with 99% conductivity or of plated high-strength aluminum alloy. They shall be rated for copper wire. Lugs shall be UL-recognized or listed

2.05 TERMINALS

- A. Terminals shall be pure copper or copper alloy which shall be crimped to the wire. All connections shall be mechanically fixed using nuts, bolts, screws, or quick-connect terminals.

2.06 WIRE

- A. Capacitor current-carrying wire shall consist of copper with thermoplastic insulation that is rated at 600V and for a minimum of 90°C. Wire shall be: NEC-rated, MTW 1337, 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.

2.07 ENCLOSURE

- A. The industrial enclosure shall be designed to UL Type 1 requirements. Enclosure shall be constructed from steel with a protective coating finish and with no knockouts. Provisions shall be made to allow for permanent conduit entry sites. Enclosure shall have a hinged, lockable cover that shall not at any time disrupt conduit connections. Openings shall be provided to allow for enclosure ventilation. Air flow shall be provided by natural convection where possible. Fan cooled models shall have cooling fans sized to provide at least six enclosure volumes of air change per minute.
- B. The general purpose enclosure shall be designed to conform to UL Type 3R requirements. Enclosure shall be constructed from steel with a protective coating finish and with no knockouts. Provisions shall be made to allow for permanent conduit entry sites. Enclosure shall have removable panels that shall not at any time disrupt the conduit connections. Openings shall be provided to allow for enclosure ventilation. Air flow shall be provided by natural convection where possible. Fan cooled models shall have cooling fans used for cooling resistors.

[PROJECT NUMBER]
[DATE]

[PROJECT NAME]
[PROJECT LOCATION]

- C. The industrial KMG shall be in either a standalone UL Type 1 enclosure or incorporated into the VFD's enclosure.
- D. The general purpose KMG shall consist of a standalone, fully enclosed outdoor suitable enclosure complete with vermin exclusion features. It shall be available in white. The enclosure shall be supplied with a base suitable for floor mounting.

PART 3 EXECUTION

3.01 TESTING

- A. The tuning inductor shall be tested for proper inductance before being assembled into the KMG filter. The KMG shall be circuit tested for proper connections and wiring configuration before leaving the factory. A functional test of the filter energized by a VFD shall be performed.

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 sine wave filter.

3.03 INSTALLATION

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

END OF SECTION