

## SECTION 26 2923

### VARIABLE-FREQUENCY MOTOR CONTROLLERS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Variable frequency controllers.

##### 1.02 REFERENCE STANDARDS

- A. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems; National Electrical Manufacturers Association.
- B. NEMA ICS 7 - Industrial Control and Systems: Adjustable-Speed Drives; National Electrical Manufacturers Association.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association.
- D. NFPA 70 - National Electrical Code; National Fire Protection Association.
- E. IEEE 519 – Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems. Motors greater than 60 HP shall comply with IEEE 519 with the point of common coupling (PCC) located at the source feeder overcurrent protective device.

##### 1.03 SUBMITTALS

- A. See Section 01 3000 (01300) - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
- D. Test Reports: Indicate field test and inspection procedures and test results.
- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Manufacturer's Field Reports: Indicate start-up inspection findings.
- G. Operation Data: NEMA ICS 7.1. Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.
- H. Maintenance Data: NEMA ICS 7.1. Include routine preventive maintenance schedule.
- I. Coordination Drawings: Prepare floor plan coordination drawings drawn to scale that identify the arrangement of the new VFD's to be provided in relationship to existing equipment and elements within the existing electrical room.

##### 1.04 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience and with service facilities within 200 miles of Project.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Toshiba; Model AS3: [www.toshiba.com](http://www.toshiba.com)
- B. ABB; Model ACH580: [www.abb.com](http://www.abb.com)
- C. Yaskawa; Model HV600 [www.yaskawa.com](http://www.yaskawa.com)
- D. For UMSL & MS&T, include Danfoss; Model VLT FC 102: [www.danfoss.com](http://www.danfoss.com)
- E. For UMKC, include Eaton.

### 2.02 DESCRIPTION

- A. Variable Frequency Controllers: Enclosed controllers suitable for operating the indicated loads, in conformance with requirements of NEMA ICS 7. Select unspecified features and options in accordance with NEMA ICS 3.1.
  - 1. Employ microprocessor-based inverter logic isolated from power circuits.
  - 2. Employ pulse-width-modulated inverter system.
  - 3. Include a DC link reactor for reduction of harmonic distortion.
  - 4. The controller, and all associated components, shall be supplied by a single vendor.
  - 5. The controller will be operating a variable volume fan motor, or water pump motor for HVAC application.
  - 6. System voltage shall be indicated on front of ASD, using minimum of 1-inch high letters.
- B. Enclosures: NEMA 250, Type 1, suitable for equipment application in places regularly open to the public. No disconnects in VFD cabinet. Disconnect must be in separate enclosure.

### 2.03 OPERATING REQUIREMENTS

- A. Rated Input Voltage for motors rated below 40 HP: 200 volts, three phase, 60 Hertz, with a voltage tolerance of +/- 10% and a frequency tolerance of +/- 2 Hz.
- B. Rated Output: Output to be rated for design ambient temperature and maximum PWM carrier frequency. Output frequency shall vary between 0.1 Hz and 400 Hz. Frequency resolution shall be 0.01 Hz digital and 0.03 Hz analog with an accuracy of +/-0.2% of maximum frequency at 25 degrees Celsius. Maximum voltage frequency shall be adjustable from 25 Hz to 400 Hz. Voltage boost shall be adjustable from 0% to 30% with starting frequency adjustable from 0 Hz to 10 Hz. The output current shall be 100% continuous and 110% for 60 seconds, based on NEC table 430-150 (Full-Load Current, Three-Phase Alternating Current Motors) for 200 volts or 460 volts.
- C. The controller shall contain three critical frequency jump points with individual bandwidth. Upper and lower frequency limits shall be capable of being varied.
- D. The PWM carrier frequency shall be adjustable from 5000 Hz to 12000 Hz.
- E. The drive shall contain two separate acceleration/deceleration times (0.1 to 1800 seconds) with a choice of linear, S, or C curves. The drive shall have a standard dynamic electric braking for motors rated 30 HP or below. The drive shall restart into a rotating motor by sensing the coasting motor speed and matching that frequency. The drive shall have adjustable soft stall

(10%-150%) and adjustable electronic overload protection (10%-100%).

- F. The drive shall have external fault input, be capable of re-setting faults remotely and locally.
- G. Input Signal:
  - 1. 0 to 10 v DC
  - 2. 0 to 5 v DC
  - 3. 4 to 20 mA DC
- H. Manual bypass is not required on VFD unless indicated on bid documents.

## **2.04 COMPONENTS**

- A. Display: Provide integral digital display to indicate output voltage, output frequency, and output current, output power (kw), and motor RPM.
- B. For MS&T, BACnet option included.

## **2.05 HARMONICS**

- A. Reference IEEE 519-2014 Total Demand Distortion (TDD) limit at the PCC (point of common coupling). VFD supplier must provide harmonic calculations to show compliance with IEEE 519-2014.
- B. VFDs provided shall have 5% reactor (or DC choke) as integral to the VFD.
- C. Additional harmonic mitigation equipment in order to achieve compliance with IEEE 519-2014 shall include, but not be limited to, the following:
  - 1. 5% THD passive harmonic filter with contactor. The passive harmonic filter shall be mounted in the same enclosure as the drive.
  - 2. A capacitor drop-out contactor shall be included to open at reduced loads.
- D. Active front end "ULH" technology the incorporates DC bus capacitors, IGBTs, LCL filtering, and LCL contactor. Maintain unity power factor at full load while complying with IEEE 519-2014. VFDs that do not utilize this technology are not allowed.
- E. VFDs that cannot produce an output voltage that is equal to the motor nameplate voltage while operating at full speed are not allowed

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with NEMA ICS 7.1, manufacturer's instructions, and per drawings.
- B. Tighten accessible connections and mechanical fasteners after placing controller.
- C. Provide engraved plastic nameplates; refer to Section 26 0553 (16075) for product requirements and location.
- D. Neatly type label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place in clear plastic holder.
- E. The service disconnect switch must be installed on the line side of the VFD. The disconnect must be in a separate enclosure from the VFD. If conditions do not allow this disconnect to be located near the motor within NEC requirements, then a second remote disconnect may be required at the motor. Consult the project manager or University Engineer if this condition

arises. All remote disconnects must be provided with auxiliary contacts hardwired to VFD safety circuit to shut down VFD when disconnect is opened. This may affect warranty on the drive so every attempt should be taken to install it per these design guidelines.

- F. If a single VFD is controlling multiple fans in an air handling unit then overload protection on each fan must be provided. No more than 4 fans shall be connected to a single VFD.
- G. The ground wire should be of the same size as the power conductors from the motor to the VFD and from the VFD to the source.
- H. Do not install VFD's on AHU's. See detail below.

### **3.02 FIELD QUALITY CONTROL**

- A. Prior to initial energization, provide the service of the manufacturer's field representative to prepare and start controllers.

### **3.03 MAINTENANCE**

- A. Furnish two extra of each air filter.
- B. Provide service and maintenance of controllers for one year from Date of Substantial Completion.

### **REFERENCES**

262923 VFD Mounting Detail.dwg

**END OF SECTION**