

VARIABLE FREQUENCY DRIVE UNITS

General

1. The CONTRACTOR shall provide variable frequency drive (VFD) units, complete and operable, as indicated in accordance with the Contract Documents.
2. It is the intent of this Section to require complete, reliable, and fully tested variable frequency drive systems suitable for attended or unattended operation.
3. Like products shall be the end product of one manufacturer in order to standardize appearance, operation, maintenance, spare parts, and manufacturer's services.
4. This requirement, however, does not relieve the CONTRACTOR of overall responsibility for the WORK.
5. The low voltage VFD shall be designed for 400 VAC at 50 Hz. Other voltages and frequencies will not be accepted and shall be rated for the FLA of the motor.

CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with the requirements, except that Shop Drawing information for the drives shall be submitted as part of the information for the driven equipment.
- B. Shop Drawings: Include the following information:
 1. Equipment Information
 - a. name of drive manufacturer
 - b. type and model
 - c. assembly drawing and nomenclature
 - d. maximum heat dissipation capacity in kW
 2. Conduit entrance provisions
 3. Circuit breaker type, frames, and settings
 4. Information related to relays, timers, pilot devices, control transformer VA, and fuse sizes, including catalog cuts
 5. Ladder Diagram
 - a. Submit the system schematic ladder diagram and interconnection diagrams.
 - b. The schematic ladder diagram shall include remote devices.
 - c. The ladder diagram shall incorporate the control logic on the corresponding elementary schematic as indicated.
 - d. Submittals with drawings not meeting this requirement will not be reviewed further and will be returned to the CONTRACTOR stamped "REJECTED."

6. Factory test data certifying compliance of similar equipment from the same manufacturer with requirements.

The VFD shall be provided with the following features:

1. Inrush current adjustment between 50 and 110 percent of motor full load current (factory set at 100 percent).
2. Overload capability at 110 percent for 60 seconds for variable torque loads and 150 percent for constant torque loads.
3. Adjustable acceleration and deceleration.
4. Input signal of 4 - 20 mA from process.
5. Output speed signal of 4 - 20 mA; Signals other than 4 - 20 mA will not be accepted.
6. Upon loss of input signal, the VFD shall operate at a preset speed.
7. A minimum of 2 selectable frequency jump points in order to avoid critical resonance frequency of the driven system.
8. Additional devices and functions as indicated
9. Solid state type metering, including power quality functions, on the line side of the VFD. Include CT's and PT's of ratios required. Solid state metering shall be provided with ModBus communication and shall be as manufactured by **ABB, Schneider, Siemens, EATON or Equivalent.**

The VFD shall be provided with, as a minimum, the following protection features:

1. Input line protection with metal oxide varistor (MOV) and RC network.
2. Protection against single phasing.
3. Instantaneous overcurrent protection.
4. Electronic overcurrent protection.
5. Ground fault protection.
6. Over temperature protection for electronics.
7. Protection against internal faults.
8. Ability to start into rotating motor (forward or reverse rotation).
9. Additional protection and control as indicated and as required by the motor and driven equipment.

1- Mains connection	
Voltage and power range	3-phase, 380 to 480 V, +10/ -15%, 0.75 to 355 kW 3-phase, 208 to 240 V, +10/ -15%, 0.75 to 75 kW Auto-identification of input line
Frequency	48 to 63 Hz
Power factor	0.98
2- Motor connection	
Voltage	3-phase, from 0 to U _{supply}
Frequency	0 to 500 Hz
Continuous loading capability (constant torque at a max ambient temperature of 40 °C)	Rated output current I ₂
Overload capacity (at a max. ambient temperature of 40 °C)	At normal use 1.1 x I _{2N} for 1 minute every 10 minutes At heavy-duty use 1.5 x I _{2hd} for 1 minute every 10 minutes Always 1.8 x I _{2hd} for 2 seconds every 60 seconds
Switching frequency Selectable	Default 4 kHz 1 kHz, 2 kHz, 4 kHz, 8 kHz, 12 kHz
Acceleration time	0.1 to 1800 s
Deceleration time	0.1 to 1800 s
Speed control Open loop Closed loop Open loop Closed loop	20% of motor nominal slip 0.1% of motor nominal speed < 1% s with 100% torque step 0.5% s with 100% torque step
Torque control Open loop Closed loop Open loop Closed loop	< 10 ms with nominal torque < 10 ms with nominal torque ± 5% with nominal torque ± 2% with nominal torque
Ambient temperature -15 to 50 °C	No frost allowed. From 40 to 50 °C with derating.
Altitude Output current	Rated current available at 0 to 1000 m. In altitudes from 1000 to 4000 m (3300 to 13,200 ft) above sea level, the derating is 1% for every 100 m (330 ft). If the installation site is higher than 2000 m (6600 ft) above sea level, please contact your local ABB distributor or office for further information.
Relative humidity	5 to 95%, no condensation allowed
Degree of protection	IP21 or IP54 (≤ 160 kW)
3- Programmable control connections	
Two analog inputs Voltage signal Current signal Potentiometer reference value Maximum delay Resolution Accuracy	0 (2) to 10 V, R _{in} > 312 kΩ single-ended 0 (4) to 20 mA, R _{in} = 100 Ω single-ended 10 V ± 2% max. 10 mA, R < 10 kΩ 12 to 32 ms 0.1% ± 1%
Two analog outputs Accuracy	0 (4) to 20 mA, load < 500 Ω ± 3%
Auxiliary voltage	24 V DC ± 10%, max. 250 mA
Six digital inputs Input impedance Maximum delay	12 to 24 V DC with internal or external supply, PNP and NPN 2.4 kΩ 5 ms ± 1 ms

Serial communication EIA-485	Modbus protocol
Product compliance	Low Voltage Directive 2006/95/EC EMC Directive 2004/108/EC Quality assurance system ISO 9001 Environmental system ISO 14001 UL, cUL, CE, C-Tick and GOST R approvals RoHS complain