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| **Date** | **Customer** | **Job Name** | **P.O. / S.O.** |
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Variable Frequency Drive (VFD)

## P1000 Mechanical Specification Submittal

**(For Open Chassis Rated Drives)**

# GENERAL

The P1000 is a high performance PWM (pulse-width-modulated) AC drive. Three-phase input line power is converted to a sine-coded, variable frequency output, which provides optimum speed control of any conventional squirrel cage induction motor. The use of IGBTs (Insulated Gate Bipolar Transistors), with a carrier frequency range of 1 kHz to 15 kHz, permits quiet motor operation.

This drive has one control logic board and keypad for all horsepower ratings. Printed circuit boards employ surface mount technology, providing both high reliability, and small physical size of the printed circuit assemblies. The dual 32 bit microprocessors deliver the computing power necessary for complete three phase motor control in all variable-torque normal duty applications.

Operating Principle: Input three-phase AC line voltage is first rectified to a fixed DC voltage. Using pulse width modulation (PWM) inverter technology, the DC voltage is processed, to produce an output waveform in a series of variable-width pulses. Unique firmware algorithms optimize motor magnetization through control of voltage, current and frequency applied to generate a nearly sinusoidal output waveform.

# STANDARDS

UL 508C (Power Conversion)

CSA 22.2 No. 14-10 (Industrial Control Equipment)

UL 1995 (Plenum)

CE mark 2006/95/EC LVD

CE mark 2004/108/EC

IEC 61800-5-1 (LVD)

EN 61800-3

IEC 60529

IEEE C62.41

BTL Listed (BACnet)

UL, cUL listed; CE marked

RoHS Compliant

# ENVIRONMENTAL & SERVICE CONDITIONS

Ambient service temperature: -10°C to 50°C (14°F to 122°F)

Ambient storage temperature: -20°C to 60°C (-4°F to 140°F)

Humidity: 95% RH or less, non-condensing

Altitude: Up to 1000 meters (3300 feet), higher by derating

Service factor: 1.0

Vibration: 9.81m/s2 (1 G) maximum at 10 to 20 Hz
 5.9 m/s2 (0.6 G) at 20 Hz to 55 Hz (small HP)
 2.0 m/s2 (0.2 G) at 20 Hz to 55 Hz (large HP)

Plenum mounting capable (IP20)

# QUALITY ASSURANCE

In circuit testing of all printed circuit boards is conducted to ensure proper manufacturing

Final printed circuit board assemblies are functionally tested via computerized test equipment

All fully assembled controls are tested with induction motor loads to assure unit specifications are met

The average MTBF (Mean Time Between Failure) is 28 years

# CONSTRUCTION

Input Section- The drive power input stage converts three-phase AC line power into a fixed DC voltage via a solid-state full wave diode rectifier with MOV (Metal Oxide Varistor) surge protection. An internal 3% DC bus reactor at ratings of greater than 30HP reduces harmonics for cleaner power (optional at smaller ratings).

Intermediate Section- The DC bus maintains a fixed, filtered DC voltage with short circuit protection as a DC supply for the drive output section. The DC bus is monitored by drive diagnostic logic circuits to continuously protect and monitor the power components.

Output Section- Insulated Gate Bipolar Transistors (IGBTs) convert DC bus voltage to a variable frequency, variable voltage PWM sine-coded AC output to the motor. Use of IGBT devices allow motor noise at 60 Hz to measure less than 2 dB
(@ 1 meter) above that resulting from across the line operation.

# CONSTRUCTION (continued)

Open Chassis (IP00) horsepower ratings:

 240VAC: 100 thru 175 HP
 480VAC: 150 thru 1000 HP
 600VAC: 125 thru 250 HP

Microprocessor based control circuit uses non-volatile memory (NVRAM) so all programming data is saved when the drive is disconnected from power

Current transformers detect the output current for motor control and protective functions

Multi-language 5-line 16-character LCD operator keypad with real time clock. Provides local programming, run/stop control, monitoring, speed reference and reset commands.

Customizable display of readouts including output frequency, output voltage, output current, output power, DC bus voltage, PI feedback and fault status. Includes parameter settings copy backup function.

Built-In real time clock for time/date stamping of fault events along with timer functions for starting, stopping and speed changes without the need for external controls

Removable I/O terminal board has backup memory. All parameter changes are automatically saved to both the main control board and the I/O board. Leave I/O wiring connected when replacing a drive

Easy to remove DC voltage heat sink cooling fans with programmable on/off control

Zero side clearance mounting capability for space savings

Drive mounting with heatsink out the back of the enclosure

USB Type B port for quick and easy PC Connection

# PROTECTION

Output current overload rating: 120% of drive’s continuous current rating for 60 seconds

Output short circuit protection

Current limited stall prevention (overload trip prevention) during acceleration, deceleration, and run conditions

Optically isolated operator keypad controls

Fault display with time stamp storage of last 10 faults

Motor hunting prevention function

Electronic ground fault protection

Electronic thermal motor overload protection (UL approved)

DC bus charge indication

Heat sink over temperature protection

Cooling fan operation hours monitor

Input/output phase loss protection

Reverse prohibit function

Short circuit withstand rating of 100K amps RMS

# OPERATION

Over 100 programmable functions with resettable factory fan and pump presets

User parameter settings initialization for re-establishing project specific parameter settings

Output frequency and speed display can be programmed for speed-related and control indications including: Hz, RPM, % or custom units

Power loss ride-thru (2 seconds capable)

Time delay on start, peak avoidance

Drive accepts either a direct acting or a reverse acting speed command signal

Bi-directional speed search capability allows starting into a rotating load. Two types: current detection and residual voltage detection

DC injection braking prevents fan wind milling at motor start

Ramp-to-stop or coast-to-stop selection

Auto restart capability: 0 to 10 attempts with adjustable delay time between attempts

One custom selectable Volts/Hertz pattern and multiple preset Volts/Hertz patterns

Analog speed reference signals have adjustable bias and gain

Automatic energy savings, reduced voltage operation

While the drive is running, operational changes in control and display functions are possible including:

 Frequency reference command
 Start/stop commands
 Acceleration time (0 to 6000 seconds)
 Deceleration time (0 to 6000 seconds)
 Monitor displays
 Remove the operator keypad

# PRODUCT FEATURES

Displacement power factor: 0.98 throughout the motor speed range

Drive efficiency: 96% at half-speed; 98% at full-speed

Starting torque capability: 150% from 3 Hz

Speed control range: 40:1

Carrier frequency: adjustable from 1 kHz to 15 kHz

Input phase insensitive; sequencing of the three phase input is unnecessary

Voltmeter, ammeter, kilowatt meter, elapsed run time meter and heatsink temperature monitoring functions

Two internal (PI) Controls

1. Drive internal PI closed loop control with selectable engineering units
2. Independent PI control of external devices

Differential PI feedback feature

Sleep function in both closed loop and open loop control

Feedback signal low pass filter

Feedback signal loss detection with selectable response

Feedback signal inverse capability

Feedback transmitter power supply: 24 VDC, 150 mA

Input and output terminal status monitors

Diagnostic fault/alarm indicators with dedicated contacts

 S-curve soft start / soft stop capability

Network communication loss detection with selectable response

Up/down motor operated pot (MOP) floating point control

17 preset speeds

Critical frequency rejection capability: 3 selectable, adjustable bandwidths

Dynamic noise control function for quiet motor operation

Programmable security code for operator keypad lockout

Run/stop command methods:

 Terminal strip (2-wire or 3-wire)
 Network communication
 Operator keypad

Speed reference (speed command) methods:

 0 to 10 VDC or -10 to 10 VDC (20 kΩ)
 4 to 20 mA or 0 to 20 mA (250 Ω)
 0 to 32 kHz pulse train
 Network communication
 Operator keypad

Eight programmable multi-function digital input terminals (24 VDC, sinking or sourcing, internal/external power supply) providing 60+ programmable functions including:

 Multi-step speed references
 Jog commands
 PID control enable/disable

Three programmable multi-function digital output terminals (2 Form-A and 1 Form-C relays, 1 A @ 250 VAC / 30 VDC) providing 50+ functions including:

 During run
 Drive ready
 Speed agree
 No load detection (broken belt/shaft alert)

One fixed Fault output relay (Form-C, 1 A @ 250 VAC / 30 VDC)

Three programmable multi-function analog input terminals (individually selectable for 0 to 10 VDC, -10 to 10 VDC, 4 to 20 mA, or 0 to 20 mA) providing 15+ functions including:

 Frequency reference
 PID setpoint
 PID feedback

Two programmable multi-function analog output terminals (individually selectable for 0 to 10 VDC, -10 to 10 VDC, or 4 to 20 mA) providing 20+ functions including:

 Output Frequency
 Output Current
 Output Power

One programmable multi-function pulse train input terminal (0 to 32 kHz) providing several functions including:

 Frequency reference
 PID setpoint
 PID feedback

1 fixed Fault output relay (Form-C, 1 A @ 250 VDC / 30 VDC)

1 built-in RS-422/485 115.2 kbps Modbus/Memobus network communication port

Stationary and rotational motor auto-tuning

Overexcitation braking function stops the motor in up to half the normal time

Motor preheat function

Upgradeable drive firmware via PC program

Heat sink over temperature speed fold-back feature

Bumpless transfer between local and remote modes

Fan failure detection and selectable response

# OPTIONS

Analog output option card provides 3 additional outputs

Network communication option cards include: DeviceNet, EtherNet/IP, Modbus TCP/IP, PROFIBUS-DP, PROFINET, EtherCAT, BACnet, LonWorks, Metasys (N2), Apogee FLN (P1) and MECHATROLINK-II

Auxiliary control power module

120 VAC digital input interface card

Remote operator mounting kit (UL Type 1, 4, 4X, 12)

DriveWizard PC software for programming and monitoring

Energy savings and harmonic prediction software

Integrated 12-pulse version (480 V, 40 HP and larger) provides a cost-effective solution for low harmonics

Tag:

Model Number:

HP:

Amps:

Volts: