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

## Z1000 Mechanical Specification Submittal

**(For NEMA 12 Rated Bypass Drives)**

# GENERAL

The Z1000 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 12.5 kHz, permits quiet motor operation.

Printed circuit boards employ surface mount technology, providing both high reliability, and small physical size of the printed circuit assemblies. The microprocessor delivers the computing power necessary for complete three phase motor control in building automation systems.

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. 14-95 (Industrial Control Equipment)

CE mark 2006/95/EC LVD

CE mark 2004/108/EC

IEC 61800-5-1 (LVD)

EN 61800-3

IEC 529

IEEE C62.41

IBC 2012

BTL Listed

UL, cUL listed

# ENVIRONMENTAL & SERVICE CONDITIONS

Ambient service temperature:

NEMA 12: -10°C to 40°C (14°F to 104°F)

Ambient storage temperature:

NEMA 12: -20°C to 70°C (-4°F to 158°F)

Humidity: 0 % to 95 %, non-condensing

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

Service factor: 1.0

Vibration: Constant Displacement of 0.33 mm max. peak to peak at (10 – 20) Hertz, Constant G’s of 0.22 G at (20 – 55) Hertz

RoHS Compliant

# 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 computer tested with induction motor loads to assure unit specifications are met.

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

# CONSTRUCTION

Input Section of the VFD - VFD 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 5% DC bus reactor reduces harmonics for cleaner power.

Intermediate Section of the VFD - DC bus maintains a fixed DC voltage, with filtering and short circuit protection, as a DC supply to the VFD output section. It is interfaced with the VFD diagnostic logic circuit, to continuously monitor and protect the power components.

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

**CONSTRUCTION (continued)**

Power and control electronics housings:

NEMA 12 enclosure: 208 V, 1 - 150 HP; 480 V, 1 - 500 HP

Microprocessor based control circuit

Non-Volatile memory (EEPROM); all programming memory is saved when the VFD is disconnected from power.

Digital operator keypad and display provides local control and readout capability:

Hand/Off/Auto commands

Speed Reference command

Reset command

Easy to remove heat sink cooling fan with programmable on/off control

# PROTECTION

Output current overload rating of 110 % 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 controls

Fault display

“Hunting” prevention logic

Electronic ground fault protection

Electronic motor overload relay protects the motor while operating in drive and bypass mode

Motor current display in both drive and bypass modes of operation as well as verification that the motor is running

Proof of flow/loss of flow detection in both drive and bypass modes

DC bus charge indication

Heat sink over temperature protection

Cooling fan operating hours recorded

Input/Output phase loss protection

Line voltage sensors to monitor for brownout and blackout conditions with adjustable fault levels to ensure the proper settings pursuant to each application.

Reverse prohibit selectable

Short circuit withstand rating of 100KAIC RMS with customer provided branch circuit protection.

Two smoke purge/fireman’s override modes (Across the line or speed selectable via the drive)

# OPERATION

Output frequency and speed display can be programmed for other speed-related and control indications, including: RPM, CFM, GPM, PSI, in WC, % of maximum RPM or custom

Power loss ride-thru (2 seconds capable)

Time delay on start, peak avoidance

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

Bi-directional “Speed Search” capability, in order to start into a rotating load. Two types: current detection and residual voltage detection

DC injection braking, to prevent fan “wind milling”

Remote Run/Stop command input

Two programmable 0 to 10 VDC or 4-20ma analog outputs, proportional to drive monitor functions including: output frequency, output current, output power, PI feedback, output voltage and more…..

Eight Programmable HVAC specific application macros

Over 100 programmable functions, resettable to factory HVAC presets

User parameter initialization, re-establish project specific parameters

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

Auto speed reference input signal, adjustable for bias and gain

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

Acceleration time (0 to 6000 seconds)

Deceleration time (0 to 6000 seconds)

Frequency reference command

Hand/Off/Auto commands

Monitor display

Removable digital operator

Automatic energy saving, reduced voltage operation

# PRODUCT FEATURES

Displacement power factor of .98 throughout the motor speed range

Internal EMI/RFI filter complies with IEC 61800-3 restricted distribution for first environment \*

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

Volt meter, ammeter, kilowatt meter elapsed run time meter and heat sink temperature monitoring functions

Two internal (PI) Controls

1. Drive internal PI closed loop control with selectable engineering units
2. Independent PI control for use with external device

Differential PI feedback feature

Sleep function in both closed loop and open loop control

Feedback signal low pass filter

Feedback signal loss detection and selectable response strategy

Feedback signal inverse and square root capability

24 Vdc, 150ma transmitter power supply

Input and output terminal status indication

Diagnostic fault indication

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

“S-curve” soft start / soft stop capability

Run/Fault output contacts

Serial communication loss detection and selectable response strategy

“Up/Down” floating point control capability

Controlled speed range of 40:1

Critical frequency rejection capability: 3 selectable, adjustable bandwidths

100% starting torque capability, available from 3 Hz to 60 Hz

Remote speed reference (speed command) signal:

0 to 10 VDC (20 kΩ)

4 to 20 mA DC (250 Ω)

Adjustable carrier frequency, from 1 kHz to 12.5 kHz

Dynamic noise control for quiet motor operation

Programmable security code

Seven Programmable digital inputs (24Vdc, 8mA) shall be provided for Remote Transfer to bypass, Safety Interlock, BAS Interlock, and numerous other bypass specific functions.

Four Programmable form C relays (24Vdc/120 VAC, 2 Amp) for: “Motor Run”, “Damper Actuator”, “Auto Transfer”, “Drive Run”, “Hand Mode”, “Auto Mode”, “System Fault”, “Bypass Run”, ”Serial Com Run” and numerous other options.

Seven preset speeds

Stationary motor auto-tuning

“Kinetic Energy Braking” (KEB) function stops the motor in up to half the time it would take without this function.

LCD keypad with Hand/Off/Auto functions.

Motor preheat function

Flash upgradeable firmware

Heat sink over temperature speed fold-back feature

“Bumpless” transfer between Hand and Auto modes

Emergency override can be used as “smoke purge” function

Fan failure detection and selectable drive action

Bypass and drive are factory assembled.

Input disconnect switch with a lockable, through-the-door operating mechanism

Drive output and Bypass contactors are both electrically and software interlocked.

BACnet, Siemens Apogee, Metasys N2, and Modbus communication protocols as standard with the ability to configure controller parameters, view controller monitors, control I/O, clear faults and view controller status in both drive and bypass modes.

Door mounted control keypad with LCD display for “Control Power”, “Drive Ready”, “Drive Run”, “Drive Selected”, “Drive Fault”, “Drive Test”, “Bypass Selected”, “Bypass Run”, “Motor OL”, ”Safety Open” “BAS Interlock”, “Auto Run”, Auto Transfer”, “Emergency Override”, “Hand Mode”, “Off Mode”, and “Auto Mode”.

Damper control circuit with end of travel feedback capability including two adjustable wait time functions. One is a run delay time where the drive will operate at a preset speed before the damper opens to pressurize the system. The other time function is an interlock wait time, so if the damper has not fully opened within the specified time, a fault will be declared.

Selectable energy savings and harmonic reduction mode. Drive automatically switches to Bypass (Across-the-line) when motor is running 60 Hz for a set time and automatically switches back when frequency reference changes.

\*Standard on 1-100 HP 208V and 1-250 HP 460V

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| GR ***Z1000 Bypass Options***  **Variable Frequency Drive (VFD) Z1000 Mechanical Specification Products and Options Submitted** |
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#### After deleting unneeded options, delete this sentence. Only one selection from each category may be specified. (Any number from “Additional Options” may be specified.) Delete all unused options.

ENCLOSURE TYPE

[B] NEMA 12 Enclosure

VOLTAGE

[D] 208 volt model for nominal, 200 or 208 VAC   
(+10/-15 %); 60 or 50 Hz (+/-5%) systems

[B] 480 volt model for nominal, 380, 400, 415, 440, 460 or 480 VAC (+10/-15 %); 60 or 50 Hz (+/-5%) systems

[P] POWER OPTIONS

MAIN INPUT DISCONNECT

[M] Circuit Breaker Disconnect with a UL508A panel SCCR of 100k rms. Sym., 480V max (Replaces Standard Input Disconnect)

DRIVE INPUT CIRCUIT

[G] Service Switch removes power from drive only

[B] 3 Contactor Bypass, (Replaces Standard 2 Contactor Bypass)

DRIVE INPUT FUSES

[F] Drive input fuses minimum rating 100,000 amp RMS

SYSTEM POWER CIRCUIT

Tag:

Model Number:

HP:

Amps:

Volts:

[A] Two Motor “AND” simultaneous control of two identical motors

[Y] Two Motor “OR” either one of two motors can be controlled

[K] Output Reactor 5%

[R] Input Reactor 3%

CAP FILTER

[N] Cap Filter is a delta-wye capacitive network for high frequency noise attenuation.

[C] CONTROL OPTIONS

ADDITIONAL OPTIONS

[W] Engraved nameplate

SERIAL COMMUNICATIONS

[L] LonWorks

[D] EtherNet/IP