



# AF-600 FP™ AC Drive

## AC Adjustable Frequency Drive

### Guide-Form Specification

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# **AF-600 FP Guide-Form Specification**

## **1.0 General Information**

### **1.1 Purpose**

This specification shall establish minimum requirements for adjustable frequency drive equipment. Drives that do not meet these requirements shall not be acceptable. The adjustable frequency drive equipment shall be the AF-600 FP as furnished by GE. It is required that the distributor have an existing Sales representative exclusively for HVAC products with expertise in HVAC systems & controls & an independent service organization, and the drive manufacturer should have engaged in the production of this type of equipment for a minimum of twenty five years.

### **1.2 Driven Equipment**

The Drive shall be capable of operating a NEMA design B squirrel cage induction motor with a full load current equal to or less than the continuous output current rating of the Drive. At base speed (60Hz) and below, the Drive shall operate in a constant V/Hz mode or a constant voltage extended frequency mode.

### **1.3 Drive Construction**

The AF-600FP Adjustable Frequency Drive shall be a sinusoidal PWM type Drive with sensorless dynamic torque vector control (DTVC) capability. The Drive shall be provided in an IP20 enclosure as standard with enclosure kits for NEMA 1 rating. In addition, the Drive shall be available in NEMA 12 enclosures at all ratings. The Drive shall be UL approved for mounting inside air handling ducts and plenums. The Drive shall be of modular construction for ease of access to control and power wiring as well as Maintenance requirements. The Drive shall consist of the following general components:

- 1.3.1 Full-Wave Diode Rectifier Bridge to convert AC supply to a fixed DC voltage
- 1.3.2 Built in DC link Harmonic Filter
- 1.3.3 Insulated Gate Bipolar Transistor (IGBT) inverter output section
- 1.3.4 The Drive shall be microprocessor based with an LCD display to program and monitor Drive parameters.
- 1.3.5 The keypad shall be divided into four (4) functional groups: Numeric Displays,
- 1.3.6 Menu Key, Navigation Keys, and Operation Keys and LED's.
- 1.3.7 Separate control and power terminal boards shall be provided.
- 1.3.8 The Drive shall provide an RS-485 serial communications port standard.
- 1.3.9 The keypad shall have copy functionality to enable copying of the parameter sets from one VFD to another.
- 1.3.10 The Drive shall have an onboard detailed description of all parameters, displays and alarms that can eliminate hardcopy of Drive Manuals
- 1.3.11 The Drive shall have a built-in logic controller

## **2.0 Operating Conditions**

- 2.0.1 The Drive's operating ambient temperature range shall be -10°C to 50°C.
- 2.0.2 The Drive's storage temperature shall be -25° to 65°C.
- 2.0.3 The Drive's relative humidity range shall be 5-95%, non-condensing.
- 2.0.4 The Drive shall be suitable for operation at altitudes up to 3,280 feet without de-rating.
- 2.0.5 The Drive shall be capable of sustaining a 1.0g vibration test.

- 2.0.6 The Drive shall be capable of side-by-side installation mounting with 0 inches clearance required. The top and bottom clearance shall be 3.4 inches minimum up to 125Hp. All drives 150Hp and above top and bottom clearance shall be 8.9 inches.

### **3.0 Standards**

- 3.0.1 The Drive shall be UL and cUL listed and not require any external fusing. The  
3.0.2 Drive shall also be CE labeled and comply with standards 61800-3 for EMC Compliance and EN 61800-2 for Low Voltage Compliance.  
3.0.3 The Drive shall be designed in accordance with applicable NEMA Standards.  
3.0.4 The Drive shall be compatible with the installation requirements of interpretive Codes such as National Electric Code (NEC) and the Occupational Safety & Health Act (OSHA).  
3.0.5 The Drive shall have EN954-1/Safety Stop Category 3 certification

### **4.0 Input Power Section**

- 4.0.1 The Drive shall be designed to operate at either 200-240Vac Three-Phase input voltage, 380-500Vac Three-Phase input voltage or 525-600Vac Three-Phase input voltage  
4.0.2 System frequency shall be 50 or 60 Hertz, +/- 5%  
4.0.3 The Drive shall be able to withstand input voltage variation of +/- 10%  
4.0.4 The Drive shall operate with an input voltage imbalance of 3.0% maximum between phases.  
4.0.5 The displacement power factor of the Drive shall greater than 0.98 lagging.  
4.0.6 The true (real) power factor of the Drive shall be equal to or greater than 0.9 nominal at rated load.  
4.0.7 The Drive shall be capable of switching the input voltage on and off a maximum of two (2) times per minute.  
4.0.8 Drive efficiency at rated load shall be 98% or higher, depending on carrier frequency selection and load.  
4.0.9 Line notching, transients, and harmonics on the incoming voltage supply shall not adversely affect Drive performance.  
4.0.10 The Drive is suitable for use on circuits capable of delivering no more than 100,000 RMS symmetrical amps.

### **5.0 Output Power Section**

- 5.0.1 The Drive shall be capable of Horsepower ratings from 1 to 60HP at 208/230Vac, from 1 to 1350HP at 460Vac, from 1 to 1350HP at 575Vac and Output Frequencies from 0 to 1000Hz. The Drive shall also have an energy saver feature with the capability of selecting a V/Hz Automatic Control Function that will modify the V/Hz curve based on load conditions that will minimize power used.  
5.0.2 Drive output voltage shall vary with frequency to maintain a constant V/Hz ratio up to base speed (60Hz) output. Constant or linear voltage output shall be supplied at frequencies greater than base speed (60Hz).  
5.0.3 The output voltage of the Drive will be capable of 0-100% of the input voltage applied at the input voltage terminals.  
5.0.4 Ramp times shall be programmable from 1-3,600 seconds.  
5.0.5 The output voltage may be switched on and off an unlimited amount of times.  
5.0.6 The Drive shall be capable of a minimum of 100% rated current in continuous operation in accordance with the requirements of NEC Table 430-150.  
5.0.7 The Drive shall be capable of 110% overload current rating for one (1) minute.

## 6.0 Drive Keypad

- 6.0.1 The Drive shall be supplied with a backlit 6 line alphanumeric Liquid Crystal Display (LCD) Multi-Function Keypad. The Keypad shall be capable of programming, monitoring, and controlling the Drive.
- 6.0.2 Keypad is divided into 4 functional groups
  - 6.0.2.1 Graphical display with status lines
  - 6.0.2.2 Menu keys and LEDs – for selecting mode, changing parameters and switching between display functions
  - 6.0.2.3 Navigation keys and LEDs
  - 6.0.2.4 Operation keys and LEDs
- 6.0.3 The Drive shall have a *Quick Menu feature*, that allows for quick access to the most commonly modified Drive Parameters for quick and easy setup.
- 6.0.4 The Drive shall be capable of being operated in “hand” mode via the keypad to allow for local control of the motor at the Drive.
- 6.0.5 The Drive Keypad shall have three (3) Indication LED’s as follows:
  - 6.0.5.1 Green – The Drive is “on”
  - 6.0.5.2 Yellow – The Drive has an alarm “warning”
  - 6.0.5.3 Flashing Red – The Drive has an “alarm”
- 6.0.6 The Drive shall display operating data, fault information, and programming parameters in English with other languages- French, Mandarin Chinese & Spanish available by parameter setting.
- 6.0.7 The Drive LCD Keypad shall be remote mountable by using an option kit which will allow for mounting the LCD Keypad up to 10feet from the Drive.
- 6.0.8 The Drive LCD Keypad shall be capable of copying the parameter set from one VFD to another at different HP ratings
- 6.0.9 *The info key provides detailed information on the drive when needed and eliminates the need for a hard copy manual*
- 6.0.10 The Drive Keypad is hot pluggable and can be removed & connected under power. No tools are required to plug out and plug in the Keypad.
- 6.0.11 Keypad shall have an Alarm Log, which shows the last 5 alarms and provides detailed information on drive operating conditions at the time of alarm occurrence.
- 6.0.12 The LCD Keypad display can be adjusted for brightness
- 6.0.13 LCD Keypad shall have Password protection to drive parameters. User can define either full access, read only access or no access
- 6.0.14 The drive is capable of tracking parameter changes from the keypad

## 7.0 Drive Features

- 7.0.1 The Drive shall be capable of remote mounting with simple wiring connections or via an RS-485 serial communications port.
- 7.0.2 Upon a fault condition, the Drive shall display drive parameters captured at the time the fault occurred to aid in trouble-shooting of the fault. The Drive will store the last ten (10) fault trips in a Fault Log Parameter.
- 7.0.3 The Drive shall operate as an open-loop system requiring no motor feedback device.
- 7.0.4 The Drive shall accept and follow a selectable external frequency reference of 0-10Vdc, 0-20ma, or 4-20mA.
- 7.0.5 The Drive will also follow an internal frequency set point off the up and down arrows on the LCD Keypad, parameter preset speeds, or serial communications speed set-point via RS-485.
- 7.0.6 The Drive shall maintain the output frequency to within 0.2% of reference when the reference is analog, and to within 0.01% of reference when the reference is digital (keypad, contact closure, or serial communications)
- 7.0.7 The Drive shall maintain set-point frequency regardless of load fluctuations.

- 7.0.8 The Drive shall be able to operate in three (3) modes: Hand, Off, or Auto.
- 7.0.9 The Drive shall be password protected to protect against unintended change of sensitive parameters.
- 7.0.10 The Drive shall have the capability of determining motor characteristics to optimize its operation through the use of pre-programmed motor data information or auto-tuning operation where the Drive can determine the motor characteristics automatically.
- 7.0.11 The Drive shall have an Electronic Thermal Overload that will protect the Motor from over-heating without the use of a motor thermistor. The motor temperature is calculated based of frequency, speed, and time by the Electronic Thermal Overload.
- 7.0.12 The Drive shall be capable of alarming on low or high motor current.
- 7.0.13 The Drive shall have a selectable Automatic Torque Boost function that will adjust motor torque based on the operating load conditions.
- 7.0.14 All Drive Operating Function Codes shall be stored in non-volatile (EEPROM) memory. The Drive will have a default set of factory function code settings that can be reset via parameter setting.
- 7.0.15 The Drive shall be capable of selecting the switching frequency via parameter setting from 1, 1.5,2.0,2.5, 3.0, 3.5, 4,5, 6,7, 8, 10,12,14 or 16 kHz.
- 7.0.16 The Drive shall be able to operate with its output disconnected for trouble-shooting and start-up.
- 7.0.17 The Drive shall have a built-in A2 RFI Filter that reduces radio frequency interference generated by the Drive/Motor System with the factory option of an A1/B1 RFI Filter
- 7.0.18 The Drive shall have IGBT soft-switching transistors and low-noise control power supply system to reduce the reflected electrical noise from the Drive.
- 7.0.19 The Drive shall have a built-in Logic Controller (LC) which includes timers, counters, comparators, logic rules, and states to process a sequence of user defined actions executed by the LC when the associated user defined event is set to *true*. The logic controller is a sequence controller capable of 20 program states.
- 7.0.20 The Drive shall have 4 built-in Auto Tune Process PID Controllers for closed-loop process control. The 4 PID Controllers shall control the proportional, integral and derivative variables of process related variables.
- 7.0.21 The Drive shall have the ability to operate in a sensor-less dynamic torque vector control mode for applications that require improved motor speed control and operating characteristics.
- 7.0.22 The Drive shall have the capability to catch a Spinning Motor (Flying Start) for fan applications. Parameter setting enables this function.
- 7.0.23 The drive shall have a realtime clock
- 7.0.24 Drive Control Card & Options can be powered by an external 24V power supply in the absence of 3 phase AC power.
- 7.0.25 *Interface to a PC will be via RS485 or USB port*
- 7.0.26 Drive shall have built-in communications to support Modbus RTU, Metasys N2 and Apogee FLN P1 as standard with option modules available for Profibus DP, DeviceNet, LonWorks, Ethernet IP and BACNet.
- 7.0.27 The drive should be capable of calculating the energy consumption & savings
- 7.0.28 The drive shall have a “ Fire Mode” of operation, which keeps the drive running regardless of the normal drive protective features.
- 7.0.29 The drive can be programmed to switch to an automatic bypass under certain conditions
- 7.0.30 The drive should be capable of programming 20 preventive maintenance events & displaying the last 10 preventive maintenance logs
- 7.0.31 The drive should be able to go into Sleep mode by monitoring load conditions
- 7.0.32 The drive should be capable of detecting a broken belt
- 7.0.33 Drive should be capable of 10 Timed Actions
- 7.0.34 Drive should have a pump cascade controller for sequential control of up to 4 pumps.
- 7.0.35 Drive should be capable of being Auto Tuned to optimize dynamic motor performance
- 7.0.36 Drive should be capable of Automatic Energy Savings to reduce energy consumption
- 7.0.37 Drive Cooling Fan should be field replaceable without needing to remove the field wiring & other drive components.

- 7.0.38 Drive should be capable of trending critical drive parameters on keypad
- 7.0.39 Dry Pump Protection and End of Curve to protect against low pressure, dry pumps, or pipe leaks. Drive shall set off an alarm, shut off pump, or other programmed action.

## 8.0 Drive Speed Control

- 8.0.3 The Drive shall be capable of at least two (2) different acceleration and deceleration ramp rates. Each ramp rate shall be independently adjustable from 1 to 3,600 seconds.
- 8.0.4 The Drive shall be capable of selecting between Linear and S-Ramp type ramp rate curves via parameter selection.
- 8.0.5 The Drive shall be capable of eight (8) independently programmable Preset Frequencies, selectable by programming three (3) digital inputs.
- 8.0.6 The Drive shall be capable of four (4) Skip Frequencies via parameter settings that enables the Drive to by-pass frequencies that cause mechanical resonance in the system.
- 8.0.7 The Drive shall have a programmable Start Delay function, adjustable from 0.0-120.0 seconds. The motor start will be delayed by the amount of time selected.
- 8.0.8 The Drive shall be capable of output frequency from 0.0 – 1000Hz.
- 8.0.9 The Drive shall provide selectable motor slip compensation that will sense output current and adjust output frequency to improve motor speed fluctuations.

## 9.0 Drive I/O Control

- 9.0.1 The Drive shall accept 4/6 digital inputs (0-24Vdc@ 4kΩ), sink or source selectable, for the following functions:
  - 9.0.1.1 No Operation – The Drive will not react to signals at this terminal
  - 9.0.1.2 Reset – Reset the Drive after a trip/alarm. Not all alarms can be reset
  - 9.0.1.3 Coast Inverse – Coasting stop, inverted input (n/c)
  - 9.0.1.4 Coast and Reset Inverse – Coasting stop, inverted input (n/c) with reset
  - 9.0.1.5 DC-Brake Inverse – Inverted input for DC Braking (n/c)
  - 9.0.1.6 Stop Inverse – Generates stop function when terminal goes from 1 to 0
  - 9.0.1.7 External interlock – Used to generate an external fault alarm on display
  - 9.0.1.8 Start – Selects start for a start/stop command
  - 9.0.1.9 Latched Start – Motor starts if a pulse is applied for 2ms
  - 9.0.1.10 Reversing – Change direction of motor shaft direction
  - 9.0.1.11 Start Reversing – Use for stop/start and for reversing at the same time
  - 9.0.1.12 Jog – Use for activating Jog Speed
  - 9.0.1.13 Preset reference on – Use for shifting between an external reference and a preset reference
  - 9.0.1.14 Preset Ref Bit 0 – Enables a choice between one of eight preset speeds
  - 9.0.1.15 Preset Ref Bit 1 – Enables a choice between one of eight preset speeds
  - 9.0.1.16 Preset Ref Bit 2 – Enables a choice between one of eight preset speeds
  - 9.0.1.17 Freeze Reference – Freezes actual speed reference for up/down functions
  - 9.0.1.18 Freeze Output – Freezes the actual motor frequency (Hz)
  - 9.0.1.19 Speed Up – Speeds up the digital control of the Speed Potentiometer
  - 9.0.1.20 Slow – Slows down the digital control of the Speed Potentiometer
  - 9.0.1.21 Setup Select bit 0 – Used to select one of the four setups
  - 9.0.1.22 Setup Select bit 1 - Same as setup select bit 0
  - 9.0.1.23 Pulse Input – Selects a pulse input when using a pulse sequence for control
  - 9.0.1.24 Ramp Bit 0 – Use with Ramp Bit 1 to select one of four ramps
  - 9.0.1.25 Ramp Bit 1 – Used with Ramp Bit 0
  - 9.0.1.26 Line failure inverse – Select to activate Line Failure
  - 9.0.1.27 Run Permissive – Use this as a logic AND with START, JOG or Freeze output

- 9.0.1.28 Hand Start – Used to put the VFD in Hand Mode
  - 9.0.1.29 Auto Start – Used to put the VFD into AUTO Mode
  - 9.0.1.30 DigiPot increase – Use the input as an increase signal of the digital pot
  - 9.0.1.31 DigiPot decrease – Use the input as an decrease signal to the digital pot
  - 9.0.1.32 DigiPot clear – Use the input to CLEAR the digital pot reference
  - 9.0.1.33 Counter A (up) – Input for Counter A increasing
  - 9.0.1.34 Counter A (down) – Input for Counter A decreasing
  - 9.0.1.35 Reset Counter A – Input for reset of Counter A
  - 9.0.1.36 Counter B (up) - Input for Counter B increasing
  - 9.0.1.37 Counter B (down) – Input for Counter B decreasing
  - 9.0.1.38 Counter B Reset – Input for reset of Counter B
  - 9.0.1.39 Sleep Mode – Forces the VFD into Sleep Mode
  - 9.0.1.40 Reset Maintenance Word – Resets all data in Preventative Maintenance Word to zero
  - 9.0.1.41 Lead Pump Start – Start / Stops the lead pump
  - 9.0.1.42 Lead Pump Alternation – Forces the alternation of the lead pump in a cascade controller
  - 9.0.1.43 Pump 1 Interlock – Used for Pump interlocks
  - 9.0.1.44 Pump 2 Interlock – Used for Pump interlocks
  - 9.0.1.45 Pump 3 Interlock – Used for Pump interlocks
- 9.0.2 The Drive shall provide two digital outputs programmed for the following functions:
- 9.0.2.1 No Operation – Default for all digital and relay outputs
  - 9.0.2.2 Control Ready – Control board receiving supply voltage
  - 9.0.2.3 Drive Ready – Drive is ready for operation; supply signal on control board
  - 9.0.2.4 Drive Ready, Remote – Drive is ready for operation in Auto Mode
  - 9.0.2.5 Stand By – Drive is ready for operation; no warnings present
  - 9.0.2.6 Drive Running – Motor is running
  - 9.0.2.7 Running/No Warning – Motor is running; no warnings present
  - 9.0.2.8 Run On Ref – Motor is running at reference speed
  - 9.0.2.9 Alarm – An alarm is present on the Drive
  - 9.0.2.10 Alarm on Warning – An alarm or warning is present on the Drive
  - 9.0.2.11 At Torque Limit – Torque limit has been exceeded
  - 9.0.2.12 Out of Current Range – Motor current is outside range of parameter settings
  - 9.0.2.13 Below Current, Low – Motor current is below parameter settings
  - 9.0.2.14 Above Current, High – Motor current is above parameter settings
  - 9.0.2.15 Out of speed range – Output speed is outside parameter settings
  - 9.0.2.16 Below speed – Output speed is lower than parameter settings
  - 9.0.2.17 Above speed – Output speed is higher than parameter settings
  - 9.0.2.18 Out of feedback range – The feedback is outside the parameter settings
  - 9.0.2.19 Below feedback – The feedback is below the parameter setting
  - 9.0.2.20 Above feedback – The feedback is above the parameter setting
  - 9.0.2.21 Thermal Warning – High temperature in motor, drive, or brake
  - 9.0.2.22 Reverse - Motor running in reverse in regards to configuration
  - 9.0.2.23 Bus OK – Serial Communication Link (RS-485) OK; no time-out present
  - 9.0.2.24 Torque Limit & Stop – Coasting stop in torque limit condition
  - 9.0.2.25 Brake, No Warning – Brake is active; no warnings present
  - 9.0.2.26 Brake Ready/No Fault – Brake is ready for operation; no fault present
  - 9.0.2.27 Brake Fault (IGBT) – Protects Drive if brake fault is present; removes voltage
  - 9.0.2.28 External interlock – Ext interlock function is activated via one of the DI's
  - 9.0.2.29 Out of Ref range –
  - 9.0.2.30 Below Reference –
  - 9.0.2.31 Above Reference –
  - 9.0.2.32 Bus Control –

- 9.0.2.33 Bus Control 1 if timeout –
- 9.0.2.34 Bus Control 0 if timeout –
- 9.0.2.35 Pulse Output –
- 9.0.2.36 Comparator 0 – If Comparator 0 = TRUE; output goes “high”
- 9.0.2.37 Comparator 1 – If Comparator 1 = TRUE; output goes “high”
- 9.0.2.38 Comparator 2 – If Comparator 2 = TRUE; output goes “high”
- 9.0.2.39 Comparator 3 – If Comparator 3 = TRUE; output goes “high”
- 9.0.2.40 Comparator 4 – If Comparator 4 = TRUE; output goes “high”
- 9.0.2.41 Comparator 5 – If Comparator 5 = TRUE; output goes “high”
- 9.0.2.42 Logic Rule 0 – If Logic Rule 0 = TRUE; output goes “high”
- 9.0.2.43 Logic Rule 1 – If Logic Rule 1 = TRUE; output goes “high”
- 9.0.2.44 Logic Rule 2 – If Logic Rule 2 = TRUE; output goes “high”
- 9.0.2.45 Logic Rule 3 – If Logic Rule 3 = TRUE; output goes “high”
- 9.0.2.46 Logic Rule 4 – If Logic Rule 4 = TRUE; output goes “high”
- 9.0.2.47 Logic Rule 5 – If Logic Rule 5 = TRUE; output goes “high”
- 9.0.2.48 LC Digital Output A – Status of Logic Controller Set Relay
- 9.0.2.49 LC Digital Output B – Status of Logic Controller Set Relay
- 9.0.2.50 LC Digital Output C – Status of Logic Controller Set Relay
- 9.0.2.51 LC Digital Output D – Status of Logic Controller Set Relay
- 9.0.2.52 LC Digital Output E – Status of Logic Controller Set Relay
- 9.0.2.53 LC Digital Output F – Status of Logic Controller Set Relay
- 9.0.2.54 No Alarm – No alarms present on Drive
- 9.0.2.55 Running Reverse – Motor is running in reverse
- 9.0.2.56 Local Reference Active – Drive is being controlled by local controls
- 9.0.2.57 Remote Reference Active – Drive is being controlled by remote speed control
- 9.0.2.58 Start Command Active – A start command is present on the Drive
- 9.0.2.59 Drive in Hand Mode – Drive is being controlled by keypad controls
- 9.0.2.60 Drive in Auto Mode – Drive is being controlled by remote controls
- 9.0.2.61 Clock Fault – Clock has been reset to default at power failure
- 9.0.2.62 Preventive Maintenance – One or more events programmed
- 9.0.2.63 No Flow – A no flow or minimum speed detected
- 9.0.2.64 Dry Pump – A dry pump condition has been detected
- 9.0.2.65 Sleep Mode – VFD has entered into sleep mode
- 9.0.2.66 Broken Belt – A broken belt condition detected
- 9.0.2.67 Bypass Valve Control – Used in compressor systems
- 9.0.2.68 Fire Mode – VFD is operating in Fire Mode
- 9.0.2.69 Fire Mode was active – VFD was in Fire Mode
- 9.0.2.70 Drive Bypass – Activates external bypass
- 9.0.2.71 Full capacity – All pumps running at full speed
- 9.0.2.72 Pump 1 Running – Pump 1 is running
- 9.0.2.73 Pump 2 Running – Pump 2 is running
- 9.0.2.74 Pump 3 Running – Pump 3 is running

9.0.3 The Drive shall accept two (2) analog input reference signals as follows:

- 9.0.3.1.1 0-10Vdc @10kΩ, maximum voltage - 20Vdc
- 9.0.3.1.2 0/4-20mA @ 200Ω, maximum current - 30mA

9.0.4 The Drive shall output one (1) analog output signal as follows:

- 9.0.4.1.1 0/4-20mA @ 500Ω; max error – 0.8%; 8 bit resolution

9.0.5 The Drive shall communicate via a RS485 Serial Communication Link

- 9.0.5.1.1 Protocol: Modbus RTU
- 9.0.5.1.2 Address: 1-247



- 9.0.5.1.3 Baud Rate: 2400, 4800, 9600, 19200, 38400, 57600, 76800, or 115200
  - 9.0.5.1.4 Parity: No or Odd
  - 9.0.5.1.5 Stop Bits: 1 or 2
  - 9.0.5.1.6 Minimum Response Delay: 1-500ms
  - 9.0.5.1.7 Maximum Response Delay: .01-10s
- 9.1 The Drive shall communicate via a RS485 Serial Communication Link
- 9.1.1.1.1 Protocol: Metasys N2
  - 9.1.1.1.2 Address: 1-247
  - 9.1.1.1.3 Baud Rate: 2400, 4800, 9600, 19200, 38400, 57600, 76800, or 115200
  - 9.1.1.1.4 Parity: No or Odd
  - 9.1.1.1.5 Stop Bits: 1 or 2
  - 9.1.1.1.6 Minimum Response Delay: 1-500ms
  - 9.1.1.1.7 Maximum Response Delay: .01-10s
- 9.1.2 The Drive shall communicate via a RS484 Serial Communication Link
- 9.1.2.1.1 Protocol: Apogee P1
  - 9.1.2.1.2 Address: 1-247
  - 9.1.2.1.3 Baud Rate: 2400, 4800, 9600, 19200, 38400, 57600, 76800, or 115200
  - 9.1.2.1.4 Parity: No or Odd
  - 9.1.2.1.5 Stop Bits: 1 or 2
  - 9.1.2.1.6 Minimum Response Delay: 1-500ms
  - 9.1.2.1.7 Maximum Response Delay: .01-10s

## 10.0 Drive Protective and Diagnostic Features

10.0.1 The drive shall be capable of selecting warnings & alarms through parameterization. A warning or an alarm is signaled by the relevant LED on the front of the adjustable frequency drive, indicated by a code on the display. A warning remains active until its cause is no longer present and under certain circumstances, operation of the motor may be continued. In the event of an alarm, the drive will have tripped. Alarms must be reset to restart operation once their cause has been rectified. The drive shall offer the following warning/alarm list:

- 10.0.1.1 Warning 1- 10V low
- 10.0.1.2 Warning / Alarm 2 - Live zero error
- 10.0.1.3 Warning / Alarm 3 – No motor
- 10.0.1.4 Warning / Alarm 4 – Line phase loss
- 10.0.1.5 Warning 5 – DC Link voltage high
- 10.0.1.6 Warning 6 – DC link voltage low
- 10.0.1.7 Warning / Alarm 7-DC over voltage
- 10.0.1.8 Warning / Alarm 8 – DC undervoltage
- 10.0.1.9 Warning / Alarm 9 – Inverter overload
- 10.0.1.10 Warning / Alarm 10- Motor Electronic Overload over temperature
- 10.0.1.11 Warning / Alarm 11- Motor thermistor overtemp
- 10.0.1.12 Warning / Alarm 12 – Torque limit
- 10.0.1.13 Warning / Alarm 13 – Overcurrent
- 10.0.1.14 Alarm 14 – Ground Fault
- 10.0.1.15 Alarm 15 – Incomplete hardware
- 10.0.1.16 Alarm 16 – Short circuit
- 10.0.1.17 Warning / Alarm 17 – Control word timeout
- 10.0.1.18 Warning 25 – Brake resistor short circuited
- 10.0.1.19 Alarm / Warning 26 – Brake resistor power limit

10.0.1.20	Warning 27 – Brake chopper fault
10.0.1.21	Alarm / Warning 28 – Brake check failed
10.0.1.22	Alarm 29 – VFD over temperature
10.0.1.23	Alarm 30 – Motor phase U missing
10.0.1.24	Alarm 31- Motor phase V missing
10.0.1.25	Alarm 32 – Motor phase W missing
10.0.1.26	Alarm 33 – Soft charge fault
10.0.1.27	Warning / Alarm 34 – Serial com bus fault
10.0.1.28	Warning 35 – Out of frequency range
10.0.1.29	Alarm 38 – Internal fault
10.0.1.30	Warning 47 – 24V supply low
10.0.1.31	Warning 40 – 1.8V supply low
10.0.1.32	Alarm 50 – AUTO TUNE calibration failed
10.0.1.33	Alarm 51 – AUTO TUNE check Unom & Inom
10.0.1.34	Alarm 52 – AUTO TUNE low Inom
10.0.1.35	Alarm 53 – AUTO TUNE motor too big
10.0.1.36	Alarm 54 – AUTO TUNE motor too small
10.0.1.37	Alarm 55 – AUTO TUNE par. Out of range
10.0.1.38	Alarm 56 – AUTO TUNE interrupted by user
10.0.1.39	Alarm 57 – AUTO TUNE timeout
10.0.1.40	Alarm 58 – AUTO TUNE internal fault
10.0.1.41	Warning 59 – Current limit
10.0.1.42	Warning 62 – Output frequency at max limit
10.0.1.43	Warning 64 – Voltage limit
10.0.1.44	Warning/Alarm/Trip 65 – Control Card overtemp
10.0.1.45	Warning 66 – Heatsink temperature low
10.0.1.46	Alarm 67 – Option configuration has changed
10.0.1.47	Alarm 68 – Safe Stop activated
10.0.1.48	Alarm 70 – Illegal frequency configuration
10.0.1.49	Alarm 80 – Drive Reset to Factory Settings

## 11.0 Quality Assurance

- 11.0.1 All Drives shall be 100% Factory Tested to ensure proper performance upon delivery.
- 11.0.2 The Drive Vendor shall provide a Warranty for material and workmanship for a period of twelve (12) months from date of commissioning or eighteen (18) months after shipment, whichever occurs first.

## 12.0 Start-Up and Service Training

- 12.0.1 Drive operational and maintenance Training and/or Start-Up Service shall be offered by GE separately. GE shall have Factory Trained personnel at Field locations convenient to the installation site, available for Trouble-Shooting and/or Start-Up assistance. GE also offers CD based & web based training.

## 13.0 Documentation

- 13.0.1 An Instruction Manual complete with wiring diagrams, schematics, operating and maintenance instructions, and parameter descriptions shall be provided with the Drive at the time of shipment.
- 13.0.2 Programming & Design Guides can be downloaded from the GE website

## **14.0 Options and Spare Parts**

14.0.1 Drive Option Kits and Spare Parts shall be available locally through local stocking Distributors or from GE directly.

## **15.0 PC Software**

15.0.1 PC based software shall be available to startup & commission the drive and can be used for:

- 15.0.1.1 Setting of the frequency converter parameters
- 15.0.1.2 Copying of parameter sets to and from a frequency converter
- 15.0.1.3 Documentation/print-out of set-up
- 15.0.1.4 Servicing and fault analysis