

PowerFlex 700H Sample Specification

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GENERAL

REFERENCES

The drive is designed to meet the following specifications:

- NFPA 70 - US National Electrical Code
- NEMA ICS 3.1 - Safety standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
- NEMA 250 - Enclosures for Electrical Equipment
- UL 508C - Underwriter's Laboratory
- CAN/CSA-C22 No. 14-M91. - Canadian Standards Association.
- IEC 146 - International Electrical Code.

REGULATORY REQUIREMENTS

The drive conforms to the following requirements:

- NFPA 70
 - IEC 146
 - C-UL marking to provide an approved listing for Canadian users.
 - UL listing
- Manufacturer will furnish the product as listed and classified by Underwriter's Laboratories as suitable for the purpose specified and indicated.
- EN Standard/CE marked for the following directives:

Low Voltage Directive (73/23/EEC)

EN50178 Electronic Equipment for use in power installations

EMC Directive (89/336/EEC)

EN61800-3 Adjustable Speed electrical power drive systems Part 3.

The drive has an internal EMC filter capable of meeting the Second Environment levels for the EMC directive without the need for additional components. First environment classification requires an additional, external filter.

QUALIFICATIONS

MANUFACTURER:

Allen-Bradley entered the AC Variable speed drive market in 1980. Rockwell Automation / Allen-Bradley Standard Drives Business continues to specialize in the design and manufacturing of PWM Adjustable Frequency Drives.

SUPPORT:

Rockwell Automation maintains factory trained and authorized service facilities within 100 miles of the project and has a demonstrated record of service for at least the previous three years. Rockwell Automation employs full-time support personnel.

CERTIFICATION:

All Allen-Bradley drive manufacturing locations are certified to the ISO-9001 Series of Quality Standards as well as the ISO-14001 Environmental Standards. This insures all quality and corrective action procedures are documented and implemented with a goal of Total Customer Satisfaction.

PRODUCT

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RATINGS

INPUT POWER:

The drive is available in two ranges and is self-adjustable to accept an input voltage range between;

380-500 V AC, three phase +/-10%.

525-690 V AC, three phase +/-10%.

Displacement power factor 0.98, lagging, over the entire speed range. The efficiency of the drive is a minimum of 97.5% at full load and speed.

The drive can be supplied as 6 , 12 or 18 pulse in configured packages.

ENVIRONMENT:

Storage ambient temperature range: -40° C to 60° C (-40° to 140°F).

Operating ambient temperature range without derating:

IP21 / Type 1 0° C to 40° C (0° to 104° F).

The relative humidity range is 5% to 95% non-condensing.

Operating elevation: up to 1000 Meters (3,300ft) without derating.

Shock: 15G peak for 11ms duration

Vibration: 2.0 mm (0.0787 inches) displacement, 1G peak, EN50178 / EN60068-2-6

OUTPUT POWER:

The output voltage is adjustable from 0 to rated motor voltage (400 V, 460 V, 575 V or 690 V). The output frequency range is adjustable from 0 to 320Hz. The inverter section will produce a pulse width modulated (PWM) waveform using latest generation IGBTs.

DESIGN

HARDWARE:

The drive hardware employs the following power components

- Diode or fully gated bridge on the input.
- AC line reactor on input for all ratings.
- Switching logic power supply operating from the DC bus.
- MOV protection available on Frame 9 only - phase to phase and phase to ground with ability to remove the phase to ground unit when applicable.
- Common Mode Capacitors available on all units. For use on ungrounded systems Frame 9 is orderable without and Frame 10 and higher removable by jumper.
- Gold plated plug-in connections on printed circuit boards.
- Microprocessor based inverter logic isolated from power circuits.
- Latest generation IGBT inverter section.
- Customer Interface common for all horsepower ratings. LCD digital display standard with choices for programming keypad and operator keys options.
- The Main Control Board is the same for all ratings to optimize spare parts stocking and exchange.
- Common control connection for all ratings.
- Optimized for 2kHz carrier frequency.
- Device Peripheral Interface (DPI) for connection to common options.
- Power LED viewable through the control box cover.
- Status LEDs for communications status, including embedded DPI status, adapter health and communications network status, viewable at HIM mounting plate.

CONTROL LOGIC:

The drive is programmable or self-adjusting for the following:

- Operating the drive with motor disconnected.
- Controlled shut down, when properly fused, with no component failure in the event of an output phase to phase or phase to ground short circuit and annunciation of the fault condition.
- Adjustable PWM carrier frequency within a range of 1-6 kHz.
- Selectable Sensorless Vector or V/Hz mode.
- Suitable for use on both Normal Duty and Heavy Duty loads.
Normal Duty ratings are
 - Rated Current continuously
 - 110% Overload capability for up to 1 minute
 - 150% Overload capability for up to 2 secondsHeavy Duty ratings are
 - Rated Current continuously
 - 150% Overload capability for up to 1 minute
 - 200% Overload capability for up to 2 seconds
- Multiple programmable stop modes including - Ramp, Coast, DC-Brake, Ramp-to-Hold and S-curve.
- Multiple acceleration and deceleration rates.
- All adjustments to be made with the door closed.
- Adjustable output frequency up to 320Hz.

TERMINAL BLOCKS:

Separate terminal blocks are provided for control and power wiring. Power terminal blocks are rated a minimum of 90 °C and marked for both inputs and outputs (L1, L2, L3 and U/T1, V/T2, W/T3)

POWER CONDITIONING:

The drive is designed to operate on an AC supply source that may contain line notching and up to 10% harmonic distortion. An input isolation transformer is not required for protection from normal line transients. If line conditions dictate the use of a transformer, the K factor should be 4.0 or less.

OPERATOR INTERFACE:

Interface to the drive is provided via a removable Human Interface Module (HIM) with integral display. This unit is a 7 line by 21-character backlit LCD display with graphics capability. It is used to display drive operating conditions, fault / alarm indications and programming information with full text support in multiple languages, including but not limited to English, German, French, Italian, Spanish, Portuguese and Dutch.

The display can be configured to display in three distinct sections.

1. The first section is a status display indicating direction, status, fault / alarm conditions and Auto / Manual mode.
2. The second section displays drive output frequency.
3. The third section can be configured to display either programming menus and information or a 2-line user display for simultaneously displaying two additional values using customized multi-lingual text and user scaled units. This section is also configurable as a "screen saver" with programmable timeout. When time expires, the LCD display automatically reverts to this display.

The LCD version is available in two styles:

- An IP20 / Type 1 drive mounted version that can also be used as a handheld terminal by connecting via a separate cable. This version will be offered in either digital (up/down keys) or analog (potentiometer) speed control.
- An IP66 / UL Type 4X,12 remote mounted version for cabinet / panel mounting that is connected via cable. This version is digital speed control only.

The keypads for these include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), numeric keys for direct entry and an ALT (alternate function) key to allow some of the more common drive programming or operating

functions to be accessed directly without knowledge of programming structure. These ALT functions include S.M.A.R.T. Start for fast and easy commissioning, View selection, Auto Manual operation, HIM removal under power, and device selection for programming.

HARD-WIRED I/O:

Hardwired I/O is provided via separate I/O cards that mount in the Control Enclosure and plug into the Main Control Board. A variety of I/O boards provide varying voltage and functionality to meet a wide range of applications.

Standard I/O Card Sets

The Standard I/O card set consists of both digital and analog I/O. It is available in two versions; one for 115 VAC digital I/O and one for 24V AC/DC digital I/O. Both board sets contain the following I/O points:

Analog I/O

- (2) differentially isolated $\pm 10V$ (bi-polar) / 20mA analog inputs , 9 bit plus sign, 160V common mode noise rejection
Both Inputs are user programmable for a variety of uses including frequency command, process loop inputs and others. Inputs are programmable for function, scaling (including invert), offset, signal loss detect and square root.
- (2) differentially isolated bipolar $\pm 10V$ (bi-polar) / 20 mA analog output, 9 bit plus sign. It is user programmable to be proportional to one of 15 process parameters including output frequency, output current, encoder feedback, output power and others. Programming is available to select either absolute or signed values of these parameters.

Jumpers and parameter settings are required to configure the analog I/O. All functions are fully programmable.

Digital I/O

- (6) digital inputs 24V AC/DC or 115 VAC
inputs are configurable as sink or source. All inputs are individually programmable for functions from a list of 31 that include Start (3-wire control), Run (2-wire control), Stop, External fault, Speed select, Jog, Process PI functions and others. 24 V Inputs draw 11.2 mA each and require a 20 V minimum for "ON" state and a maximum of 5 V for "OFF" state. 115V inputs draw 5 mA each and require a 100 V minimum for "ON" state and a maximum of 30 V for "OFF" state.
- (3) relay outputs (1-form C, 1-form B, 1-Form A)
Contact output ratings are 250V AC/ 30V DC, 2.0 Amp Maximum, resistive or inductive and require 10mA minimum clearing current,. Both relays are programmable to 28 different conditions including Fault, Alarm, At Speed, Drive Ready, PI Excess Error and others. Also available are timers for each output that can control the amount of time, after the occurring event, that the output relay actually changes state.

Jumpers and parameter settings are required to configure the digital I/O. All functions are fully programmable.

Hardware Enable

Digital input six (6) can be configured as a programmable input, or as a hardware enable by removing a jumper on the I/O board. If configured as a hardware enable, the input must be energized for the drive to run, and is implemented completely in hardware is not processed by the microprocessor.

REFERENCE SIGNALS:

The drive is capable of the following speed reference signals:

- Digital MOP
- Jog
- HIM (Program/Control panel)
- Analog Input signals (2)
- Preset Speeds (7)
- Communication module commands

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Analog input references are independently scaleable, both from the analog input side and from the speed reference side. A bi-polar analog signal (-10V to + 10V) may also be used to control direction.

The drive has over speed protection in the event that the output frequency exceeds the maximum reference by a specified amount.

All reference signals may have a trim signal applied to them for finer resolution and accuracy. Trim source and amount is programmable.

LOSS OF REFERENCE:

The drive is capable of sensing the following reference loss conditions;

- Remote potentiometer wiper loss
- 2-10V DC signals below 1 volts (reset at 1.5 volts)
- 4-20ma signals below 2 ma (reset at 3 mA)

In the event of loss of an analog input reference signal, the drive is user programmable to the following:

- Fault the drive
- Alarm and maintain last reference
- Alarm and go to preset speed
- Alarm and go to minimum speed
- Alarm and go to maximum speed
- Alarm and maintain last output frequency

Signal loss detection is available regardless of the function of the analog input.

FEATURES

ACCELERATION/DECELERATION:

Accel/Decel settings provide separate adjustments to allow either setting to be adjusted from 0.0 seconds to 3276.7 seconds. A second set of remotely selectable Accel/Decel settings is accessible through digital inputs. Programming capability allows the user to produce acc/dec profiles with linear or "S-Curve" characteristics that provide changing accel/decel rates. S-Curve profiles are adjustable.

ADJUSTMENTS:

The digital interface is used for all set-up, operation and adjustment settings. All adjustments are stored in nonvolatile memory (EEPROM). No potentiometer adjustments are used. The drive provides EEPROM memory for factory default values and user stored drive configurations.

AUTO ECONOMIZER:

This feature automatically reduces the output voltage when the drive is operating in an idle mode (drive output current less than programmed motor FLA). The voltage is reduced to minimize flux current in a lightly loaded motor thus reducing kW usage. If the load increases, the drive will automatically return to normal operation.

AUTO / MANUAL MODE:

The HIM can utilize the ALT function key to transfer the drive from Automatic mode to Manual mode and back.

When in Auto mode, the drive receives its frequency command from the programmed source.

When in Manual mode, control of the frequency command is transferred to the HIM speed control keys (or potentiometer).

The user has the choice of preloading the HIM with the current "auto" frequency reference before transferring control to allow for smooth transitions without speed "jumps".

AUTO RESTART:

The drive provides up to nine automatic fault reset and restarts following a fault condition before locking out and requiring manual restart. The automatic mode is not applicable to a ground fault, shorted output faults and other internal microprocessor faults. The time between restarts is adjustable from 0.5 seconds to 30.0 seconds.

BUS REGULATION:

DC Bus regulation is available to reduce the possibility of drive overvoltage trips due to regenerative conditions. The drive's reaction to a Bus voltage increase is programmable to one of 4 options.

Disabled:	faults the drive on Overvoltage Fault
Adjust Frequency :	adjusts the drive's output frequency to maintain bus voltage at a predetermined regulation level.
Dynamic Brake:	dissipates the excess energy on the bus through the internal DB chopper and connected resistor.
Both – DB 1st	begins by actuating the dynamic brake. If more response is needed, the drive will then adjust the output frequency.

Two bus regulation levels are available and are accessible through the digital inputs.

COMMUNICATIONS

DPI™ Peripheral INTERFACE

The drive has a Drive Peripheral Interface, which allows up to 4 independent peripherals to be connected to the drive at one time. This protocol operates at 500k

baud and allow for connection to other networks via third party suppliers. Connection and identification of DPI port addresses requires no user adjustments.

COMMUNICATIONS INTERFACE:

The drive has the capability for either internally mounted or externally mounted communications interface cards. Internal cards use drive power and can operate at higher speeds. Externally mounted cards are separately powered and connected to the drive via a cable. The following should be available:

DeviceNet

This option is an internally mounted interface board that provides drive connectivity to a DeviceNet network.

ControlNet

This option is an internally mounted interface board that provides drive connectivity to a ControlNet network.

Remote I/O:

This option is an internally mounted interface board that provides drive connectivity to Allen-Bradley Remote I/O.

Others

Other open control and communication network interface cards are available, including Profibus and Interbus-S.

CONTROL MODE:

Programming provides the ability to select either Sensorless Vector or V / Hz mode. The sensorless vector mode uses motor nameplate data plus motor operating data such as IR drop, nominal flux current and flux up time to tune the motor / drive for optimum torque performance. The volts per hertz mode can be programmed straight line, pre programmed fan curve or full custom patterns.

CURRENT LIMIT:

Programmable current limit from .1 amps to 150% of drive rated amps. Current limit is active for all drive states; accelerating, constant speed and decelerating. Both the source of the current limit value and the gain for responsiveness adjustment are programmable. The drive employs PI regulation with an adjustable gain for smooth transition in and out of current limit.

DYNAMIC BRAKING:

Drives may have an optional built in 7th IGBT for use as a dynamic braking chopper. This IGBT has the same current and power ratings as the output IGBTs.

The 7th IGBT will drive an externally mounted resistor "cage" and can provide maximum DB capability up to the drive's rating. Resistor protection for external cages shall reside in the cage itself.

FAULT MEMORY:

The last eight fault codes with respective times are stored in the fault buffer. In addition, information about the drive's condition at the time of the last fault such as operating frequency, output current, dc bus voltage and 28 other status conditions are stored at the time of fault. Information is maintained in the event of a power loss. A power up marker is also provided at each power up time to aid in analyzing fault data.

The last eight alarm codes are also stored, without time stamp for additional troubleshooting reference.

FLYING START:

The drive is capable of determining the speed and direction of a spinning motor and adjusts its output to "pick-up" the motor at the rotating speed.

INERTIA RIDE THROUGH:

The drive can respond to a loss of AC input power by adjusting the output frequency to create a regenerative situation in the motor. This regenerated energy recaptures the mechanical energy and converts it to electrical energy to power the drive logic during the power outage. This allows the drive to retain control of the motor during the power outage. Performance is based on the amount of system inertia and the length of the outage. The bus voltage level required to trigger inertia ride through is adjustable. Inertia Ride Through can be enabled or disabled via programming.

MEMORY STORAGE:

The drive stores the factory default settings in non-volatile memory (EEPROM) so that the user can return the drive to a known state. Additional memory storage locations in the drive, known as User Sets can also be stored in the drive's non-volatile memory. Three User Set locations are offered. The user can name the sets per the process / application and recall the configuration to active drive memory as needed.

MOTOR OVERLOAD PROTECTION:

The drive will provide Class 10 motor overload protection investigated by UL to comply with N.E.C. Article 430. Overload protection is speed sensitive and adjustable. To accommodate a variety of motors with different speed range capabilities, the frequency at which the overload begins to derate is programmable. A parameter is available to directly read the level of accumulated overload.

PROCESS PI CONTROL:

The internal process PI regulator has proportional and integral gain adjustments as well as error inversion and output clamping functions. The feedback can be configured for normal or square root functions. If the feedback indicates that the process is moving away from the setpoint, the regulator will adjust the drive output until the feedback equals the reference. Process control can be enabled or disabled with a hardwired input. Transitioning in and out of process control can be tuned for faster response by preloading the integrator. Protection is provided for a loss of feedback or reference signal. A signal can also be provided to indicate that excess error exists.

RIDE THROUGH:

The control logic is capable of "riding through" a power outage of at least 2 seconds in duration. The inverter section is shut off after an 28% drop in bus voltage to conserve power for the drive logic. The ride through method and trigger point are adjustable by the user.

SPEED REGULATION:

The programmable speed regulation modes include the following:

- Open Loop
- Slip Compensation with speed regulation from .1% to .5% depending on selected torque performance mode
- Process PI control

SKIP FREQUENCIES:

Three adjustable set points that lock out continuous operation at frequencies, which may produce mechanical resonance, are provided. The set points have a bandwidth adjustable from 0Hz to 30Hz.

START AT POWER UP:

A user programmable restart function is provided to automatically restart the equipment after restoration of power after an outage. A maintained 2-wire start input is required for this function.

START UP ROUTINES:

Start Up Routines allow the user to commission the drive more quickly and accurately. Two type of routines exist:

S.M.A.R.T. Start

Assisted Start Up

S.M.A.R.T. Start is accessible by using the “ALT” function key on the LCD HIM. This simple 2-keystroke access brings up a list of parameters needed to program the eight most commonly adjusted drive functions. They include Start, Stop, Minimum Speed, Maximum Speed, Acceleration Time, Deceleration Time, Reference source (speed command) and Electronic Overload setting for the motor. No knowledge of parameter organization or access is required. S.M.A.R.T. Start can commission the drive in just a few minutes.

Assisted Start Up (Basic) routine to aid the user in commissioning the drive asking simple Yes/No or “Enter Data” questions. The user is guided through the Start Up to reduce the amount of time necessary to get the drive “up and running”. The following are included in startup:

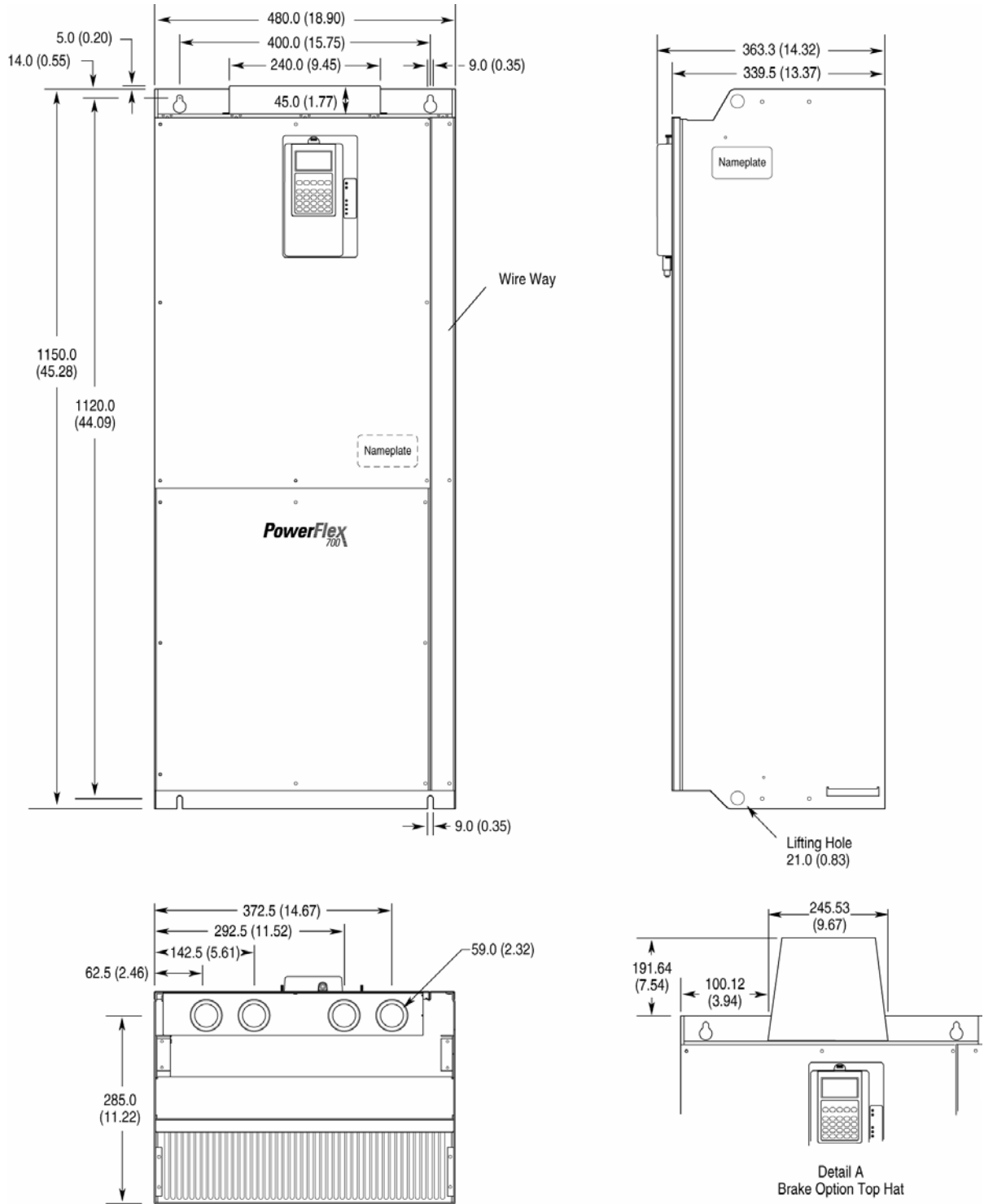
- Input Voltage Ratings
- Motor Data
- Motor Tests & Auto-tuning
- Speed & Direction Limits
- Speed Reference
- Start & Stop Modes
- Ramp setup

Auto-Tune is available independently to aid in setup of the Sensorless vector and V/Hz algorithms. Both a static (motor does not rotate) and a dynamic (motor rotates) routine are available. If tuning is not desirable, the drive can be instructed to calculate the values for tuning directly based on entered motor data.

SLEEP / WAKE MODE:

The Drive has the capability to use an analog input as a Start – Stop command. This input can be a separate input or also used as the speed reference. Signal level below the “sleep” level acts as a Stop Command and signal level above the “Wake” level acts as a Start Command. Sleep / Wake time and level are fully programmable.

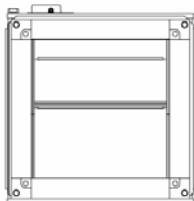
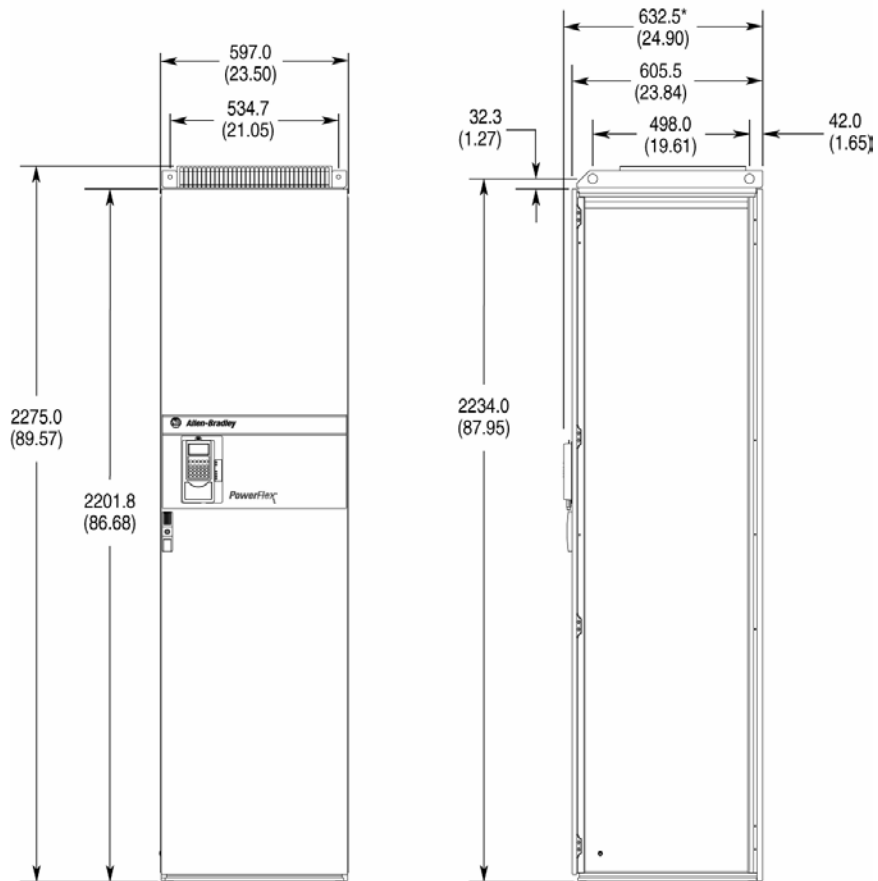
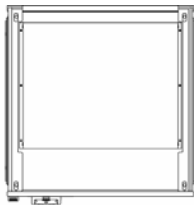
DIMENSIONS – Frame 9



Dimensions are in millimeters and (inches).

Weight kg (lbs.)		
Rating	Drive	Drive & Packaging
261A	142.9 (315.0)	176.9 (390.0)
300A	150.5 (332.5)	184.8 (407.5)

DIMENSIONS – Frame 10



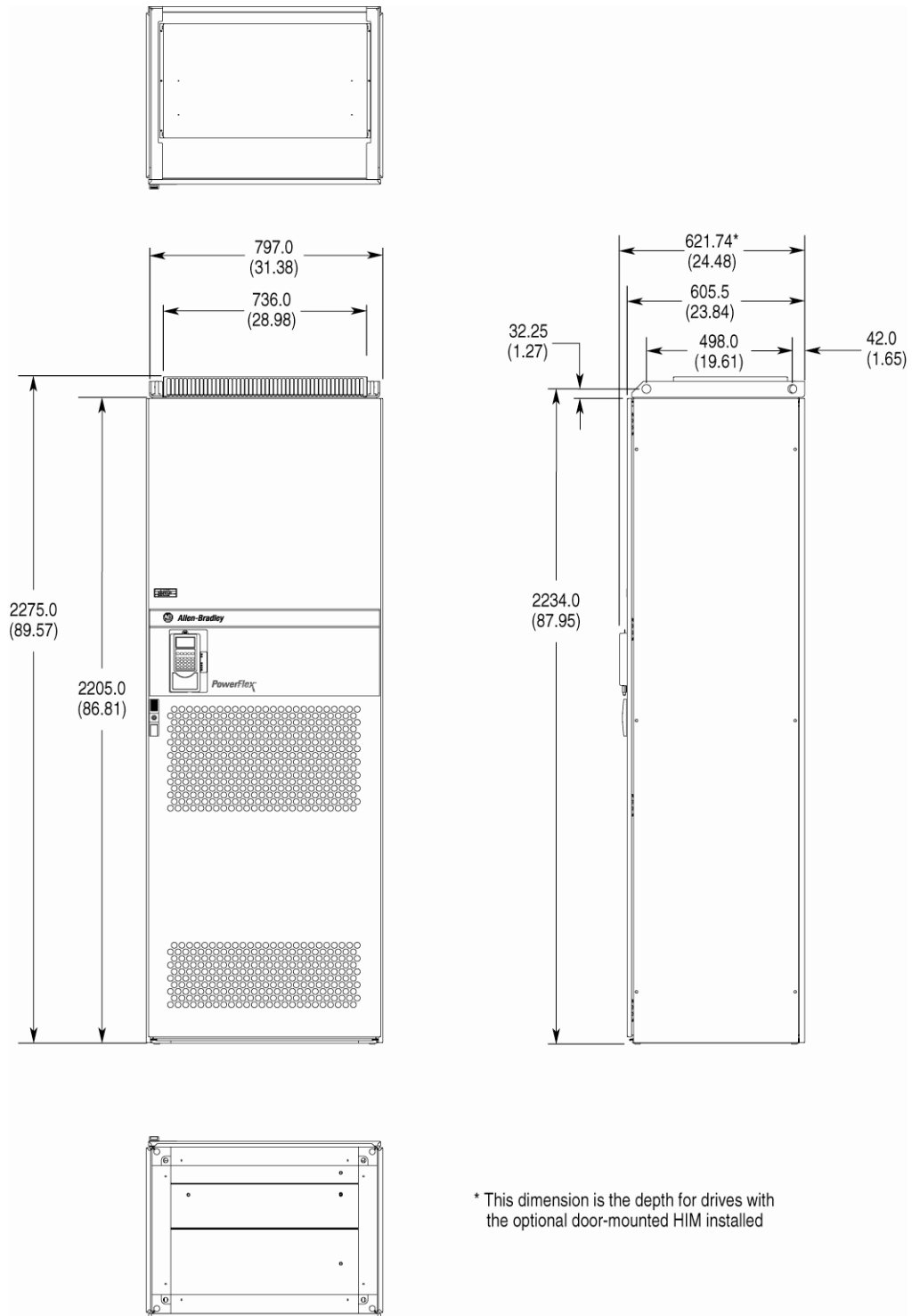
* This dimension is the depth for drives with the optional door-mounted HIM installed

Dimensions are in millimeters and (inches).

Weight kg (lbs.)	
Drive	Drive & Packaging
432 (950)	447 (985)

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DIMENSIONS – Frame 11



* This dimension is the depth for drives with the optional door-mounted HIM installed

Dimensions are in millimeters and (inches).

Weight kg (lbs.) - Drive & Enclosure	
AC Input	DC Input
614 (1350)	446 (980)