

1336 PLUS II Specifications

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
- EN Standard/CE marked for EMC directives

Emissions	Immunity
EN 50081-1	EN 50082-1
EN 50081-2	EN 50082-2
EN 55011 Class A	IEC 801-1,2,3,4,6,8
EN 55011 Class B	(per EN 50082-1,2)
- EN60204-1
- IEC 801
- EN50178
- EN61800-3
- C-UL marking to provide an approved listing for both United States and Canadian users.
- The Manufacturer will furnish the product as listed and classified by Underwriter's Laboratories as suitable for the purpose specified and indicated.

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. Full-time support personnel are employed by Rockwell Automation.

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

RATINGS

INPUT POWER:

The drive is self adjustable to accept an input voltage range between 200-240/380-480/500-600VAC, three phase +/-10%.

Displacement power factor shall range between 1.0 and 0.95, lagging, over the entire speed range (0.80 for 0.5-5hp/0.37-3.7kW, 200-480V drives). The efficiency of the drive shall be a minimum of 97% at full load and speed.

The drive can be supplied as 6 pulse or 12 pulse in a configured package.

ENVIRONMENT:

Storage ambient temperature range: -40 C to 70 C (-40 to 158 F).
Operating ambient temperature range: 0 C to 40 C (0 to 109 F) without derating. The relative humidity range is 5% to 95% non-condensing.
Operating elevation: up to 1000 Meters (3,300ft) without derating.

OUTPUT POWER:

The output voltage is adjustable from 0 to rated input voltage. The output frequency range is adjustable from 0 to 400Hz. The inverter section will produce a pulse width modulated (PWM) waveform using latest generation IGBTs.

REFLECTED WAVE

Drives less than 60 HP will have software to limit the reflected wave due to long cable lengths to a maximum of 2 time bus voltage. Larger drives will have designs to minimize reflected wave.

DESIGN

HARDWARE:

The drive hardware employs the following power components

- Diode or fully gated bridge on the input.
- DC bus inductor on all ratings 7.5HP (5.5kW) or greater.
- Switching logic power supply operating from the DC bus.
- Phase to phase and phase to ground MOV protection.
- Gold plated plug-in connections on printed circuit boards.
- Microprocessor based inverter logic isolated from power circuits.
- Latest generation IGBT inverter section.
- Inverter section shall not require commutation capacitors.
- Customer Interface common for all horsepower ratings. Interface shall include an LCD digital display, programming keypad and operator keys option.
- Two Main Control Boards
 - One common for .5 HP (.37kW) - 20 HP (15kW) and
 - One common for 15 HP (11kW) and up.
- Common control connection for all ratings.
- Optimized for 4kHz carrier frequency at 60HP (44kW) or less, and 2kHz at 75HP (55kW) and larger.
- Peripheral Interface to enable attaching common options.

CONTROL LOGIC:

The drive is programmable or self adjusting for operation under the following conditions.

- Operate 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 2-8kHz.
- Selectable Sensorless Vector or V/Hz mode.
- Selectable for variable or constant torque loads. Selection of variable torque provides 115% of rated VT current for up to one minute. Selection of constant torque provides 150% of rated CT current for up to one minute.
- 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 400Hz.

TERMINAL BLOCKS:

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

POWER CONDITIONING:

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

OPERATOR I/O

OPERATOR INTERFACE:

Interface to the drive is provided via a removable Human Interface Module (HIM) with integral display. The display is a 2 line, 16 character alphanumeric, backlit LCD used to show drive operating conditions, fault indications and programming information.

The display can also be configured for simultaneously displaying two values using customized multi-lingual text and user scaled units.

This removable Human Interface Module can store up to 2 drive configuration in EEPROM.

Two basic types of modules are available; one providing only programming information and one providing programming plus an operation keypad with Start, Stop, Speed Reference (analog pot or digital keys), direction control / indication and Jog.

Two physical packages are offered. The first is a snap-in package designed to mount on the drive's main control board. The second is a hand held version that is connected to the drive by means of cable of up to 10 meters (33ft). The hand held version is removable under power without causing a fault.

Both versions are visible and operable without opening the enclosure door.

ANALOG I/O:

Standard "on board" analog I/O consists of 3 non isolated inputs and two non isolated outputs. Up to two analog I/O option cards can be installed , replacing the standard I/O with isolation or expanded function I/O. All inputs have 12 bit resolution and all outputs have 10 bit resolution.

ANALOG OUTPUTS:

Two single ended output signals, 0 - 10V DC are available as standard. They are user programmable to be proportional to one of 13 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. A programmable offset is provided to allow modification of the analog output to obtain 2 - 10V DC.

Optionally, Up to two isolated outputs, dip switch configurable as 0-10V DC or 0-20mA, are available. These outputs offer full galvanic isolation to 195 V DC (greater than 10M ohm, less than 50 pf) to isolate the signal from drive common or earth ground. Also available is a non isolated pulse train output capable of a 5V DC pulse train at 250 KHZ maximum output rate.

Programmable gain adjustments for standard and optional outputs allow adjustment of both upper and lower settings to allow for system calibration.

ANALOG INPUTS

Three single ended (non isolated) analog inputs, jumper configurable as 0 - 10V DC, 0-20 mA or potentiometer are available as standard. They are user programmable for a variety of uses including frequency command, process loop inputs, and others.

Optionally, isolated inputs, dip switch configurable as 0-10V DC or 0-20mA are available. Also available are bipolar inputs, configurable as \pm 10V or \pm 20mA, isolated thermister input and isolated pulse train input. The bipolar inputs provide commands for both speed and direction.

Isolated inputs offer full galvanic isolation to 195 V DC (greater than 10M ohm, less than 50 pf) to isolate the signal from drive common or earth ground. Up to three isolated inputs can be supplied (two, if two outputs are required).

The pulse train input is capable of input pulse frequencies of up to 250 kHz. The thermister input monitors a nominal input of 1.8 K ohms for a PTC device. Trip points at 3.3 K ohms for overtemperature and 60 ohms for shorted circuit are provided.

Programmable gain adjustments for standard and optional outputs allow adjustment of both upper and lower settings to allow for system calibration. A programmable offset is also provided to allow modification of the analog input to obtain 2 - 10V DC or 4-20 mA.

REFERENCE SIGNALS:

The drive is capable of the following input reference signals:

- Digital pulse train input
- Digital MOP
- HIM (Program/Control panel)
- Analog Input signals as:
 - Remote potentiometer
 - 0-10V DC
 - 0-20ma

The first analog input is also programmable to be used as a trim signal for the selected speed reference. The analog inputs have programmable gain adjustments for both upper and lower settings allow for system calibration. The analog inputs are programmable for normal, inverted or square root operation.

LOSS OF REFERENCE:

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

- Remote potentiometer wiper loss
- 2-10V DC signals below 2 volts
- 4-20ma signals below 4 ma

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

- Fault and stop
- Alarm and maintain last reference within 10%
- Alarm and go to preset speed
- Alarm and go to minimum speed
- Alarm and go to maximum speed

Signal loss detection is available when the signal being monitored is

- The active Process PI reference or feedback
- The active Frequency reference

DIGITAL I/O:

Digital I/O consists of nine inputs, accessible through optional input cards and two Form A and two Form C relay outputs as standard.

DIGITAL INPUTS:

All control interface cards provide input terminals for access to fixed drive functions. The first two inputs are programmable as Start or Run and Stop in either 2 Wire configuration, 3 wire configuration or status only. The last input is an Enable signal direct to the microprocessor for immediate inverter shutdown. The remaining 6 inputs are individually programmable as fixed functions from a list of 22 that include external fault, speed select, Jog, Process PI functions and others.

Option L6 - The control terminals are rated for 115V AC and require 10ma of power per input. Each input is optically isolated from the drive control logic. Customer supplied power is required unless a control power transformer is selected.

Option L5 - The control terminals are rated for 24V AC/DC and require 2.5ma of power per input. Each input is optically isolated from the drive control logic. Customer supplied power is required to power these circuits.

Option L4 - The control terminals are rated for 5V DC and require a contact closure only. Each input is optically isolated from the drive control logic. The external circuit must be capable of a sinking current level of 10ma per input when a contact closure is made.

Option L6E - The control terminals are rated for 115V AC and require 10ma of power per input. Each input is optically isolated from the drive control logic. Customer supplied power is required unless a control power transformer is selected. Dedicated encoder input terminals are provided with jumper selection for +5vdc or +12vdc to power the encoder circuit, power can be supplied by the drive or externally.

Option L5E - The control terminals are rated for 24V AC/DC and require 2.5ma of power per input. Each input is optically isolated from the drive control logic. Customer supplied power is required to power these circuits. Dedicated encoder input terminals are provided with jumper selection for +5vdc or +12vdc to power the encoder circuit, power can be supplied by the drive or externally.

Option L4E - The control terminals are rated for 5V DC and require a contact closure only. Each input is optically isolated from the drive control logic. The external circuit must be capable of a sinking current level of 10ma per input when a contact closure is made. Dedicated encoder input terminals are provided with jumper selection for +5vdc or +12vdc to power the encoder circuit, power can be supplied by the drive or externally.

Option L9E - The control terminals are rated for 115V AC and require 10ma of power per input. Each input is optically isolated from the drive control logic. Customer supplied power is required unless a control power transformer is selected. Dedicated encoder input terminals are provided with jumper selection for +5vdc or +12vdc to power the encoder circuit, power can be supplied by the drive or externally. This card also provides the signals required if Encoder Loss Detection is needed.

Option L8E - The control terminals are rated for 24V AC/DC and require 2.5ma of power per input. Each input is optically isolated from the drive control logic. Customer supplied power is required to power these circuits. Dedicated encoder input terminals are provided with jumper selection for +5vdc or +12vdc to power the encoder circuit, power can be supplied by the drive or externally. This card also provides the signals required if Encoder Loss Detection is needed.

Option L7E - The control terminals are rated for 5V DC and require a contact closure only. Each input is optically isolated from the drive control logic. The external circuit must be capable of a sinking current level of 10ma per input when a contact closure is made. Dedicated encoder input terminals are provided with jumper selection for +5vdc or +12vdc to power the encoder circuit, power can be supplied by the drive or externally. This card also provides the signals required if Encoder Loss Detection is needed.

DIGITAL OUTPUTS:

Standard "on board" outputs include two Form A (1 N.O.) and two Form C (1 N.O - 1 N.C) output relays. Contact output ratings are 115V AC/30V DC, 5.0 Amp resistive, 2.0 Amp inductive. All four relays provided are programmable to 19 different conditions including Fault, Alarm, At Speed, Drive Ready, PI Excess Error and others. Factory settings are as follows:

- Form A Run contact
- Form C Fault contact
- Form C Alarm contact
- Form A At Speed contact

FEATURES**START UP MODE:**

The start up of the drive can be accomplished in two ways. An Assisted Start Up Feature allows the user to commission the drive by supplying basic information and answering simple Yes/No questions. Basic setup parameters including Minimum and Maximum Frequency, acceleration and deceleration times and others can be conveniently entered. Motor nameplate data. Encoder information and I/O setup can also be entered. A motor rotation test and automated sensorless vector tuning routine complete a simple assisted start up. A full manual start up is also possible.

CONTROL MODE:

Programming provides the ability to select 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. The volts per hertz mode can be programmed straight line, pre programmed fixed boost or full custom patterns.

CURRENT LIMIT:

Programmable current limit from 20% to 300% of constant torque rating. Current limit is active for all drive states; accelerating, constant speed and decelerating. The drive employs PI regulation with an adjustable gain for smooth transition in and out of current limit.

ACCELERATION/DECELERATION:

Accel/Decel settings provide separate adjustments to allow either setting to be adjusted from 0.0 seconds to 3600.0 seconds. A second set of remotely selectable Accel/Decel settings are accessible with Control Interface option. An adaptive current limit circuit can be disabled in programming for fast acceleration of low inertia loads.

SPEED REGULATION:

The programmable speed regulation modes include the following:

- Open Loop
- Slip Compensation with 0.5% speed regulation
- Droop - Negative Slip Compensation with 0.5% speed regulation
- Traverse Function
- Closed loop encoder feedback with 0.1% speed regulation
- Process PI control
- Phase Lock Loop to lock output phasing to input pulse train frequency command

SPEED PROFILES:

Programming capability allows the user to produce speed profiles with linear acceleration/deceleration or "S-Curve" profiles that provide changing accel/decel rates. S-Curve profiles shall be selectable for fixed or adjustable values.

PROCESS PI CONTROL:

The internal process PI regulator has both proportional and intergral 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 hardwire input. Transistioning 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 a drop in bus voltage to conserve power for the drive logic. The amount of drop required will be adjustable to 50% of nominal.

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 amount of voltage drop required to trigger inertia ride through and the level at which regulation occurs shall both be adjustable. Inertia Ride Through can be enabled or disable via programming.

BUS REGULATION:

DC Bus regulation is available to reduce the possibility of drive overvoltage trips due to regenerative conditions. Bus voltage is monitored and an internal regulator, triggered by a 15% rise in voltage, adjusts the drive's output frequency to maintain bus voltage at a nominal (100%) level. Bus regulation can be enabled or disabled via programming.

FAULT RESET/RUN:

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.

LOAD LOSS DETECTION:

Enabled or disabled via programming, this feature allows the user to select the output current level that indicates that the load has been disconnected (broken belt / shaft / coupling) from the motor is indicated. Action is also selectable.

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 15Hz.

RUN ON POWER UP:

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

LINE LOSS RESTART:

This programmable function selects the reconnect mode of the drive after recovery from a line loss condition. The reconnect modes are - Last Speed, Speed Search, Track Volts, or Use Encoder. Disabling this feature will force the drive to start from zero hertz.

FAULT MEMORY:

The last four faults as well as operating frequency, drive status and power mode are stored at the time of fault. Information is maintained in the event of a power loss.

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 for motors with speed ranges of 2:1, 4:1 and 10:1. A viewable parameter stores the overload usage in percent. An alarm bit can be used to adjust a process to eliminate an overload trip.

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.

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. The flying start feature is operable with or without encoder feedback.

SYNCH LOSS DETECT AND CORRECT:

The drive shall be capable of detecting a synchronous motor that has pulled out of synch and add voltage to the motor to pull the motor back into synch. This feature shall have adjustable gain and time associated with it.

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.

COMMUNICATIONS

SCANPORT PROTOCOL INTERFACE

The drive has SCANPORT protocol interface which allows up to 6 independent and different networks to be connected to the drive at one time. This protocol shall allow for connection to other networks via third party suppliers.

COMMUNICATIONS INTERFACE

The drive has the capability for either internally mounted or externally mounted communications interface cards. Internal cards use drive power. Externally mounted cards are separately powered and connected to the drive via cable.

REMOTE I/O:

This option provides a Single Point Remote I/O interface board. The board is configurable for 1/4, 1/2, 3/4, or full rack with a baud rate of 57.6, 115, or 230kbaud. The Remote I/O board may be set up by the user to control drive logic and speed reference commands and monitor drive status and process parameters.

SERIAL:

This option provides an RS232/422/485 serial interface board with DF1 or DH485 protocol, with multi-drop capability, for interfacing to the drive.

DEVICENET:

This option provides a DeviceNet interface board for interfacing the drive to the DeviceNet network.

CONTROLNET

This option provides a ControlNet interface board for interfacing the drive to the ControlNet network.