Preface

Thank you for choosing DELTA's high-performance VFD-S Series. VFD-S Series are manufactured by adopting high-quality components, material and incorporating the latest microprocessor technology available.

📖 Getting Started

This manual will be helpful in the installation, parameter setting, troubleshooting, and daily maintenance of the AC motor drives. To guarantee safe operation of the equipment, read the following safety guidelines before connecting power to the AC motor drives. Keep this operating manual handy and distribute to all users for reference.

⚠ WARNING

⚠ Always read this manual thoroughly before using VFD-S series AC Motor Drives.

⚠ **DANGER!** AC input power must be disconnected before any maintenance. Do not connect or disconnect wires and connectors while power is applied to the circuit. Maintenance must be performed by qualified technicians.

⚠ **CAUTION!** There are highly sensitive MOS components on the printed circuit boards. These components are especially sensitive to static electricity. To avoid damage to these components, do not touch these components or the circuit boards with metal objects or your bare hands.

⚠ **DANGER!** A charge may still remain in the DC-link capacitor with hazardous voltages even if the power has been turned off. To avoid personal injury, please ensure that power has turned off before operating AC drive and wait ten minutes for capacitors to discharge to safe voltage levels.

⚠ **CAUTION!** Ground the VFD-S using the ground terminal. The grounding method must comply with the laws of the country where the AC drive is to be installed. Refer to Basic Wiring Diagram (Chapter 3).

⚠ **CAUTION!** The final enclosures of the AC drive must comply with EN50178. (Live parts shall be arranged in enclosures or located behind barriers that meet at least the requirements of the Protective Type IP20. The top surface of the enclosures or barrier that is easily accessible shall meet at least the requirements of the Protective Type IP40). (VFD-S series corresponds with this regulation.)

⚠ **CAUTION!** The rated voltage of power system that is installed on AC drive must be equal to or less than 240 Volts (460V model is 480 Volts) and the current must be equal to or less than 5000A RMS.

⚠ **DANGER!** The AC drive may be destroyed beyond repair if incorrect cables are connected to the input/output terminals. Never connect the AC drive output terminals U/T1, V/T2, and W/T3 directly to the AC main circuit power supply.

♨ **CAUTION!** Heat sink may heat up over 70℃ (158℉), during the operation. Do not touch the heat sink.

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CHAPTER 6 MAINTENANCE AND INSPECTIONS

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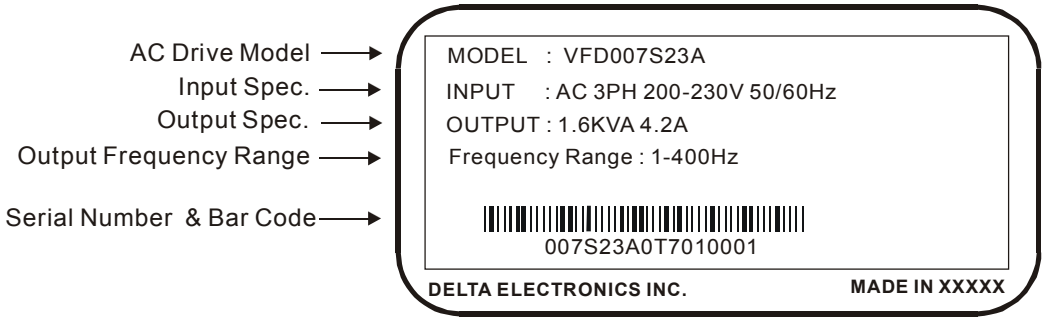
CHAPTER 1 RECEIVING AND INSPECTION

This VFD-S AC drive has gone through rigorous quality control tests at the factory before shipment. After receiving the AC motor drive, please check for the following:

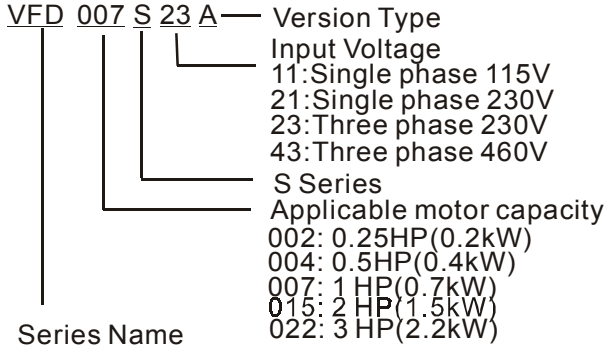
Receiving

- ✓ Check to make sure that the package includes an AC drive, the User Manual, and rubber bushings.
- ✓ Inspect the unit to insure it was not damaged during shipment.
- ✓ Make sure that the part number indicated on the nameplate corresponds with the part number of your order.

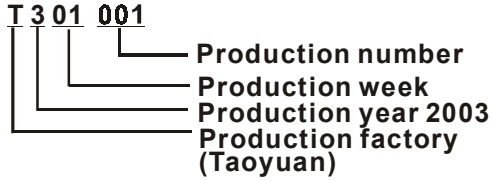
1.1 Nameplate Information ☛Example for 1HP 230V AC drive



1.2 Model Explanation



1.3 Serial Number Explanation



If there is any nameplate information not corresponding to your purchase order or any problem, please contact your supplier.

CHAPTER 2 STORAGE AND INSTALLATION

2.1 Storage

The AC drive should be kept in the shipping carton before installation. In order to retain the warranty coverage, the AC drive should be stored properly when it is not to be used over for an extended period of time. Some storage suggestions are:

Store in a clean and dry location free from direct sunlight or corrosive fumes.

Store within an ambient temperature range of -20°C to +65°C.

Store within a relative humidity range of 0% to 90% and non-condensing environment.

Store within an air pressure range of 86 kPA to 106kPA.

2.2 Ambient Conditions

Operation	Air Temperature: -10°C to +40°C (14°F to 104°F), Relative Humidity: 0% to 90%, no condensation allowed Atmosphere pressure: 86 to 106 kPa Installation Site Altitude: below 1000m Vibration: Maximum 9.80 m/s^2 (1G) at less than 20Hz Maximum 5.88 m/s^2 (0.6G) at 20Hz to 50Hz
Storage	Temperature: -20°C to +60°C (-4°F to 140°F) Relative Humidity: Less than 90%, no condensation allowed Atmosphere pressure: 86 to 106 kPa
Transportation	Temperature: -20°C to +60°C (-4°F to 140°F) Relative Humidity: Less than 90%, no condensation allowed Atmosphere pressure: 86 to 106 kPa Vibration: Maximum 9.80 m/s^2 (1G) at less than 20Hz, Maximum 5.88 m/s^2 (0.6G) at 20Hz to 50Hz
Pollution Degree	2: good for a factory type environment.

2.3 Installation

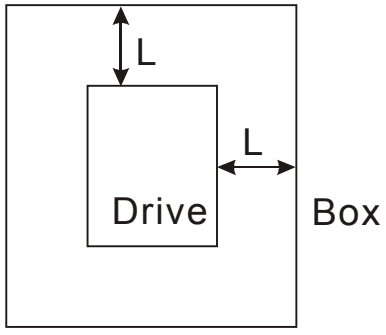
Improper installation of the AC drive will greatly reduce its life. Be sure to observe the following precautions when selecting a mounting location. **Failure to observe these precautions may void the warranty!**

- Do not mount the AC drive near heat-radiating elements or in direct sunlight.
- Do not install the AC drive in a place subjected to high temperature, high humidity, excessive vibration, corrosive gases or liquids, or airborne dust or metallic particles.
- Mount the AC drive vertically and do not restrict the air flow to the heat sink fins.

Non- Ventilated Enclosures

When selecting non-ventilated enclosures for the VFD-S series, please consider the following minimum distance (L) from the drive sides (other than the front or back covers) to the enclosure internal surfaces or box internal volume. Estimated operating temperature of drive will be lower than 40° C. (Box depth assumed as 8 in.)

Drive model S-series	Power (HP)	L (in)	Box Vol (cu.ft)
VFD002	0.25	10	3
VFD004	0.5	10	3
VFD007	1	10	3
VFD015	2	10	3
VFD022	3	12	4.7



Distance L from Drive to enclosure

2.4 Connections

DANGER

Hazardous Voltage

Before accessing the AC drive:

- Disconnect all power to the AC drive.
- Wait ten minutes for DC bus capacitors discharge.

Any Electrical or mechanical modification to this equipment without prior written consent of Delta Electronics, Inc. will void all warranties and may result in a safety hazard in addition to voiding the UL listing.

Short Circuit Withstand:

The rated voltage of power system that is installed on AC drive must be equal to or less than 240 Volts (460V model is 480 Volts) and the current must be equal to or less than 5000A RMS.

🕮 General Wiring Information

Applicable Codes

All VFD-S AC drives are Underwriters Laboratories, Inc. (UL) and Canadian Underwriters Laboratories (cUL) listed, and therefore comply with the requirements of the National Electrical Code (NEC) and the Canadian Electrical Code (CEC).

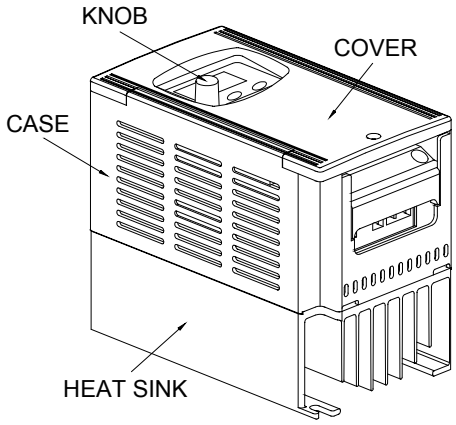
Installation intended to meet the UL and cUL requirements must follow the instructions provided in "**Wiring Notes**" as a minimum standard. Follow all local codes that exceed UL and cUL requirements. Refer to the technical data label affixed to the AC drive and the motor nameplate for electrical data.

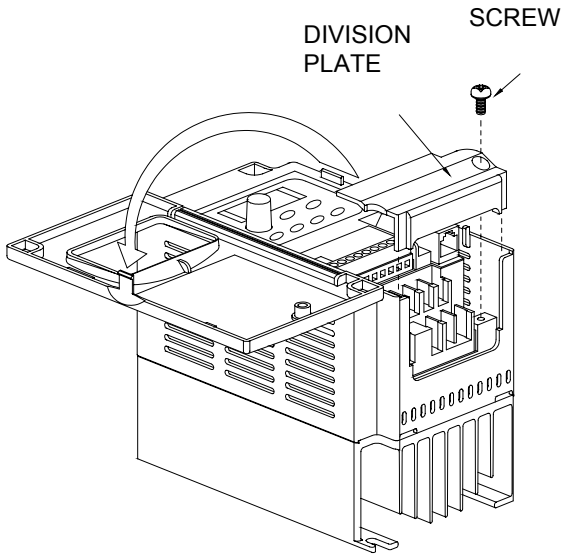
The "Line Fuse Specification" in Appendix B, lists the recommended fuse part number for each S-Series part number. These fuses (or equivalent) must be used on all installations where compliance with U.L. standards is a required.

2.5 Environments

Avoid rain and moisture,
Avoid direct sunlight,
Avoid corrosive gases or liquids,
Avoid airborne dust or metallic particles,
Avoid vibration,
Avoid magnetic interference,
Environment temperature: -10 ~ 50°C,
Environment humidity: below 90% RH,
Environment air pressure: 86 kpa ~ 106 kpa.

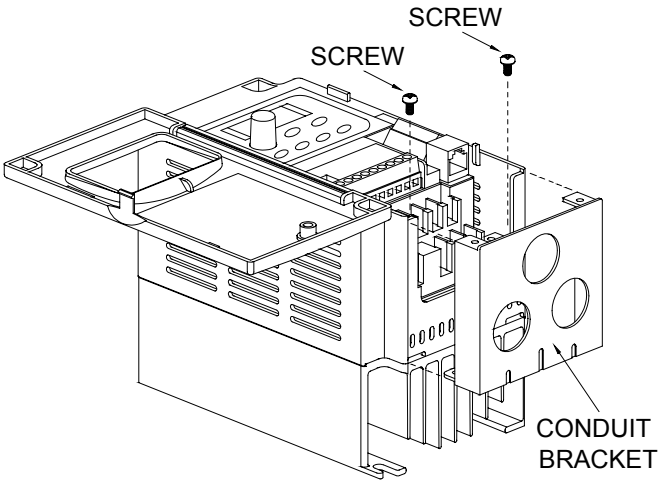
2.6 Installation Steps



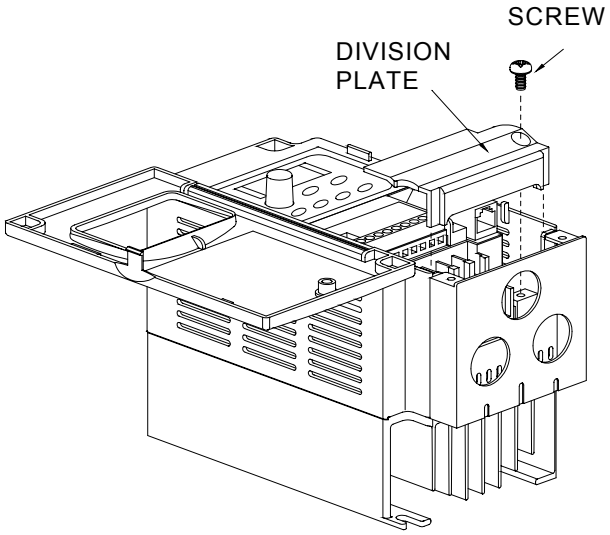


Installation Steps

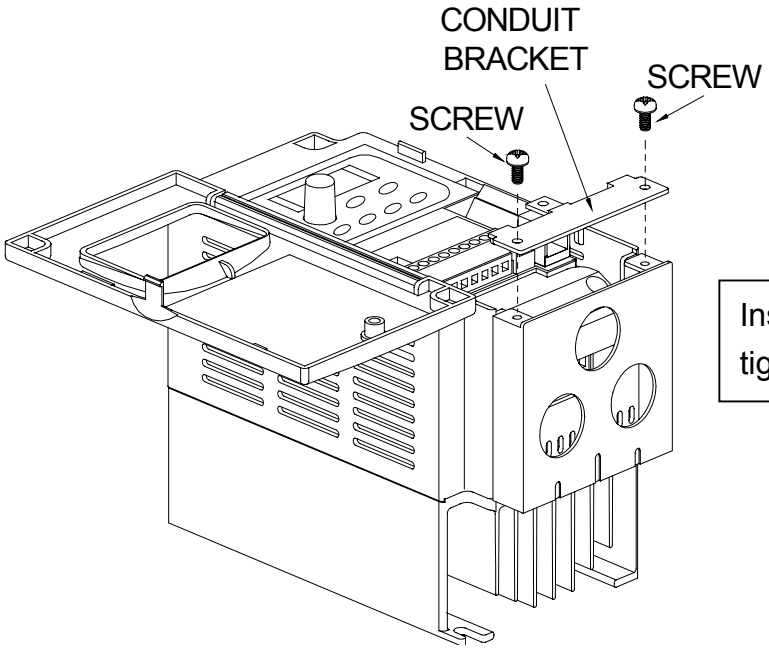
1. Remove front cover screw and open.
2. Remove Division Plate.
   If using optional conduit bracket, please refer to next page.
3. Connect AC Input Power and motor leads. Never connect the AC drive output terminals U/T1, V/T2, W/T3 to main AC Input power.
4. Reinstall Division Plate.



For Optional Conduit Bracket:
Make sure to fasten both screws on conduit bracket as shown in the drawing for safety grounding purpose. Bring all the wires out through the conduit bracket.
Screw Torque: 5 to 6 kgf-cm
(4.3 to 5.2 in-lbf)

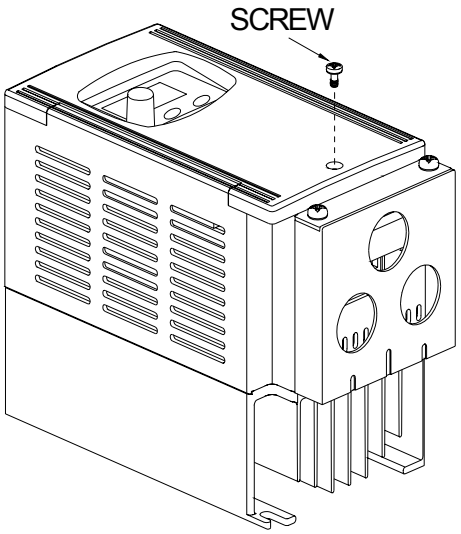


Reinstall Division Plate.
Screw Torque: 5 to 6 kgf-cm
(4.3 to 5.2 in-lbf)



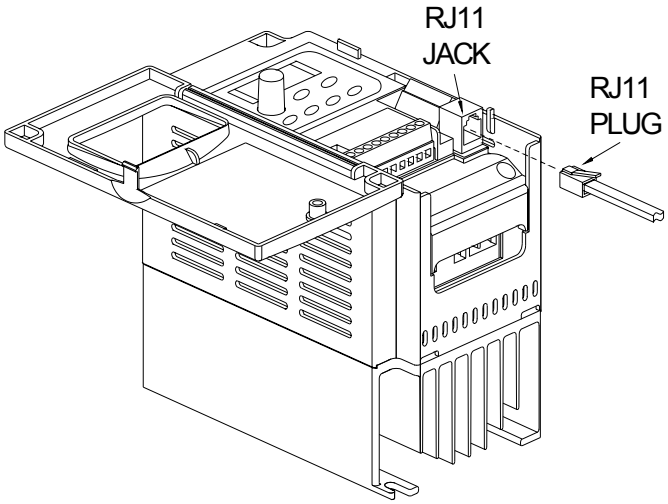
Install Conduit Bracket cover and tighten screws.

UL Enclosed Type



Close the cover and tighten screw as shown.
Screw torque: 5 to 6 kgf-cm
(4.3 to 5.2 in-lbf)

RS485



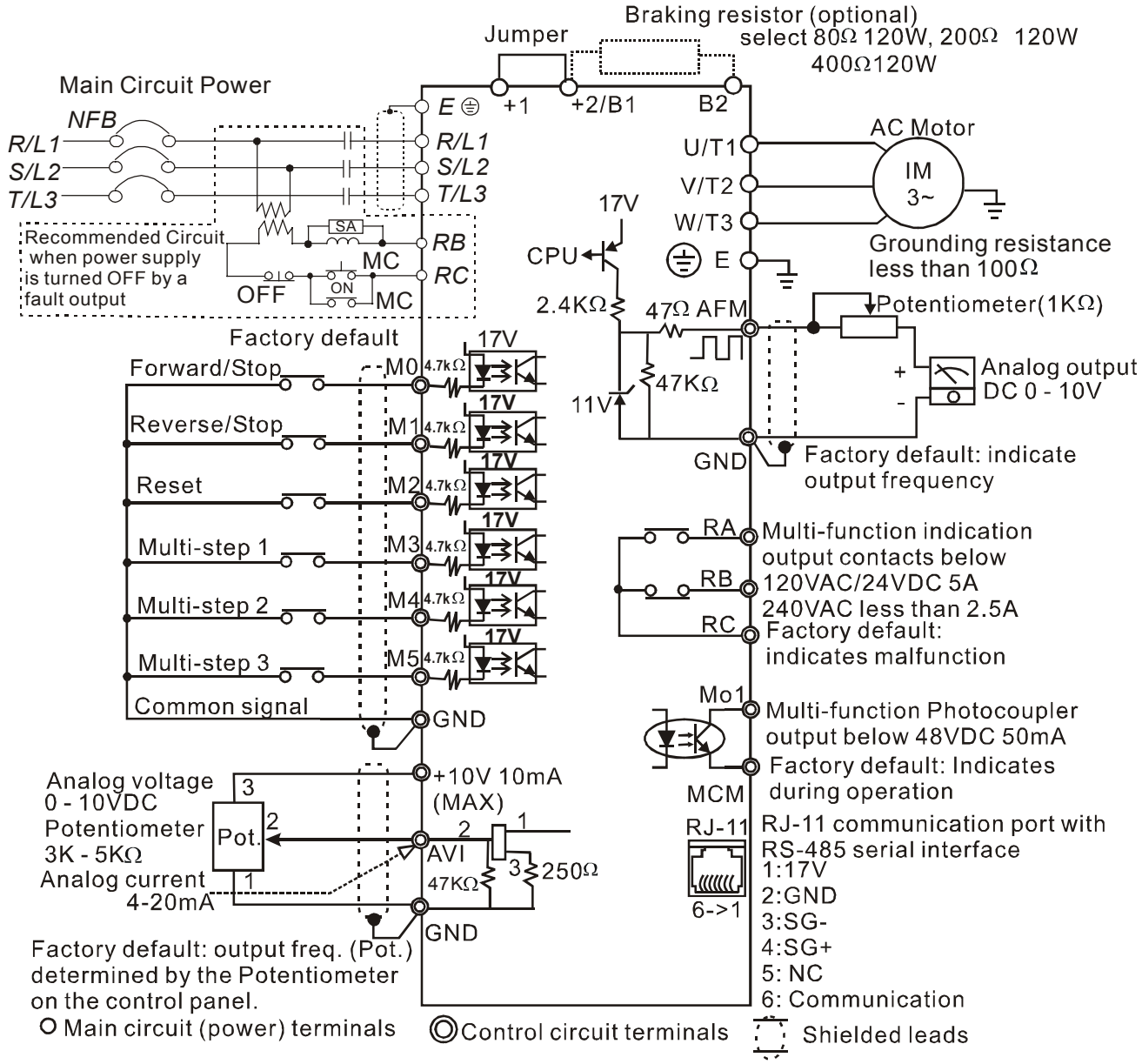
For additional communication:
Plug the communication keypad into the RJ11 jack for serial communication.

CHAPTER 3 WIRING

3.1 Basic Wiring Diagram

Users must connect wiring according to the following circuit diagram shown below.

For VFDXXXSXXA/B/D

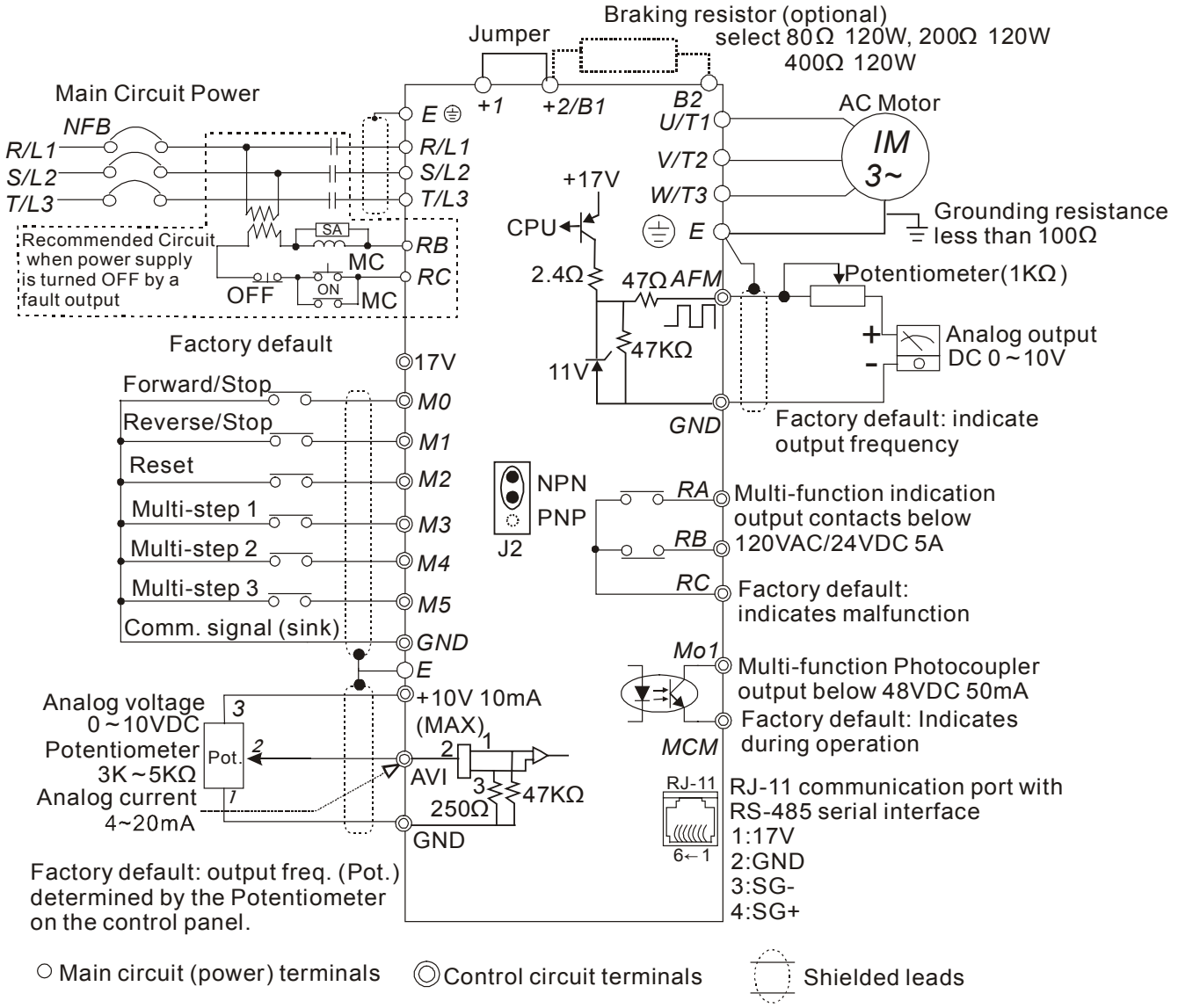


NOTE: Do not plug in a Modem or telephone line to the RS-485 communication port, permanent damage may result. Terminal 1 & 2 are the power sources for the optional copy keypad and should not be used while using RS-485 communication.

* If it is single phase model, please select any of the two input power terminals in main circuit power.

For VFDXXXSXXE

NPN (sink mode)



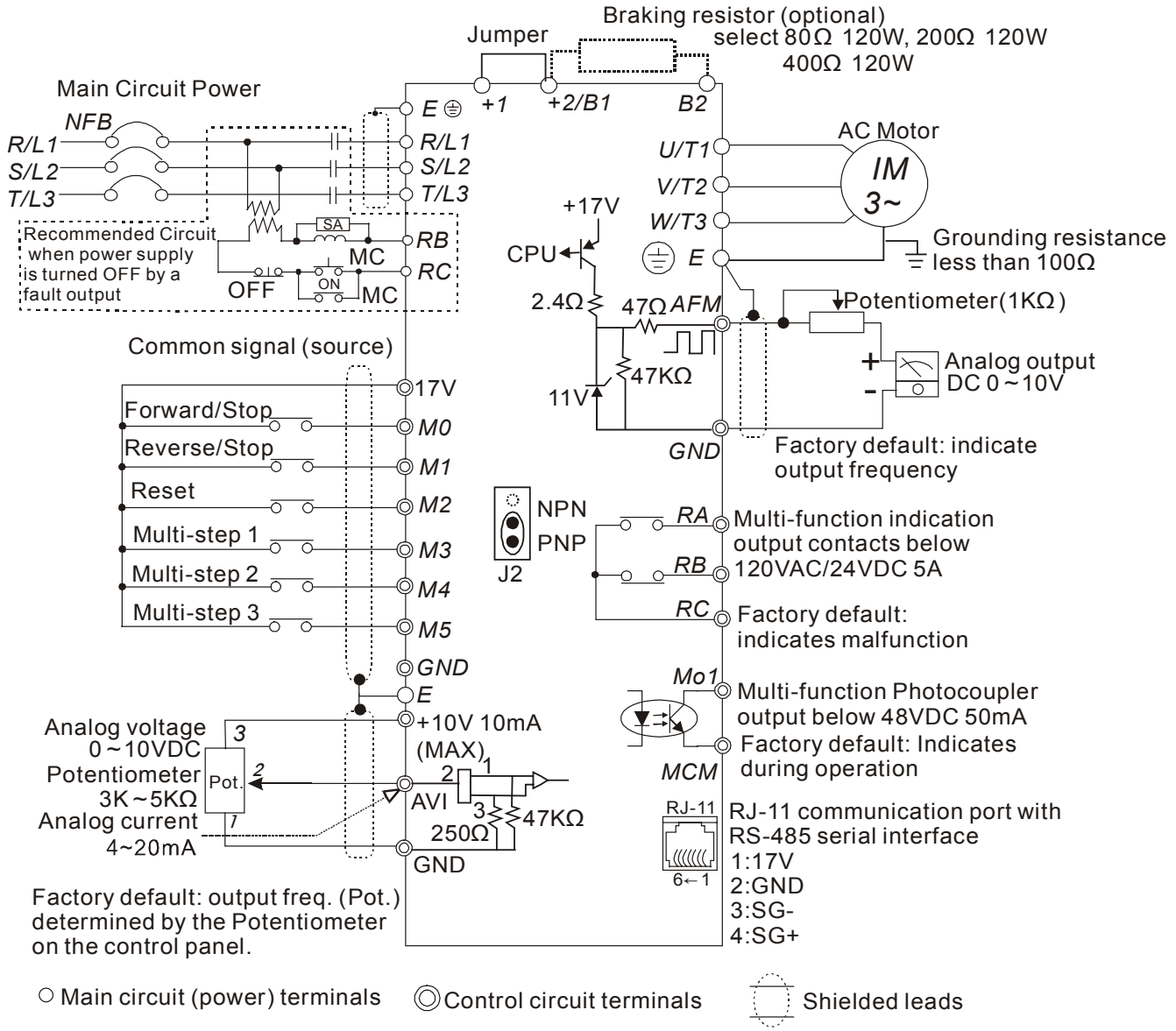
○ Main circuit (power) terminals ◎ Control circuit terminals Shielded leads

NOTE: Do not plug in a Modem or telephone line to the RS-485 communication port, permanent damage may result. Terminal 1 & 2 are the power sources for the optional copy keypad and should not be used while using RS-485 communication.

* If it is single phase model, please select any of the two input power terminals in main circuit power.

For VFDXXXSXXE

PNP (source mode)

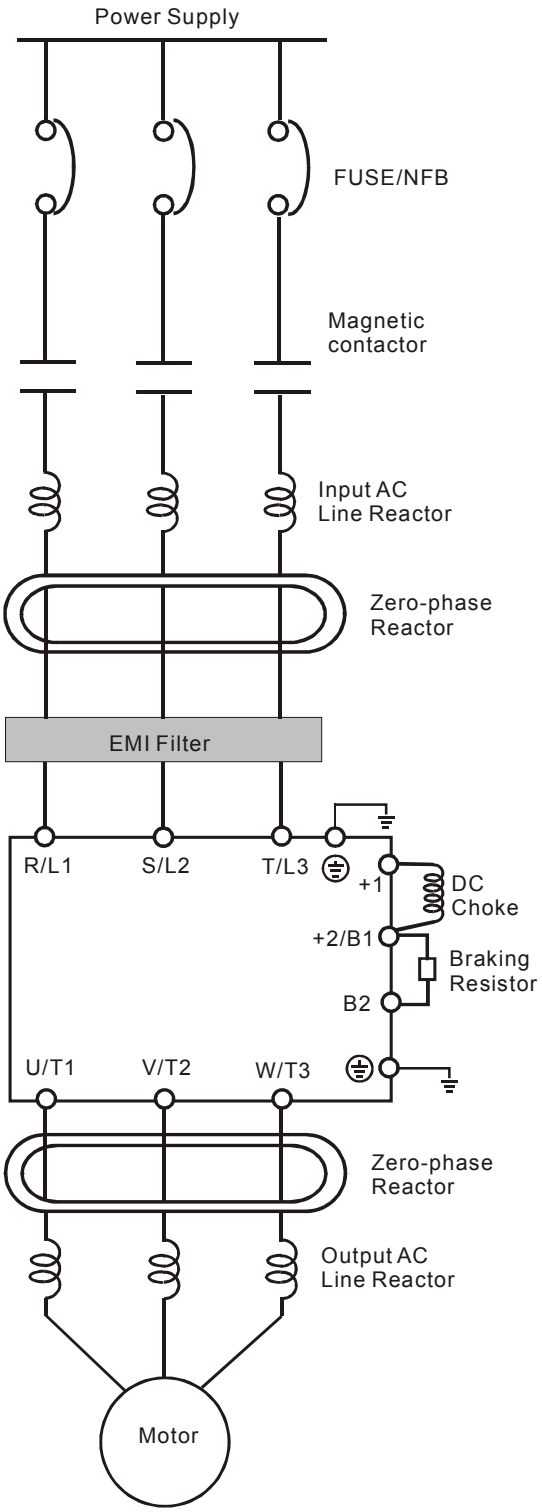


○ Main circuit (power) terminals ◎ Control circuit terminals Shielded leads

NOTE: Do not plug in a Modem or telephone line to the RS-485 communication port, permanent damage may result. Terminal 1 & 2 are the power sources for the optional copy keypad and should not be used while using RS-485 communication.

* If it is single phase model, please select any of the two input power terminals in main circuit power.

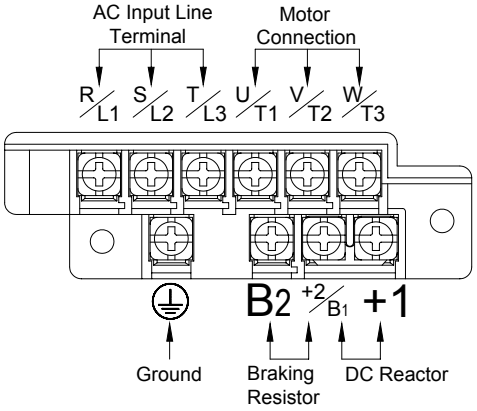
3.2 External Wiring



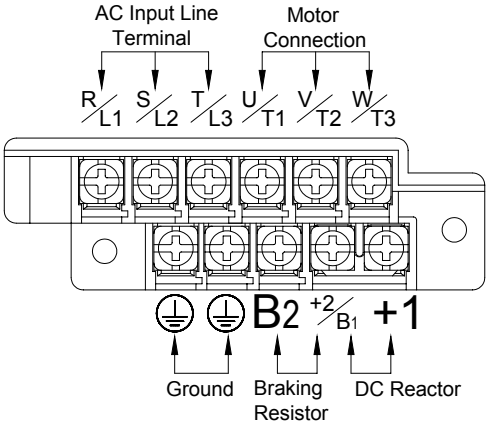
Items	Explanations
Power supply	Please follow the specific power supply requirement shown in APPENDIX-A.
Fuse/NFB (Optional)	There may be inrush current during power up. Please check the chart of APPENDIX B and select the correct fuse with rated current. NFB is optional.
Magnetic contactor (Optional)	Please do not use a Magnetic contactor as the I/O switch of the AC drive, this will reduce the operating life cycle of the AC drive.
Input AC Line Reactor (Optional)	In order to improve the input power factor, reduces harmonics and protection from AC line disturbances. (Surge, switching spike, power flick, etc.) AC line reactor should be installed when the power supply capacity is 500kVA or more and exceeds 6 times of the inverter capacity, or the wiring distance within 10m.
Zero-phase Reactor (Ferrite Core Common Choke) (Optional)	Zero phase reactors are used to reduce radio noise specify when the audio equipments installed near the inverter. Good effective for noise reduction on both the input and output sides. Attenuation quality is good in a wide range from AM band to 10Mhz. Appendix B for specifies zero phase reactors. (RF220X00A)
EMI filter (Optional)	To reduce the electromagnetic interference. Please refer to Appendix B for detail.
Braking Resistor (Optional)	Used to reduce stopping time of the motor. Please refer to the chart on Appendix B for specific Braking Resistors.
Output AC Line Reactor (Optional)	Motor surge voltage amplitudes depending on the motor cable length. For long motor cable application, it is necessary installed on the inverter output side.

3.3 Main Circuit Wiring

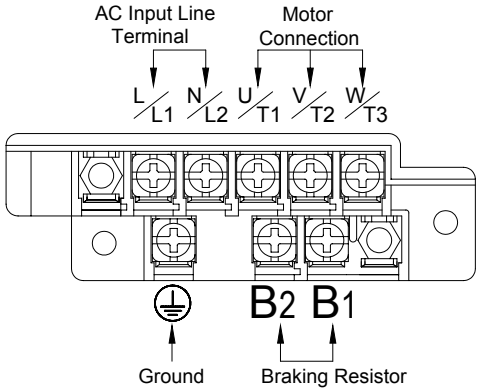
1. Main Circuit Terminals



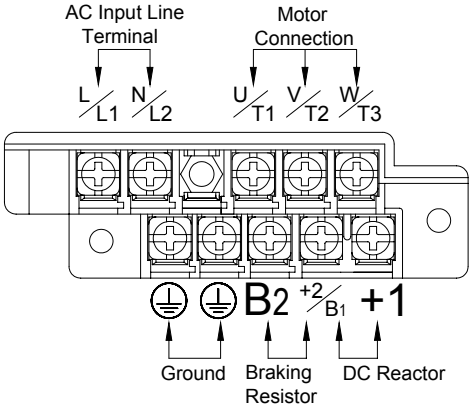
002S23B, 004S23B, 004S43B, 007S23B, 007S43B, 015S21A/B, 015S23A/B, 015S43B, 022S23A/B, 022S43B



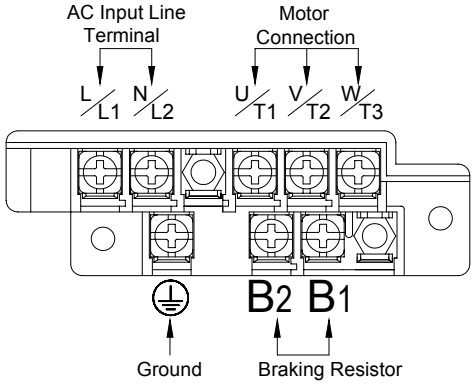
002S23A, 004S23A/E, 007S23A/E, 015S23D, 015S43A/D/E, 022S23D, 022S43A/D/E



002S11A/B, 004S11A/B, 007S11A/B



002S21A/E, 004S21A/E, 007S21A/E, 015S21D/E, 022S21D/E



022S21A/B

0.25-1 HP **(1HP: 230V/460V) and VFD015S23D**
Wire Gauge: 14-20 AWG
Wire Type: copper wire only, 75°C
Torque: 12 kgf-cm (10 in-lbf)

1-3 HP **(1HP: 115V)**
Wire Gauge: 10-18 AWG
Wire Type: stranded copper wire only, 75°C
Torque: 20 kgf-cm (17.4 in-lbf)

2. Terminal Explanations

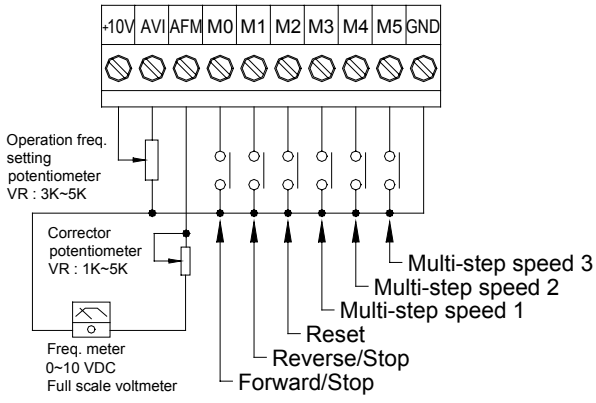
Terminal Symbol	Explanation of Terminal Function
R/L1, S/L2, T/L3	AC line input terminals (three phase)
L/L1, N/L2	AC line input terminals (single phase)
U/T1, V/T2, W/T3	Motor connections
+2/B2 – B1	Connections for Braking Resistor (optional)
+2/+1 – B1	Connections for DC Link Reactor (optional)
⏚	Earth Ground

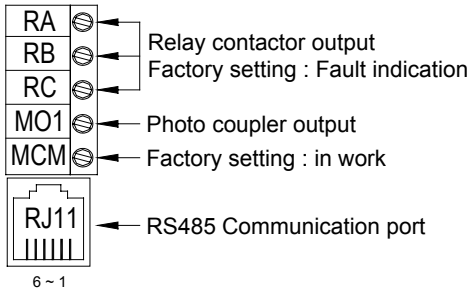
3. Terminal Dimensions

Model VFD-	002S11A/B, 002S21A/B/E, 002S23A/B, 004S11A/B, 004S 21A/B/E, 004S23A/B, 004S43A/B/E, 007S21A/B/E, 007S23A/B, 007S43A/B/E, 015S23D	007S11A/B, 015S21A/B/D/E, 015S23A/B, 015S43A/B/D/E, 022S21A/B/D/E, 022S23A/B/D, 022S43A/B/D/E
Terminal Specification (Terminal ϕ)	M3.5	M4

3.4 Control Terminal Wiring (Factory Setting)

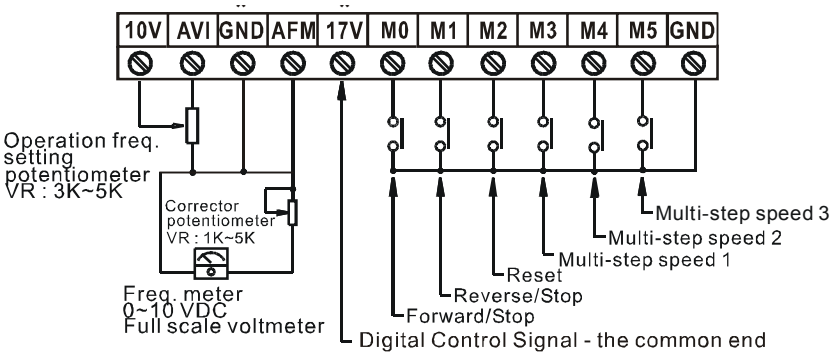
A. XXXSXXA/B/D





Wire Gauge: 24-12 AWG
Wire Type: Copper Only
Torque: 4 kgf-cm (3.5 in-lbf)

B. XXXSXXE



Wire Gauge: 24-16 AWG
Wire Type: Copper Only
Torque: 2 kgf-cm (1.7 in-lbf)

3

1. Terminal Explanations:

Terminal symbols	Terminal name	Remarks
RA-RC	Multi-Function Indication Output Contact	Refer to Pr.3-06 Relay output contact RA-RC (N.O. Contact) RB-RC (N.C. Contact)
RB-RC	Multi-Function Indication Output Contact	
MO1-MCM	Multi-function PHC output	Refer to Pr.3-05
RJ-11	Serial communication port	RS-485 serial communication interface
+10V-GND	Power for speed setting	Power Supply (+10V/10mA)
AVI-GND	Analog voltage/current freq. command	0 to +10 V (Max. Output Frequency) Input **or** 4 to 20mA (Max. Output Frequency) Input
AFM-GND	Analog frequency/current meter	0 to +10 V (Max. output Frequency) Output
17V	DC Voltage Source	(17V/20mA), used for source mode.
M0	Multi-function auxiliary input	Refer to Pr.4-04 to Pr.4-08
M1	Multi-function input 1	
M2	Multi-function input 2	
M3	Multi-function input 3	
M4	Multi-function input 4	
M5	Multi-function input 5	
GND	Digital Signal Common	

Note: Use twisted-shielded, twisted-pair or shielded-lead wires for the control signal wiring. It is recommended to run all signal wiring in a separate steel conduit. The shield wire should only be connected at the drive. Do not connect shield wire on both ends.

3.5 Wiring Notes

1. ⚠ **CAUTION:** Do not connect the AC input to any of the U/T1, V/T2, W/T3 terminals, as it will damage the AC drive.
2. ⚠ **WARNING:** Ensure all screws are tightened to the proper torque rating.

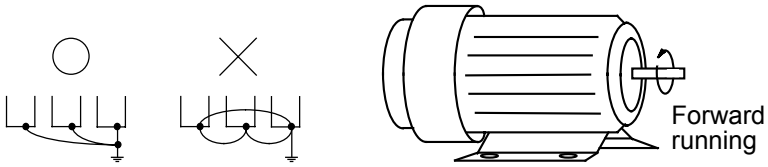
3. During installation, follow all local electrical, construction, and safety codes for the country the drive is to be installed in.

4. Ensure that the appropriate protective devices (circuit breaker or fuses) are connected between the power supply and AC drive.

5. Make sure that the leads are connected correctly and the AC drive is properly grounded. (Ground resistance should not exceed 100Ω. For 460V-class AC drive, the ground resistance should not exceed 10Ω.)

6. Use ground leads that comply with AWG/MCM standards and keep them as short as possible.

7. Multiple VFD-S units can be installed in one location. All the units should be grounded directly to a common ground terminal. The VFD-S ground terminals may also be connected in parallel, as shown in the figure below. **Ensure there are no ground loops.**



8. When the AC drive output terminals U/T1, V/T2, and W/T3 are connected to the motor terminals U/T1, V/T2, and W/T3, respectively, the motor will rotate counterclockwise (as viewed from the shaft ends of the motor) when a forward operation command is received. To reverse the direction of motor rotation, switch over any of the two motor leads.

9. Make sure that the power source is capable of supplying the correct voltage and required current to the AC drive.

10. Do not attach or remove wiring when power is applied to the AC drive.

11. Do not monitor the signals on the circuit board while the AC drive is in operation.

12. For the single-phase applications, the AC input line can be connected to any two of the three input terminals R/L1, S/L2, T/L3.

    Note: This drive is not intended for the use with single-phase motors.

13. Route the power and control wires separately, or at 90° angle to each other.

14. If a filter is required for reducing EMI (Electro Magnetic Interference), install it as close as possible to AC drive. EMI can also be reduced by lowering the Carrier Frequency.

15. If the AC drive is installed in the place where a load reactor is needed, install the filter close to U/T1, V/T2, W/T3 side of AC drive. Do not use a Capacitor or L-C Filter (Inductance-Capacitance) or R-C Filter (Resistance-Capacitance).

16. When using a GFCI (Ground Fault Circuit Interrupt), select current sensor with not less than 200mA, and not less than 0.1-second detection to avoid nuisance tripping

3.6 Motor Operation Precautions

1. When using the AC drive to operate a standard 3-phase induction motor, notice that the energy loss is greater than an inverter duty motor.

2. While using the standard induction motor at low speed, the temperature of the motor may rise, so do not operate the motor at low speed for a long period of time.

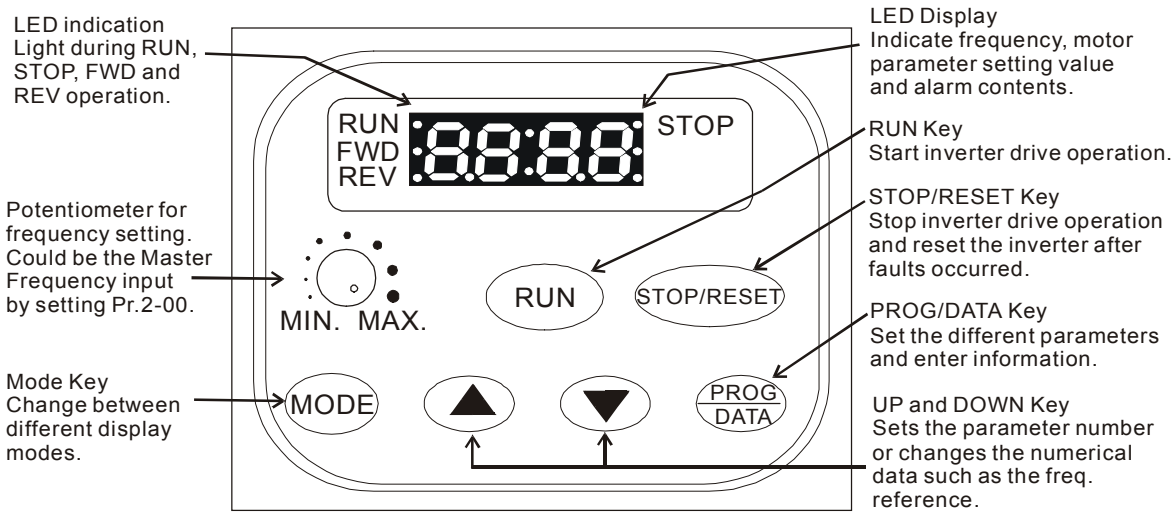
3. When the standard motor operates at low speed, the motor output torque will decrease, please decrease the load during the operation.

4. If 100% output torque is desired at low speed operation, it may be necessary to use a special motor that can handle this load (inverter duty).

CHAPTER 4 DIGITAL KEYPAD OPERATION

4.1 Description of Digital Keypad

This digital keypad includes two parts: Display panel and keypad. Display panel provides the parameter display and shows operation status of the AC drive. Keypad provides programming interface between users and AC drives.



Mode

By pressing the “mode” key repetitively, the display will show status at the AC drive such as the reference frequency, output frequency, and output current.

PROG/ DATA

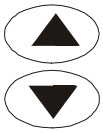
Pressing the “PROG/DATA” key will store entered data or can show factory stored data.

Run

Start the AC drive operation. This key has no function when the drive is controlled by the External Control Terminals.

Stop / Reset

Stop AC drive operation. If the drive stops due to a fault, correct the fault first, then press this key to reset the drive.



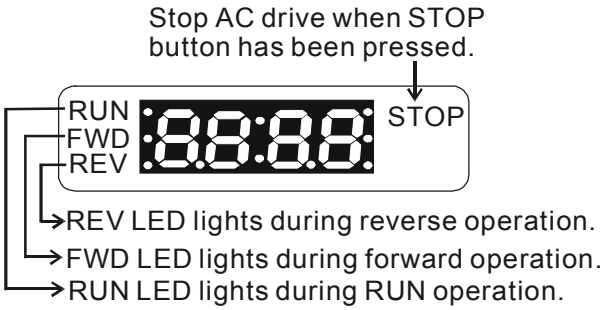
Up / Down

Press the “Up” or “Down” keys momentarily to change parameter settings. These keys may also be used to scroll through different operating values or parameters. Pressing the “Up” or “Down” key momentarily, will change the parameter settings in single-unit increments. To quickly run through the range of settings, press down and hold the key.

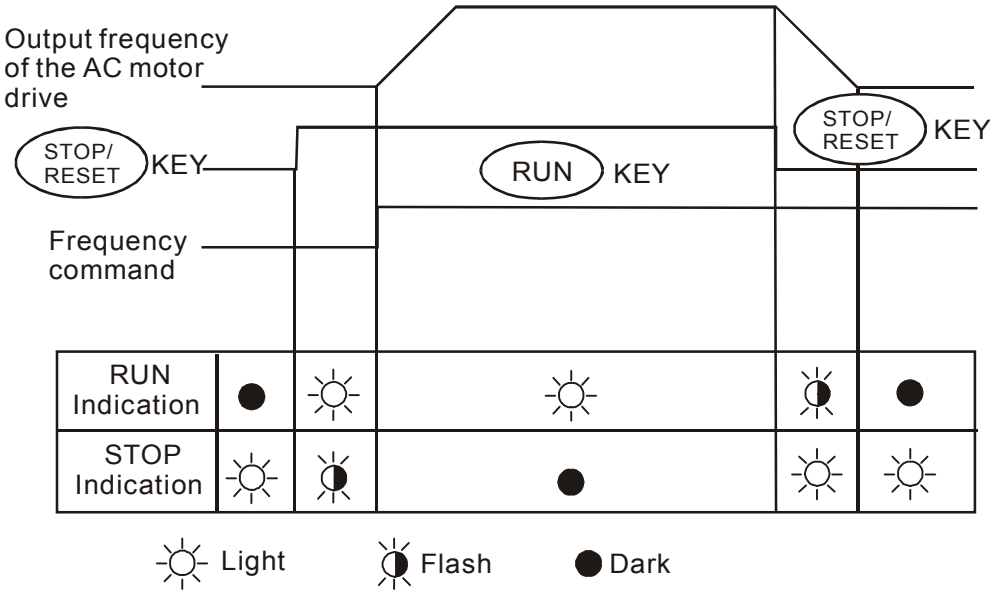
4.2 Explanations of Display Messages

Display Message	Descriptions
	The AC drive Master Frequency
	The Actual Operation Frequency present at terminals U/T1, V/T2, and W/T3.
	The output current present at terminals U/T1, V/T2, and W/T3
	The custom unit (u), where u = H x Pr 0-05.
	The counter value (C)
	The internal PLC process step currently being performed.
	The DC–BUS voltage
	The output voltage
	The specified parameter group
	The specified parameter
	The actual value stored within the specified parameter.
	AC drive forward run status
	AC drive reverse run status
	“End” displays for approximately 0.5 second if input has been accepted. After a parameter value has been set, the new value is automatically stored in memory. To modify an entry, use the ▲ and ▼ keys.
	“Err” displays, if the input is invalid.

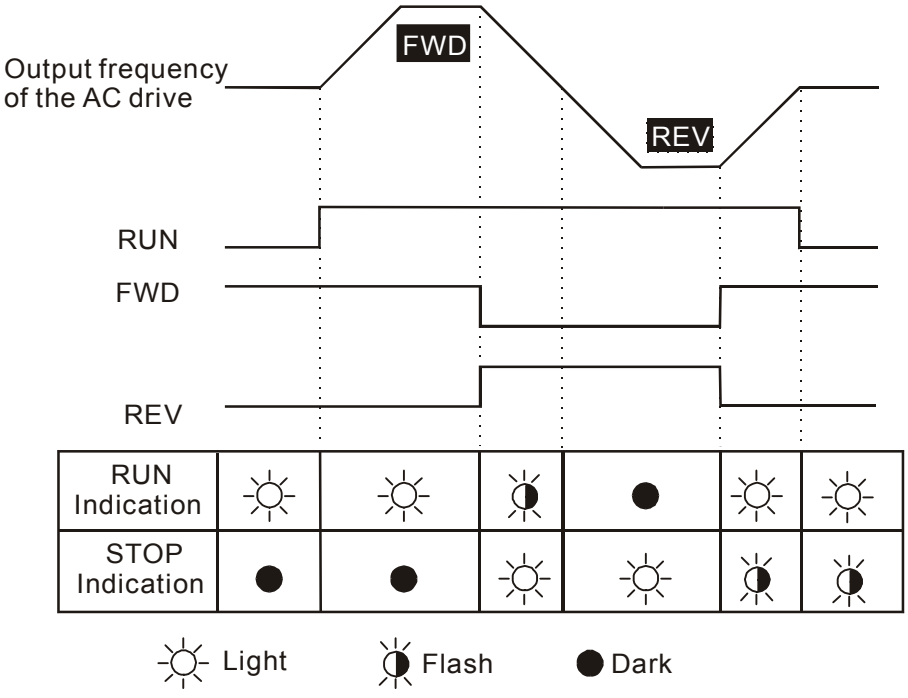
4.3 Explanation of LED Indicators



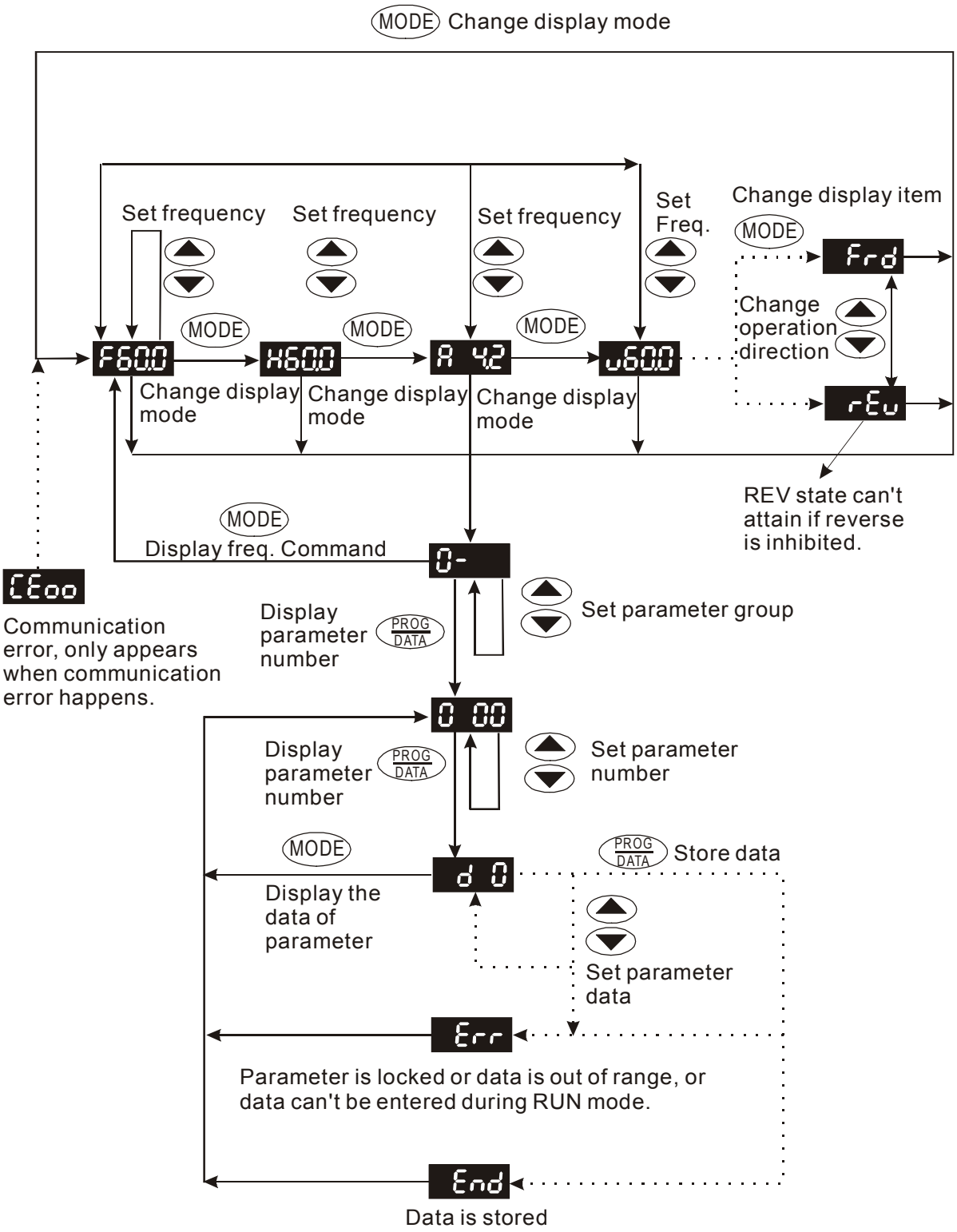
1. Description of LED functions of RUN and STOP



2. Description of LED functions of FWD and REV.



4.4 Keypad Operation



CHAPTER 5 DESCRIPTION OF PARAMETER SETTINGS

5.1 Group 0: User Parameters

0 - 00 Identity Code of AC Drive Factory setting: d#

Settings None

HP / V	1/4	1/2	1	2	3
115V/230V	d0	d2	d4	d6	d8
460V	-- -- --	d3	d5	d7	d9

🕮 This parameter shows the capacity of the AC drive. Users can read Pr.0-01 to check if it is the rated current of the AC drive corresponds to the identity code shown above and the current shown below.

HP / V	1/4	1/2	1	2	3
115V/230V	1.6A	2.5A	4.2A	7.5A	11.0A
460V	-- -- --	1.5 A	2.5 A	4.2 A	5.5 A

0 - 01 Rated Current Display of the AC drive Factory Setting: d ##.#

Settings None Unit: 0.1A

🕮 This parameter displays the rated current of the AC drive. It will display based on Pr.0-00, and is read-only.

0 - 02 Parameter Reset Factory Setting: d 0

Settings d 0 to d 9 Not used

d 10 All parameters are reset to initial factory settings

🕮 This setting allows the user to return all parameters to the factory default settings.

0 - 03	Start-up Display Selection	Factory Setting: d 0

Settings
- d 0 Display the Master Frequency (F)
- d 1 Display the actual output frequency (H)
- d 2 Display the content of users-defined unit
- d 3 Display the output current (A)

This parameter can be set during operation.

0 - 04	Content of User Defined Unit	Factory Setting: d 0

Settings
- d 0 Display the user-defined unit (u)
- d 1 Display the counter value (C)
- d 2 Display the content of PLC time (1 = tt)
- d 3 Display the DC BUS voltage (U)
- d 4 Display the output voltage (E)
- d 5 Display frequency commands of PID (P)
- d 6 Display PID feedback (after multiplying by Gain) (b)

This parameter can be set during operation.

Note: Display the user-defined unit, where unit = H X **0-05**

0 - 05	User Defined Coefficient K	Factory Setting: d 1.0

Settings d 0.1 to d 160 Unit: 0.1

This parameter can be set during operation.

📖 The coefficient K determines the multiplying factor for the user-defined unit.
The display value is calculated as follows:
Display value = (output frequency x K)

📖 The display window is only capable of showing three digits, yet you could use Pr.0-05 to create larger numbers. The display windows uses decimal points to signify numbers up to five digits as illustrated in the next page:

Display	Number Represented
999	The absence of a decimal point indicates a three–digit integer.
99.9	A signal decimal point between the middle and the right-most numbers is a true decimal point; it separates ones and tenths as in “30.5” (thirty and one-half).
999.	A single decimal point after the right-most numbers is not a true decimal point, instead it indicates that a zero follows the right-most number. For example, the number 1230 would be displayed as “123.”
99.9.	Two decimal points (one between the middle and the right-most numbers, and one after the right-most number) are not true decimal points; instead they indicate that two zeros follow the right-most number. For example, the number 34500 would be displayed as “34.5.”.

0 - 06 Software Version — Factory Setting: d #.#

Setting None

📖 The software version is read-only that stores the version number of VFD-S series software.

0 - 07 Password Input — Factory Setting: d 0

Settings d 0 to d 999 — Unit: 1

📖 Pr.0-07 and Pr.0-08 work together to provide data security for the AC drive. When Pr.0-08 is set to a value other than 0, a password must be entered to alter the values of parameters. The password is the number set in Pr.0-08, which ranges from 1 to 999. Pr.0-07 is where the password is entered to allow parameter values to be altered.

📖 Display states:
d 0: no password / correct password has been input
d 1: parameters are locked

0 - 08	Password Decode	Factory Setting: d 0
	Settings d 0 to d 999	Unit: 1

📖 For a password to be configured, the non-zero value assigned to Pr.0-08 must be entered **twice.** In other words, set the value of Pr.0-08 to the desired value and press the Prog/Data key. Then, press the Prog/Data key again to display the value of Pr.0-08. Finally, press the Prog/Data key again to store the displayed value, which then becomes the password.

For example, say that Pr.0-08 is set to 111. When the AC drive is powered-up, all the parameters will be locked and their values cannot be changed. To permit the values of parameters to be altered, navigate to Pr.0-07 and change its value to 111 (the password configured in Pr.0-08). Then press the Prog/Data key, and you may alter the parameter values.

📖 Display states:
d 0: no password
d 1: password has been set

5.2 Group 1: Basic Parameters

1 - 00	Maximum Output Frequency (Fo. max)	Factory Setting: d 60.0
	Settings d 50.0 to d 400 Hz	Unit: 0.1Hz

📖 This parameter determines the AC drive's Maximum Output Frequency. All the AC drive analog inputs (0 to +10V, 4 to 20mA) are scaled to correspond to the output frequency range.

1 - 01	Maximum Voltage Frequency	Factory Setting: d 60.0
	Settings d 10.0 to d 400 Hz	Unit: 0.1Hz

📖 This value should be set according to rated frequency of the motor as indicated on the motor nameplate. Maximum Voltage Frequency determines the volts per hertz ratio. For example, if the drive is rated for 460 VAC output and the Maximum Voltage Frequency is set to 60Hz, the drive will maintain a constant ratio of 7.66 v/Hz. The setting value must be greater than or equal to the middle freq. setting (Pr.1-03).

1 - 02	Max. Output Voltage (Vmax)	Factory Setting: d 230*
	Settings d 2.0 to d 255V*	Unit: 0.1V*
	*Twice value for 460V class	

📖 This parameter determines the Maximum Output Voltage of the AC drive. The Maximum Output Voltage setting must be smaller than or equal to the rated voltage of the motor as indicated on the motor nameplate. The setting value must be greater than or equal to the Mid-Point Voltage (Pr.1-04).

1 - 03	Mid-Point Frequency (Fmid)	Factory Setting: d 1.0
	Settings d 1.0 to d 400Hz	Unit: 0.1Hz

This parameter sets the Mid-Point Frequency of V/F curve. With this setting, the V/F ratio between Minimum Frequency and Mid-Point frequency can be determined. This parameter must be greater than or equal to Minimum Output Frequency (Pr.1-05) and equal to or less than Maximum Voltage Frequency (Pr.1-01).

1 - 04	Mid-Point Voltage (Vmid)	Factory Setting: d12.0*
	Settings d 2.0 to d 255V*	Unit: 0.1V*
	*Twice value for 460V class	

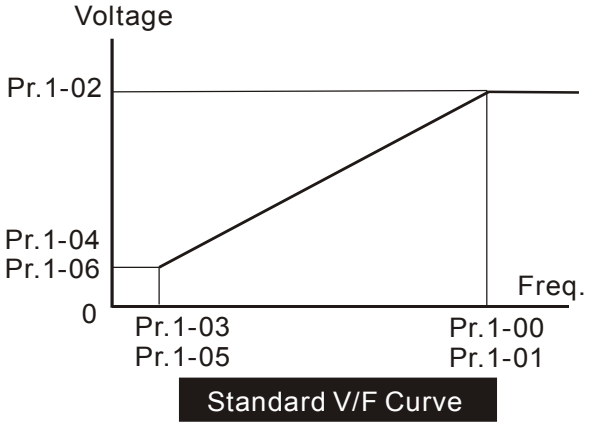
The parameter sets the Mid-Point Voltage of any V/F curve. With this setting, the V/F ratio between Minimum Frequency and Mid-Point Frequency can be determined. This parameter must be equal to or greater than Minimum Output Voltage (Pr.1-06) and equal to or less than Maximum Output Voltage (Pr.1-02).

1 - 05	Minimum Output Frequency (Fmin)	Factory Setting: d 1.0
	Settings d 1.0 to d 60.0Hz	Unit: 0.1Hz

This parameter sets the Minimum Output Frequency of the AC drive. This parameter must be equal to or less than Mid-Point Frequency (Pr.1-03).

1 - 06	Minimum Output Voltage (Vmin)	Factory Setting: d12.0*
	Settings d 2.0 to d 255V*	Unit: 0.1V*
	*Twice value for 460V class	

📖 This parameter sets Minimum Output Voltage of the AC drive. This parameter must be equal to or less than Mid-Point Voltage (Pr.1-04).



Standard V/F Curve

1 - 07	Upper Bound of Output Frequency	Factory Setting: d 100
	Settings d 1 to d110%	Unit: 1%

📖 This parameter must be equal to or greater than the Lower Bound of Output Frequency (Pr.1-08). The Maximum Output Frequency (Pr.1-00) is regarded as 100%.

1 - 08	Lower Bound of Output Frequency	Factory Setting: d 0
	Settings d 0 to d100%	Unit: 1%

📖 The Upper/Lower Bound is to prevent operation error and machine damage.

📖 If the Upper Bound of Output Frequency is 50Hz and the Maximum Output Frequency is 60Hz, the Maximum Output Frequency will be limited to 50Hz.

📖 If the Lower Bound of Output Frequency is 10Hz, and the Minimum Output Frequency (Pr.1-05) is set at 1.0Hz, then any Command Frequency between 1-10Hz will generate a 10Hz output from the drive.

📖 This parameter must be equal to or less than the Upper Bound of Output Frequency (Pr.1-07).

1 - 09	Acceleration Time 1 (Taccel 1)	Factory Setting : d10.0
1 - 10	Deceleration Time 1 (Tdecel 1)	Factory Setting : d10.0
1 - 11	Acceleration Time 2 (Taccel 2)	Factory Setting : d10.0
1 - 12	Deceleration Time 2 (Tdecel 2)	Factory Setting : d10.0

Settings d 0.1 to d 600Sec Unit: 0.1sec

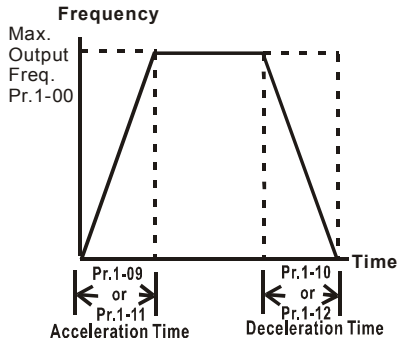
These parameters can be set during operation.

📖 Pr.1-09. This parameter is used to determine the time required for the AC drive to ramp from 0 Hz to its Maximum Output Frequency (Pr.1-00). The rate is linear unless S-Curve is "Enabled."

📖 Pr.1-10. This parameter is used to determine the time required for the AC drive to decelerate from the Maximum Output Frequency (Pr.1-00) down to 0 Hz. The rate is linear unless S-Curve is "Enabled."

📖 The acceleration/deceleration time 2 determines the time for the AC drive to acceleration/deceleration from 0Hz to Maximum Output Frequency (Pr.1-00) (acceleration/deceleration time 1 is the default). A Multi-Function Input terminal must be programmed to select acceleration/deceleration time 2 and the terminals must be closed to select acceleration/deceleration time 2. See Pr.4-04 to Pr.4-08.

📖 In the diagram shown below, the acceleration/deceleration time of the AC drive is the time between 0 Hz to Maximum Output Frequency (Pr.1-00). Suppose the Maximum Output Frequency is 60 Hz, start-up frequency (Pr.1-05) is 1.0 Hz, and acceleration/deceleration time is 10 seconds. The actual time for the AC drive to accelerate from start-up to 60 Hz is 9.83 seconds and the deceleration time is also 9.83 seconds.

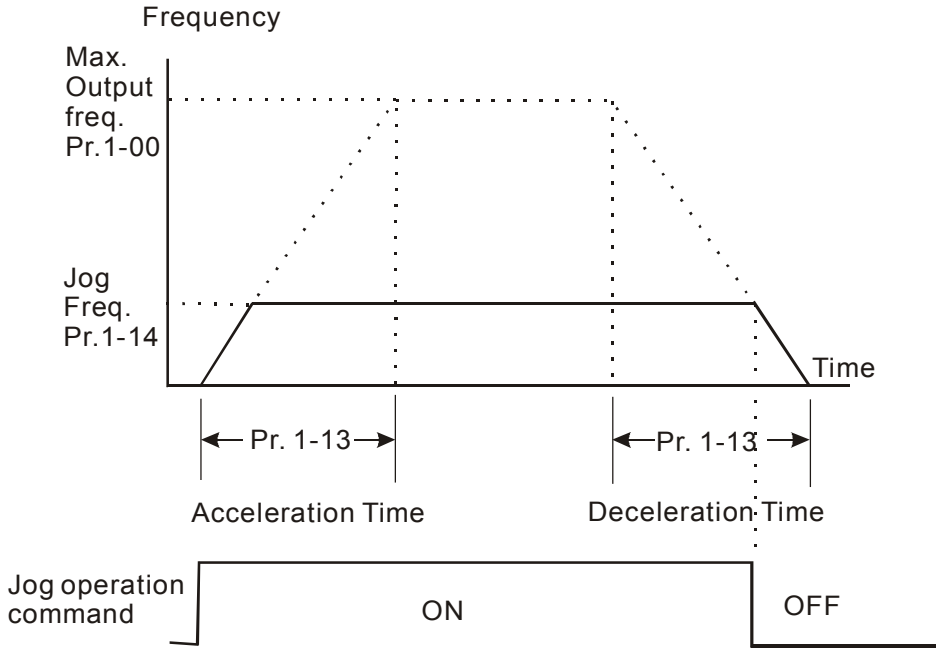


$$\text{Actual Acceleration/Deceleration Time} = \frac{\text{Acceleration/Deceleration Time} \times (\text{Master Freq.} - \text{Min.Output Freq.})}{\text{Max. Output Freq.}}$$

1 - 13	Jog Acceleration/Deceleration Time	Factory Setting: d 10.0
	Settings d 0.1 to d 600Sec	Unit: 0.1Sec
	This parameter can be set during operation.	

1 - 14	Jog Frequency	Factory Setting: d 6.0
	Settings d 1.0 to d 400Hz	Unit: 0.1Hz
	This parameter can be set during operation.	

The JOG function can be selected using Multi-function Input terminals (Pr.4-04 to Pr.4-08) if programmed for Jog (d10). When the Jog terminal is "closed", the AC drive will accelerate from Minimum Output Frequency (Pr.1-05) to Jog Frequency (Pr.1-14). When the Jog terminal "open", the AC drive will decelerate from Jog Frequency to zero. The acceleration/deceleration time is decided by the Jog acceleration/deceleration time (Pr.1-13). During operation, the AC drive cannot perform Jog command. And during Jog operation, other operation commands cannot be accepted, except command of FORWARD, REVERSE and STOP keys on the digital keypad.



1 - 15	Auto Acceleration / Deceleration	Factory Setting: d 0

Settings
- d 0 Linear acceleration / deceleration.
- d 1 Auto acceleration, linear Deceleration.
- d 2 Linear acceleration, auto Deceleration.
- d 3 Auto acceleration / deceleration
- d 4 Linear acceleration, auto deceleration, and stall prevention during deceleration.
- d 5 Auto acceleration, auto deceleration, and stall prevention during deceleration

🕮 If the auto acceleration/deceleration is selected, the AC drive will acceleration/deceleration in the fastest and smoothest means possible by automatically adjusting the time of acceleration/deceleration.

1 - 16	S-Curve in Acceleration	Factory Setting: d 0

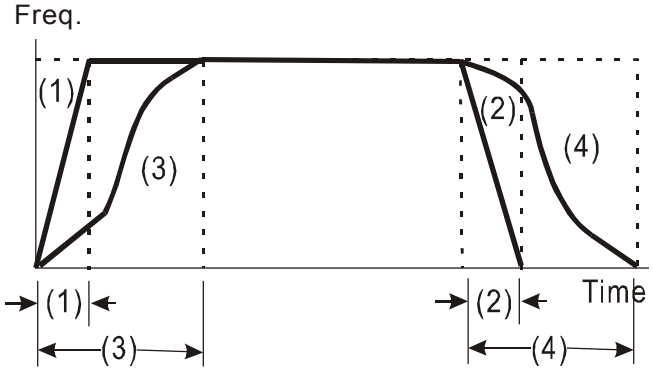
Settings d 0 to d 7

1 - 17	S-Curve in Deceleration	Factory Setting: d 0

Settings d 0 to d 7

🕮 These two parameters allow you to configure whether the acceleration and/or deceleration ramps are linear or S-shaped. The S-curve is enabled when set at d1-d7. Setting d1 offers the quickest S-curve and d7 offers the longest and smoothest S-curve. The AC drive will not follow the acceleration/deceleration time in Pr.1-09 to Pr.1-12. To Disable the S-curve, set Pr.1-16 and Pr.1-17 to d0.

🕮 From the diagram shown below, the original setting acceleration/deceleration time will be for reference when the function of the S-curve is enabled. The actual acceleration/deceleration time will be determined based on the S-curve selected (d1 to d7).



Acceleration/Deceleration characteristics
(1), (2) Disabling S curve
(3), (4) Enabling S curve

1 - 18	Jog Decelerating Time	Factory Setting: d0.0

Settings d0.0 to d600

When Pr.1-18 is set to d0.0 Jog decelerating time determined by the setting of Pr.1-13 0.1 to 600 sec, Jog decelerating time can be set independently, separates from Pr.1-13

When Pr.1-18 is set to 0.0, Pr.1-13 determines both Jog acceleration and deceleration time. When Pr.1-18 is set between 0.1 to 600 seconds, which will determine Jog Decelerating Time and Pr.1-13 will only determine Jog Accelerating Time.

5.3 Group 2: Operation Method Parameters

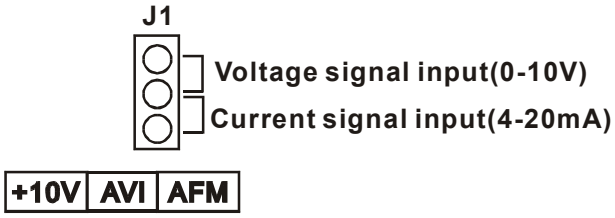
2 – 00	Source of Frequency Command	Factory Setting: d 0

Settings

- d 0 Master Frequency input determined by digital keypad. (record the frequency of power loss and it can do analog overlap plus)
- d 1 Master Frequency determined by analog signal DC 0V-10V (external terminal AVI). (won't record the frequency of power loss and it can't do analog overlap plus)
- d 2 Master Frequency determined by analog signal DC 4mA - 20mA (external terminal AVI). (won't record the frequency of power loss and it can't do analog overlap plus)
- d 3 Master Frequency determined by Potentiometer on the digital keypad. (won't record the frequency of power loss and it can do analog overlap plus)
- d 4 Master Frequency operated by RS-485 serial communication interface and record frequency of power loss. (record the frequency of power loss and it can do analog overlap plus)
- d 5 Master Frequency operated by RS-485 serial communication interface and won't record frequency before power loss. (won't record the frequency of power loss and it can do analog overlap plus)

🕮 This parameter sets the Frequency Command Source of the AC drive.
If the Frequency Command Source is external (DC 0 to +10V or 4 to 20mA), please make sure the (AVI) terminal jumper is in the proper position as shown below.

🕮 Position of jumper: Please open the top cover. It is at the lower-left corner of the panel. The jumper J1 determines the type of external analog input, either DC voltage signal or current signal.



When setting analog overlap plus, it needs to set Pr. 2-06 to select AVI or ACI.

2 - 01	Source of Operation Command	Factory Setting: d 0

Settings		
	d 0	Controlled by the keypad
	d 1	Controlled by the external terminals, keypad STOP enabled.
	d 2	Controlled by the external terminals, keypad STOP disabled.
	d 3	Controlled by the RS-485 communication interface, keypad STOP enabled.
	d 4	Controlled by the RS-485 communication interface, keypad STOP disabled.

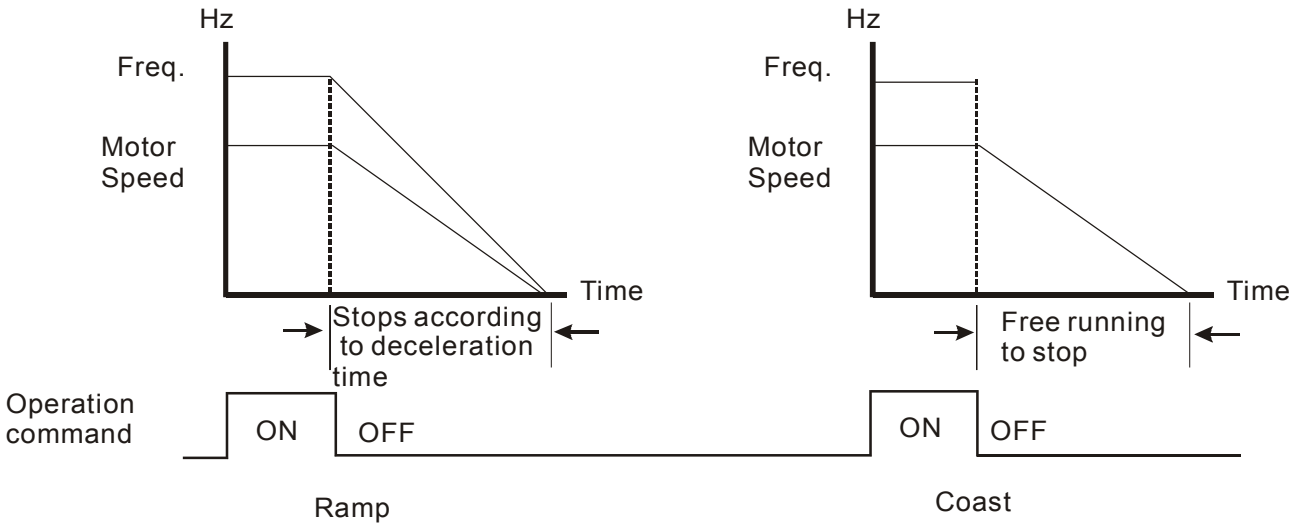
When the AC drive is controlled by an external source, please refer to parameter group 4 for detailed explanations on related parameter settings.

2 - 02	Stop Method	Factory Setting: d 0

Settings		
	d 0	Ramp stop
	d 1	Coast stop

The parameter determines how the motor is stopped when the AC drive receives a valid stop command.

1. Ramp: the AC drive decelerates the motor to Minimum Output Frequency (Pr.1-05) and then stops according to the deceleration time set in Pr.1-10 or Pr.1-12.
2. Coast: the AC drive stops output instantly upon command, and the motor free runs until it comes to a complete stop.



Note: The motor stop method is usually determined by the characteristics of the motor load and frequency of stops.

2 - 03	PWM Carrier Frequency Selections	Factory Setting: d 10
Settings	d 03 fc= 3KHz d 04 fc= 4KHz d 05 fc= 5KHz to d 10 fc= 10KHz	Unit: 1KHz

This parameter can set the carrier frequency of PWM output.

Carrier Frequency	Acoustic Noise	Electromagnetic Noise, Leakage Current	Heat Dissipation
3KHz ↕ 10KHz	Significant ↕ Minimal	Minimal ↕ Significant	Minimal ↕ Significant

🕮 From the above table, we see that the carrier frequency of PWM output has a significant influence on the electromagnetic noise, heat dissipation of the AC drive, and the acoustic noise to the motor.

2 - 04	Reverse Operation	Factory Setting: d 0

Settings	d 0	Enable REV operation
	d 1	Disable REV operation

📖 The parameter determines whether the AC drive can operate in the reverse direction.

2 - 05	Loss of ACI Signal	Factory Setting: d 0

Settings	d 0	Upon the loss of ACI, the drive will default to an output frequency of 0 Hz.
	d 1	Upon the loss of ACI, the drive will stop and display error message “EF”.
	d 2	Upon the loss of ACI, the drive will continue to run at the last known ACI input.

📖 This parameter is only effective when the Source of Frequency is commanded by a 4 to 20 mA signal. The ACI input is considered lost when the ACI signal falls below 2 mA.

5

2 - 06	Analog Auxiliary Frequency Operation	Factory Setting: d 0

Settings	d 0	Disable
	d 1	Enable + AVI (0~10V)
	d 2	Enable + ACI (4~20mA)

📖 This parameter is used to determinate that the analog signal to overlap is 0~10V (AVI) or 4~20mA (ACI).

📖 To make sure the short PIN of J1 on the panel is correct position before setting this parameter.

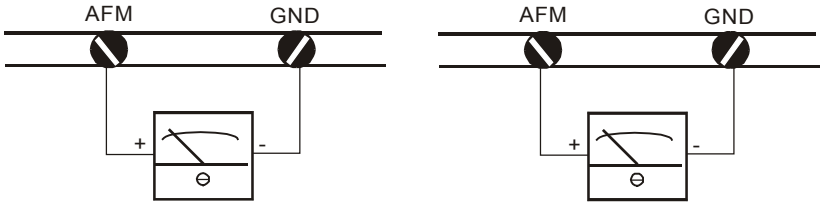
5.4 Group 3: Output Function Parameters

3 - 00	Analog Output Signal	Factory Setting: d 0
Settings	d 0	Analog frequency meter (0 to Maximum Output Frequency).
	d 1	Analog current meter (0 to 250% of the rated AC drive current).

🕮 This parameter selects either Output Frequency or current to be displayed using the 0 to10V AFM output.

3 - 01	Analog Output Gain	Factory Setting: d100
Settings	d 1 to d 200%	Unit: 1%
	The parameter can be set during operation.	

🕮 The parameter sets the voltage range of the analog output signal at terminals AFM, that corresponds with either the output frequency or the output current of the VFD.



Analog Frequency Meter Analog Current Meter

The analog output voltage is directly proportional to the output frequency of the AC drive. With the factory setting of 100%, the Maximum Output Frequency (Pr.1-00) of the AC drive corresponds to +10VDC analog voltage output. (The actual voltage is about +10VDC, and can be adjusted by Pr.3-01).

The analog output voltage is directly proportional to the output current of the AC drive. With the factory setting of 100%, the 2.5 times rated current of the AC drive corresponds to +10VDC analog voltage output. (The actual voltage is about +10VDC, and can be adjusted by Pr. 3-01)

Note: Voltmeter specification: The sourcing capability of the output is limited to 0.21mA. Sourcing voltage: 10V. Output resistance: 47kΩ.

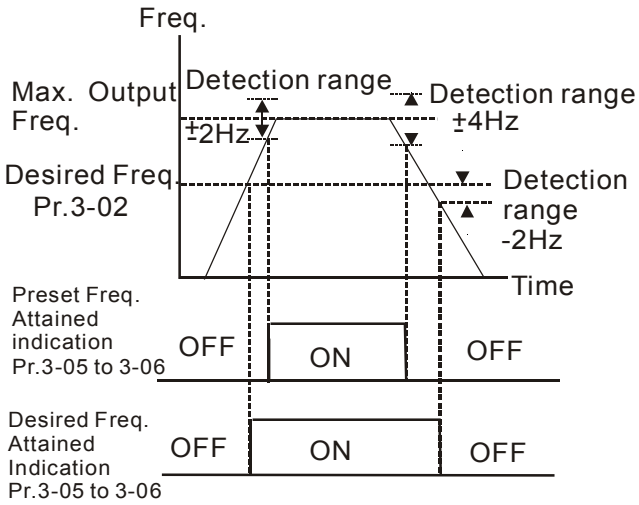
If the meter reads full scale at a voltage less than 10 volts, then Pr.3-01 should be set by the following formula:

Pr.3-01 = ((meter full scale voltage)/10) ×100%

For example: When using the meter with full scale of 5 volts, adjust Pr.3-01 to 50%.

3 - 02	Desired Frequency Attained	Factory Setting: d 1.0
	Settings d 1.0 to d 400 Hz	Unit: 0.1Hz

🕮 If a Multi-function output terminal is set to function as Desired Frequency Attained (Pr.3-05 or 3-06=d9), then the output will be activated when the programmed frequency is attained.



Desired Freq. Attained & Preset Freq. Attained

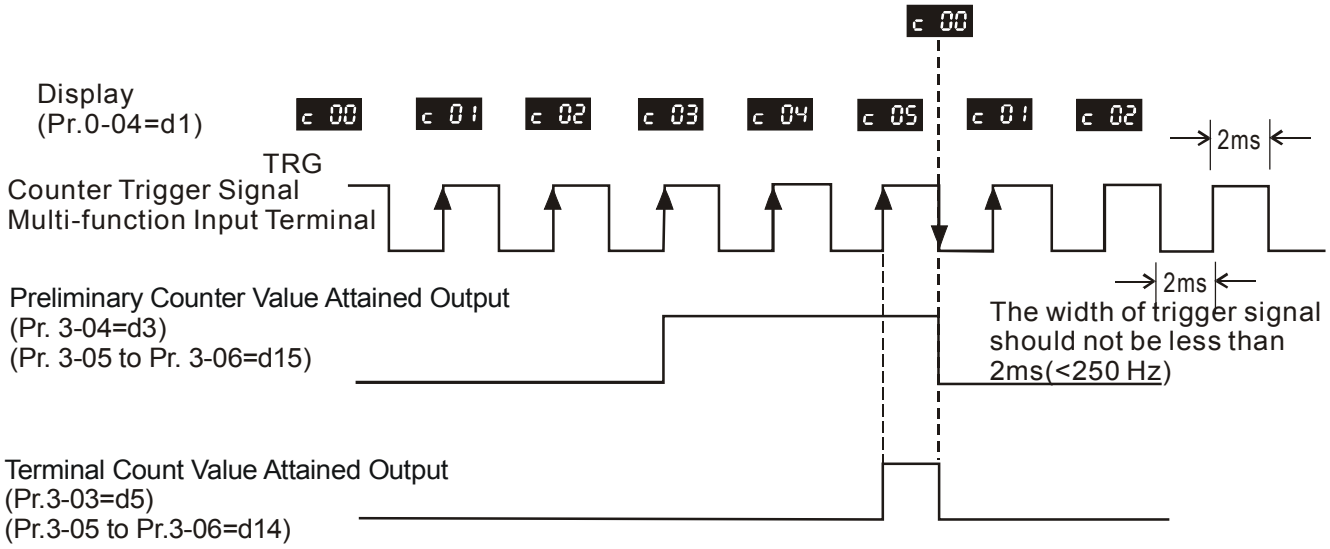
3 - 03	Terminal Count Value	Factory Setting: d 0
	Settings d 0 to d 999	

🕮 The parameter determines the upper limit value of the internal counter. The internal counter can be triggered by the external terminal (Pr.4-4 to Pr.4-8, d19). Upon completion of counting, the specified output terminal will be activated. (Pr.3-05, Pr.3-06, d14).

3 - 04	Preliminary Count Value	Factory Setting: d 0
	Settings d 0 to d 999	

🕮 When the counter value is counted up from “1” to the setting value of this parameter, the corresponding multi-function output terminal which set to d15 as Preliminary Counter Value Attained will be closed**.** The application can be that closing the multi-function output terminal makes the AC drive operate at low speed until stop before the counting value is going to be attained.

The timing diagram is shown below:



3 - 05	Multi-function Output Terminal 1 (Photocoupler output)	Factory Setting: d 1
3 - 06	Multi-function Output Terminal 2 (relay output)	Factory Setting: d 8

Settings d 0 to d 18

Function Table List:

Setting	Function	Setting	Function
d 0	Not used	d 10	PLC Program Running
d 1	AC Drive Operational	d 11	PLC Program Step Completed
d 2	Maximum Output Frequency Attained	d 12	PLC Program Completed
d 3	Zero speed	d 13	PLC Operation Paused
d 4	Over-Torque detection	d 14	Terminal Count Value Attained
d 5	Base-Block (B.B.) Indication	d 15	Preliminary Counter Value Attained
d 6	Low-Voltage Indication	d 16	Ready State Indicator
d 7	AC Drive Operation Mode	d 17	FWD command indication
d 8	Fault indication	d 18	REV command indication
d 9	Desired Frequency Attained		

Function Explanations:

d 0 Not Used.

d 1 AC drive operational: the output terminal will be activated when the drive is running.

d 2 Maximum Output Frequency Attained: the output will be activated when the AC drive attains Maximum Output Frequency.

d 3 Zero speed: the output will be activated when Command Frequency is lower than the Minimum Output Frequency.

d 4 Over-Torque Detection: the output will be activated as long as the over-torque is detected. Pr.6-04 determines the Over-Torque detection level.

d 5 Base-Block (B.B.) Indication: the output will be activated when the output of the AC drive is shut off by external Baseblock.

d 6 Low Voltage Indication: the output will be activated when low voltage is detected.

d 7 AC Drive Operation Mode: the output will be activated when the operation of the AC drive is controlled by External Control Terminals.

d 8 Fault Indication: the output will be activated when faults occur (oc, ov, oH, oL, oL1, EF, cF3, HPF, ocA, ocd, ocn, GF).

d 9 Desired Frequency Attained: the output will be activated when the desired frequency (Pr.3-02)is attained.

d10 PLC Program Running: the output will be activated when the PLC program is running.

d11 PLC Program Step Completed: the output will be activated for 0.5 sec. when each multi-step speed is attained.

d12 PLC Program completed: the output will be activated for 0.5 sec. when the PLC program cycle has completed.

d13 PLC Program Operation Paused: the output will be activated when PLC operation is paused.

d14 Terminal Count Value Attained: counter reaches Terminal Count Value.

d15 Preliminary Count Value Attained: counter reaches Preliminary Count Value.

d16 Ready State Indicator.

d17 FWD command indication: When AC drive receives the command of forward running, it will output immediately no matter AC drive is in the state of run or stop.

d18 REV command indication: When AC drive receives the command of reverse running, it will output immediately no matter AC drive is in the state of run or stop.

5.5 Group 4: Input Function Parameters

4 - 00	Potentiometer Bias Frequency	Factory Setting: d0.0
Settings	d 0.0 to d 100.0%	Unit: 0.1%

This parameter can be set during the operation.

4 - 01	Potentiometer Bias Polarity	Factory Setting: d 0

Settings d 0 Positive bias

d 1 Negative bias

This parameter can be set during the operation.

4 - 02	Potentiometer Frequency Gain	Factory Setting: d 100
Settings	d 1 to d 200%	Unit: 1%

This parameter can be set during the operation.

4 - 03	Potentiometer Reverse Motion Enable	Factory Setting: d 0

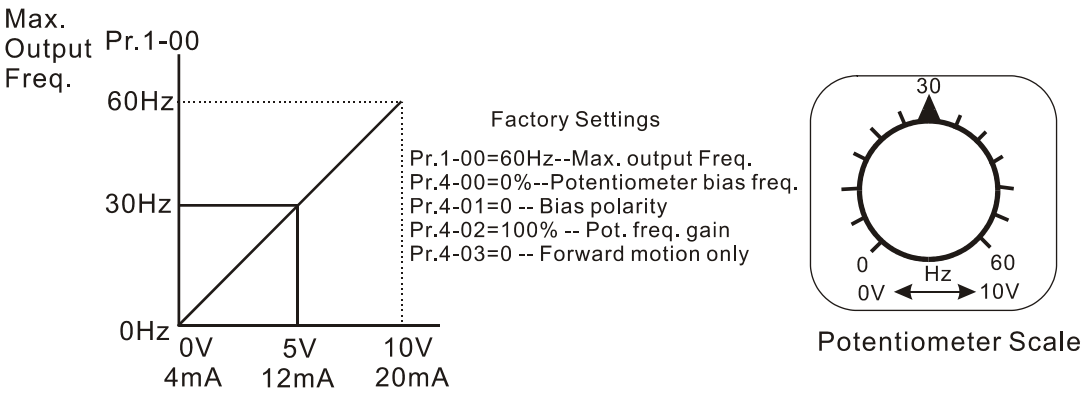
Settings d 0 Forward motion only

d 1 Reverse motion enable (must be negative bias)

📖 Pr.4-00 to Pr.4-03 are used when the source of frequency command is the analog signal (0 to +10V DC or 4 to 20 mA DC). Refer to the following examples.

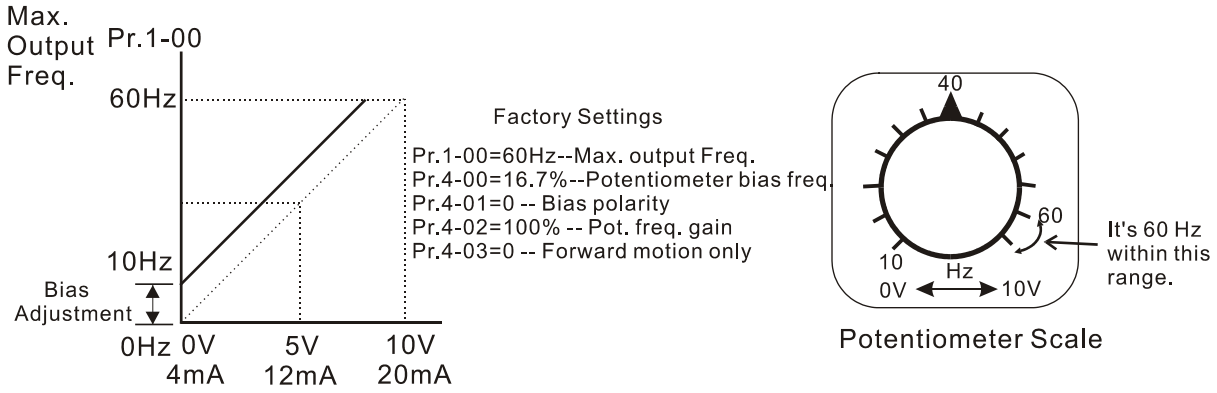
Example 1:

The following is the most common method. Set parameter 2-00 to d1 (0 to +10V signal) or d2 (4 to 20mA current signal).



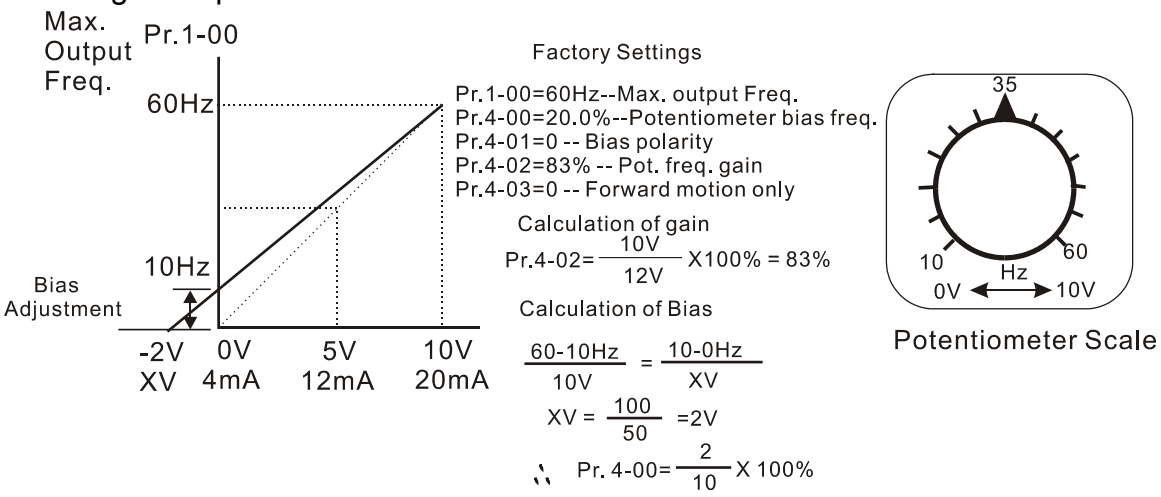
Example 2:

In this example with the potentiometer set to 0V the Output Frequency is 10 Hz. The mid-point of the potentiometer becomes 40 Hz. Once the Maximum Output Frequency is reached any further increase of the potentiometer will not increase output frequency.



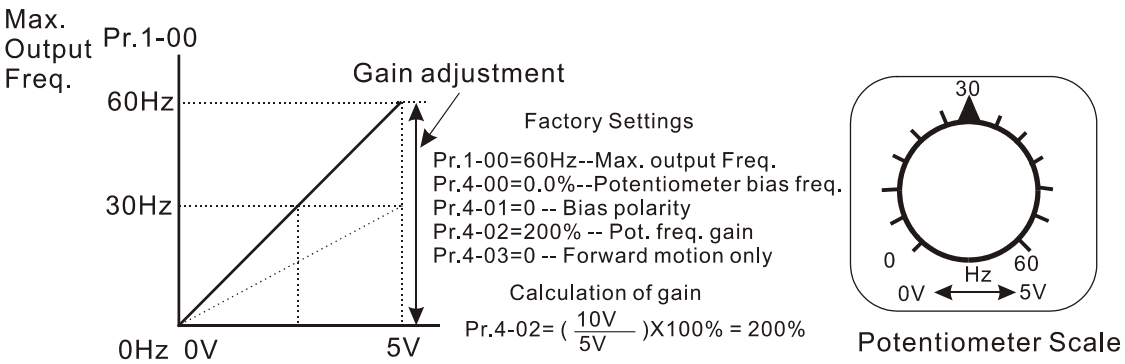
Example 3:

The example also shows the popular method. The whole scale of the potentiometer can be used as desired. In addition to signals of 0 to 10V and 4 to 20mA, the popular voltage signals also include signals of 0 to 5V, 20 to 4mA or that under 10V. Regarding the setting, please refer to the following examples.



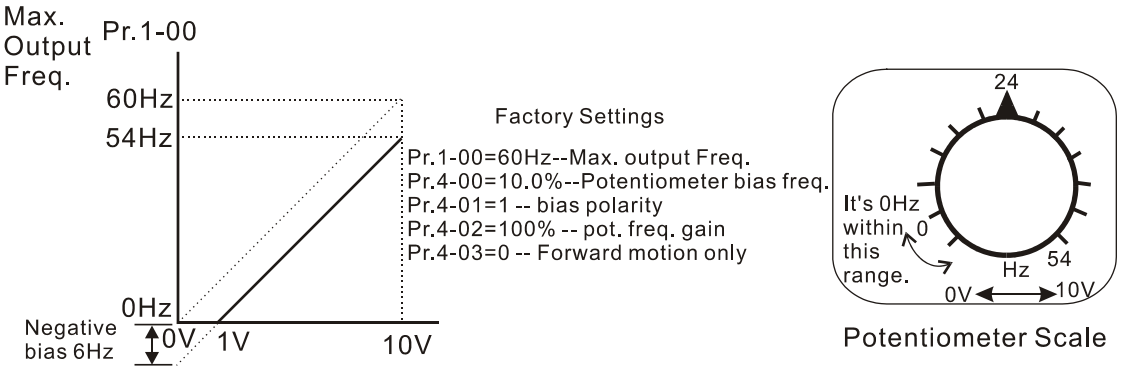
Example 4:

This example shows a potentiometer range of 0 to 5 Volts.



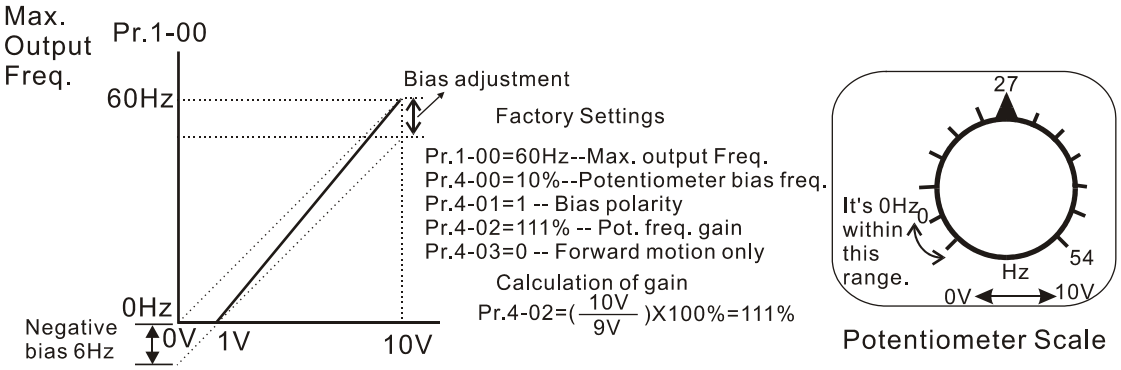
Example 5:

In this example a 1 volt negative bias is used. In a noise environment, it is advantageous to use negative bias to provide a noise margin (1V in this example).



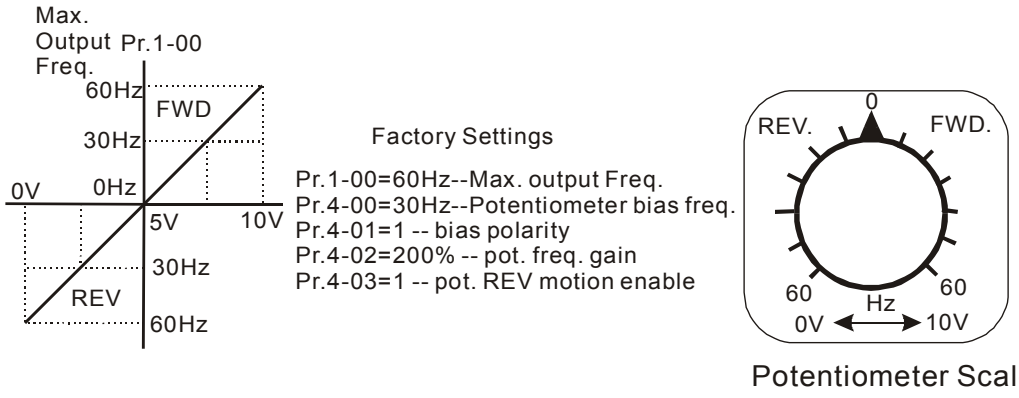
Example 6:

In this example, a negative bias is used to provide a noise margin. Also a potentiometer frequency gain is used to allow the Maximum Output Frequency to be reached.



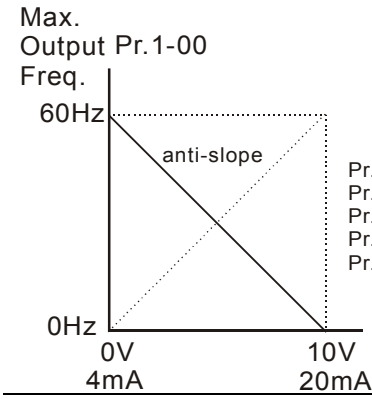
Example 7:

In this example, the potentiometer is programmed to run a motor is both forward and reverse direction. A motor will be idle when the potentiometer position is at mid-point of its scale. Using Pr.4-03 will disable the external FWD and REV controls.

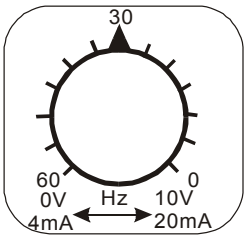


Example 8:

In this example, the option of anti-slope is shown. Anti-slope is used in an application where control of pressure, temperature, or flow is needed. Under a high pressure or flow situation, a sensor will generate a large signal such as 20 mA or 10V. With anti-slope enable, the large signal will slow or stop the AC drive



Factory Settings
Pr.1-00=60Hz--Max. output Freq.
Pr.4-00=60Hz--Potentiometer bias freq.
Pr.4-01=1 -- bias polarity
Pr.4-02=100% -- pot. freq. gain
Pr.4-03=1 -- pot. REV. motion enable



Potentiometer Scale

4 - 04	Multi-function Input Terminal (M0, M1)	Factory Setting: d 1
	Settings d 0 to d 26	
4 – 05	Multi-function Input Terminal (M2)	Factory Setting: d 6
4 – 06	Multi-function Input Terminal (M3)	Factory Setting: d 7
4 – 07	Multi-function Input Terminal (M4)	Factory Setting: d 8
4 – 08	Multi-function Input Terminal (M5)	Factory Setting: d 9
	Settings d 0,d 4 to d 26	

Parameters & Functions table:

Value	Function	Value	Function
d 0	Parameter Disable	d14	External Base Block (N.C.) (Normally Close Contact Input)
d 1	M0: FWD / STOP, M1: REV / STOP		
d 2	M0: RUN / STOP, M1: FWD / REV	d15	Increase Master Frequency
d 3	3-Wire Operation Control mode (M0, M1, M2)	d16	Decrease Master Frequency
d 4	External Fault (Normally Open)	d17	Run PLC Program
d 5	External Fault (Normally Closed)	d18	Pause PLC Program
d 6	External Reset	d19	Counter Trigger Signal
d 7	Multi-Step Speed Command 1	d20	Counter Reset
d 8	Multi-Step Speed Command 2	d21	Select ACI / Deselect AVI (the priority is higher than Pr. 2-00 and d26)
d 9	Multi-Step Speed Command 3	d22	Disable PID function
d10	Jog operation	d23	JOG FWD
d11	Acceleration/Deceleration Speed Inhibit	d24	JOG REV
d12	First or Second Acceleration or Deceleration Time Selection	d25	The source of master frequency is AVI. (The priority is higher than Pr. 2-00 and d26)
d13	External Base Block (N.O.) (Normally Open Contact Input)	d26	The source of master frequency is ACI. (The priority is higher than Pr. 2-00)

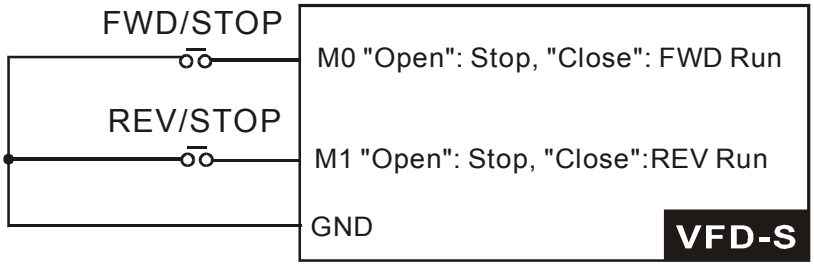
Explanations:

d0 Parameter Disable:

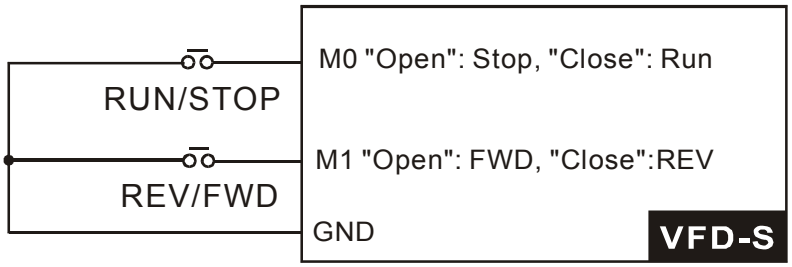
Enter value (d0) to disable any Multi-Function Input Terminal: M1 (Pr.4-04), M2 (Pr.4-05), M3 (Pr.4-06), M4 (Pr.4-07) or M5 (Pr.4-08).

Note: The purpose of this function is to provide isolation for unused Multi-Function Input Terminals. Any unused terminals should be programmed to d0 to insure they have no effect on drive operation.

d1 Two wire operation: Restricted to Pr.4-04 and external terminals M0, M1.

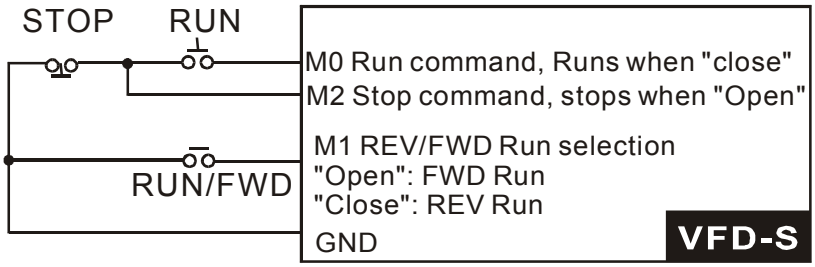


d2 Two wire operation: Restrict to Pr. 4-04 and external terminals M0, M1.



Note: Multi-function Input Terminal M0 does not have its own parameter designation. M0 must be used in conjunction with M1 to operate two and three wire control.

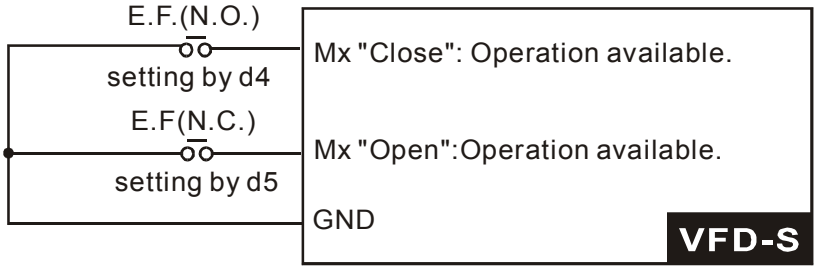
d3 Three Wire Control: Restricted to Pr.4-04 control terminals M0, M1, M2.



Note: When value d3 is selected for Pr. 4-04, this will over ride any value entered in Pr.4-05, since Pr.4-05 must be used for three wire control as shown above.

d4, d5 External Faults:

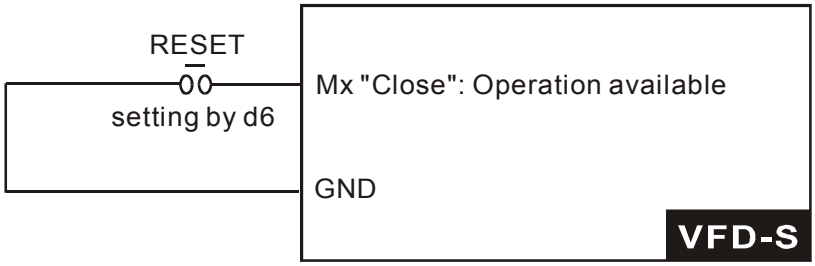
Parameter values d4, d5 programs Multi-Function Input Terminals: M1 (Pr. 4-04), M2 (Pr. 4-05), M3 (Pr. 4-06), M4 (Pr. 4-07) or M5 (Pr. 4-08) to be External Fault (E.F.) inputs.



When an External Fault input signal is received, the AC drive will stop all output and display " E.F." on Digital Keypad, the motor will free run. Normal operation can resume after the External Fault is cleared and the AC drive is reset.

d6 External Reset:

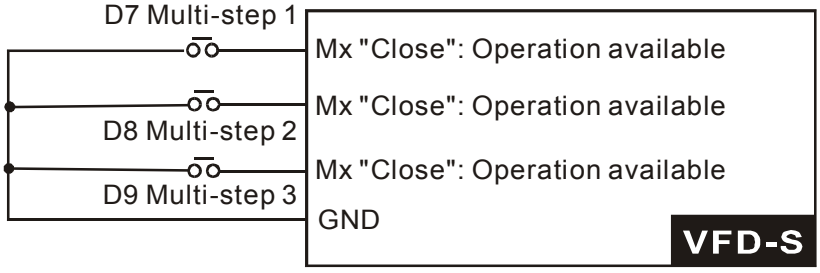
Parameter value d6 programs a Multi-Function Input Terminal: M1 (Pr.4-04), M2 (Pr.4-05), M3 (Pr.4-06), M4 (Pr.4-07) or M5 (Pr.4-08) to be an External Reset.



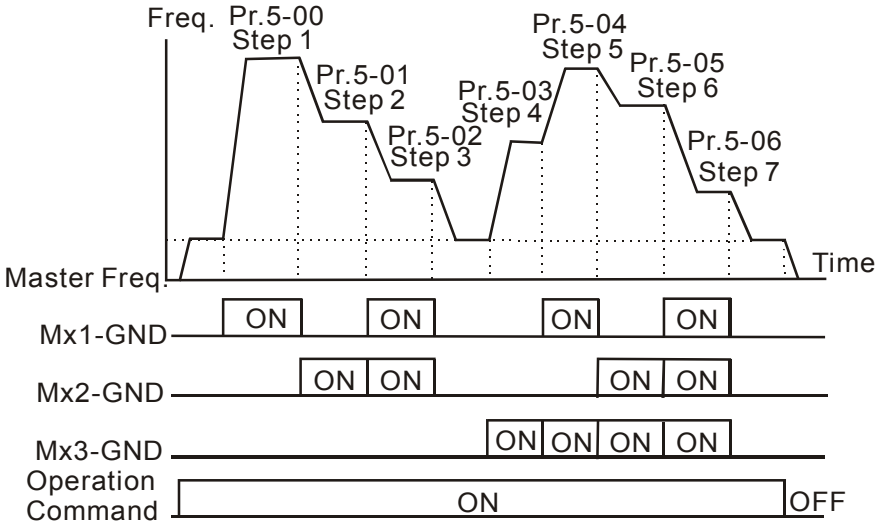
Note: the External Reset has the same function as the Reset key on the Digital keypad. After external fault such as O.H., O.C. and O.V. are clear, this input can be used to reset the drive.

d7, d8, d9 Multi-Step Speed Command:

Parameter values d7, d8, d9 programs any three of the following Multi-Function Input Terminals: M1 (Pr.4-04), M2 (Pr.4-05), M3 (Pr.4-06), M4 (Pr.4-07) or M5 (Pr.4-08) for multi-step speed command function.

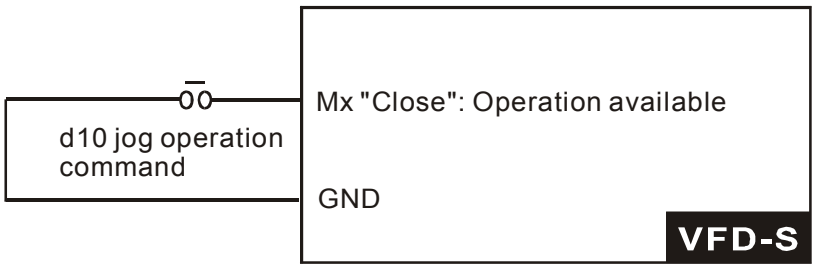


These three inputs select the multi-step speeds defined by Pr.5-00 to Pr.5-06 as shown in the following diagram. Pr.5-07 to Pr.5-16 can also control output speed by programming the AC drive's internal PLC function.



d10 Jog Operation Control:

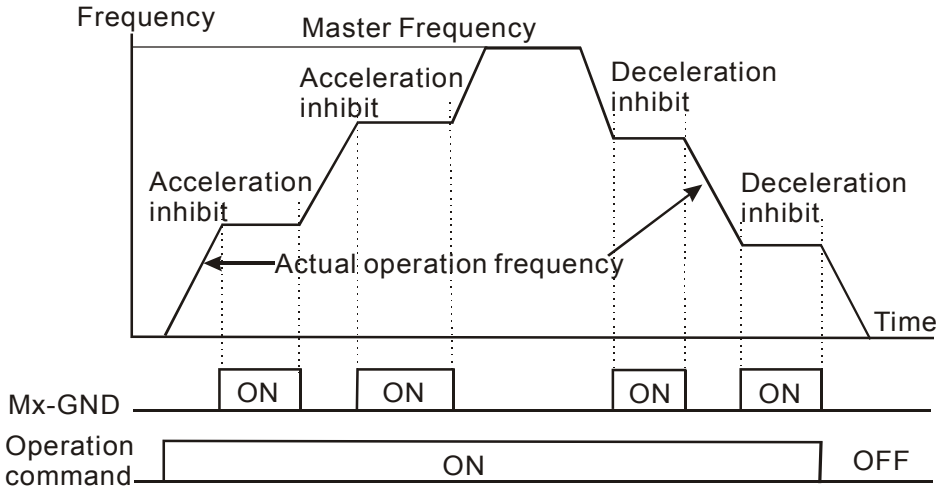
Parameter value d10 programs Multi-Function Input Terminal: M1 (Pr.4-04), M2 (Pr.4-05), M3 (Pr.4-06), M4 (Pr.4-07) or M5 (Pr.4-08) for Jog control.



Note: Jog operation programmed by d10 can only be initiated while the motor is stopped. (Refer to Pr.1-13, Pr.1-14.)

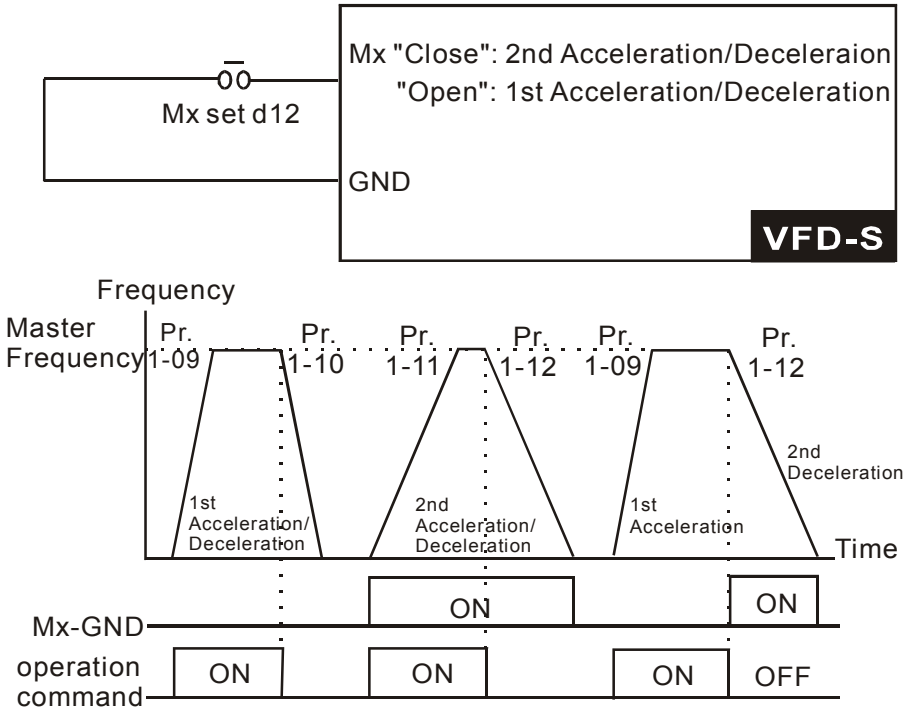
d11 Acceleration/Deceleration Speed Inhibit:

Parameter value d11 programs Multi-Function Input Terminal: M1 (Pr.4-04), M2 (Pr.4-05), M3 (Pr.4-06), M4 (Pr.4-07) or M5 (Pr.4-08) for Acceleration/deceleration Inhibit. When the command is received, acceleration and deceleration is stopped and the AC drive maintains a constant speed.



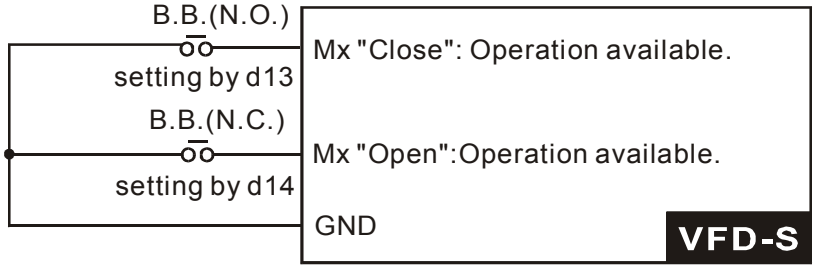
d12 First or Second Acceleration/Deceleration Time Selection:

Parameter value d12 programs a Multi-Function Input Terminal: M1 (Pr.4-04), M2 (Pr.4-05), M3 (Pr.4-06), M4 (Pr.4-07) or M5 (Pr.4-08) to control selection of First or Second Acceleration/deceleration time. (Refer to Pr.1-09 to Pr.1-12.)

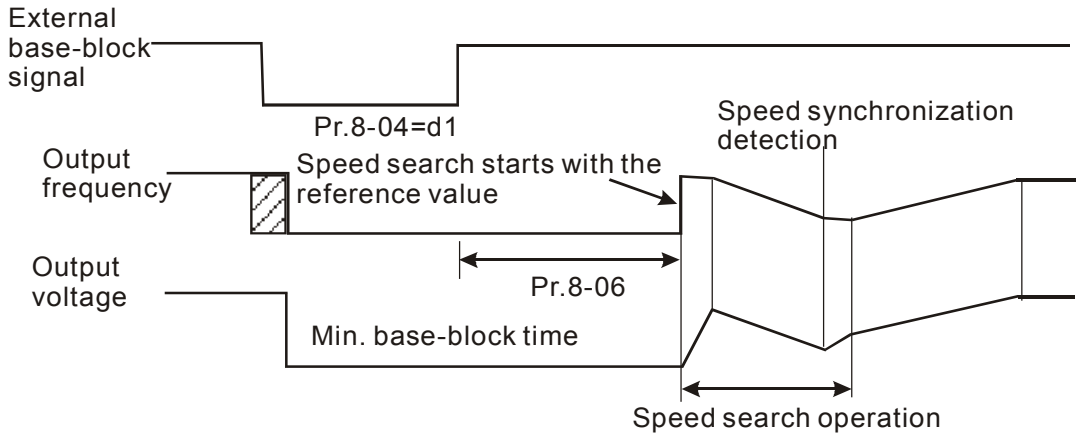


d13, d14 External Base Block:

Parameter values d13, d14 program Multi-Function Input Terminals: M1 (Pr.4-04), M2 (Pr.4-05), M3 (Pr.4-06), M4 (Pr.4-07) or M5 (Pr.4-08) for external Base Block control. Value d13 is for normally open (N.O.) input, and value d14 is for a normally closed (N.C.) input.

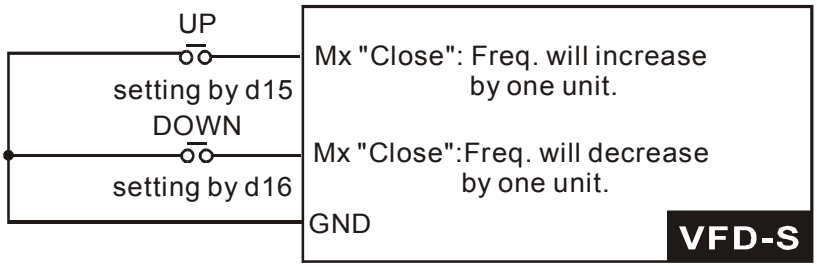


Note: When a Base-Block signal is received, the AC drive will stop all output and the motor will free run. When base block control is deactivated, the AC drive will start its speed search function and synchronize with the motor speed, and then accelerate to Master Frequency.



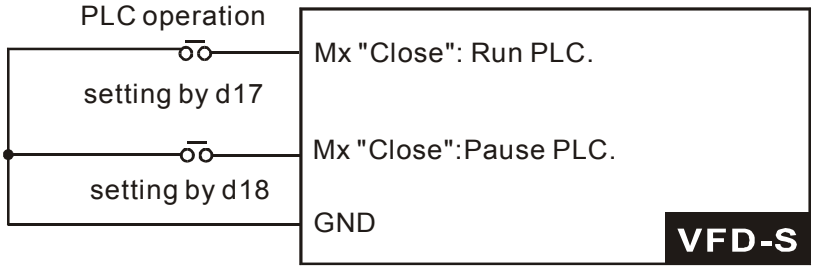
d15, d16 Increase/Decrease Master Frequency:

Parameter values d15, d16 program the Multi-Function Input Terminals: M1 (Pr.4-04), M2 (Pr.4-05), M3 (Pr.4-06), M4 (Pr.4-07) or M5 (Pr.4-08) to incrementally increase/ decrease the Master Frequency each time an input is received.



d17, d18 PLC Function Control:

Parameter value d17 programs Multi-Function Input Terminal: M1 (Pr.4-04), M2 (Pr.4-05), M3 (Pr.4-06), M4 (Pr.4-07) or M5 (Pr.4-08) to enable the AC drive internal PLC program. Parameter value d18 programs an input terminal to pause the PLC program.

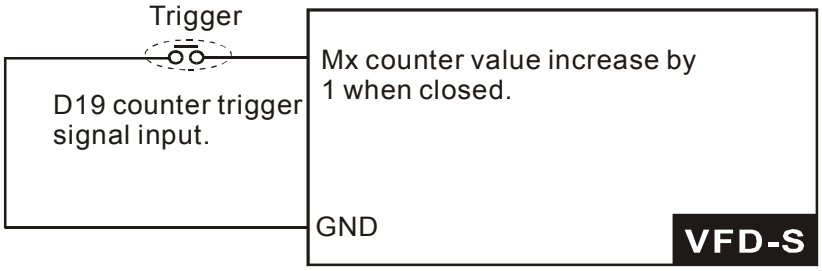


Note: Pr.5-00 to Pr.5-16 define the PLC program.

5

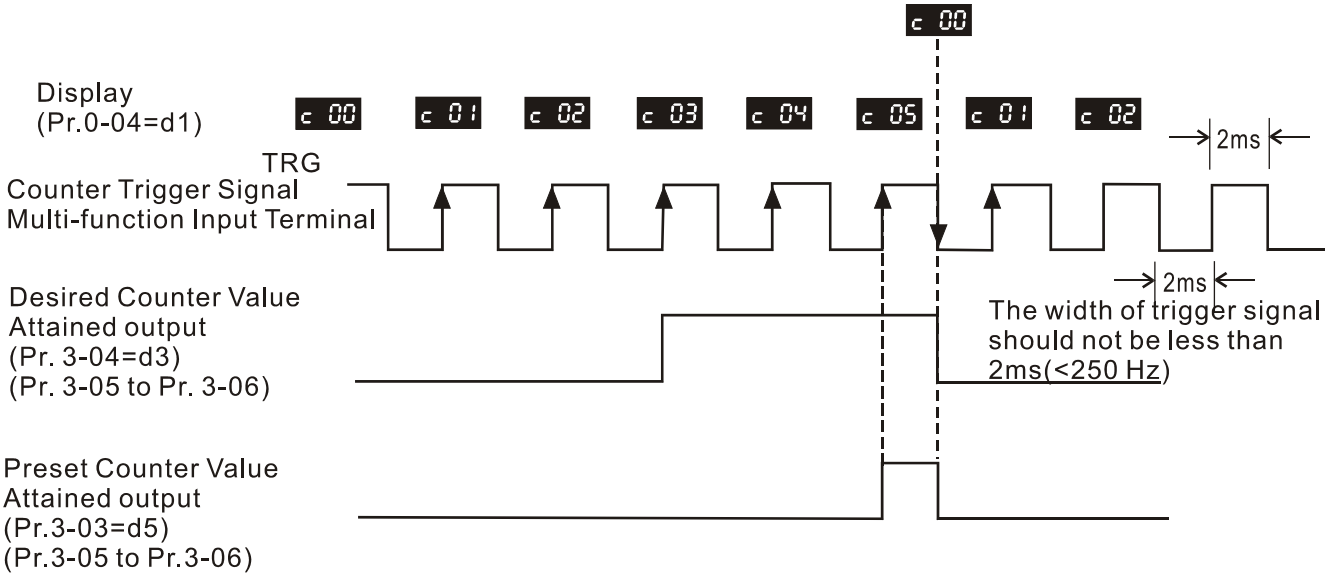
d19 Counter Trigger:

Parameter value d19 programs Multi-Function Input Terminal: M1 (Pr.4-04), M2 (Pr.4-05), M3 (Pr.4-06), M4 (Pr.4-07) or M5 (Pr.4-08) to increase the AC drive's internal counter. When an input is received, the counter is increased by 1.



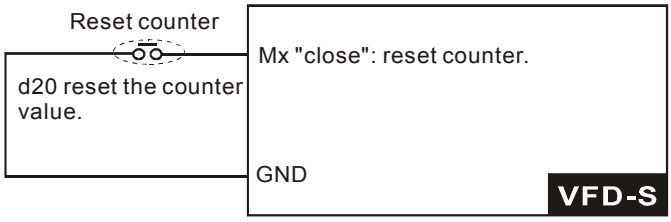
Note:

The Counter Trigger input can be connected to an external Pulse Signal Generator to count a processing step or unit of material. See the diagram below.



d20 Counter Reset:

Parameter value d20 programs Multi-Function Input Terminal: M1 (Pr.4-04), M2 (Pr. 4-05), M3 (Pr.4-06), M4 (Pr.4-07) or M5 (Pr.4-08) to reset the counter.



d21 Select ACI / Deselect AVI:

Parameter value d21 allows the user to select the input type ACI or AVI via an external switch. AVI is selected when the contact is open and ACI is selected when the contact is closed. Please note: the use of this feature will override Pr.2-00 programming and the jumper of the front of the drive must be moved to the correct location either across the AVI or ACI pin head.

4- 09	Line Start Lockout	Factory Setting: d 0

Settings: d0 Disable

d1 Enable

📖 When enabled, the AC drive will not start when powered up with run commands applied. To start in Line Start Lockout mode, the AC drive must see the run command go from stop to run after power up. When Line Start Lockout is disable (also known as Auto-Start), the drive will start when powered-up with run commands applied.

4- 10	Up/down frequency command mode	Factory Setting: d 3

Settings: d0 up/down frequency by acceleration/deceleration time

d1 up frequency according to constant speed, down frequency according to deceleration time

d2 up frequency according to acceleration time, down frequency according to constant speed

d3 up/down frequency by constant speed

4- 11	Acceleration/Deceleration speed of constant up/down frequency	Factory Setting: d 1

Settings: d0 to d1000 Hz/sec Unit: 5 Hz/sec

📖 This parameter is used to set the acceleration/deceleration speed mode when multi-function terminal is set to up/down frequency. (Pr. 4-04 ~ Pr.4-08, function d15, d16)

5.6 Group 5: Multi-step Speed and PLC (Process Logic Control) Parameters

5 - 00	1st Step Speed Frequency	Factory Setting: d 0.0
5 - 01	2nd Step Speed Frequency	Factory Setting: d 0.0
5 - 02	3rd Step Speed Frequency	Factory Setting: d 0.0
5 - 03	4th Step Speed Frequency	Factory Setting: d 0.0
5 - 04	5th Step Speed Frequency	Factory Setting: d 0.0
5 - 05	6th Step Speed Frequency	Factory Setting: d 0.0
5 - 06	7th Step Speed Frequency	Factory Setting: d 0.0

Settings d 0.0 to d 400 Hz Unit: 0.1Hz

This parameter can be set during operation.

🕮 The Multi-Function Input Terminals (refer to Pr.4-04 to 4-08) are used to select one of the AC drive Multi-Step speeds. The speeds (frequencies) are determined by Pr.5-00 to 5-06 shown above.

5 – 07	PLC Mode	Factory Setting: d 0

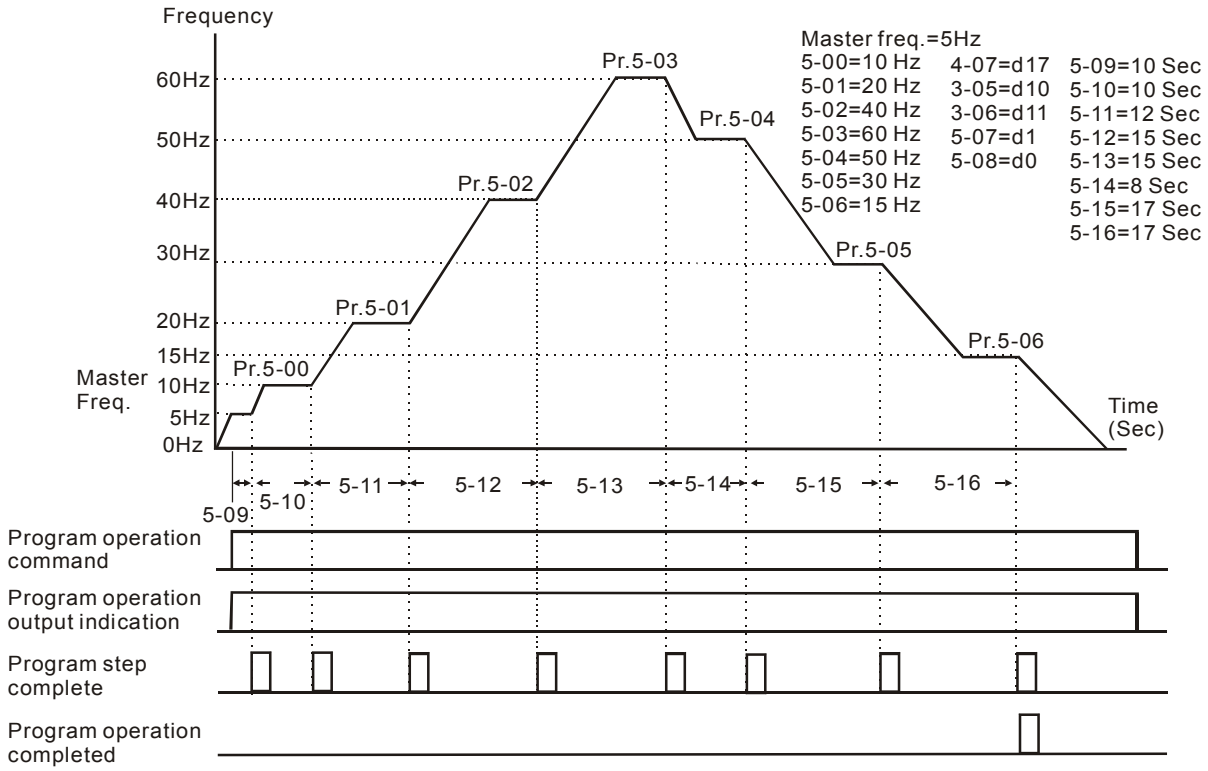
Settings	d 0	Disable PLC operation
	d 1	Execute one program cycle
	d 2	Continuously execute program cycles
	d 3	Execute one program cycle step by step
	d 4	Continuously execute program cycles step by step
	d 5	Disable PLC operation, but can set direction of 1st speed to 7th speed

🕮 This parameter selects the mode of PLC operation for the AC drive. The PLC program can be used in lieu of any External Controls, Relays or Switches. The AC drive will change speeds and directions according to the user's desired programming.

🕮 When this parameter is set to d5 and it is running by external multi-speed, the high priority of the operation direction is Pr. 5-08.

Example 1 (Pr.5-07 = d1): Execute one cycle of the PLC program. Its relative parameter settings are:

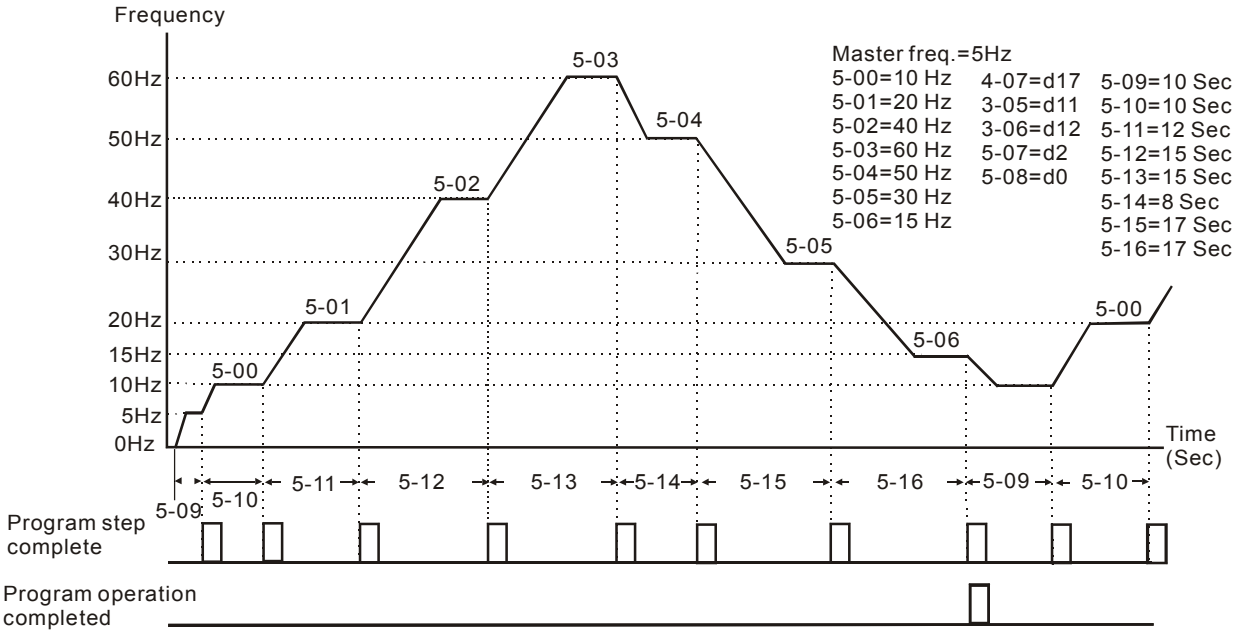
1. Pr.5-00 to 5-06: 1st to 7th step speed (sets the frequency of each step speed).
2. Pr.4-04 to 4-08: Multi-Function Input Terminals (set one multi-function terminal as d17-PLC auto-operation).
3. Pr.3-05 to 3-06: Multi-Function Output Terminals (set a Multi-Function Terminal as d10-PLC operation indication, d11-one cycle in PLC auto mode or d12-PLC operation fulfillment attainment).
4. Pr.5-07: PLC mode.
5. Pr.5-08: Direction of operation for Master Frequency and 1st to 7th step speed.
6. Pr.5-09 to 5-16: operation time setting of Master Frequency and 1st to 7th step speed.



Note: The above diagram shows one complete PLC cycle. To restart the cycle, turn the PLC program off and then back on.

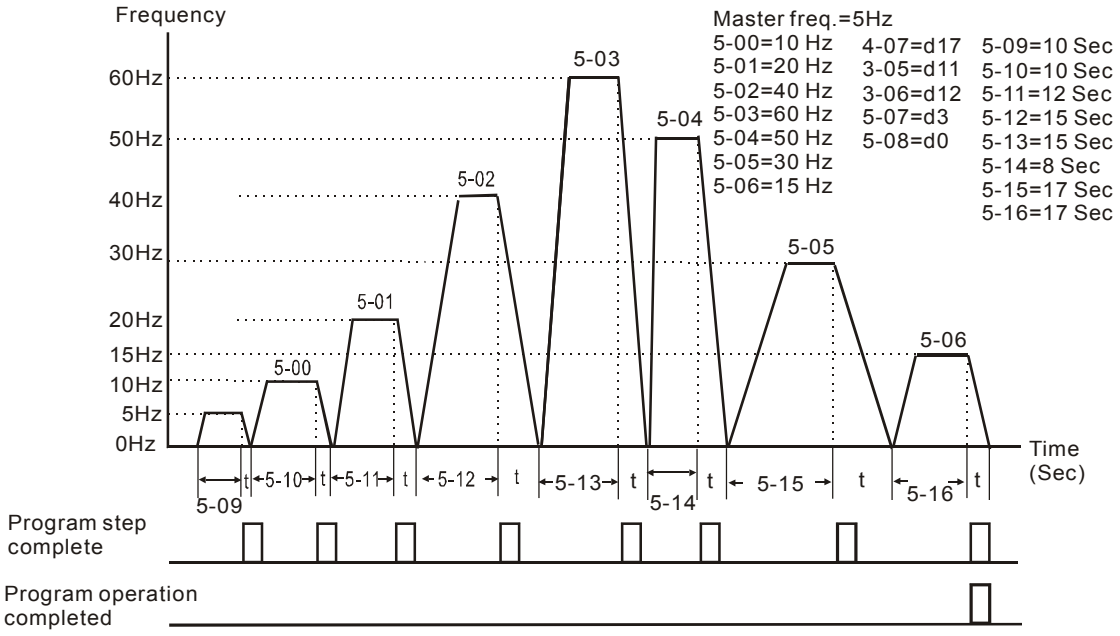
Example 2 (Pr.5-07 = d2): Continuously executes program cycles

The diagram below shows the PLC program stepping through each speed and the automatically starting again. To stop the PLC program, one must either pause the program or turn it off (Refer to Pr.4-05 to 4-08 value d17 and d18).



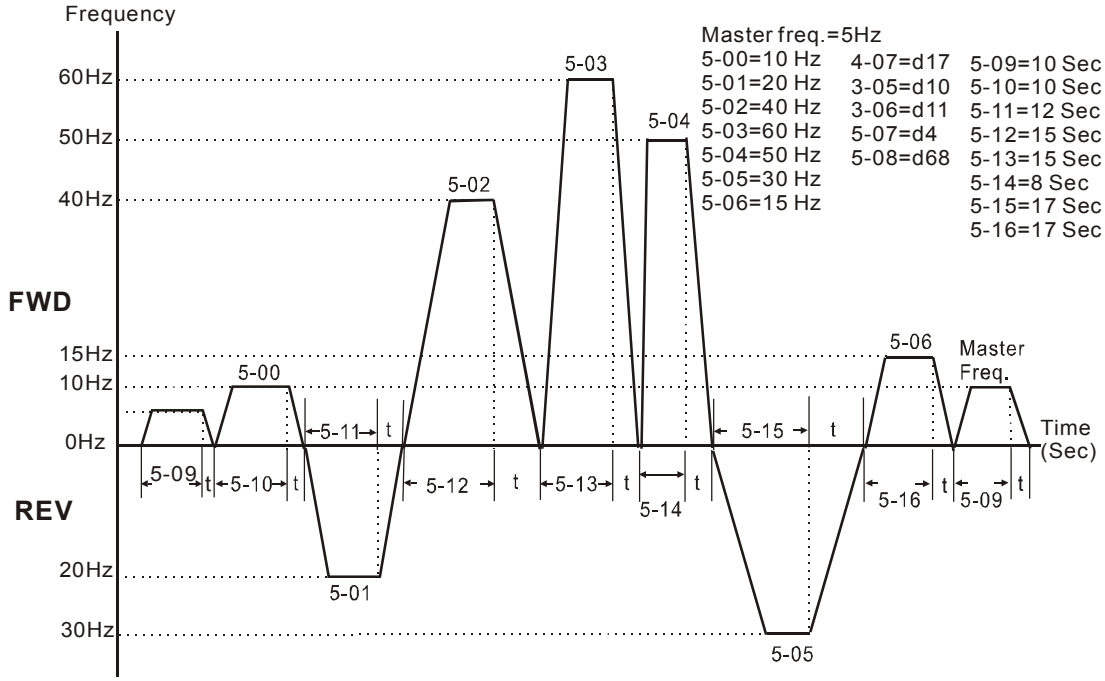
Example 3 (Pr. 5-07 = d3) Execute one cycle step by step:

The example shows how the PLC can perform one cycle at a time, within a complete cycle. Each step will use the acceleration/deceleration times in Pr.1-09 to Pr.1-12. It should be noticed that the time each step spends at its intended frequency is diminished, due to the time spent during acceleration/deceleration.



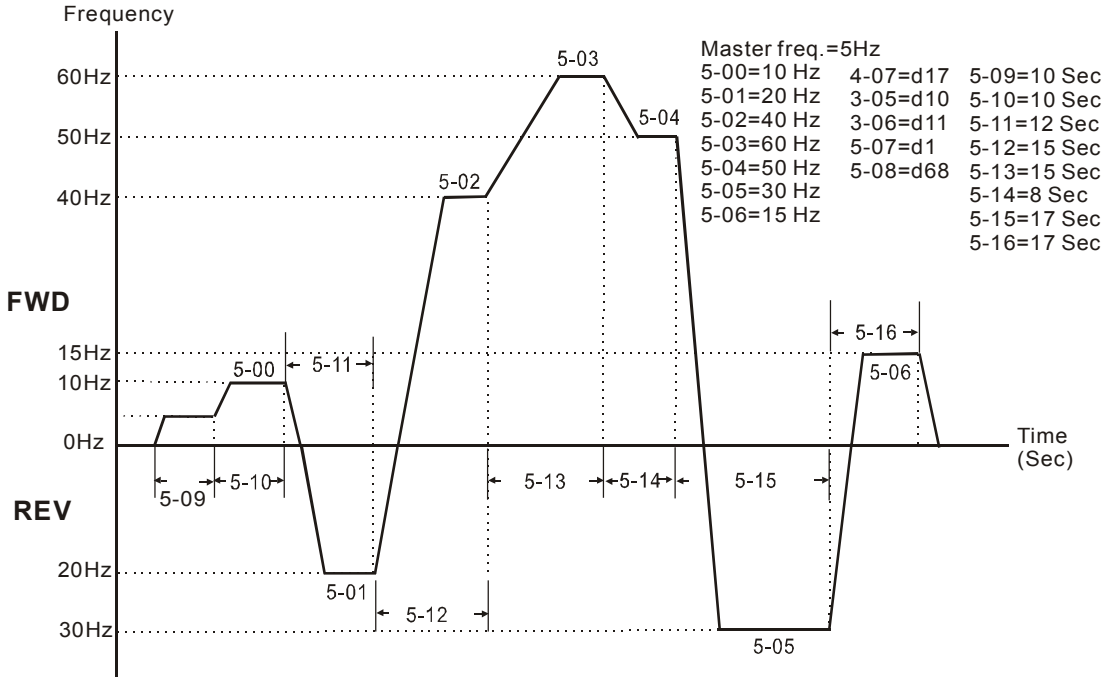
Example 4 (Pr. 5-07 =d 4) Continuously execute PLC cycles step by step:

In this explanation, the PLC program runs continuously step by step. Also shown are examples of steps in the Reverse direction.



Example 5 (Pr. 5-07 = d1 Execute one cycle of the PLC program):

In this example, the PLC program runs continuously. It should be noted that the times of reserve motion may be shorter than expected, due to the acceleration/deceleration times.



* The calculation of time for Pr.5-11, Pr.5-12, Pr.5-15 and Pr.5-16 should be carefully planned.

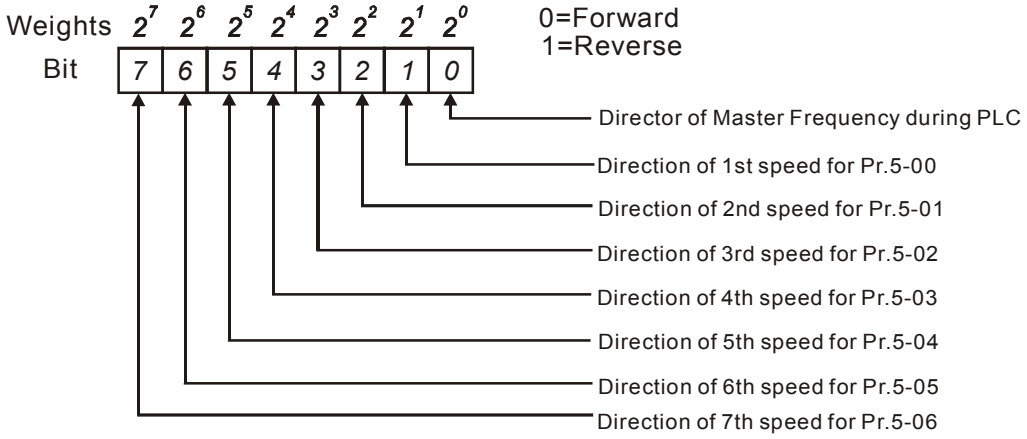
5 - 08	PLC Forward/Reverse Motion	Factory Setting: d 0

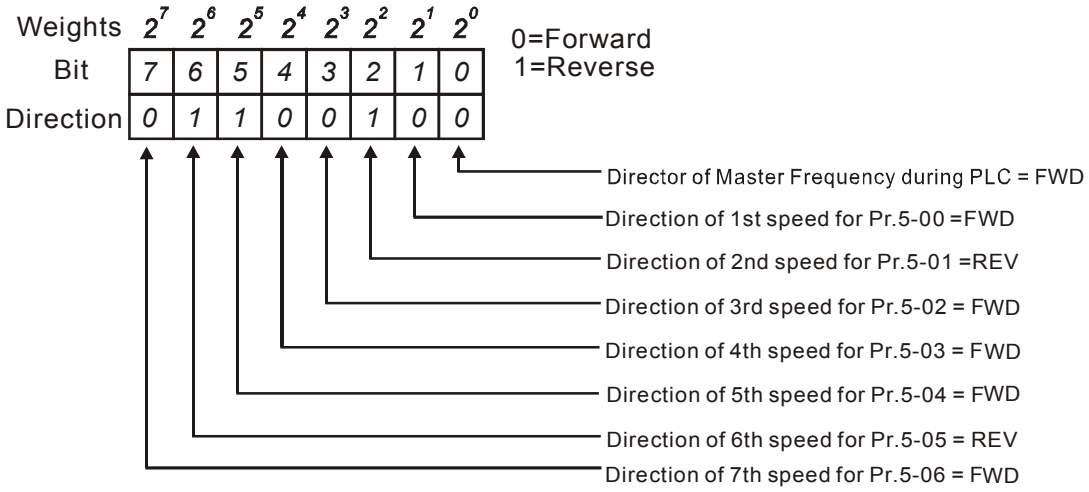
Settings d 0 to d 255

This parameter controls the direction of motion for the Multi-Step Speed Pr.5-00 to Pr.5-06 and the Master Frequency. The original direction of Master Frequency will become invalid.

Note:

The equivalent 8-bit number is used to program the forward/reverse motion for each of the 8 speed steps (including Master Frequency). The binary notation for the 8-bit number must be translated into decimal notation and then be entered.





The setting value = bit7 x 2^7+bit6 x 2^6+bit5 x 2^5+bit4 x 2^4+bit3 x 2^3+bit2 x 2^2+bit1 x 2^1+bit0 x 2^0

= 0 x 2^7+1 x 2^6+0 x 2^5+0 x 2^4+0 x 2^3+1 x 2^2+0 x 2^1+0 x 2^0

= 0+64+0+0+0+4+0+0

= 68

Setting Pr.5-08 as d68.

5 - 09	Time Duration of Master Frequency	Factory Setting: d 0
5 - 10	Time Duration of 1st Step Speed	Factory Setting: d 0
5 - 11	Time Duration of 2nd Step Speed	Factory Setting: d 0
5 - 12	Time Duration of 3rd Step Speed	Factory Setting: d 0
5 - 13	Time Duration of 4th Step Speed	Factory Setting: d 0
5 - 14	Time Duration of 5th Step Speed	Factory Setting: d 0
5 - 15	Time Duration of 6th Step Speed	Factory Setting: d 0
5 - 16	Time Duration of 7th Step Speed	Factory Setting: d 0
	Settings d 0 to d 65500	Unit: 1 sec

📖 Pr.5-10 to Pr.5-16 correspond to operation time of each multi-step speed defined by parameters 5-00 to 5-06. The maximum value of these parameters is 65500 sec., and it's displayed as d 65.5.

Note: If a parameter is set to "d0" (0 Sec), the corresponding step will be skipped. This is commonly used to reduce number of program steps

5.7 Group 6: Protection Parameters

6 - 00	Over-Voltage Stall Prevention	Factory Setting: d 1
Settings	d 0	Disable Over-Voltage Stall Prevention
	d 1	Enable Over-Voltage Stall Prevention

🕮 During deceleration, the motor DC bus voltage may exceed its Maximum Allowable Value due to motor regeneration. When this function is enabled, the AC drive will stop decelerating. Maintaining a constant output frequency when it happens. The AC drive will only resume deceleration when the voltage drops below preset value.

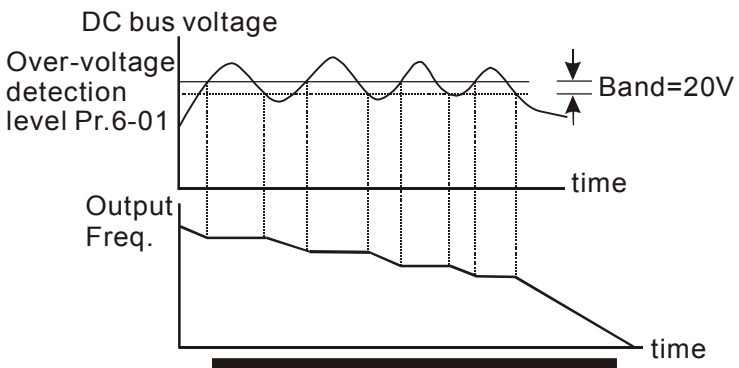
Note:

With a moderate inertial load, the over-voltage during deceleration won't happen, and the drive will stop in programmed time. The AC drive will automatically extend the deceleration time with high inertial loads. If deceleration time is critical for the application, then dynamic braking resistors should be used.

6-01	**Over-Voltage Stall Prevention Level**	Unit: 1V
Settings	230V series d350 to d410V	Factory Setting: d390
	460V series d700 to d820V	Factory Setting: d780

🕮 During deceleration, the DC bus voltage may exceed its maximum allowable value due to motor regeneration. When this function is enabled, the AC drive will stop decelerating. Maintaining a constant output frequency when it happens. The AC drive will resume deceleration when the voltage drops below preset value.

🕮 With a moderate inertial load, the over-voltage during deceleration won't happen, and the drive will stop in programmed time. The AC drive will automatically extend the deceleration time with high inertial loads. If deceleration time is critical for the application, then dynamic braking resistors should be used.

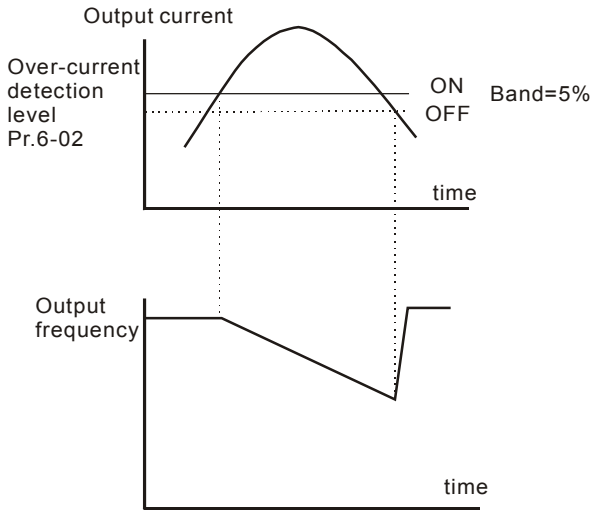


Over-voltage Stall Prevention

6-02	Over-Current Stall Prevention Level	Factory Setting: d130
	Settings d20 to d150%	Unit: 1%

📖 A setting of 100% is equal to the Rated Output Current of the drive.

📖 During acceleration and steady-state operation, the AC drive output current may increase abruptly to exceed the value specified by Pr.6-02 due to rapid acceleration or excessive load on the motor. When this function is enabled, the AC drive will decrease. The AC drive will only resume acceleration when the current drops below the level specified by Pr. 6-02.



Over-current Stall Prevention Level

6 - 03	Over-Torque Detection Mode (OL2)	Factory Setting: d 0

Settings	d 0	Over-Torque detection disabled.
	d 1	Over-Torque detection enabled during constant speed operation, and continue to run till OL1 or OL.
	d 2	Over-Torque detection enabled during constant speed operation, and operation halted after over-torque detection.
	d 3	Over-Torque detection enabled during running, and continues to run till OL1 or OL.
	d 4	Over-Torque detection enabled during running, and operation halted after over-torque detection

6 - 04	Over-Torque Detection Level	Factory Setting: d 150
	Settings d 30 to d 200%	Unit: 1%

📖 A setting of proportional to the Rated Output Current of the drive.

6 - 05	Time setting for Over-torque Detection	Factory Setting: d 0.1
	Settings d 0.1 to d 10.0 sec	Unit: 0.1sec

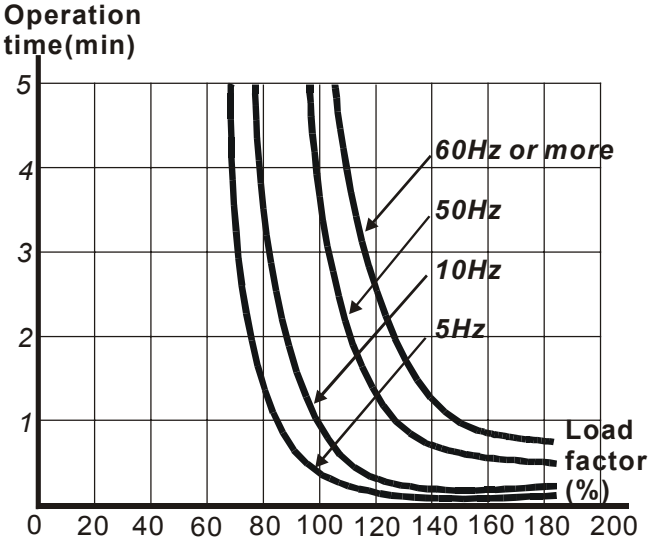
📖 If a Multi-Function Output Terminal is set as Over-Torque Detection Indication and the output current exceeds the Over-Torque Detection Level (Pr.6-04, Factory Setting: 150%), the Over-Torque Detection Time (Pr.6-05, Factory setting: 0.1) and the setting of multi-function terminal is Over-Torque Detection Indication, the contact will be “close”.

6 - 06	Electronic Thermal Overload Relay Selection	Factory Setting: d 2
	Settings d 0	Reduce Torque Motor
	d 1	Constant Torque Motor
	d 2	Inactive

📖 This function is used to limit the output power of the AC drive when powering a “self-cooled motor” at low speed.

6 - 07	Electronic Thermal Characteristic	Factory Setting: d 60
	Settings d 30 to d 600Sec	Unit: 1 Sec
	This parameter can be set during operation.	

📖 The parameter determines the time required activating the I^2t electronic thermal protection function. The graph below shows I^2t curves for 150% output power for 1 minute.



6 - 08	Present Fault Record	Factory Setting: d 0
6 - 09	Second Most Recent Fault Record	Factory Setting: d 0
6 - 10	Third Most Recent Fault Record	Factory Setting: d 0

Settings
- d 0 No fault occurred
- d 1 Over-current (oc)
- d 2 Over-voltage (ov)
- d 3 Overheat (oH)
- d 4 Overload (oL)
- d 5 Overload1 (oL1)
- d 6 External fault (EF)
- d 7 Not used
- d 8 Not used
- d 9 Current exceeds 2 times rated current during acce. (ocA)
- d 10 Current exceeds 2 times rated current during dece. (ocd)
- d 11 Current exceeds 2 times rated current during steady state operation (ocn)
- d 12 Ground fault (GF)

📖 Pr.6-08 to 6-10 store records of the three most recent faults that had occurred. Use the reset key to reset the drive when the fault no longer exits.

5.8 Group 7: Motor Parameters

7 - 00	Motor Rated Current	Factory Setting: d 85

Settings d 30 to d 120% Unit: 1%

This parameter can be set during operation.

📖 This parameter will limit the AC drive output current in order to prevent the motor from overheating.

7 - 01	Motor No-load Current	Factory Setting: d 50

Settings d 0 to d 90% Unit: 1%

This parameter can be set during operation.

📖 The rated current of the AC drive is regarded as 100%. Motor setting of no-load current will effect the slip compensation. The setting value must be less than motor rated current setting Pr.7-00

7 - 02	Torque Compensation	Factory Setting: d 1

Settings d 0 to d 10 Unit: 1

This parameter can be set during operation.

📖 This parameter may be set so that the AC drive will increase its voltage output during start-up to obtain a higher initial starting torque.

7 - 03	Slip Compensation	Factory Setting: d 0.0

Settings d 0.0 to d 10.0 Unit: 0.1

This parameter can be set during operation.

📖 While driving an asynchronous motor, load on the AC drive will increase, causing an increase in slip. This parameter may be used to compensate the nominal slip within a range of 0 to 10. When the output current of the AC drive is greater than the motor no-load current (Pr.7-01), the AC drive will adjust its output frequency according to this parameter.

5.9 Group 8: Special Parameters

8 - 00	DC Braking Voltage Level	Factory Setting: d 0
	Settings d 0 to d30%	Unit: 1%

📖 This parameter determines the level of DC Braking Voltage Level output to the motor during start-up and stopping. When setting DC Braking Voltage, the Maximum Output Voltage (Pr.1-02) is regarded as 100%. It is recommended to start with a low DC Braking Voltage Level and then increase until proper holding torque has been attained.

8 - 01	DC Braking Time during Start-up	Factory Setting: d 0.0
	Settings d 0.0 to d 60.0 sec	Unit: 0.1sec

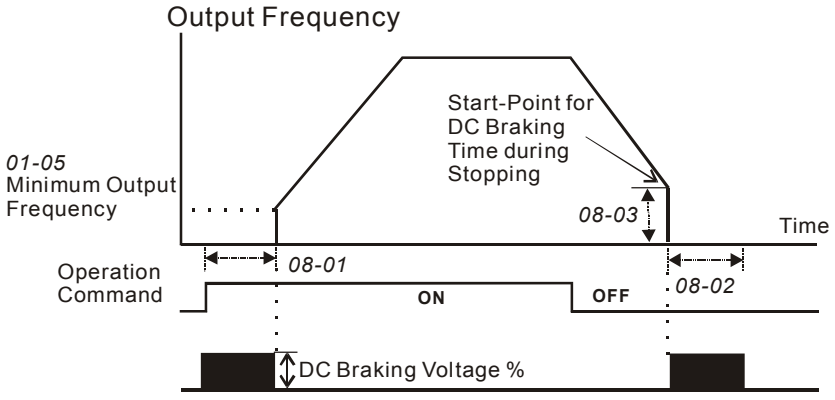
📖 This parameter determines the duration of time that the DC Braking Current will be applied to the motor during the AC drive start-up.

8 - 02	DC Braking Time during Stopping	Factory Setting: d 0.0
	Settings d 0.0 to d 60.0 sec	Unit: 0.1 sec

📖 This parameter determines the duration of time that the DC braking voltage will be applied to the motor during stopping. If stopping with DC Braking is desired, then Pr.2-02 must be set to RAMP stop (d 0).

8 - 03	Start-Point for DC Braking	Factory Setting: d 0.0
	Settings d 0.0 to d 400Hz	Unit: 0.1Hz

📖 This parameter determines the frequency when DC Braking will begin during deceleration.



NOTE: 1. DC Braking during Start-up is used for loads that may move before AC drive starts, such as fans and pumps. These loads may also be moving in the wrong direction. Under such circumstances, DC Braking can be executed to hold the load in position before applying a forward motion.

2. DC Braking during stopping is used to decrease stopping time and also to hold a stopped load in position. For high inertial loads, a dynamic braking resistor may be needed for quick decelerations.

8 - 04	Momentary Power Loss Operation Selection	Factory Setting: d 0

Settings		
	d 0	Operation stop after momentary power loss
	d 1	Operation continue after momentary power loss Speed search start with the Master Frequency reference value
	d 2	Operation continue after momentary power loss Speed search start with the min frequency

8 - 05	Maximum Allowable Power Loss Time	Factory Setting: d 2.0
Settings	d 0.3 to d 5.0Sec	Unit: 0.1sec

5

📖 During a power loss, if the power loss time is less than the time defined by this parameter, the AC drive will resume operation. If the Maximum Allowable Power Loss Time is exceeded, the AC drive output is then turned off.

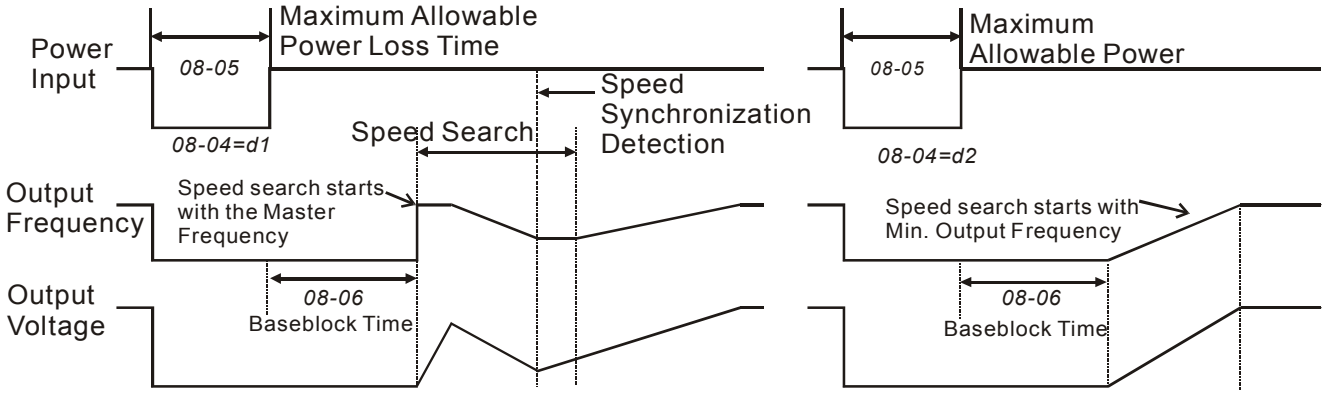
8 - 06	Base-Block Time for Speed Search	Factory Setting: d 0.5
Settings	d 0.3 to d 5.0Sec	Unit: 0.1Sec

📖 When a momentary power loss is detected, the AC drive turns off for a specified time interval determined by Pr.8-06 before resuming operation. This time interval is called Base-Block. This parameter should be set to a value where the residual output voltage is nearly zero, before the drive resumes operation.

📖 This parameter also determines the searching time when performing external Base-Block and fault reset.

8 - 07	Maximum Speed Search Current Level	Factory Setting: d 150
Settings	d 30 to d 200%	Unit: 1%

Following a power failure, the AC drive will start its speed search operation, only if the output current is greater than the value determined by Pr.8-07. When the output current is less than that of Pr.8-07, the AC drive output frequency is at a “speed synchronization point”. The drive will start to accelerate or decelerate back to the operating frequency at which it was running prior to the power failure.



Momentary Power Loss Operation

8 - 08	Skip Frequency 1 Upper Bound	Factory Setting: d 0.0
8 - 09	Skip Frequency 1 Lower Bound	Factory Setting: d 0.0
8 - 10	Skip Frequency 2 Upper Bound	Factory Setting: d 0.0
8 - 11	Skip Frequency 2 Lower Bound	Factory Setting: d 0.0
8 - 12	Skip Frequency 3 Upper Bound	Factory Setting: d 0.0
8 - 13	Skip Frequency 3 Lower Bound	Factory Setting: d 0.0

Settings d 0.0 to d 400Hz Unit: 0.1Hz

These parameters determine Skip frequency. It will cause the AC drive to skip operation at these frequency ranges with continuous frequency output.

Pr.8-9, Pr.8-11,Pr.8-13 are for Lower Bound setting, and the settings should follow as Pr.8-9≧Pr.8-11≧Pr.8-13.

8 - 14	Auto Restart After Fault	Factory Setting: d 0

Settings d 0 to d 10

After fault occurs (allowable faults: over-current OC, over-voltage OV), the AC drive can be reset/restarted automatically up to 10 times. Setting this parameter to 0 will disable the

reset/restart operation after any fault has occurred. When enabled, the AC drive will restart with speed search, which starts at the Master Frequency.

8 - 15	Automatic Voltage Regulation (AVR)	Factory Setting: d 2

Settings d 0 AVR function enabled
d 1 AVR function disabled
d 2 AVR function disabled when deceleration

📖 AVR function automatically regulates the AC drive output voltage to the Maximum Output Voltage (Pr.1-02). For instance, if Pr.1-02 is set at 200 VAC and the input voltage is at 200V to 264VAC, then the Maximum Output Voltage will automatically be reduced to a maximum of 200 VAC.

📖 Without AVR function, the Maximum Output Voltage may vary between 180V to 264VAC, due to the input voltage varying between 180V to 264 VAC.

📖 Selecting program value d2 enables the AVR function and also disables the AVR function during deceleration. This offers a quicker deceleration.

8 - 16	Dynamic Braking Voltage	Factory Setting: d 380*

Settings d 350 to d 450V* Unit: 1Volt*
*Twice value for 460V class

📖 During deceleration, the DC-bus voltage will increase due to motor regeneration. When DC bus voltage level exceeds the Dynamic Braking Voltage, the DC brake output pins (B1, B2) will be activated.

8 - 17	Lower Bound of DC Braking Start-up Frequency	Factory Setting: d 0.0

Settings d0.0 to d400 Hz Unit: 0.1Hz

📖 The setting frequency is lower than Pr.8-17, the DC Braking will not be activated when stops.

5.10 Group 9: Communication Parameters

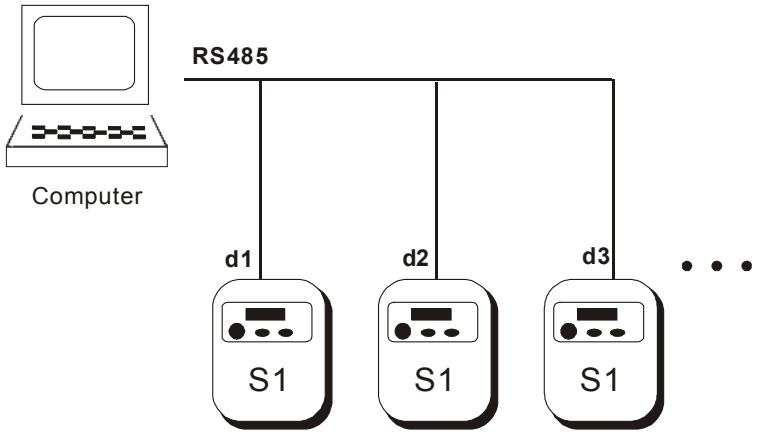
9 - 00	Communication Address	Factory Setting: d 1

Settings d 1 to d254

This parameter can be set during operation.

`

🕮 If the AC drive is controlled by RS-485 serial communication, the communication address must be set via this parameter.



9 - 01	Transmission Speed	Factory Setting: d 1

Settings d 0 Baud rate 4800 (data transmission speed: bits / second)

d 1 Baud rate 9600 (data transmission speed: bits / second)

d 2 Baud rate 19200 (data transmission speed: bits / second)

d 3 Baud rate 38400 (data transmission speed: bits / second)

This parameter can be set during operation.

🕮 Users can set parameters and control the operation of the AC drive via the RS-485 serial interface of a personal computer. This parameter is used to set the transmission speed between the computer and AC drive.

9 - 02	Transmission Fault Treatment	Factory Setting: d 0

Settings d 0 Warn and keep operating

d 1 Warn and RAMP to stop

d 2 Warn and COAST to stop

d 3 Keep operation without warning

9 - 03	Modbus Communication Watchdog Timer	Factory Setting: d 0

Settings d0 Disable Unit: 1 sec

d1 1 sec to d20 20 sec

This parameter can be set during operation.

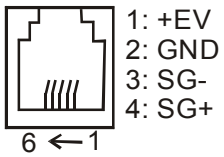
🕮 If the Watchdog timer function is enabled, the timer will start counting once the first valid Modbus communication signal is received after power-up or reset. The timer will reset to 0 after each valid Modbus communication message is received. If the watchdog timer reaches the value set in Pr. 9-03, the drive will stop its output and display the message "CE10" on the digital keypad. This fault can reset by an external terminal, keypad or a Modbus communication reset command.

9 – 04	Communication Protocol	Factory Setting: d 0

Settings d 0 Modbus ASCII mode, protocol <7,N,2>
d 1 Modbus ASCII mode, protocol <7,E,1>
d 2 Modbus ASCII mode, protocol <7,O,1>
d 3 Modbus ASCII mode, protocol <8,N,2>
d 4 Modbus ASCII mode, protocol <8,E,1>
d 5 Modbus ASCII mode, protocol <8,O,1>
d 6 Modbus RTU mode, protocol <8,N,2>
d 7 Modbus RTU mode, protocol <8,E,1>
d 8 Modbus RTU mode, protocol <8,O,1>

This parameter can be set during operation.

🕮 1.Computer Control



★ There is a built-in RS-485 serial interface, marked (RJ-11 Jack) on the control terminal block, for VFD-S Series. The pins are defined above.
Each VFD-S AC drive has a pre-assigned communication address specified by Pr. (9-00). The computer then controls each AC drive according to its communication address.

★ VFD-S can be setup to communicate on Modbus networks using one of the following modes: ASCII (American Standard Code for Information Interchange) or RTU (Remote Terminal Unit). Users can select the desired mode along with the serial port communication protocol in Pr. 9-04.

★ Code Meaning:

ASCII mode:

Each 8-bit data is the combination of two ASCII characters. For example, a 1-byte data: 64 Hex, shown as '64' in ASCII, consists of '6' (36Hex) and '4' (34Hex).

Character	'0'	'1'	'2'	'3'	'4'	'5'	'6'	'7'
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H

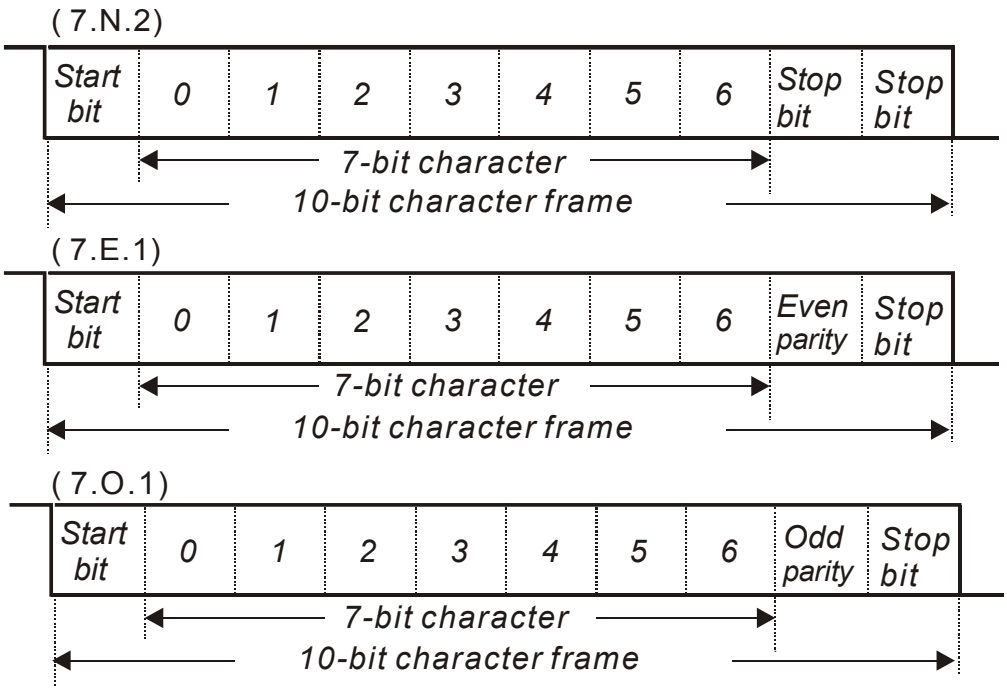
Character	'8'	'9'	'A'	'B'	'C'	'D'	'E'	'F'
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

RTU mode:

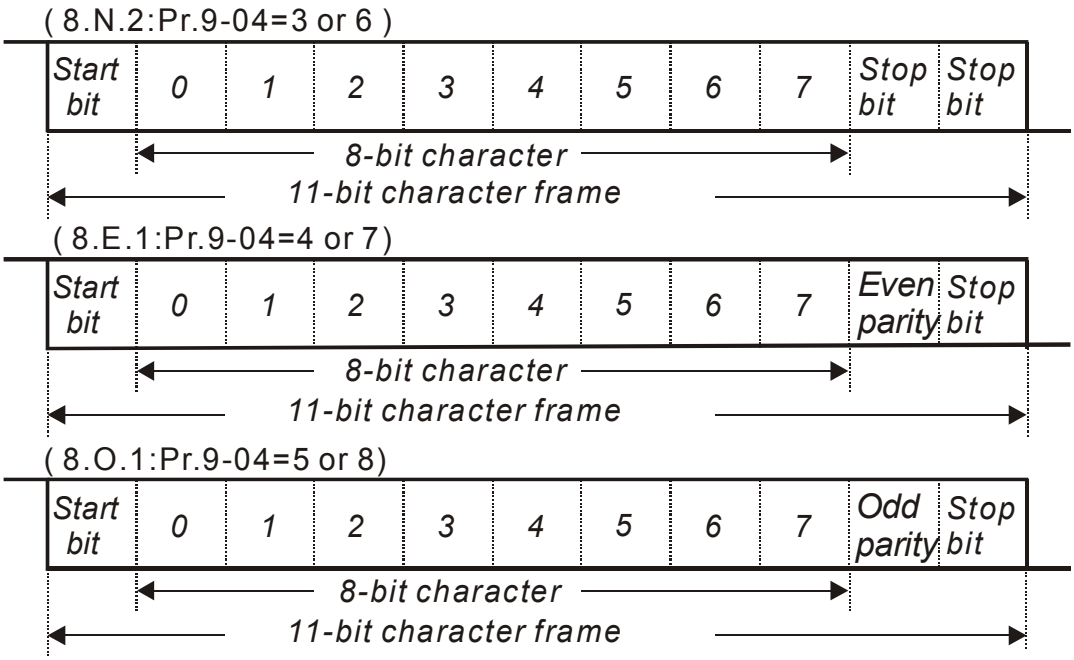
Each 8-bit data is the combination of two 4-bit hexadecimal characters. For example, 64 Hex.

2.Data Format:

2.1 10-bit character frame (For 7-bit character):



2.2 11-bit character frame (For 8-bit character):



3.Communication Protocol

3.1 Communication Data Frame:

ASCII mode:

STX	Start character ':' (3AH)
ADR 1	Communication address: 8-bit address consists of 2 ASCII codes
ADR 0	
CMD 1	Command code: 8-bit command consists of 2 ASCII codes
CMD 0	
DATA (n-1)	Contents of data: n x 8-bit data consist of 2n ASCII codes. n <= 25，maximum of 50 ASCII codes
…….	
DATA 0	
LRC CHK 1	LRC check sum: 8-bit check sum consists of 2 ASCII codes
LRC CHK 0	
END 1	End characters: END1= CR (0DH), END0= LF (0AH)
END 0	

RTU mode:

START	A silent interval of more than 10 ms
ADR	Communication address: 8-bit address
CMD	Command code: 8-bit command
DATA (n-1)	Contents of data: n x 8-bit data, n<= 25
…….	
DATA 0	
CRC CHK Low	CRC check sum: 16-bit check sum consists of 2 8-bit characters
CRC CHK High	
END	A silent interval of more than 10 ms

3.2 ADR (Communication Address)

Valid communication addresses are in the range of 0 to 254. Communication address equals to 0 means broadcast to all AC drives (AMD), in this case, the AMD will not reply any message to the master device.

For example, communication to AMD with address 16 decimal:

ASCII mode: (ADR 1, ADR 0) ='1','0' ≥ '1'=31H, '0'=30H

RTU mode: (ADR) = 10H

3.3 CMD (Command code) and DATA (data characters)

The format of data characters depends on the command code. The available command codes are described as followed: Command code: 03H, read N words. The maximum value of N is 12. For example, reading continuous 2 words from starting address 2102H of AMD with address 01H.

ASCII mode:

Command message:

STX	':'
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'3'
Starting data address	'2'
	'1'
	'0'
	'2'
Number of data (count by word)	'0'
	'0'
	'0'
	'2'
LRC CHK 1	'D'
LRC CHK 0	'7'
END 1	CR
END 0	LF

Response message:

STX	':'
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'3'
Number of data (count by byte)	'0'
	'4'
Content of starting data address 2102H	'1'
	'7'
	'7'
	'0'
Content of data address 2103H	'0'
	'0'
	'0'
	'0'
LRC CHK 1	'7'
LRC CHK 0	'1'
END 1	CR
END 0	LF

RTU mode:

Command message:

ADR	01H
CMD	03H
Starting data address	21H
	02H
Number of data (count by word)	00H
	02H
CRC CHK Low	6FH
CRC CHK High	F7H

Response message:

ADR	01H
CMD	03H
Number of data (count by byte)	04H
Content of data address 2102H	17H
	70H
Content of data address 2103H	00H
	00H
CRC CHK Low	FEH
CRC CHK High	5CH

Command code: 06H, write 1 word

For example, writing 6000(1770H) to address 0100H of AMD with address 01H.

ASCII mode:

Command message:

STX	':'
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'6'
Data address	'0'
	'1'
	'0'
	'0'
Data content	'1'
	'7'
	'7'
	'0'
LRC CHK 1	'7'
LRC CHK 0	'1'
END 1	CR
END 0	LF

Response message:

STX	':'
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'6'
Data address	'0'
	'1'
	'0'
	'0'
Data content	'1'
	'7'
	'7'
	'0'
LRC CHK 1	'7'
LRC CHK 0	'1'
END 1	CR
END 0	LF

RTU mode:

Command message:

ADR	01H
CMD	06H
Data address	01H
	00H
Data content	17H
	70H
CRC CHK Low	86H
CRC CHK High	22H

Response message:

ADR	01H
CMD	06H
Data address	01H
	00H
Data content	17H
	70H
CRC CHK Low	86H
CRC CHK High	22H

Command code: 10H, write n word, n<=12

For example, writing 6000(1770H) to Pr 5-00 (address 0500H) and 1000(03E8H) to Pr 5-01 (address 0501H) with slave address 01H.

ASCII mode:

Command message:

STX	':'
ADR 1	'0'
ADR 0	'1'
CMD 1	'1'
CMD 0	'0'
Starting Data address	'0'
	'5'
	'0'
	'0'
Number of data (count by word)	'0'
	'0'
	'0'
	'2'
Number of data (count by byte)	'0'
	'4'
Data content of address 0500H	'1'
	'7'
	'7'
	'0'
Data content of address 0501H	'0'
	'3'
	'E'
	'8'
LRC CHK 1	'7
LRC CHK 0	'2
END 1	CR
END 0	LF

Response message:

STX	':'
ADR 1	'0'
ADR 0	'1'
CMD 1	'1'
CMD 0	'0'
Starting Data address	'0'
	'5'
	'0'
	'0'
Number of data (count by word)	'0'
	'0'
	'0'
	'2'
LRC CHK 1	'E'
LRC CHK 0	'8'
END 1	CR
END 0	LF

RTU mode:

Command message:

ADR	01H
CMD	10H
Starting Data address	05H
	00H
Number of data (count by word)	00H
	02H
Number of data (count by Byte)	04H
Data content of address 0500H	17H
	70H
Data content of address 0501H	03H
	E8H
CRC CHK Low	C8H
CRC CHK High	2EH

Response message:

ADR	01H
CMD	10H
Starting Data address	05H
	00H
Number of data (count by word)	00H
	02H
CRC CHK Low	41H
CRC CHK High	04H

5

3.4 CHK (check sum)

ASCII mode:

LRC (Longitudinal Redundancy Check) is calculated by summing up, module 256, the values of the bytes from ADR1 to last data character then calculating the hexadecimal representation of the 2's-complement negation of the sum.

For example, reading 1 word from address 0401H of the AC drive with address 01H

STX	':'
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'3'
Starting data address	'0'
	'4'
	'0'
	'1'
Number of data	'0'
	'0'
	'0'
	'1'
LRC CHK 1	'F'
LRC CHK 0	'6'
END 1	CR
END 0	LF

01H+03H+04H+01H+00H+01H=0AH, the 2's-complement negation of 0AH is **F6**H.

RTU mode:

ADR	01H
CMD	03H
Starting address	21H
	02H
Number of data	00H
(count by word)	02H
CRC CHK Low	6FH
CRC CHK High	F7H

CRC (Cyclical Redundancy Check) is calculated by the following steps:

Step 1 : Load a 16-bit register (called CRC register) with FFFFH.

Step 2: Exclusive OR the first 8-bit byte of the command message with the low order byte of the 16-bit CRC register, putting the result in the CRC register.

Step 3: Examine the LSB of CRC register.

Step 4: If the LSB of CRC register is 0, shift the CRC register one bit to the right with MSB zero filling, then repeat step 3. If the LSB of CRC register is 1, shift the CRC register one bit to the right with MSB zero filling, Exclusive OR the CRC register with the polynomial value A001H, then repeat step 3.

Step 5: Repeat step 3 and 4 until eight shifts have been performed. When this is done, a complete 8-bit byte will have been processed.

Step 6: Repeat step 2 to 5 for the next 8-bit byte of the command message. Continue doing this until all bytes have been processed. The final contents of the CRC register are the CRC value. **When transmitting the CRC value in the message, the upper and lower bytes of the CRC value must be swapped, i.e. the lower order byte will be transmitted first.**

The following is an example of CRC generation using C language. The function takes two arguments:

Unsigned char* data ← a pointer to the message buffer

Unsigned char length ← the quantity of bytes in the message buffer

The function returns the CRC value as a type of unsigned integer.


```
Unsigned int crc_chk(unsigned char* data, unsigned char length){
   int j;
   unsigned int reg_crc=0xFFFF;
   while(length--){
      reg_crc ^= *data++;
      for(j=0;j<8;j++){
         if(reg_crc & 0x01){    /* LSB(b0)=1 */
            reg_crc=(reg_crc>>1) ^ 0xA001;
         }else{
            reg_crc=reg_crc >>1;
         }
      }
   }
  return reg_crc;
}
```

3.5 Address list:

The contents of available addresses are shown as below:

Content	Address	Functions	
AC drive Parameters	ggnnH	gg means parameter group, nn means parameter number, for example, the address of Pr 4-01 is 0401H. Referencing to chapter 5 for the function of each parameter. When reading parameter by command code 03H, only one parameter can be read at one time.	
Command	2000H	Bit 0-1	00: No function 01: Stop 10: Run 11: Jog + Run
		Bit 2-3	Not used
		Bit 4-5	00: No function 01: FWD 10: REV 11: Change direction
		Bit 6-15	Not used
	2001H	Freq. command	
	2002H	Bit 0	1: EF (external fault) on
		Bit 1	1: Reset
		Bit 2-15	Not used
Status monitor Read only	2100H	Error code: 0: No errors occurred 1: Over-current (oc) 2: Over-voltage (ov) 3: Overheat (oH) 5: Overload1 (oL1) 6: External fault (EF) 7: Not used 8: Not used 9: Current exceeds 2 times rated current during acceleration (ocA) 10: Current exceeds 2 times rated current during deceleration (ocd) 11: Current exceeds 2 times rated current during steady state operation (ocn) 12: Ground Fault (GF) 13: Reserved 14: Low voltage (Lv) 15: CPU failure 1 (cF1) 16: CPU failure 2 (cF2) 17: Base block 18: Overload (oL2) 19: Auto acceleration/deceleration failure (cFA) 20: Software protection enable (codE)	

Content	Address	Functions	
Status monitor Read only	2100H	21: Reserved 22: CPU failure (cF3.1) 23: CPU failure (cF3.2) 24: CPU failure (cF3.3) 25: CPU failure (cF3.4) 26: CPU failure (cF3.5) 27: CPU failure (cF3.6) 28: CPU failure (cF3.7) 29: Hardware protection failure (HPF.1) 30: Hardware protection failure (HPF.2) 31: Hardware protection failure (HPF.3) 32: CE 10 33: doG 34: SErr 35: ErEd 36: PID error	
	2101H	Status of AC Drive	
		Bit 0-1	00: RUN LED light off, STOP LED light up
			01: RUN LED blink, STOP LED light up
			10: RUN LED light up, STOP LED blink
			11: RUN LED light up, STOP LED light off
		Bit 2	01: Jog active
		Bit 3-4	00: REV LED light off, FWD LED light up
			01: REV LED blink, FWD LED light up
			10: REV LED light up, FWD LED blink
			11: REV LED light up, FRD LED light off
		Bit 5-7	Not used
		Bit 8	1: Main freq. Controlled by communication
		Bit 9	1: Main freq. Controlled by external terminal
		Bit 10	1: Operation command controlled by communication
		Bit 11	1: Parameters have been locked
		Bit 12-15	Not Used
	2102H	Frequency command F (XXX.XX)	
	2103H	Output Frequency H (XXX.XX)	
	2104H	Output Current A (XXX.XX)	
	2105H	DC-BUS Voltage U (XXX.XX)	
	2106H	Output Voltage E (XXX.XX)	
	2107H	Step number of Multi-Step Speed Operation	
	2108H	Step number of PLC operation	
	2109H	Time of PLC Operation	
	210AH	Counter Value	

3.6 Exception response:

Except for broadcast messages, the AC drive is been expected to return a normal response after receiving command messages from the master device. The following depicts the conditions that no normal response is replied to the master device.

The AC drive does not receive the messages due to a communication error; thus, the AC drive has no response. The master device will eventually process a timeout condition.

The AC drive receives the messages without a communication error, but cannot handle it, an exception response will return to the master device and an error message “CExx” will display on the keypad of AC drive. The xx of “CExx” is a decimal code equal to the exception code that will describe below.

In the exception response, the most significant bit of the original command code is set to 1, and an exception code explains the condition that caused the exception is returned. An example of exception response of command code 06H and exception code 02H:

ASCII mode:

STX	‘:’
ADR 1	‘0’
ADR 0	‘1’
CMD 1	‘8’
CMD 0	‘6’
Exception code	‘0’
	‘2’
LRC CHK 1	‘7’
LRC CHK 0	‘7’
END 1	CR
END 0	LF

RTU mode:

ADR	01H
CMD	86H
Exception code	02H
CRC CHK Low	C3H
CRC CHK High	A1H

The meaning of exception code:

Exception code	Meaning
1	**Illegal command code:** The command code received in the command message is not available for the AC drive.
2	**Illegal data address:** The data address received in the command message is not available for the AC drive.
3	**Illegal data value:** The data value received in the command message is not available for the AC drive.
4	**Slave device failure:** The AC drive is unable to perform the requested action.

The AC drive receives the messages, but detects a communication error, thus, no response is returned, but there will be error message “CExx” displayed on the keypad of AC drive. The master device will eventually process a timeout condition. The xx of “CExx” is a decimal code, the meaning of the error message is below:

Error message	Meaning
5	Reserved
6	AC drive busy: The time interval between commands is too short. Please keep an interval of 10ms at least after the return of a command. If no command returned, please keep a 10ms interval at least for the same reason.
7	Reserved
8	Reserved
9	Check Sum Error: Check if the Check Sum is correct.
10	Watchdog Timer: The timer will reset to 0 after each valid Modbus communication message is received.
11	Frame Error: Check if the Baud rate complies with the data format.
12	The command message is too short.
13	Command message length is out of range.
14	The command messages include the data that does not belong to ‘0’ to ‘9’, ‘A’ to ‘F except starting and end character (only for Modbus ASCII mode).

3.7 Communication program of PC:

The following is a simple example of how to write a communication program for Modbus ASCII mode on a PC by C language.

```
#include<stdio.h>
#include<dos.h>
#include<conio.h>
#include<process.h>

#define PORT 0x03F8    /* the address of COM1 */

/* the address offset value relative to COM1 */
#define THR    0x0000
#define RDR    0x0000
#define BRDL 0x0000
#define IER    0x0001
#define BRDH 0x0001
#define LCR    0x0003
```

```
#define MCR    0x0004
#define LSR    0x0005
#define MSR    0x0006


unsigned char rdat[60];
/* read 2 data from address 2102H of AC drive with address 1 */
 unsigned char tdat[60]={':','0','1','0','3','2','1','0','2',
                                '0','0','0','2','D','7','\r','\n'};

void main(){
   int i;
   outportb(PORT+MCR,0x08);                  /* interrupt enable */
   outportb(PORT+IER,0x01);                 /* interrupt as data in */
   outportb(PORT+LCR,(inportb(PORT+LCR) | 0x80));
      /* the BRDL/BRDH can be access as LCR.b7==1 */
   outportb(PORT+BRDL,12);                   /* set baudrate=9600,
12=115200/9600*/
   outportb(PORT+BRDH,0x00);
   outportb(PORT+LCR,0x06);                  /* set protocol, <7,N,2>=06H
<7,E,1>=1AH,    <7,O,1>=0AH
 <8,N,2>=07H,    <8,E,1>=1BH
 <8,O,1>=0BH */
   for(i=0;i<=16;i++){
      while(!(inportb(PORT+LSR) & 0x20)); /* wait until THR empty */
      outportb(PORT+THR,tdat[i]);           /* send data to THR */
   }

   i=0;
   while(!kbhit()){
      if(inportb(PORT+LSR) & 0x01){ /* b0==1, read data ready */
         rdat[i++]=inportb(PORT+RDR); /* read data form RDR */
      }
   }
}
```


5.11 Group A: PID Parameters

A - 00	PID Feedback Terminal Selection	Factory Setting: d 0

Settings		
	d 0	Disable PID function
	d 1	Negative feedback 0~10V AVI
	d 2	Negative feedback 4~20mA ACI
	d 3	Positive feedback 0~10V AVI
	d 4	Positive feedback 4~20mA ACI

🕮 Select an input terminal to serve as the PID feedback location. Please verify the feedback location is different from the Frequency Set Point location and J1 for selecting ACI or AVI must be in the correct position. (Refer to Pr. 2-00 for detail)

🕮 Negative feedback = Positive target value – detection value.
Positive feedback = Negative target value + detection value.

A - 01	Feedback Signal Gain	Factory Setting: d100

Settings d0 to d999% (d100 means gain value is 1) Unit: 1%

🕮 To Adjust feedback detective gain value. It is used to adjust target value error.

A - 02	Proportional Gain (P)	Factory Setting: d100

Settings d0 to d999% (d0: disable) (d100 means gain value is 1)

🕮 This parameter is used to determinate error gain. If I = 0 and D = 0, doing proportional gain operation.

A - 03	Integral Time (I)	Factory Setting: d100

Settings d0 to d999 (d0: disable) Unit: 0.01 second

🕮 When this parameter is defined to gain is 1 and error value is fixed, integral value is equal to error value as the setting of integral time is attained.

A - 04	Differential Time (D)	Factory Setting: d0

Settings d0 to d100 (d0: disable) Unit: 0.01 second

🕮 When this parameter is set to gain =1, PID output is differential time. At this time, error value –error value of the preceding item= additional respond speed and it is easy to have over compensation situation.

A - 05	Integration's Upper Bound Frequency	Factory Setting: d100

Settings d0 to d100%

📖 This parameter determines the integration's upper frequency limit while operating in the PID feedback loop. (Limit = 1-00×A-05 %). During a fast Integration response, it is possible for the frequency to spike beyond a reasonable point. This parameter will limit this frequency spike.

A - 06	One-Time Delay	Factory Setting: d0

Settings d0 to d999 Unit: 2 msec

📖 One-time delay of PID will slow down oscillation of the system.

📖 A setting of d0 disables this function.

A - 07	PID Frequency Output Command Limit	Factory Setting: d100

Settings d0 to d110%

📖 This parameter determines the limit of the PID Command frequency. If this parameter is set to 110%, then the maximum output frequency while in the PID operation will be (110% x Pr.01-00) 66Hz.

A - 08	Detection Time of the Feedback Error	Factory Setting: d0.0

Settings d0.0 to d650 seconds

📖 This parameter defines the detection time for the loss of a feedback analog signal. The drive will follow the operating procedure programmed in Pr.A-09 if the feedback signal is lost for more than the time set in Pr. A-08.

📖 A setting of 0.0 disables this function.

A - 09	Feedback Signal Fault Treatment	Factory Setting: d0

Settings d 0 warn and RAMP to stop

d 1 warn and COAST to stop

📖 This parameter selects the operation of the drive upon a loss of PID feedback signal.

A - 10	Dwell (sleep) Frequency	Factory Setting: d0.0

Settings d0.0 to d400Hz

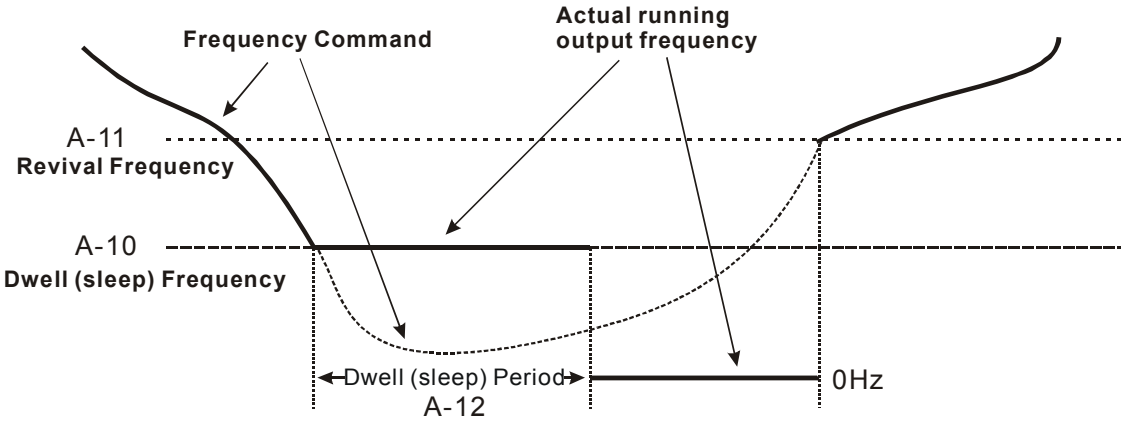
A - 11	Revival Frequency	Factory Setting: d0.0

Settings d0.0 to d400Hz

A - 12	Dwell (sleep) Period	Factory Setting: d0.0

Settings d0.0 to d650 seconds

📖 These parameters determine Dwell (sleep) functions of the AC drive. If the command frequency falls below the Dwell frequency, for the specified time in Pr. A-12, then the drive will shut off the output and wait until the command frequency rises above Pr. A-11. Please see the below diagram.

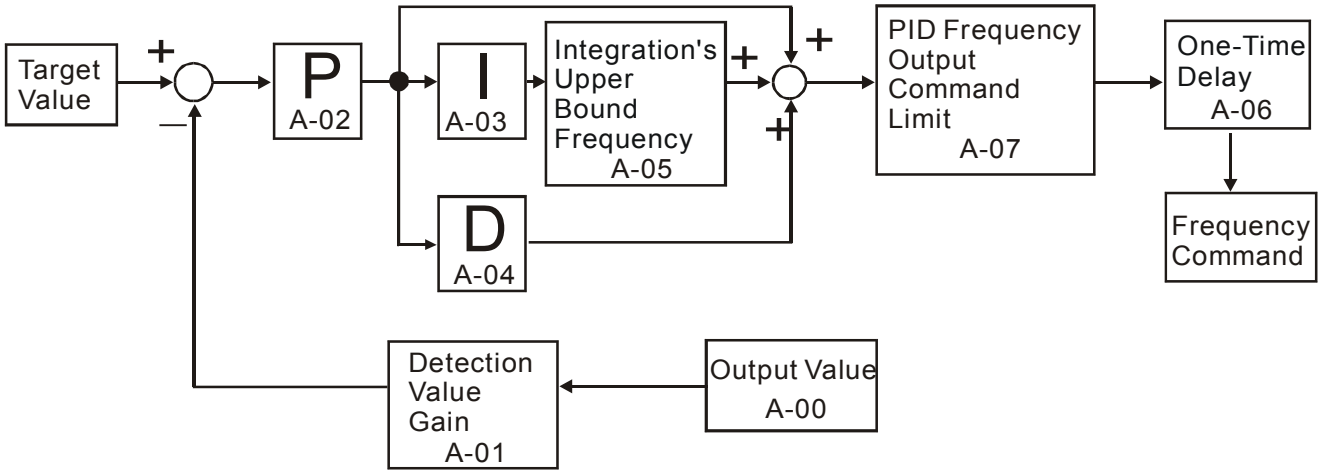


Dwell (sleep) Function

A - 13	PID User Defined	Factory Setting: d0.0

Settings d0.0 to d400

📖 When parameter A-13 is set to 0, what F and H display is the actual value of setting frequency and output frequency. When this parameter is not set to 0, the display value of F and H = actual value ×A-13/1-00. To set frequency with panel, communication, VR, AVI or ACI need to set according to the display value. For example, when 1-00=60.0Hz, if A-13 is set to 30.0 Hz, it means when the actual value of frequency is 30.00 Hz, the display value will be 15.0 Hz . If you want to let drive run at 10.0Hz, the frequency command must be 5.0 Hz. But the setting frequency of parameters, such as Max. operation frequency, 1st speed and etc., they are still needed to set with actual value.



If the input range of sensor is 0~SI_max, output range is SO_min~SO_max and then $\frac{\text{Input}}{\text{Per output}}$ is $\frac{\text{SI\_max}}{\text{SO\_max-SO\_min}}$, set drive input to sensor output

Set input range of drive is D_range= 10V(0~10V) or 16mA (4~20mA) that correspond to 0~1-00Hz and then $\frac{\text{Output}}{\text{Per input}}$ will be $\frac{\text{1-00}}{\text{D\_range}}$

According to the display value of F and H = actual value ×A-13/1-00, and then $\frac{\text{Display value of F, H}}{\text{Actual value}}$ =A-13/1-00. If you want the result to be display value = sensor output and actual value = drive output, and then

$$\frac{\text{A-13}}{\text{1-00}} = \frac{\frac{\text{SI\_max}}{\text{SO\_max-SO\_min}} \text{X} \frac{\text{A-01}}{100}}{\frac{\text{1-00}}{\text{D\_range}}} \Rightarrow \text{A-13} = \frac{\text{SI\_max}}{\text{SO\_max-SO\_min}} \text{X} \frac{\text{A-01}}{100} \text{X D\_range}$$

Example:

Sensor: 0~6 psi input corresponds to 0~5V output

drive AVI: 0~10V input corresponds to 0~60Hz, A-01=100

$$\text{A-13} = \frac{6}{5\text{-}0} \text{X} \frac{100}{100} \text{X} 10 = 12$$

CHAPTER 6 MAINTENANCE AND INSPECTIONS

Modern AC drives are based on solid state electronics technology, preventive maintenance is required to operate this AC drive in its optimal condition, and to ensure a long life. It is recommended to perform a monthly check up of the AC drive by a qualified technician. Before the check up, always turn off the AC Input Power to the unit. Wait at least 2 minutes after all display lamps have gone out, and then confirm that the capacitors have fully discharged by measuring the voltage between B1 and Ground using a multimeter set to measure DC.

6.1 Periodic Inspection

Basic check up items to detect if there were any abnormality during the operation.

1. Whether the motors are operating as expected.
2. Whether the installation environment is abnormal.
3. Whether the cooling system is operating as expected.
4. Whether any irregular vibration or sound occurred during the operation.
5. Whether the motors are overheated during the operation.
6. Always check the input voltage of the AC drive with Voltmeter.

6.2 Periodic Maintenance

⚠ **WARNING!** Disconnecting AC power before processing!

1. Tighten and reinforce the screws of the AC drive if necessary, cause it may loose due to the vibration or changing of temperatures.
2. Whether the conductors or insulators were corroded and damaged.
3. Check the resistance of the insulation with Mega-ohmeter.
4. Often check and change the capacitors and relays.
5. If use of the AC drive is discontinued for a long period of time, turn the power on at least once every two years and confirm that it still functions properly. To confirm functionality, disconnect the motor and energize the AC drive for 5 hours or more before attempting to run a motor with it.
6. Clean off any dust and dirt with a vacuum cleaner. Place special emphasis on cleaning the ventilation ports and PCBs. Always keep these areas clean, as accumulation of dust and dirt can cause unforeseen failures.

CHAPTER 7 TROUBLESHOOTING AND FAULT INFORMATION

The AC drive has a comprehensive fault diagnostic system that includes several different alarms and fault messages. Once a fault is detected, the corresponding protective functions will be activated. The following faults are displayed as shown on the AC drive digital keypad panel. The three most recent faults can be read on the digital keypad display by viewing Pr.6-08 to Pr.6-10.

NOTE: faults can be cleared by a reset from the keypad or Input Terminal.

Common Problems and Solutions:

Fault Name	Fault Descriptions	Corrective Actions
oc	The AC drive detects an abnormal increase in current.	1. Check whether the motors horsepower corresponds to the AC drive output power. 2. Check the wiring connections between the AC drive and motor for possible short circuits. 3. Increase the Acceleration time (Pr.1-09, Pr.1-11). 4. Check for possible excessive loading conditions at the motor. 5. If there are any abnormal conditions when operating the AC drive after short-circuit being removed, it should be sent back to manufacturer.
ou	The AC drive detects that the DC bus voltage has exceeded its maximum allowable value.	1. Check whether the input voltage falls within the rated AC drive input voltage. 2. Check for possible voltage transients. 3. Bus over-voltage may also be caused by motor regeneration. Either increase the decel time or add an optional braking resistor. 4. Check whether the required braking power is within the specified limits.
oH	The AC drive temperature sensor detects excessive heat.	1. Ensure that the ambient temperature falls within the specified temperature range. 2. Make sure that the ventilation holes are not obstructed. 3. Remove any foreign objects on the heatsinks and check for possible dirty heat-sink fins. 4. Provide enough spacing for adequate ventilation.
Lu	The AC drive detects that the DC bus voltage has fallen below its minimum value.	Check whether the input voltage falls within the rated AC drive's input voltage.

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Fault Name	Fault Descriptions	Corrective Actions
oL	The AC drive detects excessive drive output current. Note: The AC drive can withstand up to 150% of the rated current for a maximum of 60 seconds.	1. Check whether the motor is overloaded. 2. Reduce torque compensation setting as set in Pr.7-02. 3. Increase the AC drive's output capacity.
oL 1	Internal electronic overload trip	1. Check for possible motor overload. 2. Check electronic thermal overload setting. 3. Increase motor capacity. 4. Reduce the current level so that the drive output current does not exceed the value set by the Motor Rated Current Pr.7-00.
oL2	Motor overload. Check the parameter settings (Pr.6-03 to Pr.6-05)	1. Reduce the motor load. 2. Adjust the over-torque detection setting to an appropriate setting.
ocA	Over-current during acceleration: 1. Short-circuit at motor output. 2. Torque boost too high. 3. Acceleration time too short. 4. AC drive output capacity is too small.	1. Check for possible poor insulation at the output line. 2. Decrease the torque boost setting in Pr.7-02. 3. Increase the acceleration time. 4. Replace with the AC drive with one that has a higher output capacity (next HP size).
ocd	Over-current during deceleration: 1. Short-circuit at motor output. 2. Deceleration time too short. 3. AC drive output capacity is too small.	1. Check for possible poor insulation at the output line. 2. Increase the deceleration time. 3. Replace with the AC drive with one that has a higher output capacity (next HP size).
ocn	Over-current during steady state operation: 1. Short-circuit at motor output. 2. Sudden increase in motor loading. 3. AC drive output capacity is too small.	1. Check for possible poor insulation at the output line. 2. Check for possible motor stall. 3. Replace with the AC drive with one that has a higher output capacity (next HP size).
EF	The external terminal EF-GND goes from OFF to ON.	When external terminal EF-GND is closed, the output will be turned off. (under N.O. E.F.)

Fault Name	Fault Descriptions	Corrective Actions
	Internal memory IC can not be programmed.	1. Switch off power supply. 2. Check whether the input voltage falls within the rated AC drive input voltage. 3. Switch the AC drive back on.
	Internal memory IC can not be read.	1. Check the connections between the main control board and the power board. 2. Reset drive to factory defaults.
	Drive's internal circuitry abnormal.	1. Switch off power supply. 2. Check whether the input voltage falls within the rated AC drive input voltage. Switch on the AC drive.
	Hardware protection failure	Return to the factory.
	Software protection failure	Return to the factory.
	Auto accel/decel failure	Don't use the function of auto acceleration / deceleration.
	Ground fault: The AC drive output is abnormal. When the output terminal is grounded (short circuit current is 50% more than the AC drive rated current), the AC drive power module may be damaged. The short circuit protection is provided for AC drive protection, not user protection.	Ground fault : 1. Check whether the IGBT power module is damaged. 2. Check for possible poor insulation at the output line.
	Communication Error	1. Check the connection between the AC drive and computer for loose wires. 2. Check if the communication protocol is properly set.
	External Base Block. AC drive output is turned off.	1. When the external input terminal (B.B) is active, the AC drive output will be turned off. 2. Disable this connection and the AC drive will begin to work again.

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CHAPTER 8 SUMMARY OF PARAMETER SETTINGS

◈: The parameter can be set during operation, *: Twice the value for 460V class.

Group 0 User Parameters

Parameters	Explanation	Settings	Factory Setting
0-00	Identity Code of AC Drive	Read-only	d #
0-01	Rated Current Display	Read-only	d##.#
0-02	Parameter Reset	d10: Reset Parameter to Factory Setting	d0
0-03	Start-up Display Selection ◈	d0: F (setting frequency) d1: H (actual frequency) d2: (user-defined unit) d3: A (output current)	d0
0-04	User-Defined Unit ◈	d0: Display User-Defined Unit (u) d1: Display Counter Value (C) d2: Display Process Operation (1= tt) d3: Display DC-BUS Voltage (U) d4: Display output voltage (E) d5: Display frequency commands of PID (P) d6: Display PID feedback (after multiplying by Gain) (b)	d0
0-05	User-Defined Coefficient K ◈	d0.1 to d160	d1.0
0-06	Software Version	Read-only	d#.#
0-07	Password Input	d0 to d999	d0
0-08	Password Decode	d0 to d999	d0

Group 1 Basic Parameters

Parameters	Explanation	Settings	Factory Setting
1-00	Maximum Output Freq.	d50.0 to d400 Hz	d60.0
1-01	Maximum Voltage Frequency (Base Freq)	d10.0 to d400 Hz	d60.0
1-02	Maximum Output Voltage	d2.0V to d255V*	d230*
1-03	Mid-Point Frequency	d1.0 to d400 Hz	d1.0
1-04	Mid-Point Voltage	d2.0V to d255V*	d12*
1-05	Minimum Output Frequency	d1.0 to d60.0 Hz	d1.0
1-06	Minimum Output Voltage	d2.0V to d255V*	d12*
1-07	Upper Bound of freq.	d1 to d110%	d100
1-08	Lower Bound of freq.	d0 to d100%	d0
1-09	Acceleration Time 1 (Tacc1) ◈	d0.1 to d600 Sec	d10.0
1-10	Deceleration Time 1 (Tdec1) ◈	d0.1 to d600 Sec	d10.0
1-11	Acceleration Time 2 ◈	d0.1 to d600 Sec	d10.0
1-12	Deceleration Time 2 ◈	d0.1 to d600 Sec	d10.0
1-13	Jog Acceleration / Deceleration Time ◈	d0.1 to d600 Sec	d10.0
1-14	Jog Frequency ◈	d1.0 Hz to d400 Hz	d6.0
1-15	Auto Acceleration / Deceleration	d0: Linear Acceleration/Deceleration d1: Auto Acceleration, Linear Deceleration d2: Linear Acceleration, Auto Deceleration d3: Auto Acceleration/Deceleration d4: Linear Acceleration; Auto Deceleration, Stall Prevention during Deceleration d5: Auto Deceleration; Auto Acceleration, Stall Prevention during Deceleration	d0
1-16	S-Curve in Acceleration	d0 to d7	d0
1-17	S-Curve in Deceleration	d0 to d7	d0
1-18	Jog Decelerating Time	d 0.0 Jog Decelerating Time Determined by Pr.1-13 d 0.1 to d600	d0.0

Group 2 Operation Method Parameters

Parameters	Explanation	Settings	Factory Setting
2-00	Source of Frequency Command	d0: Master Frequency input determined by digital keypad. (record the frequency of power loss and it can do analog overlap plus) d1: Master Frequency determined by analog signal DC 0V-10V (external terminal AVI). (won't record the frequency of power loss and it can't do analog overlap plus) d2: Master Frequency determined by analog signal DC 4mA - 20mA (external terminal AVI). (won't record the frequency of power loss and it can't do analog overlap plus) d3: Master Frequency determined by Potentiometer on the digital keypad. (won't record the frequency of power loss and it can do analog overlap plus) d4: Master Frequency operated by RS-485 serial communication interface and record frequency of power loss. (record the frequency of power loss and it can do analog overlap plus) d5: Master Frequency operated by RS-485 serial communication interface and won't record frequency before power loss. (won't record the frequency of power loss and it can do analog overlap plus)	d0

Parameters	Explanation	Settings	Factory Setting
2-01	Source of Operation Command	d0: by Digital Keypad d1: by external terminals, keypad STOP enabled d2: by external terminals, keypad STOP disabled d3: by RS-485 communication interface, keypad STOP enabled d4: by RS-485 communication interface, keypad STOP disabled	d0
2-02	Stop Method	d0: Ramp Stop d1: Coast Stop	d0
2-03	PWM Carrier Frequency	d3: 3KHz d4: 4KHz d5: 5KHz d6: 6KHz d7: 7KHz d8: 8KHz d9: 9KHz d10: 10KHz	d10
2-04	Reverse Operation	d0: Enable REV d1: Disable REV	d0
2-05	Loss of ACI Signal	d0: 0 Hz, continue running d1: Stop the frequency output d2: Last ACI input command	d0
2-06	Analog Auxiliary Frequency Operation	d0: Disable d1: Enable + AVI d2: Enable + ACI	d0

Group 3 Output Function Parameters

Parameters	Explanation	Settings	Factory Setting
3-00	Analog Output Signal	d0: analog frequency d1: analog current	d0
3-01	Analog Output Gain ◈	d1 to d200%	d100
3-02	Desired Freq. Attained	d1.0 to d400 Hz	d1.0
3-03	Terminal Count Value	d0 to d999	d0
3-04	Preliminary Count Value	d0 to d999	d0
3-05	Multi-Function Output1 (Photocoupler Output)	d0: Not Used	d1
3-06	Multi-Function Output2 (Relay Output)	d1: AC Drive Operational d2: Max. Output Freq. Attained d3: Zero Speed d4: Over Torque d5: Base-Block (B.B.) d6: Low Voltage Detection d7: AC Drive Operation Mode d8: Fault Indication d9: Desired Freq. Attained d10: PLC Program Running d11: PLC Program Step Complete d12: PLC Program Complete d13: PLC Program Operation Pause d14: Terminal Count Value Attained d15: Preliminary Count Value Attained d16: Ready State Indicator d17: FWD command indication d18: REV command indication	d8

Group 4 Input Function Parameters

Parameters	Explanation	Settings	Factory Setting
4-00	Potentiometer Bias Frequency ◈	d 0.0 to d 100.0%	d0.0
4-01	Potentiometer Bias Polarity ◈	d0: Positive Bias d1: Negative Bias	d0
4-02	Potentiometer Frequency Gain ◈	d1 to d200 %	d100
4-03	Potentiometer Reverse Motion Enable	d0: Forward Motion Only d1: Reverse Motion enabled	d0
4-04	Multi-Function Input Terminal 1 (M0, M1)	d0: Parameter Disable d1: FWD/STOP, REV/STOP d2: FWD/REV, RUN/STOP d3: 3-wire Operation Control Mode d4: E.F. External Fault Input (N.O.) d5: E.F. External Fault Input (N.C.) d6: Reset d7: Multi-Step Speed Command 1 d8: Multi-Step Speed Command 2 d9: Multi-Step Speed Command 3 d10: Jog Operation d11: Acceleration/deceleration Speed Inhibit d12: First or Second Acceleration/deceleration Time Selection d13: Base-Block (B.B.) (N.O.) d14: Base-Block (B.B.) (N.C.) d15: Increase Master Frequency d16: Decrease Master Frequency d17: Run PLC Program d18: Pause PLC d19: Counter Trigger Signal d20: Counter Reset d21: Select ACI / Deselect AVI d22: Disable PID function d23: JOG FWD d24: JOG REV d25: The source of master frequency is AVI. d26: The source of master frequency is ACI.	d1
4-05	Multi-Function Input Terminal 2 (M2)		d6
4-06	Multi-Function Input Terminal 3 (M3)		d7
4-07	Multi-Function Input Terminal 4 (M4)		d8
4-08	Multi-Function Input Terminal 5(M5)		d9

Parameters	Explanation	Settings	Factory Setting
4-09	Line Start Lockout	d0: Disable d1: Enable	d0
4-10	Up/down frequency command mode	d0: Up/down frequency by acceleration/deceleration time d1: Up frequency according to constant speed, down frequency according to deceleration time d2: Up frequency according to acceleration time, down frequenc according to constant speed d3: Up/down frequency by constant speed	d3
4-11	Acceleration /Deceleration speed of constant up/down frequency	d0 to d1000 Hz/sec	d1

Group 5 Multi-Step Speed and PLC Parameters

Parameters	Explanation	Settings	Factory Setting
5-00	1st Step Speed Freq.	d0.0 to d400 Hz	d0.0
5-01	2nd Step Speed Freq.	d0.0 to d400 Hz	d0.0
5-02	3rd Step Speed Freq.	d0.0 to d400 Hz	d0.0
5-03	4th Step Speed Freq.	d0.0 to d400 Hz	d0.0
5-04	5th Step Speed Freq.	d0.0 to d400 Hz	d0.0
5-05	6th Step Speed Freq.	d0.0 to d400 Hz	d0.0
5-06	7th Step Speed Freq.	d0.0 to d400 Hz	d0.0
5-07	PLC Mode	d0: Disable PLC Operation d1: Execute one program cycle d2: Continuously execute program cycles d3: Execute one program cycle step by step d4: Continuously execute one program cycle step by step d5: Disable PLC operation, but can set direction of 1st speed to 7th speed	d0
5-08	PLC Forward/ Reverse Motion	d0 to d255 (0: FWD 1: REV)	d0
5-09	Time Duration Step 0	d0 to d65500 Sec	d0
5-10	Time Duration Step 1	d0 to d65500 Sec	d0
5-11	Time Duration Step 2	d0 to d65500 Sec	d0
5-12	Time Duration Step 3	d0 to d65500 Sec	d0
5-13	Time Duration Step 4	d0 to d65500 Sec	d0
5-14	Time Duration Step 5	d0 to d65500 Sec	d0
5-15	Time Duration Step 6	d0 to d65500 Sec	d0
5-16	Time Duration Step 7	d0 to d65500 Sec	d0

Group 6 Protection Parameters

Parameters	Explanation	Settings	Factory Setting
6-00	Over-Voltage Stall Prevention	d0: Disable d1: Enable	d1
6-01	Over-Voltage Prevention Level	230V series: d350 to d410V	d390
		460V series: d700 to d820V	d780
6-02	Over-Current Stall Prevention Level	d20 to d150%	d130
6-03	Over-Torque Detection Mode	d0: Disabled d1: Enabled during constant speed operation and continue to run to OL1 or OL. d2: Enabled during Constant Speed Operation and halted after detection d3: Enabled during running and continues before Continuous Output Time Limit (Pr.6-05) is reached d4: Enabled during running and halted after Over-Torque detection	d0
6-04	Over-Torque Detection Level	d30 to d200%	d150
6-05	Time setting for Over-torque Detection	d0.1 to d10.0 Sec	d0.1
6-06	Electronic Thermal Overload Relay Selection	d0 to d2	d2
6-07	Electronic Thermal Characteristic ◈	d30 to d600 Sec	d60
6-08	Present Fault Record	d0: No Fault occurred d1: Over Current (oc) d2: Over Voltage (ov) d3: Over Heat (oH) d4: Over Load (oL) d5: Over Load (oL1) d6: External Fault (EF) d7: Not used d8: Not used d9: Current exceed during Acceleration (ocA) d10: Current exceed during Deceleration (ocd) d11: Current exceed during Steady State (ocn) d12: Ground Fault (GF)	d0
6-09	Second Most Recent Fault Record		
6-10	Third Most Recent Fault Record		

8

Group 7 Motor Parameters

Parameters	Explanation	Settings	Factory Setting
7-00	Motor Rated Current ◈	d30 to d120%	d85
7-01	Motor No-Load Current ◈	d0 to d90%	d50
7-02	Torque Compensation ◈	d0 to d10	d01
7-03	Slip Compensation ◈	d0.0 to d10.0	d0.0

Group 8 Special Parameters

Parameters	Explanation	Settings	Factory Setting
8-00	DC Braking Voltage Level	d0 to d30%	d0
8-01	DC Braking Time during Start-Up	d0.0 to d60.0 Sec	d0.0
8-02	DC Braking time during Stopping	d0.0 to d60.0 Sec	d0.0
8-03	Start-Point for DC Braking	d0.0 to d400 Hz	d0.0
8-04	Momentary Power Loss Operation Selection	d0: Stop Operation after Momentary Power Loss d1: Continues after Momentary Power Loss, speed search starts with Master Frequency d2: Continues after Momentary Power Loss, speed search starts with Minimum Output Frequency	d0
8-05	Maximum Allowable Power Loss Time	d0.3 to d5.0 Sec	d2.0
8-06	B.B. Time for Speed Search	d0.3 to d5.0 Sec	d0.5
8-07	Maximum Speed Search Current Level	d30 to d200%	d150
8-08	Skip Frequency 1 Upper Bound	d0.0 to d400 Hz	d0.0
8-09	Skip Frequency 1 Lower Bound	d0.0 to d400 Hz	d0.0
8-10	Skip Frequency 2 Upper Bound	d0.0 to d400 Hz	d0.0
8-11	Skip Frequency 2 Lower bound	d0.0 to d400 Hz	d0.0
8-12	Skip Frequency 3 Upper bound	d0.0 to d400 Hz	d0.0
8-13	Skip Frequency 3 Lower Bound	d0.0 to d400 Hz	d0.0
8-14	Auto Restart After Fault	d0 to d10	d0
8-15	AVR Function	d0: AVR Function Enable d1: AVR Function Disable d2: AVR Function Disable when Deceleration	d2
8-16	Dynamic Braking Voltage	d350 to d450V*	d380*
8-17	DC Braking Lower Bound Limit	d0.0 to d400 Hz	d0.0

Group 9: Communication Parameters

Parameters	Explanation	Settings	Factory Setting
9-00	Communication Address ◈	d1 to d254	d1
9-01	Transmission Speed ◈	d0: Baud Rate 4800 bps d1: Baud Rate 9600 bps d2: Baud Rate 19200 bps d3: Baud Rate 38400 bps	d1
9-02	Transmission Fault Treatment ◈	d0: Warn and Keep Operating d1: Warn and Ramp to Stop d2: Warn and Coast to Stop d3: Keep Operating without Warning	d0
9-03	Modbus Communication Watchdog Timer ◈	d0: Disable d1 to d20: time setting (1 sec increment)	d0
9-04	Communication Protocol ◈	d0: 7,N,2 (Modbus, ASCII) d1: 7,E,1 (Modbus, ASCII) d2: 7,O,1 (Modbus, ASCII) d3: 8,N,2 (Modbus, ASCII) d4: 8,E,1 (Modbus, ASCII) d5: 8,O,1 (Modbus, ASCII) d6: 8,N,2 (Modbus, RTU) d7: 8,E,1 (Modbus, RTU) d8: 8,O,1 (Modbus, RTU)	d0

Group A: Communication Parameters

Parameters	Explanation	Settings	Factory Setting
A-00	PID Feedback Terminal Selection	d0: Disable PID function d1: Negative feedback 0~10V AVI d2: Negative feedback 4~20mA ACI d3: Positive feedback 0~10V AVI d4: Positive feedback 4~20mA ACI	d0
A-01	Feedback Signal Gain	d0 to d999	d100
A-02	Proportional Gain (P)	d0 to d999	d100
A-03	Integral Time (I)	d0 to d999	d100
A-04	Differential Time (D)	d0 to d100	d0
A-05	Integration's Upper Bound Frequency	d0 to d100%	d100
A-06	One-Time Delay	d0 to d999	d0
A-07	PID Frequency Output Command Limit	d0 to d110%	d100
A-08	Detection Time of the Feedback Error	d0.0 to d650 seconds	d0.0
A-09	Feedback Signal Fault Treatment	d0: warn and RAMP to stop d1: warn and COAST to stop	d0
A-10	Dwell (sleep) Frequency	d0.0 to d400Hz	d0.0
A-11	Revival Frequency	d0.0 to d400Hz	d0.0
A-12	Dwell (sleep) Period	d0.0 to d650 seconds	d0.0
A-13	PID User Defined	d0.0 to d400	d0.0

STANDARD SPECIFICATIONS

Voltage Class			115V Class			230V Class					460V Class			
Model Number VFD-□ □ □ S			002	004	007	002	004	007	015	022	004	007	015	022
Max. Applicable Motor Output (kW)			0.2	0.4	0.75	0.2	0.4	0.75	1.5	2.2	0.4	0.75	1.5	2.2
Output Rating	Rated Output Capacity (KVA)		0.6	1.0	1.6	0.6	1.0	1.6	2.9	4.2	1.2	2.0	3.3	4.4
	Rated Output Current (A)		1.6	2.5	4.2	1.6	2.5	4.2	7.5	11.0	1.5	2.5	4.2	5.5
	Maximum Output Voltage (V)		Proportional to Input Voltage											
	Rated Frequency (Hz)		1.0 to 400 Hz											
Input Rating	Rated Input Current (A)		Single phase			Single/3-phase model drive					3-phase			
			6	9	18	4.9/2.4	6.5/3.0	9.7/5.1	15.7/9.0	24/15	1.7	2.9	5.1	6.9
	Input Current for 1-phase model drive to be used as 3-phase model drive		-- --			1.9	2.7	5.1	8.4	--	-- --			
	Rated Voltage/Frequency		100/110/120 VAC 50/60 Hz			200/208/220/240 VAC 50/60Hz					380/400/415/480 VAC 50/60Hz			
	Voltage/Freq. Tolerance		Voltage: ±10%, Frequency: ±5%											
Control Characteristics	Control System		SPWM (Sinusoidal Pulse Width Modulation, carrier frequency 3k-10kHz)											
	Output Frequency Resolution		0.1Hz											
	Torque Characteristics		Including the auto-torque, auto-slip compensation; starting torque can be 150% at 5Hz											
	Overload Endurance		150% of rated current for 1 minute											
	Accel/Decel Time		0.1to 600 second (2 Independent settings for Accel/Decel Time)											
	V/F Pattern		V/F pattern adjustable											
	Stall Prevention Level		20 to 200%, Setting of Rated Current											
Operating Characteristics	Frequency Setting	Keypad	Setting by ▲ ▼ or Potentiometer											
		External Signal	Potentiometer-5KΩ/0.5W, DC 0 to +10V or 0 to +5V (Input impedance 47KΩ), RS-485 interface, 4 to 20mA (Input impedance 250Ω); Multi-Function Inputs 1 to 5 (7 steps, Jog, up/down)											
	Operation Setting Signal	Keypad	Setting by RUN, STOP											
		External Signal	M0 to M5 can be combined to offer various modes of operation, RS-485 serial interface (MODBUS).											
	Multi-Function Input Signal		Multi-step selection 0 to7, Jog, accel/decel inhibit, first/second accel/decel switch, counter, PLC operation, external Base Block (NC, NO)											
	Multi-Function Output Indication		AC Drive Operating, Frequency Attained, Non-zero, Base Block, Fault Indication, Local/Remote indication, PLC Operation indication.											
	Analog Output Signal		Analog frequency/current signal output.											
Other Function			AVR, S-Curve, Over-Voltage, Over-Current Stall Prevention, Fault Records, Adjustable Carrier Frequency, DC Braking, Momentary Power Loss restart, Frequency Limits, Parameter Lock/Reset, Reverse Inhibition, etc.											
Protection			Self-testing, Over Voltage, Over Current, Under Voltage, Overload, Overheating, External Fault, Electronic thermal, Ground Fault.											
Cooling			Forced air-cooling (**ONLY FOR** 022S2XA/B**;** XXXS43A/B/E 1HP~3HP**;** XXXSXXD**;** XXXS21E 400W~3HP). Others are Natural air-cooling.											
Enviroment	Installation Location		Altitude 1,000 m or below, keep from corrosive gasses, liquid and dust											
	Pollution Degree		2											
	Ambient Temperature		-10°C to 40°C (Non-Condensing and not frozen)											
	Storage Temperature		-20°C to 60°C											
	Ambient Humidity		Below 90% RH (non-condensing)											
	Vibration		9.80665m/s^2 (1G) less than 20Hz, 5.88m/s^2 (0.6G) at 20 to 50Hz											

A

ACCESSORIES

B.1 Non-fuse Circuit Breaker Chart

Per UL 508C, paragraph 44.8.6, part a,

1. For 1-phase drives, the current rating of the breaker shall be four times maximum of input current rating.
2. For 3-phase drives, the current rating of the breaker shall be four times maximum of output current rating.

(Note: Please select enough current capacity of NFB.)

1-phase		**3-phase**	
Model	Input Current (A)	Model	Output Current (A)
VFD002S11A/B	6.0	VFD002S23A/B	1.6
VFD002S21A/B/E	4.9	VFD004S23A/B	2.5
VFD004S11A/B	9.0	VFD004S43A/B/E	1.5
VFD004S21A/B/E	6.5	VFD007S23A/B	4.2
VFD007S11A/B	18.0	VFD007S43A/B/E	2.5
VFD007S21A/B/E	9.7	VFD015S23A/B/D	7.5
VFD015S21A/B/D/E	15.7	VFD015S43A/B/E	4.2
VFD022S21A/B/D/E	24	VFD022S23A/B/D	11.0
		VFD022S43A/B/E	5.5

Fuse Specification Chart

Smaller fuses than those shown in the table are permitted.

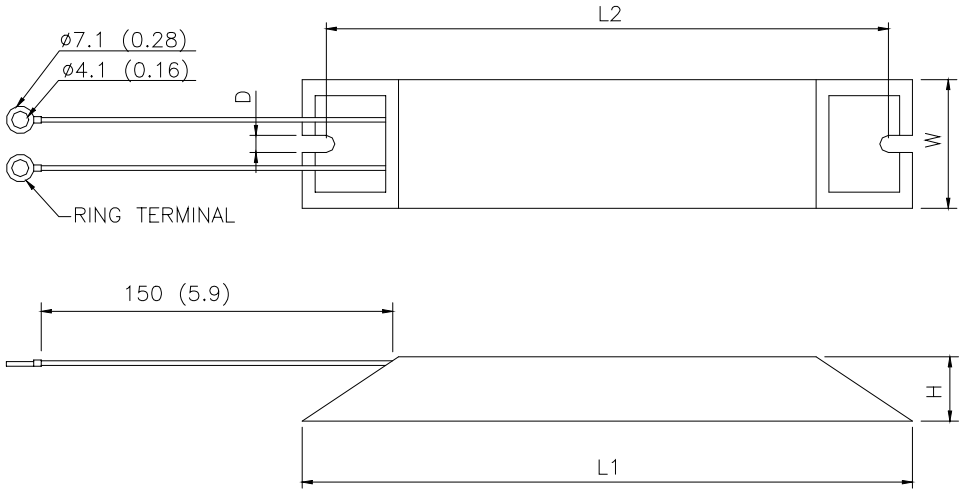
Model	I (input)(A)	I (output)(A)	Line Fuse	
			I (A)	Bussmann P/N
VFD002S11A/B	6.0	1.6	15	JJN-15
VFD002S21A/B/E	4.9	1.6	15	JJN-15
VFD002S23A/B	1.9	1.6	6	JJN-6
VFD004S11A/B	9.0	2.5	30	JJN-30
VFD004S21A/B/E	6.5	2.5	20	JJN-20
VFD004S23A/B	2.7	2.5	10	JJN-10
VFD004S43A/B/E	1.7	1.5	6	JJS-6
VFD007S11A/B	18.0	4.2	50	JJN-50
VFD007S21A/B/E	9.7	4.2	30	JJN-30
VFD007S23A/B	5.1	4.2	15	JJN-15
VFD007S43A/B/E	2.9	2.5	10	JJS-10
VFD015S21A/B/D/E	15.7	7.5	50	JJN-50
VFD015S23A/B/D	9.0	7.5	30	JJN-30
VFD015S43A/B/E	5.1	4.2	15	JJS-15
VFD022S21A/B/D/E	24	11	50	JJN-50
VFD022S23A/B/D	15.0	11.0	40	JJN-40
VFD022S43A/B/E	6.9	5.5	20	JJS-20

B.2 Braking Resistor and Unit chart for use with all Delta AC Drives

Voltage	Applicable Motor		Full Load Torque Kgf-M	Resistors Specification	Braking Resistors Model No of Units Used		Braking Torque 10%ED	Minimum Resistance rates
	HP	kW						
115V / 230V Series	1/4	0.2	0.110	80W 200Ω	BR080W200	1	400	---
	1/2	0.4	0.216	80W 200Ω	BR080W200	1	220	---
	1	0.75	0.427	80W 200Ω	BR080W200	1	125	80Ω
	2	1.5	0.849	300W 100Ω	BR300W100	1	125	55Ω
	3	2.2	1.262	300W 70Ω	BR300W070	1	125	35Ω
460V Series	1/2	0.4	0.216	80W 750Ω	BR080W750	1	230	---
	1	0.75	0.427	80W 750Ω	BR080W750	1	125	260Ω
	2	1.5	0.849	300W 400Ω	BR300W400	1	125	190Ω
	3	2.2	1.262	300W 250Ω	BR300W250	1	125	145Ω

Braking Resistor Dimensions

Unit: mm (inch)



TYPE	L1	L2	H	D	W	MAX. WEIGHT (g)
MVR200W120	165	150	20	5.3	40	240
MVR400W120	165	150	20	5.3	40	240
BR080W200	140	125	20	5.3	60	160
BR080W750	140	125	20	5.3	60	160
BR300W070	215	200	30	5.3	60	750
BR300W100	215	200	30	5.3	60	750
BR300W250	215	200	30	5.3	60	750
BR300W400	215	200	30	5.3	60	750

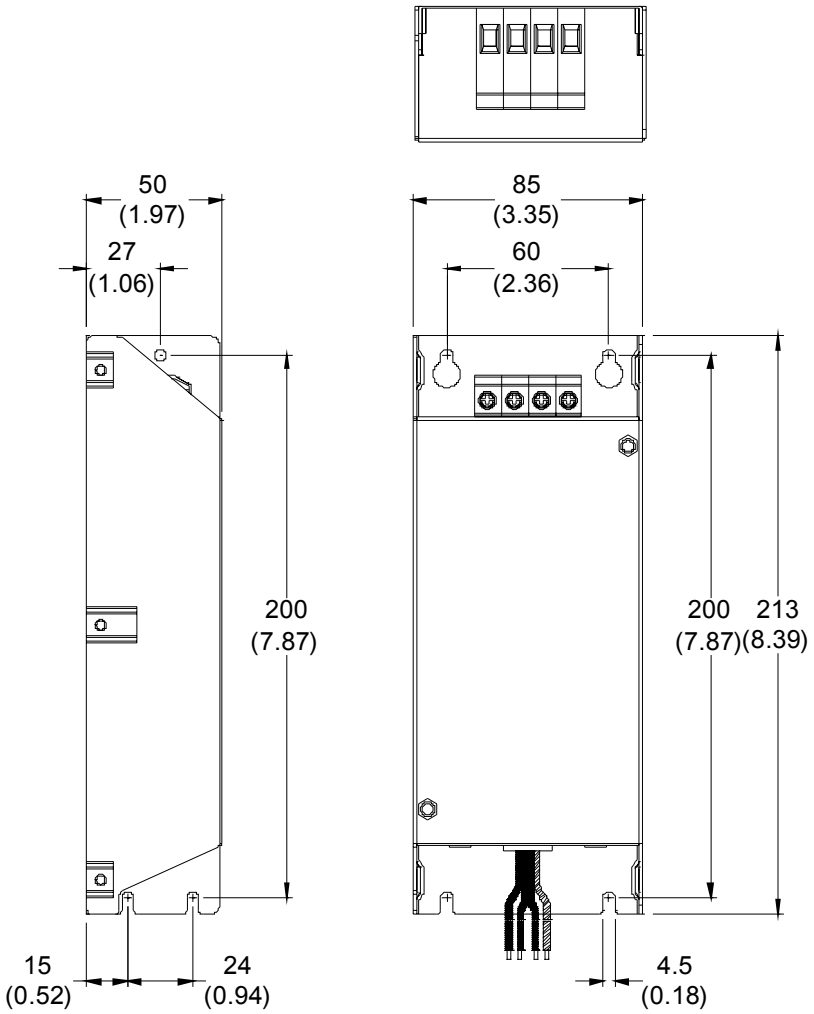
B

B.3 EMI Filters

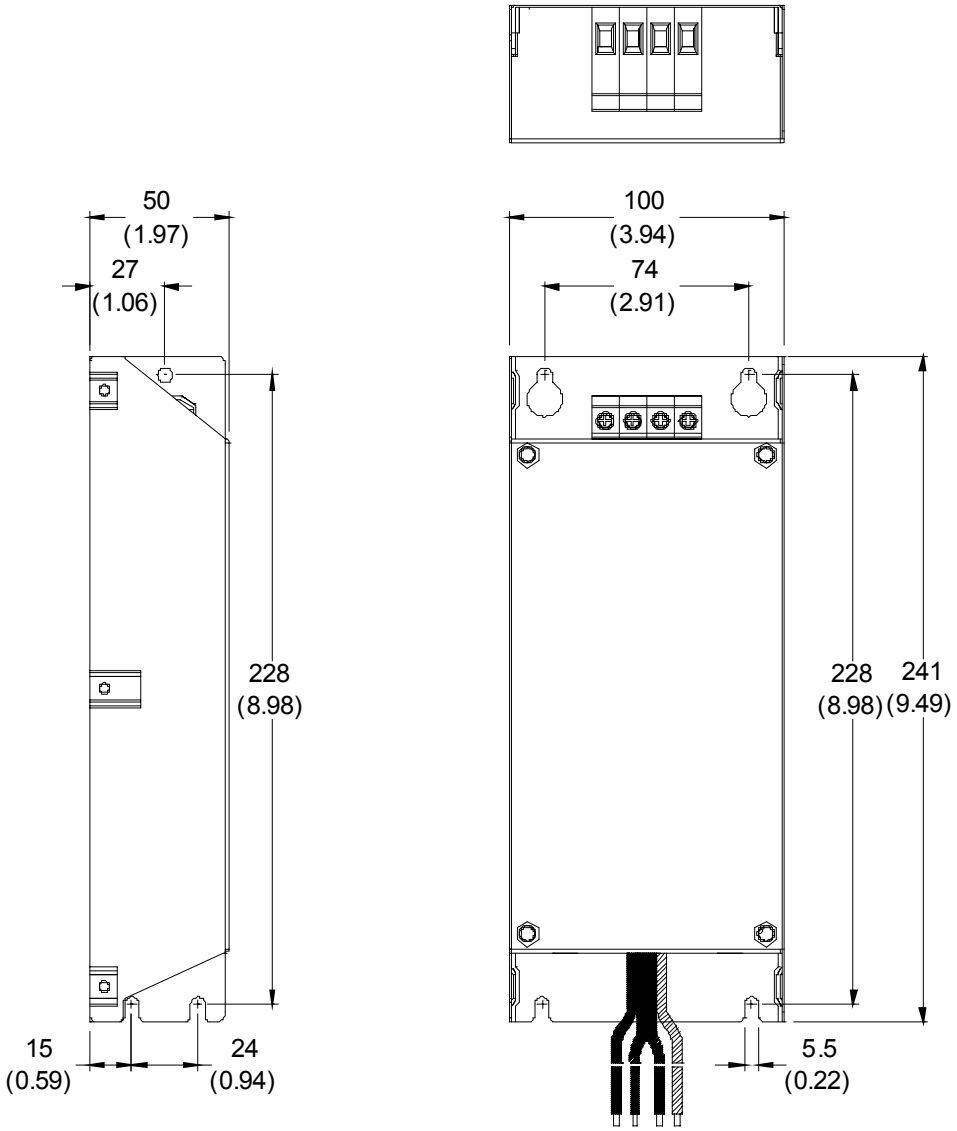
The DELTA VFD-S Series 0.25-3HP, 115V, 230V, 460V AC drive uses DELTA EMI Filter. Use the table below to find the appropriate filter for your DELTA VFD-S drive.

Model of AC Motor Drive	EMI Filter
VFD002S21A/E, VFD004S21A/E, VFD007S21A/E	RF007S21AA
VFD015S21D/E, VFD022S21/D/E	RF022S21BA
VFD004S43A, VFD007S43A	RF007S43AA
VFD015S43A, VFD022S43A	RF022S43BA
VFD002S11A, VFD004S11A	12DKT1W3S
VFD002S23A, VFD004S23A, VFD007S23A	08TDT1W4S
VFD007S11A, VFD015S21A	22DRT1W3S
VFD015S23A, VFD022S23A	20TDT1W4S
VFD022S21A	35DRT1W3C

EMI Filter (RF007S21AA/ RF007S43AA)

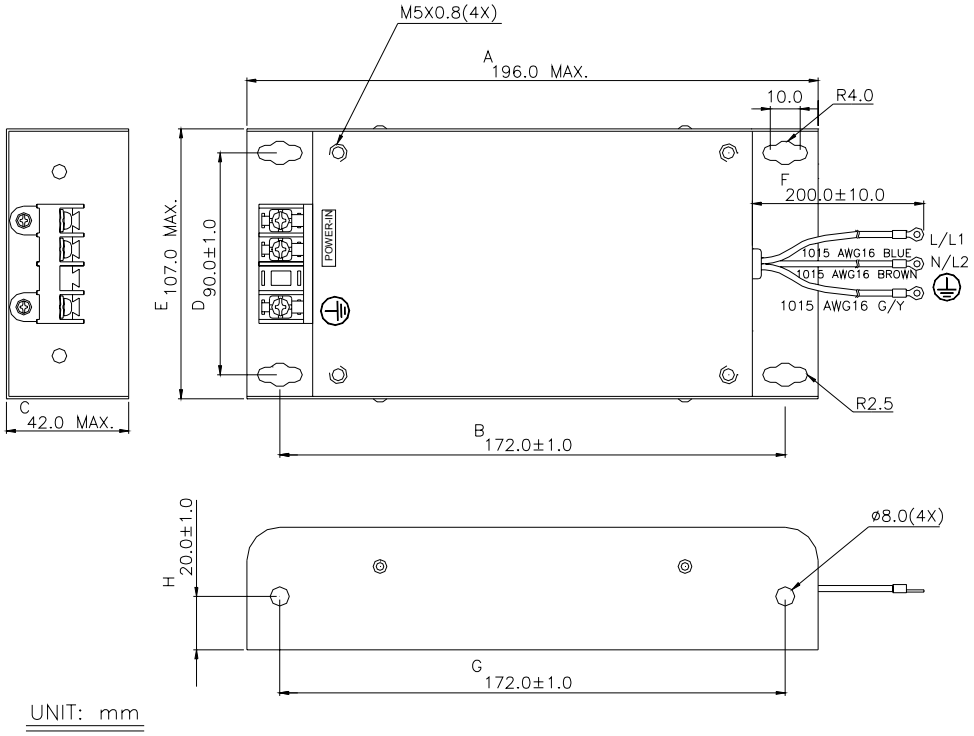


EMI Filter (RF022S21BA / RF022S43BA)

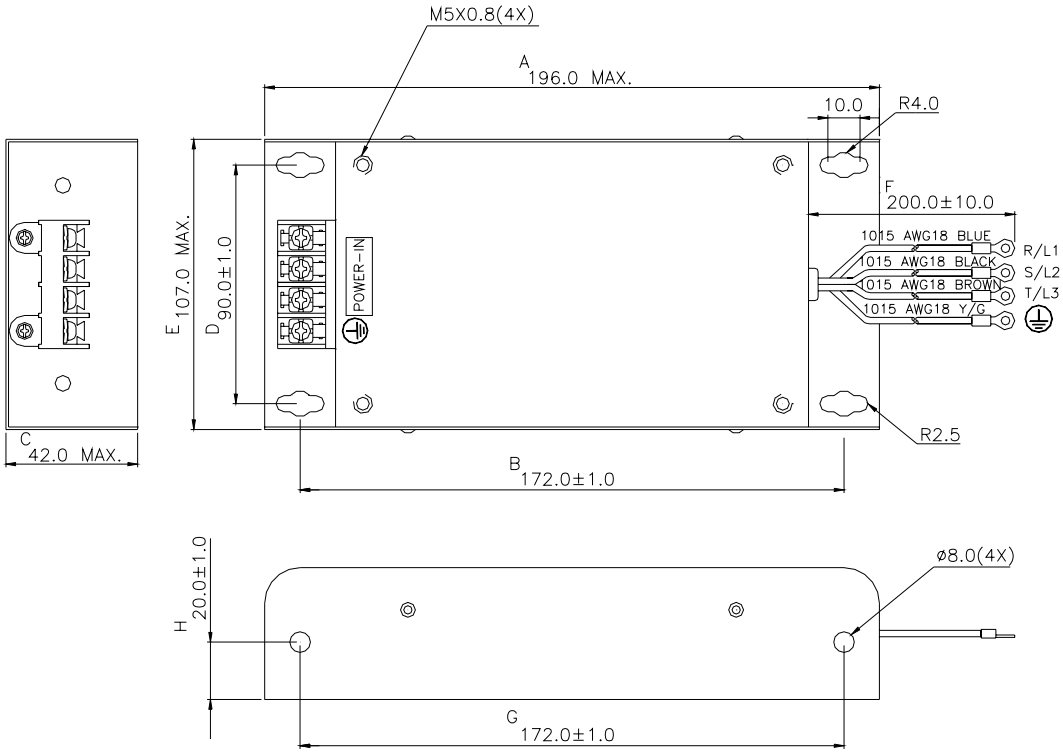


B

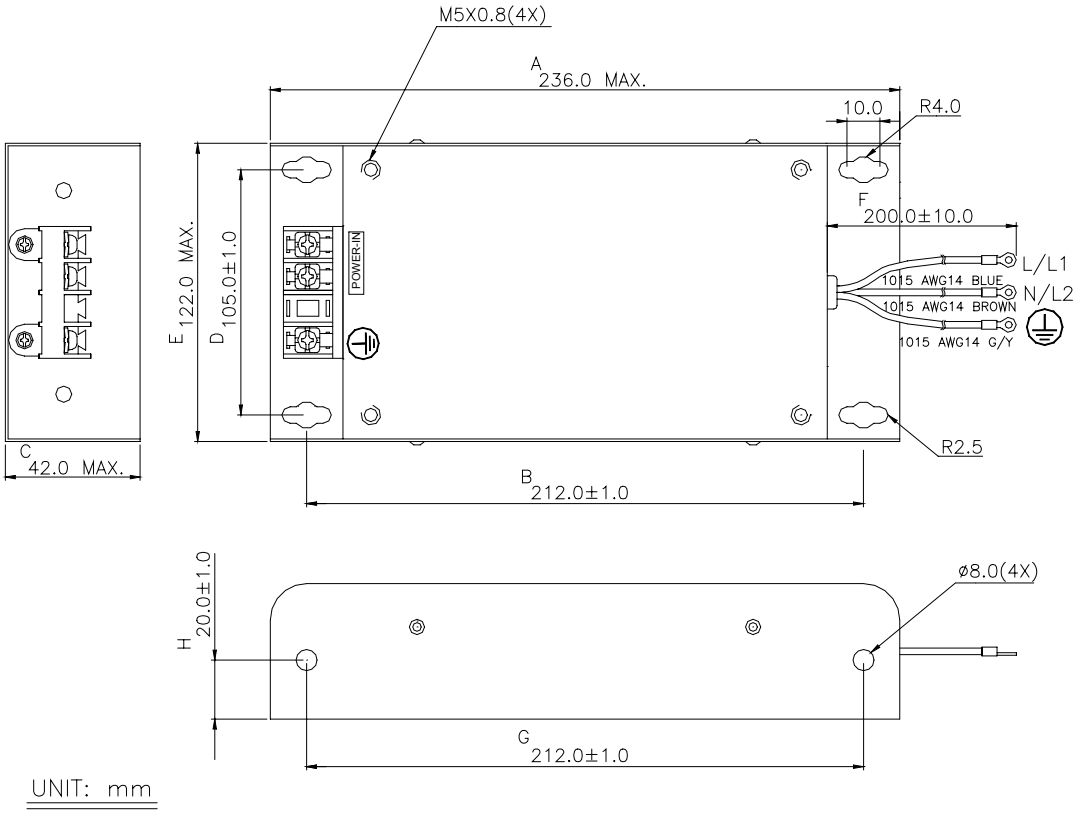
EMI Filter (12DKT1W3S)



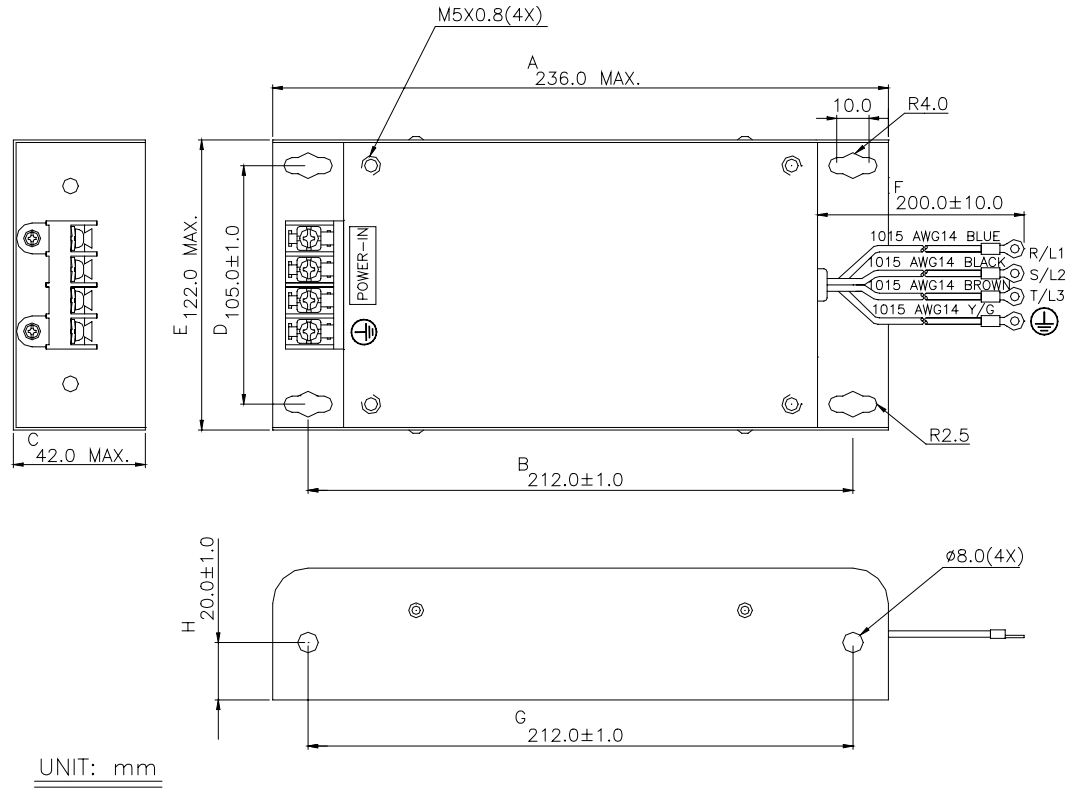
EMI Filter (08TDT1W4S)



EMI Filter (22DRT1W3S)

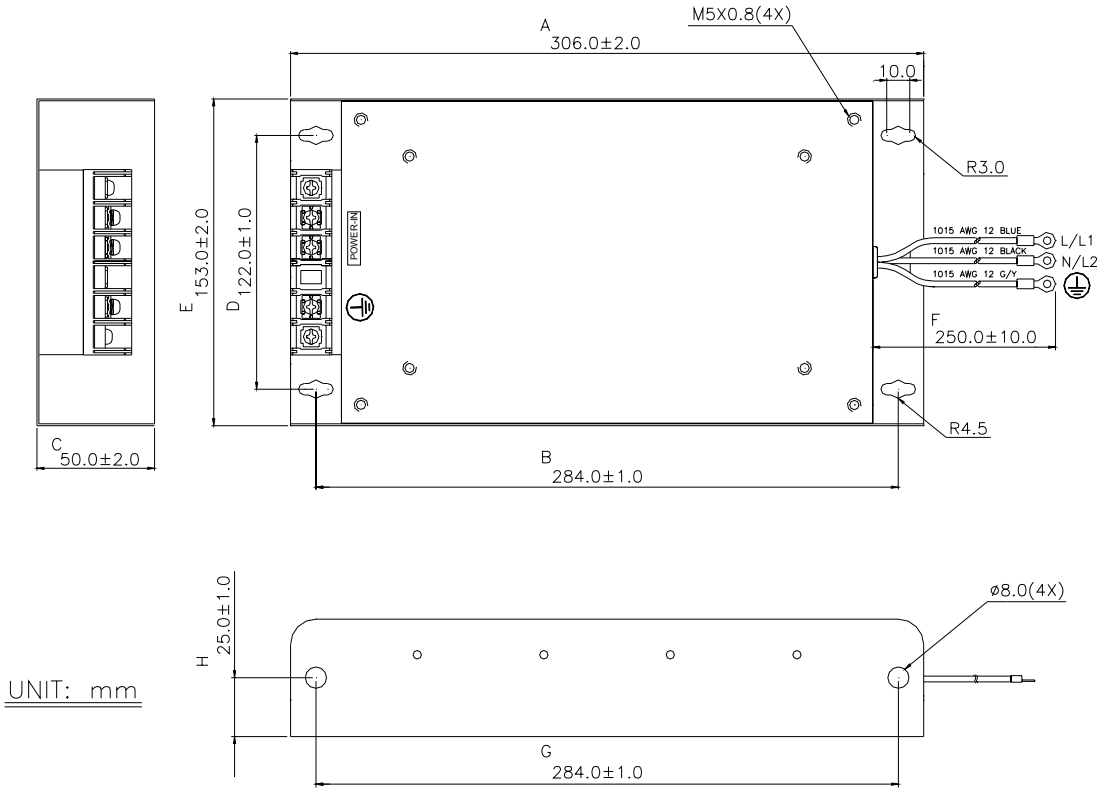


EMI Filter (20TDT1W4S)



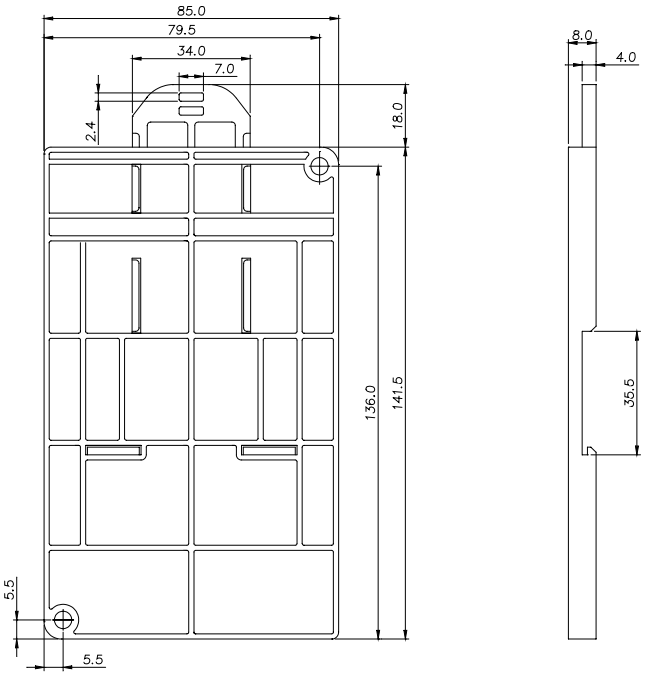
B

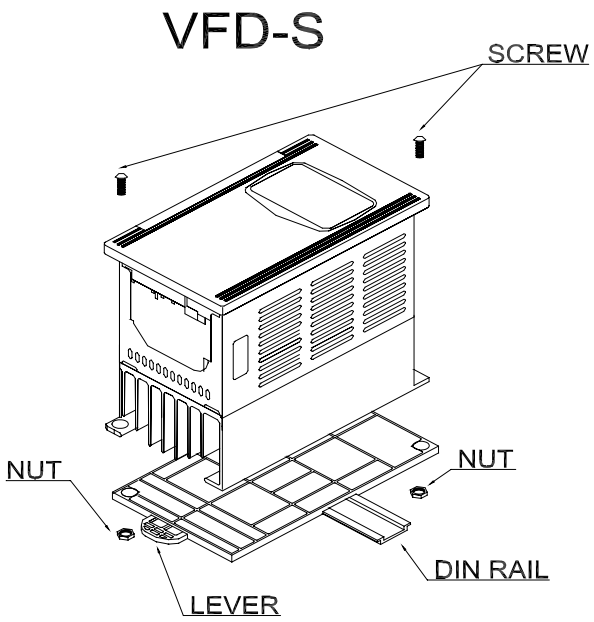
EMI Filter (35DRT1W3C)



B.4 Din Rail-DR01

Units: mm





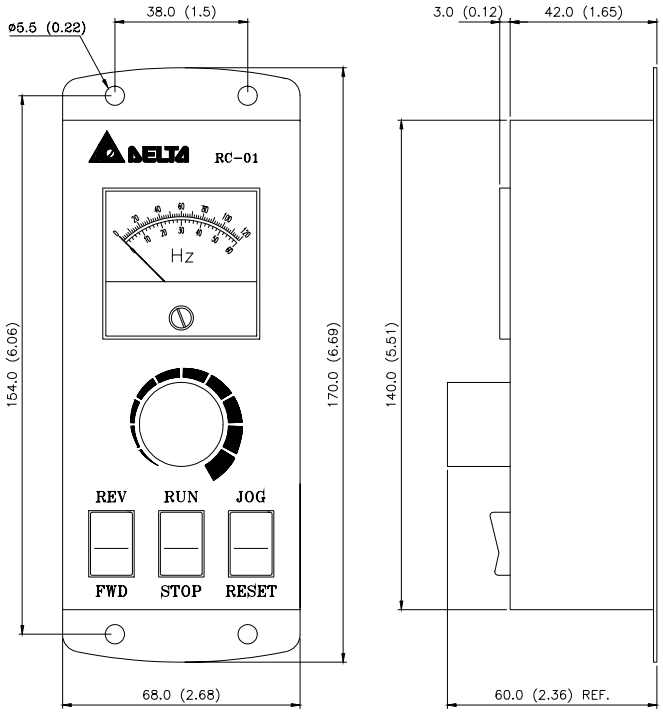
Models	Screw Size
VFD002S11A/B	M4*22
VFD002S21A/B/E	M4*22
VFD002S23A/B	M4*22
VFD004S11A/B	M4*12
VFD004S21A/B/E	M4*12
VFD004S23A/B	M4*12
VFD004S43A/B/E	M4*12
VFD007S21A/B/E	M4*12
VFD007S23A/B	M4*12
VFD007S43A/B/E	M4*12
VFD015S23D	M4*12

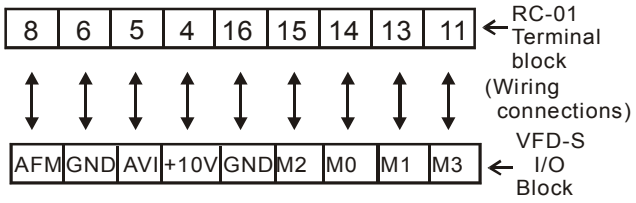
- To install the Din Rail Adapter use the specified screws for different models. Refer to the above chart.
- To mount the drive on a Din Rail, place the drive on the rail and push the lever toward the rail.

B

B.5 Remote Controller RC-01

Unit: mm (inch)





VFD-S Programming

Pr. 2-00 and Pr. 2-01 set to d01

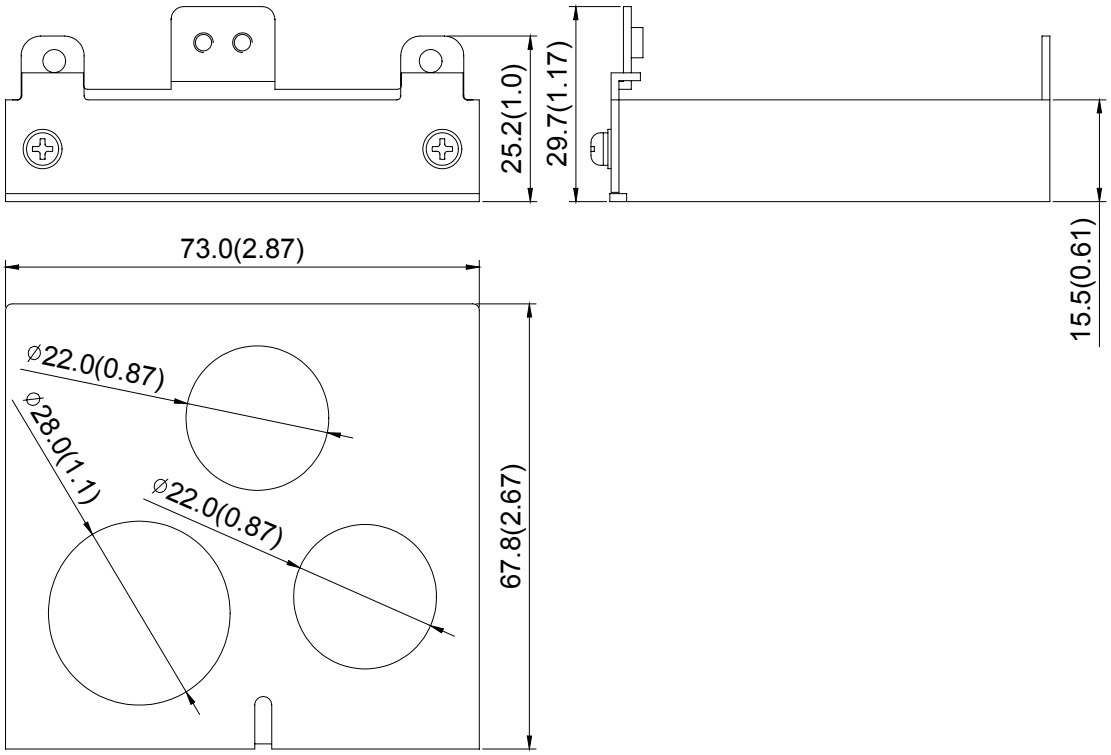
Pr. 4-04 set to d02 (M0, M1 set at RUN/STOP and FWD/REV)

Pr. 4-05 set to d06 (M2 set for reset)

Pr. 4-06 set to d10 (M3 set for jog operation)

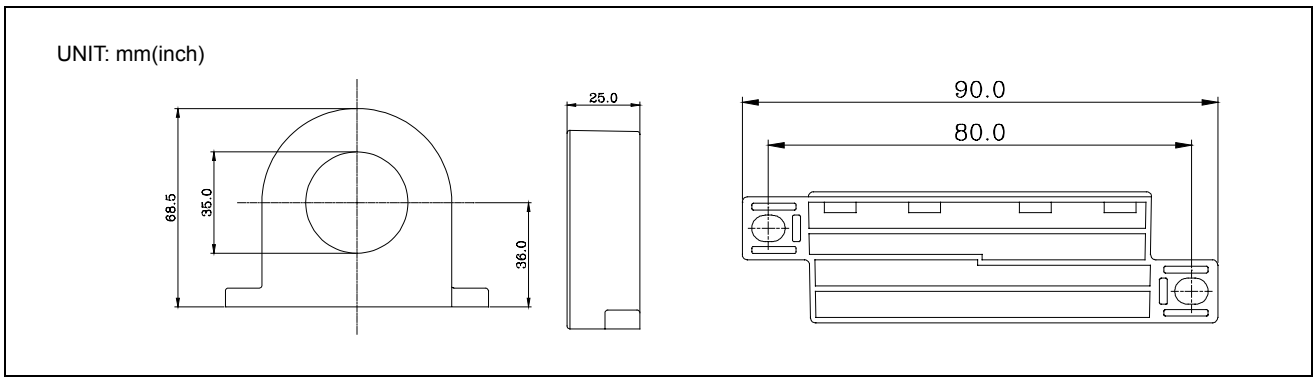
B.6 Conduit Bracket (BK-S)

Unit: mm (inch)



B

B.7 Zero Phase Reactor (RF220X00A)



Cable type (**Note**)	Recommended Wire Size			Qty.	Wiring Method
	AWG	mm^2	Nominal (mm2)		
Single-core	≦10	≦5.3	≦5.5	1	Diagram A
	≦2	≦33.6	≦38	4	Diagram B
Three-core	≦12	≦3.3	≦3.5	1	Diagram A
	≦1	≦42.4	≦50	4	Diagram B

Note: 600V Insulated Unshielded Cable.

Diagram A

Please wind each wire **4 times** around the core. The reactor must be put at inverter side as close as possible.

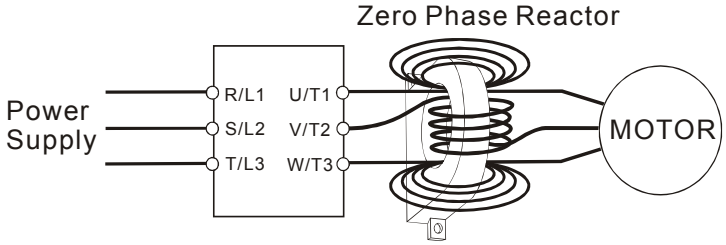
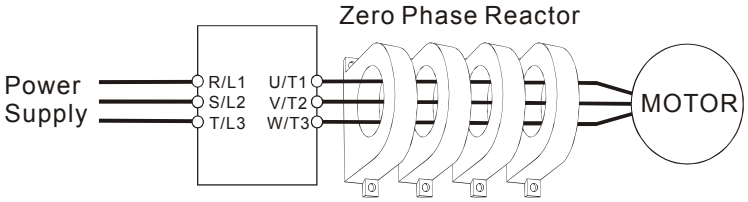


Diagram B

Please put all wires through **4 cores** in series without winding.



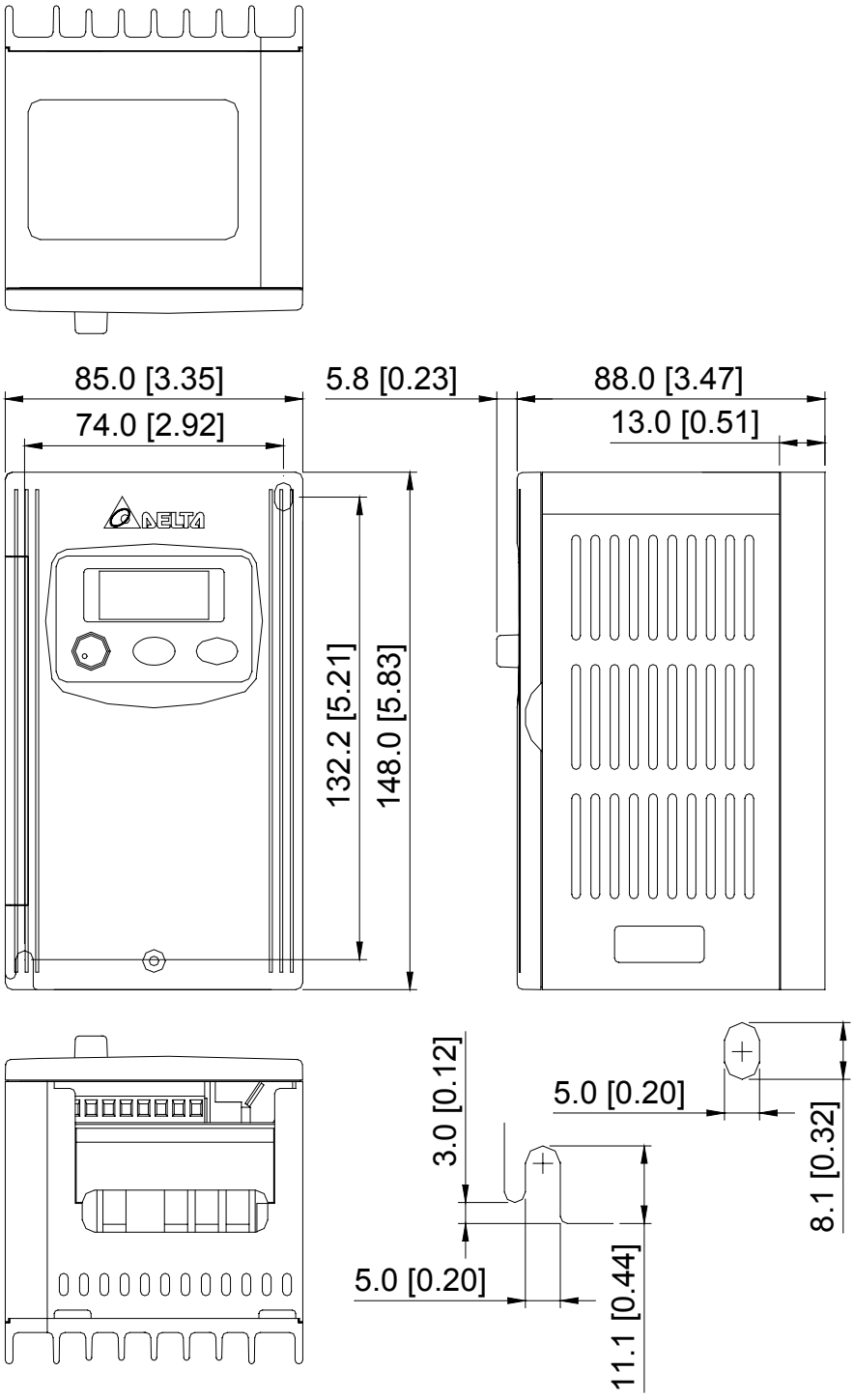
Note1: The table above gives approximate wire size for the zero phase reactors but the selection is ultimately governed by the type and diameter of cable fitted i.e. the cable must fit through the center hole of zero phase reactors.

Note2: Only the phase conductors should pass through, not the earth core or screen.

Note3: When long motor output cables are used an output zero phase reactor may be required to reduce radiated emissions from the cable.

Dimensions

VFD002S11A 0.25HP 115V / 1 Phase
VFD002S21A 0.25HP 230V / 1 Phase
VFD002S23A 0.25HP 230V / 3 Phase
Unit: mm [inches]



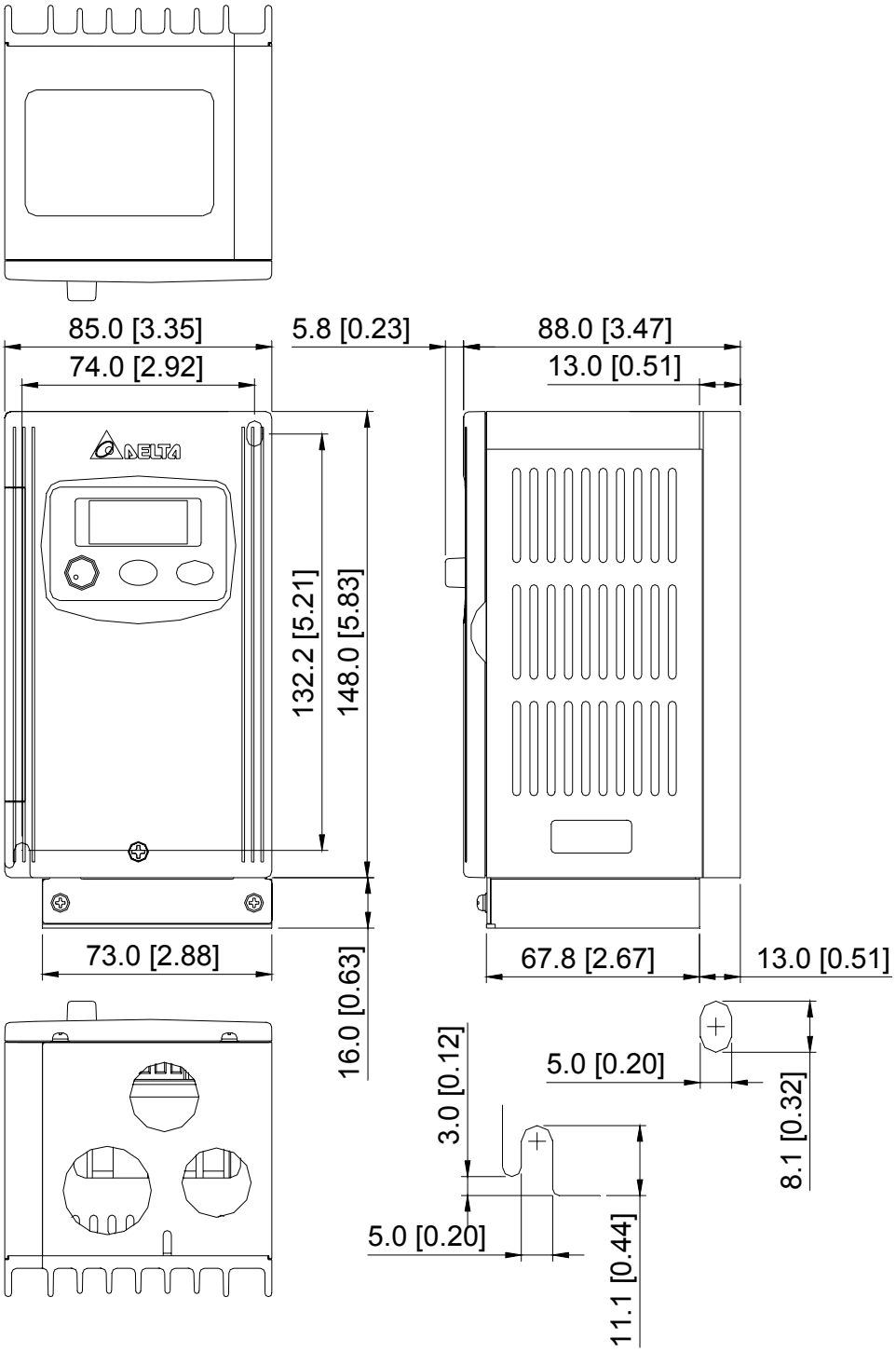
C

VFD002S11B 0.25HP 115V / 1 Phase

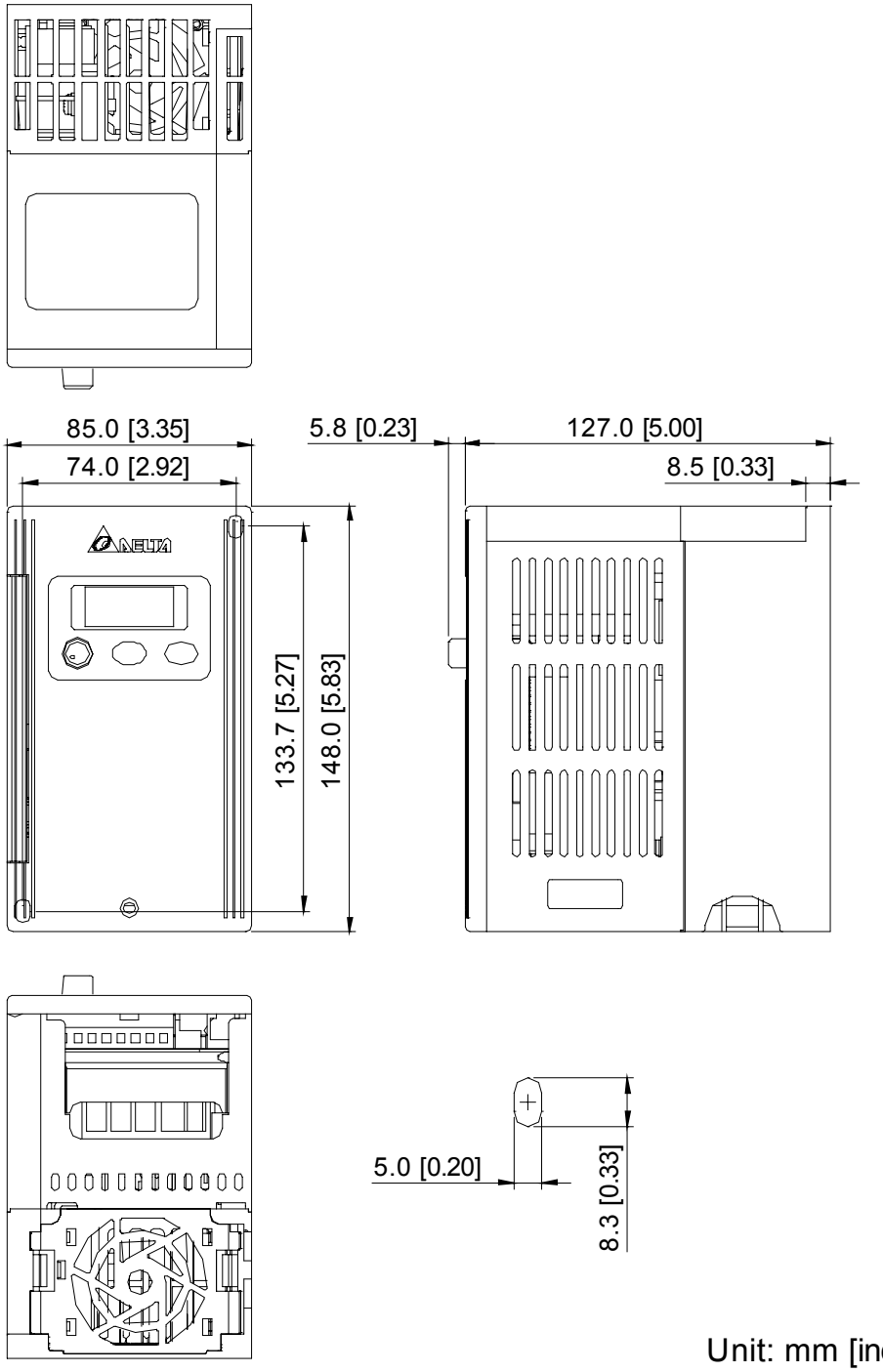
VFD002S21B 0.25HP 230V / 1 Phase

VFD002S23B 0.25HP 230V / 3 Phase

Unit: mm [inches]



VFD002S21E 0.25HP 230V / 1 Phase
VFD004S21E 0.5HP 230V / 1 Phase
VFD007S21E 1HP 230V / 1 Phase
VFD015S23D 2HP 230V / 3 Phase
Unit: mm [inches]



Unit: mm [inch]

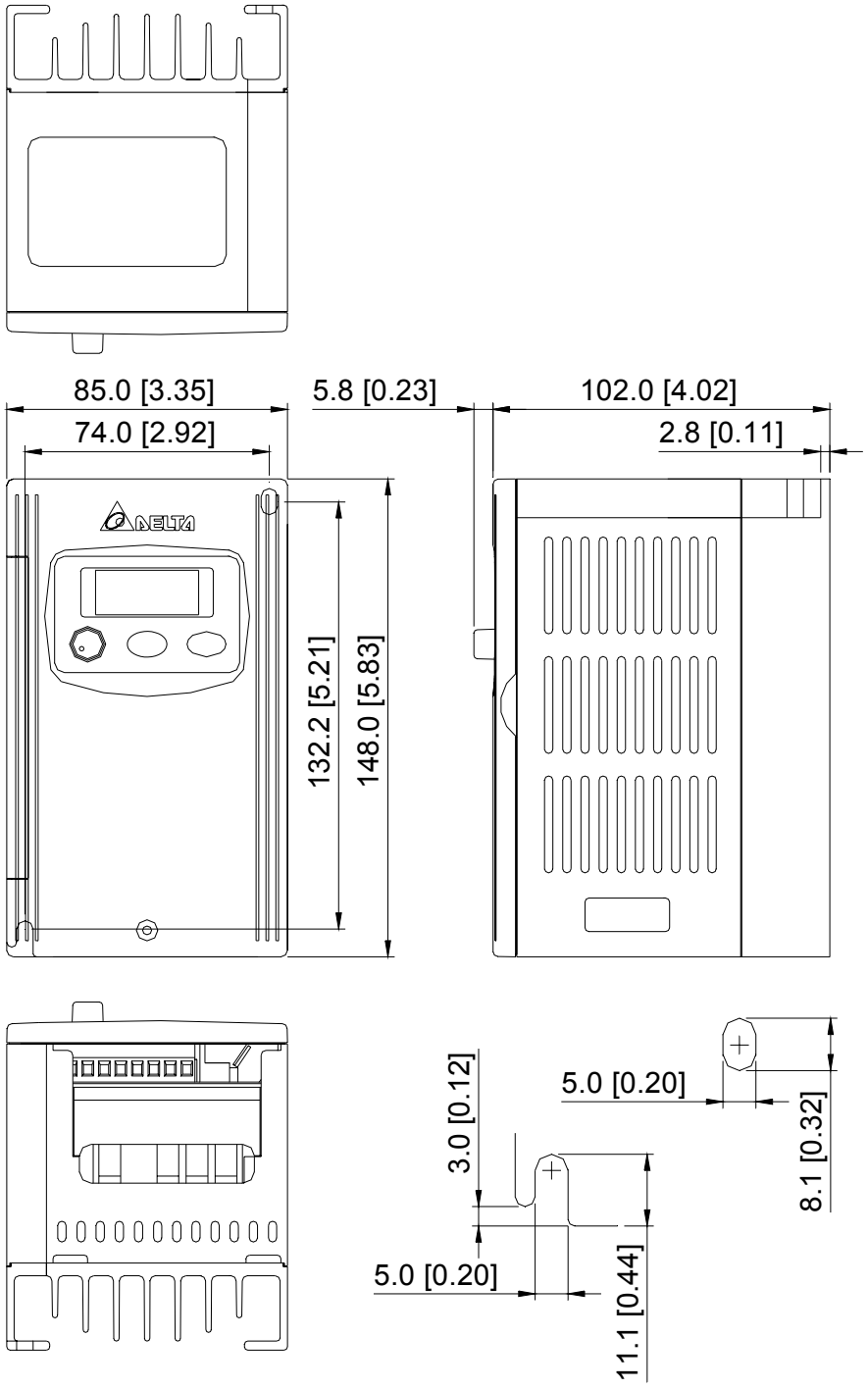
C

VFD004S11A 0.5HP 115V / 1 Phase

VFD004S21A 0.5HP 230V / 1 Phase

VFD004S23A 0.5HP 230V / 3 Phase

Unit: mm [inches]

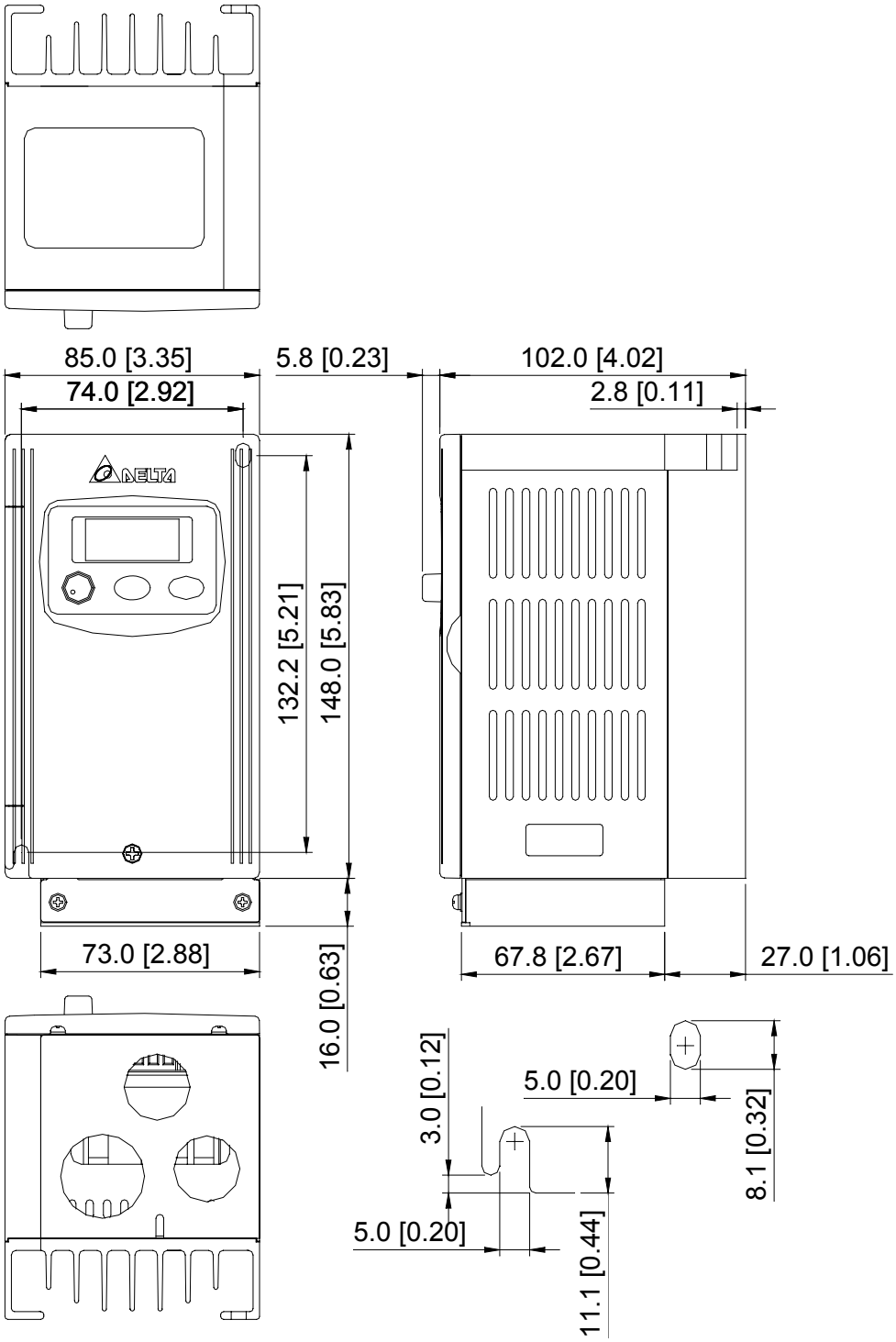


VFD004S11B 0.5HP 115V / 1 Phase

VFD004S21B 0.5HP 230V / 1 Phase

VFD004S23B 0.5HP 230V / 3 Phase

Unit: mm [inches]



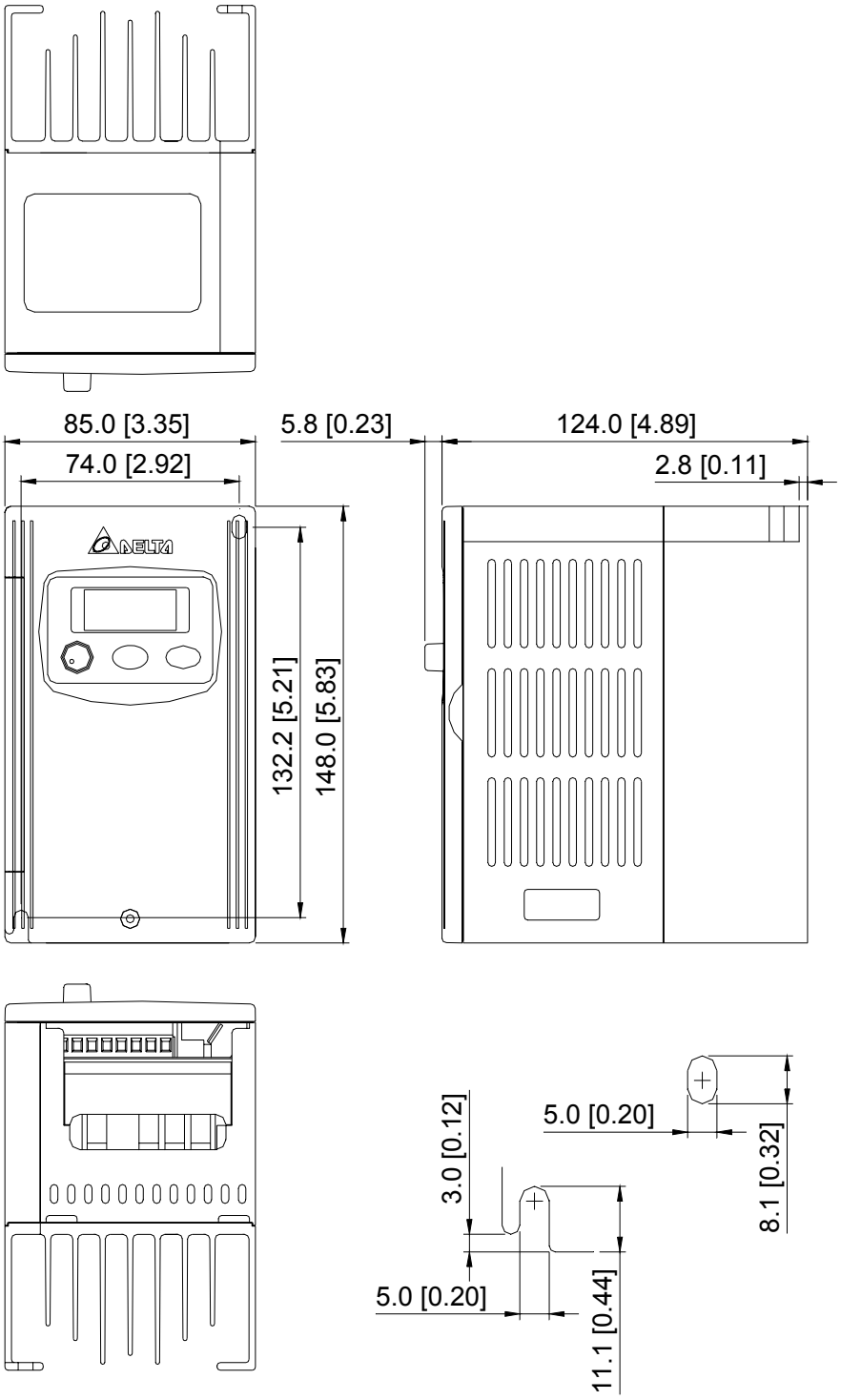
C

VFD004S43A/E 0.5HP 460V / 3 Phase

VFD007S21A 1 HP 230V / 1 Phase

VFD007S23A 1 HP 230V / 3 Phase

Unit: mm [inches]

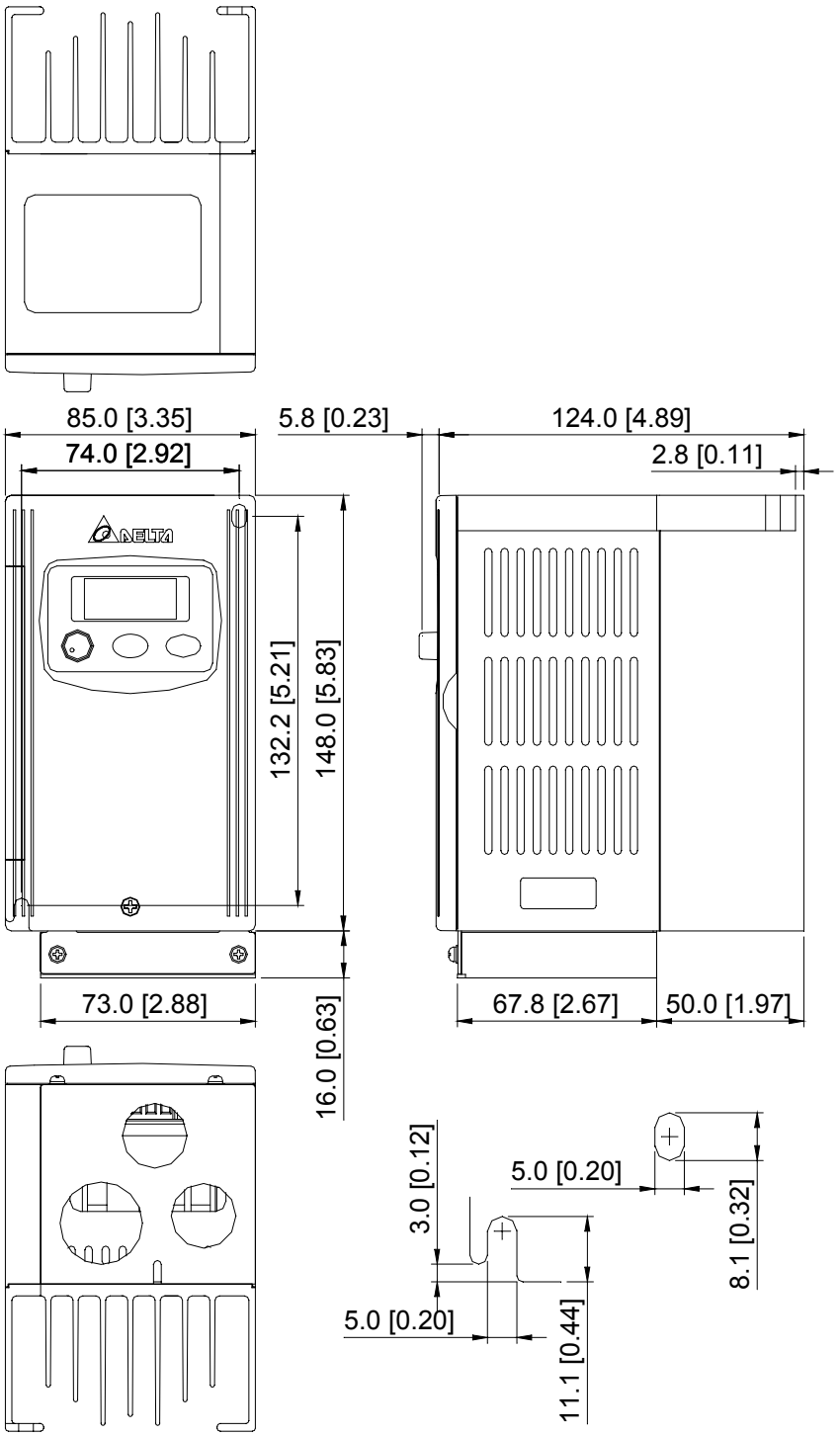


VFD004S43B 0.5HP 460V / 3 Phase

VFD007S21B 1 HP 230V / 1 Phase

VFD007S23B 1 HP 230V / 3 Phase

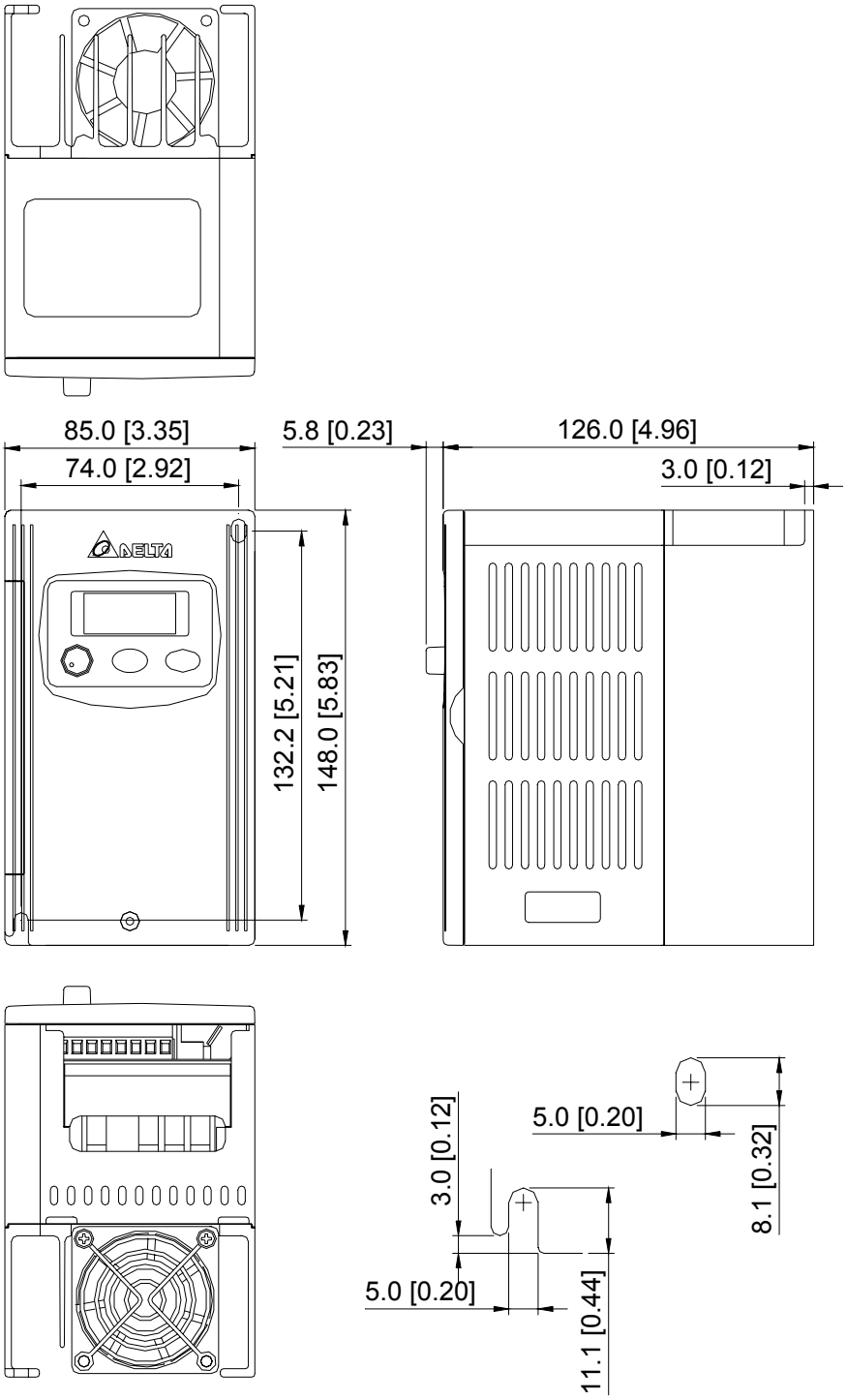
Unit: mm [inches]



C

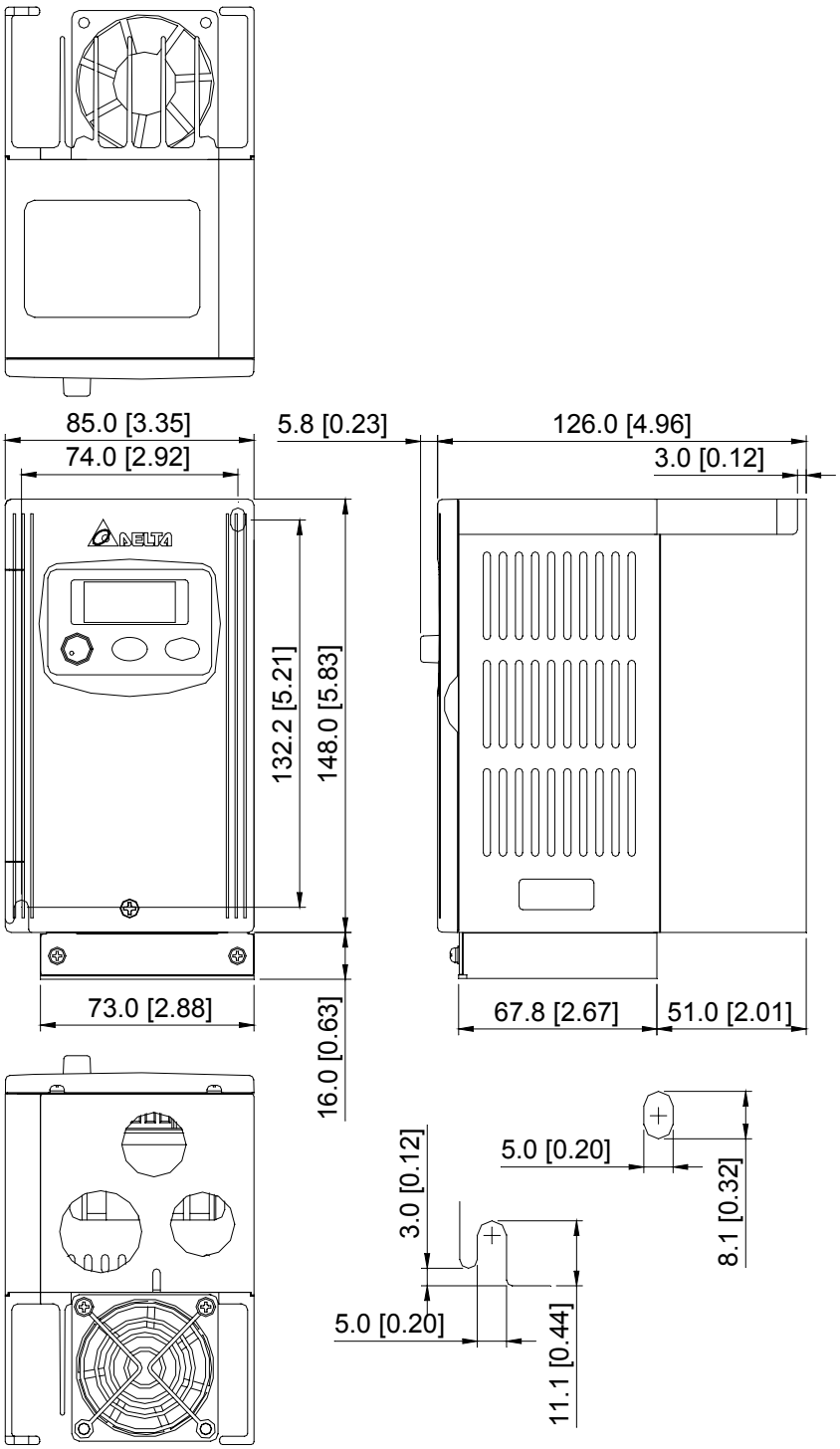
VFD007S43A/E 1 HP 460V / 3 Phase

Unit: mm [inches]



VFD007S43B 1 HP 460V / 3 Phase

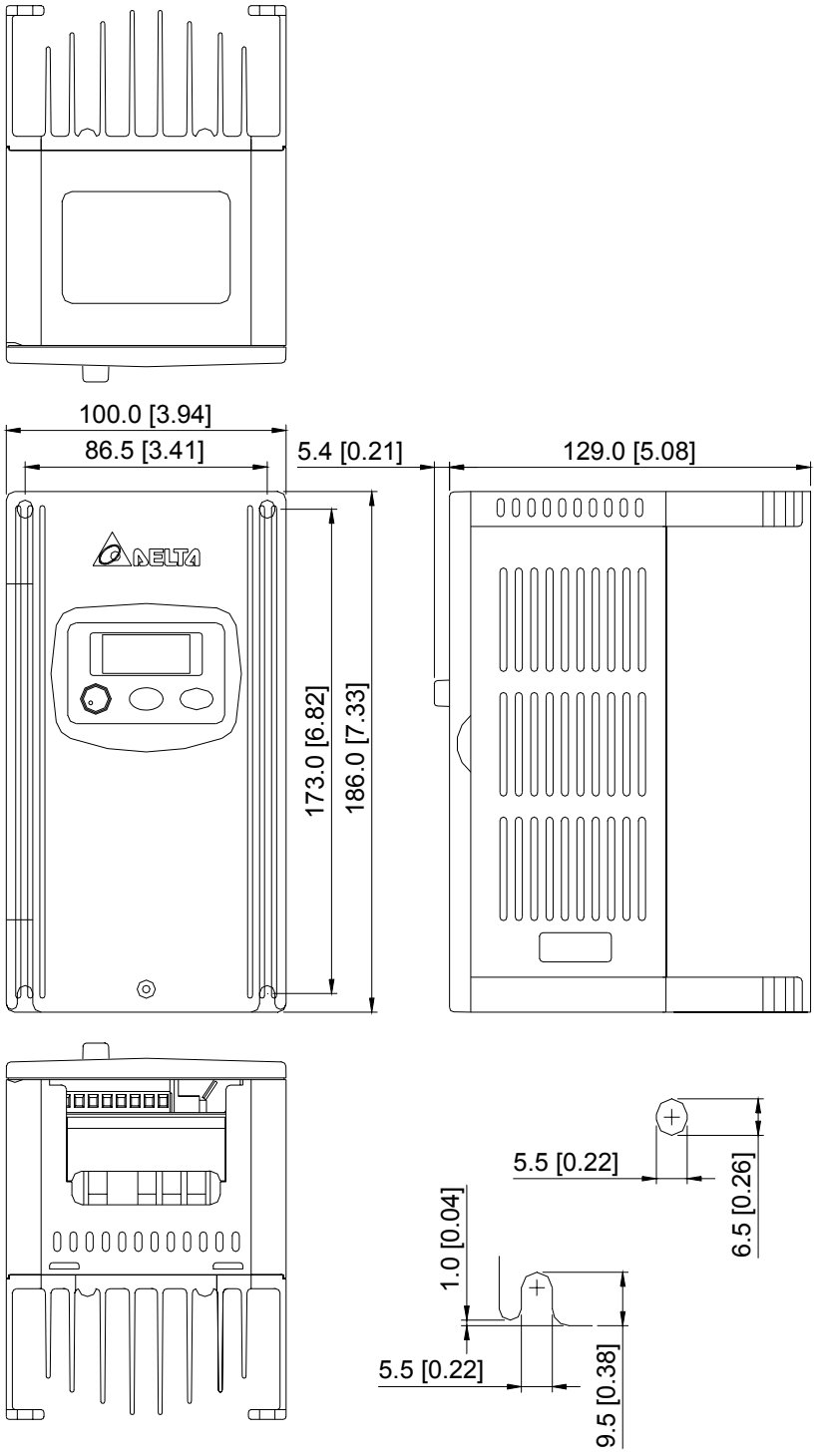
Unit: mm [inches]



C

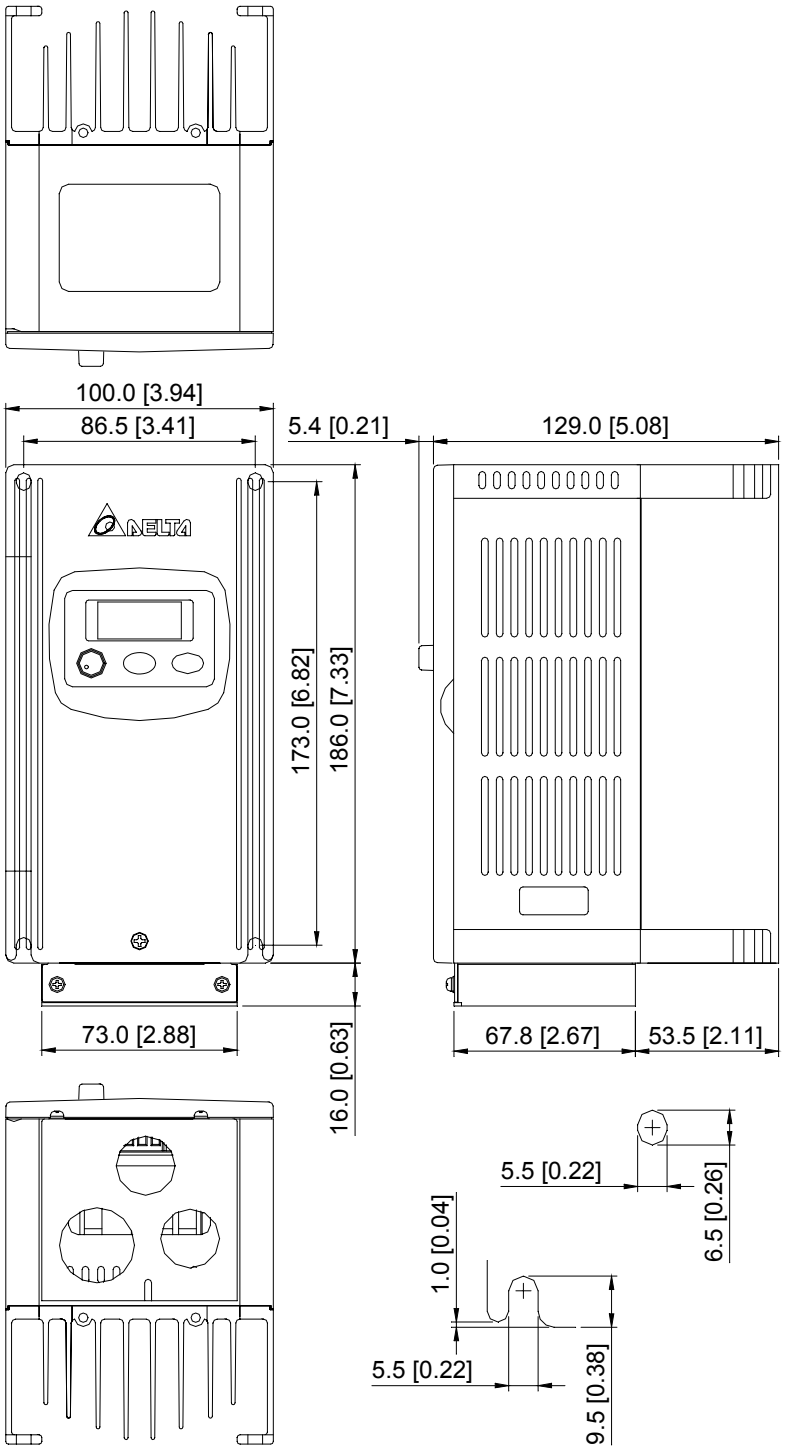
VFD007S11A 1 HP 115V / 1 Phase

Unit: mm [inches]



VFD007S11B 1 HP 115V / 1 Phase

Unit: mm [inches]

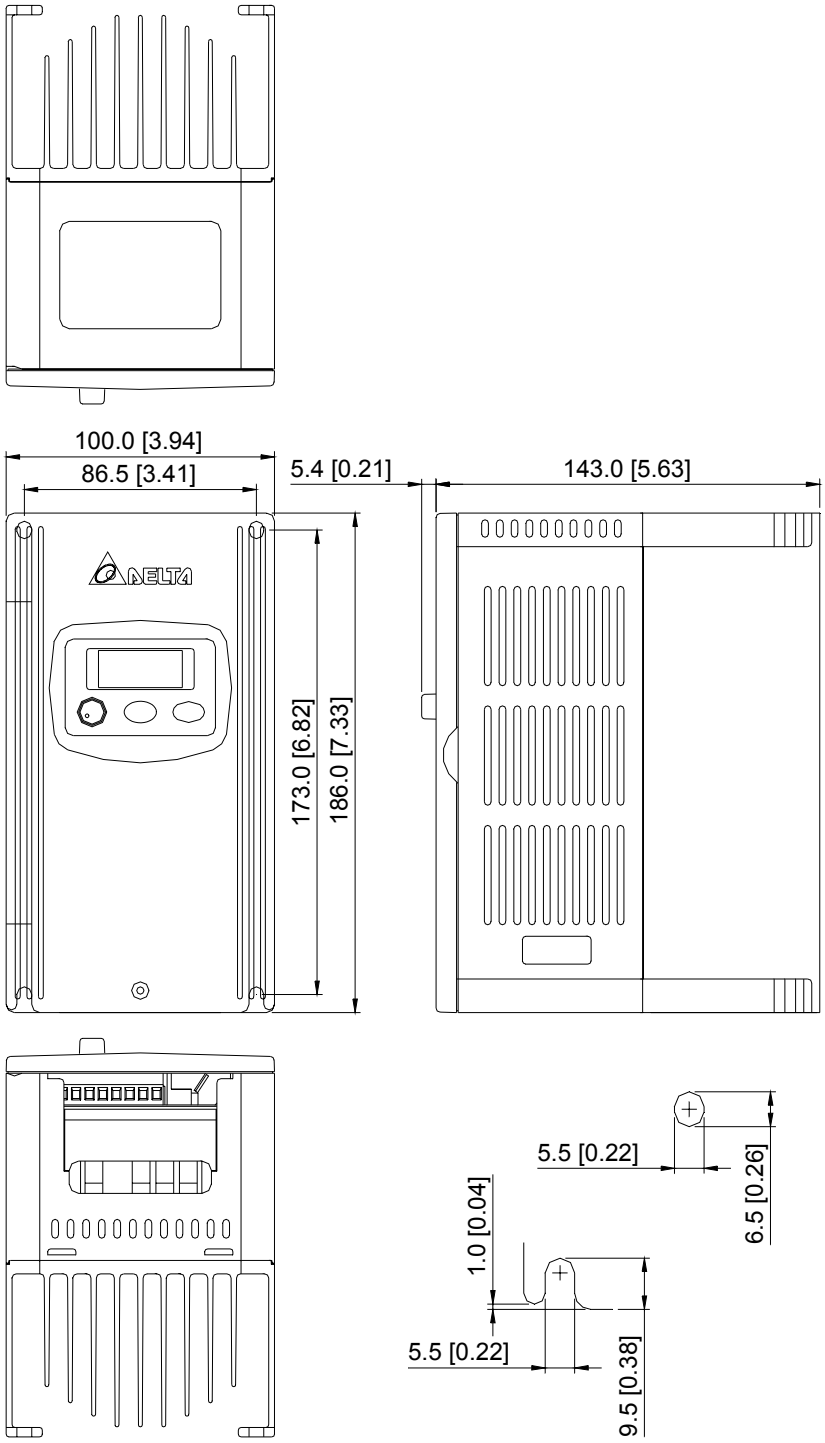


C

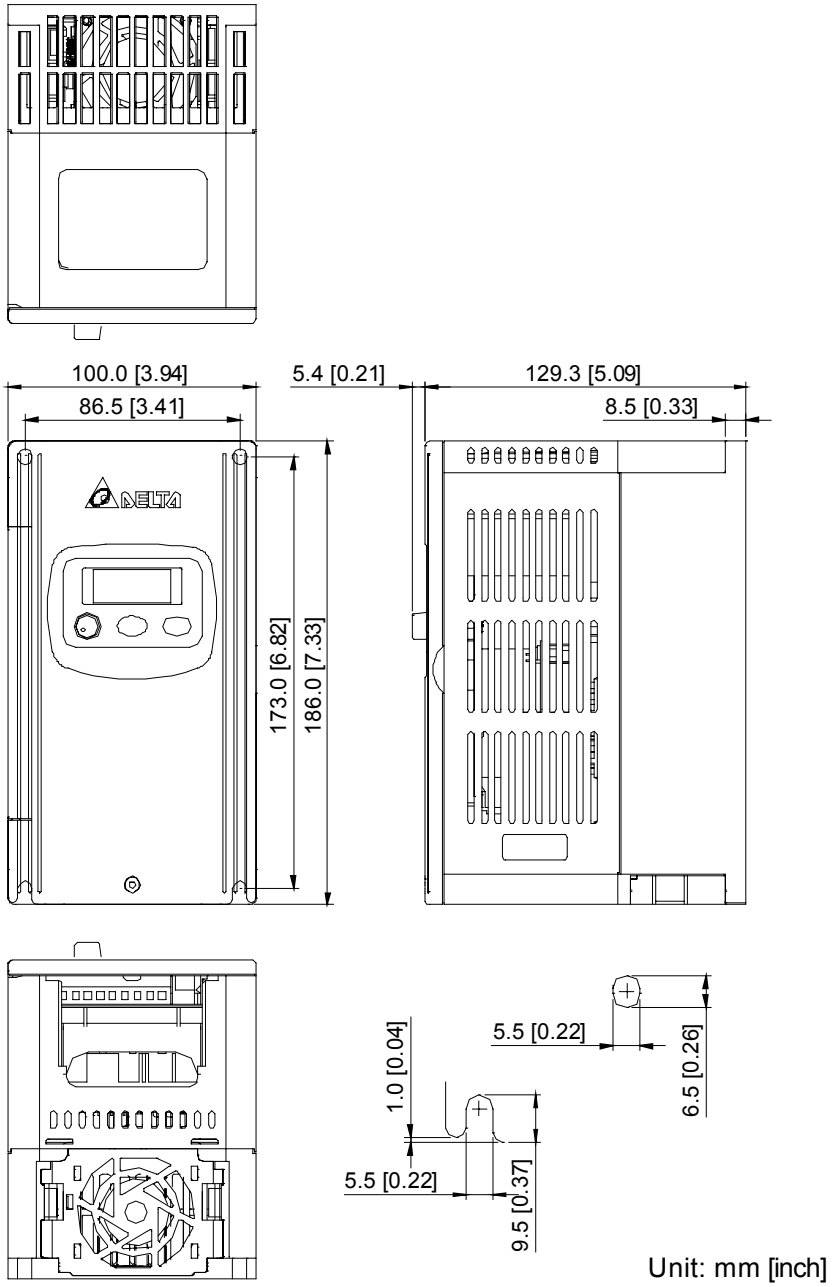
VFD015S21A 2 HP 230V / 1 Phase

VFD015S23A 2 HP 230V / 3 Phase

Unit: mm [inches]



VFD015S21D/E 2 HP 230V / 1 Phase
VFD022S21D/E 2 HP 230V / 1 Phase
VFD022S23D 2 HP 230V / 3 Phase
Unit: mm [inches]



Unit: mm [inch]

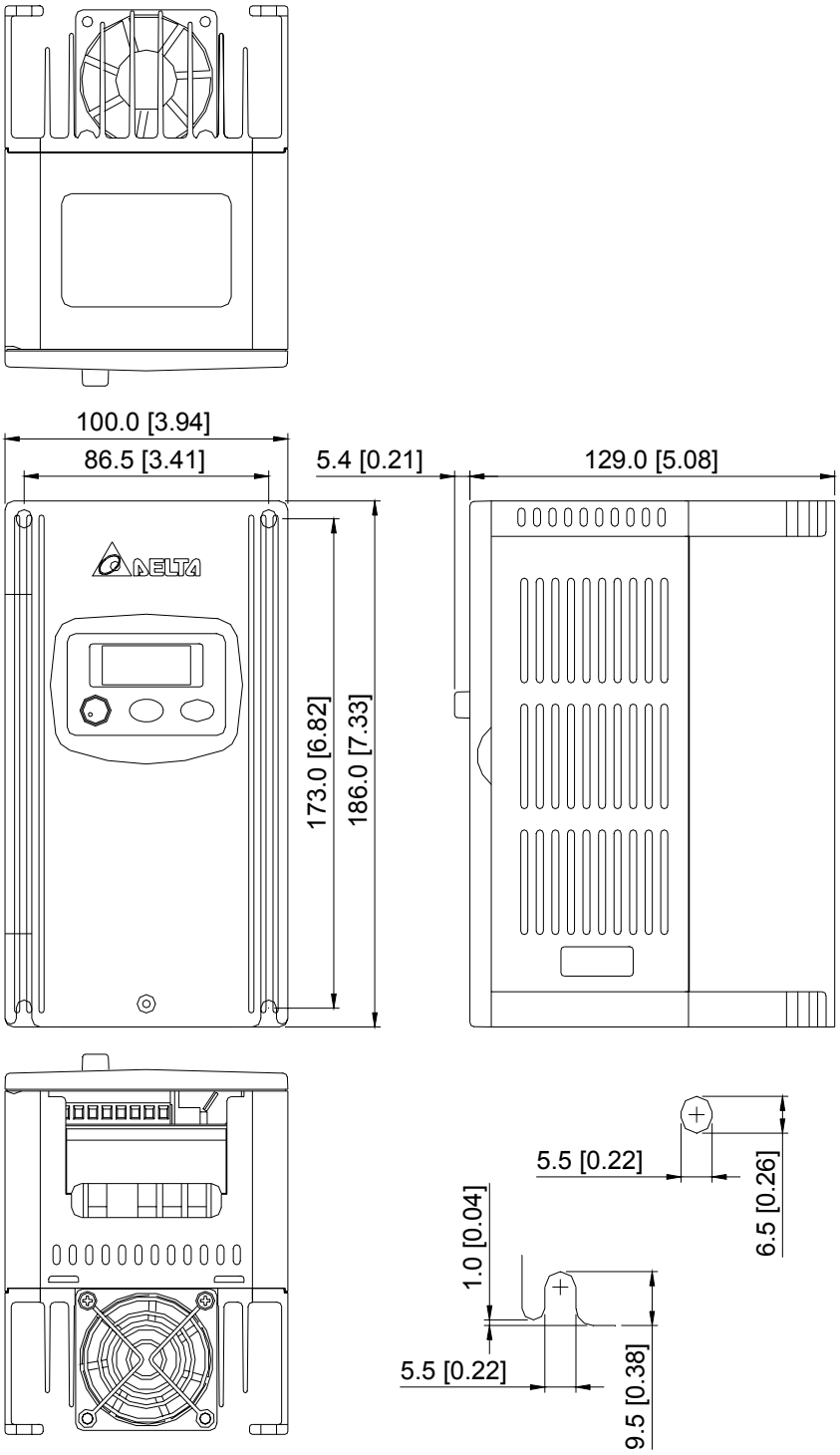
C

VFD015S43A/E 2 HP 460V / 3 Phase

VFD022S23A 3 HP 230V / 3 Phase

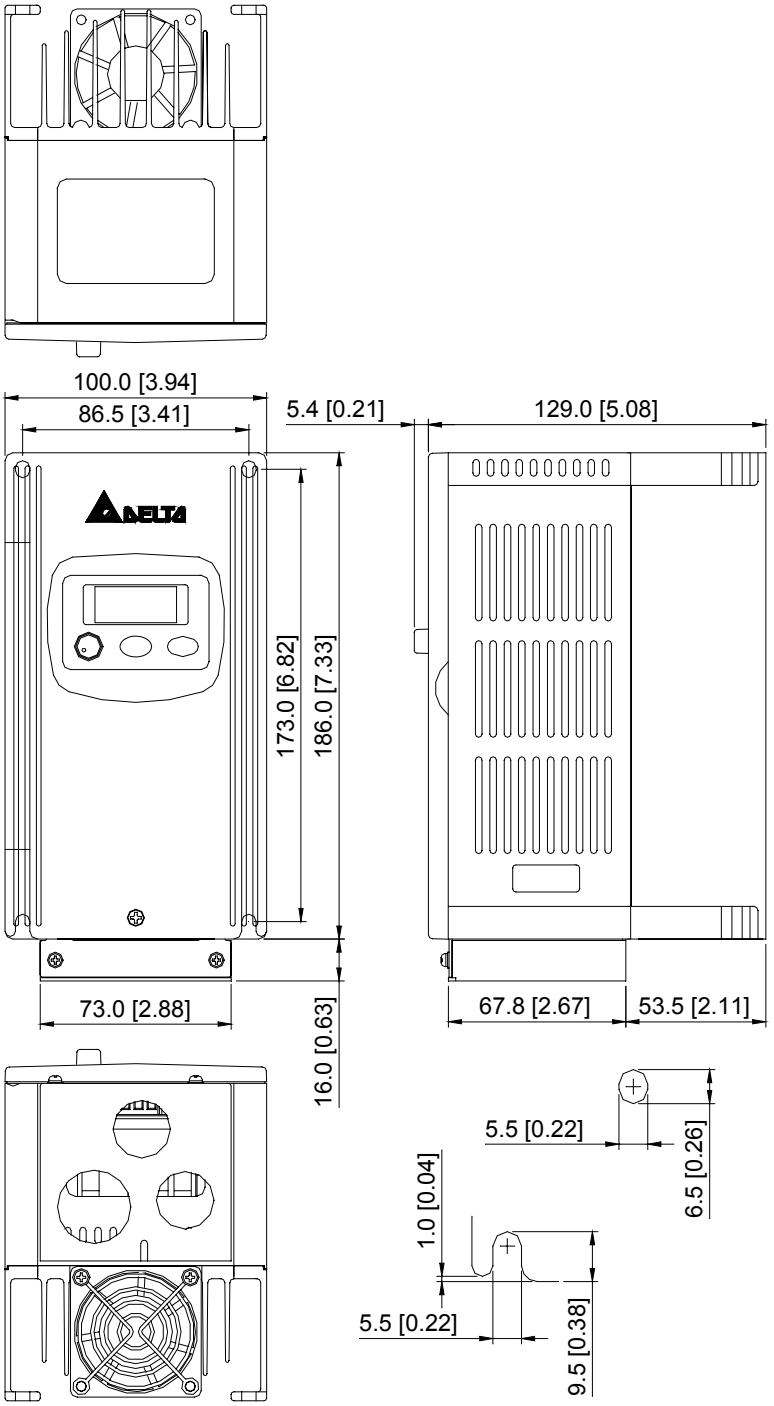
VFD022S43A/E 3 HP 460V / 3 Phase

Unit: mm [inches]



VFD015S21B 2 HP 230V / 1 Phase
VFD015S23B 2 HP 230V / 3 Phase
VFD015S43B 2 HP 460V / 3 Phase
VFD022S23B 3 HP 230V / 3 Phase
VFD022S43B 3 HP 460V / 3 Phase

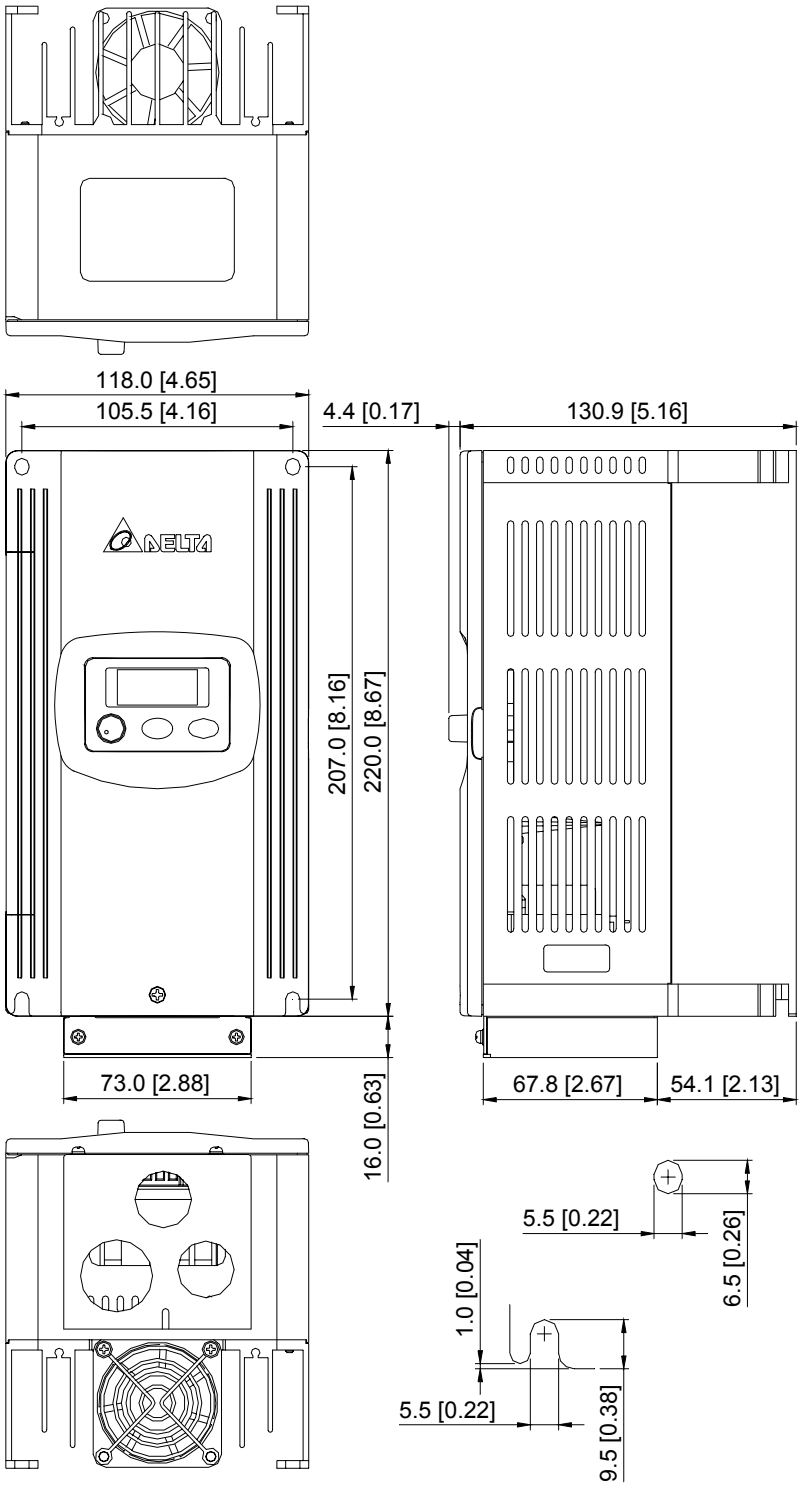
Unit: mm [inches]



C

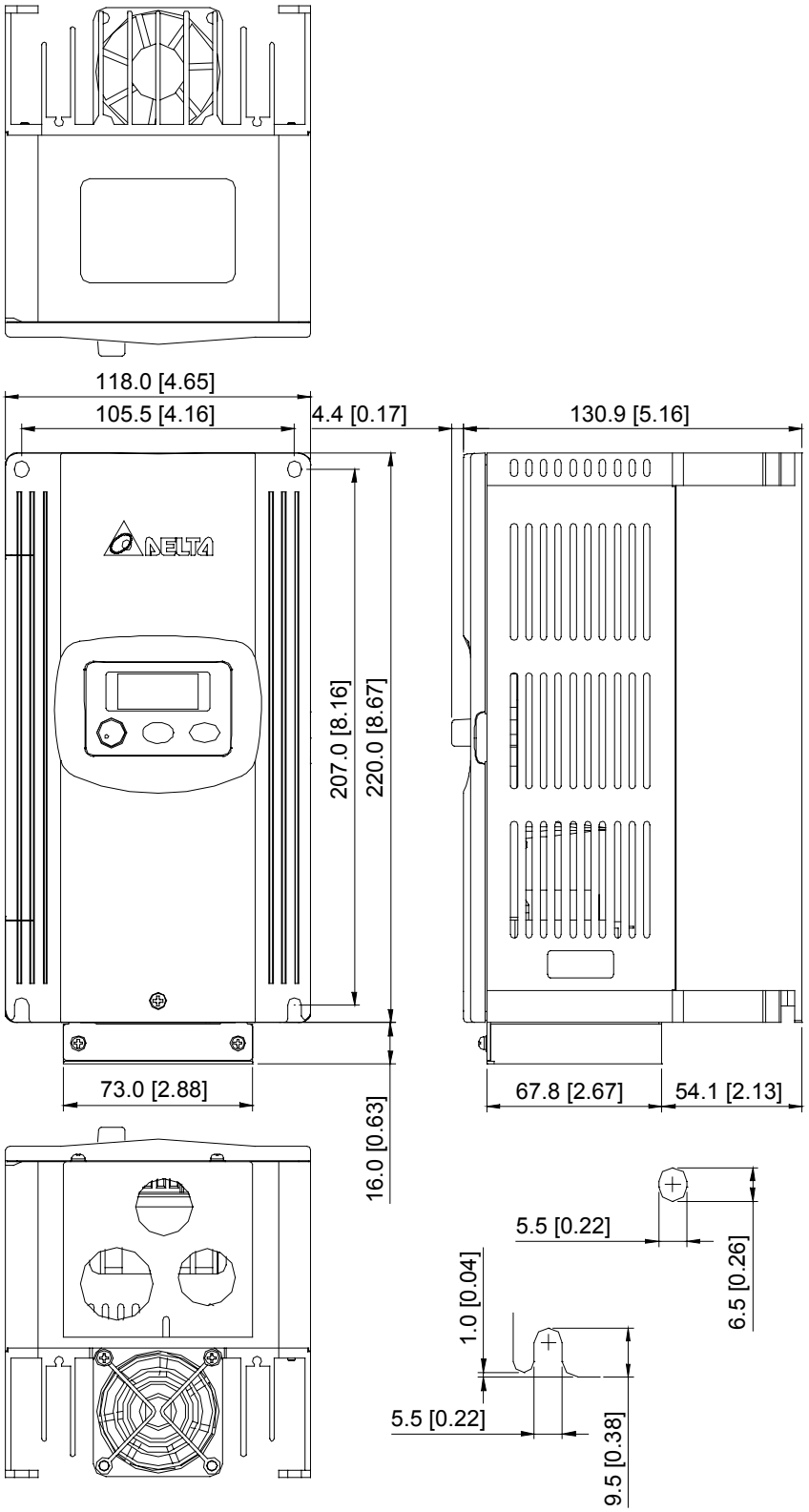
VFD022S21A 3 HP 230V / 1 Phase

Unit: mm [inches]



VFD022S21B 3 HP 230V / 1 Phase

Unit: mm [inches]



C

DELTA ELECTRONICS, INC.

EC Declaration of Conformity
According to the Low Voltage Directive 73/23/EEC and the Amendment Directive 93/68/EEC

For the following equipment:

AC Motor Drive

(Product Name)

VFD002S11A/B, VFD002S21A/B/C, VFD002S23A/B, VFD004S11A/B, VFD004S21A/B/C, VFD004S23A/B, VFD004S43A/B, VFD007S11A/B, VFD007S21A/B/C, VFD007S23A/B, VFD007S43A/B, VFD015S21A/B/C, VFD015S23A/B, VFD015S43A/B, VFD022S21A/B/C, VFD022S23A/B, VFD022S43A/B

(Model Name)

is herewith confirmed to comply with the requirements set out in the Council Directive 73/23/EEC for electrical equipment used within certain voltage limits and the Amendment Directive 93/68/EEC. For the evaluation of the compliance with this Directive, the following standard was applied:

EN 50178

The following manufacturer/importer is responsible for this declaration:

Delta Electronics, Inc.

(Company Name)

D

DELTA ELECTRONICS, INC.

EC Declaration of Conformity
According to the Electromagnetic Compatibility 89/336/EEC and the Amendment Directive 93/68/EEC

For the following equipment:

AC Motor Drive
(Product Name)

VFD002S11A/B, VFD002S21A/B/C, VFD002S23A/B, VFD004S11A/B, VFD004S21A/B/C, VFD004S23A/B, VFD004S43A/B, VFD007S11A/B, VFD007S21A/B/C, VFD007S23A/B, VFD007S43A/B, VFD015S21A/B/C, VFD015S23A/B, VFD015S43A/B, VFD022S21A/B/C, VFD022S23A/B, VFD022S43A/B
(Model Designation)

is herewith confirmed to comply with the requirements set out in the Council Directive 89/336/EEC for electromagnetic compatibility and the Amendment Directive 93/68/EEC. For the evaluation of the compliance with this Directive, the following standard was applied:

EN 61800-3, EN 55011, EN 61000-4-2, EN 61000-4-3, EN 1000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8

The following manufacturer/importer is responsible for this declaration:

Delta Electronics, Inc.
(Company Name)