Operation Manual Guide

Drive Controller PDC

We put ideas into gear.

ABM Greiffenberger Antriebstechnik

Preface

Thank you for choosing ABM's high-performance PDC Series. The PDC Series is manufactured with high-quality components and materials and incorporate the latest microprocessor technology available.

This manual is to be used for the installation, parameter setting, troubleshooting, and daily maintenance of the AC motor drive. To guarantee safe operation of the equipment, read the following safety guidelines before connecting power to the AC motor drive. Keep this operating manual at hand and distribute to all users for reference.

To ensure the safety of operators and equipment, only qualified personnel familiar with AC motor drive are to do installation, start-up and maintenance. Always read this manual thoroughly before using PDC series AC Motor Drive, especially the WARNING, DANGER and CAUTION notes. Failure to comply may result in personal injury and equipment damage. If you have any questions, please contact your dealer.

PLEASE READ PRIOR TO INSTALLATION FOR SAFETY.

DANGER!

1. AC input power must be disconnected before any wiring to the AC motor drive is made.
2. A charge may still remain in the DC-link capacitors with hazardous voltages, even if the power has been turned off. To prevent personal injury, please ensure that power has been turned off before opening the AC motor drive and wait ten minutes for the capacitors to discharge to safe voltage levels.
3. Never reassemble internal components or wiring.
4. The AC motor drive may be destroyed beyond repair if incorrect cables are connected to the input/output terminals. Never connect the AC motor drive output terminals U/T1, V/T2, and W/T3 directly to the AC mains circuit power supply.
5. Ground the PDC using the ground terminal. The grounding method must comply with the laws of the country where the AC motor drive is to be installed. Refer to the Basic Wiring Diagram.
6. PDC series is used only to control variable speed of 3-phase induction motors, NOT for 1-phase motors or other purpose.
7. PDC series shall NOT be used for life support equipment or any life safety situation.

WARNING!

1. DO NOT use Hi-pot test for internal components. The semi-conductor used in the AC motor drive is easily damaged by high-pressure.
2. There are highly sensitive MOS components on the printed circuit boards. These components are especially sensitive to static electricity. To prevent damage to these components, do not touch these components or the circuit boards with metal objects or your bare hands.
3. Only qualified personnel are allowed to install, wire and maintain AC motor drive.

CAUTION!

1. Some parameter settings will cause the motor to run immediately after applying power.
2. DO NOT install the AC motor drive in a place subjected to high temperature, direct sunlight, high humidity, excessive vibration, corrosive gases or liquids, or airborne dust or metallic particles.
3. Only use AC motor drives within specification. Failure to comply may result in fire, explosion or electric shock.
4. To prevent personal injury, please keep children and unqualified people away from the equipment.
5. When the motor cable between the AC motor drive and motor is too long, the layer insulation of the motor may be damaged. Please use a frequency inverter duty motor or add an AC output reactor to prevent damage to the motor. Refer to appendix B Reactor for details.
6. The rated voltage for the AC motor drive must be ≤ 240V (≤ 480V for 460V models) and the mains supply current capacity must be ≤ 5000A RMS (≤10000A RMS for the ≥ 40hp (30kW) models).

Table of Contents

Chapter 1 Introduction

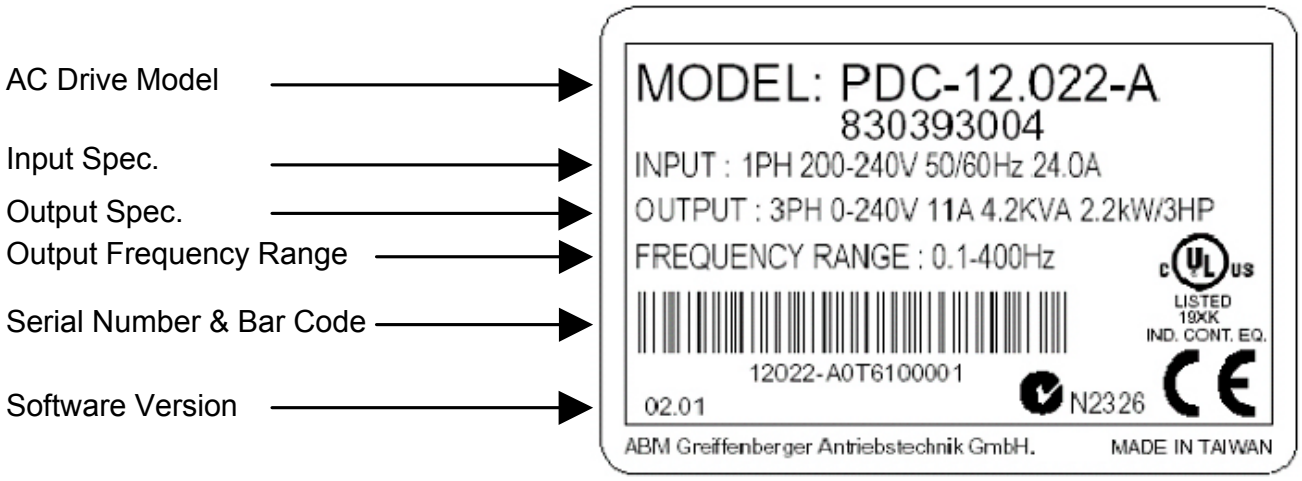
1.1 Receiving and Inspection

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

- Check to make sure that the package includes an AC motor drive, the User Manual/Quick Start and CD, dust covers and rubber bushings.
- Inspect the unit to assure it was not damaged during shipment.
- Make sure that the part number indicated on the nameplate corresponds with the part number of your order.

1.1.1 Nameplate Information

Example for 1HP/0.75kW 3-phase 230V AC motor drive



1.1.2 Model Explanation

PDC – 12. 007 – A

- Version Typ
- Applicable motor capacity

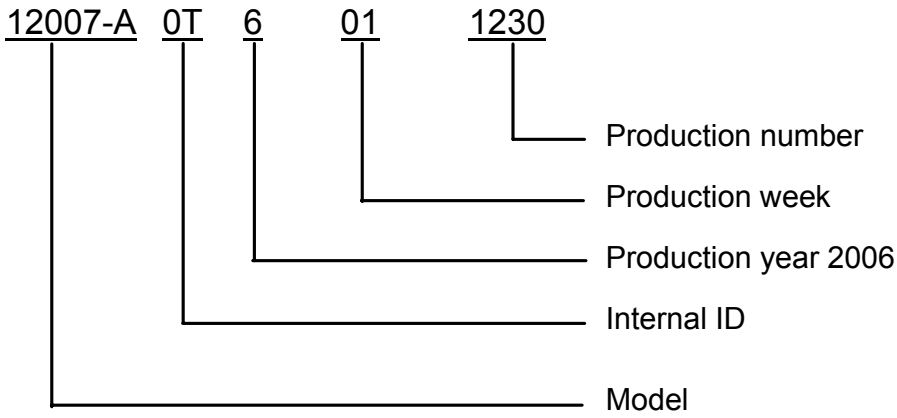
002:	0,25 kW	037:	3,7 kW
004:	0,4 kW	055:	5,5 kW
007:	0,75 kW	075:	7,5 kW
015:	1,5 kW	110:	11 kW
022:	2,2 kW		

- Mains input voltage

11:	115 V Single Phase	12:	230 V Single Phase
32:	230 V Three phase	34:	460 V Three Phase

- Series Name PDC

1.1.3 Series Number Explanation



If the nameplate information does not correspond to your purchase order or if there are any problems, please contact your distributor.

1.1.4 Drive Frames

Frame	Power range	Models
A	0.25-2hp (0.2-1.5kW)	PDC-11/12/32.002-A, PDC-11/12/32/34.004-A, PDC-12/32/34.007-A, PDC-32/34.015-A
B	1-5hp (0.75-3.7kW)	PDC-11.007-A, PDC-12.015-A, PDC-12/32/34.022-A, PDC-32/34.037-A
C	7.5-15hp (5.5-11kW)	PDC-23/34.055-A, PDC-23/34.075-A,PDC-34.110-A

Please refer to Chapter 2.3 for exact dimensions.

1.2 Appearances

(Refer to chapter 2.3 for exact dimensions)

0.25-2HP/0.2-1.5kW (Frame A)

1-5HP/0.75-3.7kW (Frame B)

NOTE

Models of frame C (7.5-15HP/5.5-11kW) are under development.

1.3 Preparation for Installation and Wiring

1.3.1 Remove Keypad

1.3.2 Remove Front Cover

Step 1	Step 2
	

1.3.3 Remove RST Terminal Cover

Frame B and Frame C

1.3.4 Remove UVW Terminal Cover

Frame B and Frame C

1.3.5 Remove Fan

1.4 Lifting

Please carry only fully assembled AC motor drives to prevent machine damage.

1.5 Storage

The AC motor drive should be kept in the shipping carton or crate before installation. In order to retain the warranty coverage, the AC motor drive should be stored properly when it is not to be used for an extended period of time. Storage conditions 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 +60 °C.
Store within a relative humidity range of 0% to 90% and non-condensing environment.
Store within an air pressure range of 86kPa to 106kPa.

CAUTION!

1. DO NOT store in an area with rapid changes in temperature. It may cause condensation and frost.
2. DO NOT place on the ground directly. It should be stored properly. Moreover, if the surrounding environment is humid, you should put exsiccator in the package.
3. If the AC motor drive is stored for more than 3 months, the temperature should not be higher than 30 °C. Storage longer than one year is not recommended, it could result in the degradation of the electrolytic capacitors.
4. When the AC motor drive is not used for a long time after installation on building sites or places with humidity and dust, it's best to move the AC motor drive to an environment as stated above.

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Chapter 2 Installation and Wiring

2.1 Ambient Conditions

Install the AC motor drive in an environment with the following conditions:

Operation	Air Temperature:	-10 ~ +50°C (14 ~ 122°F) -10 ~ +40°C (14 ~ 104°F) for side-by-side mounting
	Relative Humidity:	<90%, no condensation allowed
	Atmosphere pressure:	86 ~ 106 kPa
	Installation Site Altitude:	<1000m
	Vibration:	<20Hz: 9.80 m/s^2 (1G) max 20 ~ 50Hz: 5.88 m/s^2 (0.6G) max
Storage Transportation	Temperature:	-20°C ~ +60°C (-4°F ~ 140°F)
	Relative Humidity:	<90%, no condensation allowed
	Atmosphere pressure:	86 ~ 106 kPa
	Vibration:	<20Hz: 9.80 m/s^2 (1G) max 20 ~ 50Hz: 5.88 m/s^2 (0.6G) max
Pollution Degree	2: good for a factory type environment.	

CAUTION!

1. Operating, storing or transporting the AC motor drive outside these conditions may cause damage to the AC motor drive.
2. Failure to observe these precautions may void the warranty!

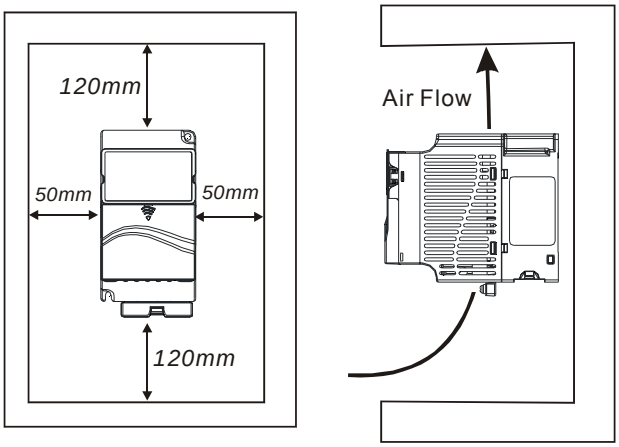
2.2 Installation

1. Mount the AC motor drive vertically on a flat vertical surface by using bolts or screws. Other directions are not allowed.
2. The AC motor drive will generate heat during operation. Allow sufficient space around the unit for heat dissipation.
3. The heat sink temperature may rise to 90°C when running. The material on which the AC motor drive is mounted must be noncombustible and be able to withstand this high temperature.
4. When the AC motor drive is installed in a confined space (e.g. cabinet), the surrounding temperature must be within 10 ~ 40°C with good ventilation. DO NOT install the AC motor drive in a space with bad ventilation.

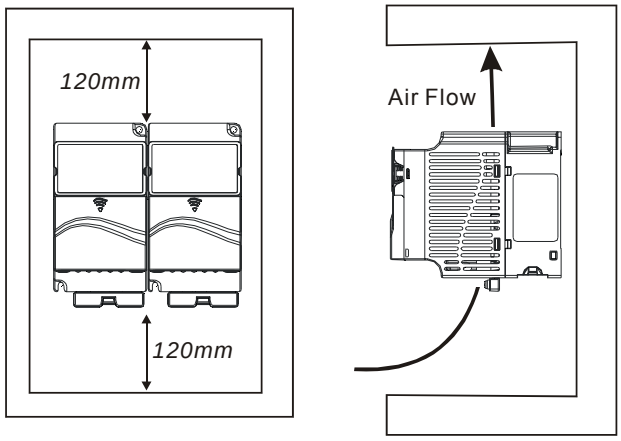
5. When installing multiple AC motor drives in the same cabinet, they should be adjacent in a row with enough space. When installing one AC motor drive below another one, use a metal separation barrier between the AC motor drives to prevent mutual heating. Refer to figure below for details.
6. Prevent fiber particles, scraps of paper, saw dust, metal particles, etc. from adhering to the heatsink.

Frame A Mounting Clearances

Option 1 (-10 to +50°C)

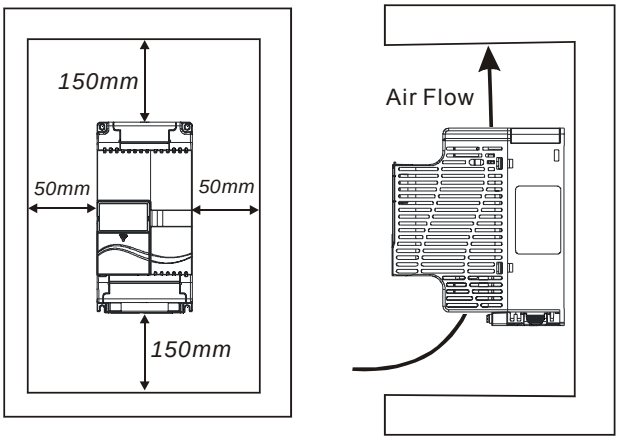


Option 2 (-10 to +40°C)

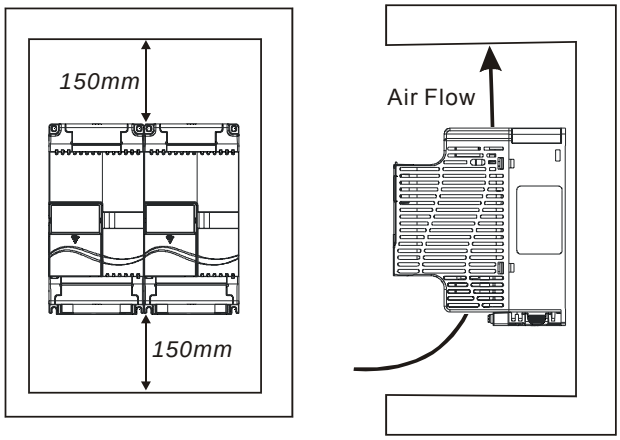


Frame B and C Mounting Clearances

Option 1 (-10 to +50°C)



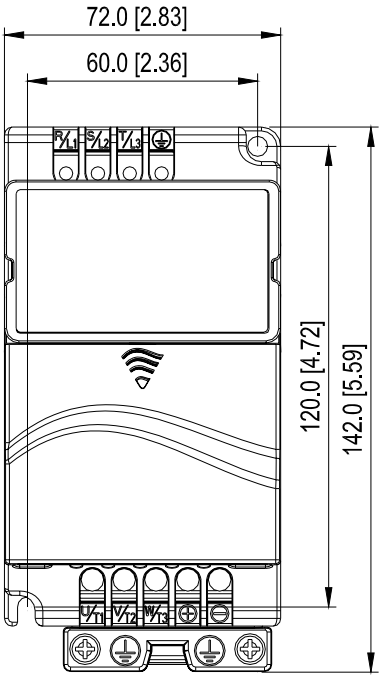
Option 2 (-10 to +40°C)

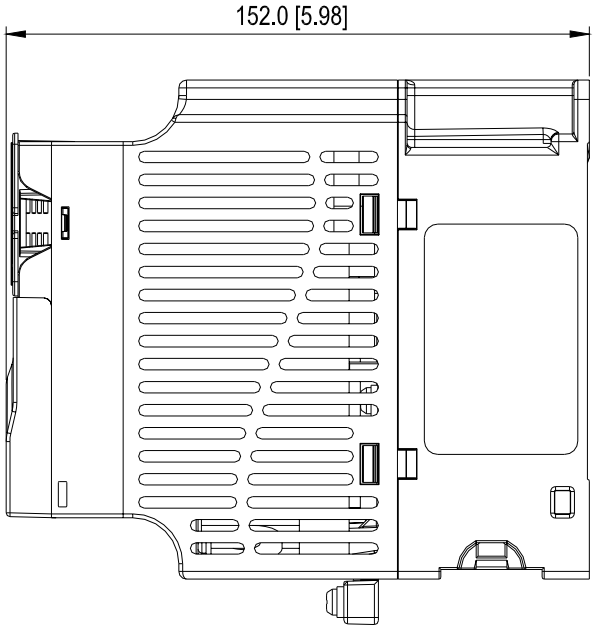


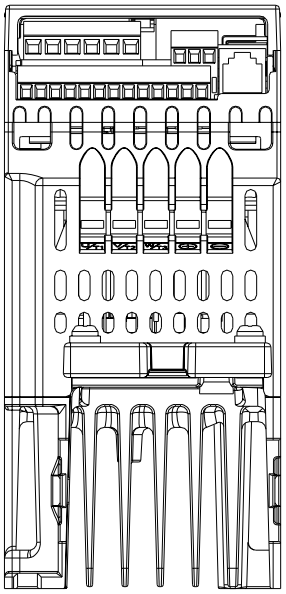
2.3 Dimensions

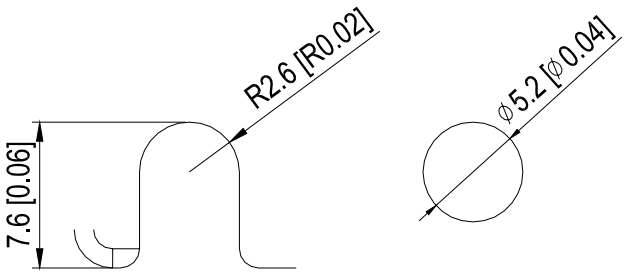
(Dimensions are in millimeter and [inch])

Frame A: PDC-11/12/32.002-A, PDC-11/12/32/34.004-A, PDC-12/32/34.007-A, PDC-32/34.015-A

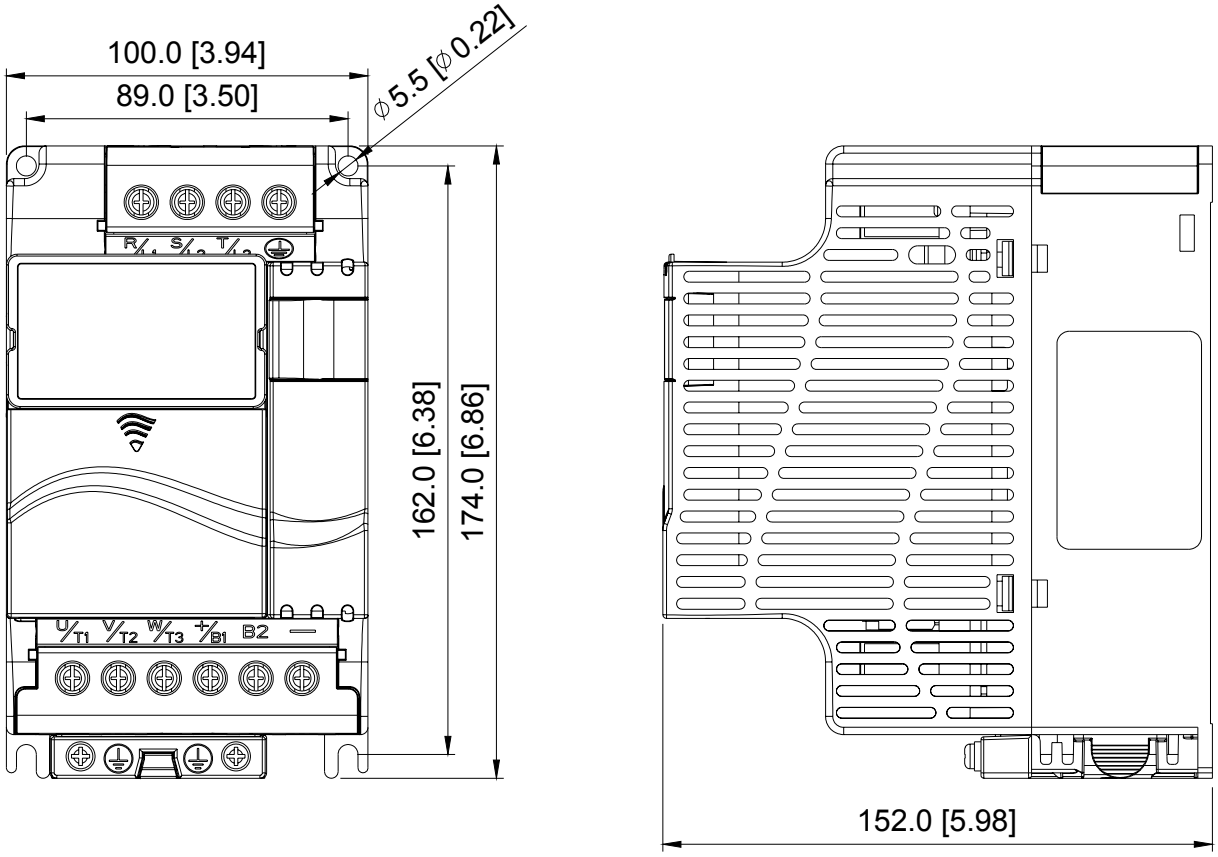


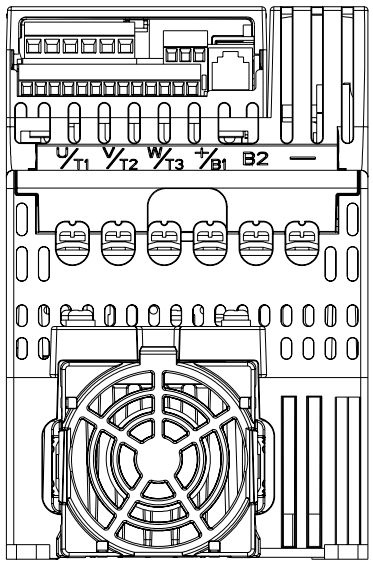


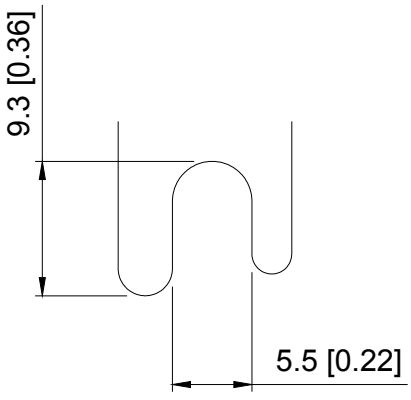




Frame B: PDC-11.007-A, PDC-12.015-A, PDC-12/32/34.022-A, PDC-32/34.037-A

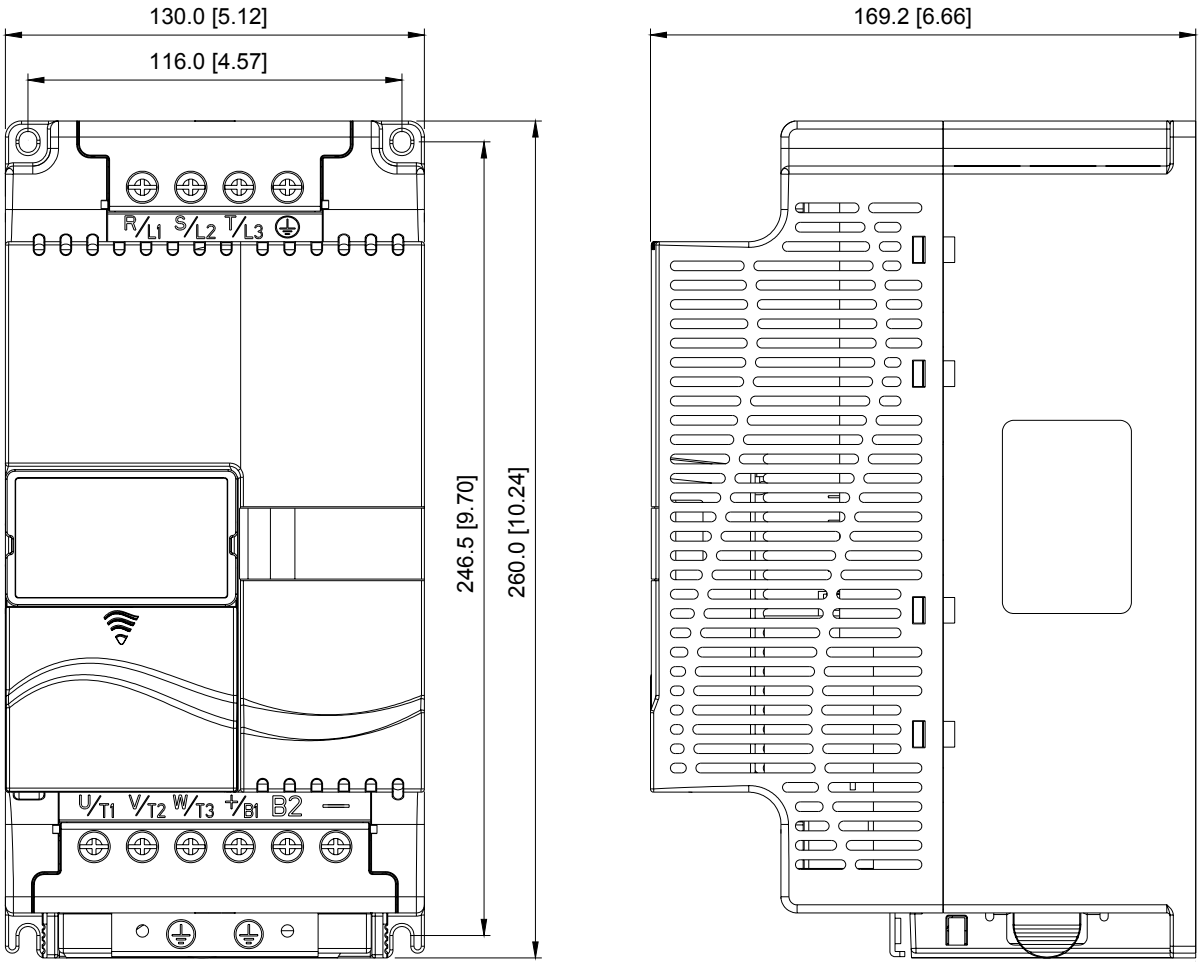


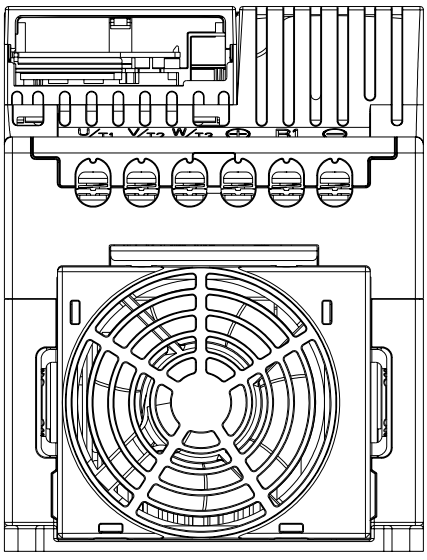


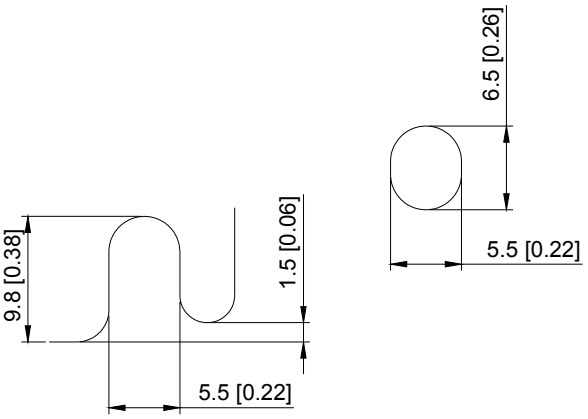


UNIT : mm(inch)

Frame C: PDC-32/34.055A, PDC-32/34.075-A, PDC-34.110-A

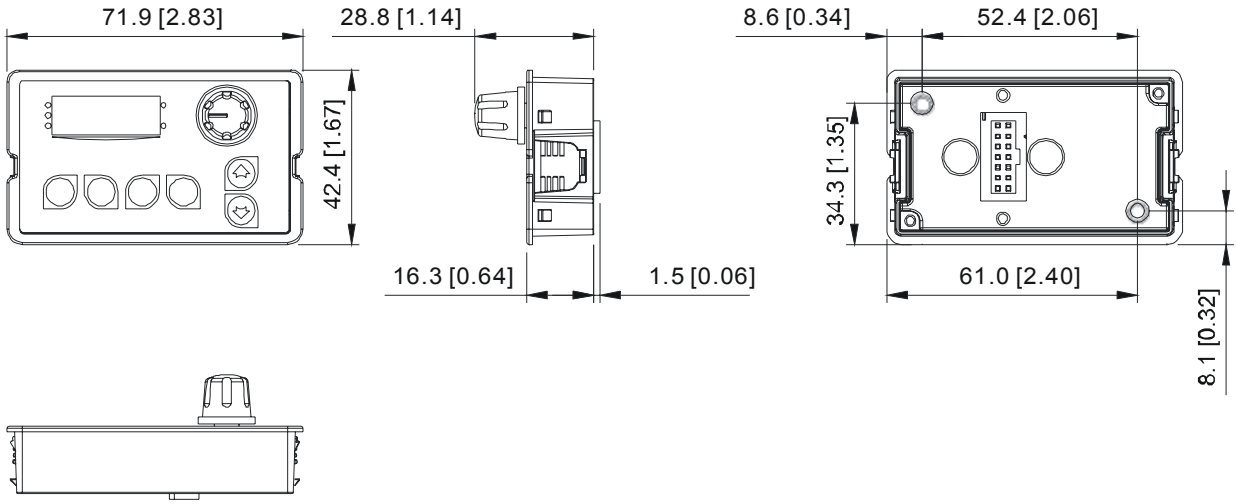






Unit: mm [inch]

PDC-KP01



2.4 Wiring

After removing the front cover, check if the power and control terminals are clear of debris. Be sure to observe the following precautions when wiring.

■ General Wiring Information

Applicable Codes

All PDC series 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 motor drive and the motor nameplate for electrical data.

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

=> UL in preparation!

2.4.1 Basic Wiring

- Make sure that power is only applied to the R/L1, S/L2, T/L3 terminals. Failure to comply may result in damage to the equipment. The voltage and current should lie within the range as indicated on the nameplate.
- Check the following items after completing the wiring:
  1. Are all connections correct?
  2. No loose wires?
  3. No short-circuits between terminals or to ground?

A charge may still remain in the DC bus capacitors with hazardous voltages even if the power has been turned off. To prevent personal injury, please ensure that the power is turned off and wait ten minutes for the capacitors to discharge to safe voltage levels before opening the AC motor drive.

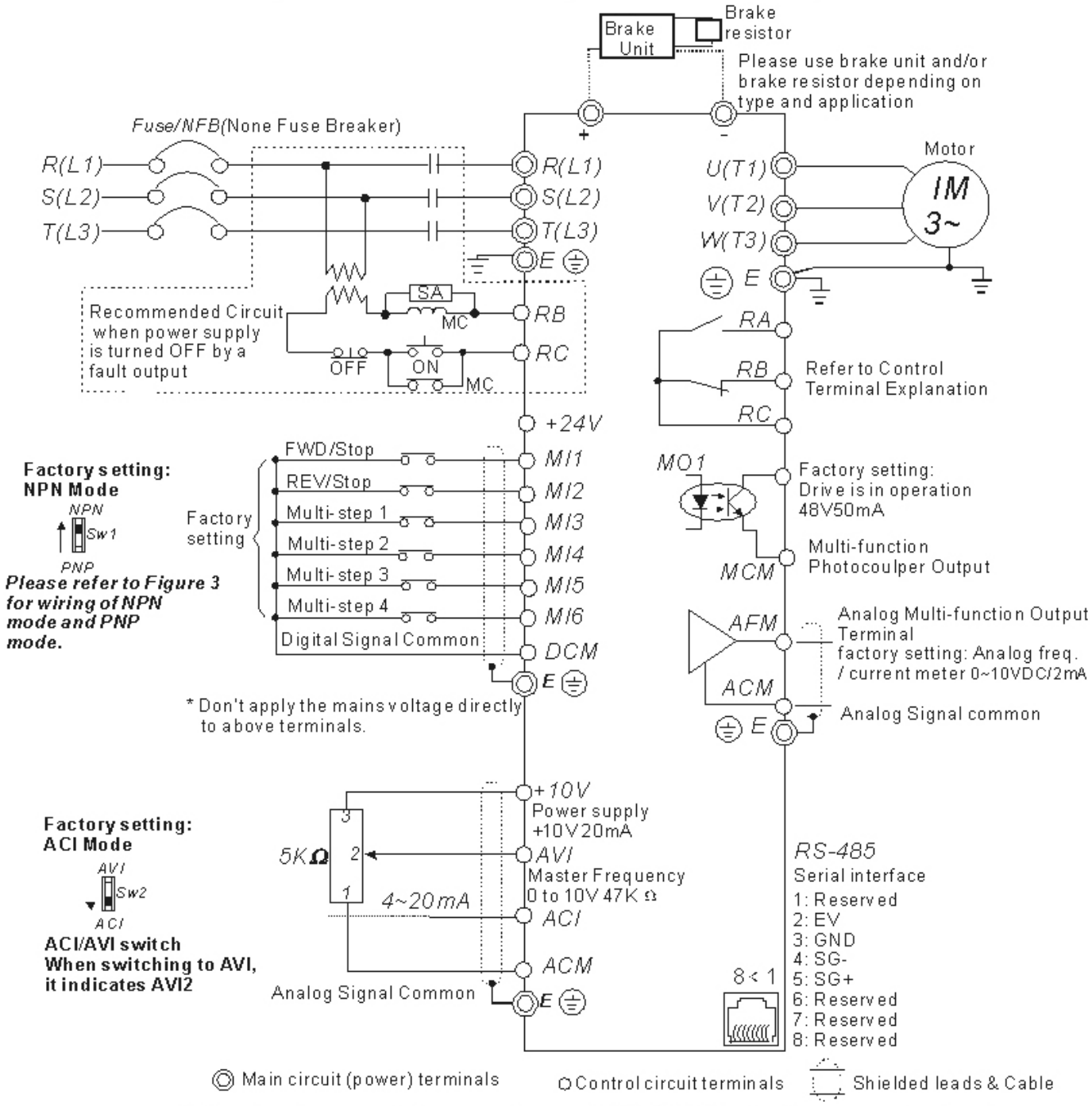
DANGER!

1. All the units must be grounded directly to a common ground terminal to prevent electric shock, fire and interference.
2. Only qualified personnel familiar with AC motor drives are allowed to perform installation, wiring and commissioning.
3. Make sure that the power is off before doing any wiring to prevent electric shocks.

Basic Wiring Diagrams

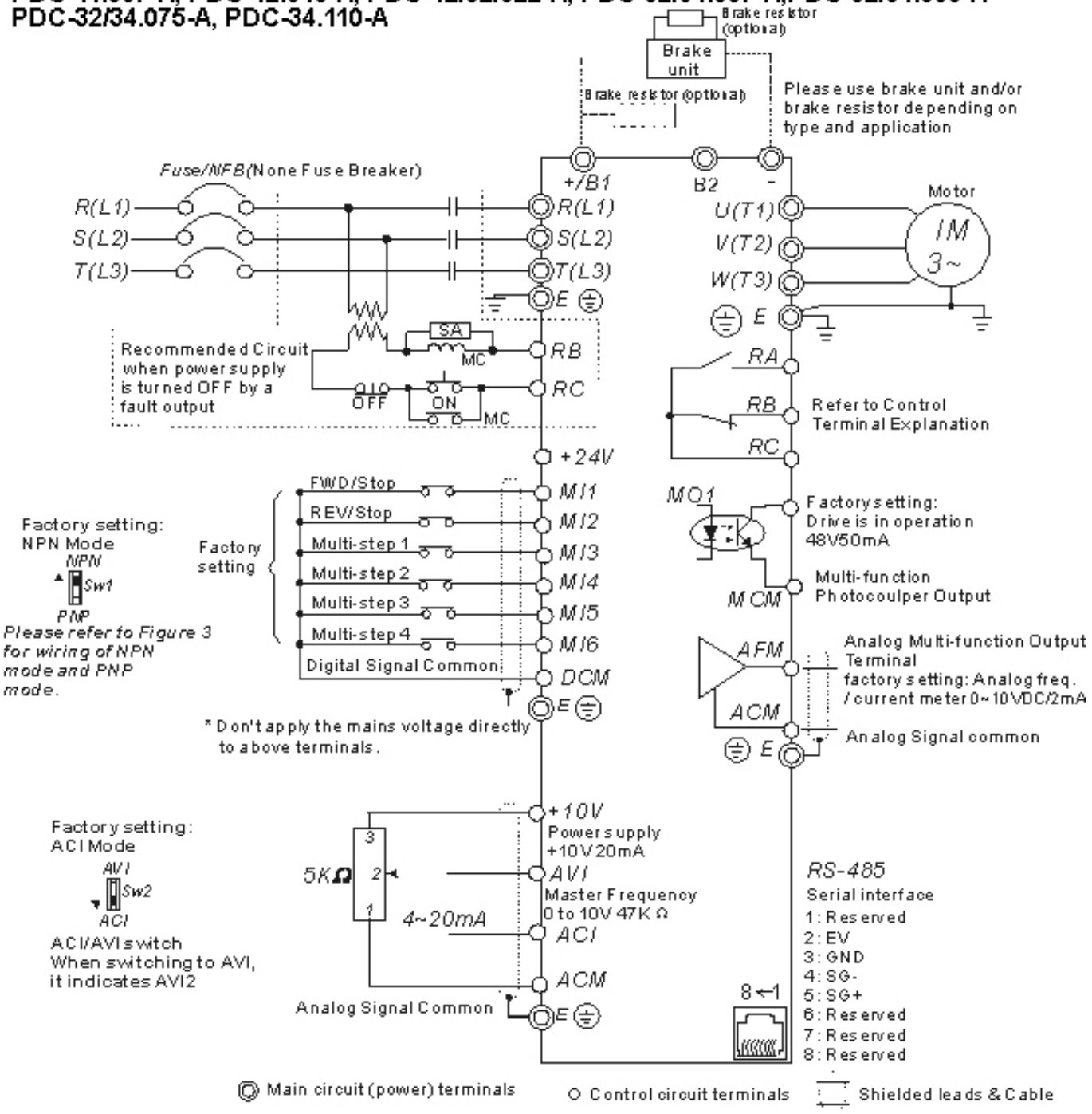
Users must connect wires according to the circuit diagrams on the following pages. Do not plug a modem or telephone line to the RS-485 communication port or permanent damage may result. Terminals 1 & 2 are the power supply for the optional copy keypad only and should not be used for RS-485 communication.

Figure 1 for models of PDC Series
PDC-11/12/32.002-A, PDC-11/12/32/34.004-A, PDC-12/32/34.007-A, PDC-32/34.015-A



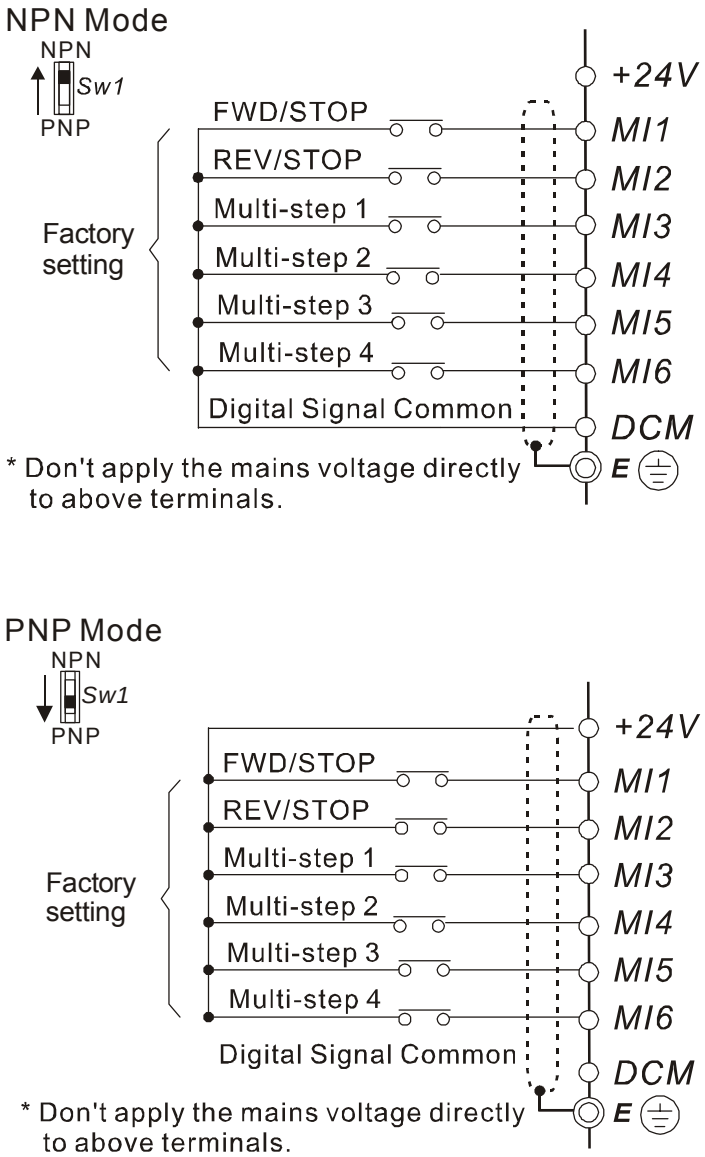
*** Single-phase models can only use R(L1), S(L2) to be the power terminals.**
*** Single-phase power cannot be used for 3-phase models.**

Figure 2 for models of PDC Series
PDC-11.007-A, PDC-12.015-A, PDC-12/32/022-A, PDC-32/34.037-A,PDC-32/34.055-A
PDC-32/34.075-A, PDC-34.110-A

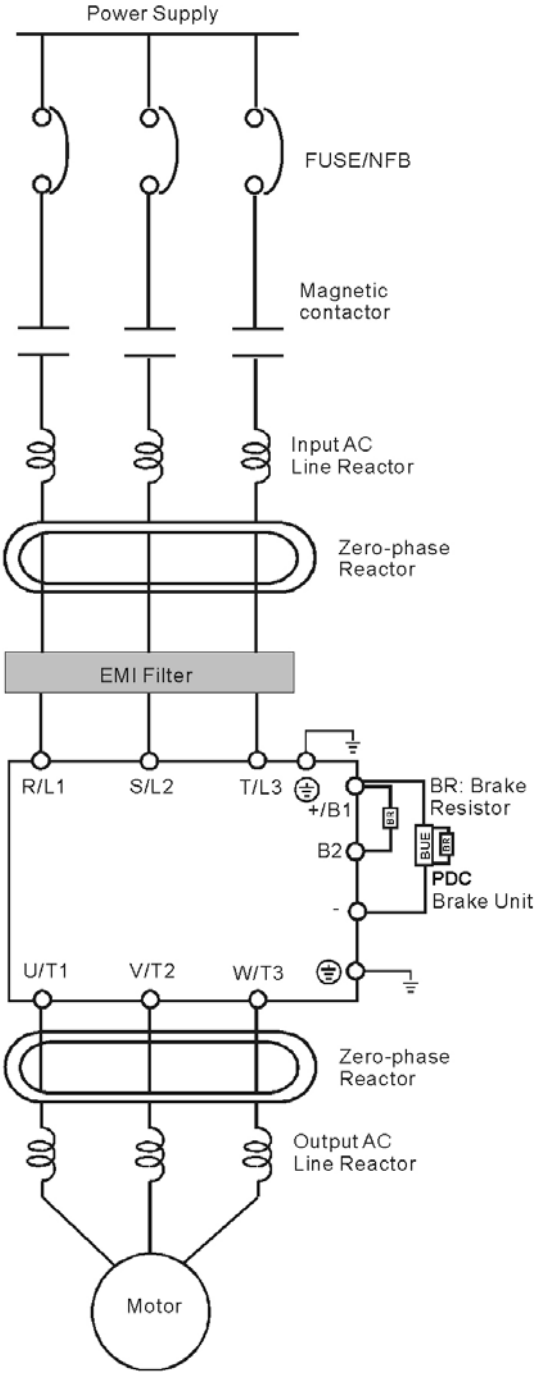


*** Single-phase models can only use R(L1), S(L2) to be the power terminals.**
*** Single-phase power cannot be used for 3-phase models.**

Figure 3 Wiring for NPN mode and PNP mode



2.4.2 External Wiring



Items	Explanations
Power supply	Please follow the specific power supply requirements shown in Appendix A.
Fuse/NFB (Optional)	There may be an inrush current during power up. Please check the chart of Appendix B and select the correct fuse with rated current. Use of an NFB is optional.
Magnetic contactor (Optional)	Please do not use a Magnetic contactor as the I/O switch of the AC motor drive, as it will reduce the operating life cycle of the AC drive.
Input AC Line Reactor (Optional)	Used to improve the input power factor, to reduce harmonics and provide protection from AC line disturbances (surges, switching spikes, short interruptions, etc.). AC line reactor should be installed when the power supply capacity is 500kVA or more and exceeds 6 times the inverter capacity, or the mains wiring distance $\leq$ 10m.
Zero-phase Reactor (Ferrite Core Common Choke) (Optional)	Zero phase reactors are used to reduce radio noise especially when audio equipment is installed near the inverter. Effective for noise reduction on both the input and output sides. Attenuation quality is good for a wide range from AM band to 10MHz. Appendix B specifies the zero phase reactor. (RF220X00A)
EMI filter (Optional)	To reduce electromagnetic interference, please refer to Appendix B for more details.
Brake resistor (Optional)	Used to reduce the deceleration time of the motor. Please refer to the chart in Appendix B for specific brake resistors.
Output AC Line Reactor (Optional)	Motor surge voltage amplitude depends on motor cable length. For applications with long motor cable (>20m), it is necessary to install a reactor at the inverter output side.

2.4.3 Main Terminals Connections

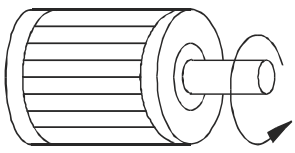
Terminal Symbol	Explanation of Terminal Function
R/L1, S/L2, T/L3	AC line input terminals (1-phase/3-phase)
U/T1, V/T2, W/T3	AC drive output terminals for connecting 3-phase induction motor
+/B1~ B2	Connections for Brake resistor (optional)
+/B1, -	Connections for External Brake unit (BUE series)
⏚	Earth connection, please comply with local regulations.

Mains power terminals (R/L1, S/L2, T/L3)

- Connect these terminals (R/L1, S/L2, T/L3) via a non-fuse breaker or earth leakage breaker to 3-phase AC power (some models to 1-phase AC power) for circuit protection. It is unnecessary to consider phase-sequence.
- It is recommended to add a magnetic contactor (MC) in the power input wiring to cut off power quickly and reduce malfunction when activating the protection function of AC motor drives. Both ends of the MC should have an R-C surge absorber.
- Do NOT run/stop AC motor drives by turning the power ON/OFF. Run/stop AC motor drives by RUN/STOP command via control terminals or keypad. If you still need to run/stop AC drives by turning power ON/OFF, it is recommended to do so only ONCE per hour.
- Do NOT connect 3-phase models to a 1-phase power source.

Control circuit terminals (U/T1, V/T2, W/T3)

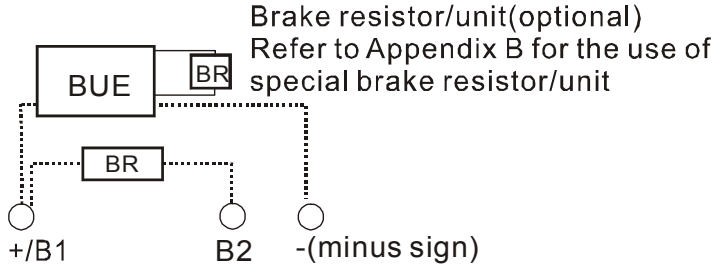
- When the AC drive output terminals U/T1, V/T2, and W/T3 are connected to the motor terminals U/T1, V/T2, and W/T3, respectively, the motor will rotate counterclockwise (as viewed on the shaft end of the motor) when a forward operation command is received. To permanently reverse the direction of motor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



- DO NOT connect phase-compensation capacitors or surge absorbers at the output terminals of AC motor drives.

- With long motor cables, high capacitive switching current peaks can cause over-current, high leakage current or lower current readout accuracy. To prevent this, the motor cable should be less than 20m for 3.7kW models and below. And the cable should be less than 50m for 5.5kW models and above. For longer motor cables use an AC output reactor.
- Use a well-insulated motor, suitable for inverter operation.

Terminals [+/B1, B2] for connecting brake resistor



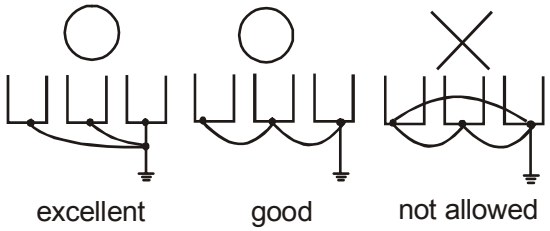
- Connect a brake resistor or brake unit in applications with frequent deceleration ramps, short deceleration time, too low braking torque or requiring increased braking torque.
- If the AC motor drive has a built-in brake chopper (frame B and frame C), connect the external brake resistor to the terminals [+/B1, B2].
- Models of frame A don't have a built-in brake chopper. Please connect an external optional brake unit (BUE-series) and brake resistor. Refer to BUE series user manual for details.
- Connect the terminals [+(P), -(N)] of the brake unit to the AC motor drive terminals [+/B1, -]. The length of wiring should be less than 5m with twisted cable.
- When not used, please leave the terminals [+/B1, -] open.

WARNING!

Short-circuiting [B2] or [-] to [+/B1] can damage the AC motor drive.

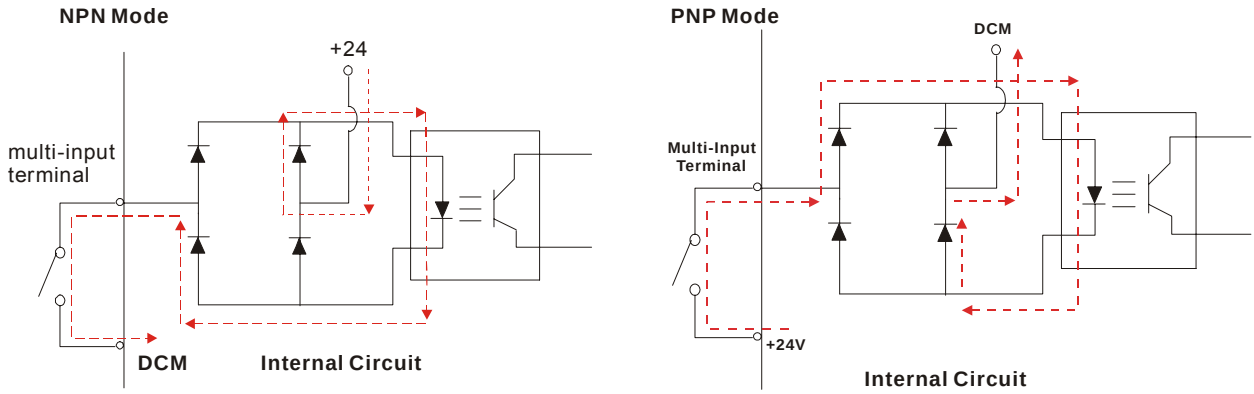
Grounding terminals (⏚)

- Make sure that the leads are connected correctly and the AC drive is properly grounded. (Ground resistance should not exceed 0.1Ω.)
- Use ground leads that comply with local regulations and keep them as short as possible.
- Multiple PDC units can be installed in one location. All the units should be grounded directly to a common ground terminal, as shown in the figure below. **Ensure there are no ground loops.**



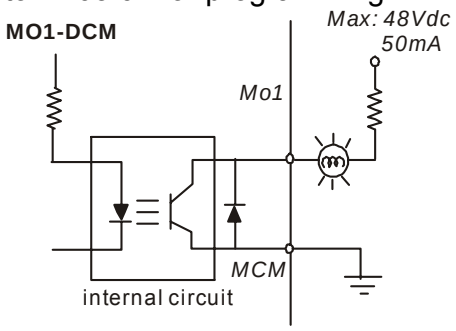
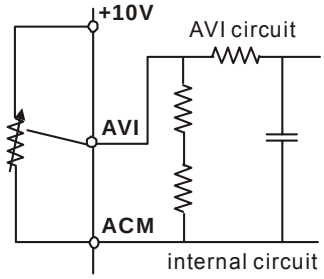
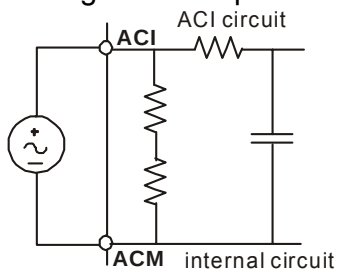
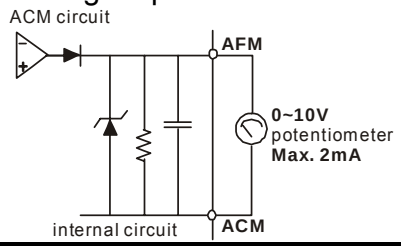
2.4.4 Control Terminals

Circuit diagram for digital inputs (NPN current 16mA.)



Terminal symbols and functions

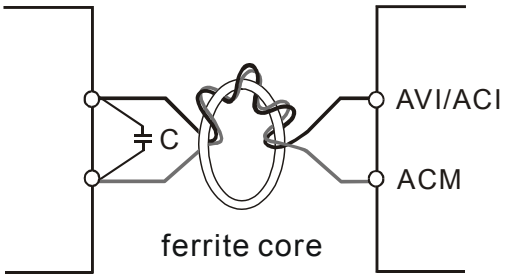
Terminal Symbol	Terminal Function	Factory Settings (NPN mode) ON: Connect to DCM
MI1	Forward-Stop command	ON: Run in MI1 direction OFF: Stop acc. to Stop Method
MI2	Reverse-Stop command	ON: Run in MI2 direction OFF: Stop acc. to Stop Method
MI3	Multi-function Input 3	Refer to Pr.04.05 to Pr.04.08 for programming the Multi-function Inputs. ON: the activation current is 16mA. OFF: leakage current tolerance is 10 μA.
MI4	Multi-function Input 4	
MI5	Multi-function Input 5	
MI6	Multi-function Input 6	
+24V	DC Voltage Source	+24VDC, 20mA used for PNP mode.
DCM	Digital Signal Common	Common for digital inputs and used for NPN mode.
RA	Multi-function Relay output (N.O.) a	Resistive Load: 5A(N.O.)/3A(N.C.) 240VAC 5A(N.O.)/3A(N.C.) 24VDC Inductive Load: 1.5A(N.O.)/0.5A(N.C.) 240VAC 1.5A(N.O.)/0.5A(N.C.) 24VDC Refer to Pr.03.00 for programming
RB	Multi-function Relay output (N.C.) b	
RC	Multi-function Relay common	

Terminal Symbol	Terminal Function	Factory Settings (NPN mode) ON: Connect to DCM
MO1	Multi-function Output 1 (Photocoupler)	Maximum 48VDC, 50mA Refer to Pr.03.01 for programming 
MCM	Multi-function output common	Common for Multi-function Outputs
+10V	Potentiometer power supply	+10VDC 20mA
AVI	Analog voltage Input 	Impedance: 47kΩ Resolution: 10 bits Range: 0 ~ 10VDC = 0 ~ Max. Output Frequency (Pr.01.00) Selection: Pr.02.00, Pr.02.09, Pr.10.00 Set-up: Pr.04.14 ~ Pr.04.17
ACI	Analog current Input 	Impedance: 250Ω Resolution: 10 bits Range: 4 ~ 20mA = 0 ~ Max. Output Frequency (Pr.01.00) Selection: Pr.02.00, Pr.02.09, Pr.10.00 Set-up: Pr.04.18 ~ Pr.04.21
AFM	Analog output meter 	0 to 10V, 2mA Impedance: 20kΩ Output current 2mA max Resolution: 8 bits Range: 0 ~ 10VDC Function: Pr.03.03 to Pr.03.04
ACM	Analog control signal (common)	Common for AVI, ACI, AFM

Control signal wiring size: 18 AWG (0.75 mm^2) with shielded wire.

Analog input terminals (AVI, ACI, ACM)

- Analog input signals are easily affected by external noise. Use shielded wiring and keep it as short as possible (<20m) with proper grounding. If the noise is inductive, connecting the shield to terminal ACM can bring improvement.
- If the analog input signals are affected by noise from the AC motor drive, please connect a capacitor (0.1 μ F and above) and ferrite core as indicated in the following diagrams:



wind each wires 3 times or more around the core

Digital inputs (MI1~MI6, DCM)

- When using contacts or switches to control the digital inputs, please use high quality components to avoid contact bounce.

Digital outputs (MO1, MCM)

- Make sure to connect the digital outputs to the right polarity, see wiring diagrams.
- When connecting a relay to the digital outputs, connect a surge absorber or fly-back diode across the coil and check the polarity.

General

- Keep control wiring as far away as possible from the power wiring and in separate conduits to avoid interference. If necessary let them cross only at 90º angle.
- The AC motor drive control wiring should be properly installed and not touch any live power wiring or terminals.

NOTE

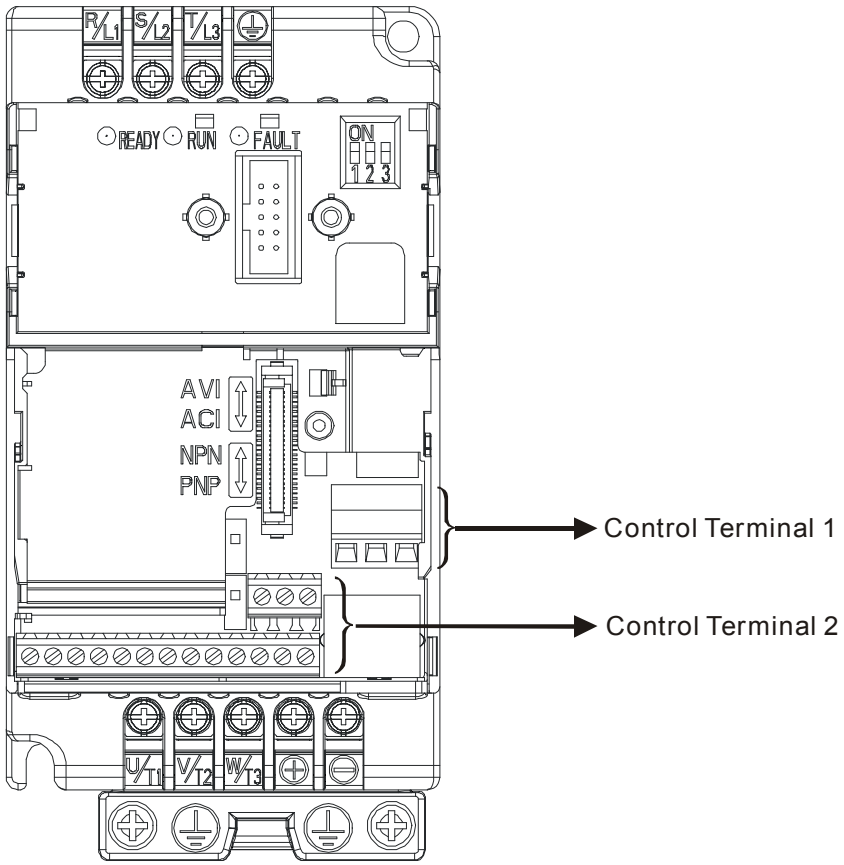
- If a filter is required for reducing EMI (Electro Magnetic Interference), install it as close as possible to AC drive. EMI can also be reduced by lowering the Carrier Frequency.
- When using a GFCI (Ground Fault Circuit Interrupter), select a current sensor with sensitivity of 200mA, and not less than 0.1-second detection time to avoid nuisance tripping.

DANGER!

Damaged insulation of wiring may cause personal injury or damage to circuits/equipment if it comes in contact with high voltage.

2.4.5 Main Circuit Terminals

Frame A: PDC-11/12/32.002-A, PDC-11/12/32/34.004-A, PDC-12/32/34.007-A, PDC-32/34.015-A



Control Terminal 1:

Torque: 5kgf-cm (4.4 lbf-in)

Wire Gauge: 12-24 AWG (3.3-0.2mm^2)

Control Terminal 2:

Torque: 2kgf-cm (2 lbf-in)

Wire Gauge: 16-24 AWG (1.3-0.2mm^2)

Power Terminal:

Torque: 14 kgf-cm (12 lbf-in)

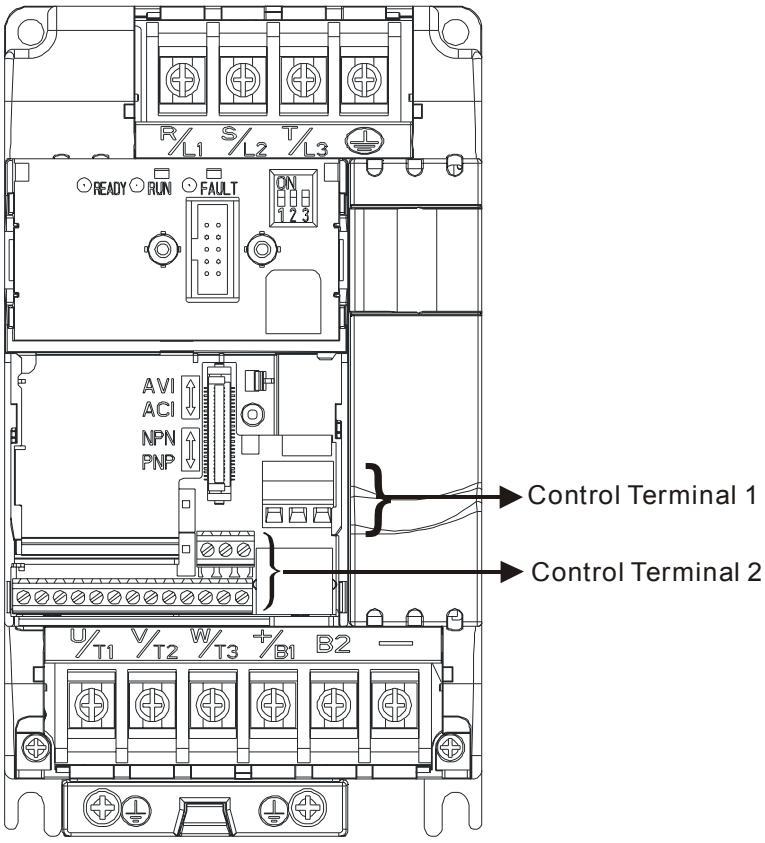
Wire Gauge: 12-14 AWG (3.3-2.1mm^2)

Wire Type: Copper only, 75^{o}C

NOTE: No T/L3 terminal on 1-phase models

Frame B

PDC-11.007-A, PDC-12.015-A, PDC-12/32/34.022-A, PDC-32/34.037-A



Control Terminal 1:

Torque: 5kgf-cm (4.4 lbf-in)

Wire Gauge: 12-24 AWG (3.3-0.2mm^2)

Control Terminal 2:

Torque: 2kgf-cm (2 lbf-in)

Wire Gauge: 16-24 AWG (1.3-0.2mm^2)

Power Terminal:

Torque: 18 kgf-cm (15.6 lbf-in)

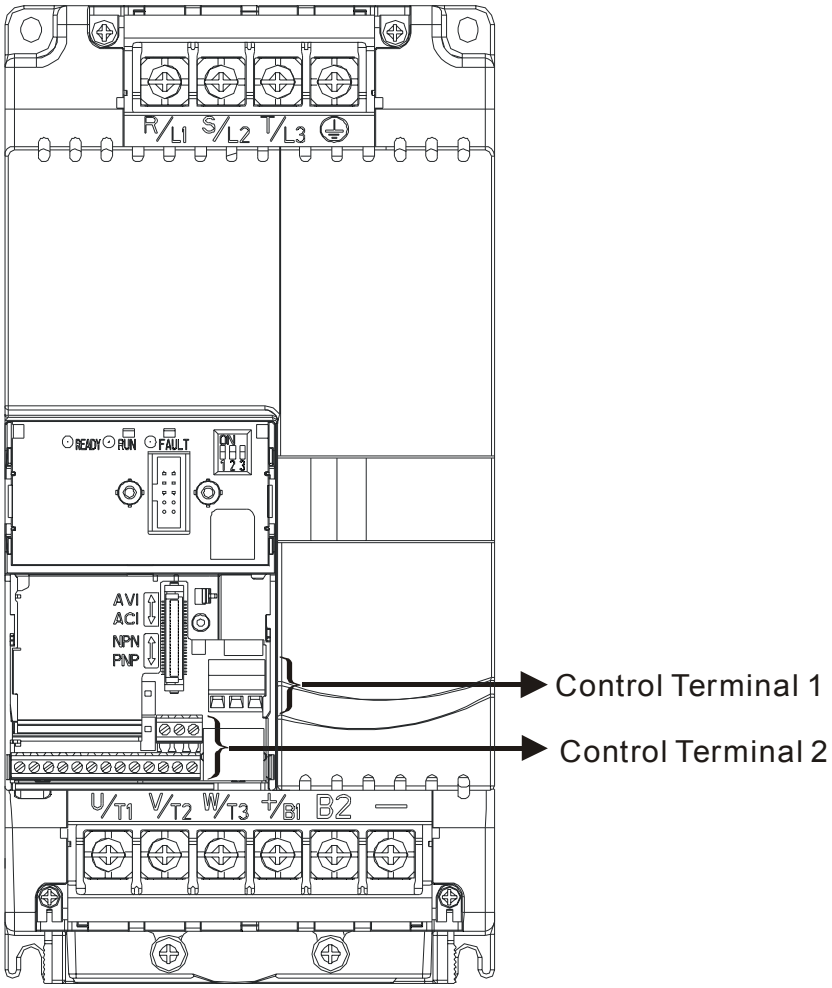
Wire Gauge: 8-18 AWG (8.4-0.8mm^2)

Wire Type: Copper only, 75^{o}C

NOTE: No T/L3 terminal on 1-phase models

Frame C

PDC-32/34.055-A, PDC-32/34.075-A, PDC-34.110-A



Control Terminal 1:

Torque: 5kgf-cm (4.4 lbf-in)

Wire Gauge: 12-24 AWG (3.3-0.2mm^2)

Control Terminal 2:

Torque: 2kgf-cm (2 lbf-in)

Wire Gauge: 16-24 AWG (1.3-0.2mm^2)

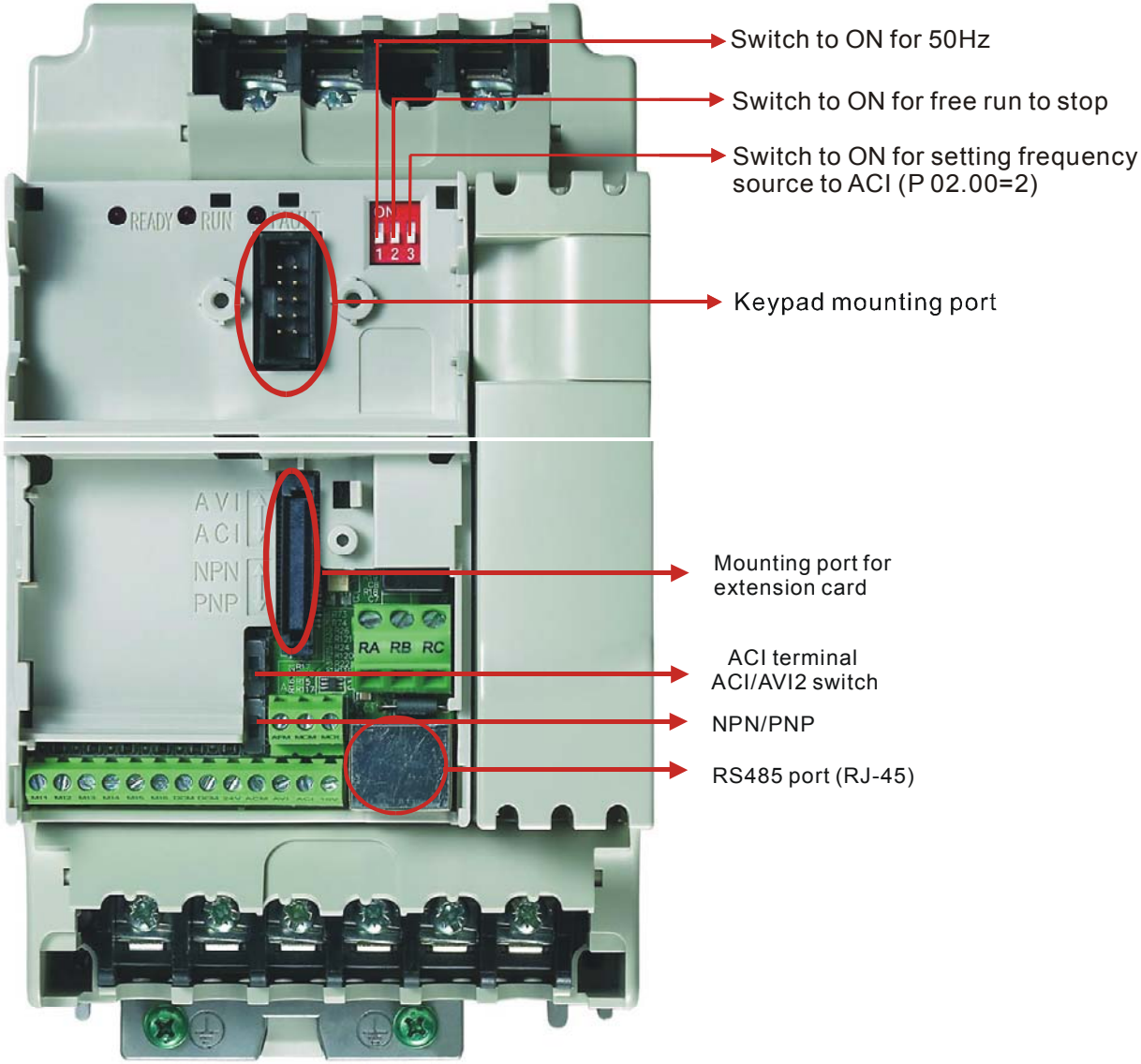
Power Terminal:

Torque: 30 kgf-cm (26 lbf-in)

Wire Gauge: 8-16 AWG (8.4-1.3mm^2)

Wire Type: Copper only, 75^{o}C

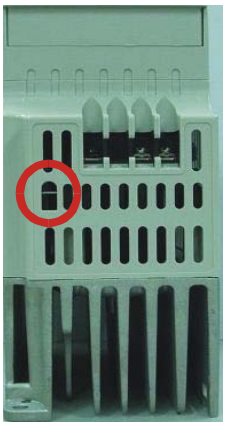
2.5 External Parts



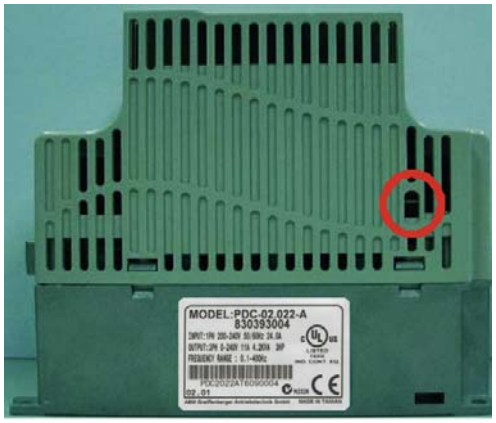
2.6 RFI Jumper

Main power isolated from earth:

If the AC motor drive is supplied from an isolated power (IT power), the RFI jumper must be cut off. Then the RFI capacities (filter capacitors) will be disconnected from ground to prevent circuit damage (according to IEC 61800-3) and reduce earth leakage current. Refer to the following figures for the position of RFI jumper.



Frame A
(on the top)



Frame B
(at the right side)

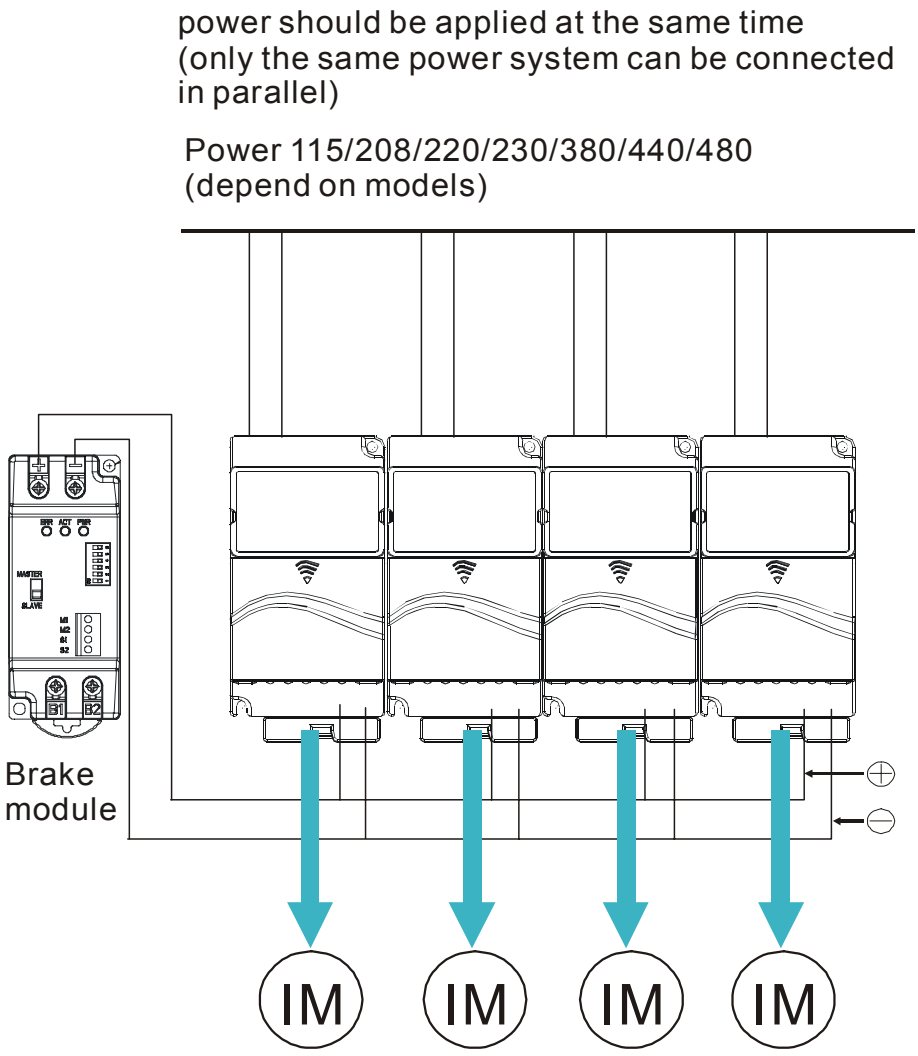
Frame C
(at the left side)

CAUTION!

1. After applying power to the AC motor drive, do not cut off the RFI jumper. Therefore, please make sure that main power has been switched off before cutting the RFI jumper.
2. The gap discharge may occur when the transient voltage is higher than 1,000V. Besides, electro-magnetic compatibility of the AC motor drives will be lower after cutting the RFI jumper.
3. Do NOT cut the RFI jumper when main power is connected to earth.
4. The RFI jumper cannot be cut when high voltage tests are performed. The mains power and motor must be separated if high voltage test is performed and the leakage currents are too high.
5. To prevent drive damage, the RFI jumper connected to ground shall be cut off if the AC motor drive is installed on an ungrounded power system or a high resistance-grounded (over 30 ohms) power system or a corner grounded TN system.

2.7 Connected the DC BUS of the AC Motor Drives in Parallel

1. The AC motor drives can absorb mutual voltage that generated to DC bus when deceleration
2. Enhance brake function and stabilize the voltage of the DC bus
3. The brake module can be added to enhance brake function after connecting in parallel
4. Only the same power system can be connected in parallel
5. It is recommended to connect 5 AC motor drives in parallel (no limit in horsepower)

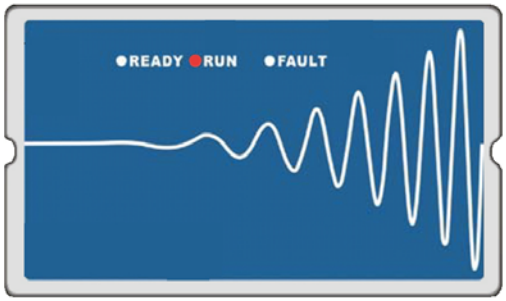


Chapter 3 Start Up

3.1 Preparations before Start-up

Carefully check the following items before proceeding.

- Make sure that the wiring is correct. In particular, check that the output terminals U/T1, V/T2, W/T3 are NOT connected to power and that the drive is well grounded.
- Verify that there are no short-circuits between terminals and from terminals to ground or mains power.
- Check for loose terminals, connectors or screws.
- Verify that no other equipment is connected to the AC motor.
- Make sure that all switches are OFF before applying power to ensure that the AC motor drive doesn't start running and there is no abnormal operation after applying power.
- Make sure that the front cover is correctly installed before applying power.
- Do NOT operate the AC motor drive with humid hands.
- Check the following items after applying power: The display without digital keypad should be as following.



When power is applied, LED „READY" should light up as shown above.

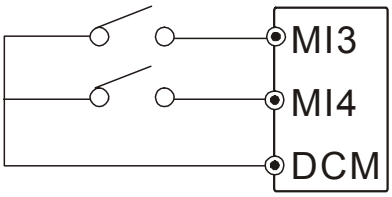
- The display with digital keypad should light up as follows (normal status with no error)

When power is ON, it will display „F 0.0" and LED „STOP" and „FWD" should light up.

- If the drive has built-in fan, it should run. The factory setting of Fan Control Pr.03.11=0 (Fan always on).

3.2 Operation Method

Refer to 4.2 How to operate the digital keypad and chapter 5 parameters for setting. Please choose a suitable method depending on application and operation rule. The operation is usually done as shown in the following table.

<table>
<tr><th>Operation Method</th><th>Frequency Source</th><th>Operation Command Source</th></tr>
<tr><td>Keypad</td><td>  </td><td> 
</td></tr>
<tr><td rowspan="2">Operate from external signal</td><td> 

Parameter setting:
04.05=10
04.06=11</td><td rowspan="2">External terminals input:
MI1-DCM
MI2-DCM</td></tr>
<tr><td>AVI, ACI</td></tr>
</table>

3.3 Trial Run

After finishing checking the items in “3.1 preparation before start-up”, you can perform a trial run. The factory setting of the operation source is from the external terminal (Pr.02.01=2).

1. After applying power, verify that LED “Ready” is on and both of LED RUN and FAULT is off.
2. Both MI1-DCM and MI2-DCM need to connect a switch.
3. Please connect a potentiometer among AVI, 10V and DCM or apply power 0-10Vdc to AVI-DCM.
4. Setting the potentiometer or 0-10Vdc power to less than 1V.
5. Setting MI1=On for forward running. And if you want to change to reverse running, you should set MI2=On. And if you want to decelerate to stop, please set MI1/MI2=Off.
6. Check following items:
   - ■ *Check if the motor direction of rotation is correct.*
   - ■ *Check if the motor runs steadily without abnormal noise and vibration.*
   - ■ *Check if acceleration and deceleration are smooth.*

If you want to perform a trial run by using digital keypad, please operate by the following steps.

- Connect digital keypad to AC motor drive correctly.
- After applying the power, verify that LED display shows F 0.0Hz.
- Set Pr.02.00=0 and Pr.02.01=0. (Refer to chapter 4 operation flow for detail)
  - Press  key to set frequency to around 5Hz.
  - Press  key for forward running. And if you want to change to reverse running, you should press  in  page. And if you want to decelerate to stop, please press  key.
  - Check following items:
    - *Check if the motor direction of rotation is correct.*
    - *Check if the motor runs steadily without abnormal noise and vibration.*
    - *Check if acceleration and deceleration are smooth.*

If the results of trial run are normal, please start the formal run.

NOTE

1. Stop running immediately if any fault occurs and refer to the troubleshooting guide for solving the problem.
2. Do NOT touch output terminals U/T1, V/T2, W/T3 when power is still applied to R/L1, S/L2, T/L3 even when the AC motor drive has stopped. The DC-link capacitors may still be charged to hazardous voltage levels, even if the power has been turned off.
3. To avoid damage to components, do not touch them or the circuit boards with metal objects or your bare hands.

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Chapter 4 Digital Keypad Operation

4.1 Description of the Digital Keypad

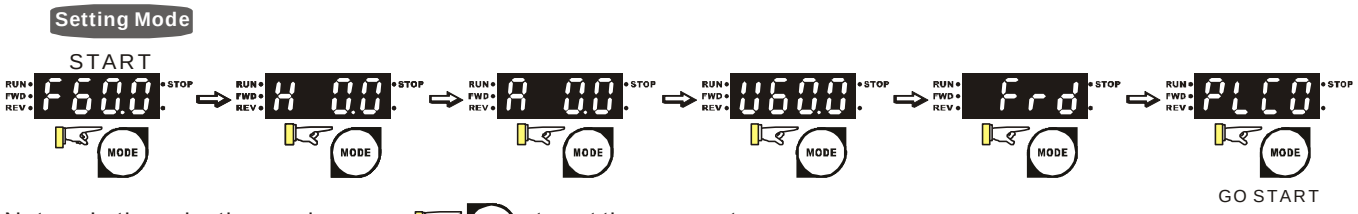
Display Message	Descriptions
	Displays the AC drive Master Frequency.
	Displays the actual output frequency at terminals U/T1, V/T2, and W/T3.
	User defined unit (where U = F x Pr.00.05)
	Displays the output current at terminals U/T1, V/T2, and W/T3.
	Displays the AC motor drive forward run status.
	Displays the AC motor drive reverse run status.
	The counter value (C).
	Displays the selected parameter.
	Displays the actual stored value of the selected parameter.
	External Fault.

Display Message	Descriptions
	Display “End” for approximately 1 second if input has been accepted by pressing PROG DATA key. After a parameter value has been set, the new value is automatically stored in memory. To modify an entry, use the ▲ and ▼ keys.
	Display “Err”, if the input is invalid.

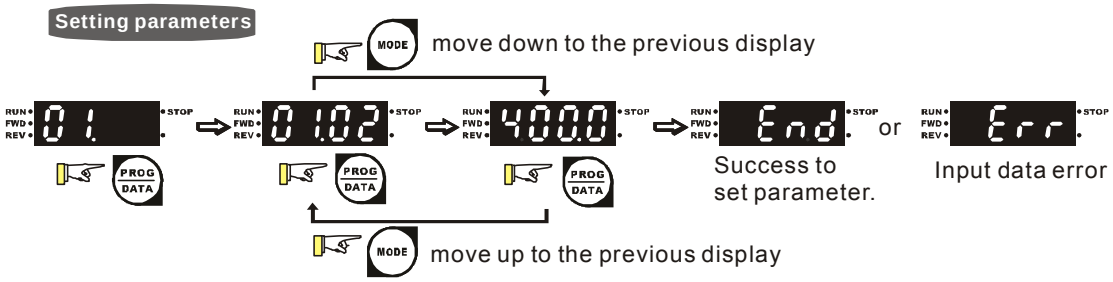
NOTE

When the setting exceeds 99.99 for those numbers with 2 decimals (i.e. unit is 0.01), it will only display 1 decimal due to 4-digital display.

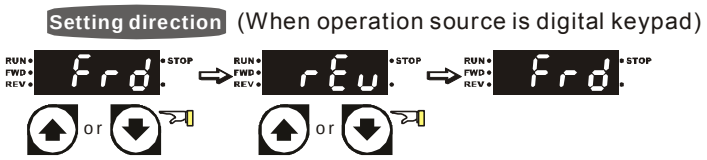
4.2 How to Operate the Digital Keypad

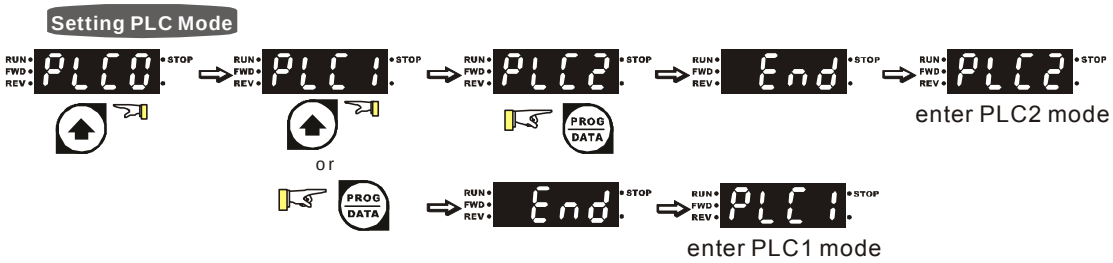


Note： In the selection mode, press PROG DATA to set the parameters.



NOTE：In the parameter setting mode, you can press MODE to return the selecting mode.





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Chapter 5 Parameters

The PDC parameters are divided into 11 groups by property for easy setting. In most applications, the user can finish all parameter settings before start-up without the need for re-adjustment during operation.

The 11 groups are as follows:

Group 0: User Parameters
Group 1: Basic Parameters
Group 2: Operation Method Parameters
Group 3: Output Function Parameters
Group 4: Input Function Parameters
Group 5: Multi-Step Speed Parameters
Group 6: Protection Parameters
Group 7: Motor Parameters
Group 8: Special Parameters
Group 9: Communication Parameters
Group 10: PID Control Parameters
Group 11: Parameters for Extension Card

5.1 Summary of Parameter Settings

✓: The parameter can be set during operation.

Group 0 User Parameters

Parameter	Explanation	Settings	Factory Setting	Customer
00.00	Identity Code of the AC motor drive	Read-only	##	
00.01	Rated Current Display of the AC motor drive	Read-only	#.#	
00.02	Parameter Reset	1: All parameters are read only 6: Clear PLC program 9: All parameters are reset to factory settings (50Hz, 230V/400V or 220V/380V depends on Pr.00.12) 10: All parameters are reset to factory settings (60Hz, 220V/440V)	0	
✓00.03	Start-up Display Selection	0: Display the frequency command value (Fxxx) 1: Display the actual output frequency (Hxxx) 2: Display the content of user-defined unit (Uxxx) 3: Multifunction display, see Pr.00.04 4: FWD/REV command 5: PLCx (PLC selections: PLC0/PLC1/PLC2)	0	
✓00.04	Content of Multi-function Display	0: Display the content of user-defined unit (Uxxx) 1: Display the counter value (c) 2: Display PLC D1043 value (C) 3: Display DC-BUS voltage (u) 4: Display output voltage (E) 5: Display PID analog feedback signal value (b) (%) 6: Output power factor angle (n) 7: Display output power (P) 8: Display the estimated value of torque as it relates to current (t) 9: Display AVI (I) (V) 10: Display ACI / AVI2 (i) (mA/V) 11: Display the temperature of IGBT (h) (°C)	0	
✓00.05	User-Defined Coefficient K	0. 1 to 160.0	1.0	
00.06	Power Board Software Version	Read-only	#.##	
00.07	Control Board Software Version	Read-only	#.##	
00.08	Password Input	0 to 9999	0	
00.09	Password Set	0 to 9999	0	
00.10	Control Method	0: V/f Control	0	

Parameter	Explanation	Settings	Factory Setting	Customer
		1: Vector Control		
00.11	Reserved			
00.12	50Hz Base Voltage Selection	0: 230V/400V 1: 220V/380V	0	

Group 1 Basic Parameters

Parameter	Explanation	Settings	Factory Setting	Customer
01.00	Maximum Output Frequency (Fmax)	50.00 to 600.0 Hz	60.00	
01.01	Maximum Voltage Frequency (Fbase)	0.10 to 600.0 Hz	60.00	
01.02	Maximum Output Voltage (Vmax)	115V/230V series: 0.1V to 255.0V 460V series: 0.1V to 510.0V	220.0 440.0	
01.03	Mid-Point Frequency (Fmid)	0.10 to 600.0 Hz	1.50	
01.04	Mid-Point Voltage (Vmid)	115V/230V series: 0.1V to 255.0V 460V series: 0.1V to 510.0V	10.0 20.0	
01.05	Minimum Output Frequency (Fmin)	0.10 to 600.0 Hz	1.50	
01.06	Minimum Output Voltage (Vmin)	115V/230V series: 0.1V to 255.0V 460V series: 0.1V to 510.0V	10.0 20.0	
01.07	Output Frequency Upper Limit	0.1 to 120.0%	110.0	
01.08	Output Frequency Lower Limit	0.0 to100.0 %	0.0	
✓01.09	Accel Time 1	0.1 to 600.0 / 0.01 to 600.0 sec	10.0	
✓01.10	Decel Time 1	0.1 to 600.0 / 0.01 to 600.0 sec	10.0	
✓01.11	Accel Time 2	0.1 to 600.0 / 0.01 to 600.0 sec	10.0	
✓01.12	Decel Time 2	0.1 to 600.0 / 0.01 to 600.0 sec	10.0	
✓01.13	Jog Acceleration Time	0.1 to 600.0 / 0.01 to 600.0 sec	10.0	
✓01.14	Jog Deceleration Time	0.1 to 600.0 / 0.01 to 600.0 sec	10.0	
✓01.15	Jog Frequency	0.10 Hz to Fmax (Pr.01.00) Hz	6.00	
01.16	Auto acceleration / deceleration (refer to Accel/Decel time setting)	0: Linear Accel/Decel 1: Auto Accel, Linear Decel 2: Linear Accel, Auto Decel 3: Auto Accel/Decel (Set by load) 4: Auto Accel/Decel (set by Accel/Decel Time setting)	0	
01.17	Acceleration S-Curve	0.0 to 10.0 / 0.00 to 10.00 sec	0.0	
01.18	Deceleration S-Curve	0.0 to 10.0 / 0.00 to 10.00 sec	0.0	
01.19	Accel/Decel Time Unit	0: Unit: 0.1 sec 1: Unit: 0.01 sec	0	

Group 2 Operation Method Parameters

Parameter	Explanation	Settings	Factory Setting	Customer
✓02.00	Source of First Master Frequency Command	0: Digital keypad UP/DOWN keys or Multi-function Inputs UP/DOWN. Last used frequency saved. 1: 0 to +10V from AVI 2: 4 to 20mA from ACI or 0 to +10V from AVI2 3: RS-485 serial communication (RJ-45). 4: Digital keypad potentiometer	1	
✓02.01	Source of First Operation Command	0: Digital keypad 1: External terminals. Keypad STOP/RESET enabled. 2: External terminals. Keypad STOP/RESET disabled. 3: RS-485 serial communication (RJ-45). Keypad STOP/RESET enabled. 4: RS-485 serial communication (RJ-45). Keypad STOP/RESET disabled.	1	
02.02	Stop Method	0: STOP: ramp to stop; E.F.: coast to stop 1: STOP: coast to stop; E.F.: coast to stop 2: STOP: ramp to stop; E.F.: ramp to stop 3: STOP: coast to stop; E.F.: ramp to stop	0	
02.03	PWM Carrier Frequency Selections	1 to 15kHz	8	
02.04	Motor Direction Control	0: Enable forward/reverse operation 1: Disable reverse operation 2: Disabled forward operation	0	
02.05	Line Start Lockout	0: Disable. Operation status is not changed even if operation command source Pr.02.01 is changed. 1: Enable. Operation status is not changed even if operation command source Pr.02.01 is changed. 2: Disable. Operation status will change if operation command source Pr.02.01 is changed. 3: Enable. Operation status will change if operation command source Pr.02.01 is changed.	1	
02.06	Loss of ACI Signal (4-20mA)	0: Decelerate to 0 Hz 1: Coast to stop and display “AErr” 2: Continue operation by last frequency command	1	
02.07	Up/Down Mode	0: by UP/DOWN Key 1: Based on accel/decel time 2: Constant speed 3: Pulse input unit	0	

Parameter	Explanation	Settings	Factory Setting	Customer
02.08	Accel/Decel Rate of Change of UP/DOWN Operation with Constant Speed	0.01~10.00 Hz	0.01	
✓02.09	Source of Second Frequency Command	0: Digital keypad UP/DOWN keys or Multi-function Inputs UP/DOWN. Last used frequency saved. 1: 0 to +10V from AVI 2: 4 to 20mA from ACI or 0 to +10V from AVI2 3: RS-485 serial communication (RJ-45). 4: Digital keypad potentiometer	0	
✓02.10	Combination of the First and Second Master Frequency Command	0: First Master Frequency Command 1: First Master Frequency Command+ Second Master Frequency Command 2: First Master Frequency Command - Second Master Frequency Command	0	
✓02.11	Keyboard Frequency Command	0.00 to 600.0Hz	60.00	
✓02.12	Communication Frequency Command	0.00 to 600.0Hz	60.00	
02.13	The Selections for Saving Keypad or Communication Frequency Command	0: Save Keypad & Communication Frequency 1: Save Keypad Frequency only 2: Save Communication Frequency only	0	
02.14	Frequency Command Selections at Stop (for Keypad and Communication)	0: by Current Freq Command 1: by Zero Freq Command 2: by Frequency Display at Stop	0	
02.15	Frequency Display at Stop	0.00 ~ 600.0Hz	60.00	
02.16	Display the Master Freq Command Source	Read Only Bit0=1: by First Freq Source (Pr.02.00) Bit1=1: by Second Freq Source (Pr.02.09) Bit2=1: by Multi-input function Bit3=1: by PLC Freq command	##	
02.17	Display the Operation Command Source	Read Only Bit0=1: by Digital Keypad Bit1=1: by RS485 communication Bit2=1: by External Terminal 2/3 wire mode Bit3=1: by Multi-input function Bit4=1: by PLC Operation Command	##	

Group 3 Output Function Parameters

Parameter	Explanation	Settings	Factory Setting	Customer
03.00	Multi-function Output	0: No function	8	

Parameter	Explanation	Settings	Factory Setting	Customer
	Relay (RA1, RB1, RC1)	1: AC drive operational 2: Master frequency attained 3: Zero speed		
03.01	Multi-function Output Terminal MO1	4: Over torque detection 5: Base-Block (B.B.) indication 6: Low-voltage indication 7: Operation mode indication 8: Fault indication 9: Desired frequency attained 10: Terminal count value attained 11: Preliminary count value attained 12: Over Voltage Stall supervision 13: Over Current Stall supervision 14: Heat sink overheat warning 15: Over Voltage supervision 16: PID supervision 17: Forward command 18: Reverse command 19: Zero speed output signal 20: Warning(FbE,Cexx, AoL2, AUE, SAvE) 21: Brake control (Desired frequency attained)	1	
03.02	Desired Frequency Attained	0.00 to 600.0Hz	0.00	
↗03.03	Analog Output Signal	0: Analog frequency meter 1: Analog current meter	0	
↗03.04	Analog Output Gain	1 to 200%	100	
03.05	Terminal Count Value	0 to 9999	0	
03.06	Preliminary Count Value	0 to 9999	0	
03.07	EF Active When Terminal Count Value Attained	0: Terminal count value attained, no EF display 1: Terminal count value attained, EF active	0	
03.08	Fan Control	0: Fan always ON 1: 1 minute after AC motor drive stops, fan will be OFF 2: Fan ON when AC motor drive runs, fan OFF when AC motor drive stops 3: Fan ON when preliminary heatsink temperature attained	0	
03.09	The Digital Output Used by PLC	Read only Bit0=1:RLY used by PLC Bit1=1:MO1 used by PLC Bit2=1:MO2/RA2 used by PLC Bit3=1:MO3/RA3 used by PLC Bit4=1:MO4/RA4 used by PLC Bit5=1:MO5/RA5 used by PLC Bit6=1:MO6/RA6 used by PLC	##	

Parameter	Explanation	Settings	Factory Setting	Customer
		Bit7=1:MO7/RA7 used by PLC		
03.10	The Analog Output Used by PLC	Read only Bit0=1:AFM used by PLC	##	
03.11	Brake Release Frequency	0.00 to 20.00Hz	0.00	
03.12	Brake Engage Frequency	0.00 to 20.00Hz	0.00	
03.13	Display the Status of Multi-function Output Terminals	Read only Bit0: RLY Status Bit1: MO1 Status Bit2: MO2/RA2 Status Bit3: MO3/RA3 Status Bit4: MO4/RA4 Status Bit5: MO5/RA5 Status Bit6: MO6/RA6 Status Bit7: MO7/RA7 Status	##	

Group 4 Input Function Parameters

Parameter	Explanation	Settings	Factory Setting	Customer
↗04.00	Keypad Potentiometer Bias	0.0 to 100.0 %	0.0	
↗04.01	Keypad Potentiometer Bias Polarity	0: Positive bias 1: Negative bias	00	
↗04.02	Keypad Potentiometer Gain	0.1 to 200.0 %	100.0	
04.03	Keypad Potentiometer Negative Bias, Reverse Motion Enable/Disable	0: No negative bias command 1: Negative bias: REV motion enabled	0	
04.04	2-wire/3-wire Operation Control Modes	0: 2-wire: FWD/STOP, REV/STOP 1: 2-wire: FWD/REV, RUN/STOP 2: 3-wire operation	0	
04.05	Multi-function Input Terminal (MI3)	0: No function 1: Multi-Step speed command 1 2: Multi-Step speed command 2 3: Multi-Step speed command 3 4: Multi-Step speed command 4 5: External reset 6: Accel/Decel inhibit 7: Accel/Decel time selection command 8: Jog Operation 9: External base block 10: Up: Increment master frequency 11: Down: Decrement master frequency	1	
04.06	Multi-function Input Terminal (MI4)		2	
04.07	Multi-function Input Terminal (MI5)		3	
04.08	Multi-function Input Terminal (MI6)		4	

Parameter	Explanation	Settings	Factory Setting	Customer
		12: Counter Trigger Signal 13: Counter reset 14: E.F. External Fault Input 15: PID function disabled 16: Output shutoff stop 17: Parameter lock enable 18: Operation command selection (external terminals) 19: Operation command selection(keypad) 20: Operation command selection(communication) 21: FWD/REV command 22: Source of second frequency command 23: Run/Stop PLC Program (PLC1) 24: Download/execute/monitor PLC Program (PLC2)		
04.09	Multi-function Input Contact Selection	Bit0:MI1 Bit1:MI2 Bit2:MI3 Bit3:MI4 Bit4:MI5 Bit5:MI6 Bit6:MI7 Bit7:MI8 Bit8:MI9 Bit9:MI10 Bit10:MI11 Bit11:MI12 0:N.O., 1:N.C. P.S.:MI1 to MI3 will be invalid when it is 3-wire control.	0	
04.10	Digital Terminal Input Debouncing Time	1 to 20 (*2ms)	1	
04.11	Min AVI Voltage	0.0 to 10.0V	0.0	
04.12	Min AVI Frequency	0.0 to 100.0%	0.0	
04.13	Max AVI Voltage	0.0 to 10.0V	10.0	
04.14	Max AVI Frequency	0.0 to 100.0%	100.0	
04.15	Min ACI Voltage	0.0 to 20.0mA	4.0	
04.16	Min ACI Frequency	0.0 to 100.0%	0.0	
04.17	Min ACI Voltage	0.0 to 20.0mA	20.0	
04.18	Max ACI Frequency	0.0 to 100.0%	100.0	
04.19	ACI/AVI2 Selection	0: ACI 1: AVI2	0	
04.20	Min AVI2 Voltage	0.0 to 10.0V	0.0	

Parameter	Explanation	Settings	Factory Setting	Customer
04.21	Min AVI2 Frequency	0.0 to 100.0%	0.0	
04.22	Max AVI2 Voltage	0.0 to 10.0V	10.0	
04.23	Max AVI2 Frequency	0.0 to 100.0%	100.0	
04.24	The Digital Input Used by PLC	Read only. Bit0=1:MI1 used by PLC Bit1=1:MI2 used by PLC Bit2=1:MI3 used by PLC Bit3=1:MI4 used by PLC Bit4=1:MI5 used by PLC Bit5=1:MI6 used by PLC Bit6=1: MI7 used by PLC Bit7=1: MI8 used by PLC Bit8=1: MI9 used by PLC Bit9=1: MI10 used by PLC Bit10=1: MI11 used by PLC Bit11=1: MI12 used by PLC	##	
04.25	The Analog Input Used by PLC	Read only. Bit0=1:AVI used by PLC Bit1=1:ACI/AVI2 used by PLC	##	
04.26	Display the Status of Multi-function Input Terminal	Read only. Bit0: MI1 Status Bit1: MI2 Status Bit2: MI3 Status Bit3: MI4 Status Bit4: MI5 Status Bit5: MI6 Status Bit6: MI7 Status Bit7: MI8 Status Bit8: MI9 Status Bit9: MI10 Status Bit10: MI11 Status Bit11: MI12 Status	##	
04.27	Internal/External Multi-function Input Terminals Selection	0~4095	0	
04.28	Internal Terminal Status	0~4095	0	

Group 5 Multi-Step Speed and PLC Parameters

Parameter	Explanation	Settings	Factory Setting	Customer
✓05.00	1st Step Speed Frequency	0.00 to 600.0 Hz	0.00	

Parameter	Explanation	Settings	Factory Setting	Customer
↗05.01	2nd Step Speed Frequency	0.00 to 600.0 Hz	0.00	
↗05.02	3rd Step Speed Frequency	0.00 to 600.0 Hz	0.00	
↗05.03	4th Step Speed Frequency	0.00 to 600.0 Hz	0.00	
↗05.04	5th Step Speed Frequency	0.00 to 600.0 Hz	0.00	
↗05.05	6th Step Speed Frequency	0.00 to 600.0 Hz	0.00	
↗05.06	7th Step Speed Frequency	0.00 to 600.0 Hz	0.00	
↗05.07	8th Step Speed Frequency	0.00 to 600.0 Hz	0.00	
↗05.08	9th Step Speed Frequency	0.00 to 600.0 Hz	0.00	
↗05.09	10th Step Speed Frequency	0.00 to 600.0 Hz	0.00	
↗05.10	11th Step Speed Frequency	0.00 to 600.0 Hz	0.00	
↗05.11	12th Step Speed Frequency	0.00 to 600.0 Hz	0.00	
↗05.12	13th Step Speed Frequency	0.00 to 600.0 Hz	0.00	
↗05.13	14th Step Speed Frequency	0.00 to 600.0 Hz	0.00	
↗05.14	15th Step Speed Frequency	0.00 to 600.0 Hz	0.00	

Group 6 Protection Parameters

Parameter	Explanation	Settings	Factory Setting	Customer
06.00	Over-Voltage Stall Prevention	115/230V series: 330.0V to 410.0V 460V series: 660.0V to 820.0V 0.0: Disable over-voltage stall prevention	390.0V 780.0V	
06.01	Over-Current Stall Prevention during Accel	0:Disable 20 to 250%	170	
06.02	Over-Current Stall Prevention during Operation	0:Disable 20 to 250%	170	
06.03	Over-Torque Detection Mode (OL2)	0: Disabled 1: Enabled during constant speed operation. After the over-torque is detected, keep running until OL1 or OL occurs. 2: Enabled during constant speed operation. After the over-torque is detected, stop running.	0	

Parameter	Explanation	Settings	Factory Setting	Customer
		3: Enabled during accel. After the over-torque is detected, keep running until OL1 or OL occurs. 4: Enabled during accel. After the over-torque is detected, stop running.		
06.04	Over-Torque Detection Level	10 to 200%	150	
06.05	Over-Torque Detection Time	0.1 to 60.0 sec	0.1	
06.06	Electronic Thermal Overload Relay Selection	0: Standard motor (self cooled by fan) 1: Special motor (forced external cooling) 2: Disabled	2	
06.07	Electronic Thermal Characteristic	30 to 600 sec	60	
06.08	Present Fault Record	0: No fault 1: Over current (oc) 2: Over voltage (ov) 3: IGBT Overheat (oH1) 4: Power Board Overheat (oH2) 5: Overload (oL) 6: Overload1 (oL1) 7: Motor over load (oL2)	0	
06.09	Second Most Recent Fault Record	8: External fault (EF) 9: Current exceeds 2 times rated current during accel.(ocA) 10: Current exceeds 2 times rated current during decel.(ocd) 11: Current exceeds 2 times rated current during steady state operation (ocn) 12: Ground fault (GFF) 13: Reserved 14: Phase-Loss (PHL) 15: Reserved 16: Auto Acel/Decel failure (CFA)		
06.10	Third Most Recent Fault Record	17: SW/Password protection (codE) 18: Power Board CPU WRITE failure (cF1.0) 19: Power Board CPU READ failure (cF2.0) 20: CC, OC Hardware protection failure (HPF1)		
06.11	Fourth Most Recent Fault Record	21: OV Hardware protection failure (HPF2) 22: GFF Hardware protection failure (HPF3) 23: OC Hardware protection failure (HPF4)		
06.12	Fifth Most Recent Fault Record	24: U-phase error (cF3.0) 25: V-phase error (cF3.1)		

Parameter	Explanation	Settings	Factory Setting	Customer
		26: W-phase error (cF3.2) 27: DCBUS error (cF3.3) 28: IGBT Overheat (cF3.4) 29: Power Board Overheat (cF3.5) 30: Control Board CPU WRITE failure (cF1.1) 31: Control Board CPU WRITE failure (cF2.1) 32: ACI signal error (AErr) 33: Reserved 34: Motor PTC overheat protection (PtC1) 35-39: Reserved 40: Communication time-out error of control board and power board (CP10)		

Group 7 Motor Parameters

Parameter	Explanation	Settings	Factory Setting	Customer
✓07.00	Motor Rated Current	30 %FLA to 120% FLA	100	
✓07.01	Motor No-Load Current	0%FLA to 99% FLA	40	
✓07.02	Torque Compensation	0.0 to 10.0	0.0	
✓07.03	Slip Compensation (Used without PG)	0.00 to 10.00	0.00	
07.04	Motor Parameters Auto Tuning	0: Disable 1: Auto tuning R1 2: Auto tuning R1 + no-load test	0	
07.05	Motor Line-to-line Resistance R1	0~65535 mΩ	0	
07.06	Motor Rated Slip	0.00 to 20.00 Hz	3.00	
07.07	Slip Compensation Limit	0 to 250%	200	
07.08	Torque Compensation Time Constant	0.01 ~10.00 Sec	0.10	
07.09	Slip Compensation Time Constant	0.05 ~10.00 sec	0.20	
07.10	Accumulative Motor Operation Time (Min.)	0 to 1439 Min.	0	
07.11	Accumulative Motor Operation Time (Day)	0 to 65535 Day	0	
07.12	Motor PTC Overheat Protection	0: Disable 1: Enable	0	
07.13	Input Debouncing Time of the PTC Protection	0~9999(*2ms)	100	

Parameter	Explanation	Settings	Factory Setting	Customer
07.14	Motor PTC Overheat Protection Level	0.1~10.0V	2.4	
07.15	Motor PTC Overheat Warning Level	0.1~10.0V	1.2	
07.16	Motor PTC Overheat Reset Delta Level	0.1~5.0V	0.6	
07.17	Treatment of the Motor PTC Overheat	0: Warn and RAMP to stop 1: Warn and COAST to stop 2: Warn and keep running	0	

Group 8 Special Parameters

Parameter	Explanation	Settings	Factory Setting	Customer
08.00	DC Braking Current Level	0 to 100%	0	
08.01	DC Braking Time during Start-Up	0.0 to 60.0 sec	0.0	
08.02	DC Braking Time during Stopping	0.0 to 60.0 sec	0.0	
08.03	Start-Point for DC Braking	0.00 to 600.0Hz	0.00	
08.04	Momentary Power Loss Operation Selection	0: Operation stops after momentary power loss 1: Operation continues after momentary power loss, speed search starts with the Master Frequency reference value 2: Operation continues after momentary power loss, speed search starts with the minimum frequency	0	
08.05	Maximum Allowable Power Loss Time	0.1 to 5.0 sec	2.0	
08.06	Base-block Speed Search	0: Disable speed search 1: Speed search starts with last frequency command 2: Starts with minimum output frequency	1	
08.07	B.B. Time for Speed Search	0.1 to 5.0 sec	0.5	
08.08	Current Limit for Speed Search	30 to 200%	150	
08.09	Skip Frequency 1 Upper Limit	0.00 to 600.0 Hz	0.00	
08.10	Skip Frequency 1 Lower Limit	0.00 to 600.0 Hz	0.00	
08.11	Skip Frequency 2 Upper Limit	0.00 to 600.0 Hz	0.00	
08.12	Skip Frequency 2 Lower Limit	0.00 to 600.0 Hz	0.00	
08.13	Skip Frequency 3 Upper Limit	0.00 to 600.0 Hz	0.00	

Parameter	Explanation	Settings	Factory Setting	Customer
08.14	Skip Frequency 3 Lower Limit	0.00 to 600.0 Hz	0.00	
08.15	Auto Restart After Fault	0 to 10 (0=disable)	0	
08.16	Auto Reset Time at Restart after Fault	0.1 to 6000 sec	60.0	
08.17	Auto Energy Saving	0: Disable 1: Enable	0	
08.18	AVR Function	0: AVR function enable 1: AVR function disable 2: AVR function disable for decel. 3: AVR function disable for stop	0	
08.19	Software Braking Level	115V / 230V series: 370.0to 430.0V 460V series: 740.0 to 860.0V	380.0 760.0	
✓08.20	Compensation Coefficient for Motor Instability	0.0~5.0	0.0	

Group 9 Communication Parameters

Parameter	Explanation	Settings	Factory Setting	Customer
09.00	Communication Address	1 to 254	1	
09.01	Transmission Speed	0: Baud rate 4800bps 1: Baud rate 9600bps 2: Baud rate 19200bps 3: Baud rate 38400bps	1	
09.02	Transmission Fault Treatment	0: Warn and keep operating 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning and keep operating	3	
09.03	Time-out Detection	0.1 ~ 120.0 seconds 0.0: Disable	0.0	
09.04	Communication Protocol	0: 7,N,2 (Modbus, ASCII) 1: 7,E,1 (Modbus, ASCII) 2: 7,O,1 (Modbus, ASCII) 3: 8,N,2 (Modbus, RTU) 4: 8,E,1 (Modbus, RTU) 5: 8,O,1 (Modbus, RTU)	0	
09.05	Reserved			
09.06	Reserved			
09.07	Response Delay Time	0 ~ 200 (unit: 2ms)	1	

Group 10 PID Control Parameters

Parameter	Explanation	Settings	Factory Setting	Customer
10.00	PID Set Point Selection	0: Disable PID operation 1: Keypad (based on Pr.02.00) 2: 0 to +10V from AVI 3: 4 to 20mA from ACI or 0 to +10V from AVI2 4: PID set point (Pr.10.11)	0	
10.01	Input Terminal for PID Feedback	0: **Positive** PID feedback from external terminal AVI (0 ~ +10VDC) 1: **Negative** PID feedback from external terminal AVI (0 ~ +10VDC) 2: **Positive** PID feedback from external terminal ACI (4 ~ 20mA)/ AVI2 (0 ~ +10VDC). 3: **Negative** PID feedback from external terminal ACI (4 ~ 20mA)/ AVI2 (0 ~ +10VDC).	0	
✓10.02	Proportional Gain (P)	0.0 to 10.0	1.0	
✓10.03	Integral Time (I)	0.00 to 100.0 sec (0.00=disable)	1.00	
✓10.04	Derivative Control (D)	0.00 to 1.00 sec	0.00	
10.05	Upper Bound for Integral Control	0 to 100%	100	
10.06	Primary Delay Filter Time	0.0 to 2.5 sec	0.0	
10.07	PID Output Freq Limit	0 to 110%	100	
10.08	PID Feedback Signal Detection Time	0.0 to 3600 sec (0.0 disable)	60.0	
10.09	Treatment of the Erroneous PID Feedback Signals	0: Warn and RAMP to stop 1: Warn and COAST to stop 2: Warn and keep operation	0	
10.10	Gain Over the PID Detection Value	0.0 to 10.0	1.0	
✓10.11	Source of PID Set point	0.00 to 600.0Hz	0.00	
10.12	PID Offset Level	1.0 to 50.0%	10.0	
10.13	Detection Time of PID Offset	0.1 to 300.0 sec	5.0	
10.14	Sleep/Wake Up Detection Time	0.0 to 6550 sec	0.0	
10.15	Sleep Frequency	0.00 to 600.0 Hz	0.00	
10.16	Wakeup Frequency	0.00 to 600.0 Hz	0.00	

Parameter	Explanation	Settings	Factory Setting	Customer
10.17	Minimum PID Output Frequency Selection	0: By PID control 1: By minimum output frequency (Pr.01.05)	0	

Group 11 Parameters for Extension Card

Parameter	Explanation	Settings	Factory Setting	Customer
11.00	Multi-function Output Terminal MO2/RA2	0: No function 1: AC drive operational 2: Master frequency attained 3: Zero speed 4: Over torque detection 5: Base-Block (B.B.) indication 6: Low-voltage indication 7: Operation mode indication 8: Fault indication 9: Desired frequency attained 10: Terminal count value attained 11: Preliminary count value attained 12: Over Voltage Stall supervision 13: Over Current Stall supervision 14: Heat sink overheat warning 15: Over Voltage supervision 16: PID supervision 17: Forward command 18: Reverse command 19: Zero speed output signal 20: Warning(FbE,Cexx, AoL2, AUE, SAvE) 21: Brake control (Desired frequency attained)	0	
11.01	Multi-function Output Terminal MO3/RA3		0	
11.02	Multi-function Output Terminal MO4/RA4		0	
11.03	Multi-function Output Terminal MO5/RA5		0	
11.04	Multi-function Output Terminal MO6/RA6		0	
11.05	Multi-function Output Terminal MO7/RA7		0	
11.06	Multi-function Input Terminal (MI7)	0: No function 1: Multi-Step speed command 1 2: Multi-Step speed command 2 3: Multi-Step speed command 3 4: Multi-Step speed command 4 5: External reset 6: Accel/Decel inhibit 7: Accel/Decel time selection command 8: Jog Operation 9: External base block 10: Up: Increment master frequency 11: Down: Decrement master frequency	0	
11.07	Multi-function Input Terminal (MI8)		0	
11.08	Multi-function Input Terminal (MI9)		0	
11.09	Multi-function Input Terminal (MI10)		0	

Parameter	Explanation	Settings	Factory Setting	Customer
11.10	Multi-function Input Terminal (MI11)	12: Counter Trigger Signal 13: Counter reset 14: E.F. External Fault Input 15: PID function disabled 16: Output shutoff stop 17: Parameter lock enable 18: Operation command selection (external terminals) 19: Operation command selection (keypad) 20: Operation command selection (communication) 21: FWD/REV command 22: Source of second frequency command 23: Run/Stop PLC Program (PLC1) 24: Download/execute/monitor PLC Program (PLC2)	0	
11.11	Multi-function Input Terminal (MI12)		0	

5.2 Parameter Settings for Applications

■ Speed Search

Applications	Purpose	Functions	Related Parameters
Windmill, winding machine, fan and all inertia loads	Restart free-running motor	Before the free-running motor is completely stopped, it can be restarted without detection of motor speed. The AC motor drive will auto search motor speed and will accelerate when its speed is the same as the motor speed.	08.04~08.08

■ DC Braking before Running

Applications	Purpose	Functions	Related Parameters
When e.g. windmills, fans and pumps rotate freely by wind or flow without applying power	Keep the free-running motor at standstill.	If the running direction of the free-running motor is not steady, please execute DC braking before start-up.	08.00 08.01

■ Energy Saving

Applications	Purpose	Functions	Related Parameters
Punching machines fans, pumps and precision machinery	Energy saving and less vibrations	Energy saving when the AC motor drive runs at constant speed, yet full power acceleration and deceleration For precision machinery it also helps to lower vibrations.	08.17

■ Multi-step Operation

Applications	Purpose	Functions	Related Parameters
Conveying machinery	Cyclic operation by multi-step speeds.	To control 15-step speeds and duration by simple contact signals.	04.05~04.08 05.00~05.14

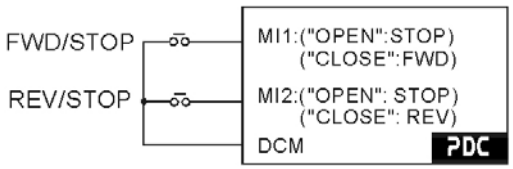
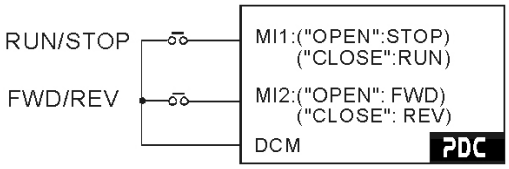
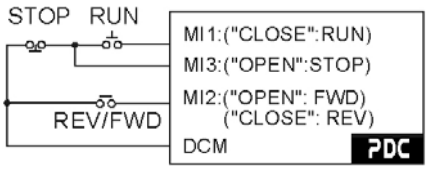
■ Switching acceleration and deceleration times

Applications	Purpose	Functions	Related Parameters
Auto turntable for conveying machinery	Switching acceleration and deceleration times by external signal	When an AC motor drive drives two or more motors, it can reach high-speed but still start and stop smoothly.	01.09~01.12 04.05~04.08

■ **Overheat Warning**

Applications	Purpose	Functions	Related Parameters
Air conditioner	Safety measure	When AC motor drive overheats, it uses a thermal sensor to have overheat warning.	03.00~03.01 04.05~04.08

■ **Two-wire/three-wire**

Applications	Purpose	Functions	Related Parameters
General application	To run, stop, forward and reverse by external terminals	  **3-wire** 	02.00 02.09 04.04

■ **Operation Command**

Applications	Purpose	Functions	Related Parameters
General application	Selecting the source of control signal	Selection of AC motor drive control by external terminals, digital keypad or RS485.	02.01 04.05~04.08

■ **Frequency Hold**

Applications	Purpose	Functions	Related Parameters
General application	Acceleration/ deceleration pause	Hold output frequency during Acceleration/deceleration	04.05~04.08

■ Auto Restart after Fault

Applications	Purpose	Functions	Related Parameters
Air conditioners, remote pumps	For continuous and reliable operation without operator intervention	The AC motor drive can be restarted/reset automatically up to 10 times after a fault occurs.	08.15~08.16

■ Emergency Stop by DC Braking

Applications	Purpose	Functions	Related Parameters
High-speed rotors	Emergency stop without brake resistor	AC motor drive can use DC braking for emergency stop when quick stop is needed without brake resistor. When used often, take motor cooling into consideration.	08.00 08.02 08.03

■ Over-torque Setting

Applications	Purpose	Functions	Related Parameters
Pumps, fans and extruders	To protect machines and to have continuous/ reliable operation	The over-torque detection level can be set. Once OC stall, OV stall and over-torque occurs, the output frequency will be adjusted automatically. It is suitable for machines like fans and pumps that require continuous operation.	06.00~06.05

■ Upper/Lower Limit Frequency

Applications	Purpose	Functions	Related Parameters
Pump and fan	Control the motor speed within upper/lower limit	When user cannot provide upper/lower limit, gain or bias from external signal, it can be set individually in AC motor drive.	01.07 01.08

■ Skip Frequency Setting

Applications	Purpose	Functions	Related Parameters
Pumps and fans	To prevent machine vibrations	The AC motor drive cannot run at constant speed in the skip frequency range. Three skip frequency ranges can be set.	08.09~08.14

■ **Carrier Frequency Setting**

Applications	Purpose	Functions	Related Parameters
General application	Low noise	The carrier frequency can be increased when required to reduce motor noise.	02.03

■ **Keep Running when Frequency Command is Lost**

Applications	Purpose	Functions	Related Parameters
Air conditioners	For continuous operation	When the frequency command is lost by system malfunction, the AC motor drive can still run. Suitable for intelligent air conditioners.	02.06

■ **Output Signal during Running**

Applications	Purpose	Functions	Related Parameters
General application	Provide a signal for running status	Signal available to stop braking (brake release) when the AC motor drive is running. (This signal will disappear when the AC motor drive is free-running.)	03.00~03.01

■ **Output Signal in Zero Speed**

Applications	Purpose	Functions	Related Parameters
General application	Provide a signal for running status	When the output frequency is lower than the min. output frequency, a signal is given for external system or control wiring.	03.00~03.01

■ **Output Signal at Desired Frequency**

Applications	Purpose	Functions	Related Parameters
General application	Provide a signal for running status	When the output frequency is at the desired frequency (by frequency command), a signal is given for external system or control wiring (frequency attained).	03.00~03.01

■ Output Signal for Base Block

Applications	Purpose	Functions	Related Parameters
General application	Provide a signal for running status	When executing Base Block, a signal is given for external system or control wiring.	03.00~03.01

■ Overheat Warning for Heat Sink

Applications	Purpose	Functions	Related Parameters
General application	For safety	When heat sink is overheated, it will send a signal for external system or control wiring.	03.00~03.01

■ Multi-function Analog Output

Applications	Purpose	Functions	Related Parameters
General application	Display running status	The value of frequency, output current/voltage can be read by connecting a frequency meter or voltage/current meter.	03.06

5.3 Description of Parameter Settings

Group 0: User Parameters **✓This parameter can be set during operation.**

00.00	Identity Code of the AC motor drive
Settings	Read Only — Factory setting: ##
00.01	Rated Current Display of the AC motor drive
Settings	Read Only — Factory setting: #.#

📖 Pr. 00.00 displays the identity code of the AC motor drive. The capacity, rated current, rated voltage and the max. carrier frequency relate to the identity code. Users can use the following table to check how the rated current, rated voltage and max. carrier frequency of the AC motor drive correspond to the identity code.

📖 Pr.00.01 displays the rated current of the AC motor drive. By reading this parameter the user can check if the AC motor drive is correct.

00.02 Parameter Reset

Factory Setting: 0

Settings	1	All parameters are read-only
	6	Clear PLC program
	9	All parameters are reset to factory settings (50Hz, 230V/400V or 220V/380V depends on Pr.00.12)
	10	All parameters are reset to factory settings (60Hz, 115V/220V/440V)

📖 This parameter allows the user to reset all parameters to the factory settings except the fault records (Pr.06.08 ~ Pr.06.12).

50Hz: Pr.01.00 and Pr.01.01 are set to 50Hz and Pr.01.02 will be set by Pr.00.12.

60Hz: Pr.01.00 and Pr.01.01 are set to 60Hz and Pr.01.02 is set to 115V, 230V or 460V.

📖 When Pr.00.02=1, all parameters are read-only. To write all parameters, set Pr.00.02=0.

00.03 ✓Start-up Display Selection

Factory Setting: 0

Settings	0	Display the frequency command value (Fxxx)	
	1	Display the actual output frequency (Hxxx)	
	2	Display the output current in A supplied to the motor (Axxx)	

3	Display the content of user-defined unit (Uxxx)	
4	FWD/REV command	
5	PLCx (PLC selections: PLC0/PLC1/PLC2)	

📖 This parameter determines the start-up display page after power is applied to the drive.

📖 For setting 5, PLC0: disable, PLC1: run PLC, PLC2: read/write PLC programs into AC motor drive.

00.04 ↗Content of Multi-function Display

Factory Setting: 0

Settings	0	Display the content of user-defined unit (Uxxx)	
	1	Display the counter value which counts the number of pulses on TRG terminal	
	2	Display PLC D1043 value (C)	
	3	Display the actual DC BUS voltage in VDC of the AC motor drive	
	4	Display the output voltage in VAC of terminals U/T1, V/T2, W/T3 to the motor.	
	5	Display PID analog feedback signal value in %	
	6	Display the power factor angle in º of terminals U/T1, V/T2, W/T3 to the motor	
	7	Display the output power in kW of terminals U, V and W to the motor.	
	8	Display the estimated value of torque in Nm as it relates to current.	
	9	Display the signal of AVI analog input terminal (V).	
	10	Display the signal of ACI analog input terminal (mA)or display the signal of AVI2 analog input terminal-(V).	
	11	Display the temperature of IGBT (h) in ˚C	

00.05 ↗User Defined Coefficient K — Unit: 0. 1

Settings 0. 1 to d 160.0 — Factory Setting: 1.0

🕮 The coefficient K determines the multiplying factor for the user-defined unit.

The display value is calculated as follows:

U (User-defined unit) = Actual output frequency * K (Pr.00.05)

Example:

A conveyor belt runs at 13.6m/s at motor speed 60Hz.

K = 13.6/60 = 0.22 (0.226667 rounded to 1 decimal), therefore Pr.00.05=0.2

With Frequency command 35Hz, display shows U and 35*0.2=7.0m/s.

(To increase accuracy, use K=2.2 or K=22.7 and disregard decimal point.)

00.06	Power Board Software Version	
	Settings	Read Only
	Display	#.##

00.07	Control Board Software Version	
	Settings	Read Only
	Display	#.##

00.08	Password Input	Unit: 1
	Settings 0 to 9999	Factory Setting: 0
	Display 0~2 (times of wrong password)	

🕮 The function of this parameter is to input the password that is set in Pr.00.09. Input the correct password here to enable changing parameters. You are limited to a maximum of 3 attempts. After 3 consecutive failed attempts, a blinking “codE” will show up to force the user to restart the AC motor drive in order to try again to input the correct password.

00.09	Password Set		Unit: 1
	Settings	0 to 9999	Factory Setting: 0
	Display	0	No password set or successful input in Pr. 00.08
		1	Password has been set

📖 To set a password to protect your parameter settings.

If the display shows 0, no password is set or password has been correctly entered in Pr.00.08.

All parameters can then be changed, including Pr.00.09.

The first time you can set a password directly. After successful setting of password the display will show 1.

Be sure to record the password for later use.

To cancel the parameter lock, set the parameter to 0 after inputting correct password into Pr. 00.08.

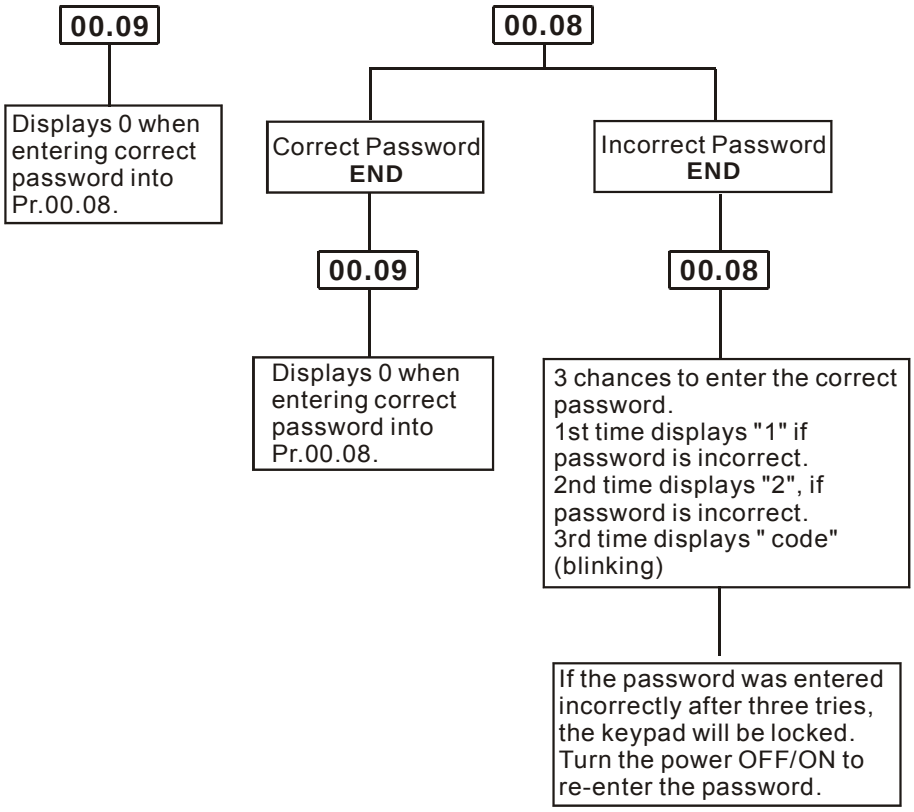
The password consists of min. 1 digits and max. 4 digits.

📖 How to make the password valid again after decoding by Pr.00.08:

Method 1: Re-input original password into Pr.00.09 (Or you can enter a new password if you want to use a changed or new one).

Method 2: After rebooting, password function will be recovered.

Password Decode Flow Chart



00.10 Control Method

Factory Setting: 0

Settings	0	V/f Control
	1	Vector Control

📖 This parameter determines the control method of the AC motor drive.

00.11 Reserved

00.12 50Hz Base Voltage Selection

Factory Setting: 0

Settings	0	230V/400V
	1	220V/380V

Group 1: Basic Parameters

01.00	Maximum Output Frequency (Fmax)		Unit: 0.01
	Settings	50.00 to 600.0 Hz	Factory Setting: 60.00

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

01.01	Maximum Voltage Frequency (Fbase)		Unit: 0.01
	Settings	0.10 to 600.0Hz	Factory Setting: 60.00

📖 This value should be set according to the rated frequency of the motor as indicated on the motor nameplate. Maximum Voltage Frequency determines the v/f curve 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 (460V/60Hz=7.66V/Hz). This parameter value must be equal to or greater than the Mid-Point Frequency (Pr.01.03).

01.02	Maximum Output Voltage (Vmax)		Unit: 0.1
	Settings	115V/230V series 0.1 to 255.0V	Factory Setting: 220.0
		460V series 0.1 to 510.0V	Factory Setting: 440.0

📖 This parameter determines the Maximum Output Voltage of the AC motor 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. This parameter value must be equal to or greater than the Mid-Point Voltage (Pr.01.04).

01.03	Mid-Point Frequency (Fmid)		Unit: 0.01
	Settings	0.10 to 600.0Hz	Factory Setting: 1.50

📖 This parameter sets the Mid-Point Frequency of the 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 Frequency (Pr.01.05) and equal to or less than Maximum Voltage Frequency (Pr.01.01).

01.04	Mid-Point Voltage (Vmid)		Unit: 0.1
	Settings	115V/230V series 0.1 to 255.0V	Factory Setting: 10.0
		460V series 0.1 to 510.0V	Factory Setting: 20.0

🕮 This 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.01.06) and equal to or less than Maximum Output Voltage (Pr.01.02).

01.05	Minimum Output Frequency (Fmin)	Unit: 0.01
	Settings 0.10 to 600.0Hz	Factory Setting: 1.50

🕮 This parameter sets the Minimum Output Frequency of the AC motor drive. This parameter must be equal to or less than Mid-Point Frequency (Pr.01.03).

🕮 The settings of 01.03, 01.04, and 01.06 are invalid in Vector Control mode.

01.06	Minimum Output Voltage (Vmin)		Unit: 0.1
	Settings	115V/230V series 0.1 to 255.0V	Factory Setting: 10.0
		460V series 0.1 to 510.0V	Factory Setting: 20.0

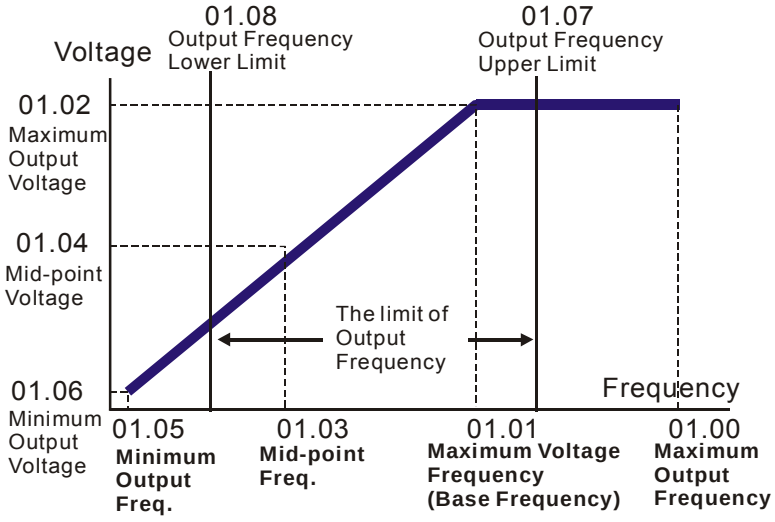
🕮 This parameter sets the Minimum Output Voltage of the AC motor drive. This parameter must be equal to or less than Mid-Point Voltage (Pr.01.04).

🕮 The settings of Pr.01.01 to Pr.01.06 have to meet the condition of Pr.01.02 ≥ Pr.01.04 ≥ Pr.01.06 and Pr.01.01 ≥ Pr.01.03 ≥ Pr.01.05.

01.07	Output Frequency Upper Limit	Unit: 0.1
	Settings 0.1 to 120.0%	Factory Setting: 110.0

🕮 This parameter must be equal to or greater than the Output Frequency Lower Limit (Pr.01.08). The Maximum Output Frequency (Pr.01.00) is regarded as 100%.

🕮 Output Frequency Upper Limit value = (Pr.01.00 * Pr.01.07)/100.



V/f Curve

01.08	Output Frequency Lower Limit	Unit: 0.1
	Settings 0.0 to 100.0%	Factory Setting: 0.0

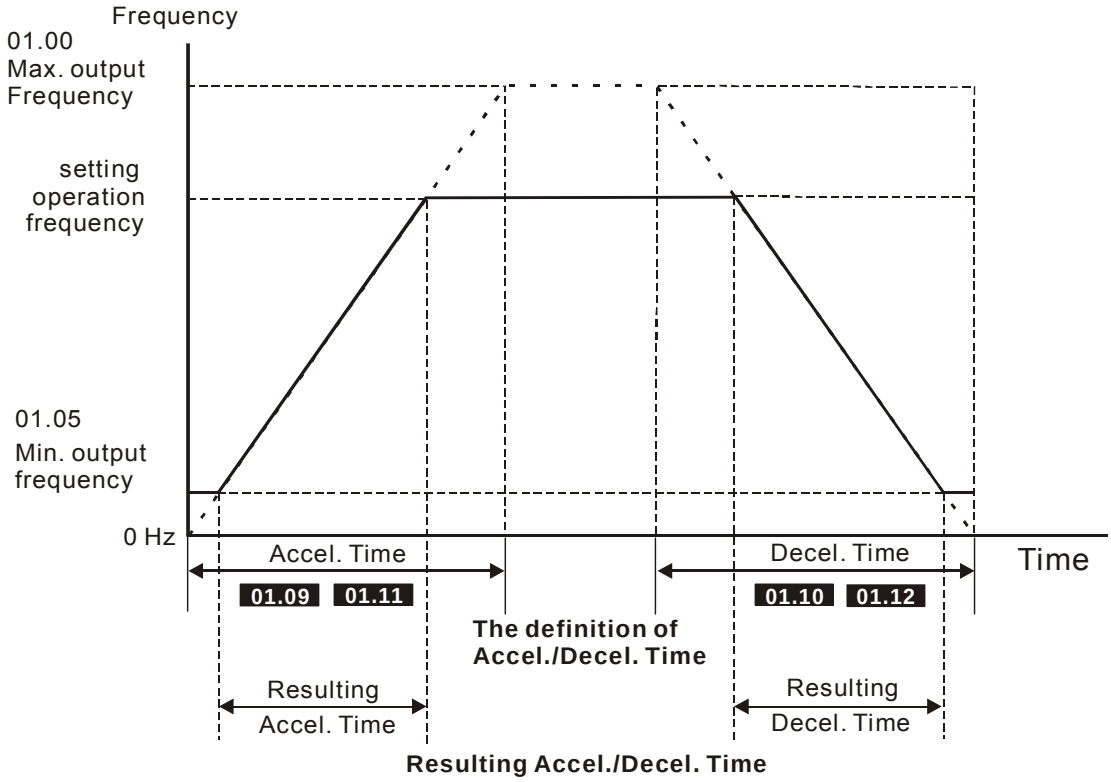
- The Upper/Lower Limits are to prevent operation errors and machine damage.
- If the Output Frequency Upper Limit is 50Hz and the Maximum Output Frequency is 60Hz, the Output Frequency will be limited to 50Hz.
- If the Output Frequency Lower Limit is 10Hz, and the Minimum Output Frequency (Pr.01.05) is set to 1.0Hz, then any Command Frequency between 1.0-10Hz will generate a 10Hz output from the drive.
- This parameter must be equal to or less than the Output Frequency Upper Limit (Pr.01.07).
- The Output Frequency Lower Limit value = (Pr.01.00 * Pr.01.08) /100.

01.09	↗Acceleration Time 1 (Taccel 1)	Unit: 0.1/0.01
01.10	↗Deceleration Time 1 (Tdecel 1)	Unit: 0.1/0.01
01.11	↗Acceleration Time 2 (Taccel 2)	Unit: 0.1/0.01
01.12	↗Deceleration Time 2 (Tdecel 2)	Unit: 0.1/0.01
	Settings 0.1 to 600.0 sec / 0.01 to 600.0 sec	Factory Setting: 10.0

01.19	Accel/Decel Time Unit	
		Factory Setting: 0
	Settings 0	Unit: 0.1 sec
	1	Unit: 0.01 sec

- The Acceleration Time is used to determine the time required for the AC motor drive to ramp from 0 Hz to Maximum Output Frequency (Pr.01.00). The rate is linear unless S-Curve is "Enabled"; see Pr.01.17.
- The Deceleration Time is used to determine the time required for the AC motor drive to decelerate from the Maximum Output Frequency (Pr.01.00) down to 0 Hz. The rate is linear unless S-Curve is "Enabled.", see Pr.01.18.
- The Acceleration/Deceleration Time 1, 2, 3, 4 are selected according to the Multi-function Input Terminals Settings. See Pr.04.05 to Pr.04.08 for more details.
- In the diagram shown below, the Acceleration/Deceleration Time of the AC motor drive is the time between 0 Hz to Maximum Output Frequency (Pr.01.00). Suppose the Maximum Output Frequency is 60 Hz, Minimum Output Frequency (Pr.01.05) is 1.0 Hz, and Acceleration/Deceleration Time is 10 seconds. The actual time for the AC motor drive to

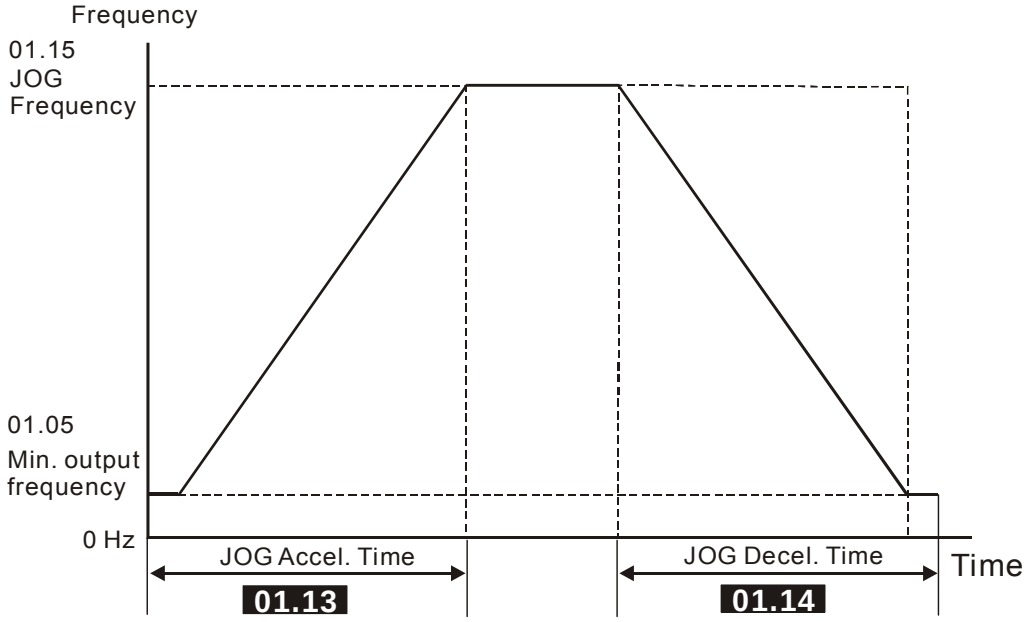
accelerate from start-up to 60 Hz and to decelerate from 60Hz to 1.0Hz is in this case 9.83 seconds. ((60-1) * 10/60=9.83secs).



01.13	↗ Jog Acceleration Time	Unit: 0.1/0.01
	Settings 0.1 to 600.0/0.01 to 600.0 sec	Factory Setting: 1.0
01.14	↗ Jog Deceleration Time	Unit: 0.1/0.01
	Settings 0.1 to 600.0/0.01 to 600.0 sec	Factory Setting: 1.0
01.15	↗ Jog Frequency	Unit: 0.01
	Settings 0.10 to Fmax (Pr.01.00)Hz	Factory Setting: 6.00

🕮 Only external terminal JOG (MI3 to MI9)can be used. When the Jog command is “ON”, the AC motor drive will accelerate from Minimum Output Frequency (Pr.01.05) to Jog Frequency (Pr.01.15). When the Jog command is “OFF”, the AC motor drive will decelerate from Jog Frequency to zero. The used Accel/Decel time is set by the Jog Accel/Decel time (Pr.01.13, Pr.01.14).

🕮 Before using the JOG command, the drive must be stopped first. And during Jog operation, other operation commands are not accepted, except commands via the FORWARD, REVERSE and STOP keys on the digital keypad.



The definition of JOG Accel./Decel. Time

01.16	↗Auto-Acceleration / Deceleration

Factory Setting: 0

Settings	0	Linear acceleration / deceleration
	1	Auto acceleration, linear Deceleration.
	2	Linear acceleration, auto Deceleration.
	3	Auto acceleration / deceleration (set by load)
	4	Auto acceleration / deceleration (set by Accel/Decel Time setting)

🕮 With Auto acceleration / deceleration it is possible to reduce vibration and shocks during starting/stopping the load.

During Auto acceleration the torque is automatically measured and the drive will accelerate to the set frequency with the fastest acceleration time and the smoothest starting current.

During Auto deceleration, regenerative energy is measured and the motor is smoothly stopped with the fastest deceleration time.

But when this parameter is set to 04, the actual accel/decel time will be equal to or more than parameter Pr.01.09 ~Pr.01.12.

🕮 Auto acceleration/deceleration makes the complicated processes of tuning unnecessary. It makes operation efficient and saves energy by acceleration without stall and deceleration without brake resistor.

🕮 In applications with brake resistor or brake unit, Auto deceleration shall not be used.

01.17	Acceleration S-Curve	Unit: 0.1/0.01
01.18	Deceleration S-Curve	Unit: 0.1/0.01

Factory Setting: 0

Settings	0.0	S-curve disabled
	0.1 to 10.0/0.01 to 10.00	S-curve enabled (10.0/10.00 is the smoothest)

🕮 This parameter is used to ensure smooth acceleration and deceleration via S-curve.

The S-curve is disabled when set to 0.0 and enabled when set to 0.1 to 10.0/0.01 to 10.00.

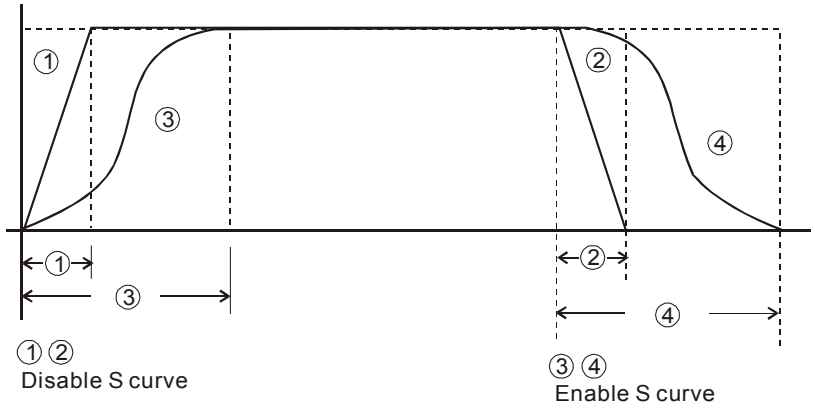
Setting 0.1/0.01 gives the quickest and setting 10.0/10.00 the longest and smoothest S-curve.

The AC motor drive will not follow the Accel/Decel Times in Pr.01.09 to Pr.01.12.

🕮 The diagram below shows that the original setting of the Accel/Decel Time is only for reference when the S-curve is enabled. The actual Accel/Decel Time depends on the selected S-curve (0.1 to 10.0).

The total Accel. Time=Pr.01.09 + Pr.01.17 or Pr.01.11 + Pr.01.17

The total Decel. Time=Pr.01.10 + Pr.01.18 or Pr.01.12 + Pr.01.18



Acceleration/deceleration Characteristics

Group 2: Operation Method Parameters

02.00 ✓Source of First Master Frequency Command

Factory Setting: 1

02.09 ✓Source of Second Master Frequency Command

Factory Setting: 0

Settings	0	Digital keypad UP/DOWN keys or Multi-function Inputs UP/DOWN. Last used frequency saved. (Digital keypad is optional)
	1	0 to +10V from AVI
	2	4 to 20mA from ACI or 0 to +10V from AVI2
	3	RS-485 serial communication (RJ-45)
	4	Digital keypad potentiometer

- 🕮 These parameters set the Master Frequency Command Source of the AC motor drive.
- 🕮 The factory setting for master frequency command is 1. (digital keypad is optional.)
- 🕮 Setting 2: use the ACI/AVI switch on the AC motor drive to select ACI or AVI2. When setting to AVI, AVI2 is indicated.
- 🕮 When the AC motor drive is controlled by external terminal, please refer to Pr.02.05 for details.
- 🕮 The first /second frequency/operation command is enabled/disabled by Multi Function Input Terminals. Please refer to Pr.04.05 ~ 04.08.

02.01 ✓Source of First Operation Command

Factory Setting: 1

Settings	0	Digital keypad (Digital keypad is optional)
	1	External terminals. Keypad STOP/RESET enabled.
	2	External terminals. Keypad STOP/RESET disabled.
	3	RS-485 serial communication (RJ-45). Keypad STOP/RESET enabled.
	4	RS-485 serial communication (RJ-45). Keypad STOP/RESET disabled.

- 🕮 The factory setting for source og first operation command is 2. (digital keypad is optional.)
- 🕮 When the AC motor drive is controlled by external terminal, please refer to Pr.02.05/Pr.04.04 for details.

02.10	✓Combination of the First and Second Master Frequency Command

Factory Setting: 0

Settings	0	First Master Frequency Command Only
	1	First Master Frequency + Second Master Frequency
	2	First Master Frequency - Second Master Frequency

02.02	Stop Method

Factory Setting: 0

Settings	0	STOP: ramp to stop	E.F.: coast to stop
	1	STOP: coast to stop	E.F.: coast to stop
	2	STOP: ramp to stop	E.F.: ramp to stop
	3	STOP: coast to stop	E.F.: ramp to stop

🕮 The parameter determines how the motor is stopped when the AC motor drive receives a valid stop command or detects External Fault.

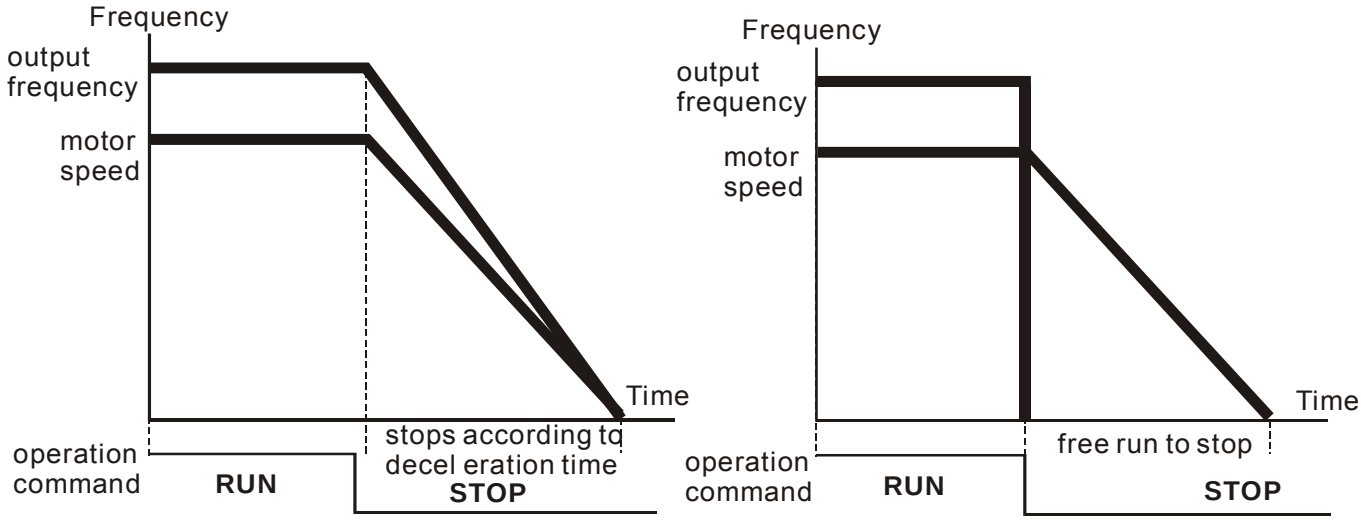
Ramp: the AC motor drive decelerates to Minimum Output Frequency (Pr.01.05) according to the deceleration time and then stops.

Coast: the AC motor drive stops the output instantly upon command, and the motor free runs until it comes to a complete standstill.

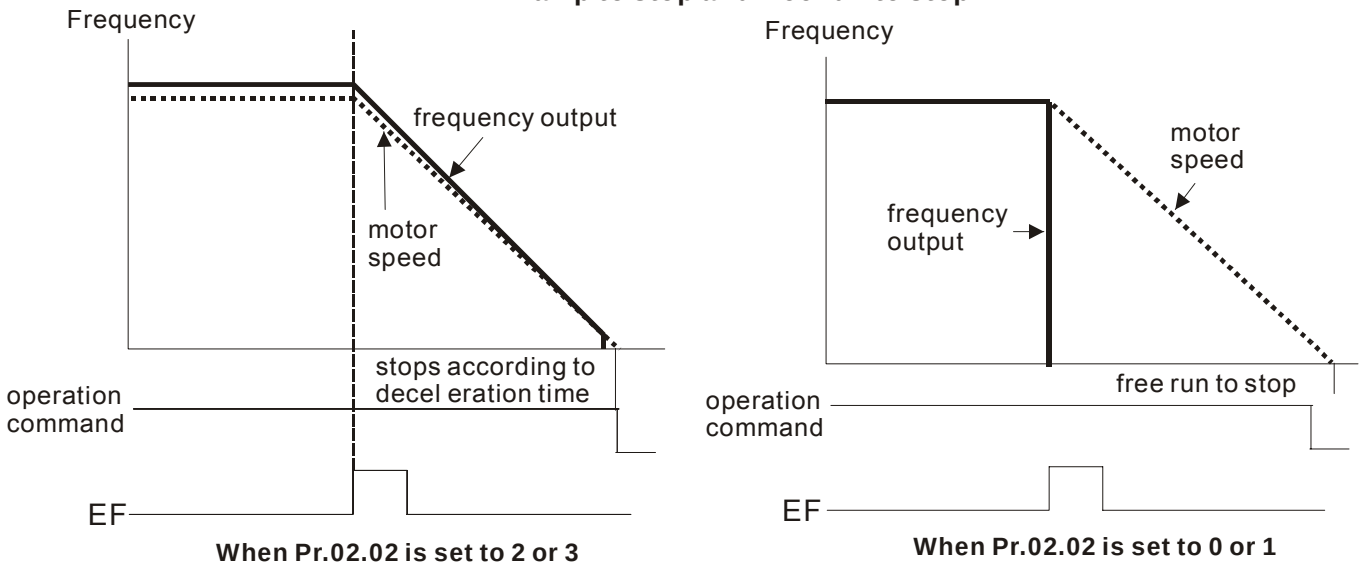
The motor stop method is usually determined by the characteristics of the motor load and how frequently it is stopped.

(1) It is recommended to use “ramp to stop” for safety of personnel or to prevent material from being wasted in applications where the motor has to stop after the drive is stopped. The deceleration time has to be set accordingly.

(2) If motor free running is allowed or the load inertia is large, it is recommended to select “coast to stop”. For example: blowers, punching machines, centrifuges and pumps.



ramp to stop and free run to stop



When Pr.02.02 is set to 2 or 3

When Pr.02.02 is set to 0 or 1

02.03 PWM Carrier Frequency Selections

Unit: 1

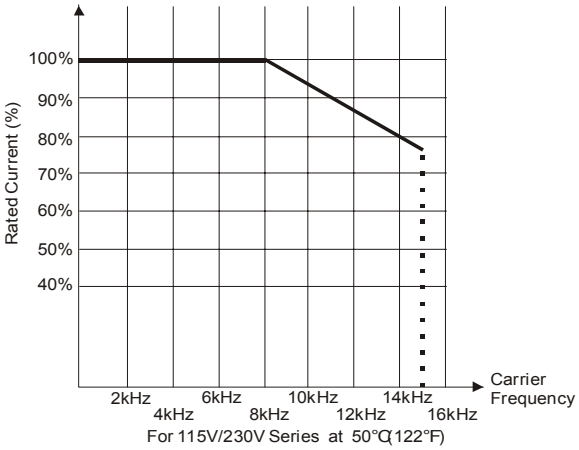
115V/230V/460V Series	
Power	0.25 to 15hp (0.2kW to 11kW)
Setting Range	1 to 15 kHz
Factory Setting	8 kHz

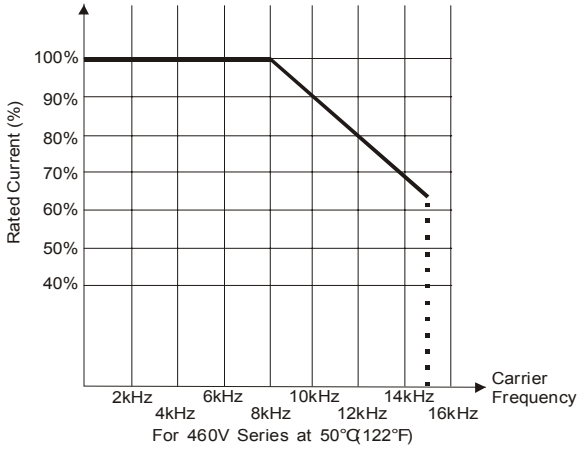
This parameter determines the PWM carrier frequency of the AC motor drive.

Carrier Frequency	Acoustic Noise	Electromagnetic Noise or leakage current	Heat Dissipation	Current Wave
1kHz	Significant	Minimal	Minimal	Minimal
8kHz	↕	↕	↕	↕
15kHz	Minimal	Significant	Significant	Significant

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

📖 The PWM carrier frequency may derate the rated current. The higher carrier frequency will decrease rated current to prevent AC motor drive overheat and extend IGBT's life. Therefore, it is necessary to have this kind of protection method. The rated current for the AC motor drive with carrier frequency (8kHz and below) is 100%. The curve between the rated current and carrier frequency (at 50°C) is shown as follows.





02.04 Motor Direction Control

Factory Setting: 0

Settings	0	Forward/Reverse operation enabled
	1	Reverse operation disabled
	2	Forward operation disabled

📖 This parameter is used to disable one direction of rotation of the AC motor drive direction of rotation. See Chapter 2 for definition of direction of rotation.

02.05 Line Start Lockout

Factory Setting: 1

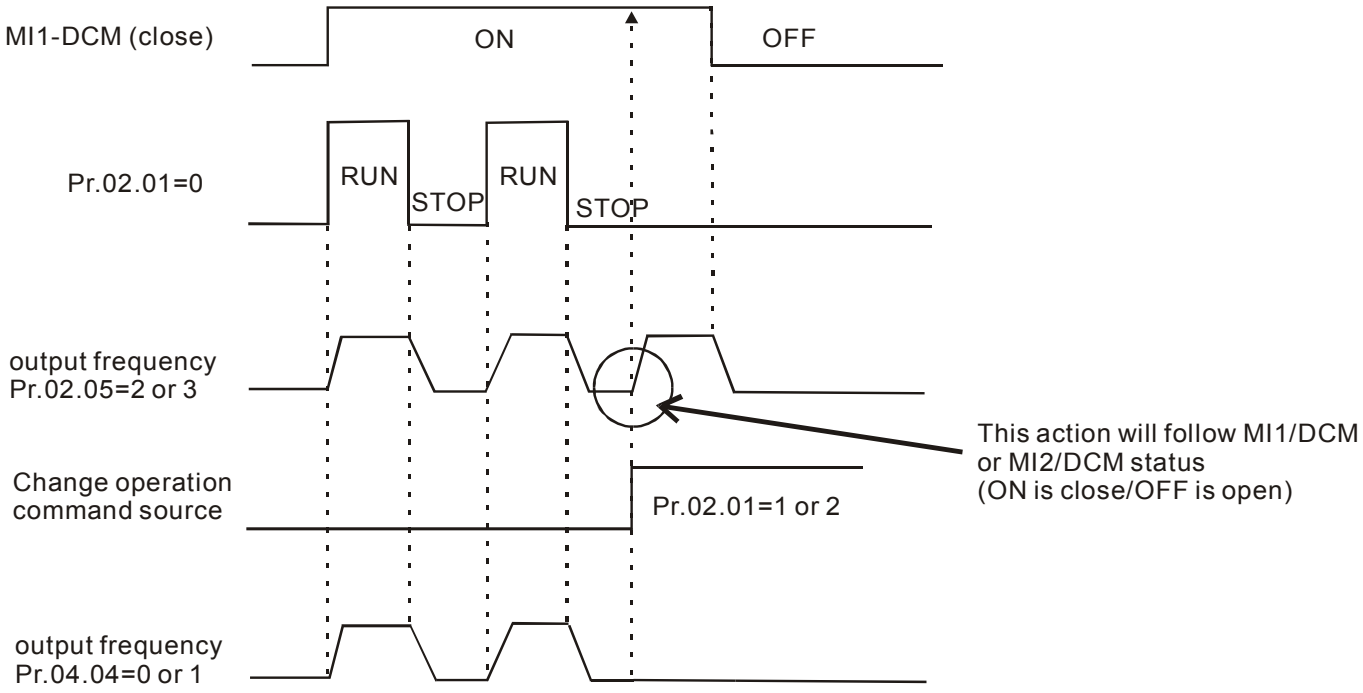
Settings	0	Disable. Operation status is not changed even if operation command source Pr.02.01 is changed.
	1	Enable. Operation status is not changed even if operation command source Pr.02.01 is changed.
	2	Disable. Operation status will change if operation command source Pr.02.01 is changed.
	3	Enable. Operation status will change if operation command source Pr.02.01 is changed.

📖 This parameter determines the response of the drive upon power on and operation command source is changed.

Pr.02.05	Start lockout (Run when power is ON)	Operation status when operation command source is changed
0	Disable (AC motor drive will run)	Keep previous status
1	Enable (AC motor drive doesn't run)	Keep previous status
2	Disable (AC motor drive will run)	Change according to the new operation command source
3	Enable (AC motor drive doesn't run)	Change according to the new operation command source

📖 When the operation command source is from external terminal and operation command is ON (FWD/REV-DCM=closed), the AC motor drive will operate according to Pr.02.05 after power is applied. **<For terminals FWD and REV only>**

1. When Pr.02.05 is set to 0 or 2, AC motor drive will run immediately.
2. When Pr.02.05 is set to 1 or 3, AC motor drive will remain stopped until operation command is received after previous operation command is cancelled.

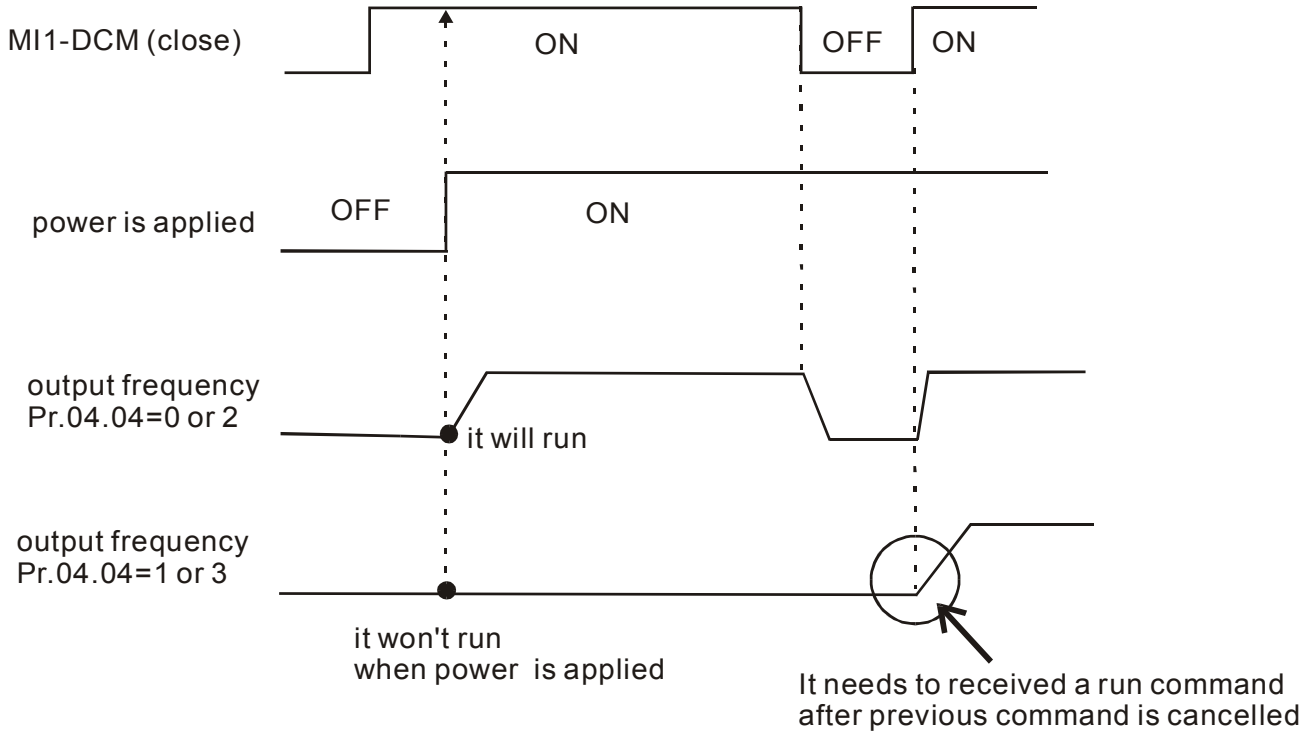


📖 When the operation command source isn't from the external terminals, independently from whether the AC motor drive runs or stops, the AC motor drive will operate according to Pr.02.06 if the two conditions below are both met.

1. When operation command source is changed to external terminal (Pr.02.01=1 or 2)
2. The status of terminal and AC motor drive is different.

And the operation of the AC motor drive will be:

1. When setting 0 or 1, the status of AC motor drive is not changed by the terminal status.
2. When setting 2 or 3, the status of AC motor drive is changed by the terminal status.



The Line Start Lockout feature does not guarantee that the motor will never start under this condition. It is possible the motor may be set in motion by a malfunctioning switch.

02.06	Loss of ACI Signal (4-20mA)	
		Factory Setting: 0
Settings	0	Decelerate to 0Hz
	1	Coast to stop and display “AErr”
	2	Continue operation by the last frequency command

- This parameter determines the behavior when ACI is lost.
- When set to 1, it will display warning message “AErr” on the keypad in case of loss of ACI signal and execute the setting. When ACI signal is recovered, the warning message will stop blinking. Please press “RESET” key to clear it.

02.07	Up/Down Mode	
		Factory Setting: 0
Settings	0	By digital keypad up/down keys mode
	1	Based on Accel/Decel Time acc. to Pr.01.09 to 01.12
	2	Constant speed (acc. to Pr. 02.08)
	3	Pulse input unit (acc. to Pr. 02.08)

02.08	Accel/Decel Rate of Change of UP/DOWN Operation with Constant Speed	Unit: 0.01
Settings	0.01~10.00 Hz/ms	Factory Setting: 0.01

📖 These parameters determine the increase/decrease of the master frequency when operated via the Multi-function Inputs when Pr.04.05~Pr.04.08 are set to 10 (Up command) or 11 (Down command).

02.11	↗Keyboard Frequency Command	Unit: 0.01
	Settings 0.00 to 600.0Hz	Factory Setting: 60.00

📖 This parameter can be used to set frequency command or read keypad frequency command.

02.12	↗Communication Frequency Command	Unit: 0.01
	Settings 0.00 to 600.0Hz	Factory Setting: 60.00

📖 This parameter can be used to set frequency command or read communication frequency command.

02.13	The Selections for Saving Keypad or Communication Frequency Command	
		Factory Setting: 0
	Settings 0 Save Keypad & Communication Frequency	
	1 Save Keypad Frequency only	
	2 Save Communication Frequency only	

📖 This parameter is used to save keypad or RS-485 frequency command.

02.14	Frequency Command Selections at Stop (for Keypad and Communication)	
		Factory Setting: 0
	Settings 0 By Current Freq Command	
	1 By Zero Freq Command	
	2 By Frequency Display at Stop	

02.15	Frequency Display at Stop	Unit: 0.01
	Settings 0.00 ~ 600.0Hz	Factory Setting: 60.00

📖 These parameters are used to determinate the frequency at stop:

When setting Pr.02.14 to 0: the frequency at stop will be current frequency.

When setting Pr.02.14 to 1: the frequency at stop will be 0.

When setting Pr.02.14 to 2: the frequency at stop will be Pr.02.15.

02.16	Display the Master Freq Command Source	
	Settings Read Only	Factory setting: ##

🕮 You can read the master frequency command source by this parameter.

Display Value	Bit	Function
1	Bit0=1	Master Freq Command Source by First Freq Source (Pr.02.00).
2	Bit1=1	Master Freq Command Source by Second Freq Source (Pr.02.09).
4	Bit2=1	Master Freq Command Source by Multi-input function
8	Bit3=1	Master Freq Command Source by PLC Freq command

02.17 Display the Operation Command Source

Settings Read Only Factory setting: ##

🕮 You can read the operation source by this parameter.

Display Value	Bit	Function
1	Bit0=1	Operation Command Source by Digital Keypad
2	Bit1=1	Operation Command Source by RS485 communication
4	Bit2=1	Operation Command Source by External Terminal
8	Bit3=1	Operation Command Source by Multi-input function
16	Bit4=1	Operation Command Source by PLC Operation Command

Group 3: Output Function Parameters

03.00 Multi-function Output Relay (RA1, RB1, RC1)

Factory Setting: 8

03.01 Multi-function Output Terminal MO1

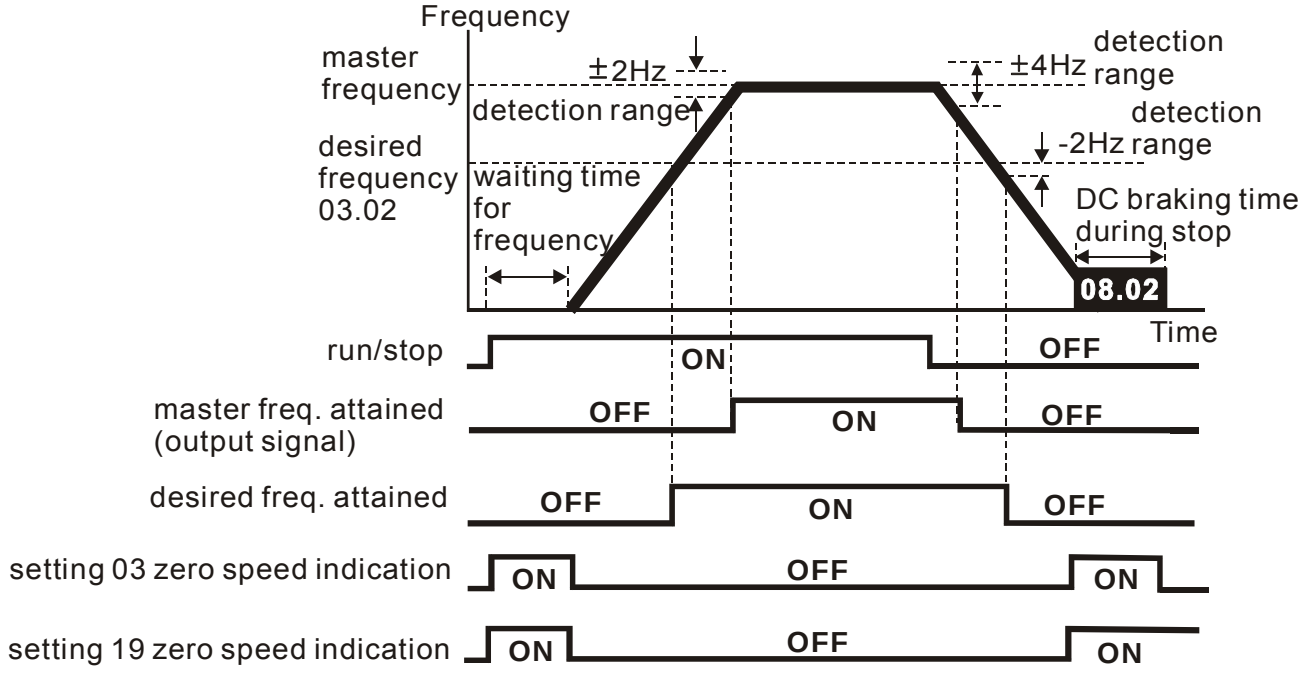
Factory Setting: 1

Settings	Function	Description
0	No Function	
1	AC Drive Operational	Active when the drive is ready or RUN command is “ON”.
2	Master Frequency Attained	Active when the AC motor drive reaches the output frequency setting.
3	Zero Speed	Active when Command Frequency is lower than the Minimum Output Frequency.
4	Over-Torque Detection	Active as long as over-torque is detected. (Refer to Pr.06.03 ~ Pr.06.05)
5	Baseblock (B.B.) Indication	Active when the output of the AC motor drive is shut off during baseblock. Base block can be forced by Multi-function input (setting 09).
6	Low-Voltage Indication	Active when low voltage(Lv) is detected.
7	Operation Mode Indication	Active when operation command is controlled by external terminal.
8	Fault Indication	Active when a fault occurs (oc, ov, oH, oL, oL1, EF, cF3, HPF, ocA, ocd, ocn, GFF).
9	Desired Frequency Attained	Active when the desired frequency (Pr.03.05) is attained.
10	Terminal Count Value Attained	Active when the counter reaches Terminal Count Value.
11	Preliminary Count Value Attained	Active when the counter reaches Preliminary Count Value.
12	Over Voltage Stall supervision	Active when the Over Voltage Stall function operating
13	Over Current Stall supervision	Active when the Over Current Stall function operating
14	Heat Sink Overheat Warning	When heatsink overheats, it will signal to prevent OH turn off the drive. When it is higher than 85°C (185°F), it will be ON.
15	Over Voltage supervision	Active when the DC-BUS voltage exceeds level

Settings	Function	Description
16	PID supervision	Active when the PID function is operating
17	Forward command	Active when the direction command is FWD
18	Reverse command	Active when the direction command is REV
19	Zero Speed Output Signal	Active unless there is an output frequency present at terminals U/T1, V/T2, and W/T3.
20	Communication Warning (FbE,Cexx, AoL2, AUE, SAvE)	Active when there is a Communication Warning
21	Brake Control (Desired Frequency Attained)	Active when output frequency ≥Pr.03.14. Deactivated when output frequency ≤Pr.03.15 after STOP command.

03.02	Desired Frequency Attained	Unit: 0.01
	Settings 0.00 to 600.0 Hz	Factory Setting: 0.00

🕮 If a multi-function output terminal is set to function as Desired Frequency Attained (Pr.03.00 to Pr.03.01=09), then the output will be activated when the programmed frequency is attained.



output timing chart of multiple function terminals when setting to frequency attained or zero speed indication

03.03	↗Analog Output Signal (AFM)	
		Factory Setting: 0
Settings	0	Analog Frequency Meter (0 to Maximum Output Frequency)
	1	Analog Current Meter (0 to 250% of rated AC motor drive current)

🕮 This parameter sets the function of the AFM output 0~+10VDC (ACM is common).

03.04	↗Analog Output Gain	Unit: 1
Settings	1 to 200%	Factory Setting: 100

🕮 This parameter sets the voltage range of the analog output signal AFM.

🕮 When Pr.03.03 is set to 0, the analog output voltage is directly proportional to the output frequency of the AC motor drive. With Pr.03.04 set to 100%, the Maximum Output Frequency (Pr.01.00) of the AC motor drive corresponds to +10VDC on the AFM output.

🕮 Similarly, if Pr.03.03 is set to 1, the analog output voltage is directly proportional to the output current of the AC drive. With Pr.03.04 set to 100%, then 2.5 times the rated current corresponds to +10VDC on the AFM output.

NOTE

Any type of voltmeter can be used. If the meter reads full scale at a voltage less than 10V, Pr. 03.04 should be set using the following formula:

Pr. 03.04 = ((meter full scale voltage)/10) x 100%

For Example: When using the meter with full scale of 5 volts, adjust Pr.03.04 to 50%. If Pr.03.03 is set to 0, then 5VDC will correspond to Maximum Output Frequency.

03.05	Terminal Count Value	Unit: 1
Settings	0 to 9999	Factory Setting: 0

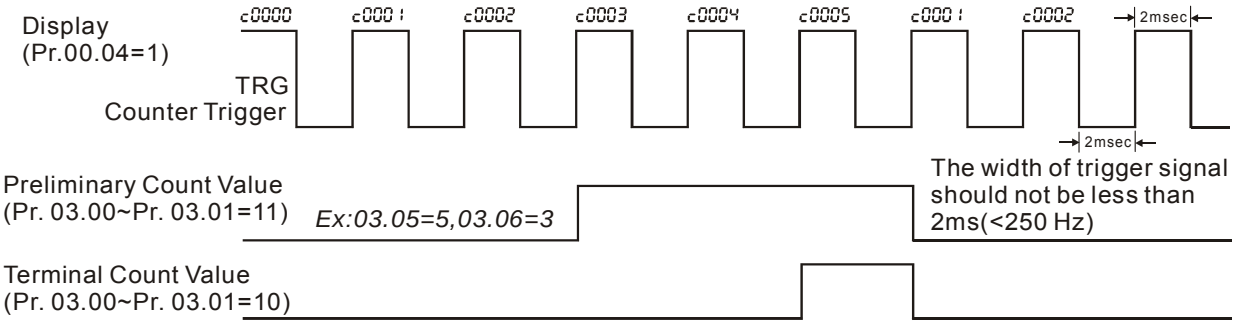
🕮 This parameter sets the count value of the internal counter. To increase the internal counter, one of Pr.04.05 to 04.08 should be set to 12. Upon completion of counting, the specified output terminal will be activated. (Pr.03.00 to Pr.03.01 set to 10).

🕮 When the display shows c555, the drive has counted 555 times. If display shows c555•, it means that real counter value is between 5,550 and 5,559.

03.06	Preliminary Count Value	Unit: 1
Settings	0 to 9999	Factory Setting: 0

When the counter value reaches this value, the corresponding multi-function output terminal will be activated, provided one of Pr.03.00 to Pr.03.01 set to 11 (Preliminary Count Value Setting). This multi-function output terminal will be deactivated upon completion of Terminal Count Value Attained.

The timing diagram:



03.07 EF Active when Terminal Count Value Attained

Factory Setting: 0

Settings	0	Terminal count value attained, no EF display
	1	Terminal count value attained, EF active

If this parameter is set to 1 and the desired value of counter is attained, the AC drive will treat it as a fault. The drive will stop and show the “EF” message on the display.

03.08 Fan Control

Factory Setting: 0

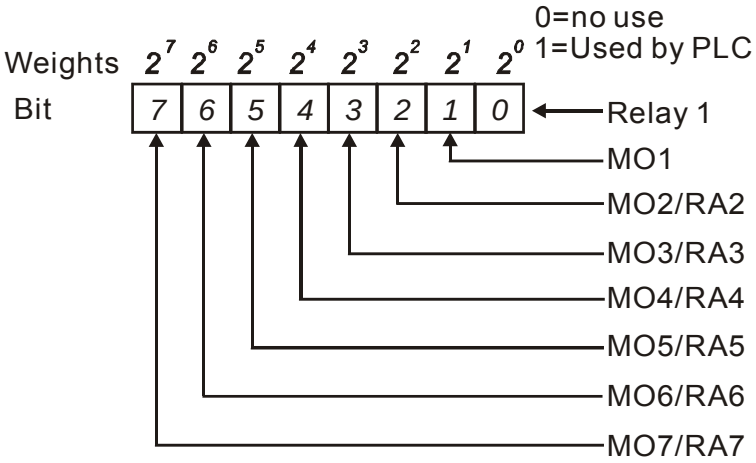
Settings	0	Fan always ON
	1	1 minute after AC motor drive stops, fan will be OFF
	2	Fan ON when AC motor drive runs, fan OFF when AC motor drive stops
	3	Fan ON when preliminary heatsink temperature attained

This parameter determines the operation mode of the cooling fan.

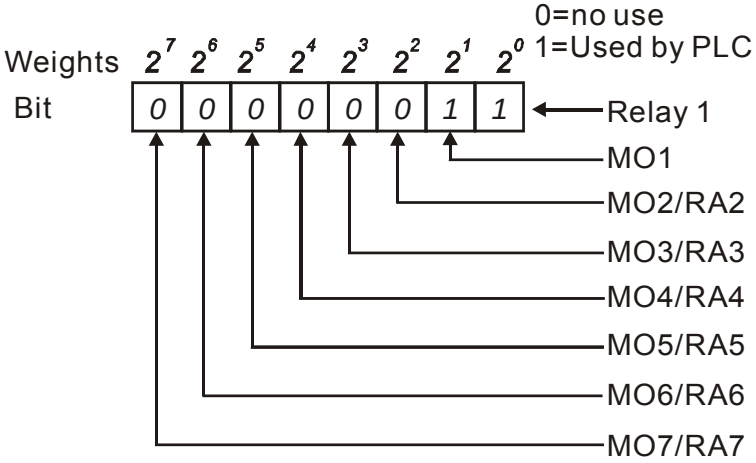
03.09	The Digital Output Used by PLC	
Settings	Read Only	Factory setting: ##
	Bit0=1: RLY used by PLC	
	Bit1=1: MO1 used by PLC	
	Bit2=1: MO2/RA2 used by PLC	
	Bit3=1: MO3/RA3 used by PLC	
	Bit4=1: MO4/RA4 used by PLC	
	Bit5=1: MO5/RA5 used by PLC	
	Bit6=1: MO6/RA6 used by PLC	
	Bit7=1: MO7/RA7 used by PLC	

📖 The equivalent 8-bit is used to display the status (used or not used) of each digital output. The value that Pr.03.09 displays is the result after converting 8-bit binary into decimal value.

📖 For standard AC motor drive, it only has 2-bit (bit0 and bit1). When extension card is installed, the number of the digital output terminals will increase according to the extension card. The maximum number of the digital output terminals is shown as follows.



📖 For example: when Pr.03.09 is set to 3 (decimal) = 00000011 (binary) that indicates Relay1 and MO1 are used by PLC. (Pr.03.09= $2^0+2^1=3$)

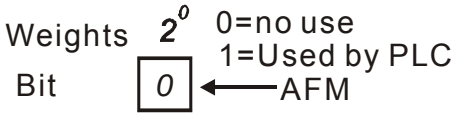


03.10	The Analog Output Used by PLC

Settings	Read Only	Factory setting: ##
	Bit0=1: AFM used by PLC	

📖 The equivalent 1-bit is used to display the status (used or not used) of each analog output.

The value that Pr.03.10 displays is the result after converting 1-bit binary into decimal value.



📖 For Example:

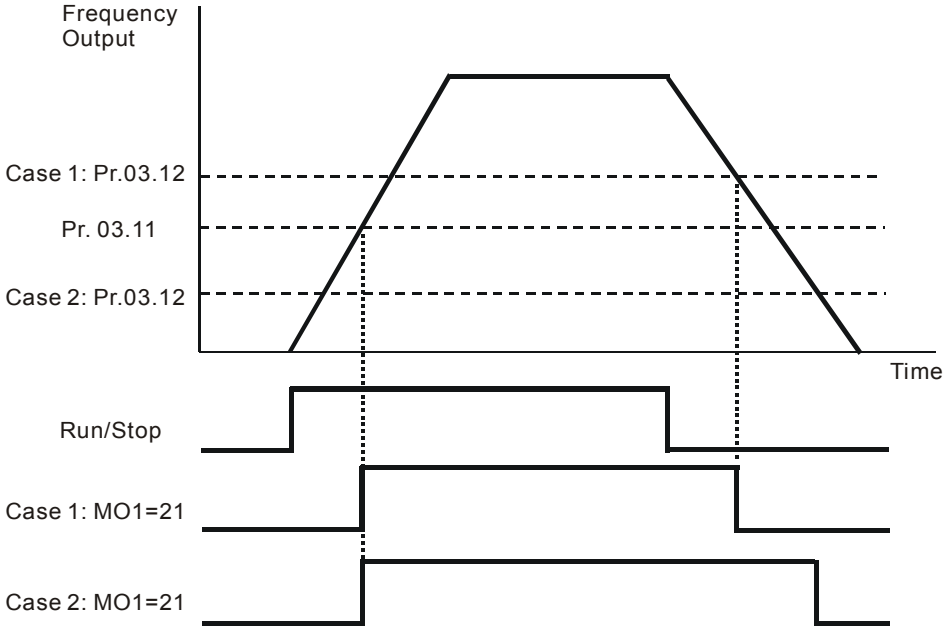
If Pr.03.10 displays 1, it means that AFM is used by PLC.

03.11	Brake Release Frequency	Unit: 0.01
Settings	0.00 to 600.0Hz	Factory Setting: 0.00
03.12	Brake Engage Frequency	Unit: 0.01
Settings	0.00 to 600.0Hz	Factory Setting: 0.00

📖 These two parameters are used to set control of mechanical brake via the output terminals (Relay or MO1) when Pr.03.00~03.01 is set to 21. Refer to the following example for details.

Example:

1. Case 1: Pr.03.12 ≥ Pr.03.11
2. Case 2: Pr.03.12 ≤ Pr.03.11



Note: MO1: setting value of Pr.03.01

03.13	Display the Status of Multi-function Output Terminals	
Settings	Read Only	Factory setting: ##
	Bit0: RLY Status	
	Bit1: MO1 Status	

Bit2: MO2/RA2 Status

Bit3: MO3/RA3 Status

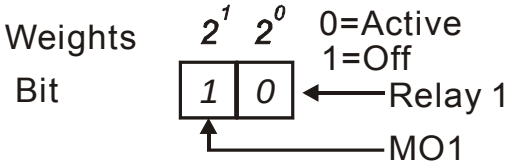
Bit4: MO4/RA4 Status

Bit5: MO5/RA5 Status

Bit6: MO6/RA6 Status

Bit7: MO7/RA7 Status

📖 For standard AC motor drive (without extension card), the multi-function output terminals are falling-edge triggered and Pr.03.13 will display 3 (11) for no action.

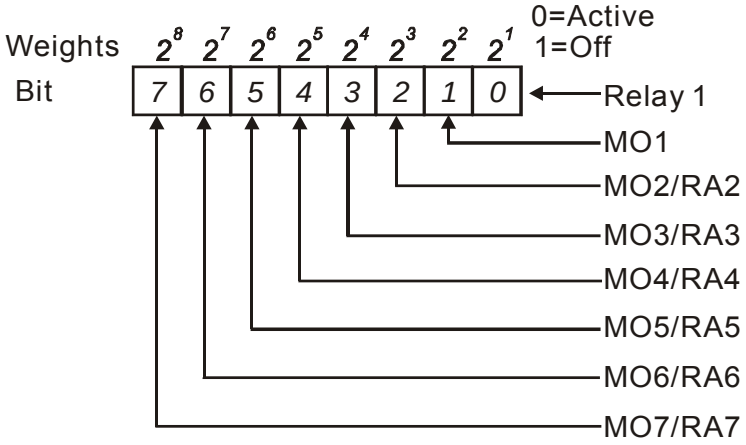


📖 For Example:

If Pr.03.13 displays 2, it means Relay 1 is active.

The display value 2 =bit 1 X 2^1

📖 When extension card is installed, the number of the multi-function output terminals will increase according to the extension card. The maximum number of the multi-function output terminals is shown as follows.

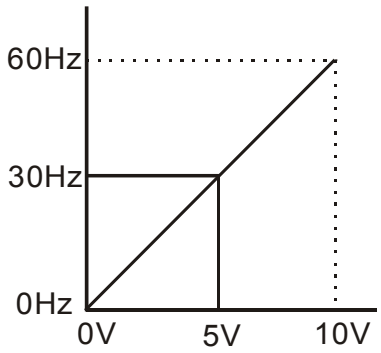


Group 4: Input Function Parameters

04.00	↗Keypad Potentiometer Bias		Unit: 0. 1
	Settings	0.0 to 100.0%	Factory Setting: 0.0
04.01	↗Keypad Potentiometer Bias Polarity		
			Factory Setting: 0
	Settings	0 Positive Bias	
		1 Negative Bias	
04.02	↗Keypad Potentiometer Gain		Unit: 0.1
	Settings	0.1 to 200.0%	Factory Setting: 100.0
04.03	Keypad Potentiometer Negative Bias, Reverse Motion Enable/Disable		
			Factory Setting: 0
	Settings	0 No Negative Bias Command	
		1 Negative Bias: REV Motion Enabled	

Example 1: Standard application

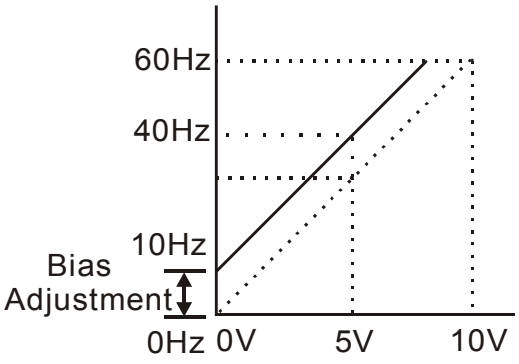
This is the most used setting. The user only needs to set Pr.02.00 to 01. The frequency command comes from keypad potentiometer on AVI.



Pr.01.00=60Hz--Max. output Freq.
Potentiometer(**AVI)**
Pr.04.00 =0%--Bias adjustment
Pr.04.01 =0--Positive bias
Pr.04.02 =100%--Input gain
Pr.04.03 =0--No negative bias command

Example 2: Use of bias

This example shows the influence of changing the bias. When the input is 0V the output frequency is 10 Hz. At mid-point a potentiometer will give 40 Hz. Once the Maximum Output Frequency is reached, any further increase of the potentiometer or signal will not increase the output frequency. (To use the full potentiometer range, please refer to Example 3.) The value of external input voltage/current 0-8.33V corresponds to the setting frequency 10-60Hz.



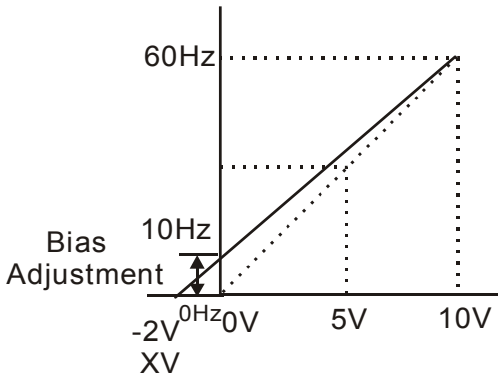
Pr.01.00=60Hz--Max. output Freq.
Potentiometer(**AVI)**
Pr.04.00 =16.7%--Bias adjustment
Pr.04.01 =0--Positive bias
Pr.04.02 =100%--Input gain
Pr.04.03 =0--No negative bias command

Gain:100%

Bias adjustment:((10Hz/60Hz)/(Gain/100%))*100%=16.7%

Example 3: Use of bias and gain for use of full range

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



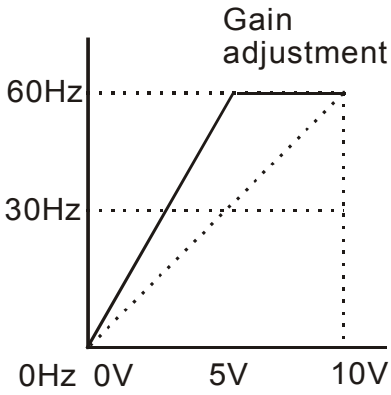
Pr.01.00=60Hz--Max. output Freq.
Potentiometer(**AVI)**
Pr.04.00 =20.0%--Bias adjustment
Pr.04.01 =0--Positive bias
Pr.04.02 =83.3%--Input gain
Pr.04.03 =0--No negative bias command

Gain:(10V/(10V+2V))*100%=83.3%

Bias adjustment:((10Hz/60Hz)/(Gain/100%))*100%=20.0%

Example 4: Use of 0-5V potentiometer range via gain adjustment

This example shows a potentiometer range of 0 to 5 Volts. Instead of adjusting gain as example below, you can set Pr. 01.00 to 120Hz to achieve the same results.

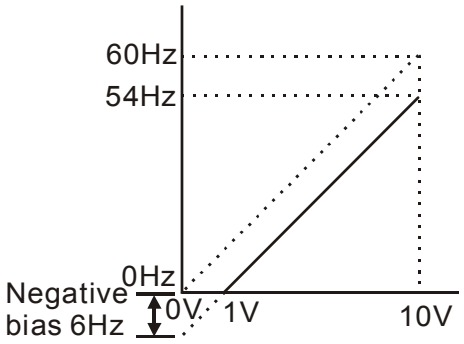


Pr.01.00=60Hz--Max. output Freq.
Potentiometer(**AVI)**
Pr.04.00 =0.0%--Bias adjustment
Pr.04.01 =0--Positive bias
Pr.04.02 =200%--Input gain
Pr.04.03 =0--No negative bias command

Gain:(10V/5V)*100%=200%

Example 5: Use of negative bias in noisy environment

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



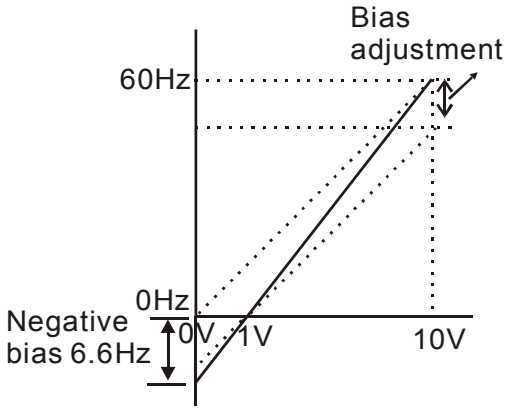
Pr.01.00=60Hz--Max. output Freq.
Potentiometer(**AVI)**
Pr.04.00 =10.0%--Bias adjustment
Pr.04.01 =1--Negative bias
Pr.04.02 =100%--Input gain
Pr.04.03 =0--No negative bias command

Gain:100%

Bias adjustment:((6Hz/60Hz)/(Gain/100%))*100%=10.0%

Example 6: Use of negative bias in noisy environment and gain adjustment to use full potentiometer range

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.



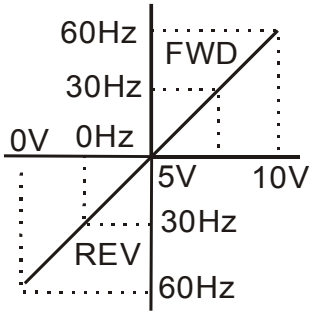
Pr.01.00=60Hz--Max. output Freq.
Potentiometer(**AVI)**
Pr.04.00 =10.0%--Bias adjustment
Pr.04.01 =1--Negative bias
Pr.04.02 =111%--Input gain
Pr.04.03 =0--No negative bias command

Gain:(10V/9V)*100%=111%

Bias adjustment:((6.6Hz/60Hz)/(Gain/100%))*100%=10.0%

Example 7: Use of 0-10V potentiometer signal to run motor in FWD and REV direction

In this example, the input is programmed to run a motor in both forward and reverse direction. The motor will be idle when the potentiometer position is at mid-point of its scale. Using the settings in this example disables the external FWD and REV controls.



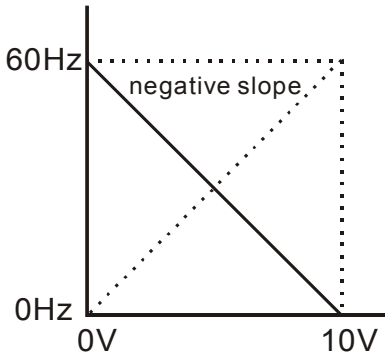
Pr.01.00=60Hz--Max. output Freq.
Potentiometer(**AVI)**
Pr.04.00 =50.0%--Bias adjustment
Pr.04.01 =1--Negative bias
Pr.04.02 =200%--Input gain
Pr.04.03 =1--Negative bias: REV motion enabled

Gain:(10V/5V)*100%=200%

Bias adjustment:((60Hz/60Hz)/(Gain/100%))*100%=200%

Example 8: Use negative slope

In this example, the use of negative slope is shown. Negative slopes are used in applications for control of pressure, temperature or flow. The sensor that is connected to the input generates a large signal (10V) at high pressure or flow. With negative slope settings, the AC motor drive will slow stop the motor. With these settings the AC motor drive will always run in only one direction (reverse). This can only be changed by exchanging 2 wires to the motor.



Pr.01.00=60Hz--Max. output Freq.
Potentiometer(**AVI)**
Pr.04.00 =100%--Bias adjustment
Pr.04.01 =0--Positive bias
Pr.04.02 =100%--Input gain
Pr.04.03 =1--Negative bias: REV motion enabled

Gain:(10V/10V)*100%=100%

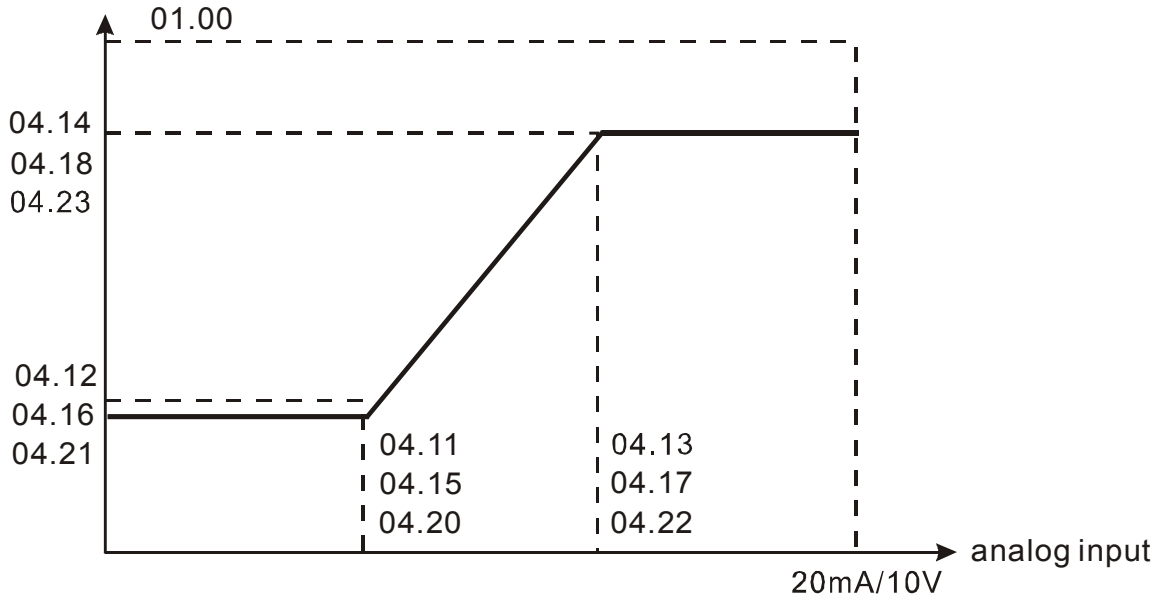
Bias adjustment:((60Hz/60Hz)/(Gain/100%))*100%=100%

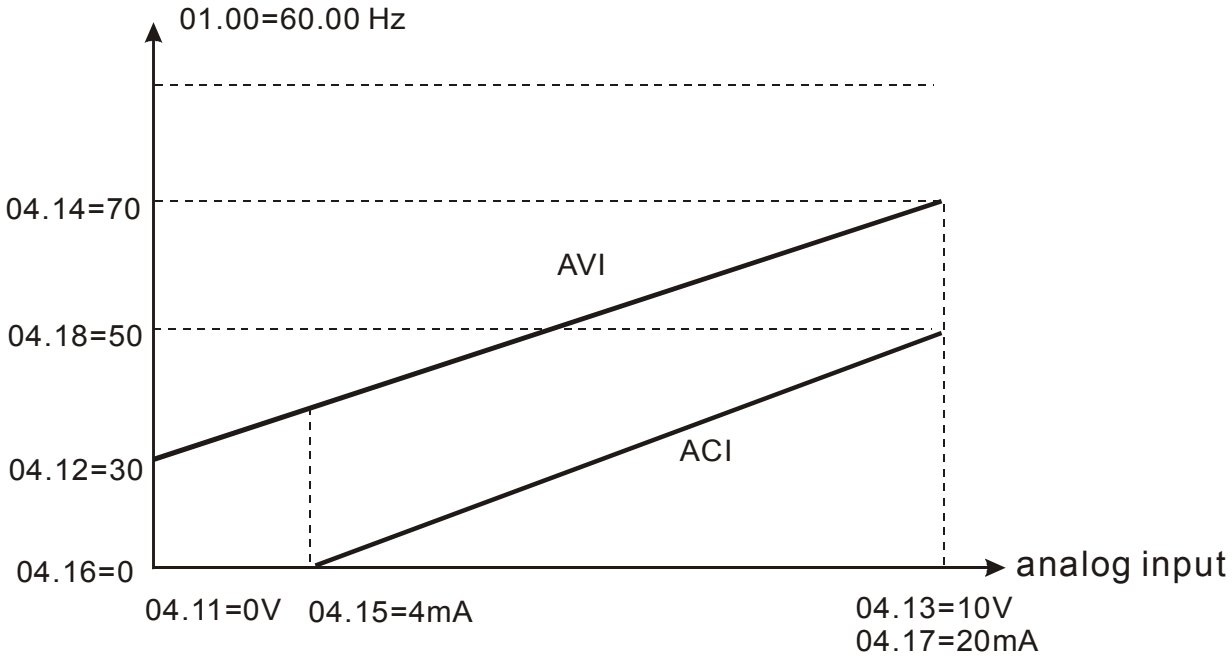
04.11	Minimum AVI Voltage	Unit: 0.1
	Settings 0.0 to 10.0V	Factory Setting: 0.0
04.12	Minimum AVI Frequency (percentage of Pr.01.00)	Unit: 0.1
	Settings 0.0 to 100.0%	Factory Setting: 0.0
04.13	Maximum AVI Voltage	Unit: 0.1
	Settings 0.0 to 10.0V	Factory Setting: 10.0
04.14	Maximum AVI Frequency (percentage of Pr. 01.00)	Unit: 0.1
	Settings 0.0 to 100.0%	Factory Setting: 100.0
04.15	Minimum ACI Voltage	Unit: 0.1
	Settings 4.0 to 20.0mA	Factory Setting: 4.0
04.16	Minimum ACI Frequency (percentage of Pr. 01.00)	Unit: 0.1
	Settings 0.0 to 100.0%	Factory Setting: 0.0
04.17	Maximum ACI Voltage	Unit: 0.01
	Settings 4.0 to 20.0mA	Factory Setting: 0.00

04.18	Maximum ACI Frequency (percentage of Pr. 01.00)	Unit: 0.1
	Settings 0.0 to 100.0%	Factory Setting: 100.0
04.19	ACI Terminal Mode Selection	
		Factory Setting: 0
	Settings 0 ACI	
	1 AVI2	
04.20	Minimum AVI2 Voltage	Unit: 0.1
	Settings 0.0 to 10.0V	Factory Setting: 0.0
04.21	Minimum AVI2 Frequency (percentage of Pr.1-00)	Unit: 0.1
	Settings 0.0 to 100.0%	Factory Setting: 0.0
04.22	Maximum AVI2 Voltage	Unit: 0.1
	Settings 0.0 to 10.0V	Factory Setting: 10.0
04.23	Maximum AVI2 Frequency (percentage of Pr.1-00)	Unit: 0.1
	Settings 0.0 to 100.0%	Factory Setting: 100.0

🕮 Please note the ACI/AVI switch on the AC motor drive. Switch to ACI for 4 to 20mA analog current signal (ACI) (Pr.04.19 should be set to 0) and AVI for analog voltage signal (AVI2) (Pr.04.19 should be set to 1).

🕮 The above parameters are used to set the analog input reference values. The min and max frequencies are based on Pr.01.00 (during open-loop control) as shown in the following.



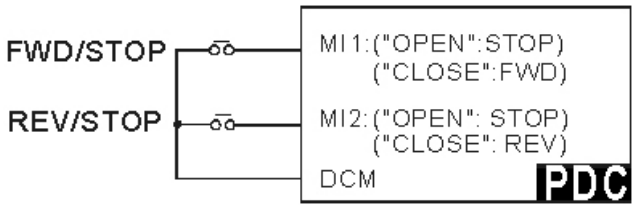
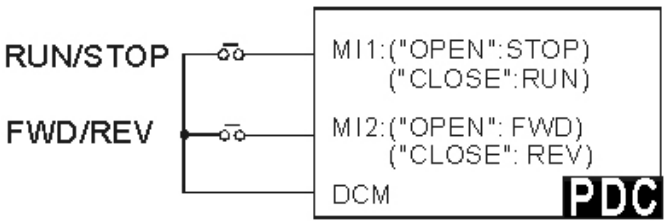
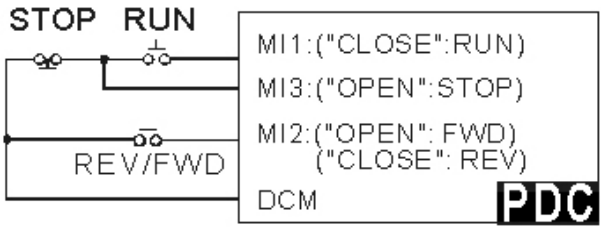


04.04	Multi-function Input Terminal (MI1, MI2) 2-wire/ 3-wire Operation Control Modes

Factory Setting: 0

Settings	0	2-wire: FWD/STOP, REV/STOP
	1	2-wire: FWD/REV, RUN/STOP
	2	3-wire Operation

📖 There are three different types of control modes:

04.04	External Terminal	
0	2-wire FWD /STOP REV / STOP	
1	2-wire FWD/ REV RUN / STOP	
2	3-wire	

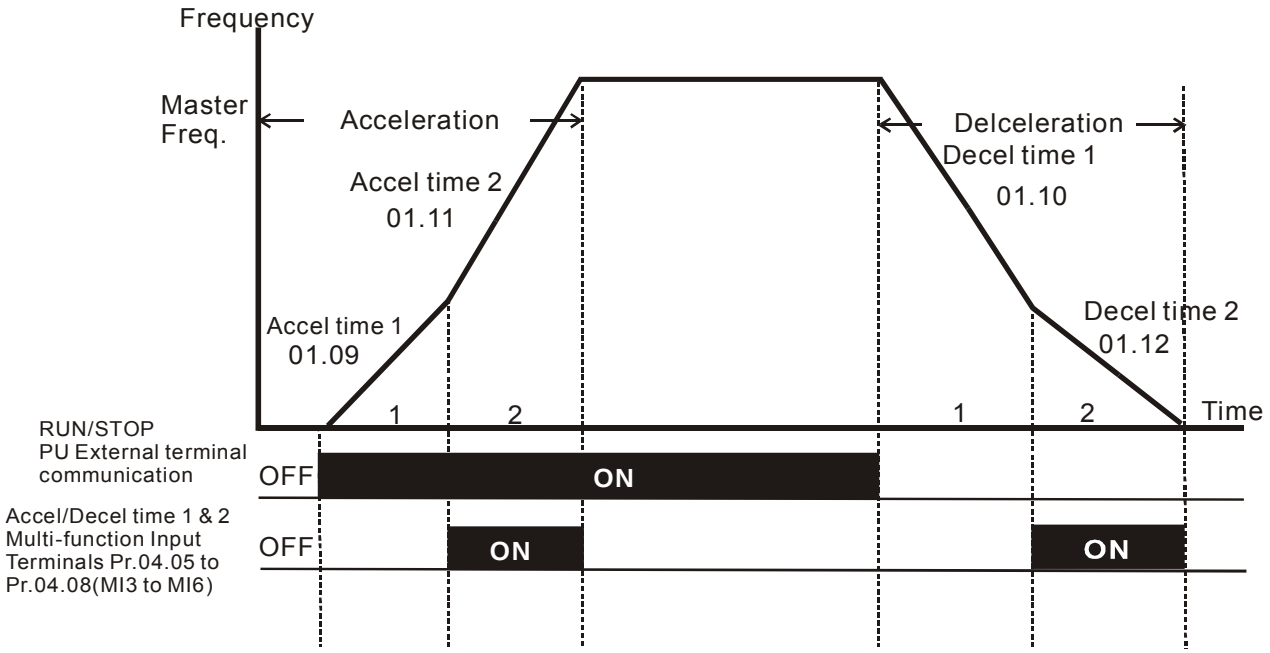
04.05	Multi-function Input Terminal (MI3)
	Factory Setting: 1
04.06	Multi-function Input Terminal (MI4)
	Factory Setting: 2
04.07	Multi-function Input Terminal (MI5)
	Factory Setting: 3
04.08	Multi-function Input Terminal (MI6)
	Factory Setting: 4

Settings	Function	Description
0	No Function	Any unused terminals should be programmed to 0 to insure they have no effect on operation.
1	Multi-Step Speed Command 1	These four inputs select the multi-speed defined by Pr.05.00 to Pr.05.14 as shown in the diagram at the end of this table. **NOTE: Pr.05.00 to Pr.05.14 can also be used to control output speed by programming the AC motor drive's internal PLC function. There are 17 step speed frequencies (including Master Frequency and Jog Frequency) to select for application.**
2	Multi-Step Speed Command 2	
3	Multi-Step Speed Command 3	
4	Multi-Step Speed Command 4	
5	External Reset	The External Reset has the same function as the Reset key on the Digital keypad. After faults such as O.H., O.C. and O.V. are cleared this input can be used to reset the drive.
6	Accel/Decel Inhibit	When the command is active, acceleration and deceleration is stopped and the AC motor drive maintains a constant speed.
7	Accel/Decel Time Selection Command	Used to select the one of 2 Accel/Decel Times (Pr.01.09 to Pr.01.12). See explanation at the end of this table.
8	Jog Operation Control	Parameter value 08 programs one of the Multi-function Input Terminals MI3 ~ MI6 (Pr.04.05~Pr.04.08) for Jog control. **NOTE: Programming for Jog operation by 08 can only be done while the motor is stopped. (Refer to parameter Pr.01.13~Pr.01.15)**

Settings	Function	Description
9	External Base Block (Refer to Pr. 08.06)	Parameter value 09 programs a Multi-function Input Terminals for external Base Block control. **NOTE: When a Base-Block signal is received, the AC motor drive will block 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.**
10	UP: Increase Master Frequency	Increase/decrease the Master Frequency each time an input is received or continuously when the input stays active. When both inputs are active at the same time, the Master Frequency increase/decrease is halted. Please refer to Pr.02.07, 02.08. This function is also called “motor potentiometer”.
11	DOWN: Decrease Master Frequency	
12	Counter Trigger	Parameter value 12 programs one of the Multi-function Input Terminals MI3~MI6 (Pr.04.05~Pr.04.08) to increment the AC drive’s internal counter. When an input is received, the counter is incremented by 1.
13	Counter Reset	When active, the counter is reset and inhibited. To enable counting the input should be OFF. Refer to Pr.03.05 and 03.06.
14	External Fault	Parameter value 14 programs one of the Multi-function Input Terminals MI3~MI6 (Pr.04.05~Pr.04.08) to be External Fault (E.F.) inputs.
15	PID function disabled	When an input ON with this setting is ON, the PID function will be disabled.
16	Output Shutoff Stop	AC motor drive will stop output and the motor free run if one of these settings is enabled. If the status of terminal is changed, AC motor drive will restart from 0Hz.
17	Parameter lock enable	When this setting is enabled, all parameters will be locked and write parameters is disabled.
18	Operation Command Selection (Pr.02.01 setting/external terminals)	ON: Operation command via Ext. Terminals OFF: Operation command via Pr.02.01 setting Pr.02.01 is disabled if this parameter value 18 is set. See the explanation below this table.

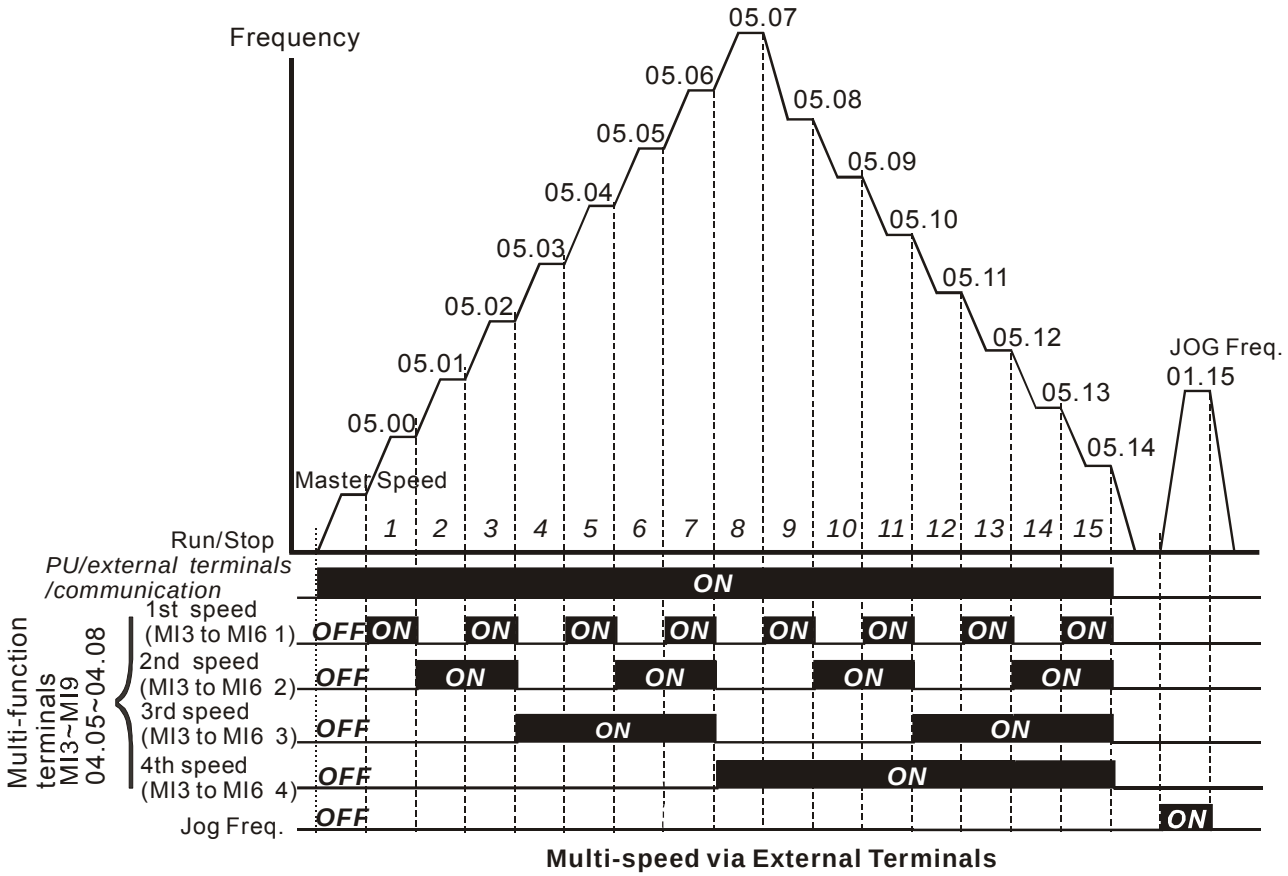
Settings	Function	Description
19	Operation Command Selection (Pr 02.01 setting/Digital Keypad)	ON: Operation command via Digital Keypad OFF: Operation command via Pr.02.01 setting Pr.02.01 is disabled if this parameter value 19 is set. See the explanation below this table.
20	Operation Command Selection (Pr 02.01 setting/ Communication)	ON: Operation command via Communication OFF: Operation command via Pr.02.01 setting Pr.02.01 is disabled if this parameter value 20 is set. See the explanation below this table.
21	Forward/Reverse	This function has top priority to set the direction for running (If "Pr.02.04=0")
22	Source of second frequency command enabled	Used to select the first/second frequency command source. Refer to Pr.02.00 and 02.09. ON: 2nd Frequency command source OFF: 1st Frequency command source
23	Run/Stop PLC Program (PLC1)	ON: Run PLC Program OFF: Stop PLC Program When AC motor drive is in STOP mode and this function is enabled, it will display PLC1 in the PLC page and execute PLC program. When this function is disabled, it will display PLC0 in the PLC page and stop executing PLC program. The motor will be stopped by Pr.02.02. When operation command source is external terminal, the keypad cannot be used to change PLC status. And this function will be invalid when the AC Motor drive is in PLC2 status.
24	Download/Execute/ Monitor PLC Program (PLC2)	When AC motor drive is in STOP mode and this function is enabled, it will display PLC2 in the PLC page and you can download/execute/monitor PLC. When this function is disabled, it will display PLC0 in the PLC page and stop executing PLC program. The motor will be stopped by Pr.02.02. When operation command source is external terminal, the keypad cannot be used to change PLC status. And this function will be invalid when the AC Motor drive is in PLC1 status.

🕮 Accel/Decel Time Selection



Accel/Decel Time and Multi-function Input Terminals

Multi-Step Speed

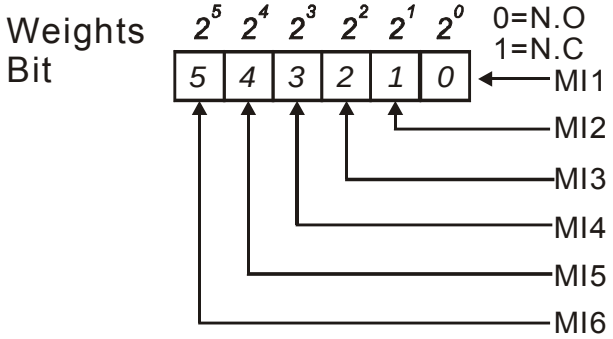


Multi-speed via External Terminals

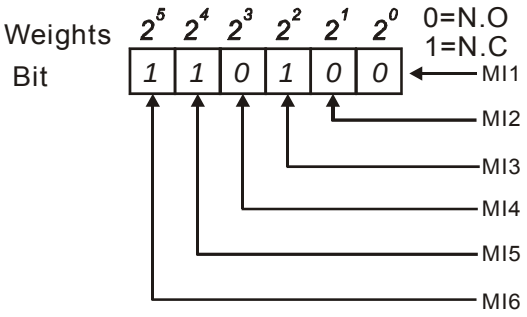
	MI6=4	MI5=3	MI4=2	MI3=1
Master frequency	OFF	OFF	OFF	OFF
1st speed	OFF	OFF	OFF	ON
2nd speed	OFF	OFF	ON	OFF
3rd speed	OFF	OFF	ON	ON
4th speed	OFF	ON	OFF	OFF
5th speed	OFF	ON	OFF	ON
6th speed	OFF	ON	ON	OFF
7th speed	OFF	ON	ON	ON
8th speed	ON	OFF	OFF	OFF
9th speed	ON	OFF	OFF	ON
10th speed	ON	OFF	ON	OFF
11th speed	ON	OFF	ON	ON
12th speed	ON	ON	OFF	OFF
13th speed	ON	ON	OFF	ON
14th speed	ON	ON	ON	OFF
15th speed	ON	ON	ON	ON

04.09	Multi-function Input Contact Selection	Unit: 1
	Settings 0 to 4095	Factory Setting: 0

- This parameter can be used to set the status of multi-function terminals (MI1~MI6 (N.O./N.C.) for standard AC motor drive).
- The MI1~MI3 setting will be invalid when the operation command source is external terminal (2/3wire).



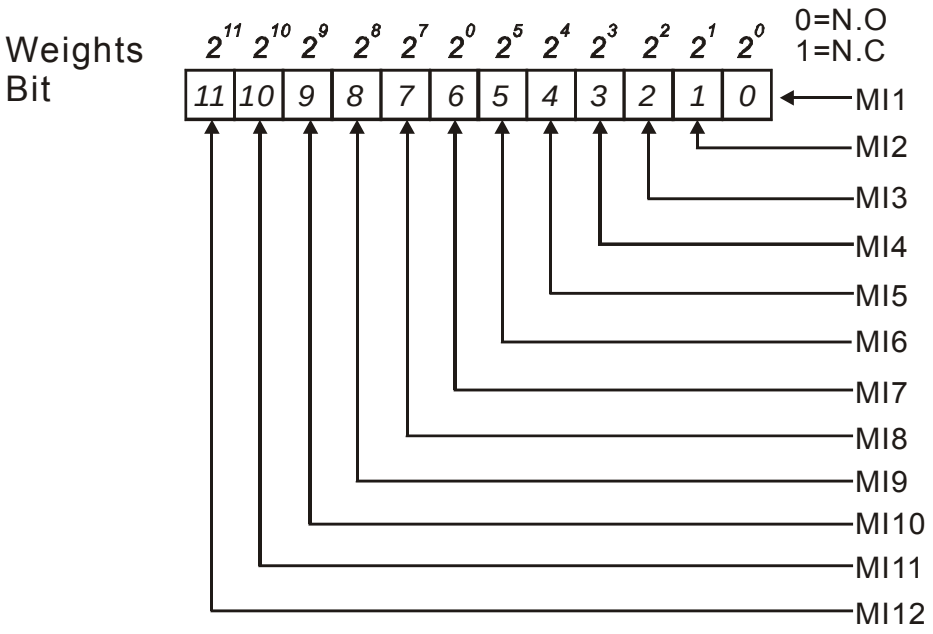
- The Setting method: It needs to convert binary number (6-bit) to decimal number for input.
- For example: if setting MI3, MI5, MI6 to be N.C. and MI1, MI2, MI4 to be N.O. The setting value Pr.04.09 should be bit5X2^5+bit4X2^4+bit2X2^2= 1X2^5+1X2^4+1X2^2= 32+16+4=52 as shown in the following.



The setting value
= bit5x2^5+bit4x2^4+bit2x2^2
= 1x2^5+1x2^4+1x2^2
=32+16+4 =52
Setting 04.09

NOTE:
2^{14}=16384 2^{13}=8192 2^{12}=4096 2^{11}=2048 2^{10}=1024
2^9=512 2^8=256 2^7=128 2^6=64 2^5=32
2^4=16 2^3=8 2^2=4 2^1=2 2^0=1

📖 When extension card is installed, the number of the multi-function input terminals will increase according to the extension card. The maximum number of the multi-function input terminals is shown as follows.

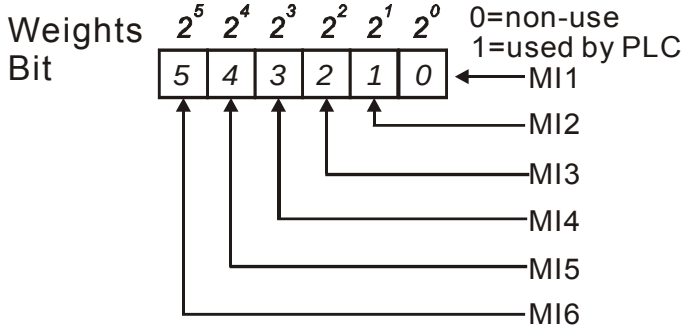


04.10	Digital Terminal Input Debouncing Time	Unit: 2
Settings	1 to 20	Factory Setting: 1

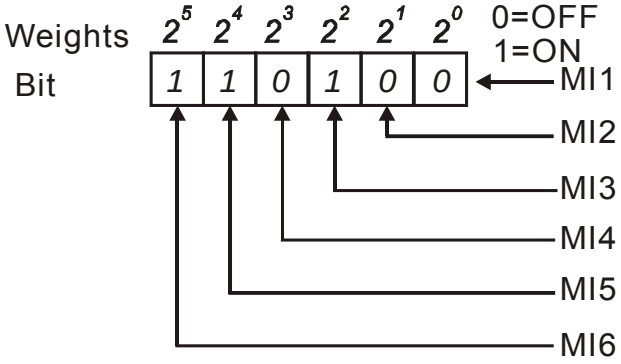
📖 This parameter is to delay the signals on digital input terminals. 1 unit is 2 msec, 2 units are 4 msec, etc. The delay time is to debounce noisy signals that could cause the digital terminals to malfunction.

04.24	The Digital Input Used by PLC	
Settings	Read Only	Factory setting: ##
Display	Bit0=1: MI1 used by PLC	
	Bit1=1: MI2 used by PLC	
	Bit2=1: MI3 used by PLC	
	Bit3=1: MI4 used by PLC	
	Bit4=1: MI5 used by PLC	
	Bit5=1: MI6 used by PLC	
	Bit6=1: MI7 used by PLC	
	Bit7=1: MI8 used by PLC	
	Bit8=1: MI9 used by PLC	
	Bit9=1: MI10 used by PLC	
	Bit10=1: MI11 used by PLC	
	Bit11=1: MI12 used by PLC	

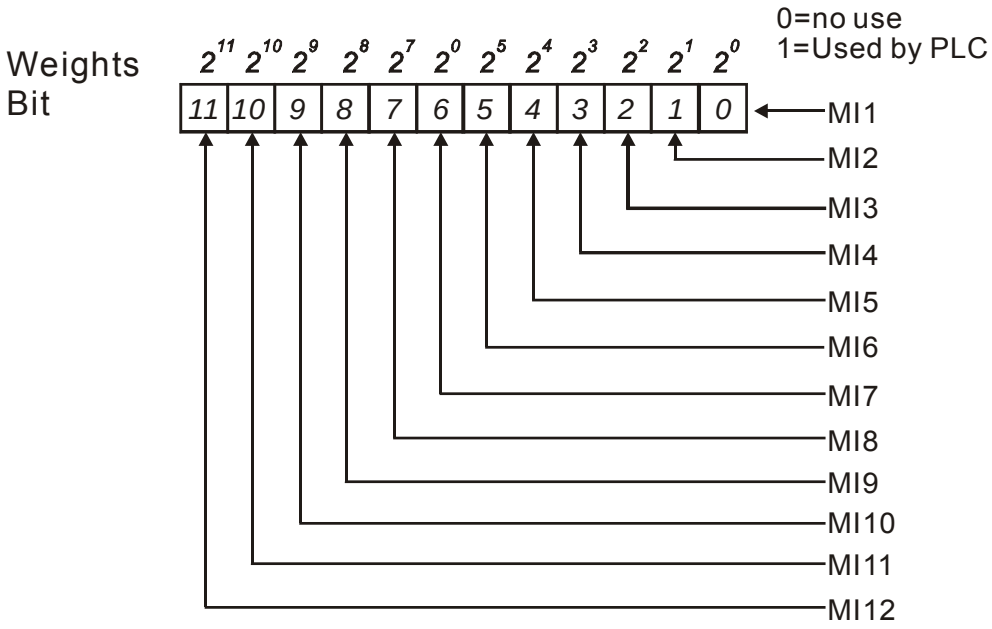
📖 For standard AC motor drive (without extension card), the equivalent 6-bit is used to display the status (used or not used) of each digital input. The value for Pr.04.24 to display is the result after converting 6-bit binary into decimal value.



📖 For example: when Pr.04.24 is set to 52 (decimal) = 110100 (binary) that indicates MI3, MI5 and MI6 are used by PLC.

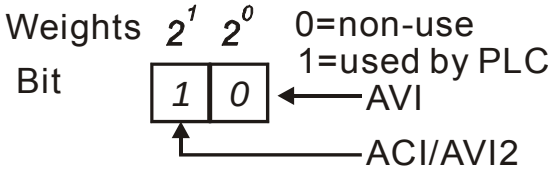


📖 When extension card is installed, the number of the digital input terminals will increase according to the extension card. The maximum number of the digital input terminals is shown as follows.



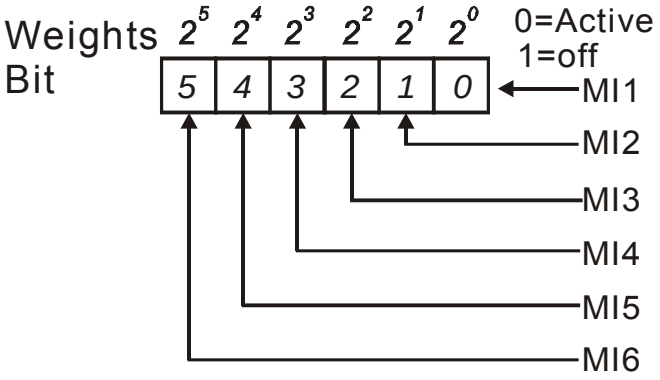
04.25	The Analog Input Used by PLC	
Settings	Read Only	Factory setting: ##
Display	Bit0=1: AVI used by PLC	
	Bit1=1: ACI/AVI2 used by PLC	

📖 The equivalent 2-bit is used to display the status(used or not used) of each analog input. The value for Pr.04.25 to display is the result after converting 2-bit binary into decimal value.



04.26	Display the Status of Multi-function Input Terminal	
Settings	Read Only	Factory setting: ##
Display	Bit0: MI1 Status	
	Bit1: MI2 Status	
	Bit2: MI3 Status	
	Bit3: MI4 Status	
	Bit4: MI5 Status	
	Bit5: MI6 Status	
	Bit6: MI7 Status	
	Bit7: MI8 Status	
	Bit8: MI9 Status	
	Bit9: MI10 Status	
	Bit10: MI11 Status	
	Bit11: MI12 Status	

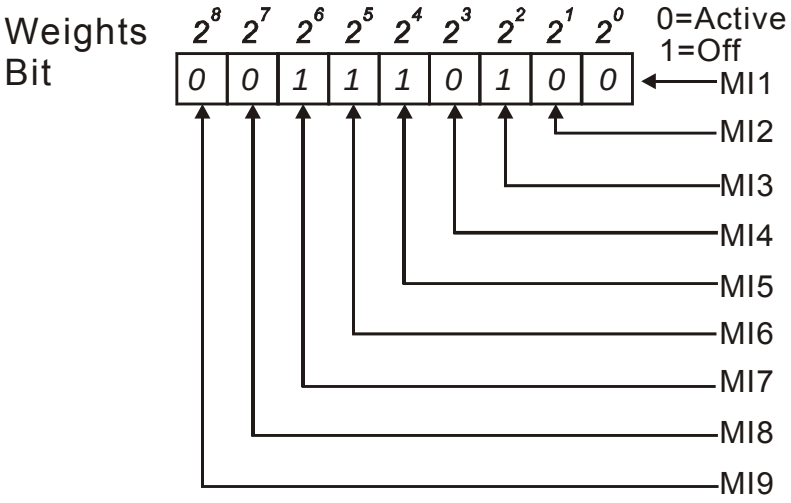
The multi-function input terminals are falling-edge triggered. For standard AC motor drive (without extension card), there are MI1 to MI6 and Pr.04.26 will display 63 (111111) for no action.



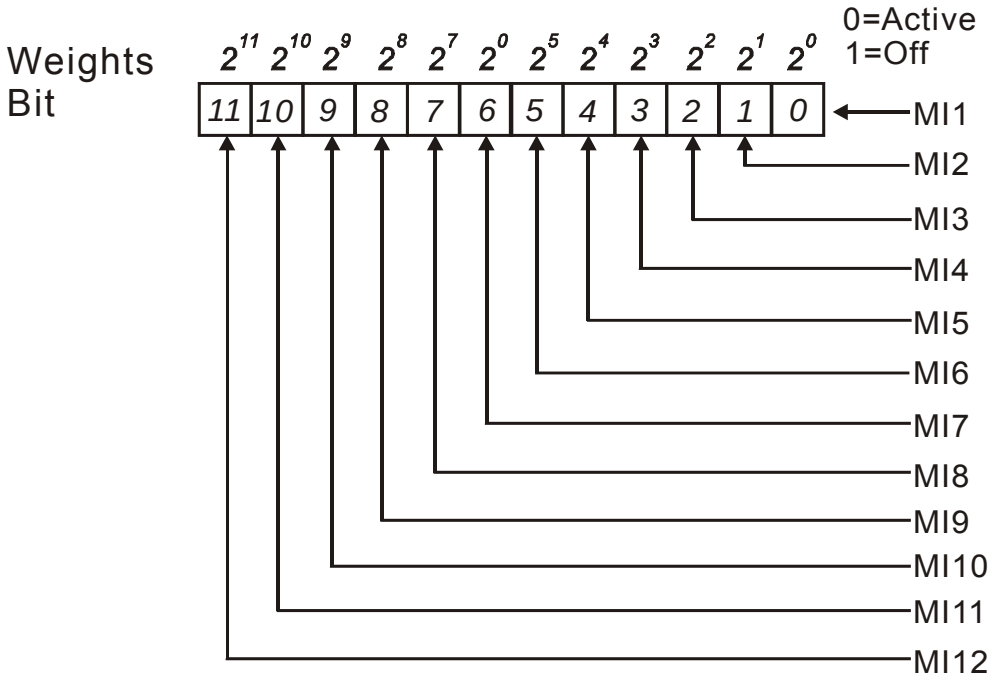
For Example:

If Pr.04.26 displays 52, it means MI1, MI2 and MI4 are active.

The display value 52= 32+16+4 =1 X 2^5+ 1X 2^4 + 1X 2^2 = bit 6 X 2^5+ bit 5 X 2^4 + bit 3 X 2^2



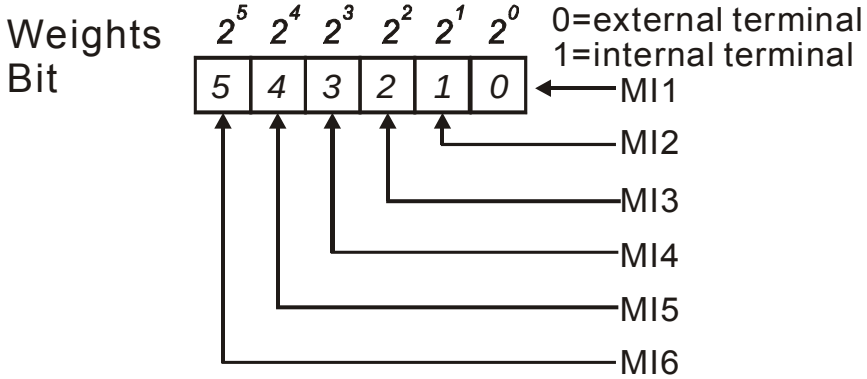
When extension card is installed, the number of the multi-function input terminals will increase according to the extension card. The maximum number of the multi-function input terminals is shown as follows.



04.27	Internal/External Multi-function Input Terminals Selection	Unit: 1
Settings	0 to 4095	Factory Setting: 0

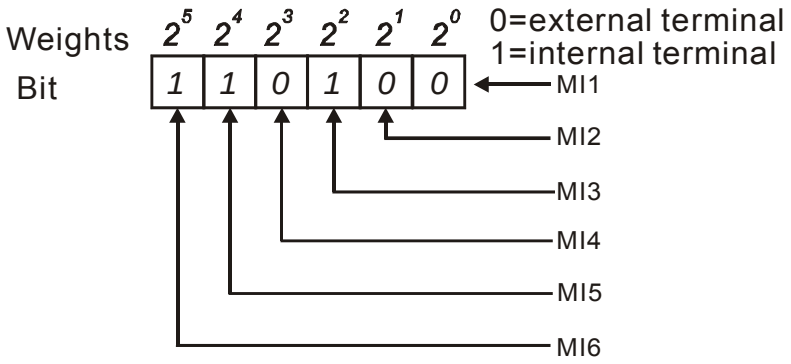
📖 This parameter is used to select the terminals to be internal terminal or external terminal. You can activate internal terminals by Pr.04.28. A terminal cannot be both internal terminal and external terminal at the same time.

📖 For standard AC motor drive (without extension card), the multi-function input terminals are MI1 to MI6 as shown in the following.



📖 The Setting method is convert binary number to decimal number for input.

📖 For example: if setting MI3, MI5, MI6 to be internal terminals and MI1, MI2, MI4 to be external terminals. The setting value should be bit5X2^5+bit4X2^4+bit2X2^2= 1X2^5+1X2^4+1X2^2= 32+16+4=52 as shown in the following.

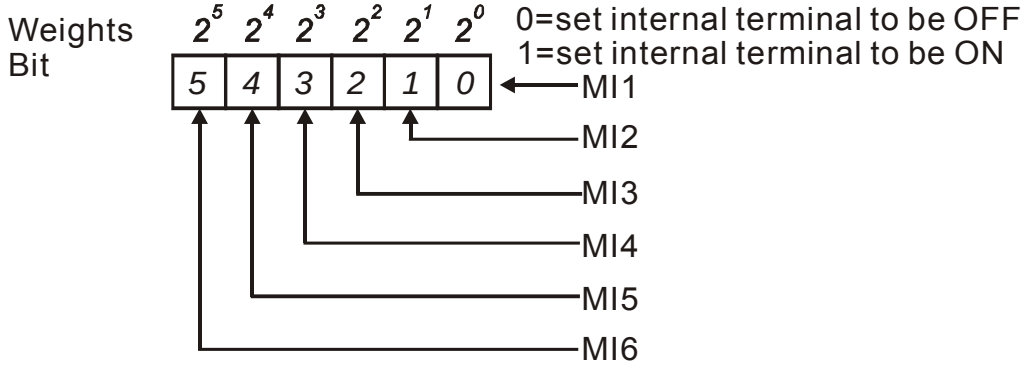


When extension card is installed, the number of the multi-function input terminals will increase according to the extension card. The maximum number of the multi-function input terminals is shown as follows.

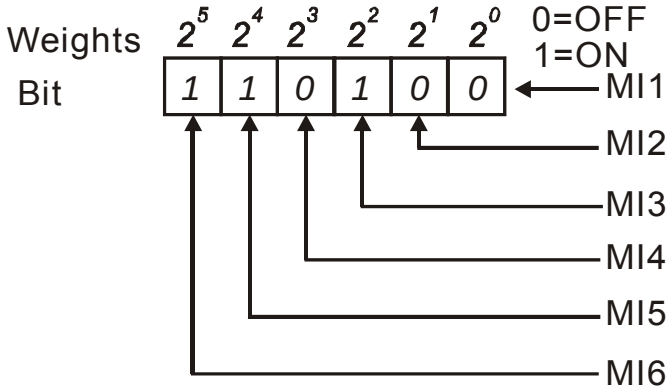
04.28	Internal Terminal Status	Unit: 1
Settings	0 to 4095	Factory Setting: 0

This parameter is used to set the internal terminal action via keypad, communication or PLC.

For standard AC motor drive (without extension card), the multi-function input terminals are MI1 to MI6 as shown in the following.



For example, if setting MI3, MI5 and MI6 to be ON, Pr.04.28 should be set to bit5X2^5+bit4X2^4+bit2X2^2= 1X2^5+1X2^4+1X2^2= 32+16+4=52 as shown in the following.



🕮 When extension card is installed, the number of the multi-function input terminals will increase according to the extension card. The maximum number of the multi-function input terminals is shown as follows.

Group 5: Multi-step speeds and PLC (Process Logic Control) parameters

05.00	✓1st Step Speed Frequency	Unit: 0.01
05.01	✓2nd Step Speed Frequency	Unit: 0.01
05.02	✓3rd Step Speed Frequency	Unit: 0.01
05.03	✓4th Step Speed Frequency	Unit: 0.01
05.04	✓5th Step Speed Frequency	Unit: 0.01
05.05	✓6th Step Speed Frequency	Unit: 0.01
05.06	✓7th Step Speed Frequency	Unit: 0.01
05.07	✓8th Step Speed Frequency	Unit: 0.01
05.08	✓9th Step Speed Frequency	Unit: 0.01
05.09	✓10th Step Speed Frequency	Unit: 0.01
05.10	✓11th Step Speed Frequency	Unit: 0.01
05.11	✓12th Step Speed Frequency	Unit: 0.01
05.12	✓13th Step Speed Frequency	Unit: 0.01
05.13	✓14th Step Speed Frequency	Unit: 0.01
05.14	✓15th Step Speed Frequency	Unit: 0.01
	Settings 0.00 to 600.0Hz	Factory Setting: 0.00

🕮 The Multi-function Input Terminals (refer to Pr.04.05 to 04.08) are used to select one of the AC motor drive Multi-step speeds. The speeds (frequencies) are determined by Pr.05.00 to 05.14 as shown above.

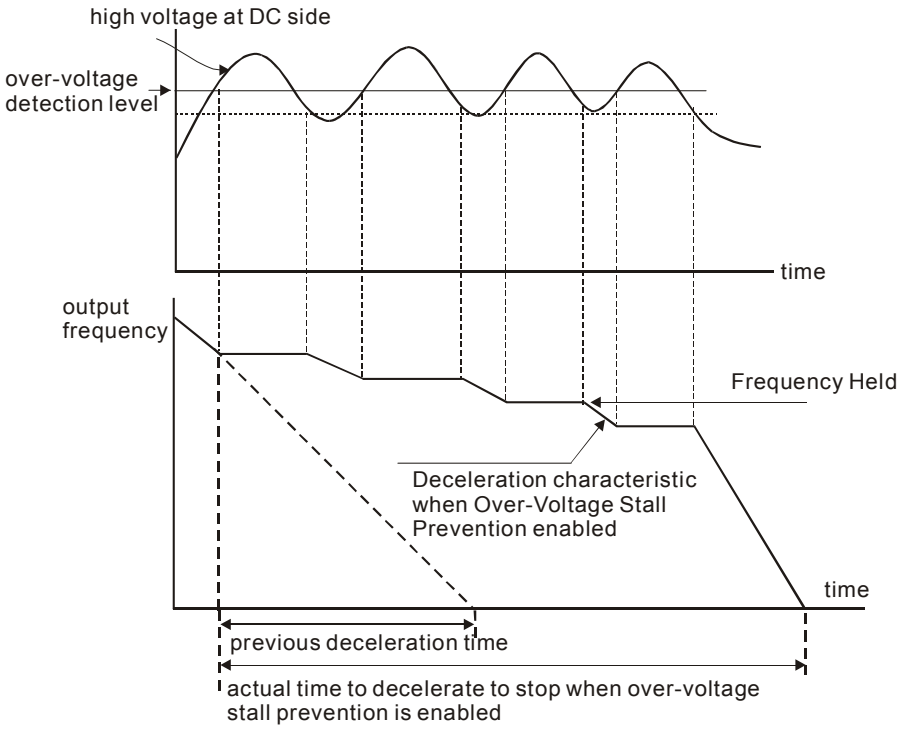
Group 6: Protection Parameters

06.00	Over-Voltage Stall Prevention		Unit: 0.1
Settings	115V/230V series	330.0 to 410.0V	Factory Setting: 390.0
	460V series	660.0 to 820.0V	Factory Setting: 780.0
	0	Disable Over-voltage Stall Prevention (with brake unit or brake resistor)	

- During deceleration, the DC bus voltage may exceed its Maximum Allowable Value due to motor regeneration. When this function is enabled, the AC motor drive will not decelerate further and keep the output frequency constant until the voltage drops below the preset value again.
- Over-Voltage Stall Prevention must be disabled (Pr.06.00=0) when a brake unit or brake resistor is used.

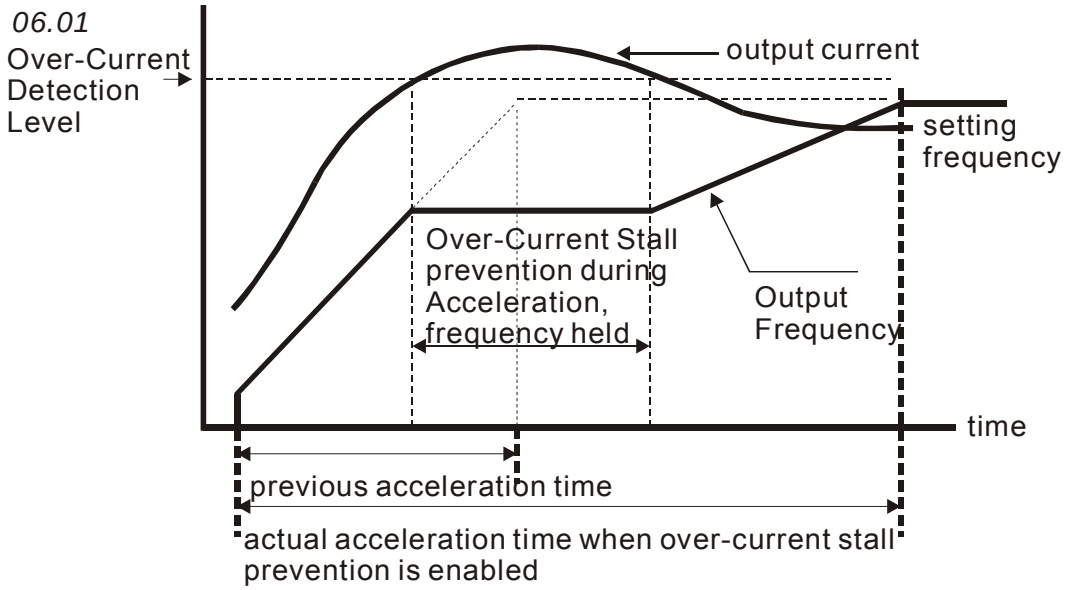
NOTE

With moderate inertia load, over-voltage stall prevention will not occur and the real deceleration time will be equal to the setting of deceleration time. The AC drive will automatically extend the deceleration time with high inertia loads. If the deceleration time is critical for the application, a brake resistor or brake unit should be used.



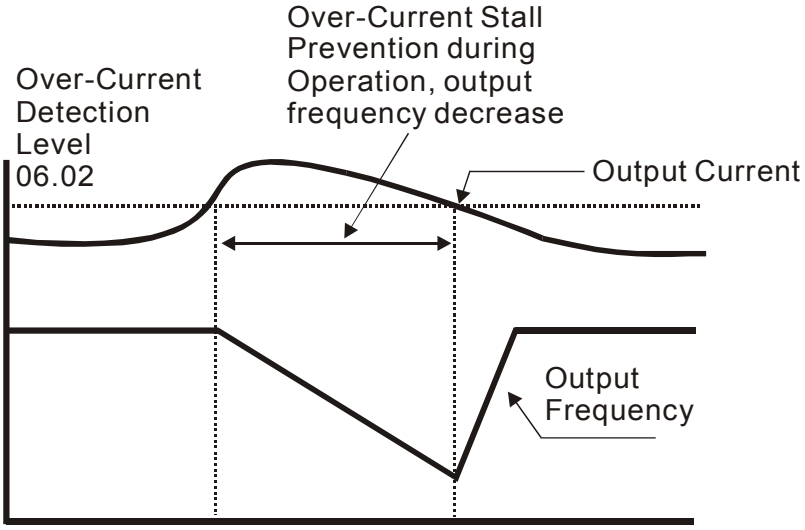
06.01	Over-Current Stall Prevention during Acceleration	Unit: 1
Settings	20 to 250%	Factory Setting: 170
	0: disable	

- A setting of 100% is equal to the Rated Output Current of the drive.
- During acceleration, the AC drive output current may increase abruptly and exceed the value specified by Pr.06.01 due to rapid acceleration or excessive load on the motor. When this function is enabled, the AC drive will stop accelerating and keep the output frequency constant until the current drops below the maximum value.



06.02	Over-current Stall Prevention during Operation	Unit: 1
Settings	20 to 250%	Factory Setting: 170
	0: disable	

- If the output current exceeds the setting specified in Pr.06.02 when the drive is operating, the drive will decrease its output frequency to prevent the motor stall. If the output current is lower than the setting specified in Pr.06.02, the drive will accelerate again to catch up with the set frequency command value.



over-current stall prevention during operation

06.03	Over-Torque Detection Mode (OL2)	
		Factory Setting: 0
Settings	0	Over-Torque detection disabled.
	1	Over-Torque detection enabled during constant speed operation. After over-torque is detected, keep running until OL1 or OL occurs.
	2	Over-Torque detection enabled during constant speed operation. After over-torque is detected, stop running.
	3	Over-Torque detection enabled during acceleration. After over-torque is detected, keep running until OL1 or OL occurs.
	4	Over-Torque detection enabled during acceleration. After over-torque is detected, stop running.

📖 This parameter determines the operation mode of the drive after the over-torque (OL2) is detected via the following method: if the output current exceeds the over-torque detection level (Pr.06.04) longer than the setting of Pr.06.05 Over-Torque Detection Time, the warning message “OL2” is displayed. If a Multi-functional Output Terminal is set to over-torque detection (Pr.03.00~03.01=04), the output is on. Please refer to Pr.03.00~03.01 for details.

06.04	Over-Torque Detection Level (OL2)	Unit: 1
	Settings 10 to 200%	Factory Setting: 150

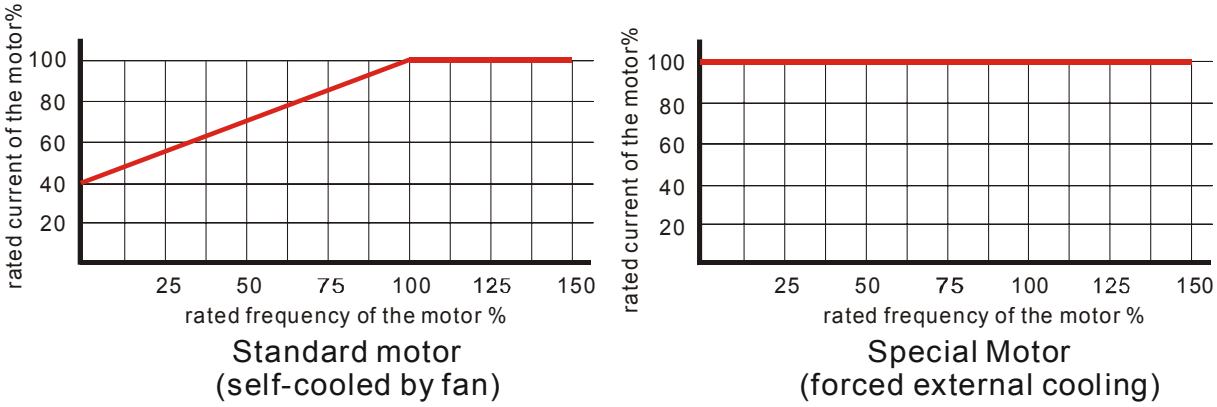
📖 This setting is proportional to the Rated Output Current of the drive.

06.05	Over-Torque Detection Time (OL2)	Unit: 0.1
	Settings 0.1 to 60.0 sec	Factory Setting: 0.1

📖 This parameter sets the time for how long over-torque must be detected before “OL2” is displayed.

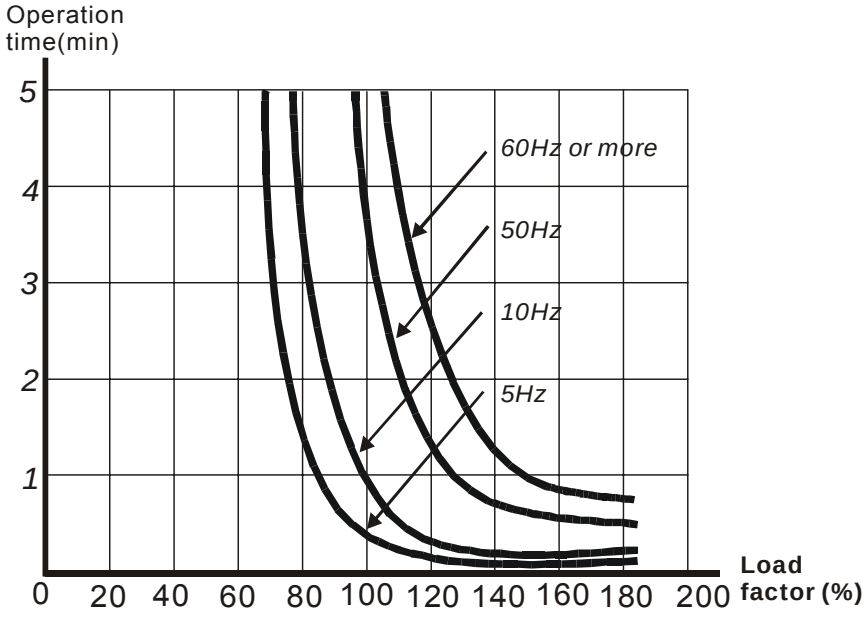
06.06	Electronic Thermal Overload Relay Selection (OL1)	
		Factory Setting: 2
Settings	0	Operate with a Standard Motor (self-cooled by fan)
	1	Operate with a Special Motor (forced external cooling)
	2	Operation disabled

This function is used to protect the motor from overloading or overheating.



06.07	Electronic Thermal Characteristic	Unit: 1
Settings	30 to 600 sec	Factory Setting: 60

The parameter determines the time required for activating the I2t electronic thermal protection function. The graph below shows I2t curves for 150% output power for 1 minute.



06.08	Present Fault Record
06.09	Second Most Recent Fault Record
06.10	Third Most Recent Fault Record
06.11	Fourth Most Recent Fault Record
06.12	Fifth Most Recent Fault Record

Factory Setting: 0

Readings	0	No fault
	1	Over-current (oc)
	2	Over-voltage (ov)
	3	IGBT Overheat (oH1)
	4	Power Board Overheat (oH2)
	5	Overload(oL)
	6	Overload (oL1)
	7	Motor Overload (oL2)
	8	External Fault (EF)
	9	Hardware protection failure (HPF)
	10	Current exceeds 2 times rated current during accel.(ocA)
	11	Current exceeds 2 times rated current during decel.(ocd)
	12	Current exceeds 2 times rated current during steady state operation (ocn)
	13	Reserved
	14	Phase-loss (PHL)
	15	Reserved
	16	Auto accel/decel failure (CFA)
	17	Software/password protection (codE)
	18	Power Board CPU WRITE Failure (cF1.0)
	19	Power Board CPU READ Failure (cF2.0)
	20	CC, OC Hardware protection failure (HPF1)
	21	OV Hardware protection failure (HPF2)
	22	GFF Hardware protection failure (HPF3)
	23	OC Hardware protection failure (HPF4)
	24	U-phase error (cF3.0)
	25	V-phase error (cF3.1)
	26	W-phase error (cF3.2)
	27	DCBUS error (cF3.3)
	28	IGBT Overheat (cF3.4)
	29	Power Board Overheat (cF3.5)

30	Control Board CPU WRITE failure (cF1.1)
31	Contrsol Board CPU READ failure (cF2.1)
32	ACI signal error (AErr)
33	Reserved
34	Motor PTC overheat protection (PtC1)
35-39	Reserved
40	Communication time-out error of control board and power board (CP10)

📖 In Pr.06.08 to Pr.06.12 the five most recent faults that occurred, are stored. After removing the cause of the fault, use the reset command to reset the drive.

Group 7: Motor Parameters

07.00	✓Motor Rated Current	Unit: 1
	Settings 30% FLA to 120% FLA	Factory Setting: FLA

📖 Use the following formula to calculate the percentage value entered in this parameter:
(Motor Current / AC Drive Current) x 100%
with Motor Current=Motor rated current in A on type shield
AC Drive Current=Rated current of AC drive in A (see Pr.00.01)

📖 Pr.07.00 and Pr.07.01 must be set if the drive is programmed to operate in Vector Control mode (Pr.00.10 = 1). They also must be set if the "Electronic Thermal Overload Relay" (Pr.06.06) or "Slip Compensation"(Pr.07-03) functions are selected.

07.01	✓Motor No-load Current	Unit: 1
	Settings 0% FLA to 90% FLA	Factory Setting: 0.4*FLA

📖 The rated current of the AC drive is regarded as 100%. The setting of the Motor no-load current will affect the slip compensation.

📖 The setting value must be less than Pr.07.00 (Motor Rated Current).

07.02	✓Torque Compensation	Unit: 0.1
	Settings 0.0 to 10.0	Factory Setting: 0.0

📖 This parameter may be set so that the AC drive will increase its voltage output to obtain a higher torque. Only to be used for V/f control mode.

📖 Too high torque compensation can overheat the motor.

07.03	✓Slip Compensation (Used without PG)	Unit: 0.01
	Settings 0.00 to 10.00	Factory Setting: 0.00

📖 While driving an asynchronous motor, increasing the load on the AC motor drive will cause an increase in slip and decrease in speed. This parameter may be used to compensate the slip by increasing the output frequency. When the output current of the AC motor drive is bigger than the motor no-load current (Pr.07.01), the AC drive will adjust its output frequency according to this parameter.

07.04	Motor Parameters Auto Tuning	Unit: 1
		Factory Setting: 0
Settings	0 Disable	
	1 Auto Tuning R1 (motor doesn't run)	
	2 Auto Tuning R1 + No-load Test (with running motor)	

🕮 Start Auto Tuning by pressing RUN key after this parameter is set to 1 or 2.
When set to 1, it will only auto detect R1 value and Pr.07.01 must be input manually. When set to 2, the AC motor drive should be unloaded and the values of Pr.07.01 and Pr.07.05 will be set automatically.

🕮 The steps for AUTO-Tuning are:

1. Make sure that all the parameters are set to factory settings and the motor wiring is correct.
2. Make sure the motor has no-load before executing auto-tuning and the shaft is not connected to any belt or gear motor.
3. Fill in Pr.01.01, Pr.01.02, Pr.07.00, Pr.07.04 and Pr.07.06 with correct values.
4. After Pr.07.04 is set to 2, the AC motor drive will execute auto-tuning immediately after receiving a "RUN" command. (Note: The motor will run!). The total auto tune time will be 15 seconds + Pr.01.09 + Pr.01.10. Higher power drives need longer Accel/Decel time (factory setting is recommended). After executing Auto-tune, Pr.07.04 is set to 0.
5. After executing, please check if there are values filled in Pr.07.01 and Pr.07.05. If not, please press RUN key after setting Pr.07.04 again.
6. Then you can set Pr.00.10 to 1 and set other parameters according to your application requirement.

NOTE

1. In vector control mode it is not recommended to have motors run in parallel.
2. It is not recommended to use vector control mode if motor rated power exceeds the rated power of the AC motor drive.

07.05	Motor Line-to-line Resistance R1	Unit: 1
Settings	0 to 65535 mΩ	Factory Setting: 0

🕮 The motor auto tune procedure will set this parameter. The user may also set this parameter without using Pr.07.04.

07.06	Motor Rated Slip		Unit: 0.01
	Settings	0.00 to 20.00Hz	Factory Setting: 3.00

📖 Refer to the rated rpm and the number of poles on the nameplate of the motor and use the following equation to calculate the rated slip.

Rated Slip (Hz) = F_{base} (Pr.01.01 base frequency) – (rated rpm x motor pole 120)

📖 This parameter is valid only in vector mode.

07.07	Slip Compensation Limit		Unit: 1
	Settings	0 to 250%	Factory Setting: 200

📖 This parameter sets the upper limit of the compensation frequency (the percentage of Pr.07.06).

Example: when Pr.07.06=5Hz and Pr.07.07=150%, the upper limit of the compensation frequency is 7.5Hz. Therefore, for a 50Hz motor, the max. output is 57.5Hz.

07.08	Torque Compensation Time Constant		Unit: 0.01
	Settings	0.01 ~10.00 sec	Factory Setting: 0.10
07.09	Slip Compensation Time Constant		Unit: 0.01
	Settings	0.05 ~10.00 sec	Factory Setting: 0.20

📖 Setting Pr.07.08 and Pr.07.09 changes the response time for the compensations.

📖 Too long time constants give slow response; too short values can give unstable operation.

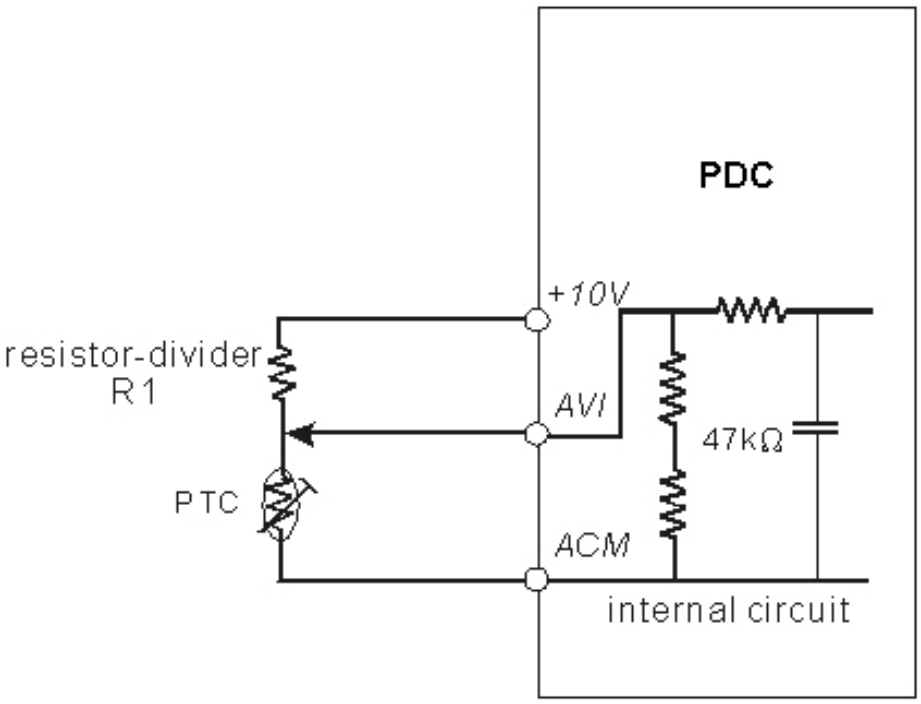
07.10	Accumulative Motor Operation Time (Min.)		Unit: 1
	Settings	0~1439	Factory Setting: 0
07.11	Accumulative Motor Operation Time (Day)		Unit: 1
	Settings	0 ~65535	Factory Setting: 0

📖 Pr.07.10 and Pr.07.11 are used to record the motor operation time. They can be cleared by setting to 0 and time is less than 1 minute is not recorded.

07.12	Motor PTC Overheat Protection		Unit: 1
			Factory Setting: 0
	Settings	0 Disable	
		1 Enable	

07.14	Motor PTC Overheat Protection Level	Unit: 0.1
	Settings 0.1~10.0V	Factory Setting: 2.4

- When the motor is running at low frequency for a long time, the cooling function of the motor fan will be lower. To prevent overheating, it needs to have a Positive Temperature Coefficient thermoistor on the motor and connect its output signal to the drive's corresponding control terminals.
- When the source of first/second frequency command is set to AVI (02.00=2/02.09=2), it will disable the function of motor PTC overheat protection (i.e. Pr.07.12 cannot be set to 1).
- If temperature exceeds the setting level, motor will be coast to stop and PtC1 is displayed. When the temperature decreases below the level of (Pr.07.15-Pr.07.16) and PtC1 stops blinking, you can press RESET key to clear the fault.
- Pr.07.14 (overheat protection level) must exceed Pr.07.15 (overheat warning level).
- The PTC uses the AVI-input and is connected via resistor-divider as shown below.
  1. The voltage between +10V to ACM: lies within 10.4V~11.2V.
  2. The impedance for AVI is around 47kΩ.
  3. Recommended value for resistor-divider R1 is 1~20kΩ.
  4. Please contact your motor dealer for the curve of temperature and resistance value for PTC.



🕮 Refer to following calculation for protection level and warning level.

1. Protection level

   Pr.07.14= V_{+10} * (R_{PTC1}//47K) / [R1+(R_{PTC1}//47K)]

2. Warning level

   Pr.07.16= V_{+10} * (R_{PTC2}//47K) / [R1+(R_{PTC2}//47K)]

3. Definition:

   V+10: voltage between +10V-ACM, Range 10.4~11.2VDC

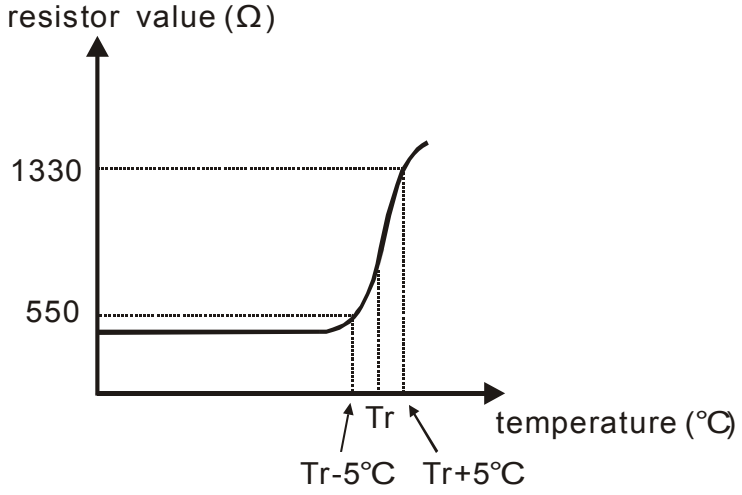
   RPTC1: motor PTC overheat protection level. Corresponding voltage level set in Pr.07.14, RPTC2: motor PTC overheat warning level. Corresponding voltage level set in Pr.07.15, 47kΩ: is AVI input impedance, R1: resistor-divider (recommended value: 1~20kΩ)

🕮 Take the standard PTC thermistor as example: if protection level is 1330Ω, the voltage between +10V-ACM is 10.5V and resistor-divider R1 is 4.4kΩ. Refer to following calculation for Pr.07.14 setting.

1330//47000=(1330*47000)/(1330+47000)=1293.4

10.5*1293.4/(4400+1293.4)=2.38(V) ≒2.4(V)

Therefore, Pr.07.14 should be set to 2.4.



07.15	Motor PTC Overheat Warning Level	Unit: 0.1
	Settings 0.1~10.0V	Factory Setting: 1.2
07.16	Motor PTC Overheat Reset Delta Level	Unit: 0.1
	Settings 0.1~5.0V	Factory Setting: 0.6
07.17	Treatment of the motor PTC Overheat	
		Factory Setting: 0
	Settings 0 Warn and RAMP to stop	
	1 Warn and COAST to stop	
	2 Warn and keep running	

🕮 If temperature exceeds the motor PTC overheat warning level (Pr.07.15), the drive will act according to Pr.07.17 and display PtC2. If the temperature decreases below the result (Pr.07.15 minus Pr.07.16), the warning display will disappear.

07.13	Input Debouncing Time of the PTC Protection	Unit: 2
	Settings 0~9999 (is 0-19998ms)	Factory Setting: 100

🕮 This parameter is to delay the signals on PTC analog input terminals. 1 unit is 2 msec, 2 units are 4 msec, etc.

Group 8: Special Parameters

08.00	DC Braking Current Level	Unit: 1
	Settings 0 to 100%	Factory Setting: 0

📖 This parameter sets the level of DC Braking Current output to the motor during start-up and stopping. When setting DC Braking Current, the Rated Current (Pr.00.01) is regarded as 100%. It is recommended to start with a low DC Braking Current Level and then increase until proper holding torque has been achieved.

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

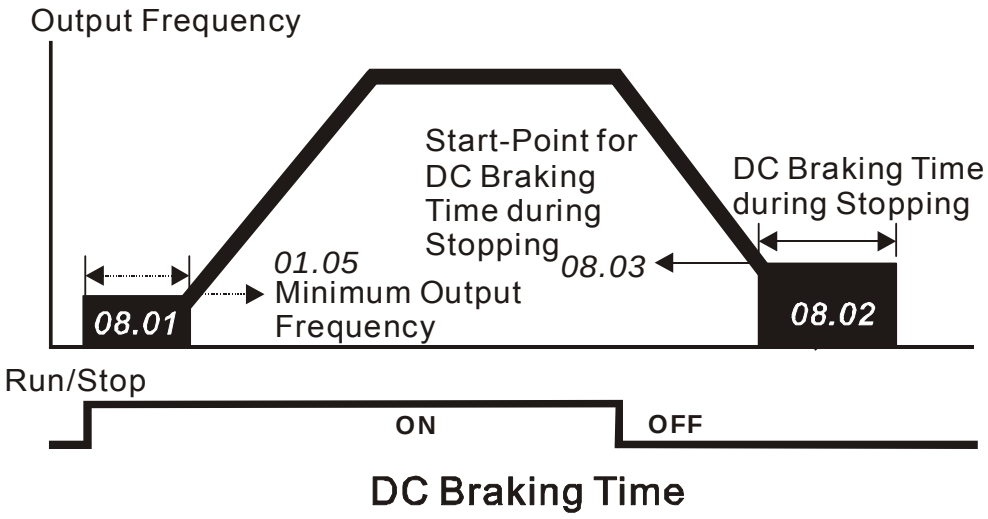
📖 This parameter determines the duration of the DC Braking current after a RUN command. When the time has elapsed, the AC motor drive will start accelerating from the Minimum Frequency (Pr.01.05).

08.02	DC Braking Time during Stopping	Unit: 0.1
	Settings 0.0 to 60.0 sec	Factory Setting: 0.0

📖 This parameter determines the duration of the DC Braking current during stopping. If stopping with DC Braking is desired, Pr.02.02 Stop Method must be set to 0 or 2 for Ramp to Stop.

08.03	Start-Point for DC Braking	Unit: 0.01
	Settings 0.00 to 600.0Hz	Factory Setting: 0.00

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



DC Braking Time

🕮 DC Braking during Start-up is used for loads that may move before the AC drive starts, such as fans and pumps. Under such circumstances, DC Braking can be used to hold the load in position before setting it in motion.

🕮 DC Braking during stopping is used to shorten the stopping time and also to hold a stopped load in position. For high inertia loads, a brake resistor for dynamic braking may also be needed for fast decelerations.

08.04	Momentary Power Loss Operation Selection	
		Factory Setting: 0
Settings	0	Operation stops (coast to stop) after momentary power loss.
	1	Operation continues after momentary power loss, speed search starts with the Master Frequency reference value.
	2	Operation continues after momentary power loss, speed search starts with the minimum frequency.

🕮 This parameter determines the operation mode when the AC motor drive restarts from a momentary power loss.

08.05	Maximum Allowable Power Loss Time	Unit: 0.1
Settings	0.1 to 5.0 sec	Factory Setting: 2.0

🕮 If the duration of a power loss is less than this parameter setting, the AC motor drive will resume operation. If it exceeds the Maximum Allowable Power Loss Time, the AC motor drive output is then turned off (coast stop).

🕮 The selected operation after power loss in Pr.08.04 is only executed when the maximum allowable power loss time is ≤5 seconds and the AC motor drive displays “Lu”.
But if the AC motor drive is powered off due to overload, even if the maximum allowable power loss time is ≤5 seconds, the operation mode as set in Pr.08.04 is not executed. In that case it starts up normally.

08.06	Base Block Speed Search	
		Factory Setting: 1
Settings	0	Disable
	1	Speed search starts with last frequency command
	2	Speed search starts with minimum output frequency (Pr.01.05)

🕮 This parameter determines the AC motor drive restart method after External Base Block is enabled.

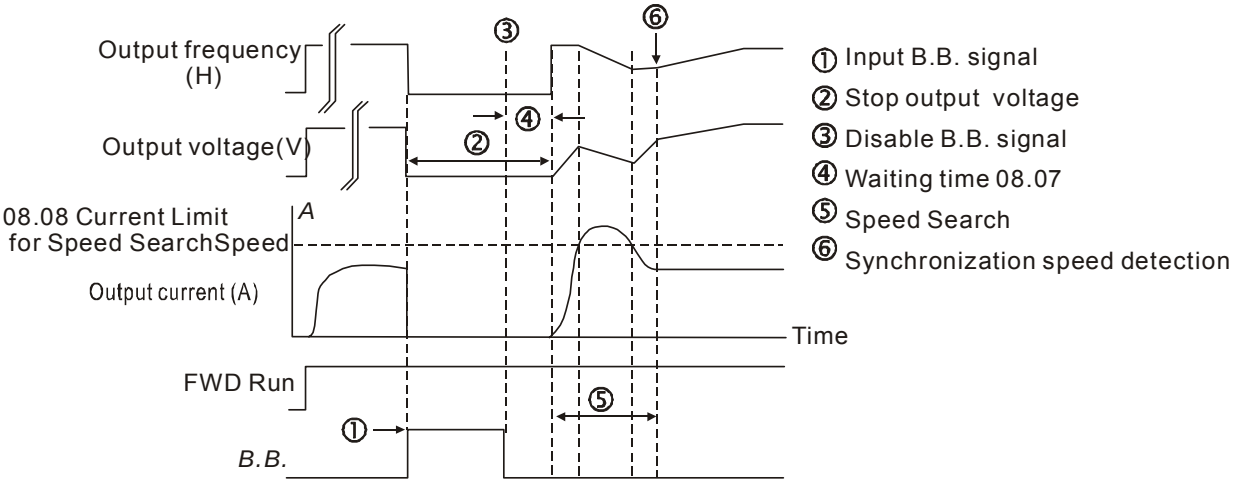


Fig 1:B.B. Speed Search with Last Output Frequency Downward Timing Chart
(Speed Search Current Attains Speed Search Level)

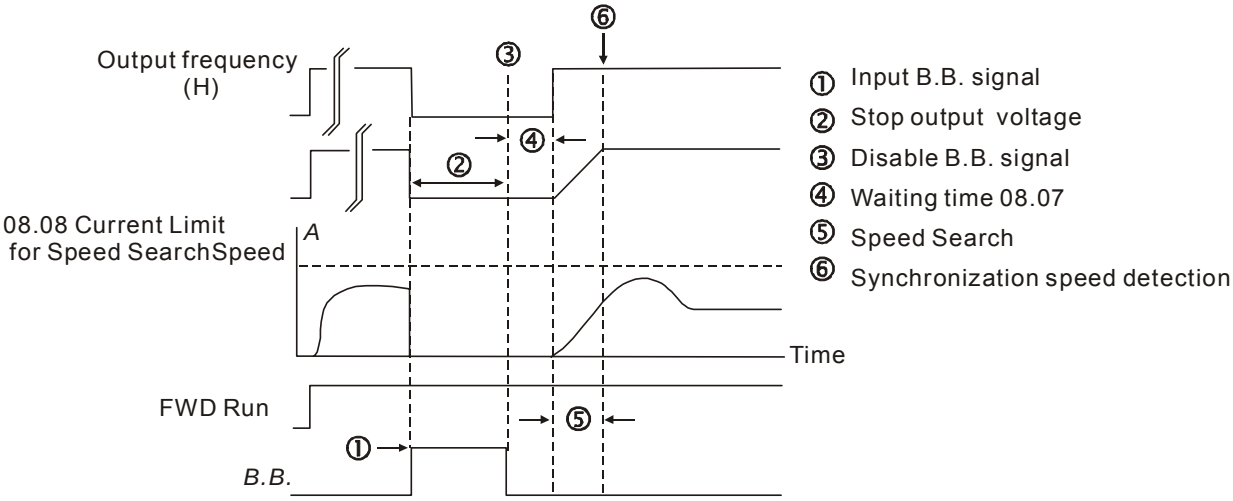


Fig 2: B.B. Speed Search with Last Output Frequency Downward Timing Chart
(Speed Search Current doesn't Attain Speed Search Level)

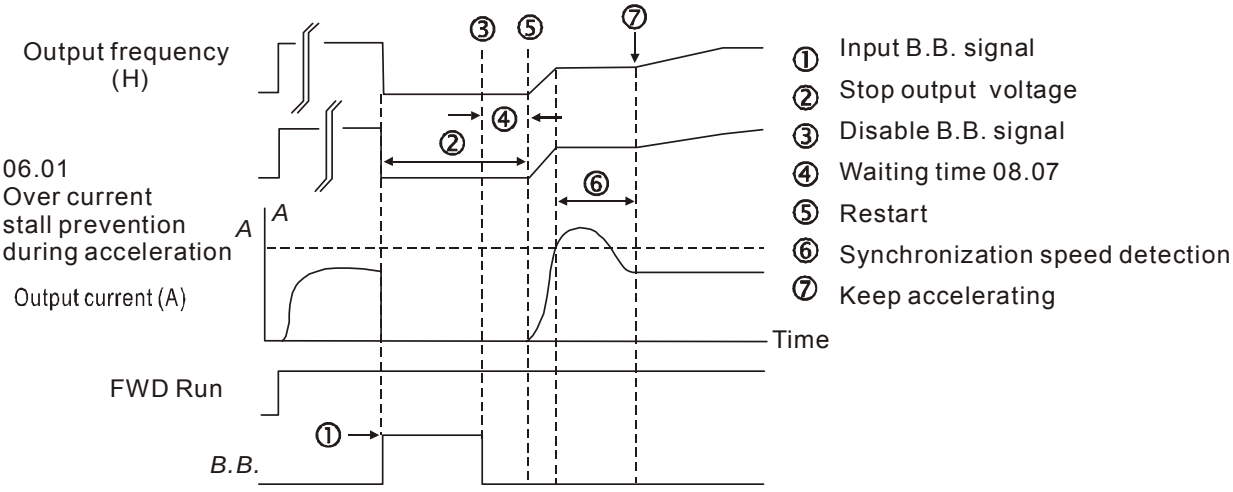


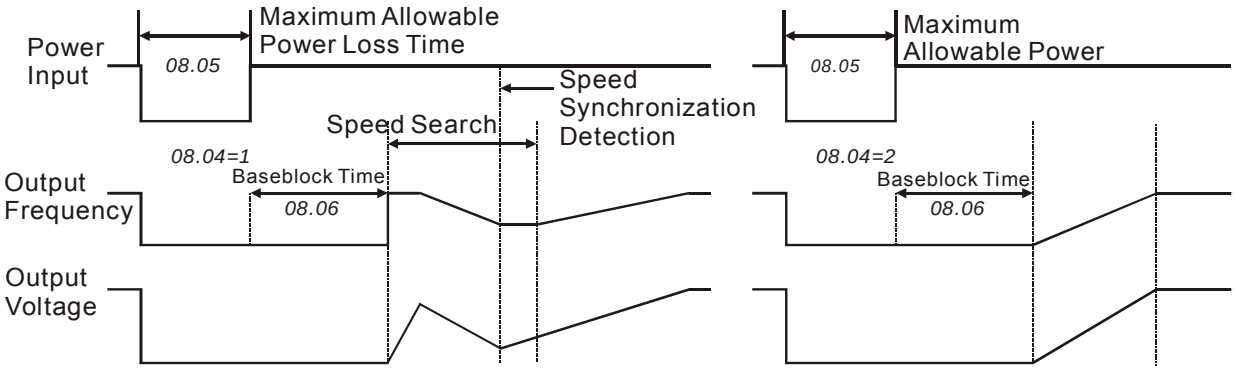
Fig3: B.B. Speed Search with Minimum Output Frequency Upward Timing Chart

08.07	Baseblock Time for Speed Search (BB)	Unit: 0.1
	Settings 0.1 to 5.0 sec	Factory Setting: 0.5

- When momentary power loss is detected, the AC motor drive will block its output and then wait for a specified period of time (determined by Pr.08.07, called Base-Block Time) before resuming operation. This parameter should be set at a value to ensure that any residual regeneration voltage from the motor on the output has disappeared before the drive is activated again.
- This parameter also determines the waiting time before resuming operation after External Baseblock and Auto Restart after Fault (Pr.08.15).
- When using a PG card with PG (encoder), speed search will begin at the actual PG (encoder) feedback speed.

08.08	Current Limit for Speed Search	Unit: 1
	Settings 30 to 200%	Factory Setting: 150

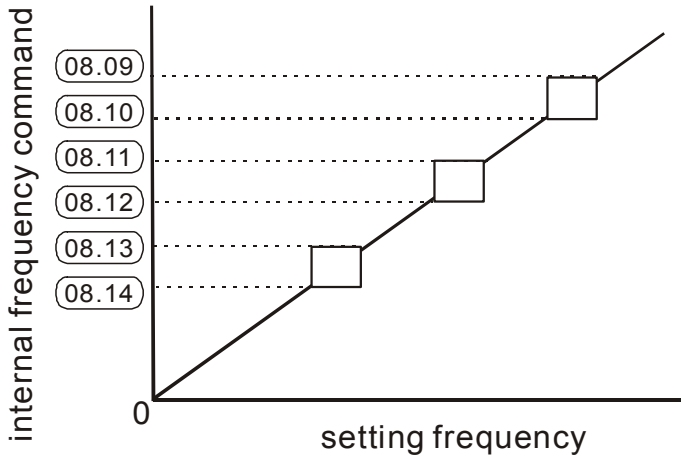
- Following a momentary power loss, the AC motor drive will start its speed search operation only if the output current is greater than the value set by Pr.08.08. When the output current is less than the value of Pr.08.08, the AC motor drive output frequency is at "speed synchronization point". The drive will start to accelerate or decelerate back to the operating frequency at which it was running prior to the power loss.



Momentary Power Loss Operation

08.09	Skip Frequency 1 Upper Limit	Unit: 0.01
08.10	Skip Frequency 1 Lower Limit	Unit: 0.01
08.11	Skip Frequency 2 Upper Limit	Unit: 0.01
08.12	Skip Frequency 2 Lower Limit	Unit: 0.01
08.13	Skip Frequency 3 Upper Limit	Unit: 0.01
08.14	Skip Frequency 3 Lower Limit	Unit: 0.01
	Settings 0.00 to 600.0Hz	Factory Setting: 0.00

- These parameters set the Skip Frequencies. It will cause the AC motor drive never to remain within these frequency ranges with continuous frequency output.
- These six parameters should be set as follows Pr.08.09 ≥ Pr.08.10 ≥ Pr.08.11 ≥ Pr.08.12 ≥ Pr.08.13 ≥ Pr.08.14.
- The frequency ranges may be overlapping.



08.15	Auto Restart After Fault	Unit: 1
Settings	0 to 10	Factory Setting: 0
	0 Disable	

- Only after an over-current OC or over-voltage OV fault occurs, the AC motor drive can be reset/restarted automatically up to 10 times.
- Setting this parameter to 0 will disable automatic reset/restart operation after any fault has occurred.

  When enabled, the AC motor drive will restart with speed search, which starts at the frequency before the fault. To set the waiting time before restart after a fault, please set Pr. 08.07 Base Block Time for Speed Search.

08.16	Auto Reset Time at Restart after Fault	Unit: 0.1
Settings	0.1 to 6000 sec	Factory Setting: 60.0

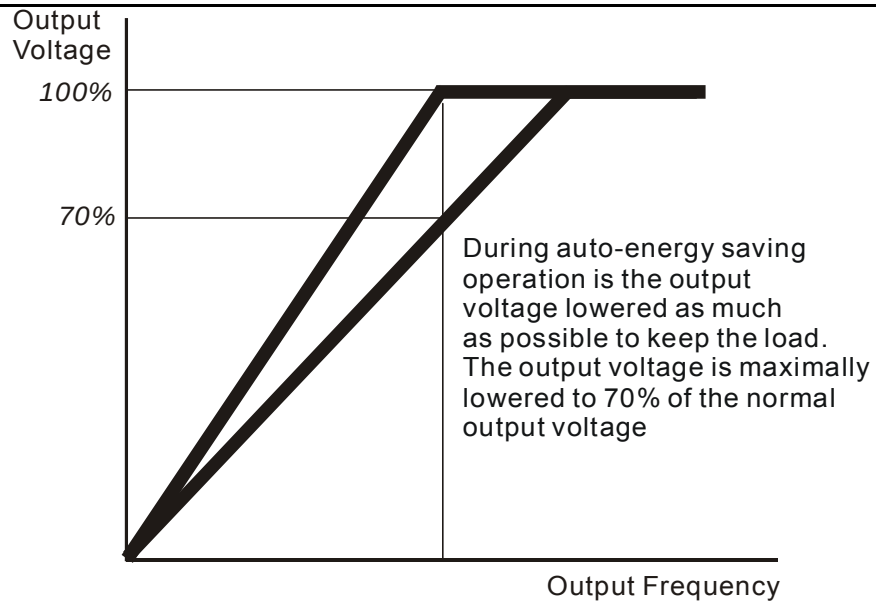
- This parameter should be used in conjunction with Pr.08.15.

  For example: If Pr.08.15 is set to 10 and Pr.08.16 is set to 600s (10 min), and if there is no fault for over 600 seconds from the restart for the previous fault, the auto reset times for restart after fault will be reset to 10.

08.17 Automatic Energy-saving

Factory Setting: 0

Settings	0	Energy-saving operation disabled
	1	Energy-saving operation enabled



08.18 Automatic Voltage Regulation (AVR)

Factory Setting: 0

Settings	0	AVR function enabled
	1	AVR function disabled
	2	AVR function disabled for deceleration
	3	AVR function disabled for stop

🕮 The rated voltage of the motor is usually 230V/200VAC 50Hz/60Hz and the input voltage of the AC motor drive may vary between 180V to 264 VAC 50Hz/60Hz. Therefore, when the AC motor drive is used without AVR function, the output voltage will be the same as the input voltage. When the motor runs at voltages exceeding the rated voltage with 12% - 20%, its lifetime will be shorter and it can be damaged due to higher temperature, failing insulation and unstable torque output.

🕮 AVR function automatically regulates the AC motor drive output voltage to the Maximum Output Voltage (Pr.01.02). For instance, if Pr.01.02 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 200VAC.

🕮 When the motor ramps to stop, the deceleration time is longer. When setting this parameter to 2 with auto acceleration/deceleration, the deceleration will be quicker.

08.19	Software Braking Level (the Action Level of the Brake resistor)	Unit: 1
Settings	115/230V series: 370.0 to 430.0V	Factory Setting: 380.0
	460V series: 740.0 to 860.0V	Factory Setting: 760.0

- This parameter sets the DC-bus voltage at which the brake chopper is activated.
- This parameter will be invalid for Frame A models (PDC002E11A/21A/23A, PDC004E11A/21A/23A/43A, PDC007E21A/23A/43A and PDC022E23A/43A) without brake chopper for which BUE brake unit must be used.

08.20	Compensation Coefficient for Motor Instability	Unit: 0.1
Settings	0.0~5.0	Factory Setting: 0.0

- The drift current will occur in a specific zone of the motor and it will make motor instable. By using this parameter, it will improve this situation greatly.
- The drift current zone of the high-power motors is usually in the low frequency area.
- It is recommended to set to more than 2.0.

Group 9: Communication Parameters

There is a built-in RS-485 serial interface, marked RJ-45 near to the control terminals. The pins are defined below:

RS-485
8←1 Serial interface
1: Reserved 2: EV 3: GND
4: SG- 5: SG+ 6: Reserved
7: Reserved 8: Reserved

Each PDC AC motor drive has a pre-assigned communication address specified by Pr.09.00. The RS485 master then controls each AC motor drive according to its communication address.

09.00	Communication Address	
	Settings 1 to 254	Factory Setting: 1

🕮 If the AC motor drive is controlled by RS-485 serial communication, the communication address for this drive must be set via this parameter. And the communication address for each AC motor drive must be different and unique.

09.01	Transmission Speed	
		Factory Setting: 1
	Settings 0	Baud rate 4800 bps (bits / second)
	1	Baud rate 9600 bps
	2	Baud rate 19200 bps
	3	Baud rate 38400 bps

🕮 This parameter is used to set the transmission speed between the RS485 master (PLC, PC, etc.) and AC motor drive.

09.02	Transmission Fault Treatment	
		Factory Setting: 3
	Settings 0	Warn and keep operating
	1	Warn and RAMP to stop
	2	Warn and COAST to stop
	3	No warning and keep operating

🕮 This parameter is set to how to react if transmission errors occur.

🕮 See list of error messages below (see section 3.6.)

09.03	Time-out Detection	Unit: 0.1
Settings	0.0 to 120.0 sec	Factory Setting: 0.0
	0.0 Disable	

📖 If Pr.09.05 is not equal to 0.0, Pr.09.02=0~2, and there is no communication on the bus during the Time Out detection period (set by Pr.09.05), “cE10” will be shown on the keypad.

09.04	Communication Protocol	
		Factory Setting: 0
Settings	0	Modbus ASCII mode, protocol <7,N,2>
	1	Modbus ASCII mode, protocol <7,E,1>
	2	Modbus ASCII mode, protocol <7,O,1>
	3	Modbus RTU mode, protocol <8,N,2>
	4	Modbus RTU mode, protocol <8,E,1>
	5	Modbus RTU mode, protocol <8,O,1>

📖 1. Control by PC or PLC

★A PDC can be set up to communicate in 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.09.03.

★Code Description:

The CPU will be about 1 second delay when using communication reset. Therefore, there is at least 1 second delay time in master station.

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

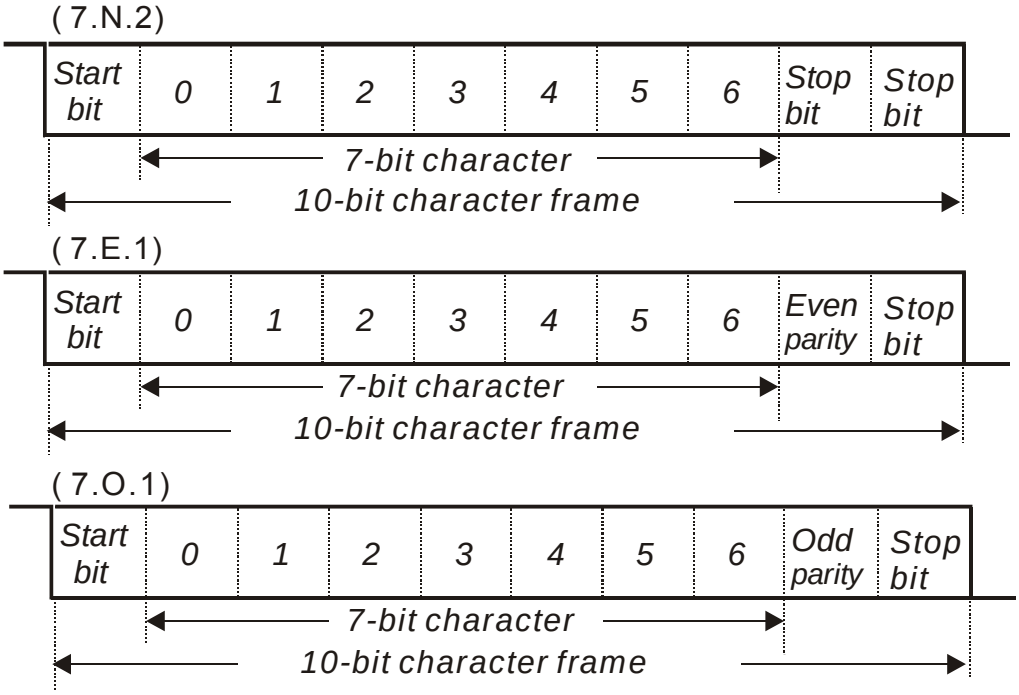
Character	‘8’	‘9’	‘A’	‘B’	‘C’	‘D’	‘E’	‘F’
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

RTU mode:

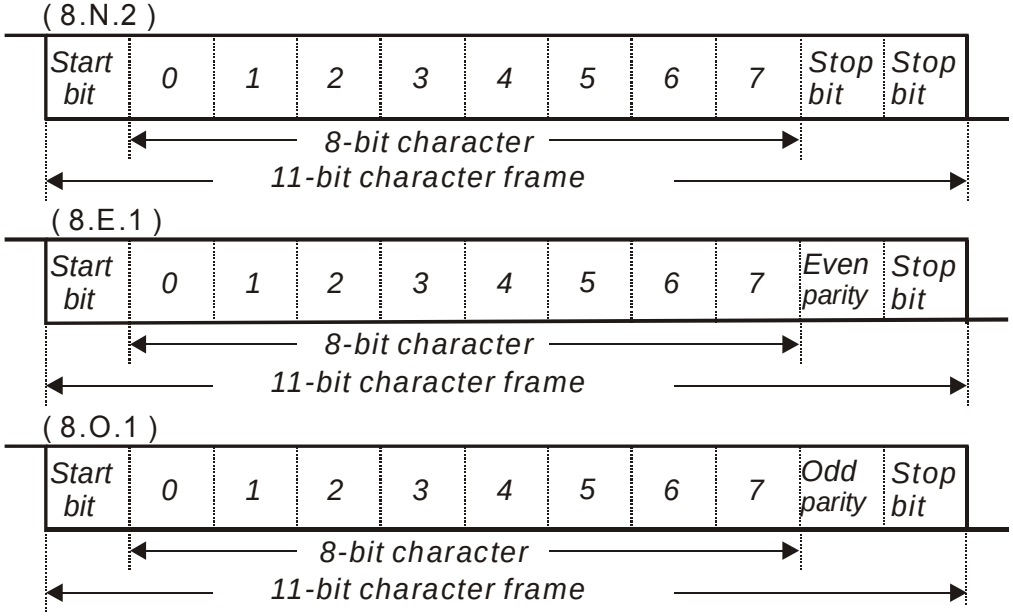
Each 8-bit data is the combination of two 4-bit hexadecimal characters. For example, 64 Hex.

📖 2. Data Format

10-bit character frame (For ASCII):



11-bit character frame (For RTU):



3. Communication Protocol

3.1 Communication Data Frame:

ASCII mode:

STX	Start character ':' (3AH)
Address Hi	Communication address:
Address Lo	8-bit address consists of 2 ASCII codes
Function Hi	Command code:
Function Lo	8-bit command consists of 2 ASCII codes
DATA (n-1) to DATA 0	Contents of data: Nx8-bit data consist of 2n ASCII codes n<=20, maximum of 40 ASCII codes
LRC CHK Hi	LRC check sum:
LRC CHK Lo	8-bit check sum consists of 2 ASCII codes
END Hi	End characters:
END Lo	END1= CR (0DH), END0= LF(0AH)

RTU mode:

START	A silent interval of more than 10 ms
Address	Communication address: 8-bit address
Function	Command code: 8-bit command
DATA (n-1) to DATA 0	Contents of data: n×8-bit data, n<=40 (20 x 16-bit data)
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 Address (Communication Address)

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

00H: broadcast to all AC drives

01H: AC drive of address 01

0FH: AC drive of address 15

10H: AC drive of address 16

:

FEH: AC drive of address 254

For example, communication to AMD with address 16 decimal (10H):

ASCII mode: Address='1','0' => '1'=31H, '0'=30H

RTU mode: Address=10H

3.3 Function (Function code) and DATA (data characters)

The format of data characters depends on the function code.

03H: read data from register

06H: write single register

08H: loop detection

The available function codes and examples for PDC are described as follows:

(1) 03H: multi read, read data from registers.

Example: reading continuous 2 data from register address 2102H, AMD address is 01H.

ASCII mode:

Command message:

STX	':'
Address	'0'
	'1'
Function	'0'
	'3'
Starting data address	'2'
	'1'
	'0'
	'2'
Number of data (count by word)	'0'
	'0'
	'0'
	'2'
LRC Check	'D'
	'7'
END	CR
	LF

Response message:

STX	':'
Address	'0'
	'1'
Function	'0'
	'3'
Number of data (Count by byte)	'0'
	'4'
Content of starting address 2102H	'1'
	'7'
	'7'
	'0'
Content of address 2103H	'0'
	'0'
	'0'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

RTU mode:

Command message:

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

Response message:

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

(2) 06H: single write, write single data to register.

Example: writing data 6000(1770H) to register 0100H. AMD address is 01H.

ASCII mode:

Command message:

STX	':'
Address	'0'
	'1'
Function	'0'
	'6'
Data address	'0'
	'1'
	'0'
	'0'
Data content	'1'
	'7'
	'7'
	'0'

Response message:

STX	':'
Address	'0'
	'1'
Function	'0'
	'6'
Data address	'0'
	'1'
	'0'
	'0'
Data content	'1'
	'7'
	'7'
	'0'

Command message:

LRC Check	'7'
	'1'
END	CR
	LF

Response message:

LRC Check	'7'
	'1'
END	CR
	LF

RTU mode:

Command message:

Address	01H
Function	06H
Data address	01H
	00H
Data content	17H
	70H
CRC CHK Low	86H
CRC CHK High	22H

Response message:

Address	01H
Function	06H
Data address	01H
	00H
Data content	17H
	70H
CRC CHK Low	86H
CRC CHK High	22H

3.4 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	':'
Address 1	'0'
Address 0	'1'
Function 1	'0'
Function 0	'3'
Starting data address	'0'
	'4'
	'0'
	'1'
Number of data	'0'
	'0'
	'0'
	'1'
LRC Check 1	'F'
LRC Check 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:

Address	01H
Function	03H
Starting data address	21H
	02H
Number of data (count by word)	00H
	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	Function	
AC drive Parameters	GGnnH	GG means parameter group, nn means parameter number, for example, the address of Pr 04.01 is 0401H. Refer 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 Write only	2000H	Bit 0-1	00B: No function 01B: Stop 10B: Run 11B: Jog + Run
		Bit 2-3	Reserved
		Bit 4-5	00B: No function 01B: FWD 10B: REV 11B: Change direction
		Bit 6-7	00B: Comm. forced 1st accel/decel 01B: Comm. forced 2nd accel/decel
		Bit 8-15	Reserved
	2001H	Frequency command	
	2002H	Bit 0	1: EF (external fault) on
		Bit 1	1: Reset
		Bit 2-15	Reserved
Status monitor Read only	2100H	Error code:	
		0: No error occurred	
		1: Over-current (oc)	
		2: Over-voltage (ov)	
		3: IGBT Overheat (oH1)	
		4: Power Board Overheat (oH2)	
		5: Overload (oL)	
		6: Overload1 (oL1)	
		7: Overload2 (oL2)	
		8: External fault (EF)	
		9: Current exceeds 2 times rated current during accel (ocA)	
		10: Current exceeds 2 times rated current during decel (ocd) Current exceeds 2 times rated current during decel (ocd)	
		11: Current exceeds 2 times rated current during steady state operation (ocn)	
		12: Ground Fault (GFF)	

Content	Address	Function	
Status monitor Read only	2100H	13: Low voltage (Lv)	
		14: PHL (Phase-Loss)	
		15: Base Block	
		16: Auto accel/decel failure (cFA)	
		17: Software protection enabled (codE)	
		18: Power Board CPU WRITE failure (CF1.0)	
		19: Power Board CPU READ failure (CF2.0)	
		20: CC, OC Hardware protection failure (HPF1)	
		21: OV Hardware protection failure (HPF2)	
		22: GFF Hardware protection failure (HPF3)	
		23: OC Hardware protection failure (HPF4)	
		24: U-phase error (cF3.0)	
		25: V-phase error (cF3.1)	
		26: W-phase error (cF3.2)	
		27: DCBUS error (cF3.3)	
		28: IGBT Overheat (cF3.4)	
		29: Power Board Overheat (cF3.5)	
		30: Control Board CPU WRITE failure (cF1.1)	
		31: Control Board CPU WRITE failure (cF2.1)	
		32: ACI signal error (AErr)	
		33: Reserved	
		34: Motor PTC overheat protection (PtC1)	
	2101H	Status of AC drive	
		Bit 0-1	00B: RUN LED is off, STOP LED is on (The AC motor Drive stops)
			01B: RUN LED blinks, STOP LED is on (When AC motor drive decelerates to stop)
			10B: RUN LED is on, STOP LED blinks (When AC motor drive is standby)
			11B: RUN LED is on, STOP LED is off (When AC motor drive runs)
		Bit 2	1: JOG command
		Bit 3-4	00B: FWD LED is on, REV LED is off (When AC motor drive runs forward)
			01B: FWD LED is on, REV LED blinks (When AC motor drive runs from reverse to forward)
			10B: FWD LED blinks, REV LED is on (When AC motor drive runs from forward to reverse)
			11B: FWD LED is off, REV LED is on (When AC motor drive runs reverse)
		Bit 5-7	Reserved
		Bit 8	1: Master frequency Controlled by communication interface
		Bit 9	1: Master frequency controlled by analog signal
		Bit 10	1: Operation command controlled by communication interface
		Bit 11-15	Reserved
	2102H	Frequency command (F)	
	2103H	Output frequency (H)	
	2104H	Output current (AXXX.X)	
	2105H	Reserved	
	2106H	Reserved	
	2107H	Reserved	

Content	Address	Function
	2108H	DC-BUS Voltage (UXXX.X)
	2109H	Output voltage (EXXX.X)
	210AH	Display temperature of IGBT (°C)

3.6 Exception response:

The AC motor drive is expected to return a normal response after receiving command messages from the master device. The following depicts the conditions when no normal response is replied to the master device.

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

The AC motor drive receives the messages without a communication error, but cannot handle them. An exception response will be returned to the master device and an error message “CExx” will be displayed on the keypad of AC motor drive. The xx of “CExx” is a decimal code equal to the exception code that is described below.

In the exception response, the most significant bit of the original command code is set to 1, and an exception code which explains the condition that caused the exception is returned.

Example of an exception response of command code 06H and exception code 02H:

ASCII mode:

STX	‘:’
Address Low	‘0’
Address High	‘1’
Function Low	‘8’
Function High	‘6’
Exception code	‘0’
	‘2’
LRC CHK Low	‘7’
LRC CHK High	‘7’
END 1	CR
END 0	LF

RTU mode:

Address	01H
Function	86H
Exception code	02H
CRC CHK Low	C3H
CRC CHK High	A1H

The explanation of exception codes:

Exception code	Explanation
01	Illegal function code: The function code received in the command message is not available for the AC motor drive.
02	Illegal data address: The data address received in the command message is not available for the AC motor drive.
03	Illegal data value: The data value received in the command message is not available for the AC drive.
04	Slave device failure: The AC motor drive is unable to perform the requested action.
10	Communication time-out: If Pr.09.05 is not equal to 0.0, Pr.09.02=0~2, and there is no communication on the bus during the Time Out detection period (set by Pr.09.05), “cE10” will be shown on the keypad.

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 in C language.

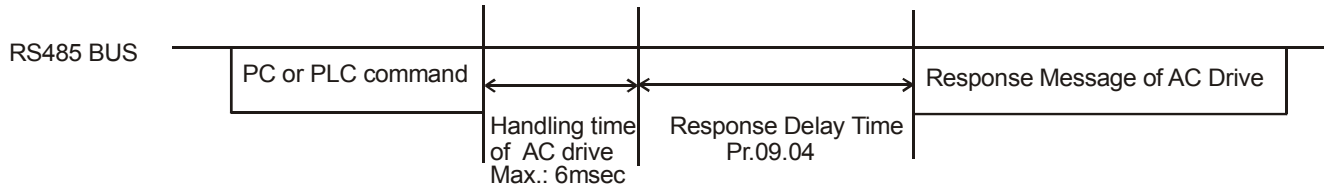
```
#include<stdio.h>
#include<dos.h>
#include<conio.h>
#include<process.h>
#define PORT 0x03F8  /* the address of COM1 */
/* the address offset value relative to COM1 */
#define THR  0x0000
#define RDR  0x0000
#define BRDL  0x0000
#define IER  0x0001
#define BRDH 0x0001
#define LCR  0x0003
#define MCR  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 */
}   }    }
```

09.05	Reserved
09.06	Reserved

09.07	Response Delay Time	Unit: 2
	Settings 0 ~ 200 (400msec)	Factory Setting: 1

📖 This parameter is the response delay time after AC drive receives communication command as shown in the following. 1 unit = 2 msec.



📖

Group 10: PID Control

10.00	PID Set Point Selection	
		Factory Setting: 0
Settings	0	Disable
	1	Digital keypad UP/DOWN keys
	2	AVI 0 ~ +10VDC
	3	ACI 4 ~ 20mA / AVI2 0 ~ +10VDC
	4	PID set point (Pr.10.11)

10.01	Input Terminal for PID Feedback	
		Factory Setting: 0
Settings	0	**Positive** PID feedback from external terminal AVI (0 ~ +10VDC).
	1	**Negative** PID feedback from external terminal AVI (0 ~ +10VDC).
	2	**Positive** PID feedback from external terminal ACI (4 ~ 20mA)/ AVI2 (0 ~ +10VDC).
	3	**Negative** PID feedback from external terminal ACI (4 ~ 20mA)/ AVI2 (0 ~ +10VDC).

- Note that the measured variable (feedback) controls the output frequency (Hz). Select input terminal accordingly. Make sure this parameter setting does not conflict with the setting for Pr.10.00 (Master Frequency).
- When Pr.10.00 is set to 2 or 3, the set point (Master Frequency) for PID control is obtained from the AVI or ACI/AVI2 external terminal (0 to +10V or 4-20mA) or from multi-step speed. When Pr.10.00 is set to 1, the set point is obtained from the keypad.
- Negative feedback means: +target value – feedback
  Positive feedback means: -target value + feedback.

10.02	↗Proportional Gain (P)	Unit: 0. 1
Settings	0.0 to 10.0	Factory Setting: 1.0

- This parameter specifies proportional control and associated gain (P). If the other two gains (I and D) are set to zero, proportional control is the only one effective. With 10% deviation (error) and P=1, the output will be P x10% x Master Frequency.

NOTE

The parameter can be set during operation for easy tuning.

10.03	✓Integral Time (I)	Unit: 0.01
	Settings 0.00 to 100.0 sec	Factory Setting: 1.00
	0.00 Disable	

📖 This parameter specifies integral control (continual sum of the deviation) and associated gain (I). When the integral gain is set to 1 and the deviation is fixed, the output is equal to the input (deviation) once the integral time setting is attained.

NOTE

The parameter can be set during operation for easy tuning.

10.04	✓Derivative Control (D)	Unit: 0.01
	Settings 0.00 to 1.00 sec	Factory Setting: 0.00

📖 This parameter specifies derivative control (rate of change of the input) and associated gain (D). With this parameter set to 1, the PID output is equal to differential time x (present deviation – previous deviation). It increases the response speed but it may cause over-compensation.

NOTE

The parameter can be set during operation for easy tuning.

10.05	Upper Bound for Integral Control	Unit: 1
	Settings 0 to 100 %	Factory Setting: 100

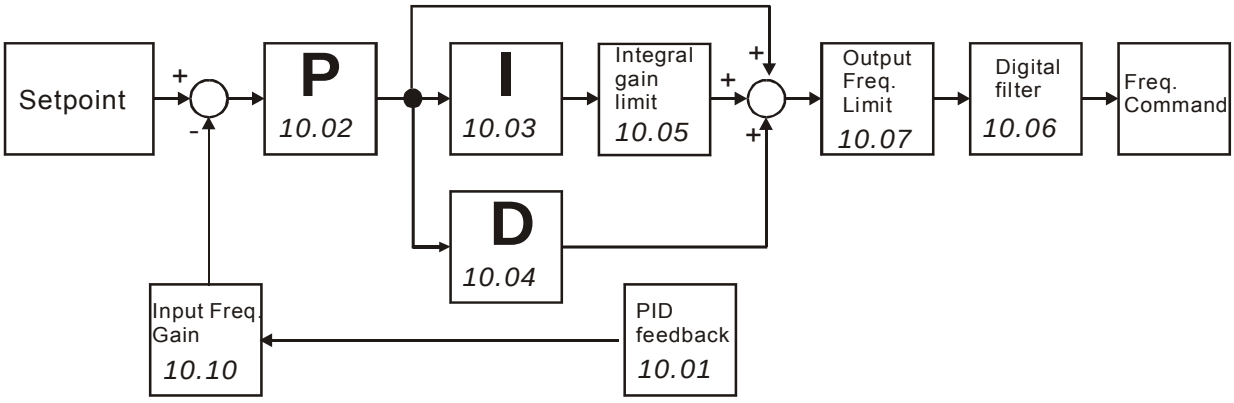
📖 This parameter defines an upper bound or limit for the integral gain (I) and therefore limits the Master Frequency.

📖 The formula is: Integral upper bound = Maximum Output Frequency (Pr.01.00) x (Pr.10.05). This parameter can limit the Maximum Output Frequency.

10.06	Primary Delay Filter Time	Unit: 0.1
	Settings 0.0 to 2.5 sec	Factory Setting: 0.0

📖 To avoid amplification of measurement noise in the controller output, a derivative digital filter is inserted. This filter helps to dampen oscillations.

The complete PID diagram is in the following:



10.07	PID Output Frequency Limit	Unit: 1
	Settings 0 to 110 %	Factory Setting: 100

🕮 This parameter defines the percentage of output frequency limit during the PID control. The formula is Output Frequency Limit = Maximum Output Frequency (Pr.01.00) X Pr.10.07 %. This parameter will limit the Maximum Output Frequency. An overall limit for the output frequency can be set in Pr.01.07.

10.08	PID Feedback Signal Detection Time	Unit: 0.1
	Settings 0.0 to d 3600 sec	Factory Setting: 60.0

🕮 This parameter defines the time during which the PID feedback must be abnormal before a warning (see Pr.10.09) is given. It also can be modified according to the system feedback signal time.

🕮 If this parameter is set to 0.0, the system would not detect any abnormality signal.

10.09	Treatment of the Erroneous Feedback Signals (for PID and PG feedback error)
	Factory Setting: 0
Settings	0 Warning and RAMP to stop
	1 Warning and COAST to stop
	2 Warning and keep operating

🕮 AC motor drive action when the feedback signals (analog PID feedback or PG (encoder) feedback) are abnormal according to Pr.10.16.

10.10	Gain Over the PID Detection Value	Unit: 0.1
	Settings 0.0 to 10.0	Factory Setting: 1.0

📖 This is the gain adjustment over the feedback detection value. Refer to PID control block diagram in Pr.10.06 for detail.

10.11	✓Source of PID Set point		Unit: 0.01
	Settings	0.00 to 600.0Hz	Factory Setting: 0.00

📖 This parameter is used in conjunction with Pr.10.00 set 4 to input a set point in Hz.

10.12	PID Offset Level		Unit: 0.1
	Settings	1.0 to 50.0%	Factory Setting: 10.0
10.13	Detection Time of PID Offset		Unit: 0.1
	Settings	0.1 to 300.0 sec	Factory Setting: 5.0

📖 This parameter is used to set detection of the offset between set point and feedback.

📖 When the offset is higher than the setting of Pr.10.12 for a time exceeding the setting of Pr.10.13, the AC motor drive will output a signal when Pr.03.00 ~ Pr.03.01 is set to 16.

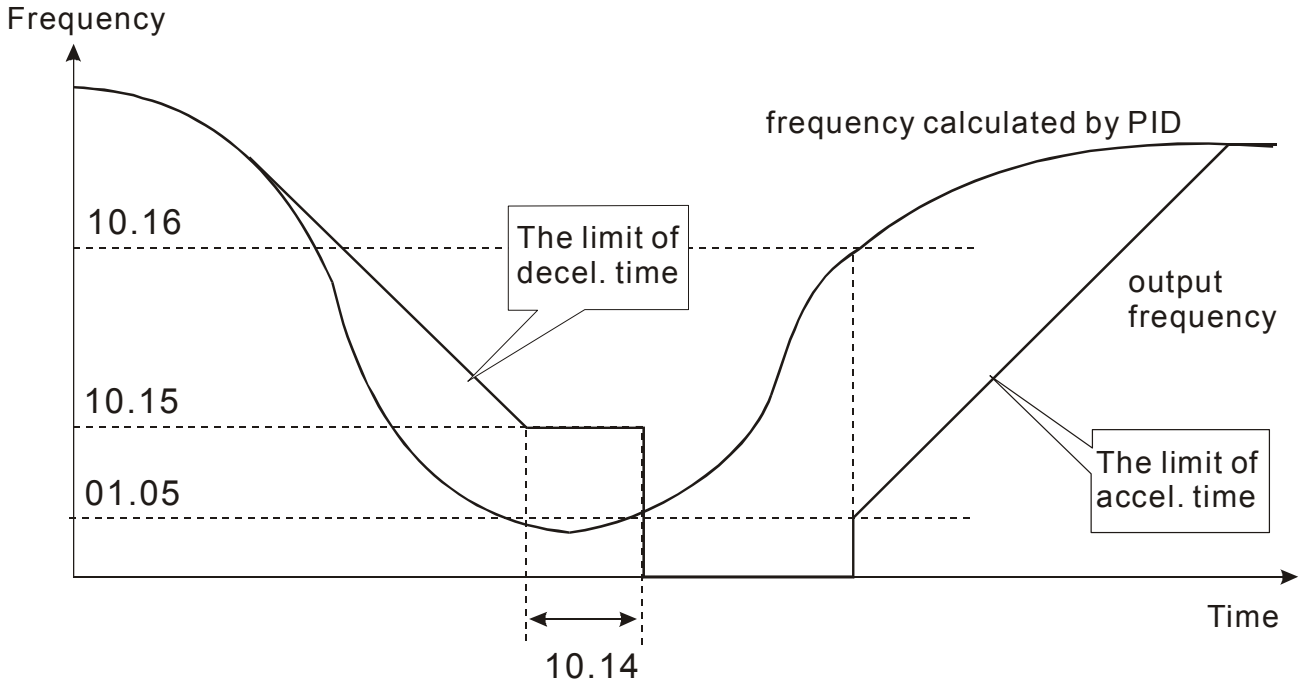
10.14	Sleep/Wake Up Detection Time		Unit: 0.1
	Settings	0.0 to 6550 sec	Factory Setting: 0.0
10.15	Sleep Frequency		Unit: 0.01
	Settings	0.00 to 600.0 Hz	Factory Setting: 0.00
10.16	Wakeup Frequency		Unit: 0.01
	Settings	0.00 to 600.0 Hz	Factory Setting: 0.00

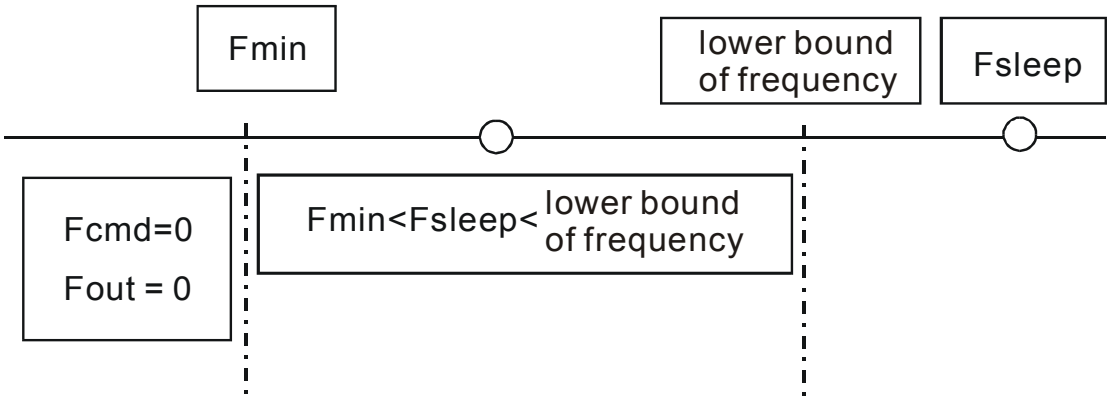
📖 When the actual output frequency $\leq$ Pr.10.15 and the time exceeds the setting of Pr.10.14, the AC motor drive will be in sleep mode.

📖 When the actual frequency command > Pr.10.16 and the time exceeds the setting of Pr.10.14, the AC motor drive will restart.

📖 When the AC motor drive is in sleep mode, frequency command is still calculated by PID. When frequency reaches wake up frequency, AC motor drive will accelerate from Pr.01.05 minimum frequency following the V/f curve.

📖 The wake up frequency must be higher than sleep frequency.





- When output frequency ≤ sleep frequency and time > detection time, it will go in sleep mode.
- When min. output frequency ≦ PID frequency ≦ lower bound of frequency and sleep function is enabled (output frequency ≤ sleep frequency and time > detection time), frequency will be 0 (in sleep mode). If sleep function is disabled, frequency command = lower bound frequency.
- When PID frequency < min. output frequency and sleep function is enabled (output frequency ≤ sleep frequency and time > detection time), output frequency =0 (in sleep mode).
  If output frequency ≤ sleep frequency but time < detection time, frequency command = lower frequency. If sleep function is disabled, output frequency =0.

10.17	Minimum PID Output Frequency Selection

Factory Setting: 0

Settings	0	By PID control
	1	By Minimum output frequency (Pr.01.05)

🕮 This is the source selection of minimum output frequency when control is by PID.

Group 11: Parameters for Extension Card

Make sure that the extension card is installed on the AC motor drive correctly before using group 11 parameters. See Appendix B for details.

11.00	Multi-function Output Terminal MO2/RA2
11.01	Multi-function Output Terminal MO3/RA3
11.02	Multi-function Output Terminal MO4/RA4
11.03	Multi-function Output Terminal MO5/RA5
11.04	Multi-function Output Terminal MO6/RA6
11.05	Multi-function Output Terminal MO7/RA7
	Settings 0 to 21 Factory Setting: 0

Settings	Function	Description
0	No Function	
1	AC Drive Operational	Active when the drive is ready or RUN command is “ON”.
2	Master Frequency Attained	Active when the AC motor drive reaches the output frequency setting.
3	Zero Speed	Active when Command Frequency is lower than the Minimum Output Frequency.
4	Over-Torque Detection	Active as long as over-torque is detected. (Refer to Pr.06.03 ~ Pr.06.05)
5	Baseblock (B.B.) Indication	Active when the output of the AC motor drive is shut off during baseblock. Base block can be forced by Multi-function input (setting 09).
6	Low-Voltage Indication	Active when low voltage (Lv) is detected.
7	Operation Mode Indication	Active when operation command is controlled by external terminal.
8	Fault Indication	Active when a fault occurs (oc, ov, oH, oL, oL1, EF, cF3, HPF, ocA, ocd, ocn, GFF).
9	Desired Frequency Attained	Active when the desired frequency (Pr.03.05) is attained.
10	Terminal Count Value Attained	Active when the counter reaches Terminal Count Value.
11	Preliminary Count Value Attained	Active when the counter reaches Preliminary Count Value.

Settings	Function	Description
12	Over Voltage Stall supervision	Active when the Over Voltage Stall function operating
13	Over Current Stall supervision	Active when the Over Current Stall function operating
14	Heat Sink Overheat Warning	When heatsink overheats, it will signal to prevent OH turn off the drive. When it is higher than 85°C (185°F), it will be ON.
15	Over Voltage supervision	Active when the DC-BUS voltage exceeds level
16	PID supervision	Active when the PID function is operating
17	Forward command	Active when the direction command is FWD
18	Reverse command	Active when the direction command is REV
19	Zero Speed Output Signal	Active unless there is an output frequency present at terminals U/T1, V/T2, and W/T3.
20	Communication Warning (FbE,Cexx, AoL2, AUE, SAvE)	Active when there is a Communication Warning
21	Brake Control (Desired Frequency Attained)	Active when output frequency ≥Pr.03.14. Deactivated when output frequency ≤Pr.03.15 after STOP command.

11.06	Multi-function Input Terminal (MI7)	
11.07	Multi-function Input Terminal (MI8)	
11.08	Multi-function Input Terminal (MI9)	
11.09	Multi-function Input Terminal (MI10)	
11.10	Multi-function Input Terminal (MI11)	
11.11	Multi-function Input Terminal (MI12)	
	Settings 0 to 23	Factory Setting: 0

Settings	Function	Description
0	No Function	Any unused terminals should be programmed to 0 to insure they have no effect on operation.
1	Multi-Step Speed Command 1	These four inputs select the multi-speed defined by Pr.05.00 to Pr.05.14 as shown in the diagram at the end of the table in Pr.04.08.
2	Multi-Step Speed Command 2	

Settings	Function	Description
3	Multi-Step Speed Command 3	**NOTE: Pr.05.00 to Pr.05.14 can also be used to control output speed by programming the AC motor drive's internal PLC function. There are 17 step speed frequencies (including Master Frequency and Jog Frequency) to select for application.**
4	Multi-Step Speed Command 4	
5	External Reset	The External Reset has the same function as the Reset key on the Digital keypad. After faults such as O.H., O.C. and O.V. are cleared this input can be used to reset the drive.
6	Accel/Decel Inhibit	When the command is active, acceleration and deceleration is stopped and the AC motor drive maintains a constant speed.
7	Accel/Decel Time Selection Command	Used to select the one of 2 Accel/Decel Times (Pr.01.09 to Pr.01.12). See explanation at the end of this table.
8	Jog Operation Control	Parameter value 08 programs one of the Multi-function Input Terminals MI7 ~ MI12 (Pr.11.06~Pr.11.11) for Jog control. **NOTE: Programming for Jog operation by 08 can only be done while the motor is stopped. (Refer to parameter Pr.01.13~Pr.01.15)**
9	External Base Block (Refer to Pr.08.06)	Parameter value 09 programs a Multi-function Input Terminals for external Base Block control. **NOTE: When a Base-Block signal is received, the AC motor drive will block 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.**
10	UP: Increase Master Frequency	Increase/decrease the Master Frequency each time an input is received or continuously when the input stays active. When both inputs are active at the same time, the Master Frequency increase/decrease is halted. Please refer to Pr.02.07, 02.08. This function is also called "motor potentiometer".
11	DOWN: Decrease Master Frequency	
12	Counter Trigger	Parameter value 12 programs one of the Multi-function Input Terminals MI7 ~ MI12 (Pr.11.06~Pr.11.11) to increment the AC drive's internal counter. When an input is received, the counter is incremented by 1.

Settings	Function	Description
13	Counter Reset	When active, the counter is reset and inhibited. To enable counting the input should be OFF. Refer to Pr.03.05 and 03.06.
14	External Fault	Parameter value 14 programs one of the Multi-function Input Terminals MI7 ~ MI12 (Pr.11.06~Pr.11.11) to be External Fault (E.F.) inputs.
15	PID function disabled	When an input ON with this setting is ON, the PID function will be disabled.
16	Output Shutoff Stop	AC motor drive will stop output and the motor free run if one of these settings is enabled. If the status of terminal is changed, AC motor drive will restart from 0Hz.
17	Parameter lock enable	When this setting is enabled, all parameters will be locked and write parameters is disabled.
18	Operation Command Selection (Pr.02.01 setting/external terminals)	ON: Operation command via Ext. Terminals OFF: Operation command via Pr.02.01 setting Pr.02.01 is disabled if this parameter value 18 is set. See the explanation below this table.
19	Operation Command Selection (Pr 02.01 setting/Digital Keypad)	ON: Operation command via Digital Keypad OFF: Operation command via Pr.02.01 setting Pr.02.01 is disabled if this parameter value 19 is set. See the explanation below this table.
20	Operation Command Selection (Pr 02.01 setting/ Communication)	ON: Operation command via Communication OFF: Operation command via Pr.02.01 setting Pr.02.01 is disabled if this parameter value 20 is set. See the explanation below this table.
21	Forward/Reverse	This function has top priority to set the direction for running (If “Pr.02.04=0”)
22	Source of second frequency command enabled	Used to select the first/second frequency command source. Refer to Pr.02.00 and 02.09. ON: 2nd Frequency command source OFF: 1st Frequency command source

Settings	Function	Description
23	Run/Stop PLC Program	ON: Run PLC Program OFF: Stop PLC Program When AC motor drive is in STOP mode and this function is enabled, it will display PLC1 in the PLC page and execute PLC program. When this function is disabled, it will display PLC0 in the PLC page and stop executing PLC program. The motor will be stopped by Pr.02.02. When operation command source is external terminal, the keypad cannot be used to change PLC status. And this function will be invalid when AC Motor drive is in PLC2 status.
24	Download/Execute/ Monitor PLC Program (PLC2)	When AC motor drive is in STOP mode and this function is enabled, it will display PLC2 in the PLC page and you can download/execute/monitor PLC. When this function is disabled, it will display PLC0 in the PLC page and stop executing PLC program. The motor will be stopped by Pr.02.02. When operation command source is external terminal, the keypad cannot be used to change PLC status. And this function will be invalid when the AC Motor drive is in PLC1 status.

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Chapter 6 Fault Code Information

The AC motor 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 motor drive digital keypad display. The five most recent faults can be read from the digital keypad or communication.

NOTE

Wait 5 seconds after a fault has been cleared before performing reset via keypad of input terminal.

6.1 Common Problems and Solutions

Fault Name	Fault Descriptions	Corrective Actions
oc	**Over current** Abnormal increase in current.	1. Check if motor power corresponds with the AC motor drive output power. 2. Check the wiring connections to U/T1, V/T2, W/T3 for possible short circuits. 3. Check the wiring connections between the AC motor drive and motor for possible short circuits, also to ground. 4. Check for loose contacts between AC motor drive and motor. 5. Increase the Acceleration Time. 6. Check for possible excessive loading conditions at the motor. 7. If there are still any abnormal conditions when operating the AC motor drive after a short-circuit is removed and the other points above are checked, it should be sent back to manufacturer.
ou	**Over voltage** The DC bus voltage has exceeded its maximum allowable value.	1. Check if the input voltage falls within the rated AC motor drive input voltage range. 2. Check for possible voltage transients. 3. DC-bus over-voltage may also be caused by motor regeneration. Either increase the Decel. Time or add an optional brake resistor (and brake unit). 4. Check whether the required braking power is within the specified limits.

Fault Name	Fault Descriptions	Corrective Actions
oH1 oH2	**Overheating** Heat sink temperature too high	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 from the heatsinks and check for possible dirty heat sink fins. 4. Check the fan and clean it. 5. Provide enough spacing for adequate ventilation. (See chapter 2)
Lu	**Low voltage** The AC motor drive detects that the DC bus voltage has fallen below its minimum value.	1. Check whether the input voltage falls within the AC motor drive rated input voltage range. 2. Check for abnormal load in motor. 3. Check for correct wiring of input power to R-S-T (for 3-phase models) without phase loss.
oL	**Overload** The AC motor drive detects excessive drive output current. **NOTE: The AC motor 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 in Pr.07.02. 3. Use the next higher power AC motor drive model.
oL1	**Overload 1** Internal electronic overload trip	1. Check for possible motor overload. 2. Check electronic thermal overload setting. 3. Use a higher power motor. 4. Reduce the current level so that the drive output current does not exceed the value set by the Motor Rated Current Pr.07.00.
oL2	**Overload 2** Motor overload.	1. Reduce the motor load. 2. Adjust the over-torque detection setting to an appropriate setting (Pr.06.03 to Pr.06.05).
HPF1	**CC (current clamp)**	Return to the factory.
HPF2	**OV hardware error**	
HPF3	**GFF hardware error**	
HPF4	**OC hardware error**	
bb	**External Base Block.** (Refer to Pr. 08.07)	1. When the external input terminal (B.B) is active, the AC motor drive output will be turned off. 2. Deactivate the external input terminal (B.B) to operate the AC motor drive again.

Fault Name	Fault Descriptions	Corrective Actions
ocA	**Over-current during acceleration**	1. Short-circuit at motor output: Check for possible poor insulation at the output lines. 2. Torque boost too high: Decrease the torque compensation setting in Pr.07.02. 3. Acceleration Time too short: Increase the Acceleration Time. 4. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model.
ocd	**Over-current during deceleration**	1. Short-circuit at motor output: Check for possible poor insulation at the output line. 2. Deceleration Time too short: Increase the Deceleration Time. 3. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model.
ocn	**Over-current during constant speed operation**	1. Short-circuit at motor output: Check for possible poor insulation at the output line. 2. Sudden increase in motor loading: Check for possible motor stall. 3. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model.
EF	**External Fault**	1. When multi-function input terminals (MI3-MI9) are set to external fault, the AC motor drive stops output U, V and W. 2. Give RESET command after fault has been cleared.
cF1.0	**Internal EEPROM can not be programmed.**	Return to the factory.
cF1.1	**Internal EEPROM can not be programmed.**	Return to the factory.
cF2.0	**Internal EEPROM can not be read.**	1. Press RESET key to set all parameters to factory setting. 2. Return to the factory.
cF2.1	**Internal EEPROM can not be read.**	1. Press RESET key to set all parameters to factory setting. 2. Return to the factory.
cF3.0	**U-phase error**	Return to the factory.
cF3.1	**V-phase error**	
cF3.2	**W-phase error**	
cF3.3	**OV or LV**	
cF3.4 cF3.5	**Temperature sensor error**	

Fault Name	Fault Descriptions	Corrective Actions
GFF	**Ground fault**	When (one of) the output terminal(s) is grounded, short circuit current is more than 50% of AC motor drive rated current, the AC motor drive power module may be damaged. **NOTE: The short circuit protection is provided for AC motor drive protection, not for protection of the user.** 1. Check whether the IGBT power module is damaged. 2. Check for possible poor insulation at the output line.
cFA	**Auto accel/decel failure**	1. Check if the motor is suitable for operation by AC motor drive. 2. Check if the regenerative energy is too large. 3. Load may have changed suddenly.
cE--	**Communication Error**	1. Check the RS485 connection between the AC motor drive and RS485 master for loose wires and wiring to correct pins. 2. Check if the communication protocol, address, transmission speed, etc. are properly set. 3. Use the correct checksum calculation. 4. Please refer to group 9 in the chapter 5 for detail information.
codE	**Software protection failure**	Return to the factory.
AErr	**Analog signal error**	Check the wiring of ACI
FbE	**PID feedback signal error**	1. Check parameter settings (Pr.10.01) and AVI/ACI wiring. 2. Check for possible fault between system response time and the PID feedback signal detection time (Pr.10.08)
PHL	**Phase Loss**	Check input phase wiring for loose contacts.
AUE	**Auto Tuning Error**	1. Check cabling between drive and motor 2. Retry again

6.2 Reset

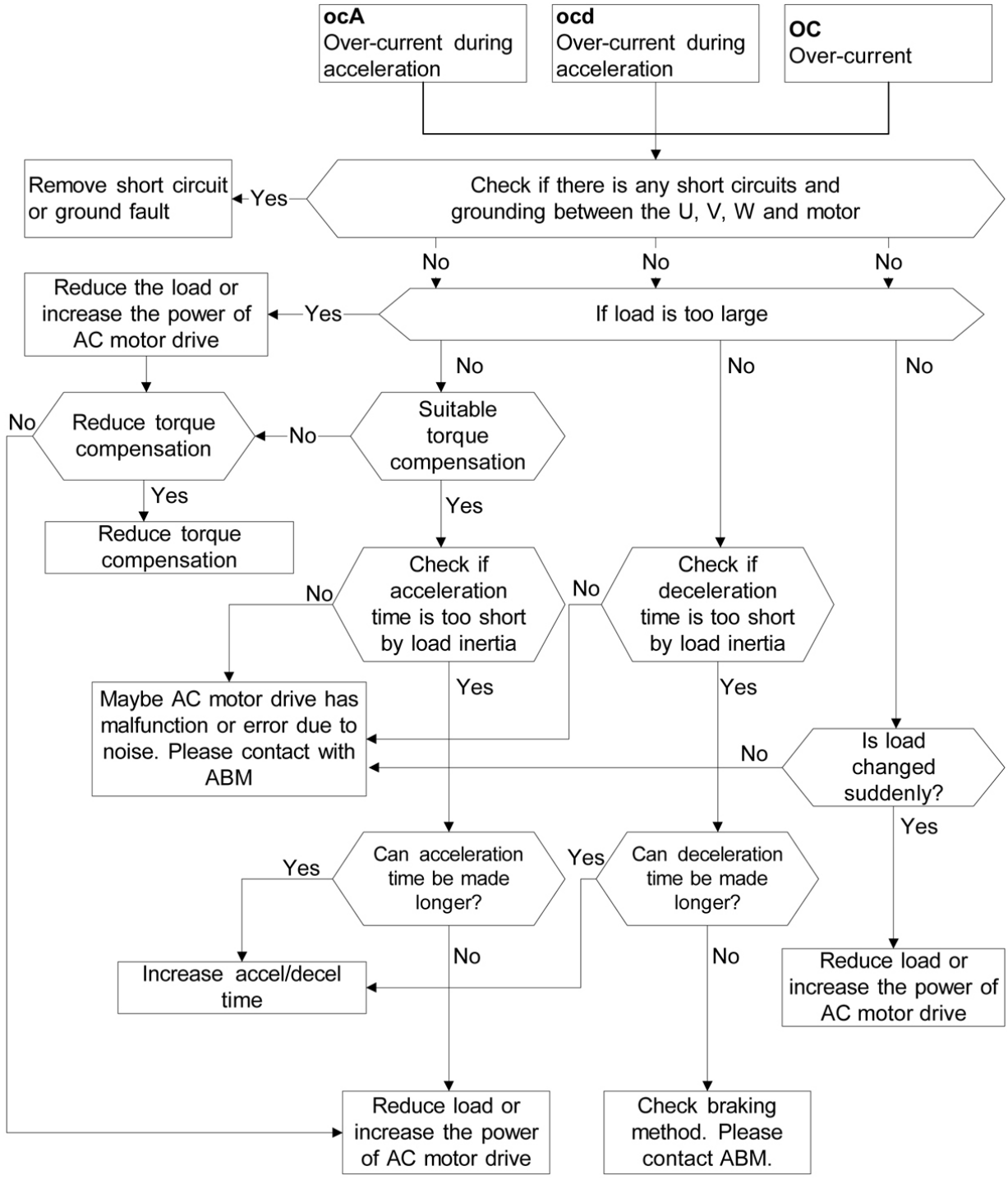
There are three methods to reset the AC motor drive after solving the fault:

1. Press STOP RESET key on keypad.
2. Set external terminal to “RESET” (set one of Pr.04.05~Pr.04.08 to 05) and then set to be ON.
3. Send “RESET” command by communication.

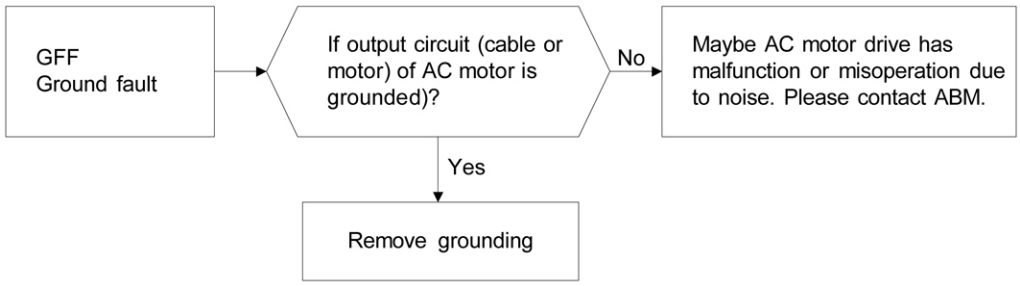
NOTE

Make sure that RUN command or signal is OFF before executing RESET to prevent damage or personal injury due to immediate operation.

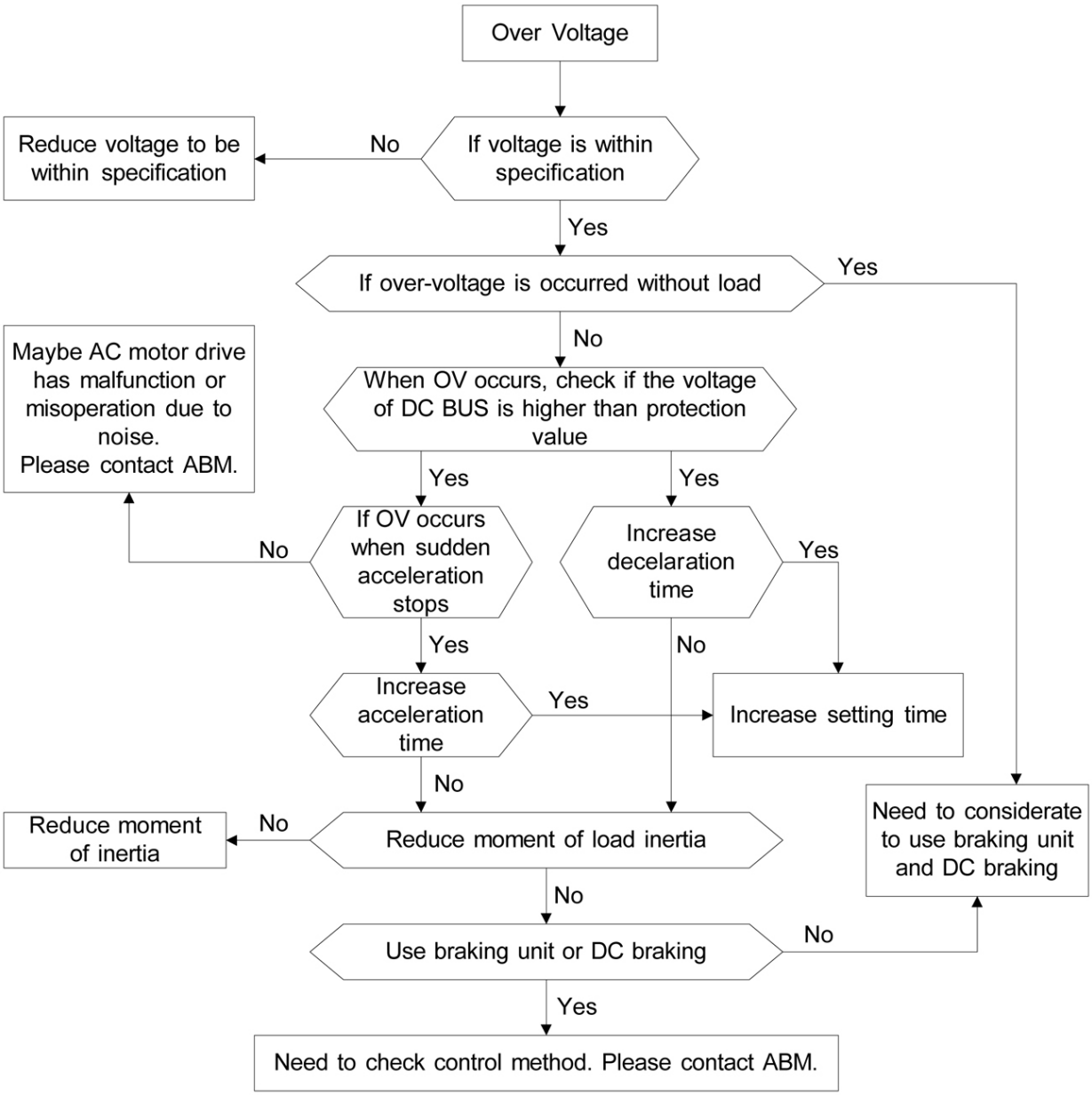
7.1 Over Current (OC)



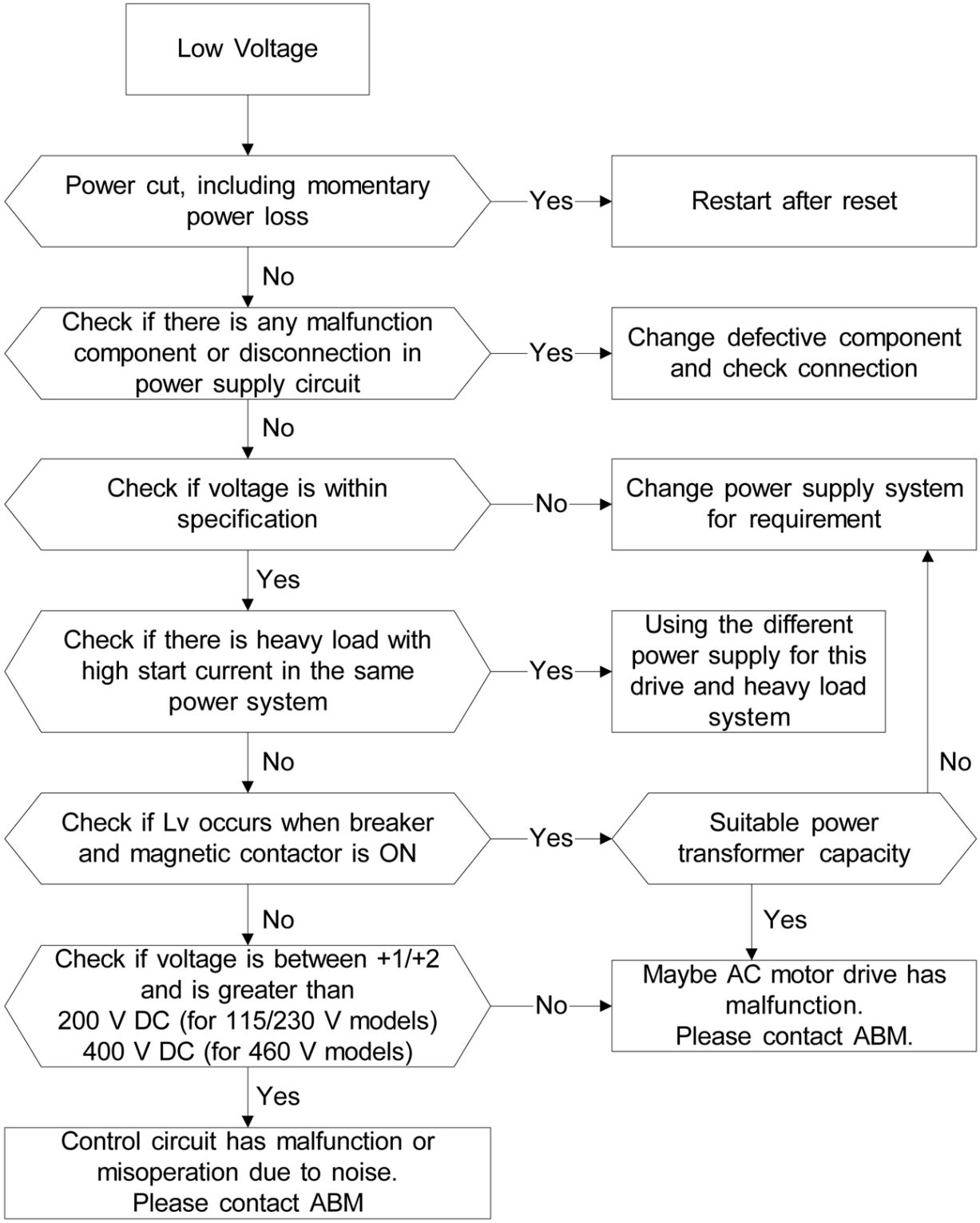
7.2 Ground Fault



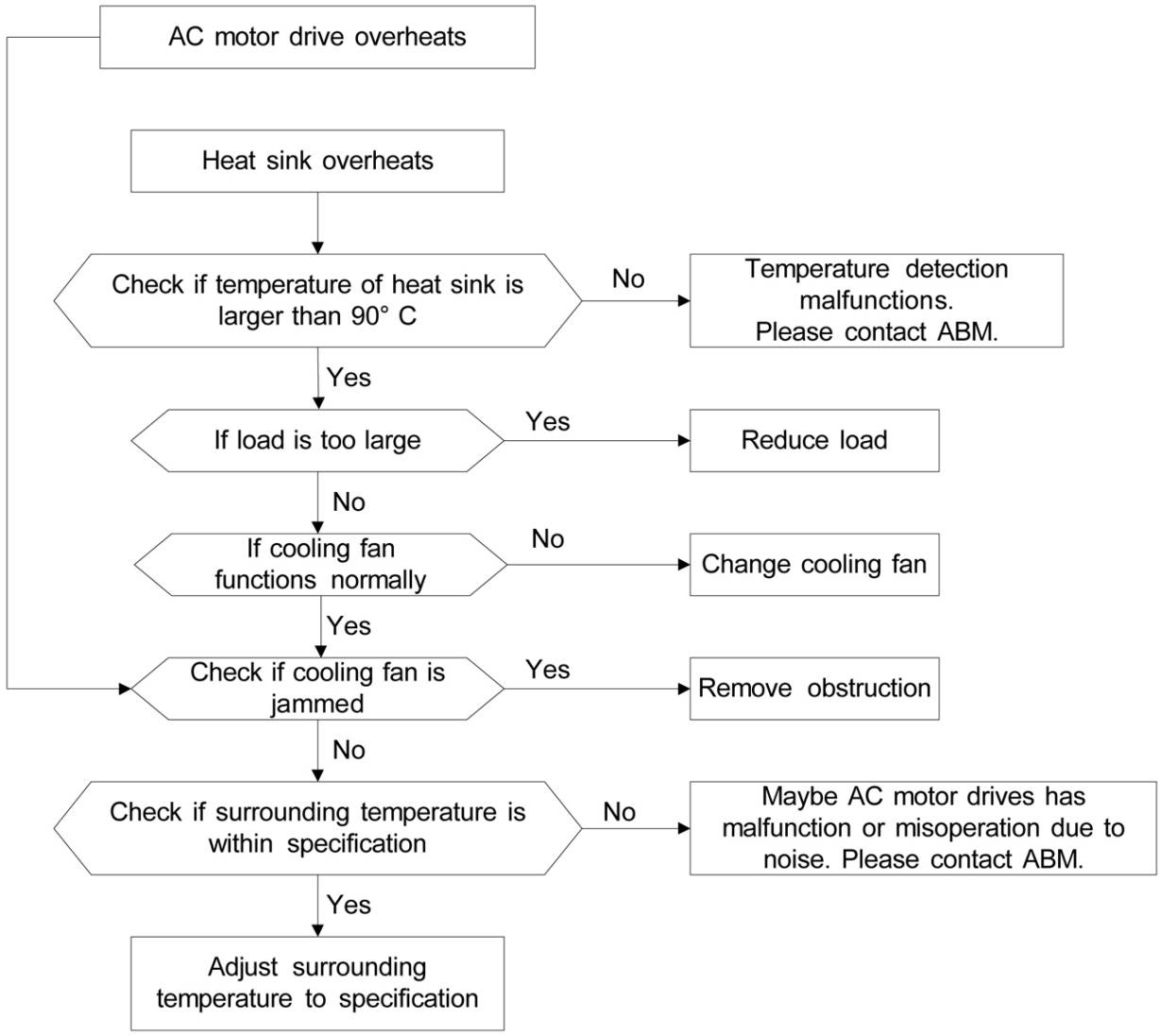
7.3 Over Voltage (OV)



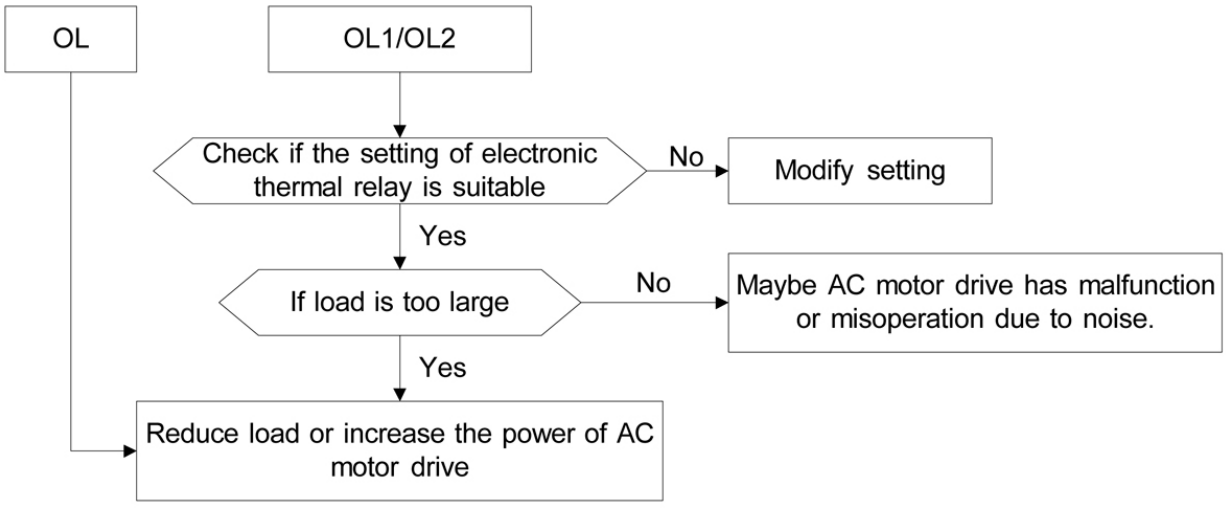
7.4 Low Voltage (Lv)



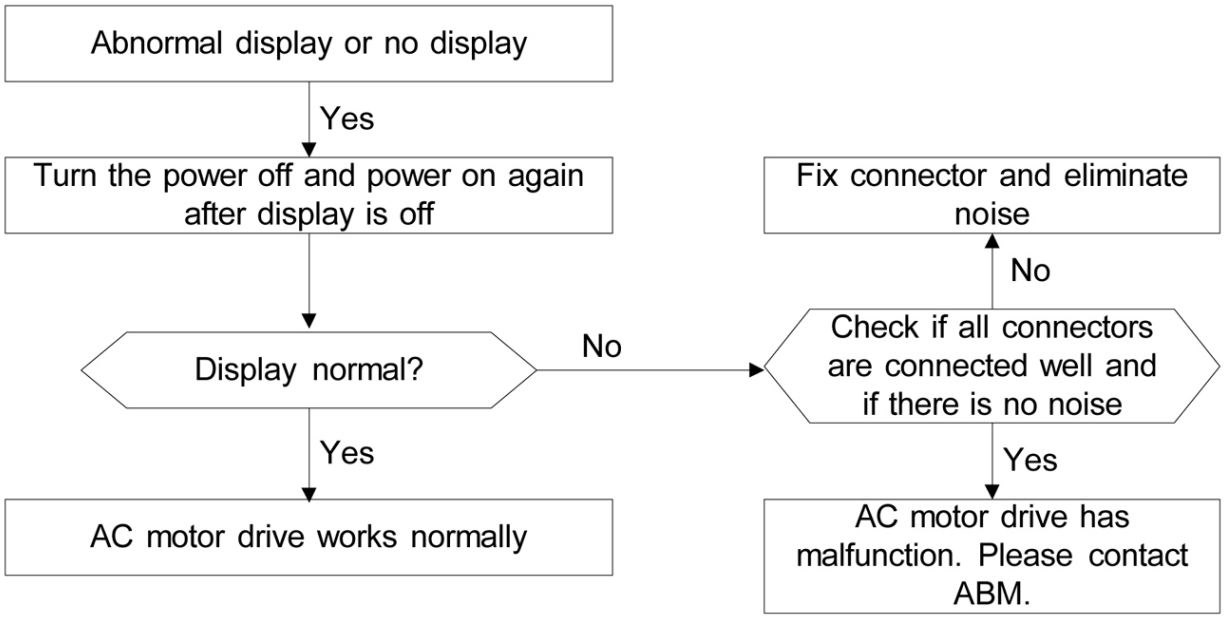
7.5 Over Heat (OH)



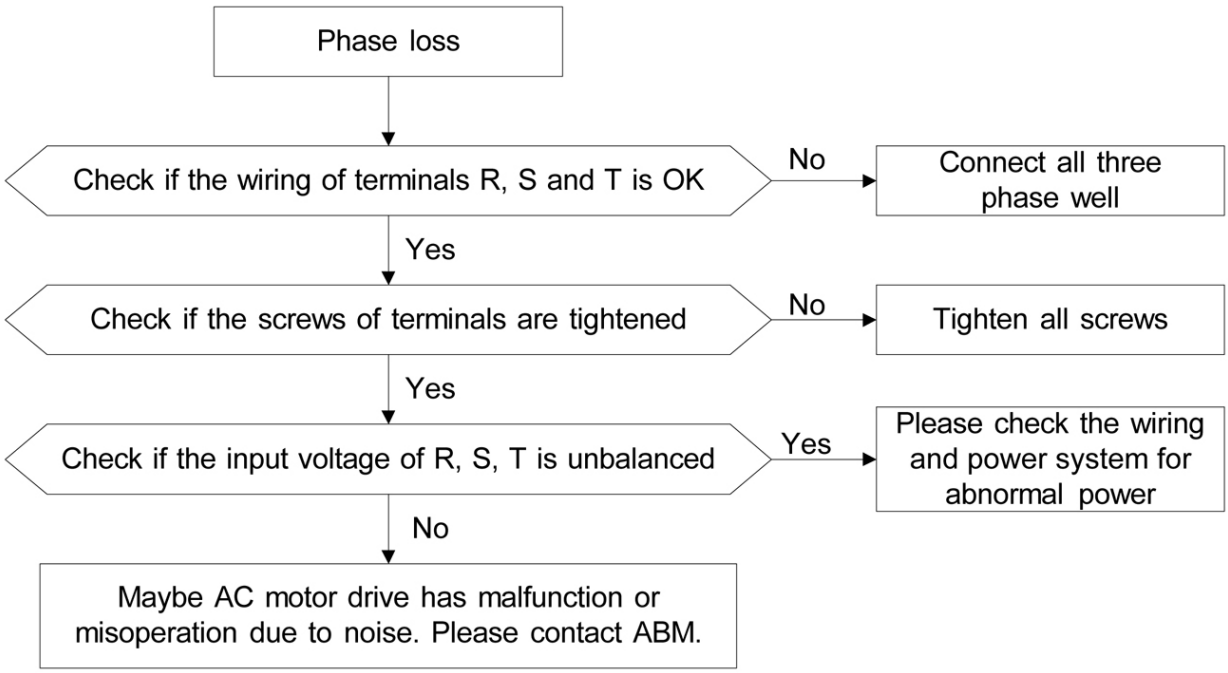
7.6 Overload



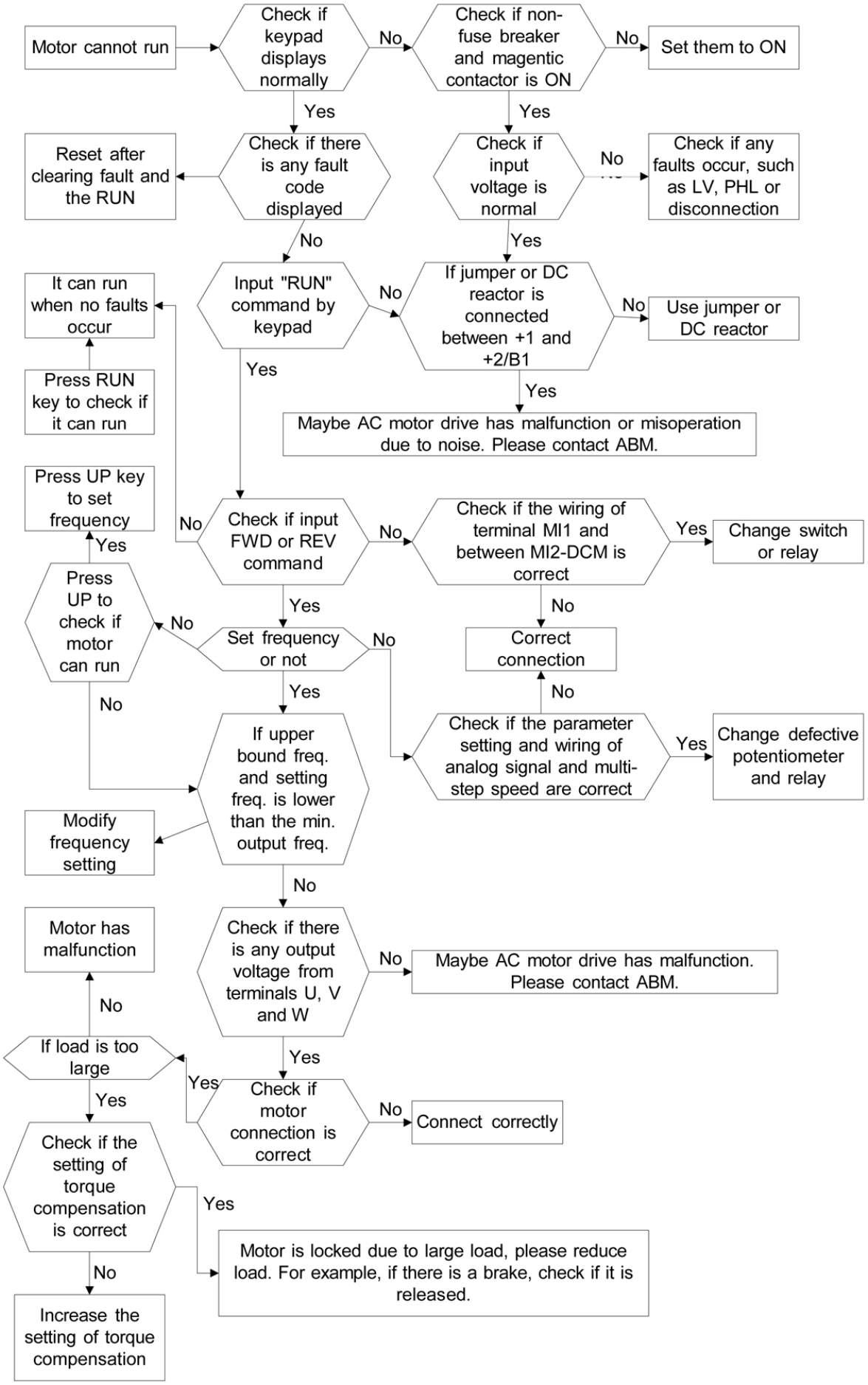
7.7 Keypad Display is Abnormal



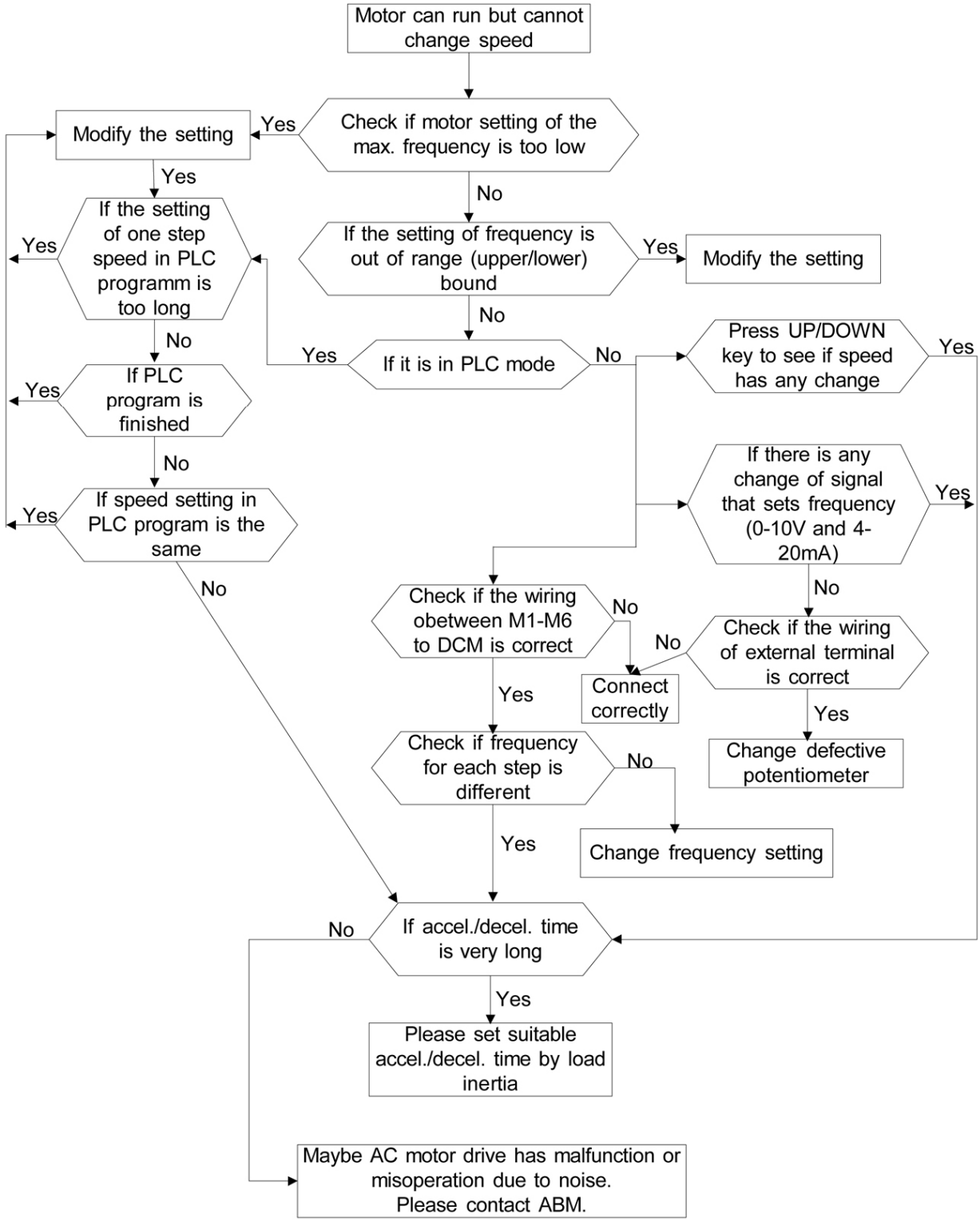
7.8 Phase Loss (PHL)



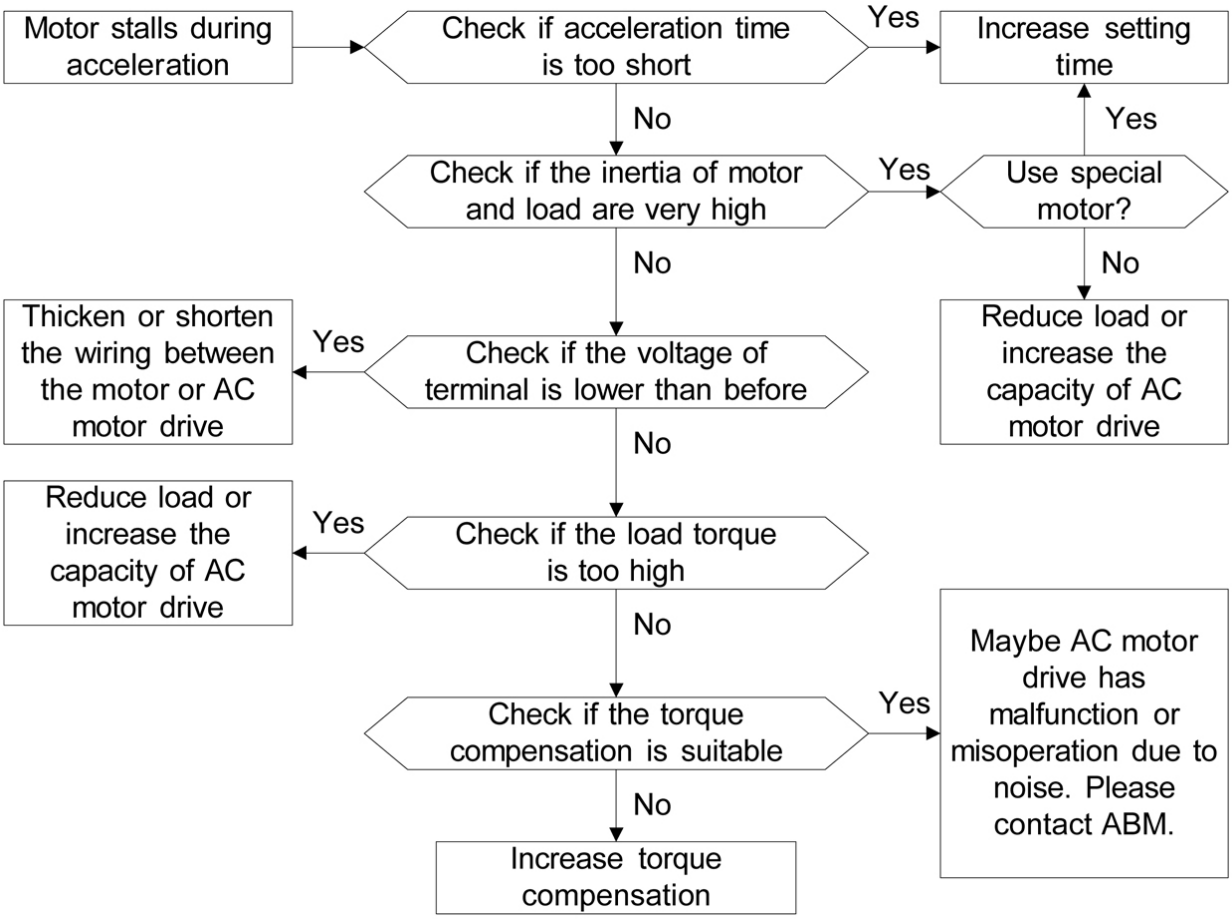
7.9 Motor cannot Run



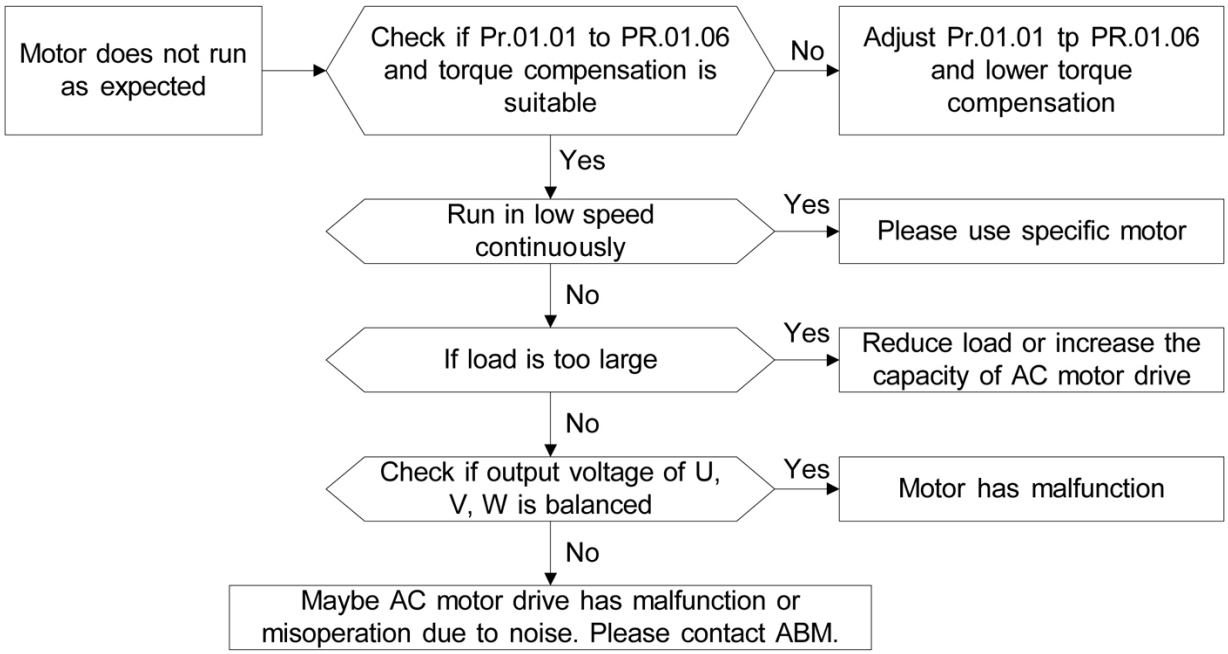
7.10 Motor Speed cannot be Changed



7.11 Motor Stalls during Acceleration



7.12 The Motor does not Run as Expected



7.13 Electromagnetic/Induction Noise

Many sources of noise surround AC motor drives and penetrate it by radiation or conduction. It may cause malfunctioning of the control circuits and even damage the AC motor drive. Of course, there are solutions to increase the noise tolerance of an AC motor drive. But this has its limits. Therefore, solving it from the outside as follows will be the best.

1. Add surge suppressor on the relays and contacts to suppress switching surges.
2. Shorten the wiring length of the control circuit or serial communication and keep them separated from the power circuit wiring.
3. Comply with the wiring regulations by using shielded wires and isolation amplifiers for long length.
4. The grounding terminal should comply with the local regulations and be grounded independently, i.e. not to have common ground with electric welding machines and other power equipment.
5. Connect a noise filter at the mains input terminal of the AC motor drive to filter noise from the power circuit. PDC can have a built-in filter as option.

In short, solutions for electromagnetic noise exist of “no product”(disconnect disturbing equipment), “no spread”(limit emission for disturbing equipment) and “no receive”(enhance immunity).

7.14 Environmental Condition

Since the AC motor drive is an electronic device, you should comply with the environmental conditions as stated in the Chapter 2.1. Here are some remedial measures if necessary.

1. To prevent vibration, the use of anti-vibration dampers is the last choice. Vibrations must be within the specification. Vibration causes mechanical stress and it should not occur frequently, continuously or repeatedly to prevent damage to the AC motor drive.
2. Store the AC motor drive in a clean and dry location, free from corrosive fumes/dust to prevent corrosion and poor contacts. Poor insulation in a humid location can cause short-circuits. If necessary, install the AC motor drive in a dust-proof and painted enclosure and in particular situations, use a completely sealed enclosure.
3. The ambient temperature should be within the specification. Too high or too low temperature will affect the lifetime and reliability. For semiconductor components, damage will occur once any specification is out of range. Therefore, it is necessary to periodically check air quality and the cooling fan and provide extra cooling of necessary. In addition, the microcomputer may not work in extremely low temperatures, making cabinet heating necessary.

4. Store within a relative humidity range of 0% to 90% and non-condensing environment. Use an air conditioner and/or exsiccator.

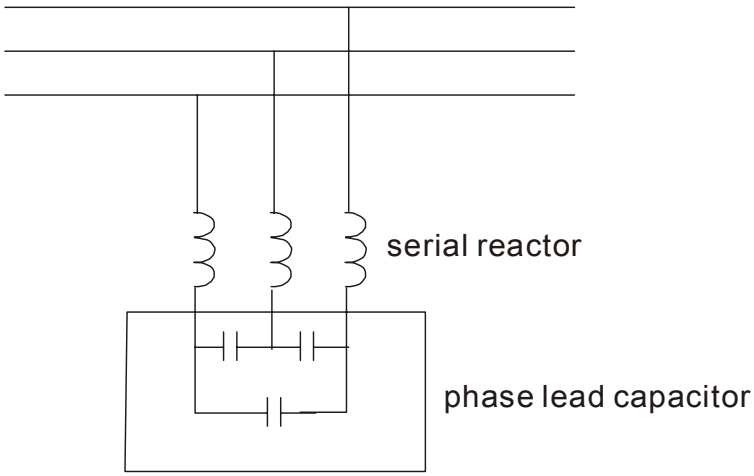
7.15 Affecting Other Machines

An AC motor drive may affect the operation of other machines due to many reasons. Some solutions are:

- High Harmonics at Power Side

High harmonics at power side during running can be improved by:

1. Separate the power system: use a transformer for AC motor drive.
2. Use a reactor or rectifier at the power input terminal of the AC motor drive or decrease high harmonic by multiple circuit.
3. If phase lead capacitors are used (never on the AC motor drive output!!), use serial reactors to prevent damage to the capacitors damage from high harmonics.



- Motor Temperature Rises

When the motor is a standard induction motor with fan, the cooling will be bad at low speeds, causing the motor to overheat. Besides, high harmonics at the output increases copper and core losses. The following measures should be used depending on load and operation range.

1. Use a motor with independent ventilation (forced external cooling) or increase the motor rated power.
2. Use a special inverter duty motor.
3. Do NOT run at low speeds for long time.

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Appendix A Specifications

Voltage Class		115V Class		
Model Number PDC-XXXE		002	004	007
Max. Applicable Motor Output (kW)		0.2	0.4	0.75
Max. Applicable Motor Output (hp)		0.25	0.5	1.0
Output Rating	Rated Output Capacity (kVA)	0.6	1.0	1.6
	Rated Output Current (A)	1.6	2.5	4.2
	Maximum Output Voltage (V)	3-Phase Proportional to Twice the Input Voltage		
	Output Frequency (Hz)	0.1~600 Hz		
	Carrier Frequency (kHz)	1-15		
Input Rating	Rated Input Current (A)	Single-phase		
		6	9	18
	Rated Voltage/Frequency	Single phase, 100-120V, 50/60Hz		
	Voltage Tolerance	± 10%(90~132 V)		
	Frequency Tolerance	± 5%(47~63 Hz)		
	Line Fuse (A)	10	10	20
Min. Brake resistor (Ω)		750	390	195
Cooling Method		Natural Cooling		Fan Cooling
Weight (kg)		1.2	1.2	1.2

Voltage Class		230V Class							
Model Number PDC-XXXE		002	004	007	015	022	037	055	075
Max. Applicable Motor Output (kW)		0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5
Max. Applicable Motor Output (hp)		0.25	0.5	1.0	2.0	3.0	5.0	7.5	10
Output Rating	Rated Output Capacity (kVA)	0.6	1.0	1.6	2.9	4.2	6.5	9.5	12.5
	Rated Output Current (A)	1.6	2.5	4.2	7.5	11.0	17	25	33
	Maximum Output Voltage (V)	3-Phase Proportional to Input Voltage							
	Output Frequency (Hz)	0.1~600 Hz							
	Carrier Frequency (kHz)	1-15							
Input Rating	Rated Input Current (A)	Single/3-phase					3-phase		
		4.9/1.9	6.5/2.7	9.5/5.1	15.7/9	24/15	20.6	26	34
	Rated Voltage/Frequency	Single/3-phase 200-240 V, 50/60Hz					3-phase 200-240V, 50/60Hz		
	Voltage Tolerance	± 10%(180~264 V)							
	Frequency Tolerance	± 5%(47~63 Hz)							
	Line Fuse (A)	6/4	10/4	10/6	20/10	25/16	25	35	35
Min. Brake Resistor (Ω)		750	390	195	100	70	40	30	20
Cooling Method		Natural Cooling			Fan Cooling				
Weight (kg)		1.1	1.1	1.1	1.9	1.9	1.9	3.5	3.5

Voltage Class		**460V Class**							
Model Number PDC-XXXE		004	007	015	022	037	055	075	110
Max. Applicable Motor Output (kW)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11
Max. Applicable Motor Output (hp)		0.5	1.0	2.0	3.0	5.0	7.5	10	15
Output Rating	Rated Output Capacity (kVA)	1.2	2.0	3.3	4.4	6.8	9.9	13.7	18.3
	Rated Output Current (A)	1.5	2.5	4.2	5.5	8.2	13	18	24
	Maximum Output Voltage (V)	3-Phase Proportional to Input Voltage							
	Output Frequency (Hz)	0.1~600 Hz							
	Carrier Frequency (kHz)	1-15							
Input Rating	Rated Input Current (A)	3-phase							
		1.9	3.2	4.3	7.1	11.2	14	19	26
	Rated Voltage/Frequency	3-phase, 380-480V, 50/60Hz							
	Voltage Tolerance	± 10%(342~528V)							
	Frequency Tolerance	± 5%(47~63Hz)							
	Line Fuse (A)	4	4	6	10	16	16	20	35
Min. Brake Resistor (Ω)		1500	750	390	250	150	100	75	50
Cooling Method		Natural Cooling		Fan Cooling					
Weight (kg)		1.2	1.2	1.2	1.9	1.9	4.2	4.2	4.2

General Specifications			
Control Characteristics	Control System		SPWM(Sinusoidal Pulse Width Modulation) control (V/f or sensorless vector control)
	Frequency Setting Resolution		0.01Hz
	Output Frequency Resolution		0.01Hz
	Torque Characteristics		Including the auto-torque/auto-slip compensation; starting torque can be 150% at 3.0Hz
	Overload Endurance		150% of rated current for 1 minute
	Skip Frequency		Three zones, setting range 0.1-600Hz
	Accel/Decel Time		0.1 to 600 seconds (2 Independent settings for Accel/Decel time)
	Stall Prevention Level		Setting 20 to 250% of rated current
	DC Braking		Operation frequency 0.1-600.0Hz, output 0-100% rated current Start time 0-60 seconds, stop time 0-60 seconds
	Regenerated Braking Torque		Approx. 20% (up to 125% possible with optional brake resistor or externally mounted brake unit, 1-15hp (0.75-11kW) models have brake chopper built-in)
	V/f Pattern		Adjustable V/f pattern
Operating Characteristics	Frequency Setting	Keypad	Setting by ▲ ▼
		External Signal	Potentiometer-5kΩ/0.5W, 0 to +10VDC, 4 to 20mA, RS-485 interface; Multi-function Inputs 3 to 9 (15 steps, Jog, up/down)
	Operation Setting Signal	Keypad	Set by RUN and STOP
		External Signal	2 wires/3 wires ((MI1, MI2, MI3)), JOG operation, RS-485 serial interface (MODBUS), programmable logic controller

General Specifications		
	Multi-function Input Signal	Multi-step selection 0 to 15, Jog, accel/decel inhibit, 2 accel/decel switches, counter, , external Base Block, auxiliary motor control is invalid, ACI/AVI selections, driver reset, UP/DOWN key settings, NPN/PNP input selection
	Multi-function Output Indication	AC drive operating, frequency attained, zero speed, Base Block, fault indication, overheat alarm, emergency stop and status selections of input terminals
	Analog Output Signal	Output frequency/current
Alarm Output Contact		Contact will be On when drive malfunctions (1 Form C/change-over contact and 1 open collector output) for standard type)
Operation Functions		Built-in PLC, AVR, accel/decel S-Curve, over-voltage/over-current stall prevention, 5 fault records, reverse inhibition, momentary power loss restart, DC braking, auto torque/slip compensation, auto tuning, adjustable carrier frequency, output frequency limits, parameter lock/reset, vector control, PID control, external counter, MODBUS communication, abnormal reset, abnormal re-start, power-saving, fan control, sleep/wake frequency, 1st/2nd frequency source selections, 1st/2nd frequency source combination, NPN/PNP selection
Protection Functions		Over voltage, over current, under voltage, external fault, overload, ground fault, overheating, electronic thermal, IGBT short circuit, PTC
Display Keypad		6-key, 7-segment LED with 4-digit, 5 status LEDs, master frequency, output frequency, output current, custom units, parameter values for setup and lock, faults, RUN, STOP, RESET, FWD/REV, PLC
Enviromental Conditions	Enclosure Rating	IP20
	Pollution Degree	2
	Installation Location	Altitude 1,000 m or lower, keep from corrosive gasses, liquid and dust
	Ambient Temperature	-10°C to 50°C (40°C for side-by-side mounting) Non-Condensing and not frozen
	Storage/ Transportation Temperature	-20 °C to 60 °C
	Ambient Humidity	Below 90% RH (non-condensing)
	Vibration	9.80665m/s^2 (1G) less than 20Hz, 5.88m/s2 (0.6G) at 20 to 50Hz
Approvals		CE (c UL us in preparation!!!)

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