VS1MD
AC Microdrive Control

10/07 **Installation & Operating Manual** MN760

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Important:

Be sure to check **www.baldor.com** for the latest software, firmware and drivers for your VS1 product. Also, you can download the latest version of this manual in Adobe Acrobat PDF format.

Table of Contents

Chapter 1
Introduction

This manual is intended for qualified electrical personnel familiar with installing, programming, and maintaining AC Drives. This manual contains information on:

- Installing and wiring the VS1MD drive
- Programming the drive
- Troubleshooting the drive

1.1 Getting Assistance from Baldor

For technical assistance, contact your Baldor District Office. Before calling, please review the troubleshooting section of this manual and you will be asked for the drive model number or catalog number that is located on the Nameplate.

1.2 Safety Notice

This equipment contains voltages that may be as high as 1000 volts! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

This equipment may be connected to other machines that have rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

Precautions: Classifications of cautionary statements

WARNING: Do not touch any circuit board, power device or electrical connection before you first ensure that power has been disconnected and there is no high voltage present from this equipment or other equipment to which it is connected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

WARNING: Be sure that you are completely familiar with the safe operation of this equipment. This equipment may be connected to other machines that have rotating parts or parts that are controlled by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

WARNING: Do not use motor overload relays with an automatic reset feature. These are dangerous since the process may injure someone if a sudden or unexpected automatic restart occurs. If manual reset relays are not available, disable the automatic restart feature using external control wiring.

WARNING: This unit has an automatic restart feature that will start the motor whenever input power is applied and a RUN (FWD or REV) command is issued. If an automatic restart of the motor could cause injury to personnel, the automatic restart feature of the VS1MD should be disabled.

WARNING: Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury.

WARNING: Do not remove cover for at least five (5) minutes after AC power is disconnected to allow capacitors to discharge. Dangerous voltages are present inside the equipment. Electrical shock can cause serious or fatal injury.

WARNING: Motor circuit may have high voltage present whenever AC power is applied, even when motor is not rotating. Electrical shock can cause serious or fatal injury.

Continued on next page

WARNING: **Improper operation of control may cause violent motion of the motor shaft and driven equipment. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment. Certain failure modes of the control can produce peak torque of several times the rated motor torque.**

WARNING: **Dynamic brake resistors may generate enough heat to ignite combustible materials. Keep all combustible materials and flammable vapors away from brake resistors.**

WARNING: **The motor shaft will rotate during the autotune procedure. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment.**

Caution: **Disconnect motor leads (U, V and W) from control before you perform a "Dielectric Withstand" test on the motor. Failure to disconnect motor from the control will result in extensive damage to the control. The control is tested at the factory for high voltage / leakage resistance as part of Underwriter Laboratory requirements.**

Caution: **Suitable for use on a circuit capable of delivering not more than the RMS symmetrical short circuit amperes listed here at rated voltage.**

Horsepower	RMS Symmetrical Amperes
1-30	5,000

Caution: **Do not connect AC power to the Motor terminals U, V and W. Connecting AC power to these terminals may result in damage to the control.**

Caution: **Baldor recommends not to use "Grounded Leg Delta" transformer power leads that may create ground loops. Instead, we recommend using a four wire Wye.**

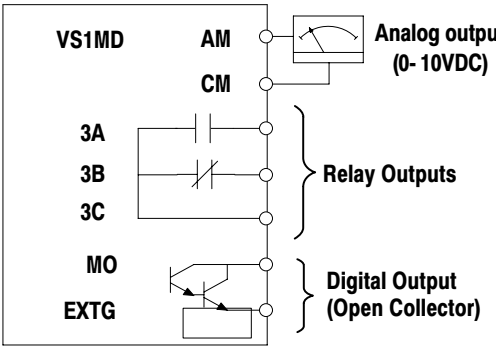
Caution: **If the DB hardware mounting is in any position other than vertical, the DB hardware must be derated by 35% of its rated capacity.**

Caution: **Only Baldor cables should be used to connect the keypad and control. These are special twisted pair cables to protect the control and keypad. Damage associated with other cable types are not covered by the Baldor warranty.**

Caution: **If an M-Contactor is installed, the control must be disabled for at least 200msec before the M-Contactor is opened. If the M-Contactor is opened while the control is supplying voltage and current to the motor, the control may be damaged. Before the control is enabled, the M-Contactor must be closed for at least 200msec.**

Caution: **Use of power correction capacitors on the output of the drive can result in erratic operation of the motor, nuisance tripping, and/or permanent damage to the drive. Remove power correction capacitors before proceeding. Failure to observe this precaution could result in damage to, or destruction of, the equipment.**

Figure 1-1 Output Connections



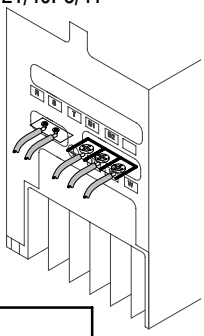
Tightening Torque = 3.5 lb-in (0.4Nm)

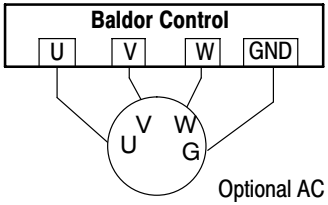
1.3 Quick Start Quick Start Guide is also available separately, see MS760.

Figure 1-2 Power & Motor Terminal Locations

Size A, B VS1MD20P5/21/40P5/41
(shown as an example)

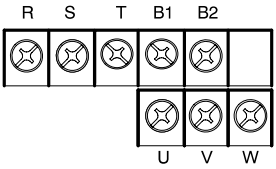
Connect "Lower Row" of wires first. (GND and Motor Wires for this example)



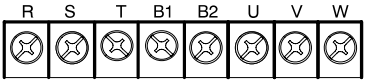


Optional AC Motor

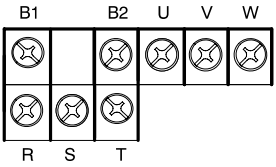
Size A, B VS1MD20P5/21/40P5/41



Size C VS1MD23/25/43/45



Size D VS1MD23/25/43/45



Powerup Procedure Refer to Chapter 3, 4 and 5 for additional details.

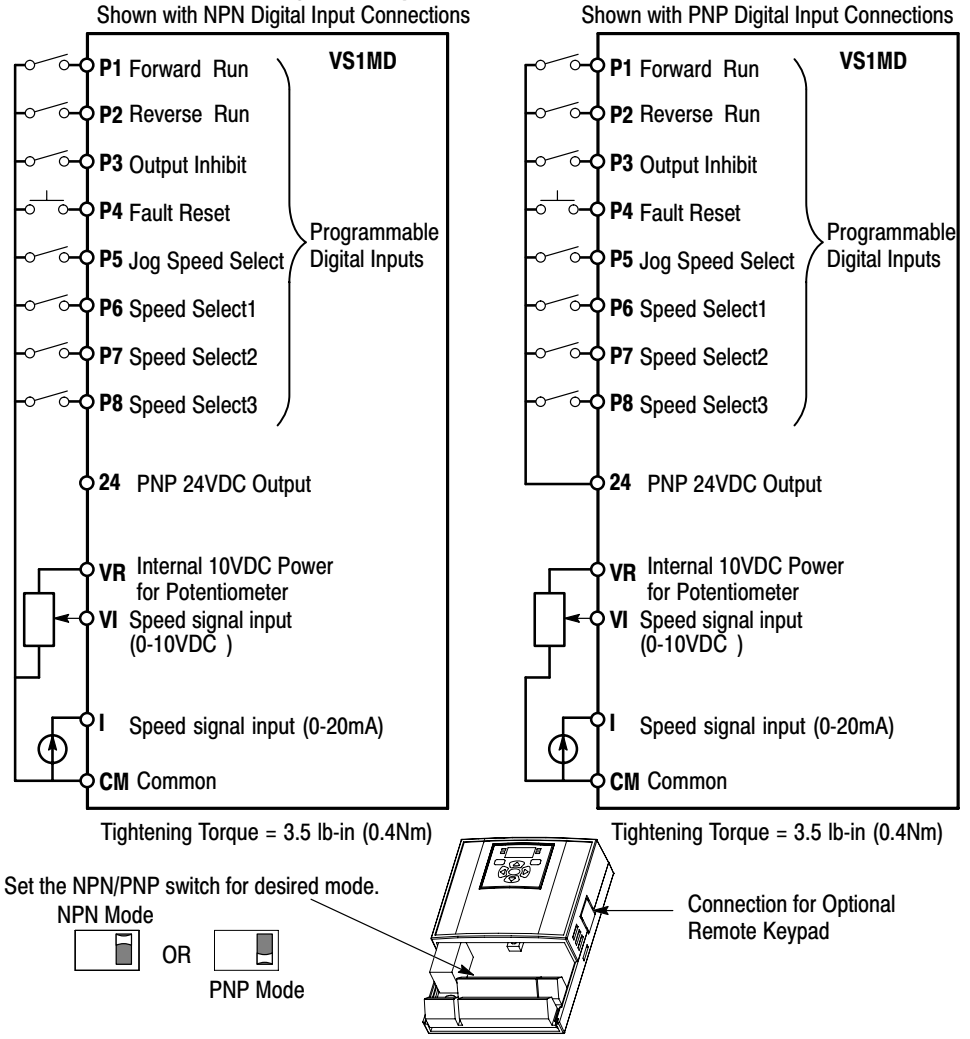
1. Remove all power from the control.
2. Connect Power & Motor, See Figure 1-2.
3. Connect input control wires, See Figure 1-3 and output control wires, See Figure 1-1.
4. Disconnect the motor from the load (including coupling or inertia wheels).
5. Turn power on. Be sure there are no faults.
6. Set the following parameters for the values displayed on the motor nameplate:
   P30 Motor HP Select
   P32 Motor Rated Current
   P33 Pole Number
   P34 Base Frequency
7. If external dynamic brake hardware is used, set the Level 2 Brake Adjust block "Resistor Ohms" and "Resistor Watts" parameters.

WARNING: The motor shaft will rotate during this procedure. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment.

8. Set H41 =1 from using the Keypad. Perform each step including auto tune.
9. Remove all power from the control.
10. Couple the motor to its load.
11. Verify freedom of motion of motor shaft.
12. Verify the motor coupling is tight without backlash.
13. Verify the holding brakes if any, are properly adjusted to fully release and set to the desired torque.
14. Turn power on. Be sure no errors are displayed.
15. Run the drive from the keypad.
16. Select and program additional parameters to suit your application, see Chapter 8.

The control is now ready for use the in keypad mode. If a different operating mode is desired, refer to Chapter 7 Parameter Descriptions and Chapter 8 Customizing for your Application.

Figure 1-3 Input Connections 2-Wire Start



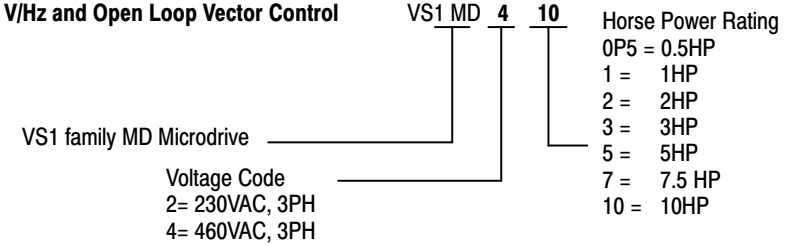
Chapter 2
General Information and Ratings

The VS1MD is a variable frequency PWM drive capable of operating in open- loop, V/Hz (volts per hertz) mode and in a sensorless vector control (SVC) mode. This chapter contains information about the VS1MD drive, including how to identify the drive.

2.1 Identify the Drive by Model Number

Each drive can be identified by its model number, as shown in Figure 2-4. The model number is on the shipping label and the drive nameplate. The model number includes the drive and any options.

Figure 2-4 Drive Identification



2.2 VS1MD Ratings, Model Numbers and Frame Sizes

Table 2-1 has drive ratings for each VS1MD Model.

Table 2-1

Catalog No.	Input Volt	Frame Size	Output		
			HP	KW	Amps
VS1MD20P5	230	A	0.5	0.4	2.5
VS1MD21	230	A	1.0	0.75	5.0
VS1MD22	230	B	2.0	1.5	8.0
VS1MD23	230	C	3.0	2.2	12.0
VS1MD25	230	C	5.0	3.7	17.0
VS1MD27	230	D	7.5	5.5	24.0
VS1MD210	230	D	10.0	7.5	32.0
VS1MD40P5	460	A	0.5	0.4	1.25
VS1MD41	460	A	1.0	0.75	2.5
VS1MD42	460	B	2.0	1.5	4.0
VS1MD43	460	C	3.0	2.2	6.0
VS1MD45	460	C	5.0	3.7	8.0
VS1MD47	460	D	7.5	5.5	12.0
VS1MD410	460	D	10.0	7.5	16.0

2.3 Storage Guidelines

If you need to store the drive, follow these recommendations to prolong drive life and performance:

1. Storage ambient temperature is -40°F to 158°F (-40°C to 70°C).
2. Storage Humidity range 0% to 90% RH non-condensing.
3. Do not expose to corrosive atmosphere.

Chapter 3
Installing the Drive

This chapter provides information that must be considered when planning a VS1MD drive installation and provides drive mounting information and installation site requirements.

3.1 Receiving & Inspection

When you receive your control, there are several things you should do immediately.

1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your control.
2. Remove the control from the shipping container and remove all packing materials from the control. The container and packing materials may be retained for future shipment.
3. Verify that the part number of the control you received is the same as the part number listed on your purchase order.
4. Inspect the control for external physical damage that may have been sustained during shipment and report any damage immediately to the commercial carrier that delivered your control.
5. If the control is to be stored for several weeks before use, be sure that it is stored in a location that conforms to published storage humidity and temperature specifications stated in this manual.

3.2 General Requirements for the Installation Site

It is important to ensure that the drives environment and operating conditions are satisfactory.

The area behind the drive must be kept clear of all control and power wiring. Power connections may create electromagnetic fields that may interfere with control wiring or components when run in close proximity to the drive.

Read the recommendations in the following sections before continuing with the drive installation.

3.2.1 Operating Conditions

Before deciding on an installation site, consider the following guidelines:

- Protect the cooling fan by avoiding dust or metallic particles.
- Do not expose the drive to a corrosive atmosphere.
- Protect the drive from moisture and direct sunlight.
- Verify that the drive location will meet the environmental conditions specified in Table 3-1.

Table 3-1 - Ambient Temperatures and Mounting Clearances

Ambient Temperature		Enclosure Rating	Minimum Mounting Clearances
Minimum	Maximum		
14°F (-10°C)	122°F (50 °C)	IP20/Open Type	2 in (50mm)
	104°F (40 °C)	IP20/NEMA 1	2 in (50mm)
	122° F (50 °C)	Side-by-Side	2 in (50mm)

3.2.2 Minimum Mounting Clearances

Be sure to provide proper top, bottom and side clearance (2" minimum each side).

3.3 Mounting the Drive

Mount the drive upright on a flat, vertical, and level surface. Refer to Figure 3-6 for mounting hole locations.

3.3.1 Protecting the Drive from Debris

The drive must be protected from debris falling through the drive vents during installation and operation. The drive is designed to operate in IP20/NEMA1 Type installations.

3.3.2 Watts Loss Data

Catalog No.	Input Volt	Frame Size	Watts Loss
VS1MD20P5	230	A	13
VS1MD21	230	A	28
VS1MD22	230	B	18
VS1MD23	230	C	56
VS1MD25	230	C	98
VS1MD27	230	D	73
VS1MD210	230	D	70
VS1MD40P5	460	A	9
VS1MD41	460	A	22
VS1MD42	460	B	32
VS1MD43	460	C	47
VS1MD45	460	C	94
VS1MD47	460	D	84
VS1MD410	460	D	113

3.3 Cover Removal

To connect power and signal wires, the cover must be removed. Remove the cover as shown in Figure 3-5.

Figure 3-5 Cover Removal

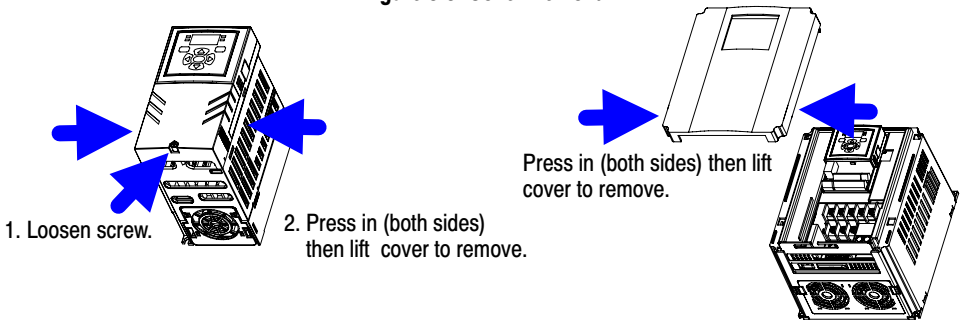


Figure 3-6 Mounting Hole Locations

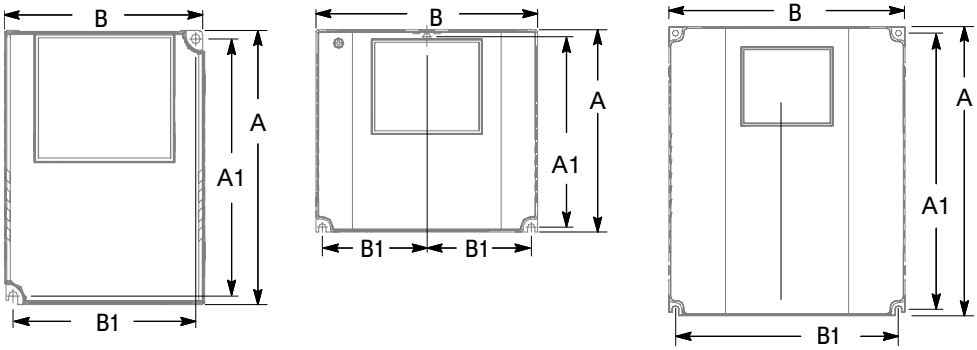


Table 3-2 Drive Dimensions

Catalog No.	Output HP	A	A1	B	B1
VS1MD20P5	0.5	5.0 (128)	4.68 (119)	2.75 (70)	2.38 (60.5)
VS1MD21	1.0	5.0 (128)	4.68 (119)	2.75 (70)	2.38 (60.5)
VS1MD22	2.0	5.0 (128)	4.68 (119)	3.93 (100)	3.56 (90.5)
VS1MD23	3.0	5.0 (128)	4.75 (120.5)	5.51 (140)	2.56 (65)
VS1MD25	5.0	5.0 (128)	4.75 (120.5)	5.51 (140)	2.56 (65)
VS1MD27	7.5	8.66 (220)	8.27 (210)	7.08 (180)	6.69 (170)
VS1MD210	10.0	8.66 (220)	8.27 (210)	7.08 (180)	6.69 (170)
VS1MD40P5	0.5	5.0 (128)	4.68 (119)	2.75 (70)	2.38 (60.5)
VS1MD41	1.0	5.0 (128)	4.68 (119)	2.75 (70)	2.38 (60.5)
VS1MD42	2.0	5.0 (128)	4.68 (119)	3.93 (100)	3.56 (90.5)
VS1MD43	3.0	5.0 (128)	4.75 (120.5)	5.51 (140)	2.56 (65)
VS1MD45	5.0	5.0 (128)	4.75 (120.5)	5.51 (140)	2.56 (65)
VS1MD47	7.5	8.66 (220)	8.27 (210)	7.08 (180)	6.69 (170)
VS1MD410	10.0	8.66 (220)	8.27 (210)	7.08 (180)	6.69 (170)

Chapter 4
Power Wiring

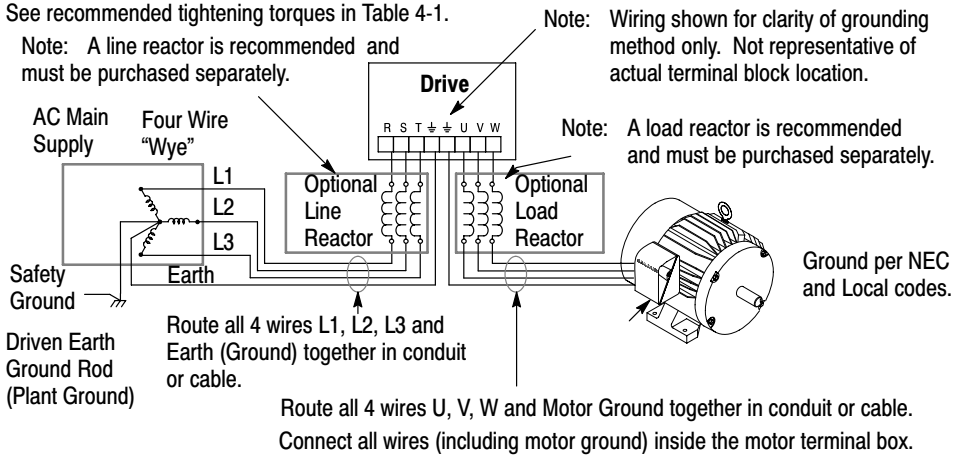
4.1 Overview of Power Connections

The recommended grounding method is shown in Figure 4-1.

Safety Ground - (G) ⏚

This is the safety ground for the drive that is required by code. One of these points must be connected to adjacent building steel (girder, joist), a floor ground rod, or bus bar. Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

Figure 4-1 Recommended System Grounding



Motor Ground

The motor ground must be connected to one of the ground terminals on the drive.

Shield Termination

Either of the safety ground terminals located on the power terminal block provides a grounding point for the motor cable shield. The motor cable shield connected to one of these terminals (drive end) should also be connected to the motor frame (motor end). Use a shield terminating or EMI clamp to connect the shield to the safety ground terminal. The NEMA 1/IP30 Kit may be used with a cable clamp for a grounding point for the cable shield.

When shielded cable is used for control and signal wiring, the shield should be grounded at the drive end only, never at both ends.

RFI Filter Grounding

Using single-phase drives with integral filter, or an external filter with any drive rating, may result in relatively high ground leakage currents. Therefore, the filter must only be used in installations with grounded AC supply systems and be permanently installed and solidly grounded (bonded) to the building power distribution ground.

Ensure that the incoming supply neutral is solidly connected (bonded) to the same building power distribution ground. Grounding must not rely on flexible cables and should not include any form of plug or socket that would permit inadvertent disconnection. Some local codes may require redundant ground connections. The integrity of all connections should be checked periodically.

4.2 Power Disconnect

A power disconnect should be installed between the input power service and the drive for a fail safe method to disconnect power. The drive will remain in a powered-up condition until all input power is removed from the drive and the internal bus voltage is depleted.

4.3 Protective Devices

Recommended fuse sizes are based on the following:
115% of maximum continuous current for time delay.
150% of maximum continuous current for Fast or Very Fast action.

Note: These recommendations do not consider harmonic currents or ambient temperatures greater than 45°C.

Be sure a suitable input power protection device is installed. Use the recommended fuses and wire sizes shown in Table 4-1 is based on the use of copper conductor wire rated at 75 °C. The table is specified for NEMA B motors.

Fast Action Fuses:	240VAC, Buss® KTN; 460VAC, Buss® KTS
Very Fast Action:	240VAC, Buss® JJN; 460VAC, Buss® JJS
Semiconductor	240VAC, Ferraz Shawmut A50QS

Buss® is a trademark of Cooper Industries, Inc.

4.4 Electrical Installation

All interconnection wires between the drive, AC power source, motor, host control and any operator interface stations should be in metal conduits or shielded cable must be used. Use listed closed loop connectors that are of appropriate size for wire gauge being used. Connectors are to be installed using crimp tool specified by the manufacturer of the connector. Only class 1 wiring should be used.

Table 4-1 Fuse & Wire Size and Terminal Tightening Torque Specifications

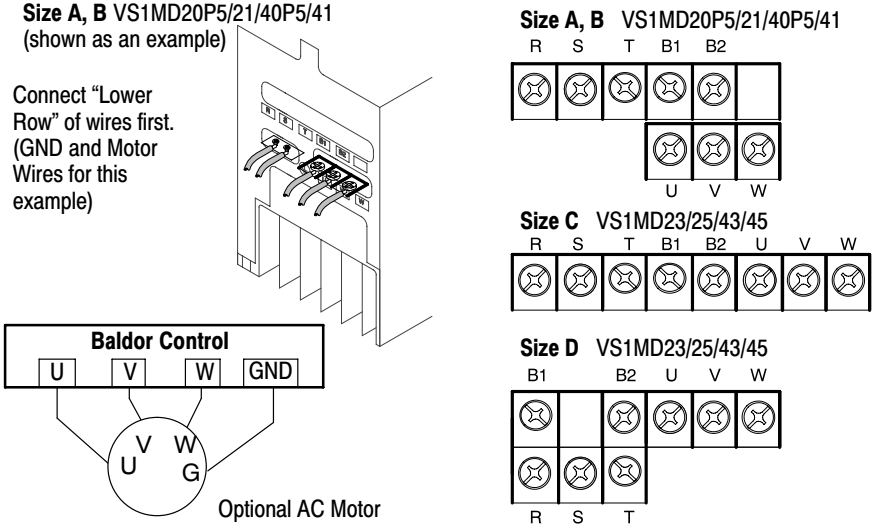
Catalog Number	Input Fuse (Amps)	Wire Gauge		Tightening Torque		Recommended AC Reactor
	Fast Acting (UL)	AWG	mm^2	lb-in	Nm	
VS1MD20P5	10	14	2.0	9	4.5	4.2mH, 3.5A
VS1MD21	10	14	2.0	9	4.5	2.13mH, 5.7A
VS1MD22	15	14	2.0	9	4.5	1.20mH, 10A
VS1MD23	25	14	2.0	13	15	0.88mH, 14A
VS1MD25	40	12	3.5	13	15	0.56mH, 20A
VS1MD27	40	10	5.5	28	32	0.39mH, 30A
VS1MD210	50	8	8.0	28	32	0.28mH, 40A
VS1MD40P5	5	14	2.0	9	4.5	18.0mH, 1.3A
VS1MD41	10	14	2.0	9	4.5	8.63mH, 2.8A
VS1MD42	10	14	2.0	9	4.5	4.81mH, 4.8A
VS1MD43	10	14	2.0	13	15	3.23mH, 7.5A
VS1MD45	20	14	2.0	13	15	2.34mH, 10A
VS1MD47	20	12	3.5	28	32	1.22mH, 15A
VS1MD410	30	12	3.5	28	32	1.14mH, 20A

Note: Wire sizes based on 75°C copper wire. Fuses based on 45°C ambient, max continuous output and no harmonic current.

4.4.1 Grounding Procedure

1. Remove covers. Cover removal is described in Chapter 3 of this manual.
2. Connect the power ground wire to the ground terminal ⏚ (see Figure 4-2).
3. Connect the motor ground wire to the ground terminal ⏚ (see Figure 4-2).

Figure 4-2 Power Terminal Locations



4.4.2 Motor Connections

All cables must be shielded and the shields must be grounded at the enclosure cable entrance.

1. Remove covers. Cover removal is described in Chapter 3 of this manual.
2. Connect the Motor leads to terminals U, V and W (see Figure 4-2 for location).

Long Motor Leads

The wire leads that connect the motor to the control are critical in terms of sizing, shielding and the cable characteristics. Short cable runs are usually trouble free but fault-monitoring circuitry can produce numerous faults when long cables (over 100 feet) are used.

100+ ft (30m). Baldor recommends adding an optional load reactor to the output of the control.

The load reactor and/or common mode choke should be placed in close physical proximity to the control. Unexpected faults may occur due to excessive charging current required for motor cable capacitance.

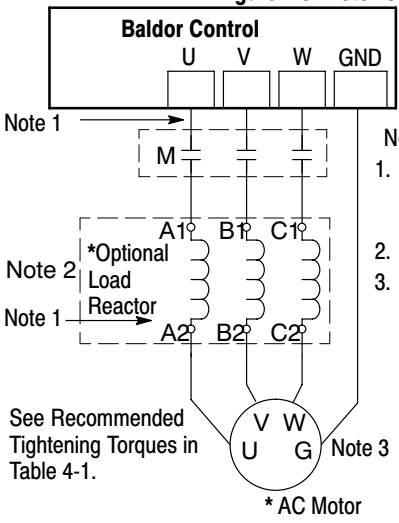
If you use long motor leads and experience unexpected trips due to current overload conditions and are not sure how to correctly size and connect the optional load reactors, please contact your Baldor representative. Baldor is always glad to assist.

4.4.3 M-Contactor Connections

If required by local codes or for safety reasons, an M-Contactor (motor circuit contactor) may be installed. However, incorrect installation or failure of the M-contactor or wiring may damage the control. If an M-Contactor is installed, the control must be disabled for at least 200msec before the M-Contactor is opened or the control may be damaged. M-Contactor connections are shown in Figure 4-3.

Caution: **If an M-Contactor is installed, the control must be disabled for at least 200msec before the M-Contactor is opened. If the M-Contactor is opened while the control is supplying voltage and current to the motor, the control may be damaged. Before the control is enabled, the M-Contactor must be closed for at least 200msec.**

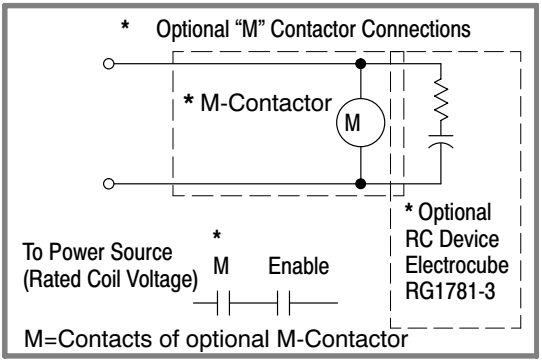
Figure 4-3 Motor Connections and Optional Connections



* Optional components not provided with control.

Notes:

1. Metal conduit should be used. Connect conduits so the use of Load Reactor or RC Device does not interrupt EMI/RFI shielding.
2. See Line/Load Reactors described previously in this section.
3. Use same gauge wire for ground as for U, V and W.



4.5 Input Power Connections

All cables must be shielded and the shields must be grounded at the enclosure cable entrance.

1. Connect the three phase input power wires to an appropriate interrupter and protection.
2. Connect the three phase AC input power leads to terminals R, S and T of the control (see Figure 4-2 for location).

4.6 Optional Dynamic Brake Hardware

If optional DB resistor is to be used, connect it to the B1 and B2 terminals, see (see Figure 4-2). Dynamic Brake (DB) Hardware must be installed on a flat, non-flammable, vertical surface for effective cooling and operation.

Chapter 5
Control Wiring

5.1 Control Wiring Overview

VS1 Analog and Digital input and output connections are made at the Control Terminals shown in Figure 5-1. These terminals are described in Table 5-1.

Control wire connections must be made using shielded twisted pair #18 AWG (0.8mm^2) wire minimum. The cable must also have an overall shield and not exceed 100 feet (30m) in length. Control wire cables must be separated from power wiring. Separate parallel runs of control cables and power cables by at least 3″. Cross power wires at right angles only. Insulate or tape ungrounded end of shields to prevent contact with other conductors or ground.

Figure 5-1

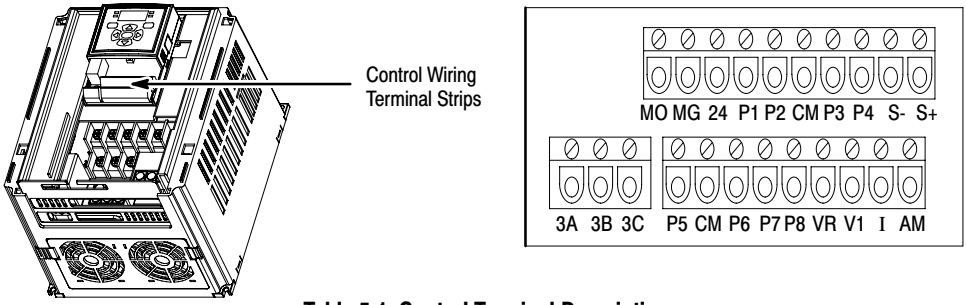


Table 5-1 Control Terminal Descriptions

Connector Terminal	Signal Description
MO	Digital Output+ (Open Collector)
MG	Digital Output- (Common)
24	Internal 24VDC power (powers P1-P8 inputs)
P1	Forward Run (Programmable, assignable)
P2	Reverse Run (Programmable, assignable)
CM	Internal 24V common (return for P1-P5 and AM inputs)
P3	Output Inhibit (Programmable, assignable)
P4	Fault Reset (Programmable, assignable)
P5	Jog Operation (Programmable, assignable)
P6	Speed Select 1 (Programmable, assignable)
P7	Speed Select 2 (Programmable, assignable)
P8	Speed Select 3 (Programmable, assignable)
VR	12V power supply for speed reference potentiometer
V1	0-10VDC Analog Input Terminal
I	0-20mA Analog Input Terminal
AM	0-10VDC Analog Output Terminal (Programmable, assignable)

Table 5-1 Control Terminal Descriptions Continued

Connector Terminal	Signal Description
3A	Relay Output - A Contact (Normally Open) (Programmable, assignable)
3B	Relay Output - B Contact (Normally Closed) (Programmable, assignable)
3C	Common - 3A, 3B Contacts
S+	Data + RS485 Communication Terminal
S-	Data - RS485 Communication Terminal

5.2 Control Input Connections

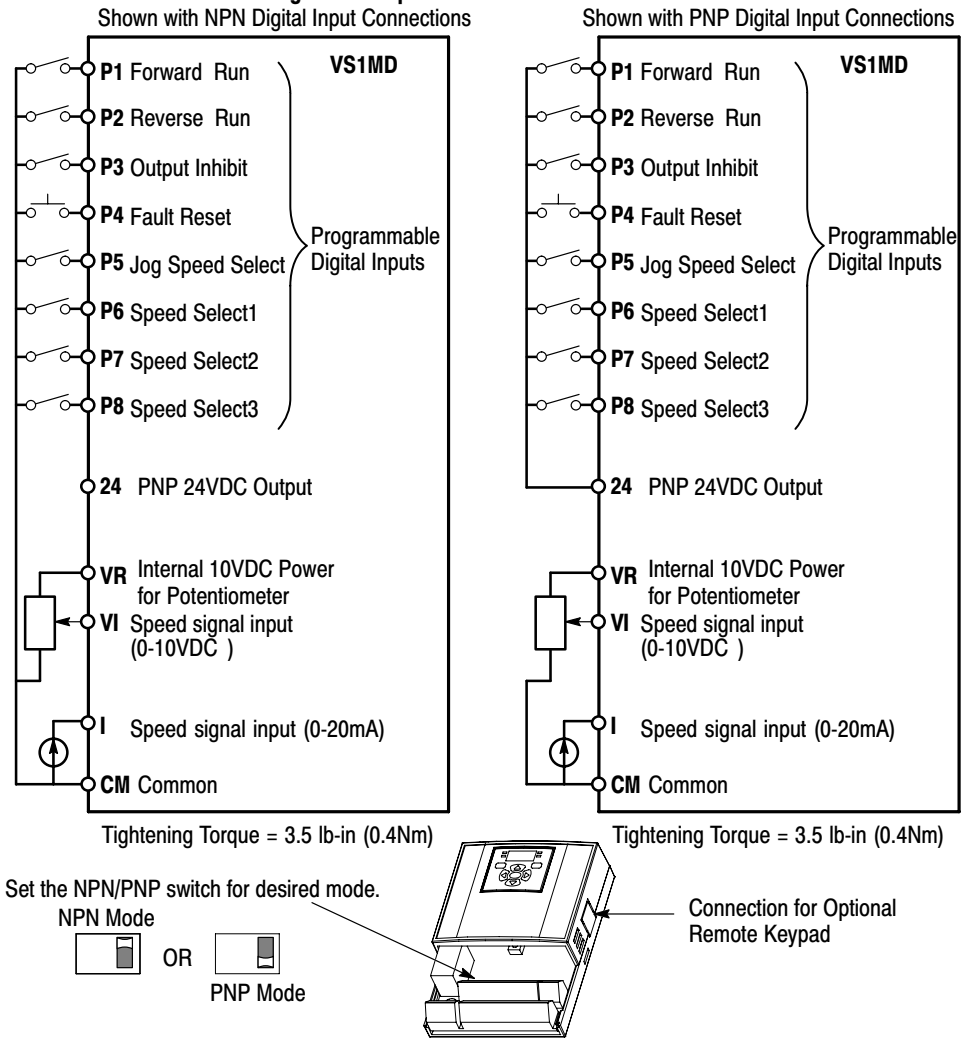
Determine if you will use NPN (factory setting) or PNP connections.

Input connections are shown in Figure 5-2. For NPN, CM (Common or ground) is used to switch the input signals. For PNP, 24 (+24VDC output) is used to switch the input signals.

1. Set the NPN/PNP switch to the desired position.
2. **For NPN Connections**
   Connect the Digital Inputs to one pole of a switch and the other switch pole to CM.
   An active low at P1 - P8 will activate the inputs.
   For PNP Connections
   Connect the Digital Inputs to one pole of a switch and the other switch pole to 24.
   An active High at P1 - P8 will activate the inputs.
3. The speed Command input can be either a Voltage (0-10VDC) or a Current (0-20mA) input.
   For Voltage input, either an external potentiometer or an external voltage reference can be used.
   a. For an External reference voltage input, connect the 0-10VDC input to the VI terminal. Connect the reference from the external source to the CM terminal.
   b. For an external potentiometer, connect the pot as shown, one end to VR terminal, the wiper to VI terminal and the other end to CM terminal.

   For Current input, connect the 0-20mA source to the I terminal, the reference to CM terminal.

Figure 5-2 Input Connections 2-Wire Start

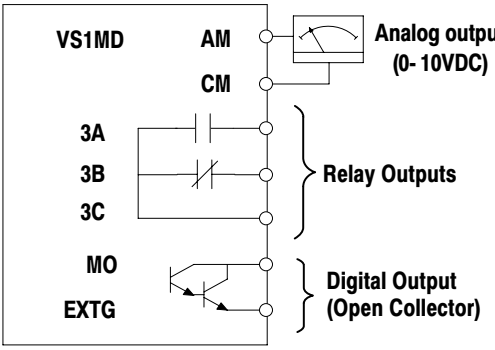


5.3 Control Output Connections

The Analog and Digital outputs are shown in Figure 5-3.

1. Connect an external analog output device to AM terminal and it's reference to CM.
2. The normally Open and Closed relay outputs can be connected to an external device, terminal 3C is the common terminal.
3. The open collector digital output can drive a digital load, connect to MO and EXTG.

Figure 5-3 Output Connections



Tightening Torque = 3.5 lb-in (0.4Nm)

Chapter 6
Using the Keypad

6.1 Keypad Overview

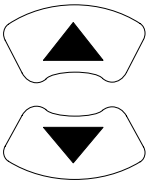
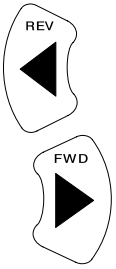
This chapter provides an overview of the integrated keypad and how to use it to program the VS1MD drive. Factory settings of parameter values allow the drive to be controlled from the integral keypad. The keypad is shown in Figure 6-1 and described in Table 6-1.

Figure 6-1 Keypad Components

Table 6-1 Key Descriptions

Key	Name	Description
START	Start Key	Starts the drive. Active when the input mode is programmed for keypad control.
STOP / RESET	Stop Key	Stops the drive in the programmed stop mode. Always active. Resets active faults after fault is cleared.
ENTER / PROG	Enter/Prog	Accesses programming menu and locks in Changed values. To enter programming mode, the Enter/Prog key must be held for 2 seconds. Holding the Enter/Prog key for 2 seconds or more will escape back to Control Reference Mode or back out of a parameter edit function.

Table 6-1 Key Descriptions Continued

Key	Name	Description
	Up/Down Arrow	**Operation Mode:** Changes the commanded speed reference. Only active when the input mode is programmed for keypad control. The Up- Arrow increases the speed reference at a controlled rate. The Down- Arrow decreases the speed reference at a controlled rate. Holding either arrow for a set period of time will increase the reference ramp rate. **Program Mode:** Increment / Decrement parameter numbers or parameter numbers.
	Left/Right Arrow	**Operation Mode:** Only active when the input mode is programmed for keypad control. Direction keys are active only when operating in reference command mode. Reverse may be disabled by a parameter. **Program Mode:** Cycle through the parameter groups or shift to the next digit to be changed (while in the parameter edit mode).

The LEDs display status information as described in Table 6-2.

Table 6-2 LED Descriptions

LED	LED Status	Description
Prog	Steady ON (Red)	Drive is in Programming Mode.
	Off	Drive is in Operational Mode.
Run	Steady ON (Red)	Drive is running at commanded Speed.
	Flashing (Red)	Drive is accelerating/decelerating to new speed stetting.
	Off	Drive is not running.
FWD	Steady ON (Red)	Drive is in Forward operation.
	Off	Drive is in Reverse operation.
STP/FLT	Steady ON (Red)	Drive is Stopped.
	Flashing (Red)	Drive is in Fault condition.
	Off	Drive is running.

6.2 Parameter Overview

To program the drive for a specific application, you adjust the appropriate parameters. Parameters define characteristics of the drive. A list of all parameters is provided in Chapter 7 of this manual. There are three types of parameters:

1. **Numbered List Parameters** (Enumerated Parameters)
   Numbered list parameters allow a selection from two or more options. Each item is represented by a parameter number. Example: Start/Stop Source (P38)
2. **Bit Parameters**
   Bit parameters have individual bits associated with features or conditions. If the bit is 0, the feature is off or the condition is false. If the bit is 1, the feature is on or the condition is true. Example: Terminal Status Display (d7)
3. **Numeric Parameters**
   These parameters have a single numerical value (for example, 0.1 volts). Example: Motor Rated Current (P32)

Parameters are also either configurable or tunable, or read-only.
Configurable parameters can be adjusted or changed only while the drive is stopped.
Tunable parameters can be adjusted or changed while the drive is running or stopped.
Read-only parameters cannot be adjusted.

6.2.1 Parameter Organization

Parameters are organized into five Parameter Groups:

1. **Drive Group**
   Parameters for the display of basic drive information.
2. **Programming Group**
   Most commonly used parameters for start-up and operation.
3. **Terminal Group**
   Input and output control parameters.
4. **Function Group 1**
   Advanced motor control parameters.
5. **Function Group 2**
   Advanced motor profile parameters.

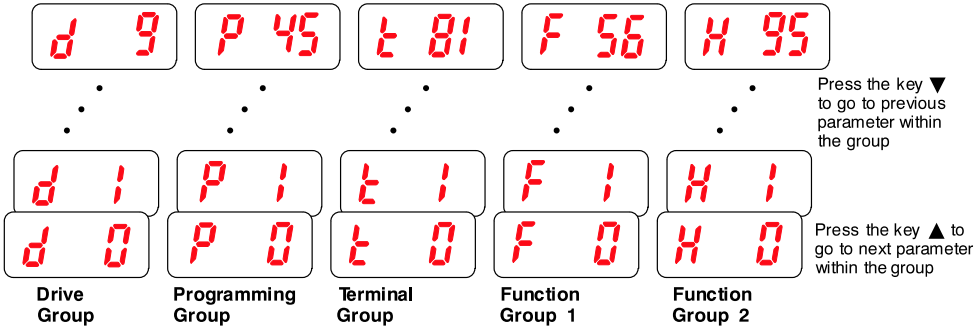
These groups are shown in Figure 6-2 and navigation between groups and between parameters within a group is also shown.

6.2.2 Navigation between and within Parameter Groups

Use this procedure to enter the programming mode and to move between groups:

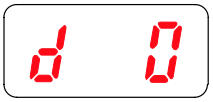
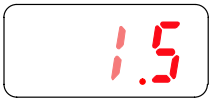
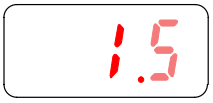
Action	Description	Display	Comments
Apply Power	Power on display shows drive status. Motor speed is 0.00	0.00	
Press and hold the "Enter/Prog" key for at least two seconds to navigate from the power on display to the Programming Group.	The "PROG" LED illuminates and the drive is in programming mode. The first parameter in the Drive Group is displayed.	d 0	Press the ▲ key to go to d1, d2 etc. within the Drive group. Press Enter/Prog to select the parameter and view the parameter value.
Press the key ▶ to display the first code in Programming Group.	The "PROG" LED remains on.	P 0	The first parameter in the Programming Group is displayed.
Press the key ▶ to display the first code in Terminal Group.	The "PROG" LED remains on.	t 0	The first parameter in the Terminal Group is displayed.
Press the key ▶ to display the first code in Function Group 1.	The "PROG" LED remains on.	F 0	The first parameter in the Function Group 1 is displayed.
Press the key ▶ to display the first code in Function Group 2.		H 0	The first parameter in the Function Group 2 is displayed.
Press the key ▶ to navigate to the next group which returns to the Drive Group.		d 0	Press Enter/Prog for 2 seconds to return to the display mode.

Figure 6-2 Parameter Group Organization

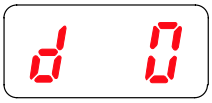
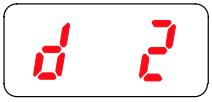


Press the ▶ key to navigate to the next group. Press the ◀ key to navigate to the previous group.

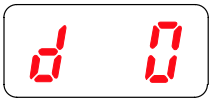
Change Motor Current Value: Use this procedure to enter the Motor Rated Current value.

Action	Description	Display	Comments
Apply Power	Power on display shows drive status. Motor speed is 0.00		
Press and hold the "Enter/Prog" key for at least two seconds to navigate from the power on display to the Programming Group.	The "PROG" LED illuminates and the drive is in programming mode. The Drive Group of parameters is displayed.		The first parameter in the Drive Group is displayed.
Press the key ▶ to display the first code in Programming Group.			The first parameter in the Programming Group is displayed.
Press Enter/Prog to set the jump code.	The initial value of the parameter is displayed.		Press the ▼ key to decrease the value to 32. Press Enter/Prog when finished.
Press Enter/Prog to view the value of Motor Rated Current value (P32).			The first parameter in the Programming Group is displayed.
Press Enter/Prog to set the jump code.	The initial value of the parameter is displayed.		Press the ▼ ▲ keys to increase or decrease the Left digit of the parameter value.
Press the key ◀ to edit the left digit.			Press the ▼ ▲ keys to increase or decrease the Left digit value. Press Enter/Prog when finished.
			

Read Parameter Value: Use this procedure to read values of Display Parameters (these values cannot be changed, they are read only).

Action	Description	Display	Comments
Apply Power	Power on display shows drive status. Motor speed is 0.00		
Press and hold the "Enter/Prog" key for at least two seconds to navigate from the power on display to the Programming Group.	The "PROG" LED illuminates and the drive is in programming mode. The Drive Group of parameters is displayed.		The first parameter in the Drive Group is displayed.
Press the ▲ key twice to change to the d2 parameter.			
Press "Enter/Prog" key to display the value of parameter d2.			Displays the value of parameter d2 (Motor Current).
Press "Enter/Prog" key to return to previous display.			

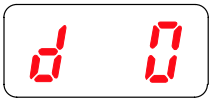
Jump to Parameter Number: To jump to parameter P45, do the following:

Action	Description	Display	Comments
Apply Power	Power on display shows drive status. Motor speed is 0.00		
Press and hold the "Enter/Prog" key for at least two seconds to navigate from the power on display to the Programming Group.	The "PROG" LED illuminates and the drive is in programming mode. The Drive Group of parameters is displayed.		The first parameter in the Drive Group is displayed.
Press the key ▶ to display the first code in Programming Group.			The first parameter in the Programming Group is displayed.
Press the key ▶ to display the first code in Programming Group.			Press the ▲ key to increase the right digit to a value of 5.
Press the key ◀ to edit the left digit.			Press the ▲ key to increase the Left digit to a value of 4.
Press Enter/Prog to jump to parameter P45.			Press the ▲ key to increase the Left digit to a value of 4. Press Enter/Prog when finished.
Press Enter/Prog once again to view the value of P45.			The first parameter in the Programming Group is displayed. Press Enter/Prog when finished.
Press the key ▶ to display the first code in Programming Group.			The first parameter in the Programming Group is displayed.

Fault Status: When a fault is active, the STOP/FAULT LED will flash. This procedure is used to review the active fault as well as the conditions at the time the fault occurred.

Action	Description	Display	Comments
When an overcurrent condition has occurred, a fault will be latched and the display will show the condition.	The Over Current Trip is displayed		
Press Enter/Prog to review the fault conditions.	First is the frequency (Speed) at which the fault occurred.		This example indicates that the drive at 30.00 Hz when the fault occurred.
Press the ▲ key to view the next status value.	The output current during the fault is next.		This example indicates that the drive was outputting 5.0 Amps when the fault occurred.
Press the ▲ key to view the next status value.	The operating status of the drive when the fault occurred is next.		This example indicates that the drive was accelerating when the fault occurred.
Press the “STOP/RESET” key to reset the fault.	The display will indicate that there is no longer a fault condition.		The STP/FLT LED will be on solid indicating that the fault is cleared and that the drive is in the stopped condition.

Restore Factory Settings: This procedure restores all parameter values to the original factory setting values.

Action	Description	Display	Comments
Apply Power	Power on display shows drive status. Motor speed is 0.00		
Press and hold the "Enter/Prog" key for at least two seconds to navigate from the power on display to the Programming Group.	The "PROG" LED illuminates and the drive is in programming mode. The Drive Group of parameters is displayed.		The first parameter in the Drive Group is displayed.
Press the key ▶ four times to display Function Group 2.			
Press Enter/Prog to set the jump code. The Restore Factory Settings parameter number is H93.	The initial value of the parameter is displayed.		Press the ▼ key to decrease the value to 3.
Press the key ◀ to shift left one digit and enter 9.			Press the ▲ key to increase the value to 9. Press Enter/Prog when finished.
Press Enter/Prog to display the value of H93.			
Press Enter/Prog to display the value of H93.	The value of H93 is 0 indicating that parameters will not be reset.		Press the ▲ key to increase the value to 1. Press Enter/Prog to reset all parameters to factory settings.
Factory Settings will be restored.	The 1 will flash while all parameter values are reset to factory settings.		Press the ▼ key to decrease the value to 0. Press Enter/Prog to exit.

6.3 Password Registration

Group	Code	Parameter Name	Setting	Unit
Function group 2	H94	[Password Registration]	-	
	H95	[Parameter Lock]	-	
Register password for Parameter lock (H95). Password is Hex characters 0 to 9, A, B, C, D, E and F.				

Factory default password is 0. Enter any new password except 0.

Do not forget the registered password. It is needed to unlock parameters.

Registering the password for the first time.

Step 1. Move to H94 code. H94 will be displayed.

Step 2. Press Enter key twice. 0 will be displayed.

Step 3. Register password. (Ex: 123) 123 will be displayed.

Step 4. 123 will blink when Enter key is pressed. 123 will be displayed.

Step 5. Press Enter key. H94 will be displayed after the new password has been registered.

Changing password. (Current PW: 123 -> New PW: 456)

Step 1. Move to H94 code. H94 will be displayed.

Step 2. Press Enter key. 0 will be displayed.

Step 3. Enter any number (e.g.: 122). 122 will be displayed.

Step 4. Press the Enter key. 0 is displayed because wrong value was entered.
Password cannot be changed in this status. 0 will be displayed.

Step 5. Enter the right password. 123 will be displayed.

Step 6. Press Enter key. 123 will be displayed.

Step 7. Enter the new password. (e.g. 456). 456 will be displayed.

Step 8. Press the Enter key. Then 456 will blink. 456 will be displayed.

Step 9. Press Enter key. H94 will be displayed.

6.4 Powerup Procedure

1. Remove all power from the control.
2. Disconnect the motor from the load (including coupling or inertia wheels).
3. Turn power on. Be sure there are no faults.
4. Set the following parameters for the values displayed on the motor nameplate:
   P30 Motor HP Select
   P32 Motor Rated Current
   P33 Pole Number
   P34 Base Frequency
5. If external dynamic brake hardware is used, set the Level 2 Brake Adjust block “Resistor Ohms” and “Resistor Watts” parameters.

WARNING: The motor shaft will rotate during this procedure. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment.

6. Set H41 =1 from using the Keypad. Perform each step including auto tune.
7. Remove all power from the control.
8. Couple the motor to its load.
9. Verify freedom of motion of motor shaft.
10. Verify the motor coupling is tight without backlash.
11. Verify the holding brakes if any, are properly adjusted to fully release and set to the desired torque.

12. Turn power on. Be sure no errors are displayed.
13. Run the drive from the keypad.
14. Select and program additional parameters to suit your application, see Chapter 8.

The control is now ready for use the in keypad mode. If a different operating mode is desired, refer to Chapter 7 Parameter Descriptions and Chapter 8 Customizing for your Application.

6.5 Keypad Frequency Setting

Group	Code	Parameter Name	Setting	Unit
Drive group	P37	[Frequency Command]	-	Hz
	P40	[Frequency Setting Method]	1	
Step 1. Set P40 [Frequency Setting Method] = 1. Step 2. Set the desired frequency in P37 and press the Prog/Ent key to save the value into memory. Step 3. The value can not be set above P36 [Frequency High Limit].				

Note: When remote keypad is connected, keypad keys on the body are deactivated.

Chapter 7
Parameter Descriptions

7.1 Overview

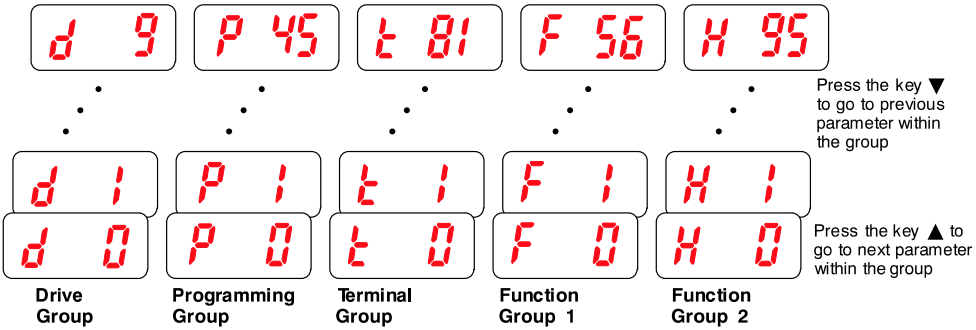
Parameters are organized into five Parameter Groups:

1. **Drive Group**
   Parameters for the display of basic drive information.
2. **Programming Group**
   Most commonly used parameters for start-up and operation.
3. **Terminal Group**
   Input and output control parameters.
4. **Function Group 1**
   Advanced motor control parameters.
5. **Function Group 2**
   Advanced motor profile parameters.

For each parameter described in this chapter, the following terms may be used:

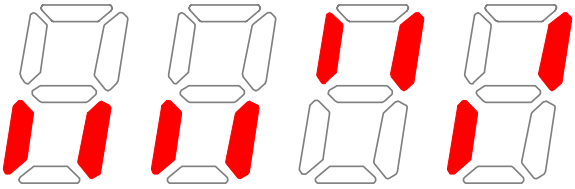
Parameter Number:	Unique number assigned to each parameter.
Parameter Name:	Unique name assigned to each parameter.
LED Display:	Display shown on LED screen when parameter is accessed.
Range:	Predefined parameter limits or selections. Note that a negative Hz value indicates reverse rotation.
Preset Value:	Factory preset value.
Access:	RO - Read Only. Parameter value can not be modified by user. R/W - Configurable. Parameter can be modified only while drive is stopped. Tune - Tunable. Parameter can be modified while drive is running or stopped.
Group:	Menu group within which parameter is located.
See also:	Associated parameters that may provide additional or related information.

Figure 7-1 Parameter Group Organization & Navigation

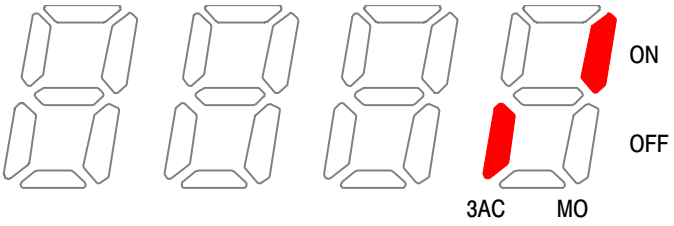


Press the ▶ key to navigate to the next group. Press the ◀ key to navigate to the previous group.

7.2 Drive Group

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
d0	RO	**Frequency Command** (Range: 0.00 to Frequency High Limit (P36) Hz) The value of the active frequency command. The commanded frequency is displayed even if the drive is not running. Preset Value: 0.00
d1	RO	**Motor RPM** (Range: 0 Motor RPM (based on P33 Motor Poles) RPM) The output motor RPM. Motor RPM is scaled based on output frequency present on terminals U, V and W based on the setting in P33 - Motor Poles. Preset Value: 0
d2	RO	**Output Current** (Range: 0.0 to Motor Rated Current (P32) Amps) The value of the output current present at terminals U, V and W. Preset Value: 0.0
d3	RO	**Output Voltage** (Range: 0.0 to Drive Rated Voltage VAC) The output voltage present at U, V, W. Preset Value: 0.0
d4	RO	**Output Power** (Range: 0.00 to (Drive Rated Power x 2) kW) The motor power applied to terminals U, V and W. Preset Value: 0.00
d5	RO	**Output Torque** (Range: 0.00 to (Drive Rated Torque x 2) [kgf / M]) The value of the output torque present at terminals U, V and W. (Enter motor nameplate efficiency in H36 to display correct torque.) Preset Value: 0.00
d6	RO	**DC Link Voltage** (Range: Based on Drive Rating VDC) The present DC bus voltage level. Preset Value: N/A
d7	RO	**Input Terminal status display** (Range: N/A) Displays of P1-P8 input terminal status. This example shows P1, P3, P4 are ON and P2, P5 are OFF. Preset Value: N/A 

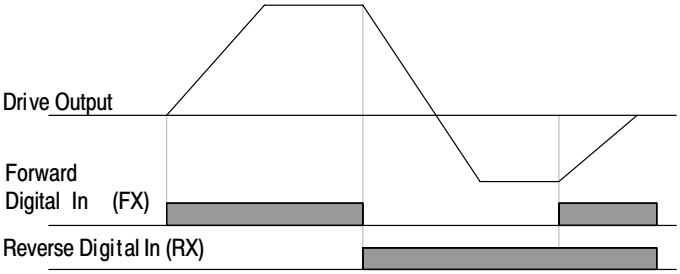
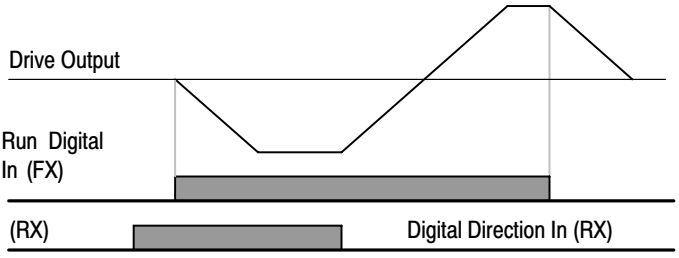
7.2 Drive Group Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
d8	RO	**Output terminal status display** (Range: N/A) Displays status of the Digital (MO) Output and the Relay (3A-C) terminals. This example shows Digital Output (MO) is ON and the Relay is OFF. Preset Value: N/A 
d9	RO	**Software Version** (Range: 1.0 to 99.9) The version of the Main Control Board software. Preset Value: 1.8
nOn	RO	**Current Fault Display** (Range: N/A) Displays the types of faults, frequency and operating status at the time of the last fault. Fault code history can be viewed in parameters H1 - H5. H6 is used to clear the fault code history. See Also: H1 - H6. See Chapter 9 for additional information. Preset Value: N/A

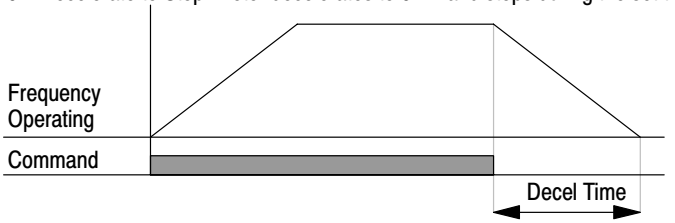
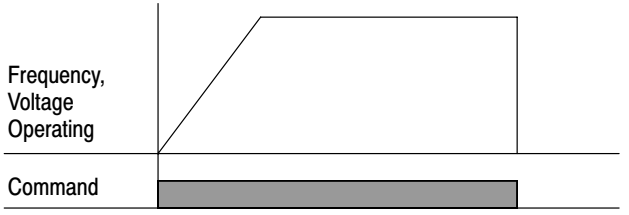
7.3 Programming Group

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
	Tune	**Jump Code** (Range: 30 -47) Sets the parameter number to jump directly to. Jump must be within the group. Preset Value: 45
	R/W	**Motor HP Select** (Range: 0.5= 0.5 HP 1= 1 HP 2= 2 HP 3= 3 HP 5= 5 HP 7.5= 7.5 HP 10= 10 HP) Sets the motor type connected to the drive output. See Also: P32, P34 Preset Value: Based on drive rating.
	R/W	**Motor Rated Current** (Range: 0.5 - 50 Amps) Sets the value of motor rated current on the nameplate. See Also: P30, P32, P34 Preset Value: Based on drive rating.
	R/W	**Pole Number** (Range: 2, 4, 6, 8, 10, 12) Sets the number of motor poles See Also: P30, P32, P34 Preset Value: 4
	R/W	**Base Frequency** (Range: 30 - 400 Hz) The drive outputs its rated voltage to the motor at this frequency (enter motor nameplate). See Also: P30, P33, F30-F38. See parameter F30 for custom V/Hz settings and V/Hz curve. Preset Value: 60.00
	R/W	**Frequency Low Limit** (Range: 0 - P36 Hz) Sets drive minimum steady state output frequency. See Also: P36, F30-F38 Preset Value: 10.00
	R/W	**Frequency High Limit** (Range: 0 - 400 Hz) Sets drive maximum steady state output frequency. See Also: P35 Preset Value: 60.00
	Tune	**Speed Command** (Range: 0 - 400 Hz) Sets the frequency (speed) that the drive is commanded to output. If the drive is running when this value is changed, it will immediately accelerate or decelerate to this value after Enter/Prog is pressed. Preset Value: 0.00

7.3 Programming Group Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
P38	R/W	**Stop/Start Source** (Range: 0= Keypad (Drive control for start, stop, forward and reverse are from drive keypad.) 1= Terminal Mode 1 (2 or 3- wire control from run forward terminal and run reverse terminal.) 2= Terminal Mode 2 (2 wire with direction switch from run terminal and directional terminal.) 3= RS485 Communication Drive operation controlled using RS-485 communications (see Appendix E) Sets the input source that is used to start and stop the drive. See Also: P40; t1 - t8 Preset Value: 0 **Terminal Operation Mode 1**: (2-Wire or 3-Wire Control Fwd/Rev): • Select one digital input (t1-t8) = 0, run forward (FX). • Select one digital input (t1-t8) = 1, run reverse (RX). • To enable 3-Wire control select one digital input (t1-t8) = 17, 3-Wire operation. • Drive stops when both inputs are off or when both inputs are on.  **Terminal Operation Mode 2**: (2-Wire Control with Fwd/Rev Switch): • Select one digital input (t1-t8) = 0, run forward (FX). Operates as a Run Command • Select one digital input (t1-t8) = 1, run reverse (RX). Operates as a Direction Switch • To enable 3-Wire control select one digital input (t1-t8) = 17, 3-Wire operation. • Drive stops when both inputs are off or when both inputs are on. 

7.3 Programming Group Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
P39	R/W	**Stop Type** (Range: 0= Decelerate to Stop (Ramp) 1= DC Brake to Stop 2= Coast to Stop) Sets the active mode for all stop sources. See Also: P38, P42, F8-F11 Preset Value: 0 0 = Decelerate to Stop. Motor decelerates to 0 Hz and stops during the set ti  1 = DC Brake to stop. See parameters F8 - F11 for further details. 2 = Coast to stop. Output frequency and voltage are shut down on a stop cor 

7.3 Programming Group Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
P40	R/W	**Speed Reference Source** (Range: 1= Digital Keypad Output frequency is set in the operation mode by pressing the up/down keys. The drive immediately responds to the new setting without pressing the enter key. 2= Analog V1 1: ± 10VV Output frequency is set by a ± 10V signal applied to analog input terminal V1. 3= Analog V1 2: 0 to +10 V Output frequency is set by a 0-10VDC signal applied to analog input terminal V1. 4= Analog Terminal I: 0 - 20mA Output frequency is set by a 0-20mA signal applied to analog input terminal I. 5= Analog Terminal V1 Mode 1+ Terminal I Output frequency is set by the sum of the ± 10V signal applied to V1 and the 0-20mA signal applied to terminal I. 6= Analog Terminal V1 Mode 1+ Terminal I Output frequency is set by the sum of the 0-10V signal applied to V1 and the 0-20mA signal applied to terminal I. 7= Analog RS485) Drive output frequency is controlled by the RS485 communications port. Sets the source of the speed reference to the drive. See Also: t32-t33, F60 Preset Value: 1
P41	Tune	**Accel Time** (Range: 0 - 6,000 sec) Sets the Accel time of the drive. When using the multiple accel/decel curves with preset speeds, this ramp serves as accel/decel time 0. H71 can be used to scale the accel/decel units and H70 determines if the time to accel/decel is relative to P35 (Frequency High Limit) or the delta change of running frequency to set frequency. See Also: P42, P36, H70, H71 Preset Value: 5.0
P42	Tune	**Decel Time** (Range: 0 - 6,000 sec) Sets the Decel time of the drive. When using the multiple accel/decel curves with preset speeds, this ramp serves as accel/decel time 0. H71 can be used to scale the accel/decel units and H70 determines if the time to accel/decel is relative to P35 (Frequency High Limit) or the delta change of running frequency to set frequency. See Also: P42, P36, H70, H71 Preset Value: 10.0

7.3 Programming Group Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
	Tune	**Preset Speed 1** (Range: 0 - 400 Hz) Provides an internal fixed speed command selectable by digital inputs. See Also: t1-t8, t10-t13 Preset Value: 10.00
	Tune	**Preset Speed 2** (Range: 0 - 400 Hz) Provides an internal fixed speed command selectable by digital inputs. See Also: t1-t8, t10-t13 Preset Value: 20.00
	Tune	**Preset Speed 3** (Range: 0 - 400 Hz) Provides an internal fixed speed command selectable by digital inputs. See Also: t1-t8, t10-t13 Preset Value: 30.00
	RO	**Drive Start/Stop Source 2** (Range: 0= Keypad (Drive control for start, stop, forward and reverse are from drive keypad.) 1= Terminal Mode 1 (2 or 3- wire control from run forward terminal and run reverse terminal.) 2= Terminal Mode 2 (2 wire with direction switch from run terminal and directional terminal.) 3= RS485 Communication Drive operation controlled using RS-485 communications (see Appendix E) This parameter serves as an alternate control mode. It is selectable by a digital input (t1-t8) = “22”. Note: Only viewable when one of the t1-t8 terminals is set for 22. See Also: P38, t1-t8 Preset Value: 1 = Terminal Mode 1
	RO	**Speed Reference Source 2** (Range: 1-7 (see table for P40)) This parameter serves as an alternate speed reference mode. It is selectable by a digital input (t1-t8) = “22”. Note: Only viewable when one of the t1-t8 terminals is set for 22. See Also: P40, P47, t1-t8 Preset Value: 1 = Keypad

7.4 Terminal Group

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
t0	Tune	**Jump Code** (Range: 0 - 81) Sets the parameter number to jump directly to. Jump must be within the group. Preset Value: 0
t1 to t8	Tune	**Digital Inputs 1-8** (Range: 0 =Forward Run Command 1 = Reverse Run Command 2 = Output Inhibit 3 = Fault Reset (RST) 4 = Jog Speed Select (2-Wire only) 5 = Speed Select1 6 = Speed Select2 7 = Speed Select3 8 = Ramp Select1 9 = Ramp Select2 10 = Ramp Select3 11 = DC Brake during start 12 = 2nd Motor Select 13 = Reserved 14 = Reserved 15 = Frequency increase (UP) Command 16 = Frequency decrease (DOWN) Command 17 = 3-Wire Stop 18 = External Trip: A Contact (EtA) 19 = External Trip: B Contact (EtB) 20 = Self-Diagnostic Function 21 = Exchange between PID operation and V/F operation 22 = Exchange between second source and drive 23 = Analog Hold 24 = Accel/Decel Disable 25 = Up/Down Save Freq. Initialization) Selects the function for the digital inputs. Preset Value: t1=0, t2=1, t3=2, t4=3, t5=4, t6=5, t7=6, t8=7

0 = **Forward Run (FX) Command**: Defines a digital input as a forward run command in 2-Wire or 3-Wire control. For both 2-Wire and 3-Wire control, P38 - Drive Mode should be set to a 1 for normal operation. For 3-Wire control an additional terminal must be defined as 17 = 3-Wire operation.

1 = **Reverse Run (RX) Command**: Defines a digital input as a reverse run command in 2-Wire or 3-Wire control.
For both 2-Wire and 3-Wire control, P38 - Drive Mode should be set to a 1 for normal operation.
For 3-Wire control an additional terminal must be defined as 17 = 3-Wire operation.

2 = **Output Inhibit**: Defines a digital input as a drive Output Inhibit. As soon as this input is closed, the drive output is instantly turned off and the motor will free wheel (coast to a rest). As soon as the input is opened, the drive will resume previous operation (if in run, the drive will immediately accelerate to the set speed). While the input is closed the drive display will show ESt [Instant Cut Off].

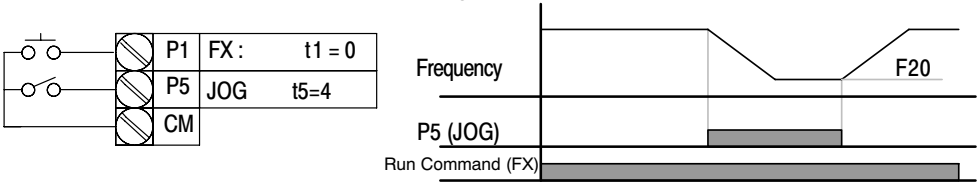
3 = **Fault Reset (RST)**: Active input resets the fault and resets the drive.

4 = **Jog**: When active, the drive ramps to the value set in Jog Frequency (F20).
Jog operation overrides all other operations except Dwell operation. If Jog Speed Command is entered during a Preset Speed, Up-Down or 2-Wire control; operation is executed at Jog frequency, see Figure 7-2. A valid start command is required separate from the dedicated jog input.
The jog function is only available for 2-Wire control.

7.4 Terminal Group Continued

(Digital Inputs 1-8 Definitions Continued)

Figure 7-2



5 = **Speed Select 1** - (see Figure 7-7)

6 = **Speed Select 2** - (see Figure 7-7)

7 = **Speed Select 3** - (see Figure 7-7)
Used to select Preset Speed 1 - 7 combinations, see P43-P45 and t10-t13, and Figure 7-7.

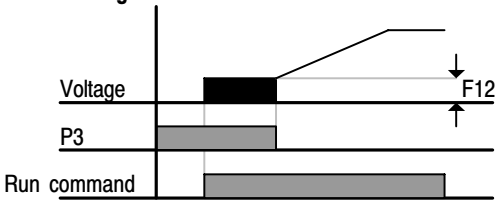
8 = **Ramp Select1** - (see Figure 7-8)

9 = **Ramp Select2** - (see Figure 7-8)

10 = **Ramp Select3** - (see Figure 7-8)
Used to define accel/decel ramp combinations for preset speeds, see (t14-t27).

11 = **DC brake during start:** DC voltage will be applied to the motor windings at a level set by DC Brake Start Voltage (F12) for as long as the digital input is closed. See also F12 and F13 - Starting DC brake parameters. See Figure 7-3.

Figure 7-3



12 = **2nd motor select:** When input is present, the drive configures itself for a second set of motor settings defined in 2nd motor operation parameters (H81 to H90).

13 = Reserved: Reserved

14 = Reserved: Reserved

15 = **Frequency increase (UP)**: Increases the frequency reference to the drive after a run command. Frequency is saved to parameter F64 on a stop command if F63 = 1 'save up/down frequency'.

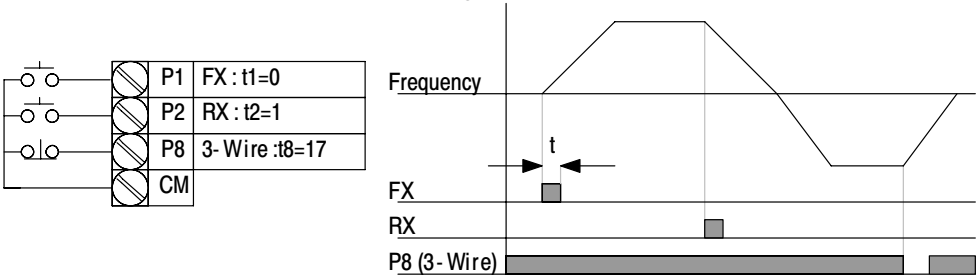
16 = **Frequency decrease (DOWN)**: decreases the frequency reference to the drive after a run command. Frequency is saved to parameter F64 on a stop command if F63 = 1 'save up/down frequency'.

17 = **3-W ire operation**: Select to define a digital input for 3-Wire control. Inputs defined as forward (FX) and reverse (RX) are momentary inputs and opening the input defined as 3-Wire operation will stop the drive. For both 2-Wire and 3-Wire control, P38 - Drive Mode should be set to a 1 for normal operation. See Figure 7-4.

7.4 Terminal Group Continued

(Digital Inputs 1-8 Definitions Continued)

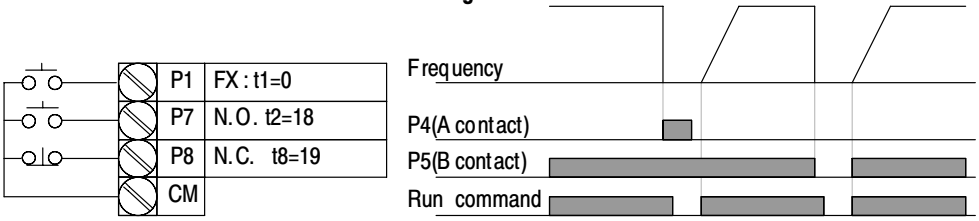
Figure 7-4



18 = **External trip - A (N.O.)**: Normally open contact input. When a digital input is set to "Ext trip-A" is ON (Closed), the drive displays the fault and turns off its output power. See Figure 7-5.

19 = **External trip - B (N.C.)**: Normally closed contact input. When a digital input is set to "Ext trip-B" is OFF (Open), the drive displays the fault and turns off its output power. See Figure 7-5.

Figure 7-5



20 = **Self-Diagnostic function**: Defines a digital input to initiate the self-diagnostic function capability of the drive unit. Parameter H60 = Self-Diagnostic function is used to define the test to conduct; IGBT fault and ground fault, Output phase short/open circuit/ground fault or ground fault (IGBT fault/output phase short/open circuit). See Chapter 8 - Customizing Your Application for advanced drive function description.

21 = **Change from PID to V/Hz Operation**: Selects a digital input to bypass the PID Feedback controller and selects the default V/Hz control settings. See Chapter 8 Customizing your application for advanced drive function.

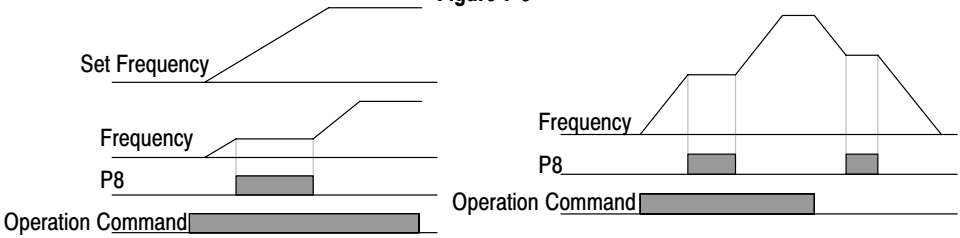
22 = **Exchange between second source and drive**: When the defined input is turned ON, setting values in P46 and P47 are used for control and reference to the drive. Settings for P46 and P47 can not be changed while the digital input is closed.

23 = **Analog Hold**: Locks the analog speed reference at the last value when the input was closed. Available when P40 = Frequency setting method is set in the range of 2-7.

7.4 Terminal Group Continued

(Digital Inputs 1-8 Definitions Continued)

Figure 7-6



24 = **Accel/Decel Disable**: Disables the acceleration or deceleration ramp while the digital input is closed, holding the reference at its last value. See Figure 7-6.

25 = **Up/Down Frequency Save Initialization**: When the digital input is active, the last Up/Down frequency is saved. Useable when digital inputs are configured as 15 = Frequency Increase (UP) and 16 = Frequency Decrease (DOWN). See Figure 7-6.

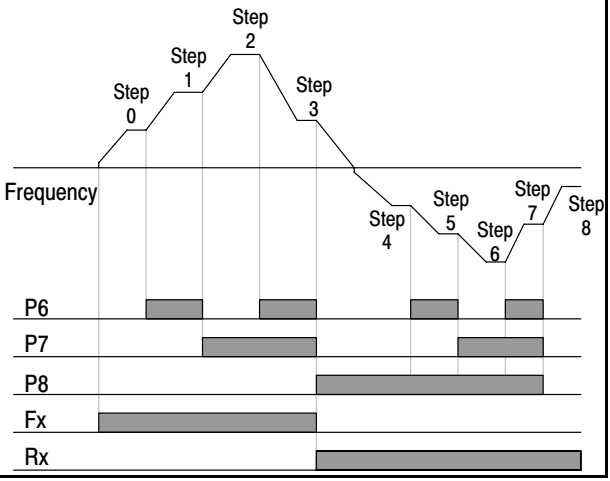
Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
t9	Tune	**Filtering Time Constant for Digital input terminal** (Range: 1 - 15) The higher the value, the slower the responsiveness of the digital input becomes. See Also: t1-t8 Preset Value: 4
t10 to t13	Tune	**Preset Speeds 4-6** (Range: 0-400Hz) Provides a fixed Speed Command value when Digital Input 1 - 8 is set for a Preset Speed (Option 5, 6 and 7). Closing a digital input programmed as a preset speed will cause the drive to operate at the defined speed. Preset speeds 1-3 are set in the programming group (P43-P45) while preset speeds 4-7 are set in the terminal group (t30-t33). See Also: t1-t8, P43-P45 Preset Value: t10 =30, t11=25, t12=20, t13=15

7.4 Terminal Group Continued

(t10 to t13 Definitions Continued)

Figure 7-7

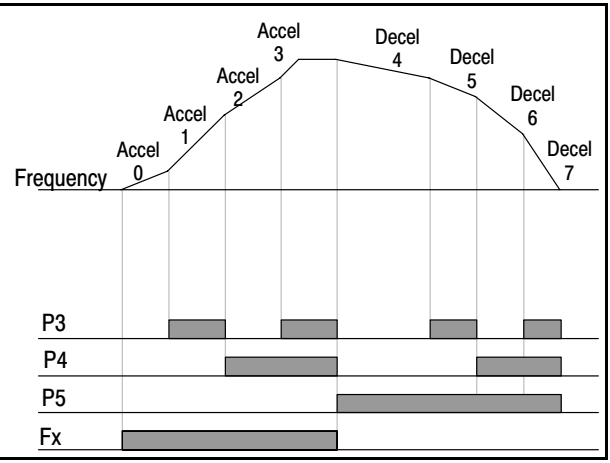
Param	Preset Speed	Speed Select		
		3	2	1
P40	Freq. Comm.	-	-	-
P43	1	-	-	✓
P44	2	-	✓	-
P45	3	-	✓	✓
t10	4	✓	-	-
t11	5	✓	-	✓
t12	6	✓	✓	-
t13	7	✓	✓	✓



Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
t14 to t27	Tune	**Preset Accel/Decel Time 1-7** (Range: 0-6000Sec) Sets multiple acceleration and deceleration ramps based on a digital input closure. See Also: t1-t8, t10-t13, P43-P45 Preset Value: t14, t15 = 3.0; t16, t17 = 4.0; t18, t19 = 5.0; t20, t21 = 6.0; t22, t23 = 7.0, t24, t25 = 8.0, t26, t27 = 9.0

Figure 7-8

Param	Preset Accel/-Decel	Ramp Select		
		3	2	1
P41, P42	0	-	-	-
t14, t15	1	-	-	✓
t16, t17	2	-	✓	-
t18, t19	3	-	✓	✓
t20, t21	4	✓	-	-
t22, t23	5	✓	-	✓
t24, t25	6	✓	✓	-
t26, t27	7	✓	✓	✓

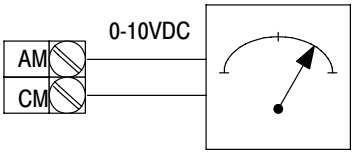


7.4 Terminal Group Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
t28	Tune	**Analog Output Select** (Range: 0-3) Selects the value to send to the analog output terminals. See Also: t29 Preset Value: 0

Figure 7-9

Setting:	10V Output Proportional to:
0 = Output Frequency	P36 – Frequency High Limit
1 = Output Current	150% of Inverter rated current
2 = Output Voltage	282VAC or 564VAC (200V or 400V Drive Rating)
3 = DC Link Voltage	400VDC or 800VDC (200V or 400V Drive Rating)

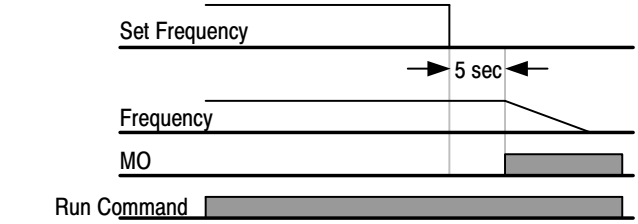


Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
t29	Tune	**Analog Output Level Adjustment** (Range: 10 - 200%) Adjusts the scaling of the analog output based on a 10V signal. See Also: t28 Preset Value: 100
t30	Tune	**Frequency detection level** (Range: 0-400 Hz) Used when t32 or t33 are set to 0-4, can not be set higher than P36 (Frequency High Limit). See also: t32-t33, Chapter 8 Preset Value: 30
t31	Tune	**Frequency detection bandwidth** (Range: 0-400 Hz) Used when t32 or t33 are set to 0-4, can not be set higher than P36 (Frequency High Limit). See also: t32-t33, Chapter 8 Preset Value: 10

7.4 Terminal Group Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
t32	Tune	**Digital Output (MO)** (Range: 0 = FDT-1 1 = FDT-2 2 = FDT-3 3 = FDT-4 4 = FDT-5 5 = Overload (OLt) 6 = Inverter Overload (LoIT) 7 = Motor Stall STALL 8 = Over voltage trip (OV) 9 = Low voltage trip (LV) 10 = Inverter overheat (OH) 11 = Command Loss 12 = During run 13 = During stop 14 = During constant run 15 = During speed searching 16 = Wait time for run signal input 17 = Fault Output 18 = Cooling Fan Trip Alarm) Sets the on/off point for the Digital output. See Also: t34, F54-F55, F59-F60, Chapter 8 Preset Value: 12
t33	Tune	**Relay Output (3A - 3C)** (Range: 0 = FDT-1 1 = FDT-2 2 = FDT-3 3 = FDT-4 4 = FDT-5 5 = Overload (OLt) 6 = Inverter Overload (LoIT) 7 = Motor Stall STALL 8 = Over voltage trip (OV) 9 = Low voltage trip (LV) 10 = Inverter overheat (OH) 11 = Command Loss 12 = During run 13 = During stop 14 = During constant run 15 = During speed searching 16 = Wait time for run signal input 17 = Fault Output 18 = Cooling Fan Trip Alarm) Sets the on/off point for the Relay outputs. See Also: t34, F54-F55, F59-F60, Chapter 8 Preset Value: 17

7.4 Terminal Group Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
t34	Tune	**Fault Relay Output** (Range: 0-7) Outputs a fault code when t33 - Relay Output is set to 17: Fault Output. See Also: t33, Chapter 8 Preset Value: 2
t35	Tune	**Criteria for Analog Input Signal Loss** (Range: 0 = Disabled. (Does not check the analog input signal loss) 1 = Activated when less than half the value set in t36, t41, t46. 2 = Activated when less than the value set in t36, t41, t46) Selects the drive mode when frequency reference set by the Analog (V1, I) input terminal or communication option is lost. Preset Value: 0 Example 1) The inverter determines the freq reference is lost when P40 - Freq set method is set to 3 (Analog V1 input), t16 to 1 and analog input signal is less than half the value set in t36. Example 2)The inverter determines the freq reference is lost when P40 - Freq set method is set to 6 (V1+I), t16 to 2 and V1 input signal is either less than the value set in t36 or I input value is less than the t46 value. Example diagram when t35 is set to 2, I62 to 2, I63 to 5.0 sec and t32 to 11: 
t36	Tune	**Analog Input 0 to -10V (NV) Min voltage** (Range: 0 to -10V) Sets the minimum voltage of the NV (-10 to 0V) input. See Also: P40, t37 Preset Value: 0
t37	Tune	**Frequency corresponding to t36** (Range: 0 - 400 Hz) Sets the inverter output minimum frequency at minimum voltage of the NV input. See Also: t37 Preset Value: 0
t38	Tune	**Analog Input 0 to -10V (NV) Max voltage** (Range: 0 to 10V) Sets the maximum voltage of the NV input. See Also: P40, t39 Preset Value: 10

7.4 Terminal Group Continued

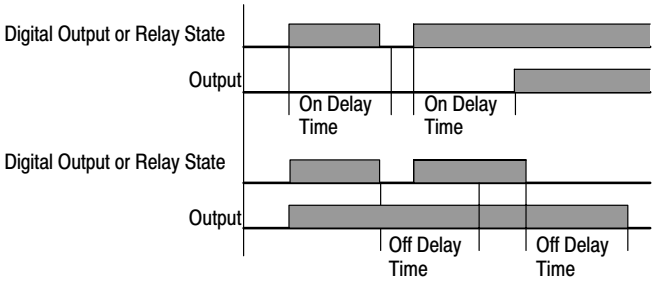
Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
	Tune	**Frequency corresponding to t38** (Range: 0 - 400 Hz) Sets the inverter output maximum frequency at maximum voltage of the NV input. See Also: t38 Preset Value: 60
	Tune	**Analog Input 0 - 10V (V1) Filter time constant** (Range: 0 - 9999) Adjusts the responsiveness of the Analog (V1) input (0 to 10V) to filter noise. See Also: P40, t41-t43 Preset Value: 10
	Tune	**Analog Input 0 - 10V (V1) Min voltage** (Range: 0 - 10V) Sets the minimum voltage of the Analog Input (V1) input. See Also: t40, t42 Preset Value: 0
	Tune	**Frequency corresponding to t41** (Range: 0 - 400 Hz) Sets the inverter output minimum frequency at minimum voltage of the V1 input. See Also: t41 Preset Value: 0
	Tune	**Analog Input 0-10V (V1) Max voltage** (Range: 0 - 10V) Sets the maximum voltage of the V1 input. See Also: t44 Preset Value: 10
	Tune	**Frequency corresponding to t43** (Range: 0-400 Hz) Sets the inverter output maximum frequency at maximum voltage of the V1 input. See Also: t43 Preset Value: 60
	Tune	**Analog Input 0-20mA (I) Filter time constant** (Range: 1-9999) Adjusts the responsiveness of the Analog (I) input (0-20mA) to filter noise. See Also: P40, t46-t49 Preset Value: 10
	Tune	**Analog Input 0-20mA (I) Min Current** (Range: 0-20mA) Sets the minimum current of the Analog 0-20mA (I) Input. See Also: t45, t47 Preset Value: 4

7.4 Terminal Group Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
	Tune	**Frequency corresponding to t46** (Range: 0-400 Hz) Sets the inverter output minimum frequency at minimum current of the I input. See Also: t46 Preset Value: 0
	Tune	**Analog Input 0-20mA (I) Max Current** (Range: 0-20mA) Sets the maximum current of the Analog 0-20mA (I) Input. See Also: t47 Preset Value: 20
	Tune	**Frequency corresponding to t47** (Range: 0-400 Hz) Sets the inverter output maximum frequency at maximum current of the I input. See Also: t48 Preset Value: 60
	Tune	**Digital Output (MO) On Delay** (Range: 0 to 3,600 Seconds) Sets the on delay timer for the digital output. See Also: t32 and t33 Preset Value: 0
	Tune	**Relay Output (3A - 3C) On Delay** (Range: 0 to 3,600 Seconds) Sets the on delay timer for the relay output. See Also: t32 and t33 Preset Value: 0
	Tune	**Digital Output (MO) Off Delay** (Range: 0 to 3,600 Seconds) Sets the off delay timer for the digital output. See Also: t47 Preset Value: 20
	Tune	**Relay Output (3A - 3C) Off Delay** (Range: 0 to 3,600 Seconds) Sets the off delay timer for the relay output. See Also: t60-t61, t64-t81 Preset Value: 0

Figure 7-10 Digital and Relay On/Off Delay

A timer function has been implemented by adding four new software parameters. Two are for the On Delay and two for the Off Delay timer to the digital outputs of the VS1MD drive. Setting a value of greater than zero will begin the On, Off or both timers when the condition set in t32 and t33 for the digital outputs is met. In the case of the On delay timer, the actual output will not change state until the time value set in t50 to t51 is met. The Condition set in t32 to t33 must be active when the timer is reached for the output state to change. In the case of the Off delay timer, once the output state is on, it will delay turning off after the Off delay value is reached on t52 to t53. When the Off delay time is reached, the condition set in t32 to t33 must still be off.



Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
t57	Tune	**Keypad Error Output** (Range: 0= Not used 1= Signal output to MO 2= Signal output to 3A, 3B contacts 3= Signal output to MO, 3A, 3B) Selects the Digital and/or Relay output when a keypad-inverter communication fails. Preset Value: 0 Relay Output Bit 2 / Digital Output Bit 0: 0 - - 1 - ✓ 2 ✓ - 3 ✓ ✓ When communication error occurs for a certain time, will be displayed and the error signal can be sent to the Digital (MO) or Relay output. Err
t59	Tune	**Communication protocol select** (Range: 0= Modbus RTU 1= CI485) Sets the protocol for the serial communication network. See Also: t60-t61, t64-t81 Preset Value: 0

7.4 Terminal Group Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
	Tune	**Inverter Number** (Range: 1-250) Sets the protocol for the serial communication network. See Also: t60-t61, t64-t81 Preset Value: 1
	Tune	**Baud Rate** (Range: 0=1200 [bps] 1=2400 [bps] 2=4800 [bps] 3=9600 [bps] 4=19200 [bps]) Selects the Baud Rate of RS485 Communication. See Also: t59-t60, t64-t81 Preset Value: 3
	Tune	**Frequency Loss Mode** (Range: 0=Continue operation at last Speed Command 1= Coast to Stop. 2= Decelerate to stop.) When the frequency reference is from the Analog Input or RS485 Port, this parameters sets the action to take if the speed reference is lost. See Also: P40, t35, t63 Preset Value: 0
	Tune	**Frequency Loss Wait Time** (Range: 0.1-120 Sec) This is the time delay before the drive takes action in the event of a command frequency loss. If there is no Speed Command input during the time set in this parameter, the drive starts to operate in the mode selected in t62. See Also: P40, t35, t62 Preset Value: 1.0
	Tune	**Communication Time Setting** (Range: 2-100 ms) Frame Communication time. See Also: t59-t61, t65-t81 Preset Value: 5
	Tune	**Parity/Stop Bit Setting** (Range: 0=Parity: None, Stop Bit: 1 1=Parity: None, Stop Bit: 2 2=Parity: Even, Stop Bit: 1 3=Parity: Odd, Stop Bit: 1) When the protocol is set, the communication format can be set. See Also: t59-t61, t64, t66-t81 Preset Value: 0
	Tune	**Read address register 1** (Range: 0-42239) Allows up to 8 discontinuous addresses to be read with one read command. Preset Value: 5

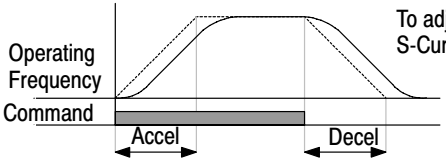
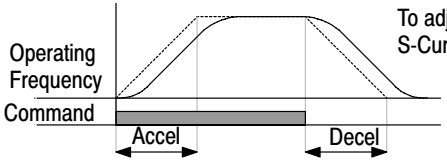
7.4 Terminal Group Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
	Tune	**Read address register 2** (Range: 0-42239) Allows up to 8 discontinuous addresses to be read with one read command. Preset Value: 6
	Tune	**Read address register 3** (Range: 0-42239) Allows up to 8 discontinuous addresses to be read with one read command. Preset Value: 7
	Tune	**Read address register 4** (Range: 0-42239) Allows up to 8 discontinuous addresses to be read with one read command. Preset Value: 8
	Tune	**Read address register 5** (Range: 0-42239) Allows up to 8 discontinuous addresses to be read with one read command. Preset Value: 9
	Tune	**Read address register 6** (Range: 0-42239) Allows up to 8 discontinuous addresses to be read with one read command. Preset Value: 10
	Tune	**Read address register 7** (Range: 0-42239) Allows up to 8 discontinuous addresses to be read with one read command. Preset Value: 11
	Tune	**Read address register 8** (Range: 0-42239) Allows up to 8 discontinuous addresses to be read with one read command. Preset Value: 12
	Tune	**Write address register 1** (Range: 0-42239) Allows up to 8 discontinuous addresses to be written with one write command. Preset Value: 5
	Tune	**Write address register 2** (Range: 0-42239) Allows up to 8 discontinuous addresses to be written with one write command. Preset Value: 6
	Tune	**Write address register 3** (Range: 0-42239) Allows up to 8 discontinuous addresses to be written with one write command. Preset Value: 7

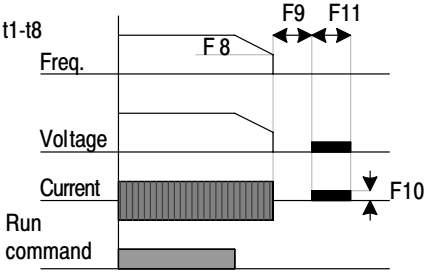
7.4 Terminal Group Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
	Tune	**Write address register 4** (Range: 0-42239) Allows up to 8 discontinuous addresses to be written with one write command. Preset Value: 8
	Tune	**Write address register 5** (Range: 0-42239) Allows up to 8 discontinuous addresses to be written with one write command. Preset Value: 5
	Tune	**Write address register 6** (Range: 0-42239) Allows up to 8 discontinuous addresses to be written with one write command. Preset Value: 6
	Tune	**Write address register 7** (Range: 0-42239) Allows up to 8 discontinuous addresses to be written with one write command. Preset Value: 7
	Tune	**Write address register 8** (Range: 0-42239) Allows up to 8 discontinuous addresses to be written with one write command. Preset Value: 8

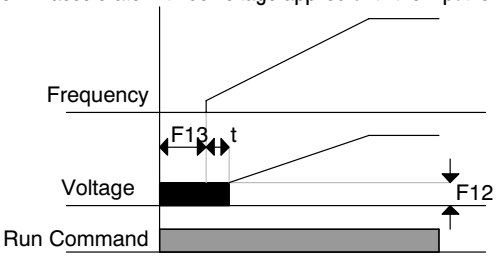
7.5 Function Group 1

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
F0	Tune	**Jump Code** (Range: 0-64) Sets the parameter number to jump directly to. Jump must be within the group. Preset Value: 0
F1	Tune	**Forward/Reverse Disable** (Range: 0 = Forward and Reverse run enable 1 = Forward run disable 2 = Reverse run disable) Enables/disables the function that allows the direction of the motor rotation to be changed. The forward or reverse command may come from a digital command, the keypad or serial command. All forward or reverse inputs will be ignored if the corresponding directional control is disabled in F1. Preset Value: 0
F2	R/W	**Accel Pattern** (Range: 0=Linear 1=S-Curve) Sets the acceleration pattern. Accel See Also: H17, H18, t1-t8 Preset Value: 0  To adjust the slope of the S-Curve see H17 and H18.
F3	R/W	**Decel Pattern** (Range: 0=Linear 1=S-Curve)) Sets the deceleration pattern. See Also: H17, H18, t1-t8 Preset Value: 0  To adjust the slope of the S-Curve see H17 and H18.

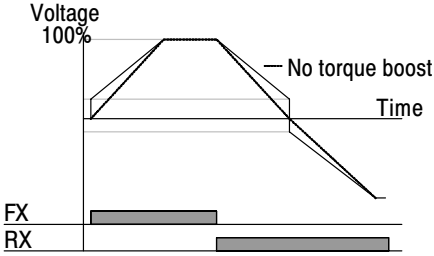
7.5 Function Group 1 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
F8	R/W	**DC Brake start frequency** (Range: 0.1-60 Hz) Sets the DC brake start frequency, it can not be set to less than P35 - Frequency low limit. Setting this value too high may cause an over current trip. Trips can be prevented by adjusting F9 - DC Brake wait time. See Also: H17, H18, t1-t8 Preset Value: 5.00 
F9	R/W	**DC Brake wait time** (Range: 0-60 Sec) The drive will hold for the time set in F9 after F8 - DC Brake start frequency is reached before it applies the voltage level set in F10 - DC Brake Voltage. Use DC Brake wait time when the load inertia is large to prevent nuisance trips or damage to the motor. Note: Only viewable when P39 - Stop mode select is set to DC Brake. See Also: P35, P39, F8-F11 Preset Value: 0.1
F10	R/W	**DC Brake Voltage** (Range: 0-200%) Sets the DC Brake Voltage as a percent of P32 - Motor Rated Current. Note: Only viewable when P39 - Stop mode select is set to DC Brake. See Also: P32,P35, P39, F8-F11 Preset Value: 50
F11	R/W	**DC Brake Time** (Range: 0-60 Sec) Sets the time for F10 - DC Brake Voltage to be applied to the motor after F9 - DC Brake wait time. Setting F10 or F11 to zero will disable the DC Brake function. In case of DC Brake at high load inertia and frequency, change the DC brake controller gain according to H37 set value. Note: Only viewable when P39 - Stop mode select is set to DC Brake. Preset Value: 1.0
F12	R/W	**DC Brake start voltage** (Range: 0-200%) Sets the amount of DC voltage before a motor starts to run. It is set as percentage of P33 - Motor rated current. See Also: F12, t1-t8 Preset Value: 50

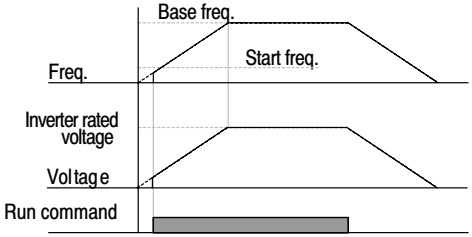
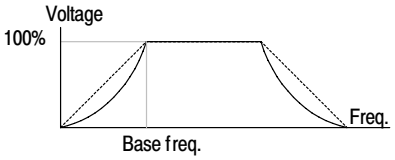
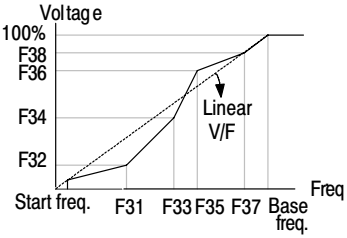
7.5 Function Group 1 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
F13	R/W	**DC Brake start time** (Range: 0-60 Sec) DC voltage is applied to the motor for DC Brake start time before motor accelerates. See Also: F12, t1-t8 Preset Value: 0 Setting F12 or F13 to 0 will disable the Starting DC brake. After F13 - DC Brake start time, the frequency is increased. If a digital input (t1-t8) is set for 11 - DC brake during start, the voltage is not released until the input is opened. The drive will accelerate with dc voltage applied until the input is open. 
F14	R/W	**Time for magnetizing a motor** (Range: 0-60 Sec) This parameter accelerates the motor after pre-exciting the motor for the set time. The amount of the pre-exciting current is set in H34 - Motor no load current. See Also: P30, P32, H32, H34, H40, H42, H44 Preset Value: 0.1
F20	Tune	**Jog Frequency** (Range: 0-400 Hz) Sets the Jog Frequency, cannot be set greater than P36 - Frequency High Limit. Jog is only available in 2-Wire control mode. See Also: P36, t1-t8 Preset Value: 10.00

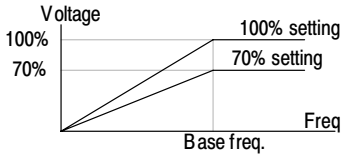
7.5 Function Group 1 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
F27	Tune	**Torque Boost select** (Range: 0=Manual Torque Boost 1=Auto Torque Boost) If F27 = 0, set manual torque boost values in F28 and F29. If F27 = 1 (Auto toque boost), the inverter automatically calculates torque boost values using motor parameters and outputs the corresponding voltage. Before enabling Auto torque boost, H34 - No load current and H42- Stator resistance must be set properly. See Also: F28-F29, H34, H41-42 Preset Value: 0 
F28	R/W	**Torque boost in forward direction** (Range: 0-15%) This parameter sets the amount of torque boost applied to a motor during forward run. It is set as a percent of maximum output voltage. See Also: F27-F29 Preset Value: 2
F29	R/W	**Torque boost in reverse direction** (Range: 0-15%) This parameter sets the amount of torque boost applied to a motor during reverse run. It is set as a percent of maximum output voltage. See Also: F27-F29 Preset Value: 2

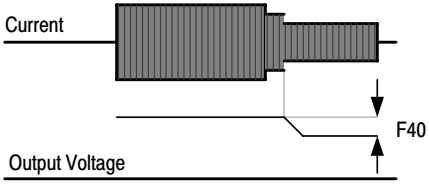
7.5 Function Group 1 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
F30	Tune	**V/F Pattern** (Range: 0=Linear 1=Square 2=User V/F) Selects a pattern for the drive. See Also: P34, P35, F31-F38, H40 Preset Value: 0 0 = Linear volts per hertz ratio from P35 - Frequency low limit to P34 -Base frequency.  1 = Squared volts per hertz ratio. Applications are fans, pumps or variable torque.  2 = User V/F is a custom volts per hertz pattern established using parameters F31-F38. 
F31	R/W	**User V/F frequency 1** (Range: 0 - 400 Hz) When F30 = 2, selects the frequency for each point in a custom volts per hertz pattern. See Also: P34, P35, F31-F38, H40 Preset Value: 15

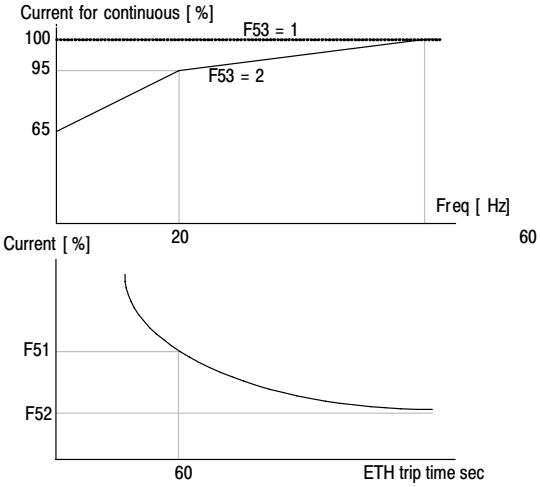
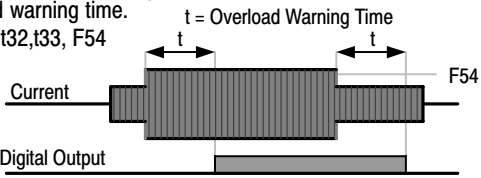
7.5 Function Group 1 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
F32	R/W	**User V/F voltage 1** (Range: 0-100%) When F30 = 2, selects the voltage for each point in a custom volts per hertz pattern. See Also: P34, P35, F31-F38, H40 Preset Value: 25
F33	R/W	**User V/F frequency 2** (Range: 0 - 400 Hz) When F30 = 2, selects the frequency for each point in a custom volts per hertz pattern. See Also: P34, P35, F31-F38, H40 Preset Value: 30
F34	R/W	**User V/F voltage 2** (Range: 0-100%) When F30 = 2, selects the voltage for each point in a custom volts per hertz pattern. See Also: P34, P35, F31-F38, H40 Preset Value: 50
F35	R/W	**User V/F frequency 3** (Range: 0 - 400 Hz) When F30 = 2, selects the frequency for each point in a custom volts per hertz pattern. See Also: P34, P35, F31-F38, H40 Preset Value: 45
F36	R/W	**User V/F voltage 3** (Range: 0-100%) When F30 = 2, selects the voltage for each point in a custom volts per hertz pattern. See Also: P34, P35, F31-F38, H40 Preset Value: 75
F37	R/W	**User V/F frequency 4** (Range: 0 - 400 Hz) When F30 = 2, selects the frequency for each point in a custom volts per hertz pattern. See Also: P34, P35, F31-F38, H40 Preset Value: 60
F38	R/W	**User V/F voltage 4** (Range: 0-100%) When F30 = 2, selects the voltage for each point in a custom volts per hertz pattern. See Also: P34, P35, F31-F38, H40 Preset Value: 100
F39	R/W	**Output voltage adjustment** (Range: 40-110%) This parameter adjusts the amount of output voltage, set as a percentage of input voltage. Use when the motor voltage is less than the input voltage. See Also: Preset Value: 100 

7.5 Function Group 1 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
F40	Tune	**Energy Savings Level** (Range: 0-30%) Adjusts the output voltage according to load status. It is set as a percent of the maximum output voltage. When used on pump and fan applications, it can dramatically reduce energy consumption by decreasing the output voltage with light loads. Preset Value: 0 
F50	Tune	**Electronic thermal select** (Range: 0-1) Setting this parameter to a 1 enables the electronic thermal overload. It activates when the motor is overheated if current is greater than the value set in F51 (time-inverse), and the drive output is turned off for the preset time. Note: Only viewable when F50 = 1 (Electronic Thermal Overload). See Also: F51, F52, F53 Preset Value: 0
F51	Tune	**Electronic thermal level for 1 minute** (Range: 50-200%) Sets the maximum current capable of flowing to the motor continuously for 1 minute. The set value is a percentage of P32 - Motor Rated Current. It can not be set lower than F52 - Electronic thermal level for continuous. See Also: F50, F52, F53 Preset Value: 150
F52	Tune	**Electronic thermal level for continuous** (Range: 50-15%) This parameter sets the amount of current to keep the motor running continuously. It cannot be set to exceed F51 - Electronic thermal level for 1 minute. See Also: F50, F52, F53 Preset Value:

7.5 Function Group 1 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
F53	Tune	**Motor cooling method** (Range: 0 = Standard Motor 1 = Variable Speed Motor) For a Standard Motor, cooling effects decrease when a motor is run at low speed. A Variable Speed motor is a special motor that uses a separately powered cooling fan to maximize cooling effect even at low speed. Preset Value: 0 
F54	Tune	**Overload Warning Level** (Range: 30-150%) Sets the amount of current to issue an alarm signal at a relay or digital output terminal (see parameters t32 and t33). The value is set as a percentage of P32 - Motor Rated Current. Select an output terminal for this function between MO (Digital Output) and 3A-C (Relay Output). If selecting MO as the output terminal, set t32 = 5 (Overload: OL). See Also: P32, t32, t33, F55 Preset Value: 150
F55	Tune	**Overload warning time** (Range: 0-30Sec) This parameter issues an alarm signal when the current greater than F54 -Overload warning level flows to the motor for F55 - Overload warning time. See also: P32, t32,t33, F54 Preset Value: 0 

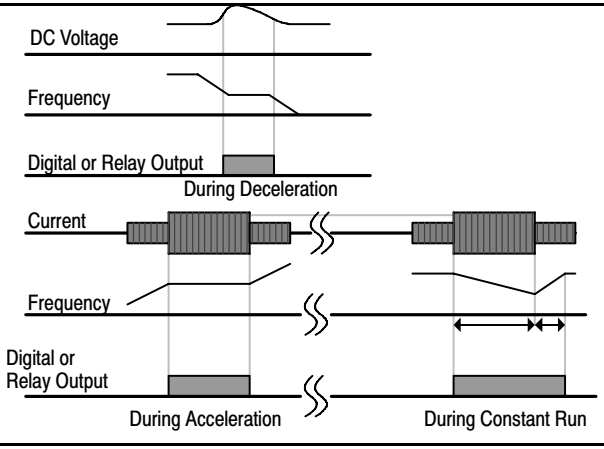
7.5 Function Group 1 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
F56	Tune	**Overload trip enable** (Range: 0-1) When set to a 1 = enabled, this parameter turns off the inverter output when the motor is overloaded. Overload level and time are set in F57 and F58 respectively. See Also: F57, F58 Preset Value: 1
F57	Tune	**Overload trip level** (Range: 30-200%) Sets the amount of overload current before the drive trips. The value is a percentage of P32 - Motor rated current. Preset Value: 180
F58	Tune	**Overload trip time** (Range: 0-60Sec) The inverter output is turned off if the current level set in F57 is exceeded for the time set in F58 - Overload trip time. See Also: F56, F57 Preset Value: 60
F59	R/W	**Stall Prevention select** (Range: 0-7) See Table 7-11 See Also: t32, t33, F60 Preset Value: 0

During:	Function Description:
Acceleration	Deceleration starts when current exceeds the value set in F60.
Constant run	Deceleration starts when current exceeds the value set in F6.
Deceleration	Deceleration stops when inverter DC link voltage rises above a certain voltage level.
t32 and t33:	The drive output is active (either the MO or relay output (3A-C) terminals when set = 7 Motor Stall. Motor stall status can be monitored even if F59 is not active
Example:	F59 = 3; stall prevention active during acceleration and constant run. When stall prevention is executed during acceleration or deceleration, accel/decel times may take longer than the user-setting time to prevent a stall condition. When stall prevention is activated during constant run, t1, t2 executed in accordance with the value set in P41 - Accel Time and P42 - Decel Time.

Figure 7-11

	During Decel Bit2	During Run Bit1	During Accel Bit0
0	-	-	-
1	-	-	✓
2	-	✓	-
3	-	✓	✓
4	✓	-	-
5	✓	-	✓
6	✓	✓	-
7	✓	✓	✓



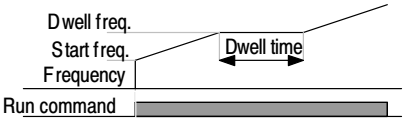
7.5 Function Group 1 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
	R/W	**Stall prevention level** (Range: 30-200%) This parameter sets the amount of current to activate stall prevention during acceleration, constant run or deceleration. The value set is a percentage of P32 - Motor Rated Current. See Also: P32, F59 Preset Value: 150
	R/W	**Save Up/down frequency** (Range: 0-1) This parameter decides whether to save the specified frequency during up/down operation. When 1 is selected, the up/down frequency is saved in F64. See Also: t1-t8,F64 Preset Value: 0
	RO	**Saved up/down frequency** (Range: N/A) Stores the up/down frequency if F63 = 1 before the drive stops or decelerates. Notes: F64 viewable when F63 = 1 (Save up/down frequency) See also: t1-t8, F63 Preset Value: 0.00
	R/W	**Start Frequency** (Range: 0.10 to 10.00 Hz) The drive starts to output its voltage at this frequency. It is the low frequency limit. Preset Value: 0.5

7.6 Function Group 2

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
	Tune	**Jump Code** (Range: 0 - 95) Sets the parameter number to jump directly to. Jump must be within the group. Preset Value: 0
	RO	**Last Fault 1** (Range: N/A) Stores information on the types of faults, the frequency, the current and the Accel/Decel condition at the time of fault. The latest fault is automatically stored in the H1 - Fault History 1. Up to the last five faults can be stored. When a fault occurs during operation, it can be monitored in the d - display parameters under nOn. See also: H6, Chapter 9 Preset Value: 0
	RO	**Last Fault 2** (Range: N/A) Stores information on the types of faults, the frequency, the current and the Accel/Decel condition at the time of fault. The latest fault is automatically stored in the H1 - Fault History 1. Up to the last five faults can be stored. When a fault occurs during operation, it can be monitored in the d - display parameters under nOn. See also: H6 Preset Value: 0
	RO	**Last Fault 3** (Range: N/A) Stores information on the types of faults, the frequency, the current and the Accel/Decel condition at the time of fault. The latest fault is automatically stored in the H1 - Fault History 1. Up to the last five faults can be stored. When a fault occurs during operation, it can be monitored in the d - display parameters under nOn. See also: H6 Preset Value: 0
	RO	**Last Fault 4** (Range: N/A) Stores information on the types of faults, the frequency, the current and the Accel/Decel condition at the time of fault. The latest fault is automatically stored in the H1 - Fault History 1. Up to the last five faults can be stored. When a fault occurs during operation, it can be monitored in the d - display parameters under nOn. See also: H6 Preset Value: 0
	RO	**Last Fault 5** (Range: N/A) Stores information on the types of faults, the frequency, the current and the Accel/Decel condition at the time of fault. The latest fault is automatically stored in the H1 - Fault History 1. Up to the last five faults can be stored. When a fault occurs during operation, it can be monitored in the d - display parameters under nOn. See also: H6 Preset Value: 0

7.6 Function Group 2 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
H6	Tune	**Reset Fault History** (Range: 0-1) Clears the fault history saved in H1 to H5. See also: H1-H5 Preset Value: 0
H7	R/W	**Dwell Frequency** (Range: 0.1-400 Hz) When run command is issued, the motor will accelerate after the Dwell Frequency is applied for the Dwell Time - H8. Dwell frequency can be set within Frequency High and Low Limits (P35 and P36). Dwell frequency is used to output torque in an intended direction. It is useful in hoisting applications to apply torque before releasing a mechanical brake. Rated slip frequency is calculated by the following formula: $f_s = f_r\left(\frac{RPM \times P}{120}\right)$ f_s= Rated slip frequency f_r= Rated frequency P=Number of motor poles See also: P35, P36, H8 Preset Value: 5.00 
H8	R/W	**Dwell Time** (Range: 0-10 Sec) Sets the time for dwell operation. See also: H7 See also: H11-H16 Preset Value: 0.0
H10	R/W	**Skip Frequency Enable** (Range: 0-1) Set this parameter = 1 to enable the skip frequency settings configured in H11 thru H16. When it is desirable to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be skipped. Three different areas of Skip frequency High/Low limit can be set. During acceleration or deceleration however, the run frequency within the set area is valid. Preset Value: 0
H11	R/W	**Skip Frequency Low Limit 1** (Range: 0.1-400 Hz) Run frequency cannot be set within the range of H11 thru H16. The frequency values of the low numbered parameters cannot be set above those of the high numbered ones. Settable within the range of Frequency High and Low Limits (P35 and P36).Sets the lower limit of frequency range 1 to skip. See Also: H10, Figure 7-12 Preset Value: 10

7.6 Function Group 2 Continued

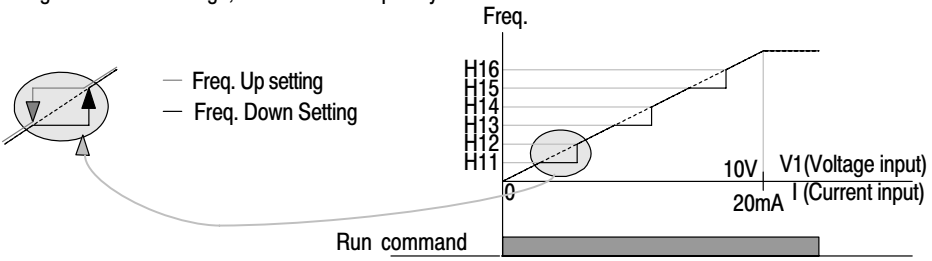
Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
	R/W	**Skip Frequency High Limit 1** (Range: 0.1-400 Hz) Run frequency cannot be set within the range of H11 thru H16. The frequency values of the low numbered parameters cannot be set above those of the high numbered ones. Settable within the range of Frequency High and Low Limits (P35 and P36).Sets the lower limit of frequency range 1 to skip. See Also: H10, Figure 7-12 Preset Value: 15
	R/W	**Skip Frequency Low Limit 2** (Range: 0.1-400 Hz) Run frequency cannot be set within the range of H11 thru H16. The frequency values of the low numbered parameters cannot be set above those of the high numbered ones. Settable within the range of Frequency High and Low Limits (P35 and P36).Sets the lower limit of frequency range 1 to skip. See Also: H10, Figure 7-12 Preset Value: 20
	R/W	**Skip Frequency High Limit 2** (Range: 0.1-400 Hz) Run frequency cannot be set within the range of H11 thru H16. The frequency values of the low numbered parameters cannot be set above those of the high numbered ones. Settable within the range of Frequency High and Low Limits (P35 and P36).Sets the lower limit of frequency range 1 to skip. See Also: H10, Figure 7-12 Preset Value: 25
	R/W	**Skip Frequency Low Limit 3** (Range: 0.1-400 Hz) Run frequency cannot be set within the range of H11 thru H16. The frequency values of the low numbered parameters cannot be set above those of the high numbered ones. Settable within the range of Frequency High and Low Limits (P35 and P36).Sets the lower limit of frequency range 1 to skip. See Also: H10, Figure 7-12 Preset Value: 30
	R/W	**Skip Frequency High Limit 3** (Range: 0.1-400 Hz) Run frequency cannot be set within the range of H11 thru H16. The frequency values of the low numbered parameters cannot be set above those of the high numbered ones. Settable within the range of Frequency High and Low Limits (P35 and P36).Sets the lower limit of frequency range 1 to skip. See Also: H10, Figure 7-12 Preset Value: 35

(H16 Description Continued)

Figure 7-12

Case 1: If frequency set value (Analog setting by voltage, current, RS485 or keypad) is within the range of skip frequency, it maintains the low limit value. If the set value is outside the range, it increases the frequency up to the set value.

Case 2: In the case of a decreasing frequency setting, if the frequency set value (Analog setting by voltage, current, RS485 or keypad) is within the range of skip frequency, it maintains skip frequency high value. If the setting is outside the range, it decreases frequency to the set value.



Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
H17	R/W	**S-Curve Accel/Decel Start Side** (Range: 0.1-100%) See Figure 7-13. Preset Value: 40
H18	R/W	**S-Curve Accel/Decel End Side** (Range: 0.1-100%) See Figure 7-13. Preset Value: 40

Figure 7-13

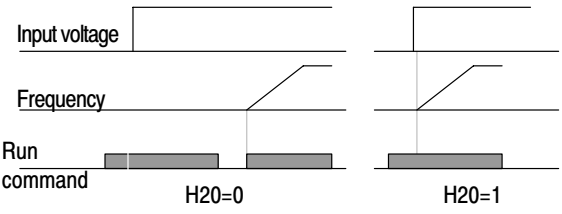
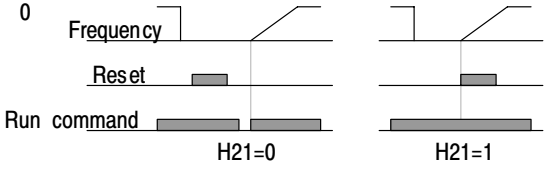
Set the speed reference value to form a curve at the start and end cycle of the acceleration and deceleration curves. If it is set higher, linear zone gets smaller. H17 sets the starting and H18 the ending ratio between S-curve and Linear in $^1/_2$ of Accel/Decel Ref. Frequency. For smooth Accel/Decel starting, increase H17 or H18 to extend the S-curve ratio.

Note: Setting Frequency Ref. for Accel/Decel (H70) is set to Max Freq and target freq is set below Max freq. the shape of the S-curve may be distorted.

$$\text{Accel time for S-c urve setting} = P41 + P41 \times \frac{H17}{2} + P41 \times \frac{H18}{2}$$

$$\text{Decel time for S-c urve setting} = P42 + P42 \times \frac{H17}{2} + P42 \times \frac{H18}{2}$$

7.6 Function Group 2 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
H19	Tune	**Phase Loss Protection** (Range: 0 = Not Used 1 = Output phase loss protection 2 = Input phase loss protection 3 = Input/output phase loss protection) Setting H19 to a value other than 0 enables Phase Loss Protection. Output Phase Loss: Inverter output is shut off in the event of more than one phase loss among U, V and W. Input Phase Loss: Inverter output is blocked at the event of more than one phase loss among R, S and T. If there is no input phase loss, output is shut off when it is time to replace the DC link capacitor. Note: Set P32 - Motor Rated Current correctly. If the actual motor rated current and the value of P32 are different, output phase loss protection function may not activate correctly. Preset Value: 0
H20	Tune	**Power On Start** (Range: 0-1) 1 = enables power on start. This parameter is activated when P38 - Drive Mode is set to 1 or 2 (Run/Stop from Control Terminal). Motor will accelerate after AC power is applied and a Forward Run (FX) or Reverse Run (RX) terminal is ON. See also: P38 Preset Value: 0 
H21	Tune	**Auto Restart** (Range: 0-1) 1 = enables auto restart. This parameter is activated when P38 - Drive Mode is set to 1 or 2 (Run/Stop by the Control Terminal). Motor will accelerate after a fault condition is reset. A Forward Run (FX) or Reverse Run (RX) terminal must be ON to Auto Restart. See also: P38, H26, H27 Preset Value: 0 

7.6 Function Group 2 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
	R/W	**Speed Search Select** (Range: 0-15) This parameter is active to prevent any possible fault when the inverter outputs its voltage to the running motor. See also: t32, t33, H23-H27, Chapter 8 Preset Value: 0
	Tune	**Speed Search Current Level** (Range: 80-200%) This parameter limits the amount of current during speed search. The value is a percentage of P32 - Motor Rated Current. See also: P32, H22, H24-H27, Chapter 8 Preset Value: 100
	Tune	**Speed Search P Gain** (Range: 0-9999) Sets the Proportional gain used for Speed Search PI Controller. See Also: Chapter 8 Preset Value: 100
	Tune	**Auto Restart Attempts** (Range: 0-9999) Sets the Integral gain used for Speed Search PI Controller. See Also: Chapter 8 Preset Value: 100
	Tune	**Auto Restart Attempts** (Range: 0-10) Sets the number of restart tries after a fault occurs. Auto restart becomes active after the time is reached in H27 - Auto Restart Time. Auto Restart is deactivated if the number of faults exceeds the value in H26 - Auto Restart Attempts. H26 is reset to its programmed value if STOP key or a control terminal reset is activated. If no trip occurs for 30 seconds after the auto restart operation, H26 is reset. It is not possible to restart (auto restart becomes deactivated) if the drive faults due to a Low Voltage (Lvt), Inverter Overheat (Oht) or a Hardware Trip (HWt) fault. This parameter sets the number of restart tries after a fault occurs. Auto restart becomes active after the time is reached in H27 - Auto Restart Time. Auto Restart is deactivated if the number of faults exceeds the value in H26 - Auto Restart Attempts. Preset Value: 0
	Tune	**Auto Restart Time** (Range: 0-60Sec) Sets the time between auto restart attempts. After the Auto Restart Time, the motor starts acceleration automatically. Preset Value: 1.0

7.6 Function Group 2 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
H32	R/W	**Slip Frequency** (Range: 0-10Hz) Sets the motor slip frequency. This is a calculated value based on the following formula: Preset Value: 1.67 Where: f_s = Rated Slip Frequency f_r =Rated Frequency RPM = Motor nameplate RPM P= Number of Motor Poles Example: f_r =60Hz, RPM= 1740, Poles = 4 $f_s = f_r - \left(\frac{RPM \times P}{120}\right) = 60 - \left(\frac{1740 \times 4}{120}\right) = 2Hz$
H34	R/W	**No Load Motor Current** (Range: 0.1-20A) The current value detected when the motor is rotating at rated speed (remove any load connected to the motor shaft). For applications where it is difficult to measure the no load current, enter a value of 50% of the rated nameplate motor current in this parameter. Preset Value: Based on drive rating.
H36	R/W	**Motor Efficiency** (Range: 50-100%) Sets the motor efficiency from the motor nameplate data. Preset Value: 87
H37	R/W	**Load Inertia Rate** (Range: 0=Load inertia rate is less than 10 times that of motor inertia 1=Load inertia rate equal to approximately 10 times the motor inertia. 2=Load inertia rate is more than 10 times that of motor inertia.) Select range according to the connected inertia in relationship to the motor inertia. See also: F8-F1 1, H40 Preset Value: 0
H39	Tune	**Carrier Frequency Select** (Range: 2-15kHz) This parameter affects the audible sound of the motor, noise emission form the inverter, inverter temperature, and leakage current. If the set value is higher, the inverter sound is more quiet, but the noise from the inverter and leakage current will be increased. Preset Value: 2

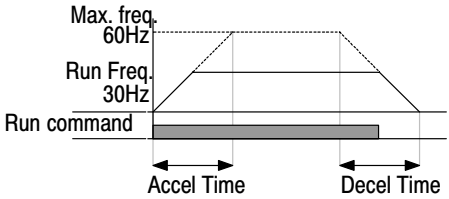
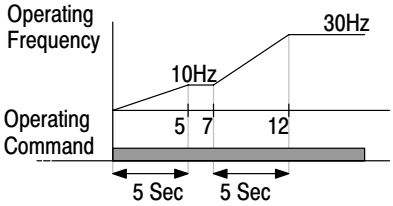
7.6 Function Group 2 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
	R/W	**Control Mode Select** (Range: 0=Volts/Frequency Control 1=Slip Compensation Control 2=PID Feedback Control 3=Sensorless Vector Control) Selects the control mode for the operation of the drive. See the following description of control method and the corresponding parameters for adjustment to each. Preset Value: 0 **Volts/Frequency** - Basic Operation of the Drive, set standard motor parameters: P30 - Motor Hp P32 - Motor Rated Current P33 - Motor Poles F30 - V/F Pattern **Slip Compensation**- Allows the motor to run at constant speed by compensating inherent induction motor slip. Set parameters: P30 - Motor Hp P32 - Motor Rated Current P33 - Motor Poles H32 - Rated Slip Freq H34 - Motor No Load Current H36 - Motor Efficiency H37 - Load Inertia **PID Feedback** - H50 thru H56 (see chapter 8 for advanced PID features) **Sensorless Vector** - Open Loop Speed Regulated drive control. Set parameters: P30 - Motor Hp P32 - Motor Rated Current H32 - Rated Slip Freq H34 - Motor No Load Current H41 - Auto tuning H42 - Stator resistance H44 - Leakage inductance F14 - Time for magnetizing
	R/W	**Auto-Tuning** (Range:0-1) If this parameter is set to a 1, it automatically measures the values to assign for parameters H42 - Stator Resistance and H44 - Leakage Inductance. See also: H40, H42, H44 Preset Value: 0
	R/W	**Stator Resistance (Rs)** (Range: 0-28 Ohms) Sets the value of the motor stator resistance. See also: H40, H41, H44 Preset Value: N/A

7.6 Function Group 2 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
H44	R/W	**Leakage Inductance (Lσ)** (Range: 0-300.0 mH) This is the leakage inductance of the stator and rotor of the motor. Preset Value: Based on drive rating.
H45	R/W	**Sensorless P Gain** (Range: 0-32767) Proportional gain for Sensorless Vector Control. Preset Value: 1000 Set H40 = 3 (Sensorless Vector Control) to display these parameters.
H46	R/W	**Sensorless I Gain** (Range: 0-32767) Integral gain for Sensorless Vector Control. Preset Value: 100 Set H40 = 3 (Sensorless Vector Control) to display these parameters.
H50	R/W	**PID Feedback Selection** (Range: 0=Terminal I Input (0-20 mA) 1=Terminal V1 Input (0-10V)) Selects the source for the PID loop feedback. See Also: H40, H50-H56 Preset Value: 0
H51	R/W	**P Gain for PID** (Range: 0-999.9%) Sets the Proportional gain for the PID Controller. See Also: H40, H50-H56 Preset Value: 300.0
H52	Tune	**I Gain for PID** (Range: 0.1-32.0 Sec) Sets the Integral gain for the PID Controller. See Also: H40, H50-H56 Preset Value: 1.0
H53	Tune	**D Gain for PID** (Range: 0-30.0 Sec) Sets the Differential gain for the PID Controller. See Also: H40, H50-H56 Preset Value: 0.0
H54	Tune	**F Gain for PID** (Range: 0-999.9[%]) Sets the Feed forward gain for the PID controller. See Also: H40, H50-H56 Preset Value: 0.0
H55	Tune	**PID output frequency high limit** (Range: 0.1-400Hz) Allows See Also: H40, H50-H56 Preset Value: 60.00

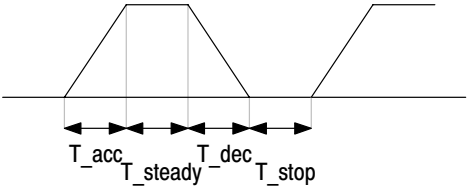
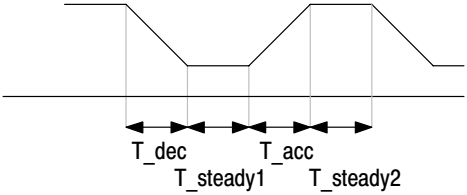
7.6 Function Group 2 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
H56	Tune	**PID output frequency low limit** (Range: 0.1-400Hz) Allows See Also: H40, H50-H56 Preset Value: 60.00
H60	Tune	**Self Diagnostics Select** (Range: 0 = Self-diagnostic disabled 1 = IGBT fault/ground fault 2 = Output phase short & open/ground fault 3 = Ground Fault) Allows Preset Value: 0
H70	Tune	**Frequency Reference for Accel/Decel** (Range: 0 - Based on P36 – Frequency High Limit 1 - Based on Delta Frequency) Set the desired Accel/Decel time sin P41 and P42. H70 = 0, the acceleration and deceleration time is the time that it takes to reach maximum frequency from 0 hertz. H70 to 1 = Delta Frequency, Accel/Decel time is the time that it takes to reach target frequency from a constant run frequency (current operating frequency). To scale the time units for accel/decel set parameter H71. See Also: P36, P41, P42, H71 Preset Value: 0 H70=0  H70=1 

7.6 Function Group 2 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
H71	Tune	**Accel/Decel Time Scale** (Range: 0 = Setting Unit: 0.01 sec Range: 0.01- 600.00 1 = Setting Unit: 0.1 sec Range: 0.1- 6000.0 2 = Setting Unit: 1 sec Range: 1- 60000) This parameter is used to scale the time units for the accel/decel ramp. The display for the VS1MD is available up to 5-digits. Therefore, if time unit is set to 0.01 sec for example, maximum accel/decel time would be 600.00 seconds. Preset Value: 1
H72	Tune	**Power-On Display** (Range: 0 = Speed Command 1 = Motor RPM 2 = Output Current 3 = Output Voltage 4 = Output Power 5 = Output Torque 6 = DC Link Voltage 7 = Digital Input Status 8 = Digital Output Status 9 = Software Version) Selects the parameter to display on the keypad when power is applied. Preset Value: 0
H74	Tune	**Gain for Motor RPM Display** (Range: 0-100Hz) This parameter is used to change the motor RPM display to a scaled custom fac When H40 = 0 (V/F Control) or 1 (PID Control), the inverter output frequency is displayed in RPM using the following formula. Motor slip is not considered. Preset Value: 100
H75	R/W	**DB Resistor Select** (Range: 0 = Unlimited 1 = Limited by setting in H76) See Also: H76 Preset Value: 1

7.6 Function Group 2 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
H76	R/W	**DB Resistor Operating Rate** (Range: 0-30%) Sets the percent of DB resistor operating rate to be activated during one sequence of operation. Continuous usage rate is a maximum of 15 seconds. See Also: H75 Preset Value: 10 T_acc: Acceleration time to reach a setting freq. T_steady: Time for constant speed operation at setting freq. T_dec: Time to decelerate to lower freq. than that in constant speed or time to stop from freq. in constant speed. T_stop: waiting time at a stop before operation is resumed. **Example 1**: $H76 = \left(\frac{T\_dec}{T\_acc + T\_steady + T\_dec + T\_stop} \right) X\ 100\ \%$  **Example 2**: $H76 = \left(\frac{T\_dec}{T\_dec + T\_steady + T\_acc + T\_steady2} \right) X\ 100\ \%$ 
H77	R/W	**Cooling Fan Control** (Range: 0 = Always ON, cooling fan operates when power is applied to drive. Fan turns off when inverter voltage becomes low due to power off. 1 = Fan operates when temp above limit; fan begins to operate when power is ON and a operating command is ON. Fan turns off when operating command is turned off. Fan will continue to operate if the heat sink temperature exceeds a certain limit regardless of operating command. Use this setting for applications requiring frequent starts and stops.) Sets whether the drive cooling fan will always operate or only when inverter temperature exceeds the temperature limit. Preset Value: 0

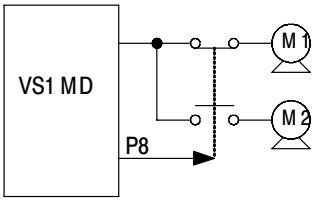
7.6 Function Group 2 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
H78	R/W	**Operating method when cooling fan fails** (Range: 0-1 0 = Continuous operation when cooling fan malfunctions Setting t32 or t33 = 18 (Cooling Fan Fault Alarm) will send an alarm signal to the output.). 1 = Control is disabled when cooling fan malfunctions. Sets what the drive will do if the cooling fan fails. See Also: t32, t33 Preset Value: 0
H81 to H90	Tune	**Second Motor Parameters** Parameters are active when a selected terminal is ON and one of the t1 thru t8 terminals is set TO 12 (2nd Motor Select). See Also: t1-t8

Param.	Description	Range	Factory Setting	Adj. run
H81	Accel Time	0 - 60000 Sec	1.0	✓
H82	Decel Time	0 - 60000 Sec	5.0	✓
H83	Base Freq	30 - 400 Hz	60.0	-
H84	V/F Pattern	0 - 2	0	-
H85	FX Torque Boost	0 - 15 %	5	-
H86	RX Torque Boost	0 - 15 %	5	-
H87	Stall Level	30 - 150 %	150	-
H88	1 Min Overload Level	50 - 200 %	150	✓
H89	Continuous Overload Level	50 - 150 %	100	✓
H90	Motor Rated Current	0.1 - 50 Amps	26.3	-

Use these settings when an inverter operates two motors connected to two different types of loads. 2nd motor operation does not drive two motors at the same time. When first selected motor operation is stopped, select a terminal for the second motor and define H81 thru H90 to run the second motor.

Sets the V/F pattern for the second motor.



H91	R/W	**Parameter Read** (Range: 0-1) H91 Copies the parameters from the drive and saves them into a remote keypad. Preset Value: 0
H92	R/W	**Parameter Write** (Range: 0-1) H92 Copies the saved file in a remote keypad and writes it to the drive. Preset Value: 0

7.6 Function Group 2 Continued

Parameter #	Access	Parameter Name, Value Range, Description and Preset Value
	R/W	**Parameter Initialize** (Range: 0 = No Action 1 = All parameters set to factory defaults To reset individual groups only and not all parameters select one of the following: 2 = P Group Parameter Reset 3 = F Group Parameter Reset 4 = H Group Parameter Reset 5 = t Group Parameter Reset) Press the Enter/Prog after setting H93. H93 will be displayed again after initialization. This parameter restores parameter values to their factory settings. Preset Value: 0
	R/W	**Password Register** (Range: 0-FFFF) This parameter is used to assign a password for the drive. See Also: H95 Preset Value: 0
	R/W	**Parameter Lock** (Range: 0-FFFF) This parameter is able to lock or unlock parameters by typing the password registered in H94. See Also: H94 Preset Value: 0

Chapter 8
Customizing for Your Application

8.1 Frequency Mode

8.1.1 Keypad Frequency Setting

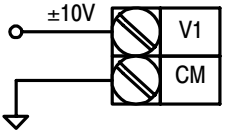
Group	Code	Parameter Name	Setting	Unit
Drive group	P37	[Frequency Command]	-	Hz
	P40	[Speed Reference Source]	1	
Step 1. Set P40 [Speed Reference Source] = 1. Step 2. Set the desired frequency in P37 and press the Prog/Ent key to save the value into memory. Step 3. The value can not be set above P36 [Frequency High Limit].				

Note: When remote keypad is connected, keypad keys on the body are deactivated.

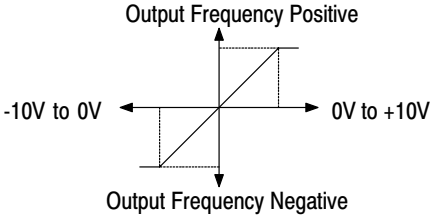
8.1.2 Frequency Setting using the ±10V Input

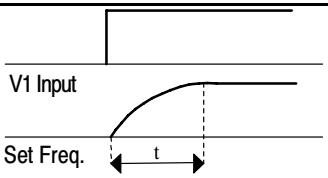
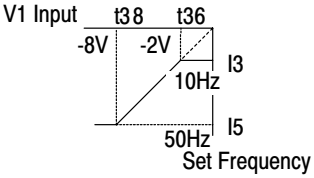
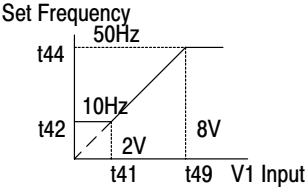
Group	Code	Parameter Name	Setting	Unit
Drive group	P37	[Frequency Command]	-	Hz
	P40	[Speed Reference Source]	2	
I/O Group	t36	[NV Input Minimum Voltage]	-	V
	t37	[Frequency Corresponding to t36]	-	Hz
	t38	[NV Input Max Voltage]	-	V
	t39	[Frequency Corresponding to t38]	-	Hz
	t40 to t44	[V1 Input]		
Step 1. Set P40 [Speed Reference Source] =2. Step 2. The set frequency can be monitored in D-0 [Frequency Command].				

Connect a ±10V signal between V1 and CM terminal.



Output corresponding to ±10V input voltage to V1 terminal



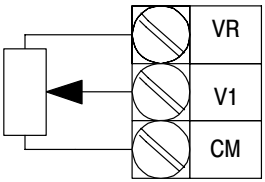
I1 (Filter time constant for NV input): Effective for eliminating noise in the frequency setting circuit. Increase the filter time constant if steady operation cannot be performed due to noise. A higher setting results in slower response (t gets longer).	
t36 to t39: Setting input range and corresponding frequency to - 10V to 0V V1 input voltage Ex) when minimum (-) input voltage is -2V with corresponding frequency 10Hz and Max voltage is –8V with run freq. 50Hz.	
t40 to t44: Setting input range and corresponding frequency to 0 to +10V V1 input voltage Ex) when minimum (+) input voltage is 2V with corresponding frequency 10Hz and Max voltage is 8V with run freq.	

8.1.3 Frequency Setting using 0 to 10V Input Terminal or Potentiometer

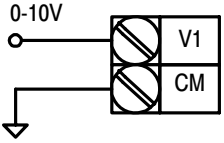
Group	Code	Parameter Name	Setting	Unit
Drive group	P37	[Speed Command]	-	Hz
	P40	[Speed Reference Source]	3	
I/O Group	t40	Filter Time Constant for V1 Input]	10	
	t41	[V1 Input Min Voltage]	-	V
	t42	[Frequency corresponding to I7]	-	Hz
	t43	[V1 Input Max Voltage]	-	V
	t44	[Frequency Corresponding to I9]	-	Hz

Step 1. Set P40 [Speed Reference Source] to "3"
Step 2. 0- 10V can be directly applied from an external controller or a potentiometer connected at terminals VR, V1 and CM.

Connect an external potentiometer as shown.



Connect a 0-10V signal between V1 and CM terminal.

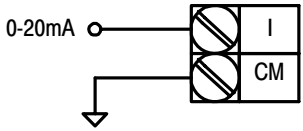


8.1.4 Frequency Setting using 0-20mA Input

Group	Code	Parameter Name	Setting	Unit
Drive group	P37	[Speed Command]	-	Hz
	P40	[Speed Reference Source]	4	
I/O Group	t45	[Filter Time Constant for I Input]	10	
	t46	[I Input Minimum Current]	-	mA
	t47	[Frequency Corresponding to I12]	-	Hz
	t48	[I input Max Current]	-	mA
	t49	[Frequency Corresponding to I14]	-	Hz

Step 1. Set P40 [Speed Reference Source] to "4".
Step 2. Frequency is set by 0 to 20mA input between I and CM terminal.

Connect a 0-20mA Current source signal between I and CM terminal.

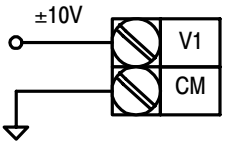


8.1.5 Frequency Setting using ±10V Input and 0-20mA Input

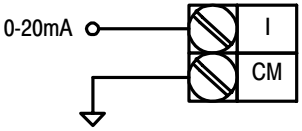
Group	Code	Parameter Name	Setting	Unit
Drive group	P37	[Speed Command]	-	Hz
	P40	[Speed Reference Source]	4	
I/O Group	t45	[Filter Time Constant for I Input]	10	
	t46	[I Input Minimum Current]	-	mA
	t47	[Frequency Corresponding to I12]	-	Hz
	t48	[I input Max Current]	-	mA
	t49	[Frequency Corresponding to I14]	-	Hz

Step 1. Set P40 [Speed Reference Source] to "5".
Step 2. Override function available using Main/Auxiliary speed adjustment
Step 3. Related code: t36, t39, t40, t44, t45, t49

Connect a ±10V signal between V1 and CM terminal.



Connect a 0-20mA Current source signal between I and CM terminal.



Override allows more precise control and a faster response by combining Main and Auxiliary speed inputs. Fast response can be achieved using Main speed and precise control can be accomplished by Aux. speed if the accuracy of Main/Aux speed is set differently.

Use these settings when Main speed is 0-20mA and Aux. speed is V1 terminal (±10V).

Group	Code	Parameter Name	Setting	Unit
I/O Group	t36	[NV Input Minimum Voltage]	0	V
	t37	[Frequency Corresponding to t36]	0.00	Hz
	t38	[NV Input Max Voltage]	10.00	V
	t39	[Frequency Corresponding to t38]	5.00	Hz
	t41	[V1 Input Min Voltage]	0	V
	t42	[Frequency Corresponding to t41]	0.00	Hz
	t43	[V1 Input Max Voltage]	10	V
	t44	[Frequency Corresponding to t43]	5.00	Hz
	t46	[I Input Minimum Current]	4	mA
	t47	[Frequency Corresponding to t46]	0.00	Hz
	t48	[I Input Max Current]	20	mA
	t49	[Frequency Corresponding to t48]	60.00	Hz

After these parameters are set, if +5V is applied to V1 with 12mA at terminal I, the output frequency would be 32.5Hz.

If -5V is applied to V1 terminal with 12mA at terminal I, the output frequency would be 27.5Hz.

8.1.6 Frequency Setting using the 0 to 10V Input and 0-20mA Input

Group	Code	Parameter Name	Setting	Unit
Drive group	P37	[Speed Command]	0.00	Hz
	P40	[Speed Reference Source]	6	
Step 1. Set P40 [Speed Reference Source] to “6”. Step 2. Related code: t40 to t44, t45 to t49 Step 3. Refer to Frequency setting using ±10V voltage input and 0-20mA input.				

8.1.7 Frequency Setting using the RS 485 Communication

Group	Code	Parameter Name	Setting	Unit
Drive group	P37	[Speed Command]	0.00	Hz
	P40	[Speed Reference Source]	7	
Set P40 [Speed Reference Source] to “7”. Related code: t59 - t61 Refer to Appendix C. RS485 communication.				

8.1.8 Operating Command using the RS 485 Communication

Group	Code	Parameter Name	Setting	Unit
Drive group	P38	[Drive Mode]	3	
I/O Group	t59	Communication Protocol Selection]	-	
	t60	[Inverter Number]	-	
	t61	[Baud Rate]	-	

Step 1. Set P38 [Drive Mode] to “3”.
Step 2. Set t59, t60 and t61 correctly.
Step 3. Drive operation is performed by RS485 communication.

8.1.9 Rotating Direction Selection using ±10V Input on V1 Terminal

Group	Code	Parameter Name	Setting	Unit
Drive group	P38	[Drive Mode]	-	
	P40	[Speed Reference Source]	2	
I/O Group	t59	Communication Protocol Selection]	-	
	t60	[Inverter Number]	-	
	t61	[Baud Rate]	-	

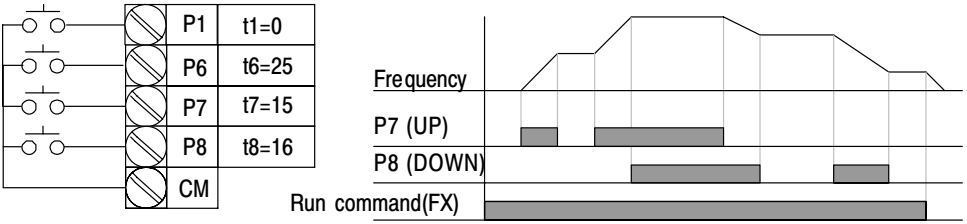
Step 1. Set P40 to 2.
Step 2. Regardless of Drive mode setting, the Inverter is operating as follows:

	FWD Run Command	REV Run Command
0 to +10V	FWD Run	REV Run
-10 to 0V	REV Run	FWD Run

Motor runs in Forward direction with +input voltage at V1 and FWD RUN command is active.
Motor runs in Reverse direction with -input voltage at V1 and FWD RUN command is active.
Motor runs in Reverse direction with +input voltage at V1 and REV RUN command is active.
Motor runs in Forward direction with +input voltage at V1 and REV RUN command is active.
When motor direction is changed, the motor decels to stop before running in the new direction.

8.2 UP-Down

Group	Code	Parameter Name	Setting
I/O Group	t1	[Digital Input1 - P1]	0
	t2	[Digital Input2 - P2]	
	t3	[Digital Input3 - P3]	
	t4	[Digital Input4 - P4]	
	t5	[Digital Input5 - P5]	
	t6	[Digital Input6 - P6]	
	t7	[Digital Input7 - P7]	15
	t8	[Digital Input8 - P8]	16
Select terminals for Up-Down operation from P1-P8. If P7 and P8 are selected, set t7 and t8 to 15 [Frequency Up command] and 16 [Frequency Down command], respectively. If P6 is selected, set t6 to t8 [Up/Down Save Frequency Initialization].			

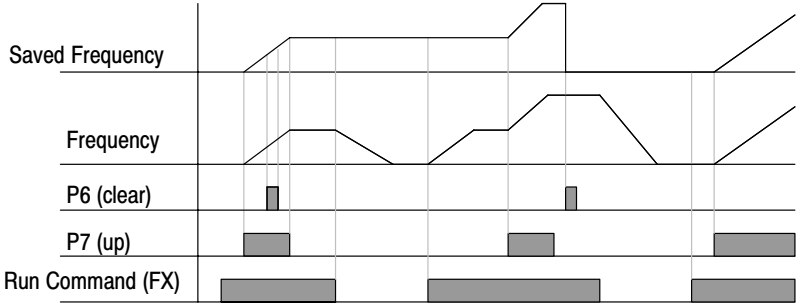


Up/down Save function: If F63, 'Save up/down frequency', is set to 1, the frequency before the inverter was stopped or decelerated is saved in F64.

F63	Save up/down frequency select	0	Remove 'save up/down frequency'
		1	Set 'save up/down frequency'
F64	Save up/down frequency	Up/down frequency saved	

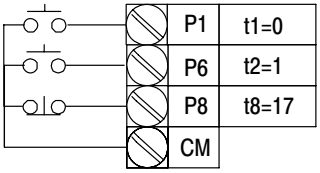
The Up/down frequency can be initialized by setting the Digital inputs as 'Up/Down Save Frequency Initialization'.

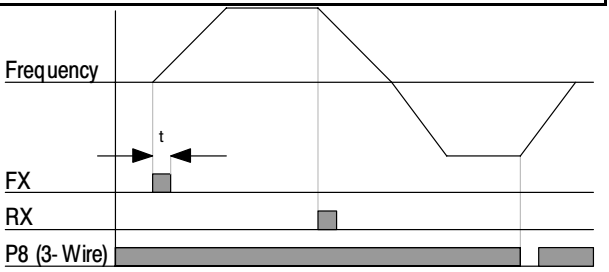
If 'Up/Down Save Frequency Initialization' signal is input while the Digital input 'Up' or 'Down' function is applied, this signal is ignored.



8.3 3-Wire

Group	Code	Parameter Name	Setting
I/O Group	t1	[Digital Input1 - P1] Forward Run Command	0
	t6	[Digital Input6 - P6] Reverse Run Command	
	t8	[Digital Input8 - P8] Stop	17
Select the terminal from P1- P8 for use as 3- Wire operation. If P8 is selected, set t8 to "17" [3- Wire Stop].			





Input signal is saved in 3- Wire operation. Therefore, inverter can be operated by momentary switch. Pulse t should not be less than 50msec.

8.4 PID Control

Group	Code	Parameter Name	Setting	Unit
Drive group	d1	[Motor RPM]		
Function group 2	H40	[Frequency Command]	2	
	H50	[PID Feedback Selection]	-	
	H51	[P Gain for PID Controller]	-	%
	H52	[I Gain for PID Controller]	-	sec
	H53	[D Gain for PID Controller]	-	sec
	H54	[F Gain for PID Controller]	-	%
	H55	[PID Output Frequency High Limit]	-	Hz
	H56	[PID Output Frequency Low Limit]	-	Hz
I/O Group	t1	[Digital Input1 - P1]	21	
	t2	[Digital Input2 - P2]	21	
	t3	[Digital Input3 - P3]	21	
	t4	[Digital Input4 - P4]	21	
	t5	[Digital Input5 - P5]	21	
	t6	[Digital Input6 - P6]	21	
	t7	[Digital Input7 - P7]	21	
	t8	[Digital Input8 - P8]	21	
Set H40 to "2" [PID Feedback control]. Output frequency of the inverter is controlled by PID control for use as constant control of flow, pressure or temperature.				

H50: Select the feedback type of PID controller.

H50	[PID Feedback Selection]	0	Terminal I input (0-20mA)
		1	Terminal V1 input (0-10V)

H51: Set the percentage of output to error. If P Gain is set to 50%, 50% of the error value will be output. Value can reach the target control value faster but it may cause oscillation.

H52: Set the time to output the accumulated error value. Set the time required to output 100% when the error value is 100%. If H52 [Integral time for PID controller (I gain)] is set to 1 sec and the error becomes 100%, 100% will be output in 1 sec. Adjusting the value may reduce the nominal error. If the value is reduced, response will be faster but setting too low may lead to controller oscillation.

H53: Set the output value to the variation of the error. The error is detected by 0.01 sec.
If differential time is set to 0.01 sec and the percentage variation of error per 1 sec is 100%, 1% per 10msec is output.

H54: PID Feed Forward Gain. Set the gain to add the target value to the PID controller output.

H55, H56: Limits the output of the PID controller.

I17 to I24: To go from PID to normal operation, set one of P1-P8 terminal to 21 and turn ON.

d1: Calculates the feedback from H50 into Motor frequency and displays it.

8.5 Auto Tune

Be sure to remove load from motor shaft before auto tune. The shaft must move freely and unloaded during this procedure.

Group	Code	Parameter Name	Setting	Unit
Function group 2	H40	[Frequency Command]	1	
	H42	[PID Feedback Selection]	-	W
	H44	[P Gain for PID Controller]	-	mH
Motor parameters will be automatically measured. The measured motor parameters in H41 can be used in Auto Torque Boost and Sensorless Vector Control.				

H41: When H41 is set to 1 and press the Enter/Prog key, Auto tuning is activated and “TUn“ will appear on the LED keypad. When finished, “H41“ will be displayed.

H42, H44: The values of motor stator resistance and leakage inductance detected in H41 are displayed, respectively. When Auto tuning is skipped or H93 - [Parameter initialize] is done, the default value corresponding to motor type (H30) will be displayed.

Press the STOP/RST key on the keypad or turn on the EST terminal to stop the Auto Tuning.

If Auto tuning of H42 and H44 is interrupted, the default value will be set. If H42 and H44 are finished and auto-tuning of leakage inductance is interrupted, the measured value of H42 and H44 are used and the default of leakage inductance is set.

Be sure accurate values are entered for stator resistance and leakage inductance. Otherwise, the performance of Sensorless vector control and Auto torque boost could be compromised.

8.6 Sensorless Vector Control

Group	Code	Parameter Name	Setting	Unit
Function group 2	H40	[Frequency Command]	3	
	P30	[PID Feedback Selection]	-	kW
	H32	[Rated Slip Frequency]	-	Hz
	P32	[Motor Rated Current]	-	A
	H34	[Motor No Load Current]	-	A
	H42	[Stator Resistance]	-	W
	H44	[Leakage Inductance]	-	mH
Function group 1	F14	[Time for Energizing a Motor]		sec

Ensure that the following parameters are entered correctly for optimal performance in Sensorless vector control.

P30: Select motor type connected to inverter output.

H32: Enter rated slip frequency based on motor nameplate RPM and rated frequency.

P32: Enter motor nameplate rated current.

H34: After removing the load, set H40[Control mode Selection] to “0“ [V/F control] and run the motor at 60Hz. Enter the current displayed in Cur-[Output current] as motor no load current.
If it is difficult to remove the load from the motor shaft, enter a value equal to 40 to 50% of H33[Motor rated current] or the factory default.

H42, H44: Enter the value of the parameter measured during H41[Auto tuning] or the factory default.

F14: This parameter accelerates the motor after pre-exciting the motor for the set time. The amount of the pre-exciting current is set in H34[Motor No Load Current].

Directly enter the motor nameplate value except motor rating when 0.2kW is used.

8.7 Speed Search

Group	Code	Parameter Name	Setting	Unit
Function group 2	H22	[Speed Search Selection]	-	
	H23	[Current Level]	-	%
	H24	[Speed Search P Gain]	-	
	H25	[Speed Search I Gain]	-	
I/O group	t32	[Digital Output Terminal Selection]	15	
	t33	[Relay Output Selection]	15	
Prevents possible faults from occurring if the inverter outputs the voltage during operation after the load is removed. The inverter estimates the motor RPM based on output current. Therefore, detecting exact speed is difficult.				

The 4 types of Speed search selections are as follows:

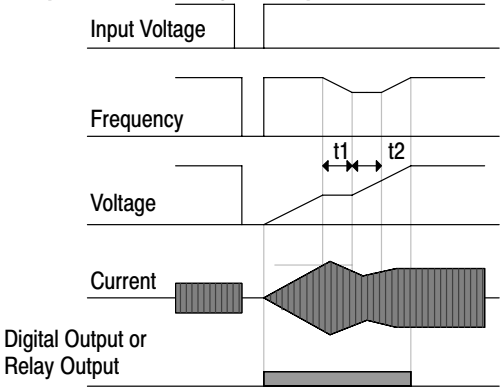
Para-meter	Value	Speed Search During H20 [Power On Start]	Speed Search During Instant Power Failure Restart	Speed Search During H21 [Restart after Fault Reset]	Speed Search During Acceleration
		Bit 3	Bit 2	Bit 1	Bit 0
H22	0	-	-	-	-
	1	-	-	✓	✓
	2	-	✓	-	-
	3	-	✓	✓	✓
	4	✓	-	-	-
	5	✓	-	✓	✓
	6	✓	✓	-	-
	7	✓	✓	✓	✓
	8	-	-	-	-
	9	-	-	✓	✓
	10	-	✓	-	-
	11	-	✓	✓	✓
	12	✓	-	-	-
	13	✓	-	✓	✓
	14	✓	✓	-	-
	15	✓	✓	✓	✓

H23: Limits current during Speed search. Set as a percentage of H33.

H24, H25: Speed search is activated by PI control.
Adjust P gain and I gain corresponding to the load characteristics.

t32, t33: Signal of active Speed search is given to external sequence by Digital output terminal (MO) and Relay output (3A-C).

Example: Speed search during instant power failure restart



- When the input power is cut off due to instant power failure, the inverter outputs Low voltage trip (LV) to hold the output.
- When the power is restored, the inverter outputs the frequency before the low voltage trip and the voltage is increased due to PI control.
- t1: If current is increasing over the preset level in H23, the rise in voltage will stop and the frequency is decreased.
- t2: If the opposite of t1 occurs, the increase in voltage starts again and the decrease in frequency stops.
- When the frequency and voltage are restored back to the nominal level, acceleration will continue at the frequency before trip.

Speed search operation is suitable for loads with high inertia. Stop the motor and restart when friction in load is high.

VS1MD keeps normal operation when instant power failure occurs and power is restored in 15msec for the use of its inverter rating.

Inverter DC link voltage can vary depending on output load quantity. Therefore, Low Voltage trip may occur when instant power failure is maintained over 15msec or output is higher than its rating.

Instant power failure specification is applied when input voltage to Inverter is 200 to 230VAC for 200V class, or 380 to 480VAC for 400V class.

8.8 Self-Diagnostic Function

How to Use Self-Diagnostic Function

Group	Code	Parameter Name	Setting
Function group 2	H60	[Self-Diagnostic Selection]	-
I/O Group	t1	[Digital Input1 - P1]	-
	t2	[Digital Input2 - P2]	20
	t3	[Digital Input3 - P3]	20
	t4	[Digital Input4 - P4]	20
	t5	[Digital Input5 - P5]	21
	t6	[Digital Input6 - P6]	20
	t7	[Digital Input7 - P7]	20
	t8	[Digital Input8 - P8]	20
Select Self-Diagnostic function in H60, Function group 2. Define one terminal among P1 to P8 terminals for this function. To define P8 for this function, set t8 to “20”.			

Perform Self-diagnostic function after input/output wiring of the inverter is finished.

This allows the user to safely check for the IGBT fault, output phase open and short, and Ground fault without disconnecting the inverter wiring.

There are 4 options:

F60	Self-Diagnostic function	0	Self-Diagnostic disabled
		1	IGBT fault and Ground fault. Ground fault of U phase in 2.2KW to 4.0KW inverters and ground fault of V phase in other rating inverters may not be detected when selecting "1". Select 3 to make sure to detect all phase of U, V, W
		2	Output phase short & open circuit and Ground fault
		3	Ground fault (IGBT fault, Output phase short and open circuit)

F60 value Note: Selecting the higher number performs all functions within lower numbers, 3 performs all.

Once H60 is set to a specific value from 1 to 3 and the terminal defined for this function among P1 to P8 terminals is turned ON, the corresponding function is conducted, displaying "dIAG".

To stop this function, press STOP/RESET key on the keypad, turn the defined terminal OFF or turn the EST terminal ON.

The fault types during Self Diagnostics are:

No.	Display	Fault Type	Diagnosis
1	UPHF	Switch above IGBT's U phase fault	Contact Baldor district office
2	UPLF	Switch below IGBT's U phase fault	
3	vPHF	Switch above IGBT's V phase fault	
4	vPLF	Switch below IGBT's V phase fault	
5	WPHF	Switch above IGBT's W phase fault	
6	WPLF	Switch below IGBT's U phase fault	
7	UWSF	Output short between U and W	Check for a short in inverter output terminal, motor connection terminal or the proper motor connection.
8	vUSF	Output short between U and V	
9	WvSF	Output short between V and W	
10	UPGF	Ground fault at U phase	Check for ground fault occurring at inverter output cable or motor or motor insulation damage.
11	vPGF	Ground fault at V phase	
12	WPGF	Ground fault at W phase	
13	UPOF	Output open at U phase	Check for proper connection of the motor to the inverter output or proper motor connection.
14	vPOF	Output open at V phase	
15	WPOF	Output open at W phase	

8.9 Parameter Read/Written

Group	Code	Parameter Name	Setting	Unit
Function group 2	H91	[Parameter Read]	1	
	H92	[Parameter Write] Note: Parameter write (H92) clears parameter values and parameter values in remote keypad are copied to inverter.	1	
Used to read/write Inverter Parameters using remote keypad.				

8.9.1 Parameter Read

Step 1. Move to H91 code.
Step 2. Press Enter/Prog key once. 0 will be displayed.
Step 3. Press Up (▲) key once. Rd will be displayed.
Step 4. Press Enter/Prog key twice. Rd will be displayed.
Step 5. H91 is displayed when Parameter read is finished.

8.9.2 Parameter Write

Step 1. Move to H92 code. H92 will be displayed.
Step 2. Press Enter/Prog key once. 0 will be displayed.
Step 3. Press Up (▲) key once. Wr will be displayed.
Step 4. Press Enter/Prog key twice. Wr will be displayed.
Step 5. H91 is displayed when Parameter read is finished.

8.10 Parameter Initialization / Lock

8.10.1 Parameter Initialization

Group	Code	Parameter Name	Setting	Unit
Function group 2	H93	[Parameter Initialization]	0 -	
			1 - Initialize All Groups	
			2 - Initialize Drive Group	
			3 - Initialize F 1 Group	
			4 - Initialize F 2 Group	
			5 - Initialize I/O group	
Select the group to be initialized and perform it in H93 code.				

Press Enter/Prog key after setting in H93. H93 will be displayed again after initialization is complete.

8.10.2 Password Registration

Group	Code	Parameter Name	Setting	Unit
Function group 2	H94	[Password Registration]	-	
	H95	[Parameter Lock]	-	
Register password for Parameter lock (H95). Password is Hex characters 0 to 9, A, B, C, D, E and F.				

Factory default password is 0. Enter/Prog any new password except 0.
Do not forget the registered password. It is needed to unlock parameters.

Registering the password for the first time.

Step 1. Move to H94 code. H94 will be displayed.
Step 2. Press Enter/Prog key twice. 0 will be displayed.
Step 3. Register password. (Ex: 123) 123 will be displayed.
Step 4. 123 will blink when Enter/Prog key is pressed. 123 will be displayed.
Step 5. Press Enter/Prog key. H94 will be displayed after the new password has been registered.

Changing password. (Current PW: 123 -> New PW: 456)

Step 1. Move to H94 code. H94 will be displayed.
Step 2. Press Enter/Prog key. 0 will be displayed.
Step 3. Enter any number (e.g.: 122). 122 will be displayed.
Step 4. Press the Enter/Prog key. 0 is displayed because wrong value was entered.
Password cannot be changed in this status. 0 will be displayed.
Step 5. Enter the right password. 123 will be displayed.
Step 6. Press Enter/Prog key. 123 will be displayed.
Step 7. Enter the new password. (e.g. 456). 456 will be displayed.
Step 8. Press the Enter/Prog key. Then “456” will blink. 456 will be displayed.
Step 9. Press Enter/Prog key. H94 will be displayed.

8.10.3 Parameter Lock

Group	Code	Parameter Name	Setting	Unit
Function group 2	H94	[Password Registration]	-	
	H95	[Parameter Lock]	-	
This parameter is used to lock the user-set parameters using the password.				

Locking the user-set parameters.

Step 1. Move to H95 code. H95 will be displayed.
Step 2. Press Enter/Prog key. UL will be displayed.
Step 3. Parameter value can be changed in UL (Unlock) status. UL will be displayed.
Step 4. Press Enter/Prog key. 0 will be displayed.
Step 5. Enter the password created in H94 (e.g.: 123). 123 will be displayed.
Step 6. Press Enter/Prog key. L will be displayed.
Step 7. Parameter value cannot be changed in L (Lock) status. L will be displayed.
Step 8. Press Enter/Prog key. H95 will be displayed.

Unlocking the user-set parameter.

Step 1. Move to H95 code. H95 will be displayed.
Step 2. Press Enter/Prog key. L will be displayed.
Step 3. Parameter value cannot be changed in L(Lock) status. L will be displayed.
Step 4. Press Enter/Prog key. 0 will be displayed.
Step 5. Enter the password created in H94 (e.g.: 123). 123 will be displayed.
Step 6. Press Enter/Prog key. UL will be displayed.
Step 7. Parameter value can be changed in UL (Unlock) status. While UL is displayed, press Enter/Prog key. H95 will be displayed.

8.11 Digital Output Terminal (MO) and Relay (3AC)

Group	Code	Parameter Name	Setting	Unit
I/O group	t32	[Digital output terminal Selection]	0 FDT-1	
	t33	[Relay Output Selection]	1 FDT-2	
			2 FDT-3	
			3 FDT-4	
			4 FDT-5	
			5 Overload [OLt]	
			6 Inverter Overload [IOLt]	
			7 Motor stall [STALL]	
			8 Over voltage trip [OV]	
			9 Low voltage trip [LV]	
			10 Inverter overheat [OH]	
			11 Command loss	
			12 During run	
			13 During stop	
			14 During constant run	
			15 During speed searching	
			16 Wait time for run input	
			17 Fault output	
			18 Cooling fan trip alarm	

I/O group	t34	[Fault relay output]		[3] Bit2	[2] Bit1	[1] Bit0	
			0	-	-	✓	
			1	-	-	-	
			2	-	✓	✓	
			3	-	✓	-	
			4	✓	-	✓	
			5	✓	-	-	
			6	✓	✓	✓	
			7	✓	✓	-	

Select the desired item to be output using MO terminal and relay (3A-C).

[1] When low voltage trip occurs.
[2] When trip other than low voltage trip occurs.
[3] When setting H26 [Number of auto restart attempts]

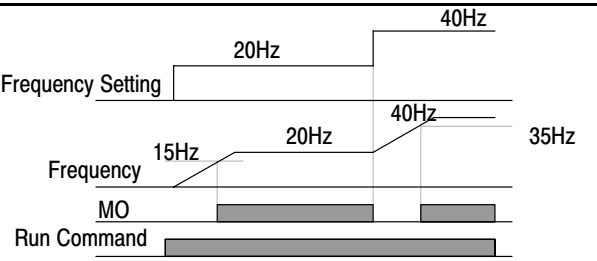
8.11.1 FDT-1

Verify the output frequency matches the user-setting frequency.

Active condition: Absolute value (preset frequency - output frequency) <= Frequency Detection Bandwidth/2

Group	Code	Parameter Name	Setting	Unit
I/O group	t31	[Detected Frequency Bandwidth]	-	
Cannot be set greater than Max frequency (P36).				

When setting t31 to 10.0



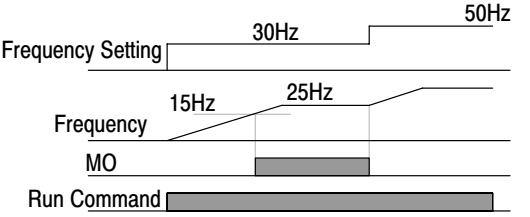
8.11.2 FDT-2

Activated when the preset frequency matches frequency detection level (t52) and FDT-1 condition is met.

Active condition: (Preset frequency = FDT level) & FDT-1

Group	Code	Parameter Name	Setting	Unit
I/O group	t30	[Detected Frequency Level]	-	
	t31	[Detected Frequency Bandwidth]	-	
Cannot be set greater than Max frequency (P36).				

When setting t30 and t31 to 30.0 Hz and 10.0 Hz, respectively



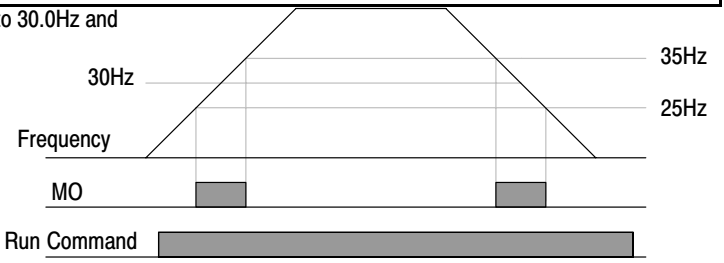
8.11.3 FDT-3

Activated when run frequency meets the following condition.

Active condition: Absolute value (FDT level - run frequency) <= FDT Bandwidth/2

Group	Code	Parameter Name	Setting	Unit
I/O group	t30	[Detected Frequency Level]	-	
	t31	[Detected Frequency Bandwidth]	-	
Cannot be set greater than Max frequency (P36).				

When setting t30 and t31 to 30.0Hz and 10.0 Hz, respectively

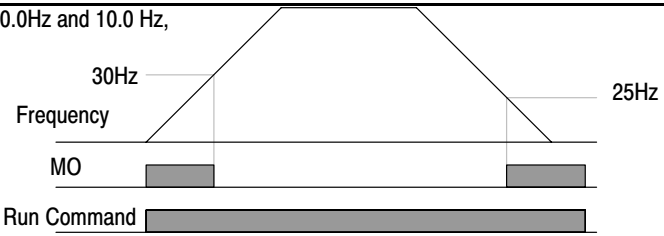


8.11.4 FDT-4

Activated when run frequency meets the following condition.
Active condition: Accel time: Run Frequency >= FDT Level
Decel time: Run Frequency > (FDT Level - FDT Bandwidth/2)

Group	Code	Parameter Name	Setting	Unit
I/O group	t30	[Detected Frequency Level]	-	
	t31	[Detected Frequency Bandwidth]	-	
Cannot be set greater than Max frequency (P36).				

When setting t30 and t31 to 30.0Hz and 10.0 Hz, respectively

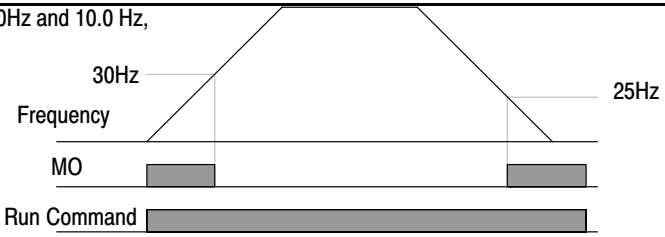


8.11.5 FDT-5

Activated as B contact contrast to FDT-4.
Active condition: Accel time: Run Frequency >= FDT Level
Decel time: Run Frequency > (FDT Level - FDT Bandwidth/2)

Group	Code	Parameter Name	Setting	Unit
I/O group	t30	[Detected Frequency Level]	-	
	t31	[Detected Frequency Bandwidth]	-	
Cannot be set greater than Max frequency (P36).				

When setting t30 and t31 to 30.0Hz and 10.0 Hz, respectively



8.11.6 Over Voltage Trip (Ovt)

Activated when over voltage trip occurs due to DC link voltage exceeded 460VDC for 230V class and 820VDC for 460V class.

8.11.7 Low Voltage Trip (Lvt)

Activated when low voltage trip occurs due to DC link voltage under 180VDC for 200V class and 360VDC for 400V class.

8.11.8 Inverter Heatsink Overheat (OHt)

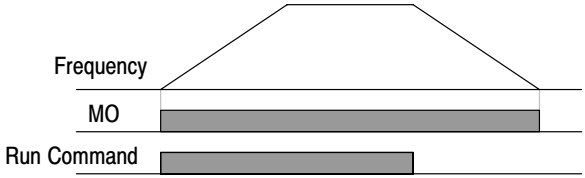
Activated when the heatsink is overheated.

8.11.9 Command Loss

Activated when Analog (V1,I) and RS485 communication commands are lost.

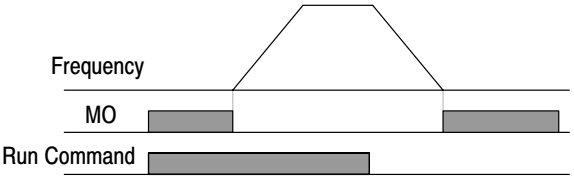
8.11.10 During Operation

Activated when run command is input and inverter outputs its voltage.



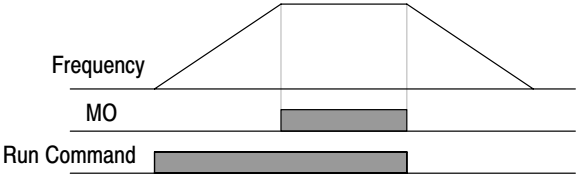
8.11.11 During Stop

Activated during stop without active command.



8.11.12 During Constant Run

Activated during constant speed operation.



8.11.13 Wait Time for Run Signal Input

This function becomes active during normal operation and that the inverter waits for active run command from external sequence.

8.11.14 Fault Output

The parameter set in t34 is activated.

For example, if setting t33, t34 to 17 and 2, respectively, Digital output relay will become active when trip other than “Low voltage trip” occurred.

8.11.15 Cooling Fan Trip Alarm

Used to output alarm signal when H78 is set to 0 (constant operation at cooling fan trip).

Chapter 9
Troubleshooting

The VS1MD constantly monitors its status and provides the following ways to determine the status of the drive and to troubleshoot problems that may occur:

- LEDs on the drive
- Fault Codes displayed on seven segment display
- Drive monitor and status parameters
- Entries in the fault queue

9.1 Verify DC Bus Capacitors are Discharged

WARNING: Do not remove cover for at least five (5) minutes after AC power is disconnected to allow capacitors to discharge. Dangerous voltages are present inside the equipment. Electrical shock can cause serious or fatal injury.

Step 1. Turn off and lock out input power. Wait 10 minutes after the display goes blank.

Step 2. Remove the drive cover.

Step 3. Verify that there is no voltage at the drive input power terminals.

Step 4. Once the drive has been serviced, install the drive cover.

Step 5. Apply input power to the drive.

9.2 Determine Drive Status Using the STP/FLT LED

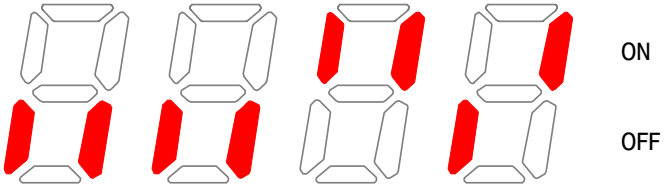
The STP/FLT LED can be used to determine at a quick glance the status of the drive. If the drive is stopped, but not faulted, this LED will be illuminated solid. If the drive is running, this LED will be off. If this LED is flashing, then this indicates that the drive is faulted thus requiring attention.

9.3 Determine Drive Status Using the STP/FLT LED

The Display Group has multiple parameters that can be utilized for monitoring the status of the drive and are useful for diagnosing certain situations.

If the drive is being operated from the terminal strip, it is useful to monitor the status of the digital inputs to determine operational problems. The digital input status can be monitored by displaying parameter d7. Figure 7-1 describes the details of understanding the status of each of the digital inputs (labeled P1 - P8 on the control board terminal strip).
In this example, P1, P3, and P4 are ON and P2, P5, P6, P7, and P8 are OFF.

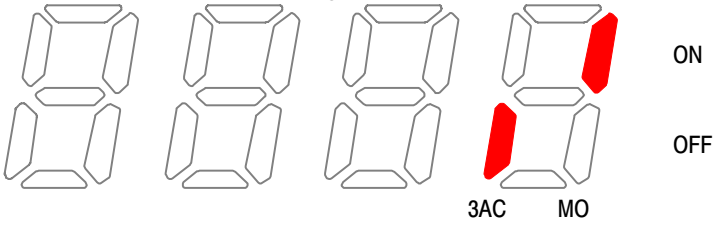
Figure 7-1



If the application is using digital outputs to reflect the internal status of the drive, these can be monitored using parameter d8. The below describes the details of understanding the status of each of the digital outputs (labeled MO for the open collector output and 3A/3B/3C for the relay output on the control board terminal strip).

Figure 7-2, the Digital output MO is ON and the Relay Output is OFF (note that the indication for the Relay is an indication of whether or not the relay coil is energized).

Figure 7-2



9.4 Reviewing Fault Status of the Drive

As noted in Chapter 6, the Display Group has an entry that designates if there is an active fault and will display the fault code associated with that fault. The fault codes are described later in this chapter. While displaying the fault code within the Display Group, you can press the enter key to display the frequency the drive was running at when the fault occurred. By pressing the up arrow one time, you can display the current the drive detected when the fault occurred. By pressing the up arrow again, you will display the drive status when the fault occurred.

Function Group 2 (H parameters) also contains the current fault along with a history of the previous 4 faults. These faults are located at parameters H1, H2, H3, H4, and H5. As with the fault memory in the Display Group, you can subsequently display the frequency, current, and status for each of these faults using the same procedure outlined in Chapter 6.

9.5 Fault Codes

Fault codes indicate conditions within the drive that require immediate attention. The drive responds to a fault by initiating a coast-to-stop sequence and turning off motor power.

The integral keypad provides visual notification of a fault condition by displaying the following:

- Fault code on the display. (See table 9.1 for the fault code descriptions.)
- Flashing STP/FLT LED

9.5.1 Manually Clearing Faults

Step 1. Note the code of the fault condition on the display.

Step 2. Address the condition that caused the fault. Refer to Table 7-1 for a description of the fault and corrective actions. The cause must be corrected before the fault can be cleared.

Step 3. After corrective action has been taken, clear the fault and reset the drive.

9.5.2 Automatically Clearing Faults (Auto Restart Feature)

The Auto Restart feature provides the ability for the drive to automatically perform a fault reset followed by a start attempt without user or application intervention. This allows remote operation. This feature can only be used for faults that are auto-resettable.

When this type of fault occurs, and H26 (Auto Restart) is set to a value greater than 0, a user-configurable timer, H27 (Retry Delay) begins. When the timer reaches zero, the drive attempts to automatically reset the fault. If the condition that caused the fault is no longer present, the fault will be reset and the drive will be restarted.

9.6 Overload Protection

IOLT : IOLT(inverter Overload Trip) protection is activated at 150% of the inverter rated current for 1 minute and greater.

OLT : OLT is selected when F56 is set to 1 and activated at 200% of F57[Motor rated current] for 60 sec in F58. This can be programmable.

Table 7-1 Fault Descriptions and Corrective Actions

Fault Code	Fault	Descriptions	Cause	Remedy
	Overcurrent	The drive disables when the output current is detected at a level higher than the inverter rated current.	Accel/Decel time is too short . Load is too heavy. Inverter enabled when the motor is rotating. Output short circuit or ground fault has occurred. Mechanical brake operating incorrectly	Increase the Accel/Decel time. Use the inverter with more hp. Resume operation after stopping the motor or use H22. Check output wiring. Check the mechanical brake
	Ground fault current	The drive disables when a ground fault occurs and the ground fault current is greater than the internal setting value of the inverter.	Ground fault has occurred in the output wiring of the drive. The insulation of the motor is damaged.	Check the wiring between the drive and the motor. Replace the motor.
	Inverter Overload	The drive disables its output when the output current of the inverter is greater than the rated level.	Load is greater than the drive rating	Upgrade to larger motor and drive or reduce the load.
	Overload trip	The drive disables if the output current of the inverter is at 150% of the inverter rated current for more than the current limit time (1 min).	Torque boost scale is set too large.	Reduce torque boost scale.

Table 7-1 Fault Descriptions and Corrective Actions Continued

Fault Code	Fault	Descriptions	Cause	Remedy
OHt	Inverter overheat	The drive disables if the heat sink overheats due to a damaged cooling fan or a blockage in the cooling fan by detecting the temperature of the heat sink.	Cooling system has problems. Cooling fan has failed. Ambient temperature is too high. Clogged ventilating slot.	Check for foreign substances clogged in the heat sink. Replace the cooling fan. Reduce ambient temperature. Clean the ventilation
POt	Output Phase loss	The drive disables its output when one or more of the output (U, V, W) phases is open. The drive detects the output current to check the output phase loss.	Faulty contact in output contactor. Faulty output wiring	Replace or repair output contactor. Check output wiring.
Out	Over voltage	The drive disables its output if the DC bus voltage increases above the bus overvoltage threshold. This fault can also occur due to a surge voltage generated at the input terminals.	Decel time is too short for the inertia of the load. Regenerative load is connected to the drive. Line voltage is too high.	Increase the Decel time. Use Dynamic Brake Unit. Check to see if line voltage exceeds the rating.
Lut	Low voltage	The drive disables its output if the DC bus voltage is less than the undervoltage threshold because insufficient torque or overheating of the motor can occur when the input voltage of the drive is too low.	Line voltage is low. Load larger than line capacity is connected to line (ex: welding machine, motor with high starting current connected to the commercial line). Faulty contactor on the input of the inverter.	Check to see if line voltage is below the rating. Check the incoming AC line. Adjust the line capacity corresponding to the load. Change contactor.

Table 7-1 Fault Descriptions and Corrective Actions Continued

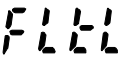
Fault Code	Fault	Descriptions	Cause	Remedy
	Electronic Thermal	The internal electronic thermal of the drive determines the motor heat. If the motor is overloaded the inverter disables the output. The drive cannot protect the motor when controlling a motor having more than 4 poles or multiple motors.	Motor has overheated. Load is greater than inverter rating. ETH level is set too low.	Reduce load and/or duty cycle. Use drive with higher hp rating. Adjust ETH level .
	Input phase loss	Drive output is disabled when one of the input phases (R, S, T) is open.	Open protective device or wire	Verify proper voltage at R,S and T inputs. Correct problem.
	Self-diagnostic malfunction	Displayed when IGBT damage, output phase short, output phase ground fault or output phase open occurs.	Damaged input device. Miswired input device.	Replace input device. Verify proper connections of input device.
	Parameter save error	Displayed when user-modified parameters fail to be stored into memory.		
	Inverter hardware fault	Displayed when an error occurs in the control circuitry of the drive.		
	Communication Error	Displayed when the drive cannot communicate with the keypad.		
	Remote keypad communication error	Displayed when drive and remote keypad do not communicate with each other. This fault does not stop Inverter operation.		

Table 7-1 Fault Descriptions and Corrective Actions Continued

Fault Code	Fault	Descriptions	Cause	Remedy
	Keypad error	Displayed after drive resets keypad upon a keypad error and the error remains for a predetermined time.		
	Cooling fan fault	Displayed when a fault condition occurs in the drive cooling fan.	Cooling fan has failed. Clogged ventilating slot.	Replace cooling fan. Clean ventilation.
	Instant Cut Off	Used for the immediate stop of the drive. The inverter instantly disables the output when the EST terminal is actuated.		
	External fault A contact input	When Digital input terminal (t1-t8) is set to 18 {External fault signal input: A (Normal Open Contact)}, the inverter disables its output.		
	External fault B contact input	When Digital input terminal (t1-t8) is set to 19 {External fault signal input: B (Normally Closed Contact)}, the drive disables its output.		

Table 7-1 Fault Descriptions and Corrective Actions Continued

Fault Code	Fault	Descriptions	Cause	Remedy
	Operating method when the frequency command is lost	When drive operation is set via an Analog input (0-10V or 0-20mA input) or option (RS485) and the signal is lost,the drive responds according to the method set in t62 (Operating method when the frequency reference is lost).		
	NTC open	When NTC connection is lost, output is disabled.		
 Parameter save error  Hardware fault  Communication error  Keypad error  NTC: NTC error				Contact Baldor District office for assistance.

Appendix A
Technical Specifications

All specifications are subject to change without notice.

Input Ratings	Voltage	230	460
	Voltage range	170-253	323-528
	Phase	Three Phase (single phase with derating)	
	Frequency	50/60Hz ±5%	
	Impedance	1% minimum from mains connection	

Output Ratings	Horsepower	1/2-10 HP @ 230VAC, 3PH 1/2-10 HP @ 460VAC, 3PH
	Overload Capacity	150% for 1 minute; 200% for 12 seconds.
	Frequency	0-400Hz
	Voltage	0 to maximum input voltage (RMS)

Protective Features	Trip	Missing control power, over current, over voltage, under voltage, over temperature (motor or control), output shorted or grounded, motor overload
	Stall Prevention	Over voltage suppression, over current suppression
	External Output	LED trip condition indicators, 4 assignable logic outputs, 2 assignable analog outputs
	Short Circuit	Phase to phase, phase to ground
	Electronic Motor Overload	Meets UL508C (I^2T)

Environmental Conditions	Temperature	-10 to 50 °C Derate 3% per degree C above 50 to 55 °C maximum ambient temperature
	Cooling	0.5hp Natural; 1-10hp Forced air
	Enclosure	IP20, NEMA 1 (optional)
	Altitude	Sea level to 3300 Feet (1000 Meters) Derate 2% per 1000 Feet (303 Meters) above 3300 Feet
	Humidity	10 to 90% RH Non-Condensing
	Shock	1G
	Vibration	0.5G at 10Hz to 60Hz
	Storage Temperature	-20 to +65 °C
	Duty Cycle	1.0

Keypad Display	Display	Four digit LED
	Keys	14 key membrane with tactile response
	Functions	Output status monitoring Digital speed control Parameter setting and display Diagnostic and Fault log display Motor run and jog Local/Remote toggle
	LED Indicators	Forward run command Reverse run command Stop command Jog active
	Remote Mount	200 feet (60.6m) maximum from control
	Trip	Separate message for each trip, last 5 trips retained in memory

Control Specifications	Control Method	V/Hz inverter, Sensorless vector
	PWM Frequency	Adjustable 1.0-15kHz
	Speed Setting	±10 VDC, 0-10 VDC, 0-20 mA; digital (keypad)
	Accel/Decel	0-6000 seconds
	Velocity Loop Bandwidth	Adjustable to 180 Hz (Control only)
	Current Loop Bandwidth	Adjustable to 1200 Hz (Control only)
	Maximum Output Frequency	400 Hz

Appendix B
Parameter Tables

B.1 Parameters Sorted by Parameter Number

Param #	Access	Parameter Name	**Description** (Range)	Factory Setting	User Setting
d0	RO	Frequency Command	0.00 to Frequency High Limit (P36) Hz	0.00	
d1	RO	Motor RPM	0 Motor RPM (based on P33 Motor Poles) RPM	0	
d2	RO	Output Current	0.0 to Motor Rated Current (P32) Amps	0.0	
d3	RO	Output Voltage	0.0 to Drive Rated Voltage VAC	0.0	
d4	RO	Output Power	0.00 to (Drive Rated Power x 2) kW	0.00	
d5	RO	Output Torque	0.00 to (Drive Rated Torque x 2) [kgf / M]	0.00	
d6	RO	DC Link Voltage	Based on Drive Rating VDC	N/A	
d7	RO	Input Terminal status display	N/A	N/A	
d8	RO	Output terminal status display	N/A	N/A	
d9	RO	Software Version	1.0 to 99.9	1.8	
n0n	RO	Current Fault Display	N/A	N/A	
P0	Tune	Jump Code	30 -47	45	
P30	R/W	Motor hp Select	0.5= 0.5 HP 1= 1 HP 2= 2 HP 3= 3 HP 5= 5 HP 7.5= 7.5 HP 10= 10 HP	Calc	
P32	R/W	Motor Rated Current	0.5 - 50 Amps	Calc	
P33	R/W	Pole Number	2, 4, 6, 8, 10, 12	4	
P34	R/W	Base Frequency	30 - 400 Hz	60.00	
P35	R/W	Frequency Low Limit	0 - P36 Hz	10.00	
P36	R/W	Frequency High Limit	0 - 400 Hz	60.00	
P37	Tune	Frequency Command	0 - 400 Hz	0.00	

B.1 Parameters Sorted by Parameter Number Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
P38	R/W	Stop/Start Source	0= Keypad 1= Terminal Mode 1 2= Terminal Mode 2 3= RS485 Communication	0	
P39	R/W	Stop Type	0= Decelerate to Stop (Ramp) 1= DC Brake to Stop 2= Coast to Stop	0	
P40	R/W	Frequency Setting Method	1= Digital Keypad 2= Analog V1 1: ± 10V 3= Analog V1 2: 0 to +10 V 4= Analog Terminal I: 0 - 20mA 5= Analog Terminal V1 Mode 1 6= Analog Terminal V1 Mode 2 7= Analog RS485	1	
P41	Tune	Accel Time	0 - 6,000 Sec	5.0	
P42	Tune	Decel Time	0 - 6,000 Sec	10.0	
P43	Tune	Preset Speed 1	0 - 400 Hz	10.00	
P44	Tune	Preset Speed 2	0 - 400 Hz	20.00	
P45	Tune	Preset Speed 3	0 - 400 Hz	30.00	
P46	RO	Drive Start/Stop Source 2	0= Keypad 1= Terminal Mode 1 2= Terminal Mode 2 3= RS485 Communication	1	
P47	RO	Frequency Setting Mode 2	1= Digital Keypad 2= Analog V1 1: ± 10V 3= Analog V1 2: 0 to +10 V 4= Analog Terminal I: 0 - 20mA 5= Analog Terminal V1 Mode 1 6= Analog Terminal V1 Mode 2 7= Analog RS485	1	

B.1 Parameters Sorted by Parameter Number Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
t0	Tune	Jump Code	0 - 81	0	
t1	Tune	Digital Input 1	0 =Forward Run Command 1 = Reverse Run Command 2 = Output Inhibit 3 = Fault Reset (RST) 4 = Jog Speed Select (2-wire only) 5 = Speed Select1 6 = Speed Select2 7 = Speed Select3 8 = Ramp Select1 9 = Ramp Select2 10 = Ramp Select3 11 = DC Brake during start 12 = 2nd Motor Select 13 = Reserved 14 = Reserved 15 = Frequency increase (UP) 16 = Frequency decrease (DOWN) 17 = 3-Wire Stop 18 = External Trip: A Contact (EtA) 19 = External Trip: B Contact (EtB) 20 = Self-Diagnostic Function 21 = Exchange between PID and V/F operation 22 = Exchange between second source and drive 23 = Analog Hold 24 = Accel/Decel Disable 25 = Up/Down Save Freq. Initialization	0	
t2	Tune	Digital Input 2		1	
t3	Tune	Digital Input 3		2	
t4	Tune	Digital Input 4		3	
t5	Tune	Digital Input 5		4	
t6	Tune	Digital Input 6		5	
t7	Tune	Digital Input 7		6	
t8	Tune	Digital Input 8		7	
t9	Tune	Filter Time Constant for Digital inputs	1 - 15	4	
t10	Tune	Preset Speed 4	0-400Hz	30	
t11	Tune	Preset Speed 5	0-400Hz	25	
t12	Tune	Preset Speed 6	0-400Hz	20	
t13	Tune	Preset Speed 7	0-400Hz	15	
t14	Tune	Preset Speed Accel Time 1	0-6000Sec	3.0	
t15	Tune	Preset Speed Decel Time 1	0-6000Sec	3.0	
t16	Tune	Preset Speed Accel Time 2	0-6000Sec	4.0	
t17	Tune	Preset Speed Decel Time 2	0-6000Sec	4.0	
t18	Tune	Preset Speed Accel Time 3	0-6000Sec	5.0	

B.1 Parameters Sorted by Parameter Number Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
t19	Tune	Preset Speed Decel Time 3	0-6000Sec	5.0	
t20	Tune	Preset Speed Accel Time 4	0-6000Sec	6.0	
t21	Tune	Preset Speed Decel Time 4	0-6000Sec	6.0	
t22	Tune	Preset Speed Accel Time 5	0-6000Sec	7.0	
t23	Tune	Preset Speed Decel Time 5	0-6000Sec	7.0	
t24	Tune	Preset Speed Accel Time 6	0-6000Sec	8.0	
t25	Tune	Preset Speed Decel Time 6	0-6000Sec	8.0	
t26	Tune	Preset Speed Accel Time 7	0-6000Sec	9.0	
t27	Tune	Preset Speed Decel Time 7	0-6000Sec	9.0	
t28	Tune	Analog Output Select	0 = Output Frequency 1 = Output Current 2 = Output Voltage 3 = DC Link Voltage	0	
t29	Tune	Analog Output Level Adjustment	10 - 200%	100	
t30	Tune	Frequency detection level	0-400Hz	30	
t31	Tune	Frequency detection bandwidth	0-400Hz	10	
t32	Tune	Digital Output (MO)	0 = FDT-1 1 = FDT-2 2 = FDT-3 3 = FDT-4 4 = FDT-5 5 = Overload (OLt) 6 = Inverter Overload (LoIT) 7 = Motor Stall STALL 8 = Over voltage trip (OV) 9 = Low voltage trip (LV) 10 = Inverter overheat (OH) 11 = Command Loss 12 = During run 13 = During stop 14 = During constant run 15 = During speed searching 16 = Wait time for run signal input 17 = Fault Output 18 = Cooling Fan Trip Alarm	12	
t33	Tune	Relay Output (3A - 3C)		17	

B.1 Parameters Sorted by Parameter Number Continued

Param #	Access	Parameter Name	**Description** (Range)	Factory Setting	User Setting
t34	Tune	Fault Relay Output	0-7	2	
t35	Tune	Criteria for Analog Input Signal Loss	0 = Disabled. 1 = Activated when less than half of set value. 2 = Activated when less than set value.	0	
t36	Tune	Analog Input 0 to -10V (NV) Min voltage	0 to -10V	0	
t37	Tune	Frequency corresponding to t36	0 - 400 Hz	0	
t38	Tune	Analog Input 0 to 10V (NV) Max voltage	0 to 10V	10	
t39	Tune	Frequency corresponding to t38	0 - 400 Hz	60	
t40	Tune	Analog Input 0 to 10V (V1) Filter time constant	0 - 9999	10	
t41	Tune	Analog Input 0 to 10V (V1) Min voltage	0 - 10V	0	
t42	Tune	Frequency corresponding to t41	0 - 400 Hz	0	
t43	Tune	Analog Input 0-10V (V1) Max voltage	0 - 10V	10	
t44	Tune	Frequency corresponding to t43	0-400 Hz	60	
t45	Tune	Analog Input 0-20mA (I) Filter time constant	1-9999	10	
t46	Tune	Analog Input 0-20mA (I) Min Current	0-20mA	4	
t47	Tune	Frequency corresponding to t46	0-400 Hz	0	
t48	Tune	Analog Input 0-20mA (I) Max Current	0-20mA	20	
t49	Tune	Frequency corresponding to t47	0-400 Hz	60	
t50	Tune	Digital Output (MO) On Delay	0 to 3,600 Sec	0	
t51	Tune	Relay Output (3A - 3C) On Delay	0 to 3,600 Sec	0	

B.1 Parameters Sorted by Parameter Number Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
t52	Tune	Digital Output (MO) Off Delay	0 to 3,600 Sec	20	
t53	Tune	Relay Output (3A - 3C) Off Delay	0 to 3,600 Sec	0	
t57	Tune	Keypad Error Output	0=Not used 1=Signal output to MO 2=Signal output to 3A, 3B contacts 3=Signal output to MO, 3A, 3B	0	
t59	Tune	Communication protocol select	0=Modbus RTU 1=CI485	0	
t60	Tune	Inverter Number	1-250	1	
t61	Tune	Baud Rate	0=1200 bps 1=2400 bps 2=4800 bps 3=9600 bps 4=19200 bps	3	
t62	Tune	Frequency Loss Mode	0=Continue operation at last frequency command 1= Coast to Stop. 2= Decelerate to stop.	0	
t63	Tune	Frequency Loss Wait Time	0.1-120 Sec	1.0	
t64	Tune	Communication Time Setting	2-100 ms	5	
t65	Tune	Parity/Stop Bit Setting	0=Parity: None, Stop Bit: 1 1=Parity: None, Stop Bit: 2 2=Parity: Even, Stop Bit: 1 3=Parity: Odd, Stop Bit: 1	0	

B.1 Parameters Sorted by Parameter Number Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
t66	Tune	Read address register 1	0-42239	5	
t67	Tune	Read address register 2	0-42239	6	
t68	Tune	Read address register 3	0-42239	7	
t69	Tune	Read address register 4	0-42239	8	
t70	Tune	Read address register 5	0-42239	9	
t71	Tune	Read address register 6	0-42239	10	
t72	Tune	Read address register 7	0-42239	11	
t73	Tune	Read address register 8	0-42239	12	
t74	Tune	Write address register 1	0-42239	5	
t75	Tune	Write address register 2	0-42239	6	
t76	Tune	Write address register 3	0-42239	7	
t77	Tune	Write address register 4	0-42239	8	
t78	Tune	Write address register 5	0-42239	5	
t79	Tune	Write address register 6	0-42239	6	
t80	Tune	Write address register 7	0-42239	7	
t81	Tune	Write address register 8	0-42239	8	

B.1 Parameters Sorted by Parameter Number Continued

Param #	Access	Parameter Name	**Description** (Range)	Factory Setting	User Setting
F0	Tune	Jump Code	0-64	0	
F1	R/W	Forward/Reverse run Disable	0 = Forward and Reverse run enable 1 = Forward run disable 2 = Reverse run disable	0	
F2	R/W	Accel Pattern	0=Linear 1=S-Curve	0	
F3	R/W	Decel Pattern	0=Linear 1=S-Curve	0	
F8	R/W	DC Brake start frequency	0.1-60 Hz	5.00	
F9	R/W	DC Brake wait time	0-60 Sec	0.1	
F10	R/W	DC Brake Voltage	0-200%	50	
F11	R/W	DC Brake Time	0-60 Sec	1.0	
F12	R/W	DC Brake start voltage	0-200%	50	
F13	R/W	DC Brake start time	0-60 Sec	0	
F14	R/W	Time for magnetizing a motor	0-60 Sec	0.1	
F20	Tune	Jog Frequency	0-400 Hz	10.00	
F27	R/W	Torque Boost select	0=Manual Torque Boost 1=Auto Torque Boost	0	
F28	R/W	Torque boost in forward direction	0-15%	2	
F29	R/W	Torque boost in reverse direction	0-15%	0	
F30	R/W	V/F Pattern	0=Linear 1=Square 2=User V/F	0	
F31	R/W	User V/F frequency 1	0 - 400 Hz	15	
F32	R/W	User V/F voltage 1	0-100%	25	
F33	R/W	User V/F frequency 2	0 - 400 Hz	30	
F34	R/W	User V/F voltage 2	0-100%	50	
F35	R/W	User V/F frequency 3	0 - 400 Hz	45	
F36	R/W	User V/F voltage 3	0-100%	75	
F37	R/W	User V/F frequency 4	0 - 400 Hz	60	

B.1 Parameters Sorted by Parameter Number Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
F38	R/W	User V/F voltage 4	0-100%	100	
F39	R/W	Output voltage adjustment	40-1 10%	100	
F40	Tune	Energy Savings Level	0-30%	0	
F50	Tune	Electronic thermal select	0-1	0	
F51	Tune	Electronic thermal level for 1 minute	50-200%	150	
F52	Tune	Electronic thermal level continuous	50-15%	10	
F53	Tune	Motor cooling method	0 = Standard Motor 1 = Variable Speed Motor	0	
F54	Tune	Overload Warning Level	30-150%	150	
F55	Tune	Overload warning time	0-30Sec	0	
F56	Tune	Overload trip enable	0-1	1	
F57	Tune	Overload trip level	30-200%	180	
F58	Tune	Overload trip time	0-60Sec	60	
F59	R/W	Stall Prevention select	0-7	0	
F60	Tune	Stall prevention level	30-200%	150	
F63	R/W	Save Up/down frequency	0-1	0	
F64	R/O	Saved up/down frequency	N/A	0.00	
F65	R/W	Start Frequency	0.10 to 10.00 Hz	0.5	
H0	Tune	Jump Code	0 - 95	0	
H1	RO	Last Fault 1	N/A	0	
H2	RO	Last Fault 2	N/A	0	
H3	RO	Last Fault 3	N/A	0	
H4	RO	Last Fault 4	N/A	0	
H5	RO	Last Fault 5	N/A	0	
H6	Tune	Reset Fault History	0-1	0	
H7	R/W	Dwell Frequency	0.1-400 Hz	5.00	
H8	R/W	Dwell Time	0-10 Sec	0.0	
H10	R/W	Skip Frequency Enable	0-1	0	

B.1 Parameters Sorted by Parameter Number Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
H11	R/W	Skip Frequency Low Limit 1	0.1-400 Hz	10	
H12	R/W	Skip Frequency High Limit 1	0.1-400 Hz	15	
H13	R/W	Skip Frequency Low Limit 2	0.1-400 Hz	20	
H14	R/W	Skip Frequency High Limit 2	0.1-400 Hz	25	
H15	R/W	Skip Frequency Low Limit 3	0.1-400 Hz	30	
H16	R/W	Skip Frequency High Limit 3	0.1-400 Hz	35	
H17	R/W	S-Curve Accel/Decel Start Side	0.1-100%	40	
H18	R/W	S-Curve Accel/Decel End Side	0.1-100%	40	
H19	R/W	Phase Loss Protection	0 = Not Used 1 = Output phase loss protection 2 = Input phase loss protection 3 = Input/output phase loss protection	0	
H20	R/W	Power On Start	0-1	0	
H21	Tune	Auto Restart	0-1	0	
H22	R/W	Speed Search Select	0-15	0	
H23	Tune	Speed Search Current Level	80-200%	100	
H24	R/W	Speed Search P Gain	0-9999	100	
H25	Tune	Speed Search I Gain	0-9999	100	
H26	Tune	Auto Restart Attempts	0-10	0	
H27	Tune	Auto Restart Time	0-60Sec	1.0	
H32	R/W	Slip Frequency	0-10	1.67	
H34	R/W	No Load Motor Current	0.1-20A	Calc	
H36	R/W	Motor Efficiency	50-100%	87	
H37	R/W	Load Inertia Rate	0=Load inertia rate < 10 times that of motor inertia 1=Load inertia rate $\approx$ 10 times the motor inertia. 2=Load inertia rate > 10 times that of motor inertia.	0	
H39	Tune	Carrier Frequency Select	2-15kHz	2	

B.1 Parameters Sorted by Parameter Number Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
H40	R/W	Control Mode Select	0=Volts/Frequency Control 1=Slip Compensation Control 2=PID Feedback Control 3=Sensorless Vector Control	0	
H41	R/W	Auto-T uning	0-1	0	
H42	R/W	Stator Resistance (Rs)	0-28 Ohms	N/A	
H44	R/W	Leakage Inductance (Lσ)	0-300.0 mH	Calc	
H45	R/W	Sensorless P Gain	0-32767	1000	
H46	R/W	Sensorless I Gain	0-32767	100	
H50	R/W	PID Feedback Selection	0=Terminal I Input (0-20 mA) 1=Terminal V1 Input (0-10V)	0	
H51	R/W	P Gain for PID	0-999.9%	300.0	
H52	Tune	I Gain for PID	0.1-32.0 Sec	1.0	
H53	Tune	D Gain for PID	0-30.0 Sec	0.0	
H54	Tune	F Gain for PID	0-999.9%	0.0	
H55	Tune	PID output frequency high limit	0.1-400Hz	60.00	
H56	Tune	PID output frequency low limit	0.1-400Hz	60.00	
H60	R/W	Self Diagnostics Select	0 = Self-diagnostic disabled 1 = IGBT fault/ground fault 2 = Output phase short & open/ground fault 3 = Ground Fault	0	
H70	R/W	Frequency Reference for Accel/Decel	0 - Based on P36 – Frequency High Limit 1 - Based on Delta Frequency	0	
H71	Tune	Accel/Decel Time Scale	0 = Setting Unit: 0.01 sec Range: 0.01- 600.00 1 = Setting Unit: 0.1 sec Range: 0.1- 6000.0 2 = Setting Unit: 1 sec Range: 1- 60000	1	

B.1 Parameters Sorted by Parameter Number Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
H72		Power-On Display	0 = Frequency Command 1 = Motor RPM 2 = Output Current 3 = Output Voltage 4 = Output Power 5 = Output Torque 6 = DC Link Voltage 7 = Digital Input Status 8 = Digital Output Status 9 = Software Version	0	
H74	R/W	Gain for Motor RPM Display	0-100Hz	100	
H75	R/W	DB Resistor select	0-1	1	
H76	R/W	DB Resistor Operating Rate	0-30%	10	
H77	R/W	Cooling Fan Control	0 = Always ON 1 = Fan operates when temp above limit	0	
H78	R/W	Operating method when cooling fan fails	0-1	0	
H81	R/W	Accel Time	0 - 60000 Sec	1.0	
H82	R/W	Decel Time	0 - 60000 Sec	5.0	
H83	R/W	Base Freq	30 - 400 Hz	60.0	
H84	R/W	V/F Pattern	0 - 2	0	
H85	R/W	FX Torque Boost	0 - 15 %	5	
H86	R/W	RX Torque Boost	0 - 15 %	5	
H87	R/W	Stall Level	30 - 150 %	150	
H88	R/W	1 Min Overload Level	50 - 200 %	150	
H89	R/W	Continuous Overload Level	50 - 150 %	100	
H90	R/W	Motor Rated Current	0.1 - 50 Amps	26.3	
H91	R/W	Parameter Read	0-1	0	
H92	R/W	Parameter Write	0-1	0	

B.1 Parameters Sorted by Parameter Number Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
H93	R/W	Parameter Initialize	0 = No Action 1 = All parameters set to factory defaults. To reset individual groups only and not all parameters select one of the following: 2 = P Group Parameter Reset 3 = F Group Parameter Reset 4 = H Group Parameter Reset 5 = t Group Parameter Reset	0	
H94	R/W	Password Register	0-FFFF	0	
H95	R/W	Parameter Lock	0-FFFF	0	

B.2 Parameters Sorted by Parameter Name

Param #	Access	Parameter Name	**Description** (Range)	Factory Setting	User Setting
H88	R/W	1 Min Overload Level	50 - 200 %	150	
F2	R/W	Accel Pattern	0=Linear 1=S-Curve	0	
H81	R/W	Accel Time	0 - 60000 Sec	1.00	
P41	Tune	Accel Time	0 - 6,000 sec	5.00	
H71	Tune	Accel/Decel Time Scale	0 = Setting Unit: 0.01 sec Range: 0.01- 600.00 1 = Setting Unit: 0.1 sec Range: 0.1- 6000.0 2 = Setting Unit: 1 sec Range: 1- 60000	1	
t38	Tune	Analog Input 0 to 10V (NV) Max voltage	0 to 10V	10	
t36	Tune	Analog Input 0 to -10V (NV) Min voltage	0 to -10V	0	
t40	Tune	Analog Input 0 to 10V (V1) Filter time constant	0 - 9999	10	
t41	Tune	Analog Input 0 to 10V (V1) Min voltage	0 - 10V	0	
t43	Tune	Analog Input 0-10V (V1) Max voltage	0 - 10V	10	
t45	Tune	Analog Input 0-20mA (I) Filter time constant	1-9999	10	
t48	Tune	Analog Input 0-20mA (I) Max Current	0-20mA	20	
t46	Tune	Analog Input 0-20mA (I) Min Current	0-20mA	4	
t29	Tune	Analog Output Level Adjustment	10 - 200%	100	
t28	Tune	Analog Output Select	0 = Output Frequency 1 = Output Current 2 = Output Voltage 3 = DC Link Voltage	0	
H21	Tune	Auto Restart	0-1	0	
H26	Tune	Auto Restart Attempts	0-10	0	

B.2 Parameters Sorted by Parameter Name Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
H27	Tune	Auto Restart Time	0-60Sec	1.00	
H41	R/W	Auto-T uning	0-1	0	
H83	R/W	Base Freq	30 - 400 Hz	60.00	
P34	R/W	Base Frequency	30 - 400 Hz	60.00	
t61	Tune	Baud Rate	0 = 1200 bps 1 = 2400 bps 2 = 4800 bps 3 = 9600 bps 4 = 19200 bps	3	
H39	Tune	Carrier Frequency Select	2-15kHz	2	
t59	Tune	Communication protocol select	0 = Modbus RTU 1 = CI485	0	
t64	Tune	Communication Time Setting	2-100 ms	5	
H89	R/W	Continuous Overload Level	50 - 150 %	100	
H40	R/W	Control Mode Select	0 = Volts/Frequency Control 1 = Slip Compensation Control 2 = PID Feedback Control 3 = Sensorless Vector Control	0	
H77	R/W	Cooling Fan Control	0 = Always ON 1 = Fan operates when temp above limit	0	
t35	Tune	Criteria for Analog Input Signal Loss	0 = Disabled. 1 = Activated when less than half of set value. 2 = Activated when less than set value.	0	
n0n	RO	Current Fault Display	N/A	N/A	
H53	Tune	D Gain for PID	0-30.0 Sec	0.00	
H76	R/W	DB Resistor Operating Rate	0-30%	10	
H75	R/W	DB Resistor select	0-1	1	
F8	R/W	DC Brake start frequency	0.1-60 Hz	5.00	
F13	R/W	DC Brake start time	0-60 Sec	0	
F12	R/W	DC Brake start voltage	0-200%	50	
F11	R/W	DC Brake Time	0-60 Sec	1.00	

B.2 Parameters Sorted by Parameter Name Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
F10	R/W	DC Brake Voltage	0-200%	50	
F9	R/W	DC Brake wait time	0-60 Sec	0.10	
d6	RO	DC Link Voltage	Based on Drive Rating VDC	N/A	
F3	R/W	Decel Pattern	0 = Linear 1 = S-Curve	0	
P42	Tune	Decel Time	0 - 6,000 sec	10.00	
H82	R/W	Decel Time	0 - 60000 Sec	5.00	
t1	Tune	Digital Input 1	0 =Forward Run Command 1 = Reverse Run Command 2 = Output Inhibit 3 = Fault Reset (RST) 4 = Jog Speed Select (2-wire only) 5 = Speed Select1 6 = Speed Select 2 7 = Speed Select 3 8 = Ramp Select 1 9 = Ramp Select 2 10 = Ramp Select3 11 = DC Brake during start 12 = 2nd Motor Select 13 = Reserved 14 = Reserved 15 = Frequency increase (UP) 16 = Frequency decrease (DOWN) 17 = 3-Wire Stop 18 = External Trip: A Contact (EtA) 19 = External Trip: B Contact (EtB) 20 = Self-Diagnostic Function 21 = Exchange between PID and V/F | 22 = Exchange between Second source and Drive 23 = Analog Hold 24 = Accel/Decel Disable 25 = Up/Down Save Freq. Initialization	0	
t2	Tune	Digital Input 2		1	
t3	Tune	Digital Input 3		2	
t4	Tune	Digital Input 4		3	
t5	Tune	Digital Input 5		4	
t6	Tune	Digital Input 6		5	
t7	Tune	Digital Input 7		6	
t8	Tune	Digital Input 8		7	

B.2 Parameters Sorted by Parameter Name Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
t32	Tune	Digital Output (MO)	0 = FDT-1 1 = FDT-2 2 = FDT-3 3 = FDT-4 4 = FDT-5 5 = Overload (OLt) 6 = Inverter Overload (LoIT) 7 = Motor Stall STALL 8 = Over voltage trip (OV) 9 = Low voltage trip (LV) 10 = Inverter overheat (OH) 11 = Command Loss 12 = During run 13 = During stop 14 = During constant run 15 = During speed searching 16 = Wait time for run signal input 17 = Fault Output 18 = Cooling Fan Trip Alarm	12	
t50	Tune	Digital Output (MO) On Delay	0 to 3,600 Sec	0	
t52	Tune	Digital Output (MO) Off Delay	0 to 3,600 Sec	20	
P46	RO	Drive Start/Stop Source 2	0= Keypad 1= Terminal Mode 1 2= Terminal Mode 2 3= RS485 Communication	1	
H7	R/W	Dwell Frequency	0.1-400 Hz	5.00	
H8	R/W	Dwell Time	0-10 Sec	0.00	
F52	Tune	Electronic thermal level continuous	50-15%	10	
F51	Tune	Electronic thermal level for 1 minute	50-200%	150	
F50	Tune	Electronic thermal select	0-1	0	
F40	Tune	Energy Savings Level	0-30%	0	
H54	Tune	F Gain for PID	0-999.9%	0.00	
t34	Tune	Fault Relay Output	0-7	2	
t9	Tune	Filter Time Constant for Digital inputs	1 - 15	4	

B.2 Parameters Sorted by Parameter Name Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
F1	R/W	Forward/Reverse run Disable	0 = Forward and Reverse run enable 1 = Forward run disable 2 = Reverse run disable	0	
d0	RO	Frequency Command	0.00 to Frequency High Limit (P36) Hz	0.00	
P37	Tune	Frequency Command	0 - 400 Hz	0.00	
t37	Tune	Frequency corresponding to t36	0 - 400 Hz	0	
t39	Tune	Frequency corresponding to t38	0 - 400 Hz	60	
t42	Tune	Frequency corresponding to t41	0 - 400 Hz	0	
t44	Tune	Frequency corresponding to t43	0-400 Hz	60	
t47	Tune	Frequency corresponding to t46	0-400 Hz	0	
t49	Tune	Frequency corresponding to t47	0-400 Hz	60	
t31	Tune	Frequency detection bandwidth	0-400Hz	10	
t30	Tune	Frequency detection level	0-400Hz	30	
P36	R/W	Frequency High Limit	0 - 400 Hz	60.00	
t62	Tune	Frequency Loss Mode	0 = Continue operation at last frequency command 1 = Coast to Stop. 2 = Decelerate to stop.	0	
t63	Tune	Frequency Loss Wait Time	0.1-120 Sec	1.00	
P35	R/W	Frequency Low Limit	0 - P36 Hz	10.00	
H70	R/W	Frequency Reference for Accel/Decel	0 - Based on P36 * Frequency High Limit 1 - Based on Delta Frequency	0	
P40	R/W	Frequency Setting Method	1= Digital Keypad 2= Analog V1 1:) 10V 3= Analog V1 2: 0 to)10 V 4= Analog Terminal I: 0 - 20mA 5= Analog Terminal V1 Mode 1 6= Analog Terminal V1 Mode 2 7= Analog RS485	1	

B.2 Parameters Sorted by Parameter Name Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
P47	RO	Frequency Setting Mode 2	1 = Digital Keypad 2 = Analog V1 1:) 10V 3 = Analog V1 2: 0 to)10 V 4 = Analog Terminal I: 0 - 20mA 5 = Analog Terminal V1 Mode 1 6 = Analog Terminal V1 Mode 2 7 = Analog RS485	1	
H85	R/W	FX Torque Boost	0 - 15 %	5	
H74	Tune	Gain for Motor RPM Display	0-100Hz	100	
H52	Tune	I Gain for PID	0.1-32.0 Sec	1.00	
d7	RO	Input Terminal status display	N/A	N/A	
t60	Tune	Inverter Number	1-250	1	
F20	Tune	Jog Frequency	0-400 Hz	10.00	
F0	Tune	Jump Code	0-64	0	
H0	Tune	Jump Code	0 - 95	0	
P0	Tune	Jump Code	30 -47	45	
t0	Tune	Jump Code	0 - 81	0	
t57	Tune	Keypad Error Output	0 = Not used 1 = Signal output to MO 2 = Signal output to 3A, 3B contacts 3 = Signal output to MO, 3A, 3B	0	
H1	RO	Last Fault 1	N/A	0	
H2	RO	Last Fault 2	N/A	0	
H3	RO	Last Fault 3	N/A	0	
H4	RO	Last Fault 4	N/A	0	
H5	RO	Last Fault 5	N/A	0	
H44	R/W	Leakage Inductance (Ls)	0-300.0 mH	Calc	

B.2 Parameters Sorted by Parameter Name Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
H37	R/W	Load Inertia Rate	0 = Load inertia rate is less than 10 times that of motor inertia 1 = Load inertia rate equal to approximately 10 times the motor inertia. 2 = Load inertia rate is more than 10 times that of motor inertia.	0	
F53	Tune	Motor cooling method	0 = Standard Motor 1 = Variable Speed Motor	0	
H36	R/W	Motor Efficiency	50-100%	87	
P30	R/W	Motor hp Select	0.5 = 0.5 HP 1= 1 HP 2= 2 HP 3= 3 HP 5= 5 HP 7.5= 7.5 HP 10= 10 HP	Calc	
H90	R/W	Motor Rated Current	0.1 - 50 Amps	26.30	
P32	R/W	Motor Rated Current	0.5 - 50 Amps	Calc	
d1	RO	Motor RPM	0 Motor RPM (based on P33 Motor Poles)	0	
H34	R/W	No Load Motor Current	0.1-20A	Calc	
H78	R/W	Operating method during fan failure	0-1	0	
d2	RO	Output Current	0.0 to Motor Rated Current (P32) Amps	0.00	
d4	RO	Output Power	0.00 to (Drive Rated Power x 2) kW	0.00	
d8	RO	Output terminal status display	N/A	N/A	
d5	RO	Output Torque	0.00 to (Drive Rated Torque x 2) [kgf / M]	0.00	
d3	RO	Output Voltage	0.0 to Drive Rated Voltage VAC	0.00	
F39	R/W	Output voltage adjustment	40-1 10%	100	
F56	Tune	Overload trip enable	0-1	1	
F57	Tune	Overload trip level	30-200%	180	
F58	Tune	Overload trip time	0-60Sec	60	
F54	Tune	Overload Warning Level	30-150%	150	

B.2 Parameters Sorted by Parameter Name Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
F55	Tune	Overload warning time	0-30Sec	0	
H51	R/W	P Gain for PID	0-999.9%	300.00	
H93	R/W	Parameter Initialize	0 = No Action 1 = All parameters set to factory defaults. To reset individual groups only, select one of the following: 2 = P Group Parameter Reset 3 = F Group Parameter Reset 4 = H Group Parameter Reset 5 = t Group Parameter Reset	0	
H95	R/W	Parameter Lock	0-FFFF	0	
H91	R/W	Parameter Read	0-1	0	
H92	R/W	Parameter Write	0-1	0	
t65	Tune	Parity/Stop Bit Setting	0 = Parity: None, Stop Bit: 1 1 = Parity: None, Stop Bit: 2 2 = Parity: Even, Stop Bit: 1 3 = Parity: Odd, Stop Bit: 1	0	
H94	R/W	Password Register	0-FFFF	0	
H19	R/W	Phase Loss Protection	0 = Not Used 1 = Output phase loss protection 2 = Input phase loss protection 3 = Input/output phase loss protection	0	
H50	R/W	PID Feedback Selection	0 = Terminal I Input (0-20 mA) 1=Terminal V1 Input (0-10V)	0	
H55	Tune	PID output frequency high limit	0.1-400Hz	60.00	
H56	Tune	PID output frequency low limit	0.1-400Hz	60.00	
P33	R/W	Pole Number	2, 4, 6, 8, 10, 12	4	
H20	R/W	Power On Start	0-1	0	

B.2 Parameters Sorted by Parameter Name Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
H72	Tune	Power-On Display	0 = Frequency Command 1 = Motor RPM 2 = Output Current 3 = Output Voltage 4 = Output Power 5 = Output Torque 6 = DC Link Voltage 7 = Digital Input Status 8 = Digital Output Status 9 = Software Version	0	
P43	Tune	Preset Speed 1	0 - 400 Hz	10.00	
P44	Tune	Preset Speed 2	0 - 400 Hz	20.00	
P45	Tune	Preset Speed 3	0 - 400 Hz	30.00	
t10	Tune	Preset Speed 4	0-400Hz	30	
t11	Tune	Preset Speed 5	0-400Hz	25	
t12	Tune	Preset Speed 6	0-400Hz	20	
t13	Tune	Preset Speed 7	0-400Hz	15	
t14	Tune	Preset Speed Accel Time 1	0-6000Sec	3.00	
t16	Tune	Preset Speed Accel Time 2	0-6000Sec	4.00	
t18	Tune	Preset Speed Accel Time 3	0-6000Sec	5.00	
t20	Tune	Preset Speed Accel Time 4	0-6000Sec	6.00	
t22	Tune	Preset Speed Accel Time 5	0-6000Sec	7.00	
t24	Tune	Preset Speed Accel Time 6	0-6000Sec	8.00	
t26	Tune	Preset Speed Accel Time 7	0-6000Sec	9.00	
t15	Tune	Preset Speed Decel Time 1	0-6000Sec	3.00	
t17	Tune	Preset Speed Decel Time 2	0-6000Sec	4.00	
t19	Tune	Preset Speed Decel Time 3	0-6000Sec	5.00	
t21	Tune	Preset Speed Decel Time 4	0-6000Sec	6.00	
t23	Tune	Preset Speed Decel Time 5	0-6000Sec	7.00	
t25	Tune	Preset Speed Decel Time 6	0-6000Sec	8.00	
t27	Tune	Preset Speed Decel Time 7	0-6000Sec	9.00	
t66	Tune	Read address register 1	0-42239	5	
t67	Tune	Read address register 2	0-42239	6	
t68	Tune	Read address register 3	0-42239	7	

B.2 Parameters Sorted by Parameter Name Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
t69	Tune	Read address register 4	0-42239	8	
t70	Tune	Read address register 5	0-42239	9	
t71	Tune	Read address register 6	0-42239	10	
t72	Tune	Read address register 7	0-42239	11	
t73	Tune	Read address register 8	0-42239	12	
t33	Tune	Relay Output (3A - 3C)	0 = FDT-1 1 = FDT-2 2 = FDT-3 3 = FDT-4 4 = FDT-5 5 = Overload (OLt) 6 = Inverter Overload (LoIT) 7 = Motor Stall STALL 8 = Over voltage trip (OV) 9 = Low voltage trip (LV) 10 = Inverter overheat (OH) 11 = Command Loss 12 = During run 13 = During stop 14 = During constant run 15 = During speed searching 16 = Wait time for run signal input 17 = Fault Output 18 = Cooling Fan Trip Alarm	17	
t51	Tune	Relay Output (3A - 3C) On Delay	0 to 3,600 Sec	0	
t53	Tune	Relay Output (3A - 3C) Off Delay	0 to 3,600 Sec	0	
H6	Tune	Reset Fault History	0-1	0	
H86	R/W	RX Torque Boost	0 - 15 %	5	
F63	R/W	Save Up/down frequency	0-1	0	
F64	R/O	Saved up/down frequency	N/A	0.00	
H18	R/W	S-Curve Accel/Decel End Side	0.1-100%	40	
H17	R/W	S-Curve Accel/Decel Start Side	0.1-100%	40	
H60	R/W	Self Diagnostics Select	0 = Self-diagnostic disabled 1 = IGBT fault/ground fault 2 = Output phase short & open/ground fault 3 = Ground Fault	0	

B.2 Parameters Sorted by Parameter Name Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
H46	R/W	Sensorless I Gain	0-32767	100	
H45	R/W	Sensorless P Gain	0-32767	1000	
H10	R/W	Skip Frequency Enable	0-1	0	
H12	R/W	Skip Frequency High Limit 1	0.1-400 Hz	15	
H14	R/W	Skip Frequency High Limit 2	0.1-400 Hz	25	
H16	R/W	Skip Frequency High Limit 3	0.1-400 Hz	35	
H11	R/W	Skip Frequency Low Limit 1	0.1-400 Hz	10	
H13	R/W	Skip Frequency Low Limit 2	0.1-400 Hz	20	
H15	R/W	Skip Frequency Low Limit 3	0.1-400 Hz	30	
H32	R/W	Slip Frequency	0-10	1.67	
d9	RO	Software Version	1.0 to 99.9	1.80	
H23	Tune	Speed Search Current Level	80-200%	100	
H25	Tune	Speed Search I Gain	0-9999	100	
H24	R/W	Speed Search P Gain	0-9999	100	
H22	R/W	Speed Search Select	0-15	0	
H87	R/W	Stall Level	30 - 150 %	150	
F60	Tune	Stall prevention level	30-200%	150	
F59	R/W	Stall Prevention select	0-7	0	
F65	R/W	Start Frequency	0.10 to 10.00 Hz	0.50	
H42	R/W	Stator Resistance (Rs)	0-28 Ohms	N/A	
P39	R/W	Stop Type	0= Decelerate to Stop (Ramp) 1= DC Brake to Stop 2= Coast to Stop	0	
P38	R/W	Stop/Start Source	0 = Keypad 1= Terminal Mode 1 2= Terminal Mode 2 3= RS485 Communication	0	
F14	R/W	Time for magnetizing a motor	0-60 Sec	0.10	

B.2 Parameters Sorted by Parameter Name Continued

Param #	Access	Parameter Name	Description (Range)	Factory Setting	User Setting
F28	R/W	Torque boost in forward direction	0-15%	2	
F29	R/W	Torque boost in reverse direction	0-15%	0	
F27	R/W	Torque Boost select	0 = Manual Torque Boost 1 = Auto Torque Boost	0	
F31	R/W	User V/F frequency 1	0 - 400 Hz	15	
F33	R/W	User V/F frequency 2	0 - 400 Hz	30	
F35	R/W	User V/F frequency 3	0 - 400 Hz	45	
F37	R/W	User V/F frequency 4	0 - 400 Hz	60	
F32	R/W	User V/F voltage 1	0-100%	25	
F34	R/W	User V/F voltage 2	0-100%	50	
F36	R/W	User V/F voltage 3	0-100%	75	
F38	R/W	User V/F voltage 4	0-100%	100	
F30	R/W	V/F Pattern	0=Linear 1=Square 2=User V/F	0	
H84	R/W	V/F Pattern	0 - 2	0	
t74	Tune	Write address register 1	0-42239	5	
t75	Tune	Write address register 2	0-42239	6	
t76	Tune	Write address register 3	0-42239	7	
t77	Tune	Write address register 4	0-42239	8	
t78	Tune	Write address register 5	0-42239	5	
t79	Tune	Write address register 6	0-42239	6	
t80	Tune	Write address register 7	0-42239	7	
t81	Tune	Write address register 8	0-42239	8	

Appendix C
CE Guidelines

C.1 CE Declaration of Conformity

Baldor indicates that the products are only components and not ready for immediate or instant use within the meaning of “Safety law of appliance”, “EMC Law” or “Machine directive”.

The final mode of operation is defined only after installation into the user’s equipment. It is the responsibility of the user to verify compliance.

C.2 EMC - Conformity and CE - Marking

The information contained herein is for your guidance only and does not guarantee that the installation will meet the requirements of the council directive 89/336/EEC.

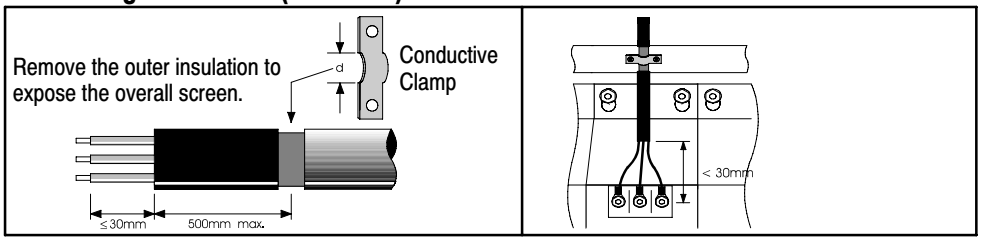
The purpose of the EEC directives is to state a minimum technical requirement common to all the member states within the European Union. In turn, these minimum technical requirements are intended to enhance the levels of safety both directly and indirectly.

Council directive 89/336/EEC relating to Electro Magnetic Compliance (EMC) indicates that it is the responsibility of the system integrator to ensure that the entire system complies with all relative directives at the time of installing into service.

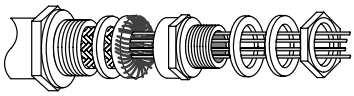
Motors and controls are used as components of a system, per the EMC directive. Hence all components, installation of the components, interconnection between components, and shielding and grounding of the system as a whole determines EMC compliance.

The CE mark does not inform the purchaser which directive the product complies with. It rests upon the manufacturer or his authorized representative to ensure the item in question complies fully with all the relative directives in force at the time of installing into service, in the same way as the system integrator previously mentioned. Remember, it is the instructions of installation and use, coupled with the product, that comply with the directive.

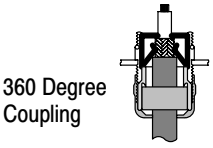
Wiring of Shielded (Screened) Cables



Shielded Couplings



360 Degree Coupling



360 Degree Coupling

Conductive 360 degree Clamp

EMC Installation Options

When installed for Class A or Class B operation, the control is compliant with EN55011 (1991)/ EN55022 (1994) for radiated emissions as described.

Grounding for Wall Mounting (Class A) also see Chapters 4 and 5.

Top cover must be installed.

- A single-star point (earth) is required.
- The protective earth connection (PE) to the motor must be run inside the screened cable or conduit between the motor and control and be connected to the protective earth terminal at the control.
- The internal/external AC supply filter must be permanently earthed.
- The signal/control cables must be screened.

Grounding for Enclosure Mounting (Class B) also see Chapters 4 and 5.

- The unit is installed for Class B operation when mounted inside an enclosure that has 10dB attenuation from 30 to 100MHz (typically the attenuation provided by a metal cabinet with no opening greater than 0.15m), using the recommended AC supply filter and having met all cable requirements.

Note: Radiated magnetic and electric fields inside the cubicle will be high and components installed inside must be sufficiently immune.

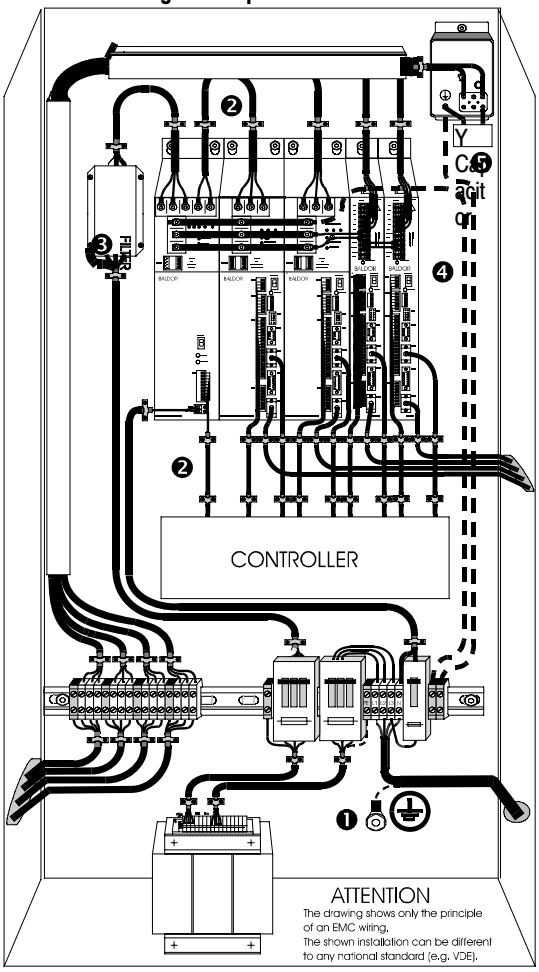
- The control, external filter and associated equipment are mounted onto a conducting, metal panel. Do not use enclosures that use insulating mounting panels or undefined mounting structures. Cables between the control and motor must be screened or in conduit and terminated at the control.

Using CE approved components will not guarantee a CE compliant system!

1. The components used in the drive, installation methods used, materials selected for interconnection of components are important.
2. The installation methods, interconnection materials, shielding, filtering and grounding of the system as a whole will determine CE compliance.
3. The responsibility of CE mark compliance rests entirely with the party who offers the end system for sale (such as an OEM or system integrator).

Baldor products which meet the EMC directive requirements are indicated with a “CE” mark. A signed CE declaration of conformity is provided in this section.

EMC Wiring Technique



1 **CABINET**
The drawing shows an electroplated zinc coated enclosure, which is connected to ground.
This enclosure has the following advantages:
- All parts mounted on the back plane are connected to ground.
- All shield (screen) connections are connected to ground.
Within the cabinet there should be a spatial separation between power wiring (motor and AC power cables) and control wiring.

2 **SCREEN CONNECTIONS**
All connections between components must use shielded cables. The cable shields must be connected to the enclosure. Use conductive clamps to ensure good ground connection. With this technique, a good ground shield can be achieved.

3 **EMC - FILTER**
The EMI or main filter should be mounted next to the power supply (here BPS). For the connection to and from the main filter screened cables should be used. The cable screens should be connected to screen clamps on both sides. (Exception: Analog Command Signal).

4 **Grounding (Earth)**
For safety reasons (VDE0160), all BALDOR components must be connected to ground with a separate wire. The diameter of the wire must be at minimum AWG#6 (10mm^2). Ground connections (dashed lines) must be made from the central ground to the regen resistor enclosure and from the central ground to the Shared Power Supply.

5 **Y-CAP ACITOR**
The connection of the regeneration resistor can cause RFI (radio frequency interference) to be very high. To minimize RFI, a Y-capacitor is used. The capacitor should only be connected between the dynamic brake resistor housing and terminal pin R1 (lead from Lin).

C.3 EMC Installation Instructions

To ensure electromagnetic compatibility (EMC), the following installation instructions should be completed. These steps help to reduce interference.
Consider the following:

- Grounding of all system elements to a central ground point
- Shielding of all cables and signal wires
- Filtering of power lines

A proper enclosure should have the following characteristics:

A) All metal conducting parts of the enclosure must be electrically connected to the back plane. These connections should be made with a grounding strap from each element to a central grounding point. [1]

B) Keep the power wiring (motor and power cable) and control wiring separated. If these wires must cross, be sure they cross at 90 degrees to minimize noise due to induction.

C) The shield connections of the signal and power cables should be connected to the screen rails or clamps. The screen rails or clamps should be conductive clamps fastened to the cabinet. [2]

D) The cable to the regeneration resistor must be shielded. The shield must be connected to ground at both ends.

E) The location of the AC mains filter has to be situated close to the drive so the AC power wires are as short as possible.

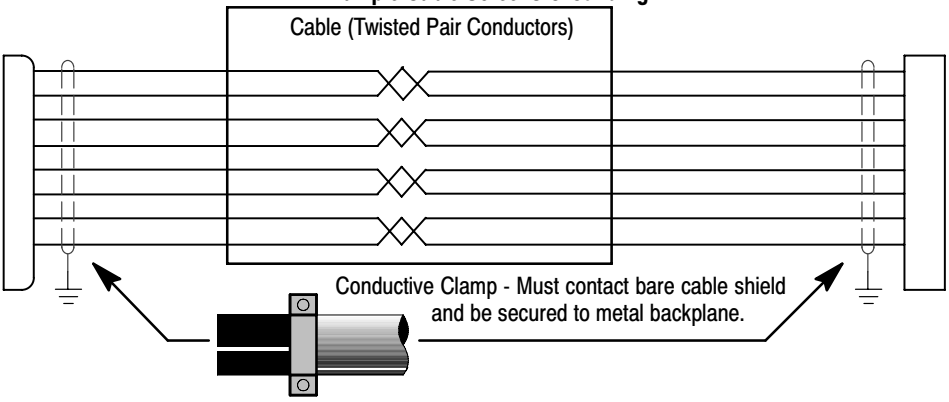
F) Wires inside the enclosure should be placed as close as possible to conducting metal, cabinet walls and plates. It is advised to terminate unused wires to chassis ground. [1]

G) To reduce ground current, use at least a 10mm^2 (6 AWG) solid wire for ground connections.

[1] Grounding in general describes all metal parts which can be connected to a protective conductor, e.g. housing of cabinet, motor housing, etc. to a central ground point. This central ground point is then connected to the main plant (or building) ground.

[2] Or run as twisted pair at minimum.

Example Cable Screens Grounding



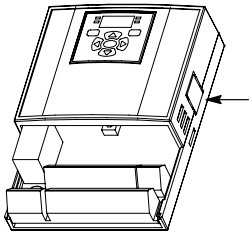
Appendix D
Options & Kits

D.1 Remote Keypad Option

Caution: Only Baldor cables should be used to connect the keypad and control. These are special twisted pair cables to protect the control and keypad. Damage associated with other cable types are not covered by the Baldor warranty.

Identify that you have the remote keypad and remote keypad connector, Figure 7-1.

Figure 7-1 Remote Keypad Connector



Model number	Description
VS1MD-RKEY2	INV - Remote - 2 meter length (6.5 ft)
VS1MD-RKEY3	INV - Remote - 3 meter length (9.8 ft)
VS1MD-RKEY5	INV - Remote - 5 meter length (16.4 ft)

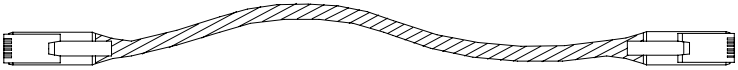
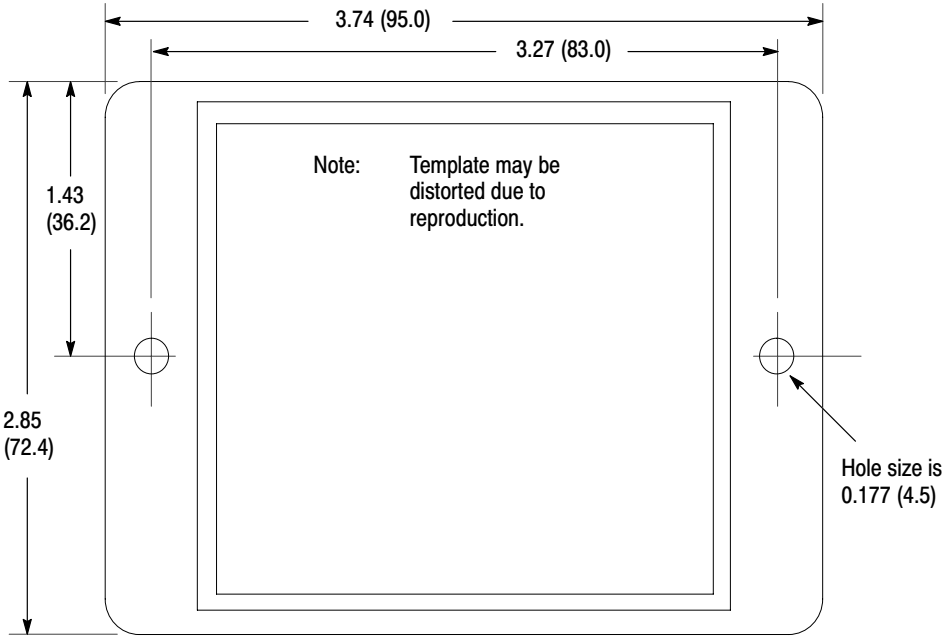


Figure 7-2 Keypad Mounting Hole Location



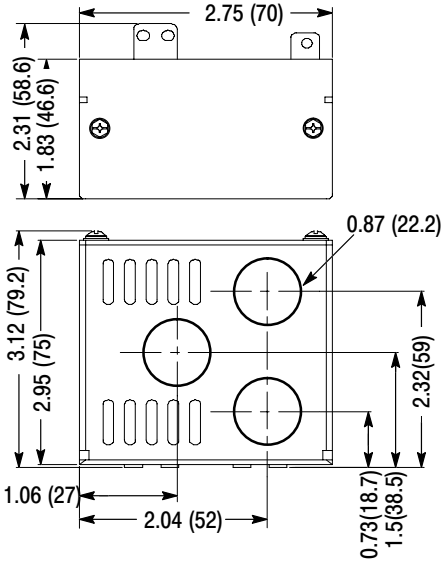
1. Drill two mounting holes the the locations shown using the Figure 7-2 as a template.
2. Mount the Remote keypad.
3. Remove the VS1MD cover, see Chapter 3.
4. Remove the plastic knockout to reveal the Remote Keypad connector shown in Figure 7-1.
5. Attach one end of the remote cable in the connector of Figure 7-1.
6. Attach the other end of the remote cable to the remote keypad.

D.2 Conduit Kit

Figure 7-3 Conduit Kit Models

Model number	Description
VS1MD-NM1A	0.5 and 1.0 HP (0.4 and 0.75 kW)
VS1MD-NM1B	V2.0 HP (1.5 kW)
VS1MD-NM1C	3.0 and 5.0 HP (2.2 and 4.0 kW)
VS1MD-NM1D	7.5 and 10.0 HP (5.5 and 7.5 kW)

VS1MD-NM1A



VS1MD-NM1C

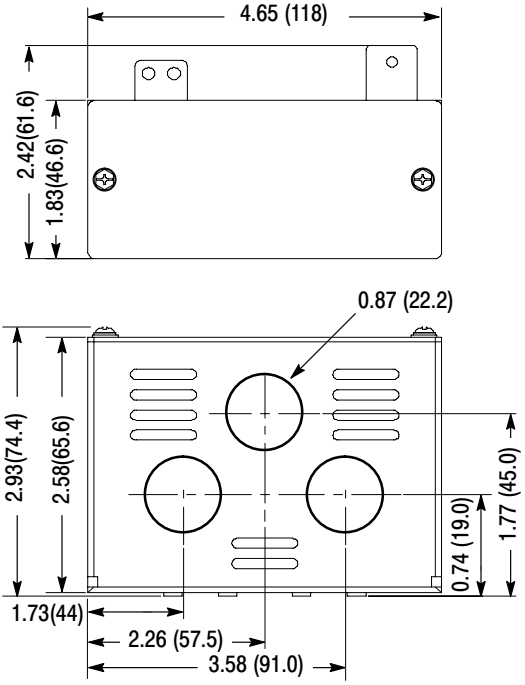
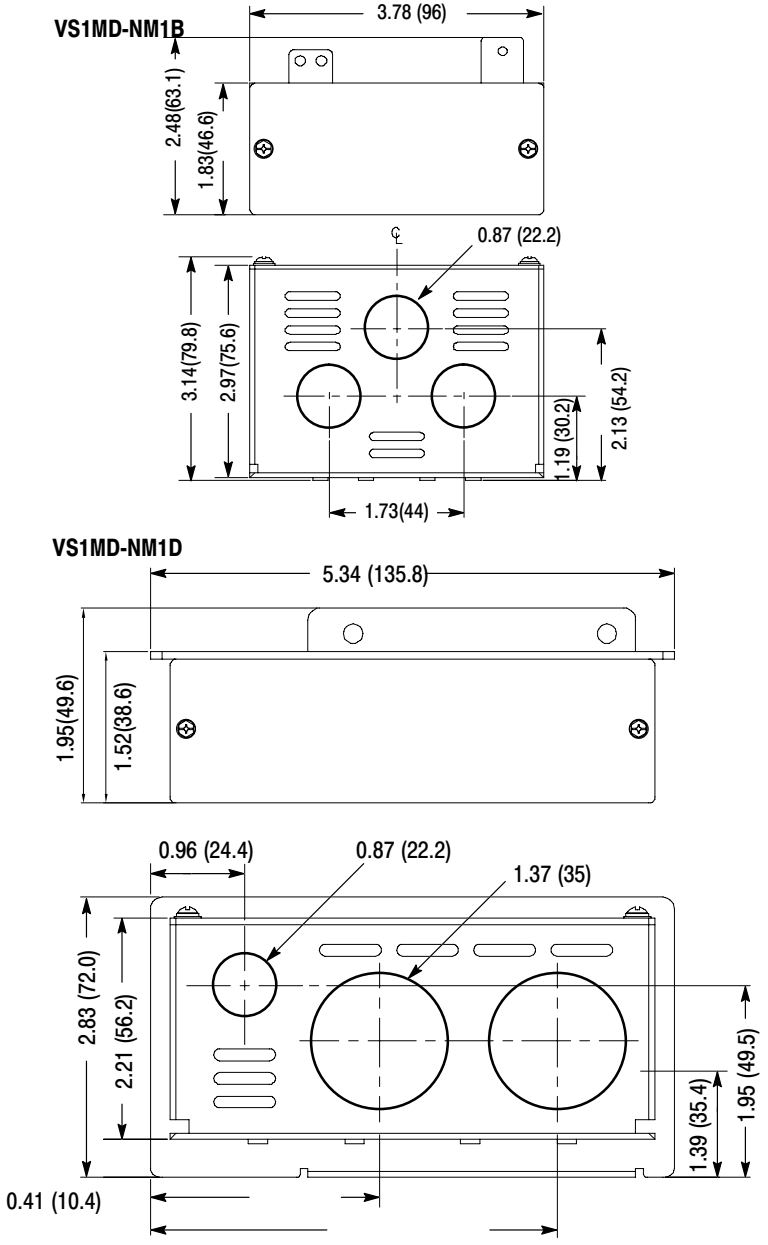


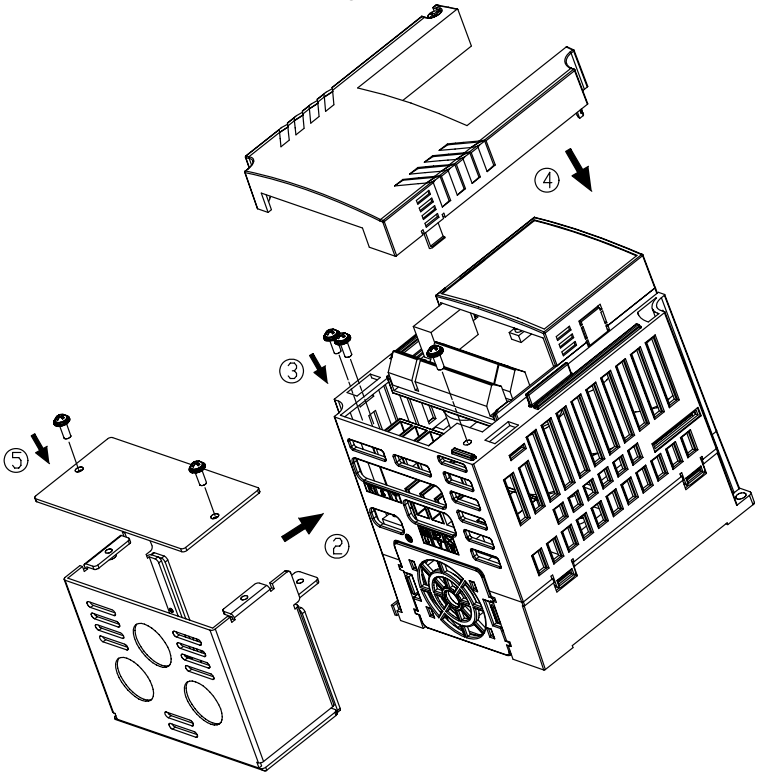
Figure 7-4 Conduit Kit Models



Conduit Kit Installation Procedure:

1. Remove the VS1MD cover, see Chapter 3.
2. Remove the Conduit box cover, Figure 7-5.
3. Attach Conduit box to control, Figure 7-5.
4. Attach Conduit to Conduit box.
5. Install wires through conduit into control and make all connections.
6. Install Conduit box cover.
7. Install VS1MD cover.

Figure 7-5



D.3 Brake Resistor

Input Voltage	Inverter capacity HP (kW)	100% Braking		150% Braking	
		Ohm	Watt [1]	Ohm	Watt [1]
230	0.5 (0.4)	400	50	300	100
	1.0 (0.75)	200	100	150	150
	2.0 (1.5)	100	200	60	300
	3.0 (2.2)	60	300	50	400
	5.0 (3.7)	40	500	33	600
	7.5 (5.5)	30	700	20	800
	10.0 (7.5)	20	1000	15	1200
460	0.5 (0.4)	1800	50	1200	100
	1.0 (0.75)	900	100	600	150
	2.0 (1.5)	450	200	300	300
	3.0 (2.2)	300	300	200	400
	5.0 (3.7)	200	500	130	600
	7.5 (5.5)	120	700	85	1000
	10.0 (7.5)	90	1000	60	1200

[1] The wattage is based on Enable duty (%ED) 5% with continuous braking time 15 sec.

Appendix E
RS485 Protocol

E.1 Installation

Item	Adjustable Range
Baud Rate	9600
Communication Type	Asynchronous
Communication System	Half Duplex
Parity	None
Stop Bits	CI485 =1 bit, Modbus RTU=Two bits
Check Sum	2 byte

1. Connect the RS485 communication line to the inverter (S+), (S-) terminals of the control terminals.
2. Check the connection and turn ON the inverter.
3. If the communication line is connected correctly, set the communication-related parameters as follows:
   P38 [Drive mode]: 3(RS485)
   P40 [Freq. mode]: 7(RS485)
   t60 [Inv. Number]: 1 to 250 (If multiple inverters are connected, be sure to use different numbers for each inverter)
   t61 [Baud-rate]: 3 (9,600 bps as Factory default)
   t62 [Lost Mode]: 0 - No action (Factory default)
   t63 [Time-Out]: 1.0 sec (Factory default)
   t59 [Comm. Prot]: 0 - Modbus-RTU
4. Connection to PC
   The maximum number of drives that can be connected is 31.
   Maximum length of communication line is 2300 ft (700m).

E.2 Operation

1. Verify computer and the inverter connections.
2. Turn ON the inverter. But do not connect the load until stable communication between the computer and the inverter is verified.
3. Start the operating program for the inverter from the computer.
4. Operate the inverter using the operating program for the inverter.

E.3 Performance Specifications

Item	Specification
Communication Method	RS485
Transmission Form	Bus method, Multi drop Link System
Applicable inverter	VS1MD series
Converter	RS232 converter
Connectable drives	Max 31
Transmission distance	Max. 1,200m (Within 700m Recommend)

E.4 Hardware Specifications

Item	Specification
Installation	Use S+, S- terminals on control terminal block
Power supply	Use Insulated power from the inverter power supply

E.5 Communications Specifications

Item	Specification
Communication speed	19200, 9600, 4800, 2400, 1200 bps selectable
Control procedure	Asynchronous communication system
Communication	Half Duplex
Characters	ASCII (8 bit)
Stop bits	CI485 =1 bit, Modbus RTU = 2 bits
Check Sum	2 bytes
Parity	None

E.6 Communications Protocol (MODBUS-RTU)

Use Modbus-RTU protocol (Open Protocol)

Computer or other hosts can be Master and inverters Slave. Inverter responds to Read/Write command from Master.

Table 7-2 Supported Function Calls

Function Code	Description
0x03	Read Hold Register
0x04	Read Input Register
0x06	Preset Single Register
0x10	Preset Multiple Register

Table 7-3 Exception Codes

Function Code	Description
0x01	Illegal Function
0x02	Illegal Data Address
0x03	Illegal Data Value
0x06	Slave Device Busy
User Defined 0x14	1. Write disable (0x004=0). 2. Read only or not program while running.

E.7 Communications Protocol (CI485)

E.7.1 Basic Format

Command message (Request)

ENQ	Drive No.	CMD	Data	SUM	EOT
1 byte	2 bytes	1 byte	n bytes	2 bytes	1 byte

Normal response (Acknowledge Response)

ACK	Drive No.	CMD	Data	SUM	EOT
1 byte	2 bytes	1 byte	n*4 bytes	2 bytes	1 byte

Negative response (Negative Acknowledge Response)

NACK	Drive No.	CMD	Error Code	SUM	EOT
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Description:
Request starts with “ENQ” and ends with “EOT”.
Acknowledge Response starts with “ACK” and ends with “EOT”.
Negative Acknowledge Response starts with “NAK” and ends with “EOT”.
“Drive Number” is the number of the drive and is indicated in 2 byte ASCII-HEX.
(ASCII-HEX: Hexadecimal consists of characters 0-9 and A - F)
CMD: Upper Case Character

Character	ASCII (Hex)	Command
R	52	Read
W	57	Write
X	58	Request for monitoring
Y	59	Action for monitoring

Data: ASCII (hex)
Example: Data value is = 3000: 3000(dec) = 0BB8 (hex) = 30h 42h 42h 38h
Error code: ASCII (20h to 7Fh)
Receive/Send buffer size: Receive= 39 byte, Send=44 byte
Monitor register buffer: 8 Word
SUM: to check the communication error
SUM=ASCII-HEX format of lower 8 bit of (Drive No. + CMD + DATA)
Example:Command Message (Request) to read one address from address “3000”.

ENQ	Drive No.	CMD	Address	Number of address to read	SUM	EOT
05h	“01” to “1F”	“R”	“3000”	“1”	“A7”	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	2 bytes	1 byte

SUM= 0 + 1 + R + 3 + 0 + 0 + 0 + 1 = 30h + 31h + 52h + 33h + 30h + 30h + 30h + 31h = 1A7h
(control values such as ENQ/ACK/NAK are excluded)

E.7.2 Detail Communication Protocol

Request for Read:

Request to read successive "n" number of address "XXXX".

ENQ	Drive No.	CMD	Address	Number of address to read	SUM	EOT
05h	"01" to "1F"	"R"	"XXXX"	"1" to "8" = n	"XX"	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	2 bytes	1 byte

Total bytes = 12 Note: Quotation marks(" ") indicate character.

Acknowledge Response:

ACK	Drive No.	CMD	Address	SUM	EOT
06h	"01" to "1F"	"R"	"XXXX"	"XX"	04h
1 byte	2 bytes	1 byte	n*4 bytes	2 bytes	1 byte

Total bytes = 7 + n * 4 (Max 39)

Negative Acknowledge Response:

NAK	Drive No.	CMD	Error Code	SUM	EOT
06h	"01" to "1F"	"R"	"**"	"XX"	04h
1 byte	2 bytes	1 byte	4 bytes	2 bytes	1 byte

Total bytes = 9

Request for Write:

ENQ	Drive No.	CMD	Address	Number of address to read	Data	SUM	EOT
05h	"01" to "1F"	"W"	"XXXX"	"1" to "8" = n	"XXXX"	"XX"	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	n*4 bytes	2 bytes	1 byte

Total bytes = 12 + n*4 (Max 44)

Acknowledge Response:

ACK	Drive No.	CMD	Address	SUM	EOT
06h	"01" to "1F"	"W"	"XXXX"	"XX"	04h
1 byte	2 bytes	1 byte	n*4 bytes	2 bytes	1 byte

Total bytes = 7 + n * 4 (Max 39)

Negative Acknowledge Response:

NAK	Drive No.	CMD	Error Code	SUM	EOT
06h	"01" to "1F"	"W"	"**"	"XX"	04h
1 byte	2 bytes	1 byte	4 bytes	2 bytes	1 byte

Total bytes = 9

Request for Monitor Register:

This is useful when constant parameter monitoring and data updates are required.
Request for Register of "n" numbers of Address (not consecutive).

ENQ	Drive No.	CMD	Address	Number of address to read	SUM	EOT
05h	"01" to "1F"	"X"	"XXXX"	"1" to "8" = n	"XX"	04h
1 byte	2 bytes	1 byte	n*4 bytes	1 byte	2 bytes	1 byte

Total bytes = 8 + n*4 (Max 40)

Acknowledge Response:

ACK	Drive No.	CMD	SUM	EOT
06h	"01" to "1F"	"X"	"XX"	04h
1 byte	2 bytes	1 byte	2 bytes	1 byte

Total bytes = 7

Negative Acknowledge Response:

NAK	Drive No.	CMD	Error Code	SUM	EOT
15h	"01" to "1F"	"X"	"**"	"XX"	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes = 9

Action Request for Monitor Register:

Request to read address registered by monitor register.

ENQ	Drive No.	CMD	SUM	EOT
05h	"01" to "1F"	"Y"	"XX"	04h
1 byte	2 bytes	1 byte	2 bytes	1 byte

Total bytes = 8 + n*4 (Max 40)

Acknowledge Response:

ACK	Drive No.	CMD	Data	SUM	EOT
06h	"01" to "1F"	"Y"	"XXXX"	"XX"	04h
1 byte	2 bytes	1 byte	n*4 bytes	2 bytes	1 byte

Total bytes = 7

Negative Acknowledge Response:

NAK	Drive No.	CMD	Error Code	SUM	EOT
15h	"01" to "1F"	"Y"	"**"	"XX"	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes = 9

Acknowledge Response:

Error Code	Description
1F	When master is sending codes other than Function code (R, W, X)
1A	When parameter address does not exist
1D	When Data value exceeds its permissible range during “W” (Write).
WM	When the specific parameters can not be written during “W” (Write). (For example, in the case of Read Only, Write disabled during Run.)
FE	When frame size of specific function is not correct and Checksum

E.8 Troubleshooting

Perform these checks when an RS485 communication error occurs.

Check	Corrective Measure
Is power provided to the converter?	Provide electric power to the converter.
Are the connections between converter and computer correct?	Refer to the converter manual.
Is Master not polling?	Verify the Master is polling the drive.
Is baud rate of computer and drive set correctly?	Set the correct value.
Is the data format of user program correct?	Set data formats to same for drive and computer.
Is the connection between the converter and the communication card correct?	Check for the correct wiring.

ASCII Codes

Character	Hex	Character	Hex	Character	Hex	Character	Hex	Character	Hex
A	41	a	61	0	30	:	3A	DLE	10
B	42	b	62	1	31	;	3B	EM	19
C	43	c	63	2	32	<	3C	ACK	06
D	44	d	64	3	33	=	3D	ENQ	05
E	45	e	65	4	34	>		EOT	04
F	46	f	66	5	35	?	3E	ESC	1B
G	47	g	67	6	36	@	3F	ETB	17
H	48	h	68	7	37	[	40	ETX	03
I	49	i	69	8	38	\	5B	FF	0C
J	4A	J	6A	9	39	]	5C	FS	1C
K	4B	k	6B	space	20		5D	GS	1D
L	4C	l	6C	!	21		5E	HT	09
M	4D	m	6D	”	22		5F	LF	0A
N	4E	n	6E	#	23	{	60	NAK	15
O	4F	o	6F	$	24	|	7B	NUL	00
P	50	p	70	%	25	}	7C	RS	1E
Q	51	q	71	&	26	to	7D	S1	0F
R	52	r	72	’	27	BEL	7E	SO	0E
S	53	s	73	(	28	BS	07	SOH	01
T	54	t	74	)	29	CAN	08	STX	02
U	55	u	75	*	2A	CR	18	SUB	1A
V	56	v	76	+	2B	DC1	0D	SYN	16
W	57	w	77	,	2C	DC2	11	US	1F
X	58	x	78	-	2D	DC3	12	VT	0B
Y	59	y	79	.	2E	DC4	13		
Z	5A	z	7A	/	2F	DEL	14		
							7F		

Baldor District Offices

UNITED STATES

ARIZONA
PHOENIX
4211 S 43RD PLACE
PHOENIX, AZ 85040
PHONE: 602-470-0407
FAX: 602-470-0464

ARKANSAS
CLARKSVILLE
1001 COLLEGE AVE
CLARKSVILLE, AR 72830
PHONE: 479-754-9108
FAX: 479-754-9205

CALIFORNIA
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COMMERCE, CA 90040
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FAX: 323-721-5859

HAYWARD
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HAYWARD, CA 94545
PHONE: 510-785-9900
FAX: 510-785-9910

COLORADO
DENVER
3855 Forest Street
Denver, CO 80207
PHONE: 303-623-0127
FAX: 303-595-3772

9980 Park Meadows Drive
Suite 214
Lone Tree, CO 80124-6739
Phone: 303-339-9629
Fax: 303-339-9633

CONNECTICUT
WALLINGFORD
65 SOUTH TURNPIKE ROAD
WALLINGFORD, CT 06492
PHONE: 203-269-1354
FAX: 203-269-5485

FLORIDA
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VIRGIN ISLANDS
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TAMPA, FL 33605
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FAX: 813-247-2984

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62 TECHNOLOGY DR.
ALPHARETTA, GA 30005
PHONE: 770-772-7000
FAX: 770-772-7200

5490 McGinnis Ferry Place
Suite 133
Alpharetta, GA 30005
Phone: 770-752-4254
Fax: 770-752-4257

ILLINOIS
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Naperville, IL 60563
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FAX: 630-848-5110

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COLUMBUS
3300 Tenth St
Columbus, IN 47201
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Fax: 812-378-2555

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INDIANAPOLIS, IN 46241
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FAX: 317-246-5110

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DES MOINES, IA 50316
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FAX: 515-263-6515

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Lawrence, KS 66049
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Fax: 785-749-4217

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ELKRIDGE, MD 21075
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FAX: 410-579-2677

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FAX: 508-854-0291

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STERLING HEIGHTS, MI 48312
PHONE: 586-978-9800
FAX: 586-978-9969

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FAX: 616-785-1788

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ROGERS, MN 55374
PHONE: 763-428-3633
FAX: 763-428-4551

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GREENSBORO, NC 27416
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FAX: 336-273-6628

OHIO
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WEST CHESTER, OH 45069
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FAX: 330-468-4778

29525 Chagrin Blvd Suite 208
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Fax: 216-360-4172

OKLAHOMA
TULSA
2 EAST DAWES
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PHONE: 918-366-9320
FAX: 918-366-9338

OREGON
PORTLAND
20393 SW AVERY COURT
TUALATIN, OR 97062
PHONE: 503-691-9010
FAX: 503-691-9012

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Santiago, Chile
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Fax: 56-2-290-0762

CHINA
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Songjiang
201611 Shanghai, China
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Fax: +86 21 5760 5336

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Tower B Wanda Plaza
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ChaoYang District
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Fax: +86 (010) 58204231

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MUNICH, GERMANY
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FAX: +49 89 90 50 8492

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SWITZERLAND
POSTFACH 73
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