30072-450-07
November 1998
Raleigh, NC, USA

Instruction Bulletin

VSD07 Adjustable Speed Drive Controller

Installation and Operation Manual

SQUARE D

⚠ DANGER

HAZARDOUS VOLTAGE

- Read and understand this bulletin in its entirety before installing or operating VSD07 drive controllers. Installation, adjustment, and maintenance of these drive controllers must be performed by qualified personnel.
- Disconnect all power before servicing drive controller. WAIT THREE MINUTES until DC bus capacitors discharge, then measure DC bus capacitor voltage as described in “Appendix D—Bus Voltage Measurement Procedure” on page 89 to verify that DC voltage is less than 45 V. The display is not an accurate indication of the absence of DC bus voltage.
- DO NOT short across the DC bus capacitors or touch terminal strip screw connections with voltage present.
- No servicable components are inside. DO NOT remove cover.
- User is responsible for conforming to all applicable code requirements with respect to grounding all equipment.
- Use only electrically insulated tools.

If the drive controller must be replaced:

- Disconnect all power.
- Place a “DO NOT TURN ON” label on drive controller disconnect.
- Lock disconnect in open position.

Electrical shock will result in death or serious injury.

INTRODUCTION

Scope of Manual

The VSD07 Adjustable Speed Drive Controller from Square D is a series of drive controllers for three-phase asynchronous motors. The VSD07 series is comprised of the following:

- 0.25 to 1 hp (0.20 to 0.75 kW), 120/208/240 Vac, single-phase input; 230/200/230 Vac, three-phase output
- 0.25 to 3 hp (0.20 to 2.2 kW), 208/240 Vac, three-phase input
- 0.5 to 3 hp (0.37 to 2.2 kW), 400/480 Vac, three-phase input
- 1 to 5 hp (0.75 to 3.7 kW), 590 Vac, three-phase input

This instruction bulletin covers the technical characteristics, specifications, installation, and wiring of all VSD07 series drive controllers.

Revision Level

This is a new document.

HANDLING THE DRIVE CONTROLLER

Receiving and Preliminary Inspection

Before installing the VSD07 drive controller, read this manual and follow all precautions:

- Before removing the drive controller from its packing material, verify that it is not damaged from shipping. Any damage to the packing carton usually indicates improper handling. If any damage is found, notify the carrier and your Square D representative.
- After removing the drive controller from its packaging, visually inspect the exterior for shipping damage. If any shipping damage is found, notify the carrier and your sales representative.
- Verify that the drive controller nameplate and label conform to the packing slip and corresponding purchase order.

⚠ CAUTION

EQUIPMENT DAMAGE HAZARD

Do not operate or install any drive controller that appears damaged.

Failure to follow this instruction can result in injury or equipment damage.

Storing and Shipping

If the drive controller is not immediately installed, store it in a clean, dry area where the ambient temperature is between -20 and +70 °C (-4 to +158 °F). If the drive controller is shipped to another location, use the original shipping material and carton to protect the drive controller.

TECHNICAL CHARACTERISTICS

Table 1: Ratings

Drive Controller	Motor Power		Input Line Current (A)			3-Phase Rated Output Current (A) [1, 2]			Total Dissi-pated Power	Short Circuit Rating	Recom-mended Fuse
120–240 VAC Controllers w/ 1-Phase Input											
Catalog No.	hp	kW	No. of Phases	Input (VAC)			Output (VAC)			W	kAIC rms sym.	Class CC
				120	208	240	230	200	230			
VSD07U07P10	0.25	0.20	1	6.0	3.5	3.0	1.4	1.6	1.4	20	1	10 A, 600 V
VSD07U09P10	0.5	0.37	1	9.2	5.3	4.6	2.2	2.5	2.2	27	1	15 A, 600 V
VSD07U18P10	1	0.75	1	15.8	9.1	7.9	4.0	4.6	4.0	45	1	25 A, 600 V
208–240 VAC Controllers w/ 1-Phase or 3-Phase Input											
Catalog No.	hp	kW	No. of Phases	Input (VAC)			Output (VAC)			W	kAIC rms sym.	Class CC
				208	240		200	230				
VSD07U07P20	0.25	0.20	1	3.6	3.2		1.6	1.4		19	1	10 A, 600 V
			3	1.9	1.7					19	1	10 A, 600 V
VSD07U09P20	0.5	0.37	1	5.4	4.7		2.5	2.2		26	1	10 A, 600 V
			3	3.1	2.7					26	1	10 A, 600 V
VSD07U18P20	1	0.75	1	9.7	8.4		4.6	4.0		47	1	15 A, 600 V
			3	5.5	4.8					47	1	15 A, 600 V
VSD07U18M20	1	0.75	3	5.5	4.8		4.6	4.0		39	1	10 A, 600 V
VSD07U25M20	1.5	1.1	3	7.1	6.3		6.2	5.4		62	1	12 A, 600V
VSD07U29M20	2	1.5	3	9.1	7.9		7.8	6.8		78	1	15 A, 600V
VSD07U41M20	3	2.2	3	12.4	10.8		11.0	9.6		117	1	20 A, 600V
400–480 VAC Controllers w/ 3-Phase Input											
Catalog No.	hp	kW	No. of Phases	Input (VAC)			Output (VAC)			W	kAIC rms sym.	Class CC
				400	480		400	460				
VSD07U09N40	0.5	0.37	3	1.6	1.4		1.3	1.1		26	1	10 A, 600 V
VSD07U18N40	1	0.75	3	2.8	2.4		2.3	2.0		41	1	10 A, 600 V
VSD07U25N40	1.5	1.1	3	3.6	3.2		3.1	2.7		51	1	10 A, 600 V
VSD07U29N40	2	1.5	3	4.6	4.0		3.9	3.4		67	1	10 A, 600 V
VSD07U41N40	3	2.2	3	6.2	5.4		5.5	4.8		101	1	10 A, 600 V

[1] The maximum transient output current setting is either 180% or 150% of the rated output current, depending on whether Line Voltage Selection (Parameter 01) is set to High or Low.

[2] Input voltage corresponds to output voltage as follows:

120 V → 230 V 208 V → 200 V 240 V → 230 V
400 V → 400 V 480 V → 460 V 590 V → 575 V

Table 1: Ratings (continued)

Drive Controller	Motor Power		Input Line Current (A)		3-Phase Rated Output Current (A)[1]	Total Dissi-pated Power	Short Circuit Rating	Recom-mended Fuse
590 VAC Controllers w/ 3-Phase Input								
Catalog No.	hp	kW	No. of Phases	Input (VAC) 590	Output (VAC) 575	W	kAIC rms sym.	Class CC
VSD07U18S60	1	0.75	3	1.9	1.6	43	1	10 A, 600 V
VSD07U29S60	2	1.5	3	3.5	3.0	63	1	10 A, 600 V
VSD07U41S60	3	2.2	3	4.7	4.2	96	1	10 A, 600 V
VSD07U72S60	5	3.7	3	7.4	6.6	154	1	10 A, 600 V

[1] The maximum transient output current setting is either 180% or 150% of the rated output current, depending on whether Line Voltage Selection (Parameter 01) is set to High or Low.

Table 2: Specifications

Environment	
Degree of protection	IP20
Resistance to vibration/shock. Applies to all but 3 hp and 5 hp 590 V drive controllers, and 1 hp, 120–240 Vac, single-phase drive controllers (VSD07U18P10).	Vibration: 1.5 mm peak-to-peak from 7 to 13 Hz 1.0 mm peak-to-peak from 13 to 22.3 Hz 2 g from 22.3 to 150 Hz IEC 88-2-6 Shock: 15 g, 11 ms, half sine, IEC 68-2-27
Pollution degree	Pollution degree 2 according to NEMA ICS-1, IEC 664, and UL 840
Maximum relative humidity	95% maximum, non-condensing and without dripping (provide heating system if there is condensation)
Maximum ambient temperature	Storage: -4 to +158 °F (-20 to +70 °C) Operation: 32 to +122 °F (0 to +50 °C) with carrier frequency < 6 kHz. See page 50.
Altitude	Up to 3,300 ft (1,000 m) without derating

Table 2: Specifications (continued)

Electrical Characteristics		
Input voltage	VSD07U••P10: VSD07U••P20: VSD07U••M20: VSD07U••N40: VSD07U••S60: Tolerance (all models):	120/208/240 Vac, 1-phase 208/240 Vac, 1- or 3-phase 208/240 Vac, 3-phase 400/480 Vac, 3-phase 590 Vac, 3-phase +10% / -15%
Input frequency	48 to 62 Hz	
Input phases	VSD07U••P10: VSD07U••P20: VSD07U••M20, N40 & S60:	1 1 or 3 3
Output voltage	See Table 1 on page 3.	
Output frequency	0 to 120 Hz, sine coded pulse width modulation (PWM)	
Output phases	3	
Switching frequency	Adjustable from 4 kHz, 6 kHz, 8 kHz, 10 kHz. Refer to “02—Carrier Frequency” on pages 48 to 49 for deration if carrier frequency is ≥ 6 kHz.	
Service factor	1.00	
Efficiency	98%	
Power factor (displacement)	0.96	
Max. transient current	150% of nominal drive controller current for 60 s 180% of nominal drive controller current for 32 s Determined by line voltage setting.	
Speed reference follower	0–10 Vdc, 4–20 mA	
Control voltage	5 logic inputs (TB1, TB12, TB-13A, TB-13B & TB-13C), 15 Vdc	
Power supply for auxiliary relays	50 mA at 12 Vdc	
Analog outputs	0–10 Vdc or 2–10 Vdc Proportional to frequency or motor load. See page 23.	
Digital outputs	Open-collector outputs: 50 mA at 30 Vdc	
Motor protection	Protection integrated in the drive controller by I^2t calculation, Class 10. See page 33.	

DIMENSIONS

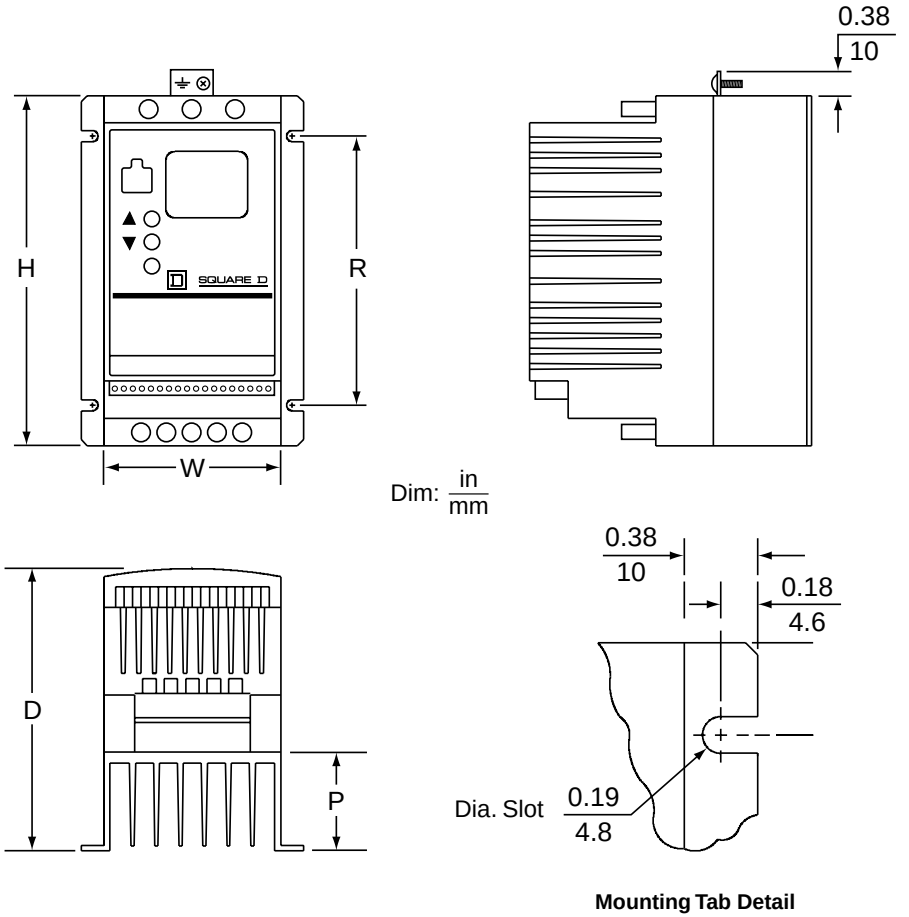


Figure 1: VSD07 Adjustable Speed Drive Controller Dimensions

Table 3: Drive Controller Dimensions

HP	V (Input)	Model	H	W	D	P	R
			in (mm)				
0.25	120/208/240	VSD07U07P10	5.75 (146)	2.88 (73)	3.76 (96)	0.80 (20)	4.37 (111)
	208/240	VSD07U07P20					
0.5	120/208/240	VSD07U09P10	5.75 (146)	2.88 (73)	3.76 (96)	0.80 (20)	4.37 (111)
	208/240	VSD07U09P20					
	400/480	VSD07U09N40					
1	120/208/240	VSD07U18P10	5.75 (146)	3.76 (96)	5.24 (133)	1.90 (48)	4.37 (111)
	208/240	VSD07U18P20	5.75 (146)	2.88 (73)	4.56 (116)	1.60 (41)	4.37 (111)
	208/240	VSD07U18M20					
	400/480	VSD07U18N40					
	590	VSD07U18S60					
1.5	208/240	VSD07U25M20	5.75 (146)	2.88 (73)	5.56 (141)	2.60 (66)	4.37 (111)
	400/408	VSD07U25N40					
2	208/240	VSD07U29M20	5.75 (146)	2.88 (73)	5.56 (141)	2.60 (66)	3.06 (78)
	400/408	VSD07U29N40					
	590	VSD07U29S60					
3	208/240	VSD07U41M20	5.75 (146)	2.88 (73)	5.56 (141)	2.60 (66)	3.06 (78)
	400/480	VSD07U41N40					
	590	VSD07U41S60					
5	590	VSD07U72S60	5.75 (146)	3.76 (96)	6.74 (171)	3.40 (86)	3.25 (83)

INSTALLATION

Installation Precautions

- The VSD07 drive controller is an open device and must be installed in a suitable enclosure. The environment around the drive controller must not exceed pollution degree 2 requirements as defined in NEMA ICS-1 Annex A, IEC 664, or UL 840.
- Figure 2 shows the minimum clearances required around the drive controller for unobstructed airflow; above and below: ≥ 2 in (50 mm), sides: ≥ 1 in (25 mm). These clearances should not be used as a minimum enclosure size.
- Mount the drive controller vertically.
- Avoid placing the drive controller near any heat sources.
- Verify that the voltage and frequency characteristics of the input line match the drive controller nameplate rating.
- Drive controllers with dual input voltage ratings must be programmed for the proper supply voltage (see Parameter 01—Line Voltage Selection in “Description of Parameters” on page 48).
- Install a disconnecting means between the input line and drive controller. Follow national and local codes.
- Fused overcurrent protection is required on the input line. Use Class CC fuses per Table 1 on page 3.
- Turn off all power before installing the drive controller. Place a “DO NOT TURN ON” label on the drive controller disconnect. Before proceeding with installation, lock the disconnect in the open position.
- Verify that the motor rating matches the output rating of the drive controller.
- For 600 V systems, if no line reactor is installed or if power factor correction is used, contact the Drives Product Support Group at (919) 217-6535.

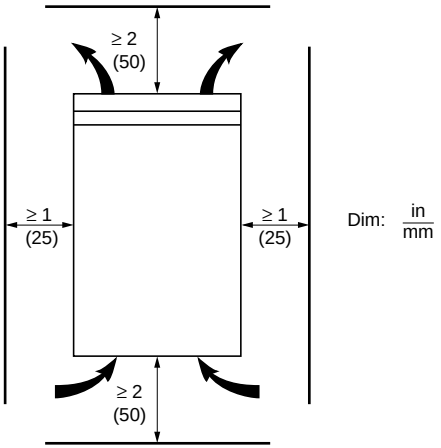


Figure 2: Clearances and Ventilation

Sizing and Ventilation of NEMA Type 12 (IP54) Metal Enclosure

Calculating Enclosure Size

To calculate the maximum allowable thermal resistance of the enclosure, Rth (°C/W):

$$Rth = \frac{T_i - T_o}{P}$$

T_i = Max. internal ambient temp. (°C) around drive controller

T_o = Max. external ambient temp. (°C) around enclosure

P = Total power dissipated in enclosure (W) (see Table 1 on pages 3–4)

NOTE: Deration is required for carrier frequency≥ 6 kHz. See page 49.

Useful heat exchange surface area, S (in^2), of a wall-mounted enclosure consists of the sides, top, and front. To calculate minimum surface area required for the enclosure:

$$S = \frac{K}{Rth}$$

Rth = Thermal resistance of the enclosure (calculated previously)
K = Thermal resistance per square inch of the enclosure
K = 186 with enclosure fan
K = 233 without enclosure fan

When sizing the enclosure:

- Use only metallic enclosures which have good thermal conduction.
- This calculation does not consider any external heat sources. Do not install enclosures where external heat sources (such as direct sunlight) can add to enclosure heat load.
- If additional devices are inside the enclosure, include the heat load of the devices in the calculation.
- The useful area for convection cooling of the enclosure varies depending upon the method of mounting. You must allow for free air movement over all surfaces considered for convection cooling.

Example calculation of the enclosure size for a VSD07U18M20 drive controller mounted in a Type 12 enclosure:

- Maximum external temperature: T_o = 25 °C
- Power dissipated inside enclosure: P = 43 W
- Maximum internal temperature: T_i = 50 °C for carrier frequency ≥ 6 kHz
- Thermal resistance per square inch of enclosure: K = 186

Maximum allowable thermal resistance, Rth:

$$Rth = \frac{50\ °C - 25\ °C}{43\ W} = 0.58\ °C/W$$

Minimum useful heat exchange surface area, S:

$$S = \frac{186}{0.58} = 320 \text{ in}^2$$

Useful heat exchange surface area (S) of the proposed wall-mounted enclosure:

- Height: 9 in
- Width: 6 in
- Depth: 10 in

front area top area side area

$$S = (9 \times 6) + (9 \times 10) + 2(9 \times 10) = 324 \text{ in}^2$$

The enclosure must provide the required surface area and must also meet your application needs. If it does not, you must do one of the following:

- Use a larger enclosure.
- Add a passive heat exchanger to the enclosure.
- Add an air conditioning unit to the enclosure.

Ventilation

When mounting the drive controller inside a Type 12 or IP54 enclosure:

- Observe minimum clearance distances shown in Figure 2 on page 9.
- Follow the “Installation Precautions” on page 8.
- If necessary, install a stirring fan to circulate the air inside the enclosure and to distribute the heat uniformly.

If there is a possibility of condensation, keep the control supply switched on during periods when the motor is not running or install thermostatically controlled strip heaters.

GENERAL WIRING PRACTICES

Power wiring to the motor must have the maximum possible separation from all other power wiring, whether from the same drive controller or other drive controllers; **do not run power and control wiring in the same conduit**. This separation reduces the possibility of coupling electrical transients from power circuits into control circuits, or from motor power wiring into other power circuits.

⚠ CAUTION

EQUIPMENT DAMAGE HAZARD

Follow wiring practices described in this document in addition to those already required by the applicable electrical codes.

Failure to follow this instruction can result in injury or equipment damage.

When wiring VSD07 drive controllers:

- Use metallic conduit for all drive controller wiring. Do not run control and power wiring in the same conduit.
- Separate metallic conduits carrying power wiring or low-level control wiring by at least 3 in (7.62 cm).
- Separate non-metallic conduits or cable trays used to carry power wiring from metallic conduit carrying low-level control wiring by at least 12 in (30.5 cm).
- Whenever power and control wiring cross, the metallic conduits and non-metallic conduits or trays must cross at right angles.
- **Wire and ground in accordance with the National Electrical Code (NEC) or Canadian Electrical Code (CEC), and all applicable local codes.**
- Do not install contactors between the drive controller and the motor as this may result in drive controller damage.
- Use only UL Listed and CSA Certified wire.

- Minimum wire voltage ratings: 300 V for 120, 208, and 240 Vac systems, and 600 V for 400, 480, and 590 Vac systems.
- Use copper wire with a minimum of 75 ˚C insulation rating.
- Strip off 0.20 to 0.25 in (5.1 to 6.4 mm) of insulation for input power, output power, and DC Bus wiring.

Branch Circuit Connections

All branch circuit components and equipment (such as transformers, feeder cables, disconnect devices, and protective devices) must be rated for the maximum input current of the VSD07 drive controller, not the motor full load current. The drive controller input current is stamped on the nameplate.

⚠ WARNING

OVERCURRENT PROTECTIVE DEVICES MUST BE PROPERLY COORDINATED

- To achieve published fault withstand current ratings, install the specified fuses.
- Do not connect drive controller to power feeder whose short circuit capacity exceeds drive controller withstand fault rating. See Table 1 on page 3.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Output Wiring Precautions

⚠ WARNING

DRIVE CONTROLLER DAMAGE

Drive controller will be damaged if input line voltage is applied to output terminals (T1, T2, T3). Check power connections before energizing drive controller.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

The drive controller is sensitive to the amount of capacitance (either phase-to-phase or phase-to-ground) present on the output power conductors. If excessive capacitance is present, the drive controller may trip on overcurrent.

Follow the guidelines below when selecting output power cable:

- Cable type: the cable selected must have a low capacitance phase-to-phase and to ground. Do not use mineral-impregnated cable because it has a very high capacitance. Immersion of cables in water increases capacitance.
- Cable length: the longer the cable, the greater the capacitance. Maximum recommended cable length: 100 ft (30.5 mm). A minimum inductance is required to protect the drive controller output from short circuits. Provide at least 24 in (61 cm) of cable at drive controller output (T1, T2, T3).
- Proximity to other output cables: because of the high frequency switching and increased capacitance, the drive controller may fault under some conditions.
- Do not use lightning arrestors or power factor correction capacitors on the output of the drive controller.
- All three power output wires, from terminals T1, T2, and T3 to the motor, must be kept tightly bundled and run in a separate metallic conduit away from all other power and control wiring.

⚠ CAUTION

DRIVE CONTROLLER SWITCH FAILURE

For proper electronic short circuit protection of the drive controller, certain values of inductance may be required in the output power wiring. Inductance can be supplied by the power wiring or auxiliary inductors.

Failure to follow this instruction can result in equipment damage.

Grounding

Ground the drive controller according to these instructions and to applicable electrical codes. To ground the drive controller:

- Connect a copper wire from the equipment ground terminal to the power system ground conductor. Wire size is determined by the drive controller size and by electrical codes.
- Verify that resistance to ground is 1 Ω or less. Improper grounding causes intermittent and unreliable operation.

⚠ DANGER

HAZARDOUS VOLTAGE

- Properly ground the drive controller panel before applying power.
- Do not use metallic conduits as a ground conductor.

Failure to follow these instructions will result in death, serious injury, or equipment damage.

Ground multiple drive controllers as shown in Figure 3. Do not loop or series the ground cables.

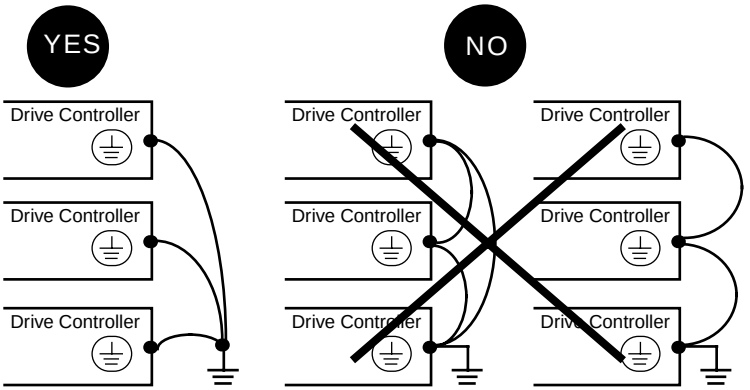


Figure 3: Grounding Multiple Drive Controllers

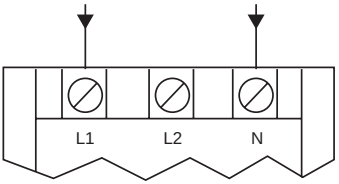
Wiring for Single-Phase or Three-Phase Input

For 120 Vac, wire the input to terminals L1 and N. For 208/240 Vac, wire the input to terminals L1 and L2. See Figures 4 and 5 on page 17.

If the drive controller is rated for single- and three-phase input, wire to terminals L1 and L2 for single-phase input, or wire to terminals L1, L2, and L3 for three-phase input.

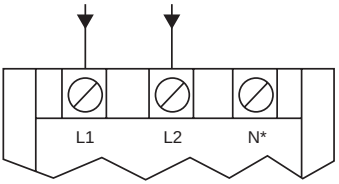
If the drive controller is rated for three-phase input, wire the input to terminals L1, L2, and L3. Refer to Figure 6.

POWER WIRING DIAGRAMS



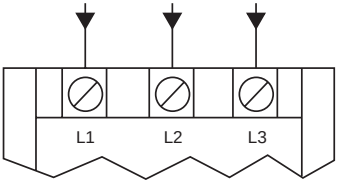
VSD07••P10 Models

Figure 4: 120 VAC Single-Phase Input Power Wiring Diagram



VSD07••P10, VSD07••P20 Models
*On VSD07••P20 models, this terminal is labeled L3.
NOTE: Do not connect 240 V to "N".

Figure 5: 208/240 VAC Single-Phase Input Power Wiring Diagram



VSD07••M20, VSD07••P20,
VSD07••N40, and
VSD07••S60 Models

Figure 6: Three-Phase Input Power Wiring Diagram

⚠ WARNING

DRIVE CONTROLLER DAMAGE

Drive controller will be damaged if input line voltage is applied to output terminals (T1, T2, T3). Check power connections before energizing drive controller.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

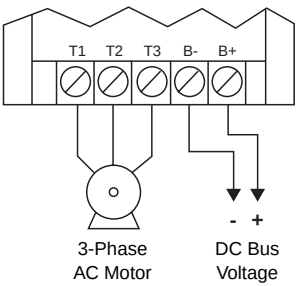


Figure 7: Output Power Wiring Diagram (all models)

Table 4: Wire Size and Torque for Power Terminals

VSD07	Maximum Wire Size [1, 2]	Torque
All Models	12 AWG	4.0–4.5 lb-in (0.45–0.5 N•m)

[1] 75 °C copper.

[2] Minimum strand size: 26 AWG.

Equipment Ground Terminal

The equipment ground connection is made by a #8-32 screw terminal mounted to the heat sink.

Using a Line Contactor

When controlling the power with an isolation line contactor, limit operations of the contactor to less than once every two minutes. Failure to follow this recommendation may cause premature failure of the filtering capacitors and precharge circuit components. Use logic inputs to start and stop the drive controller.

CONTROL WIRING

Control Wiring vs. Power Wiring

Run external control wiring in a separate conduit away from all other input and output power wiring. Failure to do this can result in electrical noise on the control wiring, causing erratic drive controller behavior. Use twisted wires or shielded cable grounded at the drive controller chassis ONLY. Recommended control wire is Belden 8760 (2-wire) or 8770 (3-wire), or equivalent.

Strip off 0.20 to 0.25 in (5.1 to 6.4 mm) of insulation for control wiring.

Maximum wire size for all control terminals is 16 AWG. Tightening torque is 0.2 lb-in (0.23 kg cm).

TB-2: Circuit Common

The TB-2 terminals are used as circuit common for analog input and analog output functions. There are two TB-2 terminals, which are internally connected on the main control board. If necessary, TB-2 may be connected to chassis ground.

NOTE: Connect TB-2 to chassis ground when using serial communications.

TB-4: P 15 Vdc

This terminal is used to provide voltage to the external logic input signals (TB-1, TB-12, TB-13A, TB-13B, and TB-13C). Do not use this terminal to power any other external circuits or loads.

Surge Suppression

Current and voltage surges and spikes in the coils of contactors, relays, and solenoids, near or connected to the drive controller cause erratic drive controller operation. Use a snubber circuit on relay and contactor coils associated with the inverter.

- For AC loads, snubbers consist of a resistor and a capacitor in series across the coil.
- For DC loads, place a free-wheeling or flyback diode across the coil.

Surge suppression devices are available. See the Square D Digest.

Start/Stop Control

There are various control schemes that allow for 2-wire and 3-wire Start/Stop circuits. See “Control Wiring Diagrams” on page 25.

Speed Reference Signals

The drive controller allows for three analog speed reference inputs:

1. Speed Potentiometer: Connect the wiper lead of a 2.5–10 kΩ potentiometer to terminal TB-5, and connect the high and low end leads to terminals TB-6 and TB-2, respectively.

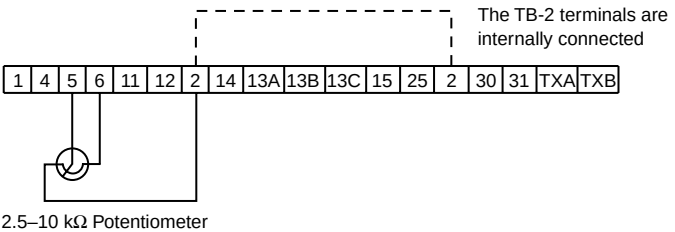


Figure 8: Speed Potentiometer Connection

2. 0–10 Vdc: Wire the positive to terminal TB-5 and the negative to terminal TB-2. TB-5 input impedance is 120 kΩ.

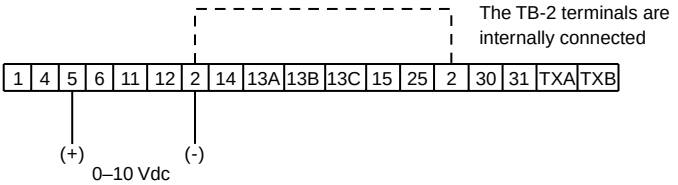


Figure 9: 0–10 VDC Connection

3. 4–20 mA: Wire the positive to terminal TB-25 and the negative to terminal TB-2. TB-25 input impedance is 100 Ω.

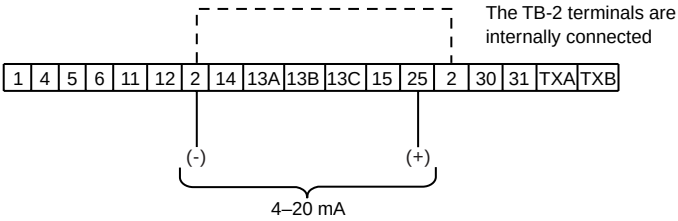


Figure 10: 4–20 mA Connection

Speed Reference Selection

If you use the analog speed reference input to control the drive controller speed, terminal TB-13A, 13B, or 13C (Parameter 10, 11, or 12) are programmed to select the source for the desired analog input signal. When the TB-13 terminal is connected to TB-4, the drive controller follows the selected analog speed reference input.

If an analog speed reference input is not selected on the terminal strip using TB-13A, 13B, or 13C, speed control defaults to standard mode, which is determined by the setting of Parameter 05—Standard Speed Source. In this mode, the sources of speed control are the ▲ (increase) and ▼ (decrease) buttons on the front of the drive controller (factory default). Speed control can be reassigned to Preset Speed 1 (Parameter 31), a 0–10 Vdc signal, or a 4–20 mA signal.

0–10 Vdc and 4–20 mA Input Signals

TB-13A, TB-13B, and TB-13C can be programmed to select a 0–10 Vdc or 4–20 mA analog speed reference input.

Preset Speeds

TB-13A can be programmed to select Preset Speed 1, TB-13B to select Preset Speed 2, and TB-13C to select Preset Speed 3. There are seven preset speeds, which are activated by different combinations of contact closures between TB-13A, 13B, 13C, and TB-4. See Parameters 31–37 on page 65.

Jog

TB-13B can be set to Jog Forward or Jog Reverse. The Jog speed is set by Preset Speed 2. Close TB-13B to TB-4 to Jog, and open the contact to Stop.

⚠ WARNING

LOSS OF CONTROL

When operating in Jog mode, the local or remote Stop command does not stop the drive controller. To stop the drive controller, open the contact between TB-13B and TB-4.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

NOTE: If the drive controller is commanded to jog while running, the drive controller enters Jog mode and runs at PRESET SPEED 2. When the Jog command is removed, the drive controller stops.

Motor Operated Potentiometer (MOP) / (Floating Point Control) +/- Speed

TB-13B and TB-13C are used for this function, which controls the drive controller speed using contacts wired to the terminal strip. Program TB-13B for Decrease Freq., and program TB-13C for Increase Freq. Closing TB-13B to TB-4 activates the Decrease Freq. function, and causes the speed setpoint to decrease until the contact is opened. Closing TB-13C to TB-4 activates the Increase Freq. function, and causes the speed setpoint to increase until the contact is opened. The Increase Freq. function only operates while the drive controller is running.

NOTE: If TB-13A, TB-13B, and TB-13C are all programmed to select speed references, and two or three of the terminals are closed to TB-4, the higher terminal has priority and will override the others. For example, if TB-13A is programmed to select 0–10 Vdc, and TB-13C is programmed to select Preset Speed 3, closing both terminals to TB-4 causes the drive controller to respond to Preset Speed 3, because TB-13C overrides TB-13A.

Analog Output Signals

Terminal TB-30 provides a 0–10 Vdc or a 2–10 Vdc signal proportional to output frequency or motor load. TB-31 provides the same signals proportional to load only. The 2–10 Vdc signal is converted to a 4–20 mA signal using a resistor in series with the signal such that the total load resistance is 500 Ω. Refer to Parameters 08 and 09 on page 53.

NOTE: These analog output signals cannot be used with "loop-powered" devices that derive power from the 4–20 mA signal.

Drive Controller Status Digital Outputs

There are two open-collector outputs at terminals TB-14 and TB-15. The open-collector circuits are current-sinking types, rated at 30 Vdc and 50 mA maximum.

The open-collector outputs are programmed to indicate any of the following: Run, Fault, Inverse Fault, Fault Lockout, At Set Speed, Above Preset Speed 3, Current Limit, Auto Speed Mode, and Reverse. See Parameter 06 on page 52 and Parameter 13 on page 57.

Figure 11 illustrates how the 12 Vdc power supply at TB-11 is used with the open-collector output to operate an external relay:

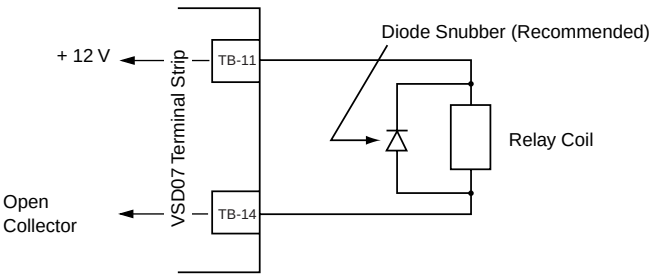


Figure 11: Connecting an External Relay

CONTROL WIRING DIAGRAMS

Terminal Strip

⚠ WARNING

LOSS OF CONTROL

When operating in Jog mode, the local or remote Stop command does not stop the drive controller. To stop the drive controller, open the contact between TB-13B and TB-4.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

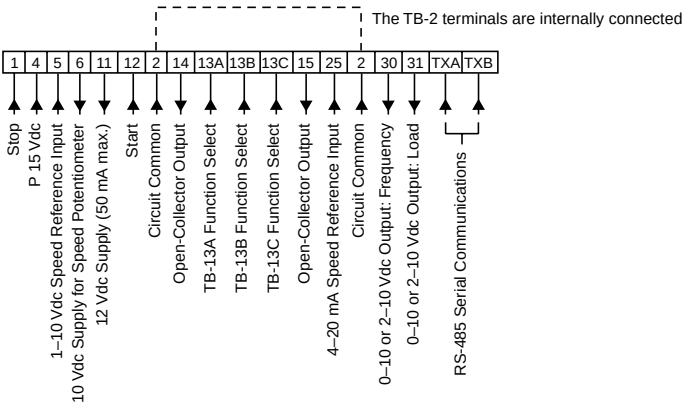


Figure 12: Control Terminal Strip

NOTE: The function of terminals TB-13A, TB-13B, TB-13C, TB-14, TB-15, TB-30, and TB-31 are dependent on the programming of certain parameters. Refer to "Description of Parameters" on page 48. Factory Default: 13A, 13B, and 13C set to "none" (01).

For additional information on operating the drive controller from the terminal strip, see "Control Wiring" on page 19. Refer to Figures 13, 14, 15, and 16 for the most common wiring configurations.

Two-Wire Start/Stop Control

Figure 13 shows how to wire one maintained contact for Run and Stop commands.

⚠ WARNING

LOSS OF CONTROL

When operating in Jog mode, the local or remote Stop command does not stop the drive controller. To stop the drive controller, open the contact between TB-13B and TB-4.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

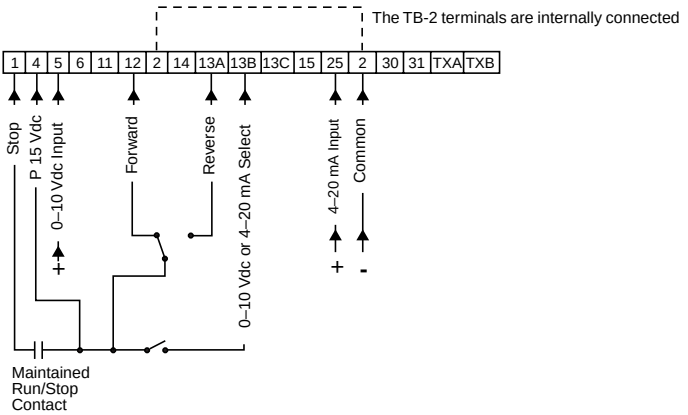


Figure 13: Two-Wire Start/Stop Control

Two-Wire Start/Stop Control Notes (refer to Figure 13 on page 26):

1. Close TB-1 to TB-4 to RUN, and open TB-1 to TB-4 to STOP.
2. If reverse direction is required, set Rotation Direction (Parameter 17) to Forward and Reverse, and set TB-13A (Parameter 10) to Start Reverse. If reverse direction is not required, wire TB-12 directly to TB-4.
3. For 0–10 Vdc or 4–20 mA speed control:
    a. Program Parameter 05—Standard Speed Source for 0–10 Vdc or 4–20 mA. This method is preferable if only one speed source is required because the TB-13 terminals can be used for other functions.

    or

    b. Program one TB-13 terminal (13A, 13B, or 13C) for 0–10 Vdc or 4–20 mA. When that terminal is closed to TB-4, the drive controller responds to the selected speed reference signal. If that terminal is not closed to TB-4, the drive controller responds to the speed control source selected in Parameter 05—Standard Speed Source. This method is used to toggle between two speed sources.

Alternate Two-Wire Start/Stop Control

Figure 14 is an alternate two-wire start/stop control diagram. One maintained contact is used for Run Forward and another maintained contact is used for Run Reverse.

⚠ WARNING

LOSS OF CONTROL

When operating in Jog mode, the local or remote Stop command does not stop the drive controller. To stop the drive controller, open the contact between TB-13B and TB-4.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

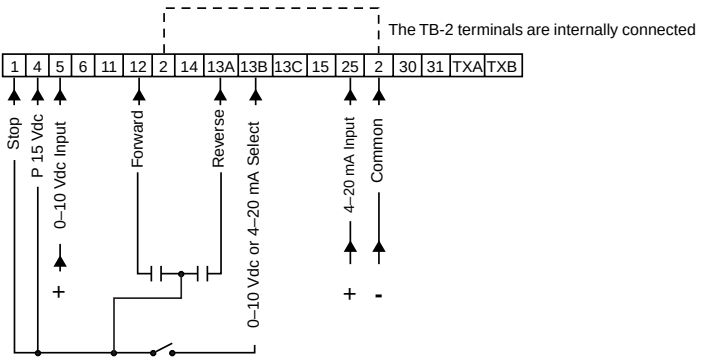


Figure 14: Alternate Two-Wire Start/Stop Control

Alternate Two-Wire Start/Stop Control Notes (refer to Figure 14 on page 28):

1. Close TB-12 to TB-4 to RUN, and open TB-12 to TB-4 to STOP.
2. For this control scheme, set TB-13A to Run Reverse. Refer to Parameter 10—TB13A Function.
3. If reverse direction is required, set Rotation Direction (Parameter 17) to Forward and Reverse. Close TB-13A to TB-2 to Run in Reverse, and open TB-13A to TB-4 to Stop. If both TB-12 and TB-13A are closed to TB-4, the drive controller stops.
4. For 0–10 Vdc or 4–20 mA speed control:
   a. Program Parameter 05—Standard Speed Source for 0–10 Vdc or 4–20 mA. This method is preferable if only one speed source is required because the TB-13 terminals can be used for other functions.

      or

   b. Program one TB-13 terminal (13A, 13B, or 13C) for 0–10 Vdc or 4–20 mA. When that terminal is closed to TB-4, the drive controller responds to the selected speed reference signal. If that terminal is not closed to TB-4, the drive controller responds to the speed control source selected in Parameter 05—Standard Speed Source. This method is used to toggle between two speed sources.

Three-Wire Start/Stop Control

Figure 15 is a typical three-wire start/stop control diagram. Momentary contacts (such as pushbuttons) are used for Start and Stop commands.

⚠ WARNING

LOSS OF CONTROL

When operating in Jog mode, the local or remote Stop command does not stop the drive controller. To stop the drive controller, open the contact between TB-13B and TB-4.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

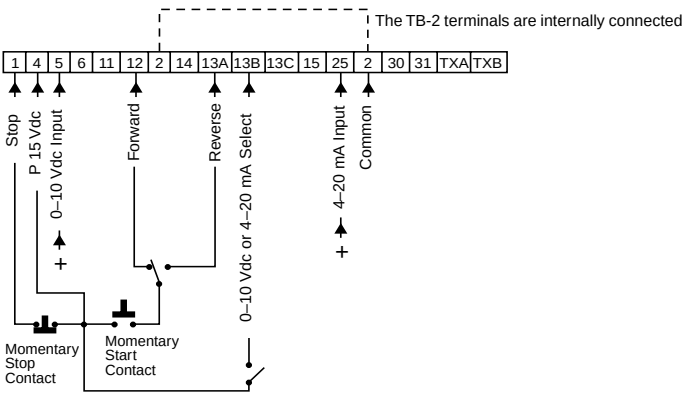


Figure 15: Three-Wire Start/Stop Control

Three-Wire Start/Stop Control Notes (refer to Figure 15 on page 30):

1. Momentarily close TB-12 to TB-4 to start the drive controller, and momentarily open TB-1 to TB-4 to stop the drive controller.
2. If reverse direction is required, set Rotation Direction (Parameter 17) to Forward and Reverse, and set TB-13A (Parameter 10) to Start Reverse. If the Fwd/Rev switch is changed while the drive controller is running, the drive controller does not change direction until the Start button is pushed. If reverse direction is not required, the Start pushbutton must be wired directly to TB-12 and TB-4.
3. For 0–10 Vdc or 4–20 mA speed control, use one of the following methods:
   a. Program Parameter 05—Standard Speed Source for 0–10 Vdc or 4–20 mA. This method is preferable if only one speed source is required because the TB-13 terminals can be used for other functions.

      or

   b. Program one TB-13 terminal (13A, 13B, or 13C) for 0–10 Vdc or 4–20 mA. When that terminal is closed to TB-4, the drive controller responds to the selected speed reference signal. If that terminal is not closed to TB-4, the drive controller responds to the speed control source selected in Parameter 05—Standard Speed Source. This method is used to toggle between two speed sources.

Speed Potentiometer and Preset Speed Control

Figure 16 shows how to wire a speed potentiometer and/or Preset Speed control for either a two-wire or three-wire start/stop circuit.

⚠ WARNING

LOSS OF CONTROL

When operating in Jog mode, the local or remote Stop command does not stop the drive controller. To stop the drive controller, open the contact between TB-13B and TB-4.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

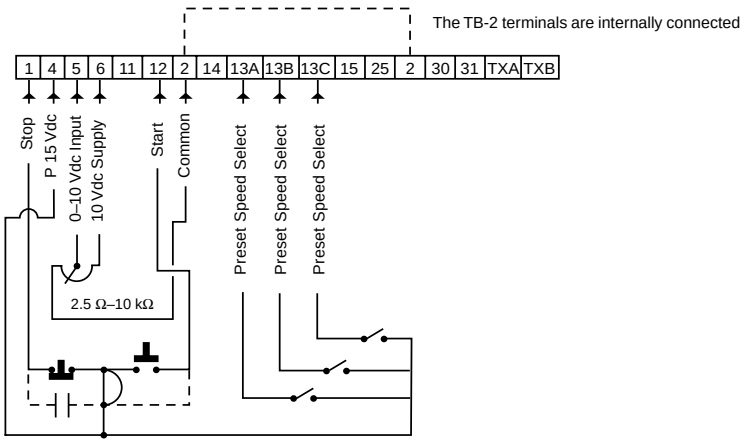


Figure 16: Speed Potentiometer and Preset Speed Control

Speed Potentiometer and Preset Speed Control Notes (refer to Figure 16 on page 32):

1. Program the Preset Speeds (Parameters 31–37) to the desired values.
2. Program TB-13A, TB-13B, and TB-13C (refer to Parameters 10, 11, and 12). To select a preset speed, close the appropriate TB-13 terminal(s) to TB-4. See preset speed table on page 66.
3. If reverse rotation is also required, TB-13A cannot be used as a Preset Speed Select. Program the TB-13A to select Run Reverse or Start Reverse. Use TB-13B and TB-13C to select preset speeds.
4. For speed potentiometer control, program Parameter 05—Standard Speed Source for 0–10 Vdc. If none of the preset speeds are selected (all of the TB-13 terminals are open), the drive controller responds to the speed potentiometer.

MOTOR THERMAL OVERLOAD PROTECTION

The VSD07 drive controller provides indirect motor thermal protection by continuously calculating the I^2t of the motor based on the setting of the parameter.

This calculation establishes thermal protection of the motor and drive controller for normal conditions of ambient temperature.

Typical trip values are:

- Motor current = 180% of nominal drive controller current for 32 s.
- Motor current = 150% of nominal drive controller current for 60 s.

If the motor current ≤ 110% of the nominal drive controller current, the drive controller will not trip.

Equivalent to Class 10 overloads.

The thermal state of the drive controller is automatically reset when power is removed.

⚠ CAUTION

LOSS OF MOTOR OVERLOAD PROTECTION

When external overload relays are connected to the drive controller output, the overload relay must be capable of operation over the expected range of drive controller output frequencies (including direct current).

When DC injection braking is used:

- The overload relay must be capable of operation with direct current flowing in the motor.
- Do not use overload relays equipped with current transformers for sensing the motor current.

MOTOR OVERHEATING

This drive controller does not provide direct thermal protection for the motor. A thermal sensor in the motor may be required for protection at all speeds and loading conditions. Consult motor manufacturer for thermal capability of motor when operated over desired speed range.

If drive trips on overload fault, allow sufficient time for the motor to cool prior to restarting.

Failure to follow these instructions can result in injury or equipment damage.

AVAILABLE TORQUE

Continuous duty:

- For self-ventilated motors, motor cooling depends on the speed.
- Continuous duty results in motor derating for speeds less than 50% of the nameplate motor speed.

Operation in overspeed:

- In overspeed operation, the voltage no longer increases with the frequency, resulting in reduced induction in the motor and loss of torque. Consult the motor manufacturer to ensure that the motor operates in overspeed.
- For a special motor, the base frequency (Parameter 27) can be adjusted between 30 and 129 Hz and the maximum frequency (Parameter 24) can be adjusted between minimum frequency and 120 Hz.

⚠ CAUTION

MACHINERY OVERSPEED

Some motors and/or loads are not suited for operation above nameplate motor speed and frequency. Consult motor manufacturer before operating motor above rated speed.

Failure to follow this instruction can result in injury or equipment damage.

INITIAL POWER UP AND MOTOR ROTATION

⚠ DANGER

HAZARDOUS VOLTAGE

- Before attempting to operate the drive controller, motor, and driven equipment, ensure that all procedures pertaining to installation and wiring have been properly followed. See “General Wiring Practices” on page 12.
- Disconnect all power before servicing the drive controller. WAIT THREE MINUTES until DC bus capacitors discharge, then measure DC bus capacitor voltage as described on page 89 to verify that DC voltage is less than 45 V. The display is not an accurate indication of the absence of DC bus voltage.
- DO NOT short across the DC bus capacitors or touch terminal strip screw connections with voltage present.
- No serviceable components are inside. DO NOT remove cover.
- User is responsible for conforming to all applicable code requirements with respect to grounding all equipment.
- Use only electrically insulated tools.

If the drive controller must be replaced:

- Disconnect all power.
- Place a “DO NOT TURN ON” label on drive controller disconnect.
- Lock disconnect in open position.

Electrical shock will result in death or serious injury.

⚠ WARNING

DRIVE CONTROLLER DAMAGE

- Drive controller will be damaged if input line voltage is applied to output terminals (T1, T2, T3). Check power connections before energizing the drive controller.
- Do not continuously cycle input power to the drive controller more than once every two minutes. Damage to the drive controller will occur.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: Before applying power, ensure that the EPM module is present and properly seated. See Figure 17 for the location of the EPM module.

Figure 17: EPM Module

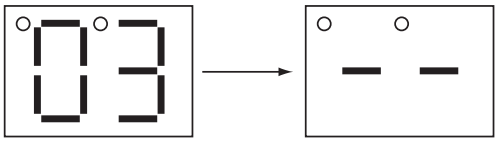
To power up the drive controller:

1. Disconnect the driven load from the motor. Verify that the drive controller input terminals (L1, L2, and L3) are wired to the proper input voltage per the nameplate rating of the drive controller.
2. Energize the incoming power line. The LED display flashes a two digit number ("03" in the example below) that identifies the parameter set contained in the drive controller. The display then indicates "- -". The drive controller is now disabled as shown below:

Apply input power.

Display flashes parameter set value (00-99).

Display then indicates "--".



Review all parameters to ensure that they are applicable to a given drive controller application. However, the following four key parameters must be checked and adjusted, if necessary, prior to motor operation:

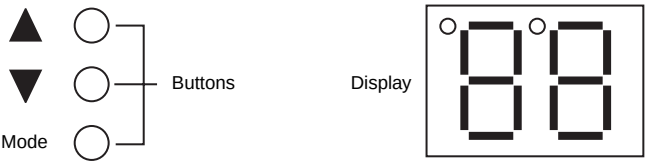
- Line Voltage
- Motor Overload
- Control Type
- Rotation

PROGRAMMING THE DRIVE CONTROLLER

The drive controller is programmed by one of three methods:

1. Using the three buttons and 2-digit LED display on the front of the drive controller.
2. Programming the Electronic Programming Module (EPM) using the optional Portable Programming Fixture.
3. Using serial communications through a serial link.

This section describes programming the drive controller using the buttons and display, which are shown below:



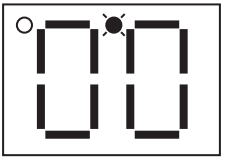
Entering the Password

To access the parameters, enter the Program mode by pressing the Mode button. This activates the Password prompt. The display reads "00" and the right-hand decimal point blinks, as shown below:

Press Mode.

Display indicates "00".

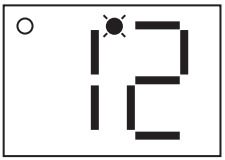
Right decimal point blinks.



Next enter the four-digit password. Since the display is only two digits, this requires two steps.

Press ▲ to scroll to the first 2 digits of password value. Default password is 1225.

Press Mode to enter first two digits.

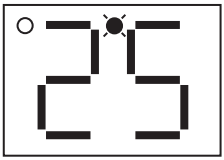


Once the Mode button is pressed, the display changes to "00" and the right-hand decimal point blinks more rapidly. This indicates that the last two digits of the password must now be entered.

Right decimal point blinks faster.

Press ▲ to scroll to last 2 digits of password value.

Press Mode to enter first two digits.



When the Mode button is pressed, the right-hand decimal point stays on instead of blinking, and "0 1" is displayed. This indicates that the Program mode is accessed at the beginning of the parameter menu (01 is the first parameter). If the display flashes "Er", the password was incorrect. Repeat the process to enter the password.

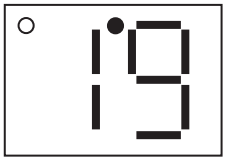
The password is stored in Parameter 44. You must change this parameter to change the password. See "44—Password" on page 67. When you have changed the password, be sure to record and keep track of the password.

Setting the Parameters

Once the Program mode is accessed, use the ▲ and ▼ buttons to scroll to the desired parameter number.

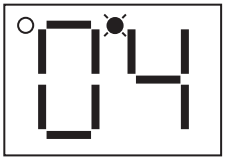
Right decimal point stays on instead of blinking.

Use ▲ and ▼ to scroll to the desired parameter number (i.e., 19—Acceleration Time).



Press Mode to display the parameter setting, a 2-digit code (see Table 6 on page 72).

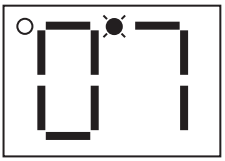
Right decimal point blinks.



Use the ▲ and ▼ buttons to scroll to a new value.

Use ▲ and ▼ to scroll to the new parameter value from the table.

Press Mode to store new value.



Press the Mode button to store the new setting and exit the Program mode. To re-enter the Program mode, press the Mode button again within two minutes, otherwise you must re-enter the password.

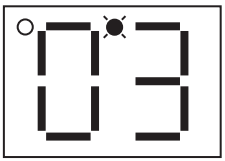
Programming Direct-Entry Parameters

Most of the parameters are programmed by entering the codes defined in Appendix A. The Minimum Frequency, Preset Speeds, and the Password (Parameters 23, 31–37, 44), however, are programmed by directly entering the value. The procedure is similar to entering the Password. The parameter value is four digits, but the display is two digits, so the value must be entered in two parts.

For example, to enter a preset speed of 32.5 Hz, first enter "03", then "25". In the display below, the Mode button has already been pressed to display the first two digits of the present setting, and the right-hand decimal point is blinking:

Use ▲ and ▼ to scroll to the first 2 digits of the new parameter value.

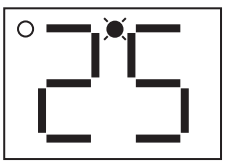
Press Mode to store the first two digits.



Once the Mode button is pressed to store the first two digits of the new parameter value, the right-hand decimal point will blink more rapidly. This indicates that the last two digits of the new parameter value must now be entered.

Use ▲ and ▼ to scroll to the last 2 digits of the new parameter value.

Press Mode to store the last two digits.



Electronic Programming Module (EPM)

Every VSD07 drive controller has an Electronic Programming Module (EPM). The EPM stores the user's parameter settings and special OEM default settings (if programmed). The EPM can be installed in another drive controller for quick set-up. For example, if a drive controller is replaced with a new one, the EPM can be taken out of the first drive controller and installed in the new drive controller. Downtime is minimized because the new drive controller doesn't require programming—it is ready to run when the EPM is installed.

- Do not remove or install the EPM while power is applied to drive controller. After removing the power from drive controller, wait three minutes before removing the EPM.

The VSD07 drive controller contains two or three sets of parameter values, depending on whether the drive controller is programmed with optional OEM default settings.

1. The factory default settings are permanently stored on the main control board and cannot be changed.
2. The user settings are stored in the EPM. When the drive controller is shipped from the factory, the user settings are the same as the factory default settings. The user settings can be changed to configure the drive controller for a particular application.
3. The optional OEM default settings are also stored in the EPM. OEM default settings are typically used in cases where many drive controllers are used for the same application, which requires that all of the drive controllers have the same parameter settings. The OEM default settings cannot be changed without the optional Portable Programming Fixture. The drive controller is programmed to operate according to the user settings or the OEM default settings. Refer to Parameter 48 on page 67.

NOTE: The drive controller will not operate without the EPM. The drive controller displays "F 1" if the EPM is missing or damaged.

A Portable Programming Fixture is an optional accessory. It can quickly and easily program many VSD07 Series drive controllers for the same configuration. Once a "master" EPM is programmed, the fixture is used to copy those settings to other EPMs.

If the OEM settings in the EPM become corrupted, the drive controller operates normally, until an attempt is made to perform a Reset OEM using Parameter 48—Program Selection. The drive controller will flash "CF" to indicate that the OEM settings are no longer valid. This requires that the EPM be re-programmed using the Portable Programming Fixture.

If the OEM settings and the user settings are both corrupted, the drive controller displays "CF" immediately and the drive controller requires a RESET 60 or RESET 50 using Parameter 48—Program Selection. Once the Reset is performed, the parameters are programmed individually to match the OEM default settings. This allows the drive controller to operate as if it were in OEM mode, even though it is actually operating in User mode. Refer to Parameter 48 on page 67.

NOTE: The drive controller also displays "CF" if a Reset OEM or Operate With OEM Settings is attempted when the drive controller is not equipped with the OEM default option.

PARAMETER MENU

Table 5: Parameter Menu

Parameter No.	Parameter Name	Range of Adjustment [1], [2]	Factory Default [1], [2]	See Page
01	Line Voltage	High (01), Low (02)	High (01)	48
02	Carrier Frequency	4 kHz (01), 6 kHz (02), 8 kHz (03), 10 kHz (04)	6 kHz (02)	48
03	Start Method	Normal (01), Start On Power Up (02), Start with DC Brake (03), Auto Restart (04)	Normal (01)	49
04	Stop Method	Coast (01), Coast With DC Brake (02), Ramp (03), Ramp With DC Brake (04)	Coast (01)	50
05	Standard Speed Source	Keypad (01), Preset Speed 1 (02), 0–10 Vdc (03), 4–20 mA (04)	Keypad (01)	51
06 13	TB-14 Output TB-15 Output	None (01), Run (02), Fault (03), Inverse Fault (04), Fault Lockout (05), At Set Speed (06), Above Preset 3 (07), Current Limit (08), Auto Speed (09), Reverse (10)	None (01) None (01)	52 to 57
08	TB-30 Output	None (01), 0–10 Vdc Freq (02), 2–10 Vdc Freq (03), 0–10 Vdc Load (04), 2–10 Vdc Load (05)	None (01)	53
09	TB-31 Output	None (01), 0–10 Vdc Load (02), 2–10 Vdc Load (03), Dynamic Braking (04)	None (01)	53
10	TB-13A Function Select	None (01), 0–10 Vdc (02), 4–20 mA (03), Preset Speed 1 (04), Run Reverse (05), Start Reverse (06), External Fault (07), Remote Keypad (08), DB Fault (09)	None (01)	54

⚠ WARNING

LOSS OF CONTROL

When operating in Jog mode, the local or remote Stop command does not stop the drive controller. To stop the drive controller, open the contact between TB-13B and TB-4.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

11	TB-13B Function Select	None (01), 0–10 Vdc (02), 4–20 mA (03), Preset Speed 2 (04), Decrease Freq (05), Jog Forward (06), Jog Reverse (07)	None (01)	55

[1] The numbers in () are the codes that correspond to the parameter value. If the range of adjustment is followed by a Table number, refer to the indicated table in Appendix A.

[2] Factory defaults are shown for a 60 Hz base frequency. See Parameter 48 for 50 Hz base frequency.

Table 5: Parameter Menu (continued)

Parameter No.	Parameter Name	Range of Adjustment [1], [2]	Factory Default [1], [2]	See Page
12	TB-13C Function Select	None (01), 0–10 Vdc (02), 4–20 mA (03), Preset Speed 3 (04), Increase Freq (05), External Fault (06), Remote Keypad (07), DB Fault (08)	None (01)	56
13	TB-15 Output	(See Parameter 6—TB-14 Output)	None (01)	57
14	Control	Terminal Strip Only (01), Remote Keypad Only (02), Terminal Strip or Remote Keypad (03)	Terminal Strip Only (01)	57
15	Serial Link	Disable (01), Enable With Timer (02), Enable Without Timer (03)	Enable With Timer (02)	57
16	Keypad Speed	Tenths Of Hz (01), Whole Hz (02)	Tenths (01)	58
17	Rotation	Forward Only (01), Forward and Reverse (02)	Forward Only (01)	58
18	Range Selector	Refer to “Description of Parameters” section.	1.0–99.0 (03)	58
19	Acceleration Time	0.1–2970 Sec (Table 6). Range depends on the setting of Parameter 18—Range Selector.	20.0 Sec (20)	59
20	Deceleration Time		20.0 Sec (20)	60
21	DC Brake Time		0.0 Sec (00)	60
22	DC Brake Voltage	0.0–30.0% (Table 7)	0.0% (00)	61
23	Minimum Frequency	0.0–Maximum Freq	0.0 Hz	61
24	Maximum Frequency	Minimum Freq—120 Hz (Table 7). Maximum setting depends on the setting of Carrier Frequency. Minimum setting 21.0 Hz if the Minimum Freq. is set below 21.0 Hz.	60.0 Hz (39)	62
25	Current Limit	30–180% (Table 8). If Line Voltage is set to Low, maximum setting 150%.	180% (75)	62
26	Motor Overload	30–100% (Table 8)	100% (70)	63
27	Base Frequency	30.0–129.0 Hz (Table 8)	60.0 Hz (30)	64
28	Fixed Boost	0.0–30.0% (Table 9)	1.0% (02)	64
29	Accel Boost	0.0–19.8% (Table 9)	0.0% (00)	65
30	Slip Compensation	0.0–5.0% (Table 9)	0.0% (00)	65
31–37	Preset Speeds	0.0–120.0 Hz	0.0 Hz	65
40	Frequency Scaling	0.0–198.0 Hz (Table 10)	60.0 Hz (30)	66
41	Load Scaling	0–198% (Table 10)	198% (99)	66
43	Serial Address	1–99	1	67
44	Password	0000–9999	1225	67

[1] The numbers in () are the codes that correspond to the parameter value. If the range of adjustment is followed by a Table number, refer to the indicated table in Appendix A.

[2] Factory defaults are shown for a 60 Hz base frequency. See Parameter 48 for 50 Hz base frequency.

Table 5: Parameter Menu (continued)

Parameter No.	Parameter Name	Range of Adjustment [1], [2]	Factory Default [1], [2]	See Page
47	Clear Fault History	Maintain (01), Clear (02)	Maintain (01)	67
48	Program Selection	User Settings (01), OEM Settings (02), Reset OEM (03), Reset 60 (04), Reset 50 (05)	User Settings (01)	67
50	Fault History	(View-Only)	(N/A)	69
51	Software Code	(View-Only)	(N/A)	69
52	DC Bus Voltage	(View-Only)	(N/A)	69
53	Motor Voltage	(View-Only)	(N/A)	69
54	Load	(View-Only)	(N/A)	69
55	0–10 Vdc Input	(View-Only)	(N/A)	69
56	4–20 mA Input	(View-Only)	(N/A)	70
57	TB Strip Status	(View-Only)	(N/A)	70
58	Keypad Status	(View-Only)	(N/A)	70
59	TB-30 Output	(View-Only)	(N/A)	71
60	TB-31 Output	(View-Only)	(N/A)	71

[1] The numbers in () are the codes that correspond to the parameter value. If the range of adjustment is followed by a Table number, refer to the indicated table in Appendix A.

[2] Factory defaults are shown for a 60 Hz base frequency. See Parameter 48 for 50 Hz base frequency.

DESCRIPTION OF PARAMETERS

01—Line Voltage Selection

This calibrates the drive controller for the actual applied input voltage, and can be set to High (01) or Low (02). Refer to the table below for the proper setting depending on the applied input voltage.

Model	Input Voltage Rating	Phase	Line Input Voltage	Setting
VSD07••P10	120/208/240 Vac	1 1	110–120 Vac or 220–240 Vac 200–208 Vac	High (01) Low (02)
VSD07••P20	208/240 Vac	1 or 3 1 or 3	220–240 Vac 200–208 Vac	High (01) Low (02)
VSD07••M20	208/240 Vac	3 3	220–240 Vac 200–208 Vac	High (01) Low (02)
VSD07••N40	400/480 Vac	3 3	440–480 Vac 380–415 Vac	High (01) Low (02)
VSD07••S60	590 Vac	3 3	575–600 Vac 460–480 Vac	High (01) Low (02)

02—Carrier Frequency

This sets the switching rate of the output IGBTs. Increasing the carrier frequency will result in less audible motor noise. Available settings are: 4 kHz, 6 kHz, 8 kHz, and 10 kHz.

The carrier frequency setting also determines the maximum output frequency of the drive controller.

Parameter Setting	Carrier Frequency	Maximum Output Frequency
01	4 kHz	66.0 Hz
02	6 kHz	96.0 Hz
03	8 kHz	120.0 Hz
04	10 kHz	120.0 Hz

NOTE: If this parameter is changed while the drive controller is running, the change will not take effect until the drive controller is stopped. Therefore, the allowable maximum frequency is not increased if the carrier frequency is increased while the drive controller is running.

If the select carrier frequency is greater than 6 kHz, the following derating rules apply:

- For carrier frequency of 8 kHz, derate maximum ambient temperature to 109 °F (43 °C), or derate output current to 92%.
- For carrier frequency of 10 kHz, derate maximum ambient temperature to 95 °F (35 °C), or derate output current to 82%.

03—Start Method

⚠ WARNING

UNINTENDED EQUIPMENT ACTION

- Automatic restart can only be used for machines or installations that present no danger for personnel or equipment in the event of automatic restarting.
- Equipment operation must conform with national and local safety regulations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

01 NORMAL: The drive controller starts when the appropriate contact is closed on the terminal strip, or by pressing the START key on the optional remote keypad. Refer to Parameter 14.

02 START ON POWER UP: The drive controller automatically starts upon application of input power.

03 START WITH DC BRAKE: When a Start command is given, the drive controller applies DC Brake Voltage (Parameter 22) for the duration of DC Brake Time (Parameter 21) prior to starting the motor to ensure that the motor is not turning at the time of the START.

04 AUTO RESTART: When a Start command is given, or after a fault, or upon application of power, the drive controller applies DC Brake Voltage (Parameter 22) for the duration of DC Brake Time (Parameter 21) prior to starting (or restarting) the motor. The drive controller attempts three restarts after a fault. During the interval between restart attempts, the display reads "SP" to indicate Start Pending. If all three restart attempts fail, the drive controller trips into Fault Lockout (displayed "Lc") and requires a manual reset. The delay time for Start Pending (SP) is 15 seconds or until the fault is removed, whichever is longer. There is no delay time at power up when Auto Restart is enabled, other than the normal power up delay of approximately 2 seconds. Refer to "Appendix C—Troubleshooting" on page 86.

NOTE: Options 02 and 04 require a two-wire start/stop circuit with a maintained Run contact. The Run contact must remain closed for the auto-start and auto-restart functions to operate.

04—Stop Method

⚠ WARNING

LOSS OF CONTROL

When operating in Jog mode, the local or remote stop command does not stop the drive controller. To stop the drive controller, open the contact between TB-13B and TB-4.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

01 COAST TO STOP: When a stop command is given, the drive controller shuts off the output to the motor, allowing it to coast freely to a stop.

02 COAST WITH DC BRAKE: When a stop command is given, the drive controller activates DC braking (after a delay of up to 2 seconds, depending on frequency) to help decelerate the load. Refer to Parameters: 21—DC Brake Time, and 22—DC Brake Voltage.

03 RAMP TO STOP: When a stop command is given, the drive controller decelerates the motor to a stop at the rate determined by Parameter 20—Deceleration Time.

⚠ WARNING

NO HOLDING TORQUE

- DC injection braking does not provide holding torque at zero speed.
- DC injection braking does not function during loss of power or drive controller fault.
- When required, use separate brake for holding torque.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

04 RAMP WITH DC BRAKE: When a stop command is given, the drive controller decelerates the motor down to 0.2 Hz (at the rate set by Parameter 20—Deceleration Time) and then activates the DC braking. This is used to bring the load to a final stop, as the motor may still be turning slightly after the drive controller stops. Refer to Parameters: 21—DC Brake Time, and 22—DC Brake Voltage.

05—Standard Speed Source

This selects the speed reference source when the drive controller is in standard speed mode.

01 KEYPAD: Use the ▲ and ▼ buttons to increase or decrease the desired operating speed.

02 PRESET SPEED 1: The drive controller operates at the frequency set into Parameter 31.

03 0–10 Vdc: The drive controller responds to a 0–10 Vdc signal wired to TB-2 and TB-5.

04 4–20 mA: The drive controller responds to a 4–20 mA signal wired to TB-2 and TB-25.

06—TB-14 Open Collector Output

This selects the status indication for the open-collector output at TB-14. The terms “open” and “close” refer to the state of the internal transistor that activates the circuit. When the transistor is “closed”, TB-14 is at the same potential as TB-4, allowing current to flow.

01 NONE: Disables the open-collector output.

02 RUN: Closes upon a start command. Opens if the drive controller is in a stop state, the drive controller faults, or input power is removed. DC braking is considered a stop state.

03 FAULT: Closes if there is no fault condition. Opens if the drive controller faults, or input power is removed.

04 INVERSE FAULT: Closes if the drive controller faults. Opens if there is no fault condition.

05 FAULT LOCKOUT: Closes when input power is applied. Opens if three restart attempts are unsuccessful, or if input power is removed.

06 AT SET SPEED: Closes if the drive controller is within ±0.5 Hz of the speed setpoint.

07 ABOVE PRESET SPEED 3: Closes if the output frequency exceeds the Preset Speed 3 setting. Opens if the output frequency is equal to or less than Preset Speed 3 (Parameter 33).

08 CURRENT LIMIT: Closes if the output current exceeds the current limit setting. Opens if the output current is equal to or less than current limit (see Parameter 25).

09 AUTOMATIC MODE: Closes if an automatic (terminal strip) speed reference is active. Opens if a standard (Parameter 5) speed reference is active.

10 REVERSE: Closes when reverse rotation is active. Opens when forward rotation is active. (see Parameter 17—Rotation Direction).

08—TB-30 Analog Output

Terminal TB-30 is used as an analog output proportional to either output frequency or motor load. Frequency Scaling (Parameter 40) or Load Scaling (Parameter 41) is used to scale the output signal.

01 NONE

02 0–10 Vdc FREQ

03 2–10 Vdc FREQ

04 0–10 Vdc LOAD

05 2–10 Vdc LOAD

NOTE: The 2–10 Vdc signal is converted to a 4–20 mA signal by connecting a resistor in series with the signal such that the total load resistance is 500 Ω. However, this output cannot be used with devices that derive power from a 4–20 mA signal.

09—TB-31 Analog Output

Terminal TB-31 is used as an analog output proportional to motor load, or as the control signal to activate the optional external dynamic braking module. Load Scaling (Parameter 41) is used to scale the output signal when TB-31 is used as an analog output proportional to motor load.

01 NONE

02 0–10 Vdc LOAD

03 2–10 Vdc LOAD

04 DYNAMIC BRAKING: TB-31 becomes the “trigger” that activates the optional external dynamic braking module. Refer to the manual included with the dynamic braking option.

NOTE: The 2–10 Vdc signal is converted to a 4–20 mA signal by connecting a resistor in series with the signal such that the total load resistance is 500 Ω. However, this output cannot be used with devices that derive power from a 4–20 mA signal.

10—TB-13A Function Select

This is used to select the function of terminal TB-13A. Closing TB-13A to TB-4 activates the selected function. The following can be selected:

01 NONE: Disables the TB-13A function.

02 0–10 Vdc: Selects 0–10 Vdc as the auto speed reference input. The 0–10 Vdc signal is wired to TB-5 and TB-2.

03 4–20 mA: Selects 4–20 mA as the auto speed reference input. The 4–20 mA signal is wired to TB-25 and TB-2.

04 PRESET SPEED 1: Selects Preset Speed 1 as the auto speed reference. The drive controller operates at the frequency programmed into Parameter 31.

05 RUN REVERSE: Close TB-13A to TB-4 to run in the reverse direction, and open to stop. This setting forces TB-12 to act as run Fwd, requiring a maintained contact to run in the forward direction. TB-1 must be closed to TB-4 for this function to operate.

06 START REVERSE: Momentarily close TB-13A to TB-4 to start the drive controller in the reverse direction. Momentarily open TB-1 to TB-4 to stop. This setting forces TB-12 to act as Start Fwd, requiring a momentary contact to start in the forward direction.

07 EXTERNAL FAULT: Sets TB-13A as a normally closed external fault input. If TB-13A is open with respect to TB-4, the controller will fault.

08 REMOTE KEYPAD: Selects the optional remote keypad as the control source. Refer to Parameter 14—Control.

09 DB FAULT: Sets TB-13A as a dynamic braking fault input when using the optional dynamic braking module. When this input is activated by the dynamic braking module, the controller will either ramp or coast to a stop, depending on the selected STOP METHOD (Parameter 04). Refer to the manual included with the dynamic braking option.

NOTE: In order for the Run Reverse and Start Reverse functions to operate, set Parameter 17—Rotation Direction to forward and reverse.

11—TB-13B Function Select

⚠ WARNING

LOSS OF CONTROL

- When operating in Jog mode, the local or remote stop command does not stop the drive controller. To stop the drive controller, open the contact between TB-13B and TB-4.
- Jog reverse operates the drive controller in reverse rotation even if rotation direction (Parameter 17) is set to forward only.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

This selects the function of terminal TB-13B. Closing TB-13B to TB-4 activates the selected function. The following functions can be selected:

01 NONE: Disables the TB-13B function.

02 0–10 Vdc: Selects 0–10 Vdc as the auto speed reference input. The 0–10 Vdc signal is wired to TB-5 and TB-2.

03 4–20 mA: Selects 4–20 mA as the auto speed reference input. The 4–20 mA signal is wired to TB-25 and TB-2.

04 PRESET SPEED 2: Selects Preset Speed 2 as the auto speed reference. The drive controller operates at the frequency programmed into Parameter 32.

05 DECREASE FREQUENCY: Decreases the speed setpoint when using the MOP function. Refer to “Speed Reference Selection” on page 21.

06 JOG FORWARD: Jog in the forward direction. In this mode, the drive controller will jog at the speed programmed into Parameter 32—Preset Speed 2.

07 JOG REVERSE: Jog in the reverse direction. In this mode, the drive controller will jog at the speed programmed into Parameter 32—Preset Speed 2.

08 DB FAULT: Sets TB-13A as a dynamic braking fault input when using the optional dynamic braking module. When this input is activated by the dynamic braking module, the drive controller will either ramp or coast to a stop, depending on the selected STOP METHOD (Parameter 04). Refer to the manual included with the dynamic braking option.

NOTE: If the drive controller is commanded to jog while running, the drive controller enters the Jog mode and runs at Preset Speed 2. When the jog command is removed, the drive controller will stops.

NOTE: External fault, if configured, overrides the Jog function.

12—TB-13C Function Select

This selects the function of terminal TB-13C. Closing TB-13C to TB-4 activates the TB-13C input function. The following functions can be selected:

01 NONE: Disables the TB-13C function.

02 0–10 Vdc: Selects 0–10 Vdc as the auto speed reference input. The 0–10 Vdc signal is wired to TB-5 and TB-2.

03 4–20 mA: Selects 4–20 mA as the auto speed reference input. The 4–20 mA signal is wired to TB-25 and TB-2.

04 PRESET SPEED 3: Selects Preset Speed 3 as the auto speed reference. The drive controller operates at the frequency programmed into Parameter 33.

05 INCREASE FREQUENCY: Increases the speed setpoint when using the MOP function. Refer to “Speed Reference Selection” on page 21.

06 EXTERNAL FAULT: Sets TB-13C as a normally closed external fault input. If TB-13C is open with respect to TB-4, the drive controller will fault.

07 REMOTE KEYPAD: Selects the optional remote keypad as the control source. Refer to Parameter 14—Control.

13—TB-15 Open Collector Output

This selects the status indication for the open-collector output at TB-15, and has the same selections as Parameter 6—TB-14 Open Collector Output.

14—Control

This selects the source of start/stop and direction commands.

01 TERMINAL STRIP ONLY: The drive controller only responds to start/stop and direction commands from the terminal strip. The keypad is totally disabled.

02 REMOTE KEYPAD ONLY: The drive controller only responds to start/stop and direction commands from the optional remote keypad.

03 TERMINAL STRIP OR REMOTE KEYPAD: Terminal TB-13A or TB-13C can be used to toggle between terminal strip control and remote keypad control. See Parameters 10 and 12.

NOTE: The stop button on the optional remote keypad is always active in (02) and (03) above.

15—Serial Link

⚠ WARNING

LOSS OF CONTROL

Setting parameter number 15, Serial Link, to 03 disables communication loss detection. Provide alternate control paths when disabling communication loss detection.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

01 DISABLED: Disables the serial link.

02 ENABLED WITH TIMER: Activates the serial link with a “watchdog” timer that will shut down the drive controller after 10 seconds of no serial activity, which could indicate a failed serial link.

03 ENABLED WITHOUT TIMER: Activates the serial link without a "watchdog" timer. Do not operate the drive controller from the serial link without the watchdog timer, as control of the drive controller could be lost if there is a failure in the serial link.

16—Keypad Speed Editing

This selects the increments of the speed setpoint when the speed source is the ▲ and ▼ buttons on the front of the drive.

01 TENTHS OF Hz: The speed setpoint changes by tenths of Hz. If the button is pressed and held, the speed setpoint changes by tenths of Hz until the next whole Hz is reached, and then the setpoint changes by 1 Hz increments.

02 WHOLE Hz: The speed setpoint only changes by one Hz increments.

17—Rotation Direction

01 FORWARD ONLY: The drive controller only allows rotation in the forward direction. However, Jog Reverse (see Parameter 11) still operates even if Forward Only is selected.

02 FORWARD AND REVERSE: The drive controller allows rotation in both directions.

18—Range Selector

This selects the range of possible settings for Parameters 19 (Acceleration Time), 20 (Deceleration Time), and 21 (DC Brake Time). Refer to the table below:

Parameter Setting	Range (s)	Increments (s)
01	0.1–9.9	0.1
02	0.3–29.7	0.3
03	1.0–99.0	1.0
04	3.0–297.0	3.0
05	10.0–990.0	10.0
06	30.0–2970.0	30.0

Once a range is selected, specific settings for Parameters 19, 20, and 21 can be selected from Table 6 on page 72. Only one range can be selected, which applies to all three parameters.

NOTE: If a new range is selected such that the values of Parameters 19, 20, and/or 21 are higher than the highest setting of the new range, the drive controller continues to operate with those values until the parameters are changed. When the parameter is viewed, "100" will be blinking to indicate that the present value is above the new range. If a new range is selected such that the values of Parameters 19, 20, and/or 21 are still within the new range, the drive controller continues to operate with those values until the parameters are changed. When the parameter is viewed, the setting number from the new range that corresponds to the closest higher value to the present value will be blinking to indicate that the present value does not have an exact match in the new range.

19—Acceleration Time

This sets the acceleration rate for all speed reference sources (keypad, speed potentiometer, 4–20 mA, 0–10 Vdc, jog, and the preset speeds). This setting is the time to accelerate from 0 Hz to the Base Frequency (Parameter 27).

To set this parameter, select a value from Table 6 on page 72 that is within the time range defined by the Range Selector setting (Parameter 18). Setting 00 cannot be selected.

20—Deceleration Time

This sets the deceleration rate for all speed reference sources (keypad, speed potentiometer, 4–20 mA, 0–10 Vdc, jog, and preset speeds). This setting is the time to decelerate from base frequency to 0 Hz. If the drive controller is set to coast to stop (Parameter 04), this parameter has no effect when a stop command is given.

To set this parameter, select a value from Table 6 in Appendix A that is within the time range defined by the range selector setting (Parameter 18). Setting 00 cannot be selected.

21—DC Brake Time

⚠ WARNING

NO HOLDING TORQUE

- DC injection braking does not provide holding torque at zero speed.
- DC injection braking does not function during loss of power or drive controller fault.
- When required, use separate brake for holding torque.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

This determines the length of time that the DC braking voltage is applied to the motor. The DC Brake Time should be set to the lowest value that provides satisfactory operation in order to minimize motor heating.

To set this parameter, select a value from Table 6 in Appendix A that is within the time range defined by the Range Selector setting (Parameter 18).

22—DC Brake Voltage

This sets the magnitude of the DC braking voltage, in percentage of the nominal DC Bus voltage (DC Bus = input AC voltage X 1.414). The point at which the DC braking is activated depends on the selected Stop Method (Parameter 04).

If Coast With DC Brake is selected, and a stop command is issued, braking is activated after a time delay of up to 2 seconds, depending on the output frequency at the time of the stop command. In this case, DC braking helps decelerate the load.

If Ramp With DC Brake is selected, braking is activated when the output frequency reaches 0.2 Hz. In this case, the drive controller decelerates the load to 0.2 Hz and then DC braking is used to stop and hold the motor.

To set this parameter, select a value from Table 7 in Appendix A. To minimize motor heating, DC Brake Voltage should be set to the lowest value that provides satisfactory operation.

23—Minimum Frequency

This sets the minimum output frequency of the drive controller for all speed reference sources except the Preset Speeds (Parameters 31–37).

When using a 0–10 Vdc or 4–20 mA analog speed reference signal, this parameter also sets the drive controller speed that corresponds to the minimum analog input (0 Vdc or 4 mA).

Unlike most other parameters, the minimum frequency is entered directly, rather than selecting a value from a table. Refer to “Programming Direct-Entry Parameters” on page 42.

NOTE: If this parameter is changed while the drive controller is running, the new value will not take effect until the drive controller is stopped.

24—Maximum Frequency

This sets the maximum output frequency of the drive controller for all speed reference sources except the Preset Speeds (Parameters 31–37). It is used with Minimum Frequency (Parameter 23) to define the operating range of the drive controller. The highest Maximum Frequency setting is determined by the Carrier Frequency setting (Parameter 02). The minimum allowable setting is either 21.0 Hz (if Minimum Frequency is set below 21.0 Hz), or is equal to the Minimum Frequency setting (if Minimum Frequency is set above 21.0 Hz).

When using a 0–10 Vdc or 4–20 mA analog speed reference signal, this parameter also sets the drive controller speed that corresponds to the maximum analog input (10 Vdc or 20 mA).

To set this parameter, select a value from Table 7 in Appendix A.

NOTE: If this parameter is changed while the drive controller is running, the new value will not take effect until the drive controller is stopped.

25—Current Limit

This sets the maximum allowable output current of the drive controller before current limiting takes effect. The maximum setting is either 180% or 150%, depending on whether Line Voltage Selection (Parameter 01) is set to High or Low.

The drive controller enters current limit when the load demands more current than the Current Limit setting. To reduce the output current, the drive controller will reduce the output frequency if the motor current exceeds the current limit setting. When the overcurrent condition passes, the drive controller accelerates the motor back up to the speed setpoint.

To set this parameter, select a value from Table 8 in Appendix A.

26—Motor Overload

⚠ CAUTION

LOSS OF MOTOR OVERLOAD PROTECTION

When using external overload relays connected to the drive controller output, the overload relay must be capable of operation over the expected range of drive controller output frequencies (including direct current).

When DC injection braking is used:

- The overload relay must be capable of operation with direct current flowing in the motor.
- Do not use overload relays equipped with current transformers for sensing the motor current.

MOTOR OVERHEATING

This drive controller does not provide direct thermal protection for the motor. Use of a thermal sensor in the motor may be required for protection at all speeds and loading conditions. Consult motor manufacturer for thermal capability of motor when operated over desired speed range.

If drive controller trips on overload fault, allow sufficient time for the motor to cool prior to restarting.

Failure to follow these instructions can result in injury or equipment damage.

The motor overload circuit protects the motor from excessive overcurrent. This circuit allows the drive controller to deliver up to 150% current for one minute, and higher current levels for shorter periods of time. If the overload circuit “times out”, the drive controller will trip into an Overload fault.

Motor Overload should be set to the ratio (in percent) of the motor current rating to the drive controller current rating in order to properly protect the motor. See the example on the next page.

To set this parameter, select a value from Table 8 in Appendix A.

Example: A 3 hp, 480 Vac drive controller with a 4.8 A rating is operating a 2 hp motor with a current rating of 3.4 A. Dividing the motor current rating by the drive controller current rating yields 71% (3.4 ÷ 4.8 = 0.71 = 71%). From Table 8 in Appendix A, setting 41 corresponds to 71%.

27—Base Frequency

The Base Frequency determines the V/Hz ratio by setting the output frequency at which the drive controller outputs full voltage to the motor. In most cases, set the Base Frequency to match the motor's rated frequency.

To set this parameter, select a value from Table 8 in Appendix A.

NOTE: If this parameter is changed while the drive controller is running, the new value will not take effect until the drive controller is stopped.

Example: A 460 Vac, 60 Hz motor requires a V/Hz ratio of 7.67 (460 V ÷ 60 Hz = 7.67 V/Hz) in order to produce full torque. Setting the Base Frequency to 60 Hz causes the drive controller to output full voltage (460 Vac) at 60 Hz, which yields the required 7.67 V/Hz. Output voltage is proportional to output frequency, so the 7.67 V/Hz ratio is maintained from 0–60 Hz, allowing the motor to produce full torque from 2 Hz (below 2 Hz there is less torque due to slip) up to 60 Hz.

28—Fixed Boost

Fixed Boost is used in applications which require high starting torque. Fixed Boost increases starting torque by increasing the output voltage at lower frequencies (below 30 Hz for 60 Hz base frequency), which increases the V/Hz ratio.

To set this parameter, select a value from Table 9 in Appendix A.

29—Acceleration Boost

Acceleration Boost helps accelerate high-inertia loads. During acceleration, the output voltage is increased to increase motor torque. Once the motor reaches the new speed setpoint, the boost is turned off and the output voltage returns to the normal value.

To set this parameter, select a value from Table 9 in Appendix A.

30—Slip Compensation

Slip Compensation is used to counteract changes in motor speed (slip) caused by changes in load. In a standard AC induction motor, the shaft speed decreases as load increases, and increases as load decreases. By increasing or decreasing the output frequency in response to an increasing or decreasing load, the slip is counteracted and speed is maintained. Most standard NEMA B motors have a 3% slip rating.

To set this parameter, select a value from Table 9 in Appendix A.

31 to 37—Preset Speed 1 to 7

Preset speeds are only active when the drive controller is in Auto mode, and are activated by closing the contacts between TB-4 and TB-13A, 13B, and 13C. The TB-13 terminals must be programmed as preset speed selects using Parameters 10–12.

Unlike most other parameters, the preset speed values are entered directly, rather than selecting a value from a table. Refer to “Programming Direct-Entry Parameters” on page 42 for instructions on programming direct-entry parameters.

NOTE: Preset speeds can operate outside of the range defined by the minimum and maximum frequency parameters (Parameters 23 and 24). The range of operation for the preset speeds is from 0 Hz to the absolute maximum frequency determined by the Carrier Frequency (see Parameter 02). Therefore, when using preset speeds, the drive controller can operate below the Minimum Frequency setting, and above the Maximum Frequency setting, but not above the absolute maximum frequency determined by the carrier frequency.

Preset Speed	TB-13A	TB-13B	TB-13C
1	Closed	Open	Open
2	Open	Closed	Open
3	Open	Open	Closed
4	Closed	Closed	Open
5	Closed	Open	Closed
6	Open	Closed	Closed
7	Closed	Closed	Closed

NOTE: When a TB-13 terminal is programmed for a function other than a preset speed select, it is considered Open for the table above.

40—Frequency Scaling

This scales the analog output signal at TB-30 when it is configured for a frequency output. This setting is the output frequency that is indicated when the output signal measures 10 Vdc.

To set this parameter, select a value from Table 10 in Appendix A.

Example: A 0–5 Vdc signal is required to indicate 0–60 Hz. Setting this parameter to 120 Hz yields 10 Vdc at 120 Hz, and 5 Vdc at 60 Hz. If the drive controller only operates up to 60 Hz, the output signal at TB-30 is limited to the desired 0–5 Vdc.

41—Load Scaling (Motor Load)

This scales the analog output signal at TB-30 and/or TB-31 when they are configured for a motor load output. This setting is the load (in %) that is indicated when the output signal measures 10 Vdc.

To set this parameter, select a value from Table 10 in Appendix A.

Example: A 0–10 Vdc signal is required to indicate 0–150% motor load. Setting this parameter to 150% yields 10 Vdc at 150% load.

43—Serial Address

If a serial link is used to communicate with drive controllers, give each drive controller a different address (from 1 to 99) so that an individual drive controller in the network can be accessed.

44—Password

This allows the password to be changed to any number between 0000 and 9999. Unlike most other parameters, the password value is entered directly, rather than selecting a value from a table. Entering 0000 for a password disables the password function so no passwords are required to enter the programming mode. Refer to “Programming Direct-Entry Parameters” on page 42.

NOTE: The factory default password is 1225.

47—Clear Fault History

01 MAINTAIN: Maintains the fault history (Parameter 50) entries for troubleshooting.

02 CLEAR: Erases the fault history (Parameter 50) entries.

48—Program Selection

This is used to select whether the drive controller operates according to the user's settings or the optional OEM default settings, and to reset the parameters to default settings. Refer to “Electronic Programming Module (EPM)” on page 43.

01 OPERATE WITH USER SETTINGS: The drive controller operates according to the user's settings. Operation in User mode allows the parameter values to be changed to suit any application.

02 OPERATE WITH OEM DEFAULTS: The drive controller operates according to the optional OEM default settings, which configure the drive controller for a specific application. When operating in OEM mode, the parameter values can be viewed, but not changed. If an attempt is made to change a parameter setting, the display flashes "CE". If the drive controller is not programmed with OEM default settings, the display flashes "CF" if this option is selected.

03 RESET OEM: Resets the user parameters to the OEM default settings. If the drive controller is not programmed with OEM default settings, the display flashes "CF" if this option is selected.

04 RESET 60: Resets the user parameters to the factory defaults for a 60 Hz base frequency.

05 RESET 50: Resets the user parameters to the factory defaults for a 50 Hz base frequency. Parameters 24, 27, and 40 will reset to 50.0 Hz default settings.

NOTE: If the user parameters are reset to the OEM defaults (using the Reset OEM option), and then Operate With User Settings is selected, the User settings will be the same as the OEM default settings. This allows the drive controller to operate as if it were in OEM mode, but the parameter values can be changed. This is useful if some of the OEM default settings need to be fine-tuned for proper operation. The new parameter values are not stored as new OEM default settings. They are stored as new user settings. Therefore, if the parameters are reset to the OEM defaults again, the parameters that were changed will be reset to their previous value. The Portable Programming Fixture is required to change OEM default settings. Refer to "Electronic Programming Module (EPM)" on page 43.

50—Fault History

The Fault History stores the last eight faults that tripped the drive controller.

Use the ▲ and ▼ buttons to scroll through the fault entries. The faults are stored from newest to oldest, with the first fault shown being the most recent. The display flashes between faults to indicate that the next fault is being viewed. When the end of the list has been reached, the display no longer flashes. Refer to “Appendix C—Troubleshooting” on page 86 for a list of the faults and possible causes.

The display reads “--” if the Fault History does not contain any fault messages.

51—Software Version

This displays the software version number for the control board software. This information is useful when contacting the factory for programming or troubleshooting assistance.

52—DC Bus Voltage

This displays the DC bus voltage in percent of nominal. Nominal DC bus voltage is determined by multiplying the drive controller's nameplate input voltage rating by 1.4.

53—Motor Voltage

This displays the output voltage in percent of the drive controller's nameplate output voltage rating.

54—Motor Load

This displays the motor load in percent of the drive controller's output current rating.

55—0 to 10 Vdc Analog Input

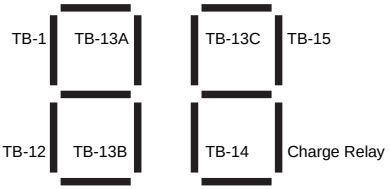
This displays the level of the 0–10 Vdc analog input signal at TB-5. A reading of 100% indicates a 10 Vdc input at TB-5.

56—4 to 20 mA Analog Input

This displays the level of the 4–20 mA analog input signal at TB-25. A reading of 20% indicates a 4 mA input at TB-25, and a reading of 100% indicates a 20 mA input at TB-25.

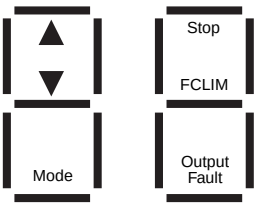
57—Terminal Strip Status

This indicates the status of several terminals using the vertical segments of the LED display. An illuminated segment indicates that the particular terminal is asserted (TB-1, TB-12,TB-13A, TB-13B, and TB-13C at TB-4 potential; TB-14 and TB-15 at TB-2 potential). The charge relay is always illuminated. See the diagram below:



58—Keypad And Protection Status

This indicates the status of the keypad buttons, and the status of the protective circuitry in the controller, using the horizontal segments of the LED. An illuminated segment indicates that the corresponding button is pressed, or the protective circuit is active. See the diagram below:



NOTE: FCLIM is an abbreviation for Fast Current Limit.

NOTE: The stop segment only functions when the optional remote keypad is used. For standard units (which do not have a stop button), the stop segment is not illuminated.

59—TB-30 Analog Output

This displays the level of the analog output signal at TB-30. A reading of 100% indicates that the output is 10 Vdc. On some drive controllers, this parameter is not present.

60—TB-31 Analog Output

This displays the level of the analog output signal at TB-31. A reading of 100% indicates that the output is 10 Vdc. On some drive controllers, this parameter is not present.

APPENDIX A—PARAMETER VALUE TABLES

Table 6: Parameter Values

Parameter 19—Acceleration Time (seconds—cannot be set to 0.0 s)
Parameter 20—Deceleration Time (seconds—cannot be set to 0.0 s)
Parameter 21—DC Brake Time (seconds)

Parameter Setting	Parameter Value depends on Range Selector setting (Parameter 18)					
	01	**02**	**03**	**04**	**05**	**06**
00	0.0	0.0	0.0	0.0	0.0	0.0
01	0.1	0.3	1.0	3.0	10.0	30.0
02	0.2	0.6	2.0	6.0	20.0	60.0
03	0.3	0.9	3.0	9.0	30.0	90.0
04	0.4	1.2	4.0	12.0	40.0	120.0
05	0.5	1.5	5.0	15.0	50.0	150.0
06	0.6	1.8	6.0	18.0	60.0	180.0
07	0.7	2.1	7.0	21.0	70.0	210.0
08	0.8	2.4	8.0	24.0	80.0	240.0
09	0.9	2.7	9.0	27.0	90.0	270.0
10	1.0	3.0	10.0	30.0	100.0	300.0
11	1.1	3.3	11.0	33.0	110.0	330.0
12	1.2	3.6	12.0	36.0	120.0	360.0
13	1.3	3.9	13.0	39.0	130.0	390.0
14	1.4	4.2	14.0	42.0	140.0	420.0
15	1.5	4.5	15.0	45.0	150.0	450.0
16	1.6	4.8	16.0	48.0	160.0	480.0
17	1.7	5.1	17.0	51.0	170.0	510.0
18	1.8	5.4	18.0	54.0	180.0	540.0
19	1.9	5.7	19.0	57.0	190.0	570.0
20	2.0	6.0	20.0	60.0	200.0	600.0
21	2.1	6.3	21.0	63.0	210.0	630.0
22	2.2	6.6	22.0	66.0	220.0	660.0
23	2.3	6.9	23.0	69.0	230.0	690.0
24	2.4	7.2	24.0	72.0	240.0	720.0
25	2.5	7.5	25.0	75.0	250.0	750.0

Table 6: Parameter Values (continued)

Parameter 19—Acceleration Time (seconds—cannot be set to 0.0 s)
Parameter 20—Deceleration Time (seconds—cannot be set to 0.0 s)
Parameter 21—DC Brake Time (seconds)

Parameter Setting	Parameter Value depends on Range Selector setting (Parameter 18)					
	01	**02**	**03**	**04**	**05**	**06**
26	2.6	7.8	26.0	78.0	260.0	780.0
27	2.7	8.1	27.0	81.0	270.0	810.0
28	2.8	8.4	28.0	84.0	280.0	840.0
29	2.9	8.7	29.0	87.0	290.0	870.0
30	3.0	9.0	30.0	90.0	300.0	900.0
31	3.1	9.3	31.0	93.0	310.0	930.0
32	3.2	9.6	32.0	96.0	320.0	960.0
33	3.3	9.9	33.0	99.0	330.0	990.0
34	3.4	10.2	34.0	102.0	340.0	1020.0
35	3.5	10.5	35.0	105.0	350.0	1050.0
36	3.6	10.8	36.0	108.0	360.0	1080.0
37	3.7	11.1	37.0	111.0	370.0	1110.0
38	3.8	11.4	38.0	114.0	380.0	1140.0
39	3.9	11.7	39.0	117.0	390.0	1170.0
40	4.0	12.0	40.0	120.0	400.0	1200.0
41	4.1	12.3	41.0	123.0	410.0	1230.0
42	4.2	12.6	42.0	126.0	420.0	1260.0
43	4.3	12.9	43.0	129.0	430.0	1290.0
44	4.4	13.2	44.0	132.0	440.0	1320.0
45	4.5	13.5	45.0	135.0	450.0	1350.0
46	4.6	13.8	46.0	138.0	460.0	1380.0
47	4.7	14.1	47.0	141.0	470.0	1410.0
48	4.8	14.4	48.0	144.0	480.0	1440.0
49	4.9	14.7	49.0	147.0	490.0	1470.0
50	5.0	15.0	50.0	150.0	500.0	1500.0
51	5.1	15.3	51.0	153.0	510.0	1530.0
52	5.2	15.6	52.0	156.0	520.0	1560.0

Table 6: Parameter Values (continued)

Parameter 19—Acceleration Time (seconds—cannot be set to 0.0 s)
Parameter 20—Deceleration Time (seconds—cannot be set to 0.0 s)
Parameter 21—DC Brake Time (seconds)

Parameter Setting	Parameter Value depends on Range Selector setting (Parameter 18)					
	01	**02**	**03**	**04**	**05**	**06**
53	5.3	15.9	53.0	159.0	530.0	1590.0
54	5.4	16.2	54.0	162.0	540.0	1620.0
55	5.5	16.5	55.0	165.0	550.0	1650.0
56	5.6	16.8	56.0	168.0	560.0	1680.0
57	5.7	17.1	57.0	171.0	570.0	1710.0
58	5.8	17.4	58.0	174.0	580.0	1740.0
59	5.9	17.7	59.0	177.0	590.0	1770.0
60	6.0	18.0	60.0	180.0	600.0	1800.0
61	6.1	18.3	61.0	183.0	610.0	1830.0
62	6.2	18.6	62.0	186.0	620.0	1860.0
63	6.3	18.9	63.0	189.0	630.0	1890.0
64	6.4	19.2	64.0	192.0	640.0	1920.0
65	6.5	19.5	65.0	195.0	650.0	1950.0
66	6.6	19.8	66.0	198.0	660.0	1980.0
67	6.7	19.8	67.0	201.0	670.0	2010.0
68	6.8	20.4	68.0	204.0	680.0	2040.0
69	6.9	20.7	69.0	207.0	690.0	2070.0
70	7.0	21.0	70.0	210.0	700.0	2100.0
71	7.1	21.3	71.0	213.0	710.0	2130.0
72	7.2	21.6	72.0	216.0	720.0	2160.0
73	7.3	21.9	73.0	219.0	730.0	2190.0
74	7.4	22.2	74.0	222.0	740.0	2220.0
75	7.5	22.5	75.0	225.0	750.0	2250.0
76	7.6	22.8	76.0	228.0	760.0	2280.0
77	7.7	23.1	77.0	231.0	770.0	2310.0
78	7.8	23.4	78.0	234.0	780.0	2340.0
79	7.9	23.7	79.0	237.0	790.0	2370.0

Table 6: Parameter Values (continued)

Parameter 19—Acceleration Time (seconds—cannot be set to 0.0 s)
Parameter 20—Deceleration Time (seconds—cannot be set to 0.0 s)
Parameter 21—DC Brake Time (seconds)

Parameter Setting	Parameter Value depends on Range Selector setting (Parameter 18)					
	01	**02**	**03**	**04**	**05**	**06**
80	8.0	24.0	80.0	240.0	800.0	2400.0
81	8.1	24.3	81.0	243.0	810.0	2430.0
82	8.2	24.6	82.0	246.0	820.0	2460.0
83	8.3	24.9	83.0	249.0	830.0	2490.0
84	8.4	25.2	84.0	252.0	840.0	2520.0
85	8.5	25.5	85.0	255.0	850.0	2550.0
86	8.6	25.8	86.0	258.0	860.0	2580.0
87	8.7	26.1	87.0	261.0	870.0	2610.0
88	8.8	26.4	88.0	264.0	880.0	2640.0
89	8.9	26.7	89.0	267.0	890.0	2670.0
90	9.0	27.0	90.0	270.0	900.0	2700.0
91	9.1	27.3	91.0	273.0	910.0	2730.0
92	9.2	27.6	92.0	276.0	920.0	2760.0
93	9.3	27.9	93.0	279.0	930.0	2790.0
94	9.4	28.2	94.0	282.0	940.0	2820.0
95	9.5	28.5	95.0	285.0	950.0	2850.0
96	9.6	28.8	96.0	288.0	960.0	2880.0
97	9.7	29.1	97.0	291.0	970.0	2910.0
98	9.8	29.4	98.0	294.0	980.0	2940.0
99	9.9	29.7	99.0	297.0	990.0	2970.0

Table 7: Parameter Values 22 and 24

Parameter 22—DC Brake Voltage (%)
Parameter 24—Maximum Frequency (Hz)

Parameter Setting	Value for Parameter		Parameter Setting	Value for Parameter		Parameter Setting	Value for Parameter	
	22	24		22	24		22	24
00	0.0	21.0	**34**	17.0	55.0	**68**	--	89.0
01	0.5	22.0	**35**	17.5	56.0	**69**	--	90.0
02	1.0	23.0	**36**	18.0	57.0	**70**	--	91.0
03	1.5	24.0	**37**	18.5	58.0	**71**	--	92.0
04	2.0	25.0	**38**	19.0	59.0	**72**	--	93.0
05	2.5	26.0	**39**	19.5	60.0	**73**	--	94.0
06	3.0	27.0	**40**	20.0	61.0	**74**	--	95.0
07	3.5	28.0	**41**	20.5	62.0	**75**	--	96.0
08	4.0	29.0	**42**	21.0	63.0	**76**	--	97.0
09	4.5	30.0	**43**	21.5	64.0	**77**	--	98.0
10	5.0	31.0	**44**	22.0	65.0	**78**	--	99.0
11	5.5	32.0	**45**	22.5	66.0	**79**	--	100.0
12	6.0	33.0	**46**	23.0	67.0	**80**	--	101.0
13	6.5	34.0	**47**	23.5	68.0	**81**	--	102.0
14	7.0	35.0	**48**	24.0	69.0	**82**	--	103.0
15	7.5	36.0	**49**	24.5	70.0	**83**	--	104.0
16	8.0	37.0	**50**	25.0	71.0	**84**	--	105.0
17	8.5	38.0	**51**	25.5	72.0	**85**	--	106.0
18	9.0	39.0	**52**	26.0	73.0	**86**	--	107.0
19	9.5	40.0	**53**	26.5	74.0	**87**	--	108.0
20	10.0	41.0	**54**	27.0	75.0	**88**	--	109.0
21	10.5	42.0	**55**	27.5	76.0	**89**	--	110.0
22	11.0	43.0	**56**	28.0	77.0	**90**	--	111.0
23	11.5	44.0	**57**	28.5	78.0	**91**	--	112.0
24	12.0	45.0	**58**	29.0	79.0	**92**	--	113.0
25	12.5	46.0	**59**	29.5	80.0	**93**	--	114.0

Table 7: Parameter Values 22 and 24 (continued)

Parameter 22—DC Brake Voltage (%)
Parameter 24—Maximum Frequency (Hz)

Parameter Setting	Value for Parameter		Parameter Setting	Value for Parameter		Parameter Setting	Value for Parameter	
	22	24		22	24		22	24
26	13.0	47.0	**60**	30.0	81.0	**94**	--	115.0
27	13.5	48.0	**61**	--	82.0	**95**	--	116.0
28	14.0	49.0	**62**	--	83.0	**96**	--	117.0
29	14.5	50.0	**63**	--	84.0	**97**	--	118.0
30	15.0	51.0	**64**	--	85.0	**98**	--	119.0
31	15.5	52.0	**65**	--	86.0	**99**	--	120.0
32	16.0	53.0	**66**	--	87.0			
33	16.5	54.0	**67**	--	88.0			

Table 8: Parameter Values 25, 26, and 27

Parameter 25—Current Limit (%)
Parameter 26—Motor Overload (%)
Parameter 27—Base Frequency (Hz)

Parameter Setting	Value for Parameter			Parameter Setting	Value for Parameter			Parameter Setting	Value for Parameter		
	25	26	27		25	26	27		25	26	27
00	30.0	30.0	30.0	**34**	98.0	64.0	64.0	**68**	166.0	98.0	98.0
01	32.0	31.0	31.0	**35**	100.0	65.0	65.0	**69**	168.0	99.0	99.0
02	34.0	32.0	32.0	**36**	102.0	66.0	66.0	**70**	170.0	100.0	100.0
03	36.0	33.0	33.0	**37**	104.0	67.0	67.0	**71**	172.0	--	101.0
04	38.0	34.0	34.0	**38**	106.0	68.0	68.0	**72**	174.0	--	102.0
05	40.0	35.0	35.0	**39**	108.0	69.0	69.0	**73**	176.0	--	103.0
06	42.0	36.0	36.0	**40**	110.0	70.0	70.0	**74**	178.0	--	104.0
07	44.0	37.0	37.0	**41**	112.0	71.0	71.0	**75**	180.0	--	105.0
08	46.0	38.0	38.0	**42**	114.0	72.0	72.0	**76**	--	--	106.0
09	48.0	39.0	39.0	**43**	116.0	73.0	73.0	**77**	--	--	107.0
10	50.0	40.0	40.0	**44**	118.0	74.0	74.0	**78**	--	--	108.0

Table 8: Parameter Values 25, 26, and 27 (continued)

Parameter 25—Current Limit (%)
Parameter 26—Motor Overload (%)
Parameter 27—Base Frequency (Hz)

Parameter Setting	Value for Parameter			Parameter Setting	Value for Parameter			Parameter Setting	Value for Parameter		
	25	26	27		25	26	27		25	26	27
11	52.0	41.0	41.0	**45**	120.0	75.0	75.0	**79**	--	--	109.0
12	54.0	42.0	42.0	**46**	122.0	76.0	76.0	**80**	--	--	110.0
13	56.0	43.0	43.0	**47**	124.0	77.0	77.0	**81**	--	--	111.0
14	58.0	44.0	44.0	**48**	126.0	78.0	78.0	**82**	--	--	112.0
15	60.0	45.0	45.0	**49**	128.0	79.0	79.0	**83**	--	--	113.0
16	62.0	46.0	46.0	**50**	130.0	80.0	80.0	**84**	--	--	114.0
17	64.0	47.0	47.0	**51**	132.0	81.0	81.0	**85**	--	--	115.0
18	66.0	48.0	48.0	**52**	134.0	82.0	82.0	**86**	--	--	116.0
19	68.0	49.0	49.0	**53**	136.0	83.0	83.0	**87**	--	--	117.0
20	70.0	50.0	50.0	**54**	138.0	84.0	84.0	**88**	--	--	118.0
21	72.0	51.0	51.0	**55**	140.0	85.0	85.0	**89**	--	--	119.0
22	74.0	52.0	52.0	**56**	142.0	86.0	86.0	**90**	--	--	120.0
23	76.0	53.0	53.0	**57**	144.0	87.0	87.0	**91**	--	--	121.0
24	78.0	54.0	54.0	**58**	146.0	88.0	88.0	**92**	--	--	122.0
25	80.0	55.0	55.0	**59**	148.0	89.0	89.0	**93**	--	--	123.0
26	82.0	56.0	56.0	**60**	150.0	90.0	90.0	**94**	--	--	124.0
27	84.0	57.0	57.0	**61**	152.0	91.0	91.0	**95**	--	--	125.0
28	86.0	58.0	58.0	**62**	154.0	92.0	92.0	**96**	--	--	126.0
29	88.0	59.0	59.0	**63**	156.0	93.0	93.0	**97**	--	--	127.0
30	90.0	60.0	60.0	**64**	158.0	94.0	94.0	**98**	--	--	128.0
31	92.0	61.0	61.0	**65**	160.0	95.0	95.0	**99**	--	--	129.0
32	94.0	62.0	62.0	**66**	162.0	96.0	96.0				
33	96.0	63.0	63.0	**67**	164.0	97.0	97.0				

Table 9: Parameter Values 28, 29, and 30

Parameter 28—Fixed Boost (%)
Parameter 29—Acceleration Boost (%)
Parameter 30—Slip Compensation (%)

Parameter Setting	Value for Parameter			Parameter Setting	Value for Parameter			Parameter Setting	Value for Parameter		
	28	29	30		28	29	30		28	29	30
00	0.0	0.0	0.0	**34**	17.0	6.8	3.4	**68**	--	13.6	--
01	0.5	0.2	0.1	**35**	17.5	7.0	3.5	**69**	--	13.8	--
02	1.0	0.4	0.2	**36**	18.0	7.2	3.6	**70**	--	14.0	--
03	1.5	0.6	0.3	**37**	18.5	7.4	3.7	**71**	--	14.2	--
04	2.0	0.8	0.4	**38**	19.0	7.6	3.8	**72**	--	14.4	--
05	2.5	1.0	0.5	**39**	19.5	7.8	3.9	**73**	--	14.6	--
06	3.0	1.2	0.6	**40**	20.0	8.0	4.0	**74**	--	14.8	--
07	3.5	1.4	0.7	**41**	20.5	8.2	4.1	**75**	--	15.0	--
08	4.0	1.6	0.8	**42**	21.0	8.4	4.2	**76**	--	15.2	--
09	4.5	1.8	0.9	**43**	21.5	8.6	4.3	**77**	--	15.4	--
10	5.0	2.0	1.0	**44**	22.0	8.8	4.4	**78**	--	15.6	--
11	5.5	2.2	1.1	**45**	22.5	9.0	4.5	**79**	--	15.8	--
12	6.0	2.4	1.2	**46**	23.0	9.2	4.6	**80**	--	16.0	--
13	6.5	2.6	1.3	**47**	23.5	9.4	4.7	**81**	--	16.2	--
14	7.0	2.8	1.4	**48**	24.0	9.6	4.8	**82**	--	16.4	--
15	7.5	3.0	1.5	**49**	24.5	9.8	4.9	**83**	--	16.6	--
16	8.0	3.2	1.6	**50**	25.0	10.0	5.0	**84**	--	16.8	--
17	8.5	3.4	1.7	**51**	25.5	10.2	--	**85**	--	17.0	--
18	9.0	3.6	1.8	**52**	26.0	10.4	--	**86**	--	17.2	--
19	9.5	3.8	1.9	**53**	26.5	10.6	--	**87**	--	17.4	--
20	10.0	4.0	2.0	**54**	27.0	10.8	--	**88**	--	17.6	--
21	10.5	4.2	2.1	**55**	27.5	11.0	--	**89**	--	17.8	--
22	11.0	4.4	2.2	**56**	28.0	11.2	--	**90**	--	18.0	--
23	11.5	4.6	2.3	**57**	28.5	11.4	--	**91**	--	18.2	--
24	12.0	4.8	2.4	**58**	29.0	11.6	--	**92**	--	18.4	--
25	12.5	5.0	2.5	**59**	29.5	11.8	--	**93**	--	18.6	--

Table 9: Parameter Values 28, 29, and 30 (continued)

Parameter 28—Fixed Boost (%)
Parameter 29—Acceleration Boost (%)
Parameter 30—Slip Compensation (%)

Parameter Setting	Value for Parameter			Parameter Setting	Value for Parameter			Parameter Setting	Value for Parameter		
	28	29	30		28	29	30		28	29	30
26	13.0	5.2	2.6	**60**	30.0	12.0	--	**94**	--	18.8	--
27	13.5	5.4	2.7	**61**	--	12.2	--	**95**	--	19.0	--
28	14.0	5.6	2.8	**62**	--	12.4	--	**96**	--	19.2	--
29	14.5	5.8	2.9	**63**	--	12.6	--	**97**	--	19.4	--
30	15.0	6.0	3.0	**64**	--	12.8	--	**98**	--	19.6	--
31	15.5	6.2	3.1	**65**	--	13.0	--	**99**	--	19.8	--
32	16.0	6.4	3.2	**66**	--	13.2	--				
33	16.5	6.6	3.3	**67**	--	13.4	--				

Table 10: Parameter Values 40 and 41

Parameter 40—Frequency Scaling (Hz)
Parameter 41—Load Scaling (%)

Parameter Setting	Value for Parameter 40 & 41	Parameter Setting	Value for Parameter 40 & 41	Parameter Setting	Value for Parameter 40 & 41
00	0.0	**34**	68.0	**68**	136.0
01	2.0	**35**	70.0	**69**	138.0
02	4.0	**36**	72.0	**70**	140.0
03	6.0	**37**	74.0	**71**	142.0
04	8.0	**38**	76.0	**72**	144.0
05	10.0	**39**	78.0	**73**	146.0
06	12.0	**40**	80.0	**74**	148.0
07	14.0	**41**	82.0	**75**	150.0
08	16.0	**42**	84.0	**76**	152.0
09	18.0	**43**	86.0	**77**	154.0
10	20.0	**44**	88.0	**78**	156.0

Table 10: Parameter Values 40 and 41 (continued)

Parameter 40—Frequency Scaling (Hz)
Parameter 41—Load Scaling (%)

Parameter Setting	Value for Parameter 40 & 41	Parameter Setting	Value for Parameter 40 & 41	Parameter Setting	Value for Parameter 40 & 41
11	22.0	**45**	90.0	**79**	158.0
12	24.0	**46**	92.0	**80**	160.0
13	26.0	**47**	94.0	**81**	162.0
14	28.0	**48**	96.0	**82**	164.0
15	30.0	**49**	98.0	**83**	166.0
16	32.0	**50**	100.0	**84**	168.0
17	34.0	**51**	102.0	**85**	170.0
18	36.0	**52**	104.0	**86**	172.0
19	38.0	**53**	106.0	**87**	174.0
20	40.0	**54**	108.0	**88**	176.0
21	42.0	**55**	110.0	**89**	178.0
22	44.0	**56**	112.0	**90**	180.0
23	46.0	**57**	114.0	**91**	182.0
24	48.0	**58**	116.0	**92**	184.0
25	50.0	**59**	118.0	**93**	186.0
26	52.0	**60**	120.0	**94**	188.0
27	54.0	**61**	122.0	**95**	190.0
28	56.0	**62**	124.0	**96**	192.0
29	58.0	**63**	126.0	**97**	194.0
30	60.0	**64**	128.0	**98**	196.0
31	62.0	**65**	130.0	**99**	198.0
32	64.0	**66**	132.0		
33	66.0	**67**	134.0		

APPENDIX B—DISPLAY MESSAGES

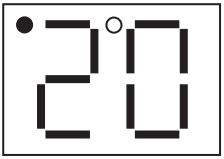
Speed Setpoint Display Stop State

The “Initial Power Up and Motor Rotation” section describes the display observed when power is first applied to the drive controller. If the drive controller is in a stop state, and the speed is controlled using the ▲ and ▼ buttons, the first push of either button causes the display to show the whole Hz portion of the present speed setpoint. The factory default speed setpoint is 20.0 Hz. This is shown below:

Push ▲ or ▼ once.

Left decimal point illuminates.

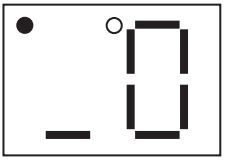
Whole Hz portion of present speed setpoint is displayed.



Push ▲ or ▼ again.

Left decimal point remains illuminated.

Tenths of Hz portion of present speed setpoint is displayed momentarily, then returns to whole Hz display.



To change the speed setpoint, use the ▲ and ▼ buttons to scroll to the desired setpoint.

If Parameter 16—Keypad Speed Editing is set for tenths of Hz, and the ▲ or ▼ button is held down, the speed setpoint will change by tenths of Hz increments until the next whole Hz is reached, at which point the setpoint will change by 1 Hz increments. If the ▲ or ▼ button is pushed repeatedly, the setpoint changes by tenths of Hz increments.

If Parameter 16—Keypad Speed Editing is set for whole Hz, the setpoint only changes by one Hz increments.

Speed Display in a Run State

If the drive controller is in a run state, the display continuously indicates the whole Hz portion of the actual output frequency to the motor (the left decimal point is not illuminated). To see the tenths of Hz portion, press the ▲ or ▼ button once. This displays the tenths of Hz portion (the left decimal point will illuminate), but does not change the speed setpoint.

To change the speed setpoint, follow the procedure described above. If the setpoint is changed faster than the acceleration or deceleration rate of the drive controller, the left decimal point starts blinking to indicate that the drive controller is accelerating or decelerating to the new setpoint.

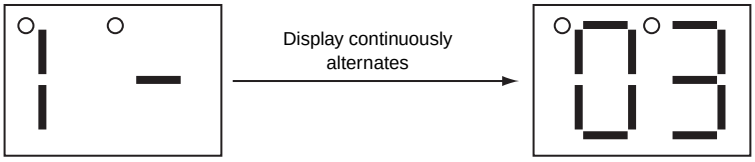
When the drive controller is given a start command, the speed display begins increasing as the drive controller accelerates to the speed setpoint. If the speed setpoint is viewed when the drive controller is started, the left decimal point starts blinking as the drive controller accelerates to the speed setpoint.

When a stop command is given, and Parameter 04—Stop Method is set for ramp to stop, the speed display begins decreasing as the drive controller decelerates to a stop. Once stopped, the display indicates "--". If the stop method is set for ramp with DC braking, the display indicates "br" during the DC braking cycle. Once the DC braking cycle ends, the display then indicates "--".

When a stop command is given, and Parameter 04—Stop Method is set for coast to stop, the display immediately indicates "--". If the stop method is set for coast with DC braking, the display indicates "br" during the DC braking cycle. Once the DC braking cycle ends, the display then indicates "--".

Speed Display When the Speed is 100 Hz or Greater

In order to display speeds in excess of 99.9 Hz, the output frequency is shown in two parts, which continuously alternate. The first part to be displayed is "1-", which indicates that the speed is 100 Hz or greater. The second part of the display shows the "tens" and "ones" portion of the setpoint, and would be a number between "00" and "20", as the maximum output frequency is 120 Hz. An example is shown below for a speed setpoint of 103 Hz:



When the speed source is changed while the drive controller is running, the display flashes the message for the new speed source to indicate that the new speed source is active. Also, if the drive controller is controlled from a speed source other than the ▲ and ▼ buttons (0–10 Vdc, 4–20 mA, etc.), and one of the ▲ or ▼ buttons is pressed, the display flashes the present speed source message to indicate that the ▲ and ▼ buttons are invalid.

Example 1: The drive controller is running and the present speed source is the keypad. TB-13A is programmed to select a 4–20 mA signal as the speed source. When TB-13A is closed to TB-2, the display flashes "Ei" to indicate that the speed source has changed to the 4–20 mA signal. If the contact between TB-13A and TB-2 is opened, the display flashes "kP" to indicate that the speed source has changed back to the ▲ and ▼ buttons.

Example 2: The speed source is a 0–10 Vdc signal. If the ▲ or ▼ button is pushed, the display flashes "Eu" to indicate that the present speed source is the 0–10 Vdc signal and that the ▲ and ▼ buttons are invalid.

Speed Source Displays and Status Messages

Table 11: Speed Source Displays

Display	Description
CP	CONTROL PAD: Speed is set using the UP and DOWN buttons on the front of the drive controller.
EI	EXTERNAL CURRENT: Speed is controlled by a 4–20 mA signal wired to TB-25 and TB-2.
EU	EXTERNAL VOLTAGE: Speed is controlled by a 0–10 Vdc signal wired to TB-5 and TB-2.
JG	JOG: The drive controller is in Jog mode, and the speed is set by Preset Speed 2 (Parameter 32).
OP	MOP (Motor Operated Potentiometer): Contacts wired to TB-13B and TB-13C are used to increase and decrease the drive controller speed.
P1–P7	PRESET SPEEDS 1–7: Speed is set by the indicated Preset Speed (Parameters 31–37).

Table 12: Status Messages

Display	Description
br	DC BRAKING: The DC braking circuit is activated.
CL	CURRENT LIMIT: The output current has exceeded the Current Limit setting (Parameter 25) and the drive controller is reducing the output frequency to reduce the output current. If the drive controller remains in Current Limit for too long, it can trip into a Current Overload fault (PF).
Er	ERROR: Invalid data has been entered.
GE	"GE" is displayed if an attempt is made to change the OEM default settings when the drive controller is operating in the OEM mode (see Parameter 48).
GF	If "GF" is displayed when a Reset OEM is attempted, it indicates that the OEM defaults in the EPM are corrupted. If "GF" is displayed upon power-up, it indicates that the OEM defaults and the user settings in the EPM are corrupted. Refer to "Electronic Programming Module (EPM)" on page 43.
LC	FAULT LOCKOUT: The drive controller has failed three restart attempts and now requires a manual reset.
SP	START PENDING: "SP" blinks during the interval between restart attempts.
●●	DECEL OVERRIDE (both decimal points illuminated): To avoid tripping into a High DC Bus Voltage fault (HF) while decelerating due to regenerative voltage from the motor, the drive controller stops decelerating in order to keep the DC bus voltage below the trip level.

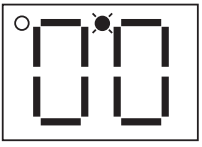
APPENDIX C—TROUBLESHOOTING

To aid in troubleshooting, Parameters 50 through 60 can be accessed without entering the password. Press the Mode button three times to skip over the password prompt, and “50” is displayed. This indicates that you are in the Program mode and Parameter 50 (Fault History) is displayed. Use the ▲ and ▼ buttons to scroll from Parameter 50 to Parameter 60. Once the desired Parameter is found, press the Mode button to see its setting. When finished, press Mode to exit the Program mode. An example is shown below:

Press Mode once.

Display indicates “00”.

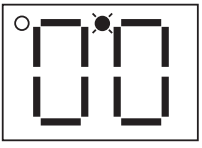
Right decimal point blinks.



Press Mode again.

Display still indicates “00”.

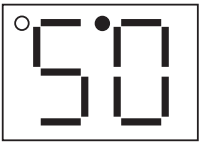
Right decimal point blinks faster.



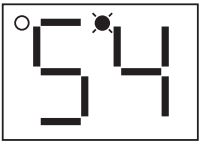
Press Mode again.

Display indicates “50” (Fault History).

Right decimal point stays on instead of blinking.



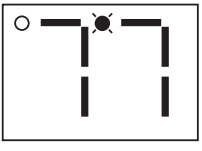
Use ▲ and▼ to scroll to the desired parameter number. In this example, parameter 54, Motor Load, has been selected.



Press Mode to view parameter contents (“77”=77% Load).

Right decimal point blinks.

Press Mode again to exit.



In the example on the previous page, Parameter 54 was viewed, which displayed Motor Load. The "77" in the example indicates that the load on the motor is 77% of the output current rating of the drive controller.

The table below lists the fault conditions that cause the drive controller to shut down, as well as some possible causes. Please contact your local Square D sales representative for more information on troubleshooting faults.

Table 13: Fault Messages

Fault	Description	Possible Causes	Corrective Action
AF	High Temperature fault	Ambient temperature too high. Fan failure (if equipped). Operating altitude.	Check motor load, fan, and ambient temperature at the drive controller. Wait for the drive controller to cool down before resetting. Derate for operating altitude.
CF	Control fault	A blank EPM, or an EPM with corrupted data has been installed.	Use Parameter 48 to reset to factory defaults or OEM defaults (if present).
EF	External fault	TB-13A and/or TB-13C is set as an External Fault input and TB-13A and/or TB-13C is open with respect to TB-4.	Refer to Parameter 10.
GF	Data fault	User data and OEM defaults in the EPM are corrupted.	1. Obtain new EPM from OEM or 2. Reset to factory defaults instead of OEM defaults.
HF	High DC Bus Voltage fault	High line voltage. Overhauling load. Deceleration rate set too fast.	Check input line voltage. Check Parameter (01)—Line Voltage for proper voltage selection. Add braking option, if necessary. Increase deceleration rate.
LF	Low DC Bus Voltage fault	Low line voltage.	Adjust line voltage.
OF	Output fault	Phase to phase or phase to ground short. Bad output transistor. Boost settings are too high.	Remove all power. With drive controller disconnected, check connecting cables and motor insulation. Replace output transistor. Adjust boost settings.
PF	Current Overload fault	Drive may be undersized. Problem with driven equipment.	Verify that drive is sized properly for motor load. Inspect motor

Table 13: Fault Messages (continued)

Fault	Description	Possible Causes	Corrective Action
cF	Compatibility fault	EPM programed for another drive and is not compatible with this drive.	Verify EPM is installed in correct drive.
SF	Single phasing fault	One phase of three-phase input is not present.	Verify input voltage at L1, L2, L3.
UF	Start fault	Start command was present when drive controller was powered up.	Must wait 2 seconds after power-up to apply Start command if Start Method is set to Normal.
F1	EPM fault	The EPM module is missing, damaged, or improperly seated.	Install, replace, or reseat the EPM module.
F2–F9, Fo	Internal faults	Control board has sensed a problem.	Consult factory.
dF	Dynamic Brake fault	DB overloaded.	1. Increase decel time or 2. Remove overhauling load.
JF	Remote (Serial) fault	Loss of communication with remote keypad or other serial device.	1. Reconnect serial device or 2. Reduce time between status updates on remote serial device or 3. Reduce cabling cross talk/noise.

To clear a fault, stop the controller, either on the terminal strip, or by using the Stop button on the optional remote keypad. The fault only clears if the condition that caused the fault has passed. For example, if the controller trips on a Low DC Bus Voltage Fault (LF) due to low input voltage, the fault cannot be cleared until the input voltage returns to a normal level.

The following faults can be cleared by Stop or by Auto Restart:

- AF (temperature)
- dF (dynamic braking)
- EF (external fault)
- HF (high bus voltage)
- JF (communications fault)
- LF (low bus voltage)
- OF (output transistor fault)
- PF (overload fault)
- SF (single-phasing fault)

Start Fault (UF) cannot occur with Auto Restart, so only Stop will clear it.

The following faults can be cleared by powering down the controller and replacing the EPM with the correct one, or by resetting the controller to factory default parameters and then asserting Stop to clear the fault:

- CF (control fault)
- cF (incompatibility fault)
- GF (data fault)

F2 to F9 and F0 (internal faults) can only be cleared by powering down the drive controller and powering it back up. In the case of F1 (EPM fault), the faulty EPM module must also be replaced or repositioned while the drive controller is powered down.

If the drive controller is programmed for Auto Restart (Parameter 03), the drive controller automatically attempts to restart three times after a fault. If all three restart attempts are unsuccessful, the drive controller trips into Fault Lockout (LC), which requires a manual reset as described above.

APPENDIX D—BUS VOLTAGE MEASUREMENT PROCEDURE

⚠ DANGER

HAZARDOUS VOLTAGE

- This equipment contains energy storage devices. Read and understand the Bus Voltage Measurement Procedure before performing procedure. Measurement of DC bus capacitor voltage must be performed by qualified personnel.
- The display is not an accurate indication of the absence of DC bus voltage.
- DO NOT short across capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Many parts in this drive controller, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Electrical shock will result in death or serious injury.

To measure the bus capacitor voltage:

1. Disconnect and verify that all power is removed from drive controller.
2. Wait 3 minutes to allow the DC bus to discharge.
3. Set the voltmeter to the 1000 Vdc scale. Measure the voltage between the terminals B- and B+ (see Figure 18) to verify that the DC voltage is less than 45 V. **Do not short across capacitor terminals with voltage present!**
4. If the bus capacitors are not fully discharged, contact your local Square D representative. **Do not operate the drive controller.**

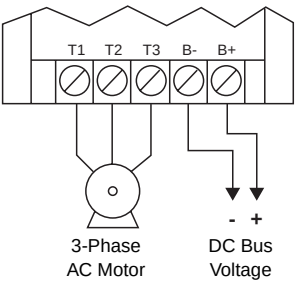


Figure 18: DC Bus Voltage Measurement Terminals

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V

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DESCRIPTION OF PARAMETERS

Square D Company
8001 Highway 64 East
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(919) 266-3671
www.squared.com

Electrical equipment should be serviced only by qualified electrical maintenance personnel. No responsibility is assumed by Square D for any consequences arising out of the use of this material.

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