

INSTALLATION AND OPERATION MANUAL

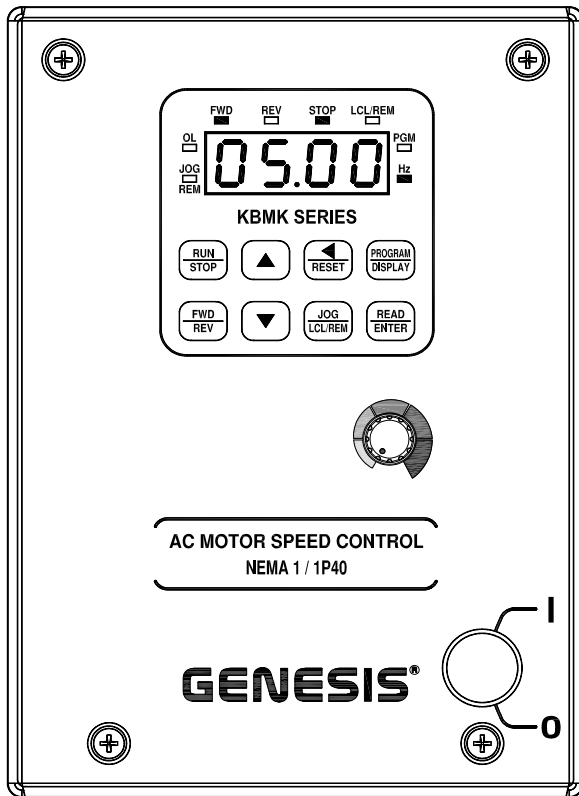
KBMK SERIES

Adjustable Frequency Drives
for 1/8 HP thru 1 HP 3-Phase AC Motors Rated 208 – 230 VAC, 50/60 Hz

NEMA 1 / IP40

Operate from 115* and 208/230 Volt 50/60 Hz AC Line

Variable Speed / Soft-Start with Electronic Motor Overload Protection¹



IMPORTANT

THIS DRIVE IS FACTORY SET FOR:

1. 60 Hz Motors.

For 50 Hz motors, see Figure 12 on page 11.

2. 208/230 Volt AC Line Input.

For 115 Volt AC Line input, see Section 7 on page 10.

 See Safety Warning, on page 4.



This Manual Covers Models KBMK-24D (Part No. 9680) and KBMK-24DF (Part No. 9681)²

The information contained in this manual is intended to be accurate.
However, the manufacturer retains the right to make changes in design which may not be included herein.

Notes: 1. UL approved as an electronic overload protector for motors. 2. Model KBMK-24DF contains a built-in AC Line Class A RFI (EMI) filter which meets CE Council Directive 89/336/EEC Industrial Requirement.



TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1 Quick-Start Instructions	3
1.1 Mounting Instructions	3
1.2 AC Line Input Connection	3
1.3 AC Line Fusing	3
1.4 Ground Connection	3
1.5 Motor Connection	3
1.6 50 Hz and 60 Hz Motor Operation	3
1.7 Jumper J1 Setting	3
1.8 Motor Overload Protection	3
2 Safety Warning	4
3 Important Application Information	4
3.1 Motor with External Fan Cooling	4
3.2 Electronic Motor Overload Protection	4
4 Introduction	5
4.1 Standard Features	5
4.2 Performance Features	5
4.3 Protection Features	5
5 Mounting	8
6 Electrical Connections	8
6.1 AC Line Input Connection	9
6.2 AC Line Fusing	9
6.3 Ground Connection	9
6.4 Motor Connection	9
6.5 Multi-Function Output Relay Connection	9
6.6 Remote Operations Which Require the Optional IODA Input/Output Multi-Function Board	9
7 AC Line Input Voltage Selection (Jumper J1)	10
8 Recommended High Voltage Dielectric Withstand Testing (Hi-Pot Testing)	10
9 Drive Operation	11
9.1 Start-Up Procedure	11
9.2 Keypad Description	11
9.3 Flow Charts for Important Programming Functions	11
9.4 4-Digit Display	15
9.5 Fault Recovery	15
10 Programmable Function Summary List	15
11 Status LEDs	22
12 Optional Accessories	22
Limited Warranty	Back Cover

<u>TABLES</u>	<u>PAGE</u>
1 Electrical Ratings	6
2 General Performance Specifications	6
3 Terminal Blocks Wire and Tightening Torque Specifications	8
4 Multi-Function Output Relay "Run" and "Fault" Operating Modes	9
5 Keypad Description	11
6 Digital Readout Codes	15
7 LED Descriptions	22
8 Optional Accessories	22

<u>FIGURES</u>	<u>PAGE</u>
1 General Connection Diagram	3
2 Maximum Allowed Motor Torque vs. Speed	4
3 Open Ventilated Motor with External Fan Cooling	4
4 Keypad Layout with Built-In Speed Potentiometer	6
5 Cover Layout	7
6 Drive Layout	7
7 Mechanical Specifications	8
8 AC Line Input, Motor, and Ground Connections	9
9 Multi-Function Output Relay Contacts	9
10 AC Line Input Voltage Selection (Jumper J1)	10
11 Typical Hi-Pot Test Setup	10
12 Programming Flow Chart to Change the Drive Output Frequency (Example: From 60 Hz Motors to 50 Hz Motors)	11
13 Programming Flow Chart to Change Motor Current (Example: From 3.6 Amps to 2.5 Amps)	12
14 Programming Flow Chart to Change Set Frequency (Example: From 5.00 Hz to 43.21 Hz)	12
15 Programming Flow Chart to Change Accel Time (Example: From 1.5 Seconds to 120 Seconds)	13
16 Programming Flow Chart to Change Display (Example: Show Motor RPM)	13
17 Programming Flow Chart to Change Display (Example: Show Custom Units "012.0")	14
18 Programming Flow Chart to Change Display (Example: Add Motor Current, Motor Voltage, and Bus Voltage to Basic Display)	14
19 Function No. Description	16

UL NOTICE

115 Volt Drives: Suitable for use on a circuit capable of delivering not more than 5 kA RMS symmetrical Amperes. 115 Volts maximum. Use copper conductors rated 75 °C. Suitable for operation in a maximum surrounding air temperature of 40 °C.

230 Volt Drives: Suitable for use on a circuit capable of delivering not more than 5 kA RMS symmetrical amperes, 230 Volts maximum. Use copper conductors rated 75 °C. Suitable for operation in a maximum surrounding air temperature of 40 °C.

IMPORTANT APPLICATION INFORMATION

1. 50 Hz Motors: This drive has been factory programmed to operate 60 Hz motors. For 50 Hz motor operation, set Function No. 0.00 to 50 Hz "0001". See Figure 12 on page 11. **2. Motor Current Setting:** The motor current is factory set to 3.6 Amps (1 HP (0.75 kW)), as shown in Table 1 on page 6. In order for the motor overload protection to operate properly, the drive must be reprogrammed to the actual motor nameplate current. Use Function No. 0.01 to enter the motor nameplate current, as shown in Figure 13 on page 12.

1 – QUICK-START INSTRUCTIONS

IMPORTANT: You must read these simplified instructions before proceeding. These instructions are to be used as a reference only and are not intended to replace the details provided herein. You must read the Safety Warning, on page 4, before proceeding.

RECONDITIONING THE BUS CAPACITORS: This drive contains bus capacitors, which must be reconditioned if the drive has been in storage for over 1 year. To recondition the bus capacitors, apply the AC Line, with the drive in the Stop Mode, for a minimum of 30 minutes.

See Figure 1. Also see Section 3 – Important Application Information on page 4.



WARNING! HIGH VOLTAGE! Disconnect main power before making connections to the drive. Do not depend on the green Power On LED (ON), located on the drive's PC board, as shown in Figure 6 on page 7, or the Status LEDs and the 4-Digit Display, located on the front cover, to no longer be illuminated as a guaranteed power off condition.

Note: It is recommended that both Feed-Through Bushings be used to connect the drive. If signal wiring (for the Multi-Function Output Relay contacts or for a Remote Speed Potentiometer) is required, it is recommended that the extra Feed-Through Bushing (supplied) be used to replace the center Hole Plug. Standard ½" fittings (not supplied) can also be used in lieu of the Feed-Through Bushings.

1.1 – MOUNTING INSTRUCTIONS

See Section 5 on page 8.

1.2 – AC LINE INPUT CONNECTION

Connect the AC Line input to Terminal Block TB1 (Terminals L1, L2), as shown in Figure 1. Also see Section 6.1 on page 9.

Application Note: If operation with a Ground-Fault Circuit-Interrupter (GFCI) is required, see Function No. 0.04 on page 16.

Note: The drive is factory set for 208/230 Volt AC Line input (Jumper J1 not installed). For 115 Volt AC Line input, install Jumper J1 (supplied). See Section 7 on page 10.

1.3 – AC LINE FUSING

It is recommended that a fuse(s) or circuit breaker(s) be installed in the AC Line. Fuse each conductor that is not at ground potential. For the recommended fuse size, see Table 1 on page 6. Also see Section 6.2 on page 9.

1.4 – GROUND CONNECTION

Connect the ground wire (earth) to Terminal Block TB1 (Terminal GND). Be sure the motor is also properly grounded. See Figure 1.

1.5 – MOTOR CONNECTION

Connect the motor to Terminal Block TB1 (Terminals U, V, W), as shown in Figure 1 above. Be sure the motor is properly grounded. Motor cable length should not exceed 100 ft. (30 m) – special reactors may be required – contact Technical Support. See Section 6.4 on page 9.

1.6 – 60 Hz AND 50 Hz MOTOR OPERATION

The drive is factory set for 60 Hz motors (Function No. 0.00 set to "0000"). For 50 Hz motors, set Function No. 0.00 to "0001", as shown in Figure 12 on page 11. For other motor frequencies, set Function No. 0.00 to "0002".

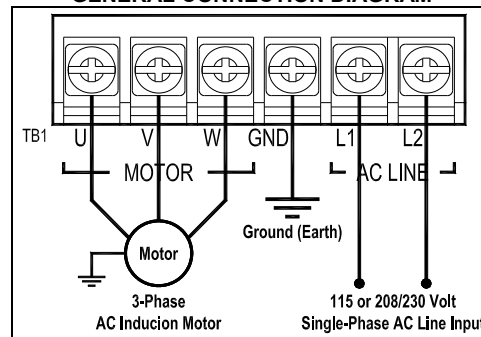
1.7 – JUMPER J1 SETTING

The drive is factory set for 208/230 Volt AC Line input (Jumper J1 not installed). For 115 Volt AC Line input, install Jumper J1 (supplied). See Section 7 on page 10.

1.8 – MOTOR OVERLOAD PROTECTION

Function No. 0.01 must be set to the motor nameplate current for proper operation of the I²t Motor Overload Protection. See Figure 13 on page 12.

**FIGURE 1
GENERAL CONNECTION DIAGRAM**



2 – SAFETY WARNING

Definition of Safety Warning Symbols



Electrical Hazard Warning Symbol: Failure to observe this warning could result in electrical shock or electrocution.



Operational Hazard Warning Symbol: Failure to observe this warning could result in serious injury or death.



SAFETY WARNING! – PLEASE READ CAREFULLY!

This product must be installed and serviced by a qualified technician, electrician, or electrical maintenance person familiar with its operation and the hazards involved. Proper installation, which includes electrical connections, fusing or other current protection, and grounding, can reduce the chance of electrical shocks, and/or fires, in this product or products used with this product, such as electric motors, switches, coils, solenoids, and/or relays. Do not use this drive in an explosion-proof application. Eye protection must be worn and insulated adjustment tools must be used when working with drive under power. This product is constructed of materials (plastics, metals, carbon, silicon, etc.) which may be a potential hazard. Proper shielding, grounding, and filtering of this product can reduce the emission of radio frequency interference (RFI) which may adversely affect sensitive electronic equipment. It is the responsibility of the equipment manufacturer and individual installer to supply this Safety Warning to the ultimate end user of this product. (SW 8/2012)

The control contains electronic Start/Stop circuits, which can be used to start and stop the control. However, these circuits are never to be used as safety disconnects since they are not fail-safe. Disconnect the input power for this purpose. Be sure to read and follow all instructions carefully. Fire and/or electrocution can result due to improper use of this product.



This product complies with all CE directives pertinent at the time of manufacture. Contact Technical Support for Declaration of Conformity. Installation of a CE approved RFI filter is required. See RFI Filters & Chokes Selection Guide D-321 (Part No. A42027) for the selection of filters to meet the Industrial or Residential Standard. Additional shielded cable and/or AC Line cables may be required along with a signal isolator (IODA Input/Output Multi-Function Board (Part No. 9668)).

3 – IMPORTANT APPLICATION INFORMATION

3.1 – MOTOR WITH EXTERNAL FAN COOLING

Most totally enclosed fan-cooled (TEFC) and open ventilated 3-phase AC induction motors will overheat if used beyond a limited speed range at full torque. Therefore, it is necessary to reduce motor load as speed is decreased.

Note: Some fan-cooled motors can be used over a wider speed range. Consult the motor manufacturer for details.



CAUTION! 1. Some motors have low speed characteristics, which cause overheating and winding failure under light load or no-load conditions. If the motor is operated in this manner for an extended period of time, it is recommended that the unloaded motor current be checked from 2 – 15 Hz (60 – 450 RPM) to ensure motor current does not exceed the nameplate rating. If the motor current exceeds the nameplate rating, the Boost value may have to be decreased (see Function No. 3.11). Do not use the motor if the motor current exceeds the nameplate rating. **2.** It is recommended that the drive be used with Inverter Duty or Totally Enclosed Non-Ventilate (TENV) motors. Inverter duty and most TENV motors can provide full rated torque over an extended speed range without overheating. See Figure 2. **3.** If external fan cooling is provided, open ventilated motors can also achieve an extended speed range at full rated torque. A box fan or blower with a minimum of 100 CFM per HP is recommended. Mount the fan or blower so the motor is surrounded by the airflow. See Figure 3.

FIGURE 2

MAXIMUM ALLOWED MOTOR TORQUE VS. SPEED

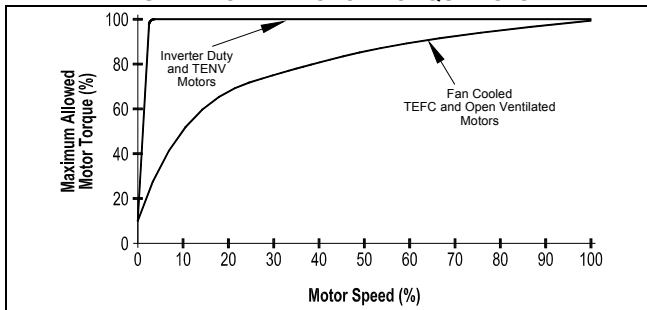
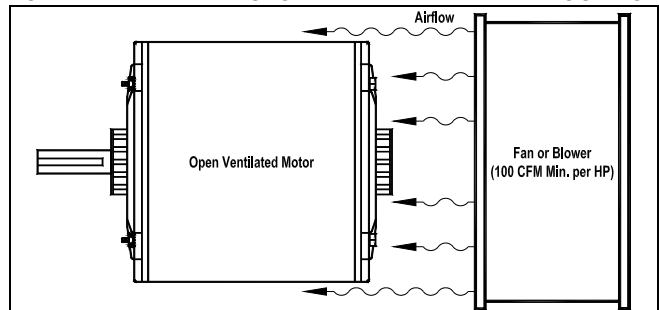


FIGURE 3

OPEN VENTILATED MOTOR WITH EXTERNAL FAN COOLING



3.2 – ELECTRONIC MOTOR OVERLOAD PROTECTION

The drive contains Modified I²t Overload Protection (UL approved as an overload protector for motors). Part of this function consists of a Current Limit (CL) circuit, which limits the drive current to a preset level of 160% of the Motor Nameplate Rated Current setting. The factory setting for motor nameplate current is the drive rated current, which must be set to the actual motor nameplate current (see Important Application Information (Item 2), on page 3). See Table 1 on page 6. Also see Function No. 0.01 on page 16.

Standard I²t is undesirable because it causes nuisance tripping. It allows a very high motor current to develop and will turn the drive off after a short period of time. KB's RMS Current Limit Circuit, which includes I²t plus an I*t timing circuit (as described in the paragraph below), avoids this nuisance tripping while providing maximum motor protection.

If the motor is overloaded to 120% of the Motor Nameplate Rated Current setting, the I*t Timer starts. If the motor continues to be overloaded at the 120% level, the timer will shut down the drive after 30 minutes. If the motor is overloaded to 160% of full load, the drive will trip in 6 seconds.

4 – INTRODUCTION

Thank you for purchasing the KBMK Series Adjustable Frequency Drive. KB Electronics, Inc. is committed to providing total customer satisfaction by producing quality products that are easy to install and operate.

The drives are variable speed controls housed in a rugged NEMA 1 / IP40 enclosure. They are designed to operate 208 – 230 Volt 50 & 60 Hz 3-phase AC induction motors from 1/8 HP thru 1 HP. The sine wave coded Pulse Width Modulated (PWM) output provides high motor efficiency and low noise. Adjustable Linear Acceleration and Deceleration make the drive suitable for soft-start applications. Model KBMK-24DF contains a built-in AC Line Class A RFI (EMI) filter which meets the CE Council Directive 89/336/EEC Industrial Requirement.

Due to its user-friendly design, the drive is easy to install and operate. Setting the drive to specific applications is accomplished using the Multi-Function Keypad, which provides easy operation and programming of the drive. To facilitate programming, all similar functions are presented in common groups.

The 4-Digit LED Display provides readout of drive operating parameters and programming functions and displays Output Frequency, Motor RPM, Output Current, Output Voltage, Bus Voltage, Function Codes and Values, Fault Codes, and Custom Units. In addition to operating the drive, the Multi-Function Keypad is used to change drive operating parameters, reprogram functions, and change the display output. The LEDs provide indication of the drive's status and operating mode (Hz, PGM, LCL/REM, STOP, FWD, REV, OL, JOG/REM).

The optional IODA Input/Output Multi-Function Board provides a variety of functions, which include preset frequency, up/down frequency control, signal isolation, isolated output voltage for controlling auxiliary devices, open collector outputs, and output relay contacts.

Main Features: Adjustable RMS Current Limit and I²t Motor Overload Protection (UL approved as an electronic overload protector for motors). Flux Vector Compensation with Static Auto-Tune and Boost provides high torque and excellent load regulation over a wide speed range. Power Start™ delivers over 200% motor torque to ensure startup of high frictional loads. Programmable Injection Braking provides rapid motor stop. Electronic Inrush Current Limit (EICL™) eliminates harmful AC Line inrush current, which allows the drive to be line switched. A Multi-Function Output Relay is provided, which can be used to turn on or off equipment or to signal a warning if the drive is put into various modes of operation. The drive is suitable for machine or variable torque (HVAC) applications.

Standard Front Panel Features: 4-Digit LED Display, Multi-Function Keypad, Status Indicator LEDs, and a Built-In Speed Potentiometer.

Optional Accessories: Optional accessories include an On/Off AC Line Switch and IODA Input/Output Multi-Function Board. See Section 12 on page 22.

4.1 – STANDARD FEATURES

Multi-Function Keypad: Used to operate the drive, change operating parameters, reprogram functions, and change the display output (Run/Stop, Forward/Reverse, Up, Down, Shift/Reset, Jog-Local/Remote, Program/Display, Read/Enter).

4-Digit LED Display: Provides readout of drive operating parameters and programming functions. Displays Output Frequency, Motor RPM, Output Current, Output Voltage, Bus Voltage, Function Codes and Values, Fault Codes, and Custom Units.

LED Status Indicators: Provide indication of the drive's status and operating mode (Hz, PGM, LCL/REM, STOP, FWD, REV, OL, JOG/REM).

Multi-Function Output Relay Contacts: Can be used to turn on or off equipment or to signal a warning if the drive is put into various modes of operation. The optional IODA Input/Output Multi-Function Board contains 9 digital and analog inputs, 4 digital and analog outputs, and 2 additional relay outputs.

Motor Current Selection: Programmable motor current allows the drive to be used on a wide range of motor horsepower.

AC Line Input Voltage Selection: (115/230 Volts AC) (J1)

Compatible with most GFCIs: See Function No. 0.04 on page 16.

4.2 – PERFORMANCE FEATURES

Power Start™ – Provides more than 200% starting torque which ensures startup of high frictional loads.

Programmable Flux Vector Compensation with Static Auto-Tune and Boost: Provides excellent load regulation and dynamic response over a wide speed range.

Speed Range: 60:1

4.3 – PROTECTION FEATURES

Motor Overload (I²t) with RMS Current Limit: Provides motor overload protection, which prevents motor burnout and eliminates nuisance trips. UL approved as an electronic overload protector for motors (UL File E188974).

Electronic Inrush Current Limit (EICL™): Eliminates harmful inrush AC Line current during startup.

Short Circuit: Shuts down the drive if a short circuit occurs at the motor (phase-to-phase).

Decel Extend: Eliminates tripping due to bus overvoltage caused by rapid deceleration of high inertial loads.

Undervoltage and Overvoltage: Shuts down the drive if the AC Line input voltage goes below or above the operating range.

MOV Input Transient Suppression.

Microcontroller Self-Monitoring and Auto-Reboot.

**TABLE 1
ELECTRICAL RATINGS**

Model	Part No.	AC Line Input			Fuse or Circuit Breaker Rating (Amps)	Voltage Range (Volts AC)	Output		Net Weight	
		Volts AC (50/60 Hz)	Phase (Φ)	Maximum Current (Amps AC)			Maximum Continuous Load Current (RMS Amps/Phase)	Maximum Horsepower (HP (kW))	Lbs.	kg
KBMK-24D	9680	115	1	14.4	20	0 – 230	3.6	1 (.75)	2.26	1.03
		208/230 ¹	1	9.5	15					
KBMK-24DF ²	9681	115	1	9.5	15	0 – 230	2.4	1/2 (0.37)	2.33	1.06
		208/230 ¹	1	9.5	15	0 – 230	3.6	1 (.75)		

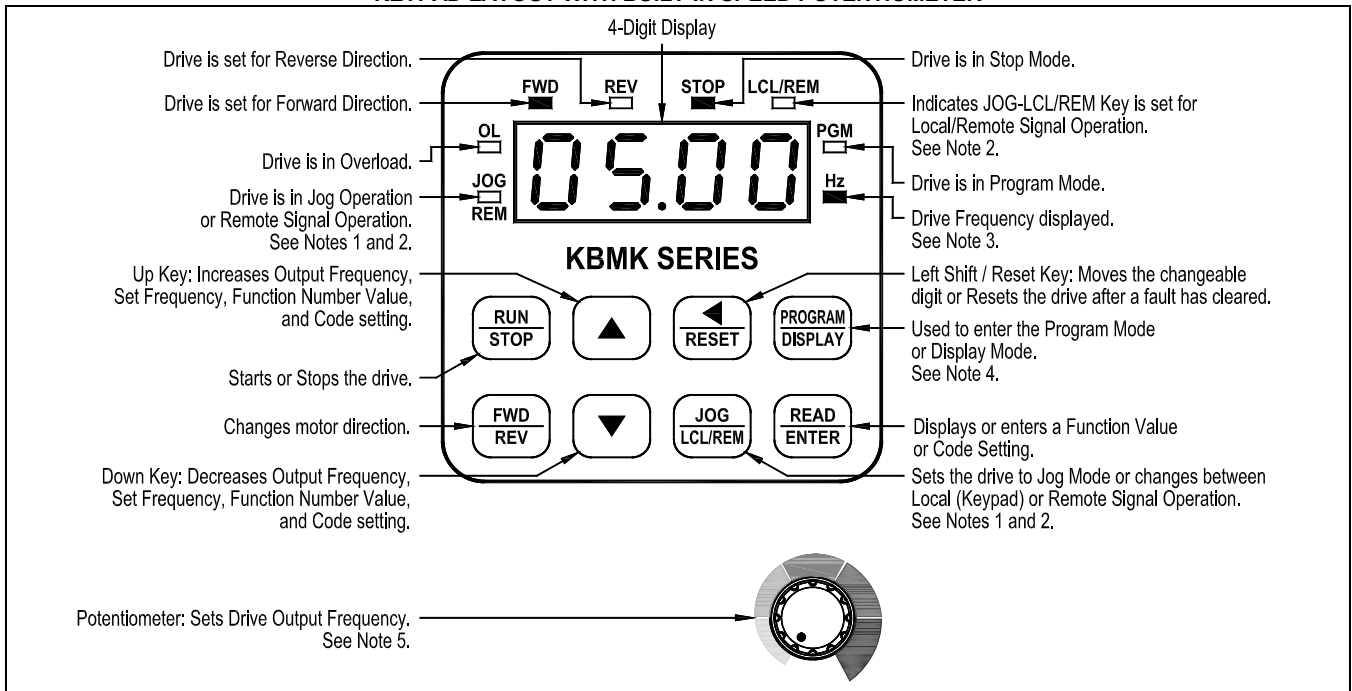
Notes: 1. The drive is factory set for 208/230 Volt AC Line input (J1 not installed). For 115 Volt AC Line input, install Jumper J1 (supplied). See Figure 10 on page 10. 2. Model KBMK-24DF contains a built-in AC Line Class A RFI (EMI) Filter which meets CE Council Directive 89/336/EEC Industrial Requirement.

**TABLE 2
GENERAL PERFORMANCE SPECIFICATIONS**

Description	Specification
115 Volt AC Line Input Voltage Operating Range (Volts AC)	115 (±15%)
208/230 Volt AC Line Input Voltage Operating Range (Volts AC)	208 (-15%) / 230 (+15%) ¹
Maximum Load (% Current Overload for 1 Minute)	150
Switching Frequency (kHz) ²	8, 10, 12
Output Frequency Resolution (Bits, Hz)	10, .06
Minimum Operating Frequency at Motor (Hz)	0.3
Speed Range (Ratio)	60:1
Speed Regulation (30:1 Speed Range, 0 – Full Load) (% Base Speed) ³	2.5
Overload Protector Trip Time for Stalled Motor (Seconds)	6
Multi-Function Output Relay Contact Rating (Amps at 30 Volts DC, 125 Volts AC, 250 Volts AC)	1, 0.5, 0.25
Undervoltage/Overvoltage Trip Points for 115 Volt AC Line Input (± 5%) (Volts AC) ⁴	76 / 141
Undervoltage/Overvoltage Trip Points for 208/230 Volt AC Line Input (± 5%) (Volts AC) ⁴	151 / 282
Operating Temperature Range (°C / °F)	0 – 40 / 32 – 104
Operating Humidity Range (% Relative, Non-condensing)	0 – 95
Storage Temperature (°C / °F)	-25 – +85 / -13 – +185

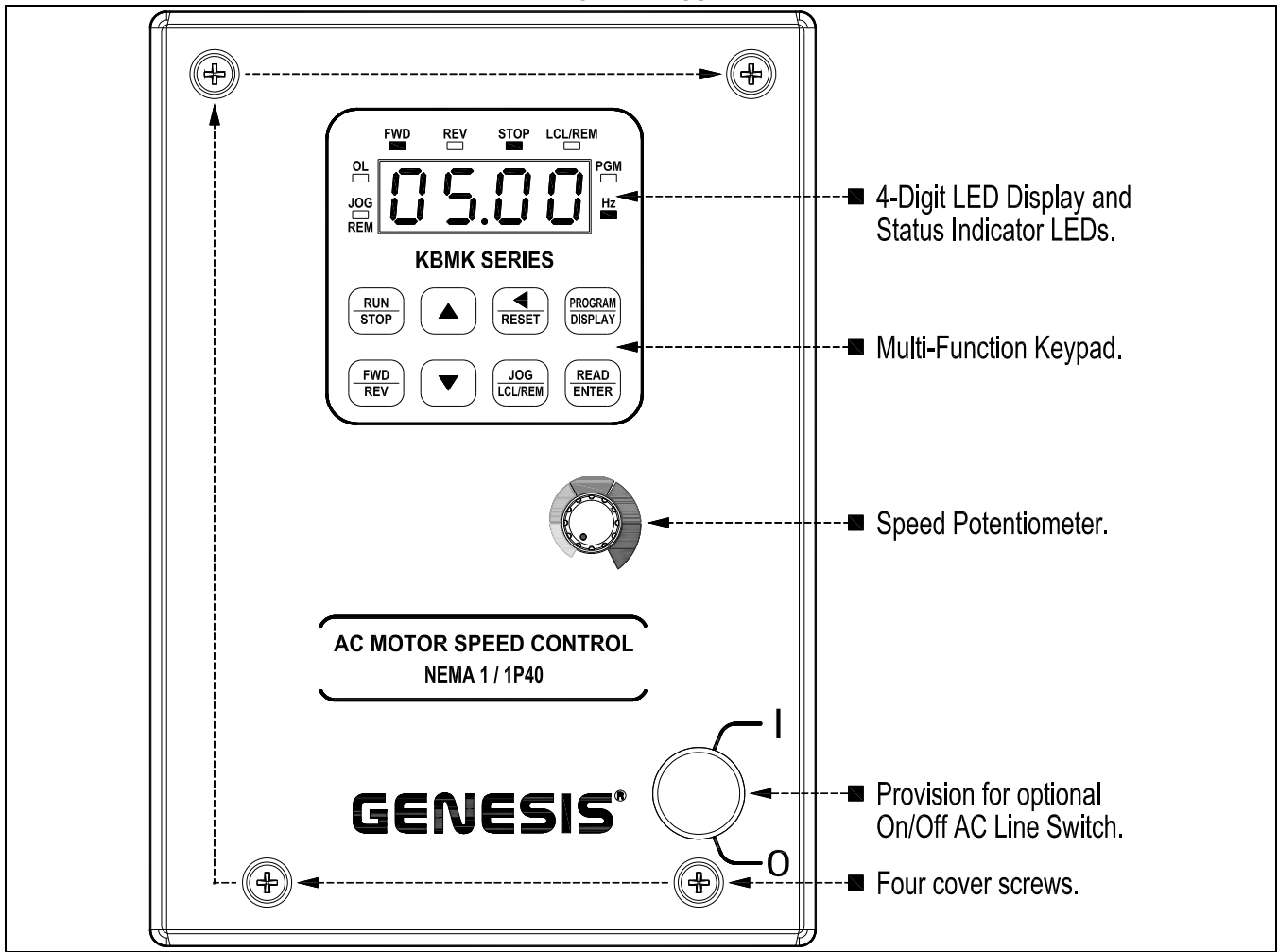
Notes: 1. The drive is factory set for 208/230 Volt AC Line input (J1 not installed). For 115 Volt AC Line input, install Jumper J1 (supplied). See Figure 10 on page 10. 2. Set by Function No. 3.15. 3. Dependent on motor performance. 4. Do not operate the drive outside the specified AC Line input voltage operating range.

**FIGURE 4
KEYPAD LAYOUT WITH BUILT-IN SPEED POTENTIOMETER**

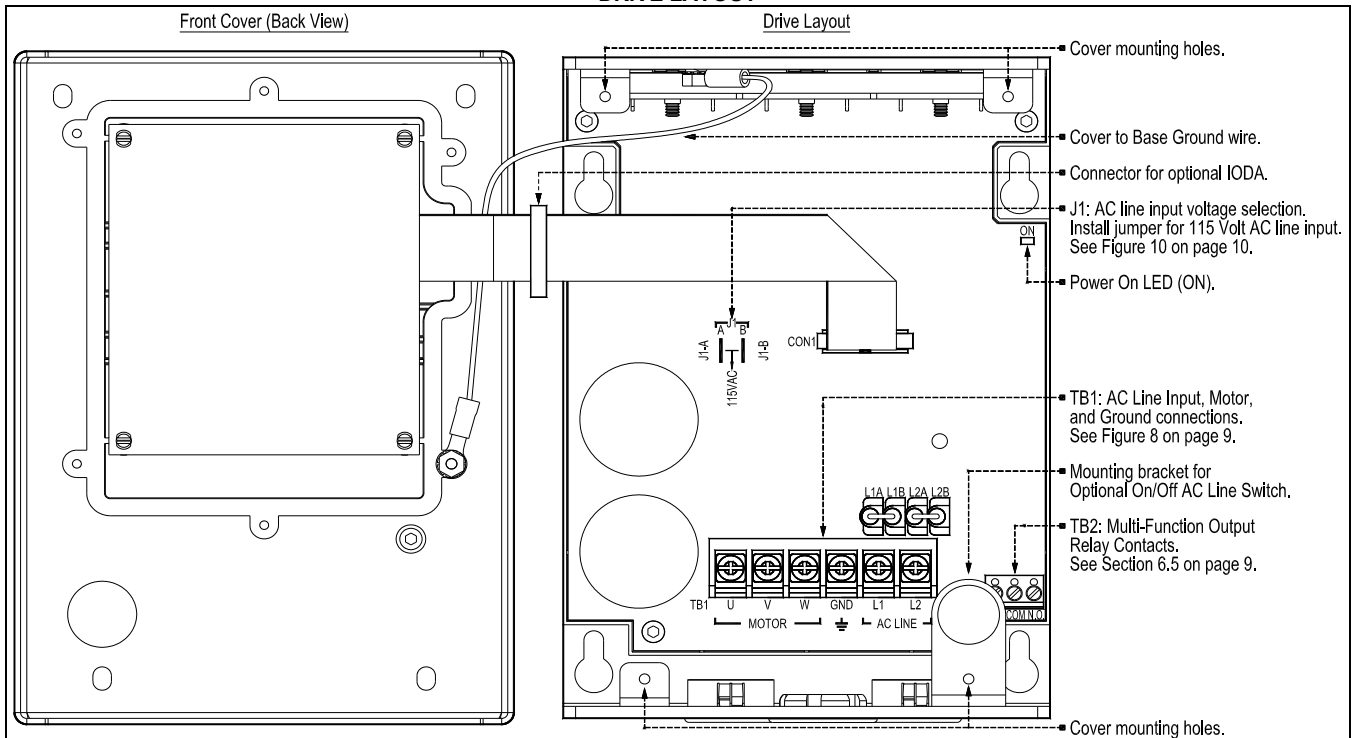


Notes: 1. The JOG-LCL/REM Key is factory programmed to function as a Jog Key. When the JOG-LCL/REM Key is pressed, the "JOG/REM" LED will illuminate and the display will show the Jog Frequency Setting (see Function No. 3.13 on page 18). 2. If the JOG-LCL/REM Key is reprogrammed for Local (Keypad) and Remote Signal Operation (see Function No. 2.02 on page 17), the "LCL/REM" LED will illuminate. Pressing the JOG-LCL/REM Key will toggle between Local (Keypad) and Remote Signal Operation. When Remote Signal Operation is selected, the "JOG/REM" LED will flash. The optional IODA Input/Output Multi-Function Board is required for remote signal operation. 3. The "Hz" LED will illuminate when the display is set to show Output Frequency. 4. If the PROGRAM/DISPLAY Key is pressed while Set Frequency is displayed, the previously entered Function Number will be shown. If the PROGRAM/DISPLAY Key is pressed while Function Number is displayed, the Set Frequency will be shown. When more than one display function is enabled, the PROGRAM/DISPLAY Key is used to toggle between displays, as shown in Figure 18 on page 14. 5. To change the Keypad for Potentiometer Operation, set Function No. 2.00 to "0001".

**FIGURE 5
COVER LAYOUT**



**FIGURE 6
DRIVE LAYOUT**



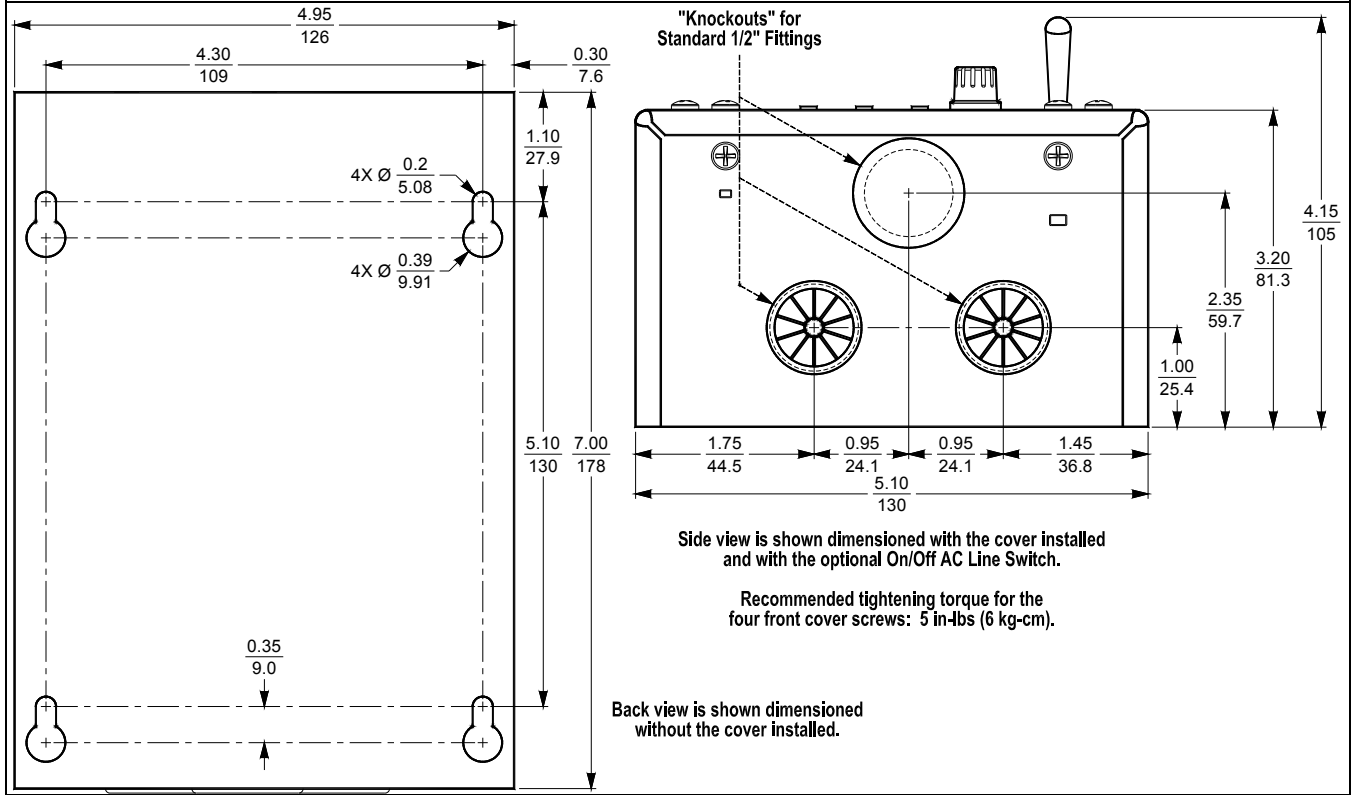
5 – MOUNTING

It is recommended that the drive be mounted vertically on a flat surface with adequate ventilation. Leave enough room below the drive to allow for AC Line, motor connections, and any other wiring that is required. Care should be taken to avoid extreme hazardous locations where physical damage can occur. When mounting the drive in an enclosure, the enclosure should be large enough to allow for proper heat dissipation so that the ambient temperature does not exceed 40°C (104 °F) at full rating. See Figure 7.



WARNING! Do not use this drive in an explosion-proof application. Be sure the drive is securely mounted.

FIGURE 7
MECHANICAL SPECIFICATIONS



6 – ELECTRICAL CONNECTIONS

Wire the drive in accordance with the National Electrical Code requirements and other local codes that may apply to the application. See Table 3, for terminal blocks wire and tightening torque specifications.



WARNING! HIGH VOLTAGE! Read Safety Warning, on page 4, before using the drive. Disconnect main power before making connections to the drive. To avoid electric shock, be sure to properly ground the drive.

Application Note: To avoid erratic operation, do not bundle the AC Line and motor wires with each other or with wires from signal following, start/stop contacts, or any other signal wires. Also, do not bundle motor wires from multiple drives in the same conduit. Use shielded cables on all signal wiring over 12" (30 cm). The shield should be earth grounded on the drive side only. Connect the drive in accordance with the National Electrical Code requirements and other local codes that may apply.

Be sure to properly fuse each AC Line conductor that is not at ground potential. Do not fuse neutral or grounded conductors. A separate AC Line switch or contactor must be connected as a disconnect so that each ungrounded conductor is opened. For fuse or circuit breaker selection, see Table 1 on page 6. Also see Section 6.1 on page 9.

The drive is designed with a removable cover. To open the cover, the two front cover screws must be removed. After mounting the drive and making all connections, install and tighten the four front cover screws to 5 in-lbs. (6 kg-cm). Do not over tighten.

TABLE 3
TERMINAL BLOCKS WIRE AND TIGHTENING TORQUE SPECIFICATIONS

Terminal Block	Description	Maximum Wire Size (Cu)		Recommended Tightening Torque	
		AWG	mm ²	in-lbs.	kg-cm
TB1	AC Line Input and Motor Wiring	12	3.3	7	8
TB2	Multi-Function Output Relay Contacts	16	1.3	3.5	4

6.1 – AC LINE INPUT CONNECTION (See Warning on Page 11)

Connect the AC Line input to Terminal Block TB1 (Terminals L1, L2), as shown in Figure 8. See Table 1 on page 6.

Application Note: If operation with a Ground-Fault Circuit-Interrupter (GFCI) is required, see Function No. 0.04 on page 16.

Note: The drive is factory set for 208/230 Volt AC Line input (Jumper J1 not installed). For 115 Volt AC Line input, install Jumper J1 (supplied). See Section 7 on page 10.

6.2 – AC LINE FUSING

The drive does not contain line fuses. Most electrical codes require that each ungrounded conductor contain circuit protection. It is recommended to install a fuse (Littelfuse 326, Buss ABC, or equivalent) or a circuit breaker (Square D QOU or equivalent) in series with each ungrounded conductor. For the recommended fuse size, see Table 1 on page 6.

CAUTION! Do not fuse neutral or ground connections. Do not fuse motor leads.

6.3 – GROUND CONNECTION

Connect the ground (earth) wires from the AC Line and motor to Terminal Block TB1 (Terminal GND). Be sure the motor is also properly grounded. See Figure 8 above.

6.4 – MOTOR CONNECTION

Connect the motor to Terminal Block TB1 (Terminals U, V, W). See Figure 8 above. Be sure the motor is properly grounded. Motor cable length should not exceed 100 ft. (30 m) – special reactors may be required – contact Technical Support. Be sure Function No. 0.01 is set to the corresponding Motor Nameplate Current.

Note: If the motor does not rotate in the desired direction, either: 1. Reverse any two motor leads (with AC Line disconnected and motor stopped). -or- 2. Use the FWD/REV Key. -or- 3. Use Function No. 1.02 to reprogram the forward and reverse direction.

6.5 – MULTI-FUNCTION OUTPUT RELAY CONNECTION

The Multi-Function Output Relay Contacts are located at Terminal Block TB2, as shown in Figure 9. The Multi-Function Output Relay is factory programmed to function as a "Run" relay (Function No. 5.00 set to "0000"). When the drive is put into the Run Mode, the relay contacts will change state (the Normally Open (N.O.) contact will close and the Normally Closed (N.C.) contact will open). See Table 4.

When the Multi-Function Output Relay is programmed to function as a "Fault" relay (Function No. 5.00 set to "0001") and a fault occurs while the drive is in the Run Mode, the relay contacts will change state. The Normally Open (N.O.) contact (closed in the Run Mode) will open and the Normally Closed (N.C.) contact (open in the Run Mode) will close. See Table 4.

The Multi-Function Output Relay can also be programmed for the following functions, as shown in the Programmable Function Summary List (Section 10, Function Group 5, on page 18): Target Frequency, Frequency Threshold, I²t or I-t Fault Mode, and Load Loss.

Relay Contact Ratings: 1 Amp at 30 Volts DC, 0.5 Amps at 125 Volts AC, and 0.25 Amps at 250 Volts AC

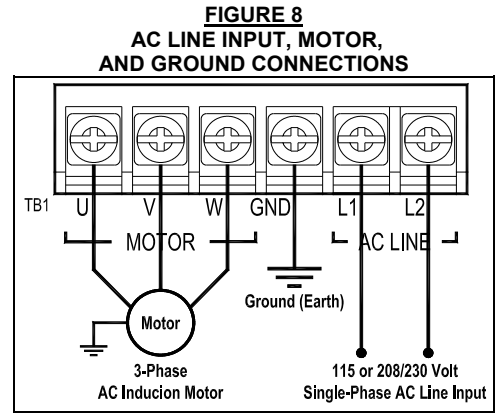


FIGURE 9
MULTI-FUNCTION OUTPUT RELAY CONTACTS

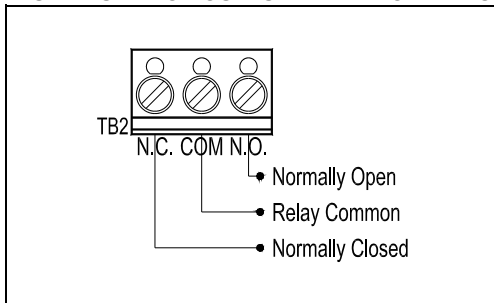


TABLE 4
MULTI-FUNCTION OUTPUT RELAY "RUN" AND "FAULT" OPERATING MODES

Drive Operating Condition	Function No. 5.00 Set to "0000"		Function No. 5.00 Set to "0001"	
	"Run" Relay Mode		"Fault" Relay Mode	
	N.O. Contact	N.C. Contact	N.O. Contact	N.C. Contact
Power Off	Open	Closed	Open	Closed
Power On (Stop Mode)	Open	Closed	Closed	Open
Run Mode	Closed	Open	Closed	Open
All Faults	Open	Closed	Open	Closed

6.6 – REMOTE OPERATIONS WHICH REQUIRE THE OPTIONAL IODA INPUT/OUTPUT MULTI-FUNCTION BOARD

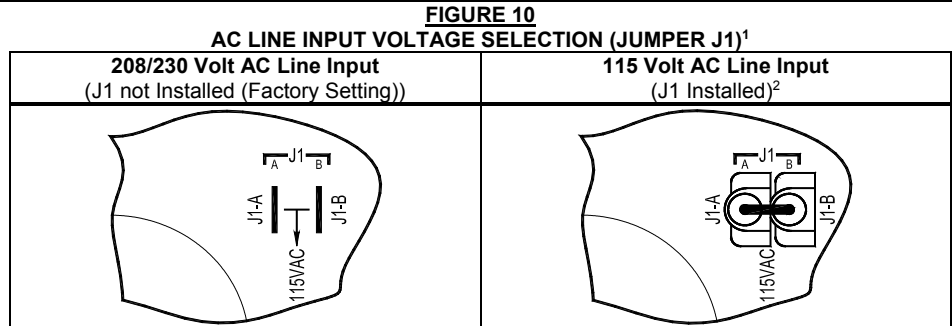
Multi-Function Input Terminals (Preset Frequency Operation, Up/Down Frequency Command, Accel/Decel 2, Forward/Stop-Reverse/Stop Command, External Fault, Reset, 2-Wire and 3-Wire Start/Stop), Signal Following, Analog Signal Output (for controlling auxiliary devices), Remote Speed Potentiometer (5 kΩ), Multi-Function Output Relays, and Multi-Function Open Collector Outputs.

7 – AC LINE INPUT VOLTAGE SELECTION (JUMPER J1)

The drive is factory set for 208/230 Volt AC Line input (Jumper J1 not installed).

For 115 Volt AC Line input, install Jumper J1 (supplied). See Figure 10.

CAUTION! Do not connect the AC Line input until Jumper J1 is set for the proper input voltage being applied to the drive. Catastrophic failure will occur if a 230 Volt AC Line is applied when the drive is set for 115 Volt AC Line input.



Notes: 1. The drive is factory set for 208/230 Volt AC Line input (Jumper J1 not installed). For 115 Volt AC Line input, install Jumper J1 (supplied). 2. Jumper J1 is supplied in the hardware bag.

8 – RECOMMENDED HIGH VOLTAGE DIELECTRIC WITHSTAND TESTING (HI-POT TESTING)

Testing agencies such as UL, CSA, VDE, etc., usually require that equipment undergo a hi-pot test. In order to prevent catastrophic damage to the drive which has been installed in the equipment, the following procedure is recommended. A typical hi-pot test setup is shown in Figure 11. This procedure must be followed for each machine to be tested. A suggested hi-pot tester is Slaughter Model 2550.

All drives have been factory hi-pot tested in accordance with UL requirements.

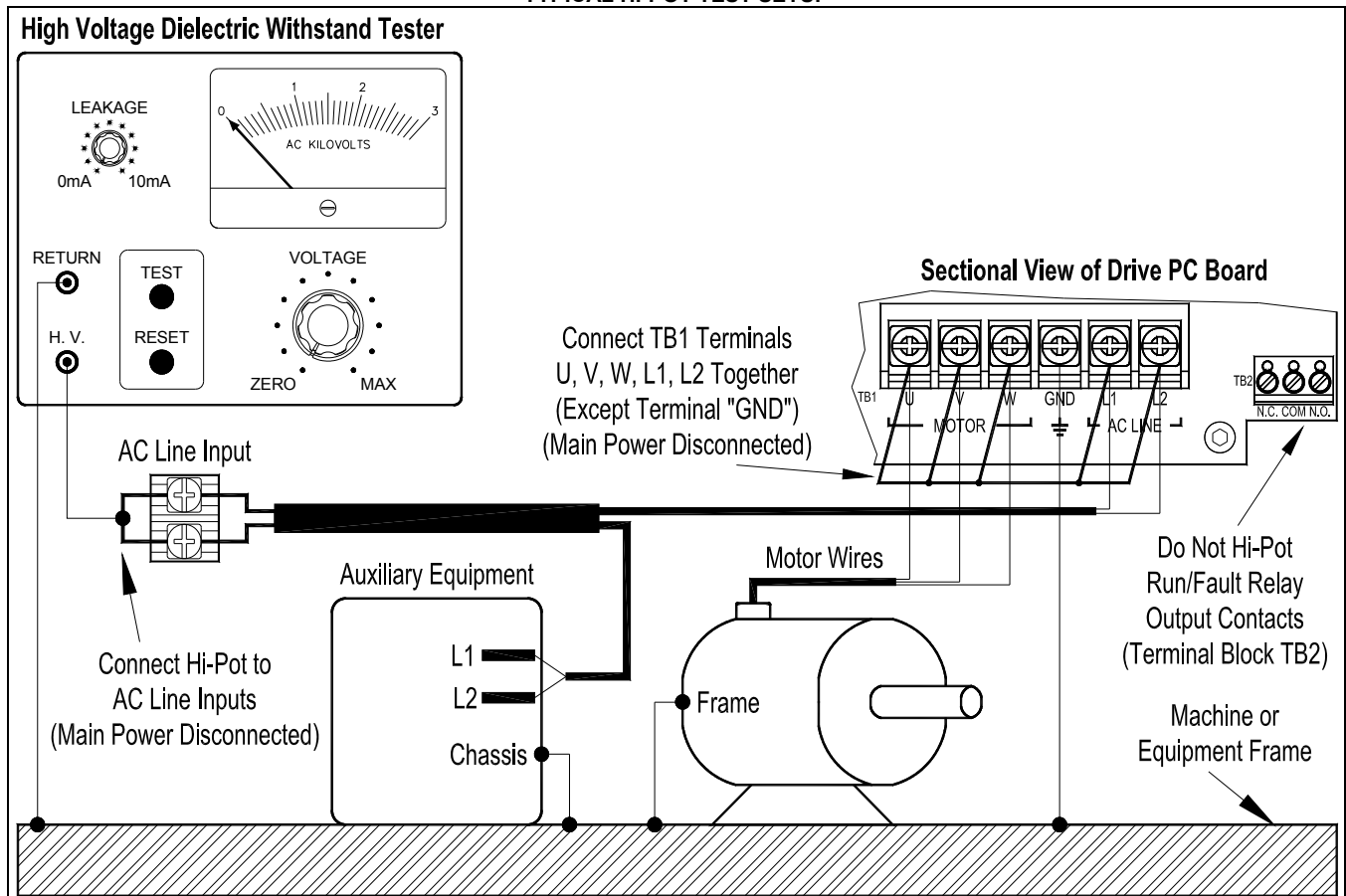
WARNING! All equipment AC Line inputs must be disconnected from the AC power.

CAUTION! Model KBMK-24DF Only: To prevent catastrophic damage to the drive, perform a DC Hi-Pot test only.

Connect all equipment AC power input lines together and connect them to the H.V. lead of the hi-pot tester. Connect the RETURN lead of the hi-pot tester to the frame on which the drive and other auxiliary equipment are mounted.

CAUTION! The hi-pot tester must have an automatic ramp-up to the test voltage and an automatic ramp-down to zero voltage. If the hi-pot tester does not have automatic ramping, then the hi-pot output must be manually increased to the test voltage and then manually reduced to zero. Instantly applying the hi-pot voltage will cause irreversible damage to the drive, which will void the warranty.

FIGURE 11
TYPICAL HI-POT TEST SETUP



9 – DRIVE OPERATION

Before operating the drive, read Section 9.2 for instructions on the Digital Keypad Operation. See Figure 4 on page 6 for the keypad layout.

The 4-digit display can indicate various functions of the drive: Set Frequency, Motor RPM, Output Current and Voltage, Custom Units, Function Numbers, Function Codes or Values, and Fault Codes. See Section 9.4 on page 15.

See Section 9.3 on pages 11 – 14 for information on programming the drive. If an error message appears while programming the drive, see Sections 9.4 and 9.5 on page 15.

9.1 – START-UP PROCEDURE

After the drive has been properly setup and all connections completed, the start-up procedure can begin. If the AC power has been properly brought to the drive, the LEDs on the front cover will indicate the drive's status, as described in Section 11 on page 22. See Section 9.4 on page 15 for the Digital Readout Codes. To start the drive, press the RUN Key. The motor will begin to accelerate to the Set Frequency. The factory set frequency is "05.00" Hz.

9.2 – KEYPAD DESCRIPTION

The Keypad has eight (8) keys, which are used to program drive functions, as described in Table 5. The eight (8) LEDs provide indication of the drive's operational status, as described in Section 11 on page 22. A Built-In Speed Potentiometer is also provided to set the Drive Frequency (Function No. 2.00 set to "0001"). See Figure 4 on page 6.

Note: To avoid damage, never operate the keypad with a screwdriver or other sharp-ended tool.

**TABLE 5
KEYPAD DESCRIPTION**

Key	Description
	Starts or Stops the drive.
	Changes motor direction.
	Up Key: Increases Output Frequency, Set Frequency, Function Number Value, and Code setting.
	Down Key: Decreases Output Frequency, Set Frequency, Function Number Value, and Code setting.
	Factory programmed to function as a Jog Key. When the key is pressed, it toggles between Run Mode and Jog Mode (the "JOG/REM" LED will illuminate and the display will show the Jog Frequency Setting (see Function No. 3.13)). If the key is reprogrammed for Local/Remote Operation (see Function No. 2.02), the key is used to toggle between Local (Keypad) or Remote Signal Operation (the "LCL/REM" LED will illuminate). Optional IODA Input/Output Multi-Function Board or Modbus is required for Local/Remote Operation.
	Used to enter Program Mode and Display Mode. If the key is pressed while Set Frequency is displayed, the previously entered Function Number will be shown. If the key is pressed while Function Number is displayed, the Set Frequency will be shown. When more than one display function is enabled, the key is used to toggle between displays. See Figure 18 on page 14.
	Left Shift / Reset Key: Moves the changeable digit or Resets the drive to clear a fault.
	Reads or Enters a Function Number's Value or Code setting. The key is also used to read or enter the frequency setting.

9.3 – FLOW CHARTS FOR IMPORTANT PROGRAMMING FUNCTIONS

See Figures 12 – 18, on pages 11 – 14, for flow charts to program important functions. The flow charts also serve as a guide to understand the programming procedure. See Table 6 on page 15 for a description of the Digital Readout Codes.

Programming Mode: When the drive is put into the Programming Mode (see Figure 19 on page 16), a Function No. will be displayed. A Function No. consists of a Group No. (digits on the left side of the decimal point) and a Group No. Code (digits on the right side of the decimal point). The digits can be changed using the Up and Down Keys. The Left Shift Key is used to move the changeable digit. When the READ Key is pressed, either a Code or Value will be displayed. Codes have specific descriptions. Values have numeric ranges.

**FIGURE 12
PROGRAMMING FLOW CHART TO CHANGE THE DRIVE OUTPUT FREQUENCY
(Example: From 60 Hz Motors to 50 Hz Motors)**

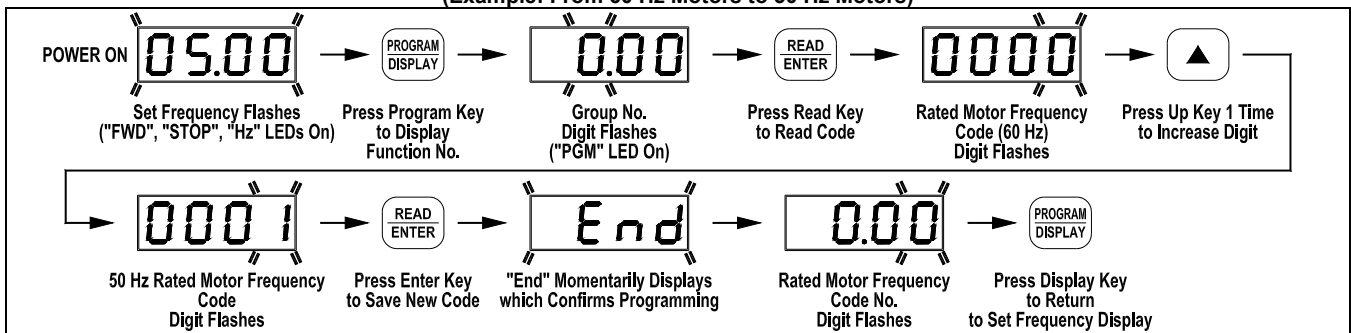
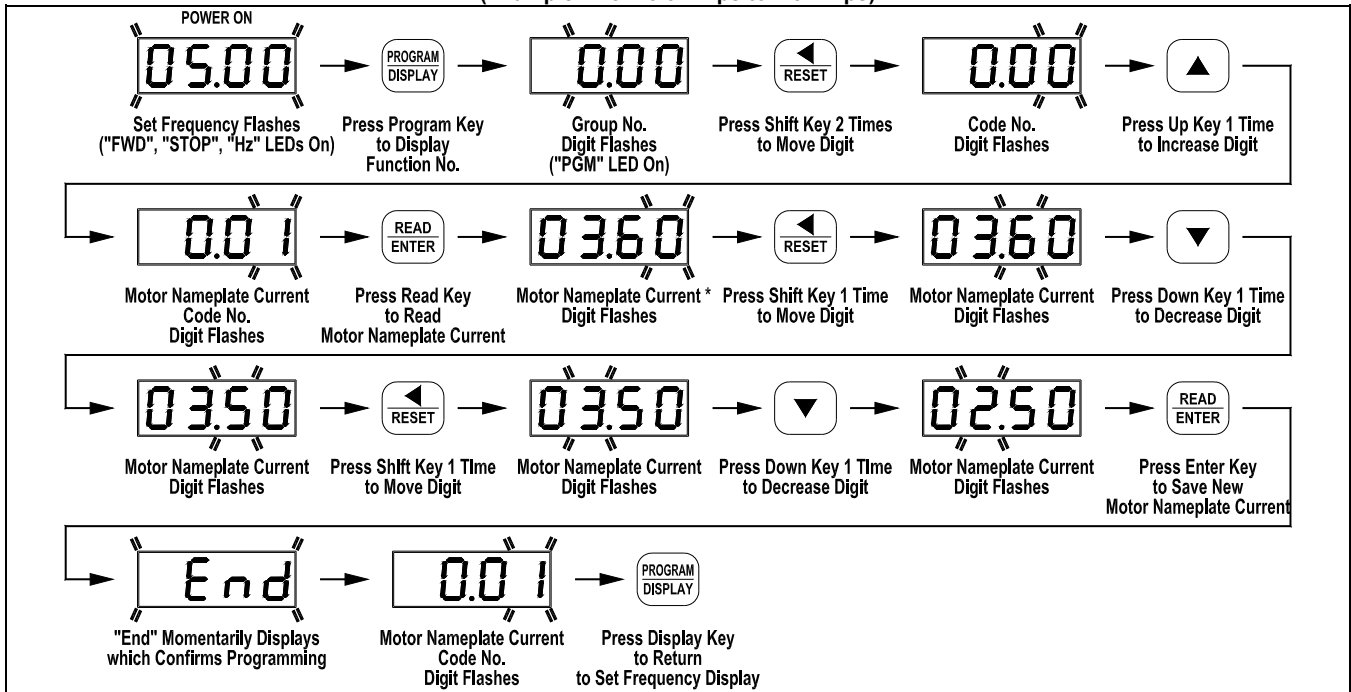
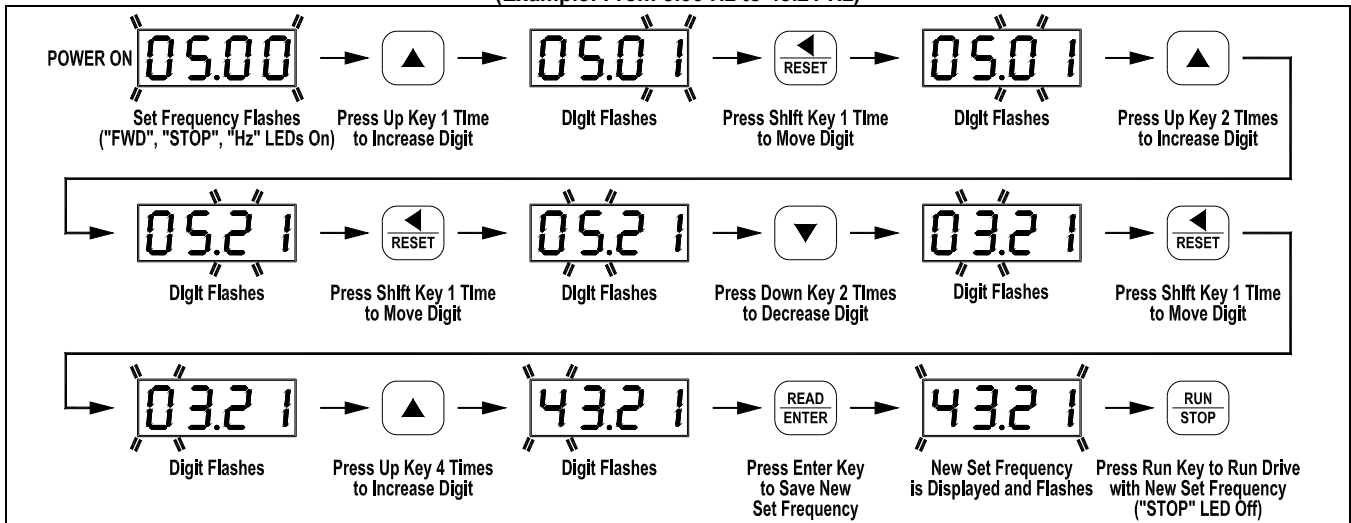


FIGURE 13
PROGRAMMING FLOW CHART TO CHANGE MOTOR CURRENT
 (Example: From 3.6 Amps to 2.5 Amps)



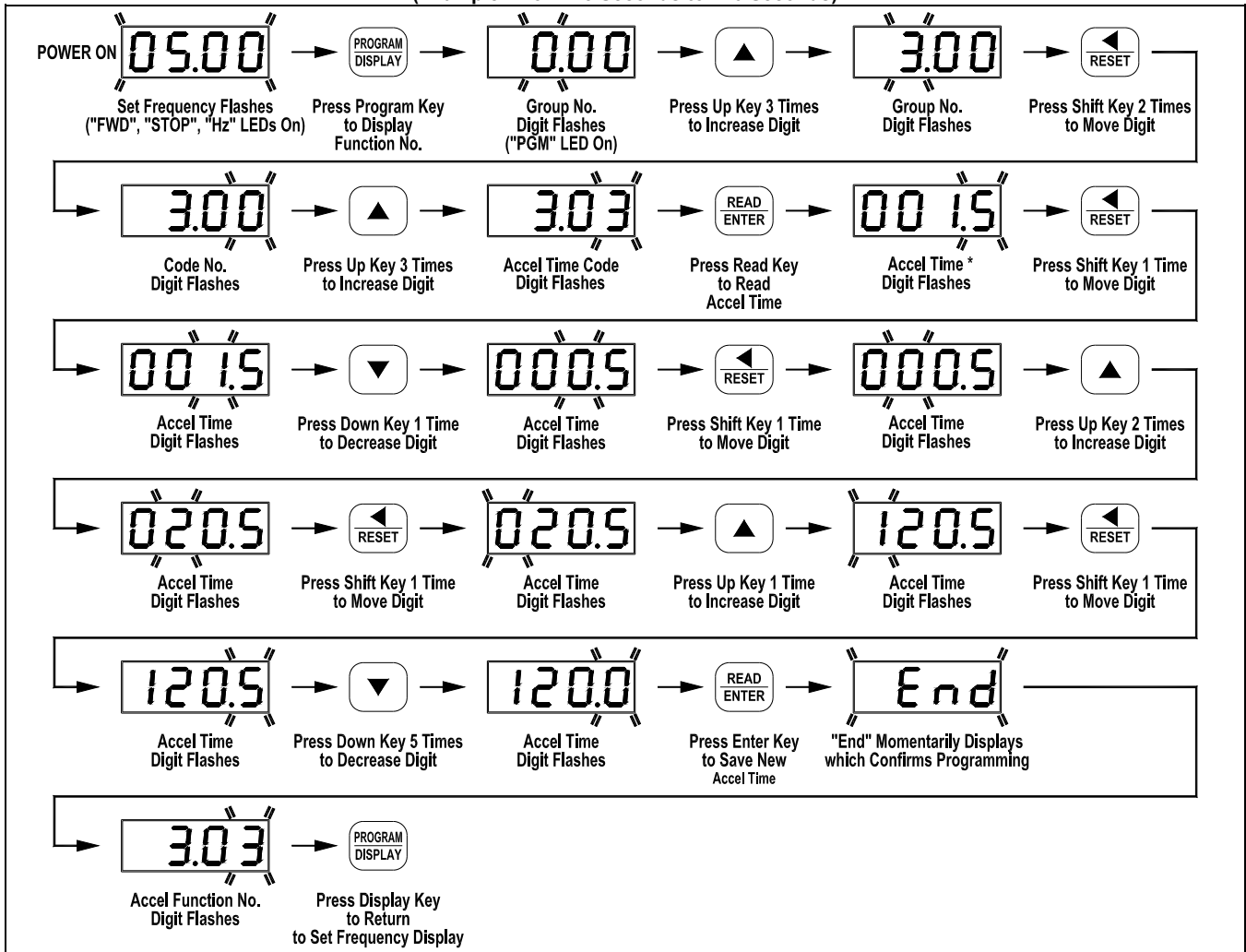
*The drive's factory setting of Motor Nameplate Current (Function No. 0.01) is 3.6 Amps.

FIGURE 14
PROGRAMMING FLOW CHART TO CHANGE SET FREQUENCY *
 (Example: From 5.00 Hz to 43.21 Hz)



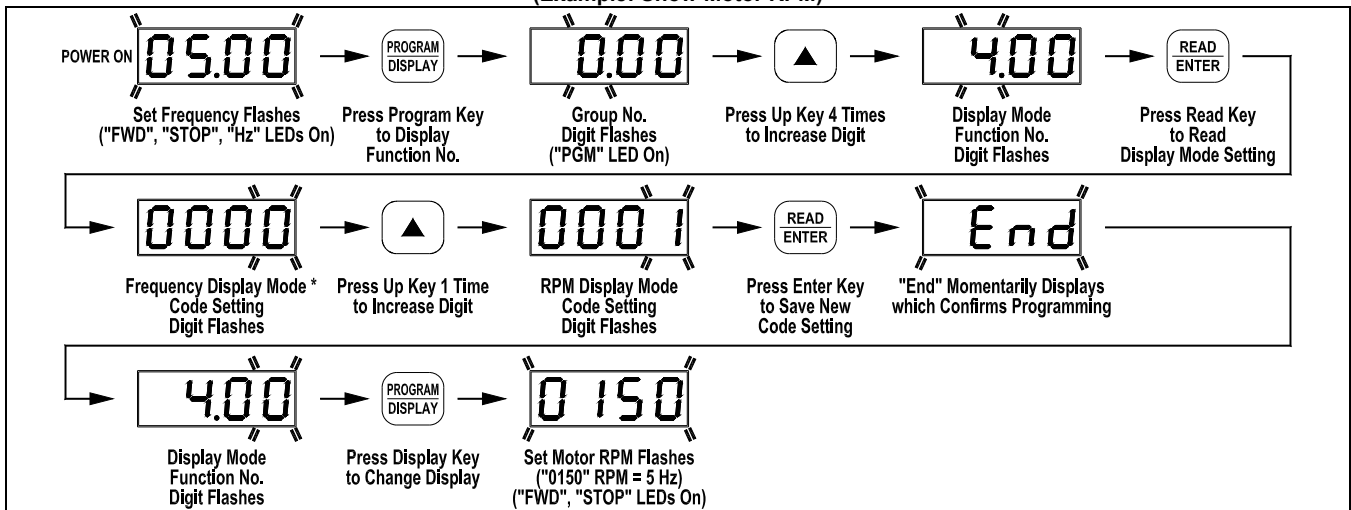
*If Function No. 2.01 is set to "0000", frequency change requires "ENTER". Throughout this sequence you must proceed to the next step within 20 seconds, before the "Press Enter Key" step, or the display will revert to "05.00". The new value will be stored in Function No. 3.00.

FIGURE 15
PROGRAMMING FLOW CHART TO CHANGE ACCEL TIME
 (Example: From 1.5 Seconds to 120 Seconds)



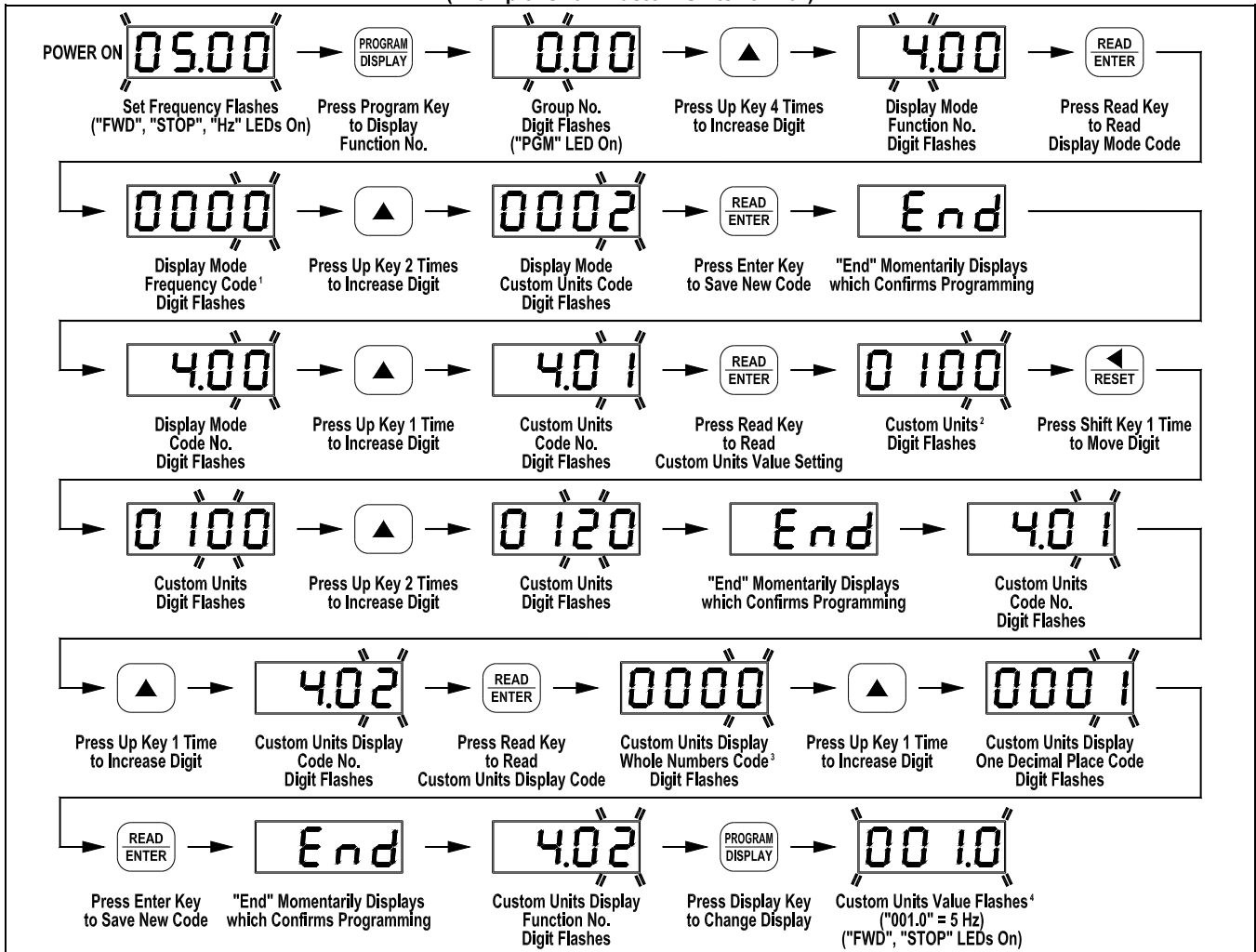
*The factory setting of Accel Time (Function No. 3.03) is "1.5" seconds. The minimum setting of Accel is 0.1 seconds, therefore, the left digits must be changed first since an Accel setting of 000.0 is not allowed.

FIGURE 16
PROGRAMMING FLOW CHART TO CHANGE DISPLAY
 (Example: Show Motor RPM)



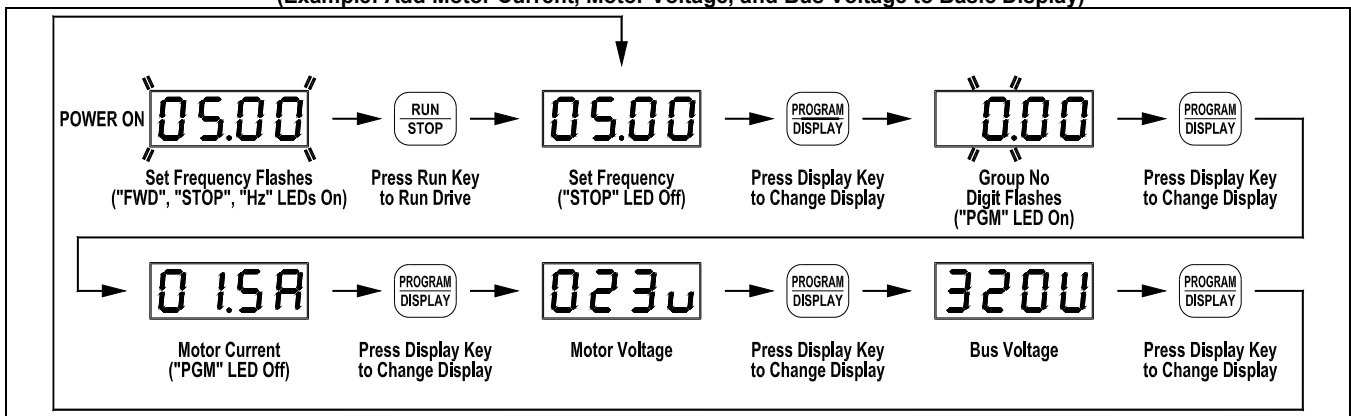
*The factory setting of Display Mode (Function No. 4.00) is Frequency ("0000").

FIGURE 17
PROGRAMMING FLOW CHART TO CHANGE DISPLAY
 (Example: Show Custom Units "012.0")



Notes: 1. The factory setting of Display Mode (Function No. 4.00) is Frequency ("0000"). 2. The factory setting of Custom Units Significant Digits (Function No. 4.01) is "0100". 3. The factory setting of Custom Units Display (Function No. 4.02) is Whole Numbers ("0000"). 4. The Custom Unit setting "012.0" will be displayed at full speed.

FIGURE 18
PROGRAMMING FLOW CHART TO CHANGE DISPLAY
 (Example: Add Motor Current, Motor Voltage, and Bus Voltage to Basic Display)



*Function Nos. 4.04 – 4.06 set to "0001".

9.4 – 4-DIGIT DISPLAY

The 4-digit display provides readout of drive status, operating parameters, and faults. See Table 6 on page 15 for a description of the Digital Readout Codes.



WARNING! Wait at least 1 minute before opening the cover. Be sure the main power switch or circuit breaker is in the "OFF" position before servicing the drive. Do not depend on the green Power On LED (ON), located on the drive's PC board, as shown in Figure 6 on page 7, or the Status LEDs and the 4-Digit Display, located on the front cover, to no longer be illuminated as a guaranteed power off condition.

TABLE 6
DIGITAL READOUT CODES

Display	Description
StoP	Drive Stopped: Indicates that the drive is in the Stop Mode. Function No. 4.03 set to "0001".
End	Parameter Changed: Momentarily flashes. Indicates that a parameter has been successfully changed.
8.0 1	Function No. Example: A Function No. consists of a Group No. (digits on the left side of the decimal point) and a Group Code No. (digits on the right side of the decimal point).
-.-A	Motor Current Display: When the display is set to show Motor Current, the format will be "XX.XA". Function No. 4.04 set to "0001".
-.-U	Motor Voltage Display: When the display is set to show Motor Voltage, the format will be "XXXU". Function No. 4.05 set to "0001".
-.-U	Bus Voltage Display: When the display is set to show Bus Voltage, the format will be "XXXU". Function No. 4.06 set to "0001".
-LU-	Low Voltage Trip: Indicates that the AC Line input voltage is below the Undervoltage Trip Point specified in Table 2 on page 6.
LU-r	Low Voltage Recovery: Indicates that a Low Voltage Trip occurred and the AC Line input voltage has returned to within the operating range specified in Table 2 on page 6.
-OU-	Overvoltage Trip: Indicates that the AC Line input voltage is above the Overvoltage Trip Point specified in Table 2 on page 6.
OU-r	Overvoltage Recovery: Indicates that an Overvoltage Trip occurred and the AC Line input voltage has returned to within the operating range specified in Table 2 on page 6.
OL-t	Overload Trip (I²t Timeout): Indicates that the motor has been overloaded for an extended period of time.
EF-t	External Fault Trip: Indicates that an external fault has occurred at one of the MFITs of the IODA Input/Output Multi-Function Board. Function Nos. 7.00 – 7.06 set to "0008".
CS-t	Current Source Trip: Indicates that the current signal output (from the IODA Input/Output Multi-Function Board) has been opened.
-SC-	Short Circuit Fault: Indicates that the drive detected a short circuit at the motor (phase-to-phase).
Err 1	Data Enter Error: Indicates that the drive is in the Program Mode and a non-valid parameter change has been attempted.
Err 2	Keypad Communication Error: Indicates that the keypad failed to initialize when the drive powered up. This is an abnormal condition – contact Technical Support.
Err 3	Flash Memory Error: Indicates that a flash memory error on the drive has occurred. This is an abnormal condition – contact Technical Support.
Err 4	IODA Error: Indicates that the drive has lost communication with the IODA Input/Output Multi-Function Board.

9.5 – FAULT RECOVERY

The drive monitors many faults. See Function No. 1.05, on page 17, for restarting the drive after a fault has been cleared. See Section 9.4, above, for the Digital Readout Codes. See Section 11 on page 22 for descriptions of the Diagnostic LEDs.

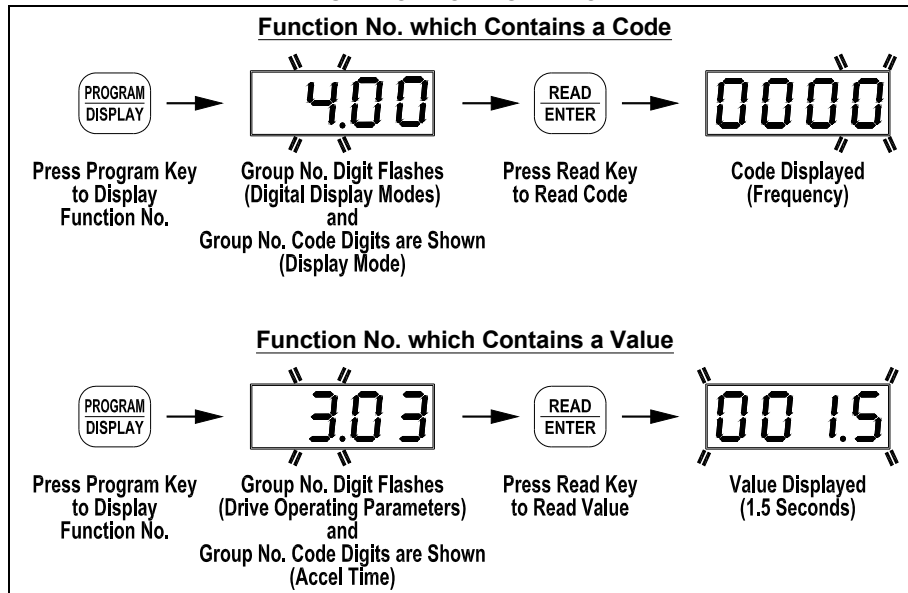
Drive Faults: Undervoltage ("–LU–"), Overvoltage ("–OU–"), Short Circuit at the motor (phase-to-phase) ("–SC–"), and I²t or I¹t Fault ("OL–t").

10 – PROGRAMMABLE FUNCTION SUMMARY LIST

All functions have been factory set, as shown in the tables on pages 16 – 21.

Programming Mode: When the drive is put into the Programming Mode (see Figure 19 on page 16), a Function No. will be displayed. A Function No. consists of a Group No. (digits on the left side of the decimal point) and a Group No. Code (digits on the right side of the decimal point). The digits can be changed using the Up and Down Keys. The Left Shift Key is used to move the changeable digit. When the READ Key is pressed, either a Code or Value will be displayed. Codes have specific descriptions. Values have numeric ranges.

FIGURE 19
FUNCTION NO. DESCRIPTION



PROGRAMMABLE FUNCTION SUMMARY LIST (Rev. 100.1)

Model Software Revision Codes (Rev. 100.1)

The Following Programmable Function List is Applicable to Software Revision Code 14/1.01 (or Higher)

PROGRAMMABLE FUNCTION GROUPS

Function Group No.	Description
0	Motor and Drive Parameters
1	Run/Stop Mode
2	Frequency Control
3	Drive Operating Parameters
4	Digital Display Modes
5	Multi-Function Output Relay Operating Mode
6	Drive Status and Reset
7	Multi-Function Input Terminals ⁽¹⁾
8	Multi-Function Output Relays and Output Signal Operation ⁽¹⁾
9	Analog Input Signal Operation ⁽¹⁾
10	Communication Mode ⁽²⁾

Notes: (1) IODA Input/Output Multi-Function Board required. (2) Modbus Communication Module required (OEM applications only).

FUNCTION GROUP 0 – Motor and Drive Parameters

Function No.	Description	Range/Code	Factory Setting
0.00 *	Rated Motor Frequency (Hz)	0000: 60 Hz 0001: 50 Hz 0002: Special (Set by Function No. 0.05)	0000
0.01 *	Motor Nameplate Current (Amps)	—	⁽¹⁾
0.02 *	Motor Type	0000: Inverter Duty, TEFC 0001: External Fan Cooled	0000
0.03 *	Torque Mode	0000: Constant Torque (Machinery) 0001: Variable Torque (HVAC)	0000
0.04 *	GFCI Operation ⁽²⁾	0000: GFCI Operation Disabled 0001: GFCI Operation with Standard GFCI 0002: GFCI Operation with Sensitive GFCI	0000
0.05 *	Motor Frequency (Hz) ^{(3), (4)}	30 – 240	60, 50
0.06 *	Motor Nameplate Voltage (% Drive Output) ⁽⁵⁾	0 – 100.0	100 ⁽⁶⁾

Notes: (1) Factory Setting is the drive rated output current. See Table 1 on page 6. This function is used to enter the Motor Nameplate Rated Current, which allows proper operation of the I²t Motor Overload Protection. (2) GFCI operation overrides the Switching Frequency set by Function No. 3.15. (3) When the drive is set for 50 Hz motors (Function No. 0.00 set to "0001"), the Motor Frequency factory setting will automatically reset to 50 Hz. (4) The Motor Frequency for standard 50 Hz or 60 Hz motors is set by Function No. 0.00. For custom motors (e.g., 100 Hz) set Function No. 0.00 to "0002" and Function No. 0.05 to the Motor Nameplate Rated Frequency. (5) This function is used for motors with non-standard nameplate rated voltage (e.g., 80 Volts AC). (6) The factory set output of the drive is 100% of the AC Line input voltage. In 60 Hz Mode (Function No. 0.00 set to "0000") the drive output will be 230 Volts, maximum, for 230 Volt motors and 460 Volts, maximum, for 460 Volt motors. In 50 Hz Mode (Function No. 0.00 set to "0001") the drive output will be 220 Volts, maximum, for 220 Volt motors and 400 Volts, maximum, for 400 Volt motors.

*Functions which can only be changed while the drive is in the Stop Mode.

FUNCTION GROUP 1 – Run/Stop Mode

Function No.	Description	Range/Code	Factory Setting
1.00 *	Run/Stop-Forward/Reverse Control	0000: Keypad 0001: External Contacts ⁽¹⁾ 0002: Communication ⁽²⁾	0000
1.01 *	Forward/Reverse Control	0000: Instant Reverse 0001: Stop Command Must be Given Prior to Reverse Command 0002: Reverse Command Disabled 0003: Forward Command Disabled	0000
1.02 *	Motor Direction	0000: Forward 0001: Reverse	
1.03 *	Start Command	0000: Accelerates to Last Set Frequency 0001: Accelerates to Lower Frequency Limit (See Function No. 3.01)	0000
1.04 *	Start Mode	0000: Spin Start 0001: Stop Before Restart	0000
1.05 *	Auto/Manual Start Mode	0000: Manual Start Mode 0001: Manual Start with Ride-Through (Set by Function No. 1.06) 0002: Auto Start After Undervoltage Fault Clears 0003: Auto Start All Faults (Except Short Circuit Fault) ⁽³⁾ 0004: Auto Start All Faults (Except I ² t, I*t, and Short Circuit Faults)	0000
1.06 *	Ride-Through Time (Seconds)	0.0 – 2.0	0.5
1.07 *	Number of Restart Attempts	0 – 10	3
1.08 *	Start Delay Time (Seconds)	0 – 240	0
1.09 *	Stop Mode	0000: Regenerate-to-Stop 0001: Coast-to-Stop 0002: Regeneration with Injection Brake-to-Stop (Set by Function Nos. 1.11 – 1.13)	0000
1.10 *	Holding Torque in Stop Mode (%)	0 – 10	1
1.11	Injection Brake Start Frequency (Hz)	0.00 – 240.0	0.00
1.12	Injection Brake Level (%)	0 – 30	0
1.13	Injection Brake Time (Seconds)	0.0 – 25.5	0.0

Notes: (1) IODA Input/Output Multi-Function Board required. (2) Modbus Communication Module required (OEM applications only). (3) For Auto Start, Function No. 1.07 must be set to greater than "0".

*Functions which can only be changed while the drive is in the Stop Mode.

FUNCTION GROUP 2 – Frequency Control

Function No.	Description	Code	Factory Setting
2.00 *	Frequency Control	0000: Keypad 0001: Built-In Potentiometer 0002: Analog Signal 1 ⁽¹⁾ 0003: Analog Signal 2 ⁽¹⁾ 0004: Communication ⁽²⁾ 0005: Up/Down Using MFITs ⁽¹⁾	0000
2.01 *	Up Key, Down Key Operation Mode	0000: Frequency Change Requires Enter Command 0001: Direct Frequency Change 0002: Keypad Disable	0000
2.02 *	Jog-Local/Remote ^{(3), (4)}	0000: Jog Enabled 0001: Jog Disabled 0002: Jog Disabled; Local/Remote Enabled (Keypad Operation) ⁽¹⁾ 0003: Jog Disabled; Local/Remote Enabled (Built-In Speed Potentiometer Operation) ⁽¹⁾	0000

Notes: (1) IODA Input/Output Multi-Function Board required. (2) Modbus Communication Module required (OEM applications only). (3) See Jog Mode (Function No. 3.12), Jog Frequency (Function No. 3.13), and Jog Accel/Decel Time (Function No. 3.14). (4) The Jog function can be reprogrammed for Local/Remote (LCL/REM) Operation. When in Remote Mode Operation, the "JOG/REM" LED will flash.

*Functions which can only be changed while the drive is in the Stop Mode.

FUNCTION GROUP 3 – Drive Operating Parameters

Function No.	Description	Range/Code	Factory Setting
3.00	Stored Set Frequency (Hz)	0.00 – 240.0	5.00
3.01	Lower Frequency Limit (Hz)	0.00 – 240.0	0.00
3.02	Upper Frequency Limit (Hz) ⁽¹⁾	0.00 – 240.0	60.0, 50.0
3.03	Accel Time (Seconds) ⁽²⁾	0.1 – 180.0	1.5
3.04	Decel Time (Seconds) ⁽²⁾	0.3 – 180.0	1.5
3.05	S-Curve Time Accel (Seconds) ⁽²⁾	0.0 – 30.0	0.0
3.06	S-Curve Time Decel (Seconds) ⁽²⁾	0.0 – 30.0	0.0
3.07 *	Skip Frequency (Hz)	0.00 – 240.0	0.00
3.08 *	Skip Frequency Bandwidth (± Hz)	0.00 – 2.00	0.00
3.09 *	Motor Overload Protection	0000: I ² t with Current Limit Enabled 0001: I ^t with Current Limit Enabled	0000
3.10 *	I ^t with Current Limit Trip Time (Seconds)	1.0 – 20.0	6.0
3.11	Boost Value (%)	0.0 – 28.0	7.0
3.12 *	Jog Mode	0000: Momentary 0001: Latching	0000
3.13	Jog Frequency (Hz)	0.00 – 240.0	5.00
3.14	Jog Accel/Decel Time (Seconds)	0.3 – 10.0	1.0
3.15 *	Switching Frequency (kHz)	0000: 8 0001: 10 0002: 12	0000
3.16	Flux Vector Compensation (%)	0.0 – 10.0	5.0

Notes: (1) When the drive is set for 50 Hz motors (Function 0.00 set to "0001"), the Upper Frequency Limit factory setting will automatically reset to 50 Hz. (2) Time set for Function Nos. 3.03 and 3.04 must be equal to or greater than the time set for Function Nos. 3.05 and 3.06, respectively.

*Functions which can only be changed while the drive is in the Stop Mode.

FUNCTION GROUP 4 – Digital Display Modes

Function No.	Description	Range/Code	Factory Setting
4.00	Display Mode	0000: Frequency 0001: RPM (Based on a 4-Pole Motor) 0002: Custom Units	0000
4.01	Custom Units Significant Digits	0 – 9999	100
4.02	Custom Units Display	0000: Whole Numbers 0001: One Decimal Place 0002: Two Decimal Places 0003: Three Decimal Places	0000
4.03	Display in Stop Mode	0000: Displays Last Run Setting 0001: Displays "StoP" 0002: Displays "0000"	0000
4.04	Motor Current Display*	0000: Disabled 0001: Enabled (Display will Show "XX.XA")	0000
4.05	Motor Voltage Display*	0000: Disabled 0001: Enabled (Display will Show "XXXu")	0000
4.06	Bus Voltage Display*	0000: Disabled 0001: Enabled (Display will Show "XXXU")	0000

*The Display Key is used to toggle between displays. See Figure 18 on page 14.

FUNCTION GROUP 5 – Multi-Function Output Relay Operating Mode

Function No.	Description	Range/Code	Factory Setting
5.00	Relay Operation Mode	0000: Run 0001: Fault ⁽¹⁾ 0002: Target Frequency (Function No. 5.01 ± Function No. 5.02) 0003: Frequency Threshold Level (> Function No. 5.01 – Function No. 5.02) ⁽²⁾ 0004: Frequency Threshold Level (< Function No. 5.01 + Function No. 5.02) ⁽³⁾ 0005: I ² t or I ^t Fault 0006: Load Loss (See Function No. 5.03)	0000
5.01	Frequency Reached (Hz)	0.00 – 240.0	0.00
5.02	Frequency Bandwidth (± Hz)	0.00 – 30.00	1.00
5.03	Load Loss Threshold ⁽⁴⁾ (% Motor Current) (Set by Function No. 0.01)	25 – 90	60

Note: (1) The Multi-Function Output Relay Contacts will change state due to all Faults and Recovered Faults. (2) The Multi-Function Output Relay will activate above the setting in Function No. 5.01 and deactivate below the setting in Function No. 5.01 minus the setting in Function No. 5.02. (3) The Multi-Function Output Relay will activate below the setting in Function No. 5.01 and deactivate above the setting in Function No. 5.01 plus the setting in Function No. 5.02. (4) The Load Loss Threshold function is not functional during acceleration/deceleration or Stop Mode.

FUNCTION GROUP 6 – Drive Status and Reset

Function No.	Description	Code	Factory Setting
6.00 *	Software Version	—	—
6.01 *	Drive Horsepower	—	—
6.02 *	Fault Log 1	—	—
6.03 *	Fault Log 2	—	—
6.04 *	Fault Log 3	—	—
6.05 **	Reset Drive to Factory Setting	1110: 50 Hz Operation 1111: 60 Hz Operation	0000

*Read only.

**Functions which can only be changed while the drive is in the Stop Mode.

FUNCTION GROUP 7 – Multi-Function Input Terminals (IODA Required)

Function No.	Description	Range/Code	Factory Setting
7.00 *	Multi-Function Input Terminal 1 ⁽¹⁾	0000: Preset Frequency Operation ⁽²⁾ 0001: Preset Frequency Operation ⁽²⁾	0000
7.01 *	Multi-Function Input Terminal 2 ⁽¹⁾	0002: Preset Frequency Operation ⁽²⁾ 0003: Up Frequency Command (See Function No. 7.14) ⁽³⁾	0001
7.02 *	Multi-Function Input Terminal 3 ⁽¹⁾	0004: Down Frequency Command (See Function No. 7.14) ⁽³⁾	0002
7.03 *	Multi-Function Input Terminal 4 ⁽¹⁾	0005: Accel/Decel 2 (See Function No. 7.16)	0009
7.04 *	Multi-Function Input Terminal 5 ⁽¹⁾	0006: Forward/Stop Command ⁽⁴⁾ 0007: Reverse/Stop Command ⁽⁴⁾	0010
7.05 *	Multi-Function Input Terminal 6 ⁽¹⁾	0008: External Fault (N.O. Contact) 0009: Reset	0003
7.06 *	Multi-Function Input Terminal 7 ⁽¹⁾	0010: N.O. Start (2-Wire or 3-Wire Start/Stop) ⁽⁴⁾ 0011: N.C. Stop (3-Wire Start/Stop) ⁽⁴⁾ 0012: External Fault (N.C. Contact)	0004
7.07	Preset Frequency 1 (Hz)	0.00 – 240.0	5.00
7.08	Preset Frequency 2 (Hz)	0.00 – 240.0	10.00
7.09	Preset Frequency 3 (Hz)	0.00 – 240.0	20.00
7.10	Preset Frequency 4 (Hz)	0.00 – 240.0	25.00
7.11	Preset Frequency 5 (Hz)	0.00 – 240.0	30.00
7.12	Preset Frequency 6 (Hz)	0.00 – 240.0	35.00
7.13	Preset Frequency 7 (Hz)	0.00 – 240.0	40.00
7.14	Up/Down Frequency Control Mode	0000: Free-Running ⁽⁵⁾ 0001: Incremental Change (See Function No. 7.15)	0000
7.15	Increment of Up/Down Frequency (Hz)	0.01 – 30.00	1.00
7.16	Accel/Decel 2 Time (Seconds)	0.3 – 180.0	1.5

Note: (1) Each of the 7 Multi-Function Inputs can be programmed for any of the respective function codes ("0000" – "0011"). (2) Preset Frequencies 1 – 7 are obtained by selecting a specific combination of 3 Multi-Function Input Terminals. The specific frequencies are programmed in Function Nos. 7.07 – 7.13. (3) For Up/Down Frequency Commands (codes "0003" and "0004"), Frequency Control (Function No. 2.00) must be set to Up/Down Using MFITs (code "0005"). (4) For Forward/Reverse Stop Commands (codes "0006" and "0007") and N.O. Start / N.C. Stop (codes "0010" and "0011"), Run/Stop-Forward/Reverse Control (Function No. 1.00) must be set to External Contacts (code "0001"). (5) The rate of change of the "UP" Control for frequency setting, using external contacts, is proportional to the Accel Time setting (Function No. 3.03). The rate of change of the "DOWN" Control for frequency setting, using external contacts, is proportional to the Decel Time Setting (Function No. 3.04).

*Functions which can only be changed while the drive is in the Stop Mode.

FUNCTION GROUP 8 – Multi-Function Output Relays and Output Signal Operation (IODA Required)

Function No.	Description	Range/Code	Factory Setting
8.00 *	Multi-Function Output Relay 1 (Terminals 23 – 25)	0000: Run 0001: Fault ⁽¹⁾	0000
8.01 *	Multi-Function Output Relay 2 (Terminals 26 – 28)	0002: Target Frequency (Function No. 8.04 ± Function No. 8.05) 0003: Frequency Threshold Level (> Function No. 8.04 – Function No. 8.05) ⁽²⁾	0001
8.02 *	Multi-Function Open Collector Output 1 (Terminals 11, 12)	0004: Frequency Threshold Level (< Function No. 8.04 + Function No. 8.05) ⁽³⁾	0002
8.03 *	Multi-Function Open Collector Output 2 (Terminals 13, 14)	0005: I ² t or I•t Fault 0006: Load Loss (See Function No. 5.03) 0007: External Fault 0008: Motor Overload ⁽⁴⁾	0004
8.04	Frequency Set Point (Hz)	0.00 – 240.0	0.00
8.05	Frequency Bandwidth (± Hz)	0.00 – 30.00	1.00
8.06	Analog Output 1 Mode (Terms. 15, 16) (0 – 5 VDC)	0000: Motor Frequency 0001: Set Frequency 0002: Motor Voltage 0003: Bus Voltage 0004: Motor Current	0000
8.07	Analog Output 1 Gain (%)	0 – 200	100
8.08	Analog Output 2 Mode (Terms. 17, 18) (See Function No. 8.09)	0000: Motor Frequency 0001: Set Frequency 0002: Motor Voltage 0003: Bus Voltage 0004: Motor Current	0000
8.09	Analog Output 2 Type ⁽⁵⁾	0000: 0 – 5 VDC 0001: 0 – 20 mA DC 0002: 4 – 20 mA DC	0000
8.10	Analog Output 2 Gain (%)	0 – 200	100

Notes: (1) The Multi-Function Output Relay Contacts and Open Collector Outputs will change state due to all Faults and Recovered Faults. (2) The Multi-Function Output Relay will activate above the setting in Function No. 8.04 and deactivate below the setting in Function No. 8.04 minus the setting in Function No. 8.05. (3) The Multi-Function Output Relay will activate below the setting in Function No. 8.04 and deactivate above the setting in Function No. 8.04 plus the setting in Function No. 8.05. (4) The Multi-Function Output Relay will change state when the I²t or I•t Timer starts. (5) Analog Output 2 Type: For 0 – 5 VDC (code "0000"), set Jumpers J2 and J3, on the IODA Input/Output Multi-Function Board, to the "VOLT" position (factory setting). For 0 – 20 mA DC (code "0001") or 4 – 20 mA DC (code "0002"), set Jumpers J2 and J3, on the IODA Input/Output Multi-Function Board, to the "CUR" position.

*Functions which can only be changed while the drive is in the Stop Mode.

FUNCTION GROUP 9 – Analog Input Signal Operation (IODA Required)

Function No.	Description	Range/Code	Factory Setting
9.00	Analog Input 1 Gain (%) ⁽¹⁾	0 – 500	100
9.01	Analog Input 1 Slope ⁽¹⁾	0000: Positive 0001: Negative	0000
9.02	Analog Input 1 Offset (%) ⁽¹⁾	0 – 100	0
9.03	Analog Input 1 Type ⁽¹⁾	0000: Unidirectional 0001: Bidirectional	0000
9.04	Analog Input 1 Response Time (mSec) ⁽¹⁾	2 – 100	2
9.05	Analog Input 2 Gain (%) ⁽²⁾	0 – 500	100
9.06	Analog Input 2 Slope ⁽²⁾	0000: Positive 0001: Negative	0000
9.07	Analog Input 2 Offset (%) ⁽²⁾	0 – 100	0
9.08	Analog Input 2 Type ⁽²⁾	0000: Analog Voltage or Current ⁽³⁾ 0001: PWM ⁽⁴⁾	0000
9.09	Analog Input 2 Response Time (mSec) ⁽²⁾	2 – 100	2

Notes: (1) For Analog Input 1 (Function Nos. 9.00 – 9.04), Frequency Control (Function No. 2.00) must be set to Analog Signal 1 (code "0002"). (2) For Analog Input 2 (Function Nos. 9.05 – 9.09), Frequency Control (Function No. 2.00) must be set to Analog Signal 2 (code "0003"). (3) For Current Signal Input, set Jumper J1, on the IODA Input/Output Multi-Function Board, to the "CUR" position. (4) 0.15 – 1 kHz (0 – 100% duty cycle).

FUNCTION GROUP 10 – Communication Mode (Modbus Communication Module Required (OEM Applications Only))

Function No.	Description	Range/Code	Factory Setting
10.00 *	Assigned Communication Station Number	1 – 247	30
10.01	Communications Watchdog Timer	0000: Disabled 0001: Enabled	0000
10.02	Watchdog Timeout (Seconds)	0.50 – 2.00	0.50
10.03	Operational Command	0 0: Stop 1: Run	—
		1 0: Forward 1: Reverse	
		2 0: N/A 1: Fault Reset	
		3 0: JOG-LCL/REM Command Off 1: JOG-LCL/REM Command On	
		4 0: N/A 1: Preset Frequency 1	
		5 0: N/A 1: Preset Frequency 2	
		6 0: N/A 1: Preset Frequency 3	
		7 0: N/A 1: Preset Frequency 4	
		8 0: N/A 1: Preset Frequency 5	
		9 0: N/A 1: Preset Frequency 6	
		10 0: N/A 1: Preset Frequency 7	
		11 Reserved	
		12 Reserved	
		13 Reserved	
		14 Reserved	
15 Reserved			
10.04	Drive Status	0 0: Stop 1: Run	—
		1 0: Forward 1: Reverse	
		2 0: Normal 1: Fault	
		3 0: JOG-LCL/REM Command Off 1: JOG-LCL/REM Command On	
		4 0: N/A 1: Preset Frequency 1	
		5 0: N/A 1: Preset Frequency 2	
		6 0: N/A 1: Preset Frequency 3	
		7 0: N/A 1: Preset Frequency 4	
		8 0: N/A 1: Preset Frequency 5	
		9 0: N/A 1: Preset Frequency 6	
		10 0: N/A 1: Preset Frequency 7	
		11 0: Jog Momentary Mode 1: Jog Latching Mode	
		12 Reserved	
		13 0: Local 1: Remote	
		14 Reserved	
15 Reserved			
10.05	Drive Status Description	00 Normal Operation	—
		01 Short Circuit Trip	
		02 Current Limit	
		03 Current Limit Trip	
		04 Undervoltage Trip	
		05 Recovered Undervoltage Trip	
		06 Overvoltage Trip	
		07 Recovered Overvoltage Trip	
		08 Stop Mode	
		09 Flash Error	
		10 External Fault Trip (IODA Input/Output Multi-Function Board)	
		11 IODA Input/Output Multi-Function Board Error	
		12 Phase Loss Trip	
		13 Current Source Trip (IODA Input/Output Multi-Function Board)	
10.06 **	Communications Error Count	—	—
10.07 **	Motor Voltage	—	—
10.08 **	Motor Current	—	—
10.09 **	Bus Voltage	—	—
10.10 **	Motor Frequency	—	—

*Functions which can only be changed while the drive is in the Stop Mode.

**Read only.

11 – STATUS LEDs

The drive's cover contains 8 LEDs which provide indication of the drive's status and operating mode (Hz, PGM, LCL/REM, STOP, FWD, REV, OL, JOG/REM). See Table 7 for a description of the LEDs.



WARNING! Wait at least 1 minute before opening the cover. Be sure the main power switch or circuit breaker is in the "OFF" position before servicing the drive. Do not depend on the Status LEDs or the 4-Digit Display to no longer be illuminated as a guaranteed power off condition.

TABLE 7
LED DESCRIPTIONS

LED	Description
JOG <input type="checkbox"/> REM	Illuminates when Jog is selected. Flashes when the drive is set for Remote Signal Operation.
OL <input type="checkbox"/>	Illuminates when the drive is in Overload.
FWD <input type="checkbox"/>	Illuminates when the drive is in the Forward Direction.
REV <input type="checkbox"/>	Illuminates when the drive is in the Reverse Direction.
STOP <input type="checkbox"/>	Illuminates when the drive is in the Stop Mode.
Hz <input type="checkbox"/>	Illuminates when the display is set to show Output Frequency.
LCL/REM <input type="checkbox"/>	Illuminates when the JOG-LCL/REM Key is reprogrammed for Local (Keypad) and Remote Signal Operation.
PGM <input type="checkbox"/>	Illuminates when the drive is in the Program Mode.

12 – OPTIONAL ACCESSORIES

Detailed instructions are provided with all accessories. See Table 8.

TABLE 8
OPTIONAL ACCESSORIES

Description	Part No.
On/Off AC Line Switch: Panel mounted. Used to turn the power on and off to the drive.	9683
IODA Input/Output Multi-Function Board: Provides a variety of functions, which include preset frequency, Up/Down Frequency, signal isolation, isolated output voltage for auxiliary devices, open collector outputs, and output relay contacts. Mounts on the drive's PC board with three screws (provided). All of the IODA Input/Output Multi-Function Board inputs and outputs are isolated from the AC Line.	9668

TO VALIDATE THE 18 MONTH WARRANTY, PLEASE REGISTER THIS PRODUCT ONLINE

↓ ↓ ↓ ↓ ↓ ↓
kbelectronics.com/registration.htm

LIMITED WARRANTY

For a period of 18 months from the date of original purchase, KB Electronics, Inc. will repair or replace without charge, devices which our examination proves to be defective in material or workmanship. This warranty is valid if the unit has not been tampered with by unauthorized persons, misused, abused, or improperly installed and has been used in accordance with the instructions and/or ratings supplied. The foregoing is in lieu of any other warranty or guarantee, expressed or implied. KB Electronics, Inc. is not responsible for any expense, including installation and removal, inconvenience, or consequential damage, including injury to any person, caused by items of our manufacture or sale. Some states do not allow certain exclusions or limitations found in this warranty and therefore they may not apply to you. In any event, the total liability of KB Electronics, Inc. under any circumstance shall not exceed the full purchase price of this product.
(Rev. 2/2000)

COPYRIGHT © 2017 KB Electronics, Inc.

All rights reserved. In accordance with the United States Copyright Act of 1976, no part of this publication may be reproduced in any form or by any means without permission in writing from KB Electronics, Inc. (8/2002)



KB Electronics, Inc.
12095 NW 39 Street, Coral Springs, FL 33065-2516
Phone: 954-346-4900; **Fax:** 954-346-3377, **Toll Free:** 800-221-6570
E-Mail: info@kbelectronics.com
www.kbelectronics.com

Copyright © 2017 KB Electronics, Inc.

(A40167) – Rev. B00 – 8/11/2017