INSTALLATION AND OPERATION MANUAL
IODA INPUT/OUTPUT MULTI-FUNCTION BOARD
(Part No. 9668)

IODA

PWR

J2
CUR VOLT CUR

CUR VOLT CUR
J3

CON2

STATUS

CON1

TB1

14 28 13 27 26 12 11 25 24 10 23 9 22 8 21 7 20 6 19 5 18 4 17 3 16 2 15 1

MAX1

VOLT

MAX2 CUR
J1
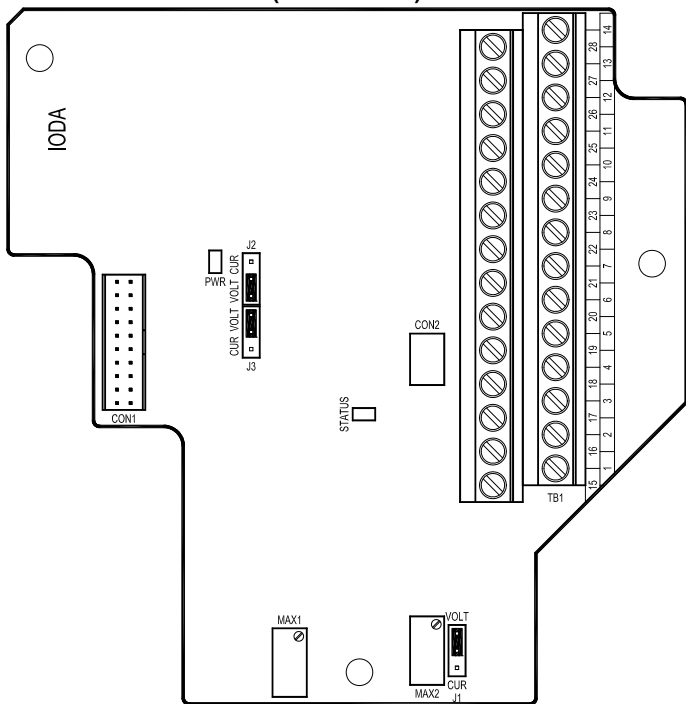
Use with Models KBDA-24D, 27D, 29, 45, 48

♻⚡⚠ **See Safety Warning, on page 4.** c(UL)us CE RoHS COMPLIANT

**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.**

KB GENESIS
Automation and Control

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

ITEMS INCLUDED IN THIS PACKAGE

- IODA Input/Output Multi-Function Board.
- Small Mounting Base (for Model KBDA-24D only).
- Large Mounting Base (for Models KBDA-27D, 29, 45, 48).
- One 6-32 X ½" and one 6-32 X 1" Socket Head Cap Screw (for Small Mounting Base).
- Two 6-32 X 1½ " Socket Head Cap Screws (for Large Mounting Base).
- 7/64" Allen key.
- IODA Input/Output Multi-Function Board Installation and Operation Manual.
- 4" Heat Shrink Tubing (used to enclose IODA wires when using the optional AC line filter).
- CE Approved Product Information Card.
- Warranty Registration Card.

1 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.

⚡⚠ **This product should 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 1/2006)**

The IODA contains electronic Start/Stop circuits, which can be used to start and stop the drive. However, these circuits are never to be used as safety disconnects since they are not fail-safe. Use only the AC line for this purpose.

Be sure to read this manual in its entirety and follow all instructions carefully before proceeding with the installation and operation. Fire and/or electrocution can result due to improper use of this product.

2 INTRODUCTION

Thank you for purchasing the IODA Input/Output Multi-Function Board. KB Electronics, Inc. is committed to providing total customer satisfaction by producing quality products that are easy to install and operate.

The 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, output relay contacts, and open collector outputs. The IODA mounts on the drive's PC board with 2 snap-ins (located on the bottom of the mounting base) and 2 screws (provided). All of the IODA inputs and outputs are isolated from the AC line.

The IODA has a green power on LED (PWR) and a red status LED (STATUS), which are used to provide operational information of the IODA. See Table 27, on page 43, for a description of the status LED. See Figure 1, on page 6, for the IODA layout. See Figure 10, on page 13, for Terminal Block TB1 Layout. See Table 1, on page 14, for Terminal Block TB1 Wire and Tightening Torque Specifications. See Table 2, on page 14, for the Functions, Features, and Terminal Assignment. See Sections 4.1 – 4.6, on pages 15 – 26, describing the use of the IODA Multi-Function Input Terminals for remote operations. See Sections 4.7 – 4.11, on pages 26 – 39, for other functions and features of the IODA.

STANDARD FEATURES

- **Signal Input Isolation:** Provides isolation between signal sources and the drive.

- **Potentiometer Operation:** A 5 kΩ potentiometer can be used to in lieu of the Keypad or the Built-In Potentiometer. The Main Speed Potentiometer can be connected for forward, reverse, or bidirectional motor speed control.

- **Multi-Function Input Terminals:** Used for a variety of functions, which include Preset Frequency; Up/Down Frequency Command; Forward/Stop and Reverse/Stop Command; External Fault; Reset; 2-Wire and 3-Wire Start/Stop.

- **Multi-Function Output Relays:** Two Multi-Function Output Relays are provided, which can be programmed for Run, Fault, Target Frequency, Frequency Threshold Level, I^2t or I•t Fault, Load Loss, External Fault, and Motor Overload.

- **Multi-Function Open Collector Outputs:** Two Multi-Function Output Relays are provided, which can be programmed for Run, Fault, Target Frequency, Frequency Threshold Level, I^2t or I•t Fault, Load Loss, External Fault, and Motor Overload.

- **Isolated Signal Output:** Two isolated analog signal outputs are provided, which can be used to monitor Motor Frequency, set Frequency, Motor Voltage Bus Voltage, and Motor Current. Analog Output 1 provides a 0 – 5 Volt DC signal output. Analog Output 2 can be programmed for 0 – 5 Volt DC, 4 – 20 mA DC, or for 0 – 20 mA DC.

- **Selectable Jumpers:** For voltage or current signal selection.

- **Multi-Turn Trimpots:** For fine adjustment and attenuation of signal inputs.

- **LEDs:** The green power on LED (PWR) indicates that power is applied to the IODA from the drive. The red status LED (STATUS) provides indication of the IODA operation.

- **Barrier Terminal:** All connections to the IODA are made via the barrier terminal block. All terminal block connections of the IODA are isolated from the AC line.

- **Easy Installation:** Uses a snap-in base and two screws (provided) for mounting and a ribbon cable for wiring to the drive.

FIGURE 1
IODA LAYOUT

Screw Holes for Large Mounting Base
Large Mounting Base (Shaded Section)
Screw Holes for Small Mounting Base

IODA

CON1

CON2:
Factory Use Only

PWR

CUR VOLT VOLT CUR

J2

J3

CON2

STATUS

MAX1

MAX2

VOLT

CUR

J1

TB1

Terminal Block TB1

Two Snap-Ins to Secure
IODA to Mounting Base

MAX2 Trimpot: Signal Scaling
for Analog Input 2

J1: Current or Voltage Signal Input
Selection for Analog Input 2

MAX1 Trimpot: Signal Scaling for Analog Input 1

Status LED (Red)

J2 & J3: Current or Voltage Signal Input Selection for Analog Output 2

Power On LED (Green)

CON1: Used for the Interconnecting Ribbon Cable to the Drive

The IODA kit contains 2 mounting bases. Use the small base for Model KBDA-24D and the large base for Models KBDA-27D, 29, 45, 48.

FIGURE 2
KBDA LAYOUT
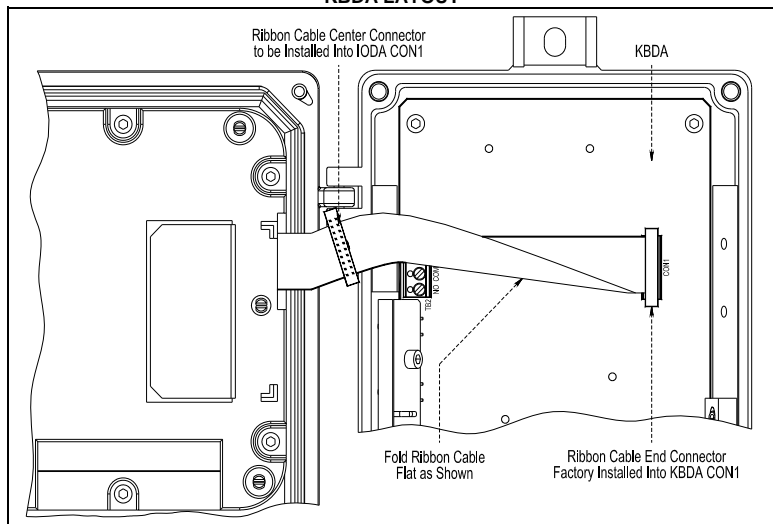
*Model KBDA-24D shown. Layout of Models KBDA-27D, 29, 45, 48 varies slightly.

3 INSTALLATION INSTRUCTIONS

The IODA is designed to be installed onto the KBDA PC board with a mounting base and screws provided. The ribbon cable in the KBDA contains a connector which is to be plugged into the mating connector on the IODA. See Figures 8 and 9, on pages 11 and 12, showing the IODA installed onto the KBDA PC board.

See Figure 3, on page 8, for the exploded view of the KBDA and IODA assembly.

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

FIGURE 3
EXPLODED VIEW OF KBDA AND IODA ASSEMBLY (KBDA-24D SHOWN)

6-32 X 1"
Socket Head Cap Screw
(use 6-32 1-1/2"
Socket Head Cap Screw for
Models KBDA-27D, 29, 45, 48)

IODA

6-32 X 1/2"
Socket Head Cap Screw
(use 6-32 1-1/2"
Socket Head Cap Screw for
Models KBDA-27D, 29, 45, 48)

Mounting Base

8
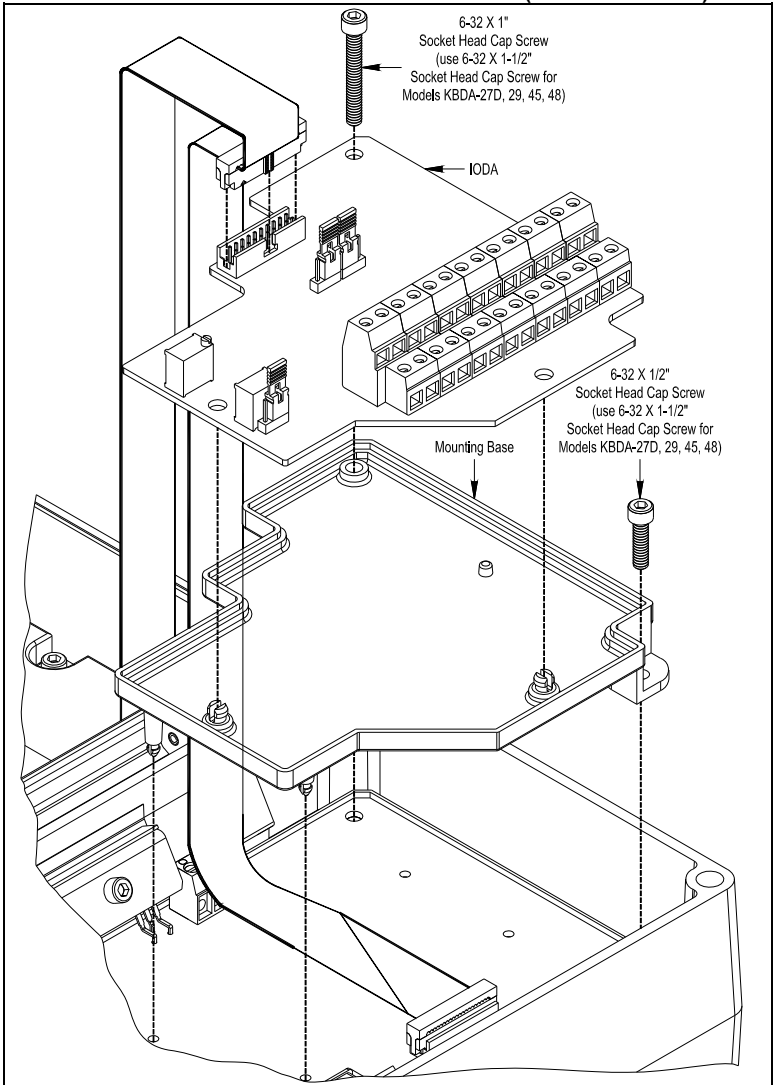
3.1 PREPARING THE DRIVE FOR INSTALLATION OF THE IODA
Use the Allen Key (supplied) to remove the two socket head cap screws located at the top corners of the KBDA PC board. See Figure 4.

FIGURE 4
PREPARING THE DRIVE FOR INSTALLATION OF THE IODA*

Use Allen Key (Supplied) to Remove these Two Socket Head Cap Screws
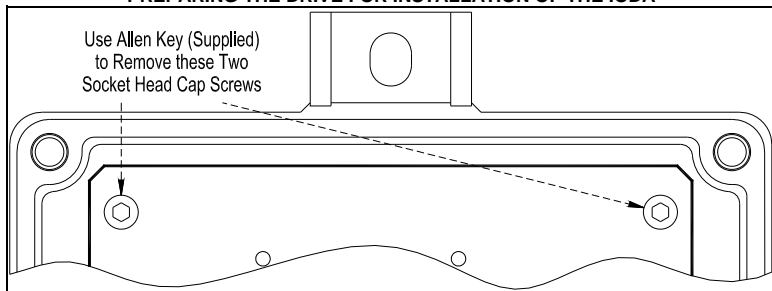
*Model KBDA-24D shown. Layout of Models KBDA-27D, 29, 45, 48 varies slightly.

3.3 INSTALLING THE IODA ONTO THE MOUNTING BASE
Use the small mounting base for Model KBDA-24D and the large mounting base for Models KBDA-27D, 29, 45, 48. Align the IODA PC board holes with the two snap-ins of the mounting base and press firmly into place until the IODA PC board is secured onto the mounting base. See Figure 5.

Note: To prevent damage to components press only on the PC board, not on any components.

FIGURE 5
INSTALLING THE IODA PC BOARD ONTO THE MOUNTING BASE

IODA PC Board   Mounting Base

Two Snap-Ins to Secure IODA to Mounting Base

9

3.4 INSTALLING THE IODA INTO THE DRIVE

Place the IODA in the area where it is to be installed. Be sure the ribbon cable is routed underneath the mounting base. Align the two snap-ins of the mounting base with the two holes on the KBDA PC board and press firmly until the mounting base is secured onto the KBDA PC board. See Figure 6.

Use the 6-32 X ½" and 6-32 X 1" screws for the small Mounting Base (see Figure 8, on page 11). Use the two 6-32 X 1½" screws for the large Mounting Base (see Figure 9, on page 12). Use the Allen Key (supplied) to tighten the screws. Do not over tighten.

Note: To facilitate the connection of the ribbon cable onto the IODA, it is recommended that the fold of the ribbon cable be positioned in the area where the IODA and mounting base will be located, as shown in Figure 6.

FIGURE 6
INSTALLING THE IODA INTO THE DRIVE

*Model KBDA-24D shown. Layout of Models KBDA-27D, 29, 45, 48 varies slightly.

3.5 INSTALLING THE RIBBON CABLE

Install the Ribbon Cable Connector, located in the middle of the Ribbon Cable, into the Mating Connector CON1 on the IODA PC board. Align the Connector Key with the Key Slot and push down until fully engaged. See Figure 7.

FIGURE 7
INSTALLING THE RIBBON CABLE INTO THE IODA CON1

3.6 IODA INSTALLED INTO THE DRIVE

After completing the installation, the IODA mounted in Model KBDA -24D will resemble Figure 8 and the IODA mounted in Models KBDA-27D, 29, 45, 48 will resemble Figure 9, on page 12.

FIGURE 8
IODA INSTALLED INTO MODEL KBDA-24D

FIGURE 9
IODA INSTALLED INTO MODELS KBDA-27D*, 29, 45, 48

*Layout of Model KBDA-27D varies slightly.

4   ELECTRICAL CONNECTIONS

See Sections 4.1 – 4.11, on pages 15 – 38, for the electrical connections to the IODA.

See Figure 10, below, for Terminal Block TB1 Layout. Common Terminals "8", "12", "14", "16", "18", "20", and "22" (shown shaded) are all internally connected and can be used with the Multi-Function Input Terminals "1" – "7", Signal Inputs 1 and 2, and Signal Outputs 1 and 2.
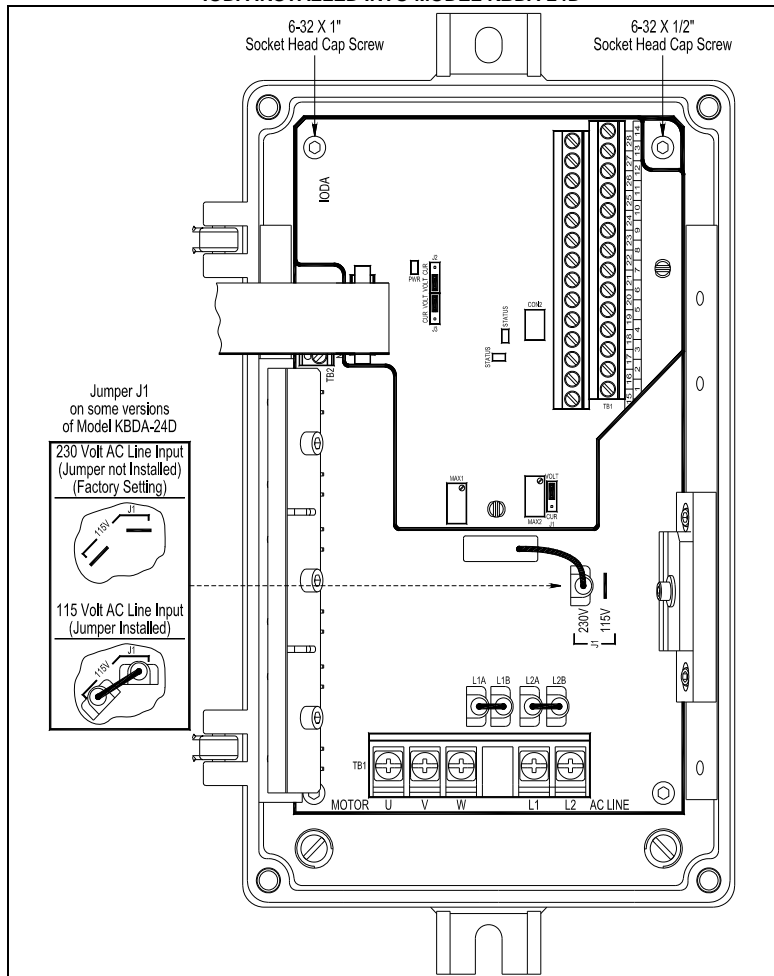
See Table 1, on page 14, for Terminal Block TB1 Wire and Tightening Torque Specifications. See Table 2, on page 14, for Terminal Block TB1 Functions, Features and Terminal Assignments.

⚠ WARNING! HIGH VOLTAGE – Read Safety Warning, on page 4, before using the drive. Disconnect main power before making connections to the IODA or the drive. To avoid electric shock, be sure to properly ground the drive.
Do not depend on the LEDs or the 4-Digit Display, to no longer be illuminated as a guaranteed power off condition. Be sure the main power switch or circuit breaker is in the "OFF" position before servicing 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 wires 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.

Local/Remote Operation: When using the IODA with signal following or remote start/stop, it is desirable to program the drive for Local/Remote Operation. In this mode, the drive frequency setting can be toggled between a process signal and the keypad using the JOG-LCL/REM Key. The following functions can be switched between "remote" and "local" (Keypad) operation: Start/Stop, Forward/Reverse, Analog Signal Inputs 1 and 2, and Up/Down Frequency Control.

Set Jog-Local/Remote (Function No. 2.02) to Jog Disabled; Local/Remote Enabled ("0002") to change the JOG-LCL/REM Key from Jog Operation to Local/Remote Operation.

Note: To stop the drive using the Keypad, when in Remote Operation, first press the JOG-LCL/REM Key and then the Stop Key.

FIGURE 10
TERMINAL BLOCK TB1 LAYOUT
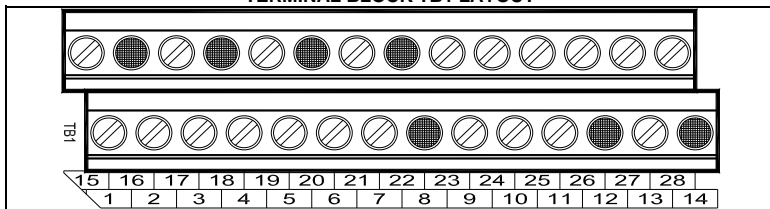
Common Terminals "8", "12", "14", "16", "18", "20", and "22" are all internally connected and are shown shaded.

TABLE 1
TERMINAL BLOCK TB1 WIRE AND TIGHTENING TORQUE SPECIFICATIONS

Maximum Wire Size (Cu)		Recommended Tightening Torque	
AWG	mm²	lbs-in	kg-cm
16	1.3	6	7

TABLE 2
FUNCTIONS, FEATURES, AND TERMINAL ASSIGNMENT

Terminal Assignment						
Multi-Function Input Terminals[1] (Digital Inputs)		Power Supply[2]	Multi-Function Outputs[2]	Analog Outputs[2]	Analog Inputs[2]	Relay Outputs[3]
1 – 7		8	11	15	19	23
0000: Preset Frequency Operation[1]		Common	Open Collector 1	Analog Output 1	Analog Input 1	RY1 N.O.
0001: Preset Frequency Operation[1]						
0002: Preset Frequency Operation[1]		9 +5 Volts	12 Common	16 Common	20 Common	24 RY1 Common
0003: Up Frequency Command (See Function No. 7.14)		10 -5 Volts	13 Open Collector 2	17 Analog Output 2	21 Analog Input 2	25 RY1 N.C.
0004: Down Frequency Command (See Function No. 7.14)						
0005: Accel/Decel 2 (See Function No. 7.16)			14 Common	18 Common	22 Common	26 RY2 N.O.
0006: Forward/Stop Command						
0007: Reverse/Stop Command						27 RY2 Common
0008: External Fault (N.O. Contact)						28 RY2 N.C.
0009: Reset						
0010: N.O. Start (2-Wire or 3-Wire Start/Stop)						
0011: N.C. Stop (3-Wire Start/Stop)						
0012: External Fault (N.C. Contact)						

Left margin label: Multi-Function Input Terminal Codes (Function Group 7)

Notes: 1. Multi-Function Input Terminals "1" – "7" can be programmed for: 7 Preset Frequencies*, Up/Down Frequency Command, Accel/Decel 2, Forward/Stop, Reverse/Stop, External Fault, Reset, and 2-Wire/3-Wire Start/Stop. 2. Common Terminals "8", "12", "14", "16", "18", "20", "22" are all internally wired together and can be used with any of the Multi-Function Input Terminals "1" – "7". 3. RY1 Common (Terminal "24") is the contact common only for Relay 1. RY2 Common (Terminal "27") is the contact common only for Relay 2.

*The 7 Preset Frequencies are obtained using a combination of Terminals 1, 2, 1+2, 3, 1+3, 2+3, 1+2+3.

TABLE 3
MULTI-FUNCTION INPUT TERMINAL, FUNCTION NO., AND CODE ASSIGNMENT

MFIT	1	2	3	4	5	6	7
Function No.	7.00	7.01	7.02	7.03	7.04	7.05	7.06
Factory Code Setting	0000	0001	0002	0009	0010	0003	0004
Code Description	Preset Frequency Operation	Preset Frequency Operation	Preset Frequency Operation	Reset	2-Wire N.O. Start/Stop	Up Frequency Command	Down Frequency Command

Each Multi-Function Input Terminal is controlled by a specific Function No. Although factory set to a specific code, they can also be reprogrammed to any Function Code "0000" – "0012" listed in Table 2, on page 14. Also see Function Group 7, on page 41.

4.1 PRESET FREQUENCIES

The drive is factory programmed for 7 Preset Frequencies, which can be selected using remote switches or contacts connected to Multi-Function Input Terminals "1" – "3". See Figures 11 and 12, on page 17. See Table 4 for the terminals to select for the preset frequencies.

The 7 Preset Frequencies are obtained using a combination of Multi-Function Input Terminals 1, 2, 1+2, 3, 1+3, 2+3, 1+2+3. The Preset Frequencies can be changed from their factory settings by reprogramming Function Nos. 7.07 – 7.13.

8th Preset Frequency: If none of the Multi-Function Input Terminals are activated, the drive will operate at the Stored Set Frequency (Function No. 3.00) of 5.00 Hz. If the 8th Preset Frequency is not required, set Function No. 3.00 to 00.00 Hz.

Note: For Preset Frequency Operation only, the drive does not have to be reprogrammed for External Contacts Operation. Multi-Function Input Terminals "1" – "3" are factory set to codes "0000", "0001", and "0002", which automatically sets the drive for Preset Frequency Operation.

Application Notes: 1. The drive is factory set for Unidirectional (Forward) Operation. For Bidirectional Operation, use two Multi-Function Inputs for Forward/Stop and Reverse/Stop, as described in Section 4.1.2, on page 18. 2. Be sure to program both Forward/Stop and Reverse/Stop Operation (codes "0006" and "0007"). If only one direction is programmed, the drive will remain "locked" in that direction.

TABLE 4
PRESET FREQUENCY SELECTION

Multi-Function Input Terminals to Select			Preset Frequency		
Terminal 1 Function No. 7.00 Set to "0000"*	Terminal 2 Function No. 7.01 Set to "0001"*	Terminal 3 Function No. 7.02 Set to "0002"*	No.	Function No.	Hz (Factory Setting)
●			1	7.07	5.00
	●		2	7.08	10.00
●	●		3	7.09	20.00
		●	4	7.10	25.00
●		●	5	7.11	30.00
	●	●	6	7.12	35.00
●	●	●	7	7.13	40.00

*Factory setting.

4.1.1 UNIDIRECTIONAL (FORWARD) PRESET FREQUENCY OPERATION

See Figures 11 and 12, on page 17, for connections. See Tables 5 and 6, on pages 17 and 18, for drive programming.

Connect the Preset Frequency Switches or Contacts to Multi-Function Input Terminals "1" – "3".

For 2-Wire Start/Stop, connect the switch or contact to Multi-Function Input Terminal "5", as shown in Figure 11, on page 17. Terminal "5" is factory set for N.O Start ("0010").

For 3-Wire Start/Stop, connect the switches or contacts to Multi-Function Input Terminals "5" and "6", as shown in Figure 12, on page 17. Terminal "5" is factory set for N.O. Start ("0010"). Terminal "6" has been arbitrarily chosen for N.C. Stop ("0011").

The common of the switches or contacts can be connected to any available common terminal ("8", "12", "14", "16", "18", "20", "22").

Note: Use a maintained switch or contact for 2-Wire Start/Stop and momentary switches or contacts for 3-Wire Start/Stop. If Start/Stop is not used, a jumper must be installed between Terminals "5" and "8" and Function No. 7.04 must be set to "0010" (factory setting).
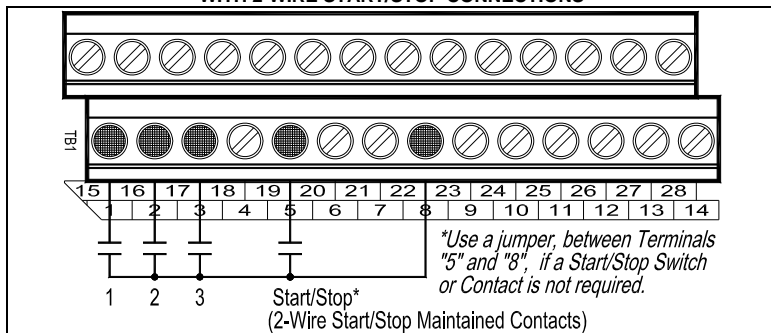
Application Notes: 1. Closing the Star/Stop Switch or Contact, without any of the Multi-Function Input Terminals "1" – "3" switches or contacts activated, will result in the drive operating at the factory preset frequency of 5.00 Hz. For zero speed operation, reprogram Function 3.00 to "00.00" Hz. **2.** The drive will operate in the forward direction without assigning a Multi-Function Input code "0006" (Forward/Stop Command) or "0007" (Reverse/Stop Command). Once these codes are assigned to a Multi-Function Input Terminal, a switch or contact must be used to select forward or reverse direction.

2-Wire Start/Stop Operation: Close the Start/Stop Switch or Contact to put the drive into the Run Mode. When a Preset Switch or Contact is closed, the preset frequency is selected. Open the Start/Stop Switch or Contact to put the drive into the Stop Mode.

3-Wire Start/Stop Operation: Momentarily close the Start/Stop Switch or Contact to put the drive into the Run Mode. When a Preset Switch or Contact is closed, the preset frequency is selected. Momentarily open the Start/Stop Switch or Contact to put the drive into the Stop Mode.

FIGURE 11
UNIDIRECTIONAL PRESET FREQUENCY SELECTION
**WITH 2-WIRE START/STOP CONNECTIONS**

Use a jumper, between Terminals "5" and "8", if a Start/Stop Switch or Contact is not required.

1 2 3 Start/Stop*
(2-Wire Start/Stop Maintained Contacts)

Note: Use Function Nos. 7.07 – 7.13 to program the desired Preset Frequencies.

TABLE 5
UNIDIRECTIONAL PRESET FREQUENCY SELECTION
WITH 2-WIRE START/STOP PROGRAMMING

Function No.	Code/Range
1.00: Run/Stop-Forward/Reverse Control	**0001:** External Contacts
3.00: Stored Set Frequency	**00.00 Hz**
7.00: Multi-Function Input Terminal 1	**0000:** Preset Frequency Operation*
7.01: Multi-Function Input Terminal 2	**0001:** Preset Frequency Operation*
7.02: Multi-Function Input Terminal 3	**0002:** Preset Frequency Operation*
7.04: Multi-Function Input Terminal 5	**0010:** N.O. Start*

Factory setting.

FIGURE 12
UNIDIRECTIONAL PRESET FREQUENCY SELECTION
WITH 3-WIRE START/STOP CONNECTIONS

1 2 3 Start Stop
(3-Wire Start/Stop Momentary Contacts)
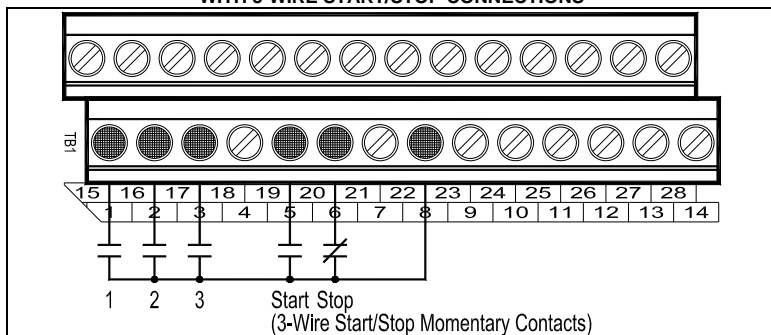
Note: Use Function Nos. 7.07 – 7.13 to program the desired Preset Frequencies.

TABLE 6
UNIDIRECTIONAL PRESET FREQUENCY SELECTION
WITH 3-WIRE START/STOP PROGRAMMING

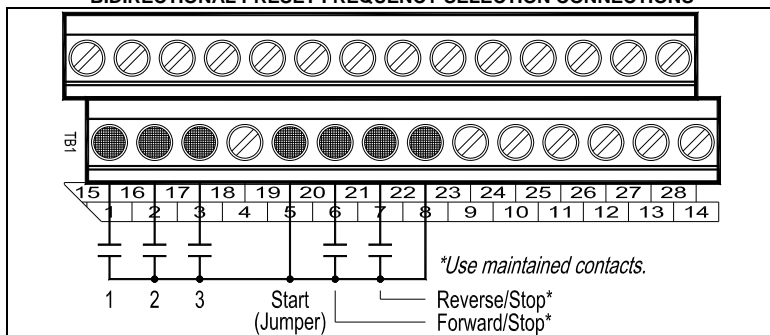| Function No.	Code/Range
1.00: Run/Stop-Forward/Reverse Control	**0001:** External Contacts
3.00: Stored Set Frequency	**00.00** Hz
7.00: Multi-Function Input Terminal 1	**0000:** Preset Frequency Operation*
7.01: Multi-Function Input Terminal 2	**0001:** Preset Frequency Operation*
7.02: Multi-Function Input Terminal 3	**0002:** Preset Frequency Operation*
7.04: Multi-Function Input Terminal 5	**0010:** N.O. Start*
7.05: Multi-Function Input Terminal 6	**0011:** N.C. Stop

Factory setting.

4.1.2 BIDIRECTIONAL PRESET FREQUENCY OPERATION

See Figure 13 for connections. See Table 7, on page 19, for drive programming.

Connect the Preset Frequency Switches or Contacts to Multi-Function Input Terminals "1" – "3". Connect the start jumper to Multi-Function Input Terminal "5", which is factory set for N.O. Start ("0010"). Connect the Forward/Stop and Reverse/Stop Switches or Contacts to any Multi-Function Input Terminals "1" – "7". Terminals "6" and "7" have been arbitrarily chosen for Forward/Stop and Reverse/Stop. The common of the switches or contacts can be connected to any available common terminal ("8", "12", "14", "16", "18", "20", "22").

Operation: Close the Forward/Stop or Reverse/Stop Switch or Contact to select Forward or Reverse direction. When a Preset Switch or Contact is closed, the preset frequency is selected. Open the respective Forward/Stop or Reverse/Stop Switch or Contact to put the drive into the Stop Mode.

FIGURE 13
BIDIRECTIONAL PRESET FREQUENCY SELECTION CONNECTIONS

Note: Use Function Nos. 7.07 – 7.13 to program the desired Preset Frequencies.

TABLE 7

TABLE 7
BIDIRECTIONAL PRESET FREQUENCY SELECTION PROGRAMMING

Function No.	Code/Range
1.00: Run/Stop-Forward/Reverse Control	**0001:** External Contacts
3.00: Stored Set Frequency	**00.00 Hz**
7.00: Multi-Function Input Terminal 1	**0000:** Preset Frequency Operation*
7.01: Multi-Function Input Terminal 2	**0001:** Preset Frequency Operation*
7.02: Multi-Function Input Terminal 3	**0002:** Preset Frequency Operation*
7.04: Multi-Function Input Terminal 5	**0010:** N.O. Start*
7.05: Multi-Function Input Terminal 6	**0006:** Forward/Stop Command
7.06: Multi-Function Input Terminal 7	**0007:** Reverse/Stop Command

Factory setting.

4.2 UP/DOWN FREQUENCY COMMAND

The Multi-Function Input Terminals can be used for remote Up/Down Frequency Control in lieu of the Keypad. See Figures 14 and 15, on pages 20 and 22.

Connect the Up and Down Switches or Contacts to Multi-Function Input Terminals "6" and "7", which are factory set for Up and Down Frequency Command ("0003" and "0004"). The common of the switches or contacts can be connected to any available common terminal ("8", "12", "14", "16", "18", "20", "22").

Notes: 1. The drive is factory set for Unidirectional (Forward) Operation. For Bidirectional Operation, use two Multi-Function Inputs for Forward/Stop and Reverse/Stop, as described in Section 4.2.2, on page 21. 2. If a Multi-Function Input Terminal is programmed for Reverse/Stop Command ("0007"), when activated, the drive will remain "locked" in Reverse Operation until two Multi-Function Input Terminals are programmed for Forward/Stop Command ("0006") and Reverse/Stop Command ("0007").

Application Notes: 1. The Up/down Frequency Command Operation can be programmed for "Free-Running" or "Incremental" frequency change by setting Up/Down Frequency Control Mode (Function No. 7.14) for "Free Running" ("0000" (factory setting)) or "Incremental Change" ("0001"). **2.** In "Free Running" Mode, the rate of change of the "Up" control is proportional to the Accel Time (Function No. 3.03) and the rate of change of the "Down" control is proportional to the Decel Time (Function No. 3.04). **3.** In "Incremental Change" Mode, the step of change of the "Up" or "Down" control is set by Function No. 7.15 (range is 0.01 – 30.00 Hz (factory set to 1.00 Hz)).

4.2.1 UNIDIRECTIONAL UP/DOWN FREQUENCY CONTROL

See Figure 14, on page 20, for connections. See Table 8, on page 21, for drive programming.

Connect the Start/Stop Switch or Contact to Multi-Function Input Terminal "5", which is factory set for N.O. Start ("0010"). The common of the switch or contact can be connected to any available common terminal ("8", "12", "14", "16", "18", "20", "22").

Note: Use a maintained switch or contact for Start/Stop. If a Start/Stop Switch or Contact is not used, a jumper must be installed between Terminals "5" and "8".

Free-Running Operation: Close the Start/Stop Switch or Contact to put the drive into the Run Mode. When the Up Switch or Contact is closed, the drive output frequency will increase for the duration of the switch or contact closure. When the Up Switch or Contact is opened, the drive output frequency will stop increasing. When the Down Switch or Contact is closed, the drive output frequency will decrease for the duration of the switch or contact closure. When the Down Switch or Contact is opened, the drive output frequency will stop decreasing. Open the Start/Stop Switch or Contact to put the drive into the Stop Mode.

Incremental Operation: Close the Start/Stop Switch or Contact to put the drive into the Run Mode. For each activation of the Up Switch or Contact, the drive output frequency will increase incrementally, equal to the frequency set by Function No.7.15 (factory set to 1.00 Hz). For each activation of the Down Switch or Contact, the drive output frequency will decrease incrementally, equal to the frequency set by Function No. 7.15 (factory set to 1.00 Hz). Open the Start/Stop Switch or Contact to put the drive into the Stop Mode.

Note: In Incremental Operation, if the Up or Down Switch or Contact is maintained for longer than 2 seconds, the drive output frequency will "free run" up or down in increments set by Function No. 7.15, for the duration of the switch or contact closure. The rate of change is equal to the Accel/Decel settings in Function Nos. 3.03 and 3.04. When the switch or contact is opened, the drive output frequency will stop changing.

FIGURE 14
UNIDIRECTIONAL UP/DOWN FREQUENCY CONTROL
WITH 2-WIRE START/STOP CONNECTIONS
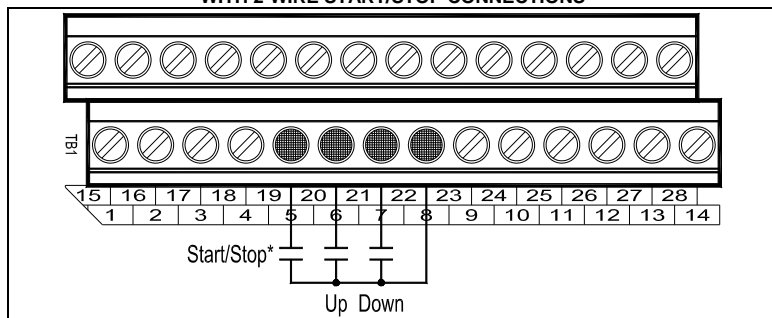
*Use a jumper, between Terminals "5" and "8", if a Start/Stop Switch or Contact is not required.

TABLE 8
UNIDIRECTIONAL UP/DOWN FREQUENCY CONTROL PROGRAMMING

Function No.	Code/Range
1.00: Run/Stop-Forward/Reverse Control	**0001:** External Contacts
2.00: Frequency Control	**0005:** Up/Down Using MFITs
7.04: Multi-Function Input Terminal 5	**0010:** N.O. Start*
7.05: Multi-Function Input Terminal 6	**0003:** Up Frequency Command*
7.06: Multi-Function Input Terminal 7	**0004:** Down Frequency Command.
7.14: Up/Down Frequency Control Mode	**0000:** Free-Running **0001:** Incremental
7.15: Increment of Up/Down Frequency**	**0.01 – 30.00 Hz:** Set to Desired Frequency

Factory setting.
**Use with Function No. 7.14 code "0001" only.

4.2.2 BIDIRECTIONAL UP/DOWN FREQUENCY CONTROL

See Figure 15, on page 22, for connections. See Table 9, on page 22, for drive programming.

Connect the Start (Jumper) to Multi-Function Input Terminal "5", which is factory set for N.O. Start ("0010"). Connect the Forward/Stop and Reverse/Stop Switches or Contacts to any Multi-Function Input Terminals "1" – "7". Terminals "3" and "4" have been arbitrarily chosen for Forward/Stop and Reverse Stop. The common of the switches or contacts can be connected to any available common terminal ("8", "12", "14", "16", "18", "20", "22").

Free-Running Operation: Close the Forward/Stop or Reverse/Stop Switch or Contact to put the drive into the Forward or Reverse Run Mode. When the Up Switch or Contact is closed, the drive output frequency will increase for the duration of the switch or contact closure. When the Up Switch or Contact is opened, the drive output frequency will stop increasing. When the Down Switch or Contact is closed, the drive output frequency will decrease for the duration of the switch or contact closure. When the Down Switch or Contact is opened, the drive output frequency will stop decreasing. Open the Forward/Stop or Reverse/Stop Switch or Contact to put the drive into the Stop Mode.

Incremental Operation: Close the Forward/Stop or Reverse/Stop Switch or Contact to put the drive into the Forward or Reverse Run Mode. For each activation of the Up Switch or Contact, the drive output frequency will increase incrementally, equal to the frequency set by Function No. 7.15 (factory set to 1.00 Hz). For each activation of the Down Switch or Contact, the drive output frequency will decrease incrementally, equal to the frequency set by Function No. 7.15 (factory set to 1.00 Hz). Open the respective Forward/Stop or Reverse/Stop Switch or Contact to put the drive into the Stop Mode.

Note: In Incremental Operation, if the Up or Down Switch or Contact is maintained for longer than 2 seconds, the drive output frequency will "free run" up or down in increments set by Function No. 7.15, for the duration of the switch or contact closure. The rate of change is equal to the Accel/Decel settings in Function Nos. 3.03 and 3.04. When the switch or contact is opened, the drive output frequency will stop changing.

FIGURE 15
BIDIRECTIONAL UP/DOWN FREQUENCY CONTROL CONNECTIONS
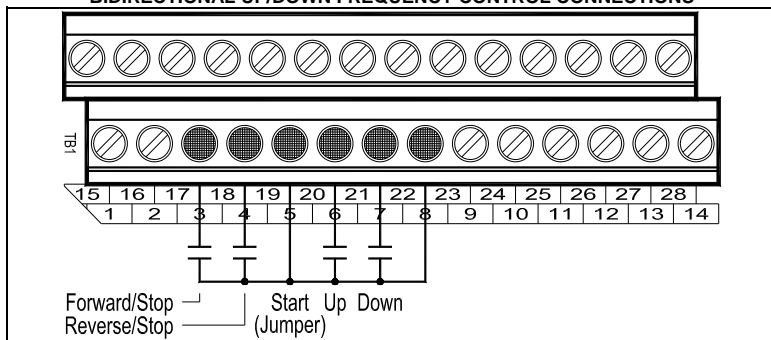
TABLE 9
BIDIRECTIONAL UP/DOWN FREQUENCY CONTROL PROGRAMMING

Function No.	Code/Range
1.00: Run/Stop-Forward/Reverse Control	**0001:** External Contacts
2.00: Frequency Control	**0005:** Up/Down Using MFITs
7.02: Multi-Function Input Terminal 3	**0006:** Forward/Stop Command
7.03: Multi-Function Input Terminal 4	**0007:** Reverse/Stop Command
7.04: Multi-Function Input Terminal 5	**0010:** N.O. Start*
7.05: Multi-Function Input Terminal 6	**0003:** Up Frequency Command*
7.06: Multi-Function Input Terminal 7	**0004:** Down Frequency Command*
7.14: Up/Down Frequency Control Mode	**0000:** Free-Running **0001:** Incremental
7.15: Increment of Up/Down Frequency**	**0.01 – 30.00 Hz:** Set to Desired Frequency

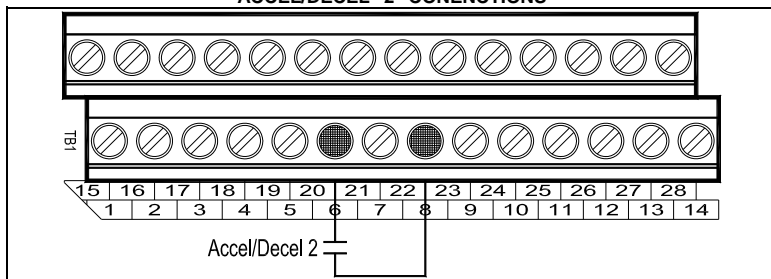*Factory setting.*
**Use with Function No. 7.14 code "0001" only.*

4.3 ACCEL/DECEL "2"

The drive provides a secondary Accel/Decel Time setting, which can be remotely selected with a normally open switch or contact connected to a Multi-Function Input Terminal. See Figure 16, on page 23, for connections. See Table 10, on page 23, for drive programming.

Connect the Accel/Decel 2 Switch or Contact to any Multi-Function Input Terminal "1" – "7". Terminal "6" has been arbitrarily chosen for Accel/Decel 2. Connect the common of the switch or contact to any available common terminal ("8", "12", 14", "16", "18", "20", "22").

Operation: When the Accel/Decel 2 Switch or Contact is closed, the Accel/Decel 2 setting is selected. When the Accel/Decel 2 Switch or Contact opened, the drive reverts to the Accel/Decel settings in Function Nos. 3.03 and 3.04. Accel/Decel 2 overrides the Accel and Decel settings in Function Nos. 3.03 and 3.04.

FIGURE 16
ACCEL/DECEL "2" CONENCTIONS

TABLE 10
ACCEL/DECEL "2" PROGRAMMING

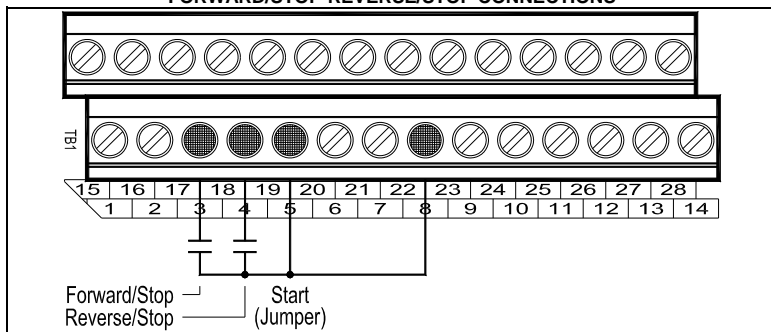| Function No.	Code/Range
7.05: Multi-Function Input Terminal 6	**0005:** Accel/Decel 2
7.16: Accel/Decel 2 Time	**0.3 – 180.0:** Set to Desired Time*

Factory set to 1.5 seconds.

4.4 FORWARD/STOP-REVERSE/STOP

Remote Forward/Stop and Reverse/Stop operation can be performed by connecting switches or contacts to the Multi-Function Input Terminals. See Figure 17, on page 24, for connections. See Table 11, on page 24, for drive programming.

Connect the Start/Stop Switch or Contact to Multi-Function Input Terminal "5", which is factory set for N.O. Start ("0010"). Connect the Forward/Stop and Reverse/Stop Switches or Contacts to any Multi-Function Input Terminals "1" – "7". Terminals "3" and "4" have been arbitrarily chosen for Forward/Stop and Reverse Stop. Connect the common of the switches or contacts to any available common terminal ("8", "12", "14", "16", "18", "20", "22").

Operation: When the Forward/Stop Switch or Contact is closed, the drive will run in the forward direction. When the Forward/Stop Switch or Contact is opened, the drive will stop. When the Reverse/Stop Switch or Contact is closed, the drive will run in the reverse direction. When the Reverse/Stop Switch or Contact is opened, the drive will stop.

FIGURE 17
FORWARD/STOP-REVERSE/STOP CONNECTIONS

TABLE 11
FORWARD/STOP-REVERSE/STOP PROGRAMMING

Function No.	Code
1.00: Run/Stop-Forward/Reverse Control	**0001:** External Contacts
7.02: Multi-Function Input Terminal 3	**0006:** Forward/Stop Command
7.03: Multi-Function Input Terminal 4	**0007:** Reverse/Stop Command
7.04: Multi-Function Input Terminal 5	**0010:** N.O. Start*

Factory setting.

4.5 EXTERNAL FAULT

The Multi-Function Input Terminals can be used to "stop" the drive when a fault condition occurs elsewhere in the equipment. The connection to the Multi-Function Input Terminal can be from a normally open or normally closed relay contact or PLC. See Figure 18, on page 25, for connections. See Table 12, on page 25, for drive programming.

Note: For a normally open contact, program the respective Multi-Function Input Terminal to "0008". For a normally closed contact, program the respective Multi-Function Input Terminal to "0012".

Connect the auxiliary equipment contact to any Multi-Function Input Terminal "1" – "7". Terminal "5" has been arbitrarily chosen for External Fault. Connect the common of the circuit to any available common terminal ("8", "12", "14", "16", "18", "20", "22").

Operation: When the circuit is activated, the drive will "stop" and the display of the drive will show "EF-t". In order to restart the drive, after the fault has been cleared, either press the Reset Key on the Keypad or use an external contact connected to Multi-Function Input Terminal "4".
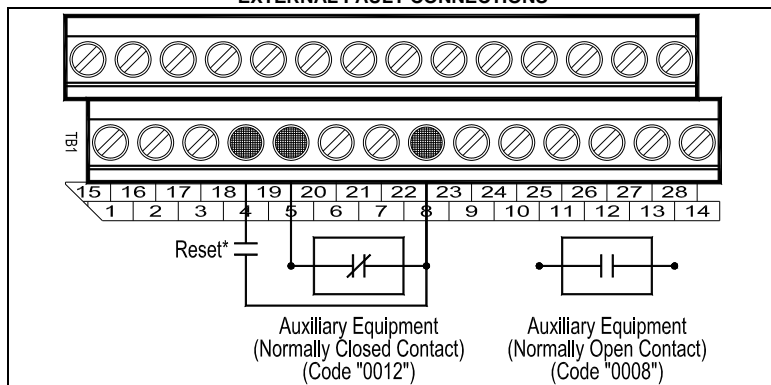
APPLICATION NOTES FOR AUTO/MANUAL START MODE (FUNCTION NO. 1.05)

After the Extenal Fault has been Cleared:

1. If the drive is set for Manual Start Mode ("0000" (factory setting)), Manual Start with Ride-Through ("0001"), or Auto Start After Undervoltage Fault Clears ("0002"), it will have to be manually restarted after the external fault has been cleared. Use the Reset Key on the Keypad or the external Reset Switch or Contact to restart the drive.

2. If the drive is set for Auto Start All Faults (Except Short circuit Fault) ("0003"), it will automatically restart after the external fault has been cleared, for the number of restart attempts set in Function No. 1.07 (factory set to 3). After which, the drive will have to be restarted using the Reset Key on the Keypad or the external Reset Switch or Contact.

3. If the drive is set for Auto Start All Faults (Except 1^2t, I•t, and Short Circuit Faults) ("0004"), it will automatically restart after the external fault has been cleared.

⚠ **CAUTION! External Fault is not to be used as an Emergency Stop or safety disconnect since it is not fail-safe. Use only the AC line for this purpose.**

FIGURE 18
EXTERNAL FAULT CONNECTIONS

Reset*

Auxiliary Equipment
(Normally Closed Contact)
(Code "0012")

Auxiliary Equipment
(Normally Open Contact)
(Code "0008")

Optional.

TABLE 12
EXTERNAL FAULT PROGRAMMING

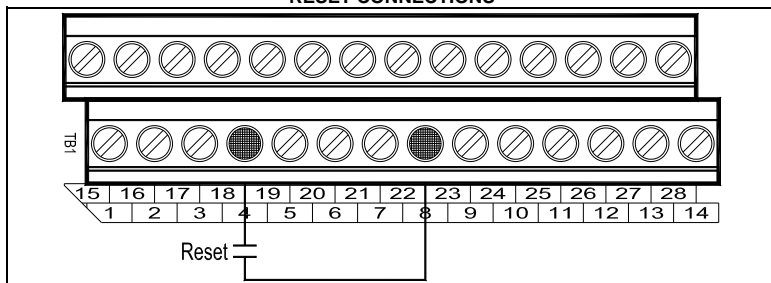| Function No.	Code
7.03: Multi-Function Input Terminal 4	**0009:** Reset*
7.04: Multi-Function Input Terminal 5	**0008:** External Fault (N.O. Contact) **0012:** External Fault (N.C. Contact)

Factory setting.

4.6 RESET

It is advisable to connect a momentary normally open switch or contact to Multi-Function Input Terminal "4". This allows the drive to be restarted after a fault has been cleared. See Figure 19 for connections. See Table 13 for drive programming.

⚠ **CAUTION! If a maintained Reset Switch or Contact is used and kept in the closed position while the drive is in the Run Mode (Start jumpered or the Start/Stop switch is in the "Start" position) and a direction is selected, the drive will automatically restart after a fault has been cleared.**

Connect the Reset Switch or Contact to Multi-Function Input Terminal "4", which is factory set to Reset ("0009"). Terminal "4" has been arbitrarily chosen for Reset. Connect the common of the switch or contact to any available common terminal ("8", "12", "14", "16", "18", "20", "22").

Operation: When a fault has been cleared, momentarily activate the Reset switch or Contact to reset the drive.

FIGURE 19
RESET CONNECTIONS

TABLE 13
RESET PROGRAMMING

Function No.	Code
7.03: Multi-Function Input Terminal 4	**0009:** Reset*

*Factory setting.

4.7 SIGNAL FOLLOWING

An analog voltage (unidirectional or bidirectional), current, or PWM signal input can be used to control motor speed in lieu of the Keypad. The drive output will linearly follow the signal input. The inputs can be programmed for the desired gain, slope, offset, and response time.

Analog Input 1 is used for a DC voltage signal which has a positive or negative slope and is unidirectional or bidirectional. Analog Input 2 is used for a DC voltage, current, or PWM signal with a positive or negative slope and is unidirectional.

Local/Remote Operation: When using the IODA with signal following or remote start/stop, it is desirable to program the drive for Local/Remote Operation. In this mode, the drive frequency setting can be toggled between a process signal and the keypad using the JOG-LCL/REM Key. The following functions can be switched between "remote" and "local" (Keypad) operation: Start/Stop, Forward/Reverse, Analog Signal Inputs 1 and 2, and Up/Down Frequency Control.

Set Jog-Local/Remote (Function No. 2.02) to Jog Disabled; Local/Remote Enabled ("0002") to change the JOG-LCL/REM Key from Jog Operation to Local/Remote Operation.

Note: To stop the drive using the Keypad, when in Remote Operation, first press the JOG-LCL/REM Key and then the Stop Key.

Operation with a Positive Slope Signal: When the signal input is increased, the drive output frequency will increase. When the signal input is decreased, the drive output frequency will decrease. See Figure 20.

Operation with a Negative Slope Signal: When the signal input is increased, the drive output frequency will decrease. When the signal input is decreased, the drive output frequency will increase. See Figure 21, on page 28.
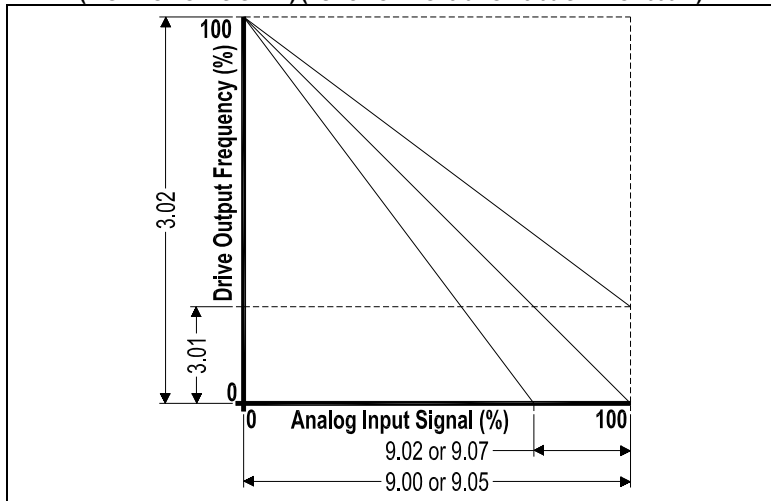
FIGURE 20
ANALOG INPUT "1" AND "2" SIGNAL GAIN AND OFFSET WITH POSITIVE SLOPE (LOW-TO-HIGH SIGNAL) (FUNCTION NO. 9.01 OR 9.06 SET TO "0000")
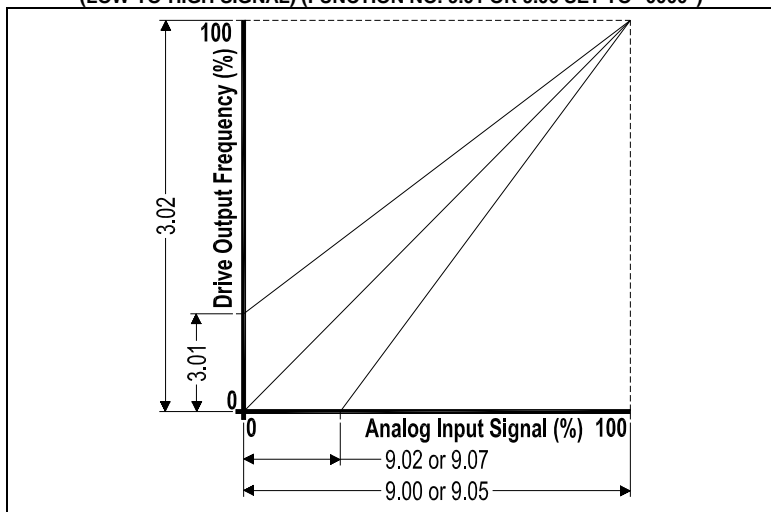
FIGURE 21
ANALOG INPUT "1" AND "2" SIGNAL GAIN AND OFFSET WITH NEGATIVE SLOPE
(HIGH-TO-LOW SIGNAL) (FUNCTION NO. 9.01 OR 9.06 SET TO "0001")

ANALOG INPUT "1"
See Table 14 for Analog Input 1 electrical ratings.

Connect the signal input to Terminal "19" and the common to Terminal "20". Connect the Start (Jumper) to Terminal "5", which is factory set for N.O. Start ("0010") and to any available common terminal ("8", "12", "14", "16", "18" "20", "22"). See Figure 22, on page 29, for connections. See Table 15, on page 29, for drive programming.

MAX1 Trimpot: If the Analog Input 1 signal is higher than 5 Volts, use Trimpot MAX1 to attenuate it. Apply the maximum signal input and set the drive for full speed output and observe the display. Rotate Trimpot MAX1 counter clockwise until the drive output frequency begins to drop. Then, rotate Trimpot MAX1 clockwise until the display returns to the maximum output frequency.

Set the signal Slope and Type and adjust the Gain, Offset, and Response Time as desired. See Figure 20, on page 27, and Figure 21, above.

TABLE 14
ANALOG INPUT "1" ELECTRICAL RATINGS

Parameter	Specification	Factory setting
Voltage Range (Volts DC)	0 – ±2.5 thru 0 – ±25	0 – 5
MAX1 Scaling Trimpot Range (Volts DC)	0 – 24	5

FIGURE 22
ANALOG INPUT "1" SIGNAL VOLTAGE FOLLOWING CONNECTIONS
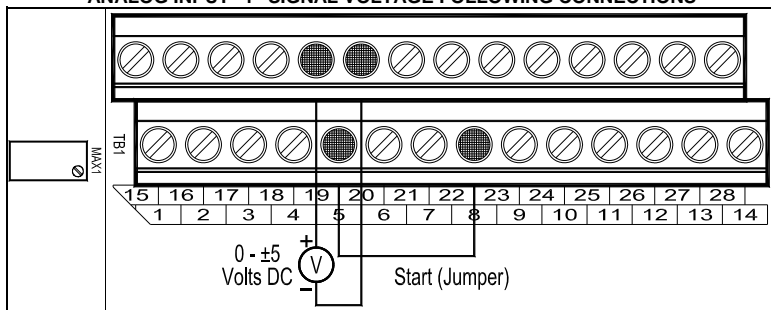
TABLE 15
ANALOG INPUT "1" SIGNAL VOLTAGE FOLLOWING PROGRAMMING

Function No.	Code/Range
2.00: Frequency Control	**0002:** Analog Signal 1
9.00: Analog Input 1 Gain	**0 – 500:** Set to the Desired Gain
7.04: Multi-Function Input Terminal 5	**0010:** N.O. Start*
9.01: Analog Input 1 Slope	**0000:** Positive **0001:** Negative
9.02: Analog Input 1 Offset	**0 – 100:** Set to the Desired Offset
9.03: Analog Input 1 Type	**0000:** Unidirectional **0001:** Bidirectional
9.04: Analog Input 1 Response Time (mSec)	**2 – 100:** Set to the Desired Time

Factory setting.

ANALOG INPUT "2"

See Table 16 for Analog Input 2 electrical ratings.

Voltage Signal Input: Set Jumper J1 to the "VOLT" position (factory setting).

Current Signal Input: Set Jumper J1 to the "CUR" position.

PWM Signal Input: Set Jumper J1 to the "VOLT" position (factory setting).

Connect the signal input to Terminal "21" and the common to Terminal "22". Connect the Start (Jumper) to Terminal "5", which is factory set for N.O. Start ("0010") and to any available common terminal ("8", "12", "14", "16", "18" "20", "22"). See Figure 23, on page 30, for connections. See Table 17, on page 30, for drive programming.

MAX2 Trimpot: If the Analog Input 2 signal voltage is higher than the input signals specified in Table 16, on page 30, use Trimpot MAX2 to attenuate it. Apply the maximum signal input and set the drive for full speed output and observe the display. Rotate Trimpot MAX2 counter clockwise until the drive output frequency begins to drop. Then rotate Trimpot MAX2 clockwise until the display returns to the maximum output frequency. Set the signal slope and adjust the gain, offset, and response time as desired.

TABLE 16
ANALOG INPUT "2" ELECTRICAL RATINGS

Parameter	Specification	Factory setting
Voltage Range (Volts DC)	0 – ±2.5 thru 0 – ±25	0 – 5
MAX2 Scaling Trimpot Range (Volts DC)	0 – 24	5
Current Range (mA DC)	0 – 20*	–
Input Impedance for Current Mode (Ω)	270	–
PWM (kHz, Duty Cycle)	0.15 – 1, 0 – 100	–

If using 4 – 20 mA DC signal input, the offset setting in Function No. 9.07 must be increased from "0%" (factory setting) to "20%". Set Jumper J1 to the "CUR" position.

FIGURE 23
ANALOG INPUT "2" SIGNAL CURRENT FOLLOWING CONNECTIONS
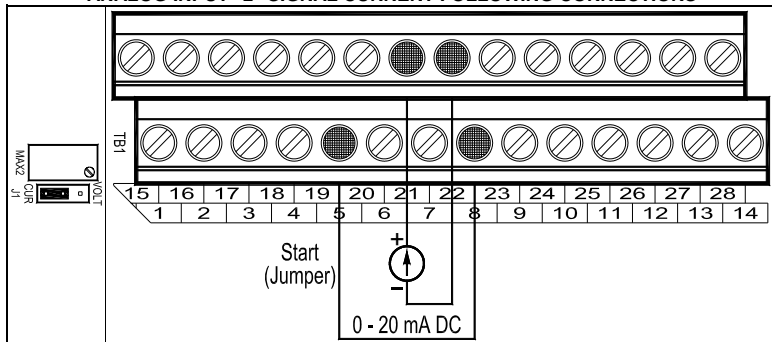
TABLE 17
ANALOG INPUT "2" SIGNAL CURRENT FOLLOWING PROGRAMMING

Function No.	Code/Range
2.00: Frequency Control	**0003:** Analog Signal 2
9.05: Analog Input 2 Gain	**0 – 500:** Set to the Desired Gain
7.04: Multi-Function Input Terminal 5	**0010:** N.O. Start*
9.06: Analog Input 2 Slope	**0000:** Positive **0001:** Negative
9.07: Analog Input 2 Offset	**0 – 100:** Set to the Desired Offset
9.08: Analog Input 2 Type	**0000:** Analog Voltage or Current
9.09: Analog Input 2 Response Time (mSec)	**2 – 100:** Set to the Desired Time

Factory setting.

4.8 ANALOG SIGNAL OUTPUT

Two analog signal outputs are provided, which will linearly follow the parameter programmed in Analog output 1 Mode (Function No. 8.06) and Analog Output 2 Mode (Function No. 8.08). They can be used to monitor Motor Frequency, Set Frequency, Motor Voltage, Bus Voltage, and Motor Current. See Figure 24 for Analog Output 1 and 2 Gain settings (factory set to 100%). See Table 18 for Analog Outputs 1 and 2 electrical ratings. See Figure 25, on page 32, for connections. See Table 19, on page 32, for drive programming.

Analog Output 1 provides a voltage signal output. Analog Output 2 provides a voltage or current signal output.

FIGURE 24
ANALOG OUTPUTS "1" AND "2" GAIN
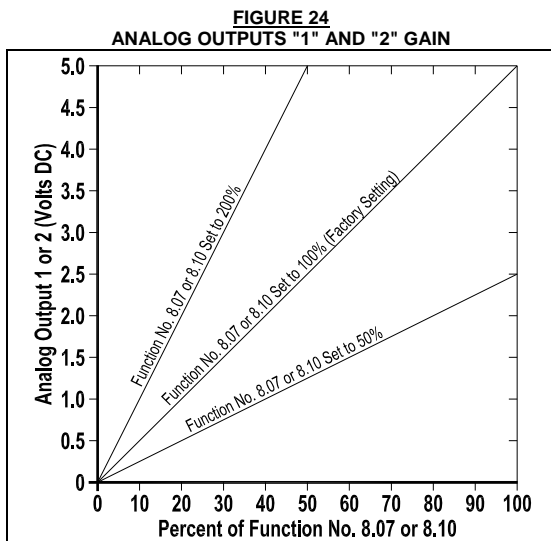
TABLE 18
ANALOG OUTPUTS "1" AND "2" ELECTRICAL RATINGS

Parameter	Specification	Factory setting
Analog Outputs 1 and 2 Voltage Range (Volts DC)	0 – 5	0 – 5
Analog Output 2 Current Range (mA DC)	0 – 20, 4 – 20	–
Analog Output 2 Impedance for Current Mode (Ω)	150	–

FIGURE 25
ANALOG OUTPUTS "1" AND "2" CONNECTIONS
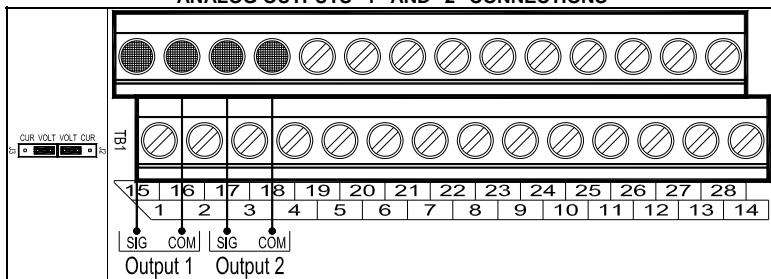
TABLE 19
ANALOG OUTPUTS "1" AND "2" PROGRAMMING

Function No.	Code/Range
8.06: Analog Output 1 Mode	**0000:** Motor Frequency **0001:** Set Frequency **0002:** Motor Voltage **0003:** Bus Voltage **0004:** Motor Current
8.07: Analog Output 1 Gain	**0 – 200:** Set to the Desired Gain
8.08: Analog Output 2 Mode	**0000:** Motor Frequency **0001:** Set Frequency **0002:** Motor Voltage **0003:** Bus Voltage **0004:** Motor Current
8.09: Analog Output 2 Type	**0000:** 0 – 5 Volts DC **0001:** 0 – 20 mA DC **0002:** 4 – 20 mA DC
8.10: Analog Output 2 Gain	**0 – 200:** Set to the Desired Gain

ANALOG OUTPUT "1"
Connect the auxiliary device signal input to Terminal "15" and the common to Terminal "16".

ANALOG OUTPUT "2"
Connect the auxiliary device signal input to Terminal "17" and the common to Terminal "18".

Voltage Signal Output: Set both Jumpers J2 and J3 to the "VOLT" position (factory setting).

Current Signal Output: Set both Jumpers J2 and J3 to the "CUR" position.

4.9 REMOTE MAIN SPEED POTENTIOMETER
A remote Main Speed Potentiometer (5 kΩ) can be used in lieu of the Keypad or the Built-In Potentiometer on the drive to control motor speed. The potentiometer can be connected for Unidirectional Operation, Bidirectional Operation with center off, or Bidirectional Operation with Forward/Reverse Switches or Contacts.

UNIDIRECTIONAL OPERATION WITH 2-WIRE START/STOP USING ANALOG INPUT 1:
Connect the potentiometer to Terminals "9" (+5 Volts), "19" (Analog Input 1), and "16" (Common) (Terminals "8", "12", "14", "18" or "22" can also be used for common). Connect the Start/Stop Switch or Contact to Terminal "5", which is factory set for N.O. Start ("0010"), and to any available common terminal ("8", "12", "14", "16", "18" "20", "22"). See Figure 26 for connections. See Table 20, on page 34, for drive programming.

Operation: When the Start/Stop Switch or Contact is closed, the drive will be in the Run Mode. Rotate the Main Speed Potentiometer clockwise to increase motor speed. Rotate the Main speed Potentiometer counterclockwise to decrease motor speed. When the Start /Stop Switch or Contact is opened, the drive will be in the Stop Mode.

UNIDIRECTIONAL OPERATION WITH 2-WIRE START/STOP USING ANALOG INPUT 2:
Connect the potentiometer to Terminals "9" (+5 Volts), "21" (Analog Input 2), and "14" (Common) (Terminals "8", "12", "16", "18" or "22" can also be used for Common). Connect the Start/Stop Switch or Contact to Terminal "5", which is factory set for N.O. Start ("0010"), and to any available common terminal ("8", "12", "14", "16", "18" "20", "22").

Operation: When the Start/Stop Switch or Contact is closed, the drive will be in the Run Mode. Rotate the Main Speed Potentiometer clockwise to increase motor speed. Rotate the Main speed Potentiometer counterclockwise to decrease motor speed. When the Start /Stop Switch or Contact is opened, the drive will be in the Stop Mode.

FIGURE 26
REMOTE UNIDIRECTIONAL MAIN SPEED POTENTIOMETER CONNECTIONS
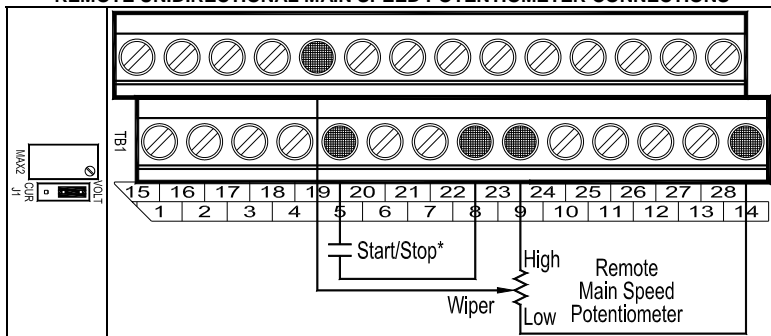
Use a jumper, between Terminals "5" and "8", if a Start/Stop Switch or Contact is not required.

TABLE 20
REMOTE UNIDIRECTIONAL MAIN SPEED POTENTIOMETER PROGRAMMING

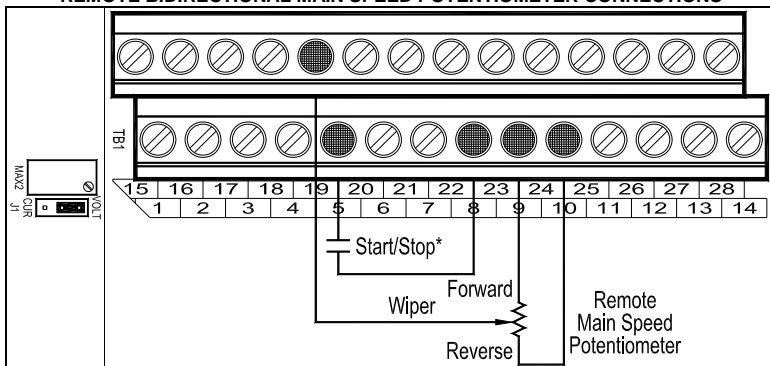| Function No.	Code
1.00: Run/Stop-Forward/Reverse Control	**0001:** External Contacts
2.00: Frequency Control	**0002:** Analog Signal 1
7.04: Multi-Function Input Terminal 5	**0010:** N.O. Start*

Factory setting.

BIDIRECTIONAL OPERATION WITH START/STOP
(Use Analog Input "1" Only)

Connect the Main Speed Potentiometer to Terminals "9" (+5 Volts), "19" (Analog Input 1), and "10" (-5 Volts). Connect the Start/Stop Switch or Contact to Terminal "5", which is factory set for N.O. Start ("0010"), and to any available common terminal ("8", "12", "14", "16", "18" "20", "22"). See Figure 27 for connections. See Table 21 for drive programming.

Operation: Close the Start/Stop Switch or contact to start the drive. At 50% rotation, the Main Speed Potentiometer is set for zero speed. Rotating the Main Speed Potentiometer clockwise will increase motor frequency in the forward direction. Rotating the Main Speed Potentiometer counterclockwise will increase motor frequency in the reverse direction. Open the Start/Stop Switch or Contact to stop the drive.

FIGURE 27
REMOTE BIDIRECTIONAL MAIN SPEED POTENTIOMETER CONNECTIONS

Use a jumper, between Terminals "5" and "8", if a Start/Stop Switch or Contact is not required.

TABLE 21
REMOTE BIDIRECTIONAL MAIN SPEED POTENTIOMETER PROGRAMMING

Function No.	Code
1.00: Run/Stop-Forward/Reverse Control	**0001:** External Contacts
2.00: Frequency Control	**0002:** Analog Signal 1
7.04: Multi-Function Input Terminal 5	**0010:** N.O. Start*
9.03: Analog Input 1 Type	**0001:** Bidirectional

Factory setting.

34

BIDIRECTIONAL OPERATION WITH FORWARD/REVERSE:

Connect the Main Speed Potentiometer to Terminals "9" (+5 Volts), "19" (Analog Input 1), and "8" (Common) (Terminals "12", "14", "16", "18" or "22" can also be used for Common). Connect the Forward Switch or Contact to a Multi-Function Input Terminal "1" – "7". Connect the Reverse Switch or Contact to a Multi-Function Input Terminal "1" – "7". Connect the Start (Jumper) to Terminal "5", which is factory set for N.O. Start ("0010"), and to any available common terminal ("8", "12", "14", "16", "18" "20", "22"). See Figure 28 for connections. See Table 22 for drive programming.

Operation: Close the Forward/Stop or Reverse/Stop Switch or Contact to put the drive in the Forward Run Mode or Reverse Run Mode. Rotate the Main Speed Potentiometer clockwise to increase motor speed and rotate the Main Speed Potentiometer counterclockwise to decrease motor speed. Open the switch or contact to put the drive in the Stop Mode.

FIGURE 28
REMOTE MAIN SPEED POTENTIOMETER
WITH FORWARD/REVERSE CONNECTIONS

TABLE 22
REMOTE MAIN SPEED POTENTIOMETER
WITH FORWARD/REVERSE PROGRAMMING

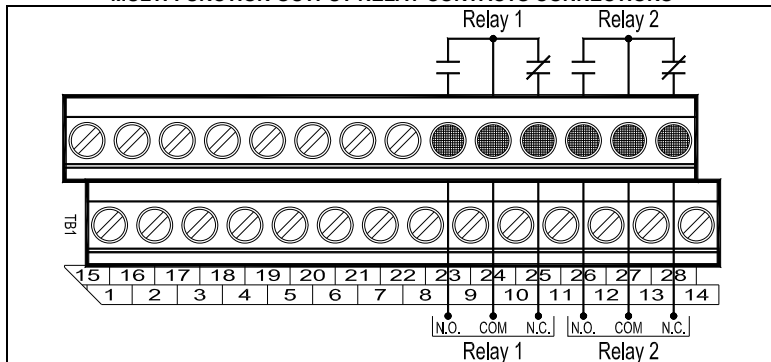| Function No.	Code
1.00: Run/Stop-Forward/Reverse Control	**0001:** External Contacts
2.00: Frequency Control	**0002:** Analog Signal 1
7.00: Multi-Function Input Terminal 1	**0006:** Forward/Stop Command
7.01: Multi-Function Input Terminal 2	**0007:** Reverse/Stop Command
7.04: Multi-Function Input Terminal 5	**0010:** N.O. Start*

Factory setting.

4.10 MULTI-FUNCTION OUTPUT RELAYS

Two Multi-Function Output Relays are provided, which can be programmed for Run, Fault, Target Frequency, Frequency Threshold Level (> 8.04 – 8.05), Frequency Threshold Level (< 8.04 + 8.05), I^2t or $I \bullet t$ Fault, Load Loss, External Fault, and Motor Overload. The maximum allowable contact load current is 1 Amp. See Figure 29 for connections. See Table 23, on page 37, for drive programming.

Note: If the drive "stops", due to an External Fault Trip ("EF–t"), which indicates that a Multi-Function Input Terminal (Function Nos. 7.00 – 7.06 set to "0008") has closed, the Multi-Function Output Relay Contacts will change state (when Function No. 8.00 or 8.01 is set to "0007").

Multi-Function Output Relay 1 Contacts: Factory programmed to operate as a "Run" Relay (Function No. 8.00 set to "0000" (factory setting)). TB1 Terminal "23" is the Normally Open (N.O.) Contact, Terminal "24" is the Common, and Terminal "25" is the Normally Closed (N.C.) Contact.

Multi-Function Output Relay 2 Contacts: Factory programmed to operate as a "Fault" Relay (Function No. 8.01 set to "0001" (factory setting)). TB1 Terminal "26" is the Normally Open (N.O.) Contact, Terminal "27" is the Common, and Terminal "28" is the Normally Closed (N.C.) Contact.

FIGURE 29
MULTI-FUNCTION OUTPUT RELAY CONTACTS CONNECTIONS

TABLE 23
MULTI-FUNCTION OUTPUT RELAY CONTACTS PROGRAMMING

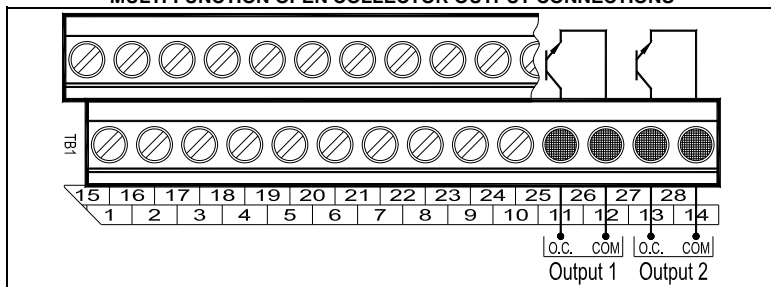| Function No.	Code
8.00: Multi-Function Output Relay 1	**0000:** Run **0001:** Fault **0002:** Target Frequency **0003:** Frequency Threshold Level (> 8.04 – 8.05) **0004:** Frequency Threshold Level (< 8.04 + 8.05) **0005:** I^2t or I•t Fault **0006:** Load Loss **0007:** External Fault **0008:** Motor Overload
8.01: Multi-Function Output Relay 2	**0000:** Run **0001:** Fault **0002:** Target Frequency **0003:** Frequency Threshold Level (> 8.04 – 8.05) **0004:** Frequency Threshold Level (< 8.04 + 8.05) **0005:** I^2t or I•t Fault **0006:** Load Loss **0007:** External Fault **0008:** Motor Overload

4.11 MULTI-FUNCTION OPEN COLLECTOR OUTPUTS

Two Open Collector Outputs are provided, which can be programmed for Run, Fault, Target Frequency, Frequency Threshold Level (> 8.04 – 8.05), Frequency Threshold Level (< 8.04 + 8.05), I^2t or I•t Fault, Load Loss, External Fault, and Motor Overload. See Figure 30, on page 38, for connections. See Table 24, on page 38, for drive programming. See Table 25, on page 38, for the Multi-Function Open Collector Output Electrical Ratings. See Figure 31, on page 39, for a typical application for the Open Collector Output.

Multi-Function Open Collector Output "1": Factory programmed to operate as a Target Frequency indicator (Function No. 8.02 set to "0002" (factory setting)). TB1 Terminal "11" is the Collector and Terminal "12" is the Emitter (internal circuit common).

Multi-Function Open Collector Output "2": Factory programmed to operate as a Frequency Threshold Level (< 8.04 + 8.05) indicator (Function No. 8.03 set to "0004" (factory setting)). TB1 Terminal "13" is the Collector and Terminal "14" is the Emitter (internal circuit common).

FIGURE 30
**MULTI-FUNCTION OPEN COLLECTOR OUTPUT CONNECTIONS**

TABLE 24
MULTI-FUNCTION OPEN COLLECTOR OUTPUT PROGRAMMING

Function No.	Code
8.02: Multi-Function Open Collector Output 1	**0000:** Run **0001:** Fault **0002:** Target Frequency **0003:** Frequency Threshold Level (> 8.04 – 8.05) **0004:** Frequency Threshold Level (< 8.04 + 8.05) **0005:** I^2t or I•t Fault **0006:** Load Loss **0007:** External Fault **0008:** Motor Overload
8.03: Multi-Function Open Collector Output 2	**0000:** Run **0001:** Fault **0002:** Target Frequency **0003:** Frequency Threshold Level (> 8.04 – 8.05) **0004:** Frequency Threshold Level (< 8.04 + 8.05) **0005:** I^2t or I•t Fault **0006:** Load Loss **0007:** External Fault **0008:** Motor Overload

TABLE 25
MULTI-FUNCTION OPEN COLLECTOR OUTPUTS ELECTRICAL RATINGS

Parameter	Specification	Factory setting
Maximum Voltage (Volts DC)	24	–
Maximum Load Current (mA DC)	60	0 – 20
Minimum External Resistance (Ω)	400	–

FIGURE 31
TYPICAL APPLICATION FOR OPEN COLLECTOR OUTPUT
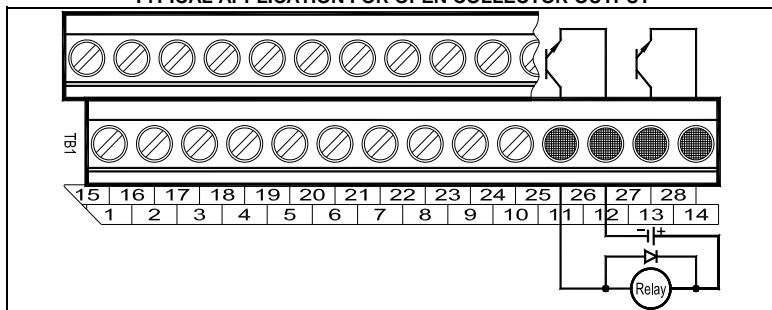
5 OPERATION

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 PWR LED will illuminate green. The red STATUS LED will indicate the drive's status, as described in Section 7, on page 43. See Table 26, on page 40, for the Digital Readout Codes. See the *KBDA Installation and Operation Manual* for other Digital Readout Codes of the drive.

Local/Remote Operation: When using the IODA with signal following, it may be appropriate to program the drive for Local/Remote Operation. In this mode, the drive frequency setting can be toggled between a process signal and the keypad using the JOG-LCL/REM Key. Set Jog-Local/Remote (Function No. 2.02) to Jog Disabled; Local/Remote Enabled ("0002") to change the JOG-LCL/REM Key from Jog Operation to Local/Remote Operation.

IODA Faults: External Fault Trip ("EF–t") indicates that a Multi-Function Input Terminal (Function Nos. 7.00 – 7.06 set to "0008") has closed (and will change the state of the Multi-Function Output Relay Contacts and the Multi-Function Open collectors (when Function No. 8.00 to 8.03 is set to "0007")). Current Source Trip ("CS–t") indicates that the current signal output (from the IODA) has been opened. Communication Error ("Err4") indicates that communication between the drive and the IODA has failed.

⚡ **WARNING! Do not depend on the LEDs or the 4-Digit Display to no longer be illuminated as a guaranteed power off condition. Be sure the main power switch or circuit breaker is in the "OFF" position before servicing the drive.**

TABLE 26
DIGITAL READOUT CODES

Display	Description
CS-t	**Current Source Trip:** Indicates that the current signal output (from the IODA) has been opened.
Err4	**IODA Error:** Indicates that the drive has lost communication with the IODA.
EF-t	**External Fault Trip:** Indicates that an external fault has occurred at one of the MFITs of the IODA. Function Nos. 7.00 – 7.06 set to "0008".

6 PROGRAMMABLE FUNCTION SUMMARY LIST

See the *KBDA Series Installation and Instruction Manuals* for other Programmable Functions.

PROGRAMMABLE FUNCTION GROUPS

Function Group No.	Description	Page
7	Multi-Function Input Terminals	40
8	Multi-Function Output Relays and Output Signal Operation	41
9	Analog Input Signal Operation	42

MODEL SOFTWARE REVISION CODES (Rev. 100.1)

The Programmable Function List, on pages 41 – 43,
is Applicable to the Following* Software Revision Codes

Model No.	Software Revision Code
IODA	33/1.03
KBDA-24D	29/1.09
KBDA-27D	35/1.03
KBDA-29	37/1.03
KBDA-45	38/1.04
KBDA-48	39/1.03

*Or higher.

FUNCTION GROUP 7
MULTI-FUNCTION INPUT TERMINALS

Function No.	Description	Range/Code	Factory Setting	Actual 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[3] (See 7.14)	0001	
7.02 *	Multi-Function Input Terminal 3[1]	0004: Down Frequency Command[3] (See 7.14)	0002	
7.03 *	Multi-Function Input Terminal 4[1]	0005: Accel/Decel 2 (See 7.16) 0006: Forward/Stop Command[4]	0009	
7.04 *	Multi-Function Input Terminal 5[1]	0007: Reverse/Stop Command[4] 0008: External Fault (N.O. Contact)	0010	
7.05 *	Multi-Function Input Terminal 6[1]	0009: Reset 0010: N.O. Start[4] (2-Wire or 3-Wire Start/Stop)	0003	
7.06 *	Multi-Function Input Terminal 7[1]	0011: N.C. Stop[4] (3-Wire Start/Stop) 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 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 incremental 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 Stop Mode.

FUNCTION GROUP 8
MULTI-FUNCTION OUTPUT RELAYS AND OUTPUT SIGNAL OPERATION

Function No.	Description	Range/Code	Factory Setting	Actual 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 (8.04 ± 8.05) **0003:** Frequency Threshold Level (> 8.04 – 8.05)[2]	0001	
8.02 *	Multi-Function Open Collector Output 1 (Terminals 11, 12)	**0004:** Frequency Threshold Level (< 8.04 + 8.05)[3] **0005:** I^{2}t or I•t Fault	0002	
8.03 *	Multi-Function Open Collector Output 2 (Terminals 13, 14)	**0006:** Load Loss (See 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 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 Output Relay contacts will change state due to all Faults and Recovered Faults. 2. The 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 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 Output Relay will change state when the I^{2}t or I•t Timer starts. 5. Analog Output 2 Type: For 0 – 5 VDC (code "0000"), set Jumpers J2 and J3, on the IODA, 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, to the "CUR" position.

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

FUNCTION GROUP 9
ANALOG INPUT SIGNAL OPERATION

Function No.	Description	Range/Code	Factory Setting	Actual 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, to the "CUR" position. 4. 0.15 – 1 kHz (0 – 100% duty cycle).

7   DIAGNOSTIC LEDs

The IODA has two PC board mounted LEDs to provide operational status. The green power on LED (PWR) indicates that power is applied to the IODA from the drive. The red status LED (STATUS) provides indication of the IODA operation, as described in Table 27.

⚠️ **WARNING! Do not depend on the LEDs or the 4-Digit Display to no longer be illuminated as a guaranteed power off condition. Be sure the main power switch or circuit breaker is in the "OFF" position before servicing the drive.**

TABLE 27
STATUS INDICATOR LED

Condition	Red STATUS LED
Normal Operation	Not Illuminated
Communication Error[1]	Flashes 1 Second On and 1 Second Off
Current Source Trip[2]	Illuminated

Notes: 1. When a Communication Error occurs, the drive's 4-Digit Display will show "Err4". 2. When a Current Source Trip occurs, the drive's 4-Digit Display will show "CS-t".