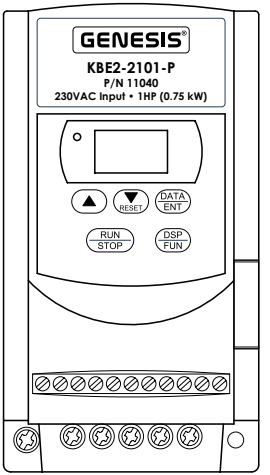
INSTALLATION AND OPERATION MANUAL

KBE2 DIGITAL AC ADJUSTABLE SPEED DRIVES

for use with 1/4 - 3 HP 3-Phase Induction Motors

115, 208/230 or 380 - 460 Volts, 50/60 Hz, 1 & 3 Phase AC Line Input



N10980

LISTED 16KJ.
POWER CONV.EQ
E177007

ISO 9002

Note: *This drive has been programmed to operate 60 Hz motors. For 50 Hz motor operation, see Section VIII-C and Table 11 on page 30.*

This Manual Covers

Panel Mount IP-20: KBE2-1125-P, 1150-P, 1101-P, 2125-P, 2150-P
2101-P, 2202-P, 2203-P, 4301-P, 4302-P, 4303-P

NEMA-4 / IP-65: KBE2-1125-4, 1150-4, 1101-4, 2101-4
2202-4, 2203-4, 4301-4, 4302-4, 4303-4

See Safety Warning on page 6

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.

GENESIS®

Automation and Control

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i. SIMPLIFIED INSTRUCTIONS

WARNING! These instructions are to be used as a guide only after reading the complete instructions contained herein.

Important Application Information: It is recommended that this drive be used with Inverter Duty or TENV motors which provide full rated torque over an extended speed range without overheating. 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 is recommended. Mount the fan so that the motor is surrounded by the airflow.

Some motors have low speed characteristics which cause overheating and winding failure under light 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 that the motor current does not exceed the nameplate rating. Do not use motor if the motor current exceeds the nameplate rating.

WARNING! Disconnect the main power when making connections to the drive.

Note: See Section III, Reconditioning Bus Capacitors on page 15.

A. AC Line Connection

1. For single phase only AC line input models (Pkg. A and Pkg. C), wire the AC line to Terminals L1, L2, as shown in Figure 3A, on page 18.
2. For dual phase (1ϕ, 3ϕ) AC line input models (Pkg. B and Pkg. C1), wire the 1ϕ according to Figures 3B and 3C, on page 18. Wire the 3ϕ AC line to Terminals L1, L2, L3.
3. For 3-Phase only AC line input models (Pkg. B and Pkg. C1), wire the AC line to Terminals L1, L2, L3, as shown in Figures 3B and 3C, on page 18.

B. Ground Connection – As shown in Figures 3A, 3B, and 3C, on page 18.

C. AC Line Fusing – Install a fuse or circuit breaker in the AC line. Fuse each conductor that is not at ground (earth) potential. See Section VI, on page 24, for recommended ratings.

D. Motor Connection – Connect the motor to Terminals T1(U), T2 (V), T3 (W) of Terminal Block TM1, as shown in Figures 3A, 3B, and 3C, on page 18, and as described in Section IV-C, on page 19. Motor cable length should not exceed 100 feet (30m) or special Load Reactors may be required – contact the Sales Department. See Section X-F, Table 22, on page 53.

Note: *This drive has been programmed to operate 60 Hz motors. For 50 Hz motor operation, see Section VIII-C and Table 11 on page 30.*

E. Power Up and Basic Keypad Operation – When applying power to the drive, the LED, located at the top left of the digital display will illuminate. The digital display will flash the set frequency (factory setting is "05.0"). To increase the frequency, press the ▲ key until the desired frequency is displayed. To decrease frequency, press the ▼/RESET key until the desired frequency is displayed. Press the RUN/STOP key to start the drive. See Section VIII, on page 26.

ii. 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 wiring, mounting in proper enclosure, fusing or other over current protection, and grounding can reduce the chance of electrical shocks, fires, or explosion in this product or products used with this product, such as electric motors, switches, coils, solenoids, and/or relays. Eye protection must be worn and insulated adjustment tools must be used when working with control 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. If further information is required on this product, contact the Sales Department. 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 effective 11/1992).

This drive contains electronic Start/Stop circuits that 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 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 the Sales Department for Declaration of Conformity.

I. INTRODUCTION

Thank you for purchasing the GENESIS® KBE2 Series Inverter. KB Electronics, Inc. is committed to providing total customer satisfaction by providing quality products that are easy to install and operate.

The KBE2 is available in IP-20 Panel Mount and NEMA-4 / IP-65 (indoor) enclosures. They operate 3-phase AC induction motors thru 3 HP. Several models are available with 115, 208/230, and 380/460 Volts AC - 50/60 Hz AC line input. They contain a 3-digit LED display with a digital keypad for simplified programming. Although very compact, the KBE2 contains many user-friendly features found in more costly drives.

These include regenerative and DC injection braking, auto/manual restart, Volts/Hz curve selection, selectable switching frequency, adjustable acceleration and deceleration, and 0 - 200 Hz operation.

An isolated multifunction terminal block provides for external control of start/stop, forward/reverse, and analog input signal following. Other functions include (3) preset speeds, analog output signal (0 - 10 Volts DC), and a programmable output relay.

The KBE2 also contains the following protection features: undervoltage, overvoltage, overtemperature, ground fault, short circuit, and I^2t motor overload protection. The fault codes are shown in the digital display. All models are UL Listed (USA and Canada), CE and C-tick (N10980) approved and ISO-9002 certified.

Optional features include a DIN Rail Mounting Kit and RFI filter. An external brake resistor is available for 2 HP and 3 HP - 230 Volt AC models and 1 HP, 2 HP, and 3 HP - 460 Volt AC models. The DownLoad Module™ (DLM) uploads and downloads drive programs. Drive-Link™ software provides PC communications to facilitate programming.

STANDARD FEATURES

- **Keypad –** Used for drive operation and programming.
- **3-Digit LED Display –** Provides indication of drive status and programming (Frequency, Functions, Fault Codes).
- **Voltage/Current Switch –** Selects either voltage/potentiometer or current signal input.
- **Regenerative and DC Injection Braking –** Provides controlled rapid stopping.
- **Short Circuit Protection –** Shuts down the drive if a short occurs at the motor (phase-to-phase or phase-to-ground).
- **Barrier Terminal Blocks –** Separate terminal blocks are provided for power (AC line, motor) and external signal wiring (potentiometer, multifunction input and output terminals, voltage and current following).
- **2 Multifunction Control Inputs –** Provides selection of Stop, Reset, Jog, and up to 3 Preset Speeds.
- **External Forward-Stop-Reverse Control –** Provides external control of motor direction and run/stop (Forward/Stop, Reverse/Stop or Run/Stop, Forward/Reverse).
- **Isolated External Signal Inputs –** Provides isolated terminals for an external signal to control output frequency (potentiometer (5k/10k), 0 - 10 VDC, 0 - 20 mADC, 4 - 20 mADC).
- **Multifunction Output Relay –** Provides normally open relay contacts for indication of Run, Frequency Reached, or Fault.
- **Output Frequency Upper Limit –** Provides adjustment of output frequency upper limit (1.0 - 200 Hz).

- **Output Frequency Lower Limit –** Provides adjustment of output frequency lower limit (0.0 - 200 Hz).
- **Acceleration and Deceleration Time –** Provides adjustment of acceleration and deceleration time (0.1 - 999 seconds).
- **Operates 60 Hz and 50 Hz Motors –** Provides tailoring of the drive for 60 Hz or 50 Hz motors (factory set for 60 Hz motors).
- **Analog Output Voltage –** Provides connections for an analog voltage (0 - 10 V DC) proportional to the output frequency.
- **Preset Volts/Hz Curves with Program Modification –** Used to tailor the drive for constant torque, high starting torque, or variable torque (HVAC) applications.
- **Approvals –** UL Listed (USA and Canada), CE, C-tick (N10980), ISO-9002.

PROTECTION FEATURES (Fault Codes are Displayed)
See Table 17, on pages 49 and 50.

- **Overvoltage and Undervoltage Protection –** Shuts down the drive if the AC line voltage goes above or below the operating range.
- **Regeneration Protection –** Eliminates tripping due to bus overvoltage caused by rapid deceleration of high inertial loads.
- **Stall Protection –** Prevents the motor from stalling during startup of high inertial loads.
- **Short Circuit Protection –** Shuts down the drive if a short circuit occurs at the motor (phase-to-phase or phase-to-ground).
- **Electronic Motor Overload Protection (I^2t) –** Prevents motor burnout and eliminates nuisance tripping due to overload.
- **Overtemperature Protection –** Shuts down the drive if the temperature exceeds safe limits.

OPTIONAL ACCESSORIES (See Section X, on page 51.)

- **Class B Residential Standard RFI Filter –** Provides noise suppression for Class B Residential Standard requirements (CE Directive 89/336/EEC).

  Note: All models are available with a built-in Class A Industrial Standard RFI Filter. Contact Sales Department.

- **Brake Resistor Kit –** Provides rapid stopping of the drive. Available for Models KBE2-2202, 2203, 4301, 4302, 4303.
- **DIN Rail Mounting Kit**
- **DownLoad Module™ (DLM) –** Uploads and downloads drive programs.
- **Drive-Link™ Software –** Provides PC communications to facilitate programming. Uses Windows® 95/98/2000/ME/XP/NT.

TABLE 1 – ELECTRICAL RATINGS

Model No.	Part No.	Rated Horsepower HP	Rated Horsepower kW	Nominal AC Line Input Voltage (Volts AC - 50/60 Hz)	Maximum AC Line Input Current (Amps AC)	Phase Input (ϕ)	Nominal Output Voltage* (Volts AC)	Maximum Continuous Output Load Current (RMS Amps/Phase)	Pkg. Ref.
KBE2-1125-P	11000	.25	.18	115	6.0	1	0 - 230	1.4	A
KBE2-1150-P	11010	.5	.37	115	10.0	1	0 - 230	2.3	
KBE2-1101-P	11016	1	.75	115	19.0	1	0 - 230	4.0	
KBE2-2125-P	11020	.25	.18	230	3.0	1	0 - 230	1.4	
KBE2-2150-P	11030	.5	.37	230	5.2	1	0 - 230	2.3	
KBE2-2101-P	11040	1	.75	230	9.4	1	0 - 230	4.2	
KBE2-2202-P	11050	2	1.5	230	19.0 / 11.0	1, 3	0 - 230	7.5	B
KBE2-2203-P	11060	3	2.2	230	27.0 / 16.0	1, 3	0 - 230	10.5	
KBE2-4301-P	11070	1	7.5	460	2.6	3	0 - 460	2.3	
KBE2-4302-P	11080	2	1.5	460	4.6	3	0 - 460	3.8	
KBE2-4303-P	11090	3	2.2	460	6.5	3	0 - 460	5.2	
KBE2-1125-4	11500	.25	.18	115	6.0	1	0 - 230	1.4	C
KBE2-1150-4	11510	.5	.37	115	10.0	1	0 - 230	2.3	
KBE2-1101-4	11516	1	.75	115	19.0	1	0 - 230	4.0	
KBE2-2101-4	11540	1	.75	230	9.4	1	0 - 230	4.2	

**For 230 and 460 Volt models, the maximum output voltage is equal to the AC line input voltage. For 115 Volt models, the maximum output voltage is equal to double the AC line input voltage.*

Table 1 continued on page 10.

TABLE 1 – ELECTRICAL RATINGS (Continued)

Model No.	Part No.	Rated Horsepower HP	Rated Horsepower kW	Nominal AC Line Input Voltage (Volts AC - 50/60 Hz)	Maximum AC Line Input Current (Amps AC)	Phase Input (ϕ)	Nominal Output Voltage* (Volts AC)	Maximum Continuous Output Load Current (RMS Amps/Phase)	Pkg. Ref.
KBE2-2202-4	11550	2	1.5	230	19.0 / 11.0	1, 3	0 - 230	7.5	C1
KBE2-2203-4	11560	3	2.2	230	27.0 / 16.0	1, 3	0 - 230	10.5	
KBE2-4301-4	11570	1	.75	460	2.6	3	0 - 460	2.3	
KBE2-4302-4	11580	2	1.5	460	4.6	3	0 - 460	3.8	
KBE2-4303-4	11590	3	2.2	460	6.5	3	0 - 460	5.2	

**For 230 and 460 Volt models, the maximum output voltage is equal to the AC line input voltage. For 115 Volt models, the maximum output voltage is equal to double the AC line input voltage.*

TABLE 2 – GENERAL PERFORMANCE SPECIFICATIONS

Description	Parameter / Range	Factory Setting
AC Line Input Voltage (VAC)	115 & 208/230 (±15%), 380 - 460 (±10%)	—
Input Line Frequency Range (Hz)	48 - 62	—
Output Waveform	Sine Coded PWM	—
Frequency Range (Hz)	0.1 - 200	60
Switching Frequency Range (kHz)	4 - 16	8
Frequency Resolution (Hz Increments)	0.1 up to 100 Hz and 1.0 from 100 Hz thru 200 Hz	—
Acceleration/Deceleration Range (Seconds)	0.1 - 999	5.0
Overvoltage Trip Point @ 230 VAC, @ 460 VAC (VAC)	290, 580	—
Undervoltage Trip Point @ 230 VAC, @ 460 VAC (VAC)	140, 280	—
Overload Rating (% for 1 Minute)	150	—
Minimum Frequency Range (Hz)	0.0 - 200	0.0
Maximum Frequency Range (Hz)	1.0 - 200	60.0
Braking Torque without Braking Resistor (%)[1]	20	20
Braking Torque with Braking Resistor (%)[2]	20 - 130[4]	20
Operating Temperature Range (°C)	-10 to 50	—
Humidity (Relative, Non-Condensing) (%)	0 - 95	—
Maximum Vibration (G)	1	—
Output Relay Contact Rating	1 Amp @ 30 Volts DC, 250 Volts AC	—
External Analog Signal Input	0 - 10 VDC,4 - 20 mADC, 0 - 20 mADC	0 - 10 VDC
Remote Speed Potentiometer (Ω)	5k or 10k	—
Analog Output Voltage (Volts DC)[3]	0 - 10	—
Built-In EMC Filter Specification ("F" Suffix Models)	Class A Industrial	—

Notes: 1. *Models KBE2-1125-P, 1150-P, 2150-P, 2101-P do not contain a braking transistor.* ***2.*** *Models KBE2-2202, 2203, 4301, 4302, and 4303 require optional brake resistor to achieve maximum braking. Maximum braking torque varies with model.* ***3.*** *Proportional to the Output Frequency Upper Limit set with F06.*

TABLE 3 – MODEL NUMBER IDENTIFICATION

KBE2 – 2 1 01 – P F S

Series

Input Voltage	Input Phase	Horsepower	Enclosure Type	RFI (EMI) Filter Option	Switch Option*
1: 115V 2: 230V 4: 460V	1: 1ϕ 2: 1ϕ & 3ϕ 3: 3ϕ	25: 0.25 HP 50: 0.5 HP 01: 1 HP 02: 2 HP 03: 3 HP	P: Panel Mount IP-20 4: NEMA-4 / IP-65 Indoor	F: With Filter Blank: Without Filter	S: With On/Off & Forward/Reverse Switch Blank: Without Switch

**Available for NEMA-4 / IP-65 Models Only.*

FIGURE 1A – MECHANICAL SPECIFICATIONS (Inches/mm)

for Models KBE2-1125-P, 1150-P, 1101-P, 2125-P, 2150-P, 2101-P (Pkg. A)

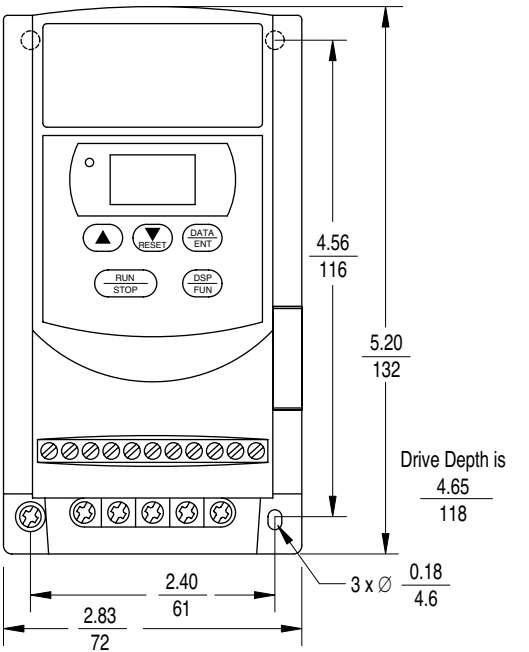
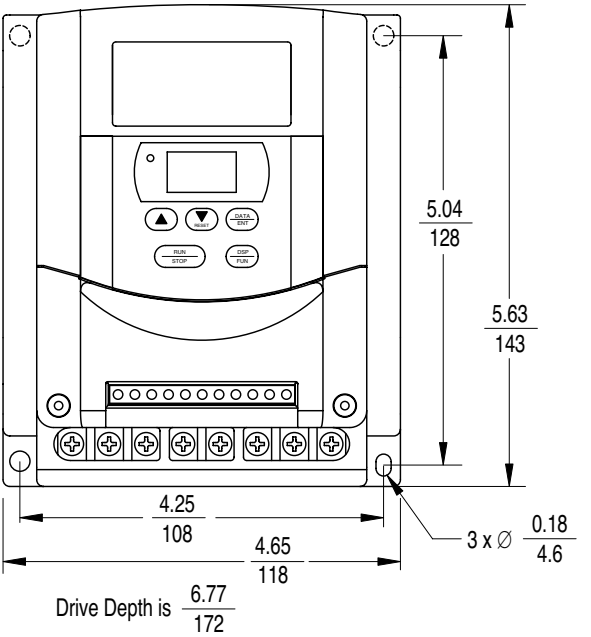


FIGURE 1B – MECHANICAL SPECIFICATIONS (Inches/mm)

for Models KBE2-2202-P, 2203-P, 4301-P, 4302-P, 4303-P (Pkg. B)



II. MOUNTING INSTRUCTIONS

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. Care should be taken to avoid extreme hazardous locations where physical damage can occur. When mounting the drive in an enclosure, the enclosure must be large enough to allow for proper heat dissipation so that the ambient temperature does not exceed 50 ºC. See Figures 1A, 1B, 1C, and 1D, on pages 12 - 15.

***Note**: NEMA-4 / IP-65 models are for indoor use only. They are not for use in explosion proof applications.*

CAUTION! To avoid overheating, do not mount the optional brake resistor under the drive.

FIGURE 1C – MECHANICAL SPECIFICATIONS (Inches/mm)

for Models KBE2-1125-4, 1150-4, 1101-4, 2101-4 (Pkg. C)

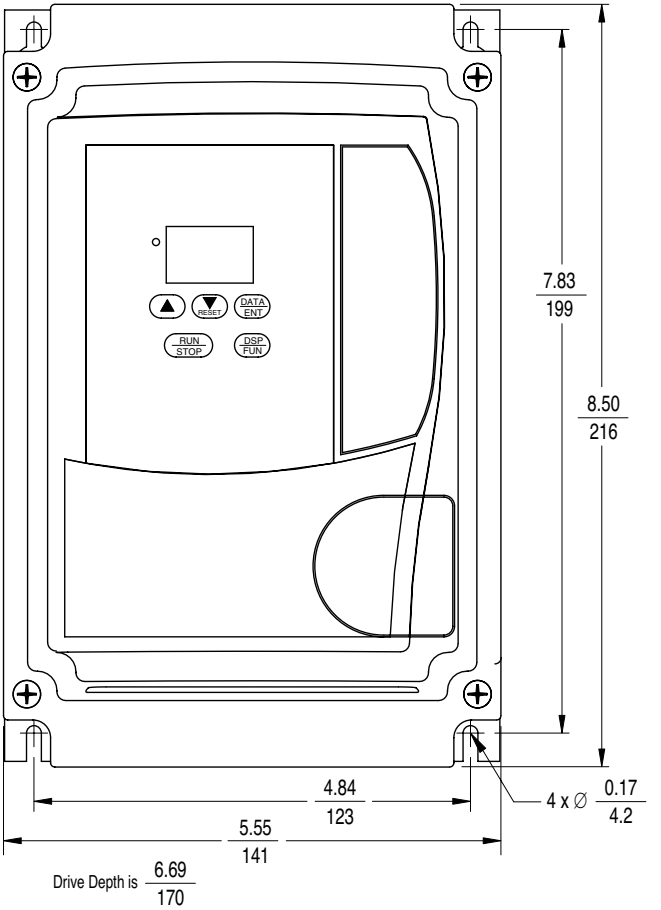
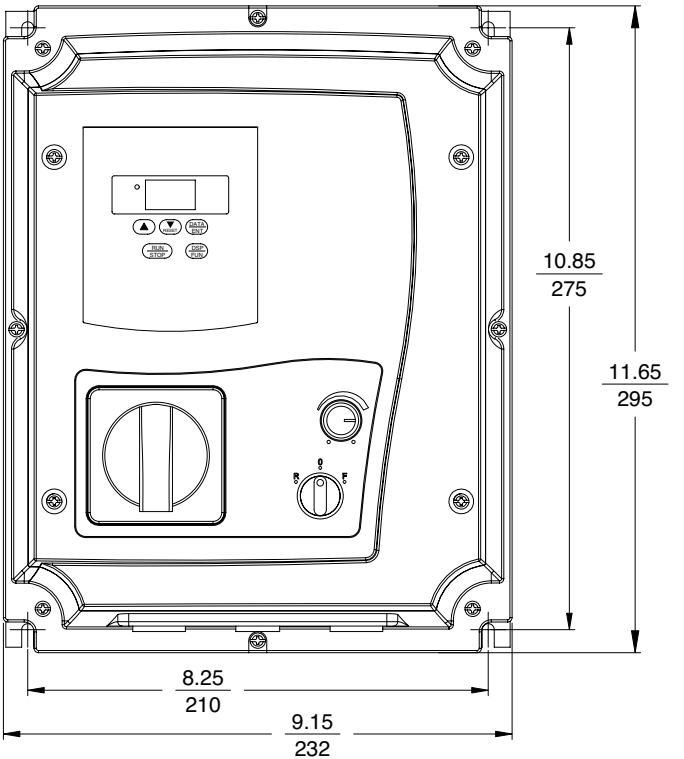


FIGURE 1D – MECHANICAL SPECIFICATIONS (Inches/mm)

for Models KBE2-2202-4, 2203-4, 4301-4, 4302-4, 4303-4 (Pkg. C1)



Drive Is Shown with Optional Power On/Off Switch, Forward-Stop-Reverse Switch, and Main Speed Potentiometer.

Drive Depth with Optional Switches: 8.35 / 212 Drive Depth without Optional Switches: 7.15 / 181

III. RECONDITIONING THE BUS CAPACITORS

It is recommended that the bus capacitors be reconditioned if this product has been in storage for over one year. To recondition the capacitors, apply the AC line, with the drive in the Stop Mode, for a minimum of one hour.

IV. TERMINAL BLOCKS TM1 and TM3 WIRING INSTRUCTIONS (Power Connections)

WARNING! Read Safety Warning, on page 6, before using this drive. Disconnect the main power when making connections to the drive.

For Terminal Block TM1 wiring information, see Table 4 on page 17.

FIGURE 2A – PKG. A and PKG. C TERMINAL BLOCK TM1 LAYOUT

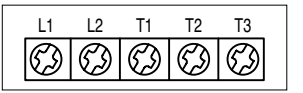


FIGURE 2B – PKG. B TERMINAL BLOCK TM1 LAYOUT

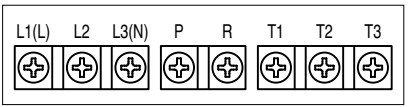
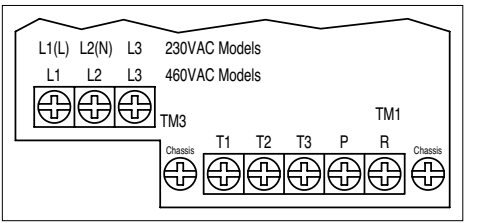


FIGURE 2C – PKG. C1 TERMINAL BLOCKS TM1 and TM3 LAYOUT



IMPORTANT APPLICATION NOTES:

1. To Avoid False Tripping – Do not bundle motor wires from multiple drives in the same conduit. Do not bundle the AC line with motor wires. (Note: AC power to multiple drives *can* be run in the same conduit.) Be sure at least 300V rated wiring is used on 115-230 Volt AC models and 600V rated wiring is used on 460 Volt AC models. Recommended insulation type is "XLPE". Do not use type "THHN". If motor wires exceed 100 feet (30 m), a Load Reactor may be required. (Do not use insulation type "THHN".) See Section X-H, Table 22, on page 54. The 3-phase input voltage imbalance must be less than 3%.

2. To Avoid Erratic Operation – Do not bundle signal wires (start/stop, frequency control, etc.) with AC line or motor wires. Use shielded cables on signal wiring over 12" (30 cm). The shield should be Earth grounded on the drive side only. Wire the drive in accordance with the National Electrical Code and other local codes that may apply. See Figures 3A, 3B, and 3C, on page 18.

Be sure to properly fuse each AC line conductor that is not at ground poten-

tial. Do not fuse neutral or grounded conductors. A separate AC line switch or contactor must be wired as a disconnect so that each ungrounded conductor is opened. See Section VI, on page 24.

TABLE 4 – TERMINAL BLOCKS TM1 AND TM3 WIRING INFORMATION

Terminal Description	Pkg.	Horsepower	Maximum Wire Size (Cu)		Recommended Tightening Torque	
			AWG	mm^2	in-lbs	kg-cm
AC Line (L1, L2) Motor (T1, T2, T3)	A	thru 1 HP @ 115 VAC and 230 VAC	14	2.1	12	14
AC Line (L1 (L), L2, L3 (N)) Motor (T1, T2, T3) Brake Resistor (P, R)	B	2 HP, 3 HP @ 230 VAC 1 HP, 2 HP, 3 HP @ 460 VAC	12	3.3	16	19
AC Line (L1 (L), L2 (N), L3) Motor (T1, T2, T3)	C	thru 1 HP @ 115 VAC and 230 VAC	14	2.1	12	14
AC Line (L1 (L), L2 (N), L3) Motor (T1, T2, T3) Brake Resistor (P, R)	C1	2 HP, 3 HP @ 230 VAC 1 HP, 2 HP, 3 HP @ 460 VAC	12	3.3	7	8

Note: *To access terminals on NEMA-4X models, remove the four screws which secure the cover. Replace the cover and the four screws after wiring is complete. Tighten but do not over tighten these screws.*

A. AC Line Connection

Note: *Be sure the drive rated AC line voltage (115, 208/230, 380/460 Volts AC) matches the actual AC line input voltage.*

1. Single phase only AC line input models (Pkg. A and Pkg. C): wire the AC line to Terminals L1, L2, as shown in Figure 3A, on page 18.

   Note: *If one of the AC line inputs is a neutral (N), wire it to Terminal L2.*

2. Dual phase (1ϕ, 3ϕ) AC line input models (Pkg. B): wire the 1ϕ AC line to Terminals L1(L), L3(N), as shown in Figure 3B, on page 18.
3. Dual phase (1ϕ, 3ϕ) AC line input models (Pkg. C1), wire the 1ϕ AC line to Terminals L1(L), L2(N), as shown in Figure 3C, on page 18.
4. Dual phase (1ϕ, 3ϕ) AC line input models (Pkg. B): wire the 3ϕ AC line to Terminals L1, L2, L3, as shown in Figure 3B on page 18.
5. 3-Phase only AC line input models (Pkg. B and Pkg. C1): wire the AC line to Terminals L1, L2, L3, as shown in Figure 3B, on page 18.

B. Ground Connection – Earth ground the drive chassis using the green ground screw that is provided on the drive, as shown in Figures 3A and 3B, on page 18.

Application Note – Do not "daisey chain" grounds to multiple drives and motors. Run a separate ground wire from each motor and/or drive to a central grounding point.

FIGURE 3A – POWER CONNECTIONS for PKG. A and PKG. C MODELS with 1ϕ AC LINE INPUT

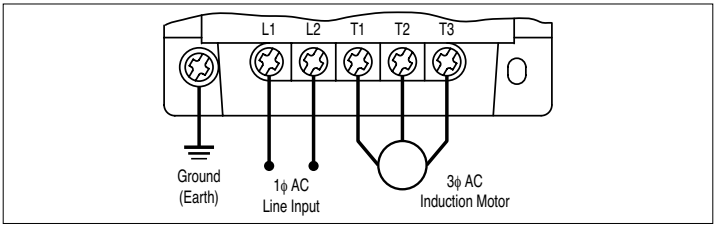


FIGURE 3B – POWER CONNECTIONS for PKG. B MODELS with 1ϕ and 3ϕ AC LINE INPUT

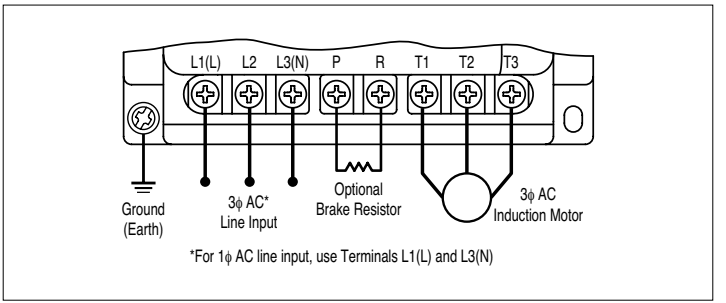
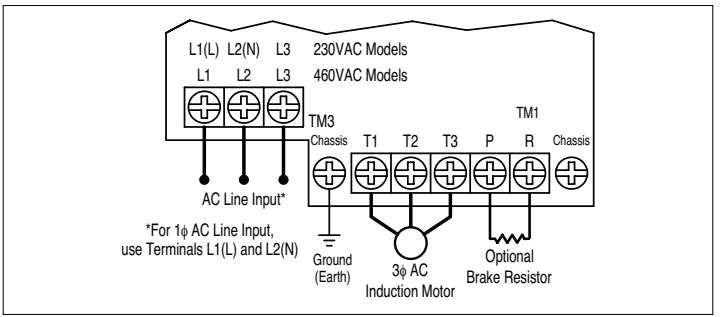


FIGURE 3C – POWER CONNECTIONS for PKG. C1 MODELS (NEMA-4) with 1ϕ and 3ϕ AC LINE INPUT



C. Motor Connection – Wire the motor to Terminals T1(U), T2(V), T3(W) of Terminal Block TM1, as shown in Figures 3A, 3B, and 3C, on page 18. Motor cable length should not exceed 100 feet (30 m).

Application Notes – 1. *If wiring exceeds 100 feet (30 m), special Load Reactors may be required, contact our Sales Department. See Section X-F, Table 22, on page 53.* ***2.*** *Be sure the motor rated voltage (208/230, 380/460 Volts AC) matches the control output voltage.*

D. Optional Brake Resistor Connection – To improve braking, an optional brake resistor can be connected to Terminals "P" and "R", as shown in Figure 3B, on page 18. This optional brake resistor can provide maximum braking torque of up to 130% (model dependent). This option is only available for Models KBE2-2202, 2203, 4301, 4302, and 4303. See Section X-D, on page 52.

CAUTION! *To avoid overheating, do not mount the optional brake resistor under the drive.*

V. TERMINAL BLOCK TM2 WIRING INSTRUCTIONS (Signal Connections)

The KBE2 contains 11 signal terminals which can be used for various functions. For Terminal Block TM2 wiring information, see Table 5.

IMPORTANT: See Application Notes, in Section IV, on page 16.

Notes: 1. *If external signal wiring is not used, proceed to Section VI, on page 24.* ***2.*** *Terminal "5" (+12V) is the supply voltage for the Start/Stop circuit and the Multifunction Input Terminals. The maximum allowable load current for Terminal "5" is 20 mA DC.* ***3.*** *All terminals of Terminal Block TM2 are isolated from the AC line and motor wiring. This eliminates the need for an isolated input signal.*

FIGURE 4A – PKG. A
TERMINAL BLOCK TM2 LAYOUT

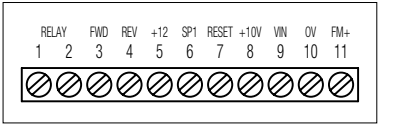


FIGURE 4B – PKG. B, PKG. C, PKG. C1
TERMINAL BLOCK TM2 LAYOUT

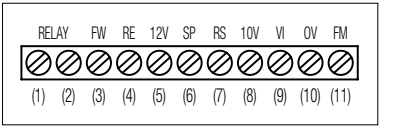


TABLE 5 – TERMINAL BLOCK TM2
WIRING INFORMATION

Terminal Description	Supply Wire Range (Cu)		Recommended Tightening Torque	
	AWG	mm^2	in-lbs	kg-cm
All Signal Inputs and Outputs (Terminals 1 - 11)	24 - 18	0.2 - 0.8	5	6

A. External Start/Stop-Forward/Reverse Connection – External control of Start/Stop and Forward/Reverse is achieved by wiring contacts to Terminals 3, 4, and 5, as shown in Figure 5A. To program the drive for external Start/Stop, set F10 [Start/Stop Control] to "001" [External Contacts], as described in Section IX, on page 42.

FIGURE 5A – EXTERNAL START/STOP-FORWARD/ REVERSE CONNECTIONS

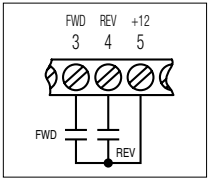
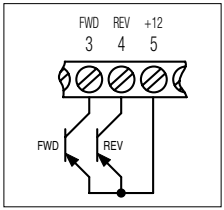


FIGURE 5B – EXTERNAL START/STOP-FORWARD/ REVERSE OPEN COLLECTOR CONNECTIONS



The drive is factory programmed to operate Forward/Stop using Terminal 3 and Reverse/Stop using Terminal 4. To program the drive to operate Run/Stop using Terminal 3 and Forward/Reverse using Terminal 4, set F03 to "001" [Run/Stop-Forward/Reverse]. The settings for external Start/Stop control using F03 [External Forward-Stop-Reverse Control] are shown in Table 6.

WARNING! The Stop contact is never to be used as a Safety Disconnect since it is not fail-safe. Use only the AC line for this purpose.

Note: *Open collectors may be used in lieu of contacts. See Figure 5B.*

TABLE 6 – EXTERNAL START/STOP CONTROL USING FUNCTION F03

Function F03 Code Setting	Contact Status		Drive Operation
	Term. 3 (FWD)	Term. 4 (REV)	
000 (Factory Setting)	Open	Open	Stop
	Closed	Open	Forward
	Open	Closed	Reverse
	Closed	Closed	Stop
001	Open	Open	Stop
	Closed	Open	Forward
	Open	Closed	Stop
	Closed	Closed	Reverse

B. External Frequency Control – Terminals 8, 9, and 10 can be wired in a variety of ways to control the output frequency of the drive, as shown in Figures 7, 8 and 9, on pages 21 and 22. See Table 7 on page 21. F11 [Frequency Control Method] is used to program the drive to control motor frequency with an external signal instead of the keypad, as described in Section IX, on page 42. F11 is factory set to "000" [Keypad]. SW1 is used to set the drive for voltage or current input signal, as described in Section V-B-1, on page 21. SW1 is factory set to the "V" position (Keypad, Potentiometer, 0 - 10 Volts DC).

TABLE 7 – SIGNAL INPUT, F11, and SW1 SETTING

Frequency Control Method	F11 Code Setting	SW1 Position
Keypad (Factory Setting)	000 (Factory Setting)	V (Factory Setting)
5 kΩ Potentiometer*	001	
0 - 10 Volts DC	001	
0 - 20 mA DC	001	I
4 - 20 mA DC	002	

* 10 kΩ may also be used

1. **Signal Input Type Selection (SW1) –** SW1 selects the external signal type to be used to control motor speed. SW1 is factory set to the "V" position for 0 - 10 Volts DC voltage following signal input or remote speed potentiometer control, as shown in Figure 6A. For 0 - 20 mA or 4 - 20 mA DC current following signal input, set SW1 to the "I" position, as shown in Figure 6B. Set F11 [Frequency Control Method] to the appropriate setting for the signal type being used, as described in Section IX, on page 42.

FIGURE 6A – SW1 Set for Remote Speed Potentiometer or Voltage Following Signal Input

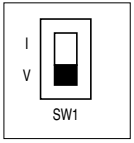
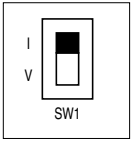


FIGURE 6B – SW1 Set for Current Following Signal Input



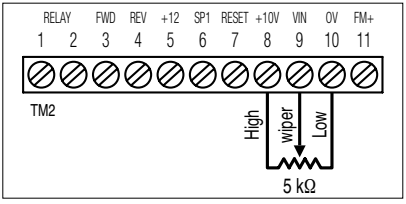
Location of SW1:

a. To access SW1 on panel mount models, remove the small cover that is located on the right side of the drive, above Terminal Block TM2, by gently sliding it upwards. Replace the cover after setting SW1 as described above.

b. To access SW1 on NEMA-4 / IP-65 models, remove the four screws which secure the cover. SW1 is located near the top right side of Terminal Block TM2. Replace the cover and the four screws after setting SW1 as described above. Tighten but do not over tighten these screws.

2. **Remote Speed Potentiometer Connection –** A 5kΩ (or 10kΩ) remote speed potentiometer can be connected to Terminal Block TM2 to control motor speed. Connect the high side of the potentiometer to Terminal 8, the wiper

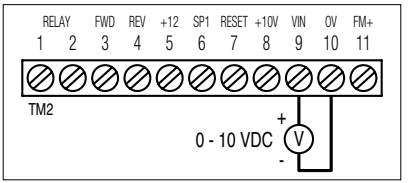
FIGURE 7 – REMOTE SPEED POTENTIOMETER CONNECTION



to Terminal 9, and the low side to Terminal 10, as shown in Figure 7, on page 21. Set F11 [Frequency Control Method] to "001" [Potentiometer] and be sure SW1 is set to the "V" position (factory setting). See Section IX, on page 42.

3. **Voltage Following Connection –** A 0 - 10 Volt DC analog signal input can be connected to Terminal Block TM2 to control motor speed. Connect the signal voltage (+) to Terminal 9 and the common (-) to Terminal 10, as shown in Figure 8. Set F11 [Frequency Control Method] to "001" [0 - 10 V] and be sure SW1 is set to the "V" position (factory setting).

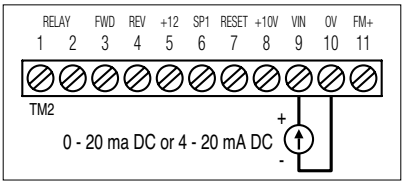
FIGURE 8 – VOLTAGE FOLLOWING CONNECTION



***Note:** F11 [Frequency Control Method] is factory set to "000" [Keypad].*

4. **Current Following Connection –** A 0 - 20 mA DC or 4 - 20 mA DC analog signal input can be connected to Terminal Block TB2 to control motor speed. Connect the signal current (+) to Terminal 9 and the common (-) to Terminal 10, as shown in Figure 9. Set SW1 to the "I" position.

FIGURE 9 – CURRENT FOLLOWING CONNECTION



   a. For 4 - 20 mA DC analog signal input, set F11 [Frequency Control Method] to "001".

   b. For 0 - 20 mA DC analog signal input, set F11[Frequency Control Method] to "002".

5. **Multifunction Input Terminals 6 and 7 Connection –** The Multifunction Input Terminals are factory programmed for Preset Speed #1 (Terminal "6" SP1) and Reset (Terminal "7" RST). Each terminal can be programmed for six functions using Function Numbers F19 for Terminal "6" and F20 for Terminal "7".

TABLE 8 – PROGRAMMABLE FUNCTIONS FOR F19 and F20

001	Jog
002	Preset Speed #1
003	Rapid Stop
004	Coast-to-Stop
005	Reset
006	Preset Speed #2

See Table 8, Figures 10A, 10B, and Table 9 on page 23.

Preset Speed Operation: Many applications require preset speed operation. The KBE2 is capable of providing 3 preset fixed speeds using Terminals "6" and "7" plus a fourth set speed. See Table 9.

FIGURE 10A MULTIFUNCTION INPUT TERMINAL CONNECTIONS

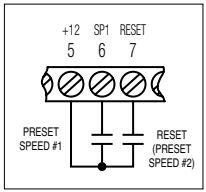
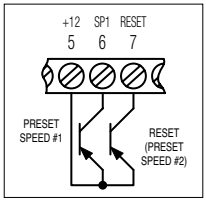


FIGURE 10B MULTIFUNCTION INPUT TERMINAL OPEN COLLECTOR CONNECTIONS



Terminal 6 has been factory programmed to Preset Speed #1 (F08 programs the frequency). Terminal 7 has been factory programmed to reset the drive. To program Terminal 7 to Preset Speed #2, use Function F20 [Multifunction Terminal 7] set to "006", as described in Section VIII-C-7, on page 36.

TABLE 9 – SELECTING PRESET OUTPUT FREQUENCY WITH MULTIFUNCTION INPUT TERMINALS 6 AND 7

Preset Speed	Terminal 6	Terminal 7	Function No. to Program Output Frequency
1	Closed	Open	F08 (10.0 Hz*)
2	Open	Closed	F26 (20.0 Hz*)
3	Closed	Closed	F27 (30.0 Hz*)
Keypad (Factory Setting)	Open	Open	Set by ▲ and ▼/RESET Keys

** Indicates factory setting of preset speed frequency (Hz).*

Note: *F19 is used to program Term. 6 to Preset Speed #1, F20 is used to program Term. 7 to Preset Speed #2. Close both Terms. 6 and 7 for Preset Speed #3 (when switching Terms. 6 and 7 together, the operation must be within 10 mSeconds).*

a. **Preset Speed #1 –** Connect Terminal 6 to Terminal 5, of Terminal Block TM2, as shown in Figures 10A and 10B. *Note: F19 must be set to "002" (factory setting). Set F08 to the desired output frequency.*

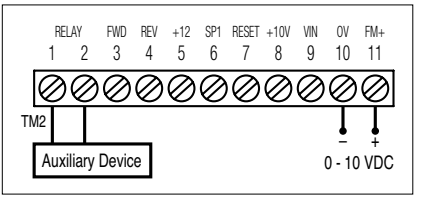
b. **Preset Speed #2 –** Connect Terminal 7 to Terminal 5, of Terminal Block TM2, as shown in Figures 10A and 10B. Set F20 to "006" (Preset Speed #2) and set F26 to the desired output frequency.

c. **Preset Speed #3 –** Connect Terminals 6 and 7, of Terminal Block TM2, to Terminal 5, as shown in Figures 10A and 10B (when switching Terms. 6 and 7 together, the operation must be within 10 mSeconds). In order to obtain Preset Speed #3, Terminals 6 and 7 must be programmed for Preset Speeds #1 and #2, as described above. Use Function F27 to set the frequency of Preset Speed #3.

d. Fourth Speed – To select a fourth speed, open connections to Terminals 6 and 7, of Terminal Block TM2, as shown in Figures 10A and 10B, on page 23. This allows the fourth speed to be the speed set by the keypad, remote potentiometer, or external signal input, depending on the Frequency control Method (F11).

C. Multifunction Output Relay Connection – Terminals 1 and 2 of Terminal Block TM2 contain a normally open (NO) relay contact. This contact changes state depending on the drive operation and the setting of Function F21. See Section IX, on page 46.

FIGURE 11 – MULTIFUNCTION OUTPUT RELAY AND ANALOG OUTPUT VOLTAGE CONNECTIONS



F21 is factory set to "003", which sets the relay to operate as a Fault Relay. See Figure 11. In the Fault Mode, the relay will change state when any of the following faults occur: OL1, OL2, OCS, OCA, OCC, OCd, OCb, OUC, LUC, and OHC. The Output Relay can be programmed using Function F21 to operate as a Run Relay (F21 = "000") or as a Frequency Reached Relay (F21 = "002").

Note: *The Output Relay contact is rated 1 Amp at 30 Volts DC or 250 Volts AC.*

D. Analog Output Voltage Connection – An analog output voltage (0 -10 Volts DC) is provided at Terminals 10 (-) and 11(+) of Terminal Block TM2. This voltage is proportional to the Output Frequency Upper Limit set with F06. See Figure 11.

VI. AC LINE FUSING

This drive does not contain AC line fuses. Most electrical codes require that each ungrounded conductor contain circuit protection. It is recommended to install a fuse or circuit breaker in series with each ungrounded conductor. Do not fuse neutral or grounded conductors. See Table 10. Check all electrical codes that apply to the application. **Do not install a fuse or circuit breaker in series with motor leads.**

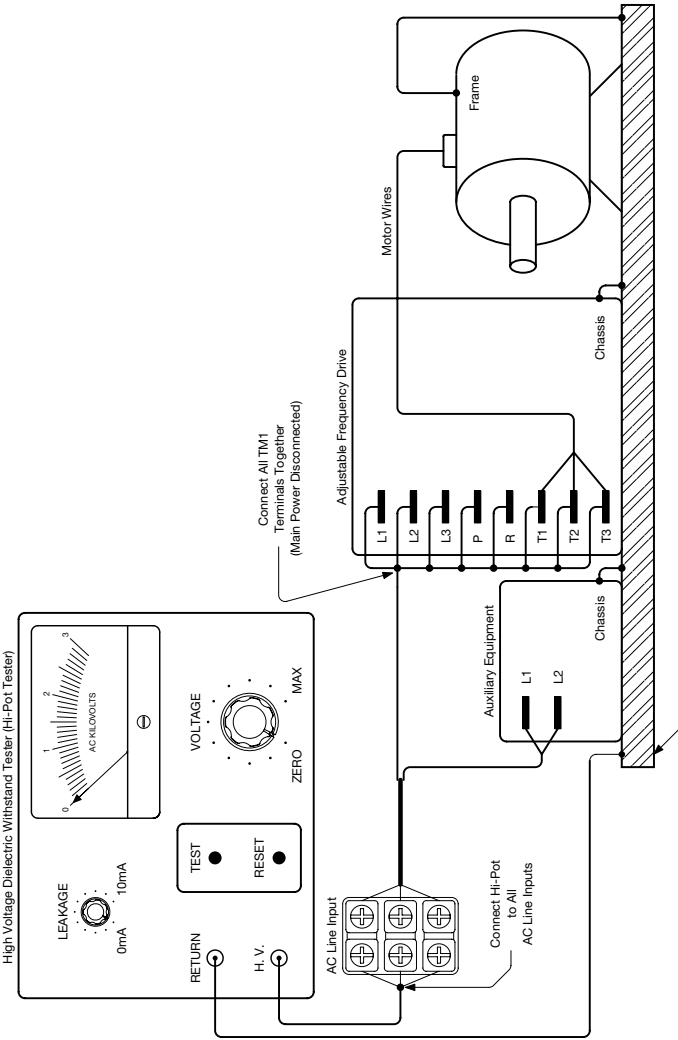
TABLE 10 – RECOMMENDED FUSE OR CIRCUIT BREAKER RATING

Model	Rating (Amps AC)
KBE2-1125	15
KBE2-1150	15
KBE2-1101	30
KBE2-2125	15
KBE2-2150	15
KBE2-2101	20

Model	Rating (Amps AC)
KBE2-2202	20, 15*
KBE2-2203	30, 15*
KBE2-4301	15
KBE2-4302	15
KBE2-4303	15

*Rating is for 1ϕ , 3ϕ.

FIGURE 12 – HI-POT SETUP



VII. RECOMMENDED HIGH VOLTAGE DIELECTRIC WITHSTAND TESTING (Hi-Pot)

Testing agencies such as UL, CSA, etc., usually require that the equipment undergo a hi-pot test. In order to prevent catastrophic damage to the drive, which has been installed in the equipment, it is recommended that the following procedure be followed. A typical hi-pot test setup is shown in Figure 12, on page 25.

Note: *All equipment AC line inputs must be disconnected from the AC power.*

CAUTION! *To avoid damage to the drive, do not connect any terminals of Terminal Block TM2 to the hi-pot tester.*

A. 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 control and other auxiliary equipment are mounted.

B. The hi-pot tester must have an automatic ramp-up to the test voltage and an automatic ramp-down to zero voltage.

Note: *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. This procedure must be followed for each machine to be tested. A suggested hi-pot tester is Slaughter Model 2550.*

WARNING! Instantaneously applying the hi-pot voltage will cause irreversible damage to the drive.

VIII. DRIVE OPERATION

Before operating the drive, read the following instructions on keypad use and programming functions. See Figure 13, on page 27, for the digital keypad layout.

Note: *To prevent damage, do not operate the keypad with a screwdriver or other sharp-ended tool.*

A. Digital Keypad Description – The digital keypad has 5 keys and a display which are used to program drive functions and control various features, as described below. See Figure 13, on page 27.

1. **3-Digit LED Display –** When power is applied to the drive, the LED, located at the top left side of the digital display, will illuminate. The digital display will flash the set frequency (factory setting is “05.0”). When the drive is in Stop Mode, the set frequency is displayed. When the drive is in the run mode, the output frequency is displayed.

2. **RUN/STOP Key –** The RUN/STOP key is used to run or stop the drive

   a. If the drive is in Stop Mode, press the RUN/STOP key to start the drive.

   b. If the drive is Run Mode, press the RUN/STOP key to stop the drive.

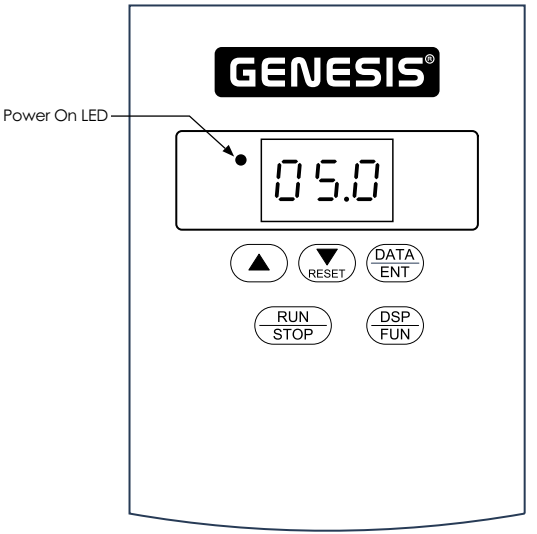
3. **DSP/FUN Key –** The DSP/FUN key is used to change the display between Display Mode and Function Mode.

   a. If DSP/FUN is pressed while frequency is displayed, the display will indicate a function number.

   b. If DSP/FUN is pressed while a function number is displayed, the display will change to the output frequency setting.

   Note: *When the DSP/FUN key is pressed, the last function number will be displayed. If the AC line is interrupted for more than 2 seconds, then "F00" will be displayed when the DSP/FUN key is pressed.*

FIGURE 13 – DIGITAL KEYPAD LAYOUT



4. **▲ Key –** The ▲ key is used to increase frequency, increase to the next higher function number, or increase the function value or code setting. Pressing the ▲ key once will cause the display to increase by 1 unit. Maintaining pressure on the ▲ key will cause the display units to increase rapidly.

   a. If the drive is in Run Mode, press the ▲ key to increase the run frequency.

b. If the drive is in Stop Mode, press the ▲ key to increase the set frequency.

c. If a function number is displayed, press the ▲ key to increase the function number to the next higher number.

d. If a function value or code is displayed, press the ▲ key to increase the function value or code setting.

5. **▼/RESET Key –** The ▼ key is used to decrease frequency, decrease to the next lower function number, decrease the function value or code setting, or reset the drive after a fault has occurred. Pressing the ▼/RESET key once will cause the display to decrease by 1 unit. Maintaining pressure on the ▼/RESET key will cause the display units to decrease rapidly.

   a. If the drive is in Run Mode, press the ▼/RESET key to decrease the frequency.

   b. If the drive is in Stop Mode, press the ▼/RESET key to decrease the set frequency.

   c. If a function number is displayed, press the ▼/RESET key to decrease the function number to the next lower number.

   d. If a function value or code is displayed, press the ▼/RESET key to decrease the function value or code setting.

   e. If a fault has occurred, press the ▼/RESET key to reset the drive.

6. **DATA/ENT Key –** The DATA/ENT key is used to display or enter a function's setting.

   a. If the desired function number is displayed, press the DATA/ENT key to display the function value or code.

   b. If the desired function value or code is displayed, press the DATA/ENT key to program the function to the new value or code. "End" will be momentarily displayed.

B. Digital Keypad Operation – Examples of basic keypad operations are described below.

Note: *When the DSP/FUN key is pressed, the last function number will be displayed. If the AC line is interrupted for more than 2 seconds, then "F00" will be displayed when the DSP/FUN key is pressed.*

1. **Setting Drive Output Frequency Using the Keypad –** The drive is factory set to run at 5.00 Hz when the drive is in the Run Mode. (Press the RUN/STOP Key to start or stop the drive.) See Figure 14 on page 29.

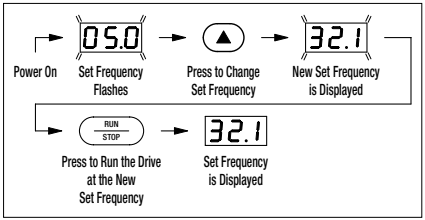
   a. To change the Set Frequency (drive in Stop Mode):

      1. Press the ▲ or ▼ key until the desired frequency is displayed.

2. Press the RUN/STOP key to run the drive at the new Set Frequency.

Note: *Figure 14 is a flow chart which illustrates the sequence to change and program the Set Frequency from 5.00 Hz to 32.1 Hz using the keypad.*

FIGURE 14 – FLOW CHART TO CHANGE SET FREQUENCY (DRIVE IN STOP MODE)

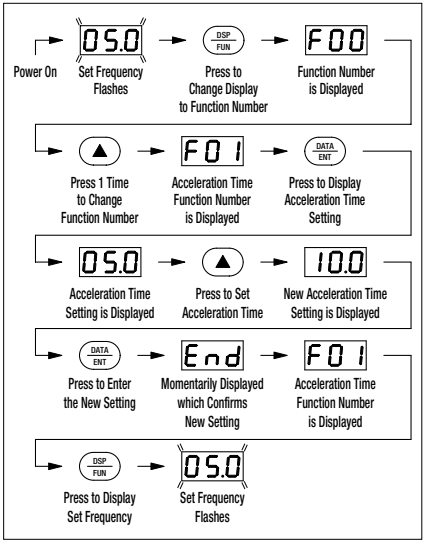


b. To change the Run Frequency (drive in Run Mode): Press the ▲ or ▼ key until the desired frequency is displayed.

Note: In Run Mode, use the Up and Down keys to set the desired frequency.

2. **F01 (Acceleration Time) –** Used to set the acceleration time of the drive. The acceleration time can be changed while the drive is in the Stop Mode or Run Mode. See Figure 15.

FIGURE 15 – FLOW CHART TO PROGRAM F01 (ACCELERATION TIME)



Example: Figure 15 illustrates the sequence to program F01 for a 10.0 second acceleration time.

a. Press the DSP/FUN key to display function number.

b. Press the ▲ key until “F01” is displayed.

c. Press the DATA/ENT key. "05.0" (5.0 seconds) will be displayed (factory setting).

d. Press the ▲ or ▼/RESET key until the desired acceleration time is displayed. Maintaining pressure on the ▲ or ▼/RESET key will cause the display units to change rapidly. The programmable range is 0.1 - 999 seconds.

e. Press the DATA/ENT key to set the new acceleration time. "F01" will be displayed.

f. Press the DSP/FUN key to return to the frequency display or press the ▲ or ▼/RESET key to change to another function number.

3. **F04 (Motor Direction) –** F04 is factory set to "000" [Forward Direction].

The motor direction can be changed while the drive is in the Stop Mode or Run Mode.

a. Press the DSP/FUN key to display function number.

b. Press the ▲ or ▼/RESET key until "F04" is displayed.

c. Press the DATA/ENT key. "000" will be displayed.

d. Press the ▲ or ▼/RESET key until code "001" is displayed.

e. Press the DATA/ENT key to set the drive for reverse motor direction. "F04" will be displayed.

f. Press the DSP/FUN key to return to the frequency display or press the ▲ or ▼/RESET key to change to another function number.

C. Programming – All drive functions have been factory programmed, as shown in Table 15, on pages 37 and 38.

Application Notes: 1. The KBE2 drive has been factory programmed for 60 Hz motors for use in constant torque applications. F05 is factory set to "004" [60 Hz Constant Torque]. To convert to 50 Hz motors used on general purpose applications, set F05 to "001" [50 Hz Constant Torque], as shown in Table 11. Also see Section IX, on page 39, for details on programming Function F05 [Volts/Hz Pattern]. **2.** To reset to factory settings use F25, as described in Section IX, on page 48.

TABLE 11 – REPROGRAMMING THE DRIVE FOR 50 Hz MOTOR OPERATION

Function to Change Motor Frequency	Factory Code Setting for 60 Hz Motors for Constant Torque Applications	New Code Setting for 50 Hz Motors for Constant Torque Applications
F05	004	001

1. **F18 [Motor Overload Protection (I^2t)] –** Motor Overload Protection is used to set the maximum motor current as a percent of the full load rating of the

drive, as described in Section IX, on page 45. F18 is factory set to "100" (100% Full Load Rating of the Drive).

Note: It is highly recommended that this function be programmed.

a. The drive must be in stop mode (press the RUN/STOP key). The set frequency will flash on the display.

b. Press the DSP/FUN key to display function number.

c. Press the ▲ or ▼/RESET key until "F18" is displayed.

d. Press the DATA/ENT key. The function value will be displayed. Factory setting is "100" (100% Full Load Rating of the Drive).

e. Press the ▲ or ▼/RESET key until the desired value is displayed. Maintaining pressure on the ▲ or ▼/RESET key will cause the display to change rapidly. The programmable range for F18 is 0.1 - 200%.

Example: If a **3.3 Amp** motor is used with Model KBE2-2101 (rated **4.2 Amps**), F18 should be set according to the following formula.

(Current Rating of Motor ÷ Current Rating of Drive) x 100
(3.3 Amps ÷ 4.2 Amps) x 100 = 79%, therefore, enter the function value "079" into F18.

f. Press the DATA/ENT key to save the new setting. "F18" will be displayed.

g. Press DSP/FUN key to return to the frequency display or press the ▲ or ▼/RESET key to change to another function number.

2. **F05 (Volts/Hz Pattern) –** Volts/Hz Pattern is used to set the drive for the application in which it will be used, as described in Section IX, on page 40. F05 is factory set to "004" for 60 Hz Constant Torque applications.

a. The drive must be in stop mode (press the RUN/STOP key).

b. Press the DSP/FUN key to display function number.

c. Press the ▲ or ▼/RESET key until "F05" is displayed.

d. Press the DATA/ENT key. "004"will be displayed.

e. Press the ▲ or ▼/RESET key until the desired setting is displayed. The programmable codes for F05 are as follows.

F05 = 001: 50 Hz Constant Torque Application
002: 50 Hz High Starting Torque Application
003: 50 Hz Variable Torque (HVAC) Application
004: 60 Hz Constant Torque Application (Factory Setting)
005: 60 Hz High Starting Torque Application
006: 60 Hz Variable Torque (HVAC) Application

f. Press DSP/FUN key to return to the frequency display or press the ▲ or ▼/RESET key to change to another function number.

Notes: 1. *Programming F05 is related to the motor characteristics not the AC line input frequency (50/60 Hz).* ***2.*** *Codes "003" and "006" are used for variable torque loads such as fans, blowers, or centrifugal pumps.*

3. F23, F24, F28 for Manual or Automatic Restart (After A Fault Has Cleared) – See Table 12, for a summary of manual and automatic restart function settings.

WARNING! Do not set the drive for automatic restart, unless automatic restart will not cause serious injury or death.

TABLE 12 – FUNCTION F23, F24, F28 CODE SETTINGS

Function Code Setting			
F23	**F24**	**F28**	**Description**
000*	000*	001*	The drive must be manually restarted after a fault has cleared, except for a momentary AC power loss.**
001	000*	001*	The drive must be manually restarted after a fault has cleared, including a momentary AC power loss.**
000*	005	001*	The drive will automatically restart after a fault has cleared but must be manually restarted after an AC power loss.
000*	005*	000	The drive will automatically restart after a fault has cleared, including an AC power loss. *Note: Function F10 must be set to "001" [External Contacts] and a jumper must be installed between Terminals 3 and 5 of Terminal Block TM2.*

*Indicates factory setting, **AC power loss of under 2 seconds.

The faults that can be manually or automatically reset are indicated by the following codes: OCS, OCA, OCC, OCd, OCb, OUC, LUC, OHC. See Table 17, on pages 49 and 50.

a. Manual Restart – The drive is factory programmed to be manually restarted whenever a fault occurs (see Table 17, on pages 49 and 50). F23 [Auto Restart After A Fault Has Cleared] is factory set to "000" [Enable Auto Restart]. In this mode, the drive must be restarted for all faults except for a momentary AC power loss. If a momentary AC power loss (under 2 seconds) occurs, the drive will shut down causing the motor to slow down or stop (depending on the load type) and then accelerate to the set frequency. If the application requires that the drive shut down even during a momentary AC power loss, set F23 to "001" [Disable Auto Restart].

To change the setting of F23 from “000” to “001”:

1. The drive must be in Stop Mode (press the RUN/STOP key). The set frequency will flash on the display.
2. Press the DSP/FUN key to display function number.
3. Press the ▲ or ▼/RESET key until “F23” is displayed.
4. Press the DATA/ENT key. The function code will be displayed. Factory setting is “000” [Enable Auto Restart].
5. Press the ▲ key until “001” [Disable Auto Restart] is displayed.
6. Press DSP/FUN key to return to the frequency display or press the ▲ or ▼/RESET key to change to another function number.

b. Automatic Restart for All Faults Except AC Power Loss* – If the application requires that the drive automatically restart after a fault has cleared, except for an AC power loss, Function F24 must be set as follows. See Table 13. *(**Note:** F23 and F24 are both factory set to “000”.)*

The faults that are automatically reset are indicated by the following codes: OCS, OCA, OCC, OCd, OCb, OUV, LUC, OHC

To change the setting of F24 from “000” to “005”:

1. The drive must be in Stop Mode (press the RUN/STOP key).
2. Press the DSP/FUN key to display function number.
3. Press the ▲ or ▼/RESET key until “F24” is displayed.
4. Press the DATA/ENT key. The number of restart attempts will be displayed. Factory setting is “000”.
5. Press the ▲ key until “005” (5-restart attempts) is displayed.
6. Press DSP/FUN key to return to the frequency display or press the ▲ or ▼/RESET key to change to another function number.

* The drive will restart with a momentary power loss of less than 2 seconds (F23 set to “000”).

TABLE 13 – FUNCTIONS F23, F24, F28 SET FOR AUTOMATIC RESTART FOR ALL FAULTS EXCEPT AC POWER LOSS

Function Number	Function Description	Code/Value	Description of Code/Value
F23	Auto Restart After a Fault Has Cleared	000 (Factory Setting)	Enable Auto Restart After a Fault Has Cleared
F24	Number of Auto Restart Attempts	005 (Factory Setting is “000”)	Five Auto Restart attempts
F28	Automatic AC Line Start	001 (Factory Setting)	Disable Automatic AC Line Start

c. Automatic Restart for All Faults Including AC Power Loss* – If the application requires that the drive automatically restart after a fault has cleared, including an AC power loss, Function F28 must be set as follows. See Table 14.

To change the setting of F28 from "001" to "000":

1. The drive must be in Stop Mode (press the RUN/STOP key).
2. Press the DSP/FUN key to display function number.
3. Press the ▲ or ▼/RESET key until "F28" is displayed.
4. Press the DATA/ENT key. The function code will be displayed. Factory setting is "001" [Disable Automatic AC Line Start].
5. Press the ▲ or ▼/RESET key until code "000" is displayed.
6. Press DSP/FUN key to return to the frequency display or press the ▲ or ▼/RESET key to change to another function number.

****Note: For Automatic Restart, Function F10 must be set to "001" [External Contacts] and a jumper must be installed between Terminals 3 and 5 of Terminal Block TM2.***

TABLE 14 – FUNCTIONS F23, F24, F28 SET FOR AUTOMATIC RESTART FOR ALL FAULTS INCLUDING AC POWER LOSS

Function Number	Function Description	Code/Value	Description of Code/Value
F23	Auto Restart After a Fault Has Cleared	000 (Factory Setting)	Enable Auto Restart After a Fault Has Cleared
F24	Number of Auto Restart Attempts	005 (Factory Setting is "000")	Five Auto Restart Attempts
F28	Automatic AC Line Start	000 (Factory Setting is "001")	Enable Automatic AC Line Start
F10	Start/Stop Control	001 (Factory Setting is "000")	External Contacts (Jumper Terms. 3 & 5 of TM2)

4. F11 (Frequency Control Method) – Frequency Control Method is used to set the drive for either keypad, potentiometer, voltage following, or current following frequency control, as described in Section IX, on page 42. F11 is factory set to "000" [Keypad] to control output frequency with the keypad.

***Note:** 1. SW1 must also be set to the proper setting for voltage or current signal input, as described in Section V-B-1, on page 21.*

To change the setting of F11 from "000" [Keypad] to "001" [External Contacts]:

a. The drive must be in Stop Mode (Press the RUN/STOP key).

b. Press the DSP/FUN key to display function number.

c. Press the ▲ or ▼/RESET key until "F11" is displayed.

d. Press the DATA/ENT key. The function code will be displayed (factory setting is "000" (Keypad]).

e. Press the ▲ or ▼/RESET key until the desired setting is displayed. The programmable codes for F11 are as follows.

F11 = 000: Keypad (Factory Setting)
001: Potentiometer, 0 - 10 V, 0 - 20 mA
002: 4 - 20 mA

f. Press DSP/FUN key to return to the frequency display or press the ▲ or ▼/RESET key to change to another function number.

5. **F10 (Start/Stop Control) –** Start/Stop Control is used to set the drive for keypad (factory setting) or external Start/Stop Control, as described in Section IX, on page 42. F10 is factory set to "000" [Keypad].

⚠ **WARNING!** The Stop contact is never to be used as a Safety Disconnect since it is not fail-safe. Use only the AC line for this purpose.

To change the setting of F10 to External Contacts:

a. The drive must be in Stop Mode (press the RUN/STOP key).

b. Press the DSP/FUN key to display function number.

c. Press the ▲ or ▼/RESET key until "F10" is displayed.

d. Press the DATA/ENT key. The function code setting will be displayed (factory setting is "000" [Keypad]).

e. Press the ▲ or ▼/RESET key until code "001" is displayed.

f. Press DSP/FUN key to return to the frequency display or press the ▲ or ▼/RESET key to change to another function number.

Notes: 1. *In order for the reverse function to operate, Function F22 must be set to "000" [Enable Reverse Run] (factory setting).* ***2.*** *The STOP key on the keypad is always operative, even if F10 is set to "001" [External Contacts].*

6. **F03 (External Forward-Stop-Reverse Control) –** External Forward-Stop-Reverse Control is used to set the drive for either Forward/Stop-Reverse/Stop (factory setting) or Run/Stop-Forward/Reverse, as described in Section IX, on page 39.

WARNING! The Stop contact is never to be used as a Safety Disconnect since it is not fail-safe. Use only the AC line for this purpose.

To change the setting of F03 to Run/Stop-Forward/Reverse:

a. The drive must be in Stop Mode (press the RUN/STOP key).

b. Press the DSP/FUN key to display function number.

c. Press the ▲ or ▼/RESET key until "F03" is displayed.

d. Press the DATA/ENT key. The function code will be displayed. Factory setting is "000" [Forward/Stop-Reverse/Stop].

e. Press the ▲ or ▼/RESET key until code "001" [Run/Stop – Forward/Reverse] is displayed.

f. Press the DSP/FUN key to return to the frequency display or press the ▲ or ▼/RESET key to change to another function number.

7. **Setting F20 for Preset Speed #2 –** Multifunction Input Terminal 7 is used to set various functions for operating the drive. F20 is factory set to "005" [Reset] to reset the drive after a fault has cleared. See Preset Speed operation in Section V-B-5, on page 23.

   To change the setting of F20 to Preset Speed #2:

   a. The drive must be in Stop Mode (press the RUN/STOP key).

   b. Press the DSP/FUN key to display function number.

   c. Press the ▲ or ▼/RESET key until "F20" is displayed.

   d. Press the DATA/ENT key. The function setting will be displayed (factory setting is "005" [Reset]).

   e. Press the ▲ or ▼/RESET key until code "006" [Preset Speed #2] is displayed.

   f. Press the DSP/FUN key to return to the frequency display or press the ▲ or ▼/RESET key to change to another function number.

   Note: *F20 can be used to set the following functions: Jog ("001"), Preset Speed #1 ("002"), Rapid Stop ("003"), Coast-to-Stop ("004"), Reset ("005") (factory setting), and Preset Speed #2 ("006").*

D. Programmable Functions (Summary List) – All functions have been factory set, as shown in Table 15, on pages 37 and 38. See Section IX, on page 39, for a detailed description of each function.

TABLE 15 – PROGRAMMABLE FUNCTIONS SUMMARY LIST

Function Number	Function Description	Function Range/Code	Factory Setting	Page Number
F01*	Acceleration Time (Seconds)	0.1 - 999	5.0	39
F02*	Deceleration Time (Seconds)	0.1 - 999	5.0	39
F03	External Forward-Stop-Reverse Control (See F10)	000: Forward/Stop-Reverse/Stop 001: Run/Stop-Forward/Reverse	000	39
F04*	Motor Direction	000: Forward Direction 001: Reverse Direction	000	40
F05	Volts/Hz Pattern[1]	001: 50Hz Constant Torque 004: 60Hz Constant Torque 002: 50Hz High Starting Torque 005: 60Hz High Starting Torque 003: 50Hz Variable Torque (HVAC) 006: 60Hz Variable Torque (HVAC)	004	40
F06*	Output Frequency Upper Limit(Hz)[1]	1.0 - 200	60.0	40
F07*	Output Frequency Lower Limit (Hz)	0.0 - 200	0.0	40
F08	Preset Speed #1 Frequency (Hz)	1.0 - 200	10.0	41
F09	Jog Frequency (Hz)	1.0 - 200	6.0	41
F10	Start/Stop Control (See F03)	000: Keypad Operation 001: External Run/Stop Contacts	000	42
F11	Frequency Control Method	000: Keypad 001: Potentiometer, 0 - 10V, 0 - 20mA 002: 4 - 20mA	000	42
F12	Switching Frequency (Code)	001: 4 kHz 004: 7.2 kHz 007: 12 kHz 010: 16 kHz 002: 5 kHz 005: 8 kHz 008: 14.4 kHz 003: 6 kHz 006: 10 kHz 009: 15 kHz	005	42
F13	Volts/Hz Curve Modification (Torque Boost) (%)	0.0 - 10.0	0.0	43
F14	Stop Method	000: Controlled Deceleration-to-Stop (with DC Injection Braking) 001: Coast-to-Stop	000	44
F15	DC Injection Brake Time (Seconds)	0.0 - 25.5	0.5	44
F16	DC Injection Brake Start Frequency (Hz)	1.0 - 10.0	1.5	45

Table 15 continued on page 38.

TABLE 15 – PROGRAMMABLE FUNCTIONS SUMMARY LIST (Continued)

Function Number	Function Description	Function Range/Code	Factory Setting	Page Number
F17	DC Injection Brake Level (% Bus Voltage)	0.0 - 20.0	8.0	45
F18	Electronic Motor Overload Protection (I^2t) (% Full Load)	1 - 200	100	45
F19	Multifunction Input Terminal 6 [2]	001: Jog 002: Preset Speed #1 003: Rapid Stop 004: Coast-to-Stop 005: Reset 006: Preset Speed #2	002	45
F20	Multifunction Input Terminal 7 [2]	001: Jog 002: Preset Speed #1 003: Rapid Stop 004: Coast-to-Stop 005: Reset 006: Preset Speed #2	005	46
F21	Multifunction Output Relay (Terminals 1, 2)	001: Run 002: Frequency Reached 003: Fault	003	46
F22	Reverse Enable/Disable	000: Enable Reverse Run 001: Disable Reverse Run	000	47
F23	Auto Restart (After a Fault Has Cleared)	000: Enable Auto Restart 001: Disable Auto Restart	000	47
F24	Number of Auto Restart Attempts	0 - 5	0	47
F25	Reset Drive to Factory Settings[1]	010: Reset Drive for 50 Hz Constant Torque Motor Operation 020: Reset Drive for 60 Hz Constant Torque Motor Operation	000	48
F26	Preset Speed #2 Frequency (Hz)	0.0 - 200	20.0	48
F27	Preset Speed #3 Frequency (Hz)[2]	0.0 - 200	30.0	48
F28	Automatic AC Line Start	000: Enable Automatic AC LIne Start 001: Disable Automatic AC LIne Start	001	48
F29	CPU Program Version	—	—	51
F30	Logs Last 3 Faults that Occurred	—	—	51

Notes: *1. Setting F25 to "010" [50 Hz] will automatically set F05 to "001" [50 Hz] and F06 to "050" [50 Hz]. Setting F25 to "020" [60 Hz] will automatically set F05 to "004" [60 Hz] and F06 to "060" [60 Hz]. 2. For Preset Speed #3, set F19 to "002", F20 to "006", and connect Terminals 6 and 7 of Terminal Block TM2 together. *Settings of F01, F02, F04, F06, and F07 can be changed while the drive is in the run mode.*

IX. PROGRAMMABLE FUNCTIONS (Detailed)

The KBE2 Series drive contains programmable functions which are described below. See Section VIII-A, on page 26, for keypad instructions. See Table 15, on pages 37 and 38.

F01 – Acceleration Time

Factory Setting: "5.00" (5.0 Seconds) – F01 is used to set the acceleration time. F01 is factory set to "05.0" for 5 second acceleration. The acceleration time is based on the time it takes for the drive output to reach 60 Hz.

If the Set Frequency is greater than 60 Hz, the acceleration time will be proportionally increased. If the drive is set to less than 60 Hz, the acceleration time will be proportionally decreased.

When accelerating high inertial loads, the acceleration time may be extended and the current limit circuit may activate due to the Stall Prevention Circuitry.

Programmable Range: 0.1 - 999 Seconds

F02 – Deceleration Time

Factory Setting: "5.00" (5.0 Seconds) – F02 is used to set the deceleration time. F02 is factory set to "05.0" for 5 second deceleration. The deceleration time is based on the time it takes for the drive output to reach zero speed (from 60 Hz) after a stop or zero speed command is given.

If the Set Frequency is greater than 60 Hz, the deceleration time will be proportionally increased. If the drive is set to less than 60 Hz, the deceleration time will be proportionally decreased.

When decelerating high inertial loads, the automatic regeneration protection circuit may activate. This circuit will extend the deceleration time to prevent the drive from tripping, due to overcharging the bus capacitors.

Programmable Range: 0.1 - 999 Seconds

F03 – External Forward-Stop-Reverse Control

Factory Setting: "000" [Forward/Stop, Reverse/Stop] – F03 is used to set the drive for external forward/stop-reverse/stop or run/stop-forward/reverse control. F03 is factory set to "000". Function F10 must be set to "001" [External Contacts], for external Start/Stop operation. See Section V-A, on page 20.

F03 = 000: Forward/Stop-Reverse/Stop
001: Run/Stop-Forward/Reverse

Notes: 1. *If both the FWD and REV contacts are closed, the drive will be in Stop Mode.* ***2.*** *If Reverse Operation does not function and "LOC" is displayed, change F22 [Reverse Enable/Disable] to "000" [Enable Reverse Run]. If F22 is set to "001" [Disable Reverse Run], the reverse command is disabled.*

F04 – Motor Direction

Factory Setting: "000" [Forward Direction] – F04 is used to set either forward or reverse motor direction using the keypad. F04 is factory set to "000" for forward operation of the motor.

F04 = 000: Forward Direction
001: Reverse Direction

Note: *In order for the Reverse Function to operate, F22 must be set to "000" [Enable Reverse Run] (factory setting).*

F05 – Volts/Hz Pattern

Factory Setting: "004" [60 Hz Constant Torque] – F05 is used to set the Volts/Hz pattern for 60 Hz and 50 Hz motors for constant torque, high starting torque, or variable torque (HVAC) applications, as shown in Figure 16, on page 41. F05 is factory set to "004" for 60 Hz motors used in constant torque applications. Also see the description for F13 [Volts/Hz Curve Modification (Torque Boost)], on page 43, which is used to modify a Volts/Hz pattern for a specific application.

F05 = 001: 50 Hz Constant Torque
002: 50 Hz High Starting Torque
003: 50 Hz Variable Torque (HVAC)
004: 60 Hz Constant Torque
005: 60 Hz High Starting Torque
006: 60 Hz Variable Torque (HVAC)

F06 – Output Frequency Upper Limit

Factory Setting: "60.0" (60.0 Hz) – F06 is used to set the output frequency upper limit to the motor and is factory set to "60.0", which will operate the motor at a maximum frequency of 60.0 Hz.

Programmable Range: 1 - 200 Hz

Note: *If the drive is set for 50 Hz motors, the Output Frequency Upper Limit will automatically be set to 50 Hz.*

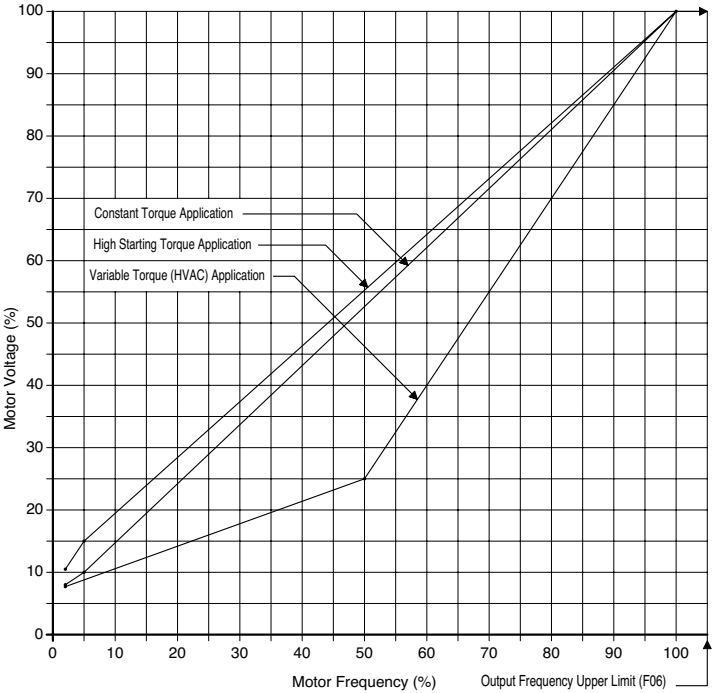
F07 – Output Frequency Lower Limit

Factory Setting: "00.0" (0.0 Hz) – F07 is used to set the output frequency lower limit to the motor and is factory set to "00.0", which will operate the motor at a minimum frequency of 0.0 Hz.

Programmable Range: 0 - 200 Hz

Note: *F07 setting cannot exceed F06 setting.*

FIGURE 16 – VOLTS/Hz PATTERN



F08 – (Preset Speed #1)

Factory Setting: "10.0" (10.0 Hz) – F08 is used to set the frequency of Preset Speed #1 and is factory set to "10.0", which will run the motor at 10.0 Hz if Terminal "6" is selected, as described in Section V-B-5, on page 22.

Programmable Range: 1 - 200 Hz

F09 – Jog Frequency

Factory Setting: "06.0" (6.0 Hz) – F09 is used to set the jog frequency. F09 is factory set to "06.0" which will run the motor at 6.0 Hz. To program the drive for Jog operation, Multifunction Input Terminals "6" or "7" must be used. See F19 on page 45 and F20 on page 46.

Programmable Range: 1 - 200 Hz

F10 – Start/Stop Control

Factory Setting: "000" [Keypad Operation] – F10 is used to set either keypad operation or external start/stop control. F10 is factory set to "000", which provides start/stop control with the keypad. (Also see F03).

F10 = 000: Keypad Operation
001: External Run/Stop Contacts

Note: *If F10 is set to "001" [External Run/Stop Contacts], the Stop Function on the keypad (RUN/STOP key) remains operational.*

F11 – Frequency Control Method

Factory Setting: "000" [Keypad Operation] – F11 is used to set the drive for either keypad control or external signal input control (speed potentiometer, 0 - 10 V, 0 - 20 mA DC, or 4 - 20 mA DC). F11 is factory set to "000", to operate the drive using the keypad.

F11 = 000: Keypad
001: Speed Potentiometer, 0 - 10 V DC, 0 - 20 mA DC
002: 4 - 20 mA DC

Note: *If a remote speed potentiometer or a 0 - 10 Volt DC signal is used, set SW1 to the "V" position (factory setting). If a 0 - 20 mA DC or 4 - 20 mA DC signal is used, set SW1 to the "I" position. See Section V-B, starting on page 20.*

F12 – Switching Frequency

Factory Setting: "005" [8 kHz] – F12 is used to set the switching frequency. F12 is factory set to "005", for a switching frequency of 8 kHz, which provides low motor noise and good motor torque. Increasing the switching frequency to the maximum of 16 kHz will further reduce motor noise. However, increased radio frequency interference will result as well as 10% derating of the maximum output current. Reducing the switching frequency will provide increased motor torque. However, the audible noise will also increase.

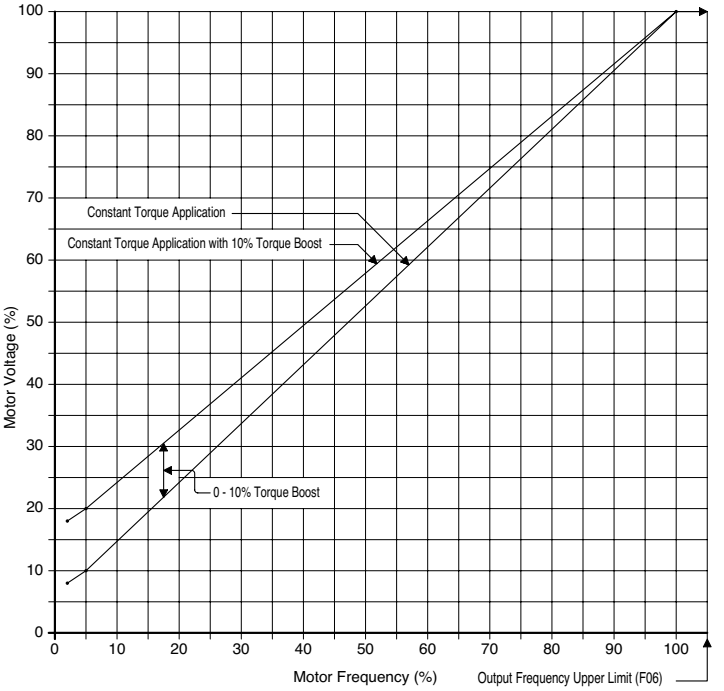
F12 =	**001:** 4 kHz	**006:** 10 kHz
	002: 5 kHz	**007:** 12 kHz
	003: 6 kHz	**008:** 14.4 kHz
	004: 7.2 kHz	**009:** 15 kHz
	005: 8 kHz	**010:** 16 kHz

F13 – Volts/Hz Curve Modification (Torque Boost)

Factory Setting: "00.0" (0.0 %) – F13 is used to increase the percent of torque boost that will be applied to the motor by modifying the Volts/Hz patterns set by F05, as shown in Figure 17. F13 is factory set to "00.0", for 0.0% torque boost.

Programmable Range: 0 - 10.0%

FIGURE 17 – VOLTS/Hz CURVE MODIFICATION (Torque Boost)

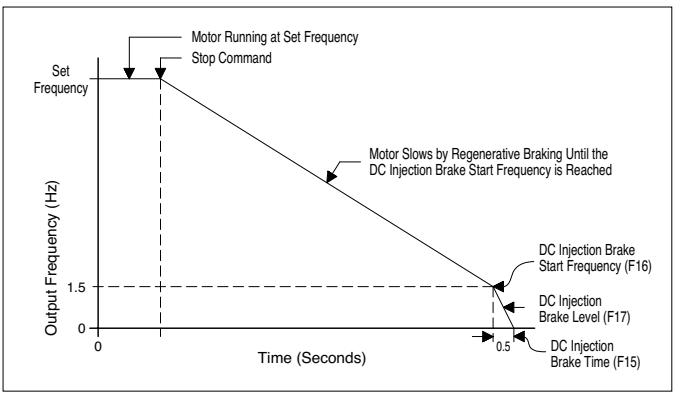


F14 – Stop Method

Factory Setting: "000" [Controlled Deceleration-to-Stop] (with DC Injection Braking) – F14 is used to select either controlled deceleration-to-stop or coast-to-stop when a stop command is given. The controlled deceleration function uses a combination of regeneration and DC injection braking to stop the motor. The factory setting utilizes regeneration as the primary method of braking. When the output frequency reaches 1.5 Hz, injection braking takes effect. For high inertial loads, the optional Brake Resistor may be required (available for Models KBE2-2202, 2203, 4301, 4302, 4303 only). See Section X-D, on page 52. If F14 is set to "000" [Controlled Deceleration-to-Stop] and a stop command is given, the drive output will decelerate to the braking frequency set by F16 [DC Injection Brake Start Frequency]. See Figure 18 and descriptions of F15 [DC Injection Brake Time], F16 [DC Injection Brake Start Frequency], and F17 [DC Injection Brake Level].

F14 = 000: Controlled Deceleration-to-Stop (with DC Injection Braking)
001: Coast-to-Stop

FIGURE 18 – CONTROLLED DECELERATION-TO-STOP WITH DC INJECTION BRAKING (F14 Set to "000")



F15 – DC Injection Brake Time

Factory Setting: "00.5" (0.5 Seconds) – F15 is used to set the DC injection brake Time. F15 is factory set to "00.5", which will apply the DC injection brake for 0.5 seconds. The brake time should not exceed the actual time to stop the load since it may cause overheating of the motor. See Figure 18.

Programmable Range: 0 - 25.5 seconds

F16 – DC Injection Brake Start Frequency

Factory Setting: "01.5" (1.5 Hz) – F16 is used to set the frequency at which DC injection braking begins. F16 is factory set to "01.5", which will start applying the DC injection brake at 1.5 Hz. See Figure 18, on page 44.

Programmable Range: 1 - 10 Hz

F17 – DC Injection Brake Level

Factory Setting: "08.0" (8%) – F17 is used to set the DC injection brake level, as a percent of bus voltage. F17 is factory set to "08.0", which will apply a DC Injection Brake voltage of 8% of the bus voltage to the motor. See Figure 18, on page 44.

Programmable Range: 0 - 20%

Note: *Do not increase the DC Injection Brake Level beyond what is necessary to stop the motor since motor overheating may occur.*

F18 – Electronic Motor Overload Protection (I^2t)

Factory Setting: "100" (100%) – F18 is used to set the maximum motor current, as a percent of the full load rating of the drive. F18 is factory set to "100", which will allow loading the motor up to 100% of the full load rating of the drive. I^2t provides motor overload protection which prevents motor burnout and eliminates nuisance trips due to overload. The drive is factory set to trip at 150% of F18 setting in 1 minute. To reset the drive, after it has tripped, press the ▼/RESET key or activate an external reset contact wired to Terminal 7 of Terminal Block TM2.

Programmable Range: 1 - 200%

Example: If a **3.3 Amp** motor is used with Model KBE2-2101 (rated **4.2 Amps**), F18 should be set according to the following formula.

(Current Rating of Motor ÷ Current Rating of Drive) x 100
(3.3 Amps ÷ 4.2 Amps) x 100 = 79%, therefore, enter "079" into F18.

F19 – Multifunction Input Terminal 6

Factory Setting: "002" Preset Speed #1 – F19 is used to set the function of Terminal 6 of Terminal Block TM2. F19 is factory set to "002", which will run the drive at the frequency set by F08 [Preset Speed #1 Frequency] when Terminal 6 is connected to Terminal 5. See Section V-B-5, on page 22.

F19 = 001: Jog. See F09 [Jog Frequency].

F19 = 002: Preset Speed #1. See F08 [Preset Speed #1 Frequency].

F19 = 003: Rapid Stop. The drive will decelerate-to-stop when a momentary "Stop" command is given. "E.S." will flash on the display. To restart the drive, press the RUN/STOP key (if F10 is set to "000" [Keypad Operation]) or open and close the direction contact (if F10 is set to"001" [External Run/Stop Contacts]).

F19 = 004: Coast-to-Stop. The drive will coast-to-stop when a momentary "Stop" command is given. "b.b." will flash on the display. To restart the drive, press the RUN/STOP key (if F10 is set to "000" [Keypad Operation]) or open and close the direction contact (if F10 is set to "001" [External Run/Stop Contacts]).

F19 = 005: Reset: Used to reset the drive after a fault has cleared.

F19 = 006: Preset Speed #2. See F26 [Preset Speed #2 Frequency] and F27 [Preset Speed #3 Frequency].

F20 – Multifunction Input Terminal 7

Factory Setting: "005" [Reset] – F20 is used to set the function of Terminal 7 of Terminal Block TM2. F20 is factory set to "005", which is used to reset the drive, after a fault has cleared, when Terminal 7 is connected to Terminal 5. Set F20 to the desired function code as follows. See Section V-B-5, on page 22.

F20 = 001: Jog. See F09 [Jog Frequency].

F20 = 002: Preset Speed #1. See F08 [Preset Speed #1 Frequency].

F20 = 003: Rapid Stop. The drive will decelerate-to-stop when a momentary "Stop" command is given. "E.S." will flash on the display. To restart the drive, press the RUN/STOP key (if F10 is set to "000" [Keypad Operation]) or open and close the direction contact (if F10 is set to"001" [External Run/Stop Contacts]).

F20 = 004: Coast-to-Stop. The drive will coast-to-stop when a momentary "Stop" command is given. "b.b." will flash on the display. To restart the drive, press the RUN/STOP key (if F10 is set to "000" [Keypad Operation]) or open and close the direction contact (if F10 is set to "001" [External Run/Stop Contacts]).

F20 = 005: Reset: Used to reset the drive after a fault has cleared.

F20 = 006: Preset Speed #2. See F26 [Preset Speed #2 Frequency] and F27 [Preset Speed #3 Frequency].

Note: *When using the Rapid Stop command, the stop method programmed by F14 [Stop Method] will be bypassed.*

F21 – Multifunction Output Relay (Terminals 1 and 2)

Factory Setting: "003" [Fault] – F21 is used to set the function of the Multifunction Output Relay. F21 is factory set to "003" [Fault], which sets the relay to function as a Fault Relay, and change state when a fault condition has occurred, as shown in Table 16 on page 47. See Section V-C, on page 24.

F21 = 001: Run
002: Frequency Reached
003: Fault

TABLE 16 – MULTIFUNCTION OUTPUT RELAY OPERATING MODES

F21 Setting	Output Relay Contacts				
	Power Off	Drive In Stop Mode	Drive In Run Mode	Frequency Reached	Fault
001 [Run]	Open	Open	Closed	—	—
002 [Frequency Reached]	Open	Open	—	Closed	—
003 [Fault]	Open	Open	—	—	Closed

F22 – Reverse Enable/Disable

Factory Setting: "000" [Enable Reverse Run] – F22 is used to enable or disable the drive from operating in the reverse direction. F22 is factory set to "000" [Enable Reverse Run] which will allow the drive to be operated in the reverse direction.

F22 = 000: Enable Reverse Run
001: Disable Reverse Run

Note: *If F22 is set to "001" [Disable Reverse Run], F04 [Motor Direction] can only be programmed to "000" [Forward Direction].*

F23 – Auto Restart After a Fault has Cleared

Factory Setting: "000" [Enable Auto Restart] – F23 is used to enable or disable automatically restarting the drive after a momentary power loss (not exceeding 2 seconds). F23 is factory set to "000" [Enable Auto Restart], which will automatically restart the drive after a momentary power loss. To set the drive for manual restart, after a momentary power loss, set F23 to "001" [Disable Auto Restart].

F23 = 000: Enable Auto Restart (see note below)
001: Disable Auto Restart

Note: *If the power loss time does not exceed 2 seconds, Auto Restart will occur. If the power loss time exceeds 2 seconds, Auto Restart will be attempted only if F24 [Number of Auto Restart Attempts] is set to "001" - "005".*

F24 – Number of Auto Restart Attempts

Factory Setting: "000" [Zero Auto Restart Attempts] – F24 is used to set the number of Auto Restart Attempts that will be performed after a fault has cleared. F24 is factory set to "000" [Zero Auto Restart Attempts], which will not allow the drive to automatically restart after a fault has cleared.

Programmable Range: 0 - 5 Auto Restart Attempts

F25 – Reset Drive to Factory Settings

Factory Setting: "020" [60 Hz Operation] – F25 is used to reset the drive to factory settings for both 50 Hz and 60 Hz motors.

F25 = 010: Reset Drive for 50 Hz Constant Torque Motor Operation
020: Reset Drive for 60 Hz Constant Torque Motor Operation

Note: *Setting F25 to "010" [50 Hz] will automatically set F05 [Volts/Hz Pattern] to "001" [50 Hz] and F06 [Output Frequency Upper Limit] to "050" [50 Hz]. Setting F25 to "020" [60 Hz] will automatically set F05 to "004" [60 Hz] and F06 to "060" [60 Hz].*

F26 – Preset Speed # 2 Frequency

Factory Setting: "20.0" (20.0 Hz) – F26 is used to set the Preset Speed #2 frequency. F26 is factory set to"20.0", which will run the motor at 20.0 Hz. See Section V-B-5, on page 22.

Programmable Range: 01.0 - 200 Hz

F27 – Preset Speed # 3 Frequency

Factory Setting: "30.0" (30.0 Hz) – F27 is used to set the Preset Speed #3 frequency. F27 is factory set to"30.0", which will run the motor at 30.0 Hz. See Section V-B-5, on page 22.

Programmable Range: 01.0 - 200 Hz

F28 – Automatic AC Line Start

Factory Setting: 001 [Disable Automatic AC Line Start] – F28 is used to enable or disable automatic starting of the drive when the AC line is applied. F28 is factory set to "001", which will disable automatic starting of the drive when the AC line is applied.

F28 = 000: Enable Automatic AC Line Start
001: Disable Automatic AC Line Start

The faults that can be manually or automatically reset are indicated by the following codes: OCS, OCA, OCC, OCd, OCb, OUC, LUC, OHC. (See Table 17, on pages 49 and 50.)

Notes: ***1.*** *In order for the drive to automatically restart after a fault has cleared, including AC line restart, set F23 to "000" [Enable Auto Restart], F24 to "005" [Five Auto Restart Attempts], and F28 = "000".* ***2.*** *F10 must be set to "001" (External Contacts) and a jumper must be wired to Terminals 3 and 5 of Terminal Block TM2.*

Programmable Functions (Detailed) is continued on page 51.

TABLE 17 – FAULT CODES AND CORRECTIVE ACTIONS

Display Indication	Description	Probable Cause	Corrective Action
CPF	Program error.	Noise interference.	Add appropriate filtering.
EPR	EEPROM error.	EEPROM is defective.	Return the drive for repair.
OU	AC line input voltage is too high.	Line voltage is too high.	Correct the line voltage.
		Detection circuitry is defective.	Return the drive for repair.
LU	AC line input voltage is too low.	Line voltage is too low.	Correct the line voltage.
		Detection circuitry is defective.	Return the drive for repair.
OH	Overtemp. while the drive is in stop mode.	Ambient temperature is too high.	Improve ventilation to reduce ambient temperature.
		Detection circuitry is defective.	Return the drive for repair.
OC	Overload while the drive is in stop mode.	Detection circuitry is defective.	Return the drive for repair.
OL1*	Motor overload.	Electronic motor overload protection is set too low.	Increase the I^2t setting (F18).
		Incorrect Volts/Hz Pattern setting.	Change the Volts/Hz pattern setting (F05).
		Load exceeds motor rating.	Replace with an appropriately rated motor.
OL2*	Drive overload.	Incorrect Volts/Hz Pattern setting.	Change the Volts/Hz pattern setting (F05).
		Load exceeds drive rating.	Replace with an appropriately rated drive.
OCS*	Drive trips during startup.	Shorted motor (phase-to-phase or phase-to-ground).	Repair motor.
		Leakage current to ground due to multiple motor wires in the same conduit.	Isolate motor wires.
		Transistor module is defective.	Return the drive for repair.
OCA*	Overcurrent during acceleration.	Acceleration time setting too low.	Change the acceleration time setting (F01).
		Incorrect Volts/Hz pattern setting.	Change the Volts/Hz pattern setting (F05).
		Motor load exceeds drive rating.	Replace with an appropriately rated drive.
OCC*	Overcurrent at set frequency.	Transient loading.	Check the load.
		Transient power surge.	Install a line reactor.
OCd*	Overcurrent during deceleration.	Deceleration time setting too low.	Increase the deceleration time setting (F02).
OCb*	Overcurrent during braking.	DC injection brake time setting too long.	Change the DC Injection Brake Time (F15).
		Incorrect DC injection brake start frequency setting.	Change the Injection Brake Start Frequency (F16).
		DC injection brake level setting too high.	Change the Injection Brake Level (F17).

**Faults which will cause the Output Relay to change state if F21 [Multifunction Output Relay] is set to "003" [Fault] (factory setting).*

Table 17 continued on page 50.

TABLE 17 – FAULT CODES AND CORRECTIVE ACTIONS (Continued)

Display Indication	Description	Probable Cause	Corrective Action
OUC*	Overvoltage at set speed or during deceleration.	Deceleration time is set too low.	Increase the deceleration time setting (F02).
		AC line input voltage too high.	Correct the AC line input voltage.
		Inertial load too great.	Replace with an appropriately rated drive.
LUC*	Low voltage at set speed.	AC line voltage is too low or incorrect drive voltage rating.	Correct the AC line input voltage.
			Replace with an appropriately rated drive.
OHC*	Heat sink overtemperature at set speed.	Load current exceeds drive rating.	Replace with an appropriately rated drive.
		Ambient temperature is too high.	Improve ventilation to reduce ambient temperature.
E.S.	Rapid Stop.	When the external stop signal is activated using the multifunction input terminal, the motor will decelerate and stop. The display will flash "E.S." after the motor stops.	Press the ▼/RESET key or use an external contact to reset the drive.
b.b.	Coast-to-Stop.	When the external stop signal is activated using the multifunction input terminal, the drive will cease operation.	Press the ▼/RESET key or use an external contact to reset the drive.
LOC	Motor direction locked.	Attempt to reverse motor direction when F22 = 001.	Change F22 to "000".
		Attempt to program F22= 001 when F04 = 001.	Change F04 to "000".
Er1	Keypad operation error.	Pressing the ▲ or ▼/RESET key when F11 = 001 or Preset Speed operation is selected.	Use ▲ or ▼/RESET to change frequency setting F11 = 000. (Keypad Operation).
		Attempt to change F29 setting (CPU Version).	Factory set.
		Attempt to change a function that cannot be changed while the drive is running.	Stop the drive and then change the function range or code.
Er2	Frequency setting error.	F06 and F07 frequency setting are the same.	Set F06 frequency setting higher than F07.

**Faults which will cause the Output Relay to change state if F21 [Multifunction Output Relay] is set to "003" [Fault] (factory setting).*

TABLE 18 – STATUS INDICATORS WHEN THE DRIVE IS IN EXTERNAL START/STOP MODE (F10 = 001)

Display Indication	Description
SP0	The drive has been set to Zero Frequency using the keypad or external frequency command.
SP1	The drive is in Stop Mode due to an interruption and resumption of the AC power. To restart the drive, open and close the Start/Stop contact. ***Note:*** *F28 is set to "001" [Disable Automatic AC Line Start] (factory setting).*
SP2	The RUN/STOP key is pressed while the drive is in the Run Mode.

F29 – CPU Program Version

Factory Setting: Current Software Version – F29 is used to display the software version of the drive.

F30 – Logs Last 3 Faults that Occurred

F30 logs the last three faults that occurred, in chronological order. Press the key to scroll through the three faults that occurred. The decimal point in the display indicates the chronological occurrence of the fault ("x.xx" indicates the latest fault that occurred. "xx.x" indicates the previous fault that occurred. "xxx." indicates the first fault that occurred). Press the ▼/RESET key to erase all three recorded faults ("-.- - ", "- -.-", and "- - -." will be displayed when the key is pressed). See Table 17, on pages 49 and 50.

X. OPTIONAL ACCESSORIES

A. DIN Rail Mounting Kit (Part No. 14000) – Available for all models except KBE2-1125-4, 1150-4, 1101-4, 2101-4, 2202-4, 2203-4, 4301-4, 4302-4, 4303-4.

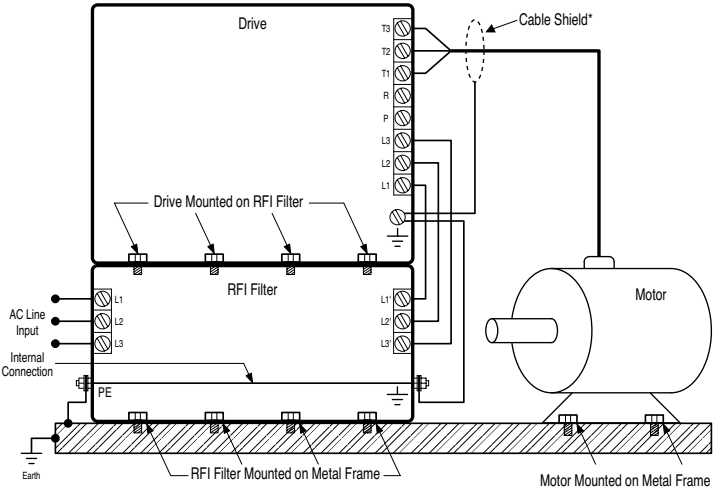
B. Class B Residential Standard RFI (EMI) Filters – Provides RFI noise suppression and complies with CE Directive 89/336/EEC relating to the EMC Class B Residential Standard. See Table 19 and Figure 19, on page 52. The recommended maximum wiring distance between drive and filter is 12" (30 cm).

TABLE 19 – CLASS B RESIDENTIAL STANDARD RFI FILTERS

Part No.	Rating	Drive Model	Dimensions	
			Inches	mm
14020	10 Amps @ 230 Volts AC –1ϕ	All 230 Volt AC thru 1 HP	2.99 x 6.14 x 0.98	76 x 156 x 25
14012	20 Amps @ 230 Volts AC – 1ϕ	All 230 Volt AC thru 3 HP	4.84 x 6.81 x 1.54	123 x 173 x 39
14015	10 Amps @ 460 Volts AC – 3ϕ	All 380/460 Volt AC thru 3 HP	4.84 x 6.81 x 1.54	123 x 173 x 39

Note: *All models are available with a built-in Class A Industrial Standard RFI Filter. Contact Sales Department.*

FIGURE 19 – RECOMMENDED RFI FILTER CONNECTION



*Cable shield should be grounded on drive side only.

C. Remote Speed Potentiometer Kit (Part No. 9831) – Provides remote mounting of the speed potentiometer to control motor speed. Kit includes a linear 5kΩ - 5 Watt wire wound potentiometer, mounting hardware, and panel insulator.

D. Brake Resistor – Provides rapid stopping with high inertial loads. See Table 20. This option is only available for Models KBE2-2202, 2203, 4301, 4302, and 4303.

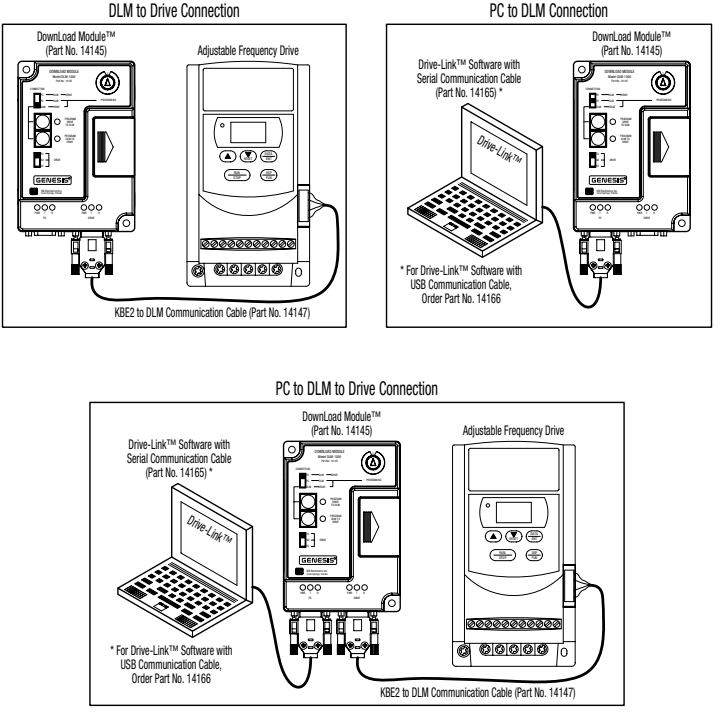
TABLE 20 – BRAKE RESISTOR SELECTION CHART

Drive Model No.*	Motor HP, (kW)	Braking Torque (%)	Brake Resistor				
			Part No.	Ω	W	Dimensions (W x H x L)	
						Inches	mm
KBE2-2202	2, (1.5)	120	14180	100	150	1.57 x 0.79 x 8.46	40 x 20 x 215
KBE2-2203	3, (2.2)	115	14190	70	200	2.36 x 1.18 x 6.49	60 x 30 x 165
KBE2-4301	1, (0.75)	125	14230	750	60	1.57 x 0.79 x 4.53	40 x 20 x 115
KBE2-4302	2, (1.5)	120	14240	400	150	1.57 x 0.79 x 8.46	40 x 20 x 215
KBE2-4303	3, (2.2)	130	14250	250	200	2.36 x 1.18 x 6.49	60 x 30 x 165

* Includes all "-P" and "-4" suffix models.

E. DownLoad Module™ (DLM) (Part No. 14145) – Uploads and downloads drive programs. Requires KBE2 to DLM Communication Cable (Part No. 14147). See Figure 20.

FIGURE 20 – DLM CONNECTIONS



F. Drive-Link™ Software (Part No. 14165) – Provides PC communications to facilitate programming. Uses Windows® 95/98/2000/ME/XP/NT. Requires DownLoad Module™ (DLM) (Part No. 14145) and KBE2 to DLM Serial Communication Cable (Part No. 14147). See Figure 20. For Drive-Link™ Software with USB cable, order Part No. 14166.

G. AC Line Reactor – Eliminates erratic operation or tripping due to a noisy or unstable AC power source. The following are some typical problems associated with an AC line which will require the addition of a line reactor: multiple drives on the same line, solenoids, power factor correction capacitors and machinery switching "on" and "off". See Table 21 for the recommended AC Line Reactor. AC Line Reactors can be purchased from ACME, MTE, and TCI.

TABLE 21 – RECOMMENDED AC LINE REACTOR SELECTIOIN CHART

Drive Model	AC Line Input Phase(s)	AC Line Reactor Rating		
		Volts AC	Amps AC	mH
KBE2-2125	1	230	3	7
KBE2-2150	1	230	5.2	4.2
KBE2-2101	1	230	9.4	2.1
KBE2-2202	1	230	19	1.1
	3*	230	11	1.1
KBE2-2203	1	230	27	0.71
	3*	230	20	0.71
KBE2-4301	3*	460	2.5	8.4
KBE2-4302	3*	460	5	4.2
KBE2-4303	3*	460	7.5	3.6

Note: For 3-phase AC line inputs, a 3-phase reactor or three 1-phase reactors must be used.

H. AC Load Reactor – Eliminates false tripping when motor wires exceed 100 feet (30 m). See Table 22, for the recommended AC Load Reactor. AC Load Reactors can be purchased from ACME, MTE, and TCI.

Note: *The voltage rating of the AC Load Reactor must be equal or greater than the drive's nominal AC line input voltage rating.*

TABLE 22 – RECOMMENDED 3-PHASE AC LOAD REACTOR SELECTION CHART

Motor Rating (Nominal) (Amps AC)	AC Load Reactor Rating	
	Amps AC	mH
2	2	11
3	3	7.4
3.4	4	5.5
4.8	6	3.7
7.6	8	2.8
11	12	1.8
14	16	1.4
21	25	0.88
27	27	0.82
34	35	0.63
40	45	0.49

– NOTES –

XI. 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)

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