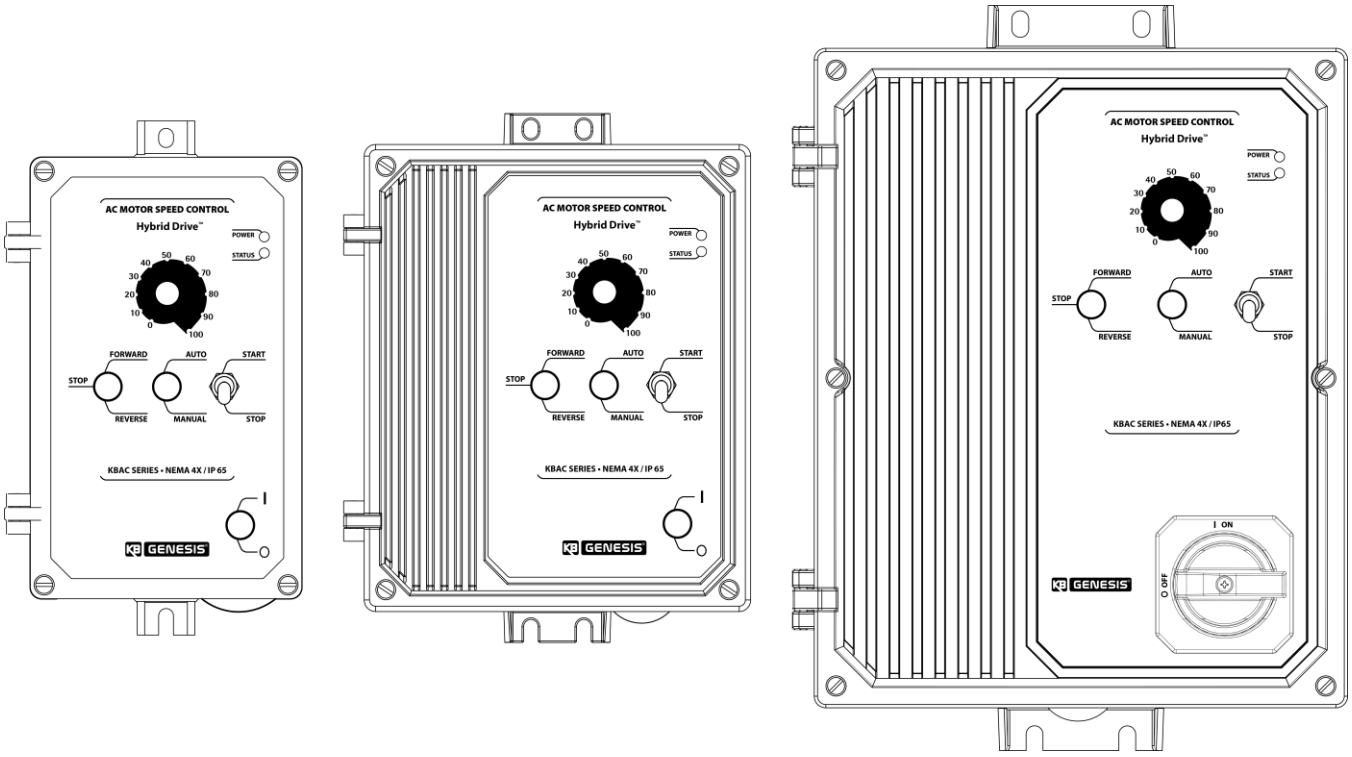
INSTALLATION AND OPERATION MANUAL
KBAC SERIES

Adjustable Frequency Drive for 3-Phase AC Motors
NEMA 4X / IP65

Variable Speed / Soft-Start AC Motor Drive
With Electronic Motor Overload Protection[1]
Washdown and Watertight for Indoor and Outdoor Use

Rated for 208 – 230 and 400/460 Volt 50 Hz and 60 Hz
3-Phase and PSC[2] AC Induction Motors from Subfractional thru 10 HP

Operates from 115, 208/230, and 400/460 Volt 50/60 Hz AC Line Input[3]



NOTE: The drive is factory set for 60 Hz motors. For 50 Hz motors, see Section 10.4 on page 19.

See Safety Warnings on page 5.

c UL us LISTED IND. CONT. EQ. – 70ZA

CE[4]

RoHS COMPLIANT

This Manual Covers 2G and 3G Models[3,5]

KBAC-24D, 27D, 29, 29 (1P), 45, 48, 217, 217S, 217F, 217SF, 416, 416S, 416F, 416SF

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

Notes: ***1.*** *UL approved as an electronic overload protector for motors.* ***2.*** *Special software is available for PSC motors – contact Technical Support.* ***3.*** *Third Generation (3G) drives are jumper selectable (J12) for standard and sensitive GFCIs.* ***4.*** *Installation of a CE approved RFI (EMI) filter is required.* ***5.*** *Third Generation (3G) drives KBAC-24D, 27D, 29, 29 (1P), 45, 48 are marked "(3G)" on the product label. All KBAC-217, 416 Series drives are Third Generation (3G).*

PENTA KB POWER™
A COMPLETE LINE OF MOTOR DRIVES

KBAC Manual

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TABLE 1
DRIVE MODEL NO., PART NO., AND CASE REFERENCE SIZE

Model No.	Part No. Gray Case (2G and 3G[2])	Part No. White Case[1] (2G and 3G[2])	Case Reference Size	Model No.[3]	Part No. Gray Case	Part No. White Case[1]	Case Reference Size
KBAC-24D	9987	9988	A	KBAC-217	8868	8879	C
KBAC-27D	9520	9521	B	KBAC-217S	8863	8855	C
KBAC-29	9528	9529	B	KBAC-217F	8861	8853	C
KBAC-29 (1P)	10001	10002	B	KBAC-217SF	8869	8880	C
KBAC-45	9530	9531	B	KBAC-416	8870	8881	C
KBAC-48	9540	9541	B	KBAC-416S	8864	8856	C
				KBAC-416F	8874	8883	C
				KBAC-416SF	8871	8882	C

Notes: 1. *White FDA approved finish.* ***2.*** *Third Generation (3G) drives KBAC-24D, 27D, 29, 29 (1P), 45, 48 are marked "(3G)" on the product label. Third Generation (3G) drives are jumper selectable (J12) for standard and sensitive GFCIs.* ***3.*** *All KBAC-217, 416 Series drives are Third Generation (3G).*

UL NOTICE

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

460 Volt Drives: Suitable for use on a circuit capable of delivering not more than 5 kA RMS symmetrical Amperes. 460 Volts maximum. Use copper conductors rated 75 °C. Suitable for operation in a maximum surrounding air temperature of 40 °C.

1 – QUICK-START INSTRUCTIONS

Also see Section 4 – Important Application Information on page 5.

Important: You must read these simplified instructions before proceeding. These instructions are to be used as a reference only and are not intended to replace the details provided herein. You must read the Safety Warnings on page 5 before proceeding.

Reconditioning the Bus Capacitors: If this drive has been in storage for over one year, it is necessary to recondition the power supply bus capacitors. To recondition the bus capacitors, apply the AC Line, with the drive in the Stop Mode, for a minimum of one hour. Not following this procedure will cause the bus capacitors to fail.

WARNING! High Voltage! Disconnect the main power before making connections to the control. Do not depend on the POWER or STATUS LEDs, located on the front cover, to no longer be illuminated as a guaranteed power off condition.

1.1 – MOUNTING INSTRUCTIONS

See Section 5 on page 12.

1.2 – AC LINE INPUT FUSING

It is recommended that a fuse(s) or circuit breaker be installed in the AC Line. Fuse each conductor that is not at ground potential. For the recommended fuse size, see Table 2 on page 7. Also see Section 6 on page 15.

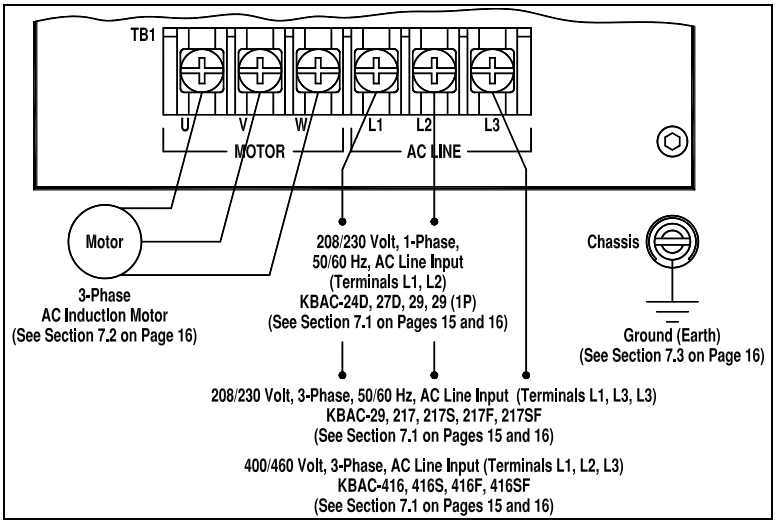
1.3 – AC LINE INPUT CONNECTION

Connect the AC Line input to Terminal Block TB1, as shown in Figure 1. Also see Section 7.1 on pages 15 and 16.

GFCI Operation: Third Generation (3G) drives are jumper selectable (J12) for standard and sensitive GFCIs.

CAUTION! The rated AC Line voltage of the drive must match the actual AC Line input voltage. On KBAC-24D, 27D the setting of Jumper J1 must match the actual AC Line input voltage.

FIGURE 1
GENERAL CONNECTION DIAGRAM



KBAC-24D, 27D, 29 (1P): Designed to accept 1-phase (Terminals L1, L2) AC Line input only. Rated for 208/230 Volt AC Line input with Jumper J1 set to the "230V" position (factory setting). Rated for 115 Volt AC Line input with Jumper J1 set to the "115V" position. KBAC-27D is rated for 1½ HP maximum with 115 Volt AC Line input and 2 HP maximum with 208/230 Volt AC Line input.

KBAC-29: Designed to accept 1-phase (Terminals L1, L2) or 3-phase (Terminals L1, L2, L3) AC Line input. Rated for 208/230 Volt AC Line input only. Rated for 2 HP maximum with 1-phase AC Line input and 3 HP maximum with 3-phase AC Line input.

KBAC-217, 217S, 217F, 217SF: Designed to accept 3-phase (Terminals L1, L2, L3) AC Line input only. Rated for 208/230 Volt AC Line input only.

KBAC-45, 48, 416, 416S, 416F, 416SF: Designed to accept 3-phase (Terminals L1, L2, L3) AC Line input only. Rated for 400/460 Volt AC Line input only.

1.4 – MOTOR CONNECTION

Connect the motor to Terminal Block TB1 Terminals U, V, W, as shown in Figure 1 above. See Section 7.2 on page 16. Motor cable length should not exceed 100 ft. (30 m) – special reactors may be required – contact Technical Support.

1.5 – GROUND CONNECTION

Connect the ground wire (earth) to the ground screw, as shown in Figure 1 above. See Section 7.3 on page 16. Be sure the motor is also properly grounded.

1.6 – 60 Hz AND 50 Hz MOTOR OPERATION

The drive is factory set for 60 Hz motor operation (Jumper J4 set to the "1X" position and Jumper J5 set to the "60Hz" position). For 50 Hz motor operation, be sure Jumper J4 is set to the "1X" position and set Jumper J5 to the "50Hz" position. See Section 10.4 on page 19.

1.7 – START/STOP SWITCH

A prewired Start/Stop Switch is supplied to electronically "start" and "stop" the drive, as described in Section 7.5 on page 17. This switch must be used to "start" the drive each time the AC Line is applied to the drive or to "restart" the drive. Also see Section 10.8 on page 20.

1.8 – JUMPER SETTINGS

All jumpers have been factory set for most applications. However, some jumpers may need to be set in order to tailor the drive for a specific application. See Section 10 on pages 19 and 20.

IMPORTANT: To ensure that the motor is properly protected with the I^2t Overload Protection feature, it is required that Jumper J2 is set to the corresponding position for the motor horsepower being used, as shown in Figure 23 on page 19.

1.9 – TRIMPOT ADJUSTMENTS

All trimpots have been factory set for most applications. Some applications require adjustment of the trimpots to tailor the drive for a specific requirement. See Section 12 on page 21 and 22.

1.10 – DIAGNOSTIC LEDs

After power has been applied, observe the LEDs to verify proper drive operation, as described in Section 13 on page 23.

2 – SAFETY WARNINGS

Definition of Safety Warning Symbols

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

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

SAFETY WARNING! – PLEASE READ CAREFULLY!

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

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

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

3 – IMPORTANT APPLICATION INFORMATION

3.1 – MOTOR WITH EXTERNAL FAN COOLING

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

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

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

FIGURE 2
MAXIMUM ALLOWED MOTOR TORQUE VS. SPEED

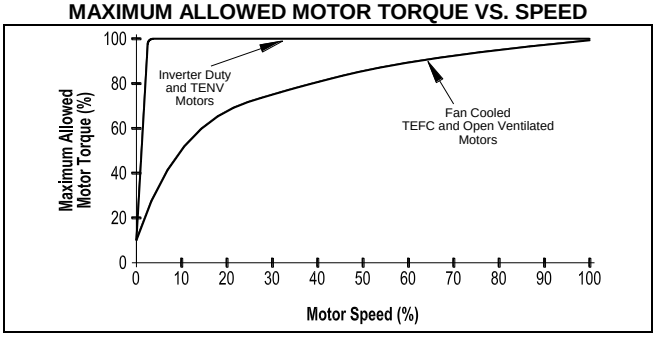
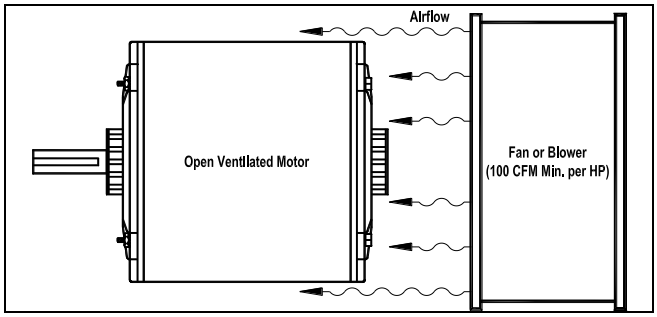


FIGURE 3
OPEN VENTILATED MOTOR WITH EXTERNAL FAN COOLING



3.2 – Electronic Motor Overload Protection

The drive contains Modified I^2t Overload Protection (UL approved as an overload protector for motors). Part of this function consists of a Current Limit (CL) circuit, which limits the drive current to a preset level of 160% of the rated drive current. The CL Trimpot is used to recalibrate the drive current from 60% thru 200%. The Power Start™ circuit provides an overshoot function that allows most motors to develop more than 200% of starting torque and breakdown torque.

Standard I^2t is undesirable because it causes nuisance tripping. It allows a very high motor current to develop and will turn the drive off after a short period of time. The RMS Current Limit Circuit, which includes I^2t plus an I•t timing circuit (as described in the paragraph below), avoids this nuisance tripping while providing maximum motor protection.

If the motor is overloaded to 120% of full load (75% of the CL setting), the I•t Timer starts. If the motor continues to be overloaded at the 120% level, the timer will shut down the drive after 30 minutes. If the motor is overloaded to 160% of full load, the drive will trip in 6 seconds.

4 – INTRODUCTION

Thank you for purchasing the KBAC Adjustable Frequency Drive. KB Electronics is committed to providing total customer satisfaction by producing quality products that are easy to install and operate. The KBAC is manufactured with surface mount components incorporating advanced circuitry and technology.

The drives are variable speed controls housed in a rugged NEMA 4X / IP65 washdown and watertight die-cast aluminum enclosure. They are designed to operate 208 – 230 and 400/460 Volt 50 & 60 Hz 3-phase AC induction motors from subfractional thru 10 HP. The sine wave coded Pulse Width Modulated (PWM) output operates at a carrier frequency of 16 kHz which provides high motor efficiency and low noise. Adjustable Linear Acceleration and Deceleration are provided, making the drive suitable for soft-start applications.

Due to its user-friendly design, the KBAC AC drive is easy to install and operate. Tailoring to specific applications is accomplished with selectable jumpers and trimpots, which eliminate the computer-like programming required on other drives. However, for most applications no adjustments are necessary.

Main features include adjustable RMS Current Limit and I^2t Motor Overload Protection (UL approved as an electronic overload protector for motors). In addition, Adjustable Slip Compensation with Static Auto-Tune and Boost provides high torque and excellent load regulation over a wide speed range. Power Start™ delivers over 200% motor torque to ensure start-up of high frictional loads. Electronic Inrush Current Limit (EICL™) eliminates harmful AC Line inrush current. A Run/Fault Relay is provided, which can be used to turn equipment on or off, to signal a warning if the drive is put into the Stop Mode, or if a fault has occurred. The drive is suitable for machine or variable torque (HVAC) applications. Also, a jumper is provided for selection of Regenerative or DC Injection Braking.

Standard front panel features include Diagnostic LEDs for "Power On" and "Drive Status", a Start/Stop Switch, and a Main Speed Potentiometer. Other features include a Barrier Terminal Block to facilitate wiring of the AC Line and motor, adjustable trimpots (MIN, MAX, ACCEL, DECEL, COMP, CL, JOG, BOOST), customer selectable jumpers (Line Voltage (dual voltage models only)), Motor Horsepower, Automatic Ride-Through / Manual Start, Motor Frequency, Frequency Multiplier, Fixed/Adjustable Boost, Regenerative / Injection Braking, "Run" or "Fault" Output Relay Operation, NO/NC Stop Contact, Constant/Variable Torque, Switching Frequency, and GFCI operation (Third Generation (3G) drives only).

Optional accessories include: Forward-Stop-Reverse Switch, On/Off AC Line Switch, Run-Stop-Jog Switch, Signal Isolator, Auto/Manual Switch, Class A AC Line Filter, Multi-Speed Board, and Liquidtight Fittings. A connector is provided for easy installation of accessories. Custom software: all models can be factory programmed for applications which require special timing, PLC functions, and GFCI operation.

4.1 – STANDARD FEATURES

Industrial Duty Die-Cast Aluminum Case with Hinged Cover: Available in dark gray finish or FDA approved white finish.

Simple to Operate: Does not require programming. Uses trimpots and jumpers, which are factory set for most applications.
Motor HP Selection Jumper (J2): Allows the drive to be used on a wide range of motors without recalibration.

Switching Frequency and GFCI Selection Jumper (J12): Allows the drive to be operated at 8 kHz or 12 kHz and on Standard (G1) or Sensitive (G2) GFCIs. (Third Generation (3G) drives only.)

Diagnostic LEDs: Power on (POWER) and drive status (STATUS).

Run/Fault Relay Output Contacts: Can be used to turn equipment on or off, to signal a warning if the drive is put into the Stop Mode, or a fault has occurred.

Start/Stop Switch: Provides electronic start and stop functions.

Barrier Terminal Block: Facilitates wiring of motor, AC Line, and Run/Fault Relay Output Contacts.

Jumper Selection of Drive Output Frequency: Increases the motor speed up to two times the rated RPM.

Ride-Through: Provides smooth recovery to the previous set speed during a momentary power loss (of less than 2 seconds).

Holding Torque at Zero Speed: Resists motor shaft rotation when the drive is in Stop Mode.

Adjustable Trimpots: Maximum Speed (MAX), Minimum Speed (MIN), Acceleration (ACCEL), Deceleration (DECEL), DC Injection Brake (DECEL), Boost (BOOST), Current Limit (CL), Jog (JOG), Slip Compensation (COMP).

Selectable Jumpers: AC Line Input Voltage (J1 – KBAC-24D, 27D only), Motor Horsepower (J2), Automatic Ride-Through or Manual Start (J3), Frequency Multiplier (J4), Motor Frequency (J5), Fixed or Adjustable Boost (J6), Regeneration or DC Injection Braking (J7), "Run" or "Fault" Output Relay Operation (J8), Normally Open or Closed Stop Contact (J9), Constant or Variable Torque (J10), Switching Frequency and GFCI (J12 – Third Generation (3G) drives only).

4.2 – PEERFORMANCE FEATURES

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

Slip Compensation with Static Auto-Tune and Boost: Provides excellent load regulation over a wide speed range.

Speed Range: 60:1.

4.3 – PROTECTION FEATURES

Motor Overload (I^2t) with RMS Current Limit: Provides motor overload protection which prevents motor burnout and eliminates nuisance trips. UL approved as an electronic overload protector for motors.

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

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

Regeneration: Eliminates tripping due to high bus voltage caused by rapid deceleration of high inertial loads.

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

MOV Input Transient Suppression: Protects the drive components against damaging voltage spikes on the AC Line.

Microcontroller Self-Monitoring and Auto Reboot.

TABLE 2
ELECTRICAL RATINGS

Model No.	Part No. Gray	Part No. White[1]	Ac Line Input Volts AC (50/60 Hz)	Ac Line Input Phase (Φ)	Ac Line Input Maximum Current (Amps AC)	Fuse or Circuit Breaker Rating (Amps)	Output Voltage Range (Volts AC)	Output Maximum Continuous Load Current (Amps/Phase)	Output Maximum Horsepower (HP (kW))	Horsepower Selection (Jumper J2)[2]					Net Weight lbs	Net Weight kg
KBAC-24D	9987	9988	115	1	14.4	20	0 – 208/230	3.6	1 (0.75)	**1**	3/4	1/2	1/4	1/8	5.9	2.7
			208/230	1	8.1	15										
KBAC-27D	9520	9521	115	1	22	25	0 – 208/230	5.5	1½ (1.13)	—	**1½**[3]	1	3/4	1/2	10.3	4.7
			208/230	1	16.7	20	0 – 208/230	6.7	2 (1.5)	2						
										A	**B**	**C**	**D**	**E**		
KBAC-29	9528	9529	208/230	1	16.7	20	0 – 208/230	6.7	2 (1.5)	—	**2**[4]	1½	1	3/4	10.3	4.7
				3	11.7	15	0 – 208/230	9.0	3 (2.25)	3[4]						
KBAC-29 (1P)	10001	10002	208/230	1	20.5	25	0 – 208/230	9.0[5]	3 (2.25)	**3**	2	1½	1	3/4		
KBAC-45	9530	9531	400/460	3	7.2	10	0 – 400/460[6]	5.5	3 (2.25)	**3**	2	1½	1	3/4		
KBAC-48	9540	9541	400/460	3	11	15	0 – 400/460[6]	8.3	5 (3.75)	**5**	3	2	1½	1		
										A	**B**	**C**	—	—		
KBAC-217	8868	8879	208/230	3	22.1	25	0 – 208/230	17	5	**5**	3	2	—	—	22	10
KBAC-217S	8863	8855														
KBAC-217F	8861	8853														
KBAC-217SF	8869	8880														
KBAC-416	8870	8881	400/460	3	20.8	25	0 – 400/460[6]	16	10	**10**	7.5	3				
KBAC-416S	8864	8856														
KBAC-416F	8874	8883														
KBAC-416SF	8871	8882														

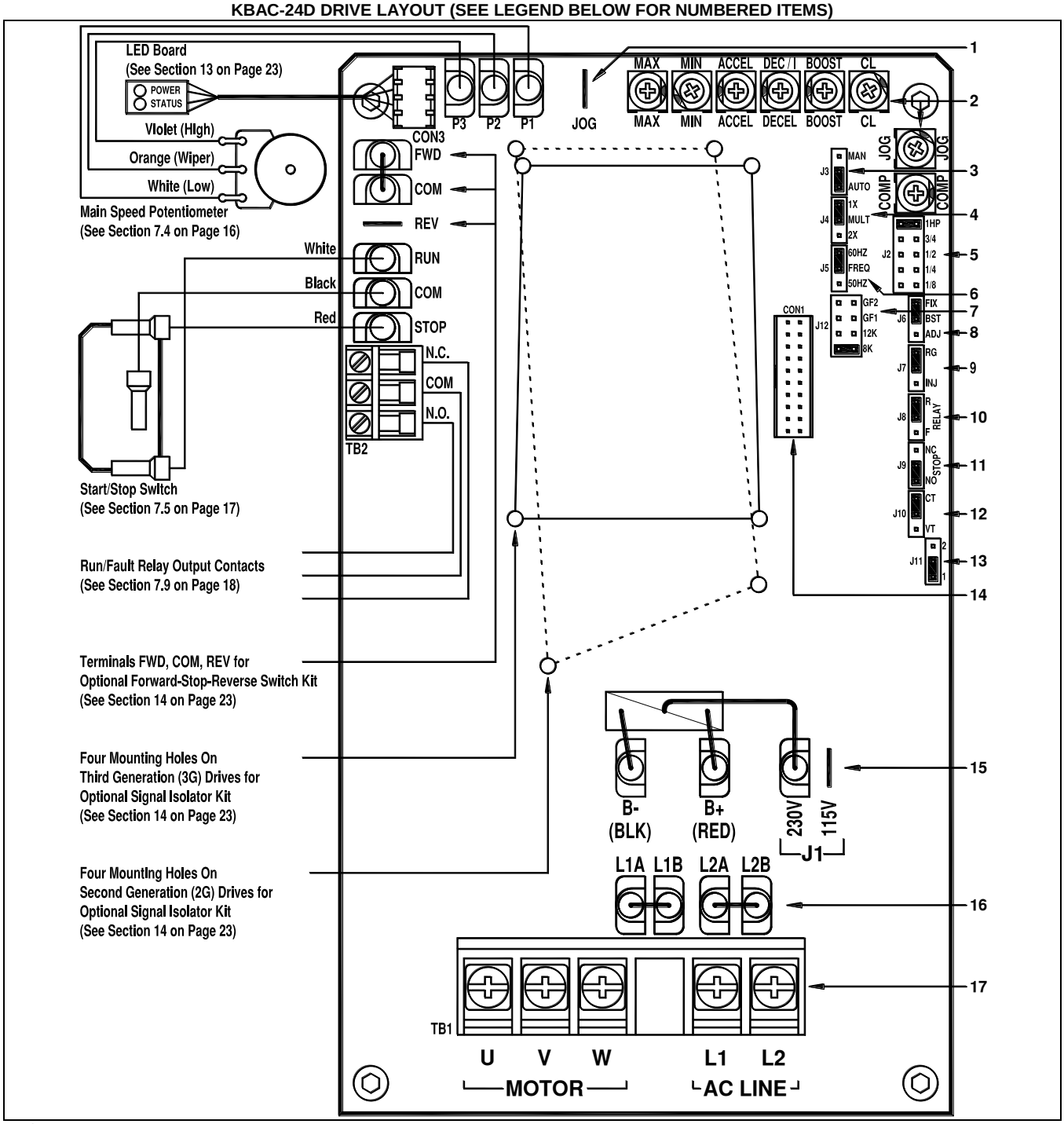
Notes: 1. *White FDA approved finish.* ***2.*** *Bold indicates factory setting. KBAC-24D: J2 is labeled "1", "3/4", "1/2", "1/4", "1/8" (factory set to the "1" position). KBAC-27D: J2 is labeled "2", "1½", "1", "3/4", "1/2" (factory set to the "1½" position). KBAC-29, (29 (1P), 45, 48: J2 is labeled "A", "B", "C", "D", "E" (factory set according to the table). KBAC-217, 416 Series: J2 is labeled "A", "B", "C" (factory set to the "A" position).* ***3.*** *KBAC-27D: Rated 1½ HP maximum with 115 Volt AC Line input and 2 HP maximum with 208/230 Volt AC Line input.* ***4.*** *KBAC-29: Rated 2 HP maximum with 1-phase AC Line input and 3 HP maximum with 3-phase AC Line input.* ***5.*** *KBAC-29 (1P): Rated 9 Amps at 35 °C / 95 °F and derated to 8.3 Amps at 40 °C / 104 °F. For ambient temperatures above 40 °C / 104 °F, the drive is derated 2.5% per °C.* ***6.*** *KBAC-45, 48, 416 Series: Rated 0 – 400 Volts AC for 50 Hz motor operation and 0 – 460 Volts AC for 60 Hz motor operation.*

TABLE 3
GENERAL PERFORMANCE SPECIFICATIONS

Description	Specification	Factory Setting
115 Volt AC Line Input Voltage Operating Range (Volts AC)	115 (±15%)	—
208/230 Volt AC Line Input Voltage Operating Range (Volts AC)	208 (-15%) / 230 (+15%)	—
400/460 Volt AC Line Input Voltage Operating Range (Volts AC)	380 (-15%) – 460 (+15%)	—
Maximum Load (% Current Overload for 2 Minutes)	150	—
Switching Frequency (kHz) (Jumper J12) (3G Drives Only)[1]	8, 12	8
Signal Following Input Voltage Range[2] (Volts DC)	0 – 5	—
Output Frequency Resolution (Bits, Hz)	10, 0.06	—
Maximum Speed Trimpot (MAX) Range (% Frequency Setting)	70 – 110	100
Minimum Speed Trimpot (MIN) Range (% Frequency Setting)	0 – 40	0
Acceleration Trimpot (ACCEL) Range (Seconds)	0.3 – 20	1.5
Deceleration Trimpot (DECEL) Range (Seconds)	0.3 – 20	1.5
DC Injection Brake (DECEL) (Seconds)	0.3 – 6.0	1.7
Boost Trimpot (BOOST) Range (Volts)	0 – 30	5
Current Limit Trimpot (CL) Range (% Full Load)	40 – 200	160
Jog Trimpot (JOG) Range (% Frequency Setting)	0 – 100	35
Slip Compensation Trimpot (COMP) Range at Drive Rating (Volts/Hz)	0 – 3	1.5
Motor Frequency Setting (Hz) (Jumper J5)	50, 60	60
Output Frequency Multiplier (1X, 2X) (Jumper J4)[3]	1, 2	1
Minimum Operating Frequency at Motor (Hz)	1	—
Speed Range (Ratio)	60:1	—
Speed Regulation (30:1 Speed Range, 0 – Full Load) (% Base Speed)[4]	2.5	—
Overload Protector Trip Time for Stalled Motor (Seconds)	6	—
Undervoltage/Overvoltage Trip Points for 115 Volt AC Line Input (± 5%) (Volts AC)[5]	76 – 141	—
Undervoltage/Overvoltage Trip Points for 208/230 Volt AC Line Input (± 5%) (Volts AC)[5]	151 – 282	—
Undervoltage/Overvoltage Trip Points for 400/460 Volt AC Line Input (± 5%) (Volts AC)[5]	302 – 567	—
Run/Fault Relay Output Contact Rating (Amps at 30 Volts DC, 125 Volts AC, 250 Volts AC)	1, 0.5, 0.25	—
Operating Temperature Range (°C / °F)	0 – 40 / 32 – 104	—
Operating Humidity Range (% Relative, Non-Condensing)	0 – 95	—
Storage Temperature (°C / °F)	-2.5 – +85 / -13 – +185	—

Notes: 1. *Third Generation (3G) drives are marked "(3G)" on the product label.* ***2.*** *Requires an isolated signal. If a non-isolated signal is used, or if using 0 to ±2.5 thru 0 to ±25 Volts DC, or 4 – 20 mA DC signal input, install the Signal Isolator.* ***3.*** *Allows the motor to operate up to two times the rated RPM. Constant horsepower will result when operating the drive in the "X2" mode above the motor rated frequency.* ***4.*** *Dependent on motor performance.* ***5.*** *Do not operate the drive outside the specified AC Line input voltage operating range.* ***6.*** *See Table 2 above.*

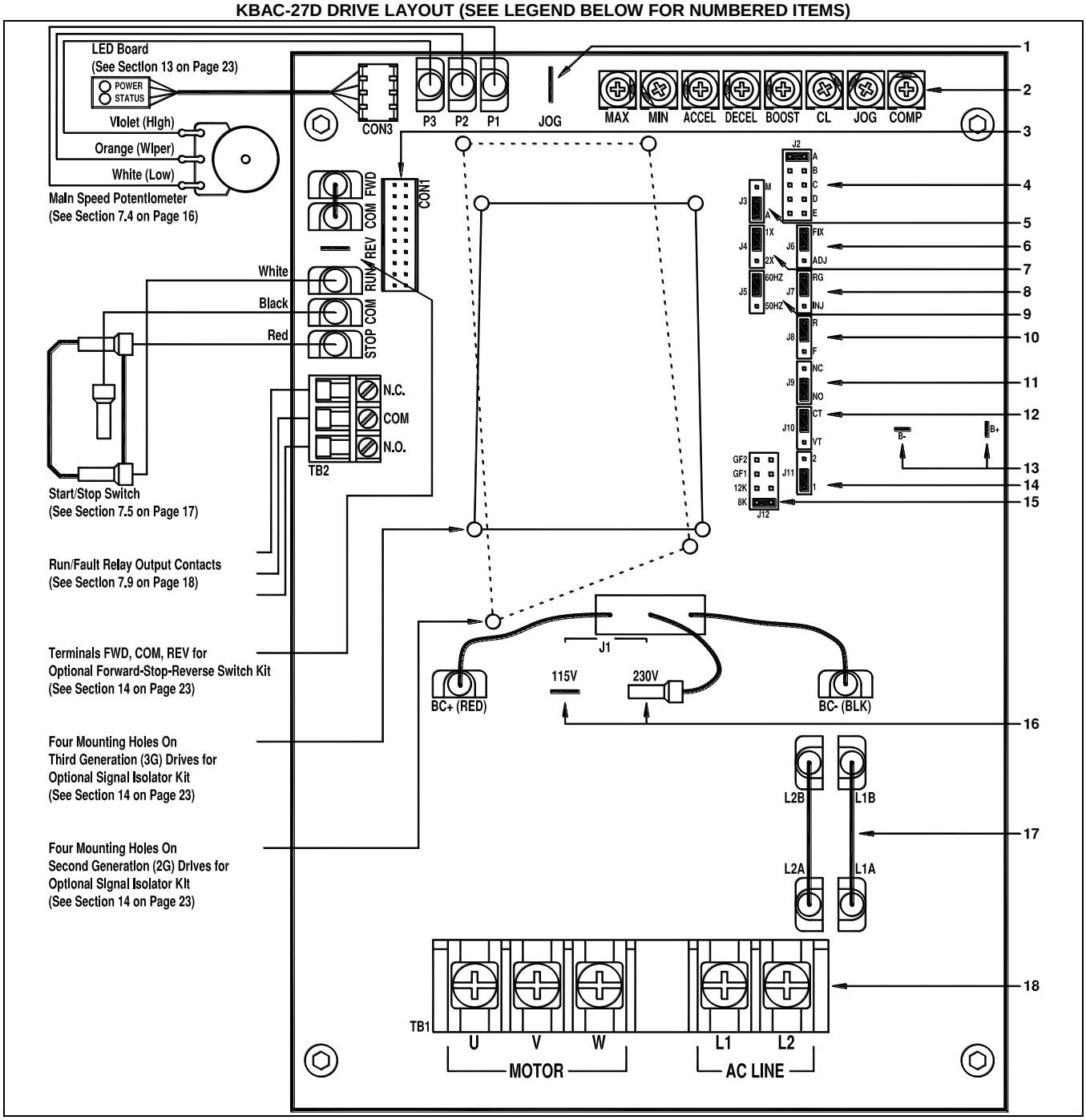
FIGURE 4
KBAC-24D DRIVE LAYOUT (SEE LEGEND BELOW FOR NUMBERED ITEMS)



LEGEND:

1. Jog Terminal: Used with optional Run-Stop-Jog Switch Kit. See Section 14 on page 23.
2. Adjustable Trimpots: Maximum Speed (MAX), Minimum Speed (MIN), Acceleration (ACCEL), Deceleration (DECEL), DC Injection Brake (DECEL), Boost (BOOST), Current Limit (CL), Jog (JOG), Slip Compensation (COMP). See Section 12 on pages 21 and 22.
3. Jumper J3: Automatic Ride-Through or Manual Start selection. See Section 10.3 on page 19.
4. Jumper J4: Frequency Multiplier selection. See Section 10.4 on page 19.
5. Jumper J2: Motor Horsepower selection. See Section 10.2 on page 19.
6. Jumper J5: Motor Frequency selection. See Section 10.4 on page 19.
7. Jumper J12: Switching Frequency and GFCI selection. Third Generation (3G) drives only. See Section 10.11 on page 20.
8. Jumper J6: Adjustable Boost selection. See Section 10.5 on page 20.
9. Jumper J7: Regeneration or DC Injection Braking. See Section 10.6 on page 20.
10. Jumper J8: "Run" or "Fault" Output Relay Operation selection. See Section 10.7 on page 20.
11. Jumper J9: Normally Open or Closed Stop Contact selection. See Section 10.8 on page 20.
12. Jumper J10: Constant or Variable Torque selection. See Section 10.9 on page 20.
13. Jumper J11: Factory use only.
14. Connector CON1: Used to connect optional accessories to the drive.
15. Jumper J1: AC Line Input Voltage selection. See Section 10.1 on page 19.
16. Terminals L1A/L1B and L2A/L2B: Used for optional On/Off AC Line Switch Kit and RFI Filter Kit. See Section 14 on page 23.
17. Terminal Block TB1: AC Line input and Motor connections. See Sections 7.1 and 7.2 on page 15 and 16.

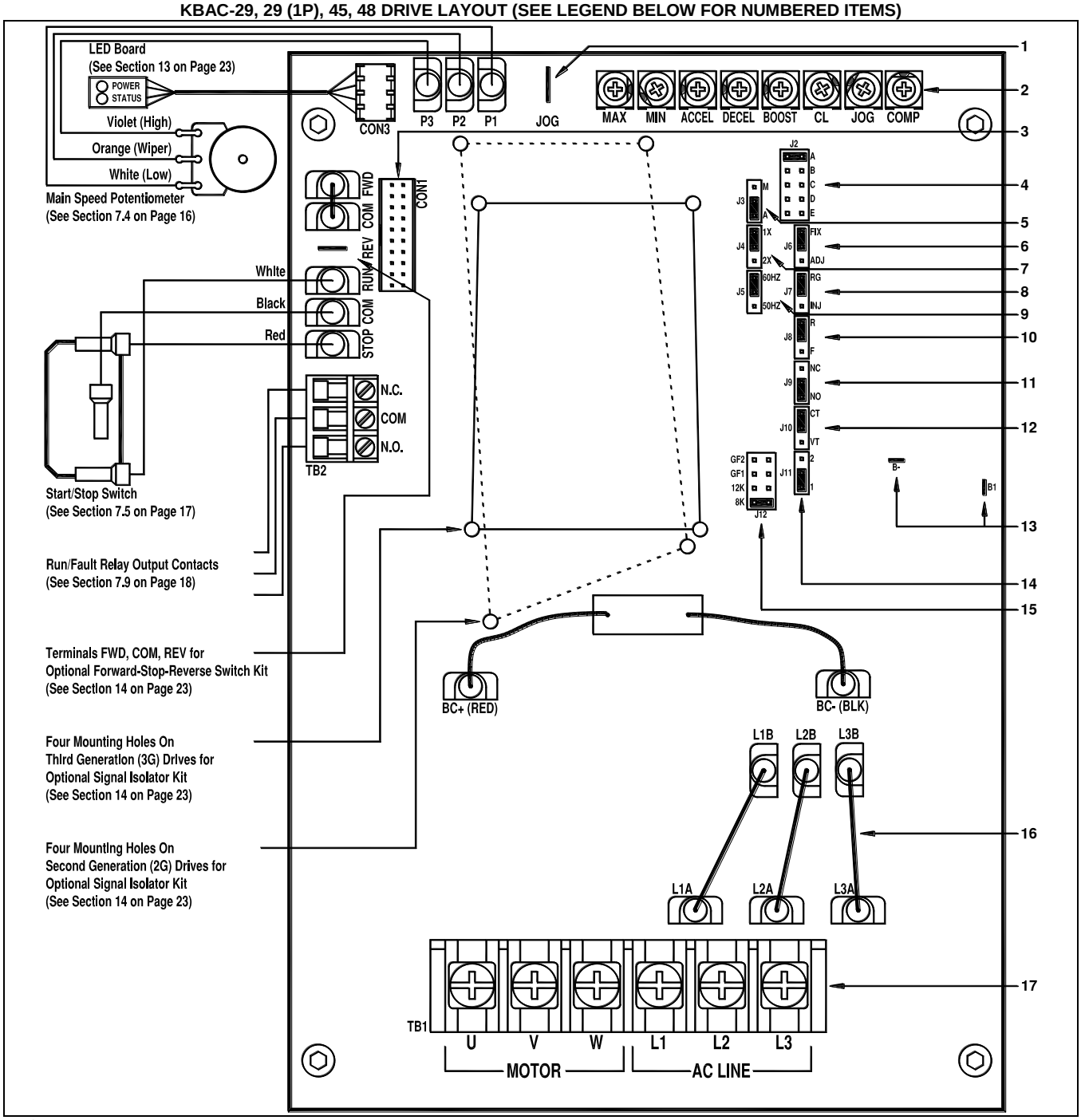
FIGURE 5
KBAC-27D DRIVE LAYOUT (SEE LEGEND BELOW FOR NUMBERED ITEMS)



LEGEND:

1. Jog Terminal: Used with optional Run-Stop-Jog Switch Kit. See Section 14 on page 23.
2. Adjustable Trimpots: Maximum Speed (MAX), Minimum Speed (MIN), Acceleration (ACCEL), Deceleration (DECEL), DC Injection Brake (DECEL), Boost (BOOST), Current Limit (CL), Jog (JOG), Slip Compensation (COMP). See Section 12 on pages 21 and 22.
3. Connector CON1: Used to connect optional accessories to the drive.
4. Jumper J2: Motor Horsepower selection. See Section 10.2 on page 19.
5. Jumper J3: Automatic Ride-Through or Manual Start selection. See Section 10.3 on page 19.
6. Jumper J6: Adjustable Boost selection. See Section 10.5 on page 20.
7. Jumper J4: Frequency Multiplier selection. See Section 10.4 on page 19.
8. Jumper J7: Regeneration or DC Injection Braking. See Section 10.6 on page 20.
9. Jumper J5: Motor Frequency selection. See Section 10.4 on page 19.
10. Jumper J8: "Run" or "Fault" Output Relay Operation selection. See Section 10.7 on page 20.
11. Jumper J9: Normally Open or Closed Stop Contact selection. See Section 10.8 on page 20.
12. Jumper J10: Constant or Variable Torque selection. See Section 10.9 on page 20.
13. Terminals B+ and B-: Used to power optional accessories.
14. Jumper J11: Factory use only.
15. Jumper J12: Switching Frequency and GFCI selection. Third Generation (3G) drives only. See Section 10.11 on page 20.
16. Jumper J1: AC Line Input Voltage selection. See Section 10.1 on page 19.
17. Terminals L1A/L1B and L2A/L2B: Used for optional On/Off AC Line Switch Kit and RFI Filter Kit. See Section 14 on page 23.
18. Terminal Block TB1: AC Line input and Motor connections. See Sections 7.1 and 7.2 on page 15 and 16.

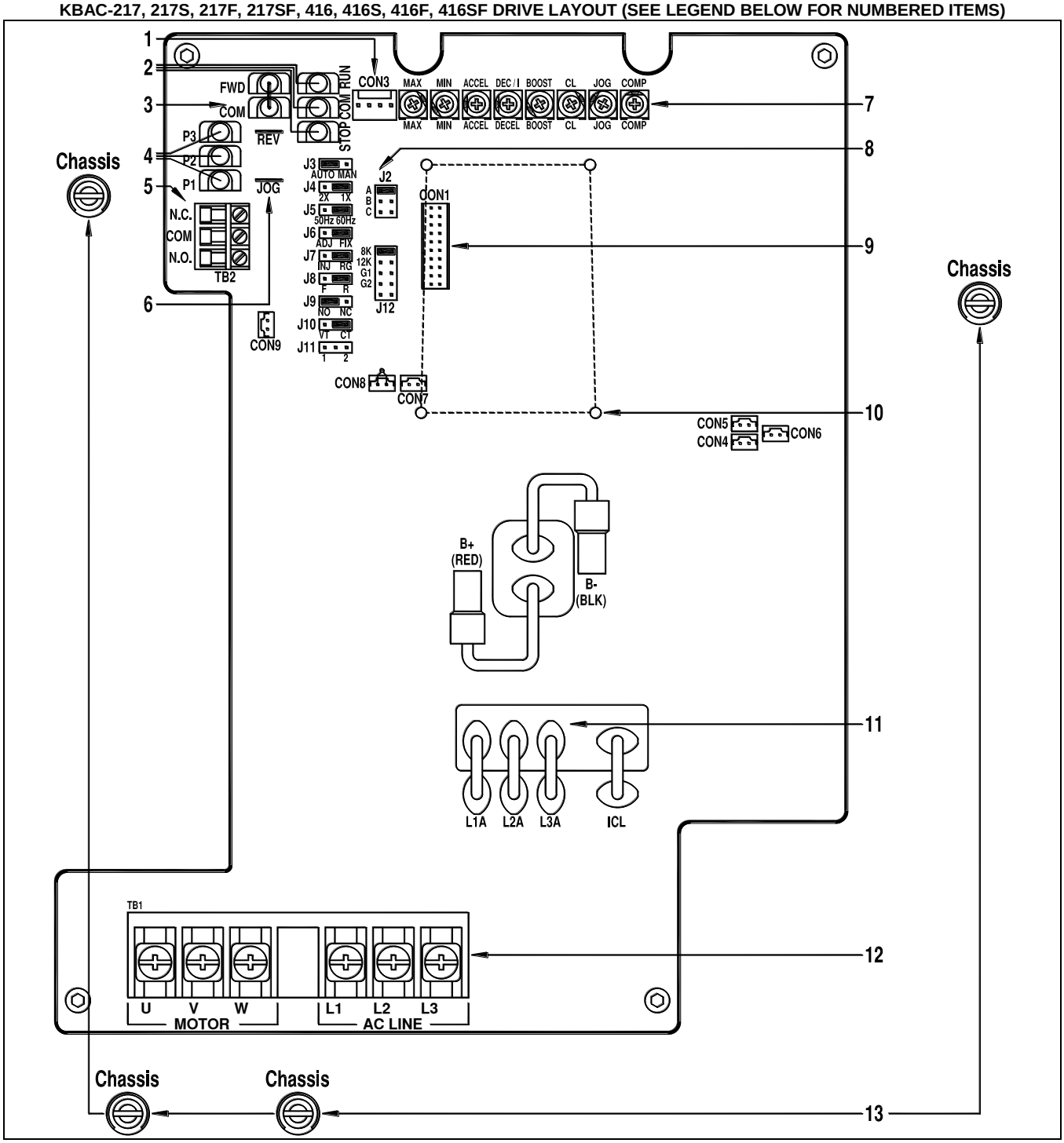
FIGURE 6
KBAC-29, 29 (1P), 45, 48 DRIVE LAYOUT (SEE LEGEND BELOW FOR NUMBERED ITEMS)



LEGEND:

1. Jog Terminal: Used with optional Run-Stop-Jog Switch Kit. See Table 14 on page 23.
2. Adjustable Trimpots: Maximum Speed (MAX), Minimum Speed (MIN), Acceleration (ACCEL), Deceleration (DECEL), DC Injection Brake (DECEL), Boost (BOOST), Current Limit (CL), Jog (JOG), Slip Compensation (COMP). See Section 12 on pages 21 and 22.
3. Connector CON1: Used to connect optional accessories to the drive.
4. Jumper J2: Motor Horsepower selection. See Section 10.2 on page 19.
5. Jumper J3: Automatic Ride-Through or Manual Start selection. See Section 10.3 on page 19.
6. Jumper J6: Adjustable Boost selection. See Section 10.5 on page 20.
7. Jumper J4: Frequency Multiplier selection. See Section 10.4 on page 19.
8. Jumper J7: Regeneration or DC Injection Braking. See Section 10.6 on page 20.
9. Jumper J5: Motor Frequency selection. See Section 10.4 on page 19.
10. Jumper J8: "Run" or "Fault" Output Relay Operation selection. See Section 10.7 on page 20.
11. Jumper J9: Normally Open or Closed Stop Contact selection. See Section 10.8 on page 20.
12. Jumper J10: Constant or Variable Torque selection. See Section 10.9 on page 20.
13. Terminals B1 and B-: Used to power optional accessories.
14. Jumper J11: Factory use only.
15. Jumper J12: Switching Frequency and GFCI selection. Third Generation (3G) drives only. See Section 10.11 on page 20.
16. Terminals L1A/L1B, L2A/L2B, L3A/L3B (Not Installed on KBAC-29 (1P)): Used for optional On/Off AC Line Switch Kit and RFI Filter Kit. See Section 14 on page 23.
17. Terminal Block TB1: AC Line input and Motor connections. See Sections 7.1 and 7.2 on page 15 and 16.

FIGURE 7
KBAC-217, 217S, 217F, 217SF, 416, 416S, 416F, 416SF DRIVE LAYOUT (SEE LEGEND BELOW FOR NUMBERED ITEMS)



LEGEND:

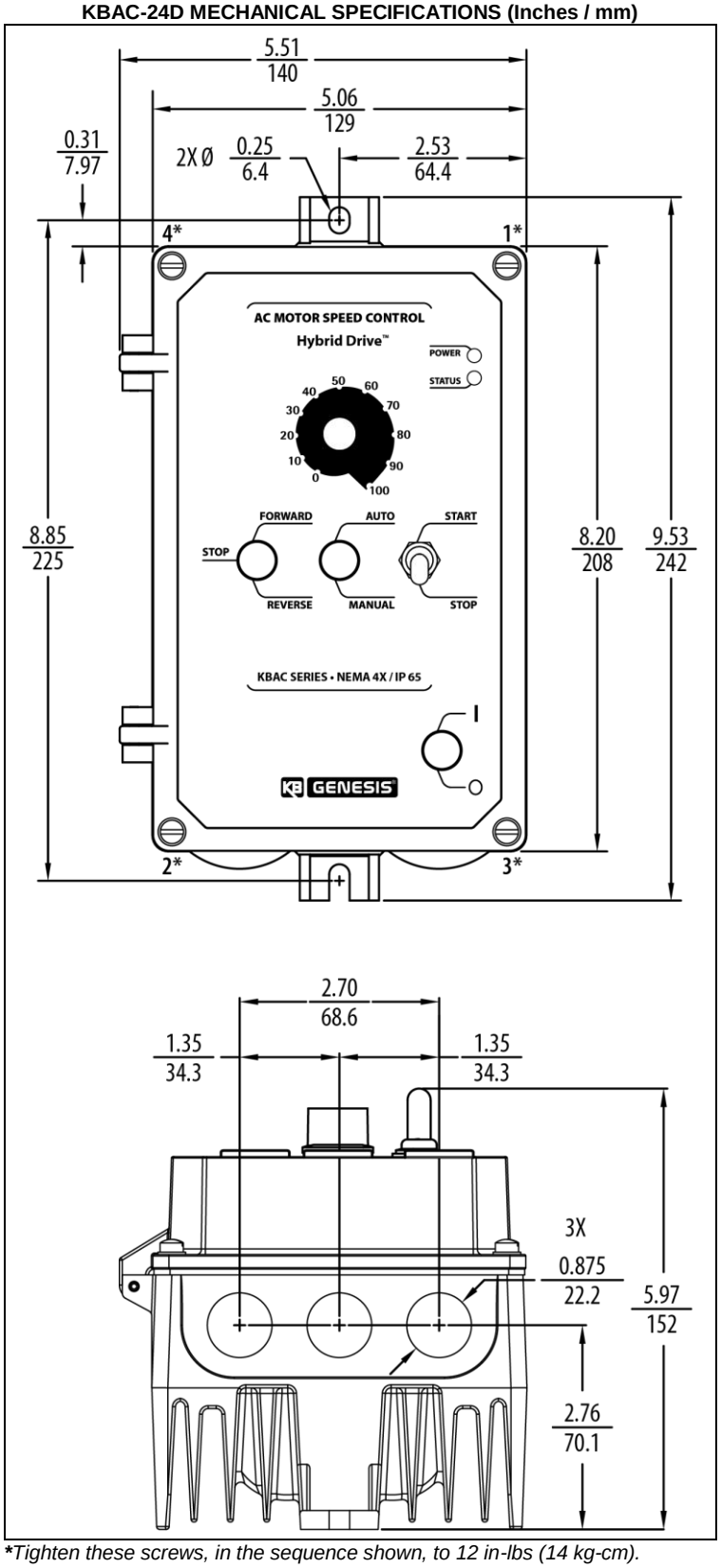
1. Connector CON3: For diagnostic LED board. See Section 13 on page 23.
2. Terminals RUN, COM, STOP: For factory installed Start/Stop Switch. See Section 7.5 on page 17.
3. Terminals FWD, STOP, REV: For optional Forward-Stop-Reverse Switch. See Section 14 on page 23.
4. Terminals P1, P2, P3: For factory installed Main Speed Potentiometer. See Section 7.4 on page 16.
5. Terminal Block TB2: Run/Fault Relay Output Contacts. See Section 7.9 on page 18.
6. Jog Terminal: Used with optional Run-Stop-Jog Switch Kit. See Section 14 on page 23.
7. Adjustable Trimpots: Maximum Speed (MAX), Minimum Speed (MIN), Acceleration (ACCEL), Deceleration (DECEL), DC Injection Brake (DECEL), Boost (BOOST), Current Limit (CL), Jog (JOG), Slip Compensation (COMP). See Section 12 on pages 21 and 22.
8. Selectable Jumpers: Motor Horsepower (J2), Automatic Ride-Through or Manual Start (J3), Frequency Multiplier (J4), Motor Frequency (J5), Fixed or Adjustable Boost (J6), Regeneration or DC Injection Braking (J7), "Run" or "Fault" Output Relay Operation (J8), Normally Open or Closed Stop Contact (J9), Constant or Variable Torque (J10), Switching Frequency and GFCI (J12). See Section 10 on pages 19 and 20.
9. Connector CON1: Used to connect optional accessories to the drive.
10. Four mounting holes for optional Signal Isolator. See Section 14 on page 23.
11. Terminals L1A, L2A, L3A: Used for factory installed On/Off AC Line Switch and factory installed RFI Filter Kit. See Section 14 on page 23.
12. Terminal Block TB1: AC Line input and Motor connections. See Sections 7.1 and 7.2 on page 15 and 16.
13. Ground Screws: Chassis (earth ground).

5 – MOUNTING

It is recommended that the drive be mounted vertically on a flat surface with adequate ventilation. Leave enough room below the drive to allow for AC Line, motor connections, and any other wiring that is required. Although the drive is designed for outdoor and washdown use, care should be taken to avoid extreme hazardous locations where physical damage can occur. When mounting the drive in an enclosure, the enclosure should be large enough to allow for proper heat dissipation so that the ambient temperature does not exceed 40 °C (104 °F) at full rating. See Figures 8 – 10 on pages 12 – 14.

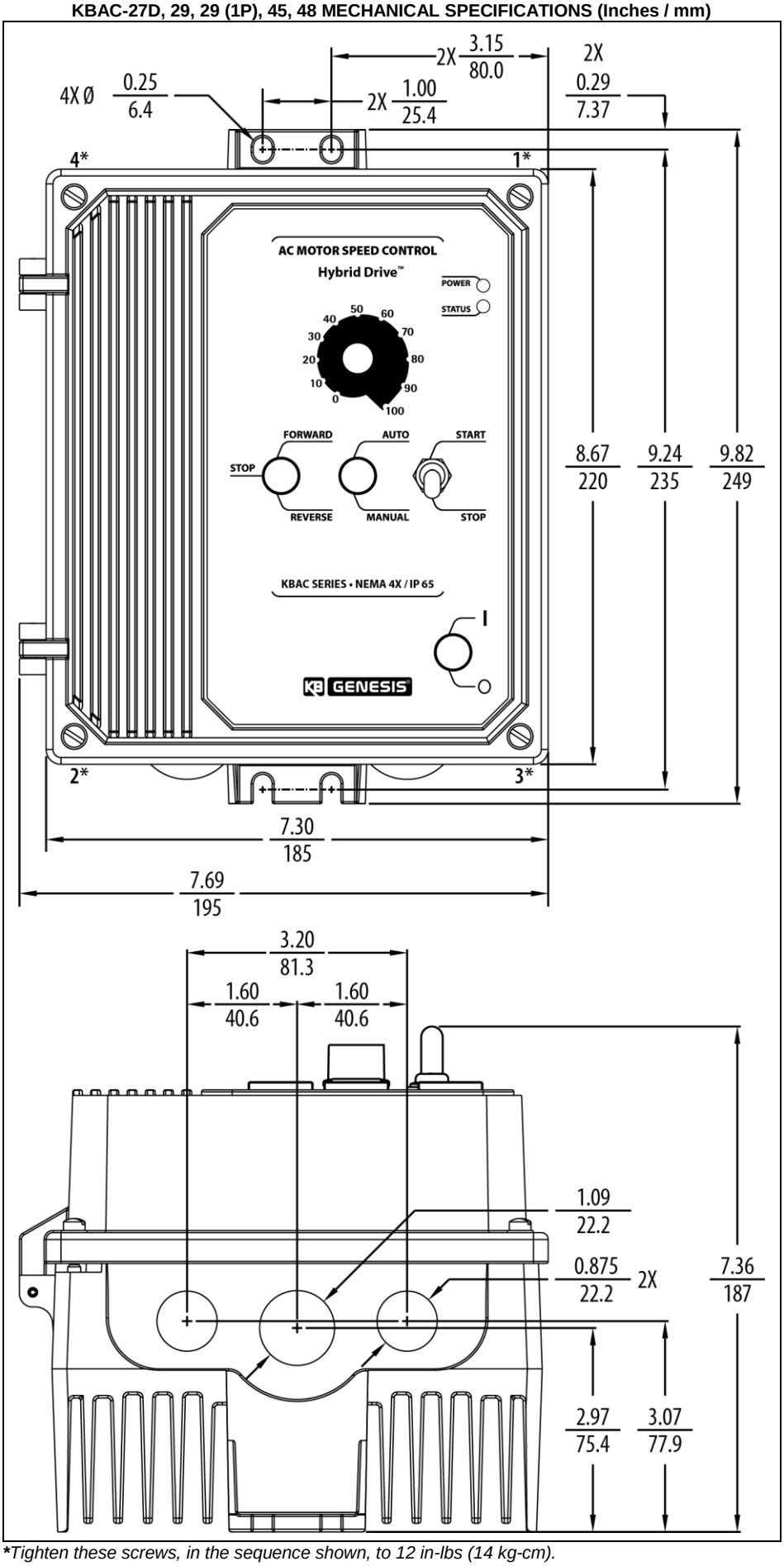
WARNING! Do not use this drive in an explosion-proof application. Be sure the control is securely mounted.

FIGURE 8
KBAC-24D MECHANICAL SPECIFICATIONS (Inches / mm)



Tighten these screws, in the sequence shown, to 12 in-lbs (14 kg-cm).

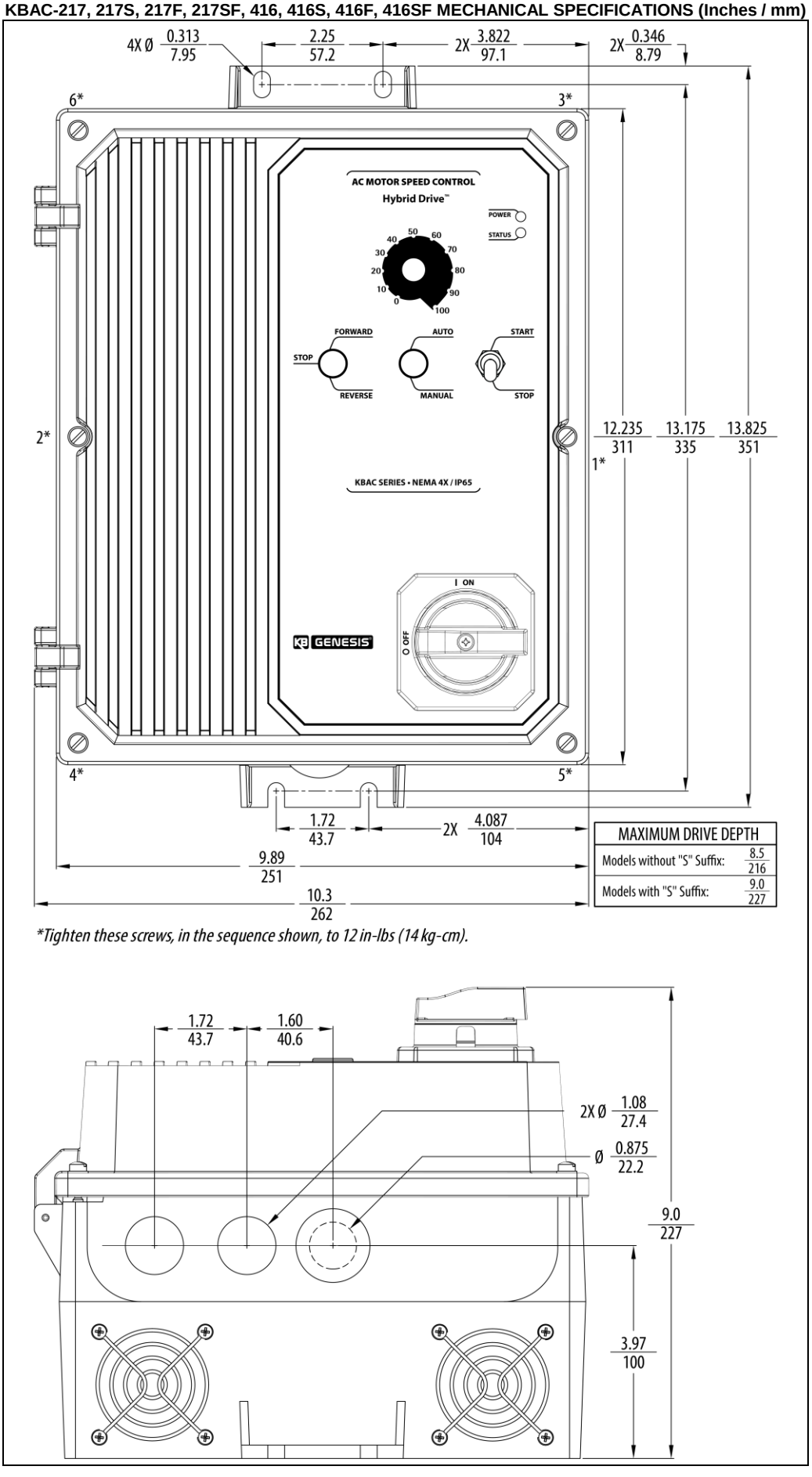
FIGURE 9
KBAC-27D, 29, 29 (1P), 45, 48 MECHANICAL SPECIFICATIONS (Inches / mm)



Tighten these screws, in the sequence shown, to 12 in-lbs (14 kg-cm).

FIGURE 10

KBAC-217, 217S, 217F, 217SF, 416, 416S, 416F, 416SF MECHANICAL SPECIFICATIONS (Inches / mm)



6 – AC LINE INPUT FUSING

The drive does not contain line fuses. Most electrical codes require that each ungrounded conductor contain circuit protection. Do not fuse neutral or ground connections. It is recommended to install a fuse (Littelfuse 312/314, Buss ABC, or equivalent) or a circuit breaker in series with each ungrounded conductor. Do not fuse motor leads. For the recommended fuse size, see Table 2 on page 7.

⚠ **CAUTION!** Do not fuse neutral or grounded connections.

7 – ELECTRICAL CONNECTIONS

Wire the drive in accordance with the National Electrical Code requirements and other local codes that may apply to the application.

WARNING! Read Safety Warnings, on page 5, before using the drive. Disconnect main power before making connections to the drive. To avoid electric shock, be sure to properly ground the drive. It is highly recommended that the Signal Isolator be installed when using signal following.

WARNING! HIGH VOLTAGE! REMOTE CONNECTIONS OF POTENTIOMETER, SWITCHES, ETC., WILL HAVE WIRING THAT IS AT LINE POTENTIAL. IT IS REQUIRED THAT THE SIGNAL ISOLATOR BE INSTALLED FOR REMOTE CONNECTIONS.

Be sure to properly fuse each AC Line conductor that is not at ground potential. Do not fuse neutral or grounded conductors. A separate AC Line switch or contactor must be wired as a disconnect so that each ungrounded conductor is opened. For fuse or circuit breaker selection, see Table 2 on page 7. Also see Section 6 above.

To maintain the watertight integrity of the drive, be sure to use suitable liquidtight fittings and wiring which are appropriate for the application. Liquidtight Fittings Kits are available for all models. See Section 14 on page 23.

The drive is designed with a hinged case so that when the front cover is open, all wiring stays intact. To open the cover, the four screws must be loosened so they are no longer engaged in the case bottom. After mounting and wiring, close the cover making sure that the wires do not get caught or crimped as the cover is closed. Tighten the four screws so that the gasket is slightly compressed. The recommended tightening torque is 12 in-lbs (14 kg-cm) – do not overtighten. See Figures 8 – 10 on pages 12 – 14 for the tightening sequence.

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

TABLE 4
TERMINAL BLOCK WIRE SIZE AND TIGHTENING TORQUE SPECIFICATIONS

Terminal Block	Description	Model	Maximum Wire Size (Cu)		Recommended Tightening Torque	
			AWG	mm^2	in-lbs	kg-cm
TB1	AC Line Input and Motor Wiring	KBAC-24D	12	3.3	7	8
		KBAC-27D, 29, 29 (1P), 45, 48	12	3.3	12	14
TB2	Run/Fault Relay Output Contacts	KBAC-24D, 27D, 29, 29 (1P), 45, 48	14	2.08	3.5	4
		KBAC-217, 217S, 217F, 217SF, 416, 416S, 416F, 416SF	12	3.3	4.4	5

7.1 – AC LINE INPUT CONNECTION

Connect the AC Line input to Terminal Block TB1. See Figures 11 – 13 on pages 15 and 16.

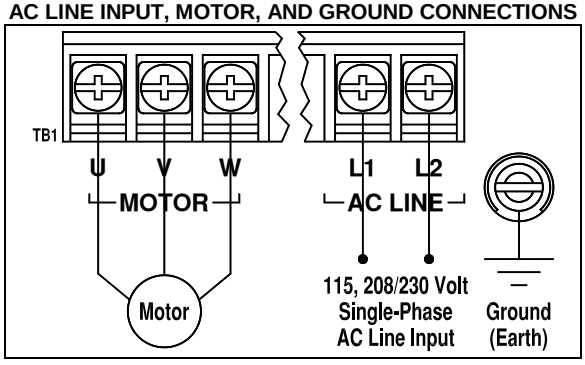
GFCI Operation: Second Generation (2G) models require custom software – contact Technical Support. Third Generation models are jumper selectable (J12) for Standard (G1) or Sensitive (G2) GFCIs.

⚠ **CAUTION!** The rated AC Line voltage of the drive must match the actual AC Line input voltage. On KBAC-24D, 27D the setting of Jumper J1 must match the AC Line input voltage.

KBAC-24D, 27D: Designed to accept 1-phase AC Line input only (Terminals L1, L2). Rated for 208/230 Volt AC Line input with Jumper J1 set to the "230V" position (factory setting). Rated for 115 Volt AC Line input with Jumper J1 set to the "115V" position. See Figure 11.

KBAC-29 (1P): Designed to accept 1-phase AC Line input (Terminals L1, L2). Rated for 208/230 Volt AC Line input only. See Figure 11.

FIGURE 11
KBAC-24D, 27D*, 29 (1P)
AC LINE INPUT, MOTOR, AND GROUND CONNECTIONS



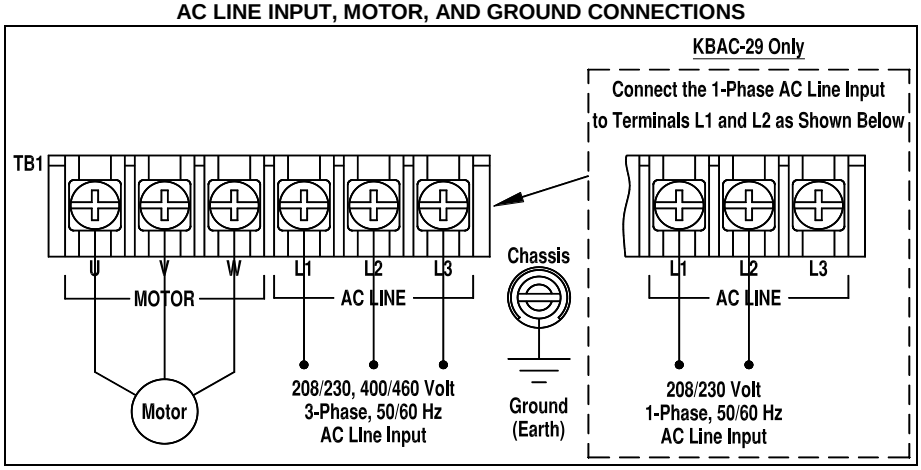
KBAC-29: Designed to accept 1-phase (Terminals L1, L2) or 3-phase (Terminals L1, L2, L3) AC Line input. Rated for 208/230 Volt AC Line input only. See Figure 12.

KBAC-45, 48: Designed to accept 3-phase AC Line input only (Terminals L1, L2, L3). Rated for 400/460 Volt AC Line input only. See Figure 12.

KBAC-217, 217S, 217F, 217SF: Designed to accept 3-phase (Terminals L1, L2, L3) AC Line input. Rated for 208/230 Volt AC Line input only. See Figure 13.

KBAC-416, 416S, 416F, 416SF: Designed to accept 3-phase (Terminals L1, L2, L3) AC Line input. Rated for 400/460 Volt AC Line Input only. See Figure 13.

FIGURE 12
KBAC-29*, 45, 48
AC LINE INPUT, MOTOR, AND GROUND CONNECTIONS

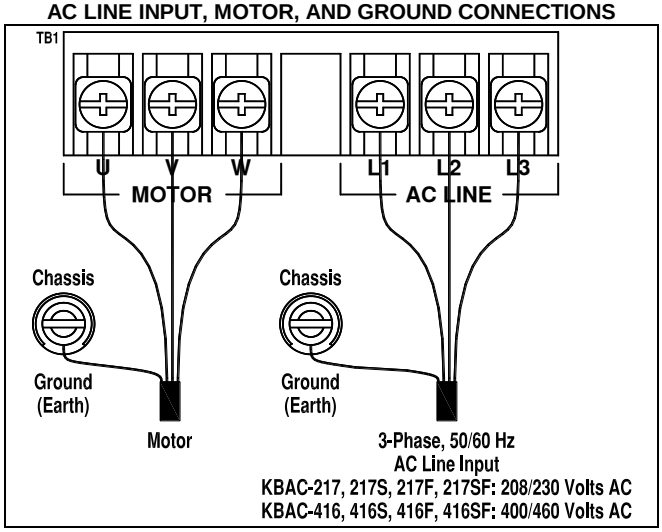


7.2 – MOTOR CONNECTION

Connect the motor to Terminal Block TB1 Terminals U, V, W. See Figures 11 – 13 on pages 15 and 16.

Motor cable length should not exceed 100 feet (30 m) – special reactors may be required – contact Technical Support. Be sure Jumper J2 is set to the corresponding motor horsepower rating, as described in Section 10.2 on page 19.

FIGURE 13
KBAC-217, 217S, 217F, 217SF, 416, 416S, 416F, 416SF
AC LINE INPUT, MOTOR, AND GROUND CONNECTIONS



7.3 – GROUND CONNECTION

Connect the Ground Wire (Earth) to the Green Ground Screw. The Ground Screws are located next to Terminal Block TB1. See Figures 11 – 13 on pages 15 and 16.

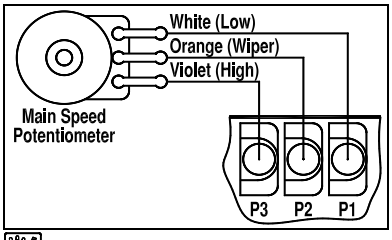
7.4 – REMOTE MAIN SPEED POTENTIOMETER CONNECTION

The drive is supplied with a prewired Main Speed Potentiometer mounted on the front cover. To operate the drive from a remote potentiometer (5 kΩ), remove the white, orange, and violet potentiometer leads from Terminals P1, P2, P3. The wires may be taped and left inside the drive. The potentiometer assembly may be removed if a watertight seal is used to cover the hole in the front cover. Connect the Main Speed Potentiometer to Terminals P1 (low side), P2 (wiper), and P3 (high side). See Figure 14.

WARNING! Do not earth ground any Main Speed Potentiometer terminals.

Application Note: If it is required that the Remote Main Speed Potentiometer be isolated from the AC Line, install the Signal Isolator. See Section 14 on page 23.

FIGURE 14
REMOTE
MAIN SPEED POTENTIOMETER
CONNECTION



WARNING! HIGH VOLTAGE!
See Warning on page 15.

7.5 – REMOTE START/STOP SWITCH CONNECTIONS

The drive is supplied with a prewired Start/Stop Switch mounted on the front cover to electronically start and stop the drive. Also see Section 10.8 on page 20.

To operate the drive from a remote Start/Stop Switch (type (ON)-OFF-ON, SPDT), remove the white, black, and red wires from Terminals RUN, COM, and STOP. The wires may be taped and left inside the drive. The switch assembly may be removed if a liquidtight seal is used to cover the hole in the front cover. After applying power to the drive, momentarily set the Start/Stop Switch to the "START" position. Jumper J9 must be set to the "NO" position. See Figure 15.

For Start/Stop Switch with normally closed stop contact, set Jumper J9 to the "NC" position. See Figure 16.

FIGURE 15
REMOTE START/STOP SWITCH CONNECTION WITH NORMALLY OPEN STOP CONTACT (J9 SET TO THE "NO" POSITION)

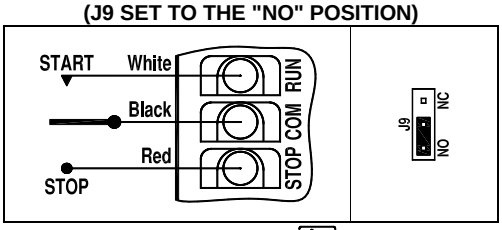
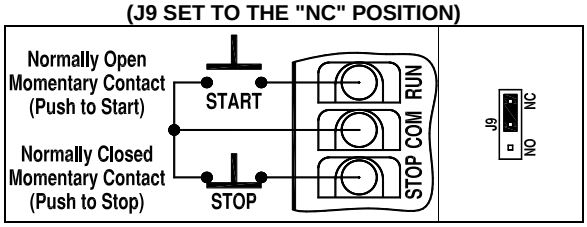


FIGURE 16
REMOTE START/STOP SWITCH CONNECTION WITH NORMALLY CLOSED STOP CONTACT (J9 SET TO THE "NC" POSITION)



WARNING! HIGH VOLTAGE! See Warning on page 15.

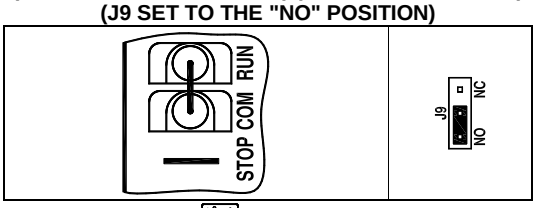
7.6 – AUTOMATIC RESTART

Automatic restart requires the elimination of the Start/Stop Switch. Remove the white, black, and red wires from Terminals RUN, COM, and STOP. The wires may be taped and left inside the drive. The switch assembly may be removed if a liquidtight seal is used to cover the hole in the front cover.

To eliminate the Start/Stop function, hardwire Terminals RUN and COM with the jumper that is provided. Be sure Jumper J9 is set to the "NO" position. See Figure 17.

WARNING! Using a jumper to eliminate the Start/Stop function will cause the motor to run at the Main Speed Potentiometer setting when the AC Line is applied.

FIGURE 17
START/STOP FUNCTION ELIMINATED (TERMINALS HARDWIRED) (JUMPER INSTALLED) (J9 SET TO THE "NO" POSITION)



WARNING! HIGH VOLTAGE! See Warning on page 15.

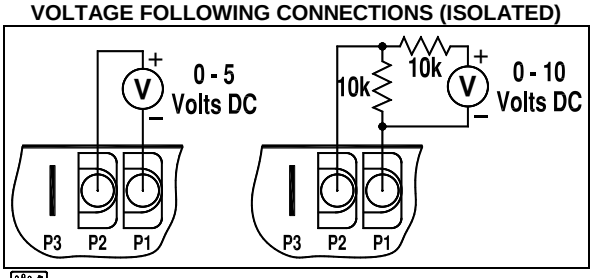
7.7 – VOLTAGE FOLLOWING CONNECTIONS

An isolated* 0 – 5 Volt DC analog signal input can also be used to control motor speed in lieu of the Main Speed Potentiometer. The drive output will linearly follow the analog signal input. Wire the signal input positive lead (+) to Terminal P2 and the negative lead (-) to Terminal P1. With external circuitry, a 0 – 10 Volt DC analog signal can also be used. See Figure 18.

WARNING! The signal input must be isolated from the AC Line. Earth grounding signal wiring will damage the drive and void the warranty. It is highly recommended that the Signal Isolator be installed when using signal following.

*If a non-isolated signal is used, install the Signal Isolator. It accepts voltage (0 to ±2.5 thru 0 to ±25 Volts DC) or current (4 – 20 mA DC) signal inputs. See Section 14 on page 23.

FIGURE 18
VOLTAGE FOLLOWING CONNECTIONS (ISOLATED)



WARNING! HIGH VOLTAGE! See Warning on page 15.

Note: For signal following operation, the Minimum Speed Trimpot (MIN) must be set fully counterclockwise.

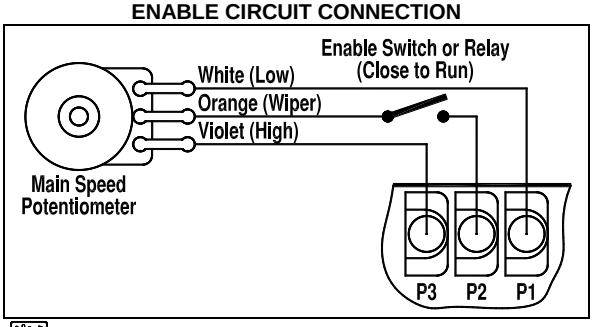
7.8 – ENABLE CIRCUIT CONNECTION

The drive can also be started and stopped with an Enable circuit (close to run, open to stop). See Figure 19.

The Enable function is established by wiring a switch or contact in series with the orange Main Speed Potentiometer lead which connects to Terminal P2. When the Enable Switch is closed, the motor will accelerate to the Main Speed Potentiometer setting. When the Enable Switch is opened, the motor will decelerate to stop.

WARNING! If the Enable Switch is to be mounted remotely, it is highly recommended that the Signal Isolator be installed.

FIGURE 19
ENABLE CIRCUIT CONNECTION

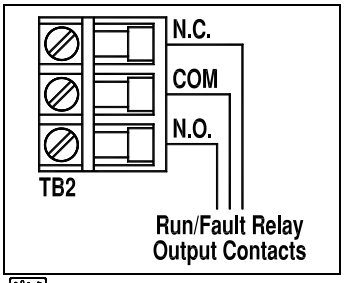


WARNING! HIGH VOLTAGE! See Warning on page 15.

7.9 – RUN/FAULT RELAY CONNECTION

The Run/Fault Relay Output Contacts are located at Terminal Block TB2 and can be used to turn equipment on or off or to signal a warning if the drive is put into the Stop Mode or a fault has occurred. See Figure 20. The Run/Fault Relay Contact status for various drive operating conditions is shown in Table 5.

FIGURE 20
RUN/FAULT RELAY OUTPUT CONTACTS CONNECTION



WARNING! HIGH VOLTAGE!
See Warning on page 15.

TABLE 5
DRIVE OPERATING CONDITION AND RUN/FAULT RELAY CONTACT STATUS

Drive Operating Condition	Description	Run Relay Operation (J8 set to the "R" Position) (Factory Setting)		Fault Relay Operation (J8 set to the "F" Position)	
		Normally Open Contact	Normally Closed Contact	Normally Open Contact	Normally Closed Contact
Power Off	Main Power Disconnected	Open	Closed	Open	Closed
Run Mode[1]	Normal Drive Operation	Closed	Open	Closed	Open
Stop Mode[1]	Selected by Operator	Open	Closed	Closed	Open
Fault[2]	Drive Tripped	Open	Closed	Open	Closed

Notes: 1. *Run Mode or Stop Mode is selected using the Start/Stop Switch.* ***2.*** *Overload, I^2t, Short Circuit, Undervoltage and Overvoltage.*

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

Testing agencies such as UL, CSA, VDE, etc., usually require that equipment undergo a hi-pot test. In order to prevent catastrophic damage to the drive which has been installed in the equipment, the following procedure is recommended. A typical hi-pot test setup is shown in Figure 21. All drives have been factory hi-pot tested in accordance with UL requirements.

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

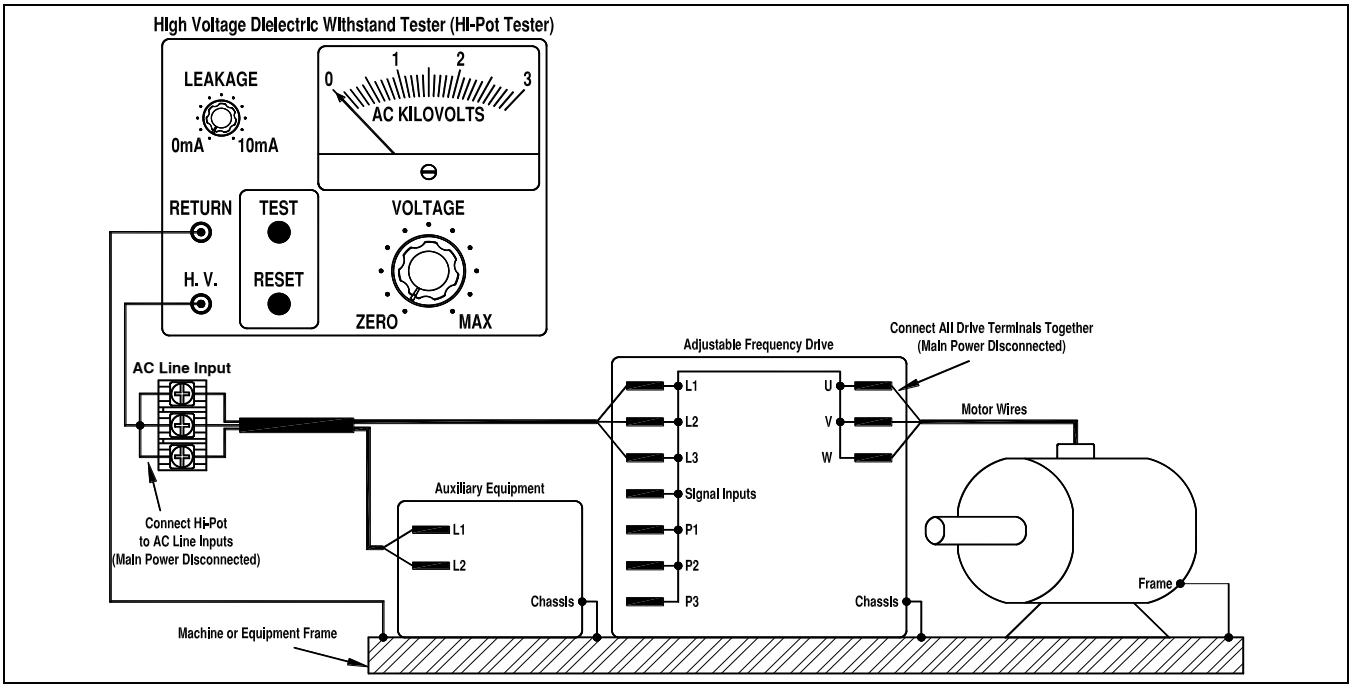
Connect all equipment AC power input lines together and connect them to the H.V. lead of the hi-pot tester. Connect the RETURN lead of the hi-pot tester to the frame on which the drive and other auxiliary equipment are mounted.

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.

CAUTION! Instantly applying the hi-pot voltage will cause irreversible damage to the drive, which will void the warranty.

FIGURE 21
TYPICAL HI-POT TEST SETUP



9 – RECONDITIONIONG THE BUS CAPACITORS

If this drive has been in storage for over one year it is necessary to recondition the power supply bus capacitors. To recondition the bus capacitors, apply the AC Line, with the drive in the Stop Mode, for a minimum of one hour. Not following this procedure will cause the bus capacitors to fail.

10 – SETTING SELECTABLE JUMPERS

The drive has customer selectable jumpers which must be set before the drive can be used.

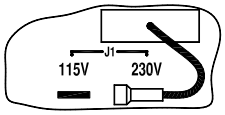
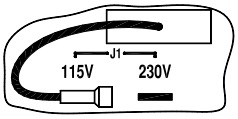
WARNING! HIGH VOLTAGE! Disconnect the AC Line before changing position of jumpers.

10.1 – AC LINE INPUT VOLTAGE SELECTION (KBAC-24D, 27D ONLY) (J1)

CAUTION! The rated AC Line voltage of the drive must match the actual AC Line input voltage. On KBAC-24D, 27D the setting of Jumper J1 must match the actual AC Line input voltage.

Jumper J1 is factory installed on Terminal "230V" for 208/230 Volt AC Line input. For 115 Volt AC Line input, the jumper must be removed and installed on Terminal "115V". To remove the terminal, use pliers to gently rock the terminal back and forth while pulling it upward. See Figure 22.

FIGURE 22
AC LINE INPUT VOLTAGE SELECTION (KBAC-24D*, 27D ONLY)

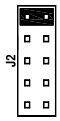
208/230 Volt AC line Input (Factory Setting)	115 Volt AC Line Input
	

*****Layout of KBAC-24D varies slightly.*

10.2 – MOTOR HORSEPOWER SELECTION (J2)

Jumper J2 must be set to the corresponding position for the motor being used. See Figure 23.

FIGURE 23
MOTOR HORSEPOWER SELECTION (J2)

	KBAC-24D	KBAC-27D		KBAC-29*	KBAC-29 (1P)*	KBAC-45*	KBAC-48*	KBAC-217 Series*	KBAC-416 Series*
	**1**	2**	A	3***	3	**3**	**5**	**5**	**10**
	3/4	**1½****	B	**2*****	**2**	2	3	3	7.5
	1/2	1	C	1½	1½	1½	2	2	5
	1/4	3/4	D	1	1	1	1½	—	—
	1/8	1/2	E	3/4	3/4	3/4	1	—	—

*The factory setting is shown in **bold**. *****J2 on KBAC-29, 29 (1P), 45, 48 is labeled "A, B, C, D, E" and on KBAC-217, 416 Series is labeled "A, B, C". ******KBAC-27D: Rated 1½ HP maximum with 115 Volt AC Line input and 2 HP maximum with 208/230 Volt AC Line input. *******KBAC-29: Rated 2 HP maximum with 1-phase AC Line input and 3 HP maximum with 3-phase AC Line input.*

10.3 – AUTOMATIC RIDE-THROUGH OR MANUAL START SELECTION (J3)*

Jumper J3 is factory set to the "A" position for Automatic Ride-Through. If the power is interrupted for up to 2 seconds, the drive will shut down and then "ride-through" and automatically return to the set frequency. See Figure 24.

If Jumper J3 is set to the "M" position, the drive will have to be manually restarted for a momentary power loss using the Start/Stop Switch. Also see Section 13.2 on page 23 for the Status (ST) LED indication.

*****On KBAC-24D, 217, 217S, 217F, 217SF, 416, 416S, 416, 416F, 416SF Jumper J3 is labeled "AUTO" and "MAN".

FIGURE 24
AUTOMATIC RIDE-THROUGH OR MANUAL START SELECTION

Automatic Ride-Through (Factory Setting)	Manual Start
	

10.4 – MOTOR FREQUENCY SELECTION (J4 AND J5)

Both Jumpers J4 and J5 must be set for the appropriate motor nameplate frequency rating. See Figures 25 and 26.

10.4.1 – SETTING THE DRIVE FOR 60 Hz OR 50 Hz MOTOR OPERATION

The drive is factory set to operate 60 Hz motors. Jumper J4 is factory set to the "1X" position and Jumper J5 is factory set to the "60Hz" position. For 50 Hz motors, set Jumper J5 to the "50Hz" position, and be sure Jumper J4 is set to the "1X" position. See Figure 26.

10.4.2 – SETTING THE DRIVE FOR TWO TIMES THE RATED MOTOR RPM

The drive can also operate the motor up to two times the rated RPM. However, constant horsepower will result when operating the drive in the "2X" mode above the motor rated frequency. For 120 Hz output with 60 Hz motor, set Jumper J4 to the "2X" position and be sure Jumper J5 is set to the "60Hz" position. For 100 Hz output with 50 Hz motor, set Jumper J4 to the "2X" position and set Jumper J5 to the "50Hz" position. See Figure 26.

FIGURE 25
AVAILABLE TORQUE VS. OUTPUT FREQUENCY

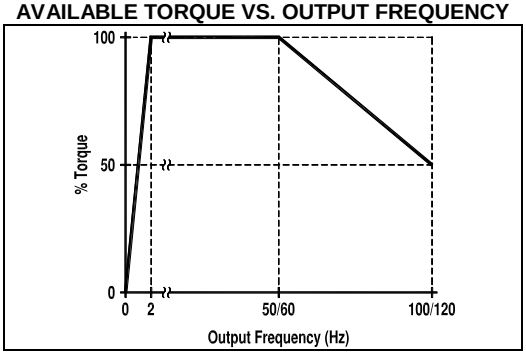
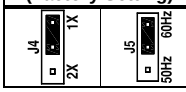
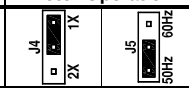
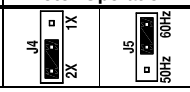
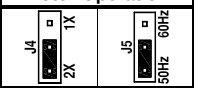


FIGURE 26
MOTOR FREQUENCY SELECTION

60 Hz Motor Operation (Factory Setting)	50 Hz Motor Operation	120 Hz Motor Operation	100 Hz Motor Operation
			

10.5 – BOOST MODE SELECTION (J6)
Jumper J6 is factory set to the "FIX" position for Fixed Boost. For Adjustable Boost using the BOOST Trimpot, set Jumper J6 to the "ADJ" position. See Figure 27 Also see Section 12.8 on page 22 for the Boost Trimpot.

FIGURE 27
BOOST MODE SELECTION

Fixed Boost (Factory Setting)	Adjustable Boost
	

10.6 – BRAKING MODE SELECTION (J7)
Jumper J7 is factory set to the "RG" position for Regenerative Braking when the Start/Stop Switch is set to the "STOP" position. For DC Injection Braking, set Jumper J7 to the "INJ" position. See Figure 28. Also see Section 12.5 on page 21 for the DC Injection Brake Trimpot.

When the Injection Brake Mode is selected, the DECEL Trimpot is used to set the amount of time the DC current is applied to the motor.

FIGURE 28
BRAKING MODE SELECTION

Regenerative Braking (Factory Setting)	DC Injection Braking
	

10.7 – RUN/FAULT OUTPUT RELAY OPERATION SELECTION (J8)
Jumper J8 is factory set to the "R" position for "Run" operation of the Run/Fault Relay. For "Fault" operation of the Run/Fault Relay, set Jumper J8 to the "F" position. See Figure 29.

For Run/Fault Relay output contacts, see Section 7.9 on page 18. The Run/Fault Relay contact status for various drive operating conditions is shown in Table 5 on page 18.

FIGURE 29
RUN/FAULT OUTPUT RELAY OPERATION SELECTION

"Run" Operation (Factory Setting)	"Fault" Operation
	

10.8 – STOP CONTACT TYPE SELECTION (J9)
Jumper J9 is factory set to the "NO" position for a normally open stop contact. For remote normally closed stop contact, set Jumper J9 to the "NC" position. See Figure 30. For wiring information, see Section 7.5 on page 17.

FIGURE 30
STOP CONTACT TYPE SELECTION

Normally Open Stop Contact (Factory Setting)	Normally Closed Stop Contact
	

10.9 – TORQUE MODE SELECTION (J10)
Jumper J10 is factory set to the "CT" position for Constant Torque Mode, which is desirable for most machine applications. For Variable Torque Mode, used for HVAC and fan applications, set Jumper J10 to the "VT" position. See Figure 31.

10.10 – JUMPER J11
Factory use only.

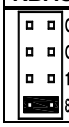
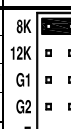
FIGURE 31
TORQUE MODE SELECTION

Constant Torque (Factory Setting)	Variable Torque
	

10.11 – SWITCHING FREQUENCY AND GFCI SELECTION (J12)
(THIRD GENERATION (3G) DRIVES ONLY)
Jumper J12 is factory set to the "8K" position for a switching frequency at the motor of 8 kHz. For 12 kHz switching frequency, set Jumper J12 to the "12K" position. This jumper also allows the drive to be used on standard ("G1" position) or sensitive ("G2" position) GFCIs. See Figure 32.

Note: GFCI operation may increase audible motor noise.

FIGURE 32
SWITCHING FREQUENCY AND GFCI SELECTION

KBAC-24D, 27D, 29, 29 (1P), 45, 48		KBAC-217, 416 Series	
	Sensitive GFCI		8 kHz Switching Frequency*
	Standard GFCI		12 kHz Switching Frequency
	12 kHz Switching Frequency		Standard GFCI
	8 kHz Switching Frequency*		Sensitive GFCI
			Not Used

**Factory setting.*

**Factory setting.*

11 – DRIVE OPERATION

11.1 – START-UP PROCEDURE
After the drive has been properly setup (jumpers and trimpots set to the desired positions) and wiring completed, the start-up procedure can begin. If the AC power has been properly brought to the drive, the power (PWR) LED will illuminate green. The status (ST) LED will indicate drive status, as described in Section 13.2 on page 23.

To start the drive, momentarily set the Start/Stop Switch to the "START" position. The motor will begin to accelerate to the set speed.

WARNING! Using a jumper to eliminate the start/stop function will cause the motor to run at the Main Speed Potentiometer setting when the AC Line is applied. See Section 11.2 on page 21.

Note: *If the motor rotates in the incorrect direction, it will be necessary to disconnect the AC Line, reverse any two motor leads, and repeat the start-up procedure.*

11.2 – RESTARTING THE DRIVE AFTER A FAULT HAS CLEARED[1,2]

The drive monitors five faults: Undervoltage, Overvoltage, Short Circuit at the motor (phase-to-phase), Overload and Phase Loss Detection. See Section 13.2 on page 23 for the Status (ST) LED indication. Also see Section 10.3 on page 19 for Automatic Ride-Through or Manual Restart selection with Jumper J3.

To restart the drive after a fault has been cleared, use the Start/Stop Switch.[2,3] If the Start/Stop Switch has been eliminated (bypassed), see Section 7.6 on page 17.[4] The drive can be restarted (after the fault has been cleared) by disconnecting the AC power, and all LEDs are no longer illuminated, and then reconnecting the AC power.

Notes: 1. *For an Overload Fault, be sure the fault has been cleared before restarting the drive. Check the motor current with an AC RMS responding ammeter. Also, the CL setting may be set too low. See Section 13.7 on page 30.* ***2.*** *For an Overvoltage Fault, if the drive is set for Automatic Ride-Through, the drive will automatically restart when the AC Line voltage returns to below the specified Overvoltage Trip Point.* ***3.*** *If the Forward-Stop-Reverse Switch has been installed, it can be used to restart the drive.* ***4.*** *If the Start/Stop Switch has been eliminated (bypassed), the AC Line must be used to restart the drive after an Overload Fault has been cleared.*

12 – TRIMPOT ADJUSTMENTS

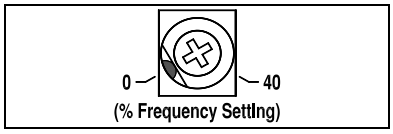
The drive contains trimpots which are factory set for most applications. See Figures 4 – 7 on pages 8 – 11 for the location of the trimpots and their approximate factory calibrated positions. Some applications may require readjustment of the trimpots in order to tailor the drive for a specific requirement. The trimpots may be readjusted as described in this section.

WARNING! If possible, do not adjust trimpots with the main power applied. If adjustments are made with the main power applied, an insulated adjustment tool must be used and safety glasses must be worn. High voltage exists in this drive. Fire and/or electrocution can result if caution is not exercised. The Safety Warnings on page 5 must be read and understood before proceeding.

12.1 – MINIMUM SPEED TRIMPOT (MIN)

Sets the minimum speed of the motor. The MIN Trimpot is factory set to 0% of frequency setting. For a higher minimum speed setting, rotate the MIN Trimpot clockwise. See Figure 33.

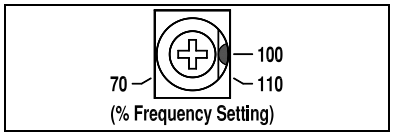
FIGURE 33
MINIMIM SPEED TRIMPOT RANGE



12.2 – MAXIMUM SPEED TRIMPOT (MAX)

Sets the maximum speed of the motor. The MAX Trimpot is factory set to 100% of frequency setting. For a lower maximum speed setting, rotate the MAX Trimpot counterclockwise. For a higher maximum speed setting, rotate the MAX Trimpot clockwise. See Figure 34.

FIGURE 34
MAXIMUM SPEED TRIMPOT RANGE

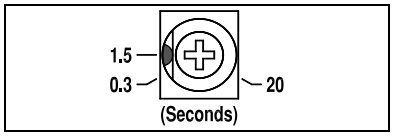


12.3 – ACCELERATION TRIMPOT (ACCEL)

Sets the amount of time for the motor to accelerate from zero speed to full speed. The ACCEL Trimpot is factory set to 1.5 seconds. For a longer acceleration time, rotate the ACCEL Trimpot clockwise. For more rapid acceleration, rotate the ACCEL Trimpot counterclockwise. See Figure 35.

Note: Rapid acceleration settings may cause the current limit circuit to activate, which will extend the acceleration time.

FIGURE 35
ACCELERATION TRIMPOT RANGE

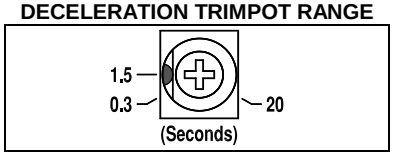


12.4 – DECELERATION TRIMPOT (DECEL)

Sets the amount of time for the motor to decelerate from full speed to zero speed. The DEC/I Trimpot is factory set to 1.5 seconds. For longer deceleration time, rotate the DEC/I Trimpot clockwise. For more rapid deceleration, rotate the DEC/I Trimpot counterclockwise. See Figure 36.

Application Note: On applications with high inertial loads, the deceleration time may automatically increase. This will slow down the decrease speed to prevent the bus voltage from rising to the Overvoltage Trip point. This function is called Regeneration Protection. It is recommended that for very high inertial loads that both the ACCEL and DEC/I Trimpots be set to greater than 10 seconds.

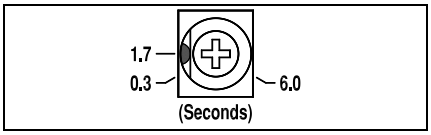
FIGURE 36
DECELERATION TRIMPOT RANGE



12.5 – DC INJECTION BRAKE TRIMPOT (DECEL)

The drive is factory set for Regenerative Braking (Jumper J7 set to the "RG" position). When the drive is set for DC Injection Brake (Jumper J7 set to the "INJ" position), the DECEL Trimpot is used to set the amount of time the DC current is applied to the motor. See Figure 37. Also see Section 10.6 on page 20.

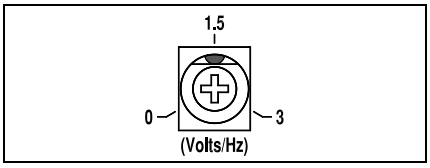
FIGURE 37
DC INJECTION BRAKE TRIMPOT RANGE



12.6 – SLIP COMPENSATION TRIMPOT (COMP)

Sets the amount of Volts/Hz to maintain set motor speed under varying loads. The COMP Trimpot is factory set to 1.5 Volts/Hz, which provides excellent speed regulation for most motors. To increase the slip compensation, rotate the COMP Trimpot clockwise. To decrease the slip compensation, rotate the COMP Trimpot counterclockwise. See Figure 38.

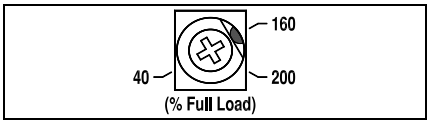
FIGURE 38
SLIP COMPENSATION TRIMPOT RANGE



The slip compensation may be adjusted as follows:

1. Wire an AC RMS ammeter in series with one motor phase.
2. Run the motor and set the unloaded speed to approximately 50% (900 RPM on 4-pole 1500/1725 RPM motors).
3. Using a tachometer, record the unloaded speed.
4. Load the motor to the nameplate rated current (AC Amps).
5. Adjust the COMP Trimpot until the loaded RPM is equal to the unloaded RPM.
6. The motor is now compensated to provide constant speed under varying loads.

FIGURE 39
CURRENT LIMIT TRIMPOT RANGE

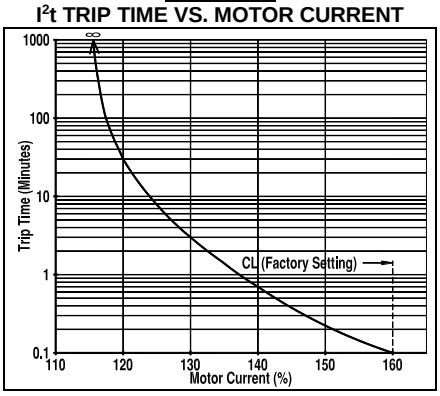


12.7 – MOTOR OVERLOAD (I^2t) WITH RMS CURRENT LIMIT TRIMPOT (CL)*

Sets the current limit (overload), which limits the maximum current to the motor, which prevents motor burnout and eliminates nuisance trips. The CL Trimpot is factory set to 160% of the drive rated current. To increase the current limit, rotate the CL Trimpot clockwise. To decrease the
current limit, rotate the CL Trimpot counterclockwise. See Figures 39 and 40.

UL approved as an electronic overload protector for motors.

FIGURE 40
I^2t TRIP TIME VS. MOTOR CURRENT



The current limit may be adjusted as follows:

1. Connect an AC RMS ammeter in series with one motor phase.
2. Set the CL Trimpot fully counterclockwise.
3. Adjust the speed setting to 30%.
4. Lock the motor shaft and adjust the CL Trimpot to 160% of the motor nameplate rated current.

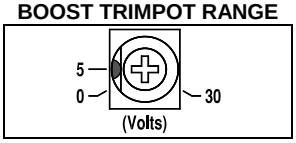
***Note:** This adjustment must be made within 6 seconds or an I^2t Trip will occur.*

⚠ **CAUTION!** Adjusting the current limit above 160% of the motor nameplate rated current can cause overheating of the motor. Consult the motor manufacturer. Do not leave the motor in a locked rotor condition for more than a few seconds since motor damage may occur. In order to ensure that the motor is properly protected with the I^2t feature, it is required that the CL Trimpot be set for 160% of the motor nameplate rated current, as described below.

12.8 – BOOST TRIMPOT (BOOST)

The drive is factory set for Fixed Boost (Jumper J6 set to the "FIX" position). When the drive is set for Adjustable Boost (Jumper J6 set to the "ADJ" position), the BOOST Trimpot can be used to adjust the amount of boost voltage to the motor. See Figure 41. Also see Section 10.5 on page 20.

FIGURE 41
BOOST TRIMPOT RANGE



Application Note: The Boost function operates over a frequency range of 0 – 15 Hz. If the frequency range required is above 15 Hz, Boost adjustment is not necessary.

WARNING! To avoid motor winding overheating and failure, do not overboost the motor.

***Note:** An unloaded motor with excessive boost will draw more current than a partially loaded motor.*

The boost voltage may be adjusted as follows:

1. Wire an AC RMS ammeter in series with one motor phase.
2. Run the motor unloaded at approximately 4 Hz (or 120 RPM).
3. Increase the boost until the ammeter reaches the motor nameplate rated current (Amps AC).
4. Using the Main Speed Potentiometer, slowly adjust the motor speed over a 1 – 15 Hz (0 – 450 RPM) range. If the motor current exceeds the nameplate rating, decrease the boost setting.

12.9 – JOG TRIMPOT (JOG)

The Jog feature requires the installation of the optional Run-Stop-Jog Switch Kit. The JOG Trimpot range is shown in Figure 42. Connect the switch as sown in Figure 43.

FIGURE 42
JOG TRIMPOT RANGE

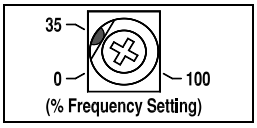
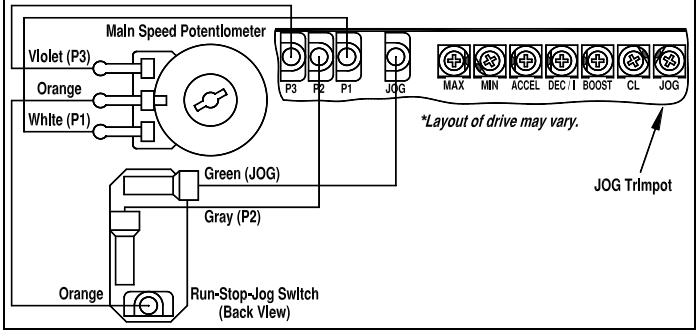


FIGURE 43
RUN-STOP-JOG SWITCH CONNECTION (SPDT WITH CENTER OFF)



The orange Main Speed Potentiometer wire (wiper) which connects to Terminal P2 on the drive must be removed and installed on Terminal RUN on the switch. Terminal JOG on the drive connects to "JOG" on the switch. Terminal "P2" on the drive connects to the center (common) terminal on the switch. When the switch is in the "JOG" position, the JOG Trimpot is used to set the "jog" speed. When the switch is in the "RUN" position, the Main Speed Potentiometer is used for speed setting. The Run-Stop-Jog Switch is available as an optional accessory. See Section 14 on page 23.

13 – DIAGNOSTIC LEDs

The drive contains two diagnostic LEDs mounted on the enclosure cover to display the drive's operational status.

WARNING! Do not depend on the PWR LED as a guaranteed power off condition. Be sure the main power switch or circuit breaker is in the "OFF" position before servicing this drive.

13.1 – POWER ON LED (PWR)

The "PWR" LED will illuminate green when the AC Line is applied to the drive.

13.2 – STATUS LED (ST)

The "ST LED is a tricolor LED which provides indication of a fault or abnormal condition. The information provided can be used to diagnose an installation problem such as incorrect input voltage, overload condition, and drive output miswiring. It also provides a signal which informs the user that all drive and microcontroller operating parameters are normal. Table 6 summarizes the "ST" LED functions.

TABLE 6
DRIVE OPERATING CONDITION AND STATUS LED INDICATOR

Drive Operating Condition	Flash Rate[1] and LED Color
Normal Operation	Slow Flash Green
Overload (120% – 160% Full Load)	Steady Red[2]
I^2t (Drive Timed Out)	Quick Flash Red[2]
Short Circuit	Slow Flash Red
Undervoltage	Quick Flash Red / Yellow[3]
Overvoltage	Slow Flash Red / Yellow[3]
Stop	Steady Yellow
Stand-By[4]	Slow Flash Yellow
Input Phase Loss[5]	Rapid Flash Yellow
Overtemperature Trip[6]	Slow / Quick Flash Red[1]

Notes: 1. *Slow Flash = 1 second on and 1 second off. Quick Flash = 0.25 second on and 0.25 second off.* ***2.*** *When the Overload is removed, before the I^2t times out and trips the drive, the "ST" LED will flash green.* ***3.*** *When the Undervoltage or Overvoltage condition is corrected, the "ST" LED will flash Red / Yellow / Green.* ***4.*** *Only if the Forward-Stop-Reverse Switch is installed.* ***5.*** *KBAC-29, with three-Phase AC Line input and KBAC-45, 48. Rapid Flash = 4 mSec on and 6 mSec off.* ***6.*** *KBAC-217, 416 Series only.*

14 – OPTIONAL ACCESSORIES

Detailed instructions are provided with all accessories. See Table 7.

TABLE 7
OPTIONAL ACCESSORIES

Description		KBAC-24D	KBAC-27D	KBAC-29	KBAC-29 (1P)	KBAC-45	KBAC-48	KBAC-217 Series KBAC-416 Series
Forward-Stop-Reverse Switch Kit: Provides motor reversing and stop functions. Mounts on the enclosure cover and is supplied with a switch seal to maintain liquidtight integrity.		9480	9480	9480	9480	9480	9480	8888
On/Off AC Line Switch Kit: Disconnects the AC Line. Mounts on the enclosure cover and is supplied with a switch seal to maintain liquidtight integrity.		9482	9523	9523	9523	9532	9532	"S" Suffix Models (Factory Installed)
Run-Stop-Jog Switch Kit: Selects speed setting from either the Main Speed Potentiometer or the JOG Trimpot. Mounts on the enclosure cover and is supplied with a switch seal to maintain liquidtight integrity.		9340	9340	9340	9340	9340	9340	8889
SIAC-PS Signal Isolator Kit: Provides isolation between a non-isolated signal source and the drive. Mounts on the drive's PC board with four snap-ins.	2G	9600C	9600C	9600C	9600C	9600C	9600C	—
	3G[1]	8890	8890	8890	8890	8890	8890	8890
Auto/Manual Switch Kit: When used with the Signal Isolator, it selects remote process signal or the Main Speed Potentiometer. Mounts on the enclosure cover and is supplied with a switch seal to maintain liquidtight integrity.		9481	9481	9481	9481	9481	9481	8891
SIAC-PS Signal Isolator Kit and Auto/Manual Switch Kit		9605	9605	9605	9605	9605	9605	8893
AC Line Filter Kit[2]: Provides Class A RFI (EMI) suppression. Installs onto the drive's PC board with quick-connect terminals.	"S" Suffix	9507	9512	9479	—	9479	9479	"F" Suffix Models (Factory Installed)
"S" Suffix filter is used when On/Off AC Line Switch is installed. "NS" Suffix filter is used when On/Off AC Line Switch is not installed.	"NS" Suffix	9507	9512	9515	—	9515	9515	
Liquidtight Fittings Kit: Provide a liquidtight seal for wiring the drive.		9526	9526	9526	9526	9526	9526	8892

Notes: 1. *Third Generation (3G) drives are marked "(3G)" on the product label.* ***2.*** *Complies with CE Council Directive 89/336/EEC Industrial Standard.*

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

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KBelectronics.com/registration.htm

LIMITED WARRANTY

For a period of 18 months from the date of original purchase, KB Electronics 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 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 under any circumstance shall not exceed the full purchase price of this product.
(Rev. 2/2000)

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