

INSTALLATION AND OPERATION MANUAL

KBVF 4G SERIES

Variable Frequency Drives – For OEM Applications

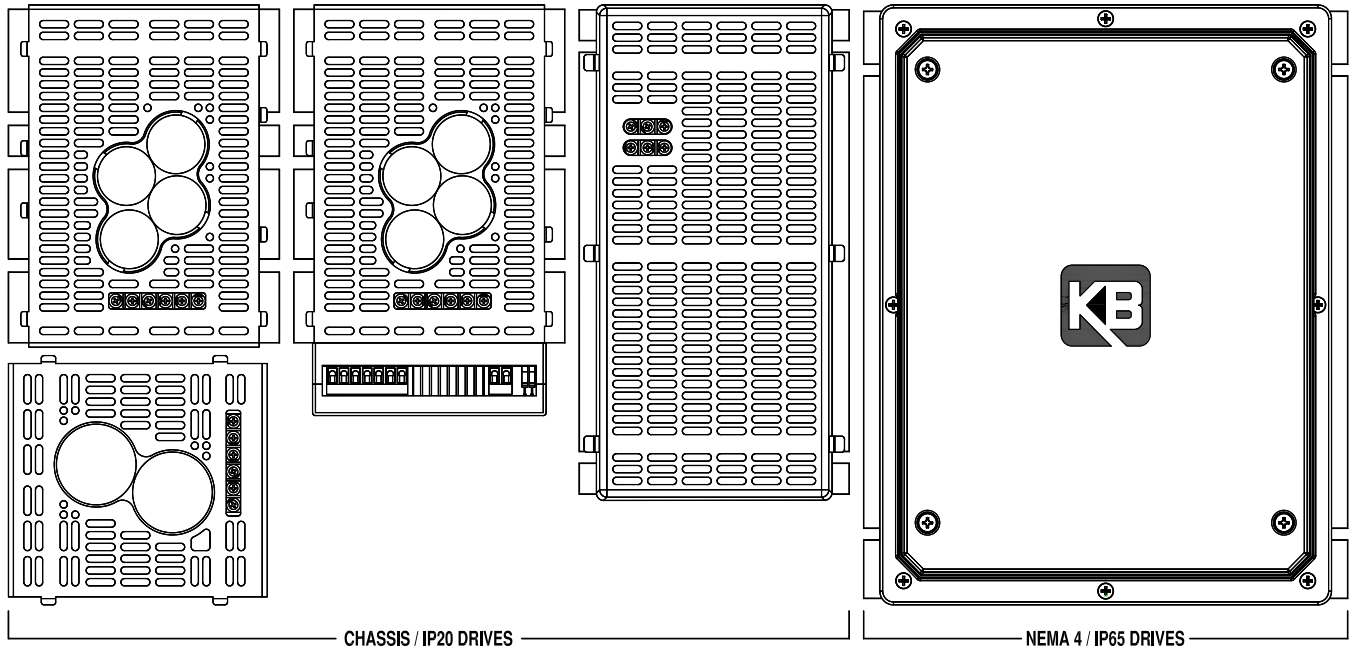
Designed for Multiple Motor Technologies
(Asynchronous, PMSM, and Others)

Chassis / IP20 and NEMA 4 / IP65 Enclosures

**Variable Speed / Soft-Start AC Motor Drive
with Electronic Motor Overload Protection**

**Rated for 208 – 230 and 400/460 Volt 50 Hz and 60 Hz
Motors from Subfractional thru 3 HP**

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



THIS MANUAL COVERS THE FOLLOWING KBVF 4G SERIES MODELS

Chassis / IP20 Drives: KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D, 27, 29, 29 (1P), 42, 45, 48

NEMA 4 / IP65 Drives: KBVF-27E, 27EF, 29E, 29EF, 29EF (1P), 42E, 42EF, 45E, 45EF, 48E, 48EF

PENTA KB POWER
A Complete Line of Motor Drives



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GFCI DISCLAIMER

The drives are tested and designed to operate with standard and sensitive GFCIs. This ensures that our drives will operate with most GFCIs. Motor characteristics, wire lengths, etc., may affect system performance with GFCIs. Therefore, to verify that your GFCI will operate with our drive and in your application, it is highly recommended that you contact our Technical Support team with information about your application and your specific GFCI. **To read our online white paper on GFCIs: [Click Here](#)**

UL NOTICE FOR KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D

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

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

UL NOTICE FOR KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF

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 50 °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 50 °C.

IMPORTANT: 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 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 drive. Do not depend on the PWR or ST LEDs to no longer be illuminated as a guaranteed power off condition.

1.1 – MOUNTING

See Section 9 on page 11.

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 1 on page 9. Also see Section 10 on page 13.

1.3 – AC LINE INPUT CONNECTION

Connect the AC Line input as shown in Figures 1 – 5.

CAUTION! The rated AC Line voltage of the drive must match the actual AC line input voltage.

KBVF-13, 14: Rated for 115 Volt 1-phase AC Line input. Wire the AC Line input to Terminals L1 and L2. See Figure 1.

KBVF-21D, 22D, 23D, 24D, 26D: The setting of Jumper J1 must match the actual AC Line input voltage. Rated for 208/230 Volt 1-phase AC Line input with Jumper J1 (on upper PCB) set to the "230V" position (factory setting). Rated for 115 Volt 1-phase AC Line input with Jumper J1 (on upper PCB) set to the "115V" position. Wire the AC Line input to Terminals L1 and L2. See Figure 1.

KBVF-23, 24: Rated for 208/230 Volt 1-phase AC Line input. Wire the AC line input to Terminals L1 and L2. See Figure 1.

KBVF-27, 27E, 27EF, 29, 29E, 29EF: Rated for 208/230 Volt 1-phase or 3-phase AC Line Input. Wire the 1-phase AC Line input to Terminals L1 and L2. Wire the 3-phase AC Line input to Terminals L1, L2, and L3. See Figure 2.

KBVF-29 (1P), 29EF (1P): Rated for 208/230 Volt 1-phase AC Line input. Wire the AC Line input to Terminals L1 and L2. Terminal L3 is not used. See Figure 3.

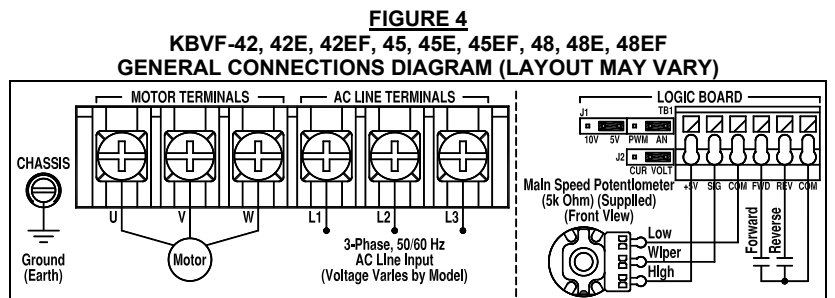
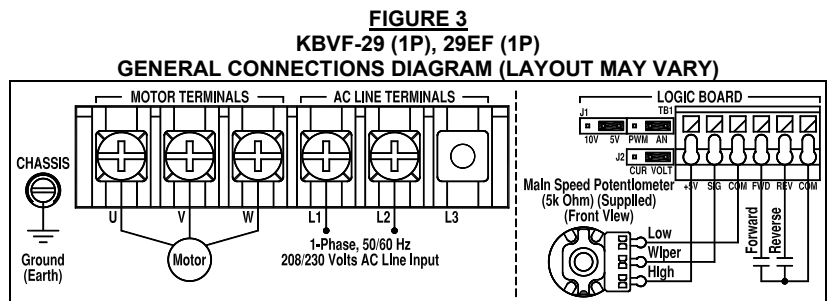
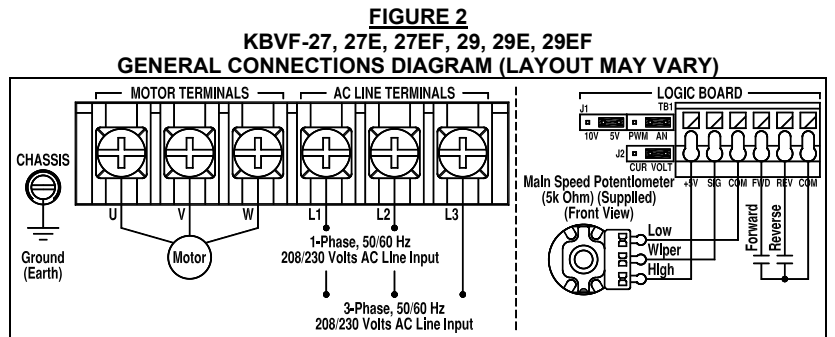
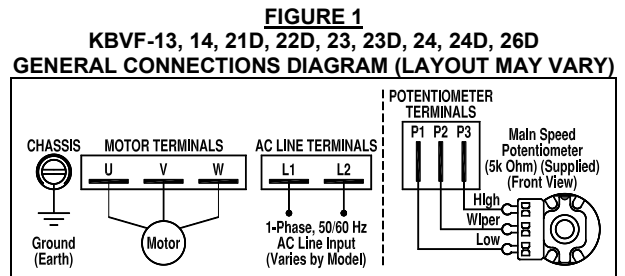
KBVF-42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: Rated for 400/460 Volt 3-phase AC Line input. Wire the AC Line input to Terminals L1, L2, and L3. See Figure 4.

1.4 – MOTOR CONNECTION

Wire the motor to Terminals U, V, and W as shown in Figures 1 – 4. 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(s) (earth) to the chassis green ground screw(s), as shown in Figures 1 – 4 above. Be sure the motor is also properly grounded. Due to its double insulated design, the KBVF-21D does not contain a ground screw.



1.6 – MAIN SPEED POTENTIOMETER CONNECTION

All drives are supplied with a remote mountable (5 kΩ) Main Speed Potentiometer to control motor speed. See Figures 1 – 4 on page 4. Also see Section 11.4 on page 15.

KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D: Wire the Main Speed Potentiometer to Terminals P1 (low), P2 (wiper), and P3 (high). The drive is factory set for forward speed operation. The jumper on CON2 is set to the "F" position. For reverse speed operation, set the jumper on CON2 to the "R" position.

KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: Wire the Main Speed Potentiometer to TB1 Terminals COM (low), SIG (wiper), and +5V (high). For forward speed operation, wire a jumper between Terminals FWD and COM. For reverse speed operation, wire a jumper between Terminals REV and COM.

1.7 – JUMPER SETTINGS

All jumpers have been factory set for most applications. Some applications may require setting of the jumpers to tailor the drive for a specific requirement. See Section 14 on pages 18 and 19.

1.8 – 60 Hz AND 50 Hz MOTOR OPERATION

The drive is factory set for 60 Hz motor operation. Jumper J1 on KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D and Jumper J5 on KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF are set to the "60Hz" position. Jumper J2 on KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D and Jumper J5 on KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF are set to the "1X" position. For 50 Hz, 100 Hz, and 120 Hz motor operation, see Section 14.2 on page 18.

1.9 – TRIMPOT ADJUSTMENTS

All trimpots have been factory set for most applications. Some applications may require adjustment of the trimpots to tailor the drive for a specific requirement. See Section 16 on page 20.

1.10 – SIGNAL FOLLOWING CONNECTION

An analog signal input can be used to control motor speed in lieu of the Main Speed Potentiometer. The drive output will linearly follow the signal input. See Section 11.5 on page 15.

KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D: Accepts a 0 – 5 Volt DC signal input. The signal input must be isolated from the AC Line. Wire the signal input positive lead (+) to Terminal P2 and the negative lead (–) to Terminal P1.

WARNING! Earth grounding signal wiring will damage the drive and void the warranty.

If a non-isolated signal is used, install the optional SIVFR-PS, which accepts voltage (0 to ±2.5 thru 0 to ±25 Volts DC) or current (4 – 20 mA DC) signal inputs.

KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: Built-in signal isolation. Accepts voltage (0 to 5 Volts DC) or current (4 – 20 mA DC) signal inputs. Wire the signal input to Terminal Block TB1.

1.11 – DIAGNOSTIC LEDs

After applying power, observe the PWR (Power On) and ST (Status) LEDs to verify proper drive operation. See Section 17 on page 21.

2 – SAFETY WARNINGS

Definition of Safety Warning Symbols



Electrical Hazard Warning Symbol: Failure to observe this warning could result in electric 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 drive contains electronic start/stop circuits, which can be used to start and stop the drive. However, these circuits are never to be used as safety disconnects since they are not fail-safe. Disconnect the input power for this purpose. Be sure to read and follow all instructions carefully. Fire and/or electrocution can result due to improper use of this product.



This product complies with all CE directives pertinent at the time of manufacture. Contact Technical support for Declaration of Conformity. Installation of a CE approved RFI filter is required. Additional shielded cable and/or AC Line cables may be required along with a signal isolator.

3 – IMPORTANT APPLICATION INFORMATION ON ELECTRONIC MOTOR OVERLOAD PROTECTION

UL approved as an overload protector for motors. The drive contains Modified I²t Overload Protection. Part of this function consists of a Current Limit (CL) circuit, which limits the drive current to a factory 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 I²t is undesirable because it causes nuisance tripping. It allows a very high motor current to develop and will turn the drive off after a short period of time. KB's RMS Current Limit Circuit 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 I²t Timer starts. If the motor continues to be overloaded at the 120% level, the drive will trip the I²t Fault after 30 minutes. If the motor is overloaded to 160% of full load, the drive will trip the I²t Fault after 6 seconds.

4 – INTRODUCTION

Thank you for purchasing the KBVF 4G Series Adjustable Frequency Drive. KB Electronics is committed to providing total customer satisfaction by producing quality products that are easy to install and operate.

The drives are variable speed controls housed in Chassis / IP20 and NEMA 4 / IP65 washdown and watertight enclosures. They are designed to operate 208 – 230 and 400/460 Volt 50 and 60 Hz PMSM motors from subfractional thru 3 HP. The sinewave 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 drive is easy to install and operate. Tailoring to specific applications is accomplished with selectable jumpers and adjustable trimpots, which eliminate the computer-like programming required on other drives. However, for most applications no adjustments are necessary.

MAIN FEATURES: Adjustable RMS Current Limit and I²t 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 on KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF 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. The drive is suitable for machine or variable torque (HVAC) applications.

ACCESSORIES: **Class A and B RFI Filter:** For KBVF-21D, 22D, 23D, 24D, 26D. Externally mounted. Provide RFI and EMI Suppression. Comply with CE Council Directive 89/336/EEC relating to the Class A Industrial Standard and Class B Residential Standard. **Class A RFI Filter:** For KBVF-27EF, 29EF, 29EF (1P), 42EF, 45EF, 48EF. Built-in. Provide RFI and EMI Suppression. Comply with CE Council Directive 89/336/EEC relating to the Class A Industrial Standard. **Liquidtight Fittings:** For KBVF-27E, 27EF, 29E, 29EF, 29EF (1P), 42E, 42EF, 45E, 45EF, 48E, 48EF. **SIVFR-PS Signal Isolator with Power supply and Run/Fault Relay:** For KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D. Can be used for unidirectional (single-ended) or bidirectional (wig-wag) speed control and accepts voltage and current signal inputs. **Dynamic Brake Module:** Provides up to 25% continuous and 200% instantaneous braking torque (maximum 1 HP (0.75 kW)).

4.1 – STANDARD FEATURES

- **Simple to Operate:** Does not require programming. Uses trimpots and jumpers, which are factory set for most applications.
- **Diagnostic LEDs:** Power on (PWR) and drive status (ST).
- **Jumper Selection of Drive Output frequency:** Increases the motor speed up to two times the rated RPM.
- **Compatible with GFCIs:** With optional software. Contact Technical support
- **Industry Standard Mounting.**
- **IP20 Finger-Safe Cover:** KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D, 27, 29, 29 (1P), 42, 45, 48.
- **NEMA 4 / IP65 Enclosure:** KBVF-27E, 27EF, 29E, 29EF, 29EF (1P), 42E, 42EF, 45E, 45EF, 48E, 48EF.
- **Run/Fault Relay Output Contacts:** Built-in on KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF. The optional SIVFR-PS is required on KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D. 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.
- **Quick-Connect Terminals:** KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D. Facilitates wiring of AC Line, motor, remote Main Speed Potentiometer, and signal inputs.
- **Terminal Blocks:** KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF. Facilitates wiring of AC Line, motor, remote Main Speed Potentiometer, Run/Fault Relay Output Contacts, and signal inputs.
- **Signal Isolation:** Built-in on KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF. The optional SIVFR-PS is required on KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D. Provides isolation between a non-isolated signal and the drive.

4.2 – PROTECTION FEATURES

- **Motor Overload (I²t) with RMS Current Limit:** Provides motor overload protection which prevents motor burnout and eliminates nuisance trips. UL approved as an electronic overload protector for motors.
- **Electronic Inrush Current Limit (EICL™):** Eliminates harmful inrush AC Line current during startup. KBVF-21D, 22D contain ICL in lieu of EICL™.
- **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.
- **AC Line Input Phase Loss Detection:** On KBVF-29, 45, 48 the drive trips if an AC Line input phase is lost.
- **Motor Filter:** Built-in on KBVF-21D, 22D, 13, 23, 23D, 14, 24, 24D, 26D. Reduces harmful voltage spikes to the motor.
- **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.**

4.3 – PERFORMANCE 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.

4.4 – TRIMPOT ADJUSTMENTS

- **Minimum Speed (MIN):** Sets the minimum speed of the motor.
- **Maximum Speed (MAX):** Sets the maximum speed of the motor.
- **Acceleration (ACC):** Sets the amount of time for the motor to accelerate from zero speed to full speed.
- **Deceleration (DEC):** Sets the amount of time for the motor to decelerate from full speed to zero speed.
- **Slip Compensation (COMP):** Maintains set motor speed under varying loads.
- **Current Limit (CL):** Sets the current limit (overload) which limits the maximum current (torque) to the motor.

FIGURE 5
KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D
DRIVE LAYOUT

(LAYOUT MAY VARY SLIGHTLY) (KBVF-22 SHOWN WITHOUT THE FINGER-SAFE-COVER)

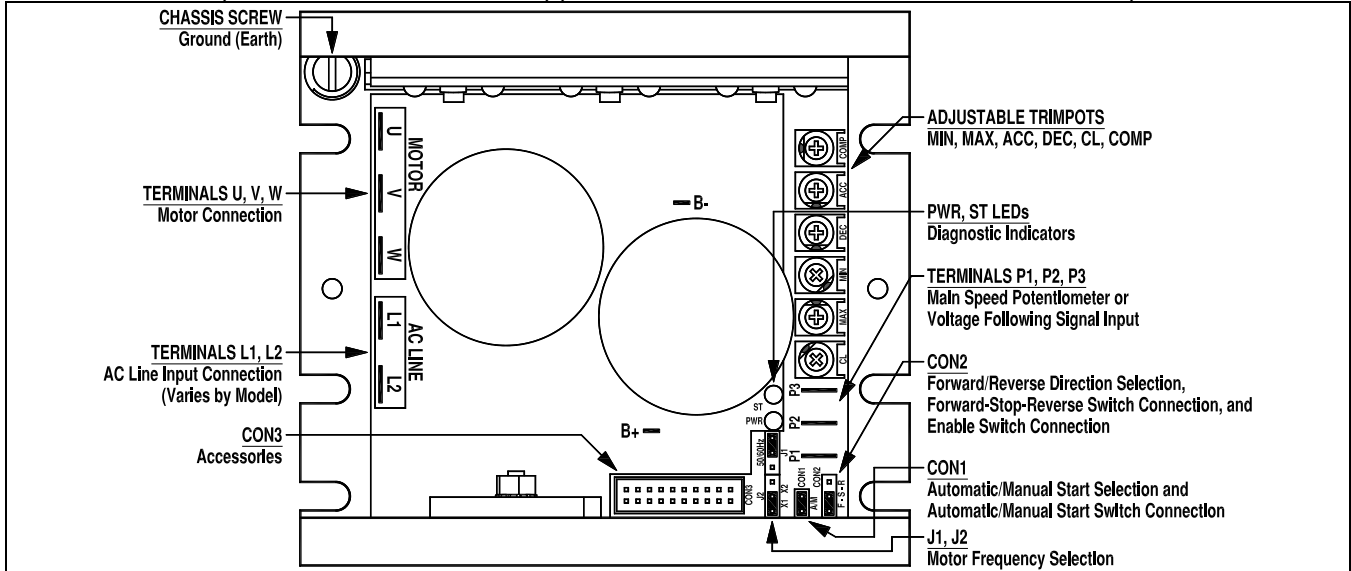


FIGURE 6
KBVF-27, 29, 29 (1P), 42, 45, 48
DRIVE LAYOUT

(LAYOUT MAY VARY SLIGHTLY) (SHOWN WITHOUT THE FINGER-SAFE-COVER)

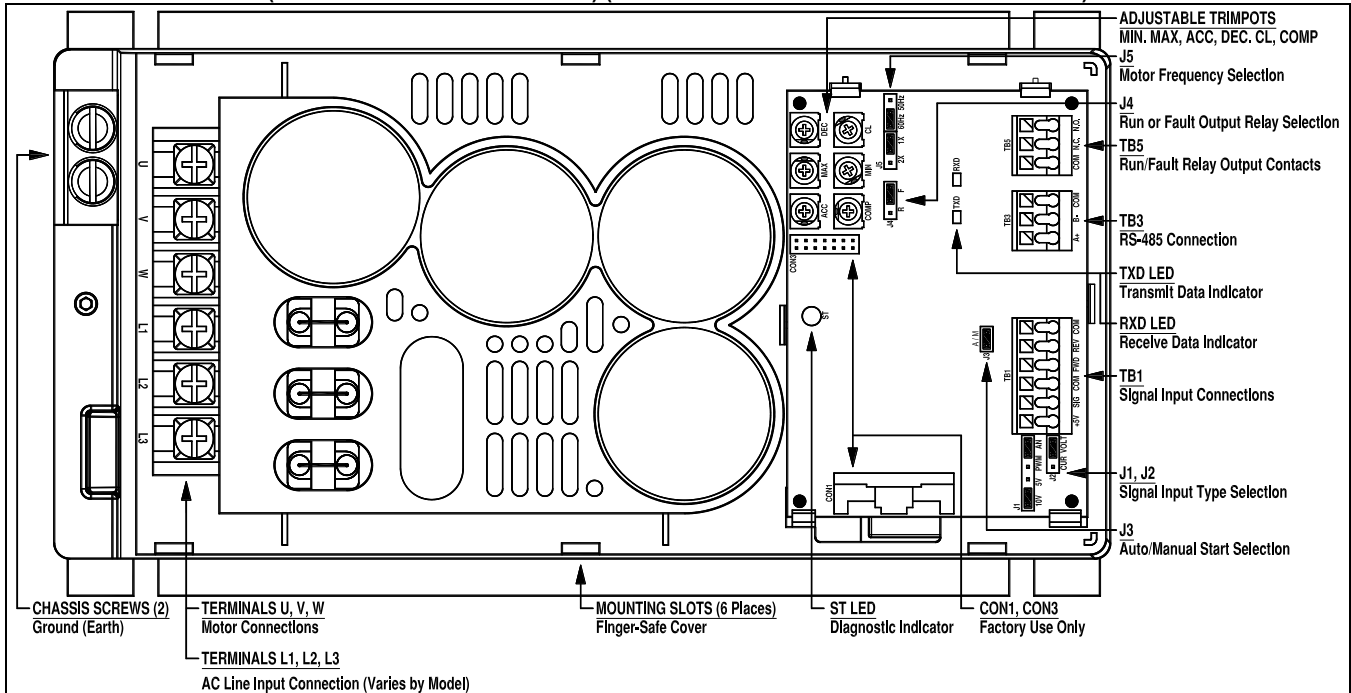


FIGURE 7
KBVF-27E, 27EF, 29E, 29EF, 29EF (1P), 42E, 42EF, 45E, 45EF, 48E, 48EF
DRIVE LAYOUT
(LAYOUT MAY VARY SLIGHTLY) (SHOWN WITHOUT THE ENCLOSURE COVER)

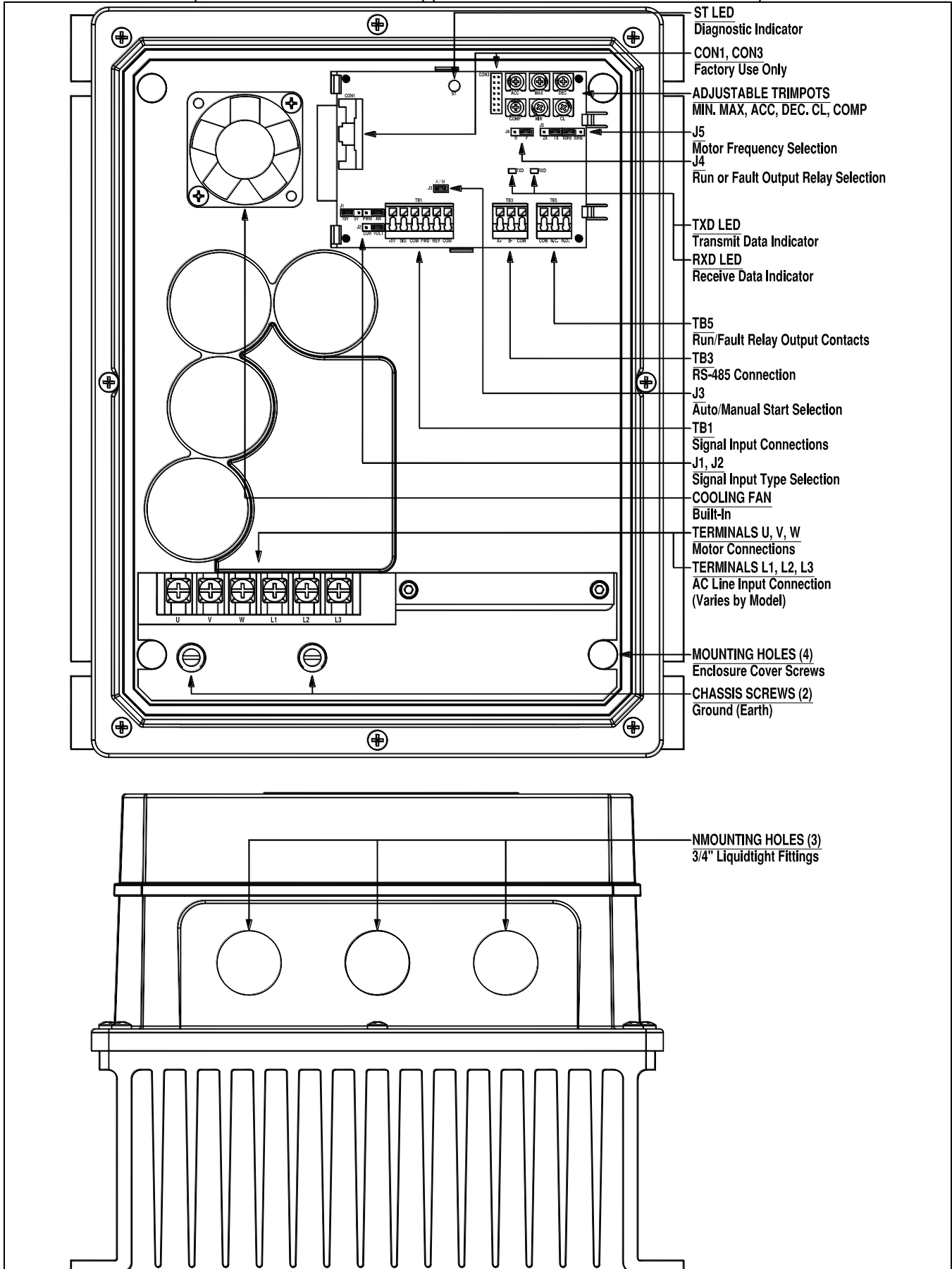


TABLE 1
ELECTRICAL RATINGS

Model No.	Part No. ¹	Enclosure	Ac Line Input			Recommended Fuse ⁴ or Circuit Breaker Rating (Amps)	Output			Net Weight	
			Volts AC (50/60 Hz)	Phase (Φ)	Maximum Current (Amps AC)		Voltage Range (Volts AC)	Maximum Continuous Load Current (Amps/Phase)	Maximum Horsepower (HP (kW))	lbs.	kg
KBVF-13	TBA	IP20	115	1	9.6	15	0 – 230	2.4	1/2 (0.37)	1.3	0.6
KBVF-14	TBA	IP20	208/230	1	14.0	20	0 – 230	4.0	1 (0.75)	2.2	1.0
KBVF-21D	TBA	IP20	115	1	4.0	5	0 – 230	1.0	1/10 (0.07)	0.7	0.3
			208/230	1	2.5						
KBVF-22D	TBA	IP20	115	1	6.0	10	0 – 230	1.5	1/4 (0.18)	1.3	0.6
			208/230	1	3.8	5					
KBVF-23	TBA	IP20	208/230	1	6.0	10	0 – 230	2.4	1/2 (0.37)	1.3	0.6
KBVF-23D	TBA	IP20	115	1	9.6	15	0 – 230	2.4	1/2 (0.37)	1.3	0.6
			208/230	1	6.0	10					
KBVF-24	TBA	IP20	208/230	1	10.0	15	0 – 230	4.0	1 (0.75)	2.2	1.0
KBVF-24D	TBA	IP20	115	1	14.0	20	0 – 230	4.0	1 (0.75)	2.2	1.0
			208/230	1	10.0	15					
KBVF-26D ²	TBA	IP20	115	1	22.0	25	0 – 230	5.5	1½ (1.13)	2.9	1.3
			208/230	1	14.0	20					
KBVF-27	TBA	IP20	208/230	1	17.0	20	0 – 230	6.7	2 (1.5)	4.1	1.9
				3	8.7	10					
KBVF-27E	TBA	NEMA 4 / IP65	208/230	1	17.0	20	0 – 230	6.7	2 (1.5)	11.1	5
				3	8.0	10					
KBVF-27EF	TBA	NEMA 4 / IP65	208/230	1	17.0	20	0 – 230	6.7	2 (1.5)	11.1	5
				3	8.0	10					
KBVF-29	TBA	IP20	208/230	3	11.7	15	0 – 230	9.0	3 (2.25)	4.6	2.1
KBVF-29 (1P)	TBA	IP20	208/230	1	21.0	25	0 – 230	9.0	3 (2.25)	3.95	1.8
KBVF-29E	TBA	NEMA 4 / IP65	208/230	3	12.0	15	0 – 230	9.0	3 (2.25)	11.1	5
KBVF-29EF	TBA	NEMA 4 / IP65	208/230	3	12.0	15	0 – 230	9.0	3 (2.25)	11.1	5
KBVF-29EF (1P)	TBA	NEMA 4 / IP65	208/230	1	21.0	25	0 – 230	9.0	3 (2.25)	3.95	1.8
KBVF-42	TBA	IP20	400/460	3	2.6	5	0 – 400/460	2.0	1 (0.75)	11.1	5
KBVF-42E	TBA	NEMA 4 / IP65	400/460	3	—	—	0 – 400/460	—	1 (0.75)	11.1	5
KBVF-42EF	TBA	NEMA 4 / IP65	400/460	3	—	—	0 – 400/460	—	1 (0.75)	11.1	5
KBVF-45 ³	TBA	IP20	400/460	3	5.3	10	0 – 400/460	4.6	3 (2.25)	11.1	5
KBVF-45E ³	TBA	NEMA 4 / IP65	400/460	3	6.0	10	0 – 400/460	4.6	3 (2.25)	11.1	5
KBVF-45EF ³	TBA	NEMA 4 / IP65	400/460	3	6.0	10	0 – 400/460	4.6	3 (2.25)	11.1	5
KBVF-48 ³	TBA	NEMA 4 / IP65	400/460	3	—	—	0 – 400/460	—	3 (2.25)	11.1	5
KBVF-48E ³	TBA	NEMA 4 / IP65	400/460	3	—	—	0 – 400/460	—	3 (2.25)	11.1	5
KBVF-48EF ³	TBA	NEMA 4 / IP65	400/460	3	—	—	0 – 400/460	—	3 (2.25)	11.1	5

Notes: 1. The Part No. is TBA (To Be Assigned) and is OEM specific. 2. KBVF-26D is rated 2 HP (1.5 kW) for most premium efficiency motors. 3. KBVF-45, 45E, 45EF, 48, 48E, 48EF are rated 0 – 400 Volts AC for 50 Hz motor operation and 0 – 460 Volts AC for 60 Hz motor operation. 4. For fuse type, see Section 10 on page 13.

TABLE 2
GENERAL PERFORMANCE SPECIFICATIONS

Description	Specification	Factory Setting
115 Volt AC Line Input Voltage Operating Range (Volts AC $\pm 15\%$)	115	—
208/230 Volt AC Line Input Voltage Operating Range (Volts AC $\pm 15\%$)	208 / 230	—
400/460 Volt AC Line Input Voltage Operating Range (Volts AC $\pm 15\%$)	380 – 460	—
Maximum Load (% Current Overload for 2 Minutes)	150	—
Carrier, Switching Frequency (kHz)	16, 8	—
Signal Following Input Voltage Range (Volts DC)	0 – 5	—
Run/Fault Relay Output Contact Rating (Amps at 30 Volts DC, 125 Volts AC, 250 Volts AC)	1, 0.5, 0.25	—
Output Frequency Resolution (Hz)	0.06	—
Minimum Speed Trimpot (MIN) Range (% Frequency Setting)	0 – 40	0
Maximum Speed Trimpot (MAX) Range (% Frequency Setting)	70 – 110	100
Acceleration Trimpot (ACC) Range (Seconds)	0.3 – 20	1.5
Deceleration Trimpot (DEC) Range (Seconds)	0.3 – 20	1.5
Slip Compensation Trimpot (COMP) Range at Drive Rating (Volts/Hz)	0 – 3	1.5
Current Limit Trimpot (CL) Range (% Full Load)	40 – 200	160
Motor Frequency Setting (Hz)	50, 60	60
Output Frequency Multiplier (1X, 2X) ¹	1, 2	1
Minimum Operating Frequency at Motor (Hz)	0.3	—
Speed Range (Ratio)	60:1	—
Speed Regulation (30:1 Speed Range, 0 – Full Load) (% Base Speed) ²	2.5	—
Overload Protector Trip Time for Stalled Motor (Seconds)	6	—
Undervoltage/Overvoltage Trip Points for 115 Volt AC Line Input ($\pm 5\%$) (Volts AC) ³	76 – 141	—
Undervoltage/Overvoltage Trip Points for 208/230 Volt AC Line Input ($\pm 5\%$) (Volts AC) ³	151 – 282	—
Undervoltage/Overvoltage Trip Points for 400/460 Volt AC Line Input ($\pm 5\%$) (Volts AC) ³	302 – 567	—
Braking	Regenerative ⁴	—
Operating Temperature Range ($^{\circ}\text{C}$ / $^{\circ}\text{F}$) for KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D, 27, 29, 29 (1P), 42, 45, 48	0 – 40 / 32 – 104	—
Operating Temperature Range ($^{\circ}\text{C}$ / $^{\circ}\text{F}$) for KBVF-27E, 27EF, 29E, 29EF, 29EF (1P), 42E, 42EF, 45E, 45EF, 48E, 48EF	0 – 50 / 32 – 122	—
Operating Humidity Range (% Relative, Non-Condensing)	0 – 95	—
Storage Temperature ($^{\circ}\text{C}$ / $^{\circ}\text{F}$)	-25 – +85 / -13 – +185	—

Notes: 1. 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. 2. Dependent on motor performance. 3. Do not operate the drive outside the specified AC Line input voltage operating range. 4. DC Injection Braking available. Requires factory programming. Contact Technical Support.

7 – IP20 FINGER-SAFE COVER (KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D, 27, 29, 29 (1P), 42, 45, 48)

The Finger-Safe Cover provides protection against accidental contact with high voltage. The Finger-Safe Cover will have to be removed before wiring the drive or setting selectable jumpers. All trimpots can be readjusted with the Finger-Safe Cover installed.



WARNING! High Voltage! Disconnect main power when removing or installing the Finger-Safe Cover. To prevent accidental contact with high voltage, it is required that the Finger-Safe Cover be properly installed onto the drive after all wiring and setup is complete. It provides protection against electric shock which limits the potential liability to the equipment manufacturer and installer.

7.1 – REMOVING THE FINGER-SAFE COVER

Notice the orientation of the Finger-Safe Cover before removing it. To remove the Finger-Safe Cover, gently lift the retainer clips until they disengage from the base.

7.2 – INSTALLING THE FINGER-SAFE COVER

To install the Finger-Safe Cover, be sure it is properly oriented onto the base and the retainer clips are aligned. Gently push the Finger-Safe Cover onto the base until the retainer clips are fully engaged with the base.

8 – NEMA 4 / IP65 ENCLOSURE COVER (KBVF-27E, 27EF, 29E, 29EF, 29EF (1P), 42E, 42EF, 45E, 45EF, 48E, 48EF)

The enclosure provides washdown and watertight protection for indoor and outdoor use. The optional Liquidtight Fittings Kit provides a liquidtight seal for wiring the drive.

WARNING! High Voltage! Disconnect main power when removing or installing the cover. To prevent accidental contact with high voltage, it is required that the cover be properly installed onto the drive after all wiring and setup is complete. It provides protection against electric shock which limits the potential liability to the equipment manufacturer and installer.

8.1 – REMOVING THE ENCLOSURE COVER

Notice the orientation of the cover before removing it. To remove the cover, the four screws must be removed. The screws are not captive and care should be taken so they do not fall into the drive when removed. Also, when removing the cover, be careful not to pull on the interconnecting wires from the enclosure cover to the drive.

8.2 – INSTALLING THE ENCLOSURE COVER

To install the enclosure cover, be sure it is properly oriented onto the base. After mounting and wiring, align the cover make sure the wires do not get caught or crimped. Tighten the four screws so that the gasket is slightly compressed. The recommended tightening torque is 10 in-lbs. (11.5 kg-cm) – do not overtighten. See Figures 12 on page 13 for the tightening sequence.

9 – MOUNTING

It is recommended that the drive be mounted vertically on a flat surface with adequate ventilation. Leave enough room to allow for AC Line, motor connections, and any other wiring that is required. Care should be taken to avoid extreme hazardous locations where physical damage to the drive 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, specified in Table 2 on page 10, is not exceeded at full drive rating. See Figures 8 – 11 on pages 11 – 13.

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

FIGURE 8
KBVF-13, 21D, 22D, 23, 23D
MECHANICAL SPECIFICATIONS (In / mm)
(KBVF-22D SHOWN)

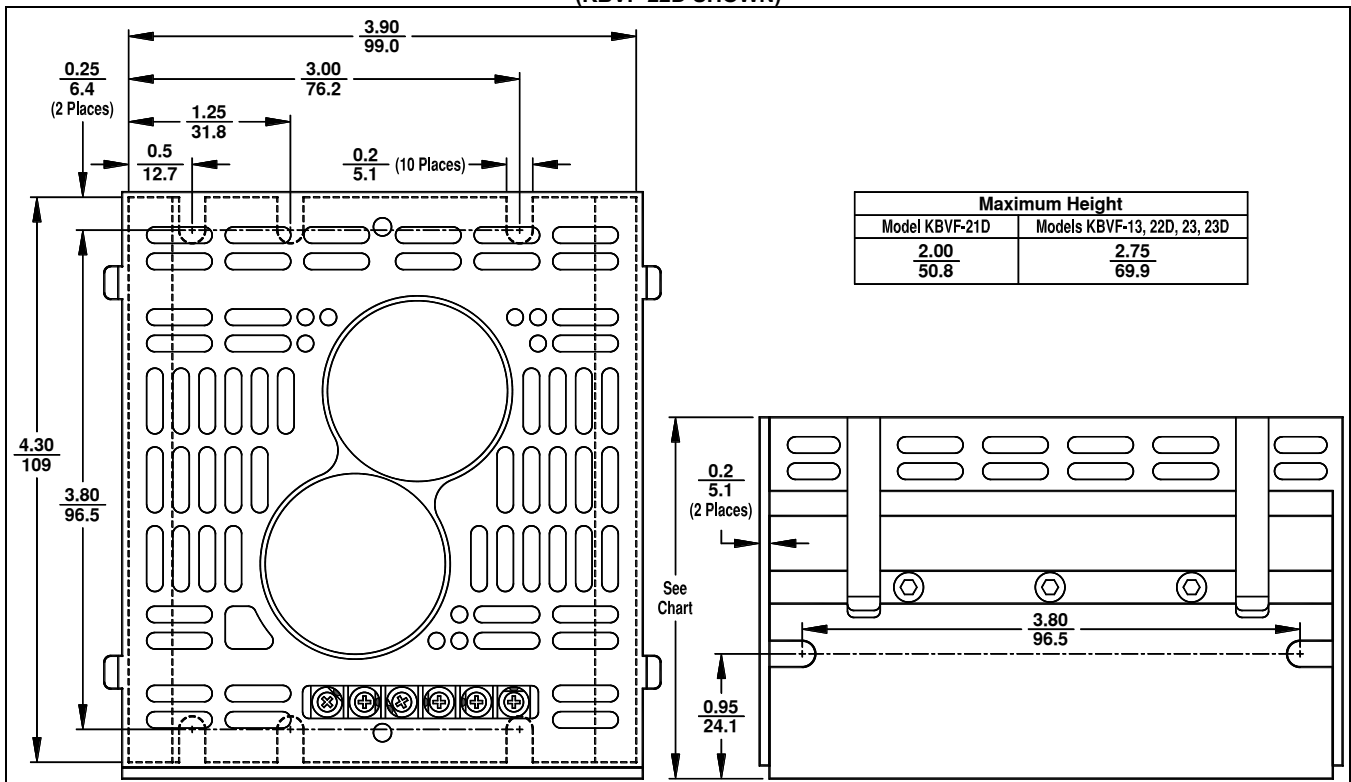


FIGURE 9
KBVF-14, 24, 24D, 26D
MECHANICAL SPECIFICATIONS (In / mm)
(KBVF-26D SHOWN)

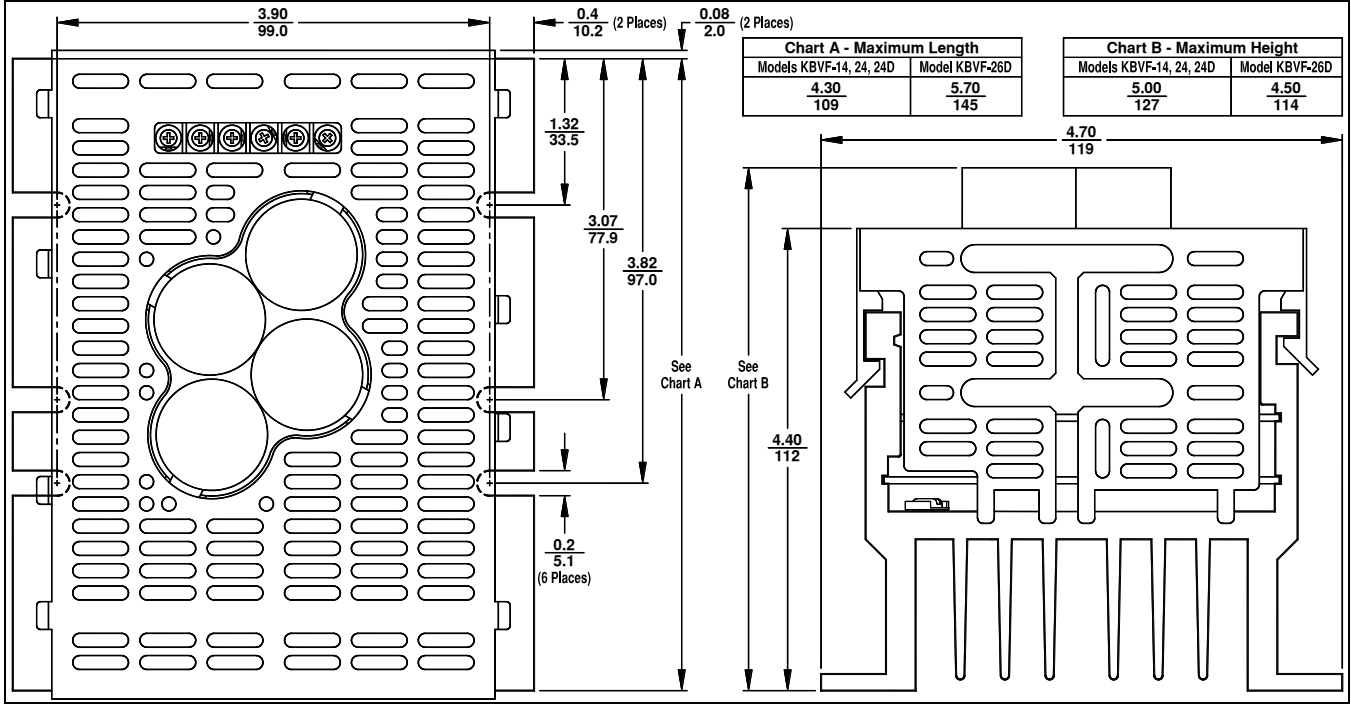


FIGURE 10
KBVF-27, 29, 29 (1P), 42, 45, 48
MECHANICAL SPECIFICATIONS (In / mm)

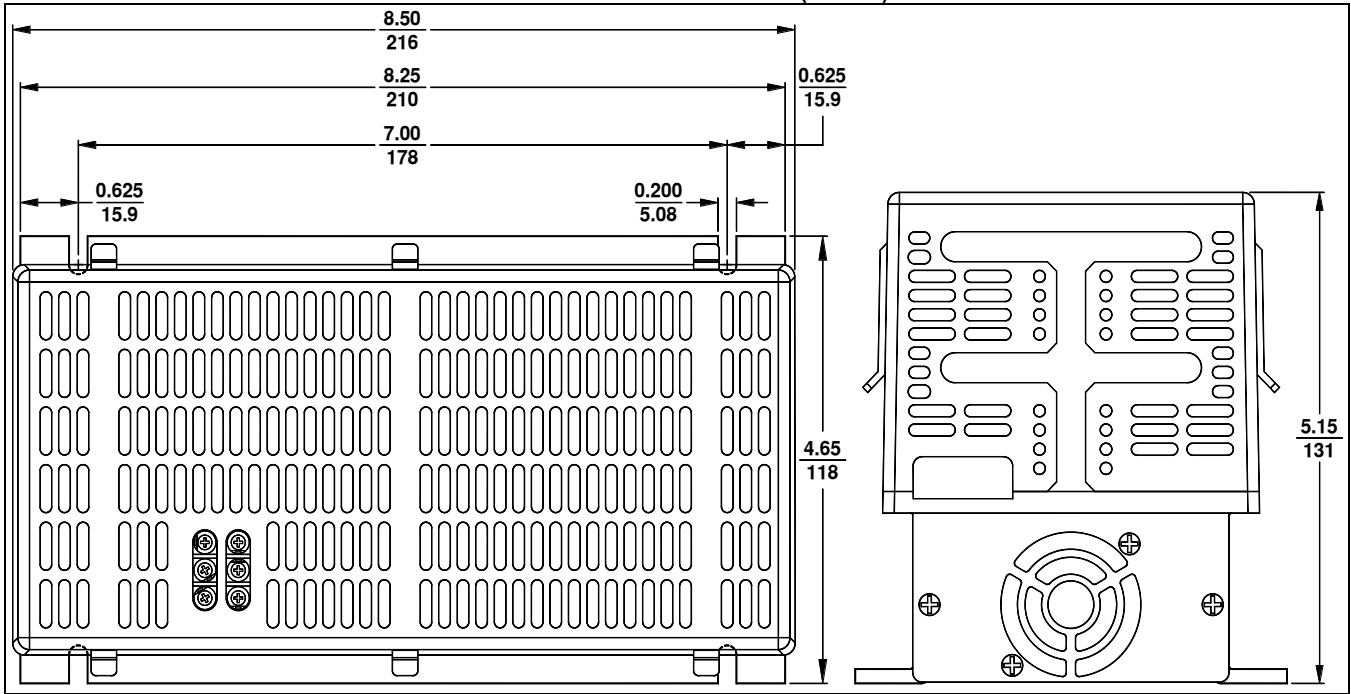
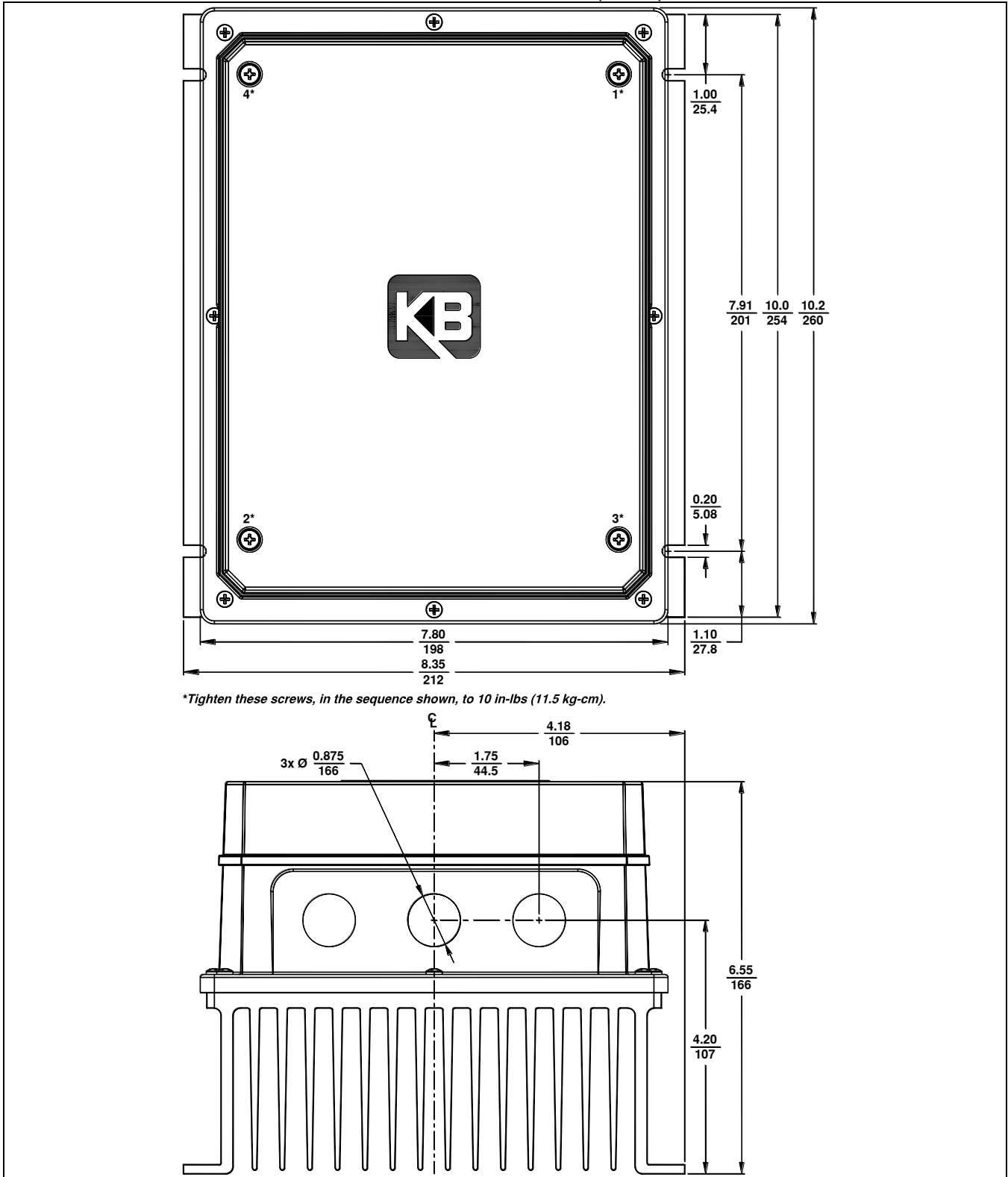


FIGURE 11
KBVF-27E, 27EF, 29E, 29EF, 29EF (1P), 42E, 42EF, 45E, 45EF, 48E, 48EF
MECHANICAL SPECIFICATIONS (In / mm)



*Tighten these screws, in the sequence shown, to 10 in-lbs (11.5 kg-cm).

10 – 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. For the recommended fuse size, see Table 1 on page 9.

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

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

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 1 on page 9.

To maintain the watertight integrity of the NEMA 4 / IP65 enclosure (KBVF-27E, 27EF, 29E, 29EF, 29EF (1P), 42E, 42EF, 45E, 45EF, 48E, 48EF), use the Liquidtight Fittings Kit and wiring which are appropriate for the application. See Section 19 on page 21.

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.

WARNING! High Voltage! 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 and motor.

WARNING! High Voltage! On KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D remote connections of the Main Speed Potentiometer, switches, signal following, etc., will have wiring that is at line potential. It is required that the SIVFR-PS be installed.

TABLE 3
KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF
TERMINAL BLOCK WIRE SIZE AND TIGHTENING TORQUE SPECIFICATIONS¹

Terminal Block	Description	Maximum Wire Size (Cu)		Recommended Tightening Torque	
		AWG	mm ²	in-lbs.	kg-cm
TB1	AC Line Input and Motor Connections (U, V, W, L1, L2, L3)	12	3.3	12	14
TB1 ²	Signal Input Connections (+5V, SIG, COM, FWD, REV, COM)	16	1.3	—	—
TB3 ²	Communications Connections (A+, B-, COM)	16	1.3	—	—
TB5 ²	Run/Fault Relay Output Contacts Connections (COM, N.C., N.O.)	16	1.3	—	—

Notes: 1. KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D contain quick-connect terminals in lieu of terminal blocks for AC Line Input, motor, and signal input connections. 2. KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF Terminal Blocks TB1, TB2, and TB3 have push-in spring connections which do not require tools. To remove the wire, press on the tab above the terminal.

11.1 – AC LINE INPUT CONNECTION

Connect the AC Line input to Terminal Block TB1. See Figures 12 – 16.

CAUTION! The rated AC Line voltage of the drive must match the actual AC Line input voltage. On KBVF-21D, 22D, 23D, 24D, 26D the setting of Jumper J1 must match the actual AC Line input voltage.

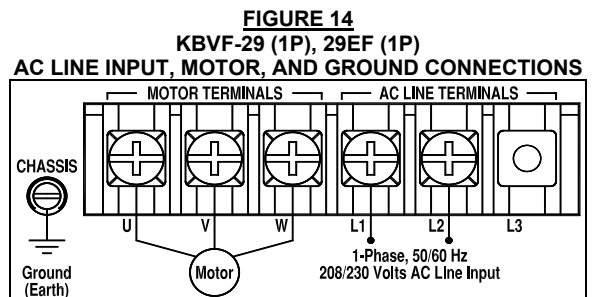
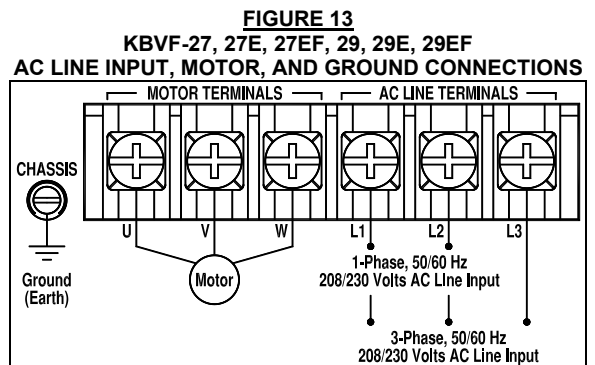
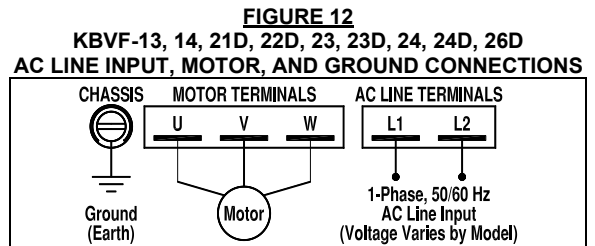
KBVF-13, 14: Rated for 115 Volt 1-phase AC Line input. Wire the AC Line input to Terminals L1 and L2. See Figure 12.

KBVF-21D, 22D, 23D, 24D, 26D: The setting of Jumper J1 must match the actual AC Line input voltage. Rated for 208/230 Volt 1-phase AC Line input with Jumper J1 (on upper PCB) set to the "230V" position (factory setting). Rated for 115 Volt 1-phase AC Line input with Jumper J1 (on upper PCB) set to the "115V" position. Wire the AC Line input to Terminals L1 and L2. See Figure 12.

KBVF-23, 24: Rated for 208/230 Volt 1-phase AC Line input. Wire the AC Line input to Terminals L1 and L2. See Figure 12.

KBVF-27, 27E, 27EF, 29, 29E, 29EF: Rated for 208/230 Volt 1-phase or 3-phase AC Line Input. Wire the 1-phase AC Line input to Terminals L1 and L2. Wire the 3-phase AC Line input to Terminals L1, L2, and L3. See Figure 13.

KBVF-29 (1P), 29EF (1P): Rated for 208/230 Volt 1-phase AC Line input. Wire the AC Line input to Terminals L1 and L2. Terminal L3 is not used. See Figure 14.

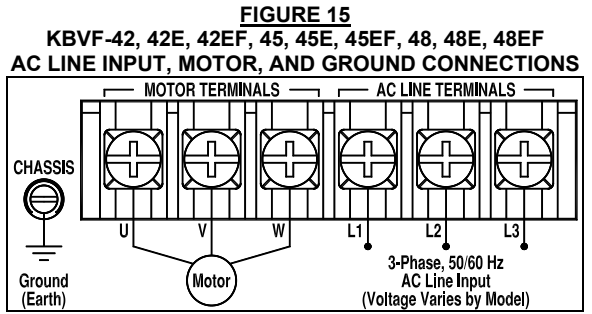


KBVF-42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: Rated for 400/460 Volt 3-phase AC Line input. Wire the AC Line input to Terminals L1, L2, and L3. See Figure 15.

11.2 – MOTOR CONNECTION

Connect the motor to Terminals U, V, W. Motor cable length should not exceed 100 feet (30 m) – special reactors may be required – contact Technical Support. See Figures 12 – 15 on pages 14 and 15.

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



11.3 – GROUND CONNECTION

Connect the ground wire (Earth) to the green ground screw. See Figures 12 – 15 on pages 14 and 15.

11.4 – MAIN SPEED POTENTIOMETER CONNECTION

All drives are supplied with a remote mountable (5 kΩ) Main Speed Potentiometer to control motor speed.

Note: When mounting the Main Speed Potentiometer, install the insulating disc (supplied) between the potentiometer and the panel.

KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 24P, 26D: Wire the Main Speed Potentiometer to Terminals P1 (low), P2 (wiper), and P3 (high). Motor direction is selected with a Forward-Stop-Reverse Switch or contact wired to the FSR CON2. See Figure 16 and Section 11.7 on page 16.

Application Note: If it is required that the Remote Main Speed Potentiometer be isolated from the AC Line potential, install the optional SIVFR-PS.

KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: Wire the Main Speed Potentiometer to Terminals COM (low), SIG1, (wiper), and +5V (high). Motor direction is selected with a Forward-Stop-Reverse Switch or contact wired to Terminals 0V (common of switch), FWD, and REV. If a Forward-Stop-Reverse Switch is not used, a jumper must be installed between Terminals 0V and FWD (for forward speed operation) or between Terminals 0V and REV (for reverse speed operation). See Figure 17.

FIGURE 16
KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D
MAIN SPEED POTENTIOMETER CONNECTION

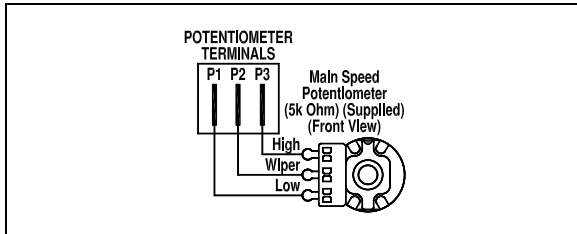
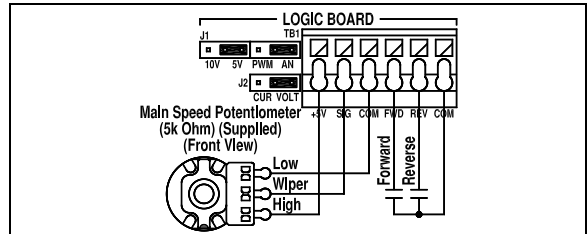


FIGURE 17
KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P),
42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF
MAIN SPEED POTENTIOMETER CONNECTION



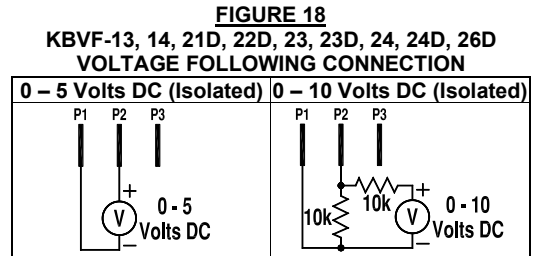
11.5 – SIGNAL FOLLOWING CONNECTIONS

The drive output will linearly follow the analog signal input.

11.5.1 – VOLTAGE FOLLOWING

A 0 – 5 Volt DC analog signal input can be used to control motor speed in lieu of the Main Speed Potentiometer.

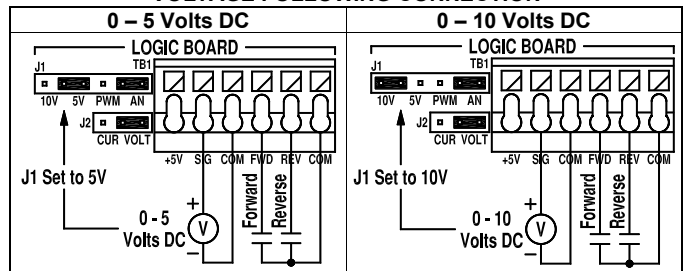
KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D: Wire the isolated signal input positive (+) lead to Terminal P2 and the negative (-) lead to Terminal P1. With external circuitry, a 0 – 10 Volt DC analog signal can also be used. See Figure 18.



WARNING! For KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D 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 SIVFR-PS be installed when using signal following. If a non-isolated signal is used, install the SIVFR-PS.

KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: Wire the signal input positive (+) lead to TB1 Terminal SIG and the negative (-) lead to TB1 Terminal COM. With a 0 – 10 Volt DC analog signal can also be used. Set Jumper J1 to the "5V" and "AN" positions. Set Jumper J2 to the "VOLT" position. See Figure 19.

FIGURE 19
KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E,
42EF, 45, 45E, 45EF, 48, 48E, 48EF
VOLTAGE FOLLOWING CONNECTION



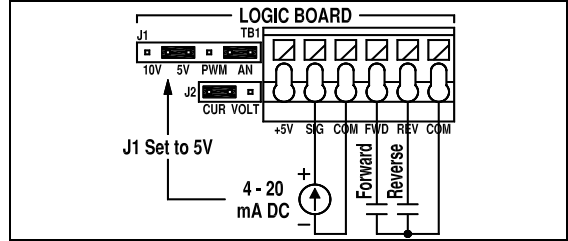
11.5.2 – CURRENT FOLLOWING CONNECTION

A 4 – 20 mA DC analog signal input can be used to control motor speed in lieu of the Main Speed Potentiometer.

KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D: The optional SIVFR-PS is required.

KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: Wire the signal input positive (+) lead to TB1 Terminal SIG and the negative (-) lead to TB1 Terminal COM. Jumper J1 must be set to the "5V" position. Set Jumper J2 to the "CUR" position. See Figure 20.

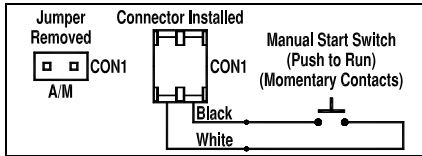
FIGURE 20
KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF
CURRENT FOLLOWING CONNECTION



11.6 – MANUAL START SWITCH CONNECTION

The Manual Start Mode is used to manually start the drive or restart the drive (reset) if a fault has occurred. To operate the drive in the Manual Start Mode, remove the factory installed jumper that is on the A/M connector. Install the 2-wire connector (supplied). The connector must be wired to a momentary switch or contact. See Figure 21.

FIGURE 21
MANUAL START SWITCH CONNECTION



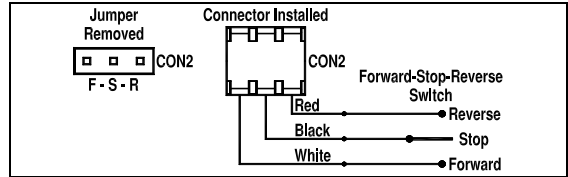
In the Manual Start Mode, the drive will trip due to all faults (Overvoltage, Undervoltage, Short Circuit, and I²t) and remain tripped even when the fault is cleared. To Start/Reset the drive, the switch or contact must be manually closed. Also, the drive must be restarted each time the AC Line is interrupted. For Automatic Start, see Section 14.3 on page 18.

11.7 – FORWARD-STOP-REVERSE SWITCH CONNECTION

The drive can be operated with a "maintained" type Forward-Stop-Reverse switch, contact, or open collector.

Application Note: The drive can also be factory programmed for a "momentary" type switch – contact Technical Support.

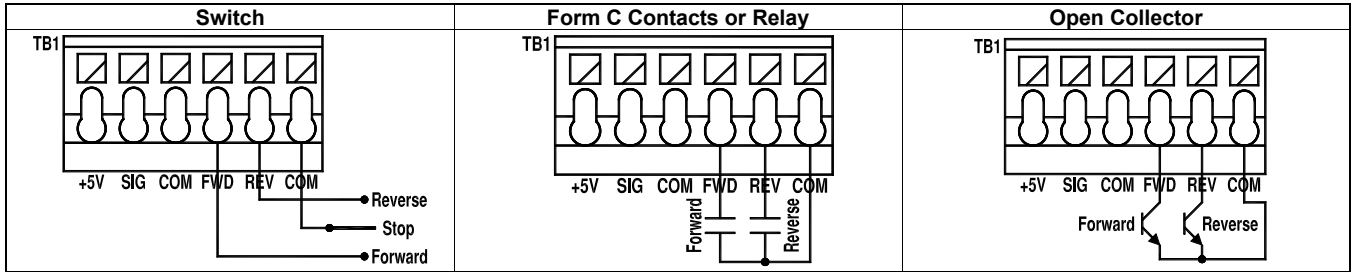
FIGURE 22
KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D
FORWARD-STOP-REVERSE SWITCH CONNECTION



KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D: Remove the factory installed jumper on CON2 and install the 3-wire connector (supplied). CON2 is located on the lower PCB. Wire the switch to the 3-wire connector. See Figure 22.

KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: Wire the switch to TB1 Terminals FWD, REV, and COM. See Figure 23.

FIGURE 23
KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF
FORWARD-STOP-REVERSE SWITCH CONNECTIONS



11.8 – ENABLE SWITCH CONNECTION

The drive can be started and stopped with a "maintained" type Enable Switch (close to run, open to stop).

Application Notes: 1. A contact or open collector can also be used in lieu of a switch. 2. The drive can also be factory programmed for a "momentary" type switch – contact Technical Support.

KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D: Remove the factory installed jumper on CON2 and install the 3-wire connector (supplied). The connector must be wired to a "maintained" switch. For Forward Enable, wire the switch to the white and black wires (the red wire is not used). For Reverse Enable, wire the switch to the red and black wires (the white wire is not used). See Figure 24.

KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: For Forward Enable, wire the switch to TB1 Terminals FWD and COM. For Reverse Enable, wire the switch to TB1 Terminals REV and COM. See Figure 25.

FIGURE 24
KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D
ENABLE SWITCH CONNECTION

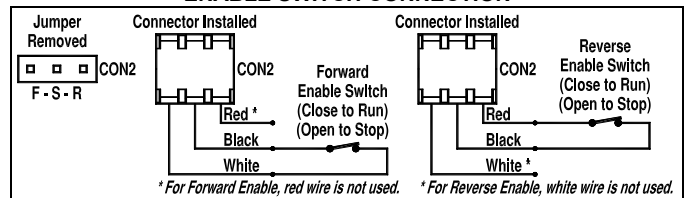
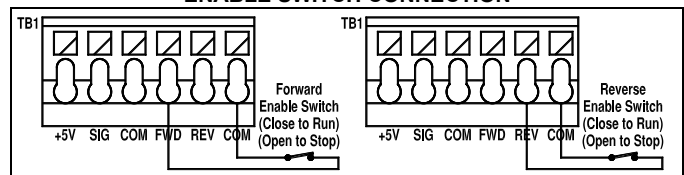


FIGURE 25
KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF
ENABLE SWITCH CONNECTION



11.9 – RUN/FAULT RELAY CONNECTION

The Run/Fault Relay Output Contacts 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. For Run Relay Operation, set Jumper J4 to the "R" position. For Fault Relay Operation, set Jumper J4 to the "F" position. The Run/Fault Relay Contact status for various drive operating conditions is shown in Table 4.

KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D: The optional SIVFR-PS is required.

KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: The Run/Fault Relay Output normally open (N.O.) and normally closed (N.C.) contacts are located at Terminal Block TB5. See Figure 26.

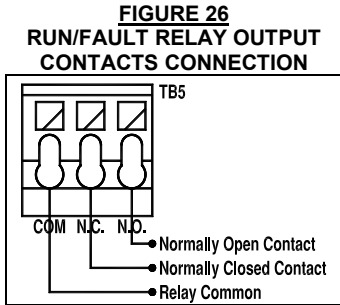


TABLE 4
DRIVE OPERATING CONDITION AND RUN/FAULT RELAY CONTACT STATUS

Drive Operating Condition	Description	Run Relay Operation (J4 set to the "R" Position) (Factory Setting)		Fault Relay Operation (J4 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, I²t, Short Circuit, Undervoltage and Overvoltage.

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

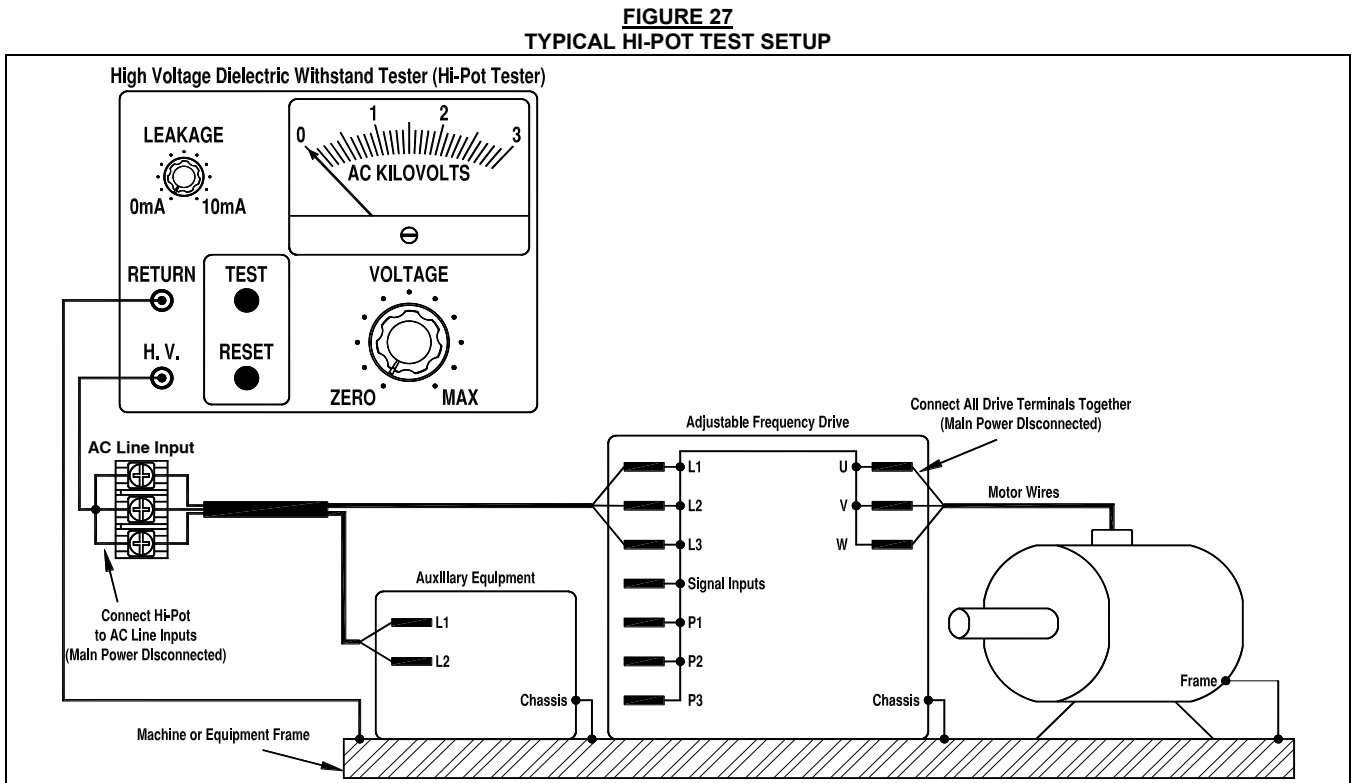
Testing agencies such as UL, CSA, VDE, etc., usually require that equipment undergo a hi-pot test. In order to prevent catastrophic damage to the drive which has been installed in the equipment, the following procedure is recommended. A typical hi-pot test setup is shown in Figure 27. All drives have 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.

Note: The hi-pot tester must have an automatic ramp-up to the test voltage and an automatic ramp-down to zero voltage. If the hi-pot tester does not have automatic ramping, then the hi-pot output must be manually increased to the test voltage and then manually reduced to zero. 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.



13 – 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.

14 – ON-BOARD PARAMETERS – SELECTABLE JUMPERS

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

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

14.1 – AC LINE INPUT VOLTAGE SELECTION (KBVF-21D, 22D, 23D, 24D, 26D)

CAUTION! The rated AC Line voltage of the drive must match the actual AC Line input voltage. The drive setting must match the actual AC Line input voltage.

KBVF-21D, 22D, 23D, 24D: For 208/230 Volt AC Line input (factory setting), do not install the supplied jumper. For 115 Volt AC Line input, install the supplied jumper onto Terminals J1A and J1B. See Figure 28.

KBVF-26D: For 208/230 Volt AC Line input, install the supplied jumper onto the center terminal and Terminal 230VAC (factory setting). For 115 Volt AC Line input, install the supplied jumper onto the center terminal and Terminal 115VAC. Do not remove the center terminal. See Figure 29.

14.2 – MOTOR FREQUENCY SELECTION

The drive must be set for the actual motor nameplate frequency rating.

14.2.1 – SETTING THE DRIVE FOR 60 Hz and 50 Hz MOTOR OPERATION

The drive is factory set to operate 60 Hz motors.

KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D: Jumper J1 is factory set to the "60Hz" position and Jumper J2 is factory set to the "X1" position for 60 Hz motors. For 50 Hz motors, set Jumper J1 to the "50Hz" position and set Jumper J2 to the "X1" position. See Figure 30.

KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: Jumper J5 is factory set to the "60Hz" and "1X" positions for 60 Hz motors. For 50 Hz motors, set Jumper J5 to the "50Hz" and "1X" positions. See Figure 31.

14.2.2 – 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 above the motor rated frequency.

KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D: For 120 Hz output with a 60 Hz motor, set Jumper J1 to the "60Hz" position and set Jumper J2 to the "X2" position. For 100 Hz output with a 50 Hz motor, set Jumper J1 to the "X2" position and set Jumper J2 to the "50Hz" position. See Figure 30 and 32.

KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: For 120 Hz output with a 60 Hz motor, set Jumper J5 to the "60Hz" and "2X" positions. For 100 Hz output with a 50 Hz motor, set Jumper J5 to the "50Hz" and "2X" positions. See Figures 31 and 32.

14.3 – AUTOMATIC OR MANUAL START SELECTION

For Automatic Start (factory setting), the jumper is installed on Connector A/M. The drive will automatically start when power is applied and a run command is given. The drive will also automatically restart after a recovered fault due to undervoltage, overvoltage, or short circuit. See Figure 33.

For Manual Start, see Section 11.6 on page 16.

FIGURE 33
Automatic Start
(Jumper Installed)
(Factory Setting)



FIGURE 28
KBVF-21D, 22D, 23D, 24D
AC LINE INPUT VOLTAGE SELECTION

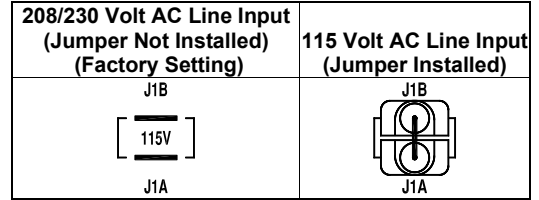


FIGURE 29
KBVF-26D
AC LINE INPUT VOLTAGE SELECTION

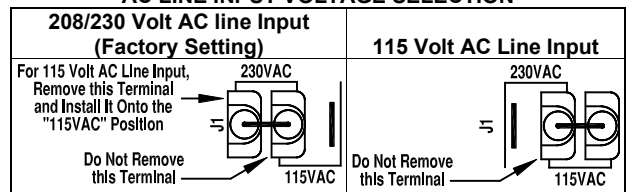


FIGURE 30
KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D
MOTOR FREQUENCY SELECTION

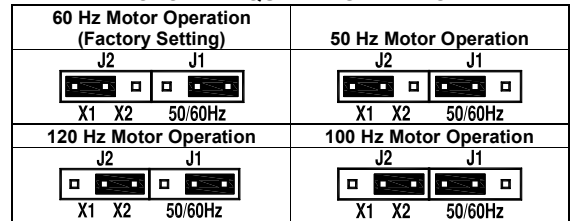


FIGURE 31
KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF
MOTOR FREQUENCY SELECTION

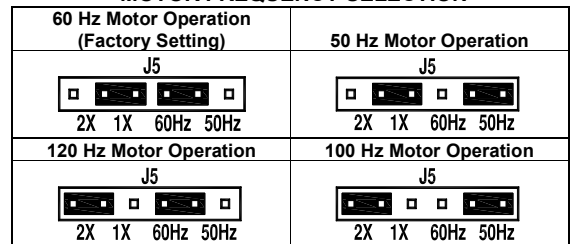
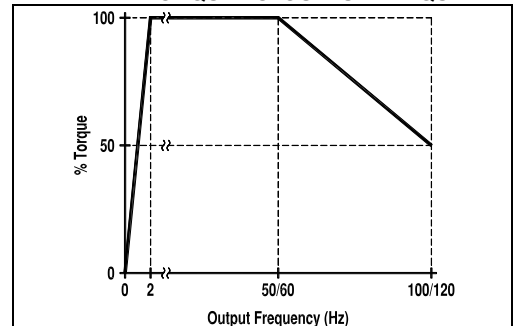


FIGURE 32
AVAILABLE TORQUE VS. OUTPUT FREQUENCY



14.4 – FORWARD/REVERSE SPEED SELECTION

KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D: For Forward Speed Operation, set the jumper on CON2 to the "F" position (factory setting). For Reverse Speed Operation, set the jumper on CON2 to the "R" position. See Figure 34. Also see Section 11.7 on page 16.

14.5 – RUN/FAULT RELAY OPERATION SELECTION

KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D: The optional SIVFR-PS is required.

KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: Jumper J4 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 J4 to the "F" position. See Figure 35. See Section 11.9 on page 17.

14.6 – ANALOG OR PWM SIGNAL INPUT SELECTION

KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D: The optional SIVFR-PS is required.

KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: For an analog signal input, set Jumper J1 to the "AN" position. For a PWM signal input, set Jumper J1 to the "PWM" position. See Figure 36.

14.7 – 5 VOLT DC OR 10 VOLT DC SIGNAL INPUT SELECTION

KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D: The optional SIVFR-PS is required.

KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: For a 0 – 5 Volt DC signal input, set Jumper J1 to the "5V" position (factory setting). For a 0 – 10 Volt DC signal input, set Jumper J1 to the "10V" position. See Figure 37.

14.8 – VOLTAGE OR CURRENT SIGNAL INPUT SELECTION

KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D: The optional SIVFR-PS is required.

KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF: For voltage following, set Jumper J12 to the "VOLT" position (factory setting). For current following, set Jumper J2 to the "CUR" position. See Figure 38.

FIGURE 34
KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D
FORWARD/REVERSE SPEED SELECTION

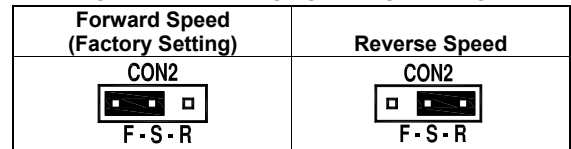


FIGURE 35
KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF
RUN/FAULT RELAY OPERATION SELECTION

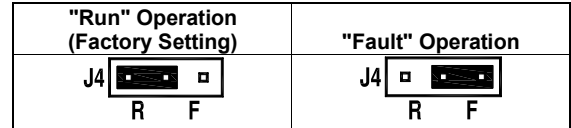


FIGURE 36
KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF
ANALOG OR PWM SIGNAL INPUT SELECTION

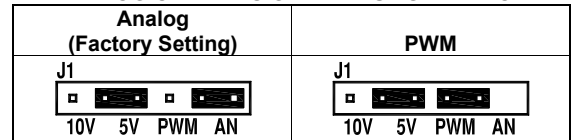


FIGURE 37
KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF
5 VOLT OR 10 VOLT DC SIGNAL INPUT SELECTION

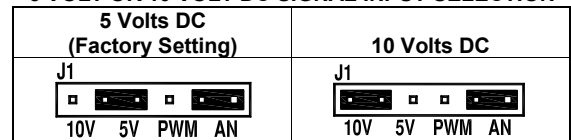
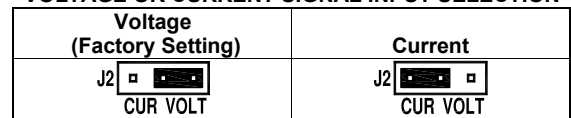


FIGURE 38
KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF
VOLTAGE OR CURRENT SIGNAL INPUT SELECTION



15 – ON-BOARD PARAMETERS – ADJUSTABLE TRIMPOTS

The drive contains trimpots which are factory set for most applications. Some applications may require readjustment of the trimpots in order to tailor the drive for a specific requirement.

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

15.1 – 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 39.

15.2 – MAXIMUM SPEED TRIMPOT (MAX)

Sets the maximum speed of the motor. The MAX Trimpot is factory set to 100% of frequency setting. For a higher maximum speed setting, rotate the MAX Trimpot clockwise. For a lower maximum speed setting, rotate the MAX Trimpot counterclockwise. See Figure 40.

15.3 – ACCELERATION TRIMPOT (ACC)

Sets the amount of time for the motor to accelerate from zero speed to full speed. The ACC Trimpot is factory set to 1.5 seconds. For a longer acceleration time, rotate the ACC Trimpot clockwise. For more rapid acceleration, rotate the ACC Trimpot counterclockwise. See Figure 41.

FIGURE 39
MIN TRIMPOT RANGE

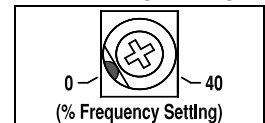


FIGURE 40
MAX TRIMPOT RANGE

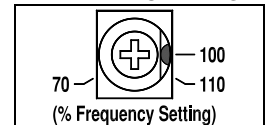
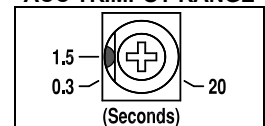


FIGURE 41
ACC TRIMPOT RANGE

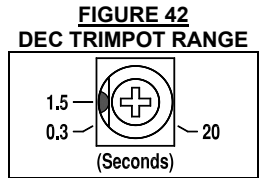


Application Note: Rapid acceleration settings may cause the current limit circuit to activate, which will extend the acceleration time. It is recommended that for very high inertial loads that the ACC Trimpot be set to greater than 10 seconds.

15.4 – DECELERATION TRIMPOT (DEC)

Sets the amount of time for the motor to decelerate from full speed to zero speed and is factory set to 1.5 seconds. For longer deceleration time, rotate the DEC Trimpot clockwise. For more rapid deceleration, rotate the DEC Trimpot counterclockwise. See Figure 42.

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 the DEC Trimpot be set to greater than 10 seconds.

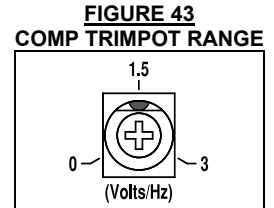


15.5 – SLIP COMPENSATION TRIMPOT (COMP)

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 43.

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%.
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.



15.6 – MOTOR OVERLOAD (I²t) 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 44 and 45.

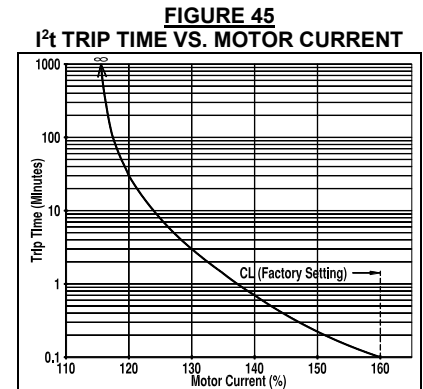
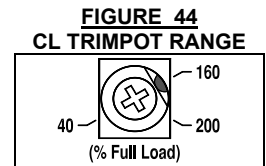
*UL approved as an electronic overload protector for motors.

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. To ensure that the motor is properly protected with the I²t feature, it is required that the CL Trimpot be set for 160% of the motor nameplate rated current, as described below.

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 approximately 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 I²t Trip will occur.



16 – DRIVE OPERATION

16.1 – START-UP PROCEDURE

After the drive has been properly setup (jumpers and trimpots set to the desired positions) and wiring completed, the startup procedure can begin. If the AC power has been properly brought to the drive, the power (PWR) LED on KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D will be illuminated green. The status (ST) LED will indicate drive status, as described in Section 17.2 on page 21.



WARNING! In Automatic Start Mode, the motor will run at the set speed when the AC Line is applied.

16.2 – FAULT RECOVERY

The drive monitors four faults (Undervoltage, Overvoltage, Short Circuit at the motor (phase-to-phase), I²t). Table 5 describes how the drive will automatically start (factory setting) after the fault has cleared. In Manual Start Mode, the drive must be manually reset for any fault, as described in Section 11.6 on page 16.

16.3 – RESTARTING THE DRIVE AFTER I²t FAULT HAS CLEARED

The drive can be restarted after an I²t Fault has cleared by any of the following three methods.

Note: If an I²t Fault occurs, the motor may be overloaded. Check the motor current with an AC RMS responding ammeter. Also, the CL setting may be set too low.

**TABLE 5
FAULT RECOVERY AND RESETTING THE DRIVE ***

Fault	Start Mode
Undervoltage	Drive will automatically start after the bus voltage returns to the operational level or when the drive is first turned on (power up).
Overvoltage	Drive will automatically start after the bus voltage returns to the operational level.
Short Circuit	Drive will automatically start after the short circuit is removed.
I ² t	Drive must be manually restarted.

*The fault must be cleared before the drive can be reset.

1. Disconnect and reconnect the AC power and wait approximately 15 seconds. The "ST" LED must change from quick flashing red to flashing red/yellow.
2. Set the Main Speed Potentiometer to zero (fully counterclockwise). The MIN Trimpot must set to zero (fully counterclockwise).
3. Open and close the Enable switch or contact.

17 – DIAGNOSTIC LEDs

The drive contains two PCB mounted diagnostic LEDs 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.

17.1 – POWER ON LED (PWR)

The PWR LED on KBVF-13, 14, 21D, 22D, 23, 23D, 24, 24D, 26D will illuminate steady green when the AC Line is applied to the drive and during normal drive operation.

Note: If the PWR LED flashes, an abnormal condition has occurred. Disconnect power to the drive and contact Technical support.

17.2 – 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. See Table 7.

TABLE 6
DRIVE OPERATING CONDITION AND STATUS LED INDICATOR

Drive Operating Condition	Color and Flash Sequence	Flash Rate (Repeating)	Flash Rate ¹ and LED Color
Normal Operation	Green	1 Second On / Off	Slow Flash Green
Overload (120% – 160% Full Load)	Red	On Continuously	Steady Red ²
I ² t (Drive Timed Out)	Red	0.25 Second On / Off	Quick Flash Red ²
Short Circuit	Red	1 Second On / Off	Slow Flash Red
Undervoltage	Red / Yellow	0.25 Second On / Off	Quick Flash Red / Yellow ³
Overvoltage	Red / Yellow	1 Second On / Off	Slow Flash Red / Yellow ³
Stop	Yellow	On Continuously	Steady Yellow
Phase Loss Detection ⁴	Yellow	0.04 Second On / 0.06 Second Off	
Communication Error ⁵	Green / Red	1 Second On / Off	

Notes: 1. Slow Flash = 1 second on and 1 second off. Quick Flash = 0.25 second on and 0.25 second off. 2. In Manual Start Mode, when the Overload is removed, before the I²t times out and trips the drive, the ST LED will flash green. 3. In Manual Start Mode, when the Undervoltage or Overvoltage condition is corrected, the ST LED will flash Red / Yellow / Green.

18 – COMMUNICATIONS – RS-485 MODBUS RTU

The KBVF-27, 27E, 27EF, 29, 29 (1P), 29E, 29EF, 29EF (1P), 42, 42E, 42EF, 45, 45E, 45EF, 48, 48E, 48EF support RS-485 MODBUS RTU communications.

18.1 – SPECIFICATIONS

TABLE 7
RS-485 SPECIFICATIONS

Baud Rate	Data Bits	Stop Bits	Parity
9600	8	1	Even

18.2 – DATA TRANSMIT AND DATA RECEIVE LEDs

The TXD LED provides indication of data transmission. The RXD LED provides indication of data received.

19 – ACCESSORIES

Detailed instructions are provided with all accessories.

SIVFR-PS Signal Isolator with Power Supply and Run/Fault Relay (Part No. 9920): Provides isolation between a non-isolated signal voltage (0 to ±2.5 thru 0 to ±25 Volts DC) or current source (4 – 20 mA DC) and the drive. Can be used in unidirectional (single-ended) or in bidirectional (wig-wag) mode. Run/Fault Relay Output Contacts are also provided, which 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.

Liquidtight Fittings Kit (Part No. 9526): For KBVF-27E, 27EF, 29E, 29EF, 29EF (1P), 42E, 42EF, 45E, 45EF, 48E, 48EF. Provides a liquidtight seal for wiring the drive.

RFI Filters and Chokes: Provide RFI and EMI Suppression. Comply with CE Council Directive 89/336/EEC relating to the Class A Industrial Standard and Class B Residential Standard. Contact Technical Support for RFI Filters and Chokes Selection Guide Publication No. D-321 (Part No. A42027).

Dynamic Brake Module (Part No. 9598): Provides up to 25% continuous braking and 200% instantaneous braking torque (maximum 1 HP (0.75 kW)).

Custom Software: All models can be factory programmed for applications that require special switching, timing, PLC functions, and GFCI operation. Contact Technical Support.

NOTES

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



KBelectronics.com/registration.htm

LIMITED WARRANTY

For a period of 18 months from the date of original purchase, KB Electronics 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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**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.**



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(A40488) – Rev. A00 – 2/27/2020