Installation & Operation Manual

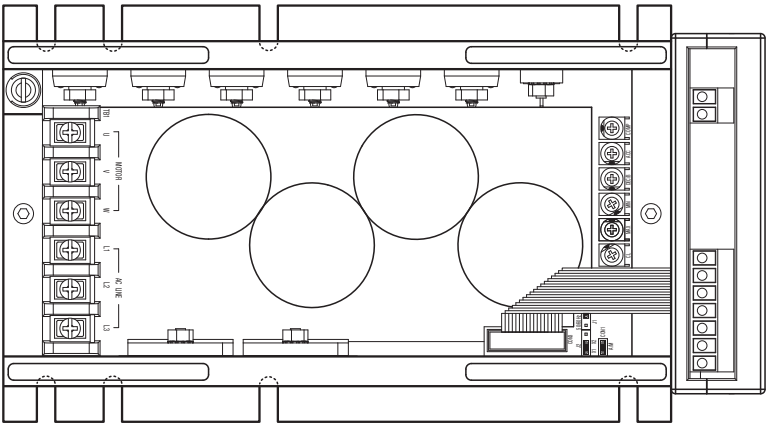
KBVF SERIES

Chassis / IP-20 AC Drives

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

Rated for 208-230 and 400/460 Volt 50 & 60 Hz
3-Phase & PSC** AC Induction Motors from 2 thru 5 HP

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



This Manual Covers Models KBVF-27, 29, 45, 48

See Safety Warning, on page 8.

CE****

Note: The drive is factory set for 60 Hz motors. For 50 Hz motors, see Section 6.1, on page 14.

c UL us

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.

**UL approved as an electronic overload protector for motors. **Custom software is required for PSC motors. See PSC Motor Addendum (Part No. A42142). ***Do not use this drive with GFCIs. Special software is available – contact our Sales Department. ****Installation of a CE approved RFI filter is required.*

PENTA KB POWER™

A Complete Line of Motor Drives

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Items Included in this Package:

KBVF Adjustable Frequency Drive, KBVF Series Installation and Operation Manual, Main Speed Potentiometer Kit with Insulator and Mounting Hardware, 3 Main Speed Potentiometer Quick-Connect Terminals, 2-Wire and 3-Wire Connector Kit (Models KBVF-27, 29 Only), Status Indicator Label, Trimpot Adjustment Tool, CE Approved Product Information Card, Warranty Registration Card.

FIGURE 1 – MODELS KBVF-27, 29 QUICK-START CONNECTION DIAGRAM

(Shown without Finger-Safe Cover Installed)

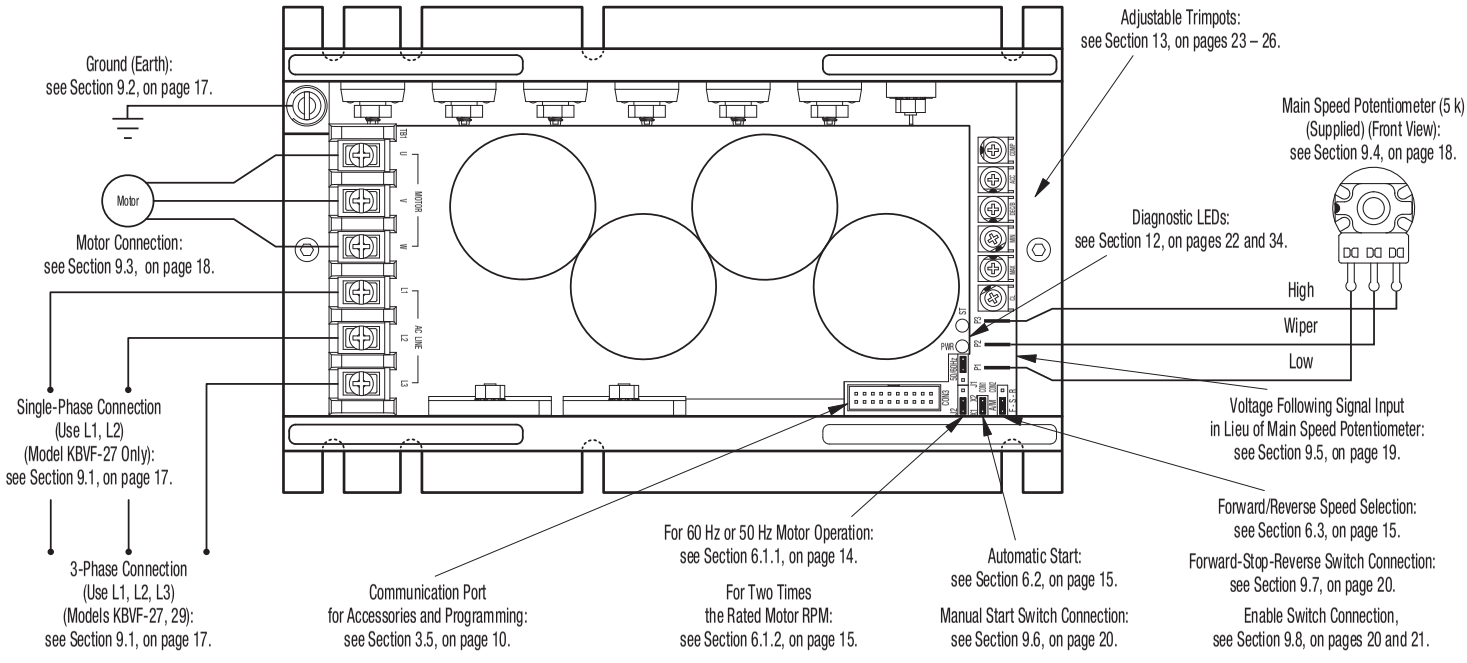


FIGURE 2 – MODELS KBVF-45, 48 QUICK-START CONNECTION DIAGRAM

(Shown without Finger-Safe Cover Installed)

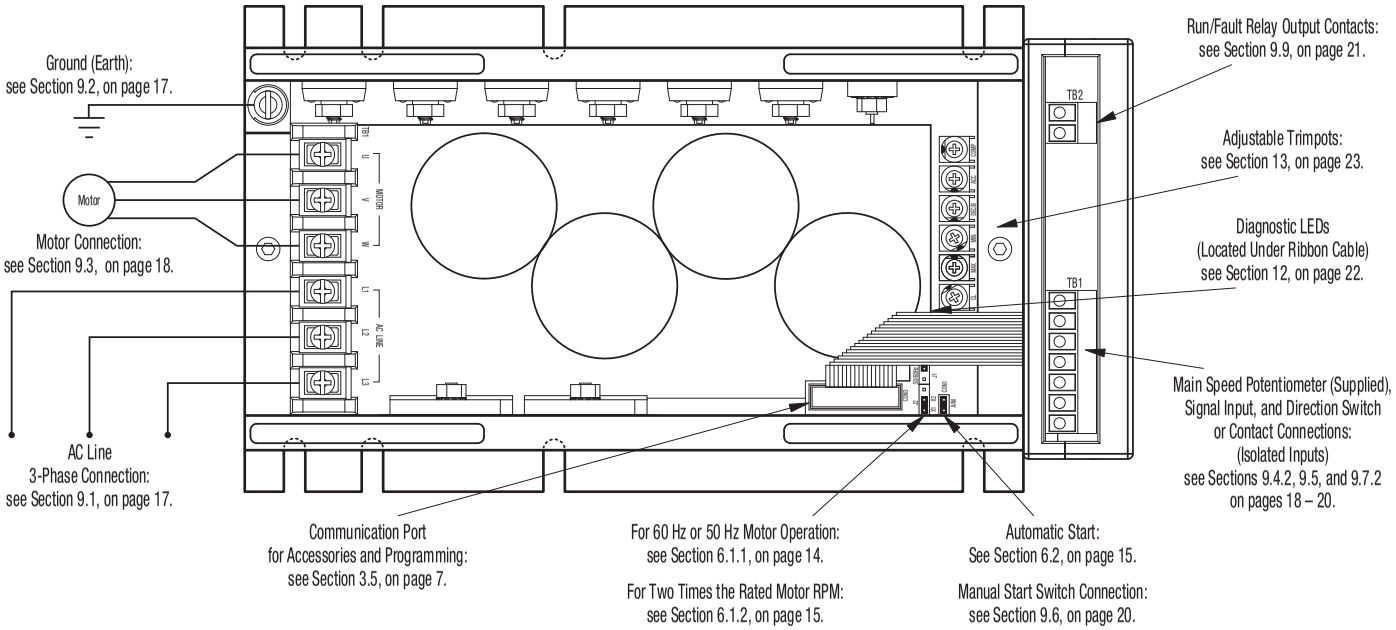
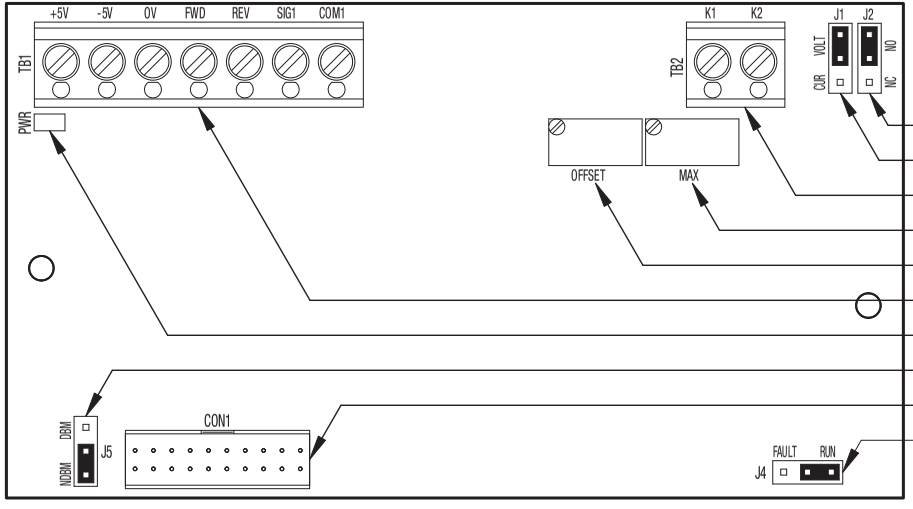


FIGURE 3 – SIVFR CONTROL LAYOUT

(SIVFR is Built-In on Models KBVF-45, 48 and Optional on Models KBVF-27, 29)



All jumpers are shown in factory set positions.

- Sets the Run/Fault Relay Output Contacts for normally open or closed operation.
- Sets the drive for operation with a voltage or current input signal.
- Run/Fault Relay Output Contacts connection.
- Maximum Speed adjustment trimpot.
- Signal Offset adjustment trimpot.
- Signal Input, Direction Switch, and Main Speed Potentiometer connections.
- Power on LED.
- Sets the drive for operation with the optional Dynamic Brake Module.
- Used to connect the Signal Isolator and Run/Fault Relay to the KBVF.
- Sets the operation of the Run/Fault Relay to Run or Fault.

1 QUICK-START INSTRUCTIONS

Important – You must read these simplified instructions before proceeding. These instructions are to be used as a reference only and are not intended to replace the details provided herein. You must read the Safety Warning on, page 8, before proceeding.

See Figures 1 – 3, on pages 4 – 6. Also see Section 4 — Important Application Information, on pages 13 and 14.

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

1.1 AC LINE CONNECTION – Wire the AC line input to Terminal Block TB1. Model KBVF-27 is designed for single-phase (Terminals "L1", "L2") or 3-phase (Terminals "L1", "L2", "L3") AC line input. Models KBVF-29, 45, 48 are designed for 3-phase (Terminals "L1", "L2", "L3") AC line input only. See Figures 1 and 2, on pages 4 and 5. Also see Section 9.1, on page 17.

Application Note – Do not wire this drive to a GFCI. If operation with a GFCI is required, contact our Sales Department.

Model KBVF-27 – Rated for 208/230 Volt single-phase or 3-phase AC line Input.

Model KBVF-29 – Rated for 208/230 Volt 3-phase AC line input.

Models KBVF-45, 48 – Rated for 400/460 Volt 3-phase AC line input.

1.2 GROUND CONNECTION – Connect the ground wire (earth) to the ground screw, as shown in Figures 1 and 2, on pages 4 and 5. See Section 9.2, on page 17.

1.3 AC LINE 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 11. Also see Section 10, on page 22.

1.4 MOTOR CONNECTION – Wire the motor to Terminals "U", "V", "W", of Terminal Block TB1, as shown in Figures 1 and 2, on pages 4 and 5. (Special reactors may be required for cable lengths over 100 ft. (30 m) – consult our Sales Department.) See Section 9.3, on page 18.

Note: *The drive is programmed to operate 3-phase AC induction motors. For PSC motors, optional software is required – consult our Sales Department.*

1.5 MOUNTING INSTRUCTIONS – See Section 7, on page 15 and 16.

1.6 60 Hz & 50 Hz MOTOR OPERATION (JUMPERS J1 & J2 ON THE LOWER PC BOARD) – The drive is factory set for 60 Hz motor operation (Jumper J1 set to the "60Hz" position and Jumper J2 set to the "X1" position). For 50 Hz motor operation, set Jumper J1 to the "50Hz" position and be sure Jumper J2 is set to the "X1" position. See Section 6.1.1, on page 14.

1.7 TRIMPOT SETTINGS – All trimpots have been factory set for most applications, as shown in Figure 5, on page 13. Some applications require adjustments of the trimpots in order to tailor the drive for a specific requirement. See Section 13, on pages 23 – 26.

1.8 MAIN SPEED POTENTIOMETER CONNECTION – The drive is supplied with a 5 kΩ potentiometer (supplied) to control motor speed. On Models KBVF-27, 29, the potentiometer is to be connected to terminals "P1", "P2", and "P3". On Models KBVF-45, 48, the potentiometer is to be connected to the SIVFR.

<u>Models KBVF-27, 29</u>

Unidirectional Speed Operation – Wire the potentiometer to Terminals "P1" (low), "P2" (wiper), "P3" (high), as described in Section 9.4.1, on page 18. To select forward or reverse motor direction, see Section 6.3, on page 15. To install a Forward-Stop-Reverse Switch, see Section 9.7.1, on page 20.

Bidirectional Speed Operation – See Section 9.4.2, on page 18.

Models KBVF-45, 48

Unidirectional Speed Operation – Wire the potentiometer to Terminals "+5V" (high), "SIG1" (wiper), "COM1" (low), of Terminal Block TB1 on the SIVFR, as described in Section 9.4.2, on page 18. Be sure Jumper J1, on the SIVFR, is set to the "VOLT" position (factory setting). A jumper must be installed between Terminals "0V" and "FWD", of Terminal Block TB1, in order for the drive to operate.

Bidirectional Speed Operation – Wire the potentiometer to Terminals "+5V" (high), "SIG1" (wiper), "– 5V" (low), of Terminal Block TB1 on the SIVFR, as described in Section 9.4.2, on page 18. Be sure Jumper J1 (on the SIVFR) is set to the "VOLT" position (factory setting).

1.9 SIGNAL FOLLOWING – An analog signal input can be used to control motor speed instead of the Main Speed Potentiometer. The drive output will linearly follow the analog signal input. A Signal Isolator (SIVFR) is built-in on Models KBVF-45,48 and optional on Models KBVF-27, 29.

Models KBVF-27, 29

Wire the ***isolated**** 0 – 5 Volt DC signal input positive lead (+) to Terminal "P2" and the negative lead (–) to Terminal "P1". See Section 9.5, on page 19.

**If a non-isolated signal is used, install the SIVFR Signal Isolator (Part No. 9597). The SIVFR accepts voltage (0 to ±2.5 thru 0 to ±25 Volts DC) or current (4 – 20 mA DC) signal inputs. See Section 3.5, on page 10.*

***Note:** For signal following operation, the Minimum Speed Trimpot (MIN) must be set fully counter-clockwise.*

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 SIVFR – Signal Isolator and Run/Fault Relay (Part No. 9597) be installed when using signal following.

Models KBVF-45, 48

Wire the voltage (0 to ±2.5 thru 0 to ±25 Volt DC) or current (4 – 20 mA DC) signal input to Terminals "SIG1" (+) and "COM1" (–) of Terminal Block TB1 on the SIVFR. For voltage following, be sure Jumper J1 (on the SIVFR) is set to the "VOLT" position (factory setting). For current following, set Jumper J1 (on the SIVFR) to the "CUR" position. A jumper must be installed between Terminals "0V" and "FWD", of Terminal Block TB1, in order for the drive to operate.

2 SAFETY WARNING

Definition of Safety Warning Symbols

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

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

This product should be installed and serviced by a qualified technician, electrician, or electrical maintenance person familiar with its operation and the hazards involved. Proper installation, which includes installation of the Finger-Safe Cover, wiring, mounting in proper enclosure, fusing or other current protection, and grounding can reduce the chance of electrical shocks, fires, or explosion in this product or products used with this product, such as electric motors, switches, coils, solenoids, and/or relays. Eye protection must be worn and insulated adjustment tools must be used when working with 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/FSC 5/2005) Be sure to 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 our Sales Department 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 to meet the Industrial or Residential Standard. Additional shielded cable and/or AC line cables may be required along with a signal isolator (SIVFR (Part No. 9597)).

3 INTRODUCTION

Thank you for purchasing the KBVF Adjustable Frequency Drive. KB Electronics, Inc. is committed to providing total customer satisfaction by producing quality products that are easy to install and operate. The KBVF is manufactured with surface mount components incorporating advanced circuitry and technology. A Finger-Safe Cover is included for added liability protection.

The KBVF Adjustable Frequency Drives provide variable speed control for standard 3-phase and Permanent Split Capacitor (PSC)[1] AC induction motors from 2 thru 5 HP. This manual covers models with single-phase and 3-phase AC line input. 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 KBVF 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. For more advanced programming, PC based Drive-Link™ software is available.

Main features include adjustable RMS Current Limit and I^2t Motor Overload Protection.[2] 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 startup of high frictional loads. Electronic Inrush Current Limit (EICL™) eliminates harmful AC line inrush current. The drive is suitable for machine or variable torque (HVAC) applications. With optional Drive-Link™ software, the drive can be programmed for DC Injection Braking.

For AC line and motor wiring, a barrier terminal block is provided. Other features include: adjustable trimpots (MIN, MAX, ACC, DEC/B[3], COMP, CL), customer selectable jumpers (Automatic-Manual Start, Motor Frequency, Frequency Multiplier, Forward/Reverse). Diagnostic LEDs are provided for power (PWR) and drive status (ST). A 5 kΩ Main Speed Potentiometer is also included.

A Signal Isolator (built-in on Models KBVF-45,48 and optional on Models KBVF-27, 29) can be used for unidirectional or bidirectional speed control and accepts voltage and current signal input. Other optional accessories include: Multi-Speed Board, Programming Kit, and Modbus Communication Module. A connector is provided for easy installation of accessories.

Notes: 1. *Optional software is required for PSC motors – contact our Sales Department.* ***2.*** *UL approved as an electronic overload protector for motors.* ***3.*** *In 50 Hz Mode, the DEC/B Trimpot automatically becomes Adjustable Boost.*

3.1 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). See Section 12, on page 22 and 23.
- **Jumper Selection of Drive Output Frequency –** Increases the motor speed up to two times the rated RPM. See Section 6, on page 14 and 15.
- **Industry Standard Mounting –** See Section 7, on page 15 and 16.
- **Finger-Safe Cover –** Meets IP-20 standard. See Section 5, on page 14.
- **Models KBVF-29, 48 contain a built-in cooling fan**.

Note: GFCI Operation – This drive can operate with GFCIs (optional software required) – contact our Sales Department.

3.2 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

3.3 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. See Section 4.2, on pages 13 and 14. Also see Section 13.7, on pages 25 and 26.
- **Electronic Inrush Current Limit (EICL™) –** Eliminates harmful inrush AC line current during startup.
- **Short Circuit –** Prevents drive failure if a short circuit occurs at the motor (phase-to-phase).
- **Regeneration –** Eliminates nuisance tripping due to high bus overvoltage 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.**
- **Microcontroller Self Monitoring and Auto-Reboot.**

3.4 TRIMPOT ADJUSTMENTS

- **Minimum Speed (MIN on Models KBVF-27, 29 and OFFSET on SIVFR of Models KBVF-45, 48)** Sets the minimum speed of the motor. See Section 13.1, on page 23.
- **Maximum Speed (MAX) –** Sets the maximum speed of the motor. See Section 13.2, on page 23.
- **Acceleration (ACC) –** Sets the amount of time for the motor to accelerate from zero speed to full speed. See Section 13.3, on page 24.
- **Deceleration (DEC/B) –** Sets the amount of time for the motor to decelerate from full speed to zero speed. See Section 13.4, on page 24.
- **Slip Compensation (COMP) –** Maintains set motor speed under varying loads. See Section 13.5, on page 24.
- **Boost (DEC/B) –** In 50 Hz mode, the trimpot automatically becomes Adjustable Boost, which can be used to set the Volts/Hz Curve for 50 Hz motors to obtain maximum performance. In 50 Hz Mode, the deceleration time is automatically set to the same as the acceleration time. See Section 13.6, on page 25.
- **Current Limit (CL) –** Sets the current limit (overload) which limits the maximum current (torque) to the motor. See Section 13.7, on pages 25 and 26.

3.5 OPTIONAL ACCESSORIES

- **SIVFR – Signal Isolator and Run/Fault Relay (Part No. 9597) –** 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 or in bidirectional mode. Run/Fault Relay Output Contacts are also provided, which can be used to turn on or off equipment or to signal a warning if the drive is put into the Stop Mode or a fault has occurred. Mounts on the end of the drive. This option is built-in on models KBVF-45, 48.
- **Multi-Speed Board (Part No. 9503) –** Provides multi-speed operation using external contacts or a PLC. Mounts on the end of the drive. For Models KBVF-27, 29 only. Also available factory installed on Models KBVF-45, 48 – contact our Sales Department.
- **Programming Kit (Part No. 9582) –** Includes DownLoad Module™ (DLM) handheld programming device which uploads and downloads drive programs, PC to DLM serial communication cable, DLM to inverter communication cable, and PC Windows® based Drive-Link™ communication software.

- **DIVF – Modbus Communication Module (Part No. 9568) –** Allows the drive to communicate with PLCs, PCs, and HMIs with Modbus RTU protocol utilizing a serial communication cable. If a USB communication cable is required, purchase Part No. 19008.
- **Custom Software –** All models can be factory programmed for applications which require special switching, timing, PLC functions, and GFCI operation – contact our Sales Department.

TABLE 1 – GENERAL PERFORMANCE SPECIFICATIONS

Description		Specification	Factory Setting
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	—
Carrier, Switching Frequency (kHz)		16, 8	—
Signal Following Input Voltage Range[1] (Volts DC)	KBVF-27, 29	0 – 5	—
	KBVF-45, 48	0 to ±2.5 thru 0 to ±25	0 to ±5
Signal Following Input Current Range[1] (mA DC)		4 – 20	—
Output Frequency Resolution (Bits, Hz)		10, .06	—
Minimum Speed Trimpot (MIN) Range (% Frequency Setting)		0 – 40	0
Maximum Speed Trimpot (MAX) Range (% Frequency Setting)		70 – 110	100
Acceleration Trimpot (ACC) and Deceleration Trimpot (DEC/B) Range (Seconds)		.3 – 20	1.5
Boost Trimpot (DEC/B) Range (50 Hz Only) (Volts/Hz)		0 – 30	5
Slip Compensation Trimpot (COMP) Range at Drive Rating (Volts/Hz)		0 – 3	1.5
Current Limit Trimpot (CL) Range (Amps AC)	KBVF-27	4.0 – 12.5	10.7
	KBVF-29	5.5 – 17.0	14.4
	KBVF-45	3.0 – 8.5	7.4
	KBVF-48	5.0 – 15.5	13.3
Motor Frequency Setting (Hz) (Jumper J1)		50, 60	60
Output Frequency Multiplier (X1, X2) (Jumper J2)[2]		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)[3]		2.5	—
Overload Protector Trip Time for Stalled Motor (Seconds)		6	—
AC Line Input Undervoltage/Overvoltage Trip Points for 208/230 Volt AC Line (±5%) (Volts AC)[4]		151 – 282	—
AC Line Input Undervoltage/Overvoltage Trip Points for 400/460 Volt AC Line (±5%) (Volts AC)[4]		302 – 567	—
Run/Fault Relay Output Contacts Rating[5] (Amps at 30 Volts DC, 125 Volts AC, 250 Volts DC)		1, 0.5, 0.25	—
Operating Temperature Range (°C / °F)		0 – 45 / 32 – 113	—

Notes: 1. *Models KBVF-27, 29: 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 SIVFR Signal Isolator (Part No. 9597). Models KBVF-45, 48: contain built-in signal isolation.* ***2.*** *Allows the motor to operate up to two times the rated RPM. Constant motor horsepower will result when operating the drive in the "X2" mode above the motor rated frequency.* ***3.*** *Dependent on motor performance.* ***4.*** *Do not operate the drive outside the specified AC line input voltage operating range.* ***5.*** *Models KBVF-45, 48 only.*

TABLE 2 – ELECTRICAL RATINGS

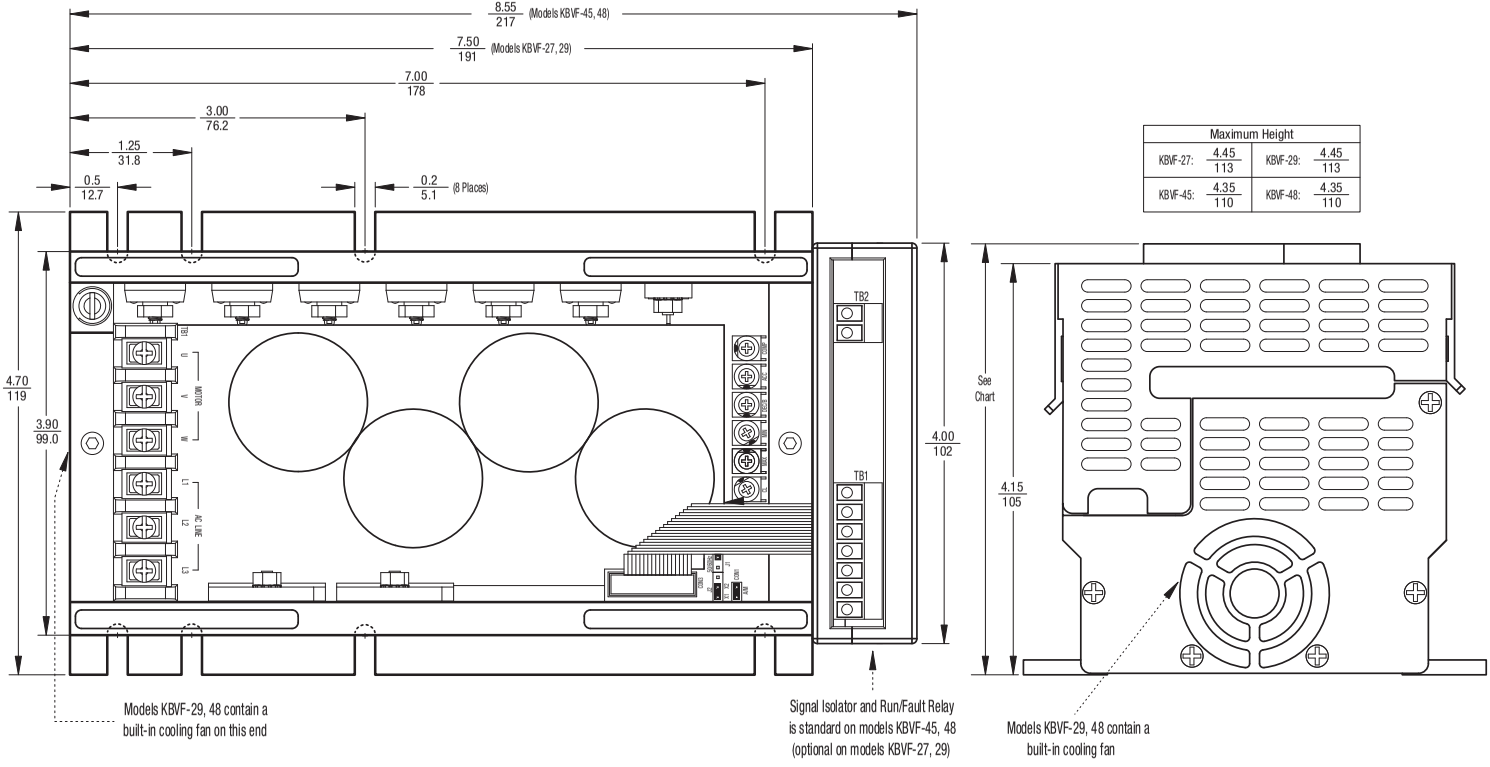
Model	Part No.	AC Line Input			Drive Output			Fuse or Circuit Breaker Rating (Amps)	Net Wt.	
		Volts AC (50/60 Hz)	Phase (ϕ)	Maximum Current (Amps AC)	Voltage Range (Nominal) (Volts AC)	Maximum Continuous Load Current (RMS Amps/Phase)	Maximum Horsepower (HP (kW))		lbs	kg
KBVF-27	9591	208/230	1	17.0	0 – 230	6.7	2 (1.5)	20	4.1	1.9
			3	8.0				10		
KBVF-29[1]	9593	208/230	3	10.8	0 – 230	9.0	3 (2.25)	15	4.6	2.1
KBVF-45[2]	9590	400/460	3	5.3	0 – 400/460	4.6	3 (2.25)	10	4.1	1.9
KBVF-48[1, 2]	9592	400/460	3	9.6	0 – 400/460	8.3	5 (3.75)	15	4.6	2.1

Notes: 1. *Models KBVF-29, 48 contain built-in cooling fan.* ***2.*** *Models KBVF-45, 48 are rated 0 – 400 Volts AC for 50 Hz motor operation and 0 – 460 Volts AC for 60 Hz motor operation.*

**All models contain a Terminal Block for AC line and motor wiring. The Signal Isolator and Run/Fault Relay is standard on Models KBVF-45, 48 and optional on Models KBVF-27, 29.*

FIGURE 4 – MECHANICAL SPECIFICATIONS (INCHES/mm) & CONTROL LAYOUT

(TOP VIEW SHOWN WITHOUT FINGER-SAFE COVER INSTALLED) (SIDE VIEW SHOWN WITH FINGER-SAFE COVER INSTALLED)
(SEE FIGURE 5, ON PAGE 13, FOR EXPANDED VIEW OF JUMPERS AND TRIMPOTS)



4 IMPORTANT APPLICATION INFORMATION

4.1 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.*

WARNING! 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 motor if the motor current exceeds the nameplate rating.**

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 6.

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 7.

4.2 ELECTRONIC MOTOR OVERLOAD PROTECTION –

The drive contains Modified I^2t Overload Protection.* Part of this function consists of a Current Limit (CL) circuit, which limits the drive current to a factory preset

FIGURE 5 – EXPANDED VIEW OF JUMPERS AND TRIMPOTS

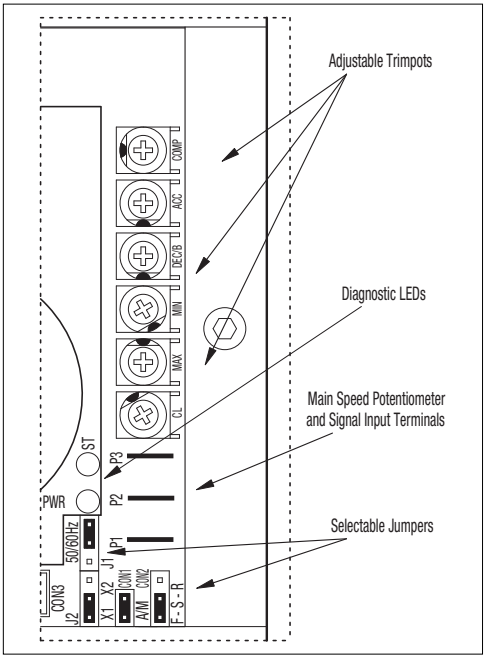


FIGURE 6 – MAXIMUM ALLOWED MOTOR TORQUE vs. SPEED

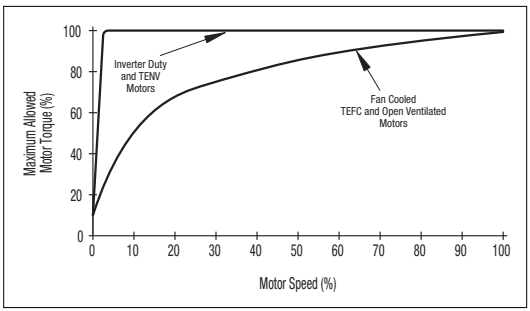
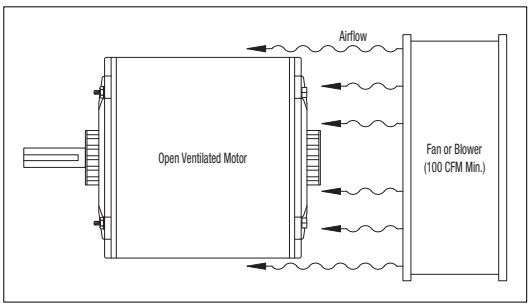


FIGURE 7 – OPEN VENTILATED MOTOR WITH EXTERNAL COOLING



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. 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 I^2t 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.

**UL approved as an overload protector for motors.*

5 FINGER-SAFE COVER

The drive is designed with an IP-20 Finger-Safe Cover which provides protection against accidental contact with high voltage.

WARNING! Disconnect main power when removing or installing the Finger-Safe Cover.

WARNING! 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 offers protection against electric shock which limits the potential liability to the equipment manufacturer and installer.

5.1 REMOVING THE FINGER-SAFE COVER – 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. Notice the orientation of the Finger-Safe Cover before removing it.

To remove the Finger-Safe Cover, gently lift up on the four retainer clips until the cover disengages from the base.

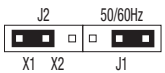
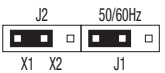
Note: *The Finger-Safe Cover is designed with a removable panel (on the trimpots side) which must be removed for installation of optional accessories SIVFR Signal Isolator and Run/Fault Relay (Part No. 9597) or Multi-Speed Board (Part No. 9503). Complete instructions are provided with the accessories.*

5.2 INSTALLING THE FINGER-SAFE COVER – To install the Finger-Safe Cover, be sure to properly align the retainer clips. Gently push the Finger-Safe Cover onto the base until the retainer clips are fully engaged with the base.

6 SETTING SELECTABLE JUMPERS

The drive has customer selectable jumpers which must be set before the drive can be used. For the location of jumpers, see Figure 5, on page 13.

FIGURE 8 – 60 Hz & 50 Hz MOTOR SELECTION

60 Hz Motor Operation (Factory Setting) (J1 Installed in "60Hz" Position) (J2 Installed in "X1" Position)	50 Hz Motor Operation (J1 Installed in "50Hz" Position) (J2 Installed in "X1" Position)
	

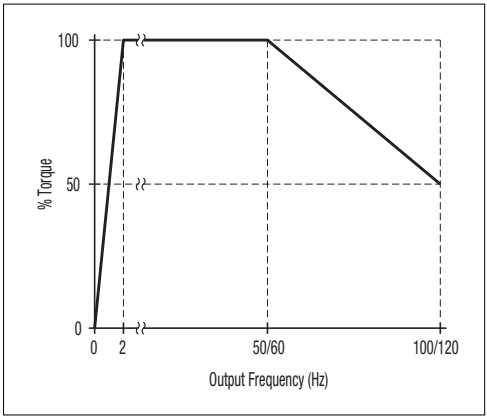
6.1 60Hz AND 50 Hz MOTOR OPERATION AND DRIVE OUTPUT FREQUENCY SELECTION (JUMPERS J1 AND J2) – Both jumpers must be set for the appropriate motor nameplate frequency rating. Jumpers J1 and J2 are located on the lower PC board.

6.1.1 Setting the Drive for 60 Hz or 50 Hz Motor Operation – The drive is factory set to operate 60 Hz motors. Jumper J1 is factory set to the "60Hz" position and Jumper J2 is factory set to the "X1" position. For 50 Hz motors, set Jumper J1 to the "50Hz" position and be sure Jumper J2 is set to the "X1" position. See Figure 8.

6.1.2 Setting the Drive for Two Times the Rated Motor RPM – The drive can also be used to operate the motor up to two times the rated RPM. However, constant horsepower will result when operating the drive in the "X2" mode above the motor rated frequency. See Figure 9.

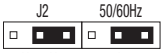
For 120 Hz output with 60 Hz motor, be sure Jumper J1 is set to the "60Hz" position and set Jumper J2 to the "X2" position. For 100 Hz output with 50 Hz motor, set Jumper J1 to the "50Hz" position and set Jumper J2 to the "X2" position. See Figure 10.

FIGURE 9 – AVAILABLE TORQUE vs. OUTPUT FREQUENCY



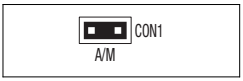
6.2 AUTOMATIC START (CON1) – The drive is factory set for Automatic Start (jumper installed onto CON1), as shown in Figure 11. CON1 is located on the lower PC board. The drive will automatically start when power is applied and a run command is given. The drive will automatically restart after a recovered fault due to undervoltage, overvoltage, or short circuit.

FIGURE 10 – 120 Hz & 100 Hz DRIVE OUTPUT FREQUENCY SELECTION

120 Hz Output with 60 Hz Motor (J1 Installed in "60Hz" Position) (J2 Installed in "X2" Position)	100 Hz Output with 50 Hz Motor (J1 Installed in "50Hz" Position) (J2 Installed in "X2" Position)
	

For an I^2t Trip, due to a prolonged overload, the drive must be manually restarted. See Section 11.2, on page 22. Also see Section 12.2, on page 23.

FIGURE 11 – AUTOMATIC START (Jumper Installed)



For **Manual Start**, a momentary contact must be installed onto CON1, as described in Section 9.6, on page 20.

6.3 FORWARD/REVERSE SPEED SELECTION – Models KBVF-27, 29 are factory set for Forward Speed Operation (jumper installed in the "F-S" position of CON2). For reverse Speed Operation, install the jumper in the "R-S" position. CON2 is located on the lower PC board. See Figure 12. See Section 9.7, on page 20.

FIGURE 12 – MODELS KBVF-27, 29 FORWARD/REVERSE SPEED SELECTION

Forward Speed Operation (Factory Setting) (Jumper Installed in "F" Position)	Reverse Speed Operation (Jumper Installed in "R" Position)
	

To wire a **Forward-Stop-Reverse Switch**, or if installing the SIVFR Signal Isolator (built-in on Models KBVF-45, 48), see Section 9.7, on page 20.

7 MOUNTING INSTRUCTIONS

WARNING! This drive must be mounted in an enclosure. Care should be taken to avoid extreme hazardous locations where physical damage to the drive can occur due to moisture, metal chips, dust, and other contamination, including corrosive atmosphere that may be harmful. See Safety Warning on pages 8 and 9. 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. Do not use this drive in an explosion proof application.

The enclosure should be large enough to allow for proper heat dissipation so that the ambient temperature does not exceed 45 °C (113 °F). Leave enough room to allow for AC line, motor connection, and other wiring that is required. See Figure 4, on page 12.

When mounting the Main Speed Potentiometer, be sure to install the insulating disc between the potentiometer and the panel.

Models KBVF-29, 48:

1. When mounting these drives in a vertical direction, the cooling fan must be on top.
2. When mounting the drive in an enclosure, be sure to leave at least 2" of clearance around the cooling fan for proper heat dissipation.

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

Testing agencies such as UL, CSA, 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 13. **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.

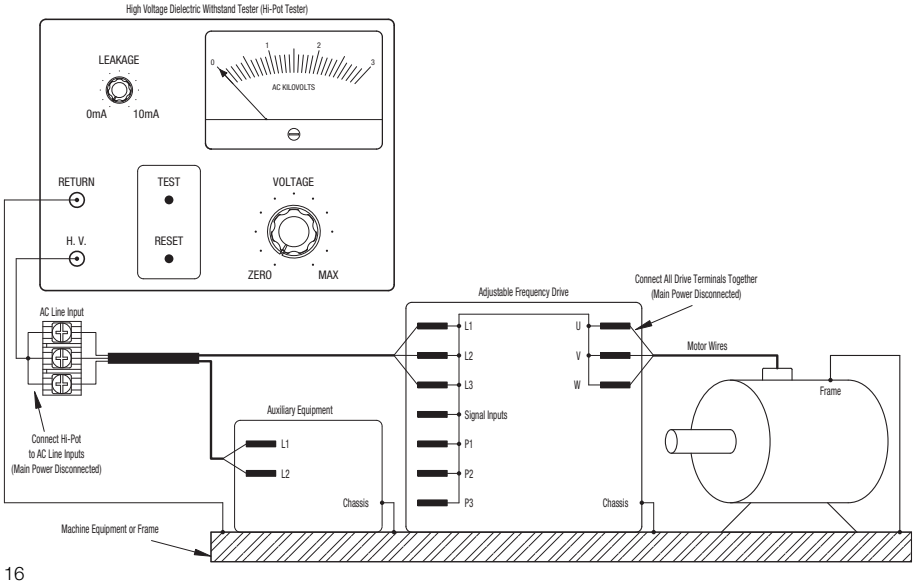
8.1 Connect all equipment AC power input lines together and connect them to the H.V. lead of the Hi-Pot Tester. Connect the RETURN of the Hi-Pot Tester to the frame on which the drive and other auxiliary equipment are mounted.

8.2 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 being 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 13 – TYPICAL HI-POT TEST SETUP



9 WIRING INSTRUCTIONS

WARNING! Read Safety Warning, on pages 8 and 9, before using the drive. Disconnect main power when making connections to the drive. To avoid electric shock, be sure to properly ground the drive.

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

Be sure to properly fuse each AC line conductor that is not at ground potential. **Do not fuse neutral or grounded conductors.** A separate AC line switch or contactor must be wired as a disconnect so that each ungrounded conductor is opened. For fuse or circuit breaker selection, see Section 10, on page 22.

TABLE 3 – TERMINAL BLOCK WIRING INFORMATION*

Terminal Block			Maximum Wire Size (Cu)		Recommended Tightening Torque	
Designation	Description	Location	AWG	mm^2	in-lbs	kg-cm
TB1	AC Line Input and Motor Wiring	Upper PC Board	12	3.3	12	14
TB1**	Signal Input, Direction Switch, and Main Speed Potentiometer	SIVFR***	16	1.3	3.5	4
TB2**	Run/Fault Relay Output Contacts	SIVFR***	16	1.3	3.5	4

**Models KBVF-27, 29 contain quick-connect terminals for signal input. Connectors are provided for wiring of Direction Switch and Manual Start Switch.*
***Models KBVF-45, 48 only. ***SIVFR – Signal Isolator and Run/Fault Relay is standard on Models KBVF-45, 48 and optional on Models KBVF-27, 29.*

9.1 AC LINE CONNECTION – Wire the AC line input to Terminal Block TB1. Model KBVF-27 is designed for single-phase (Terminals "L1", "L2") or 3-phase (Terminals "L1", "L2", "L3") AC line input. Models KBVF-29, 45, 48 are designed for 3-phase (Terminals "L1", "L2", "L3") AC line input only. See Figures 1 and 2, on pages 4 and 5.

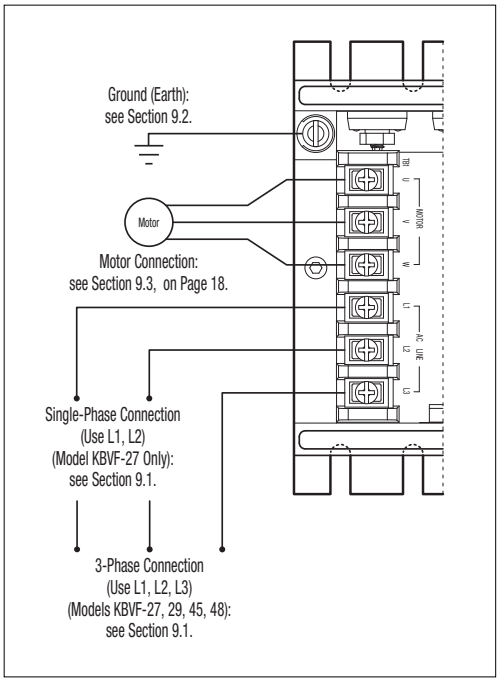
Application Note: GFCI Operation – Do not connect this drive to an AC power source controlled by a Ground Fault Circuit Interrupter. Special software is required for GFCI operation – contact our Sales Department.

Model KBVF-27 – Rated for 208/230 Volt single-phase or 3-phase AC line Input.

Model KBVF-29 – Rated for 208/230 Volt 3-phase AC line input.

Models KBVF-45, 48 – Rated for 400/460 Volt 3-phase AC line input.

FIGURE 14 – AC LINE INPUT, MOTOR, AND GROUND CONNECTIONS



9.2 GROUND CONNECTION – Connect the ground wire (earth) to the green ground screw. The ground screw is located on the heat sink. See Figure 14.

9.3 MOTOR CONNECTION – Wire the motor to Terminals "U", "V", "W". The terminals are located on the upper PC board. See Figure 14, on page 17. Motor cable length should not exceed 100 ft (30 m) – special reactors may be required – consult our Sales Department.

Note: *The drive is programmed to operate 3-phase AC induction motors. For PSC motors, optional software is required – contact our Sales Department.*

9.4 MAIN SPEED POTENTIOMETER CONNECTION – The drive is supplied with a 5 kΩ Main Speed Potentiometer to control motor speed.

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

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

9.4.1 Models KBVF-27, 29 – Wire the Main Speed Potentiometer to Terminals "P1" (low), "P2" (wiper), "P3" (high). The terminals are located on the lower PC board. See Figure 15.

If installing the SIVFR Signal Isolator, see Section 9.4.2.

9.4.2 Models KBVF-45, 48 – Wire the Main Speed Potentiometer to Terminal Block TB1 on the SIVFR.

FIGURE 15 – MODELS KBVF-27, 29 MAIN SPEED POTENTIOMETER CONNECTION (UNIDIRECTIONAL OPERATION)

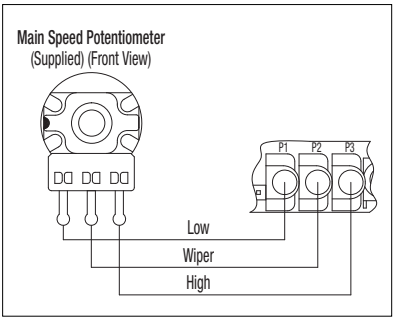


FIGURE 16 – UNIDIRECTIONAL MAIN SPEED POTENTIOMETER & FORWARD-STOP-REVERSE SWITCH CONNECTIONS (JUMPER J1 INSTALLED IN "VOLT" POSITION)

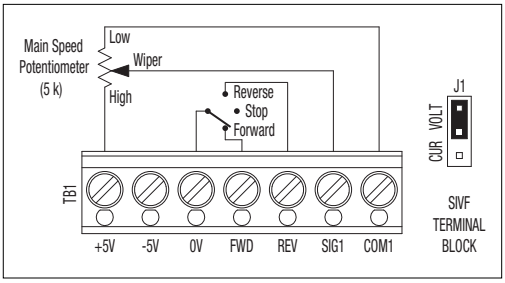
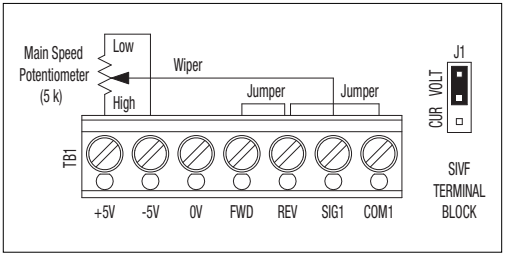


FIGURE 17 – BIDIRECTIONAL MAIN SPEED POTENTIOMETER CONNECTION (TERMINALS "FWD", "REV", "COM1" HARDWIRED) (JUMPER J1 INSTALLED IN "VOLT" POSITION)



<u>For Unidirectional Speed Operation</u>**:** Wire the Main Speed Potentiometer to Terminals "+5V" (high), "SIG1" (wiper), "COM1" (low). Motor direction is selected with a Forward-Stop-Reverse Switch wired to Terminals "0V" (common of switch), "FWD", "REV". See Figure 16. If a Forward-Stop-Reverse Switch is not used, a jumper must be installed between Terminals "0V" and "FWD", of Terminal Block TB1, in order for the drive to operate.

<u>For Bidirectional Speed Operation</u>**:** Wire the Main Speed Potentiometer to Terminals "+5V" (high), "SIG1" (wiper), "– 5V" (low). Terminals "FWD", "REV", "COM1" must be hard wired together. See Figure 17.

9.5 SIGNAL FOLLOWING CONNECTIONS – The drive output will linearly follow the analog signal input.

Models KBVF-27, 29

Wire the ***isolated**** 0 – 5 Volt DC signal input positive lead (+) to Terminal "P2" and the negative lead (–) to Terminal "P1". The terminals are located on the lower PC board. With external circuitry, a 0 – 10 Volt DC analog signal can also be used. See Figure 18.

**If a non-isolated signal is used, install the SIVFR Signal Isolator (Part No. 9597). The SIVFR accepts voltage (0 to ±2.5 thru 0 to ±25 Volts DC) or current (4 – 20 mA DC) signal inputs. See Section 3.5, on page 10.*

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

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 recommended that the SIVFR – Signal Isolator and Run/Fault Relay (Part No. 9597) be installed when using signal following.

Models KBVF-45, 48

The SIVFR is factory calibrated for 0 to ±5 Volt DC signal input. Wire the voltage (0 to ±2.5 thru 0 to ±25 Volt DC) or current (4 – 20 mA DC) signal input to Terminals "SIG1" (+) and "COM1" (–) of Terminal Block TB1 on the SIVFR. For voltage following, be sure Jumper J1 (on the SIVFR) is set to the "VOLT" position (factory setting). For current following, set Jumper J1 (on the SIVFR) to the "CUR" position. See Figures 19 and 20. A jumper must be installed between Terminals "0V" and "FWD", of Terminal Block TB1, in order for the drive to operate.

Application Note – In the Voltage Following Mode, the input will accept a "+" and "–" input voltage, which will run the motor in the forward and reverse direction.

FIGURE 18 – MODELS KBVF-27, 29
VOLTAGE FOLLOWING SIGNAL INPUT CONNECTION

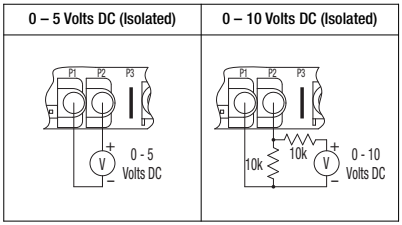


FIGURE 19 – MODELS KBVF-45, 48
VOLTAGE FOLLOWING SIGNAL INPUT CONNECTION
(0 to ±2.5 THRU 0 to ±25 VOLTS DC)
(JUMPER J1 INSTALLED IN "VOLT" POSITION)

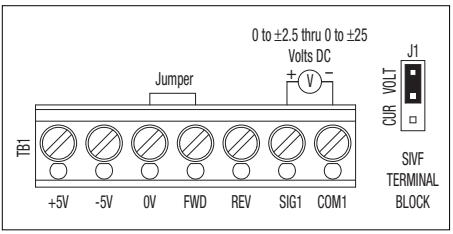


FIGURE 20 – MODELS KBVF-45, 48
CURRENT FOLLOWING SIGNAL INPUT CONNECTION
(JUMPER J1 INSTALLED IN "CUR" POSITION)

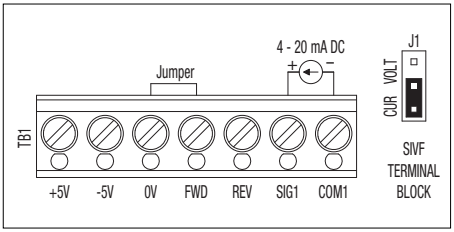
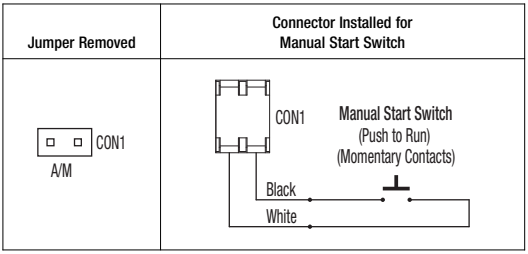


FIGURE 21 – MANUAL START SWITCH CONNECTION



***Notes: 1.** The MIN Trimpot on Models KBVF-45, 48 is not functional. Use the OFFSET Trimpot on the SIVFR to offset the signal input, as described in Section 13.2.1, on page 23.* ***2.** Do not use the MAX Trimpot on Models KBVF-45, 48. Use the MAX Trimpot on the SIVFR to scale the signal input, as described in Section 13.2.2.*

9.6 MANUAL START SWITCH CONNECTION (CON1) – 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 on CON1 and install the 2-wire connector (supplied). CON1 is located on the lower PC board. The connector must be wired to a momentary switch or contact, as shown in Figure 21, on page 19.

In the Manual Start Mode, the drive will trip due to all faults (Overvoltage, Undervoltage, Short Circuit, and I^2t) 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 6.2, on page 15.

Notes: 1. *See Section 11.2, on page 22. Also see Section 12.2, on page 23.* ***2****. The drive can be factory programmed for Run/Stop operation with momentary contacts.*

FIGURE 22 – FORWARD-STOP-REVERSE SWITCH CONNECTION

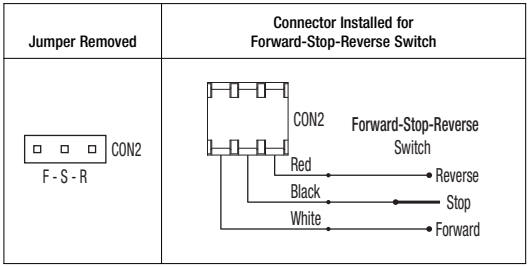


FIGURE 23 – FORM "C" CONTACT OR RELAY FORWARD-STOP-REVERSE CONNECTION

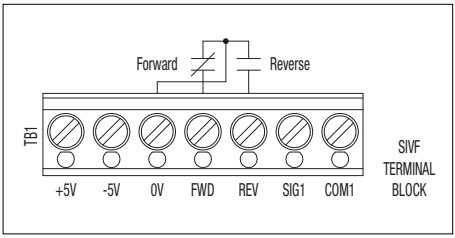
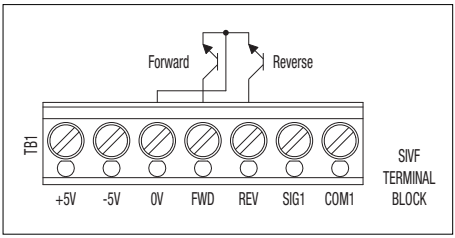


FIGURE 24 – OPEN COLLECTOR FORWARD-STOP-REVERSE CONNECTION



9.7 FORWARD-STOP-REVERSE SWITCH CONNECTION (CON2) – The drive can operate using a Forward-Stop-Reverse Switch, Contact, or Open Collector.

9.7.1 Models KBVF-27, 29 – Remove the factory installed jumper on CON2 and install the 3-wire connector (supplied). CON2 is located on the lower PC board. The connector must be wired to a "maintained" switch or contact. See Figure 22. Also see Forward/Reverse Speed Selection, in Section 6.3, on page 15.

If installing the SIFVR Signal Isolator, see Section 9.7.2.

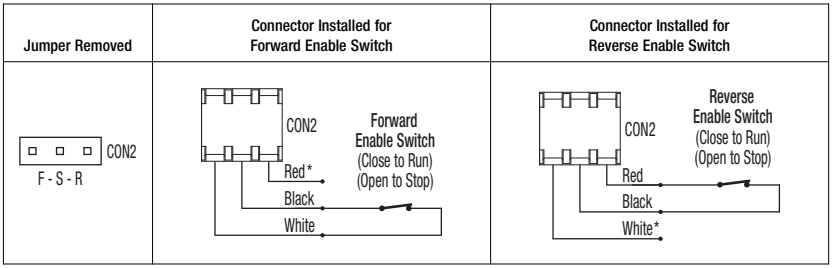
Note: *The drive can be factory programmed for momentary contact operation.*

9.7.2 Models KBVF-45, 48 – Wire the Forward-Stop-Reverse Switch as shown in Figure 16, on page 18. If using Form "C" Contact or Relay, wire the circuit as shown in Figure 23. If using Open Collector, wire the circuit as shown in Figure 24.

9.8 ENABLE SWITCH CONNECTION (CON2) – The drive can be started and stopped with an Enable Switch (close to run, open to stop). Remove the factory installed jumper on CON2 and install the 3-wire connector (supplied). CON2 is located on the lower PC board. The connector must be wired to a "maintained" switch or contact. See Figure 25, on page 21.

For **Forward Enable Operation**, wire the switch to the white and black wires. For **Reverse Enable Operation**, wire the switch to the red and black wires. When the switch is closed, the drive will run. When the switch is opened, the drive will stop.

FIGURE 25 – ENABLE SWITCH CONNECTION



For Forward Enable Switch connection, the red wire is not used. For Reverse Enable Switch connection, the white wire is not used.* ***The unused wire must be insulated or it may be cut off at the connector.*

9.9 RUN/FAULT RELAY – The Run/Fault Relay is built-in on Models KBVF-45, 48 and optional on Models KBVF-27, 29. The Run/Fault Relay Output Contacts are located at TB2 of the SIVFR and can be used to turn on or off equipment or to signal a warning if the drive is put into the Stop Mode or a fault has occurred. See Figure 26.

FIGURE 26
RUN/FAULT RELAY CONNECTION

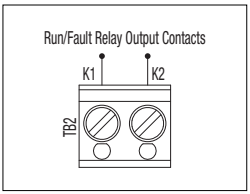


FIGURE 27 – RUN/FAULT RELAY OUTPUT CONTACT SELECTION

Normally Open Contacts	Normally Closed Contacts
Jumper J2 Installed in "NO" Position (Factory Setting)	Jumper J2 Installed in "NC" Position
	

For normally open contacts, set Jumper J2 (on the SIVFR) to the "NO" position. For normally closed contacts, set Jumper J2 (on the SIVFR) to the "NC" position. See Figure 27.

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

Drive Operating Condition	Description	Relay Contact Status (Terminals K1 and K2 of TB2)			
		Run Relay Operation (Jumper J4 Installed in "RUN" Position) (Factory Setting)		Fault Relay Operation (Jumper J4 Installed in "FAULT" Position)	
		Jumper J2 Installed in "NO" Position (Factory Setting)	Jumper J2 Installed in "NC" Position	Jumper J2 Installed in "NO" Position (Factory Setting)	Jumper J2 Installed in "NC" Position
Power Off	Main Power Disconnected	Open	Closed	Open	Closed
Run Mode*	Normal Drive Operation	Closed	Open	Closed	Open
Stop Mode*	Selected by Operator	Open	Closed	Closed	Open
Fault**	Drive Tripped	Open	Closed	Open	Closed

**Run Mode or Stop Mode is selected using the Forward-Stop-Reverse Switch. **Fault: Overload, I^2t, Short Circuit, Undervoltage, and Overvoltage.*

10 AC LINE FUSING

This drive does not contain AC 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 326, 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 11.

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

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 startup procedure can begin. If the AC power has been properly brought to the drive, the power (PWR) LED will be illuminated green. The status (ST) LED will indicate drive status, as described in Section 11.2. To remove and install the Finger-Safe Cover, see Section 5, on page 14.

11.2 FAULT RECOVERY – The drive monitors four faults (Undervoltage, Overvoltage, Short Circuit at the motor (phase-to-phase), I^2t). Table 5 describes how the drive will automatically start (factory setting) after the fault has cleared.

Application Note – In Manual Start Mode, the drive must be manually reset for any fault. Use the Manual Start Switch, as described in Section 9.6, on page 20. Also see Section 12.2, on page 23.

TABLE 5 – FAULT RECOVERY & RESETTING THE DRIVE*

Fault	Automatic Start Mode (Factory Setting)
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^2t	Drive must be ***manually restarted***.

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

11.3 RESTARTING THE DRIVE AFTER AN I^2t FAULT HAS CLEARED – The drive can be restarted after an I^2t Fault has cleared by any of the following methods.

***Note:** If an I^2t 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. See Section 13.7, on pages 25 and 26.*

TABLE 6 – DRIVE OPERATING CONDITION & STATUS LED INDICATOR

Drive Operating Condition	Flash Rate[1] and LED Color
Normal Operation (Run)	Slow Flash Green
Overload (120% – 160% Full Load)	Steady Red[2]
I^2t (Drive Timed Out)	Quick Flash Red
Short Circuit	Slow Flash: Red
Undervoltage	Quick Flash Red / Yellow[3]
Overvoltage	Slow Flash Red / Yellow[3]
Stop	Steady Yellow

***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 I^2t 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.*

1 Disconnect and reconnect the AC power (approximately 15 seconds). The "ST" LED must change from quick flashing red to flashing red/yellow.

2 Setting the Main Speed Potentiometer to zero (fully counterclockwise).

***Note:** In order to be able to reset the drive by setting the Main Speed Potentiometer to zero, it is necessary to have the MIN Trimpot set to zero (fully counterclockwise).*

3 Open and close the Enable switch or contact. See Section 9.8, on pages 20 and 21.

12 DIAGNOSTIC LEDS

The drive contains two diagnostic LEDs to display the drive's operational status. See Figure 5, on page 13, for the location of the "PWR" and "ST" LEDs.

12.1 POWER ON (PWR) – The "PWR" LED will illuminate green when the AC line is applied to the drive.

12.2 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, on page 22, summarizes the "ST" LED functions.

Note: *The drive is factory set to the Automatic Start Mode. For Manual Start/Reset, see Section 9.6, on page 20.*

13 TRIMPOT ADJUSTMENTS

The drive contains trimpots which are factory set for most applications. See Figure 5, on page 13, 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 below.

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. Safety Warning, on pages 8 and 9, must be read and understood before proceeding.

13.1 MINIMUM SPEED (MIN / OFFSET) – Sets the minimum speed of the motor.

13.1.1 Models KBVF-27, 29 – The MIN Trimpot is factory set to 0% of frequency setting. For a higher minimum speed setting, rotate the MIN Trimpot clockwise. See Figure 28.

13.1.2 Models KBVF-45, 48 – The OFFSET Trimpot on the SIVFR is a 10-turn trimpot which allows for accurate setting of the minimum speed of the motor. The OFFSET Trimpot is factory set to 0% of frequency setting. For a higher minimum speed setting, rotate the OFFSET Trimpot clockwise. See Figure 29.

Note: *The MIN Trimpot on Models KBVF-45, 48 is not functional.*

FIGURE 28 – MINIMUM SPEED TRIMPOT RANGE MODELS KBVF-27, 29

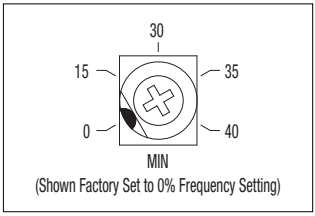


FIGURE 29 – OFFSET TRIMPOT MODELS KBVF-45, 48

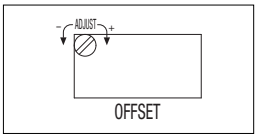
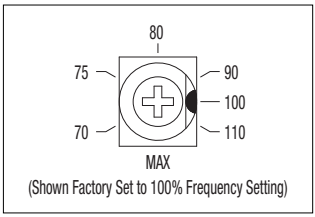


FIGURE 30 – MAXIMUM SPEED TRIMPOT RANGE MODELS KBVF-27, 29



13.2 MAXIMUM SPEED (MAX) – Sets the maximum speed of the motor.

13.2.1 Models KBVF-27, 29 – 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 30.

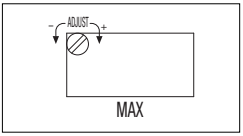
13.2.2 Models KBVF-45, 48 – The MAX Trimpot on the SIVFR is a 10-turn trimpot which allows for accurate setting of the maximum speed of the motor. The MAX trimpot is factory set to 100% of frequency setting. For a higher maximum speed setting, rotate the MAX Trimpot clockwise. For a lower maximum speed setting, rotate the MAX Trimpot counterclockwise. See Figure 31,

on page 24.

13.3 ACCELERATION (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 longer acceleration time, rotate the ACC Trimpot clockwise. For more rapid acceleration, rotate the ACC Trimpot counterclockwise. See Figure 32.

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

FIGURE 31 – MAXIMUM SPEED TRIMPOT MODELS KBVF-45, 48



13.4 DECELERATION (DEC/B) – Sets the amount of time for the motor to decelerate from full speed to zero speed. The DEC/B Trimpot is factory set to 1.5 seconds. For longer deceleration time, rotate the DEC/B Trimpot clockwise. For more rapid deceleration, rotate the DEC/B Trimpot counterclockwise. See Figure 33.

Application Note – On applications with high inertial loads, the deceleration may automatically increase in time. This will slow down the rate of speed of decrease 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 ACC and DEC/B Trimpots should be set to greater than 10 seconds.**

For rapid stopping, install the optional DBVF – Dynamic Brake Module (Part No. 9598). See Section 3.5, on page 10.

FIGURE 32 – ACCELERATION TRIMPOT RANGE ALL MODELS

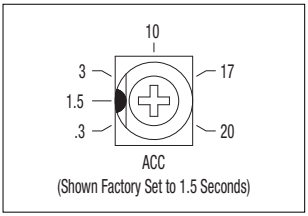
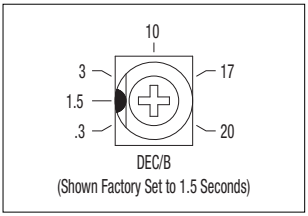


FIGURE 33 – DECELERATION TRIMPOT RANGE ALL MODELS

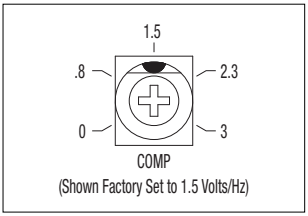


13.5 SLIP COMPENSATION (COMP) – Sets the amount of Volts/Hz to maintain set motor speed under varying loads. The COMP Trimpot is factory set to 1.5 Volts/Hz, which provides excellent speed regulation for most motors. To increase the slip compensation, rotate the COMP Trimpot clockwise. To decrease the slip compensation, rotate the COMP Trimpot counterclockwise. See Figure 34.

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 34 – SLIP COMPENSATION TRIMPOT RANGE ALL MODELS



13.6 BOOST (DEC/B) – When the drive is set for 50 Hz Motor Operation (Jumper J1 installed in the "50Hz" position), the DEC/B Trimpot automatically becomes the adjustable BOOST Trimpot.

Most 60 Hz motors conforming to NEMA standards can operate from a preset Volts/Hz curve. 50 Hz motors, however, generally differ widely in their characteristics. Therefore, it is necessary to have adjustable Boost to obtain maximum motor performance.

To increase the boost, rotate the BOOST Trimpot clockwise. To decrease the boost, rotate the BOOST Trimpot counterclockwise. See Figure 35.

In order for the 50 Hz motor to run properly, the boost must be adjusted. If the application does not require full torque below 10 Hz, the Boost (DEC/B) Trimpot can be conservatively set at 8% (9 o'clock position).

Note: *In 50 Hz motor operation, the deceleration time is automatically set to the same as the Acceleration Trimpot (ACC) setting.*

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

FIGURE 35 – BOOST TRIMPOT RANGE ALL MODELS

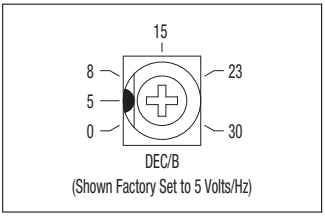


FIGURE 36 – CL TRIMPOT RANGE MODEL KBVF-27

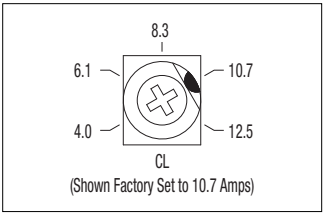


FIGURE 37 – CL TRIMPOT RANGE MODEL KBVF-29

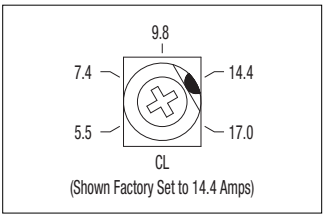
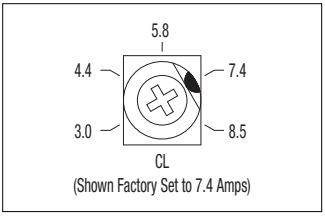


FIGURE 38 – CL TRIMPOT RANGE MODEL KBVF-45



<u>The Boost (DEC/B)Trimpot may be adjusted as follows:</u>

1. Wire an AC RMS ammeter in series with one motor phase.
2. Run the motor unloaded at approximately 4 Hz (or 120 RPM).

   Note: *An unloaded motor with excessive boost will draw more current than a partially loaded motor.*
3. Increase the boost until the ammeter reaches the nameplate rated current (Amps AC).
4. Using the Main Speed Potentiometer, slowly adjust the motor speed over a 0 – 15 Hz (0 – 450 RPM) range. If the motor current exceeds the nameplate rating, decrease the boost setting.

13.7 MOTOR OVERLOAD (I^2t) WITH RMS CURRENT LIMIT (CL)* – Sets the current limit (overload), which limits the maximum current to the motor, 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 36 – 39, on pages 25 and 26.

**UL approved as an electronic overload protector for motors.*

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 rating. This is accomplished as follows:

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

1. Connect an AC RMS ammeter in series with one motor phase.

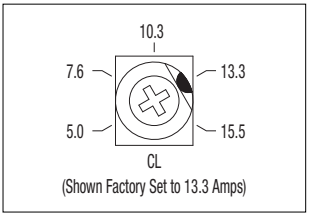
2. Set the CL Trimpot fully counterclockwise.

3. Adjust the speed setting to 30% of full speed.

4. Lock the motor shaft and adjust the CL Trimpot to 160% of the motor nameplate rated current.

Example: A 2 HP motor has a full load current rating of 5.2 Amps. Set the CL Trimpot to 5.2 X 160% = 8.3 Amps

FIGURE 39 – CL TRIMPOT RANGE MODEL KBVF-48



– NOTES –

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