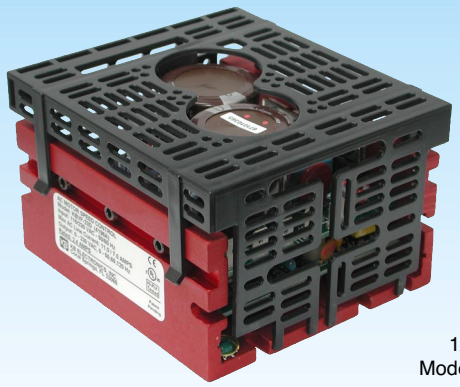
KBVF

CHASSIS MOUNT INVERTER

Variable Speed / Soft-Start AC Motor Controls with I^2t Electronic Overload Protection for 3-Phase Induction Motors rated 1½ HP for standard efficiency motors and 2 HP for most premium efficiency motors

TYPICAL APPLICATIONS

• Conveyors • Feeders • Packaging Equipment
• Fans • Pumps • Printing Presses • Indexers



1/2 HP
Model Shown

STANDARD FEATURES

- **Operates standard 208-230VAC 3-phase AC motors, with 115 and 230 VAC input single phase.**
- **Controls 50, 60 and 50/60 Hz motors with a convenient jumper selection**
- **Sinewave coded PWM** – Provides high motor torque and efficient operation
- **Power Start™** – Provides more than 200% starting torque
- **30:1 speed range with full motor torque****
- **16 kHz switching frequency** – Provides quiet motor operation
- **I^2t motor overload protection** – Provides motor overload protection and eliminates nuisance trips and motor burnout
- **Slip Compensation with Boost** – Provides excellent load regulation over a wide speed range
- **EICL™** – Eliminates harmful inrush AC line current during startup
- **dV/dT filter** – Reduces harmful voltage spikes to motor
- **Regeneration protection** – Eliminates tripping due to bus overvoltage
- **Jumper Selections**
  Forward - Stop - Reverse /Enable - Automatic - Manual Start
  0-60, 0-120, 0-50 Hz
- **Trimpot Adjustments**
  Minimum Speed - MIN • Maximum Speed - MAX
  Acceleration - ACCEL • Deceleration - DECEL***
  Slip Compensation - COMP • Current Limit - CL
- **Protection Features**
  MOV input transient protection
  Short circuit protected phase to phase at motor
  Micro controller self-monitoring and auto reboot
  Overvoltage and undervoltage protection
- **LED Diagnostic Indicators**
  Power on • Motor overload • I^2t Trip • Undervoltage • Stop
  Overvoltage • Short Circuit Trip • Microcontroller status

Notes: * Model KBVF-26D UL pending.
** Dependent on motor capability.
*** In 50Hz mode, DECEL trimpot automatically becomes Adjustable Boost.

ACCESSORIES

- **SIVF Signal Isolator (Part No. 9474):** Provides an isolated interface between non-isolated signal sources and the KBVF adjustable Frequency Drive.
- **Multi-Speed Board (Part No. 9503):** Provides four (4) user selectable preset speeds.
- **KBRF-300 RFI Filter (Part No. 9484):** Provides conducted EMC suppression to meet CE residential directives.
- **KBRF-250 RFI Filter (Part No. 9509):** Under chassis mount. Meets CE industrial directives.

DESCRIPTION

The KBVF Adjustable Frequency Drive is designed to provide variable speed control of standard three-phase AC induction motors. Adjustable linear acceleration and deceleration are provided, making the drive suitable for soft start applications. The output voltage is sinewave coded PWM operating at 16 kHz, which provides high motor torque, high efficiency and low noise. The KBVF is a full featured drive, and due to its user friendly design, it is easy to install and operate. Simple trimpot adjustments eliminate the computer-like programming required on other drives. However, for most applications, no adjustments are necessary.

The KBVF main features include Adjustable RMS Current Limit and I^2t Motor Overload Protection. Adjustable Slip Compensation provides excellent load regulation over a wide speed range. Power Start™ delivers over 200% motor torque to insure startup of high frictional loads. Several models, through 2 HP, are available to control standard 208-230VAC - 50, 60 and 50/60Hz motors from either a 115 or 230VAC-50/60Hz – 1ϕ AC line. The KBVF is easily tailored to specific requirements via selectable jumpers, such as Frequency Range (0-60, 0-120, 0-50 Hz), Auto/Manual Restart, and Forward-Stop-Reverse/Enable operation. Other standard features include Electronic Inrush Current Limit (EICL™), which eliminates harmful AC line inrush current, and a built-in dV/dT filter, which reduces harmful voltage spikes to the motor. Also, two LED indicator lamps provide the user with diagnostic information.

IMPORTANT APPLICATION INFORMATION

Most fan-cooled (TEFC and open ventilated) 3-phase motors will overheat if used with an inverter beyond a limited speed range at full rated torque. Therefore, it is necessary to reduce motor load as speed is decreased. Consult motor manufacturer for details.

Inverter duty and most totally enclosed nonventilated (TENV) motors can provide full rated motor torque over an extended speed range without overheating.

⚠ **Therefore, it is recommended that this control be used with inverter duty and totally enclosed nonventilated (TENV) motors.**

If external fan cooling is provided, open-ventilated motors can also achieve an extended speed range at full rated torque. A box fan or blower with a minimum of 100 CFM is recommended. Mount the fan a few inches from the motor so it is surrounded by the air flow.

PENTA KB POWER™

A Complete Line of Motor Drives

ELECTRICAL RATINGS

Model No.	KB Part No.	Input Voltage (VAC – 50/60 Hz) Single Phase	Nominal Output Voltage (VAC)	Maximum Horsepower Rating HP, (kW)	Maximum Continuous Output Load Current (RMS Amps/Phase)	Maximum AC Line Input Current (Amps AC)
KBVF-13	9957	115	0 – 230	1/2, (0.37)	2.4	11.0
KBVF-23	9958	230	0 – 230	1/2, (0.37)	2.4	7.0
KBVF-23D	9959	115/230	0 – 230	1/2, (0.37)	2.4	11.0 / 7.0
KBVF-14	9977	115	0 – 230	1, (0.75)	4.0	16.0
KBVF-24	9978	230	0 – 230	1, (0.75)	4.0	10.0
KBVF-24D	9979	115/230	0 – 230	1, (0.75)	4.0	16.0 / 10.0
KBVF-26D	9496	115/230	0 – 230	1½[2]*, (1.13) [1.5]*	5.5	22.0 / 14.0

*2 HP for most premium efficiency motors.

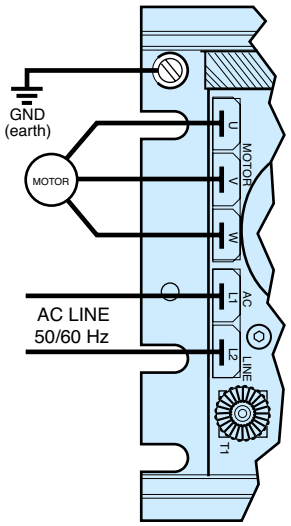
GENERAL PERFORMANCE SPECIFICATIONS – (ALL MODELS)

Parameter	Specification	Factory Setting
Recommended AC Line Input Operating Range (% of nominal 115/230 VAC)	±10	—
Maximum Input Voltage Range 115 VAC, 230 VAC (VAC)	97 – 135, 195 – 270	—
Maximum Load (% Current Overload for 2 Minutes)	150	—
Switching Frequency - at Motor (kHz)	16	—
Signal Following Input Voltage (VDC)*	0 – 5	—
Signal Following Input Resolution (bits)	8	—
Minimum Speed Trimpot Range (% of frequency setting)	0 – 40	0
Output Frequency Setting (Hz)	50, 60, 120	60
Maximum Speed Trimpot Range (% of frequency setting)	70 – 110	100
Speed Range (ratio)	50:1	—
Acceleration and Deceleration Trimpot Ranges (secs)	0.3 – 20	1.5
Boost Trimpot Range (50 Hz only) (%)	6 – 30	—
Slip Compensation Trimpot Range (Volts/Hz/Amp)	0 – 3	—
Current Limit Trimpot Range 1/2 HP, 1 HP, 1½ (2) HP (Amps AC)	1.5 – 4.5, 2.5 – 7.5, 2.2 – 8.8	—
Speed Regulation (0-Full Load, 30:1 Speed Range) (% Base Speed)	2.5	—
Operating Temperature Range (°C)	0 – 45	—
Overload Protector Trip Time (Stalled Motor) (secs)	6	—
Bus Overvoltage Trip Point (VDC) (Equivalent AC Line Volts – 230 VAC Line)	400 (283)	—
Bus Undervoltage Trip Point (VDC) (Equivalent AC Line Volts – 230 VAC Line)	260 (184)	—

*Isolated input signal must be used.

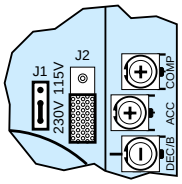
CONNECTION DIAGRAMS

Motor and AC Line Connections

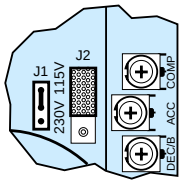


Input Voltage Selection

1/2 HP and 1 HP Models

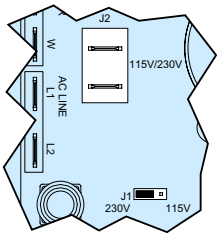


CONTROL SET FOR 230 VAC
(Factory Setting)

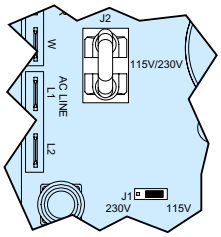


CONTROL SET FOR 115 VAC

Model KBVF-26D

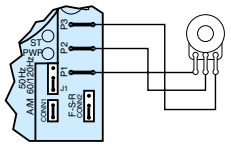


CONTROL SET FOR 230 VAC (Jumper J2 removed)
(Factory Setting)

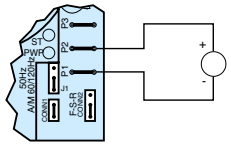


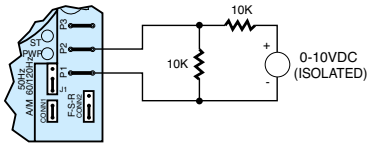
CONTROL SET FOR 115 VAC

Main Speed Potentiometer and Input Signal Connections

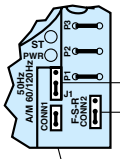


Signal Following 0 – 5VDC (Isolated)





JUMPER SETTINGS



MOTOR FREQUENCY SELECTION

50 Hz / 60/120 — 50/60 Hz AND 60 Hz (FACTORY SETTING)

50 Hz / 60/120 — 50 Hz (NO JUMPER INSTALLED)

60/120 — 120 Hz

FORWARD REVERSE SELECTION

F – S – R / CONN2 — CONTROL SET FOR "FORWARD" SPEED OPERATION. (FACTORY SETTING)

F – S – R / CONN2 — CONTROL SET FOR "REVERSE" SPEED OPERATION.

FORWARD-STOP-REVERSE/ENABLE

FORWARD-STOP-REVERSE SWITCH CONNECTION

F – S – R — REVERSE / STOP / FORWARD

ENABLE SWITCH CONNECTION

F – S – R — CLOSE TO ENABLE

AUTO/MANUAL SELECTION

A/M — CONTROL SET FOR "AUTOMATIC START" OPERATION. (FACTORY SETTING)

MANUAL START SWITCH CONNECTION

A/M — MANUAL START MODE

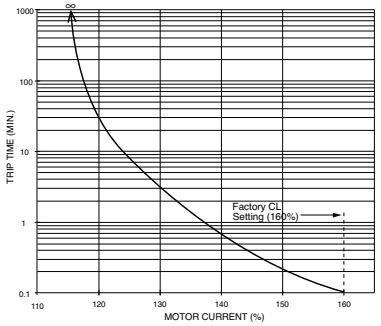
YOU GET MORE WITH KB INVERTERS!

ELIMINATE MOTOR FAILURE DUE TO OVERLOAD WITH THE KBVF AC MOTOR CONTROL

The KBVF contains modified I^2t overload protection. Part of this function consists of a current limit (CL) circuit, which limits the control current to a factory preset level of 160% of rated motor current. The I^2t circuit provides an overshoot function that allows most motors to develop more than 200% starting and breakdown torque. The setting is adjustable from 50% to 200% of rated motor current via the CL trimpot.

If the motor is overloaded to 120% of full load (or 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 control after 30 minutes. If the motor is overloaded to 140% of its full load rating, the control will trip after 50 seconds. In full current limit, the control will trip in approximately 6 seconds. The graph presented illustrates the time versus current relationship.

Modified I^2t Trip Time vs. Motor Current

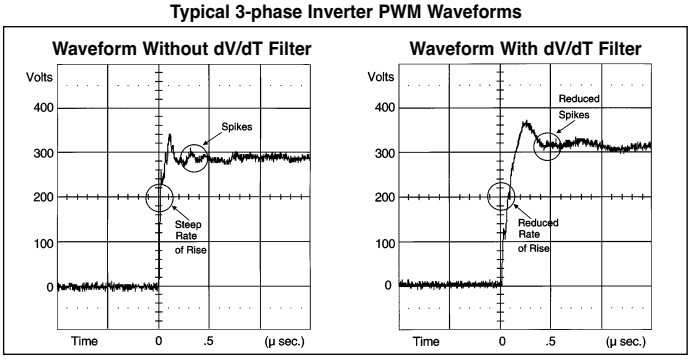


Standard I^2t is undesirable because it causes nuisance tripping. It allows a very high motor current to develop and will turn the drive off after a short period of time. Our modified I^2t system avoids this nuisance tripping while offering maximum motor protection.

AC MOTORS LAST LONGER WITH KB AC INVERTERS

It is a known fact that AC inverters produce very fast rising voltages (dV/dT) that are harmful to motor windings. Some motor manufacturers are now using spike resistant magnet wire that reduces the chance of insulation breakdown. Unfortunately, most motors do not contain the spike resistant wire, especially motors below one horsepower. To substantially reduce the chance of motor winding damage all KB inverters contain a built-in dV/dT filter. The following data compares a typical inverter waveform with and without the KB filter. It can be observed that the waveform with the dV/dT filter has a reduced rate of voltage rise and reduced voltage spikes.

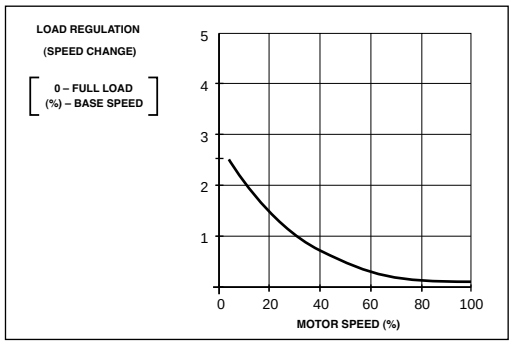
Typical 3-phase Inverter PWM Waveforms



MAINTAIN CONSTANT MOTOR SPEED UNDER VARYING LOADS WITH THE KBVF

The KBVF contains unique micro controller programming that uses an active motor current algorithm and boost to stabilize motor speed. Base speed load regulation is up to 2.5% over a 30:1 speed range. The KBVF contains a slip compensation (COMP) trimpot, which is factory calibrated for most motors. It can be fine tuned for specific applications, if necessary. Controllers without this feature typically can stabilize motor speed to only 6% of base speed.

Load Regulation vs. Motor Speed



ELIMINATE HARMFUL INRUSH CURRENT WITH THE KBVF AC MOTOR CONTROL

The KBVF drive contains an Electronic Inrush Current Limit (EICL™) circuit. The EICL™ prevents high AC inrush current each time the drive is connected to the AC line.

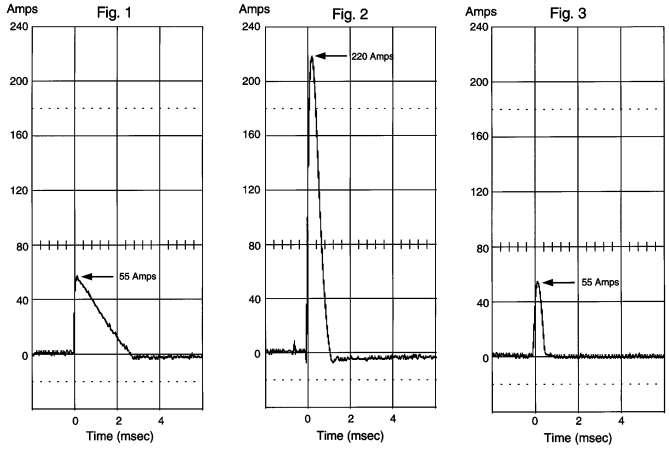
Most competitive drives use a thermistor-type of inrush current limiter. The thermistor operates favorably when the drive is initially connected to the AC line. The problem with the thermistor occurs when the drive is disconnected from the AC line for a short period of time (1/2 - 2 minutes). During this time the main bus capacitor(s) discharge. However, the thermistor takes more than 3 minutes to cool down to the point where its resistance increases enough to limit inrush current. If the drive is reconnected to the AC line before the thermistor has cooled, very high inrush current results, which can damage the control's input bridge or can weld the contacts of the AC line switch. In many cases the main circuit breaker or fuse will trip.

Several drive manufacturers suggest connecting their drives and leaving them on continuously to avoid the restart problem. This philosophy does not work since the drive can be shut down due to momentary power outages and an operator inadvertently turning it off and then on. Some competitive drives do not utilize any type of ICL. Therefore, harmful inrush current can exist each time the drive is connected to the AC line.

Fig. 1: The current surge of a control using a thermistor ICL when started for the first time. The current surge is normal.

Fig. 2: The current surge of a control using a thermistor ICL after the control is restarted after a 1-minute shutdown. The current surge is abnormal and can damage the input power bridge and trip the main circuit breaker.

Fig. 3: The current surge of a KBVF control using EICL™. The current surge is normal whether started for the first time or restarted anytime.



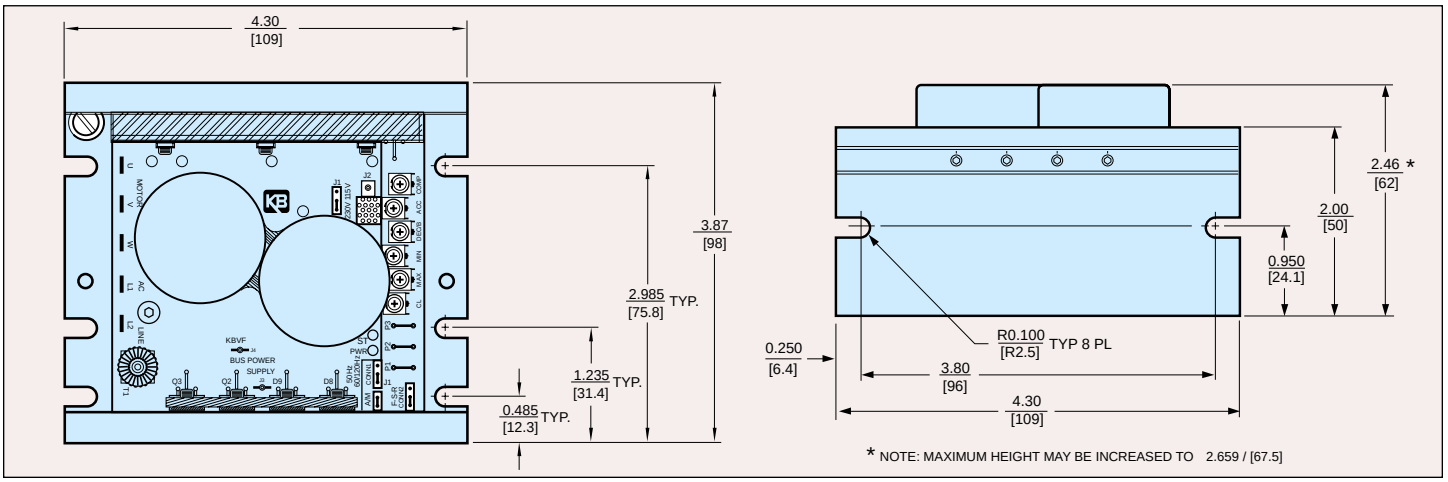
THE KBVF STATUS INDICATORS SAVE INSTALLATION TIME

The KBVF adjustable frequency drive contains two LED status indicators. The first LED is a tricolor lamp (ST) that indicates a fault or abnormal condition. The information provided can be used to diagnose an installation problem, such as incorrect input voltage, overload condition and control circuit miswiring. It also provides a "normal" signal that informs the user that all control and micro processor operating parameters are proper. The second LED is a Power On indicator (PWR) that senses the presence of the bus voltage and the operation of the main control logic power supply. The status functions are summarized below:

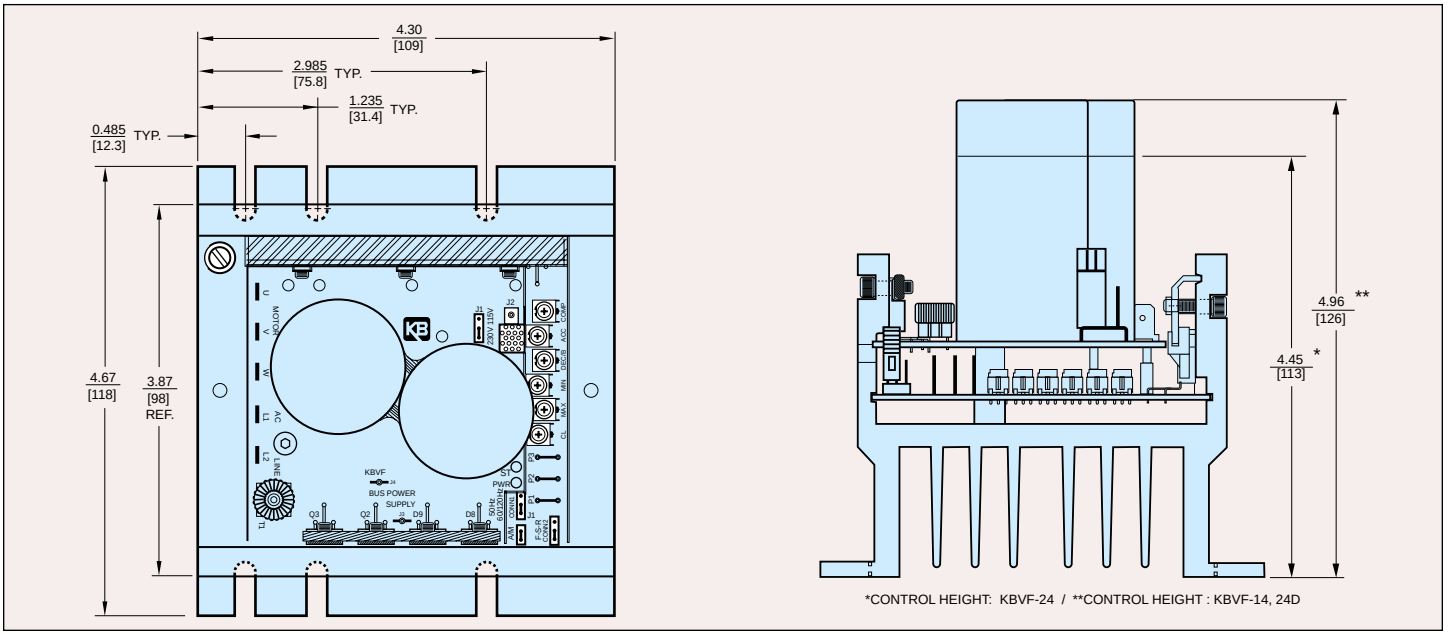
KBVF STATUS INDICATORS				
LED Ref.	**Function**	**State[1]**	**LED Color**	**LED – Recovered Fault (Man. Mode)**
"ST" (Status)	Normal Control Operation	Slow Flash	Green	—
	CL (current limit)	Steady	Red	Green[2]
	I^2t	Quick Flash	Red	Green[2]
	Short Circuit	Slow Flash	Red	—
	Undervoltage	Quick Flash	Red/Yellow	Red/Yellow/Green
	Overvoltage	Slow Flash	Red/Yellow	Red/Yellow/Green
	Stop	Steady	Yellow	Green[2]
"PWR" (Power)	Bus & Power Supply	Steady	Green	—

Notes: (1) Slow flash: 1 sec. on, 1 sec. off – Quick Flash: .25 sec. on, .25 sec. off. — (2) Flashing Green.

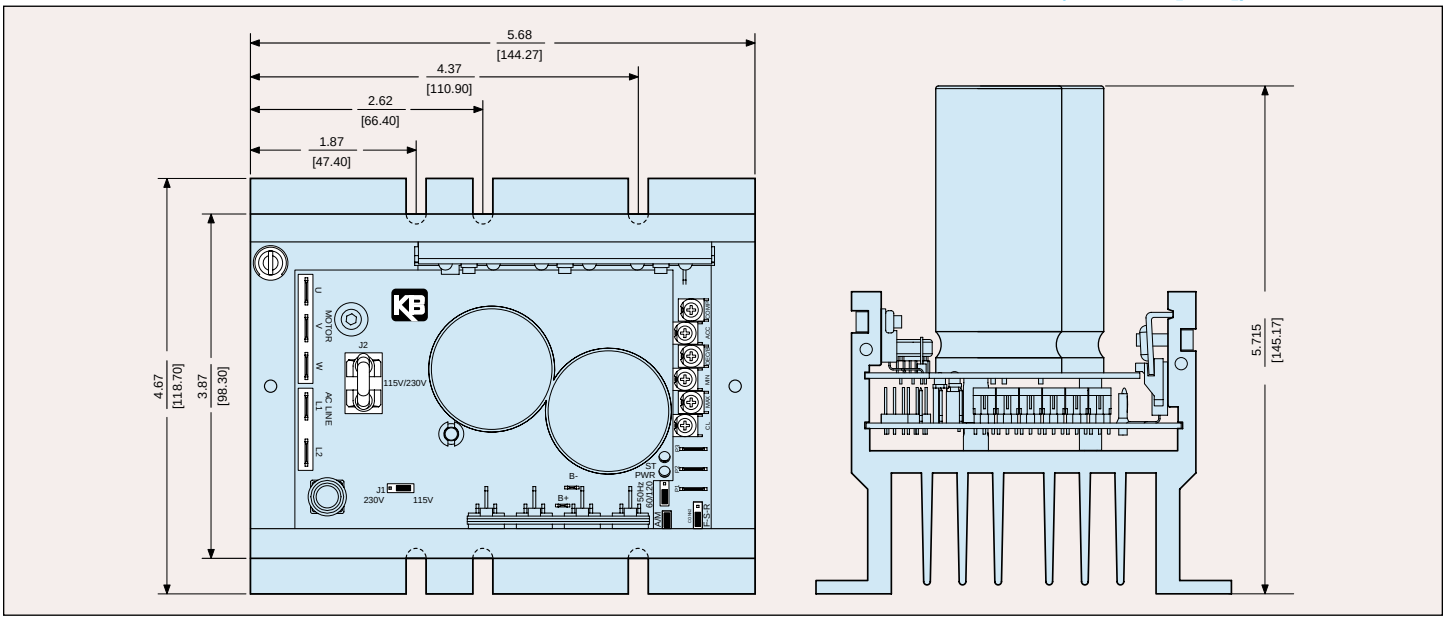
KBVF 1/2 HP CONTROL LAYOUT & MECHANICAL SPECIFICATIONS – (INCHES/[mm])



KBVF 1 HP CONTROL LAYOUT & MECHANICAL SPECIFICATIONS – (INCHES/[mm]



KBVF-26D CONTROL LAYOUT & MECHANICAL SPECIFICATIONS – (INCHES/[mm])



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