INSTALLATION AND OPERATION MANUAL
KBMD-240D MULTI-DRIVE™

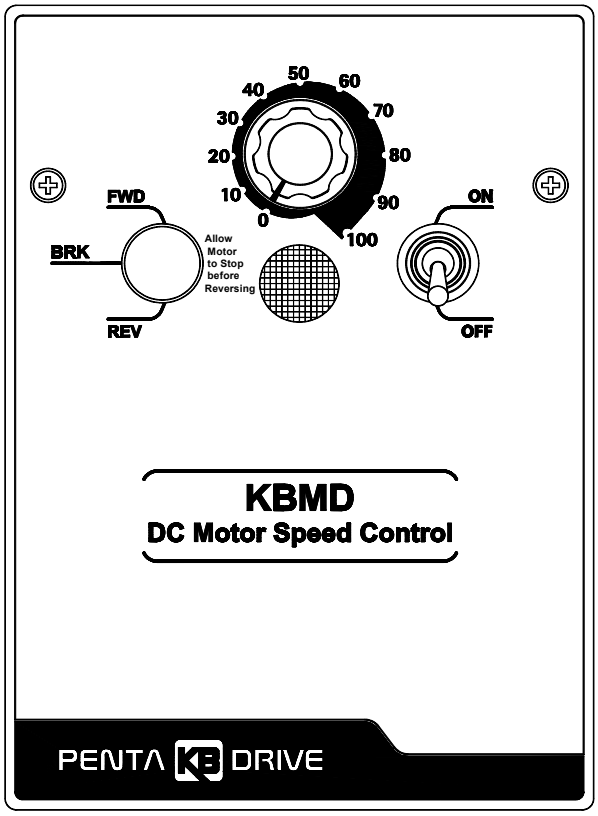
DC Motor Speed Control

NEMA 1 / IP40

with Adjustable Acceleration and Deceleration
for Subfractional thru 2 HP (1.5 kW)[1] Permanent Magnet and Shunt Wound Motors
Rated 90 and 180 Volts DC Output

Operates from 115 or 230 Volt 50/60 Hz AC Line Input

Ultra-Fast Current Limit Circuit Prevents Demagnetization of Permanent Magnet Motors



Model KBMD-240D (Part No. 9370) Shown[3]

IMPORTANT

1. The control is factory set for 230 Volt AC Line input. For 115 Volt AC Line input, see Section 7 on page 7.
2. A Plug-In Horsepower Resistor®, AC Line Fuse, and Armature Fuse must be installed for this control to operate. See Sections 6 and 8 on pages 7 and 8.

See Safety Warning on page 4.

c UL us LISTED IND. CONT. EQ. – 70ZA

CE[2]

RoHS COMPLIANT

This Manual Covers Models KBMD-240D (Part No. 9370) and KBMD-240D w/ FBR (Part No. 9371)[3]

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

Notes: 1. *Rated 0.75 HP (0.6 kW), with 115 Volt AC Line input, and 1.5 HP (1.13 kW), with 230 Volt AC Line input. With the optional Auxiliary Heat Sink, the maximum ratings are 1 HP (0.75 kW) with 115 Volt AC Line input and 2 HP (1.5 kW) with 230 Volt AC Line input.* ***2.*** *Requires CE approved RFI (EMI) filter.* ***3.*** *The Forward-Brake-Reverse Switch Kit is built-in on Model KBMD-240D w/ FBR (Part No. 9371) and optional on Model KBMD-240D (Part No. 9370).*

PENTA KB POWER™
A COMPLETE LINE OF MOTOR DRIVES

KBMD Manual

Scan this QR Code to View, Download, or Print the Online Manual

TABLE OF CONTENTS

1 – QUICK-START INSTRUCTIONS

Also see Section 4 – Important Application Information on page 6.

Important: You must read these simplified instructions before proceeding. These instructions are to be used as a reference only and are not intended to replace the details provided herein. You must read the Safety Warnings on page 4 before proceeding.

WARNING! High Voltage! Disconnect the main power before making connections to the control. Do not depend on the orange Pilot Light, located on the front cover, or the green Power On LED (PWR ON), located on the control's PC board, to no longer be illuminated as a guaranteed power off condition.

1.1 – MOUNTING INSTRUCTIONS

See Section 5 on page 6.

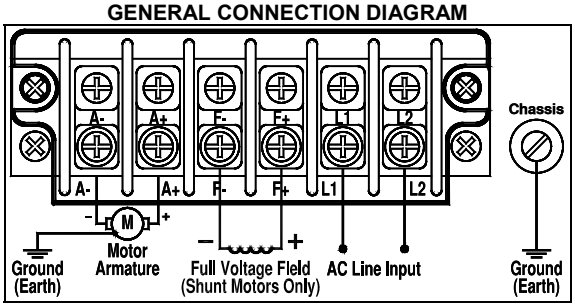
1.2 – PLUG-IN HORSEPOWER RESISTOR

Install the correct Plug-In Horsepower Resistor according to armature voltage and motor horsepower. See Section 6 on page 7.

1.3 – DUAL VOLTAGE SWITCH SETTING

The control is factory set for 230 Volt AC Line input (Dual Voltage Switch set to the "230" position), for use with 180 Volt motors. For 115 Volt AC Line input, for use with 90 Volt Motors, set the Dual Voltage Switch to the "115" position. See Section 7 on page 7.

FIGURE 1
GENERAL CONNECTION DIAGRAM



1.4 – AC LINE INPUT AND MOTOR ARMATURE FUSING

A 20 Amp fuse is factory installed in the AC Line input fuse holder. Fuse each AC Line conductor that is not at ground potential. See Section 8 on page 8.

Install a fuse (supplied separately by your distributor) in the Motor Armature Fuse Holder. Select the correct Armature Fuse according to Table 4 on page 8.

1.5 – AC LINE INPUT CONNECTION

Connect the AC Line Input to Terminals L1 and L2 as shown in Figure 1 above. See Section 9.1 on page 9.

1.6 – MOTOR ARMATURE CONNECTION

Connect the Motor Armature positive lead to Terminal A+ and the negative lead to Terminal A-, as shown in Figure 1, above. Also see Section 9.2 on page 9. Be sure the Motor is properly grounded. Motor cable length should not exceed 100 ft. (30 m) – special reactors may be required – contact Technical Support.

1.7 – GROUND CONNECTION

Connect the ground wire (earth) to the green Ground Screw (chassis) located on the right side of the terminal block, as shown in Figure 1 above. Be sure the motor is also properly grounded.

1.8 – MOTOR FIELD CONNECTION (SHUNT WOUND MOTORS ONLY)

See Section 9.4 on page 9.

WARNING! Do not connect the Armature leads to Terminals F+ and F-. Do not use Terminals F+ and F- for any purpose other than to power the Field of a Shunt Wound Motor. Shunt Wound Motors may be damaged if the Field remains energized without Armature rotation for an extended period of time.

Full Voltage Field: For 90 Volt Motor with 100 Volt Field or 180 Volt Motor with 200 Volt Field, connect the Field positive (+) lead to Terminal F+ and the negative (-) lead to Terminal F-.

Half Voltage Field: For 90 Volt Motor with 50 Volt Field or 180 Volt Motor with 100 Volt Field, connect the Field positive (+) lead to Terminal F+ and the negative (-) lead to Terminal L1.

1.9 – TRIMPOT ADJUSTMENTS

All Trimpots have been factory set for most applications. The trimpots may be readjusted, as described in Section 12 on page 11.

1.10 – PILOT LIGHT AND DIAGNOSTIC LEDs

After applying power to the control and setting the On/Off AC Line Switch to the "ON" position, the panel mounted Pilot Light will illuminate and the Power On LED (PWR ON) will illuminate green. The CL LED will illuminate red if the control is in overload. See Section 13 on page 12.

2 – SAFETY WARNINGS

Definition of Safety Warning Symbols

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

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

SAFETY WARNING! – PLEASE READ CAREFULLY!

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

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

CE This product complies with all CE directives pertinent at the time of manufacture. Contact Technical Support for Declaration of Conformity. Installation of a CE approved RFI filter is required. See RFI Filters & Chokes Selection Guide D-321 (Part No. A42027) for the 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.

UL NOTICE

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.

3 – INTRODUCTION

Thank you for purchasing the KBMD-240D Multi-Drive full-wave variable speed DC motor control. KB Electronics, Inc. is committed to providing total customer satisfaction by producing quality products that are easy to install and operate.

The electronics of the control consists of KB's patented KBMM™ speed control module with its ultra-fast current limit circuitry, which prevents demagnetization in Permanent Magnet Motors. Keyhole slots facilitate mounting while a readily accessible terminal block simplifies wiring for AC Line input, Motor Armature, and Motor Field (Shunt Wound Motors only). The control contains AC Line input and Motor Armature Fuse Holders.

The control is housed in a rugged NEMA 1 / IP40 enclosure. It is designed to operate a wide range of permanent magnet and Shunt Wound Motors by installing the appropriate Plug-In Horsepower Resistor (supplied separately). The control accepts either 115 or 230 Volt AC Line input by setting the Dual Voltage Switch, located under the front cover.

The control can operate motors from sub-fractional through 0.75 HP (0.6 kW), with 115 Volt AC Line input, and 1.5 HP (1.13 kW), with 230 Volt AC Line input. With the optional Auxiliary Heat Sink, the maximum ratings are increased to 1 HP (0.75 kW) with 115 Volt AC Line input, and 2 HP (1.5 kW), with 230 Volt AC Line input.

The versatility of the control is further enhanced with the Forward-Brake-Reverse Switch Kit (optional on Model KBMD-240D (Part No.9371) and built-in on Model KBMD-240D w/ FBR (Part No. 9371)), which is used to change motor direction and dynamically brake the motor to stop. Remote mountable RFI (EMI) Filters and Chokes are also available to comply with the CE Council Directive 89/336/EEC relating to the Class A Industrial Standard.

3.1 – STANDARD FEATURES

- **Simple to Operate:** Does not require programming. Uses trimpots which are factory set for most applications.
- **Dual Voltage Switch (115 or 230 Volts AC Operation):** Located under the front cover.
- **Auto-Inhibit:** Allows the control to be rapidly switched "on" and "off" using the AC Line.
- **Adjustable Trimpots:** Minimum Speed (MIN), Maximum Speed (MAX), Current Limit (CL), IR Compensation (IR), Acceleration (ACCEL), and Deceleration (DECEL).
- **Plug-In Horsepower Resistor:** Allows for a single model to be used on a wide range of motors. Supplied separately – contact your distributor.
- **Barrier Terminal Block:** Facilitates wiring of the AC Line input, Motor Armature, and Motor Field (Shunt Wound Motors only).
- **Diagnostic LEDs:** PC board mounted. Indicate power on (PWR ON) and current Limit (CL).
- **Pilot Light:** Panel mounted. Indicates that power is applied to the control and the On/Off AC Line Switch is set to the "ON" position.
- **On/Off AC Line Switch:** Panel mounted. Used to turn the power on and off to the control.
- **Main Speed Potentiometer (5 kΩ):** Panel mounted. Provides adjustment of motor speed.
- **Built-In Fuse Holders:** For Motor Armature and AC Line input. A 20 Amp fuse is factory installed in the AC Line input fuse holder. Motor Armature fuses are supplied separately by your distributor.

3.2 – PROTECTION FEATURES

- **Short Circuit Protection:** Protects the control from short circuits (occurring at the motor only).
- **MOV input transient suppression.**

TABLE 1
GENERAL PERFORMANCE SPECIFICATIONS

Description	Specification	Factory Setting
115 Volt AC Line Input Voltage Operating Range (Volts AC) [1, 2]	115 (±15%)	230
230 Volt AC Line Input Voltage Operating Range (Volts AC) [1, 2]	230 (±15%)	
Line Voltage Regulation (at Full Load, ±10% Line Variation) (% Speed)	0.5	—
Armature Feedback Load Regulation (0 – Full Load, 50:1 Speed Range) (% Set Speed)	1	—
Maximum Load (% Current Overload for 1 Minute)	200	—
Speed Range (Ratio)	50:1	—
Minimum Speed (MIN) Trimpot Range (% Base Speed)	0 – 30	0
Maximum Speed (MAX) Trimpot Range (% Base Speed)	50 – 110	100
Acceleration (ACCEL) Trimpot Range (Seconds)	0.2 – 10	2
Deceleration (DECEL) Trimpot Range (Seconds)	0.2 – 10	2
Current Limit (CL) Trimpot Range (% Full Load)	0 – 200	150
IR Compensation (IR) Trimpot Range (Volts DC) (at Specified Full Load at 90, 180 Volts DC Output)	0 – 24, 48	3, 6
Operating Temperature Range (°C / °F)	0 – 40 / 32 – 104	—
Operating Humidity Range (% Relative, Non-Condensing)	0 – 95	—
Storage Temperature (°C / °F)	-25 – +85 / -13 – +185	—

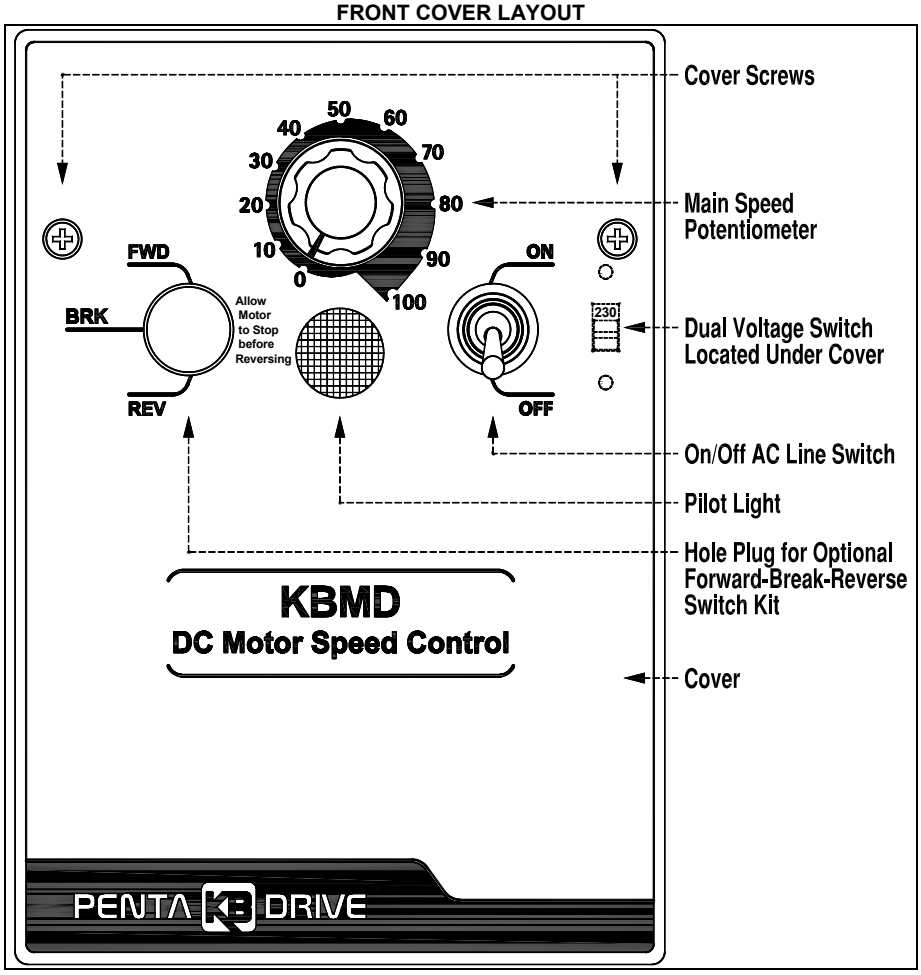
Notes: 1. *The control is factory set for 230 Volt AC Line input (Dual Voltage Switch set to the "230" position). For 115 Volt AC Line input, set the Dual Voltage Switch to the "115" position).* ***2.*** *Do not operate the control outside the specified AC Line input voltage operating range.* ***3.*** *Dependent on motor performance.*

TABLE 2
ELECTRICAL RATINGS

Maximum Horsepower (HP (kW))	AC Line Input				Output		Net Weight	
	Volts AC (50/60 Hz)	Phase (Φ)	Maximum Current (Amps RMS)	Fuse or Circuit Breaker Rating (Amps)	Maximum Voltage (Volts DC)	Maximum Continuous Load Current (Amps DC)	Lbs.	kg
0.75 (0.6)	115	1	12	20[2]	90	8	2	0.9
1.5 (1.13)	230	1	12	20[2]	180	8		
1 (0.75)[1]	115	1	16[1]	25	90	11[1]	4	1.8
2 (1.5)[1]	230	1	16[1]	25	180	11[1]		

Notes: 1. *Rating with control mounted onto optional Auxiliary Heat Sink.* ***2.*** *A 20 Amp fuse is factory installed in the AC Line input Fuse Holder.*

FIGURE 2
FRONT COVER LAYOUT



4 – IMPORTANT APPLICATION INFORMATION

4.1 – MOTOR TYPE

The control is designed for Permanent Magnet (PM) and Shunt Wound DC motors. Controls operated on 115 Volt AC Line input are designed for 90 Volt SCR rated motors. Controls operated on 230 Volt AC Line input are designed for 180 and 90 Volt SCR rated motors. Use of higher voltage motors will result in a reduction of the available maximum speed. Also, if the motor is not an SCR rated type, the actual AC Line current at full load should not exceed the motor's DC nameplate current rating.

WARNING! Do not switch the armature in and out of circuit or catastrophic failure will result. If armature switching is required for reversing or dynamic braking, install the optional Forward-Brake-Reverse Switch Kit (Model KBMD-240D (Part No. 9370D) only). The Forward-Brake-Reverse Switch Kit is built-in on Model KBMD-240D w/ FBR (Part No. 9371).

4.2 – TORQUE REQUIREMENTS

The motor selected for the application must be capable of supplying the necessary torque. In order to ensure the motor is not overloaded, a DC ammeter should be connected in series with the armature to be sure that the current under full load does not exceed the motor nameplate rating.

4.3 – ACCELERATION START

The control contains an adjustable acceleration start feature which allows the motor to smoothly accelerate from zero speed to full speed over a time period of 0.2 – 10 seconds. The acceleration trimpot (ACCEL) is factory set for 2 seconds.

4.4 – LIMITATION IN USE

The control is designed for use on machine applications.

CAUTION! Contact Technical support before using this control on constant horsepower applications such as saws and drill presses. Do not use this control in an explosive atmosphere. Be sure the control is used within its ratings. Follow all instructions carefully.

4.5 – STEP-DOWN TRANSFORMER AND AC LINE SWITCHING

When using a step-down transformer (460 Volts AC to 230 Volts AC), be sure the output current rating of the transformer is at least 3 times the current rating of the motor. Do not switch the primary side of the transformer to disconnect power or catastrophic failure can result. Always disconnect the control from the secondary side of the transformer.

5 – MOUNTING

The control is designed with a NEMA 1 / IP40 enclosure for indoor use. It is recommended that the control be mounted vertically on a flat surface with adequate ventilation. A mounting template is included to facilitate mounting of the control. Care should be taken to avoid extreme hazardous locations where physical damage can occur.

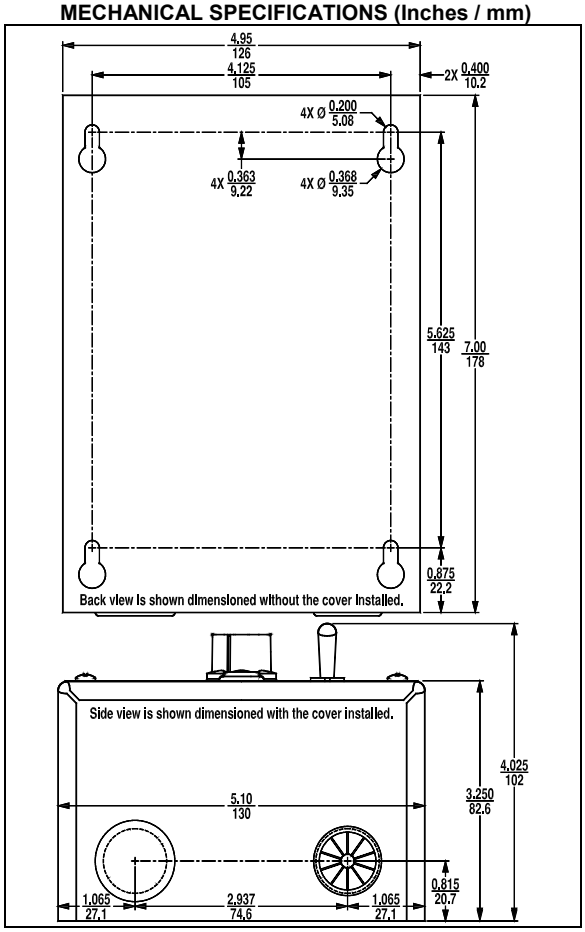
WARNING! Do not use this control in an explosion-proof application. Be sure the control is securely mounted.

See Figure 3 for the mechanical specifications. See Section 16 on page 13 for the mechanical specifications with the optional Auxiliary Heat Sink.

Leave enough room below the control to allow for AC Line input, Motor Armature, Motor Field (Shunt Wound Motors only) connections, and any other wiring that is required. When mounting the control in an enclosure, the enclosure should be large enough to allow for proper heat dissipation so that the ambient temperature does not exceed 40°C (104 °F) at full rating.

To open the cover, remove the two screws. After mounting the control and making all connections, install and tighten the two screws to 5 in-lbs (6 kg-cm). Standard 3/4" fittings (not supplied) can be used in lieu of the Feed-Through Bushings.

FIGURE 3
MECHANICAL SPECIFICATIONS (Inches / mm)



6 – PLUG-IN HORSEPOWER RESISTOR

In order for the IR Compensation and Current Limit settings to be correct, the proper Plug-In Horsepower Resistor must be installed for the particular motor and input voltage being used, as shown in Table 3. When installing the Plug-In Horsepower Resistor, be sure that the male pins are fully inserted into the mating female sockets on the PC board.

WARNING! HIGH VOLTAGE! Read Safety Warnings on page 4 before using the control. Disconnect the main power before making connections to the control.

TABLE 3
PLUG-IN HORSEPOWER RESISTOR SELECTION[1]

Motor Horsepower		Plug-In Horsepower Resistor	
90 Volt DC Motors	**180 Volt DC Motors**	**Value (Ω)**	**Part No.**
1/100 – 1/50	1/50 – 1/25	1	9833
1/50 – 1/30	1/25 – 1/15	0.51	9834
1/30 – 120	1/15 – 1/10	0.35	9835
1/20 – 1/12	1/10 – 1/6	0.25	9836
1/12 – 1/8	1/6 – 1/4	0.18	9837
1/8 – 1/5	1/4 – 1/3	0.1	9838
1/4	1/2	0.05	9839
1/3	3/4	0.035	9840
1/2	1	0.025	9841
3/4	1½	0.015	9842
1[2]	2[2]	0.01	9843

Notes: 1. *For overlapping motor horsepower range, use lower value Plug-In Horsepower Resistor.* ***2.*** *Indicates that Auxiliary Heat Sink must be used to achieve rating indicated.*

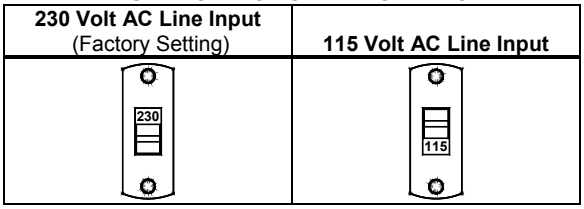
7 – DUAL VOLTAGE SWITCH OPERATION

7.1 – Dual Voltage Switch Setting

The Dual Voltage Switch is located under the cover and must be set before applying power to the control. It is factory set to the "230" position for 230 Volt AC Line input. For 115 Volt AC Line input, set the Dual Voltage Switch to the "115" position. See Figure 4.

WARNING! Do not connect the AC Line input until the Dual Voltage Switch is set for the proper input voltage being applied to the control. Catastrophic failure will occur if a 230 Volt AC Line is applied when the Dual Voltage Switch is set to the "115" position.

FIGURE 4
DUAL VOLTAGE SWITCH SETTING



7.2 – Modifications to the Dual Voltage Switch for Step-Down Operation or 230 Volts AC Input with 90 or 180 Volts DC Output

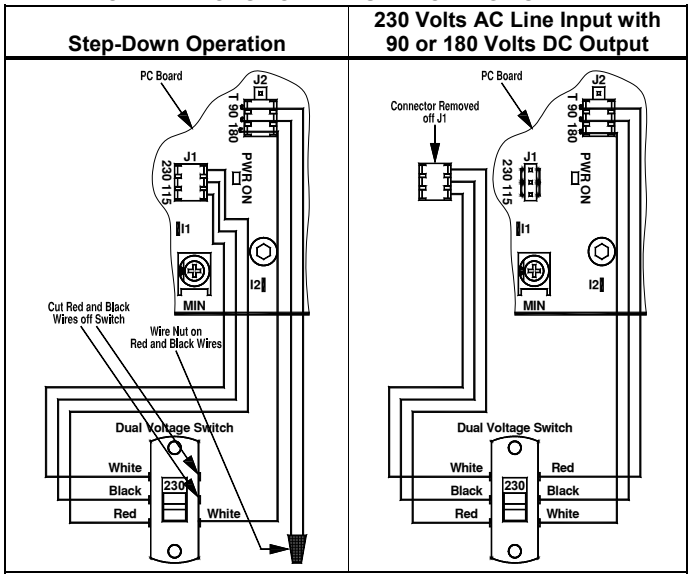
There are two modifications to the dual voltage switch which can make the control more versatile. The **Step-Down Operation** modification allows the control to be operated on 115 or 230 Volt AC Line input for 90 Volt DC motors only. The **230 Volts AC Line Input with 90 or 180 Volts DC Output** modification allows the control to be operated on 230 Volt AC Line input only, with either a 180 or 90 Volt DC motor. See Figure 5.

CAUTION! 1. Check with the motor manufacturer before using step-down mode if the motor is smaller than 1/8 HP. With 230 Volt AC Line input, the motor is being subjected to the peak voltages of the AC Line, even though the average voltage is limited to 90 Volts DC. **2.** When using a 90 Volt DC shunt wound motor with a control powered from a 230 Volt AC Line, the half voltage field connections must be used. Connect the motor field positive (+) lead to Terminal F+ and the negative (-) lead to Terminal L1.

Step-Down Operation: This modification allows the control to be operated on 115 or 230 Volt AC Line input for 90 Volt DC motors only. Cut off the red and black wires that are on the right side of the Dual Voltage Switch, strip off the required insulation from the wires, and connect them together with a wire nut. Set the Dual Voltage Switch to the corresponding AC Line input being applied to the control.

230 Volts AC Line Input with 90 or 180 Volts DC Output: This modification allows the control to be operated on 230 Volt AC Line input only, with either a 180 or 90 Volt DC motor. Remove the connector off the PC board Jumper J1, which goes to the left side of the Dual Voltage Switch. Wrap the loose connector with electrical tape so it does not come into contact with other components. With the Dual Voltage Switch set to the "230" position, the control will power a 180 Volt DC motor. With the Dual Voltage Switch set to the "115" position, the control will operate in step-down to power a 90 Volt DC motor.

FIGURE 5
MODIFICATIONS TO THE DUAL VOLTAGE SWITCH



8 – AC LINE INPUT AND MOTOR ARMATURE FUSING

The control contains AC Line and Motor Armature Fuse Holders. Most electrical codes require that each ungrounded AC Line input conductor contain circuit protection. It is recommended to install a fuse (Littelfuse 326, Buss ABC, or equivalent) or a circuit breaker (Square D QOU or equivalent) in series with each ungrounded AC Line Input conductor. For the recommended fuse size, see Table 4.

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

TABLE 4
AC LINE INPUT AND MOTOR ARMATURE FUSE SELECTION

Motor Horsepower		Motor Armature Fuse		AC Line Input Fuse	
90 Volt DC Motors	180 Volt DC Motors	Rating (Amps AC)	Part No.	Rating (Recommended) (Amps AC)	Part No.
1/100 – 1/50	1/50 – 1/25	1/3	—	20	9954 (Factory Installed)
1/50 – 1/30	1/25 – 1/15	1/2	9736	20	
1/30 – 120	1/15 – 1/10	3/4	9737	20	
1/20 – 1/12	1/10 – 1/6	1¼	3739	20	
1/12 – 1/8	1/6 – 1/4	2	9740	20	
1/8 – 1/5	1/4 – 1/3	2½	9741	20	
1/4	1/2	4	9742	20	
1/3	3/4	5	9743	20	
1/2	1	8	9744	20	
3/4	1½	12	9745	20	
1*	2*	20	9954	25	9747

**Indicates that Auxiliary Heat Sink must be used to achieve rating indicated.*

9 – ELECTRICAL CONNECTIONS

The control is designed with a removable cover. To open the cover, remove the two front cover screws. After mounting the control and making all connections, install and tighten the two front cover screws to 5 in-lbs. (6 kg-cm). See Table 5 on page 9 for the Minimum Supply Wire Size Requirements. See Table 6 on page 9 for the Terminal Block Wire and Tightening Torque Specifications. See Figure 6 for the Control Layout and Internal Wiring Diagram. See Figure 7 on page 9 for the AC Line Input, Motor Armature, and Ground connections.

Note: *Wire the control in accordance with the National Electrical Code requirements and other local codes that may apply to the application.*

WARNING! HIGH VOLTAGE! Read Safety Warnings on page 4 before using the control. Disconnect the main power before making connections to the control. To avoid electric shock, be sure to properly ground the control.

Application Note: To avoid erratic operation, do not bundle AC Line input and motor wires with each other. Also, do not bundle motor wires from multiple controls in the same conduit. Use shielded cables on all signal wiring over 12" (30 cm). The shield should be earth grounded on the control side only.

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 used as a disconnect so that each ungrounded conductor is opened. For fuse or circuit breaker selection, see Section 8 above.

FIGURE 6
CONTROL LAYOUT AND INTERNAL CONNECTION DIAGRAM
(Model KBMD-240D (Part No. 9370) Shown)

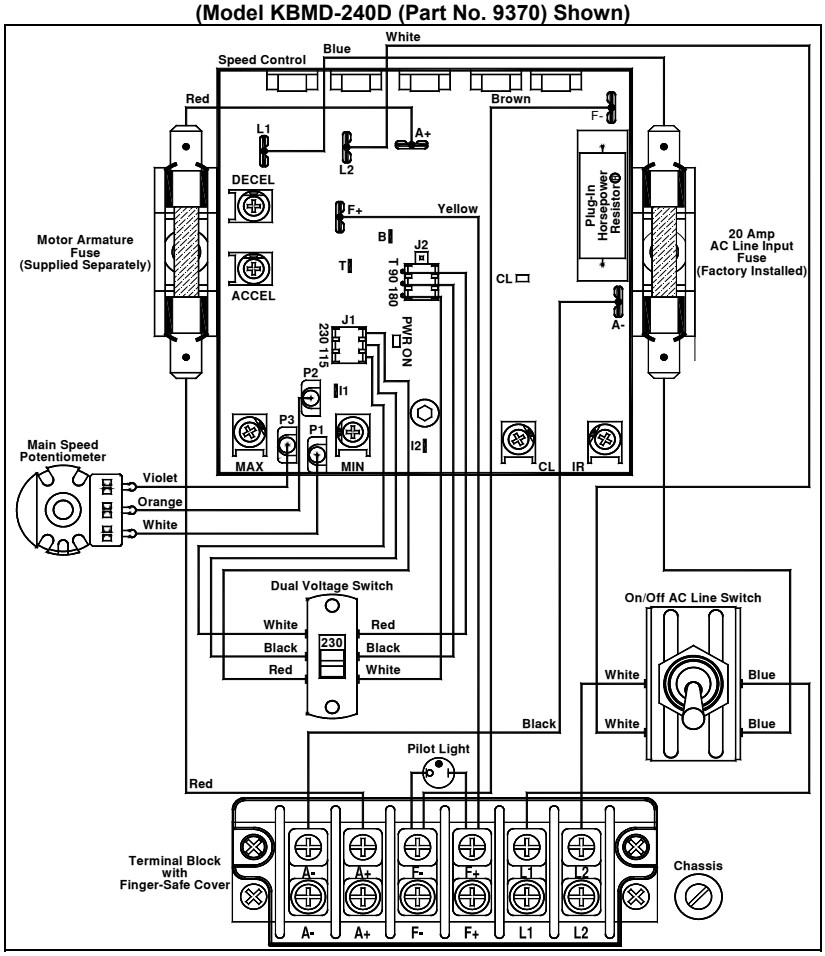


TABLE 5
MINIMUM SUPPLY WIRE SIZE REQUIREMENTS

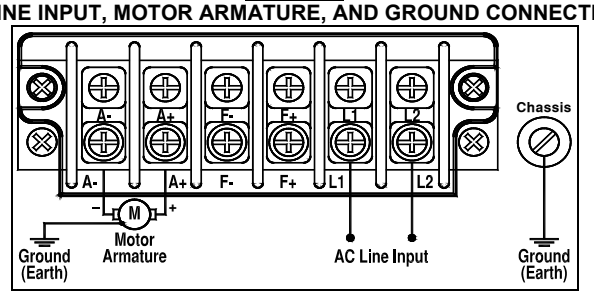
Maximum Motor Current (Amps DC)	Maximum Motor HP (kw)		Minimum Wire Size (Cu)			
			Maximum 50 Foot (15 m) Run		Maximum 100 Foot (30 m) Run	
	90 Volt DC Motors	180 Volt DC Motors	AWG	mm^2	AWG	mm^2
8	0.75 (0.6)	1½ (1.13)	16	1.31	14	2.08
11*	1 (0.75) *	2 (1.5) *	14	2.08	12	3.31

**Rating is with control mounted onto optional Auxiliary Heat Sink.*

TABLE 6
TERMINAL BLOCK WIRE AND TIGHTENING TORQUE SPECIFICATIONS

Description	Maximum Wire Size (Cu)		Recommended Tightening Torque	
	AWG	mm^2	in-lbs	kg-cm
AC Line Input, Motor Armature, and Motor Field (Shunt Motors Only)	14	2.08	10	11.5

FIGURE 7
AC LINE INPUT, MOTOR ARMATURE, AND GROUND CONNECTIONS



9.1 – AC LINE INPUT CONNECTION
Connect the AC Line input to Terminals L1 and L2. See Figure 7 above.

Note: *The control is factory set for 230 Volt AC Line input (Dual Voltage Switch Set to the "230" position). For 115 Volt AC Line input, set the Dual Voltage Switch to the "115" position. See Section 7 on page 7.*

9.2 – MOTOR ARMATURE CONNECTION
Connect the Motor Armature positive (+) lead to Terminal A+ and the negative (-) lead to Terminal A-. Be sure the motor is properly grounded. Motor cable length should not exceed 100 ft. (30 m) – special reactors may be required – contact Technical support. See Figure 7 above.

Note: *If the motor does not rotate in the desired direction, reverse the motor leads (with AC Line disconnected and motor stopped).*

9.3 – GROUND CONNECTION
Connect the ground (earth) wires from the AC Line input to the green ground screw located on the right side of the Terminal Block. Be sure the motor is also properly grounded. See Figure 7 above.

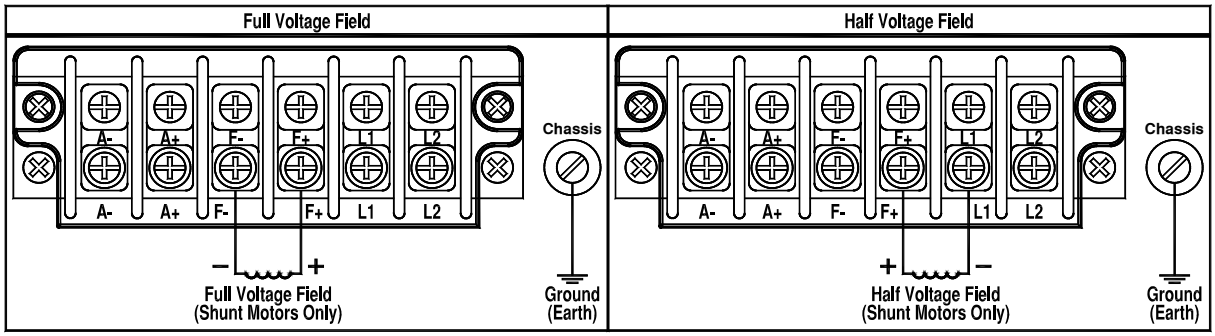
9.4 – MOTOR FIELD CONNECTION (SHUNT WOUND MOTORS ONLY)

WARNING! Do not connect the Armature leads to Terminals F+ and F-. Do not use Terminals F+ and F- for any purpose other than to power the Field of a Shunt Wound Motor. Shunt Wound Motors may be damaged if the Field remains energized without Armature rotation for an extended period of time.

Full Voltage Motor Field: For motors with full voltage field (90 Volt motors with 100 Volt field and 180 Volt motors with 200 Volt field), connect the field positive (+) lead to Terminal F+ and the negative (-) lead to Terminal F-. See Figure 8.

Half Voltage Motor Field: For motors with half voltage field (90 Volt motors with 50 Volt field and 180 Volt motors with 100 Volt field), connect the field positive (+) lead to Terminal F+ and the negative (-) lead to Terminal L1. See Figure 8.

FIGURE 8
MOTOR FIELD CONNECTION



10 – 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 control which has been installed in the equipment, the following procedure is recommended. A typical hi-pot test setup is shown in Figure 9. **All controls have been factory hi-pot tested in accordance with UL requirements.**

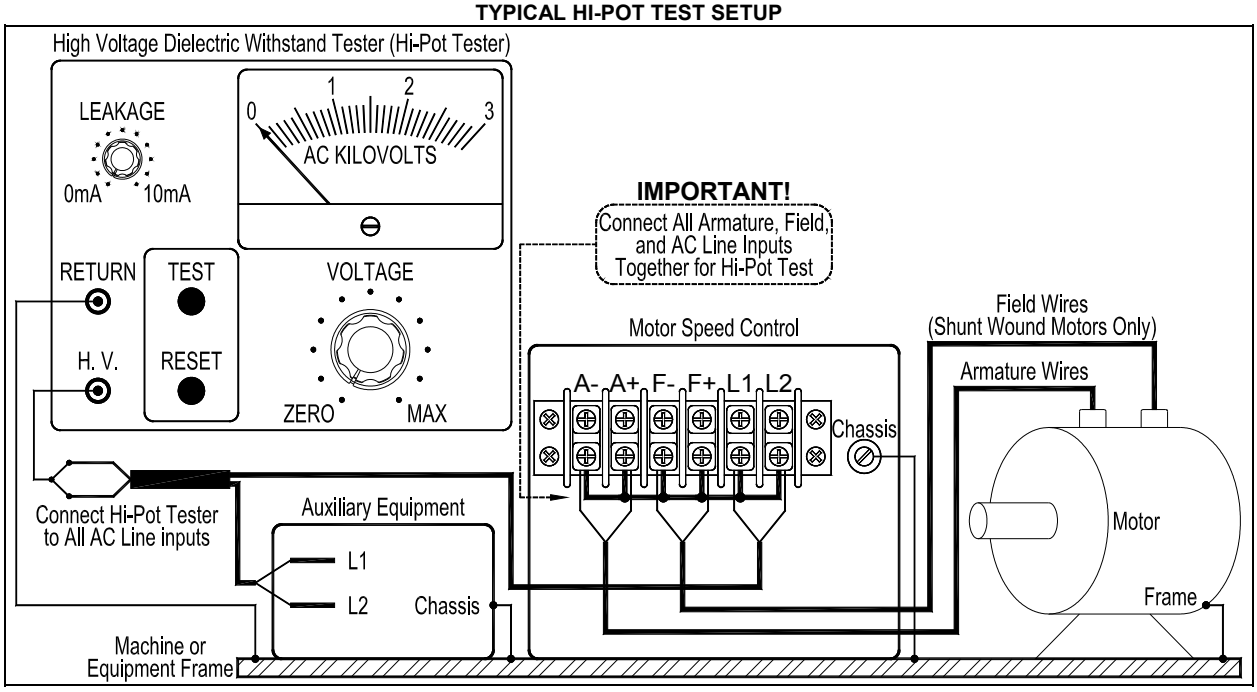
WARNING! All equipment AC Line inputs must be disconnected from the AC power before performing the Hi-Pot Testing.

CAUTION! Instantly applying the hi-pot voltage will cause irreversible damage to the control, which will void the warranty. The hi-pot tester must have automatic ramp-up to the test voltage and automatic ramp-down to zero voltage.

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

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

FIGURE 9
TYPICAL HI-POT TEST SETUP



11 – CONTROL OPERATION

After the control has been properly setup (all connections completed and AC Line Fuse, Motor Armature Fuse, and Plug-In Horsepower Resistor Installed), the start-up procedure can begin.

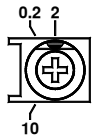
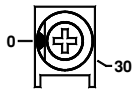
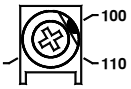
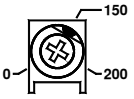
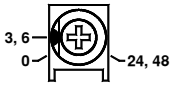
- Set the Main Power Switch to the control to the "OFF" position.
- Set the panel mounted On/Off AC Line Switch to the "OFF" position.
- Verify correct connections of the AC Line input, Motor Armature, and Motor Field (Shunt Wound Motors only).
- Be sure the correct Plug-In Horsepower Resistor is installed and fully inserted into the mating terminals. See Section 6 on page 7.
- Be sure the correct AC Line Input Fuse and Armature Fuse are properly installed into the fuse holders. See Section 8 on page 8.
- Set the panel mounted Main Speed Potentiometer to "0%" (fully counterclockwise).
- If installed, set the Forward-Brake-Reverse Switch to the "BRK" position.
- Set the Main Power Switch to the control to the "ON" position.
- Set the panel mounted On/Off AC Line Switch to the "ON" position.
- The PC board mounted green PWR ON LED and the orange panel mounted Pilot Light should illuminate.
- If installed, set the Forward-Brake-Reverse Switch to the "FWD" or "REV" position.
- Adjust the panel mounted Main Speed Potentiometer for the desired motor speed setting.

12 – TRIMPOT ADJUSTMENTS

The control contains trimpots which have been factory set for most applications. See Figure 6 on page 8 for the location of the trimpots and their approximate factory calibrated positions. Some applications may require readjustment of the trimpots in order to set the control for a specific requirement. The trimpots may be readjusted as described in this section. See Figure 10.

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 control. Electrocution can result if caution is not exercised. Safety Warnings on page 4 must be read and understood before proceeding.

FIGURE 10
TRIMPOT RANGES

ACCEL TRIMPOT	DECEL TRIMPOT	MIN TRIMPOT	MAX TRIMPOT	CL TRIMPOT	IR TRIMPOT
					

12.1 – ACCELERATION TRIMPOT (ACCEL)

The ACCEL Trimpot allows for a smooth start over an adjustable time period each time the AC power is applied or the Main Speed Potentiometer is adjusted to a higher speed. The ACCEL Trimpot has been factory set to 2 seconds, which is the amount of time it will take for the motor to accelerate from zero speed to full speed. To increase the acceleration time, rotate the ACCEL Trimpot clockwise. To decrease the acceleration time, rotate the ACCEL Trimpot counterclockwise. See Figure 10 above.

12.2 – DECELERATION TRIMPOT (DECEL)

The DECEL Trimpot controls the amount of ramp-down time when the Main Speed Potentiometer is adjusted to a lower speed. The DECEL Trimpot has been factory set to 2 seconds, which is the amount of time it will take for the motor to decelerate from full speed to zero speed. To increase the deceleration time, rotate the DECEL Trimpot clockwise. To decrease the acceleration time, rotate the DECEL Trimpot counterclockwise. See Figure 10 above.

Note: *The deceleration time cannot be set to less than the natural coast time of the motor and actual load.*

12.3 – MINIMUM SPEED TRIMPOT (MIN)

The MIN Trimpot sets the minimum speed of the motor when the Main Speed Potentiometer is set fully counterclockwise. The MIN Trimpot has been factory set to 0% of base motor speed. To increase the minimum speed, rotate the MIN Trimpot clockwise. To decrease the minimum speed, rotate the MIN Trimpot counterclockwise. See Figure 10 above.

Note: *Readjusting the MIN Trimpot will affect the maximum speed setting. Therefore, it is necessary to readjust the MAX Trimpot if readjusting the MIN Trimpot. It may also be necessary to repeat these adjustments until both the minimum and maximum speeds are set to the desired levels.*

12.4 – MAXIMUM SPEED TRIMPOT (MAX)

The MAX Trimpot sets the maximum speed of the motor when the Main Speed Potentiometer is set fully clockwise. The MAX Trimpot is factory set to 100% of base motor speed. To increase the maximum speed, rotate the MAX Trimpot clockwise. To decrease the maximum speed, rotate the MAX Trimpot counterclockwise. See Figure 10 above.

CAUTION! Do not set the maximum speed above the rated motor RPM since unstable motor operation may occur.

12.5 – CURRENT LIMIT TRIMPOT (CL)

The CL Trimpot sets the current limit (overload), which limits the maximum current (torque) to the motor. The CL also limits the AC Line inrush current to a safe level during startup. The CL Trimpot is factory set to 1.5 times the full load rating of the motor. To increase the current limit, rotate the CL Trimpot clockwise **(do not exceed 2 times motor current rating (maximum clockwise position))**. To decrease the current limit, rotate the CL Trimpot counterclockwise. See Figure 10 above.

Note: *The correct value Plug-In Horsepower Resistor must be installed for the CL to operate properly. Calibration of the CL Trimpot is normally not required when the proper Plug-In Horsepower Resistor is installed.*

To Recalibrate the CL Trimpot:

1. Disconnect the AC power and connect a DC ammeter in series with either motor armature lead.
   (***Note:*** *If only an AC ammeter is available, connect it in series with either AC Line input lead.)*
2. Set the Main Speed Potentiometer to approximately 30% – 50% position.
3. Set the CL Trimpot fully counterclockwise. The CL LED will illuminate red.
4. Lock the motor shaft (be sure the CL Trimpot is set fully counterclockwise).
5. Apply power and rotate the CL Trimpot clockwise until the desired current reading is observed on the DC ammeter. Factory Current Limit setting is 1.5 times the full load rating of the motor (with a DC ammeter connected in series with the motor armature). If using an AC ammeter connected in the AC Line input, the factory Current Limit setting will read 0.75 times the full load rating of the motor. **Do not exceed 2 times motor current rating (maximum clockwise position).**

Note: *On cyclical loads, it may be normal for the CL LED to momentarily flash.*

WARNING! Do not leave motor shaft locked for more than 2 – 3 seconds or motor damage may result.

12.6 – IR COMPENSATION TRIMPOT (IR)

The IR Trimpot sets the amount of compensating voltage required to keep the motor speed constant with varying loads. If the load does not vary substantially, the IR Trimpot may be set to a minimum level (approximately 25% rotation). The IR Trimpot is factory set to provide 3 Volts of compensation for 90 Volt DC output controls and 6 Volts of compensation for 180 Volt DC output controls. To increase the amount of compensating voltage, rotate the IR Trimpot clockwise. To decrease the amount of compensating voltage, rotate the IR Trimpot counterclockwise. See Figure 10 on page 11.

Notes: 1. *The correct value Plug-In Horsepower Resistor must be installed for the IR Compensation to operate properly. Calibration of the IR Trimpot is normally not required when the proper Plug-In Horsepower Resistor is installed.* ***2.*** *Excessive IR Compensation will cause the motor to become unstable, which causes cogging.*

To Recalibrate the IR Trimpot:

1. Set the IR Trimpot to approximately 25% rotation.
2. Run the motor unloaded at approximately 1/3 speed and record the RPMs.
3. Run the motor with the maximum load and adjust the IR Trimpot so that the motor speed under load equals the unloaded speed recorded in step 2.
4. Remove the load and recheck the RPMs.
5. If the unloaded RPM has changed, repeat steps 2 – 4 for more exact regulation. The control is now compensated to provide minimal speed change with varying loads.

13 – PILOT LIGHT AND LED STATUS INDICATORS

The control contains a panel mounted Pilot Light and PC board mounted LEDs to indicate the control's operational status.

WARNING! Do not depend on the Pilot Light or PWR ON LED to no longer be illuminated as a guaranteed power off condition.

13.1 – PILOT LIGHT

The panel mounted Pilot Light will illuminate orange when the AC Line is applied and the On/Off AC Line Switch is set to the "ON" position.

13.2 – POWER ON LED (PWR ON)

The PC board mounted PWR ON LED will illuminate green when the AC Line is applied and the On/Off AC Line Switch is set to the "ON" position.

13.3 – CURRENT LIMIT LED (CL)

The PC board mounted CL LED will illuminate red when the control goes into current limit, indicating that the current limit set point has been reached (set by the CL Trimpot). See Section 12.5 on page 11.

14 – OPTIONAL ACCESSORIES

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

TABLE 7
OPTIONAL ACCESSORIES

Option	Part No.	Description
Forward-Brake-Reverse Switch Kit[1]	9860	Mounts inside the control. Includes switch and prewired dynamic brake resistor. See Section 15 on page 13.
Auxiliary Heat Sink	9861	Extends control rating to 1 HP at 115 Volt AC Line input and 2 HP at 230 Volt AC Line input. See Section 16 on page 13.
KBRF-200A RFI (EMI) Filters[2]	9945	Remote mounted. Rated 24 Amps at 115 or 230 Volts AC.
KBRF-300 RFI (EMI) Filter[2]	9484	Remote mounted. Complies with Class A Industrial Standard. Rated 16 Amps at 115 or 230 Volts AC.
AC Line or Motor Choke	9993	Rated 18 Amps at 300 Volts DC.

Notes: 1. *The Forward-Brake-Reverse Switch Kit (Part No. 9860) is optional on Model KBMD-240D (Part No.9371) and built-in on Model KBMD-240D w/ FBR (Part No. 9371).* ***2.*** *RFI (EMI) filters are recommended for Compliance with the CE Council Directive 89/336/EEC relating to the Class A Industrial Standard. See Data Sheet Part No. A42027 – contact Technical Support.*

15 – FORWARD-BRAKE-REVERSE SWITCH KIT (PART NO. 9860)

The Forward-Brake-Reverse Switch Kit provides motor direction switching and dynamic braking. See Figure 11.

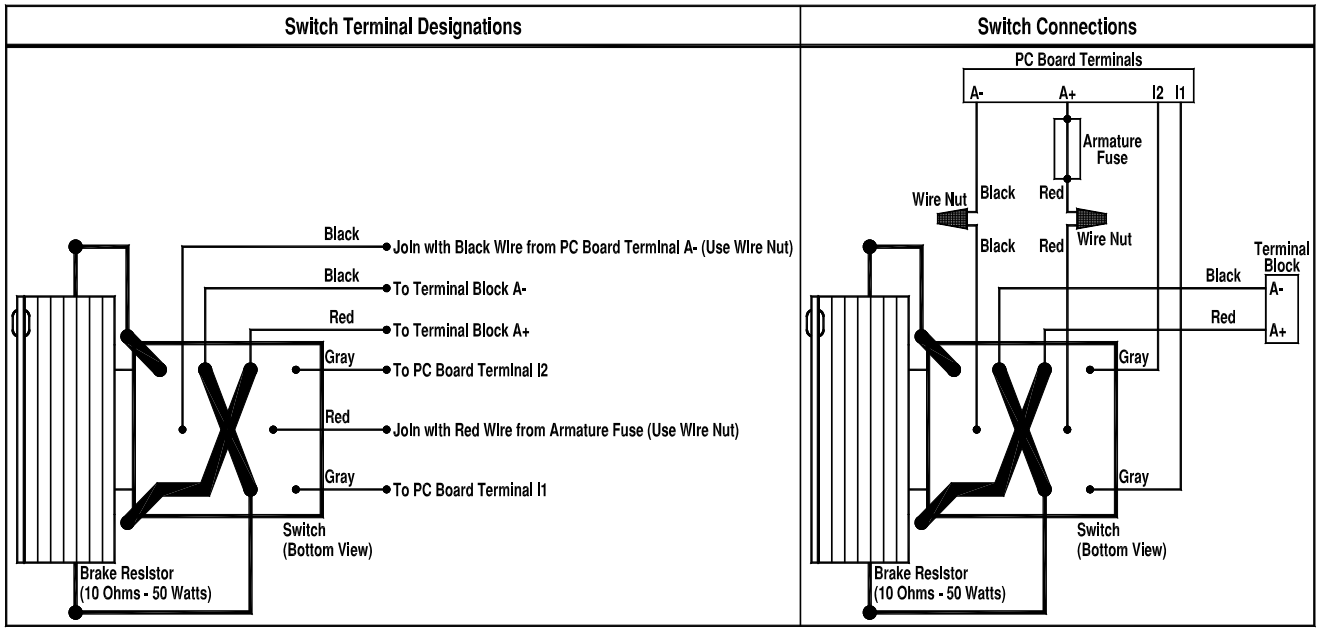
The switch is designed with a mechanical hesitation, to prevent switching from one direction to another without first stopping in the center position. This hesitation prevents motor "plugging" and allows the motor to come to a complete stop before switching directions.

When the switch is in the center (Brake) position, the 10Ω – 50 Watt brake resistor is applied across the motor to dissipate the voltage as the motor comes to a complete stop. In this position, the switch simultaneously shorts Terminals I1 and I2 to inhibit the control output.

When switching into the Forward or Reverse direction, the brake resistor is disengaged from the motor and the Inhibit is opened. The motor will run in the direction selected and at the speed set by the Main Speed Potentiometer.

Note: *The Forward-Brake-Reverse Switch Kit is optional on Model KBMD-240D (Part No. 9370) and built-in on Model KBMD-240D w/ FBR (Part No. 9371).*

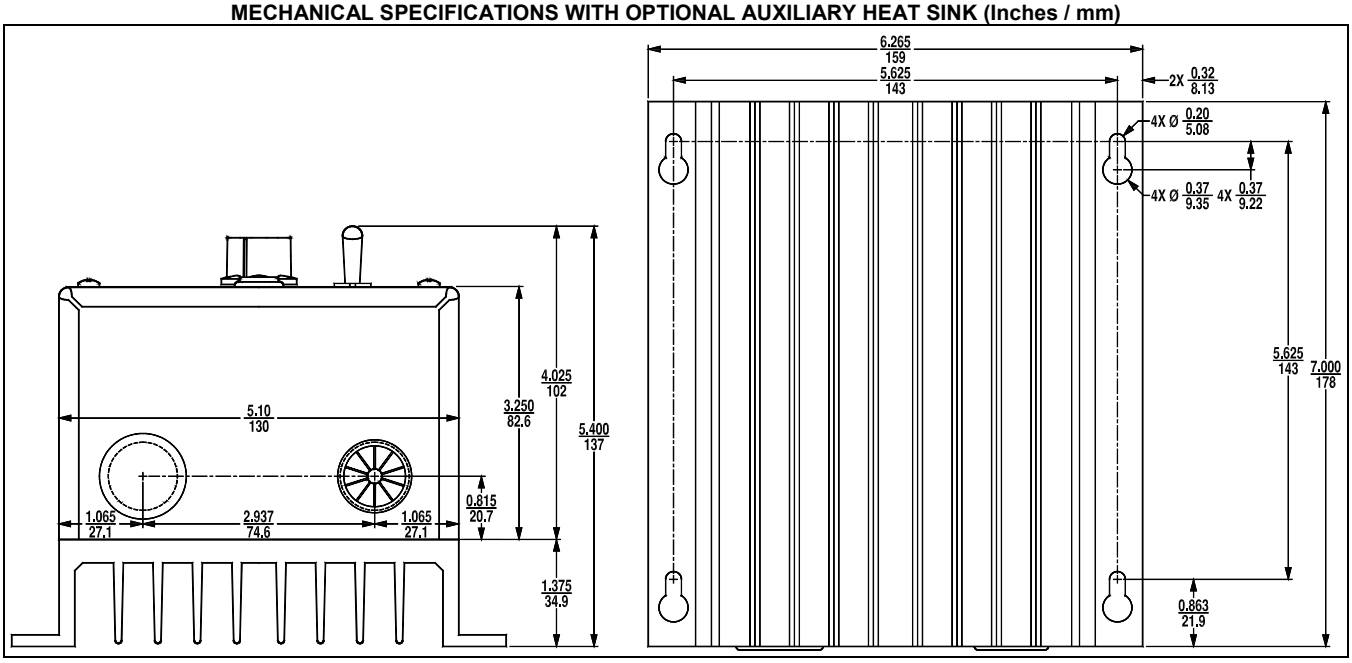
FIGURE 11
FORWARD-BRAKE-REVERSE SWITCH TERMINAL DESIGNATIONS AND CONNECTION



16 – OPTIONAL AUXILIARY HEAT SINK (PART NO. 9861)

The control can be mounted onto the optional Auxiliary Heat Sink to increase its maximum ratings to 1 HP (0.75 kW) on 115 Volt AC Line input and 2 HP (1.5 kW) on 230 Volt AC Line input. Use the four (4) 10-32 X 1/2" screws provided to mount the control onto the heat sink. Tighten the screws to 10 in-lbs (11.5 kg-cm). See Figure 12.

FIGURE 12
MECHANICAL SPECIFICATIONS WITH OPTIONAL AUXILIARY HEAT SINK (Inches / mm)



17 – TROUBLESHOOTING GUIDE

Tables 8 and 9 provide troubleshooting information on the control's symptoms and their possible causes along with corrective actions.

WARNING! High Voltage! Disconnect the main power before attempting to troubleshoot the control. Do not depend on the panel mounted Pilot Light or the PC board mounted PWR ON LED to no longer be illuminated as a guaranteed power off condition. Safety Warnings on page 4 must be read and understood before proceeding.

TABLE 8
TROUBLESHOOTING GUIDE
FOR MODELS WITHOUT FORWARD-BRAKE-REVERSE SWITCH KIT INSTALLED
(Model KBMD-240D (Part No. 9370) Only)

Symptom	Possible Cause	Corrective Action
Motor does not run. Pilot Light and PWR ON LED are not illuminated.	Main Power switch or On/Off AC Line Switch is in the "OFF" position.	Set Main Power Switch or On/Off AC Line Switch to the "ON" position.
	AC Line input not connected to drive.	Connect AC Line input to Terminals L1 and L2.
	Defective Power Switch or On/Off AC Line Switch.	Replace Power Switch or On/Off AC Line Switch.
	Blown AC Line input fuse.	Replace fuse. See Table 4 on page 8. If fuse blew due to miswiring, the control may have been damaged.
Motor does not run. Pilot Light and PWR ON LED are illuminated.	Main Speed Potentiometer is set to 0%.	Adjust the Main Speed Potentiometer to the desired setting.
	Defective motor, worn brushes, etc.	Check for defective motor, worn brushes, etc. Replace brushes, etc., or motor.
	Plug-In Horsepower Resistor not installed.	Install Plug-In Horsepower Resistor. See Table 3 on page 7.
	Blown Armature Fuse.	Replace fuse. See Table 4 on page 8.
AC Line input Fuse blows or Circuit Breaker trips.	The AC Line input Fuse or Circuit Breaker is the incorrect rating.	Install the correct fuse or circuit breaker. See Table 2 on page 5.
Motor hums, or runs at very low speed (with the Main Speed Potentiometer set above 0%) or the Motor slows down substantially when the load is applied.	Low AC Line Input voltage.	Check AC Line Input voltage.
	Overload condition. Control in current limit mode (CL Trimpot not set correctly), CL LED is illuminated.	Reduce loading. CL Trimpot setting may have to be increased. See Section 12.5 on page 11.
	Plug-In Horsepower Resistor is incorrect value.	Install correct Plug-In Horsepower Resistor. See Table 3 on page 7.
	Incorrect wiring. Armature and Motor Field connections interchanged (Shunt Wound Motors only).	Correct wiring. Armature has lower resistance than field.
Erratic motor performance.	Defective motor, worn brushes, etc.	Check for defective motor, worn brushes, etc. Replace brushes, etc., or motor.
	Overload condition.	Remove overload.
	Plug-In Horsepower Resistor is incorrect value.	Install correct Plug-In Horsepower Resistor. See Table 3 on page 7.
	IR and/or CL trimpots not set correctly.	Readjust IR Comp and/or CL trimpots. See Sections 12.5 and 12.6 on pages 11 and 12.
	Dual Voltage Switch set incorrectly.	Set Dual Voltage Switch to the corresponding AC Line input voltage.
	Defective control module.	Replace control module.
Motor continues to run with the Main Speed Potentiometer is set to 0%.	MIN Trimpot is not set fully counterclockwise.	Readjust MIN Trimpot.
	IR Trimpot set too high.	Lower IR Trimpot setting. See Section 12.6 on page 12.
Motor runs in the wrong direction.	Armature leads reversed.	Reconnect the motor armature leads.

TABLE 9
TROUBLESHOOTING GUIDE
FOR MODELS WITH FORWARD-BRAKE-REVERSE SWITCH KIT INSTALLED
(Optional on Model KBMD-240D (Part No. 9370) and Built-In on Model KBMD-240D w/ FBR (Part No. 9371))

Symptom	Possible Cause	Corrective Action
Motor will not run in Forward or Reverse direction.	Faulty wiring or loose connections to the Forward-Brake-Reverse Switch.	Correct the wiring.
	Defective Forward-Brake-Reverse Switch.	Replace Forward-Brake-Reverse Switch.
No braking action in brake mode.	Faulty wiring or loose connection.	Correct the wiring.
	Defective Forward-Brake-Reverse Switch.	Replace Forward-Brake-Reverse Switch.
	Defective Brake Resistor.	Replace Brake Resistor.

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, Inc. will repair or replace without charge, devices which our examination proves to be defective in material or workmanship. This warranty is valid if the unit has not been tampered with by unauthorized persons, misused, abused, or improperly installed and has been used in accordance with the instructions and/or ratings supplied. The foregoing is in lieu of any other warranty or guarantee, expressed or implied. KB Electronics, Inc. is not responsible for any expense, including installation and removal, inconvenience, or consequential damage, including injury to any person, caused by items of our manufacture or sale. Some states do not allow certain exclusions or limitations found in this warranty and therefore they may not apply to you. In any event, the total liability of KB Electronics, Inc. under any circumstance shall not exceed the full purchase price of this product. (Rev. 2/2000)

KB Electronics, Inc.
12095 NW 39 Street, Coral Springs, FL 33065-2516
Phone: 954-346-4900; **Fax:** 954-346-3377, **Toll Free:** 800-221-6570
E-Mail: info@kbelectronics.com
www.kbelectronics.com

(A40241A) – Rev. B00 – 8/25/2017