

VARI-DRIVE

NEMA-1
SCR Variable Speed
DC Motor Control

1/100 – 1/3 HP @ 90 VDC
1/50 – 3/4 HP @ 180 VDC

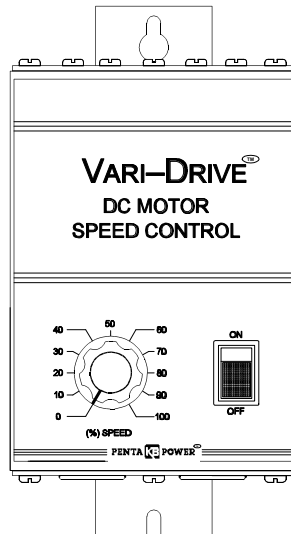
Installation and Operating Instructions



*See Page 2



See Safety Warning on page 2



MODEL KBWM-120 for 115 VAC line
with 90 VDC PM Motors

MODEL KBWM-240 for 230 VAC line
with 180 VDC PM Motors.

- Plug-in Horsepower Resistor[®]* eliminates the need to calibrate IR Comp. and CL.
- Contains AC Line and Armature* Fusing.
- Rugged all-metal Nema 1 enclosure.
- Built-in ON/OFF AC Line Switch with indicator lamp.
- Patented KBMM[™] speed control module prevents demagnetization of PM motors.

*This control will not operate without installing the proper size Plug-in Horsepower Resistor[®] and armature fuse – supplied separately.

PENTA KB POWER[™]

A COMPLETE LINE OF MOTOR DRIVES

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i.  **KBWM-120, 240 SIMPLIFIED OPERATING INSTRUCTIONS**

IMPORTANT – You must read these simplified operating instructions before you proceed. These instructions are to be used as a reference only and are not intended to replace the detailed instructions provided herein. **You must read the Safety Warning on page 2 before proceeding.**

1. CONNECTIONS.

A. AC line – Wire AC line to terminals L1 and L2. Be sure the model number corresponds to the correct input voltage.

B. Motor –Wire the motor armature leads to terminals A(+) and A(-). Be sure the motor voltage corresponds to the control voltage rating and model number.

Note: Although control is specifically designed for PM motors it can also be used for shunt wound motors. (See sec. IV D, p. 9.)

C. Ground – Be sure to earth ground the control by attaching a ground wire to the green stud located between the Bx knockouts.

2. PLUG-IN HORSEPOWER RESISTOR[®]

The correct Plug-in Horsepower Resistor[®] **must** be installed for optimum performance. (See sec. II A, p. 5.)

3. ARMATURE FUSE*

The correct value armature fuse must be installed for maximum protection. (See sec. II B, ii, p. 5.)


4. TRIMPOT SETTINGS

All trimpots have been set according to fig. 1, p. 4. (See sec. VI, p. 11.)

*Plug-in Horsepower Resistor[®] and armature fuse supplied by your distributor.

MODEL NO. and VOLTAGE RATING


Model Number	AC Line Voltage VAC–50/60 Hz	Armature Voltage (VDC)
KBWM-120	115	90 – 100
KBWM-240	230	180

 **ii. SAFETY WARNING! — PLEASE READ CAREFULLY**

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 wiring, mounting in proper enclosure, fusing or other overcurrent protection and grounding, can reduce the chance of electric 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 control 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. If information is required on this product, contact our factory. It is the responsibility of the equipment manufacturer and individual installer to supply this safety warning to the ultimate user of this product. (SW effective 11/92)

This control contains electronic Start/Stop and Inhibit circuits that 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. Use only the AC line for this purpose.

The input circuits of this control (potentiometer, start/stop, Inhibit) are not isolated from AC line. **Be sure to follow all instructions carefully. Fire and/or electrocution can result due to improper use of this product.**

 **This product complies with all CE directives pertinent at the time of manufacture. Contact factory for detailed installation instructions and Declaration of Conformity.**

I. GENERAL INFORMATION

The KBWM™ Vari-Drive™ adjustable speed SCR control for DC motors offers proven reliability in a rugged all-metal NEMA-1 enclosure. The Vari-Drives™ are equipped with the *ultimate* KBMM™ speed control module. They are specifically designed for fractional horsepower permanent magnet (PM) DC motors. Two models are offered. The KBWM-120 is designed for 115 VAC input and is rated 1/100-1/3 HP at 90 VDC. For motors rated 1/50-3/4 HP at 180 VDC use Model KBWM-240.

KB's exclusive Plug-in Horsepower Resistor® automatically presets the drive's IR Comp. for maximum performance and CL circuits for safe operation on various motors. Although factory calibrated, internal trimpots for Min, Max, IR, CL, Accel and Decel can be used to fine-tune the KBWM™ for specific applications. Connections to the control are via a barrier terminal block. By changing the orientation of the front cover, the wiring can be brought in either from the bottom or the top of the control.

Motor failure due to demagnetization is eliminated by the patented ultra-fast Direct-Fed™ current limit circuit. The controls contain AC line and armature* fusing, which provide protection against catastrophic failure. Auto-Inhibit®, a KB exclusive, allows the drive to be turned on and off rapidly using the AC line without damage to the control and/or motor. The internal CL LED is a diagnostic indicator that lights when the motor is overloaded.

A conveniently located front panel lighted rocker switch controls AC line input power to the drive.

*Plug-in Horsepower Resistor® and armature fuse supplied separately.

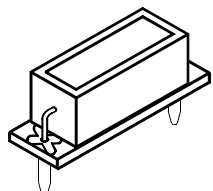
TABLE 1 – GENERAL PERFORMANCE SPECIFICATIONS

Speed Range (Ratio)	50:1	Decel Time Range (Full - 0 Speed) (Secs.)2 – 10
Load Regulation - Armature Feedback (0 - Full Load, 50:1 Speed Range) (% Base Speed)	1*	Min. Speed Trimpot Range (% Full Speed)	0 – 30*
Line Voltage Regulation (at Full Load, ± 10% Line Variation) (% Base Speed)	*	Max. Speed Trimpot Range (% Full Speed)	50 - 110*
Control Linearity (% Speed Vs. Dial Rotation)	2	IR Comp. Trimpot Range (at Specified Full Load) (Volts)	0 - 24
CL/Torque Range (% Full Load)	0 – 200	Maximum Allowable Ambient Temperature at Full Rating (°C/°F)	50/122
Accel Time Range (0 - Full Speed) (Secs.)2 – 10		

*Performance is for SCR rated PM motors only. Lower performance can be expected with other motor types. Factory setting is for 3% load regulation. To obtain superior regulation, see sec. VI F, p. 13.

PLUG-IN HORSEPOWER RESISTOR

A Plug-in Horsepower Resistor® must be installed to match the drive to the motor horsepower and armature current. See table 4, p. 6 for the correct value. Plug-in Horsepower Resistors® are stocked by your distributor.



CAUTION
Be sure Plug-in Horsepower Resistor® is inserted completely into mating socket.

FIG. 1 – CONTROL LAYOUT (Trimpots shown in appropriate factory setting)

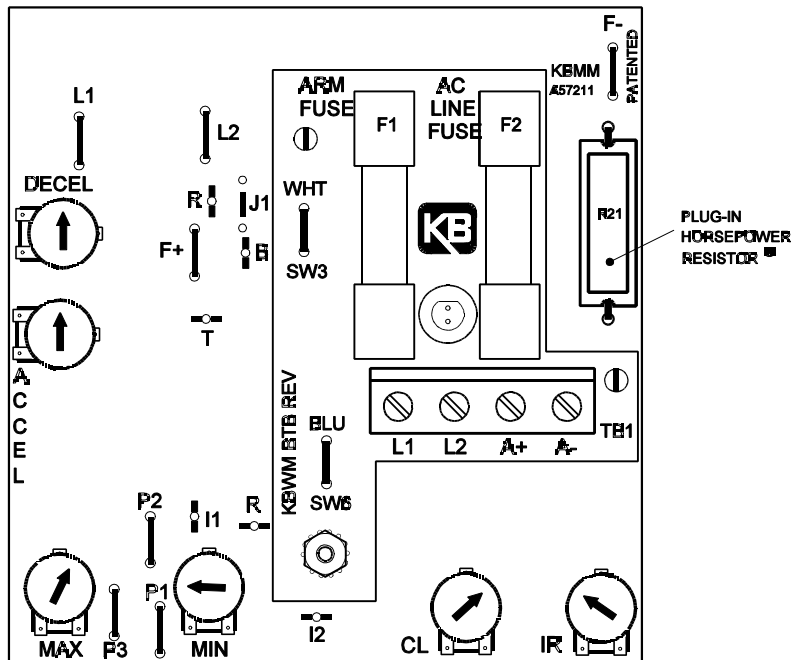


TABLE 2 – ELECTRICAL RATINGS

Model Number	Part No.	Input Voltage (VAC-50/60 Hz)	Max. AC Load Current (RMS Amps)	Armature Voltage (VDC)	Max. DC Load Current (DC Amps)	Max. Horsepower HP, (KW)
KBWM-120	9380	115	5.0	0 – 100	3.5	1/3, (.25)
KBWM-240	9381	230	5.0	0 – 200	3.5	3/4, (.50)

II. CONTROL SETUP.

Remove the four (4) 6x32 screws (two on top and two on the bottom) from the enclosure. Slide open the control by separating the front and rear covers. See location of screws (fig. 4, p. 8).

A. Plug-in Horsepower Resistor® – (Must be obtained from your distributor as a separate part.) The Plug-in Horsepower Resistor® is designed to match the control and motor without having to recalibrate the IR Comp. and CL for most applications. **(Note: For recalibration of IR Comp. and CL see sec. VI E, F on page 12 and 13.)** Using the Plug-in Horsepower Resistor® chart, choose the closest value based on motor horsepower and/or armature current. (See table 4, p. 6.)

B. Fusing

- i. AC line fuse – The KBWM™ contains a 5 amp single AC line fuse used to protect the control against catastrophic failure. If fuse blows, the control may be miswired, the motor is shorted or grounded or the speed control module is defective. Replace with Buss 3 AG type - slow blo. **Note: Bypassing or eliminating the fuse will void warranty.**

CAUTION: Most electrical codes require that each ungrounded conductor contain fusing. Separate branch fusing or circuit breakers may be required on 230VAC line.

- ii. Armature Fuse — The KBWM™ has provision for installing an armature fuse that helps protect the motor and control from damage due to overload. Armature fuses are 3 AG type and are available from your distributor. **Note: An armature fuse must be installed or control will not operate.** Fuse value is calculated based on 1.7 times the DC amperage rating of the motor. See table 3, p. 6.

TABLE 3 – FUSE SELECTION CHART

90 VDC	180 VDC	Approx. Motor Current (DC Amps)	Fuse Rating (AC Amps)
Motor Horsepower Range			
1/100	1/50	.1	2/10
1/50	1/25	.2	3/10
1/30	1/15	.3	1/2
1/20	1/10	.5	3/4
1/15	1/8	.7	1
1/10	1/5	1.0	1
1/8	1/4	1.3	2
1/6	1/3	1.7	3
1/4	1/2	2.5	4
1/3	3/4	3.3	5

TABLE 4 – PLUG-IN HORSEPOWER RESISTOR® CHART

90 VDC	180 VDC	Approx. Motor Current (DC Amps)	Plug-in Horsepower Resistor Value (Ohms)	Individual Plug-in Horsepower Resistor® P/N
Motor Horsepower Range				
1/100	1/50	.1	1.0	9833
1/50	1/25	.2	.51	9834
1/30, 1/25	1/15	.35	.35	9835
1/20	1/10	.5	.25	9836
1/15, 1/12	1/6	.8	.18	9837
1/10, 1/8, 1/6	1/4	1.3	.1	9838
1/4	1/2	2.5	.05	9839
1/3	3/4	3.3	.035	9840

Notes:

1. Motor horsepower and armature current must be specified in order to select correct Plug-in Horsepower Resistor®.
2. For motor horsepower not indicated use lower ohm value Plug-in Horsepower Resistor®.

Note: Specific applications may require a different fuse value than indicated. This is based on several factors such as ambient temperature.

III. MOUNTING.

The KBWM™ is mounted via the rear cover mounting strap. Before attempting to wire the control, locate the mounting holes using the rear cover as a template or use the dimensions as shown in the outline drawing. (See fig. 2, p. 8.) Be sure the control is mounted on a flat surface in a location where it will **not** be exposed to contaminants such as water, metal chips, solvents or excessive vibration and/or temperature extremes. **Note: Allow adequate clearance around control to permit motor and AC power cables to enter through the Bx knockouts on bottom of enclosure.**

When mounting in an airtight enclosure, the air space should be large enough to provide adequate heat dissipation. It is recommended that an enclosure with minimum dimension of 12"H 12"W 6"D (300mm 300mm 150mm) be used. The maximum allowable ambient temperature at full rating is 50 °C (122 °F). Consult your factory representative if more information is required. **Note: The KBWM™ can be oriented so that the AC power and motor wiring can be brought in to the top of the control. Mount the rear cover so that the Bx knockouts are located on the top by rotating rear cover 180°. The front cover is then installed right side up using the four (4) 632 screws.** After wiring the front cover, it can be installed onto the mating rear cover with the four (4) 632 screws previously removed from the top and bottom of enclosures.

IV. WIRING.

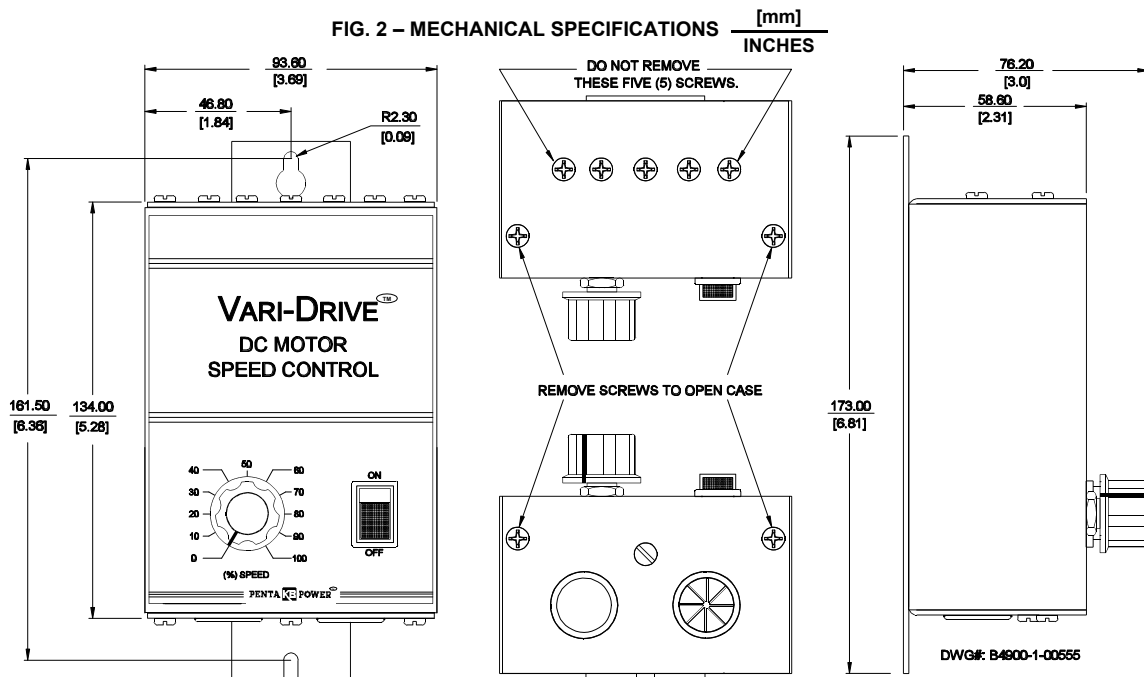
Be sure the AC power is "off" before wiring control. Read Safety Warning on page 2 before attempting to use this control.



WARNING! To avoid erratic operation, do not bundle AC line and motor wires with potentiometer, voltage following, enable, inhibit or other signal wiring. Use shielded cables on all signal wiring over 12" (30 cm) – Do not ground shield.

TABLE 5 – TERMINAL BLOCK WIRING INFORMATION

Terminal Block Designation	Connection Designation	Supply wire Gauge		Maximum Tightening Torque (in – lbs.)
		Minimum	Maximum	
TB1	L1, L2, A+, A-	22	14	3.5



- A. **AC Line** – Wire the AC power to terminals L1, and L2. Be sure that the control model corresponds to the correct AC line input voltage. Model KBWM-120 is for 115 VAC 50/60 Hz and model KBWM-240 is for 230 VAC 50/60 Hz. (See fig. 3.)

Caution: If control is wired to a transformer, it is advisable to switch the secondary to disconnect power. If the primary is switched, additional snubber capacitors may have to be added across terminal L1 and L2 to prevent power bridge damage.

Separate branch fusing or circuit breaker may be required on 230 VAC applications. (See sec. IV E, p. 13.)

- B. **Motor Armature** – Wire the motor armature wires to terminals A(+) and A(-). Be sure the motor voltage corresponds to the control voltage rating. (See fig. 3) **Note: If motor runs in the incorrect direction reverse the armature leads.**

WARNING! Do not wire a switch or relay in series with the armature leads. Armature switching can cause catastrophic failure of motor and or control. If reversing or dynamic braking is required, consult factory.

- C. **Ground (earth)** – Be sure to ground motor and control to green ground stud located between the Bx knockouts. See fig. 6, p. 14.
- D. **Field (Shunt motors only)** – Do not use F+ and F- terminals for any other motor type. The KBWM™ control is primarily designed for permanent magnet (PM) motors. However, a shunt motor can also be controlled by wiring the shunt field directly to the " quick disconnect terminals located on the main speed control module. See fig. 1, p. 4, for the F(+) and F(-) terminal locations. Attach motor field using insulated 1/4" Q-D female terminals. (See fig. 4A and 4B, p. 10).

CAUTION – Shunt-Wound motors may be damaged if field remains connected without motor rotating for an extended period of time.

FIG. 3 – AC LINE AND ARMATURE CONNECTION

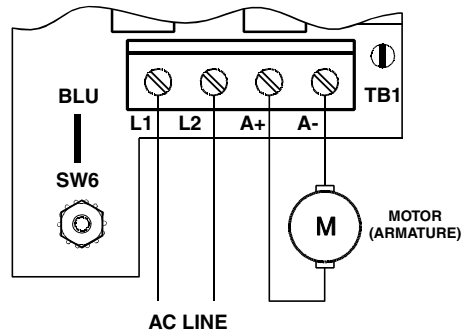


TABLE 6 – FIELD CONNECTION (Shunt Wound Motors Only)

AC Line Voltage (VAC)	Motor Voltage	Field Voltage (VDC)	Field Connection
115	90	100	F+, F-
115	90	50	F+, L1
230	180	200	F+, F-
230	180	100	F+, L1

FIG. 4A – FULL VOLTAGE FIELD

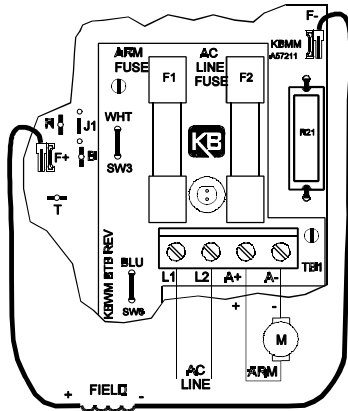
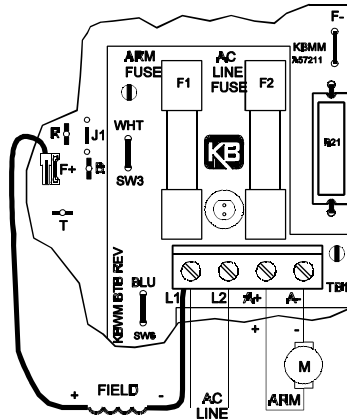


FIG. 4B – HALF VOLTAGE FIELD



- E. **Fusing** – As indicated in sec. II B the KBWM™ contains a single AC line fuse on 230 VAC applications. In the USA and other countries where the 230 volt is derived from two (2) "hot" leads, both AC lines should be connected to a separate dual circuit breaker. Do not fuse neutral or grounded connections.

- F. **AC Line Switch** – The KBWM™ contains a double pole AC line switch which opens both legs of the AC line.

V. OPERATION.

After wiring is complete, recheck connections to be sure they are correct. Also be sure correct armature fuse and Plug-in Horsepower Resistor® are installed. Turn main power on. Internal lamp in power switch should be lighted indicating control is receiving AC line voltage. Gradually increase main speed dial setting. Motor should rotate in proportion to dial setting.

Note: if motor runs in opposite direction to what is required, turn power off and reverse armature leads.



WARNING! If control is operated with rear cover off, be sure to wear safety glasses and use insulated tools if any adjustments are to be made.

CL LED – A red light-emitting diode (LED) can be found on the speed control PC board. It lights when the current limit circuit activates indicating an overload condition. This is normal when the motor accelerates to full speed or when a transient peak load condition exists. However, if the LED lights continuously, a severe overload condition may exist. A DC ammeter should be installed in series with either armature lead to observe motor current during actual operation. (See Safety Warning on page 2). If the actual DC current exceeds the motor rating, a higher horsepower motor should be used. If actual current is equal to or less than the rated motor current, the CL adjustment may be incorrect, or the Plug-in Horsepower Resistor[®] value may be too high. Refer to the CL trimpot adjustment procedure and the Plug-in Horsepower Resistor[®] chart on page 6.

VI. TRIMPOT ADJUSTMENTS AND CONTROL FUNCTIONS.



WARNING! If adjustments are made under power, insulated adjustment tools must be used and eye protection must be worn.

The KBWM[™] has been factory adjusted to provide 0 - full speed using the speed control knob. Minimum and Maximum speed trimpots are provided to change the speed from other than 0 - full speed. The Acceleration (ACCEL) trimpot is provided to allow for a smooth start over an adjustable time period each time the AC power is applied or the speed pot is rotated. The DECEL trimpot controls the amount of ramp-down time when the speed pot is adjusted to a lower speed. The Current Limit (CL, or torque output) adjustment is factory set to approximately 1 times the motor rating. The IR Compensation (IR) is factory adjusted to provide excellent motor regulation under normal operation.

Note: For the IR Comp. and CL trimpot settings to be correct, the proper Plug-in Horsepower Resistor[®] must be installed. (See table 4 p. 6.) Do not attempt to change the settings of the trimpots unless absolutely necessary since they are factory adjusted to near optimum settings.

The following procedure, presented in order of adjustment sequence, should be used when readjusting all trimpot functions:

- A. **Acceleration Start** – The ACCEL is factory set at approximately 2 seconds. To readjust to different times, set the knob to the desired position as shown in fig. 5, p. 12.

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- B. **Deceleration** – The DECEL is factory set to provide a ramp-down time of 2 seconds. To change the ramp-down time, adjust the DECEL trimpot as indicated in fig. 5.

- C. **Minimum Speed Adjustment** – If a higher than zero minimum speed is needed, readjust the minimum speed by turning the speed control knob to zero setting (full CCW position). Then adjust the Min. Speed trimpot to the desired setting.

Note: The Min. speed adjustment will affect the Max. speed setting. Therefore, it is necessary to readjust the Max. speed after the Min. speed.

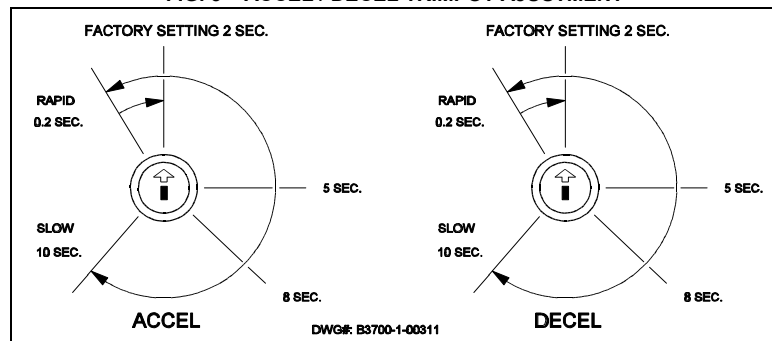
- D. **Maximum Speed Adjustment** – Turn Speed Control Knob to full speed (maximum CW position). Adjust Max. speed trimpot to new desired setting.

Note: Do not attempt to adjust the Max. speed above the rated motor RPM since unstable motor operation may occur. For moderate changes in the Max. speed, there will only be a slight effect on the Min. speed setting.

- E. **Current Limit (CL/Torque Adjustment)** – CL circuitry is provided to protect the motor and control against overloads. The CL also limits the inrush current to a safe level during startup. The CL is factory set to approximately 1.5 times the full load rating of the motor. (CL trimpot is nominally set to approximately 65% of full CW rotation.) **Note:** Proper size Plug-in Horsepower Resistor[®] must be installed.

To set the CL to factory specifications adjust as follows:

FIG. 5 – ACCEL / DECEL TRIMPOT AJUSTMENT



1. Set speed control knob at approximately 30 - 50% CW rotation. Set CL trimpot to full CCW position.
2. Connect a DC ammeter in series with the armature lead.
3. Lock shaft of motor (be sure CL pot is in full CCW position). Apply power and rotate CL pot CW until DC ammeter reads 1.5 times motor rating. (Do not exceed 2 times motor rating.) Do not leave motor in locked rotor position for more than a few seconds or damage may occur.

Note: If only an AC ammeter is available, it can be installed in series with AC input line. Follow above instructions; however, set AC amperage at .75 motor rating.

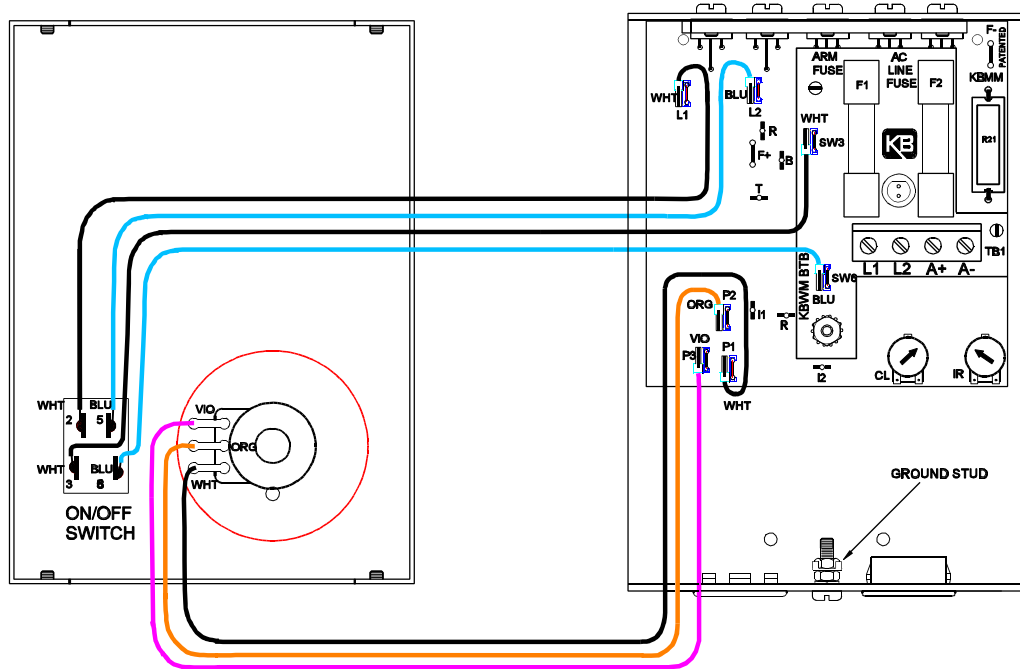
- F. **IR Compensation Adjustment.** IR compensation is provided to improve load regulation. If the load presented to the motor does not vary substantially, the IR adjustment may be set at a minimum level (approximately 1/4 of full setting). The control is factory adjusted to approximately 3% regulation. If superior performance is needed (less than 1% speed change of base speed from 0 - full load), then the IR Comp. should be adjusted as follows:

Note: Excessive IR Comp. will cause control to become unstable, which causes motor cogging.

1. Set IR Comp. trimpot at approximately 25% of CW rotation. Run motor unloaded at approximately 1/3 speed and record RPM.
2. Run motor with maximum load and adjust IR Comp. trimpot so that the motor speed under load equals the unloaded speed per step 1.
3. Remove load and recheck unloaded RPM. If unloaded RPM has shifted, repeat procedure for more exact regulation.

The control is now compensated to provide minimal speed change under large variations of applied load.

FIG. 6 – INTERNAL CONNECTION DIAGRAM



VII – LIMITED WARRANTY

For a period of 18 months from date of original purchase, KB 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, and we are 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 so that they may not apply to you. In any event, KB's total liability, under all circumstances, shall not exceed the full purchase price of this unit. (rev 4/88)



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