KBIC®

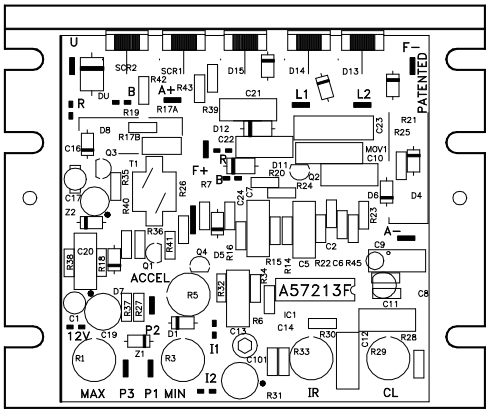
Solid State SCR DC Motor Speed Controls

See table 2 page 4 for KBIC® models covered by this manual

***Patented* Ultra Fast CL Circuit Prevents Demagnetization in PM Motors**

Installation and Operating Instructions

See SAFETY WARNING on page 4



Basic KBIC®

PATENTED

***See Page 3**

PENTA KB POWER™

A COMPLETE LINE OF MOTOR DRIVES

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TABLE OF CONTENTS

Section		Page
i.	Safety Warning	3
ii.	Simplified Instructions	3
iii.	Introduction	6
I.	Application Information	6
II.	Installation Instructions	7
III.	Adjustments & Control Functions	10
IV.	Switching Circuits	11
V.	Limited Warranty	16

TABLES

1.	Nominal Trimpot Settings	3
2.	Electrical Ratings	4
3.	General Performance Specifications	4
4.	Fuse Selection Chart	5
5.	Plug-in Horsepower Resistor® Chart	5
6.	Minimum Supply Wire Requirements	8
7.	Field Connections	8
8.	Parts List	15

FIGURES

1.	Basic KBIC®	5
2.	Mechanical Specifications	7
3.	Connection Diagrams	8
4.	ACCEL Trimpot Adjustment	10
5a.	Master/Slave Circuit	12
5b.	Dynamic Brake Circuit	13
5c.	Overload Protection	13
6.	Schematic	14

i. SAFETY WARNING!

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 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. Use only the AC line for this purpose.

The input circuits of this control (potentiometer, 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.

ii. SIMPLIFIED INSTRUCTIONS – Read these simplified instructions before operating control. (See Safety Warning.)

1. Be sure input AC line voltage corresponds to control voltage. (See Electrical Rating chart, table 2 p. 4.)
2. Install the correct Plug-in Horsepower Resistor® according to armature voltage and motor horsepower (See chart, p. 5).
3. Recheck connections: AC line to L1 and L2, armature to A+ and A- and Field (Shunt motors only) to F+ and F-. (Note: if motor runs in improper direction, interchange armature leads.)
4. Nominal trimpot settings are as follows (expressed in % of full CW rotation):
5. It is recommended that both AC line and armature fuses should be installed in this product. (See sec. IID, p. 9.)

TABLE 1 – NOMINAL TRIMPOT SETTINGS (For detailed instruction see Sec. III)

MIN (minimum speed)	15%		CL (current limit/torque)	50%	
MAX (maximum speed)	60%		ACCEL (acceleration start)	50%	
IR (IR Compensation)	25%				

TABLE 2 – ELECTRICAL RATINGS

Model Number	AC Line Voltage (VAC) ± 15% 50/60Hz	Motor Voltage (VDC)[3]	RATING WITHOUT AUXILIARY HEATSINK			RATING WITH AUXILIARY HEATSINK			FIELD VOLTAGE (Shunt wound Motor Only) (VDC)
			Max. AC Load Current (RMS Amps)	Max. DC Load Current (Avg. Amps)	MAX HP	Max. AC Load Current (RMS Amps)	Max. DC Load Current (Avg. Amps)	MAX HP	
KBIC-120	115	0 - 90	9.0	6.0	0.5	18.0	12.0	1	50, 100
KBIC-125	115	0 - 90	12.0	8.0	0.75	24.0	16.0	1.5	50, 100
KBIC-240	230	0 - 180	9.0	6.0	1	18.0	12.0	2	100, 200
KBIC-225	230	0 - 180	12.0	8.0	1.5	24.0	16.0	3	100, 200
KBIC-240D[1]	115	0 - 90	9.0	6.0	0.5	18.0	12.0	1	50, 100
	230	0 - 180			1			2	100, 200
KBIC-240DS[2]	115 / 230	0 - 90	9.0	6.0	0.5	18.0	12.0	1	100

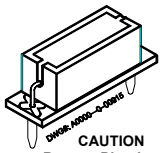
Notes:
(1) Model KBIC-240D is designed to accept 115 or 230 VAC line input to provide 0 - 130 VDC with a 115 or 230 VAC line and 0 - 220 VDC with a 230 VAC line.
(2) Model KBIC-240DS is designed to accept 115 or 230 VAC line input to provide 0-130 VDC with a 115 or 230 VAC line. (Also see Information Sheet A40058)
(3) A higher output voltage can be reached by increasing MAX trimpot setting.

TABLE 3 – GENERAL PERFORMANCE SPECIFICATIONS

Speed Range (ratio)	50:1
Load Regulation (% base speed) (0 - full load; 50:1 speed range)	1*
Line Voltage Regulation (% base speed at full load; 100 - 130 VAC)	1/2*
Control Linearity (% speed vs. dial rotation)	2
CL/Torque Range (% full load)	0 - 300
ACCEL Time Period (0 - full speed) (secs)	0.5 - 4.0
MIN Speed Trimpot Range (% full speed)	0 - 30*
MAX Speed Trimpot Range (% full speed)	50 - 110*
IR Compensation Trimpot Range (at specified full load) (volts)	0 - 24
Maximum Allowable Ambient Temperature at full rating (°C/°F)	45/113
Maximum Inrush Start Current (Peak DC amps)	3 times CL Setting

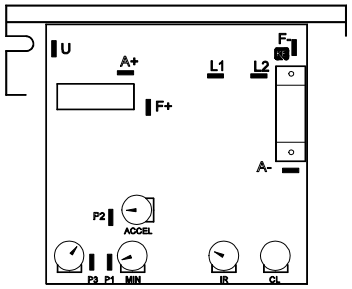
PLUG-IN HORSEPOWER RESISTOR®

A Plug-in Horsepower Resistor® must be installed to match the KBIC® to the motor horsepower and voltage. See table 4, p. 5 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.

*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. III E, p. 11.



DWG#: A2600-1-00535

WARNING: If control is wired to a transformer, do not switch the primary side of transformer to disconnect power or catastrophic failure can result. Always disconnect control from secondary side of transformer.

CAUTION: Do not bundle potentiometer connections (P1, P2, P3) and Inhibit™ connections (I1, I2) with AC line or motor wires.

WARNING: Armature Switching. Do not switch the armature in and out of circuit or catastrophic failure will result. If armature switching is required for dynamic brake or reversing, use model KBRG, KBPB or KBCC-R suffix controls.

NOTE: (Shunt motors only) For 90V DC motors with 50VDC fields and 180VDC motors with 100VDC fields, use half voltage field connections F+ and L1. (See table 7, p. 8)

C. Voltage Following – All models can be controlled with an **isolated** analog reference voltage (0-7 VDC) in lieu of the main speed potentiometer. The voltage is connected to P2 (+) and F-. The control output voltage will linearly follow the input voltage. The source impedance of the input should be 10K ohms or less. The Min and Max trimpots are rendered inoperative in the voltage following mode. Use auxiliary trimpots for scaling and to limit the control range. If the input signal is not isolated, or is a current signal (4 - 20 mA), the KBSI-240D or SI-5 Barrier Terminal Board Signal Isolator must be used. It will allow direct connection to process controllers and microprocessors.

CAUTION:
1. The voltage feeding P2 and F- must be isolated from the AC line. Do not earth ground P2 or F- to setup a zero or ground reference.
2. Do not bundle signal wires to P2 and F- with AC line or motor connections. If signal wires are over 18 inches, use shielded cables.

D. Fusing – The KBIC® has provision for adding a built-in AC line fuse and armature fuse*. The AC line fuse protects the control against catastrophic failure. If the fuse blows, the control is miswired, the motor is shorted or grounded, or the KBIC® control is defective. The armature fuse provides overload protection for the motor and control. Choose the proper size armature fuse and AC line fuse (see fuse chart table 4, p. 5) by multiplying the maximum DC motor amps by 1.7. Armature and AC line fuse kits are available from your distributor. On domestic 230 Volt AC lines, separate branch circuit protection for each line must be used. All fuses should be normal blow ceramic 3AG or MDA or equivalent. The Barrier Terminal Kit (optional) contains prewired AC line and armature fuses. *Contact your distributor.

III. ADJUSTMENTS AND CONTROL FUNCTIONS

The KBIC® is factory adjusted to provide 0 to full speed range using a 5K potentiometer. Minimum and maximum speed trimpots are provided to change the speed range from other than 0 to full speed. An acceleration start (located directly behind the MIN trimpot) is factory set to provide motor acceleration from 0 to full speed over a time period of 2 seconds (approx.) each time the AC power is applied. The current limiting (CL, or torque output) adjustment is factory set to approximately one and a half times the motor rating. The IR Compensation (IR) is factory adjusted to provide excellent motor regulation under normal operation.

NOTE: In order for the IR comp and CL trimpot settings to be correct, the proper Plug-in Horsepower Resistor® must be installed for the particular motor and input voltage being used. Do not attempt to change the settings of the trimpots unless absolutely necessary since they are factory adjusted to near optimum settings.

IMPORTANT NOTE:
Readjusting the ACCEL time will affect the MAX speed and IR Comp. settings which will have to be readjusted (see this Section). If the ACCEL time is decreased to the minimum time of 0.5 seconds (6 o'clock trimpot position), then increase the IR trimpot 25% CW rotation and decrease the MAX trimpot 20% CCW rotation. If the ACCEL time is increased to the maximum time of 4 seconds (full rotation), then decrease the IR and increase the MAX as per above percentages of rotation.

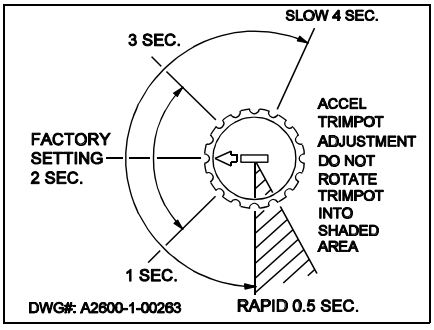
The following procedure is presented in required order of adjustment. It should be followed when readjusting all trimpot functions:

A. Acceleration Start – (ACCEL trimpot is located directly behind the MIN trimpot.) If the ACCEL is to be readjusted to different times, adjust the trimpot to the desired time according to fig. 4.

B. Maximum Speed Adjustment – Set main speed pot 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 be a slight effect on the MIN speed setting when the MIN speed is set at zero. There may be significant variation in the MIN speed setting if the MIN speed is at a higher than zero setting.

FIG. 4 – ACCEL TRIMPOT ADJUSTMENT



C. Minimum Speed Adjustment – If a higher than zero speed is desired, readjust the minimum speed by turning the main speed potentiometer 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, and it may be necessary to repeat the sequence until both the MIN and the MAX speeds are set to the desired levels.

D. 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 approx. 50% of full CW rotation.)

Note: The correct value Plug-in Horsepower Resistor® must be installed in order for the CL and IR comp. to operate properly.

Calibration of the CL & IR comp. is normally not required when the proper Plug-in Horsepower Resistor® is installed.

To set the CL to factory specifications adjust as follows:

1. Set main speed potentiometer 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 slowly until DC ammeter reads 1.5 times motor rating (do not exceed 2 times motor rating). Note: Complete this step within 5 seconds to avoid damaging motor.

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 0.75 times motor rating.

E. IR Compensation Adjustment – IR compensation is provided to substantially 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 desired (less than 1% speed change of base speed from 0 to 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 unload 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.

IV. SWITCHING CIRCUITS

A. AC Line Switching – The KBIC® can be safely turned "on" and "off" rapidly using the AC Line (no waiting time is required). Auto Inhibit® circuitry contained in the KBIC® automatically resets critical components each time the AC line is interrupted. This, along with Acceleration Start and CL, will provide a smooth start each time the AC line is connected.

Warning: Do not disconnect and reconnect the Armature with the AC line applied or catastrophic failure will result.

B. Armature Switching – If the armature is to be disconnected and reconnected with AC power applied, the Inhibit Circuit™ must be simultaneously activated and deactivated. Connect I1 and I2 together to activate the Inhibit Circuit™. See fig. 5B for dynamic brake circuit.

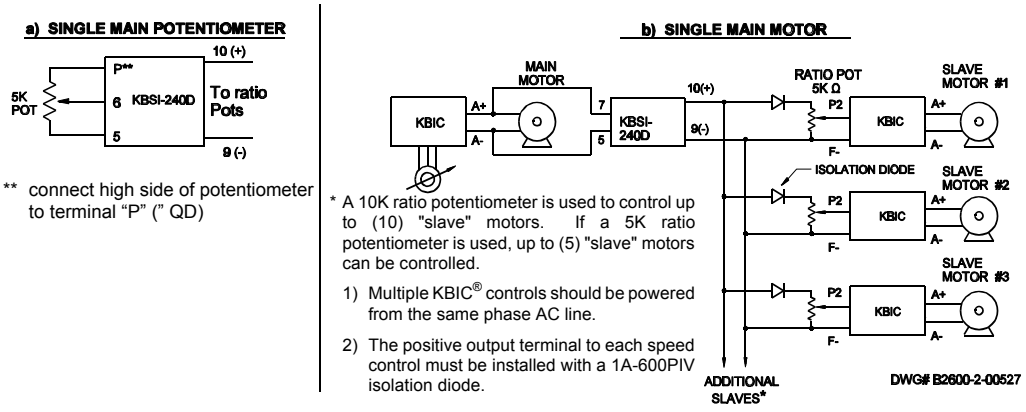
C. Reversing and Dynamic Braking – KB has developed the APRM®* which provides anti-plug "instant" reversing and solid state dynamic braking. The APRM® is built in as standard in all KBCC-R suffix models and in all KBPB™ models. *Patented.

FIG. 5 APPLICATIONS

A. Master/Slave Connections. The KBIC can be used with the KBSI to drive multiple motors:

(a) From a single main potentiometer
(b) From a single main motor.

FIG. 5A – MASTER SLAVE CIRCUIT



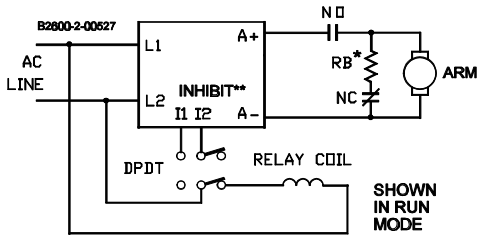
** connect high side of potentiometer to terminal "P" (" QD)

* A 10K ratio potentiometer is used to control up to (10) "slave" motors. If a 5K ratio potentiometer is used, up to (5) "slave" motors can be controlled.

1) Multiple KBIC® controls should be powered from the same phase AC line.

2) The positive output terminal to each speed control must be installed with a 1A-600PIV isolation diode.

FIG. 5B – DYNAMIC BRAKE CIRCUIT (Using Inhibit™)



Notes (Dynamic Brake Circuit)

* Choose RB resistance and wattage according to braking requirements.

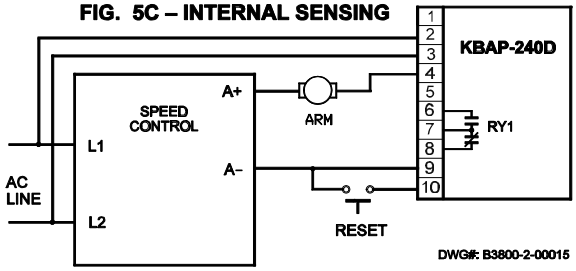
** Inhibit™ circuit extinguishes output of control during brake. When the armature is reenergized, the Inhibit™ releases which allows for a smooth start.

C. Overload Protection with KBAP-240D (P/N 9106) (Optional)

The KBAP-240D is a multipurpose DC Current Sensing Relay and Overload Protector. It is specifically designed for use with DC motors and speed controls from 1/8 - 3 HP. KBAP-240D operates by sensing current in the armature circuit. When the preset level is reached, the output relay (RY1) trips. An adjustable time delay (0.2 - 15 secs.) is incorporated, which eliminates nuisance tripping. Manual or automatic reset is provided at the user's option along with a LED, which indicates when the preset current level has been reached. When an overload occurs, the KBAP-240D can be used to shut the system down, sound an alarm, or initiate corrective action before damage occurs.

Internal Sensing. Wire the KBAP in accordance with the following wiring diagram.

FIG. 5C – INTERNAL SENSING



V. – LIMITED WARRANTY - KBIC®

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)

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

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