

5 HP
Chassis Mount
Solid State
DC Motor
Speed Control
Model
KBCC-255

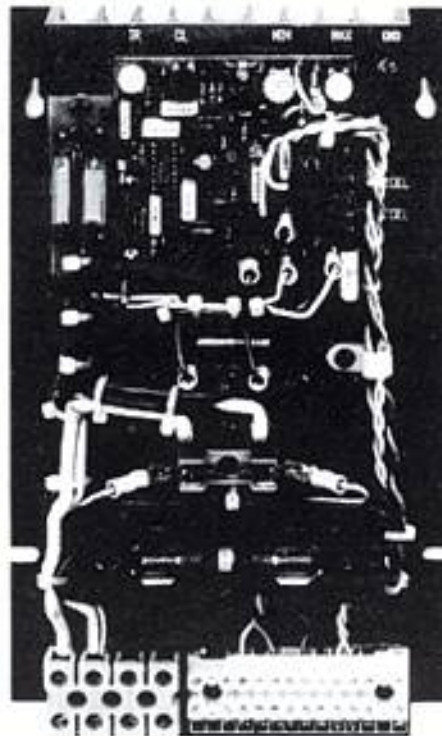
Installation
and
Operating
Instructions*

*See Safety Warning on Page 2.

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PENTA  **POWER**

A COMPLETE LINE OF SCR DRIVES



5K Remote
Potentiometer



Knob with Dial Plate.
(Accessory item not included)



KB Part No. 9832

Model KBCC-255

- Designed for PM and Shunt Motors—rated 180VDC
- Includes Armature and Control Fusing
- Separate Power Bridge Cube
- Current Limit Led Indicator

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SAFETY WARNING—PLEASE READ CAREFULLY

This product should be installed and serviced by a qualified technician, electrician or electrical maintenance personnel 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 when working with control under power. This product is constructed of materials (plastics, metals, carbon, silicon, etc.) which may be a potential hazard. Individual material safety data sheets (MSDS) are available upon request. 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 3/88).

****IMPORTANT****

Read these simplified instructions before operating control.

1. Be sure input AC line voltage corresponds to control voltage. (240 VAC—50/60 Hz 1 ϕ).
2. Recheck connections: AC line to L1 and L2; armature to A+ and A- and Field (Shunt motors only) to F+ and F-. Connect ground via ground screw (Note: If motor runs in improper direction, interchange armature leads).
3. Nominal trimpot settings are as follow (expressed in % of full CW rotation):

TABLE 1: NOMINAL TRIMPOT SETTINGS

MIN (minimum speed):	15%	For detailed instructions see Sec. III
MAX (maximum speed):	65%	
IR (IR compensation):	25%	
CL (current limit/torque):	75%	
ACCEL (acceleration start):	30%	
DECEL (deceleration):	0%	

FOR TECHNICAL ASSISTANCE CALL TOLL FREE (^{OUTSIDE} NY STATE ONLY) 1-800-221-6570

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 exclusion 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. 10/84)

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.

TABLE 2. ELECTRICAL RATINGS

MODEL NUMBER	AC VOLTS INPUT (50/60 Hz)	MAX. AC LOAD CURRENT (RMS AMPS)	MAX. DC LOAD CURRENT (AVG. AMPS)	MAX HP	FUSE SIZE (AMPS)
KBCC-255	240	38	26	5	40

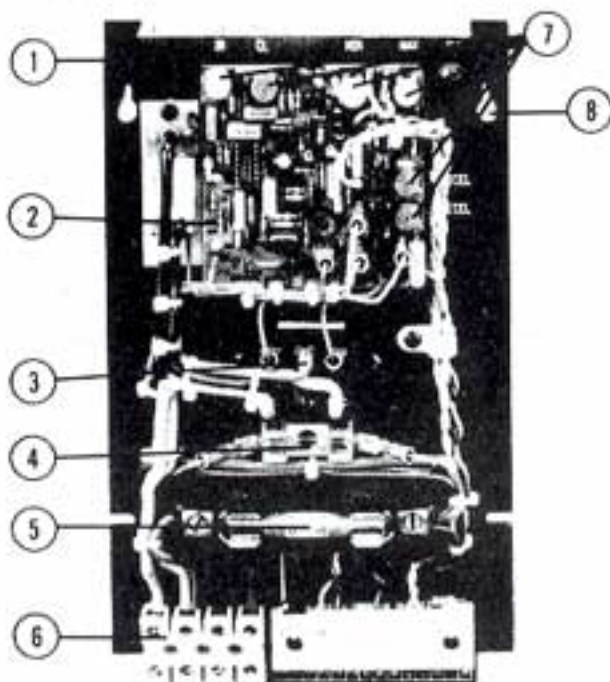
TABLE 3. GENERAL PERFORMANCE SPECIFICATIONS

Speed range (ratio)	50:1
Load regulation—armature feedback (0-full load, 50:1 speed range) (% base speed)	1*
Load regulation—tachometer feedback (0-full load, 50:1 speed range) (% set speed)	1*
Line voltage regulation—armature feedback (at full load, $\pm 10\%$ line variation (% base speed)	$\frac{1}{2}$ *
Line voltage regulation—tachometer feedback (at full load, $\pm 10\%$ line variation) (% set speed)	$\frac{1}{2}$ *
Control linearity (% speed vs. dial rotation)	2
CL/torque range (% full load)	0-200
ACCEL/DECEL time range (0-full speed) (secs.)	1-10
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 ($^{\circ}\text{C}/^{\circ}\text{F}$)	45/113
Tachometer feedback input volts (per 1000 RPM) (VDC)	7/50

*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 F. (page 11). Other factory trimpot settings are as follows: CL-150% FL, ACCEL-3 secs., MIN-(0)-speed, MAX-full speed & IR-3 volts.

FIG. 1. FEATURES AND FUNCTIONS

- (1) Rugged Aluminum Heatsink
- (2) KBMM Speed Control
- (3) Power Bridge Module
- (4) Control Fuse (4A)
- (5) Armature Fuse (40A)
- (6) Barrier Terminal Block
- (7) Trimpots: MIN, MAX, ACCEL, DECEL, IR and CL
- (8) Keyhole slots facilitate mounting



INTRODUCTION

The KBCC™ Full Wave Solid State DC Motor Speed Control represents the latest state-of-the-art design achievable through modern technology.

Features Include:

- **Integrated Circuitry**
Used to control and amplify command and reference levels with both closed and open loop feedback to provide superior motor regulation. (Speed changes due to load, line voltage, or temperature variations are held to minimum levels).
- **High Quality Components**
Selected and tested for proven dependability.
- **Transient Protection**
Used to prevent failure of the power bridge circuit caused by voltage spikes on the AC Line.
- **High Reliability**
When used in accordance with the instructions included in this manual, the KBCC™ will provide years of trouble-free operation.

SECTION I. APPLICATION INFORMATION

A. Motor Type. The KBCC™ is designed for Permanent Magnet (PM) and Shunt Wound D.C. motors. Controls operated on 240 volt AC inputs are designed for 180 volt SCR rated motors. Use of higher voltage motors will result in degradation of full speed performance. Also, if motor is not an SCR rated type, the actual AC line amperage at full load should not exceed the motor's DC nameplate rating.

B. Torque Requirements. When replacing an AC induction motor with a DC motor and speed control, consideration must be given to the maximum torque requirements. The full load torque rating of the DC motor must be equal to, or greater than, that of the AC motor.

C. Acceleration Start. The KBCC™ contains an adjustable acceleration start feature which allows the motor to smoothly accelerate from 0-full speed over a time period of 1-10 seconds. The "ACCEL" is factory set at 3 seconds.

D. Limitations in Use. The KBCC™ controls are designed for use on machine applications.

CAUTION: Consult factory before using on constant horsepower applications such as saws or drill presses. Do not use in explosive atmosphere.

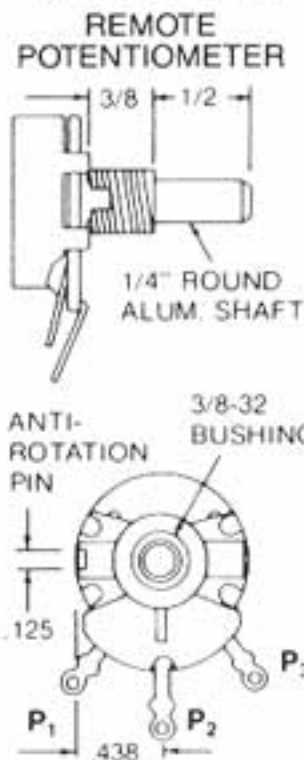
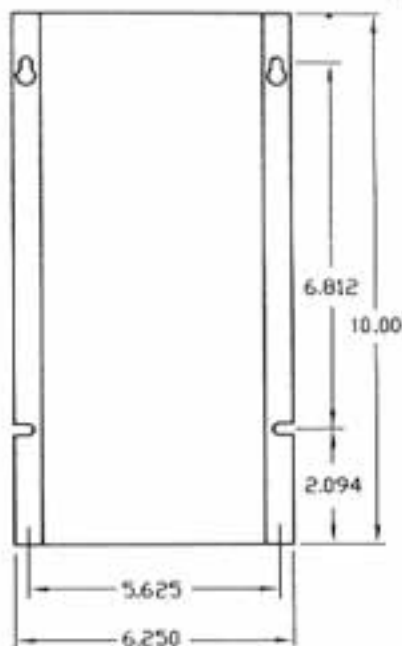
CAUTION: Be sure the KBCC™ is used within its max. ratings. Follow all installation instructions carefully. (Refer to Section II.)

SECTION II. INSTALLATION INSTRUCTIONS

A. Location and Mounting. The KBCC™ controls should be mounted on a flat surface and located in an area where it will not be exposed to contaminants such as water, metal chips, solvents or excessive vibration.

When mounting in an enclosure the air space should be large enough to provide adequate heat dissipation. The maximum allowable ambient temperature at full rating is 45°C/113°F. Consult factory if more information is required. *Note: Control dissipates approx. 60 watts of heat under full load.*

FIG. 2 MECHANICAL SPECIFICATIONS (inches)



B. Initial Setup and Wiring

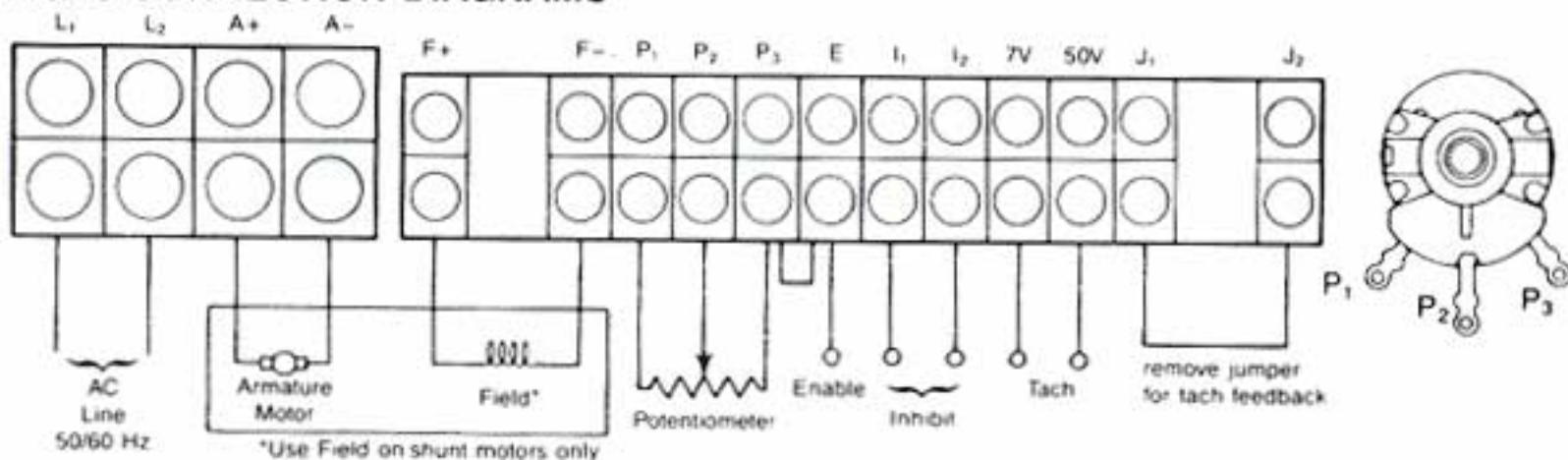
1. The KBCC can be connected to a standard 240V 50/60 Hz AC line [Be sure the AC input voltage corresponds to the control voltage rating and the motor rating (e.g. 180VDC motor on 240VAC)].
2. Follow the recommended supply wire sizes as per Table 5.
3. Follow the NEC and other electrical codes that apply.
4. Connect control in accordance to connection diagram—See Fig. 3.
5. Use separate branch fuse or circuit breaker protection for each ungrounded AC main input line.

TABLE 4. MINIMUM SUPPLY WIRE SIZE REQUIREMENTS [AC Line and Armature]

MAX. MOTOR AMPS (DC AMPS)	MAX. MOTOR HP 180V	MINIMUM WIRE SIZE (AWG) Cu Only	
		MAX. 50 FOOT RUN	MAX. 100 FOOT RUN
26	5	10	8*

*Maximum recommended wire size. (Maximum tightening torque is 20 in. lbs.)

FIG. 3 CONNECTION DIAGRAMS



Field Voltage

Use F+ and F- for 200VDC field. Use F+ and L1 for 100VDC field.

Tachometer Connection (Note: DC Tachs Only)

- (1) For tach feedback, remove jumper between terminals J₁ and J₂.
- (2) Connect tach as follows:
 - (a) 7 volts/1000 RPM Connect (+) lead to Terminal 7V
Connect (-) lead to Terminals I₂ or F-
 - (b) 50 volts/1000 RPM Connect (+) lead to Terminal 50V
Connect (-) lead to Terminal I₂ or F-

Application Note: Set IR Comp trimpot to minimum setting (full ccw rotation) when using tach feedback.

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 the transformer output to prevent damage to the power bridge.

CAUTION: Do not bundle control wires P_1 , P_2 , P_3 , I_1 , I_2 with line or motor leads. If wires are over 18" use shielded cables.

WARNING: Armature Switching. Do not switch the armature in and out of circuit unless Inhibit Circuit is used or catastrophic failure will result.

C. Voltage Following.

All models can be controlled with an isolated analog reference voltage (0-9VDC) in lieu of the main speed potentiometer. The voltage is connected to $P_2(+)$ 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 Minimum Speed Trimpot (MIN) can be used to provide an offset speed. If an offset is not required, adjust the MIN to 0+ or 0- speed as desired. The Max trimpot is rendered inoperative in the voltage following mode. Use an auxiliary trimpot to limit the control range. If the input signal is not isolated, or is a current signal (4-20ma), the KBSI-240D Signal Isolator must be used. It will allow direct connection to process controllers and microprocessors.

CAUTION: 1. The voltage feeding P_2 and $F-$ must be isolated from the AC line. Do not ground P_2 or $F-$ to set up a zero or ground reference.
2. Do not bundle signal wires to P_2 and $F-$ with AC line or motor connections. If signal wires are over 18", use shielded cables.

D. Fusing.

1. **Armature Fuse.** The armature fuse provides overload protection for the motor and control. The KBCC control contains fuses that are rated for the maximum horsepower. To provide proper protection for motors rated less than maximum, fuse at approximately 1.7 times the DC amperage rating of the motor. (The factory installed fuse is rated 40A, type SC-40.)
2. **AC Line Fuse.** The installer should provide fuse or circuit breaker protection for each ungrounded supply conductor. Use a 40A rated fuse (Buss type SC-40 or equiv.) Do not fuse neutral or grounded conductors.
3. **Control Fuse.** A factory-installed 4A fuse (Type 3AG or equiv. ¼" x 1¼") is used to protect the Speed Control Module which provides logic to the power bridge and a separate field supply for the motor.

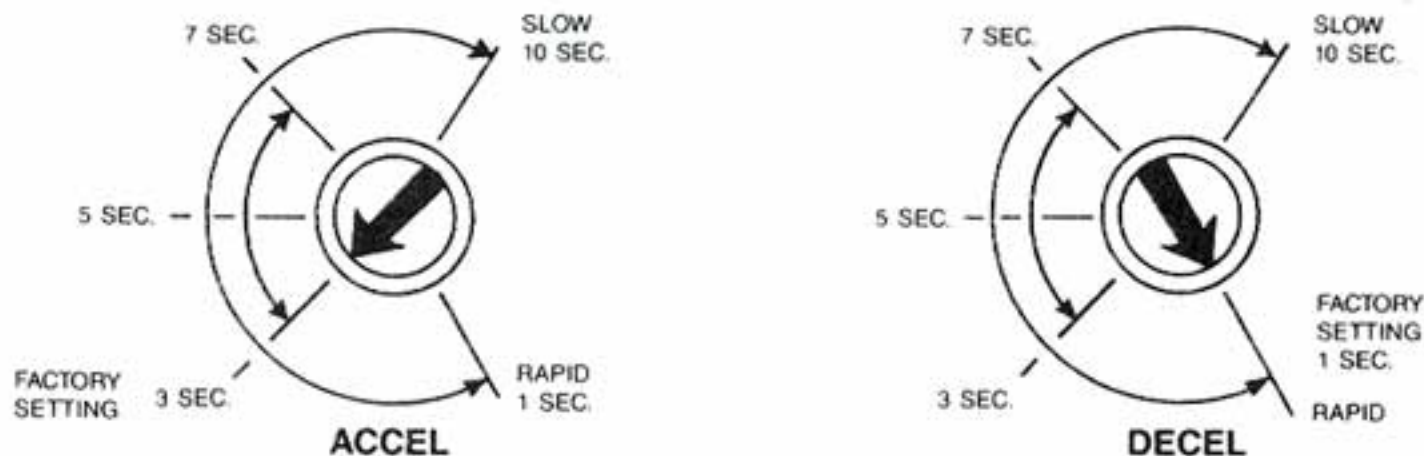
SECTION III—ADJUSTMENTS AND CONTROL FUNCTIONS

The KBCC 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 1½ times the motor rating. The IR Compensation (IR) is factory adjusted to provide excellent motor regulation under normal operation.

NOTE: 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:

Fig. 4 ACCEL/DECEL TRIMPOT ADJUSTMENT



A. Acceleration Start. The ACCEL is factory set at approx. 3 seconds. To readjust to different times, set the knob to the desired position as indicated in Fig. 4.

B. Deceleration. The DECEL is factory set to provide minimum ramp-down time. To increase the ramp-down time adjust the DECEL trimpot as indicated in Fig. 4.

C. Minimum Speed Adjustment. If a higher than zero minimum speed is desired, 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 re-adjust 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 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 approx. 75% of full CW rotation.)

To set the CL to factory specifications adjust as follows:

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 slowly until DC ammeter reads 1.5 times motor rating (do not exceed 2 times motor rating).

F. 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 unloaded RPM has shifted, repeat procedure for more exact regulation.

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

NOTE: For tach feedback applications the IR Comp can be set to minimum rotation (full ccw).

SECTION IV. SWITCHING CIRCUITS

A. *Inhibit™ and AC Line Switching.* The KBCC™ can be turned "on" and "off" using the AC Line. Auto Inhibit® circuitry contained in the KBCC™ automatically resets critical components each time the AC line is interrupted. This, along with Acceleration Start and CL, provides 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. See armature switching.

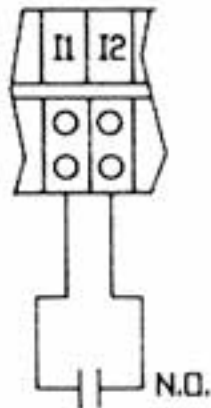
B. *Inhibit™ and Armature Switching.* If the armature is to be disconnected and reconnected with AC power applied the Inhibit Circuit™ must be simultaneously activated and deactivated. Connect I₁ and I₂ together to activate the Inhibit Circuit™. When the Inhibit is activated, the control output will be electronically extinguished which eliminates arcing. See Fig. (5) for Dynamic brake circuit.

Warning: Do not use Inhibit as a failsafe or safety switch.

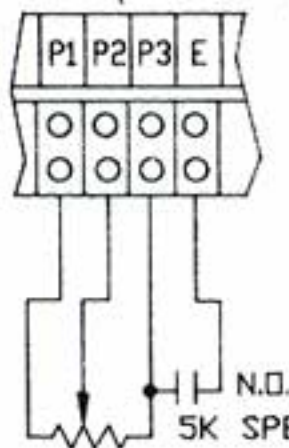
C. *Reversing and Dynamic Brake.* KB has developed the APRM® * which provides anti-plug "instant" reversing and solid state dynamic braking. The APRM® is built in as standard in all KBCC-R suffix models and in all KBPB™ models. *Patented [Note: 3 Horsepower maximum rating.]

FIG. 5. SWITCHING CIRCUITS—CONNECTION DIAGRAMS

INHIBIT™ (make to stop)



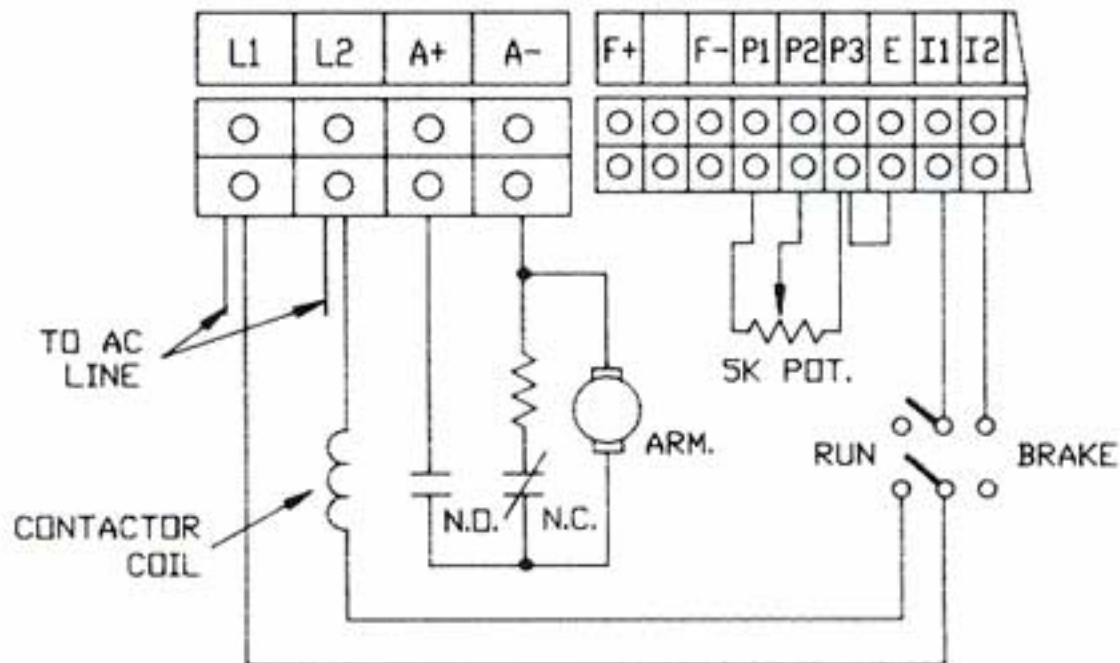
ENABLE⁽¹⁾ (make to run)



NOTE:

REMOVE JUMPER
BETWEEN P3 AND E

DYNAMIC BRAKE CIRCUIT™⁽²⁾ (using Inhibit™)



APPLICATION NOTES:

- ENABLE:** Stop time is adjustable with DECEL trimpot. To obtain zero speed when Enable is open MIN speed trimpot must be set to zero speed. Two speed operation can be obtained by setting the MIN speed to the desired level.
- DYNAMIC BRAKE:** Choose RB resistance and wattage according to braking requirements. Inhibit Circuit extinguishes output of control during brake. When armature is reenergized the Inhibit releases and provides a smooth start. Choose relay or contactor with appropriate rating.

SECTION V. TROUBLESHOOTING GUIDE

The following Troubleshooting Guide is intended for use by a qualified technician. The Guide is designed to isolate common malfunctions of the KBCC and/or motor. It should be used with the parts lists and schematics contained in this manual.

SYMPTOM

1. Motor does not run.

2. Motor hums, or runs at very low speed (with control knob set at high number) or motor slows down substantially when load is applied.

3. Erratic motor performance.

4. Motor continues to run when speed control knob is set to 0.

5. Motor runs in wrong direction.

6. Motor runs full speed.

POSSIBLE CAUSE

1. AC voltage not brought to L1, L2 terminals.

2. Blown line or armature fuse.

3. Speed control knob set to 0.

4. Defective motor.

5. CL trimpot set to min(ccw).

1. Low voltage.

2. Overload condition; control in current limit mode (CL) (trimpot not set correctly.)

3. Incorrect wiring. Armature and shunt connections interchanged (shunt motor only).

1. Defective motor, worn brushes etc.

2. Overload condition.

3. IR comp and/or CL trimpots not set properly.

4. Defective speed control module.

1. Min speed trimpot not set to proper position.

2. IR comp trimpot set too high.

1. Armature leads reversed.

1. Main speed pot wired incorrectly.

2. Tachometer polarity reversed.

CORRECTIVE ACTION

1. Correct wiring to control.

2. Replace blown fuse with SL-40 or equiv. If fuse blew due to miswiring, power bridge module may be defective.

3. Turn knob CW to start motor.

4. Check for defective motor, worn brushes, etc. Replace motor.

5. Adjust CL trimpot to 75%.

1. Check line voltage at control and rewire as required.

2. Reduce loading; CL trimpot setting may have to be increased. See Section IV.

3. Correct wiring (armature has lower resistance than field).

1. Repair motor.

2. Remove overload.

3. Readjust trimpots as per Section IV.

4. Replace module.

1. Readjust min. trimpot.

2. Lower IR comp trimpot setting.

1. Reconnect armature leads.

1. Reconnect pot.

2. Interchange tach leads.

SECTION VI (A) SPEED CONTROL PARTS LIST

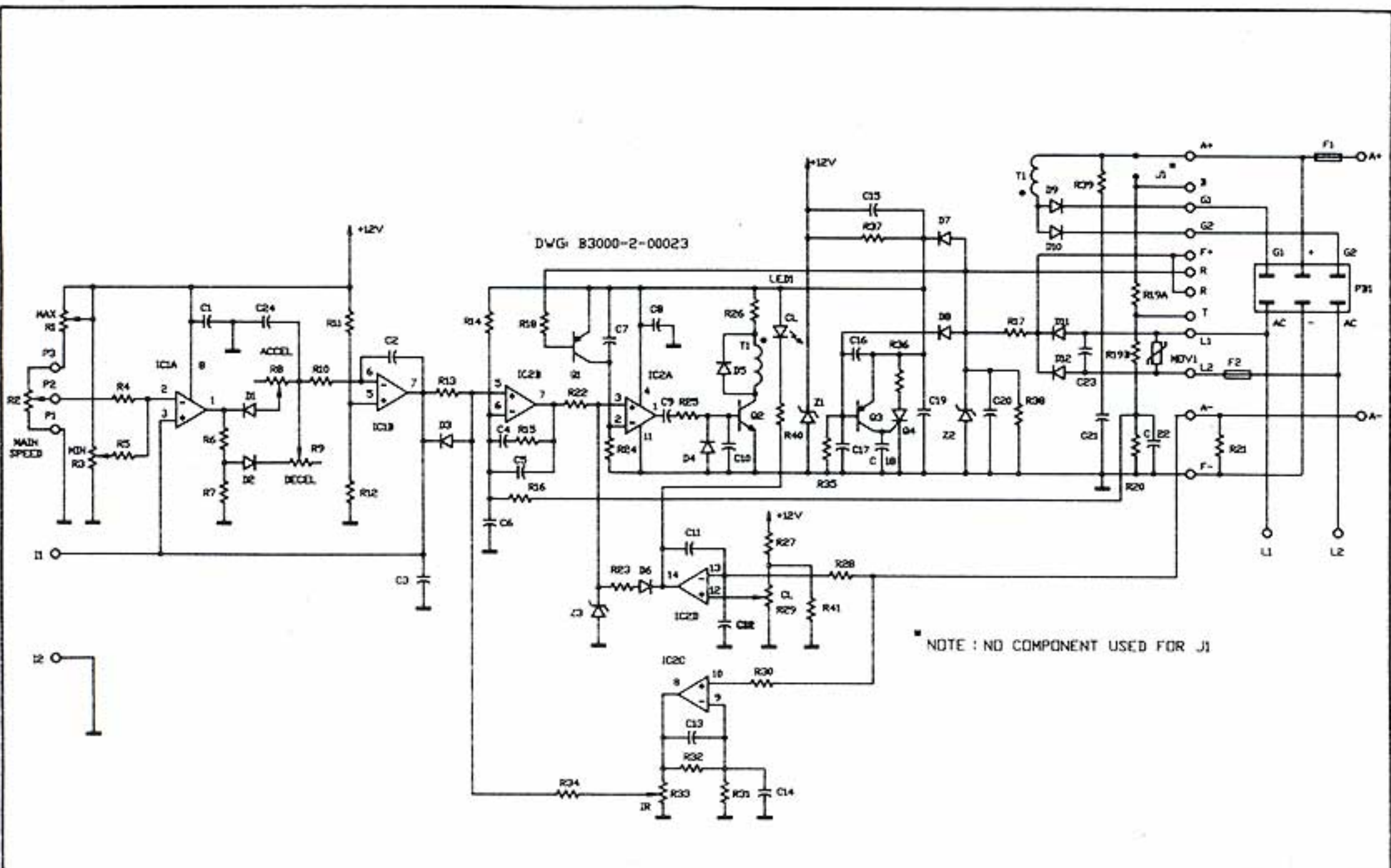
MODEL KBCC-255—RATED 5HP-240V

CKT. REF.	VALUE/RATING	MFG. TYPE	FUNCTION
C1,12	0.01ufd-25V	Ceramic Tubular	Capacitor
C14-16,18	0.01ufd-25V	Ceramic Tubular	Capacitor
C2	1.5ufd-50V	Electrolytic	Capacitor
C3,24	0.0039-0.0047ufd-25V	Ceramic Tubular	Capacitor
C4	1.0ufd-50V	Non-Polar	Capacitor
C5,7	0.1ufd-63V	Metal Film	Capacitor
C6,8,10	0.022ufd-25V	Ceramic Tubular	Capacitor
C9	0.01ufd-63V	Metal Film	Capacitor
C11,22	0.022ufd-63V	Metal Film	Capacitor
C13,20	0.047ufd-63V	Metal Film	Capacitor
C17	4.7ufd-35V	Electrolytic	Capacitor
C19	100.0ufd-35V	Electrolytic	Capacitor
C21	0.047ufd-400VDC	Metal Film	Capacitor
C23	0.047ufd-250VAC/630VDC	Rifa or Wima	Capacitor
C25	0.47ufd-50V	Electrolytic	Capacitor
D1-10	1A-600V	1N4005GP	Diode
D11,12	1.5A-600V	1N5397GP	Diode
IC1		LM358P	Dual Op-Amp
IC2		LM324	Quad Op-Amp
J1*			
MOV1	275V	V275LA20AX1300	Transient Suppressor
PB1	42.5A-600VDC	B612F-2 (lgt. 30 ma Max)	Power Bridge
Q1,3	0.6A-40V	2N4403	Small Signal Transistor
Q2	0.6A-40V	2N4401	Small Signal Transistor
Q4	0.8A-50V	S347S101E	Small Signal SCR
R1	10K-0.125W-10%	PTC-10YV	Max Trimpot
R2	5K-5W-20%		Main Speed Pot
R3	25K-0.125W-10%	PTC-10YV	Min Trimpot
R4	33K-0.25W-5%	Carbon Film	Resistor
R5,16,18,23	47K-0.25W-5%	Carbon Film	Resistor
R28,30,31	47K-0.25W-5%	Carbon Film	Resistor
R6	24K-0.25W-5%	Carbon Film	Resistor
R7,12,25	3.3K-0.25W-5%	Carbon Film	Resistor
R8	500K-0.125W-10%	PTC-10YV	Accel Trimpot
R9	500K-0.125W-10%	PTC-10YV	Decel Trimpot
R10	5.6K-0.25W-5%	Carbon Film	Resistor
R11	56K-0.25W-5%	Carbon Film	Resistor
R13,35	22K-0.25W-5%	Carbon Film	Resistor
R14,32	2.2M-0.25W-5%	Carbon Film	Resistor
R15	560K-0.25W-5%	Carbon Film	Resistor
R17	12K-7W-5%	CW-7	Resistor
R19A	62K-0.25W-5%	Carbon Film	Resistor
R19B	12K-0.25W-5%	Carbon Film	Resistor
R20	3.9K-0.25W-5%	Carbon Film	Resistor
R21*	.003 ohm-10W-5%	Wire Wound	Resistor
R22	68K-0.25W-5%	Carbon Film	Resistor
R24,27,34	100K-0.25W-5%	Carbon Film	Resistor
R26	47 ohm-0.25W-5%	Carbon Film	Resistor
R29	2.5K-0.125W-10%	PTC-10YV	CL Trimpot
R33	10K-0.125W-10%	PTC-10YV	IR Trimpot
R36	1.0 ohm-0.25W-5%	Carbon Comp.	Resistor
R37	1.8K-0.25W-5%	Carbon Film	Resistor
R38	6.8K-0.25W-5%	Carbon Film	Resistor
R39	470 ohm-0.25W-5%	Flameproof	Resistor
T1	1:1	KB Standard	Pulse Transformer
Z1	12V-1W-5%	1N4742A	Zener Diode
Z2	22V-1W-5%	1N4748A	Zener Diode

*R21 is (2) .005 ohm-5W-5% resistors wired in parallel

**No component or jumper used on printed circuit board. An 82K-0.5W-5% resistor is installed externally on terminal block.

SECTION VI (B) KBCC™—255 SPEED CONTROL SCHEMATIC





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