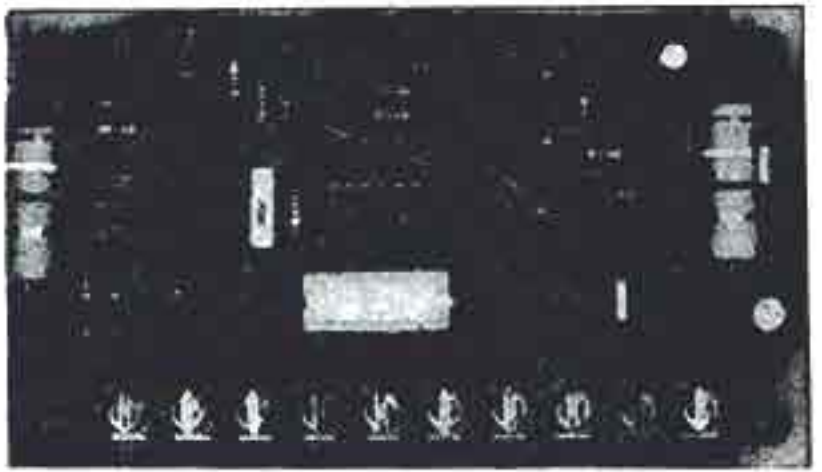
Current Sensing Relay and Overload Protector for DC Motors and Controls

Installation and Operating Instructions

Model No. KBAP-240D



- Jumper selection for current range, Auto/Manual reset and AC input voltage.
- Trimpots for current & trip time delay and hysteresis
- LED indicator for trip level
- Operates on 120VAC and 240VAC 50/60 Hz.

See SAFETY WARNING on page 3.

PENTA KB POWER™

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INTRODUCTION

I. DESCRIPTION

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. The unit can be used with larger or smaller motors by utilizing the external sensing method of connection. KBAP–240D operates by sensing current in the armature circuit. When the preset level is reached, an output relay trips. An adjustable time delay (.2–15 secs.) is incorporated, which eliminates nuisance tripping. Manual or automatic reset is provided at the user's option along with an LED, which indicates when the preset current level has been reached. In addition, a Hysteresis trimpot is provided which can be used to increase the differential between the pull-in and drop-out points of the output relay. 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. The unit can be operated on either 120 or 240VAC line voltage, and has five preset current trip points (2.5/5/10/15/20), which can be further adjusted with a built-in trimpot. A block diagram (see Fig. 1) illustrates the basic concept of KBAP operation.

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 (see instruction information which accompanies product), 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).

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.

KBAP-240D

II. SPECIFICATIONS

AC Power Requirement	120/240VAC-50/60 Hz
Current Sensing Trip Points	2.5/5/10/15/20/ext. Amps DC
Current Trimpot Range (approx.)	50-150% of Trip Point
Trip Time Range	.2-15 secs.
Hysteresis Trimpot Range (approx.)	(± 30% of Current Trip Point
Temperature Drift	4 ma per °C
Temperature Operating Range	0-55°C
Maximum Continuous Sensing Current (internal sensing)	16 ADC
Maximum Intermittent Sensing Current (internal sensing)	25 ADC
Output Contact Rating	1.0A-28VDC/.5A-120VAC
Output Contact Life:	
Mechanical	5 million operations
Electrical	100,000 operations (full rating)
Dimensions	2.75" W × 4.85" L × 1.1" H 70mm × 123mm × 28mm

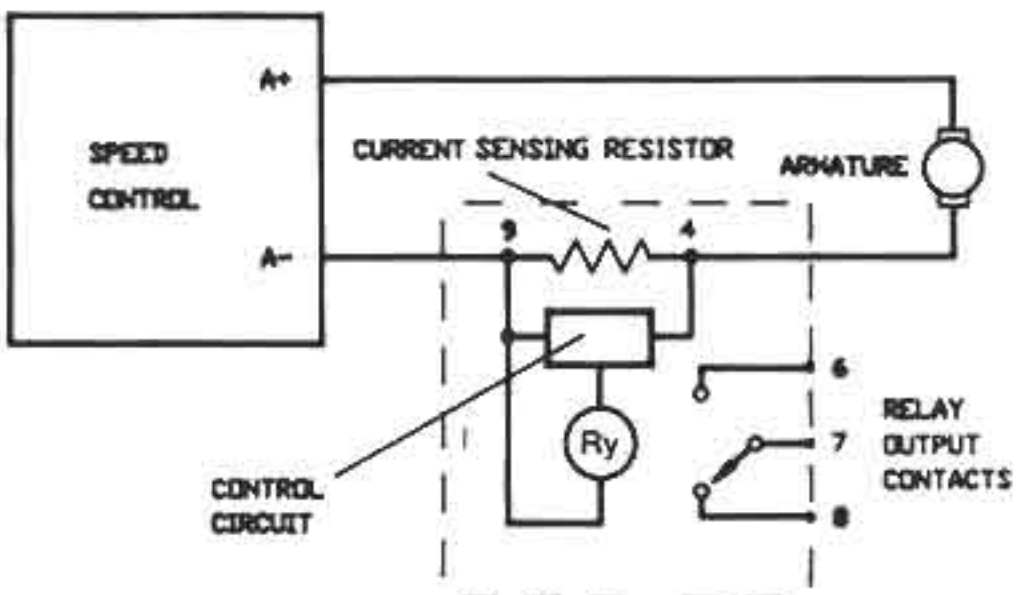


Fig. 1 KBAP-240D Block Diagram

III. INSTALLATION.

(A) *MOUNTING.* Mount the KBAP using (4) 6-32 screws. Use the outline drawing (Fig. 2) to locate mounting holes. The unit is designed to be mounted in any position, providing its components do not come in contact with other wiring or grounded metal parts. Location should be free from contamination, such as water, metal chips, or other conductive material.

(B) *WIRING.* The KBAP can be wired for current sensing using the internal or external method of connection. The internal method of connection utilizes a built-in current sensing resistor (.006 ohms). For internal sensing, the KBAP has a DC current range of 2.5 to 20 amps DC, which can be further adjusted with the current trimpot (CUR ADJ).

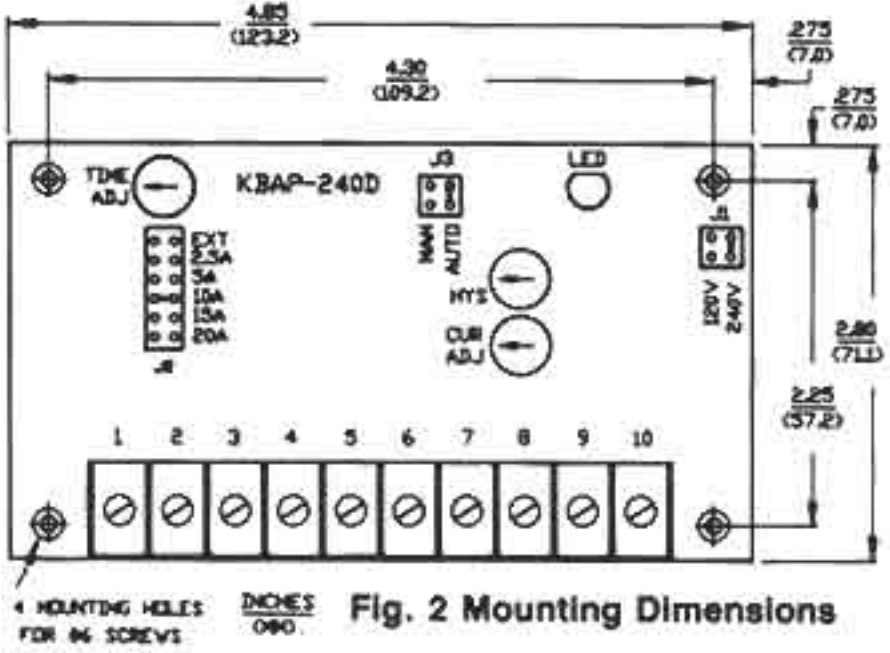


Fig. 2 Mounting Dimensions

SPECIAL APPLICATION NOTE ON EXTERNAL SENSING

The KBAP can also be used for other current ranges below and above the built-in current range by utilizing external sensing. In this mode of operation, current sensing is through the current sensing resistor built into the DC drive or speed control. If the drive does not use a current sensing resistor, a standard current shunt can be used. For example, if an application requires current sensing to be in the range of 100 amps DC, an external 100mv shunt must be used. 100mv is required to cause current trip in the external mode. Therefore, a 100 amp-100mv shunt must be employed for this application. Note: Jumper J1 must be in the correct position (120/240), depending on the input voltage to the motor speed control. Jumper J2 must be in the EXT. current sensing position. Jumper J3 can be either in the automatic or manual reset mode. If placed in the manual mode, resetting must be provided each time current trip takes place.

(i) **Internal sensing.** Wire the KBAP in accordance with the following wiring diagram (see Fig. 3).

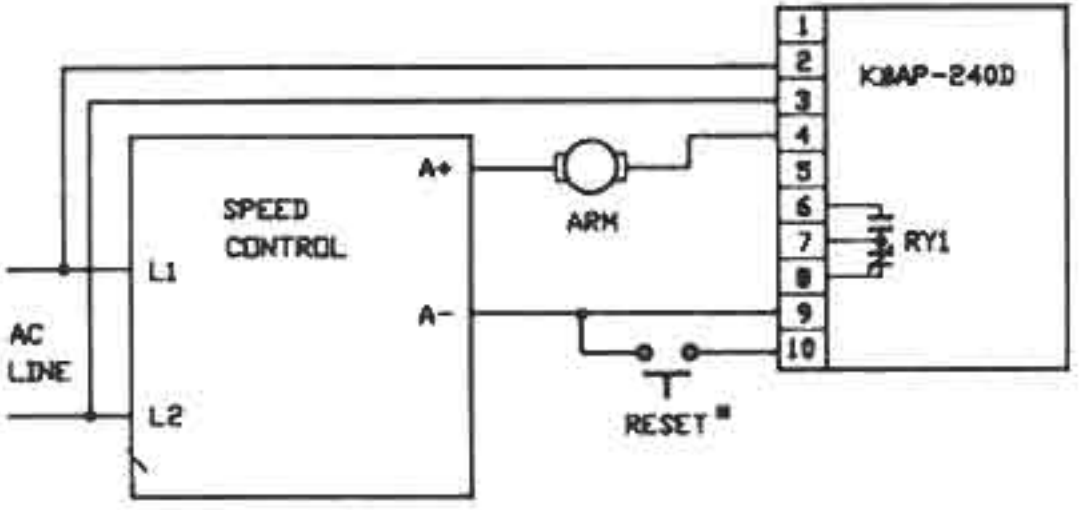


Fig. 3 Internal Sensing

(ii) **External sensing.** Wire the KBAP in accordance with the following wiring diagram (see Fig. 4).

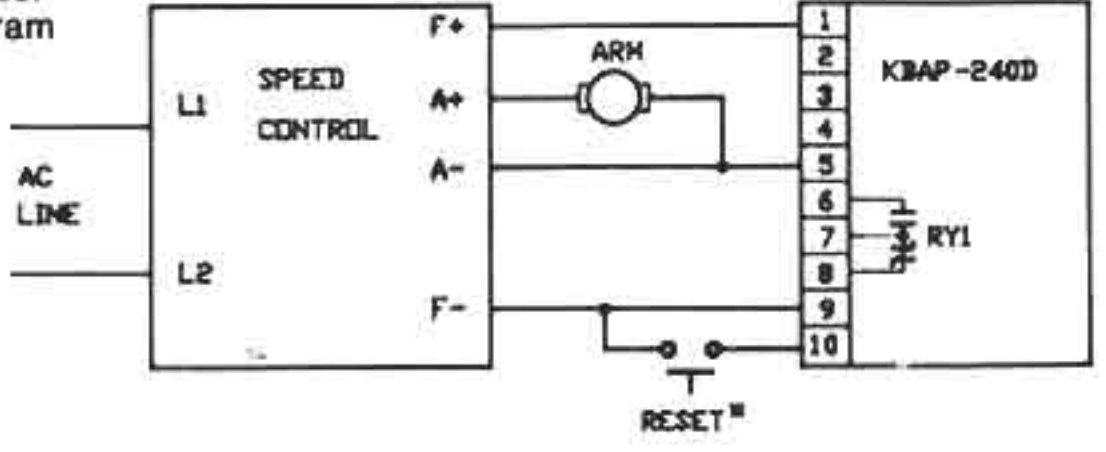


Fig. 4 External Sensing

(iii) **External sensing** *using external shunt.* Connect the KBAP in accordance with the wiring diagram (see Fig. 5).

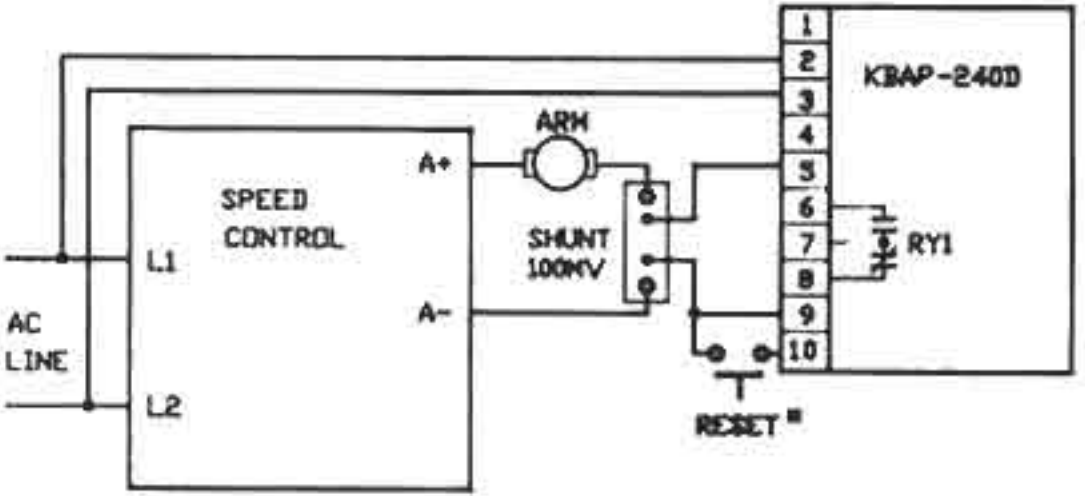


Fig. 5 External Shunt Sensing

(iv) **Wiring of output contacts.** The KBAP contains form C contacts for external switching (see rating in Specifications). These contacts can be wired to an external alarm or shutdown system as required in the application. **They can also be wired directly to the controls inhibit terminals I_1 & I_2 for direct speed control shutdown (J3 should be set in manual reset (MAN) position.** Contacts are shown in wiring diagram (see Fig. 6).

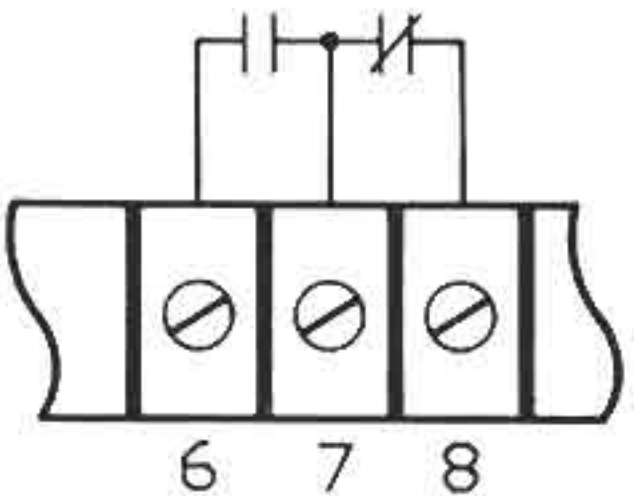


Fig. 6 External Contacts

FACTORY SETTINGS:

Jumpers	Position
J1	240V
J2	10A
J3	AUTO

Trimpots	% Rotation
"CUR"	50%
"TIME"	0%
"HYS"	0%

(C) *JUMPER SELECTIONS.*

(i) **Operating Voltage** *(J1).* Select position "120V" for 120VAC speed control inputs. Select "240V" for 240VAC inputs.

(ii) **Current Trip Point** *(J2).* Select position based on desired current trip point. If the desired trip point is between settings, use the closest value.

(iii) **Manual/Auto Reset** *(J3).* The KBAP-240D can be operated either in the Manual Reset or the Automatic Reset modes.

a) Manual Reset "MAN.": When the sensing current exceeds the trip point value and the delay time (adjustable .2–15 secs.) has been reached, relay contacts (RY1) will trip. When the sensing current drops below the trip point value, the relay contacts will stay tripped until the reset contacts (9,10) are joined momentarily.

b) Automatic Reset "AUTO": When the sensing current exceeds the trip point value and the delay time (adjustable .2–15 secs.) has been reached, the relay contacts (RY1) will trip. When the sensing current drops below the trip point value, the relay contacts will automatically reset (un-trip).

(D) *TRIMPOT ADJUSTMENTS.*

(i) **Current Adjustment** *Trimpot ("CUR ADJ").* This trimpot is used to change the current trip point from the preset value selected with Jumper J2. It has an approximate range of 50%–150% of the preset value.

Note: The factory setting for the "CUR ADJ" is approximately 9 o'clock (this will vary slightly from control to control).

RESETTING THE "CUR ADJ" TRIMPOT

Application Note: Current trip point must be set lower than the current limit set point of the speed control.

a) **Approximate method.** If the application does not require an accurate current trip point, the "approximate method" can be used.

Example: Suppose a 12 A trip point is desired.

1. Set J2 for 10A
2. Rotate the "CUR ADJ" trimpot clockwise (cw) to approximately 11 o'clock (see diagram Fig. 7).

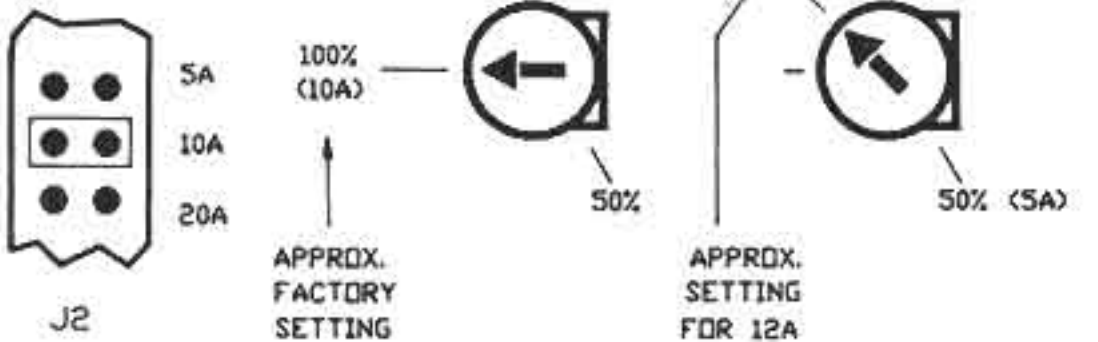


Fig. 7 Current Trip Point Adjustment

b) **Accurate method.** Use this method if the application requires an accurate trip point setting.

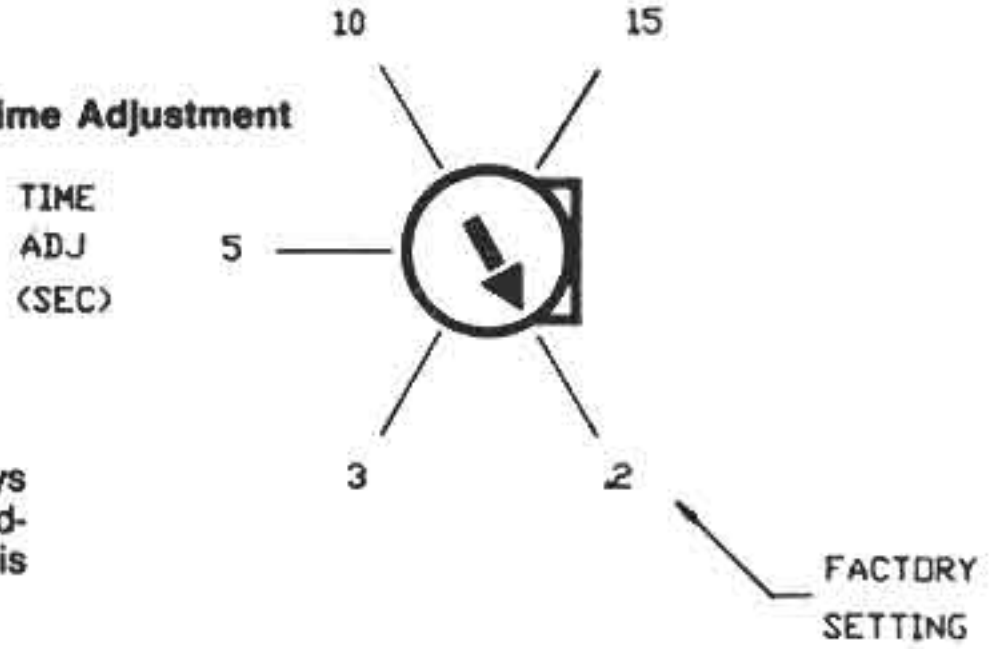
Note: The "TIME ADJ" trimpot must be set to the maximum time during this calibration. Otherwise nuisance time tripping will occur.

1. Set J2 for the closest trip point value.
2. Wire a DC ammeter in series with motor armature.
3. Load motor to desired trip point current.
4. Rotate "CUR ADJ" trimpot counterclockwise until LED just turns on. (If LED is already on when load is applied, then rotate trimpot clockwise (cw) until LED just goes off.)
5. Unit is now calibrated for desired current trip point.

(ii) **Time Adjustment Trimpot** (TIME ADJ.) This trimpot is used to delay tripping of the relay contacts

after the current trip point has been reached. The TIME ADJ range is from .2–15 seconds and is factory set for .2 seconds. For other time settings see diagram below (Fig. 8).

Fig. 8 Time Adjustment



Note: Although the TIME ADJ delays relay tripping, the LED will light immediately when the current trip point is reached.

(iii) **Hysteresis Adjustment** *Trimpot* (HYS). This trimpot is used to control the difference between the pull-in current trip point and the drop-out trip point. It is factory set for approximately .25 amps differential. For example: If the current trip point is set at 10 amps, the relay will activate or pull in at 10.00 amps. The relay will drop out or deactivate at 9.75 amps.

The pull-in and drop-out points can be changed by increasing the HYS setting. Increasing the setting will increase the pull-in set point and decrease the drop-out set point by approximately the same amount. The HYS trimpot has a range of (±) 1.5% to (±) 30%.

For example, if the current trip point is set at 10.0 amps (the relay contacts pull in at 10.00 amps), the drop-out point will be 9.7 amps. If the HYS trimpot is increased to full clockwise rotation, the pull-in set point will increase approximately 30% to 13 amps and the drop-out point will decrease approximately 30% to 7 amps. See Fig. 9 below for trimpot adjustment.

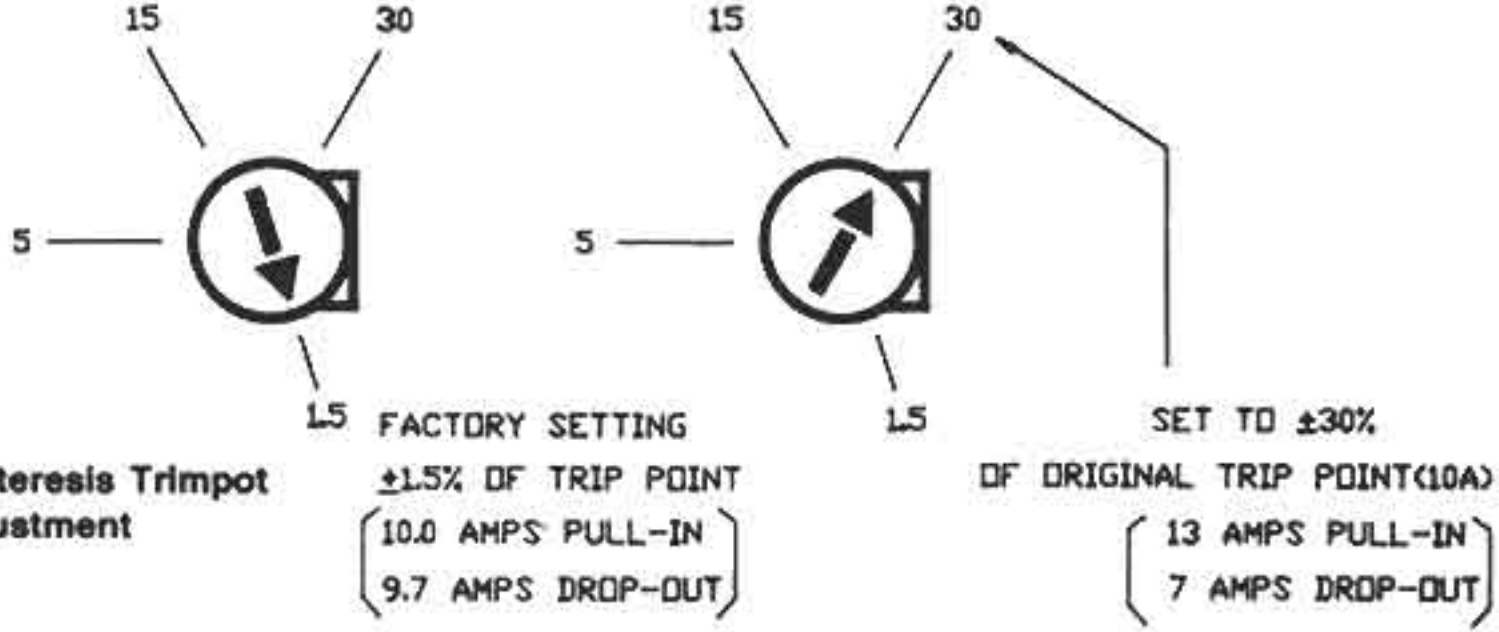


Fig. 9 Hysteresis Trimpot Adjustment

The HYS trimpot can be adjusted between pull-in and drop-out points as required.

(E) *LED INDICATOR.* LED 1 lights when the current trip point level has been reached. It extinguishes when the current drops below the trip point. When the time delay is increased (see TIME ADJ), the relay contact closure is delayed: however, the LED will light instantaneously when the current trip point is reached.

IV. APPLICATION INFORMATION.

(A) Relationship of acceleration start, time adjust, CL setting and current trip point.

(i) **Current Limit** *(CL).* Most speed controls contain an electronic current limit circuit. This limits the maximum current the motor can draw under maximum load. For example, a typical 3/4 HP 90V PM motor has a full load rating of 7.5 amps DC. A typical CL setting would be 11.0 amps which provides for a 50% overload. If a KBAP-240D is wired into the circuit, its setting must be below 11.0 amps DC. If it is set above 11 amps, it can never trip.

Therefore: The setting of the KBAP must always be less than the CL set point.

A typical setting for the KBAP for his application would be between 8 and 10 amps DC which is higher than the full load current and less than the CL set point.

(ii) **Acceleration** *(ACCEL).* Suppose from the above example we have following:

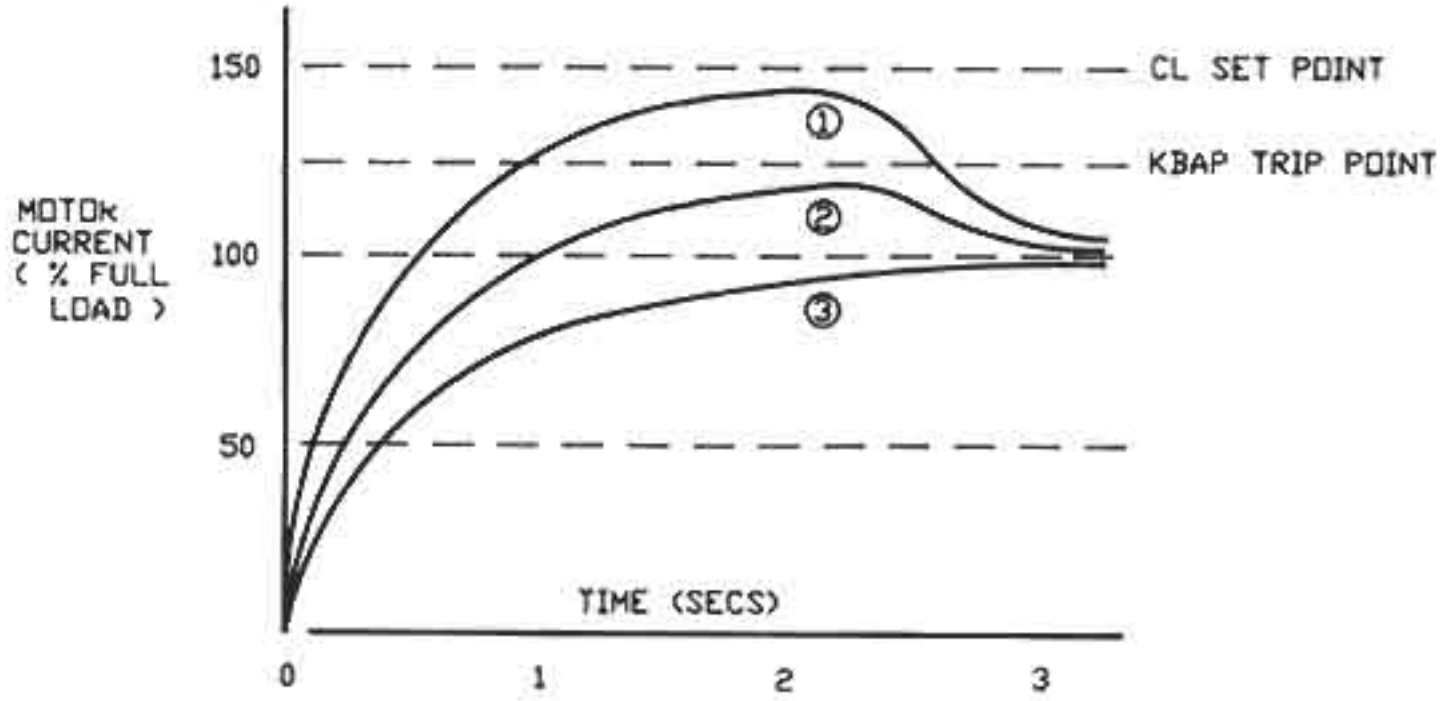
Full load motor amps:	7.5 amps
CL set point:	11.0 amps
KBAP current trip:	9.0 amps

During the startup of a DC motors, the inrush current generally reaches the CL level. If the KBAP Time Delay is not set longer than the time it takes for the startup current to drop below the KBAP trip point, the KBAP will trip during startup.

Therefore: Set the TIME ADJ so that the KBAP delay is greater than the startup time of the motor.

Another way of preventing the KBAP from false tripping during motor startup is to increase the acceleration start (ACCEL) of the speed control. This will usually decrease the motor startup current to a level below the KBAP trip point. See Fig. 10.

Fig. 10 Motor Starting Current vs. Time



1. *Rapid Accel.* Motor current climbs above KBAP set point. KBAP relay will trip unless time delay (TIME ADJ trimpot) is set greater than motor start time.
   Note: In the above example, the TIME ADJ trimpot must be set for (3) seconds or greater in order to avoid nuisance tripping.
2. *Medium Accel.* Motor current climbs to just about KBAP set point. This situation is borderline and may cause nuisance KBAP relay tripping. Avoid this by increasing speed control accel time or KBAP TIME ADJ.

Note: To find out if application is borderline, slightly lower the speed control accel and/or the KBAP TIME ADJ to the point where startup tripping occurs. Then readjust the accel time or KBAP TIME ADJ far beyond this point to avoid startup tripping.

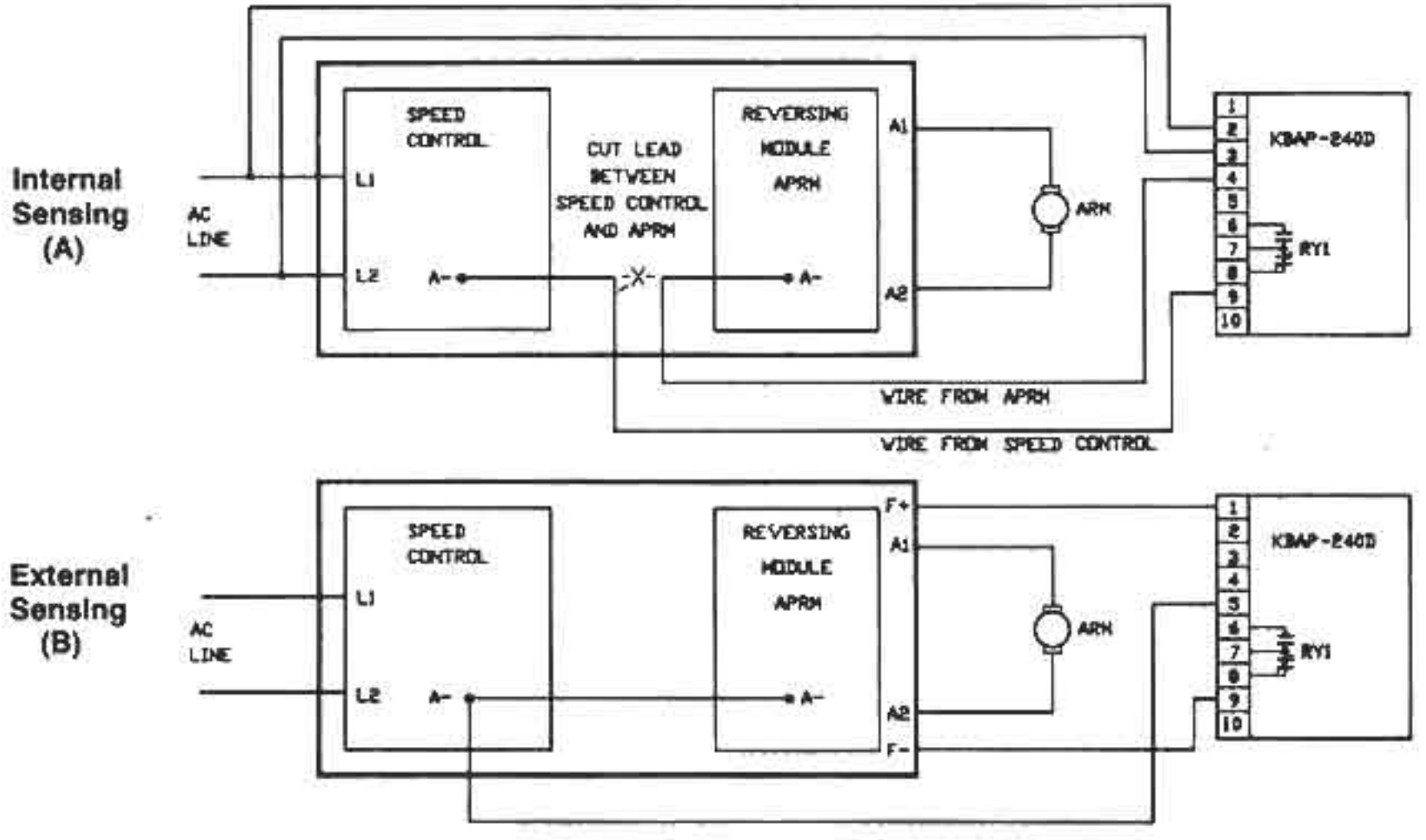
3. Longer accel time prevents high starting current which avoids false tripping of the KBAP.

(iii) **Current Limit** *(CL).* Another way of avoiding startup current tripping is to raise the KBAP current trip point. Since the speed control current limit must be greater than the KBAP set point, the CL level may have to be increased. *Caution* must be exercised when increasing CL since damage to the speed control and motor may occur.

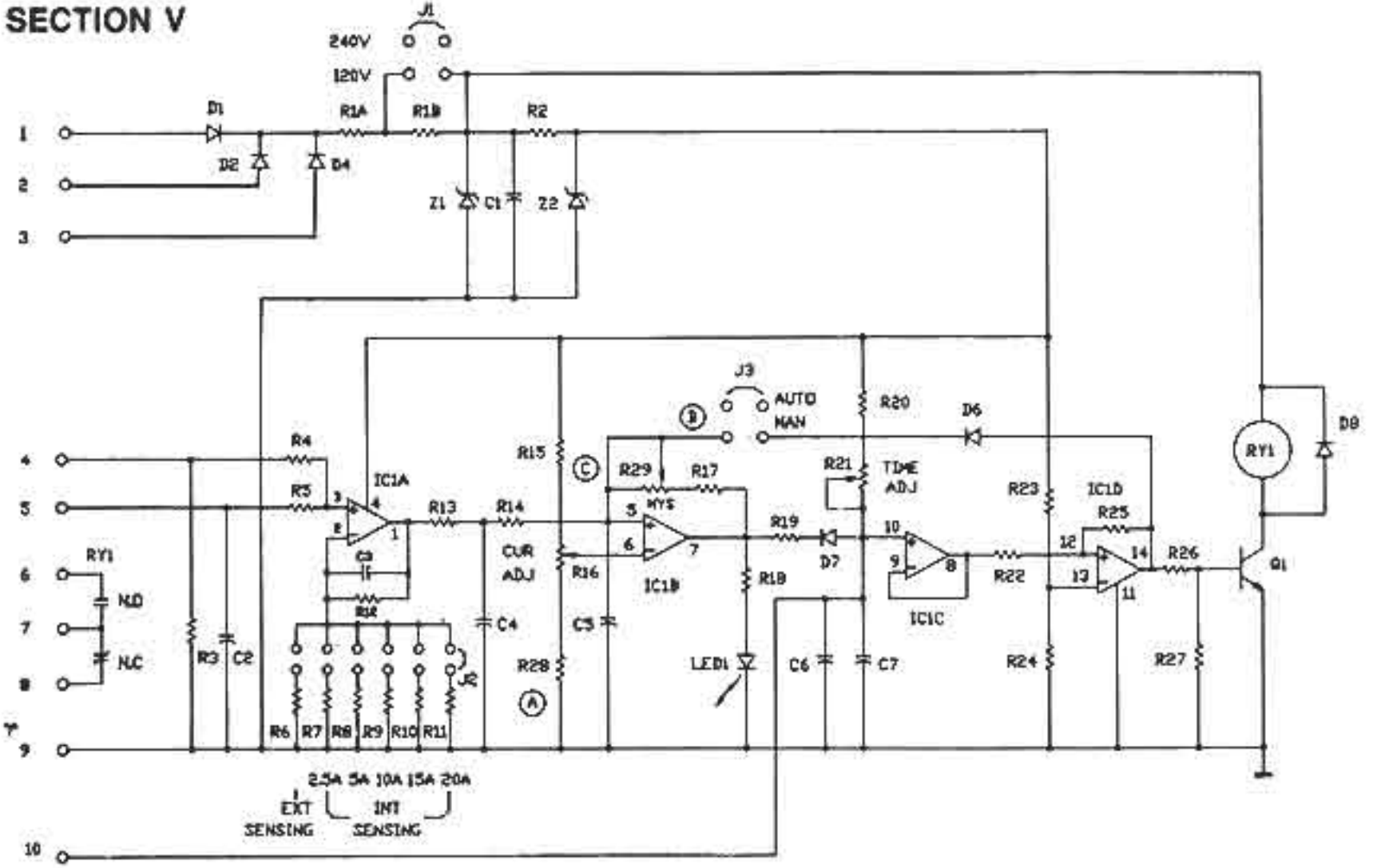
(iv) **Instant Trip with rapid accel time.** Some applications may require the KBAP to "instant trip" on overload and also require rapid acceleration start. This requirement is not compatible with KBAP operation since each time the motor starts, nuisance tripping will occur. To eliminate this tripping on start, a time delay relay (1–2 sec.) can be added with its contacts wired across terminals 9 and 10 of the KBAP. It will reset the KBAP after starting, thereby reducing the nuisance tripping.

(B) *REVERSING APPLICATIONS.* The KBAP set for Internal Sensing (see Fig. 3) is suitable for unidirectional current only. Therefore, reversing controllers utilizing relays or reversing modules *cannot* be connected directly to the KBAP. For these applications the KBAP must be connected between the speed control and reversing module. For external Sensing (see Fig. 4) the KBAP can be connected directly to the reversing control. See Fig. 11 for correct connection diagrams (used for KB Models KBPB and KBCC-R suffix).

Fig. 11 Connections for Reversing Controllers



SECTION V


J1
240V
120V
D1
R1A
R1B
R2
D2
D4
Z1
C1
Z2
J3
AUTO
MAN
R20
D6
D8
RY1
R4
R5
IC1A
R15
R29
R17
HYS
R21
TIME ADJ
R23
IC1D
R25
R13
R14
CUR ADJ
R16
IC1B
R19
D7
R18
IC1C
R22
R26
Q1
RY1
N.O
N.C
C3
R12
C4
C5
R3
C2
R28
LED1
C6
C7
R24
R27
J2
R6
R7
R8
R9
R10
R11
2.5A 5A 10A 15A 20A
EXT SENSING
INT SENSING
1
2
3
4
5
6
7
8
9
10

SEC. VI. Parts List P/N Model KBAP-240D

CKT REF	VALUE/RATING	MFR. TYPE	FUNCTION	PART NO.
C1	100.0 MF-35V	Electrolytic	Capacitor	A13701
C2,4-6	0.01 MF-25V	Ceramic Tubular	Capacitor	A14831
C3	0.1 MF-63V	Mylar	Capacitor	A11110
C7	22.0 MF-35V	Electrolytic	Capacitor	A13365
D1,2,6-8	1A-600V	1N4005GP	Diode	A68016
IC1		LM324N	Quad. Op-Amp	A73004
LED1	35mA, 3mcd (Min)	GI-MV5753	Current Trip Indicator	A74022
Q1	600mA-40V	2N4401	Small Signal Transistor	A71001
R1A,1B	3.9K-3W-5%	MO-3	Resistor	A66755
R2	470 ohm-0.25W-5%	Flameproof	Resistor	A62601
R3	0.006 ohm-5W-5%	Wire Wound	Sensing Resistor	A67009
R4,22	47K-0.25W-5%	Carbon Film	Resistor	A62347
R5,8,14,26	10K-0.25W-5%	Carbon Film	Resistor	A62310
R6,11	30K-0.25W-5%	Carbon Film	Resistor	A62330
R7	3.9K-0.25W-5%	Carbon Film	Resistor	A62239

(Continued)

Parts List P/N Model KBAP-240D (Continued)

CKT REF	VALUE/RATING	MFR. TYPE	FUNCTION	PART NO.
R8	7.5K-0.25W-5%	Carbon Film	Resistor	A62275
R9,15	15K-0.25W-5%	Carbon Film	Resistor	A62315
R10,24	22K-0.25W-5%	Carbon Film	Resistor	A62322
R12	2.2M-0.25W-5%	Carbon Film	Resistor	A62522
R13	100 ohm-0.25W-5%	Carbon Film	Resistor	A62101
R15	15K-0.25W-5%	Carbon Film	Resistor	A62315
R16	25K-0.125W-20%	PTC-10YV	Current Adjust Trimpot	A60614
R17	27K-0.25W-5%	Carbon Film	Resistor	A62327
R18,27	4.7K-0.25W-5%	Carbon Film	Resistor	A62210
R19	1K-0.25W-5%	Carbon Film	Resistor	A62210
R20	3.3K-0.25W-5%	Carbon Film	Resistor	A62233
R21	500K-0.125W-20%	PTC-10YV	Time Adjust Trimpot	A60618
R23	6.8K-0.25W-5%	Carbon Film	Resistor	A62268
R25	1.0M-0.25W-5%	Carbon Film	Resistor	A62510
R28	8.2K-0.25W-5%	Carbon Film	Resistor	A62282
R29	1.0M-0.12W-20%	PTC-10YV	Hysteresis Adj. Trimpot	A60619
RY1	1A-28 VDC; 0.5A-120 VAC	T81C5D111-24(P&B)	SPDT Relay	A77820
Z1	27 V-1W-5%	1N4750A	Zener Diode	A72027
Z2	22 V-1W-5%	1N4748A	Zener Diode	A72022

SECTION VII

LIMITED WARRANTY

For a period of 2 years 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 aforegoing 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.

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