



INSTRUCTION MANUAL
RBA/PC
Resistance Bulb Alarm

No. 193-751-00B

April 2016

1.1 SCOPE OF MANUAL

This manual contains a description, installation and operating instructions, and maintenance instructions for the Resistance Bulb Alarm. To support any maintenance that might be required, a description of the theory of operation is also included, and a list of replaceable parts is given. A list of recommended spares is also included.

1.2 PURPOSE OF EQUIPMENT

The Resistance Bulb Alarm (RBA) provides a signal that will operate an alarm system at a predetermined but adjustable value of DC voltage that is controlled by a temperature-sensitive resistance bulb. The unit can also be supplied to operate the same or separate alarms at two different predetermined and adjustable values of bulb-controlled voltages. As standard equipment, a lamp is supplied on the front panel for each trip point to indicate visually the state (tripped or untripped) of the alarm.

1.3 GENERAL DESCRIPTION

The unit amplifies the applied input signal, adds the adjustable trip-point signal(s), and then uses the composite signal to drive the control amplifier(s). The signal for the external alarm system is produced by the closing or opening of a relay (or relays) controlled by the control amplifier(s). High stability is achieved through the use of feedback in each of the stages other than the control amplifier(s).

1.4 SPECIFICATIONS

The specifications of the RBA are given in Table 1-1.

TABLE 1-1. RBA SPECIFICATIONS

| | |
|------------------------|---|
| <u>INPUT SPANS</u> | RANGE A: 10 ohms change RANGE B: 25 ohms change RANGE C: 100 ohms change RANGE D: 400 ohms change 2 & 3 Wire RTD Only |
| <u>INPUT IMPEDANCE</u> | 1 megohm minimum |
| <u>ZERO ADJUSTMENT</u> | Adjustable $\pm 10\%$ of span, minimum |

TABLE 1-1. RBA SPECIFICATIONS (Cont'd)FRONT PANEL ADJUSTMENTSTRIP POINTS

Multiturn front panel adjustment over a range of 0% to 110% of span

INPUT ZERO

±10% of span (minimum)

OUTPUT

SPDT relay contacts 5 A @ 117 VAC non-inductive or 28 VDC

PERFORMANCEREPEATABILITY

Trip point repeats within ±0.1% full span

DEADBAND

1% of span, standard

AMBIENT TEMPERATURE RANGE

0°F to +150°F (-18°C to +65°C)

AMBIENT TEMPERATURE EFFECT

Less than ±0.01%/°F over above range

RESPONSE

50 milliseconds for a step change of 1% of span beyond set points

ISOLATION

Input, output, and power input are isolated with no DC connections between them. Both AC and DC powered units have this as standard

POWER INPUT24 VDC, 45 VDC, 65 VDC, ±10%
5 watts maximumLINE VOLTAGE EFFECT

±0.005%/1% line change

1.5 MODEL NUMBERING SYSTEM

Model Numbers describe an instrument's type, functional range, and features. If all accompanying documentation of a unit should be missing, one can still "translate" the Model Number back into a working description of the unit by using the information in this paragraph as a guide. The model number may be found on a label attached to the plastic handle.

BASIC EXAMPLE:

RBA/P2W510A/D-XIX3/24DC

RBA, platinum bulb, 2 wires,
510 ohm offset, Range A, dual
trip, output in XIX3 configu-
ration, 24 VDC

BASIC INSTRUMENT TYPE:

RBA Indicates Resistance Bulb Alarm

INPUT:

Type of Resistance Bulb
Number of wires on bulb
Zero offset in ohms
Span range letter

OUTPUT RELAY MODES:

First Letter: S indicates single trip
D indicates dual trip (both
upper and lower trip point)

XIX3: XI indicates that upper trip-
point relay is energized when
input signal is below upper
trip point (fail-safe mode);
standard unless other option
requested

X3 indicates that lower trip-
point relay is energized when
input signal is above lower
trip point (fail-safe mode);
standard unless other option
requested

POWER INPUT:

DC power, 24 VDC $\pm 10\%$ unless stated otherwise,
e.g., 45 VDC, 65 VDC

Table 1-2 lists the option letters in the model number and explains their meanings.

TABLE 1-2. EXPLANATION OF OPTION LETTERS IN MODEL NUMBERS

| | |
|-----|--|
| -AD | Adjustable Deadband |
| -AR | Factory Set Response Time Delay |
| -DD | Downscale Burnout Drive |
| -FU | Fuse Option |
| -HS | Hermetically Sealed Relay Output |
| -MR | Manual Reset - External Pushbutton |
| -RF | RFI Filtered Enclosure For Card Rack |
| -TT | Precision 10-Turn Dial (Trip Point Adjust) |
| -IO | Indicator Output |

INSTALLATION INFORMATION

2.1 GENERAL INSTALLATION INFORMATION

Installation, in general, consists of adjustment (when required), mechanical mounting, and making the electrical connections to the unit. The following paragraphs describe the necessary procedures.

2.2 ADJUSTMENT

Units are checked for proper performance at the factory before they are shipped. However, unless adjustment was requested to a specific trip point (or pair of trip points), the unit should be adjusted by the user before the unit is placed in service.

NOTE

Adjustments should not be made in the field on units that are adjusted at the factory to a value (or values) specified in the purchase order. Units that are adjusted at the factory to customer's specifications have protective caps over the ZERO, UPPER, and LOWER trip point potentiometers; do NOT remove these caps.

A precision decade resistance box (hereafter called simply resistance box with an accuracy within $\pm 0.05\%$ or better) is required for adjustment. In the following procedure, it is assumed that the unit being adjusted is a dual-trip unit (with both upper and lower trip points) and with both upper and lower deadband adjustment options included. If the unit actually being adjusted does not have all these features, simply perform those steps that apply to that particular unit and omit the others. Disassemble the unit to the extent necessary to expose the circuit board so the adjustment potentiometers are accessible. Refer to the appropriate portion of Section 5 for the required procedures, and refer to the assembly drawing near the end of the manual for locations of adjustable potentiometers.

To adjust a unit, proceed as follows:

- a. Connect unit and test equipment as shown in Figure 2-1. Initially turn the trip point, ZERO, and DEADBAND potentiometers fully counterclockwise. If the trip point potentiometers have 10-turn dials (TT option), carefully turn each dial to the desired setting instead of full counterclockwise. It is assumed here that the LOWER trip point dial is set to a number greater than 0 and that the UPPER dial is set to a number less than 100.

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- b. Adjust the resistance box to a value equal to that of the bulb at the temperature of the desired lower trip point.
- c. Apply power to the unit.

NOTE

Refer to paragraph 1.6 for information on how to use the model number to obtain the output configuration.

- d. Refer to Table 2-1 to determine which state of a lamp corresponds to a given state of the associated output section for a given configuration of that section. Turn the ZERO potentiometer clockwise until the lower section of the unit trips, and then turn the potentiometer counter-clockwise until this section just untrips.

TABLE 2-1. OUTPUT STATES VS. OUTPUT CONFIGURATIONS

| OUTPUT | | ALARM STATE | OUTPUT LAMP & (RELAY) STATE |
|---------------|----|-------------|-----------------------------|
| CONFIGURATION | | | |
| UPPER | X1 | TRIPPED | LAMP "OFF" (K1 DEENERGIZED) |
| | | UNTRIPPED | LAMP "ON" (K1 ENERGIZED) |
| | X2 | TRIPPED | LAMP "ON" (ENERGIZED) |
| | | UNTRIPPED | LAMP "OFF" (K1 DEENERGIZED) |
| LOWER | X3 | TRIPPED | LAMP "OFF" (K2 DEENERGIZED) |
| | | UNTRIPPED | LAMP "ON" (K2 ENERGIZED) |
| | X4 | TRIPPED | LAMP "ON" (K2 ENERGIZED) |
| | | UNTRIPPED | LAMP "OFF" (K2 DEENERGIZED) |

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- e. Slowly turn the LOWER trip point potentiometer clockwise until the lower section of the unit just trips.
- f. Check, and readjust if necessary, the ZERO potentiometer by verifying that the lower section of the unit can be tripped and untripped with the LOWER trip point potentiometer. Leave this section of the unit in the tripped condition with the potentiometer adjusted almost, but not quite, fully counterclockwise. If the unit has the TT option, return the LOWER trip point dial to the desired setting, and make sure that this section of the unit is in the tripped condition.
- g. Turn the LOWER DEADBAND potentiometer fully clockwise. Increase the resistance of the resistance box to a value equal to that of the bulb at the temperature of the upper end of the lower deadband, and then slowly turn the LOWER DEADBAND potentiometer counterclockwise until the lower section of the unit returns to the untripped condition.
- h. Recheck the trip and return action of the lower section of the unit with the resistance box set at resistance corresponding to the lower trip point temperature and to the upper end of the lower deadband. Verify that the lower section of the unit trips at the desired lower trip point and exhibits the desired deadband.
- i. Adjust the resistance box to a value equal to that of the bulb at the temperature of the desired upper trip point.
- j. Turn the UPPER trip point potentiometer clockwise until this section of the unit is in the untripped condition, and then slowly turn the potentiometer counterclockwise until this section trips again. If the unit has the TT option, return the UPPER trip point dial to the desired setting, and make sure that this section of the unit is in the tripped condition.
- k. Turn the UPPER DEADBAND potentiometer fully clockwise. Decrease the resistance of the resistance box to a value equal to that of the bulb at the temperature of the lower end of the upper deadband, and then slowly turn the UPPER DEADBAND potentiometer counterclockwise until the upper section of the unit returns to the untripped condition.

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- l. Reread the trip and return action of the upper section of the unit with the resistance box set at resistances corresponding to the upper trip point temperature and to the lower end of the upper deadband. Verify that the upper section of the unit trips at the desired upper trip point and exhibits the desired deadband.
- m. After step (l) has been successfully completed, turn off the power input to the unit and disconnect the resistance box.

2.3 MECHANICAL INSTALLATION

Figure 2-2 shows the outline dimensions and other installation requirements. Be sure to observe the applicable special procedures and precautions given with the illustration. Although the units are designed to operate in free air at quite a high ambient temperature, it is advisable if possible to mount the unit on a surface made of material that can serve as a heat sink. Be sure that the card rack has adequate ventilation.

2.4 ELECTRICAL CONNECTIONS

The electrical connections are made to terminals on the mating connector for the unit. The terminals to be used for the electrical connections are indicated in Figure 2-3. The following paragraphs provide additional information on wiring the unit.

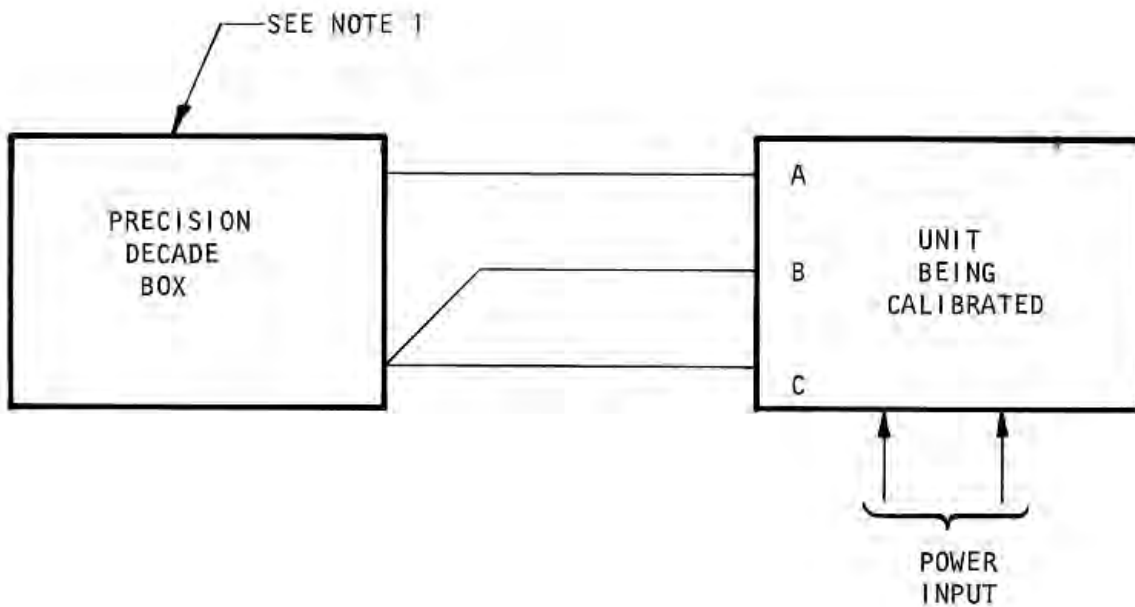
2.4.1 General Wiring Techniques

No special wire or cable is required for signal connections to the unit. To avoid transients and stray pickup, it is recommended that twisted conductors be used where they are run close to other services (such as power wiring). Spade-lug connectors are recommended for all wire terminations. All terminals are supplied with 6-32 screws long enough to easily accept three spade-lug connectors.

2.4.2 Power Connections

Refer to paragraph 1.6 for information on how to use the model number to determine the type of power required.

Terminal 9 is connected to the + (positive) side of the source and terminal 8 is connected to the - (negative) side. The DC source should be regulated to within $\pm 10\%$ of the nominal voltage and should be capable of delivering 3 watts.



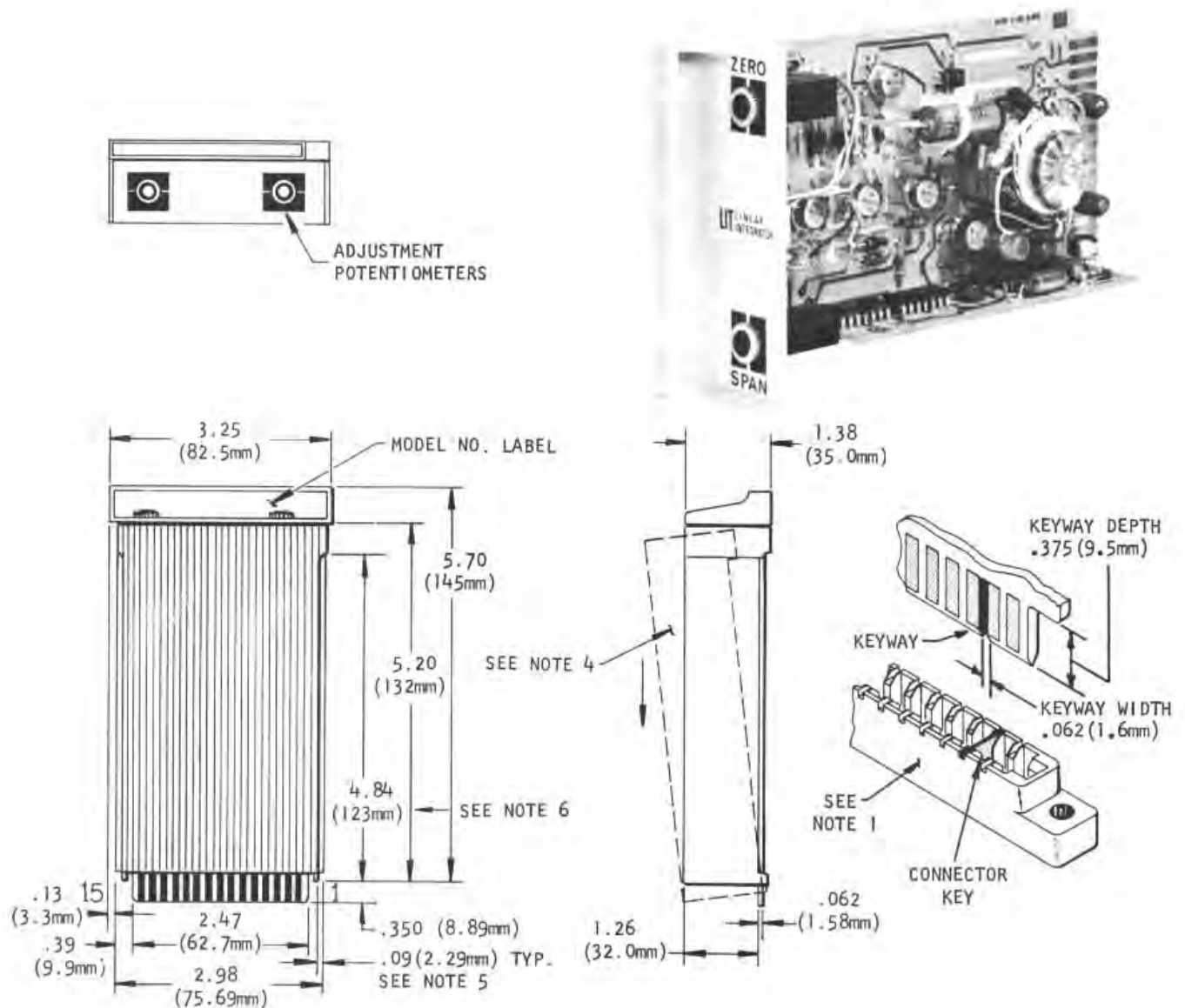
NOTES:

1. DECADE BOX MUST BE ACCURATE TO WITHIN $\pm 0.05\%$ OR BETTER

Figure 2-1. Test equipment Setup For Adjustment Of Unit

SECTION 2

INSTALLATION INFORMATION

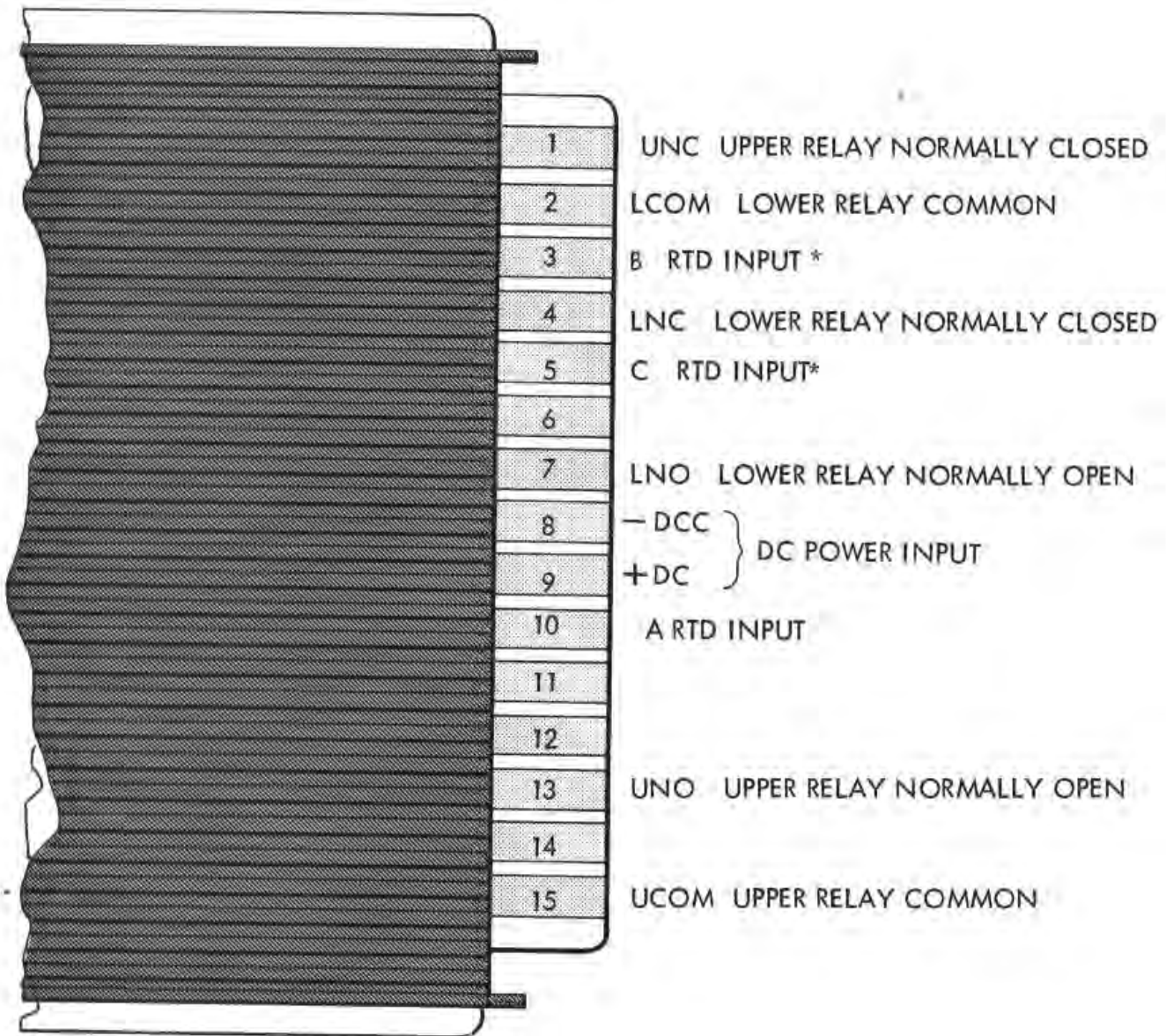


NOTES:

1. Connectors used must have contacts on .156 (3,96mm) centers, with contacts for both surfaces of board (recommended type: Viking part no. 2VK155/1-2).
2. Maximum card insertion depth in connector is .350 (8,89mm).
3. Minimum width of connector insertion slot is 2.470 (62,70mm).
4. Removable plastic safety cover, 2.800 (71,12mm) wide. To remove safety cover, spread forward locking feet and lift front end approximately 1/4 inch; then slide cover to rear to disengage from card. **CAUTION** - DO NOT LIFT FRONT HIGHER THAN 1/4" OR TABS AT CONTACT END WILL BREAK.
5. Maximum card edge-guide insertion depth is .09 (2,29mm). Guides must be non-conductive.
6. Card edge-guides cannot extend beyond here.
7. Card extender part no. 350-513-00 is available for testing transmitter while in operating position

Figure 2-2. Outline and Installation

INSTALLATION INFORMATION



* FOR TWO WIRE RTD INPUT JUMPER PIN 3 TO PIN 5 ON EXTERNAL TERMINAL STRIP

Figure 2-3. Electrical Connections For Plug-In Units

3.1 OPERATING PROCEDURE

Once adjusted and installed, the unit may be operated unattended. The only controls on the outside of the unit are the ZERO and trip point potentiometers which, after initial adjustment, need no further attention. A lamp associated with each output relay is included on the unit as a standard feature. These lamps inform the operator when an alarm condition has occurred. Note carefully, however, that an illuminated lamp does not necessarily indicate an alarm condition, since a relay may be energized either with a normal (non-alarm) input signal (X1 and X3 output configurations, non-fail-safe operation). There are no other indicators on the unit. Because the circuit uses highly reliable solid-state components, except for relays, the unit should operate virtually maintenance-free for a long period of time. However, if a malfunction should occur, refer to Section 5 for maintenance information.

A unit may become warm during operation, especially where the ambient temperature is rather high. This is perfectly normal and should not be a cause for concern unless a malfunction is also observed.

THEORY OF OPERATION**4.1 INTRODUCTION**

This section describes the theory of operation of the unit. The description is based on a unit that has dual trips in the X1, X3 configuration (see main schematic diagram) and two deadband adjustments. If the particular unit supplied does not have all these features, simply disregard those elements of the schematic and the accompanying text that do not apply.

4.2 CIRCUIT DESCRIPTION

The main schematic diagram of the unit is near the end of this manual. Except where otherwise indicated, refer to this diagram when reading the following paragraphs.

4.2.1 Power-Inverter Circuit For Plug-In Unit

In a plug-in unit (RBA schematic diagram), the DC applied to the unit is converted to a square wave of approximately 3 KHz by Q1, Q2, and the primaries of T1, functioning as a DC-to-AC inverter. Filter L1-C3 prevents the 3-KHz signal from getting back into the external DC source. CR8 provides protection against damage from inadvertent application of DC of incorrect polarity. In a unit with the -FU option, fuse F1 protects the inverter from damage that could result from an overload. The square-wave output from center-tapped secondary 8-13 is applied to CR14, CR15, CR16, and CR17. These outputs are filtered by C12, R39, CR12 and C11 to produce a +12V output and C14, R40, CR13 and C13 to produce a -12V output as operating voltages for the unit. A somewhat higher positive voltage (point C) is utilized for operating the output relay(s) and lamp(s). The other secondary of T1 (points D & E) provides AC input to the circuit that develops the DC excitation source for the resistance bulb. (PC2).

4.2.2 Description Of Resistance-Bulb Excitation Source Circuit

The circuit that produces the excitation for the resistance bulb consists of CR201 and an associated filter capacitor, resistors, and zener diodes. The AC voltage supplied to points D and E is applied through R201 to half-wave rectifier CR201. C201 filters the pulsating output from IR201 and the resulting DC voltage is applied through R202 to zener diode CR202 for initial regulation and then through R203 to zener diode CR203 for final regulation to 6.2 volts. This voltage is applied as excitation to the bridge circuit that includes the resistance bulb as one of the legs.

4.2.3 Description Of Lead-Length Compensation And Zero-Adjust Circuit

This circuit is arranged as a bridge with the resistance bulb (including the resistance of leads A and B) and the sum of R208 and the resistance between terminals 3 and 2 of the ZERO potentiometer as one pair of legs, and R205 and the sum of R206 and the resistance between terminals 1 and 2 of the ZERO potentiometer as the other pair of legs. The regulated output across CR203 in the resistance-bulb excitation source is applied to the bridge between the junction of lead C of the bulb and R208 (at lead B, which is connected to lead C at the bulb) and the junction of R205 and R206. The effect of leads A and B of the resistance bulb is cancelled because these leads are connected to opposite sides

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of the bulb. Since lead C is common to both legs of the bridge that are connected to input terminal B, the resistance of lead C has no effect on the operation of the bridge. Thus, complete lead-length compensation of the resistance bulb is accomplished. The ZERO potentiometer modifies the original bulb-determined voltage at the A input terminal so that, with the bulb at minimum resistance, the total voltage at this point will allow the output of the lower section of the unit to just trip when the LOWER trip point potentiometer is turned almost fully counterclockwise. This composite signal (voltage at the A input terminal originally determined by the resistance of the bulb and then modified by the zero-adjust voltage) is applied to input buffer IC2.

4.2.4 Description Of Input Buffer Circuit

The input buffer consists of IC2 and associated components. The stage serves to isolate the input-signal source from later stages in the unit, so adjustments in the value of trip point(s) will not affect the input signal. The composite signal at the A input terminal is applied through R29 and R19 to the non-inverting input (pin 3) of IC2, which is used as a buffer amplifier with sufficient gain and a low output impedance to reliably drive the following stages. C9, R19 and C2 together with IC2, form an active low-pass filter with a very sharp cutoff characteristic to remove any noise or other high-frequency components from the signal applied to IC2. R26 and R16 provide feedback to the inverting input and thus determine the gain of IC2. R16 is selected to establish the gain of IC2 according to the range of variation in bulb resistance. The ± 12 -volt outputs from the power supply are used to power IC2.

4.2.5 Description Of Upper Comparator Circuit

The upper comparator consists of IC3 and associated components. The output from IC2 is applied through UPPER TRIP PT. ADJ potentiometer to the inverting input (pin 2) of IC3. The voltage at pin 3 (non-inverting input) is determined by the setting of the UPPER DEADBAND ADJ. potentiometer. With no input signal, a portion of the -6.2V derived by CR13 is applied to the inverting input. This voltage is inverted by IC3 and therefore CR11 and CR10 are reverse-biased. When the input signal is applied and reaches the upper trip point, the output of IC3 becomes negative. This negative voltage forward-biases CR11 and CR10 thus providing feedback for IC3 and input to the relay driver circuit.

When the applied signal again falls below the upper trip point, the output of IC3 does not immediately return to the original positive state. Since the feedback through CR11 keeps pin 3 less positive than before the output from IC3 remains negative until the input signal from IC2 decreases to a value below that of the signal at pin 3. When this occurs, the output of IC3 returns to its original positive state, thus reverse-biasing CR11. The difference between the value of voltage that forward-biases CR11 then reverse-biases it, is determined by the DEADBAND ADJ.

THEORY OF OPERATION**4.2.6 Description Of Lower Comparator Circuit**

The lower comparator circuit consists of ICI and its associated components. The description of this circuit is the same as the upper comparator circuit described in paragraph 4.2.5.

4.2.7 Description Of Upper Relay Driver

The upper relay driver consists of Q5, Q6 and associated components. With jumper JX1 connected, transistor Q5 is conducting and consequently relay K1 is energized below the upper trip-point level. When the upper trip point is reached by the input signal, Q5 is turned off and K1 becomes deenergized. With jumper JX2 connected Q5 is conducting when the input signal is below the upper trip point. Since Q5 is conducting Q6 is off and consequently relay K1 is deenergized. When the input signal goes above the upper trip point, Q5 is turned off, Q6 is turned on causing K1 to become energized and the upper lamp to illuminate.

4.2.8 Description Of Lower Relay Driver

The lower relay driver consists of Q3 and Q4. The circuit description of the lower relay driver is the same as the upper relay driver described in paragraph 4.2.7.

MAINTENANCE INFORMATION

5.1 INTRODUCTION

This section contains information on maintenance of the unit. General troubleshooting procedures are given, using conventional signal-tracing techniques. Precautions and special techniques used to replace components are also described.

5.2 PERIODIC MAINTENANCE

It is suggested that the adjustment of the unit be checked approximately every 6 months as described in Section 2. No other periodic maintenance is required.

5.3 CORRECTIVE MAINTENANCE

The following paragraphs provide information on corrective maintenance of the unit. Corrective maintenance should be carried out only by qualified personnel who have read and thoroughly understand the description of circuit operation given in Section 4.

5.3.1 Disassembly Of A Plug-In Unit

To remove the cover of a plug-in unit proceed as follows:

- a. Gently spread the forward locking feet and lift the front of the cover NO MORE THAN 1/4 INCH. Excessive force applied to the cover may break the rear retaining clips.
- b. With the front of the cover raised, slide the cover to the rear to disengage it from the plug-in card.

If it is desired to test a plug-in unit in the operating position, a circuit-board extender (Part No. 350-513-00 or equivalent) is required to bring the unit forward so the components on the circuit board are accessible for troubleshooting.

5.3.2 Troubleshooting

The schematic diagram(s) includes flagged numbers at various points in the circuit. Table 5-1 gives the voltages and waveforms at these points for specified input-signal conditions. The assembly drawing(s) shows the physical locations of the parts on the circuit board. Bear in mind that the circuit board is protected with a moisture-resistant coating. Therefore, it may be necessary to use a needle-point probe and exert a fair amount of pressure to break through the coating when it is desired to observe the signal or voltage at a specific point. When connecting a probe to a component on the circuit board, exercise care to make sure the probe does not short-circuit to an adjacent component. In general, troubleshooting is carried out by tracking the signal with an oscilloscope and referring to the schematic diagram(s) to

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determine what component might be causing an observed abnormal indication. If the original symptom was a complete failure of the unit to operate, the most logical components to suspect are those associated with the power supply in the unit (including the voltage regulators). If the unit tripped (or failed to trip) with an applied input that should have produced the opposite condition, check the outputs from the power supply, and, if these are normal, apply a standard input signal and trace the resulting signal through the unit.

5.3.3 Component Replacement Techniques And General Precautions

Replace all defective components with identical parts. Refer to the assembly drawing(s) for a list of replacement parts. The letter S and a number, all enclosed in a circle, appear after the description of certain parts in this list. The number indicates the number of spares recommended to be kept on hand for that part, per unit, for up to ten units of the same type. For more than ten units, a spares complement of 10% on the indicated parts should be used.

Most parts used in the unit are quite small and are located in a confined area. Therefore, small hand tools are a necessity when servicing the unit. The following is a summary of the general techniques and precautions that should be observed to prevent damage to components in the unit:

- a. Use a transformer-operated low-voltage soldering iron with a grounded tip and rated at not more than 50 watts. A temperature-controlled tip is desirable.
- b. Use extreme care when unsoldering the leads to any component. Do not keep the soldering iron on a point for more than a few seconds at a time. Use a suction-type solder-removing tool as an aid in unsoldering transistors and integrated circuits. The protective coating on the unit may be removed with trichlorethane or equivalent. Be sure adequate ventilation is provided when using this or any other chemical.

NOTE

Unused connections on integrated circuits are left unsoldered to aid in removal. Refer to the main assembly drawing for more complete information.

- c. Do not excessively bend or twist the leads of small components; they break easily.
- d. Before removing a component, observe the lead dress. Be sure that the lead dress of the replacement is the same as that of the original.

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- a. Remove all flux from soldered joints with trichlorethane or equivalent.

NOTE

Units that were adjusted at the factory to customer's specifications have protective caps over the UPPER and LOWER trip point potentiometers. These caps must be removed so the unit can be readjusted. LIFT, DO NOT TWIST, the caps off, using a screwdriver tip as a prying tool. Snap the caps back in place, WITHOUT TWISTING, when readjustment has been completed.

- f. Test, and if necessary, adjust the unit for proper operation as follows:

- (1) Connect the unit and test equipment as shown in Figure 2-1, except do not connect the resistance box.
- (2) Apply power input to the unit. Jumper +IN to common and adjust R38 for 0V at pin 6 of IC2. Disconnect jumper and connect resistance box.
- (3) For a unit without a 10-turn dial (no TT option), adjust the resistance box to a value equal to that of the bulb at the temperature of the lower trip point. For a unit with one or two 10-turn dials (TT option), adjust the resistance box to a value slightly higher than that of the bulb at its lowest specified operating temperature; note that this temperature will, in general, be lower than that of the desired lower trip point. If the unit does not have the TT option, continue by performing step (d) and the following steps in paragraph 2.2. If the unit does have the TT option, continue with step (4) in the present paragraph.

NOTE

Adjust the sealed potentiometers only if required to obtain the specified results.

- (4) Set the LOWER trip point dial to exactly 0. From a higher value, adjust the resistance box to a value equal to that of the bulb at its lowest specified operating temperature. If the lower section of the unit is now in the untripped condition, adjust ZERO potentiometer until lower section just trips.

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NOTE

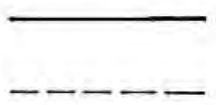
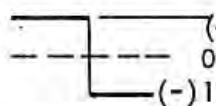
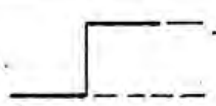
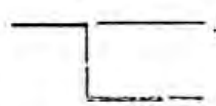
If the field selected resistor (FSR) does not allow for sufficient adjustment of the ZERO potentiometer proceed as follows:

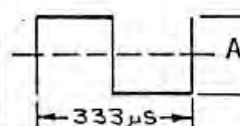
- (1) Replace FSR with new FSR. Install Bourns switching device on FSR.
- (2) Set ZERO potentiometer to mid-range. Apply 0% Input to the Input terminals.
- (3) Set Bourns switching device for the exact resistance to read 0% at pin 6 of IC2.
- (4) When the exact value of resistance has been determined note the resistance of the FSR selected by the switching device. Apply solder to the appropriate pads and their adjacent collectors.
- (5) Slowly increase the resistance of the resistance box until the lower section of the unit just untrips, and note the value on the resistance box. Slowly decrease the resistance of the resistance box until the lower section of the unit just trips again. The difference in values of the resistance box at which the lower section of the unit untrips and trips must be not more than 1% of the maximum resistance span for the bulb range over which unit may be used. In addition, the trip and untrip resistances on the resistance box must each repeat within $\pm 0.1\%$ of this same resistance span when the procedure is repeated. Make sure that the lower section of the unit is in the tripped condition with the resistance of the resistance box set to that of the bulb at its lowest specified operating temperature.
- (6) Turn the LOWER DEADBAND potentiometer fully clockwise, and then slowly increase the resistance of the resistance box until the lower section of the unit just untrips. The resistance at which this occurs must be higher than the trip value in step (5) by not less than 20% of the maximum bulb-resistance span.
- (7) If necessary, repeat steps (4), (5), and (6) to make sure that all specified conditions are met.

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- (8) Set LOWER trip point dial to 100. From a higher value, decrease the input to exactly the 100% value. If the lower section of the unit is now in the untripped condition, adjust R8 until the lower section just trips.
 - (9) Set the UPPER trip point dial to 100. From a lower value, increase the input to exactly the 100% value. If the upper section of the unit is not tripped, adjust R37 until the upper section just trips.
 - (10) Slowly decrease the resistance of the resistance box until the upper section of the unit just untrips, and note the value on the resistance box. Slowly increase the resistance of the resistance box until the upper section of the unit just trips again. The difference in values of the resistance box at which the upper section of the unit untrips and trips must be not more than 1% of the maximum resistance span for the bulb range over which the unit may be used. In addition, the trip and untrip resistances on the resistance box must each repeat within $\pm 0.1\%$ of this same resistance span when the procedure is repeated. Make sure that the upper section of the unit is in the tripped condition with the resistance of the resistance box set to that of the bulb at the highest specified operating temperature.
 - (11) Turn the UPPER DEADBAND potentiometer fully clockwise, and then slowly decrease the resistance of the resistance box until the upper section of the unit just untrips. The resistance at which this occurs must be lower than the trip value in (10) by not less than 20% of the maximum bulb-resistance span.
 - (12) If necessary, repeat steps (9), (10), and (11) to make sure that all specified conditions are met.
- g. When proper operation of the unit has been verified as in step (f), readjust the unit by the procedure given in Section 2. When the performance of the unit is known to be satisfactory, apply clear acrylic to reseal the unit where required.

TABLE 5-1. WAVE FORMS AND AMPLITUDE

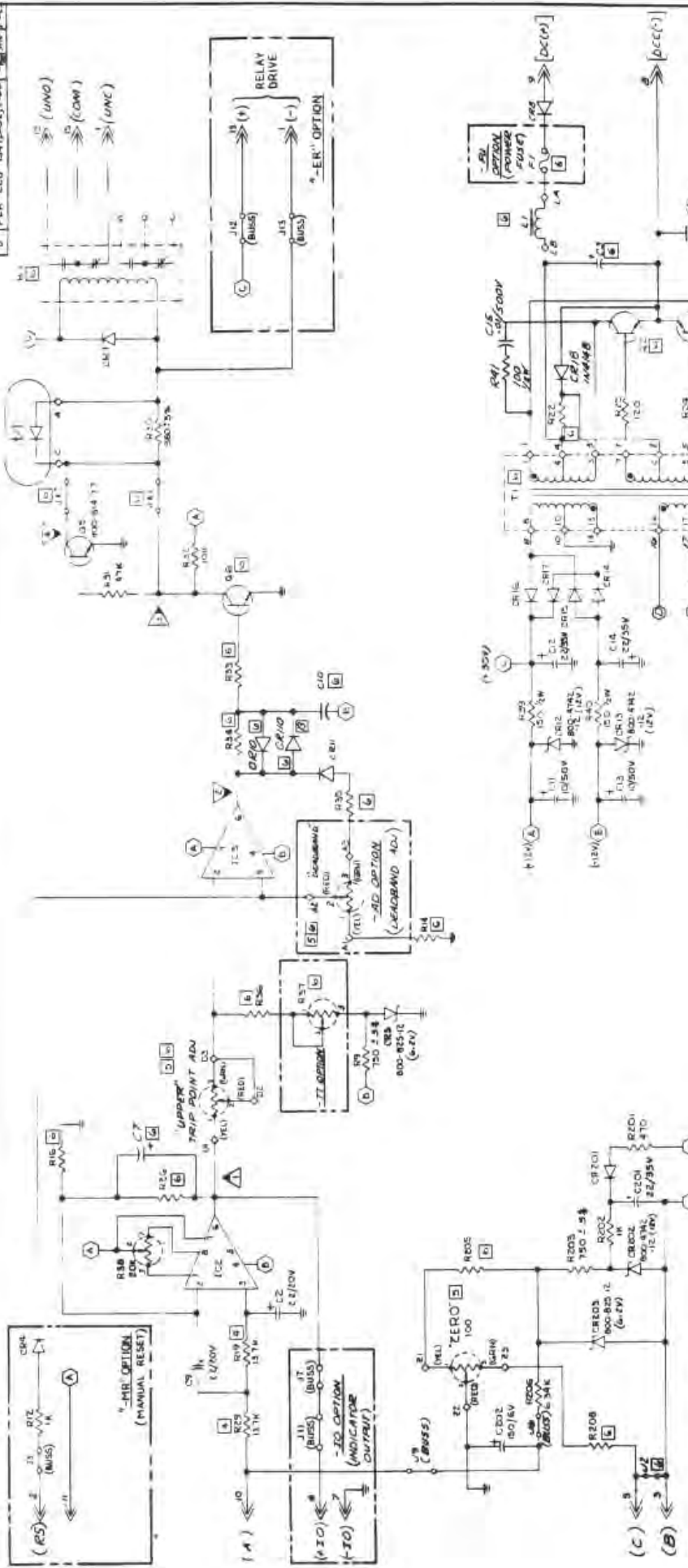
| TEST POINT | WAVE FORM AND AMPLITUDE OR VOLTAGE LEVEL |
|------------|---|
| 1 |  <p>0 TO 1V DEPENDING ON INPUT 0V</p> |
| 2,5* |  <p>(+) 10V INPUT LESS THAN SET POINT 0 (-) 10V INPUT GREATER THAN SET POINT</p> |
| 3,6* |  <p>+6V (X2), +20V (X1) (X4)*, (X3)* 0</p> |
| 4,7* |  <p>+20V (X2), (X4)* 0</p> |

| POWER INPUT | | | | |
|-------------|--|-------------------------------------|-------|-------|
| TEST POINT | WAVE FORM | POWER INPUT AND WAVE FORM AMPLITUDE | | |
| | | 24VDC | 45VDC | 65VDC |
| A |  <p>A 333μs</p> | 48V | 90V | 130V |

* WAVE FORMS 5, 6, & 7 ARE FOR DUAL TRIP UNITS ONLY

REVISION E&F STD A P-1

WYPER CAME (100)



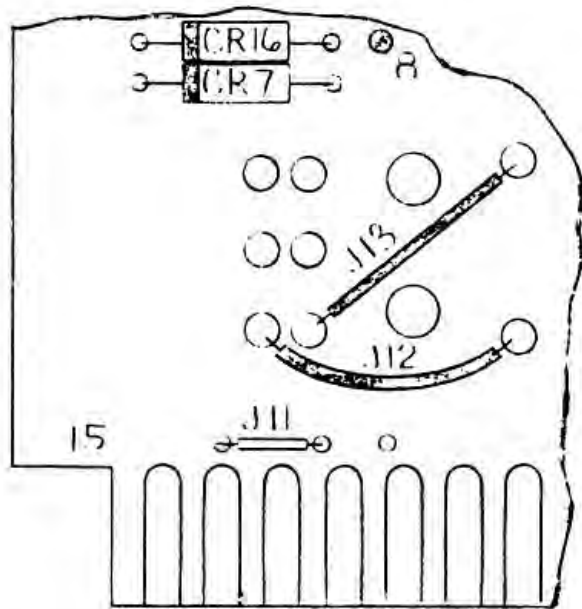
13. CR10 IS ORD. MTD. IN RETIREE.
14. ○ INDICATES ELECTRICAL COMMONS (SAME LETTERS).
 LETTERS ARE NOT ON P.C. BOARD OR ASSY DWG.
15. ↓ INDICATES CIRCUIT COMMON (GROUND).
16. ○ INDICATES IDENTIFIED WIRING PAD ON P.C. BOARD.
17. ◊ INDICATES CONNECTOR PIN POSITION (15 PIN).
18. ● TEST POINTS, FILLED END IS POINTER REFER TO SECTION 3 OF MANUAL, "MAINTENANCE."
19. SEE LIST OF MATERIALS FOR VALUE, USAGE AND P/N.
20. ITEMS NOT MOUNTED ON P.C. BOARD.
21. METAL FILM RESISTOR 11%.
22. ALL POTENTIOMETERS INCREASE C.W. FROM 1 TO 3.
23. IC 2 IS M.I.L. PN 801-B(16-3), IC 3 IS 800-RES-3(16) DIODES ARE 800-RES-1(16) RESISTORS ARE CARB. COMP. 1% TOL. 1%.
24. RESISTANCE IN OHMS; CAPACITANCE IN MICROFARADS.
- NOTE: UNLESS OTHERWISE SPECIFIED

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SCHEMATIC
 SINGLE PLUG-IN
 RBA

193-451-000

| REV | DESCRIPTION | DATE | BY | APPR |
|-----|-------------|------|----|------|
|-----|-------------|------|----|------|



MOUNTING OF J12 & J13

NOTES: UNLESS OTHERWISE SPECIFIED

TOLS UNLESS NOTED:
 X = ±.10
 XX = ±.030
 XXX = ±.010
 ANGLES = ± 30°
 HOLES = +.002 -001

| | | |
|-------------|---------|--------|
| DRAWN | T. HART | 213-76 |
| CHECKED | | |
| PROJ. ENGR. | | |
| CUSTMR | | |

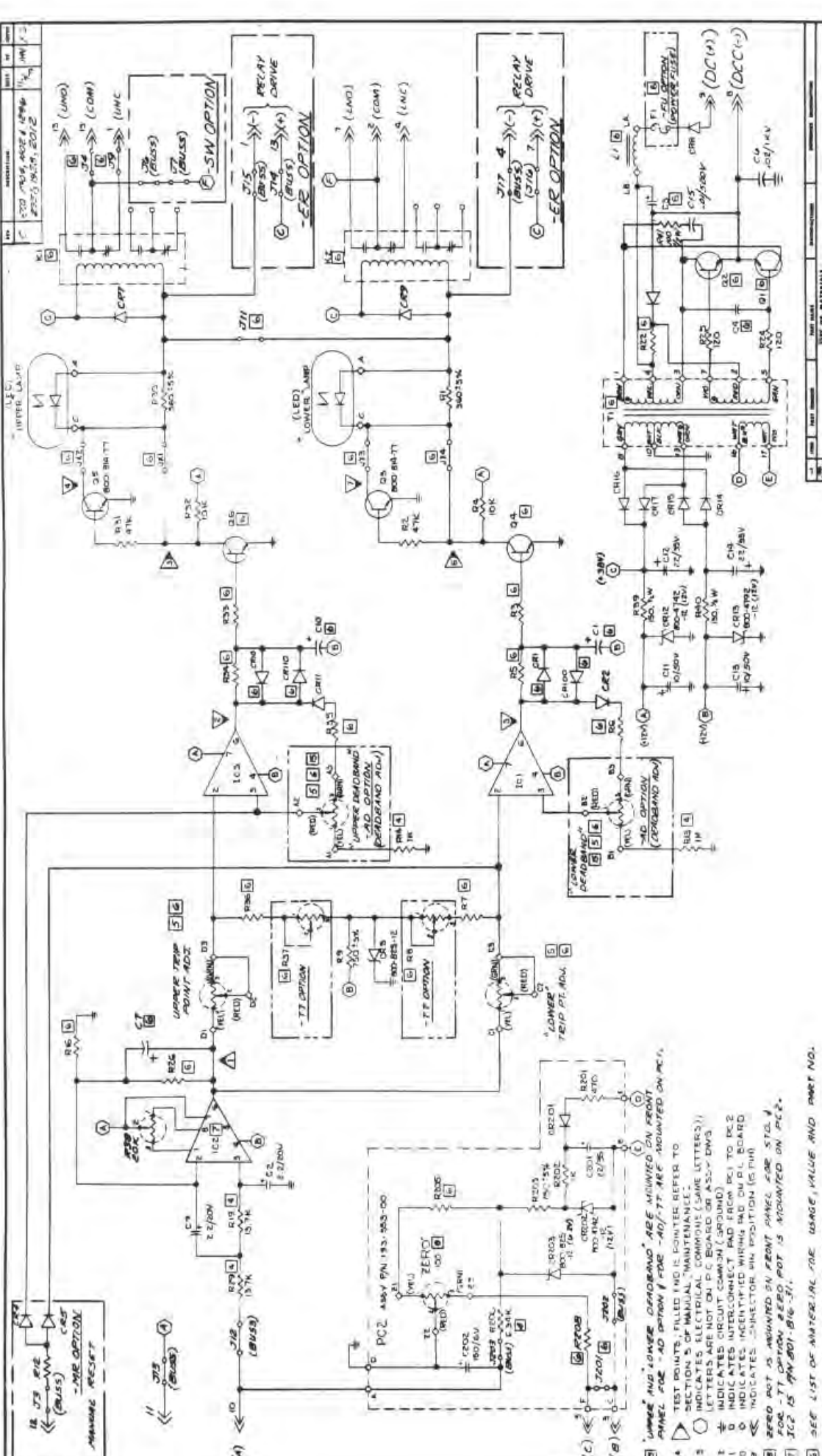
MOORE INDUSTRIES INC.
 SEPULVEDA ■ CALIF.

P.C. BOARD ASSEMBLY
 PLUG-IN RBA SINGLE

DO NOT SCALE
 DRAWING
 SCALE: 2/1

DWG. NO. 193-551-00 REV. D

| | | | |
|-----|----------|----|-----|
| REV | DATE | BY | CHK |
| 1 | 10/15/64 | WJ | WJ |
| 2 | 11/10/64 | WJ | WJ |



| | | | |
|-----|----------|----|-----|
| REV | DATE | BY | CHK |
| 1 | 10/15/64 | WJ | WJ |
| 2 | 11/10/64 | WJ | WJ |

SCHEMATIC
PLUG-IN DUAL
RBA

193-452-00C

193

SEE LIST OF MATERIAL FOR USAGE, VALUE AND PART NO.

ITEMS NOT MOUNTED ON PL BOARD

METAL FILM RESISTOR, 1/4W

ALL POTENTIOMETERS INCREASE CW FROM 1 TO 5.

ALL INTD CKTS ARE WALL PIN 800-B5C-31. DIODES ARE 800-448-117. RESISTORS ARE CARB. COMB. 1/4W 100W.

RESISTANCE W OHMS (CAPACITANCE IN MICROFARADS).

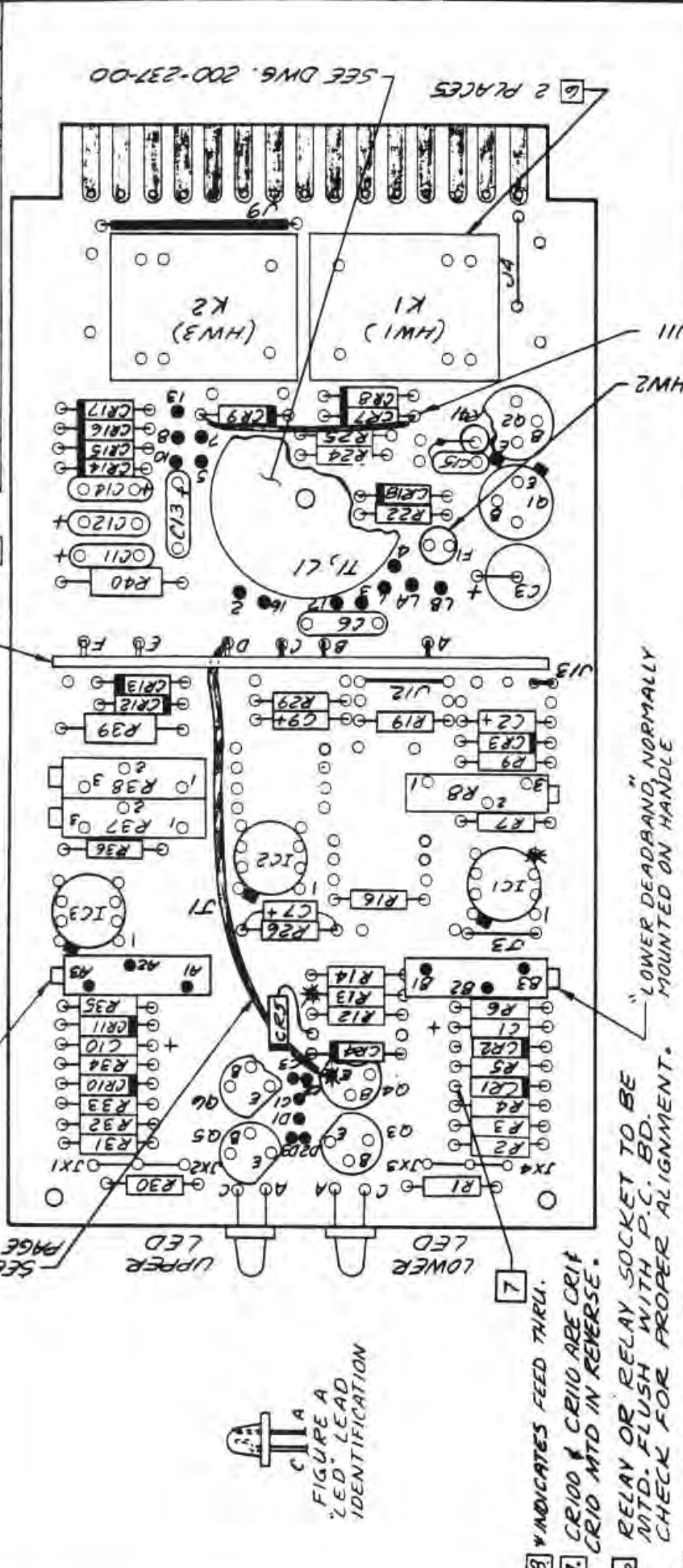
NOTES: UNLESS OTHERWISE SPECIFIED

- 1. UPPER AND LOWER DEADBANDS ARE MOUNTED ON FRONT PANEL FOR -AD OPTION 1 FDBE -AD-77. REC ADJUSTED ON PC1.
- 2. TEST POINTS, FILLED AND OPEN CIRCLES REFER TO SECTION 5 OF MANUAL "MAINTENANCE".
- 3. INDICATES ELECTRICAL COMMONS (SAME LETTERS). LETTERS ARE NOT ON PC BOARD OR ASSY DWG.
- 4. INDICATES CIRCUIT COMMON (GROUND).
- 5. INDICATES INTERCONNECT PAD FROM PC1 TO PC2.
- 6. INDICATES IDENTIFIED WIRING HAD ON THE BOARD.
- 7. INDICATES DIRECTOR IN POSITION (STW).
- 8. ZERO POT IS MOUNTED ON FRONT PANEL FOR STD 1 FOR -7T OPTION ZERO POT IS MOUNTED ON PC2. IC2 IS PN 801-916-31.
- 9. SEE LIST OF MATERIAL FOR USAGE, VALUE AND PART NO.
- 10. ITEMS NOT MOUNTED ON PL BOARD.
- 11. METAL FILM RESISTOR, 1/4W.
- 12. ALL POTENTIOMETERS INCREASE CW FROM 1 TO 5.
- 13. ALL INTD CKTS ARE WALL PIN 800-B5C-31. DIODES ARE 800-448-117. RESISTORS ARE CARB. COMB. 1/4W 100W.
- 14. RESISTANCE W OHMS (CAPACITANCE IN MICROFARADS).

| REV. | DESCRIPTION | DATE | BY | APPROV. |
|------|--------------------------|---------|-----|---------|
| C | ECO 193, 251, 193B, 201Z | 1/24/74 | JAN | JAN |

PC2 5

UPPER DEADBAND, NORMALLY MOUNTED ON HANDLE



LOWER DEADBAND, NORMALLY MOUNTED ON HANDLE

| | |
|---|---|
| MOORE INDUSTRIES INC. VAN NUYS • CALIF. | 193-552-00C PAGE 1 OF 2 |
| PC BOARD ASSEMBLY PLUG-IN RBA DUAL TRIP (DC POWERED) | DO NOT SCALE DRAWING SCALE 2:1 JOB NO 193 |
| REFERENCE DESIGNATION | MANUFACTURER |
| PART NAME | LIST OF MATERIALS |
| PART NUMBER | 9-2978 |
| ITEM | NO. UNLESS NOTED |
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| 100 | 100 |

- 1. ALL JUMPERS ARE 22 AWG BUSS, TEFLON SLEEVED AS REQ'D.
- 2. ALL LEADS & TERMINALS MUST BE SOLDERED TO PADS.
- 3. CLIP OFF UPPER HALF OF F-PIN AND SOLDER JUMPER TO PAD ON PC2.
- 4. PC2 TO STAND 1/16" OFF PCI.
- 5. RELAY OR RELAY SOCKET TO BE MTD. FLUSH WITH P.C. BD. CHECK FOR PROPER ALIGNMENT.
- 6. * INDICATES FEED THRU.
- 7. CR100 & CR110 ARE ORIF. CR10 MTD IN REVERSE.
- 8. UPPER DEADBAND, NORMALLY MOUNTED ON HANDLE
- 9. LOWER DEADBAND, NORMALLY MOUNTED ON HANDLE

SEE PAGE 2

UPPER LED

LOWER LED

FIGURE A "LED" LEAD IDENTIFICATION

SEE DWG. 200-237-00

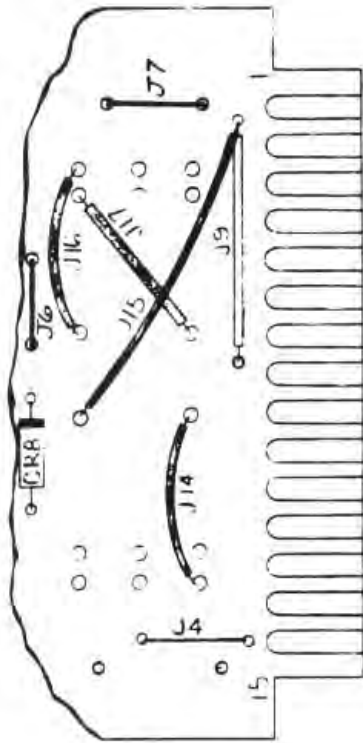
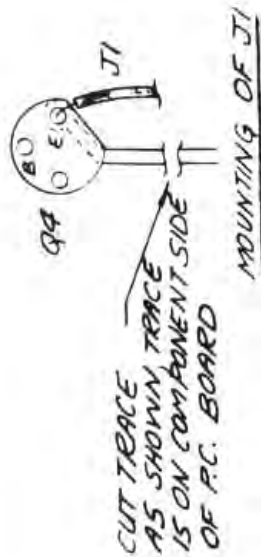
2 PLACES

SCALE 2:1

MOORE INDUSTRIES INC.
VAN NUYS • CALIF.

193-552-00C
PAGE 1 OF 2

NOTES-UNLESS OTHERWISE SPECIFIED:

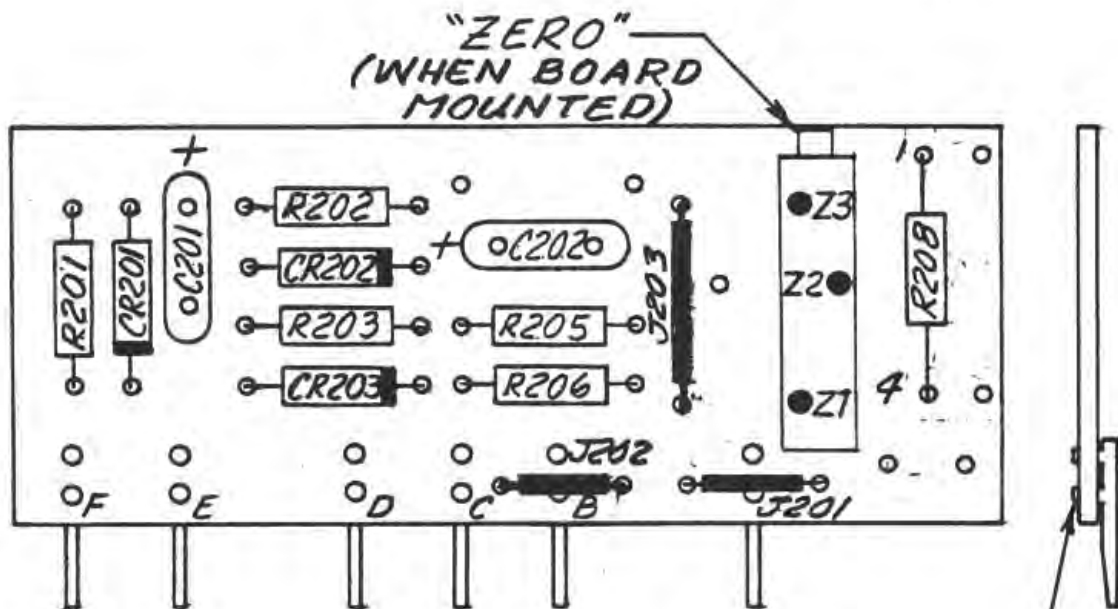


MOUNTING OF J14, J15, J16, & J17

| ITEM NO | PART NUMBER | PART NAME | MANUFACTURER | REFERENCE DESIGNATION |
|---------|-------------|--|---|-----------------------------------|
| | | LIST OF MATERIALS | | |
| | | P.C. BOARD ASSEMBLY PLUG-IN RBA DUAL TRIP D.C. POWERED DO NOT SCALE DRAWING SCALE 2/1 FOR NO 192 | MOORE INDUSTRIES INC. VAN NUYS - CALIF. | 193-552-00C PAGE 2 OF 2 |
| | | THIS UNLESS NOTED N ± .1 XX ± .03 ZM ± .010 ANGLES ± 30° FINISH | DRAWN CHECKED PROJ ENGR CUST | |
| | | NEXT ASSEMBLY ON FILE | | |

NOTES. UNLESS OTHERWISE SPECIFIED

| REV. | DESCRIPTION | DATE | BY | APPROV. |
|------|-------------|--------|-----|-------------|
| B | ECO 1904 | 4/8/73 | JVN | [Signature] |



HW201-
HW206

REMOVE EXCESS
TYP. 6 PLCS

3. NEXT ASS'Y - 193-552-00.
2. ALL LEADS & TERMINALS MUST BE SOLDERED TO PADS.
1. JUMPERS ARE 22 AWG BUSS, TEFLON SLEEVED AS REQ'D.

NOTES - UNLESS OTHERWISE SPECIFIED:

| | | | | |
|---|----------------------|-------------|---------|---|
| DIMENSIONS ARE IN INCHES UNLESS NOTED OTHERWISE | DRAWN | R. Kelley | 10/2/73 | MOORE INDUSTRIES INC. VAN NUYS ■ CA. |
| | CHECKED | C. Fiedler | 5/22/74 | |
| TOLS. UNLESS NOTED: .X = ±.10 .XX = ±.030 .XXX = ±.010 ANGLES = ± 30' | PROJ. ENGR. | [Signature] | | P.C. BOARD ASSEMBLY, PLUG-IN RBA PC2 - DUAL TRIP |
| | DO NOT SCALE DRAWING | | | |
| SCALE: 2:1 | CUSTMR. | | | DWG. NO. 193-553-00 |
| | | | | REV. B |

RETURN PROCEDURES

To return equipment to Moore Industries for repair, follow these four steps:

1. Call Moore Industries and request a Returned Material Authorization (RMA) number.

Warranty Repair –

If you are unsure if your unit is still under warranty, we can use the unit's serial number to verify the warranty status for you over the phone. Be sure to include the RMA number on all documentation.

Non-Warranty Repair –

If your unit is out of warranty, be prepared to give us a Purchase Order number when you call. In most cases, we will be able to quote you the repair costs at that time. The repair price you are quoted will be a "Not To Exceed" price, which means that the actual repair costs may be less than the quote. Be sure to include the RMA number on all documentation.

2. Provide us with the following documentation:
 - a) A note listing the symptoms that indicate the unit needs repair
 - b) Complete shipping information for return of the equipment after repair
 - c) The name and phone number of the person to contact if questions arise at the factory
3. Use sufficient packing material and carefully pack the equipment in a sturdy shipping container.
4. Ship the equipment to the Moore Industries location nearest you.

The returned equipment will be inspected and tested at the factory. A Moore Industries representative will contact the person designated on your documentation if more information is needed. The repaired equipment, or its replacement, will be returned to you in accordance with the shipping instructions furnished in your documentation.

WARRANTY DISCLAIMER

THE COMPANY MAKES NO EXPRESS, IMPLIED OR STATUTORY WARRANTIES (INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE) WITH RESPECT TO ANY GOODS OR SERVICES SOLD BY THE COMPANY. THE COMPANY DISCLAIMS ALL WARRANTIES ARISING FROM ANY COURSE OF DEALING OR TRADE USAGE, AND ANY BUYER OF GOODS OR SERVICES FROM THE COMPANY ACKNOWLEDGES THAT THERE ARE NO WARRANTIES IMPLIED BY CUSTOM OR USAGE IN THE TRADE OF THE BUYER AND OF THE COMPANY, AND THAT ANY PRIOR DEALINGS OF THE BUYER WITH THE COMPANY DO NOT IMPLY THAT THE COMPANY WARRANTS THE GOODS OR SERVICES IN ANY WAY.

ANY BUYER OF GOODS OR SERVICES FROM THE COMPANY AGREES WITH THE COMPANY THAT THE SOLE AND EXCLUSIVE REMEDIES FOR BREACH OF ANY WARRANTY CONCERNING THE GOODS OR SERVICES SHALL BE FOR THE COMPANY, AT ITS OPTION, TO REPAIR OR REPLACE THE GOODS OR SERVICES OR REFUND THE PURCHASE PRICE. THE COMPANY SHALL IN NO EVENT BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES EVEN IF THE COMPANY FAILS IN ANY ATTEMPT TO REMEDY DEFECTS IN THE GOODS OR SERVICES. BUT IN SUCH CASE THE BUYER SHALL BE ENTITLED TO NO MORE THAN A REFUND OF ALL MONIES PAID TO THE COMPANY BY THE BUYER FOR PURCHASE OF THE GOODS OR SERVICES.

ANY CAUSE OF ACTION FOR BREACH OF ANY WARRANTY BY THE COMPANY SHALL BE BARRED UNLESS THE COMPANY RECEIVES FROM THE BUYER A WRITTEN NOTICE OF THE ALLEGED DEFECT OR BREACH WITHIN TEN DAYS FROM THE EARLIEST DATE ON WHICH THE BUYER COULD REASONABLY HAVE DISCOVERED THE ALLEGED DEFECT OR BREACH, AND NO ACTION FOR THE BREACH OF ANY WARRANTY SHALL BE COMMENCED BY THE BUYER ANY LATER THAN TWELVE MONTHS FROM THE EARLIEST DATE ON WHICH THE BUYER COULD REASONABLY HAVE DISCOVERED THE ALLEGED DEFECT OR BREACH.

RETURN POLICY

For a period of thirty-six (36) months from the date of shipment, and under normal conditions of use and service, Moore Industries ("The Company") will at its option replace, repair or refund the purchase price for any of its manufactured products found, upon return to the Company (transportation charges prepaid and otherwise in accordance with the return procedures established by The Company), to be defective in material or workmanship. This policy extends to the original Buyer only and not to Buyer's customers or the users of Buyer's products, unless Buyer is an engineering contractor in which case the policy shall extend to Buyer's immediate customer only. This policy shall not apply if the product has been subject to alteration, misuse, accident, neglect or improper application, installation, or operation. THE COMPANY SHALL IN NO EVENT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.



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