MOORE INDUSTRIES

EP-RBX

Extended Performance
Resistance Bulb Transmitter

USER'S MANUAL

April 2016

149-714-00 D

Table of Contents

Introduction

The EP-RBX is an extended-performance, resistance bulb transmitter. It is used to convert input from a two- or three- wire resistance/temperature detector (RTD) to proportional 4-20 or 10-50 milliamp, standard process current.

The output is accurate to within 0.05 percent of the application's span, and can be configured to be linear with respect to temperature. This makes the EP-RBX ideal for interface to process computers.

This manual contains descriptions, specifications, calibration procedures, installation notes, maintenance information, and troubleshooting steps for the EP-RBX. The notes and cautions in text are provided to assist the user in avoiding inconveniences and practices that could result in damage to the unit, or personal injury.

Description

The EP-RBX is a 2-wire, loop-powered unit, available in either DIN-style or Hockey Puck (HP) housings. It requires a 11-42 Vdc power source, and accepts inputs from any 2- or 3-wire RTD or slide-wire potentiometer. When used with 3-wire RTD's, it provides constant current excitation, and true lead length compensation.

The unit's aluminum DIN-style housing option is ideal for high-density installations. The HP housing option provides a compact, aluminum package that may be surface mounted, installed in explosion-proof enclosures, or mounted on relay track. The physical dimensions for both of these housing types are in the Installation Section of this manual.

The EP-RBX is a highly versatile unit. Its design provides the user with the capability to change aspects of its operation through a simple re-positioning of internal jumpers on the printed circuit boards. This makes it possible for an EP-RBX used in one application to be removed, reconfigured, and installed in a different application; or used to replace faulty existing equipment.

The Calibration Section of this manual describes how to set these internal, solderless jumpers to select:

- RTD Type (2- or 3-wire)
- Elevated Zero (EZ) Value
- Input Span
- Output Mode (normal or reverse)
- Output Range (4-20 mA or 10-50 mA)

Table 1, on the following page, contains the specifications for the EP-RBX.

Options

The EP-RBX is designed to provide the user with a highly accurate, dependable unit, capable of performing in many diverse environments.

The following is a partial list of the standard options available with the EP-RBX. For a more complete list of options, and information on mounting and enclosure types, contact your Moore Industries Sales Representative.

EZ Option — Elevated Zero. Required for all units, the EZ is jumper-selectable for values from 40 to 160 ohms. Other values available upon request. Contact the factory for more information.

LNP Option — Linear Output Proportional to Temperature. Provides linearization calibrated for 100 ohm platinum RTD. Requires temperature range and midpoint data from customer's application.

RF Option — Filtered Terminal Block and Case. Moore Industries' patented RFI/EMI protection rated at 50V/m - abc = ±0.1% F.S., as defined by SAMA Standard 33.1.

RO Option — Reversed Output. For example, in an RO-equipped, 4-20 mA EP-RBX, 4 mA would represent 100 percent of output span, 20 mA would represent zero. Not available with LNP-equipped units.

RTB Option — Removable Terminal Block Option. Provides quick connect/disconnect capability. Available with DIN-style housing only.

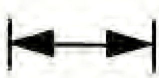
Table 1. EPRBX Equipment Specifications

Characteristic	Specification
Input	Field-selectable: 2-wire or 3-wire RTD **Ranges:** 0-5 through 0-10Ω 0-10 through 0-20Ω 0-20 through 0-40Ω 0-40 through 0-80Ω 0-80 through 0-160Ω 0-160 through 0-320Ω 0-320 through 0-640Ω Higher ranges available upon request
Output	Field-selectable: 4-20 mA or 10-50 mA
Power	11-42 Vdc
Performance	**Calibration Capability:** ±0.05% of span (linearity and repeatability) **Linearization:** 0.1% of full scale for spans less than 200Ω **Elevated Zero:** Field-selectable for EZ values of 40-160Ω (consult factory for other EZ values) **Load Capability:** 650Ω at 24 Vdc (higher voltage equals higher load capability) **Over Voltage Protection:** 70 Vdc, maximum **Line Voltage Effect:** ±0.002% of span per volt change, measured at the input terminals **RTD Excitation Current:** 1 mA, maximum
Environmental Ratings	**Ambient Operating Temperature:** -29 to +82 °C(-20 to +180 °F) **Effect of Temperature on Performance:** ±0.01% of span per °F (10Ω and higher)
Note: See Installation Section for physical dimensions.	

Controls

In addition to the adjustability afforded the customer by the internal jumpers, multiturn potentiometers on the unit's front panel control settings for Zero and Span. The potentiometers are labeled:

 represents Zero

 represents Span

The Span potentiometer equates the unit's output to 100 percent at 20 (or 50) mA. The Zero potentiometer provides for zero percent output, ±5 percent of span.

For units equipped with the LNP Option, an additional internal potentiometer is provided, which adjusts the linearization to 0.1 percent of full scale (for spans less than 200 ohms).

DIN-style units' front panel potentiometers require 15 turns to move their wipers from one end of their range to the other. HP-style units' require 25 turns. The linearization potentiometer, when present, is a 25-turn type.

All potentiometers are equipped with a slip-clutch, which prevents damage if the pot is turned too far during unit calibration. A slight change in torque will be felt when a wiper stop is reached (i.e., you may feel it start to "slip"). If the wiper stop is not detected, turn the potentiometer:

- 15 rotations for DIN-style units
- 25 rotations for HP-style units
- 25 rotations for the linearization pot, when LNP Option is installed...

...in either direction to reach the wiper stop.

Model Number. The model number of an EP-RBX can be used to identify the unit's input/output configuration, other functional characteristics, any options ordered, and the housing type with which the device was manufactured. That is, the model number reflects the way the unit was configured when it was originally shipped from the factory.

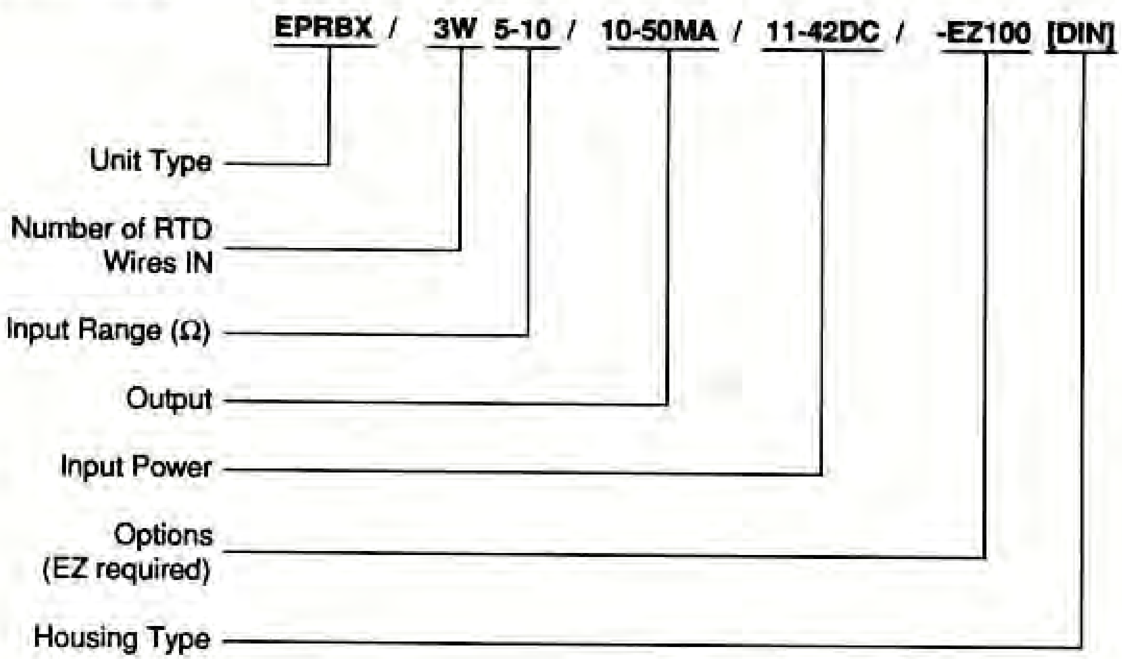
On HP units, the model number is on a stainless steel tag located above the terminal block. On DIN-style units, the number is on a label attached to the side panel.

At the bottom of this page is an example of a typical Moore Industries product model number. The significance of each field is described.

Serial Number. Moore Industries maintains a complete serial number-dependent history on every unit we sell or service.

If a problem develops with the performance of one of your EP-RBX units, provide the factory with the serial number, and one of our skilled Customer Service Representatives will be happy to help you. The serial number is located on the same tag as the model number.

EXAMPLE



Calibration

Each EP-RBX is calibrated and thoroughly tested for compliance with Moore Industries' strict quality guidelines prior to shipment.

Customers may order units set and calibrated to specific levels by the factory, however it is recommended that, at minimum, the performance levels of all units be checked by the customer on site. Full re-calibration, including internal jumper repositioning, is strongly recommended for any unit moved from one application to another, or in the event that performance problems are detected.

The calibration of an EP-RBX is presented in this manual in four phases. It is recommended that all of the instructions and notes be read before beginning to calibrate your unit(s).

Phase one of calibration consists of determining whether unit disassembly is required, and performing the disassembly as necessary.

The next phase is performing the calibration equipment setup.

If full calibration is desired, phase three is calculating the appropriate output values to be used in the calibration procedure.

The calculating phase is followed by the calibration procedure itself; setting the internal jumpers that control gain, span and zero (full calibration only), and adjusting the potentiometers for span, zero, and linearization (if the LNP Option is present).

Using the Calibration Procedures — References to Jumpers.

In this manual, jumpers are referenced according to their position on the printed circuit board (PCB) pins. Jumpers are either "installed" or "stored".

J9, J20, and JE, for example, are designations used for jumpers that are positioned (installed) across ***BOTH*** of the available pins at that location on the PCB.

A jumper reference ending with an "S", denotes a stored jumper. That is, jumpers J9S, J20S, and JES are positioned across ***ONLY ONE*** of the available pins at that location.

If desired, stored jumpers can be removed from the PCB entirely.

Calibration Phase 1: Disassembly Requirement/Procedure

The first step in calibrating an EP-RBX is determining whether disassembly of the unit will be necessary.

Disassembly IS NOT Required for EP-RBX's:

- That have been calibrated at the factory to customer-specified levels. These can be identified by special caps or stickers affixed to the adjustment potentiometers.
- Whose Zero and Span is known to meet the application's requirement.

Level checks and adjustment of the external potentiometers are all that will be necessary before these units can be placed into service. Check the model number to verify input span, output, and EZ.

If, given these criteria, your unit does not require disassembly, skip to the Calibration Setup Section, which follows. Perform steps 6, and 7. Disregard steps 1 through 5. Complete the rest of the calibration procedures, as appropriate.

Disassembly IS Required for EP-RBX's:

- That are to be moved from one application to another.
- Whose operating parameters are not within the required range for a given application.

Every EP-RBX is fully tested and calibrated prior to shipment from Moore Industries, however, unless specific settings have been requested by the customer, it will be necessary to disassemble the unit for a full calibration.

Also, any calibration of the the internal potentiometers on LNP-equipped units.

To disassemble an HP-style EP-RBX, remove the four front panel screws shown in figure 1. All jumpers and potentiometers will be accessible at this level of disassembly. Further disassembly is not recommended.

To disassemble a DIN-style EP-RBX, place the unit on its left side panel (terminal block facing forward), and remove the six screws that secure the right panel, as shown in figure 2. With this panel removed, all internal jumpers and potentiometers will be accessible. No further disassembly is recommended.

CAUTION
Do not damage any of the mylar insulators in the housing. Failure of these insulators will result in unit malfunction and possible damage.

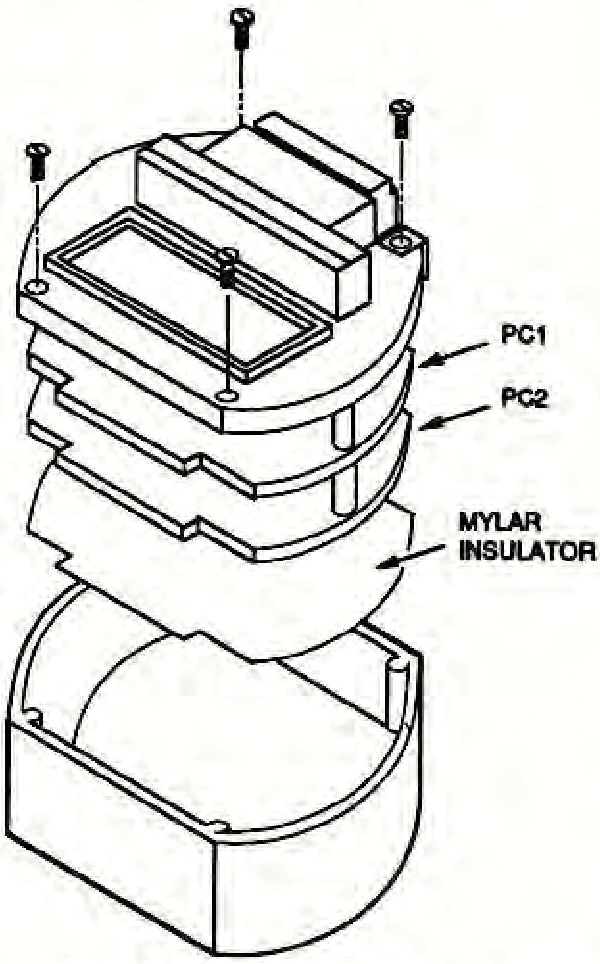


Figure 1. *HP-style EP-RBX Disassembly*

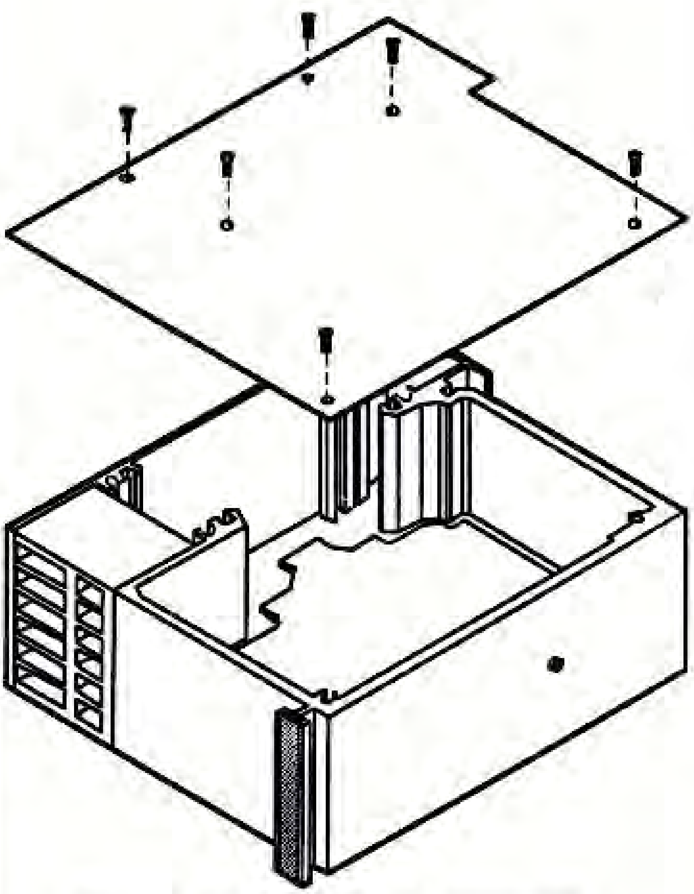


Figure 2. *DIN-style EP-RBX Disassembly*

Calibration Phase 2: Calibration Equipment & Setup

All calibration procedures should be performed in a laboratory setting, or at a technician's bench. This will allow the user to monitor changes in the output more easily, and to more carefully control inputs.

Table 2 lists the equipment needed to calibrate an EP-RBX. The materials listed are not supplied with the unit.

1. Disassemble the unit.

2. Verify installation of, or re-install the following internal jumpers (refer to figures 3, 4, or 5, as appropriate) to set:

   a. **RTD TYPE** — J20 to calibrate for a 2-wire RTD application, or J20S for a 3-wire RTD application

   b. **OUTPUT** — J29S and J49S for 4-20 mA, or J29 and J49 for 10-50 mA

   c. **OUTPUT MODE** — J40 and J41 for normal output, or J38 and J39 for RO-equipped units.

Table 2. *EP-RBX Calibration Equipment*

Equipment	Specifications
Decade Resistance Box	Dekabox model DB62 or equivalent. Accurate to 0.05% of Input Range.
DC Milliammeter **- OR -** **DC Voltmeter with Load Resistor**	Fluke model 8600A or equivalent. Accurate to 0.05% of Input Range. Voltmeter accurate to 0.05% of output range or better; Resistor: 250Ω (±0.1%) for 4-20 mA output, and 100Ω (±0.1%) for 10-50 mA output.
Variable DC Power Source	Capable of 11-42 volt output.
Screwdriver	Both slotted and Phillips-head types. Width of heads 2.54 mm (0.1 in), maximum
Pliers or Technician's Tweezers	Appropriate for removal/installation of standard circuit jumpers

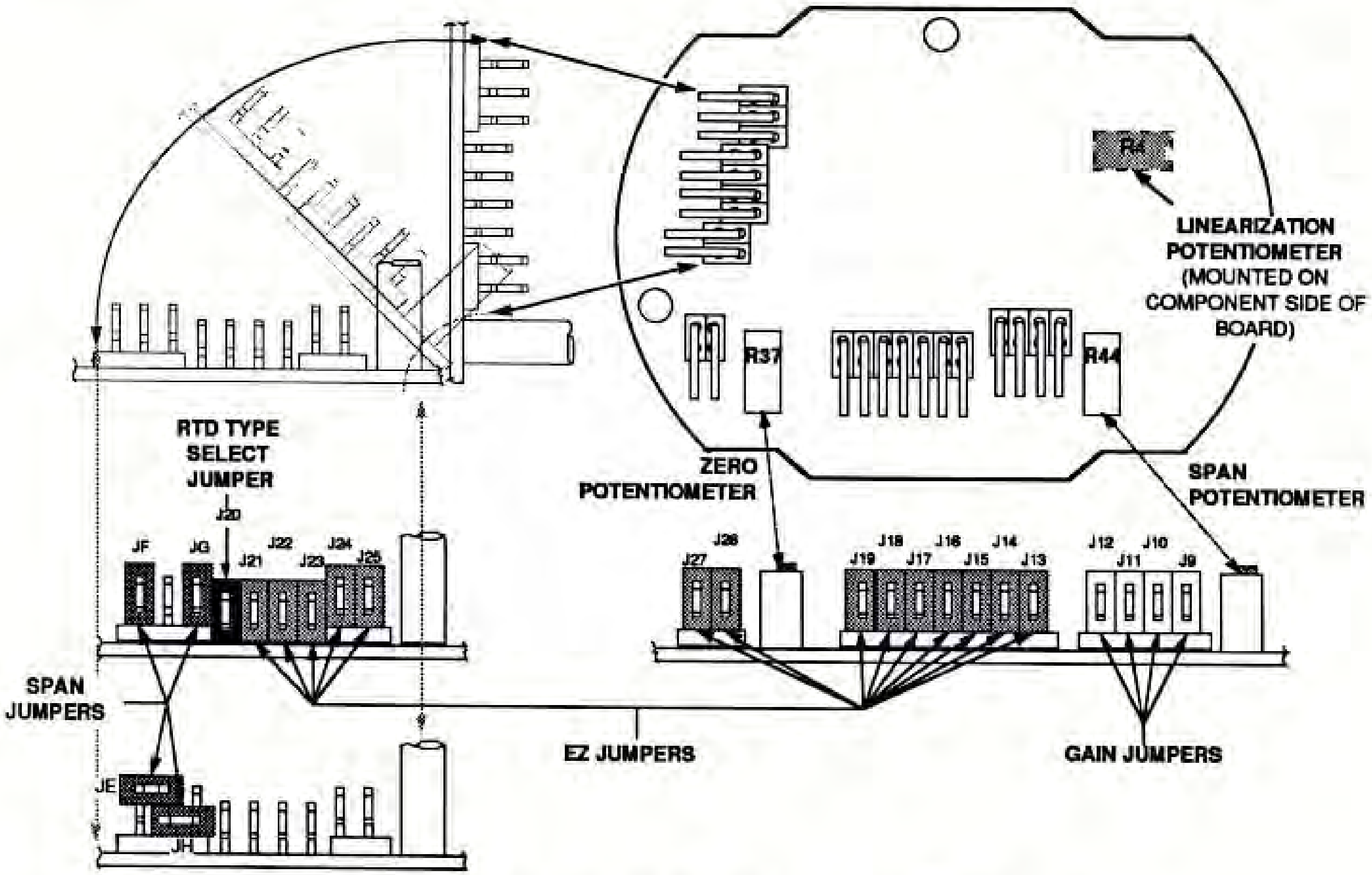


Figure 3. Jumpers and Pots, the HP-style EP-RBX Printed Circuit Board 1

3. Remove all GAIN and SPAN jumpers.

4. Install, or verify installation of EZ jumpers J13 through J19, and J25, J26, J27.

EP-RBX

5. For **Non-LNP EP-RBX's:** Set Linearization Potentiometer fully counter-clockwise.

For **LNP-equipped EP-RBX's:** Set Linearization Potentiometer fully counter-clockwise, ***then four (4) turns clockwise.***

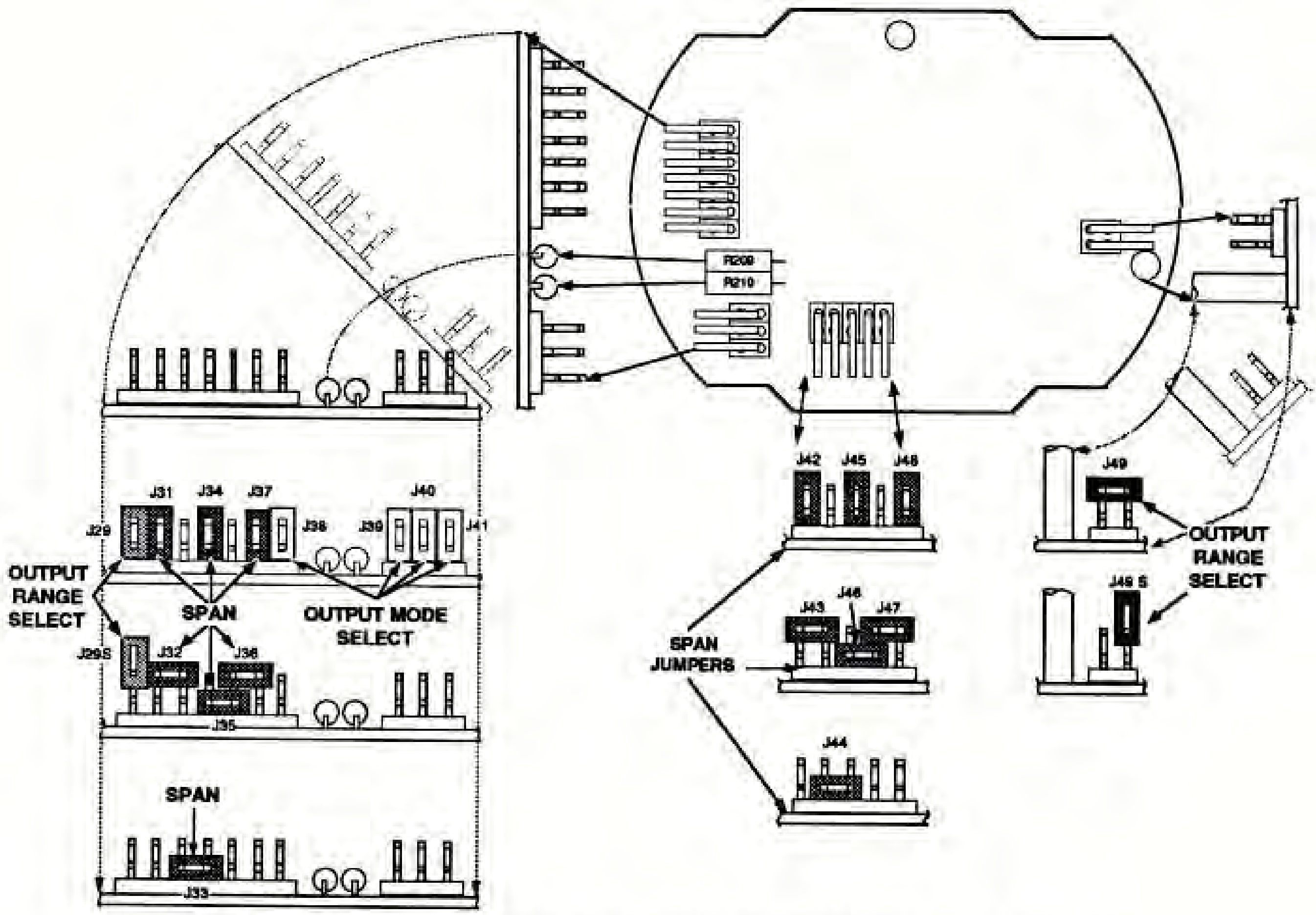


Figure 4. *Jumpers and Pots, the HP-style EP-RBX Printed Circuit Board 2*

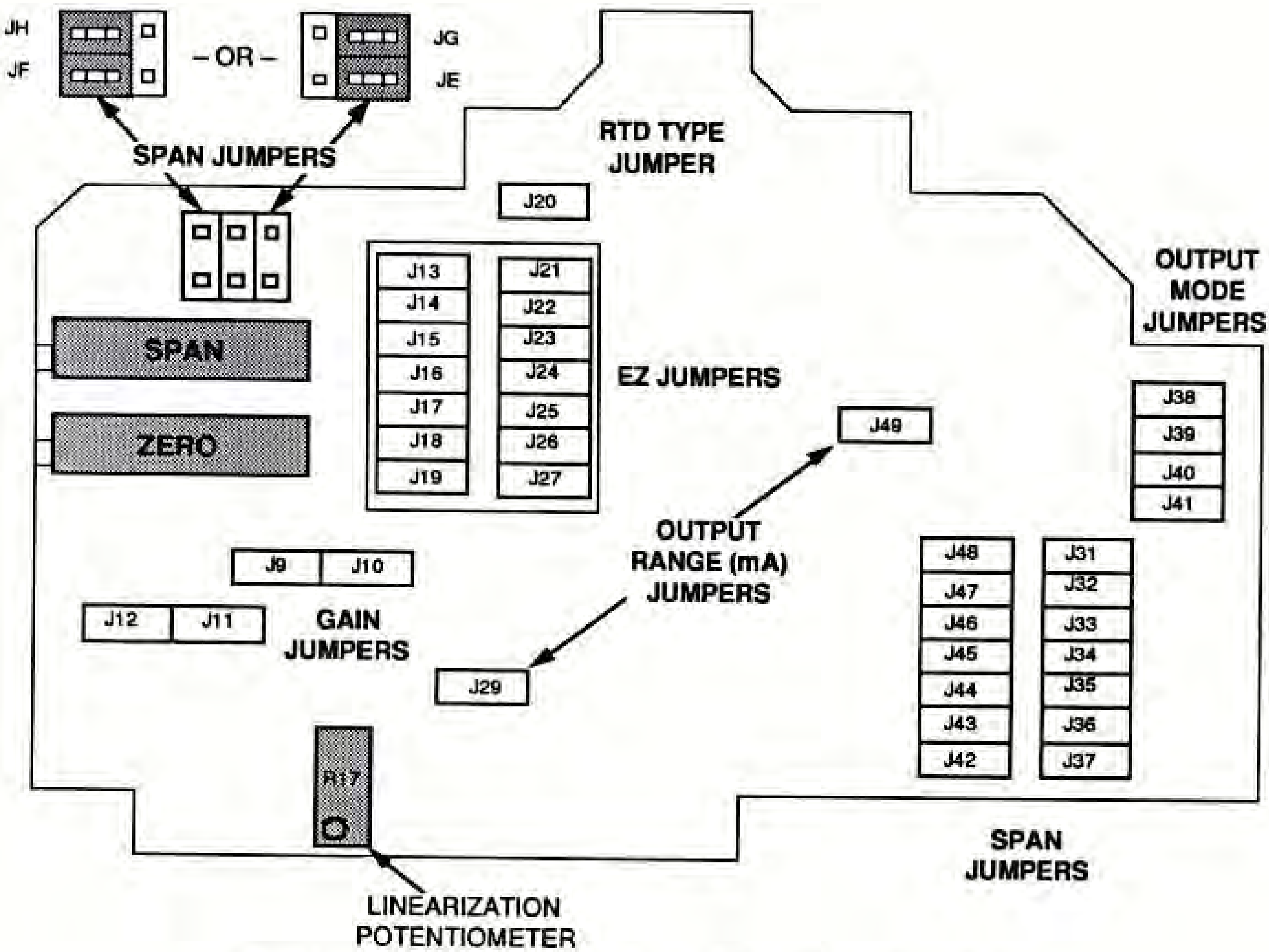


Figure 5. *Jumpers and Pots, the DIN-style EP-RBX Printed Circuit Board*

EP-RBX

6. Set front panel zero and span potentiometers to midscale; 12.5 turns from either wiper stop for HP-style units, or 7.5 turns from either wiper stop for DIN-style units.

7. Connect unit as shown in figure 6. Apply appropriate input power, and allow 15 minutes for setup to stabilize.

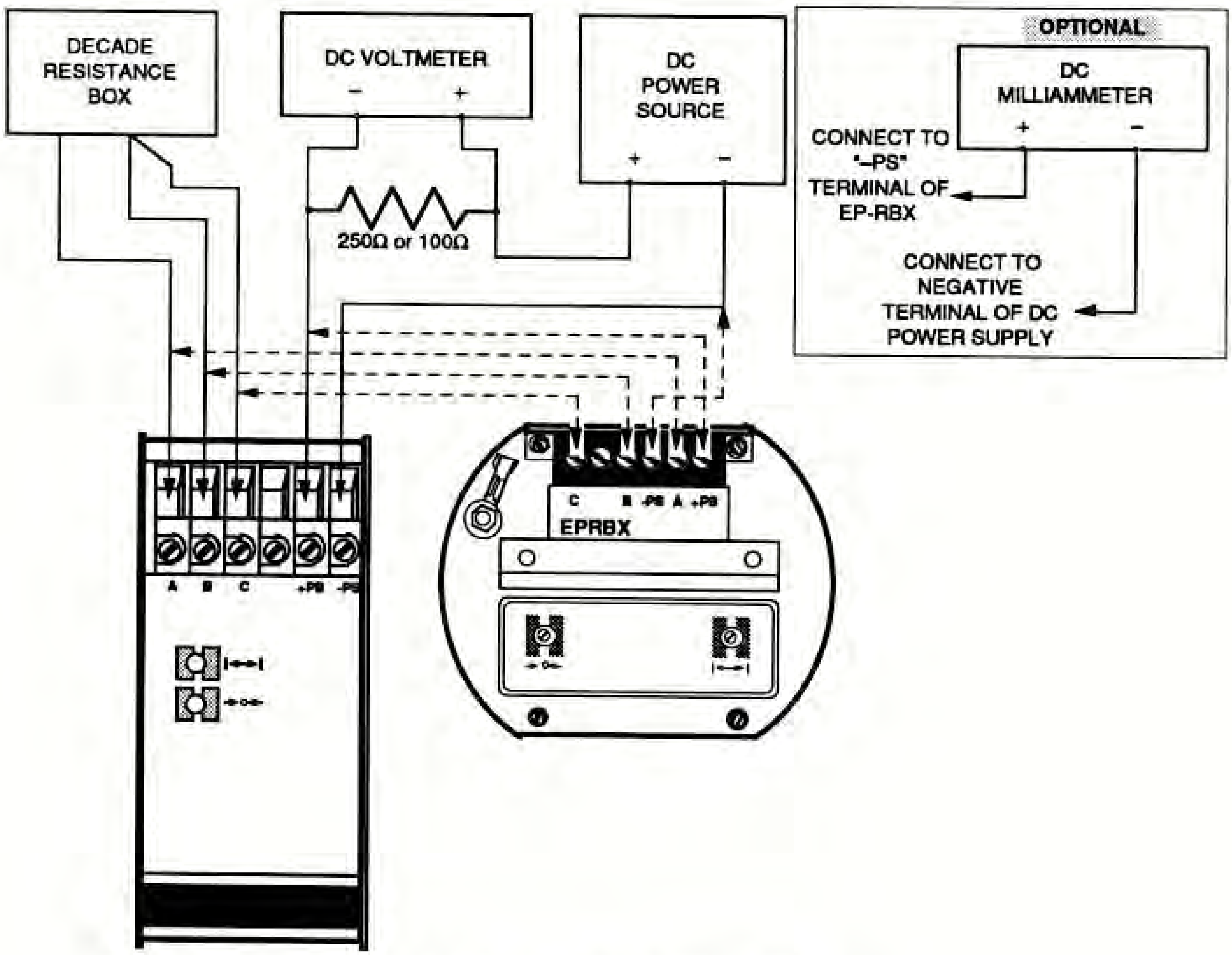


Figure 6. EP-RBX Calibration Setup

Calibration Phase 3:
Calculating Appropriate Output Values

NOTE:
If your EP-RBX did not meet the requirements for disassembly, skip this section, and proceed with step 12 in the Fine Adjustment Section of "Calibrating Gain, Span, and Zero".

Non-LNP Units. When calibrating EP-RBX's that are configured for linear output with respect to resistance, first find the values for 0, 25, 50, 75, and 100 percent of the span's equivalent resistance (according to the appropriate published temperature vs. resistance tables)

Then add each of these values to the lowest resistance value in the unit's range.

Each of the sums is equal to the resistance required in the calibration setup to produce the appropriate output, 1-5 volts, 4-20 or 10-50 milliamps, according to the way your EP-RBX has been configured.

Worksheet "A", on the following page, is provided to help keep track of the determined values. The accompanying example text illustrates, step by step, how to perform the calculations.

Use the example as a guide filling in the white spaces of the worksheet according to the instructions in the appropriate shaded areas, according to the requirements for your unit.

WORKSHEET "A" — EP-RBX, NO LNP OPTION							
EP-RBX	2W 3W	5-10 10-20 20-40 40-80 80-160 160-320 320-640	4-20 mA 10-50 mA	11-42 Vdc	EZ		HP DIN
Temperature Range (From APPLICATION)		...... to ...... (In °C or °F)		Equivalent Resistance Values (From Published Tables)		...... Ω to ...... Ω (a) (b) INPUT RANGE	
		SPAN = (b) – (a)		.... Ω (Δ)			
0% of SPAN equals... (0) · (Δ) =	...0... (c)	...plus lowest value in INPUT RANGE equals... (c) + (a) =	......Ω (r) 0% INPUT	Which will equate to...	1.000 volt, if using a voltmeter... ——— 4.0 mA or 10 .0 mA, if using a milliammeter...	... during calibration.	
25% of SPAN equals... (0.25) · (Δ)	.... (c1)	...plus 0% INPUT equals... (c1) + (a) =	......Ω (r1) 25% INPUT		2.000 volts, if using a voltmeter... ——— 8.0 mA or 20 .0 mA, if using a milliammeter...		
50% of SPAN equals... (0.50) · (Δ)	.... (c2)	...plus 0% INPUT equals... (c2) + (a) =	......Ω (r2) 50% INPUT		3.000 volts, if using a voltmeter... ——— 12.0 mA or 30.0 mA, if using a milliammeter...		
75% of SPAN equals... (0.75) · (Δ)	.... (c3)	...plus 0% INPUT equals... (c3) + (a) =	......Ω (r3) 75% INPUT		4.000 volts, if using a voltmeter... ——— 16.0 mA or 40.0 mA, if using a milliammeter...		
100% of SPAN equals... (Δ)	.... (c4)	...plus 0% INPUT equals... (c4) + (a) =	......Ω (r4) 100% INPUT		5.000 volts, if using a voltmeter... ——— 20.0 mA or 50.0 mA, if using a milliammeter...		

Calibration Example, Non-LNP EP-RBX.

An EP-RBX with the following model number is to be fully calibrated:

EPRBX / 3W20-40 / 4-20MA / 11-42DC /-EZ100[DIN]

From the number, we know that the output is to be linear with respect to resistance, not temperature.; and for this example, it is to be calibrated for use with an RTD measuring temperatures in a 0 to 75 degree (F) range.

The Calibration Setup procedures are performed, and while the unit is left to stabilize, the NO LNP worksheet is filled out as follows:

Referencing published tables for Fahrenheit temperature vs. resistance (platinum, 100 ohm RTD), the unit's span is the equivalent value for 75° minus the equivalent value for 0°; (b) — (a) from the worksheet. The numbers are:

109.30Ω — 93.03Ω, or 16.27Ω
("Δ" from the worksheet)

The percentages of span, or "(cx)"values are calculated:

(c) = 0(16.27), or 0Ω
(c1) = 0.25(16.27), or 4.0675Ω
(c2) = 0.50(16.27), or 8.135Ω
(c3) = 0.75(16.27), or 12.2025Ω
(c4) = 1.0(16.27), or 16.27Ω

Continuing with the worksheet, the corresponding resistance values, "(rx)", are determined:

(r) = 0 + 93.03, or 93.03Ω
(r1) = 4.0675 + 93.03, or 97.0975Ω
(r2) = 8.135 + 93.03, or 101.165Ω
(r3) = 12.2025 + 93.03, or 105.2325Ω
(r4) = 16.27 + 93.03, or 109.30Ω

Using a voltmeter to calibrate this EP-RBX, then, and assuming that the internal jumpers have been set according to the instructions is this manual, an output of:

- 1.000 volt will be produced when 93.03Ω resistance is present in the calibration setup
- 2.000 volts will be produced when 97.098Ω resistance is present
- 3.000 volts will be produced when 101.165Ω resistance is present
- 4.000 volts will be produced when 105.23Ω resistance is present
- 5.000 volts will be produced when 109.30Ω resistance is present.

If a milliammeter were used instead of the voltmeter/ 250Ω resistor combination, outputs would be 4.0 mA, 8.0 mA, 12.0 mA, 16.0 mA and 20.0 mA, respectively.

LNP-Equipped Units. EP-RBX's whose output has been configured to be linear with respect to temperature require a different method of determining the resistance values to be used in their calibration.

Also, a correction factor must be derived, in order to compensate for the approximated temperature values used when determining the resistance.

This correction factor is necessary because, for example, 25 percent of a 75 degree unit span is 18.75 degrees. Most published temperature vs. resistance tables list temperature values to the nearest whole degree. It will be necessary, therefore, to approximate this percentage of span to the nearest degree, 19, and to proportionally correct the output used to calibrate the unit.

Worksheet "B" is provided to assist in determining the correct values. Again, an example is provided for further assistance in performing the calculations and filling in the worksheet.

Use the example as a guide, and fill in the white spaces of the worksheet as appropriate for your unit.

EP-RBX

WORKSHEET "B" — EP-RBX, WITH LNP OPTION

EP-RBX 2W 3W	5-10 10-20 20-40 40-80 80-160 160-320 320-640	4-20 mA 10-50 mA	11-42 Vdc EZ	- LNP	HP DIN

Temperature Range (From APPLICATION)	.....° to .....° (a) to (b)	TEMPERATURE SPAN (b) – (a) =	.........° (Δ)

OUTPUT if using a Voltmeter =	1 -5 volts, LOW = 1 volt RANGE = 4 volts	OUTPUT if using a Milliammeter =	FOR 4 - 20 mA units, LOW = 4 mA RANGE = 16 mA	FOR 10 - 50 mA units, LOW = 10 mA RANGE = 40 mA

INPUT

0% of SPAN	0° (c)	(a) + (c) =	......° (t) ACTUAL TEMP IN	Equivalent Resistance	......Ω (r)
25% of SPAN (to nearest degree)	......° (c1)	(a) + (c1) =	......° (t1) ACTUAL TEMP IN		......Ω (r1)
50% of SPAN (to nearest degree)	......° (c2)	(a) + (c2) =	......° (t2) ACTUAL TEMP IN		......Ω (r2)
75% of SPAN (to nearest degree)	......° (c3)	(a) + (c3) =	......° (t3) ACTUAL TEMP IN		......Ω (r3)
100% of SPAN	......° (c4)	(a) + (c4) =	......° (t4) ACTUAL TEMP IN		......Ω (r4)

OFFSETS

(t1) – (a)	......° (d1) ESTIMATE	(d1) / (Δ) =	...... (e1) ERROR	(e1) · (RANGE) =	...... (f1) CORRECTION FACTOR
(t2) – (a)	......° (d2) ESTIMATE	(d2) / (Δ) =	...... (e2) ERROR	(e2) · (RANGE) =	...... (f2) CORRECTION FACTOR
(t3) – (a)	......° (d3) ESTIMATE	(d3) / (Δ) =	...... (e3) ERROR	(e3) · (RANGE) =	...... (f3) CORRECTION FACTOR

OUTPUTS

For 0% INPUT, set Decade Box to:	...... (r)	The meter will read...	LOW	...the correct output.
For 25% INPUT, set Decade Box to:	...... (r1)		LOW + (f1)	
For 50% INPUT, set Decade Box to:	...... (r2)		LOW + (f2)	
For 75% INPUT, set Decade Box to:	...... (r3)		LOW + (f3)	
For 100 % INPUT, set Decade Box to:	...... (r4)		LOW + RANGE	

Calibration Example, LNP-Equipped EP-RBX

An EP-RBX with the following model number is to be fully calibrated:

EPRBX / 3W20-40 / 4-20MA / 11-42DC /-EZ88.66-LNP[DIN]

The unit is to be calibrated for use with an RTD measuring temperatures in a -20 to +75 degree (F) range.

The Calibration Setup procedures are performed, and while the unit is left to stabilize, the LNP worksheet is filled out as follows:

The span (Δ) for this unit will be:

(b) – (a), or (+75) – (-20), or +95 °F.

The values for 0, 25, 50, 75, and 100 percent of the span are calculated ***TO THE NEAREST WHOLE DEGREE***. From the worksheet, the "(c*x*)" values are:

(c) = 0 • 95, or 0°
(c1) = 0.25 • 95, or approximately 24°
(c2) = 0.50 • 95, or approximately 48°
(c3) = 0.75 • 95, or approximately 71°, and
(c4) = 1 • 95, or 95°

The values for actual temperature input, "(t*x*)" are calculated using the worksheet:

(t) = (-20) + 0, or -20
(t1) = (-20) + 24, or +4
(t2) = (-20) + 48, or +28
(t3) = (-20) + 71, or +51
(t4) = (-20) + 95, or 75

The corresponding resistance values, "(r*x*)" from the appropriate table, are:

(r) = 88.66Ω
(r1) = 93.91Ω
(r2) = 99.13Ω
(r3) = 104.12Ω
(r4) = 113.61Ω.

NOTE:
These resistance values, when present in the calibration setup, WILL NOT produce proportional outputs of 1, 2, 3, 4, and 5 volts (4-20, or 10-50 milliamps). The output values used must take into account the correction factor.

Next, the corrected percentage of span is determined for each level to be used in the calibration procedure. The approximate percentage of span "(t*x*)" is compared to lowest value in the application's temperature range "(a)". The result is the actual offset estimate, "(d*x*)".

(d1) = (t1) – (a), or (+4) – (-20), or 24°
(d2) = (t2) – (a), or (+28) – (-20), or 48°
(d3) = (t3) – (a), or (+51) – (-20), or 71°

The percentage of span represented by the "(d*x*)" values is determined. The result is the error, "(f*x*)", which will be added to the output.

(f1) = (d1) ÷ (Δ), or 24 ÷ 95, or 0.2526

(f2) = (d2) ÷ (Δ), or 48 ÷ 95, or 0.5053

(f3) = (d3) ÷ (Δ), or 71 ÷ 95, or 0.7474

The output span (the "RANGE" value from the worksheet) is multiplied by the appropriate error factor, yielding the required output shift. This shift is added to the lowest value in the rated output range ("LOW" from the worksheet), and the result is the corresponding corrected output.

A voltmeter is to be used to calibrate the unit in this example. The voltage output for the calibration setup is as follows.

- When 0 percent of span is applied, it will be 1 volt.
- When 25 percent of span is applied, it will be **4 • (e1), or (4) • (0.2526), or 1.0105 volts.**

  That is, when 25 percent of the input span resistance, 93.91Ω, is present in the calibration setup, the output will be 1 + 1.0105, or 2.0105.
- When 50 percent of span is applied, it will be **4 • (e2), or (4) • (0.5053), or 2.021 volts.**

  That is , when 50 percent of the input span resistance, 99.13Ω, is present in the calibration setup, the output will be 1 + 2.021, or 3.021.

- When 75 percent of span is applied, it will be **4• (e3), or (4) • (0.7474), or 2.9895 volts.**

  That is, when 75 percent of the input span resistance, 104.12Ω, is present in the calibration setup, the output will be 1 + 2.9895, or 3.9895.

- When 100 percent of the input span resistance, 113.61Ω, is present in the calibration setup, the output will be 5 volts.

Calibration Phase 4: Calibrating Gain, Span, and Zero

The procedure for arriving at the correct setting for gain, span, and zero consists of:

- Performing an initial jumper setup and applying input;
- Checking for proper output;
- Repositioning jumpers if necessary;
- Adjusting ZERO, SPAN, and LINEARIZATION (LNP units only) potentiometers.

Figure 7 is a graphic overview of the procedure.

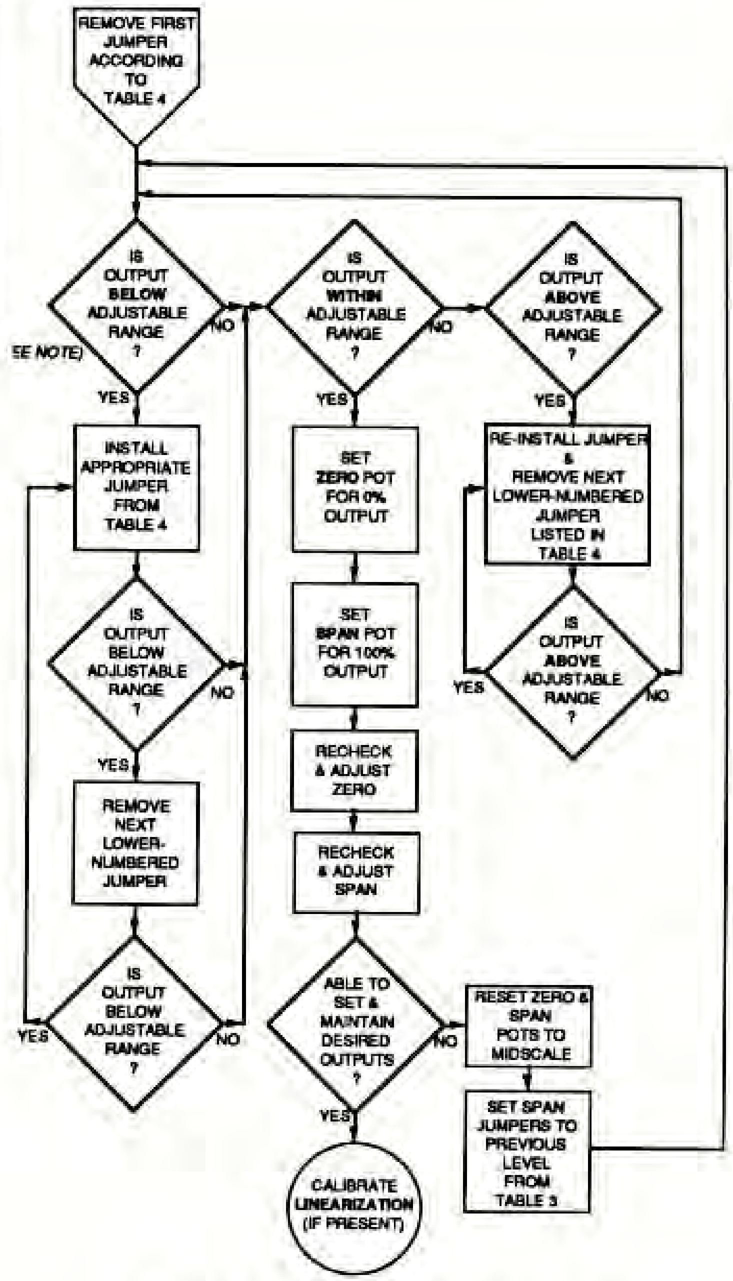


Figure 7. Setting the EP-RBX Jumpers

Using the Procedures — Output Levels.
Throughout the following procedure, the term "IDLE" will be used to mean an output reading of 800 mV, ±10%; or 3.3 mA, ±10%, if using a milliammeter. For RO-equipped units, IDLE will be used to mean 4.8 volts, ±40 mV; or 19.3 mA, ±0.03 mA.

The term "CORRECT" will signify the optimum output level for proper adjustment of the Zero and Span potentiometers.

For non-LNP EP-RBX's, CORRECT is 1 volt, ±300 mV, or if using a milliammeter, 3.8 to 4.2 mA (4-20 mA units), and 9.7 to 10.3 mA (10-50 mA units).

For LNP-equipped units, CORRECT is the lowest value in the rated output range ("LOW" from the worksheet), plus the correction factor, "fx".

For units with the RO Option, CORRECT will mean 5 volts, ±300 mV; or 19.8 to 20.2 mA (4-20 mA units), and 49.7 to 50.3 mA (10-50 mA units).

NOTE:
Adjustable Range is approximately 0.95 to 1.3 V, 3.8 to 5.2 mA, or 9.5 to 13 mA, as appropriate.

GAIN & SPAN JUMPERS:

1. Determine span of the unit to be calibrated. Refer to "Δ" value from the appropriate worksheet.
2. Install GAIN and SPAN jumpers according to the instructions in table 3.

NOTE:

EP-RBX's configured with an EZ lower than 0°C (100Ω) or 32°F (93.03Ω) are termed "Negative EZ" units. These require the following alternate procedure for setting the SPAN jumpers.

Table 3. *Installing Gain & Span Jumpers*

If "Δ" is AT LEAST	...But NOT ABOVE	Install GAIN Jumpers	Install SPAN Jumpers
4.0	5.9	J11 & J12	J31, J48, JE, & JG
5.8	7.6	J10 & J11	
7.5	9.2	J9 & J12	
9.1	10.9	J9 & J10	
8.0	11.7	J11 & J12	J32, J47, JE, & JG
11.4	15.1	J10 & J11	
14.8	18.5	J9 & J12	
18.2	21.9	J9 & J10	
15.9	23.5	J11 & J12	J33, J46, JE, & JG
22.8	30.4	J10 & J11	
29.7	37.1	J9 & J12	
36.6	44.2	J9 & J10	
32	46	J11 & J12	J34, J45, JE, & JG
45	59	J10 & J11	
58	73	J9 & J12	
72	86	J9 & J10	
63	92	J11 & J12	J35, J44, JE, & JG
89	118	J10 & J11	
116	145	J9 & J12	
143	172	J9 & J10	
123	180	J11 & J12	J36, J43, JE, & JG
175	232	J10 & J11	
226	284	J9 & J12	
278	335	J9 & J10	
245	359	J11 & J12	J37, J42, JF, & JH
348	462	J10 & J11	
450	563	J9 & J12	
553	667	J9 & J10	

a. Determine the "correct" set of span jumpers, regardless of EZ, based on the "Δ" from the worksheet for your unit, according to Table 3.

This is the "SPAN JUMPER REFERENCE".

b. Install the jumper set listed immediately BEFORE the SPAN JUMPER REFERENCE.

Example:

The "Δ" from the worksheet for an EP-RBX configured with a negative EZ is 47. The appropriate SPAN jumper set listed in table 3 is J34, J45, JE, and JG. Because of the negative EZ, however, it will be necessary to install the set listed before it in the table. The correct SPAN jumper set for this unit would be J33, J46, JE and JG.

3. Set decade box to 0 percent input resistance, "(r)" value from appropriate worksheet.
4. Note output. If above IDLE, remove J25.

NOTE:
This configuration is the "CALIBRATION REFERENCE".

EZ:

To set the EZ jumpers, use table 4 and the "Δ" value from the appropriate worksheet to determine which jumper to move first.

Table 4. *Moving EZ Jumpers*

If "Δ" is between:	Move this jumper FIRST...	...Then install this jumper, if appropriate
4 and 10.9	J19	J27
11 and 21.9	J19	J27
22 and 44	J18	J26
45 and 86	J17	J25
87 and 172	J16	J24
173 and 335	J15	J23
336 and 667	J15	J23

NOTE:
The EZ jumpers are located on PCB1 of HP-style EP-RBX's.

When removing or installing jumpers, always observe the output reading. If the output is CORRECT, stop, and go on to the next section, step 10, which deals with calibrating the span potentiometer.

Figure 8 illustrates the technique for positioning EZ jumpers on both the HP- and DIN-style EP-RBX. The instructions are comprised of steps 5 through 9.

5. Remove first jumper appropriate for your application, as listed in table 4. (Table 4 is also shown on the illustration itself).
6. Note output. If CORRECT, skip to next section, Step 10 under "SPAN POTENTIOMETER".
7. If output is NOT CORRECT, install appropriate jumper, according to the instructions in column 3 of table 4.
8. Note output. If CORRECT, skip to next section, Step 10 under "SPAN POTENTIOMETER.
9. If output is NOT CORRECT, re-install the jumper in its original position (column 2).

   a. Remove the jumper with the next lower number in figure 8, and again observe output.

   b. If output is still NOT CORRECT, install *that* jumper in its secondary postion, according to figure 8.

   Repeat this step as necessary, observing output level while removing and installing/re-installing successively lower-numbered jumpers, until the output is CORRECT.

For Example:

J17 is removed. Output is checked, and is observed to be NOT CORRECT. J25 is then installed, the output is again checked, and is observed to be NOT CORRECT. J17 is then *re*-installed, and the next lower-numbered jumper from the table/figure, J16, is removed. Output is NOT CORRECT, and so J24 is installed. This is continued until the output is observed to be CORRECT.

NOTES:

If the EZ fails to reach the "CORRECT" level after having removed and re-installed all of the jumpers, return the setup to CALIBRATION REFERENCE (steps 1-4, above), increase the gain (move the GAIN jumpers to the position listed next in table 3), and repeat steps 5 through 9.

If the unit still fails to achieve the CORRECT level, return the setup to CALIBRATION REFERENCE, and again increase the gain. Repeat this until CORRECT output is produced.

SPAN POTENTIOMETER:

10. With ZERO calibrated, set input resistance to 100 percent, "(r4)" value from appropriate worksheet.
11. Observe output reading, and adjust SPAN potentiometer until output reaches appropriate rated maximum;

    5 volts, ±300 mV,
    20 mA, ±0.2 mA (for 4-20 mA units), or
    50 mA, ±0.3 mA (for 10-50 mA units).

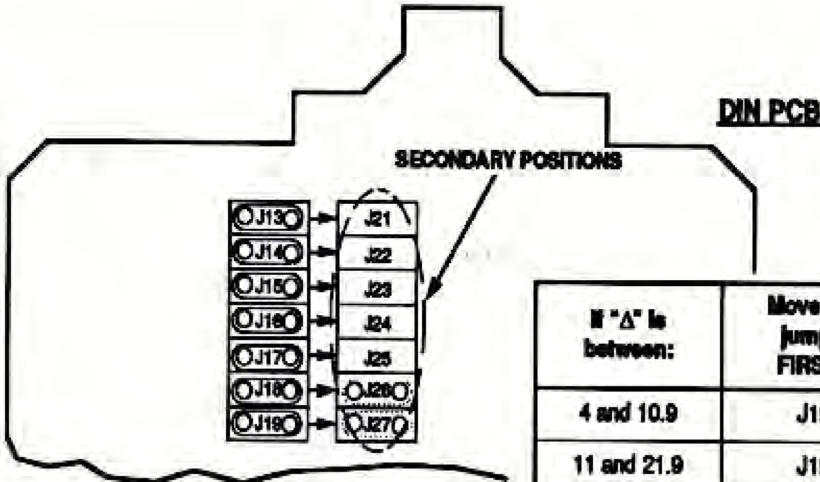
    For RO-equipped units, set SPAN so that output is at the appropriate rated minimum.

NOTES:

If unsuccessful in calibrating the EP-RBX using the procedures above, return setup to CALIBRATION REFERENCE (steps 1-4), and install the SPAN jumpers listed previously in the table.
Refer to the notes and example for negative EZ units, following Steps 1 and 2.

Repeat the calibration, starting with step 3.

***If difficulties continue,** contact Moore Industries' Customer Service Department, at 1-800-999-2900.*



If "Δ" is between:	Move this jumper FIRST...	...Then install this jumper, if appropriate
4 and 10.9	J19	J27
11 and 21.9	J19	J27
22 and 44	J18	J26
45 and 86	J17	J25
87 and 172	J16	J24
173 and 335	J15	J23
336 and 667	J15	J23

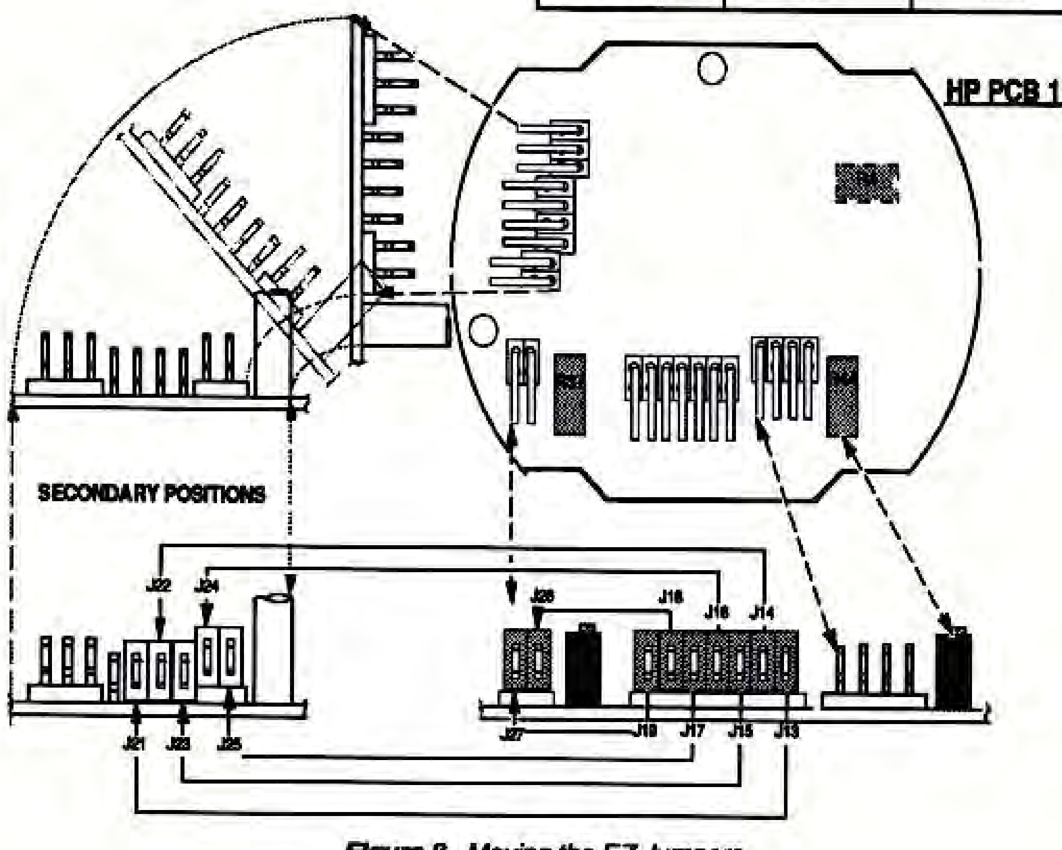


Figure 8. Moving the EZ Jumpers

FINE ADJUSTMENTS:

12. Set decade box to 0 percent input resistance level (r), and verify CORRECT output.

    Adjust ZERO potentiometer as necessary.

13. Set decade box back to 100 percent input resistance level (r4), and verify maximum rated output (refer to step 11, above). Adjust SPAN potentiometer.

14. Repeat steps 12 and 13 until unit output is CORRECT at 0 percent input resistance (r), and at rated maximum level at 100 percent input resistance (r4).

Calibrating the Linearization Potentiometer

LNP-equipped units' output is linear with respect to temperature. The EZ and span of these units must be calibrated before adjusting the setting of Linearization.

Set the decade resistance box to 50 percent input level, "(r2)" from LNP worksheet, and note the output.

If the desired output level is present, the linearization potentiometer is calibrated. If the level is not appropriate, note whether it is ABOVE or BELOW desired level.

For ABOVE:

1. Subtract desired level (from worksheet) from actual output reading. This is the error.
2. Multiply error by a factor of 3. This is the correction.
3. Add correction to actual output reading. This is corrected level.
4. Adjust Linearization Potentiometer (see figure 3 or 5, as appropriate), until output is at corrected level.
5. Execute the procedure for Fine Adjutments (steps 12 through 14).

For BELOW:

1. Subtract actual output reading from desired output level. This is the error.
2. Multiply error by a factor of 3. This is the correction.
3. Subtract correction from actual output reading. This is corrected level.
4. Adjust Linearization Potentiometer (see figures 3 or 5, as appropriate), until output is at corrected level.
5. Execute the procedure for Fine Adjustments (steps 12 through 14).

Installation

Installing the EP-RBX is a procedure that consists of physically mounting each device, and then completing the necessary electrical connections.

It is strongly recommended that each unit be calibrated and mounted before effecting any electrical connections.

Mounting

Figures 9 and 10, respectively, give the mounting dimensions for the HP and DIN-style EP-RBX.

Although the unit is constructed of a durable aluminum alloy, care should be taken to locate it in an area that is protected from dust, moisture, and corrosive atmospheres.

It is also recommended that the EP-RBX be mounted on a surface that helps dissipate heat, especially if the ambient temperature of the installation site is unusually high.

HP Housing. When equipped with spring clips, the HP-style EP-RBX is mounted in an explosion-proof enclosure. The standard spring clips supply adequate tension to hold the unit in place once seated in the enclosure.

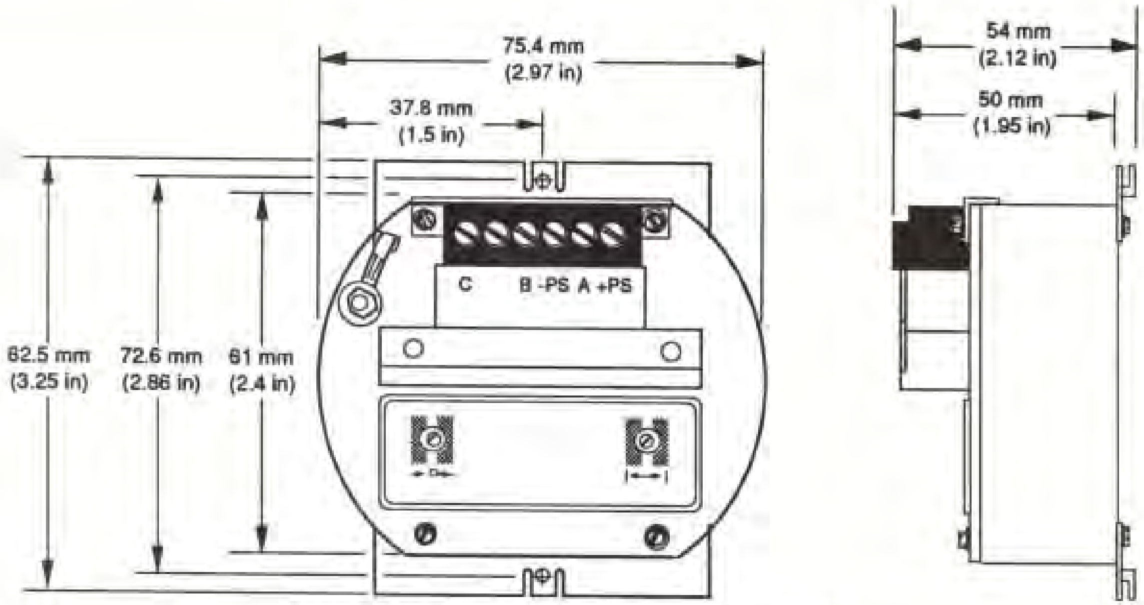


Figure 9. *HP-style EP-RBX Outline Dimensions*

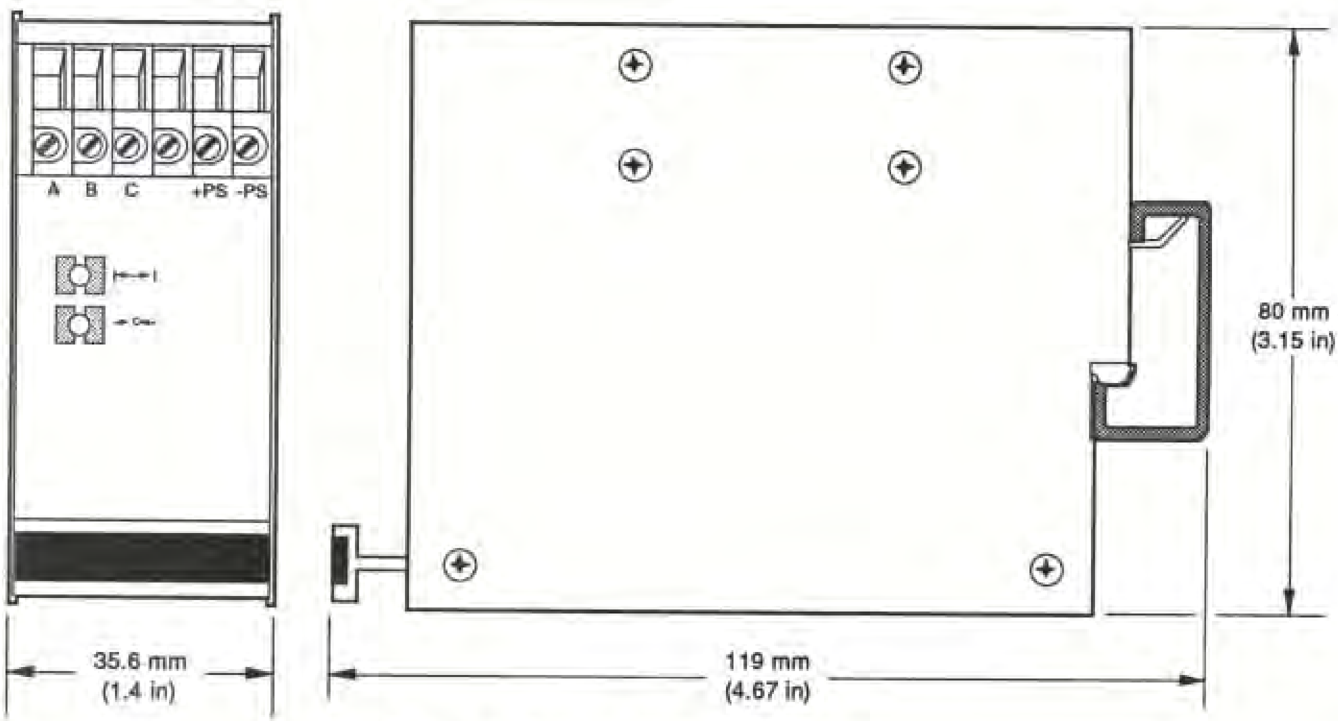


Figure 10. *DIN-style EP-RBX Outline Dimensions*

HP-style units can also be equipped with flange plates for mounting on relay track, or similar flat surfaces. Dimensions for the flange plate is also shown in figure 9.

DIN-style Housing. The DIN-style housing is designed for mounting the unit on any standard G-rail. Figure 10 includes the dimensions for the rail.

To mount the DIN-style EP-RBX, position the G-rail so that the smaller of its two flanges is toward the top.

Tilt the unit slightly backward, and insert the spring flanges on the back panel under the top flange of the rail. Push inward and down until the EP-RBX snaps into place.

To remove the unit, pull outward (from the bottom) and up.

Electrical Connections

RTD output is connected to the EP-RBX at the front panel terminals labeled "A", "B", and "C". Terminals A and B are primary; C is used when lead length compensation is desired.

Loop power is connected to the unit at the terminals marked "+PS" and "-PS".

There is no special wiring required for connections, but to avoid noise, transients, and stray pickups, it is recommended that signal and power lines be routed separately, and that twisted conductors be used where connecting leads are run close to other services (such as power wiring).

Figure 11 shows the EP-RBX connected in a typical application.

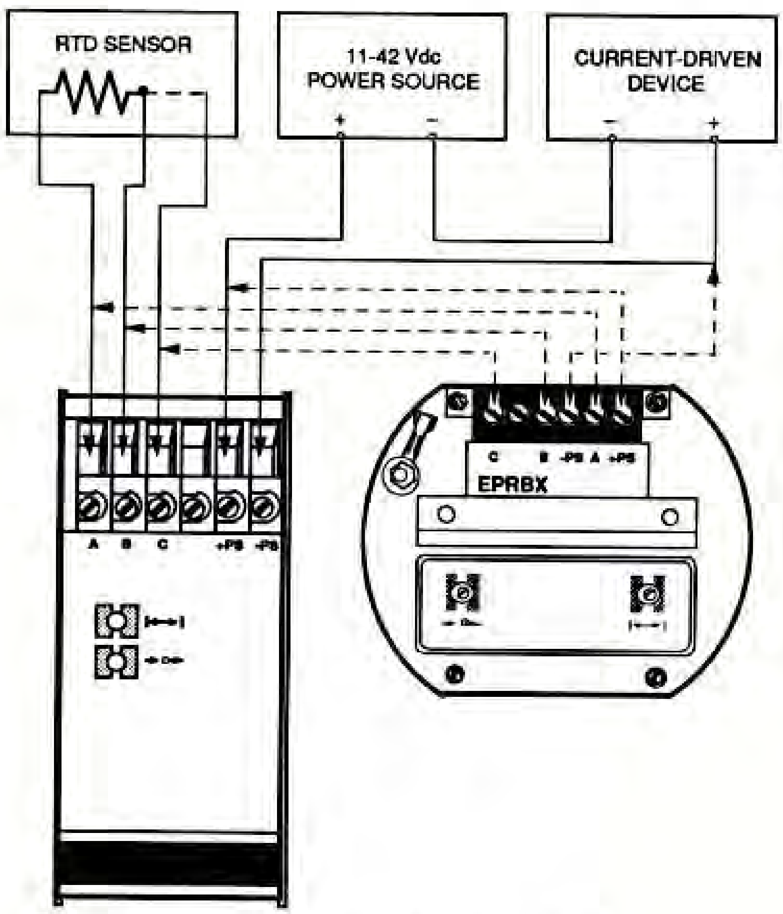


Figure 11. *Typical EP-RBX Hookup*

Wires are connected to the EP-RBX with compression screws in the terminal block. Use a slotted screwdriver (head width 2.54 mm (0.1 in) or less) to secure the wires in the appropriate terminals.

Wire sizes of 14-18 AWG are recommended for RTD connection. Wire length from the RTD to the EP-RBX should be identical for all wire leads. The loop-power wire leads should be the same type as those used in the rest of the loop. However, 20-22 AWG wire is recommended for dc power connections.

Unit Operation

The EP-RBX operates from loop power (12-42 Vdc), and accepts input from 2- or 3-wire RTD's. Once calibrated, installed, and supplied with power, the unit will operate unattended, and maintenance-free.

During normal operation, the unit may become warm, especially in areas where the ambient temperature is high. This condition does not impair the EP-RBX's operation, and may be disregarded as long as unit performance is not impaired.

Maintenance

Maintenance of the unit is limited to a periodic check of the connection terminals of the unit in the field. Keep the terminals clean and tight, and ensure that there is adequate ventilation or heat dissipation for the unit.

Troubleshooting

If a problem develops with the performance of the EP-RBX, remove and recalibrate the unit. Refer to the Calibration Section of this manual.

Any units found to be performing below specification after re-calibration should be returned to Moore Industries immediately. Instructions for the return of the equipment are on the back cover of this manual. Customers may also contact Moore Industries directly.

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.

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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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