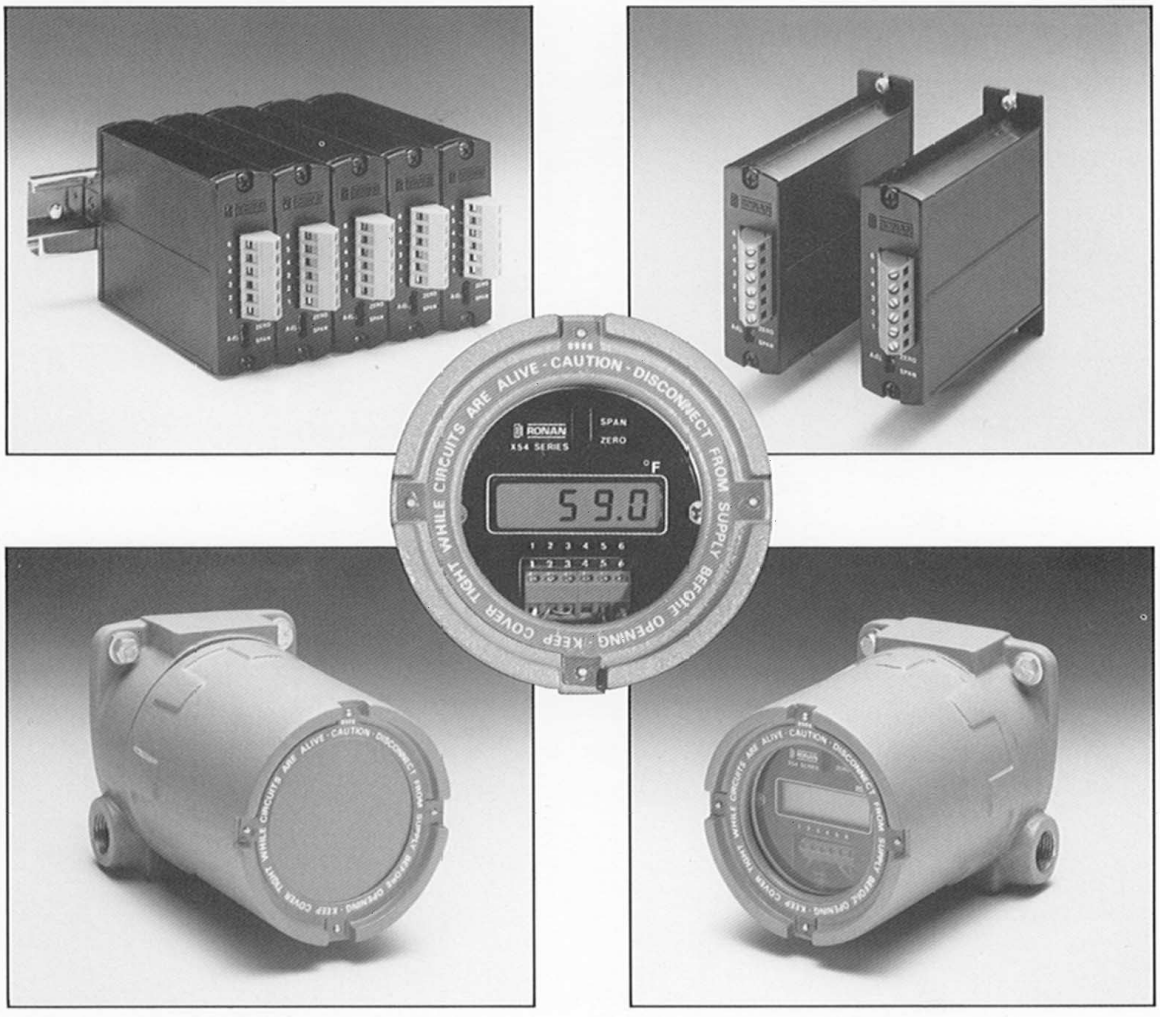
Instructions
and
Operating Manual

SERIES X54

THERMOCOUPLE, mA, mV, V ISOLATED 2-WIRE TRANSMITTERS



RONAN

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WARRANTY

1.0 GENERAL DESCRIPTION

The Ronan Series X54-210 two-wire transmitter design utilizes state of the art, micropower, solid-state devices, holding the internal current consumption to less than the zero span current of 4 mA. The available options such as linearized output, integral 3-1/2 or 4-1/2-digit LCD, local readout and various types of housings and mountings, establish the X54-200 Series as one of the most versatile transmitter lines on the market. The input\output transformer-isolated transmitter provides very accurate measurements, immune to ground loop currents, while grounding both the signal source and the output instrumentation or the power supply.

The transmitters are available in various types of housings, such as: explosion-proof NEMA Type 7, suitable for Class I, Division 1, Groups B, C and D locations (X54-210, -220), NEMA Type 4 weatherproof for indoor/outdoor installation or general purpose.

The general purpose, aluminum extrusion housing is suitable for direct surface mounting (X54-215, -225) or rail mounting (X54-216, -226). Front-mounted compression-type terminals allow convenient sensor and output lead connections.

The transmitter, mounted in the explosion-proof housing, is available with a 3-1/2 or 4-1/2-digit LCD readout and linearized output. The readout indicates temperature or engineering units scaled to customer requirements. Scaling can be altered by the use of range plugs (DIP headers), which are available from Ronan and are easily installed in the field.

The Model X54-210 thermocouple transmitter has an integral cold reference junction to match the specified thermocouple type.

The transmitter output current is jumper-selectable in two ranges: 4-20 mA and 10-50 mA. The high impedance of the output current stage enables the transmitter to maintain its accuracy with wide dc voltage variations in the power/output leads. The operating voltage may vary from 12 to 60 Vdc. To determine the maximum loop resistance use the equation in Section 2.0.

2.0 SPECIFICATIONS

NOTE: Specifications apply to an ambient temperature of 25°C ±2°C unless otherwise stated. Specifications subject to change without notice.

Inputs:
X54-210 Series: Thermocouple Type E, J, K, T, R, S.
X54-220 Series: mV or mA.

Input Impedance:
mV or T/C input >10 Mohms.
mA input <25 ohms – develops 100 mV full-scale input span for all current inputs.

Span Adjustment: Front-accessible, multi-turn, infinite resolution potentiometer permits ±10% adjustment.

Zero Adjustment: Front-accessible, multi-turn, infinite resolution potentiometer permits ±10% adjustment.

Input Open Circuit Response (T/C and mV Inputs): Upscale drive standard; downscale drive optional.

Calibrated Accuracy: ±0.1% of span plus linearization.

Isolation: Input and output circuits isolated from power and each other by transformers.

Common Mode Rejection: >130 dB, at 60 Hz.

Common Mode Voltage: 600 Vdc or peak ac maximum without damage.

Ambient Temperature Coefficient:
Ambient Temperature Range: –10°F to 175°F (–20° to 80°C).
Gain: < ±0.02%/°F [±0.01%/°F from +32° to 158°F (0° to 70°C)].
Zero: < ±2 µV/°F referred to input.
Reference Junction: < ±2 µV/°F from +40° to 120°F.

Operating Ambient Temperature Range:
Two-wire Transmitter:
–20° to 175°F (–25° to 80°C).
Liquid Crystal Display:
–20° to 175°F (–25° to 80°C).

Output: Standard 4-20 mA or 10-50 mA, jumper-selectable.

Load Effect: < .05% change in output current for load variation from short circuit to maximum resistance at 24 Vdc.

Power Supply Range: 12 to 60 Vdc (4 to 20 mA out); 12 to 60 Vdc (10 to 50 mA out).

Power Supply Effects: <±0.01% of range for a ±10 V change.

Maximum Loop Resistance versus Power Supply Voltage (PSV):
4-20 mA Range:
$$\text{R loop maximum} = \frac{\text{PSV} - 12\ \text{V}}{20\ \text{mA}}$$

10-50 mA range:
$$\text{R loop maximum} = \frac{\text{PSV} - 12\ \text{V}}{50\ \text{mA}}$$

Display Module:
LCD digit size 0.35" (9 mm).
Optimal view angle 60°.

Radio Frequency Effects: <0.4 mV (referred to input), +0.2% of span (referred to output) when

exposed to 5 W transmitter with frequency range 20-460 MHz at a distance of 1 m.

Terminals: Compression type, wire size 14 AWG max., 10 A max., 300 V max.

Weight:
General Purpose Housing: 0.5 lbs. (0.23 kg).
Explosion-proof Housing: 4.2 lbs. (1.88 kg).

3.0 CIRCUIT OPERATION

3.1 General Circuit Operation (See Figure 1)

The basic two-wire transmitter consists of a DC-DC power supply, a voltage reverence V_S, an imput amplifier A1, an output current amplifier A2, a voltage-controlled current source I_S, an output sensing resistor RA, and transfomer T2 with two analog switches for modulation/ demodulation to provide input/output isolation.

The power supply derives its operating voltage from the drop across V_S. This voltage powers an oscillator which drives T1 to provide the required operating voltages.

The input signal is applied to A1 which provides the correct gain and offset for the desired input span. The output is switched through "M" to T2. The output of T2 is demodulated by "D" and applied to A2. Resistor RA senses the output current and provides a feedback to A2 to control the current source I_S. Fuse F1 protects the output/power supply circuitry from a reversed power connection.

3.2 Detailed Circuit Description (See Drawing X54-1000)

The input signal is applied to amplifier U2. R5 or R6 is used to provide upscale or downscale indication with an open input. The gain of U2 is determined by resistors RN1(8-9), R3, and gain potentiometer R1. A positive offset is added by RN1(7-10) to provide an output from U2 of typically 0.2 to 1.0 volts.

An external reference junction resistor is connected between "–" and "RJR" terminals and, along with RN1(3-14), RN1(4-13), RN1(5-12), R4, R24, and potentiometer R2, provides cold junction compensation and zero adjustment.

If the linearizer circuit is not used, the output of U2 is passed through U4B to Q2. (See Section

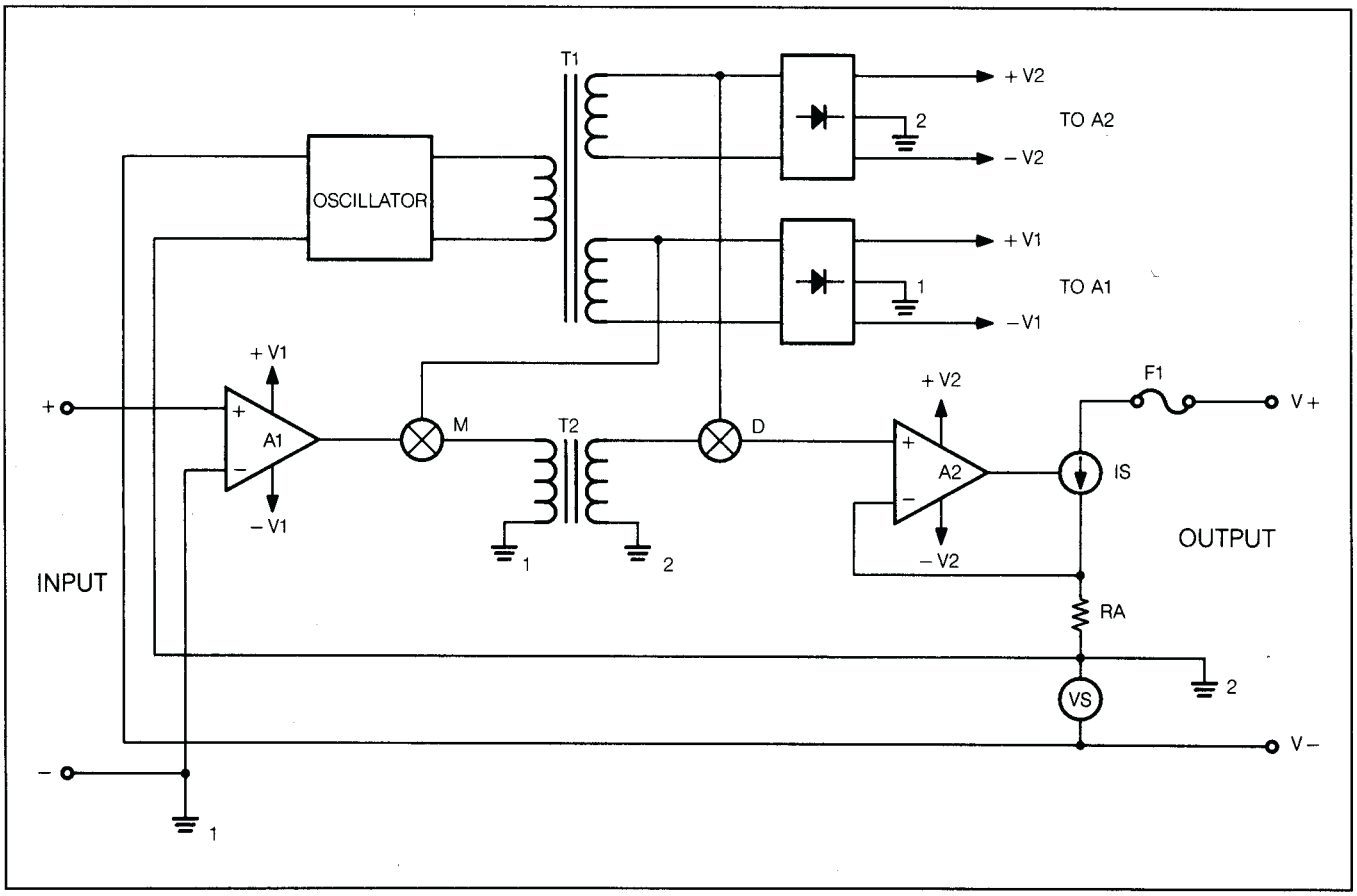


Figure 1: Simplified Block Diagram.

3.3 for a description of the linearizer.) Transistor Q1 is switched by the power supply transformer to drive T2 with pulses which are proportional in amplitude to the input signal. On the secondary side, Q2 is driven by a separate, isolated winding of T1 to sample the pulses in phase with the input. The demodulated signal is filtered by R14, C13 and applied to U5.

The current output stage consists of op-amp U5, FET Q3, and current-sense resistor R21. The output current develops a voltage across R21 which is fed back to U5 to control the current through Q3. The developed sense voltage is .1 to .5 volts. For a 10 to 50 mA output, jumper "5" is used to reduce the sense resistance so the developed sense voltage is kept at .1 to .5 volts. Q4 and R23 are used to limit the output current. When the output exceeds approximately 65 mA, Q4 begins to conduct and pull down the input at U5-pin 3 to prevent any further increase in output current.

The two-wire operating voltage is applied to pins V+ and V–. Fuse F1 protects the circuitry from a reversed power connection. The voltage drop across zener diode D12 is used to power oscillator U1, C9 and R12 which drives T1 to produce the required operating voltages. When two-wire voltage is first applied, current sources D1 provides a small current for D12 to allow normal circuit operation so Q3 can begin conducting.

3.3 Linearizer Circuit Description

In applications where a linear output is required, a linearizer circuit is used to compensate for the non-linearity of the input sensor. The linearizer circuit operates by providing gain and offset changes to amplifier U4B.

Linearization is accomplished by dividing the input span into five segments using quad op-amp U3, and its associated components, and linearizing each segment. Since each amplifier operates the same, the following description will refer only to U3A.

The signal from U2 is applied through input resistor RN2(2-15) to the summing junction of U3A and to U4B through R7. A fixed current is taken from U3-2 through resistor RN3 and below the break point, a smaller current is supplied to this summing junction through RN2(2-15). The larger offset current through RN3 causes the output of U3 to go positive, supplying current through D8 to balance the currents at the summing junction. As the current through RN2(2-15) becomes larger, the current through D8 becomes less. When the current through RN2(2-15) becomes slightly larger than that going through RN3, the output of U3 will go to a negative voltage level and start drawing current from the summing junction through RN4 and D9. When the transition from a positive to a negative voltage occurs, this segment of the linearizer starts to modify, or linearize, the primary signal at U4B through RN2(7-10). An increase or a decrease in the gain is selected by jumper "1".

3.4 Display Modules

3.4.1 3-1/2-Digit Display Module (See Drawings X54-1001 and X54-1002): The X54 3-1/2-digit display module consists of two boards: the X54-1001 display board and the X54-1002 interface board. The display board contains the analog to digital converter (ADC) and the liquid crystal display (LCD). The interface board contains the circuitry to change the offset and gain and the decimal point drivers. The operating voltages for both boards is derived from the 7-8 winding of T1 on the transmitter board.

The signal for the display is taken from across R26 on the transmitter. This signal is applied to a divider consisting of RN1(2-13) and RN1(1-14) on the interface board. The ratio of this divider is determined by the desired readout range. RN1(7-8), CR2 and RN1(3-12), CR1 provide a stable ±2.5 volts which, through potentiometer R4, RN1(4-11) and RN1(6-9) or RN1(5-10) provide the required offset to the signal. Potentiometer R3 with R1 and R2 provides an adjustable 1 volt reference for the ADC on the display board. U1 inverts the backplane signal from the LCD board and provides for the display of one of two decimal points, if required.

The conditioned signal is then applied to the input of the ADC (U1) on the display board. The ADC uses the dual-slope conversion method to give a stable and accurate display. With a 1 volt reference, the display will be "1999" for a 1.999 volt input.

3.4.2 4-1/2-Digit Display Module (See Drawings X54-1012 and X54-1013): The X54 4-1/2-digit module consists of two boards: the X54-1012 display board and the X54-1013 interface board. The display board contains the analog to digital converter (ADC) and the liquid crystal display (LCD). The interface board contains the circuitry to change the offset and gain and the decimal point drivers. The operating voltages for both boards is derived from the 7-8 winding of T1 on the transmitter board.

The signal for the display is taken from across R26 on the transmitter. This signal is applied to a divider consisting of HDR1(7-8) and HDR1 (6-9) on the interface board. The ratio of this divider is determined by the desired readout range. HDR1(4-11), D2 and HDR1(2-13), D2 provide a stable ±2.5 volts which, through potentiometer R2, HDR1(5-10) and HDR1(1-14) or

HDR1(3-12) provide the required offset to the signal. Potentiometer R2 with R3 and R4 provide an adjustable 1 volt reference for the ADC on the display board. U1 inverts the back-plane signal from the LCD board and provides for the display of one of three decimal points, if required.

The conditioned signal is then applied to the input of the ADC (U1) on the display board. The ADC uses the dual-slope conversion method to give a stable and accurate display. With the "2V" jumper installed and a 1 volt reference, the display will be "19999" for a 1.9999 volt input. With the 2 V jumper not installed, "19999" will be displayed for a 199.99 mV input.

4.0 CALIBRATION

Calibration of the X54-200 series transmitter entails adjusting the zero and span potentiometers for the correct output currents when an accurate input signal is applied.

4.1 Thermocouple Input Model X54-210

An accurate thermocouple simulator should be used to provide the calibration input signal. Connect its output directly to the transmitter's input terminals using the correct type of thermocouple wire. If a thermocouple simulator is not available, an accurate millivolt source and ice point reference may be used as shown in Figure 2.

To measure the output current, an accurate milliammeter is connected in the output current loop as shown in Figure 2.

To perform the calibration, begin by setting the input to the zero of the transmitter's span (e.g. for a 100° to 500°C span, set the thermocouple simulator to provide the equivalent of a 100°C output). Some temperatures and outputs for various thermocouples are shown in Table 1. Adjust the front panel ZERO control to obtain

Temp. °C	Thermoelectric Voltage in Millivolts Reference Junction at 0°C					
	E	J	K	T	R	S
0	0.000	0.000	0.000	0.000		
+50	3.047	2.585	2.022	2.035		
+100	6.317	5.268	4.095	4.277		
+150	9.787	8.008	6.137	6.702		1.029
+200	13.419	10.777	8.137	9.286		1.440
+250	17.178	13.553	10.151	12.011	1.923	1.873
+300	21.033	16.325	12.207	14.860	2.400	2.323
+350	24.961	19.089	14.292	17.816	2.896	2.786
+400	28.943	21.846	16.395	20.869	3.407	3.260
+450	32.960	24.607	18.513		3.933	3.743
+500	36.999	27.388	20.640		4.471	4.234
+550	41.045	30.210	22.772		5.021	4.732
+600	45.085	33.096	24.902		5.582	5.237
+650	49.109	36.066	27.022		6.155	5.751
+700	53.110	39.130	29.128		6.741	6.274
+800	61.022		33.277		7.949	7.345
+900	68.783		37.325		9.203	8.448
+1000	76.358		41.269		10.503	9.585
+1200					13.224	11.947
+1400					16.035	14.368
+1600					18.842	16.771
+1700					20.215	17.942

Table 1: T/C Voltages vs. Temperature Reference: Thermocouple Reference Table National Bureau of Standards.

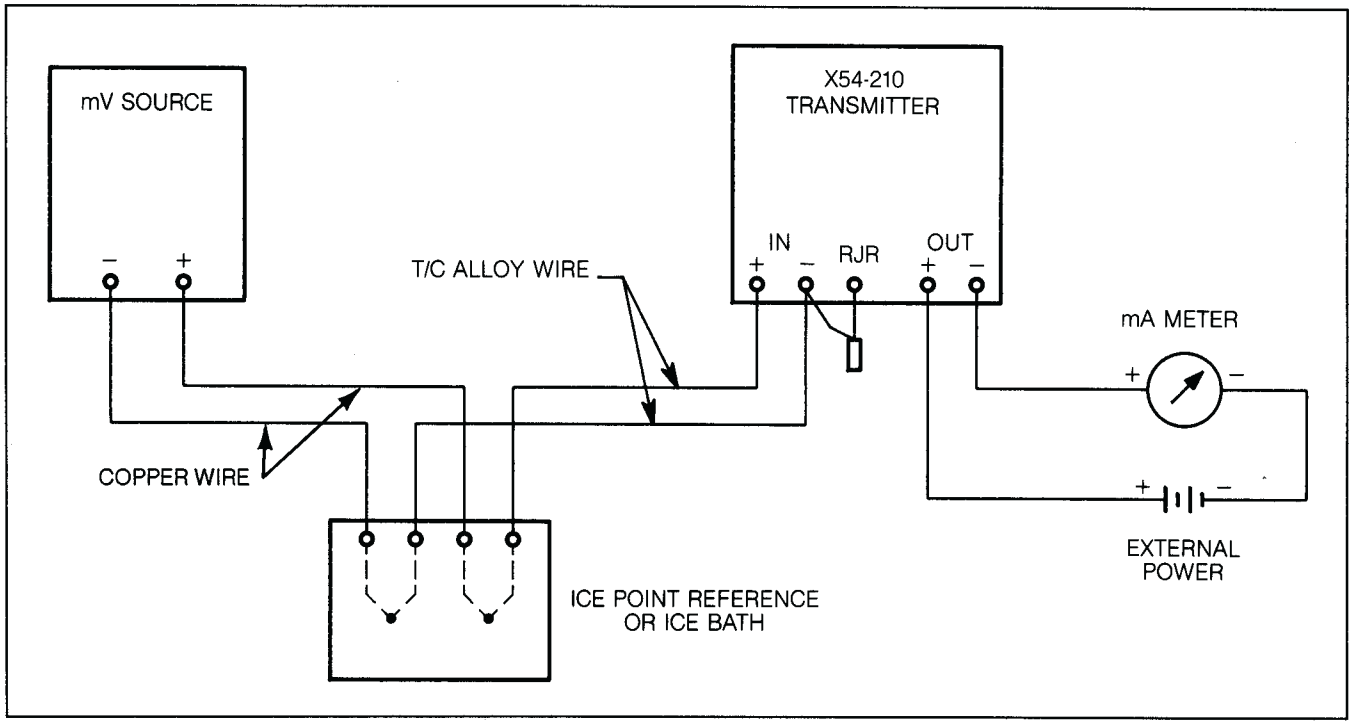


Figure 2: Connection for mA, mV or V Calibration.

an output current of 4 mA (or 10 mA for a 10-50 mA output). Change the input simulator to the full-span value and adjust the front panel SPAN control to obtain a 20 mA (or 50 mA) output. Repeat until both zero and full-span outputs are correct. Several mid-span values should also be checked to verify proper operation of the transmitter.

4.2 mA, mV Input – Model X54-220

The calibration procedure for the mA, mV input transmitter is the same as for the thermocouple transmitter except that a voltage or current source is used in place of the thermocouple simulator.

A convenient and accurate method for calibrating the transmitter is to use a calibrator such as the Ronan Model X86. Connect the X86 to the transmitter as shown in Figure 3. The input span and zero are easily set on the X86 and the output is monitored on the same unit.

4.3 3-1/2-Digit Display

The 3-1/2-digit display module is calibrated separately from the transmitter. Before the display module is calibrated, the calibration of the transmitter must be verified.

With the transmitter at the zero of its span, adjust potentiometer R4 on the X54-1002 printed circuit board for the zero of the display range (not necessarily the same as the transmitter range). Set the transmitter to full-span and adjust the potentiometer R3 for the correct display. Repeat if necessary.

4.4 4-1/2-Digit Display

The 4-1/2-digit display module is calibrated separately from the transmitter. Before the display module is calibrated, the calibration of the transmitter must be verified.

With the transmitter at the zero of its span, adjust potentiometer R1 on the X54-1013 printed circuit board for the zero of the display range (not necessarily the same as the transmitter range). Set the transmitter to full-span and adjust potentiometer R2 for the correct display. Repeat if necessary.

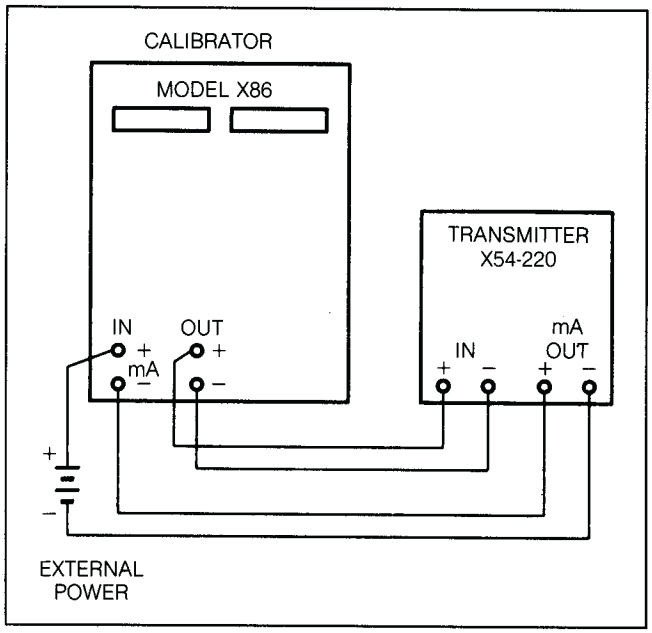


Figure 3: Connection for mA Calibration.

5.0 TROUBLESHOOTING/REPAIR

The Model X54 transmitter may be removed from the housing without disconnecting any external wiring, allowing easy access to all circuit components. Visually inspect the boards(s) for any obvious damage to the components.

The troubleshooting procedure should be started with a check of the loop voltage and the compliance with the connections as shown in Figure 2 or 3.

A plug-in replaceable fuse is located on the printed circuit board which protects against a reversal of the applied power. The module will not draw any current when this fuse is open.

When troubleshooting always apply an input signal that is within the operating range of the unit under test and monitor the output signal. If power is properly applied, trace the signal from the input toward the output following the test sequence in Table 2.

For additional support refer to "Detailed Circuit Description" in Section 3.

Test Step	Test Points	Expected Test Value	Test Equipment	Notes
10 V power to oscillator U1	Across CR12	9.5 to 10.5 V	DC voltmeter	
Oscillator U1 output	U1, pins 8, 9 10 or 11 to pin 7	Square wave approximately 100 KHz	Scope	10 V peak
Input amplifier power supply	Cathode CR14 to ground 1	Approximately 4 Vdc	Scope	Ripple should be unobserved except for thin spikes. If large ripple, suspect faulty filter cap C16 or input circuit.
Input amplifier power supply	Anode CR13 to ground 1	Approximately –4 Vdc	Scope	Ripple should be unobserved except for thin spikes. If large ripple, suspect faulty filter cap C17.
Output amplifier power supply	Cathode CR15 to ground 2	Approximately 4 Vdc	Scope	Ripple should be unobserved except for thin spikes. If large ripple, suspect faulty filter cap C15 or output circuit.
Output amplifier power supply	Anode CR16 to ground 2	Approximately –4 Vdc	Scope	Ripple should be unobserved except for thin spikes. If large ripple, suspect faulty filter cap C14.
Input amplifier response	U2, pin 6 ground 1	Direct response to an in-range input signal	Scope or DC voltmeter	In-range signal is approximately .2 to 1.0 Vdc
Modulator/ Demodulator response	Across C7	Direct response to an in-range input signal	Scope or DC voltmeter	In-range signal is approximately .2 to 1.0 Vdc
Modulator/ Demodulator response	U5, pin 3 to ground 2	Direct response to an in-range input signal	Scope or DC voltmeter	In-range signal is approximately .1 to .5 Vdc
Output amplifier response	Current loop	In-range output current	DC milliammeter	Using ZERO and SPAN controls, a full-scale reading should be obtained.

Table 2: Transmitter Test Sequence.

PARTS LIST–THERMOCOUPLE TRANSMITTER

Model X54-1000

Item	Qty.	Ident.	Description	Part No.	Mfg.
1	1		PC Board	X54-1000F	Ronan
2	1	R23	Resistor, M.F., 1%, 6.19 ohm	RN55C6R19F	Mepco
3	1	R22	Resistor, M.F., 1%, 16.9 ohm	RN55C16R9F	Mepco
4	1	R21	Resistor, M.F., 1%, 24.9 ohm	RN55C24R9F	Mepco
5	1	R4	Resistor, M.F., 1%, 1.00 k	RN55C1001F	Mepco
6	1	R24	Resistor, M.F., 1%, 249 ohm	RN55C2490F	Mepco
7	3	R7, 9, 11	Resistor, M.F., 1%, 10.0 k	RN55C1002F	Mepco
8	1	R12	Resistor, M.F., 1%, 75.0 k	RN55C7502F	Mepco
9	1	R3	Resistor, M.F., 1%, 1.27 k	RN55C1271F	Mepco
10	1	R25	Resistor, 1.4 W, 5%, 5.6 ohm	RC07GF5R6J	AB

PARTS LIST–THERMOCOUPLE TRANSMITTER (CONT.)

Model X54-1000

Item	Qty.	Iden.	Description	Part No.	Mfg.
11	2	R27, 28	Resistor, 1/4 W, 5%, 15 ohm	RCO7GF150J	AB
12	1	R10	Resistor, 1/4 W, 5%, 220 ohm	RC07GF221J	AB
13	1	R19	Resistor, 1/4 W, 5%, 2.2 k	RC07GF222J	AB
14	2	R14, 26	Resistor, 1/4 W, 5%, 4.7 k	RC07GF472J	AB
15	1	R18	Resistor, 1/4 W, 5%, 3.9 k	RC07GF392J	AB
16	1	R15	Resistor, 1/4 W, 5%, 6.8 k	RC07GF682J	AB
17	2	R13, 16	Resistor, 1/4 W, 5%, 470 k	RC07GF474J	AB
18	1	R5	Upscale: 68 M, 5% Downscale: Not Used	RC07GF686J	AB
19	1	R6	Upscale: Not Used Downscale: 68 M, 5%	RC07GF686J	AB
20	1	C10	Capacitor, Mica 20 pF	200R501M05	Arco
21	1	C11	Capacitor, Mica 47 pF	470R501M05	Arco
22	1	C9	Capacitor, Mica 82 pF	820R501M05	Arco
23	1	C12	Capacitor, Mica 820 pF	821R301M05	Arco
24	1	C3	Not Used		
25	4	C14, 15, 16, 17	Capacitor, Ceramic, .1/50 V	104R500C20	Kemet
26	7	C2, 4, 5, 7, 19, 20, 21	Capacitor, Ceramic, .1 M.F.	104A101C20	Unitrode
27	1		Capacitor, Ceramic, .001/1 KV	102R102C20	Sprague
28	1	C18	Capacitor, Ceramic, 1/50 V	105R500C20	Sprague
29	2	C6, 8	Capacitor, Ceramic, .05 µF/50 V	503R500C20	Sprague
30	2	C1, 13	Capacitor, Ceramic, .22/50 V	224R500C10-R	Kemet
31	2	Q1, 2	FET-N-Channel	2N4393	Motorola
32	1	Q4	Transistor, NPN	2N6715-5	National
33	1	Q3	DMOS Power FET	VN0109N5	Supertex
34	1		Heat Sink	X54B122	Thermalloy
35	2	D2, 3	Diode, Voltage Ref., 2.5 V	LM385Z-2.5	National
36	1	D12	Diode, Zener. 10 V	1N4740A	Motorola
37	1	D19	Diode, Rectifier	1N4148	Motorola
38	1	D1	Current Source, 2.7 mA	1N5308	Motorola
39	4	D13, 14, 15, 16	Diode, Germanium	1N270	Knox
40	2	D17, 18	Diode, Zener	1N961B	Motorola
41	1	U2	Op Amp	OP07CP	PMI
42	1	U4	Dual Op Amp	LF442CN	National
43	1	U5	Op Amp	LM308N	National
44	1	U1	Hex Inverter	74C14N	National
45	1	T1	Transformer	EPA-1144	PCA

PARTS LIST–THERMOCOUPLE TRANSMITTER (CONT.)

Model X54-1000

Item	Qty.	Iden.	Description	Part No.	Mfg.
46	1	T2	Transformer	EPA-1143	PCA
47	2	F1	Socket	450-3703-01-04-00	Cambion
48	1	F1	Fuse, 125 mA	273.125	Little Fuse
49	1		Screw, 4-40 x 3/8, Flathead		Phillip
50	1		Lock Washer, Split	#4	
51	1		Nut, Small Pattern	#4	
52	1	RN1	Socket, 16 Pin	16-511-11	Aries
53	1	RN1	Header, 16 Pin	16-600-11	Aries
54	1	RN1	Cover, 16 Pin	16-650-10	Aries
55	1		Connector, Dual 6 Pin	535512-1	Amp
56	2	5	Line Plug, 2 Pin	CAS36SP100230430	RNI
57	1	J5	4-20 mA: Not Used 10-50 mA: Shunt	531220-2	
58	1	R1	Potentiometer, 500 ohm	89PR500	Beckman
59	1	R2	Potentiometer, 50 k	89PR50K	Beckman
			Parts for Linearized Output		
60	1	U3	Quad Op Amp	LM346N	National
61	2	R17, 20	Resistor, 1/4 W, 5%, 3.3 M	RC07GF335J	AB
62	1	R8	Resistor, M.F., 1%, 10.0 k	RN55C1002F	Mepco
63	1	RN3	Resistor, Network, 49.9 k	RKH5BP4992F	Speer
64	1	RN4	Resistor, Network, 4.99 k	RKH4SP4991F	Speer
65	8	CR4, 5, 6, 7, 8 9, 10, 11	Diode, Low Leakage	1N457A	Fairchild
66	1	RN2	Socket, 16 Pin	16-511-11	Aries
67	12	1, 2, 3, 4	Line Plug, 3 Pin	CAS36SP100230430	RNI

PARTS LIST–3-1/2-DIGIT DISPLAY BOARD

Model X54-1001

Item	Qty.	Ident.	Description	Part No.	Mfg.
1	1	PCB	LCD Display Module	X54-1001C	Ronan
2	1	LCD	3-1/2-Digit LCD	33D9R02GHJ or 3937-363-020	Epson or Hamlin
3	1	U1	3-1/2-Digit LCD Driver	ICL7126CPL	Intersil or Teledyne
4	1	U1	40 Pin IC Socket	D1LB40P-11	CA
5	2	R1, 5	Resistor, 5%, 1/4 W, 15 ohm	RC07GF150J	AB
6	1	R2	Resistor, 1%, 1/4 W, 237 k	RN55C2373F	Mepco

PARTS LIST–3-1/2-DIGIT DISPLAY BOARD (CONT.)

Model X54-1001

Item	Qty.	Ident.	Description	Part No.	Mfg.
7	1	R3	Resistor 5%, 1/4 W, 2.4 Mohm	RC07GF245J	AB
8	1	R4	Resistor 1%, 1/4 W, 750 ohm	RN55C7500F	Mepco
9	1	C2	Capacitor, Mica 47 pF	470R501M05	Sprague
10	2	C3, 4	Capacitor, Poly, 0.1 µF	104R101K10	Mepco
11	1	C6	Capacitor, Poly, 0.047 µF	473R251K10	Mepco
12	2	C1, 5	Capacitor, Ceramic, 0.1 µF	104A101C10	Kemet
13	1	PC Connector	Dual Row Header	10-89-2123	Amp

NOTE: All components on component side except the LCD (LCD on circuit side).

PARTS LIST–3-1/2-DIGIT INTERFACE BOARD

Model X54-1002

Item	Qty.	Ident.	Description	Part No.	Mfg.
1	1	PCB	X54 Interface Board	X54-1002D	Ronan
2	1	U1	CMOS, Hex Schmitt Trigger	74C14N	National
3	3	C1, 2, 3	Capacitor, Ceramic, .1 µF	104A101C20	Sprague
4	1	RN1	14 Pin Socket	CA-14LS2-10SD	CA
5	2		Connector	1716034	Phoenix
6	1	Header*	Dual 5 Pin Connector	86418-9	Amp
7	1	J1	Header, 6 Pin	6-910-11	Molex
8	1	J1**	Header, 6 Pin	X54B147	Ronan
9	2	CR1, 2	Diode, Voltage Reference	LM385Z-2.5V	National
10	1	R1	Resistor, M.F., 1%, 60.4 k	RN55C6042F	Mepco
11	1	R2	Resistor, M.F., 1%, 4.53 k	RN55C4531F	Mepco
12	1	R4	Potentiometer, 2M	89PR2M	Beckman
13	3	W1, 2, 3	Line Plug, 3 Pin	CAS36SP100230430	RNI
14		R3		89PR50K	Beckman
15	6		EMI, Filter Cap.	ME1214-001	Mu-Rata/Erie
16	1		Holder	X54B129	Ronan
17	2		4-40 x 3/8 Ph Pn Hd Screw		West Valley
18	2		Spacer	9015	H.H. Smith

* Item #11 is on circuit side. Other items are on component side.
** Install X54B147 in J1 positions 1 through 6.

PARTS LIST–TERMINAL CONNECTOR

Model X54-1003

Item	Qty.	Ident.	Description	Part No.	Mfg.
1	1	PCB	PC Board	X54-1003B	Ronan
2	2		Connector Block	1716034	Phoenix
3	1		Connector Pins	6-910-11	Aries
4*	1		#6		
5*	1		22 Gage Wire, 4", Green		

* NOTE:
Used only for X54-600. The lug is crimped on one end of the wire. The other end is soldered to Pin 4 of the connector clock (on back of board).

PARTS LIST–4-1/2-DIGIT DISPLAY BOARD

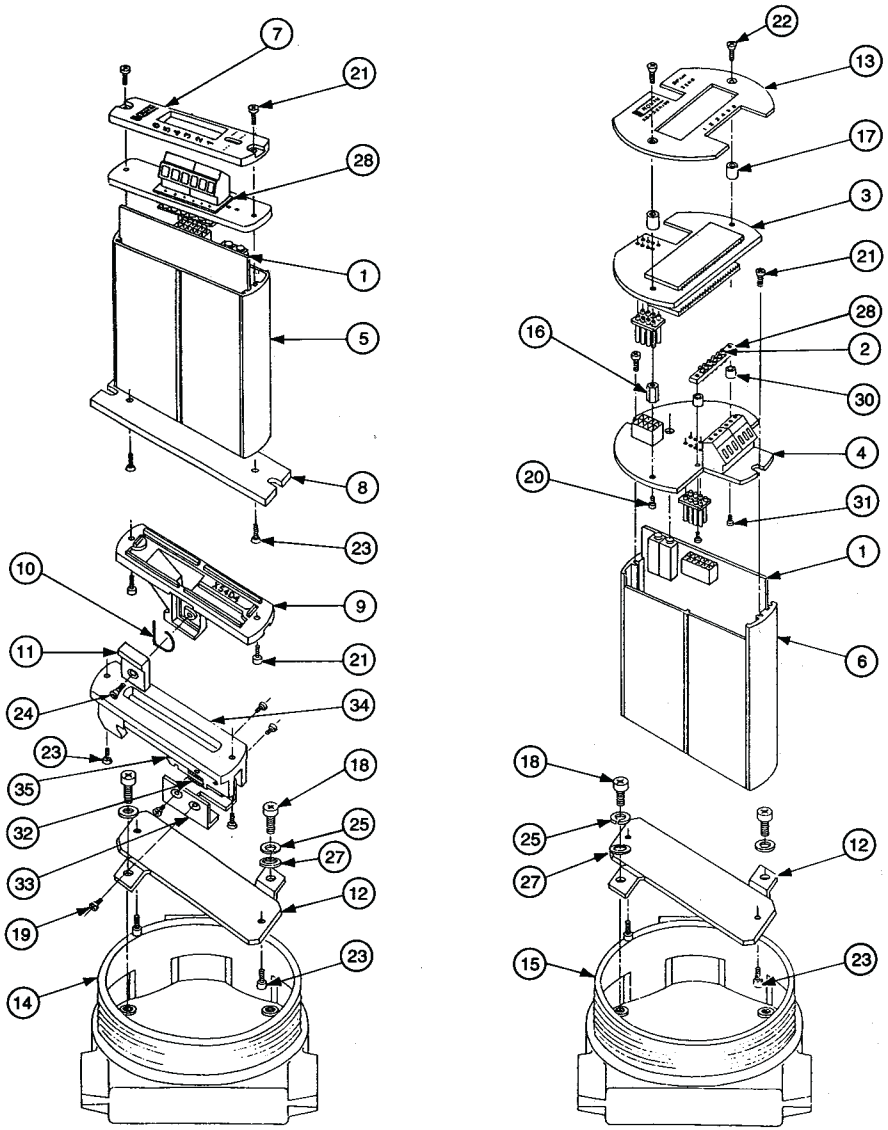
Model X54-1012

Item	Qty.	Ident.	Description	Part No.	Mfg.
1	1	PCB	PC Board	X54-1012B	Ronan
2	2	R5, 6	Resistor, 1/4, 5%, 150 ohm	RC07GF150J	
3	2	R1, 3	Resistor, 1/4 W, 5%, 100 k	RC07GF104J	AB
4	1	R2	Resistor, M.F., 1%, 15.4 k	RN55C1542F	Mepco
5	1	R4	Resistor, M.F., 1%, 80.6 k	RN55C8062F	Mepco
6	3	C5, 1, 2	Capacitor, Ceramic, .1/100 V	104A101C20	Unitrode
7	2	C3, 4	Capacitor, Polycarb, 1/50 V	105R500K05	ECI
8	1	C6	Capacitor, Mica, 47 pF	470R501M05	Arco
9	1	U1	4-1/2-Digit A/D	ICL7129ACPL	Maxim
10	1		4-1/2-Digit LCD	4201-363-020	Hamlin
11	1		Strip Line Plug, 3 Pin	4201-363-420 or CA-S36SP-230-430	Hamlin CA
12	1		Strip Line Plug, 2 Pin	CA-S36SP-230-430	CA
13	1	DP3, 4	Shunt	531220-2	
14	1		Header, 8 Pins	10-89-1243	

PARTS LIST–4-1/2-DIGIT INTERFACE BOARD

Model X54-1013

Item	Qty.	Ident.	Description	Part No.	Mfg.
1	1	PCB	PC Board	X54-1013B	Ronan
2	2	R3, 4	Resistor, M.F., 1%, 16.5 k	RN55C1652F	Mepco
3	2	C1, 2	Capacitor, Ceramic, .1/100 V	104A101C20	Unitrode
4	2	D1, 2	Diode, Voltage Reference	LM385-2.5V	National
5	1	R2	Potentiometer, 15 Turn, 50 k	89PR50K	Beckman
6	1	R1	Potentiometer, 15 Turn, 500 k	89PR500K	Beckman
7	1	J2	8 Pin Socket	86418-7	Amp
8	2	HDR1, 2	14 Pin Socket	CA-14LS2-105D	CA
9	6		EMI Filter Capacitor	ME1214-001	Mu-Rata/ Erie
10	1		Holder	X54B129	Ronan
11	2		4-40 x 3/8 Ph Pn Hd Screw		West Valley
12	2		Spacer	9015	HH Smith
13	1	J1	Header, 6 Pin	6-910-11	Molex
14	1	J1	Header, 8 Pin	X54B147	Ronan



Terminal Connector	T/C Input Type	RTD Input Type		mA Input Type
		Two-Wire	3-Wire	
Pin 1 to Pin 2				Loop Resistor 3.125 Ohm
Pin 2 to Pin 3	Compensation Resistor X80A209	Jumper 360-0017-03-00		

X54D23 (-1) (-2) (-3) (-4) (-5)

- (-5) Without LCD DIN-Rail Mounting Type TS-35 x 7.5
- (-4) With LCD Explosion Proof Housing
- (-3) Without LCD Explosion Proof Housing Mounting
- (-2) Without LCD DIN-Rail Mounting Type TS-32
- (-1) Without LCD Surface Mounting

Item	Quantity -1	-2	-3	-4	-5	Part Number	Description	Mfg.
1	1	1	1	1	1	X54-1000E	T/C Transmitter PCB Assy.	Ronan
	1	1	1	1	1	X54-1004E	RTD Transmitter PCB Assembly	Ronan
	1	1	1	1	1	X54-1005	Freq. Transmitter PCB Assembly	Ronan
2	–	–	–	6	–	ME1214-001	EMI Suppression Filter	Murate
3	–	–	–	1	–	X54-1001B/1012A	Display PCB Assembly	Ronan
4	–	–	–	1	–	X54-1002C/1013A	Interface PCB Assembly	Ronan
5	1	1	1	–	1	X54C7-3	Extrusion	Ronan
6	–	–	–	1	–	X54C7-2	Extrusion	Ronan
7	1	1	1	–	1	X54B128	Cover Modification	Ronan
8	1	–	–	–	–	X54B3	Surface Mounting Plate	Ronan
9	–	1	–	–	–	X54D4	DIN-Rail Mounting Bottom Cover	Ronan
10	–	2	–	–	–	X54B5	DIN-Rail Mounting Spring	Ronan
11	–	2	–	–	–	X54D4-1	Spring Retainer	Ronan
12	–	–	1	1	–	X54B8	Mounting Plate	Ronan
13	–	–	–	1	–	X54B9	LCD Cover Plate	Ronan
14	–	–	1	–	–	X1HDC	Exp. Proof Housing (Glass Top*)	Adalet
15	–	–	–	1	–	X1HDGC	Exp. Proof Housing (Solid Top*)	Adalet
16	–	–	–	2	–	9293	6-32 x 7/16" Hex Spacer	H. H. Smith
17	–	–	–	2	–	9207	1/4 O.D. x 3/16" Round Spacer	H. H. Smith
18	–	–	2	2	–		8-32 x 5/16" Ph Pan Hd Ms	
19	–	–	–	–	4		4-40 x 1/4" Ph Flat Hd Black Ms	
20	–	–	–	2	–		6-32 x 1/4" Ph Pan Hd Ms	
21	2	4	2	–	2		4-40 x 5/16" Ph Pan Hd Black Ms	
22	–	–	–	2	–		6-32 x 1/2" Ph Flat Hd 100° Csk Black Ms	
23	2	–	2	2	2		4-40 x 5/16" Ph Flat Hd Black Ms	
24	–	2	–	–	–		6-32 x 1/4" Ph Flat Hd Black Ms	
25	–	–	2	2	–		#8 Split Lock Washer	
27	–	–	2	2	–		#8 Flat Washer	
28	1	1	1	–	1	X54C127	RFI Module Assembly	Ronan
	–	–	–	1	–	X54B129	Filter Holder	Ronan
30	–	–	–	2	–	9015	Spacer	H. H. Smith
31	–	–	–	2	–		4-40 x 3/8 Ph Rd Hd Ms	
32	–	–	–	–	1	NN-37	Spring	Century Spring
33	–	–	–	–	1	X54B145	Locker Holder	Ronan
34	–	–	–	–	1	X54C146	X54 Base	Ronan
35	–	–	–	–	1	X54C168	Locker	Ronan

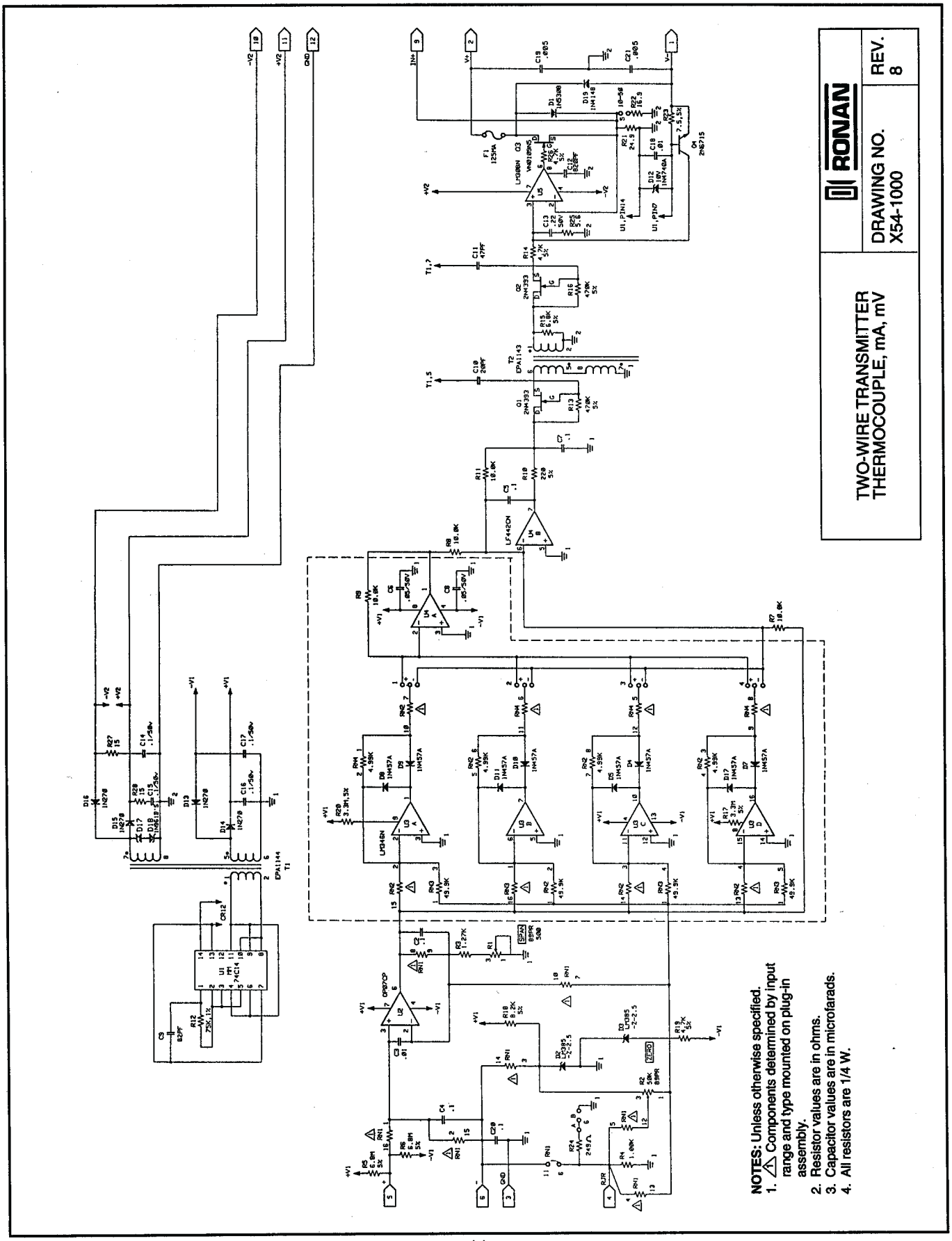
* Not Shown

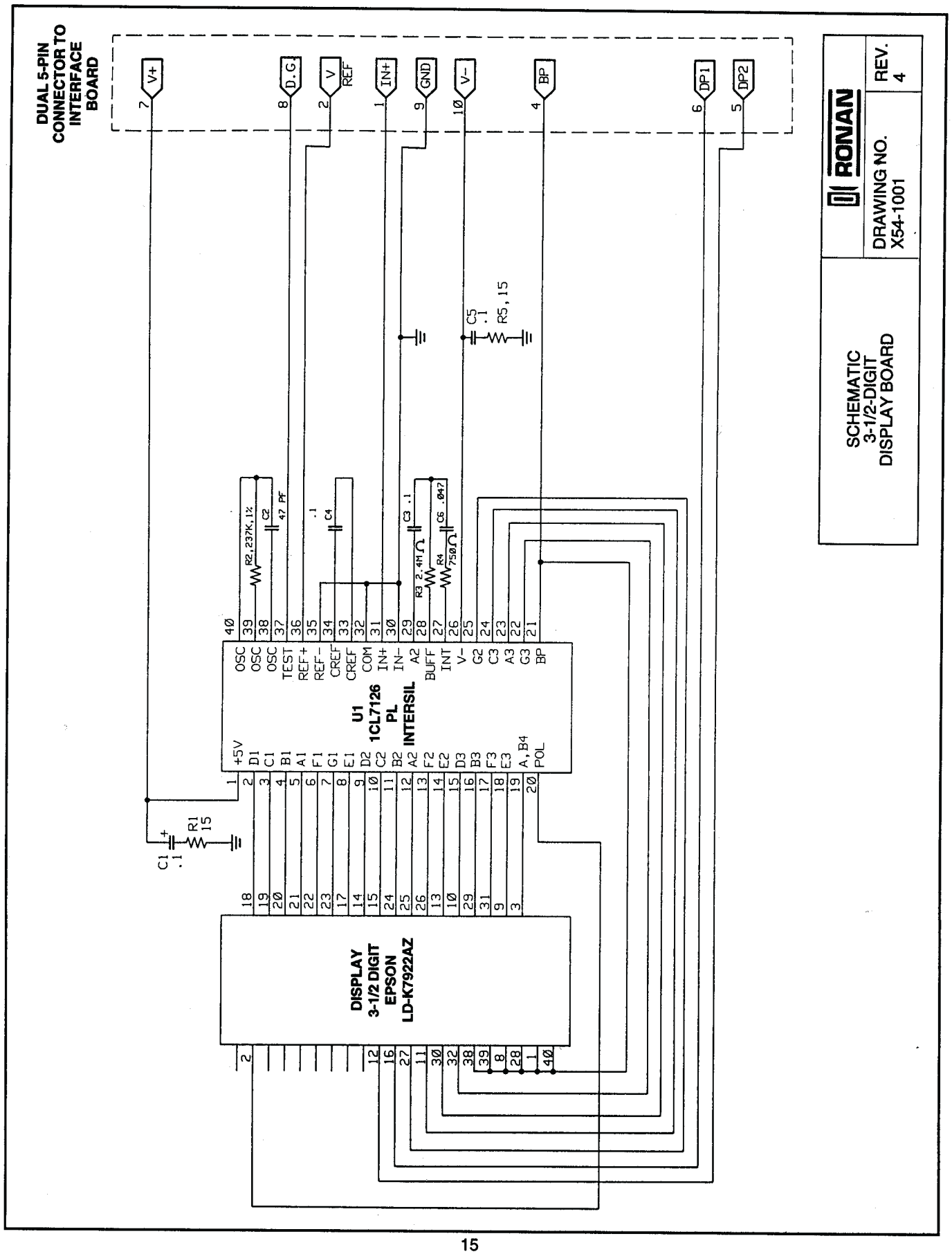
MECHANICAL AND ELECTRONIC ASSEMBLY X54 SERIES

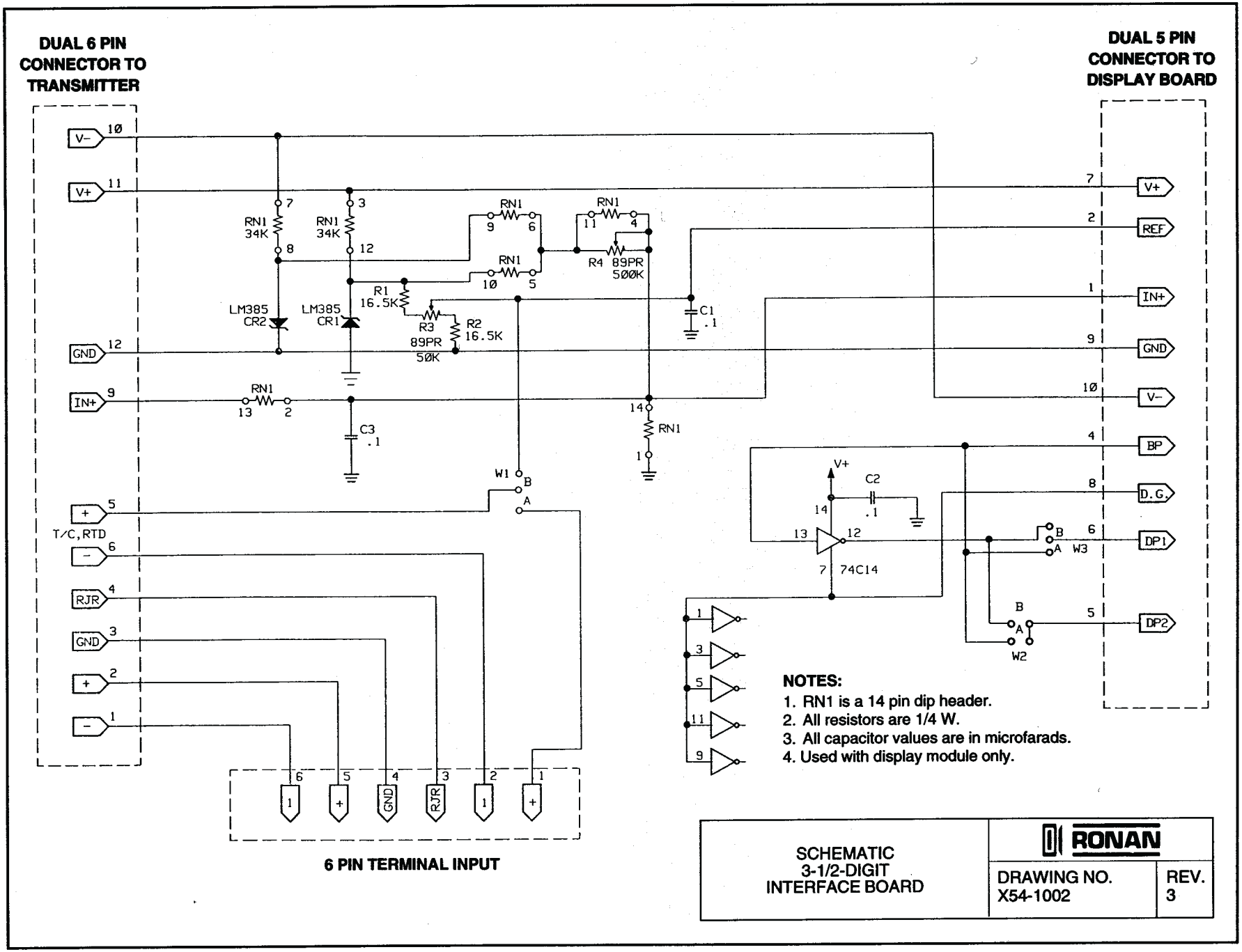
RONAN

DRAWING NO. X54D23

REV. 11


TWO-WIRE TRANSMITTER
THERMOCOUPLE, mA, mV
RONAN
DRAWING NO.
X54-1000
REV.
8
NOTES: Unless otherwise specified.
1. ⚠ Components determined by input range and type mounted on plug-in assembly.
2. Resistor values are in ohms.
3. Capacitor values are in microfarads.
4. All resistors are 1/4 W.


DUAL 5-PIN CONNECTOR TO INTERFACE BOARD
V+
D.G.
V REF
IN+
GND
V-
BP
DP1
DP2
U1 ICL7126 PL INTERSIL
DISPLAY 3-1/2 DIGIT EPSON LD-K7922AZ
SCHEMATIC 3-1/2-DIGIT DISPLAY BOARD
RONAN
DRAWING NO. X54-1001
REV. 4

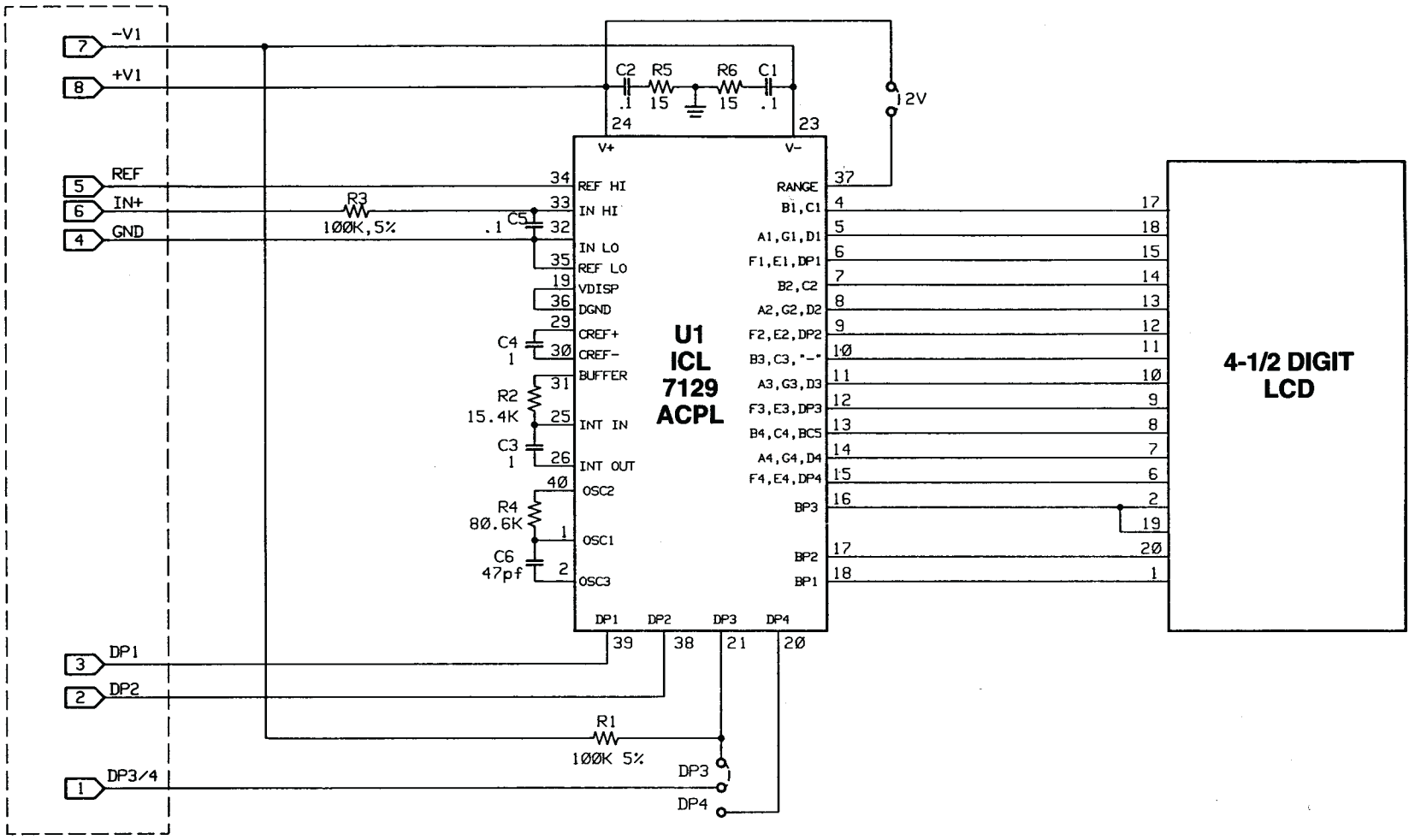


NOTES:

1. RN1 is a 14 pin dip header.
2. All resistors are 1/4 W.
3. All capacitor values are in microfarads.
4. Used with display module only.

SCHEMATIC 3-1/2-DIGIT INTERFACE BOARD	RONAN	
	DRAWING NO. X54-1002	REV. 3

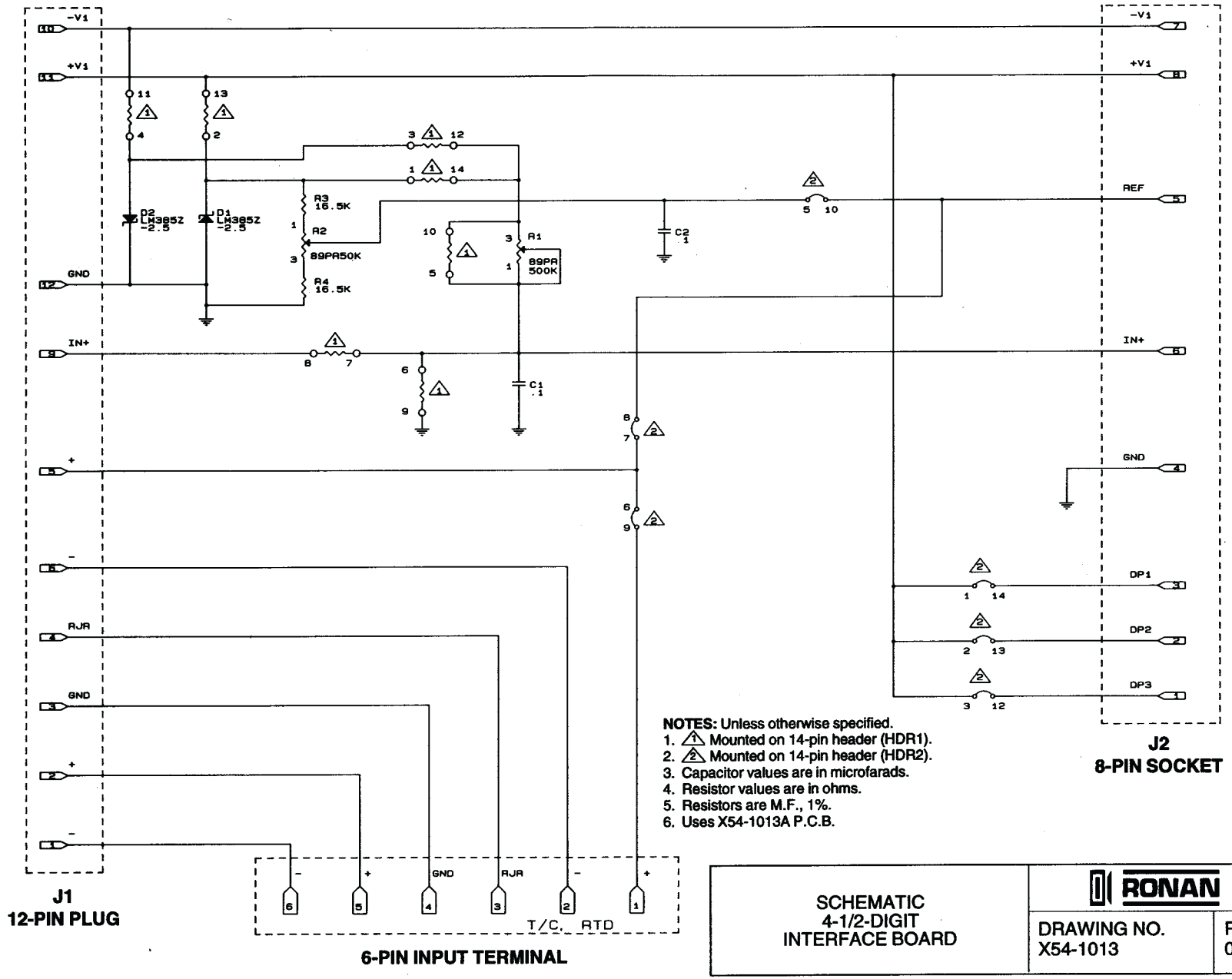
8 PIN PLUG



NOTES: Unless otherwise specified.

1. Capacitor values are in microfarads.
2. Resistor values are in ohms.
3. Resistors are M.F., 1%.
4. Uses X54-1012A P.C.B.

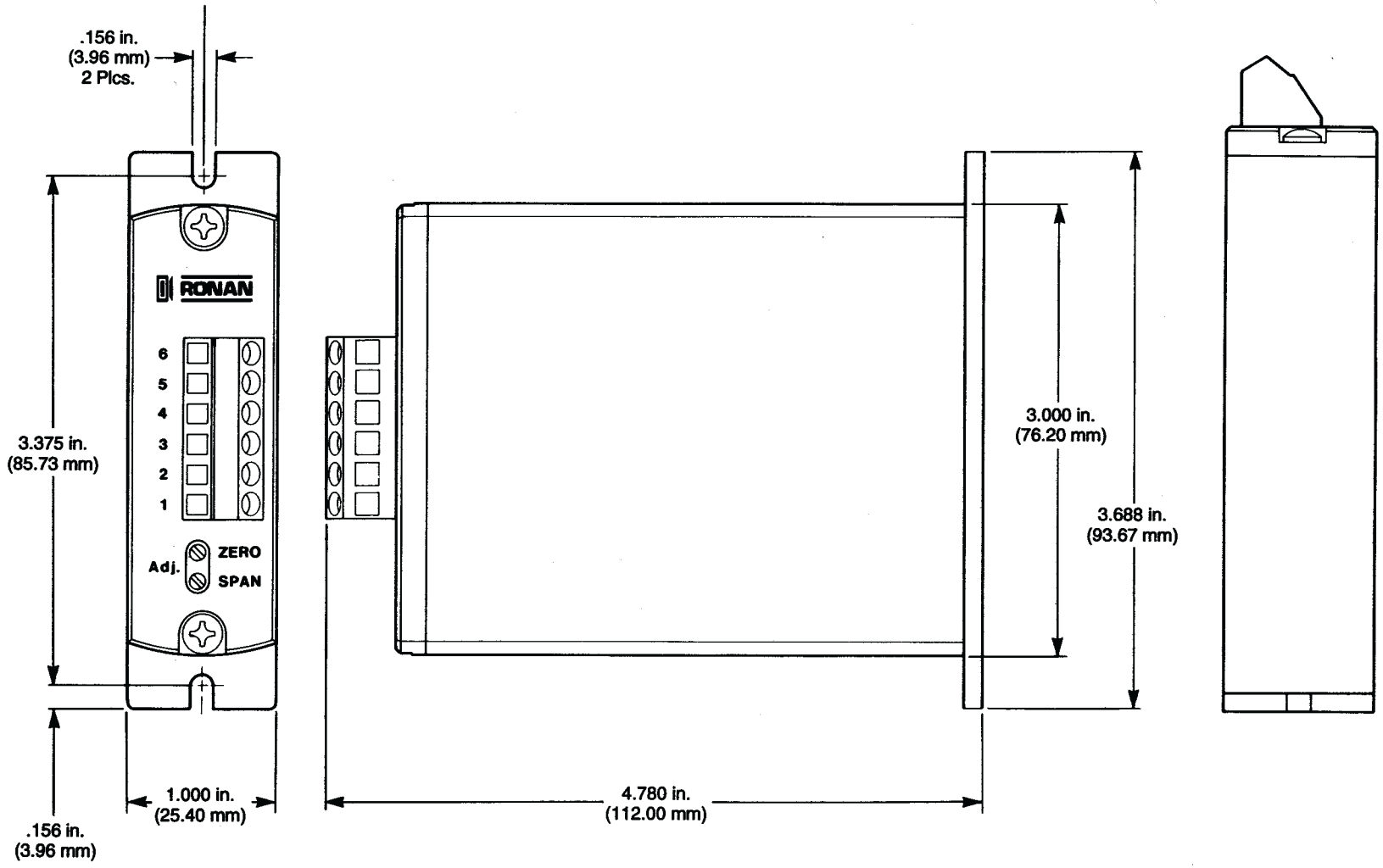
SCHEMATIC 4-1/2-DIGIT DISPLAY BOARD	RONAN	
	DRAWING NO. X54-1012	REV. 1



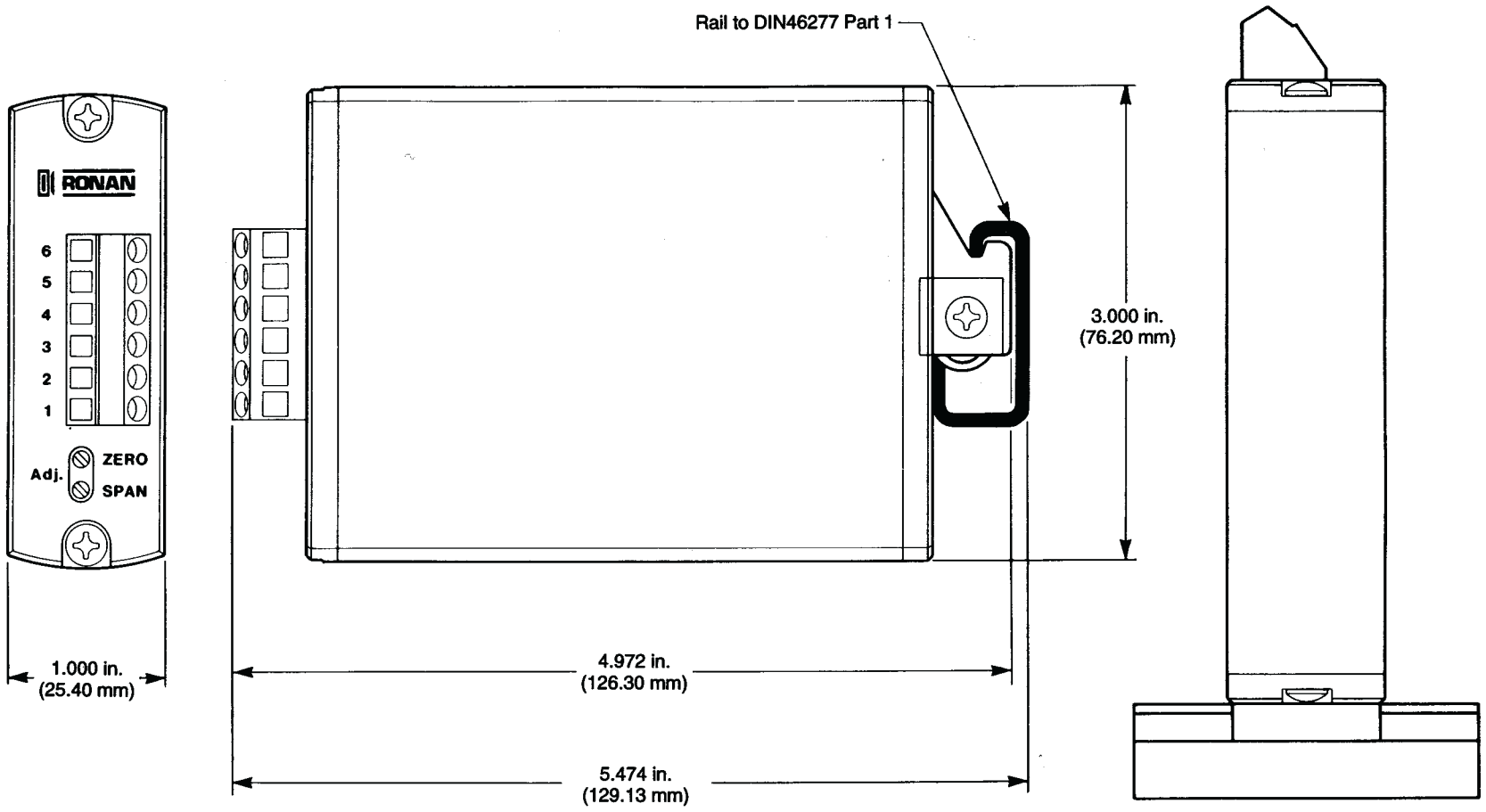
NOTES: Unless otherwise specified.

1. ⚠1 Mounted on 14-pin header (HDR1).
2. ⚠2 Mounted on 14-pin header (HDR2).
3. Capacitor values are in microfarads.
4. Resistor values are in ohms.
5. Resistors are M.F., 1%.
6. Uses X54-1013A P.C.B.

SCHEMATIC 4-1/2-DIGIT INTERFACE BOARD	RONAN	
	DRAWING NO. X54-1013	REV. 0

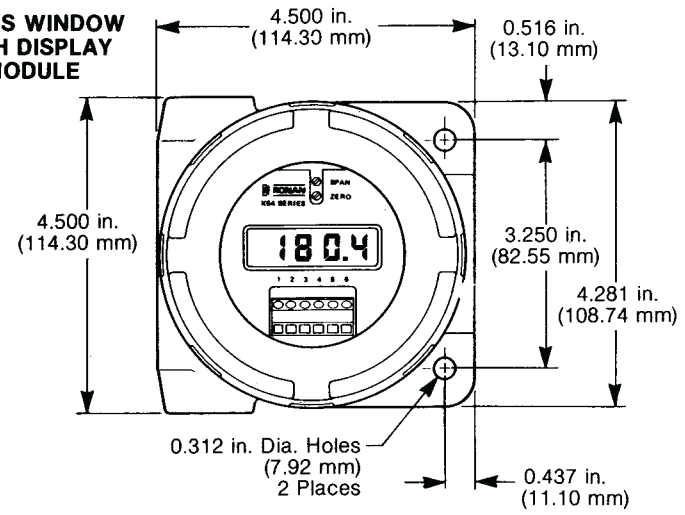


OUTLINE DRAWING TWO-WIRE TRANSMITTER SURFACE MOUNT	RONAN	
	DRAWING NO. X54C12	REV. 2

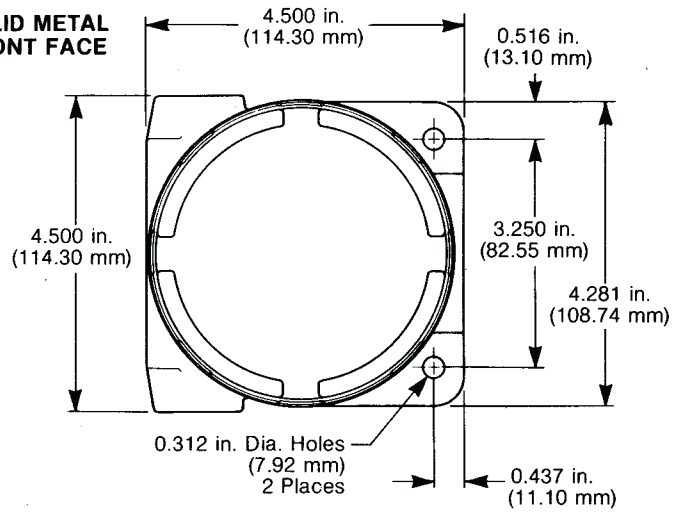


OUTLINE DRAWING TWO-WIRE TRANSMITTER DIN RAIL MOUNT	RONAN	
	DRAWING NO. X54C13	REV. 2

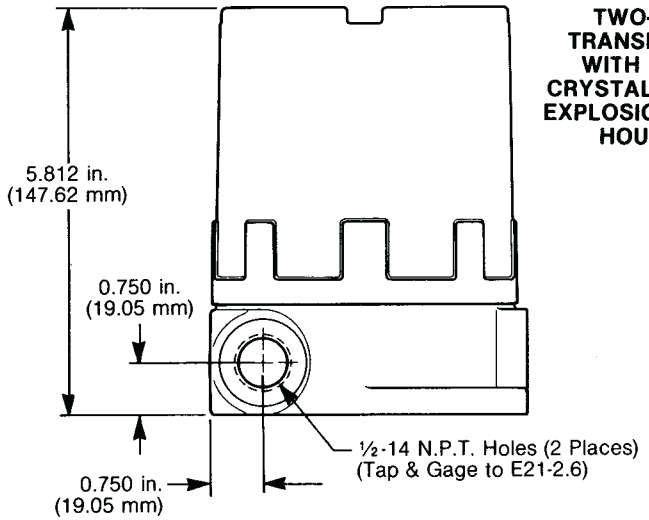
GLASS WINDOW WITH DISPLAY MODULE



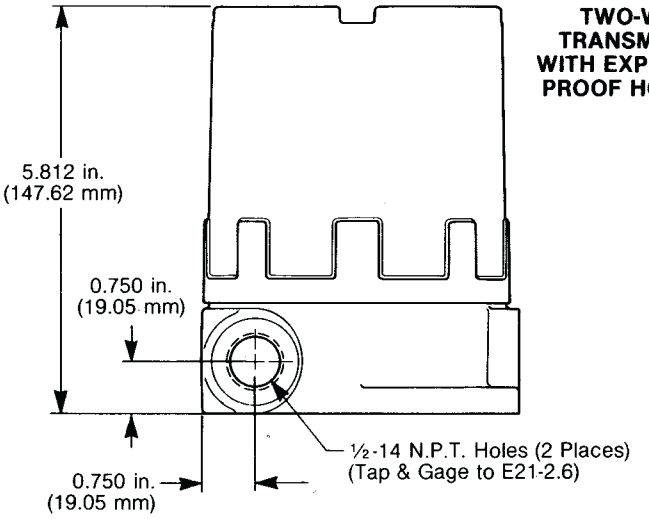
SOLID METAL FRONT FACE



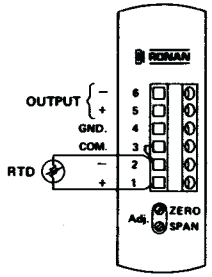
TWO-WIRE TRANSMITTER WITH LIQUID CRYSTAL DISPLAY EXPLOSION-PROOF HOUSING



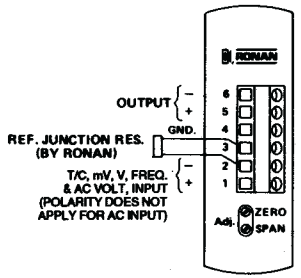
TWO-WIRE TRANSMITTER WITH EXPLOSION-PROOF HOUSING



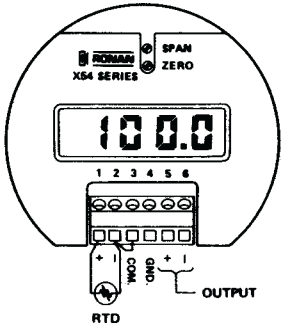
OUTLINE DRAWING EXPLOSION-PROOF HOUSING	RONAN	
	DRAWING NO. X54C14/X54C15	REV. 0/0



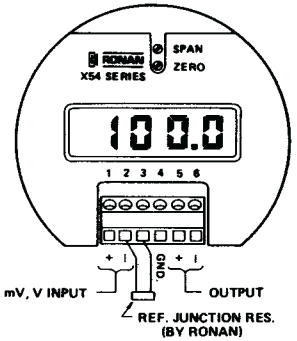
2 WIRE RTD INPUT
mA OUTPUT



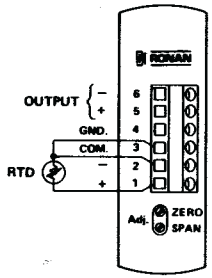
THERMOCOUPLE, mV, V, AC V, FREQ. INPUT
mA OUTPUT



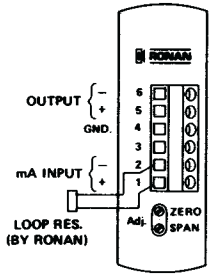
2 WIRE RTD INPUT, mA OUTPUT
WITH DISPLAY



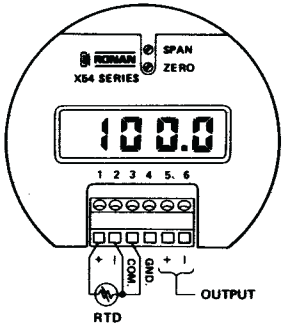
THERMOCOUPLE, mV, V, AC V, FREQ. INPUT
mA OUTPUT WITH DISPLAY



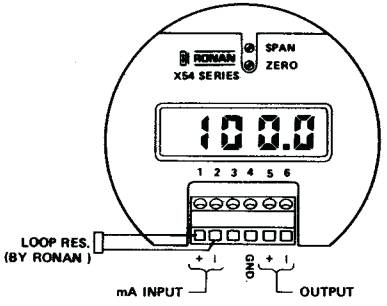
3 WIRE RTD INPUT
mA OUTPUT



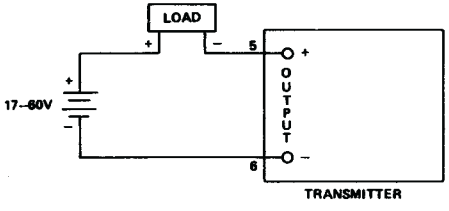
mA INPUT
mA OUTPUT

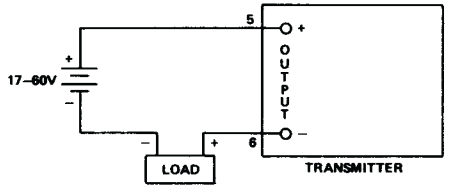


3 WIRE RTD INPUT, mA OUTPUT
WITH DISPLAY



mA INPUT, mA OUTPUT
WITH DISPLAY





LOAD AND POWER SUPPLY CONNECTION

WIRING DIAGRAM TWO-WIRE TRANSMITTER SERIES X54	RONAN	
	DRAWING NO. X54C16	REV. 2

RONAN

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X54T/C / Rev. 1

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