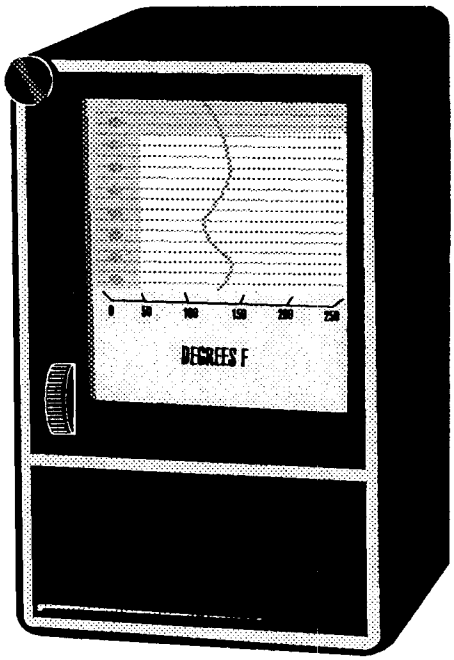
RD255, RD288, RD292

Strip Chart Recorders for Thermocouples, dc Inputs, and Events



OMEGA®

An OMEGA Technologies Company

Operator's Manual

TABLE OF CONTENTS
RD288 DC INPUT RECORDER
RD255 THERMOCOUPLE RECORDER
RD292 EVENT RECORDER

SECTION 1 INTRODUCTION

1.1 SAFETY CONSIDERATIONS

All OMEGA recorders provide some method for grounding the metal case. Use this provision -- DO NOT assume that the recorder is grounded just because it is plugged into a 3-prong outlet. Make certain your power system ground is not faulty. FAILURE TO PROPERLY GROUND AN ELECTRICAL DEVICE CAN BE FATAL. This applies to battery operated recorders as well, because the signal itself could be a lethal voltage.

Recorders using sensitive signal conditioners may not operate properly without a case ground.

1.2 GENERAL DESCRIPTION

1.2.1 RD288 Galvanometric Recorder

The OMEGA® RD288 DC Input Recorder permits full scale measurement of a signal by striking a stylus against pressure sensitive paper. The RD288 Recorder consists of several basic elements; galvanometer, spring-loaded striker, back-up bar (writing edge), chart drive motor and cam, and pressure sensitive paper.

A rotating cam lifts the striker away from the galvanometric pointer, allowing free movement of the pointer. The cam allows the striker to fall against the pointer, pressing it against the pressure sensitive paper. This action removes the white top coating on the paper and exposes the black base material at the point where the pointer and back-up bar cross. Each strike makes one dot.

When chart speed, and cam RPM are chosen properly, the succession of dots has the appearance of a continuous line.

The motor which rotates the cam also provides the motion to move the chart paper through the recorder.

Three RD288 Recorder models are available from OMEGA Engineering:

PART NUMBER	DESCRIPTION
RD288-1MA	1 Input, 1 mA Recorder
RD288-100MV	1 Input, 100 mV Recorder
RD288-4-20MA	1 Input, 4-20 mA Recorder

Figure 1-1 shows the RD255 and RD292 recorder. The RD288 Recorder looks almost the same as the RD255 Recorder.

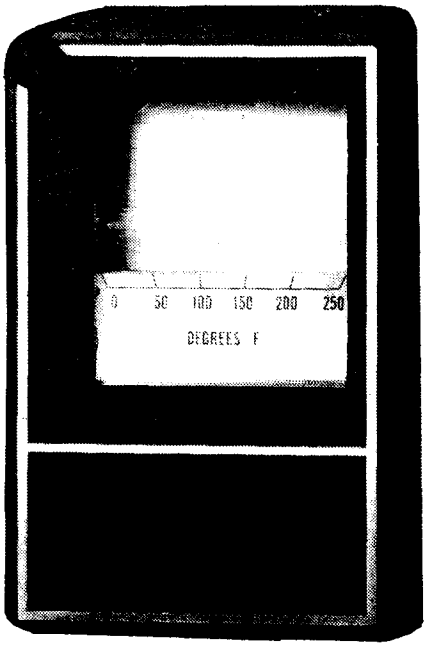


Figure 1-1.
RD255 Recorder

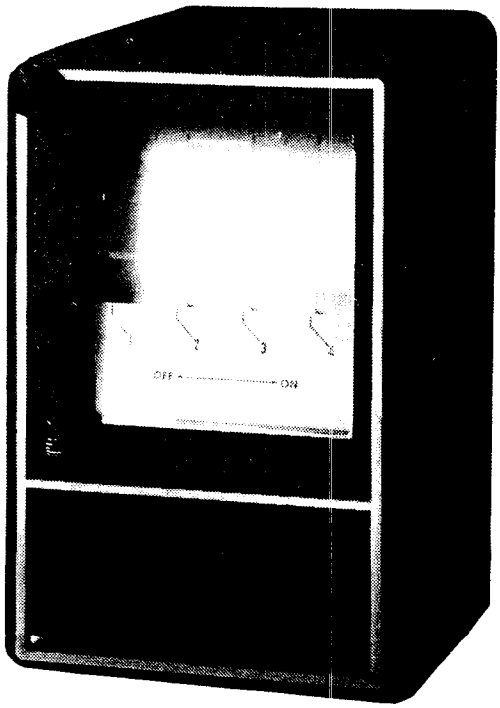


Figure 1-2.
RD292 Recorder

1.2.2 RD255 Thermocouple Recorder

The OMEGA® RD255 Thermocouple Recorder measures temperature from remote thermocouple probes. Input connection is via a built-in standard SMP connector. The RD255 Recorder permits full scale measurement of a signal by striking a stylus against pressure sensitive paper. The RD255 Recorder consists of several basic elements; galvanometer, spring-loaded striker, back-up bar (writing edge), chart drive motor and cam, and pressure sensitive paper.

A rotating cam lifts the striker away from the galvanometric pointer, allowing free movement of the pointer. The cam allows the striker to fall against the pointer, pressing it against the pressure sensitive paper. This action removes the white top coating on the paper and exposes the black base material at the point where the pointer and back-up bar cross. Each strike makes one dot.

When chart speed, and cam RPM are chosen properly, the succession of dots has the appearance of a continuous line.

The motor which rotates the cam also provides the motion to move the chart paper through the recorder.

Six RD255 Recorder models are available from OMEGA Engineering (other ranges are available upon request):

PART NUMBER	DESCRIPTION
RD255J-500F	1 Input, Type J T/C Recorder
RD255K-1000F	1 Input, Type K T/C Recorder
RD255E-1000F	1 Input, Type E T/C Recorder
RD255R-1000F	1 Input, Type R T/C Recorder
RD255S-1000F	1 Input, Type S T/C Recorder
RD255T-250F	1 Input, Type T T/C Recorder

1.2.3 RD292 Event Recorder

The OMEGA® RD292 Event Recorder monitors from one to eight channels of on-off operations. The number, duration, chronological time, and relation of all occurrences can be easily recorded.

The RD292 Event Recorder writes basic on-off information from an external contact closure in a continuous trace pattern against an accurate time base.

The operation is similar for each model. Writing pens press against the chart paper and leave a continuous trace. When an event (contact closure) occurs, the actuator (solenoid) snaps the pen to the right, forming a pulse 0.04 to 0.06 high. The trace is rectangular; pulse width depends on event duration.

Three signatures are possible with any pen depending on the action of the external switch. Impulses or sharp pips are recorded from transient information of limited duration, such as counting passing objects. Rectangular pulses result when the contact closure is longer compared to the chart speed of the recorder while line (band) recording is formed by a series of continuous impulses such as those produced by rotating machinery.

Response time of any pen is 10 ms allowing recording of on-off signals up to 20 Hz frequency. Resolution between pulse pairs (succeeding events) is 60 ms. Chart speed is 1 in/hr (25.4 mm/hr). Writing speed is 1 strike every 2 seconds.

Four RD292 Recorder models are available from OMEGA Engineering:

PART NUMBER	DESCRIPTION
RD292-TTL4	4 Input, 3-50V AC or DC, TTL, Event Recorder
RD292-TTL8	8 Input, 3-50V AC or DC, TTL, Event Recorder
RD292-HIV4	4 input, 50-500V AC or DC, HIV, Event Recorder
RD292-HIV8	8 Input, 50-500V AC or DC, HIV, Event Recorder

SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the packing list and verify that all equipment has been received. If there are any questions about the shipment, please call the OMEGA Customer Service Department at 1-800-622-2378.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

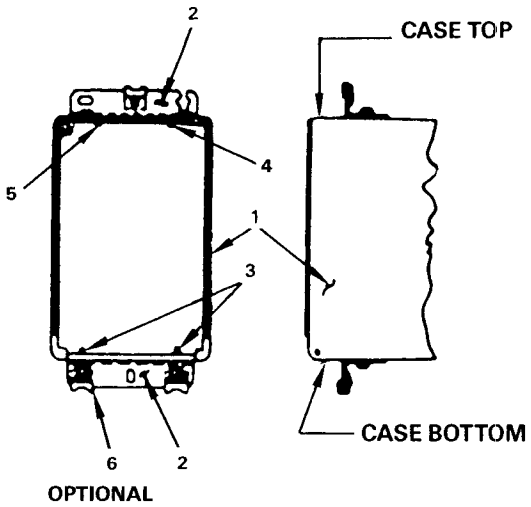
The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save the packing material and carton in the event reshipment is necessary.

2.2 INSTALLATION

The RD288/RD255/RD292 Recorders can be panel-mounted or used as table-top portable instruments. Hardware is furnished for both purposes.

PORTABLE: Install (4) rubber feet in tapped holes at the bottom of case using (4) 4-40 x 1/4" screws provided. Snap white plastic cardholder into holes at top.

PANEL-MOUNTING: Refer to Figure 2-1. Mount both brackets to recorder and make panel cut-out to size required. Refer to Figure 2-2 for mounting dimensions. Before use, the recorder must be wired up (refer to Section 2.3) and loaded with chart paper (refer to Section 2.4).

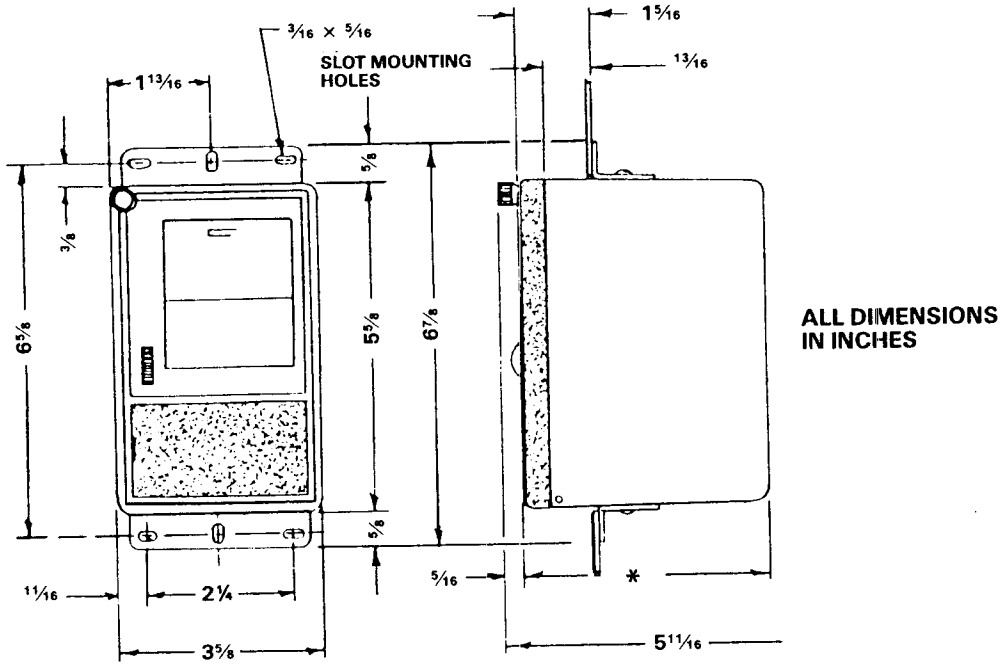


NOTE
Use short screws (3) at bottom only.

Figure 2-1. Mounting Bracket Assembly

TABLE 2-1
MOUNTING BRACKET ASSEMBLY

ITEM	QTY PER ASS'Y	PART NO.	DESCRIPTION
1	1	Recorder	Case of Recorder
2	2	A-4423	Bracket, Top and Bottom
3	2	8-32 x 1/4"	Screw, Pan Head
4	2	8-32 x 3/8"	Screw, Pan Head
5	2	A-4491	Speed Nut
6	Opt'l	A-4630PI	Speed Nut



* This dimension is either 4-5/16 or 6 (refer to Specifications)

Figure 2-2. Mounting Dimensions

2.3 WIRING

2.3.1 RD288 Recorder Wiring

The RD288 Recorders have a label inside showing all terminal and pin numbers regardless of whether or not they have been supplied pre-wired. The serial plate gives all voltage, frequency, model and serial information for the particular recorder.

Table 2-2 shows the standard connections for the RD288 series AC-powered recorders.

TABLE 2-2
WIRING

CONNECTOR PIN	RD288 SERIES
1	+ Galvo
2	- Galvo
3	High Line
4	Low Line
5	Case
6	NC

If the RD288 Recorder is supplied with attached line cord, pins 3 and 4 are not used.

When the RD288 Recorder is supplied with a DC (optional) motor, pin 3 is positive and pin 4 is negative.

2.3.2 RD255 Recorder Wiring

Input connection to the RD255 Recorder is made via an SMP connector in the rear of the case. A line cord is provided to supply power to the unit.

2.3.3 RD292 Recorder Wiring

Actuator connections are made through a barrier strip on the case rear and a line cord is provided for the motor. Figure 7-1 shows the basic schematic for one channel of the event recorder.

Figure 2-3 illustrates the wiring terminal connections for the four-channel models. The two terminals under each numbered bracket designate the channel number printed on the chart paper. Screws and solder lugs are packed with the hardware kit.

Figure 2-4 illustrates the terminal connections for the eight-channel models. Terminals are in-line (upper and lower) with channel numbers as printed on the chart paper, or from right to left when viewed from the case rear.

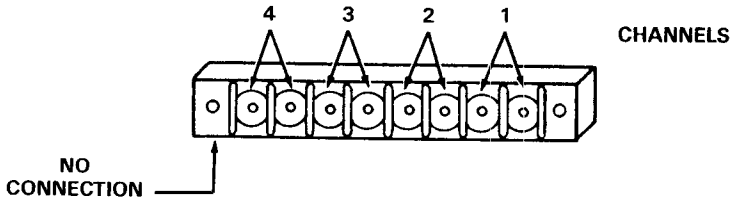


Figure 2-3. 4-Channel Model Terminal Connections

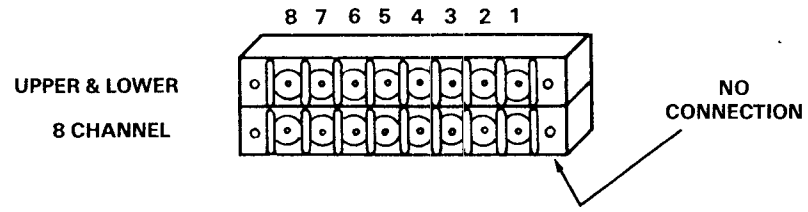


Figure 2-4. 8-Channel Model Terminal Connections

2.4 CHART LOADING, RE-ROLL MODE

A warning to "RENEW CHART" appears on the last three feet of each roll of paper. Do not use partial rolls of paper in the re-roll mode. Refer to Figure 2-5.

1. Turn off power before loading chart paper.

2. Open recorder by loosening thumbscrew (a).

3. Unlatch paper retaining clips (b).

4. Open panel to chassis latch (c) RH side plate.

5. Remove supply (d) and take up roller (e). If paper is still attached to supply roller, carefully slide the paper from between the front panel and chart drive. Do not pull the paper backwards through the recorder because of the danger of snagging the pointer.

6. Insert the supply roller into the new roll of chart paper. The perforated end of the paper is nearest to the roller shoulder.

7. Unroll about a foot of paper. Slide the paper between the panel and side plate, sprocket holes first. Keep paper taut and close to the drive drum to prevent snagging the pointer.

8. Engage the supply roller shaft in both seating notches (f) and check to be sure that the paper sprocket holes engage the time drum sprockets.

9. Slide cardboard sleeve all the way on the take up roller against the disc.

10. Butt paper against disc and tape the paper to the sleeve, printed side out. Wrap a few turns of the paper to be sure paper is started correctly.

11. Continue rolling paper and place roller shaft into notches. (Lower notch LH side.)

12. Close clips (b), latch (c) and recorder front panel. Tighten thumbscrew (a).

13. Advance paper with the chart advance wheel (g), to assure that paper moves through the recorder. Set to time.

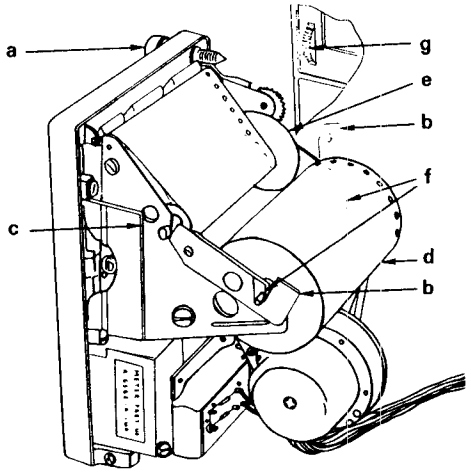


Figure 2-5. Chart Loading, Re-Roll Mode

2.5 CHART LOADING, TEAR-OFF MODE

A warning the "RENEW CHART" appears on the last three feet of each roll of paper.

1. Turn off power before loading chart paper.

2. Open recorder by loosening thumbscrew (a).

3. Unlatch paper retaining clips (b).

4. Open panel to chassis latch (c) RH side plate.

5. Slide drive belts (h) from chamfered grooves to center of top roller to release pressure on paper.

6. Remove supply roll (d). If paper is still attached to supply roll, carefully slide the paper from between the front panel and chart drive. Do not pull the paper backwards through the recorder because of the danger of snagging the pointer.

7. Insert supply roller into the new roll of chart paper. The perforated end of paper is nearest to the roller shoulder.

8. Unroll about a foot of paper. Slide the paper between the panel and side plate, sprocket holes first. Keep paper taut and close to the drive drum to prevent snagging the pointer.

9. Engage the supply roller shaft in both seating notches (f) and check to be sure that the paper sprocket holes engage the time drum sprockets.

10. Pull drive belts (h) back into the grooves (i).

11. Close clips (b), latch (c) and recorder front panel. Tighten thumbscrew (a).

12. Advance paper with the chart advance wheel (g), to assure that paper drives through the recorder. Set to time.

Refer to Figure 2-6.

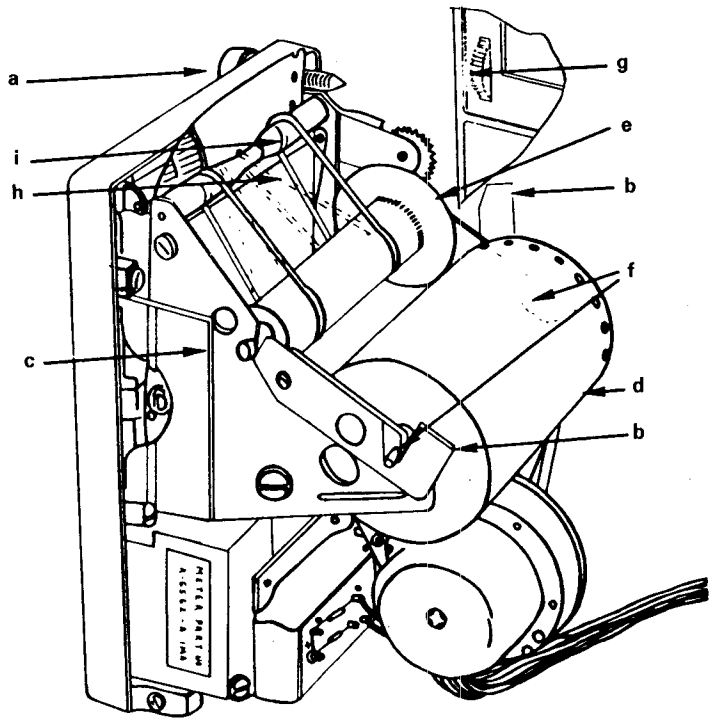


Figure 2-6. Chart Loading, Tear-Off Mode

2.6 CONVERTING RE-ROLL AND TEAR-OFF MODES

RE-ROLL TO TEAR-OFF: (Uses Drive Belts) Remove cardboard sleeve from take-up roller. Proceed with tear-off loading instructions.

TEAR-OFF TO RE-ROLL: (Uses Cardboard Sleeve) Store drive belts under front nameplate. Replace guide roller and finger-tighten knurled release screw. Continue with re-roll loading instructions.

SECTION 3 OPERATION

3.1 CONTROLS AND INDICATORS

RE-ROLL OR TEAR-OFF: Chart drive mode may be quickly changed. Follow the instructions printed on the back of the nameplate.

NAMEPLATE: Provides access for mechanical galvanometer zero adjustment (refer to Section 3.2).

CHART ADVANCE: Push in and roll down thumbwheel to advance chart paper for time setting.

QUICK REVIEW: Chart may be unrolled for analysis. Lift left retaining clip and set roller shaft in top notch. Snap the clip back in place. Unroll the paper as needed. Rewind the chart with the gear. Return the shaft to the bottom position by unlocking and relocking the retaining clip.

ACCESS WINDOW: Slides down to provide access to chart for notes.

3.2 CALIBRATION PROCEDURE

3.2.1 RD288 Recorder Calibration

The RD288 Recorder is calibrated by zeroing the galvanometer. The zero adjustment is located behind the front nameplate. Remove the nameplate by inserting a small flat screwdriver into the left hand slot and prying up. Recorders are normally supplied as zero left, center, or right. Variations may place the zero some other place on or off scale.

3.2.1.1 Zero On Scale

With signal disconnected, rotate the zero adjustment to give the recording on the appropriate line of the paper. To check accuracy, apply a known voltage or current equivalent to full scale. The maximum error should be less than ±2% of span. There is no adjustment for span.

3.2.1.2 Zero Off Scale

Apply a known voltage or current equivalent to low end scale and adjust the mechanical zero adjustment to give recording on the most left hand line of the chart paper. Check full scale by applying a known full scale signal. The maximum error should be less than ±2% of full scale value.

3.2.2 RD255 Recorder Calibration

3.2.2.1 Equipment Needed

1. Jeweler's screwdriver,
2. 115 or 220VAC or variable 12 VDC power supply, as required,
3. DVM ±0.5% accuracy or better,
4. Adjustable millivolt source with 10μV or better accuracy and resolution.

3.2.2.2 Calibration

Refer to thermocouple reference tables for 0°C reference (see Section T of the OMEGA Temperature Measurement Handbook). Find the mV equivalent for the span and thermocouple type in question.

EXAMPLE: Given the range 0 to 100°F, Type J;
The mV output at 0°F is -.885 mV. The mV output at 100°F is +1.942 mV. The span mV is the difference between these two values (2.827 mV).

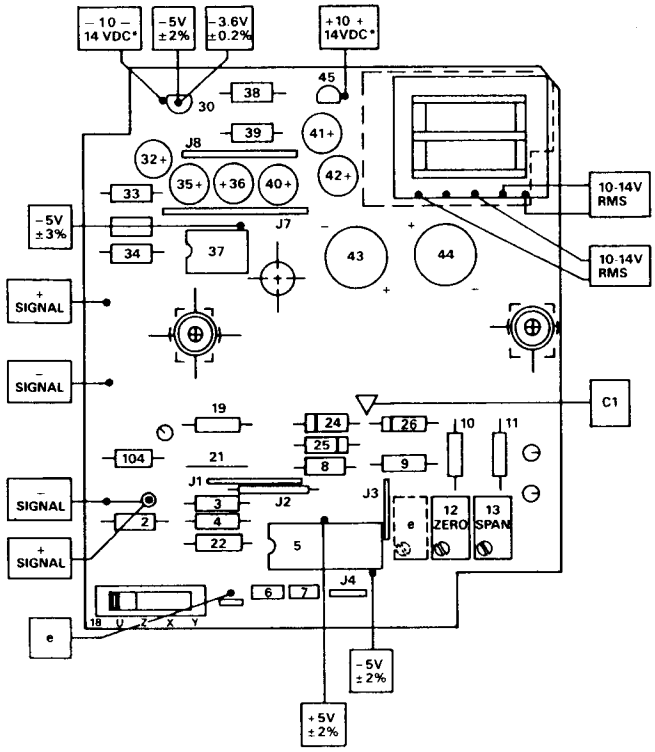
To calibrate:

1. Apply the appropriate primary power (i.e., 115VAC).

2. With switch (18, refer to Figure 3-1) in the Z position, apply any signal which brings the pointer on scale and vary the primary supply. There should be no change in reading when primary is changed between the limits shown in Table 3-1. If there is a variation, refer to Figure 3-1 before proceeding with steps (3) through (9) outlined in Table 3-2.

TABLE 3-1
VOLTAGE LIMITS

NOMINAL VOLTAGE	LIMITS
115V, 50/60 Hz	100 to 130V
220V, 50/60 Hz	200 to 260V
12VDC	10 to 14V



1. All DC voltages referenced to signal common (C1).

2. Voltages shown for 115, 240VAC or 12VDC primary.

* Some models may be 2X voltage.

Figure 3-1. Voltage Chart

TABLE 3-1
CALIBRATION

STEP	SWITCH POSITION (ITEM 18)	INPUT SIGNALS (mV)	INPUT SIGNAL LEADS	ADJUST TRIMMER #	RECORDER STYLUS INDICATION
3	S (Span)	0	Copper	Zero (12)	Zero Scale
4	S	Span mV (Note 1)	Copper	Span (13)	Full Scale
5	Repeat Steps 3, and 4				
6	Z (Zero)	Any on Scale	Copper	"e" (28) (Note 2)	On Scale
7	Z	Zero Scale mV (Note 3)	Copper	Zero (12)	Zero Scale
8	Z	Full Scale mV (Note 4)	Copper	None	Full Scale
9	U (Use)	Known Temp.	Thermo-couple	None	Known Temp. Within %2% of Span (Note 5)

NOTE 1: For the example above, 2.827 mV.

NOTE 2: "e" is factory adjusted dependent on the span and thermocouple type. Its value is written on each circuit board at calibration. The general formula is "e" = [1+(10,000/"Item 8")]*"v" where "v" for Type J = -0.661, K = -0.517, T = -0.513, E = -0.773, R & S = -0.073.

NOTE 3: For the example above, -0.885 mV. Observe polarity.

NOTE 4: For the same example, +1.942 mV.

NOTE 5: This disregards limits of error of thermocouple materials, installation errors and condition of the thermocouple being used.

3.3 SCALE REPLACEMENT (Refer to Figure 3-2)

1. Lower access window, then grasp white plastic bezel at top center, bending it to release both top tabs.
2. Lift out both windows, noting their positions and lay to one side with the bezel.
3. Remove scale.
4. Replace scale.
5. Replace the bottom window. Insert bottom two tabs of bezel.
6. Replace top window, then snap in left top tab, then right.
7. Check access window to be sure of proper operation.

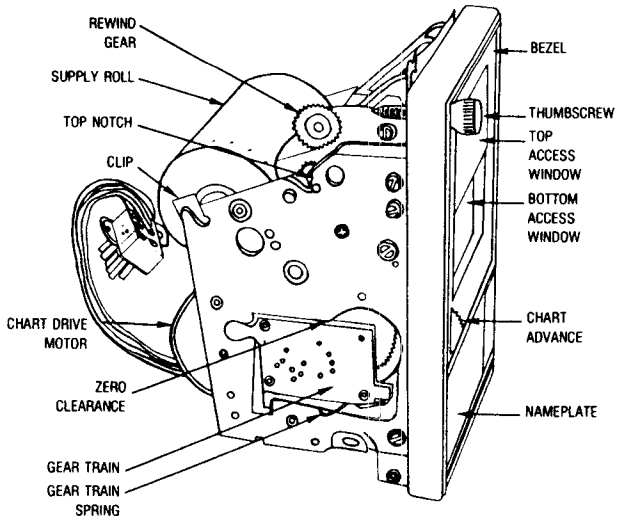


Figure 3-2. View of RD288 Recorder With Case Removed

SECTION 4 TROUBLESHOOTING

4.1 MECHANICAL TROUBLESHOOTING

If the recorder does not operate at all, check to see if the instrument is properly connected to the correct power source as indicated on the serial plate.

The following describes some common problems and possible causes.

GALVANOMETER DOESN'T FOLLOW THE SIGNAL: With the striker in its maximum open position, the distance between the striker and paper should be 1/8". The pointer should be midway. If the pointer is not centered, the galvanometer could have a bent pointer, broken taut band, or cracked jewel. Defects not so visible such as an open or shorted coil or debris in the air gap will also cause the problem.

4.2 ELECTRICAL TROUBLESHOOTING

Instruments with amplifiers or other signal conditioning such as shunts or multipliers having functioning galvanometers may have developed one or more defective components. In general, if checkouts are made in the order outline below, the defective part will be located.

1. Measure the main power on the PC Board.

2. Measure AC voltage on all transformer secondaries.

3. Measure DC voltage across power supply capacitors.

4. Measure DC voltage across each zener and at the voltage pins of the operational amplifier.

5. Apply a signal and measure to see that it gets to the input pin of the operational amplifier.

6. All amplifier type signal conditioners have an output of 100mV into a 100 load. Galvanometers are 1mA, 100 ohm.

7. Visually inspect for broken connections, or defective components.

8. Recorders with multipliers or shunts can be checked by making a resistance reading. DC voltmeters will measure 1000 times the full scale voltage (i.e., 100VDC full scale resistance will be 100,000). DC current meters will have a resistance of 0.1 divided by full scale DC current (i.e., 10mA DC full scale will have a resistance of 10 ohms).

4.3 GENERAL TROUBLESHOOTING

In the process of troubleshooting, resist the temptation to change the galvanometer zero adjust or any electrical adjustments unless you have facilities for complete calibration of the instrument. You may adjust the galvanometer zero but first note where it was, and after moving it return the zero (with no signal applied) to where it belongs. If the galvanometer has suppression (zero off scale) don't adjust unless you have facilities for calibration.

SECTION 5 SPECIFICATIONS

5.1 RD288 RECORDER

INPUTS (RESISTANCE IN Ω):	0-1 mA (100), 4-20 mA (6.25), 0-100mV (100)
ACCURACY:	±2%
RESPONSE TIME:	1 second maximum
STRIKING RATE:	Once every 2 seconds
MAXIMUM CONTINUOUS INPUT:	150%
USABLE CHART WIDTH:	2-5/16"
CHART LENGTH:	63 feet
CHART SPEED:	1"/hr
CHART MOTOR VOLTAGE:	115V, 60 Hz standard; 220V, 50 or 60 Hz, or 6, 12, 24, 48VDC unregulated or inverter motors optional
CONNECTIONS:	Input, 6-pin connector; connection, detachable line cord
DIMENSIONS:	3-5/8"W x 5-5/8"H x 4-5/16"D (93 x 143 x 110 mm)
WEIGHT:	3.75 lb (1.7 kg)

5.2 RD255 RECORDER

INPUT TYPES:	E, J, K, R, S, T thermocouples
RANGES:	0-250°F; 0-500°F; 0-1000°F; 0-100°C; 0-300°C
ACCURACY:	±2% span
T/C BREAK PROTECTION:	Upscale
MAXIMUM LOOP RESISTANCE:	1000 Ohms
RESPONSE TIME:	1 second maximum
STRIKING RATE:	Once every 2 seconds
USABLE CHART WIDTH:	2-5/16"
CHART LENGTH:	63 feet
CHART SPEED:	1"/Hr
CHART MOTOR VOLTAGE:	115V, 60 Hz standard; 220V, 50 or 60 Hz, or 6, 12, 24, 48 VDC unregulated or inverter motors optional
CONNECTIONS:	Inputs, SMP connector; power, line cord
DIMENSIONS:	3-5/8"W x 5-5/8"H x 4-5/16"D (93 x 143 x 110 mm)
WEIGHT:	3.75 lb (1.7 kg)

5.3 RD292 RECORDER

TTL TYPE

INPUT:	3 to 50VAC or DC
CURRENT:	-0.5 to 10 mA
INPUT RESISTANCE:	6 kilohms

HIV TYPE

INPUT:	-50 to 500VAC or DC
CURRENT:	-0.0 to 5 mA
INPUT RESISTANCE:	100 kilohms
CHART SPEED:	1 inch/hour (25.4 mm/hr)
DURATION OF CHART PAPER ROLL:	1 month (paper 63 feet)
EVENT RESOLUTION:	20 events/hour
STRIKING RATE:	Once every 2 seconds
PRIMARY POWER:	100 to 140 VAC 50/60 Hz
INPUT ISOLATION:	2500 V (optically coupled)
REPETITION RATE:	Up to 10 events per second
CONNECTIONS:	Input, barrier strip; power, fixed line cord
AMBIENT TEMPERATURE:	0 to 5°C, 32 to 122°F
DIMENSIONS:	3-5/8"W x 5-5/8"H x 6"D (93 x 143 x 152 mm)
WEIGHT:	4-Input models: 4.4 lb (2 kg); 8-Input models: 4.8 lb (2.18 kg)
PAPER:	1 roll, 63 feet (Part Number SL-650)

5.4 ACCESSORIES

PART NUMBER	DESCRIPTION
SL-650	Paper, 1 Roll, 63 ft, for Event Recorder
SL-651	Paper, 1 Roll, 63 ft, 50 Divisions
SL-652	Paper, 1 Roll, 63 ft, 40 Divisions
SL-653	Paper, 1 Roll, 63 ft, 60 Divisions

SECTION 6 THEORY OF CIRCUIT OPERATION FOR RD255 RECORDER (Refer to Figure 6-1)

The circuit consists of cold junction compensation, chopper stabilized amplifier with zero and span adjustments, input overload protection and regulated power supplies.

Cold junction compensation is accomplished by the voltage divider formed by thermistor (14) and resistor (27) produces an output charge across (2) which matches the thermocouple EMF between -10 and 60°C. Bias resistor (21) and (22) are chosen so that the resulting voltage across item (2) matches the thermocouple output at zero scale.

When the slide switch is in the Span (S) position the bias and cold junction compensation voltages are removed. When the switch is in the Zero (Z) position, a fixed resistor (17) is substituted for the thermistor. Its value is the same as the thermistor resistance at 0°C. This simulates placing the cold junction and thermistor in an ice bath (0°C reference). Switching to USE (U) replaces the fixed resistor with the thermistor which measures the temperature of the cold junction and applies an opposing voltage which exactly cancels the thermocouple cold junction output voltage over the ambient temperature range of -10 to 60°C.

Zero adjustment is provided by trimmer item (12). Total adjustment range is ±25% of the span and is not affected by the size of the span (gain).

Span adjustment is provided by trimmer item (13). Total adjustment range is ±25% of the normal overall gain which is determined by feedback resistors items (8) and (4).

Input protection diodes (24), (25) and (26) protect the amplifier input in the event of accidental application of external voltages higher than ±5V internal supply voltage.

Power supply, voltage for amplifier and other circuits, is provided from 12V secondary of power transformer item (46) for 115 or 220V primaries or converter item (46a) for 12VDC primary. The rectifier and filtered voltage drives voltage regulators to provide the required ±5VDC for all circuits.

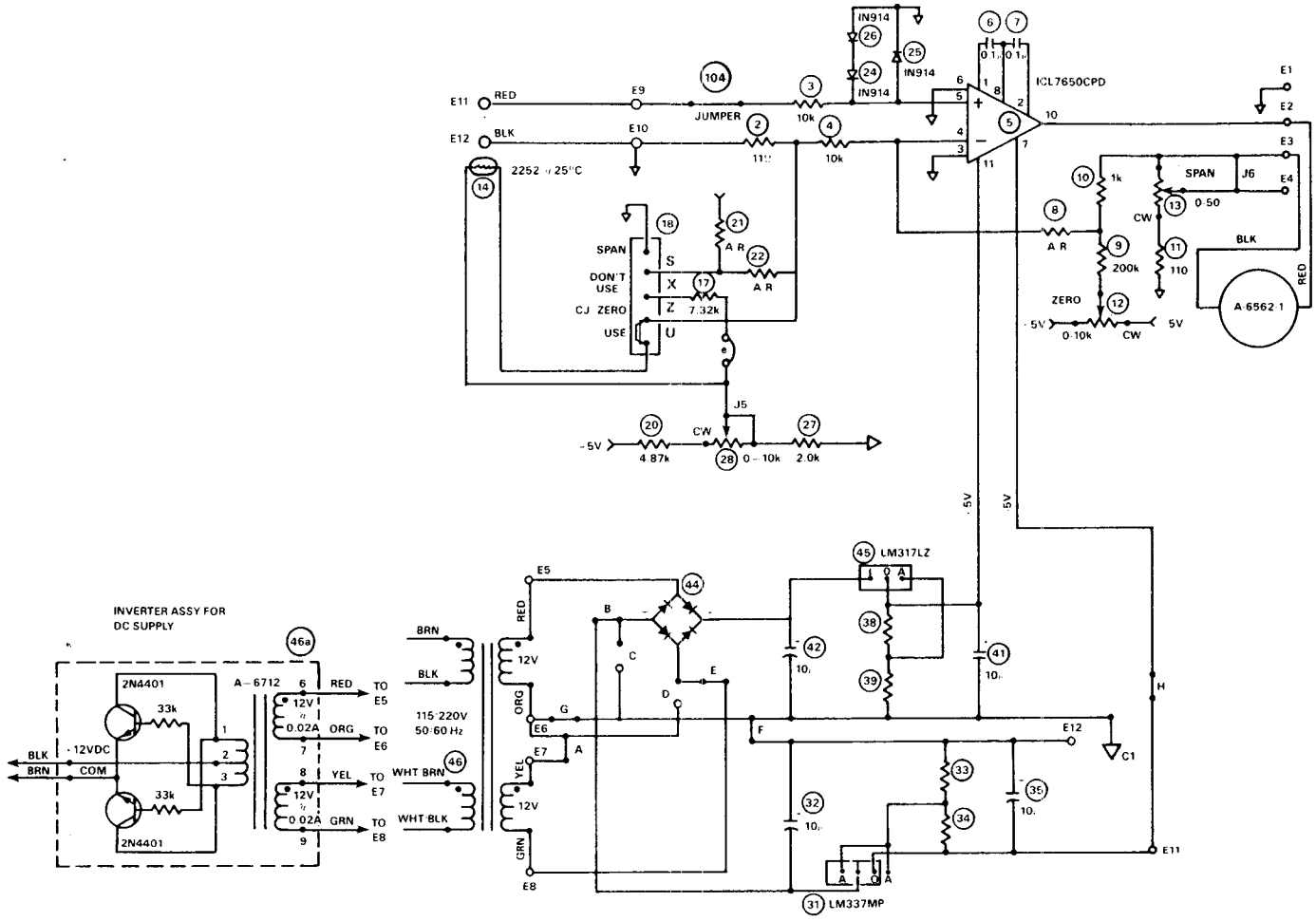
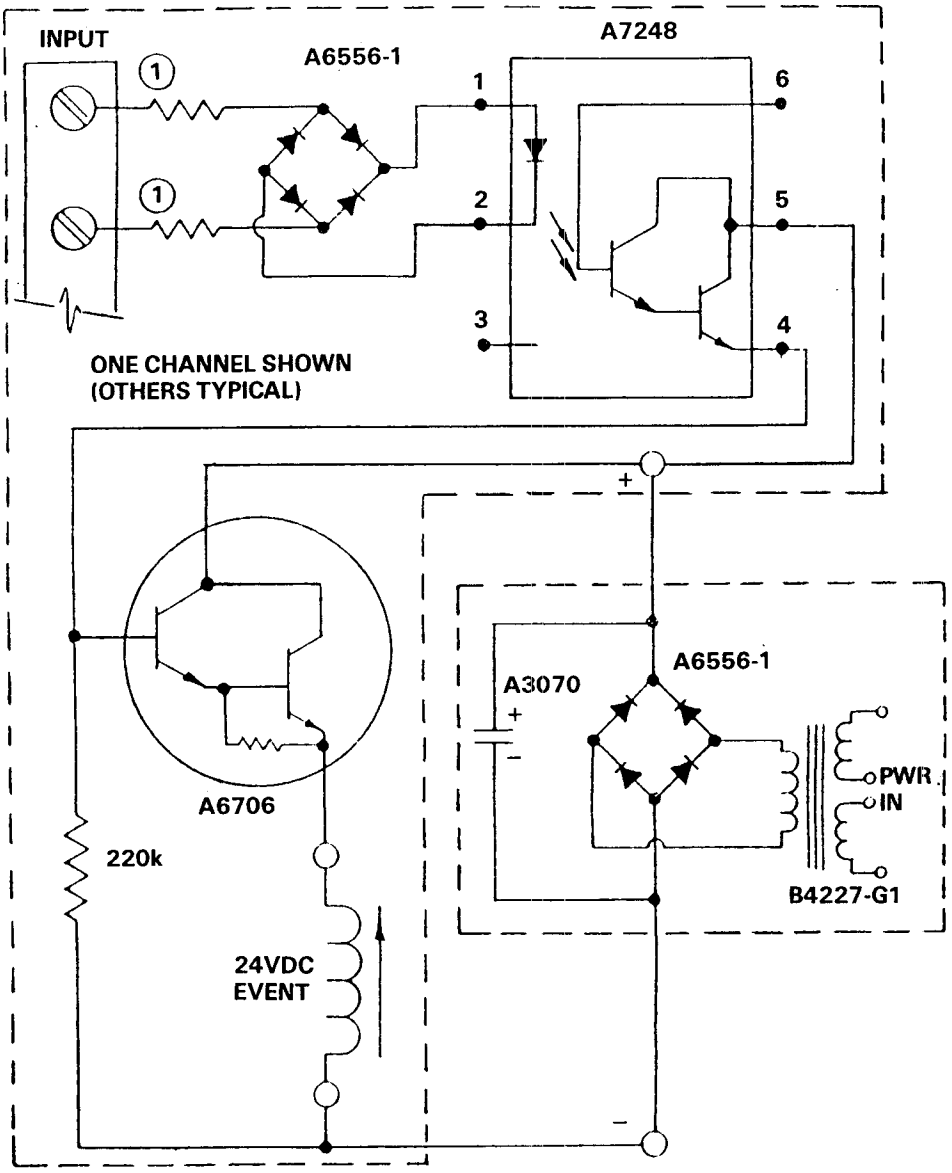


Figure 6-1. RD255 Recorder Schematic

SECTION 7 SCHEMATIC FOR RD292 RECORDER



NOTE
RD292-TTL uses a 1.8k resistor at place (1).
RD292-HIV uses a 51k resistor at place (1).

Figure 7-1. Basic Schematic Diagram for RD292 Recorder

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