Operating Instructions and Installation Information for Model MDTR-352L Digital Transducer Readout

This unit operates on:

- ☐ 115 V AC, ±10%, 50/60 Hz
- ☐ 220 V AC, ±10%, 50/60 Hz

Options:

- ☐ ______________________

schaevitz

The Name in Transducer Technology

Return to Rich Bundy 7404

SPECIFICATIONS

Power Requirements
115 V AC ±10%, 50-400 Hz
Optional:
220 V AC ±10%, 50-400 Hz

Transducer Excitation
1.0 V AC rms sine wave; 5.0 kHz; 10 mA

Input Impedance
20 kilohms

Sensitivity
75 mV AC rms input produces full scale display at maximum gain (span). Gain is adjusted using a FINE GAIN potentiometer control and a programmable COARSE GAIN DIP switch.

Full Scale Display
±1999, 3-position programmable decimal point

Overrange Indication
When input exceeds ±1999 counts, the digits blank out; the polarity sign and decimal point remain on.

Display
7-segment, high brightness, red LED; 0.56 inch (14,2 mm) high

Conversion Rate
2.5 readings per second

Non-linearity and Hysteresis
Less than ±0.1% of full scale, ±1 count

Stability
±0.05% of full scale (after 30 minutes warm-up)

Thermal Coefficient of Sensitivity
±0.03% of full scale/°F
(±0.05% of full scale/°C)

Operating Temperature Range
30°F to 140°F (0°C to 60°C)

Zero Suppression
FINE ZERO potentiometer control provides a range of 100 counts. A programmable DIP switch provides COARSE ZERO offsets of up to positive (+) or negative (–) full scale (100% zero suppression).

Digital Output (Optional)
Parallel BCD, TTL compatible

Weight
8 ounces (230 grams)

DESCRIPTION

The Schaevitz MDTR-352L is a precision instrument for the excitation and digital readout of a single 5- or 6-wire, AC-operated LVDT or RVDT transducer. The instrument includes all required signal conditioning circuitry, and features front-panel-accessible gain (span) and zero (offset) controls, and a rear-mounted screw terminal strip for transducer connections. A special demodulator circuit eliminates the need for phase adjustment in most applications.

Fully self-contained for mounting in a DIN cutout, the MDTR needs only transducer and AC power line connections to provide a complete measurement system. Physical variables such as displacement, force, weight, and pressure can be read out directly in engineering units on the 3-1/2 digit display, which gives readings of up to ±1999.

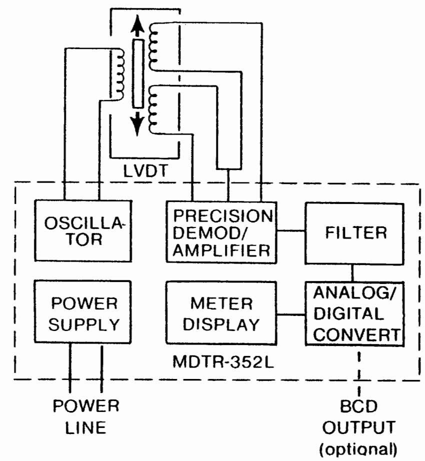

Figure 1. MDTR-352L Block Diagram

INSTALLATION

NOTE: Read all installation and calibration instructions in this manual prior to attempting installation.

Along with the MDTR-352L, the package contains one card edge connector, two plastic mounting slides, two 6-32 x 1/2-inch long screws, and two 8-32 x 5/8-inch long screws. The following additional materials are required to complete a measurement system: AC line power, a 5- or 6-wire LVDT or RVDT transducer of known sensitivity, a transducer mounting fixture, small insulating tubing, connecting cables, soldering equipment, and two flat-blade screwdrivers (one very small).

Suggested Installation Sequence

A. Read all instructions and definitions.

B. Make panel cutout as shown in Figure 2. and pull cables through it OR mount module to panel per instructions on Page 7.

C. Connect AC leads to card edge connector per instructions on Page 7-9.

D. Set decimal point jumpers per instructions on Page 8.

E. *Optional BCD output units only:* Make BCD connections per instructions on Page 20-21.

F. Mount transducer and connect to MDTR per instructions on Page 10-11.

G. If MDTR was not mounted in step B, do so at this time.

Suggested Calibration Sequence

A. Remove MDTR cover lens per instructions on Page 12.

B. Match MDTR to transducer (set COARSE GAIN) per instructions on Page 13-14.

C. Calibrate system per instructions on Page 16-19.

D. Replace MDTR cover lens per instructions on Page 12.

Installation Definitions

LVDT core or RVDT shaft displacements are defined by both magnitude and direction. On an LVDT, the **"positive"** direction of movement goes from the **"null position"** (electrical center) of a coil assembly towards the electrical connection end of the coil, and **"negative"** movement goes away from the connection end. To a user facing the shaft end of an RVDT, "positive" shaft rotation is clockwise (CW) from the null position, and "negative" rotation is counterclockwise (CCW).

Magnitude is expressed in terms of **"full range"** and percentages of **"full scale."** If an LVDT's nominal linear range of displacement is ±X inches, full range is twice X inches, full scale is X inches (either plus or minus direction), and 1/2-full scale is X/2 inches. Because an RVDT shaft is capable of continuous (360°) rotation, it has two nulls. The preferred null is factory-marked. If the RVDT range which will produce the required linearity is ±X degrees of shaft travel, full range is twice X degrees, full scale is X degrees (either CW or CCW rotation), and 1/2-full scale is X/2 degrees. For both the LVDT and RVDT, full scale and 1/2-full scale refer to motion originating at the transducer's null position.

Example: A full scale core movement in the positive direction for an LVDT with a nominal linear range of ±X inches starts at the LVDT null and moves X inches towards the transducer's electrical connection end. This final core position is called the **"positive full scale core position."**

NOTE: If the transducer's full range of travel is not needed, a smaller range (with the transducer null position as its midpoint) can be used, within the limitations of gain adjustment. For maximum performance, calibration should be executed as if the desired range were the transducer's full range: i.e., full scale is considered to be 1/2 of the desired range.

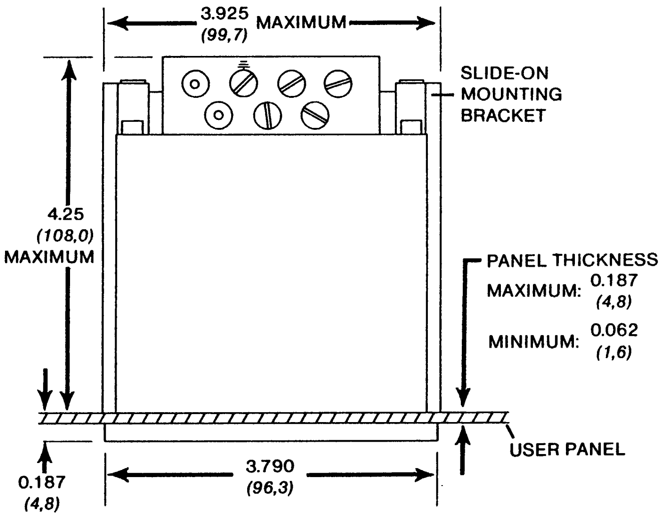

Figure 2a. MDTR Dimensions, Top View

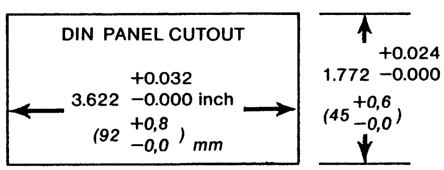

Figure 2b. MDTR DIN Panel Cutout Dimensions

Figure 2. MDTR-352L Dimensions, in Inches *(mm)*

Mounting

The MDTR-352L comes in an enclosure designed for panel mounting in a DIN cutout. It will accommodate any panel thickness between 1/16 inch (1,6 mm) and 3/16 inch (4,7 mm). Figure 2 shows the required panel and cutout dimensions, as well as the depth that the instrument requires behind the panel. When mounting, be certain to provide additional space at the rear for instrument connections.

Mounting is accomplished in stages. Before performing other installation procedures:

1. Choose mounting location and cut the required panel opening.
2. Bring all connecting cables from behind the panel through the cutout.
3. Insert the meter through the cutout (from the panel front) as far as it will go.
4. From behind the unit and mounting panel, slip the plastic mounting slides into the MDTR's side panels' center grooves. (See Figure 2a.)
5. Fasten slides to the MDTR's rear standoffs using the 8-32 x 5/8 self-threading screws.

AC Power Connections and Decimal Point Selection

WARNING: Read these instructions thoroughly before making any connections to the MDTR. Improper wiring may result in serious damage to the equipment.

1. The MDTR-352L is factory wired to operate only from the power source checked on the front cover of this manual.

2. AC power connections and the decimal point selection jumper should be soldered to the card edge connector (supplied separately) before the connector is attached to the MDTR.

   NOTE: To avoid electrical shock or short circuits, always slide a short length of insulating tubing onto a lead before soldering, then push the tubing down over the soldered terminal.

3. **AC Power Connections:** Solder the AC power leads to pins 15 and S of the card edge connector. It is not necessary to ground the MDTR-352L.

4. **Decimal Point Selection:** Set the desired decimal point location by soldering an insulated wire jumper between card edge connector pins, as indicated below:

Decimal Point	**Connect Pins**
X.XXX	C and R
XX.XX	3 and R
XXX.X	D and R
XXXX	(No Jumper)

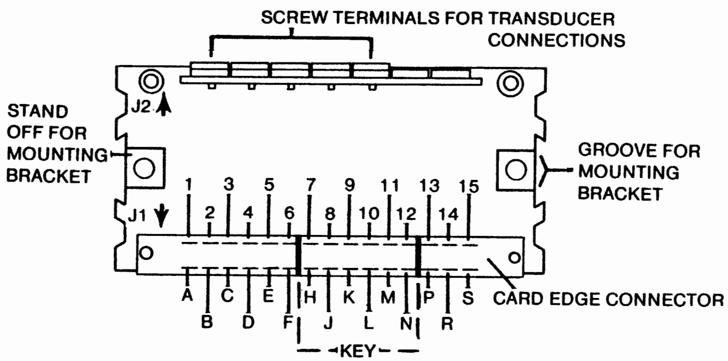

Figure 3. Rear View (Card Edge Connector in Place)

5. If the MDTR is equipped with the optional BCD output, refer to page 20 and make the necessary BCD output connections.

6. Fit the card edge connector onto strip J1 at the rear of the MDTR, as shown in Figure 3 (numbers on top, letters on bottom). Use the two 4-40 x 1/2 inch self-threading screws to secure the connector to MDTR standoffs.

   Note: Installing the card edge connector upside down will result in serious damage to the unit.

Transducer Hookup

Note: The MDTR-352L requires a minimum of five transducer leads.

After the transducer has been mounted, connect its leads to the MDTR's rear screw terminals (see Figure 4). Avoid running the transducer cable parallel to power lines or near interference producing equipment.

Schaevitz transducer should be connected as shown in Table 1. Figure 5 indicates the proper connections for transducers made by other manufacturers. These connections will normally result in the proper output polarity. If the output polarity must be reversed, interchange connections to S1 (SIG 1) and S2 (SIG 2).

Note: **If the transducer has a shielded cable, connect the shield to the MDTR's common (CT) terminal (⏚). If transducer cables are extended by more than a nominal 10 feet (3 meters), shield the secondary leads from the excitation leads and connect the shield to the common terminal.**

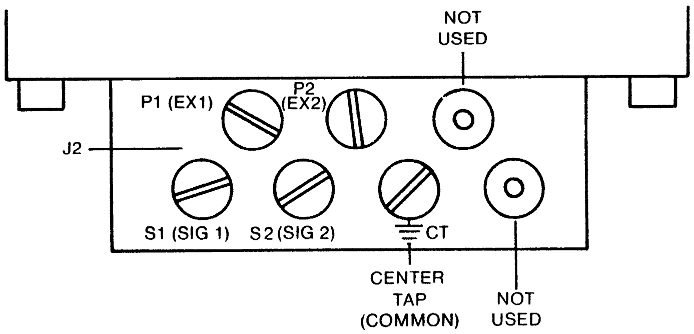

Figure 4. Transducer Connection Terminals, J2, at Rear of Unit

Transducer Series \ Connect to MDTR	P1 (EX 1)	P2 (EX 2)	S1 (SIG 1)	S2 (SIG 2)	(Center Tap/ Common) CT ⏚	Not Used*
LBB Gage Head	red	blue	white	green	yellow & shield	
all others:						
Color-coded	yellow/black or yellow	yellow/red or brown	black	red	blue & green	
Letter-coded	E	F	D	A	B, C, & H*	G & I
Number-coded	1	2	3	6	4 & 5	

*These will not exist on some units.

Table 1. Electrical Connections to Schaevitz Transducers

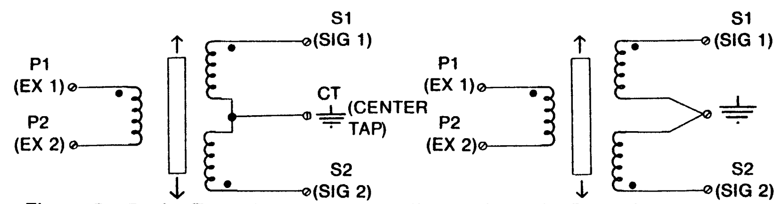

Figure 5a. 5-wire Transducer Hookup   Figure 5b. 6-wire Transducer Hookup

Figure 5. Electrical Connections Guide for Non-Schaevitz Transducers (Dots indicate start leads.)

Removing MDTR Cover Lens

CAUTION: When removing or reinstalling display lens, be careful to avoid cracking the lens or damaging the MDTR's internal components.

To permit access to the internal controls, carefully insert a very small screwdriver into the notched hole at the center bottom of the lens and gently pry it out.

To reinstall the lens, position the hole at the bottom and bow the lens very slightly convex (so its side edges are closer to the unit than the notched hole is). Insert the side edges behind their retaining clasps and allow the lens to unbend into place.

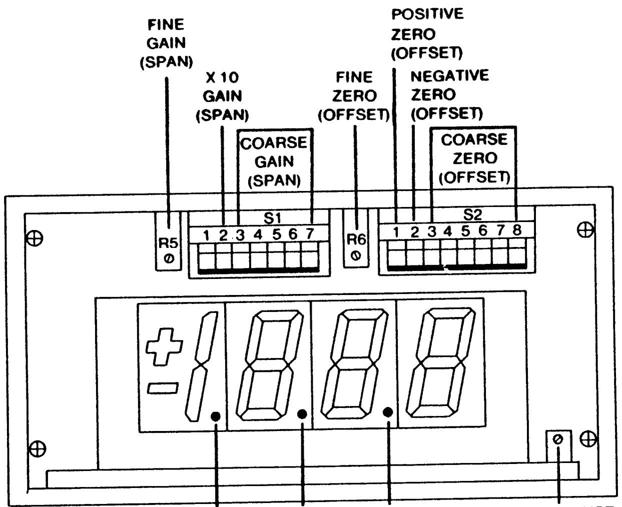

Figure 6. Front View (LED Display Lens Removed)

Matching the MDTR to the Transducer (Setting COARSE GAIN)

A 7-position DIP switch (located behind the MDTR's front panel - "S1" of Figure 6) is used to match the MDTR's gain (span) range to the sensitivity of the particular transducer being used.

1. **Determining Required Gain (Span):** Obtain the transducer's sensitivity or full scale output from catalog specifications sheet and apply to one of the following empirical formulas:

$$G = \frac{N}{S \times D} \quad \text{or} \quad G = \frac{N}{F}$$

where:

G is the display gain (span) required, in counts per millivolt.

N is the ± full scale display desired, up to ±1999 counts, regardless of decimal point position, e.g.: "N" would be 1500 for a full scale display of ±1.500.

S is the transducer's sensitivity, in mV output/V input/0.001 inch displacement or mV output/V input/degree of rotation.

D is the full scale displacement from null, in thousandths of an inch (for LVDTs) or degrees of rotation (for RVDTs).

F is the transducer's full scale sensitivity, in mV output/V input. This number may be obtained as follows:

a. Directly from the catalog specifications or data sheet if the full scale sensitivity is given in mV/V.

b. Where the full scale output is given along with the excitation or input voltage, "F" may be calculated by dividing the full scale output in mV by the excitation (input) voltage in volts.

Example: A Schaevitz Model 050 HR LVDT has a range of ±0.050 inch and a sensitivity of 6.3 mV/V/0.001 inch. For a readout showing displacement from null directly in thousandths of an inch, with a resolution of 0.0001 inch, the desired display would show ±50.0 (thousandths).

Then: N = 500, S = 6.3, and D = 50.

$$G = \frac{500}{6.3 \times 50} = 1.59$$

2. **Programming COARSE GAIN:** After determining the required gain (G), use Table 2 to adjust positions 2 through 7 of COARSE GAIN DIP switch S1. (The left-most position 1 is not used.)

NOTE: When two different switch combinations will both give the required gain, the combination with the smaller nominal gain range is preferred.

Example: Continuing our previous example (G = 1.59), Table 2 indicates that a gain value of 1.59 can be achieved with either of two switch combinations, of which one is preferred:

Position 1 2 3 4 5 6 7	**Nominal Gain Range**
– ↓ ↓ ↓ ↓ ↓ ↑	0.9 - 1.8
– ↑ ↑ ↓ ↓ ↓ ↑	1.53 - 1.62 (preferred)

Table 2. Nominal Gain Range Settings for DIP Switch, S1

NOMINAL GAIN RANGE (Counts Per Millivolt)		S1 COARSE GAIN (SPAN) DIP SWITCH POSITIONS						
Position 2: (Value = X 1) ↑	Position 2: (Value = X 10) ↓	1	2	3	4	5	6	7
0.00—0.09	0.00—0.9*	(POSITION 1 IS NOT USED)	(POSITION 2 DETERMINED BY CHOICE OF GAIN RANGE)	↓	↓	↓	↓	↓
0.09—0.18	0.9—1.8*			↓	↓	↓	↓	↑
0.18—0.27	1.8—2.7*			↓	↓	↓	↑	↓
0.27—0.36	2.7— 3.6			↓	↓	↓	↑	↑
0.36—0.45	3.6— 4.5			↓	↓	↑	↓	↓
0.45—0.54	4.5— 5.4			↓	↓	↑	↓	↑
0.54—0.63	5.4— 6.3			↓	↓	↑	↑	↓
0.63—0.72	6.3— 7.2			↓	↓	↑	↑	↑
0.72—0.81	7.2— 8.1			↓	↑	↓	↓	↓
0.81—0.90	8.1— 9.0			↓	↑	↓	↓	↑
0.90—0.99	9.0— 9.9			↓	↑	↓	↑	↓
0.99—1.08	9.9—10.8			↓	↑	↓	↑	↑
1.08—1.17	10.8—11.7			↓	↑	↑	↓	↓
1.17—1.26	11.7—12.6			↓	↑	↑	↓	↑
1.26—1.35	12.6—13.5			↓	↑	↑	↑	↓
1.35—1.44	13.5—14.4			↓	↑	↑	↑	↑
1.44—1.53	14.4—15.3			↑	↓	↓	↓	↓
1.53—1.62	15.3—16.2			↑	↓	↓	↓	↑
1.62—1.71	16.2—17.1			↑	↓	↓	↑	↓
1.71—1.80	17.1—18.0			↑	↓	↓	↑	↑
1.80—1.89	18.0—18.9			↑	↓	↑	↓	↓
1.89—1.98	18.9—19.8			↑	↓	↑	↓	↑
1.98—2.07	19.8—20.7			↑	↓	↑	↑	↓
2.07—2.16	20.7—21.6			↑	↓	↑	↑	↑
2.16—2.25	21.6—22.5			↑	↑	↓	↓	↓
2.25—2.34	22.5—23.4			↑	↑	↓	↓	↑
2.34—2.43	23.4—24.3			↑	↑	↓	↑	↓
2.43—2.52	24.3—25.2			↑	↑	↓	↑	↑
2.52—2.61	25.2—26.1			↑	↑	↑	↓	↓
2.61—2.70	26.1—27.0			↑	↑	↑	↓	↑
2.70—2.79	27.0—27.9			↑	↑	↑	↑	↓
2.79—2.88	27.9—28.8			↑	↑	↑	↑	↑
Position 2: ↑	Position 2: ↓							

*Use preferred range from "value=X 1" nominal gain range column.

Calibration

The following is assumed at this point:

- The decimal point jumpers are set.
- The transducer is mounted.
- The transducer and MDTR are connected.
- The initial coarse gain has been set.

1. Apply AC line power and allow at least 30 minutes for the electronics to stabilize.

2. Place all 8 positions of the COARSE ZERO DIP switch (S2) in the down (off) position. (See Figure 7.)

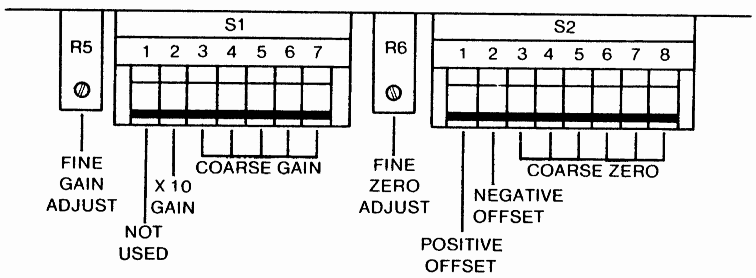

Figure 7. Gain (Span) and Zero (Offset) Controls

3. Disconnect the transducer excitation wires from screw terminals P1 (EX 1) and P2 (EX 2) to obtain a zero MDTR input signal.

4. Using a very small screwdriver, adjust the FINE ZERO potentiometer control (R6) to obtain **000** on the display.

5. Re-connect the transducer excitation wires to screw terminals P1 (EX 1) and P2 (EX 2).

6. Displace the transducer core to obtain **000** on the MDTR display. This is the transducer's null position.

NOTE: If this adjustment is mechanically difficult or impractical, approximate the correct position as closely as possible and then turn the FINE ZERO control to obtain a zero reading.

If the FINE ZERO does not have a wide enough range to reach **000**, the COARSE ZERO DIP switch S2 can be used to offset the zero in either direction in increments of approximately 48 counts.

If the FINE ZERO has been turned fully clockwise and the display is still negative, a positive offset is required. For a positive offset, S2 position 1 must be up and position 2 must be down. For a negative offset, the reverse is true. S2 positions 3 through 8 govern the offset magnitude, as shown in Table 3. Once S2 has been changed, adjust the FINE ZERO control to obtain the proper **000** reading.

S2 Positions 1 (+)	2 (−)	3	4	5	6	7	8	Display Offset in Counts
SELECT (+) OR (−) AS DESIRED		↓	↓	↓	↓	↓	↓	None
		↓	↓	↓	↓	↓	↑	48
		↓	↓	↓	↓	↑	↓	96
		↓	↓	↓	↓	↑	↑	144
		↓	↓	↓	↑	↓	↓	192
		↑	↓	↓	↑	↑	↑	1872

Table 3. Nominal Values of COARSE ZERO Controls

7. Accurately displace the transducer core from the null position to the transducer's positive full scale position. Adjust the FINE GAIN potentiometer control (R5) to obtain the display desired for this position.

   Note: Initially, the COARSE GAIN control (S1) was programmed by calculation to provide an approximate gain range. Due to transducer/instrument sensitivity variations, the FINE GAIN may not have the range required to obtain the proper display. Range may be increased or decreased by changing S1 positions 7, 6, and 5.

8. Repeat steps 6 and 7 to verify proper calibration.

The MDTR is now calibrated for a readout that goes from −full scale to +full scale. Most users will wish to stop calibrating at this point. For some applications, however, it is necessary that the display go from zero to +full range. (Recall that full range is equal to twice full scale.)

Example: Refer to the example described in "Matching the MDTR to the Transducer." In that situation, the above steps would program the instrument for a display of ±**50.0** (thousandths of an inch of displacement). Alternatively, if the unit were calibrated for a display of from zero to +full range, the readout would go from **00.0** to **+100.0** (thousandths of an inch). In the latter case, a reading of **+50.0** would indicate an LVDT core at the midpoint of its linear travel — the null position.

If a display of from zero to +full range is desired, continue calibration as follows:

9. Displace the transducer core to the negative full scale core position.

10. Place the positive offset switch (position 1 of DIP switch S2) in the up position.

11. Using Table 3 as a guide, adjust the COARSE ZERO switches (positions 3 through 8 of DIP switch S2) to reduce the display reading to near zero.

12. Adjust the FINE ZERO potentiometer control (R6) to obtain a zero display.

The instrument is now calibrated for a zero to +full range display.

Parallel BCD Output (Optional)

The BCD option provides 15 lines of latched-and-buffered parallel BCD output, including POLARITY and PRINT commands. Outputs are positive true, TTL/DTL and CMOS compatible, and capable of driving two TTL loads.

Three additional lines are provided:

EOC/HOLD - Falling edge of "End of Conversion" indicates conversion is complete. Output is CMOS compatible, 0 to +5 V. A logical "0" applied (open collector or equivalent) will hold the last reading in display.

Note: The EOC signal drives an internal timing circuit and generates the PRINT command, which indicates that the BCD data are valid. If the printer or other output device is unable to operate at a rate of 2.5 readings per second, a printer "BUSY" signal must be applied to the EOC/HOLD input. This will synchronize the measurements with the speed of the printer.

OVERRANGE/BLANK — A logical "0" output indicates that the input exceeded ±1999 counts. Output is CMOS compatible, 0 to +5 V. A logical "0" applied (open collector or equivalent) blanks the display.

DISPLAY TEST — A logical "0" applied (open collector or equivalent) forces a reading of "1888" to test the display segments.

Pin Assignments of J1 Card Edge Connector

A.	Do Not Use	1.	Do Not Use
B.	Analog Ground	2.	Do Not Use
C.	Decimal Point (X.XXX)	3.	Decimal Point (XX.XX)
D.	Decimal Point (XXX.X)	4.	EOC/HOLD
E.*	BCD 2	5.*	BCD 1
F.*	BCD 8	6.*	BCD 4
H.*	BCD 20	7.*	BCD 10
J.*	BCD 80	8.*	BCD 40
K.*	BCD 200	9.*	BCD 100
L.*	BCD 800	10.*	BCD 400
M.*	PRINT	11.	DISPLAY TEST
N.	BLANK/OVERRANGE	12.*	BCD 1000
P.	Do Not Use	13.*	POLARITY (−)
R.	Digital Ground	14.	Do Not Use
S.	AC Power Input	15.	AC Power Input

* These signals are active with BCD option only.

TROUBLESHOOTING

WARNING: This unit contains Electrostatic Sensitive Devices (ESD). Removal and handling of the internal components could degrade or damage the components by static discharges. Repairs must be done in a static-safeguarded work area. A grounded wrist strap must be worn. **Attempts by unauthorized persons to perform repairs in the field will void the warranty.**

Problem: **Can't obtain zero display with the FINE ZERO control.**

Suggestion: Refer to Table 3 and the note following calibration step 6 for guidelines on changing the COARSE ZERO (S2) settings. Then try the FINE ZERO again to obtain zero.

Problem: **Can't obtain the proper scaling on the display.**

Suggestion: Check COARSE GAIN DIP switch S1 settings. (See "Matching the MDTR to the Transducer.")

Problem: **The reading goes in the wrong direction when the transducer core is displaced.**

Suggestion: Reverse S1 (SIG 1) and S2 (SIG 2) transducer leads.

Problem: **The display fluctuates rapidly (mainly when readings are positive).**

Suggestion: Check for loose cable connections, especially with the transducer leads.

Problem: **The display fluctuates rapidly, mainly in the last 2 digits; the count fluctuations near zero and full scale are about the same.**

Suggestion: This could be an EMI/RFI noise problem, introduced by the transducer cable and/or AC power line. Remove the transducer connections and place a jumper between MDTR screw terminals S1 (SIG 1), S2 (SIG 2), and ⏚. If the noise disappears, the source is pickup by the transducer cable. Isolate the cable from power lines and arc-producing equipment. (Refer to the note on shielding under "Transducer Hookup.") If the noise remains, it is coming from the power line. Add a line filter or try a different power receptacle.

Problem: **Instrument appears to have a slow drift that exceeds MDTR specifications.**

Suggestion: Perform the following operations to determine whether the symptoms indicate MDTR instrument drift or actual transducer/fixture displacement: Place a jumper between screw terminals S1 (SIG 1), S2 (SIG 2), and ⏚. Zero with the FINE ZERO control and observe. Also offset the zero with the COARSE ZERO switches and observe. If symptoms cease, readings indicated actual transducer/fixture movement. If symptoms persist, return MDTR to factory. (See "Warranty" and "Factory Service" sections.)

Note: To improve long-term stability, the MDTR-352L uses a ratiometric measurement technique that reduces signal errors from excitation variations.

Problem: **Digits blank out. Polarity sign and programmed decimal point remain on.**

Suggestion: This is the normal overrange signal that indicates a reading in excess of ±1999 counts. If this signal is received before the maximum range is reached, there are several possible reasons: either the instrument gain is set too high, the S2 zero offset switches are set improperly, or there is a short in the transducer cable from the excitation to the output signal.

OPERATING INSTRUCTIONS ADDENDUM
FOR
MODEL MDTR-352L WITH ANALOG OUTPUT

SPECIFICATIONS

Voltage Output	1 mVdc/count, bipolar referenced to analog ground
Current Output	2 mAdc Max.

CALIBRATION

1. First calibrate the digital display per the instructions on pages 16 to 19 in the MDTR-352L Manual.

2. Then obtain a display of 000 on the meter. Adjust control. R1 (Analog Zero) for an analog output of 0.000 Vdc.

3. Obtain a positive full scale display on the meter. Adjust control, R2 (Analog Gain) for an analog output of +1 mVdc for every count

Examples:	Transducer Range	Display	Analog Output
	+/- 0.100 inches	+/- .100 (In.)	+/- 100 mVdc
	+/- 0.100 inches	+/- 100.0 (Mils)	+/- 1.000 Vdc
	+/- 0.250 inches	+/- .250 (In.)	+/- 250 mVdc
	+/- 2.000 inches	+/- 1.999 (In.)	+/- 2.000 Vdc
	+/- 0.250 inches with 100% zero suppression	0 to .500 (In.)	0 to +500 mVdc

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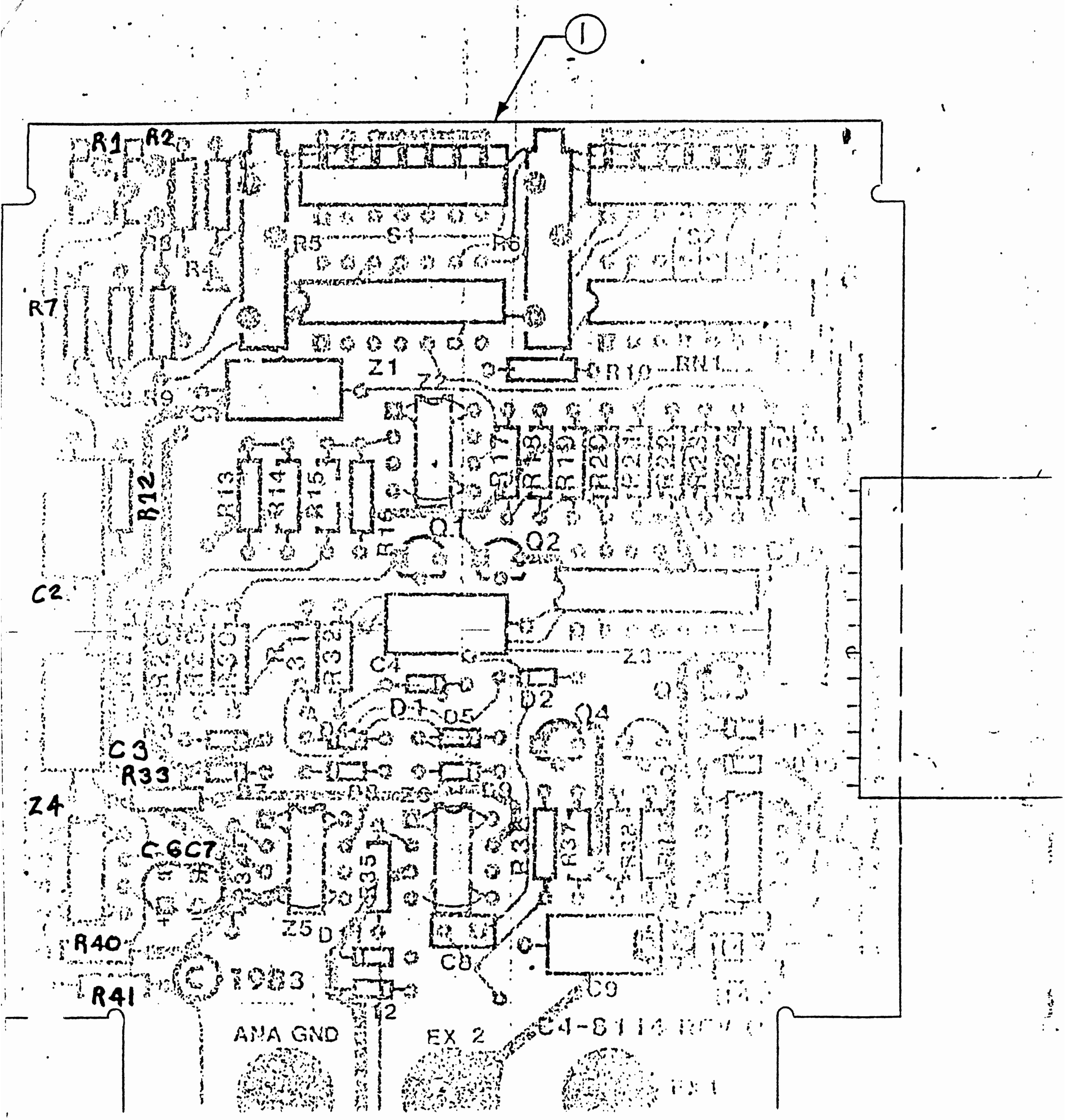
  Analog
 Zero Gain     See Instruction Manual, Page 12 for other
---------------------------------------------------------controls
: :R1: :R2: :R5: :    S1    : :R6: :    S2    0:      :
: :__: :__: :__: :________: :__: :__________:      :
:                                                    :
:                ________ ___ ___ ____               :
:                : + : :_: :_: :_:   :               :
:                : - : :_: :_: :_:   :               :
:                :___________________:               :
:____________________________________________________:
```

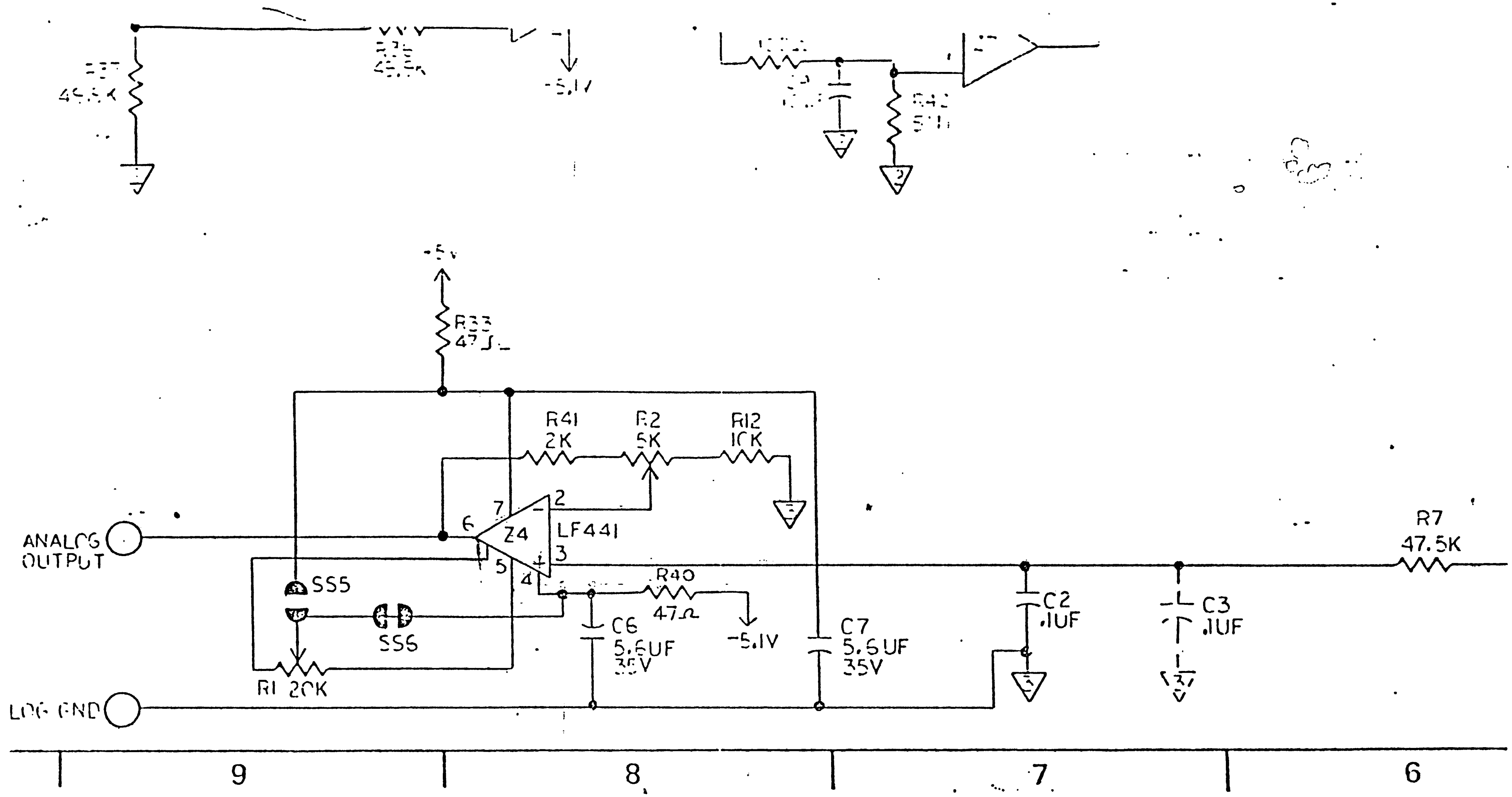
Filename MDTRAOPL Disk 16

Parts List
Analog Output Modification
MDTR-352L

	Description		Manf.	Part No.	Qty
Z4	LIC, Op Amp		National	LF441CN	1
R7	Resistor, MF	47.5K 1%		RN55D4752F	1
R33,R40	Resistor, CF	47 1/4W 5%			2
R1	Trim Pot	20K 1/4"Sq	Bourns	3266X-1-203	1
R2	Trim Pot	5K 1/4"Sq	Bourns	3266X-1-502	1
R12	Resistor, MF	10K 1%		RN55D1002F	1
R41	Resistor, MF	2K 1%		RN55D2001F	1
C2, C3	Capacitor, Cer	0.1uF 20%		CK14BR104M	2
C6, C7	Capacitor, Tant	5.6uF 35V			2

30


1
R1
R2
R5
S1
R6
R4
R7
Z1
R10
RN1
R9
R12
R13
R14
R15
R17
R18
R19
R20
Q1
Q2
C2
C4
Z3
D1
D5
D2
Q4
C3
R33
Z4
C6
C7
R35
R37
Z5
R40
R41
C8
C9
© 1983
ANA GND
EX 2



45.5K
-5.1V
R42
+5v
R33
R41
2K
R2
5K
R12
10K
ANALOG OUTPUT
Z4
LF441
R7
47.5K
SS5
SS6
R40
47Ω
-5.1V
C6
5.6UF
35V
C7
5.6UF
35V
C2
.1UF
C3
.1UF
R1 20K
LOG GND
9
8
7
6