



# RM-350 & RM-350TB DIGITAL PANEL METERS

## INTRODUCTION.

The RM350 and RM-350TB are three and one-half-digit, fixed range instruments with automatic polarity. The RM-350 has a card-edge connector and the RM-350TB has a terminal block connector. The meters are available in any one of five ranges:  $\pm 199.9$  millivolts F. S.,  $\pm 1.999$  volts F. S.,  $\pm 19.99$  volts F. S.,  $\pm 199.9$  volts F. S. or  $\pm 1000$  volts F. S.

Except for the  $\pm 199$  millivolt range, modification from one range to another may be easily accomplished by the substitution, addition or deletion of one or two resistors. Calibration is readily accomplished by the adjustment of one potentiometer, accessible at the front of the instrument. For operation, an external  $\pm 5$  vdc ( $\pm 5\%$ ) power supply is required. See figure 1 for a typical power supply circuit.

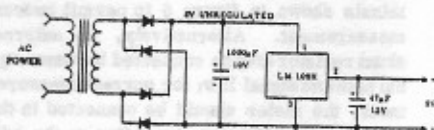


Figure 1. Typical Power Supply Schematic

## SPECIFICATIONS.

Range:	0 to $\pm 199.9$ mVDC
	or 0 to $\pm 1.999$ VDC
	or 0 to $\pm 19.99$ VDC
	or 0 to $\pm 199.9$ VDC
	or 0 to $\pm 1000$ VDC

Accuracy:  $\pm(0.05\% \text{ Rdg.} + 0.05\% \text{ F.S.})$

Update Rate: 3 readings/second, nominal

Display: 0.5" high, LED

Operating Temperature:  $0^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$

Power:  $\pm 5$  vdc ( $\pm 5\%$ ) @ 200 mA maximum

Size: See figures 3 and 4

Weight: 5 oz (142 grams)

T/C:  $\pm 0.02\% \text{ Rdg./}^{\circ}\text{C}$  on 200 mV & 2V ranges;  
 $\pm 0.025\% \text{ Rdg./}^{\circ}\text{C}$  on other ranges

Input Z: 200 mV range, 100 M $\Omega$ ; 2V range,  
1000 M $\Omega$ ; 20V range, 1 M $\Omega$ ; 200V &  
1000V ranges, 10 M $\Omega$

Common-Mode 80 db minimum  
Rejection:

Common Mode  $\pm 100$  mV between SIG LO &  
Compliance: neg. terminal of B+ supply

Decimal Location: May be positioned by  
jumper on connector to  
any one of three locations;  
 $\pm X, X, X, X$

Input Current: 250 pA maximum (room temp.)

Input Voltage  $\pm 50$  vdc or 50 vrms maximum.

# INSTRUCTIONS

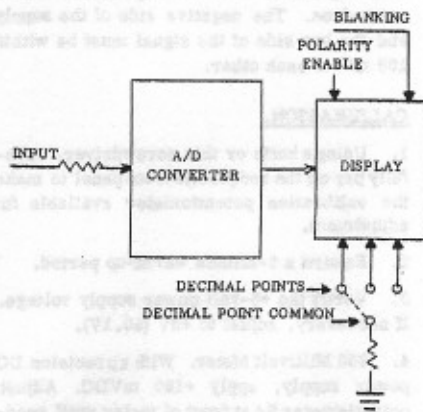


Figure 2. Simplified Block Diagram

## MOUNTING DATA

A rectangular panel outout is recommended for mounting the instruments. The recommended dimensions are:

92 millimeters (+1; -0 mm) (3.622 inches  
(.040; -0 in.).

43 millimeters (+1; -0 mm) (1.693 inches  
(.040; -0 in.).

The meters will also fit the DIN/NEMA standard outout, 92 mm x 45 mm (3.622 in x 1.772 in) and the widely used 99.7 mm x 42.72 mm (3.925 in. x 1.682 in.) outout.

Any panel thickness from 1.524 mm (0.060 in) to 4.57 mm (0.18 in.) may be used.

To mount the meter, remove the spring retainer from its holes in the sides of the meter at the rear. Insert the meter from the front of the panel outout. Replace the spring retainer and slide it behind the mounting panel to fasten the meter in place. It does not matter whether the spring retainer swings from above or below the meter.

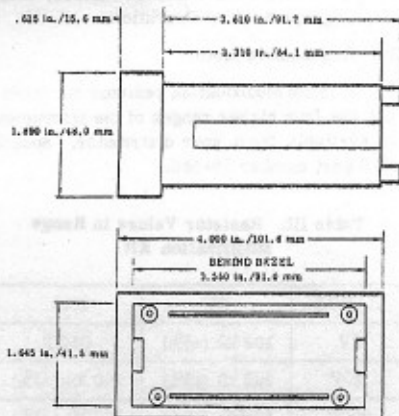


Figure 3. Card-Edge Configuration



Stanford Applied  
Engineering SAM-15S/1-2  
Polarizing Key Part Number 007900

Masterite  
Industries S014GR15-SR-H-X  
Polarizing Key Part Number 60217-1

Microplastics,  
Inc. MP-0156-15-SP-1  
Polarizing Key Part Number 04-0001-000

A polarizing key should be installed between contacts 1 and 2. A connector with polarizing key installed is available from NLS. Part number is 46-107-1. The connector is fastened to the case with two screws, 1-40 x 7/16".

Table I. Connector Pin Information  
for RM-350

Pin No.	Function
1	Signal High
2	N/C
3	Signal Low
4	N/C
5	Decimal Pt. Com.
6	N/C
7	$10^0$ Decimal
8	N/C
9	Power Gnd
10	Number Display Enable
11	+5 Volts
12	Polarity Enable
13	$10^1$ Decimal
14	N/C
15	$10^2$ Decimal

Table II. Terminal Block Contact  
Information for RM-350TB

Contact No.	Function
1	Signal High
2	Signal Low
3	Decimal Pt. Com.
4	$10^0$ Decimal
5	Power Ground
6	+5 Volts
7	$10^1$ Decimal
8	$10^2$ Decimal

## OPERATION (RM-350)

1. Power Supply. Connect the negative side

Input Current: 250 pA maximum (room temp.)

Input Voltage ±50 vdc or 50 vrms maximum,  
Protection: 200 mV or 2V ranges; ± 150 vdc  
or 150 vrms maximum, 20V  
range; ±1000 vdc or 700 vrms  
maximum, 200V & 1000 V  
range.

Overload Positive overload: +1; negative  
Indication: overload: -1 is displayed for in-  
puts exceeding full scale.

#### OPERATING PRINCIPLES (See figure 2)

Analog-to-digital conversion is accomplished in a single monolithic integrated circuit. The output of the A/D converter drives an LED display. Separate enable inputs provide means for independently blanking the polarity sign and the numerals. Decimal point selection is accomplished by external jumpers.

Light-emitting diodes (LED), arranged to form seven-segment numerals, provide the digital display. Electrical energy is converted to light within the LED, eliminating the need for light bulbs. In addition to the digital display, LED's are grouped to display plus and minus signs to indicate polarity, an over-range "1" to indicate an overload, and the three decimal points.

Figure 3. Card-Edge Configuration

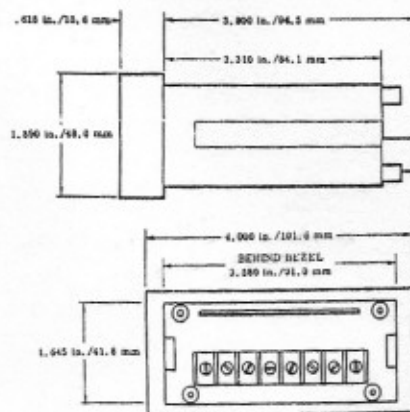


Figure 4. Terminal Block Configuration

#### MATING CONNECTOR (RM-350)

Any of the following connectors may be used to mate with the RM-350.

Manufacturer	Connector Part Number
Viking	2VH15/1AB5
	Polarizing Key Part Number 091-0024-000

#### OPERATION (RM-350)

- Power Supply.** Connect the negative side of your 5V supply to pin 9 of the connector and the positive side to pin 11.
- Signal.** Connect the signal to be measured to pin 1 of the connector. A shielded lead may be needed if the signal has a high source resistance. Connect the low side of the signal to be measured to pins 3 and 9 of the connector. It will usually be better to do this with two separate wires rather than a jumper across 3 and 9 at the connector. This will eliminate current flow through the signal low connection to pin 3.
- Polarity Display:** To blank the polarity display, an internal jumper may be removed (figure 5). To dim the polarity display, the internal jumper may be replaced by a resistor. The value of the resistor is best determined experimentally by the brightness desired. For instructions on removing meter from case refer to the paragraph on RANGE MODIFICATION. The polarity display may also be dimmed or blanked by external connections. First remove the internal jumper. Dimming is then accomplished by connecting a resistor between pins 11 and 12 of the mating connector. Full brightness is obtained by connecting a jumper between these pins.

4. Number Display. The number display may be blanked or dimmed in the same way as the polarity display. An internal jumper or resistor is used for internal control. Pins 10 and 11 on the mating connector are used for external control.

5. Decimal Indication. Jumper between pin 5 and pins 7, 13 or 15 depending upon which decimal point is to be illuminated. See below. If a decimal is not desired, do not install a jumper.

DECIMAL LOCATION	+ 1 . 0 . 0 . 0
PIN NUMBER	15 13 7

6. Connector. Plug connector onto P/C fingers at rear of RM-350. Orient connector so the keying tab mates with the slot in the P/C board.

7. Readings. Apply power and signal. Within 10 seconds the RM-350 will display the correct reading.

#### NOTE

If it is desired to power the RM-350 from a +5V supply which is not floating with respect to the signal to be measured, the following conditions must be met. The supply must be well regulated, have low impedance, and be noise-free. The negative side of the supply and the low side of the signal must be within 100 mV of each other.

#### OPERATION (RM-350TB)

1. Power Supply. Connect the negative side of your 5V supply to contact 5 of the terminal block and the positive side to contact 6.

2. Signal. Connect the signal to be measured to contact 1 of the terminal block. A shielded lead may be needed if the signal has a high source resistance. Connect the low side of the signal to be measured to contacts 2 and 5. It will usually be better to do this with two separate wires rather than a jumper across contacts 2 and 5 at the terminal block. This will eliminate current flow through the signal low connection to pin 2.

3. Polarity Display. To blank the polarity display, an internal jumper may be removed (figure 5). To dim the polarity display, the internal jumper may be replaced by a resistor. The value of the resistor is best determined experimentally by the brightness desired.

4. Number Display. The number display may be blanked or dimmed in the same way as the polarity display (see Figure 5).

5. Decimal Indication. Jumper between contact 3 and contacts 4, 7, or 8 depending upon which decimal point is to be illuminated. See below. If a decimal is not desired, do not install a jumper.

DECIMAL LOCATION	+ 1 . 0 . 0 . 0
CONTACT NO.	8 7 4

6. Readings. Apply power and signal. Within 10 seconds the RM-350TB will display the correct reading.

#### NOTE

If it is desired to power the RM-350TB from a +5V supply which is not floating with respect to the signal to be measured, the following conditions must be met. The supply must be well regulated, have low impedance, and be noise-free. The negative side of the supply and the low side of the signal must be within 100 mV of each other.

#### CALIBRATION.

1. Using a knife or thin screwdriver, carefully pry off the red plastic front panel to make the calibration potentiometer available for adjustment.

2. Ensure a 5-minute warm-up period.

3. Verify the +5-volt power supply voltage. If necessary, adjust to +5V ( $\pm 0.1V$ ).

4. 200 Millivolt Meter. With a precision DC power supply, apply +190 mVDC. Adjust potentiometer R4 at front of meter until read-out displays +190.

#### NOTE

As in paragraph 3 above, for a 2-volt meter, apply +1.900 VDC; a 20-volt meter, apply +19.00 VDC; a 200-volt meter, apply +190.0 VDC; and a 1000-volt meter, apply 900 VDC.

#### RANGE MODIFICATION (Except 200 mV unit)

1. Remove two screws fastening mating connector to meter case (RM-350 only).

2. Unplug mating connector (RM-350 only).

3. Remove red plastic front panel (see Calibration).

4. Remove two screws and two retaining brackets behind front panel.

5. Slide meter out of case.

6. Observe resistor values for R9 and R10 and compare to figure 5 and Table III.

7. Install resistors specified in Table III to attain desired range. Note that resistors R9 and R10 plug in. No soldering is required.

8. If a decimal indication is required, refer to paragraph 5 under Operation.

9. Reassemble meter.

10. A range modification resistor set covering the four higher ranges of the instrument is available from your distributor. Specify NLS part number 39-356.

Table III. Resistor Values in Range Modification Kit

RANGE	R9	R10
2V	100 k $\Omega$ ( $\pm 5\%$ )	OMIT
20V	909 k $\Omega$ ( $\pm 1\%$ )	100 k $\Omega$ ( $\pm 1\%$ )
200V	10 M $\Omega$ ( $\pm 1\%$ )	100 k $\Omega$ ( $\pm 1\%$ )
1000V	10 M $\Omega$ ( $\pm 1\%$ )	10 k $\Omega$ ( $\pm 1\%$ )

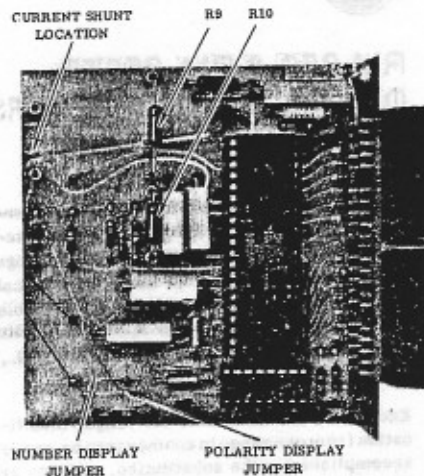


Figure 5. Component Location

#### CURRENT MEASUREMENT.

A shunt resistor may be plugged in to the terminals shown in figure 5 to permit current measurement. Alternatively, an external shunt resistor may be connected between signal high and signal low; for current measurement, the meter should be connected in the 200mV or the 2 V range, depending on the full scale voltage drop which can be tolerated. Table IV shows the shunt resistor value required. The accuracy of measurement will be determined largely by the accuracy of the shunt resistor.

TABLE IV SHUNT RESISTOR VALUES

Full Scale Current Range	Shunt Resistor for meter in 200 mV Range
2 mA	100 OHMS
20 mA	10 OHMS
200 mA	1 OHMS
2A	.1 OHM*

Full Scale Current Range	Shunt Resistor for meter in 2 V Range
2 mA	1000 OHMS
20 mA	100 OHMS
200 mA	10 OHMS
2A	1 OHM*

\* Use external shunt only.

#### MAINTENANCE

To facilitate maintenance, all six integrated circuits plug in to the printed circuit board and can be easily removed without soldering. These include the four LED displays, the ICL7107CPL chip and the CD4049AE chip.