# RM-351/115 & RM-351TB/115
# RM-351/230 & RM-351TB/230
# DIGITAL PANEL METERS

# INSTRUCTIONS


## INTRODUCTION.

The RM-351/115, RM-351TB/115, RM-351/230 and the RM-351TB/230 are three and one-half digit, fixed-range digital panel meters for making DC voltage measurements. DC current can also be measured by internally or externally connecting a shunt resistor between DC Signal Hi and DC Signal Lo. The meters are line-powered (the last three digits of the model number indicate the line input voltage) and the display consists of 0.6-inch LCD numerals, decimal point and a polarity sign.

Connections to the RM-351/115 and RM-351/230 are made via two card-edge connectors. Connections to the RM-351TB/115 and RM-351TB/230 are made via two terminal blocks.

The meters are available in any one of four ranges; ±1.999 volts F.S., ±19.99 volts F.S., ±199.9 volts F.S. or ±1000 volts F.S.

Modification from any 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.

## SPECIFICATIONS.

Range: 0 to ±1.999 VDC
or 0 to ±19.99 VDC
or 0 to ±199.9 VDC
or 0 to ±1000 VDC

Accuracy: ±(0.05% Rdg. + 0.05% F.S.)

Update Rate: 3 readings/second, nominal

Display: 0.6" high, LCD

Operating Temperature: 0°C to +50°C

Power:
RM-351/115, RM-351TB/115: 105 to 125 VAC 50/60 Hz
RM-351/230, RM-351TB/230: 210 to 250 VAC 50/60 Hz

Size: See figures 1 and 2

Weight: 13 ounces (368 g)

T/C: ±0.02% Rdg/°C on 2V range; ±0.025% Rdg/°C on other ranges

Input Z: 2V range, 1000 MΩ; 20V range, 1 MΩ; 200V and 1000V ranges, 10 MΩ

Common-Mode Rejection: 80 db minimum

Common-Mode Compliance: ±100 mV between SIG LO and DC PWR COM

Decimal Location: May be positioned by jumper on connector to any one of three locations; =X.X.X.X

Input Current: 250 pA maximum (room temp.)

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

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

## CONSTRUCTION.

The RM Series DC reading, AC powered panel meters each contain two printed circuit board assemblies, mounted one above the other. The lower assembly is the display/main board assembly. The upper assembly is the power supply. For the RM-351/115 and RM-351/230, all interconnections between the upper and lower assemblies are made via mating connectors at the rear of the meter. For the RM-351TB/115 and RM-351TB/230, all interconnections between the upper and lower assemblies are made via terminal blocks.

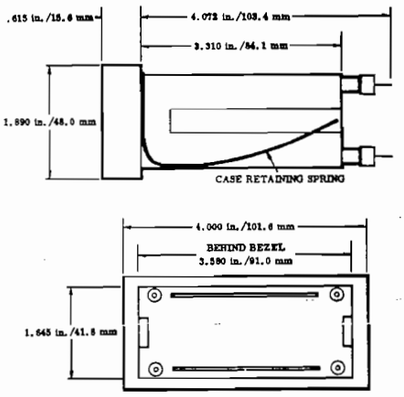



Figure 1. Card-Edge Configuration

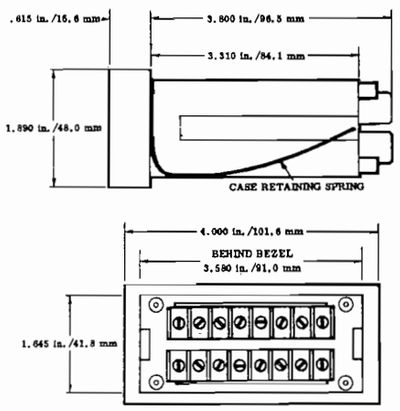



Figure 2. Terminal Block Configuration

## MOUNTING DATA.

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

92 millimeters +1, -0 mm (3.622 inches +0.040, -0 in.)

43 millimeters +1, -0 mm (1.693 inches +0.040, -0 in.)

The meters will also fit the DIN/NEMA standard cutout, 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.) cutout.

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

## MATING CONNECTORS (RM-351/115 and RM-351/230).

1. Sources. Any of the following connectors may be used to mate with the RM-351/115 and the RM-351/230:

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

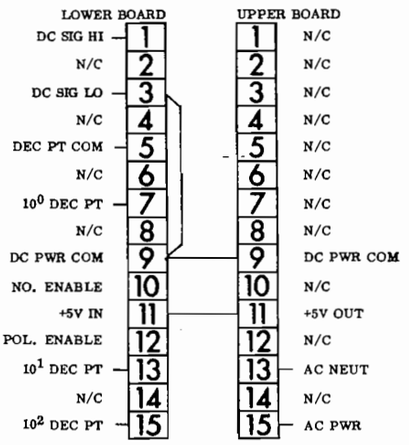
The mating connector for the display/main board assembly (the lower assembly) should have a polarizing key installed between contacts 1 and 2. This connector with polarizing key installed is available from NLS; part number is 46-107-1. The mating connector for the power supply assembly (upper assembly) should have a polarizing key installed between contacts 2 and 3. The NLS part number for this connector with key installed is 46-107-2. One each of these connectors is furnished with the instrument.

2. Mounting. Before mounting the connectors, check to see that one of them has a polarizing key between contacts 1 and 2 and the other has a polarizing key between contacts 2 and 3. The first connector mounts between the lower bosses and the second between the upper bosses. The locations of the polarizing keys should correspond to slots in the printed circuit boards. Use the screws provided (4-40 x 7/16" RDH PHH) to fasten the connectors to the case.

3. Wiring. Figure 3 provides wiring information for the connectors. Connect contacts 9 and 11 of the upper connector to the corresponding contacts on the lower connector. Jumper pins 3 and 9 of the lower connector. Connect the DC voltage to be measured to contacts 1 and 3 of the lower connector (signal HI to 1 and signal LO to 3). To display a decimal point, jumper between contact 5 and contact 7, 13, or 15 on the lower connector, depending upon which decimal point is to be displayed. See below.

| | | | | | |
|---|---|---|---|---|---|
| DECIMAL LOCATION | + | 1 | . | 0 | . | 0 | . | 0 |
| CONTACT NUMBER | | | 15 | | 13 | | 7 | |

Connect the AC power to contacts 13 and 15 on the upper connector. The "hot" side of the AC line should be connected to contact 15 since it is this contact which is connected to the internal fuse.




CONTACT NUMBERS 1 THRU 15 READ FROM LEFT TO RIGHT WHEN FACING REAR OF METER.

Figure 3. Connector Pin Information for RM-351/115 or /230

## TERMINAL BLOCK WIRING (RM-351TB/115 and RM-351TB/230).

Figure 4 provides wiring information for the terminal blocks. Connect contacts 5 and 6 of the upper terminal block to the corresponding contacts on the lower terminal block. Jumper contacts 2 and 5 on the lower terminal block. Connect the DC voltage to be measured to contacts 1 and 2 of the lower terminal block (signal HI to 1 and signal LO to 2). To display a decimal point, jumper between contact 3 and contact 4, 7, or 8 on the lower terminal block, depending upon which decimal point is to be displayed. See below.

| | | | | | |
|---|---|---|---|---|---|
| DECIMAL LOCATION | + | 1 | . | 0 | . | 0 | . | 0 |
| CONTACT NUMBER | | | 8 | | 7 | | 4 | |

Connect the AC power to contacts 7 and 8 of the upper terminal block. The "hot" side of the AC line should be connected to contact 8 since it is this contact which is connected to the internal fuse.

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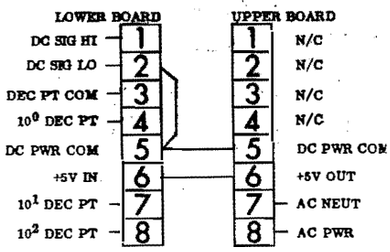


CONTACT NUMBERS 1 THRU 8 READ FROM LEFT TO RIGHT WHEN FACING REAR OF METER.

Figure 4. Terminal Block Contact Information for RM-351TB/115 or /230

## POLARITY DISPLAY BLANKING.

The polarity display may be blanked by cutting two P.C. traces and adding two jumpers on the lower P.C. board assembly. Figure 5 shows the location of the two jumpers and one of the traces to be cut; figure 6 shows the other trace to be cut. The traces to be cut contain two parallel lines about one-sixteenth inch long. For instructions on removing the meter from the case, refer to the paragraph on Range Modification.

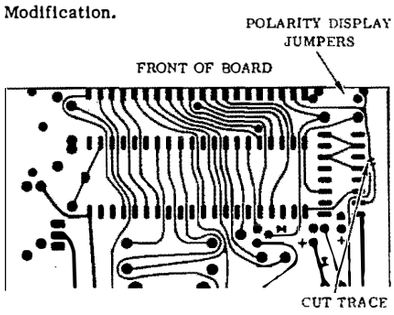


**Figure 5. Printed Circuit Top View**

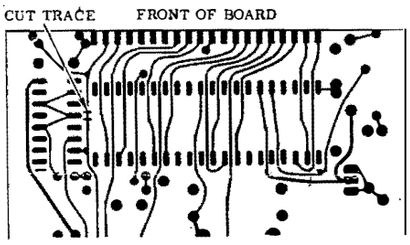


**Figure 6. Printed Circuit Bottom View**

## CALIBRATION.

1. Using a knife or a small screwdriver blade, carefully pry off the red plastic front panel to gain access to the calibration potentiometer.

2. Verify that the line voltage is correct.

3. Allow for a five-minute warm-up period.

4. Apply DC input signal voltages as follows:

| Range of Instrument | Calibration Voltage |
|---|---|
| 2 V | +1.900 V |
| 20 V | +19.00 V |
| 200 V | +190.0 V |
| 1000 V | +900.0 V |

5. Adjust potentiometer at lower right of display panel until display agrees with input.

6. Disconnect calibration voltages and line power.

7. Replace red plastic front panel.

## RANGE MODIFICATION.

A range modification resistor set needed to modify the instrument to any of its four ranges is available from your distributor. Specify NLS part number 39-356. The procedure for changing ranges is as follows:

1. Remove all sources of power and signal voltage from the meter.

2. (RM-351/115 and RM-351/230 only) Remove the four screws fastening mating connectors to meter case and unplug the two mating connectors.

3. Remove plastic front panel (see step 1 under Calibration).

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

5. Slide meter out of case.

6. Install resistors specified in Table I to attain desired range. See figure 7 for component location. Note that these resistors (R9 and R10) plug into sockets in the lower board assembly. No soldering is required.

7. Reassemble meter.

8. Calibrate meter.

9. If a decimal indication is required, refer to the applicable paragraphs on wiring (connectors or terminal blocks).

Table I. Resistor Values for Range Modification

| RANGE | R9 | R10 |
|---|---|---|
| 2V | 100 kΩ (±5%) | OMIT |
| 20V | 909 kΩ (±1%) | 100 kΩ (±1%) |
| 200V | 10 MΩ (±1%) | 100 kΩ (±1%) |
| 1000V | 10 MΩ (±1%) | 10 kΩ (±1%) |

## CURRENT MEASUREMENT.

A shunt resistor may be plugged into the terminals shown in figure 7 (lower board) 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 a 2-volt-range meter or be so modified. Table II shows the shunt resistor value required. The accuracy of measurement will be determined largely by the accuracy of the shunt resistor.

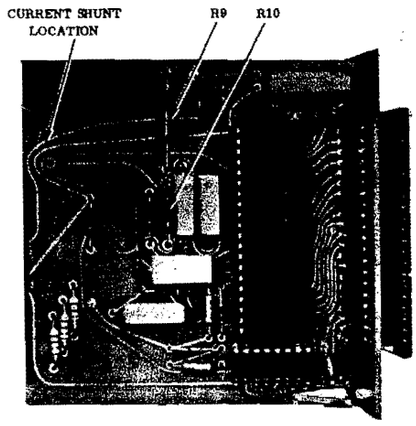


**Figure 7. Component Location**

Table II. Shunt Resistor Values

| Full Scale Current Range | Shunt Resistor Value |
|---|---|
| 2 mA | 1000 Ohms |
| 20 mA | 100 Ohms |
| 200 mA | 10 Ohms |
| 2 A | 1 Ohm* |

*Use external shunt only.

## MAINTENANCE.

1. General. To facilitate maintenance, all three integrated circuits on the lower board assembly are plug-in components. They can be easily removed and installed without soldering. They include the LCD display, the ICL7106CPL chip and the CD4049AE chip.

2. Component Access. To gain access to the components within the instrument, perform the first five steps under Range Modification.

3. Fuse Replacement. The RM-351/115 & the RM-351TB/115 meters are protected with a 3AG, 1/8 ampere, "slo-blo" fuse. The RM-351/230 and the RM-351TB/230 meters are protected with a 3AG, 1/16 ampere, "slo-blo" fuse. The fuse is mounted in fuse clips on the upper board assembly. To replace the fuse, gain access as set forth in paragraph 2 above then replace the fuse and reassemble the meter.



**Non-Linear Systems**
*Originator of the digital voltmeter.*

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