

### FEATURES

- **Dual Voltage Power** - 115/230 VAC, pin-selected
- **Low Cost** —
- **Balanced Differential Inputs**, 80 dB CMR Noise Rejection
- **Autozeroing, Ratiometric Reference** for Drift Correction
- **1000 M $\Omega$  CMOS High Impedance Inputs**
- **The DM-3104 is a high-brightness equivalent to the DM-3100L**
- **Very high luminosity LED displays** for bright ambient applications such as field instruments, vehicle panels, photo studios, etc.

### APPLICATIONS

- **Ammeter** - Accepts user-supplied shunts for  $\pm 20 \mu\text{A}$  to  $\pm 2\text{A}$  Full Scale Ranges
- **Voltmeter** - Accepts user-supplied attenuators for  $\pm 2\text{V}$  to  $\pm 1\text{ kV}$  Full Scale Ranges
- **Ohmmeter** - 200 $\Omega$  to 10M $\Omega$  Full Scale Range



### DESCRIPTION

The DM-3104 is a very low cost, dual AC-powered Digital Panel Meter. Analog voltages over the range of  $\pm 1.999\text{ Vdc}$  are displayed with  $3\frac{1}{2}$  digits of resolution. The DM-3104 is powered from the AC line; 115 or 230 VAC is pin-selectable. The unit can provide  $+5\text{V}$  and  $-5\text{Vdc}$  (@ 100 milliamps and 5 milliamps respectively) to power customer-supplied external circuitry.

The DM-3104 uses a self-illuminated red LED display with .6" high numerals. It is clearly visible from many feet away in normal or dim light.

Inputs to the DM-3104 are balanced differential (80 dB Common Mode Rejection) so the meter will accurately display small signals even in electrically noisy industrial environments. CMOS circuitry results in an extremely high input impedance (1000 Megohms, typically) and a very low bias current of 5 picoamps - inputs with a source impedance as high as 100 kilohms can be displayed with accuracy. The input circuitry will also safely tolerate over-voltages up to  $\pm 250\text{ Vdc}$  (155 VRMS). Inputs are sampled and displayed about four times per second.

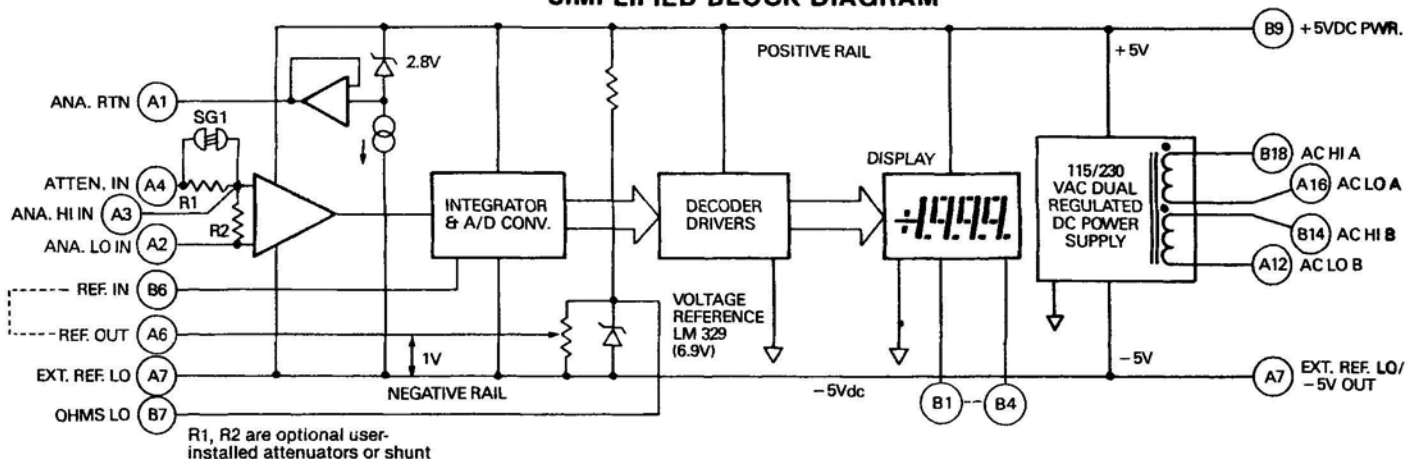
Autozeroing and a ratiometric reference in-out loop permit the DM-3104 to be used for drift correction in bridge-type measurement systems. Meter accuracy is adjustable to  $\pm 1/10\%$  ( $\pm 1$  count). Temperature drift of zero is  $\pm 1$  count from 0 to  $50^\circ\text{C}$ , while temperature drift of gain runs typically  $\pm 50$  ppm of Reading/ $^\circ\text{C}$ .

The AC-powered DM-3104 was designed for installations where existing dc supplies are noisy, inaccessible, or overloaded. This meter may be used wherever a voltage, or a unit which can be made proportional to voltage, must be displayed with accuracy and clarity. The basic input range of  $\pm 1.999\text{ Vdc}$  can be expanded with a simple voltage divider to display voltages up to  $\pm 1\text{ kV}$  or up to  $\pm 2\text{A}$  using current shunts. Blank pads on the meter's circuit board can accept user-supplied voltage attenuator resistors, current shunts, or digital ohmmeter components.

The DM-3104 is supplied in MPS's standard short depth black polycarbonate case, measuring only 3.00"W x 2.15"D x 1.76"H. All connections are made on the back panel to an optional 18-pin edge connector. Cutout dimensions are 1.812"H x 3.062"W (46.0 x 77.8 mm), minimum.

Note: DPM's are supplied without bezel labels and logos.

### SIMPLIFIED BLOCK DIAGRAM



MODEL DM-3104

**SPECIFICATIONS, DM-3104**

(Typical @ +25°C, unless noted)

**ANALOG INPUT**

<b>Configuration</b> .....	True, balanced differential bipolar -1.999 Vdc to +1.999 Vdc Input pad area will accept user- installed range change
<b>Input Bias Current</b> .....	5 pA typical, 50 pA maximum
<b>Displayed Accuracy @ +25°C</b> .....	Adjustable to $\pm 0.1\%$ reading, $\pm 1$ count
<b>Resolution</b> .....	1 mV
<b>Temperature Drift of Zero</b> .....	Autozeroed $\pm 1$ count over 0 to +50°C
<b>Temperature Drift of Gain</b> .....	$\pm 50$ ppm of Reading/°C typ. $\pm 100$ ppm of Reading/°C max.
<b>Input Impedance</b> .....	100 Megohms, minimum
<b>Input Overvoltage</b> .....	$\pm 250$ Volts dc, 155 VRMS con- tinuous max. $\pm 300$ Volts intermittent max.
<b>Common Mode Rejection</b> .....	80 dB, DC to 60 Hz, 1 Kilohm un- balance
<b>Common Mode Voltage Range</b> .....	Within +Vs - .5V and -Vs +1V where +Vs is the positive rail (Pin B9) and -Vs is the negative rail (Pin A7)). -Vs is approximately equal to -5V below PWR. COM. (Pin A9)
<b>Warm-Up Time</b> .....	Within 10 minutes
<b>Reference</b> .....	Internal, referred to the negative rail (-Vs). External, user-supplied reference optional for ratiometric operation.
<b>External Ref. Range</b> .....	+100 mV to 2V, referred to -Vs
<b>Ramp-up Time</b> (Integration Period)	83.3 mS

**DISPLAY**

<b>Number of Digits</b> .....	3 decimal digits and most significant "1" digit (3½ digits)
<b>Decimal Points</b> .....	Selectable decimal points are in- cluded for scale multipliers.
<b>Display Type</b> .....	Red, light-emitting diode (LED) self illuminated.
<b>Display Height</b> .....	0.6 inches (15.2 mm)
<b>Overscale</b> .....	Inputs exceeding the full scale range blank the display, leaving a "1" MSD and sign.
<b>Autopolarity</b> .....	A minus sign is automatically dis- played for negative inputs, and may also be blanked
<b>Sampling Rate</b> .....	Factory set at 3 conversions per second. May be rewired up to 20 conversions/second.

**Brightness Specifications:**

2400 min., 4800 typ. microcandelas per display segment (7 segments per digit)

**I/O CONNECTIONS**

<b>Analog HI Input (Pin A3)</b> .....	Differential input voltages are con- nected between these inputs. A bias current path to POWER COMMON (if $\pm 5V$ -powered) or ANALOG RETURN from both these inputs must be exter- nally provided. External circuits must constrain these inputs to be within the common mode voltage range.
<b>Analog LO Input (Pin A2)</b> .....	
<b>Attenuator IN (Pin A4)</b> .....	Connected in series through R1 (Optional attenuator resistor) to Ana. HI In (Pin A3). Supplied with a jumper in place of R1.
<b>Analog Return (Pin A1)</b> .....	This pin may be used as a low-noise bias current return for some floating inputs. If not possible, inputs may be referenced to POWER COMMON (if $\pm 5V$ -powered). Analog Return is approximately -2.8V below +Vs and can sink 30 mA to -Vs.
<b>Reference In/Out (Pins B6/A6)</b> .....	Normally, REF. IN and REF. OUT should be jumpered together. An external floating source referred to EXT. REF. LO (Pin A7) may be sub- stituted for ratiometric operation.

<b>Decimal Points</b> .....	Connect selected pin to DECIMAL POINT COMMON (Pin B5)
<b>Display Test (Pin A5)</b> .....	Connect this input to +5 Vdc (Pin B9) to light all display segments.
<b>Polarity Enable (Pin A8)</b> .....	Ground this input to Pin A9 to auto- matically display a minus sign for negative inputs.
<b>Ohms Lo (Pin B7)</b> .....	This connection is used in the ohm- meter configuration, otherwise do not use.

**POWER CONNECTIONS**

For 115 VAC input: (parallel both  
windings)

1. Connect AC LINE HI A (Pin B18) to  
AC LINE HI B (Pin B14). Connect  
both to the hot side of the AC  
line (mains).
2. Connect AC LINE LO A (Pin A16) to  
AC LINE LO B (Pin A12). Connect  
both to the neutral side of the AC  
line (mains).

For 230 VAC input: (Series both  
windings)

1. Connect AC LINE HI B (Pin B14)  
to AC LINE LO A (Pin A16). Make  
no other connections to these  
two leads.
2. Connect AC LINE HI A (Pin B18) to  
the the hot side of the AC line  
(mains).
3. Connect AC LINE LO B (Pin A12) to  
the neutral side of the AC line  
(mains).

DC Power Ground (Pin A9) may be  
connected to earth ground if input  
circuits permit.

For DC-Power Only:

A bipolar  $\pm 5V$  power supply or two  
isolated single supplies are required.  
Connect +5V to Pin B9, -5V to Pin  
A7 and Power Ground to Pin A9

**POWER REQUIREMENTS**

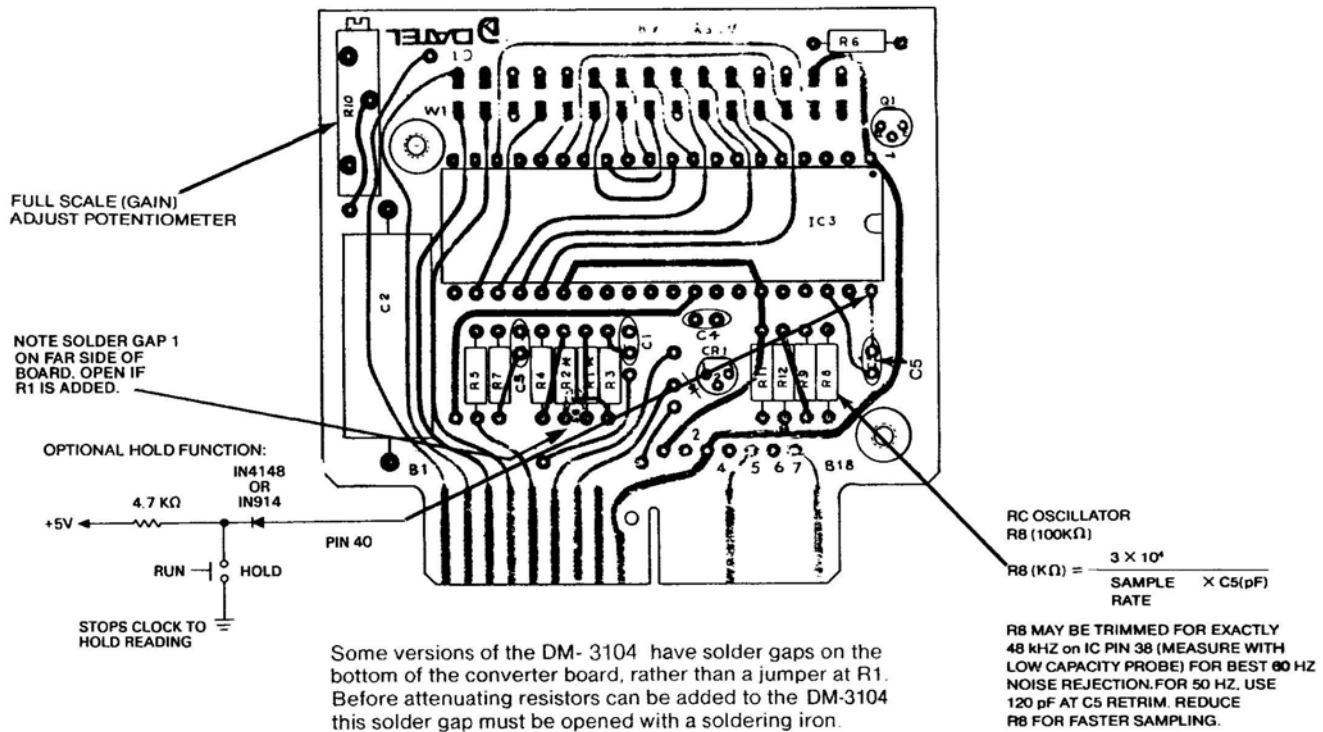
<b>AC Power</b> .....	115 or 230 VAC, $\pm 10\%$ , 47 to 440 Hz, 4 watts typical
<b>DC Power</b> .....	+5V $\pm 0.25$ Vdc @ 250 mA typical, 400 mA max. and -5V Vdc @ 5 mA typ, 25 mA max. Logic spikes must be less than 50 mV. Bypass supplies externally if necessary.
<div style="border: 1px solid black; padding: 5px; display: inline-block;">                     Users will normally power from AC-only. DC-only power is optional.                 </div>	
<b>Calibration</b> .....	A multiturn screwdriver pot adjusts the full scale reading (gain). Zero is automatic (autozeroing). Suggested recalibration in stable conditions is 90 days.

**PHYSICAL-ENVIRONMENTAL**

<b>Short-Depth Case</b> .....	Interchangeable with other Datel cases.
<b>Outline Dimensions</b> .....	3.00"W x 2.15"D x 1.76"H (76.2 x 54.6 x 44.7 mm)
<b>Cutout Dimensions</b> .....	1.812"H x 3.062"W (46.0 x 77.7 mm)
<b>Mounting Method</b> .....	Through a front panel cutout secured by (4) 4-40 front access screws which are concealed by the bezel.
<b>Weight</b> .....	Approximately 5 ounces (142g)
<b>Connector</b> .....	Double-sided edgeboard PC type, solder tab, gold-plated fingers, Dual 18-pin, 0.100" centers, Datel #58-2075010, (not included)
<b>Mounting Position</b> .....	Any
<b>Operating Temperature Range</b> .....	0 to +50°C
<b>Storage Temperature Range</b> .....	-25 to +85°C
<b>Altitude</b> .....	0 to 15,000 feet (4600m)
<b>Relative Humidity</b> .....	20% to 80% non-condensing

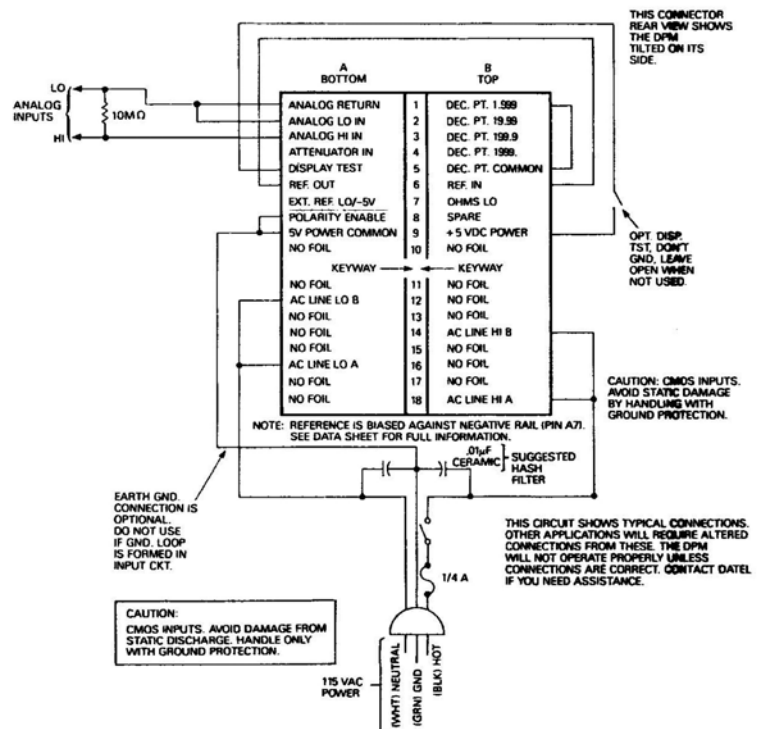
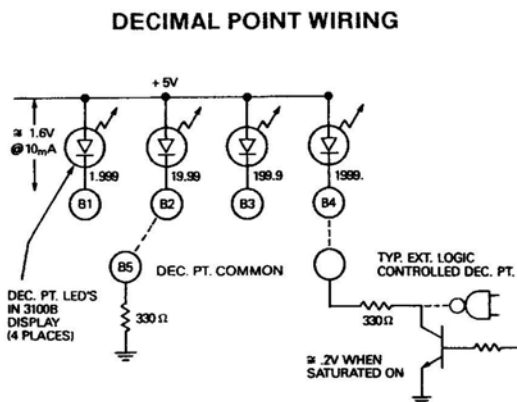


**DM-3104 COMPONENT LOCATIONS**



The DM-3104 pinout is identical to DM-3100B

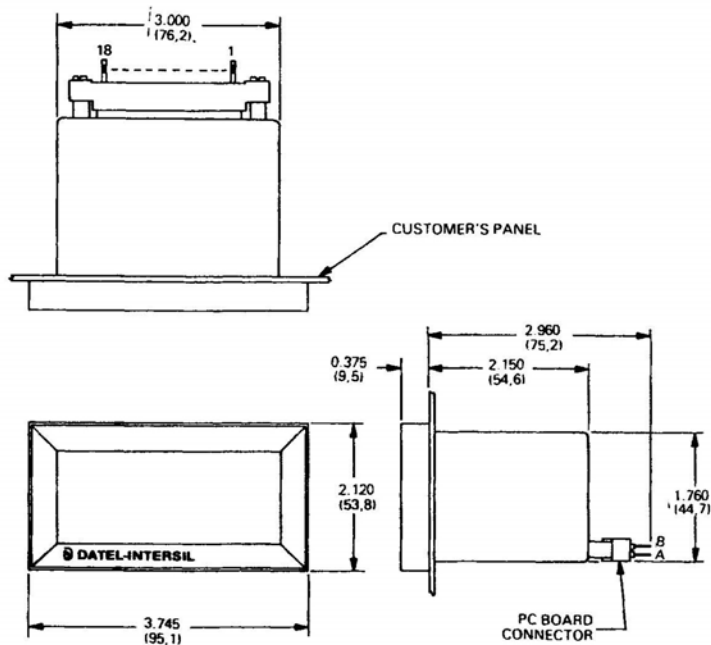
**INPUT/OUTPUT CONNECTIONS WITH SINGLE-ENDED INPUT**



**ORDERING INFORMATION**

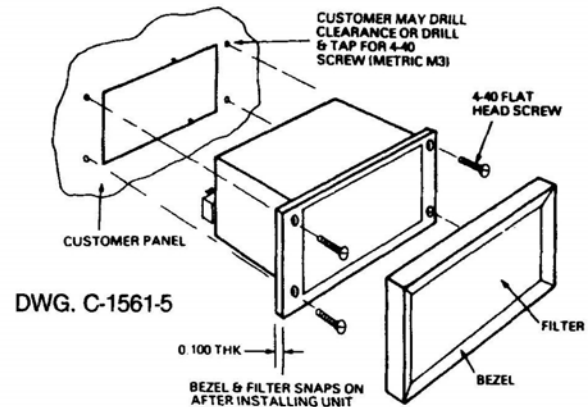
MODEL	DESCRIPTION
DM-3104	DPM, AC-Powered
58-2075010	Dual 18-pin connector, .100" ctrs., solder-tabs (not included)

**MECHANICAL DIMENSIONS  
INCHES (MM)**



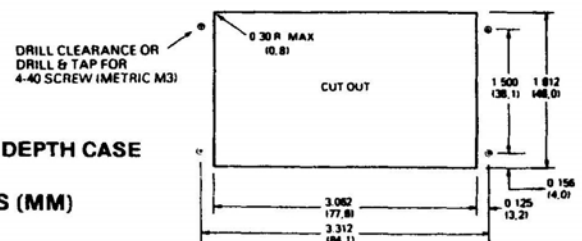
DWG. C-1561-4

**PANEL MOUNTING**



DWG. C-1561-5

**SHORT DEPTH CASE  
INCHES (MM)**

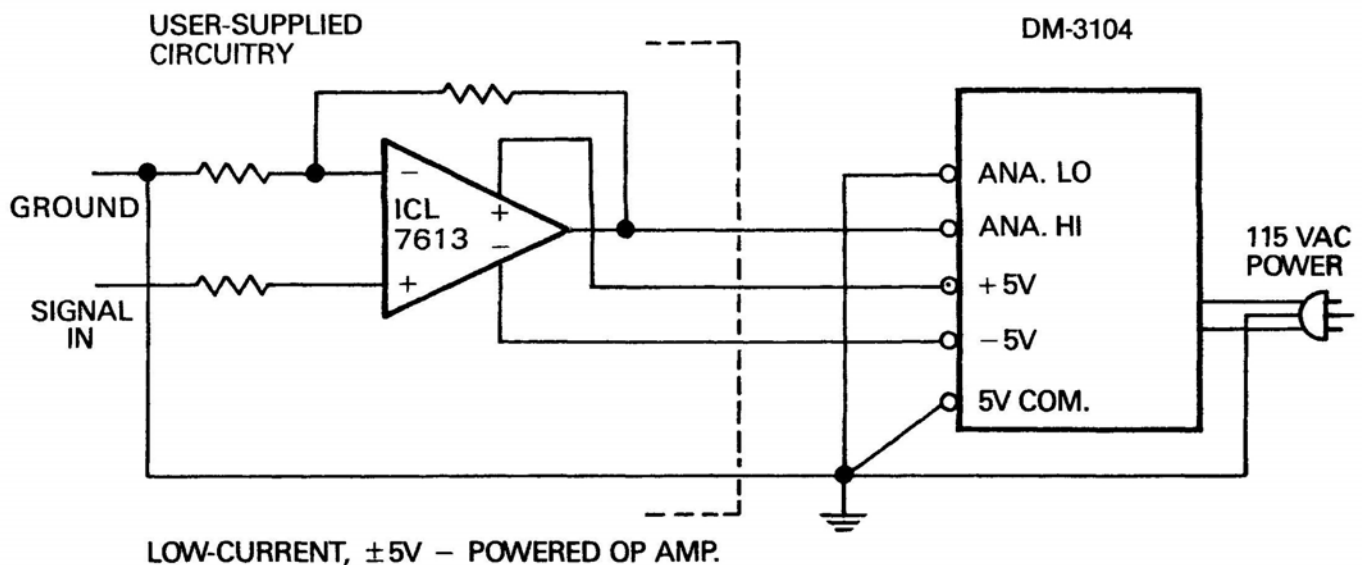


DWG. C-1561-3

**SINGLE-ENDED INPUT WITH GAIN**

The internal power supply of the **DM-3104** can be used to power external circuitry. The drawing below shows an op amp—user-supplied—in a single-ended configuration to provide gain for a low level input. Power is from the +5V and -5V power in connections (B9 and A7, respectively) on

the **DM-3104**. Where low level signals will be amplified, it is important to pay attention to ground routing. A single common ("Mecca") ground point, as indicated in the diagram, is recommended.



## APPLICATIONS

## RATIOMETRIC CONNECTIONS WITH BRIDGE INPUTS

The DM- 3104 has a reference in-out loop which makes possible ratiometric measurements. Representative connections are illustrated below. Ratiometric operation eliminates changes in the DPM reading due to voltage variations in the Bridge's external excitation source. The input gain on the DM- 3104 varies inversely with voltage at Reference In — as REF IN voltage increases, meter gain decreases. Meter input gain thus can be made to compensate for variations in the bridge excitation source voltage. (The DPM is set for unity gain when REF IN V equals +1V as referred to EXT. REF. LO).

For all applications,  $V_{IN} = 2 V_{REF}$  at full scale (1999 counts). For small values of  $V_{REF}$  (100 mV or lower), increased display noise, nonlinearity, rollover and CMR errors will be apparent. Avoid  $V_{REF}$  inputs beyond about 2V to prevent inte-

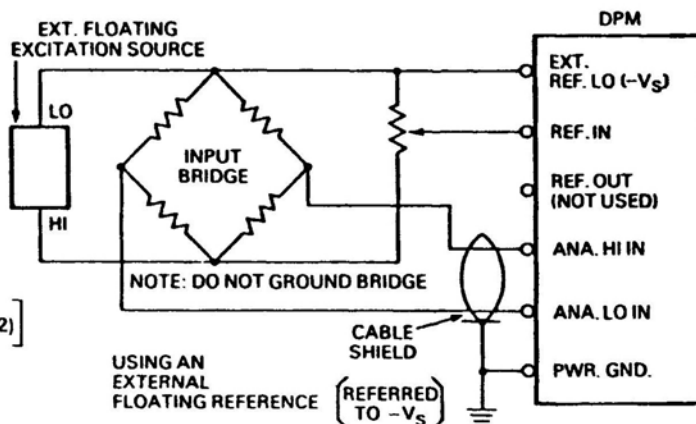
grator saturation with full scale inputs. Variable  $V_{REF}$  is not intended for wide gain changes as in multimeter applications. Instead, it should be used for drift correction, scaling to engineering units, or for modest amounts of gain.

**A note on grounding:** The DM- 3104 's internal voltage reference source is biased against the internal negative supply rail (EXT. REF. LO). Note that this is *not* the same electrical connection as the 5V Power Common connection. Refer to the Simplified Block Diagram.

Because of this configuration, external reference sources should be isolated from the 5V Power Common and should have the Reference Lo Output from the external source connected to the negative supply rail.

$$\text{DISPLAY} = \frac{1 \text{ VOLT}}{(\text{REF. IN}) - \left[ \begin{array}{c} \text{EXT.} \\ \text{REF.} \\ \text{LO} \end{array} \right]} \times \left[ \begin{array}{cc} \text{ANA} & \text{ANA} \\ \text{HI} & \text{LO} \\ \text{IN} & \text{IN} \end{array} \right]$$

$$= \frac{1 \text{ VOLT}}{(\text{PIN B6}) - (\text{PIN A7})} \times [(\text{PIN A3}) - (\text{PIN A2})]$$

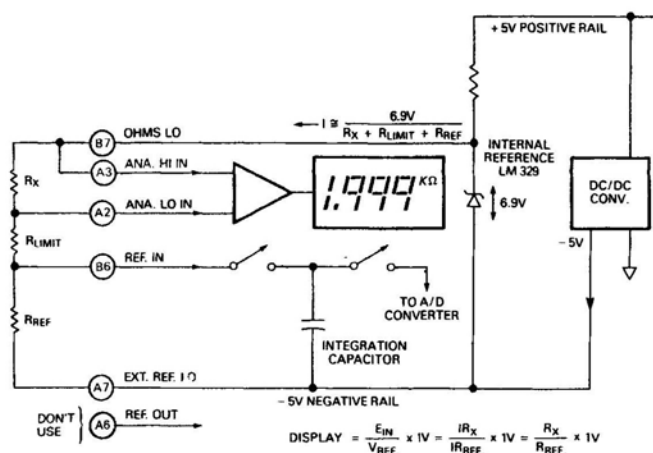


## DIGITAL OHMMETER CONNECTIONS

The digital ohmmeter circuit uses the DM-3104's ratio-metric capability. An external reference resistor of known resistance, accuracy, and temperature drift is connected in series with the unknown resistance. A constant, stable volt-

age from the DPM's internal reference diode is applied to the resistor pair to produce a constant current. This current develops two voltage drops across the resistors which are proportional only to the ratio of the resistances since the current through them is identical.

The chart below lists recommended  $R_{REF}$  and  $R_{LIMIT}$  resistance values corresponding to different ohmmeter ranges. Values of  $R_{LIMIT}$  were selected to limit the current through  $R_{REF}$  and  $R_x$  to 1 milliampere maximum.



RANGE	RESOLUTION	R <sub>LIMIT</sub>	R <sub>REF</sub>	DECIMAL POINT
19.99 MΩ	10 kΩ	22 MΩ	10 MΩ	B2 to B5
1.999 MΩ	1 kΩ	3.6 MΩ	1 MΩ	B1 to B5
199.9 kΩ	100 Ω	360 kΩ	100 kΩ	B3 to B5
19.99 kΩ	10 Ω	36 kΩ	10 kΩ	B2 to B5
1.999 kΩ	1 Ω	6.2 kΩ	1 kΩ	B1 to B5
199.9 Ω	.1 Ω	6.8 kΩ	100 Ω	B3 to B5

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ISO 9001 and 14001 REGISTERED



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