DMS-20PC Series, 3½ Digit, LED Display, Digital Panel Voltmeters combine a precision A/D converter, a factory-trimmed, highly stable, voltage reference; and a large (0.37”/9.4mm), easy-to-read LED display in a single package that is only slightly larger than the display itself. Displays are offered in either red, orange, amber, yellow, green or blue colors. High-intensity and low-power (35mW total) red LEDs are also optional.

These low-cost meters are fully self-contained and fully functional. Their subminiature (1.38” x 0.88” x 0.48”), epoxy-encapsulated cases incorporate built-in color filters and bezels; are moisture and vibration proof; and function well in the harshest environments. Their 12-pin, dual-in-line configuration offers component-like, plug-in convenience and maximum versatility. Operating temperature range is 0 to +60°C.

The meters come with one of four, differential, input voltage ranges: ±200mV, ±2V, ±20V or ±200V. Input impedance is a minimum 800kΩ. CMRR is typically 86dB (dc to 60Hz), and CMV is ±2V. Input overvoltage protection (on the non-inverting input) is ±250V.

Devices are fully calibrated at the factory to an accuracy of ±1 count (±0.05% of full scale range) and never require calibration or adjustment.

A DISPLAY ENABLE function permits the display to be disabled for “power-down” operation. All models have a DISPLAY TEST function. Standard red LED models offer an optional DISPLAY HOLD function.

Small size, low cost and adjustment-free reliability make the DMS-20PC Series the best choice for all your 3½ digit, LED, DPM applications.

**FEATURES**

- Lowest-cost LED meters
- Subminiature size: 1.38” x 0.88” x 0.48” (35mm x 22mm x 12mm)
- Large (0.37”/9.4mm) LED display
- Choice of 6 LED colors
- High-intensity or low-power (7mA) red LEDs optional
- Epoxy-encapsulated, 12-pin DIP package with built-in color filter and bezel
- 4 differential input voltage ranges
- Factory calibrated, ±1 count accuracy
- Single +5V power supply
- User-selectable decimal point placement
- DISPLAY ENABLE function for “power-down” mode
- DISPLAY TEST and HOLD (optional) functions
- 0 to +60°C temperature range

**SIMPLIFIED SCHEMATIC DIAGRAM**

Figure 1. DMS-20PC Series simplified schematic
DMS-20PC Series

3½ Digit, LED Display, Low-Cost, Subminiature Digital Panel Voltmeters

Performance/Functional Specifications

Typical at Ta = +25°C and supply voltage = +5V using the single-ended input circuit, unless otherwise noted.

Analog Inputs

<table>
<thead>
<tr>
<th>Model</th>
<th>Full Scale Input Range</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0</td>
<td>±200 mV</td>
<td>–</td>
<td>±200</td>
<td>–</td>
<td>mV</td>
</tr>
<tr>
<td>DMS-20PC-1</td>
<td>±2 V</td>
<td>–</td>
<td>±2</td>
<td>–</td>
<td>Volts</td>
</tr>
<tr>
<td>DMS-20PC-2</td>
<td>±20 Volts</td>
<td>–</td>
<td>±20</td>
<td>–</td>
<td>Volts</td>
</tr>
<tr>
<td>DMS-20PC-3</td>
<td>±200 Volts</td>
<td>–</td>
<td>±200</td>
<td>–</td>
<td>Volts</td>
</tr>
</tbody>
</table>

Input Impedance:

<table>
<thead>
<tr>
<th>Model</th>
<th>Typ.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0, -1</td>
<td>1 KΩ</td>
<td>MΩ</td>
</tr>
<tr>
<td>DMS-20PC-2, -3</td>
<td>100 KΩ</td>
<td>MΩ</td>
</tr>
</tbody>
</table>

Overvoltage Protection:

<table>
<thead>
<tr>
<th>Model</th>
<th>Typ.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0</td>
<td>±250 Volts</td>
<td></td>
</tr>
<tr>
<td>DMS-20PC-1</td>
<td>±2 Volts</td>
<td></td>
</tr>
</tbody>
</table>

Common Mode Voltage Range

<table>
<thead>
<tr>
<th>Model</th>
<th>Typ.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0</td>
<td>±2 Volts</td>
<td></td>
</tr>
<tr>
<td>DMS-20PC-1</td>
<td>±2 Volts</td>
<td></td>
</tr>
</tbody>
</table>

CMRR (dc to 60Hz)

<table>
<thead>
<tr>
<th>Model</th>
<th>Typ.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0</td>
<td>86 dB</td>
<td></td>
</tr>
</tbody>
</table>

Performance

Sampling Rate

2.5 reading per second

Accuracy (3 minute warm-up):

<table>
<thead>
<tr>
<th>Model</th>
<th>Typ.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0 (Vin = +0.19V)</td>
<td>±1 Count</td>
<td>±3 Counts</td>
</tr>
<tr>
<td>DMS-20PC-1 (Vin = +1.9V)</td>
<td>±1 Count</td>
<td>±3 Counts</td>
</tr>
<tr>
<td>DMS-20PC-2 (Vin = +19V)</td>
<td>±2 Count</td>
<td>±3 Counts</td>
</tr>
</tbody>
</table>

Zero Reading (Vin = 0 Volts)

<table>
<thead>
<tr>
<th>Model</th>
<th>Typ.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0</td>
<td>±0.01 Count</td>
<td>±0.001 Count</td>
</tr>
<tr>
<td>DMS-20PC-1</td>
<td>±0.01 Count</td>
<td>±0.001 Count</td>
</tr>
</tbody>
</table>

Temperature Drift (0 = +60°C)

<table>
<thead>
<tr>
<th>Model</th>
<th>Typ.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0</td>
<td>±0.2 Cnts/°C</td>
<td>±0.4 Cnts/°C</td>
</tr>
</tbody>
</table>

Power Supply Requirements

Supply Voltage

<table>
<thead>
<tr>
<th>Model</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0-X-RL</td>
<td>4.75</td>
<td>+5.00</td>
<td>+5.25</td>
<td>Volts</td>
</tr>
</tbody>
</table>

Supply Current:

<table>
<thead>
<tr>
<th>Model</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0-X-RL</td>
<td>7 mA</td>
<td>12 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMS-20PC-0-X-BL &amp; -PGL</td>
<td>12 mA</td>
<td>17 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMS-20PC-0-X-RS, -RH</td>
<td>60 mA</td>
<td>90 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMS-20PC-0-X-RS-H</td>
<td>60 mA</td>
<td>90 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMS-20PC-0-X-RH</td>
<td>75 mA</td>
<td>100 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMS-20PC-0-X-RS-H</td>
<td>90 mA</td>
<td>120 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMS-20PC-0-X-GS-H</td>
<td>90 mA</td>
<td>120 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMS-20PC-0-X-AS, -GS, -OS, -YS</td>
<td>90 mA</td>
<td>120 mA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Display

Display Type and Size

3½ digit, 0.37"/9.4mm high LED

Polarity Indication

Autopolarity ("—" for negative Vin)

Overrange Indication

"—1_ _ _ _ _ _ " for negative inputs
"1_ _ _ _ _ _ " for positive inputs

Physical/Environmental

Operating Temperature

<table>
<thead>
<tr>
<th>Model</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0-X-XL</td>
<td>0 °C</td>
<td>+60 °C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Storage Temperature

<table>
<thead>
<tr>
<th>Model</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0-X-XL</td>
<td>−20 °C</td>
<td>+75 °C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Humidity (non-condensing)

<table>
<thead>
<tr>
<th>Model</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0-X-XL</td>
<td>0 %</td>
<td>95 %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Case Material

Polycarbonate

Weight

<table>
<thead>
<tr>
<th>Model</th>
<th>Weight</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0-X-XL</td>
<td>0.4 ounces (11 grams)</td>
<td></td>
</tr>
</tbody>
</table>

1. REFERENCE OUTPUT (Pin 8) and INPUT (Pin 7): Pin 8 is a precision reference actively trimmed at the factory. In normal operation, pin 8 must be tied to pin 7 to achieve all listed accuracy and drift specifications.

2. ANALOG COMMON (Pin 10): This pin is connected to an internal, low-noise, "relative" ground. It is used in certain differential and "floating" measurements as described in the Applications section of this data sheet and Ap Note DMS-AN3 at http://www.murata-ps.com/data/meters/dms-an3.pdf. Pin 10 should not be connected to pin 3 (5V RETURN) or to your system’s analog ground.

3. Decimal Point Placement: The location of the decimal point is user-selectable, and the decimal point control pins (DP1-DP3) are active low functions. Select the appropriate decimal point by tying the appropriate pin (pin 4, 5 or 6) to pin 3 (5V RETURN). Unused decimal point location pins should be left open.

Hard wiring is preferable, however, you can use logic gates to exercise dynamic control over the location of the decimal point if the following drive conditions are met:

<table>
<thead>
<tr>
<th>Model</th>
<th>Applied 0° Voltage</th>
<th>Load Current*</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS-20PC-0-X-XL</td>
<td>+0.05V max.</td>
<td>0.7 mA max.</td>
</tr>
<tr>
<td>All Others</td>
<td>+0.4V max.</td>
<td>6 mA max.</td>
</tr>
</tbody>
</table>

* The driving gates must be able to sink this much current.

See www.murata-ps.com/dpm-availability for model-specific availability.

TECHNICAL NOTES

Ordering Information

DMS-20PC - 1 - RS - C

Input Range:

0 = ±200mV
1 = ±2V
2 = ±20V
3 = ±200V

Add -C for RoHS

Leave blank for standard models.

Add -H for DISPLAY HOLD option (available on standard red and green LED models only).

LED Color:

As = Standard Amber
Bs = Standard Blue
Gs = Standard Green
Os = Standard Orange
Rs = Standard Red
Ys = Standard Yellow
Rh = High-Intensity Red
Rl = Low-Power Red
Bl = Low-Power Blue
Pgl = Low-Power Green

Accessories:

DMS-20-CP Panel cutout punch
DMS-BZL3-C DMS-20 bezel assembly
DMS-BZL4-C DMS-20 bezel assembly with sealing gasket
DMS-EB2-C Application/evaluation board with standard MOLEX connector, decimal point solder pads and attenuation resistor pads.

A panel-mount retaining clip is supplied with each model.

RoHS Compliant Parts:

Add "-C" suffix to part number.

www.murata-ps.com/support

www.murata-ps.com/dpm-availability

DMS-20PC Series

3½ Digit, LED Display, Low-Cost, Subminiature Digital Panel Voltmeters

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DMS-20PC Series

3½ Digit, LED Display, Low-Cost, Subminiature Digital Panel Voltmeters

8. Suggested Mating Connectors:

Panel mounted:
- Connector housing: Murata Power Solutions P/N 4320-01069-0
- Terminal type: Murata Power Solutions P/N 4400-01032-0
- Crimping tool: Murata Power Solutions P/N 39-2099000
- Wire size: 22 to 26 AWG
- Insulation diameter: 0.062" (1.57mm) maximum
- Stripping length: 0.100 to 0.125" (2.54 to 3.17mm)
- Board mounted:
  - Socket: Murata Power Solutions P/N 4320-01074-0

APPLICATIONS

DMS-20PC meters are highly versatile devices that can be used in hundreds of applications. The application circuits chosen for this section are ones that have historically received many inquiries.

The schematic in Figure 1 shows that the meter's high-impedance input consists of an op amp powered from a ±5Vdc power supply (the –5V is internally generated). One can easily see why input signals applied to (+) INPUT LO and (+) INPUT HI have to be kept within the power supply rails of ±5V. Also note that only pin 11 has a current-limiting 909kΩ series resistor. High input voltages that have a common ground with pin 3 (5V RETURN) must only be applied to pin 11 (+) INPUT HI and never to pin 12. In these high-voltage cases, pin 12 should always be tied to pin 3 (5V RETURN).

The schematic also shows that pin 3 is the meter’s zero-volt reference point — regardless of the type of power or signal source used. This is an important point to keep in mind when a digital or analog multimeter is used to make system measurements. The multimeter’s negative lead (usually the black one) must be connected to pin 3 (5V RETURN).

1. Single-Ended Input Configurations: True single-ended measurements can be made with any DMS-20PC meter. The circuit of Figure 2 avoids problems normally associated with ground-loop currents. Separate ground runs should be used for 5V RETURN (pin 3) and –) INPUT LO (pin 12).

8. Suggested Mating Connectors:

Panel mounted:
- Connector housing: Murata Power Solutions P/N 4320-01069-0
- Terminal type: Murata Power Solutions P/N 4400-01032-0
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1. Single-Ended Input Configurations: True single-ended measurements can be made with any DMS-20PC meter. The circuit of Figure 2 avoids problems normally associated with ground-loop currents. Separate ground runs should be used for 5V RETURN (pin 3) and –) INPUT LO (pin 12).
2. Differential Input Configurations: Differential measurements can be made with all DMS-20PC meters. Figure 3, though not a practical real-world application, uses a voltage divider to demonstrate the concept of a differential input signal. Be careful not to exceed the ±2V common mode voltage limitation for 5V-powered meters.

\[
\frac{50k\Omega}{R2} \times \frac{V}{R1 + R2} = \text{Reading}
\]

3. Engineering Scaling: For measuring voltages greater than the full scale input range of a given meter, the input signal must be attenuated. A simple voltage divider (similar to that shown in Figure 4) will scale the input to within the range of the selected meter. R1 and R2 should be precision, ±1%, metal-film resistors with absolute TCR’s less than 50ppm/°C. See Ap Note 4 for more information on engineering scaling.

4. Floating Signal Source Measurements: Floating signals can be measured using the circuits shown in Figures 5 and 6. Connecting pin 10 (ANALOG COMMON) or pin 3 (5V RETURN) to (-) INPUT LO (pin 12) provides the reference point for the meter’s input. A “floating” input is a signal that has no galvanic connection to the meter’s power supply. In the figures below, the 1.5V battery illustrates a true floating input.

5. Process Control (4-to-20mA) Measurements: In many common process-control applications, a 4-to-20mA current loop is used to transmit information. Because DMS-20PC meters have such high input impedance, a simple shunt resistor across the meter’s input can be used to convert the loop current to a voltage. See Figure 7. The value of the shunt resistor is a function of the scaling requirements of the particular application and can be calculated using the following equation:

\[
R_{\text{shunt}} = R_1 = \frac{V_{\text{fs}}}{I_{\text{fs}}}
\]

Where: 
- \(V_{\text{fs}}\) = Full scale reading (in Volts)
- \(I_{\text{fs}}\) = Relative full scale current (in Amps)
To calibrate the circuit of Figure 7, perform the following:

1. With 4mA applied, adjust the 50kΩ potentiometer (R2) to display a reading of “000” (assuming that is the desired reading).

2. With 20mA applied, adjust the gain-adjust potentiometer on the back of the meter to display a reading of “1000”.

For different full scale readings, alter the value of R_shunt accordingly.

Example: For a meter with a 2V full scale input (1.999 full scale reading) and a desired display reading of “1000” (with an input of 20mA), \( V_{FS} = 1.000 \) Volts

\[
R_{\text{shunt}} = \frac{1.000}{0.020 - 0.004} \times 1000 \\
R_{\text{shunt}} = 62.5 \text{ Ohms}
\]

6. Power Supply Monitoring: One of the most common digital panel meter applications involves monitoring the output voltage of the system power supply — often this supply also powers the meter itself. The low-power, red LED DMS-20PC-2-RL can be configured to allow power supply monitoring over the range of 4.5-18Vdc. The circuit in Figure 8 uses a low-drop-out, three-terminal regulator (LM-2931Z-5, available from National Semiconductor) to provide regulated 5V-power to the meter.

8. External Gain Adjustment: Connect REFERENCE OUT (pin 8) to REFERENCE IN (pin 7) for normal, factory calibrated, operation. Use the circuit shown in Figure 10 for applications needing external gain adjustment. Calibration is performed with a precise, near-full-scale, input voltage.
MECHANICAL SPECIFICATIONS

MECHANICAL DIMENSIONS: Inches (mm)
TOLERANCES: 2 PL DEC ±0.02 (±0.51)
3 PL DEC ±0.010 (±0.254)
LEAD DIMENSIONS: 0.025 (0.635) x 0.025 (0.635) NOMINAL
RECOMMENDED PC BOARD FINISHED HOLE DIAMETER:
0.042 ±0.003 (1.067 ±0.076)

LEAD DIMENSIONS: 0.025 (0.635) x 0.025 (0.635) NOMINAL

RECOMMENDED PC BOARD FINISHED HOLE DIAMETER:
0.042 ±0.003 (1.067 ±0.076)

Leading Dimensions: 0.025 (0.635) x 0.025 (0.635) NOMINAL

RECOMMENDED PC BOARD FINISHED HOLE DIAMETER:
0.042 ±0.003 (1.067 ±0.076)

BEZEL INSTALLATION AND RECOMMENDED DRILL AND PANEL CUTOUT

This product is subject to the following operating requirements and the Life and Safety Critical Application Sales Policy:
Refer to: http://www.murata-ps.com/requirements/

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