





# **DMS-20LCD Series**

3<sup>1</sup>/<sub>2</sub> Digit, LCD Display Low-Cost, Subminiature Digital Panel Voltmeters

### Features

- Lowest cost
- Lowest power, 2mW
- Subminiature size: 1.38" x 0.88" x 0.43" 35mm x 22mm x 11mm
- Large (0.37"/9.4mm), enhancedcontrast LCD display
- · Backlit displays optional
- Epoxy-encapsulated, 12-pin DIP
- Panel or pc-board mountable
- 4 differential input voltage ranges
- High accuracy, ±1 count (±0.05%)
- Single +5V supply or 9V battery
- · Low-battery annunciator
- User-selectable decimal point placement
- 0 to +60°C temperature range

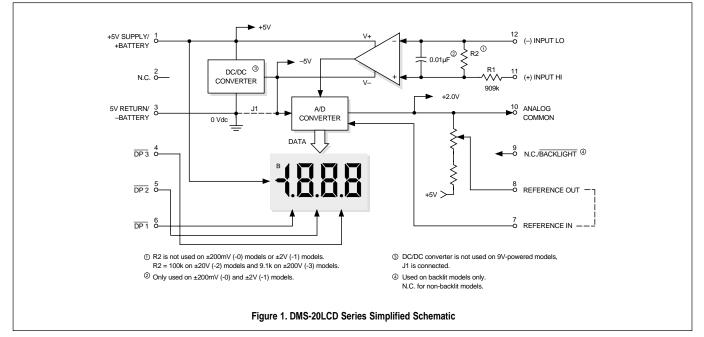
DMS-20LCD Series, 3½ Digit, LCD Display, Digital Voltmeters represent the ultimate combination of low price, low power, small size and high performance in digital meters. Epoxy encapsulated in a subminiature (1.38" x 0.88" x 0.43"), 12-pin DIP package, these completely self-contained, fully operational meters offer a combination of ruggedness, long-term reliability and component-like ease-of-use simply not available in any other meters.

Incorporating a precision reference and a factory-calibrated, autozeroing A/D converter, DMS-20LCD meters are extremely accurate (±1 count) and are only slightly larger than their 0.37"/9.4mm, enhanced-contrast, LCD displays. All models incorporate a built-in bezel and are easily mounted in either panels or pc boards. Both backlit and non-backlit versions are available.

DMS-20LCD meters have 4 differential input voltage ranges (±200mV, ±2V, ±20V and ±200V) and a user-friendly input structure. Input impedance is a minimum 800k $\Omega$ . CMRR is typically 86dB with a CMV of ±2V. Non-inverting inputs are overvoltage protected to ±100V (±250V for the ±200V input model).

All DMS-20LCD meters operate from a single +5V supply (drawing 400 $\mu$ A) or a single +9V supply/battery (drawing 230 $\mu$ A). All models have a low-battery ("B") annunciator and feature autopolarity changeover and overrange indication.

Also available is an application/evaluation board (DMS-EB2) that plugs directly onto the back of any DMS-20LCD allowing direct inputs for common applications such as 4-20mA inputs, zero/gain adjust, decimal point location, and input voltage dividing.



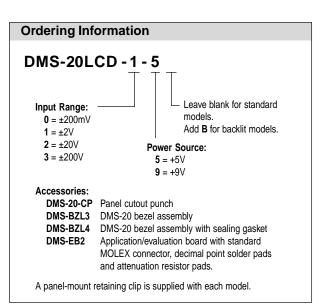
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## **Performance/Functional Specifications**

Typical at  $T_A = +25^{\circ}C$  and supply voltage = +5V (using the single-ended input circuit) or +9V (using the differential input circuit), unless otherwise noted.

Analog inputs         Min.         Typ.         Max.         Units           Full Scale input Range:         -         +200         -         mV           DMS-20LCD-0         -         +200         -         Wolts           DMS-20LCD-1         -         +200         -         Wolts           DMS-20LCD-0, 1         100         1000         -         MΩ           DMS-20LCD-0, 1, 1         100         1000         -         MΩ           DMS-20LCD-0, 1, -2         -         -         +200         Volts           DMS-20LCD-0, -1, -2         -         -         +250         Volts           DMS-20LCD-0, -1, -2         -         -         +250         Volts           DMS-20LCD-0, -1, -2         -         -         +250         Volts           DMS-20LCD-3         -         +2         Volts         Volts           Common Mode Voltage Range @         -         +2         Volts         Volts           DMS-20LCD-0, (+, = +1         PM         Volts         Counts         Stanging Rate         2.5 samplers         Counts           DMS-20LCD-1 (wa = +1.9V)         -         ±1         ±2         Counts         Counts						
DMS-20LCD-0          ±200          VOIts           DMS-20LCD-2          ½20          Volts           DMS-20LCD-2          1200          Volts           DMS-20LCD-2, -3         0.8         1          MQ           DMS-20LCD-2, -3         0.8         1          MQ           DMS-20LCD-2, -3         0.8         1          MQ           DMS-20LCD-3           ±200         Volts           DMS-20LCD-3           ±200         Volts           DMS-20LCD-3           ±20         Volts           DMS-20LCD-3           ±20         Volts           Common Mode Voltage Range @           ±20         Volts           Common Indue Varter<(Pins 4-6):         Trie to pin 3 to activate         Trie to pin 3 to activate         Trie to pin 3 to activate           Logic Compatibility         Trie to pin 3 to activate         Trie to pin 3 to activate         Trie to pin 3 to activate           Portermance          +1         ±2         Counts         Counts         Counts         Counts	Analog Inputs	Min.	Тур.	Max.	Units	
DMS-20LCD-1          ±20          Volts           DMS-20LCD-2          ±200          Volts           Input Impedance:          ±200          MΩ           DMS-20LCD-0, -1         100         1000          MΩ           DMS-20LCD-0, -1, -2           ±250         Volts           DMS-20LCD-0, -1, -2           ±250         Volts           DMS-20LCD-0, -1, -2           ±250         Volts           Corrootage Protection: ①           ±250         Volts           DMS-20LCD-0, -1, -2           ±250         Volts           Corrootage Protection: ①           ±250         Volts           DMS-20LCD-0           ±20         Volts           Counts Compatibility           ±20         Counts           Backlight (Pin 9)          ±1         ±2         Counts           DMS-20LCD-1 (Wa = 10.19V)         -         ±1         ±2         Counts           DMS-20LCD-1 (Wa = 19.19V)         -         ±1						
DMS-20LCD-2 DMS-20LCD-0, -1          ±20          Volts           Input Inpedance: DMS-20LCD-0, -1         100         1000          MA           DMS-20LCD-0, -1         0.8         1          MA           DMS-20LCD-0, -1, -2          +100         Volts           DMS-20LCD-3          +2         Volts           Common Mode Voltage Range @          #2         Volts           Perimance         TT         to stivate         TT           Sampling Rate         2         Sampling Rate         2         Counts           Accuracy (1 minute warm-up): DMS-20LCD-1 (Nn = +1.9V)         +1         +2         Counts           DMS-20LCD-1 (Nn = +1.9V)         -         ±1         ±2         Counts           DMS-20LCD-2 (Nn = +1.9V)         -         ±2         ±3         Counts           DMS-20LCD-1 (Nn = +1.9V						
DMS-20LCD-3          ±200          Voits           Input Impedance: DMS-20LCD-0, -1         1000         1000          MΩ           DMS-20LCD-2, -3         0.8         1          MΩ           DMS-20LCD-0, -1, -2           ±100         Voits           DMS-20LCD-3, -2           ±20         Voits           DMS-20LCD-3, -2           ±20         Voits           DMS-20LCD-3, -2           ±20         Voits           DMS-20LCD-3, -1, -2           ±20         Voits           Common Mode Voitage Range @           ±20         Voits           Common Inputs @           ±20         Voits           Decimal Point Placement (Pins 4-5):         Firetorin 3 to activate         TTL (on 5V-pwered models)           Backlight (Pin 9)          ±1         ±2         Counts           DMS-20LCD-0 (Vm = +0.19V)          ±1         ±2         Counts           DMS-20LCD-0 (Vm = +1.9V)          ±2         ±3         Counts           DMS-20LCD-1 (Vm = +1.9V)         - </th <td></td> <td></td> <td></td> <td></td> <td></td>						
Input Impedance: DMS-20LCD-0, -1         100         1000          MΩ           DMS-20LCD-2, -3         0.8         1          MΩ           Overoltage Protection: ① DMS-20LCD-3, -2           ±100         Voits           DMS-20LCD-3           ±250         Voits           Cornon Mode Voltage Range ②           ±250         Voits           Common Mode Voltage Range ③           ±25         Voits           Control Inputs ③          86          dB           Control inputs ③          TE to pin 3 to activate         TTL (on 5V-pow=red models)           Backlight (Pin 9)         TE to pin 3 to activate         TTL (on 5V-pow=red models)         TTL Con 5V-pow=red models)           Backlight (Pin 9)          ±1         ±2         Counts           DMS-20LCD-0 (V <sub>N</sub> = +0.19V)          ±1         ±2         Counts           DMS-20LCD-3 (V <sub>N</sub> = +1.9V)          ±1         ±2         Counts           DMS-20LCD-3 (V <sub>N</sub> = +19V)          ±1         ±2         Counts           DMS-20LCD-3 (V <sub>N</sub> = +19V)          ±1         ±2						
DMS-20LCD-0, -1 DMS-20LCD-2, -3         100         1000          MΩ           Overoitage Protection: ① DMS-20LCD-0, -1, -2 DMS-20LCD-3          +100         Voits           Common Mode Voitage Range ②           +250         Voits           Common Mode Voitage Range ②          +2         Voits         Voits           Common Mode Voitage Range ③          +2         Voits         Voits           Control Inputs ③          +2         Voits         Voits           Decimal Point Placement (Pins 4-6): Functionality         The to pin 3 to activate TTL (on 5V-powered models)         The to pin 3 to activate           Backlight (Pin 9)         The to pin 3 to activate         The to pin 3 to activate         The to pin 3 to activate           DMS-20LCD-0 (V <sub>M</sub> + 10.9V)         The to pin 3 to activate         The to pin 3 to activate         The to pin 3 to activate           DMS-20LCD-1 (V <sub>M</sub> + 19.9V)         The to pin 3 to activate         The to pin 3 to activate         The to pin 3 to activate           DMS-20LCD-2 (V <sub>M</sub> = +19.9V)         The to pin 3 to activate         Counts         Counts           DMS-20LCD-3 (V <sub>M</sub> = +19.0V)         The to pin 3 to activate         Counts         Counts           DMS-20LCD-3 (V <sub>M</sub> = +19.0V)         The to pin 4.00			±200		VOItS	
DMS-20LCD-2, -3         0.8         1          MΩ           DVervoltage Protection: ① DMS-20LCD-0, -1, -2 DMS-20LCD-3          +100         Volts           Common Mode Voltage Range ②           +220         Volts           Common Mode Voltage Range ②           +22         Volts           Common Mode Voltage Range ③          +2         Volts           Common Mode Voltage Range ③          +2         Volts           Control Inputs ③          +2         Volts           Decimal Point Placement (Pins 4-6): Functionality         Tile to pin 3 to activate TTL (on 5V-powered models)            Performance          +1         +2         Counts           DMS-20LCD-0 (Vm = +0.19V)          +1         +2         Counts           DMS-20LCD-1 (Vm = +1.9V)          +2         +3         Counts           DMS-20LCD-3 (Vm = +19V)          +2         +3         Counts           DMS-20LCD-3 (Vm = +19V)          +2         +3         Counts           DMS-20LCD-3 (Vm = +19V)          +2         +3         Counts           Zero Reading (Vm = 0 Volts)						
Overvoltage Protection: ① DMS-20LCD-0, -1, -2 DMS-20LCD-3 ±100 ±250         Voits Voits           Common Mode Voltage Range ②  ±2         Voits           Common Mode Voltage Range ③ ±2         Voits           Common Mode Voltage Range ③ ±2         Voits           Common Mode Voltage Range ③ ±2         Voits           Control Inputs ③ Ecimal Point Placement (Pins 4-6): Functionality         Tie to pin 3 to activate TTL (on 5V-powered models)           Backlight (Pin 9)         Tie to pin 3 to trun on backlight (Pin 9)         Tie to pin 3 to run on backlight TTL (on 5V-powered models)           DMS-20LCD-0 (Vin = +0.19V) ±1         ±2         Counts Counts           DMS-20LCD-1 (Vin = +1.9V) ±2         ±3         Counts           DMS-20LCD-2 (Vin = +19V) ±2         ±3         Counts           DMS-20LCD-3 (Vin = +19V)						
DMS-20LCD-0, -1, -2 DMS-20LCD-3          +-         +100         Volts           Common Mode Voltage Range @           +2         Volts           Common Mode Voltage Range @          86          dB           Control Inputs @          86          dB           Control Inputs @         Tie to pin 3 to activate          dB           Decimal Point Placement (Pins 4-6): Functionality         Tite to pin 3 to activate            Backlight (Pin 9)         Tite to pin 3 to activate             Performance         2.5 samples rescond         Counts           DMS-20LCD-0 (Vin = +0.19V)          ±1         ±2         Counts           DMS-20LCD-1 (Vin = +1.9V)          ±1         ±2         Counts           DMS-20LCD-2 (Vin = +19V)          ±2         ±3         Counts           DMS-20LCD-3 (Vin = +19V) <td< th=""><td></td><td>0.8</td><td>1</td><td></td><td>IVIS2</td></td<>		0.8	1		IVIS2	
DMS-20LCD-3          +250         Voits           Common Mode Voltage Range ②          +2         Voits           CMRR (dc to 60Hz)          86          dB           Control Inputs ③          86          dB           Decimal Point Placement (Pins 4-6): Functionality Logic Compatibility         Tie to pin 3 to activate TTL (on 5V-powered models)            Backlight (Pin 9)         Tie to pin 3 to turue nobally          ±1         ±2         Counts           Performance          ±1         ±2         Counts         Counts           DMS-20LCD-0 (Vin = +0.19V)          ±1         ±2         Counts           DMS-20LCD-1 (Vin = +1.9V)          ±1         ±2         Counts           DMS-20LCD-3 (Vin = +19V)          ±1         ±2         Counts           DMS-20LCD-3 (Vin = +19V)          ±1         ±2         Counts           Zero Reading (Vin = 0 Volts)         "-OU1"         "000"         "001"         Counts           DMS-20LCD-3 (Vin = +19V)          ±1         ±2         ±3         Counts           Zero Reading (Vin = 0 Volts)         "-OU1"         "						
Common Mode Voltage Range ②           ±2         Volts           CMRR (dc to 60Hz)          86          dB           Control Inputs ③         Decimal Point Placement (Pins 4-6): Functionality Logic Compatibility         Tie to pin 3 to activate TTL (on 5V-powered models)         dB           Backlight (Pin 9)         Tie to pin 3 to activate TTL (on 5V-powered models)         activate TTL (on 5V-powered models)           Backlight (Pin 9)         Tie to pin 3 to activate TTL (on 5V-powered models)         activate TTL (on 5V-powered models)           BMS-20LCD-0 (Vin = +0.19V)          ±1         ±2         Counts           DMS-20LCD-1 (Vin = +1.9V)          ±2         ±3         Counts           DMS-20LCD-2 (Vin = +19V)          ±2         ±3         Counts           DMS-20LCD-3 (Vin = +19V)          ±2         ±3         Counts           Zero Reading (Vin = 0 volts)         "-         ±0.2         ±0.4         Chts/°C						
CMRR (dc to 60Hz)          86          dB           Control Inputs ③         Decimal Point Placement (Pins 4-6): Functionality Logic Compatibility         Tie to pin 3 to activate TTL (on 5V-powered models)         Tie to pin 3 to activate TTL (on 5V-powered models)           Backlight (Pin 9)         Tie to pin 3 to turn on backlight           Performance         2.5 samples per second           Accuracy (1 minute warm-up): DMS-20LCD-0 (Vin = +0.19V)          ±1         ±2         Counts           DMS-20LCD-1 (Vin = +1.9V)          ±1         ±2         Counts           DMS-20LCD-2 (Vin = +19V)          ±1         ±2         Counts           DMS-20LCD-3 (Vin = +19V)          ±1         ±2         Counts           DMS-20LCD-3 (Vin = +19V)          ±2         ±3         Counts           DMS-20LCD-3 (Vin = +19V)          ±1         ±2         Counts           DMS-20LCD-3 (Vin = +19V)          ±2         ±3         Counts           Zero Reading (Vin = 0 Volts)         "-         ±10.4         Conts''C           Supply Requirements (5V Models)          ±0.4         Chts/*C           Supply Current: Standard Models          +400         +600				±250	Volts	
Control Inputs ③           Decimal Point Placement (Pins 4-6): Functionality Logic Compatibility         Tie to pin 3 to activate TTL (on 5V-powered models)           Backlight (Pin 9)         Tie to pin 3 to turn on backlight           Performance         Sampling Rate           Accuracy (1 minute warm-up): DMS-20LCD-0 (Vm = +0.19V)            DMS-20LCD-1 (Vm = +1.9V)            ±1         ±2         Counts           DMS-20LCD-2 (Vm = +19V)          ±1         ±2         Counts           DMS-20LCD-2 (Vm = +19V)          ±2         ±3         Counts           DMS-20LCD-2 (Vm = +19V)          ±0.2         ±0.4         Cnts/*C           Power Supply Requirements (5V Models)         "-001"         "000"         "001"         Temperature Drift (0 to +60°C)          ±0.2         ±0.4         Cnts/*C           Power Supply Requirements (5V Models)         "-         ±4.0         +600         µA           Backlit Models          +44.00         +600         µA           Backlit Models          +35         +50         mA           Power Supply Requirements (9V Models)          +35         +50         mA           Backlit Models         -	Common Mode Voltage Range ②			±2	Volts	
Decimal Point Placement (Pins 4-6): Functionality Logic Compatibility         Tie to pin 3 to activate TTL (on 5V-powered models)           Backlight (Pin 9)         Tie to pin 3 to turn on backlight           Performance         Sampling Rate         2.5 samples per second           Accuracy (1 minute warm-up): DMS-20LCD-0 (V <sub>IN</sub> = +0.19V) ±1         ±2         Counts           DMS-20LCD-1 (V <sub>IN</sub> = +1.9V) ±1         ±2         ±3         Counts           DMS-20LCD-2 (V <sub>IN</sub> = +19V) ±2         ±3         Counts           DMS-20LCD-3 (V <sub>IN</sub> = +19V) ±2         ±3         Counts           DMS-20LCD-3 (V <sub>IN</sub> = +19V) ±2         ±3         Counts           Zero Reading (V <sub>IN</sub> = 0 Volts)         "-001"         "000"         "001"           Temperature Drift (0 to +60°C)          ±0.2         ±0.4         Chts/°C           Power Supply Requirements (5V Models)          ±0.4         Chts/°C           Standard Models          ±400         +600         µA           Backlit Models          ±35         ±50         mA           Backlit Models          ±35         ±50         mA           Backlit Models          ±35         ±50 <td>CMRR (dc to 60Hz)</td> <td></td> <td>86</td> <td></td> <td>dB</td>	CMRR (dc to 60Hz)		86		dB	
Functionality Logic Compatibility         Tie to pin 3 to activate TTL (on 5V-powered models)           Backlight (Pin 9)         Tie to pin 3 to turn on backlight           Performance         Sampling Rate         2.5 samples per second           Accuracy (1 minute warm-up): DMS-20LCD-0 (V <sub>IN</sub> = +0.19V)          ±1         ±2         Counts           DMS-20LCD-1 (V <sub>IN</sub> = +1.9V)          ±1         ±2         Counts           DMS-20LCD-2 (V <sub>IN</sub> = +1.9V)          ±2         ±3         Counts           DMS-20LCD-3 (V <sub>IN</sub> = +1.9V)          ±2         ±3         Counts           Zero Reading (V <sub>IN</sub> = 0 Volts)         "-001"         '000"         "001"         Temperature Drift (0 to +60°C)          ±0.2         ±0.4         Chts/°C           Supply Voltage         +4.75         +5.00         +5.25         Volts           Supply Voltage          +400         +600         µA           Backlit Models	Control Inputs ③					
Logic Compatibility         TTL (on SV-powered models)           Backlight (Pin 9)         Tie to pin 3 to turn on backlight           Performance         samples rescond           Sampling Rate         2.5 samples per second           Accuracy (1 minute warm-up): DMS-20LCD-0 (Vm = +0.19V)          ±1         ±2         Counts           DMS-20LCD-1 (Vm = +1.9V)          ±1         ±2         Counts           DMS-20LCD-2 (Vm = +19V)          ±2         ±3         Counts           DMS-20LCD-3 (Vm = +19V)          ±2         ±3         Counts           DMS-20LCD-3 (Vm = +19V)          ±2         ±3         Counts           DMS-20LCD-3 (Vm = 0 Volts)         "-001"         "000"         '001"         Temperature Drift (0 to +60°C)          ±0.2         ±0.4         Cnts/°C           Power Supply Requirements (5∨ Models)          ±400         +600         µA           Backlit Models          +4.00         +660         µA           Backlit Models          +230         +350         mA           Display Type and Size         3½         Upit N         N         N           Display Type and Size         3½	Decimal Point Placement (Pins 4-6):					
Backlight (Pin 9)         Tie to pin 3 to turn on backlight           Performance         Sampling Rate         2.5 samples per second           Accuracy (1 minute warm-up): DMS-20LCD-0 (Vin = +0.19V)          ±1         ±2         Counts           DMS-20LCD-1 (Vin = +1.9V)          ±1         ±2         Counts           DMS-20LCD-2 (Vin = +19V)          ±2         ±3         Counts           DMS-20LCD-3 (Vin = +190V)          ±0.2         ±0.4         Cnts/°C           Pomer Supply Requirements (5V Models)         "-001"         "000"         "001"         Counts           Supply Voltage         +4.75         +5.00         +5.25         Volts           Supply Voltage         +4.75         +5.00         +5.25         Volts           Supply Voltage         +4.75         +5.00         #A           Backlit Models          +400         +600         µA           Backlit Models          +400         +600         µA           Backlit Models          +400         +60         µA           Backlit Models          +35         +50         mA           Display         Display Type and Size         3½ Digit	Functionality		•			
Performance           Sampling Rate         2.5 samples per second           Accuracy (1 minute warm-up): DMS-20LCD-0 (VIN = +0.19V)          ±1         ±2         Counts           DMS-20LCD-1 (VIN = +1.9V)          ±1         ±2         Counts           DMS-20LCD-2 (VIN = +19V)          ±2         ±3         Counts           DMS-20LCD-3 (VIN = +19V)          ±2         ±3         Counts           DMS-20LCD-3 (VIN = +19V)          ±0.2         ±0.4         Cnts/°C           Power Supply Requirements (5V Models)         "-001"         "000"         "01"         Temperature Drift (0 to +60°C)          ±0.2         ±0.4         Cnts/°C           Power Supply Requirements (5V Models)          +400         +600         µA           Backlit Models          +400         +600         µA           Backlit Models          +35         +50         mA           Supply Voltage         +7.5         +9.0         +14.0         Volts           Supply Voltage          +35         +50         mA           Backlit Models          +230         +350         µA           Backlit	Logic Compatibility	TT	L (on 5V-po	wered mode	els)	
Sampling Rate         2.5 samples per second           Accuracy (1 minute warm-up): DMS-20LCD-0 (Vin = +0.19V)          ±1         ±2         Counts           DMS-20LCD-1 (Vin = +1.9V)          ±1         ±2         Counts           DMS-20LCD-2 (Vin = +19V)          ±2         ±3         Counts           DMS-20LCD-3 (Vin = +19V)          ±2         ±3         Counts           Zero Reading (Vin = 0 Volts)         "-001"         "000"         "001"         Temperature Drift (0 to +60°C)          ±0.2         ±0.4         Cnts/°C           Power Supply Requirements (5V Models)         "-         ±40.4         Cnts/°C           Standard Models          +400         +600         µA           Backlit Models          +35         +50         mA           Power Supply Requirements (9V Models)          +230         +350         µA           Backlit Models          +230         +350         µA           Backlit Models          +230         +350         mA           Display          +230         +350         mA           Display Type and Size          +230	Backlight (Pin 9)	Tie	to pin 3 to tu	urn on backl	ight	
Accuracy (1 minute warm-up): DMS-20LCD-0 ( $V_{N} = +0.19V$ )          ±1         ±2         Counts           DMS-20LCD-1 ( $V_{N} = +1.9V$ )          ±1         ±2         Counts           DMS-20LCD-2 ( $V_{N} = +19V$ )          ±2         ±3         Counts           DMS-20LCD-3 ( $V_{N} = +19V$ )          ±2         ±3         Counts           Zero Reading ( $V_{N} = 0$ Volts)         "-001"         "000"         "001"         "           Temperature Drift (0 to +60°C)          ±0.2         ±0.4         Cnts/°C           Power Supply Requirements (5V Models)         "          ±35         Volts           Supply Current:         -         +4.75         +5.00         +5.25         Volts           Supply Voltage         +7.5         +9.0         +14.0         Volts           Supply Current:         -         +35         +50         mA           Power Supply Requirements (9V Models)          +230         +350 $\mu A$ Backlit Models          +35         +50         mA           Display         Display Type and Size         3½ Digit LCD, 0.37"/9.4mm high           Polarity Indication          +230	Performance					
DMS-20LCD-0 (Vin = +0.19V) $\pm 1$ $\pm 2$ Counts           DMS-20LCD-1 (Vin = +1.9V) $\pm 1$ $\pm 2$ Counts           DMS-20LCD-2 (Vin = +19V) $\pm 2$ $\pm 3$ Counts           DMS-20LCD-3 (Vin = +190V) $\pm 2$ $\pm 3$ Counts           Zero Reading (Vin = 0 Volts)         "-001"         "000"         "001"         Counts           Temperature Drift (0 to +60°C) $\pm 0.2$ $\pm 0.4$ Cnts/°C           Power Supply Requirements (5V Models) $\pm 0.2$ $\pm 0.4$ Cnts/°C           Supply Current: $\pm 4.00$ $\pm 6.00$ $\mu A$ Backlit Models $\pm 35$ $\pm 5.0$ mA           Supply Voltage $\pm 7.5$ $\pm 9.0$ $\pm 14.0$ Volts           Supply Current: $\pm 2.0$ $\pm 35.0$ $\mu A$ Backlit Models $\pm 2.0$ $\pm 35.0$ $\mu A$ Backlit Models $\pm 2.0$ $\pm 35.0$ $\mu A$ Display Type and Size $3^{-1} \sqrt{1}$	Sampling Rate	2.5 samples per second				
DMS-20LCD-0 (Vin = +0.19V) $\pm 1$ $\pm 2$ Counts           DMS-20LCD-1 (Vin = +1.9V) $\pm 1$ $\pm 2$ Counts           DMS-20LCD-2 (Vin = +19V) $\pm 2$ $\pm 3$ Counts           DMS-20LCD-3 (Vin = +190V) $\pm 2$ $\pm 3$ Counts           Zero Reading (Vin = 0 Volts)         "-001"         "000"         "001"         Counts           Temperature Drift (0 to +60°C) $\pm 0.2$ $\pm 0.4$ Cnts/°C           Power Supply Requirements (5V Models) $\pm 0.2$ $\pm 0.4$ Cnts/°C           Supply Current: $\pm 4.00$ $\pm 6.00$ $\mu A$ Backlit Models $\pm 35$ $\pm 5.0$ mA           Supply Voltage $\pm 7.5$ $\pm 9.0$ $\pm 14.0$ Volts           Supply Current: $\pm 2.0$ $\pm 35.0$ $\mu A$ Backlit Models $\pm 2.0$ $\pm 35.0$ $\mu A$ Backlit Models $\pm 2.0$ $\pm 35.0$ $\mu A$ Display Type and Size $3^{-1} \sqrt{1}$	Accuracy (1 minute warm-up):					
DMS-20LCD-1 (VIN = +1.9V) $\pm 1$ $\pm 2$ Counts           DMS-20LCD-2 (VIN = +19V) $\pm 2$ $\pm 3$ Counts           DMS-20LCD-3 (VIN = +190V) $\pm 2$ $\pm 3$ Counts           Zero Reading (VIN = 0 Volts)         "-001"         "000"         "001"         Counts           Temperature Drift (0 to +60°C) $\pm 0.2$ $\pm 0.4$ Cnts/°C           Power Supply Requirements (5V Models) $\pm 0.2$ $\pm 0.4$ Cnts/°C           Supply Current:          +400 $\pm 60.0$ $\mu A$ Backlit Models $\pm 35$ $\pm 50$ mA           Power Supply Requirements (9V Models) $\pm 35$ $\pm 50$ mA           Supply Voltage $\pm 7.5$ $\pm 9.0$ $\pm 14.0$ Volts           Supply Current: $\pm 35$ $\pm 50$ mA           Standard Models $\pm 230$ $\pm 350$ $\mu A$ Backlit Models $\pm 35$ $\pm 50$ mA           Display Type and Size $3½$			±1	±2	Counts	
DMS-20LCD-3 (VIN = +190V) $\pm 2$ $\pm 3$ Counts           Zero Reading (VIN = 0 Volts)         "-001"         "000"         "001"           Temperature Drift (0 to +60°C) $\pm 0.2$ $\pm 0.4$ Cnts/°C           Power Supply Requirements (5V Models) $\pm 0.2$ $\pm 0.4$ Cnts/°C           Supply Voltage $\pm 4.75$ $\pm 5.00$ $\pm 5.25$ Volts           Supply Current:         +4.75 $\pm 400$ $\pm 600$ $\mu A$ Backlit Models $\pm 400$ $\pm 600$ $\mu A$ Backlit Models $\pm 420$ $\pm 41.0$ Volts           Supply Voltage $\pm 7.5$ $\pm 9.0$ $\pm 14.0$ Volts           Supply Current:         Standard Models $\pm 230$ $\pm 350$ $\mu A$ Backlit Models $\pm 230$ $\pm 350$ $\mu A$ Backlit Models $\pm 230$ $\pm 350$ $\mu A$ Backlit Models $\pm 230$ $\pm 350$ $\mu A$ Display Type and Size $3^{1/2}$	DMS-20LCD-1 (VIN = +1.9V)		±1	±2	Counts	
Zero Reading (Vin = 0 Volts)         "-001"         "000"         "001"           Temperature Drift (0 to +60°C)          ±0.2         ±0.4         Cnts/°C           Power Supply Requirements (5V Models)         #4.75         ±5.00         ±5.25         Volts           Supply Voltage         ±4.75         ±5.00         ±5.25         Volts           Supply Current:         -         ±400         ±600         µA           Backlit Models          ±400         ±600         µA           Backlit Models          ±35         ±50         mA           Power Supply Requirements (9V Models)          ±35         ±50         mA           Supply Voltage         ±7.5         ±9.0         ±14.0         Volts           Supply Current:          ±35         ±50         mA           Backlit Models          ±35         ±50         mA           Display         Dype and Size         3½ Digit LCD, 0.37"/9.4mm high         mA           Polarity Indication         Autopolarity ("-" for negative Vin         "1" for positive Vin           "1" for positive Vin         "1" for positive Vin         "2           Physical/Environmental	DMS-20LCD-2 (VIN = +19V)		±2	±3	Counts	
Temperature Drift (0 to +60°C)          ±0.2         ±0.4         Cnts/°C           Power Supply Requirements (5∨ Models)          ±0.4         Cnts/°C           Supply Voltage         +4.75         +5.00         +5.25         Volts           Supply Current: Standard Models          +400         +600         µA           Backlit Models          +35         +50         mA           Power Supply Requirements (9∨ Models)          +35         +50         mA           Supply Voltage         +7.5         +9.0         +14.0         Volts           Supply Current: Standard Models          +230         +350         µA           Backlit Models          +35         +50         mA           Display          +230         +350         µA           Backlit Models          +35         +50         mA           Display          +35         +50         mA           Display Type and Size         3½ Digit LCD, 0.37"/9.4mm high         Polearity Indication         "1" for negative VIN         "1" for positive VIN           0verrange Indication         "-1" for negative VIN         "1" for	DMS-20LCD-3 (VIN = +190V)		±2	±3	Counts	
Power Supply Requirements (5V Models)           Supply Voltage         +4.75         +5.00         +5.25         Volts           Supply Current: Standard Models          +400         +600         µA           Backlit Models          +35         +50         mA           Power Supply Requirements (9V Models)          +35         +50         mA           Supply Voltage         +7.5         +9.0         +14.0         Volts           Supply Current: Standard Models          +230         +350         µA           Backlit Models          +35         +50         mA           Display         Current: Standard Models          +230         +350         µA           Backlit Models          +35         +50         mA           Display         Display          +35         +50         mA           Overrange Indication         Autopolarity ("-" for negative VIN "1" for positive VIN            Physical/Environmental         O          +60         °C           Storage Temperature         0          +75         °C           Humidity (Non-condensing)         0	Zero Reading (VIN = 0 Volts)	"-001"	"000"	"001"		
Supply Voltage         +4.75         +5.00         +5.25         Volts           Supply Current: Standard Models          +400         +600         µA           Backlit Models          +35         +50         mA           Power Supply Requirements (9V Models)          +35         +50         mA           Supply Voltage         +7.5         +9.0         +14.0         Volts           Supply Current: Standard Models          +230         +350         µA           Backlit Models          +35         +50         mA           Display          +35         +50         mA           Display          +35         +50         mA           Polarity Indication         Auto-plantity ("-" for negative VIN")            Overrange Indication        1" for negative VIN "1            "1" for positive VIN"         "1" for positive VIN            Physical/Environmental          +60         °C           Storage Temperature         0          +75         °C           Humidity (Non-condensing)         0          95         %	Temperature Drift (0 to +60°C)		±0.2	±0.4	Cnts/°C	
Supply Current: Standard Models          +400 +35         +600 +50         μA mA           Power Supply Requirements (9∨ Models)          +35         +50         mA           Supply Voltage         +7.5         +9.0         +14.0         Volts           Supply Voltage         +7.5         +9.0         +14.0         Volts           Supply Current: Standard Models          +230         +350         μA           Backlit Models          +35         +50         mA           Display          +35         +50         mA           Display          +35         +50         mA           Overrange Indication         Autopolarity ("-" for negative VIN)         •           Overrange Indication         "-1" for negative VIN         •           "1" for positive VIN         "1" for positive VIN         •           Physical/Environmental         0          +60         °C           Storage Temperature         0          +75         °C           Humidity (Non-condensing)         0          95         %	Power Supply Requirements (5)	/ Models)				
Standard Models Backlit Models +35         +600 +35         μA mA           Power Supply Requirements (9V Models) +7.5         +9.0         +14.0         Volts           Supply Voltage         +7.5         +9.0         +14.0         Volts           Supply Current: Standard Models +230         +350         μA           Backlit Models +35         +50         mA           Display Backlit Models +35         +50         mA           Display Backlit Models +35         +50         mA           Display Backlit Models +35         +50         mA           Display         Tope and Size         3½ Digit LCD, 0.37"/9.4mm high meative Vin>           Overrange Indication         Auto "1" for negative Vin> "1" for positive Vin>            Physical/Environmental          +60         °C           Operating Temperature         0          +75         °C           Humidity (Non-condensing)         0          95         %	Supply Voltage	+4.75	+5.00	+5.25	Volts	
Standard Models Backlit Models +35         +600 +35         μA mA           Power Supply Requirements (9V Models) +7.5         +9.0         +14.0         Volts           Supply Voltage         +7.5         +9.0         +14.0         Volts           Supply Current: Standard Models +230         +350         μA           Backlit Models +35         +50         mA           Display Backlit Models +35         +50         mA           Display Backlit Models +35         +50         mA           Display Backlit Models +35         +50         mA           Display         Tope and Size         3½ Digit LCD, 0.37"/9.4mm high meative Vin>           Overrange Indication         Auto "1" for negative Vin> "1" for positive Vin>            Physical/Environmental          +60         °C           Operating Temperature         0          +75         °C           Humidity (Non-condensing)         0          95         %	Supply Current:					
Power Supply Requirements (9∨ Models)           Supply Voltage         +7.5         +9.0         +14.0         Volts           Supply Current:          +230         +350         µA           Backlit Models          +230         +350         mA           Display          +35         +50         mA           Display          +35         +50         mA           Polarity Indication         Autopolarity ("-" for negative VIN)         •           Overrange Indication         "-1" for positive VIN         "1" for positive VIN           Physical/Environmental         0          +60         °C           Storage Temperature         -20          +75         °C           Humidity (Non-condensing)         0          95         %			+400	+600	μA	
Supply Voltage         +7.5         +9.0         +14.0         Volts           Supply Current:          +230         +350         µA           Backlit Models          +35         +50         mA           Display          +35         +50         mA           Display          +35         +50         mA           Display          +35         +50         mA           Olsplay          +35         +50         mA           Polarity Indication         Autopolarity ("-" for negative VIN)         (	Backlit Models		+35	+50	mA	
Supply Current: Standard Models          +230         +350         μA           Backlit Models          +35         +50         mA           Display          +35         +50         mA           Display          +35         +50         mA           Polarity Indication         Autopolarity ("-" for negative VIN)         Overrange Indication         "-1" for negative VIN         "           Physical/Environmental         0          +60         °C         Storage Temperature         0          +75         °C           Humidity (Non-condensing)         0          95         %	Power Supply Requirements (9V Models)					
Standard Models          +230         +350         μA           Backlit Models          +35         +50         mA           Display         Jisplay         Jisplay         Jisplay         Jisplay           Display         3½ Digit LCD, 0.37"/9.4mm high         Material         Material           Polarity Indication         Autopolarity ("-" for negative VIN         VIN           Overrange Indication         "-1" for negative VIN         VIN           Physical/Environmental         0          +60         °C           Storage Temperature         0          +75         °C           Humidity (Non-condensing)         0          95         %	Supply Voltage	+7.5	+9.0	+14.0	Volts	
Standard Models          +230         +350         μA           Backlit Models          +35         +50         mA           Display         Jisplay         Jisplay         Jisplay         Jisplay           Display         3½ Digit LCD, 0.37"/9.4mm high         Material         Material           Polarity Indication         Autopolarity ("-" for negative VIN         VIN           Overrange Indication         "-1" for negative VIN         VIN           Physical/Environmental         0          +60         °C           Storage Temperature         0          +75         °C           Humidity (Non-condensing)         0          95         %	Supply Current:					
Display         Display Type and Size       3½ Digit LCD, 0.37"/9.4mm high         Polarity Indication       Autopolarity ("-" for negative VIN)         Overrange Indication       "-1" for negative VIN         "1" for positive VIN       "1" for positive VIN         Physical/Environmental       0        +60       °C         Storage Temperature       0        +75       °C         Humidity (Non-condensing)       0        95       %			+230	+350	μA	
Display Type and Size     3½ Digit LCD, 0.37"/9.4mm high       Polarity Indication     Autopolarity ("-" for negative VIN       Overrange Indication     "-1" for negative VIN       "1" for positive VIN     "1" for positive VIN       Physical/Environmental     0      +60     °C       Operating Temperature     0      +75     °C       Humidity (Non-condensing)     0      95     %	Backlit Models		+35	+50	mA	
Polarity Indication       Autopolarity ("-" for negative VIN)         Overrange Indication       "-1" for negative VIN "1" for positive VIN         Physical/Environmental       0        +60       °C         Operating Temperature       0        +75       °C         Humidity (Non-condensing)       0        95       %	Display					
Overrange Indication         "-1" for negative V <sub>IN</sub> "1" for positive V <sub>IN</sub> Physical/Environmental         "1" for positive V <sub>IN</sub> Operating Temperature         0          +60         °C           Storage Temperature         -20          +75         °C           Humidity (Non-condensing)         0          95         %           Case Material         Polycarbonate	Display Type and Size	31⁄2	31/2 Digit LCD, 0.37"/9.4mm high			
"1" for positive Vince           Physical/Environmental         0          +60         °C           Operating Temperature         0          +75         °C           Storage Temperature         0          95         %           Humidity (Non-condensing)         0          95         %           Case Material         Polycar/bonate	Polarity Indication	Auto	Autopolarity ("-" for negative VIN)			
Physical/Environmental         Operating Temperature       0        +60       °C         Storage Temperature       -20        +75       °C         Humidity (Non-condensing)       0        95       %         Case Material       Polycarbonate	Overrange Indication					
Operating Temperature         0          +60         °C           Storage Temperature         -20          +75         °C           Humidity (Non-condensing)         0          95         %           Case Material         Polycarbonate	Physical/Environmental		1" TOP	POSITIVE VIN		
Storage Temperature     -20      +75     °C       Humidity (Non-condensing)     0      95     %       Case Material     Polycarbonate	-	0		160	°C	
Humidity (Non-condensing)     0      95     %       Case Material     Polycarbonate					-	
Case Material Polycarbonate					-	
		U		1	%	
Weight 0.4 ounces (11 grams)						
	Weight		0.4 ounces	s (11 grams)		

- ① Applies for transient or continuous overvoltages applied to (+) INPUT HI (pin 11) with (-) INPUT LO (pin 12) properly connected. Pin 12 is not overvoltage protected (see Figure 1). Voltages applied to pin 12 should not exceed the supply voltage.
- ② Listed spec applies to 5V-powered models only. For 9V-powered models, both (-) INPUT LO (pin 12) and (+) INPUT HIGH (pin 11) must always be at least 1.5V above –BATTERY (pin 3) and at least 1.5V below +BATTERY (pin 1).
- ③ See Technical Notes.



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## **Technical Notes**

- 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.
- 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 3 of the DATEL Panel Meter Catalog. Pin 10 should not be connected to pin 3 (5V RETURN/–BATTERY) 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/ –BATTERY). Unused decimal point location pins should be left open. For 5V-powered models, the decimal location pins are TTL compatible and may be hard wired as described above or driven with 5V TTL logic gates.

4. BACKLIGHT (Pin 9) Function: Grounding pin 9 (i.e. connecting it to pin 3) turns on the backlighting LED's. For non-backlit models, pin 9 has no internal connection. All backlit models include internal current-limiting resistors. With nominal +5V or 9V supplies, backlit devices typically draw 35mA of supply current. The current drawn by the backlight (and therefore the current drawn by the meter) can be reduced by installing a 1/4 Watt resistor between pins 3 and 9. The brightness of the meter will be reduced proportionately.

9V-powered backlit models function with supply voltages up to +14V, however, activating the backlight with voltages greater than 9.2V can damage the meter. Therefore, a 1/4 Watt series resistor must be installed between pins 3 and 9 in these situations. The value of the series resistor is determined using the following formula:

$$R_{\text{Series}} = \frac{+BATTERY - 9.2V}{0.035} \text{ Ohms}$$

Example: If +BATTERY (pin 1 with respect to pin 3) is +12.6V,

$$R_{Series} = \frac{+12.6 - 9.2V}{0.035}$$
 Ohms

Rseries = 97 Ohms

- 5. Low Battery Annunciator: The "B" annunciator in the upper left-hand corner of the display turns on when the supply voltage for 5V-powered models falls below approximately +3.75V or when the supply voltage for 9V-powered models falls below approximately 7.2V. This function can not be disabled.
- 6. Gain Adjust: There is a gain-adjust potentiometer on the back of each meter. It has approximately ±50 counts (±2.5%) range of adjustment. Since these devices essentially have no zero/offset errors, a gain adjustment is effectively an overall accuracy adjustment. Though they may be performed at any point (except zero), accuracy adjustments are most effective when performed with higher level input signals. The circuit shown in Figure 9 provides ±10% range of adjustment.
- 7. Soldering Methods: All models in the DMS-20LCD Series easily withstand most common wave soldering operations. We recommend, however, that you evaluate the effects your particular soldering techniques may have on the meter's plastic case and high-precision electrical performance. We recommend the use of water-soluble solders and thorough cleaning procedures.

#### 8. Suggested Mating Connectors:

Panel mounted:	
Connector housing	DATEL P/N 39-2079400
Terminal type	DATEL P/N 39-2099090
Crimping tool	DATEL 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

DATEL P/N 39-2359625

## Applications

DMS-20LCD meters are available in either 5V-powered or 9Vpowered models. 9V devices operate directly from 7.5V to 14V supplies (usually batteries) without the need for external voltage regulators. 9V devices, however, can not be used to measure voltages referenced to the negative battery terminal (pin 3) because the minus input to the meter (pin 12, (–) INPUT LO) must always be at least 1.5V above pin 3. 9V-powered meters can only be used to make differential and not single-ended measurements.

5V-powered devices operate from any well-regulated +5V supply and will accurately measure voltages both above and below pin 3 (5V RETURN) in either single-ended or differential configurations.

 Single-Ended Input Configurations: True single-ended measurements can only be made with 5V-powered meters. 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).

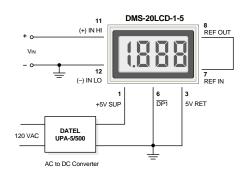
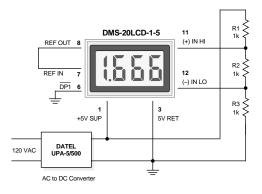


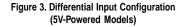
Figure 2. Single-Ended Input Configuration (5V-Powered Models)

#### DMS-20LCD



 Differential Input Configurations: Differential measurements can be made with either 5V-powered or 9V-powered 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.





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.

$$50k\Omega < R1 + R2 < 10M\Omega$$

$$R2 x V_{IN} = Reading$$

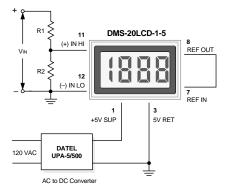


Figure 4. Input Attenuation Circuit

4. Floating Signal Source Measurements: Floating signals can be measured using the circuits shown in Figures 5 and 6. Figure 5 uses a 5V-powered meter. Figure 6 uses a 9V-powered meter. Connecting pin 10 (ANALOG COMMON) 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.

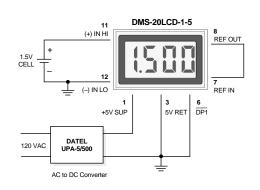


Figure 5. Floating Input Measurements (5V-Powered Models)

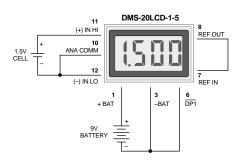


Figure 6. Floating Input Measurements (9V-Powered Models)

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-20LCD 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

#### DMS-20LCD

## Applications

function of the scaling requirements of the particular application and can be calculated using the following equation:

 $R_{\text{Shunt}} = R1 = V_{\text{Fsr}} / I_{\text{Fsr}}$ 

Where: V<sub>Fsr</sub> = Full scale reading (in Volts)

I<sub>Fsr</sub> = Relative full scale current (in Amps)

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

$$\begin{split} R_{Shunt} &= 1.000 V / (0.020 - 0.004) A \\ R_{Shunt} &= 1.000 V / 0.016 A = 62.5 \ Ohms \end{split}$$

To calibrate the circuit of Figure 7, perform the following:

- With 4mA applied, adjust the 50kΩ potentiometer (R2) to display a reading of "000" (assuming that is the desired reading).
- With 20mA applied, adjust the gain-adjust potentiometer on the back of the meter to display a reading of "1999". For different full scale readings, alter the value of Rshunt accordingly.

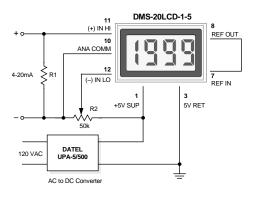


Figure 7. 4-to-20mA Current Loop Operation (5V-Powered Models)

6. Power Supply Monitoring: A popular application for DATEL's low-power LCD meters is monitoring the supply voltage in batteryoperated portable equipment. Figure 8 demonstrates how a 9Vpowered DMS-20LCD can be used to monitor its own supply. The meter used is the DMS-20LCD-1-9. A three-resistor voltage divider is used to attenuate the battery voltage and also to satisfy the requirement that the input voltages applied to pins 12 and 11 be at least 1.5 Volts above and below the battery voltage applied to pins 1 (+BATTERY) and 3 (-BATTERY). The divider should be designed so that 1/10th the battery voltage falls across the inputs to the meter:

$$\frac{R2}{(R1 + R2 + R3)} = 0.1$$

Therefore, the 9V battery voltage appears to the meter inputs as 0.9V. With the decimal point moved to its DP2 position (pin 5 tied to pin 3), the meter reads 9.00 Volts.

The circuit can be calibrated by first measuring the actual battery voltage with another meter and then adjusting the gainadjust potentiometer on the back of the DMS-20LCD until a similar reading is obtained. If possible, the resistors in the divider should be  $\pm 1\%$  metal-film types with TCR's less than 50ppm/°C.

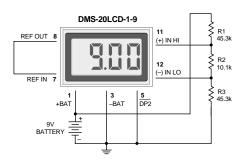


Figure 8. Power Supply Monitor (9V-Powered Models)

7. External Gain Adjustment: Connect REFERENCE OUT (pin 8) to REFERENCE IN (pin 7) for normal, factory calibrated, operation. Use the circuit shown in Figure 9 for applications needing external gain adjustment. Calibration is performed with a precise, near-full-scale, input voltage.

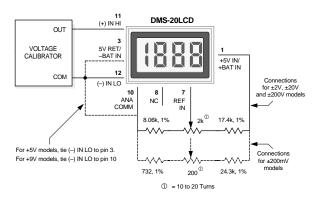
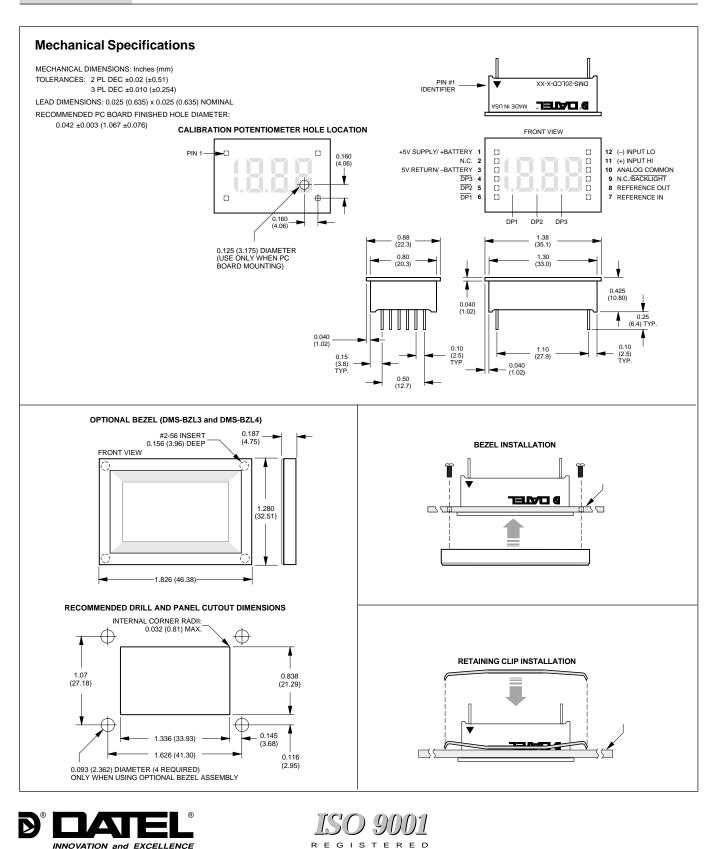


Figure 9. External Gain Adjustment

#### DMS-20LCD

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