



# **DIGITAL METERS**

**INNOVATION AND EXCELLENCE IN  
PRECISION DATA ACQUISITION**



## **COMPANY HISTORY**

Founded in 1970, DATEL is a multinational company located approximately 35 miles south of Boston in Mansfield, Massachusetts. Our modern 180,000 square-foot facility houses our administrative offices, components and sub-systems engineering groups, modular and sub-systems production facilities, and the most modern thin-film and thick-film hybrid production facility in the industry. DATEL's hybrid manufacturing operation is a fully qualified MIL-STD-1772 facility, supporting our high quality standards.

Our worldwide sales network extends to every major data acquisition product market-place. The people who implement this sales network are skilled professionals dedicated to providing our customers with the highest possible standards of data acquisition products available today.

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DATEL offers one of the industry's broadest data acquisition product lines, meeting the rapidly growing need for components and sub-systems to interface with computers in industrial, commercial, scientific and military applications. These products employ five basic technologies: monolithic CMOS, monolithic bipolar, thin-film hybrid, thick-film hybrid and discrete component circuits. Many products employ a combination of these technologies to achieve higher levels of performance and complexity. The present product lines include: data converters, sample-hold amplifiers, analog multiplexers, amplifiers, data acquisition sub-systems, computer analog I/O boards, process monitors/controllers, digital panel meters, thermal printers, digital calibrators and power supplies.

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**Data Acquisition and Conversion Handbook:**

A technical guide to A/D - D/A converters and their applications





## NEW DISPLAY PRODUCTS

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### **DMH-30 Series** **3 1/2 Digit Hybrid** **Mini Voltage Meters**



- 24-Pin DDIP Package
- Single +5V Supply, no External Parts Required
- Hermetic Version (DMH-30MM) with Extended Temperature Range per MIL-D-871577

### **DMS-30PC Series** **Mini, 3 1/2 Digit** **Voltage Meters**



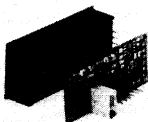
- Packaged in a 12-Pin Plastic DIP, with a Color Filter Case (0.9"H x 2.1"W x 0.5"D)
- Available in Many Bright LED Colors: Red, Orange, Amber, Yellow, and Green

### **DMS-30LCD Series** **Mini, 3 1/2 Digit** **LCD Digital Panel Meters**



- +5V dc and +9 or +12V dc (low current) Models Available
- Large (0.450"), Enhanced Contrast LCD Display
- Low Power (245  $\mu$ A) Models Available

### **DMS-EB** **Evaluation Board for** **the DMS-30PC Meter**



- Provisions for 4-20 mA Operation
- Operate a DMS-30PC from a +9V or +12V dc Battery
- Signal I/O Connectors for Easy Power and Signal Input

### **GPP-42** **High Resolution, 42-Column** **Serial/Parallel Panel Printer**



- High Speed, 200 Characters per Second
- Built-in 8400 Character Buffer
- 30,000,000Line MTBF

## **Contact DATEL for:**

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- **Data Acquisition & Control Boards**
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- **Power Supplies**

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# TABLE OF CONTENTS

---

<b>Miniature Voltage Meters.....</b>		<b>2</b>
DMH-30 Series	3 1/2 Digit, Hybrid Mini Voltage Meters.....	3
DMS-30PC Series	Mini, 3 1/2 Digit, LED Digital Panel Meters .....	7
DMS-30LCD Series	Miniature, 3 1/2 Digit, LCD Digital Panel Meters.....	11
DMS-EB	Evaluation Board for DMS-30PC/LCD Meters .....	15
<b>Digital Panel Meters, 3 1/2 Digits.....</b>		<b>19</b>
DBM-20	20 Segment LED Bar Meter with TTL Outputs .....	21
DM-31	Single Board, 3 1/2 Digit, LED Panel Meter.....	23
DM-3100B, -3104	AC Powered, 3 1/2 Digit LED Panel Meters .....	25
DM-3100L, -3103	Low-cost, 3 1/2 Digit LED Panel Meters .....	27
DM-3100MIL	Ruggedized, 3 1/2 Digit LED Panel Meter .....	29
DM-3100N, -3101	Low-cost, 3 1/2 Digit LED Panel Meters .....	31
DM-3100U1	Micropowered, 3 1/2 Digit LCD Panel Meters.....	33
DM-3100U2, -U3	AC/DC-powered, 3 1/2 Digit LCD Panel Meters .....	35
DM-3100X	Micropowered, 3 1/2 Digit LCD Panel Meter.....	37
DM-3102A, -3102B	Autoranging, 3 1/2 Digit Panel Meters .....	39
<b>Digital Panel Meters, 4 1/2 Digits.....</b>		<b>42</b>
DM-4100D	4 1/2 Digit Panel Meter with Tri-State Data Outputs .....	43
DM-4101L	4 1/2 Digit LED Panel Meter with Data Outputs.....	46
DM-4101N	4 1/2 Digit Differential Input LED Panel Meter .....	48
DM-4102, -4103, -4106	4 1/2 Digit Multiplexed BCD Input LED Slave Displays .....	50
DM-4104	4 1/2 Digit Parallel Input LED Slave Displays .....	52
DM-4105	4 1/2 Digit LCD Panel Meter with Data Outputs.....	54
DM-4200	4 1/2 Digit LED Panel Meter with Data Outputs.....	56
DM-9000 Series	DIN/NEMA Size Panel Meters .....	59
DM-LX3	Single Board, 3 1/2 Digit LCD Panel Meter.....	65
PC-6	Programmable 10 MHz Counter-Timer .....	76
<b>Process Monitors/Controllers.....</b>		<b>81</b>
PM-5050	Thermocouple Input Intelligent Process Monitor/Controller .....	83
PM-5060	RTD/Thermistor Input Intelligent Process Monitor/Controller .....	89
PM-5070	Strain Gage Input Intelligent Process Monitor/Controller.....	95
PM-5080	Voltage/Current Input Intelligent Process Monitor/Controller.....	101

**Precision Voltage Calibrators ..... 107**

DVC-350A Hand-Held, Battery-Powered Voltage Calibrator ..... 109  
DVC-8500 Miniature AC-Powered High-Precision Voltage Calibrator ..... 115

**Panel Mount Thermal Printers ..... 119**

APP-20A1, D1, E1, J1 Parallel Input 20 Column Thermal Printers ..... 127  
APP-20A21, D21, E21, J21 Serial Input 20-Column Thermal Printers ..... 130  
APP20-A3, D3, E3, J3 IEEE-488 Bus Compatible 20-Column Thermal Printer ..... 134  
APP-48A1, E1, J1 Byte-Parallel Input 48-Column Thermal Printer ..... 137  
APP-48A2, E2, J3, D2 Serial Input 48-Column Thermal Printers ..... 140  
APP-48A3, E3, J3, D3 IEEE-488 Bus Compatible 48-Column Thermal Printers ..... 144  
APP-M20 Rugged Mobile 20-Column Thermal Printer ..... 148  
APP-M48 Rugged Mobile 48-Column Thermal Printer ..... 150  
APP-TR1, 2, 5 Take-Up/Rewind Reels for Panel Printers ..... 152  
DPP-Q7 BCD Input, 7-Column Thermal Printer ..... 154  
MPP-20 Low-Cost Serial/Parallel Input 20-Column Thermal Printer ..... 158

**Selected New Products ..... 169**

GPIB-PCIIA High Speed Instrumentation Interface Board for IBM-PC/XT/AT and PS/2 ..... 172  
AT-GPIB High Speed Instrumentation Interface Board for IBM-PC/AT ..... 176  
PC-DIO-24 24 Channel Digital I/O Board for IBM-PC/XT/AT ..... 180  
PC-DIO-96 96 Channel Digital I/O Board for IBM-PC/XT/AT ..... 183  
PC-TIO-10 10 Channel Digital I/O Board for IBM-PC/XT/AT ..... 186  
LabWindows 2.0 PC/XT/AT Menu-Driven Data Acquisition Software ..... 189  
PC-430 Very High Speed A/D-DSP Coprocessor Board for IBM-PC/AT ..... 192

**Advanced Technology A/D Conversion Components Summary Tables ..... 202**

# **MINIATURE VOLTAGE METERS**

### 3.5 DIGIT, MINIATURE VOLTAGE METERS

	Model	Power	Std. Input	Case	Features
<b>NEW</b> Self-Contained 3.5 Digit LED	DMH-30PC-0	+5Vdc	±200 mV	A	Encapsulated (Plastic), 24-pin DDIP
	DMH-30PC-1	+5Vdc	+2Vdc	A	Encapsulated (Plastic), 24-pin DDIP
	DMH-30PC-2	+5Vdc	+20Vdc	A	Encapsulated (Plastic), 24-pin DDIP
Ultra-Miniature	DMH-30MM-0	+5Vdc	±200mV	A	Hermetically Sealed, Quartz window, Ceramic 24-pin DDIP, MIL-D-87157 Temperature Range
	DMH-30MM-1	+5Vdc	±2Vdc	A	
	DMH-30MM-2	+5Vdc	±20Vdc	A	
<b>NEW</b> Self-Contained Single-Piece 3.5 Digit LED	DMS-30PC-0-RL	+5Vdc	±200mV	B	Sealed, Plastic Case, Low Power RED Display
	DMS-30PC-1RL	+5Vdc	±2Vdc	B	
	DMS-30PC-2-RL	+5Vdc	±20Vdc	B	
	DMS-30PC-0-RS	+5Vdc	±200mV	B	Sealed, Plastic Case, Standard Intensity RED Display
	DMS-30PC-1-RS	+5Vdc	±2Vdc	B	
	DMS-30PC-2-RS	+5Vdc	±20Vdc	B	
	DMS-30PC-0-RH	+5Vdc	±200mV	B	Sealed, Plastic Case, High Intensity RED Display
	DMS-30PC-1-RH	+5Vdc	±2Vdc	B	
	DMS-30PC-2-RH	+5Vdc	±20Vdc	B	
	DMS-30PC-0-GL	+5Vdc	±200mV	B	Sealed, Plastic Case, Low Power GREEN Display
	DMS-30PC-1-GL	+5Vdc	±2Vdc	B	
	DMS-30PC-2-GL	+5Vdc	±20Vdc	B	
	DMS-30PC-0-GS	+5Vdc	±200mV	B	Sealed, Plastic Case, Standard Intensity GREEN Display
	DMS-30PC-1-GS	+5Vdc	±2Vdc	B	
	DMS-30PC-2-GS	+5Vdc	±20Vdc	B	
DMS-30PC-0-AS	+5Vdc	±200mV	B	Sealed, Plastic Case, Standard Intensity AMBER Display	
DMS-30PC-1-AS	+5Vdc	±2Vdc	B		
DMS-30PC-2-AS	+5Vdc	±20Vdc	B		
DMS-30PC-0-YS	+5Vdc	+200mV	B	Sealed, Plastic Case, Standard Intensity YELLOW Display	
DMS-30PC-1-YS	+5Vdc	±2Vdc	B		
DMS-30PC-2-YS	+5Vdc	±20Vdc	B		
DMS-30PC-0-OH	+5Vdc	±200mV	B	Sealed, Plastic Case, High Intensity ORANGE Display	
DMS-30PC-1-OH	+5Vdc	±2Vdc	B		
DMS-30PC-2-OH	+5Vdc	±20Vdc	B		
<b>NEW</b> Self-Contained Single-Piece 3.5 Digit LCD	DMS-30LCD-0/5	+5Vdc	±200mV	C	Sealed, Plastic Case
	DMS-30LCD-1/5	+5Vdc	±2Vdc	C	
	DMS-30LCD-2/5	+5Vdc	±20Vdc	C	
	DMS-30LCD-0/9	+9 to +15Vdc	±200mV	C	
	DMS-30LCD-1/9	+9 to +15Vdc	±2Vdc	C	
DMS-30LCD-2/9	+9 to +15Vdc	±20Vdc	C	Suitable for battery operation	

#### CASE SIZES

- A 1.29"W x 0.25"D x 0.80"H (33 x 6 x 20 mm)
- B 2.19"W x 0.54"D x 0.95"H (55 x 14 x 24 mm)
- C 2.16"W x 0.66"D x 0.92"H (55 x 16 x 24 mm)



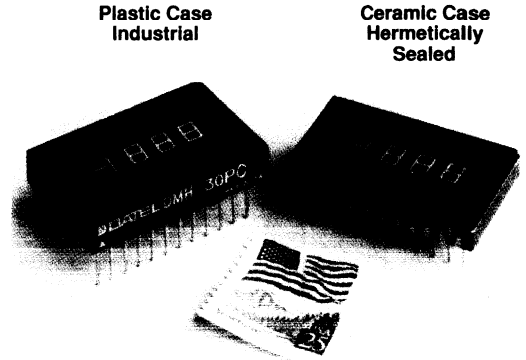
PRELIMINARY DATA

# DMH-30 Series

## 3 1/2 Digit, Hybrid Mini Voltage Meters

### FEATURES

- 24-pin, DDIP package
- Single +5V supply, no external parts needed
- Laser trimmed to  $\pm 0.05\%$  ( $\pm 1$  digit)
- External 1.23V reference available
- Models for  $\pm 200$  mV dc,  $\pm 2$  V dc, or  $\pm 20$  V dc input range
- User-selectable decimal point placement
- Fully autozeroing, auto-polarity changeover
- DISPLAY TEST pin
- Red filter, transparent case
- Low power STANDBY mode
- Hermetic version (DMH-30MM) with extended temperature range per MIL-D-87157



### GENERAL DESCRIPTION

Housed in a standard 24-pin DDIP package, DATEL's DMH-30 is the smallest functionally complete 3 1/2 digit, LED display voltmeter available.

It is an ideal component for high performance measurement systems requiring a small display area. Designed for direct PC board mounting, it lends itself to space-critical applications such as avionics instrumentation displays.

The DMH-30 packs many useful features into a small package. In STANDBY mode the display is off, reducing current consumption to 1 mA. This feature is best for battery-powered applications.

Models available include both plastic and hermetically sealed ceramic DDIP versions with input voltage ranges of  $\pm 200$  mV,  $\pm 2$  V, and  $\pm 20$  V. All versions feature laser-trimmed accuracies of  $\pm 0.05\%$  of reading,  $\pm 1$  count typical.

High impedance, differential inputs of 1,000 M $\Omega$  (1 M $\Omega$  for the DMH-30XX-2) minimize circuit loading. A single +5V supply at 200 mA is all that is needed for complete operation. Operation extends over the 0 to +60 °C (DMH-30PC) and -40 to +75 °C (DMH-30MM) temperature ranges.

Other features include an internal reference, full autozeroing, auto-polarity changeover, user-selectable decimal point placement and overrange indication.

### APPLICATIONS

- Board-level diagnostics
- Automatic test equipment
- Lab/test instruments
- Portable monitors
- Weigh scales
- Avionics Displays
- Digital thermometers

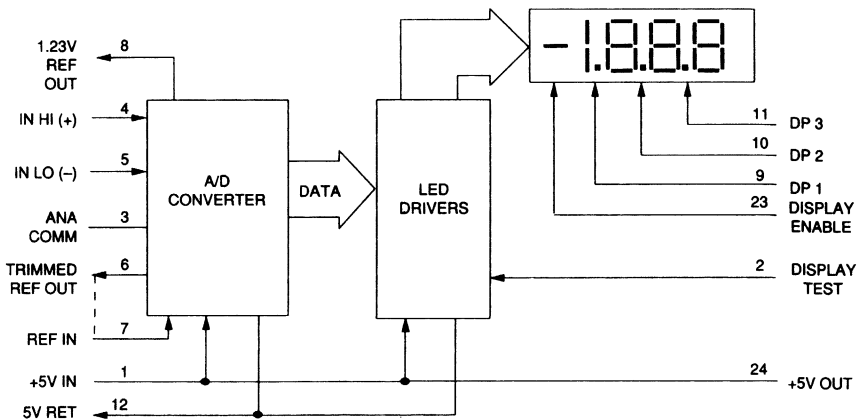


Figure 1. DMH-30 Simplified Block Diagram

**FUNCTIONAL SPECIFICATIONS**

Specifications cited are derived from tests at ambient temperature of +25 °C and supply voltage (V<sub>cc</sub>) of +5.0V dc unless otherwise specified. Specifications are for all models unless otherwise noted.

INPUT	MIN	TYP	MAX	UNITS
<b>Full Scale Input</b>				
DMH-30XX-0	—	±200	—	mV dc
DMH-30XX-1	—	±2	—	V dc
DMH-30XX-2	—	±20	—	V dc
<b>Input Impedance</b>				
DMH-30XX-0; -1	100	1000	—	MΩ
DMH-30XX-2	0.8	1.1	—	MΩ
<b>Input Overvoltage</b>	—	—	±250	V dc
<b>Common Mode Volt. Range</b>	—	—	±2.0	V dc
<b>CMR, dc to 60 Hz</b>	—	86	—	dB
<b>Sampling Rate</b>	—	2.5	—	Samp./S
<b>PERFORMANCE</b>				
<b>Accuracy, after 3 minute warm-up time</b>				
DMH-30XX-0 (V <sub>IN</sub> = 0.19000V)	—	±1	±2	Counts
DMH-30XX-1 (V <sub>IN</sub> = 1.9000V)	—	±1	±2	Counts
DMH-30XX-2 (V <sub>IN</sub> = 19.000V)	—	±2	±3	Counts
<b>Zero Reading (V<sub>IN</sub> = 0V)</b>	—	0	±1	Counts
<b>Temperature Drift of Gain</b>				
DMH-30PC-X (0 to +60 °C)	—	±0.15	±0.3	Cnts/ °C
DMH-30MM-X (-40 to +75 °C)	—	±0.15	±0.3	Cnts/ °C
<b>1.23V REF OUT</b> ①	+1.200	+1.230	+1.250	V dc
<b>PHYSICAL</b>				
<b>Display Type and Size</b>	3 1/2 digit red LED, 0.165" high			
<b>Polarity Indication</b>	Autopolarity ("." for negative V <sub>IN</sub> )			
<b>Overrange Indication</b>	-1... for negative V <sub>IN</sub> 1... for positive V <sub>IN</sub>			
<b>Weight</b>	0.5 oz. (nominal)			
<b>Case Material</b>				
DMH-30PC	Acrylic			
DMH-30MM	Ceramic			
<b>ENVIRONMENTAL</b>				
<b>Operating Temperature</b>				
DMH-30PC	0 to +60 °C			
DMH-30MM	-40 to +75 °C			
<b>Storage Temperature</b>				
DMH-30PC	-40 to +75 °C			
DMH-30MM	-50 to +100 °C			
<b>Humidity</b>	0 to 95% non-condensing			
<b>POWER SUPPLY REQUIREMENTS</b>				
<b>Supply Voltage (pin 1 to 12)</b>	+4.75	+5.00	+5.25	V dc
<b>Supply Current</b>	—	120	200	mA

① 1.23V REF OUT (pin 8) referenced to ANA COMM, (pin 3) at 15 μA maximum.

**TECHNICAL NOTES**

1. Decimal Point Selection - The decimal point is user-selectable for various application needs. Select the appropriate decimal point by strapping pins 9, 10, or 11 to +5V IN, (pin 1), or DISPLAY ENABLE (pin 23).
2. Display Test - To test the LED display, connect the DISPLAY TEST (pin 2) to +5V IN (pin 1). When enabled, this function replaces the actual input value and creates a display of 1888. DISPLAY TEST will show the minus sign only when a negative value exists on the input. *Do not leave in test mode for more than 10 seconds.*
3. Enable Display - Connect the DISPLAY ENABLE (pin 23) to +5V OUT (pin 24) to enable the display. Leaving pin 23 open reduces the overall power consumption to 1 mA. The meter could be operated to provide a display only when needed.

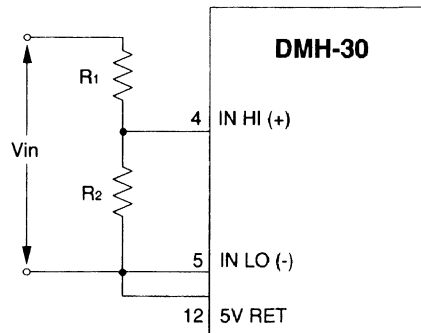
**APPLICATIONS**

The DMH-30 is highly versatile and is designed for use in many applications measuring a variety of parameters. The small size, readability and very accurate measurement capabilities of the DMH-30 make it the best alternative for any application.

**Engineering Scaling** - the most common parameters measured with the DMH-30 are voltages. In some cases users will have to attenuate the input voltage if it is larger than the rated voltage limit. The simple circuit in Figure 2 can attenuate and/or scale the input variable.

$$50\text{ K}\Omega < R_1 + R_2 < 10\text{ M}\Omega$$

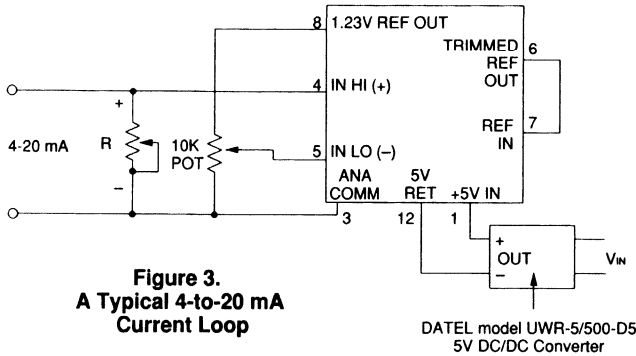
$$\frac{R_2}{R_1 + R_2} \times V_{IN} = \text{Reading}$$



**Figure 2. Simple Attenuation Circuit for Scaling Input Voltages**



**Process Control Signal Measurement 4-to-20 mA** - In process control applications, a 4-to-20 mA current loop transmits control signals. The DMH-30 uses a shunt resistor across the input. The value of the shunt resistor is dependent upon scaling requirements of the application and can be calculated. A potentiometer tied between the 1.23V REF OUT (pin 8) and ANA COMM (pin 3) provides an offset adjustment.



**Figure 3.**  
**A Typical 4-to-20 mA Current Loop**

**SHUNT RESISTOR VALUE**

Where:  $V_{FSR}$  = Full Scale Voltage Reading  
 $I_{FSR}$  = Full Scale Current

$$R = \frac{V_{FSR}}{I_{FSR}}$$

For 2V full scale:

$$R = \frac{2 - 0}{20 - 4} = \frac{2V}{16 mA} = 125 \Omega$$

A 200  $\Omega$  potentiometer would work well for this voltage range. Adjust the pot before placing it in the circuit.

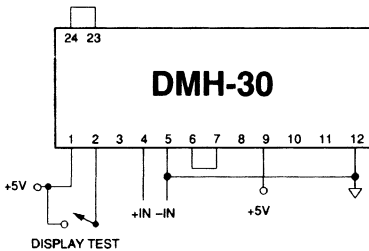
Note: the UWR-5/500-D5 provides the required isolation between the +5V supply and the 4-to-20 mA current loop

To calibrate the circuit shown in Figure 3, do the following:

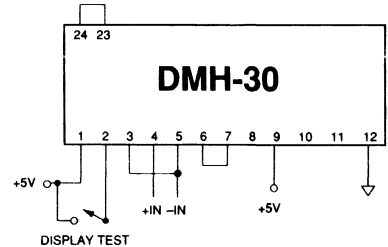
1. With 4 mA applied, adjust the 10K pot to obtain a reading of "0", if desired.
2. With 20 mA applied, adjust R to desired full scale reading.
3. Repeat steps 1 and 2 since both pots interact.

**Input Configuration**

**Analog Input Connections** - For single ended measurements, tie the IN LO (-) (pin 5) to ground as shown in Figure 4. For differential inputs, tie pin 5 to ANA COMM, pin 3.

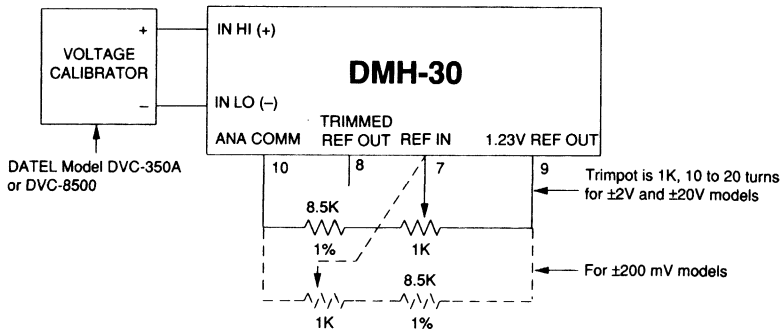


**Figure 4a. Typical Single-Ended Input Connections**



**Figure 4b. Typical Differential Input Connections**

**Full Scale Calibration** - Strap the TRIMMED REF OUT (pin 6) to REF IN (pin 7) for normal, factory calibrated, operation. Use the 1.23V REF OUT (pin 8) for applications needing external gain adjustment. Figure 5 shows the wiring configuration for each model. Calibration is performed with a near full scale input precision voltage.

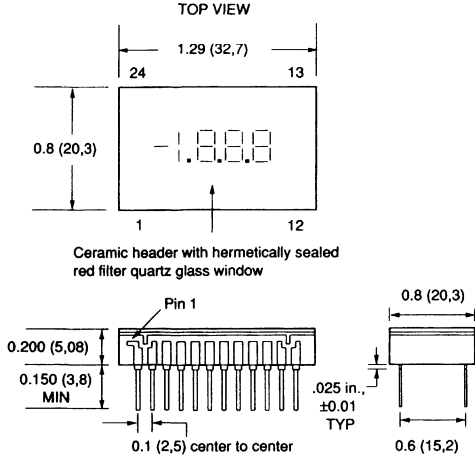


**Figure 5. Using the 1.23V REF OUT to Change the Calibration**

MECHANICAL DIMENSIONS

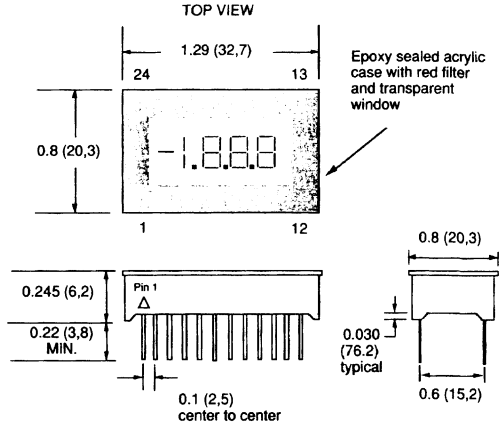
INCHES  
(mm)

DMH-30MM-X



Note: Pin Dimensions 0.010 X 0.018  
Pins have a 0.025 in., ±0.01 stand-off from case

DMH-30PC-X



Note: Pin Dimensions 0.010 X 0.018

Soldering Information: These meters will withstand normal wave soldering with freon fms used in the cleaning step. Other soldering methods should be evaluated carefully as to their effect on the plastic display case.

ORDERING INFORMATION

DMH-30 Series 3 1/2 Digit, Mini Voltage Meters

MODELS

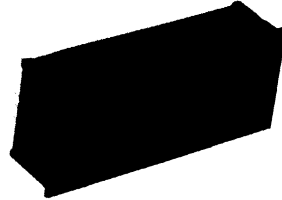
DMH-30PC-0	±200 mV dc, Plastic package
DMH-30PC-1	±2V dc, Plastic package
DMH-30PC-2	±20V dc, Plastic package
DMH-30MM-0	±200 mV dc, Ceramic package
DMH-30MM-1	±2V dc, Ceramic package
DMH-30MM-2	±20V dc, Ceramic package

PIN	FUNCTION	PIN	FUNCTION
1	+5V IN	13	NO CONNECTION
2	DISPLAY TEST	14	NO CONNECTION
3	ANA COMM	15	NO CONNECTION
4	IN HI (+)	16	NO CONNECTION
5	IN LO (-)	17	NO CONNECTION
6	TRIMMED REF OUT	18	NO CONNECTION
7	REF IN	19	NO CONNECTION
8	1.23V REF OUT	20	NO CONNECTION
9	DP1	21	NO CONNECTION
10	DP2	22	NO CONNECTION
11	DP3	23	DISPLAY ENABLE
12	+5V RET	24	+5V OUT

PRELIMINARY DATA

### FEATURES

- Very small, ideal for thru/behind the panel or PC board mounting
- Full size (0.56") digit height
- Packaged in a 12-pin plastic DIP, with a color filter case (0.9"H x 2.1"W x 0.5"D)
- Available in many bright LED colors: red, orange, amber, yellow, and green
- Super bright versions available
- Low power 75 mW models, using high efficiency LED's
- Differential inputs with optional ranges of  $\pm 200$  mV,  $\pm 2$ V, and  $\pm 20$ V dc
- Factory calibrated to within  $\pm 1$  count, no external adjustments necessary
- Autozero A/D converter for long term stability with no adjustments
- A +5V supply is the only power required
- "Display Test" pin available
- User-selectable decimal point placement
- Fully encapsulated package well suited for harsh environments
- Many optional support products to cover virtually all possible applications
- Installation tools for easy prototyping available, cut-out punch, retaining clip inserter



CMR to 86 dB, high impedance, differential input, overvoltage protection (to  $\pm 250$ V dc), and a built-in, high stability, double regulated laser trimmed reference circuit allows for extreme accuracy (0.05%,  $\pm 1$  digit), repeatability and a very long MTBF.

The large (0.56") 3 1/2 digit LED display is available in a wide variety of colors including; red, bright red, orange, green, amber, and yellow to suit every application. The DMS-30PC Series meters are available in three voltage input ranges:  $\pm 200$  mV (DMS-30PC-0),  $\pm 2$ V dc (DMS-30PC-1), and  $\pm 20$ V dc (DMS-30PC-2).

Input impedances are 1,000 megohms for both the  $\pm 200$  mV and  $\pm 2$ V dc models and 1 megohm for the  $\pm 20$ V dc model, minimizing circuit loading. A single +5V dc supply (no other parts required) makes the DMS-30PC Series fully operational over a very broad temperature range of 0 to +60 °C.

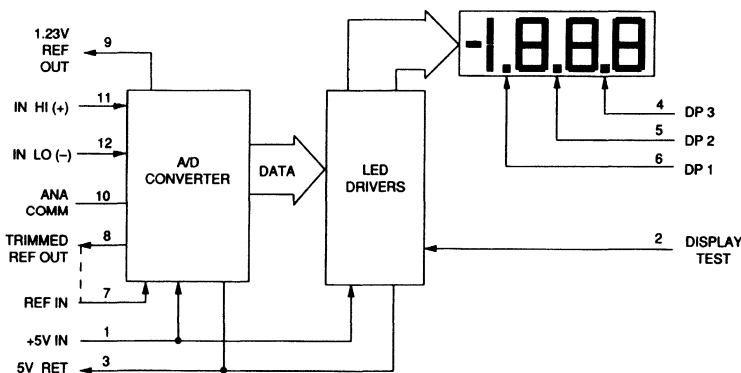
The DMS-30PC Series is ideal for high performance, high reliability measurement systems where low cost and ease of use are paramount.

The built-in bezel, low power drain, fully encapsulated (plastic) case, and small footprint with large LED display were designed for direct PC board mounting, panel mount application, and mobile/portable instrumentation.

### GENERAL DESCRIPTION

The DMS-30PC Series is a line of fully operational, self-contained and complete 3 1/2 digit voltmeters. DATEL incorporates the display and converter circuitry into our assembly, using the most modern microelectronic hybrid packaging techniques.

The result is a very small and solid digital voltmeter which can be handled like a component unlike awkward PC boards or conventional meter housed in plastic boxes.



### APPLICATIONS

- Board-level diagnostics
- Weigh scales
- Automatic test equipment
- Avionics displays
- Lab/test equipment
- Digital thermometers
- Harsh environment useage
- Process monitoring
- Portable/mobile instruments

Figure 1. DMS-30PC Simplified Block Diagram

**FUNCTIONAL SPECIFICATIONS**

Specifications cited are derived from tests at ambient temperature of +25 °C and supply voltage (Vcc) of +5.0V dc unless otherwise noted, using circuit shown in Figure 4.

INPUT	MIN	TYP	MAX	UNITS
Full Scale Input	See Ordering Information			
Input Impedance				
DMS-30PC-0, -1	100	1000	-	MΩ
DMS-30PC-2	0.8	1.1	-	MΩ
Input Overvoltage Protection	-	-	±250	V dc
Common Mode Volt. Range	-	-	±2.0	V dc
CMR (dc to 60 Hz)	-	86	-	dB
Sampling Rate	2.5 Samples/Second			
<b>PERFORMANCE</b>				
Accuracy, after 3 minute warm-up time				
DMS-30PC-0 (VIN = 0.19000V)	-	±1	±2	Counts
DMS-30PC-1 (VIN = 1.9000V)	-	±1	±2	Counts
DMS-30PC-2 (VIN = 19.000V)	-	±2	±3	Counts
Zero Reading (VIN = 0V)	-	0	±1	Counts
Temperature Drift of Gain (0 to +60 °C)	-	±0.15	±0.3	Cnts/ °C
External Reference (1.23V dc, pin 9 ref. to pin 10, at 15 μA max.)	+1.20	+1.23	+1.25	V dc
<b>PHYSICAL</b>				
Display Type and Size	3 1/2 digit LED, 0.56" high See Ordering Guide for Colors			
Polarity Indication	Autopolarity ("-" for negative VIN)			
Overrange Indication	-1 for negative VIN 1 for positive VIN			
Weight	0.5 oz.			
Case Material	Acrylic			
<b>ENVIRONMENTAL</b>				
Operating Temperature	0 to +60 °C (all models)			
Storage Temperature	-40 to +75 °C (all models)			
Humidity	0 to 95% non-condensing			
<b>POWER SUPPLY REQUIREMENTS</b>				
Supply Voltage (all models)	5.00V dc (±5%)			
Supply Current		120	200	mA
Low power models:				
DMS-30PC-X-RL	-	15	22	mA
DMS-30PC-X-GL	-	60	100	mA
DMS-30PC-X-OL	-	60	100	mA

**TECHNICAL NOTES**

1. Decimal Point Selection:  
Tie desired pin (4, 5, or 6) to GND (pin 3).
2. Display TEST  
Tie DISPLAY TEST (pin 2) to +5V dc (pin 1). When enabled, display reads 1888. DISPLAY TEST will show "-" only when a negative input exists. Do not leave "test" on for more than 10 seconds.

**APPLICATIONS**

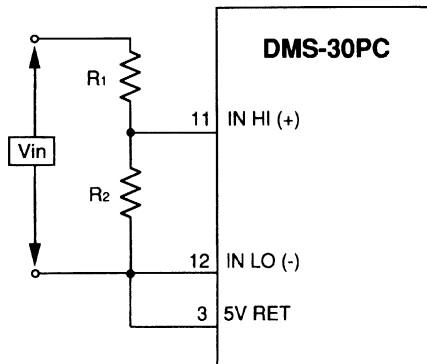
The DMS-30PC Series are highly versatile meters designed for a very wide variety of applications. Their small size, reliability, accuracy, and large LED display make them ideal for all phases of product development from initial concept prototyping to finished goods.

The following applications may be implemented easily using the DMS-EB application/evaluation board. Refer to ordering information.

**Engineering Scaling** - One of the most common physical parameters measured with the DMS-30PC is voltage. For measuring voltages larger than the full scale input range of the meter, the input signal must be attenuated. The simple voltage divider circuit shown in Figure 2 allows scaling the input to a voltage that is within the range of the DMS-30PC model that you are using.

$$5 \text{ K}\Omega < R_1 + R_2 < 10 \text{ M}\Omega$$

$$\frac{R_2}{R_1 + R_2} \times V_{IN} = \text{Reading}$$

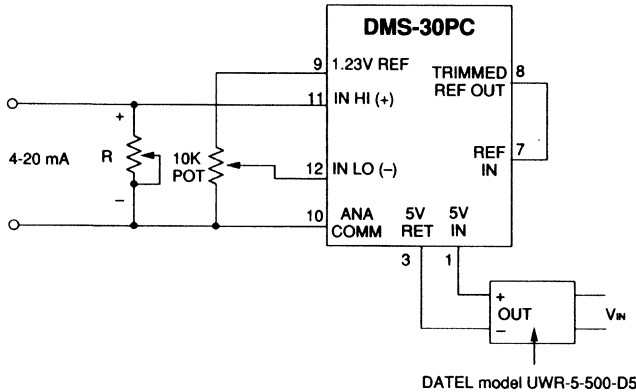


**Figure 2. Simple Attenuation Circuit for Scaling Input Voltages**

**Process Control Signal Measurement, 4-to-20 mA**

In process control applications, a 4-to-20 mA current loop is used to transmit control signals. The current is sensed by the DMS-30 using a shunt resistor across the input.

The value of the shunt resistor is dependent upon scaling requirements of the application and can be calculated. A potentiometer tied between the 1.23V precision reference and analog common is used as an offset adjustment.

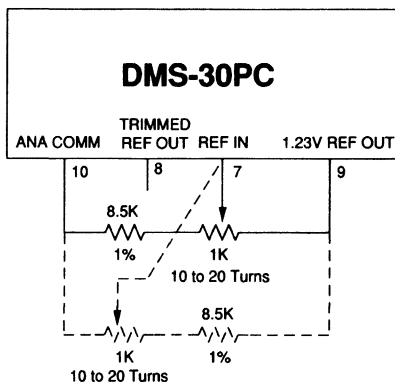


**Figure 3. A Typical 4-to-20 mA Current Loop**

**Using the 1.23V REF OUT (pin 9) to Change the Gain/Calibration**

Use the 1.23V REFERENCE OUTPUT (pin 9) for applications needing external gain adjustment. Figure 4 shows the wiring configuration for ±2V and ±20V models. Reverse positions of potentiometer and 8.5 K resistor for ±200 mV models.

Optimum calibration is performed with a near full scale input voltage from a precision voltage source.



**Figure 4. Using EXTERNAL REFERENCE OUT to Change DMS-30 Gain**

**Determining Shunt Resistor Value**

Where:  $V_{FSR}$  = Full Scale Voltage Reading  
 $I_{FSR}$  = Full Scale Current

$$R = \frac{V_{FSR}}{I_{FSR}}$$

For 2V full scale:

$$R = \frac{2 - 0}{20 - 4} = \frac{2V}{16 \text{ mA}} = 125 \Omega$$

A 200 Ω potentiometer would work well for this voltage range. Adjust the pot before placing it in circuit.

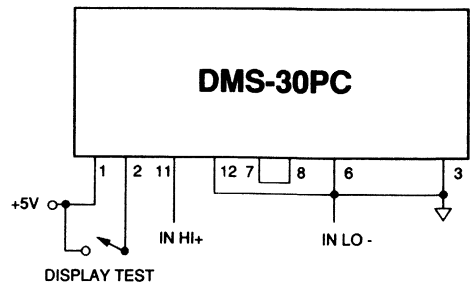
NOTE: the UWR-5/500-D5 provides the required isolation between the +5V supply and the 4-to-20 mA current loop.

**Calibration**

1. With 4 mA applied, adjust the 10K pot to obtain a reading of "0", if desired.
2. With 20 mA applied, adjust R to desired full scale reading.
3. Repeat steps 1 and 2 since both pots interact.

**Single-Ended Connections**

For single-ended measurements tie IN LO (pin 12) to GROUND. Strap the trimmed voltage reference output (pin 8) to REF IN (pin 7) for normal operation.



**Figure 5. Typical Single-Ended Connections**

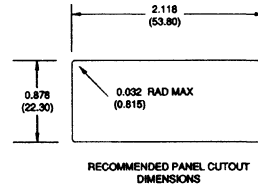
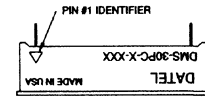
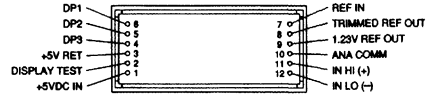
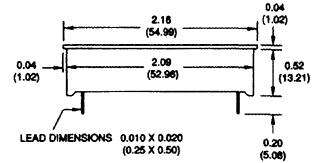
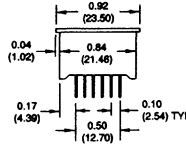
ORDERING INFORMATION

MECHANICAL DIMENSIONS

DMS-30PC Series, 3 1/2 Digit, Miniature Voltage Meters

Inches  
(mm)

MODEL	INPUT RANGE	FEATURES
DMS-30PC-0-RL	±200 mV	Low Power Red LED
DMS-30PC-1-RL	±2V dc	Low Power Red LED
DMS-30PC-2-RL	±20V dc	Low Power Red LED
DMS-30PC-0-RS	±200 mV	Standard Intensity Red LED
DMS-30PC-1-RS	±2V dc	Standard Intensity Red LED
DMS-30PC-2-RS	±20V dc	Standard Intensity Red LED
DMS-30PC-0-RH	±200 mV	High Intensity Red LED
DMS-30PC-1-RH	±2V dc	High Intensity Red LED
DMS-30PC-2-RH	±20V dc	High Intensity Red LED
DMS-30PC-0-GS	±200 mV	Standard Intensity Green LED
DMS-30PC-1-GS	±2V dc	Standard Intensity Green LED
DMS-30PC-2-GS	±20V dc	Standard Intensity Green LED
DMS-30PC-0-GL	±200 mV	Low Power Green LED
DMS-30PC-1-GL	±2V dc	Low Power Green LED
DMS-30PC-2-GL	±20V dc	Low Power Green LED
DMS-30PC-0-YS	±200 mV	Standard Intensity Yellow LED
DMS-30PC-1-YS	±2V dc	Standard Intensity Yellow LED
DMS-30PC-2-YS	±20V dc	Standard Intensity Yellow LED
DMS-30PC-0-OS	±200 mV	Standard Intensity Orange LED
DMS-30PC-1-OS	±2V dc	Standard Intensity Orange LED
DMS-30PC-2-OS	±20V dc	Standard Intensity Orange LED
DMS-30PC-0-OL	±200 mV	Low Power Orange LED
DMS-30PC-1-OL	±2V dc	Low Power Orange LED
DMS-30PC-2-OL	±20V dc	Low Power Orange LED
DMS-30PC-0-AS	±200 mV	Standard Intensity Amber LED
DMS-30PC-1-AS	±2V dc	Standard Intensity Amber LED
DMS-30PC-2-AS	±20V dc	Standard Intensity Amber LED



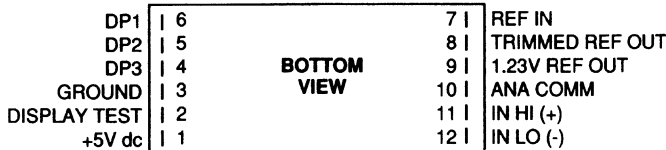
OPTIONS

- DMS-EB** Application/Evaluation board  
Available with standard MOLEX connector,  
DP solder gaps, attenuation resistor pads.
- RN-3100/4100** Resistor Gain Kit - Available for user-  
**RN-DMS-LED** designed attenuator network.

TOLERANCES UNLESS OTHERWISE SPECIFIED

2 PL DEC ±0.02	3 PL DEC ±0.002
±(0.50)	±(0.05)

NOTE:  
Recommended printed circuit  
board finished hole diameter:  
0.042(1.067) ± 0.002(0.051)





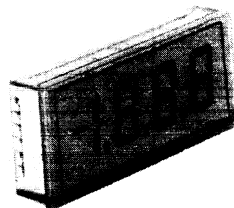
# DMS-30LCD Series

## Miniature, 3 1/2 Digit LCD Digital Panel Meter

PRELIMINARY DATA

### FEATURES

- Sub-miniature package w/full size LCD display
- +5V dc & +9/12V dc (low current) models available
- Large (0.450"), enhanced contrast LCD display
- Ultra-slim profile
- Backlit version available
- Completely sealed modular package.
- Evaluation board available for multiple application
- Differential input for  $\pm 200$  mV,  $\pm 2$  V dc,  $\pm 20$  V dc ranges
- Autozero and autopolarity changeover
- Low power (245  $\mu$ A) models available
- Laser trimmed reference; 0.05% accuracy
- All segments TEST pin
- User selectable decimal point



### GENERAL DESCRIPTION

The DMS-30LCD Series is the ONLY fully operational, self-contained, 3 1/2 digit LCD voltmeter incorporating state-of-the-art hybrid circuit technology. The DMS-30LCD Digital Voltmeter is built with Surface Mount Components for low part count, increased reliability, and very low cost. CMR to 86 dB, high impedance, differential input, overvoltage protection (to  $\pm 250$  V dc), and a built-in, high stability, double regulated laser trimmed reference circuit allows for extreme accuracy (0.05%,  $\pm 1$  digit), repeatability and a very long MTBF. Incorporating a dual slope, integrating A/D converter with modern LSI microchip technology and super stable passives, the DMS-30LCD series provides advanced integrated circuit precision and reliability in a true component-like package.

The large (0.450") 3 1/2 digit LCD display is available in standard or enhanced contrast versions for daylight use. The DMS-30LCD series meters are available in three voltage input

ranges;  $\pm 200$  mV (DMS-30LCD-0),  $\pm 2$  V dc (DMS-30LCD-1), and  $\pm 20$  V dc (DMS-30LCD-2) with input impedance of 1,000 Megohm (1 MOhm for DMS-30LCD-2) minimizing circuit loading. All models are also available in choice of +5V dc or +9/12V dc (245  $\mu$ A, typical) for battery operation. Operating temperature range is 0 to 60  $^{\circ}$ C.

The DMS-30LCD series are ideal for high performance, high reliability measurement systems where low cost and ease of use are paramount. Their small size and simple, plug-in operation (12-pin package) make them the perfect replacement for older, less reliable digital panel meters or as design-ins for your latest OEM instruments and other equipment.

Also available is an evaluation/prototype board that plugs directly onto the DMS-30LCD allowing direct inputs for such common applications as 4-20 mA inputs, Zero and Offset (Span) adjustments, automatic decimal point placement, and voltage divider circuits. The built-in bezel, low power drain, fully encapsulated (plastic) case, and small footprint with large LCD display were designed for direct PC board mounting, panel mount application, and mobile/portable instrumentation.

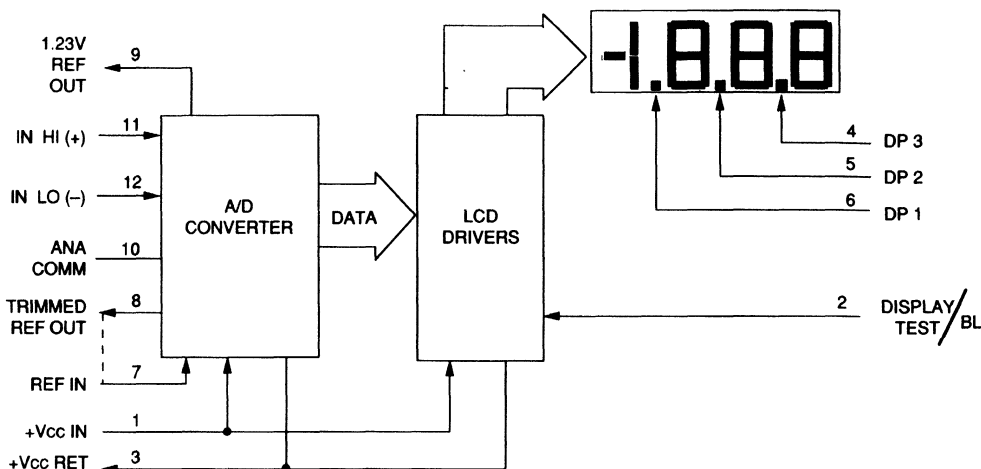


Figure 1. DMS-30LCD Simplified Block Diagram

**SPECIFICATIONS**

Specifications listed were derived from tests at ambient temperature of +25 °C unless otherwise noted using the circuit shown in Figure 4.

INPUT	MIN	TYP	MAX	UNITS
<b>Input Impedance</b>				
DMS-30LCD-0,1	100	1000	–	MOhms
DMS-30LCD-2	0.8	1.1	–	MOhms
<b>Input Overvoltage Protect</b>	–	–	±250	V dc
<b>Com. Mode Volt Range*</b>	–	–	±2.0	V dc
<b>CMR (DC to 60 Hz)</b>	–	86	–	dB
<b>Sampling Rate</b>	–	2.5	–	Samp./S
<b>Full Scale Input</b>	See Ordering Information			

**PERFORMANCE**

<b>Accuracy, after 3 min.</b>				
-0 Model (VIN=0.19000V)	–	±1	±2	Counts
-1 Model (VIN=1.9000V)	–	±1	±2	Counts
-2 Model (VIN=19.000V)	–	±2	±3	Counts
<b>Zero Reading (VIN=0V)</b>	–	0	±1	Count
<b>Temperature Drift of Gain</b> (0 to 60 °C)	–	±0.15	±0.3	Cnts/°C
<b>External Reference</b> (1.23V dc, pin 9 referenced to pin 10, @ 3.0 µA max)	+1.200	+1.230	+1.250	V dc

**DISPLAY**

<b>Display Type and Size</b>	3 1/2 Digit, Enhanced Contrast LCD 0.450" height
<b>Polarity Indication</b>	Autopolarity ("–" for Neg VIN)
<b>Overrange Indication</b>	-1 for negative VIN 1 for positive VIN
<b>Weight</b>	0.5 Oz.
<b>Case Material</b>	Clear Acrylic

**ENVIRONMENTAL**

<b>Operating Temperature</b>	0 to +60 °C (All Models)
<b>Humidity</b>	0 to 95% non-condensing
<b>Storage Temperature</b>	-20 to +75 °C (All Models)

**POWER SUPPLY REQUIREMENTS**

<b>5V dc Model</b>	
Voltage	5.00V dc (± 5%)
Current	500 µA (typ), 900 µA (max)
<b>9V dc Model</b>	
Voltage	8.5 - 12.6V dc
Current	245 µA (typ), 300 µA (max)

\* Not applicable to +9V/12V models.

**TECHNICAL NOTES**

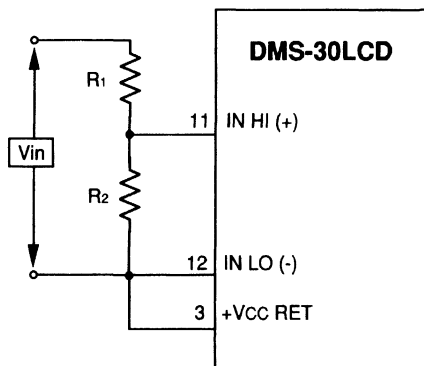
1. Analog Input Connections:  
Single-ended measurements;  
5V dc Model; tie IN LO (pin 12) to ground (pin 3).  
9V dc Model; tie IN LO (pin 12) to ANA COMM (pin 10).
2. Decimal Point Selection:  
Tie desired pin (4, 5, or 6) to GROUND (pin 3).
3. Display TEST (Not available on backlit models)  
Tie DISPLAY TEST (pin 2) to +5V dc (pin 1). When enabled, display reads 1888. DISPLAY TEST will show "–" only when negative input exists. *Do not leave "test" on for more than 10 seconds.*
4. Backlit Models  
For +5V dc model, apply +5V to BL (pin 2)  
For +9V dc model, apply +9V to BL (pin 2)

**APPLICATIONS**

- Board-level diagnostics
- Automatic test equipment
- Lab/test equipment
- Harsh environment usage
- Portable/mobile instruments
- Weigh scales
- Avionics displays
- Digital thermometers
- Process monitoring

$$5\text{ K}\Omega < R_1 + R_2 < 10\text{ M}\Omega$$

$$\frac{R_2}{R_1 + R_2} \times V_{IN} = \text{Reading}$$



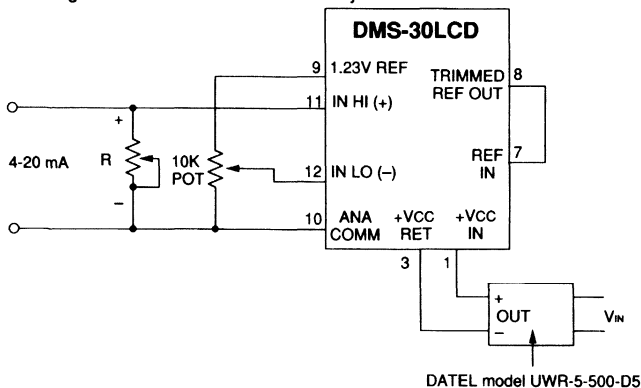
**Figure 2. Simple Attenuation Circuit for Scaling Input Voltages**



**Process Control Signal Measurement, 4-to-20 mA**

In process control applications, a 4-to-20 mA current loop is used to transmit control signals. The current is sensed by the DMS-30 using a shunt resistor across the input.

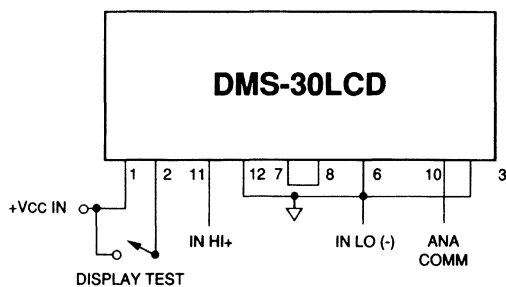
The value of the shunt resistor is dependent upon scaling requirements of the application and can be calculated. A potentiometer tied between the 1.23V precision reference and analog common is used as an offset adjustment.



**Figure 3. A Typical 4-to-20 mA Current Loop**

**Single-Ended Connections**

For single-ended measurements tie IN LO (pin 12) to GROUND. Strap the trimmed voltage reference output (pin 8) to REF IN (pin 7) for normal operation.



**Figure 4. Typical Single-Ended Connections**

**Determining Shunt Resistor Value**

Where:  $V_{FSR}$  = Full Scale Voltage Reading  
 $I_{FSR}$  = Full Scale Current

$$R = \frac{V_{FSR}}{I_{FSR}}$$

For 2V full scale:

$$R = \frac{2 - 0}{20 - 4} = \frac{2V}{16 \text{ mA}} = 125 \Omega$$

A 200  $\Omega$  potentiometer would work well for this voltage range. Adjust the pot before placing it in circuit.

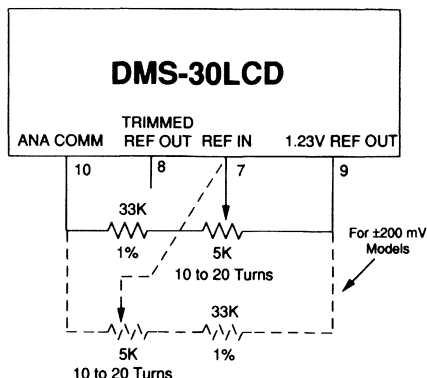
NOTE: the UWR-5/500-D5 provides the required isolation between the +5V supply and the 4-to-20 mA current loop.

**Calibration**

1. With 4 mA applied, adjust the 10K pot to obtain a reading of "0", if desired.
2. With 20 mA applied, adjust R to desired full scale reading.
3. Repeat steps 1 and 2 since both pots interact.

**Using the 1.23V REF OUT (pin 9) to Change the Gain/Calibration**

Use the 1.23V reference output (pin 9) for applications needing external gain adjustment. Figure 5 shows the wiring configuration for  $\pm 2V$  and  $\pm 20V$  models. Reverse positions of potentiometer and 33K resistor for  $\pm 200 \text{ mV}$  models. Calibration is performed with a near full scale input.



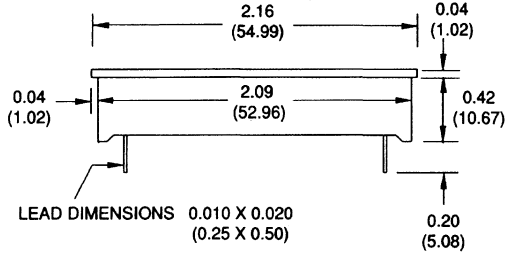
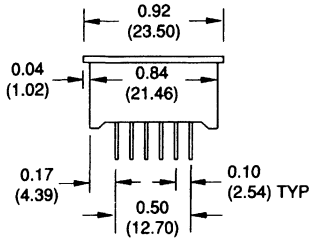
**Figure 5. Using REFERENCE OUT to Change DMS-30LCD Gain**

DP1	6	7	REF IN
DP2	5	8	TRIMMED REF OUT
DP3	4	9	1.23V REFERENCE OUT
GROUND/-9V dc	3	10	ANA COMM
DISPLAY TEST/BL	2	11	IN HI (+)
+5V dc/+9V dc	1	12	IN LO (-)

**BOTTOM VIEW**

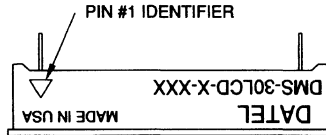
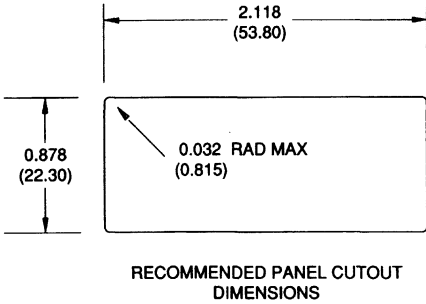
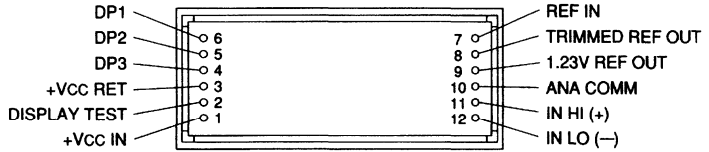
**MECHANICAL DIMENSIONS**  
(Drawn to scale)

NOTE:  
Recommended printed circuit board finished hole diameter:  
0.042(1.067) ± 0.002(0.051)



**TOLERANCES UNLESS OTHERWISE SPECIFIED**

2 PL DEC ±0.02 ±(0.50)	3 PL DEC ±0.002 ±(0.05)
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**ORDERING INFORMATION**

DMS-30LCD Series, 3 1/2 Digit, Miniature Voltage Meter

MODEL #	INPUT RANGE	FEATURES
DMS-30LCD-0/5	±200 mV	+5V dc Operation
DMS-30LCD-1/5	±2V dc	+5V dc Operation
DMS-30LCD-2/5	±20V dc	+5V dc Operation
DMS-30LCD-0/9	±200 mV	9 to 12V dc (Battery) Operation
DMS-30LCD-1/9	±2V dc	9 to 12V dc (Battery) Operation
DMS-30LCD-2/9	±20V dc	9 to 12V dc (Battery) Operation

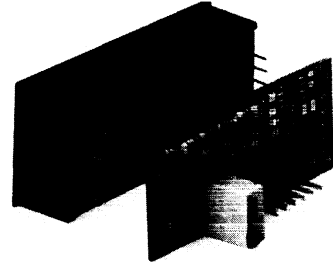
**OPTIONS**

- DMS-EB** Application/Evaluation Board with standard MOLEX connector, external gain adjustment potentiometer, DP solder gaps, attenuation resistor pads.
- RN-DMS/LCD** Resistor Gain Kit Available for user designed attenuator network.

PRELIMINARY DATA

### FEATURES

- Provisions for 4-20 mA operation
- SPAN (GAIN) and OFFSET adjustments
- Input divider network for large voltages
- Operate DMS-30PC from 9/12V dc battery
- On-board solder gaps for decimal point placement
- Exact size as DMS-30PC (0.83" x 2.02")
- Signal I/O connectors for easy power & signal input
- Delivery from stock, very low cost



### GENERAL DESCRIPTION

The DMS-EB evaluation board was designed specifically to allow quick, easy evaluation of DATEL's new, state-to-the-art hybrid DMS-30PC Digital Voltmeter. The DMS-EB's versatility, low cost and direct DMS-30PC plug-in compatibility makes interfacing a breeze. The DMS-EB covers many common panel meter applications while providing simple signal and power I/O terminations (via standard MOLEX connectors) and plug-in versatility when changing from one application to another.

The DMS-EB has provisions for such common applications as input dividers for large input voltages, SPAN (GAIN) and OFFSET adjustment, 4 - 20 mA process monitoring, 9/12V dc battery operation, direct decimal point placement, and allows for direct signal I/O wiring (via interface connector or solder directly to the board). The DMS-EB is fully compatible with all three versions of the DMS-30PC ( $\pm 200$  mV,  $\pm 2$ V,  $\pm 20$ V) making it interchangeable from meter to meter and application to

application. Solder gaps are conveniently placed on the board and may be quickly bridged or cut as required. It's broad applicability and ergonomic design are a result of direct customer demands.

This low cost addition to DATEL's expanding line of Hybrid meter products is evidence of our continuing commitment to offer the finest quality, most versatile American-made products available.

### APPLICATIONS

- 4-20 mA process monitoring
- Portable/mobile applications
- Fine tuning of SPAN and OFFSET
- Interchangeability between meters
- Quick prototyping and evaluation
- Bench top instrumentation

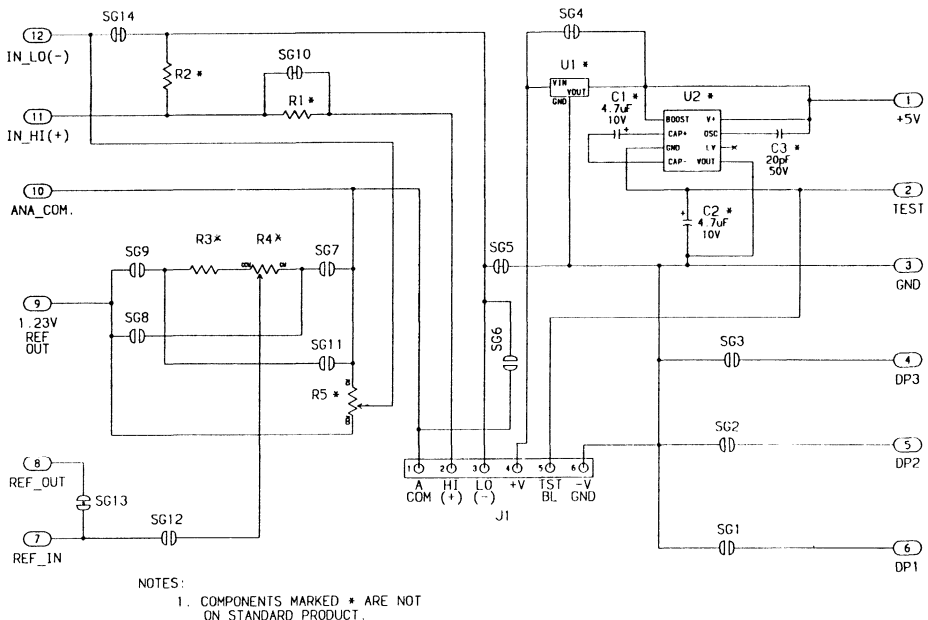
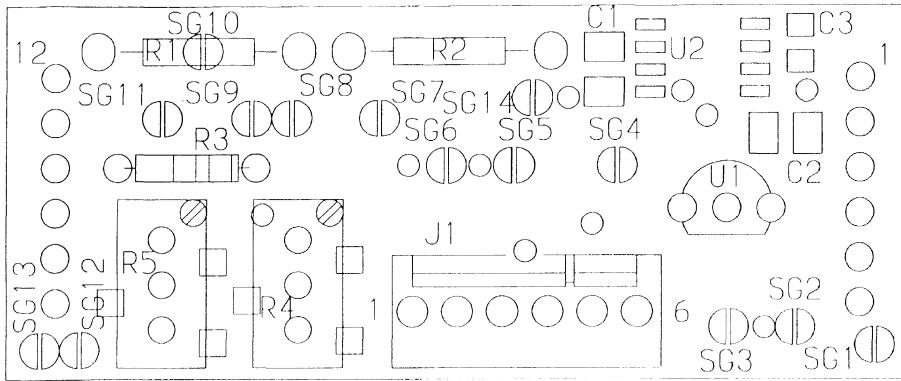


Figure 1. Block Diagram



When using 7805 (TO3), metal tab points toward SG1, SG2, SG3.

Figure 2. Board Layout

**APPLICATIONS**

As shipped, the DMS-EB is configured for Single-Ended Operation and Internal Reference. This configuration is preferred for simple voltage measurements and will, generally, cover most standard applications.

Simply plug the meter into the board (pin 1 to pin 1), connect +5V dc (pin 4) and the power return to pin 6 (GROUND).

**Decimal Point Placement:**

- Close SG1 for 1.999 (DP1)
- Close SG2 for 19.99 (DP2)
- Close SG3 for 199.9 (DP3)

**9V dc/12V dc Battery (supply) Operation:**

- Install U1
  - Use 7805 for all standard power models; 7.5 - 12.5V dc
  - 78L05 for Low power models;
    - Low Power Green (-GL) 7.0 - 9.5V dc
    - Low Power Orange (-OL) 7.0 - 9.5V dc
    - Low Power Red (-RL) 7.0 - 20V dc
- Open SG4
- Apply +9V dc (+12V dc) to pin 4
- Apply -9V dc (-12V dc) to pin 6

**Using Full Range SPAN Adjustment:**

Configuring the DMS-EB for SPAN adjustment is simply a matter of installing resistor R3 (10.5 KΩ, 1%) and potentiometer R4 (DMS-30PC-1 and PC-2 models).

DMS-30PC-0 (±200 mV) SPAN adjustment requires that you open SG8 and SG11 and close SG9 and SG7, then install R3 and R4.

Adjust SPAN as desired. DMS-30PC-1/2 SPAN adjustment is typically +10% and -5%. The DMS-30PC-0 has a much wider SPAN adjust, however, it should be limited to +10% for optimum accuracy.

**Differential Signal Inputs (Signal Referenced to Power Source):**

Open SG5 and/or SG6 (these are in series so that only one need be opened)  
Apply Input Signal to In High (pin 2) and In Low (pin 3 of J1)

Note: Common Mode Voltage must not exceed ±1.5V dc

**Measuring Input Voltages Larger than 1.999V dc (Use DMS-30PC-1 Only):**

*CAUTION: Do not exceed 250V dc input signal*

Cut SG10  
Voltages exceeding ±100V dc, also cut 2 adjoining traces.

Calculate value of R1 & R2 as follows:

$$R2 = \text{FSR} \times R1 / |V_{IN}| - \text{FSR} \quad \text{Where:}$$

FSR = Full Scale Range of Meter (0 - 1.999V)

$V_{IN}$  = Input Voltage @ J1 (Pins 2 and 3)

A typical value for R1 is 1 MOhm.  
The sum of R1 + R2 should be between 50 KΩ and 10 MΩ

EXAMPLE:  $V_{IN}$  is 199.9V dc and display reading must also be 199.9.

1. Assume  $R1 = 1.0 \text{ MOhm}$
2.  $R2 = \text{FSR} \times R1 / |V_{IN}| - \text{FSR}$   
 $R2 = (1.999 \times 1,000,000) / 199.9 - 1.999$   
 $R2 = 10101.01\Omega$  or 10 KΩ
3. DP3 is enabled via SG3

**4-20 mA Operation**  
(recommend use of 2V model DMS-30PC-1):

- Install R2 ( $R2 = FSR / 0.016$ ) where FSR is desired reading of meter
- Open SG5 and SG14
- Close SG6
- Close SG10 (if Open)
- Install R5 (50K Potentiometer) for ZERO Adjust
- Install R3 (10.5 K $\Omega$ , 1%) and R4 (2K Potentiometer) for SPAN Adjust
- Apply 4 mA, adjust R5 for ZERO offset
- Apply 20 mA, adjust R4 for full range SPAN
- Check SPAN and ZERO and readjust for best readings.

NOTE: Current source must be isolated from 5V dc power source.

**For Current Measurements**  
(recommend use of 200 mV model DMS-30PC-0);

Install R2 ( $R2 = FSR / I_{max} \times 10000$ ) where;  
FSR is desired reading (0 - 1999) and I<sub>max</sub> is between 0 - 1 Amp.

- Open SG5
- Close SG6
- Close SG10 (if Open)
- Install R4 (2 K $\Omega$  potentiometer) for SPAN Adjust
- Open SG8 and SG11
- Close SG7 and SG9
- Apply Input signal (current) to In High and In Low
- Adjust R4 for Desired Full Scale Readings
- Decimal Points are enabled via SG1, SG2, SG3.

EXAMPLE: 1.0 Amp Input must read 1.000.

$$R2 = 1000 / 1 \times 10000 \quad R2 = 0.1 \text{ Ohm}$$

Move DP1 via SG1 for reading of 1.000

**CAUTION:** Do not exceed 1 Amp input current

**CONNECTOR PINOUT**

Pin	Function
1	Analog Common
2	Input High
3	Input Low
4	+5V dc (+9/12V dc)
5	TEST (Tie to Pin 4 to Enable)
6	GROUND (-9/12V dc)

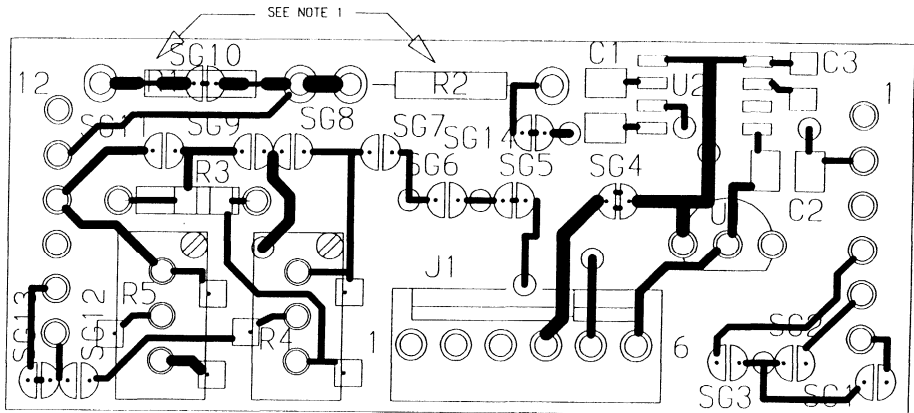
**ORDERING INFORMATION**

DMS-EB	Evaluation Board w/Connectors
RN-DMS/LED	Resistor Accessory Kit for DMS-30PC
RN-DMS/LCD	Resistor Accessory Kit for DMS-30LCD

NOTES:

1. NOT USED ON STANDARD PRODUCT.

ITEM NO.	REF DES.	DESCRIPTION	ITEM NO.	REF DES.	DESCRIPTION
1	U1	78L05	29	R5	50K TRIM POT*
8	U2	ICL7660	30	C1, C2	4.7 $\mu$ F 10V
10	R1	*	32	C3	*
14	R2	*	49	J1	*
18	R3	10.5K	51	*	*
23	R4	2K TRIM POT	52	PWB	C-187B1



**Figure 3. Mechanical Drawing and Layout**

**Contact**  
**DATEL for your Power Supply**  
**and Module component needs.**

**Dial**  
**1-800-233-2765**  
**for**  
**Immediate Assistance**

# **DIGITAL PANEL METERS**

### 3 1/2 DIGIT DIGITAL PANEL METERS

	Model	Power	Std. Input	Case*	Features
3.5 Digit LED	DM-3100L-1	+5Vdc	±2Vdc	B	Short Depth Case
	DM3100N-1	+5Vdc	±2Vdc	A	Provisions for 4-20 mA input
	DM-3101-1	+5Vdc	±2Vdc	A	High Intensity Display
	DM3103-1	+5Vdc	±2Vdc	B	High Intensity Display
	DM-31-1	+5Vdc	±2Vdc		Low Cost - Uncased
	DM-3100B-1	115/230VAC	±2Vdc	B	Short Depth Case
	DM3104-1	115/230VAC	±2Vdc	B	High Intensity Display
	DM-9115-1	115/230VAC	±2Vdc	C	NEMA 12 (Vibration Std)
3.5 Digit LCD	DM-3100U-1	+5/9Vdc	±2Vdc	A	Units Display (Batt. Pwr.)
	DM-3100X-1	+5/9Vdc	±2Vdc	B	Battery Powered
	DM-3102A	+5Vdc	±2Vdc	A	Units Display Autoranging (200 mV - 200V)
	DM-LX3-1	+5Vdc	±2Vdc		Low Cost - Uncased
	DM-3100U2	115VAC	±2Vdc	A	Units Display
Other Digital Panel Products	DBM-20	+5Vdc	Adjustable	A	20 Segment LED Bar Graph w/ TTL Outputs
	PC-6	+5Vdc		B	10 MHz Counter/Timer

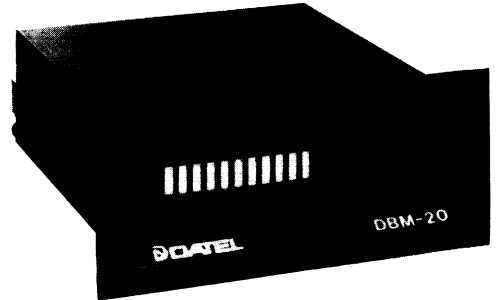
NOTE: Input range kits are available for all DM-3100, 4100, and 9000 Series DPMs

\* Refer to page 67 for actual dimensions



**FEATURES**

- 20-segment, high-intensity analog bar graph display
- TTL outputs for process control or alarm circuits
- Adjustable input range from +0.1 to +2.4V dc full-scale. Higher voltage and current ranges (including 4–20 mA) with user-installed options
- Instant response with no overshoot



**DESCRIPTION**

The DBM-20 Bar Meter is a panel-mounted, self-illuminated 20-segment red LED (Light Emitting Diode) bar display. It accepts a dc or slowly varying input signal, converts that signal to digital form and displays it in the form of a progression of lighted LED segments arranged to shape a single bar graph.

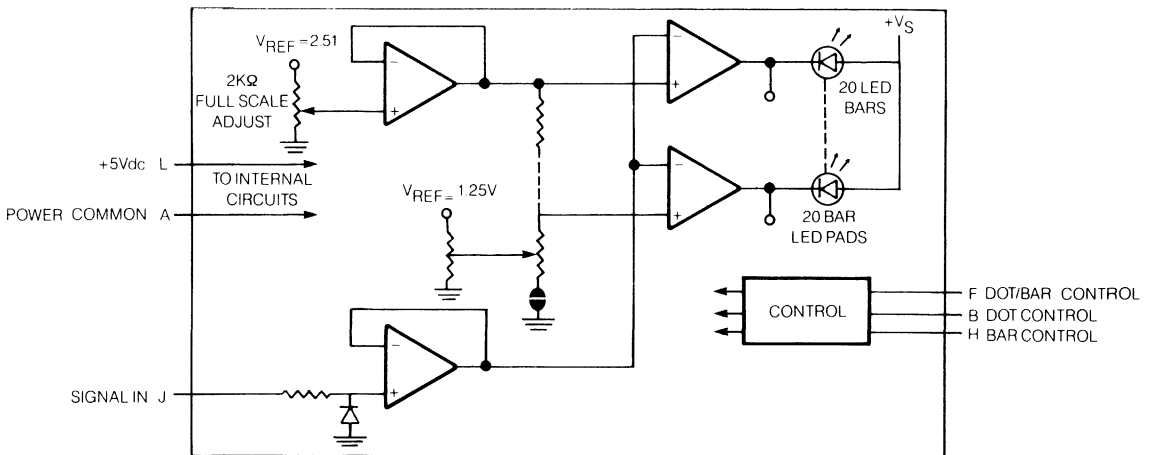
The DBM-20 is particularly well-suited for trend measurement, where relative changes in the measured variable must be easily recognized. Applications of this type include measurement of belt speed, noise level, pollution effluent and the like.

The DBM-20 contains 20 TTL driver pads corresponding to the 20 bar graph LED segments. TTL outputs can be wired from the pads to any of the four unused finger connectors. These outputs can be used as setpoint trips in simple control loops, or to control alarm circuits. The meter also provides internal pads for the installation of additional logic circuitry, such as TTL comparators, DIP relays, and driver ICs, to be used in conjunction with the TTL outputs.

The DBM-20 features an adjustable input range from +0.1 to +2.4V dc full scale. Other voltage and current ranges (including 4–20 mA) are easily obtained by installing resistors/potentiometer on the provided locations. The inputs provide high input impedance (100 K $\Omega$ , minimum) and a low input bias current (10 nA, typical). The DBM-20's input configuration is single-ended unipolar.

The meter displays an instant response with no overshoot. The user has a choice of either a Bar mode display or Dot mode display. In the Bar mode, all LED's will light up from the left of the display up to the high end of the input signal. In the Dot mode, only the LED at the high end of the input signal will light.

A red optical display filter has 20-unit graduation markings in white. The filter may be changed by opening the housing from the rear. The low-profile housing is a rugged, black polycarbonate case that is impact and solvent resistant. Its dimensions are 2.53"W x 3.34"D x 0.94"H. Panel mounting cutout dimensions are 2.56"W x 0.97"H.



**Simplified Block Diagram of DBM-20**

**FUNCTIONAL SPECIFICATIONS**

(Typical at +25°C unless noted)

**INPUT CHARACTERISTICS**

**Input Voltage Range**..... Adjustable +100 mV dc to +2.4V dc Full Scale, Unipolar (R3 at rear of instrument sets the Full Scale). Higher voltage and current inputs (including 4–20 mA) are easily configured with user-installed options. Factory-installed range changes available in OEM quantities.

**Input Impedance**..... 100 KΩ min.

**Input Bias Current**..... 10 nA typ, 50 nA max.

**Input Configuration**..... Single-ended

**Input Offset Voltage**..... Solder-gapped to signal ground. May be adjustable 0 to +1.25V dc with addition of a 1 KΩ user-installed pot.

**LED Trip Point Nonlinearity**..... 0.5% typ, 2% max.

**Input Overvoltage**..... ±35V max.

**Temperature Coefficient**..... 1% of Full Scale, 0 to +50°C

**DISPLAY**

**Type**..... 20 self-illuminated red light-emitting diodes (LED). Segment size 0.20"H x 0.07"W.

**Modes**

**Bar**..... All LED's light starting from the display left side, according to the input voltage (Connect pin L, F and H).

**Dot**..... Only one LED lights starting from the left side according to the input voltage (Connect pins B and F).

**INPUT/OUTPUT CONNECTIONS**

**Pin A**..... Power and Signal Common.

**Pin F**..... Dot/Bar Control.

**Dot mode**..... Connect pins B and F.

**Bar mode**..... Connect pins F, L and H.

**Pin J**..... Signal Input.

**Pin L**..... +5 V dc Power Input.

**Pins B, C, D, E, H, K**..... Connected to drilled internal PCB pads for user circuits.

**PHYSICAL/ENVIRONMENTAL**

**Input/Output Connector**..... Edgeboard PC type using bottom side only. 10-pins, 0.156" centers, DATEL model 58-2073082 or equivalent (included).

**Case Material**..... Black polycarbonate plastic, impact and solvent resistant.

**Case Outline Dimensions (Less Bezel)**..... 2.53"W x 3.34"D x 0.94"H (64,3 x 84,8 x 23,8 mm)

**Front Panel Mounting Cutout**..... 2.56"W x 0.97"H min. (65,1 x 24,6 mm). Thickness range 0.062" to 0.625" (1,6 to 15,9 mm).

**Bezel Dimensions**..... 1.32"H x 2.92"W x 0.157"D (33,5 x 74,2 x 4 mm)

**User Circuits**..... 4 Internal uncommitted 14-pin DIP pads are drilled for user circuits such as DIP relays and a driver IC (to be used in conjunction with the 20 TTL outputs).

**Power required**..... +5V dc ±0.25V dc at 250 mA typ, regulated (unregulated power supplies cannot be used because of display switching currents).

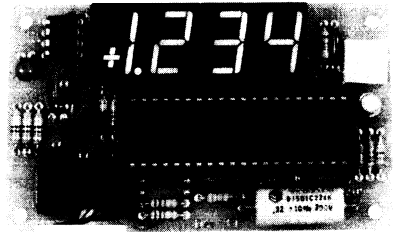
**Operating Temperature Range**..... 0 to +50°C.

**Storage Temperature Range**..... -25°C to +85°C.

ORDERING GUIDE	
MODEL	DESCRIPTION
DBM-20	20-segment LED bar meter (includes one connector)
UPA-5/500	115 VAC to +5V dc power adapter (not included)
58-2073082	Edgeboard connector, 10 pins

**FEATURES**

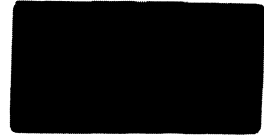
- Compact single board design
- 0.56" bright red 3½ digit display
- Fits into most panel cutouts
- 80 dB CMRR
- True balanced high-impedance inputs
- Logic powered (+5V dc @ 280mA)
- Standard ± 1.999V dc input range; user-installed options set other voltage or current ranges.



**GENERAL DESCRIPTION**

The DM-31 is a low-cost single board DPM. The DPM adapts easily into most test instruments and data acquisition systems.

Its compact dimensions (2" x 3.5" x 0.5") let the DPM be easily installed into most panel cutouts. The DM-31 has provisions for modifying the voltage and current ranges.



**APPLICATIONS**

The DM-31 may be used for any application where a physical or electrical parameter needs to be measured and can be converted with user-supplied external circuits into the basic dc voltage, current or resistance ranges which the DM-31 accepts and displays. Such parameters include temperature, pressure, flow rate, RPM, noise, weight, velocity, frequency and many others. The DM-31 is intended for applications in analytical instruments, test and measurement equipment, data acquisition systems, research and development instrumentation, laboratory analyzers and other devices. Industries using the DM-31 include petrochemical, power utilities, batch and continuous processing, telecommunications, paper, glass, metals and chemical manufacturing, photographic, automotive and medical services.

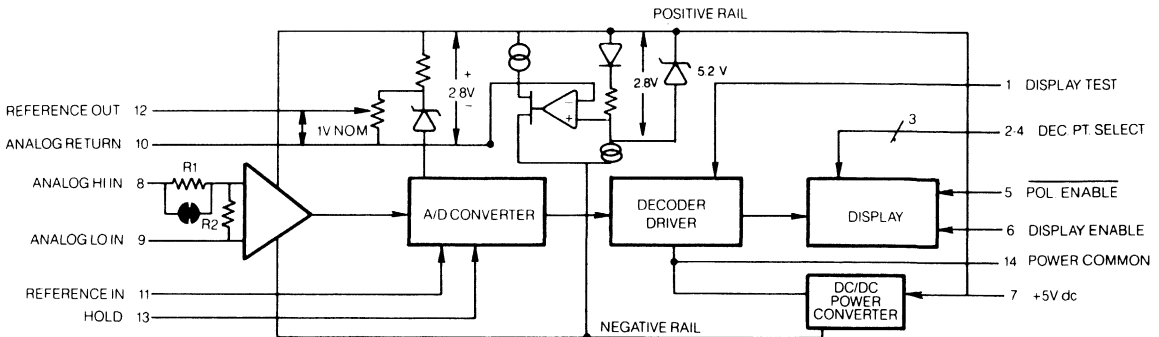
**ORDERING INFORMATION**

**DM-31 - 1**

Model	Description
DM-31-1	Single-Board Digital Panel Meter (including plug connector)

**ACCESSORIES**

Part Number	Description
39-2106705	14-pin dip connector
UPA-5/500	115V AC to +5V dc power adaptor
39-8194910	DM-31 mounting accessory kit



**Simplified Block Diagram of a DM-31**

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25°C, 2V range unless noted)

**ANALOG INPUT**

<b>Full-Scale Input Range</b>	Refer to "FEATURES" Ranges field-modifiable.
<b>Input Impedance</b>	100 Megohms (minimum) 1000 Megohms (typical)
<b>Input Bias Current</b>	5 pA (typical) 50 pA (maximum)
<b>Input Overvoltage</b>	±250V dc, 175V RMS continuous (maximum) ±300V intermittent (maximum)
<b>External Reference Range</b>	±100 mV to ±2V referred to -Vs
<b>Common-Mode Rejection</b>	80 dB (typical), from dc to 60 Hz, with a 1 Kilohm unbalanced input
<b>Common-Mode Voltage Range</b>	Both the inputs must remain within 0.5V dc below the +5V dc supply and 1.0V dc above the -5V dc supply.
<b>Resolution</b>	1 mV
<b>Display Accuracy</b>	Adjustable to ±0.1% of reading, ±1 count
<b>Temperature Drift of Zero</b>	Autozeroed ±1 count over a 0° to +50°C temperature range
<b>Temperature Drift of Gain</b>	±50 ppm of reading/°C (typical) ±100 ppm of reading/°C (maximum)
<b>Sampling Time</b>	83.3 mS (nominal)
<b>Sampling Rate</b>	3 conversions per second. May be rewired for up to 20 conversions per second

**DISPLAY**

<b>Number of Digits</b>	3 decimal digits and most significant "1" digit (3½ digits)
<b>Decimal Points</b>	Selectable using decimal point select signal lines.
<b>Display Type</b>	LED (red, high efficiency)
<b>Display Height</b>	0.56" (14,2 mm)
<b>Overscale</b>	Inputs exceeding the full- scale range display a "+1" MSD with other digits blanked.
<b>Autopolarity</b>	A "+" sign is automatically displayed for positive inputs and a "-" sign for negative inputs. The user may blank the polarity using the POLARITY ENABLE line.
<b>Power Consumption</b>	+5V dc nominal, -1, +2V regulated required. Logic spikes must not exceed 50 mV. Use an external bypass capacitor or other means to attenuate noise. Current at 5V is 280 mA average, 450 mA maximum. Current varies rapidly as digits switch so that unregulated supplies cannot be used. Current is approximately 5 mA with displays blanked.

**PHYSICAL****External Dimensions**

3.5"W x 2"H x 0.5"D (88,9 x 50,8 x 12,7 mm)

**Panel Cutout Dimensions (For Optional Bezel/Filter)**1.156"H x 2.375"W (29,36 x 60,33 mm) Bezel/Panel thickness  
0.040" to 0.062" (1,0 to 1,6 mm) (snug fit at 0.062")**Optional Snap-In Bezel/Filter Dimensions**Outside dimensions: 1.343"H x 2.531"W (34,1 x 64,3 mm)  
Display opening: 0.812"H x 2.0"W (20,6 x 50,8 mm) Front panel  
bezel relief height: 0.062" (1,6 mm)**Mounting Kit**Optional, includes bezel/filter, DIP connector, standoffs, and  
hardware. See Ordering Information.**Weight**

1.2 ounces (35g)

**ENVIRONMENTAL****Altitude**

0 to 15,000 feet (4900m)

**Operating Temperature Range**

32°F to 122°F (0° to 50°C)

**Storage Temperature Range**

-13°F to +185°F (-25°C to 85°C)

**Relative Humidity**

10% to 90% non-condensing

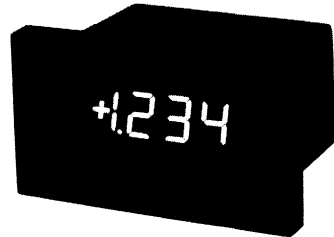


# DM-3100B/DM-3104

## AC Powered, 3 1/2 Digit LED Panel Meters

### FEATURES

- 3 1/2 Digit red LED (DM-3100B) and high brightness red LED (DM-3104) models
- Selectable 115/230VAC powered
- Balanced high-impedance differential inputs
- 80 dB CMRR
- Autozeroing capability
- Allows ratiometric reference for drift correction
- Standard  $\pm 1.999V$  dc input range; user-installed options set other voltage or current ranges.



### GENERAL DESCRIPTION

The DM-3100B and the DM-3104 are 3 1/2 digit LED display devices. The DPM's are dual AC-powered DPM's, easily configurable for a variety of applications. The versatility is due to logic power outputs (+5V dc and -5V dc) provided by the DPM.

The DM-3100B and the DM-3104 use 0.56" and 0.6" display respectively. The displays are clearly visible from many feet away in normal or dim light.

Inputs to the DPM's are balanced differential (80 dB Common Mode Rejection). The meter accurately displays 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 (5 picoamps). Inputs with a source impedance as high as 100 kilohms can be displayed accurately. The input circuitry safely tolerates overvoltages up to  $\pm 250V$  dc (155V RMS). Inputs are sampled and displayed about four times per second.

The DPM's are designed for installations where existing dc supplies are noisy, inaccessible, or overloaded. The meters may be used wherever a voltage, or a unit which can be made proportional to voltage, must be displayed with accuracy and clarity.

The DPM's are supplied in DATEL's standard short depth black polycarbonate case.

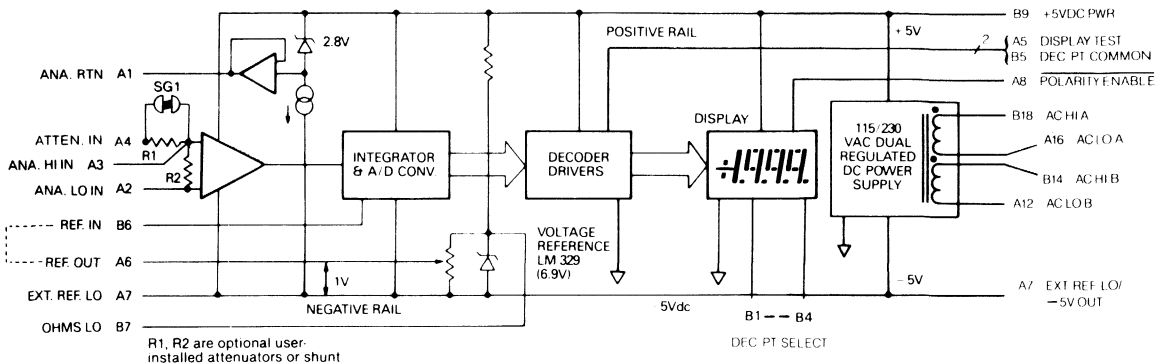
### ORDERING INFORMATION

#### DM-3100B - 1 DM-3104-1

Model	Description
DM-3100B-1	3 1/2 Digit, LED, 115/230 V AC powered (includes one connector)
DM-3104-1	3 1/2 Digit, LED high brightness, 115/230 V AC powered (includes one connector)

#### ACCESSORIES

Part Number	Description
58-2075010	Connector, dual 18-pin, 0.1" centers
UPA-5/500	115V AC to $\pm 5V$ dc (@ 500 mA) power adaptor



Simplified Block Diagram of DM-3104 and DM-3100B

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25°C, 2V range unless noted)

**ANALOG INPUT**

- Full-Scale Input Range** ..... Refer to "FEATURES" Ranges field-modifiable.
- Input Impedance** ..... 100 Megohms (minimum) 1000 Megohms (typical)
- Input Bias Current** ..... 5 pA (typical) 50pA (maximum)
- Input Overvoltage** ..... ±250V dc, 175V RMS continuous (maximum) ±300V intermittent (maximum)
- External Reference Range** ..... ±100 mV to ±2V referred to -Vs (EXT. REF LO)
- Common-Mode Rejection** ..... 80 dB (typical), from dc to 60 Hz, with a 1 Kiloohm unbalanced input
- Common-Mode Voltage Range** ..... Both the inputs must remain within 0.5V dc below the +5V dc supply and 1.0V dc above the -5V dc supply.
- Resolution** ..... 1 mV
- Display Accuracy** ..... Adjustable to ±0.1% of reading, ±1 count
- Temperature Drift of Zero** ..... Autozeroed ±1 count over a 0° to +50 C temperature range
- Temperature Drift of Gain** ..... ±50 ppm of reading/°C (typical) ±100 ppm of reading/°C (maximum)
- Warm-Up Time** ..... 10 minutes (typical)
- Sampling Time** ..... 83.3 mS (nominal)
- Sampling Rate** ..... 3 conversions per second. May be rewired for up to 20 conversions per second

**DISPLAY**

- Number of Digits** ..... 3 decimal digits and most significant "1" digit (3½ digits)
- Brightness** ..... 2400 min, 4800 typ microcandelas per display segment (seven segments per digit)
- Decimal Points** ..... Selectable using decimal point select signal lines.
- Display Type** ..... DM-3100B, red LED DM-3104, High brightness red LED
- Display Height** ..... DM-3100B, 0.56" (14,2 mm) DM-3104, 0.6" (15,2)
- Overscale** ..... The inputs exceeding the full-scale range display a "1" MSD and sign with other digits blanked.
- Autopolarity** ..... A "+" sign is automatically displayed for positive inputs and a "-" sign for negative inputs. The user may blank the polarity using the POLARITY ENABLE line.

**POWER REQUIREMENTS**

**AC Power**

115 or 230 VAC, ±10%, 47 to 440 Hz, 4 watts typical

**dc Power**

+5V ±0.25Vdc @ 250 mA typical, 400 mA maximum and -5V dc @ 5 mA typical, 25 mA maximum. Logic spikes must be less than 50 mV. Bypass supplies externally if necessary.

(Users will normally power from AC-only; dc-only power is optional.)

**CALIBRATION**

A multitrans screwdriver pot adjusts the full scale reading (gain). Zero is automatic (autozeroing). Suggested recalibration in stable conditions is 90 days.

**PHYSICAL**

**External Dimensions**

Short-Depth Case 3.0"W x 2.15"D x 1.76"H (76,2 x 54,6 x 44,7 mm)

**Panel Cutout Dimensions**

1.812"H x 3.062"W (46,0 x 77,7 mm)

**Weight**

5 ounces (142g) approximately

**ENVIRONMENTAL**

**Altitude**

0 to 15,000 feet (4900m)

**Operating Temperature Range**

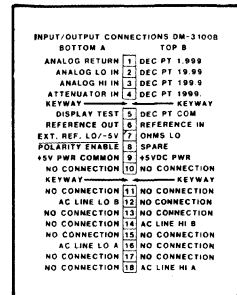
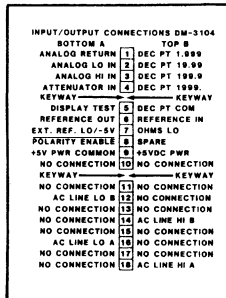
32°F to 122°F (0° to 50°C)

**Storage Temperature Range**

-13°F to +185°F (-25°C to 85°C)

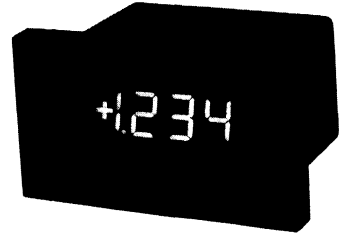
**Relative Humidity**

20% to 80% non-condensing



### FEATURES

- **Balanced differential inputs**
- **1000 M $\Omega$  CMOS high-impedance inputs**
- **3½ Digit 0.56" red LED (DM-3100L) and 0.6" high brightness red LED Models (DM-3103).**
- **Logic Power (+5V dc)**
- **Compact Short-Depth cases**
- **80 dB CMRR**
- **Autozeroing Capability**
- **Standard  $\pm 1.999V$  dc input range; user-installed options set other voltage or current ranges.**
  1. **Accepts shunts for  $\pm 20 \mu A$  to  $\pm 2A$  FS ranges**
  2. **Accepts attenuators for  $\pm 2V$  to  $\pm 200V$  FS ranges**
  3. **Digital ohmmeter, 2K $\Omega$  to 10M $\Omega$  FSR**



### GENERAL DESCRIPTION

The DM-3100L and DM-3103 are 3½ digit Short-Depth versions of the DM-3100N and DM-3101 respectively. The DPM's have bright red LED displays making them easily readable from many feet away. The short-depth cases used are ideally suited for shallow panels. The DPM's are easily field-modifiable for different input voltage and current ranges.

The DPM's accept a DC or slowly-varying input voltage and display that input on front panel numerical indicators. They employ conventional dual-slope A/D converters plus 7 segment display decoder-drivers all in one LSI microcircuit. Since the microcircuits require approximately 10V to power the A/D section, the internal DC/DC converters generate -5V from +5V power input to form bipolar supplies.

The DM-3100L and DM-3103 employ balanced differential inputs. When used with a bridge or transducer input, the DPM's offer high noise immunity. In such configurations the DPM's can accurately measure very small signals in the presence of much larger common mode signals.

The high impedance (1000 megohms) inputs will not load down sensitive input circuits.

The meters can be operated ratiometrically. That is, the DPM's

internal circuits automatically compensate for reference drifts in the supplies of balanced bridge or transducer sensors.

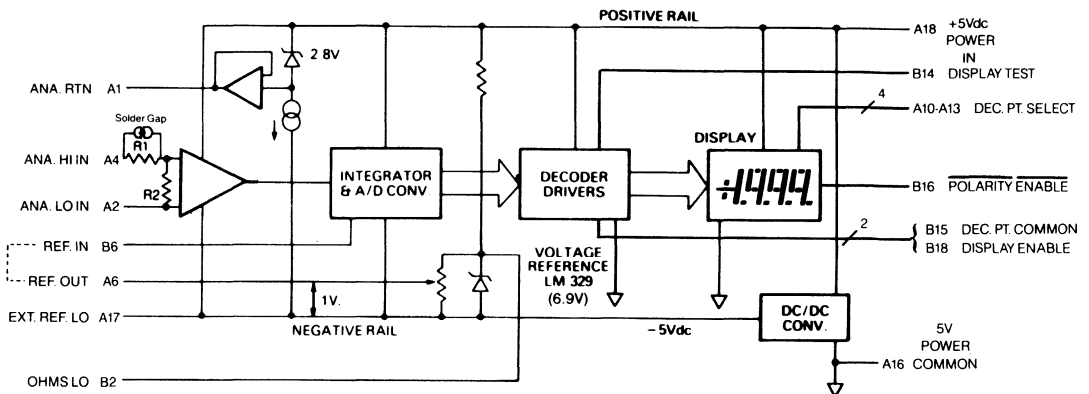
The DPM's find use in analytical instruments, industrial process controllers, portable diagnostic instruments, automatic test equipment, medical instruments, airborne, marine and ground vehicles and data acquisition/data logging systems.

### ORDERING INFORMATION

DM-3100L - 1/DM-3103 - 1	
Model	Description
DM-3100L-1	3 1/2-digit LED DPM in short depth case (includes one connector)
DM-3103-1	High-brightness version of DM-3100L (includes one connector)

### ACCESSORIES

Part Number	Description
58-2075010	Connector, dual 18-pin, 0.1" centers
UPA-5/500	115V AC to $\pm 5V$ dc (@ 500 mA) power adaptor



Simplified Block Diagram of DM-3100L and DM-3103

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25°C, 2V range unless noted)

**ANALOG INPUT**

- Full-Scale Input** ..... Refer to "FEATURES"
- Range** ..... Ranges field-modifiable.
- Input Impedance** ..... 100 Megohms (minimum)  
1000 Megohms (typical)
- Input Bias Current** ..... 5 pA (typical) 50 pA  
(maximum)
- Input Overvoltage** ..... ±250V dc, 175V RMS  
continuous (maximum)  
±300V intermittent  
(maximum)
- External Reference Range** ..... ±100 mV to ±2V referred to  
-Vs (EXT. REF LO)
- Common-Mode Rejection** ..... 80 dB (typical, from dc to 60  
Hz, with a 1 Kilohm  
unbalanced input)
- Common-Mode Voltage Range** ..... Both the inputs must  
remain within 0.5V dc below  
+5V dc supply and 1.0V dc  
above -5V dc supply.
- Resolution** ..... 1 mV
- Display Accuracy** ..... @Adjustable to ±0.1% of  
reading, ±1 count
- Temperature Drift of Zero** ..... Autozeroed ±1 count over 0  
to +50°C temperature range
- Temperature Drift of Gain** ..... ± 50 ppm of  
reading/°C (typical)  
±100 ppm of reading/°C  
(maximum)
- Warm-Up Time** ..... 10 minutes (typical)
- Sampling Time** ..... 83.3 mS (nominal)
- Sampling Rate** ..... 3 conversions per second.  
May be rewired for up to 20  
conversions per second

**DISPLAY**

- Number of Digits** ..... 3 decimal digits and most  
significant "1" digit (3½ digits)
- Decimal Points** ..... Selectable using decimal  
point select signal lines.
- Display Type** ..... DM-3100L, red LED  
DM-3103, High brightness red  
LED
- Display Height** ..... DM-3100L 0.56" (14.2 mm)  
DM-3103 0.6" (15.2 mm)
- Brightness (DM-3103)** ..... 2400 minimum, 4800 typical  
microcandelas per display  
segment (7 segments per  
digit)
- Overscale** ..... The inputs exceeding the full-  
scale range blank the display  
leaving a "1" MSD and sign.
- Autopolarity** ..... A "+" sign is automatically  
displayed for positive inputs  
and a "-" sign for negative  
inputs. The user may blank  
the polarity using the  
POLARITY ENABLE line.

**POWER REQUIREMENTS**

External +5, ±0.25V dc regulated required at 280 mA typical, 450 mA maximum. Logic spikes must not exceed 50 mV. Power current varies rapidly so that unregulated supplies cannot be used.

**CALIBRATION**

A multitrn screwdriver pot adjusts the full scale reading (gain). Zero is automatic (autozeroing). Suggested recalibration in stable conditions is 90 days.

**PHYSICAL**

**External Dimensions Short-Depth Case**

3.0"W x 2.15"D x 1.76"H (76.2 x 54.6 x 44.7 mm)

**Panel Cutout**

1.812"H x 3.062"W (46.0 x 77.7 mm)

**Weight**

5 ounce (142g) approximately

**ENVIRONMENTAL**

**Altitude**

0 to 15,000 feet (4900m)

**Operating Temperature Range**

32°F to 122°F (0° to 50°C)

**Storage Temperature Range**

-13°F to +185°F (-25°C to 85°C)

**Relative Humidity**

20% to 80% non-condensing

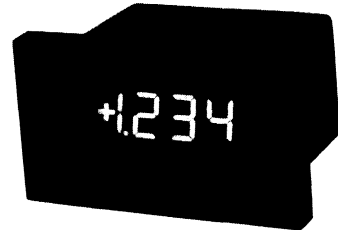
INPUT/OUTPUT CONNECTION DM-3100L		
BOTTOM A		TOP B
ANALOG RETURN	1	NO CONNECTION
ANALOG LO INPUT	2	OHMS LO
NO CONNECTION	3	NO CONNECTION
ANALOG HI INPUT	4	NO CONNECTION
NO CONNECTION	5	NO CONNECTION
REFERENCE OUT	6	REFERENCE IN
NO CONNECTION	7	NO CONNECTION
NO CONNECTION	8	NO CONNECTION
NO CONNECTION	9	NO CONNECTION
DEC PT 1 999	10	NO CONNECTION
DEC PT 19 99	11	NO CONNECTION
DEC PT 199 9	12	NO CONNECTION
DEC PT 1999	13	NO CONNECTION
NO CONNECTION	14	DISPLAY TEST
NO CONNECTION	15	DEC PT COM
PWR COMMON	16	POLARITY ENABLE
EXT. REF. LO	17	NO CONNECTION
+5VDC PWR IN	18	DISPLAY ENABLE
NOTE: REFERENCE IS BIASED AGAINST NEGATIVE RAIL (EXT. REF. LO)		

INPUT/OUTPUT CONNECTION DM-3103		
BOTTOM A		TOP B
ANALOG RETURN	1	NO CONNECTION
ANALOG LO INPUT	2	OHMS LO
NO CONNECTION	3	NO CONNECTION
ANALOG HI INPUT	4	NO CONNECTION
NO CONNECTION	5	NO CONNECTION
REFERENCE OUT	6	REFERENCE IN
NO CONNECTION	7	NO CONNECTION
NO CONNECTION	8	NO CONNECTION
NO CONNECTION	9	NO CONNECTION
DEC PT 1 999	10	NO CONNECTION
DEC PT 19 99	11	NO CONNECTION
DEC PT 199 9	12	NO CONNECTION
DEC PT 1999	13	NO CONNECTION
NO CONNECTION	14	DISPLAY TEST
NO CONNECTION	15	DEC PT COM
PWR COMMON	16	POLARITY ENABLE
EXT. REF. LO	17	NO CONNECTION
+5VDC PWR IN	18	DISPLAY ENABLE
NOTE: REFERENCE IS BIASED AGAINST NEGATIVE RAIL (EXT. REF. LO)		



## FEATURES

- 3½ Digits LED display, +5V dc-powered
- Extended Operating Temperature Range (-46°C to +49°C)
- Designed to meet Military Standards:
  - Vibration Testing per MIL-STD-202
  - Humidity Testing per MIL-STD-202
  - Inspected per MIL-STD-105
- Balanced Different Inputs
- Withstands 3 shocks @ 25 g's for 11ms Vertical Axis
- Standard ±1.999 Vdc input range;



## GENERAL DESCRIPTION

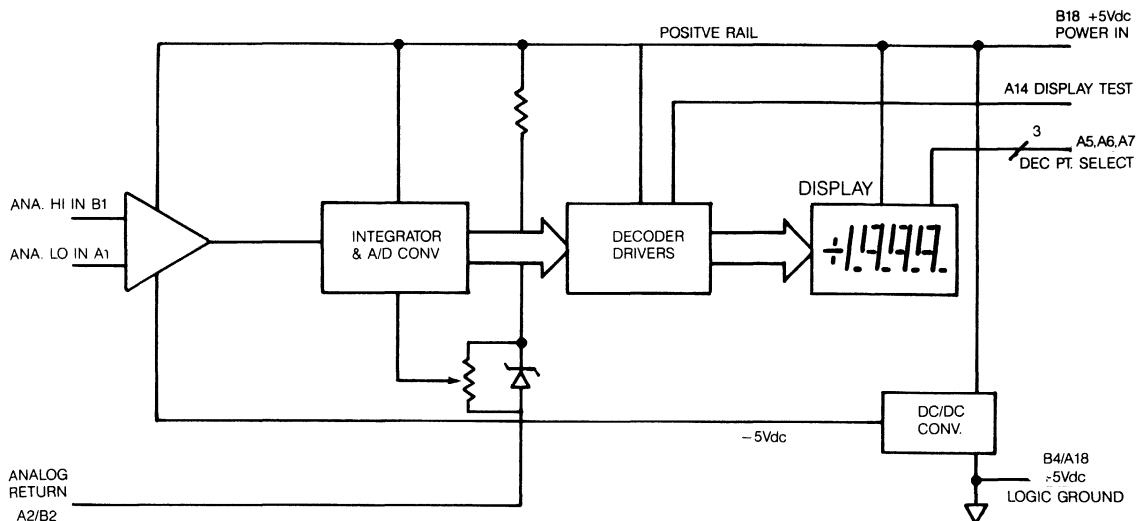
The DM-3100MIL is a 3½ Digit, LED Display, +5V dc-powered digital panel meter. The DPM is designed to operate over an extended temperature range of -46°C to +49°C and conform to military standards. The DM-3100MIL meets and exceeds vibration and humidity testing per MIL-STD-202. It will also withstand shock testing (3 shocks @ 25 g's for 11ms vertical axis). The DPM successfully meets and exceeds the military specifications by using all hermetically sealed components and conformally coating the circuit boards. Its compact design lets this DPM fit into a short-depth case. The design and rigorous testing permits using the DM-3100MIL in portable test equipment for field use, ground vehicles, submerged vessels and aircraft. The DM-3100MIL offers a standard +/-1.999 Vdc input range; a +/-199.9 mV range is available to OEM quantity customers.

Overall, the DM-3100MIL is a highly reliable DPM designed for the rugged military environment.

## ORDERING INFORMATION

### DM-3100MIL-1

Model	Description
DM-3100MIL-1	Ruggedized, 3½ digit meter
ACCESSORIES	
Part Number	Description
58-2075010	Connector, dual 18-pin, 0.1" centers (one included with each meter)
UPA-5/500	115V AC to +5V dc (@ 500 mA) adaptor



Simplified Block Diagram of DM-3100MIL

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25°C, 2V range unless noted)

**ANALOG INPUT**

- Full-Scale Input Range** ..... Refer to "FEATURES"
- Input Impedance** ..... 100 Megohms (minimum)  
1000 Megohms (typical)
- Input Bias Current** ..... 5 pA (typical)  
50 pA (maximum)
- Input Overvoltage** ..... ±250V dc, 175V RMS  
continuous (maximum).  
±300V intermittent  
(maximum).
- Common-Mode Rejection** ..... 80 dB (typical), from dc  
to 60 Hz, with a 1  
Kilohm unbalanced input.
- Common-Mode Voltage Range** ..... Both the inputs must  
remain within 0.5V dc  
below the +5V dc supply  
and 1.0V dc above the  
-5V dc supply.
- Resolution** ..... 1 mV
- Display Accuracy** ..... Adjustable to ±0.1% of  
reading, ±1 count.
- Temperature Drift of Zero** ..... Autozeroed ±1 count over  
-46° to +49°C  
temperature range.
- Temperature Drift of Gain** ..... ±50 ppm of reading/°C  
(typical).  
±100 ppm of reading/°C  
(maximum).
- Warm-Up Time** ..... 10 minutes (typical)
- Sampling Time** ..... 83.3 mS (nominal)
- Sampling Rate** ..... 3 conversions per second.  
May be rewired up to 20  
conversions per second.

**DISPLAY**

- Number of Digits** ..... 3 decimal digits and  
most significant "1" digit  
(3½ digits).
- Decimal Points** ..... Selectable using decimal  
point select signal lines.
- Display Type** ..... Red LED
- Display Height** ..... .3"
- Overscale** ..... Inputs exceeding the full-  
scale range blank the display  
leaving a "1" MSD and sign.
- Autopolarity** ..... A "+" sign is automatically  
displayed for positive inputs  
and a "-" sign for negative  
inputs. The user may blank the  
polarity using the  
POLARITY ENABLE line.

**POWER REQUIREMENTS**

External +5 dc, ±0.25V dc regulated required at 280 mA typical, 450 mA maximum. Logic spikes must not exceed 50 mV. Power current varies rapidly so that unregulated supplies cannot be used.

**CALIBRATION**

A multiturn screwdriver pot adjusts the full scale reading (gain). Zero is automatic (autozeroing). Suggested recalibration in stable conditions is 90 days.

**PHYSICAL**

**External Dimensions**

Short-Depth Case  
3.0"W x 2.15"D x 1.76"H (76,2 x 54,6 x 44,7 mm)

**Panel Cutout Dimensions**

1.812"H x 3.062"W (46,0 x 77,7 mm)

**Weight**

5 ounces (142g) approximately

**ENVIRONMENTAL**

**Altitude**

0 to 50,000 feet

**Operating Temperature Range**

-51°F to 88°F (-46°C to 49°C)

**Storage Temperature Range**

-124°F to +185°F (-69°C to +85°C)

**Relative Humidity**

MIL-STD-202, Method 106D (98% relative humidity)

**Vibration**

MIL-STD-202, Method 204C  
Section 2.2, (Condition A) (10G at 10 to 500Hz)

**Shock**

3 shocks @ 25 g's for 11ms Vertical Axis

**Marking**

MIL-STD-130

**Marking Permanency**

MIL-STD-202, Method 215

**Inspection**

MIL-STD-105

INPUT/OUTPUT CONNECTIONS DM-3100MIL		
BOTTOM A		TOP B
INPUT SIGNAL LO	1	INPUT SIGNAL HI
ANALOG RETURN	2	ANALOG RETURN
NC	3	NC
NC	4	PWR COMMON
DEC PT 100	5	NC
DEC PT 10	6	NC
DEC PT 1	7	NC
NC	8	NC
NC	9	NC
NC	10	NC
NC	11	NC
NC	12	NC
NC	13	NC
DISPLAY TEST	14	NC
NC	15	NC
NC	16	NC
NC	17	NC
PWR COMMON	18	+5V DC INPUT

### FEATURES

- **Balanced differential inputs**
- **1000 MΩ CMOS high-impedance inputs**
- **Compact low-profile case**
- **Logic powered (+5V dc)**
- **Internal provision for an offset pot for various applications**
- **80 dB CMRR**
- **Standard ± 1.999V dc input range; user-installed options set other voltage or current ranges.**
- **Autozeroing capability**



### GENERAL DESCRIPTION

The DM-3100N and its high-brightness equivalent, the DM3101 are 3 1/2 digit Solid State devices using red LED displays. The bright red LED displays make them easily readable from many feet away. Packaged in compact low profile cases, these DPM's have provisions for user-installed resistors and offset potentiometers.

The autozeroing capability further enhances the versatility of the meter. A pot can be internally installed so that an offset can be obtained with a zero input to the meter, or a zero reading with an offset input.

The DPM's accept a DC or slowly-varying input voltage and display that input on front panel numerical indicators. They employ conventional dual-slope A/D converters plus 7 segment display decoder-drivers all in one LSI microcircuit. Since the microcircuits require approximately 10V to power the A/D section, the internal DC/DC converters generate -5V from +5V power input to form bipolar supplies.

Another feature of these DPM's is that a balanced differential input is used. When used with bridge or transducer inputs, it offers high noise immunity and can accurately measure very small signals in the presence of much larger common mode signals.

A very noteworthy feature of the meters is that they can be operated ratiometrically. This means that internal circuits in the DPM's automatically compensate for reference drifts in the supplies of balanced bridge or transducer sensors.

These DPM's find use in analytical instruments, industrial process controllers, portable diagnostic instruments, automatic test equipment, medical and patient monitoring instruments, airborne, marine and ground vehicles and data acquisition/ data logging systems.

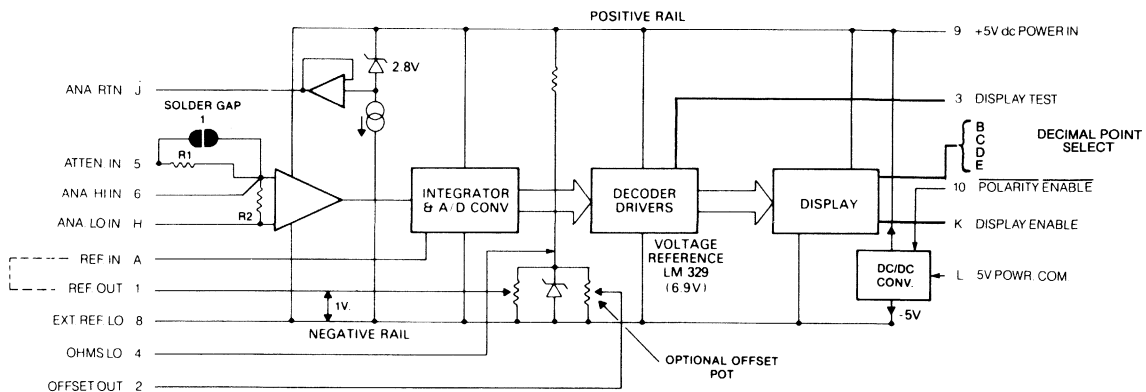
### ORDERING INFORMATION

#### DM-3100N - 1/DM-3101 - 1

Model	Description
DM-3100N-1	3 1/2 Digit LED DPM in low-profile case (includes one connector)
DM-3101-1	High-brightness version of DM-3100N (includes one connector)

#### ACCESSORIES

Part Number	Description
58-2073082	Dual 10-pin, 0.156" centers connector
TP-50K	Offset pot
UPA-5/500	115V AC to ±5V dc (@ 500 mA) power adaptor



**Simplified Block Diagram of DM-3100N and DM-3101**

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25°C, 2V range unless noted)

**ANALOG INPUT**

<b>Full-Scale Input Range</b> .....	Refer to "FEATURES" Ranges field-modifiable.
<b>Input Impedance</b> .....	100 Megohms (minimum) 1000 Megohms (typical)
<b>Input Bias Current</b> .....	5 pA (typical) 50 pA (maximum)
<b>Input Overvoltage</b> .....	±250V dc, 175V RMS continuous (maximum) ±300V intermittent (maximum)
<b>External Reference Range</b> .....	±100 mV to ±2V referred to -Vs (EXT. REF LO)
<b>Common-Mode Rejection</b> .....	80 dB (typical), from dc to 60 Hz, with 1 Kilohm unbalance
<b>Common-Mode Voltage Range</b> .....	Both the inputs must remain within 0.5V dc below +5V dc supply and 1.0V dc above -5V dc supply
<b>Resolution</b> .....	1 mV
<b>Display Accuracy</b> .....	Adjustable to ±0.1% of reading, ±1 count
<b>Temperature Drift</b> .....	Autozeroed ±1 count over 0 to +50°C temperature range
<b>Temperature Drift of Gain</b> .....	±50 ppm of reading/°C (typical) ±100 ppm of reading/°C (maximum)
<b>Warm-Up Time</b> .....	10 minute (typical)
<b>Sampling Time</b> .....	83.3 mS (nominal)
<b>Sampling Rate</b> .....	3 conversions per second. May be required up to 20 conversions per second.

**DISPLAY**

<b>Number of Digits</b> .....	3 decimal digits and most significant "1" digit (3½ digits)
<b>Decimal Points</b> .....	Selectable using decimal point select signal lines.
<b>Display Type</b> .....	DM-3100N, Red LED DM-3101, High brightness Red LED
<b>Display Height</b> .....	DM-3100N, 0.56" (14,2 mm) DM-3101, 0.6" (15,2 mm)
<b>Overscale</b> .....	The inputs exceeding the full- scale range blank the display leaving a "1" MSD and sign.
<b>Autopolarity</b> .....	A "+" sign is automatically displayed for positive inputs and a "-" sign for negative inputs. The user may blank the polarity using the <u>POLARITY ENABLE</u> line.

**POWER REQUIREMENTS**

External +5, ±0.25V dc regulated required at 280 mA typical, 450 mA max. Logic spikes must not exceed 50 mV. Power current varies rapidly so that unregulated supplies cannot be used.

**CALIBRATION**

A multiturn screwdriver pot adjusts the full scale reading (gain). Zero is automatic (autozeroing). Suggested recalibration in stable conditions is 90 days.

**PHYSICAL**

**External Dimensions**

Low-Profile Case 2.53"W x 3.34"D x 0.94"H (64,3 x 84,8 x 23,8 mm)

**Panel Cutout Dimensions**

2.56"W x 0.97"H (minimum) (65,1 x 24,6 mm)

**Mounting Method**

Refer to end of this section.

**Weight**

5 ounces (142g) approximately

**ENVIRONMENTAL**

**Altitude**

0 to 15,000 feet (4900m)

**Operating Temperature Range**

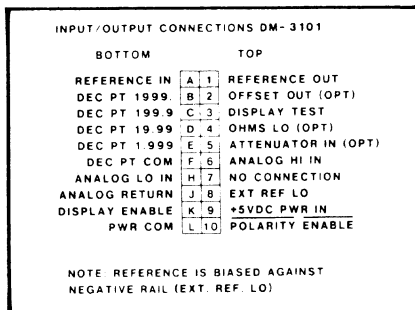
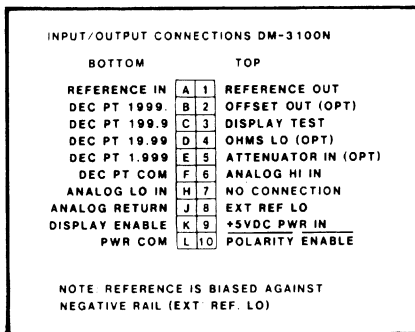
32°F to 122°F (0° to 50°C)

**Storage Temperature Range**

-13°F to +185°F (-25°C to 85°C)

**Relative Humidity**

20% to 80% non-condensing

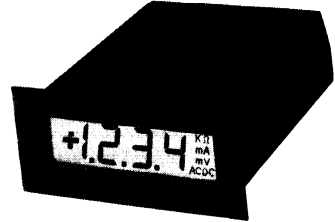




# DM-3100U1 Micropowered 3½ Digit LCD Panel Meters

## FEATURES

- Ultra-low power consumption
- .5" high 3½ digits LCD readout
- 5V or 9 to 15V dc-powered
- Internal ratiometric reference for drift correction
- Selectable unit descriptors: A, mA, V, mV, Ω, KΩ, AC, or DC
- Balanced differential inputs with 5 pA bias currents
- Autozeroing with 80 db CMR noise rejection
- User-configurable to accept 4 to 20 mA inputs
- Standard ±1.999V dc input range; user-installed options set other voltage or current ranges.
  1. Offset pot for 4-20 mA and other applications
  2. Accepts shunts for ±20 μA to ±2A FS ranges
  3. Accepts attenuators for ±2V to ±200V FS ranges
  4. Digital ohmmeter, 2KΩ to 10MΩ FSR



## GENERAL DESCRIPTION

The DM-3100U1 is a 3½ digit, LCD-type DPM that uses very little power and can be powered by +4V to +15V dc sources. The 0.5" high numeric display is visible under ambient room light from many feet away. This device is packaged in a low-profile case, allowing a higher packing density on the final product's panel. Besides measuring dc voltages and current, unit descriptors (A, mA, V, mV, Ω, KΩ, AC, and DC) indicate what is being measured.

The versatility of this meter is further enhanced by its autozeroing capabilities. If the customer desires, an offset pot can be internally installed so that a desired reading can be obtained with a zero output to the meter.

This DPM accepts a dc or slowly varying input voltage and displays that input on front panel numerical indicators. It employs a conventional dual-slope A/D converter plus 7 segment display decoders/drivers all in one LSI microcircuit. Since this microcircuit requires approximately 9V to power the A/D section, an internal dc/dc converter generates -5V from +5V power input. Together these two voltage sources form a bipolar power supply to power the A/D converter. The DM-3100U1 may also be powered directly from a single 9V battery @ 3 mA without using the dc/dc converter.

Another feature of the DM-3100U1 is that it employs a balanced differential input. When used with a bridge or

transducer input, it offers high noise immunity and can accurately measure very small signals in the presence of much larger common mode noise. Another characteristic of this balanced differential input is that it will not load down sensitive input circuits due to its high input impedance of 1000 megohms, and low 5 pA bias current.

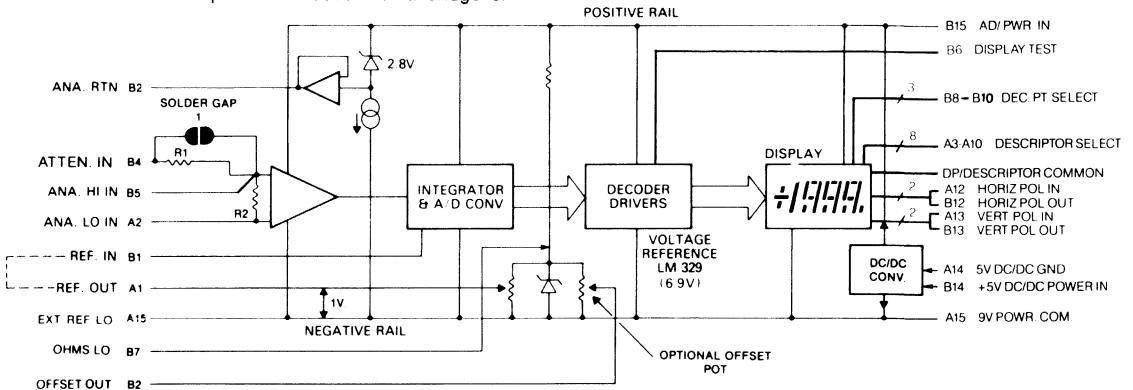
A very noteworthy feature of this meter is that it can be operated ratiometrically. This means that it has internal circuits that can automatically compensate for reference drifts in the supplies of balanced bridge or transducer sensors and still give accurate readings.

## ORDERING INFORMATION DM-3100U1 - 1

Model	Description
DM-3100U1-1	3 1/2-digit micropowered LCD DPM with descriptors (Includes one connector)

### ACCESSORIES

Part Number	Description
58-2073083	Connector, dual 15-pin, 0.1" centers
TP-50K	Offset pot
UPA-5/500	Power Supply



Simplified Block Diagram of DM-3100U1

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25°C, 2V range unless noted)

**ANALOG INPUT**

- Full Scale Input Range** ..... -1.999V dc to +1.999V dc  
Input pad area will accept user-installed range change
- Input Impedance** ..... 100 Megohms, minimum
- Input Bias Current** ..... 5 pA typical, 50 pA maximum
- Input Overvoltage** ..... ±250 volts dc 175 VRMS continuous max.  
±300 Volts intermittent max.
- External Ref. Range** .... +100 mV to +2V, referred to -Vs
- Common Mode Rejection** ..... 80 dB, dc to 60 Hz, 1 Kiloohm unbalance
- Common Mode Voltage Range** ..... Within +Vs-0.5V to -Vs+1.0V, where +Vs is the positive rail (Pin B15) and -Vs is the negative rail (Pin A15) -Vs is approximately equal to -5V below PWR. COM.
- Resolution Displayed Accuracy** ..... 1mV  
Adjustable to ± of reading, ± count
- Temperature Drift of Zero** ..... Autozeroed ±1 count over 0 to +50°C
- Temperature Drift of Gain** ..... ±50 ppm of Reading/°C typ.  
±100 ppm of Reading/°C max
- Ramp-up Time** ..... (integration Period)  
83.3 mS
- Sampling Rate** ..... Factory set at 3 conversions per second. May be rewired up to 20 conversions/second

**DISPLAY**

- Number of Digits** ..... 3 decimal digits and most significant "1" digit (3½ digits)
- Decimal Points** ..... Selectable decimal points are included for scale multipliers
- Display Type** ..... Field effect liquid crystal displays (LCD) requiring room light for viewing. Black digits against a light background
- Display Height Overscale** ..... 0.5 inches (12.7 mm)  
Inputs exceeding the full scale range blank the display, leaving a "1" MSD and sign
- Autopolarity** ..... A minus sign is automatically displayed for negative inputs, and may also be blanked
- Descriptors** ..... K, Ω, mA, mV, AC, and DC  
This field of function labels is positioned to the right of the decimal digits. Individual unit descriptors may be selected for display.

**POWER CONNECTIONS**

**A/D Power In (Pin B15)**

Connect +9 to +15V dc source to this pin, referred to 9V dc Power Common (PIN A15). When using a +5V dc power source, connect this pin to pin B14.

**+5V dc Power In (PIN B14)**

Connect this pin to the +5V dc power source, referred to +5V dc Power Ground (PIN A14)

**POWER REQUIREMENTS**

5V between B14/B15 and A14; 12mA typ., 15mA max. OR 9 to 15 V dc between B15 and A15; 9V, 9 mA; 15V, 20 mA. max

**CALIBRATION**

A multiturn screwdriver pot adjusts the full scale reading (gain). Zero is automatic (autozeroing). Suggested recalibration is 90 days.

**PHYSICAL-ENVIRONMENTAL**

- Outline Dimensions**  
2.53"W x 3.25"D x 0.94"H (64.3 x 82.5 x 23.8 mm)
- Cutout Dimensions**  
2.56"W x 0.97"H min. (65.1 x 24.6 mm)
- Mounting Method**  
See Mounting Section
- Weight**  
Approximately 5 ounces (142g)

**TEMPERATURE RANGE**

- Operating**  
0 to +50°C
- Storage**  
0°C to +55°C
- Altitude**  
0 to 15,000 feet (4900m)
- Relative Humidity**  
20% to 80% non-condensing

**I/O SIGNAL FEATURES**

Besides the common I/O Signals defined elsewhere, this device also has some important I/O features:

**Reference In/Out (Pins B1/A1)**

Normally, REF. IN and REF. OUT should be jumpered together. An external floating source referred to EXT.REF. LO (Pin A15) may be substituted for ratiometric operations.

**Vertical Polarity In (Pin A13)**

**Vertical Polarity Out (Pin B13)**

For reverse sensing applications, VERT. POL. OUT may be jumpered to HORIZ. POL. IN (no other connections). This will display a minus sign with positive inputs and no sign (implied positive) with negative inputs.

See Backplane Out

**Backplane Out (Pin A11)**

Connect all unused Polarity, Decimal Points and Descriptors to Backplane Out.

INPUT/OUTPUT CONNECTIONS DM-3100U1	
BOTTOM A	TOP B
REFERENCE OUT	1 REFERENCE IN
ANALOG LO IN	2 ANALOG RETURN
mA DSCRPT IN	3 OFFSET OUT (OPT)
KΩ DSCRPT IN	4 ATTENUATOR HI IN (OPT)
KΩ DSCRPT IN	5 ANALOG HI IN
mA DSCRPT IN	6 DISPLAY TEST
mV DSCRPT IN	7 OHMS LO
DC DSCRPT IN	8 DEC PT 199.9
AC DSCRPT IN	9 DEC PT 19.99
mV DSCRPT IN	10 DEC PT 1.999
BACKPLANE OUT	11 OP/DSCRPT COM
HORIZ POL IN	12 HORIZ POL OUT
VERT POL IN	13 VERT POL OUT
+5V DC DC GND	14 +5V DC/DC PWR IN
+9V PWR COM/EXT.REF.LO	15 A/D PWR IN

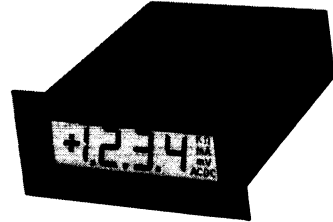
NOTE: REFERENCE IS BIASED AGAINST NEGATIVE RAIL (EXT. REF. LO).



# DM-3100U2,-U3 AC/DC-powered 3½ Digit LCD Panel Meters

## FEATURES

- **Dual powered:** +9 to +15V dc/115VAC (DM-3100U2), +9 to 15V dc/230VAC (DM-3100U3)
- **Selectable unit descriptors:** A, mA, V, mA, Ω, kΩ AC or dc
- **Balanced high-impedance differential inputs**
- **80dB CMRR**
- **Autozeroing capability**
- **Internal provision for an offset potentiometer for various applications**
- **Standard ± 1.9999V dc input range; user-installed options set other voltage or current ranges.**
  1. **Offset pot for 4-20 mA and other applications**
  2. **Accepts shunts for ± 20 μA to ± 2A FS ranges**
  3. **Accepts attenuators for ± 2V to ± 200V FS ranges**
  4. **Digital ohmmeter, 2KΩ to 10MΩ FSR**



## GENERAL DESCRIPTION

The DM-3100U2 and DM-3100U3 are 3½ digit LCD display devices. The DPM's operate with either AC or +9 to +15V dc voltages. The DM-3100U2 uses 115V AC at 47 to 440Hz. The DM-3100U3 uses 230V AC at 47 to 440Hz. The input voltage and current ranges are easily field-modifiable.

Both models use DATEL's low profile DPM case. The input section is balanced differential for excellent noise rejection and uses a high-impedance (1000 MΩ) CMOS front end with low 5 pA bias currents.

Both meters are autozeroed and accept external ratiometric reference inputs to reduce drift errors in instrumentation systems.

The LCD display on both meters contains unit descriptors (A, mA, V, mV, Ω, KΩ, AC, dc) which are pin-programmable for dedicated VOM and DVM applications.

The AC supply in both meters produces an additional filtered dc output of approximately +12V dc @ 5 mA for customer use. A suggested application is to charge standby NiCad batteries. Since this power output pin is also used for power input when

dc-powered, the NiCads may be left continuously connected so the meter will continue operating if there is an AC power failure.

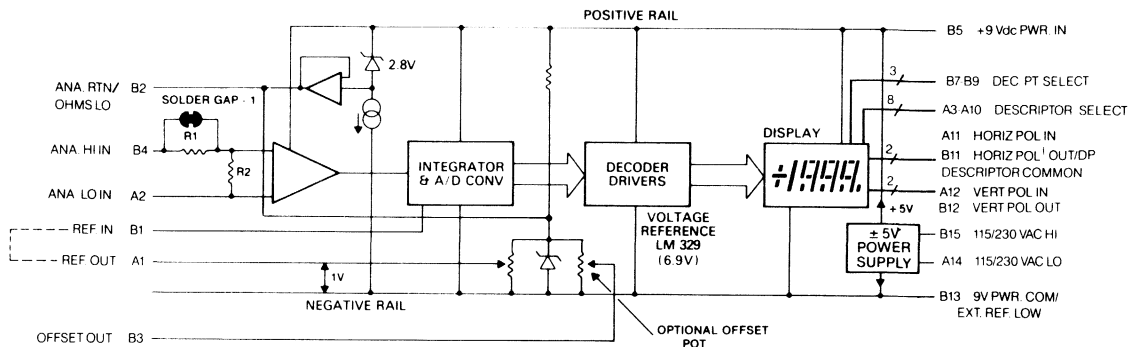
## ORDERING INFORMATION

### DM-3100U2 - 1/DM-3100U3 - 1

Model	Description
DM-3100U2-1	3 1/2-Digit, LCD Digital panel meter, 115V AC or +9 to +15V dc powered (one connector included)
DM-3100U3-1	3 1/2-Digit, LCD Digital panel meter, 230V AC or +9 to +15V dc powered (one connector included)

## ACCESSORIES

Part Number	Description
58-2073083	Connector dual 15-pin, 0.1" centers
TP-50K	Offset pot



Simplified Block Diagram of DM-3100U2 and DM-3100U3

**FUNCTIONAL SPECIFICATIONS both models**

(Typical at +25°C, unless noted)

**ANALOG INPUT**

- Full-Scale Input Range** ..... Refer to "FEATURES"  
Ranges field-modifiable.
- Input Impedance** ..... 100 Megohms (minimum)  
1000 Megohms (typical)
- Input Bias Current** ..... 5 pA (typical) 50 pA (maximum)
- Input Overvoltage** ..... ±250V dc, 175V RMS  
continuous (maximum)  
±300V dc intermittent (maximum)
- External Reference Range** ..... ±100 mV to ±2V referred  
to -Vs
- Common-Mode Rejection** ..... 80 dB (typical),  
from dc to 60 Hz, with a 1  
Kilohm unbalanced input
- Common-Mode Voltage Range** ..... Both the inputs must  
remain within 0.5V dc below  
the +5V dc supply and 1.0V dc  
above the -5V dc supply.
- Resolution** ..... 1 mV
- Display Accuracy** ..... Adjustable to ±0.1% of  
reading, +/-1 count
- Temperature Drift of Zero** ..... Autozeroed ±1 count  
over a 0°C to +50°C  
temperature range
- Temperature Drift of Gain** ..... ±50 ppm of reading/°C  
(typical) ±100 ppm of  
reading/°C (maximum)
- Sampling Time** ..... 83.3 mS (nominal)
- Sampling Rate** ..... 3 conversions per second

**DISPLAY**

- Number of Digits** ..... 3 decimal digits and most  
significant "1" digit (3½ digits)
- Decimal Points** ..... Selectable using decimal  
point select signal lines.
- Display Type** ..... Field-effect liquid crystal  
display (LCD)
- Display Height** ..... 0.5" (12,7mm)
- Overscale** ..... Inputs exceeding the full-  
scale range display "+1"  
MSD with zeroes blanked.
- Autopolarity** ..... A "+" sign is automatically dis-  
played for positive inputs and  
a "-" sign for negative inputs.  
The user may blank the polarity.
- Descriptors** ..... Ω, kΩ, mA, mV, AC, dc, A, V.  
This field of function labels is posi-  
tioned to the right of the decimal  
digits. Individual unit descriptors  
may be selected for display.

**POWER REQUIREMENTS**

- AC**  
¼ watt, maximum, 115 or 230V AC.
- dc**  
+9 to +15V dc, filtered @ 9 mA typical, 20 mA maximum. Logic  
spikes must be less than 50 mV.

**CALIBRATION**

A multiturn screwdriver pot adjusts the full scale reading (gain). Zero is automatic (autozeroing). Suggested recalibration in stable conditions is 90 days.

**PHYSICAL**

- External Dimensions**  
2.53"W x 3.25"D x 0.94"H (64,3 x 82,5 x 23,8mm)
- Panel Cutout Dimensions**  
2.56"W x 0.97"H (65,1 x 24,mm)
- Mounting Method**  
Refer to end of this section.
- Weight**  
5 ounces (142g) approximately

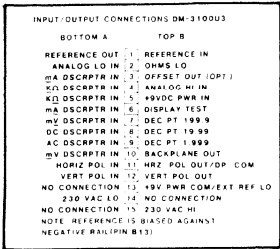
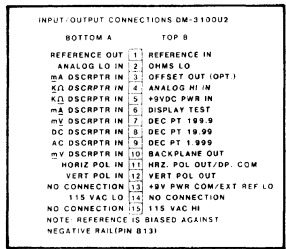
**ENVIRONMENTAL**

- Altitude**  
0 to 15,000 feet (4900m)
- Operating Temperature Range**  
+32°F to 122°F (0° to 50°C)
- Storage Temperature Range**  
+32°F to 131°F (0° to 55°C)
- Relative Humidity**  
20% to 80% non-condensing

**I/O SIGNAL FEATURES**

- Besides the common I/O Signals defined elsewhere, this device also has some important I/O features.
- Horizontal Polarity In (Pin A11)**  
**Horizontal Polarity Out (Pin B11)**  
Normally these inputs are jumpered together to continuously display the horizontal portion of the polarity sign.
- Vertical Polarity In (Pin A12)**  
**Vertical Polarity Out (Pin B12)**  
Jumper these inputs when HORIZ. POL. is jumpered for automatic sign display with bipolar inputs. For reverse sensing applications VERT. POL. OUT may be jumpered to HORIZ. POL. IN (no other connections). This will display a minus sign with positive inputs and no sign (implied positive) with negative inputs. See BACKPLANE OUT.
- Backplane Out (Pin B10)**  
Connect all unused polarity, decimal points and descriptor pins to BACKPLANE OUT.

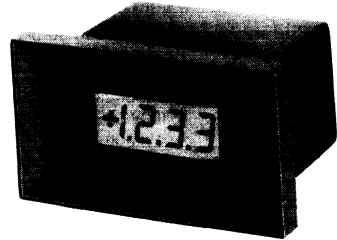
**Descriptors**  
Electrical units are displayed by connecting their respective pins to DESCRIPTOR COMMON Pin B11.





### FEATURES

- Consumes very low power
- Dual dc-voltage power in (+5V dc or +9 to +15V dc)
- Balanced high-impedance differential inputs
- 80 dB CMRR
- Autozeroing capability
- Standard  $\pm 1.999V$  dc input range; user-installed options set other voltage or current ranges.
  1. Accepts shunts for  $\pm 20 \mu A$  to  $\pm 2A$  FS ranges
  2. Accepts attenuators for  $\pm 2V$  to  $\pm 200V$  FS ranges
  3. Digital ohmmeter,  $200\Omega$  to  $10M\Omega$  FSR



### GENERAL DESCRIPTION

The DM-3100X is a 3½ digit LCD display device. The DPM consumes typically less than 0.03 watts. Powered by a range of +4V dc to +15V dc the DM-3100X may be configured to measure different voltage, current and resistance ranges. The DPM is contained in a short-depth case.

The versatility of this meter is further enhanced by its autozeroing circuits which eliminate zero drift.

This DPM accepts a dc or slowly varying input voltage and displays that input on front panel numerical indicators. It employs a conventional dual-slope A/D converter plus 7 segment display decoder-drivers all in one LSI microcircuit. Since this microcircuit requires approximately 9V to power the A/D section, an internal dc/dc converter generates -5V from +5V power input. Together these two voltage sources form a bipolar power supply to power the A/D converter. The DM-3100X may also be powered directly from a single 9V battery @ 3 mA without using the dc/dc converter.

The DM-3100X employs a balanced differential input. When used with a bridge or transducer input, it offers high noise immunity and can accurately measure very small signals in the presence of much larger common mode noise. The DPM's high-impedance input circuits will not load down the sensitive input circuits.

The meter can be operated ratiometrically. That is, the DPM's internal circuits automatically compensate for references drifts in the supplies of balanced bridge or transducer sensors and still give accurate readings.

The DM-3100X finds use in analytical instruments, industrial process controllers, portable diagnostic instruments, automatic test equipment, medical instruments, airborne, marine, and ground vehicles, and data acquisition/data logging systems.

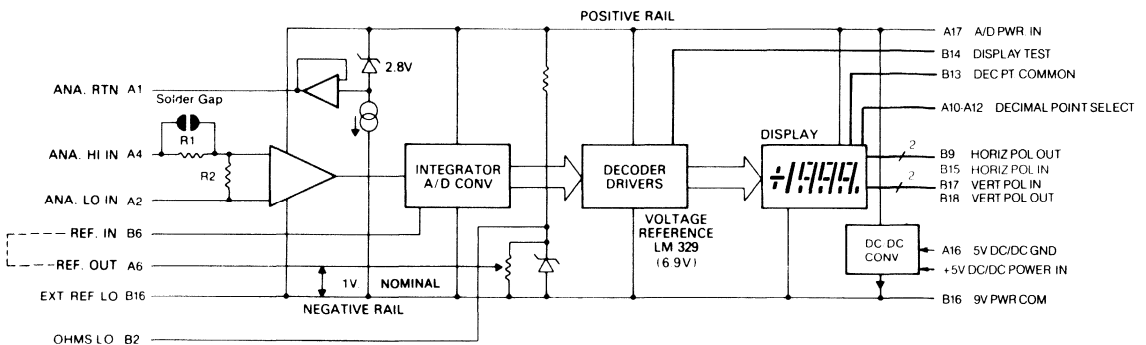
### ORDERING INFORMATION

#### DM-3100X - 1

Model	Description
DM-3100X-1	3 1/2-digit LCD DPM (Includes one connector)

#### ACCESSORIES

Part Number	Description
58-2075010	Connector, dual 18-pin, 0.1" centers
UPA-5/500	115V AC to $\pm 5V$ dc (@ 500 mA) power adaptor



Simplified Block Diagram of a DM-3100X

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25°C, 2V range unless noted)

**ANALOG INPUT**

- Full-Scale Input Range** ..... Refer to "FEATURES"  
Ranges field-modifiable.
- Input Impedance** ..... 100 Megohms (minimum)  
1000 Megohms (typical)
- Input Bias Current** ..... 5 pA (typical) 50 pA  
(maximum)
- Input Overvoltage** ..... ±250V dc, 175V RMS  
continuous (maximum)  
±300V dc intermittent  
(maximum)
- External Reference Range** ..... ±100 mV to ±2V referred  
to -Vs
- Common-Mode Rejection** ..... 80 dB (typical),  
from dc to 60Hz, with 1  
Kilohm unbalance
- Common-Mode Voltage Range** ..... Both the inputs must  
remain within 0.5V dc below  
+5V dc supply and 1.0V dc  
above -5V dc supply
- Resolution** ..... 1 mV
- Display Accuracy** ..... Adjustable to ±0.1% of  
reading, ±1 count
- Temperature Drift of Zero** ..... Autozeroed ± count  
over 0°C to +50°C  
temperature range
- Temperature Drive of Gain** ..... ±50 ppm of  
reading/°C (typical) ± 100  
ppm of reading/°C  
(maximum)
- Sampling Time** ..... 83.3 mS (nominal)
- Sampling Rate** ..... 3 conversions per second

**DISPLAY**

- Number of Digits** ..... 3 decimal digits and most  
significant "1" digit (3½ digits)
- Decimal Points** ..... Selectable using decimal  
point select signal lines
- Display Type** ..... Field effect liquid crystal  
display (LCD)
- Display Height** ..... 0.5" (12.7mm)
- Overscale** ..... The inputs exceeding the full-  
scale range display "+1"  
MSD with zeroes blanked.
- Autopolarity** ..... A "+" sign is automatically  
displayed for positive inputs  
and a "-" sign for negative  
inputs. The user may blank  
the polarity.

**POWER CONSUMPTION**

The DPM requires 5V dc regulated at 12 mA typical and 15 mA maximum, or 12V dc regulated, at 12 mA typical and 15 mA maximum or 15V dc regulated at 18 mA typical and 20 mA maximum. The logic spikes must not exceed 50 mV.

**PHYSICAL**

**External Dimensions**

Short-Depth Case 3.0"W x 2.15"D x 1.76"H (76.2 x 54.6 x 44.7mm)

**Panel Cutout Dimensions**

3.062"W x 1.812"H (46.0 x 77.7mm)

**Mounting Method**

Refer to end of this section.

**Weight**

5 ounce (142g) Approximately

**ENVIRONMENTAL**

**Altitude**

0 to 15,000 feet (4900m)

**Operating Temperature Range**

+32°F to 122°F (0°C to 50°C)

**Storage Temperature Range**

+32°F to 131°F (0°C to 55°C)

**Relative Humidity**

20% to 80% non-condensing

**I/O SIGNAL FEATURES**

Besides the common I/O Signals defined elsewhere, this device also has some important I/O features.

**Decimal Points**

Connect selected pin to DECIMAL POINT COMMON (Pin B13). See Backplane Out.

**Horizontal Polarity In (Pin B15)**

**Horizontal Polarity Out (Pin B9)**

Normally these inputs are jumpered together to continuously display the horizontal portion of the polarity sign. Omit the jumper for applications not requiring sign display. See Backplane Out.

**Vertical Polarity In (Pin B17)**

**Vertical Polarity Out (Pin B18)**

Jumper these inputs when HORIZ.POL. is jumpered for automatic sign display with bipolar inputs. For reverse sensing applications, VERT.POL. OUT may be jumpered to HORIZ.POL. IN (no other connections). This will display a minus sign with positive inputs and no sign (implied positive) with negative inputs. See Backplane Out.

**Backplane Out (Pin A13)**

Connect all unused Polarity, and Decimal Points to Backplane Out. For VOM or DVM applications, a 470 kΩ resistor may be used for each Decimal Point. A rotary switch pole to B13 will then select the desired Decimal Point.

INPUT/OUTPUT CONNECTIONS DM-3100X		
BOTTOM A		TOP B
ANALOG RETURN	1	NO CONNECTION
ANALOG LO INPUT	2	OHMS LO
NO CONNECTION	3	NO CONNECTION
ANALOG HI INPUT	4	NO CONNECTION
NO CONNECTION	5	NO CONNECTION
REFERENCE OUT	6	REFERENCE IN
NO CONNECTION	7	NO CONNECTION
NO CONNECTION	8	NO CONNECTION
NO CONNECTION	9	HORIZ POL OUT
DEC PT 199.9	10	NO CONNECTION
DEC PT 19.99	11	NO CONNECTION
DEC PT 1.999	12	NO CONNECTION
BACKPLANE OUT	13	DEC PT COM
NO CONNECTION	14	DISPLAY TEST
NO CONNECTION	15	HORIZ POL IN
+5V DC/DC PWR COM	16	+5V PWR COM
A/D PWR IN	17	VERT POL IN
+5V DC/DC PWR IN	18	VERT POL OUT

NOTE: REFERENCE IS BIASED AGAINST NEGATIVE RAIL (EXT. REF. LO).

### FEATURES

- **Two Model Ranges**
  - Model DM-3102A: 200 mV, 2V, 20V, and 200V dc full scale autoranges
  - Model DM-3102B: 2V, 20V, 200V, and 1000V dc full scale autoranges
- **Accuracy Adjustable to ±0.1% or ±1 count over any full scale range**
- **3½ Digit LCD displays .5" high (12,7mm)**
- **Low power consumption, 5V dc at 30 mA typical**
- **Multiplexed BCD data outputs to drive a slave display**
- **-5V dc power output at 15 mA for external low power circuitry**
- **Seven unit descriptors: K, Ω, m, DC, AC, V, A**
- **Balanced differential inputs with 9 megohms nominal input impedance**

### GENERAL DESCRIPTION

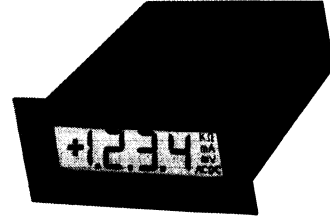
The DM-3102 is a 3½ digit, four decade, autoranging digital panel meter (DPM) with true balanced differential analog inputs. The low profile DPM is available in two model configurations. Model DM-3102A has 4 full-scale ranges of 200 mV, 2V, 20V, and 200V dc while Model DM-3102B has 4 full-scale ranges of 2V, 20V, 200V and 1000V dc.

Both models are powered from a +5V dc power source, typically drawing 15mA. Output power of -5V dc at 15mA is available to the user for powering low power external circuitry. The multiplexed BCD data outputs allow interfacing the DPM to micro-processors or UART'S. They may also drive an additional slave display meter. This is made easier with the presence of the STROBE, RUN/HOLD and BUSY/DONE signal lines. A RUN/HOLD signal freezes the display and stops A/D conversions. Based on a single chip CMOS A/D converter, the DM-3102A/B autoranging meter has an accuracy of ±1 count in 20,000 counts, or .1% of any full scale range.

Typical conversion cycle time of the A/D converter is 300 milliseconds. (Worst-case autoranging time interval would be 900 milliseconds maximum.) Analog input signals enter through a .1% matched resistor network and typical signal input impedance is 9 megohms.

### INTERFACING

To reduce the amount of wiring required to implement a slave display, four-wire BCD data is multiplexed using four digit drive outputs. Each digit drive sequentially turns on its respective signal when the drive signal is high. The digit is blanked when the drive line is low. The DM-3102A/B minimizes the wiring to a remote display, UART, or microprocessor since only 14 wires are needed to transfer the data which include 4 BCD data lines, 4 digit strobes, 4 range indications, polarity, and BUSY/DONE.



### DISPLAY DESCRIPTOR SELECTION

The DM-3102A/B display allows enabling optional unit descriptors by jumpering pins on the converter PWA. Polarity and overrange indicators, as well as the unit descriptors, are driven by logic on the converter PWA.

#### PIN

A3	B5	A2	A1	B1	B2	B3	B4
----	----	----	----	----	----	----	----

#### DESCRIPTORS

'm [V]'	m [A]	AC	DC	'[m] V'	'[m] A'	Ω	K
---------	-------	----	----	---------	---------	---	---

To activate the desired unit descriptor, the corresponding pin must be connected to pin B6 B.P. (display common). Connect any unused unit descriptors to pin B12 (B.P.)

### ORDERING INFORMATION

Model	Description
DM-3102A	Digital panel meter autoranging 200mV, 2V, 20V, 200V full scale ranges. (Includes two connectors)
DM-3102B	Digital panel meter autoranging 2V, 20V, 200V, 1000V full scale ranges. (Includes two connectors)

#### ACCESSORIES

Part Number	Description
58-2073083	Dual 15-pin, 0.100" centers PC edge board connector (Not included — order two with DPM).
UPA-5/500	AC to +5V dc power adapter.
DM-4106	Low-profile Slave Display (No description)

## FUNCTIONAL SPECIFICATIONS

(Typical at +25°C, 2V range unless otherwise noted)

## ANALOG INPUT

**Configuration** ..... True balanced differential bipolar inputs. If single-ended inputs are preferred, close SG4 solder gap.

**Full Scale Input Range**

**DM-3102A** ..... ±200V dc

**DM-3102B** ..... ±1000V dc

**Input Bias Current** ..... 1 pA typical, 10 pA maximum.

**Display Accuracy** ..... Adjustable to ±0.1% of reading, +/-1 count.

**Warm-Up Time** ..... 5 minutes.

**Resolution** ..... 100 µV in last digit (200mV range only).

**Temperature Drift of Zero** ..... Autozeroed, ±1 count over 0°C to +50°C temperature range.

**Temperature Drift of Gain** ..... ±50ppm of reading/°C typical — ±100ppm of reading/°C maximum.

**Input Impedance** ..... 9 Megohms, nominal.

**Input Overvoltage** ..... ±300 volts dc intermittent maximum, 175 VRMS continuous maximum on the 200V range, model A.

±350 volts dc intermittent maximum, 1500 VRMS continuous maximum on the 1000V range, model B.

**Reference** ..... Internal, referred to Analog Common, (between pins A13/B13). An external, user-supplied reference referenced to pin B15 is optional for ratiometric operation.

**External Reference Range** ..... +90mV to +200mV dc referenced to Analog Common, pin B15.

**Common-Mode Voltage Range** ..... Both inputs must remain within ±3V dc of Power Common. The user must provide external circuitry to keep the inputs within the common-mode range.

## DISPLAY

**Number of Digits** ..... 3 decimal digits and most significant "1" digit (3½ digits).

**Display Type** ..... Black digits on white Liquid Crystal Display (LCD). Requires external illumination under low ambient light conditions.

**Display Height** ..... 0.5 inches (12,7 mm).

**Overrange** ..... Inputs exceeding the full scale range cause the 'OR' symbol in the upper left corner to flash (A Model only).

**Autopolarity** ..... A plus or minus sign is automatically displayed for positive or negative voltage inputs. The polarity display may be disabled by opening solder gap SG1.

**Sampling Rate** ..... Approximately 3 conversions per second.

**Decimal Points** ..... Automatically shifted by auto-ranging logic.

## POWER REQUIREMENTS

**External**

+5V dc unregulated is required at 15mA typical, 30mA maximum. Logic spikes must not exceed 50mV. [Note: Any current consumed by external devices using the -5V output (pin A15) must be added to +5V power consumption to yield total meter power consumption.]

**Power Output**

-5V dc unregulated is available to the user by closing solder gap SG2 (normally open). The solder gap is located on the bottom of the converter/display board.

## PIN DETAILS

**PIN# SIGNAL DESCRIPTION**

Analog HI Input (PINS A/B12)

Analog LO Input (PINS A/B9)

Differential input signals are applied to pins A/B12 and A/B9. A single-ended input configuration is available by closing solder gap SG4. This effectively ties the ANALOG LO to input (pins A/B9) to ANALOG COMMON (pins A/B15).

**Reference IN/Out (Pins A13/B13)**

The instrument is calibrated when a +0.1V dc drop exists between pins B13 (+) and B15 (-). An internal reference voltage circuit, adjustable by potentiometer R3, provides this reference voltage. To use this internal reference, the user joins pins A13 and B13 at the connector. If the user wishes to generate an external reference voltage, pin A13 is used as the input, biased against pin B15.

**Busy/Done Out (Pin A11)**

This output is High during A/D conversions. The falling edge indicates that a new valid digit Strobe output will appear in 1.3 milliseconds. The high Busy level may be used by automatic equipment to prevent changing the input voltage during conversion.

**Digit Strobe Out (Pin B7, B8, B9, B10)**

Strobe consists of 4 positive pulses per conversion of approximately 4 microseconds width and approximately 1.6 milliseconds apart issued after an A/D conversion. They indicate that valid multiplexed data is available on the BCD data output lines, starting with the Most Significant Digit (MSD). The Polarity of the BCD data is not multiplexed out with the BCD data. A fifth line (Polarity Out, Pin A12) must be polled to determine the sign.

**Run/Hold IN (Pin B11)**

For normal operation, leave this pin open. Grounding Pin B11 halts A/D conversions and displays the last valid sample until the pin returns to a high state.

**Polarity Out (Pin A12)**

A high on this line indicates a positive input; a low indicates a negative input. This output is valid even for a zero reading. In other words, a display of +0000 means that the signal is positive but less than the LSB.

**-5V Power Out (Pin A15)**

Up to 15mA of -5V dc power may be taken to power external user-supplied circuits such as signal conditioners.

**PHYSICAL-ENVIRONMENTAL**

**Outline Dimensions**

2.53"W X 3.34"D X 0.94"H (64,3 X 85 X 23,8mm).

**Cutout Dimensions**

2.562"W X 0.97"H min. (65,1 X 24,6mm)

**Weight**

Approximately 5 ounces (142g).

**Connector**

Two dual 15-pin, 0.100" centers, Datel Part #58-2073083 (two included with meter).

**Mounting Position**

Limited by readability of LCD's (typical viewing angle of 70%).

**Operating Temperature Range**

32°F to 122°F (0°C to +50°C)

**Altitude**

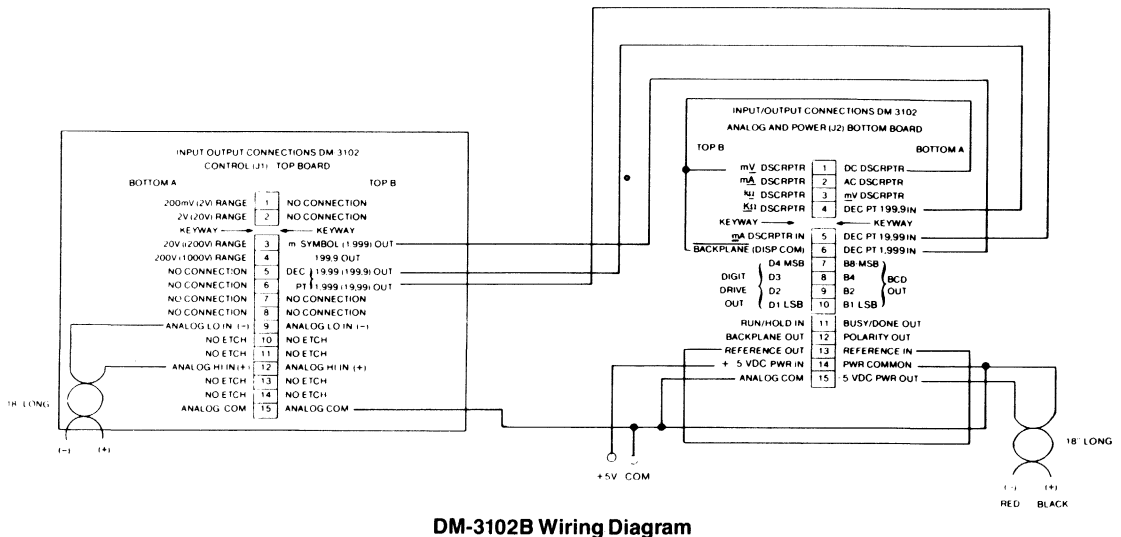
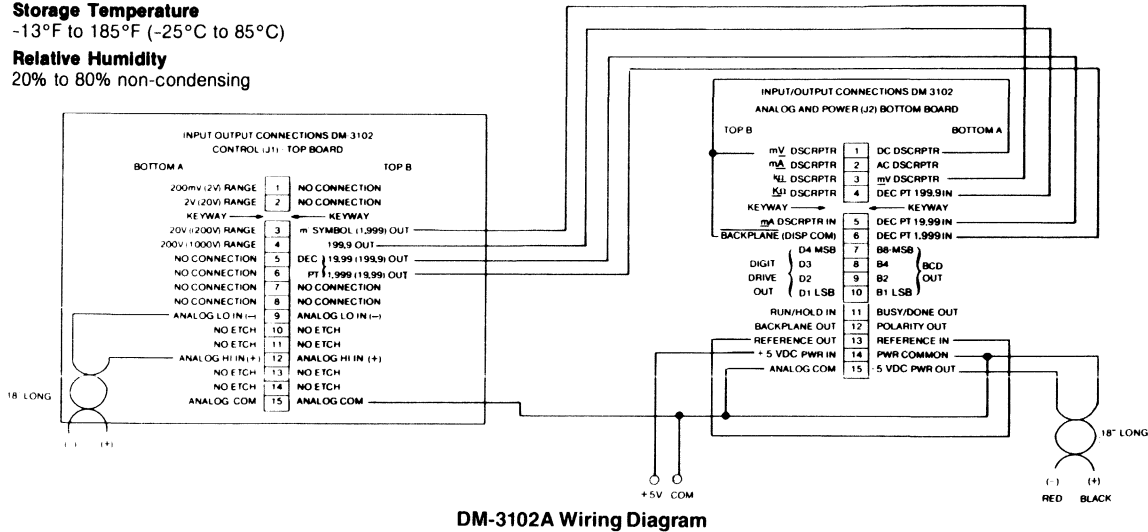
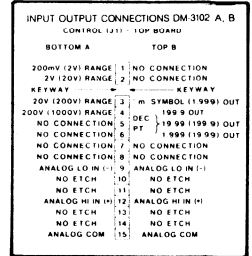
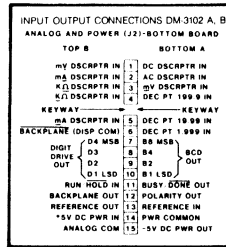
0 to 15,000 feet (4,900m)

**Storage Temperature**

-13°F to 185°F (-25°C to 85°C)

**Relative Humidity**

20% to 80% non-condensing



## 4 1/2 DIGIT DIGITAL PANEL METERS

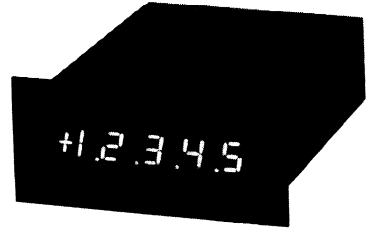
	Model	Power	Std. Input	Case*	Features
<b>4.5 Digit LED</b>	<b>DM-4101N-1</b>	+5Vdc	±2Vdc	A	High Intensity Display
	<b>DM-9200-1</b>	+5Vdc	±2Vdc	C	NEMA 12 (Vibration Standard)
	<b>DM-4100D-1</b>	+5Vdc	±2Vdc	A	High Speed Sampling Serial/ParallelBCD Output
	<b>DM-4101D-1</b>	+5Vdc	±2Vdc	A	High Intensity Display Serial/Parallel BCD Output
	<b>DM-4101L-1</b>	+5Vdc	±2Vdc	B	Serial BCD Output
	<b>DM-4200-1</b>	+5Vdc	±2Vdc	A	Serial BCD Output
	<b>DM-9215-1</b>	115/230VAC	±2Vdc	C	NEMA 12 (Vibration)
<b>4.5 Digit LCD</b>	<b>DM-4105-1</b>	+5Vdc	±2Vdc	A	Serial BCD OUT (Batt. Pwr.)
<b>Other Digital Panel Products</b>	<b>DBM-20</b>	+5Vdc	Adjustable	A	20 Segment LED Bar Graph w/ TTL Outputs
	<b>PC-6</b>	+5Vdc		B	10 MHz Counter/Timer

NOTE: Input range kits are available for all DM-3100, 4100, and 9000 Series DPMs

\* Refer to page 67 for actual dimensions

### FEATURES

- Tri-state BCD data outputs
- Data outputs gated for use with 4-, 8-, 12- or 16-bit bus structures
- Standard  $\pm 1.9999V$  dc input range; user-installed options set other voltage or current ranges.
- High-impedance inputs with low 5 pA bias currents
- Autozeroing, ratiometric for drift-free operation
- Low power consumption: +5V dc at 500 mA
- Provides  $\pm 13.5V$  dc outputs at 20 mA for external circuits
- Up to 30 conversions per second possible
- Designed for single-ended, bipolar inputs



### GENERAL DESCRIPTION

The DM-4100D provides full 4½ digit DPM capabilities with tri-state BCD outputs. Built-in ability to provide 3½ digit displays with 10 times the normal sampling rate. Designed for single-ended inputs, this meter has all the features found in DATEL's DPM product line plus voltage and data outputs. The unit is accurate to within .02% FSR ( $\pm 2$  counts). Input circuitry is autozeroed on each conversion cycle to reduce zero drift. All this performance has been packed into a low-profile black polycarbonate case only 2.53" wide x 3.34" deep x 0.94" high (64,3 x 85 x 23,8mm).

The DM-4100D's 3-state BCD outputs take it beyond many so-called "microprocessor-compatible" DPM's. The 3-state outputs mean that the meter can be connected directly to a microcomputer's data bus. They also permit multiple DM-4100D's to be daisy-chained to a single set of computer or printer input connections — the computer inputs "see" only those meter outputs which have been enabled. And, since each 4-bit group (corresponding to a single BCD-encoded numeral) may be gated separately, a single rear-panel change makes the DM-4100D compatible with processors using 4-, 8-, 12-, or

### ORDERING INFORMATION

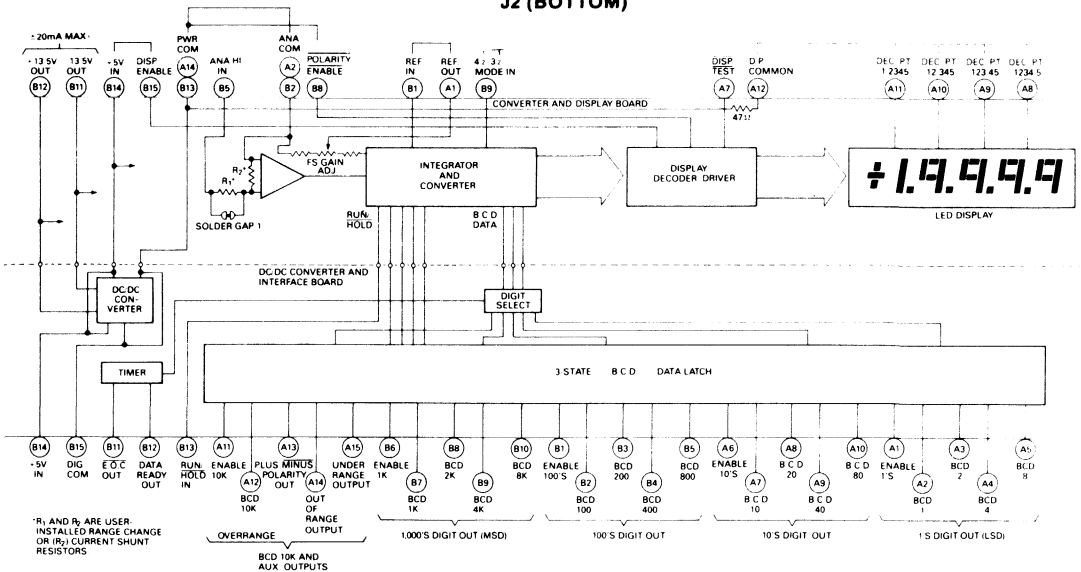
#### DM-4100D - 1

Model	Description
DM-4100D-1	Micro-bussable 4 1/2-Digit, single-ended input DPM (includes 2 connectors)

#### ACCESSORIES

Part Number	Description
58-2073083	Dual 15-pin edge connector, 0.1" centers
UPA-5/500	115V AC to 5V dc power adaptor

### ANALOG AND POWER CONNECTOR J2 (BOTTOM)



Simplified Block Diagram of a DM-4100D

16-bit data words. Digital outputs for the Display Polarity, Underrange, Out of Range, E.O.C., "Data Ready" (a 10  $\mu$ second pulse occurring 10  $\mu$ seconds after the digital data is valid), and meter Run/Hold status make microcomputer control of the meter possible with minimal external hardware. Sufficient control circuitry is already built into the DM-4100D so that it can directly interface with DATEL's DPP-Q7 thermal printer (or a similar printer) to become a functional data logger.

The DM-4100D's input CMOS circuitry can safely handle over-voltages to  $\pm 250V$  dc. The meter's converter board contains blank circuit pads to accept input attenuation resistors or current shunts. Temperature drift of the autozeroed input amplifier is  $\pm 1$  count from  $0^\circ$  to  $+50^\circ C$ . Temperature drift of gain measures  $\pm 50$  ppm of FSR/ $^\circ C$  (typical) and  $\pm 100$  ppm of FSR/ $^\circ C$  maximum.

The DM-4100D uses a dual slope integrating converter which provides normal mode rejection of AC power line noise. It provides an input-to-output conversion linearity to within  $\pm 0.2\%$  of reading, or  $\pm 2$  counts. The standard sampling rate is 3 conversions per second, but a rear pin connector may be used to disable the least significant digit. In the  $3\frac{1}{2}$  digit mode, the DM-4100D provides 30 conversions/second.

Power to the meter is  $+5V$  dc @ 380 mA typical (500 mA maximum), and may be supplied directly from a microcomputer bus. A built-in dc-dc converter (to power the meter's analog input circuitry) provides  $\pm 13.5V$  dc  $\pm 5\%$  (@  $\pm 20$  mA max.) to power user-supplied circuitry. The  $\pm 13.5V$  output was specifically intended to power an external instrumentation or CAZ amp, providing the DM-4100D with a differential analog input. DATEL's UPA-5/500,  $5V$  @ 500mA power supply is available as an accessory.

**FUNCTIONAL SPECIFICATIONS**

(Typical at  $25^\circ C$ , 2V range unless noted)

**ANALOG INPUT**

- Full-Scale Input Range** ..... Refer to "FEATURES" Ranges field-modifiable.
- Input Impedance** ..... 100 Megohms (minimum) 1000 Megohms (typical)
- Input Bias Current** ..... 5 pA (typical) 50 pA (maximum)
- Input Overvoltage** .....  $\pm 250V$  dc, 155V RMS continuous (maximum)  $\pm 300V$  intermittent (maximum)
- External Reference Range** .....  $+100$  mV to  $+2V$  referred to Analog Common
- Common-Mode Rejection Range** ..... 80 dB (typical), from dc to 60 Hz, with 1 Kilohm unbalance
- Common-Mode Voltage Range** ..... Both the inputs must remain within 0.5V dc below the  $+5V$  dc supply and 1.0V dc above the  $-5V$  dc supply.
- Resolution** ..... 1 mV (least significant digit)
- Display Accuracy** ..... Adjustable to  $\pm 0.02\%$  of reading,  $\pm 2$  counts
- Temperature Drift of Zero** ..... Autozeroed  $\pm 1$  count over 0 to  $+50^\circ C$  temperature range
- Temperature Drift of Gain** .....  $\pm 50$  ppm of reading/ $^\circ C$  (typical)  $\pm 100$  ppm of reading/ $^\circ C$  (maximum)
- Sampling Time** ..... 83.3 mS (nominal)
- Sampling Rate** ..... 3 conversions per second. May be rewired for up to 20 conversions per second

NOTE: The DM-4100D's display is not latched; the display may not track the meter's BCD data out.

**DISPLAY**

- Number of Digits** ..... 4 decimal digits and most significant "1" digit ( $4\frac{1}{2}$  digits)
- Decimal Points** ..... Selectable using decimal point select signal lines.
- Display Type** ..... Red LED's
- Display Height** ..... 0.3" (7,6 mm)
- Overscale** ..... The display flashes when inputs exceed the full-scale range.
- Autopolarity** ..... A "+" sign is automatically displayed for positive inputs and a "-" sign for negative inputs. The user may blank the polarity using the POLARITY ENABLE line.

**CALIBRATION**

A multiturn screwdriver pot (rear-panel mounted) adjusts the full scale reading (gain). Zero is automatic (autozeroing). Suggested recalibration in stable conditions is 90 days.

**POWER CONSUMPTION**

The DPM requires  $+5V$  dc regulated ( $\pm 5\%$ ) at 380 mA typical and 500 mA maximum. Logic spikes must not exceed 50 mV. Any current taken from the  $\pm 13V$  dc outputs must be added to the above specifications to yield the total meter power consumption.

**PHYSICAL**

- External Dimensions**  
2.53"W x 3.34"D x 0.95"H (64,3 x 85 x 23,8mm)
- Panel Cutout Dimensions**  
2.562"W x 0.97"H (65,1 x 24,6mm)
- Weight**  
Approximately 4.1 ounces (116 grams)

**ENVIRONMENTAL**

- Altitude**  
0 to 15,000 feet (4900m)
- Operating Temperature Range**  
 $32^\circ F$  to  $122^\circ F$  ( $0^\circ$  to  $50^\circ C$ )
- Storage Temperature Range**  
 $-13^\circ F$  to  $+195^\circ F$  ( $-25^\circ C$  to  $+85^\circ C$ )
- Relative Humidity**  
20% to 80% non-condensing



**I/O SIGNAL FEATURES**

Besides the common I/O Signals defined elsewhere, this device also has some important I/O features.

**J2 ANALOG CONNECTOR (LOWER)**

**-13V, +13V dc Power Out (Pins B11, B12)**

Up to 20mA of unregulated + and -13.5V dc power may be taken directly from the meter to power external user-supplied circuits such as signal conditioners.

**Analog H1 Input (Pin B5)**

Signal input normal voltage range is -1.9999 to +1.9999V dc.

**3½/4½ Mode Input (Pin B9)**

Leave open or high for 4½ digit mode. Logic low (connected to POWER COMMON) causes Least Significant Digit to read permanent zero, and causes meter to operate in 3½ digit mode. Conversions in 3½ digit mode occur at 10 times usual speed, i.e., 30 conversions per second.

**+5V In (Pin B14)**

Power input to the meter; connections made between +5V IN and POWER COMMON (pins A14 and B13); requires regulated supply (±5%), capable of supplying 500 mA maximum.

**J1 DATA CONNECTOR (UPPER)**

**Digit Enable Input**

These are active high, and operate on data in groups of 4 bits (e.g., Enable 10's controls BCD 10, 20, 40 and 80; Enable 10,000's controls BCD 10,000 (overrange), PLUS/MINUS, OUT OF RANGE, and UNDERRANGE.

- Enable 1's (Pin A1)
- Enable 10's (Pin A6)
- Enable 100's (Pin B1)
- Enable 1,000's (Pin B6)
- Enable 10,000's (Pin A11)

**BCD Data Outputs**

1, 2, 4, 8 (and 10, 20, 40, 80, etc) BCD data is fully latched. Outputs are 3-state and controlled in groups of 4. Outputs are DTL/TTL compatible, positive true, and sink 4.0 mA @ 0.4V (2½ TTL loads).

- BCD 1 (Pin A2), 2 (Pin A3), 4 (Pin A4), 8 (Pin A5)
- BCD 10 (Pin A7), 20 (Pin A8), 40 (Pin A9), 80 (Pin A10)
- BCD 100 (Pin B2), 200 (Pin B3), 400 (Pin B4), 800 (Pin B5)
- BCD 1000 (Pin B7), 2000 (Pin B8), 4000 (Pin B9), 8000 (Pin B10)
- BCD 10,000 (Pin A12)

**Plus/Minus Polarity Out (Pin A13)**

This is true for positive input. 3-state latch enabled by pin A11.

**BCD OUTPUT**

**Format**

BCD outputs 3-state, gatable in 4-bit groups, full parallel output available.

**Fanout**

2½ TTL loads.

**Logic Controls**

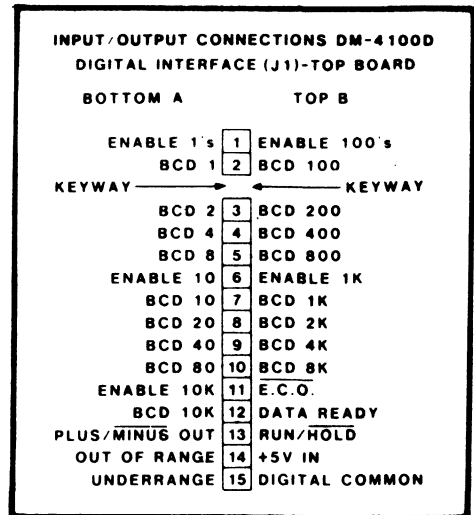
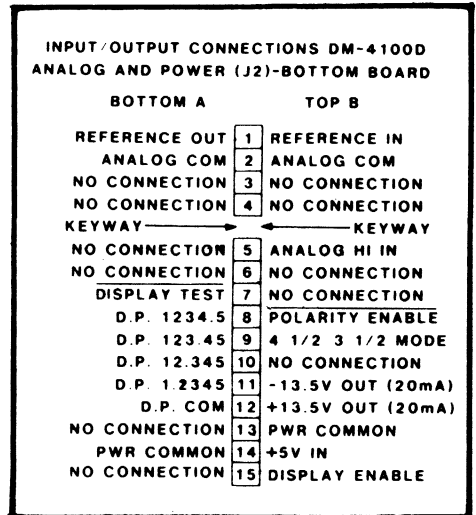
E.O.C. pulse, "Data Ready" (Print Pulse), Overrange, Underrange, Out of Range, PLUS/MINUS Polarity OUT, and RUN/HOLD.

**D.C. Power In**

+5V dc, regulated (±5%), @ 380 mA typical, 500 mA maximum.

**D.C. Power Out**

±13.5V dc, ±5%, @ ±20 mA, unregulated, for external signal conditioning.



# DM-4101L

## 4 1/2 Digit LED Panel Meter with Data Outputs



### FEATURES

- Large .56" digits
- Replaces the DM-4100L with improved driver circuit for 20% brighter LED display
- $\pm 5V$  dc outputs at 15 mA for user's circuits
- Balanced differential inputs with 5 pA bias currents
- Internal ratiometric reference for drift correction
- Autozeroing with 86dB CMR noise rejection
- Standard  $\pm 1.9999V$  dc input range; user-installed options set other voltage or current ranges.
- BCD Outputs available to drive DM-4103 slave displays



### GENERAL DESCRIPTION

The DM-4101L replaces DATEL's older DM-4100L DPM, offering higher performance at an even lower price. The improved display driver circuitry gives a 20% brighter output from the .56" high LED's. Besides offering DATEL's standard input features, this device provides multiplexed BCD outputs. These outputs can drive a remote display, such as the DM-4103, or be used by an external microprocessor. This DPM is housed in a short-depth case, a feature appreciated by many OEM's.

The quality performance features of the DM-4100L have been retained. CMOS circuitry provides an extremely high input impedance (1000 Megohms), and extremely low input bias current (5 picoamps). The meter's dual slope converter autozeroes the input in each conversion cycle for a true zero reading. And a reference in/out loop permits use of the DM-4101L in ratiometric and bridge-type circuits.

Additional features include a Busy/Done Output which indicates when an A/D conversion is complete. Overscale and Underscale outputs can be used with external circuitry for autoranging. A Run/Hold line permits a reading to be held for several seconds while an operator copies down the reading. And an externally-accessible Display Enable line can blank the display to minimize power consumption, while the A/D

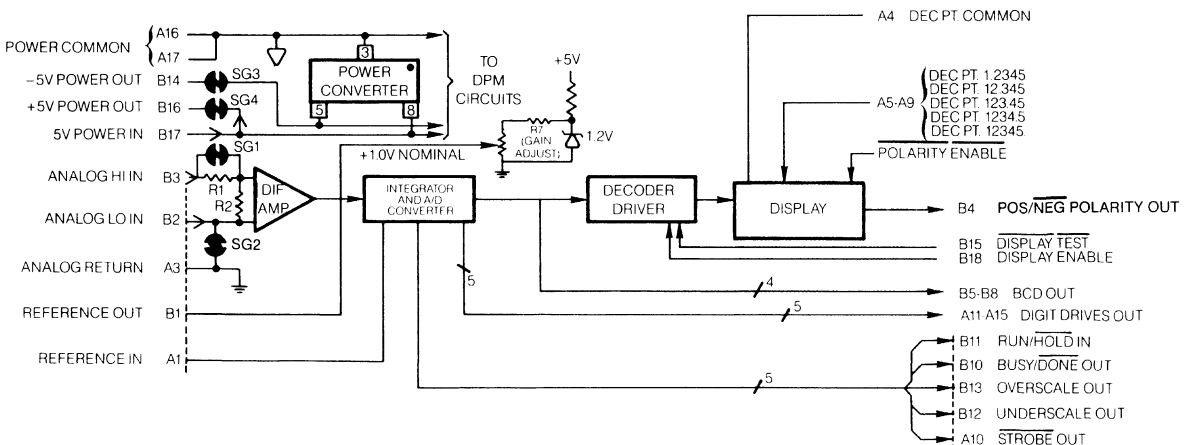
converter and BCD outputs are running to drive an external slave display. BCD outputs, used in conjunction with a strobe line from the DM-4101L's A/D converter, can drive a remote slave display (Model DM-4103), or provide A/D data conversion for a microprocessor.

Power to the meter is +5V dc at 350 mA maximum. A dc-to-dc converter in the DM-4101L provides a -5V dc output (at 15 mA maximum) to power user circuitry.

### ORDERING INFORMATION

#### DM-4101L - 1

Model	Description
DM-4101L-1	4 1/2-digit DPM with BCD outputs (Includes one connector)
DM-4103	MUX'D BCD Slave Display
ACCESSORIES	
Part Number	Description
58-2075010	Dual 18-pin, 0.1" centers PC edgeboard connector
UPA-5/500	115V AC to 5V dc power adaptor



Simplified Block Diagram of a DM-4101L

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25° C, 2V range unless noted)

**ANALOG INPUT**

- Full-Scale Input Range** ..... As specified in "FEATURES"
- Input Impedance** ..... 100 Megohms (minimum)  
1000 Megohms (typical)
- Input Bias Current** ..... 5 pA (typical) 50 pA (maximum)
- Input Overvoltage** ..... ±250V dc, 175 VRMS  
continuous (maximum)  
±300V intermittent (maximum)
- External Reference Range** ..... +100 mV to +2V referred to Analog Return
- Common-Mode Rejection** ..... 86 dB typical
- Common-Mode Voltage Range** ..... Both inputs must remain within ±4V of Power Common
- Resolution** ..... 100 μV in last digit
- Displayed Accuracy** ..... Adjustable to ±0.2% of reading, ±2 counts
- Temperature Drift of Zero** ..... Autozeroed ±1 count over 0° to +50° C
- Temperature Drift of Gain** ..... ±50 ppm of reading/°C (typical), ±100 ppm of Reading/°C (maximum)
- Ramp-up Time (Integration Period)** ..... 83.3 ms
- Sampling Rate** ..... Approximately 3 conversions per second.

**DISPLAY**

- Number of Digits** ..... 4 decimal digits and most significant "1" digit (4½ digits)
- Decimal Points** ..... Right-of-digit selectable decimal points are included for scale multipliers
- Display Type** ..... Red, light-emitting diode (LED), self-illuminated
- Display Height** ..... 0.56 inches (14,2 mm)
- Overscale** ..... Inputs exceeding the full-scale range cause the display to blink
- Autopolarity** ..... A "+" is displayed for positive inputs, a "-" for negative inputs. Polarity may be disabled.
- Sampling Rate** ..... Approximately 3 conversions per second.

**POWER REQUIREMENTS**

External +5V, ±0.25V dc regulated required at 350 mA maximum, 250 mA typical. Logic spikes must not exceed 50 mV. (+5V OUT and -5V OUT current must be added to the +5V power requirements for total meter consumption.

**PHYSICAL**

**External Dimensions**

Short-Depth Case 3.0"W x 2.15"D x 1.76"H (76,2 x 54,6 x 44,7 mm)

**Panel Cutout Dimensions**

1.812"H x 3.062"W (46,0 x 77,7 mm)

**Mounting Method**

Refer to end of this section.

**Weight**

5 ounces (142g) approximately

**ENVIRONMENTAL**

**Altitude**

0 to 15,000 feet (4900m)

**Operating Temperature Range**

32°F to 122°F (0° to 50°C)

**Storage Temperature Range**

-13°F to +185°F (-25°C to 85°C)

**Relative Humidity**

20% to 80% non-condensing

**I/O SIGNAL FEATURES**

Besides the common I/O Signals defined elsewhere, this device also has some important I/O features.

**Reference Output (Pin B1)**

**Reference Input (Pin A1)**

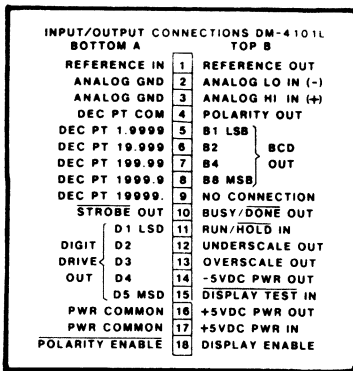
Normally Pins A1 and B1 are jumpered together. The instrument is calibrated when a + 1.0V dc drop exists between Pins A1 (+) and A3 (-). An external reference input to Pin A1 which is biased against Pin A3 may be used by disconnecting Pin B1. Ratiometric drift-correcting action may then be achieved over the reference input range of +0.1V dc to +2.0V dc.

**-5V Power Out (Pin B14)**

Up to 15 mA of -5V dc power may be taken to power external user-supplied circuits such as signal conditioners.

**+5V Power Out (Pin B16)**

is an additional +5V power source.



# DM-4101N

## 4½ Digit Differential Input LED Panel Meter



### FEATURES

- Improved replacement for the DM-4100N
- Improved driver circuit for 20% brighter LED display
- Balanced, high-impedance differential inputs with 5 pA bias currents
- Internal ratiometric reference for drift correction
- ± 5V dc outputs at 15 mA for user's circuits
- Displayed digits are .3" high
- Standard ±1.9999V dc input range; user-installed options set other voltage or current ranges.



### GENERAL DESCRIPTION

The DM-4101N replaces DATEL's older DM-4100N DPM, offering higher performance at an even lower price. Improved display driver circuitry yields a 20% brighter output from the .3" high LED's while requiring a maximum of 350 mA current. This device is packaged in a low-profile case, allowing a higher packing density on the final product's panel.

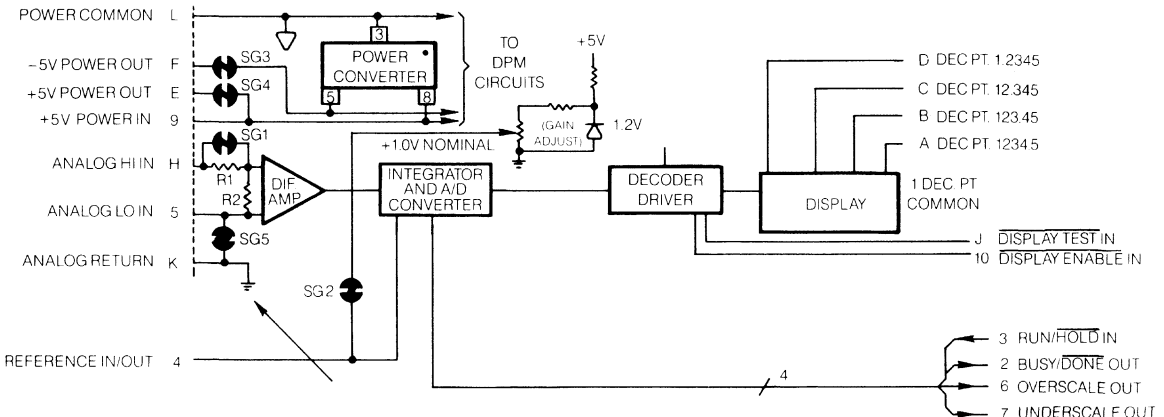
The DM-4101N offers such high performance features as ultra-high impedance analog signal inputs (1000 MΩ, typically) which require extremely low input bias currents (5 pA typical). Inputs are bipolar and autozeroed.

Other features include Overrange and Underscale Outputs which can be used in external autoranging circuits; a Hold input which permits display of a given value indefinitely; and a Busy/Done line which goes low at the end of a conversion cycle. The DM-4101N's display may be disabled to reduce power consumption, while keeping the A/D converter cycling. A Reference In/Out line can accept an external reference for use in ratiometric and bridge-type applications.

Power to the meter is +5V dc @ 250 mA max. -5V Out @ 15 mA is available to power user circuits.

### ORDERING INFORMATION DM-4101N - 1

Model	Description
DM-4101N-1	4 1/2-digit panel motor (includes one connector)
ACCESSORIES	
Part Number	Description
58-2073082	Dual 10-pin 0.156" centers, PC edgeboard connector (not included with DPM)
UPA-5/500	115V AC to 5V dc power adaptor



**Simplified Block Diagram of a DM-4101N**

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25°C, 2V range unless noted)

**ANALOG INPUT**

- Full-Scale Input Range** ..... Refer to "FEATURES" Ranges field-modifiable.
- Input Bias Current** ..... 5 pA (typical) 50pA (maximum)
- Displayed Accuracy** .... Adjustable to  $\pm 0.2\%$  of reading,  $\pm 2$  counts
- Resolution** ..... 100  $\mu$ V in last digit
- Temperature Drift of Zero** ..... Autozeroed  $\pm 1$  count over 0°C to +50°C
- Temperature Drift of Gain** ..... +50 ppm of reading/ $^{\circ}$ C typical,  $\pm 100$  ppm of reading/ $^{\circ}$ C maximum
- Input Impedance** ..... 100 Megohms, minimum; 1000 Megohms, typical
- Input Overvoltage** .....  $\pm 5$ V dc maximum
- ANALOG LO IN** .....  $\pm 5$ V dc maximum continuous referred to Power Common
- ANALOG HI IN** .....  $\pm 100$ V dc maximum continuous or  $\pm 250$ V dc for 5 seconds referred to Power Common
- External Reference Range** ..... +100 mV to +2V referred to Analog Return
- Common Mode Rejection** ..... 86 dB typical to Analog Return at dc
- Common Mode Voltage Range** ..... Both inputs must remain within  $\pm 4.0$ V dc of Power Common

**DISPLAY**

- Number of Digits** ..... Four decimal digits and most significant "1" digit
- Display Type** ..... Red, light-emitting diode (LED)
- Display Height** ..... 0.3 inches (7,6mm)
- Overscale** ..... Inputs exceeding the full scale range cause the display to blink.
- Autopolarity** ..... A minus sign is automatically displayed for negative voltage inputs and may be blanked.
- Sampling Rate** ..... 3 Conversions per second

**POWER REQUIREMENTS**

External +5,  $\pm 0.25$ V dc regulated required at 250 mA typical, 350 mA maximum. Logic spikes must not exceed 50 mV. +5V OUT and -5V OUT currents must be added to the +5V IN power requirements.

**CALIBRATION**

A multiturn screwdriver pot adjusts the full scale reading (gain). Zero is automatic (autozeroing). Suggested recalibration is 90 days.

**PHYSICAL**

**External Dimensions**  
2.53"W x 3.25"D x 0.94"H (64,3 x 82,5 x 23,8mm)

**Panel Cutout Dimensions**  
2.56"W x 0.97"H (65,1 x 24,mm)

**Mounting Method**  
Refer to end of this section.

**Weight**  
5 ounces (142g) approximately

**ENVIRONMENTAL**

**Altitude**  
0 to 15,000 feet (4900m)

**Operating Temperature Range**  
+32°F to 122°F (0° to 50°C)

**Storage Temperature Range**  
+32°F to 131°F (0° to 55°C)

**Relative Humidity**  
20% to 80% non-condensing

INPUT/OUTPUT CONNECTIONS DM-4101N			
BOTTOM		TOP	
DEC PT 1999.9	A 1	DEC PT COM	
DEC PT 199.99	B 2	BUSY/DONE OUT	
DEC PT 19.999	C 3	RUN/HOLD IN	
DEC PT 1.9999	D 4	REF IN/OUT	
+5VDC PWR OUT	E 5	ANALOG LO IN(-)	
-5VDC PWR OUT	F 6	OVERSCALE OUT	
ANALOG HI IN(+)	H 7	UNDERSCALE OUT	
DISPLAY TEST IN	J 8	DISPLAY ENABLE	
ANALOG GND	K 9	+5VDC PWR IN	
PWR COMMON	L 10	POLARITY ENABLE	

# DM-4102, DM-4103, DM-4106

## 4½ Digit Multiplexed BCD Input LED Slave Displays



### FEATURES

- Remote slave displays for DATEL digital panel meters
- Data repeater for second operator station up to 25 feet away
- Simple 12-wire interface, ideal for ribbon cable
- Operates with any 3 to 4½ digit DPM with multiplexed BCD data outputs

### GENERAL DESCRIPTION

The slave display meters function as repeaters for decimal data from a master data source. Data sources include DATEL's DPM's and a variety of microprocessor peripheral interface circuits. Depending on the model, the multiplexed BCD data is displayed using either LED or LCD display technology. The DM-4102 (LED) and the DM-4106 (LCD) are packaged in a low profile case, while the DM-4103 (LED) is packaged in a short depth case. The DM-4106 may use a battery source and is suitable for digital thermometer repeater applications.

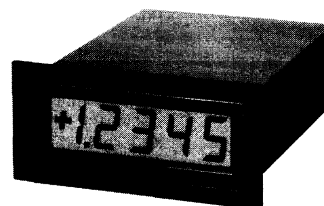
Any of these slave displays may be used interchangeably with the multiplexed BCD output DPM's by rewiring the connector.



DM-4102



DM-4103



DM-4106

### CIRCUIT OPERATION

To reduce the amount of wiring required to implement a slave display, 4-wire BCD data is multiplexed using 5 digit drive outputs which direct the BCD data to the proper digit. Using the DM-4200, -4101L and -4105 master DPM's as BCD data sources, these slave displays rely on the persistence of vision of the human eye to store an image of the displayed digit. This multiplexing technique is commonly used with DPM's and DVM's. Each digit drive has the effect of sequentially turning on its respective digit when the drive signal is high. The digit is blanked when the drive is low.

Digits are scanned in this manner in the DM-4101L, -4200, and -4105 approximately 150 times per second. The BCD data is updated with every A/D conversion which is approximately 3 times per second. For applications from other multiplexed data sources, digits must be updated at least 30 times a second (30 scans/sec) to avoid annoying display flicker.

Full parallel input data will require a multiplexer and possibly a storage register.

These display slaves may be connected to popular microprocessors by using peripheral interface circuits and a suitable rotating stack (FIFO) driver program.

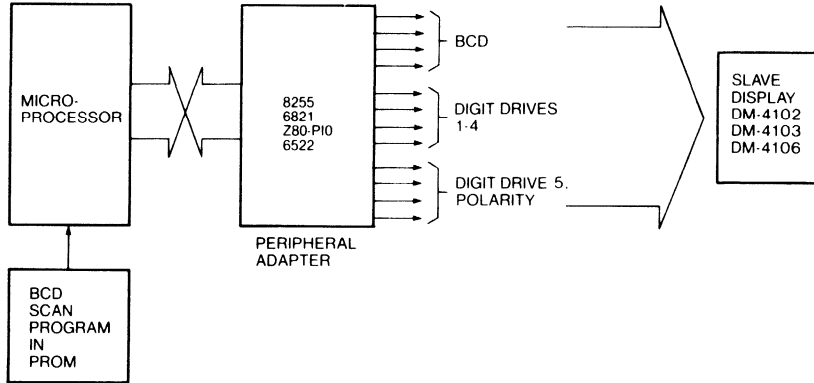
### ORDERING INFORMATION

Model	Description
DM-4102	4½ digit, LED, low-profile slave
DM-4103	4½ digit, LED, short-depth slave
DM-4106	4½ digit, LCD, low-profile slave

To Order, Specify Model Number.

### ACCESSORIES

Part Number	Description
58-2073083	15-pin edge connector for DM-4102 and DM-4106 (one included with each order)
58-2075013	18-pin edge connector for DM-4103 (one included with each display)



**Microprocessor Output To Slave Display**

**FUNCTIONAL SPECIFICATIONS**

- Data Input** ..... Multiplexed 1-2-4-8 binary coded decimal (BCD) data and polarity, TTL logic levels ("0" ≤ 0.08V, "1" ≥ 2.0V), 1 TTL load.  
Multiplex rate 30 scans/second minimum.
- Display** ..... 4½ digits (±19999 counts).
- Power Required** ..... +5V dc regulated, wired from master DPM.  
DM-4102 5V @ 250 mA max.  
DM-4103 5V @ 350 mA max.  
DM-4106 5V @ 10 mA max.
- Operating Temperature Range** ..... 32°F to 122°F (0° to +50°C)
- Storage Temperature Range** ..... -13°F to +131°F (-25°C to +55°C).
- Case Material** ..... Polycarbonate Plastic.
- Mounting Method** ..... Refer to end of this section.

**Decimal Points** ..... Jumper-selected 1.2.3.4.5, on rear connector.

INPUT/OUTPUT CONNECTIONS DM-4103		
BOTTOM A	TOP B	
NO CONNECTION	1	NO CONNECTION
NO CONNECTION	2	NO CONNECTION
NO CONNECTION	3	NO CONNECTION
DEC PT COM	4	POLARITY INPUT
DEC PT 1.9999	5	B1 LSB
DEC PT 19.999	6	B2
DEC PT 199.99	7	B4
DEC PT 1999.9	8	B8 MSB
DEC PT 19999.	9	NO CONNECTION
NO CONNECTION	10	NO CONNECTION
D1 LSD	11	NO CONNECTION
DIGIT D2	12	NO CONNECTION
DRIVE D3	13	OVERSCALE INPUT
INPUTS D4	14	NO CONNECTION
D5 MSD	15	DISPLAY TEST IN
PWR COMMON	16	+5VDC PWR OUT.
PWR COMMON	17	+5VDC PWR IN
POLARITY ENABLE	18	DISPLAY ENABLE

INPUT/OUTPUT CONNECTIONS DM-4106		
BOTTOM A	TOP B	
DEC PT 19.999	1	DEC PT 1999.9
DEC PT 1.9999	2	DEC PT 199.99
POLARITY INPUT	3	NO CONNECTION
NO CONNECTION	4	NO CONNECTION
NO CONNECTION	5	DEGREE SIGN IN
NO CONNECTION	6	B1 LSB
NO CONNECTION	7	B2
NO CONNECTION	8	B4
NO CONNECTION	9	B8 MSB
DIGIT D2	10	B F INPUT/OUTPUT
DRIVE D3	11	B F INPUT (MSB COM)
INPUTS D4	12	OVERSCALE INPUT
D5 MSD	13	OVERSCALE INPUT
PWR COMMON	14	+5VDC PWR IN
NO CONNECTION	15	+5VDC PWR OUT

INPUT/OUTPUT CONNECTIONS DM-4102		
BOTTOM A	TOP B	
DEC PT 19.999	1	DEC PT 1999.9
DEC PT 1.9999	2	DEC PT 199.99
POLARITY INPUT	3	NO CONNECTION
NO CONNECTION	4	NO CONNECTION
NO CONNECTION	5	DISPLAY TEST
NO CONNECTION	6	B1 LSB
NO CONNECTION	7	B2
NO CONNECTION	8	B4
NO CONNECTION	9	B8 MSB
DIGIT D2	10	DISPLAY ENABLE
DRIVE D3	11	DEC PT COM
INPUTS D4	12	NO CONNECTION
D5 MSD	13	OVERSCALE INPUT
PWR COMMON	14	+5VDC PWR IN
NO CONNECTION	15	+5VDC PWR OUT

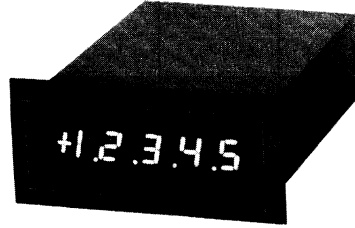
# DM-4104

## 4½ Digit Parallel Input LED Slave Display



### FEATURES

- Bright 0.3" high LED display
- Operates with 2½ to 4½ digit DPM's
- Latches BCD data in 4-bit nibbles
- Interfaces directly to a 4-, 8-, 12-, or 16-Bit data bus or to a full parallel 18-bit data bus
- Remote flashing alarm function
- Logic powered



### GENERAL DESCRIPTION

The DM-4104 slave display meter interfaces directly to a parallel 18-bit or to a multiplexed BCD (Binary Coded Decimal) master unit. This type of master unit includes DATEL's DPM's and a variety of microprocessor-based systems. The DM-4104 is packaged in a compact low-profile case.

Master digital panel meters accept a dc or slowly varying input voltage and display that input on front panel numerical indicators. In addition to dc voltages, DPM's can be adapted to measure practically any physical parameter which can be converted to electrical units. If the DPM provides parallel or multiplexed BCD outputs, the inputs of the DM-4104 Slaved Digital Panel Display can be electrically connected to these outputs to display the same information shown on the master DPM. There are several uses for slaved displays, among them being a remote workstation situation that requires the same up-to-the-instant information as the master unit. Other uses may be distributed networks, such as medical monitoring stations, industrial process control stations or linked data acquisition/data logging systems. The DM-4104 is not dependent exclusively on master DPM's. Any device that can convert physical parameters into bussable BCD outputs, such as a parallel microcomputer port, can control the DM-4104.

The DM-4104 interfaces directly to 4, 8, 12 or 16-bit data busses or full parallel 18-bit data busses. The BCD data inputs are latching (enables data to be stored on electrical command) and bussable in 4-bit NIBBLES. A display blank may be used as a flashing alarm, blinking the display off and on

using an external control. Right-of-digit selectable decimal points are included as well as a minus sign. The DM-4104 doesn't accept analog inputs.

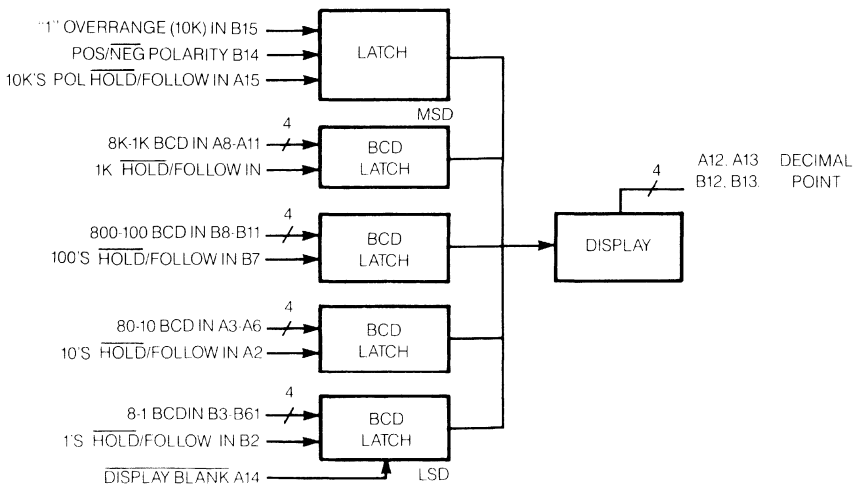
Power requirements of the DM-4104 Slaved Digital Panel Display is an external +5, ±0.25V dc, regulated at 450 mA typical (550 mA maximum). Power current varies rapidly — unregulated power supplies cannot be used. DATEL's UPM-5/1000 Single Output Power Supply is the recommended power supply for the DM-4104.

### ORDERING INFORMATION DM-4104

Model	Description
DM-4104-1	4½ Digit Slave Digital Panel Display (includes one connector)

### ACCESSORIES

Part Number	Description
58-2073083	15-pin edge connector
UPM-5/1000	Power Supply



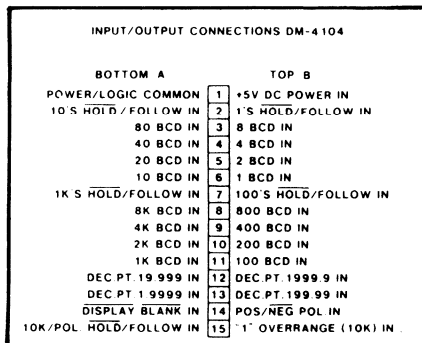
**Simplified Block Diagram of a DM-4104**



**FUNCTIONAL SPECIFICATIONS**

(Typical at 25° C, 2V range unless noted)

- Input configuration** ..... Full parallel BCD, internally latchable in 4-bit nybbles.
- Number of Digits** ..... 4 decimal digits and most significant "1" digit (4½ digits)
- Display Type** ..... Red, light emitting diode (LED), self-illuminated
- Display Height** ..... 0.3 inches (7,6mm)
- Decimal Points** ..... Right-of-digit selectable decimal points are selected by rear connector pins.
- Power Requirement** ..... External +5V, ±0.25V dc regulated required at 450 mA typical, 550 mA maximum. Logic spikes must not exceed 50 mV. Power current varies rapidly so that unregulated supplies cannot be used.
- Connector** ..... Dual 15-pin, 0.100" centers, DATEL #58-2073083 (one included with meter)
  
- Low-Profile** ..... 2.53"W x 3.34"D x 0.94"H
- Case Dimensions** ..... (64,3 x 82,5 x 23,8mm)
- Cutout Dimensions** ..... 2.562"W x 0.97"H (minimum) (65,1 x 24,6mm)
- Mounting Method** ..... See end of this section.
- Mounting Position** ..... See end of this section.
- Weight** ..... 3 ounces (15,9g)
- Operating** ..... (0°C to +50°C)
- Temperature Range** ..... 32°F to 122°F)
- Storage** ..... (-25°C to +85°C)
- Temperature Range** ..... -13°F to 185°F)
- Altitude** ..... 0 to 15,000 feet (4900m)
- Relative Humidity** ..... 10% to 90%, non-condensing



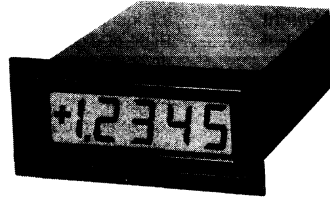
# DM-4105

## Micro-powered LCD Panel Meter with Data Outputs



### FEATURES

- Ultra-low power consumption
- .5" high 4½ digits LCD readout
- Draws only 3 mA from a 5V dc power source
- Balanced differential inputs with 5 pA bias currents
- Autozeroing with ratiometric reference for drift correction
- Right-most digit may be °C or °F descriptor for 3½ digit thermometer applications
- BCD outputs available to drive DM-4106 remote slave displays
- Standard ±1.999V dc input range; user-installed options set other voltage or current ranges.



### GENERAL DESCRIPTION

The DM-4105 is a 4½ digit, LCD-type DPM that uses very little power and produces outputs usable by other devices. The 0.5" high numeric display is visible under ambient room light from many feet away. Digit-serial BCD outputs are available to pass the digitized input signal on to microcomputers, data loggers, or printers.

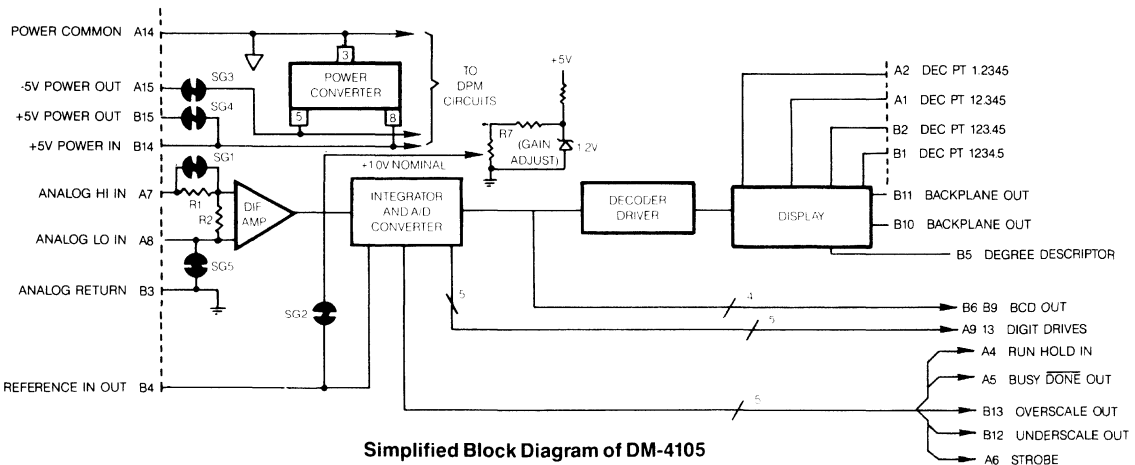
The DM-4105 provides excellent electrical performance in a compact panel-mounting package. Analog inputs have a very high input impedances (1000 Megohm typical) with very low bias currents of 5 pA (typical). Common Mode Rejection Ratio (CMRR) is 86 dB. The meter is autozeroed on each conversion cycle to minimize drift of zero. A Reference In-Out loop can be used to correct drift in externally excited ratiometric circuits.

A variety of designed-in features makes it easy to use the DM-4105 in many applications. Blank circuit pads will accept user-supplied current shunts, voltage dividers, and ohmmeter components. Overrange and Underrange outputs can be used to trigger external autoranging circuitry (the DM-4105 display has Overrange and Underrange descriptors which may be set by the user). In 3½ digit thermometer applications, a degree sign can be enabled on the display, while the right-most digit (LSD) can be solder-gap programmed as "C" for Celsius readings or "F" for Fahrenheit readings.

The DM-4105 is powered from +5V dc at 3 mA typical (5 mA maximum.). It may be powered using 4 "AA" alkaline cells. A -5V output (at up to 15 mA output) is provided to power external circuits. The meter's low-profile polycarbonate case is 2.53"W x 3.25"D x 0.94"H (64,3 x 82,5 x 23,8mm).

### ORDERING INFORMATION

Model	Description
DM-4105-1	4 1/2-digit micro-powered DPM with data output (one connector included)
ACCESSORIES	
Part Number	Description
58-2073083	15-pin edge connector
UPA-5/500	115V AC to 5V dc power adaptor
DM-4106	Low-profile slave display



Simplified Block Diagram of DM-4105

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25°C, 2V range unless noted)

**ANALOG INPUT**

- Full-Scale Input Range** ..... Refer to "FEATURES" Ranges field-modifiable.
- Input Impedance** ..... 100 Megohms (minimum)  
1000 Megohms (typical)
- Input Bias Current** ..... 5 pA (typical) 50 pA (maximum)
- Input Overvoltage** ..... ±250V dc, 175V RMS continuous (maximum)  
±300V intermittent (maximum)
- External Reference Range** ..... ±100 mV to ±2V referred to -Vs
- Common-Mode Rejection** ..... 86 dB (typical), from dc to 60 Hz, with 1 Kilohm unbalanced
- Common-Mode Voltage Range** ..... Both the inputs must remain within 0.5V dc below +5V dc supply and 1.0V dc above -5V dc supply.
- Resolution** ..... 1 mV
- Display Accuracy** ..... Adjustable to ±0.2% of reading, ±2 counts
- Temperature Drift of Zero** ..... Autozeroed ±1 count over 0°C to +50°C temperature range
- Temperature Drift of Gain** ..... ±50 ppm of reading/°C (typical) ±100 ppm of reading/°C (maximum)
- Sampling Rate** ..... 3 conversions per second

**DISPLAY**

- Number of Digits** ..... 4 decimal digits and most significant "1" digit (4½ digits)
- Decimal Points** ..... Selectable using decimal point select signal lines.
- Display Type** ..... Liquid Crystal Display (LCD)
- Display Height** ..... 0.5 inches (12.7mm)
- Overscale** ..... An indicator flashes when inputs exceed the fullscale range.
- Autopolarity** ..... A "+" sign is automatically displayed for positive inputs and a "-" sign for negative inputs. The user may blank the polarity display.

**POWER CONSUMPTION**

The DPM requires +5 to +6V dc regulated at 3mA typical and 5mA maximum. Logic spikes must not exceed 50 mV. Any current taken from the -5V dc output must be added to the above specifications to yield the total meter power consumption. These figures exclude use of the +5V dc output.

**I/O SIGNAL FEATURES**

Besides the common I/O Signals defined elsewhere, this device also has some important I/O features.

**Degree Symbol(°) In (Pin B5)**

The temperature degree symbol may be displayed between the 1's and 10's digit by tying pin B5 to B11. To blank the degree symbol, tie B5 to B10. The 1's digit may be dedicated an F (Fahrenheit) or C (Celsius) unit abbreviation by modifying internal solder gaps. This modification provides a 3½ digit (1.9.9.9.°C) instrument.

**-5V dc Power Out**

Up to 15mA of unregulated -5V dc power may be taken directly from the meter to power external user-supplied circuits such as signal conditioners.

**+5V dc Power Out**

A separate pin on the I/O connector lets the user take +5V dc indirectly from the input power source. The amount of current taken is limited only by the power source.

**PHYSICAL**

**External Dimensions**

2.53"W x 3.34"D x 0.95"H (64,3 x 85 x 23,8mm)

**Panel Cutout Dimensions**

2.562"W x 0.97"H (65,1 x 24,6mm)

**Mounting Method**

Refer to end of this section.

**Weight**

Approximately 5 ounces (142g)

**ENVIRONMENTAL**

**Altitude**

0 to 15,000 feet (4900m)

**Operating Temperature Range**

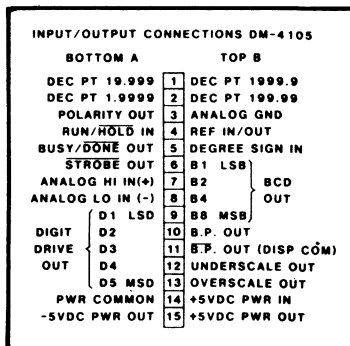
32°F to 122°F (0°C to 50°C)

**Storage Temperature Range**

32°F to 131°F (0°C to 55°C)

**Relative Humidity**

20% to 80% non-condensing



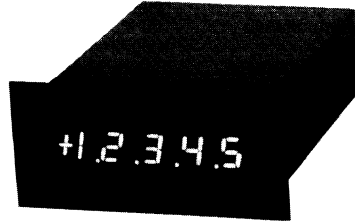
# DM-4200

## 4½ Digit LED Panel Meter with Data Outputs



### FEATURES

- BCD outputs to drive DM-4102 remote slave displays
- $\pm 5V$  dc outputs for user's circuits
- Balanced differential inputs with 5 pA bias currents
- Internal ratiometric reference for drift correction
- High-brightness .3" high LED display
- Standard  $\pm 1.999V$  dc input range; user-installed options set other voltage or current ranges.



### GENERAL DESCRIPTION

The DM-4200 is a 4½ digit DPM using high-brightness LED's and housed in DATEL's low-profile enclosure. Besides offering DATEL's standard input features, this device provides multiplexed BCD outputs. These outputs can drive a remote display, such as the DM-4102, or can be used by an external microprocessor.

A dual slope A/D converter changes the signal inputs to a BCD digital code. Decoder drivers cause the input voltage to be displayed on .3" high LED numerals. The BCD-encoded numerals (digit serial) are also output to a rear-panel connector where they may be used to drive a slave display, or become A/D inputs to a printer or microcomputer.

The DM-4200 is housed in a compact, low profile polycarbonate case only .94" high. The DM-4200 can be used in process control panels, OEM products, and medical instrumentation to provide a clear, unambiguous display of dc voltages.

CMOS input circuitry gives the DM-4200 very high input impedance (1000 M $\Omega$  typical, 100 M $\Omega$  minimum), and a very low input bias current (5 pA typical, 50 pA maximum). The meter's input amplifier is autozeroed to minimize zero drift. The reference voltage is brought out on a rear panel pin (Reference Out), where it can correct drift in external ratiometric bridge circuits.

BCD outputs, multiplexed by digit, are available. The outputs are 1 TTL load, and can be used to drive a remote display.

Overscale and Underscale outputs can be used with external circuits to autorange the meter. A Run/ Hold output can be tied low to stop the meter's A/D conversions, and to continuously display the last reading. A Busy/Done output goes low to indicate the end of an A/D conversion.

A built-in dc-to-dc converter provides -5V Out (at 15 mA maximum) to power user circuits. Power input is +5V dc ( $\pm 25V$ ) regulated at 200 mA typical and 250 mA maximum.

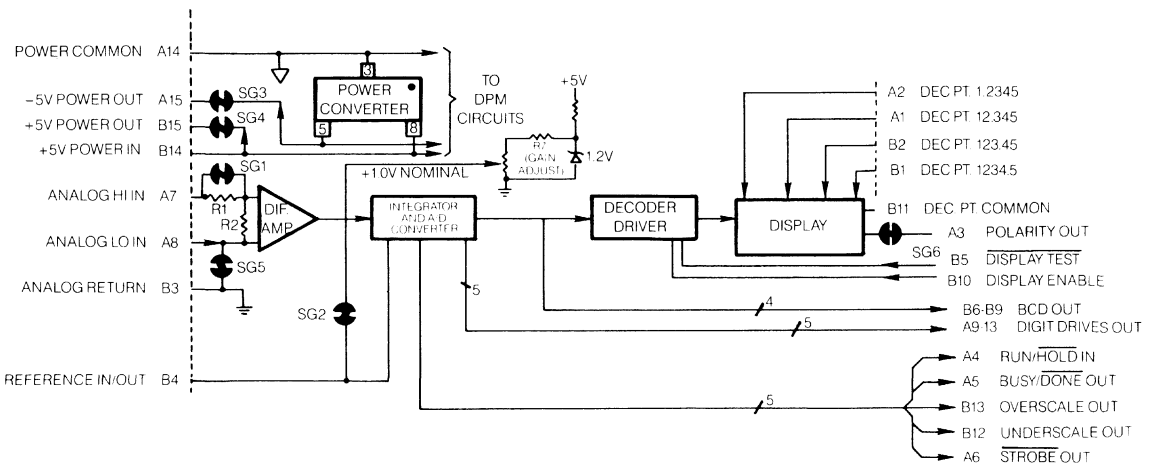
### ORDERING INFORMATION

**DM-4200 - 1**

Model	Description
DM-4200-1	4 1/2-Digit DPM with BCD outputs (includes connector)

### ACCESSORIES

Part Number	Description
DM-4102	Mux'd BCD Slave Display
58-2073083	Dual 15-pin, 0.1" centers, P.C. edgeboard connector
UPA-5/500	115V AC to 5V dc power adaptor



**Simplified Block Diagram of a DM-4200**

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25°C, 2V range unless noted)

**ANALOG INPUT**

- Full-Scale Input Range** ..... Refer to "FEATURES" Ranges field-modifiable.
- Input Impedance** ..... 100 Megohms (minimum)
- Input Bias Current** ..... 5 pA (typical) 50 pA (maximum)
- Input Overvoltage** ..... ±250V dc, 175V RMS continuous (maximum) ±300V intermittent (maximum)
- External Reference Range** ..... ±100 mV to ±2V referred to -Vs
- Common-Mode Rejection** ..... 80 dB (typical), from dc to 60 Hz, with a 1 Kilohm unbalanced input
- Common-Mode Voltage Range** ..... Both the inputs must remain within 0.5V dc below the +5V dc supply and 1.0V dc above the -5V dc supply.
- Resolution** ..... 1 mV
- Display Accuracy** ..... Adjustable to ±0.1% of reading, ±1 count
- Temperature Drift of Zero** ..... Autozeroed ± count over a 0° to +50°C temperature range
- Temperature Drift of Gain** ..... ±50 ppm of reading/°C (typical) ±100 ppm of reading/°C (maximum)
- Sampling Time** ..... 83.3 mS (nominal)
- Sampling Rate** ..... 3 conversions per second.

**DISPLAY**

- Number of Digits** ..... 3 decimal digits and most significant "1" digit (3½ digits)
- Decimal Points** ..... Selectable using decimal point select signal lines.
- Display Type** ..... LED (red, high efficiency)
- Display Height** ..... 0.3 inches high (7.6 mm)
- Overscale** ..... The display indicates inputs exceeding the full-scale range.
- Autopolarity** ..... A "+" sign is automatically displayed for positive inputs and a "-" sign for negative inputs. The user may blank the polarity using the POLARITY ENABLE line.

**POWER CONSUMPTION**

The DPM requires +5, ±0.25 dc regulated at 200mA typical and 400mA maximum. Logic spikes must not exceed 50 mV. Any current taken from the -5V dc output must be added to the above specifications to yield the total meter power consumption. These figures exclude use of the +5V dc output.

**PHYSICAL**

**External Dimensions**

2.53"W x 3.34"D x 0.95"H (64,3 x 85 x 23,8mm)

**Panel Cutout Dimensions**

2.562"W x 0.97"H (65,1 x 24,6mm)

**Mounting Method**

Refer to end of this section.

**Weight**

Approximately 5 ounces(142g)

**ENVIRONMENTAL**

**Altitude**

0 to 15,000 feet (4900m)

**Operating Temperature Range**

32°F to 122°F (0°C to 50°C)

**Storage Temperature Range**

32°F to +131°F (0°C to 55°C)

**Relative Humidity**

20% to 80% non-condensing

**I/O SIGNAL FEATURES**

Besides the common I/O Signals defined elsewhere, this device also has some important I/O features.

**-5V dc Power Out**

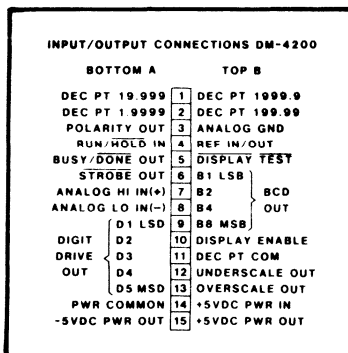
Up to 15mA of unregulated -5V dc power may be taken directly from the meter to power external user-supplied circuits such as signal conditioners.

**+5V dc Power Out**

A separate pin on the I/O connector lets the user take +5V dc indirectly from the input power source. The amount of current taken is limited only by the power source.

**Data Outputs**

4-wire Binary Coded Decimal (BCD 1-2-4-8) per digit, multiplexed. Polarity display may be disabled. This would be used for unsigned reverse sensing (implied positive) applications with negative inputs.



## **Contact DATEL for:**

- **Panel Meters, Printers, & Calibrators**
- **Data Acquisition & Control Boards**
- **Data Conversion Components**
- **Power Supplies**

**Dial  
1-800-233-2765  
for  
Immediate Assistance**

### FEATURES

- Fit into industry standard DIN/NEMA size panel cutouts
- Meets NEMA vibration standards
- 3½ or 4½ digit display
- Bright 0.56" light emitting diode (LED) and 0.5" liquid crystal display (LCD)
- Powered by AC or dc sources
- Overvoltage protection  $\pm 250V$  dc
- High resolution  
0.001V (3½ digit DPM's)  
0.0001V (4½ digit DPM's)
- Balanced high-impedance differential inputs
- Autozeroing capability
- 80 dB CMRR
- Standard  $\pm 1.9999V$  dc input range; user-installed options set other voltage or current ranges.

### GENERAL DESCRIPTION

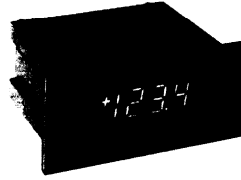
The DM-9000 Series DPM's offer the user 3½ or 4½ digits of display, using either AC or dc power sources. This panel meter line offers two types of displays. The high-efficiency red LED's provide excellent readability from up to 23 feet (7 meters) away, even under bright ambient light. The high contrast LCD's have viewing angles of up to 75 degrees from normal and are ideally suited for low power applications.

These DPM's may be operated in Differential, Single-Ended or Ratiometric modes. In differential mode, the balanced inputs of the DM-9000 Series provide high noise immunity and accurately measure very small signals in the presence of much larger common-mode voltages. The high impedance (100 megohms) will not load down sensitive input circuits. The single-ended mode in the DM-9000 Series DPM's is solder gap selectable and is easy to use for simple applications.

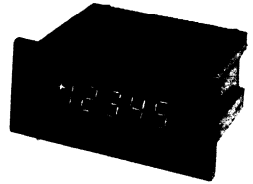
For ratiometric measurements, the DPM's reference the input voltages to the user-supplied voltage using the REF IN/OUT pin (Pin 4). The ratiometric mode of operation corrects for input errors created by drift in transducer excitation sources, i.e., bridge type applications.

The 4½ digit panel meters (DM-92XX models) have OVERRANGE and UNDERRANGE outputs, usable in auto-ranging circuits and a BUSY/DONE output which goes low at the end of each analog-to-digital conversion cycle.

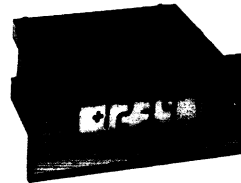
All models accept a HOLD (or RUN/HOLD) signal from the user, inhibiting continuous sampling. The units display the last data sampled, acting as temporary single sample storage and display devices.



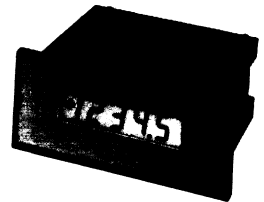
DM-9100  
DM-9115



DM-9200  
DM-9215



DM-9150  
DM-9165



DM-9250  
DM-9265

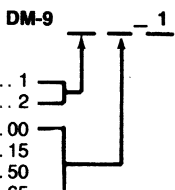
### ORDERING INFORMATION

#### Model

DM-9000 Series

To Order, Specify:

#### Features

3 1/2 Digits .....	1	
4 1/2 Digits .....	2	
LED, dc Power .....	00	
LED, AC Power .....	15	
LCD, dc Power .....	50	
LCD, AC Power .....	65	

#### ACCESSORIES

##### Part Number Description

39-7341560	Screw Terminal Block Connector
58-2073078	Dual 15-pin edge connector (one included with each meter)
UPA-5/500	115V AC to 5V dc Power adapter

Functionally, a DPM is made up of four parts; the integrator and A/D converter, decoder driver, display, and power supply (see Figure 1).

All AC models accept 100, 117, 220 or 240 VAC sources. Refer to Table 1 for power supply pin connections

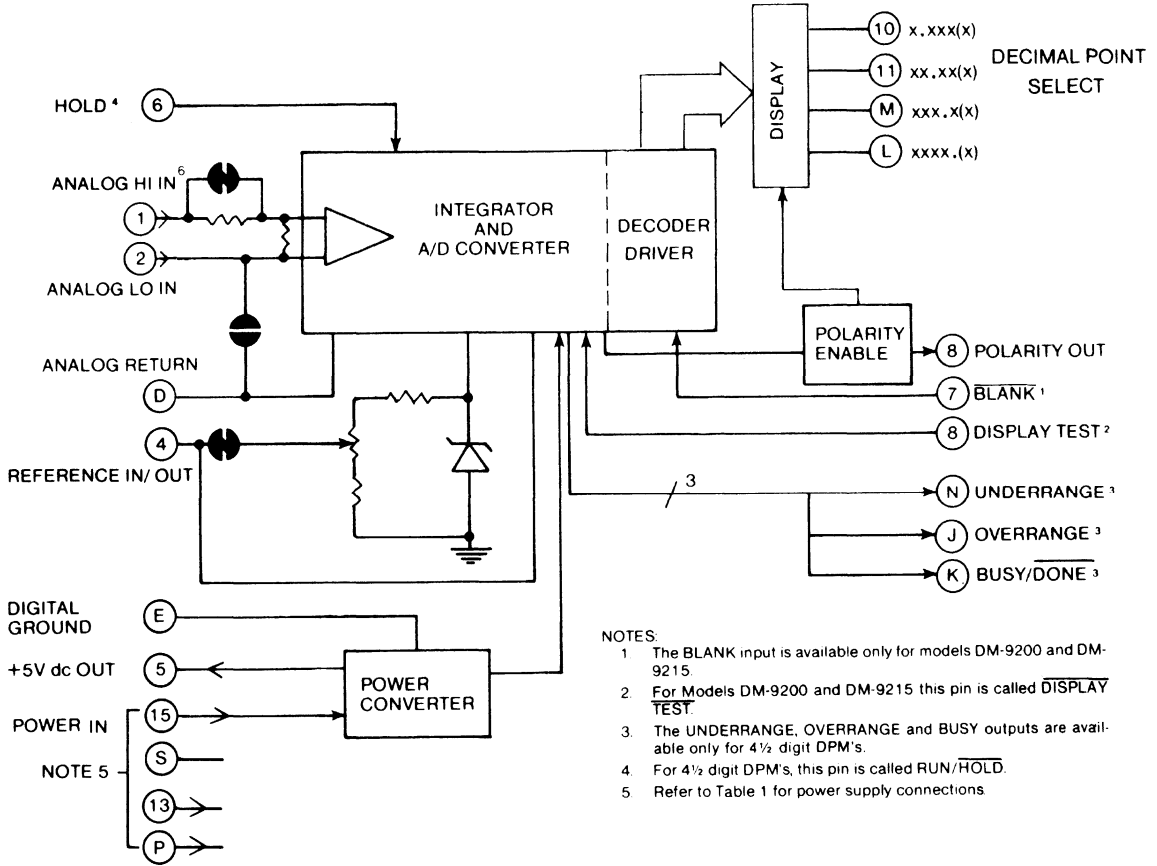


Figure 1. Simplified Block Diagram

Table 1. Power Supply Connections

PIN NUMBER INPUT VOLTAGE	15	13	S	P
5V dc				
115 VAC				
220 VAC				
240 VAC				
100 VAC				

**NOTE**

The DM-9000 Series DPM's uses pins P, 13, 15, and S for power connections. Use of these pins is different for dc and AC models. AC models use different combinations of these pins for different power inputs. It is therefore important to check the information presented here for correct power applications.

Note 1: Pin S is POWER COMMON for dc models.



**FUNCTIONAL SPECIFICATIONS**

(Typical @ 25°C, 2V range unless noted)

**ANALOG INPUT**

**Full Scale Input** ..... Refer to "FEATURES"

**Range** ..... Ranges field-modifiable  
**Input Impedance** ..... 100 Megohms (minimum)  
**Input Bias Current** ..... 5 pA (typical)  
 50 pA (maximum)

**Input Overvoltage**  
**ANALOG LO IN** } ..... ±100V dc  
 continuous, referenced to  
**ANALOG HI IN** } ..... POWER COMMON.  
 ±250V dc (5 seconds  
 maximum) referenced to  
 POWER COMMON.

**External Ref. Range** .... +100 mV to +2V dc  
 referenced to ANALOG  
 RETURN.

**Common-Mode** ..... 80 dB (typical from  
**Rejection** ..... dc to 60 Hz, with a 1 Kilohm  
 unbalanced input

**Common-Mode** ..... Both the inputs must  
**Voltage Range** ..... remain within 0.5V dc below  
 the +5V dc supply and 1.0V  
 dc above the -5V dc supply

**Resolution** ..... 1 mV, 3½ digit DPM's  
 100 µV, 4½ digit DPM's

**Accuracy** ..... Adjustable to ±0.02% of  
 reading (maximum), ±2  
 counts

**Temperature Drift** ..... Autozeroed ±1 count  
**of Zero** ..... over a 0 to +50°C  
 temperature range

**Temperature Drift** ..... +50 ppm of  
**of Gain** ..... reading/°C (typical)  
 ±100 ppm of reading/°C  
 (maximum)

**Warm-Up Time** ..... 5 minutes (typical)

	3½ digit DPM's	4½ digit DPM's
<b>Sampling Time (nominal)</b>	83.3 ms	74 ms
<b>Conversion Time (nominal)</b>	333 ms	296 ms

**DISPLAY SPECIFICATIONS**

**Number of Digits** ..... 3½ and 4½ digits  
**Decimal Points** ..... Selectable  
**Display Type** ..... LED (Red, high efficiency)  
 LCD (Liquid crystal with high  
 contrast ratio, high  
 temperature fluid)  
**Display Height** ..... LED 0.56" (14,22 mm)  
 LCD 0.5" (12,70 mm)  
**Auto Polarity** ..... A "+" sign is automatically  
 displayed for positive inputs  
 and a "-" sign is for negative  
 inputs. The user may blank  
 the polarity using solder gap  
 options.

**Over Scale** ..... The display indicates inputs  
 exceeding the full-scale  
 range. Refer to the table  
 below.

Model Number	Overscale Display
DM-9100, DM-9115, DM-9150, DM-9165 DM-9200, 9215	Blanks the display leaving a "1" MSD and sign.  Blanks "1" MSD and displays all other digits as zeros and flashes.
DM-9250, DM-9265	Blanks "1" MSD, displays all other digits as zeros and flashes error sign (▲ in the top left corner).

**POWER CONSIDERATIONS**

**Power Consumption with no external load**

MODEL	Typical	Maximum
DM-9100	0.9 W	1.1W
DM-9115	2.6W	3.2W
DM-9150	0.02W	0.025W
DM-9165	0.9W	1.1W
DM-9200	0.9W	1.1W
DM-9215	2.6W	3.2W
DM-9250	0.02W	0.025W
DM-9265	0.9W	1.1W

Power output for AC models: +5V dc @ 100mA (maximum)  
 Power output for dc models: Limited by user's dc source

**CALIBRATION**

A screwdriver pot allows adjusting the full scale reading (gain).  
 Zero is automatic (autozeroing). Suggested recalibration period  
 under normal operating conditions is 90 days.

**PHYSICAL-ENVIRONMENTAL**

**External Dimensions**

3.6"W x 3.57"D x 1.67"H (91,44 mm x 90,68 mm x 42,42 mm)

**Panel Cutout Dimensions**

NEMA Standard: 3.924" x 1.682" (99,67 mm x 42,72 mm) DIN  
 Standard: 3.622" x 1.772" (92 mm x 45 mm)

**Weight**

AC models: 11 Ounces (311,8 grams) dc models: 6 Ounces  
 (170,1 grams)

**Altitude**

0 to 15,000 feet (4900 m)

**TEMPERATURE RANGES**

**Operating**

0° to 50° Celsius

**Storage**

-25° to +85° Celsius

**Relative Humidity**

10% to 90%, non-condensing (for LED models) 0 to 90% (non-condensing) from -25° to +35°C derated linearly to 25% at +50°C (for LCD models)

**PIN DETAILS**

Figure 2 shows the pin connections for the different models in the DM-9000 Series.

**INTERNAL GROUNDING CONNECTIONS:**

The internal connections for ANALOG RETURN (Pin D), DIGITAL GROUND (Pin E) and POWER COMMON (Pin S) differ based on the DPM model. For 3½ digit DPM's DIGITAL GROUND and POWER COMMON are internally connected. For 4½ digit DPM's ANALOG RETURN, DIGITAL GROUND and POWER COMMON are internally connected. Depending on the application and input configuration, the user may have to make the grounding connections. POWER COMMON is internal for AC models and is not user accessible.

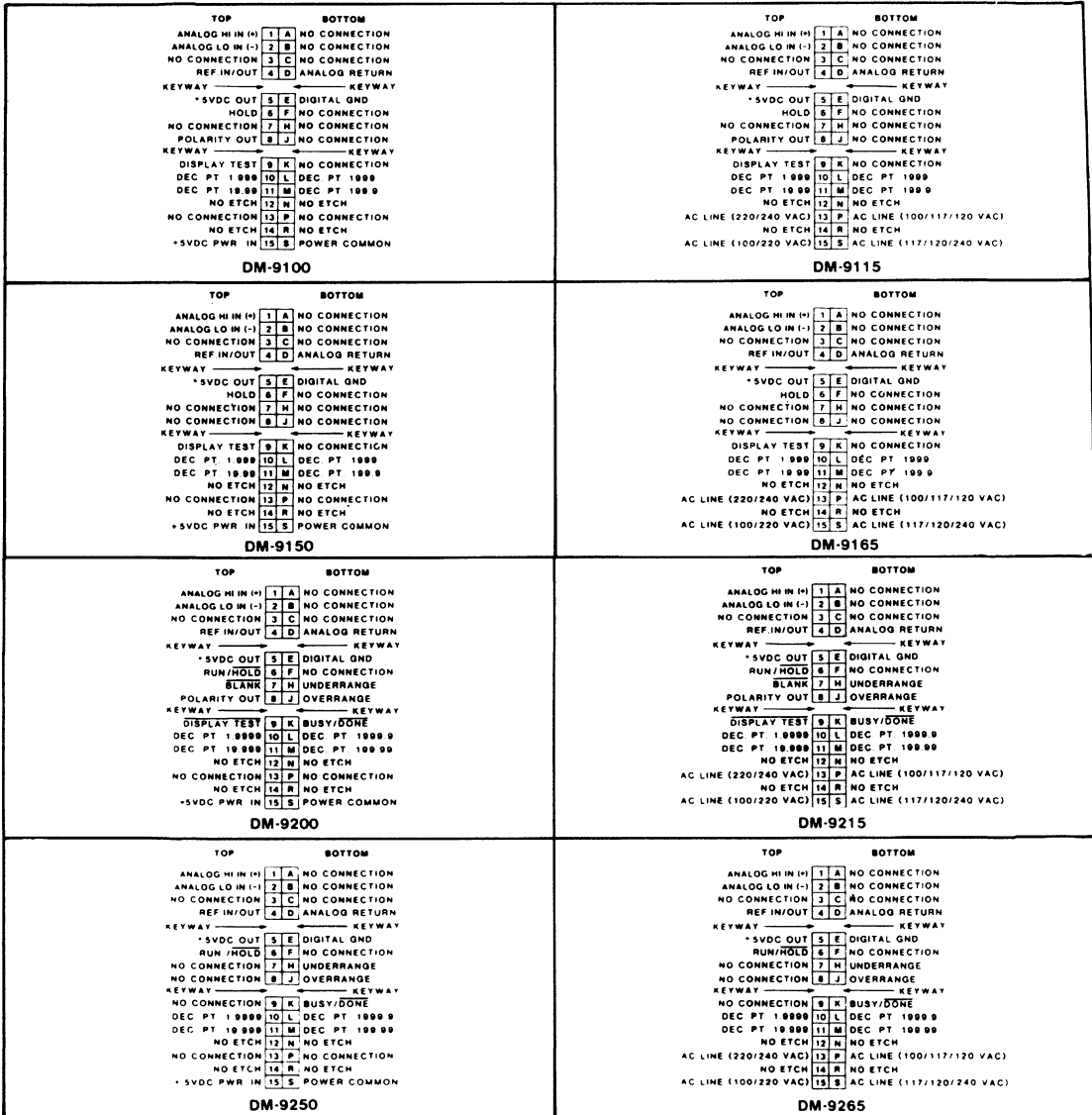


Figure 2. Pin Details of DM-9000 Series DPM's

Table 2 lists the voltage and current levels on the DM-9000 Series DPM's input/output pins.

**Table 2. Logic Levels for Input/Output Pins**

Model Number	Pin Number	Pin	Parameter	Minimum	Typical	Maximum	Units
9100 9115	6	HOLD IN	$V_{IL}$	--	--	1.5	Volts
			$V_{IH}$	3.5	--	--	Volts
	8	POLARITY OUT	Positive Inputs	2.5	--	--	Volts
			Negative Inputs	--	--	0.5	Volts
9150 9165	6	HOLD IN	$V_{IL}$	--	--	1.5	Volts
			$V_{IH}$	3.5	--	--	Volts
9200 9215 9250 9265	6	RUN/ $\overline{\text{HOLD}}$ IN	$V_{IH}$	2.8	2.2	--	Volts
			$V_{IL}$	--	1.6	0.8	Volts
			$I_{IL}$ (@V = 0V)	--	0.02	0.1	milli-amperes
			$I_{IH}$ (@V = 5V)	--	0.1	10	milli-amperes
K 8 H J	BUSY/ $\overline{\text{DONE}}$ POLARITY OUT OVERRANGE OUT UNDERRANGE OUT	$V_{OL}$ (@I = 1.6mA)	--	0.25	0.4	Volts	
		$V_{OH}$ (@I = -1mA)	2.4	4.2	--	Volts	
		$V_{OH}$ (@I = -10 $\mu$ A)	4.9	4.99	--	Volts	
9200 9215	7	$\overline{\text{BLANK}}$ IN	$V_{IL}$	--	--	0.8	Volts

<u>PIN#</u>	<u>SIGNAL</u>	<u>DESCRIPTION</u>	<u>PIN#</u>	<u>SIGNAL</u>	<u>DESCRIPTION</u>
1	ANALOG HI IN	Differential input voltages connect to these inputs. A bias current path to POWER COMMON (if + 5V dc powered) or ANALOG RETURN from both these inputs must be externally provided. External circuits must restrict these inputs to be within the common-mode voltage range.	5	+ 5V dc OUT	This pin delivers + 5V dc (@ 100mA maximum for AC models) for user circuits. The dc model output is limited to the user's dc source limit.
2	ANALOG LO IN		6	$\overline{\text{RUN/HOLD}}$ IN (low = $\overline{\text{HOLD}}$ )	For models DM-9200, DM-9215, DM-9250, and DM-9265 a TTL high (or open) on this pin enables continuous sampling. A TTL low (or ground) will hold and display the last sample for temporary single sample storage. For models DM-9100, DM-9115, DM-9150, and DM-9165 a TTL low (or open) on this pin enables continuous sampling. A TTL high holds the display.
4	REF IN/OUT	The instrument is calibrated when a + 1.0V dc drop exists between this pin and ANALOG RETURN (Pin D). The DPM's are provided with a solder gap option to allow an external ratiometric reference. The external source must be biased against ANALOG RETURN (Pin D).			

<u>PIN#</u>	<u>SIGNAL</u>	<u>DESCRIPTION</u>	<u>PIN#</u>	<u>SIGNAL</u>	<u>DESCRIPTION</u>
7	<u>BLANK IN</u> (active low)	This pin's function is available only on models DM-9200 and DM-9215. A TTL low (or ground) on this pin blanks the display, excluding the selected decimal points and the polarity sign. Data remains valid even with the display blanked.	D	<u>ANALOG RETURN IN</u>	This pin may be used as a reference for some floating inputs. If not possible, inputs may be referenced to POWER COMMON (if + 5V dc powered). ANALOG RETURN is approximately - 2.8V below + Vs and can sink 30 mA to - Vs.
8	<u>POLARITY OUT</u>	This pin goes low when the DPM receives a negative input signal. It is valid even for a zero reading. A display of +0000 means the signal is positive but less than the least significant digit.	H	<u>UNDERRANGE OUT</u> (active high)	This pin goes high if the previous input displays + 1800 counts or less. The pin remains high until the beginning of signal integration in the next measurement cycle.
9	<u>DISPLAY TEST IN</u>	To test the display, apply + 5V dc to this pin for models DM-9100, DM-9115, DM-9150, and DM-9165 or ground this pin for models DM-9200 and DM-9215. The display will read 1.888(8). This pin is not available in models DM-9250 and DM-9265.	J	<u>OVERRANGE OUT</u> (active high)	This pin is high if the previous input signal exceeds the A/D converter range of + 19999 counts. The pin remains high until the beginning of reference integration in the next measurement cycle. UNDERRANGE and OVERRANGE are normally used as up/down ranging gain selection controls for an auto-ranging input selection.
10	<u>DECIMAL POINT SELECT</u> (active low) x.xxx(x)	} Connect the selected decimal point to Pin E, Digital Ground.	K	<u>BUSY/DONE OUT</u> (low=DONE).	This pin goes high during A/D conversions. The pin remains high until the conversion is complete or until the end of a measurement in the case of an OVERRANGE. The pin may be used to prevent the input voltage from changing during conversions.
11	<u>DECIMAL POINT SELECT</u> (active low) xx.xx(x)				
M	<u>DECIMAL POINT SELECT</u> (active low) xxx.x(x)				
L	<u>DECIMAL POINT SELECT</u> (active low) xxxx(x)				

### FEATURES

- Compact, single board design
- 3 1/2 digit LCD display
- Balanced high-impedance differential inputs
- 80dB CMRR
- Low power consumption
- Fits easily into most panel cutouts
- Autozeroing capability
- Ratiometer reference for drift correction
- Standard  $\pm 1.999V$  dc input range; user-installed options set other voltage or current ranges.



### GENERAL DESCRIPTION

The DM-LX3 is a compact, uncased, single board digital panel meter (DPM). The DPM displays a range of input voltages and currents on a 0.75" LCD display. The DM-LX3 operates on logic power (+5V dc) or 4 "AA" alkaline batteries.

Despite its small size and low cost, the DM-LX3 offers very high instrument performance. CMOS circuitry provides 1000 Megohm input impedance and 5 picoamp input bias current; the meter will not "load down" sensitive input signals. Analog inputs to the meter are balanced differential, and offer 80 dB Common Mode Rejection. Overvoltages to  $\pm 250V$  dc (175 VRMS) are handled without damage.

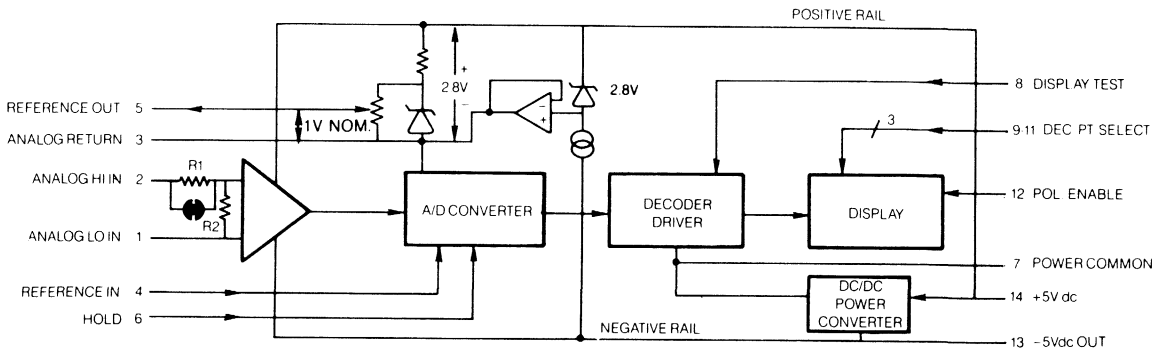
A significant feature is an externally-accessible Reference In-Out loop which sets the meter's gain. This permits the DM-LX3 to be used in ratiometric applications such as a digital ohmmeter. Here, an external reference voltage, derived from a bridge-type input circuit, causes the meter's gain to compensate for voltage drift in the bridge excitation source.

Other circuit features include autopolarity, a display hold circuit, and a selectable display test. Autozeroing holds the meter's zero drift to  $\pm 1$  count maximum over the 0°C to 50°C operating range. Temperature drift of gain is typically within  $\pm 50$  ppm of reading/°C. The meter's on-board dc-to-dc converter can also be used to supply -5V out at 20 mA maximum to power user-supplied signal conditioning components.

### ORDERING INFORMATION

DM-LX3-1

Model	Description
DM-LX3-1	3 1/2 Digit single board DPM with Liquid Crystal Display (includes one P1 connector)
ACCESSORIES	
Part Number	Description
39-2106705	P1 connector for J1 jack; 14-pin DIP connector and cover
UPA-5/500	115V AC in, +5V dc (@ 500 mA) out, power adaptor



Simplified Block Diagram of a DM-LX3

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25°C, 2V range unless noted)

**ANALOG INPUT**

<b>Full-Scale Input Range</b>	Refer to "FEATURES" Ranges field-modifiable.
<b>Input Impedance</b>	100 Megohms (minimum) 1000 Megohms (typical)
<b>Input Bias Current</b>	5 pA (typical) 50 pA (maximum)
<b>Input Overvoltage</b>	±250V dc, 175V RMS continuous (maximum) ±300V intermittent (maximum)
<b>External Reference Range</b>	±100 mV to ±2V referred to -Vs
<b>Common-Mode Rejection</b>	80 dB (typical), from dc to 60 Hz, with a 1 Kilohm unbalanced input
<b>Common-Mode Voltage Range</b>	Both the inputs must remain within 0.5V dc below the +5V dc supply and 1.0V dc above the -5V dc supply.
<b>Resolution</b>	1 mV
<b>Display Accuracy</b>	Adjustable to ±0.1% of reading, ±1 count
<b>Temperature Drift of Zero</b>	Autozeroed ±1 count over a 0° to +50°C temperature range
<b>Temperature Drift of Gain</b>	±50 ppm of reading/°C (typical) ±100 ppm of reading/°C (maximum)
<b>Sampling Time</b>	83.3 mS (nominal)
<b>Sampling Rate</b>	3 conversions per second.

**DISPLAY**

<b>Number of Digits</b>	3 decimal digits and most significant "1" digit (3½ digits)
<b>Decimal Points</b>	Selectable using decimal point select signal lines.
<b>Display Type</b>	LCD
<b>Display Height</b>	0.75" (19mm)
<b>Overscale</b>	The inputs exceeding the full- scale range display "+1" MSD with zeroes blanked.
<b>Underscale</b>	The inputs below the 1800 counts display "-1" MSD with zeroes blanked.
<b>Autopolarity</b>	A "+" sign is automatically displayed for positive inputs and a "-" sign for negative inputs. The user may blank the polarity using the POLARITY ENABLE line.

**CALIBRATION**

A multiturn screwdriver pot adjusts the full scale reading (gain). Zero is automatic (autozeroing). Suggested recalibration is 90 days.

**PHYSICAL****External Dimensions**

4.0"W x 2.0"H x 0.56"D (102 x 51 x 14 mm)

**Panel Cutout Dimensions**

2.88" x 1.13" (72 x 29 mm) (Requires a 0.125" (3.2 mm) diameter hole for gain adjust pot)

**Weight**

1.8 ounces (52g)

**ENVIRONMENTAL****Altitude**

0 to 15,000 feet (4900m)

**Operating Temperature Range**

+32°F to 122°F (0° to 50°C)

**Storage Temperature Range**

+32°F to +131°F (0°C to 55°C)

**Relative Humidity**

20% to 80% non-condensing

**I/O SIGNAL FEATURES**

Besides the common I/O Signals defined elsewhere, this device also has some important I/O features:

**-5V dc OUT (Pin 13)**

A voltage output may be used from the internal dc-to-dc converter to power user-supplied external circuitry.

**POWER CONSUMPTION****+5V dc POWER IN**

+5V dc (3.5 to 7.0V dc) at 3.5mA nominal. May be supplied from four "AA" alkaline batteries in series, or a regulated (+/-5%) power supply (DATEL UPA-5/500).

**dc POWER OUT**

-5V dc (-3.5V to -7.0V dc, depending on input) @ 20 mA maximum.

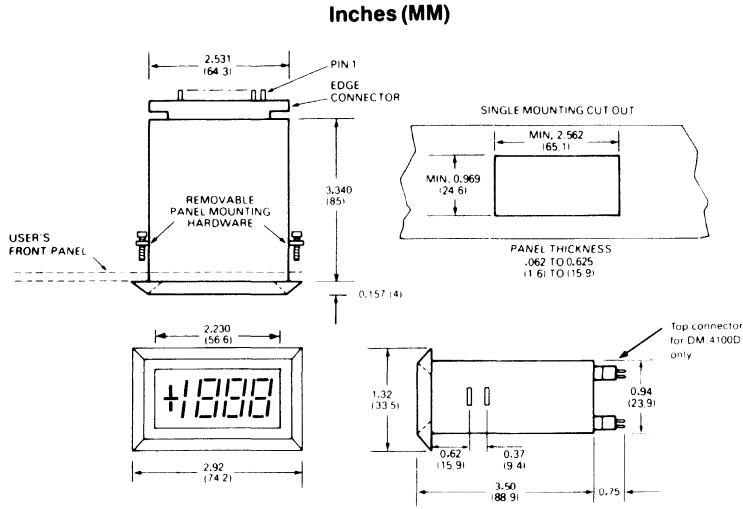
Any current taken at -5V dc out must be added to +5V power to yield total meter power.

## DIGITAL PANEL METER CASE MOUNTING CONFIGURATIONS

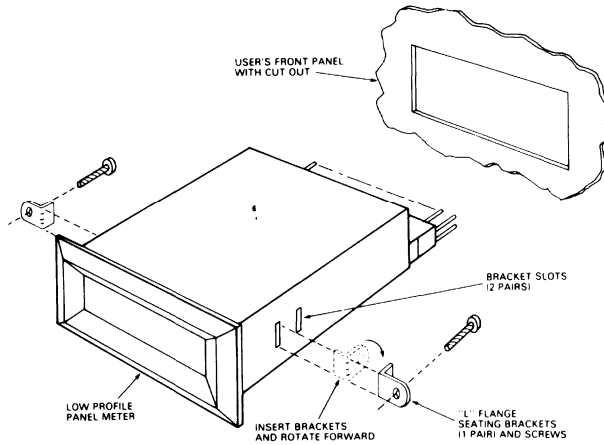
DATEL DPM cases are designed to meet different industry-standard specifications. Table 1 shows the different case dimensions and the DPM models. A user may select a DPM depending on the front panel requirements: low profile, short depth, DIN, or NEMA dimensions. Some DPM models also meet NEMA vibration specifications.

### DPM Case Dimensions

Case Type	Dimensions W x D x H	DPM Model Number
Low-Profile	2.53" x 3.34" x 0.94" (64,3 x 84,8 x 23,8 mm)	DM-3100N
		DM-3100U1
		DM-3100U2
		DM-3100U3
		DM-3102
		DM-4100D
		DM-4101N
		DM-4102
		DM-4104
		DM-4105
		DM-4106
DBM-20		
Short-Depth	3.00" x 2.15" x 1.76" (76,2 x 54,6 x 44,7 mm)	DM-3100B
		DM-3100L
		DM-3100X
		DM-4101L
		DM-4103
PC-6		
DIN/NEMA	3.6" x 3.57" x 1.67" (91,44 x 90,68 x 42,42 mm)	DM-9100
		DM-9115
		DM-9150
		DM-9165
		DM-9200
		DM-9215
		DM-9250
DM-9265		
Uncased	4.0" x 2.0" x 0.56" (102 x 51 x 14 mm)	DM-LX-3
		3.5" x 2.0" x 0.5" (88,9 x 50,8 x 12,7 mm)

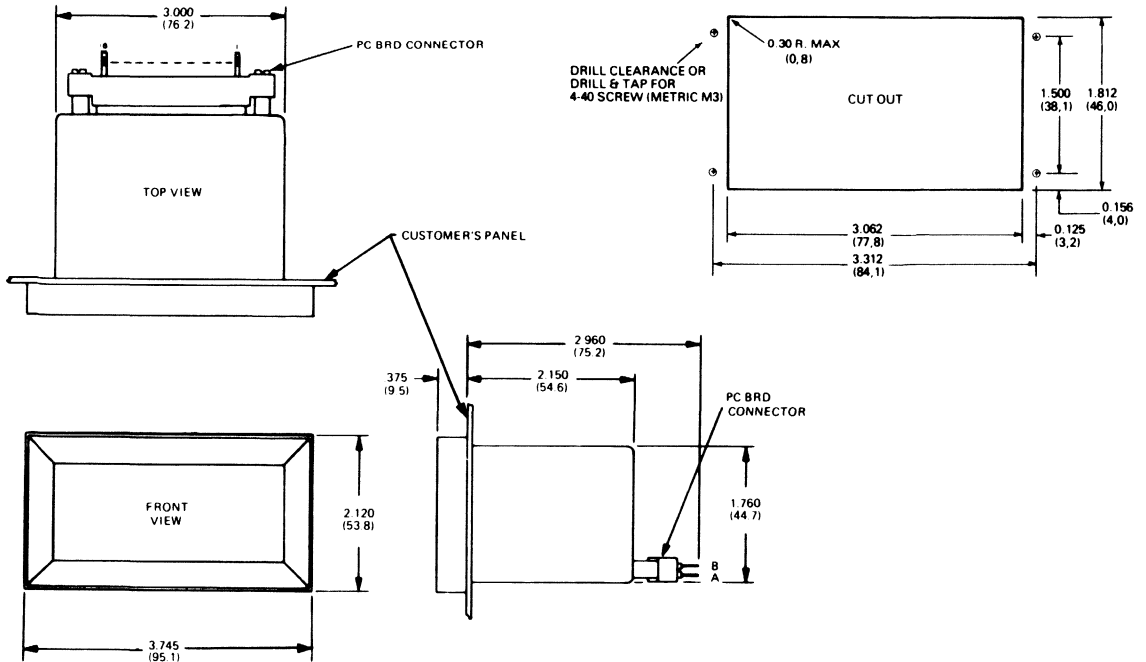


**Mechanical and Panel Cutout Dimensions for a Low-Profile DPM Case**

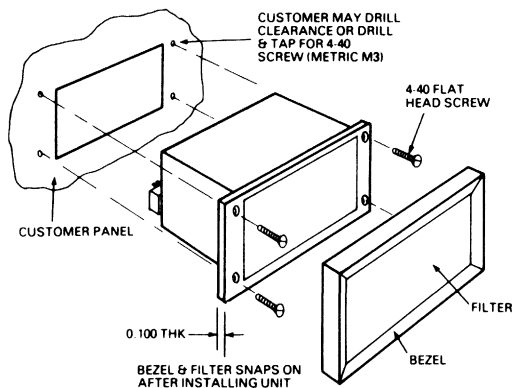


**Panel Installation of a Low-Profile DPM Case**

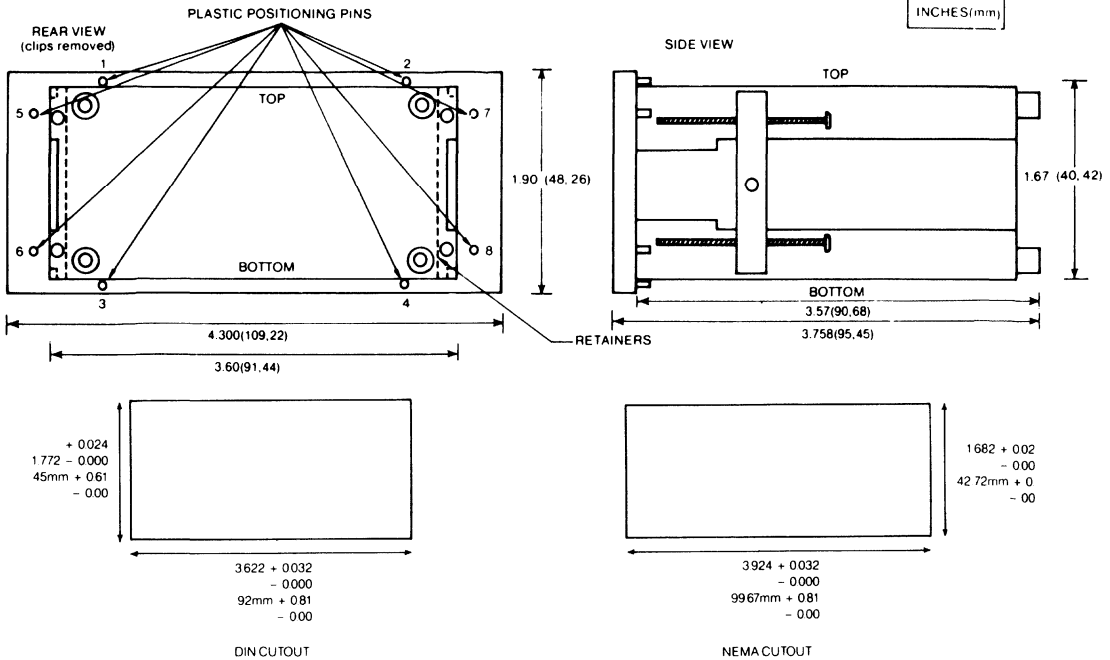




**Mechanical and Panel Cutout Dimensions of a Short-Depth DPM Case**

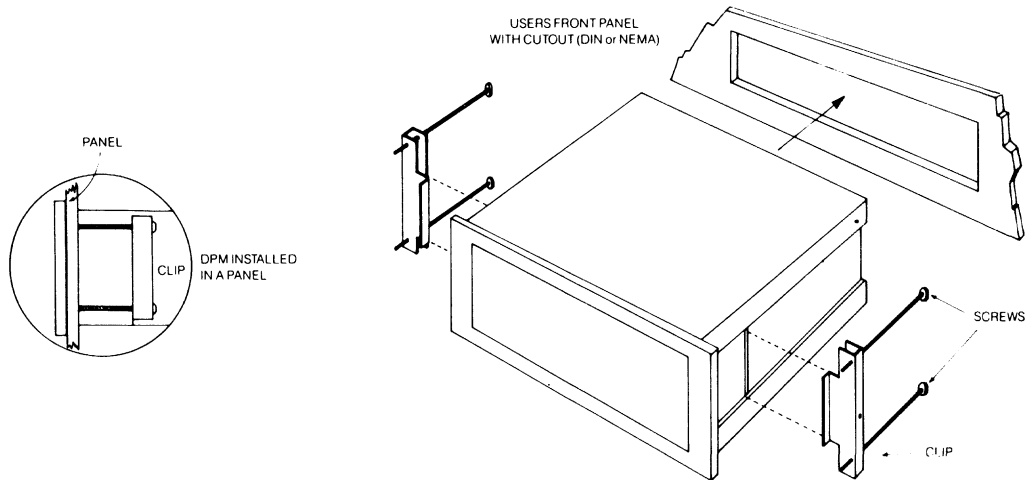


**Panel Installations of a Short-Depth DPM Case**

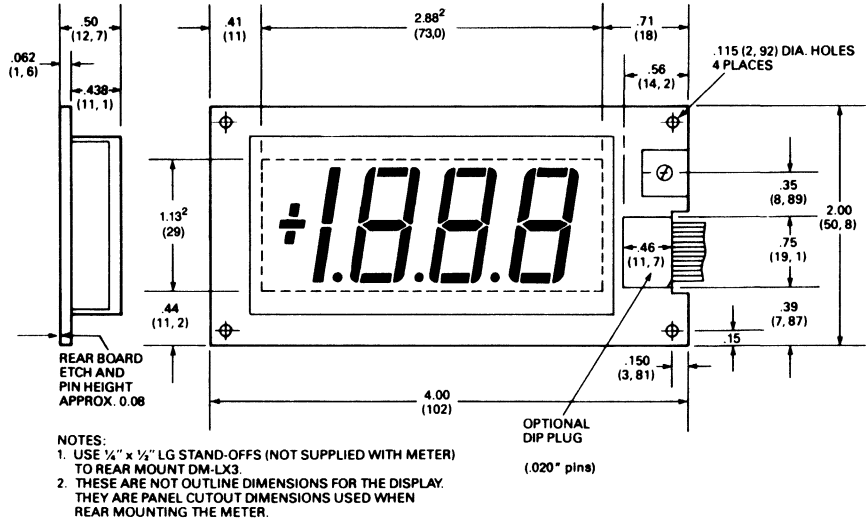


Note: The DM 9000 Series DPM Case is designed to fit into industry standard DIN or NEMA size panel cutouts. Remove the plastic positioning pins 1, 2, 3 and 4 to fit the DPM into NEMA size panel cutout, or pins 5, 6, 7, and 8 to fit the DPM into a Din size panel cutout.

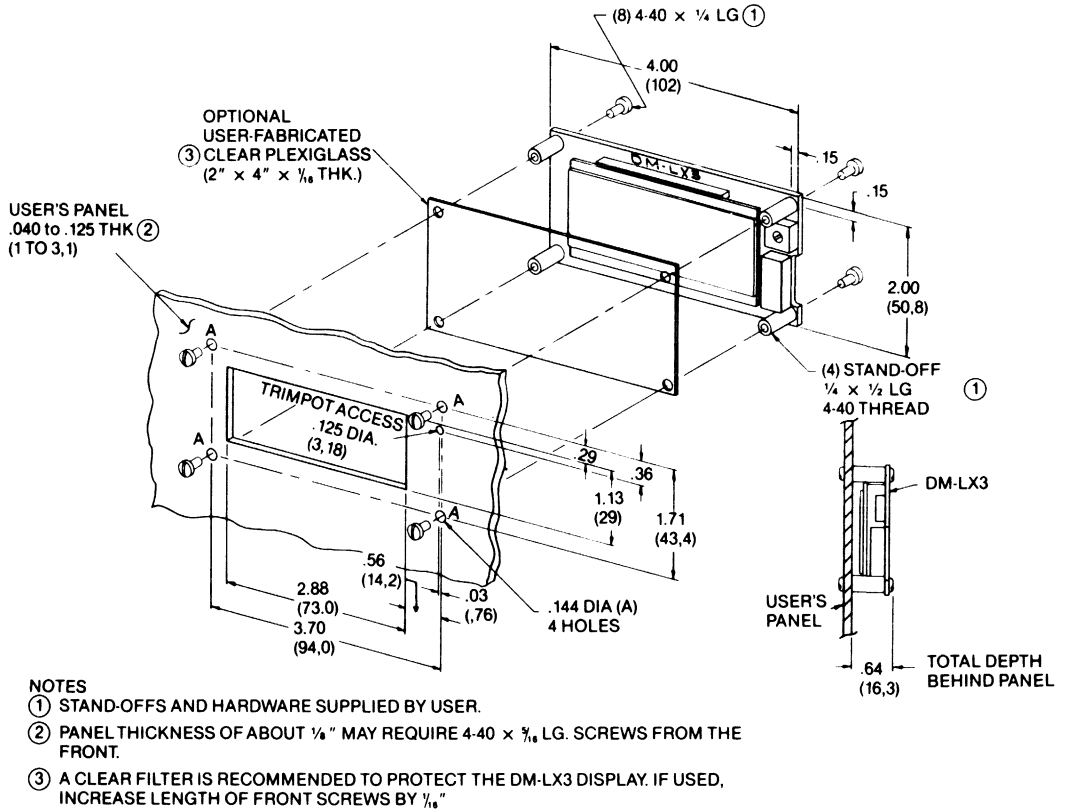
**Mechanical and Panel Cutout Dimensions of a DIN/NEMA DPM Case**



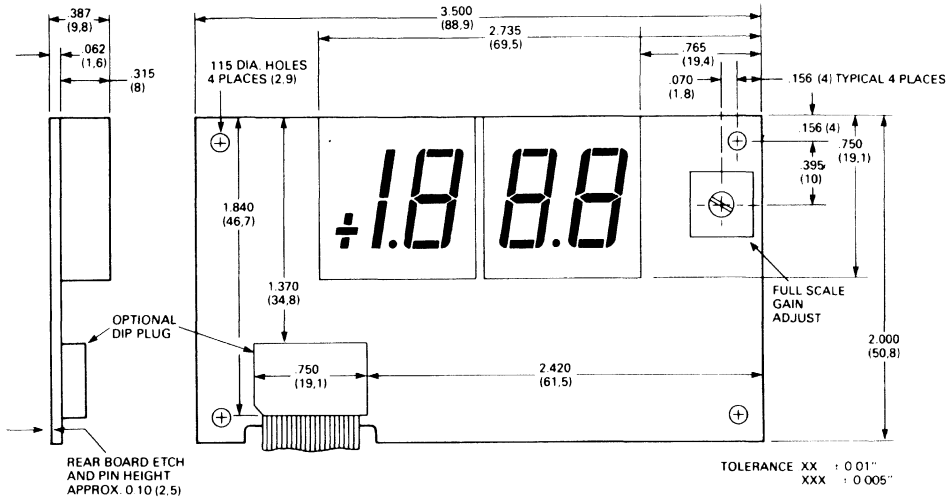
**Panel Installation of a DIN/NEMA DPM Case**



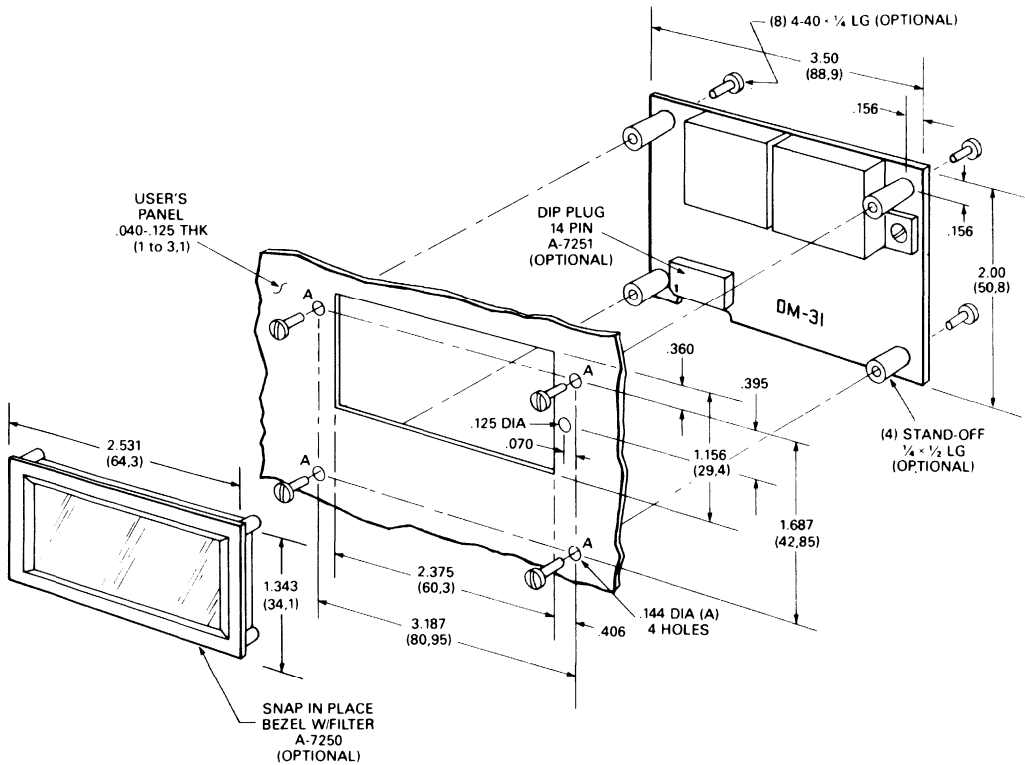
**DM-LX3 Mechanical Dimensions**



**DM-LX3 Panel Mounting**



DM-31 Mechanical Dimensions



DM-31 Panel Mounting with Optional Bezel/Filter

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**FUNCTIONAL PINOUT DESCRIPTION**

<b>ANALOG HI IN ANALOG LO IN</b>	Differential input voltages connect to these inputs. A bias current path to POWER COMMON or ANALOG RETURN from both these inputs must be externally provided. External circuits must restrict these inputs to be within the common-mode voltage range.
<b>ANALOG RETURN IN</b>	This signal line may be used as a reference for some floating inputs. If not possible, inputs may be referenced to POWER COMMON. ANALOG RETURN is approximately -2.8V below +Vs and can sink 30 mA to -Vs.
<b>ATTENUATOR IN</b>	This signal line is used as ANALOG HI IN line for higher voltage and current ranges. Install the attenuator and shunt resistors prior to using this signal line.
<b>BLANK IN</b>	Activating this signal line blanks the display, excluding the selected decimal points and the polarity sign. Data remains valid even with the display blanked.
<b>BUSY/DONE OUT</b>	This signal line is active during A/D conversions. The signal line remains active until the conversion is complete or until the end of measurement in the case of an OVERRANGE. This signal line may be used to prevent the input voltage from changing during conversions.
<b>BCD OUT</b>	Depending on the DPM model, these signal lines are digit serial outputs or 3-state outputs. Refer to the data sheets for details on these signal lines.
<b>DATA READY OUT</b>	This signal is a short pulse (10 microseconds) which is produced 10 microseconds after the data is valid in the DPM latches. This signal line may be used to trigger an external microprocessor-based device.
<b>DECIMAL POINT SELECT IN</b>	The decimal points are selectable depending upon the application and range of operation. To select a decimal point on the display, connect the decimal point signal line to ground or DECIMAL POINT COMMON.
<b>DESCRIPTORS IN</b>	Some DPM models are equipped with descriptors to display electrical units. The descriptors function as labels only. They do not select functions.
<b>DIGIT DRIVES OUT</b>	These signal lines multiplex the BCD data and direct the BCD to the proper digit. These signal lines scan the five displays approximately 150 times per second (1.3 Milliseconds per digit). DIGIT DRIVES may be used for driving remote slave displays.
<b>DISPLAY ENABLE IN</b>	This signal line must be active for normal operation. Not activating this signal line blanks the display, but keeps the A/D converter sampling to reduce display turn-on drift.
<b>DISPLAY TEST IN</b>	Activating this signal line displays 1888 on the DPM.
<b>EOC OUT</b>	This signal line goes high during A/D conversions. This may be used to prevent the input voltage from changing during conversions.
<b>EXT REF LO IN</b>	The reference input from an external source must be referred to this signal line.
<b>HOLD IN</b>	Activating this signal line will hold and displays the last sample storage.

<b>HORIZONTAL POLARITY</b>	Activating this signal line displays the horizontal portion of the polarity sign.
<b>OFFSET OUT</b>	This signal line provides a 0 to 6.9V dc output referred to the negative rail. Using this signal line requires installing optional offset potentiometer.
<b>OHMS LO OUT</b>	This signal line is used in the ohmmeter configuration only. This signal line is 6.9V dc above the DPM's -5V dc negative rail.
<b>OVERRANGE OUT</b>	This signal line is high if the previous input signal exceeds the A/D converter range of +19999 counts. The signal line remains high until the beginning of reference integration in the next measurement cycle. UNDERRANGE and OVERRANGE are normally used as up/down ranging gain selection controls for an auto-ranging input selection.
<b>OUT OF RANGE OUT</b>	See OVERRANGE.
<b>OVERSCALE OUT</b>	See OVERRANGE.
<b>POLARITY ENABLE IN</b>	Activating this signal line causes a '+' sign to be displayed for positive inputs and a '-' sign for negative inputs.
<b>POLARITY OUT</b>	This signal line is active when the DPM receives a negative input signal. It is valid even for a zero reading. A display of +0000 means the signal is positive but less than the least significant digit.
<b>POWER COMMON IN</b>	The common of the external dc power source must be connected to this signal line. This signal line may also be used as a bias current return path for signal inputs.
<b>REFERENCE IN</b>	Normally the DPM is calibrated when a +1V dc drop exists between the signal line and ANALOG RETURN. For ratiometric operation, an external reference is biased against ANALOG RETURN, on EXT REF LO.
<b>REFERENCE OUT</b>	This signal line is normally jumpered to the REFERENCE IN LINE. This signal line is approximately +1V dc above ANALOG RETURN.
<b>REF IN/OUT</b>	The DPM is calibrated when a +1V dc drop exists between the signal line and ANALOG RETURN. The DPM's are provided with an option to allow external ratiometric reference. The external source must be biased against ANALOG RETURN, on EXT REF LO.
<b>RUN/HOLD IN</b>	See HOLD.
<b>STROBE OUT</b>	After every A/D conversion, five negative pulses of approximately 6.7 microseconds width and approximately 1.3 milliseconds apart are issued on this line. The STROBE signal indicates that valid multiplexed data is available on the BCD data output lines. The data starts with the most significant digit.
<b>UNDERRANGE OUT</b>	This signal line is active if the previous input displays 1800 counts or less. The signal line remains high until the beginning of signal integration in the next measurement cycle.
<b>UNDERSCALE OUT</b>	See UNDERRANGE.
<b>VERTICAL POLARITY</b>	This signal line must be used with the HORIZONTAL POLARITY line for automatic sign display of bipolar inputs.

## **Contact DATEL for:**

- **Panel Meters, Printers, & Calibrators**
- **Data Acquisition & Control Boards**
- **Data Conversion Components**
- **Power Supplies**

**Dial  
1-800-233-2765  
for  
Immediate Assistance**

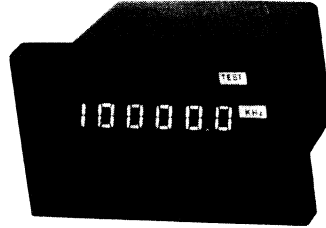
# PC-6

## Programmable 10 MHz Counter-Timer



### FEATURES

- Performs five functions: unit counter, frequency counter, sub-second period counter, frequency ratio counter, and sub-second interval timer
- Offers four full-scale ranges to measure frequency and time (period and interval)
- All functions, ranges, and input slopes programmable using TTL-compatible inputs or front-access command switches
- 6-digit LED display with descriptors



### GENERAL DESCRIPTION

The DATEL PC-6 is a low cost, ultra-compact, programmable 10 MHz Universal Counter-Timer. Frequency and time measurements are displayed on a 6-digit, .3" high Light Emitting Diode (LED) display. The counter is housed in a panel-mount polycarbonate short depth case.

Frequency measurements to 10 MHz can be made using an internal crystal timebase (Frequency Counter function, with the measured Frequency display in kHz), or with an external timebase (Frequency Ratio Counter where FA/FB is displayed). The PC-6 can also function as a Unit Counter, a Sub-Second Period Timer (single input, measuring the period of a single waveform), or a Sub-Second Interval Timer (dual input, measuring the time period from a start pulse on Input A to a stop pulse on Input B). Four ranges for each function permit resolution on frequency measurements to .1 Hz and resolution on time measurements to 100 pS.

The PC-6 differs from many available Universal counter-timers in being programmable. Counter function, range, and input slope are selected by a binary code. The code is input either

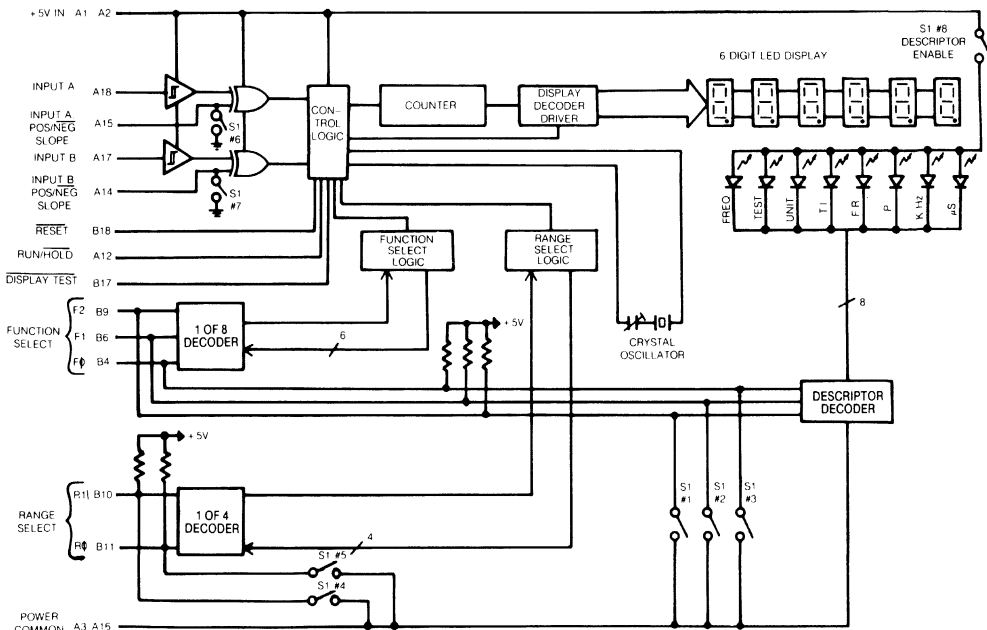
electrically on rear-panel, TTL-compatible digital inputs; or manually by setting a front-access Command DIP Switch.

### ORDERING INFORMATION

To Order, Specify: PC-6

#### ACCESSORIES

Part Number	Description
58-2075010	Dual 18-pin edge connector
UPA-5/500	115V AC in, +5V dc (@ 500mA) out power adaptor



Simplified Block Diagram of a PC-6



**SPECIFICATIONS**

(Typical at +25° C unless noted)

**FUNCTIONS**

**Unit (Event) Counter**

Event counter displays total number of low-to-high transitions (or high-to-low, see Input Slope Selection Chart). Clears by RESET (Pin B-18).

**Measurement Range** . . . . .999,999 counts occurring at up to 10 MHz rate.

**Frequency Counter**

**Measurement Range** . . . . .10 MHz max. with 50 nS min. pulse width.

**Full Scale Ranges** . . . . .10000.0 kHz, 9999.99 kHz, 999.999 kHz, 99.9999 kHz.

**Gate Times** . . . . .User-selectable: 10mS, 100mS, 1S, 10S.

**Timebase** . . . . .Internal.

**Displayed Unit** . . . . .kHz.

**Sub-Second Period Timer (Single Input)**

**Measurement Range** . . . . .500 nS to .999999S.

**Full Scale Ranges** . . . . .999999.9  $\mu$ S, 9999.99  $\mu$ S, 999.999  $\mu$ S, 99.9999  $\mu$ S.

**Cycles Measured** . . . . .User-selectable: 1, 10, 100, 1000.

**Displayed Unit** . . . . . $\mu$ S.

**Frequency Ratio Counter**

Frequency Ratio Counter measures a frequency at Input A referenced to another frequency at Input B, and displays the unitless ratio FA/FB.

**Full Scale Ranges** . . . . .99999.9:1, 9999.99:1, 999.999:1, 99.9999:1.

**Frequency Range, Input A** . . . . .10 MHz maximum with 50% duty cycle square waves

**Frequency Range, Input B** . . . . .2.0 MHz maximum

**Cycles Measured** . . . . .User-selectable: 1, 10, 100, 1000.

**Displayed Unit** . . . . .Pure ratio, FA/FB.

**Sub-Second Interval Timer (Dual Input)**

Time Interval Timer measures time period from a start pulse at Input A to a stop pulse at Input B.

**Measurement Range** . . . . .500 nS to .999999S.

**Full Scale Ranges** . . . . .999999.9  $\mu$ S, 9999.99  $\mu$ S, 999.999  $\mu$ S, 99.9999  $\mu$ S.

**Cycles Measured** . . . . .User-selectable: 1, 10, 100, 1000.

**Displayed Unit** . . . . . $\mu$ S.

**Test**

Test measures the PC-6 internal oscillator frequency (10 MHz nominally).

**Resolution** . . . . .10 Hz, 10 Hz, 1 Hz, .1 Hz.

**Gate Times** . . . . .User-selectable: 10 mS, 100 mS, 1S, 10S

**Overall Accuracy**

$\pm 1$  count

**Crystal Accuracy**

10 ppm accuracy, total (typical) over full temperature range.

**Display**

Six self-illuminated red LED digits, .3" (7,6mm) high.

**Decimal Point**

A decimal point is automatically positioned to set display for units shown

**Descriptors**

Set of 8 LED lamps, which illuminate lenses to indicate Function and Displayed Unit. consists of: FREQ, TEST, UNIT, T.I. (Time Interval), F.R. (Frequency Ratio), P (Period), kHz, and  $\mu$ S. Descriptors are automatically selected with Function and Range Selection, or may be disabled by opening Command Switch #8.

**Overrange**

"Over" lamp on front panel lights: counting on displayed digits continues

**Front-Access Control**

Command Switch S1 can be used to select Function, Range, Input Slope, and to enable or disable Descriptors

**Time Between Measurement Cycles**

200mS, all Functions, all Ranges.

**I/O SIGNAL FEATURES**

**+5V IN (Pins A-1, A-2)**

**POWER COMMON (Pins A-3, A-16)**

Power to PC-6 is input here: +5V (regulated) @ 350 mA required. All logic inputs may be tied to +5V IN for Logic Hi; all inputs may be tied to POWER COMMON for Logic Lo. All inputs are returned at POWER COMMON.

**INPUT A (Pin A-18)**

**INPUT B (Pin A-17)**

Signals to be measured are input here (return at POWER COMMON). INPUT A is used for all functions except Test. INPUT B is used only in Frequency Ratio and Time Interval functions

**INPUT A: POS/ $\overline{\text{NEG}}$  SLOPE IN (Pin A-15)**

**INPUT B: POS/ $\overline{\text{NEG}}$  SLOPE IN (Pin A-14)**

These logic inputs select positive or negative slopes for INPUT A and INPUT B (see "Input Slope Selection" Chart). Connecting either input to POWER COMMON sets that input for a negative slope; connecting either to +5V IN selects a positive slope.

1 = Logic HI (+3.5V < VH < +5V).  
0 = Logic LO (0V < VL < +1.5V).

**F2 (Pin B-9) FUNCTION**

**F1 (Pin B-6) INPUT**

**F0 (Pin B-4) CODE**

**R1 (Pin B-10) RANGE**

**R0 (Pin B-11) INPUT CODE**

These five pins select all Functions and Ranges on the PC-6. See "PC-6 Function and Range Selection Chart" for details. Inputs are CMOS with 10k $\Omega$  pull-ups to +5V for compatibility with open collector logic.

1 = Logic HI (+3.5V < VH < +5V).

0 = Logic LO (0V < VL < +1.5V).

**RESET INPUT (Pin B-18)**

Connecting this pin to POWER COMMON stops any measurement in progress, resets the main counter, and displays all zeros. Tie to +5V IN for normal operation. Input is to a Schmitt Trigger (negative-going threshold = 1.5V typ; positive-going threshold is +0.8V typ).

**POWER REQUIREMENTS**

+5V IN regulated at 350 mA typical between pins A1 / A2 (+5V IN) and A3/A16 (POWER COMMON). Logic spikes must not exceed 50 mV. Current varies rapidly as digits switch so that unregulated supplies cannot be used.

**PHYSICAL-ENVIRONMENTAL**

Outline Dimensions Short-Depth Case, 3.00"W x 2.15"D x 1.76"H (76,2 x 54,6 x 47,7 mm)

**Cutout Dimensions**

1.812"H x 3.062"W (46,0 x 77,7 mm)

**Mounting Method**

See end of this section.

**Weight**

Approximately 7.4 ounces (210 g)

**Operating Temperature Range**

0° to +50°C (32° to 122°F)

**Storage Temperature Range**

-25°C to +85°C (-13° to +185°F)

**Altitude**

0 to 15,000 feet (4900m)

**Relative Humidity**

10% to 90% non-condensing

INPUT OUTPUT CONNECTIONS PC-6		
BOTTOM A		TOP B
+5V PWR IN	1	NO CONNECTION
	2	NO CONNECTION
PWR COMMON	3	NO CONNECTION
NO CONNECTION	4	FUNCTION F0
KEYWAY	5	KEYWAY
NO CONNECTION	6	NO CONNECTION
NO CONNECTION	7	FUNCTION F1
NO CONNECTION	8	NO CONNECTION
NO CONNECTION	9	FUNCTION F2
NO CONNECTION	10	RANGE R1
NO CONNECTION	11	RANGE R0
	12	NO CONNECTION
NO CONNECTION	13	NO CONNECTION
B SLOPE	14	NO CONNECTION
A SLOPE	15	NO CONNECTION
PWR COMMON	16	NO CONNECTION
INPUT B	17	DISPLAY TEST
INPUT A	18	RESET

THE WAVEFORMS BELOW INDICATE THE MINIMUM TIMES AN INPUT MUST BE HIGH OR LOW TO INCREMENT THE COUNTER CIRCUITRY IN THE PC 6

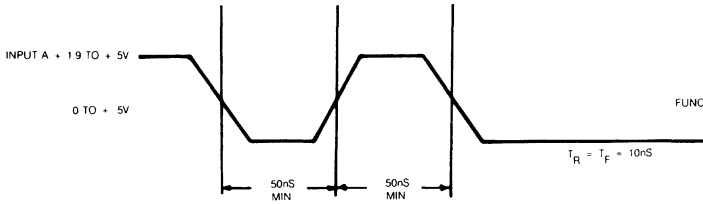


FIGURE 1  
FUNCTION - FREQUENCY, FREQUENCY RATIO, UNIT COUNTER

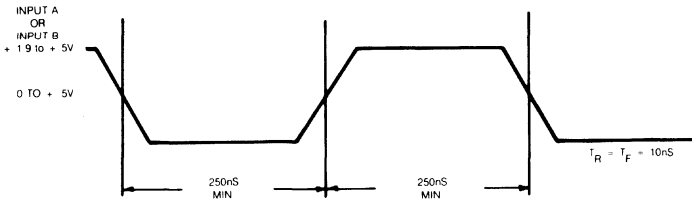


FIGURE 2  
FUNCTION - PERIOD, TIME INTERVAL

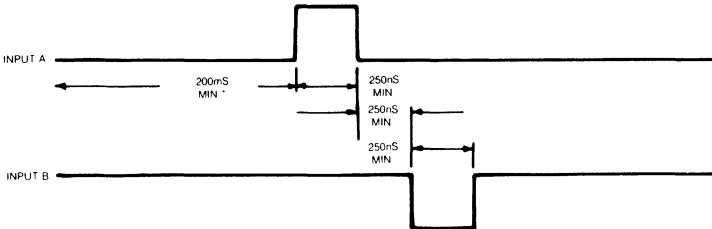


FIGURE 3  
FUNCTION - TIME INTERVAL

\* 200ms REQUIRED BETWEEN MEASUREMENTS FOR INTERNAL CIRCUITRY TO UPDATE

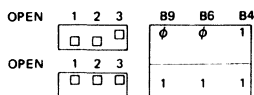
**PC-6 Input Waveforms**

PC-6 FUNCTION AND RANGE SELECTION CHART															
FUNCTION <sup>8</sup>	FULL SCALE DISPLAY RANGES	GATING TIMES/ CYCLES MEASURED	FUNCTION/RANGE SELECTION					TYPICAL INPUT WAVEFORM	SIGNAL <sup>4</sup> INPUT PIN(S)						
			S1 DIP SWITCH												
							Rear-Panel Logic Input <sup>1</sup>								
							B9 B6 B4 B10 B11								
UNIT (EVENT) COUNTER	99999 counts	N/A	OPEN	1	2	3	2	φ	1	-	-		A-18		
FREQUENCY COUNTER (Internal Time-base)	10000.0 kHz	01S	OPEN	1	2	3	4	5	2	φ	φ	φ	φ		A-18 <sup>7</sup>
	9999.99 kHz	1S	OPEN	1	2	3	4	5	φ	φ	φ	φ	1		
	999.999 kHz	1S	OPEN	1	2	3	4	5	φ	φ	φ	1	φ		
	99.9999 kHz	10S	OPEN	1	2	3	4	5	φ	φ	φ	1	1		
SUB-SECOND PERIOD TIMER (single input)	99999.9 μS	1	OPEN	1	2	3	4	5	1	1	φ	φ	φ		A-18 <sup>7</sup>
	9999.99 μS	10	OPEN	1	2	3	4	5	1	1	φ	φ	1		
	999.999 μS	100	OPEN	1	2	3	4	5	1	1	φ	1	φ		
	99.9999 μS	1000	OPEN	1	2	3	4	5	1	1	φ	1	1		
FREQUENCY RATIO COUNTER (External Time-base)	99999.9:1	1	OPEN	1	2	3	4	5	1	φ	1	φ	φ		A-18 (INPUT A)
	9999.99:1	10	OPEN	1	2	3	4	5	1	φ	1	φ	1		
	999.999:1	100	OPEN	1	2	3	4	5	1	φ	1	1	φ		A-17 (INPUT B)
	99.9999:1	1000	OPEN	1	2	3	4	5	1	φ	1	1	1		
SUB-SECOND INTERVAL TIMER (dual input)	99999.9 μS	1 <sup>6</sup>	OPEN	1	2	3	4	5	1	φ	φ	φ	φ		A-18 (INPUT A) A-17 (INPUT B)
	9999.99 μS	10	OPEN	1	2	3	4	5	1	φ	φ	φ	1		
	999.999 μS	100	OPEN	1	2	3	4	5	1	φ	φ	1	φ		
	99.9999 μS	1000	OPEN	1	2	3	4	5	1	φ	φ	1	1		
TEST	10000.0 kHz <sup>3</sup>	01S	OPEN	1	2	3	4	5	φ	1	φ	φ	φ	N/A	N/A
	0000.00 kHz <sup>3</sup>	1S	OPEN	1	2	3	4	5	φ	1	φ	φ	1		
	000.000 kHz <sup>3</sup>	1S	OPEN	1	2	3	4	5	φ	1	φ	1	φ		
	00.0000 kHz <sup>3</sup>	10S	OPEN	1	2	3	4	5	φ	1	φ	1	1		

**NOTES:**

- 1) φ = Logic Low (0V < V<sub>L</sub> < +1.5V)  
 1 = Logic High (+3.5V < V<sub>H</sub> < +5.0V)  
 - = Don't care.

2) FREQUENCY COUNTER may identically be selected by:

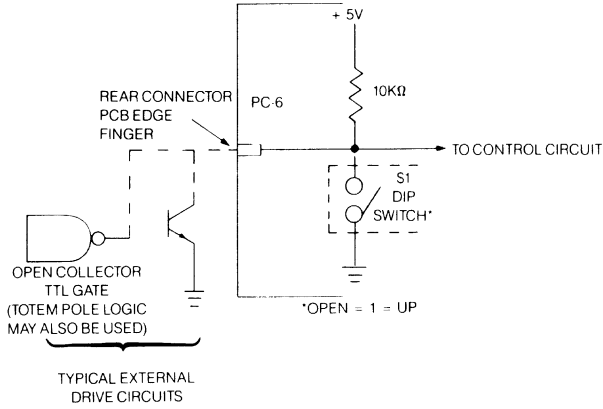


Range Selection codes are those given in the above chart for φφφ Function Code.

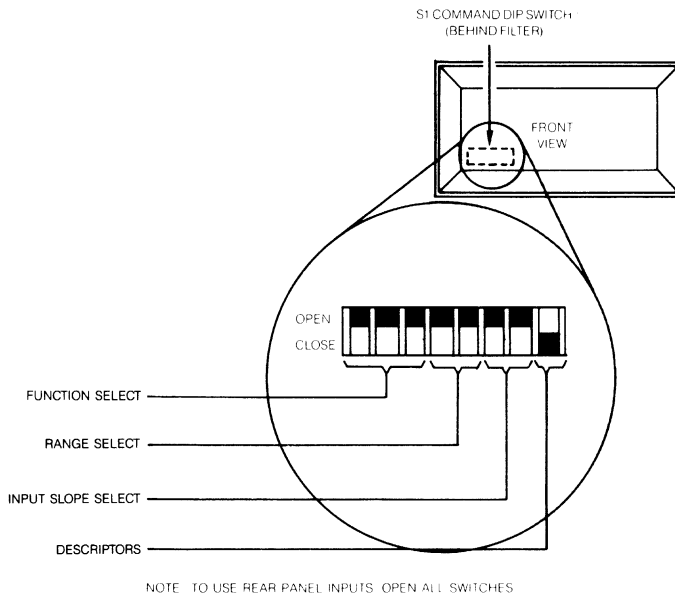
- 3) TEST measures the internal oscillator frequency of the PC-6. This is nominally 10.0MHz (10000kHz). In the lower three ranges on TEST, the 10.0MHz frequency will be over-scale (Overrange light will turn on). The least significant digits on these ranges are accurately displayed to permit more accurate calibration of the PC-6.
- 4) All input signals are returned at A-16, POWER COMMON.
- 5) On the PC-6, Gating Times or Number of Cycles Measured is selected automatically with the Full Scale Display Range.
- 6) To measure a single cycle in the INTERVAL TIMER function, the PC-6 must be "primed," first by a single cycle preceding that to be measured. The first cycle sets the counter circuitry; the second cycle is measured.
- 7) In FREQUENCY and PERIOD functions, i.e. INPUT B (pin A-17) to POWER COMMON (pin A-16).
- 8) When switching from one function to another, or from one range to another, the PC-6 commences a new measurement immediately. Decimal point location and Descriptors also change immediately. However, the numbers displayed will not be updated until the full cycle (Gate Time, or Number of Cycles Measured) has run out. In switching to or from 1 or 10 second Gate Times, be sure to wait long enough for the displayed numerals to update.

**APPLICATION NOTES**

The PC-6 is designed to fit into automatic test equipment. In most applications, the tester's built-in logic circuitry can program the PC-6's functions, ranges and input slopes. The PC-6 with external circuits (switches, power supply and connectors) may be configured as a full, self-contained benchtop counter for test and repair applications.



**PC-6 Typical Programmable Function Input**

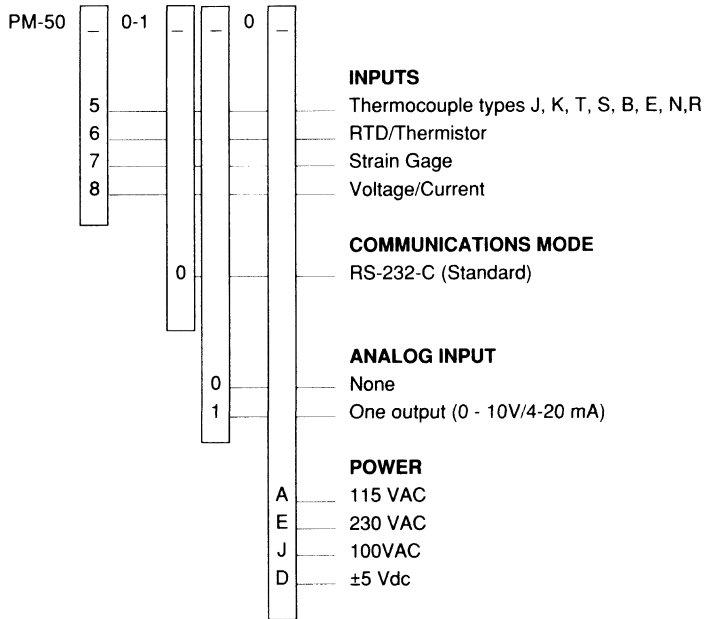


**PC-6 Command Switch Location**

# **PROCESS MONITORS/ CONTROLLERS**

## PROCESS MONITORS/CONTROLLERS

DATEL designs and manufactures a complete line of Process Monitors/Controllers supporting Thermocouples, RTDs, Strain Gages, and Voltage/Current signal inputs. These low cost units contain such features as built-in RS-232 serial port, user-selectable setpoint outputs (up to 4 discrete and 1 optional Analog), built-in configuration and setup command set, fully isolated inputs (to 1500 Volts, typ.) and a six-character, 14-segment vacuum fluorescent display (blue-green). Each model may be configured and operated from either the front panel or via the serial port. For reliability, accuracy, and low price, DATEL's PM-5000 Series Process Monitors/Controllers are simply the best.



## FEATURES

- Microprocessor-based, with all operating parameters set/recalled using the front panel or via the RS-232-C serial communications port.
- Totally menu-driven monitor configuration including:
  1. J, K, T, S, B, E, N, or R type thermocouple measurement.
  2. Cold junction compensation (CJC) enable/disable option.
  3. Celsius or Fahrenheit display option with 0.1, 1.0 degree resolution.
  4. Up to 4 setpoint entries, with up to 25 degrees hysteresis.
  5. Serial communications options for baud rate, parity, stop bits.
- Automatic display of open thermocouple conditions. Automatic gain and offset calibration.
- Total signal-to-logic and line-to-logic isolation (1400V).
- Over 50 simple ASCII commands usable via the serial port for data acquisition and control.
- Four MOSFET setpoint outputs (300V, 100mA load) are individually programmable for absolute, relative, high-, or low-going temperatures.
- Six character (five digits), 14-segment, alphanumeric 0.4" high fluorescent blue-green display with six custom annunciators.



- Security feature to prevent front panel tampering.
- All parameter values saved in EEPROM.
- Optional analog output (0 to 10V dc or 4-to-20 mA). User-programmable temperature range for scaling.
- Screw-terminal connectors for easy power and input connections.
- Compact 1/2 DIN case, standard DIN panel mount cutout.
- Interfaces directly to Date! thermal printers.
- Optional RS-485 interface for 32-point multi-drop applications.

*DATEL'S PM-5050 INTELLIGENT PROCESS MONITOR AND DISPLAY IS SPECIFICALLY DESIGNED FOR REAL-TIME THERMOCOUPLE DATA ACQUISITION AND CONTROL APPLICATIONS. THE HIGH-ISOLATION INPUT AND FOUR SETPOINT OUTPUTS ARE TOTALLY CONTROLLABLE FROM THE EASY-TO-USE RS-232-C ASYNCHRONOUS COMMUNICATIONS PORT. ENGINEERED FOR RUGGED INDUSTRIAL ENVIRONMENTS, THE PM-5050 OFFERS UP TO 1400V ISOLATION, 128dB CMRR, AND A HIGH RFI AND EMI IMMUNITY.*

## FUNCTIONAL DESCRIPTION

The functionality built into the PM-5050 allows high-precision process monitoring with real-time display of process parameters. The monitor supports eight thermocouple types: J, K, T, S, B, E, N, and R. Functionally, the PM-5050 has five sections: isolated analog input section, microprocessor and control logic, front panel key board and display, serial communications port, and setpoint outputs. (See the Block Diagram in Figure 1.)

The isolated analog input section consists of thermocouple input circuitry, signal conditioning pre-amplifiers, cold junction compensation (CJC) circuits, and a voltage-to-frequency converter. The analog input section is isolated up to 1400V RMS from the control logic and power lines. The 128dB CMRR ensures accurate readings by rejecting unwanted common mode voltages sometimes introduced by ground loops. The CJC input is located in the screw terminal connector, thus offering a true cold junction compensation reference.

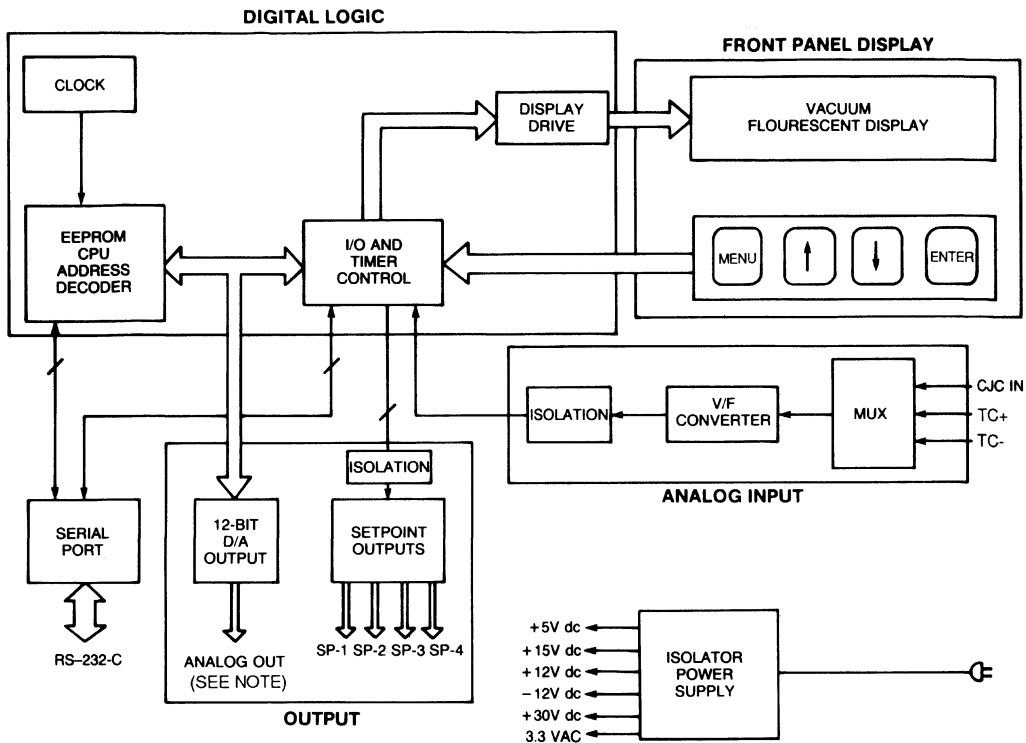
The microprocessor and control logic linearizes the input signal depending on the thermocouple type used. This section also processes commands received from both the front panel keypad and the RS-232-C serial communications port. The

monitor supports over 50 ASCII commands for operation via the serial communications port. The command structure uses simple command/reply message protocols. All control parameters set on the monitor are saved in an EEPROM and are automatically retrieved on power up.

A significant feature of the monitor is the easy-to-use front panel keypad. All meter functions are user-selectable by a few simple keystrokes. The display is completely menu-driven with selectable parameters appearing directly on the display. The vacuum fluorescent display has six custom annunciators, four for indicating setpoint status, and two for calibration parameters (full-scale, and zero). The PM-5050 displays five digits, such as 3001.6, providing a tenth of a degree of resolution.

## ORDERING INFORMATION

*See Last Page*



NOTE: The optional analog output is user-configurable for 4-to-20 mA or 0 to +10V dc.

Figure 1. PM-5050 Block Diagram

The PM-5050's serial port is configurable to perform as either a DTE or DCE device, depending on how the communication cable is wired. The monitor supports simple ASCII commands to exercise the functions. In addition to the commands that read, set, and invoke control parameters, the software in the monitor also supports diagnostic commands. The PM-5050 is configurable for baud rates from 110 to 9600 baud.

The PM-5050 provides the user four opto-isolated setpoint outputs (SP-1 through SP-4) to respond to four front panel-selectable preset temperatures. The annunciators on the vacuum fluorescent display indicate the setpoint status.

The setpoint outputs are isolated from power lines, logic, and input to up to 1500 volts. The setpoints are individually programmable for high- or low-going, absolute, or relative temperatures. For relative setpoint operation, setpoints SP-2, SP-3, and SP-4 are active relative to setpoint SP-1. The setpoints may be set in degrees C or degrees F with user-selectable hysteresis bands up to 25 degrees.

The setpoint outputs are solid state MOSFET relays able to drive up to 100 mA, 300V loads. The setpoint outputs are usable as alarm outputs or to control heater circuits in temperature control applications. The alarm status is displayed through the display annunciators.

Table 1 shows the various types of thermocouple input ranges available.

Table 1. Thermocouple Input Ranges, Accuracy and Drift, (maximum)

Thermocouple Type	Temperature Range (°C)	Accuracy	Temperature Drift (°C/°C)
J	-210 to -100 -100 to +760	+0.2°C +0.1°C	0.1
K	-212 to -100 -100 to 0 0 to +1371	+0.3°C +0.1°C +0.2°C	0.15
S	0 to 300 +300 to 1768	+0.7°C +0.5 C	0.3
T	-270 to -200 -200 to +400	+1.0°C +0.5°C	0.1
B	+210 to +750 +750 to +1820	+1.0 C +0.6°C	0.3
E	-270 to -200 -200 to -100 -100 to +900	+0.7 C +0.2°C +0.1°C	0.15
R	-50 to 0 0 to +850 +850 to +1768	+1.2°C +0.4°C +0.5°C	0.3
N	-200 to 0 0 to +400	+0.4°C +0.2°C	0.3



**FUNCTIONAL SPECIFICATIONS**

(Typical at 25 degrees C, unless noted)

**ANALOG INPUT**

<b>Analog-to-digital conversion</b>	Voltage-to-frequency converter, microprocessor controlled
<b>Conversion time</b>	300 mSec, maximum
<b>Resolution (User-selectable)</b>	0.1 degree or 1 degree
<b>Range Tempco</b>	+25 ppm/°C, typical +50 ppm/°C, maximum
<b>CJC error 0 to 60°C</b>	+0.5°C, maximum
<b>Stability</b>	Automatic gain and offset calibration every 1.8 seconds
<b>Configuration</b>	Differential (Isolated)
<b>Range</b>	-10mV to +70mV dc
<b>Impedance</b>	100 Megohms, minimum
<b>Common mode voltage</b>	1400V (peak AC or dc)
<b>Differential input overvoltage protection (Short to or across AC line without damage.)</b>	230 VAC, 5 seconds
<b>Normal mode rejection ratio, at 50/60 Hz</b>	80 dB, minimum
<b>Common mode rejection ratio, dc to 60 Hz</b>	128 dB, minimum 140 dB, typical

**DISPLAY SPECIFICATIONS**

<b>Type</b>	14-segment, alphanumeric, blue-green vacuum fluorescent
<b>Number of characters</b>	6 alphanumeric characters
<b>Annunciators</b>	SP-1, SP-2, SP-3, SP-4, ZERO, F.S.

**SETPOINT OUTPUT SPECIFICATIONS**

<b>Number of setpoint outputs</b>	4
<b>Setpoint control</b>	User-programmable for high or low-going, absolute or relative temperatures. For relative operation, SP-2, SP-3, and SP-4 are active relative to SP-1
<b>Output type</b>	Opto-isolated MOSFET's
<b>Isolation</b>	1000V minimum, 1500V typical
<b>Output rating (maximum)</b>	300V at 100 mA resistive load
<b>Hysteresis range</b>	User-selectable; 25 degrees, maximum

**POWER REQUIREMENTS**

<b>Operating Voltage</b>	100, 115, 230 VAC +5V dc, or +9 to +36V dc (optional)
--------------------------	--

**Power Consumption**

<b>AC Models</b>	2.5W typical, 4W max.
<b>DC Models</b>	385 mA @ 5V dc

**SERIAL COMMUNICATION SPECIFICATIONS (RS-232-C standard)**

<b>Baud rate</b>	110 to 9600 baud
<b>Format</b>	
<b>Data bits</b>	7 or 8
<b>Parity</b>	Even, odd, or none
<b>Stop bits</b>	1 or 2

**ANALOG OUTPUT SPECIFICATIONS (OPTION)**

<b>Types</b>	Voltage or current, user-selectable
<b>VOLTAGE</b>	0 to 10V dc, at 2A maximum
<b>Resolution</b>	12 bits
<b>Non-linearity</b>	±0.1%
<b>Gain Tempco</b>	±50 ppm/degree C
<b>Offset Tempco</b>	±0.1 mV/degree C
<b>Span</b>	Programmable using front panel keys.
<b>CURRENT</b>	4-to-20 mA
<b>Compatibility</b>	ISA type U
<b>Excitation</b>	Internal
<b>Accuracy</b>	0.1% full-scale range
<b>Load Resistance</b>	100 ohms, minimum 1000 ohms, maximum
<b>Span and Offset</b>	Programmable using front panel keys

**PHYSICAL SPECIFICATIONS**

<b>Case quality</b>	High-impact, flame retardant polycarbonate
<b>Case dimensions</b>	3.622"W x 1.771"H x 5.47"L (92 W x 45 H x 139 L) mm
<b>Length including terminals</b>	6" (152 mm)
<b>Bezel dimensions</b>	3.97" W x 2.08" H x 0.35"D (101 W x 53 H x 9 D) mm
<b>Panel cutout</b>	1/8 DIN standard 3.622"W x 1.772"H (92W x 45H) mm
<b>Front panel control</b>	Membrane keypad with 4 key switches
<b>Weight</b>	1 pound 4 ounces

**ENVIRONMENTAL SPECIFICATIONS**

<b>Operating temperature range (see note)</b>	0 to +60°C (+32 F to +140°F)
<b>Storage temperature range</b>	-40°C to +85°C (-40°F to +185°F)
<b>Relative humidity</b>	0 to 90%, non-condensing

**NOTE:** The monitor will operate from -10°C to +70°C at a reduced accuracy.

**ANALOG OUTPUT**

The PM-5050 has an optional analog output which outputs a voltage or current in proportion (or inverse proportion) to the temperature reading. The output is suitable for simple control applications (e.g., heater control) or to drive external measuring devices such as strip chart recorders.

An on-board 12-bit D/A converter provides a 0 to 10V dc or 4 to 20 mA output. The temperature range for the output is programmable from either the front panel or the serial communications port. The on-board microprocessor performs the required D/A output scaling.

**PM-5050 MENU DESCRIPTION**

The PM-5050 is operable from both the front panel key pad and the serial communications port. The front panel keypad consists of four keys: MENU SELECT, UP ARROW, DOWN ARROW, and ENTER. The menus are interactive, with the process parameter appearing directly on the display. The MENU select key scrolls through the menus available at each level and the ARROW keys scroll through options available for each parameter selected. The ENTER key sets the value for the selected parameter. Table 2 shows the parameter values.

The serial communications menu also allows enabling a data output mode. In this mode, the PM-5050 continuously outputs a data message to a printer at a user-selectable rate. The data message consists of information on the monitor configuration, status of setpoints, and thermocouple data.

**Table 2. PM-5050 Front Panel Menu Options**

Menu	Menu Selection Choice	Parameter Selection Choices
Security Code	See Notes	Enable/Disable
Input	TC type Unit Resolution CJC	J, K, T, S, B, E, N, and R Degree C of Degree F 0.1°C or 1.0°C On or Off
Setpoint	1 to 4 Hysteresis	User-selectable Up to 25 degrees
Serial Communications	Baud rate Parity Stop bits ID number	110, 300, 600, 1200, 2400, 4800 and 9600 Odd, Even, or None 1 or 2 0 through 99
Self-test	Diagnostics	
Calibration		A/D, CJC, and D/A
D/A output		Zero and full-scale

**NOTES**

The PM-5050 uses three different security codes for the following:

1. Enable the security to prevent front panel tampering.
2. Enabling the calibration mode to calibrate the meter.
3. Disabling the security to change monitor settings.

**PM-5050 SERIAL COMMUNICATIONS**

A standard feature included in the PM-5050 is an RS-232-C serial communications port. The PM-5050 may operate as a DTE or DCE device depending on the connection scheme used from the J1 connector to a typical D-type connector.

The monitor receives configuration information and process parameters via the serial port, using conventional ASCII message formats. The monitor is configurable for different baud

rates, parity, stop bits and ID number using the front panel keys. The monitor supports over 50 simple ASCII commands usable via the serial port for data acquisition and control.

The host may issue three types of commands to the monitor: configuration commands, data acquisition commands, and diagnostic commands.

**Configuration commands:** These commands set the PM-5050 to the user-selected operating mode. The monitor responds to the commands either with an acknowledge character or by echoing the command message back to the source.

**Data acquisition commands:** These commands read and log in temperature data and the status of the monitor. The monitor responds with a fixed-format ASCII message. The reply message consists of an ASCII string containing the monitor's ID number, thermocouple data and status, the status of the monitor configuration, and checksum. The data acquisition commands also operate in a continuous mode. In this mode the PM-5050 sends data, status, and checksum to the host system at a user-selectable rate.

**Diagnostic commands:** These commands test the PM-5050 display, perform calibration, read RAM locations, read reference voltage values, and check the result of built-in self test routines. Table 3 lists some command descriptions.

**Table 3. PM-5050 Command Descriptions (partial list)**

Configuration Commands	Set thermocouple type Set temperature unit (°C or °F) Set resolution (0.1 or 1.0) Set/Read setpoints values Set/Read hysteresis value Set/Read D/A scaling values Transmit data in decimal or hex format Transmit to host temperature measured Transmit to host CJC temperature
Data Acquisition Commands	Transmit to host last 64 data samples with status Transmit to host the PM-5050 status Enable/Disable command echo Enable/Disable terminal emulation mode Enable/Disable reply messages on setpoint conditions Set reply message format Send thermocouple data to host Output digital data to D/A section
Diagnostics Command	Test display segments Perform calibration Read internal reference values Read raw temperature value Read CJC value Perform self-test

**APPLICATION: MONITORING AND CONTROLLING PROCESS TEMPERATURE**

The PM-5050 has built-in features applicable to controlling process temperature. Figure 2 shows a typical PM-5050 application configuration.

The setpoint outputs provide the on/off control to a process and an alarm at preset temperatures. These setpoints may be absolute, or relative to a certain process temperature. The optional analog output is a linear controlling voltage (0 to +10V dc) that is usable to control a heater coil.

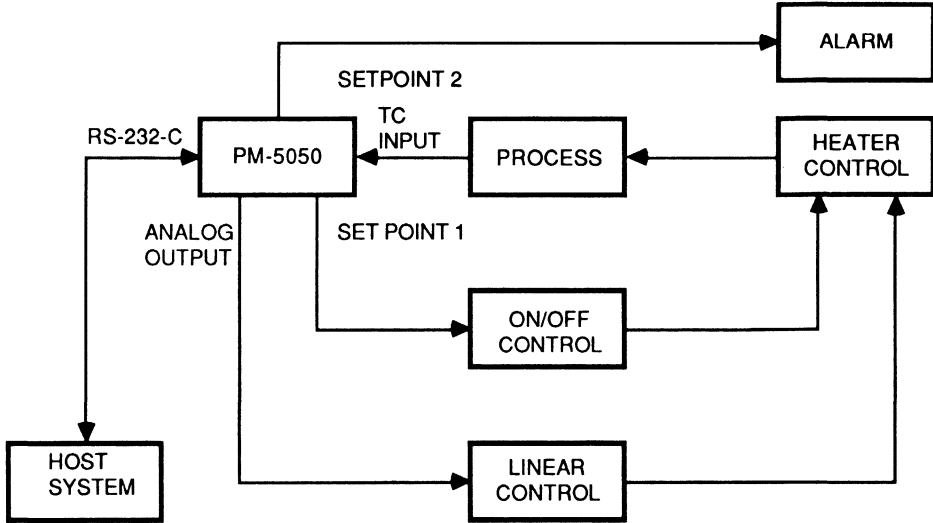


Figure 2. Temperature Control By A Host System Using the PM-5050

The PM-5050 automatically scales the analog output to a user-programmed temperature range. All process parameters may be set from the front panel or via the serial communications port. Users may also operate the PM-5050 from an intelligent host system using simple ASCII commands to acquire data and control the process.

**PM-5050 INPUT/OUTPUT CONNECTIONS**

The PM-5050 uses terminal blocks TB1 and TB2 for thermocouple inputs and power connections respectively. The setpoint outputs and serial communications are provided on the J1 connector. Tables 4 through 6 show pinouts for I/O connections.

Table 4a. Setpoint Output Connections (J1)

Setpoint	Connections
SP-1	B1 B2
SP-2	A1 A2
SP-3	B4 B5
SP-4	A4 A5

Table 4b. RS-232-C Connections (J1)

Signal	Connection
TXD	B21
RXD	B20
CTS	B18
RTS	B19
DTR	A16
GND	B16
+5V dc	A6

Table 5. Thermocouple Input Connections (TB1)

Signal	Connection
TC +	TB1-2
TC -	TB1-4

Table 6: AC Power Supply Connections (TB2)

Signal	Connection
GROUND	TB2-1
115/230/100 VAC Hot	TB2-2
110/230/100 VAC Neutral	TB2-3

**PM-5050 MECHANICAL DIMENSIONS**

The PM-5050 fits into standard 1/8 DIN panel cutouts. Mounting procedures involve tightening two screws through a metal

bracket (supplied) against the front panel. Figure 3 shows the mechanical dimensions of the monitor.

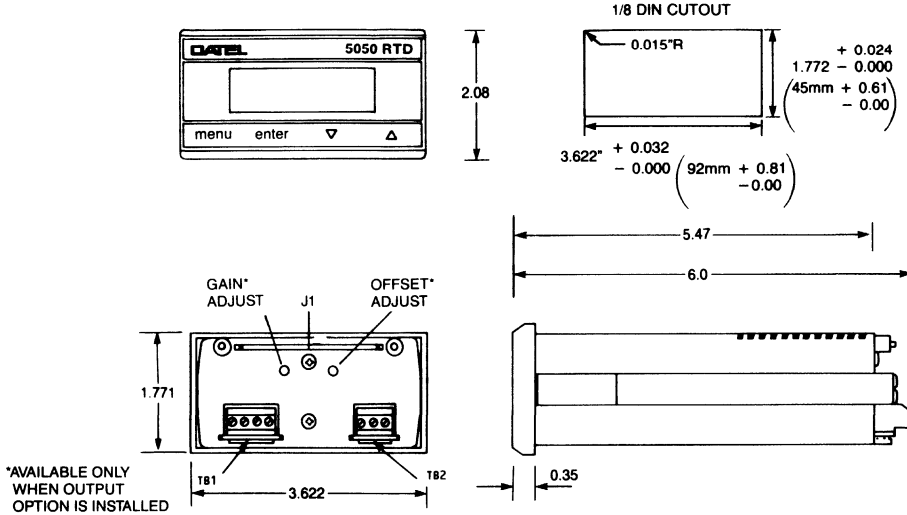
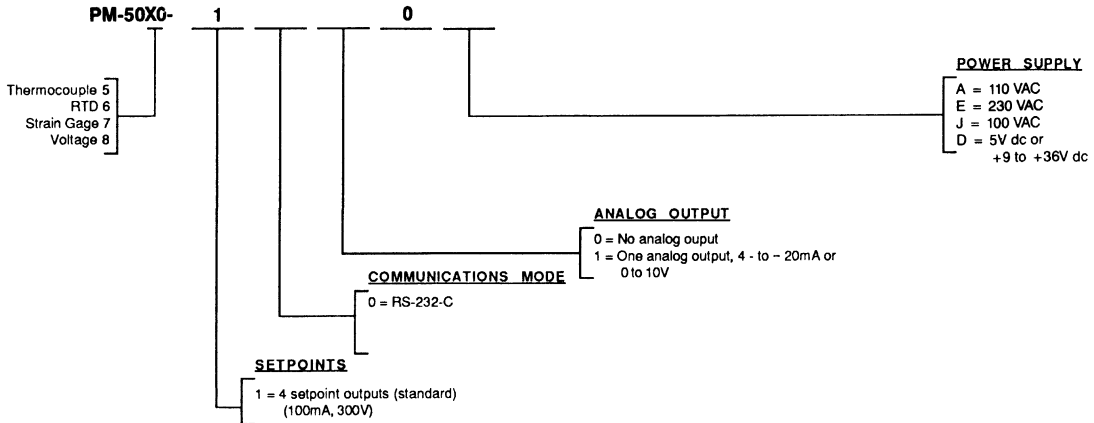


Figure 3. PM-5050 Mechanical Dimensions

**ORDERING INFORMATION**



DATEL warrants this product to be free of defects in material and workmanship for a period of one year from the date of shipment, under normal use and service. DATEL's obligation under this warranty are limited to replacing or repairing the product, at its option, at its factory or facility. The defective product must be shipped to DATEL's facility for repair or replacement within the warranty period, transportation and charges prepaid. This warranty shall not apply to a product which has been subject to misuse, negligence, or accident. In no case shall DATEL's liability exceed the original purchase price. The aforementioned provisions do not extend the original warranty period of this product which has either been repaired or replaced by DATEL.

NOTE: Equipment sold by DATEL, Inc. is not intended to be used, nor shall it be used, as a "Basic Component" under 10 CFR 21 (NRC).

Should this equipment be used in or with any nuclear installation or activity, you will indemnify us and hold us harmless from any liability or damage whatsoever arising out of the use of the equipment in such a manner.

**FEATURES**

- Microprocessor-based, with all operating parameters set/recalled using the front panel or via the RS-232-C serial communications port.
- Totally menu-driven monitor configuration allows:
  - 1) Measuring inputs from
    - a) 100Ω RTD's, types:
      - American (Alpha = 0.00391)
      - European (Alpha = 0.00385, DIN 43760)
    - b) Thermistors, types:
      - 2252Ω, 3000Ω, 5000Ω, 10000Ω
  - 2) Two-, three-, or four-wire operation
  - 3) Celsius or Fahrenheit display option with 0.1, 1.0° resolution.
  - 4) Up to 4 setpoint entries, with up to 25° hysteresis.
  - 5) Serial communications options for baud rate, parity, stop bits.
- Automatic display of open RTD input conditions. Automatic gain and offset callbration.
- Total signal-to-logic and line-to-logic isolation.
- Over 50 simple ASCII commands usable via the serial port for data acquisition and control.
- Four MOSFET setpoint outputs (300V, 100 mA load) are individually programmable for absolute, relative, high-, or low-going temperatures.
- Interfaces directly to IBM PC or compatibles.
- 1400V input isolation for transient protection.



- Interfaces directly to DATEL's printers: APP-20\_21, MPP-20, APP-48\_2
- Six character (five digits), 14-segment, alphanumeric 0.4" high fluorescent blue-green display with six custom annunciators.
- Security feature to prevent front panel tampering.
- All parameter values saved in EEPROM.
- Optional analog output (0 to 10V dc or 4-to-20 mA). User-programmable temperature range for scaling.
- Screw-terminal connectors for easy power and input connections.
- Compact 1/8 DIN case, standard DIN panel mount cutout.

*DATEL's PM-5060 Intelligent Process Monitor and Display is specifically designed for high-accuracy, real-time RTD and thermistor data acquisition and control applications. The high-isolation input and four setpoint outputs are totally controllable from the easy-to-use front panel or the RS-232-C asynchronous communications port. Engineered for rugged industrial environments, the PM-5060 offers up to 1400V isolation, 128 dB CMRR, and a high RFI and EMI immunity.*

**GENERAL DESCRIPTION**

The PM-5060 is an ideal choice for applications requiring highly accurate high-resolution temperature measurement and display. The functionality built into the PM-5060 allows high-precision process monitoring with real-time display of process parameters. The monitor supports 100Ω platinum RTD types DIN 43760 (with Alpha = 0.00385) and American (with Alpha = 0.00391). The device also supports inputs from 2,252Ω, 3,000Ω, 5,000Ω, and 10,000Ω thermistors. The PM-5060 is usable with two-, three-, or four-wire inputs.

Functionally, the PM-5060 has five sections: an isolated analog input section, microprocessor and control logic, front panel keyboard and display, serial communications port and setpoint outputs. (See the Block Diagram in Figure 1).

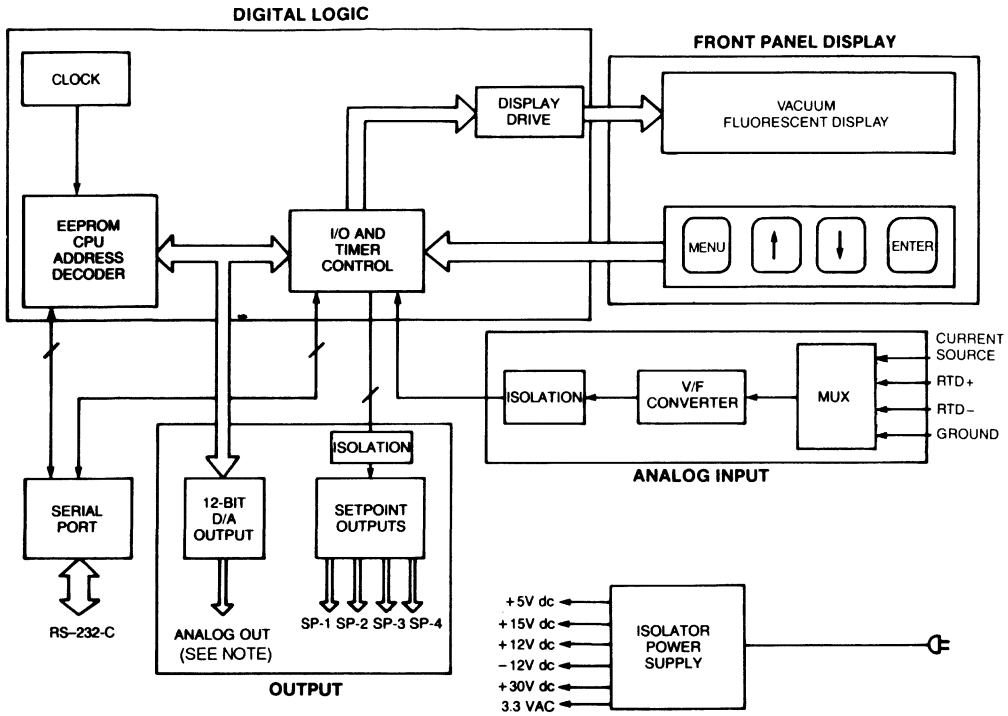
The isolated analog input section consists of RTD/thermistor input circuitry, signal conditioning pre-amplifiers, and a voltage-to-frequency converter. The analog input section is isolated up

to 1400V RMS from the control logic and power lines. The 128 dB CMRR ensures accurate readings by rejecting unwanted common mode voltages sometimes introduced by ground loops.

The microprocessor and control logic linearize the input signal depending on the RTD/thermistor type used. This section also processes commands received from both the front panel keypad and the RS-232-C serial communications port. The monitor supports over 50 ASCII commands for operation via the serial communications port. The command structure uses simple command/reply message protocols. All control parameters set on the monitor are saved in an EEPROM and are automatically retrieved on power up.

**ORDERING INFORMATION**

SEE LAST PAGE



NOTE: The optional analog output is user-configurable for 4-to-20 mA or 0 to +10V dc.

Figure 1. PM-5060 Block Diagram

A significant feature of the monitor is the easy-to-use front panel keypad. All meter functions are user-selectable by a few simple keystrokes. The display is completely menu-driven with selectable parameters appearing directly on the display. The vacuum fluorescent display has six custom annunciators, four for indicating setpoint status, and two for indicating calibration parameters (full-scale, and zero). The PM-5060 displays five digits, such as 1472.3, providing a tenth of a degree of resolution.

The PM-5060's serial port is configurable to perform as either a DTE or DCE device, depending on how the communication cable is wired. The monitor supports simple ASCII commands to exercise the functions. In addition to the commands that read, set, and invoke control parameters, the software in the monitor also supports diagnostic commands. The PM-5060 is configurable for baud rates from 110 to 9600 baud.

The PM-5060 provides the user four opto-isolated setpoint outputs (SP-1 through SP-4) to respond to four front panel-selectable preset temperatures. The annunciators on the vacuum fluorescent display indicate the setpoint status.

The setpoint outputs are isolated to power lines, logic, and input to up to 1400V. The setpoints are individually programmable for high- or low-going, absolute, or relative temperatures. For relative setpoint operation, setpoints SP-2, SP-3, and SP-4 are active relative to setpoint SP-1. The setpoints may be set in

degrees C or degrees F with user-selectable hysteresis bands up to 25°.

The setpoint outputs are solid-state MOSFET relays able to drive up to 100 mA, 300V loads. The setpoint outputs are usable as alarm outputs or to control heater circuits in temperature control applications. The alarm status is displayed through the display annunciators. Table 1 lists the input ranges of common input devices and their accuracy.

Table 1. Input Ranges and Accuracy

Input Type	Range	Accuracy	
		Typical	Maximum
100Ω Platinum RTD Alpha = 0.00391	-200 to +850°C	±0.1°C	±0.5°C
100Ω Platinum RTD Alpha = 0.00385 (DIN 43760)	-200 to +850°C	±0.2°C	±0.5°C
2252Ω Thermistors	-50 to 0°C 0 to +150°C	±2°C ±0.2°C	—
3000Ω Thermistors	-50 to 0°C 0 to +150°C	±3°C ±0.2°C	—
5000Ω Thermistors	0 to +150°C	±0.2°C	—
10000Ω Thermistors	0 to +150°C	±0.3°C	—

**FUNCTIONAL SPECIFICATIONS**

(Typical at +25°C, unless noted)

**ANALOG INPUTS**

<b>Analog-to-digital</b> .....	Voltage-to-frequency conversion converter, microprocessor controlled
<b>Conversion Time</b> .....	300 mSec., maximum
<b>Resolution (User-selectable)</b> .....	0.1° or 1°
<b>Range Tempco</b> .....	+25 ppm/°C, typical +50 ppm/°C, maximum
<b>Stability</b> .....	Automatic gain and offset calibration every 1.8 Sec.
<b>Configuration</b> .....	Differential (Isolated)
<b>Range</b> .....	-10 mV to +70 mV dc
<b>Impedance</b> .....	100 Megohms, minimum
<b>Common mode voltage</b> .....	1400V (peak AC or DC)
<b>Differential Input overvoltage protection Short to (or across) AC line without damage.</b> .....	115 VAC, continuous 230 VAC, 5 Sec.
<b>Normal mode rejection ratio, dc to 60 Hz</b> .....	80 dB, minimum
<b>Input bias current</b> .....	8 nA, maximum

**DISPLAY SPECIFICATIONS**

<b>Type</b> .....	14-segment, alphanumeric, blue-green vacuum fluorescent
<b>Number of characters</b> .....	6 alphanumeric characters
<b>Annunciators</b> .....	SP-1, SP-2, SP-3, SP-4, ZERO, F.S.

**SETPOINT OUTPUT SPECIFICATIONS**

<b>Number of setpoint outputs</b>	4
<b>Setpoint control</b> .....	User-programmable for high or low-going, absolute or relative temperatures. For relative operation, SP-2, SP-3, and SP-4 are active relative to SP-1.
<b>Output type</b> .....	Opto-isolated MOSFET's
<b>Output rating (maximum)</b> .....	300V at 100 mA resistive load
<b>Hysteresis range</b> .....	User-selectable; 25° max.

**SERIAL COMMUNICATION SPECIFICATIONS****(Standard RS-232-C)**

<b>Baud rate</b> .....	110 to 9600 baud
<b>Format</b>	
<b>Data bits</b> .....	7 or 8
<b>Parity</b> .....	even, odd, or none
<b>Stop bits</b> .....	1 or 2

**ANALOG OUTPUT SPECIFICATIONS (OPTION)**

<b>Types</b> .....	Voltage or current, user-selectable
<b>VOLTAGE</b> .....	0 to 10V dc, at 2 mA max.
<b>Resolution</b> .....	12 bits
<b>Non-linearity</b> .....	±0.1%
<b>Gain Tempco</b> .....	±50 ppm/°C
<b>Offset Tempco</b> .....	±0.1 mV/°C
<b>Span</b> .....	Programmable using front panel keys.
<b>CURRENT</b> .....	4-to-20 mA
<b>Compatibility</b> .....	ISA type U
<b>Excitation</b> .....	Internal
<b>Accuracy</b> .....	0.1% full-scale range
<b>Load Resistance</b> .....	100Ω, minimum 1000Ω, maximum
<b>Span and Offset</b> .....	Programmable using front panel keys

**PHYSICAL SPECIFICATIONS**

<b>Case quality</b> .....	High-impact, flame retardant polycarbonate
<b>Case dimensions</b> .....	3.622"W x 1.771"H x 5.47"L (92 W x 45 H x 139 L) mm
<b>Length, including terminals</b> .....	6" (152 mm)
<b>Bezel dimensions</b> .....	3.97" W x 2.08" H x 0.35" D (101 W x 53 H x 9 D) mm
<b>Panel cutout</b> .....	1/8 DIN standard 3.622"W x 1.772"H (92W x 45H) mm
<b>Front panel control</b> .....	Membrane keypad with 4 key switches
<b>Weight</b> .....	1 pound, 4 ounces

**ENVIRONMENTAL SPECIFICATIONS**

(The monitor will operate from -10°C to +70°C at a reduced accuracy.)

<b>Operating temperature range</b> .....	0 to +60°C (+32°F to +140°F)
<b>Storage temperature range</b> .....	-40°C to +85°C (-40°F to +185°F)
<b>Relative humidity</b> .....	0 to 90%, non-condensing

**POWER REQUIREMENTS**

<b>Operating Voltage (See Ordering Information)</b> .....	115, 230, 100 VAC +5V, or +9 to +36V dc (optional)
<b>Power Consumption</b>	
<b>AC Models</b> .....	2.5 W typical, 4 W max.
<b>DC Models</b> .....	385 mA @ 5V dc

**ANALOG OUTPUT**

The PM-5060 has an optional analog output which outputs a voltage or current in proportion (or inverse proportion) to the temperature reading. The output is suitable for simple control applications (e.g., heater control) or to drive external measuring devices such as strip chart recorders.

An on-board 12-bit D/A converter provides a 0 to 10V dc or 4 to 20 mA output. The temperature range for the output is programmable from either the front panel or the serial communications port. The on-board microprocessor performs the required D/A output scaling.

**PM-5060 MENU DESCRIPTION**

The PM-5060 is operable from the both the front panel keypad and the serial communications port. The front panel keypad consists of four keys: MENU SELECT, UP ARROW, DOWN ARROW, and ENTER. Table 2 shows the menu structures. The menus are interactive, with the process parameter appearing directly on the display. The MENU select key scrolls through the menus available at each level and the ARROW keys scroll through options available for each parameter selected. The ENTER key locks the value for the selected parameter.

The serial communications menu also allows enabling a data output mode. In this mode, the PM-5060 continuously outputs a data message to a printer at a user-selectable rate. The data message consists of information on the monitor configuration, status of setpoints, and input data.

**Table 2. PM-5060 Front Panel Menu Options**

Menu	Menu Selection Choice	Parameter Selection Choices
Security Code	See Notes	Enable/Disable
Input	RTD, American	Alpha = 0.00391
	RTD, European	Alpha = 0.00385
	Thermistor	2252Ω 3000Ω 5000Ω 10000Ω
	Unit	Degree C or Degree F
	Resolution	0.1°C or 1.0°C
Setpoint	1 — 4	User-selectable
	Hysteresis	Up to 25°
Serial Communications	Baud rate	110, 300, 600, 1200, 2400, 4800 and 9600
	Parity	Odd, Even, or None
	Stop bits	1 or 2
	ID number	0 through 99
	Set data output rate	Multiples of 0.6 Sec.
Self-test	Diagnostics	
Calibration		A/D and D/A
D/A output		Zero and Full-scale

NOTES: The PM-5060 uses three different security codes for the following:

1. Enabling the security to prevent front panel tampering.
2. Enabling the calibration mode to calibrate the meter.
3. Disabling the security to change monitor settings.

**PM-5060 SERIAL COMMUNICATIONS**

A standard feature included in the PM-5060 is an RS-232-C serial communications port. The PM-5060 may operate as a DTE or DCE device, depending on the connection scheme used from the J1 connector to a typical D-type connector.

The monitor receives configuration information and process parameters via the serial port, using conventional ASCII message formats. The monitor is configurable for different baud rates, parity, stop bits and ID number using the front panel keys. The monitor supports over 50 simple ASCII commands usable via the serial port for data acquisition and control.

The host may issue three types of commands to the monitor: configuration commands, data acquisition commands, and diagnostic commands.

**Configuration commands:** These commands set the PM-5060 to the user-selected operating mode. The monitor responds to the commands either with an acknowledge character or by echoing the command message back to the source.

**Data acquisition commands:** These commands read and log in temperature data and the status of the monitor. The monitor responds with a fixed format ASCII message. The reply message consists of an ASCII string containing the monitor's ID number, RTD/thermistor data and status, the status of the monitor configuration, and checksum. The data acquisition commands also operate in a continuous mode. In this mode the PM-5060 sends data, status, and checksum to the host system at a user-selectable rate.

**Diagnostic commands:** These commands test the PM-5060 display, perform calibration, read RAM locations, read reference voltage values, and check the result of built-in self test routines. Table 3 lists some command descriptions.

**Table 3. PM-5060 Command Descriptions (partial list)**

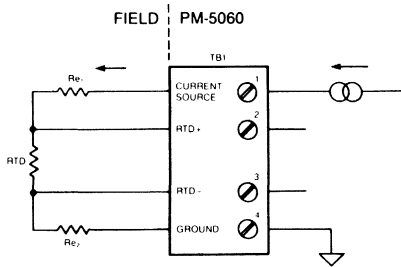
Command Type	Description
Configuration Commands	Set input type Set temperature unit (°C or °F) Set resolution (0.1 or 1.0) Set/Read setpoints' values Set/Read hysteresis value Set/Read D/A scaling values Transmit data in decimal or hex format Transmit to host temperature measured
Data Acquisition Commands	Transmit to host last 50 data samples with status Transmit to host the PM-5060 status Enable/Disable command echo Enable/Disable terminal emulation mode Enable/Disable reply messages on setpoint conditions Set reply message format Send temperature data to host Output digital data to D/A section
Diagnostics Command	Test display segments Perform calibration Read internal reference values Read raw temperature value Perform self test



**TWO-, THREE-, and FOUR-WIRE RTD CONFIGURATIONS**

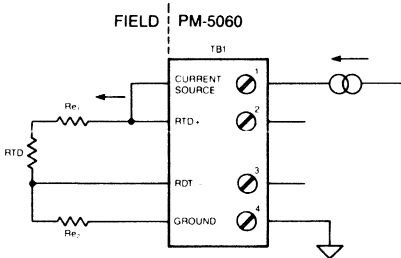
The PM-5060 accepts inputs from a variety of commercial RTD's and thermistors. The device operates with varying degrees of efficiency based upon the way the input signal is brought into the monitor. Figure 2 shows how inputs may be connected using two-, three-, or four-wire schemes. Each scheme has its advantages; the user must weigh accuracy versus economy when designing their configuration.

NOTE: When using a thermistor sensor, a 400Ω resistor must be installed externally across the RTD+ and RTD- inputs.



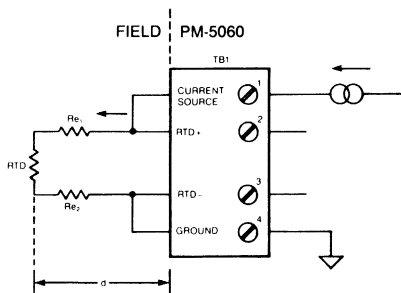
•MOST ACCURATE

**Figure 2a. Four-wire Input Configuration**



•MORE ECONOMICAL,  
ASSUMES THAT  $R_{e1} = R_{e2}$

**Figure 2b. Three-wire Input Configuration**



•MOST ECONOMICAL  
•LEAST ACCURATE  
•ERROR PROPORTIONAL TO DISTANCE d  
•SIMILAR TO 4-WIRE CONFIGURATION,  
BUT  $R_{e1}$  AND  $R_{e2}$  NOT FACTORED OUT.

**Figure 2c. Two-wire Input Configuration**

**PM-5060 INPUT/OUTPUT CONNECTIONS**

The PM-5060 uses terminal blocks TB1 and TB2 for RTD/ thermistor inputs and power connections respectively. The setpoint outputs and serial communications are provided on the J1 connector. Tables 4 through 7 show pinouts for I/O and power connections.

**Table 4a. Setpoint Output Connections (J1):**

Setpoint	Connections
SP-1	B1 B2
SP-2	A1 A2
SP-3	B4 B5
SP-4	A4 A5

**Table 4b. RS-232-C Connections (J1)**

Signal	Connection
TXD	B21
RXD	B20
CTS	B18
RTS	B19
DTR	A16
GND	B16
+5V dc	A6

**Table 5. AC Power Supply Connections (TB2)**

Signal	Connection
GROUND	TB2-1
115/230/100V AC Hot	TB2-2
110/230/100V AC Neutral	TB2-3

**Table 6. DC Power Connections (TB2)**

Signal	Connection
+5V dc	TB1-1
+9 to +36V dc	TB2-2
GROUND	TB2-3

**Table 7. Input Connections (TB1)**

Signal	Connection
CURRENT SOURCE	TB1-1
RTD +	TB1-2
RTD -	TB1-3
GROUND	TB1-4

**PM-5060 MECHANICAL DIMENSIONS**

The PM-5060 fits into standard 1/8 DIN panel cutouts. Mounting procedures involve tightening two screws through a metal

bracket against the front panel. Figure 3 shows the mechanical dimensions of the monitor.

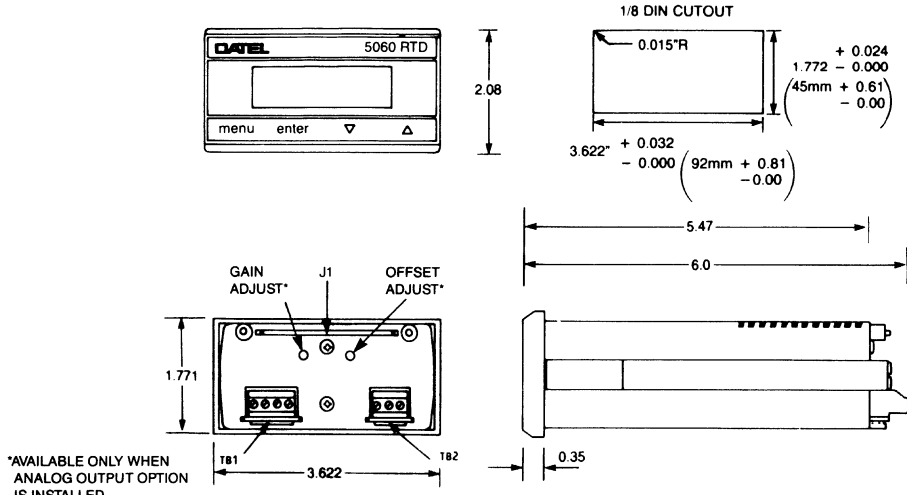
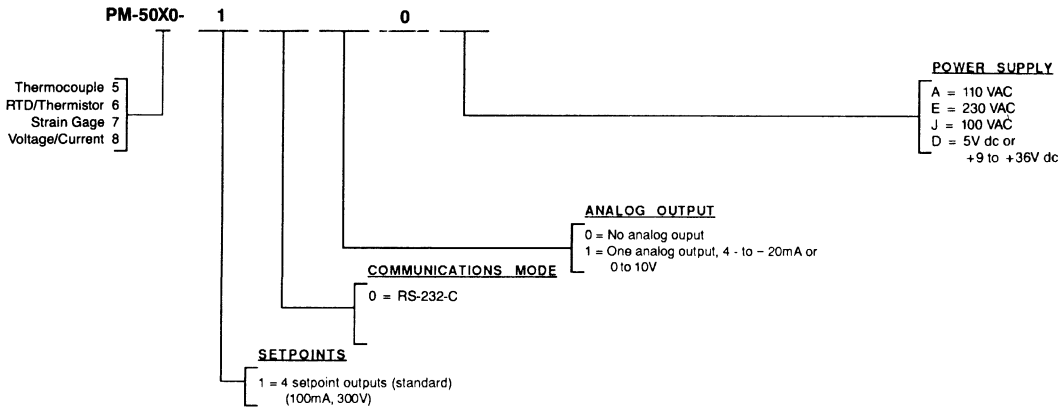


Figure 3. PM-5060 Mechanical Dimensions

**ORDERING INFORMATION**



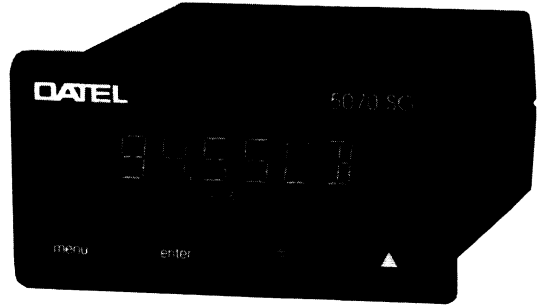
DATEL warrants this product to be free of defects in material and workmanship for a period of one year from the date of shipment, under normal use and service. DATEL's obligations under this warranty are limited to replacing or repairing the product, at its option, at its factory or facility. The defective product must be shipped to DATEL's facility for repair or replacement within the warranty period, transportation and charges prepaid. This warranty shall not apply to a product which has been subjected to misuse, negligence, or accident. In no case shall DATEL's liability exceed the original purchase price. The aforementioned provisions do not extend the original warranty period of this product which has either been repaired or replaced by DATEL.

NOTE: Equipment sold by DATEL, Inc. is not intended to be used, nor shall it be used, as a "Basic Component" under 10 CFR 21 (NRC).

Should this equipment be used in or with any nuclear installation or activity, you will indemnify us and hold us harmless from any liability or damage whatsoever arising out of the use of the equipment in such a manner.

**FEATURES**

- Two bipolar signal inputs plus a precision excitation output for strain gage and other bridge-type applications
- Four MOFSET setpoint outputs (300V/100 mA load) and optional analog output for control applications
- 72 Commands to set control schemes, transmit data, perform bridge calibration and scaling, set communications protocol, and initiate diagnostic routines
- Microprocessor-based, with all operating parameters set through the front panel (or remote host) and stored internally in non-volatile EEPROM memory
- Easy-to-use scaling function converts bridge output to engineering units for display
- Two powerful math functions permit sophisticated input manipulation and advanced control algorithms
- Cyclical 5-digit display of up to eight system variables, including input PEAKS and VALLEYS
- Displays standard or user-defined engineering units
- Stand-alone, or operation via standard RS-232-C communication interface



- Interfaces easily with serial-input printers, or logs data directly to computer disk via the serial communications port
- Adjustable sample rate with optional averaging
- Security feature prevents front panel tampering
- Screw terminal connectors for easy power and signal connections
- Menu-driven calibration procedure requires no potentiometer adjustments; continuous automatic gain and offset calibration
- Compact 1/8 DIN case fits standard panel cutouts

*DATEL's PM-5070 provides all the functions necessary for precision bridge measurement, including excitation output, input scaling, and the toughness to withstand harsh industrial environments. The PM-5070 goes beyond simple measurement. With two signal inputs, four setpoint outputs, optional analog output, and two powerful math functions, the PM-5070 is equipped to handle even demanding control applications. When combined with a host computer the PM-5070 forms a full-function operator station for real-time process monitoring and control, data archiving, and statistical analysis--all at a fraction of the cost of large dedicated systems.*

**GENERAL DESCRIPTION**

The PM-5070 consists of six functional sections: an isolated analog input section excitation circuit, microprocessor and control logic, front panel keyboard and display, serial communications port, and setpoint outputs. A seventh section, analog output, is optional. Figure 1 is the block diagram of the PM-5070.

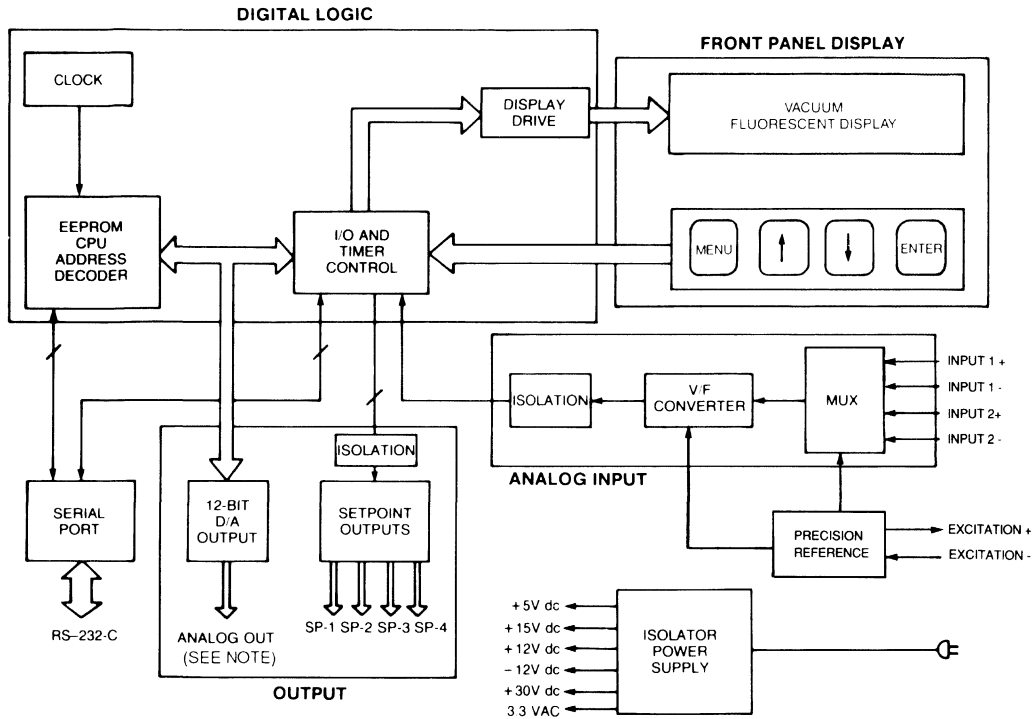
The isolated analog input section consists of multiplexing circuitry, signal conditioning pre-amplifiers, and a voltage-to-frequency converter. The multiplexing circuitry arbitrates between the two signal inputs. Both input channels are true differential, with INPUT 1 offering a  $\pm 50$  mV full-scale range and INPUT 2 providing  $\pm 10$  V. Typically, INPUT 1 is used for the bridge input, while INPUT 2, operating ratiometrically, is used as the excitation reference input. For applications requiring only a single input, multiplexing may be disabled and faster sample rates obtained. The single channel sample rate can be set to 100 ms, 200 ms, 300 ms, or 400 ms; multiplexed rates are 200 ms, 400 ms, 600 ms, or 800 ms.

The analog input section is isolated up to 1500V RMS from the control logic and power lines. A common mode rejection ratio of 140 dB ensures accurate readings in the presence of environmental noise and ground loops. Typical accuracy is 0.01% over the full-scale range.

The excitation circuit utilizes a precision reference coupled with an amplifier to generate a +10 V excitation output. The output can drive up to a 30 mA, more than enough for bridge excitation or to power other types of external sensor circuitry.

The microprocessor and control logic provide the system timing used to convert the V/F output to an equivalent digital value. This section also processes commands received via both the front panel and the RS-232 serial communication port. The microprocessor accesses operating software contained in PROM memory, while user-defined operating parameters are stored in EEPROM and are automatically retrieved on power-up.

**ORDERING INFORMATION**  
 See Last Page



NOTE: The optional analog output is user-configurable for 4-to-20 mA or 0 to +10V dc.

Figure 1. PM-5070 Block Diagram

A major feature of the PM-5070 is the easy-to-use front panel keypad. During set-up and parameter selection, the MENU and ENTER keys are used to traverse a hierarchical menu structure which prompts the user for operating parameter values. The two arrow keys are used to scroll through the choices for a particular parameter, or in some cases, to ramp a numeric value to the required setting. If desired, the keypad can be disabled and operating parameters entered through the serial port using simple ASCII commands.

During set-up, the six-character alphanumeric display presents menu choices and parameters using easy-to-remember mnemonics. During operation, the readout displays up to five digits of numeric data plus engineering units. The display also features six annunciators: four for indicating setpoint status and two for calibration parameters (full-scale and zero). Another unique feature is the ability to alternately display up to eight system variables. When used in this mode, each of the selected variables displays for approximately two seconds.

The PM-5070's RS-232-C communication port connects directly to any host computer with similar interface (e.g. IBM PC/XT/AT or compatible). Commands and parameters can be

read/set at the host computer. In addition, data can be sent from the PM-5070 to the host for storage and analysis. The port is full duplex with handshake, and can be configured as DTE or DCE. The port supports baud rates ranging from 110 to 9,600 baud, one or two stop bits, and odd, even, or no parity.

The PM-5070 provides four opto-isolated setpoint outputs which respond to user-defined setpoint limits. A setpoint can be associated with any of the eight system variables (INPUT 1, INPUT 2, PEAK 1, PEAK 2, VALLEY 1, VALLEY 2, FUNCTION 1, or FUNCTION 2). Further, each setpoint is assigned a trip direction (high-or low-going) and a hysteresis (deadband) value. The setpoint outputs are fully isolated MOSFET relays able to drive 100 mA/ 300V loads. The outputs can be used in to trip alarm systems or in discrete control applications .

The PM-5070's optional analog output section consists of a precision 12-bit D/A converter which is user-configured to output either 0-10V or 4-20 mA. The output value can be set through the serial port or controlled proportionally by either INPUT 1, INPUT 2, FUNCTION 1, or FUNCTION 2. Controlling the output with a function allows implementing sophisticated control algorithms such as PI and PD.

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25 °C, 300ms conversion rate unless noted)

**ANALOG INPUTS**

**Conversion Technique**..... Voltage-to-Frequency  
**V/F Resolution**..... 30,000 counts  
**Input 1 Range**..... ±50 mV  
**Input 2 Range**..... ±10V  
**Input 1 Accuracy**..... 0.01% of full-scale  
**Input 2 Accuracy**..... 0.1% of full-scale  
**Conversion Time**..... User-selectable: 100 ms,200 ms,  
 300 ms, 400 ms (single channel)  
**Range Tempco**..... ± 20 ppm/ °C typical  
 ± 50 ppm/ °C maximum  
**Stability**..... Automatic gain and offset  
 calibration every minute  
**Input 1 Impedance**..... 100 M ohms  
**Input 2 Impedance**..... 100 K ohms  
**Common Mode Voltage**... 1400 VAC peak @ 50 - 60 Hz  
**Common Mode Rejection** 140 dB to 100 Hz  
**Normal Mode Rejection**.. 80 dB min @ 50 - 60 Hz  
**Over Voltage Protection** 130V RMS maximum

**EXCITATION**

**Voltage**..... +10V dc  
**Load Current**..... 30 mA max  
**Accuracy**..... ±1.0%

**DISPLAY**

**Type**..... 14-segment, alphanumeric,  
 blue-green vacuum flourescent  
**Number of Characters**... 6 alphanumeric (5 digits plus engi-  
 neering units)  
**Character Height**..... 0.38"  
**Annunciators**..... 4 setpoint status indicators;  
 zero and full-scale indicators  
**Variables Displayed**..... 1 to 8 variables displayed  
 alternately at 2 second intervals  
 (INPUT 1, INPUT 2, PEAK 1, PEAK  
 2, VALLEY 1, VALLEY 2, FUNC-  
 TION 1, FUNCTION 2)

**SETPOINT OUTPUTS**

**Number**..... 4  
**Control Source**..... INPUT 1, INPUT 2, PEAK 1, PEAK 2,  
 VALLEY 1, VALLEY 2, FUNCTION 1,  
 FUNCTION 2, or serial port  
**Trip Direction**..... User-programmed as high- or low-going  
**Hysteresis Range**..... 0 - 100%  
**Output Type**..... Opto-isolated MOSFET  
**Isolation**..... 1500VRMS  
**ON Resistance**..... 25 Ohm  
**Output Rating**..... 300V, 100 mA continuous

**SERIAL COMMUNICATIONS**

**Protocol**..... RS-232-C, full duplex  
 (standard)  
**Baud Rate**..... User-programmable: 110 - 9600  
 Baud  
**Data Bits**..... 7 or 8  
**Stop Bits**..... 1 or 2  
**Parity**..... Even, odd, or none

**ANALOG OUTPUT (OPTION)**

**Control Source**..... INPUT 1, INPUT 2, FUNCTION 1,  
 FUNCTION 2, or serial port  
**Mode**..... User-configured: voltage or  
 current

**Voltage:**

**Range**..... 0 - 10V (2 mA max)  
**D/A Resolution**..... 12 bits  
**Non-linearity**..... ±0.1%  
**Gain Tempco**..... 0.1 mV/ °C  
**Offset Tempco**..... 20 ppm/ °C

**Current:**

**Range**..... 4 - 20 mA  
**Compatibility**..... ISA type U  
**Excitation**..... Internal or external  
**Accuracy**..... 0.1% of full-scale range  
**Load Resistance**..... 100 Ohm, minimum; 1000 Ohm,  
 maximum

**PHYSICAL**

**Case Material**..... High-impact, flame retardant  
 polycarbonate  
**Case Dimensions**..... 1/8 DIN cutout:  
 Width: 3.622" (92 mm)  
 Height: 1.772" (45 mm)  
 Depth: 5.47" (138 mm) w/o  
 terminals  
 6.00" (148mm) w/terminals  
**Bezel Dimensions**..... Depth: 0.35" (9 mm)  
 Width: 3.96" (101 mm)  
 Height: 2.08" (53 mm)  
**Front Panel Keypad**..... Membrane with 4 key switches  
**Weight**..... 1.32 lb (0.6 Kg)  
**Power**..... 90 - 110 VAC, 50 Hz  
 (PM-5070-1XX0J)  
 104 - 126 VAC, 60 Hz  
 (PM-5070-1XX0A)  
 207 - 253 VAC, 50 Hz  
 (PM-5070-1XX0E)  
 2.5 Watts typical, 4 Watts  
 maximum

**ENVIRONMENTAL**

**Operating Temperature Range**  
**Rated Accuracy**..... 32 to 140 °F (0 to +60 °C)  
**Reduced Accuracy**.. 5 to 158 °F (-15 to +70 °C)  
**Storage Temp. Range**..... -91 to 185 °F (-40 to +85 °C)  
**Relative Humidity**..... 0 to 90% non-condensing

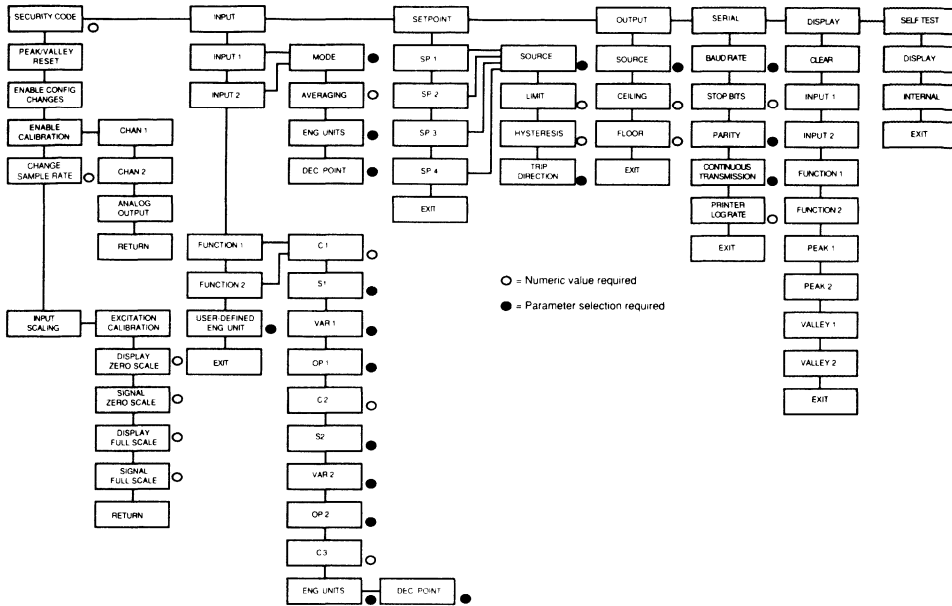


Figure 2: PM-5070 Menu Flow Chart

**PM-5070 MENU**

The PM-5070's powerful software provides capabilities and flexibility unmatched by conventional panel instruments. The 72 built-in software commands:

- Specify data acquisition and display parameters
- Define input scaling
- Define setpoint and analog output characteristics
- Create custom math functions
- Configure the serial communication protocol
- Specify data transmission parameters
- Let the user calibrate and diagnose the unit

Commands are issued and parameters entered in one of two ways: either directly at the monitor using the four front-panel

buttons, or at a host computer connected to the meter through the serial communications port.

When configuring the PM-5070 from the front panel, the MENU and ENTER keys are used to scan a hierarchical menu structure. Menu items display as easy-to-understand mnemonics (or entire words) on the alphanumeric readout. At the uppermost menu level there are seven menu items: SECURITY CODE, INPUT, SETPOINT, OUTPUT (if the analog output option is installed), SERIAL, DISPLAY, and SELFTEST. Each major menu contains submenus, and each submenu presents the parameters needed to complete the configuration. Figure 2 depicts the menu structure.

**Security Code Menu**

Upon entering this menu the user is immediately prompted to enter one of five security codes. The codes, when correctly entered, allow the user to:

- Reset peak, valley, and math function variables
- Change operating parameters
- Calibrate the meter
- Set the sampling rate
- Specify input scaling parameters

**Input Menu**

Using this menu, the user identifies the nature of each input signal and defines how the value of the signal will appear. Specified parameters include:

- Input is enabled/disabled
- Input is scaled/used ratiometrically
- Sample averaging (1 to 10)
- Engineering units displayed
- Decimal point location

The INPUT menu also gives the user the opportunity to define one or two custom math functions to manipulate system variables for display or control output.

**Setpoint Menu**

This menu allows the user to define, in turn, each of the four available setpoint outputs. For each setpoint the user specifies:

- The source which controls the output (INPUT 1, INPUT 2, PEAK 1, PEAK 2, VALLEY 1, VALLEY 2, FUNCTION 1, or FUNCTION 2)
- Setpoint limit
- Hysteresis
- Trip direction

**Output Menu**

This menu is only available when the analog output option is installed. When available, the menu allows the user to define:

- The source which controls the output (either INPUT 1, INPUT 2, FUNCTION 1, or FUNCTION 2)
- The zero and full-scale limits of the controlling source

**Serial Menu**

Using this menu the user defines the protocol used in communications through the serial port. Parameters specified include:

- Baud rate (110 to 9,600)
- Number of stop bits
- Odd, even, or no parity
- Meter ID number (required for multidrop applications)
- Transmission rate for logging data to a printer

**Display Menu**

With this menu the user specifies which of the eight system variables are to be displayed alternately at two second intervals.

**Selftest Menu**

This menu provides access to a series of diagnostic tests which verify the integrity of the display segments and the meter's internal circuitry.

**MATH FUNCTIONS**

One of the most powerful features of the PM-5070 are the two user-configurable math functions. The two functions have the generalized form:

$$[[[C1 \times S1] \times VAR1] OP1 [[C2 \times S2] \times VAR2]] OP2 (C3)$$

Where:

- C1, C2, C3 = numeric constants
- S1, S2 = scaling factors
- VAR1, VAR2 = any one of the eight system variables
- OP1, OP2 = an arithmetic operator: +, -, x, /

The constants, scale factors, variables, and operators constituting the function are specified either from the front panel (within the INPUT menu), or from a host computer connected through the serial port.

During operation, the value of a function is calculated at the monitor's sample rate. This value can be displayed and/or used to control setpoint or analog outputs. Because of their flexibility, the two functions may be used in a variety of ways: for engineering units scaling, as control algorithms, or for combining inputs to calculate other physical process variables.

**SERIAL COMMUNICATIONS**

A standard feature of the PM-5070 is an RS-232-C serial communications port. Using this port, the PM-5070 can be connected to a host computer or PLC having a similar interface. Any configuration parameter which can be set using the meter's front panel can alternatively be set by issuing a simple ASCII command from the host computer. Additionally, the host can read the current meter status, log data, and directly control the setpoint and analog outputs.

PM-5070 commands all conform to a simple ASCII format and can be incorporated into any structured language program. As an example, the command to change the trip limit of setpoint number 4 to 500 is: WSP 4,500

**TYPICAL STRAIN GAGE INTERFACE**

Figure 3 illustrates a typical strain gage interface. The bridge output is connected to the PM-5070's INPUT 1 connections, while INPUT 2 is used to measure the excitation voltage. In this configuration INPUT 2 is used ratiometrically, meaning that the monitor will adjust the INPUT 1 reading to compensate for any variations in the excitation source. Ratiometric operation is specified through the front panel or with a serial port command.

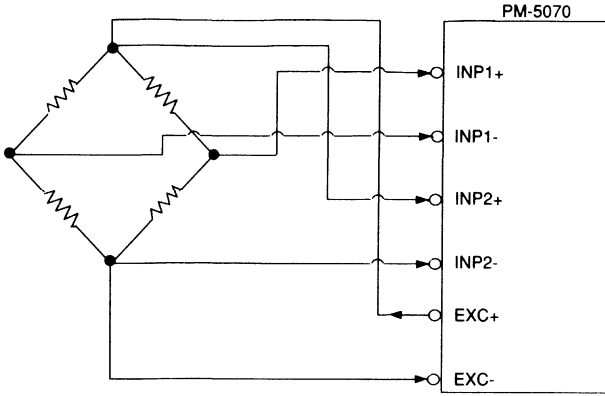
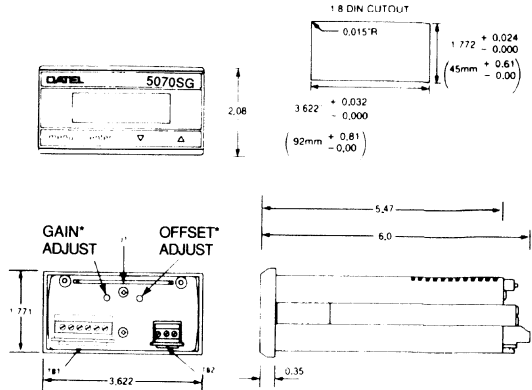


Figure 3. Strain Gage Interface



NOTE: GAIN AND OFFSET ADJUSTMENT POTENTIOMETERS ARE AVAILABLE ONLY ON MODELS HAVING THE ANALOG OUTPUT OPTION.

Figure 4. Mechanical Dimensions

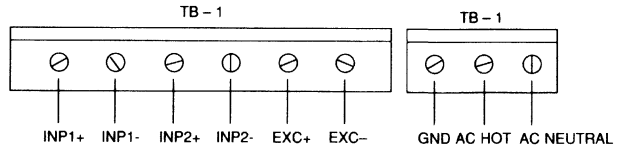
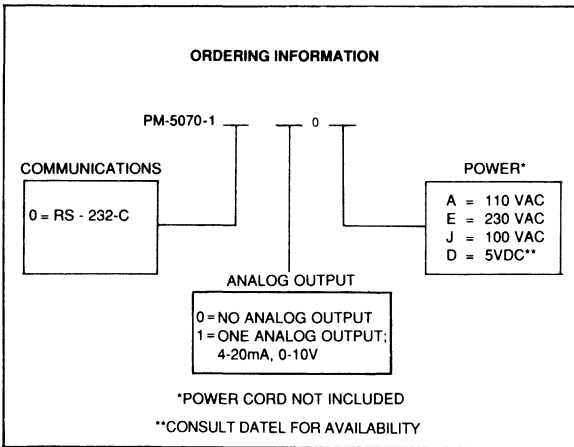


Figure 5: Signal/Power Connections

WARRANTY


DATEL warrants this product to be free from defects in material and workmanship under normal use and service for a period of one year from the date of shipment. DATEL's obligations under this warranty are limited to replacing or repairing the unit, at its option, at its factory or facility, when the unit is returned to DATEL's facility, transportation charges prepaid, and which is after examination disclosed to the satisfaction of DATEL to be thus defective. This warranty shall not apply to any such equipment which shall have been repaired or altered except by DATEL or which shall have been subjected to misuse, negligence, or accident. In no case shall DATEL's liability exceed the original purchase price. The aforementioned provisions do not extend the original warranty period of any product which has either been repaired or replaced by DATEL.

NOTE: Equipment sold by DATEL, Inc. is not intended to be used, nor shall it be used, as a "Basic Component" under 10 CFR 21 (NRC).

Should this equipment be used in or with any nuclear installation or activity, the Purchaser will indemnify Datel, Inc. and hold Datel, Inc. harmless from any liability or damage whatsoever arising out of the use of the equipment in such a manner.



## FEATURES

- Two signal inputs, four MOSFET setpoint outputs (300V/100 mA load) and one analog output for control applications (optional)
  - 72 Commands to set control schemes, transmit data, perform calibration and scaling, set communications protocol, and initiate diagnostic routines
  - Microprocessor-based, with all operating parameters set through the front panel (or remote host) and stored internally in non-volatile EEPROM memory
  - Easy-to-use input scaling function
  - Two powerful math functions permit sophisticated input manipulation and advanced control algorithms
  - Cyclical 5-digit display of up to eight system variables, including input PEAKS and VALLEYS
  - Displays standard or user-defined engineering units
  - Stand-alone, or operation via standard RS-232-C communication interface
- 
- Interfaces easily with serial-input printers, or logs data directly to computer disk via the communications port
  - Adjustable sample rate with optional averaging
  - Security feature prevents front panel tampering
  - Screw terminal connectors for easy power and signal connections
  - Menu-driven calibration procedure requires no potentiometer adjustments; continuous automatic gain and offset calibration
  - Compact 1/8 DIN case fits standard panel cutout

*DATEL's PM-5080 Intelligent Process Monitor represents a new generation of microprocessor-based, panel-mounted instrumentation. The PM-5080 offers two voltage/current signal inputs, four programmable setpoint outputs, and an optional analog output. Powerful user-defined math functions make the PM-5080 easily adapted to a wide variety of process monitoring and control applications. When combined with a host computer, the PM-5080 forms a full-function operator station for real-time process monitoring and control, data archiving, and statistical analysis — all at a fraction of the cost of large dedicated systems.*

## GENERAL DESCRIPTION

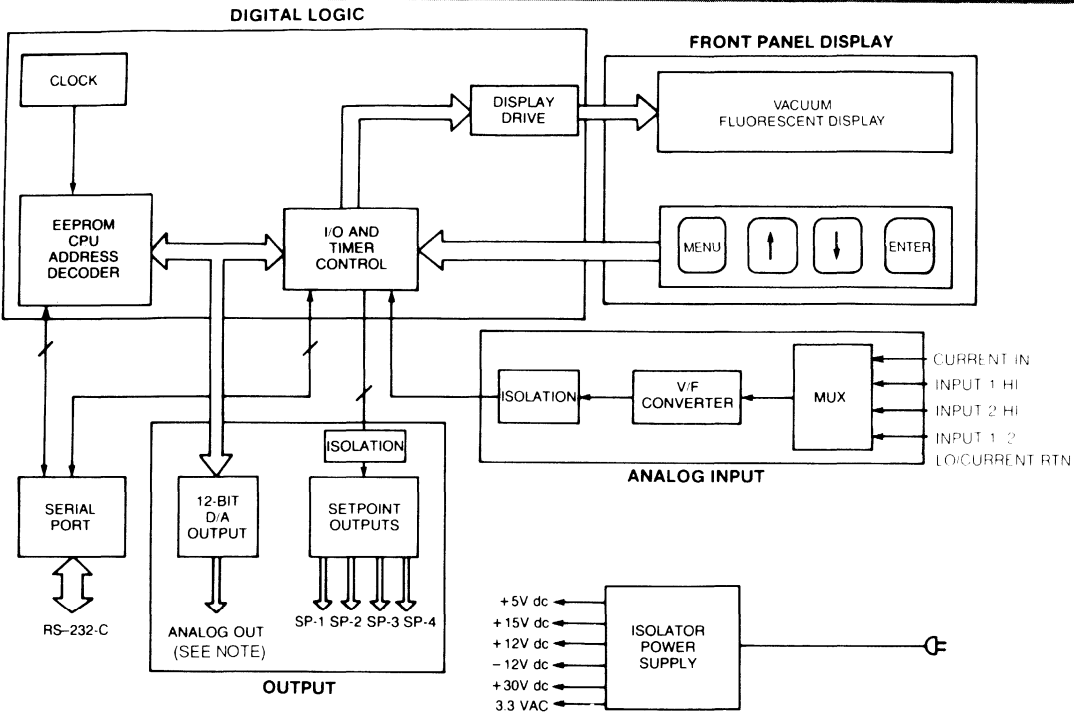
The PM-5080 consists of five functional sections: an isolated analog input section, microprocessor and control logic, front panel keyboard and display, serial communications port, and setpoint outputs. A sixth section, analog output, is optional. Figure 1 is the block diagram of the PM-5080.

The isolated analog input section consists of multiplexing circuitry, signal conditioning pre-amplifiers, and a voltage-to-frequency converter. The multiplexing circuitry gives the user a choice of two input pair combinations: one 0-100 mV input and one 0-10V input, or one 0-20 mA current input and

one 0-10V input. For applications requiring only a single input, multiplexing may be disabled and faster sample rates obtained. The single channel sample rate can be set to 100 ms, 200 ms, 300 ms, or 400 ms; multiplexed rates are 200 ms, 400 ms, 600 ms, or 800 ms.

### ORDERING INFORMATION

SEE LAST PAGE



NOTE: The optional analog output is user-configurable for 4-to-20 mA or 0 to +10V dc.

Figure 1. PM-5080 Block Diagram

The analog input section is isolated up to 1500V RMS from the control logic and power lines. A common mode rejection ratio of 140dB ensures accurate readings in the presence of environmental noise and ground loops.

The microprocessor and control logic provide the system timing used to convert the V/F output to an equivalent via both the front panel and the RS-232-C serial communication port. The microprocessor accesses operating software contained in PROM memory, while user-defined operating parameters are stored in EEPROM and are automatically retrieved on powerup.

A major feature of the PM-5080 is the easy-to-use front panel keypad. During set-up and parameter selection, the MENU and ENTER keys are used to traverse a hierarchical menu structure which prompts the user for operating parameter values. The two arrow keys are used to scroll through the choices for a particular parameter, or in some cases, to ramp a numeric value to the required setting. If desired, the keypad can be disabled and operating parameters entered through the serial port using simple ASCII commands.

During set-up, the six-character alphanumeric display presents menu choices and parameters using easy-to-remember mnemonics. During operation, the readout displays up to five digits of numeric data plus engineering units. The display also features six annunciators: four for indicating setpoint status and two for calibration parameters (full-scale and zero). Another unique feature is the ability to alternately display up to eight system variables. When used

in this mode, each of the selected variables displays for approximately two seconds.

The PM-5080's RS-232-C communication port connects directly to any host computer with similar interface (e.g. IBM PC/XT/AT or compatible). Commands and parameters can be read/set at the host computer. In addition, data can be sent from the PM-5080 to the host for storage and analysis. The port is full duplex with handshake, and can be configured as DTE or DCE. The port supports baud rates ranging from 110 to 9,600 baud, one or twostop bits, and odd, even, or no parity.

The PM-5080 provides four opto-isolated setpoint outputs which respond to user-defined setpoint limits. A setpoint can be associated with any of the eight system variables (INPUT 1, INPUT 2, PEAK 1, PEAK 2, VALLEY 1, VALLEY 2, FUNCTION 1 or FUNCTION 2). Further each setpoint is assigned a trip direction (high or low going) and a hysteresis (deadband) value. The setpoint outputs are fully isolated MOSFET relays able to drive 100mA/300V loads. The outputs can be used to trip alarm systems or in discrete control applications.

The PM-5080's optional analog output section consists of a precision 12-bit D/A converter which is user-configured to output either 0-10V or 4-20 mA. The output value can be set through the serial port or controlled proportionally by either INPUT 1, INPUT 2, FUNCTION 1, or FUNCTION 2. Controlling the output with a function allows implementing sophisticated control algorithms such as PI and PD.

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25 °C, 300 mS conversion rate unless noted)

**ANALOG INPUTS**

<b>Conversion Technique</b> .....	Voltage-to-Frequency
<b>V/F Resolution</b> .....	30,000 counts
<b>Input 1 Range</b> .....	0 - 100 mV or 0 - 20 mA
<b>Input 2 Range</b> .....	0 - 10V
<b>Input 1 Accuracy (V)</b> .....	0.01% of full-scale
<b>Input 1 Accuracy (I)</b> .....	0.05% of full-scale
<b>Input 2 Accuracy</b> .....	0.1% of full-scale
<b>Conversion Time</b> .....	User-selectable: 100 ms, 200 ms, 300 ms, 400 ms
<b>Range Tempco</b> .....	± 20 ppm/ °C typical ± 50 ppm/ °C maximum
<b>Stability</b> .....	Automatic gain and offset calibration every minute
<b>Input 1 Impedance</b> .....	100 M Ohms
<b>Input 2 Impedance</b> .....	1 M Ohms
<b>Common Mode Voltage</b> .....	1400 VAC peak @ 50 - 60 Hz
<b>Common Mode Rejection</b> ....	140 dB to 100 Hz
<b>Normal Mode Rejection</b> .....	80 dB min @ 50 - 60 Hz
<b>Over Voltage Protection</b> ....	130V RMS maximum

**DISPLAY**

<b>Type</b> .....	14-segment, alpha numeric, blue-green vacuum fluorescent
<b>Number of Characters</b> .....	6 alphanumeric (5 digits plus engineering units)
<b>Character Height</b> .....	0.38"
<b>Annunciators</b> .....	4 setpoint status indicators; zero and full-scale indicators
<b>Variables Displayed</b> .....	1 to 8 variables displayed alternately at 2 second in- tervals (INPUT 1, INPUT 2, PEAK 1, PEAK 2, VAL- LEY 1, VALLEY 2, FUNC- TION 1, FUNCTION 2)

**SETPOINT OUTPUTS**

<b>Number</b> .....	4
<b>Control Source</b> .....	INPUT 1, INPUT 2, PEAK 1 PEAK 2, VALLEY 1, VALLEY 2, FUNCTION 1, FUNCTION 2, or serial port
<b>Trip Direction</b> .....	User-programmed as high- or low-going
<b>Hysteresis Range</b> .....	0 - 100%
<b>Output Type</b> .....	Opto-isolated MOSFET
<b>Isolation</b> .....	1500VRMS
<b>On Resistance</b> .....	25 Ohm
<b>Output Rating</b> .....	300V, 100 mA continuous

**SERIAL COMMUNICATIONS**

<b>Protocol</b> .....	RS-232-C, full duplex (standard)
<b>Baud Rate</b> .....	User-programmable: 110-9600 Baud
<b>Data Bits</b> .....	7 or 8
<b>Stop Bits</b> .....	1 or 2
<b>Parity</b> .....	Even, odd, or none

**ANALOG OUTPUT (OPTION)**

<b>Control Source</b> .....	INPUT 1, INPUT 2, FUNCTION 1, FUNCTION 2, or serial port
<b>Mode</b> .....	User-configured: voltage, current
<b>Voltage:</b>	
<b>Range</b> .....	0 - 10V (2 mA max)
<b>D/A Resolution</b> .....	12 bits
<b>Non-linearity</b> .....	±0.1%
<b>Gain Tempco</b> .....	0.1 mV/ °C
<b>Offset Tempco</b> .....	20 ppm/ °C

**Current:**

<b>Range</b> .....	4 - 20 mA
<b>Compatibility</b> .....	ISA type U
<b>Excitation</b> .....	Internal or external
<b>Accuracy</b> .....	0.1% of full-scale range
<b>Load Resistance</b> .....	100 Ohm, minimum; 1000 Ohm, maximum

**PHYSICAL**

<b>Case Material</b> .....	High-impact, flame retardant polycarbonate
<b>Case Dimensions</b> .....	1/8 DIN cutout: Width: 3.622" (92 mm) Height: 1.772" (45 mm) Depth: 5.47" (138 mm) w/o terminals; 6.00" (148mm) w/terminals
<b>Bezel Dimensions</b> .....	Depth: 0.35" (9 mm) Width: 3.96" (101 mm) Height: 2.08" (53 mm)
<b>Front Panel Keypad</b> .....	Membrane with 4 key switches
<b>Weight</b> .....	1.32 lb (0.6 Kg)
<b>Power</b> .....	90 - 110 VAC, 50 Hz (PM-5080-1XX0J) 104 - 126 VAC, 60 Hz (PM-5080-1XX0A) 207 - 253 VAC, 50 Hz (PM-5080-1XX0E) 2.5 Watts typical, 4 Watts maximum

**ENVIRONMENTAL**

<b>Operating Temperature Range</b>	
<b>Rated Accuracy</b> .....	32 to 140 °F (0 to +60 °C)
<b>Reduced Accuracy</b> .....	5 to 158 °F (-15 to +70 °C)
<b>Storage Temp. Range</b> .....	-91 to 185 °F (-40 to +85 °C)
<b>Relative Humidity</b> .....	0 to 90% non-condensing

**PM-5080 MENU**

The PM-5080's powerful software provides capabilities and flexibility unmatched by conventional panel instruments. The 72 built-in software commands:

- Specify data acquisition and display parameters
- Define setpoint and analog output characteristics
- Create custom math functions
- Configure the serial communication protocol
- Let the user calibrate and diagnose the unit

Commands are issued and parameters entered in one of two ways: either directly at the monitor using the four front-panel buttons, or at a host computer connected to the meter through the serial communication port.

When configuring the PM-5080 from the front panel, the MENU and ENTER keys are used to scan a hierarchical menu structure. Menu items display as easy-to-understand mnemonics (or entire words) on the alphanumeric readout.

At the uppermost menu level there are seven menu items: SECURITY CODE, INPUT, SETPOINT, OUTPUT, (if the analog output option is installed), SERIAL, DISPLAY, and SELF-TEST. Each major menu contains submenus, and each submenu presents the parameters needed to complete the configuration. Figure 2 depicts the menu structure.

**Security Code Menu**

Upon entering this menu the user is immediately prompted to enter one of five security codes. The codes, when correctly entered, allow the user to:

- Reset peak, valley, and math function variables
- Change operating parameters
- Calibrate the meter
- Set the sampling rate
- Specify input scaling parameters

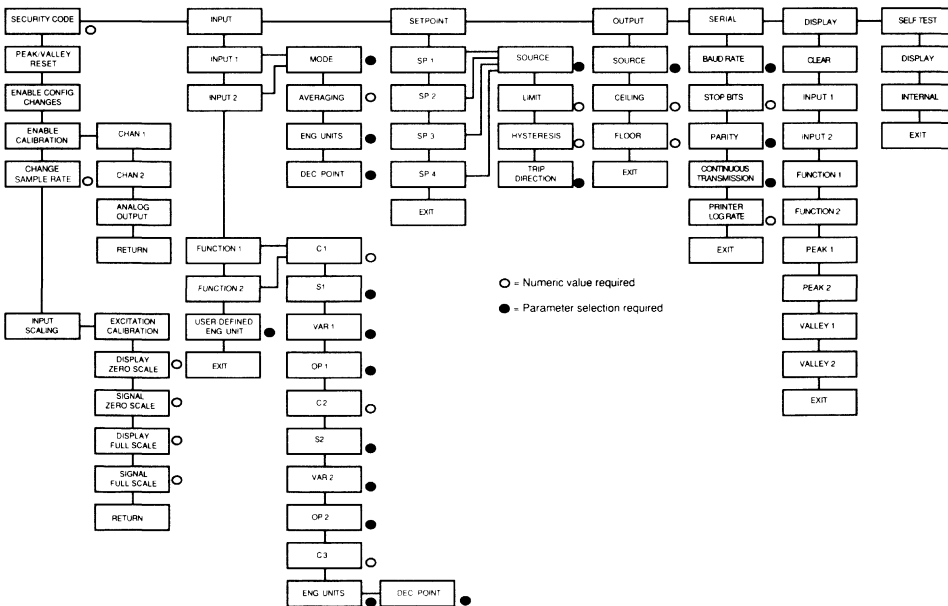


Figure 2. PM-5080 Menu Structure

**Input Menu**

Using this menu, the user identifies the nature of each input signal and defines how the value of the signal will appear. Specified parameters include:

- Input is enabled/disabled/scaled
- Input is voltage or current
- Sample averaging (1 to 10)
- Engineering units displayed
- Decimal point location

The INPUT menu also gives the user the opportunity to define one or two custom math functions to manipulate system variables for display or control output.

**Setpoint Menu**

This menu allows the user to define, in turn, each of the four available setpoint outputs. For each setpoint the user specifies:

- The source which controls the output (INPUT 1, INPUT 2, PEAK 1, PEAK 2, VALLEY 1, VALLEY 2, FUNCTION 1, or FUNCTION 2)
- Setpoint limit
- Hysteresis
- Trip direction

**Output Menu**

This menu is only available when the analog output option is installed. When available, the menu allows the user to define:

- The source which controls the output (either INPUT 1, INPUT 2, FUNCTION 1, or FUNCTION 2)
- The zero and full-scale limits of the controlling source

**Serial Menu**

Using this menu the user defines the protocol used in communications through the serial port. Parameters specified include:

- Baud rate (110 to 9,600)
- Number of stop bits
- Odd, even, or no parity
- Meter ID number (required for multidrop applications)
- Transmission rate for logging data to a printer

**Display Menu**

With this menu the user specifies which of the eight system variables are to be displayed alternately at two second intervals.

**Selftest Menu**

This menu provides access to a series of diagnostic tests which verify the integrity of the display segments and the meter's internal circuitry.

**MATH FUNCTIONS**

One of the most powerful features of the PM-5080 are the two user-configurable math functions. The two functions have the generalized form:

$$[(C1 \times S1) \times VAR1] OP1 [(C2 \times S2) \times VAR2]] OP2 (C3)$$

Where:

- C1, C2, C3 = numeric constants
- S1, S2 = scaling factors
- VAR1, VAR2 = any one of the eight system variables
- OP1, OP2 = an arithmetic operator: +, -, x, /

The constants, scale factors, variables, and operators constituting the function are specified either from the front panel (within the INPUT menu), or from a host computer connected through the serial port.

During operation, the value of a function is calculated at the monitor's sample rate. This value can be displayed and/or used to control setpoint or analog outputs. Because of their flexibility, the two functions may be used in a variety of ways: for engineering units scaling, as control algorithms, or for combining inputs to calculate other physical process variables. One use of the math functions is illustrated in the application example given below.

**SERIAL COMMUNICATIONS**

A standard feature of the PM-5080 is an RS-232-C serial communications port. Using this port, the PM-5080 can be connected to a host computer or PLC having a similar interface. Any configuration parameter which can be set using the meter's front panel can alternatively be set by issuing a simple ASCII command from the host computer. Additionally, the host can read the meter status, log data, and directly control the setpoint and analog outputs.

PM-5080 commands all conform to a simple ASCII format and can be incorporated into any structured language program. As an example, the command to change the trip limit of setpoint number 4 to 500 is: WSP 4,500.

**APPLICATION EXAMPLE**

A coal burning power plant is required to monitor the amount of carbon monoxide (CO) expelled into the atmosphere. To do this, the PM-5080's dual inputs are employed. One input is connected to a flow sensor which tracks the total flow of gas through the discharge flue; the second input is connected to an in-line analyzer which measures the amount of CO in the discharge gas.

Using the PM-5080's scaling function, the flow meter's 4-20mA output is converted to 0-300 cubic feet/minute for display. One of the monitor's math functions is used to compute and display the rate at which CO is expelled into the atmosphere:

CO Discharge Rate=Total Discharge Rate x %CO in flow

$$\text{FUNCTION 1} = \text{INPUT1} \times (\text{INPUT2} \times 0.1)$$

Formatting to the general form of the equation and scaling for display:

$$\text{FUNCTION 1} = [(C1 \times S1 \times \text{VAR1}) \text{ OP1} (C2 \times S2 \times \text{VAR2})] \text{ OP2}(C3) \\ = [(1 \times 0.1 \times \text{INPUT1}) \times (1 \times 0.01 \times \text{INPUT2})] / 100$$

In this example, the function is also used to control two set-point outputs: one setpoint trips an alarm system should the CO discharge rate rise above a preset level; the second setpoint initiates an emergency plant shutdown if the discharge level reaches an even higher preset level. If desired, the function could also be used to drive an analog output which would control the plant's burners such that CO discharge is kept below a selected setpoint limit.

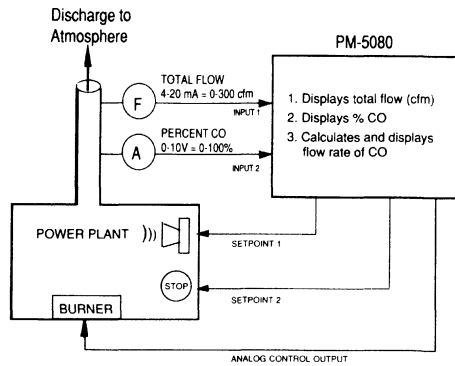
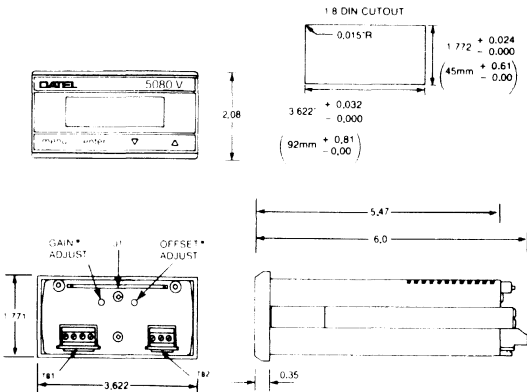
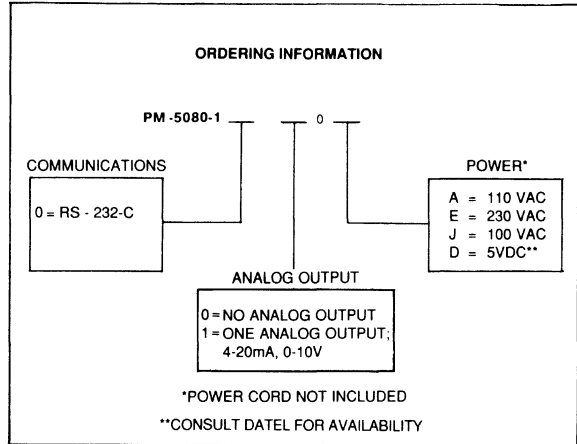


Figure 3. Application Example



NOTE: GAIN AND OFFSET ADJUSTMENT POTENTIOMETERS ARE AVAILABLE ONLY ON MODELS HAVING THE ANALOG OUTPUT OPTION.

Figure 4. Mechanical Dimensions



**WARRANTY**

DATEL warrants this product to be free from defects in material and workmanship under normal use and service for a period of one year from the date of shipment. DATEL's obligations under this warranty are limited to replacing or repairing the unit, at its option, at its factory or facility, when the unit is returned to DATEL's facility, transportation charges prepaid, and which is after examination disclosed to the satisfaction of DATEL to be thus defective. This warranty shall not apply to any such equipment which shall have been repaired or altered except by DATEL or which shall have been subjected to misuse, negligence, or accident. In no case shall DATEL's liability exceed the original purchase price. The aforementioned provisions do not extend the original warranty period of any product which has either been repaired or replaced by DATEL.

NOTE: Equipment sold by DATEL, Inc. is not intended to be used, nor shall it be used as a "Basic Component" under 10 CFR 21 (NRC).

Should this equipment be used in or with any nuclear installation or activity, the Purchaser will indemnify DATEL, Inc. and hold DATEL, Inc. harmless from any liability or damage whatsoever arising out of the use of the equipment in such manner.

**PRECISION  
VOLTAGE  
CALIBRATORS**



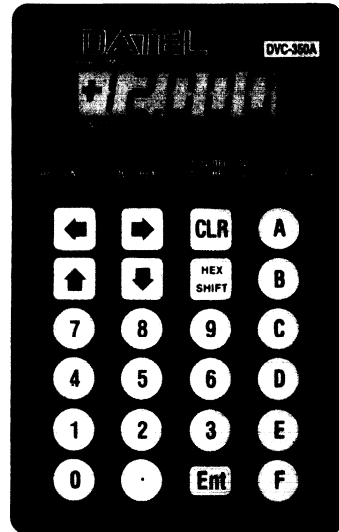
## VOLTAGE CALIBRATORS

MODEL	OUTPUT RANGE	SETTABLE INCREMENTS	ACCURACY	SOURCE/SINK CURRENT	DISPLAY	POWER	CASE/MOUNTING
DVC-350A	$\pm 1.2000$ or $\pm 12.000$	100 $\mu$ V or 1 mV	0.015%	20 mA	4 1/2 DIGIT LCD	9V Battery or 115 VAC Adaptor (optional)	5.75 X 3.60 X 1.29 in (146 X 91 X 33 mm) HAND HELD
DVC-8500	$\pm 19.999$	1 mV	0.005%	25 mA	4 1/2 DIGIT MECHANICAL	100 VAC (J) 115 VAC (A) 230 VAC (E)	5.59 X 2.11 X 5.78 (142 X 54 X 147 mm)



### FEATURES

- Hand-held, lightweight 11 ounces (342 grams)
- Laboratory accuracy of  $\pm 0.015\%$  of FSR at  $+25^{\circ}\text{C}$
- $4\frac{1}{2}$  Digit LCD display
- 100  $\mu\text{V}$  increments
- Two output voltage ranges:  
Decimal:  $\pm 1.2\text{V}$  dc,  $\pm 12\text{V}$  dc  
Hexadecimal:  $\pm 1\text{V}$  dc,  $\pm 10\text{V}$  dc
- Up to 20 mA source or sink current capability
- Rated accuracy down to 6.5V dc battery level using rechargeable 7.2V battery or conventional 9V battery
- Right and left binary shift for hexadecimal calibration of A/D or D/A converters
- Convenient, easy-to-use membrane keyboard with audible feedback
- Finger-touch cursor control with automatic voltage increment or decrement
- Dual voltage output capability: absolute 0 volts (with current limiting) and entered value
- Automatic current limiting and low battery indication
- AC adapter/charger operation optional



*THE DVC-350A'S ACCURACY AND PORTABILITY MAKES IT THE CALIBRATOR-OF-CHOICE FOR PRECISE ADJUSTMENT OF ANALYZERS, RECORDERS, CONTROLLERS, DATA ACQUISITION SYSTEM COMPUTERS, AND MANY OTHER LAB AND FIELD APPLICATIONS.*

### INTRODUCTION

DATEL's Model DVC-350A hand-held, microprocessor-based voltage calibrator provides the user with two entry modes of operation and four output voltage ranges. The outputs have an unprecedented 0.015% accuracy, commonly found only in laboratory-type calibrators.

Complementing the DVC-350A's portability and flexibility is an outstanding array of features and the large  $4\frac{1}{2}$  digit LCD display. Mode of entry is switch-selectable as either decimal or hexadecimal. Decimal mode output ranges are  $\pm 1.2\text{V}$  dc in 100  $\mu\text{V}$  increments and  $\pm 12\text{V}$  dc in 1 mV increments. Hexadecimal mode offers output voltage ranges of  $\pm 1\text{V}$  dc in 244  $\mu\text{V}$  increments and  $\pm 10\text{V}$  dc in 2.44 mV increments.

The hexadecimal mode is notably useful for computer-oriented calibration of digital panel meters, A/D's, and data acquisition systems. It eliminates the need for tedious hexadecimal-to-decimal number conversion; the DVC-350A does it all automatically. The DVC-350A accepts and converts hexadecimal numbers up to FFF hex.

### APPLICATIONS

The DVC-350A is a universal field and laboratory voltage calibrator with outstanding accuracy and stability. In the lab, the

DVC-350A is an ideal voltage source for engineering prototypes, breadboards, and test setups without competing with other instruments for space and AC outlets.

Size and portability, however, make the DVC-350A an outstanding field instrument. It easily fits into a coat pocket or attache case. It makes remote site calibration easy and accurate. The DVC-350A is extremely effective for calibrating A/D converters, V/F converters, DPM's and transducers (load cells, strain gages, LVDT'S, etc.).

### DESCRIPTION

The DVC-350A owes its accuracy to the precision and stability of the power supply, the analog output circuitry, and its high performance, 14-bit CMOS digital-to-analog converter, characterized by its precision and lower power consumption. As shown in Figure 1, the 14-bit digital input to the DAC is routed by the 8-bit CMOS microprocessor which also takes the entered data from the keyboard and updates the  $4\frac{1}{2}$  digit LCD display.

### ORDERING INFORMATION

SEE LAST PAGE

The DVC-350A uses an extremely stable switching power supply. The power supply circuitry incorporates the latest power supply technology, operating with battery potentials from 20V dc down to 6.5V dc without degrading performance. The low battery indicator on the display turns on at a 6.7V dc battery potential.

The DVC-350A uses one standard 9V alkaline battery or a rechargeable Nickel-Cadmium battery. The calibrator may also operate using an optional AC adaptor/charger when a Ni-Cd battery is installed. When using an alkaline battery, remove the battery before using the adapter.

The low output impedance amplifier of the DVC-350A will source or sink up to 20 mA over the specified output voltage ranges without compromising its performance and accuracy.

The device begins current limiting at 22 mA, turning on an overload symbol on the display. At higher current loading, the calibrator's accuracy will be somewhat degraded until such time as its short-circuit protection circuit shuts down the output at 33 mA. The overload circuitry protects the calibrator from external loads lower than 480 ohms on the 12V scale or 48 ohms on the 1.2V scale.

## FUNCTIONAL SPECIFICATIONS

(Typical at +25° C unless otherwise noted)

### VOLTAGE OUTPUT

#### Ranges

Decimal	0 to $\pm 1.2V$ dc, 0 to $\pm 12V$ dc
Hexadecimal	0 to $\pm 0.99975V$ dc, 0 to $\pm 9.9975V$ dc (HEX = FFF)

Zero Volts Output Error . . . . . +100  $\mu V$

Output Type . . . . . Low-impedance dc voltage, current limited.

Current Capability . . . . . Output will sink or source 20 mA maximum over the full scale ranges.

Output Overload . . . . . Greater than +20 mA current will turn on the overload indicator and output accuracy will degrade.

Output Impedance . . . . . 30 milliohms.

Capacitive Load . . . . . No limitation.

Output Connector Type . . . . . Two banana-type jacks, 0.75" spacing on centers.

### OUTPUT PROTECTION

Current . . . . . 33 mA short circuit-proof (Will shut down at this point)

Voltage . . . . . 15V (dc or AC peak-to-peak) maximum (Damage to output circuitry might result when exceeding this value).

Output Settling Time . . . . . 5 seconds to rated accuracy, 2 seconds to 99% of final output.

## PERFORMANCE

Accuracy	Within $\pm 0.015\%$ of full scale
Resolution	12V scale; 1 mV increment 1.2V scale; 100 $\mu V$ increment 10V scale; 2.44 mV increment 1V scale; 244 $\mu V$ increment

### Temperature Drift of Zero

(12V scale)	within $\pm 10 \mu V/^\circ C$
(1.2V scale)	within $\pm 1 \mu V/^\circ C$

### Temperature Drift of Calibration

(+15°C to +35°C)	$\pm 10$ ppm of setting/ $^\circ C$
(0°C to +50°C)	$\pm 15$ ppm of setting/ $^\circ C$

### Operating Temperature Range

0°C to +50°C

### Storage Temperature Range

-25°C to +85°C

Output Noise . . . . . 150  $\mu V$  peak-to-peak, wideband (12V dc scale)

## POWER REQUIREMENTS

Supply Battery Voltage . . . . . 20V dc to 6.5V dc (no effect on Range performance)

Supply Current . . . . . 20mA (no load) at +9V dc

Battery Type . . . . . 9V alkaline or Ni-Cd

Battery Life (GC9B NiCd) (before requiring recharging)	Min.*	Typ.	Units
	1.0	4	hours

\* 12V at 20 mA output would require an input current of 55 mA at 9V.

## PHYSICAL DIMENSIONS

Size . . . . . 5.75"L x 3.6"W x 1.29"H  
146 x 91 x 33mm

Weight . . . . . 11 ounces (342 grams)

Case . . . . . ABS plastic

Keyboard Life . . . . . 10 million cycles per switch (minimum)

Key Operating Force . . . . . 4 to 8 ounces,  
124 to 248 grams

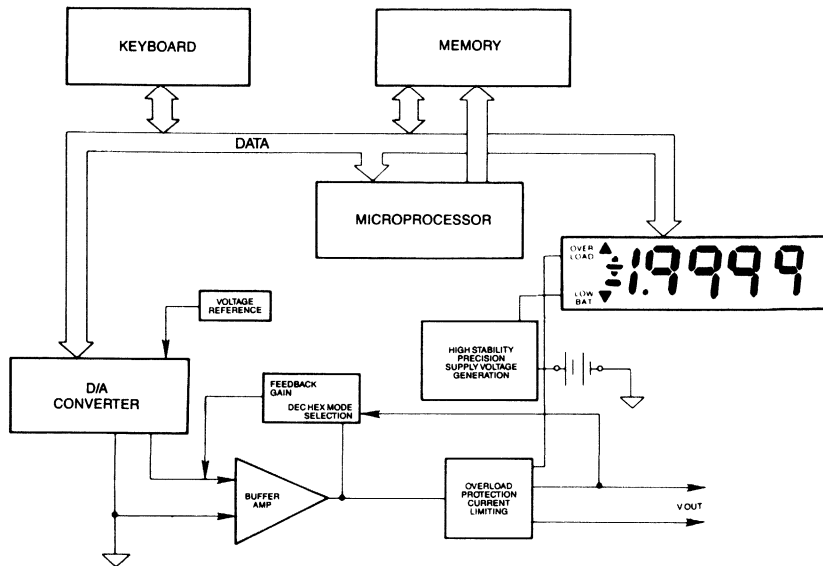


Figure 1. DVC-350A Block Diagram

**SWITCHES AND INDICATORS**  
(Refer to Figure 2)

Power, output polarity, range, and decimal/hexadecimal mode switches are located above the keypad; each is clearly labeled. Decimal and hexadecimal mode selection is switch-selectable.

The three-position polarity switch on the keyboard allows “+” or “-” polarity output selection as well as 0V dc output indicated by the alternately flashing “+” and “-” sign.

An oscillating polarity sign (between + and -) indicates that the calibrator is producing a 0 volt output. In this mode, the display still reads the last keyboard entry which becomes an output when the switch moves from the center position to the left (-) or right (+).

**KEYBOARD**  
(Refer to Figure 2)

The DVC-350A's touch-sensitive membrane keyboard consists of 24 decimal, hexadecimal, and function keys. A minimum force of 4 ounces activates the keys. An internal buzzer provides audible feedback for all keypad entries (except the increment and decrement key).

**Cursor left/right keys**

The cursor keys move the cursor left and right to select the desired digit to be incremented or decremented by the increment/decrement keys. The cursor is not visible on the display and the user must use the increment/decrement keys to find the cursor position. The device provides an audible feedback when using the cursor left/right keys until the cursor position is at either end of the display.

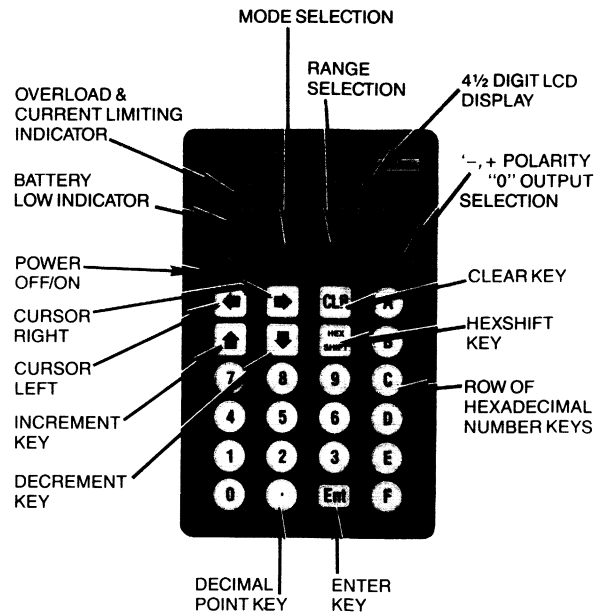


Figure 2. Keys, Indicators, Switches

**Increment/decrement keys**

These keys allow the user to increase or decrease the value in a display position by one unit. The change is immediately present on the output. These keys are always active.

**Alpha keys**

The A, B, C, D, E, F keys are only used in the hexadecimal mode and are combined with numeric keys to create a valid hexadecimal entry. Figures 3 and 4 clarify how the device converts decimal numbers to hexadecimal numbers while Table 1 lists equivalent voltage outputs for displayed hexadecimal values.

**Numeric keys**

The numeric keys allow entering decimal values within the decimal and hexadecimal ranges. Out-of-range values result in a 'bad entry' indication.

**Decimal point key**

This key is used to enter a decimal point when in decimal mode.

**Clear entry key**

Pressing this key while in the decimal and hexadecimal modes clears the keyboard entry and the display.

**Enter key**

Pressing the ENTER key permits the newly-entered decimal value to appear at the output connectors of the calibrator. This key must be used when entering a decimal number from the keyboard. The ENTER key does not need to be pressed when using the increment and decrement keys, since the output of the calibrator changes automatically with the use of these keys.

**Hex shift key**

Pressing the HEX SHIFT key changes the function of the increment/decrement keys. After enabling this function, the increment key multiplies the displayed hexadecimal value by 2 and the decrement key divides the entered hexadecimal value by 2. A second depression of the HEX SHIFT key disables the function. The display shows 4 decimal points to indicate that the HEX SHIFT function is active. This key is only valid in the hex operation mode.

**DISPLAY**

The DVC-350A uses a 4½ digit liquid crystal display with indication of current limit and low battery conditions. Sourcing or draining more than 22 mA turns on the current limit indicator in the upper left corner, indicating an automatic current limiting and overload condition.

When battery potential is lower than 6.5V dc, the low battery indicator in the lower left corner turns on.

Invalid entries, in both modes, turn on the " b.B.EE " (bad entry) message, displaying it for about 3 seconds before returning to the last valid entry.

When in Hexadecimal mode with HEX SHIFT enabled, attempting to multiply a zero display by 2 results in a display of '1' in the LSB position since the microprocessor automatically shifts left. This action is graphically shown in Figure 5.

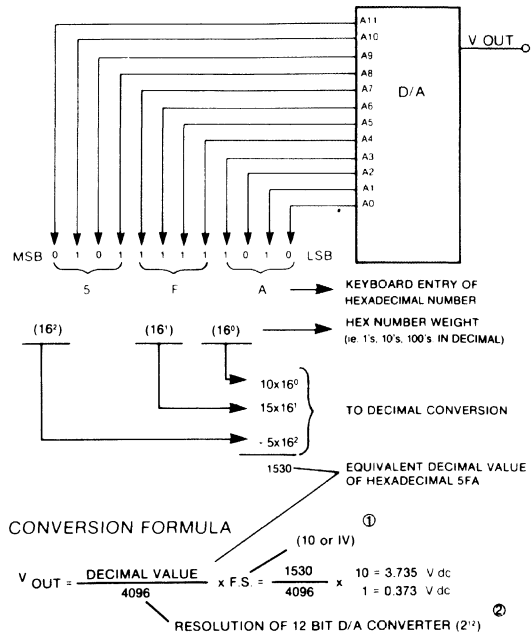
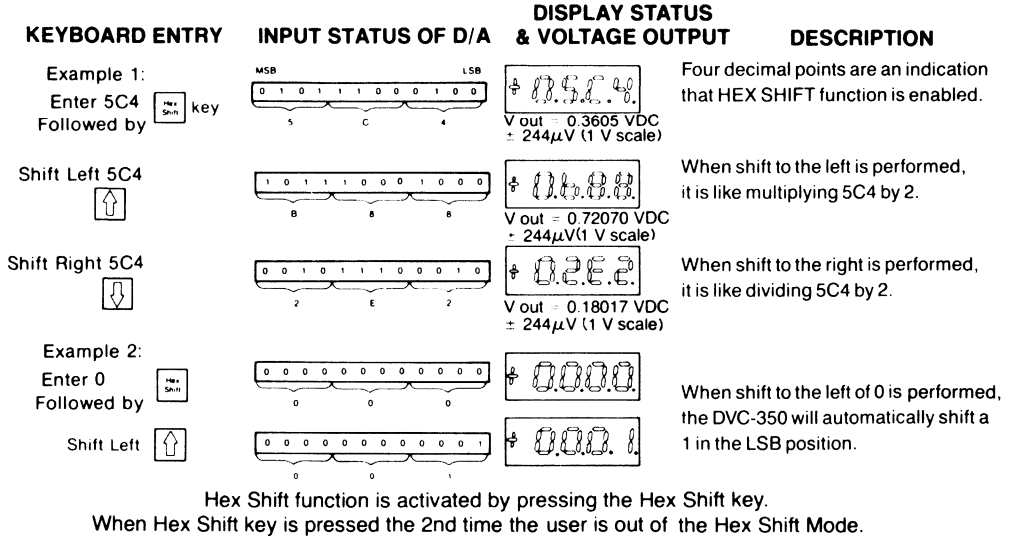


Figure 3. Hexadecimal Mode Operation

	DECIMAL	BINARY	HEXADECIMAL
0	0 0 0 0	0	0
1	0 0 0 1	1	1
2	0 0 1 0	2	2
3	0 0 1 1	3	3
4	0 1 0 0	4	4
5	0 1 0 1	5	5
6	0 1 1 0	6	6
7	0 1 1 1	7	7
8	1 0 0 0	8	8
9	1 0 0 1	9	9
10	1 0 1 0	A	A
11	1 0 1 1	B	B
12	1 1 0 0	C	C
13	1 1 0 1	D	D
14	1 1 1 0	E	E
15	1 1 1 1	F	F

**Note:** In hexadecimal, B and D are displayed as lower case, b and d respectively. Note the difference between letter ( b ) and the numeral ( 5 ).

Figure 4. Decimal, Binary, Hexadecimal Chart



Hex Shift function is activated by pressing the Hex Shift key.  
When Hex Shift key is pressed the 2nd time the user is out of the Hex Shift Mode.

Figure 5. HEX SHIFT Key Operation

Table 1. DVC-350A Coding Table

DISPLAYED HEXADECIMAL VALUES	DECIMAL VOLTAGE OUTPUT EQUIVALENT	
	10 VDC SCALE	1 VDC SCALE
FFF	9.9975	.99975
.		
.		
.		
800	5.0000	.50000
.		
.		
400	2.5000	.25000
.		
.		
100	0.6250	.06250
.		
.		
010	0.0390	.00390
.		
.		
002	0.00488	.00048
001	0.00244	.00024
000	0.00000	.00000

**EXAMPLES OF DVC-350A ENTRY**

**Decimal Mode**

Power: On  
Mode: DEC (decimal)  
Range: 12V dc,  
Polarity: +  
Enter: 9.354

Press the decimal number and decimal point keys, reading from left to right, followed by the ENTER key. The display will indicate a value of +9.354 and an analog voltage of +9.354V dc will be present at the output of the unit.

**Hexadecimal Mode**

Power: On  
Mode: HEX (hexadecimal)  
Range: 10V dc  
Polarity: +  
Enter: 1FA

Follow the same procedure described in the earlier example with the addition of using the hexadecimal ALPHA keys. After pressing the ENTER key, the display will read 1FA with a corresponding output voltage of +1.235V dc. The DVC-350A automatically converts the hexadecimal number entry into a decimal equivalent voltage output (see the conversion formula presented in Figure 3).

**HOUSING AND MECHANICAL DIMENSIONS**

The ABS plastic housing has access holes for adjustment potentiometers. Procedures for adjustment are covered in the DVC-350A User Manual. Figure 6 shows the locations of the battery compartment and voltage connectors.

The mechanical dimensions of the DVC-350A appear in Figure 7.

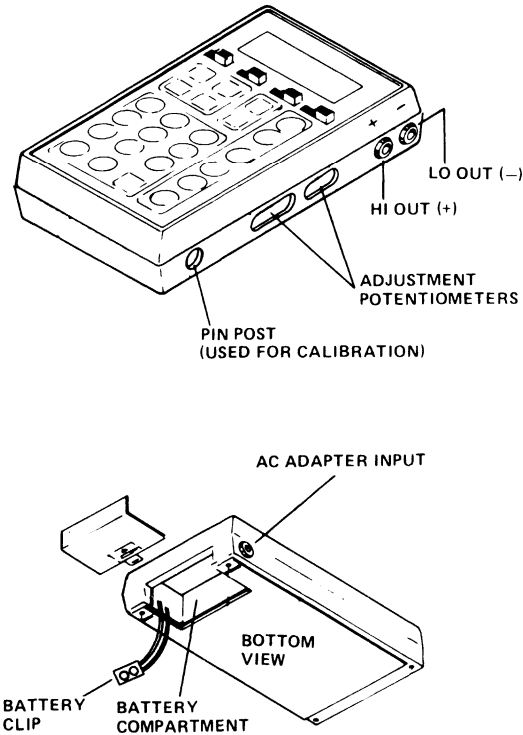


Figure 6. Terminals and Battery Locations

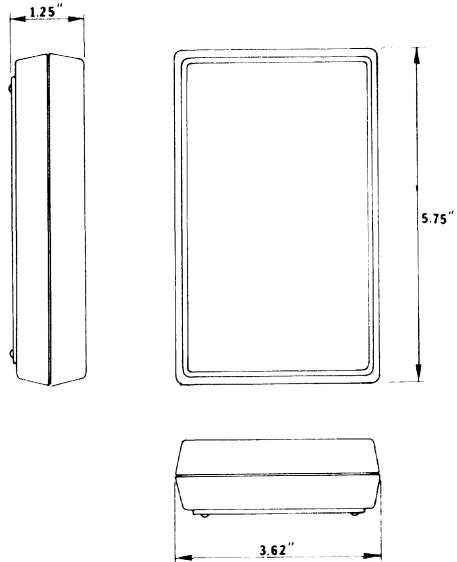


Figure 7. DVC-350A Mechanical Dimensions

ORDERING GUIDE	
<p><b>DVC-350A Includes:</b></p> <p><b>Calibrator</b> Water resistant carrying case (inside pocket for test leads and spare batteries).</p> <p><b>Test Leads Set</b> Two 3 foot, 20 AWG, leads, stackable banana plugs (with retracting hook clips).</p> <p><b>Certificate of Calibration</b> <b>Operations manual</b></p>	<p><b>Accessory Kit (MODEL 39-7267690)</b></p> <p>Includes:</p> <ul style="list-style-type: none"> <li>• AC Adapter/Charger, UL/CSA approved</li> <li>• 7.2V Rechargeable Ni-Cd battery</li> </ul>

**WARRANTY**

DATEL warrants this product to be free of defects in material and workmanship for a period of one year from the date of shipment, under normal use and service. DATEL's obligations under this warranty are limited to replacing or repairing the product, at its option, at its factory or facility. The defective product must be shipped to DATEL's facility for repair or replacement within the warranty period, transportation and charges prepaid. This warranty shall not apply to a product which has been repaired or altered, except by DATEL, or which has been subjected to misuse, negligence, or accident. In no case shall DATEL's liability exceed the original purchase price. The aforementioned provisions do not extend the original warranty period of this product which has either been repaired or replaced by DATEL.

## FEATURES

- $\pm 19.999$  Volts full-scale output range, attenuation kits available for  $\pm 1.9999V$  FSR and  $\pm 199.99$  mV FSR
- Millivolt settability with accuracy of  $\pm 25$  ppm of setting  $\pm 1/2$  LSB (0.005% of Full-scale Range)
- Output range set from quick-select front panel lever switches
- Continuous front panel  $\pm 1.5$  mV vernier control
- Rated accuracy up to 25 mA output
- Current from short-circuit-proof output transformer-isolated  $\pm 300$  Volts to AC line
- Miniature aluminum case includes bench-top stand or can be panel mounted
- Choice of 100, 115, or 230 VAC power supplies
- Low cost

## GENERAL DESCRIPTION

DATEL's low-cost miniature Digital Voltage Calibrator, model DVC-8500, is a 4 1/2 digit voltage reference source with a full-scale output range of -19.999 Volts to +19.999 Volts in 1 millivolt steps. An active buffered output amplifier provides very low output impedance and up to 25 milliamps output current at the rated accuracy of  $\pm 25$  ppm of setting,  $\pm 500$   $\mu V$ . This short-circuit proof output is selected by unique front-panel lever switches. These switches provide rapid, positive contact adjustment, far superior to traditional thumbwheel switches. Voltage outputs may be continuously varied within  $\pm 1.5$  millivolts of selected readings by using the front panel vernier control. The DVC-8500 output is available from both front panel banana jacks and a rear panel 36-pin gold-plated PC connector fitted with lug terminals.

The DVC-8500 Digital Voltage Calibrator is small enough for bench-top use or panel mounting. It fulfills many laboratory needs such as calibrating A/D and D/A Converters, Digital Panel Meters, Operational and Instrumentation Amplifiers, Voltage/Frequency Converters and Digital Voltmeters. The small size and light-weight design of the DVC-8500 make it an ideal portable instrument for a technician's repair kit. When mounted on its bench-top tilt stand, the DVC-8500 uses very little space and can be positioned close to test circuits.

The miniature calibrator features high performance for such a small, low-cost instrument. An oven-stabilized zener diode internal reference provides an overall accuracy of  $\pm 500$   $\mu V$  and  $\pm 25$  ppm of the setting with zero drift of  $\pm 5$   $\mu V/^\circ C$  and full-scale drift of 4 ppm/ $^\circ C$  max.

Rear connector sense feedback inputs to reduce errors



caused by cable resistance. A front panel LED overload lamp lights if the output exceeds 25 mA and current limiting occurs at 70 mA output. The output circuit can accept up to  $\pm 25$  mA source or sink current at rated accuracy. The rear connector also includes a low-Z output of the +10 Volt reference source with 5 mA maximum drive for external reference tracking. Wideband output noise is 25 microvolts, pk-pk max.

Powered by a choice of 100, 115 or 230 VAC  $\pm 10\%$ , and 47 to 440 Hz at 10 watts, the DVC-8500 offers transformer isolation up to  $\pm 300$  VDC. Output line rejection is within  $\pm 50$  microvolts of zero and within  $\pm 25$  ppm of full-scale range. The black-anodized extruded aluminum housing provides excellent shielding to electrical noise.

**FUNCTIONAL SPECIFICATIONS**

(Typical between 0°C and +50°C at steady ambient temperature after 5 minute warm-up)

**VOLTAGE OUTPUT**

<b>Output Type</b> .....	Shielded transformer isolated, active low impedance DC voltage output, current limited.
<b>Output Voltage Range</b> .....	0 to +19,999 Volts DC or 0 to -19,999 Volts DC, lever switch selected, 1 mV steps (Range $\pm 20.0005$ Volts using vernier control).
<b>Output Current Range</b> .....	0 to 25 mA (source current) to rated voltage output accuracy.
<b>Output Overload</b> .....	Greater than 25 mA (source current) will illuminate front panel LED overload lamp. Output is current limited (continuous short-circuit proof) to 70 mA (source current) at any voltage up to $\pm 20$ V dc.
<b>Output Impedance</b> .....	Less than 10 milliohms.
<b>Capacitive Load</b> .....	no limitation

**PERFORMANCE**

<b>Accuracy @ +25°C with Vernier Control at Zero</b> .....	Within $\pm 25$ ppm of setting, $\pm 500 \mu\text{V}$ when calibrated (0.005% of Full-scale range).
<b>Resolution</b> .....	Set within $\pm 1$ mV increments. A front panel vernier control provides $\pm 1.5$ mV continuous offset with 100 $\mu\text{V}$ graduations.
<b>Temperature Drift of Zero</b> .....	Within $\pm 5 \mu\text{V}/^\circ\text{C}$
<b>Temperature Drift of Calibration</b> .....	Within $\pm 4$ ppm of setting/ $^\circ\text{C}$
<b>Operating Temperature Range</b> .....	0°C to +50°C
<b>Storage Temperature Range</b> .....	-25°C to +85°C
<b>Warm-Up Time</b> .....	5 minutes to rated accuracy
<b>Output Noise</b> .....	25 $\mu\text{V}$ pk-pk, wideband (no cap load)
<b>Reference Source</b> .....	6.4V oven-stabilized low TC zener reference diode
<b>AC Line Voltage Rejection</b> .....	Zero: $\pm 50 \mu\text{V}$ over full line range Calibration: $\pm 25$ ppm of setting over full line range
<b>Power Transformer Isolation</b> .....	1000 Megohms. Transformer primary has a grounded shield for capacitive isolation.
<b>Breakdown</b> .....	300 VRMS, min.

**FRONT PANEL****Output Selector**

<b>Switches</b> .....	Six lever-operated detented switches are set in millivolts ( $\pm 19999$ mV range)
<b>Polarity</b> .....	2 positions, + or -
<b>Leading Digit</b> .....	2 positions, 0 or 1
<b>4 Digits</b> .....	10 positions, 0 thru 9
<b>Output Vernier</b> .....	Rotary potentiometer, range $\pm 1.5$ mV of selected output. Graduated in 100 $\mu\text{V}$ divisions. Clockwise rotation labeled "INCR" (increase) will increase the absolute value of the selected output. "INCR" will make a negative output more negative or positive output more positive. Counterclockwise rotation labeled "DECR" (decrease).
<b>Overload Light</b> .....	Red LED lamp illuminates if output exceeds $\pm 25$ mA.
<b>Power Switch</b> .....	Toggle switch, AC power on or off.
<b>Power Light</b> .....	Red LED lamp illuminates when AC power is on.

**INPUT/OUTPUT CONNECTORS**

<b>Front Panel</b> .....	Voltage output (blue) and output common (black) available from two (2) gold plated brass banana jacks, 0.166" (4.22 mm) i.d., 0.56" (14.2 mm) deep, 0.75" (19.05 mm) between centers. (Order DATEL test leads, model 38-8193902)
<b>Rear Connections:</b>	
<b>Voltage Output</b> .....	Parallel connection with front panel jack.
<b>Output and Reference Common</b> .....	Parallel connection with front panel jack. Transformer isolated $\pm 300$ V from case ground.
<b>Reference Output</b> .....	Low impedance $\pm 10$ Volt DC output from +6.4V ref. diode. Drain must not exceed $\pm 5$ mA maximum. Ref. output is opposite polarity of calibrator output.
<b>Sense Input</b> .....	Connect to remote load to compensate for cable resistance voltage drops. See diagram. This input must be tied to voltage output if not used.
<b>Sense Common</b> .....	Return for sense inputs. Tie to output common if sense is not used.

Rear connections are arranged as dual 36-pin PC edge-board connections on 0.1" centers. Individual connections consist of 4 gold-plated fingers on a common pad area in



parallel with the 4-finger pad on the bottom. Each dual-pad (8 fingers total) is drilled and plated through for optional lug connection using 4-40 hardware. Shorting bars and 4-40 hardware are included to short sense and common connections if not used.

For rear connections, use a Viking#3VH36/1JN-5 or equivalent PC connector.

**ADJUSTMENTS**

Calibration adjustment trim pots are accessible by partially removing circuit board from case.

**POWER SUPPLY**

**Requirement:**

- DVC-8500A**..... 115 VAC, ±10%, @ 47-440 Hz, 10 watts (includes US-style, 3-prong line cord)
- DVC-8500E**..... 230 VAC, ±10%, @ 47-440 Hz, 10 watts (includes US-style, 3-prong line cord)
- DVC-8500J**..... 100 VAC, ±10%, @ 47-440 Hz, 10 watts (includes US-style, 3-prong line cord)
- Grounding**..... Ground wire to case, but transformer-isolated ±300 VRMS from output common.
- Fuses:**
- DVC-8500A**..... 0.15 A AGC SLO-BLO
- DVC-8500E**..... 0.1 A AGC SLO-BLO
- DVC-8500J**..... 0.15 A AGC SLO-BLO

**MECHANICAL DIMENSIONS**

- Case**..... 5.59"W x 2.11"H x 5.78"D (142,0 x 53,6 x 146,8 mm) (Bench-top stand retracted)
- Bezel**..... 5.86"W x 2.25"H x 0.50"THK (148,7 x 57,0 x 12,7 mm)
- Servicing**..... Bezel, front panel and mother board are removable from front while unit remains secured in panel. Bezel is lifted off by removing the two 0.050-inch (4-40) Allen hex key set screws on the bottom side edges. PC boards may be removed by loosening the PC board guide track retaining screws on the lowest position of the panel mounting seats.
- Weight**..... 2.25 pounds (1,0 Kg)
- Cutout**..... 5.62" x 2.16" (142,7 x 54,8 mm)

**MOUNTING**

Choice of bench-top mounting or panel mounting through a cutout measuring 2.16"H x 5.62"W (54,8 x 142,7 mm) and secured by 2 U-Straps. See ordering guide for optional panel-mount kit.

**ORDERING GUIDE**

**Accessories:**

- DVC-8500A..... Calibrator, 115 VAC
- DVC-8500E..... Calibrator, 230 VAC
- DVC-8500J..... Calibrator, 100 VAC
- Panel-Mount Kit, P/N 38-8193022..... Consists of (2) U-Straps, rear PC board connector and hardware
- Test Lead Set, 38-819302..... Consists of (2) 3-foot, 20 gauge leads, red and black. Stackable banana plugs and retracting hook clips
- 10:1 Attenuator, 38-8193900..... For ±1.9999V output range
- 100:1 Attenuator, 38-8193901..... For ±199.99 mV output range

## **Contact DATEL for:**

- **Panel Meters, Printers, & Calibrators**
- **Data Acquisition & Control Boards**
- **Data Conversion Components**
- **Power Supplies**

**Dial  
1-800-233-2765  
for  
Immediate Assistance**

**PANEL  
MOUNT  
THERMAL  
PRINTERS**

## PANEL MOUNT THERMAL PRINTERS

Model	Columns	Input Interface	Power (Note 1)	Character Set	Case*	Special Features
DPP-Q7	7	BCD	115/230 VAC	Numeric (decimal or hex) plus sign	A	Simple DATEL DPM interface
APP-20A1	20	Parallel	115/230 VAC	96 char ASCII	A	Inverted, tall character options
APP-20D1	20	Parallel	+12 Vdc	96 char ASCII	A	Inverted, tall character options
APP-20A21	20	RS-232/20 mA loop	115/230 VAC	96 char ASCII	A	Inverted, tall, condensed character options
APP-20A21	20	RS-232/20 mA loop	+12 Vdc	96 char ASCII	A	Inverted, tall, condensed character options
APP-20D21	20	IEEE-488	115/230 VAC	96 char ASCII	A	Inverted, tall character options
MPP-20A	20	RS-232/Parallel	115 VAC	127 char ASCII	A	Inverted, tall, enhanced character options
MPP-20D	20	RS-232/Parallel	+12 Vdc	127 char ASCII	A	Inverted, tall, enhanced character options
MPP-20E	20	RS-232/Parallel	230 VAC	127 char ASCII	A	Inverted, tall, enhanced character options
APP-48A1	48	Parallel	115 VAC	192 char ASCII	B	Inverted character options
APP-48A2	48	RS-232	115/230 VAC	192 char ASCII	B	Inverted character options
APP-48D2	48	RS-232	+12 Vdc	192 char ASCII	B	Inverted character options
APP-48A3	48	IEEE-488	115/230 VAC	192 char ASCII	B	Inverted character options
APP-48D3	48	IEEE-488	+12 Vdc	192 char ASCII	B	Inverted character options
APP-M20A1	20	Parallel	115/230 VAC	96 char ASCII	C	Hardened for shock, vibration and humidity (mobile)
APP-M20A21	20	RS-232	115/230 VAC	96 char ASCII	C	
APP-M20D21	20	RS-232	+12 Vdc	96 char ASCII	C	
APP-M48D1	48	Parallel	+12 Vdc	192 char ASCII	D	8 International Character Sets High Res Graphics, 200 Line Buffer CUSTOM CHARACTERS AVAILABLE
APP-M48D2	48	RS-232	+12 Vdc	192 char ASCII	D	
<b>NEW</b> GPP-42	42	Serial/Parallel	115/230 VAC (50/60 Hz)	256 char ASCII	E	

NOTE 1. 100 VAC versions available for most models ("J" version); European line cords also available ("E" version). Consult factory.

CASES\* Refer to pages 163 to 168 for dimensional drawings.

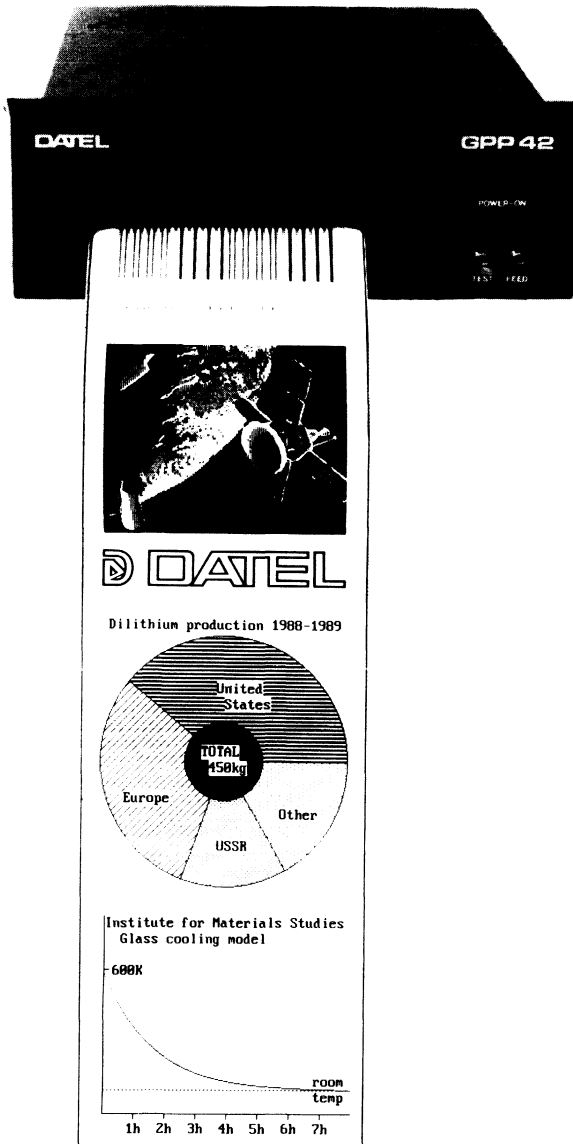
A = 4.44"W x 2.76"H x 8.00"D

B = 8.20"W x 2.84"H x 8.14"D

C = 5.36"W x 3.74"H x 8.00"D (Including mobile-mount brackets)

D = 9.25"W x 3.25"H x 10.44"D (Including mobile-mount brackets)

E = 8.20"W x 2.84"H x 10.50"D



### FEATURES

- High speed (200 characters per second)
- High resolution graphics
- User-selectable serial and parallel ports
- Built-in 8400 character buffer
- 42-Column fixed printhead
- User-selectable 110/220 VAC
- Built-in self test
- 30,000,000 line MTBF

### GENERAL DESCRIPTION

DATEL's newest high speed, ruggedly reliable, 42-column thermal printer sets the standard for all other industrial grade panel printers. It's 30,000,000 line MTBF combined with high speed print rate (5 lines per second, max) and built-in 8400 character buffer (200 lines) allows prolonged, unattended data logging.

These characteristics apply to either of the user-selectable serial (RS-232C) or parallel (Centronics) ports. Selectable serial port parameters and the extended operating temperature range (0 +50 °C) adds even more flexibility. Two print speeds are available: 120 CPS and 200 CPS. A bit mapped, high resolution graphics mode may be selected from software or via internal DIP switches. A wide variety of additional print modes are available including: standard text, inverted text, double width text, reverse text (black background, white text), and graphics. Eight international character sets are also available (4 hardware selectable, 8 software selectable).

The 200 line input buffer allows data transfer rates up to 9600 baud without handshaking (printhead speed is 1200 baud). The serial port is configurable to support software-based X-ON/X-OFF protocol, hardware handshaking, or simple twisted pair communications. An automatic baud rate error detect is a standard feature and compares actual data input rates with selected rates. Error notification is via a red LED on the front panel. Typical power consumption is 20 watts with jumper-selectable choice of 110 or 220 VAC. Panel mounting is quick and easy using 4 pan-head screws.

### APPLICATIONS

- Prolonged, unattended data logging
- Mixed graphics and text
- Industrial control panels
- Scientific industrial instrumentation
- On-site hardcopy backup
- Data communication equipment
- Process control instrumentation

**SPECIFICATIONS (Typical at +25°C unless noted)****GRAPHIC PRINTOUT****Print Mode**

Graphics mode selected by software command, or switch SW3 on the control board.

**Dots per line**

256

**Dot Density**

2.86 per mm.

**Mode**

Bit mapped.

**CHARACTER PRINTOUT****Number of Columns**

42

**Characters**

Standard 96 ASCII character set.  
8 international character sets.  
126 additional characters including Greek letters, European characters, graphic symbols etc.

**Print Mode**

Inverted and non-inverted modes controlled by software commands.

**Print Format**

7 x 6 dot matrix (1 dot character space) with 3 dot line character-line spacing. Double characters 7 x 12 dot matrix.

**Character Size**

Character matrix 7 x 5 dot.  
Matrix size 2.45mm x 1.75mm.

**Printing Method**

256 dot line, non-impact thermal ceramic printhead.

**Printing Rate**

5 lines per sec.  
20mSec. per dot line.

**Print Colour**

Black characters on white paper.

**Print Paper**

Thermal paper 4.5 inches (112mm) wide x 150 foot (45mm) rolls.

**PRINTHEAD****Dot Size**

0.42mm (H) x 0.32mm (W)

**Paper Pitch**

0.35mm (line dot spacing)

**Print Speed**

20mSec. per dot line.

**Head Life**

30 Million dot lines (330 x 150 ft rolls).

**Mechanism Life**

5,000 hours.

**Head Temperature**

Max Temperature controlled by CPU and thermistor mounted on ceramic head.

**INTERFACE****Serial Input**

RS232-C with hardware or software X-ON, X-OFF handshaking. Baud rates from 300 to 9600. Automatic adjustment to input word length, stop bits and parity. Front panel indication of incorrect baud rate.

**Parallel Input**

8 bit Centronics.

**Memory**

200 line interface buffer memory. Data transmission halted when memory full.

**POWER SUPPLIES**

GPP42-A 110 volts 50/60Hz  
GPP42-E 240 volts 50/60Hz  
Mains input voltage is selectable on the power supply board.

**Power Consumption**

15 Watts (idling).  
20 Watts (characters).  
40 Watts (graphics).

**PHYSICAL****Temperature Range**

0°C to +50°C.

**Storage Temperature**

-20°C to +85°C.

**Weight**

2 Kgs.

**Dimensions**

8.2" (W) x 2.84" (H) x 10.5" (D).  
208mm (W) x 72mm (H) x 267 (D).

**Mounting**

Front panel cutout.  
Cutout size 8.4" (W) x 2.9" (H), 213mm (W) x 74mm (H).

**OPERATION****1. INTERFACE BOARD****Baud Rate Test**

In the serial input mode the interface will continually verify the input baud rate is the same as the printer selected baud rate. Should a baud rate error occur, the red lamp on the front panel will flash, warning the operator.

**Self Test**

The full 256 character set plus a graphics 'chess board' is used to 'self test' the control board and printhead mechanism. The self test program is controlled by the front panel switch, the paper FEED switch being held down before depressing and releasing the TEST switch. The printer will repeat the test pattern until the paper FEED switch is released. During the 'self test' data input is disabled. To ensure there is no accidental loss in data the self test switch can be disabled using SW8 of the DIP switch on the back panel.

DIP Switch SW8	ON	OFF
Self Test	Enable	Disable

**Data Process (Graphics Mode)**

In the graphics mode the input data is transmitted as a number which represents 16 consecutive pixels, eg pixel ON = "1", pixel OFF = "0", in binary form. The control board CPU decodes the transmitted number back to binary format and the data stored in memory. When 16 numbers (256 bits) have been stored the head controller program takes over.

**Head Controller**

The head control program starts when the local print buffer memory has a complete character line or graphics line data entry. In the character mode the head controller program sends 7 blocks of data to the head via the driver ICs, causing a dot line to be printed on the thermal paper. The control program then drives the stepper motor which feeds the paper forward before the next block is transmitted to head. This process is repeated 7 times creating 7 x 5 dot matrix characters on the paper.

**Paper Out**

The control board continuously monitors the paper sensor. When the sensor indicates paper empty, the data transfer from the interface to the control board is stopped immediately and the paper feed control on the front panel is disabled. Note, if the printer is left powered up while a new roll of paper is inserted, data sent to the printer during this time will be stored by the interface board memory, and not be lost.

**Head Position**

The head must be lifted up off the roller to feed a new roll of paper under the head, see page 7. The controller program constantly monitors the head up/head down sensor. With the head in the up position, printing and data from the interface board is stopped until the head is returned to the down position. This ensures no loss of data.

**OPERATION, continued**

**End of Message**

The interface will monitor the data input flow to the RAM and when the data flow stops the interface controller will send an additional line feed at the end of the message. This ensures the last data line is fed clear of the printhead and it also gives the operator a visual indication that the data from the modem, PC, etc has ceased.

**Interface Memory**

The interface RAM can store up to 200 print lines in the character mode which is equivalent to 2 full pages of A4 text. Some of the more important advantages of this memory is that messages will not be lost when the printhead is removed for reloading the paper or cleaning the head, and data can be transmitted to the printer at 9600 baud and not be limited to the printhead speed of 1200 baud. The interface controller monitors the status of the RAM and will stop data input to the printer when the memory is full.

Table 1

INPUTTYPE	BAUD RATE	SWITCH POSITION						
		1	2	3	4	5	6	7
RS232	9600	ON	ON	ON	ON	ON	ON	OFF
RS232	4800	OFF	ON	ON	ON	ON	ON	ON
RS232	2400	ON	OFF	ON	ON	ON	ON	ON
RS232	1200	OFF	OFF	ON	ON	ON	ON	ON
RS232	600	ON	ON	OFF	ON	ON	ON	ON
RS232	300	ON	OFF	OFF	ON	ON	ON	ON
CENTRONICS	PARALLEL	OFF	OFF	OFF	OFF	OFF	OFF	OFF

**2. CONTROL BOARD**

**Power On**

The control board function DIP switch positions are read into memory, the buffer memory is cleared and the initialisation is completed with a 10 dot line paper feed.

**Data Transfer**

Data held by the interface board memory is transferred to a local buffer by the control board CPU program, the data being transferred in blocks of one character line, ie a maximum of 42 ASCII characters or the number of characters up to the receipt of CR.

**Data Process (Character Mode)**

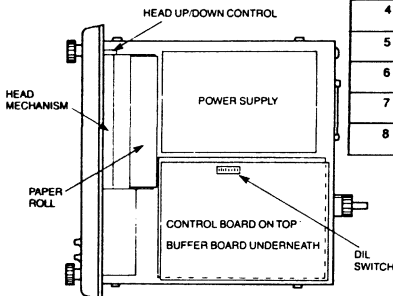
The data is processed by the CPU and ROM which combine to function as a print character generator. The character generator transforms the ASCII code to 7 x 5 dot matrix character format which is stored in memory. The printhead control program will then use the stored data to drive the printhead to form the dot matrix character on the thermal paper.

**Head Temperature**

The printhead temperature is controlled and monitored continuously by a thermistor sensor on the head. Control is obtained by using the thermistor circuit to control the strobe pulse width to the driver ICs, thus controlling the power sent to the head. If the head temperature exceeds a preset limit, the drive to the printhead is disabled.

CONTROL BOARD - DIP SWITCH

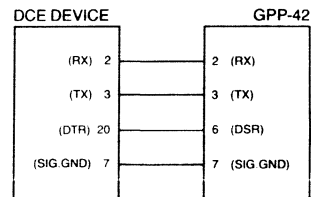
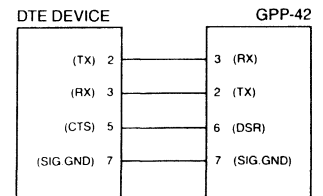
SWITCH NO.	POSITION	FUNCTION
1	ON	RESET
	OFF	
2	ON	PAPER FEED
	OFF	
3	ON	GRAPHICS CHARACTERS
	OFF	
4	ON	SEE TABLE 2
	OFF	
5	ON	SEE TABLE 2
	OFF	
6	ON	NOT USED
	OFF	NOT USED
7	ON	REVERSE, BLACK/WHITE PRINT
	OFF	NORMAL PRINT
8	ON	REVERSE MOTOR
	OFF	NORMAL MOTOR FEED



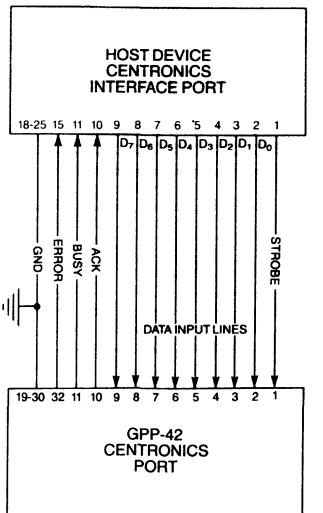
**3. POWER SUPPLY**

The power is supplied by a small switch mode power supply with jumper selection of 110VAC or 240VAC power line input. The power supply provides the printer with +24VDC for the thermal head and stopper motor drive and +5VDC which drives all the logic circuits and printhead sensor circuits.

**TYPICAL RS232 CONNECTION**



**TYPICAL CENTRONICS CONNECTION**



**COMMANDS AND CONTROLS**

Note: all software commands are illustrated using BASIC.

**Line Feed (LF)**

Paper feeds one character line making a character line space between last printed line and next one.

```
100 PRINT #1, CHR$(&HA);
```

**Carriage Return (CR)**

Paper feeds for printing to start on next character line.

```
200 PRINT #1, CHR$(&HD);
```

**Form Feed (FF)**

Paper feeds to make a 3 character line space between successive character lines.

```
300 PRINT #1, CHR$(&HC);
```

**Graphics**

The graphics mode can be selected by software command, allowing program switching between graphics and character modes, or by switch selection on the control board, SW3.

Software command is in the form:

```
ESC + "S" + n1 + n2
```

where n1 is the high order graphics limit (HEX) and n2 is the lower order graphics limit (HEX). The total number of graphics lines being HEX(n1 n2), eg.

```
If n1 = 1 and n2 = 2C,
then H12C = decimal 300.
```

This means that after 300 graphic dot lines the printer will treat all transmitted data in the character mode.

Then to turn on the graphics mode the following program would be used.

```
400 PRINT #1, CHR$(&HD)
410 PRINT #1, CHR$(&H1B); "S";
CHR$(&H1);
CHR$(&H2C);
```

It is important to note that n1 and n2 must not be greater than HEX FF and that the graphics command is always preceded by CR. The limitation of n1 and n2 = HFF means the maximum number of dot lines that can be controlled by a single command is HFFF, ie 65,535 dot lines.

This is equivalent to half a roll of paper. For continuous graphic mode the switch SW3 on the control board should be switched to on.

**Inverted Printing**

This is a very important feature for panel mounted printers as normal transmitted text will read from the bottom of the page to the top when printed, and is known as the "lister" mode. By using the inverted mode, the printed text appears upside down and back to front. However, when the message is removed from the printer and then turned through 180 degrees, the printing is read as normal text.

The software command is in the form:

```
ESC + "U" + n
```

where n = 1 is the "lister" mode  
n = 0 is the "text" mode.

On initialisation the printer goes into "text" mode and the printer stays in this mode until commanded to go into the "lister" mode. A change in command can only be made at the beginning of a new character line.

The software command takes the form:

```
500 PRINT #1, CHR$(&H1B); "U";
CHR$(&H1);
```

**Double Width Characters**

Switching in and out of double width mode can be achieved at any point in the program using the SO and SI commands.

The command takes the form:

```
600 PRINT #1, CHR$(&HE);
"DOUBLE WIDTH"
610 PRINT #1, CHR$(&HF);
"NORMAL WIDTH"
```

**International Sets**

International character sets can be chosen by hardware, using the DIP switch on the control board, see table 2, or by using software commands, see table 3.

Table 2

Character Set	SW4	SW5
British	OFF	OFF
American	OFF	ON
German	ON	OFF
Japanese	ON	ON

Note: SW4 and SW5 are located on the control board

The software command takes the form:

```
ESC + "R" + n
```

The range of n is shown in table 3. The initial set will depend on the setting of SW4 and SW5 on the control board, see table 2. The software selection of an alternative set will take precedence over the SW4 and SW5 positions, and control the printer until a further selection is made or until power-down.

Table 3

n	Character Set
0	Japanese
1	American
2	German
3	British
4	French
5	Spanish
6	Italian
7	Swedish

The software commands will take the form:

```
700 PRINT #1, CHR$(H1B); "R";
CHR$(H3);
```

The characters which change for each set and their ASCII code in HEX is shown in table 4.

**Black/White Background**

This function allows the operator to reverse print, colour, ie, white characters on a black background. The reverse printing command applies to both character and graphic commands.

The software command takes the form:

```
ESC + "T" + n
```

where n = 0 is normal black characters  
n = 1 is reverse white characters.

The command for white characters would be:

```
800 PRINT #1, CHR$(&H1B); "T";
CHR$(&H1);
```

**Page Length**

This software command defines a page as a number of character lines plus a number of blank character lines.

It takes the general form:

```
ESC + "C" + n1(HEX) + n2(HEX)
```

where n1 = number of character lines per page  
n2 = number of blank lines at end of page.



**COMMANDS AND CONTROLS, continued**

Note: Page length = n1 + n2  
 0 < n1 < FF (n1 in HEX)  
 0 < n2 < FF (n2 in HEX)  
 If n1 < + n2 max page size is 30 lines.  
 Default n1 = number of character lines in buffer  
 n2 = 1

Typical program would be:  
 900 PRINT #1, CHR\$( &H1B); "C";  
 CHR\$( &H1A);  
 CHR\$( &H3);

**Change Print Speed**  
 Print speed can be changed to 120 characters per second. The general form to change print speed is:  
 ESC + "M" + n

where n = 0 normal printing,  
 200 CPS  
 where n = 1 low speed printing,  
 120 CPS

Typical program would be:  
 1100 PRINT #1, CHR\$( &H1B); "M";  
 CHR\$( &H1);

**ASCII CHARACTER FONT**

Table 5 (in Hex)

HI LO	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0		SP	0	*	P	*	F	—	⊥		⊥	⊥	⊥	⊥	⊥	⊥
1	X-ON	!	1	A	Q	a	q	—	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
2		"	2	B	R	b	r	—	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
3	X-OFF	*	3	C	S	c	s	—	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
4		*	4	D	T	d	t	—	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
5		%	5	E	U	e	u	—	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
6		&	6	F	V	f	v	—	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
7		'	7	G	W	w	—	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
8	CAN	(	8	H	X	h	x	—	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
9		)	9	I	Y	y	—	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
A	LF	*	:	J	Z	j	z	—	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
B	ESC	+	:	K	*	k	*	—	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
C	FF	,	<	L	*	l	*	—	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
D	CR	-	=	M	*	m	*	—	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
E	SO	.	>	N	*	n	*	—	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
F	SI	/	?	O	-	o	SP	+	/	⊥	⊥	⊥	⊥	⊥	⊥	⊥

\* See Table 4

**LOADING NEW ROLL OF PAPER**

1. Withdraw print module tray from printer.
2. Check head up/down lever is in the up position.
3. Remove axle and old roll former from printer discarding the former.
4. Cut (preferably) or tear end of paper in a diagonal
5. Insert axle into new paper roll and slot axle and roll into printer using slots provided.
6. Feed paper down through slot provided so that approximately six inches of paper is hanging below the printer.
7. Feed paper up under the printhead
8. Backwind the paper roll to ensure:
  - (a) there is no excess paper between roll and head.
  - (b) the roll turns freely on the axle.
9. Move the head up/down lever into the down position and slide the print module tray back into the printer.
10. Using the front panel feed switch, advance the paper just to make sure it has been loaded correctly.

**TO CHANGE THE AC LINE VOLTAGE INPUT:**

1. Disconnect the mains.
2. Remove the top cover.
3. Locate the blue jumper plug just above the mains input pins on the left.
4. The jumper is connected as follows: 240 VAC 1 and 240 110 VAC 1 and 110

If the AC line voltage is changed the fuse must also be changed.

**CAUTION – any jumper change should only be attempted by qualified personnel familiar with electronic assemblies.**

FUSE RATING	
1A (20 mm)	240 VAC
2A (20 mm)	110 VAC

**POWER SUPPLY BOARD**

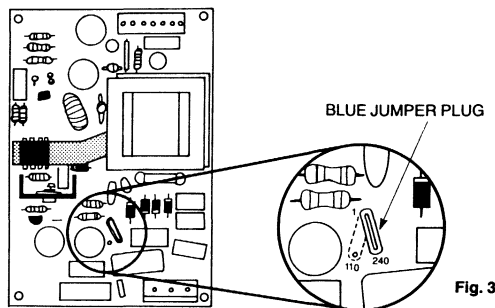
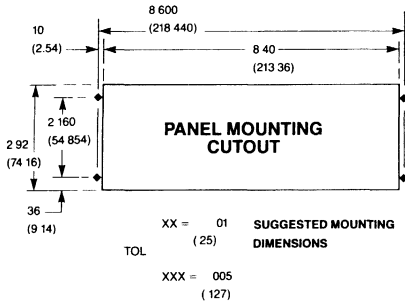
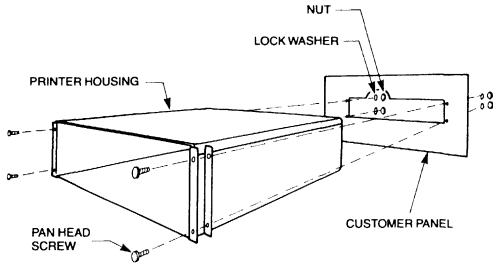
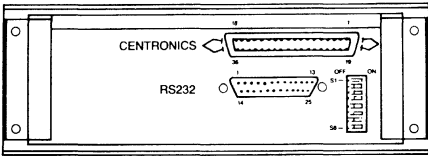


Fig. 3

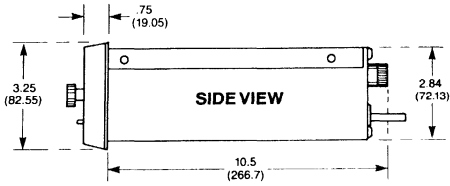
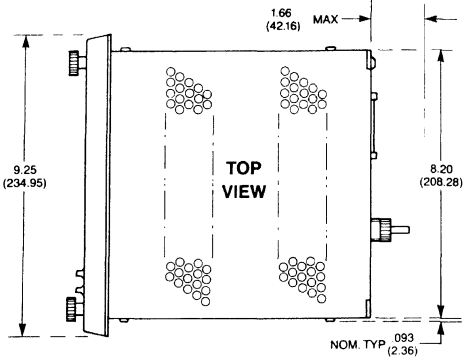
**MOUNTING DETAILS**



**PRINTER REAR VIEW**



**MECHANICAL DIMENSIONS – INCHES (MM)**



**ORDERING INFORMATION**

**GPP-42A** FACTORY SET FOR 110V 60HZ SUPPLIES

Centronics® is a registered trademark.



# APP-20A1, D1, E1, J1 Parallel Input 20 Column Thermal Printers

## FEATURES

- Minature 20-column, parallel input, alphanumeric thermal printer includes all interface electronics and power supply
- Full 96-character ASCII set, TALL character mode, inverted printing option
- Fast 1.1 lines/second; 66 lines/minute
- Quiet, inkless, virtually maintenance-free
- Light-weight and compact; only 4.25 lbs (AC version), 2.2 lbs (DC version)
- Selectable positive/negative true data inputs
- Available with dual 115/230 VAC, 100 VAC, or +12V dc power supply

## GENERAL DESCRIPTION

The APP-20 prints the full ASCII character set of upper and lower case letters, numerals, punctuation, etc. in 20 columns across, 2 5/16" wide (58,6 mm) thermal paper. A dot-line thermal printhead forms 5 x 7 matrix characters which are 0.11 inches (2,8 mm) high. The printing rate is 1.1 lines per second regardless of the number of characters printed and a 150 foot roll of thermal paper prints almost 9,000 lines of data (180,000 characters max.) at 5 lines per inch (2 lines/cm) spacing.

The internal control microprocessor of the APP-20 offers special OEM programming features which would be impossible with a standard mechanical printer. Perhaps the most striking feature is the inverted text printout mode. In this mode, printing appears upside down from the front panel. However, when the paper is torn off and inverted, the last line printed is at the bottom as normal text would be. In fact the APP-20 may be mounted with its front panel horizontal (facing upward) for text printing applications. In these applications the APP-20 is a text printer, like a teletypewriter. In the normal front-panel application, the APP-20 prints the last line at the top (Lister mode). This mode is commonly used in printing data logger applications. Since the Text and Lister Modes are pin-selected, users may combine inverted text with normal listings on the same printout.

Other programming features are either data-coded or pin-selected (see specifications). These include double-height characters, single-character printing, form feed, horizontal tab, backspace, delete, and selected data polarity.

Extended-height characters are used for emphasis and may be intermixed on one line with regular height characters. Characters are normally entered as 8-bit TTL parallel asynchronous data to a 20-character line buffer. However, single characters may be printed one at a time to echo a keyboard.

A form feed (FF) character advances the paper 11 lines to separate adjacent records and a horizontal tab (HT) com-



For a ruggedized version of the APP-20, suitable for mobile applications, see the APP-M20.

mand indexes input data to print in columns 4, 5, and 15 for tabular data. All data inputs may be selected as positive or negative true logic coding.

The AC power supply used in the APP-20A1 and APP-20E1 is a dual-voltage type (115/230 VAC) so that OEMs need to stock only one version (USA or European line cords are supplied). Power consumption is 5 W at idle and averages 17 W while printing, with an occasional 24 W peak. Also available are 100 VAC and +12V dc versions (J1 and D1).

The APP-20 may be operated at -20°C to +50°C and may be stored at -45°C to +85°C (the paper will begin to darken after several days exposure to temperatures exceeding +60°C).

## ORDERING GUIDE

MODEL	DESCRIPTION
APP-20A1	115 VAC Power (jumper-selectable for 230 VAC), USA plug
APP-20E1	230 VAC Power (jumper-selectable for 115 VAC), European plug
APP-20J1	100 VAC Power, USA plug
APP-20D1	+12V dc Power at 1 Amp
APP-TR2A	Automatic take-up reel/Rewind accessory, 115 VAC powered
APP-TR2E	Automatic take-up reel/Rewind accessory, 230 VAC powered
APP-TR2D	Automatic take-up reel/Rewind accessory, +12V dc powered
32-2242572	Box of 10 rolls black image paper
33-8193200	Printer Stand Kit

**FUNCTIONAL SPECIFICATIONS**

(Typical at +25°C unless noted)

**PRINTOUT****Number of Columns** 20**Characters Printed**

All upper and lower case ASCII letters, numbers, punctuation and special symbols shown in the ANSI X3.4-1977 specification.

**Printing Format** 5 columns x 7 row matrix**Character Spacing (Horizontal)**

Approx. 9 characters per inch

**Line Spacing**

Approx. 0.2 inches (5,1 mm). 5 lines per inch (4 dot widths spaced between lines)

**Character Size** Normal: 0.11"H x 0.07"W  
Tall: 0.165"H x 0.07"W**Printing Method**

Dot-line, thick-film non-impact ceramic thermal printhead.

**Paper Motion**

Stepping Motor, Friction Roller, and gear reduction. Paper advance (4 dot widths) occurs automatically after printing. A line may be viewed immediately after printing.

**Printing Rate (Max.)**

1.1 lines per second regardless of number of printed characters per line.

**Data Transfer Rate**

2.2 KHz max. for loading one line of 20 characters

**Printing Paper**

Thermal paper 2.31 inches wide (58,6 mm) with active surface facing away from roll center. Supplied on rolls of 150 feet length (45 m). Approx. 140 feet usable (42 m). Supplied in boxes of 10 rolls, DATEL model number 32-2242572.

**Printout Color**

Black characters on white paper.

**Data Capacity**

Approximately 8,400 lines (168,000 characters max.) per 140 feet of paper roll.

**Printhead Life**

30 million lines typical (random character distribution and usage with DATEL-supplied paper and unmodified printers).

**Mechanism Life**

5000 hours, typical

**Maintenance**

Periodic cleaning with isopropyl alcohol of mechanism, printhead and roller is suggested for dirt accumulation de-

pending on operating conditions. Printhead design is self-cleaning.

**FRONT PANEL****Power On**

Red Light-emitting diode illuminates when power is applied.

**Feed**

2 position momentary toggle switch. Actuating either up or down advances paper continuously at 2.9 lines/second or 0.6 inches/second (1,5 cm/sec).

**End-of-Paper Indicator**

Red LED illuminates when approximately one inch of paper remains (printing automatically stops). DATEL thermal paper features a red "paper low" warning stripe on the last six feet of paper.

**Housing Latch**

Rotating "UNLOCK" knob 1/4 turn counter-clockwise frees mechanism from housing and electronics. Knob is pulled out to replace paper roll. This disconnects power to the mechanism and stops printing.

**POWER SUPPLY****Supply Voltage**

APP-20A1:	105 to 130 VAC (jumper selectable* for 210 to 260 VAC)
APP-20E1:	210 to 260 VAC (jumper selectable* for 105 to 130 VAC)
APP-20J1:	85 to 105 VAC (jumper selectable* for 170 to 210 VAC)
APP-20D1:	+10.5 to +15V dc

\*Jumpers are located in the printer housing and are accessible when the print module assembly is removed

**Frequency** 47 to 440 Hz**Power Consumption**

AC models:	5 W idling, 17 W average while printing
DC models:	200 mA idling, 1 A average while printing

**Line Cords**

Captive 3-wire line cords approximately 6 feet (2 m) long supplied with grounding plugs for US (A and J models) or European (E models, 2 prong and gnd. shell). D models supplied with line cord terminating in spade lug connectors.

**Fuses**

A and J models:	1/2 Amp SLO-BLO
E models:	1/4 Amp SLO-BLO
D models:	2 Amp SLO-BLO
Dimensions:	0.25" dia x 1.25" long
3AG type accessible on rear panel	

**PHYSICAL/ENVIRONMENTAL****Operating Temperature Range**

0°C to +50°C

**Storage Temperature Range**

-25°C to +85°C (Paper darkens above +60°C)

**Altitude**

0 to 10,000 feet (3000 meters)

**Relative humidity**

0% to 90% (no condensation)

**Acceleration (Non-operating)**

±5G, 3 axes, 0 to 50 Hz

**Weight**

AC models: 4.25 pounds (with paper roll), 1.93 kg

DC models: 2.2 pounds, 1 kg

**MECHANICAL****Housing Outline Dimensions**

4.44"W x 2.76"H x 8.75"D

(113 x 70 x 222 mm)

Allow an additional 1.5" for connector hood and cable clearance.

**Bezel Dimensions**

5.25"W x 2.82"H x 0.78"D

(134 mm x 72 mm x 20 mm)

**Front Panel Mounting Cutout**

4.50"W x 2.78"H

(115 mm x 71 mm)

**Mounting Method**

Using four sets of 4-40 hardware (not supplied) in housing mounting flanges. Mounting bolts are concealed by slideout front panel bezel.

# APP-20A21, D21, E21, J21

## Serial Input 20-Column Thermal Printers



### FEATURES

- Miniature, 20-column serial input alphanumeric thermal printer includes all interface electronics and power supply
- RS-232-C and 20 mA current loop compatible
- 20 mA current loop input is optoisolated to 300 VRMS, 100 Megohms to eliminate ground loop noise; the APP-20 can be located hundreds of feet from the computer
- Selectable 75 to 9600 Baud Rates with 9/10/11-bit character lengths
- Prints full 96-character ASCII set with TALL and condensed printing modes.
- Jumper or logic selectable inverted (TEXT) printing or normal (LISTER) printing
- Available with dual 115/230 VAC, 100 VAC, or +12V dc power supply
- 4.25 LB feather weight (DC version only 2.2 LB). 1.2 lines per second (72 lines per minute) in "Paper Saver" mode
- Quiet, inkless, virtually maintenance-free



For a ruggedized version of the APP-20, suitable for mobile applications, see the APP-M20

Extended and reduced height characters are standard. There are four character heights available. They are: Normal (0.115"H x 0.08"W), TALL (0.165"H x 0.08"W), Paper Saver (0.065"H x 0.08"W) and Extended Paper Saver (0.090"H x 0.08"W). Normal and TALL characters can be mixed on the same line, with the TALL characters being used to accent words, phrases or numbers. Paper Saver and Extended Paper Saver character heights can be mixed together on a single line in the same manner as the TALL and Normal character size combination and achieve the same effect, but because of their reduced height, substantially less paper is used. An additional benefit to reduced character height printing is a slight increase in the print rate and the optical density of the printout. This is particularly useful in printing data logger applications where the printer is left unattended for extended periods of time and running out of paper would be a serious problem.

A form feed (FF) character advances the paper 11 character lines to separate adjacent records, and a horizontal tab (HT) command indexes input data to print in columns 1, 4, 9 and 15 for tabular data.

The AC power supply used in the APP-20A21 and APP-20E21 is a dual-voltage type (115/230 VAC) so that OEM's need to stock only one model (either U.S.A. or European line cords are supplied). Jumper plugs, located internally, select either 115 or 230 VAC, 47 - 400 Hz. They can be accessed when the print module assembly is pulled out of the housing as in the paper loading procedure. Also available are 100 VAC (J21) and +12V dc (D21) versions.

Power consumption is 5 watts at idle and averages 17 watts while printing with an occasional 24 watt peak.

The APP-20 may be operated at -20°C to +50°C and may be stored at -45°C to +85°C. (The paper will begin to darken after several days of exposure to temperatures exceeding +60°C.

### GENERAL DESCRIPTION

The APP-20 prints the full ASCII character set of 96 upper and lower case letters, numerals, punctuation, etc. in 20 columns across 2-15/16" (58.6 mm) wide thermal paper. A dot-line thermal print head forms 5 x 7 dot matrix characters which are 0.11 inches (2.8 mm) high. The print rate in "Paper Save" mode is 1.2 lines per second (1/2 height characters continuously) regardless of the number of characters printed per line. A 130 foot roll of thermal paper allows almost 16,850 lines to be printed at 10.8 lines per inch (4.2 lines/cm) spacing (in PAPER SAVER MODE).

The internal control microprocessor of the APP-20 offers special printout features which would be impossible with a conventional mechanical printer. One of the most striking features is the inverted text printout mode. In this mode, the printout appears to be upside down with respect to the front panel. However, when the paper is torn off and inverted, the last line printed is at the bottom as normal text would be. In fact, the APP-20 may be mounted with its front panel facing upwards for text printing applications. In these applications, the APP-20 is a text printer, like a teletypewriter. In normal applications, the APP-20 prints the last line at the top (Lister Mode). This mode is commonly used in printing data logger applications. Since the Text and Lister Modes are pin selectable, users may combine inverted text with normal listings on the same printout.

Other programming features are either data-coded or pin selected. These include extended or reduced height characters, form feed, horizontal tab, and backspace.

**FUNCTIONAL SPECIFICATIONS**

(Typical at +25°C unless noted)

**PRINTOUT**

**Number of Columns** 20

**Characters Printed**

All upper and lower case ASCII letters, numbers, punctuation, and special symbols shown in the ANSI X3.4-1977 specification.

**Printing Format** 5 columns x 7 row dot matrix.

**Character Size**

Tall.....	0.165"H x 0.08"W (4,2 x 2 mm)
Normal.....	0.115"H x 0.08"W (2,9 x 2 mm)
Extended Paper Saver.....	0.090"H x 0.08"W (2,3 mm x 2 mm)
Paper Saver.....	0.065"H x 0.08"W (1,7 mm x 2 mm)

**Character Spacing (Horizontal)**

Approximately 9 characters/in (3,5/cm)

**Line Spacing**

Tall.....	0.236" (6 mm) 4.2 lines/inch (1,7 per cm)
Normal.....	0.185" (4,7 mm) 5.4 lines/inch (2,1 per cm)
Extended Paper Saver.....	0.118" (3 mm) 8.5 lines/inch (3,3 per cm)
Paper Saver.....	0.092" (2,4 mm) 10.8 lines/inch (4,25 per cm)

**Printing Method**

Dot-line, non-impact thermal printhead.

**Paper Motion**

Stepping Motor, Friction Roller, and Gear Reduction. Paper advance (4 dot lines) occurs automatically after printing. A line is visible immediately after printing.

**Print Rates**

Tall.....	0.90 lines/sec. 54 lines/min.
Normal.....	1.05 lines/sec. 63 lines/min.
Extended Paper Saver.....	1.00 lines/sec. 60 lines/min.
Paper Saver.....	1.20 lines/sec. 72 lines/min.

**Line Feed Cycle Times**

Tall.....	680 mS
Normal.....	370 mS
Extended Paper Saver.....	340 mS
Paper Saver.....	250 mS

**Printing Paper**

Thermal paper 2.31 in. (58,6 mm) wide with active surface

facing away from roll center. Supplied on rolls 130 feet long (approximately) in boxes of 10 rolls (Datel PIN 32-2242572)

**Printout Color**

Black printout on white paper.

**Data Capacity**

Based on a roll length of 130 feet, the approximate data capacities/character size are:

Tall.....	6,550 lines/130' roll
Normal.....	8,425 lines/130' roll
Extended Paper Saver....	13,260 lines/130' roll
Paper Saver.....	16,850 lines/130' roll

**Note:** These figures represent the maximum number of lines/roll for each character size. The mixing of character sizes either on the same line or on a line by line basis will affect the accuracy of these figures.

**Printhead Life**

30 million lines (random character distribution and usage with DATEL-supplied paper and unmodified printers).

**Mechanism Life**

5000 hours of actual use minimum.

**Maintenance**

Periodic cleaning with clinical grade isopropyl alcohol of the printhead and roller is recommended for dirt accumulation depending on operating conditions.

**FRONT PANEL CONTROLS AND INDICATORS**

**Power ON**

Yellow light-emitting diode illuminates when power is applied.

**End Of Paper**

A red light-emitting diode illuminates when the paper supply has one inch remaining, and the printing has stopped. Datel thermal paper features a red "paper low" warning stripe on the last six feet of paper.

**Paper Feed/Self-Test Switch**

A two position momentary action toggle switch.

To activate the Paper Feed Function, lift the switch lever to the up position and hold it until the desired amount of paper is fed – then release it.

To activate the Self-Test function, depress the switch lever to the down position and release it. The printer will begin printing the full 96 ASCII character set. This will continue until the Self-Test mode is manually cancelled by lifting the toggle switch to the Paper Feed position and holding it there until a blank paper feed occurs, then release it. If Self-Test is invoked again without first removing power from the printer (which will reset the pattern back to the beginning), the pattern displayed will be continued from where it left off previously.

**Housing Latch**

Rotating "UNLOCK" knob 1/4 counter clockwise frees mechanism from housing and electronics.

**POWER SUPPLY****Supply Voltages**

APP-20A21:.....	105 to 130 VAC (jumper selectable* for 210-260 VAC)
APP-20E21:.....	210 to 260 VAC (jumper selectable* for 105-130 VAC)
APP-20J21:.....	85 to 105 VAC (jumper selectable* for 170-210 VAC)
APP-20D21:.....	+10.5 to +15V dc

\*Jumpers are located in the printer housing and are accessible when the print module assembly is removed.

**Input Frequency Range** 47 to 440 Hz

**Power Consumption**

AC models.....	5 watts at idle, 17 watts avg. during printing.
DC models.....	360 mA at idle, 1.2 Avg. while printing.

**Note:** The APP-20D21 (and APP-M20D21) will operate off a typical 3 A (min.) linear regulated general purpose power supply having transient tolerance of 10 A for 10 mS. If the supply is not exclusively for use with the APP-20, a larger unit is required because line disturbances may occur.

**Line Cords**

AC models.....	Captive 3-wire line cord approximately 6 feet (2m) long supplied with grounding plug for US (A and J models) or two prongs and ground shell for European (E and V models).
DC models.....	MOLEX® 03-09-1094 housing with MOLEX® 02-09-1118 crimp-on female terminals (sockets).

**Fuse**

AJ models.....	1/2 amp SLO-BLO
E models.....	1/4 amp SLO-BLO
D models.....	2 amp SLO-BLO
3AG type, dimensions.....	0.25" dia. x 1.25" long, mounted on printer housing rear panel.

**PHYSICAL/ENVIRONMENTAL**

**Operating Temperature Range** -20°C to +50°C

**Storage Temperature Range**

-45°C to +85°C (Warning: The paper will begin to darken after several days of exposure to temperatures exceeding +60°C).

**Altitude** 0 to 10,000 feet (3048 meters)

**Relative Humidity** 0% to 90% (no condensation)

**Acceleration (Non-Operating)** +5G, 3 axes, 0 to 50 Hz

**Weight**

AC models:.....	4.25 lbs (1.9 kg), paper included
DC models:.....	2.2 lbs (1 kg), paper included

**Housing Outline Dimensions**

4.44"W x 2.76"H x 8.75"D\* (113 x 70 x 222 mm)

\*Allow an additional 1.5" for connector hood and cable clearance.

**Bezel Dimensions**

5.25"W x 2.82"H x 0.78"D (134 x 72 x 20 mm)

**Front Panel Mounting Cutout**

4.50"W x 2.78"H x (115 x 71 mm)

**Mounting Method**

Using 4 sets of 4-40 hardware in printer housing mounting flanges. Mounting bolts are concealed by the bezel attached to the slide out print module assembly.

**Interface Type**

Serial asynchronous 20 mA current loop or RS-232-C compatible.

**Input Data Rates**

The following data rates, which are selectable at the rear connector by either jumpers or TTL logic levels, are supported: 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600.

**Word Length**

Automatic word length recognition is standard. Word lengths of 9, 10 and 11 bits consisting of the following are supported:

- A. 1 Start bit always
- B. 7 or 8 data bits
- C. Parity or no parity (parity adds 1 bit, no parity adds 0 bits)
- D. 1 or 2 stop bits

**Note:** 8 data and one parity are not allowed.

**Data Coding Levels**

"1" (MARK) Current Loop: 20 mA nominal (15 to 25 mA)

RS-232-C: -3 to -15V

"0" (SPACE)

Current Loop: 0 mA nominal (0 to 0.5 mA), 2.6 to 2.8V, drop to "1" Isolation: 300 Vrms, 100 Megohms

RS-232-C: +3 to +15V (refer to EIA spec. for further information)

**Input Logic Levels**

All connections are compatible with DTL/TTL and TTL-LS levels. CMOS 4049 buffers may also be used. Outputs can drive 2 TTL loads, min.

All logic inputs include internal pullup resistors and may be floated for the positive level, and tied to signal GND (pin 7) for low level. All inputs are level sensitive; risetime is not critical.



Exceptions: Tall character control (pin 8) floats to ground via a 2K ohm resistor. Tall character control (pin 9) has a 1K ohm pullup and may not be driven by type 4049 CMOS.

<b>ORDERING GUIDE</b>	
<b>MODEL</b>	<b>DESCRIPTION</b>
APP-20A21	115 VAC powered, (jumper-selectable for 230 VAC) USA type power cord and plug included.
APP-20D21	+10.5 to +15V dc powered, MOLEX <sup>®</sup> connector and pins included.
APP-20E21	230 /VAC powered, (jumper-selectable for 115 VAC) European power cord included.
APP-20J21	100 VAC powered, USA type power cord included.
APP-M20D21	+10.5 to +15V dc ruggedized mobile printer, including mounting bracket, power cable and printout illuminating lamps.
APP-TR2A	Automatic take-up reel/rewind accessory, 115 VAC powered
APP-TR2E	Automatic take-up reel/rewind accessory, 230 VAC powered
APP-TR2D	Automatic take-up reel/rewind accessory, +12V dc powered
32-2242572	20 column thermal printer paper (10 130' rolls)
33-8193200	Printer stand kit for bench top applications.

# APP-20A3, E3, J3

## IEEE-488 Bus Compatible

### 20-Column Thermal Printer



#### FEATURES

- Complete 20-column panel-mount printer with IEEE-488 interface and power supply built in
- Full 96-character ASCII set, TALL character mode, inverted printing option
- Fast 1.1 lines/second
- Quiet, inkless, virtually maintenance-free
- Light-weight and compact; only 4.25 lbs (AC version), 2.2 lbs (dc version)
- Available with dual 115/230 VAC or 100 VAC power supply

#### GENERAL DESCRIPTION

The APP-20A3/E3/J3 is a miniature 20-column panel-mount alpha-numeric thermal printer with complete power supply and interface electronics to accept data using the IEE-488 Standard General Purpose Instrument Bus (GPIB). The APP-20 functions as a Listen Only device with its own user-selectable 5-bit My Listen Address (MLA). While sharing a party-line 488 Instrument Bus, unique addressed messages can be sent to only the selected APP-20 or to groupes of remotely-addressed APP-20's.

The APP-20 prints the full ASCII character set of upper and lower case letters, numerals, punctuation, etc. in 20 columns across 2 5/16" wide (58,6 mm) thermal paper. A dot-line thermal printhead forms 5 x 7 matrix characters which are 0.11 inches (2,8 mm) high. The printing rate is 1.1 lines per second regardless of the number of characters printed and a 150 foot roll of thermal paper prints almost 9,000 lines of data (180,000 characters max.) at 5 lines per inch (2 lines/cm) spacing.

The internal control microprocessor of the APP-20 offers special OEM programming features which would be impossible with a conventional mechanical printer. Perhaps the most striking feature is the inverted text printout mode. In this mode, printing appears upside down from the front panel. However, when the paper is torn off and inverted, the last line printed is at the bottom as normal text would be. In fact, the APP-20 may be mounted with its front panel horizontal (facing upward) for text printing applications. In these applications, the APP-20 is a text printer, like a teletypewriter. In the normal front-panel application, the APP-20 prints the last line at the top (Lister mode). This mode is commonly used in printing data logger applications. Since the Text and Lister Modes are pin-selected, users may combine inverted text with normal listings in the same printout.

Other programming features are either data-coded or pin-selected (see specifications). These include double-height characters, single-character printing, form feed, horizontal tab, backspace, delete, and selected data polarity.



Extended-height characters are used for emphasis and may be intermixed on one line with regular height characters.

A form feed (FF) character advances the paper 11 lines to separate adjacent records and a horizontal tab (HT) command indexes input data to print in columns 4, 9, and 15 for tabular data. The AC power supply used in the APP-20A3 and APP-20E3 is a dual voltage type (115/230 VAC) so that OEMs need to stock only one version. Power consumption is 5 watts at idle and averages 17 watts while printing. Also available 100 VAC model (J3)

The printer may be operated at +10°C to +40°C.

For a ruggedized version of the APP-20, suitable for mobile applications, see the APP-M20.

**FUNCTIONAL SPECIFICATIONS**

(Typical at +25°C unless noted)

**GENERAL**

**Function**..... The APP-20 prints alphanumeric information on internal roll paper from externally supplied ASCII character codes.

**PRINTOUT**

**Number of Columns**....20  
**Characters Printed**.... All upper and lower case ASCII letters, numbers, punctuation and special symbols shown in the ANSI X3. 4-1977 specification.

**Printing Format**..... 5 columns x 7 row matrix  
**Character Spacing (Horizontal)**..... Approx. 9 characters per inch  
**Line Spacing**..... Approx. 0.2 inches (5,1 mm). 5 lines per inch (4 dot widths spaced between lines)

**Character Size**

**Normal**..... 0.11"H x 0.07"W  
**Tall**..... 0.165"H x 0.07"W

**Printing Method**..... Dot-line, thick-film non-impact ceramic thermal printhead

**Paper Motion**..... Stepping Motor, Friction Roller, and gear reduction. Paper advance (4 dot widths) occurs automatically after printing. A line may be viewed immediately after printing.

**Printing Rate**

**(Max.)**..... 1.1 lines per second regardless of number of printed characters per line.

**Data Byte Throughput Period**

1. All printable characters, 400 microseconds/character max.
2. CR print command or LF, 0.9 seconds typical., 1 second max.
3. FF character, 5 seconds max.

**Printing Paper**..... Thermal paper 2.31 inches wide (58,6 mm) with active surface facing away from roll center. Supplied on rolls of 150 feet length (45 m). Approx. 140 feet usable (42 m). Supplied in boxes of 10 rolls, DATEL model number 32-2242572

**Printout Color**..... Black characters on white paper

**Data Capacity**..... Approximately 8,400 lines (168,000 characters max.) per 140 feet of paper roll

**Printhead Life**..... 30 million lines typ (random character distribution and usage with DATEL-supplied paper and unmodified printers)

**Mechanism Life**..... 5,000 hours, typical

**Maintenance**..... Periodic cleaning with isopropyl alcohol of mechanism, printhead and roller is suggested for dirt accumulation depending on operating conditions. Printhead design is self-cleaning.

**FRONT PANEL**

**Power On**..... Red Light-emitting diode illuminates when power is applied

**Feed**..... 2 position momentary toggle switch. Actuating either up or down advances paper continuously at 2.9 lines/second or 0.6 inches/second (1,5 cm/sec).

**End of Paper Indicator**..... A red light emitting diode illuminates when the paper supply has one inch remaining. DATEL thermal paper features a red "paper low" warning stripe on the last six feet of paper.

**Housing Latch**..... Rotating "UNLOCK" knob 1/4 turn counter-clockwise frees mechanism from housing and electronics. Knob is pulled out to replace paper roll. This disconnects power to the mechanism and stops printing.

**POWER SUPPLY**

**Supply Voltage**  
**APP-20A3**..... 105 to 130 VAC (jumper selectable\* for 210-260 VAC)  
**APP-20E3**..... 210 to 260 VAC (jumper selectable\* for 105-130 VAC)  
**APP-20J3**..... 85 to 105 VAC (jumper selectable\* for 170-210 VAC)

\*Jumpers are located in the printer housing and are accessible when the print module assembly is removed

**Frequency**..... 47 to 440 Hz

**Power Consumption**

**AC models**..... 5 W idling, 17 W average while printing

**Line Cords**..... Captive 3-wire line cords approximately 6 feet (2 m) long supplied with grounding plugs for US (A and J models) or European (E models, 2 prong and ground shell)

**Fuses**

**A and J models**..... 1/2 Amp SLO-BLO  
**E models**..... 1/4 Amp SLO-BLO

**PHYSICAL-ENVIRONMENTAL-MECHANICAL**

- Operating Temperature Range**..... +10°C to +40°C
- Storage Temperature Range**..... -25°C to +85°C (Paper darkens above +60°C)
- Altitude**..... 0 to 10,000 feet (3,000 meters)
- Relative Humidity**..... 0% to 90% (no condensation)
- Acceleration (Non-operating)**..... ±5G, 3 axes, 0 to 50 Hz
- Weight**
  - AC models:**..... 4.25 lbs (with paper roll), 1,93 kg
  - DC models:**..... 2.2 lbs, 1 kg
- Dimensions:**..... 0.25" dia x 1.25" long 3AG type accessible on rear panel
- Housing Outline Dimensions**..... 4.44"W x 2.76"H x 8.75"D (113 x 70 x 222 mm)  
Allow an additional 1.5" for connector hood and cable clearance.
- Bezel Dimensions**..... 5.25"W x 2.82"H x 0.78"D (134 x 72 x 20 mm)
- Front Panel Mounting Cutout**..... 4.50"W x 2.78"H (115 x 71 mm)
- Mounting Method**..... Using four sets of 4-40 hardware (not supplied) in housing mounting flanges. Mounting bolts are concealed by slide-out front panel bezel.

**INPUT/OUTPUT CONNECTIONS**

- Type**..... Byte-parallel IEEE-488-1978 General Purpose Instrument Bus
- List of Allowable Subsets (see IEEE-488-1978, Appendix C)..... SHØ, AH1, TØ, TEØ, L1, LEØ, SRØ, RL2, PPØ, DC1, DTØ, CØ
- Drivers**..... E1 (open collector)

**ORDERING GUIDE**

MODEL	DESCRIPTION
APP-20A3	20-column thermal printer, IEEE-488 Interface, 115/230 VAC transformer wired as 115, USA line cord.
APP-20E3	20-column thermal printer, IEEE-488 Interface, 115/230 VAC transformer wired as 230, 2-prong and ground shell line cord.
APP-20J3	20-column thermal printer, IEEE-488 Interface, 100 VAC, USA line cord.
32-2242572	Box of 10 paper rolls, black image
33-8193200	Printer stand kit for bench-top applications
APP-TR2A	Automatic take-up reel/Rewind accessory, 115 VAC powered
APP-TR2E	Automatic take-up reel/Rewind accessory, 230 VAC powered
APP-TR2D	Automatic take-up reel/Rewind accessory, +5V dc powered



# APP-48A1, E1, J1

## Byte-Parallel Input 48-Column Thermal Printer

### FEATURES

- Complete 48-column panel-mount printer with byte-parallel Centronics-compatible data electronics and power supply built-in.
- Prints full 96-character, upper and lower case ASCII alphanumeric. Includes 2nd 96-character set of special figures, currency symbols, mathematical operators.
- Thermal printhead, 5 X 7 dot matrix, few moving parts for OEM reliability. No ink, no ribbons, no hammers, no mess!
- Prints inverted text (like a TTY) under data-coded control. Last line printed at bottom of text.
- Internal microprocessor includes 1-line, 48-column data register.
- 6 pound mini-lightweight.
- Prints up to 72 lines per minute.
- Choice of 100/115/230 VAC power supplies.

### GENERAL DESCRIPTION

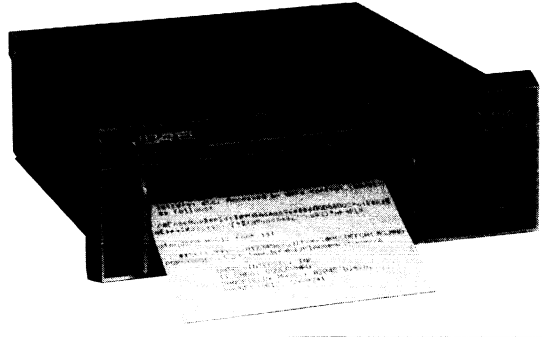
The APP-48 A1, E1, J1 series is a miniature, panel-mounting 48-column alphanumeric printer with quiet, inkless thermal printing and complete, internal byte-parallel data electronics and power supply. The 8-bit parallel data signals are directly compatible with the universally-accepted Centronics Interface standard which uses an asynchronous 3-wire handshake.

This interface is ideal for connection to popular microprocessors through Peripheral Interface (PIA/PIO) parallel port LSI integrated circuits. A conventional 25-pin D-connector is mounted on the APP-48 A1's rear panel for connection to a host computer data source.

The APP-48 is designed as a miniature, panel-mounting printing RO data terminal for applications in test and measurement, instrumentation, analytical instruments, diagnostic test systems, custom automatic test equipment and microcomputer development systems.

Besides the 8-bit parallel interface, the APP-48 is also available with full serial RS-232-C/20 mA loop interfaces and a byte-parallel IEEE-488 GPIB interface BUS. DATEL also manufactures a 20-column APP-20 mini-thermal printer with choice of parallel, serial or IEE-488 interfaces. A seven-column numeric full-parallel BCD thermal printer is also available as model DPP-Q7.

The printing technology on the APP-48 uses a quiet OEM-rugged thermal 5 X 7 dot matrix method with no ink ribbons, platens, hammers or ink mess. Only two moving parts are used to provide very long life and high reliability.



For a ruggedized version of the APP-48, suitable for mobile applications, see the APP-M48.

The internal microprocessor controls the data electronics, printhead and motor drivers. Data-coded control characters (STX/ETX) allow inverted printout for text applications so that the last line will appear either at the top or bottom of the printout. Normal data entry uses standard 96-character ASCII-encoded alphanumerics. SO/SI data-coded control characters map the input ASCII coding into a second set of 96 characters stored in a type 2716 Programmable Memory.

The lightweight 6 pound (2,7 kg) APP-48 mounts through a 8.40"W X 2.92"H (213, 4 X 74,2 mm) front panel cutout with four screws. A choice of power supplies are available: 100VAC, 115VAC, 230VAC. For AC units, power consumption is 40 watts printing, 12 w idle. The operating temperature range is 0 to +50°C.

### ORDERING GUIDE

MODEL	DESCRIPTION
APP-48A1	Printer with 115/230 VAC (XfmR, USA line cord, 115V wired.
APP-48-E1	Printer with 115/230 VAC XfmR, European line cord, 230V wired.
APP-48J1	Printer with 100 BAC XfmR, USA line cord.
32-2242568	Box of 10 paper rolls, black image.
33-8193205	Printer Stand Kit.
APP-TR5A	Take-up Reel/Rewind Accessory, 115 VAC powered.
APP-TR5E	Take-up Reel/Rewind Accessory, 230 VAC powered.
APP-TR5D	Take-up Reel/Rewind Accessory, +12V dc powered.
58-2079130	Spare Mating DB-25S Connector (1 supplied)

**FUNCTIONAL SPECIFICATIONS**

(Typical at +25°C unless noted)

**PRINTOUT****Number of Columns** 48**Characters Printed**

96-character set per ANSI X3.4-1977 specification. A second 96-character is accessed by SO/SI control.

**Printing Inversion** Selectable using STX/ETX control characters (may not be intermixed on the same line)**Printing Format** 5 dot columns x 7 dot row matrix per character.**Line Spacing**

0.164 inch (4.2 mm) line to line. Approximately 6 lines per inch.

**Printout Width (48 columns)**

4.77 inches (121.2 mm)

**Character Size**

0.070"W x 0.110"H (1,8 X 2,8 mm)

**Printing Rate**

1.2 lines/second maximum. Depends on data loading period and printing period. Data Loading Period equals 110 µS minute per character. Printing period equals 750 mS minute per line.

**Printing Paper**

Thermal paper 5 inches (127 mm) wide by 150 foot (45 m) rolls. A red stripe appears when approximately 10 feet of paper remain. User-supplied paper must detach from the roll.

**Data Capacity**

Approximately 11,000 lines in 150 feet usable per roll.

**Printhead Life**

30 million characters with random data and DATEL-supplied paper.

**Mechanism Life**

5000 hours in non-hostile applications.

**DATA CODED FUNCTIONS**

Character	Meaning	Hex Code
Nul	Null, ignored	00
BS	Backspace, delete previous character, decrement column address counter toward the left	08
SO	Map input data to 2nd 96-character set, mixable within a line.	0E
SI	Reset to normal ASCII character set, mixable within a line.	0F
STX	Change to inverted (text) printing. Not mixable within a line.	02
ETX	Change to non-inverted (lister) printing. Not mixable within a line.	03
HT	Tab successively to columns 9, 17, 25, 33.	09
LF	Feed one line, no print, no data register change.	0A
FF	Advance 11 lines, no register change.	0C
CR	Print register contents, advance one line, clear register. Requires 750 mS during which input data may not be loaded. LF is not required LF will be ignored in the sequence CR, LF. Loading of 48 characters and/or spaces will automatically start printing.	0D
DEL	Decrement column address to the left, clear that data register, load a rubout obliteration pattern and increment column address to the right.	7F

NOTE: Data is loaded starting at the left margin.

**POWER SUPPLY**

**Required Power**

- APP-48A1 ..... 105 to 130 VAC @ 47 to 440 Hz, jumper-selectable\* for 210 to 250 VAC. Includes USA-style power cord.
- APP-48E1 ..... 210 to 250 VAC @ 47 to 440 Hz, jumper-selectable\* for 105 to 130 VAC. Includes European-style power cord.
- APP-48J1 ..... 100 VAC @ 47 to 440 Hz. Includes USA-style power cord.

\* Jumpers are located at the top rear of the power regulator board.

**CONSUMPTION**

**AD models**

40 watts max printing, 12 watts max idling

**FUSES**

- A1, J1 Models..... 1 amp
- E1 Model..... 1/2 amp

**PHYSICAL**

**Operating Temperature Range**

0 to +50°C

**Storage Temperature Range**

-30°C to +85°C without paper. Warning: The paper darkens after long exposure above +60°C.

**Humidity**

10% to 90%, non-condensing

**Weight**

6 pounds (no paper) 2,7kg

**Paper Roll**

0.7 lb (0.3 kg)

**Outline Dimensions**

8.20"W X 3.25"H X 8.14"D  
(208,3 X 72,1 X 206,8 mm)

**Bezel Dimensions**

9.25"W X 3.25"H X 0.75" Thick  
(235,0 X 82,6 X 19,1 mm)

**Front Panel Mounting Cutout**

8.40"W X 2.92"H 213,4 X 74,2 mm)  
requiring 4 #8 mounting bolts.

**Connector Type**

DB-25P mounted on rear panel (25 pin D connector).  
Mates to a supplied DB-25S connector (DATEL P/N 58-2079130).

# APP-48A2, E2, J2, D2

## Serial Input 48-Column Thermal Printers



### FEATURES

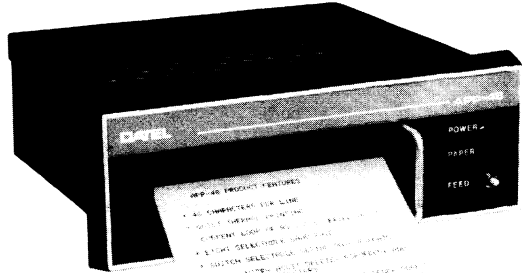
- Complete 48-column panel-mount printer with full serial data electronics and power supply built in.
- Accepts standard RS-232-C input at 110 to 9600 baud; also provides optoisolated 20 mA current loop input for operation hundreds of feet from the data source.
- Prints full 96-character, upper and lower case ASCII alphanumeric. Includes a second 96-character set of special figures, currency symbols, European punctuation, mathematical operators, Greek letters.
- Dot-line thermal printhead, few moving parts for OEM reliability.
- Prints inverted text like a TTY under software control. Last printed line is at bottom of text.
- Internal microprocessor includes 1-line, 48-column data buffer. Optional 132 character buffer (APP-48\_4) permits continuous data input.
- Prints up to 72 lines per minute.
- 6-pound (2.7 kg) mini-lightweight.
- Choice of 100/115/230 VAC or +12V dc power supplies.

### GENERAL DESCRIPTION

Datel APP-48 panel-mount alphanumeric thermal printer highlights half a decade of thermal printer experience and leadership. Beginning in 1975 Datel pioneered the concept of including *all* data and power supply electronics *inside* the miniature housing.

The non-moving thermal printhead technology employed today in the APP-48 obsoletes ink printers with their twirling printwheels banging hammers and internal mess due to ink ribbons or platen.

The APP-48 accepts full serial input which has been formatted into 10 or 11-bit packed ASCII characters and is driven to either 20 mA loop or RS-232-C data levels. One printable line (up to 48 columns) of input data is stored in an internal input register. Data input is then halted briefly (750 mS) while the APP-48 drives the thermal printhead elements and advances to the next line after printing. The character is formed in a 5 column by 7 row dot matrix on specially-coated, thermally sensitive paper measuring 5 inches



For a ruggedized version of the APP-48, suitable for mobile applications, see the APP-M48

(127 mm) wide. Input data may be accepted at switch-selected data rates from 110 to 9600 baud. Commonly used with teletypewriters, computer serial I/O ports and data terminals.

With the optional 132-character FIFO buffer installed (APP-48\_4), the printer will accept continuous full serial input at 110 baud (11-bit word length) or 300 baud (10-bit word length).

The 20 mA current loop data input is optoisolated so that common mode noise is rejected. Also the APP-48 may be operated at lower baud rates many hundreds of feet from the data source using only voice grade telephone wire.

The RS-232-C inputs include Request-To-Send and Data-Terminal-Ready standard control signals to synchronize start-stop data transfer from a remote source. A rear-panel DIP switch set selects the data baud rate, input format and other parameters.

The APP-48 prints the full 96-character set of standard ASCII characters. A second 96-character alphanumeric data set is stored in internal memory. This set may be accessed by transmitting the shift out control code (SO) before loading the next character. Shift in (SI) restores the normal 96-character ASCII set. The second set includes special figures, currency symbols, mathematical operators, European punctuation, Greek letters, etc.

The STX/ETX control codes change the mode to inverted printing where the last record is at the bottom of the text when viewed normally. In this mode the APP-48 may be mounted with its panel horizontal with printout feeding upwards like a teletypewriter. Under software control, lines may be alternated between lister (normal) and text (inverted) print modes.



The print mechanism of the APP-48 consists of a stationary dot-line thermal printhead, Software-controlled stepping motor and cogged belt/print roller drive. The lightweight 6 pound (2.7 kg) APP-48 mounts through a 8.40"W X 2.92"H (213.4 X 74.2 mm) front panel cutout with four screws. A 3-pronged line plug is captive to the internal AC power supply which is available as 115, 230, or 100 VAC, 47 to 440 Hz Power consumption is 40 watts maximum during printing and 12 watts while idling or accepting data. The printer is also available with a +12V dc power supply. The dc version draws 1.5 amps while printing, 0.7 amps idling. The overall dimensions of the APP-48 are 8.12"W X 2.84"H X 8.32"D (206,3 X 72,2 X 211,3 mm). The operating temperature range is 0 to +50°C and the front bezel measures 9.25"W X 3.25"H X 0.75" thick (235,0 X 82,6 X 19,1 mm)

**SPECIFICATIONS,**

(Typical at +25°C unless noted)

**PRINTOUT**

**Numbers of Columns** 48

**Characters Printed**

96-character set upper and lower case ASCII letters, numbers, punctuation per ANSE X3.4-1977 Specification. A second 96-character set is accessible by transmitting the ASCII Shift Out (SO) character. This second set consists of European characters, mathematical symbols, Greek letters, some graphics symbols, monetary symbols, and others. The original ANSI X3.4 set is restored using the Shift In (SI) control character.

**Printout Inversion.**Character-lines may be printed out inverted with STX and ETX control characters. (Note: Normal and Inverted Text may not be intermixed on the same line)

**Printout Format...** 5 dot columns by 7 dot row matrix per character.

**Printout Color.....** Black characters on white paper.

**Line Spacing.....** 0.164 inch (4,2 mm) line to line. Approximately 6 lines per inch.

**Vertical Spacing**

**Between Characters** 0.1 inch (2.5 mm)

**Printout Width**

**(48 columns).....** 4.77 inches (121,2)

**Character Size.....** 0.070"WX0.110 H (1,8 X 2.8 mm)

**Printing Method....**Dot-line, non- impact inkless ceramic thermal printhead.

**Printing Rate.....** Up to 72 lines per minute. (1.2 lines per second) at highest 9600 baud rate, regardless of the number of characters printed per line. The time required to print each line is:

$$\frac{\text{char line \# bits char}}{\text{Baud Rate}} + 0.75 \quad \text{Seconds}$$

**Printing Paper.....** Thermal paper 5 inches (127 mm) wide X 150 foot (45 m) rolls. Supplied only in boxes of 10 rolls. Reorder part no. 33-22422568. A red warning strip is displayed on the paper when approximately 10 feet of paper remain\*.

**Data Capacity.....** Approx. 11,00 lines in 150 feet usable per roll.

**Printhead Life.....** 30 million characters typical with random characters and Datel 33-22422568 paper rolls.

**Mechanism Life....** 5,000 hours, typical in non-hostile environments.

\*For users fabricating their own paper rolls, the end of the paper must detach from the core when paper is exhausted.

**INTERFACE**

**Interface Type.....** Full serial asynchronous either with or without data loading handshake controls.

**Input Data Rate....**A rear panel DIP switch set selects one of the following data baud rates:

110	1200
150	2400
300	4800
600	9600

Note: The external data source must either halt or pad nulls during the 750 mS print and advance cycle. Continuous data input at 110 or 300 baud is possible when the 132 character FIFO buffer option is installed (OAPP-48\_4).

**Data Format.....**Selectable 10 or 11 bits per character. 7 or 8 data bits, odd, even or no parity. 1 or 2 stop bits.

**Electrical Data Inputs**

Two inputs, EIA RS-232-C or 20 mA current loop on separate pin sets on the rear panel DB-25P data connector. A Request to Send output (RS-232-C circuit CA, pin 4) and Data Terminal Ready output (RS-232-C circuit CD, pin 20) are provided. (Note: The logic polarity of Request to Send is Switch Selectable)

CD, pin 20) are provided. ( Note: the logic polarity of Request to Send is switch selectable)

**Self Test**..... An internal rotating 96-character ASCII set may be printed using two external jumpers from pin 25 to pin 7 (ground) and from pin 2 to 3.

**Data Coding Levels**  
Current Loop\* RS-232-C

"1" 20 mA nom -3 to -15V  
"0" 0 mA nom +3 to +15V  
\*10<sup>5</sup> Megohms resistance,  
1500V dc isolation.

**DATA-CODED FUNCTIONS**

Character	meaning	Hex.	Octal
NUL	Null, ignored	00	000
BS	Backspace delete previous character	08	010
	Shift Out. Maps input data into the 2nd 96-character (non-standard set)	0E	016
SI	Shift In. Reset into ASCII data set	0F	017
Note1	SO and SI may be transmitted before each character. If SO or SI are not sent, printer will remain in last character set status. Power-on reset selects the ASCII character set.		
Note 2	Backspace decrements the column address counter loads a space character, and leaves column counter, decremented The recommended procedure to clear a line of any length before printing is to load 48 backspaces.		

Character	Meaning	Hex.	Octal.
STX	Changes to inverted printing (text) mode	02	002
ETX	Changed to normal, non-inverted (lister) printing mode.	03	003

**Note:** STX and ETX must be transmitted before each line and cannot be accepted within a line. If STX and ETX are not sent, the other printer will remain in the last mode status. Power-on reset may be DIP switch selected to automatically start in either the text or lister mode.

Character	Meaning	Hex.	Octal.
HT	Horizontal tab. Successively indexes to columns 9, 17, 25 and 33 for data logging or tabular applications.	09	011
LF	Line Feed. Advances one line, no print, no change of input register.	0A	012
FF	Form Feed. Advances 11 lines, no register change.		
CR	Carriage Return is used to print register contents, clear the register and advance one line. CR requires 750 mS, during which input data cannot be accepted. LF is not required to advance the line. If the sequence CR LF is sent, LF is ignored*	0D	015
DEL	Delete. Clear previous character column, load rub-out obliteration pattern, and advance column counter to original address. It is not possible to backspace and obliterate previously printed characters	7F	177

\* A full input register will also automatically start the printing cycle

**FRONT PANEL**

**Power On**..... Yellow Light Emitting Diode (LED) illuminates when power is applied. Note: Since most users will connect the APP-48 through a master system power on-off switch. There is not spearate power on-off switch on the APP-48.

- Feed**..... Momentary pushbutton switch (Note 1) advances paper as long as it is depressed. (Note 2)
- End of Paper**..... Red LED illuminates when approx. one inch of paper is remaining and disables further printing until paper is renewed. A red warning stripe appears on paper before the LED illuminates. (Note 2)

Note: 1 A line will finish printing if Feed is depressed while executing the print and advance cycle.

Note: 2 Feed and End of Paper functions cause Request to Send to go false to inhibit the data transmitter.

**POWER SUPPLY**

**Required Power**

- APP-48A2..... 105 to 30VAC @ 47 to 440 Hz, jumper-selectable \* for 210 to 250 VAC. Includes USA-style power cord.
- APP-48E2..... 210 to 250 VAC @ 47 to 440 Hz, jumper-selectable\* for 105 to 130 VAC. Includes European-style power cord.
- APP-48J2..... 100 VAC 47 to 440 Hz. Includes USA-style power cord.
- APP-48D2..... +10.5 to 15V dc. Line cord with space lugs included (black = +12V dc, white = 12V dc return, green = green).

\*Jumpers are located at the top rear of the power regulator board.

**Consumption**

- AC Model..... 40 watts max printing, 12 watts max idling.
- DC Model..... 1.5A printing (avg), 0.7 amps idling.

**Fuses**

- AC Models..... 115 and 100 VAC, 1 amp 230 VAC, 1/2 amp
- DC Model..... 3 AG, 5A SLO-BLO

**PHYSICAL**

**Operating Temperature**

Range..... 0 to +50°C

**Storage Temperature**

Range..... -30°C to +85 without paper.

Warning: The paper begins to darken after long exposure to +60°C and above.

**Weight**..... 6 pounds (no paper) (2.7 kg)

**Paper Roll**..... 0.7 lbs. (0.3 kg)

**Outline Dimension**. 8.12"W X 2.84"H X 8.32"D (206.25 X 72.14 X 211.33 mm)

**Bezel Dimensions**. 9.25"W X 3.25"H X 0.75"Thick. (235.0 X 82.6 X 19.1 mm).

**Mounting Method**. Through a front panel cutout measuring 8.40"W X 2.92"H (213.4 X 74.2 mm) 4 #8 mounting bolts and hardware are required.

**Mounting Position** Horizontal (Panel Mount) or Vertical (with panel facing upwards)

**Acceleration**

(non-operating).... Within ±5G 0 to 50 Hz, 3 Axes

**Relative Humidity**. 0 to 90% non-condensing

**Altitude**..... 0 to 10,000 feet (3048 m)

**ORDERING INFORMATION**

MODEL	DESCRIPTION
<b>APP-48A2</b>	Printer, 115/230 VAC (115 VAC wired), 47-440 Hz, USA Plug
<b>APP-48E2</b>	Printer, 115/230 VAC (230 VAC wired), 47-440 Hz, European Plug
<b>APP-48J2</b>	Printer, 100 VAC, 47-440 Hz, USA Plug
<b>APP-48D2</b>	Printer, +12V dc Power
<b>APP-48_4</b>	Printer with optional 132-character data buffer (specify desired power supply).
<b>33-2242568</b>	Box of 10 thermal paper rolls (150 feet per roll)
<b>58-2079130</b>	Spare Mating DB-25S Data Connector (1 supplied)
<b>33-8193205</b>	Printer stand kit (for bench-top applications)
<b>APP-TR5A</b>	Take-up reel/rewind accessory, 115 VAC powered
<b>APP-TR5E</b>	Take-up reel/rewind accessory, 230 VAC powered
<b>APP-TR5D</b>	Take-up reel/rewind accessory, ±12V dc powered.

# APP-48A3, E3, J3, D3

## IEEE-488 Bus Compatible

### 48-Column Thermal Printers



#### FEATURES

- Complete 48-column panel-mount printer with IEEE-488 interface and built-in power supply
- Prints full 96-character, upper and lower case ASCII alphanumerics. Includes second 96-character set of special figures, currency symbols, European punctuation, mathematical operators, etc.
- Dot-line thermal printhead, few moving parts for OEM reliability. No ink, no hammers, no mess!
- Prints inverted text (like a TTY) under software control
- Internal microprocessor includes one line, 48-column data buffer
- Prints up to 72 lines per minute
- 6 pound (2.7 kg) mini-light weight
- Choice of 100/115/230 VAC or +12V dc power supplies

#### GENERAL DESCRIPTION

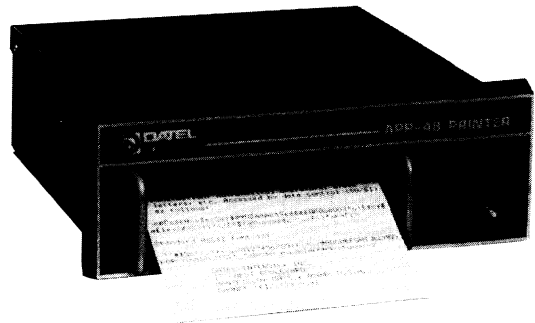
The APP-48A3/E3/J3/D3 is a miniature 48-column panel-mount/table top alphanumeric thermal printer. It comes complete with power supply and GPIB compatible interface electronics to provide hard copy output via the IEEE-488 General Purpose Interface Bus (GPIB). The APP-48 operates as a "Listen Only" device using a unique user-selectable 5-bit "My Listen Address" (MLA).

The IEEE-488 IB compatible devices which can send data messages to the APP-48 include computers, programmable calculators, digital voltmeters and spectrum analyzers. In addition, by using readily available GPIB interface boards, most popular mini and microcomputers can easily make use of the APP-48.

The APP-48 is fully IEEE Std. 488-1978 GPIB (General Purpose Interface Bus) compatible. The GPIB compatible APP-48 communicates with the controller using standard open collector drives. One printable line (up to 48 columns) of input data is stored in an internal data buffer register. The data input is then halted for 750 mS while the APP-48 activates the thermal printhead elements to output the alphanumeric characters, after which the paper is advanced to the next line. Each character is formed by a 5 column by 7 row dot matrix on specially coated, heat sensitive paper which measures 5 inches (127 mm) wide. There are no baud rate switches or jumpers to worry about as print rate is a direct function of the GPIB handshake protocol.

The APP-48 GPIB data format is 8 parallel, bi-directional lines, normally 7 data bits and 1 parity bit with 3 handshake lines:

- A. DAV (Data Valid)
- B. NRD (Not Ready for Data)
- C. NDAC (Not Data Accepted)



The APP-48 prints the full 96-character set of standard ASCII characters. A second 96 alphanumeric character set is stored in an internal memory. This set may be accessed by transmitting the shift out control code (SO) before loading the next character. Shift in (SI) restores the normal 96-character ASCII set. The second set includes special figures, currency symbols, mathematical operators, European punctuation, Greek letters, etc.

The STX/ETX control codes change the mode to inverted printing where the last record is at the bottom of the text when viewed normally. In this mode, the APP-48 may be mounted with its panel horizontal with printout feeding upwards like a teletypewriter. Under software control, lines may be alternated between lister (normal) and text (inverted) print modes.

The print mechanism of the APP-48 consists of a stationary dot-line thermal printhead, software-controlled stepping motor and cogged belt/print roller drive. The lightweight 6 pound (2.7 kg) APP-48 mounts through a 8.40"W x 2.92"H (213,4 x 74,2 mm) front panel cutout with four screws. A 3-prong line plug is captive to the internal AC power supply which is available as 115, 230 or 100 VAC, 47 to 440 Hz. Power consumption is 40 watts, maximum during printing and 12 watts while idling or accepting data. The printer is also available with a +12V dc power supply. The dc version draws 1.5 Amps while printing, 0.7mA idling. The overall dimensions of the APP-48 are 8.12"W x 2.84"H x 8.32"D (206,3 x 72,2 x 211,3 mm). The operating temperature range is 0 to +50°C and the front bezel measures 9.25"W x 3.25"H x 0.75" thick (235,0 x 82,6 x 19,1 mm).

For a ruggedized version of the APP-48, suitable for mobile applications, see the APP-M48

**FUNCTIONAL SPECIFICATIONS**

(Typical at +25°C unless noted)

**PRINTOUT**

**Numbers of Columns..** 48

**Characters Printed....** 96-character set, upper and lower case ASCII letters, numbers, punctuation per ANSI X3.4-1977 Specification. A second 96-character set is accessible by transmitting the ASCII Shift Out (SO) character. This second set consists of European characters, mathematical symbols, Greek letters, some graphics symbols, monetary symbols and others. The original ANSI X3.4 set is restored using the Shift In (SI) control characters.

**Printout Inversion....** Character-lines may be printed out inverted with the STX and ETX control characters. When switch nine at the rear of the printer is OFF (switched left), the unit comes up in List mode, when it is ON (switched right), the unit comes up in Text (inverted) mode. STX = Text Mode. ETX = Lister Mode. (Note: Normal and inverted text may not be intermixed on the same line)

**Printout Format.....** 5 dot columns by 7 dot row matrix per character.

**Printout Color.....** Black characters on white paper.

**Line Spacing.....** 0.164 inch (4,2 mm) line to line. Approximately 6 lines per inch.

**Vertical Spacing Between Characters.....** 0.1 inch (2,5 mm)

**Printout Width (48 Columns).....** 4.77 inches (121,2 mm)

**Character Size.....** 0.070"W x 0.110"H (1,8 x 2,8 mm)

**Printing Method.....** Dot-line, non-impact, inkless ceramic thermal printhead.

**Printing Rate.....** Up to 72 lines per minute, 1.2 lines per second max. regardless of the number of characters to be printed per line.

**Printing Paper.....** Thermal paper 5 inches (127 mm) wide x 150 foot (45 m) rolls. Supplied only in boxes of 10 rolls. Reorder part no. 33-2242568. A red warning stripe is displayed on the paper when approximately 10 feet of paper remain.

**Data Capacity.....** Approx. 11,000 lines in 150 feet usable per roll.

**Printhead Life.....** 30 million characters typical with random characters and DATEL 33-2242568 paper rolls.

**Mechanism Life.....** 5000 hours, typical in non-hostile environments.

**INTERFACE**

**Interface Type.....** IEEE 488 STD (1978) compatible.

**Data Format.....** 8 parallel, bi-directional data lines, normally 7 data bits and 1 parity bit. 3 handshake lines: A) DAV (data valid) B) NRFD (not ready for data) C) NDAC (not data accepted).

**Electrical Data Inputs.....** IEEE 488 STD (1978) Interface Bus compatible.

**Self Test.....** An internal rotating 96 character ASCII set printed when the bottom switch (SWØ) is switched left. The switch is accessible at the rear panel. NOTE: The unit must be powered down for 2 sec. min. after changing any switch position for the change to become effective.

<b>Data Coding Levels...</b>	Logic Level	Voltage Level
	0 (False)	≥2.0V (High)
	1(True)	≥+0.8V(Low)

**DATA-CODED FUNCTIONS**

Character	Meaning	Hex	Octal
NUL	Null, ignored	00	000
BS	Backspace, delete previous character	08	010
SO	Shift Out, Maps input data into the 2nd 96-character (non-standard set)	0E	016
SI	Shift In, Reset into standard ASCII data set	0F	017
STX	Changes to inverted printing (text) mode	02	002
ETX	Changes to normal, non-inverted (lister) printing mode	03	003
HT	Horizontal tab successively indexes to columns 9, 17, 25 and 33 for data logging or tabular applications.	09	011
LF	Line Feed advances one line, no print, no change of input register.	0A	012
FF	Form Feed advances 11 lines, no register change.	0C	014
CR	Carriage Return is used to print register and advances one line. CR requires 750 mS, during which input data cannot be accepted. LF is not required to advance the line. If the sequence CR, LF is sent, LF is ignored.*	0D	015
DEL	Delete. Clear previous character column, load rubout obliteration pattern, and advance column counter to original address. It is not possible to backspace and obliterate previously-printed characters.	7F	177

\*A full input register will also automatically start the printing cycle.

**FRONT PANEL**

- Power On**..... Yellow Light Emitting Diode (LED) illuminates when power is applied. NOTE: Since most users will connect the APP-48 through a master system power on-off switch, there is no separate power on-off switch on the APP-48.
- Feed**..... Momentary pushbutton switch (Note 1) advances paper as long as it is depressed. (Note 2)

**End of Paper**..... Red LED illuminates when approximately one inch of paper is remaining and disables further printing until paper is renewed. A red warning stripe appears on paper before the LED illuminates (Note 2)

**Note 1:** A line will finish printing if Feed is depressed while executing the print and advance cycle.

**Note 2:** Feed and End of paper functions inhibit data transmission from the controller to the printer.

**POWER SUPPLY**

**Required power**

- APP-48A3..... 105 to 130 VAC at 47 to 440 Hz, jumper-selectable\* for 210 to 250 VAC. Includes USA-style power cord.
- APP-48E3..... 210 to 250 VAC at 47 to 440 Hz, jumper-selectable\* for 105 to 130 VAC. Includes European-style power cord.
- APP-48J3..... 100 VAC at 47 to 440 Hz. Includes USA-style power cord.
- APP-48D3..... +10.5 to 15V dc. Line cord with spade lugs included (Black = +12V dc, White = 12V dc return, Green = ground)

\*Jumpers are located at the top rear of the power regulator board.

**Consumption**

- AC models..... 40 watts max printing, 12 watts max idling
- DC models..... 1.5 A printing (avg), 0.7 Amps idling

**Fuses**

- AC models..... 115 and 100 VAC, 1 Amp 230 VAC, 1/2 Amp
- DC models..... 3 AG 5A SLO-BLO

**PHYSICAL/ENVIRONMENTAL**

**Operating Temperature Range**.....

0 to +50°C

**Storage Temperature Range**.....

-30°C to +85°C without paper. The paper begins to darken after long exposure to +60°C and above.

**Weight**..... 6 pounds (no paper) (2,7kg)

**Paper Roll**..... 0.7 lbs (0,3 kg)

**Outline Dimensions**... 8.12"W x 2.84"H x 3.32"D (206,25 x 74,2 x 221,33 mm)

**Bezel Dimensions**..... 9.25"W x 3.25"H x 0.75" thick  
(213,4 x 74,2 mm)

**Mounting Method**..... Through a front panel cutout measuring 8.40"W x 2.92"H (213,4 x 74,2 mm) 4 #8 mounting bolts and hardware are required.

**Mounting Position**..... Horizontal (Panel Mount) or Vertical (with panel facing upwards)

**Acceleration (Non-operating)**..... Within ±5G, 0 to 50 Hz, 3 Axes

**Relative Humidity**..... 0 to 90%, non-condensing

**Altitude**..... 0 to 10,000 feet (3048 m)

<b>ORDERING GUIDE</b>	
<b>MODEL</b>	<b>DESCRIPTION</b>
APP-48A3	Printer, 115/230 VAC, 47-440 Hz, USA Plug (115 VAC wired)
APP-48E3	Printer, 115/230 VAC, 47-440 Hz, European Plug (230 VAC wired)
APP-48J3	Printer, 100 VAC, 47-440 Hz, USA Plug
APP-48D3	Printer, +12V dc Power
33-2242568	Box of 10 black image paper rolls
58-2079130	Spare Mating DB-25S Data Connector (1 supplied)
APP-TR5A	Takeup/Rewind Accessory, 115 VAC
APP-TR5E	Takeup/Rewind Accessory, 230 VAC
APP-TR5D	Takeup/Rewind Accessory, +12V dc

# APP-M20

## Rugged Mobile 20-Column Thermal Printer



### FEATURES

- Ruggedized construction - designed to comply with MIL-STD-202E and 810C for shock, humidity, and vibration
- +12V dc powered, for use with standard vehicle battery; AC models also available
- Low power consumption - 1.2 A printing, 360 mA standby
- Illuminated printout, extra TALL character printing and paper advance features for easy viewing day or night
- 20 column output with the full 96 ASCII character set available
- Quiet non-distracting thermal printing
- Compact - smaller than a CB radio
- Slide mounted for easy removal

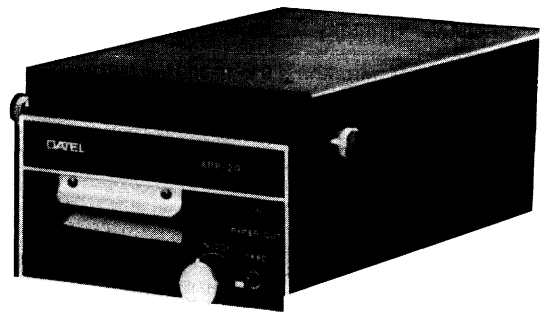
### APPLICATIONS

- Radio communications system with many varied applications
- Portable personal computers
- Test and measurement equipment for field use
- Hard copy output for medical and analytical instrumentation
- Diagnostic test equipment
- Remote data loggers and factory automation productivity systems

### GENERAL DESCRIPTION

The APP-M20 is a 20 column thermal printer specifically designed for use in harsh environments. With its slide mount and illuminated printout, the APP-M20 is particularly well suited for use in mobile applications. The mechanical specifications (except for the mounting bracket) and electrical specifications correspond exactly to those of the popular panel mount models.

The APP-M20 user will benefit from the microprocessor controlled interface, compact size (smaller than a CB radio) and quiet, inkless thermal printing. The TALL character height printing capability, Form Feed (paper advance) and illuminated paper output slot make reading the printer output at a glance extremely easy, both day and night. In addition, the APP-M20 offers a special "inverted text" option, where the last line printed is at the bottom of the printout. The APP-M20 thermal printing mechanism requires virtually no maintenance outside of an occasional printhead cleaning. No replacement printheads or ribbons need to be carried. The APP-M20 can be ordered with the bracket installed either on the top, on the bottom (by special order), or in a panel mount configuration making it installable virtually anywhere.



Much effort has been put into the hardware design to ensure that the printers will stand up to the rigors of mobile operation. The APP-M20 has passed testing by an independent laboratory for shock, vibration and humidity, conforming to MIL-STD-202E and MIL-STD-810C. Copies of these test results are available from DATEL upon request.

The APP-M20 voltage input requirements are +10.5 to +14.5 V dc at 1.2 A while printing and 360 mA during standby. No special powerline conditioning is required.

The APP-M20 prints the full 96 ASCII character set across 2-15/16" (58,6 mm) wide thermal paper. A single dot line, thick film, thermal printhead forms 5 x 7 dot matrix characters which are 0.11" (2,8 mm) high at a rate of 63 lines of 20 characters per minute. A standard 130' roll of paper will display 8,400 lines of alphanumerics at 5 lines per inch (2 lines per cm) spacing.

The operating temperature range is from -20°C to +50°C. The printer can withstand up to 95% relative humidity.

A mounting bracket and slides are shipped with each printer for easy installation.



**FUNCTIONAL SPECIFICATIONS**

(Typical at 25°C unless noted)

(For complete specifications, refer to the standard parallel, serial, or IEEE-488 model brochures: APP- 20D21).

**INTERFACE TYPES (3)**

Serial RS-232-C or 20 mA current loop (APP-M20D21)

**PRINT CHARACTERISTICS**

Printing Rate..... 63 lines/minute  
 Number of Columns..... 20  
 Characters Available..... 96 Standard ASCII  
 Character Height..... 0.11" (127 mm)

**PHYSICAL AND ENVIRONMENTAL**

Dimensions

Overall Clearance..... 6.16"W x 3.57"H x 11.52"D  
 (156,46 x 90,68 x 292,60 mm)  
 Housing..... 5.36"W x 2.76"H x 8.00"D  
 (136,14 x 70,10 x 203,20 mm)  
 Mounting Hood..... 5.36"W x 0.75"H x 8.0"D  
 (135,14 x 19,0 x 203,20 mm)  
 Bezel..... 5.25"W x 2.82"H x 0.78"D  
 (133,87 x 71,91 x 19,89 mm)  
 Weight..... 2.5 lbs (1,14 kg)  
 Operating Temp Range... -20°C to +50°C  
 Storage Temp Range..... -45°C to +85°C (Caution: the  
 paper will begin to darken after  
 several days of exposure to  
 temperatures in excess of  
 +60°C)  
 Relative Humidity..... 0% to 95% non-condensing  
 Shock..... 10 g at 10 to 500 Hz

**POWER**

Power Requirement..... +10.5 to 14.4V dc  
 Current Draw..... 1.2 A printing; 360 mA standby  
 Connector..... MOLEX receptacle with crimp-  
 on female terminals

**ORDERING GUIDE**

<b>MODEL</b>	<b>DESCRIPTION</b>
APP-M20D21	Serial input 20-column ruggedized printer
APP-TRD	Automatic, panel-mount take-up reel (+12V powered)
32-2242572	20-column thermal printer paper (10 130' rolls)

# APP-M48

## Rugged Mobile 48-Column Thermal Printer



### FEATURES

- Ruggedized construction — designed to comply with MIL-STD-202E and 810C for shock, humidity, and vibration
- +12V dc powered, for use with standard auto battery
- Low power consumption — 2.3A printing, 1A standby
- Illuminated printout, inverted text option and paper advance features for easy viewing — day or night
- 48 column output with the full 96 ASCII character set, plus second 96-character set of special symbols
- Quiet, non-distracting thermal printing; virtually maintenance free
- Compact size, slide-mounted for easy removal
- Available in Serial or Parallel compatible versions (APP-M48D1, APP-M48D2)

### APPLICATIONS

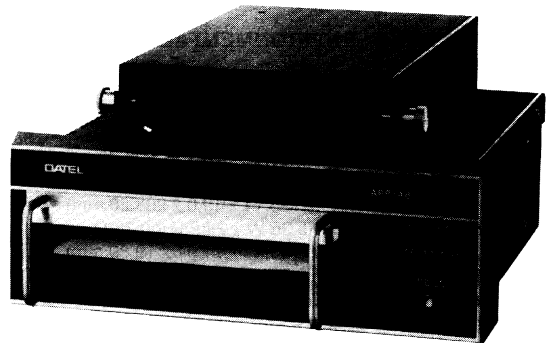
- Radio communications systems
- Portable personal computers
- Test and measurement equipment for field use
- Hard copy output for medical and analytical instrumentation
- Remote data loggers

### GENERAL DESCRIPTION

The APP-M48 is a 48 column thermal printer specifically designed for use in harsh environments. With its slide mount and illuminated printout, the APP-M48 is particularly well suited for mobile applications. The mechanical specifications (except for the mounting bracket) and electrical specifications correspond exactly to those of the popular panel mount models (APP-48D1, 2).

The APP-M48 user will benefit from the microprocessor controlled interface, compact size, and quiet, inkless thermal printing. The inverted text option (last line printed is at the bottom of the printout), Form Feed (paper advance) and illuminated paper output slot make reading the printer output at a glance extremely easy, both day and night. In addition, the APP-M48 thermal printing mechanism requires virtually no maintenance. No replacement printheads or ribbons need to be carried. The APP-M48 can be ordered with the bracket installed either on the top, on the bottom (on special order) or in a panel mount configuration making it installable virtually anywhere.

Much effort has been put into the hardware design to ensure that the printers will stand up to the rigors of mobile op-



eration. The APP-M48 has passed testing by an independent laboratory for shock, vibration and humidity, conforming to MIL-STD-202E and MIL-STD-810C. Copies of these test results are available from DATEL upon request.

The APP-M48 voltage input requirements are +10.5 to +14.5V dc at 2.3 A average while printing and 1 mA during standby. No special powerline conditioning is required.

The APP-M48 prints the full 96 ASCII character set across 5" (127 mm) wide thermal paper. A second 96-character set includes special characters such as currency symbols, European punctuation, mathematical operators, Greek letters, etc. A single dot line, thick film, thermal printhead forms 5x7 dot matrix characters which are 0.11" (2.8 mm) high at a rate of 1.2 lines per second.

The operating temperature range is from -20°C to +50°C. The printer can withstand up to 95% relative humidity.

A mounting bracket and slides are shipped with each printer for easy installation.

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25°C unless noted)

(For complete specifications, refer to the standard parallel or serial model brochures: APP-48D1, APP-48D2, APP-48D3)

**INTERFACE TYPES (4)**

- 8-bit parallel (APP-M48D1)
- Serial RS-232-C or 20 mA current loop (APP-M48D2)
- RS-232-C/20 mA loop with 132 byte buffer (APP-M48D4)

**PRINT CHARACTERISTICS**

- Printing Rate..... 72 lines/minute
- Number of Columns..... 48
- Characters Available..... 96 Standard ASCII plus 96 special characters
- Character Height..... 0.11" (127 mm)

**PHYSICAL ENVIRONMENT**

- Dimensions
- Overall Clearance..... 9.25"W x 4.00"H x 10.44"D  
(234,95 x 101,6 x 265,18 mm)
- Housing..... 8.20"W x 2.84"H x 8.14"D  
(208,28 x 72,14 x 206,76 mm)
- Mounting Hood..... 5.36"W x 0.75"H x 8.0"D  
(135,14 x 19,0 x 203,20 mm)
- Printer Beze..... 19.25"W x 3.25"H x 0.75"D  
(234,95 x 82,55 x 19,1 mm)
- Weight..... 6 lbs. (2.7 kg)
- Operating Temp Range... -20°C to +50°C
- Storage Temp Range..... -45°C to +85°C (Caution: the paper will begin to darken after several days of exposure to temperatures in excess of +60°C)
- Relative Humidity..... 0% to 95% non-condensing
- Shock..... 10g at 10 to 500Hz

**POWER**

- Power Requirement..... +10.5 to +14.4 V dc
- Current Draw..... 2.3A printing; 1.0A standby
- Connection..... 5' long power cord

**ORDERING GUIDE**

MODEL	DESCRIPTION
APP-M48D1	Parallel input 48 column ruggedized printer
APP-M48D2	Serial input 48 column ruggedized printer
APP-TR5D	Automatic, panel-mount take-up reel (+12V powered)
32-2242572	48 column thermal printer paper (10 130' rolls)

# APP-TR1, 2, 5

## Take-Up/Rewind Reels for Panel Printers



### FEATURES

- Automatically takes up printout from all DATEL thermal printers and many other brands of panel mount printers
- Allows manual paper withdrawal for easy viewing while powered ON
- Very fast rewind
- Easy-to-install panel mounting
- AC and DC powered models available
- +12 VDC model is ideal for vehicular/mobile applications
- Low cost - dependable

### DESCRIPTION

The APP-TR Series Take-up/Rewind Accessories automatically take up the printout as it is generated by DATEL panel-mount thermal printers. The APP-TR is also compatible with other brands of panel-mount printers which use similar width paper. The APP-TR is a completely self-contained unit, designed for panel mounting.

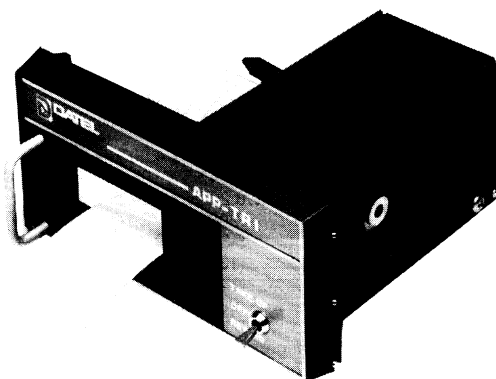
The front bezels of the APP-TR1, APP-TR2, and APP-TR5 match the bezels of DATEL's DPP-Q7, APP-20, and APP-48 thermal printers respectively. The APP-TR2 is also compatible with DATEL's low-cost MPP-20 printer.

The APP-TR bezels mount on hinges which allow the user to swing open the unit for easy access to the paper rollers. The paper is taken up by a slotted take-up shaft which does not require the use of spools or axles which are easily lost. Also, the APP-TR take-up mechanisms have been designed so that the paper can be pulled out and read while the power is on; when the paper is released it is automatically re-wound.

A front panel mounted three-position switch (TAKE UP/OFF/REWIND) is the only operator control on the unit. The "TAKE UP" position is the normal position, while the "REWIND" positions allows the paper to be quickly re-wound to its original state (first line printed is at the outside of the roll).

The APP-TR is available with several power supply options: 90 - 130VAC (for American and Japanese line power), 210 - 260VAC (European), and a +12V dc version ideal for mobile applications.

All of the necessary mounting hardware is provided for mounting the APP-TR in a standard 1/8" thick panel. The APP-TR must be mounted directly below and in line with the companion printer; the paper printout exiting from the printer must travel straight down to enter into the take up reel properly. The distance between the printer and the APP-TR depends on how much usable panel space is available, and how much of the printout the user wishes to display.



### ORDERING GUIDE

APP-TR1A	DPP-Q7 compatible (1.75" paper), 115VAC powered
APP-TR2A	APP-20/MPP-20 compatible (2.31" paper), 115VAC powered
APP-TR5A	APP-48 compatible (5.0" paper), 115VAC powered
APP-TR2E	APP-20/MPP-20 compatible (2.31" paper), 230VAC powered
APP-TR5E	APP-48 compatible (5.0" paper), 230VAC powered
APP-TR2D	APP-20/MPP-20 compatible (2.31" paper), +12V dc powered
APP-TR5D	APP-48 compatible (5.0" paper), +12V dc powered

**FUNCTIONAL SPECIFICATIONS** (Typical @ 25°C unless otherwise noted)**COMPATIBILITY**

APP-TR1A:	DATEL's DPP-Q7 Panel-mount Thermal Printer or any printer using 1.75" - wide (max.) paper.
APP-TR2A, E, D:	DATEL's APP-20 and MPP-20 Panel-mount Thermal Printers or any printer using 2.31" - wide (max.) paper.
APP-TR5A, E, D:	DATEL's APP-48 Panel-mount Thermal Printer, or any printer using 5.00" - wide (max.) paper.

**POWER****Requirements**

APP-TR1A/  
 APP-TR2A: 90 to 130VAC, 0.18A, 10W, 47 to 440Hz  
 APP-TR5A: 90 to 130VAC, 0.3A, 16W, 47 to 440HZ

APP-TR2E: 210 to 250VAC, 0.09A, 10W, 47 to 440Hz  
 APP-TR5E: 210 to 260VAC, 0.15A, 16W, 47 to 440Hz

APP-TR2D: +10 to +14V dc, 0.9A, 10W  
 APP-TR5D: +12 to +14V dc, 1.5A, 16W

**Fuses**

APP-TR1/TR2A 1/2 Amp, SLO BLO  
 APP-TR1A/APP-TR2A: 1/2 Amp, SLO BLO  
 APP-TR5A: 1 Amp, SLO BLO

APP-TR2E: 1/4 Amp, SLO BLO  
 APP-TR5E: 1/2 Amp, SLO BLO

APP-TR2D/  
 APP-TR5D: 2 Amp, SLO BLO

**Power Cords**

"A" models: 6', USA-style line cord  
 "E" models: 6', European-style line cord (2 prongs and ground shell)  
 "D" models: 6' line cord which spade lug termination (3):  
 BLACK = +12V  
 WHITE = 12V return  
 GREEN = Chassis ground

**PERFORMANCE**

Paper roll capacity: 150' (all models)  
 Paper tension: 2 oz. min, 12 oz. max  
 Paper rewind time: 45 seconds for 150' roll

**PHYSICAL/ENVIRONMENTAL****Case Dimensions**

APP-TR1/  
 APP-TR2: 6.56"W x 3.25"H x 5.75"D (166,62 x 82,55 x 146,05mm)  
 APP-TR5: 9.25"W x 3.25"H x 5.75"D (234,95 x 82,55 x 146,05mm)

**Panel Cutout Dimensions**

APP-TR1/  
 APP-TR2: 5.944"W x 3.040"H (150,977 x 77,21mm)  
 APP-TR5: 8.634"W x 3.040"H (219,30 x 77,21mm)

(Mounting hardware supplied for all models)

**Weight**

APP-TR1/  
 APP-TR2: 1.05 lbs  
 APP-TR5: 1.25 lbs

**Case Construction:** Aluminum case, plastic front bezel

**Operating Temperature Range:** 0 to + 50°C

# DPP-Q7

## BCD Input, 7-Column Thermal Printer



### FEATURES

- 6 Numeric columns and sign
- 4 Lines/second OEM-reliable thermal printer
- Includes all electronics for parallel BCD input
- Selectable leading zero blanking
- Positive or negative true TTL/DTL inputs
- Available in 100, 110, 230 VAC versions
- 4.4 Pound panel-mount featherweight
- No ink, ribbons or hammers; virtually maintenance free

### GENERAL DESCRIPTION

Imagine a low cost 7-column panel-mounting printer just slightly larger than most digital panel meters. Imagine this lightweight, high-reliability digital panel printer installed in your instrument or system front panel. And imagine an inkless, non-impact thermal printing method with only two moving parts which will last for years.

This is DATEL's miniature 4 line per second DPP-Q7 thermal panel printer. A no-nonsense, simple to apply, OEM-designed digital output device that weighs in at only 4.4 pounds (2.0 Kg). OEM features are designed into the DPP-Q7 such as selectable leading zero blanking, selectable positive or negative true coding inputs and choice of 100 to 230 VAC line power. Full parallel TTL input BCD electronics are included as standard.

Other OEM design features include a selection of printout formats, manual print and advance front panel switch, and a low paper switch output. A unique mounting technique uses an aluminum housing which attaches directly through a front panel cutout. This housing permanently holds the electronics, although the mechanical assembly can be completely removed for paper replacement using a single front panel thumbscrew.

As the mechanical assembly is removed, it disconnects from the internal electronics PC board connectors, so that no lethal power voltages are exposed during paper reloading. However, the external PC board connectors at the rear of the case remain connected to the signal inputs. The housing supports the weight of the mechanical assembly and is mounted on a front panel through a 4.50" x 2.78" cut-out and secured by four screws. Three DPP-Q7 panel printers can conveniently be mounted across a 19" x 3 1/2" high rack-mount panel.

OEM pricing makes the DPP-Q7 ideal for instrument products. Comparable impact parallel printers with BCD decoding and drive electronics usually list for more than the DPP-Q7.



Standard 1 3/4" wide thermographic papers are used in handy 130 foot rolls giving about 7,800 lines per roll with 5 lines per inch. The 7-segment digits are .155" high with left-of-digit decimal points selectable at each digit. Seven column printing formats include sign, and six digits or 2-channel (ident) digits, sign and 4 data digits. Other 7-column decimal formats, as well as hexadecimal formats, are also available.

The DPP-Q7 Digital Panel Printer extends back 8.62" from the front surface of the mounting panel, including space allowance for the two 30-conductor PC board connectors and AC fuses.

Three universal AC line voltages (100,115, and 230 VAC) will power the DPP-Q7 Printer at approximately 20 watts.

The DPP-Q7 is ruggedly built, using a simple, but sophisticated mechanical design which is optimized for heavy duty OEM applications. A proprietary printhead character coating allows the head to be conservatively rated at 3 million lines, minimum.

**FUNCTIONAL SPECIFICATIONS**

(Typical at +25°C unless noted)

**GENERAL****Number of columns** 7-Column formats available:

- a) Leading ± sign and 6 decimal digits
- b) 2 Leading ident or channel digits, ± sign and 4 data digits

**Decimal digit format:**

7-segment 0 to 9 digits .155" (4mm) high with 10° slant and selectable left decimal point.

**Printing method:**

Thick film thermal print head, black characters on white paper (using DATEL 32-2242570 paper)

**Printer paper:**

1.75" wide x 130 feet long, (44.5 x 39.62 m), thermal paper with the thermal surface facing away from the center of the roll (DATEL P/N 32-2242570)

**Paper advance:**

Via stepper motor

**PERFORMANCE**

Max. printing rate: 4 lines per second

Print and paper advance cycle: 250 milliseconds

Line spacing: 0.2 inch (5mm)

Line density: 5 lines per inch

Line capacity per paper roll: approx. 7,800 lines

Minimum print head life: 3 million lines

**INPUTS**

DTL/TTL compatible, selectable positive or negative true, level sensitive, TTLs low power Schottky logic used on all inputs.

**Logic Levels:**Positive true:  $+2.0V \leq "1" \leq +5.0V$   
 $0V \leq "0" \leq +0.5V$ Negative true:  $0V \leq "1" \leq +0.5V$   
 $+2.0V \leq "0" \leq +5.0V$ 

Note: Pullup resistors to +5V may be optionally removed on all inputs and output.

**Data: (24 lines)**

Full parallel BCD (1-2-4-8), selectable positive or negative-true, 1 TTLs load plus 10 K Ohm pullup to +5V. May be used with Form A (normally open) or Form B (normally closed) switch closure inputs. Level sensitive (rise-time non-critical). Data is stored.

**Change Data Polarity: (Pin C1-B11)**

Selects input polarity of data, decimal points and ± sign simultaneously.

LOW = positive true coding  
HIGH = negative true coding

6 TTLs loads, plus 1K Ohm pullup to +5V, level sensitive

**Print and Advance Command: (Pin C1-B14)**

Level sensitive for Form A or Form B contact closure selectable positive or negative true.

1 TTLs load plus 10K Ohm pullup to +5V.

Pulse Width: 1 microsecond to 200mSec (data must be valid 1 µsec after leading edge and 500 n Sec. before the print command).

Maximum print command rate: 3 per second

Paper advance automatically occurs after digit printing. Holding print command TRUE longer than the busy output is true (200 to 250 mSec. typ) causes continuous 4 lines/sec printing.

**Change Print Polarity: (Pin C1-B7)**

HIGH = negative true coding

LOW = positive true coding

1 TTLs load, plus 10 K Ohm pullup to +5V, level sensitive.

**Leading Zero Suppress: (Pin C1-B4)**

blanks all leading zero's to the left of decimal point except a zero just left of the decimal point.

HIGH = Leading 0's blanked

LOW = full print (no suppression)

2 Low Power TTL loads, plus 10 K Ohm pullup to +5V, level sensitive.

**Minus Sign: (Pin C1-B1)**

Selectable positive or negative true using data level select input.

1 TTLs load plus 10 K Ohm pullup to +5V, level sensitive.

**Plus Sign: (Pin C1-A5)**

(Selectable positive or negative true using change data polarity input). (Minus sign must also be printed since it is used as the horizontal portion of the plus sign).

1 TTLs load plus 10 K Ohm pullup to +5V, level sensitive.

Note: Printing "plus" sign only results in vertical portion of plus sign. See above. Usable as 100% over-range digit.

**Blanked Character:**

Created by loading 1-1-1-1 in a given column. Can be hard-wired.

**Decimal Points: (6 lines)**

1 TTLs load plus 10 K Ohm pullup to +5V, level sensitive.

(Selectable positive or negative true using change data polarity inputs).

**No-Print Paper Advance: (Pin C1-A3)**

Ground this line .5µS to .1 sec. minimum to advance one line. Hold to ground for continuous advance at 6.7 lines per second.

**No Print Paper Advance:**

May also be created by loading the illegal BCD character 1-1-1-1 in all decimal locations, and disabling all decimal points and ± signs, then initiating a print/advance command.

**Test: (Pin C2-B6)**

LOW = ± .8 .8 .8 .8 printout when print/advance command is given.

1 TTLs load plus 10 K Ohm pullup to +5V, level sensitive (2 minutes max, this test, DPP-7)

**Change Busy Polarity: (Pin C1-A2)**

HIGH = positive true busy out

LOW = negative true busy out

1 TTLs load, plus 10 K Ohm pullup to +5V, level sensitive.

## OUTPUTS

### DTL/TTL compatible

Positive true:  $0V \leq "0" \leq +0.4V$   
 $+2.4 \leq "1" \leq +5.0V$

Negative true:  $+2.4V \leq "0" \leq +5.0V$   
 $0V \leq "1" \leq +0.4V$

**Busy: (Pin C2-B12)** Open collector TTL 7438 with 1 k ohm pullup to +5V)

Remains TRUE during print and advance cycle (approximately 200 to 250 milliseconds). Data inputs may be change 500 nanoseconds after transition to TRUE. Next print command can be enabled when busy goes FALSE. Selectable positive or negative true. 10 TTL loads.

### Out of Paper: (Pin C2-B4)

The switch opens when approx. 6' (2m) of paper are left on roll. Paper roll visually indicates "low paper" within 10 to 15 feet (3 to 4.5m) of end of roll using red stripe on roll. Switch is in series with PC board contacts which disconnect if printer mechanism is not completely seated in case. Open switch contact or print mechanism removed will disable both local and remote print command. Pin C2-B4 has an internal 1 K ohm pullup to +5V normally grounded by switch before paper is low.

## FRONT PANEL

### Power On

Red light emitting diode illuminates when power is applied.

### End of Paper

Yellow light emitting diode illuminates when the paper supply has 2" remaining at which time the printer stops printing.

### Paper Roll Replacement:

By sliding out front panel printer assembly. PC board interlock automatically disconnects all power to printer assembly and power supply with electronics remain with housing case. Removal by a single front panel 1/4 turn thumbscrew.

### Print/Remote/Advance

Front panel 3 position toggle switch, stable in center position (REMOTE), must be held in top (ADVANCE) or bottom (PRINT) positions.

#### ADVANCE:

When switch is held up, the printer continuously advances paper without printing at a 6.7 line per second rate.

#### REMOTE:

Center position enables all external inputs.

#### PRINT:

When switch is pushed down, printer prints one line and stops. After print and advance, external input is accepted even if the switch is held down.

## TEMPERATURE RANGES

**Operating:** 0 to + 40°C (to +50°C at derated speed)

**Storage:** -25°C to +85°C (Paper darkens above +60°C)

Active printhead temperature sensor is employed to adjust drive energy to the existing head temperatures.

## HEXADECIMAL PRINTOUT

Users requiring full alphanumeric printout (upper and lower case letters, numerals, punctuation and special characters should select Datel's model APP-20 thermal printer using a 5 X 7 dot matrix character format: The DPP-Q7 is also available as an extended numeric printout called hexadecimal which includes 6 extra letters (A through F) beyond the 10 numerals. Hexadecimal code is ideal for machine microprocessor systems. Because of the 7-segment format, the b and d must be lower case. Also, the 1-1-1-1 code will no longer blank a column, although leading zero suppression may be selected. The type 4 printout (.9.9.9 .9.9.9 decimal or .F.F.F .F.F.F hexadecimal) with a blanked center column is available for two data points printed on the same line.

### Hexadecimal Coding

Input	Printout	Input	Printout
0000	0	1000	8
0001	1	1001	9
0010	2	1010	A
0011	3	1011	b
0100	4	1100	C
0101	5	1101	d
0110	6	1101	E
0111	7	1111	F

## POWER SUPPLY

### DPP-Q7A:

105-125 VAC, 47-440 Hz @ 40 watts max (10 watts, typ standby) U.S.A. grounding line cord. Jumper-selectable\* for 230 VAC.

### DPP-Q7E:

205-240 VAC, 47-440 Hz @ 40 watts max (10 watts, typ standby). 2 prong with 8 gnd. shell line cord. Jumper-selectable\* for 115 VAC.

### DPP-Q7J:

90-110 VAC, 47-440 Hz @ 40 watts max (10 watts, typ standby)

### AC Fuse:

DPP-Q7A/J: .25" x 1.25" Buss MDL or equivalent  
 1/2A SLO-BLO  
 DPP-Q7E: 1/4A SLO-BLO

### Notes:

1. Case is grounded to AC power ground
2. +5V, 200mA max. logic power out available

\*Jumpers are located in the printer housing and are accessible when the print module is removed.

## CONNECTORS

### Data and Controls:

(2)30-conductor (15 per side)  
 Double-sided PC board connectors.  
 0.1" centers. Datel #58-2073083 (included)

### AC Power

Supplied captive line cord with European or U.S.A. plug.

### WEIGHT (with housing and full paper roll)

4.4 lbs. (2.0 kg)

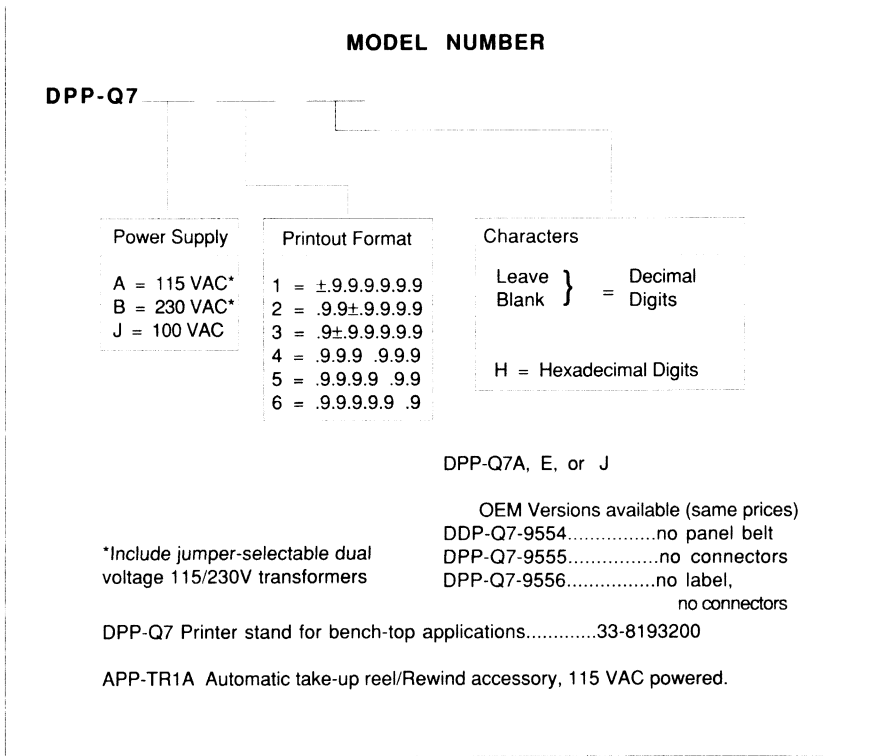


**DIMENSIONS**

Front panel mounting cutout:  
4.50" W x 2.72" H (115 mm x 69 mm)

Front panel Bezel dimensions:  
5.25" W x 2.82" H (134 mm x 72 mm)

Depth behind front surface of mounting panel including  
clearance for rear PC connectors and fuses:  
8.7" (221 mm)



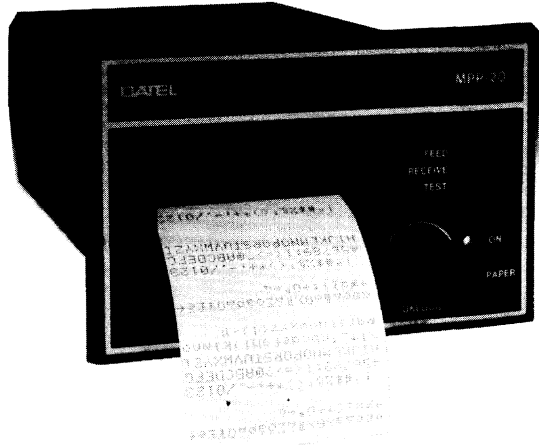
# MPP-20

## Low-Cost Serial/Parallel Input 20-Column Thermal Printer



### FEATURES

- Two communications modes:
  - RS-232-C serial
  - Centronics® -compatible parallel
- No external interface logic required
- Two character sizes, 20-characters per line
- Prints full 96-character ASCII set with 31 additional special characters
- Enhanced and inverted character output formats via data-encoded commands
- Front panel SELF-TEST and FEED controls
- SUPERTORQUE mode for operation in sub-zero temperatures
- AC- or dc-powered models
- Rugged, lightweight 4.2 pounds design
- Low cost
- Very high OEM reliability
- Quiet, virtually maintenance-free operation



*The MPP-20 Thermal Printer is the newest addition to DATEL's proven line of OEM-reliable thermal printers. Able to communicate in both serial and parallel modes, the low-cost MPP-20 thermal printer's rugged construction, variable output styles, and ease of application make it the choice of OEM's and end-users alike.*

### GENERAL DESCRIPTION

Able to use the full set of 96 ASCII characters and 31 special characters, the device prints output characters on 2-5/16 inch wide (58,6mm) thermal printer (see Figure 1). The printout has 20 columns of characters with the print rate varying as a function of the print format selected. Whether operating in the serial or parallel mode, all signals interface with the device via a single connector which attaches to the rear of the enclosure. The user accomplishes all unit wiring using a 30-pin card-edge connector (included).

The MPP-20 uses microprocessor-driven logic for timing character generation, printhead drive, and motor stepping. This technology accounts for the small size of the MPP-20 printer, at the same time making it easy to install and maintain.

The serial mode of operation uses straightforward two-, three-, or four-wire cabling schemes. One line carries serial transmissions of data to the MPP-20. Two other lines provide handshaking and status monitoring while the fourth is a system ground. The host queries the MPP-20 to detect when it is ready to accept data.

When ready, the MPP-20 loads one printable line of characters (20 columns wide) into an internal data buffer. The MPP-20 then halts any data input for a short period of time while it prints the line and advances the paper one line.

Parallel data operations are designed to be compatible with the Centronics® data bus configuration. This configuration has become an accepted de-facto standard for simple data transmission. The data is present on the data bus in the form of an eight-bit word. The MPP-20 loads and interprets

the data word upon receipt of a strobe signal from the host. The MPP-20 issues a negative going acknowledge pulse upon storage of each character.

In either mode, the MPP-20 interprets the received ASCII code into a printable character via a look-up table resident in the microprocessor's memory. The character is then fed to the print control logic for storage in a print buffer. After storing 20 consecutive characters (or spaces, punctuation, etc.), the print head burns an image of the characters onto the temperature-sensitive paper. The print drive logic controls a stepper motor which in turn drives the paper roll. The speed at which the motor turns is directly a function of the various output attributes selected (see Table 1). Selection of some attributes, such as ENHANCED feature, require longer burning time thus affecting the overall throughput rate. For instance, selecting the SUPERTORQUE attribute, used to drive the motor slowly in colder environments, would also add to the total throughput.

### ORDERING GUIDE

MODEL	DESCRIPTION
MPP-20A	115 VAC-powered, USA-type power cord and plug included
MPP-20D	+10.5 to +15V dc-powered, Molex connector and pins included
MPP-20E	230 VAC-powered, European-type power cord and plug included
MPP-20J	100 VAC-powered, USA-type power cord and plug included
32-2242572	Black printout paper, 10 rolls
58-2073083	Connector, input/output, dual 15 pin 0.100 inches on center, cardedge type (one included with each printer)
APP-TR2A/E/D/J	Take-up/Rewind Reel

**FUNCTIONAL SPECIFICATIONS**

(Typical at 25°C)

Parameter	Min.	Typ.	Max.	Units
<b>PRINTOUT</b>				
Print Rate (1)				
Normal Size	-	90	-	lines/minute
Tall	-	50	-	lines/minute
Line Density				
Normal Size	-	7	-	lines/inch
Tall	-	3	-	lines/inch
Tall	-	3.8	-	lines/inch
Tall	-	1.2	-	lines/inch
Line-to-Line Spacing				
Normal Size	-	0.14	-	inches
Tall	-	3.6	-	mm
Tall	-	0.26	-	inches
Tall	-	6.5	-	mm
Character Size				
Height, Normal	-	0.10	-	inches
Height, Normal	-	2.5	-	mm
Height, Tall	-	0.20	-	inches
Height, Tall	-	5.1	-	mm
Character Format	-	5 X 7	-	dot matrix
Character				
Horizontal Spacing	-	2.8	-	mm
Horizontal Spacing	-	0.11	-	inches
Line Feed Cycle Time			see table	
Normal	-	370		ms
Tall	-	680	1	m

**POWER CONSUMPTION**

Model	Min.	Typ.	Max.	Units
AC Models	-	-	5.8	watts, idling
AC Models	-	-	17	watts, printing
DC Models	-	-	400	mA, idling
DC Models	-	-	1.6	amps, printing

**POWER REQUIREMENTS**

Model	Min.	Typ.	Max.	Units
MPP-20A	105	115	130	Volts
MPP-20E	200	220	250	Volts
Frequency Range	47	-	440	Hertz
MPP-20J	90	100	110	Volts
Frequency	47	-	440	Hertz
MPP-20D	+10.5	+12	+15	Volts, dc regulated

**VOLTAGE LEVELS**

(TTL- and TTLS- compatible)

Parameter	Min.	Typ.	Max.	Units
<b>Input Logic</b>				
Low	0	-	+0.8	Volts dc (logic 0, or False)
High	+24	-	+5.0	Volts dc (logic 1, or True)
<b>Outputs</b>				
Low	0	-	+0.4	Volts dc (logic 0, or False)
High	+24	-	+5.0	Volts dc (logic 1, or True)

**PRINT MECHANISM**

Printhead Life	30 x 10 <sup>6</sup>	-	-	character life
Mechanism Life	5000	-	-	hours

**ENVIRONMENT**

Condition	Min.	Typ.	Max.	Units
<b>Temperature Range(2,4)</b>				
Operating	-20	+25	+50	Degrees Celcius
Storage	-45	-	+85	Degrees Celcius
Relative Humidity no condensation	0	-	90	Percent

**PAPER**

Data Capacity (3)				
Normal Size	-	-	10,600	Lines
Tall Size	- 2.31 inches by 140 foot			
Type	Black on white, DATEL number 32-2242572			

**NOTES**

1. Transmission at 9600 baud.
2. Paper darkens after 48 hours of exposure to temperatures exceeding +60 degrees Celcius.
3. Capacity dependent upon the mix of normal and tall characters.
4. +50 degrees Celcius operation is for continuous operation. Derated throughput is usable up to +55 degrees Celcius.

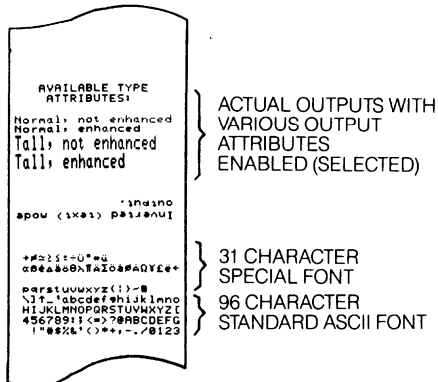


Figure 1. MPP-20 Sample Printouts

Table 1. Throughput Rate Variations

Output Character Attribute	Normal Size		Tall Size		Notes
	Millisecs added to basic cycle	Equiv. through-put lines/sec.	Millisecs added to basic cycle	Equiv. through-put lines/sec.	
Std Size	0	1.5	-	-	-
Tall Size	-	-	543	.86	1,3,4
Enhanced	560	.85	1081	.45	4
Supertorque	116	1.35	240	.71	5
Special Font	91	1.4	180	.74	2,3

**NOTES**

- Figure given is worst case, i.e., full line of tall characters. Minor variations occur with fewer tall characters per line.
- Same speed reduction occurs regardless of proportion of standard and special characters.
- All figures are for full lines of printable characters.
- Two burns take place for each dot of character formation. Between burns in a pair, the paper makes a half increment so as to fill in the gaps with redundant marks. When enhancement is added to tall characters, quadruple burns are generated at each character-mapping point.
- Supertorque is state of lowered step motor frequency. It executes by trebling the time delay in the paper motion subroutines.

The basic print cycle at 9600 Baud lasts 667 milliseconds. This serial mode print cycle reflects a 640 ms-long busy state and a 27 ms-long ready state.

Internal power supplies provide the various voltages used by the logic stepping motor and printhead. These supplies also provide an external +5 volts dc at 100 mA for user needs.

**TTL Compatibility**

All input/output signals, whether data or control, are designed to be fully TTL compatible. Table 2 lists the signals and their nominal current levels.

Table 2. TTL Signal Levels

MPP-20 SIGNAL	Input Current Low (mA)
TEXT/LIST	0.5
EOP	1.6
NEG/POS TRUE	0.7
DATA STROBE	5
TALL CHARACTER	0.5
DATA BITS	0.5
BAUD RATE PINS	-0.7
CR/CRLF	0.5
SO SUPPRESS	0.5

**Interface Specifications**

RS-232-C RDY/BSY (Pin A2):

Voltage Output (High) +4.5 volts dc with 3K ohm terminator  
+4.75 volts dc open circuit, 330 ohms source resistance

Voltage Output (Low) -5.5 volts dc with 3K ohm terminator  
-12 volts dc open circuit, 3K ohms resistance

ACTIVE PRINTING

(Pin B9):

(High) +5.0 volts dc (from 2K ohms source)  
(Low) 0 to +0.5 volts dc

Current Output (Low) 10 mA at 0.45 V dc

ACK (Pin B3):

Voltage Output (High) +5.0 volts dc (from 500 ohms source)

Voltage Output (Low) +0.4 volts dc (sinking 20 mA)

Voltage Output (Low) +0.9 volts dc (sinking 80 mA)

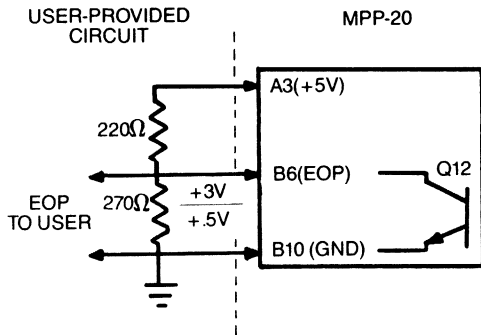
BUSY (Pin A9): Signal levels same as ACK (Pin B3)

**OPERATIONAL DESCRIPTION**

**Pin Functions:**

**Outputs**

**EOP (Pin B6):** This pin switches to logic ground when the paper (End Of Paper) supply is nearly exhausted, providing a 0.5 volt dc source at 50 mA for external alarming. This signal is not available after withdrawing the print module for paper renewal. In systems where this is an inconvenience, the circuit shown in Figure 3 may be added at the MPP-20 user connector.



**Figure 3. EOP Signal Support Circuit (User-Supplied)**

With this circuit in place and the print module present but out of paper, the EOP state supports approximately 15 TTL loads (24 mA). Removing the print module assembly results in pins A3, B6, and B10 being disconnected. The circuit shown in Figure 3 supports approximately 1 TTL load (1.6mA).

**XON/XOFF (Pin A7):** The MPP-20 uses this serial control line to notify the user of its status. Three basic conditions trigger activity on this line:

- 1) At completion of any lengthy operation, such as printing, the MPP-20 issues an XON control character to the user.
- 2) Upon receipt of an XON control character from the user device, the MPP-20 echoes a single XON, indicating that the printer is ready to receive.
- 3) The MPP-20 issues a single XOFF whenever the MPP-20 enters the busy state for reasons uncontrolled by user software. Typically, TEST, FEED, and EOP conditions trigger this state.

**Inputs**

**SUPERTORQ (Pin B7):** Grounding this pin lowers the paper feed stepper motor frequency, providing extra torque in cold environments if necessary. Printer throughput is somewhat reduced. This pin is normally at a TTL high level (+5 Volts dc.) See Table 1.

**ENHANCE (Pin B8):** If this pin is logically low when the print cycle begins, the line prints bold by performing a double burn of each dot.

**TEXT/LIST (Pin B2):** A logic low on this pin puts the printer in LISTER mode, which causes the characters to appear right side up when viewed from the front panel. The most recent line printed appears at the top of the printout while the first line appears at the bottom.

Floating the pin (no connection = high) puts the printer in the TEXT mode. In this mode, the characters appear upside down when viewed from the front panel. Removing the paper from the printer and inverting it so that the characters are right side up, the printout appears as normal text. Definition of the print direction must be established before starting the print cycle.

**NEG/POS TRUE: (Pin A8)**

Parallel data may be sent either positive or negative true. Parallel data may be inverted, for Centronics-compatibility (positive-true data operation), by tying this pin to logic ground.

**SO SUPPRESS: (Pin A15)**

A logic low on this pin prevents SO characters from taking effect. Does not affect the tall character select line, pin B11.

**TALL CHARACTER: (Pin B11)**

The TTL signal on this pin identifies characters as tall or normal (high for tall) as an alternative to SO/SI codes. This line also functions during serial operation and overrides the SI control character (but not the SO). With the NEG/POS TRUE pin A8 floated (high), tall characters are not available, and SO/SI therefore takes control. Centronics-compatibility requires that this pin be grounded whenever positive true data is selected (pin A8 grounded).

**Control Characters**

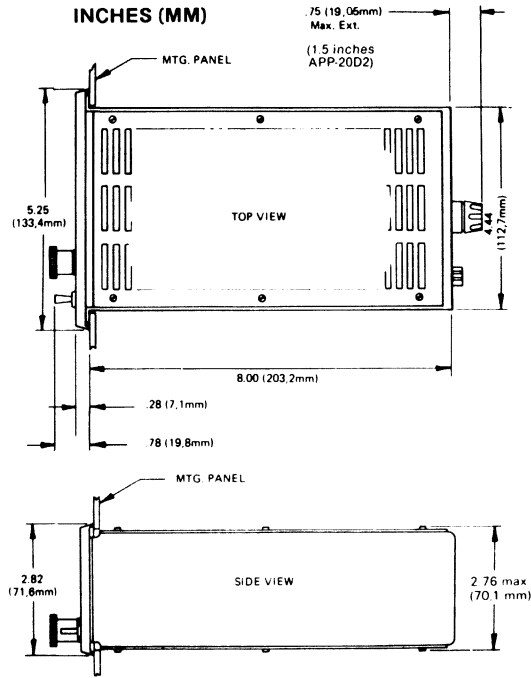
The MPP-20 responds to a set of 15 specific control characters, each causing the printer to perform a specific function. These functions, their mnemonics, and hexadecimal codes appear in Table 3.

**Table 3. MPP-20 Responses to Control Characters**

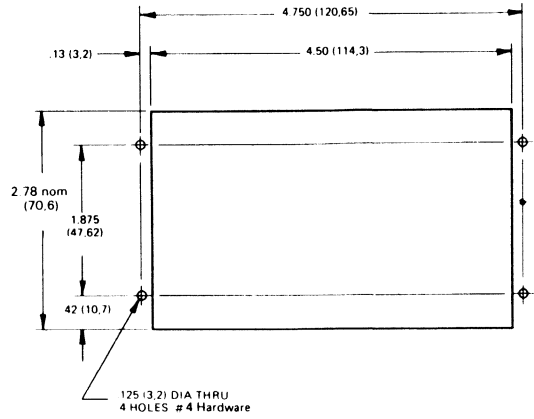
MNEMONIC	HEX CODE	NAME	ACTION PRODUCED
NUL	00	Null	None
BS	08	Backspace	Moves the column pointer back one position, deleting one character. On reaching column 1, the printer ignores subsequent BS commands.
HT	09	Horizontal Tab	Successively indexes the column pointer to positions 1, 4, 9, 15, and 20. Upon reaching position 20, the printer no longer responds to HT.
LF	0A	Linefeed	Advances the paper by one line. The amount of paper fed increases if tall characters have been requested by either invoking the SO state or if a logical "1" is the MSB of the parallel data input (bit 7, pin B11.) LF clears the line buffer without printing and resets the character column pointer to column 1.
VT	0B	Vertical Tab	Causes the printer to skip 5 lines. Does not print the data in the buffer; therefore, it is lost unless first printed as a result of receiving a CR. Upon receipt, cancels any existing SO, DC2, and SUB flags in the flag register. The column pointer resets to position 1. Head of form sensor will interrupt VT.
FF	0C	Form Feed	Same as VT except skips 11 lines. Head of form sense interrupts FF.
CR	0D	Carriage Return	Initiates printout of characters in line buffer and causes a line feed.
SO	0E	Shift Out	Sets the tall character mode. Cancel lable either by SI, VT, FF, or RS. Using the SO/SI control characters allows mixing tall and normal sized characters on the same line. Grounding pin A15 (SO SUPPRESS) at the user connector suppresses the tall character selection option. The SO state can be locked on (in both serial and parallel modes) by holding parallel data bit 7 at logic 0 at the user connector, pin B11.
SI	0F	Shift In	Cancels SO state. Unit powers up in SI state.
DC1	11	Device Control 1 (XON)	Causes the printer to return an XON in the serial mode one time if idle. Useful in systems that cannot monitor the RS-232 signal input line.
DC2	12	Enhanced Print Request	Prints an entire line bold if this character is received any time before CR. Self-clearing after each line.
DC4	14	Cancel Enhance Request	Cancels the enhanced mode.
SUB	1A	Substitute	Shifts to the alternate set of 31 special characters, if not disabled by solder-gap SG2 closure.
CAN	1B	Cancel	Shifts back to the standard set of ASCII characters. This is the power-up default condition.
RS	1E	Paper Feed	Causes a paper feed. Cancels DC2, SO, and SUB flags in the flag register. Feed ends after: 1) 84 lines (12") are fed, or 2) A head of form sensor returns a "stop" before 84 lines, or 3) 2 lines are fed with a "stop" signal strapped low.

# APP-20 Series

## OUTLINE DIMENSIONS INCHES (MM)

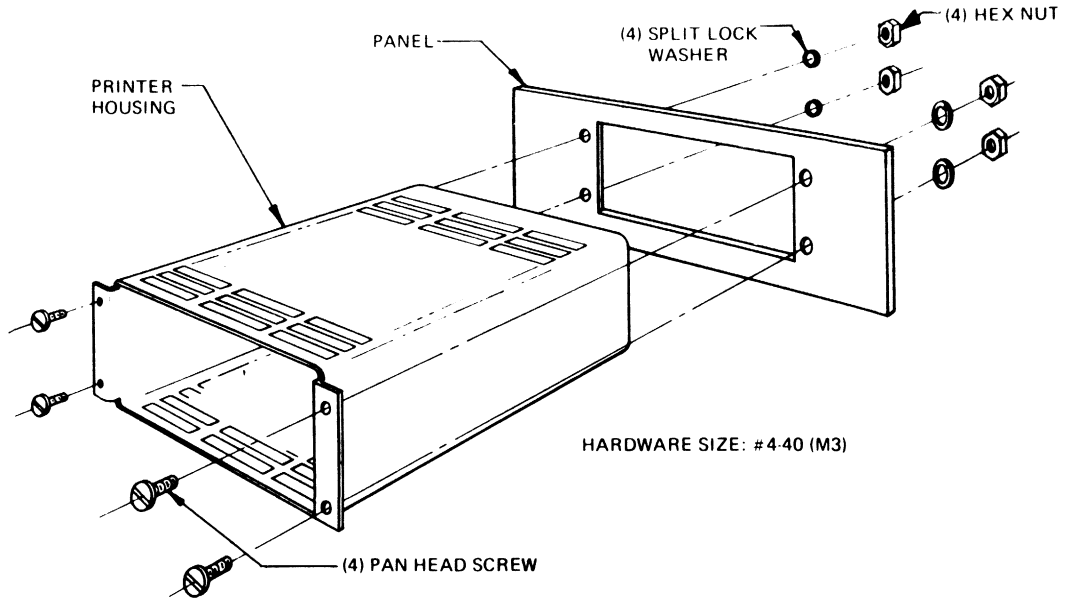


## PANEL CUTOUT



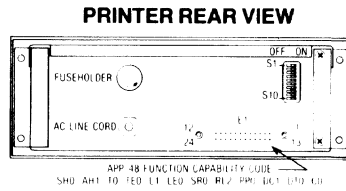
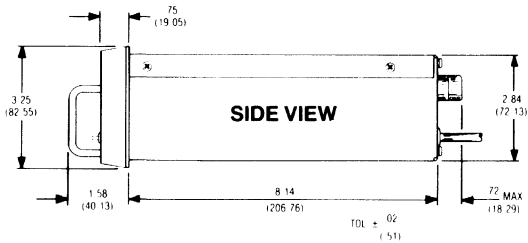
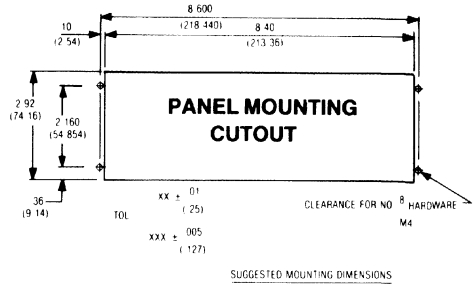
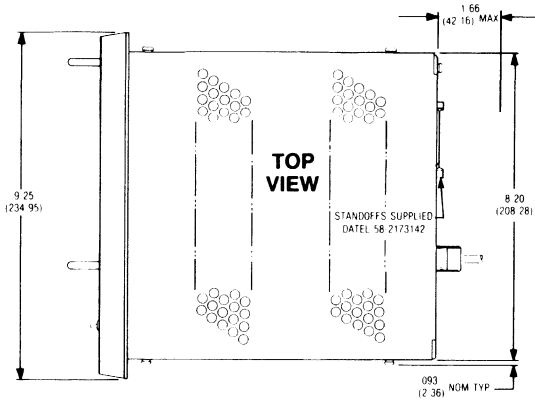
NOTE  
TOLERANCE .XX + .01 (0,25)  
XXX - .005 (0,10)

## MOUNTING DETAILS

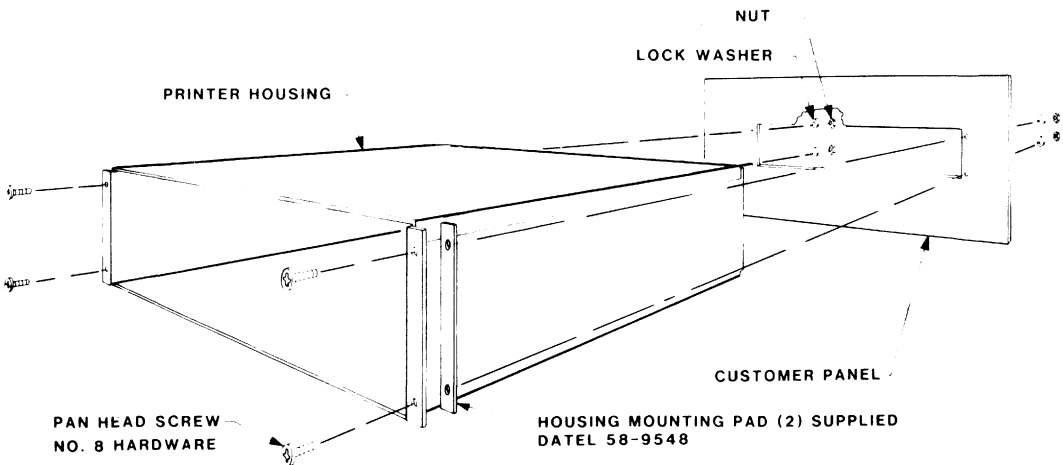


# APP-48 Series

## MECHANICAL DIMENSIONS — INCHES (MM)



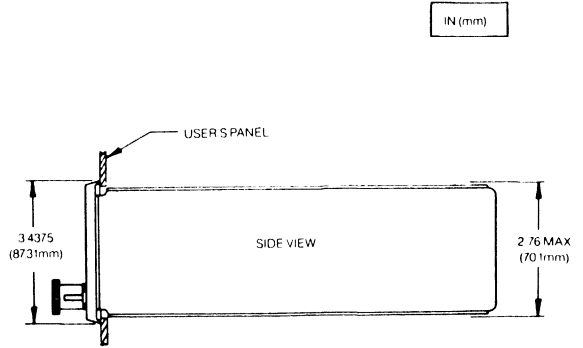
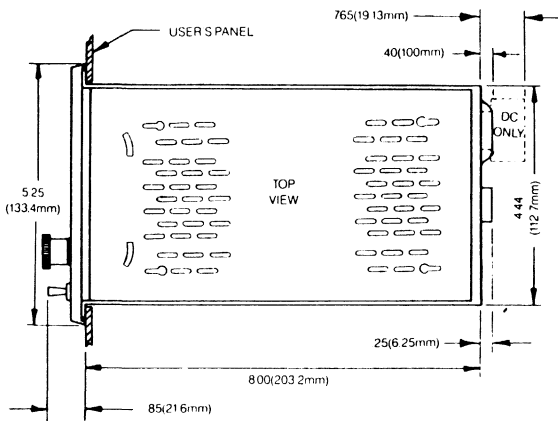
## MOUNTING DETAILS





# MPP-20/DPP-Q7

## Physical Dimensions



NOTE: Bezel height for DPP-Q7 is 2.82" (71.6mm)

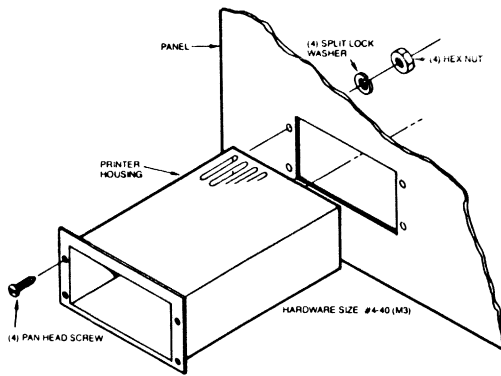
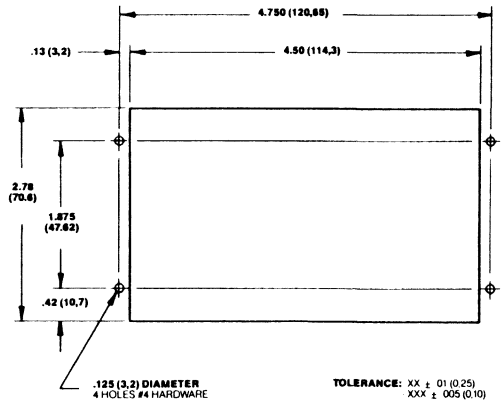
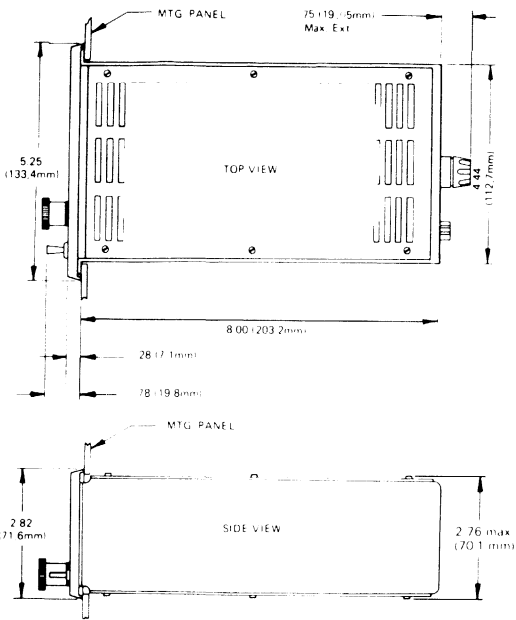


Figure 11. MPP-20 Mounting Details

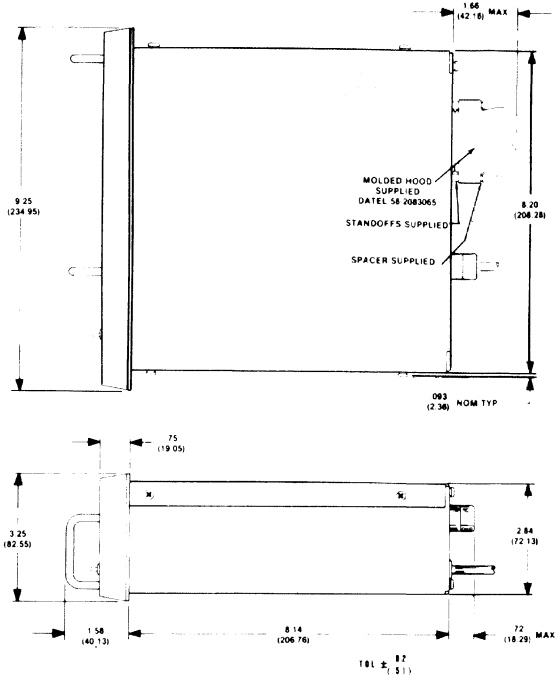
## CUTOUT TEMPLATE



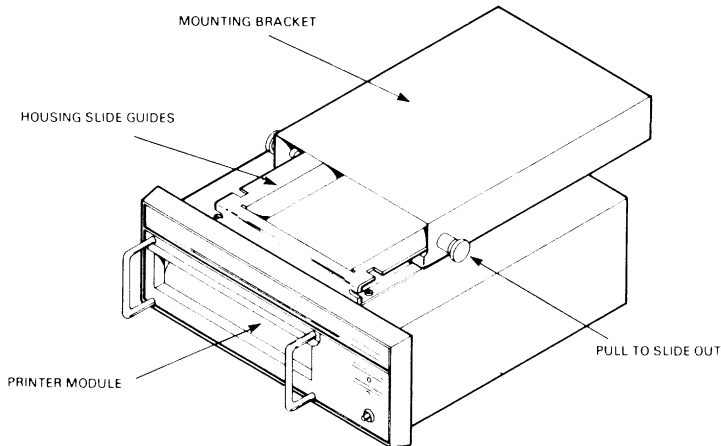
# APP-M20 Series



# APP-M48 Series

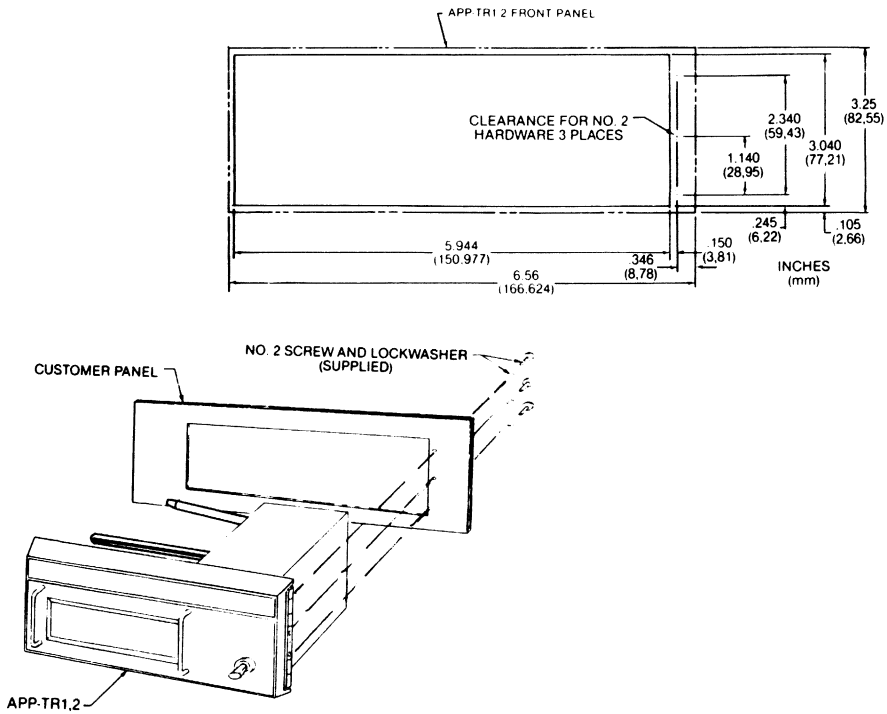
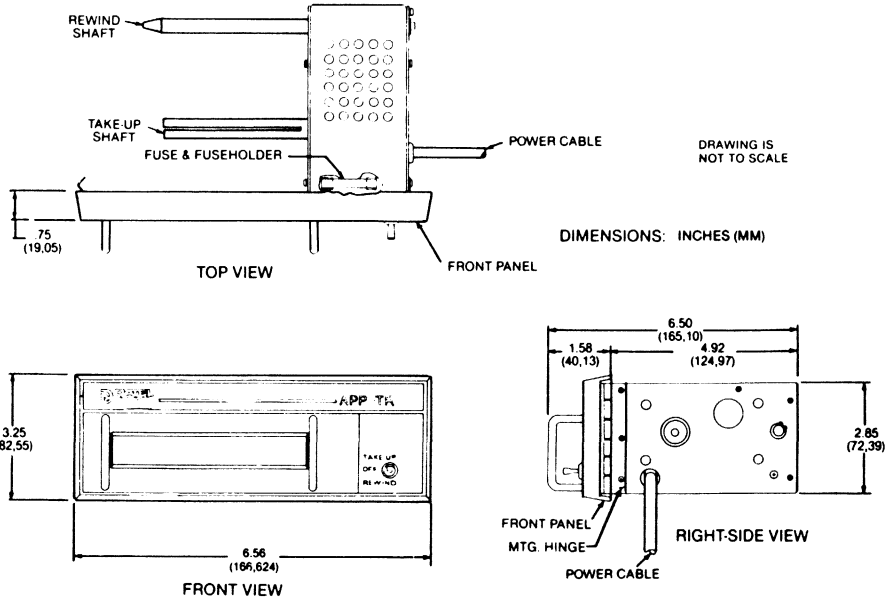


## MOUNTING BRACKET



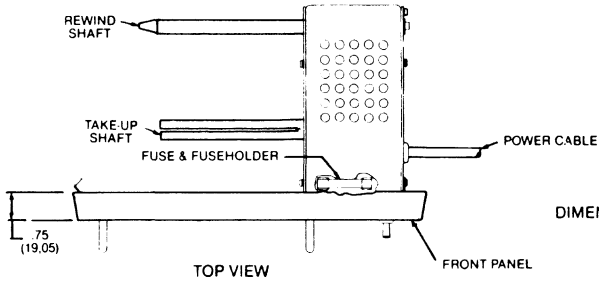
# APP-TR1,-TR2

## OUTLINE DIMENSIONS-INCHES (MM)

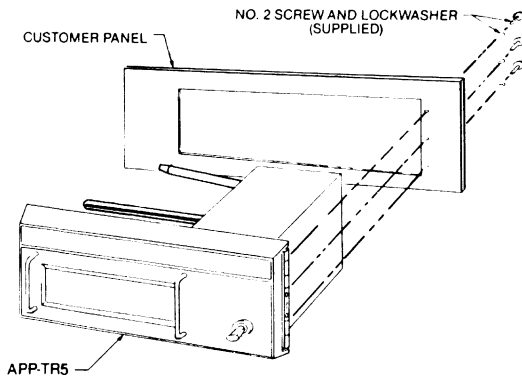
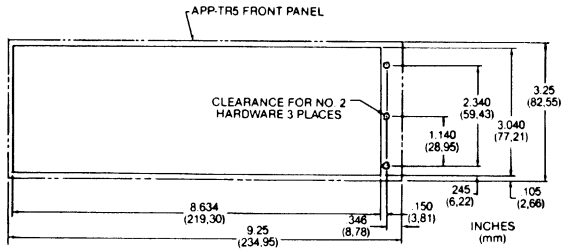
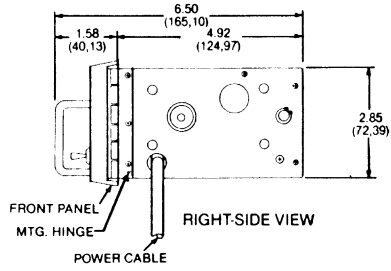
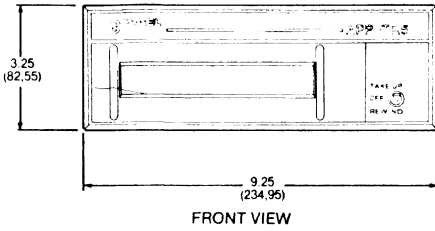


# APP-TR5

## OUTLINE DIMENSIONS-INCHES (MM)



DIMENSIONS: INCHES (MM)



# **Selected New Products**

## MULTIBUS I

Model	A/D Channels	A/D Resolution	A/D Speed	PGA	In/Out Ranges	D/A Channels	D/A Resolution	Notes
ST-702	8 D Isolated 1 KV	13 Bits	33 ms	x50, x100	5V Down to 50 mV	None	--	Direct thermocouple connections, on board linearize and CJC
ST-711 ST-732	32S / 16D	12 Bits	20 $\mu$ s	x1 to x1 K Software	5V, 10V Down to 50 mV	2 (732)	12 Bits	On board start timer, Interrupt
ST-703	None	--	--	--	2.5V to 10V 4 to 20 mA	4 Isolated	12 Bits	350V Isolation per channel
ST-724	None	--	--	--	5V, 10V 4 to 20 mA	4	12 Bits	
ST-728	None	--	--	--	5V, 10V 4 to 20 mA	4 or 8	12 Bits	
ST-716	None	--	--	--	5V, 10V	4 or 8	16 Bits	
ST-705	8 D	13 Bits	33 ms	x1 to x200	4V Down to 20 mV	None	--	RS-232 subsystem and CPU, Direct thermocouple connection, linearize, CJC
ST-519	TTL discrete I/O	--	--	--	TTL	--	--	72 TTL lines, In/Out, Interrupt

## PC/AT A/D-D/A BOARDS

Model	A/D Channels	A/D Resolution	A/D Speed	Prog. Gain Amplifier	In/Out Ranges	D/A Channels	D/A Resolution	Notes
PC-414A	4 SE w/simul sampling	12 Bits	1.5 MHz	x1 or x10	5V, 10V, 1V	1	12 Bits	
PC-414B	4 SE	14 Bits	500 KHz	---	5V, 10V	1	12 Bits	4K-sample FIFO memory, analog trigger,
PC-414C	4 SE	12 Bits	1 MHz	---	5V, 10V	1	12 Bits	parallel data port, counter/timer, DMA
PC-414D	1 SE	12 Bits	4 MHz	---	1V	1	12 Bits	Vectored interrupt
PC-414E	16 SE	12 Bits	400 KHz	x1 to x100	10V to 100 mV	1	12 Bits	
PC-430A	4 SE w/simul sampling	12 Bits	1.5 MHz	x1 or x10	5V, 10V, 1V	None	---	Local 32 MHz 320C30 DSP, 512K memory, DMA
PC-430B	4 SE	14 Bits	500 KHz	---	5V, 10V	None	---	Fast "no prgmg" command executive,
PC-430C	4 SE	12 Bits	1 MHz	---	5V, 10V	None	---	DSP library,
PC-430D	1 SE	12 Bits	4 MHz	---	1V	None	---	Vectored interrupt
PC-430E	16 SE	12 Bits	400 KHz	x1 to x100	10V to 100 mV	None	---	
PC-462	4 Monitor Channels	12 Bits	25 KHz	---	0 to $\pm$ 15V or 5V, 10V	2 Isolated, V or I mode	12 Bits	Programmable power DAC

## VMEBUS A/D - D/A BOARDS

Model	A/D Channels	A/D Resolution	A/D Speed	Prog. Gain Amplifier	In/Out Ranges	D/A Channels	D/A Resolution	Notes
DVME-601A	16 S/ 8 D Expandable to 256	12 Bits	20 $\mu$ s	x1 to x1K	5, 10V down to 50 mV	None	---	68010 CPU 256K memory RS-232, 5 TTL I/O Counter/Timers "No prgmg" Command Exec. Vectored interrupt
DVME-601B		12 Bits	4 $\mu$ s					
DVME-601C		16 Bits	35 $\mu$ s					
DVME-601D		16 Bits	400 ms					
DVME-601E		12 Bits	2 $\mu$ s					
DVME-611/612A	32 S/ 16 D Expandable to 256	12 Bits	20 $\mu$ s	x1 to x128 Software Pgmbly	5V, 10V down to 50 mV	2 (612)	12 Bits	Short I/O SA:16, SD:16 Vectored interrupt
DVME-611/612B		12 Bits	4 $\mu$ s					
DVME-611/612C		16 Bits	35 $\mu$ s					
DVME-611/612D		16 Bits	400 ms					
DVME-611/612E		12 Bits	2 $\mu$ s					
DVME-611/612F		14 Bits	4 $\mu$ s					
DVME-613	16 S/8 D Isolated 500V	12-14-16 Bits	40 $\mu$ s	x1 to x100	5V, 10V down to 50 mV	None	---	8 In/8 Out TTL, SA:24, SD:16 Start timer, interrupt
DVME-624	None	---	---	---	2.5 to 10V 4 to 20 mA	4 Isolated	12 Bits	SA:16, SD:16 350V Isolation
DVME-626	None	---	---	---	5V, 10V	6	16 Bits	SA:16, SD:16
DVME-628	None	---	---	---	2.5 to 10V 4 to 20 mA	8	12 Bits	SA:16, SD:16
DVME-641	32 S/16 D	Slave MUX board	6 $\mu$ s Settling	---	5V, 10V 4 to 20 mA	---	---	Slave input expander to 601, 611, 612
DVME-643	8D Isolated	Slave MUX board	2.5 ms Settling	x50, x100	5V Down to 50 mV	---	---	Slave input expander to 601, 611, 612
DVME-645	16 S/8D	Slave MUX board	6 $\mu$ s Settling	---	5V, 10V	---	---	Simultaneous Sample/Hold Expander to 601, 611, 612
DVME-614A	4 Simul. S/H	12 Bits	1.5 MHz	x1 or x10	1V, 5V, 10V	1	12 Bits	4K-sample FIFO memory Analog trigger Parallel data port Sample counter/timer Simultaneous sampling Vectored interrupt
DVME-614B	4 S	14 Bits	500 KHz	---	5V, 10V			
DVME-614C	4 S	12 Bits	1 MHz	---	5V, 10V			
DVME-614D	1 S	12 Bits	4 MHz	---	5V, 10V			
DVME-614E	16 S	12 Bits	400 KHz	x1 to x100	1, 5, 10V, 100mV			
DVME-630A	4 Simul. S/H	12 Bits	1.5 MHz	x1 or x10	1V, 5V, 10V	None	---	Local 32 MHz 320C30 DSP, 512 K Memory, Fast "no prgmg" command Executive, Interrupt DSP library
DVME-630B	4 S	14 Bits	500 KHz	---	5V, 10V			
DVME-630C	4 S	12 Bits	1 MHz	---	5V, 10V			
DVME-630D	1 S	12 Bits	4 MHz	---	5V, 10V			
DVME-630E	16 S	12 Bits	400 KHz	x1 to x100	1, 5, 10V, 100mV			
DVME-622	None	---	---	---	5V, 10V	16 Simul. Update	12 Bits	3 $\mu$ s settling per channel

# GPIB-PCIIA

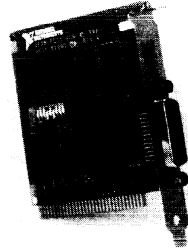
## High Speed Instrumentation

## Interface Board for IBM-PC/XT/AT and PS/2



### FEATURES

- Full Function Talker/Listener/Controller (TLC)
- Half size board fits any bus I/O slot
- Interface up to 15 instruments per interface card
- Shared interrupt capability for IBM GPIB adapter compatibility
- Fully compatible with LabWindows 2.0 Software
- Data transfer rates to 300 Kbytes/sec
- Transparent DMA handling
- FREE software package



### GENERAL DESCRIPTION

DATEL's GPIB-PCIIA is a low cost, full function instrumentation interface card (half-size) conforming to the ANSI/IEEE 488-1978 standard. This high speed, 8-bit parallel bus is extremely popular and has long been the method of choice for importing data from benchtop instruments, controlling and setting up instruments, and for interconnecting a wide variety of compatible instruments to a single Talker/Listener/Controller ...the personal computer. The GPIB-PCIIA is supplied with a FREE software package that eliminates the need for intimate knowledge of the hardware or understand the IEEE-488 protocol.

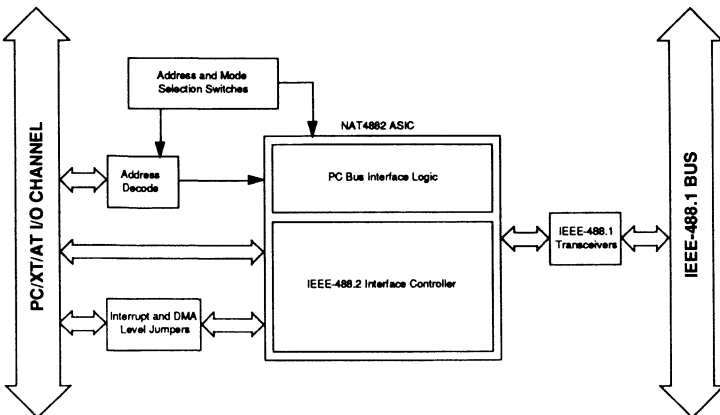
Used specifically for interfacing IBM-PC/XT/AT and PS/2 personal computers (and compatibles) to the vast array of programmable devices via the General Purpose Interface Bus (often called HP-IB), the GPIB-PCIIA is compatible with all revision levels of the IEEE-488 standard. Full handshake and

interface management functions are built directly on the board. Combining National Semiconductor 75160A and 75162A transceivers with NEC uPD7210 GPIB TLC integrated circuit makes the GPIB-PCIIA interface card one of the most versatile instrumentation interfaces available. Standard IEEE-488 cables may be used to connect the GPIB-PCIIA with up to 14 instruments.

Each GPIB-PCIIA board is supplied with a full set of FREE software drivers including an interactive menu-driven configuration program, an interactive control program, and diagnostics that are fully compatible with MS-DOS. This package is installed as part of the operating systems and may be accessed from all popular languages including BASICA, Microsoft C, and QuickBASIC. In addition, the GPIB-PCIIA is fully compatible with LabWindows 2.0 (optional) for full menu-driven operation.

### APPLICATIONS

- Controller for up to fourteen Benchtop Instruments
- Interface for Wide Variety of Scopes, DMM's, Analyzers
- High Speed Data Collection via Standalone Instruments
- Data Communication Between and Remote Instruments
- Engineering/Test Bench Data Concentrator
- Production/Manufacturing Automation



### BLOCK DIAGRAM



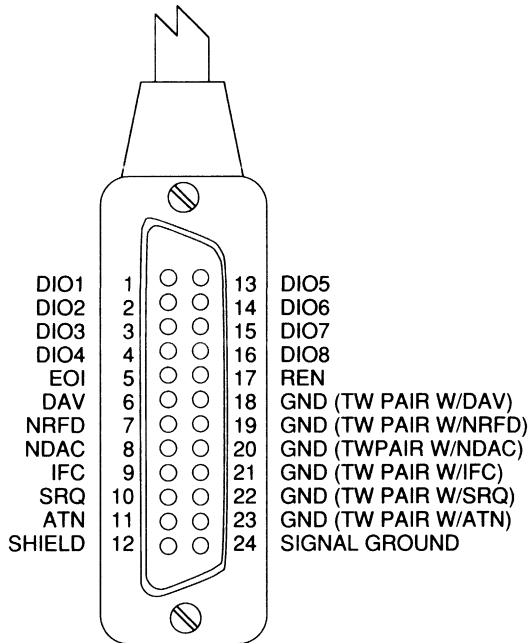
**IEEE-488 (GPIB) COMPATIBILITY**

The General Purpose Interface Bus (GPIB) is defined by ANSI/IEEE Standard 488-1978 and is often referred to as the IEEE-488 bus (also called HP-IB). The GPIB is an 8-bit parallel digital bus with full handshake and interface management capability. Its high speed and very well defined protocol make it extremely popular (and growing) for interfacing programmable devices with computers. The GPIB-PCIIA is compatible with all revision levels of the IEEE-488 standard.

The IEEE-488 standard specifies allowable subsets of interface functions. The codes supported by the GPIB-PCIIA are listed in the following table:

CAPABILITY CODE	DESCRIPTION
<b>SH1</b>	Source Handshake
<b>AH1</b>	Acceptor Handshake
<b>T5, TE5</b>	Talker, Extended Talker
<b>L3, LE3</b>	Listener, Extended Listener
<b>SR1</b>	Service Request
<b>PP1, PP2</b>	Local/Remote Parallel Poll
<b>RL1</b>	Remote/Local
<b>C1, C2, C3, C4, C5</b>	Controller
<b>E1, E2</b>	Three-state bus drivers with automatic switch to open collector, during Parallel Poll

**CONNECTOR PINOUT**



**HARDWARE CAPABILITY**

**Address Decoding**

Address Decoding is accomplished by matching the address lines on the GPIB-PCIIA to those on the IBM PC I/O channel and enabling reads and writes to the GPIB interface controller.

**Buffering and Data Routing**

A bidirectional internal bus handles data transfers between the IBM PC I/O channel and the GPIB interface controller.

**Interrupt Arbitration**

Interrupt requests may be generated by the GPIB-PCIIA for transparent interrupt handling under control of Interrupt Arbitration circuitry. A choice of six interrupt lines (levels) are available via jumper plugs on the board.

**DMA Arbitration**

The DMA arbitration circuit recognizes when DMA operations are enabled or disabled and when the last transfer has taken place. It also routes the DMA request and acknowledge signals to the selected DMA channel. A choice of three DMA channels are available using the host DMA controller. All DMA handling is transparent once configured.

**Configuration Switches and Jumpers**

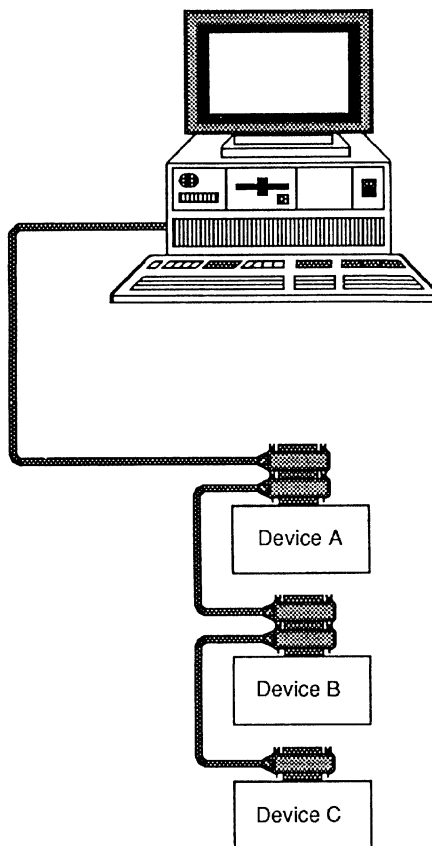
The GPIB-PCIIA contains a 5-gang DIP switch for address channel selection as well as jumpers for interrupt request lines and DMA channel selection.

**GPIB Interface Controller**

The GPIB-PCIIA employs an NEC uPD7210 which implements virtually all IEEE-488 functions. Twenty-one program registers are to configure, control, and monitor the interface functions as well as to pass commands and data to and from the computer and the GPIB-PCIIA.

**GPIB Transceivers**

National Semiconductor 75160A and 75162A transceivers are used to interface the Interface Controller (NEC uPD7210) to the IEEE-488 bus. The ICs are specifically designed to provide (glitch-free) power-up/power-down bus protection. Each GPIB-PCIIA counts as a single IEEE-488 bus load and, therefore, up to 14 additional devices may be connected to the bus before exceeding the loading restrictions.



**LINEAR CONFIGURATION**

**SOFTWARE SUPPORT**

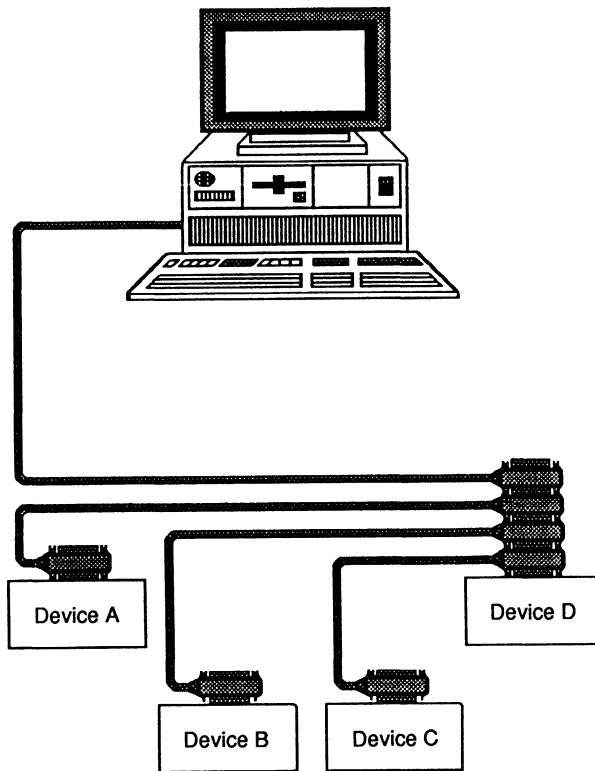
Each GPIB-PCIIA is supplied with a FREE software package (NI-488.2 MS-DOS) which includes an MS-DOS handler that has all GPIB Talker/Listener/Controller functions and installs as part of the operating system. This handler may be accessed via all popular languages such as BASICA, Microsoft C, and QuickBASIC.

Besides the free software, the GPIB-PCIIA is supported by LabWindows 2.0 (refer to LabWindows documentation for a complete description).

**SPECIFICATIONS**

(All specifications are typical at 25 °C unless otherwise noted)

<b>IEEE-488 BUS TRANSFER RATES</b>	
DMA .....	> 300 Kbytes/sec
Block Length .....	up to 64 Kbytes
<b>POWER REQUIREMENTS</b>	
+ 5 V dc	
Typical .....	0.6 A
Maximum .....	1.1 A
<b>PHYSICAL</b>	
Dimensions .....	4.2" x 4.5"
I/O Connector .....	IEEE-488 Standard 24-pin
Operating Temperature .....	0 °C to +50 °C
Humidity (non-condensing) .....	10% to 85%
Storage Temperature .....	-55 °C to +150 °C



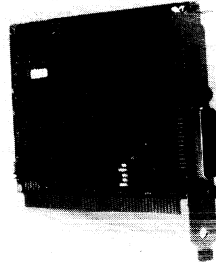
# AT-GPIB

## High Speed Instrumentation Interface Board for IBM-PC/AT



### FEATURES

- Full IEEE-488.2 (GPIB) compatibility
- Uses National Instruments NAT4882 and TURBO488 ASICs
- Data transfer speeds to 1 megabyte/sec
- FIFO Buffers for complete GPIB to PC/AT bus decoupling
- Choice of 11 interrupt lines
- Choice of three 16-bit DMA channels
- Full 16-bit GPIB to PC/AT bus transfers
- FREE Software for complete Talker/Listener/Controller Support



### GENERAL DESCRIPTION

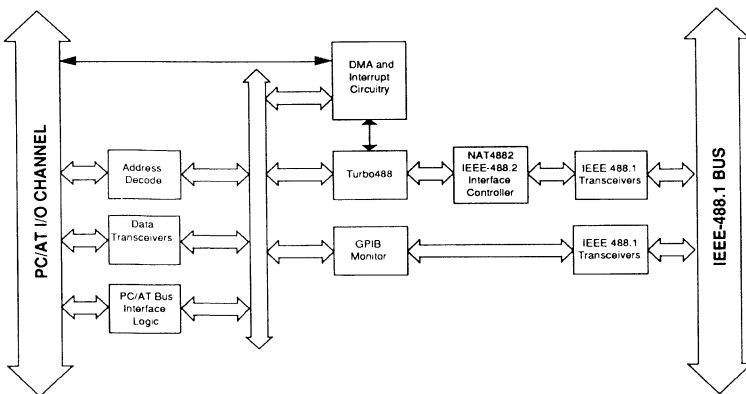
DATEL's AT-GPIB is the high performance IEEE-488.2 champion! It's low cost, full Talker/Listener/Controller support, and very high speed (1 megabyte/sec transfers speed) coupled with FREE software support means virtually anyone can be up and running in minutes. Designed around National Instrument's NAT4882 and Turbo488 ASICs (Application Specific Integrated Circuit), the AT-GPIB is a full function instrumentation interface card conforming to all revisions of the IEEE-488 standard including IEEE 488.2-1987. Full handshake and interface management functions are built directly on the board. On-board monitor and diagnostic circuitry adds flexibility to the AT-GPIB for applications such as testing proper low-level functionality of GPIB compatible instruments.

Used specifically for interfacing IBM-PC/AT personal computers (and compatibles) to the vast array of programmable devices via the General Purpose Interface Bus (often called HP-IB), the AT-GPIB takes full advantage of the PC/AT's 16-bit parallel architecture for extremely high speed data transfers. The emerging popularity of the PC/AT bus for instrumentation interface means you can upgrade now without the worry of obsolescence.

The NAT4882 interface controller performs the basic IEEE-488 Talker/Listener/Controller functions as well as the enhanced Controller functions required by the most recent revision of the IEEE-488 standard. The interface controller is accessed

### APPLICATIONS

- Controller for up to thirteen **Benchtop Instruments**
- Interface to Wide Variety of Scopes, **DMM's, Analyzers**
- **Very High Speed Data Collection**
- **Data Communication Between Local Controller and Remote Instruments**
- **Engineering/Test Bench Data Concentrator**
- **Production/Manufacturing Automation**



### BLOCK DIAGRAM

through the Turbo488 and contains program registers for configuration, control, and monitoring of AT-GPIB IEEE-488 interface functions as well as transferring commands and data to and from other IEEE-488 devices. Operating at a clock speed of 20 MHz, the NAT4882 is the fastest GPIB chip available. It is also software compatible with the NEC uPD7210 and TI 9914A.

The Turbo488 ASIC is a high speed CMOS device that allows sustained data transfers at the maximum specified rate of 1 megabyte/sec for both reads and writes. The Turbo488 increases the performance of data I/O transfers via software (programmed) as well as data transfer via the high speed DMA controller on the PC/AT motherboard. The Turbo488 contains FIFO buffers allowing complete GPIB to PC/AT bus transfer decoupling as well as allowing a 16-bit PC/AT bus interface with byte-to-word packing and unpacking in hardware. The use of these two ASICs significantly increases throughput associated with GPIB driver software. Standard IEEE-488 cables may be used to connect the AT-GPIB with up to thirteen instruments (the on-board diagnostics take up one additional bus load).

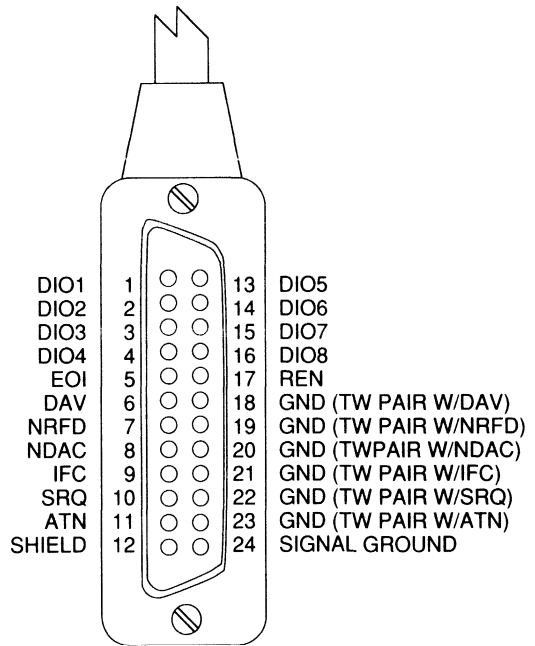
Each AT-GPIB board is supplied with a full set of FREE software drivers including an interactive configuration program, an interactive control program, and diagnostics that are fully compatible with MS-DOS. This package is installed as part of the operating systems and may be accessed from all popular languages including BASICA, Professional BASIC, Microsoft C, and QuickBASIC. Also, a Universal Language Interface (ULI) is included allowing use of standard I/O functions such as BASIC PRINT and INPUT statements to send/receive HP-style commands to and from the driver from most DOS languages and spreadsheets. The AT-GPIB is fully compatible with LabWindows 2.0 (optional) for full menu-driven operation.

**IEEE-488.1 and .2 (GPIB) COMPATIBILITY**

The General Purpose Interface Bus (GPIB) is defined by ANSI/IEEE Standard 488.1-1987 and is often referred to as the IEEE-488 bus (also called HP-IB). It's high speed and very well defined protocol make it extremely popular (and growing) for interfacing programmable devices with computers. The AT-GPIB is compatible with all revision levels of the IEEE-488 standard including IEEE-488.2-1987. The IEEE-488 standard specifies allowable subsets of interface functions. The codes supported by the AT-GPIB are listed in the following table:

CAPABILITY CODE	DESCRIPTION
SH1	Source Handshake
AH1	Acceptor Handshake
T5, TE5	Talker, Extended Talker
L3, LE3	Listener, Extended Listener
SR1	Service Request
PP1, PP2	Local/Remote Parallel Poll
RL1	Remote/Local
C1, C2, C3, C4, C5	Controller
E1, E2	Three-state bus drivers with automatic switch to open collector, during Parallel Poll

**CONNECTOR PINOUT**



**Talker**

The AT-GPIB has all the Talker requirements for an IEEE-488.2 Controller: basic Talker with unaddress if MLA (T5, TE5) as well as supporting optional functionality: respond to a Serial Poll and a Talk-only mode.

**Listener**

The AT-GPIB has all the IEEE-488.2 Listener requirements for receiving device-specific messages: basic Listener with unaddress if MTA (L3, LE3) as well as optional Listen-only capability.

**Controller**

The AT-GPIB has all required IEEE-488.2 Controller function capabilities: System Controller (C1), send IFC and take charge (C2), send REN (C3), respond to SRQ (C4), send interface messages (C5), and take control synchronously (C5). Also implemented are optional functions: receive control (C5), pass control (C5), pass control to self (C5), and parallel poll (C5).

**Passing Control**

The AT-GPIB can pass and receive control and implements the following required functions: C1, C2, C3, C4, C5, T5, TE5.

**Electrical**

The AT-GPIB implements the IEEE-488 required E2 electrical interface. Open-collector drivers drive the SRQ, NTFD, and NDAC signal lines. Tri-state drivers drive the DAV, EOI, ATN, REN, and IFC signal lines. When an IEEE-488 device in a IEEE-488 system is not in Parallel Poll Active State (PPAS), the AT-GPIB uses three-state drivers to drive the DIO1 through 8 signal lines. If an IEEE-488 device in the IEEE-488 system is in Parallel Poll Active State (PPAS), the AT-GPIB uses open-collector drivers to drive the DIO1 through 8 signal lines.

**ADDITIONAL REQUIREMENTS**

The AT-GPIB implements all of the additional IEEE-488.2 requirements including:

- Provide low-level GPIB control for:
  - Pulse IFC TRUE for greater than 100  $\mu$ Sec
  - Set the REN signal line either TRUE or FALSE
  - Send any interface message (singly or combination) defined in IEEE-488
  - Send and detect IEEE-488 END message
- Input and Output all IEEE-488.2 codes, formats, protocols, and commands
- Sense the state of SRQ signal line
- Sense TRUE to FALSE SRQ line transitions
- Examine the status byte on a bit by bit basis
- Detect error conditions of the AT-GPIB attempting to source handshake a byte while all other devices are in AIDS
- Timeout on AT-GPIB-to-device and device-to-AT-GPIB message exchanges

**RECOMMENDATIONS**

The AT-GPIB implements all IEEE-488.2 Controller recommendations including:

- Monitor bus lines - PC/AT monitoring of all bus lines via AT-GPIB circuitry
- Timeouts - Timeout values can be varied via AT-GPIB
- SRQ Interrupts - AT-GPIB interrupt request upon SRQ transition (0 to 1)

**HARDWARE CAPABILITY**

**Address Decode**

The AT-GPIB occupies 32 bytes in the I/O address space of the PC/AT. The base address is set via a 5-gang DIP switch. Decoding is accomplished by matching the address lines on the AT-GPIB to those on the PC/AT I/O channel and enabling reads and writes to the GPIB interface controller (NAT4882) via the Turbo488.

**Data Transceivers**

The AT-GPIB uses the full 16-bit data path of the PC/AT I/O bus. The number of accesses to the AT-GPIB by the controller is effectively halved, thereby substantially increasing data throughput.

**PC/AT Bus Interface Logic**

The AT-GPIB buffers all signals to and from the PC/AT bus to ensure that electrical noise does not affect reliability.

**DMA and Interrupt Logic**

The AT-GPIB requests interrupts from the CPU via one of 11 jumper selectable interrupt request lines. Interrupt request lines 3, 4, 5, 6, 7, 9, 10, 11, 12, 14, or 15 may be selected. Full 16-bit Direct Memory Access (DMA) can be accomplished on DMA channels 5, 6, or 7 (jumper selectable). The AT-GPIB uses PC/AT DMA controller demand-mode transfers vs normal cycle-steal transfers. This allows the maximum IEEE-488 bus specified performance of 1 megabytes/sec.

**SOFTWARE SUPPORT**

Each AT-GPIB is supplied with a FREE software package (NI-488.2 MS-DOS) which includes an MS-DOS handler that has all GPIB Talker/Listener/Controller functions and installs as part of the operating system. This handler may be accessed via all popular languages such as BASICA, Microsoft C, and QuickBASIC.

Besides the free software, the AT-GPIB is supported by LabWindows 2.0 (refer to LabWindows documentation for a complete description).

**SPECIFICATIONS**

(All specifications are typical at 25 °C unless otherwise noted)

<b>CLOCK INPUTS</b>	
Turbo488 Clock.....	20 MHz
NAT4882 Clock.....	20 MHz
<b>IEEE-488 BUS TRANSFER RATES</b>	
Read from GPIB Instrument	
Maximum.....	1 Megabyte/sec
Write to GPIB Instrument,	
Maximum.....	1 Megabyte/sec
GPIB Commands, maximum.....	350 Kbytes/sec
(Actual rates are instrumentation dependant)	
<b>POWER REQUIREMENTS</b>	
+ 5 V dc	
Typical.....	0.66 A
Maximum.....	1.50 A
<b>PHYSICAL</b>	
Dimensions.....	4.2" x 6.5"
I/O Connector.....	IEEE-488 standard 24-pin
Operating Temperature.....	0 °C to +70 °C
Humidity (non-condensing).....	5% to 90%
Storage Temperature.....	-55 °C to +150 °C

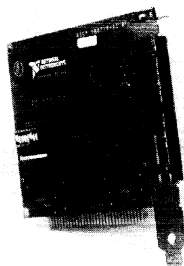
# PC-DIO-24

## 24 Channel Digital I/O Board for IBM-PC/XT/AT



### FEATURES

- 24 parallel (TTL Level) bits in 3 x 8-bit ports
- Update/Transfer Rates to 300 Kbytes/sec maximum
- 100% compatible with LabWindows software package
- Independent bidirectional ports for sense/control applications
- Uses 8255 Programmable Peripheral Interface (PPI)
- Delivery from stock! Very low cost!



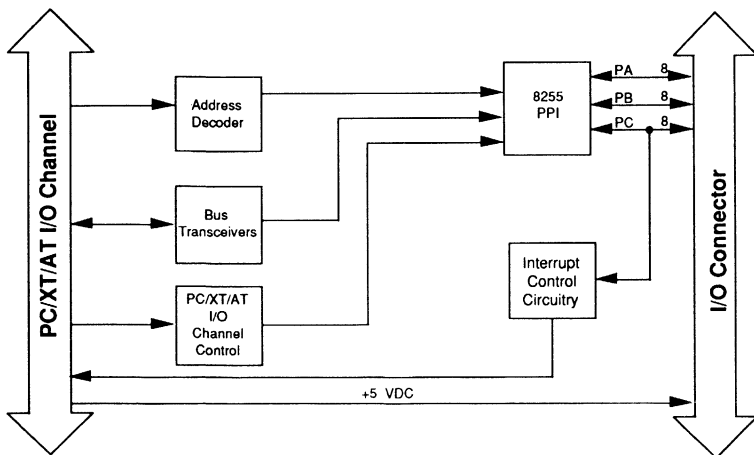
### GENERAL DESCRIPTION

DATEL's PC-DIO-24 is a high performance, low cost 24 channel parallel I/O board for IBM-PC/XT/AT and compatible personal computers. The 24 channels are arranged in 3 x 8-bit ports (using Intel/AMD 8255). Each port may be independently programmed for either input or output for complex, discrete monitoring and control applications often found in industry and research laboratories. The half size board is bus compatible with both the IBM-PC/XT and IBM-PC/AT and provides for periodic interrupt capability via a sophisticated Programmable Interval Timer.

All channel control circuitry including channels latches, address decoding, data buffers, and interface timing and control are built into the PC-DIO-24 so that you need not be concerned with writing complex control software. However, its flexible design allows the experienced programmer direct access to all three (8-bit) ports for direct port manipulation/control. Interrupt requests may be generated via the 8255 on any of six interrupt lines. All input and output data is buffered to and from the CPU via an on-board data transceiver. PC-DIO-24 data

transfer (programmed I/O) is done in 8-bit segments, via the transceiver, at a rate of 300 Kbytes/sec (tested on 8 MHz IBM PC/AT). All lines are TTL compatible with drive current (Darlington) of -4.0 mA (-1.0 mA, minimum). Power consumption is a very low 5V dc (at 0.16 A, typical). All I/O signals (and 5V dc output power) are available at a 50 pin header (with optional, removable ribbon cable and dual screw terminal connector blocks) for easy access.

The PC-DIO-24 is fully compatible with the LabWindows, an auto-code generating, menu-driven software package for data acquisition and analysis. The PC-DIO-24 may also be programmed directly from other languages such as Microsoft C and QuickBASIC, etc. It's compact size, low cost and high performance make the PC-DIO-24 the perfect choice for interfacing to printers, instruments (BCD format), panel meters, and other peripherals as well as high density mixed digital I/O signals, monitoring contact closures, and higher power ON/OFF control schemes when used with solid state relay modules from OPTO 22, P and B, etc.



### APPLICATIONS

- Controller for Centronics Printers
- Interface for Industry Standard Solid State Relay Modules
- High Density Mixed Digital I/O Acquisition/Control Schemes
- BCD Input or Output from Digital Panel Meters, etc.
- High Speed, Digital Test Pattern Generator
- Status Monitor for Contact Closures, Relays, Solenoids, etc.

PC-DIO-24 BLOCK DIAGRAM



**HARDWARE CAPABILITY**

**PC-DIO-24 I/O CONNECTOR**

**Programmable Peripheral Interface (PPI)**

The PC-DIO-24 is designed around a single 8255 PPI consisting of a 24-bit parallel digital I/O lines. The PPI contains 3 x 8-bit parallel ports programmable as either inputs or outputs on a per port basis. Ports A and B are used for byte-wide digital I/O while port C is capable of 4-bit (or 8-bit) I/O and may be used for digital data I/O, control lines, status monitoring, or as handshake lines for external peripherals. The PC-DIO-24 can be programmed for unidirectional or bidirectional I/O.

**Address Decode**

The Base address for the PC-DIO-24 is set via a single 8-gang DIP switch. Address decode circuitry is built in the PC-DIO-24 for direct access to the 8255. This allows easy access to all 8255 functions.

**PC/XT/AT I/O Channel Control**

PC/XT/AT I/O channel control circuitry receives bus signals to control PC-DIO-24 operation. These channel control signals specify the type of bus cycle in progress. Bus cycles can be either memory or I/O, read or write and can transfer 8-bit data.

**Data Transceiver**

All data is buffered to and from the PC bus via a data transceiver. This is an 8-bit wide transceiver that latches data from the PC-DIO-24 to/from the IBM-PC/XT/AT.

**Interrupt Control Circuitry**

Interrupt requests may be generated by the 8255 via lines PC0 or PC3 of the lower 4-bits of Port C for simple, one-shot interrupt requests. One of six interrupt lines may be selected via a 2 x 6 on-board jumper and associated with interrupt enable signals being generated (jumpers) from PC2, PC4, or PC6.

**Signal I/O Connector**

All signals are terminated at a 50-pin male header with optional ribbon cable and screw terminal board for easy signal I/O. Port A is shown in the connector pinout as PA7 through PA0. Ports B and C are similarly designated using PB7 and PC7. Each port may be configured (via software) as either input or output and may be changed at any time. +5V dc from the IBM-PC/XT/AT is also available at pin 49 of the I/O header.

PC7	1	2	GND
PC6	3	4	GND
PC5	5	6	GND
PC4	7	8	GND
PC3	9	10	GND
PC2	11	12	GND
PC1	13	14	GND
PC0	15	16	GND
PB7	17	18	GND
PB6	19	20	GND
PB5	21	22	GND
PB4	23	24	GND
PB3	25	26	GND
PB2	27	28	GND
PB1	29	30	GND
PB0	31	32	GND
PA7	33	34	GND
PA6	35	36	GND
PA5	37	38	GND
PA4	39	40	GND
PA3	41	42	GND
PA2	43	44	GND
PA1	45	46	GND
PA0	47	48	GND
+5V dc	49	50	GND

**SOFTWARE SUPPORT**

The PC-DIO-24 is fully supported by National Instruments LabWindows 2.0. LabWindows is an icon-based set of software tools capable of automatic code generation for virtually any data acquisition and control scheme. Not limited to data collection alone, LabWindows will graphically display your collected data and is available with a (optional) powerful data analysis package supporting a math coprocessor (not required) for FFT, FHT, integration/differentiation, linear equations, Polynomial curve-fitting, Statistics, Butterworth and Chebyshev digital filters, power spectrum analysis, etc.

LabWindows employs Microsoft C and QuickBASIC compatible libraries for maximum speed and versatility. Pull down menus and Icon-based user interface make this package a breeze to use. Also included with LabWindows is an huge library for support of many common industrial/laboratory instruments using RS-232, GPIB, data acquisition boards, etc. LabWindows may also be used as a stand alone data analysis and graphics package for data collected from any source including keyboard entered data.

DATEL also offers a second, low cost, library of functions supporting the PC-DIO-24 from Microsoft C or QuickBASIC. The routines (functions) in PC LabDriver are callable from both of the above languages for simple, fast applications specific programs.

**SPECIFICATIONS**

(All specifications are typical at 25 °C unless otherwise noted)

<b>DIGITAL I/O LINES</b>	
Input Logic (low)	
Minimum.....	0V
Maximum.....	0.8V
Input Logic (high)	
Minimum.....	2.0V
Maximum.....	5.25V
Output Logic (low)	
at 1.7 mA, minimum .....	0V
at 1.7 mA, maximum .....	0.45V
Output Logic (high)	
at -200 $\mu$ A, minimum.....	2.4V
at -200 $\mu$ A, maximum.....	5.0V
Input Load Current	
(0 < Vin < 5V), minimum.....	-10 $\mu$ A
(0 < Vin < 5V), maximum.....	10 $\mu$ A
Darlington Drive Current	
(R ext = 750 Ohms, V ext = 1.5V)	
Minimum .....	-1.0 mA
Maximum .....	-4.0 mA
<b>DATA TRANSFER RATE</b>	
Programmed I/O	
(Using 8 MHz IBM PC/AT) .....	300 Kbytes/sec
<b>POWER CONSUMPTION</b>	
+5V dc, typical.....	0.16 A
<b>PHYSICAL</b>	
Dimensions .....	3.9" x 6.5"
I/O Connector.....	50-pin, male ribbon cable connector
<b>ENVIRONMENTAL</b>	
Operating Temperature.....	0 °C to +70 °C
Humidity (non-condensing) .....	5% to 90%
Storage Temperature .....	-55 °C to +150 °C
Noise Emission .....	FCC Class A verified (shielded ribbon cable)

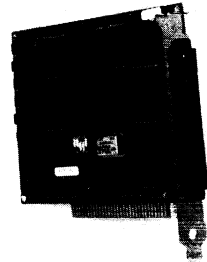


# PC-DIO-96

## 96 Channel Digital I/O Board for IBM-PC/XT/AT

### FEATURES

- 96 parallel (TTL Level) bits in 12 x 8-bit ports
- Programmable interval timer (for up to 6 periodic CPU interrupts)
- Update/Transfer Rates to 460 Kbytes/sec (maximum)
- 100% Compatible with LabWindows Software Package
- Independent bidirectional ports for Sense/Control Applications
- Uses 4 x 8255A programmable peripheral interface ICs
- Delivery from stock! Very low cost!

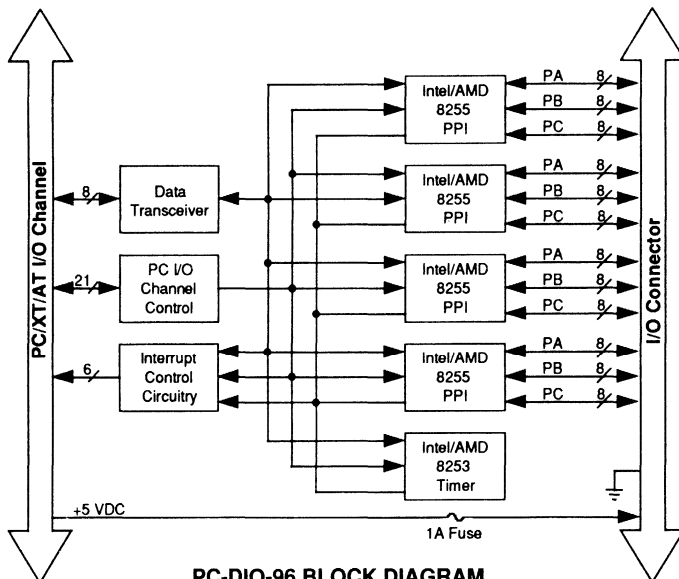


### GENERAL DESCRIPTION

DATEL's PC-DIO-96 is a high performance, low cost 96 channel parallel I/O board for IBM-PC/XT/AT and compatible personal computers. The 96 channels are arranged in 4 x 24-bit ports (using 4 Intel/AMD 8255's) that may be further divided into 12 x 8-bit ports. Each port may be independently programmed for either input or output for complex, discrete monitoring and control applications often found in industry and research laboratories. The half size board is bus compatible with both the IBM-PC/XT and IBM-PC/AT and provides for periodic interrupt capability via a sophisticated Programmable Interval Timer.

design allows the experienced programmer direct access to all 12 (8-bit) ports for direct port manipulation/control. The programmable interval timer may also be accessed for generating periodic interrupt requests (priority level set via jumpers) to the CPU. The 2 MHz clock of the timer may be reduced via 16 or 32-bit dividers allowing interrupt generation from 20  $\mu$ sec to 35 minutes. All input and output data is buffered to and from the CPU via an on-board data transceiver. PC-DIO-96 data transfer (programmed I/O) is done in 8-bit segments, via the transceiver, at a rate of 460 Kbytes/sec (tested on Compaq Systempro 386/33). All lines are TTL compatible with drive current (Darlington) of -4.0 mA (-1.0 mA, minimum). Power consumption is a very low 5V dc (at 0.45A, typical). All I/O signals (and 5V dc output power) are available at a 100 pin header (with optional, removable ribbon cable and dual screw terminal connector blocks) for easy access.

All channel control circuitry including channels latches, address decoding, data buffers and interface timing and control are built into the PC-DIO-96 so that you need not be concerned with writing complex control software. However, it's flexible



### APPLICATIONS

- Controller for Centronics Printers
- Interface for Industry Standard Solid State Relay Modules
- High Density Mixed Digital I/O Acquisition/Control Schemes
- BCD Input or Output from Digital Panel Meters, etc.
- High Speed, Digital Test Pattern Generator
- Status Monitor for Contact Closures, Relays, Solenoids, etc.

The PC-DIO-96 is fully compatible with LabWindows, an auto-code generating, menu-driven software package for data acquisition and analysis. The PC-DIO-96 may also be programmed directly from other languages such as Microsoft C and QuickBASIC, etc.

Its compact size, low cost and high performance make the PC-DIO-96 the perfect choice for interfacing to printers, instruments (BCD format), panel meters, and other peripherals as well as high density mixed digital I/O signals, monitoring contact closures, and higher power ON/OFF control schemes when used with solid state relay modules from OPTO 22, P&B, etc.

## HARDWARE CAPABILITY

### Programmable Peripheral Interface (PPI)

The PC-DIO-96 is designed around four 8255A PPIs consisting of 4 x 24-bit parallel digital I/O lines. Each PPI contains 3 x 8-bit parallel ports programmable as either inputs or outputs on a per port basis. Ports A & B are used for byte-wide digital I/O while port C is capable of 4-bit (or 8-bit) I/O and may be used for digital data I/O, control lines, status monitoring, or as handshake lines for external peripherals. The PC-DIO-96 can be programmed for unidirectional or bidirectional I/O.

### Data Transceiver

All data is buffered to and from the PCbus via a data transceiver. This is an 8-bit wide transceiver that latches data from the PC-DIO-96 to and from the IBM-PC/XT/AT.

### Programmable Interval Timer

The PC-DIO-96 has an on-board programmable interval timer capable of generating periodic interrupts to the computer CPU. The programmable interval timer employs a high speed 8253 counter/timer clocked at 2 MHz to generate the interrupt request. Interrupt priority levels/lines are set via jumper switches on the main board. The output rate of the 8253 is reduced using 16 or 32-bit dividers yielding interrupts request rates from 20  $\mu$ sec to 35 minutes.

### Interrupt Control Circuitry

Interrupt requests may be generated by the 8255A via lines PC0 or PC3 of the lower 4-bits of Port C for one-shot requests or by counter 0 and 1 of the programmable interval timer for repetitive interrupt requests from 20  $\mu$ sec to 35 minutes periods. One of six interrupt request lines may be selected via on-board jumpers and associated with interrupt levels in software. A master enable bit controls interrupt requests in software.

### Signal I/O Connector

All signals are terminated at a 100-pin male header with optional ribbon cable and dual screw terminal boards for easy signal I/O. Port A for each of the 4 PPIs is shown in the connector pinout (below) as xPA7 through xPA0 and designated as A, B, C, or D for the four PPIs. Ports B and C for each PPI are similarly designated using xPB7, xPC7, etc. Each port may be configured via software) as either input or output and may be changed at any time. +5V dc from the IBM-PC/XT/AT is also available via pins 49 and 99 of the I/O header.

## SOFTWARE SUPPORT

The PC-DIO-96 is fully supported by LabWindows 2.0. LabWindows is an icon-based set of software tools capable of automatic code generation for virtually any data acquisition and control board or system. Not limited to data collection alone, LabWindows will graphically display your collected data and is available with a powerful data analysis package supporting a math coprocessor (not required) for FFT, FHT, integration/differentiation, linear equations, Polynomial curve-fitting, Statistics, Butterworth and Chebyshev digital filters, power spectrum analysis, etc.

LabWindows employs Microsoft C and QuickBASIC compatible libraries for maximum speed and versatility. Pull down menus and Icon-based user interface make this package a breeze to use. Also included with LabWindows is an huge library for support of many common industrial/laboratory instruments using RS-232, GPIB, data acquisition boards, etc. LabWindows may also be used as a stand alone data analysis and graphics package for data collected from any source including keyboard entered data.

**SPECIFICATIONS**

**PC-DIO-96 I/O CONNECTOR**

(All specifications are typical at 25 °C unless otherwise noted)

<b>DIGITAL I/O LINES</b>	
Input Logic (low)	
Minimum .....	0V
Maximum .....	0.8V
Input Logic (high)	
Minimum	2.0V
Maximum .....	5.25V
Output Logic (low)	
at 1.7 mA, minimum .....	0V
at 1.7 mA, maximum .....	0.45V
Output Logic (high)	
at -200 μA, minimum.....	2.4V
at -200 μA, maximum.....	5.0V
Input Load Current	
(0 < Vin < 5V), minimum.....	-10 μA
(0 < Vin < 5V), maximum.....	10 μA
Darlington Drive Current	
(R ext = 750 Ohms, V ext = 1.5V)	
Minimum .....	-1.0 mA
Maximum .....	-4.0 mA
<b>DATA TRANSFER RATE</b>	
Programmed I/O	
(Using 8 MHz IBM PC/AT) .....	300 Kbytes/sec
<b>POWER CONSUMPTION</b>	
+5V dc, typical.....	0.16 A
<b>PHYSICAL</b>	
Dimensions .....	3.9" x 6.5"
I/O Connector.....	50-pin, male ribbon cable connector
<b>ENVIRONMENTAL</b>	
Operating Temperature.....	0 °C to +70 °C
Humidity (non-condensing) .....	5% to 90%
Storage Temperature.....	-55 °C to +150 °C
Noise Emission .....	FCC Class A verified (shielded ribbon cable)

APC7	1	51	CPC7
BPC7	2	52	DPC7
APC6	3	53	CPC6
BPC6	4	54	DPC6
APC5	5	55	CPC5
BPC5	6	56	DPC5
APC4	7	57	CPC4
BPC4	8	58	DPC4
APC3	9	59	CPC3
BPC3	10	60	DPC3
APC2	11	61	CPC2
BPC2	12	62	DPC2
APC1	13	63	CPC1
BPC1	14	64	DPC1
APC0	15	65	CPC0
BPC0	16	66	DPC0
APB7	17	67	CPB7
BPB7	18	68	DPB7
APB6	19	69	CPB6
BPB6	20	70	DPB6
APB5	21	71	CPB5
BPB5	22	72	DPB5
APB4	23	73	CPB4
BPB4	24	74	DPB4
APB3	25	75	CPB3
BPB3	26	76	DPB3
APB2	27	77	CPB2
BPB2	28	78	DPB2
APB1	29	79	CPB1
BPB1	30	80	DPB1
APB0	31	81	CPB0
BPB0	32	82	DPB0
APA7	33	83	CPA7
BPA7	34	84	DPA7
APA6	35	85	CPA6
BPA6	36	86	DPA6
APA5	37	87	CPA5
BPA5	38	88	DPA5
APA4	39	89	CPA4
BPA4	40	90	DPA4
APA3	41	91	CPA3
BPA3	42	92	DPA3
APA2	43	93	CPA2
BPA2	44	94	DPA2
APA1	45	95	CPA1
BPA1	46	96	DPA1
APA0	47	97	CPA0
BPA0	48	98	DPA0
+5V	49	99	+5V
GND	50	100	GND

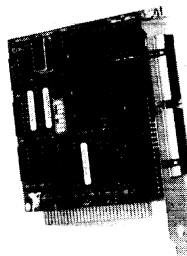
# PC-TIO-10

## 10 Channel Digital I/O Board for IBM-PC/XT/AT



### FEATURES

- 10 parallel (TTL Level) 16-bit counter/timers
- 16 parallel digital I/O lines (bidirectional)
- 2 external interrupt lines
- Counter/Timer rates to 5 MHz
- 100% compatible with LabWindows Software Package
- Delivery from stock! Very low cost!

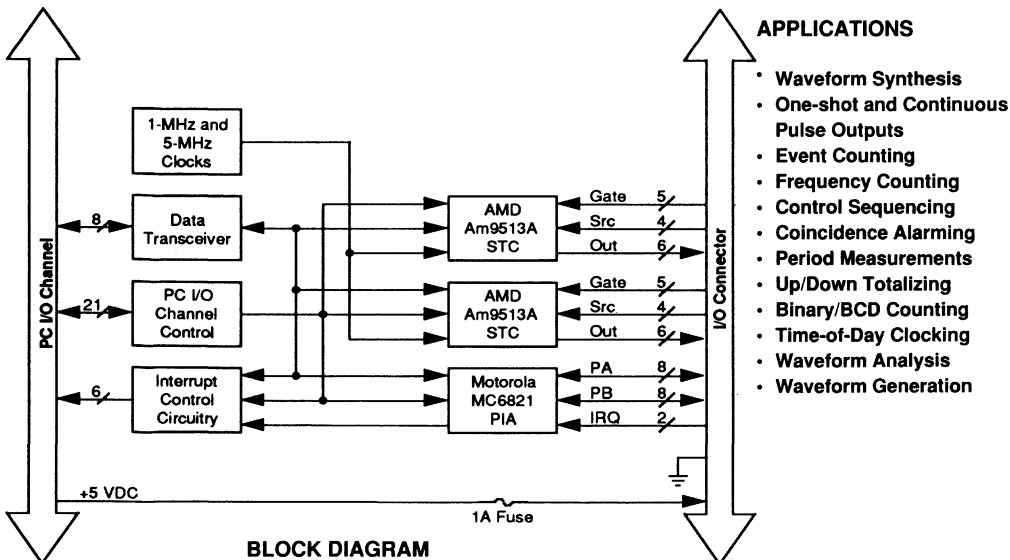


### GENERAL DESCRIPTION

DATEL's PC-TIO-10 is a very high performance, low cost 10 channel Counter/Timer board designed for IBM-PC/XT/AT and compatible personal computers. Each of the 10 input channels are a full 16-bits wide with update speeds to 5 MHz (200 nSec resolution). Additionally, the PC-TIO-10 has 16 bidirectional, parallel digital I/O lines. Designed around two AMD Am9513A System Timing Controller (STC) chips and one MC6821 PIA (Digital I/O), the PC-TIO-10 allows PC/XT/AT interface to a wide variety of applications including waveform synthesis and generation, event counting, pulse generation, frequency counting to 5 MHz, control sequencing, coincidence alarming, period measurements, programmable one-shot or continuous outputs, up/down counting, periodicity analysis, totalizing, and much more. Each Am9513A (5 channels) may be cascaded for a single channel counter or timer of up to 80-bits. The half size board is bus compatible with both the IBM-PC/XT and IBM-PC/AT and provides for periodic interrupt capability via one of six interrupt lines (jumper selectable). The base address of the PC-TIO-10 is set via a single 7-gang DIP switch on the board.

The 16 digital I/O lines may be used for applications such as external control of power supplies and solid state relays as well as simple, byte-wide data I/O and other discrete monitoring and control applications often found in industry and research laboratories. Additionally, port A is configured as a low drive CMOS compatible output while port B is a high drive, totem-pole configuration capable of TTL compatible outputs suitable for SSR and Darlington-type switch control applications.

All channel control circuitry including channels latches, address decoding, data buffers, and interface timing and control are built into the PC-TIO-10 so that you need not be concerned with writing complex control software. However, it's flexible design allows the experienced programmer direct access to many of the functions of each Am9513A STC chip for direct manipulation/control. DATEL also provides a low cost library of functions for programming the PC-TIO-10 from Microsoft C or QuickBASIC. Additionally, we provide several simple



example programs in the User's Manual allowing even the novice programmer immediate access to the PC-TIO-10. National Instruments LabWindows 2.0 may also be used with the PC-TIO-10. A 50-pin header brings all input and output control pins for each counter, 2 interrupt request lines, and +5V dc and GND out to the rear of the IBM PC/XT/AT. An optional, removable ribbon cable and screw terminal connector block is available for signal I/O connections.

**HARDWARE CAPABILITY**

**Am9513A System Timing Controller (STC)**

Two STC's are used on each PC-TIO-10, each of which has 5 x 16-bit Counter/Timer channels. The channels may be cascaded to form two channels of 80-bit counter/timers. These STC's operate in a wide variety of different modes. Each device has a gate, source and output for the 5 x 16-bit counters as well as an independently controlled frequency scaler output for pulse output timing. The main frequency input is connected to a 1 MHz clock allowing count resolutions to 1 µSec. Each counter gate and output is routed to the 50-pin output header. However, only 8 of the counter sources are brought out with the source of counter 5 (from each device) tied to a 5 MHz clock for 200 nSec resolution.

**MC6821 Peripheral Interface Adapter (PIA)**

Each PC-TIO-10 contains a single MC6821 PIA capable of bidirectional data I/O from 2 x 8-bit ports with associated control lines. The individual I/O lines of the 2 x 8-bit ports may be programmed as inputs or outputs and changed at any time. While the two ports are programmed similarly, they are unique in that port A is a low-drive CMOS compatible output while port B is a high drive TTL compatible output suitable for Darlington switch control applications.

**Data Transceiver**

The data transceiver buffers all data between the PC-TIO-10 and the IBM PC/XT/AT I/O channel. All data transfers are byte wide (8-bits).

**I/O Channel Control**

Operational control of the PC-TIO-10 is regulated by the I/O channel control circuitry in conjunction with bus control signals. These bus control signals regulate the type of bus cycle in progress.

Additionally, the I/O channel control circuitry monitors PC/XT/AT address lines for specific PC-TIO-10 address selection. The base address of the PC-TIO-10 is set via an 8-gang DIP switch.

**Interrupt Control**

Interrupt requests are regulated by the interrupt control circuitry via one of two interrupt input lines on the PC-TIO-10. One of six PC/XT/AT interrupt request lines may be selected (jumpers). Interrupt enable bits may be set via software for maximum flexibility.

**I/O Connector**

All signal I/O is accomplished through a 50-pin male header at the rear of the PC-TIO-10. A 50 conductor ribbon cable and screw termination box are also available (optional). The SOURCE<sub>n</sub>, GATE<sub>n</sub>, and OUT<sub>n</sub> (see connector pinout) are the source, gate, and output signals for the respective STCs. The TIRQ1 and EXTIRQ2 are the interrupt input signals for the PC-TIO-10. The An and Bn pins designate the various bits of port A and B. Power from the PC/XT/AT I/O channel is also available on pin 34.

**CONNECTOR PINOUT**

SOURCE 1	1	2	GATE 1
OUT 1	3	4	SOURCE 2
GATE 2	5	6	OUT 2
SOURCE 3	7	8	GATE 3
OUT 3	9	10	SOURCE 4
GATE 4	11	12	OUT 4
GATE 5	13	14	OUT 5
SOURCE 6	15	16	GATE 6
OUT 6	17	18	SOURCE 7
GATE 7	19	20	OUT 7
SOURCE 8	21	22	GATE 8
OUT 8	23	24	SOURCE 9
GATE 9	25	26	OUT 9
GATE 10	27	28	OUT 10
FOUT 1	29	30	FOUT 2
EXTIRQ 1	31	32	EXTIRQ 2
GND	33	34	+5V
A0	35	36	A1
A2	37	38	A3
A4	39	40	A5
A6	41	42	A7
B0	43	44	B1
B2	45	46	B3
B4	47	48	B5
B6	49	50	B7

**SOFTWARE SUPPORT**

DATEL carries a complete line of software support tools for the PC-TIO-10. From a low-cost function (utility routines) library allowing user to write their own application specific routines in Microsoft "C" or QuickBASIC. Additionally, National Instruments LabWindows 2.0 is available from DATEL allowing you to graphically create your own acquisition and control routines without programming (refer to LabWindows documentation for a complete description).

**SPECIFICATIONS**

(All specifications are typical at 25 °C unless otherwise noted)

INPUT/OUTPUT LIMITS	
Counter/Timer I/O	
Input Logic (low)	
Minimum	0V
Maximum	0.8V
Input Logic (high)	
Minimum	2.2V
Maximum	5.25V
Output Logic (low)	
at 3.2 mA, minimum	0V
at 3.2 mA, maximum	0.4V
Output Logic (high)	
at -200 µA, minimum	2.4V
at -200 µA, maximum	5.0V
Input Load Current	
(0 < Vin > 5.25V), minimum	-10 µA
(0 < Vin > 5.25V), maximum	10 µA
DIGITAL I/O LINES	
Input Logic (low)	
Minimum	0V
Maximum	0.8V
Input Logic (high)	
Minimum	2.0V
Maximum	5.25V
Output Logic (low)	
at 3.2 mA, minimum	0V
at 3.2 mA, maximum	0.4V
Output Logic (high)	
at -200 µA, minimum	2.4V
at -200 µA, maximum	5.0V
Port A Input Low	
at 0.4V, maximum	-2.4V
Port A Input High	
at 2.4V, maximum	-200 µA
Port B Input Leakage	
(0.4V to 2.4V)	10 µA
Port B Darlington Drive	
at 1.5V	-1.0 mA to -10.0 mA

TIMING I/O	
Channels 10	(5 channels per STC cascable) 2 Frequency Scaler Outputs
Resolution	16-bits (counters/timers) 4-Bits (Frequency Scaler)
Base Clocks	5 MHz 1 MHz 100 KHz 10 KHz 1 KHz 100 Hz
Clock Accuracy	+0.01%
Signal Compatibility	TTL (inputs and outputs)
Source Frequency, maximum	7 MHz
Source Cycle Time, maximum	145 nSec
Source Pulse Duration, minimum	70 nSec
Gate Pulse Duration, minimum	145 nSec
EXTERNAL INTERRUPTS	
Channels	2
Sensitivity (Software Programmable)	Rising/Falling Edge
Pulse Width, minimum	100 nSec
Compatibility (with 4.7 Kohm Pull-up Resistors)	TTL
POWER CONSUMPTION	
+5V dc	
Typical	0.6 A
PHYSICAL	
Dimensions	3.9" x 4.75"
I/O Connector	50-pin, male ribbon cable connector
ENVIRONMENTAL	
Operating Temperature	0 °C to +70 °C
Humidity (rH non-condensing)	5% to 90%



## FEATURES

- IBM-PC/XT/AT and PS-2 compatible
- Supports DIO-24/96, TIO-10, AT-GPIB, GPIB-II/IIA
- Dramatically cuts programming time
- Automatic code generation (C or QuickBASIC)
- Powerful, full screen graphics
- Complex, sophisticated data analysis
- FFT and wave form analysis
- High speed data throughput
- Extensive IEEE-488, RS-232 support
- ON-line debugging, editing, and execution
- Executes under standard DOS

## GENERAL DESCRIPTION

LabWindows 2.0 is a unique software package allowing interactive, menu-driven program development and automatic code generation for even the most complex data collection, analysis, control, and display applications. Sparkling graphics, high speed data streaming, and complex data analysis routines may be designed and executed with minimal programming!

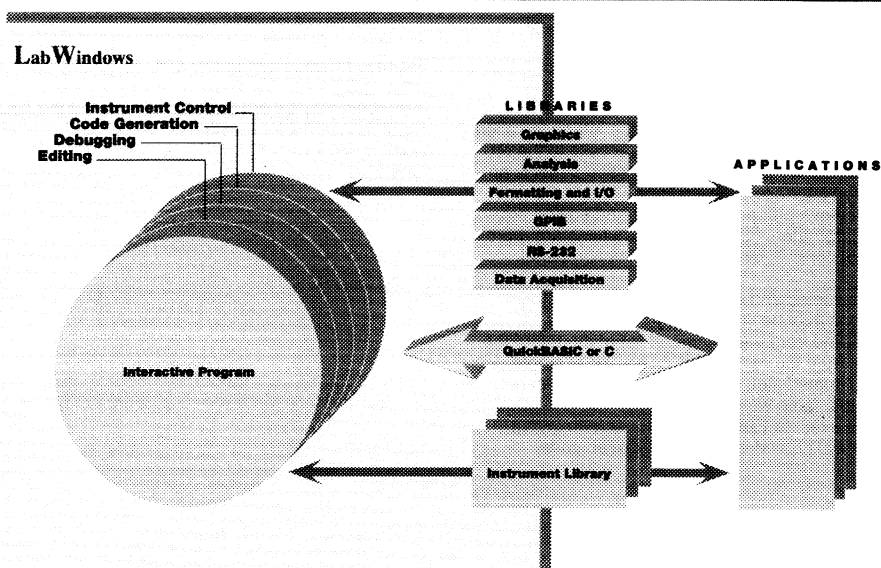
LabWindows 2.0 can perform virtually any data acquisition & control job in a fraction of the time spent developing your own programs. From Fast Fourier Transforms, complex waveform analysis and data capture from boards and instruments to data entered from the keyboard, LabWindows 2.0 saves time and money.

LabWindows is designed using pull down menus for fast, easy point and execute code generation. Also supplied are extensive analysis libraries, full screen graphics and wide support for the digital I/O, counter/timer, and GPIB cards carried by DATEL.

LabWindows is not tied to any specific I/O board or data acquisition subsystem (many of the included libraries use specific boards) so that this one package may be used with existing hardware and future upgrades without compatibility worries. In fact, LabWindows may be used to analyze and display data entered from the keyboard or gathered over your computers serial or GPIB port from other instruments.

## APPLICATIONS

- Complex waveform analysis
- High speed data acquisition and control
- Menu-driven program development
- Multiple order curve-fitting
- Statistics data analysis
- Graphic display of data



## QuickBASIC or C Compatible Programming

LabWindows 2.0 gives you interactive tools allowing development of application programs using a subset of Microsoft QuickBASIC and C programming languages. This allows programs to be developed and executed from LabWindows as well as saving the program modules in ASCII text files for later, stand-alone compilation and execution. As a result, all existing software tools retain their value. The extensive application libraries are included as both executable and object files for linking to your stand-alone application programs. A special screen oriented utility makes linking stand-alone programs as easy as filling in the blanks.

## Editing and Debugging

LabWindows pull down menus and mouse interface gives you easy, direct access to many editing and debugging functions. The editor allows you to cut, copy, paste, move, and search or replace sections of code as needed. Shortcut keystroke combinations are also available for all operations for fast keyboard access to these functions.

Four interactive window areas allow for development and testing of programs you have created. Any two of these windows may be displayed at one time.

- *The Program Window* has a full screen editor for program development and execution.
- *The Interactive Window* is a scratch pad area specifically designed for execution of designated sections of program code.
- *The Standard Input/Output Window* allows you to view data that has been computed or collected by the program as well as input data requested by an executing program.
- *The Error List Window* displays syntax and execution errors found in an executing program.

In the Interactive Mode, your programs execute interpretively allowing you to set breakpoints as well as run the program in a step mode for debugging purposes. The run-time debugger is very flexible and allows for source code level tracing, highlighting of selected portions of code, and code exclusion from compilation. Program variables and data may be viewed and modified on the fly when executing a program under full screen variable and array display options.

## Automatic Code Generation

LabWindows 2.0 is designed around a unique interface called a function panel. This function panel gives access to the entire range of LabWindows libraries. The function panel is an intuitive, full screen interface allowing library function execution without the tedious process of entering and editing program code. All parameters for the library functions are represented by pictorial controls directly on the function panel.

Parameters are selected and entered using these pictorial controls. Functions may be immediately executed by selecting the GO command from the command list at the top of the panel. Functions from the instrument library, for example, may be executed immediately thus verifying instrument response in much the same way that functions from the graphics library may be executed interactively for screen layout without manually writing and editing the required code.

This speeds data capture, analysis, and display time, allowing you to concentrate on the task at hand rather than waiting weeks or even months to set up your application, write the code and finally see the displayed data.

Program code required to perform a specific library function is automatically generated at the bottom of the function panel as the pictorial controls are accessed and manipulated. This code can then be executed, modified, or copied directly into your program by selecting the KEEP command from the command list.

## LabWindows 2.0 Support

LabWindows has two libraries for instrument control functions. One is for full talker, listener and controller support for IEEE-488 (GPIB)-based instrumentation and the other for RS-232 based instruments. The GPIB library includes many IEEE-488 functions including read, write, clear, trigger, status, serial poll, wait for SRQ, and much more.

The incorporated driver supports both the AT-GPIB board for PC/AT machines and the GPIB-II/IIA for PC/XT machines. Both these drivers are powerful and flexible enough to support all GPIB and RS-232 instruments. LabWindows 2.0 allows data transfer from the external GPIB-based instrument to your computer memory for immediate graphic display or mathematical manipulation or to disk files for data logging applications.

The RS-232 library includes functions for performing input and output over multiple RS-232 (including those from DATEL's MCOMM-232 and MCOMM-422 boards) serial ports under interrupt control, including read, read byte, read terminated buffer, write, write byte, read to file, write from file, manage input/output queue, configure port, get port status, set XON/XOFF modes, send break, and set CTS mode.

In addition to the AT-GPIB and GPIB-II/IIA boards, LabWindows supports the PC-DIO-24, PC-DIO-96 (digital I/O cards), and the PC-TIO-10 (counter/timer board) for the PC/XT bus. With the functions in the Data Acquisition Library, all of these boards may be programmed from the function panel by simply selecting the appropriate pictorial controls.

LabWindows GPIB, RS-232 and the Data Acquisition Libraries may be used separately or in conjunction with any of your other programs. Because the library modules are so flexible, programs may be developed that combine the functions of various libraries for creation of "virtual" instrumentation, or each module may be used in a stand-alone mode of operation.

**LabWindows Instrument Library**

The *Instrument Library* has over 50 ready-to-use modules for a wide variety of instruments. Each module is complete and allows immediate communication and data processing from the instrument. Also included are a multitude of modules for communicating with many common GPIB-based instruments.

For example, the function "read.waveform(1, wave)" might access a GPIB-based oscilloscope for a captured waveform on channel 1, read the raw data, convert this data to real numbers, and place the data in an array named "wave". Low level GPIB command syntax and associated overhead is reduced to a single command line that is written for you. Complete TLC capability is achieved with a single module.

Operation is fully transparent so that data may be collected immediately. Since the supplied modules were developed using standard LabWindows tools, you can create your own custom modules for data capture and analysis. This user-extensible feature allows you to create custom modules using a special screen oriented editor resulting in your own function panel user interface.

Once this has been created, you simply write the underlying control code in QuickBASIC or C. The resultant module is then stored in a file that can be either QuickBASIC or C oriented regardless of the language used to develop the function.

**LabWindows Graphics Library**

The *Graphics Library* is a very flexible set of functions designed specifically for data presentation on both screen and hardcopy. Two-dimensional color plots for line, connected point, scatter, and bar charts are available as is real-time graphics (strip charts, numeric plots), linear, log, and semi-log plots.

Single and multiple curve plots are standard with support for both integer and floating point data types are supported. Labeling, scaling, grid type, point style, and color are user selectable. Graphs may be stored and retrieved from disk once created. Multiple, independent viewports may be created with individually defined display attributes.

For example, the plots or waveforms displayed in one viewport may be changed or manipulated without affecting any other port on the screen. Multiple curve fits, connected point plots, scatter charts, and/or bar charts may be created and displayed. Hardcopies may be obtained by dumping the screen to dot-matrix printers, high resolution laser printers, or to GPIB/RS-232 compatible plotters.

**LabWindows Formatting and I/O Library**

Several useful modules for converting data from ASCII (string variables), used by serial and GPIB-based instruments, to numeric format are included as are conversion routines for integer array to real array, screen input/output functions, and file input/output functions. Numeric data may then be passed to the *Analysis and Graphics Libraries* for manipulation. Additionally, special binary data format conversion routines are also included. The *Formatting and I/O Library* also has functions for creating and reading ASCII and binary files in user-defined formats.

**LabWindows Standard Analysis Library**

The *LabWindows Standard Analysis Library* contains modules for array and matrix manipulation, complex mathematics such as logarithmic, exponential, and trigonometric functions as well as powerful statistical functions. One and two dimensional array addition, subtraction, multiplication, division, inversion, linear evaluation, and min/max values are supported. Sub-arrays may be defined and manipulated.

Full support for scalar/1-dimensional complex mathematics and rectangular-to-polar, polar-to-rectangular conversions are standard functions. Machines equipped with a math coprocessor will see enhanced speed and accuracy. If the coprocessor is not installed, LabWindows uses emulation routines for floating point calculations.

**LabWindows Advanced Analysis Library**

In addition to the standard LabWindows Libraries outlined above, an *Advanced Analysis Library* is available. This *Advanced Analysis Library* extends the capability of the *Standard Analysis Library* by adding many powerful analytical and processing functions.

In addition to the *Standard Analysis Library*, the *Advanced Analysis Library* contains functions for Fast Fourier (FFT) and Fast Hartley (FHT) Transforms, numeric integration and differentiation, power spectrum analysis, correlation analysis, digital filters (Butterworth & Chebyshev), RMS calculations, linear equation problem solving capability, polynomial and exponential curve fit, and enhanced statistical functions.

As with all LabWindows Libraries, all functions may be integrated into your application program or may be used in the standalone mode for discrete analysis. Mathematical coprocessor will be implemented, if installed.

**Hardware Requirements**

A minimum system compatible with LabWindows is an IBM-PC/XT/AT (or compatible) or PS/2, a graphics adapter card, MS-DOS operating system, 640K of RAM memory, one hard disk drive, one floppy disk drive. In addition, the following optional equipment may be necessary depending upon application; GPIB interface card (GPIB-II/IIA or AT-GPIB), one or more serial ports, and any digital I/O and counter timer cards (PC-DIO-24/96 & PC-TIO-10), a dot matrix or laser printer or compatible plotter.

LabWindows supports over 150 dot matrix and laser printers including; HP LaserJet/ThinkJet, Epson FX/LQ series, IBM Proprinter, and any HP-GL compatible plotter. LabWindows also supports most popular graphics cards.

**ORDERING INFORMATION**

LabWindows 2.0/5	5 1/4" Diskette
LabWindows 2.0/3	3 1/2" Diskette
LabWindows 2.0/5AA	5 1/4" Diskette w/advanced Analysis Library
LabWindows 2.0/3AA	3 1/2" Diskette w/advanced Analysis Library

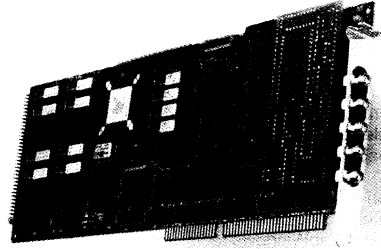
# PC-430

## Very High Speed A/D-DSP Coprocessor Board for IBM-PC/AT



### FEATURES

- Up to 4 MHz A/D sample rate
- Choice of 12 or 14-bit A/D resolution
- 4-Channel Simultaneous Sample/Hold's are optional
- On-board 320C30 32 MHz digital signal processor
- 512 kilobytes dual-ported RAM
- Two 1K x 32 internal DSP RAM
- 8K x 32 expansion RAM
- On-board DSP Library - FFT's, filters, matrix math, floating point, etc.
- Fast, simple, powerful command executive and driver. **No local programming required.**
- DMA and Interrupt to PC/AT host
- Operates with: IBM-PC/AT™ PS-30, EISA computers and compatibles



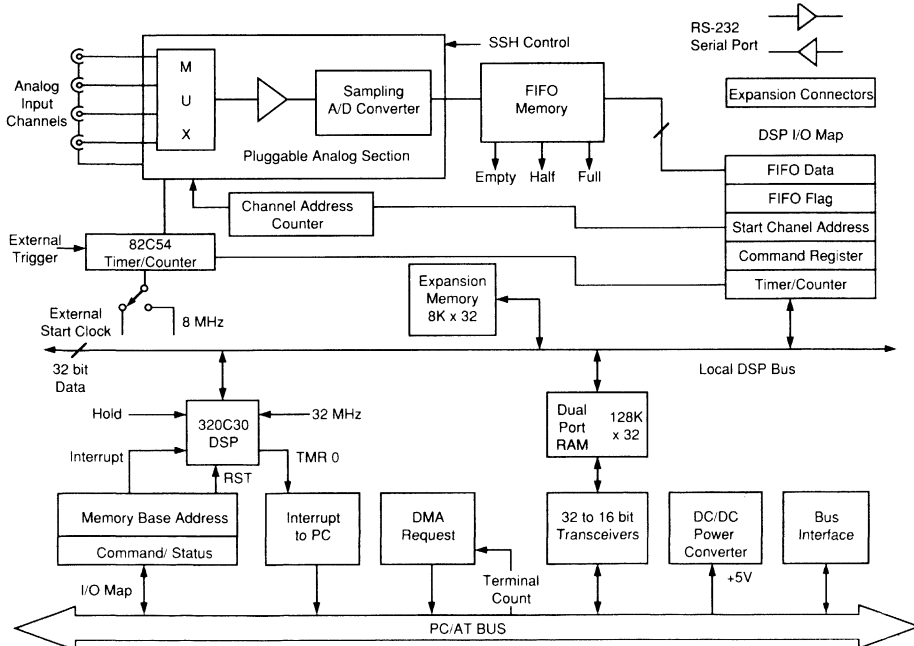
### GENERAL DESCRIPTION

Advanced performance from the PC-430's on-board Digital Signal Processor (DSP) offers a broad range of high speed waveform analysis and recording applications. The PC-430 will acquire up to sixteen analog input channels, digitize them and store them in local memory while DSP math processing and data transfer is done concurrently. The system is intended for preprocessing "seamless" A/D data streams to mass storage.

The PC-430 is ideal for non-stop, continuous Fast Fourier Transform (FFT) processing, communications receiver signal

collection to disk or simultaneous graphics display of spectral data. Application areas include signal recovery from noisy channels, harmonic distortion analyzers and vibration/resonance filtering systems. For use with ultrasonic, sonar or acoustic signals, the interrupt-driven, simultaneous block transfers of data insure no information loss. Other uses include high speed mapping and imaging, satellite channels, astrophysics, seismology, biomedical signals, array processing, control systems, simulators, engine analyzers, aerodynamics, and vehicle systems.

™IBM-PC/AT is trademarked by IBM Corporation



PC-430 Simplified Block Diagram

The board consists of a pluggable analog input subsection, timer-counters, DSP central processing unit (CPU), dual port RAM, local RAM, bus interface, registers and DC power supply. Input signals pass through a very high speed channel multiplexer (except Model PC-430D) to a sampling analog-to-digital (A/D) converter. On Model PC-430A, all four channels are acquired simultaneously by a quad simultaneous sample/hold (SSH) section. A choice of speeds and resolution is offered in the analog section.

A/D triggering for spectral and FFT applications must be precisely controlled. This is handled by a programmable timer-counter section which can control the interval between A/D conversions and the interval between multi-sample A/D scans. The number of samples may also be counted for repeating array sampling. The timer-counter may use an on-board crystal oscillator or an external timebase for precision phase-tracking. The digital output of the A/D passes directly to a first-in, first-out (FIFO) memory. The FIFO acts to decouple the precision timing of the A/D section with the block transfers governed by the DSP internal direct memory access (DMA) controller. Additional timers internal to the DSP are also used.

A/D FIFO data may be sent to dual port random access memory (DPR) shared with the host PC/AT bus. The DPR is organized as 128K by 32 bits. Block transfers may be controlled by the DMA controller in the DSP. The DMA may run in background while math processing continues. Local FIFO and DMA interrupts to the DSP arbitrate these activities. Typically, a swapped dual buffer method is used so that samples are not lost during other processing. Local hardware registers control all A/D, FIFO, and trigger activity.

Single cycle fetch and execution, zero-overhead of looping instructions, software variable wait states, block repeat and an internal instruction cache memory are some of the advanced high speed features of the Texas Instruments 320C30 DSP. The DSP uses 32-bit local data paths for very high speed. Data passed to the host PC/AT bus uses 32-to-16 bit transceivers to the DPR. Simultaneous access attempts to the DPR by both the PC/AT host and the DSP are resolved by high speed arbitration logic. The DSP also has a separate 8K by 32-bit local expansion memory for the stack or temporary data. The architecture of the DSP allows simultaneous processing of two tables from two sections of memory. This provides optimum processing of FFT's and other array functions.

The PC-430 appears as both I/O and memory addresses to the host PC/AT. The I/O base address is selected by on-board switches whereas the memory base address is software programmed through the I/O registers. At power up, the PC-430 appears disconnected from host memory and must be enabled through the I/O registers after writing the memory base address. Since the DPR occupies 512 kilobytes, it will be located in extended memory at 10 0000h or above for most PC's. The PC-430 will operate with 80286, 80386, and 80486 CPU's. The DPR may be addressed up to 16 megabytes.

Access to extended memory is provided in the Executive software package. After loading in the Executive from disk to the DPR, the DSP is transitioned from reset to run using an I/O control bit. The board may be reset at any time or relocated to another memory base address using this technique. The com-

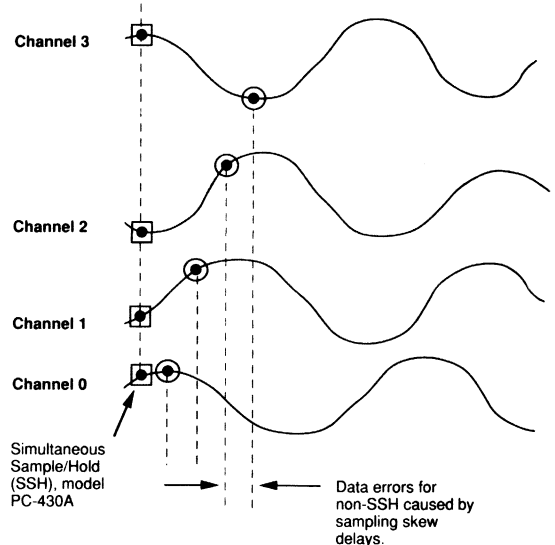
prehensive Executive Software Package offers fast A/D sample collection and DSP math without writing any local programs. A simple, powerful, high speed command list is used to access the local DSP library. The Exec controls very fast buffer transfers to disk or memory using PC bus interrupts generated from the PC-430. Either host DMA or program transfers may be used. Host DMA and interrupt levels are also software programmed from the I/O registers.

Dattel recommends installing the PC-430 in a high quality name-brand host computer. Integrity of bus loading and timing is especially important with high speed boards such as the PC-430.

**Simultaneous Sample/hold**

Four input signals are sampled at the same time using the PC-430's Simultaneous Sample/Hold (SSH) option. Once the signals are acquired, they are rapidly digitized sequentially by the A/D converter. For correlation of phase-related signals, SSH removes skew delay errors from conventional mux scanning.

**PC-430A SIMULTANEOUS SAMPLE/HOLD**



- ◻ DATTEL's SSH DESIGN
- ◉ WITHOUT SSH TECHNOLOGY

<b>FUNCTIONAL SPECIFICATIONS</b> (Typical at +25 °C, dynamic conditions, gain=1, unless noted)			
<b>ANALOG INPUTS</b>			
<b>Number of Channels</b>	4 channels (430A,B,C) 1 channel (430D) 16S/8D channels (430E)		
<b>Input Configuration (A/D)</b>	Single-ended, non-isolated Models PC-430A, PC-430B, PC-430C and PC-430D. The model PC-430E has 16S or 8 differential channels.		
<b>Full Scale Input Ranges</b>	0 to +10V ±10V	±5V	±1.25V
(user-selectable) 430A [gain = 1] 430B 430C 430D 430E	✓ ✓ ✓ - ✓	- ✓ ✓ - ✓	- - - ✓ -
<b>Programmable Gains</b> (Model PC-430A only)	Programmable gain of 10 is selectable on 2 channels; 0 to +1V, ±1V [See Tech. Note 1]		
<b>Input Impedance</b> [See Tech. Note 2]	10 Megohm, min. power on		
<b>Input Bias Current</b>	±1 nA		
<b>Input Capacitance</b>	10 pF per channel		
<b>Input Overvoltage</b>	± 15 V (no damage)		
<b>O.V. Recovery Time</b>	2 microseconds max.		
<b>Common Mode Volt. Range</b>	±10V Max. (PC-430E)		
<b>Common Mode Rejection</b> (dc to 60 Hz )	-80 dB (PC-430E)		
<b>Addressing Modes</b>	1. Single channel 2. Simultaneous Sample/Hold 3. Sequential with autosequenced addressing 4. Random addressing by host software		
<b>SAMPLE/HOLD</b>			
<b>Acquisition Time</b> (FSR step)	750 nS max. (430A,E,B)		
<b>Aperture Delay</b>	200 nS max. (430C) 50 nS max. (430D) 6 nS (430A,E) 30 nS (430B,C, E) 10 nS (430D)		
<b>Aperture Delay Uncertainty</b>	±1 nS (430A) ±5 nS (430B,C,E) ±10 nS (430D)		
<b>Droop Rate</b>	1 μV/μS		
<b>SSH Channel-to-Channel Linearity Tracking</b>	± 0.03% (430A only)		
<b>A/D CONVERTER</b>			
<b>Resolution</b>	12 bits (430A,C,D,E) 14 bits (430B)		
<b>Conversion Period</b> (A/D and S/H)	500 nanoseconds (430A) 1 microsecond (430B,C,E) 200 nanoseconds (430D)		

<b>A/D CONVERTER</b>	
<b>Output Coding</b>	Positive-true right-justified straight binary (unipolar) or right-justified two's complement (bipolar) with sign extension through bit 15.
<b>Trigger Sources</b> (Software selectable)	1. Local Pacer sample clock 2. External TTL sample clock
<b>TOTAL SYSTEM CHARACTERISTICS</b>	
[See Tech. Note 3] <b>Integral Non-linearity</b>	±1 LSB of FSR (430A,C,E) ±1.5 LSB of FSR (430B, D) ± 0.75 LSB of FSR (430A,C,E)
<b>Differential Non-linearity</b>	± 1 LSB of FSR (430B, D) ±0.1 LSB per °C (430A,C,D,E)
<b>Full Scale Temperature Coefficient</b>	±0.3 LSB per °C (430B) ±0.1 LSB per °C (430A,C,D, E)
<b>Zero or Offset Temperature Coefficient</b>	±0.3 LSB per °C (430B) ±0.1 LSB per °C (430A,C,D, E)
<b>Power Supply Rejection</b>	±0.004% per % of bus +5V
<b>A/D MEMORY</b>	
<b>Architecture</b>	First-In, First-Out (FIFO)
<b>Memory Capacity</b>	1024 A/D samples, standard. Up to 4096 A/D samples (optional).
<b>TOTAL SYSTEM DYNAMIC PERFORMANCE</b>	
<b>System Bandwidth</b> (single channel, half-scale input, to rated specifications)	1 MHz (430A,C,E) 200 KHz (430B) 2.5 MHz (430D)
<b>Total Throughput to FIFO</b> (single channel, gain=1)	700 nanoseconds (430A) 2 microseconds (430B,E) 1 microsecond (430C) 250 nS (430D)
<b>Throughput to FIFO per A/D sample</b> (sequential channels, gain = 1) [See Tech. Note 5]	1 microsecond (430A) 3 microseconds (430B) 2 microseconds (430C) 4 microseconds (430E)
<b>Throughput to FIFO</b> (sequential channels, gain = 10)	10 microseconds (430A)
<b>Total Harmonic Distortion</b> [See Tech. Note 6]	-72 dB (430A,C,E) -75 dB (430B) -68 dB (430D)
<b>TRIGGER CONTROL</b>	
<b>Programmable Timer/Counter Type Functions</b>	82C54  1. EOC sample count 2. A/D start rate (16 bit divisor) 3. Scan trigger rate (16 bit divisor)
<b>Pacer Sample Counter</b>	1 to 65,536 samples. Drives the Acquire flag/interrupt gate for A/D start pulses.
<b>Clock Source</b> Internal External	1. 8 MHz crystal clock 2. TTL input, user-selectable

<b>PC/AT-BUS INTERFACE</b>	
<b>Architecture</b>	I/O and memory mapped, for IBM-PC/AT, PS-30, EISA bus and compatibles.
<b>I/O Mapping</b>	Decodes two 8-bit I/O registers. Decodes I/O address lines A9-A2. 3F0H maximum.
<b>Data Transfer</b>	Memory block transfer or host DMA, software selectable.
<b>Data Bus</b>	16 bits.
<b>Direct Memory Access</b>	1 channel, selectable on channels 5, 6 or 7
<b>DMA Request Conditions (software selectable)</b>	FIFO full, half full, not empty, scan acquire flag (sample count) or user programmable.
<b>Control/Status Functions</b>	Board reset, FIFO flags, interrupt select and status, DMA select and status, trigger source, timer control and period, sample count load, A/D enable, MUX auto-sequence, DSP hold/ack, DPR enbl/dsbl.
<b>Number of Interrupts</b>	1 interrupt, selectable on levels 7, 9 thru 12, or 15.
<b>Bus Interrupt Sources</b>	DSP interrupt request to PC or DMA terminal count from bus.
<b>LOCAL MICROCOMPUTER</b>	
<b>CPU Type</b>	TI TMS 320C30 with internal DMA.
<b>Local Data Bus</b>	32 bits
<b>CPU Clock Speed</b>	32.000 MHz
<b>Local DMA Controller</b>	Internal to 320C30 CPU
<b>Primary Memory (Dual ported to PC/AT)</b>	128K x 32 static RAM
<b>Expansion Memory</b>	8K x 32 static RAM
<b>Internal DSP Memory</b>	Two 1K x 32
<b>Dual Port Access</b>	Hold mode by control bit or from PC/AT dynamic hold per each access.
<b>CPU Test Port</b>	Supports TI XDS1000 Extended Development System.
<b>Local Interrupts</b>	Int 0-3 from PC host request, A/D FIFO or acquire flags or optional external interrupt.
<b>MISCELLANEOUS</b>	
<b>Analog Section Modularity</b>	The MUX-S/H-A/D module is socketed for function interchange.
<b>Analog Section Adjustments</b>	Offset and gain per channel for SSH on PC-430A. A single offset and gain pot is provided on PC-430B, C, D, and E.
<b>Analog Input Connectors</b>	Four miniature threaded coaxial, type SMA, mounted on rear slot.
<b>Trigger Connector</b>	5th SMA for external TTL trigger.
<b>I/O Expansion Port, P2</b>	Dual-row header connector for 320C30 I/O (unbuffered).
<b>Memory Expansion Port, P3</b>	Dual-row header connector for 320C30 memory (unbuffered).

<b>MISCELLANEOUS (continued)</b>	
<b>Serial Port and External Trigger/Pacer Clock, P1</b>	Two serial channels, Compatible to 320C30 serial ports. Both scan (Trigger) and A/D sample (Pacer) clocks are accepted at connector.
<b>RS-232-C Serial Port</b>	Dual-row header. 3 header pins. Uses software UART.
<b>Operating Temp. Range</b>	0 °C to +60 °C
<b>Storage Temp. Range</b>	-25 °C to +85 °C
<b>Humidity</b>	10% to 90%, non-condensing
<b>Altitude</b>	0 to 10,000 feet. Forced cooling is recommended.
<b>Power Required</b>	+5V dc at 3.5 Amps maximum from AT bus.
<b>Outline Dimensions</b>	4.2 x 13.2 inches, compatible to PC/AT bus.

**TECHNICAL NOTES**

- [1] Resistor-programmed gain from x1 to x100 is available on PC-430E with increased settling delay at higher gain.
- [2] The input impedance of 10 megohms minimum avoids attenuation errors from external input source resistance. For many applications, an inline coaxial 50Ω shunt, inserted adjacent to the front connectors, is recommended to reduce line reflections and standing wave errors.
- [3] Allow 20 minutes warmup time to rated specifications for model PC-430B.
- [4] Total throughput includes MUX settling time after changing the channel address, S/H acquisition time to rated specifications, A/D conversion and FIFO transfer. Total throughput is not delayed by host software whenever the FIFO is not full.
- [5] The rates shown for sequential sampling are the maximum A/D converter start rates and include MUX sequencing and settling. For example, if four channels of the PC-430C were scanned, the maximum sample rate on any one channel would be 2 microseconds X 4 channels = 8 microseconds (125 KHz per channel).
- [6] THD test conditions are:
  - 1. Input frequency:
    - 500 KHz (PC-430A)
    - 200 KHz (PC-430B, and PC-430E)
    - 300 KHz (PC-430C)
    - 1 MHz (PC-430D)
  - 2. Generator/filter THD is -90 dB minimum.
  - 3. THD computed by FFT to 5th harmonic.
$$THD = 20 * \log_{10} \frac{(V2^2 + V3^2 + V4^2 + V5^2)^{0.5}}{V_{IN}}$$
  - 4. Inputs are 1/2 full scale. No channel advance.
  - 5. A/D trigger rate:
    - 1.5 MHz (PC-430A)
    - 500 KHz (PC-430B, PC-430C, and PC-430E)
    - 4 MHz (PC-430D)

**PC-430 Software**

The PC-430 system has been designed to optimize three competing objectives:

- Easy to use (no local programming)
- Fast
- Powerful (access to full DSP library)

To achieve these mutually exclusive goals, a high speed command list form of control is used. The Application Function Block (AFB) is a short list calling local library functions. No local programming is needed. The user writes the AFB file with any text editor and it is then converted on the PC side to an internal binary form. The converted AFB is then downloaded to PC-430 Dual Port Ram(DPR) and executed. The AFB is powerful because of full access to the local DSP library and because repeating functions may be looped. These loops in turn may be nested. Loops can run with a loop count or "forever" until stopped.

Unlike a slow ASCII interpreter, the AFB runs at the full speed of the 320C30 DSP with minimal overhead. And to accept fast A/D's without sample loss, only a fully integrated hardware/software system will handle the bandwidth. This hardware system consists of local FIFO A/D memory, local FIFO interrupts and a local Direct Memory Access (DMA) controller inside the DSP which runs in background. FIFO interrupts cause DMA data block transfers while the DSP continues foreground processing.

**Executive Package**

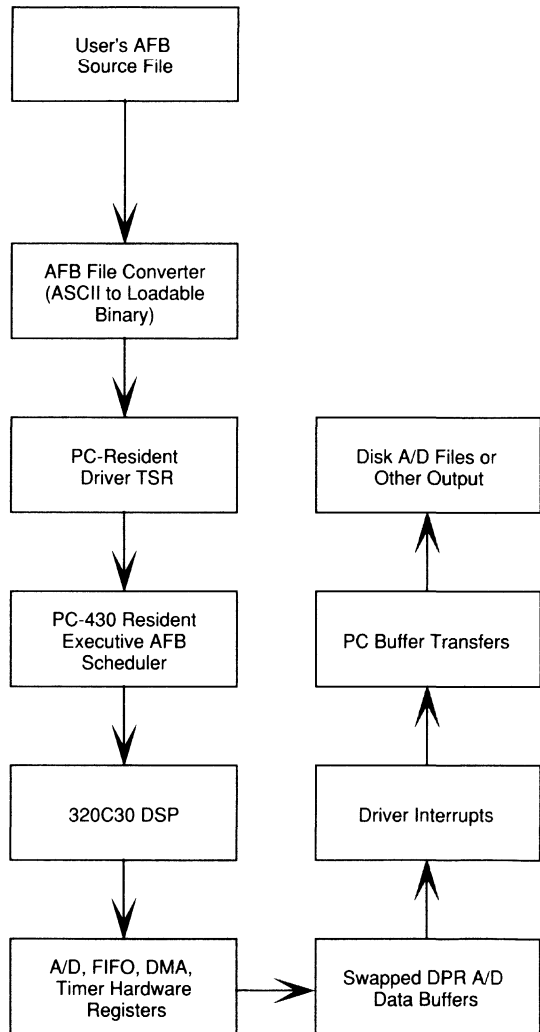
The complete Executive Software Package is an integrated environment for full control of the PC-430. It includes programs which run on both the host PC and the PC-430. The Executive Software Package consists of:

- The AFB ASCII to binary file converter (AFBCNVRT)
- A small menu shell
- The PC Host Terminate-and-Stay-Resident (TSR) Driver
- The Executive scheduler, DSP library, boot code, vectors, and full local PC-430 system.

To use this environment, the user simply converts the AFB text file to a binary file, downloads this to the PC-430 through the Driver and retrieves data files.

**Software Hierarchy**

The relationship between software in the PC host and in the PC-430 is illustrated in this diagram. Control flows downward from the user's AFB and A/D data flows upward.





**Library Functions**

The following functions are downloaded at power up by the Driver to the PC-430 DPR and form the resident on-board DSP library. They may be called from the DPR by including them in the user's downloaded AFB.

**A/D Scan Routines**

initad	Initialize the start channel address.
inittim0	Initialize timer 0
inittim1	Initialize timer 1
inittim2	Initialize timer 2
sadtsc	Select internal or external A/D trigger source.
sadcr	Select the A/D internal conversion rate.
sstr	Select the internal scan trigger rate.
sadspc	Select the number of A/D samples.
stads	Set the total number of A/D samples under 65K. (For 65K or greater, refer to the special techniques.)
stfoi	Enable or disable local FIFO interrupts.
sadr	Enable or disable A/D conversions.
rfifo	Reset FIFO.
calad	Calibrate A/D single samples.
fifoisr	FIFO local interrupt service routine.
scommreg	Set A/D command register.

**PC-430 I/O Registers**

I/O Address	Direction	Function
I/O BASE + 0	Write Read	PC Command Register PC Status Register
I/O BASE + 2	Write Read	Memory Base Address Not Used

**Command Register  
(Write I/O BASE + 0)**

- PC Interrupt Level Enable [Bits 2 - 0]
- DMA Enable/Disable [Bits 4, 3]
- DSP Interrupt Request [Bit 5]
- DSP Hold Request [Bit 6]
- DSP Reset/Run [Bit 7]
- [Bits 15 - 8 Are Not Used].

**DSP Array Routines**

fir	Do FIR filter on array with user-supplied coefficients.
iir	Do IIR filter on array with user-supplied coefficients.
linfir	Convolution on linear array.
cirfir	Convolution on circular array.
windham, windhan	Multiply a Hamming or Hanning window with signal data array.
windrec	Multiply a rectangular window with a signal data array.
windblh	Multiply a Blackman-Harris window with signal data array.
windrco	Multiply a Raised Cosine window with signal data array.
cfftc	Do complex Fast Fourier Transform (FFT) on array.
fft	Do real FFT on array.
bitrev	Generate complex array of bit-reversed twiddle factors.
twiddle_r	Generate array of twiddles for real FFT.
dct	Do Discrete Cosine Transform on array (for signal compression).
magfft	Calculate magnitude of real FFT array.
dbfft	Performs log10 on FFT array to prepare data for graphic display.
call sine, call cos	Generate sine or cosine arrays.
call const	Fill array with constant.

**Status Register  
(Read I/O BASE + 0)**

- Bits 5 - 0 and 15 - 8 are not used.
- DMA Terminal Count Status [Bit 6]
- DSP Hold Acknowledge [Bit 7]

**Memory Base Address Register  
(Write Only to I/O BASE + 2)**

- Bits 1, 0 and 15 - 8 are not used.
- Memory Enable/Disable [Bit 2]
- BASE Address, LA23 - 19 [Bits 7 - 3]

## Array Transcendentals

The 320C30 DSP uses an internal 32-bit floating point format which is optimized for hardware speed.

ieeedsp	Convert IEEE-754 floating point array to 320 format.
dspiieee	Convert 320 array to IEEE-754 floating point format.
matadd	Doubleword matrix addition on array.
matmul	Doubleword matrix multiplication on array.
hstgrm	Histogram of doubleword array.
int2flt	Convert doubleword integer array to 320 floating point.
sign_extend	Extends polarity bit from 15 to 31.

## Single Variable Transcendentals

sine, cosine, tangent  
 hyperbolic sine, cosine, tangent  
 inverse sine, cosine, tangent  
 square root, powers, exponential  
 natural logarithm, Base10 logarithm

These functions are available in the TI "C" compiler library.

## Buffer Management

defsbuff, defdbuff	Define single and double buffers.
set ibuf, set obuf	Setup input and output double buffers. Post current buffer addresses in Exec status area. Used for non-stop A/D filling without sample loss.
unrav2, unrav4	Separate one array of sequential multichannel data into two or four single channel arrays.
concat	Compress an array of one A/D sample per 32-bit longword into an array of contiguous 16-bit A/D words. Concat forms a single 32-bit longword from the 16-bit LSB's of two longwords. MSB's are discarded.
switch_buffers	Swap double buffers.
ibuf_ready ibuf_release	Input buffer transfer handshakes.

dprxfer	Do block transfers within PC-430 local memory between buffers using buffer numbers.
addxfer	Do block transfers within PC-430 local memory between absolute addresses. Overlapped transfers will preserve data.
int2pc	Send buffer ready or local timer interrupt to PC.

## PC-resident Driver

The final portion of the full Executive package is the Driver containing a library of functions to control the PC-430. This is a Terminate-and-Stay-Resident (TSR) program which is loaded into the PC Host, and offers a simple menu to control the PC-430. No programming is required. A brief Help function is available. Since the Driver remains resident, its functions may be used through the menu shell or may be controlled by a user's program after exiting from the Driver.

The Driver functions are:

- Install PC Interrupt Service Routine (ISR) to respond to PC-430 buffer full flags.
- Initialize the PC interrupt and DMA systems.
- Set the PC-430 extended memory base address and test memory.
- Download the Exec, library and full local system to the PC-430 DPR from a system binary file.
- Boot the local PC-430 system and confirm.
- Allocate a PC Host buffer to receive PC-430 data.
- Download a converted AFB file and start execution.
- Collect data to buffer or disk using swapped double buffer interrupts. (Extended memory block transfers to a user-defined buffer may also be called from a user's host program.)
- Stop the AFB and save the PC-430 data buffer to a file.
- Load and run a user COFF object file.
- Run the Monitor/Debugger.
- Calibrate the A/D. Halt and reset the DSP. Quit to DOS.
- Deallocate Driver TSR

**Resident Debugger/Monitor**

For users who prefer more direct control of the PC-430 instead of the AFB, optional user programs written in TI "C" or 320C30 assembly language may be run after downloading from the host. Once debugged, local executable code may be loaded into a PROM which replaces some of the on-board RAM. Or the user may simply retain the download method.

An integrated windowed package consisting of the Debugger (on the PC-430 side) and the Monitor (on the host PC side) offers the following functions:

- Load TI COFF-format object file.
- Display or modify memory (in hex, decimal integer, ASCII, or TI/IEEE floating point).
- Display or modify CPU registers.
- Disassemble memory.
- View file.
- Set, display, or remove breakpoints.
- Go from address until optional breakpoint.
- Single Step DSP, Halt/reset DSP, Block fill.
- Shell out to DOS, Quit to DOS.

**AFB Source File Format**

The AFB source format uses symbolic names for internal PC-430 library functions. The C-like file may be written in free form with the user's choice of loop nesting indentation, skipped lines, etc. Comments after the function name delimiter are ignored. After the user writes the AFB, the AFBCNVRT file converter prepares a binary output file which is subsequently downloaded through the Driver for execution.

Here is an AFB example which defines buffers, generates a sine wave, then prepares an FFT array for floating point output:

```

DEFDBUF,           ;function to define double buffer
  0x0L,            ;starting buffer number
  0x400L,          ;buffer length
  0x200L,          ;alignment

DEFSBUF,           ;define single buffer
  0x2L,            ;buffer number
  0x100L,          ;buffer length
  0x100L,          ;alignment

TWIDDLE_R,        ;generate twiddle factors
  0x2L,            ;buffer number 2

BEGIN,             ;begin flag
  FOREVER          ;-1 = loop forever flag

CALL_SINE,         ;fill buffer with sine array
  0x00000000L,    ;buffer number 0
  0x00000020L,    ;period of the sine wave

FFT,               ;do FFT on buffer
  0x0L,            ;buffer number 0
  0x200L,          ;number of points
  0x9L,            ;Log 2 of number of points
  0x2L,            ;buffer for twiddle factors

MAGFFT,            ;take magnitude of FFT data
  0x0L,            ;buffer number 0
  0x200L,          ;FFT size

DSPIEEE,           ;convert to IEEE format
  0x0L,            ;buffer number 0
  0x100L,          ;buffer length

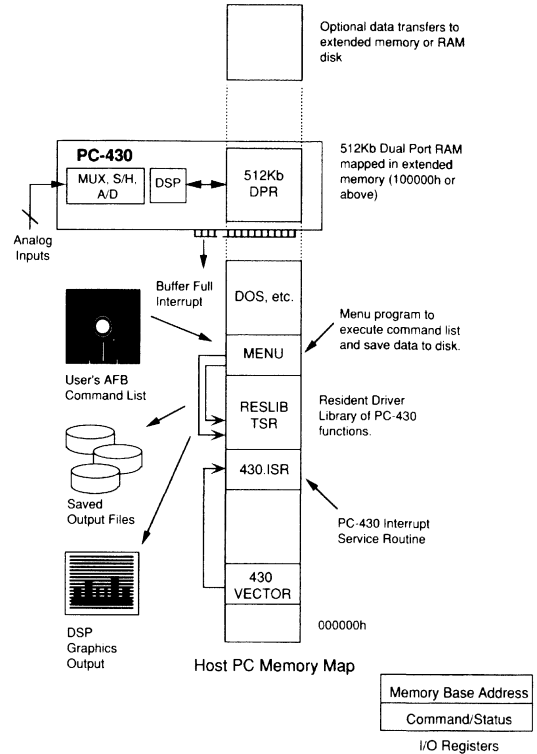
SET_OBUF,         ;signal to PC that buffer is ready
  0x0L,            ;buffer 0
  0x100L,          ;buffer length

END                ;end flag for this loop
    
```

**PC-430 Host System Architecture**

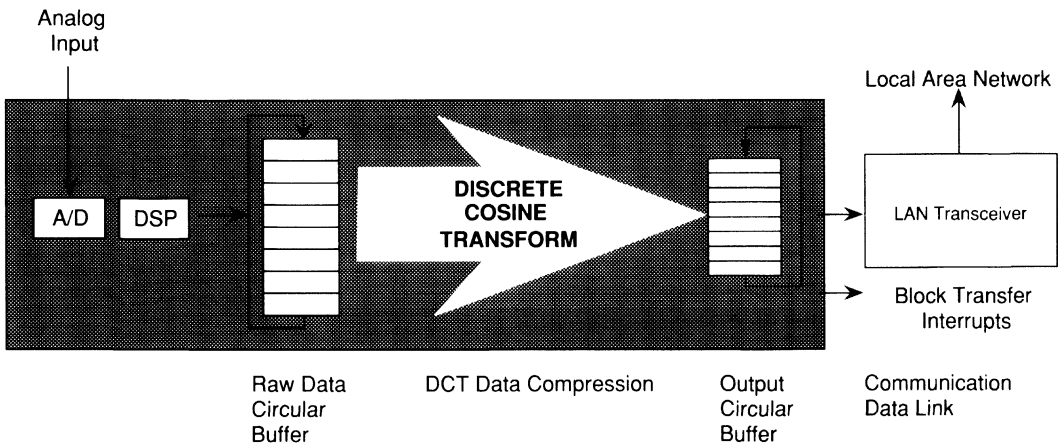
When the PC-430 is fully installed, the host PC memory map contains the resident library, the Interrupt Service Routine, a small menu program and the PC-430's dual port RAM. These systems all work together to provide fast disk or buffer transfers of DSP'd A/D data. The entire system is controlled by simple user-written command files.

**PC-430 Host System Architecture**



**High Speed A/D Data Compression For Communications Link Transmission**

Capture of high frequency multi-channel A/D data requires huge memory arrays. Retransmission of that data in real time with limited-bandwidth communications links needs reduction of data on the fly. Using the PC-430's resident functions, raw A/D data may be compressed before assembling in link packets.

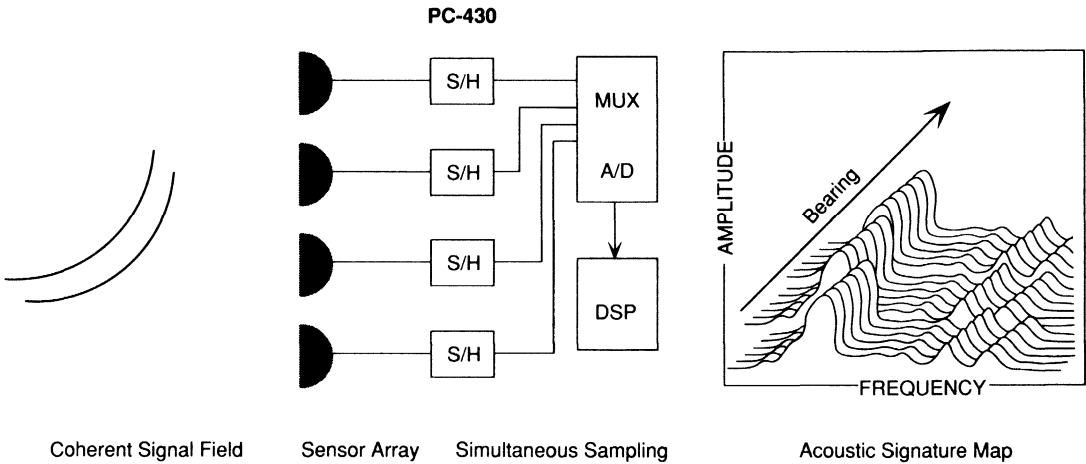


**High Speed A/D Data Compression for Data Link Transmission**

**Phased Array Spectral Mapper/tracker**

The PC-430's unique simultaneous sample/hold facility allows signals to be captured without phase errors. The on-board DSP library then provides functions to compute the spectral content of coherent signals. Cross-channel phase delay comparison may then determine the relative

bearings of those signals. By reference to a table of spectral signatures, distant emitters may then be tracked while other frequencies are rejected. The resulting output arrays may be plotted by the host PC's color graphics system.



**Phased Array Spectral Mapper/Tracker**

ORDERING GUIDE						
Model	A/D Bits	FIFO Size (Samples)	Channels	Sample Rate Single Channel	Simultaneous Sample/Hold	PGA
PC-430A1	12	1K	4	1.5 MHz	4 channels	x1,x10
A2		4K				
PC-430B1	14	1K	4	500 KHz	none	none
B2		4K				
PC-430C1	12	1K	4	1 MHz	none	none
C2		4K				
PC-430D1	12	1K	1	4 MHz	none	none
D2		4K				
PC-430E1	12	1K	16S/8D	250 KHz (scan)	none	x1 to x100
E2		4K		500 KHz (1 channel)		(Resistor select)

Each board is power-cycle burned-in, tested and calibrated. All models include a user's manual. The warranty period is one year.

**Software:**

PC-430EXEC Executive, driver, and command converter program, 3.5" and 5.25" MS-DOS disks

PC-430BUG Monitor/Debugger, MS-DOS disks

Contact Datel about fully integrated control/store/display software.

61-7342340 SMA male to BNC male coaxial cable, 1 meter length (1 cable required per channel)

## **Contact DATEL for:**

- **Panel Meters, Printers, & Calibrators**
- **Data Acquisition & Control Boards**
- **Data Conversion Components**
- **Power Supplies**

**Dial  
1-800-233-2765  
for  
Immediate Assistance**

**Advanced  
Technology  
A/D Converter  
Components  
Summary Tables**

## SAMPLING A/D CONVERTERS

	Model	Resolution (Bits)	Throughput (MHz)	Linearity Error (Max)	Power Watts (Max)	Case
	<b>ADC-HS12B</b>	12	0.066	±3/4 LSB	1.8	32-Pin DIP
	<b>ADS-111</b>	12	0.500	±3/4 LSB	1.8	24-Pin DIP
	<b>ADS-112</b>	12	1.0	±3/4 LSB	1.7	24-Pin DIP
	<b>ADS-193</b>	12	1.0	±3/4 LSB	1.7	40-Pin DIP
	<b>ADS-21PC</b>	12	1.3	±1 LSB	2.5	46-Pin DIP
	<b>ADS-132</b>	12	2.0	±3/4 LSB	3.2	32-Pin DIP
<i>Preliminary</i>	<b>ADS-117</b>	12	2.0	±3/4 LSB	1.8	24-Pin DIP
<i>Preliminary</i>	<b>ADS-118</b>	12	5.0	±1 LSB	2.5	24-Pin DIP
	<b>ADS-131</b>	12	5.0	±1 LSB	4.0	40-Pin DIP
	<b>ADS-130</b>	12	10.0	±1 LSB	4.2	40-Pin DIP
<i>Advanced</i>	<b>ADS-120</b>	12	20.0	±1 LSB	4.2	40-Pin DIP
	<b>ADS-924</b>	14	0.300	±1 LSB	1.8	24-Pin DIP
	<b>ADS-928</b>	14	0.500	±3/4 LSB	3.4	32-Pin DIP
<i>Preliminary</i>	<b>ADS-941</b>	14	1.0	±3/4 LSB	3.3	32-Pin DIP
<i>Preliminary</i>	<b>ADS-942</b>	14	2.0	±1 LSB	3.4	32-Pin DIP
<i>Advanced</i>	<b>ADS-944</b>	14	5.0	±1 LSB	3.4	40-Pin DIP
<i>Advanced</i>	<b>ADS-945</b>	14	10.0	±1 LSB	4.2	40-Pin DIP
<i>Advanced</i>	<b>ADS-976</b>	16	0.200	±2 LSB	1.8	32-Pin DIP
<i>Preliminary</i>	<b>ADS-930</b>	16	0.500	±1 1/2 LSB	2.4	40-Pin DIP



## A/D CONVERTERS

	<b>Model</b>	<b>Resolution (Bits)</b>	<b>Conversion Time (μsec)</b>	<b>Linearity Error</b>	<b>Power (Watts)</b>	<b>Case</b>
	<b>ADC-207</b>	7	0.050	±1/2 LSB	0.25	18-Pin DIP
	<b>ADC-228</b>	8	0.040	±1/2 LSB	1.25	24-Pin DIP
	<b>ADC-208</b>	8	0.050	±3/4 LSB	0.60	24-Pin DIP
	<b>ADC-304</b>	8	0.050	±1/2 LSB	0.39	28-Pin DIP
<i>New</i>	<b>ADC-530</b>	12	0.350	±3/4 LSB	2.10	32-Pin DIP
	<b>ADC-500</b>	12	0.500	±1 LSB	1.70	32-Pin DIP
	<b>ADC-505</b>	12	0.550	±1 LSB	1.70	32-Pin DIP
	<b>ADC-508</b>	12	0.700	±1 LSB	1.70	32-Pin DIP
	<b>ADC-520</b>	12	0.800	±1/2 LSB	1.60	32-Pin DIP
	<b>ADC-521</b>	12	0.800	±1/2 LSB	1.60	32-Pin DIP
	<b>ADC-511</b>	12	1.0	±3/4 LSB	1.25	24-Pin DIP
	<b>ADC-HZ12B</b>	12	8	±1/2 LSB	1.5	32-Pin DIP
	<b>ADC-HX12B</b>	12	20	±1/2 LSB	1.5	32-Pin DIP
	<b>ADC-HC12B</b>	12	300	±1/2 LSB	0.17	32-Pin DIP
	<b>ADC-908</b>	14	1.0	±1/2 LSB	2.70	32-Pin DIP
	<b>ADC-914</b>	14	2.4	±1 LSB	1.20	24-Pin DIP

## D/A CONVERTERS

Model	Resolution (Bits)	Settling Time	Linearity Error	Power (Watts)	Case
DAC-HF8	8	25 ns	±1/2 LSB	0.750	24-Pin DIP
DAC-HF10	10	25 ns	±1/2 LSB	0.900	24-Pin DIP
DAC-HF12	12	50 ns	±1/2 LSB	0.900	24-Pin DIP
DAC-HK12	12	3 µs	±1/2LSB	0.700	24-Pin DIP
DAC-HZ12	12	3 µs	±1/2 LSB	0.390	24-Pin DIP
DAC-HP16	16	15 µs	±0.003% FSR	0.600	24-Pin DIP

## SAMPLE HOLD AMPLIFIERS

	Model	Linearity (%)	Acquisition Time	Aperture Delay	Aperture Jitter	Bandwidth (MHz)	Hold Mode Droop	Case
	SHM-HU	0.1	25 ns	6 ns	10 ps	50	50 µV/µs	24-Pin DIP
	SHM-7	0.1	40 ns	3 ns	10 ps	40	100 µV/µs	24-Pin DIP
	SHM 40	0.1	40 ns	3 ns	10 ps	40	100 µV/µs	24-Pin DIP
	SHM-6	0.02	2 µs	20 ns	2 ns	5	10 µV/µs	32-Pin DIP
<i>New</i>	SHM-43	0.01	35 ns	5 ns	1 ps	150	5 µV/µs	24-Pin DIP
<i>New</i>	SHM-49	0.01	140 ns	6 ns	15 ps	16	1 µV/µs	8-Pin DIP
	SHM-45	0.01	200 ns	6 ns	±50 ps	16	0.5 µV/µs	24-Pin DIP
	SHM-4860	0.01	200 ns	6 ns	±50 ps	16	0.5 µV/µs	24-Pin DIP
	SHM-30	0.01	500 ns	25 ns	0.1 ns	4.5	0.01 µV/µs	14-Pin DIP
	SHM-20	0.01	1 µs	30 ns	1 ns	2	0.8 µV/µs	14-Pin DIP
	SHM-91	0.003	2 µs	15 ns	300 ps	2	5 µV/µs	24-Pin DIP
<i>New</i>	SHM-945	0.0004	500 ns	5ns	10 ps	12	0.5 µV/µs	24-Pin DIP
<i>Advanced</i>	MSH-840*	0.01	750 ns	6 ns	±1 ns	1	1 µV/µs	32-Pin DIP

\* QUAD Simultaneous Sample-Hold with 4-Channel Multiplexer

## HYBRID DATA ACQUISITION SYSTEMS

Model	Resolution (Bits)	Throughput (KHz)	Linearity Error (Max)	Power (Watts Max)	Channels	Case	
HDAS-16	12	50	±3/4 LSB	1.75	16 SE	62-Pin	
HDAS-8	12	50	±3/4 LSB	1.75	8 DE	62-Pin	
HDAS-75	12	75	±3/4 LSB	0.7	8 SE	40-Pin DIP	
HDAS-76	12	75	±3/4 LSB	0.7	4 DE	40-Pin DIP	
HDAS-534	12	250	±3/4 LSB	3.0	4 DE	40-Pin DIP	
HDAS-538	12	250	±3/4 LSB	3.0	8 SE	40-PIN DIP	
HDAS-524	12	400	±3/4 LSB	3.0	4 DE	40-Pin DIP	
HDAS-528	12	400	±3/4 LSB	3.0	8 SE	40-Pin DIP	
<i>Preliminary</i>	HDAS-950	16	100	±1/2 LSB @ 14 BITS	1.4	8 SE	40-Pin DIP
<i>Preliminary</i>	HDAS-951	16	100	±1/2 LSB @ 14 BITS	1.4	4 DE	40-Pin DIP

## MULTIPLEXERS

	Model	Channels	Settling Time 20V to 0.01%	Access Time	Input Range	Power (Watts)	Case
	MXD-409	4 D	3 $\mu$ s	500 ns	$\pm 15V$	0.105	16-Pin DIP
	MX-808	8 SE	3 $\mu$ s	500 ns	$\pm 15V$	0.105	16-Pin DIP
	MXD-807	8 D	3 $\mu$ s	500 ns	$\pm 15V$	0.105	28-Pin DIP
	MX-1606	16 SE	3 $\mu$ s	500 ns	$\pm 15V$	0.105	28-Pin DIP
	MVD-409	4 D	2.8 $\mu$ s	350 ns	$\pm 15V$	0.055	16-Pin DIP
	MV-808	8 SE	2.8 $\mu$ s	350 ns	$\pm 15V$	0.055	16-Pin DIP
	MVD-807	8 D	2.4 $\mu$ s	300 ns	$\pm 15V$	0.105	28-Pin DIP
	MV-1606	16 SE	2.4 $\mu$ s	300 ns	$\pm 15V$	0.105	28-Pin DIP
	MX-818C	8 SE/4D	800 ns	125 ns	$\pm 15V$	0.540	18-Pin DIP
	MX-1616C	16 SE/8 D	800 ns	150 ns	$\pm 15V$	0.900	28-Pin DIP
<i>New</i>	MX-826	8 SE	200 ns	70 ns	$\pm 10.5V$	0.395	24-Pin DIP
<i>New</i>	MX-850	4 SE	50 ns	20 ns	$\pm 10V$	0.250	14-Pin DIP

## OPERATIONAL AMPLIFIERS

Model	DC Open Loop Gain (V/V)	Settling Time ( $\mu$ sec)	Slew Rate (V/ $\mu$ sec)	Gain Bandwidth (MHz)	Case
AM-500	$10^6$	200 ns/0.01%	1000	100	14-Pin DIP
AM-1435	$10^5$	70 ns/0.01%	300	1000	14-Pin DIP

## INSTRUMENTATION AMPLIFIERS

Model	Gain Range	Settling Time	Case
AM-551	1 to 1000	2 $\mu$ s/0.01%	16-Pin DIP

## RESISTOR TUNEABLE OSCILLATORS

Model	Frequency Range	Accuracy	Case
ROJ-20	20 Hz to 20 KHz	0.5% @ 1 KHz	24-pin DIP
ROJ-1K	1KHz to 100 KHz	0.5% @ 10 KHz	24-pin DIP

# TUNABLE ACTIVE FILTERS

Model	Poles	Low Pass	High Pass	Band Pass	Band Reject	Rolloff (dB/Oct)	Frequency Cutoff Range (FC)	Filter Type	Gain	Case
FLT-DL41 *	4	◆				30	100 to 400KHz	CA	+1	32 DIP
FLT-DL42 *	4	◆				30	250 to 1000 KHz	CA	+1	32 DIP
FLT-DL51 *	5	◆				50	120 to 470 KHz	CA	+1	32 DIP
FLT-DL52 *	5	◆				50	300 to 1200KHz	CA	+1	32 DIP
FLT-DL41/DL51 § *	7	◆				50	100 to 400KHz	CA	+1	2-32 DIP
FLT-DL42/DL52 § *	7	◆				50	0.25 to 1.0MHz	CA	+1	2-32 DIP
FLT-C1	7	◆				52	78 Hz-20 KHz	CH	1, 2, 4, 8	32 DIP
FLJ-DC	2	◆	◆	◆	◆	12	1 Hz-159 KHz	BU,CH,BE	1 ~ 10	40 QDIP
FLJ-D1	2	◆	◆	◆	◆	12	1 Hz-1 599 KHz	BU	1 ~ 10	40 QDIP
FLJ-D2	2	◆	◆	◆	◆	12	100 Hz-159.9 KHz	BU	1 ~ 10	40 QDIP
FLJ-D5LA1	5	◆				60	10 Hz-2 KHz	CA	0 ±0.3 dB max	40 QDIP
FLJ-D5LA2	5	◆				60	100 Hz-20 KHz	CA	0 ±0.3 dB max	40 QDIP
FLJ-D6LA1	6	◆				80	10 Hz-2 KHz	CA	0 ±0.3 dB max	40 QDIP
FLJ-D6LA2	6	◆				80	100 Hz-20 KHz	CA	0 ±0.3 dB max	40 QDIP
FLJ-VB	2			◆		12	200Hz-20KHz	BU	±1dB	40 QDIP
FLJ-VH	4		◆			24	20Hz-20KHz	BU	+0.5dB	40 QDIP
FLJ-VL	4	◆				24	100Hz-100KHz	BU	±0.5dB	40 QDIP
FLJ-R3BA1	3			◆		—	10Hz-2KHz	CA	0 ±1dB max	40 QDIP
FLJ-R3BA2	3			◆		—	100Hz-20KHz	CA	0 ±1dB max	40 QDIP
FLJ-R8LA1	8	◆				135	10Hz-2KHz	CA	0 ±0.1dB max	40 QDIP
FLJ-R8LA2	8	◆				135	100Hz-20KHz	CA	0 ±0.1dB max	40 QDIP
FLJ-R8LB1	8	◆				100	10Hz-2KHz	CA	0 ±0.1dB max	40 QDIP
FLJ-R8LB2	8	◆				100	100Hz-20KHz	CA	0 ±0.1dB max	40 QDIP
FLJ-UR1BA1	1			◆		—	40Hz-1.6KHz	BU	0 ±1dB	20 SIP
FLJ-UR2BA1	2			◆		—	40Hz-1.6KHz	BU	0 ±1dB	20 SIP
FLJ-UR2EA1	2				◆	—	40Hz-1.6KHz	BU	0 ±0.3dB	20 SIP
FLJ-UR2LH1	2	◆	◆			12	40Hz-1.6KHz	BU	0 ±0.3dB	20 SIP
FLJ-UR4HA1	4		◆			24	40Hz-1.6KHz	BU	0 ±1dB	20 SIP
FLJ-UR4HB1	4		◆			42	40Hz-1.6KHz	CH	0 ±1dB	20 SIP
FLJ-UR4LA1	4	◆				24	40Hz-1.6KHz	BU	0 ±0.3dB	20 SIP
FLJ-UR4LB1	4	◆				42	40Hz-1.6KHz	CH	0 ±0.3dB	20 SIP
FLJ-UR1BA2	1			◆		—	400Hz-10KHz	BU	0 ±1dB	20 SIP
FLJ-UR2BA2	2			◆		—	400Hz-10KHz	BU	0 ±1dB	20 SIP
FLJ-UR2EA2	2				◆	—	400Hz-10KHz	BU	0 ±0.3dB	20 SIP
FLJ-UR2LH2	2	◆	◆			12	400Hz-20KHz	BU	0 ±0.3dB	20 SIP
FLJ-UR4HA2	4		◆			24	400Hz-5KHz	BU	0 ±1dB	20 SIP
FLJ-UR4HB2	4		◆			42	400Hz-5KHz	CH	0 ±1dB	20 SIP
FLJ-UR4LA2	4	◆				24	400Hz-20KHz	BU	0 ±0.3dB	20 SIP
FLJ-UR4LB2	4	◆				42	400Hz-20KHz	CH	0 ±0.3dB	20 SIP
FLT-U2	2	◆	◆	◆		12	0.001Hz-200KHz	BU,CH,BE,CA	0.1-1000	16 DIP

BU = Butterworth BE = Bessel  
CH = Chebyshev CA = Causer/Elliptical

All Filters operate over the commercial temperature range -20°C to +70°C  
Model FLT-U2 also operates at -55°C to +125°C  
§ Cascaded Pair \* Preliminary

ACTIVE FILTERS

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