D DATEL

POWER

D DATEL

UWR-3.3-4250-D5

D DATEL
UWR-5-2000-D12

D DATEL

BWR-12/830-D48

BWR-15/670-D48
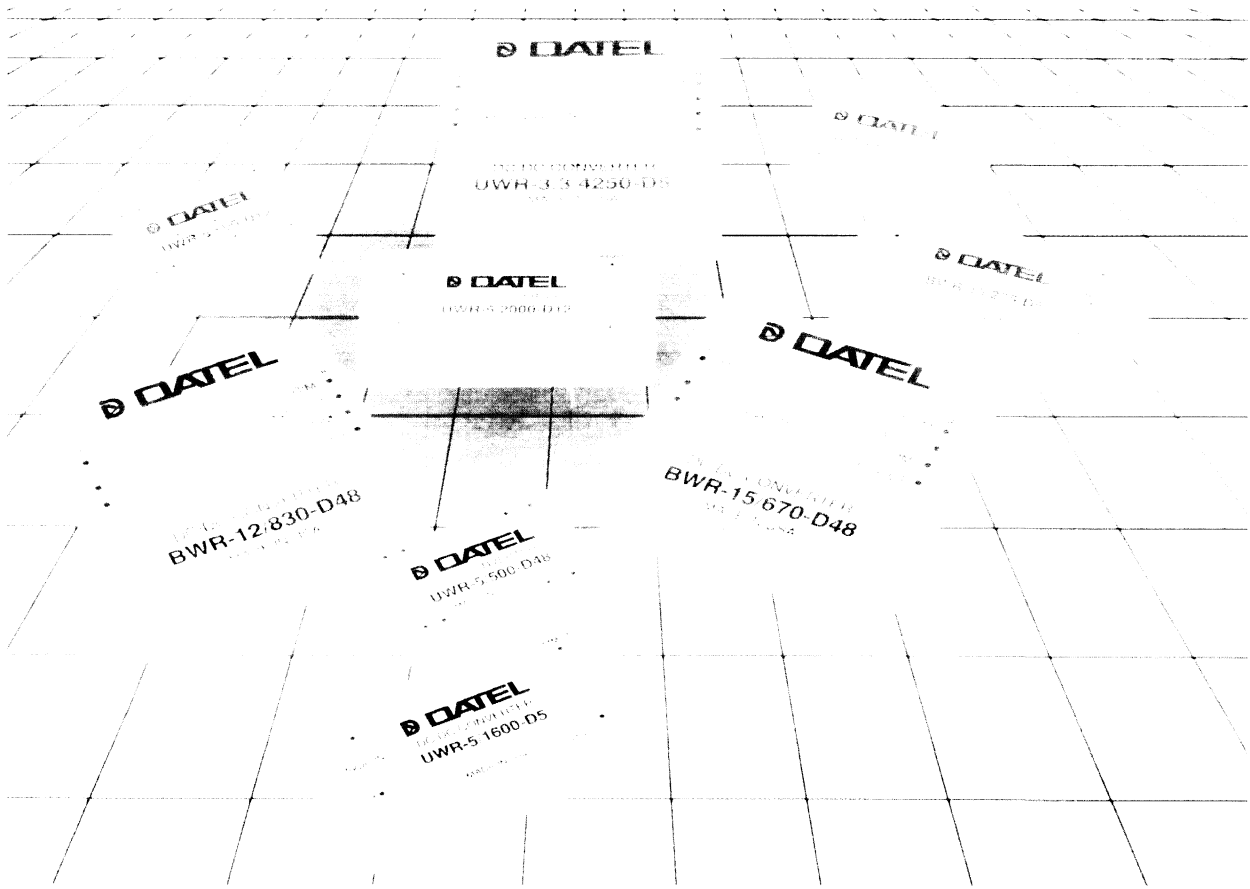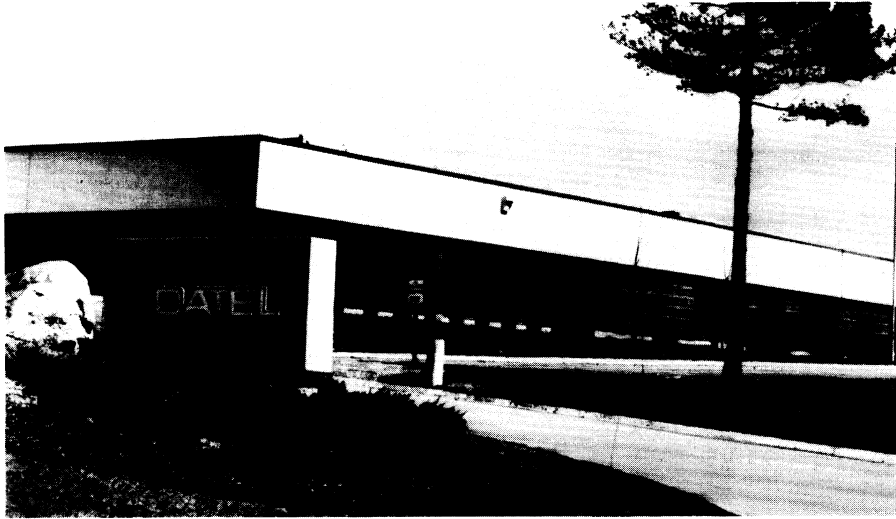
D DATEL
UWR-5-500-D48

D DATEL
UWR-5-1600-D5

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 marketplace. 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.

PRODUCT INFORMATION

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.

AVAILABLE LITERATURE

DATEL'S ALL NEW DATA ACQUISITION HANDBOOK SERIES

The following additional Handbooks are presented in complete data sheet format and include Selection Guides, Application Notes, and Ordering Information.

Volume 1. Components
ADS, ADC, DAC, SHM, HDAS, MUX, AM

Volume 2. Data Acquisition
VMEbus, Multibus, PC/XT/AT bus-compatible Boards

Volume 3. Industrial Monitor and Control Products
Process Monitors, Digital Panel Meters, Thermal Panel Printers, Benchtop and Hand-held Calibrators

Also available are the following Application Notes:

AN-1   High-Speed A/D Converter Designs: Layout and Interfacing Pitfalls

AN-2   Picking the Right Sample-and-Hold Amp for Various Data Acquisition Needs

AN-3   Data Converters: Getting to Know Dynamic Specifications

Data Acquisition and Conversion Handbook:
A technical guide to A/D - D/A converters and their applications

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356

NEW POWER CONVERTERS

ALL NEW HIGH EFFICIENCY DC-TO-DC CONVERTER MODULES

New

20 Watt High Efficiency, Wide Input Range Power Converters

- Wide Input Ranges:
  +4.6 to +13.2V, +9 to +18V, +18 to +72V

- Output Ranges:
  +3.33V, +5V, +12V, +15V, ±5V, ±12V, ±15V

- Industry Standard Pin-Out and Packaging in
  2" x 2" x 0.45

New

10 Watt High Efficiency, Wide Input Range Power Converters

- Wide Input Ranges:
  +4.7 to +7V, +9 to +18V, +18 to +72V

- Output Ranges:
  +3.33V, +5V, +12V, +15V, ±5V, ±12V, ±15V

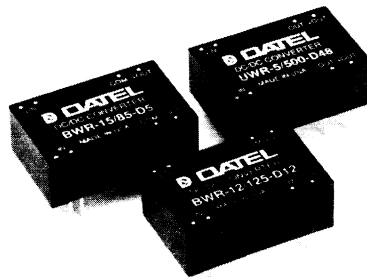- Industry Standard Pin-Out and Packaging in
  2" x 1" x 0.375"

New

3 Watt High Efficiency, Wide Input Range Power Converters

- Wide Input Ranges:
  +4.5 to +9V, +9 to +18V, +18 to +72V

- Output Ranges:
  +5.0V, +12V, +15V, ±12V, ±15V

- Industry Standard Pin-Out and Packaging
  (24-pin DDIP)

PRODUCT INDEX

PRODUCT INDEX

Contact DATEL for:

- **Power Supplies**

- **Data Conversion Components**

- **Data Acquisition & Control Boards**

- **Panel Meters, Printers, & Calibrators**

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1-800-233-2765
for
Immediate Assistance

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356

All New
High Efficiency
DC-to-DC
Converter
Modules

XWR Series 20 Watt

Single and Dual Output
DC - DC Converters

$\mathbb{D}^{®}$ DATEL®

FEATURES

- **Input ranges; 4.6-13.2V dc, 9-18V dc, 18-72V dc**
- **Power densities to 11 Watts per cubic inch**
- **Industry standard pinout and packaging**
- **Typical efficiencies of 84%**
- **Internal input/output filtering**
- **Short circuit protection**
- **TTL-compatible ON/OFF control**
- **Available in 3.3V, 5V, 12V, 15V, ±5V, ±12V, ±15V outputs**
- **Delivery from stock**
- **Input/output overvoltage protection**
- **VOUT adjustment capability**
- **Insulated case bottom (will not short PC etch)**
- **Metal case shielding**
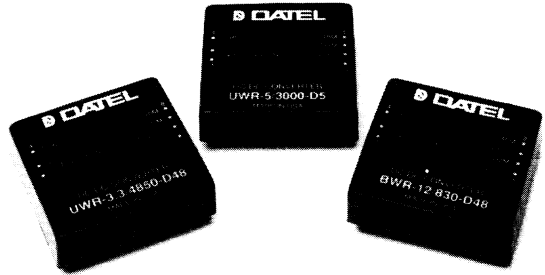
GENERAL DESCRIPTION

The XWR Series of high efficiency DC-to-DC converters are built directly on ceramic substrates using ultra-low profile, surface mount components and the latest in thick film hybrid circuit techniques. Their high frequency, current mode design allows up to 20 Watts of fully regulated, very low ripple power with typical efficiencies of 84%.

Pin-to-pin compatibility with many other manufacturers makes these converters ideal as drop-in replacements or as new de-

sign-ins where reliability and accuracy in an industry-standard package (2" x 2" x 0.45") is crucial.

Available in unipolar or bipolar configurations, the XWR Series of DC-to-DC converters are ideal for demanding applications including modern telecommunications, portable/mobile instrumentation, industrial control and PC board subsystems, and automotive/avionics/marine power distribution systems.

DESIGN FEATURE	BENEFIT	APPLICATIONS
Built on ceramic substrates using low profile, surface mount components	Low part count, compact size (industry standard 2"W x 2"L x 0.45"H)	Telecommunications equipment Automotive/avionics/marine systems and equipment
Designed with the latest in hybrid circuit techniques	High reliability with typical efficiencies of 84%	Local power distribution systems
Non-latching output current limiting, overvoltage clamping and input overvoltage shutdown	Protection for converter output and load under extreme conditions	Portable/mobile/battery operated instrumentation
TTL compatible ON/OFF control input	User-selectable operation. May also be used to synchronize these devices with system clock to reduce system EMI	PC board subsystems Portable computer and computer controlled equipment

Single Output Models
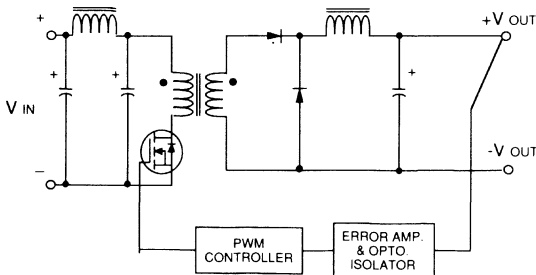
Dual Output Models
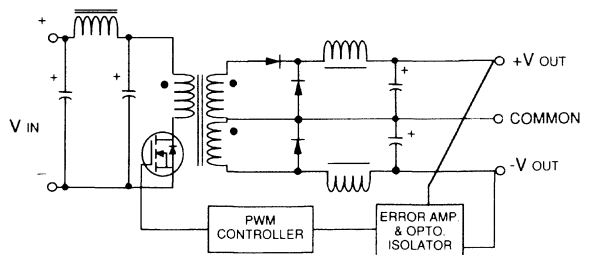
Figure 1. XWR Series 20 Watt Block Diagrams

SPECIFICATIONS

All specifications are typical at nominal line, full load, and room temperature unless otherwise noted.

INPUT SPECIFICATIONS	
Input Range	See Table 1
Input Filter	PI Type (D5 & D12 only)
	L-type for D48
Overvoltage Protection	See Table 1
Reverse Polarity Protection	10A (max)

OUTPUT SPECIFICATIONS	
Voltage Balance	
(dual outputs w/bal. loads)	±1% (max)
Voltage Setting Accuracy	
Single Output Models	±1% (max)
Dual Output models	±1.5% (max)
External Trim Range	±5%
Load Regulation	
5V output 10-100%L	±0.5%
Dual output 20-100%L	±2%
Dual output 50-100%L	±1%
Line Regulation	±0.2%
Ripple/Noise, 20 MHz BW	See Table 1
Temperature Coefficient	±0.02%
Transient Response on 50%	
Load Step	100 µS to 1% of final value
Short Circuit Protection	Continuous, auto-recovery
Overvoltage Protection	Clamping, See Table 1
Thermal Protection	115 °C on case

GENERAL SPECIFICATIONS	
Remote ON/OFF Control	TTL-Compatible (High = Off)
Efficiency	See Table 1
Isolation Voltage	500V dc
Switching Frequency	165 KHz, ±5 KHz

ENVIRONMENTAL SPECIFICATIONS	
Operating Temperature	-25 to +105 °C with derating to 0W out

PHYSICAL CHARACTERISTICS	
Dimensions	2" x 2" x 0.45"
Shielding	5 sided
Case Material	Corrosion resistant steel, baked enamel finish.
Pins	Brass, solder plated

TECHNICAL NOTES

1. ON/OFF Operation - Applications requiring ON/OFF power control may employ a TTL logic high on pin 4 to disable the converter, while a logic low (or no connection) enables the converter.

2. Synchronization - All units may be synchronized with an external clock for applications where there is a need to minimize the overall EMI noise of the system. To activate this feature, apply a rectangular clock pulse of 1 µSec. duration with a typical frequency of 180 KHz (±5%) and an amplitude of 2-10V to the CONTROL input (pin 4). Reference the input to the minus input pin 2.

3. Output Trimming - Units may be trimmed ±5% using either a fixed resistor or an external trimpot as shown below.

4. Noise Reduction - For applications requiring lower noise levels, DATEL recommends using external output capacitors. Use a 20 µF, 20V tantalum capacitor with dual output converters, and a 47 µF, 20V tantalum capacitor for single output models. Reduce input ripple on D48 models by using a 20 to 50 µF, 100V capacitor on the input.

CONNECTIONS
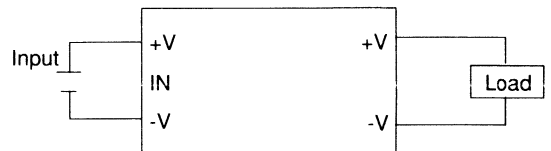
Single Output Type

Double (±) Output Type
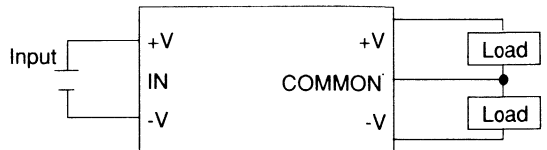
Custom Output

For 10V, 24V, or 30V output, simply use the BWR Series as shown.
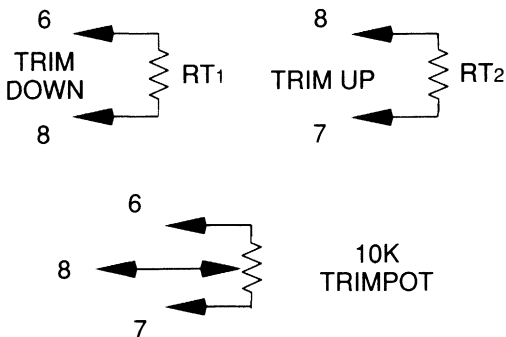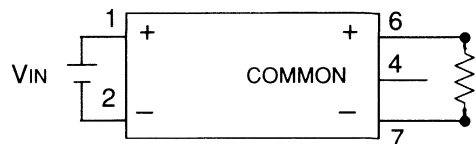
Figure 2. External Output Trimming

GENERAL SPECIFICATIONS AND ORDERING GUIDE

Model Number	Range	Input Voltage Shutdown ±5%	Input Nom.	Current mA Max. No Load	Current mA Max. Full Load	Eff. min. 100% Load	Output Voltage (V)	Output Current (A)	Output 20 MHz BW Ripple p-p	Clamp
UWR-3.3/4250-D5	4.6-13.2V	14V	5V 12V	30 30	3850 1575	73 74	3.33	4.25	50 mV	N/A
UWR-5/3000-D5	4.6-13.2V	14V	5V 12V	20 15	3795 1875	79 80	5.00	3.00	50 mV	6.8V
UWR-12/1250-D5	4.6-13.2V	14V	5V 12V	75 45	3750 1543	80 81	12.0	1.25	75 mV	15V
UWR-15/1000-D5	4.6-13.2V	14V	5V 12V	75 45	3.700 1.524	81 82	15.0	1.00	75 mV	18V
BWR-5/1500-D5	4.6-13.2V	14V	5V 12V	25 20	3.800 1563	79 80	+5 -5	±1.50	75 mV	6.8V
BWR-12/625-D5	4.6-13.2V	14V	5V 12V	75 45	3.750 1829	80 82	+12 -12	±0.625	75 mV	15V
BWR-15/500-D5	4.6-13.2V	14V	5V 12V	75 45	3750 1829	81 82	+15 -15	±0.500	75 mV	18V
UWR-3.3/4850-D12	9.0-18V	21V	12V 15V	25 25	1777 1400	75 76	3.33	4.85	50 mV	N/A
UWR-5/4000-D12	9.0-18V	21V	12V 15V	20 20	2032 1625	82 82	5.00	4.00	50 mV	6.8V
UWR-12/1650-D12	9.0-18V	21V	12V 15V	45 35	1964 1590	84 83	12.0	1.65	75 mV	15V
UWR-15/1300-D12	9.0-18V	21V	12V 15V	45 35	1935 1548	84 84	15.0	1.3	75 mV	18V
BWR-5/1700-D12	9.0-18V	21V	12V 15V	20 15	1685 1350	80 80	+5 -5	±1.7	75 mV	6.8V
BWR-12/830-D12	9.0-18V	21V	12V 15V	45 35	2000 1588	84 83	+12 -12	±0.830	75 mV	15V
BWR-15/670-D12	9.0-18V	21V	12V 15V	45 35	1985 1587	84 84	+15 -15	±0.670	75 mV	18V
UWR-3.3/4850-D48	18-72V	76V	24V 48V	20 15	854 422	78 79	3.33	4.85	50 mV	N/A
UWR-5/4000-D48	18-72V	76V	24V 48V	20 15	1021 505	81 82	5.00	4.00	50 mV	6.8V
UWR-12/1650-D48	18-72V	76V	24V 48V	25 20	990 500	82 83	12.0	1.650	75 mV	15V
UWR-15/1300-D48	18-72V	76V	24V 48V	25 20	960 480	83 84	15.0	1.300	75 mV	18V
BWR-5/1700-D48	18-72V	76V	24V 48V	20 15	843 421	83 82	+5 -5	±1.700	75 mV	6.8V
BWR-12/830-D48	18-72V	76V	24V 48V	20 15	1016 508	82 82	+12 -12	±0.830	75 mV	15V
BWR-15/670-D48	18-72V	76V	24V 48V	20 15	1004 508	83 82	+15 -15	±0.670	75 mV	18V

DERATING CURVES

Note: Full input ranges shown except where indicated.

UWR-5/3000-D5
BWR-12/750-D5
BWR-15/600-D5

UWR-3.3/4200-D5

-D48 Models   For 24 to 68V Input Only (except 3.3V)

-D5 Models operating at
9 to 13.2V Input
(except 3.3V output)

UWR-5/4000-D12, -D48
BWR-12/830-D12, -D48
BWR-15/670-D12, -D48

UWR-3.3/4850-D12, -D48
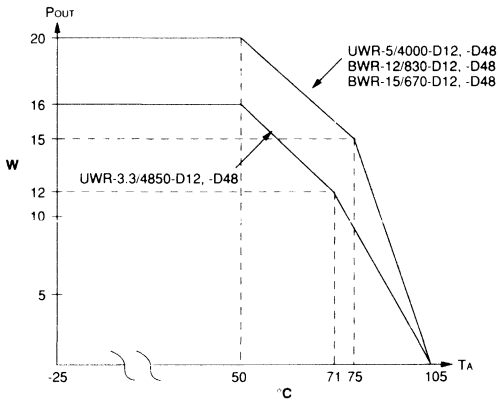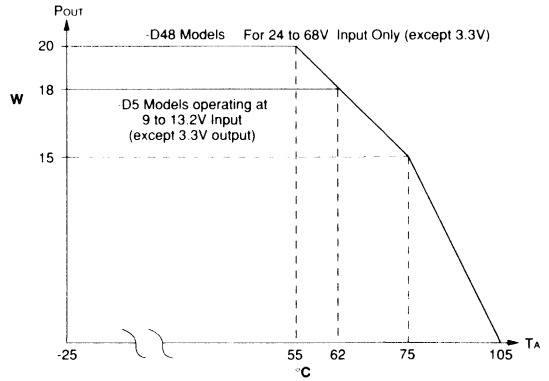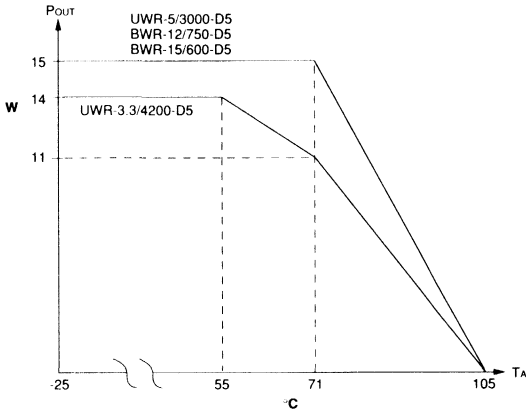
I/O CONNECTIONS

Pin Number	Functions	
	Single	Dual
1	+Input	+Input
2	-Input	-Input
3	No Pin	No Pin
4	Control	Control
5	No Pin	+Output
6	+Output	Common
7	-Output	-Output
8	Trim	Trim

MECHANICAL DIMENSIONS

NOTE: Not drawn to scale

INCHES
(mm)

| | B | ± 0.01 |

A

BOTTOM VIEW 5

1.800
(45,7)

1.200
(30,5)

2.02 Max.
(51,3)

0.200 (5,1)

0.400
(10,0)
Typ.

0.400
(10,0)
Typ.

= Denotes
symmetry

0.100
(2,5)

| | A | ± 0.01 |

2.02 Max.
(51,3)

B

METAL CASE

INSULATED BASE

0.45 Max.
(11,3)

0.20 Min.
(5.0)

0.040 ±0.002 DIA.
(1,0)
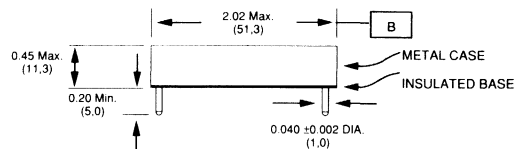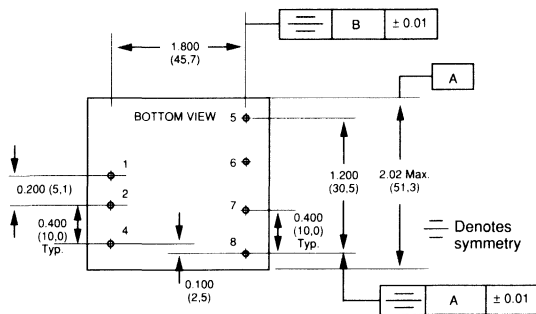
XWR Series 10 Watt

Single and Dual Output
DC-to-DC Power Converters

D DATEL®

FEATURES

- **Input ranges; 4.7-7V dc, 9-18V dc, 18-72V dc**
- **Industry standard pinout**
- **Very low profile 0.375" tall**
- **Insulated case bottom (will not short PC etch)**
- **Typical efficiencies of 84%**
- **Metal case shielding**
- **Internal input/output filtering**
- **Short circuit protection**
- **100% burn-in at full load**
- **Outputs: 3.3V, 5V, 12V, 15V, ±5V, ±12V, or ±15V**
- **Delivery from stock**
- **Industry standard 2" x 1" x 0.375"**

GENERAL DESCRIPTION

The XWR (Wide Input Range) Series of dc-to-dc converters are the very latest in high frequency, current mode technology allowing up to 10 Watts of fully regulated, very low ripple power with typical efficiencies of 84%. Their very wide input ranges (up to 4:1) are ideal for demanding applications found in automotive, aerospace, marine, and telecommunication industries.

These high efficiency converters are built on ceramic substrate using low profile, surface mount components and the latest in hybrid circuit techniques for low part count and very high reliability. Non-latching output current limiting, overvoltage clamping, and thermal power limiting are several protection schemes incorporated to protect the converter output and load from extreme conditions.

The metal case bottom is insulated for safety and allows placing board etch directly beneath the module. Incorporating modern thermal management technologies ensures extreme reliability over extended lifetimes.

Industry standard packaging (2" x 1" x 0.375") coupled with across the board pin-out compatibility with other suppliers makes DATEL's 10 Watt UWR/BWR Series of dc-to-dc power converters ideal as drop-in replacements for larger, less reliable converters from other manufacturers.

APPLICATIONS

- **Telecommunications equipment**
- **Local power distribution systems**
- **PC board subsystems**
- **Portable/mobile/battery operated instrumentation**
- **Field use equipment**
- **Portable computer and computer controlled cquipment**
- **Automotive/avionics/marine systems and equipment**

Single Output Models *

Dual Output Models *
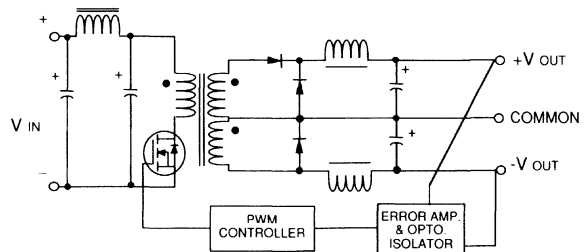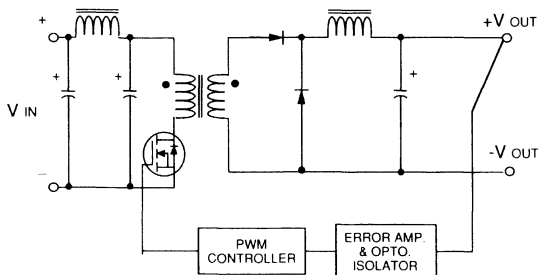
* -D48 models are flyback design

Figure 1. XWR-Series Simplified Block Diagrams

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General Specifications and Ordering Information

Model Number	Range (V dc)	Input Nominal (V dc)	Input Current (mA) Max. No Load	Input Current (mA) Max. Full Load	Eff. Min. 100% Load	Output Voltage (V)	Output Current (A)	Output 20 MHz BW Ripple/Noise p-p (typ)	Clamp
UWR-3.3/1800-D5	4.7-7.0	5	30	1715	70	3.33	1.8	50 mV	N/A
UWR-5/1600-D5	4.7-7.0	5	30	2210	73	5.00	1.6	50 mV	6.8V
UWR-12/665-D5	4.7-7.0	5	40	2225	75	12.0	0.665	75 mV	15V
UWR-15/530-D5	4.7-7.0	5	40	2225	75	15.0	0.530	75 mV	18V
BWR-5/700-D5	4.7-7.0	5	30	1842	76	±5.0	±0.700	50 mV	6.8V
BWR-12/335-D5	4.7-7.0	5	40	2220	73	±12.0	±0.335	15 mV	15V
BWR-15/275-D5	4.7-7.0	5	40	2225	73	±15.0	±0.275	15 mV	18V
UWR-3.3/2500-D12	9.0-18	12	30	915	75	3.33	2.5	50 mV	N/A
UWR-5/2000-D12	9.0-18	12	15	1030	81	5.00	2.0	50 mV	6.8V
UWR-12/830-D12	9.0-18	12	35	1000	81	12.0	0.830	75 mV	15V
UWR-15/665-D12	9.0-18	12	35	992	82	15.0	0.665	75 mV	18V
BWR-5/800-D12	9.0-18	12	15	830	80	±5.0	±0.800	50 mV	6.8V
BWR-12/415-D12	9.0-18	12	35	1000	83	±12.0	±0.415	25 mV	15V
BWR-15/330-D12	9.0-18	12	35	992	84	±15.0	±0.330	25 mV	18V
UWR-3.3/1800-D48	18-72	24	15	340	75	3.33	1.8	50 mV	N/A
		48	15	170	75				
UWR-5/1800-D48	18-72	24	15	480	78	5.00	1.8	75 mV	6.8V
		48	10	240	78				
UWR-12/750-D48	18-72	24	15	515	82	12.0	0.750	75 mV	15V
		48	10	260	82				
UWR-15/600-D48	18-72	24	15	508	83	15.0	0.600	75 mV	18V
		48	10	257	83				
BWR-5/700-D48	18-72	24	15	365	79	±5.0	±0.700	75 mV	6.8V
		48	10	185	78				
BWR-12/415-D48	18-72	24	15	515	81	±12.0	±0.415	75 mV	15V
		48	10	260	80				
BWR-15/330-D48	18-72	24	15	508	82	±15.0	±0.330	75 mV	18V
		48	10	257	81				

SPECIFICATIONS

All specifications are typical at nominal line, full load, and room temperature unless otherwise noted.

INPUT SPECIFICATIONS	.
Input Range	See Table 1
Input Filter	PI Type (L type for -D48)
Reverse Polarity Protection	6A, max.

OUTPUT SPECIFICATIONS	
Voltage Balance (dual outputs	
with balanced loads)	±1%, max.
Voltage Setting Accuracy	
Single Output Models	±1%, max.
Dual Output models	±1.5%, max.
Load Regulation, max.	
5V output 0-100%L	±0.5%
Dual output 20-100%L	±2%
Dual output 50-100%L	±1%
Line Regulation	±0.2%
Ripple/Noise, 20 MHz BW	See Table 1
Temperature Coefficient	±0.2%
Transient Response	
on 50% Load Step	100µS to 1% of final
	value
Short Circuit Protection	Continuous, auto-recovery
Thermal Protection	Automatic shutdown at 115 °C, case.

GENERAL SPECIFICATIONS	
Efficiency	See Table 1
Isolation Voltage	500V dc
Switching Frequency	165 KHz, ±5 KHz

ENVIRONMENTAL SPECIFICATIONS	
Operating Temperature	-25 to +105 °C Ambient
Derating	to 0 Watts out
Storage Temperature	-55 to + 125 °C

PHYSICAL CHARACTERISTICS	
Dimensions	2" x 1" x 0.375"
Shielding	5 sided
Case Material	Corrosion resistant steel, baked enamel finish.
Pins	Brass, solder plated

I/O CONNECTIONS

Pin	Functions	
	Single	Dual
1	+Input	+Input
2	-Input	-Input
3	+Output	+Output
4	No Pin	Common
5	Common	-Output

DERATING CURVE
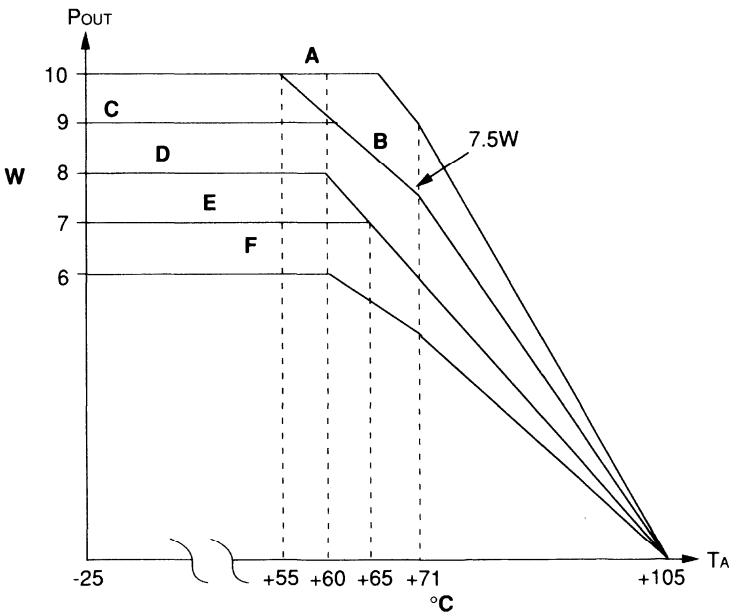
A

BWR-12/415-D12
BWR-15/330-D12
UWR-12/830-D12
UWR-15/665-D12

B

BWR-12/415-D48
BWR-15/330-D48
UWR-5/2000-D12

C

UWR-5/1800-D48
UWR-15/600-D48
UWR-12/750-D48

D

BWR-5/800-D12
BWR-15/275-D5
BWR-12/335-D5
UWR-5/1600-D5
UWR-3.3/2500-D12
UWR-12/665-D5
UWR-15/1600-D5

E

BWR-5/700-D5
BWR-5/700-D48

F UWR-3.3/1800-D5
UWR-3.3/1800-D48

TECHNICAL NOTE

External capacitors are not required for normal operation. For applications requiring lower input/output ripple and noise, DATEL recommends the following:

To reduce *input* voltage/current ripple:
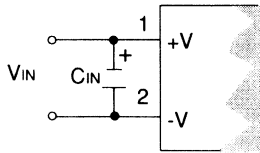
Models	Approximate C$_{IN}$ Values	Type
-D5	47 µF, 10V	Tantalum or electrolytic
-D12	10 µF, 35V	Tantalum or electrolytic
-D48	10 µF, 100V	Tantalum or electrolytic

To reduce *output* voltage ripple:
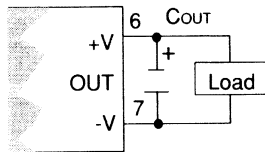
Output Voltage	Approx. C$_{OUT}$ Values	Type
3.3V	100 µF, 6V	Tantalum or electrolytic
5V	47µF, 10V	Tantalum or electrolytic
12V	22 µF, 20V	Tantalum or electrolytic
15V	22 µF, 20V	Tantalum or electrolytic

CONNECTIONS

Single output type
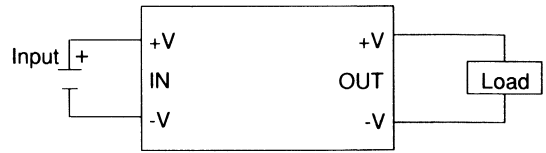
Double (±) Output Type
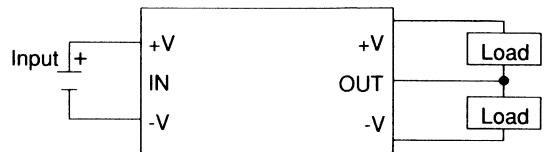
Custom Output

For 10V, 24V, or 30V output, simply use the BWR Series as shown.

MECHANICAL DIMENSIONS

0.38 (9.65)

METAL CASE

0.20 MIN (5.08)

INSULATED BASE

TOLERANCES UNLESS OTHERWISE SPECIFIED

2 PL DEC ±0.02 3 PL DEC ±0.002
±(0.50) ±(0.050)

0.040 DIAMETER (1.016)

0.10 (2.54)

0.400 (10.160)

0.100 (2.540)

0.400 (10.160)

0.200 (5.080)

1.02 (25.91)

0.60 (15.24)   0.800 (20.320)

2.02 (51.31)
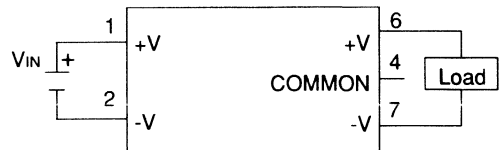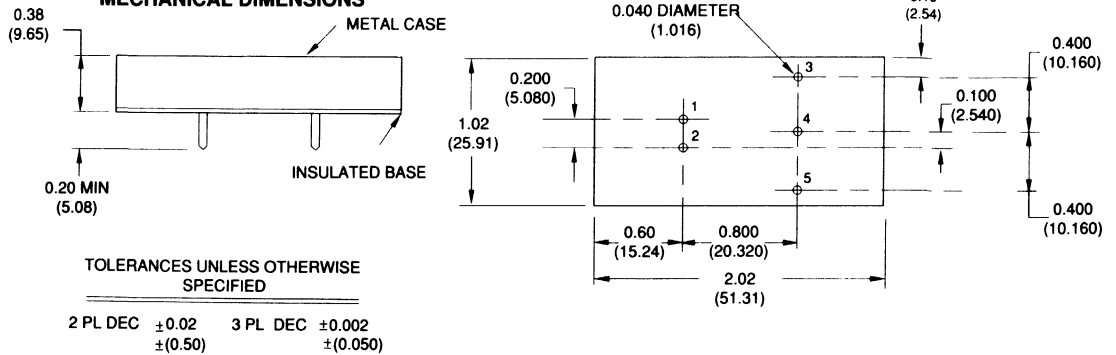
XWR Series 3 Watt
Single/Dual Output
DC-DC Power Converters

®𝔇 ⃞𝖀𝖠𝕋𝖤𝕃®

FEATURES

- **Wide input ranges; 4.5-9V dc, 9-18V dc, 18-72V dc**
- **Industry standard pinout and packaging**
- **Very low profile 0.435" tall**
- **Switching frequency 200 KHz (typical)**
- **Typical efficiencies to 82%**
- **State-of-the-art thermal management technology**
- **Internal input/output filtering**
- **Short circuit protection**
- **100% burn-in at full load**
- **Available in 5V, 12V, 15V, ±12V, and ±15V outputs**
- **Delivery from stock**
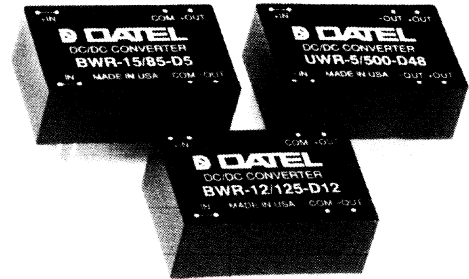
GENERAL DESCRIPTION

The XWR (Wide Input Range) Series of dc-to-dc converters are the very latest in high frequency, current mode technology allowing up to 3 Watts of fully regulated, very low ripple power with efficiencies to 82%. Their very wide input ranges (2:1, 4:1) are ideal for demanding applications found in automotive, aerospace, marine, and telecommunication applications.

These high efficiency dc-to-dc converters are built on PC board using low profile, surface mount components and the latest in hybrid circuit techniques for low part count and very high reliability. All 3 Watt modules are protected (output and load) via non latching output current limiting circuitry. Incorporating modern thermal management technologies ensures extreme accuracy over extended lifetimes without power derating.

Industry standard packaging (0.8" x 1.250" x 0.435") coupled with across the board pin-out compatibility with other suppliers makes the DATEL 3 Watt UWR/BWR Series of dc-to-dc power converters ideal as drop-in replacements for other more costly, less reliable power converters or as original design-ins where quality and low cost are paramount.

APPLICATIONS

- **Telecommunications equipment**
- **Local power distribution systems**
- **PC board subsystems**
- **Portable/mobile/battery operated instrumentation**
- **Field use equipment**
- **Portable computer and computer controlled equipment**
- **Automotive/avionics/marine systems and equipment**

I/O CONNECTIONS

Pin	Functions	
	Single	dual
22, 23	+Input	+Input
2, 3	-Input	-Input
9, 16	-Output	Common
11	+Output	-Output
14	+Output	+Output

Single Output Models
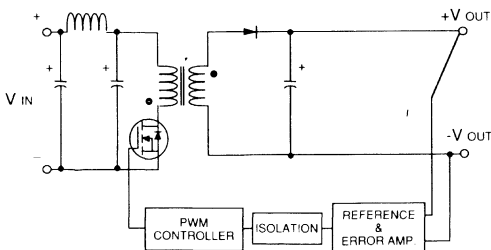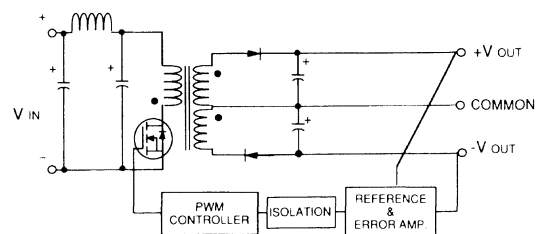
Dual Output Models

Figure 1. XWR-Series Simplified Block Diagrams

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356

SPECIFICATIONS

All specifications are typical at nominal line, full load, and room temperature unless otherwise noted.

INPUT SPECIFICATIONS

Input Range	See Table 1
Input Filter	PI Type

OUTPUT SPECIFICATIONS

Voltage Balance (dual outputs with balanced loads)	±1%, max.
Voltage Setting Accuracy Single/Dual Output Models	±1%, max.
Load Regulation 10 mA to F/L, BWR Series	±1%, Balanced Loads
0-100%L, UWR Series	±0.5%
Line Regulation, UWR Series	±0.5%
Line Regulation, BWR Series High Line to Low Line	±0.5%, Balanced Loads
Ripple/Noise, 20 MHz BW	See Table 1
Temperature Coefficient	±0.02%
Transient Response on 50% Load Step	200 µS to 1% of final value
Short Circuit Protection	Continuous, auto-recovery

GENERAL SPECIFICATIONS

Efficiency	See Table 1
Isolation Voltage	1000V dc
Switching Frequency	200 KHz, typ.

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature	-25 to +75 °C Ambient
Derating	None

PHYSICAL CHARACTERISTICS

Dimensions	0.800" x 1.250" x 0.435"
Case Material	Black Plastic
Pins	Brass, Gold plated

TECHNICAL NOTE

1. Noise Reduction - For applications requiring lower output noise levels, DATEL recommends using external capacitors. Use a 22 µF, 20V for 12V and 15V output UWR and BWR models. For 5V output models, use a 47 µF, 10V capacitor.

MECHANICAL DIMENSIONS

INCHES (mm)
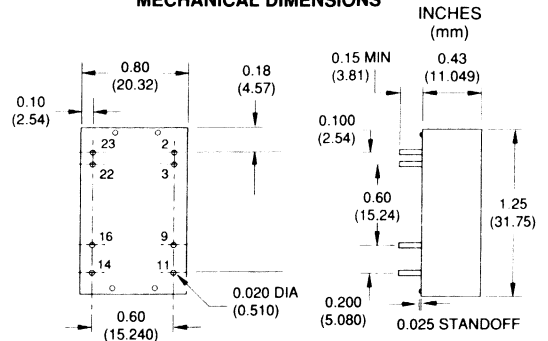
TOLERANCES UNLESS OTHERWISE SPECIFIED

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

Table 1. General Specifications and Ordering Guide

	Input				Output				
	Voltage V dc		Current mA		Volts	Current	Power	Ripple &	Minimum
Model	Nom	Range	NL	FL	(V)	(A)	(W)	Noise mV	Efficiency
UWR-5/500-D5	5	4.5-9	25	714	5.00	0.500	2.50	100	70
UWR-12/250-D5	5	4.5-9	25	833	12	0.250	3.00	75	72
UWR-15-200-D5	5	4.5-9	25	833	15	0.200	3.00	75	72
BWR-12/105-D5	5	4.5-9	60	714	±12	0.105	2.50	75	70
BWR-15/85-D5	5	4.5-9	60	729	±15	0.085	2.55	75	70
UWR-5/500-D12	12	9-18	25	278	5.00	0.500	2.50	100	70
UWR-12/250-D12	12	9-18	25	347	12.0	0.250	3.00	75	72
UWR-12/200-D12	12	9-18	25	347	15.0	0.200	3.00	75	72
BWR-12/125-D12	12	9-18	25	333	±12	0.125	3.00	75	75
BWR-15/100-D12	12	9-18	25	333	±15	0.100	3.00	75	75
UWR-5/500-D48	48	18-72	10	69	5.00	0.500	2.50	100	75
UWR-12/250-D48	48	18-72	10	83	12.0	0.250	3.00	75	75
UWR-15/200-D48	48	18-72	10	83	15.0	0.200	3.00	75	75
BWR-12/125-D48	48	18-72	10	76	±12	0.125	3.00	75	82
BWR-15/100-D48	48	18-72	10	76	±15	0.100	3.00	75	82

Contact DATEL for:

- **Power Supplies**

- **Data Conversion Components**

- **Data Acquisition & Control Boards**

- **Panel Meters, Printers, & Calibrators**

Dial
1-800-233-2765
for
Immediate Assistance

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DC-to-DC Converter Modules

DIP Series
Miniature 1 Watt
DC-DC Converters

$\boxed{\mathbb{D}}^{®}$ □∕∆⊤∈L ®

FEATURES

- **Compact 24-Pin DIP Package**
- **Low noise, regulated outputs**
- **Pi Input Filter**
- **300V dc isolation**
- **Short Circuit Protection**

GENERAL DESCRIPTION

This family of miniature converters meets the demands of to-day's densely populated PC boards. Measuring only 1.25" x 0.8" x 0.4", each unit delivers 1 Watt of clean, fully regulated power. These devices are ideal for powering sensitive analog circuits, or in any application where low-power, isolated and regulated outputs are required.
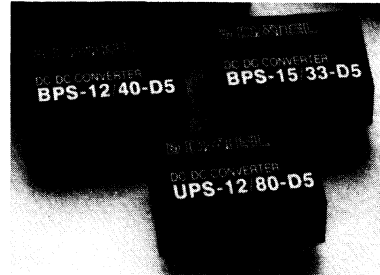
All models include internal Pi-type filters to minimize reflected ripple current. Other features include continuous short circuit protection with automatic restart, 300V dc isolation, and no derating over the full operating temperature range of -25 to +71 °C.

The converters accept a 5V nominal input, and provide +12V, ±12V, +15V, or ±15V outputs.

FUNCTIONAL SPECIFICATIONS

All specifications typical at nominal line, full load, and at 25 °C unless otherwise noted.

OUTPUTS

Voltage Accuracy	±5% max
Line Regulation	±0.3%
Load Regulation	±0.4%
Temperature Coefficient	±0.01%/ °C
Ripple/Noise ①	20 mV Pk-Pk, max.
Overshoot, 10% to 90% Load	±0.1%
Warm-up Drift, 30 Minutes	±0.2%
Short Circuit Protection	Continuous
Short Circuit Restart	Automatic

INPUT

Input Voltage Range	4.5 to 5.5V dc
Input Current	
No Load	90 mA
Full Load	380 mA
Input Filter	Pi Network
Reflected Ripple Current	15 mA p-p
Fault Mode Current	150% of FL Input Current, max

GENERAL

Efficiency	50%
Isolation Voltage	300V dc, min
Isolation Capacitance	80 pF
Isolation Resistance	10E9 Ohms
Switching Fequency	40 to 70 kHz

ENVIRONMENTAL

Operating Temp Range	-25 to +71 °C
Storage Temp Range	-40 to +125 °C
Humidity, Non-Condensing	20% to 95% RH
Cooling	Free Air Convection

PHYSICAL

Weight	0.5 oz. (14 grams)
Case Material	Non-Conductive Black Plastic

Notes
① 20 MHz bandwidth, 15 µF tantalum capacitor across each output.

DIP Case Pin Connections

DIP Series Converters

Input Voltage	Output Voltage	Output Current	Case	Model Number
5 Vdc	12 Vdc	80 mA	DIP	UPS-12/80-D5
5 Vdc	15 Vdc	65 mA	DIP	UPS-15/65-D5
5 Vdc	±12 Vdc	±40 mA	DIP	BPS-12/40-D5
5 Vdc	±15 Vdc	±33 mA	DIP	BPS-15/33-D5

Pin	Single Output	Dual Output
1	+V Input	+V Input
2	NC	-V Output
3	NC	Common
10	-V Output	Common
11	+V Output	+V Output
12	-V Input	-V Input
13	-V Input	-V Input
14	+V Output	+V Output
15	-V Output	Common
22	NC	Common
23	NC	-V Output
24	+V Input	+V Input

DIP Case
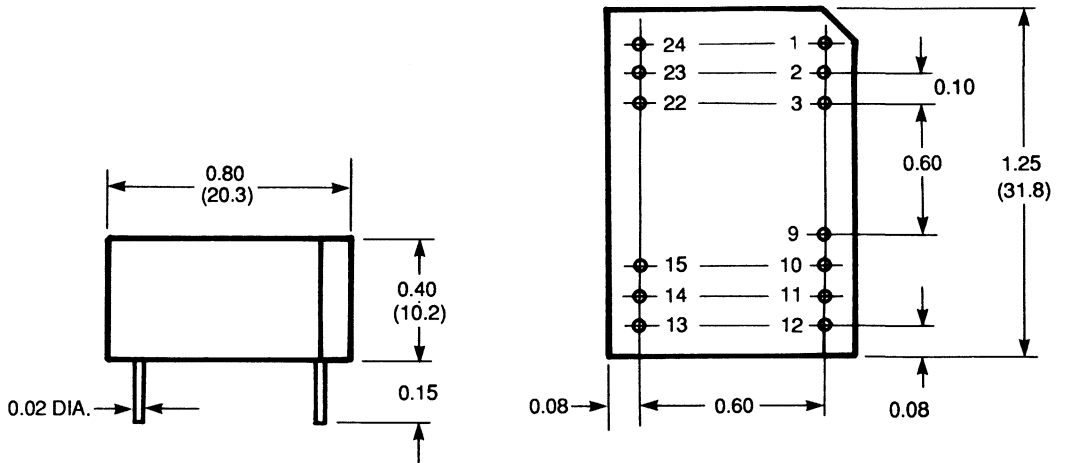
LP Series 10 Watt
Single and Dual Output
DC-DC Power Converters

DATEL

FEATURES

- **Fixed input ranges; 5V, 12V, 24V, 28V, 48V (±10%)**
- **Compact, Modular PC board mount (3.5" x 2.5" x 0.88")**
- **500V dc input to output isolation (300V dc for ±12V Models)**
- **Output current limiting short circuit protection**
- **Very wide operating temperature (-25 °C to +71 °C)**
- **Single or dual outputs**
- **Delivery from stock!**
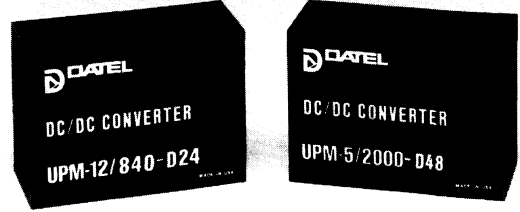
GENERAL DESCRIPTION

The LP Series of high performance, mid-range power 10 Watt DC-to-DC converters provide efficient, low cost, regulated power in a compact PC board mount package. Twelve different 10 Watt converters are available with popular unipolar and bipolar output voltages for wide applicability. Encased in non-conductive plastic, the 10 Watt LP Series converters are available with or without mating PC board sockets. Their 3.5" x 2.5" x 0.88" package and low price are ideal for a wide variety of applications from special in-house designs to high volume OEM products. Highly regulated (0.02%, Line/Load), with 0.01% temperature coefficients (depending upon model), and isolation to 500V dc, these ruggedly reliable converters provide years of cost effective, trouble-free operation under less than ideal conditions. Outstanding output accuracy combined with

low thermal rise, tight regulation, and very low noise and ripple make these power converters ideal for sensitive circuits. A Pi network input filter suppresses input reflected ripple current. Additional features include transformer isolation and current-limiting output protection.

The 10 Watt LP Series are available with input voltages of 5V, 12V, 24V, 28V, and 48V (±10%) with either unipolar or bipolar outputs of 5V, ±12V, and ±15V. The 10 Watt LP Series converters are found in applications ranging from Industrial Control Systems, Telecommunications Equipment, Analog Systems, Digital Circuits, Field/Mobile Instrumentation, or wherever high reliability at the lowest possible cost is demanded.

APPLICATIONS

- **Telecommunications Equipment**
- **Local Power Distribution Systems**
- **PC Board Subsystems**
- **Portable/Mobile/Battery Operated Instrumentation**
- **Portable Computer and Computer Controlled Equipment**
- **Automotive/Avionics/Marine Systems and Equipment**

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DATEL®

SPECIFICATIONS
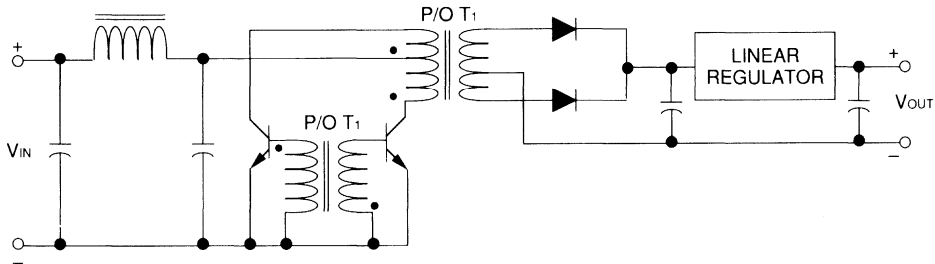
	SINGLE OUTPUT MODELS		
	UPS-5/2000-D24	UPM-5/2000-D28	UPM-5/2000-D48
Output Voltage	5V	5V	5V
Output Current	2000 mA	2000 mA	2000 mA
Input Voltage	24V dc	28V dc	48V dc
Input Voltage Tolerance	22.32 — 26.4V	26.04 — 30.8V	44.64 — 52.8V
No Load Input Current	45 mA	40 mA	20 mA
Full Load Input Current, max.	640 mA	550 mA	320 mA
Line Regulation	0.02%	0.02%	0.02%
Load Regulation	0.05%	0.05%	0.05%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C
Breakdown Voltage, min.	500V dc	500V dc	500V dc
Reflected Ripple Current, max.	32 mA pk-pk	32 mA pk-pk	32 mA pk-pk

	DUAL OUTPUT MODELS		
	BPM-12/420-D5	BPM-12/420-D12	BPM-12/420-D24
Output Voltage	±12V	±12V	±12V
Output Current	420 mA	420 mA	420 mA
Input Voltage	5V dc	12V dc	24V dc
Input Voltage Tolerance	4.5 — 5.5V	10.8 — 13.2V	21.6 — 26.4V
No Load Input Current	980 mA	340 mA	175 mA
Full Load Input Current, max.	4000 mA	1530 mA	760 mA
Line Regulation	0.05%	0.05%	0.05%
Load Regulation	0.05%	0.05%	0.05%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C
Breakdown Voltage, min.	300V dc	300V dc	300V dc
Reflected Ripple Current, max.	120 mA pk-pk	46 mA pk-pk	23 mA pk-pk

GENERAL SPECIFICATIONS — ALL MODELS

Output Voltage Accuracy .... ±1%
Output Noise and Ripple, maximum ....50 mV pk-pk (5 mV RMS),
Operating Temperature Range .... -25 °C to +71 °C
Storage Temperature Range .... -55 °C to +85 °C
Case Material .... Diallyl Phthalate

The 10 Watt Series uses the MS-7 Socket.

SPECIFICATIONS

	DUAL OUTPUT MODELS		
	BPM-12/420-D28	BPM-12/420-D48	BPS-15/412-D5
Output Voltage	±12V	±12V	±15V
Output Current	420 mA	420 mA	412 mA
Input Voltage	28V dc	48V dc	5V dc
Input Voltage Tolerance	25.2 — 30.8V	42 — 54V	4.65 — 5.5V
No Load Input Current	130 mA	120 mA	260 mA
Full Load Input Current, max.	650 mA	415 mA	3700 mA
Line Regulation	0.05%	0.05%	0.02%
Load Regulation	0.05%	0.05%	0.02%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.01%/°C
Breakdown Voltage, min.	300V dc	300V dc	500V dc
Reflected Ripple Current, max.	20 mA pk-pk	13 mA pk-pk	130 mA pk-pk

	DUAL OUTPUT MODELS		
	BPS-15/412-D12	BPS-15/412-D24	BPS-15/412-D28
Output Voltage	±15V	±15V	±15V
Output Current	412 mA	412 mA	412 mA
Input Voltage	12V dc	24V dc	28V dc
Input Voltage Tolerance	11.16 — 13.2V	21.6 — 26.4V	44.64 — 52.8V
No Load Input Current	110 mA	55 mA	45 mA
Full Load Input Current, max.	1590 mA	770 mA	660 mA
Line Regulation	0.02%	0.02%	0.02%
Load Regulation	0.02%	0.02%	0.02%
Temperature Coefficient	0.01%/°C	0.01%/°C	0.01%/°C
Breakdown Voltage, min.	500V dc	500V dc	500V dc
Reflected Ripple Current, max.	54 mA pk-pk	38 mA pk-pk	39 mA pk-pk

GENERAL SPECIFICATIONS — ALL MODELS

Output Voltage Accuracy ....±1%
Output Noise and Ripple, maximum ....50 mV pk-pk (5 mV RMS),
Operating Temperature Range ....-25 °C to +71 °C
Storage Temperature Range.................-55 °C to +85 °C
Case Material ....Diallyl Phthalate

The 10 Watt Series uses the MS-7 Socket.

MECHANICAL DIMENSIONS AND I/O CONNECTIONS
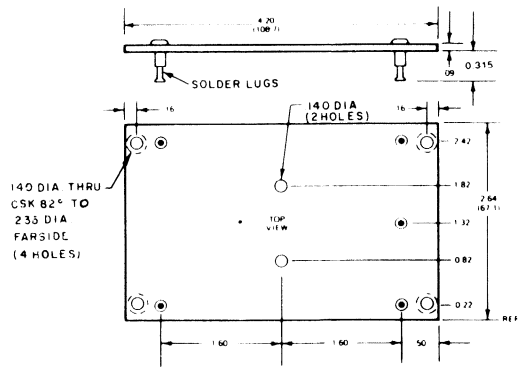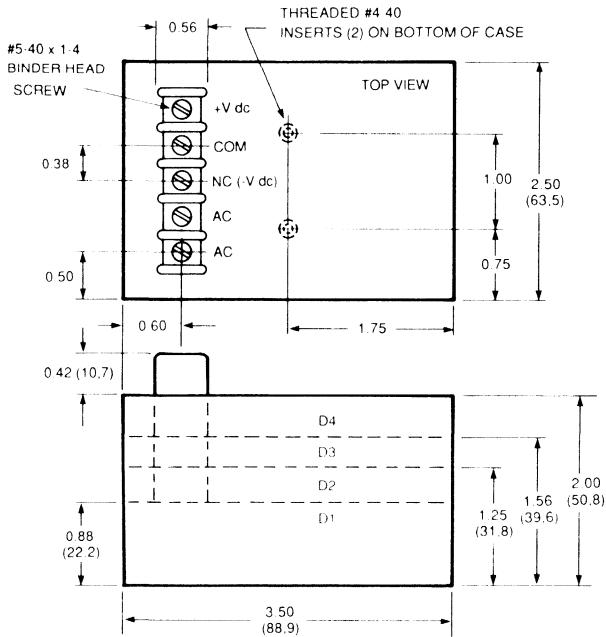
SOCKET MS-7

THREADED #4 40
INSERTS (2) ON BOTTOM OF CASE

0.56

#5-40 x 1-4
BINDER HEAD
SCREW

TOP VIEW

+V dc

COM

NC (-V dc)

AC

AC

0.38

0.50

0.60

1.75

1.00 2.50
(63.5)

0.75

0.42 (10.7)

D4

D3

D2

D1

0.88
(22.2)

2.00
1.56 (50.8)
1.25 (39.6)
(31.8)

3.50
(88.9)

NOTE. PIN DESIGNATIONS IN PARENTHESIS ARE FOR
BIPOLAR OUTPUT MODELS

SOLDER LUGS

140 DIA THRU
CSK 82° TO
233 DIA
FARSIDE
(4 HOLES)

140 DIA
(2 HOLES)

TOP
VIEW

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LP Series 5 Watt
Single and Dual Output
DC-to-DC Power Converters

D° DATEL®

FEATURES

- **Fixed input range; 5V, 12V, 24V, 28V, 48V ($\pm$10%)**
- **Chassis or PC board mount (2" x 2" x 0.75")**
- **500V dc input to output isolation (300V dc for 24V models)**
- **Output current limiting short circuit protection**
- **Very wide operating temperature (-25 °C to +71 °C)**
- **Single or dual outputs**
- **Delivery from stock!**
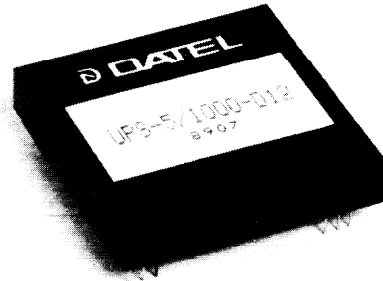
GENERAL DESCRIPTION

The LP Series of high performance, mid-range power 5 Watt DC-to-DC converters provide the accuracy and reliability you've come to expect from DATEL. Sixteen different 5 Watt models are available in a standard 2" x 2" x 0.75" package to cover virtually any application from special in-house designs to high volume OEM applications. Their compact size, low price, and rugged reliability means years of cost effective, trouble-free operation under less than ideal conditions. Outstanding output accuracy combined with low thermal rise, tight regulation, and very low noise and ripple make these power converters ideal for sensitive circuits. A Pi network input filter suppresses input reflected ripple current. Additional features include transformer isolation and current-limiting output protection.

The 5 Watt LP Series are available with input voltages of 5V, 12V, 24V, 28V, 48V ($\pm$10%) with unipolar or bipolar outputs of 5V, 12V, 24V, $\pm$12V, and $\pm$15V. The 5 Watt LP Series converters are found in applications ranging from Industrial Control Systems, Telecommunications Equipment, Analog Systems, Digital Circuits, Field/Mobile Instrumentation, or wherever high reliability at the lowest possible cost is demanded.

APPLICATIONS

- **Telecommunications Equipment**
- **Local Power Distribution Systems**
- **PC Board Subsystems**
- **Portable/Mobile/Battery Operated Instrumentation**
- **Portable Computer and Computer Controlled Equipment**
- **Automotive/Avionics/Marine Systems and Equipment**

SPECIFICATIONS
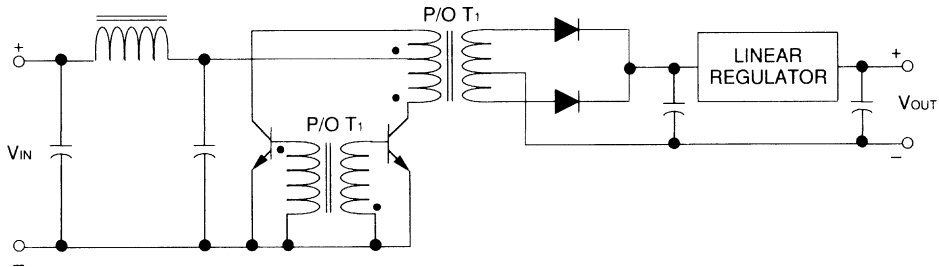
	SINGLE OUTPUT MODELS		
	UPS-5/1000-D12	UPS-5/1000-D24	UPS-5/1000-D28
Output Voltage	5V	5V	5V
Output Current	1000 mA	1000 mA	1000 mA
Input Voltage	12V dc	24V dc	28V dc
Input Voltage Tolerance	±10%	±10%	±10%
No Load Input Current	50 mA	25 mA	20 mA
Full Load Input Current, max.	640 mA	320 mA	275 mA
Line Regulation	0.02%	0.02%	0.02%
Load Regulation	0.04%	0.04%	0.04%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C
Breakdown Voltage, min.	500V dc	500V dc	500V dc
Reflected Ripple Current, max.	54 mA pk-pk	22 mA pk-pk	22 mA pk-pk

	SINGLE OUTPUT MODELS			
	UPS-12/470-D5	UPS-12/470-D24	UPM-24/210-D5	UPM-24/210-D12
Output Voltage	12V	12V	24V	24V
Output Current	470 mA	470 mA	210 mA	210 mA
Input Voltage	5V dc	24V dc	5V dc	12V dc
Input Voltage Tolerance	±10%	±10%	±10%	±10%
No Load Input Current	500 mA	120 mA	500 mA	200 mA
Full Load Input Current, max.	2000 mA	415 mA	2000 mA	830 mA
Line Regulation	0.02%	0.02%	0.05%	0.05%
Load Regulation	0.04%	0.04%	0.01%	0.01%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C	0.02%/°C
Breakdown Voltage, min.	500V dc	500V dc	300V dc	300V dc
Reflected Ripple Current, max.	61 mA pk-pk	25 mA pk-pk	100 mA pk-pk	42 mA pk-pk

GENERAL SPECIFICATIONS — ALL MODELS

Output Voltage Accuracy ....±1%
Output Noise and Ripple, maximum ....50 mV pk-pk (5 mV RMS),
                                        35 mV pk-pk for dual output
Operating Temperature Range ....-25 °C to +71 °C
Storage Temperature Range ....-55 °C to +85 °C
Case Material ....Diallyl Phthalate

The 5 watt series uses 2 DILS-1 or DILS-2 terminal strips for sockets.

SPECIFICATIONS

	DUAL OUTPUT MODELS			
	BPS-12/230-D5	**BPS-12/230-D12**	**BPS-12/230-D24**	**BPS-12/230-D28**
Output Voltage	±12V	±12V	±12V	±12V
Output Current	±230	±230	±230	±230
Input Voltage	5V dc	12V dc	24V dc	28V dc
Input Voltage Tolerance	±10%	±10%	±10%	±10%
No Load Input Current	130 mA	55 mA	25 mA	25 mA
Full Load Input Current, max.	1650 mA	690 mA	340 mA	300 mA
Line Regulation	0.02%	0.02%	0.02%	0.02%
Load Regulation	0.02%	0.02%	0.02%	0.02%
Temperature Coefficient	0.01%/°C	0.01%/°C	0.01%/°C	0.01%/°C
Breakdown Voltage, min.	500V dc	500V dc	500V dc	500V dc
Reflected Ripple Current, max.	58 mA pk-pk	24 mA pk-pk	24 mA pk-pk	23 mA pk-pk

	DUAL OUTPUT MODELS				
	BPD-15/190-D5	**BPS-15/190-D12**	**BPS-15/190-D24**	**BPS-15/190-D28**	**BPS-15/190-D48**
Output Voltage	±15V	±15V	±15V	±15V	±15V
Output Current	±190	±190	±190	±190	±190
Input Voltage	5V dc	12V dc	24V dc	28V dc	48V dc
Input Voltage Tolerance	±10%	±10%	±10%	±10%	±10%
No Load Input Current	135 mA	55 mA	30 mA	25 mA	14 mA
Full Load Input Current, max.	1700 mA	710 mA	350 mA	300 mA	180 mA
Line Regulation	0.02%	0.02%	0.02%	0.02%	0.02%
Load Regulation	0.02%	0.02%	0.02%	0.02%	0.02%
Temperature Coefficient	0.01%/°C	0.01%/°C	0.01%/°C	0.01%/°C	0.01%/°C
Breakdown Voltage, min.	500V dc	500V dc	500V dc	500V dc	500V dc
Reflected Ripple Current, max.	20 mA pk-pk	25 mA pk-pk	25 mA pk-pk	24 mA pk-pk	25 mA pk-pk

GENERAL SPECIFICATIONS — ALL MODELS

Output Voltage Accuracy .... ±1%
Output Noise and Ripple, maximum ....50 mV pk-pk (5 mV RMS),
                                        35 mV pk-pk for dual output
Operating Temperature Range .... -25 °C to +71 °C
Storage Temperature Range .... -55 °C to +85 °C
Case Material .... Diallyl Phthalate

The 5 Watt Series uses 2 DILS-1 or DILS-2 terminal strips for sockets.

□ATEL®

MECHANICAL DIMENSIONS AND I/O CONNECTIONS

```
              2.00
             (50.8)
                          G2        0.75
  0.40                              (18.0)
 (10.20)   G3           G1   0.43
                             (11.0)
          0.02 DIA

      +IN      +V dc        1.80
                            1.60  1.70

            NC (COM)        1.10   2.00
                            0.80  (50.8)

      GND      COM          0.30
             (-V dc)        0.10  0.20
                                         REF
  0.10        1.80
```

NOTE: PIN DESIGNATIONS IN PARENTHESIS
ARE FOR BIPOLAR OUTPUT MODELS

SOCKET DILS - 1

```
        A
      B
   .095            Pin Position 21
 188
   100          Cap Removable
            For Contact Replacement
 280                .025
  C
```

Model	No. of Contacts	A	B	C	
DILS-1	20	2.090	1.900	.645	WIRE-WRAP
DILS-2	20	2.090	1.900	.145	SOLDER PIN

LP Series 4.5 Watt
Single and Dual Output
DC-DC Power Converters

℠ ⅅ𝖠𝖳𝖤𝖫

FEATURES

- **Fixed input range; 5V, 24V, 28V (±14%, maximum)**
- **Fixed output; ±15V dc (at 150 mA)**
- **Chassis or PC board mount (2" x 2" x 0.40")**
- **300V dc input to output isolation**
- **Very wide operating temperature (-25 °C to +71 °C)**
- **Output ripple of 1 mV (RMS, maximum)**
- **Delivery from stock!**

GENERAL DESCRIPTION

The LP Series of high performance, mid-range power 4.5 Watt DC-to-DC converters provide the accuracy and reliability you've come to expect from DATEL. All three models are available in a standard 2" x 2" x 0.40" package to cover virtually any application from special in-house designs to high volume OEM use. Their compact size, low price, and rugged reliability means years of cost effective, trouble-free operation under virtually any environmental or electrical condition. Outstanding output accuracy combined with overall temperature coefficient of 0.005% per °C, and very low noise and ripple make these power converters ideal for sensitive circuits.

The 4.5 Watt LP Series are available with fixed input voltages of 5V, 24V, and 28V with voltage tolerances of ±0.25V, ±3.5V, and ±4.0V, respectively. Output voltage is a highly regulated ±15V at ±150 mA. Their industry standard package (2" x 2" x 0.40") and convenient heat sinking capability via two threaded 2-56 studs combined with their low price and off-the-shelf delivery make this series of mid-power DC/DC power converters ideal for a wide range of applications. Just a few of the more common application areas are; Industrial Control Systems, Telecommunications Equipment, Analog Systems, Digital Circuits, Field/Mobile Instrumentation, or wherever high reliability at the lowest possible cost is demanded.
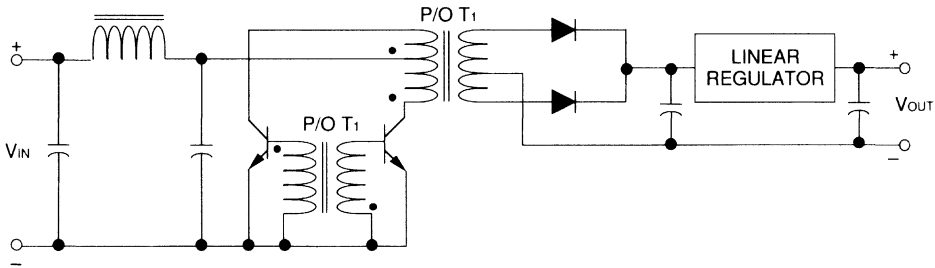
APPLICATIONS

- **Telecommunications Equipment**
- **Local Power Distribution Systems**
- **PC Board Subsystems**
- **Avionics Subsystems/ Instrumentation**
- **Portable Computer and Computer Controlled Equipment**
- **Marine Systems and Equipment**

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356

SPECIFICATIONS

	SINGLE OUTPUT MODELS		
	BPM-15/150-D5	BPM-15/150-D24	BPM-15/150-D28
Output Voltage	±15V dc	±15V dc	±15V dc
Output Voltage Accuracy	±`%	±1%	±1%
Rated Output Current①	±150 mA	±150 mA	±150 mA
Input Voltage	5V dc	24V dc	28V dc
Input Voltage Tolerance	±0.25V	±3.5V	±4V
Maximum Input Current	1.75A	0.35A	0.3A
Efficiency, Full Load	51%	54%	54%
Line Regulation	0.05%	0.05%	0.05%
Load Regulation	0.05%	0.05%	0.05%
Temperature Coefficient, max.	0.005%/°C	0.005%/°C	0.005%/°C
Output Ripple, RMS max.	1 mV	1 mV	1 mV
Output Impedance, max.	0.05Ω	0.05Ω	0.05Ω
Transient Recovery Time, max.	50 μSec	50 μSec	50 μSec
Case Material	Aluminum	Aluminum	Aluminum
Module Size, Inches	2.0 x 2.0 x 0.4	2.0 x 2.0 x 0.4	2.0 x 2.0 x 0.4
Module Size, Millimeters	50.8 x 50.8 x 10.2	50.8 x 50.8 x 10.2	50.8 x 50.8 x 10.2
Module Weight	3.0 ounces (85 grams)	3.0 ounces (85 grams)	3.0 ounces (85 grams)
Case/Pin Configuration	B	B	B
Mating Socket	MS-6	MS-6	MS-6

THESE POWER SUPPLIES ARE COVERED BY GSA CONTRACT

① Above 35 °C (95 °F) mounting surface temperature, derated 1.3 mA/°C.

MECHANICAL DIMENSIONS AND I/O CONNECTIONS
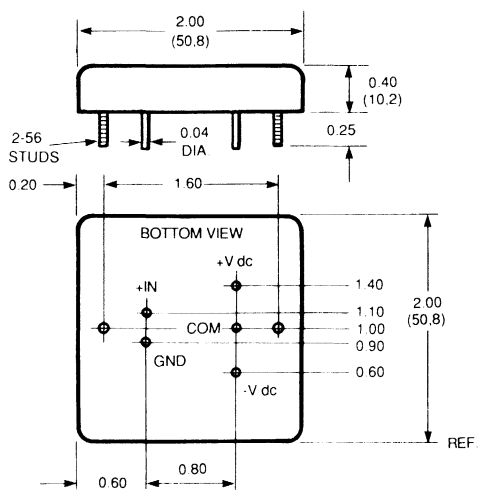
GENERAL SPECIFICATIONS

Isolation Resistance, minimum .... 100 Megohms
Isolation Capacitance, maximum .... 100 pF
BreakdownVoltage, minimum .... 300V dc
Operating Temperature Range .... -25 °C to +71 °C
Storage Temperature Range .... -55 °C to +85 °C

The 4.5 watt Series uses 2 DILS-1 or DILS-2 terminal strips for sockets.

SOCKET MS-6
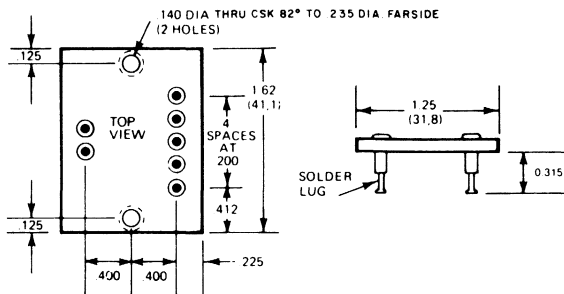
LP Series 3 Watt
Single and Dual Output
DC-DC Power Converters

FEATURES

- **Fixed input range; 5V, 12V, 28V (±10%)**
- **Chassis or PC board mount (2" x 2" x 0.75")**
- **500V dc input to output isolation (300V dc for 24V/28V Models)**
- **Output current limiting short circuit protection**
- **Very wide operating temperature (-25 °C to +71 °C)**
- **Single or dual outputs**
- **Delivery from stock!**

D DATEL

DC DC CONVERTER
UPS-5/600-D12

GENERAL DESCRIPTION

The LP Series of high performance 3 Watt DC-to-DC converters provide the accuracy and reliability you've come to expect from DATEL. Fourteen different 3 Watt models are available in a standard 2" x 2" x 0.75" package to cover virtually any application from special in-house designs to your high volume OEM applications. Their compact size, low price, and rugged reliability means you can meet the design-in price specification for high volume applications without the headaches and worry associated with poor quality offshore throwaways.

Outstanding output accuracy combined with low thermal rise, tight regulation, and very low noise and ripple make these power converters ideal for sensitive circuits. A Pi network

input filter suppresses input reflected ripple current. Additional features include transformer isolation and current-limiting output protection.

The 3 Watt LP Series are available with input voltages of 5V, 12V, 28V (±10%) with either unipolar or bipolar outputs of 5V, 12V, 24V, 28V, ±12V, and ±15V. The 3 Watt LP Series converters are found in applications ranging from Industrial Control Systems, Telecommunications Equipment, Analog Systems, Digital Circuits, Field/Mobile Instrumentation, or wherever high reliability at the lowest possible cost is demanded.

APPLICATIONS

- **Telecommunications Equipment**
- **Local Power Distribution Systems**
- **PC Board Subsystems**
- **Portable/Mobile/Battery Operated Instrumentation**
- **Portable Computer and Computer Controlled Equipment**
- **Low Power Automotive/Avionics/Marine Systems and Equipment**

SPECIFICATIONS
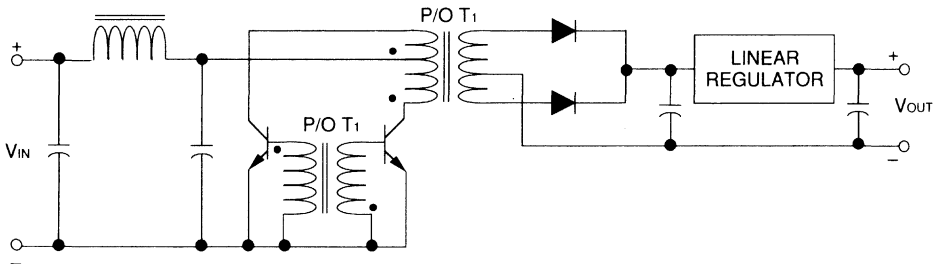
	SINGLE OUTPUT MODELS		
	UPS-5/600-D5	UPS-5/600-D12	UPS-5/600-D28
Output Voltage	5V	5V	5V
Output Current	600 mA	600 mA	600 mA
Input Voltage	5V dc	12V dc	28V dc
Input Voltage Tolerance	±10%	±10%	±10%
No Load Input Current	125 mA	50 mA	20 mA
Full Load Input Current, max.	935 mA	364 mA	135 mA
Line Regulation	0.02%	0.02%	0.02%
Load Regulation	0.04%	0.04%	0.04%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C
Breakdown Voltage, min.	500V dc	500V dc	500V dc
Reflected Ripple Current, max.	32 mA pk-pk	24 mA pk-pk	21 mA pk-pk

	SINGLE OUTPUT MODELS				
	UPS-12/250-D5	UPS-12/250-D28	UPM-24/125-D12	UPM-28/100-D5	UPM-28/100-D12
Output Voltage	12V	12V	24V	28V	28V
Output Current	250 mA	250 mA	125 mA	100 mA	100 mA
Input Voltage	5V dc	28V dc	12V dc	5V dc	12V dc
Input Voltage Tolerance	±10%	±10%	±10%	±10%	±10%
No Load Input Current	140 mA	25 mA	125 mA	300 mA	125 mA
Full Load Input Current, max.	863 mA	125 mA	530 mA	1350 mA	500 mA
Line Regulation	0.02%	0.02%	0.05%	0.05%	0.05%
Load Regulation	0.04%	0.04%	0.05%	0.05%	0.05%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C	0.02%/°C	0.02%/°C
Breakdown Voltage, min.	500V dc	500V dc	300V dc	300V dc	300V dc
Reflected Ripple Current, max.	31 mA pk-pk	21 mA pk-pk	16 mA pk-pk	40 mA pk-pk	15 mA pk-pk

GENERAL SPECIFICATIONS — at 25 °C

Output Voltage Accuracy .... ±1%
Output Noise and Ripple, maximum ....20 mV pk-pk (2 mV RMS),
Operating Temperature Range .... -25 °C to +71 °C
Storage Temperature Range .... -55 °C to +85 °C
Case Material .... Diallyl Phthalate

The 3 watt series uses 2 DILS-1 or DILS-2 terminal strips for sockets.

SPECIFICATIONS

	DUAL OUTPUT MODELS		
	BPS-12/125-D5	BPS-12/125-D12	BPS-12/125-D28
Output Voltage	±12V	±12V	±12V
Output Current	125 mA	125 mA	125 mA
Input Voltage	5V dc	12V dc	28V dc
Input Voltage Tolerance	±10%	±10%	±10%
No Load Input Current	130 mA	55 mA	25 mA
Full Load Input Current, max.	965 mA	380 mA	145 mA
Line Regulation	0.02%	0.02%	0.02%
Load Regulation	0.02%	0.02%	0.02%
Temperature Coefficient	0.01%/°C	0.01%/°C	0.01%/°C
Breakdown Voltage, min.	500V dc	500V dc	500V dc
Reflected Ripple Current, max.	34 mA pk-pk	23 mA pk-pk	21 mA pk-pk

	DUAL OUTPUT MODELS		
	BPS-15/100-D5	BPS-15/100-D12	BPS-15/100-D28
Output Voltage	±15V	±15V	±15V
Output Current	100 mA	100 mA	100 mA
Input Voltage	5V dc	12V dc	28V dc
Input Voltage Tolerance	±10	±10	±10
No Load Input Current	135 mA	55 mA	25 mA
Full Load Input Current, max.	955 mA	376 mA	143 mA
Line Regulation	0.02%	0.02%	0.02%
Load Regulation	0.02%	0.02%	0.02%
Temperature Coefficient	0.01%/°C	0.01%/°C	0.01%/°C
Breakdown Voltage, min.	500V dc	500V dc	500V dc
Reflected Ripple Current, max.	33 mA pk-pk	24 mA pk-pk	21 mA pk-pk

GENERAL SPECIFICATIONS — at 25 °C

Output Voltage Accuracy ....±1%
Output Noise and Ripple, maximum ....20 mV pk-pk (2 mV RMS),
Operating Temperature Range ....-25 °C to +71 °C
Storage Temperature Range..................-55 °C to +85 °C
Case Material ....Diallyl Phthalate

The 3 watt series uses 2 DILS-1 or DILS-2 terminal strips for sockets.

MECHANICAL DIMENSIONS AND I/O CONNECTIONS

SOCKETS DILS-1, DILS-2
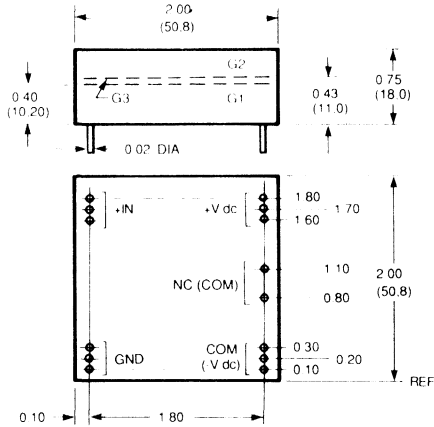
NOTE PIN DESIGNATIONS IN PARENTHESIS
ARE FOR BIPOLAR OUTPUT MODELS
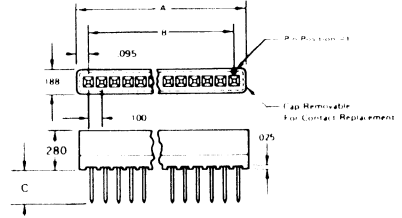
Model	No. of Contacts	A	B	C	
DILS-1	20	2.090	1.900	.645	WIRE-WRAP
DILS-2	20	2.090	1.900	.145	SOLDER PIN

**VERY GENEROUS QUANTITY
DISCOUNTS ARE AVAILABLE.
CONSULT FACTORY.**

**1-800-233-2765
(FAX) 1-508-339-6356**

LP Series 1 Watt
Single and Dual Output
DC-DC Power Converters

D® DATEL®

FEATURES

- **Fixed input range; 5V, 12V, 28V (±10%)**
- **Chassis or PC board mount (2" x 1.5" x 0.38")**
- **300V dc input to output isolation**
- **Output current limiting short circuit protection**
- **Very wide operating temperature (-25 °C to +71 °C)**
- **Single or dual outputs**
- **Delivery from stock!**

DATEL
DC DC
CONVERTER
UPM-5/200-D12

DATEL
DC/DC
CONVERTER
BPM-15 25-D5
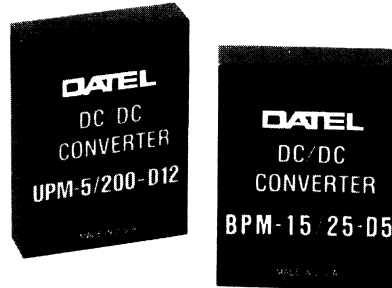
GENERAL DESCRIPTION

The LP Series of high performance 1 Watt DC-to-DC converters provide the accuracy and reliability you've come to expect from DATEL. Thirteen different 1 Watt models are available in a standard 2" x 1.5" x 0.38" package to cover virtually any application from special in-house designs to your high volume OEM applications. Their compact size, low price, and rugged reliability means you can meet the design-in price spec for high volume applications without the headaches and worry associated with poor quality offshore throwaways.

Outstanding output accuracy combined with low thermal rise, tight regulation, and very low noise and ripple make these power converters ideal for sensitive circuits. A Pi network

input filter suppresses input reflected ripple current. Additional features include transformer isolation and current-limiting output protection.

The 1 Watt LP Series are available with input voltages of 5V, 12V, 28V (±10%) with either unipolar or bipolar outputs of 5V, 12V, 24V, 28V, ±12V, and ±15V. The low power LP Series converters are found in applications ranging from Industrial Control Systems, Telecommunications Equipment, Analog Systems, Digital Circuits, Field/Mobile Instrumentation, or wherever high reliability at the lowest possible cost is demanded.

APPLICATIONS

- **Telecommunications Equipment**
- **Local Power Distribution Systems**
- **PC Board Subsystems**
- **Portable/Mobile/Battery Operated Instrumentation**
- **Portable Computer and Computer Controlled Equipment**
- **Low Power Automotive/Avionics/ Marine Systems and Equipment**

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356

SPECIFICATIONS
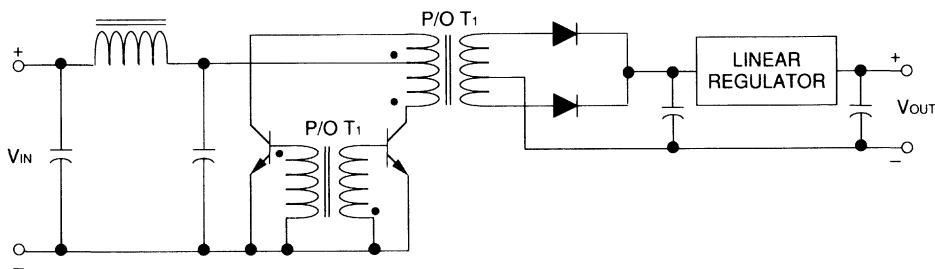
SINGLE OUTPUT MODELS			
	UPM-5/200-D12	**UPM-5/200-D28**	**UPM-12/80-D5**
Output Voltage	12V	28V	5V
Output Current	5V, 200 mA	5V, 200 mA	12V, 80 mA
No Load Input Current	100 mA	40 mA	220 mA
Full Load Input Current, max.	220 mA	100 mA	500 mA
Line Regulation	0.05%	0.05%	0.05%
Load Regulation	0.01%	0.01%	0.05%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C
Output Noise and Ripple, max.	20 mV pk-pk	20 mV pk-pk	20 mV pk-pk
Reflected Ripple Current, max.	1V mA pk-pk	5 mA pk-pk	25 mA pk-pk
Isolation Voltage, min.	300V dc	300V dc	300V dc

SINGLE OUTPUT MODELS				
	UPM-24/40-D5	**UPM-24/40-D12**	**UPM-28/25-D5**	**UPM-28/25-D12**
Output Voltage	5V	12V	5V	12V
Output Current	24V, 40 mA	24V, 40 mA	28V, 25 mA	28V, 25 mA
No Load Input Current	220 mA	95 mA	160 mA	80 mA
Full Load Input Current, max.	500 mA	210 mA	400 mA	180 mA
Line Regulation	0.05%	0.05%	0.05%	0.05%
Load Regulation	0.05%	0.05%	0.05%	0.05%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C	0.02%/°C
Output Noise and Ripple, max.	20 mV pk-pk	20 mV pk-pk	20 mV pk-pk	20 mV pk-pk
Reflected Ripple Current, max.	25 mA pk-pk	10 mA pk-pk	20 mA pk-pk	9 mA pk-pk
Isolation Voltage, min.	300V dc	300V dc	300V dc	300V dc

COMMON SPECIFICATIONS

(Typical at 25 °C unless noted.)

Input Voltage Tolerance	±10%
Output Voltage Accuracy	±1.0%
Transient Recovery Time	50 µSec
Short Circuit Protection	Output Current Limiting
Operating Temperature Range	-25 °C to +71 °C
Storage Temperature Range	-55 °C to +85 °C
Output Impedance	0.02Ω
	(0.07Ω for UPM-5/200 Model)
Back Ripple Current, maximum	5% (3% typical) of I_{IN}
Capacitive Coupling, maximum	50 pF
Breakdown Voltage, minimum	300V dc
Case Material	Dially Phthalate
Weight	1.5 ounce (43 grams)

The 1 watt Series uses 2 DILS-1 or DILS-2 terminal strips for sockets.

SPECIFICATIONS

	DUAL OUTPUT MODELS		
	BPM-12/25-D5	BPM-12/25-D12	BPM-12/25-D28
Input Voltage	5V	12V	28V
Output Current	±12, ±25 mA	±12, ±25 mA	±12, ±25 mA
No Load Input Current	150 mA	80 mA	30 mA
Full Load Input Current, max.	350 mA	165 mA	65 mA
Line Regulation	0.05%	0.05%	0.05%
Load Regulation	0.05%	0.05%	0.05%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C
Output Noise and Ripple, max.	20 mV pk-pk	20 mV pk-pk	20 mV pk-pk
Reflected Ripple Current, max.	17 mA pk-pk	8 mA pk-pk	3 mA pk-pk
Isolation Voltage, min.	300V dc	300V dc	300V dc

	DUAL OUTPUT MODELS		
	BPM-15/25-D5	BPM-15/28-D12	BPM-15/25-D28
Input Voltage	5V	12V	28V
Output Current	±15, ±25 mA	±15, ±25 mA	±15, ±25 mA
No Load Input Current	160 mA	80 mA	30 mA
Full Load Input Current, max.	400 mA	180 mA	80 mA
Line Regulation	0.05%	0.05%	0.05%
Load Regulation	0.05%	0.05%	0.05%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C
Output Noise and Ripple, max.	20 mV pk-pk	20 mV pk-pk	20 mV pk-pk
Reflected Ripple Current, max.	20 mA pk-pk	9 mA pk-pk	4 mA pk-pk
Isolation Voltage, min.	300V dc	300V dc	300V dc

COMMON SPECIFICATIONS

(Typical at 25 °C unless noted.)

```
Input Voltage Tolerance ........................±10%
Output Voltage Accuracy .....................±1.0%
Transient Recovery Time ......................50 µSec
Short Circuit Protection.........................Output Current Limiting
Operating Temperature Range .............-25 °C to +71 °C
Storage Temperature Range.................-55 °C to +85 °C
Output Impedance ................................0.02Ω
Back Ripple Current, maximum     5% (3% typical) of $I_{IN}$
Capacitive Coupling, maximum............50 pF
Breakdown Voltage, minimum..............300V dc
Case Material........................................Dially Phthalate
Weight ..................................................1.5 ounce (43 grams)
```

The 1 watt Series uses 2 DILS-1 or DILS-2 terminal strips for sockets.

MECHANICAL DIMENSIONS AND I/O CONNECTIONS

SOCKETS DILS-1, DILS-2

2.00
(50.8)

0.38 (9.5)

0.15 MIN.

0.02 DIA.

BOTTOM VIEW

+IN

+V dc — 1.10

(+V dc) COM — 0.90

COM — 0.60

0.40

GND   (COM) -V dc

1.50
(38,1)

REF.

1.70

0.10
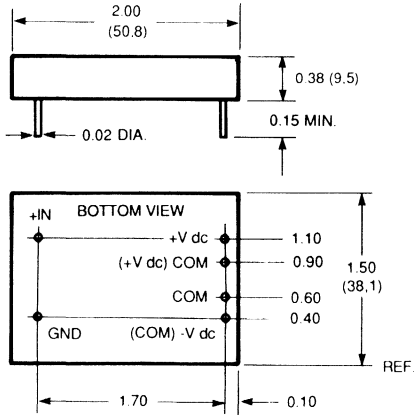
NOTE: PIN DESIGNATIONS IN PARENTHESIS
ARE FOR UNIPOLAR OUTPUT MODELS
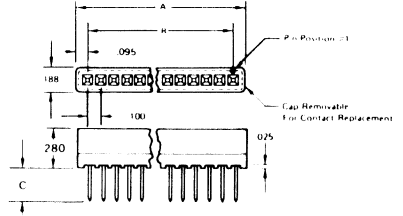
Model	No. of Contacts	A	B	C	
DILS-1	20	2.090	1.900	.645	WIRE-WRAP
DILS-2	20	2.090	1.900	.145	SOLDER PIN

Wide Input Range,
15/25/30 Watt, Single, Dual, Triple Output DC-DC Power Converters

®Ⓓ®ⅅ𝒜𝕋𝔼𝕃®

FEATURES

- **Wide input ranges; 9 - 18V dc, 18 - 36V dc**
- **State-of-the-Art Thermal Management Technologies**
- **Internal input/output filtering**
- **Short circuit protection**
- **100 KHz switching frequencies**
- **Six-sided shield for EMI/RFI protection**
- **Remote ON/OFF control**
- **Available in +5V, ±12V, ±15V outputs**
- **Delivery from stock**

GENERAL DESCRIPTION

These mid and high power dc-to-dc power converters feature wide ranging inputs for general applicability across a board spectrum of applications. Featuring switching frequencies to 100 KHz and operating efficiencies of 84% (typical), their very low thermal rise and temperature coefficient of ±0.02% per °C (maximum) results in trouble-free operation for prolonged periods. Their very wide input ranges are ideal for battery powered applications found in automotive, aerospace, marine, and telecommunication applications.

All models feature remote ON/OFF control capability, input to output isolation of 500V dc (minimum), short circuit protection, and six-sided continuous shielding for EMI/RFI protection. A Pi

network input filter, reverse voltage protection (via shunt diode), overvoltage protection on all ranges, and external trimming capability (±10%) are ideal for sensitive circuitry requiring a semi-custom output voltage. Output ripple is a low 10 mV (RMS, maximum) with output voltage accuracy of ±1% (depending upon model). Remote ON/OFF logic compatibility is CMOS (or Open Controller TTL) with "ON" levels of +5.5V dc or OPEN circuit) and "OFF" level of 1.8V dc. Shutdown idle current is 5 mA and input resistance of ON/OFF control pin is 100 Kohms (0 to 9V dc). The 15 Watt converter modules measure 2.56" x 3.0" x 0.83" while the 25 and 30 Watt converters are 4.56" x 2.56" x 0.83". All converters are easily PC board mountable.
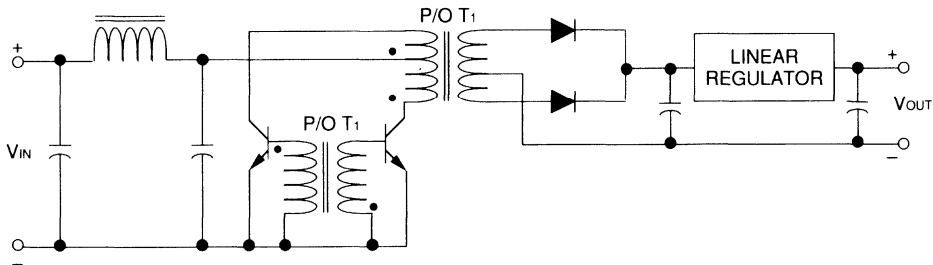
APPLICATIONS

- **Telecommunications Equipment**
- **Local Power Distribution Systems**
- **PC Board Subsystems**
- **Portable/Mobile/Battery Operated Instrumentation**
- **Field Use Equipment**
- **Portable Computer and Computer Controlled Equipment**
- **Automotive/Avionics/Marine Systems and Equipment**

SPECIFICATIONS

	SINGLE OUTPUT MODELS			
	UPS-5/3000-D12	UPS-5/3000-D24	UPS-5/5000-D12	UPS-5/5000-D24
Output Voltage	+5V	+5V	+5V	+5V
Output Current	+3000 mA	+3000 mA	+5000 mA	+5000 mA
Input Voltage (Nominal)	12V	24V	12V	24V
Input Voltage Tolerance	9 — 18V	18 — 36V	9 — 18V	18 — 36V
No Load Input Current, max.	30 mA	20 mA	30 mA	20 mA
Full Load Input Current, max.	1700 mA	810 mA	2800 mA	1350 mA
Line Regulation, max.	±0.2%	±0.2%	±0.2%	±0.2%
Load Regulation, max.	±1%	±1%	±1%	±1%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C	0.02%/°C
Case Configuration	X	X	Z	Z

	SINGLE OUTPUT MODELS			
	UPS-12/1250-D12	UPS-12/1250-D24	UPS-12/2500-D12	UPS-12/2500-D24
Output Voltage	+12V	+12V	+12V	+12V
Output Current	+1250 mA	+1250 mA	+2500 mA	+2500 mA
Input Voltage (Nominal)	12V	24V	12V	24V
Input Voltage Tolerance	9 - 18V	18 - 36V	9 - 18V	18 - 36V
No Load Input Current, max.	30 mA	20 mA	30 mA	20 mA
Full Load Input Current, max.	1600 mA	780 mA	3200 mA	1550 mA
Line Regulation, max.	±0.2%	±0.2%	±0.2%	±0.2%
Load Regulation, max.	±1%	±1%	±1%	±1%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C	0.02%/°C
Case Configuration	X	X	Z	Z

SPECIFICATIONS (Single Outputs)

All specifications typical at nominal line, full load, and 25 °C unless otherwise noted.

INPUT SPECIFICATIONS
Input Range .... 12V (9 — 18V)
24V (18 — 36V)
Input Filter .... PI Type
Reverse Voltage Protection .... Internal Shunt Diode

OUTPUT SPECIFICATIONS
Voltage Accuracy
Single Output, maximum .... ±1%
External Trim Adjustment Range .... ±10%
Ripple and Noise (20 MHz BW) .... 10 mV RMS
(75 mV pk-pk, maximum)
Temperature Coefficient, maximum ..... ±0.02% per °C
Short Circuit Protection .... Indefinite
Overvoltage Protection
5V, typical 6.8V
12V, typical 15V
Line Regulation
Single, maximum .... ±0.2%
Load Regulation
Single, maximum .... ±1%

GENERAL SPECIFICATIONS
Efficiency
Minimum 75%
Typical 84%
Isolation Voltage, minimum .... 500V dc
Isolation Resistance .... 10 Megohms
Switching Frequency .... 100 KHz
Case Grounding .... Capacitively coupled to input
Operating Temperature .... -25 °C to +71 °C
Storage Temperature .... -40 °C to +100 °C
EMI/RFI .... Six-sided continuous shield
Case Material .... Black coated copper with
non-conductive base

REMOTE ON/OFF CONTROL
Logic Compatibility .... CMOS or open collector TTL
Ec - ON .... +5.5V dc or open collector
Ec - OFF .... 1.8V dc
Shutdown Idle Current .... 5 mA
Input Resistance .... (EIN 0 to 9V dc), 100 Kohms
Control Common .... Referenced to Input Minus

DATEL®

SPECIFICATIONS

	SINGLE OUTPUT MODELS			
	UPS-15/1000-D12	UPS-15/1000-D24	UPS-15/2000-D12	UPS-15/2000-D24
Output Voltage	+15V	+15V	+15V	+15V
Output Current	+1000 mA	+1000 mA	+2000 mA	+2000 mA
Input Voltage (Nominal)	12V	24V	12V	24V
Input Voltage Tolerance	9 - 18V	18 - 36V	9 - 18V	18 - 36V
No Load Input Current, max.	30 mA	20 mA	30 mA	20 mA
Full Load Input Current, max.	1600 mA	780 mA	3200 mA	1550 mA
Line Regulation, max.	±0.2%	±0.2%	±0.2%	±0.2%
Load Regulation, max.	±1%	±1%	±1%	±1%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C	0.02%/°C
Case Configuration	X	X	Z	Z

SPECIFICATIONS (Single Outputs)

All specifications typical at nominal line, full load, and 25 °C unless otherwise noted.

INPUT SPECIFICATIONS

Input Range ....12V (9 — 18V)
                                                        24V (18 — 36V)
Input Filter ....PI Type
Reverse Voltage Protection ....Internal Shunt Diode

OUTPUT SPECIFICATIONS

Voltage Accuracy
   Single Output, maximum ....±1%
External Trim Adjustment Range ....±10%
Ripple and Noise (20 MHz BW) ....10 mV RMS
                                                        (75 mV pk-pk, maximum)
Temperature Coefficient, maximum .....±0.02% per °C
Short Circuit Protection ....Indefinite
Overvoltage Protection
   15V, typical..18V
Line Regulation
   Single, maximum ....±0.2%
Load Regulation
   Single, maximum ....±1%

GENERAL SPECIFICATIONS

Efficiency
   Minimum...75%
   Typical 84%
Isolation Voltage, minimum ....500V dc
Isolation Resistance ....10 Megohms
Switching Frequency ....100 KHz
Case Grounding ....Capacitively coupled to input
Operating Temperature ....-25 °C to +71 °C
Storage Temperature.............................-40 °C to +100 °C
EMI/RFI ....Six-sided continuous shield
Case Material...Black coated copper with
                                                        non-conductive base

REMOTE ON/OFF CONTROL

Logic Compatibility...............................CMOS or open collector TTL
Ec - ON ....+5.5V dc or open collector
Ec - OFF ....1.8V dc
Shutdown Idle Current ....5 mA
Input Resistance ....(E_{IN} 0 to 9V dc), 100 Kohms
Control Common....................................Referenced to Input Minus

SPECIFICATIONS

DUAL OUTPUT MODELS			
	BPS-12/625-D12	BPS-12/625-D24	BPS-12/1250-D12	BPS-12/1250-D24
Output Voltage	±12V	±12V	±12V	±12V
Output Current	±625 mA	±625 mA	±1250 mA	±1250 mA
Input Voltage (Nominal)	12V	24V	12V	24V
Input Voltage Tolerance	9 — 18V	18 — 36V	9 — 18V	18 — 36V
No Load Input Current, max.	25 mA	25 mA	25 mA	25 mA
Full Load Input Current, max.	1520 mA	750 mA	3050 mA	1500 mA
Line Regulation, max.	±0.2%	±0.2%	±0.2%	±0.2%
Load Regulation, max.	±1%	±1%	±1%	±1%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C	0.02%/°C
Case Configuration	X1	X1	Z1	Z1

DUAL OUTPUT MODELS			
	BPS-15/500-D12	BPS-15/500-D24	BPS-15/1000-D12	BPS-15/1000-D24
Output Voltage	±15V	±15V	±15V	±15V
Output Current	±500 mA	±500 mA	±1000 mA	±1000 mA
Input Voltage (Nominal)	12V	24V	12V	24V
Input Voltage Tolerance	9 - 18V	18 - 36V	9 - 18V	18 - 36V
No Load Input Current, max.	25 mA	25 mA	25 mA	25 mA
Full Load Input Current, max.	1520 mA	750 mA	3050 mA	1500 mA
Line Regulation, max.	±0.2%	±0.2%	±0.2%	±0.2%
Load Regulation, max.	±1%	±1%	±1%	±1%
Temperature Coefficient	0.02%/°C	0.02%/°C	0.02%/°C	0.02%/°C
Case Configuration	X1	X1	Z1	Z1

SPECIFICATIONS (Dual Outputs)

All specifications typical at nominal line, full load, and 25 °C
unless otherwise noted.

INPUT SPECIFICATIONS

Input Range ....12V (9 — 18V)
24V (18 — 36V)
Input Filter ....PI Type
Reverse Voltage Protection ....Internal Shunt Diode

OUTPUT SPECIFICATIONS

Voltage Accuracy
Dual Output, maximum
+ Output ....±1%
- Output ....±3%
External Trim Adjustment Range ....±10%
Ripple and Noise (20 MHz BW) ....10 mV RMS (75 mV pk-pk,
max.)
Temperature Coefficient, maximum .....±0.02% per °C
Short Circuit Protection ....Indefinite
Overvoltage Protection
12V, typical..15V
15V, typical..18V
Line Regulation
Dual, maximum ....±0.2%
Load Regulation
Dual, maximum ....±1%

GENERAL SPECIFICATIONS

Efficiency
Minimum...75%
Typical 84%
Isolation Voltage, minimum ....500V dc
Isolation Resistance ....10 Megohms
Switching Frequency ....100 KHz
Case Grounding ....Capacitively coupled to input
Operating Temperature ....-25 °C to +71 °C
Storage Temperature ....-40 °C to +100 °C
EMI/RFI...Six-sided continuous shield
Case Material...Black coated copper with
non-conductive base

REMOTE ON/OFF CONTROL

Logic Compatibility...............................CMOS or open collector TTL
Ec - ON ....+5.5V dc or open collector
Ec - OFF ....1.8V dc
Shutdown Idle Current ....5 mA
Input Resistance ....(E_{IN} 0 to 9V dc), 100 Kohms
Control Common....................................Referenced to Input Minus

SPECIFICATIONS

	TRIPLE OUTPUT MODELS			
	TPS-5/1500-12/310-D12	TPS-5/1500-12/310-D24	TPS-5/1500-15/250-D12	TPS-5/1500-15/250-D24
Output Voltage	+5/±12V	+5/±12V	+5/±15V	+5/±15V
Output Current	+1500/±310 mA	+1500/±310 mA	+1500/±250 mA	+1500/±250 mA
Input Voltage (Nominal)	12V	24V	12V	24V
Input Voltage Tolerance	9 - 18V	18 - 36V	9 - 18V	18 - 36V
No Load Input Current, max.	50 mA	40 mA	50 mA	40 mA
Full Load Input Current, max.	1600 mA	780 mA	1600 mA	780 mA
Line Regulation, max.	±1%	±1%	±1%	±1%
Load Regulation, max.	±5%	±5%	±5%	±5%
Temperature Coefficient	0.05%/°C	0.05%/°C	0.05%/°C	0.05%/°C
Case Configuration	T	T	T	T

SPECIFICATIONS (Triple Outputs)

All specifications typical at nominal line, full load, and 25 °C unless otherwise noted.

INPUT SPECIFICATIONS

Input Range .... 12V (9 — 18V)
24V (18 — 36V)
Input Filter .... PI Type
Reverse Voltage Protection .... Internal Shunt Diode

OUTPUT SPECIFICATIONS

Voltage Accuracy
  Triple Output, maximum
    5V .... ±2%
    12V/15V .... ±3%
External Trim Adjustment Range .... ±10%
Ripple and Noise (20 MHz BW) .... 10 mV RMS (75 mV pk-pk,
max.)
Temperature Coefficient, maximum ..... ±0.02% per °C
Short Circuit Protection .... Indefinite
Overvoltage Protection
  5V, typical 6.8V
  12V, typical 15V
  15V, typical 18V
Line Regulation
  Triple, maximum .... ±1%
Load Regulation
  Triple, maximum .... ±5%

GENERAL SPECIFICATIONS

Efficiency
  Minimum 75%
  Typical 84%
Isolation Voltage, minimum .... 500V dc
Isolation Resistance .... 10 Megohms
Switching Frequency .... 100 KHz
Case Grounding .... Capacitively coupled to input
Operating Temperature .... -25 °C to +71 °C
Storage Temperature .... -40 °C to +100 °C
EMI/RFI .... Six-sided continuous shield
Case Material .... Black coated copper with
non-conductive base

REMOTE ON/OFF CONTROL

Logic Compatibility .... CMOS or open collector TTL
Ec - ON .... +5.5V dc or open collector
Ec - OFF .... 1.8V dc
Shutdown Idle Current .... 5 mA
Input Resistance .... (E$_{IN}$ 0 to 9V dc), 100 Kohms
Control Common .... Referenced to Input Minus

MECHANICAL AND INPUT/OUTPUT CONNECTIONS

	PIN FUNCTIONS		
Pin Number	Single (UPS)	Dual (BPS)	Triple (TPS)
1	+ Input	+ Input	+ Input
2	- Input	- Input	- Input
3	No Pin	+ Output	+ Output
4	Output Trim	Common	Common
5	No Pin	- Output	- Output
6	+ Output	No Pin	+5V dc Output
7	No Pin	No Pin	No Pin
8	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF

CASE PIN CONNECTIONS

	PIN CONNECTIONS				
Pin Number	X	X1	T	Z	Z1
1	+ Input	+ Input	+ Input	+ Input	+ Input
2	- Input	- Input	- Input	- Input	- Input
3	No Pin	+ Output	+ Output	+ Sense	+ Output
4	Output Trim	Common	Common	Output Trim	Common
5	No Pin	- Output	- Output	- Sense	- Output
6	+ Output	No Pin	+5V dc Output	+ Output	No Pin
7	Output	No Pin	No Pin	- Output	No Pin
8	ON/OFF	ON/OFF	ON/OFF	ON/OFF	ON/OFF

CASE X/T
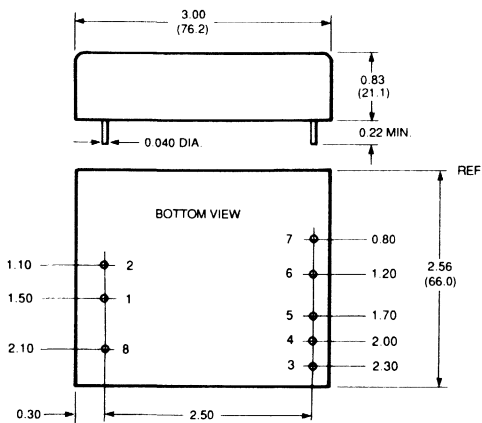
CASE Z
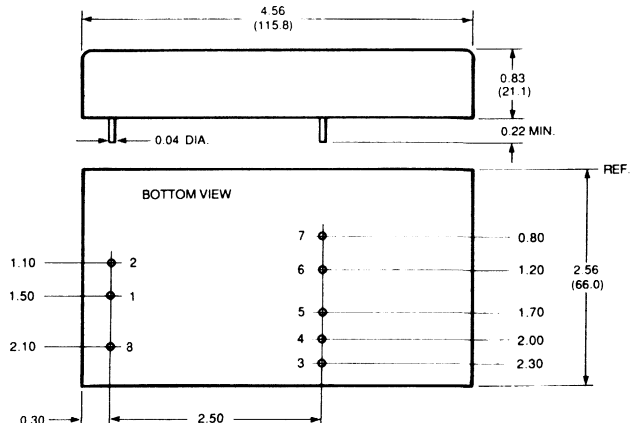
Contact DATEL for:

- **Power Supplies**

- **Data Conversion Components**

- **Data Acquisition & Control Boards**

- **Panel Meters, Printers, & Calibrators**

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for
Immediate Assistance

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356

AC-to-DC
Power Supplies
and Modules

Line Powered

+5V dc Output
Power Modules

D® DATEL®

FEATURES

- **Operated from line voltage (115 VAC ±10%, 60-440 Hz)**
- **Fully regulated**
- **High accuracy (±1%)**
- **Current limiting short circuit protection**
- **Isolated to 1500 VAC**
- **Wide operating temperature (-25 °C to +71 °C without derating)**
- **Very low output ripple (1mV, maximum)**
- **Output current to 2 Amps at 5V dc**
- **Delivery from stock**
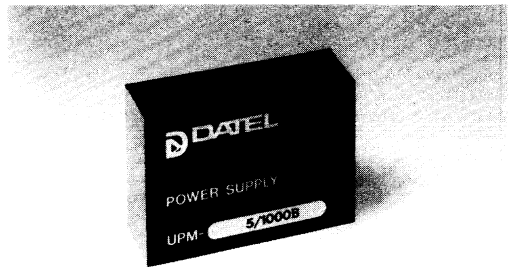
GENERAL DESCRIPTION

The UPM-5 Series of line operated power modules are high performance dc supplies capable of providing a fully regulated +5 V dc output at currents from 250 mA to 2 Amps. Their compact size (3.5" x 2.5" x 0.875"), modular design, and ability to be socketed (socket # MS-7) make them ideal for PC board mount applications.

AC input-to-dc output isolation is rated at 1500 VRMS with isolation resistance of 100 Megohms. Four different output ratings (250 mA, 500 mA, 1.0A, and 2.0A) from five different supplies allows you to match your application with the supply that fits rather than settling for an "almost right" choice. Temperature coefficients of 0.02% per °C (maximum) com-

bined with an operating temperature range of -25 °C to +71 °C means accurate, trouble-free operation over prolonged periods. Also, every UPM-5 Series power module has #4-40 x 0.15 deep threaded inserts (2 each) for easy heat sink mounting or for mounting the supply to a variety of surfaces. The UPM-5 Series has excellent output voltage regulation with output ripple limited to 1 mV, maximum. Transient recovery time is 50 µSec (maximum) with current limiting short circuit protection to ensure safe operation for your other circuits.

Case material is phenolic and packaging/pinout is compatible with most other industry standard AC-to-dc supplies making them ideal as the first or second source drop-in.

APPLICATIONS

- **Telecommunications Equipment**
- **Local Power Distribution Systems**
- **PC Board Subsystems**
- **Bench Top Instrumentation**
- **Process Instrumentation**
- **Laboratory Equipment**
- **Computer Controlled Equipment**

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356
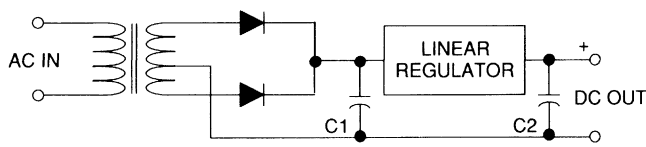
SPECIFICATIONS

	+5V dc OUTPUT MODELS				
	UPM-5/250	**UPM-5/500**	**UPM-5/1000**	**UPM-5/1000B**	**UPM-5/2000**
Output Voltage	5V dc	5V dc	5V dc	5V dc	5V dc
Output Current	250 mA	500 mA	1000 mA	1000 mA	2000 mA
Line Regulation	0.1%	0.1%	0.1%	0.25%	0.1%
Load Regulation	0.05%	0.05%	0.05%	0.25%	0.05%
Output Accuracy	±1%	±1%	±1%	±2%	±1%
Output Impedance (Ohms)	0.05	0.05	0.01	0.01	0.005
Weight	14 ounces (397 grams)	14 ounces (397 grams)	18 ounces (510 grams)	18 ounces (510 grams)	24 ounces (680 grams)
Case Size	C1	C1	C2	C2	C3

MECHANICAL DIMENSIONS AND I/O CONNECTIONS
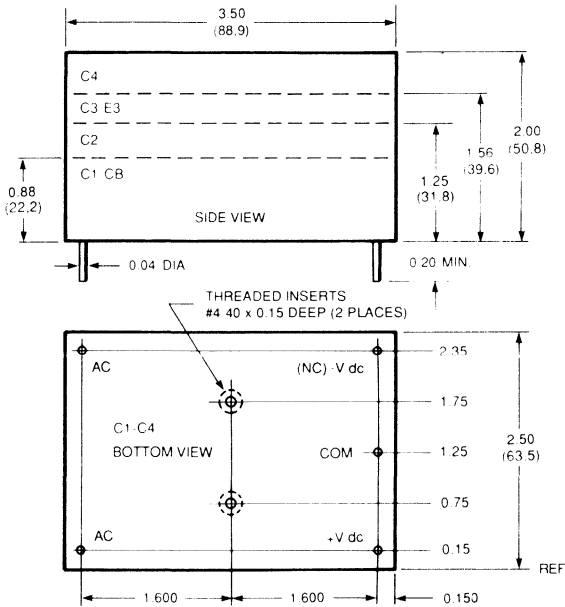
GENERAL SPECIFICATIONS (at 25 °C)

Voltage Input ....103.5 to 126.5 VAC
                              60 to 440 Hz
Temperature Coefficient   0.02% per
Output Ripple, maximum ....1 mV RMS
Transient Recovery Time, maximum ...50 µSec
Isolation Resistance, minimum ....100 Megohms
Isolation Capacitance, maximum ....250 pF
Breakdown Voltage, minimum..............1500 VAC
Operating Temperature ....-25 °C to +71°C
                            (No Derating)
Storage Temperature.............................-25 °C to +85°C
Case Material..Phenolic
Module Size
  UPM-5/250 ....3.5" x 2.5" x 0.88"
                           (88.9 x 63.5 x 22.2)
  UPM-5/ 500 ....3.5" x 2.5" x 0.88"
                           (88.9 x 63.5 x 22.2)
  UPM-5/1000 ....3.5" x 2.5" x 1.25"
                           (88.9 x 63.5 x 31.8)
  UPM-55/1000B..............................3.5" x 2.5" x 1.25"
                           (88.9 x 63.5 x 31.8)
  UPM-5/2000 ....3.5" x 2.5" x 1.56"
                           (88.9 x 63.5 x 39.6)

SOCKET MS-7
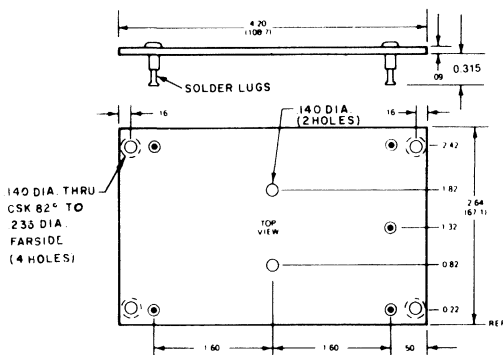
Line Operated
Dual Output
Power Modules

DATEL®

FEATURES

- **Operated from line voltage (115 VAC ±10%, 60-440 Hz)**
- **Fully regulated ±5V, ±12V, ±15V**
- **High accuracy (±1%)**
- **Current limiting short circuit protection**
- **Isolated to 1500 VAC**
- **Wide operating temperature (-25 °C to +71 °C no derating)**
- **Very low output ripple**
- **Delivery from stock**
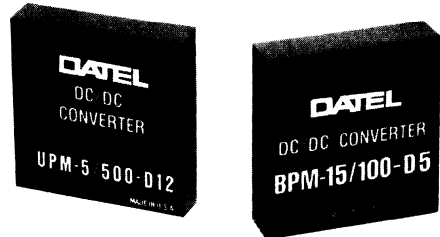
GENERAL DESCRIPTION

The BPM-5, BPM-12, and BPM-15 Series of line operated dual output power modules are high performance DC supplies capable of providing a fully regulated output of ±5V, ±12V, and ±15V at currents from 60 mA to 500 mA (depending upon model). Their compact size (3.5" x 2.5"), modular design, and ability to be socketed (socket # MS-7) make them ideal for PC board mount applications.

AC input-to-dc output isolation is rated at 1500 VRMS with isolation resistance of 100 Megohms. Multiple output ratings (±60 mA, ±100 mA, ±200 mA, ±250 mA, ±300 mA, and ±500 mA) from nine different supplies allows you to match your application with the supply that fits rather than settling for an "almost right" choice. Temperature coefficients of 0.02% per °C (maximum) combined with an operating temperature range

of -25 °C to +71 °C means accurate, trouble-free operation over prolonged periods. Also, every BPM-5, BPM-12, and BPM-15 Series power module has #4-40 x 0.15 deep threaded inserts (2 each) for easy heat sink mounting or for mounting the supply to a variety of surfaces. The BPM Series has excellent output voltage regulation with output ripple limited to 1 mV (BPM-5 models only, all others are 2 mV). Transient recovery time is 50 μSec (maximum) with current limiting short circuit protection to ensure safe operation for your other circuits.

Case material is phenolic and packaging/pinout is compatible with most other industry standard AC-to-dc supplies making them ideal as the first or second source drop-in.
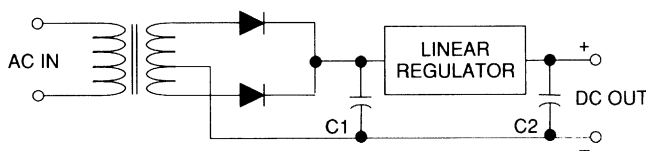
APPLICATIONS

- **Telecommunications Equipment**
- **Local Power Distribution Systems**
- **PC Board Subsystems**
- **Bench Top Instrumentation**
- **Process Instrumentation**
- **Laboratory Equipment**
- **Computer Controlled Equipment**

SPECIFICATIONS

DUAL OUTPUT MODELS		
	BPM-5/250	BPM-5/500
Output Voltage	±5V dc	±5V dc
Output Current	±250 mA	±500 mA
Line Regulation	0.1%	0.1%
Load Regulation	0.05%	0.05%
Output Accuracy	±1%	±1%
Output Impedance (Ohms)	0.05	0.03
Weight	14 oz. (397 grams)	18 oz. (510 grams)
Case Size	C1	C2

DUAL OUTPUT MODELS		
	BPM-12/100	BPM-12/200	BPM-12/300
---	---	---	---
Output Voltage	±12V dc	±12V dc	±12V dc
Output Current	±100 mA	±200 mA	±300 mA
Line Regulation	0.05%	0.05%	0.05%
Load Regulation	0.02%	0.02%	0.02%
Output Accuracy	±2%	±1%	±1%
Output Impedance (Ohms)	0.1	0.05	0.05
Weight	14 oz. (397 grams)	18 oz. (510 grams)	24 oz. (680 grams)
Case Size	C1	C2	C3

GENERAL SPECIFICATIONS (at 25 °C)

Voltage Input ....103.5 to 126.5 VAC
　　　　　　　　　　　　　　　　　　60 to 440 Hz
Temperature Coefficient........................0.02% per °C
Output Ripple, maximum
　BPM-5 Models only...........................1 mV RMS
　BPM-12 ....2 mV RMS
　BPM-15 ....2 mV RMS
Transient Recovery Time, maximum ...50 μSec
Isolation Resistance, minimum ....100 Megohms
Isolation Capacitance, maximum ....250 pF
Breakdown Voltage, minimum..............1500 VAC
Operating Temperature ....-25 °C to +71 °C
　　　　　　　　　　　　　　　　　　(No Derating)
Storage Temperature.............................-25 °C to +85 °C
Case Material...Phenolic
Module Size ....3.5" x 2.5" (88.9 x 63.5)
　　　　　　　　　　　　　　　　　　See Case Sizes for Height

SPECIFICATIONS

	DUAL OUTPUT MODELS			
	BPM-15/60	BPM-15/100	BPM-15/200	BPM-15/300
Output Voltage	±15V dc	±15V dc	±15V dc	±15V dc
Output Current	60 mA	100 mA	200 mA	300 mA
Line Regulation	0.05%	0.05%	0.05%	0.05%
Load Regulation	0.02%	0.02%	0.02%	0.02%
Output Accuracy	±1%	±1%	±1%	±1%
Output Impedance (Ohms)	0.2	0.1	0.05	0.03
Weight	14 oz. (397 grams)	14 oz. (397 grams)	18 oz. (510 grams)	24 oz. (680 grams)
Case Size	C1	C1	C2	C3

GENERAL SPECIFICATIONS (at 25 °C)

Voltage Input ....103.5 to 126.5 VAC
                        60 to 440 Hz
Temperature Coefficient........................0.02% per °C
Output Ripple, maximum
  BPM-5 Models only...........................1 mV RMS
  BPM-12 ....2 mV RMS
  BPM-15 ....2 mV RMS
Transient Recovery Time, maximum ...50 µSec
Isolation Resistance, minimum ....100 Megohms
Isolation Capacitance, maximum ....250 pF
Breakdown Voltage, minimum..............1500 VAC
Operating Temperature ....-25 °C to +71 °C
                        (No Derating)
Storage Temperature............................-25 °C to +85 °C
Case Material...Phenolic
Module Size ....3.5" x 2.5" (88.9 x 63.5)
                        See Case Sizes for Height

MECHANICAL DIMENSIONS AND I/O CONNECTIONS   SOCKET MS-7
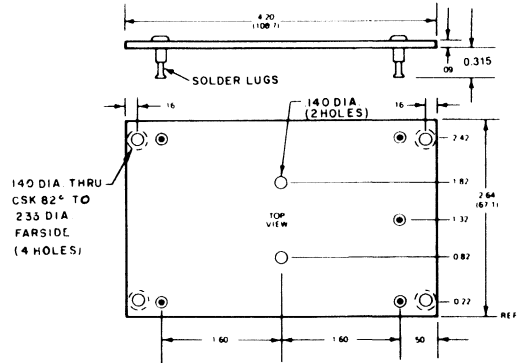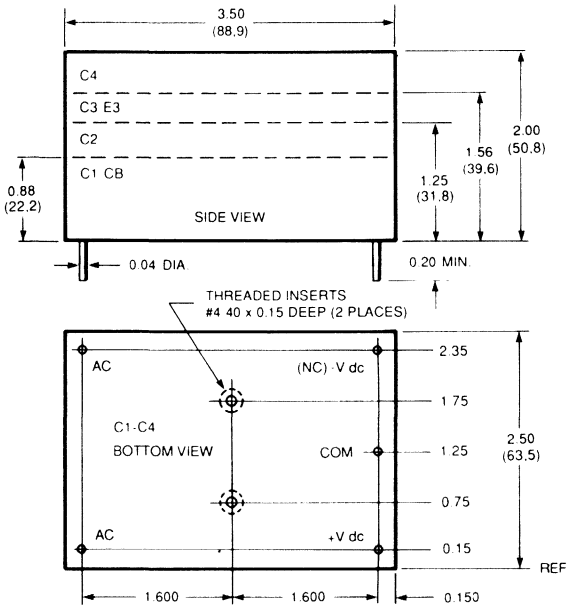
SIDE VIEW

3.50
(88,9)

C4

C3 E3

C2

C1 CB

2.00
(50,8)

1.56
(39,6)

1.25
(31,8)

0.88
(22,2)

0.04 DIA

0.20 MIN.

THREADED INSERTS
#4 40 x 0.15 DEEP (2 PLACES)

BOTTOM VIEW

AC   (NC) -V dc

C1-C4

COM

AC   +V dc

2.35

1.75

1.25

0.75

0.15

2.50
(63.5)

REF

1.600   1.600   0.150

SOLDER LUGS

4.20
(106.7)

0.315

.09

140 DIA
(2 HOLES)

16   16

140 DIA THRU
CSK 82° TO
.235 DIA
FARSIDE
(4 HOLES)

TOP
VIEW

2.42

1.82

2.64
(67.1)

1.32

0.82

0.22

REF

1.60   1.60   .50

Line Operated

Triple Output
Power Modules

𝔻° ⎯⎯⎯⎯⎯®

FEATURES

- **Operated from line voltage (115 VAC ±10%, 60-440 Hz)**
- **Fully regulated**
- **High accuracy (±1%)**
- **Current limiting short circuit protection**
- **Isolated to 1500 VAC**
- **Delivery from stock**
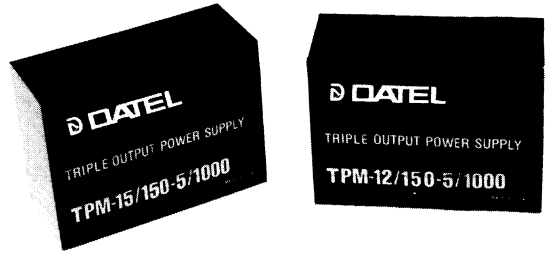
GENERAL DESCRIPTION

The TPM Series of line operated triple output power modules are high performance dc supplies capable of providing a fully regulated output of ±12/5V and ±15V/5V from 115VAC (±10%) line power. Their compact size (3.5" x 2.5"), modular design, and ability to be socketed (socket # MS-13) make them ideal for PC board mount applications.

AC input-to-dc output isolation is rated at 1500 VRMS with isolation resistance of 100 Megohms. Multiple output ratings from four different supplies allows you to match your application with the supply that fits rather than settling for an "almost right" choice. Temperature coefficients of 0.02% per °C (maximum) combined with an operating temperature range

of -25 °C to +71°C means accurate, trouble-free operation over prolonged periods. Also, every TPM Series power module has #4-40 x 0.15" deep threaded inserts (2 each) for easy heat sink mounting or for mounting the supply to a variety of surfaces. The TPM Series has excellent output voltage regulation with output ripple limited to 2 mV/1 mV (bipolar/5V). Transient recovery time is 50 µSec (maximum) with current limiting short circuit protection to ensure safe operation for your other circuits.

Case material is phenolic and packaging/pinout is compatible with most other industry standard AC to dc supplies making them ideal as the first or second source drop-in.
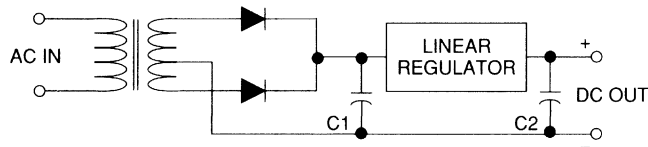
APPLICATIONS

- **Telecommunications Equipment**
- **Local Power Distribution Systems**
- **PC Board Subsystems**
- **Bench Top Instrumentation**
- **Process Instrumentation**
- **Laboratory Equipment**
- **Computer Controlled Equipment**

SPECIFICATIONS

TRIPLE OUTPUT MODELS			
TPM-12/100—5/500	**TPM-12/150—5/1000**	**TPM-15/100—5/500**	**TPM-15/150—5/1000**
Output Voltage ± 12/5	± 12/5	± 15/5	± 15/5
Output Current 100 mA/500 mA	150 mA/1000 mA	100 mA/500 mA	150 mA/1000 mA
Line Regulation 0.02%/0.05%	0.02%/0.05%	0.02%/0.05%	0.02%/0.05%
Load Regulation 0.05%/0.01%	0.05%/0.01%	0.05%/0.01%	0.05%/0.01%
Output Accuracy ± 1	± 1	± 1	± 1
Output Impedance (Ohms) 0.1	0.1	0.1	0.1
Case Size E3	E3	E3	E3

GENERAL SPECIFICATIONS (at 25 °C)

Voltage Input ....103.5 to 126.5 VAC
60 to 440 Hz
Temperature Coefficient.......................0.02% per °C
Output Ripple
(5V Output).......................................1 mV RM
(+/-12V or ±15V)..............................2 mV RMS
Transient Recovery Time, maximum ...50 µSec
Isolation Resistance, minimum ....100 Megohms
Isolation Capacitance, maximum ....250 pF
Breakdown Voltage, minimum..............1500 VAC
Operating Temperature ....-25 °C to +71 °C
(No Derating)
Storage Temperature...........................-25 °C to +85 °C
Case Material ....Phenolic
Module Size ....3.5" x 2.5" x 1.56"
(88.9 x 63.5 x 39.6)
Module Weight ....24 ounces (681 grams)

SOCKET MS-13
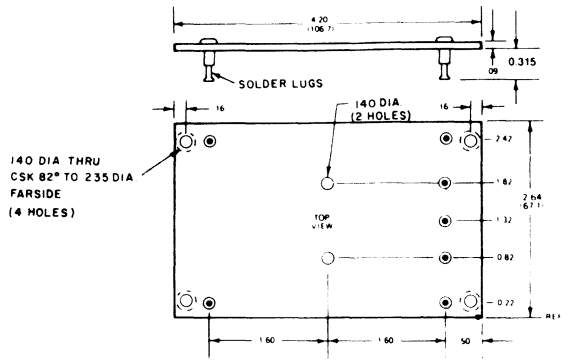
MECHANICAL DIMENSIONS AND I/O CONNECTIONS
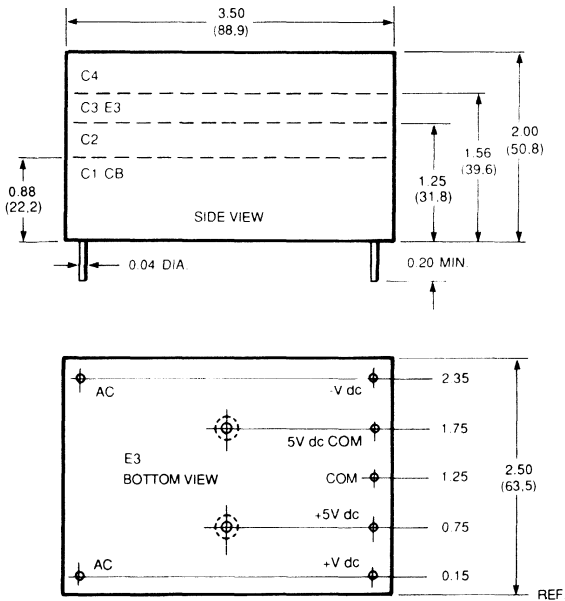
Line Operated

Single Output, Modular Switching Power Supplies

D⟩ DATEL®

FEATURES

- **Operated from line voltage (90 to 130 VAC at 47-450 Hz)**
- **Fully regulated 5V dc output (at 5 Amps)**
- **High Accuracy (±1%)**
- **Current limiting short circuit protection**
- **Isolated to 1000 VAC**
- **PC Board or Chassis Mount (Screw Terminal)**
- **Delivery from stock**
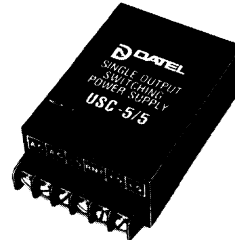
GENERAL DESCRIPTION

The USM-5/5 and USC-5/5 Series of line operated single output switching power supplies are high performance, line operated dc supplies capable of providing a fully regulated output of 5V dc at 5 Amps. Their compact size (3.5" x 2.5" x 1.25"), modular design, and ability to be mounted on either a PC Board (USM-5/5) or other flat surface (USC-5/5) via two threaded screw holes make them ideal for field use where AC power is available. Screw terminal type power connections are standard (USC-5/5). Sockets are available for the USM-5/5.

AC input-to-dc output isolation is rated at 1000 VRMS with isolation resistance of 50 Megohms. Temperature coefficients of 0.02% per °C (maximum) combined with an operating temperature range of -25 °C to +71°C means accurate, trouble-free operation over prolonged periods. Also, both USM and USC Series power modules have either threaded screw inserts (2 each) or external threaded studs for easy heat sink mounting or for mounting the supply to a variety of surfaces. The USM/USC Series has excellent output voltage regulation with output ripple limited to 50 mV. Transient recovery time is 300 µSec (maximum) with current limiting short circuit protection to ensure safe operation for your other circuits.

Case material is phenolic and packaging/pinout is compatible with most other industry standard AC to dc supplies making them ideal as the first or second source drop-in.
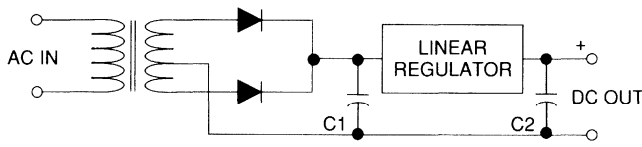
APPLICATIONS

- **Process Control Equipment**
- **Telecommunications Equipment**
- **Local Power Distribution Systems**
- **Bench Top Instrumentation**
- **Process Instrumentation**
- **Laboratory Equipment**
- **Computer Controlled Equipment**

SPECIFICATIONS

	SINGLE OUTPUT MODELS	
	USM-5/5	**USC-5/5**
Output Voltage	5V dc	5V dc
Output Current	5000 mA	5000 mA
Line Regulation	0.05%	0.05%
Load Regulation	0.1%	0.1%
Output Impedance (Ohms)	0.002	0.002
Case Type	C2	H

GENERAL SPECIFICATIONS (at 25 °C)

Voltage Input ....90 to 103 VAC
        47 to 450 Hz
Output Current ....5 Amps
Temperature Coefficient......................0.02% per °C
Output Ripple, maximum ....50 mV pk-pk
Output Accuracy ....±1%
Efficiency, typical.................................80%
Transient Recovery Time, maximum ...300 µSec
Isolation Resistance, minimum ....50 Megohms
Isolation Capacitance, maximum ....100 pF
Breakdown Voltage, minimum..............1000 VAC
Overvoltage Protection ....6.5 V dc
Operating Temperature ....-25 °C to +71 °C
        (No Derating)
Storage Temperature............................-25`°C to +85 °C
Case Material ....Phenolic
Module Size ....3.5" x 2.5" x 1.25"
        (88.9 x 63.5 x 39.6)
Module Weight ....24 ounces (680 grams)

SOCKET MS-7
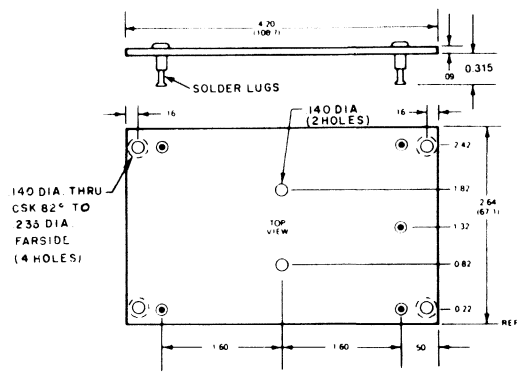
CASE C2
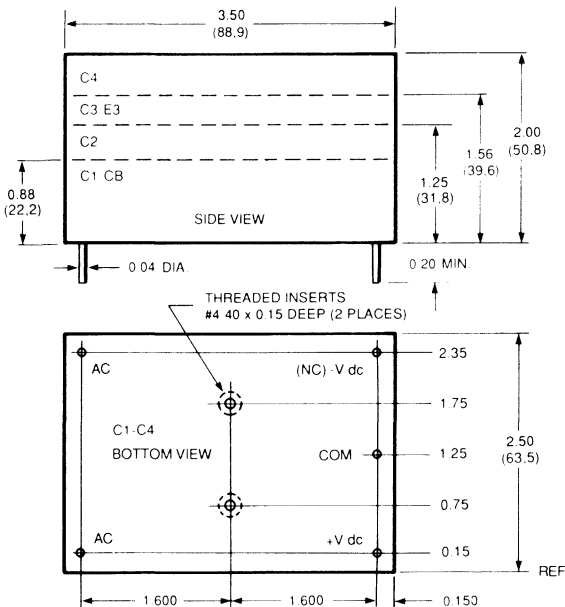
CASE H
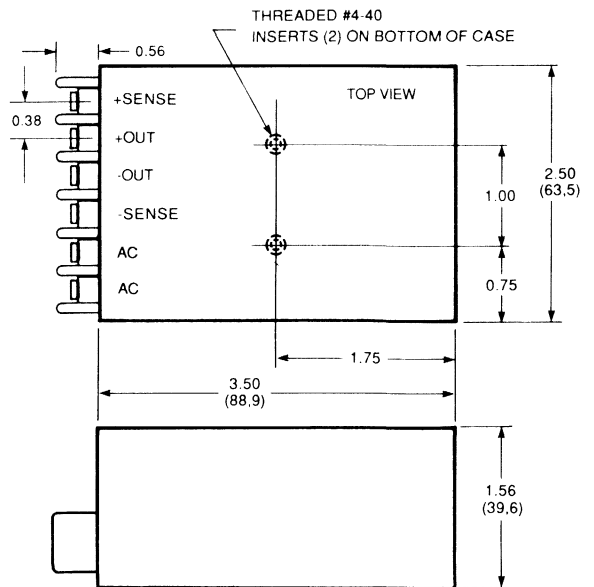
Line Operated
Dual Output
High Voltage Power Modules

FEATURES

- **Operated from line voltage (103 to 126 VAC at 60-550 Hz)**
- **Fully regulated ±120VDC, ±150VDC, ±180VDC output**
- **High accuracy (±1%)**
- **Current limiting short circuit protection**
- **Isolated to 1500 VAC**
- **Output ripple 10mV RMS (maximum)**
- **Delivery from stock**

GENERAL DESCRIPTION

The BPM Series of high voltage output modules are high performance, line operated AC supplies designed specifically to be used with DATEL's AM-3000 series of high voltage operational amplifiers. The three models are capable of providing a fully regulated ±120 VDC, ±150 VDC, ±180 VDC output at 20 mA (16 mA for ±180 VDC model). Their compact size (3.5″ x 2.5″ x 1.56″), modular design, and ability to be mounted on a PC Board make them ideal for supplying safe, high voltage power to various components on the PC board. Sockets are available for all three models.

All three models (BPM-120/25, BPM-150/20, and BPM-180/16) have AC input-to-DC output isolation rated at 1500 VRMS

(minimum) with isolation resistance of 100 Megohms. Temperature coefficients of 0.02% per °C (maximum) combined with an operating temperature range of -25 °C to +71 °C means accurate, trouble-free operation over prolonged periods. The BPM Series has excellent output voltage regulation with output ripple limited to 10 mV (RMS, maximum). Transient recovery time is 50 µSec (maximum) with current limiting short circuit protection to ensure safe operation for your other circuits.

Case material is phenolic and packaging/pinout is compatible with most other industry standard AC supplies making them ideal as the first or second source drop-in.
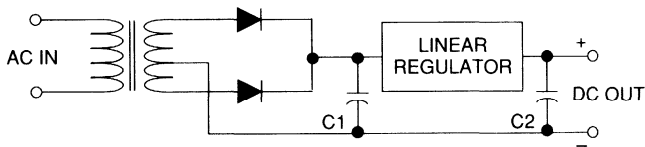
APPLICATIONS

- **High Voltage Operational Amplifiers**
- **Local Power Distribution Systems**
- **Bench Top Instrumentation**
- **Laboratory Equipment**

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356

SPECIFICATIONS

DUAL OUTPUT MODELS		
BPM-120/25	**BPM-150/20**	**BPM-180/16**
Output Voltage ± 120 VDC	± 150 VDC	± 180 VDC
Output Current 20 mA	20 mA	16 mA
Line Regulation 0.05%	0.05%	0.05%
Load Regulation 0.2%	0.2%	0.2%
Output Impedance (Ohms) 5	5	0.002
Case Type C3	C3	C3

GENERAL SPECIFICATIONS (at 25 °C)

Voltage Input ....115VAC (±10%)
                            60 to 550 Hz
Temperature Coefficient......................0.02% per °C
Output Ripple, maximum ....10 mV RMS
Output Accuracy ....±1%
Transient Recovery Time, maximum ...50 μSec
Isolation Resistance, minimum ....100 Megohms
Isolation Capacitance, maximum ....250 pF
Breakdown Voltage, minimum..............1500 VAC
Operating Temperature ....-25 °C to +71 °C
                            (No Derating)
Storage Temperature............................-25 °C to +85 °C
Case Material..Phenolic
Module Size ....3.5" x 2.5" x 1.25"
                            (88.9 x 63.5 x 39.6)
Module Weight ....24 ounces (680 grams)

SOCKET MS-7

MECHANICAL DIMENSIONS AND I/O CONNECTIONS
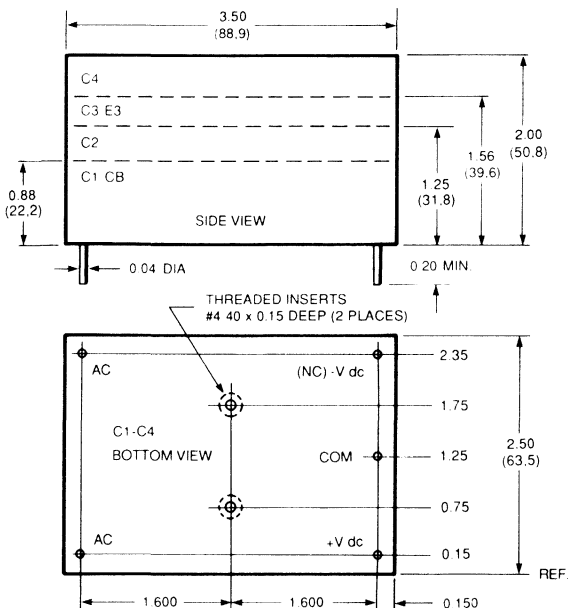
UPA Series
+5V dc, +12V dc, Plug-in
Regulated Power Supplies

$\mathbb{D}$® $\square$ /ATEL®

FEATURES

- **Operated from line voltage (115 VAC ±10%, 60 Hz)**
- **Fully regulated +5V at 500 mA, +12V at 200 mA**
- **Current limiting short circuit protection**
- **Isolated to 1500 VAC**
- **Wide operating temperature (-25 °C to +71 °C without Derating)**
- **Low output ripple; 8mV**
- **Delivery from stock**

GENERAL DESCRIPTION

The UPA Series of plug-in type wall adapters are line operated dc power modules capable of providing a fully regulated +5 V dc and +12 V dc output at currents of 500 mA and 200 mA, respectively. Their light weight, compact size, modular design, and very low cost make them ideal for powering any of DATEL's panel meters as well as a wide variety of other products where regulated AC-to-dc power is required in a truly portable package.

Both models (UPA-5/500, UPA-12/200) have AC input-to-dc output isolation of 1500 VRMS and are constructed of flame-retardant molded cases. Operating with minimal heat dissipation, both models are guaranteed to provide line/load regulation of 0.3% (typical) with very low output ripple (8 mV RMS, maximum). All adapters are current limiting short circuit protected.

Overall operating temperature range of -25 °C to +71 °C means accurate, trouble-free operation for prolonged periods. Measuring only 2.06" x 2.18" x 1.71", these light-weight modules use screw type dc output terminals allowing you to add any length dc power cord you desire.
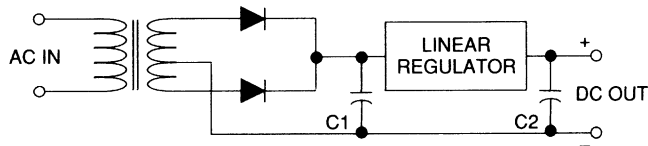
APPLICATIONS

- **Portable AC to dc Power**
- **Power for Digital Panel Meters**
- **Bench Top Instrumentation**
- **Process Instrumentation**
- **Laboratory Equipment**
- **Computer Controlled Equipment**

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356

SPECIFICATIONS

	+5V dc and +12V dc OUTPUT MODELS	
	UPA-5/500	UPM-12/200
Output Voltage	+4.8 — +5.3V dc	+11.5 — +12.5V dc
Output Current	500 mA	200 mA
Line Regulation	0.03%	0.03%
Load Regulation	0.03%	0.03%

MECHANICAL DIMENSIONS AND I/O CONNECTION
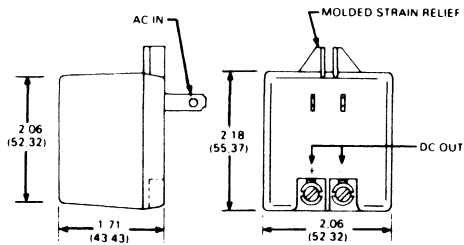
GENERAL SPECIFICATIONS (at 25 °C)

Voltage Input .... 103.5 to 126.5 VAC 60 Hz
Output Voltage
  UPA-5/500 .... + 4.8 to 5.3V dc
  UPA-12/200 .... +11.5 to 12.5V dc
Output Ripple, maximum .... 8 mV RMS
Breakdown Voltage, minimum .... 1500 VAC
Operating Temperature .... -25 °C to +71 °C
                                                            (No Derating)
Storage Temperature .... -25 °C to +85 °C
Case Material .... Flame Retardant Plastic
Module Size .... 2.06 x 2.18" x 1.71"

Chassis Mount

Line Operated Single and Dual Output Power Supplies

🅓° 🄳🄰🅃🄴🄻®

FEATURES

- **Operated from line voltage (115 VAC ±10%, 60-440 Hz)**
- **Fully regulated 5V, ±15V**
- **High accuracy (±1%)**
- **Current limiting short circuit protection**
- **Isolated to 1500 VAC**
- **Terminal strip for input/output connections**
- **Delivery from stock**
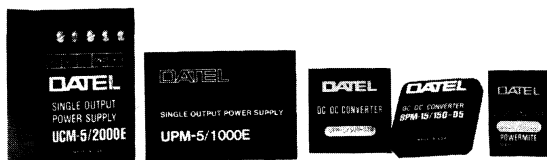
GENERAL DESCRIPTION

The UCM-5 and BCM-15 Series of line operated single and dual output power supplies are high performance, line operated dc supplies capable of providing a fully regulated output of 5V or ±15V at a wide variety of output power ranges. Their compact size (3.5" x 2.5"), modular design, and ability to be mounted on virtually any surface via two threaded screw holes make them ideal for field use where AC power is available. Screw terminal type power connections are standard.

AC input-to-dc output isolation is rated at 1500 VRMS with isolation resistance of 100 Megohms. Multiple ouput ratings (±60 mA, ±100 mA, ±200 mA, 250 mA, ±300 mA, 500 mA, 1000 mA and 2000 mA) from eight different supplies allow you to match your application with the supply that fits rather than settling for an "almost right" choice. Temperature

coefficients of 0.02% per °C (maximum) combined with an operating temperature range of -25 °C to +71°C means accurate, trouble-free operation over prolonged periods. Also, every UCM and BCM Series power module has threaded screw inserts (2 each) for easy heat sink mounting or for mounting the supply to a variety of surfaces. The UCM/BCM Series has excellent output voltage regulation with output ripple limited to 1 mV (BCM models are 2mV). Transient recovery time is 50 µSec (maximum) with current limiting short circuit protection to ensure safe operation for your other circuits.

Case material is Phenolic and packaging/pinout is compatible with most other industry standard AC to dc supplies making them ideal as the first or second source drop-in.

APPLICATIONS

- **Process Control Equipment**
- **Telecommunications Equipment**
- **Local Power Distribution Systems**
- **Bench Top Instrumentation**
- **Process Instrumentation**
- **Laboratory Equipment**
- **Computer Controlled Equipment**

GENERAL SPECIFICATIONS (at 25 °C)

Voltage Input	103.5 to 126.5 VAC
	60 to 440 Hz
Temperature Coefficient	0.02% per °C
Output Ripple, maximum	
UCM	1 mV RMS
BCM	2 mV RMS
Output Accuracy	±1%
Transient Recovery Time, maximum	50 µSec
Isolation Resistance, minimum	100 Megohms
Isolation Capacitance, maximum	250 pF
Breakdown Voltage, minimum	1500 VAC
Operating Temperature	-25 °C to +71 °C
	(No Derating)
Storage Temperature	-25 °C to +85 °C
Case Material	Phenolic
Module Size	3.5" x 2.5" (88.9 x 63.5)
	See Case Sizes for Height

SPECIFICATIONS

	SINGLE OUTPUT MODELS			
	UCM-5/250	**UCM-5/500**	**UCM-5/1000**	**UCM-5/2000**
Output Voltage	5V dc	5V dc	5V dc	5V dc
Output Current	250 mA	500 mA	1000 mA	2000 mA
Line Regulation	0.05%	0.05%	0.05%	0.05%
Load Regulation	01%	0.1%	0.1%	0.1%
Output Impedance (Ohms)	0.05	0.05	0.01	0.005
Weight	14 oz. (397 grams)	14 oz. (397 grams)	18 oz. (510 grams)	24 oz. (680 grams)
Case	D1	D1	D2	D3

	DUAL OUTPUT MODELS			
	BCM-15/60	**BCM-15/100**	**BCM-15/200**	**BCM-15/300**
Output Voltage	±15	±15	±15	±15
Output Current	±60	±100	±200	±300
Line Regulation	0.02%	0.02%	0.02%	0.02%
Load Regulation	0.05%	0.05%	0.05%	0.05%
Output Impedance (Ohms)	0.2	0.1	0.05	0.05
Weight	14 oz. (397 grams)	14 oz. (397 grams)	18 oz. (510 grams)	24 oz. (680 grams)
Case	D1	D1	D2	D3

MECHANICAL DIMENSIONS AND I/O CONNECTIONS
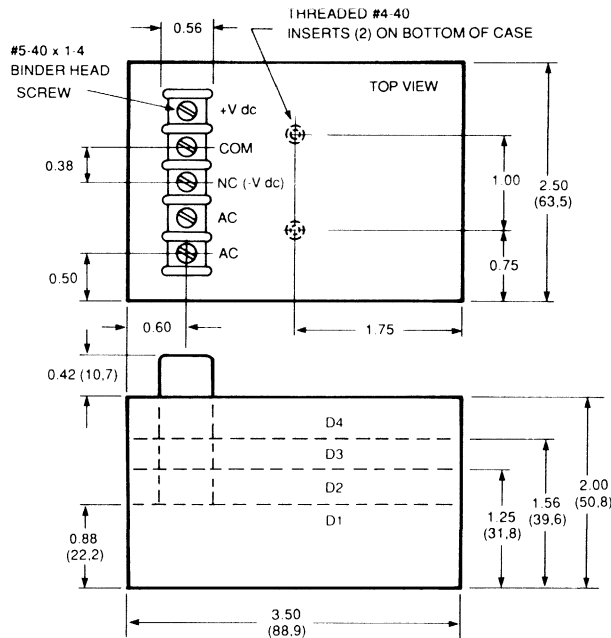
NOTE: PIN DESIGNATIONS IN PARENTHESIS ARE FOR
BIPOLAR OUTPUT MODELS

Modern Power Supply
Principles and
Practice

⚛®□ΛΤΕΓ®

Modern electronic power supplies are the result of an evolutionary process which has taken place over many years. The requirement for stable, well-regulated dc power for precision electronic circuits is a continuing need in industry and in R and D laboratories. Over the years, available power supplies from a number of manufacturers have offered continually improved performance at relatively low prices. Whereas early supplies used vacuum tube diodes and regulators and were notoriously bulky, modern supplies use the latest available components such as silicon diode rectifiers, precision zener or bandgap references, tantalum capacitors, ferrite core transformers, and monolithic voltage regulators to achieve high performance in compact packages.

There are a number of different types of power supplies in common use today. The basic two categories are AC-to-dc supplies and dc-to-dc converters. These types may be further classified by the types of regulation employed, which may be linear regulation, ferroresonant regulation, or switching regulation. DATEL specializes in both AC-to-dc supplies and dc-to-dc converters. Linear regulation is used on almost all of our supplies, but switching regulation is also employed in four models. All of these supplies are of the constant voltage type, and therefore the discussion which follows will center on the constant voltage supply.

There are several important requirements for the modern electronic power supply, in addition to moderate cost, for powering today's precision electronic circuits. These requirements include specifications such as excellent line and load regulation (0.01% to 0.2%), low output noise and ripple (a few millivolts RMS), low output impedance (0.005 to 0.1 ohm), low temperature drift (0.01% to 0.02% per °C), and output short circuit protection. This last requirement is important because it saves the power supply from destruction upon inadvertant shorting of its output terminals. Power supplies with these features are used in a wide variety of instruments and systems to power linear and digital IC's, A/D and D/A converters, operational amplifiers, and other functional circuits.

IDEAL POWER SUPPLY MODEL

Figure 1 illustrates a model of an ideal constant voltage supply. In this idealized case, the power supply output is a constant voltage source with zero output impedance, zero output ripple or noise, and zero voltage change with either input (line) change or output load change. In addition, the output voltage does not change with either time or temperature.
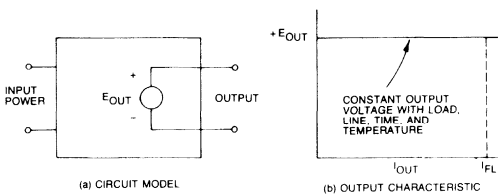
In practice we know that such a supply is not possible. Figure 2 shows two important characteristics of the non-ideal power supply: imperfect load regulation and output ripple. For a high quality regulated supply, both of these imperfections would be quite small in terms of the output voltage.
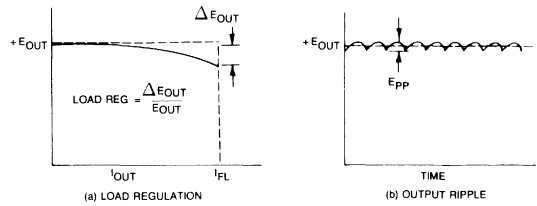

**Figure 2. Two Characteristics of a
Non-ideal Power Supply**

POWER SUPPLY SPECIFICATIONS

In any discussion of power supplies, certain key specifications occur over and over again. These specifications must be understood at the basic definition level. The most often occurring power supply specifications include output voltage accuracy, line regulation, load regulation, output ripple and noise, output impedance, transient recovery time, temperature coefficient and isolation resistance and capacitance. These terms are defined in the Glossary of Power Supply Terms.

Following are a few of these specifications, with illustrations showing the derivation of the actual specification.

Breakdown Voltage - The maximum AC or dc voltage which may be applied between input and output terminals of a supply. See Figure 3.

Isolation - The resistive and capacitive coupling between the input and output of an isolated supply. This is generally given in megohms and picofarads and is normally determined by the transformer characteristics. See Figure 3.
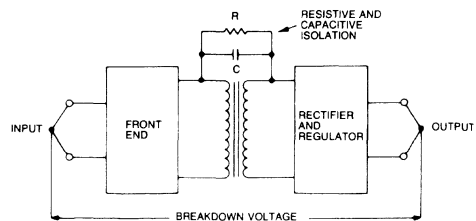

**Figure 1. Ideal Constant Voltage
Power Supply Model**

Figure 3. Breakdown Voltage and Isolation

Output Impedance - Defined as dV_{out}/d_{out}. This can be measured at dc or at a specified AC frequency. A typical output impedance vs. frequency graph is shown in Figure 4. Output impedance is sometimes called "dynamic load regulation".
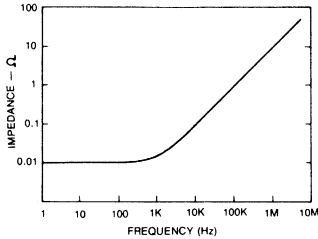
Figure 4. Output Impedance vs. Frequency

Transient Recovery Time - The time required for the output voltage to settle within specified regulation limits after an instantaneous change in output load current. This is generally measured with a defined load change. See Figure 5.
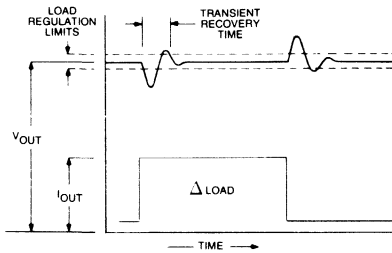
Figure 5. Transient Recovery Time

POWER SUPPLY DESIGN AND OPERATION

The modern regulated power supply is manufactured using many solid state components and consists of the following basic sections as shown in Figure 6: transformer, rectifier, filter, dc regulator, and voltage reference source.
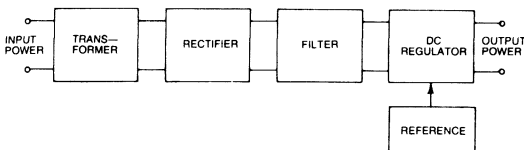
Figure 6. Block Diagram of Power Supply

The transformer takes the ac line voltage, normally 115/230 VAC, and transforms it into the desired voltage level for the supply output. The secondary voltage is then full wave rectified to give dc. The rectified voltage has very high ripple and must therefore be filtered to give a smooth dc output. The filter may take various forms from a single capacitor to more elaborate inductor-capacitor combinations. Most modern power supplies, however, use a single capacitor filter since the dc regulator which follows the filter effectively rejects this ripple at the output.

Figure 7 shows the two circuit configurations used to achieve full wave rectification. Figure 7(a) illustrates a full wave, center-tapped rectifier circuit which uses two diodes to rectify the voltage. This is followed by a single capacitor filter circuit. Figure 7(b) shows a full wave bridge rectifier circuit which uses four diodes but does not require a secondary center tap on the transformer. It also has a single capacitor filter. Both circuits produce the full-wave rectified output voltage shown in Figure 8.

The filtered voltage across the capacitor is a reasonably smooth voltage output compared with the input. The amount of decay in the capacitor voltage between half cycles depends on the load current and the size of the filter capacitor. Near the peak of the rectified voltage, the filter capacitor is recharged by a large current pulse. There is no further charging of the capacitor then until the next half-cycle peak voltage.

Both of the rectifier circuits are less than ideal since they experience electrical losses. These losses are from three basic sources: the voltage drop across the rectifier diodes, the transformer resistance loss, and the transformer core loss. There is a difference in efficiency for the two full wave rectifier circuits. The center-tapped configuration has half the average output current flowing through each diode, but the diodes experience
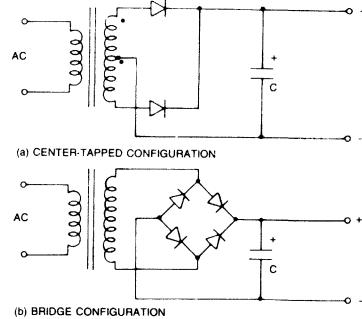
(a) CENTER-TAPPED CONFIGURATION

(b) BRIDGE CONFIGURATION
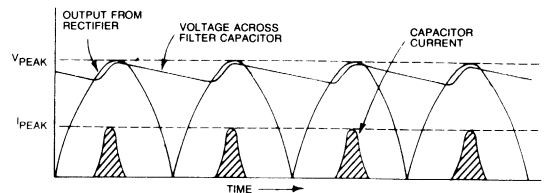
Figure 7. Full-Wave Rectifier Circuits

Figure 8. Voltage and Current Waveforms for Full-Wave Rectifier Circuit

twice the reverse voltage as the diodes in the bridge rectifier circuit. The bridge rectifier circuit also has half the average output current flowing through each diode but there are always two diodes in series.

While the two diode drops cause a decrease in efficiency compared with the center-tapped configuration, the efficiency comparison also depends on the transformer secondary resistance. For the same amount of secondary copper, the bridge configuration would have half the secondary resistance of the center-tapped configuration. As a quick calculation of approximate efficiency, note that for a 5V output supply the bridge configuration would experience two diode drops of about 0.7 volts each giving an upper limit on efficiency of about 78%. This does not include transformer winding or core losses, or loss in the regulator which follows.

For a dual output supply, the same configurations are used with a single transformer. Figure 9 shows a dual output supply using the center-tapped configuration with four rectifier diodes. The filter capacitors and regulators are also included. The bridge configuration can also be used to develop dual output voltages by using two separate bridges with two separate transformer windings, requiring a total of 8 diodes.
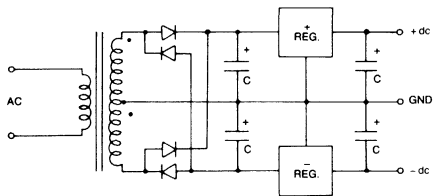

Figure 9. Dual Output Power Supply

The power supply circuits discussed here can be modeled by the circuit shown in Figure 10. From this circuit, precise computations can be made of the output voltage, ripple, efficiency, etc. The transformer secondary voltage in rectified form is modeled by an ideal voltage source with an output of $V \sin wt$. This source is in series with another voltage source V_D which represents this diode forward voltage drops. R_S is the equivalent transformer resistance of both secondary and primary reflected to the secondary plus the dynamic diode resistance. L_S is the transformer leakage inductance, and C is the filter capacitor. In some applications this simple supply would be entirely satisfactory. This is true for constant load circuits which are not affected by high ripple. For most precision electronic circuits, however, good load regulation, line regulation, and low ripple voltage are necessary. For this performance, a linear dc regulator is required.
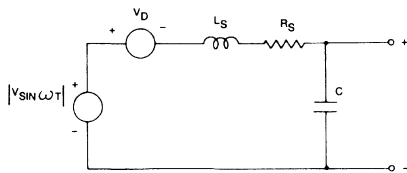

Figure 10. Power Supply Circuit Model

DC REGULATORS

To make a truly precision power supply a linear dc regulator is normally employed. Linear regulators are composed of three basic parts: a series-pass transistor, a high gain differential input amplifier (or operational amplifier), and a stable voltage reference source. A typical series regulator circuit is shown in Figure 11. Here Q_1 is the series-pass transistor which determines the output voltage by means of the voltage at its base. This base voltage in turn is determined by the output of the differential amplifier A_1 which is a high voltage gain device; A_1 can also be an operational amplifier.

A_1 amplifies the difference between the divided down output voltage and a reference voltage and applies a correction voltage to the base of Q_1. C_1 is a small value capacitor used to stabilize the amplifier and C_2 is a large value output capacitor used to give a low output impedance at high frequencies and to absorb small values of instantaneous reverse current fed back into the supply.
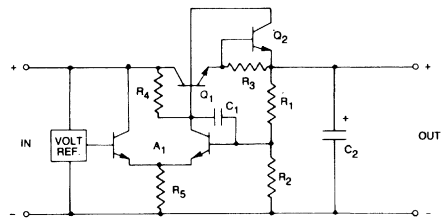

Figure 11. Linear Series Regulator Circuit

The regulator also contains a current limiting circuit consisting of Q_2 and R_3. R_3 is a current sampling resistor in series with the output. If the output current should exceed its rated value by a specified amount, the voltage developed across R_3 turns on Q_2 which then diverts current from the base of Q_2 lowering the output voltage. Once Q_2 is on, slight increases in output current rapidly drop the output voltage, thereby providing overload protection. Figure 12(a) shows a V-1 characteristic for this type of overload protection.

Another type of output overload protection frequently used is called foldback current limiting. This is a bit more complex than the current limiting shown in Figure 11 but has the advantage of lower internal power dissipation in the supply. As the load approaches a short circuit, both output voltage and output current are decreased. This overload characteristic is also shown in Figure 12(b). The much lower internal power dissipation under short circuit condition is seen from the diagram where the short circuit current is 25% of rated current. This gives a total of 0.25VI watts of internal dissipation compared with about 1.1VI for normal current limiting. Output overload protection is extremely important in modern power supplies so that inadvertent overloading or shorting of the output does not damage the supply.

An important feature of heavy duty type power supplies is remote sensing. Remote sensing is a method of bringing the regulator input lines directly from the load in order to circumvent the voltage drop in the load current carrying wires. The actual connections for this feature are shown in Figure 13. The power supply has an additional sensing line for each voltage output that comes to the regulator input. If the sensing lines

are connected directly to the output voltages at the supply output terminals, then it is called local sensing. Most supplies, since they do not have the remote sensing feature, are therefore operating with local sensing.
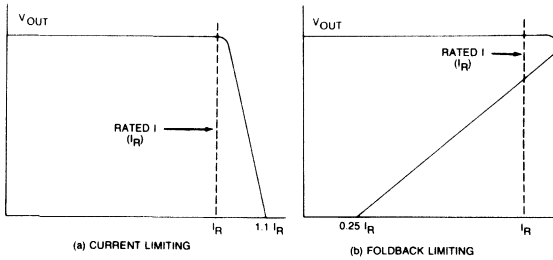

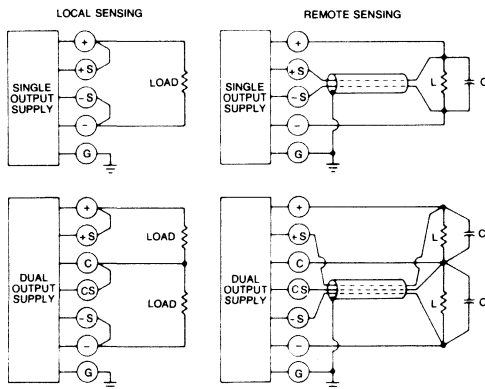**Figure 12. Output Overload Characteristics**

Figure 13. Remote Sensing Connections

Another feature that some of the better supplies have is overvoltage protection. It is possible for the output of a supply to rise above its normal output voltage due to a failure in the regulator circuit or due to application of a high reverse voltage externally. With overvoltage protection, a circuit in the supply senses when the output rises above a preset limit and shuts down the supply output. This protection can be important when there is potential damage to a large number of integrated circuits due to higher-than-specified supply output voltage.

CONVERTERS, dc-to-dc

Becoming very popular for the local transformation of power supply voltages are dc-to-dc converters. If, for example, it is necessary to power a +15V linear circuit on an all -5V logic circuit board, the simplest way may be to use a 5V to +15V dc-to-dc converter to perform the task.

A simplified circuit diagram of a dc-to-dc converter is shown in Figure 14. A key component in this supply is the small transformer which may be a ferrite core or tape wound core unit. The transformer, in conjunction with switching transistors Q_1 and Q_2, constitutes a self-oscillating circuit which generates a high frequency square wave at the transformer primary. This square wave is then rectified and filtered at the secondary. After filtering, the output voltage goes through a linear regulator circuit. The supply shown has a dual output and therefore two sets of rectifier-filters and regulators.
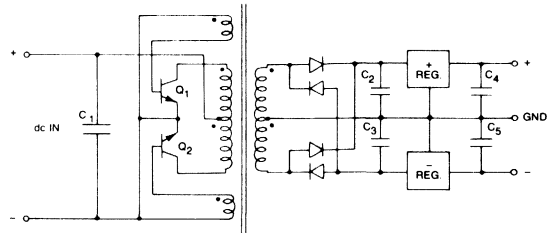

Figure 14. dc-to-dc Converter Power Supply

When the circuit is first turned on, an imbalance in leakage currents will cause one of the two transistors to turn on by means of the regenerative action of the transformer winding connected to the transistor base. With one transistor on, the magnetic flux builds up in the transformer core until it begins to saturate. As the transformer goes into saturation the flux collapses, producing a voltage of opposite polarity across the transformer windings. This turns the previous transistor off and the other transistor on. Then the process repeats itself for the other side of the primary winding.

The obvious advantage of a dc-to-dc converter over a line operated power supply is in the small size for the power produced. Switching is normally done at a rate of 8 kHz to 25 kHz for most dc-to-dc converters. Because of this fast rate compared with a 50 or 60 Hz line frequency, the transformer can be quite small. In addition, the filter capacitors can be small due to the higher frequency and the fact that the wav form to be filtered is a square wave rather than a sine wave.

Because of the fast switching operation of these supplies, they have some characteristics different from line operated units. The output ripple voltage consists of small spikes which occur at twice the switching rate. In most good quality dc-to-dc converters, these spikes have very low RMS value but have peak-to-peak values between 5 and 50 millivolts. They may also appear to be larger than they really are if not measured properly. They should be measured with a scope probe right across the converter output or else at a load point which is bypassed by a 0.0°F ceramic capacitor. Another characteristic is known as back ripple current. Illustrated in Figure 15, this is caused by the surge current charging the filter capacitor and the converter switching. It occurs for a very short time but causes current spikes at the converter input. These spikes are effectively filtered by either a capacitor input filter or a more complex pi input filter. The result in a good quality dc-to-dc converter is that the peak-to-peak back ripple current is less that 1% of the dc input current.
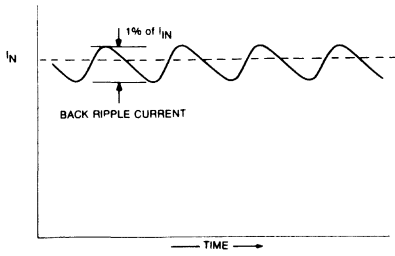
Figure 15. Back Ripple Current of a dc-to-dc Converter

POWER SUPPLY APPLICATION

Worst Case Voltage. An important calculation to make with power supplies is the worst case output voltage. This must be determined from the regulation, accuracy, and temperature stability specifications of the supply. As an example, assume DATEL's BMP-15/100 operated from no load to full load over the ambient temperature range of 25 °C to +71 °C:

Accuracy	1.00%	
Line Regulation	0.02%	
Load Regulation	.05%	
Change with *T	0.90%	(0.02% /°C x (70 °C -25 °C)
Total Change	1.97%	

Since the output is ±15V dc this means that each of the two voltages can be +15V ±0.296V.

Series Stacking of Supplies. Constant voltage dc power supplies may have their outputs stacked in series to provide a number of multi-voltage outputs. When doing this, it should be remembered that current limiting will take place at the value of the lowest current limit in the stack. A series stack of supplies is shown in Figure 16. Note that ground may be placed on any of the output points. Dc-to-dc converters may have outputs stacked in the same manner.
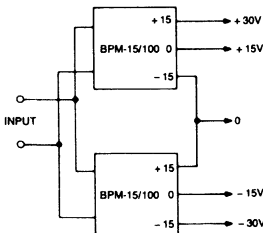
Parallel connection of power supply outputs cannot be done, however, except in special cases where the regulators are connected together to equalize the load of each supply. This cannot be done with most power supplies.

Wire Size of Power Supply Runs. A common problem with power supply applications is voltage drop along the output lines which can seriously degrade output load regulation. For example, No. 20 copper wire has a resistance of about ten milliohms per foot. If a 5V, 1 ampere logic supply is used with one foot of No. 20 line to the load and one foot of No. 20 line from the load, the voltage drop under full load would be 20 mV which is 0.4% of the output voltage. Thus, total load regulation for a 0.1% supply would be degraded to 0.5% due to the line resistance. It is important to carefully select the wire size or the size of the circuit board conductor used based on the distance to the load and the load current.

Remote Sensing. This topic was discussed briefly before. Remote sensing is an effective way to preserve the load regulation specification if there must be some distance between the supply and load. In general, the small modular type supplies do not have remote sensing. But the more expensive heavy duty supplies do. DATEL MP Series supplies incorporate remote sensing. The output connections for a remote sensing supply are shown in Figure 14 for both single and dual output supplies. The sense terminals, which go directly to the regulator, are marked with an S. If the supply is close to the load, the sense terminals may be connected directly to the voltage output terminals resulting in local sensing. Note that for remote sensing a dual output supply requires a 6 total leads between supply and load.

Power Distribution and Return. The manner in which power is run to a load is critical to the regulation experienced at the load. If power is distributed and returned through a parallel or bussed system, as shown in Figure 17, each circuit in the system is operated at a different supply potential due to the distributed and accumulated current through the resistance in the supply and return paths. In addition, any unbalanced capacitive decoupling between the power and ground points of each circuit will cause impedance differences between the circuits, resulting in unwanted AC paths and voltages across each circuit. This all combines to disturb the transmission of signals from one circuit to another.

The ideal situation is to have each circuit at the same potential, which can be achieved by a radial distribution or single point system as shown in Figure 18. In this case, the distributive
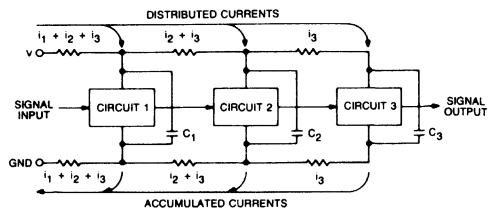

Figure 16. Series Stacking of Supplies

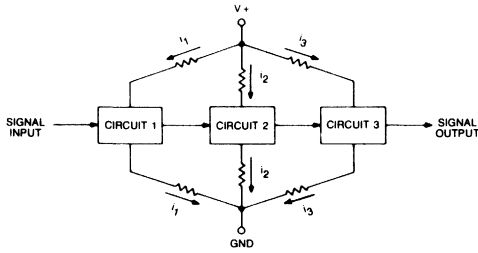**Figure 17. Parallel Distribution and Return**

Figure 18. Radial Distribution and Return

and accumulative effects are eliminated, and the only potential difference between circuits is limited to the amount of current drawn by each circuit and the resistance of its individual power and ground paths.

Complete radial distribution and return of power in a complex system is of course impossible, so compromises have to be made where parallel distribution and return must be used. Parallel and radial distribution and return can be combined by grouping circuits in a logical manner. For example, one group of circuits which draws a small amount of power might be connected for parallel distribution while another group of circuits with heavy power demand is connected radially, close to the power supply. See Figure 19.

When multiple output supplies are connected to both analog and digital circuits, the same precautions should be used. The treatment of ground lines is especially important here, with the objective of keeping power line drops from signal paths. The best system, as shown in Figure 20, is to have a single ground point for both supplies so that the signal lines can also be connected to this point.
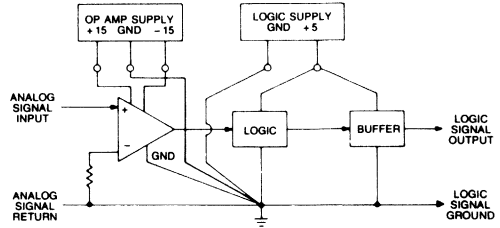
Figure 20. Combination Analog and Digital Supply Connection

Figure 19. Combination Radial and Parallel Distribution

Glossary of Power Supply Terms

AMBIENT TEMPERATURE: The temperature of still air surrounding a power supply. For power supplies a good practical definition is: **the temperature measured at a point 1/2" from the body of a power supply which is protected from direct air movement by a suitable enclosure.** It should be noted that the temperature of circulating air, such as in a temperature chamber with a fan, is not a correct ambient temperature measurement since the power supply is being cooled by the circulating air.

BACK RIPPLE CURRENT: For dc-to-dc converters, the input peak-to-peak AC current, as a percentage of input current, with an ideal voltage source input. This ripple current is caused by switching transients in the converter and is less than 1% in well-designed converters.

BREAKDOWN VOLTAGE: The maximum AC or dc voltage which may be applied between input and output terminals of a supply.

EFFICIENCY: The ratio of output power to input power expressed as a percentage. This is generally measured under full load at nominal line voltage.

FARADAY SHIELD: An electrostatic shield between input and output windings of a transformer. This is done to reduce capacitive coupling between the input and output of the power supply.

FOLDBACK CURRENT LIMITING: An overload protection method whereby the output current is decreased as the load approaches short circuit. Under output short circuit, the output current is therefore less than rated output current. This technique minimizes internal power dissipation under overload conditions.

ISOLATION: The resistive and capacitive coupling between the input and output of an isolated supply. This is generally given in megohms and picofarads and is normally determined by the transformer characteristics.

LEAKAGE CURRENT: The AC or dc current flowing between input and output of an isolated supply with a specified voltage applied between input and output.

LINE REGULATION: The maximum deviation of the output voltage in percent as the input voltage is varied from nominal to high line and nominal to low line. Output load and ambient temperature are held constant.

OUTPUT CURRENT LIMITING: An overload protection method whereby the maximum output current is automatically limited in value under overload conditions so that the power supply is not damaged.

OUTPUT IMPEDANCE: Defined as dV_{out}/dI_{out}. This can be measured at dc or at a specified AC frequency. Output impedance is sometimes called "dynamic load regulation".

OUTPUT VOLTAGE: The nominal dc value of the voltage **at the output terminals** of the supply. It is assumed that any ripple or noise is averaged in the measurement.

Glossary of Power Supply Terms

OUTPUT VOLTAGE ACCURACY: The maximum deviation of the output voltage from its rated dc value. Input voltage is nominal value and temperature is room temperature (+25 °C).

OVERSHOOT: A transient voltage change in excess of the normal regulation limits which can occur when a power supply is turned on or off, or when there is a step change in line voltage or load.

OVER VOLTAGE PROTECTION: A mechanism whereby the output is shut down if the output voltage for any reason exceeds a specified value. This feature is specially important for 5 Volt logic supplies.

RATED OUTPUT CURRENT: The maximum current which can be drawn from the output of the supply for specified regulation or temperature change. The output current is derated with temperature for some supplies.

REMOTE SENSING: A method whereby the regulator circuit senses the voltage directly at the load. This is done by running separate wires from the regulator to the load in order to circumvent the voltage drop in the lines carrying the load current.

RIPPLE AND NOISE: The magnitude of AC voltage appearing superimposed on the dc output. It is usually stated in either peak-to-peak or RMS volts. For line operated supplies the ripple is normally a 120 Hz waveform. For dc-to-dc converters the ripple is twice the switching frequency.

SERIES REGULATION: A popular regulation method whereby a control device (transistor) is placed in series with the power source in order to regulate the voltage across the load.

STABILITY: The percent change in output voltage as a function of time at constant input voltage, load and temperature.

TEMPERATURE COEFFICIENT: The average change in output voltage per degree Centigrade change in temperature with load and input voltage held constant. The coefficient is generally derived from output voltage measurements at room temperature and the two extremes of the operating temperature range.

TEMPERATURE RANGE, OPERATING: The range of environmental temperatures (usually in °C) over which a power supply can be safely operated.

TEMPERATURE RANGE, STORAGE: The range of environmental temperatures (usually in °C) over which a power supply can be safely stored, non-operating.

TRANSIENT RECOVERY TIME: The time required for the output voltage to settle within specified regulation limits after an instantaneous change in output load current. This is generally measured with a defined load change. .

WARM-UP TIME: The time (after power turn on) required for the output voltage to reach its equilibrium value within the output accuracy specification.

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DVC-8500	± 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)

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- **Laboratory accuracy of ±0.015% of FSR at +25°C**
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  Hexadecimal: ±1V dc, ±10V dc
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- **Rated accuracy down to 6.5V dc battery level using rechargeable 7.2V battery or conventional 9V battery**
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- **AC adapter/charger operation optional**
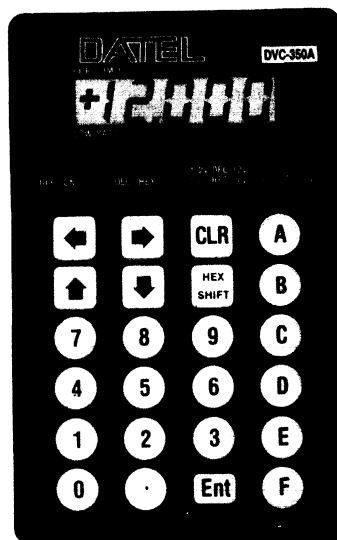
THE DVC-350A'S ACCURACY AND PORTABILITY MAKES IT THE CALIBRATOR-OF-CHOICE FOR PRECISE ADJUSTMENT OF ANALYZERS, RECORDERS, CONTROLLERS, DATA ACQUISITION SYSTEM COMPUTERS, AND MANY OTHER LAB AND FIELD APPLICATIONS.

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 4½ digit LCD display. Mode of entry is switch-selectable as either decimal or hexadecimal. Decimal mode output ranges are ±1.2V dc in 100 μV increments and ±12V dc in 1 mV increments. Hexadecimal mode offers output voltage ranges of ±1V dc in 244 μV increments and ±10V 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 4½ digit LCD display.

ORDERING INFORMATION
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DVC-350A

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 ±1.2V dc, 0 to ±12V dc
Hexadecimal . . . . 0 to ±0.99975V dc,
0 to ±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 $\pm0.015\%$ of full scale

Resolution . . . . 12V scale; 1 mV increment
1.2V scale; 100 μV increment
10V scale; 2.44 mV increment
1V scale; 244 μV increment

Temperature Drift of Zero
(12V scale) . . . . within $\pm10 \mu$V/°C
(1.2V scale) . . . . within $\pm1 \mu$V/°C

Temperature Drift of Calibration
(+15°C to +35°C) . . . . ±10ppm of setting/°C
(0°C to +50°C) . . . . ±15ppm of setting/°C

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

Storage Temperature Range . . . . −25°C to +85°C

Output Noise . . . . 150 μV peak-to-peak, wideband (12V dc scale)

POWER REQUIREMENTS

Supply Battery Voltage Range . . . 20V dc to 6.5V dc (no effect on performance)

Supply Current . . . . 20mA (no load) at +9V dc

Battery Type . . . . 9V alkaline or Ni-Cd

Battery Life (GC9B NiCd)	Min.*	Typ.	Units
(before requiring recharging)	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 × 3.6"W × 1.29"H
146 × 91 × 33mm

Weight . . . . 11 ounces (342 grams)

Case . . . . ABS plastic

Keyboard Life . . . . 10 million cycles per switch (minimum)

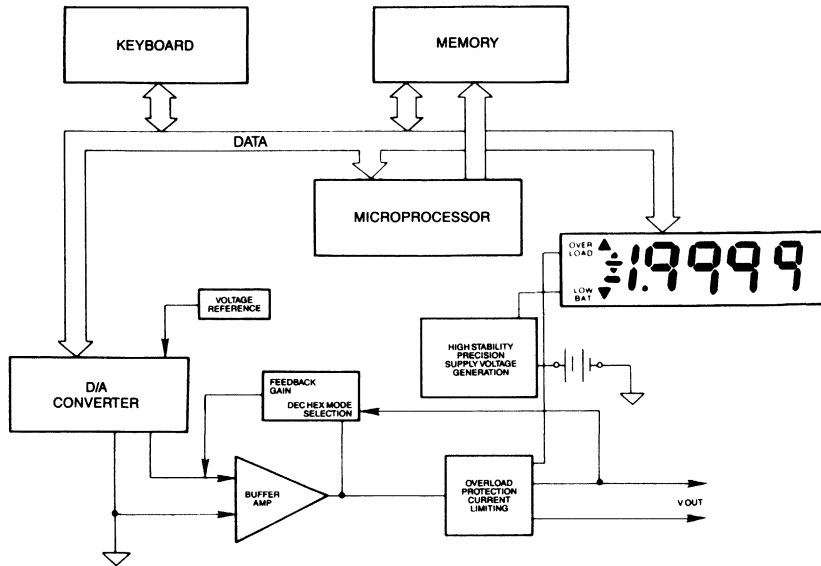**Key Operating Force** . . . . . . 4 to 8 ounces, 124 to 248 grams

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.
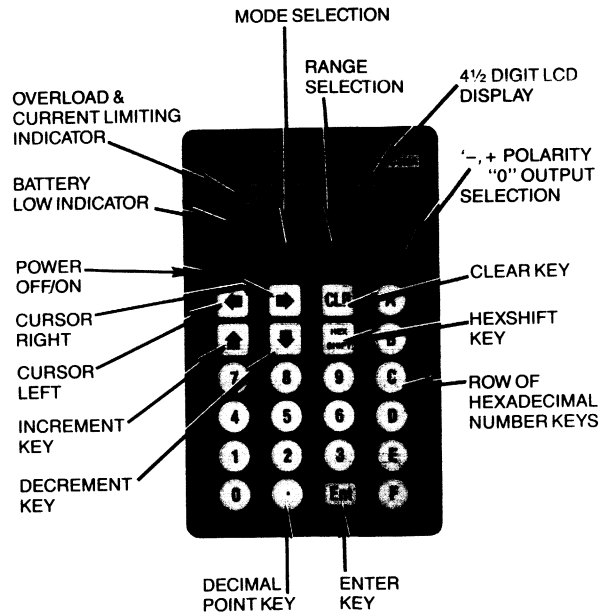

Figure 2.   Keys, Indicators, Switches

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 " $b.Rd.\varepsilon$ " (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.
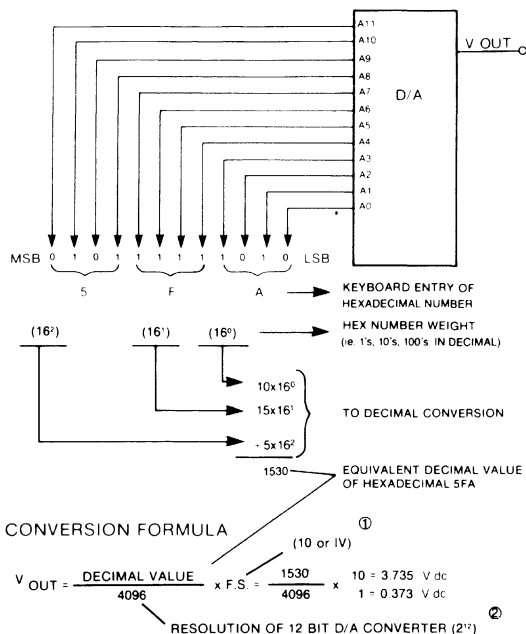
Figure 3. Hexadecimal Mode Operation

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

KEYBOARD ENTRY	INPUT STATUS OF D/A	DISPLAY STATUS & VOLTAGE OUTPUT	DESCRIPTION

Example 1:
Enter 5C4
Followed by [Hex Shift] key

MSB ─────────── LSB
| 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
      5   c   4

[display: 0.5.C.4.]
V out = 0.3605 VDC
± 244μV (1 V scale)

Four decimal points are an indication that HEX SHIFT function is enabled.

Shift Left 5C4
[⇑]

| 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
      8   8   8

[display: 0.b.8.8.]
V out = 0.72070 VDC
± 244μV (1 V scale)

When shift to the left is performed, it is like multiplying 5C4 by 2.

Shift Right 5C4
[⇓]

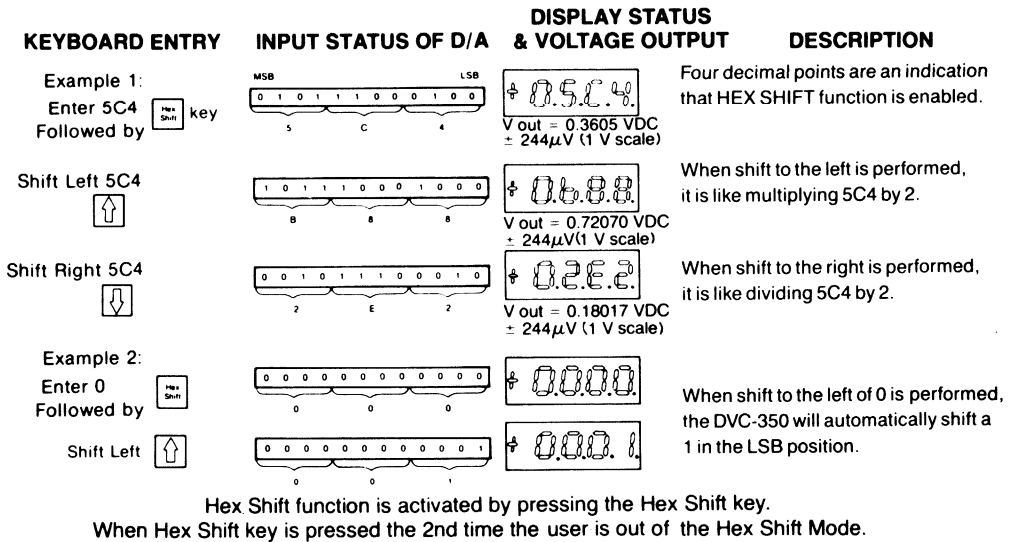| 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
      2   E   2

[display: 0.2.E.2.]
V out = 0.18017 VDC
± 244μV (1 V scale)

When shift to the right is performed, it is like dividing 5C4 by 2.

Example 2:
Enter 0
Followed by [Hex Shift]

| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
      0   0   0

[display: 0.0.0.0.]

Shift Left [⇑]

| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
      0   0   1

[display: 0.0.0.1.]

When shift to the left of 0 is performed, the DVC-350 will automatically shift a 1 in the LSB position.

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).
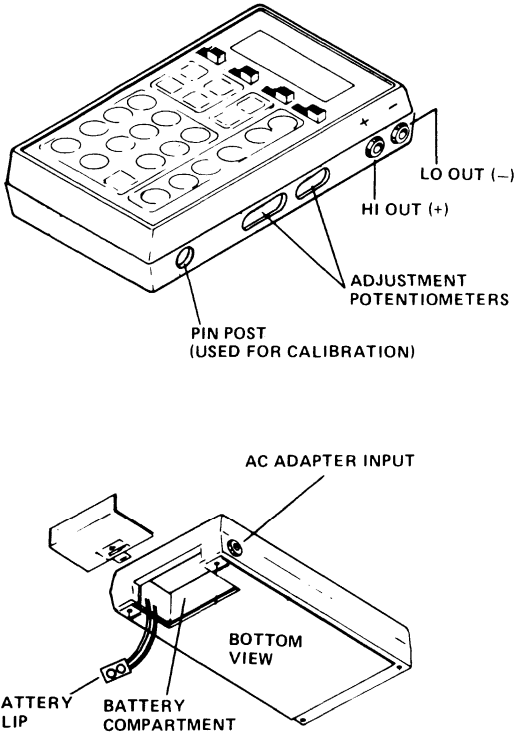
LO OUT (−)

HI OUT (+)

ADJUSTMENT
POTENTIOMETERS

PIN POST
(USED FOR CALIBRATION)

AC ADAPTER INPUT

BOTTOM
VIEW

BATTERY
CLIP

BATTERY
COMPARTMENT

Figure 6. Terminals and Battery Locations

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.

1.25″

5.75″

3.62″
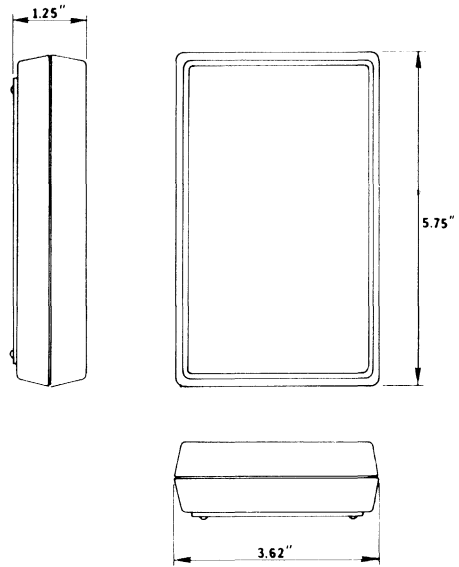
Figure 7. DVC-350A Mechanical Dimensions

ORDERING GUIDE	
DVC-350A Includes:	**Accessory Kit** (MODEL 39-7267690)
Calibrator Water resistant carrying case (inside pocket for test leads and spare batteries).	Includes: • AC Adapter/Charger, UL/CSA approved • 7.2V Rechargeable Ni-Cd battery
Test Leads Set Two 3 foot, 20 AWG, leads, stackable banana plugs (with retracting hook clips).	
Certificate of Calibration Operations manual	

DATEL

FEATURES

- ±19.999 Volts full-scale output range, attenuation kits available for ±1.9999V FSR and ±199.99 mV FSR
- Millivolt settability with accuracy of ±25 ppm of setting ±1/2 LSB (0.005% of Full-scale Range)
- Output range set from quick-select front panel lever switches
- Continuous front panel ±1.5 mV vernier control
- Rated accuracy up to 25 mA output
- Current from short-circuit-proof output transformer-isolated ±300 Volts to AC line
- Miniature aluminum case includes bench-top stande 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 impedence and up to 25 milliamps output current at the rated accuracy of ±25 ppm of setting, ±500 μV. 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 ±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 ±500 μV and ±25 ppm of the setting with zero drift of ±5 μV/°C and full-scale drift of 4 ppm/°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 ±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 ±10%, and 47 to 440 Hz at 10 watts, the DVC-8500 offers transformer isolation up to ±300 VDC. Output line rejection is within ±50 microvolts of zero and within ±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
Output Type............... Shielded transformer isolated, active low impedence DC voltage output, current limited.

Output Voltage Range......................... 0 to +19.999 Volts DC or 0 to -19.999 Volts DC, lever switch selected, 1 mV steps (Range ±20.0005 Volts using vernier control).

Output Current Range......................... 0 to 25 mA (source current) to rated voltage output accuracy.

Output Overload........ 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 ±20V dc.

Output Impedance..... Less than 10 milliohms.

Capacitive Load........ no limitation

PERFORMANCE
Accuracy @ +25°C with Vernier Control at Zero................ Within ±25 ppm of setting, ±500 µV when calibrated (0.005% of Full-scale range).

Resolution................ Set within ±1 mV increments. A front panel vernier control provides ±1.5 mV continuous offset with 100 µV graduations.

Temperature Drift of Zero...................... Within ±5 µV/°C

Temperature Drift of Calibration............ Within ±4 ppm of setting/°C

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

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

Warm-Up Time........... 5 minutes to rated accuracy

Output Noise............ 25 µV pk-pk, wideband (no cap load)

Reference Source..... 6.4V oven-stabilized low TC zener reference diode

AC Line Voltage Rejection................... Zero: ±50 µV over full line range
Calibration: ±25 ppm of setting over full line range

Power Transformer Isolation................... 1000 Megohms. Transformer primary has a grounded shield for capacitive isolation.

Breakdown................. 300 VRMS, min.

FRONT PANEL
Output Selector Switches.................... Six lever-operated detented switches are set in millivolts (±19999 mV range)

Polarity................. 2 positions, + or -

Leading Digit........:.. 2 positions, 0 or 1

4 Digits................. 10 positions, 0 thru 9

Output Vernier.......... Rotary potentiometer, range ±1.5 mV of selected output. Graduated in 100 µV 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. Counter-clockwise rotation labeled "DECR" (decrease).

Overload Light.......... Red LED lamp illuminates if output exceeds ±25 mA.

Power Switch............ Toggle switch, AC power on or off.

Power Light............... Red LED lamp illuminates when AC power is on.

INPUT/OUTPUT CONNECTORS
Front Panel............... Voltage output (blue) and output comon (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)

Rear Connections:
Voltage Output...... Parallel connection with front panel jack.

Output and Reference Common..... Parallel connection with front panel jack. Transformer isolated ±300V from case ground.

Reference Output.. Low impedance ±10 Volt DC output from +6.4V ref. diode. Drain must not exceed ±5 mA maximum. Ref. output is opposite polarity of calibrator output.

Sense Input.......... Connect to remote load to compensate for cable resistance voltage drops. See diagram. This input must be tied to voltage output if not used.

Sense Common...... Return for sense inputs. Tie to output common if sense is not used.

Rear connections are arranged as dual 36-pin PC edgeboard 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,
38-8193902.............. 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:

- **Power Supplies**

- **Data Conversion Components**

- **Data Acquisition & Control Boards**

- **Panel Meters, Printers, & Calibrators**

Dial
1-800-233-2765
for
Immediate Assistance

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356

Selected New Products

3.5 DIGIT, MINIATURE VOLTAGE METERS

	Model	Power	Std. Input	Case	Features
NEW Self-Contained 3.5 Digit LED Ultra-Miniature	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
	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	
NEW 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	
NEW 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	Sealed. Plastic Case. Suitable for battery operation
	DMS-30LCD-1/9	9 to 15Vdc	2Vdc	C	
	DMS-30LCD-2/9	9 to 15Vdc	20Vdc	C	

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)

DATEL

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 ±0.05% (±1 digit)**
- **External 1.23V reference available**
- **Models for ±200 mV dc, ±2V dc, or ±20V 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**

Plastic Case
Industrial

Ceramic Case
Hermetically
Sealed
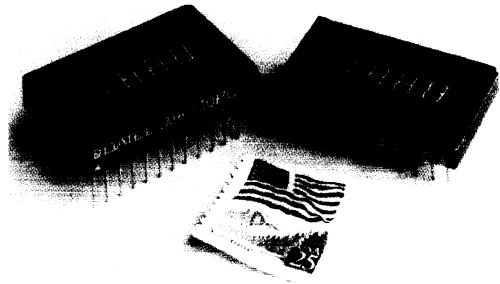
GENERAL DESCRIPTION

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 ±200 mV, ±2V, and ±20V. All versions feature laser-trimmed accuracies of ±0.05% of reading, ±1 count typical.

High impedance, differential inputs of 1,000 MΩ (1 MΩ 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**
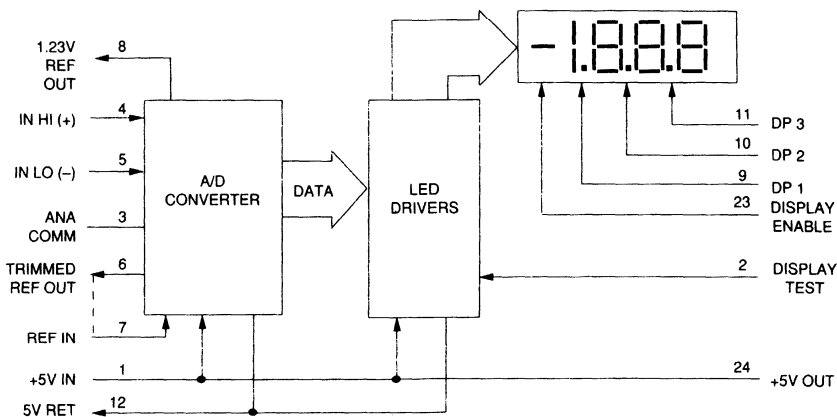- **Avionics Displays**
- **Digital thermometers**

Figure 1. DMH-30 Simplified Block Diagram

FUNCTIONAL SPECIFICATIONS

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

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

$$50\ K\Omega < R_1 + R_2 < 10\ M\Omega$$

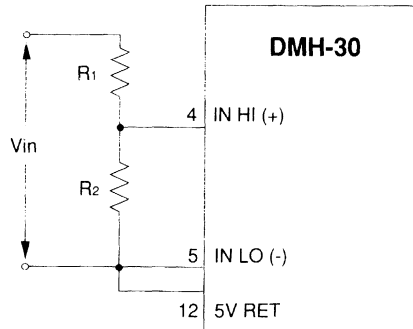$$\frac{R_2}{R_1 + R_2} \times V_{IN} = Reading$$

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.
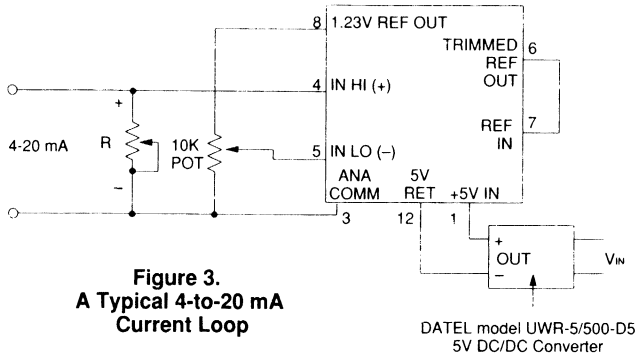

Figure 3.
A Typical 4-to-20 mA
Current Loop

DATEL model UWR-5/500-D5
5V DC/DC Converter

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 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 interract.

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.
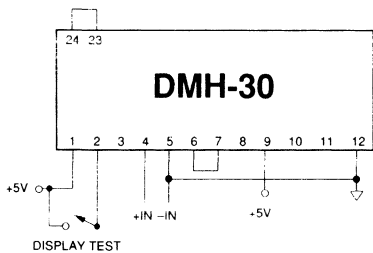
Figure 4a. Typical Single-Ended Input Connections
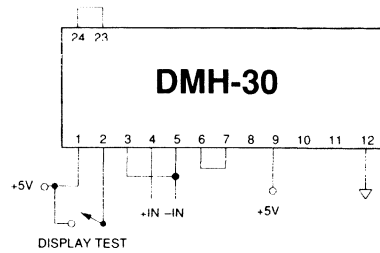
Figure 4b. Typical Differential Input Connections

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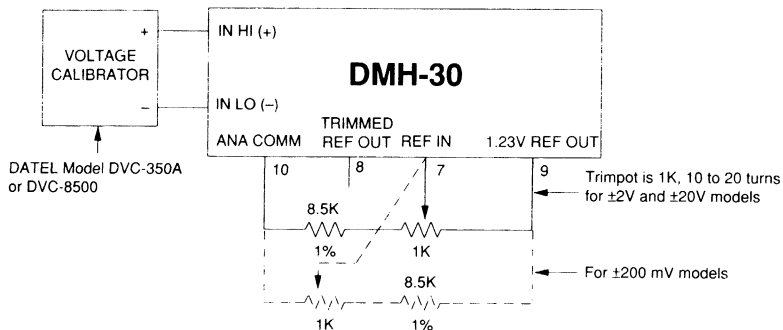
Figure 5. Using the 1.23V REF OUT to Change the Calibration

MECHANICAL DIMENSIONS

INCHES
(mm)

DMH-30MM-X

TOP VIEW

1.29 (32,7)

24   13

0.8 (20,3)

12

Ceramic header with hermetically sealed
red filter quartz glass window

Pin 1   0.8 (20,3)

0.200 (5,08)

0.150 (3,8)
MIN   .025 in.,
±0.01
TYP

0.1 (2,5) center to center   0.6 (15,2)
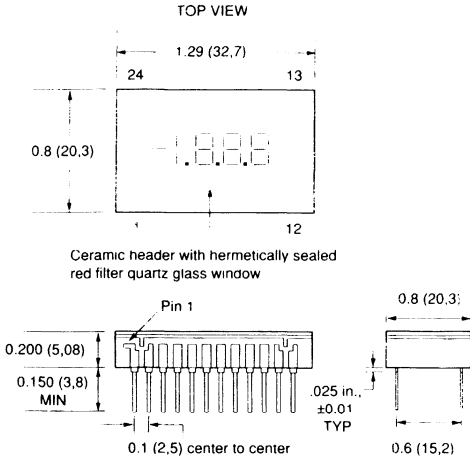
Note: Pin Dimensions 0.010 X 0.018
Pins have a 0.025 in., ±0.01
stand-off from case

DMH-30PC-X

TOP VIEW

1.29 (32,7)   Epoxy sealed acrylic
case with red filter
24   13   and transparent
window

0.8 (20,3)

1   12   0.8 (20,3)

0.245 (6,2)   Pin 1   0.030
(76,2)
0.22 (3,8)   typical
MIN
0.6 (15,2)

0.1 (2,5)
center to center
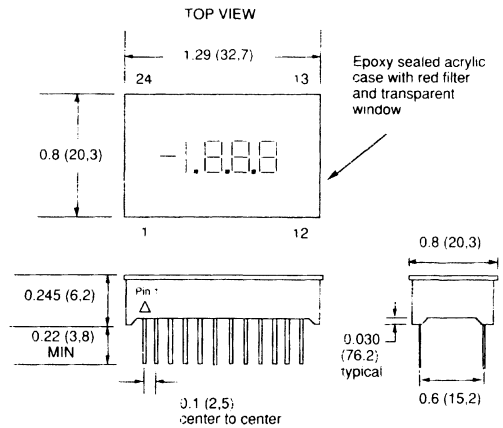
Note: Pin Dimensions 0.010 X 0.018

Soldering Information: These meters will withstand normal
wave soldering with freon tms used in the cleaning step. Oth-
er 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	FUNCITON
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

DMS-30PC Series
Mini, 3 1/2 Digit, Digital Panel Meters

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 ±200 mV, ±2V, and ±20V dc**
- **Factory calibrated to within ±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**
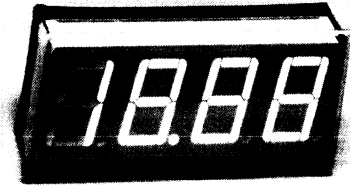
GENERAL DESCRIPTION

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.

CMR to 86 dB, high impedance, differential input, overvoltage protection (to ±250V dc), and a built-in, high stability, double regulated laser trimmed reference circuit allows for extreme accuracy (0.05%, ±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: ±200 mV (DMS-30PC-0), ±2V dc (DMS-30PC-1), and ±20V dc (DMS-30PC-2).

Input impedances are 1,000 megohms for both the ±200 mV and ±2V dc models and 1 megohm for the ±20V 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.

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			
PERFORMANCE				
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
PHYSICAL				
Display Type and Size	3 1/2 digit LED, 0.56" high			
	See Ordering Guide for Colors			
Polarity Indication	Autopolarity ("-" for negative VIN)			
Overange Indication	-1 for negative VIN			
	1 for positive VIN			
Weight	0.5 oz.			
Case Material	Acrylic			
ENVIRONMENTAL				
Operating Temperature	0 to +60 °C (all models)			
Storage Temperature	-40 to +75 °C (all models)			
Humidity	0 to 95% non-condensing			
POWER SUPPLY REQUIREMENTS				
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.

$$5 \ K\Omega < R_1 + R_2 < 10 \ M\Omega$$

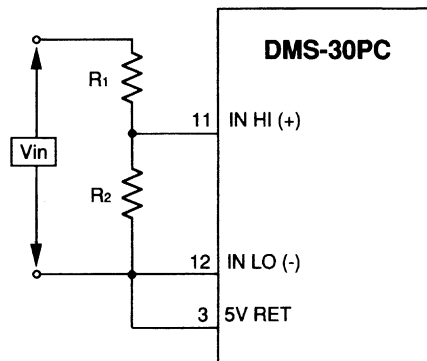$$\frac{R_2}{R_1 + R_2} \ X \ V_{IN} = Reading$$

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 1.23 volt precision reference and analog common is used as an offset adjustment.

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

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:

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

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.

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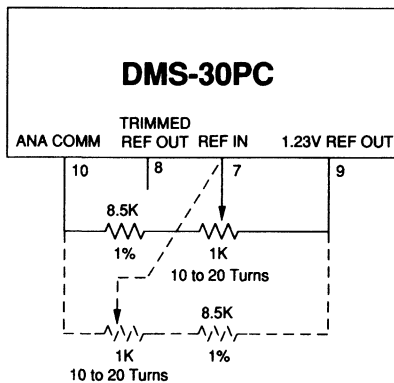
Figure 4. Using EXTERNAL REFERENCE OUT to Change DMS-30 Gain

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

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

MECHANICAL DIMENSIONS

Inches
(mm)

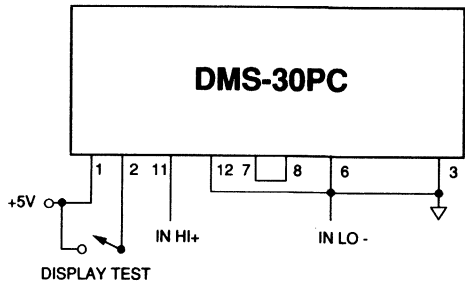| MODEL	INPUT RANGE	FEATURES
DMS-30PC-0-RL	±200 mV	Low Power Red LED
DMS-30PC-1-RL	±2V dc	Low Power Red LED
DMS-30PC-2-RL	±20V dc	Low Power Red LED
DMS-30PC-0-RS	±200 mV	Standard Intensity Red LED
DMS-30PC-1-RS	±2V dc	Standard Intensity Red LED
DMS-30PC-2-RS	±20V dc	Standard Intensity Red LED
DMS-30PC-0-RH	±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
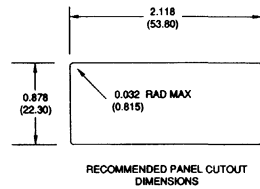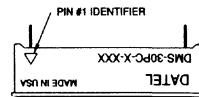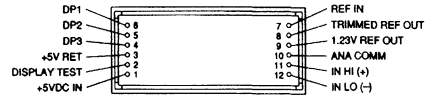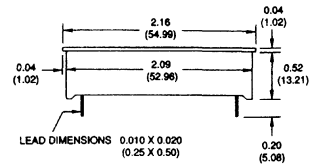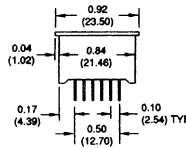
OPTIONS

DMS-EB　　　Application/Evaluation board
Available with standard MOLEX connector,
DP solder gaps, attentuation 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)

DP1	I 6		7 I	REF IN
DP2	I 5		8 I	TRIMMED REF OUT
DP3	I 4	**BOTTOM**	9 I	1.23V REF OUT
GROUND	I 3	**VIEW**	10 I	ANA COMM
DISPLAY TEST	I 2		11 I	IN HI (+)
+5V dc	I 1		12 I	IN LO (-)
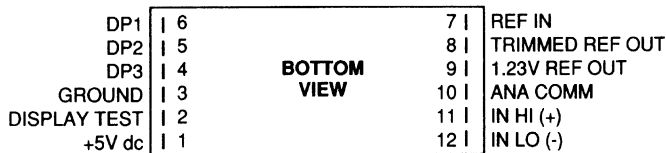
DMS-30LCD Series
Miniature, 3 1/2 Digit
LCD Digital Panel Meter

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 ±200 mV, ±2V dc, ±20V dc ranges
- Autozero and autopolarity changeover
- Low power (245 µA) models available
- Laser trimmed reference; 0.05% accuracy
- All segments TEST pin
- User selectable decimal point
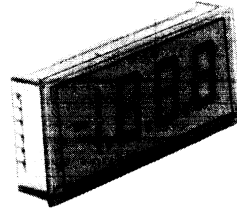
GENERAL DESCRIPTION

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 ±250V dc), and a built-in, high stability, double regulated laser trimmed reference circuit allows for extreme accuracy (0.05%, ±1 digit), repeatability and a very long MTBF.   Incorporating a dual slope, integrating A/D converter with modern LSI micro-chip 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; ±200 mV (DMS-30LCD-0), ±2V dc (DMS-30LCD-1), and ±20V 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 µA, typical) for battery operation.   Operating temperature range is 0 to 60 °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.
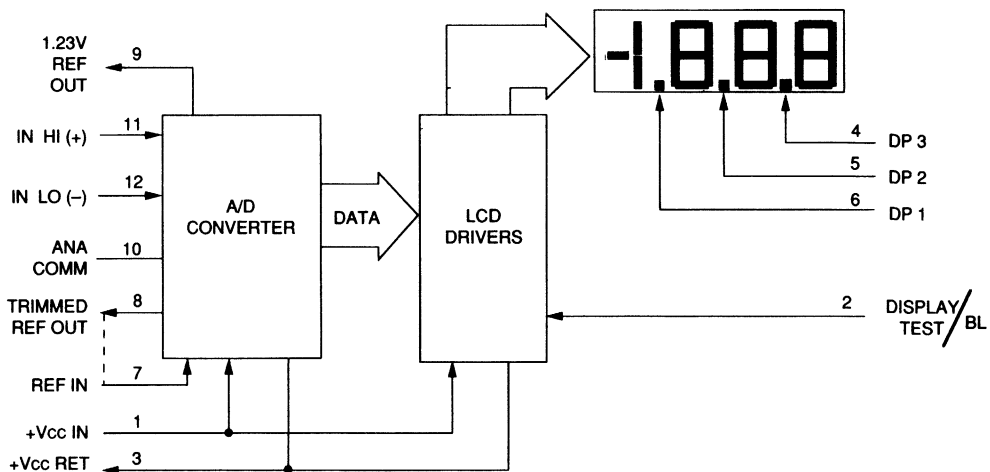
Figure 1. DMS-30LCD Simplified Block Diagram

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

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

DISPLAY	
Display Type and Size	3 1/2 Digit, Enhanced Contrast LCD 0.450" height
Polarity Indication	Autopolarity ("-" for Neg V_{IN})
Overrange Indication	-1 for negative V_{IN}
	1 for positive V_{IN}
Weight	0.5 Oz.
Case Material	Clear Acrylic

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

POWER SUPPLY REQUIREMENTS	
5V dc Model	
Voltage	5.00V dc (± 5%)
Current	500 µA (typ), 900 µA (max)
9V dc Model	
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 useage**
* **Portable/mobile instruments**
* **Weigh scales**
* **Avionics displays**
* **Digital thermometers.**
* **Process monitoring**

$$5\ K\Omega < R_1 + R_2 < 10\ M\Omega$$

$$\frac{R_2}{R_1 + R_2}\ X\ V_{IN} = Reading$$
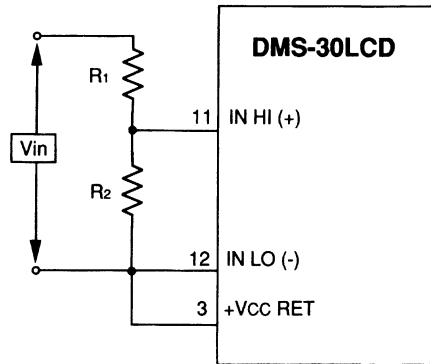
Figure 2. Simple Attenuation Circuit for Scaling Input Voltages

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 1.23 volt precision reference and analog common is used as an offset adjustment.
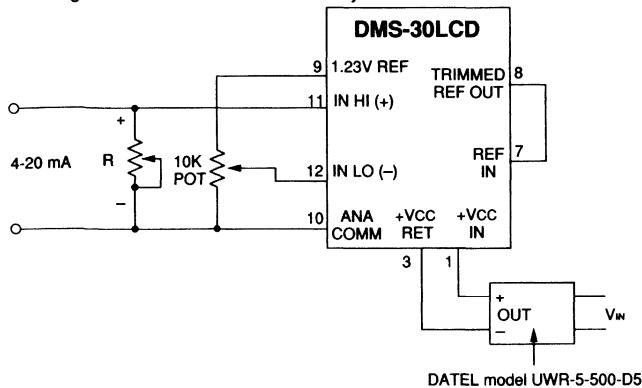
Figure 3. A Typical 4-to-20 mA Current Loop

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.
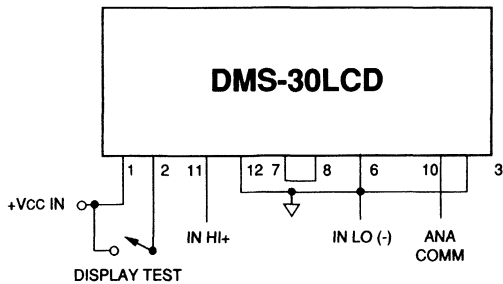
Figure 4. Typical Single-Ended Connections

Determining Shunt Resistor Value

Where: V_{FSR} = Full Scale Voltage Reading
$\qquad\;\; I_{FSR}$ = 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 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 interract.

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 ±2V and ±20V models. Reverse positions of potentiometer and 33K resistor for ±200 mV models. Calibration is performed with a near full scale input.
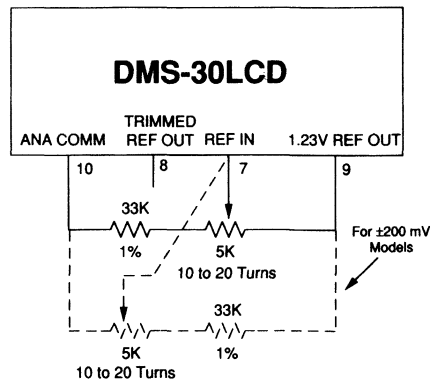
Figure 5. Using REFERENCE OUT to Change DMS-30LCD Gain

MECHANICAL
DIMENSIONS
(Drawn to scale)
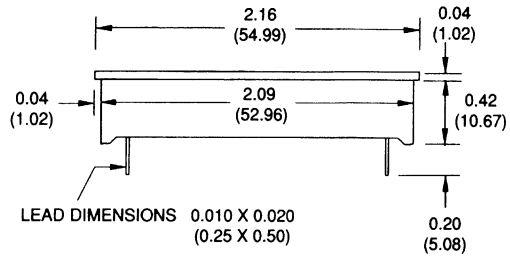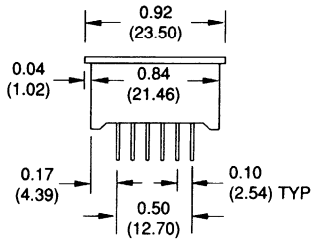
NOTE:
Recommended printed circuit
board finished hole diameter:
0.042(1.067) ± 0.002(0.051)

0.92
(23.50)

0.04
(1.02)

0.84
(21.46)

0.17
(4.39)

0.10
(2.54) TYP

0.50
(12.70)

2.16
(54.99)

0.04
(1.02)

0.04
(1.02)

2.09
(52.96)

0.42
(10.67)

LEAD DIMENSIONS 0.010 X 0.020
(0.25 X 0.50)

0.20
(5.08)

TOLERANCES UNLESS OTHERWISE
SPECIFIED

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

DP1 — 6 ... 7 — REF IN
DP2 — 6 ... 7 — TRIMMED REF OUT
DP3 — 5 ... 8 — 1.23V REF OUT
+VCC RET — 4 ... 9 — ANA COMM
 — 3 ... 10 —
DISPLAY TEST — 2 ... 11 — IN HI (+)
+VCC IN — 1 ... 12 — IN LO (−)

2.118
(53.80)

0.878
(22.30)

0.032 RAD MAX
(0.815)
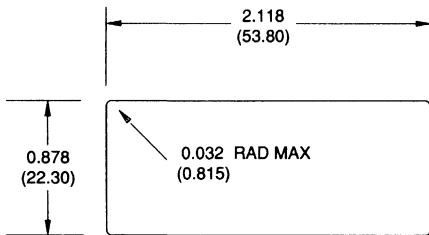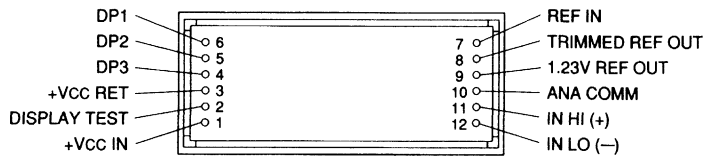
RECOMMENDED PANEL CUTOUT
DIMENSIONS

PIN #1 IDENTIFIER

XXX-X-DCL03-SMD
DATEL
MADE IN USA
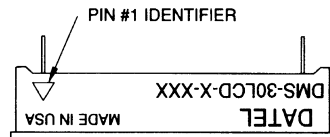
ORDERING INFORMATION

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, attentuation resistor pads.

RN-DMS/LCD   Resistor Gain Kit
Available for user designed attenuator network.

® **DATEL** ®

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**
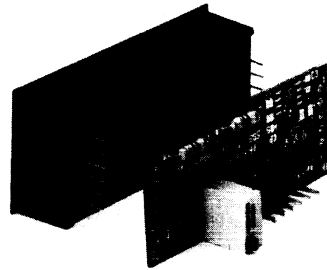
GENERAL DESCRIPTION

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 OFF-SET 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 (±200 mV, ±2V, ±20V) 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**
- **Interchangability between meters**
- **Quick prototyping and evaluation**
- **Bench top instrumentation**
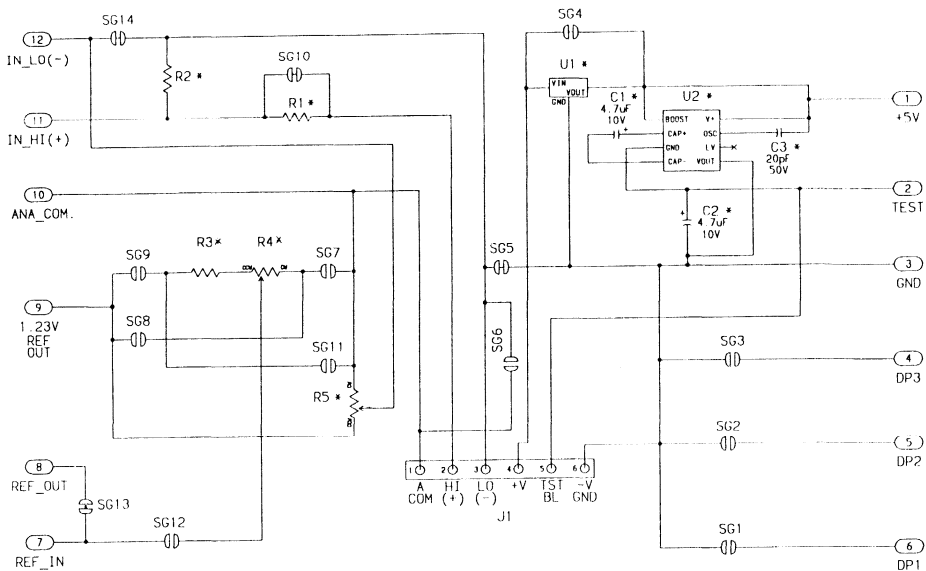
Figure 1. Block Diagram
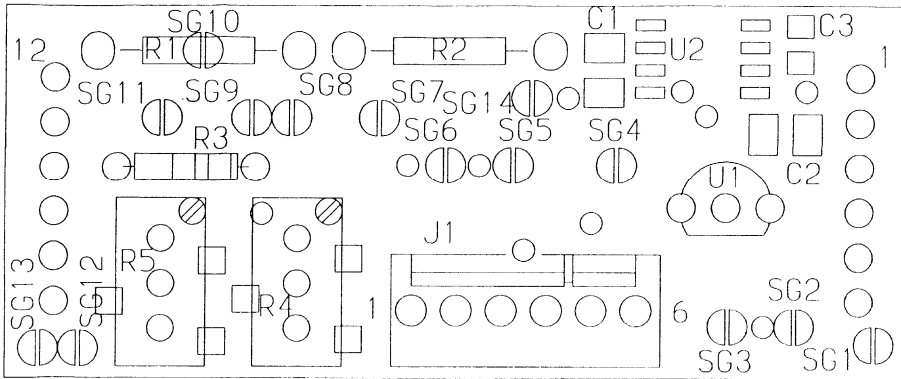
When using 7805 (TO3), metal tab points toward SG1, SG2, SG3.

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:

$R2 = FSR \times R1 / |V_{IN}| - FSR$ 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 MOhm
2. $R2 = FSR \times R1 / |V_{IN}| - FSR$
   R2 = (1.999 x 1,000,000) / 199.9 - 1.999
   R2 = 10101.01Ω 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 KΩ, 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 / Imax x 10000) where;
FSR is desired reading (0 - 1999) and Imax is between
0 - 1 Amp.

Open SG5
Close SG6
Close SG10 (if Open)
Install R4 (2 KΩ 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 x 10000   R2 = 0.1 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	4.7uF 10V
10	R1	*	32	C3	*
14	R2	*	49	J1	*
18	R3	10.5K	51	*	*
23	R4	2K TRIM POT	52	PWB	C-18781
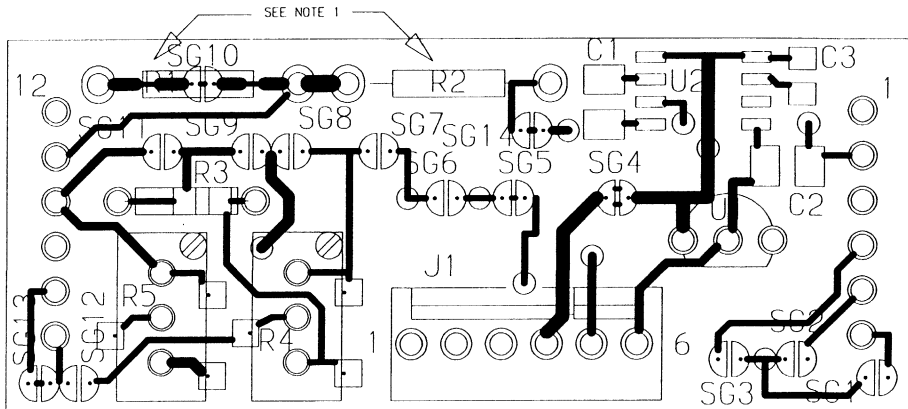
Figure 3. Mechanical Drawing and Layout

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and Module component needs.

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12-Bit, 2.0 MHz, Low-Power
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Features

- 2.0 MHz minimum throughput
- Functionally complete
- Small 24-pin DIP
- Low-power, 1.4 Watts
- Three-state output buffers
- Samples to Nyquist
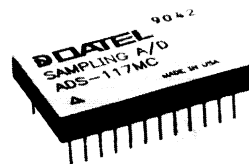
ADS-118
12-Bit, 5.0 MHz, Low-Power
Sampling A/D Converter

Features

- 5.0 MHz minimum throughput
- Functionally complete
- Small 24-pin DIP
- Low-power, 2.3 Watts
- Three-state output buffers
- Samples to Nyquist
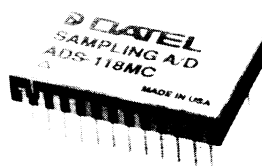
ADS-941
14-Bit, 1.0 MHz, High Resolution
Sampling A/D Converter

Features

- 1.0 MHz minimum throughput
- Functionally complete
- Small 32-pin DIP
- Low-power, 2.8 Watts
- Three-state output buffers
- Samples up to Nyquist
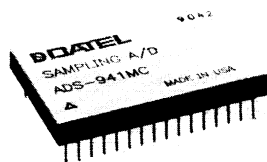
ADS-942
14-Bit, 2.0 MHz, High Resolution
Sampling A/D Converter

Features

- 2.0 MHz minimum throughput
- Functionally complete
- Small 32-pin DIP
- Low-power 2.9 Watts
- Three-state output buffers
- Samples up to Nyquist

ADS-930
16-Bit, 500 KHz, High Resolution
Sampling A/D Converter

Features

- 500 KHz sampling rate
- Functionally complete
- Small 40-pin DIP
- Low-power, 1.8 Watts
- Three-state output buffers
- Samples up to Nyquist
- 16-Word FIFO memory

ADC-530
12-Bit, Ultra-Fast, Low-Power
A/D Converter

Features

- 350 nSec MAX. conversion time
- Low-power, 2.1 Watts
- Small initial errors
- Three-state output buffers
- Small 32-pin DIP
- No missing codes

HDAS-950/951
16-Bit, 100 KHz
Data Acquisition Systems

Features

- 16-bit resolution, 100 KHz
- 8 SE 4 D channels
- Miniature 40-pin DDIP
- Full-scale gain range from 100 mV to 10V
- High-impedance output state

SHM-945
High-Speed, Hybrid
Precision Sample/Hold

Features

- 500 nSec MAX acquisition time to 0.00076%
- Differential input
- 0.0004% linearity
- 16-bit performance over military temperature range
- Small 24-pin DDIP package
- Operates at different gain settings

SHM-43
High-Speed, 0.01%
Hybrid Sample/Hold

Features

- 35 nS MAX acquisition time to 0.01%
- 1 Picosecond aperture uncertainty
- 75 MHz small-signal bandwidth
- 520 Milliwatt maximum power dissipation
- Small 14-pin DIP package
- CMOS control signal
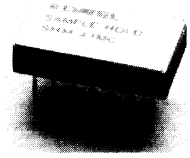
MX-826
Precision, High-Speed
Multiplexer

Features

- 225 nSec Max. settling time to 0.01%
- 400 nSec. Max. settling time to 0.003%
- 150 nSec. Max. settling time to 0.1%
- 8 Channels single-ended inputs
- 395 Milliwatts power dissipation
- Small 24-pin DDIP package
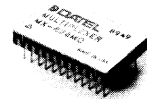
MX-850
Precision, High Speed
Multiplexer

Features

- 50 Nanoseconds settling time to 0.01%
- 70 Nanoseconds settling time to 0.003%
- 100 Nanoseconds settling time to 0.001%
- 4 Channels, single-ended inputs
- 207 Milliwatts power dissipation
- Small 14-pin DIP package
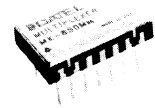
MSH-840
Quad Simultaneous
Sample Hold

Features

- 4 Simultaneous sample/holds
- Internal 4 channel multiplexer
- 750 nSec acquisition time, 10V step to 0.01%
- 2 channels with optional X10 gain
- Control logic for interfacing to A/D's
- Low-power, 1.5 Watts
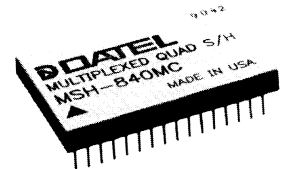
SHM-49
High-Speed, 0.01%
Hybrid Sample/Hold

Features

- 16 MHz small signal bandwidth
- Small 8-pin DIP or LCC package
- 200 nS Max. acquisition time to 0.01%
- 72 dB feedthrough attenuation
- ±25 Picoseconds aperture uncertainty
- 413 Milliwatts power dissipation

ADS-120
12-Bit, 20 MHz
Sampling A/D Converter

Features

- 20 MHz minimum throughput
- Samples to Nyquist
- Functionally complete
- Small 40-pin DIP
- Low-power, 4.2 Watts
- Three-state output buffers
- High input bandwidth

ADS-944
14-Bit, 5.0 MHz, High Resolution
Sampling A/D Converter

Features

- 5.0 MHz minimum throughput
- Functionally complete
- Small 32-pin DIP
- Low-power, 3.4 Watts
- Three-state output buffers
- Samples to Nyquist

ADS-945
14-Bit, 10.0 MHz, High Resolution
Sampling A/D Converter

Features

- 10 MHz sampling rate
- Functionally complete
- Small 40-pin DIP
- Low-power, 4.2 Watts
- Three-state output buffers
- Samples up to Nyquist
- 16-Word FIFO memory

ADS-976
16-Bit, 200 KHz, Low-Power
Sampling A/D Converter

Features

- 200 KHz sampling rate
- Compatible to industry standard ADC76, AD376, AD1376
- Small 32-pin DIP
- Low-power, 1.8 Watts
- Samples to Nyquist
- 16-Word FIFO memory

FLT-DL
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Digitally Programmable
Active Filters

Features

- Digitally programmable
- 4- and 5-pole CAUER response
- Cascadable 7-pole CAUER response
- Cutoff frequencies to 1.2 MHz
- Small 32-pin DIP
- -55 to +125 °C operation

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Data Acquisition Boards for IBM-PC/XT/AT

GPIB-PCIIA

High Speed Instrumentation
Interface Board for IBM-PC/XT/AT and PS/2

D® DATEL®

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- **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**
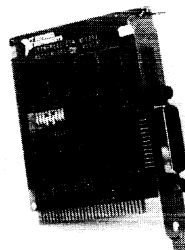
GENERAL DESCRIPTION

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

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356

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. It's 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
SH1	Source Handshake
AH1	Acceptor Handshake
T5, TE5	Talker, Extneded 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 Parellel Poll

CONNECTOR PINOUT

DIO1	1		13	DIO5
DIO2	2		14	DIO6
DIO3	3		15	DIO7
DIO4	4		16	DIO8
EOI	5		17	REN
DAV	6		18	GND (TW PAIR W/DAV)
NRFD	7		19	GND (TW PAIR W/NRFD)
NDAC	8		20	GND (TWPAIR W/NDAC)
IFC	9		21	GND (TW PAIR W/IFC)
SRQ	10		22	GND (TW PAIR W/SRQ)
ATN	11		23	GND (TW PAIR W/ATN)
SHIELD	12		24	SIGNAL GROUND

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.
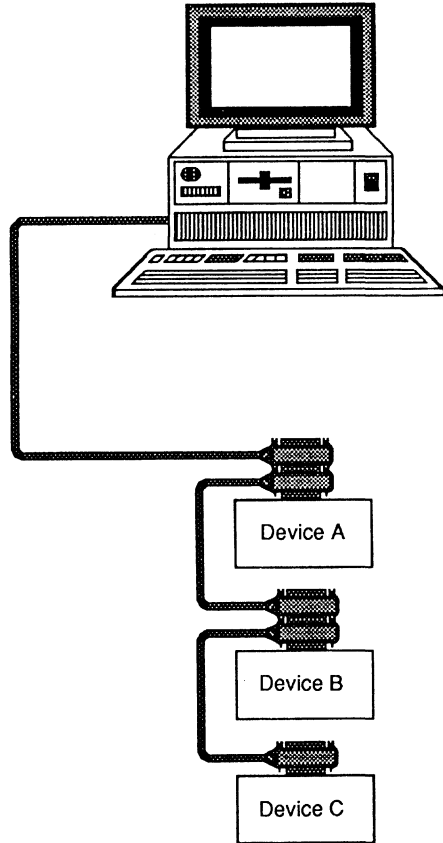
LINEAR CONFIGURATION

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)

IEEE-488 BUS TRANSFER RATES
DMA ....> 300 Kbytes/sec Block Length ....up to 64 Kbytes
POWER REQUIREMENTS

+ 5 V dc
    Typical ....0.6 A
    Maximum..1.1 A

PHYSICAL
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
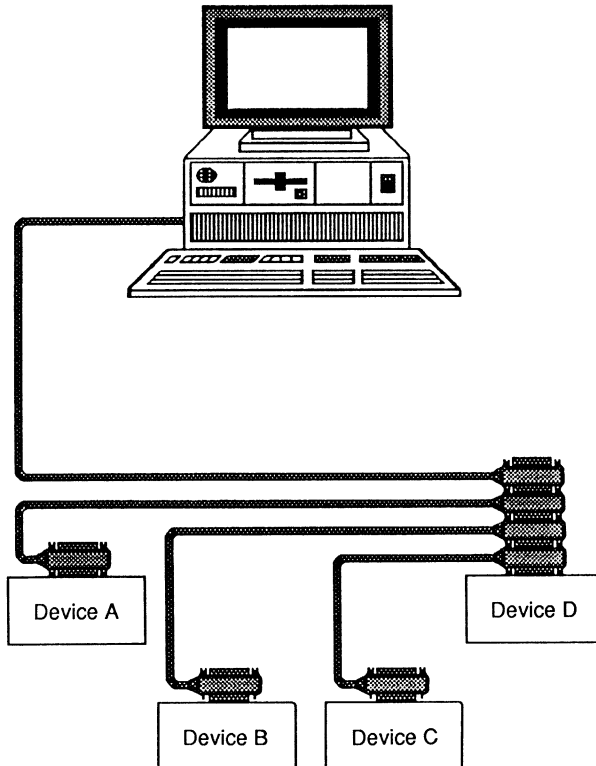
AT-GPIB
High Speed Instrumentation
Interface Board for IBM-PC/AT

®️ DATEL®️

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**
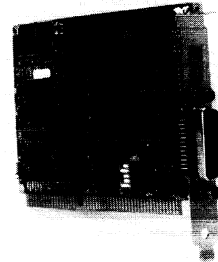
GENERAL DESCRIPTION

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.
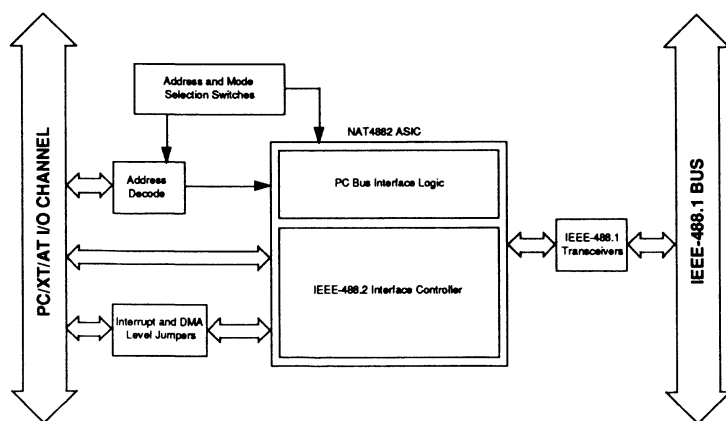
Used specifically for interfacing IBM-PC/AT personal computers (and compatibles) to the vast array of programmable devices via the General Purpose Interface Bus (often called HP-IB), the AT-GPIB takes full advantage of the PC/AT's 16-bit parallel architecture for extremely high speed data transfers. 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**
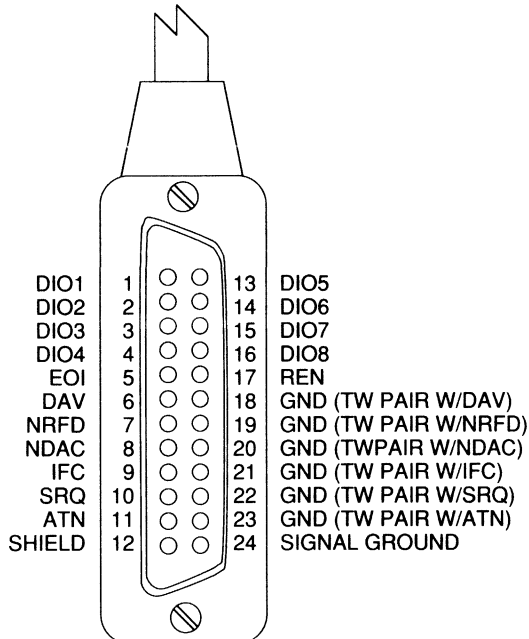- **Production/Manufacturing Automation**
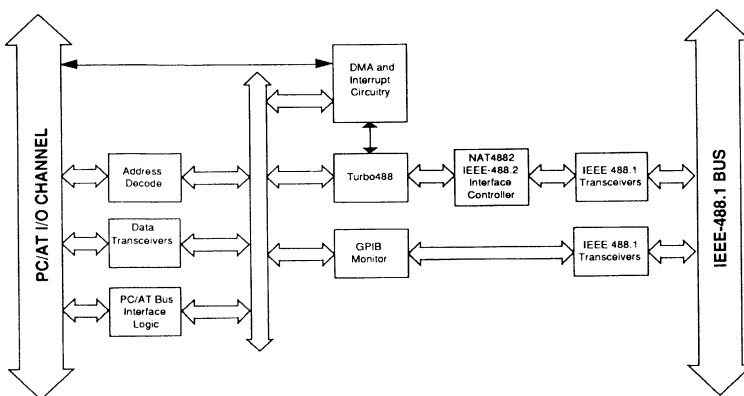
BLOCK DIAGRAM

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, Extneded 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 Parellel Poll

CONNECTOR PINOUT

DIO1	1	13	DIO5
DIO2	2	14	DIO6
DIO3	3	15	DIO7
DIO4	4	16	DIO8
EOI	5	17	REN
DAV	6	18	GND (TW PAIR W/DAV)
NRFD	7	19	GND (TW PAIR W/NRFD)
NDAC	8	20	GND (TWPAIR W/NDAC)
IFC	9	21	GND (TW PAIR W/IFC)
SRQ	10	22	GND (TW PAIR W/SRQ)
ATN	11	23	GND (TW PAIR W/ATN)
SHIELD	12	24	SIGNAL GROUND

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 μSec
  - 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)

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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)

CLOCK INPUTS
Turbo488 Clock .... 20 MHz NAT4882 Clock .... 20 MHz

IEEE-488 BUS TRANSFER RATES

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)

POWER REQUIREMENTS

+ 5 V dc
    Typical .... 0.66 A
    Maximum .... 1.50 A

PHYSICAL
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

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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!**
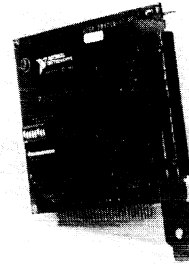
GENERAL DESCRIPTION

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.
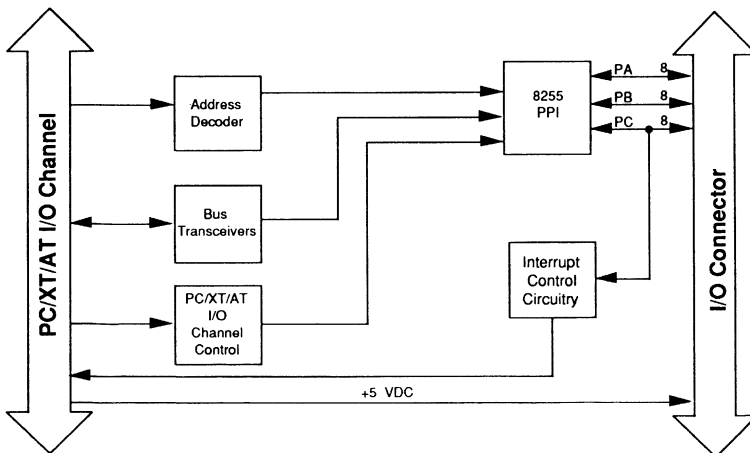
APPLICATIONS

- **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

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356

HARDWARE CAPABILITY

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.

PC-DIO-24 I/O CONNECTOR

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 Lab-Windows 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)

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 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

DATA TRANSFER RATE	
Programmed I/O	
(Using 8 MHz IBM PC/AT)	300 Kbytes/sec

POWER CONSUMPTION	
+5V dc, typical	0.16 A

PHYSICAL	
Dimensions	3.9" x 6.5"
I/O Connector	50-pin, male ribbon cable connector

ENVIRONMENTAL	
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)

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!**
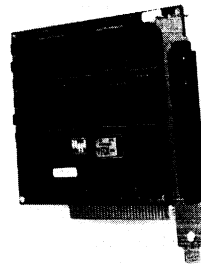
GENERAL DESCRIPTION

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-bits 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.

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 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 µsec 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.

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-96 BLOCK DIAGRAM
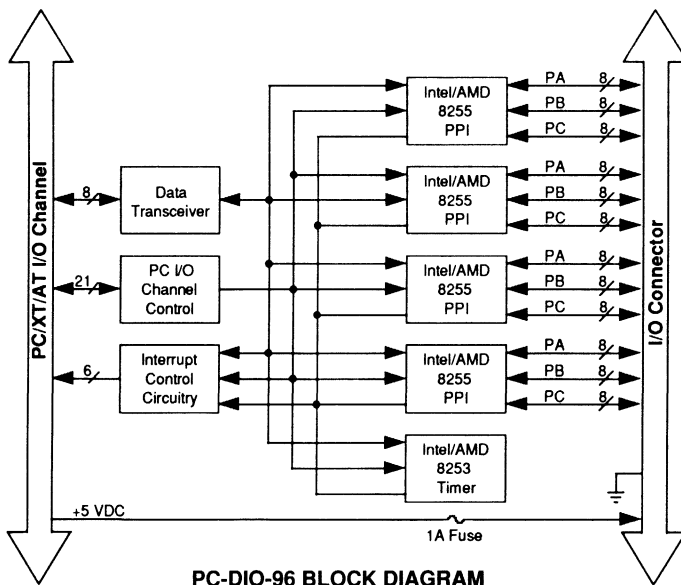
The PC-DIO-96 is fully compatible with LabWindows, an auto-code generating, menu-driven software package for data acquisition and analysis. The PC-DIO-96 may also be programmed directly from other languages such as Microsoft C and QuickBASIC, etc.

It's 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 μsec 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 μsec 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

(All specifications are typical at 25 °C unless otherwise noted)

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 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

DATA TRANSFER RATE

Programmed I/O
    (Using 8 MHz IBM PC/AT) ....300 Kbytes/sec

POWER CONSUMPTION

+5V dc, typical..0.16 A

PHYSICAL

Dimensions ....3.9" x 6.5"
I/O Connector...50-pin, male ribbon
                               cable connector

ENVIRONMENTAL

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 I/O CONNECTOR

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!**
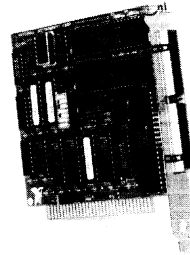
GENERAL DESCRIPTION

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

APPLICATIONS

- **Waveform Synthesis**
- **One-shot and Continuous Pulse Outputs**
- **Event Counting**
- **Frequency Counting**
- **Control Sequencing**
- **Coincidence Alarming**
- **Period Measurements**
- **Up/Down Totalizing**
- **Binary/BCD Counting**
- **Time-of-Day Clocking**
- **Waveform Analysis**
- **Waveform Generation**

BLOCK DIAGRAM
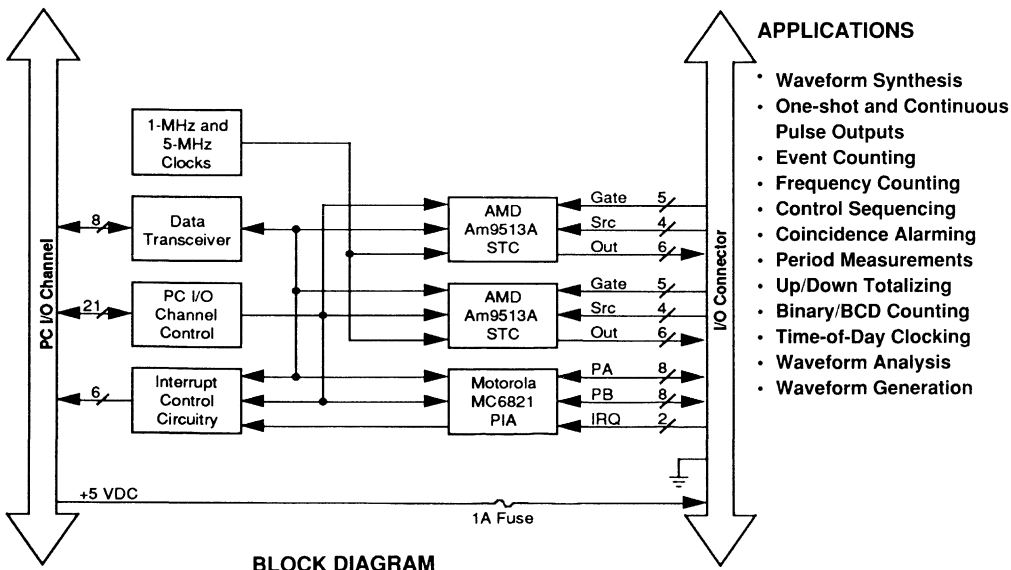
example programs in the User's Manual allowing even the novice programmer immediate access to the PC-TIO-10. National Instruments LabWindows 2.0 may also be used with the PC-TIO-10.   A 50-pin header brings all input and output control pins for each counter, 2 interrupt request lines, and +5V dc and 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 SOURCEn, GATEn, and OUTn (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 cascadable) 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%

LabWindows 2.0
PC/XT/AT Menu-Driven
Data Acquisition Software

D® DATEL®

FEATURES

- IBM-PC/XT/AT snd 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 inter-
active, menu-driven program development and automatic
code generation for even the most complex data collection,
analysis, control, and display applications. Sparkling graph-
ics, 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 exten-
sive 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 ac-
quisition subsystem (many of the included libraries use specif-
ic 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
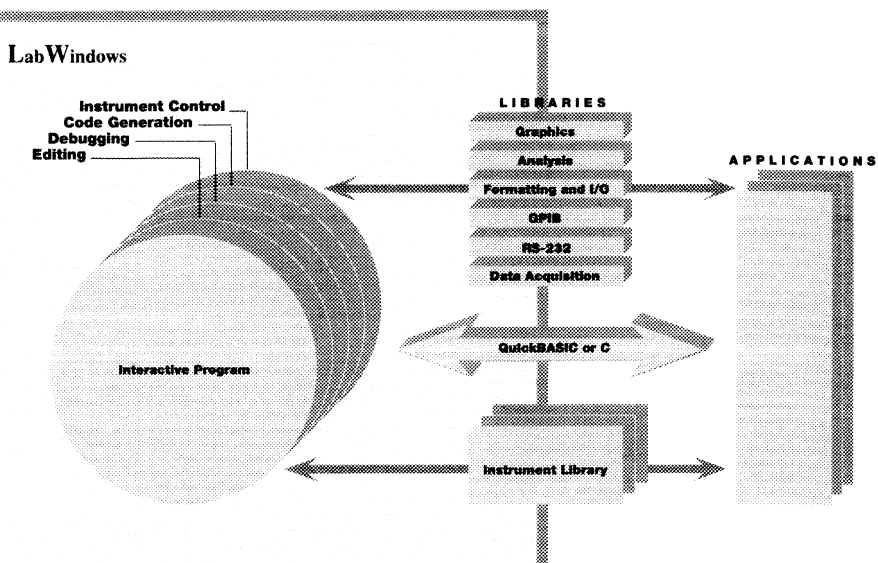
QuickBASIC or C Compatible Programming

LabWindows 2.0 gives you interactive tools allowing develop-ment of application programs using a subset of Microsoft QuickBASIC and C programming languages. This allows pro-grams to be developed and executed from LabWindows as well as saving the program modules in ASCII text files for lat-er, stand-alone compilation and execution. As a result, all ex-isting software tools retain their value. The extensive applica-tion libraries are included as both executable and object files for linking to your stand-alone application programs. A spe-cial screen oriented utility makes linking stand-alone pro-grams 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 com-binations are also available for all operations for fast keyboard access to these functions.

Four interactive window areas allow for development and test-ing 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 er-rors 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, high-lighting 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 en-tire range of LabWindows libraries. The function panel is an intuitive, full screen interface allowing library function execu-tion without the tedious process of entering and editing pro-gram code. All parameters for the library functions are repre-sented by pictorial controls directly on the function panel.

Parameters are selected and entered using these pictorial controls. Functions may be immediately executed by select-ing 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 re-sponse in much the same way that functions from the graph-ics 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 com-mand 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 mathemat-ic 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 in-terrupt control, including read, read byte, read terminated buf-fer, 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, LabWin-dows 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 Librar-ies 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 trigometric 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

℗ DATEL ®

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**
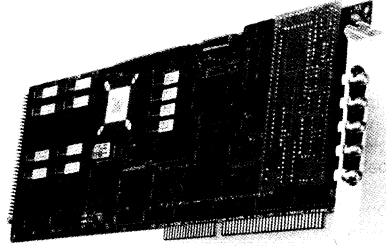
GENERAL DESCRIPTION

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
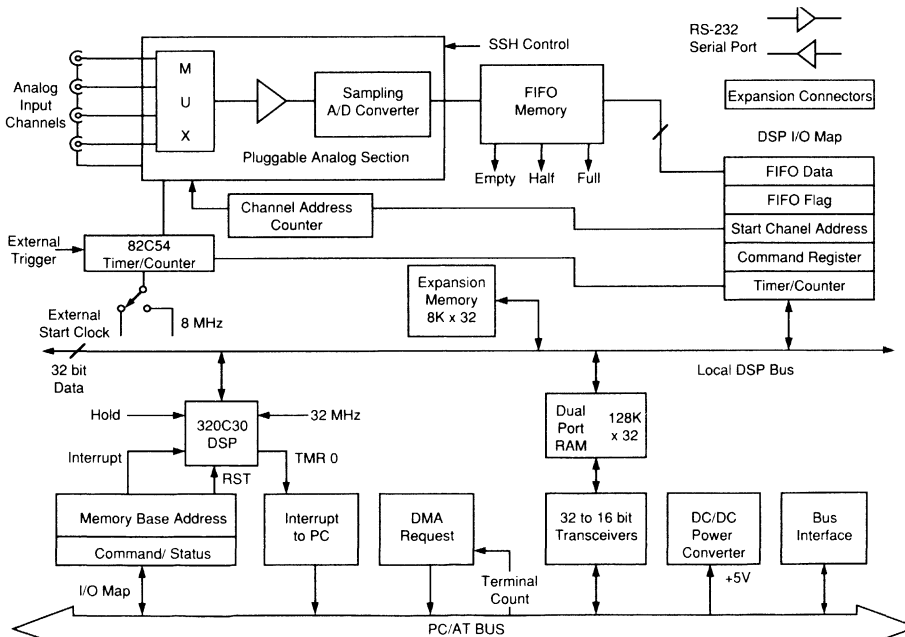
PC-430 Simplified Block Diagram

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.

Datel 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
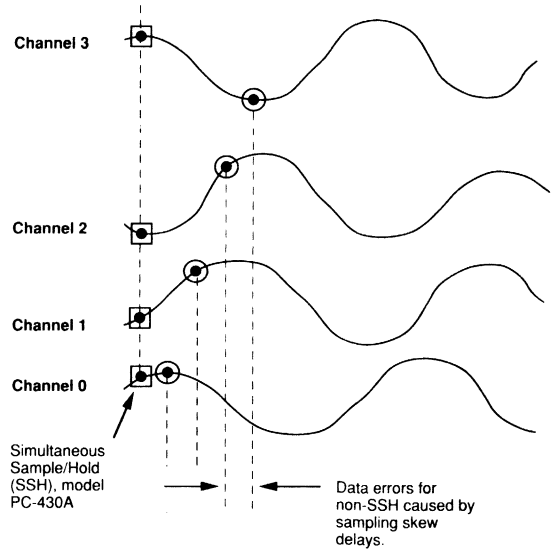
■ DATEL's SSH DESIGN

◉ WITHOUT SSH TECHNOLOGY

FUNCTIONAL SPECIFICATIONS (Typical at +25 °C, dynamic conditions, gain=1, unless noted)

ANALOG INPUTS

Number of Channels	4 channels (430A,B,C) 1 channel (430D) 16S/8D channels (430E)
Input Configuration (A/D)	Single-ended, non-isolated Models PC-430A, PC-430B, PC-430C and PC-430D. The model PC-430E has 16S or 8 differential channels.

Full Scale Input Ranges	0 to +10V ±10V	±5V	±1.25V
(user-selectable) 430A	✔	-	-
[gain = 1] 430B	✔	✔	-
430C	✔	✔	-
430D	-	-	✔
430E	✔	✔	-

Programmable Gains (Model PC-430A only)	Programmable gain of 10 is selectable on 2 channels; 0 to +1V, ±1V [See Tech. Note 1]
Input Impedance [See Tech. Note 2]	10 Megohm, min. power on 1.5 Kilohms min. power off
Input Bias Current	± 1 nA
Input Capacitance	10 pF per channel
Input Overvoltage	± 15 V (no damage)
O.V. Recovery Time	2 microseconds max.
Common Mode Volt. Range	±10V Max. (PC-430E)
Common Mode Rejection (dc to 60 Hz)	-80 dB (PC-430E)
Addressing Modes	1. Single channel 2. Simultaneous Sample/Hold 3. Sequential with autosequenced addressing 4. Random addressing by host software

SAMPLE/HOLD

Acquisition Time (FSR step) to 0.01% of FSR	750 nS max. (430A,E,B) 200 nS max. (430C) 50 nS max. (430D)
Aperture Delay	6 nS (430A,E) 30 nS (430B,C, E) 10 nS (430D)
Aperture Delay Uncertainty	±1 nS (430A) ±5 nS (430B,C,E) ±10 nS (430D)
Droop Rate	1 µV/µS
SSH Channel-to-Channel Linearity Tracking	± 0.03% (430A only)

A/D CONVERTER

Resolution	12 bits (430A,C,D,E) 14 bits (430B)
Conversion Period (A/D and S/H)	500 nanoseconds (430A) 1 microsecond (430B,C,E) 200 nanoseconds (430D)

A/D CONVERTER

Output Coding	Positive-true right-justified straight binary (unipolar) or right-justified two's complement (bipolar) with sign extension through bit 15.
Trigger Sources (Software selectable)	1. Local Pacer sample clock 2. External TTL sample clock

TOTAL SYSTEM CHARACTERISTICS

[See Tech. Note 3]	
Integral Non-linearity	±1 LSB of FSR (430A,C,E) ±1.5 LSB of FSR (430B, D)
Differential Non-linearity	± 0.75 LSB of FSR (430A,C,E) ± 1 LSB of FSR (430B, D)
Full Scale Temperature Coefficient	±0.1 LSB per °C (430A,C,D,E) ±0.3 LSB per °C (430B)
Zero or Offset Temperature Coefficient	±0.1 LSB per °C (430A,C,D, E) ±0.3 LSB per °C (430B)
Power Supply Rejection	±0.004% per % of bus +5V

A/D MEMORY

Architecture **Memory Capacity**	First-In, First-Out (FIFO) 1024 A/D samples, standard. Up to 4096 A/D samples (optional).

TOTAL SYSTEM DYNAMIC PERFORMANCE

System Bandwidth (single channel, half-scale input, to rated specifications)	1 MHz (430A,C,E) 200 KHz (430B) 2.5 MHz (430D)
Total Throughput to FIFO (single channel, gain=1)	700 nanoseconds (430A) 2 microseconds (430B,E) 1 microsecond (430C) 250 nS (430D)
Throughput to FIFO per A/D sample (sequential channels, gain = 1) [See Tech. Note 5]	1 microsecond (430A) 3 microseconds (430B) 2 microseconds (430C) 4 microseconds (430E)
Throughput to FIFO (sequential channels, gain = 10)	10 microseconds (430A)
Total Harmonic Distortion [See Tech. Note 6]	-72 dB (430A,C,E) -75 dB (430B) -68 dB (430D)

TRIGGER CONTROL

Programmable Timer/ Counter Type **Functions**	82C54 1. EOC sample count 2. A/D start rate (16 bit divisor) 3. Scan trigger rate (16 bit divisor)
Pacer Sample Counter	1 to 65,536 samples. Drives the Acquire flag/interrupt gate for A/D start pulses.
Clock Source Internal External	1. 8 MHz crystal clock 2. TTL input, user-selectable

PC/AT-BUS INTERFACE

Architecture	I/O and memory mapped, for IBM-PC/AT, PS-30, EISA bus and compatibles.
I/O Mapping	Decodes two 8-bit I/O registers. Decodes I/O address lines A9-A2. 3F0H maximum.
Data Transfer	Memory block transfer or host DMA, software selectable.
Data Bus	16 bits.
Direct Memory Access	1 channel, selectable on chanels 5, 6 or 7
DMA Request Conditions (software selectable)	FIFO full, half full, not empty, scan acquire flag (sample count) or user programmable.
Control/Status Functions	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.
Number of Interrupts	1 interrupt, selectable on levels 7, 9 thru 12, or 15.
Bus Interrupt Sources	DSP interrupt request to PC or DMA terminal count from bus.

LOCAL MICROCOMPUTER

CPU Type	TI TMS 320C30 with internal DMA.
Local Data Bus	32 bits
CPU Clock Speed	32.000 MHz
Local DMA Controller	Internal to 320C30 CPU
Primary Memory (Dual ported to PC/AT)	128K x 32 static RAM
Expansion Memory	8K x 32 static RAM
Internal DSP Memory	Two 1K x 32
Dual Port Access	Hold mode by control bit or from PC/AT dynamic hold per each access.
CPU Test Port	Supports TI XDS1000 Extended Development System.
Local Interrupts	Int 0-3 from PC host request, A/D FIFO or acquire flags or optional external interrupt.

MISCELLANEOUS

Analog Section Modularity	The MUX-S/H-A/D module is socketed for function interchange.
Analog Section Adjustments	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.
Analog Input Connectors	Four miniature threaded coaxial, type SMA, mounted on rear slot.
Trigger Connector	5th SMA for external TTL trigger.
I/O Expansion Port, P2	Dual-row header connector for 320C30 I/O (unbuffered).
Memory Expansion Port, P3	Dual-row header connector for 320C30 memory (unbuffered).

MISCELLANEOUS (continued)

Serial Port and External Trigger/Pacer Clock,P1	Two serial channels, Compatible to 320C30 serial ports. Both scan (Trigger) and A/D sample (Pacer) clocks are accepted at connector. Dual-row header.
RS-232-C Serial Port	3 header pins. Uses software UART.
Operating Temp. Range	0 °C to +60 °C
Storage Temp. Range	-25 °C to +85 °C
Humidity	10% to 90%, non-condensing
Altitude	0 to 10,000 feet. Forced cooling is recommended.
Power Required	+5V dc at 3.5 Amps maximum from AT bus.
Outline Dimensions	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 attentuation 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.

$$THD = 20 * log10 \frac{(V2^2 + V3^2 + V4^2 + V5^2)^{0.5}}{V_{IN}}$$

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.
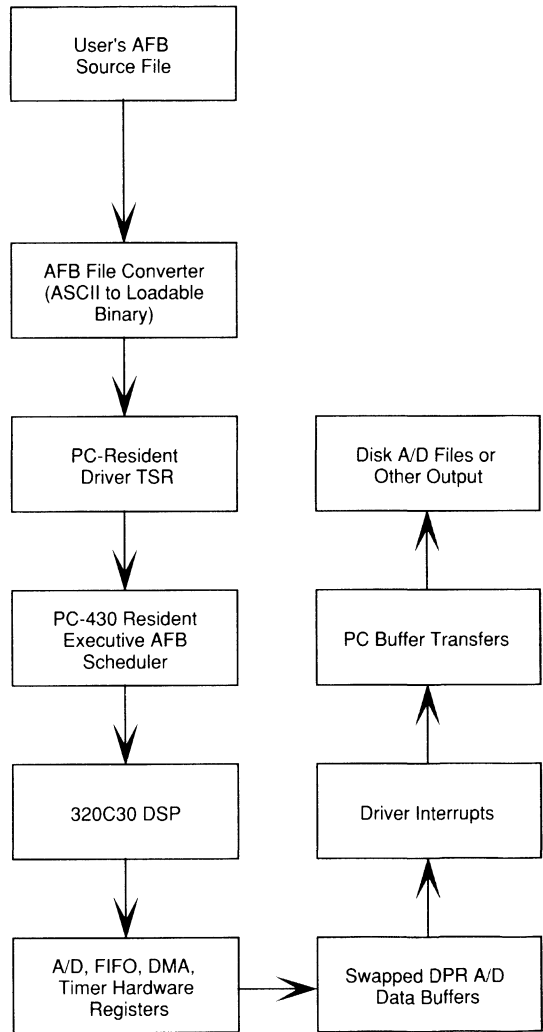
Library Functions

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.)
sfifoi	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.

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.

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].

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.
dspieee	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

defsbuf, defdbuf	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

Host PC Memory Map
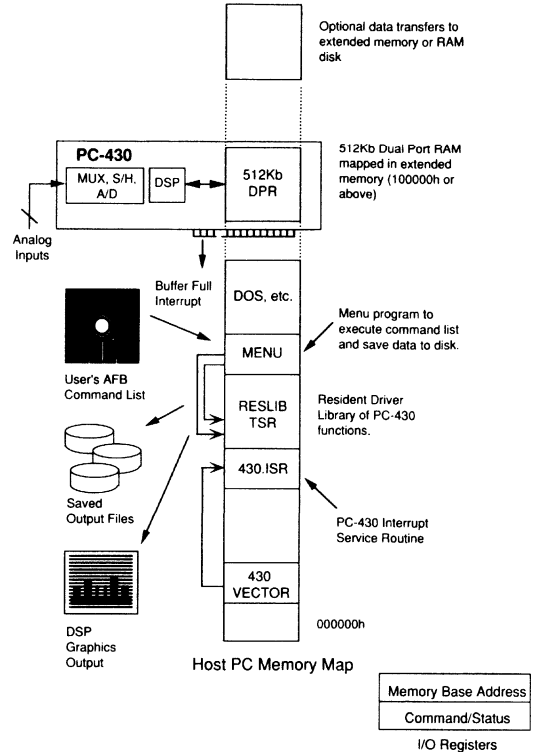
High Speed A/D Data Compression For
Communications Link Transmission

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.
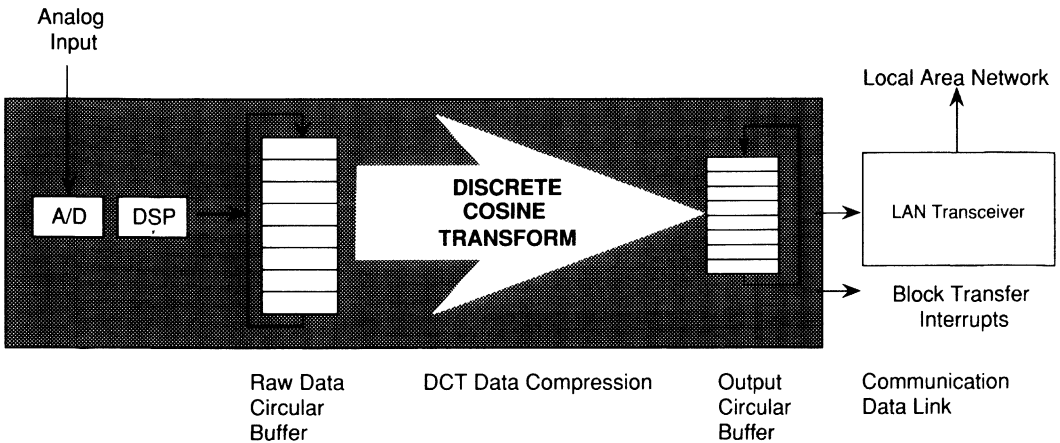
High Speed A/D Data Compression for Data Link Transmission

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.

PC-430

Coherent Signal Field　　　Sensor Array　　Simultaneous Sampling　　　　Acoustic Signature Map
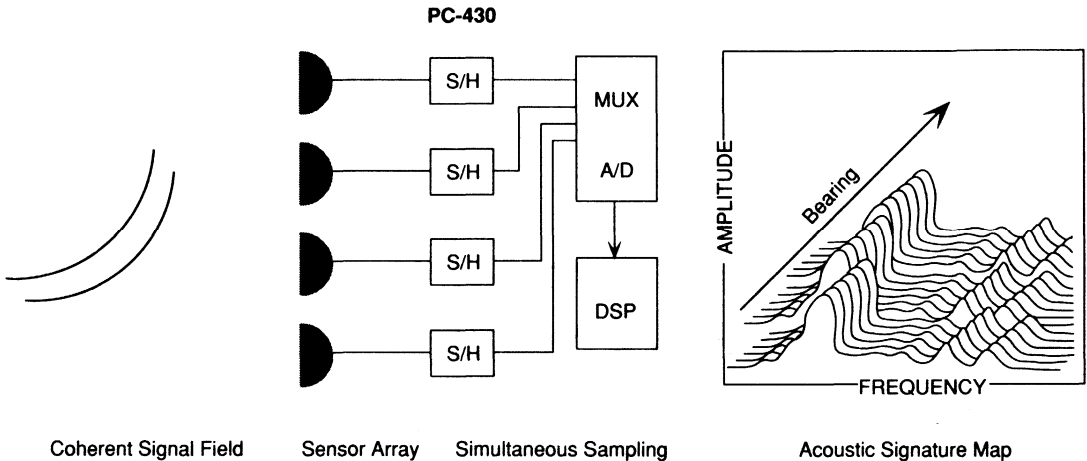
Phased Array Spectral Mapper/Tracker

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)

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Immediate Assistance

**Data Acquisition
Board Products
Summary Tables**

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 µs	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	4K-sample FIFO memory, analog trigger, parallel data port, counter/timer, DMA Vectored interrupt
PC-414B	4 SE	14 Bits	500 KHz	---	5V, 10V	1	12 Bits	
PC-414C	4 SE	12 Bits	1 MHz	---	5V, 10V	1	12 Bits	
PC-414D	1 SE	12 Bits	4 MHz	---	1V	1	12 Bits	
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 Fast "no prgmg" command executive, DSP library, Vectored interrupt
PC-430B	4 SE	14 Bits	500 KHz	---	5V, 10V	None	---	
PC-430C	4 SE	12 Bits	1 MHz	---	5V, 10V	None	---	
PC-430D	1 SE	12 Bits	4 MHz	---	1V	None	---	
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 ±15V or 5V, 10W	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		12 Bits	20 µs					
DVME-601B	16 S / 8 D	12 Bits	4 µs		5, 10V			68010 CPU 256K memory
DVME-601C	Expandable	16 Bits	35 µs	x1 to x1K	down to 50 mV	None	---	RS-232, 5 TTL I/O Counter/Timers
DVME-601D	to 256	16 Bits	400 ms					"No prgmg" Command Exec.
DVME-601E		12 Bits	2 µs					Vectored interrupt
DVME-611/612A		12 Bits	20 µs					
DVME-611/612B		12 Bits	4 µs					
DVME-611/612C	32 S / 16 D	16 Bits	35 µs	x1 to x128	5V, 10V	2 (612)	12 Bits	Short I/O
DVME-611/612D	Expandable	16 Bits	400 ms	Software	down to 50 mV			SA:16, SD:16
DVME-611/612E	to 256	12 Bits	2 µs	Pgmble				Vectored interrupt
DVME-611/612F		14 Bits	4 µs					
DVME-613	16 S/8 D Isolated 500V	12-14-16 Bits	40 µs	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 µs 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 µs 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			4K-sample FIFO memory
DVME-614B	4 S	14 Bits	500 KHz		5V, 10V			Analog trigger
DVME-614C	4 S	12 Bits	1 MHz	---	5V, 10V	1	12 Bits	Parallel data port Sample counter/timer
DVME-614D	1 S	12 Bits	4 MHz		5V, 10V			Simultaneous sampling
DVME-614E	16 S	12 Bits	400 KHz	x1 to x100	1, 5, 10V, 100mV			Vectored interrupt
DVME-630A	4 Simul. S/H	12 Bits	1.5 MHz	x1 or x10	1V, 5V, 10V			
DVME-630B	4 S	14 Bits	500 KHz		5V, 10V			Local 32 MHz 320C30
DVME-630C	4 S	12 Bits	1 MHz	---	5V, 10V	None	---	DSP, 512 K Memory, Fast "no prgmg" command
DVME-630D	1 S	12 Bits	4 MHz		5V, 10V			Executive, Interrupt
DVME-630E	16 S	12 Bits	400 KHz	x1 to x100	1, 5, 10V, 100mV			DSP library
DVME-622	None	---	---	---	5V, 10V	16 Simul. Update	12 Bits	3 µs settling per channel
DVME-621	None	---	---	---	5V, 10V @ 100 mA or 160 mA	4 Isolated	12 Bits	Power DAC's, voltage or current mode, active drivers, 500V isolation

Contact DATEL for:

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

Dial
1-800-233-2765
for
Immediate Assistance

Advanced Technology A/D Conversion Components Summary Tables

SAMPLING A/D CONVERTERS

	Model	Resolution (Bits)	Throughput (MHz)	Linearity Error (Max)	Power Watts (Max)	Case
	ADC-HS12B	12	0.066	±3/4 LSB	1.8	32-Pin DIP
	ADS-111	12	0.500	±3/4 LSB	1.8	24-Pin DIP
	ADS-112	12	1.0	±3/4 LSB	1.7	24-Pin DIP
	ADS-193	12	1.0	±3/4 LSB	1.7	40-Pin DIP
	ADS-21PC	12	1.3	±1 LSB	2.5	46-Pin DIP
	ADS-132	12	2.0	±3/4 LSB	3.2	32-Pin DIP
Preliminary	ADS-117	12	2.0	±3/4 LSB	1.8	24-Pin DIP
Preliminary	ADS-118	12	5.0	±1 LSB	2.5	24-Pin DIP
	ADS-131	12	5.0	±1 LSB	4.0	40-Pin DIP
	ADS-130	12	10.0	±1 LSB	4.2	40-Pin DIP
Advanced	ADS-120	12	20.0	±1 LSB	4.2	40-Pin DIP
	ADS-924	14	0.300	±1 LSB	1.8	24-Pin DIP
	ADS-928	14	0.500	±3/4 LSB	3.4	32-Pin DIP
Preliminary	ADS-941	14	1.0	±3/4 LSB	3.3	32-Pin DIP
Preliminary	ADS-942	14	2.0	±1 LSB	3.4	32-Pin DIP
Advanced	ADS-944	14	5.0	±1 LSB	3.4	40-Pin DIP
Advanced	ADS-945	14	10.0	±1 LSB	4.2	40-Pin DIP
Advanced	ADS-976	16	0.200	±2 LSB	1.8	32-Pin DIP
Preliminary	ADS-930	16	0.500	±1 1/2 LSB	2.4	40-Pin DIP

A/D CONVERTERS

	Model	Resolution (Bits)	Conversion Time (μsec)	Linearity Error	Power (Watts)	Case
	ADC-207	7	0.050	±1/2 LSB	0.25	18-Pin DIP
	ADC-228	8	0.040	±1/2 LSB	1.25	24-Pin DIP
	ADC-208	8	0.050	±3/4 LSB	0.60	24-Pin DIP
	ADC-304	8	0.050	±1/2 LSB	0.39	28-Pin DIP
New	ADC-530	12	0.350	±3/4 LSB	2.10	32-Pin DIP
	ADC-500	12	0.500	±1 LSB	1.70	32-Pin DIP
	ADC-505	12	0.550	±1 LSB	1.70	32-Pin DIP
	ADC-508	12	0.700	±1 LSB	1.70	32-Pin DIP
	ADC-520	12	0.800	±1/2 LSB	1.60	32-Pin DIP
	ADC-521	12	0.800	±1/2 LSB	1.60	32-Pin DIP
	ADC-511	12	1.0	±3/4 LSB	1.25	24-Pin DIP
	ADC-HZ12B	12	8	±1/2 LSB	1.5	32-Pin DIP
	ADC-HX12B	12	20	±1/2 LSB	1.5	32-Pin DIP
	ADC-HC12B	12	300	±1/2 LSB	0.17	32-Pin DIP
	ADC-908	14	1.0	±1/2 LSB	2.70	32-Pin DIP
	ADC-914	14	2.4	±1 LSB	1.20	24-Pin DIP

ANALOG-TO-DIGITAL CONVERTERS

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
New	**SHM-43**	0.01	35 ns	5 ns	1 ps	150	5 µV/µs	24-Pin DIP
New	**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
New	**SHM-945**	0.0004	500 ns	5ns	10 ps	12	0.5 µV/µs	24-Pin DIP
Advanced	**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

SAMPLE HOLD AMPLIFIERS

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
Preliminary	HDAS-950	16	100	±1/2 LSB @ 14 BITS	1.4	8 SE	40-Pin DIP
Preliminary	HDAS-951	16	100	±1/2 LSB @ 14 BITS	1.4	4 DE	40-Pin DIP

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MULTIPLEXERS

	Model	Channels	Settling Time 20V to 0.01%	Access Time	Input Range	Power (Watts)	Case
	MXD-409	4 D	3 µs	500 ns	±15V	0.105	16-Pin DIP
	MX-808	8 SE	3 µs	500 ns	±15V	0.105	16-Pin DIP
	MXD-807	8 D	3 µs	500 ns	±15V	0.105	28-Pin DIP
	MX-1606	16 SE	3 µs	500 ns	±15V	0.105	28-Pin DIP
	MVD-409	4 D	2.8 µs	350 ns	±15V	0.055	16-Pin DIP
	MV-808	8 SE	2.8 µs	350 ns	±15V	0.055	16-Pin DIP
	MVD-807	8 D	2.4 µs	300 ns	±15V	0.105	28-Pin DIP
	MV-1606	16 SE	2.4 µs	300 ns	±15V	0.105	28-Pin DIP
	MX-818C	8 SE/4D	800 ns	125 ns	±15V	0.540	18-Pin DIP
	MX-1616C	16 SE/8 D	800 ns	150 ns	±15V	0.900	28-Pin DIP
New	MX-826	8 SE	200 ns	70 ns	±10.5V	0.395	24-Pin DIP
New	MX-850	4 SE	50 ns	20 ns	±10V	0.250	14-Pin DIP

ANALOG MULTIPLEXERS

OPERATIONAL AMPLIFIERS

Model	DC Open Loop Gain (V/V)	Settling Time (µsec)	Slew Rate (V/µsec)	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 µs/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

AMPLIFIERS

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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

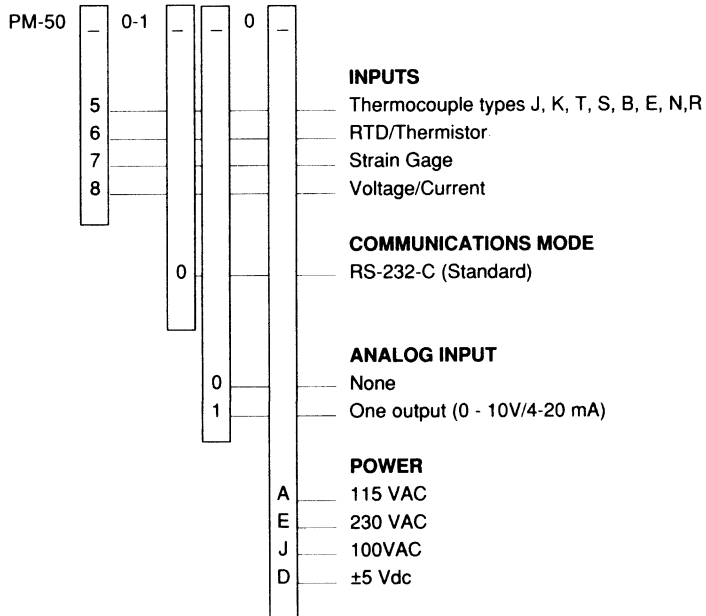BU = Butterworth BE = Bessel
CH = Chebyshev CA = Cauer/Elliptical

All Filters operate over the commercial temperature range -20°C to +70°
Model FLT-U2 also operates at -55°C to +125°C
§ Cascaded Pair   * Preliminary

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 configura-
tion and setup command set, fully isolated inputs (to
1500 Volts, typ.) and a six-character, 14-segment vac-
uum 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.

PM-50 _ 0-1 _ _ 0 _

INPUTS

5	Thermocouple types J, K, T, S, B, E, N,R
6	RTD/Thermistor
7	Strain Gage
8	Voltage/Current

COMMUNICATIONS MODE

0	RS-232-C (Standard)

ANALOG INPUT

0	None
1	One output (0 - 10V/4-20 mA)

POWER

A	115 VAC
E	230 VAC
J	100VAC
D	±5 Vdc

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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-A20A21	20	RS-232/20 mA loop	115/230 VAC	96 char ASCII	A	Inverted, tall, condensed character options
APP-A20D21	20	RS-232/20 mA loop	+12 Vdc	96 char ASCII	A	
APP-20A3	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	
MPP-20E	20	RS-232/Parallel	230 VAC	127 char ASCII	A	
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	
APP-M48D2	48	RS-232	+12 Vdc	192 char ASCII	D	
NEW GPP-42	42	Serial/Parallel	115/230 VAC (50/60 Hz)	256 char ASCII	E	8 International Character Sets High Res Graphics, 200 Line Buffer CUSTOM CHARACTERS AVAILABLE

NOTE 1. 100 VAC versions available for most models ("J" version); European line cords also available ("E" version). Consult factory.

CASES
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

DIGITAL PANEL METERS

	Model	Power	Std. Input	Features
3.5 Digit LED	DM-3100L-1	+5Vdc	±2Vdc	Short Depth Case
	DM3100N-1	+5Vdc	±2Vdc	Provisions for 4-20 mA input
	DM-3101-1	+5Vdc	±2Vdc	High Intensity Display
	DM3103-1	+5Vdc	±2Vdc	High Intensity Display
	DM-31-1	+5Vdc	±2Vdc	Low Cost - Uncased
	DM-3100B-1	115/230VAC	±2Vdc	Short Depth Case
	DM3104-1	115/230VAC	±2Vdc	High Intensity Display
	DM-9115-1	115/230VAC	±2Vdc	NEMA 12 (Vibration Std)
4.5 Digit LED	DM-4101N-1	+5Vdc	±2Vdc	High Intensity Display
	DM-9200-1	+5Vdc	±2Vdc	NEMA 12 (Vibration Standard)
	DM-4100D-1	+5Vdc	±2Vdc	High Speed Sampling Serial/ParallelBCD Output
	DM-4101D-1	+5Vdc	±2Vdc	High Intensity Display Serial/Parallel BCD Output
	DM-4101L-1	+5Vdc	±2Vdc	Serial BCD Output
	DM-4200-1	+5Vdc	±2Vdc	Serial BCD Output
	DM-9215-1	115/230VAC	±2Vdc	NEMA 12 (Vibration)
3.5 Digit LCD	DM-3100U-1	+5/9Vdc	±2Vdc	Units Display (Batt. Pwr.)
	DM-3100X-1	+5/9Vdc	±2Vdc	Battery Powered
	DM-3102A	+5Vdc	±2Vdc	Units Display Autoranging (200 mV - 200V)
	DM-LX3-1	+5Vdc	±2Vdc	Low Cost - Uncased
	DM-3100U2	115VAC	±2Vdc	Units Display
4.5 Digit LCD	DM-4105-1	+5Vdc	±2Vdc	Serial BCD OUT (Batt. Pwr.)
Other Digital Panel Products	DBM-20	+5Vdc	Adjustable	20 Segment LED Bar Graph w/ TTL Outputs
	PC-6	+5Vdc		10 MHz Counter/Timer

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

Power Converter Worksheet/Request for Quote

(Please XEROX this form for FAX or MAIL Requests)

CUSTOMER INFORMATION

DATE _____

NAME _____

COMPANY _____

STREET _____

MS _____

CITY _____

STATE _____

ZIP CODE _____

TELEPHONE _____

FAX # _____

For New Applications, Use This Section:

OUTPUT (V/A):	INPUT (V):	QUANTITY	PRICE

For Existing Applications, Use This Section:

MODEL #:	MANUFACTURER:	QUANTITY:	PRICE:	DELIVERY:

Application/Special Requirements: _____

_____

_____

_____

_____

_____

_____

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FAX (508) 339-6356
For Immediate Assistance,
Dial 1-800-233-2765

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