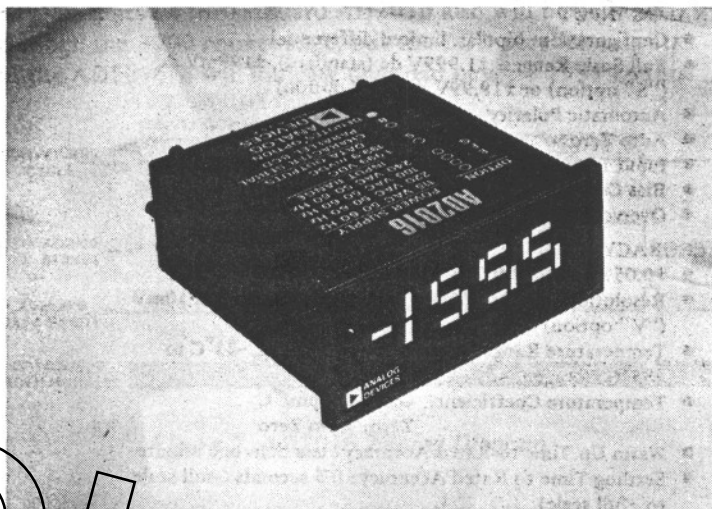


**FEATURES**

"Second Generation" MOS/LSI Design  
Large 0.5" (13mm) LED Displays  
AC Line Powered, Universal Transformer  
±199.9mV dc, ±1.999V dc or ±19.99V dc Full Scale Ranges  
Auto-Zero Correction  
Limited Differential Input  
Character Serial Data Output Standard, Parallel Data Optional  
Industry Standard Case Design — Second Sources Available

**APPLICATIONS**

General Purpose ac Line Powered DPM Requirements

**GENERAL DESCRIPTION**

The AD2016 is a low cost, 3½ digit, line powered Digital Panel Meter with large LED displays, designed for general purpose DPM applications. The AD2016 measures bipolar input voltages over full scale ranges of ±199.9mV dc, ±1.999V dc or ±19.99V dc with an accuracy of ±0.05% reading ±0.025% full scale, ±1 digit. By using the "limited differential" input first used on Analog Devices' AD2010, the AD2016 input prevents ground loop problems and provides common mode noise rejection at common mode voltages up to ±200mV. Normal mode rejection is 40–45dB at 50 to 60Hz.

AD2016 models are available for operation at any line voltage and frequency required throughout the world. But, since the AD2016 uses a "universal" transformer, simple internal changes by bridging solder pads allow easy changing of the input power voltage for specific requirements. Thus, the OEM need not stock a variety of models for export requirements, but can easily change the voltage as required.

**THE BENEFITS OF SECOND GENERATION DESIGN**

The AD2016 is designed around MOS/LSI (Metal Oxide Semiconductor, Large Scale Integration) integrated circuits to reduce the number of components and power consumption, which greatly enhances reliability. However, these ICs provide the performance and features of earlier DPM design. The large 0.5 inch (13mm) LED displays provide the visual appeal of the gas discharge displays with the reliability of all solid state devices.

**VERSATILE DATA INTERFACING**

Since the AD2016 is designed around MOS/LSI circuits, the BCD output data is presented in a bit parallel, character serial format compatible to CMOS logic systems. Although some

applications, such as interfacing with microprocessors are simplified with this data format, many applications involving line printers or comparators require parallel data outputs. For these applications, the AD2016/B provides parallel BCD data, TTL compatible. The conversion from a serial to a parallel format is done using shift registers, so the output data is fully latched. The AD2016/B also has two "Hold" inputs, one which stops DPM conversions and one which prevents data updating. Thus, the data outputs can be held for data transfer while the DPM continues to convert and update the display.

**STANDARD PACKAGING/SECOND SOURCES**

The AD2016 is packaged in Analog Devices' ac line powered DPM case, which requires the same panel cutout as cases used by most other manufacturers of ac line powered DPMs. In addition, the pin connections are the same as several other DPMs, including the Analog Devices' AD2009. (Even the BCD outputs of the AD2016/B are the same as the AD2009). With this commonality between DPMs, the user is assured of having second sources available or can update instrument or system designs to utilize the newer technology of the AD2016 without expensive mechanical or electrical changes to current products.

**DESIGNED AND BUILT FOR RELIABILITY**

Even beyond the reliability advantages of the LSI IC design and LED displays, the AD2016 has had extreme care taken in its design and manufacture to insure reliability. Manufacturing processes are monitored by continual quality assurance inspections to insure proper workmanship and testing. Automatic test equipment is used to test each DPM at board level and final assembly to assure thorough testing without error. And, each AD2016 gets one full week of failure-free burn-in at 50°C and with cycled power before shipment.

- 45dB at 50–60Hz (40dB, "V" option)

#### COMMON MODE REJECTION

Input Range	Limited Differential (dc-10kHz, no imbalance)	Floating <sup>3</sup> (dc-100Hz, 1k $\Omega$ imbalance)
$\pm 199.9\text{mV}$	50dB	120dB
$\pm 1.999\text{V}$	35dB	120dB
$\pm 19.99\text{V}$	15dB	100dB

#### COMMON MODE VOLTAGE

- Limited Differential Mode:  $\pm 200\text{mV}$
- Floated On Power Supply Transformer When No BCD Outputs or Control Signals are Used:  $\pm 300\text{V}$  dc or  $600\text{V}$  ac p-p

#### CONVERSION RATE

- 5 conversions per second
- Hold and read on command

#### CONTROL INPUTS<sup>3</sup>

Logic "0" or grounding blanks the entire display except for the decimal points at the tens and hundreds digits. Logic "1" or open circuit for normal operation. Display blanking has no effect on the output data and the display is valid immediately upon removal of a blanking input.

**Converter Hold** (CMOS, TTL/DTL Compatible, 1 LPTTL Load)

Logic "0" or grounding causes the DPM to cease conversions and display the data from the last conversion. Logic "1" or open circuit for normal operation. After a "Converter Hold" is removed, one or two conversions are needed before the reading or BCD data is valid.

**Decimal Points** (Not TTL Compatible)

Grounding or Logic "0" will illuminate the desired decimal point. External drive circuitry must sink 50mA at a 25% duty cycle when a decimal point is illuminated.

**Data Hold** (AD2016/B Only) (TTL/DTL Compatible, 1 TTL Load)

Logic "0" or grounding inhibits updating of the latched parallel output data of the AD2016/B. Logic "1" or open circuit allows the data to be updated after each DPM conversion. This input has no effect on the normal conversion of the DPM.

#### SIZE

- 4.22" W x 1.97" H x 4.13" L (107 x 50 x 105mm)
- 4.77" (121mm) to rear of card edge connector
- Panel Cutout Required: 1.682" x 3.924" (42.72 x 99.67mm)

#### WEIGHT

- 12 ounces (340 grams)

#### ORDERING GUIDE<sup>4</sup>

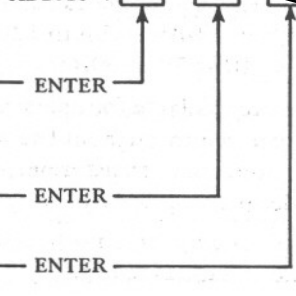
##### Power Input

- |                    |   |         |
|--------------------|---|---------|
| 117V ac $\pm 10\%$ | 1 | } ENTER |
| 220V ac $\pm 10\%$ | 2 |         |
| 100V ac $\pm 10\%$ | 3 |         |
| 240V ac $\pm 10\%$ | 4 |         |

##### Input Range

- |                         |   |         |
|-------------------------|---|---------|
| $\pm 1.999\text{V}$ dc  | 1 | } ENTER |
| $\pm 199.9\text{mV}$ dc | 2 |         |
| Standard                | 3 |         |
| Parallel BCD            | 1 | } ENTER |
|                         | 2 |         |

AD2016 -



#### DISPLAY LENS OPTIONS<sup>5</sup>

- Lens 7 – Red with ADI logo
- Lens 8 – Red without ADI logo

#### CONNECTOR (OPTIONAL)

30 pin, 0.156 spacing card edge connector, Amphenol 225-21524-601 (117) or equivalent

Optional: Order AC2611

#### NOTES

- <sup>1</sup> Guaranteed at  $+25^{\circ}\text{C}$ .
  - <sup>2</sup> Guaranteed
  - <sup>3</sup> No control inputs or data outputs can be used when the AD2016 is floated on the power supply transformer at high common mode voltages.
  - <sup>4</sup> Only one AC power supply input and input range may be specified. The "B" option can be ordered with any combination of power and range options.
  - <sup>5</sup> Lens 7 is supplied if no lens option is specified.
- Specifications subject to change without notice.

## Wiring Connections

Figure 1 is a wiring diagram for AD2016 applications. The "limited differential" input uses a  $47\Omega$  resistor to isolate the analog input from the digital and power supply sections to prevent ground loop problems. The analog ground must be connected to Pin 10 only, since there may be up to 200mV voltage difference between the input and digital ground.

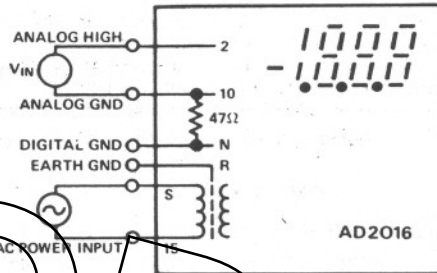


Figure 1. AD2016 Wiring Interconnections

## Decimal Points

Grounding, or Logic "0", applied to the appropriate pin will illuminate the desired decimal point. External drive circuitry, if used, must sink 50mA at a 25% duty cycle when the decimal point is turned on.

## Display Blanking

Grounding, or Logic "0", blanks the entire AD2016 display with the exception of the decimal points on the tens and hundreds digit. The display is valid immediately upon removal of a blanking signal.

## Converter Hold

Grounding, or Logic "0", causes the DPM to cease conversions and display the data from the last conversion. After a "Converter Hold" input is removed, the auto zero circuitry requires one or two conversions before the display and data outputs are again valid.

## Data Hold (AD2016/B only)

Grounding, or Logic "0", on this input inhibits updating of the parallel BCD outputs of the AD2016/B. If the parallel data is interfaced to a printer, comparators, or a computer, requiring the data to be held stable for proper operation, the Data Hold input should be used to prevent data updating, but the DPM itself will continue making conversions. After a Data Hold input is removed, the BCD data will be updated at the end of the conversion cycle.

## Extended Range Measurements

Although the full scale range of the AD2016 is 2000 counts, and it flashes the display to indicate overrange beyond this point, it actually makes measurements up to approximately 3000 counts. Beyond this point, it will flash a constant number. Thus, one can use this extra measurement range as a guide

to reducing the input to the normal range. Note that the display will flash only the three full digits, since it is impossible to flash a "2" on the overrange readout. Thus, a reading of 2.300V or 230.0mV on an AD2016 will read as "300" and will be flashing.

BCD outputs on the standard AD2016 also will be valid up through the 3000 count range, but the BCD parallel outputs of the AD2016/B will indicate overload beyond 1999 counts.

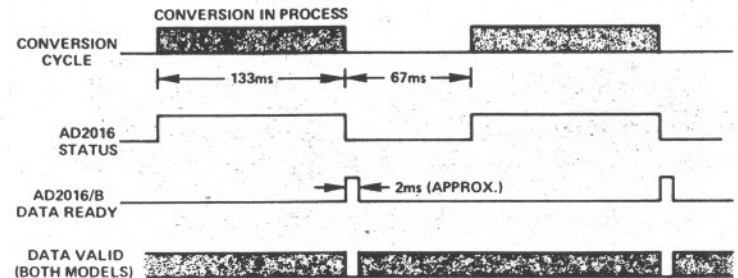


Figure 2. AD2016 Timing Diagram

## Interfacing Data Outputs — Character Serial Data

The BCD data outputs standard on the AD2016 are in a bit parallel character serial format. There are four BCD bit outputs (1, 2, 4, 8) and four digit outputs ( $10^0$ ,  $10^1$ ,  $10^2$ ,  $10^3$ ) called D1, D2, D3 and D4 respectively. The BCD bits are gated onto the output lines sequentially in the order D1, D3, D2, D4 and the BCD bits are valid for the digit whose digit line is high. The serial output data is valid except when it is being updated, which occurs within 2 milliseconds after the Status line goes low, indicating the end of a conversion.

## Interfacing Data Outputs — Parallel Data

The AD2016/B has data outputs in a full parallel BCD format. The output data is latched and is valid except for a 2ms period at the end of conversion when the "Data Ready" output is high (Logic "1"). As described above, the "Data Hold" input can be used to inhibit updating of the parallel data outputs without affecting the conversion of the DPM.

## Calibration Procedures

A precision voltage reference is needed for the calibration of the AD2016. The location of the calibration potentiometers is shown in Figure 5. Always adjust the zero offset before the gain if zero adjustment is necessary.

**Zero Adjustment:** Short the signal inputs (Pins 2 and 10) and adjust the zero offset potentiometer until the meter reads 000.

**Gain Adjustment:** Apply an input of +1.800V (+180.0mV on AD2016/S, or +18.00V on AD2016/V) and adjust the gain potentiometer until the meter reads 1800 exactly.

PIN DESIGNATIONS

AD2016 CHARACTER SERIAL

AD2016/B

PIN REF	PIN FUNCTION	PIN REF	PIN FUNCTION
1	NC	A	NC
2	SIGNAL INPUT	B	NC
3	STATUS (PRINT)	C	NC
4	POLARITY	D	CONVERTER HOLD
5	NC	E	D2
6	D4	F	NC
7	BCD 2 <sup>3</sup>	H	BCD 2 <sup>0</sup>
8	BCD 2 <sup>1</sup>	J	BCD 2 <sup>2</sup>
9	CLOCK OUTPUT	K	D1
10	SIGNAL GROUND	L	DP3 XX.X
11	NC	M	DP2 X.XX
12	D3	N	DIGITAL GROUND
13	DISPLAY BLANK	P	DP1 .XXX
14	NC	R	SHIELD (EARTH GROUND)
15	AC LINE HIGH	S	AC LINE LOW

PIN REF	PIN FUNCTION	PIN REF	PIN FUNCTION
1	DATA HOLD	A	NC
2	SIGNAL INPUT	B	NC
3	DATA READY	C	OVERLOAD
4	POLARITY	D	CONVERTER HOLD
5	BCD 8	E	BCD 1
6	BCD 2	F	BCD 4
7	BCD 80	H	BCD 10
8	BCD 20	J	BCD 40
9	BCD 800	K	BCD 100
10	SIGNAL GROUND	L	DP3 XX.X
11	BCD 400	M	DP2 X.XX
12	BCD 200	N	DIGITAL GROUND
13	DISPLAY BLANK	P	DP1 .XXX
14	OVERRANGE	R	SHIELD (EARTH GROUND)
15	AC LINE HIGH	S	AC LINE LOW

(NC = NO CONNECTION)

Figure 3.

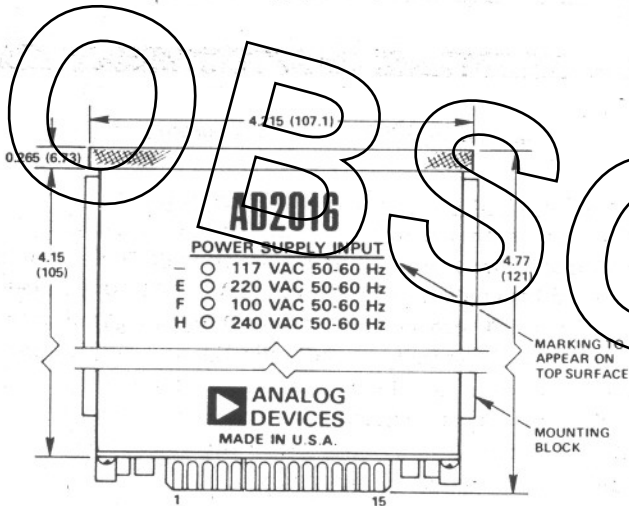
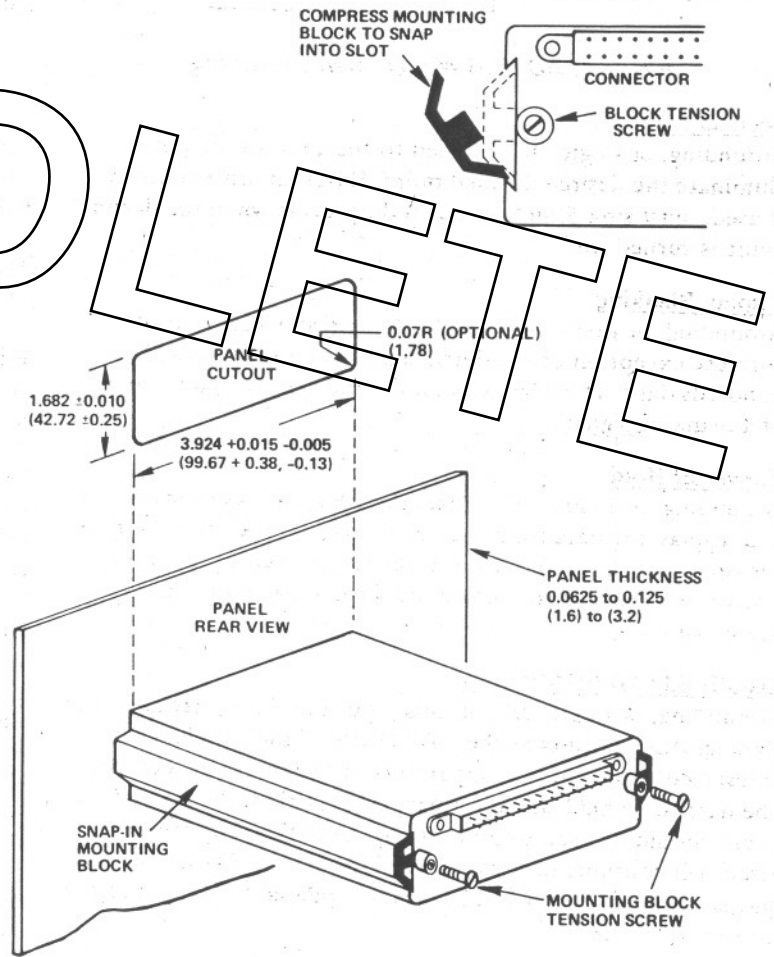


Figure 4.



MOUNTING INSTRUCTIONS:

1. SLIDE DPM THROUGH PANEL CUTOUT FROM FRONT OF PANEL.
2. SNAP MOUNTING BLOCK INTO SLOT ON DPM SIDES.
3. TIGHTEN MOUNTING BLOCK TENSION SCREWS SNUGLY TO SECURE DPM TO PANEL (DO NOT OVERTIGHTEN!)
4. SNAP LENS ONTO FRONT OF DPM.

Figure 5. AD2016 Mechanical Outline (Dimensions shown in inches and (mm))

Figure 6. AD2016 Mounting Instructions (Dimensions shown in inches and (mm))

