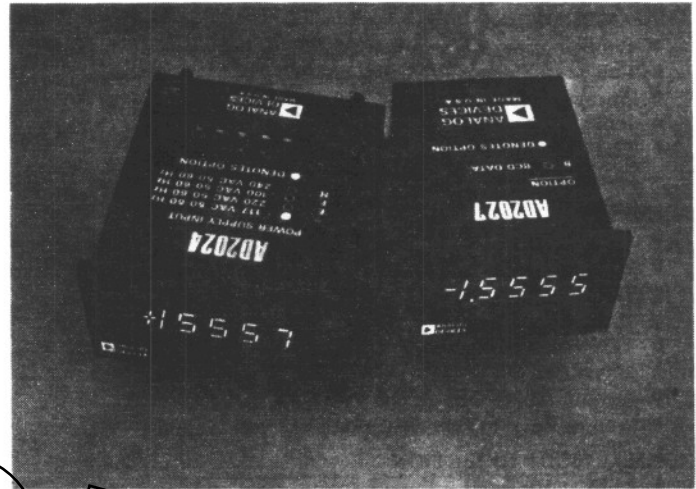


**AD2024/AD2027****FEATURES**

"Second Generation" MOS-LSI Design  
Large 0.43" (11mm) LED Displays  
4½ Digit Resolution — 20,000 Counts Full Scale  
Limited Differential Input  
Either Line Powered (AD2024) or Logic Powered (AD2027)  
Industry Standard Case Designs

**APPLICATIONS**

High Resolution/High Accuracy Readout for:  
Test Equipment  
Process Control Instrumentation  
Analytical and Scientific Instruments

**GENERAL DESCRIPTION**

The AD2024 and AD2027 are low cost 4½ digit DPMs with large LED displays. Both units offer the same features and identical performance, but the AD2024 is ac line powered and the AD2027 is +5V dc powered.

**THE BENEFITS OF SECOND GENERATION DESIGN**

The AD2024 and AD2027 are designed around MOS-LSI (Metal Oxide Semiconductor, Large Scale Integration) integrated circuits which greatly reduce the number of components and interconnections required to provide the performance and features expected in a high resolution 4½ digit DPM.

This "Second Generation" design, therefore, offers greatly increased reliability and significantly lower cost at little compromise in performance. The large 0.43 inch (11mm) LED displays offer the brightness and readability previously available only with gas discharge displays with the added advantage of an all solid state component.

**HIGH RESOLUTION AND VERSATILE FEATURES**

These DPMs measure dc input voltages over a full scale range of  $\pm 1.9999V$  with an accuracy of  $\pm 0.005\%$  reading  $\pm 0.005\%$  of full scale  $\pm 1$  digit. Using the "limited differential" input first used by Analog Devices on the AD2010, the AD2024 and AD2027 prevent ground loop problems and provide 50dB of common mode rejection at common mode voltages up to  $\pm 200mV$ . Normal mode rejection is 25dB at 50–60Hz.

BCD data outputs are provided in a bit parallel, character serial format compatible with CMOS logic systems. When applications require parallel BCD data, such as interfaces to printers, comparators or slave displays, parallel BCD output options are available that are compatible to standard TTL logic systems.

External power supply outputs at +5V and -25V (-25V only on the AD2027) are made available for powering external circuitry. In addition, control inputs for conversion "Hold", display blanking and decimal point selection are provided.

**INDUSTRY STANDARD CASE DESIGNS**

Although both the AD2024 and AD2027 have identical electrical designs, they are packaged in the case sizes that have become industry standards for ac line powered and +5V dc logic powered DPMs respectively. The AD2024 fits the 3.924" x 1.682" (99.67 x 42.74mm) panel cutout common to most ac line powered DPMs, and the AD2027 fits the 3.175" x 1.810" (80.65 x 45.97mm) panel cutout of the Analog Devices logic power case design, now used by several other manufacturers of logic powered DPMs. Thus, interchangeability is assured, allowing mechanical second sourcing for both these DPMs.

**DESIGNED AND BUILT FOR RELIABILITY**

Even beyond the reliability advantages of the LSI-IC design and LED displays, the AD2024 and AD2027 have had extreme care taken in their 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 thoroughly and without error. And each AD2024 and AD2027, like every Analog Devices DPM, receives a full one week failure-free burn-in before shipment.

# SPECIFICATIONS

## DISPLAY OUTPUTS

- Seven Segment LED Display, 0.43" (11mm) high, for four data digits, 100% overrange and polarity indication.
- Overload indication by blanking all digits, polarity sign remains valid.
- Decimal points (4) selectable at input.
- Display Blanking

## ANALOG INPUT

- Configuration: Bipolar, limited differential
- Full Scale Range:  $\pm 1.9999V$  ( $\pm 19.999V$ , "V" Option)
- Automatic Polarity
- Input Impedance:  $100M\Omega$  ( $1M\Omega$ , "V" Option)
- Bias Current:  $30nA$  ( $3nA$ , "V" Option)
- Overvoltage Protection: 120V rms sustained

## ACCURACY

- $\pm 0.005\%$  reading  $\pm 0.005\%$  full scale  $\pm 1$  digit<sup>1</sup>
- Resolution:  $100\mu V$
- Temperature Range<sup>2</sup>: 0 to  $+50^\circ C$  operating.  $-20$  to  $+85^\circ C$  storage. (AD2024/B: 0 to  $+45^\circ C$  operating)
- Temperature Coefficient: Gain:  $\pm 30ppm/^\circ C$ . Zero Offset:  $\pm 10\mu V/^\circ C$  ( $\pm 40ppm/^\circ C$  &  $\pm 100\mu V/^\circ C$ , "V" Option)
- Warmup Time: One minute to rated accuracy
- Settling Time to Rated Accuracy: 450ms

## NORMAL MODE REJECTION

- 25dB at 50–60Hz

## COMMON MODE REJECTION

- 50dB, dc to 1kHz,  $\pm 200mV$  common mode voltage
- AD2024 (floated on power supply transformer if data outputs and control signals are not used) – 110dB at 120V rms common mode voltage,  $1k\Omega$  imbalance at input

## CONVERSION TIME

- 180ms for full scale reading
- 210ms for overload conversion

## CONVERSION RATE

- 5 conversions per second

## DIGITAL INTERFACE SIGNALS

- Inputs
  - Display Blank – (DTL/TTL Compatible, 4 TTL Loads). Logic "0" or grounding blanks display, including polarity sign, but not decimal points. The display is valid immediately upon removal of the blanking signal.
  - Hold – (DTL/TTL Compatible, 2 TTL Loads). Logic "0" or grounding causes the DPM to hold and display the last conversion. Upon removal of the hold, the DPM resumes conversions.
  - Decimal Points – (Not TTL Compatible). Logic "0" or grounding turns on appropriate decimal point. External circuitry must sink 60mA when a decimal point is illuminated.
- Outputs
  - DTL/TTL Compatible<sup>3</sup> – Status. Logic "1" indicates conversion in process. All digital outputs are valid when status is at logic "0". 5 TTL loads. – Polarity. Logic "1" indicates positive polarity, latched. 5 TTL loads.
  - CMOS and LP Schottky Compatible – Overload, Logic "1" indicates overload ( $\geq 20,000$ ), latched. – BCD outputs.  $4\frac{1}{2}$  BCD digits, character serial, bit parallel, 1 LP Schottky Load.
  - Digital Strobe Outputs – (CMOS or LP Schottky Compatible) Logic "1" on any of these line indicates the output data is valid for that digit, 1 LP Schottky Load.
  - Parallel BCD Output (Option "B"). –  $4\frac{1}{2}$  BCD digits, positive true, latched. Drives 5 TTL loads. – Data Ready. Logic "1" indicates output data is valid. Drives 2 TTL loads.

## EXTERNAL POWER SUPPLY OUTPUTS

- AD2024: +5V at 25mA, -25V at 5mA
- AD2027: -25V at 5mA

## POWER SUPPLY INPUTS

- AD2024: ac line, 50-60Hz, 4.2W
- AD2027: +5V dc,  $\pm 5\%$  at 850mA

## CALIBRATION ADJUSTMENTS

- Gain
- Zero
- Recommended recalibration interval: 6 months

## SIZE

- AD2024: 3.92"W x 1.67"H x 4.48"D (100 x 42 x 114mm)  
Panel cutout: 3.930" x 1.682" (99.8 x 42.7mm)
- AD2027: 3"W x 1.8"H x 4"D (76 x 46 x 102mm)  
Panel cutout: 3.175" x 1.810" (80.65 x 45.97mm)

## WEIGHT

- AD2024: 14 ounces (395 grams)
- AD2027: 10 ounces (280 grams)

## OPTIONS – ORDERING GUIDE

- AD2024
  - AC Power Inputs
    - AD2024 – 117V ac
    - AD2024/E – 220V ac
    - AD2024/F – 100V ac
    - AD2024/H – 240V ac $\pm 10\%$
  - Input Range Options
    - AD2024 –  $\pm 1.9999V$  Full Scale
    - AD2024/V –  $\pm 19.999V$  Full Scale
  - Data Output Options (available with any power input options)
    - AD2024 – Character serial data outputs
    - AD2024/B – Parallel BCD option
  - Display Lens Options<sup>4</sup>
    - Lens 7 – Red with ADI logo
    - Lens 8 – Red without ADI logo
  - Connector – 36 pin, 0.156" spacing, card edge connector, Viking 2VK18D/1-2 or equivalent. – Optional: Order AC2610.
  - AD2024/B option also requires a 30 pin, 0.156" spacing, card edge connector, Viking 2VK15D/1-2 or equivalent. – Optional: Order AC1501.
- AD2027
  - Input Range Options
    - AD2027 –  $\pm 1.9999V$  Full Scale
    - AD2027/V –  $\pm 19.999V$  Full Scale
  - Data Output Options
    - AD2027 – Character serial data outputs
    - AD2027/B – Parallel BCD option
  - Display Lens Options<sup>4</sup>
    - Lens 5 – Red with ADI logo
    - Lens 6 – Red without ADI logo
  - Connector – AC1501 (see above) or equivalent. AD2027/B option requires two each.

## NOTES

- <sup>1</sup> Guaranteed at  $+25^\circ C$  and nominal power supply voltage.
- <sup>2</sup> Guaranteed.
- <sup>3</sup> For CMOS compatibility, 3.3k pullup resistors to the +5V output of the DPM are required.
- <sup>4</sup> If no lens is specified, Lens 5 or 7 is supplied as appropriate. Specifications subject to change without notice.

# Applying the AD2024 and AD2027

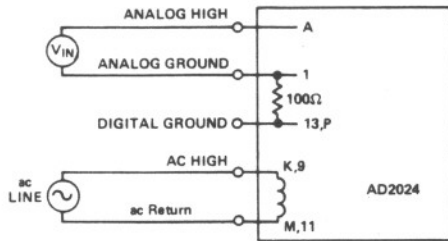


Figure 1. AD2024 Wiring Interconnections

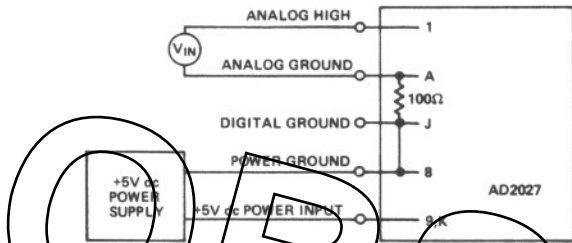


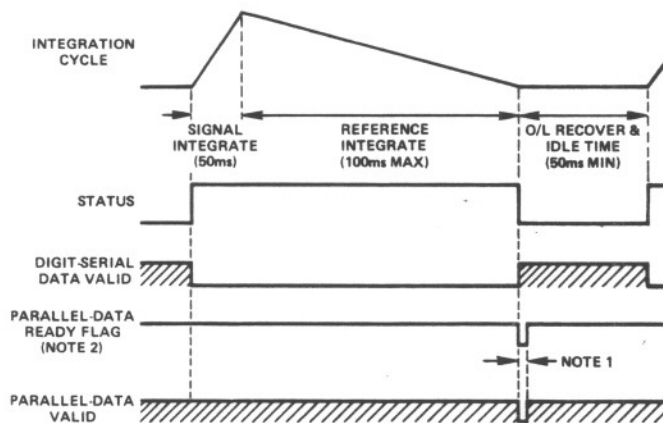
Figure 2. AD2027 Wiring Interconnections

## Interfacing Data Outputs

The standard data outputs are in a bit parallel character serial format compatible to CMOS and LP Schottky logic systems. The BCD outputs are multiplexed, and a digit output is provided for each of the five digits of output. Thus, the four BCD lines on the output at a given time are valid for the digit whose digit line is currently high. The bit parallel character serial data is valid when the DPM status line is low for a period of 50ms between each conversion cycle. The overload line is latched output which is at logic "1", whenever the input exceeds the full 20,000 count range.

Optional parallel BCD outputs ("B" option) are available on a separate card which is internally connected to the DPM. The output data then is presented in a full parallel format and is latched. The parallel data is valid whenever the data ready output is high.

Pin connections for the "B" option are shown in the interconnection tables and a full timing diagram is shown in Figure 3.



NOTE 1. APPROX. 5ms REQUIRED TO LOAD PARALLEL-OUT REGISTERS.  
NOTE 2. B OPTION.

Figure 3. AD2024/AD2027 Timing Diagram

| PIN   | FUNCTION              | PIN   | FUNCTION                    |
|-------|-----------------------|-------|-----------------------------|
| 1     | Analog Ground         | A     | Analog High                 |
| 2     | 10 <sup>1</sup> Digit | B     | 10 <sup>0</sup> Digit (LSD) |
| = KEY |                       | = KEY |                             |
| 3     | BCD 2                 | C     | 10 <sup>2</sup> Digit       |
| 4     | 10 <sup>3</sup> Digit | D     | BCD 4                       |
| 5     | BCD 8                 | E     | BCD 1                       |
| 6     | Mux Step 1            | F     | 10 <sup>4</sup> Digit (MSD) |
| 7     | +5V dc (Out)          | H     | -25V dc (Out)               |
| 8     | NC                    | J     | NC                          |
| 9     | ac High               | K     | ac High                     |
| 10    | NC                    | L     | NC                          |
| 11    | ac RETURN             | M     | ac Return                   |
| 12    | NC                    | N     | NC                          |
| 13    | Digital Ground        | P     | Digital Ground              |
| 14    | NC                    | R     | Status                      |
| 15    | Polarity              | S     | Hold                        |
| 16    | Display Blank         | T     | DP1.XXXX                    |
| 17    | DP1XXX.X              | U     | DP1X.XXX                    |
| 18    | Overload              | V     | DP1XX.XX                    |

AD2024 – Signal and Pin Connections

| PIN   | FUNCTION                    | PIN   | FUNCTION              |
|-------|-----------------------------|-------|-----------------------|
| 1     | Analog High                 | A     | Analog Ground         |
| 2     | 10 <sup>0</sup> Digit (LSD) | B     | Mux Step 1            |
| 3     | BCD 8                       | C     | BCD 1                 |
| 4     | BCD 2                       | D     | BCD 4                 |
| 5     | 10 <sup>4</sup> Digit (MSD) | E     | 10 <sup>1</sup> Digit |
| 6     | 10 <sup>3</sup> Digit       | F     | 10 <sup>2</sup> Digit |
| 7     | NC                          | H     | -25V DC (Out)         |
| 8     | Power Ground                | J     | Digital Ground        |
| 9     | +5V (In)                    | K     | +5V (In)              |
| 10    | NC                          | L     | NC                    |
| = KEY |                             | = KEY |                       |
| 11    | Display Blank               | M     | NC                    |
| 12    | Hold                        | N     | Polarity              |
| 13    | Overload                    | P     | Status                |
| 14    | DP1.XXXX                    | R     | DP1X.XXX              |
| 15    | DP1XX.XX                    | S     | DP1XXX.X              |

NOTE 1: BCD multiplexer clock pulse available for remote placement of BCD option.

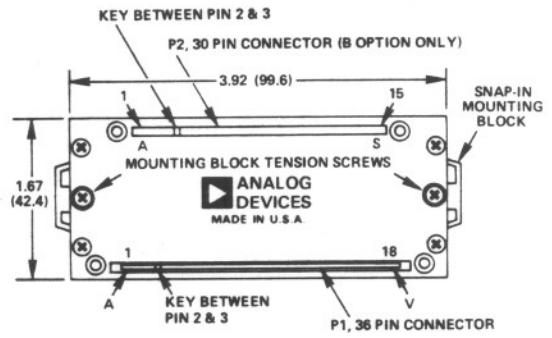
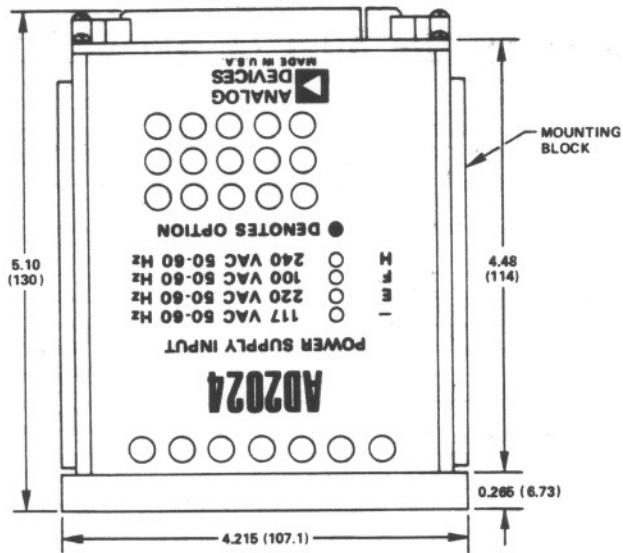
AD2027 – Signal and Pin Connections

| PIN   | FUNCTION       | PIN   | FUNCTION                   |
|-------|----------------|-------|----------------------------|
| 1     | +5V dc (In)    | A     | NC (Do Not Use)            |
| 2     | BCD 1 (In)     | B     | BCD 8 (In)                 |
| = KEY |                | = KEY |                            |
| 3     | BCD 4 (In)     | C     | BCD 2 (In)                 |
| 4     | BCD 2000       | D     | BCD 4                      |
| 5     | BCD 40         | E     | BCD 80                     |
| 6     | BCD 800        | F     | BCD 8000                   |
| 7     | BCD 100        | H     | BCD 1000                   |
| 8     | BCD 10,000     | J     | BCD 200                    |
| 9     | BCD 20         | K     | BCD 2                      |
| 10    | BCD 8          | L     | BCD 10                     |
| 11    | BCD 1          | M     | BCD 4000                   |
| 12    | BCD 400        | N     | 10 <sup>4</sup> Digit (In) |
| 13    | Data Ready     | P     | Status (In)                |
| 14    | Polarity (In)  | R     | Mux Step (In)              |
| 15    | Polarity (Out) | S     | Digital Ground             |

NOTES: 1) Overload output is on main DPM connector.

2) Pins marked "In" are made available for remote placement of BCD option card and are not normally used since all connections are interval.

AD2024/AD2027 BCD Options – Signal and Pin Connections



PANEL CUTOUT: 3.930 × 1.682 (99.82 × 42.72)

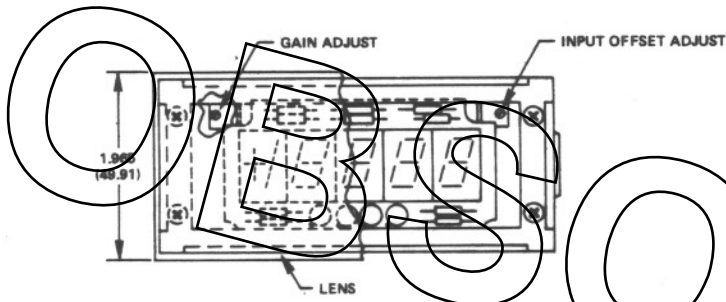
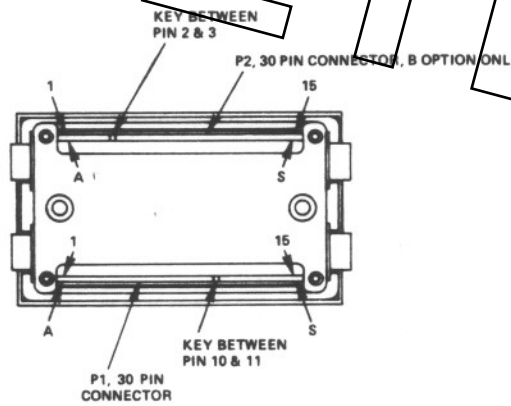


Figure 4. AD2024 Mechanical Outline  
(Dimensions shown in inches and (mm))



PANEL CUTOUT: 3.175 × 1.180 (80.65 × 45.97)

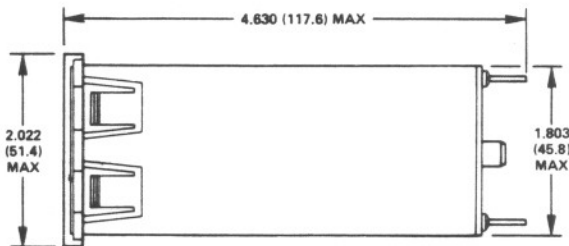
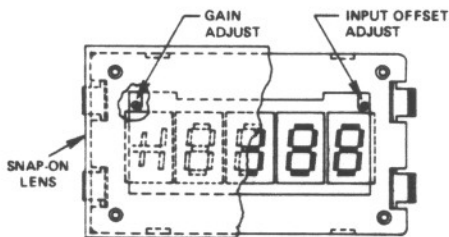


Figure 5. AD2027 Mechanical Outline  
(Dimensions shown in inches and (mm))