

**FEATURES**

- Microprocessor compatible (6800, 8085, Z80)
- TTL-/CMOS-compatible inputs
- On-chip data latches
- Endpoint linearity
- Low power consumption
- Monotonicity guaranteed (full temperature range)
- Latch free (no protection Schottky required)

**ENHANCED PRODUCT FEATURES**

- Supports defense and aerospace applications (AQEC)
- Military temperature range (-55°C to +125°C)
- Controlled manufacturing baseline
- One assembly/test site
- One fabrication site
- Product change notification
- Qualification data available on request

**APPLICATIONS**

- Microprocessor controlled gain circuits
- Microprocessor controlled attenuator circuits
- Microprocessor controlled function generation
- Precision AGC circuits
- Bus structured instruments

**GENERAL DESCRIPTION**

The AD7524-EP is a low cost, 8-bit monolithic CMOS DAC designed for direct interface to most microprocessors.

An 8-bit DAC with input latches, the load cycle of the AD7524-EP is similar to the write cycle of the random access memory. Using an advanced thin-film on the CMOS fabrication process, the AD7524-EP provides accuracy to 1/8 LSB with a typical power dissipation of less than 10 mW.

An improved design eliminates the protection Schottky previously required and guarantees TTL compatibility when using a 5 V supply. The loading speed has also been increased for compatibility with most microprocessors.

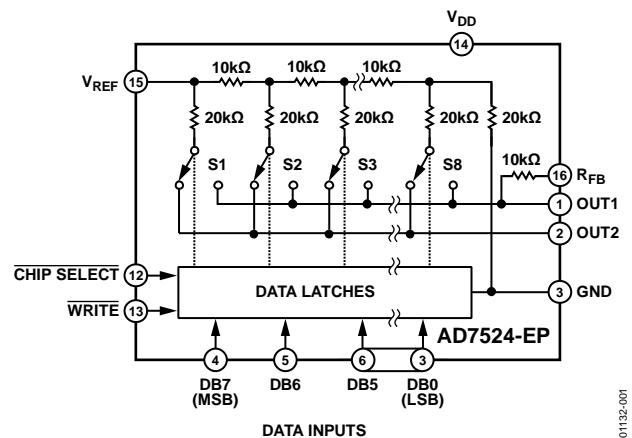
**FUNCTIONAL BLOCK DIAGRAM**


Figure 1.

01132-001

Featuring operation from 5 V to 15 V, the AD7524-EP interfaces directly to most microprocessor buses or output ports.

Excellent multiplying characteristics (2- or 4-quadrant) make the AD7524-EP an ideal choice for many microprocessor controlled gain setting and signal control applications.

Additional application and technical information can be found in the [AD7524](#) data sheet.

**TABLE OF CONTENTS**

|                                 |   |  |   |
|---------------------------------|---|--|---|
| Features .....                  | 1 | Write Cycle Timing Diagram.....                  | 4 |
| Enhanced Product Features ..... | 1 | Absolute Maximum Ratings .....                   | 5 |
| Applications.....               | 1 | ESD Caution.....                                 | 5 |
| Functional Block Diagram .....  | 1 | Pin Configuration and Function Descriptions..... | 6 |
| General Description .....       | 1 | Outline Dimensions .....                         | 7 |
| Revision History .....          | 2 | Ordering Guide .....                             | 7 |
| Specifications.....             | 2 |  |   |

**REVISION HISTORY**

**3/2018— Rev. 0 to Rev. A**

|                                  |   |
|----------------------------------|---|
| Change to Features Section ..... | 1 |
| Changes to Ordering Guide .....  | 7 |

**1/2012—Revision 0: Initial Version**

## SPECIFICATIONS

$V_{REF} = 10\text{ V}$ ,  $V_{OUT1} = V_{OUT2} = 0\text{ V}$ , unless otherwise noted. Temperature range goes from  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

Table 1.

| Parameter  | Limit, $T_A = 25^{\circ}\text{C}$ |                        | Limit, $T_{MIN}, T_{MAX}^1$ |                        | Unit                    | Test Conditions/<br>Comments  |
|--|-----------------------------------|------------------------|-----------------------------|------------------------|-------------------------|---|
|  | $V_{DD} = 5\text{ V}$             | $V_{DD} = 15\text{ V}$ | $V_{DD} = 5\text{ V}$       | $V_{DD} = 15\text{ V}$ |                         |   |
| STATIC PERFORMANCE   |                                   |                        |                             |                        |                         |   |
| Resolution   | 8                                 | 8                      | 8                           | 8                      | Bits                    |   |
| Relative Accuracy  | $\pm 1/2$                         | $\pm 1/2$              | $\pm 1/2$                   | $\pm 1/2$              | LSB max                 |   |
| Monotonicity   | Guaranteed                        | Guaranteed             | Guaranteed                  | Guaranteed             |                         |   |
| Gain Error <sup>2</sup>  | $\pm 2\frac{1}{2}$                | $\pm 1\frac{1}{4}$     | $\pm 3\frac{1}{2}$          | $\pm 1\frac{1}{2}$     | LSB max                 |   |
| Average Gain TC <sup>3</sup>                                     | $\pm 40$                          | $\pm 10$               | $\pm 40$                    | $\pm 10$               | ppm/ $^{\circ}\text{C}$ | Gain TC measured from $25^{\circ}\text{C}$ to $T_{MIN}$ or from $25^{\circ}\text{C}$ to $T_{MAX}$   |
| DC Supply Rejection, $\Delta\text{Gain}/\Delta V_{DD}^3$         | 0.08                              | 0.02                   | 0.16                        | 0.04                   | % FSR/% max             | $\Delta V_{DD} = \pm 10\%$  |
| Output Leakage Current   | 0.002                             | 0.001                  | 0.01                        | 0.005                  | % FSR/% typ             |   |
| $I_{OUT1}$ (Pin 1)   | $\pm 50$                          | $\pm 50$               | $\pm 400$                   | $\pm 200$              | nA max                  | $\overline{\text{DB0}}$ to $\overline{\text{DB7}} = 0\text{ V}$ ; $\overline{\text{WR}}$ , $\overline{\text{CS}} = 0\text{ V}$ ; $V_{REF} = \pm 10\text{ V}$  |
| $I_{OUT2}$ (Pin 2)   | $\pm 50$                          | $\pm 50$               | $\pm 400$                   | $\pm 200$              | nA max                  | $\overline{\text{DB0}}$ to $\overline{\text{DB7}} = V_{DD}$ ; $\overline{\text{WR}}$ , $\overline{\text{CS}} = 0\text{ V}$ ; $V_{REF} = \pm 10\text{ V}$  |
| DYNAMIC PERFORMANCE  |                                   |                        |                             |                        |                         |   |
| Output Current Settling Time (to $\frac{1}{2}$ LSB) <sup>3</sup> | 400                               | 250                    | 500                         | 350                    | ns max                  | OUT1 load = $100\ \Omega$ , $C_{EXT} = 13\text{ pF}$ ; $\overline{\text{WR}}$ , $\overline{\text{CS}} = 0\text{ V}$ ; $\overline{\text{DB0}}$ to $\overline{\text{DB7}} = 0\text{ V}$ to $V_{DD}$ to $0\text{ V}$ |
| AC Feedthrough <sup>3</sup>                                      |                                   |                        |                             |                        |                         |   |
| At OUT1  | 0.25                              | 0.25                   | 0.5                         | 0.5                    | % FSR max               | $V_{REF} = \pm 10\text{ V}$ , 100 kHz sine wave; $\overline{\text{DB0}}$ to $\overline{\text{DB7}} = 0\text{ V}$ ; $\overline{\text{WR}}$ , $\overline{\text{CS}} = 0\text{ V}$                                   |
| At OUT2  | 0.25                              | 0.25                   | 0.5                         | 0.5                    | % FSR max               | $V_{REF} = \pm 10\text{ V}$ , 100 kHz sine wave; $\overline{\text{DB0}}$ to $\overline{\text{DB7}} = 0\text{ V}$ ; $\overline{\text{WR}}$ , $\overline{\text{CS}} = 0\text{ V}$                                   |
| REFERENCE INPUT  |                                   |                        |                             |                        |                         |   |
| $R_{IN}$ (Pin 15 to GND) <sup>4</sup>                            | 5                                 | 5                      | 5                           | 5                      | k $\Omega$ min          |   |
|  | 20                                | 20                     | 20                          | 20                     | k $\Omega$ max          |   |
| ANALOG OUTPUTS   |                                   |                        |                             |                        |                         |   |
| Output Capacitance <sup>3</sup>                                  |                                   |                        |                             |                        |                         |   |
| $C_{OUT1}$ (Pin 1)   | 120                               | 120                    | 120                         | 120                    | pF max                  | $\overline{\text{DB0}}$ to $\overline{\text{DB7}} = V_{DD}$ ; $\overline{\text{WR}}$ , $\overline{\text{CS}} = 0\text{ V}$  |
| $C_{OUT2}$ (Pin 2)   | 30                                | 30                     | 30                          | 30                     | pF max                  |   |
| $C_{OUT1}$ (Pin 1)   | 30                                | 30                     | 30                          | 30                     | pF max                  | $\overline{\text{DB0}}$ to $\overline{\text{DB7}} = 0\text{ V}$ ; $\overline{\text{WR}}$ , $\overline{\text{CS}} = 0\text{ V}$  |
| $C_{OUT2}$ (Pin 2)   | 120                               | 120                    | 120                         | 120                    | pF max                  |   |
| DIGITAL INPUTS   |                                   |                        |                             |                        |                         |   |
| Input High Voltage Requirement, $V_{IH}$                         | 2.4                               | 13.5                   | 2.4                         | 13.5                   | V min                   |   |
| Input Low Voltage Requirement, $V_{IL}$                          | 0.8                               | 1.5                    | 0.5                         | 1.5                    | V max                   |   |
| Input Current, $I_{IN}$  | $\pm 1$                           | $\pm 1$                | $\pm 10$                    | $\pm 10$               | $\mu\text{A}$ max       | $V_{IN} = 0\text{ V}$ or $V_{DD}$   |
| Input Capacitance <sup>3</sup>                                   |                                   |                        |                             |                        |                         |   |
| $\overline{\text{DB0}}$ to $\overline{\text{DB7}}$               | 5                                 | 5                      | 5                           | 5                      | pF max                  | $V_{IN} = 0\text{ V}$   |
| $\overline{\text{WR}}$ , $\overline{\text{CS}}$                  | 20                                | 20                     | 20                          | 20                     | pF max                  | $V_{IN} = 0\text{ V}$   |

| Parameter  | Limit, $T_A = 25^\circ\text{C}$ |                               | Limit, $T_{\text{MIN}}, T_{\text{MAX}}^1$ |                               | Unit              | Test Conditions/<br>Comments                             |
|--|---------------------------------|-------------------------------|---|-------------------------------|-------------------|--|
|  | $V_{\text{DD}} = 5\text{ V}$    | $V_{\text{DD}} = 15\text{ V}$ | $V_{\text{DD}} = 5\text{ V}$              | $V_{\text{DD}} = 15\text{ V}$ |                   |  |
| <b>SWITCHING CHARACTERISTICS</b>                   |                                 |                               |   |                               |                   |  |
| Chip Select to Write Setup Time, $t_{\text{CS}}^5$ | 170                             | 100                           | 240                                       | 150                           | ns min            | See Figure 2<br>$t_{\text{WR}} = t_{\text{CS}}$          |
| Chip Select to Write Hold Time, $t_{\text{CH}}$    | 0                               | 0                             | 0   | 0                             | ns min            |  |
| Write Pulse Width, $t_{\text{WR}}$                 | 170                             | 100                           | 240                                       | 150                           | ns min            | $t_{\text{CS}} \geq t_{\text{WR}}, t_{\text{CH}} \geq 0$ |
| Data Setup Time, $t_{\text{DS}}$                   | 135                             | 60                            | 170                                       | 100                           | ns min            |  |
| Data Hold Time, $t_{\text{DH}}$                    | 10                              | 10                            | 10  | 10                            | ns min            |  |
| <b>POWER SUPPLY</b>                                |                                 |                               |   |                               |                   |  |
| $I_{\text{DD}}$                                    | 1                               | 2                             | 2   | 2                             | mA max            | All digital inputs $V_{\text{IL}}$ or $V_{\text{IH}}$    |
|  | 100                             | 100                           | 500                                       | 500                           | $\mu\text{A max}$ | All digital inputs 0V or $V_{\text{DD}}$                 |

<sup>1</sup> Temperature range is as follows:  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$ .

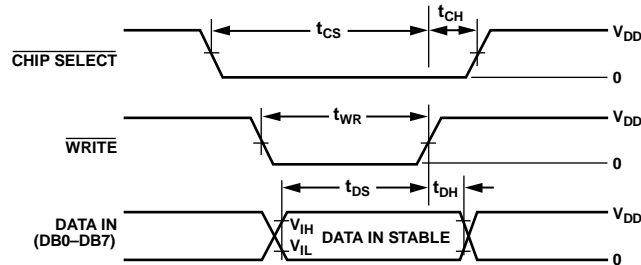
<sup>2</sup> Gain error is measured using internal feedback resistor. Full-scale range (FSR) =  $V_{\text{REF}}$ .

<sup>3</sup> Guaranteed not tested.

<sup>4</sup> DAC thin-film resistor temperature coefficient is approximately  $-300\text{ ppm}/^\circ\text{C}$ .

<sup>5</sup> AC parameter, sample tested @  $25^\circ\text{C}$  to ensure conformance to specification.

## WRITE CYCLE TIMING DIAGRAM



### NOTES

- ALL INPUT SIGNAL RISE AND FALL TIMES MEASURED FROM 10% TO 90% OF  $V_{\text{DD}}$ .  $V_{\text{DD}} = 5\text{ V}$ ,  $t_{\text{R}} = t_{\text{F}} = 20\text{ ns}$ ;  $V_{\text{DD}} = 15\text{ V}$ ,  $t_{\text{R}} = t_{\text{F}} = 40\text{ ns}$ .
- TIMING MEASUREMENT REFERENCE LEVEL IS  $\frac{V_{\text{IH}} + V_{\text{IL}}}{2}$
- $t_{\text{DS}} + t_{\text{DH}}$  IS APPROXIMATELY CONSTANT AT 145ns MIN AT  $25^\circ\text{C}$ ,  $V_{\text{DD}} = 5\text{ V}$  AND  $t_{\text{WR}} = 170\text{ ns}$  MIN. THE AD7524 IS SPECIFIED FOR A MINIMUM  $t_{\text{DH}}$  OF 10ns. HOWEVER, IN APPLICATIONS WHERE  $t_{\text{DH}} > 10\text{ ns}$ ,  $t_{\text{DS}}$  MAY BE REDUCED ACCORDINGLY UP TO THE LIMIT  $t_{\text{DS}} = 65\text{ ns}$ ,  $t_{\text{DH}} = 80\text{ ns}$ .

01132-002

Figure 2. Timing Diagram

## ABSOLUTE MAXIMUM RATINGS

$T_A = 25^\circ\text{C}$ , unless otherwise noted.

**Table 2.**

| Parameter                            | Rating                                      |
|--------------------------------------|---|
| $V_{DD}$ to GND                      | -0.3 V to +17 V                             |
| $V_{R_{FEEDBACK}}$ to GND            | $\pm 25$ V                                  |
| $V_{REF}$ to GND                     | $\pm 25$ V                                  |
| Digital Input Voltage to GND         | -0.3 V to $V_{DD} + 0.3$ V                  |
| OUT1, OUT2 to GND                    | -0.3 V to $V_{DD} + 0.3$ V                  |
| Power Dissipation (Any Package)      |   |
| To $75^\circ\text{C}$                | 450 mW                                      |
| Derates above $75^\circ\text{C}$ by  | 6 mW/ $^\circ\text{C}$                      |
| Operating Temperature, Extended      | $-55^\circ\text{C}$ to $+125^\circ\text{C}$ |
| Storage Temperature Range            | $-65^\circ\text{C}$ to $+150^\circ\text{C}$ |
| Lead Temperature (Soldering, 10 sec) | $300^\circ\text{C}$                         |

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### ESD CAUTION



**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

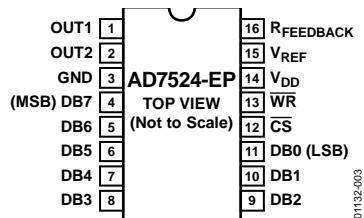
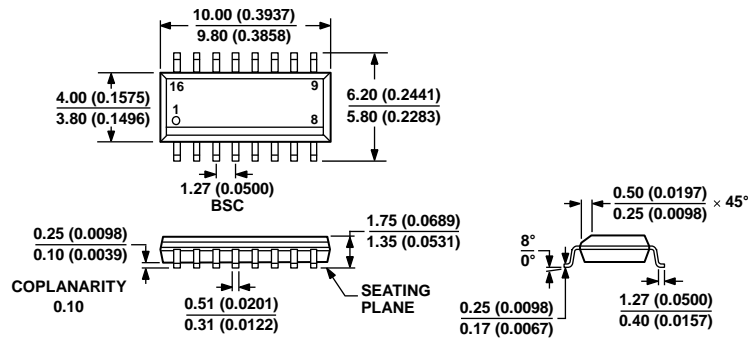


Figure 3. Pin Configuration

Table 3. Pin Function Descriptions

| Pin No. | Mnemonic                  | Description   |
|---------|---------------------------|---|
| 1       | OUT1                      | DAC Current Output.   |
| 2       | OUT2                      | DAC Analog Ground. This pin should normally be tied to the analog ground of the system.                           |
| 3       | GND                       | Ground.   |
| 4       | DB7 (MSB) to<br>DB0 (LSB) | Parallel Data Bit 7 to Data Bit 0.  |
| 12      | $\overline{CS}$           | Chip Select Input. Active low. Used in conjunction with $\overline{WR}$ to load parallel data to the input latch. |
| 13      | $\overline{WR}$           | Write. When low, use in conjunction with $\overline{CS}$ to load parallel data.                                   |
| 14      | $V_{DD}$                  | Positive Power Supply Input. These parts can be operated with a supply of 5 V.                                    |
| 15      | $V_{REF}$                 | DAC Reference Voltage Input Terminal.   |
| 16      | $R_{FEEDBACK}$            | DAC Feedback Resistor Pin. Establish voltage output for the DAC by connecting to external amplifier output.       |

# OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-012-AC  
 CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS  
 (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR  
 REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

060606-A

Figure 4. 16-Lead Standard Small Outline Package [SOIC\_N]  
 Narrow Body  
 (R-16)

Dimensions shown in millimeters and (inches)

## ORDERING GUIDE

| Model <sup>1</sup> | Nonlinearity (V <sub>DD</sub> = 15 V) | Temperature Range | Package Description | Package Option |
|--------------------|---------------------------------------|-------------------|---------------------|----------------|
| AD7524SR-EP        | ±0.5 LSB                              | -55°C to +125°C   | 16-Lead SOIC_N      | R-16           |
| AD7524SR-EP-RL7    | ±0.5 LSB                              | -55°C to +125°C   | 16-Lead SOIC_N      | R-16           |
| AD7524SRZ-EP       | ±0.5 LSB                              | -55°C to +125°C   | 16-Lead SOIC_N      | R-16           |
| AD7524SRZ-EP-RL7   | ±0.5 LSB                              | -55°C to +125°C   | 16-Lead SOIC_N      | R-16           |

<sup>1</sup> Z= RoHS Compliant Part.

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