# 10-Bit Digital Temperature Sensor

a

**in 6-Lead SOT-23**

**AD7814**

**FEATURES**

**10-Bit Temperature-to-Digital Converter**

**–55**°**C to +125**°**C Operating Temperature Range**

**FUNCTIONAL BLOCK DIAGRAM**

±**2**°**C Accuracy**

**SPI- and DSP-Compatible Serial Interface Shutdown Mode**

**Space-Saving SOT-23 Package**

**APPLICATIONS**

**Hard Disk Drives Personal Computers**

**Electronic Test Equipment Office Equipment Domestic Appliances Process Control**

**GND**

**BAND GAP TEMPERATURE SENSOR**

**AD7814**

**10-BIT ANALOG/DIGITAL CONVERTER**

|  |  |
| --- | --- |
| **TEMPERATURE VALUE REGISTER** | |
|  |  |

**SERIAL BUS INTERFACE**

**VDD**

**CS SCLK DIN DOUT**

**GENERAL DESCRIPTION**

The AD7814 is a complete temperature monitoring system in a SOT-23 package or 8-lead MSOP package. It contains a band gap temperature sensor and 10-bit ADC to monitor and digitize the temperature reading to a resolution of 0.25°C.

The AD7814 has a flexible serial interface that allows easy inter- facing to most microcontrollers. The interface is compatible with SPI®, QSPI™, and MICROWIRE™ protocol, and is also compatible with DSPs. The part features a standby mode that is controlled via the serial interface.

The AD7814’s wide supply voltage range, low supply current, and SPI-compatible interface make it ideal for a variety of applications, including personal computers, office equipment, and domestic appliances.

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**PRODUCT HIGHLIGHTS**

1. The AD7814 has an on-chip temperature sensor that allows an accurate measurement of the ambient temperature. The measurable temperature range is –55°C to +125°C, with a

± 2°C temperature accuracy.

1. Supply voltage of 2.7 V to 5.5 V
2. Space-saving 6-lead SOT-23 package and 8-lead MSOP package
3. 10-bit temperature reading to 0.25°C resolution
4. Standby mode that reduces the current consumption to 1 µA

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# AD7814–SPECIFICATIONS1 (T

**A**

**= TMIN**

### to T

**MAX, VDD**

### = 2.7 V to 5.5 V, unless otherwise noted.)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter** | **Min** | **Typ** | **Max** | **Unit** | **Test Conditions/Comments** |
| TEMPERATURE SENSOR AND ADC |  | | ± 2.0 | °C | TA = 0°C to 85°C. VDD = 3 V to 5.5 V2 |
| Accuracy |
|  |  | | ± 2.5 | °C | TA = –40°C to 0°C. VDD = 3 V to 5.5 V2 |
|  | ± 2.0 | | ± 3.5 | °C | TA = –55°C to +125°C. VDD = 3 V to 5.5 V |
| Resolution | 10 | |  | Bits |
| Update Rate, tR | 400 | |  | µs |
| Temperature Conversion Time | 25 | |  | µs |
| SUPPLIES  Supply Voltage  Supply Current  Normal Mode  Shutdown Mode (VDD = 5 V)  Shutdown Mode (VDD = 3 V)  Power Dissipation  Power Dissipation  1 sps  10 sps  100 sps | 2.7 | 250  1.23  0.43  80  3.7  3.9  5.8 | 5.5  400  3  1 | V  µA  µA  µA  µW  µW  µW  µW | For Specified Performance  VDD = 3 V. Using Normal Mode VDD = 3 V. Using Shutdown Mode |
| DIGITAL INPUT3 | 2.4 |  |  | V | VIN = 0 V to VDD |
| Input High Voltage, VIH |
| Input Low Voltage, VIL |  |  | 0.8 | V |
| Input Current, IIN |  |  | ± 1 | µA |
| Input Capacitance, CIN |  |  | 10 | pF | All Digital Inputs |
| DIGITAL OUTPUT3 | VDD – | 0.3 V |  | V | ISOURCE = ISINK = 200 µA |
| Output High Voltage, VOH |
| Output Low Voltage, VOL |  |  | 0.4 | IOL = 200 µA |
| Output Capacitance, COUT |  |  | 50 | pF |

NOTES

1All specifications apply for –55°C to +125°C unless otherwise stated.

2For VDD = 2.7 V to 3 V and TA = –40°C to +85°C, the typical temperature error is ± 2°C.

3Guaranteed by design and characterization, not production tested.

Specifications subject to change without notice.

**TIMING CHARACTERISTICS1, 2, 3 (T**

**A**

**= TMIN**

### to T

**MAX, VDD**

### = 2.7 V to 5.5 V, unless otherwise noted.)

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Limit** | **Unit** | **Comments** |
| t1 | 0 | ns min | *CS* to SCLK Setup Time |
| t2 | 50 | ns min | SCLK High Pulse Width |
| t3 | 50 | ns min | SCLK Low Pulse Width |
| t44 | 35 | ns max | Data Access Time After SCLK Falling Edge |
| t5 | 20 | ns min | Data Setup Time Prior to SCLK Rising Edge |
| t6 | 0 | ns min | Data Hold Time After SCLK Rising Edge |
| t7 | 0 | ns min | *CS* to SCLK Hold Time |
| t84 | 40 | ns max | *CS* to DOUT High Impedance |

NOTES

1Guaranteed by design and characterization, not production tested.

2All input signals are specified with tr = tf = 5 ns (10% to 90% of V DD) and timed from a voltage level of 1.6 V.

3See Figure 2.

4Measured with the load circuit of Figure 1.

Specifications subject to change without notice.

**ABSOLUTE MAXIMUM RATINGS\***

VDD to GND . . . . . . . . . . . . . . . . . . . . . . . . . . –0.3 V to +7 V

Digital Input Voltage to GND . . . . . . . –0.3 V to VDD + 0.3 V

Digital Output Voltage to GND . . . . . –0.3 V to VDD + 0.3 V

Operating Temperature Range . . . . . . . . . . –55°C to +125°C

Storage Temperature Range . . . . . . . . . . . . –65°C to +150°C

Junction Temperature . . . . . . . . . . . . . . . . . . . . . . . . . 150°C

SOT-23, Power Dissipation . . . . . . . . . . . . . . . . . . . . 450 mW

**TO OUTPUT**

**PIN CL**

**50pF**

**200**µ**A**

**IOL**

**1.6V**

θJA Thermal Impedance . . . . . . . . . . . . . . . . . . . . 240°C/W

Lead Temperature, Soldering

Vapor Phase (60 sec) . . . . . . . . . . . . . . . . . . . . . . 215°C

Infrared (15 sec) . . . . . . . . . . . . . . . . . . . . . . . . . . 220°C

MSOP Package, Power Dissipation . . . . . . . . . . . . . . 450 mW

θJA Thermal Impedance . . . . . . . . . . . . . . . . . . . . 206°C/W

Lead Temperature, Soldering

Vapor Phase (60 sec) . . . . . . . . . . . . . . . . . . . . . . 215°C

Infrared (15 sec) . . . . . . . . . . . . . . . . . . . . . . . . . . 220°C

\*Stresses above those listed under Absolute Maximum Ratings may cause perma- nent 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.

**200**µ**A IOH**

Figure 1. Load Circuit for Data Access Time and Bus Relinquish Time

**ORDERING GUIDE**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Model** | **Temperature Range** | **Temperature Error1** | **Package Description** | **Package Option** | **Branding Information** |
| AD7814ART-500RL7 AD7814ART-REEL AD7814ART-REEL7 AD7814ARTZ-500RL72 AD7814ARTZ-REEL2 AD7814ARTZ-REEL72 AD7814ARM AD7814ARM-REEL AD7814ARM-REEL7 AD7814ARMZ2 AD7814ARMZ-REEL2 AD7814ARMZ-REEL72 | –55°C to +125°C  –55°C to +125°C  –55°C to +125°C  –55°C to +125°C  –55°C to +125°C  –55°C to +125°C  –55°C to +125°C  –55°C to +125°C  –55°C to +125°C  –55°C to +125°C  –55°C to +125°C  –55°C to +125°C | ± 2°C  ± 2°C  ± 2°C  ± 2°C  ± 2°C  ± 2°C  ± 2°C  ± 2°C  ± 2°C  ± 2°C  ± 2°C  ± 2°C | 6-Lead SOT-23  6-Lead SOT-23  6-Lead SOT-23  6-Lead SOT-23  6-Lead SOT-23  6-Lead SOT-23  8-Lead MSOP  8-Lead MSOP  8-Lead MSOP  8-Lead MSOP  8-Lead MSOP  8-Lead MSOP | RT-6 RT-6 RT-6 RT-6 RT-6 RT-6 RM-8 RM-8 RM-8 RM-8 RM-8 RM-8 | CAA CAA CAA CAA CAA CAA CAA CAA CAA CAA CAA CAA |

1Temperature error is over 0°C to 85°C temperature range.

2Z = Pb-free part

**CAUTION**

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the AD7814 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

**WARNING!**

**ESD SENSITIVE DEVICE**

**PIN FUNCTION DESCRIPTIONS**

|  |  |  |  |
| --- | --- | --- | --- |
| **Pin Mnemonic** | **SOT-23**  **Pin No.** | **MSOP**  **Pin No.** | **Description** |
| GND | 1 | 7 | Analog and Digital Ground |
| DIN | 2 | 6 | Serial Data Input. Serial data to be loaded to the part’s control register is |
|  |  |  | provided on this input. Data is clocked into the control register on the rising |
|  |  |  | edge of SCLK. |
| VDD | 3 | 5 | Positive Supply Voltage, 2.7 V to 5.5 V |
| SCLK | 4 | 4 | Serial Clock Input. This is the clock input for the serial port. The serial clock |
|  |  |  | is used to clock data out of the temperature value register of the AD7814 and |
|  |  |  | to clock data into the control register on the part. |
| *CS* | 5 | 3 | Chip Select Input. Logic input. The device is selected when this input is low. |
|  |  |  | The SCLK input is disabled when this pin is high. |
| DOUT | 6 | 2 | Serial Data Output. Logic output. Data is clocked out of the temperature |
|  |  | value register at this pin. Data is clocked out on the falling edge of SCLK. |
| NC | 1, 8 | No Connect |

**PIN CONFIGURATIONS**

**SOT-23**

**MSOP**

**GND 1**

|  |  |  |
| --- | --- | --- |
|  | **AD7814**  **TOP VIEW**  **(Not to Scale)** |  |
| **6** |
|  |
| **5** |
|  |
| **4** |
|  |

**DIN 2**

**VDD 3**

**DOUT CS SCLK**

**NC DOUT CS SCLK**

**1**

**2**

**3**

**4**

**NC = NO CONNECT**

|  |  |  |
| --- | --- | --- |
|  | **AD7814**  **TOP VIEW**  **(Not to Scale)** |  |
| **8** |
| **7** |
| **6** |
| **5** |
|  |

**NC GND DIN VDD**

**CIRCUIT INFORMATION**

The AD7814 is a 10-bit digital temperature sensor. The part houses an on-chip temperature sensor, a 10-bit A/D converter, a reference, and serial interface logic functions in a SOT-23 package. The A/D converter section consists of a conventional successive-approximation converter based around a capacitor DAC. The parts are capable of running on a 2.7 V to 5.5 V power supply.

The on-chip temperature sensor allows an accurate measurement of the ambient device temperature to be made. The working measurement range of the AD7814 is –55°C to +125°C.

**CONVERTER DETAILS**

The conversion clock for the part is internally generated so no external clock is required except when reading from and writing to the serial port. In normal mode, an internal clock oscillator runs the automatic conversion sequence. A conversion is initi- ated approximately every(каждые) 350 µs. At this time(в это время), the part wakes(активизация) up and performs a temperature conversion. This temperature con- version typically takes(считываются) 25 µs, at which time the part automati- cally shuts down. The result of the most recent (новый) temperature conversion is available in the serial output register at any time. Once the conversion is finished, an internal oscillator starts counting and is designed to time out every 350 µs. The AD7814 then powers up and does a conversion. Please note that if the CS is brought low every 350 µs (± 30%), then the same tempera- ture value will be output onto the DOUT line every time with- out changing. It is recommended that the *CS* line is not brought low every 350 µs (± 30%). The ± 30% covers process variation. The *CS* should become active (high to low) outside this range.

The device is designed to autoconvert every 350 µs. If the AD7814 is accessed during the conversion process, an internal signal is generated to prevent any update of the temperature value register during the conversion. Otherwise the user could read back spurious data. The design of this feature results in this internal lockout signal being reset only at the start of the next autoconversion. Therefore, if the *CS* line goes active before the internal lockout signal has been reset to its inactive mode, the internal lockout signal will not be reset. To ensure that no lock- out signal is set, bring the *CS* low at a greater or less time than 350 µs (± 30%). This will mean that the AD7814 is not inter- rupted during a conversion process. The AD7814 can be placed in a shutdown mode, via the control register, in which case the on-chip oscillator is shut down and no further conversions are initiated until the AD7814 is taken out of shutdown mode. The conversion result from the last conversion prior to shutdown can still be read from the AD7814 even when it is in shutdown mode.

In the automatic conversion mode, every time a read or write operation takes place, the internal clock oscillator is restarted at the end of the read or write operation. The result of the con- version is typically available 25 µs later. Similarly, when the part is taken out of shutdown mode, the internal clock oscil- lator is restarted and the conversion result is typically available

25 µs later. Reading from the device before conversion is com- plete will provide the same set of data.

**TEMPERATURE VALUE REGISTER**

The temperature value register is a read-only register that stores the temperature reading from the ADC in 10-bit twos comple- ment format. The temperature data format is shown in Table I. This shows the full theoretical range of the ADC from –128°C to +127°C, but in practice the temperature measurement range is limited to the operating temperature range of the device (–55°C to +125°C). A typical performance curve is shown in Figure 7.

**Table I. Temperature Data Format**

|  |  |
| --- | --- |
| **Temperature** | **Digital Output DB9 . . . DB0** |
| –128°C  –125°C  –100°C  –75°C  –50°C  –25°C  –0.25°C  0°C  +0.25°C  +10°C  +25°C  +50°C  +75°C  +100°C  +125°C  +127°C | 10 0000 0000  10 0000 1100  10 0111 0000  10 1101 0100  11 0011 1000  11 1001 1100  11 1111 1111  00 0000 0000  00 0000 0001  00 0010 1000  00 0110 0100  00 1100 1000  01 0010 1100  01 1001 0000  01 1111 0100  01 1111 1100 |

**SERIAL INTERFACE**

The serial interface on the AD7814 consists of four wires *CS*, SCLK, DIN, and DOUT. The interface can be operated in

3-wire mode with DIN tied to Ground, in which case the inter- face has read-only capability, with data being read from the data register via the DOUT line. The DIN line is used to write the part into standby mode, if required. The *CS* line is used to select the device when more than one device is connected to the serial clock and data lines.

The part operates in a slave mode and requires an externally applied serial clock to the SCLK input to access data from the data register. The serial interface on the AD7814 is designed to allow the part to be interfaced to systems that provide a serial clock that is synchronized to the serial data, such as the 80C51, 87C51, 68HC11, 68HC05, and PIC16Cxx microcontrollers, as well as DSP processors.

A read operation from the AD7814 accesses data from the temperature value register, while a write operation to the part writes data to the control register.

**CS**

**SCLK**

**DOUT**

**t1 t7**

**2**

**t**

**1 2 3 4 11 15 16**

**t3 t8**

**t4**

**LEADING**

**ZERO DB9 DB8 DB0**

**t6**

**DIN DON'T**

**CARE**

**t5**

**DON'T CARE**

**POWER- DOWN**

Figure 2. Serial Interface Timing Diagram

**Read Operation**

Figure 2 shows the timing diagram for a serial read from the AD7814. The *CS* line enables the SCLK input. Ten bits of data and a leading zero are transferred during a read operation. Read operations occur during streams of 16 clock pulses. The serial data is accessed in a number of bytes if 10 bits of data are being read. At the end of the read operation, the DOUT line remains in the state of the last bit of data clocked out of the AD7814 until *CS* returns high, at which time the DOUT line goes into three-state.

**Write Operation**

**AD7814 to MC68HC11 Interface**

Figure 3 shows an interface between the AD7814 and the MC68HC11 microcontroller. The MC68HC11 is configured in the master mode with its CPOL bit set to a logic one and its CPHA bit set to a logic one. When the MC68HC11 is config- ured like this, its SCLK line idles high between data transfers. Data is transferred to and from the AD7814 in two 8-bit serial data operations. The diagram shows the full (4-wire) interface. PC1 of the MC68HC11 is configured as an output and used to drive the *CS* input.

Figure 2 also shows the timing diagram for a serial write to the AD7814. The write operation takes place at the same time as the read operation. Data is clocked into the control register on the part on the rising edge of SCLK. Only the third bit in the data stream provides a user-controlled function. This third bit is the power-down bit which, when set to a 1, puts the AD7814 into shutdown mode. The first 2 bits of the data stream are

**AD7814\***

**SCLK DOUT DIN CS**

**MC68HC11\***

**SCLK MISO MOSI PC1**

“don’t cares” while all other bits in the data stream, other than the power-down bit, should be 0 to ensure correct operation of

the AD7814. Data is loaded to the control register on the fif- teenth falling SCLK edge and the data takes effect at this time (i.e., if the part is programmed to go into shutdown, it does so at this point). If the *CS* is brought high before this fifteenth SCLK edge, the control register will not be loaded and the power-down status of the part will not change.

**MICROPROCESSOR INTERFACING**

The AD7814’s serial interface allows for easy interface to most microcomputers and microprocessors. Figures 3 through 6 show some typical interface circuits.

The serial interface on the AD7814 consists of four wires: *CS*, DIN, DOUT, and SCLK. All interface circuits shown utilize all four interface lines. However, it is possible to operate the inter- face with three wires. If the application does not require the power-down facility offered by the AD7814, the DIN line can be tied permanently low. Thus, the interface can be operated from just three wires: SCLK, *CS*, and DOUT.

The serial data transfer to and from the AD7814 requires a 16-bit read operation. Many 8-bit microcontrollers have 8-bit serial ports and this 16-bit data transfer is handled as two 8-bit transfers. Other microcontrollers and DSP processors transfer 16 bits of data in a serial data operation.

**\*ADDITIONAL PINS OMITTED FOR CLARITY**

Figure 3. AD7814 to MC68HC11 Interface

**AD7814 to 8051 Interface**

An interface circuit between the AD7814 and the 8051 micro- controller is shown in Figure 4. The 8xC51 is configured in its Mode 0 serial interface mode. The serial clock line of the 8xC51 (on P3.1) idles high between data transfers. Data is transferred to and from the AD7814 in two 8-bit serial data operations. The AD7814 outputs the MSB of its data stream as the first valid bit while the 8xC51 expects the LSB first. Thus, the data read into the serial buffer needs to be rearranged before the correct data word from the AD7814 is available in the accumulator.

In the example shown, the AD7814 is connected to the serial port of the 8051. Because the serial interface of the 8xC51 con- tains only one data line, the DIN line of the AD7814 is tied low in the interface example given in Figure 4.

For applications that require the use of the power-down feature of the AD7814, the serial interface should be implemented using data port lines on the 8051. This allows a full-duplex serial interface to be implemented. The method involves ‘bit- banging’ a port line to generate a serial clock while using two other port lines to shift data in and out with the fourth port line connecting to *CS*. Port lines 1.0 through 1.3 (with P1.1 config- ured as an input) can be used to connect to SCLK, DOUT, DIN, and *CS*, respectively, to implement this scheme.

**AD7814\***

**SCLK DOUT DIN CS**

**8051\***

**P3.1 P3.0 P1.2 P1.3**

**AD7814\***

**SCLK DOUT DIN CS**

**ADSP-21xx\***

**SCK DR DT RFS**

**\*ADDITIONAL PINS OMITTED FOR CLARITY**

Figure 4. AD7814 to 8051 Interface

**AD7814 to PIC16C6x/7x Interface**

Figure 5 shows an interface circuit between the AD7814 and the PIC16C6x/7x microcontroller. The PIC16C6x/7x synchronous serial port (SSP) is configured as an SPI master with the clock polarity bit set to a logic one. In this mode, the serial clock line of the PIC16C6x/7x idles high between data transfers. Data is transferred to and from the AD7814 in two 8-bit serial data operations. In the example shown, port line RA1 is being used to generate the *CS* for the AD7814.

**TFS**

**\*ADDITIONAL PINS OMITTED FOR CLARITY**

Figure 6. AD7814 to ADSP-21xx Interface

**MOUNTING THE AD7814**

The AD7814 can be used for surface or air temperature sensing applications. If the device is cemented to a surface with ther- mally conductive adhesive, the die temperature will be within about 0.1°C of the surface temperature, thanks to the device’s low power consumption. Care should be taken to insulate the back and leads of the device from the air, if the ambient air temperature is different from the surface temperature being measured.

**AD7814\***

**SCLK DOUT DIN CS**

**PIC16C6x/7x\***

**SCK SDO SDI RA1**

The ground pin provides the best thermal path to the die, so the temperature of the die will be close to that of the printed circuit ground track. Care should be taken to ensure that this is in good thermal contact with the surface being measured.

As with any IC, the AD7814 and its associated wiring and cir- cuits must be kept free from moisture to prevent leakage and

**\*ADDITIONAL PINS OMITTED FOR CLARITY**

Figure 5. AD7814 to PIC16C6x/7x Interface

**AD7814 to ADSP-21xx Interface**

Figure 6 shows an interface between the AD7814 and the ADSP-21xx DSP processor. To ensure correct operation of the interface, the SPORT control register should be set up as follows:

TFSW = RFSW = 1, Alternate Framing

INVRFS = INVTFS = 1, Active Low Framing Signal

DTYPE = 00, Right Justify Data

SLEN = 1111, 16-Bit Data Words

ISCLK = 1, Internal Serial Clock

TFSR = RFS = 1, Frame Every Word

IRFS = 0, RFS Configured As Input

ITFS = 1, TFS Configured As Output

The interface requires an inverter between the SCLK line of the ADSP-21xx and the SCLK input of the AD7814. The ADSP- 21xx has the TFS and RFS of the SPORT tied together with TFS set as an output and RFS set as an input. The DSP operates in alternate framing mode and the SPORT control register is set up as described earlier.

corrosion, particularly in cold conditions where condensation is more likely to occur. Water-resistant varnishes and conformal coatings can be used for protection. The small size of the AD7814 package allows it to be mounted inside sealed metal probes, which provide a safe environment for the device.

**SUPPLY DECOUPLING**

The AD7814 should be decoupled with a 0.1 µF ceramic capacitor between VDD and GND. This is particularly important if the AD7814 is mounted remotely from the power supply.

**1.0**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

**0.8**

**0.6**

**TEMPERATURE ERROR**

**0.4**

**0.2**

**0**

**–0.2**

**–0.4**

**–55**

**–40 0 25 40 85 100 120**

**TEMPERATURE –** °**C**

Figure 7. Typical Temperature Error

**OUTLINE DIMENSIONS**

**6-Lead Small Outline Transistor Package [SOT-23] (RT-6)**

Dimensions shown in millimeters

**2.90 BSC**

**6 5 4**

**1.60 BSC 2.80 BSC**

**PIN 1 INDICATOR**

**1.30**

**1.15**

**0.90**

**0.15 MAX**

**1 2**

**1.90**

**BSC**

**0.50**

**0.30**

**3**

**0.95 BSC**

**1.45 MAX**

**SEATING PLANE**

**0.22**

**0.08**

**10**°

**4**° **0**°

**0.60**

**0.45**

**0.30**

**COMPLIANT TO JEDEC STANDARDS MO-178AB**

**8-Lead Mini Small Outline Package [MSOP] (RM-8)**

Dimensions shown in millimeters

**3.00 BSC**

**8 5**

**3.00**

**BSC**

**4.90**

**BSC**

**1 4**

**PIN 1**

**0.65 BSC**

**0.15**

**0.00**

**0.38**

**0.22**

**1.10 MAX**

**0.23 8**°

**0**°

**0.08**

**0.80**

**0.60**

**0.40**

**COPLANARITY 0.10**

**SEATING PLANE**

**COMPLIANT TO JEDEC STANDARDS MO-187AA**

C01041–0–8/04(E)

## Revision History

**Location Page**

**8/04—Data Sheet Changed from REV. D to REV. E.**

Changes to ORDERING GUIDE 3

Changes to CONVERTER DETAILS section 5

Changes to Read Operation section 6

Updated OUTLINE DIMENSIONS 8

**5/02—Data Sheet Changed from REV. C to REV. D.**

Updates to SPECIFICATIONS 2