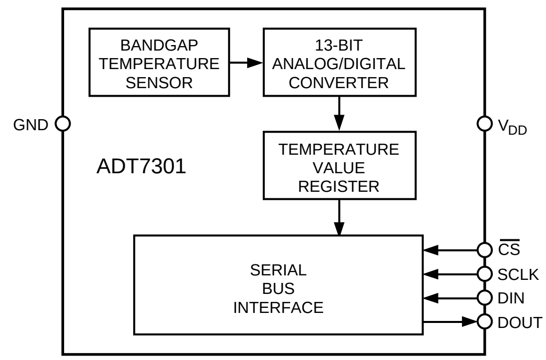
13-Bit, ±0.5°C Accurate, MicroPower Digital Temperature Sensor in 6-Lead SOT-23

Preliminary Technical Data ADT7301

FEATURES
13-Bit Temperature-to-Digital Converter
–40°C to +150°C Operating Temperature Range
Max Temperature of 150°C
±0.5°C Accuracy
0.03125°C Temperature Resolution
Operating Current of 1 µA
SPI- and DSP-Compatible Serial Interface
Shutdown Mode
Space-Saving SOT-23 and microSOIC Packages

APPLICATIONS
Medical Equipment
Automotive
Cell Phone
Hard Disk Drives
Personal Computers
Electronic Test Equipment
Office Equipment
Domestic Appliances
Process Control

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADT7301 is a complete temperature monitoring system available in SOT-23 and MSOP packages. It contains a bandgap temperature sensor and a 13-bit ADC to monitor and digitize the temperature reading to a resolution of +0.03125°C.

The ADT7301 has a flexible serial interface that allows easy interfacing 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 ADT7301'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, automotive and domestic appliances.

PRODUCT HIGHLIGHTS

1. The ADT7301 has an on-chip temperature sensor that allows an accurate measurement of the ambient temperature. The measurable temperature range is –40°C to +150°C.
2. Supply voltage of +2.7 V to +5.5 V.
3. Space-saving 6-lead SOT-23 and 8-lead microSOIC packages.
4. Temperature accuracy of ±0.5°C.
4. 13-bit temperature reading to +0.03125°C resolution.
5. The ADT7301 features a shutdown mode that reduces the power consumption to 4.88 µW with V_{DD} = 3.3 V @ 1 SPS.

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($T_A = T_{MIN}$ to T_{MAX}, V_{DD} = +2.7 V to +5.5 V, unless otherwise noted)

Parameter	Min	Typ	Max	Units	Test Conditions/Comments
TEMPERATURE SENSOR AND ADC					
Accuracy @ V_{DD} = +3.3 V (±10%)		tbd	±0.5	°C	T_A = 0°C to 70°C.
		tbd	±1	°C	T_A = –40°C to +85°C.
		tbd	±2	°C	T_A = –40°C to +125°C.
		tbd	±3[2]	°C	T_A = –40°C to +150°C.
Temperature Resolution		0.03125		°C	
Auto Conversion Update Rate, t_R		1		sec	Temperature measurement every 1 second
Temperature Conversion Time		800		µs	
SUPPLIES					
Supply Voltage	2.7		5.5	V	For Specified Performance
Supply Current					
Normal Mode @ 3.3 V (±10%)		1.6	2.2	mA	Powered up and converting
		190	300	µA	Powered up an not converting
Shutdown Mode @ 3.3V (±10%)		0.2	1	µA	
Power Dissipation					
Normal Mode (Average)		631		µW	V_{DD} = +3.3 V. Auto Conversion Update, t_R
Shutdown Mode (Average)[3]					
1 sps		4.88		µW	V_{DD} = +3.3 V - Shutdown Mode
10 sps		42.9		µW	V_{DD} = +3.3 V - Shutdown Mode
100 sps		423		µW	V_{DD} = +3.3 V - Shutdown Mode
DIGITAL INPUT[4]					
Input High Voltage, V_{IH}	2.4			V	
Input Low Voltage, V_{IL}			0.8	V	
Input Current, I_{IN}			±1	µA	V_{IN} = 0 V to V_{DD}
Input Capacitance, C_{IN}			10	pF	All Digital Inputs
DIGITAL OUTPUT[4]					
Output High Voltage, V_{OH}	V_{DD} – 0.3 V				$I_{SOURCE} = I_{SINK}$ = 200 µA
Output Low Voltage, V_{OL}			0.4	V	I_{OL} = 200 µA
Output Capacitance, C_{OUT}			50	pF	

NOTES

[1] All specifications apply for –40°C to +150°C unless otherwise stated.

[2] It is not recommended to operate the device at temperatures above +125°C for greater than a total of 5% of the lifetime of the device. Any exposure beyond this limit will affect device reliability.

[3] The ADT7301 is taken out of shutdown mode and a temperature conversion is immediately performed after this write operation. Once the temperature conversion is complete the ADT7301 is put back into shutdown mode.

[4] Guaranteed by design and characterization, not production tested.

Specifications subject to change without notice.

Preliminary Technical Data

($T_A = T_{MIN}$ to T_{MAX}, V_{DD} = +2.7 V to +5.5 V, unless otherwise noted)

Parameter	Min	Typ	Max	Units	Test Conditions/Comments
TEMPERATURE SENSOR AND ADC					
Accuracy @ V_{DD} = +5 V (±10%)		tbd	±0.5	°C	T_A = 0°C to 70°C.
		tbd	±1	°C	T_A = –40°C to +85°C.
		tbd	±2	°C	T_A = –40°C to +125°C.
		tbd	±3[2]	°C	T_A = –40°C to +150°C.
Temperature Resolution		0.03125		°C	
Autoconversion Update Rate, t_R		1		sec	Temperature measurement every 1 second
Temperature Conversion Time		800		µs	
SUPPLIES					
Supply Voltage	2.7		5.5	V	For Specified Performance
Supply Current					
Normal Mode @ 5 V (±10%)		1.6	2.2	mA	Powered up and converting
		280	400	µA	Powered up an not converting
Shutdown Mode @ 5 V (±10%)		0.2	1	µA	
Power Dissipation					
Normal Mode (Average)		1.41		mW	V_{DD} = +5 V. Auto Conversion Update, t_R
Shutdown Mode (Average)[3]					
1 sps		7.4		µW	V_{DD} = +5 V - Shutdown Mode
10 sps		65		µW	V_{DD} = +5 V - Shutdown Mode
100 sps		641		µW	V_{DD} = +5 V - Shutdown Mode
DIGITAL INPUT[4]					
Input High Voltage, V_{IH}	2.4			V	
Input Low Voltage, V_{IL}			0.8	V	
Input Current, I_{IN}			±1	µA	V_{IN} = 0 V to V_{DD}
Input Capacitance, C_{IN}			10	pF	All Digital Inputs
DIGITAL OUTPUT[4]					
Output High Voltage, V_{OH}	V_{DD} – 0.3 V				$I_{SOURCE} = I_{SINK}$ = 200 µA
Output Low Voltage, V_{OL}			0.4	V	I_{OL} = 200 µA
Output Capacitance, C_{OUT}			50	pF	

NOTES

[1] All specifications apply for –40°C to +150°C unless otherwise stated.

[2] It is not recommended to operate the device at temperatures above +125°C for greater than a total of 5% of the lifetime of the device. Any exposure beyond this limit will affect device reliability.

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[4] Guaranteed by design and characterization, not production tested.

Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS[1]

V_{DD} to GND . . . . –0.3 V to +7 V
Digital Input Voltage to GND . . . . –0.3 V to V_{DD} + 0.3 V
Digital Output Voltage to GND . . . . . –0.3 V to V_{DD} + 0.3 V
Operating Temperature Range[2] . . . . . –40°C to +150°C
Storage Temperature Range . . . . –65°C to +150°C
Junction Temperature . . . . +150°C
6-Lead SOT-23 (RJ-6) . . . .
  Power Dissipation[3] . . . . $W_{MAX} = (T_{JMAX} - T_A{}^4)/\theta_{JA}$
  Thermal Impedance
    θ_{JA}, Junction-to-Ambient (still air) . . . 190.4°C/W
8-Lead MSOP (RM-8) . . . .
  Power Dissipation[3] . . . . $W_{MAX} = (T_{JMAX} - T_A{}^4)/\theta_{JA}$
  Thermal Impedance[5]
    θ_{JA}, Junction-to-Ambient (still air) . . . 205.9°C/W
    θ_{JC}, Junction-to-Case . . . . 43.74°C/W
IR Reflow Soldering
    Peak Temperature . . . . +220°C (-0/+5°C)
    Time at Peak Temperature . . . . 10 to 20 secs
    Ramp-up Rate . . . . 2-3°C/sec
    Ramp-down Rate . . . . -6°C/sec

[1] 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.

[2] It is not recommended to operate the device at temperatures above +125°C for greater than a total of 5% of the lifetime of the device. Any exposure beyond this limit will affect device reliability.

[3] Values relate to package being used on a standard 2-layer pcb. Reference Figure 2. for a plot of max power dissipation vs. ambient temperature (T_A).

[4] T_A = Ambient Temperature.

[5] Junction-to-Case resistance is applicable to components featuring a preferential flow direction, eg. components mounted on a heat sink. Junction-to-Ambient resistance is more useful for air-cooled PCB-mounted components.

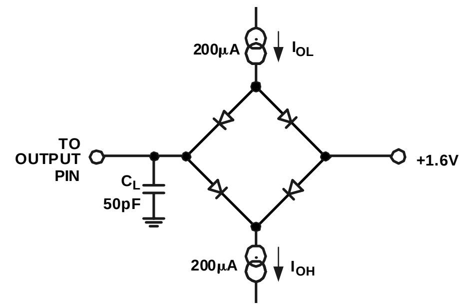


Figure 1. Load Circuit for Data Access Time and Bus Relinquish Time

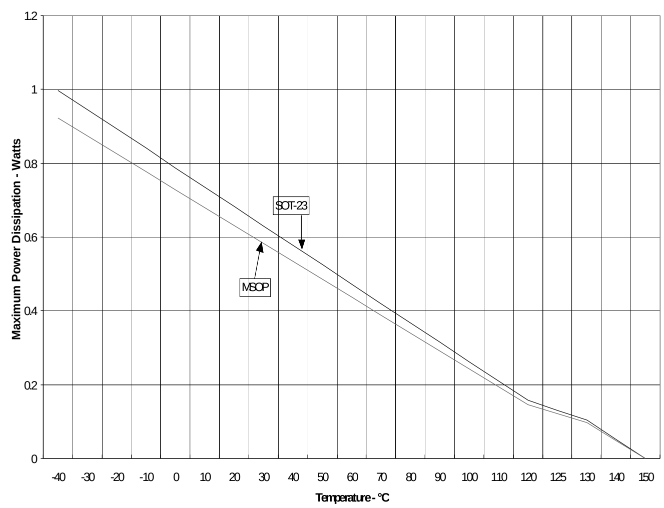


Figure 2. Plot of Maximum Power Dissipation vs. Temperature

TIMING CHARACTERISTICS[1, 2, 3]

($T_A = T_{MIN}$ to T_{MAX}, V_{DD} = +2.7 V to +5.5 V, unless otherwise noted)

Parameter	Limit	Units	Comments
t_1	5	ns min	$\overline{CS}$ to SCLK Setup Time
t_2	25	ns min	SCLK High Pulsewidth
t_3	25	ns min	SCLK Low Pulsewidth
t_4[4]	35	ns max	Data Access Time After SCLK Falling Edge
t_5	20	ns min	Data Setup Time Prior to SCLK Rising Edge
t_6	5	ns min	Data Hold Time After SCLK Rising Edge
t_7	5	ns min	$\overline{CS}$ to SCLK Hold Time
t_8[4]	40	ns max	$\overline{CS}$ to DOUT High Impedance

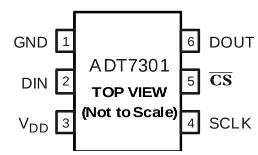
NOTES
[1] Guaranteed by design and characterization, not production tested.
[2] All input signals are specified with tr = tf = 5 ns (10% to 90% of V_{DD}) and timed from a voltage level of 1.6 V.
[3] See Figure 2.
[4] Measured with the load circuit of Figure 1.

PIN FUNCTION DESCRIPTION

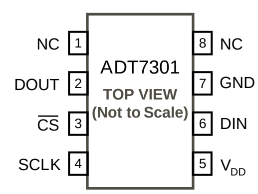
Pin Mnemonic	SOT-23 Pin No.	Description
GND	1	Analog and Digital Ground.
DIN	2	Serial Data Input. Serial data to be loaded to the part's control register is provided on this input. Data is clocked into the control register on the rising edge of SCLK.
V_{DD}	3	Positive Supply Voltage, +2.7 V to +5.5 V.
SCLK	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 ADT7301 and also to clock data into the control register on the part.
$\overline{CS}$	5	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	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.

PIN CONFIGURATIONS

SOT-23



MSOP



ORDERING GUIDE

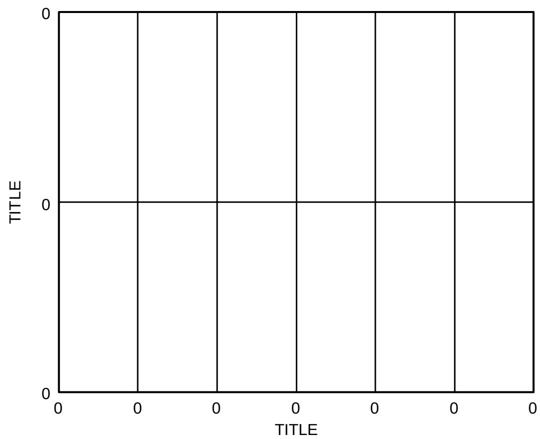
Model	Temperature Range	Temperature Accuracy*	Package Description	Samples Branding Information	Package Option
ADT7301-3.3BRT	–40°C to +150°C	±0.5°C	6-Lead SOT-23	TCS	RJ-6
ADT7301-3.3BRM	–40°C to +150°C	±0.5°C	8-Lead MSOP	TCS	RM-8
ADT7301-5BRT	–40°C to +150°C	±0.5°C	6-Lead SOT-23		RJ-6
ADT7301-5BRM	–40°C to +150°C	±0.5°C	8-Lead MSOP		RM-8

*Temperature accuracy is over 0°C to +70°C temperature range.

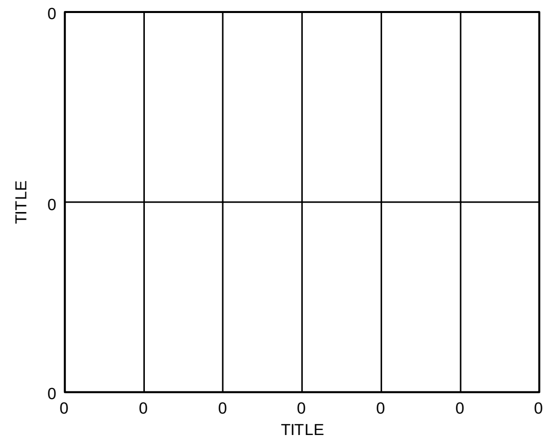
CAUTION

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 ADT7301 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.

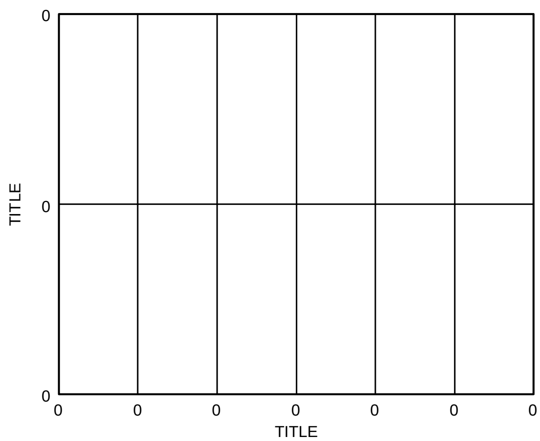
TYPICAL PERFORMANCE CURVES



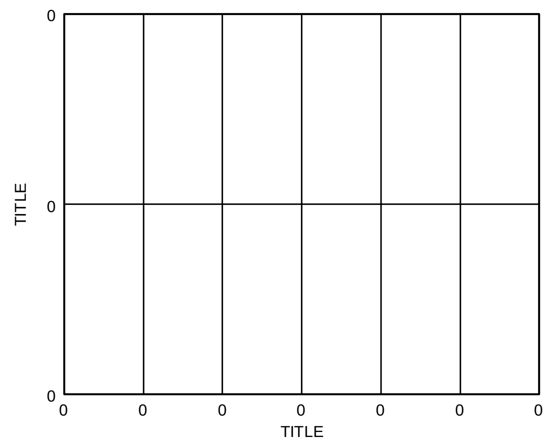
TPC 1. Temperature Accuracy @ 3.3 V and 5 V



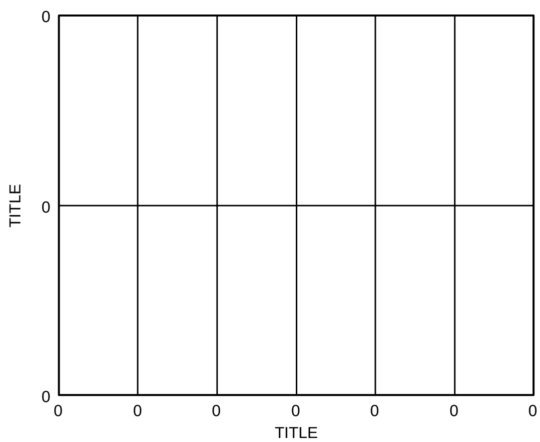
TPC 2. Operating Supply Current vs Temperature



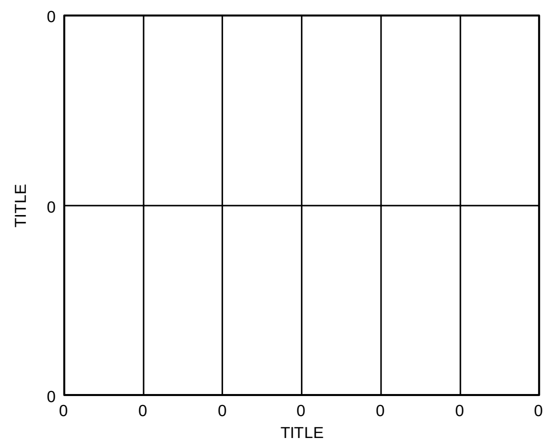
TPC 3. Operating Supply Current vs Supply Voltage



TPC 4. Power-Down Current vs Supply Voltage



TPC 5. Temperature Accuracy vs Supply Ripple Frequency



TPC 6. Response to Thermal Shock

CIRCUIT INFORMATION

The ADT7301 is a 13-bit digital temperature sensor with a 14th bit as a sign bit. The part houses an on-chip temperature sensor, a 13-bit A/D converter, a reference circuit and serial interface logic functions in SOT-23 and MSOP packages. 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 specified measurement range of the ADT7301 is –40°C to +150°C. At +150°C the ADT7301 is limited to 5% of it's +55°C operational life time. The structural integrity of the device will start to deteriorate when operated at voltage and temperature maximum specifications.

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 an automatic conversion sequence. During this automatic conversion sequence a conversion is initiated every 1 sec. At this time, the part powers up it's analog circuitry and performs a temperature conversion. This temperature conversion typically takes 800 µs, after which time the analog circuitry of the part automatically shuts down. The analog circuitry powers up again when the 1 sec timer times out and the next conversion begins. The result of the most recent temperature conversion is always available in the serial output register as the serial interface circuitry never shuts down.

The ADT7301 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 ADT7301 is taken out of shutdown mode. The ADT7301 can be taken out of shutdown mode by writing all zeros into the control register. The conversion result from the last conversion prior to shutdown can still be read from the ADT7301 even when it is in shutdown mode.

In the normal conversion mode, every time a read or write operation takes place the internal clock oscillator is reset at the end of the read or write operation. This causes the device to start a temperature conversion and the result is typically available 800 µs later. Similarly, when the part is taken out of shutdown mode, the internal clock oscillator is started and a conversion is initiated. The conversion result is available typically 800 µs later. Reading from the device before a conversion is complete will cause the ADT7301 to stop converting and only start again when serial communitation is finished. This read operation will provide the previous result.

TEMPERATURE VALUE REGISTER

The temperature value register is a 14-bit read-only register that stores the temperature reading from the ADC in 13-bit twos complement format plus a sign bit. The MSB (DB13) is the sign bit. The ADC can theoretically measure a temperature span of 255 °C. The internal temperature sensor is guaranteed to a low value limit of -40 °C and a high limit of +150 °C. The temperature data format is shown in Table I. This table shows the temperature measurement range of the device (–40°C to +150°C). A typical performance curve is shown in TPC 1.

Table I. Temperature Data Format

Temperature	Digital Output DB13 . . . DB0
–40°C	11, 1011 0000 0000
–30°C	11, 1100 0100 0000
–25°C	11, 1100 1110 0000
–10°C	11, 1110 1100 0000
-0.03125°C	11, 1111 1111 1111
0°C	00, 0000 0000 0000
+0.03125°C	00, 0000 0000 0001
+10°C	00, 0001 0100 0000
+25°C	00, 0011 0010 0000
+50°C	00, 0110 0100 0000
+75°C	00, 1001 0110 0000
+100°C	00, 1100 1000 0000
+125°C	00, 1111 1010 0000
+150°C	01, 0010 1100 0000

Temperature Conversion Formula:

1. Positive Temperature = ADC Code(d)/32

2. Negative Temperature = (ADC Code*(d) - 16384)/32
*Using all 14 bits of the data byte, includes the sign bit.

Negative Temperature = (ADC Code(d)* - 8192)/32
*DB13 (sign bit) is removed from the ADC Code

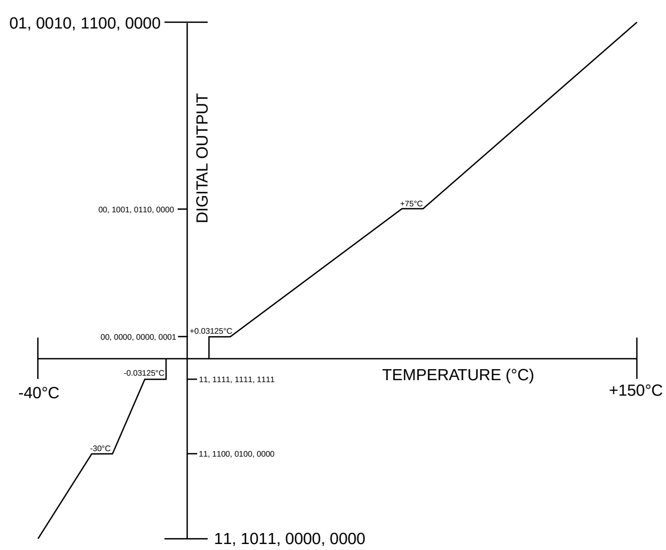


Figure 2. Temperature to Digital Transfer Function

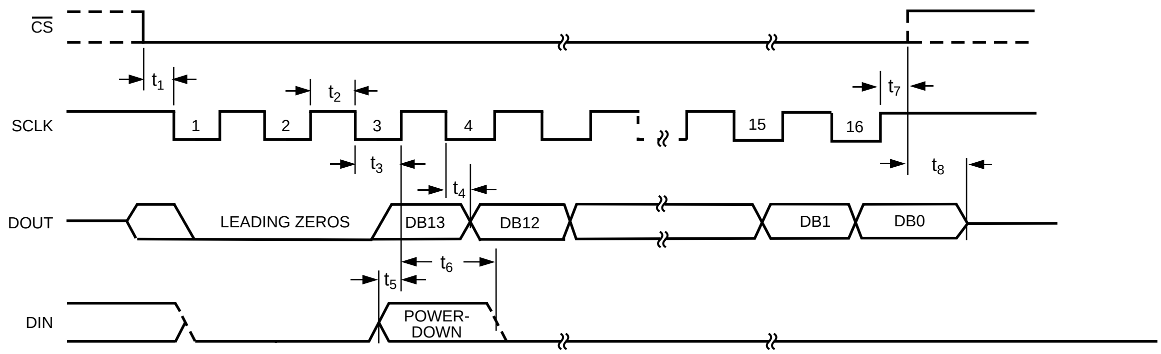


Figure 3. Serial Interface Timing Diagram

SERIAL INTERFACE

The serial interface on the ADT7301 consists of four wires, $\overline{CS}$, SCLK, DIN and DOUT. The interface can be operated in 2-wire mode with $\overline{CS}$ and DIN tied to Ground, in which case the interface has read-only capability, with data being read from the data register via the DOUT line. It is advisable to utilise $\overline{CS}$ so as to improve synchronisation between the ADT7301 and the master device.The DIN line is used to write the part into standby mode, if required. The $\overline{CS}$ 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 ADT7301 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 ADT7301 accesses data from the Temperature Value Register while a write operation to the part writes data to the Control Register.

Read Operation

Figure 3 shows the timing diagram for a serial read from the ADT7301. The $\overline{CS}$ line enables the SCLK input. Thirteen bits of data plus a sign bit are transferred during a read operation. Read operations occur during streams of 16 clock pulses. The first two bits out are Leading Zeros and the next fourteen bits contain the temperature data. If $\overline{CS}$ remains low and sixteen more SCLK cycles are applied then the ADT7301 loops around and outputs the two leading zeros plus the 14 bits of data that are in the temperature value register. When the $\overline{CS}$ returns high the DOUT line goes into three-state. Data is clocked out onto the DOUT line on the falling edge of SCLK.

Write Operation

Figure 3 also shows the timing diagram for a serial write to the ADT7301. The write operation takes place at the same time as the read operation. 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 ADT7301 into shutdown mode. Besides the power-down bit all bits in the input data stream should be zero so as to ensure correct operation of the ADT7301. Data is loaded into the Control Register on the sixteenth rising 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 $\overline{CS}$ is brought high before this sixteenth SCLK edge, the Control Register will not be loaded and the power-down status of the part will not change. Data is clocked into the ADT7301 on the rising edge of SCLK.

MICROPROCESSOR INTERFACING

The ADT7301's serial interface allows for easy interface to most microcomputers and microprocessors. Figures 4 through 7 show some typical interface circuits.

The serial interface on the ADT7301 consists of four wires: $\overline{CS}$, DIN, DOUT and SCLK. All interface circuits shown utilize all four interface lines. However, it is possible to operate the interface with three wires. If the application does not require the power-down facility offered by the ADT7301, the DIN line can be tied permanently low. Thus, the interface can be operated from just three wires, SCLK, $\overline{CS}$, and DOUT.

The serial data transfer to and from the ADT7301 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.

ADT7301 to MC68HC11 Interface

Figure 4 shows an interface between the ADT7301 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 configured like this, its SCLK line idles high between data transfers. Data is transferred to and from the ADT7301 in two 8-bit serial data operations. The diagram shows the full (four-wire) interface. PC1 of the MC68HC11 is configured as an output and used to drive the $\overline{CS}$ input.

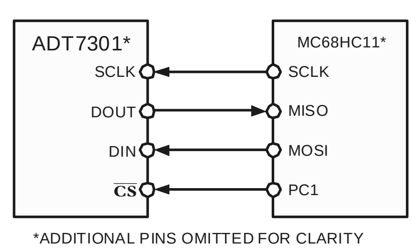


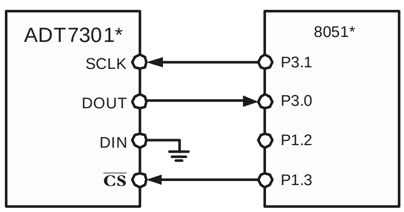
Figure 4. ADT7301 to MC68HC11 Interface

ADT7301 to 8051 Interface

An interface circuit between the ADT7301 and the microcontroller is shown in Figure 5. 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 ADT7301 in two 8-bit serial data operations. The ADT7301 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 ADT7301 is available in the accumulator.

In the example shown, the ADT7301 is connected to the serial port of the 8051. Because the serial interface of the 8xC51 contains only one data line, the DIN line of the ADT7301 is tied low in the interface example given in Figure 5.

For applications that require the use of the power-down feature of the ADT7301, 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 $\overline{CS}$. Port lines 1.0 through 1.3 (with P1.1 configured as an input) can be used to connect to SCLK, DOUT, DIN and $\overline{CS}$, respectively, to implement this scheme.

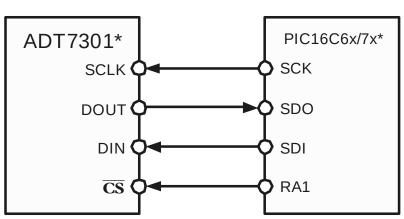


*ADDITIONAL PINS OMITTED FOR CLARITY

Figure 5. ADT7301 to 8051 Interface

ADT7301 to PIC16C6x/7x Interface

Figure 6 shows an interface circuit between the ADT7301 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 ADT7301 in two 8-bit serial data operations. In the example shown, port line RA1 is being used to generate the $\overline{CS}$ for the ADT7301.



*ADDITIONAL PINS OMITTED FOR CLARITY

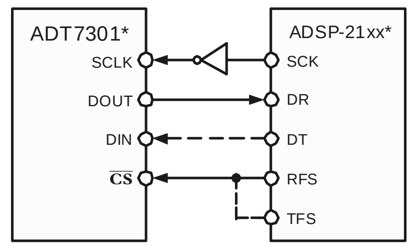
Figure 6. ADT7301 to PIC16C6x/7x Interface

ADT7301 to ADSP-21xx Interface

Figure 7 shows an interface between the ADT7301 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 ADT7301. 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 above.



*ADDITIONAL PINS OMITTED FOR CLARITY

Figure 7. ADT7301 to ADSP-21xx Interface

MOUNTING THE ADT7301

The ADT7301 can be used for surface or air-temperature sensing applications. If the device is cemented to a surface with thermally 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.

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 ADT7301 and its associated wiring and circuits must be kept free from moisture to prevent leakage and 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 ADT7301 package allows it to be mounted inside sealed metal probes, which provide a safe environment for the device.

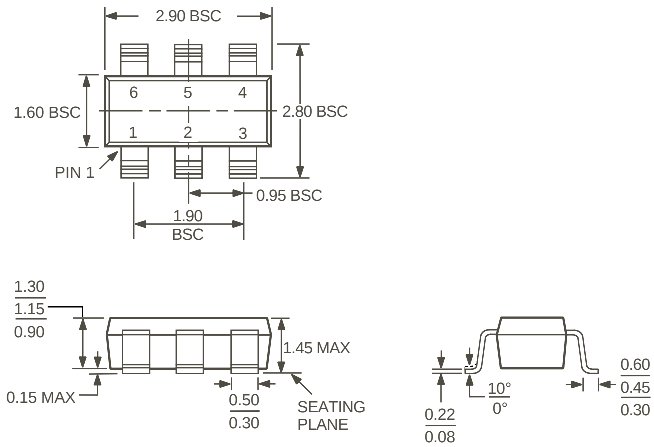
SUPPLY DECOUPLING

The ADT7301 should be decoupled with a 0.1 µF ceramic capacitor between V_{DD} and GND. This is particularly important if the ADT7301 is mounted remote from the power supply.

OUTLINE DIMENSIONS

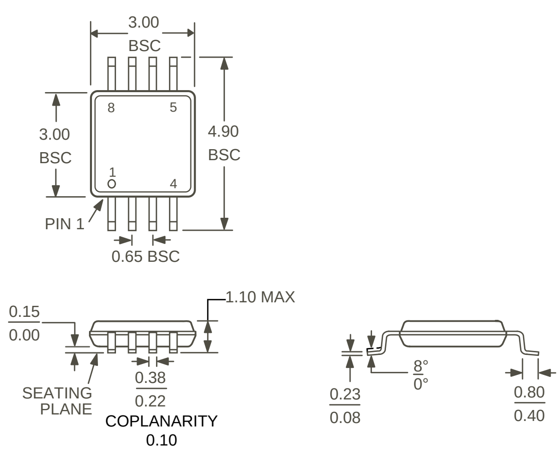
Dimensions shown in millimeters.

6-Lead Plastic Surface Mount SOT-23 (RJ-6)



COMPLIANT TO JEDEC STANDARDS MO-178AB

8-Lead Plastic Surface Mount Mini/Micro SOIC (MSOP) (RM-8)



COMPLIANT TO JEDEC STANDARDS MO-187AA