T₇m ₇a ₇S₇0 ad Vo ag₇Mo o S_M ₇S₇ a Ta o

The ADT7485A is a digital temperature sensor and voltage monitor for use in PC applications with Simple Serial Transport (SST) interface. It can monitor its own temperature as well as the temperature of a remote sensor diode. It can also monitor four external voltage channels and its own supply voltage. The ADT7485A is controlled by a single SST bidirectional data line. This device is a fixed-address SST client where the target address is chosen by the state of the address pin, ADD.

Features

On-Chip Temperature Sensor
Remote Temperature Sensor
Monitors Up to 5.0 Voltages
SST Interface
This Device is Pb-Free, Halogen Free and is RoHS Compliant

Applications

Personal Computers Portable Personal Devices Industrial Sensor Nets



TEMPERATURE SENSOR

INPUT ATTENUATORS

AND

ANALOG MULTIPLEXER TEMPERATURE VALUE REGISTERS

A/D CONVERTER

> VOLTAGE VALUE REGISTERS

Figure 1. Functional Block Diagram

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Table 1. PIN ASSIGNMENT

Pin No.	Mnemonic	Туре	Description
1	V _{CC}	Power Supply	3.3 V 10%. V _{CC} is also Monitored through this Pin
2	GND	Ground	Ground Pin
3	D1+	Analog Input	Positive Connection to Remote 1 Temperature Sensor
4	D1–	Analog Input	Negative Connection to Remote 1 T

Table 4. ELECTRICAL CHARACTERISTICS

(T_A = T_{MIN} to T_{MAX}, V_{CC} = V_{MIN} to V_{MAX}

TYPICAL PERFORMANCE CHARACTERISTICS



Figure 2. SST O/P Level vs. Supply Voltage



Figure 4. Local Temperature Error



Figure 3. Supply Current vs. Temperature



Figure 5. SST O/P Level vs. Temperature

Figure 6. Supply Current vs. Voltage

Figure 7. Remote Temperature Error

Table 7. 16-BYTE DIB DETAILS

Byte	Name	Value	Description
0	Device Capabilities	0xc0	Fixed Address Device
1	Version/Revision	0x10	Meets Version 1 of SST Specification
2, 3	Vendor ID	00x11d4	Contains Company

Voltage Channel	Full-scale Voltage		
12 V	16 V		
5.0 V	8.0 V		
V _{CC}	4.0 V		
2.5 V	4.0 V		
V _{CCP}	4.0 V		

Table 10. MAXIMUM REPORTED INPUT VOLTAGES

Input Circuitry

The internal structure for the analog inputs is shown in Figure 14. The input circuit consists of an input protection diode and an attenuator, plus a capacitor that forms a first-order, low-pass filter to provide input immunity to high frequency noise.



Figure 14. Internal Structure of Analog Inputs

biased above ground by an internal diode at the D1 input. If the sensor is operating in an extremely noisy environment, C1 can be added as a noise filter. Its value should not exceed 1,000 pF.



*CAPACITOR C1 IS OPTIONAL. IT SHOULD ONLY BE USED IN NOISY ENVIRONMENTS.

Figure 15. Signal Conditioning for Remote Diode Temperature Sensors

To measure ΔV_{BF} , the operating current through the sensor is switched between three related currents. Figure 15 shows N1 I and N2 I as different multiples of the current I. The currents through the temperature diode are switched between I and N1 I, giving ΔV_{BE1} , and then between I and N2 I, giving ΔV_{BE2} . The temperature can then be calculated using the two ΔV_{BE} measurements. This method can also cancel the effect of series resistance on the temperature measurement. The resulting ΔV_{BE} waveforms are passed through a 65 kHz low-pass filter to remove noise and then through a chopper-stabilized amplifier to amplify and rectify the waveform, producing a dc voltage proportional to ΔV_{BE} . The ADC digitizes this voltage, and a temperature measurement is produced. To reduce the effects of noise, digital filtering is performed by averaging the results of 16 measurement cycles for low conversion rates. Signal conditioning and measurement of the internal temperature sensor is performed in the same manner.

Reading Temperature Measurements

The temperature data returned is two bytes in little endian format, that is, LSB before MSB. All temperatures can be read together by using Command Code 0x00 with a read length of 0x04. The command codes and returned data are described in Table 14.

Table 14. TEMPERATURE CHANNEL COMMAND CODES

Temp Channel	Command Code	Returned Data
Internal	0x00	LSB, MSB
External	0x01	



Figure 16. Connections for NPN and PNP Transistors

The ADT7485A shows an external temperature value of 0x8000 if the external diode is an open or short circuit.

Layout Considerations

Digital boards can be electrically noisy environments. Take the following precautions to protect the analog inputs from noise, particularly when measuring the very small voltages from a remote diode sensor:

- 1. Place the ADT7485A as close as possible to the remote sensing diode. Provided that the worst noise sources, such as clock generators, data/address buses, and CRTs, are avoided, this distance can be four to eight inches.
- 2. Route the D1+ and D1 tracks close together in parallel with grounded guard tracks on each side. Provide a ground plane under the tracks if possible.
- 3. Use wide tracks to minimize inductance and reduce noise pickup. A 5 mil track minimum width and spacing is recommended.





4. Try to minimize the number of copper/solder joints, which can cause thermocouple effects. Where copper/solder joints are used, make sure that they are in both the D1+ and D1 paths and are at the same temperature.

- 5. Thermocouple effects should not be a major problem because 1 C corresponds to about $240 \,\mu$ V, and thermocouple voltages are about $3 \,\mu$ V/ C of the temperature difference. Unless there are two thermocouples with a big temperature differential between them, thermocouple voltages should be much less than 200 mV.
- 6. Place a 0.1 μF bypass capacitor close to the ADT7485A.
- 7. If the distance to the remote sensor is more than eight inches, the use of a twisted pair cable is recommended. This works for distances of about 6 feet to 12 feet.
- 8. For very long distances (up to 100 feet), use shielded twisted pair cables, such as Belden #8451 microphone cables. Connect the twisted pair cable to D+ and D and the shield to GND, close to the ADT7485A. Leave the remote end of the shield unconnected to avoid ground loops.

Because the measurement technique uses switched current sources, excessive cable and/or filter capacitance can affect the measurement. When using long cables, the filter capacitor can be reduced or removed. Cable resistance can also introduce errors. A 1 Ω series resistance introduces about 0.5 C error.

Temperature Offset

As CPUs run faster, it is more difficult to avoid high frequency clocks when routing the D+ and D tracks around a system board. Even when the recommended layout guidelines are followed, there may still be temperature errors, attributed to noise being coupled onto the D+ and D lines. High frequency noise generally has the effect of producing temperature measurements that are consistently too high by a specific amount. The ADT7485A has temperature offset command code of 0xe0 through which a desired offset can be set. By doing a one-time calibration of the system, the offset caused by system board noise can be calculated and nulled by specifying it in the ADT7485A. The offset is automatically added to every temperature measurement. The maximum offset is 128 C with 0.25 C resolution. The offset format is the same as the temperature data format; 16-bit, twos complement notation, as shown in Table 15. The offset should be programmed in little endian format, that is, LSB before MSB. The offset value is also returned in little endian format when read.

Table 16. ORDERING INFORMATION

Device Order Number*	Package Type	Package Option	Shipping [†]
ADT7485AARMZ-R	10-lead MSOP	RM-10	3,000 Tape & Reel

+For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

*This is Pb-Free package.