



# SOT23 Local Temperature Comparators with SMBus Serial Interface

MAX1755/MAX1756

## General Description

The MAX1755/MAX1756 are temperature monitors with  $\pm 3^{\circ}\text{C}$  accuracy, each with a built-in comparator and SMBus™-controlled variable trip threshold. This DAC-programmable threshold allows specific thermal zones and system responses to overtemperature conditions to be adjusted under software control. The MAX1755/MAX1756 feature serial programmability, low cost, wide supply-voltage range, and a tiny package.

The MAX1755 has a self-clearing thermostat output ( $\overline{\text{OVERT}}$ ), and the MAX1756 has a latched interrupt output ( $\overline{\text{ALERT}}$ ). A variety of slave addresses allow for up to six devices per system (Table 3).

The MAX1755 has  $4^{\circ}\text{C}$  of built-in hysteresis. The MAX1756 detects both low-to-high and high-to-low temperature transitions within an  $8^{\circ}\text{C}$  temperature window. This arrangement supports “windowing” algorithms where the comparison threshold is reprogrammed “on-the-fly.”

The MAX1755/MAX1756 are offered in the 6-pin SOT23 package and are specified over the  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  temperature range. For other temperature sensors with SMBus interfaces, refer to the MAX1617, MAX1618, MAX1668, and MAX1805 data sheets.

## Applications

Local Temperature Monitoring  
Desktop Computers  
Notebook Computers  
Servers  
Workstations  
Memory Modules  
Multichip Modules  
Industrial Control Systems  
Automotive

*Pin Configurations appear at end of data sheet.*

*SMBus is a trademark of Intel Corp.*

## Features

- ◆ Programmable Temperature Threshold
- ◆ Built-In Hysteresis
- ◆ SMBus 2-Wire Serial Interface
- ◆  $\overline{\text{OVERT}}$  Thermostat Output (MAX1755)
- ◆  $\overline{\text{ALERT}}$  Interrupt Output (MAX1756)
- ◆ Threshold Accuracy
  - $\pm 3^{\circ}\text{C}$  ( $+25^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$ )
  - $\pm 5^{\circ}\text{C}$  ( $0^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ )
- ◆ 200 $\mu\text{A}$  (max) Supply Current
- ◆ +2.375V to +5.5V Supply Range
- ◆ Tiny 6-Pin SOT23 Package

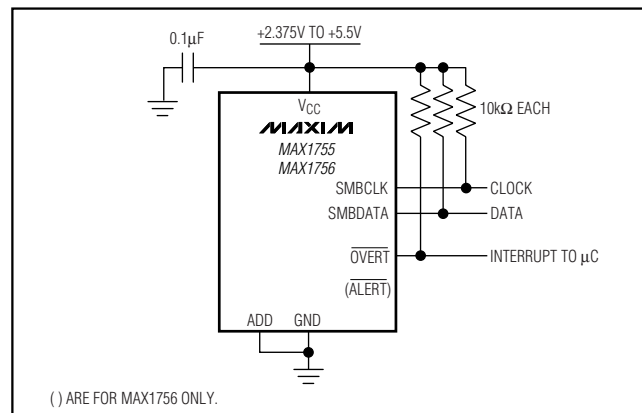
## Ordering Information

PART*	TEMP RANGE	PIN-PACKAGE	TOP MARK
MAX1755AAUT-T	$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	6 SOT23-6	AANM
MAX1755BAUT-T	$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	6 SOT23-6	AANL
MAX1756AAUT-T	$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	6 SOT23-6	AANO
MAX1756BAUT-T	$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	6 SOT23-6	AANL

\*A and B suffixes on these devices select different combinations of slave addresses. See Table 3 to determine the appropriate suffix.

**Note:** Requires a special solder temperature profile described in the Absolute Maximum Ratings section.

## Typical Operating Circuit



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## ABSOLUTE MAXIMUM RATINGS (Note 1)

V<sub>CC</sub> to GND .....-0.3V to +6V  
 ADD to GND .....-0.3V to (V<sub>CC</sub> + 0.3V)  
 SMBCLK, SMBDATA, ALERT, OVERT to GND .....-0.3V to +6V  
 SMBDATA, ALERT, OVERT Current.....-1mA to +50mA

Continuous Power Dissipation (T<sub>A</sub> = +70°C)  
 6-Pin SOT23 (derate 9.1mW/°C above +70°C).....727mW  
 Operating Temperature Range (extended).....-40°C to +125°C  
 Junction Temperature .....+150°C  
 Storage Temperature Range .....-65°C to +150°C

**Note 1:** This device is constructed using a unique set of packaging techniques that impose a limit on the thermal profile to which the device can be exposed during board-level solder attach and rework. The limit permits the use of only the solder profiles recommended in the industry-standard specification, JEDEC 020A, paragraph 7.6, Table 3 for IR/VPR and Convection reflow. Preheating is required. Hand or wave soldering is not allowed.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

(V<sub>CC</sub> = +3.3V, T<sub>A</sub> = 0°C to +125°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
<b>TEMPERATURE COMPARATOR AND POWER SUPPLY</b>					
DAC Resolution (Note 3)	Monotonicity guaranteed	2			°C
Temperature Comparison Error	T <sub>A</sub> = +25°C to +100°C	-3		+3	°C
	T <sub>A</sub> = 0°C to +125°C	-5		+5	
Temperature Hysteresis	With respect to temperature comparison value (MAX1755)	-4.5	-4	-3.5	°C
Temperature Window	Lower threshold with respect to temperature comparison value (MAX1756)	-9	-8	-7	
Sampling Frequency		0.50	1	2.00	kHz
Supply Voltage Range		2.375		5.5	V
Undervoltage Lockout Threshold	V <sub>CC</sub> input, rising edge	2.05	2.2	2.35	V
Undervoltage Lockout Hysteresis			30		mV
Power-On Reset Threshold	V <sub>CC</sub> , falling edge	0.2	1.7	2.3	V
Operating Supply Current	SMBus static, logic inputs forced to V <sub>CC</sub> or GND		85	200	μA
Standby Supply Current	SMBus static, logic inputs forced to V <sub>CC</sub> or GND		0.8	4	μA
ADD Input High Voltage		0.8 × V <sub>CC</sub>			V
ADD Input Low Voltage				0.2 × V <sub>CC</sub>	V
<b>SMBus INTERFACE</b>					
Logic Input High Voltage	SMBCLK, SMBDATA; V <sub>CC</sub> = 2.7V to 5.5V	2.1			V
Logic Input Low Voltage	SMBCLK, SMBDATA; V <sub>CC</sub> = 2.7V to 5.5V			0.8	V
SMBus Output Low Sink Current	SMBDATA forced to 0.4V; V <sub>CC</sub> = 2.7V to 5.5V	6			mA
ALERT, OVERT Output Low Sink Current	Pin forced to 0.4V	6			mA
ALERT, OVERT Output High Leakage Current	Pin forced to 5.5V			1	μA
Logic Input Current (ADD, SMBCLK, SMBDATA)	Inputs forced to V <sub>CC</sub> or GND	-1		+1	μA
SMBus Input Capacitance	SMBCLK, SMBDATA			5	pF
SMBus Clock Frequency	(Note 4)	DC		100	kHz
SMBCLK Clock Low Time	t <sub>LOW</sub> , 10% to 10% points, V <sub>CC</sub> = 2.7V to 5.5V	4.7			μs
SMBCLK Clock High Time	t <sub>HIGH</sub> , 90% to 90% points, V <sub>CC</sub> = 2.7V to 5.5V	4			μs
SMBus Rise Time	SMBCLK, SMBDATA; 10% to 90% points, V <sub>CC</sub> = 2.7V to 5.5V			1	μs

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MAX1755/MAX1756

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{CC} = +3.3V$ ,  $T_A = 0^{\circ}C$  to  $+125^{\circ}C$ , unless otherwise noted. Typical values are at  $T_A = +25^{\circ}C$ .) (Note 2)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
SMBus Fall Time	SMBCLK, SMBDATA; 90% to 10% points, $V_{CC} = 2.7V$ to $5.5V$			300	ns
SMBus Start Condition Setup Time	$V_{CC} = 2.7V$ to $5.5V$	4.7			$\mu s$
SMBus Repeated Start Condition Setup Time	$t_{SU:STA}$ , 90% to 90% points, $V_{CC} = 2.7V$ to $5.5V$	250			ns
SMBus Start Condition Hold Time	$t_{HD:STA}$ , 10% of SMBDATA to 90% of SMBCLK, $V_{CC} = 2.7V$ to $5.5V$	4			$\mu s$
SMBus Stop Condition Setup Time	$t_{SU:STO}$ , 90% of SMBCLK to 10% of SMBDATA; $V_{CC} = 2.7V$ to $5.5V$	4			$\mu s$
SMBus Data Valid to SMBCLK Rising-Edge Time	$t_{SU:DAT}$ , 10% or 90% of SMBDATA to 10% of SMBCLK; $V_{CC} = 2.7V$ to $5.5V$	250			ns
SMBus Data Hold Time (Master Transmitter)	$t_{HD:DAT}$ , $V_{CC} = 2.7V$ to $5.5V$	0			$\mu s$
SMBus Data Hold Time (Slave Transmitter)	$t_{HD:DAT}$ , $V_{CC} = 2.7V$ to $5.5V$	300			ns

## ELECTRICAL CHARACTERISTICS

( $V_{CC} = +3.3V$ ,  $T_A = -40^{\circ}C$  to  $+125^{\circ}C$ , unless otherwise noted.) (Note 2)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
<b>TEMPERATURE COMPARATOR AND POWER SUPPLY</b>					
DAC Resolution (Note 3)	Monotonicity guaranteed	2			$^{\circ}C$
Temperature Comparison Error		-5		+5	$^{\circ}C$
Temperature Hysteresis	With respect to temperature comparison value (MAX1755)	-4.5		-3.5	$^{\circ}C$
Temperature Window	Lower threshold with respect to temperature comparison value (MAX1756)	-9		-7	
Supply Voltage Range		2.375		5.5	V
Operating Supply Current	SMBus static, logic inputs forced to $V_{CC}$ or GND			200	$\mu A$
<b>SMBus INTERFACE</b>					
SMBus Output Low Sink Current	SMBDATA forced to $0.4V$ ; $V_{CC} = 2.7V$ to $5.5V$	6			mA
$\overline{ALERT}$ , $\overline{OVERT}$ Output Low Sink Current	Pin forced to $0.4V$	6			mA
$\overline{ALERT}$ , $\overline{OVERT}$ Output High Leakage Current	Pin forced to $5.5V$			1	$\mu A$

**Note 2:** Limits are 100% production tested at  $T_A = +25^{\circ}C$ . Limits over operating temperature are guaranteed by design.

**Note 3:** Guaranteed, but not 100% tested.

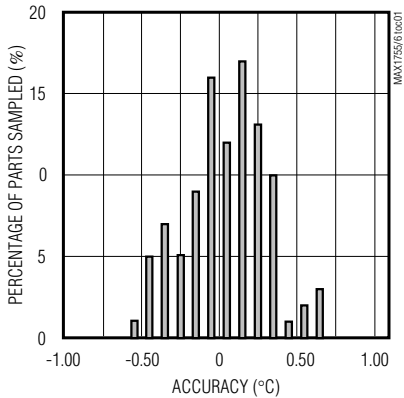
**Note 4:** The SMBus logic block is a static design that works with clock frequencies down to DC. While slow operation is possible, it violates the 10kHz minimum clock frequency and SMBus specifications and may monopolize the bus.

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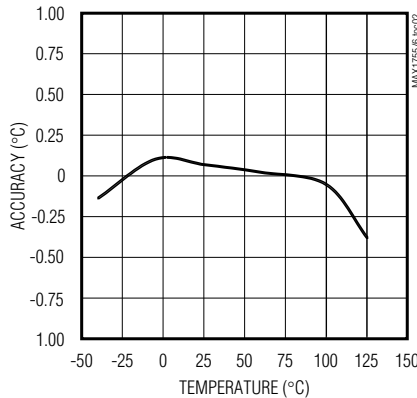
## Typical Operating Characteristics

( $V_{CC} = +3.3V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

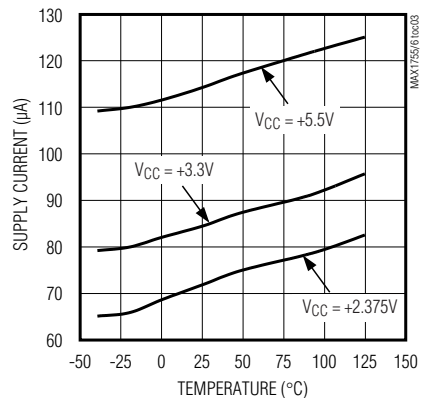
**TRIP THRESHOLD ACCURACY PERCENTAGE OF PARTS SAMPLED vs. ACCURACY**



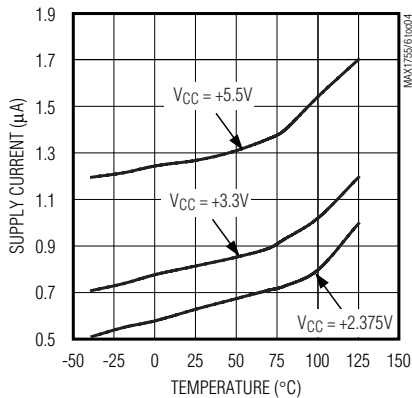
**ACCURACY vs. TEMPERATURE SETTING**



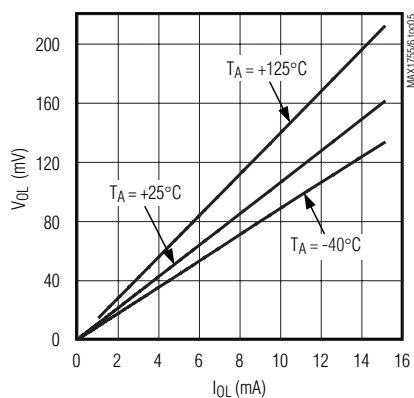
**SUPPLY CURRENT vs. TEMPERATURE**



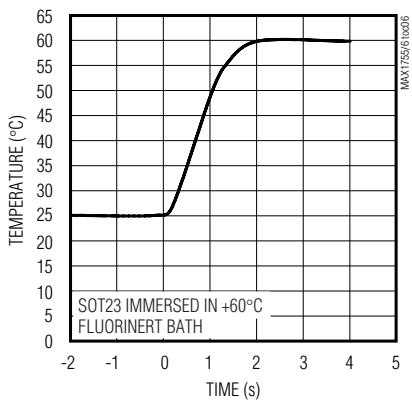
**SUPPLY CURRENT vs. TEMPERATURE (STANDBY)**



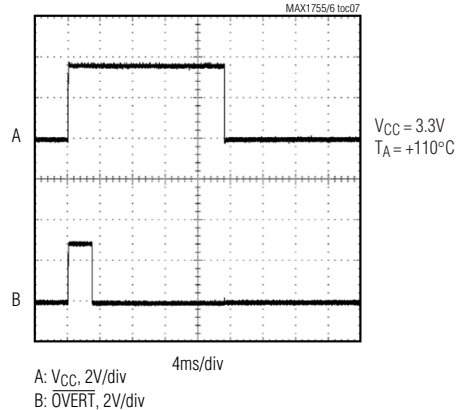
**VOL vs. IOL**



**SOT23 THERMAL STEP RESPONSE**



**STARTUP AND POWER-DOWN**



# SOT23 Local Temperature Comparators with SMBus Serial Interface

MAX1755/MAX1756

## Pin Description

PIN	NAME	FUNCTION
1	ADD	SMBus Address-Select Pin. See Table 3.
2	SMBDATA	SMBus Serial-Data Input/Output, Open Drain
3	SMBCLK	SMBus Serial-Clock Input
4	$\overline{\text{OVERT}}$	Open-Drain Thermostat Output ( <b>MAX1755 Only</b> )
	$\overline{\text{ALERT}}$	Open-Drain SMBus Alert (Interrupt) Output ( <b>MAX1756 Only</b> )
5	VCC	Supply Voltage Input, +2.375V to +5.5V. Bypass VCC to GND with a 0.1 $\mu$ F capacitor. If supply is noisy, insert 100 $\Omega$ resistor in series with this connection.
6	GND	Ground

## Detailed Description

The MAX1755/MAX1756 are temperature comparators designed to work in conjunction with an external  $\mu$ C or other digital intelligence through an SMBus interface. The  $\mu$ C is typically a power-management or keyboard controller, which generates SMBus serial commands from a GPIO port or through a dedicated SMBus interface block.

Figure 1 illustrates the circuit blocks in the MAX1755/MAX1756. The output of an analog temperature-to-voltage converter signal is compared to the temperature-stable output of a serially programmed dual-output digital-to-analog converter (DAC). Great care is taken in the design to ensure that the thermal signal is proportional to absolute temperature or PTAT. A precision comparator with low-input offset voltage is used to compare the PTAT voltage to the DAC output.

The DAC provides two levels: one is set to the rising trip threshold and the other is set to the falling threshold (hysteresis) level by a digital subtractor. This arrangement makes the hysteresis value very accurate with respect to the rising trip point. Each DAC level is alternately compared to the PTAT voltage through a sampling system that reuses the same comparator, thereby reducing errors due to comparator offset. The sampling rate is typically 1kHz.

A simplified SMBus interface enables the system to program the temperature thresholds and read the part's status register.

## SMBus Digital Interface

The SMBus block utilizes the read-byte/write-byte protocol. It only supports 8-bit reads and writes, has no command byte, and does not need to support the Alert Response feature. From a software perspective, the MAX1755/MAX1756 appear as write registers containing the DAC comparison value and as read registers containing the status byte. A standard SMBus 2-wire serial interface is used to program DAC values and read the status byte. Figure 2 shows the SMBus data protocols and Figure 3 details the SMBus timing.

### Programming the TMAX Register

The TMAX register is programmed using a standard SMBus Send Byte operation. The temperature data format is 6 bits plus sign in two's complement form, with each data bit representing 2°C (Table 1). The MSB is transmitted first, LSB last. The MSB (B7) of the TMAX register is an embedded control bit, which can either invert the polarity of the  $\overline{\text{OVERT}}$  output (MAX1755) or mask low-going (THYST) interrupts (MAX1756). The B6 bit of the TMAX register is the sign bit for the remaining 6 bits that make up the binary-coded temperature threshold.

### Software Standby Mode

If the DAC code is set to negative full scale, the device goes into software standby mode. In standby mode, supply current is reduced to 0.8 $\mu$ A. At very low supply voltages (UVLO threshold), the supply current is higher due to address decoding. Typical supply current can be as high as 250 $\mu$ A, depending on the ADD setting, while the typical ADD input current can be as high as 40 $\mu$ A. Exiting standby mode causes the slave address to be checked again.

# SOT23 Local Temperature Comparators with SMBus Serial Interface

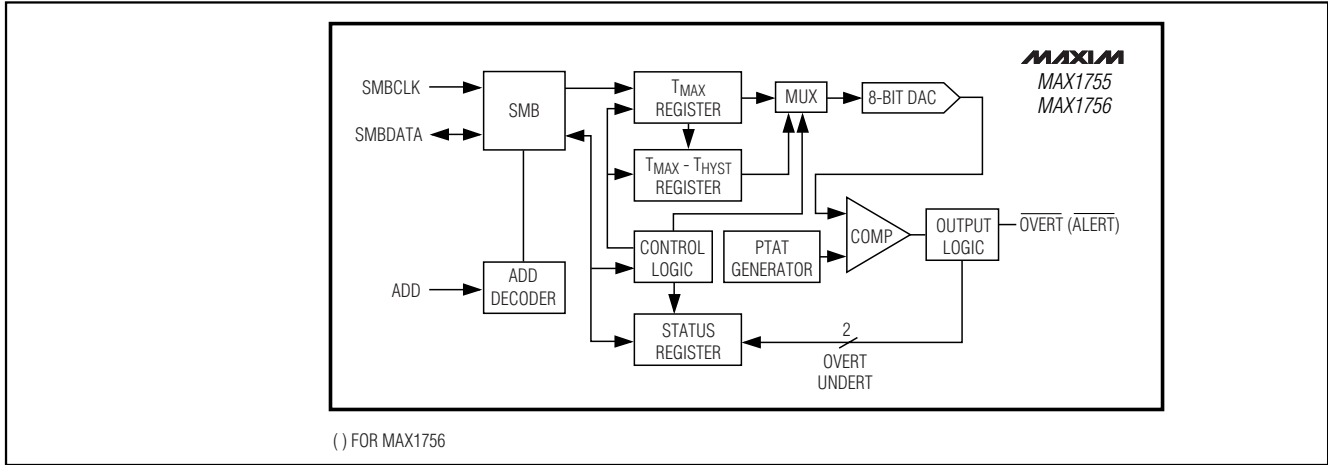


Figure 1. MAX1755/MAX1756 Block Diagram

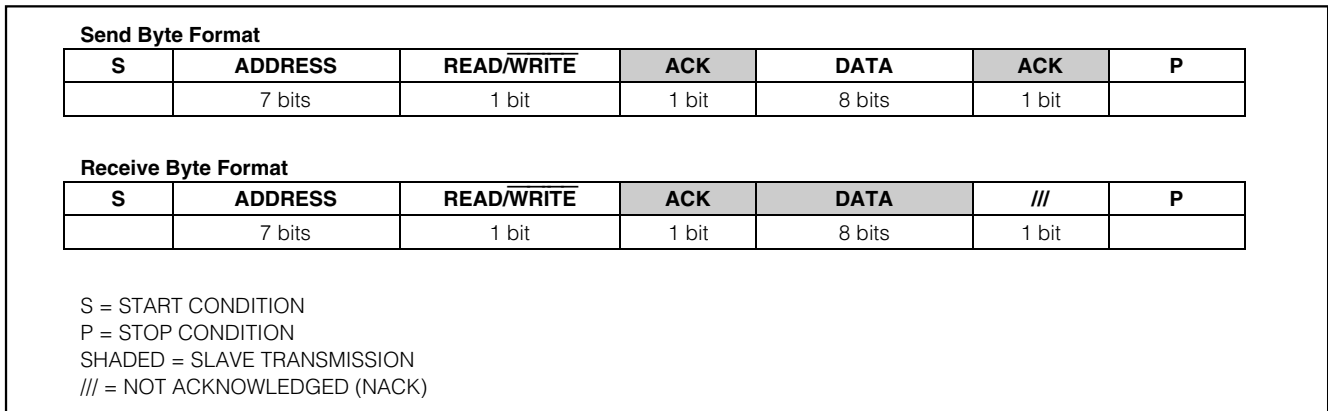


Figure 2. SMBus Protocols

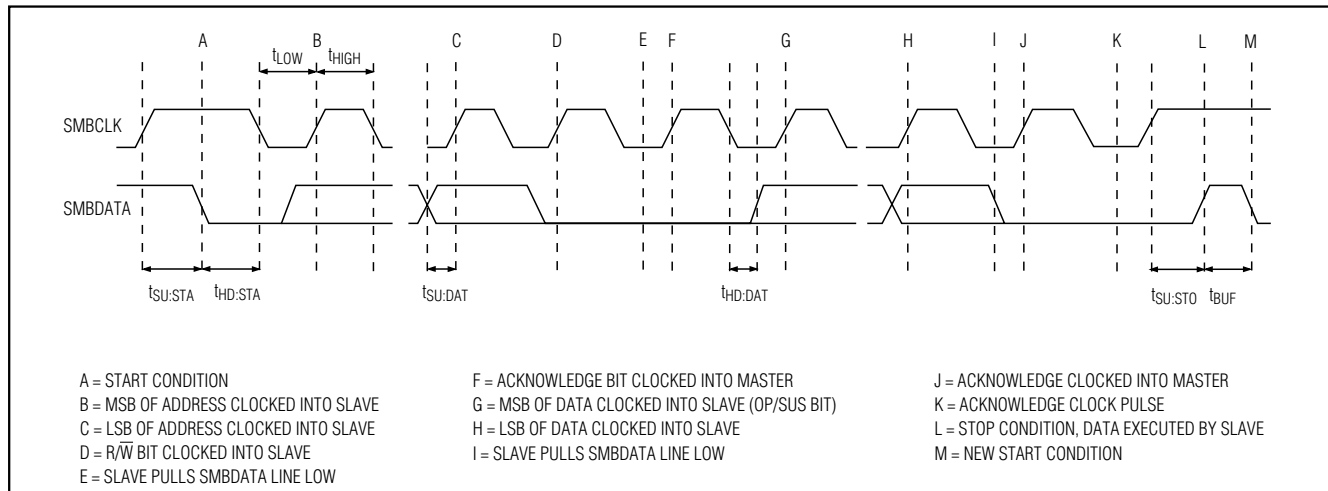


Figure 3. SMBus Write Timing Diagram

# SOT23 Local Temperature Comparators with SMBus Serial Interface

MAX1755/MAX1756

**Table 1. TMAX Register Data Format (Two's Complement)**

MASK/POLARITY BIT POR STATE	DAC REGISTER VALUE				NOMINAL TEMPERATURE THRESHOLD (°C)
	MASK OR POLARITY	SIGN	MSB	LSB	
1 / 0	X	0	111111		+126
1 / 0	X	0	111110		+124
1 / 0	X	0	110010		+100 (POR State)
1 / 0	X	0	001100		+24
1 / 0	X	0	000001		+2
1 / 0	X	0	000000		0
1 / 0	X	1	111111		-2
1 / 0	X	1	111110		-4
1 / 0	X	1	101100		-40
1 / 0	X	1	100101		-54
1 / 0		Between (X 1 100101) and (X 1 000001)			-54
1 / 0	X	1	000001		-54
1 / 0	X	1	000000		Standby Mode

**POLARITY bit:** 0 =  $\overline{\text{OVERT}}$  is active low; 1 =  $\overline{\text{OVERT}}$  is active high (MAX1755).

**MASK bit:** A logic 1 disables  $T_{\text{HYST}}$  (negative-going) interrupts (MAX1756).

## **$\overline{\text{OVERT}}$ Thermostat Output (MAX1755)**

The  $\overline{\text{OVERT}}$  output is a self-clearing interrupt output that is activated when the current temperature equals or exceeds  $T_{\text{MAX}}$ .  $\overline{\text{OVERT}}$  normally goes low when active, but this polarity can be changed through the POLARITY bit in the  $T_{\text{MAX}}$  register. The latch is cleared when the current temperature reading is equal to or less than the current  $T_{\text{MAX}}$  value minus 4°C, which provides for 4°C of hysteresis (Figure 4).

## **$\overline{\text{ALERT}}$ Interrupt (MAX1756)**

The  $\overline{\text{ALERT}}$  interrupt output signal is latched and can only be cleared by reading the status register or writing a new  $T_{\text{MAX}}$  value. Interrupts are generated when the device temperature goes above the current  $T_{\text{MAX}}$  DAC setting or below the current DAC setting minus 8°C ( $T_{\text{HYST}}$ ). The POR state masks undertemperature interrupts (see Figure 4).

## **Status Register**

The bit functions for the status register are summarized in Table 2. The OVER bit (MSB) indicates when the  $T_{\text{MAX}}$  threshold is crossed. The UNDER bit (B6) indicates when the  $T_{\text{HYST}}$  threshold is crossed. For the MAX1755, the UNDER bit is not masked during POR; if the die temperature is less than 96°C, this bit asserts.

For the MAX1756, the UNDER bit is masked to zero during POR. OVER and UNDER are cleared by any read or write operations. In the MAX1755, the OUTPUT bit (B5) mirrors the state of the  $\overline{\text{OVERT}}$  signal. The OUTPUT bit is not used in the MAX1756 and returns zero. The  $\overline{\text{DEFAULT}}$  bit (B1) indicates that the DAC is at the default value. This condition implies that the POR threshold was crossed. The  $\overline{\text{DEFAULT}}$  bit is cleared using a Send Byte operation. The ERROR bit (LSB) indicates that the UVLO threshold was crossed, and therefore the conversion is inaccurate. Use a Send Byte operation and make sure that  $V_{\text{CC}}$  is in the valid operating range to clear this bit. The remaining bits in the status register (B4, B3, B2) are reserved for future use.

## **Slave Addresses**

The MAX1755/MAX1756 appear to the SMBus as one address for both reads and writes. The device address can be set to one of three different values by pin-strapping ADD, so up to six ICs can reside on the same bus without address conflicts (Table 3). A test for the current state of the address pins is done at POR and when exiting standby mode. The results of this test are latched as the current address. This scheme allows for the use of three-way pin-strapping to set the address ( $V_{\text{CC}}$ , GND, floating).

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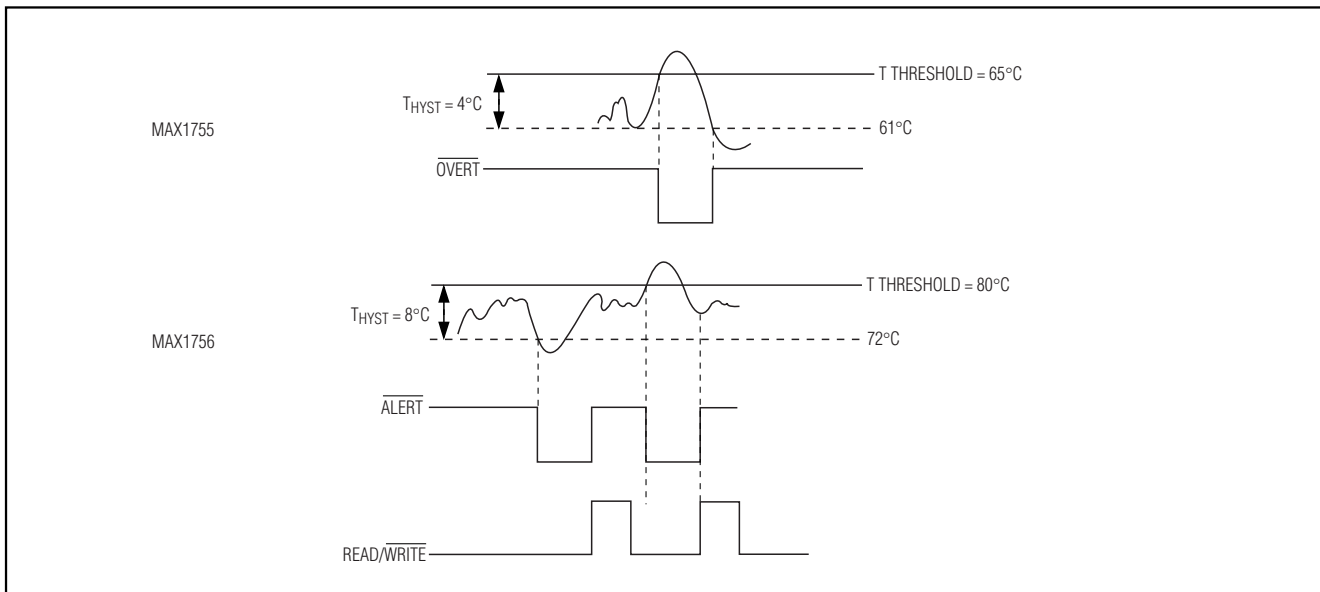


Figure 4.  $\overline{\text{OVERT}}$ ,  $\overline{\text{ALERT}}$  Response

**Table 2. Status Register Bit Assignments**

BIT	NAME	POR STATE	FUNCTION
7 (MSB)	OVER	0	This bit indicates that the $T_{\text{MAX}}$ threshold was crossed. Send a Send Byte or Receive Byte to clear this bit.
6	UNDER	Not masked (MAX1755)	This bit indicates that the $T_{\text{HYST}}$ threshold was crossed. Send a Send Byte or Receive Byte to clear this bit. See Table 1.
		0 (MAX1756)	
5	OUTPUT	Not latched	MAX1755: This bit exactly follows the current state of the $\overline{\text{OVERT}}$ pin (self-clearing). MAX1756: This bit is reserved for future use (returns 0).
4, 3, 2	RFU	N/A	Reserved for future use.
1	$\overline{\text{DEFAULT}}$	0	This bit indicates that the DAC is at the default value; POR threshold was crossed. Send a Send Byte to clear this bit.
0	ERROR	1	This bit indicates that the conversion is inaccurate; UVLO threshold was crossed. Send a Send Byte and bring $V_{\text{CC}}$ back up to a valid operating range to clear this bit.

### POR and UVLO

The MAX1755/MAX1756 have volatile memory. To prevent power-supply conditions from corrupting the data in memory and causing erratic behavior, a POR voltage detector monitors  $V_{\text{CC}}$  and clears the memory if  $V_{\text{CC}}$  falls below 1.5V (typ, see the *Electrical Characteristics*). When power is first applied and  $V_{\text{CC}}$  rises above 1.5V (typ), the logic blocks begin operating, although the address decoder is not enabled until  $V_{\text{CC}} > \text{UVLO}$  voltage. The UVLO comparator prevents the DAC and tem-

perature comparator from operating until there is sufficient headroom ( $V_{\text{CC}} \geq 2.2\text{V}$  typ).

### Power-Up Defaults:

- $T_{\text{MAX}}$  register is set to +100°C.
- $\overline{\text{ALERT}}$  and  $\overline{\text{OVERT}}$  are reset to High-Z state.
- $\overline{\text{OVERT}}$  polarity is set to active-low (MAX1755 only).
- $\overline{\text{ALERT}}$  low-going hysteresis interrupts are masked (MAX1756 only).
- Status byte is cleared.



# SOT23 Local Temperature Comparators with SMBus Serial Interface

**Table 3. Slave Address Decoding (ADD Pin)**

DEVICE	ADD PIN CONNECTED TO	ADDRESS
<b>MAX1755A</b>	VCC	1001 000
MAX1755A	GND	1001 001
MAX1755A	Floating	0101 001
<b>MAX1755B</b>	VCC	0011 000
MAX1755B	GND	0011 001
MAX1755B	Floating	0101 000
<b>MAX1756A</b>	VCC	1001 010
MAX1756A	GND	1001 011
MAX1756A	Floating	0101 011
<b>MAX1756B</b>	VCC	0011 010
MAX1756B	GND	0011 011
MAX1756B	Floating	0101 010

## Applications Information

### Thermal Considerations

The MAX1755/MAX1756 supply current is typically 85µA. When used to drive high-impedance loads, the devices dissipate negligible power. Therefore, the die temperature is essentially the same as the package temperature. The key to accurate temperature monitoring is good thermal contact between the MAX1755/MAX1756 package and the device being monitored. In some applications, the 6-pin SOT23 package may be small enough to fit underneath a socketed µP, allowing the device to monitor the µP's temperature directly. Accurate temperature monitoring depends on the thermal resistance between the device being monitored and the MAX1755/MAX1756 die. Heat flows in and out of plastic packages primarily through the leads. Short, wide copper traces leading to the temperature monitor ensure that heat transfers quickly and reliably. The rise in die temperature due to self-heating is given by the following formula:

$$\Delta T_J = P_{DISSIPATION} \times \theta_{JA}$$

where  $P_{DISSIPATION}$  is the power dissipated by the MAX1755/MAX1756, and  $\theta_{JA}$  is the package's thermal resistance.

The typical thermal resistance is 110°C/W. To limit the effects of self-heating, minimize the output currents. For example, if the MAX1755 or MAX1756 sink 6mA, the output voltage is guaranteed to be less than 0.4V. Therefore, an additional 2.4mW of power is dissipated within the IC. This corresponds to a 0.26°C shift in the die temperature.

### ALERT Software Model Example of Temperature Windowing

The MAX1756  $\overline{ALERT}$  interrupt output is designed so effective clock-throttling and/or fan-speed control can be done by the host firmware, while keeping the commands and registers of the MAX1756 very simple.

At initial power-up,  $T_{MAX}$  is set to +100°C. The user can modify this as needed using Send Byte. The POR state masks undertemperature interrupts. The initial temperature is assumed to be very low, below the  $T_{HYST}$  undertemperature threshold. No  $\overline{ALERT}$  signal is issued, since  $T_{HYST}$  interrupts are masked.

If the system heats up sufficiently to exceed  $T_{MAX}$ , this generates the first interrupt. The host reads the status byte, determining that the  $T_{MAX}$  temperature was exceeded. The interrupt, although cleared, is immediately asserted again since the temperature still exceeds  $T_{MAX}$ . The host now immediately writes a new value to the DAC register, approximately 4°C above the old D/A value. This hopefully places the ( $T_{MAX} - T_{HYST}$ ) window centered around the current device temperature. This new DAC value also writes a zero to the MASK bit, enabling  $T_{HYST}$  interrupts. Writing a new value clears the status byte and  $\overline{ALERT}$  latch. The system then takes whatever corrective action is needed (clock throttling or fan control).

If the temperature continues to increase, another corrective action routine is done, similar to above. If the temperature decreases below  $T_{HYST}$ , an interrupt is generated and the host can remove the corrective action (if desired), set a new  $T_{MAX}$  value, and clear status, similar to the routine above.

If desired, the host can now mask undertemperature interrupts to avoid nuisance interrupts as the system cools.

### Temperature Measurement Using a Software SAR

A useful application of the MAX1755 is to determine the ambient temperature with a successive approximation algorithm to set the  $T_{MAX}$  register. Like a successive approximation register (SAR) analog-to-digital converter, the C code routine provided in Listing 1 tests 1 bit at a time in the  $T_{MAX}$  register from MSB to LSB. Based on the response of the  $\overline{OVERT}$  signal, the bit is either set or cleared. This simple set and check algorithm repeats until all of the bits are set.

# SOT23 Local Temperature Comparators with SMBus Serial Interface

## Listing 1. Measuring Temperature by Successive Approximation

```

/* Use successive approximation to measure the ambient temperature.
** Returns the measured temperature in degrees C.
**
** global variables:
** __int8 shadow_command contains the last command we wrote
** __int8 shadow_status contains the last status value we read
**
** External functions:
** SMBusSendByte(__int8 address, __int8 command);
** SMBusReceiveByte(__int8 address, __int8* received_data);
** Delay_msec(int delay_time_msec);
*/
int MeasureTemperature()
{
    /* Write a test temperature, then read the status byte.
    ** Use the state of the OVER bit to determine each successive bit.
    */
    signed __int8 Thi = 127;                /*upper limit starts at maximum */
    signed __int8 Tlo = -128;              /*lower limit starts at minimum */

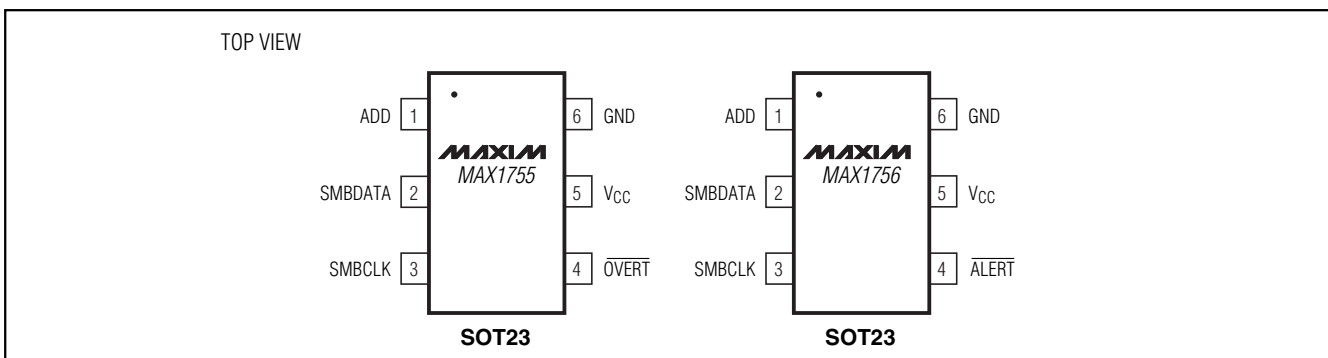
    while ( (Thi - Tlo) > 0 ) {
        signed __int8 Ttest = (Thi + Tlo) / 2;    /* guess between Thi and Tlo */

        SMBusSendByte(address, Ttest);          /* set new threshold */
        shadow_command = Ttest;
        Delay_msec(SAR_delay_time);

        SMBusReceiveByte(address, &shadow_status); /* get status byte */
        if (shadow_status & 0x80) {              /* over temperature? */
            if (Tlo == Ttest)
                break; /* close enough, exit loop */
            Tlo = Ttest;                          /* move lower limit up */
        } else { /* not over temperature */
            if (Thi == Ttest)
                break; /* close enough, exit loop */
            Thi = Ttest;                          /* move upper limit down */
        }
    }
    return Ttest*2; /* temperature in degrees C = twice the threshold number */
}

```

## Pin Configurations



## Chip Information

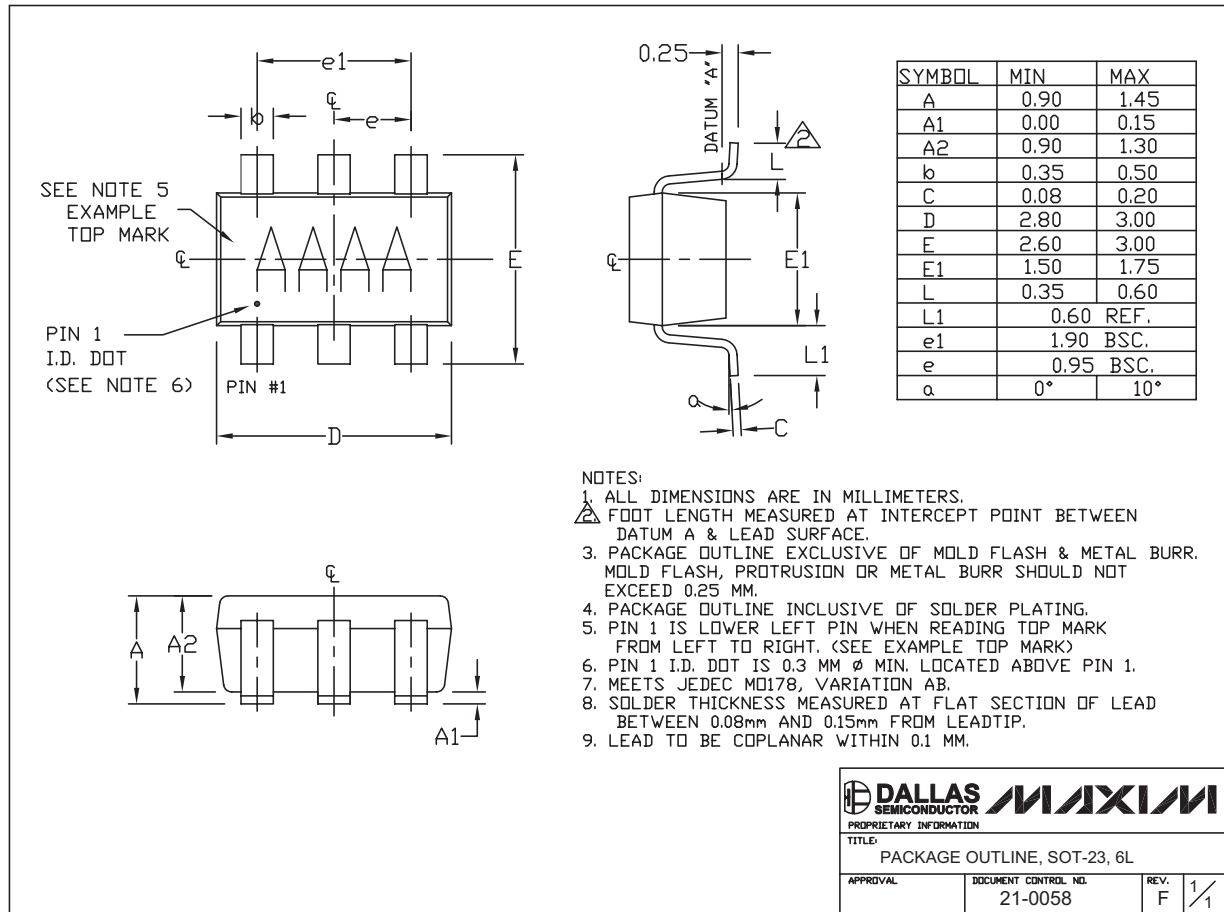
TRANSISTOR COUNT: 2963

# SOT23 Local Temperature Comparators with SMBus Serial Interface

## Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)

MAX1755/MAX1756



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