19-2120; Rev 0; 8/01

12-Bit Plus Sign Temperature Sensors with SMBus/I2C-Compatible Serial Interface

MAX6633/MAX6634/MAX6635

General Description

The MAX6633/MAX6634/MAX6635 combine a temperature sensor, a programmable overtemperature alarm, and an SMBus™/I2C™-compatible serial interface into a single package. They convert their die temperatures into digital values using internal analog-to-digital converters (ADCs). The result of the conversion is then held in a temperature register as a 12-bit + sign value, allowing 0.0625°C resolution, readable at any time through the serial interface. The devices are capable of reading temperatures up to +150°C.

The MAX6633/MAX6634/MAX6635 feature a shutdown mode that saves power by turning off everything except the power-on reset (POR) and the serial interface. The devices can be configured to separate addresses, allowing multiple devices to be used on the same bus.

The MAX6633 has four address pins, allowing up to 16 devices to be connected to a single bus. The MAX6634 has three address pins, allowing up to eight devices to be connected to a single bus. The MAX6635 has two address pins, allowing up to four devices to be connected to a single bus.

The MAX6633/MAX6634/MAX6635 make temperature data available for transfer over the serial interface. The MAX6634 incorporates a dual-mode ALERT output (open drain) and can serve as an upgraded alternative to the LM75. The MAX6635 includes an ALERT output and an OVERT output (both open drain) and can function as an upgraded replacement for the LM76 in most applications. The MAX6634/MAX6635 feature user-programmable temperature thresholds. All three devices come in an 8-pin SO package.

Applications

Battery Temperature Alarms

PC Temperature Control

Automotive Equipment

Pin Configurations appear at end of data sheet.

SMBus is a trademark of Intel Corp.

I2C is a trademark of Philips Corp.

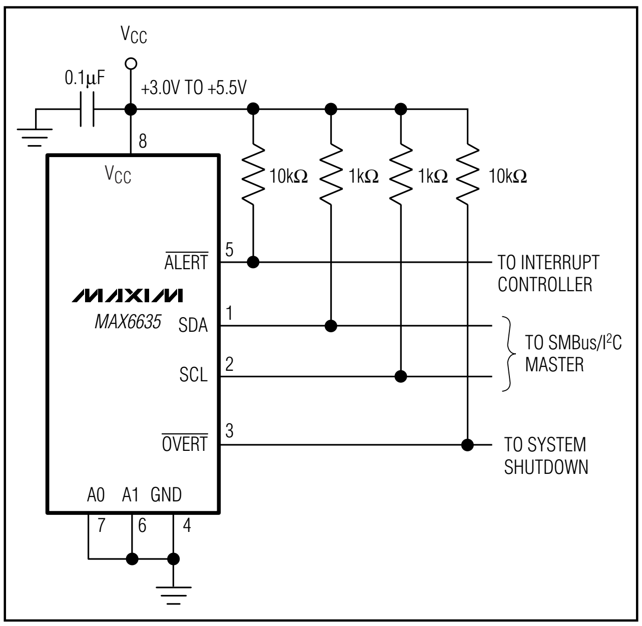
Features

- **+3V to +5.5V Supply Range**
- **Accuracy**
  - **±1°C max (0°C to +50°C)**
  - **±1.5°C max (-20°C to +85°C)**
  - **±2.5°C max (-40°C to +125°C)**
  - **±2.5°C typ (+150°C)**
- **User-Programmable Temperature Thresholds (MAX6634/MAX6635)**
- **User-Configurable Alarm Output(s) (MAX6634/MAX6635)**
- **Ability to Respond to SMBus/I2C-Compatible Alert Response Address (MAX6634/MAX6635)**
- **OVERT Output for System Shutdown (MAX6635)**
- **Multiple Devices per Bus**
  - **16 devices (MAX6633)**
  - **8 devices (MAX6634)**
  - **4 devices (MAX6635)**

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX6633MSA	-55°C to +150°C	8 SO
MAX6634MSA	-55°C to +150°C	8 SO
MAX6635MSA	-55°C to +150°C	8 SO

Typical Operating Circuit



For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

12-Bit Plus Sign Temperature Sensors with SMBus/I²C-Compatible Serial Interface

ABSOLUTE MAXIMUM RATINGS

V_{CC}, SDA, SCL ....-0.3V to +6.0V
All Other Pins ....-0.3V to V_{CC} +0.3V
SDA, $\overline{ALERT}$, $\overline{OVERT}$ Current ....-1mA to +50mA
ESD Protection (Human Body Model)................................2000V
Continuous Power Dissipation (T_A = +70°C)
8-Pin SO (derate 5.88mW/°C above +70°C)................471mW
Junction Temperature ....+150°C
Operating Temperature Range ....-55°C to +150°C
Storage Temperature Range ....-65°C to +150°C
Lead Temperature (soldering, 10s) ....+300°C

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_{CC} = +3.0V to +5.5V, T_A = -55°C to +125°C, unless otherwise noted. Typical values are V_{CC} = +3.3V, T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
TEMPERATURE-TO-DIGITAL CONVERTER CHARACTERISTICS						
Supply Range	V_{CC}		3.0		5.5	V
Accuracy (Note 1)		0°C ≤ T_A = ≤ +50°C, V_{CC} = +3.3V	-1.0	±0.4	+1.0	°C
		-20°C ≤ T_A = ≤ +85°C, V_{CC} = +3.3V	-1.5	±0.6	+1.5	
		-40°C ≤ T_A = ≤ 125°C, V_{CC} = +3.3V	-2.5	±1.0	+2.5	
		T_A = -55°C, V_{CC} = +3.3V	-2.8	±1.5	+2.8	
		T_A = +150°C, V_{CC} = +3.3V		±2.5		
Power-Supply Rejection Ratio	PSRR			0.2	0.5	°C/V
POR Threshold Hysteresis				90		mV
Supply Current in Shutdown		V_{CC} = +3.0V, SMBus inactive		12	20	µA
		V_{CC} = +5.5V, SMBus inactive		20	30	
Average Operating Current		V_{CC} = +3.0V, SMBus inactive		150		µA
		V_{CC} = +5.5V, SMBus inactive		200		
Peak Operating Current (Note 2)		V_{CC} = +3.0V, SMBus inactive		270	350	µA
		V_{CC} = +5.5V, SMBus inactive		350	700	
Conversion Rate			1.4	2	2.4	Hz
DIGITAL INTERFACE						
Logic Input Low Voltage	V_{IL}	V_{CC} = +3.0V to +5.5V			0.65	V
Logic Input High Voltage	V_{IH}	V_{CC} = +3V	2.2			V
		V_{CC} = +5.5V	2.4			
Input Leakage Current	I_{I_LEAK}	V_{IN} = GND or V_{CC}			±1	µA
Output Low Sink Current	I_{OL}	V_{OL} = 0.6V (SMBDATA, $\overline{ALERT}$, $\overline{OVERT}$)	6			mA
Output Leakage Current	I_{O_LEAK}	$\overline{ALERT}$, $\overline{OVERT}$ at V_{CC}			±1	µA
Input Capacitance	C_{IN}			5		pF

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +3.0V to +5.5V, T_A = -55°C to +125°C, unless otherwise noted. Typical values are V_{CC} = +3.3V, T_A = +25°C, unless otherwise noted.)

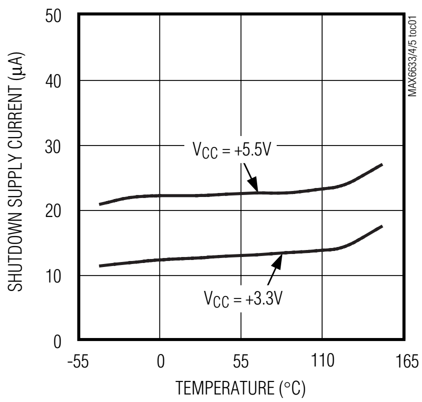
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
SMBus TIMING (Note 3, Figures 1, 2, and 3)						
Serial Clock Frequency	f_{SCL}		10		100	kHz
Bus Free Time Between STOP and START Condition	t_{BUF}		4.7			µs
START Condition Setup Time			4.7			µs
Repeat START Condition Setup Time	$t_{SU:STA}$	90% to 90%	4.7			µs
START Condition Hold Time	$t_{HD:STA}$	10% of SMBDATA to 90% of SMBCLK	4			µs
STOP Condition Setup Time	$t_{SU:STO}$	90% of SMBCLK to 10% of SMBDATA	4			µs
Data Setup Time	$t_{SU:DAT}$	90% of SMBDATA to 10% of SMBCLK	250			ns
Data Hold Time (Note 4)	$t_{HD:DAT}$		300			ns
Receive SCL/SDA Rise Time	t_R				1	µs
SCL/SDA Fall Time (Note 4)	t_F				300	ns
Clock Low Period	t_{LOW}	10% to 10%	4.7			µs
Clock High Period	t_{HIGH}	90% to 90%	4			µs
SMBus Timeout			25		48	ms

Note 1: Guaranteed by design and characterization.
Note 2: Peak operating current measured during conversion. See Figure 4.
Note 3: Guaranteed by design, not production tested.
Note 4: A master device must provide a hold time of at least 300ns for the SDA signal in order to bridge the undefined region of SCL's falling edge.

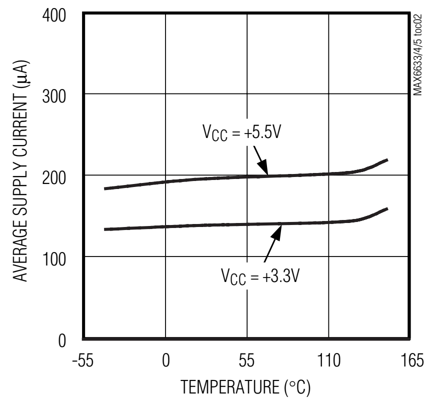
Typical Operating Characteristics

(V_{CC} = +3.3V, T_A = +25°C, unless otherwise noted.)

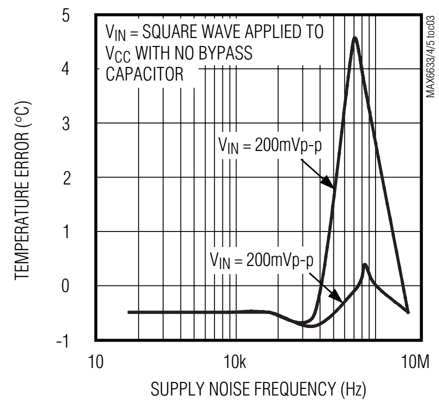
SHUTDOWN SUPPLY CURRENT vs. TEMPERATURE



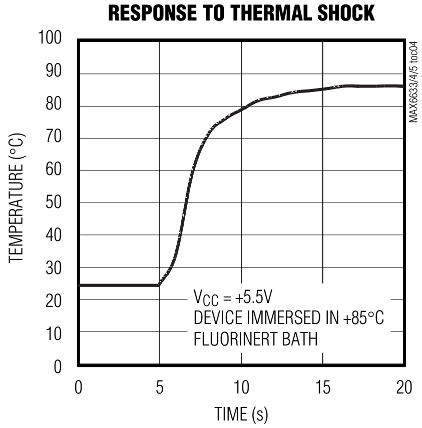
AVERAGE SUPPLY CURRENT vs. TEMPERATURE



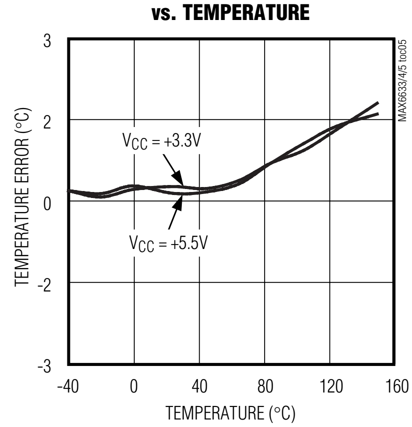
TEMPERATURE ERROR vs. SUPPLY NOISE FREQUENCY



RESPONSE TO THERMAL SHOCK



TEMPERATURE ERROR vs. TEMPERATURE



Pin Description

PIN			NAME	FUNCTION
MAX6633	MAX6634	MAX6635		
1	1	1	SDA	Serial Data Input/Output. Open drain.
2	2	2	SCL	Serial Clock Input
3	—	—	A3	Address Pin
4	4	4	GND	Ground
5	5	—	A2	Address Pin
6	6	6	A1	Address Pin
7	7	7	A0	Address Pin
8	8	8	V_{CC}	Supply Voltage Input. +3.0V to +5.5V. Bypass V_{CC} to GND with a 0.1µF capacitor.
—	3	5	$\overline{ALERT}$	$\overline{ALERT}$ Output. Open drain.
—	—	3	$\overline{OVERT}$	$\overline{OVERT}$ Output. Open drain.

Detailed Description

The MAX6633/MAX6634/MAX6635 continuously convert their die temperatures into digital values using their integrated ADCs. The resulting data is readable at any time through the SMBus/I^{2}C-compatible serial interface. The device functions as a slave on the SMBus interface, supporting Write Byte, Write Word, Read Byte, and Read Word commands. Separate addresses can be configured using the individual address pins. Figures 5, 6, and 7 show the functional diagrams of the MAX6633/MAX6634/MAX6635, respectively.

SMBus/I^{2}C-Compatible Operation

The MAX6633/MAX6634/MAX6635 are readable and programmable through their SMBus/I^{2}C-compatible serial interface. Figures 1, 2, and 3 show the timing details of the clock (SCL) and data (SDA) signals. The devices function as slaves on the SMBus and support Write Byte, Write Word, Read Byte, and Read Word commands. Figure 8 is the MAX6633/MAX6634/MAX6635 programmer's model.

Addressing

Separate addresses can be configured using the individual address pins. The address of each device is selected by connecting the address (A_) pins to one of two potentials: GND or V_{CC}. The MAX6635 makes two address pins available (A0, A1), allowing up to four devices to be connected to a single bus line. The MAX6634 makes three address pins available (A0, A1, A2), allowing up to eight devices to be connected to a single bus line. The MAX6633 makes four address pins available (A0, A1, A2, A3), allowing as many as 16 devices to be connected to a single bus line. Table 1 shows the full SMBus/I^{2}C address for each device type.

Control Registers (MAX6633)

Three registers control the operation of the MAX6633 (Figure 5 and Tables 2 through 6). The Pointer register is the first addressed and determines which of the other two registers is acted upon. The other two are the Temperature and Configuration registers. The temperature value is stored as 12 bits plus a sign bit, read only, and contains the latest temperature data. The true register length is 16 bits, with the lower 3 unused in this part. The digital temperature data contained in the temperature register is in °C, using a two's-complement format with 1LSB corresponding to 0.0625°C.

The Configuration register is 8 bits, read/write, and contains the SMBus timeout disable bit, fault queue enable bit, and the shutdown bit.

Control Registers (MAX6634)

Six registers control the operation of the MAX6634 (Figure 6 and Tables 2 through 7). The pointer register is the first addressed and determines which of the other five registers is acted upon. The other five are the Temperature, Configuration, High-Temperature (T_{HIGH}), Low-Temperature (T_{LOW}), and Hysteresis (T_{HYST}) registers. The temperature value is stored as 12 bits plus a sign bit, read only, and contains the latest temperature data. The true register length is 16 bits, with the lowest 2 used as status bits, and the third bit (D2) is unused. The digital temperature data contained in the temperature register is in °C, using a two's-complement format with 1LSB corresponding to 0.0625°C.

12-Bit Plus Sign Temperature Sensors with SMBus/I2C-Compatible Serial Interface

Write Byte Format

S	ADDRESS	WR	ACK	COMMAND	ACK	DATA	ACK	P
	7 bits			8 bits		8 bits		
	Slave Address: equivalent to chip-select line of a 3-wire interface			Command Byte: selects register you are writing to		Data Byte: data goes into the register set by the command byte		

Write Word Format

S	ADDRESS	WR	ACK	COMMAND	ACK	DATA	ACK	DATA	ACK	P
	7 bits			8 bits		8 bits (MSB)		8 bits (LSB)		
	Slave Address: equivalent to chip-select line of a 3-wire interface			Command Byte: selects register you are writing to		Data Bytes: data goes into the register set by the command byte				

Read Byte Format

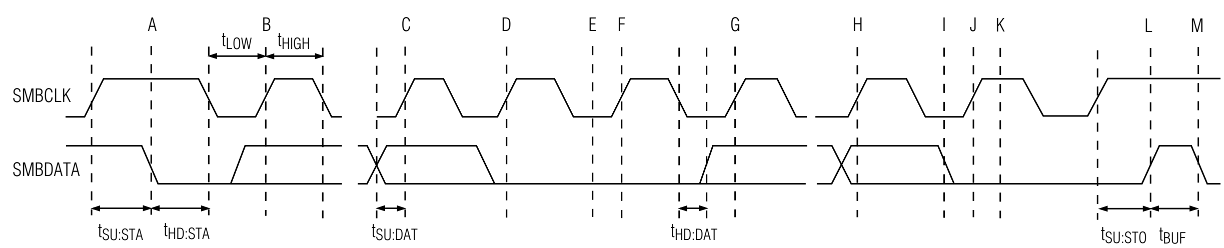
S	ADDRESS	WR	ACK	COMMAND	ACK	S	ADDRESS	RD	ACK	DATA	///	P
	7 bits			8 bits			7 bits			8 bits		
	Slave Address: equivalent to chip-select line			Command Byte: selects register you are reading from			Slave Address: repeated due to change in data-flow direction			Data Byte: reads from the register set by the command byte		

Read Word Format

S	ADDRESS	WR	ACK	COMMAND	ACK	S	ADDRESS	RD	ACK	DATA	ACK	DATA	///	P
	7 bits			8 bits			7 bits			8 bits (MSB)		8 bits (LSB)		
	Slave Address: equivalent to chip-select line			Command Byte: selects register you are reading from			Slave Address: repeated due to change in data-flow direction			Data Bytes: reads from the register set by the command byte				

S = Start condition
P = Stop condition
Shaded = Slave transmission
/// = Not acknowledged

Figure 1. SMBus Protocols



A = START CONDITION
B = MSB OF ADDRESS CLOCKED INTO SLAVE
C = LSB OF ADDRESS CLOCKED INTO SLAVE
D = R/$\overline{W}$ BIT CLOCKED INTO SLAVE
E = SLAVE PULLS SMBDATA LINE LOW
F = ACKNOWLEDGE BIT CLOCKED INTO MASTER
G = MSB OF DATA CLOCKED INTO SLAVE
H = LSB OF DATA CLOCKED INTO SLAVE
I = SLAVE PULLS SMBDATA LINE LOW
J = ACKNOWLEDGE CLOCKED INTO MASTER
K = ACKNOWLEDGE CLOCK PULSE
L = STOP CONDITION, DATA EXECUTED BY SLAVE
M = NEW START CONDITION

Figure 2. SMBus Write Timing Diagram

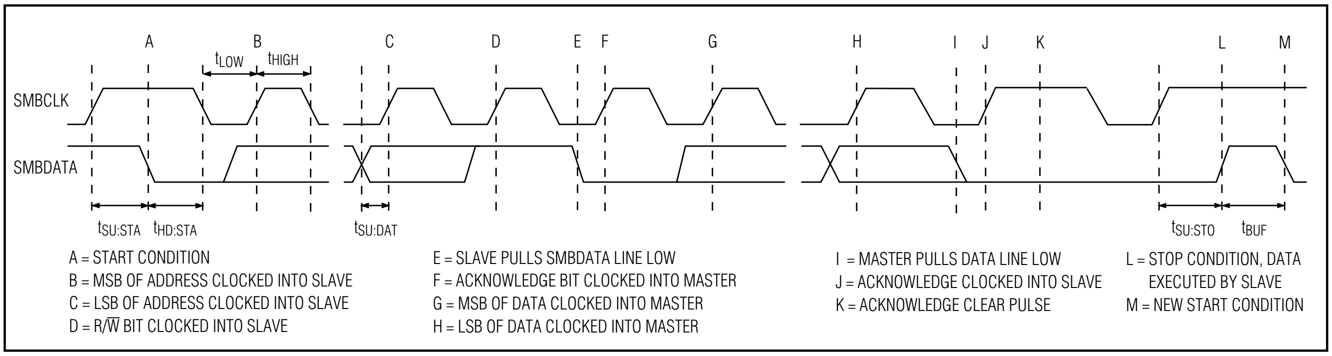


Figure 3. SMBus Read Timing Diagram

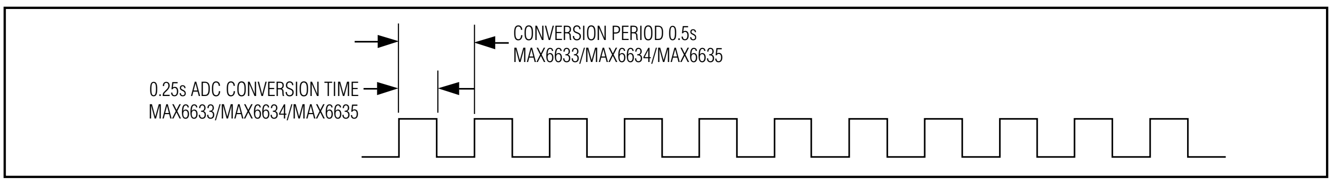


Figure 4. ADC Conversion Timing Diagram

The Configuration register is 8 bits, read/write, and contains the SMBus timeout disable bit, fault queue enable bit, the temperature alarm output polarity select bits, the interrupt mode select bit, and the shutdown bit. Registers T_{HIGH} and T_{LOW} are 16 bits, read/write, and contain the values that trigger $\overline{ALERT}$. Register T_{HYST} is 16 bits, read/write, and contains the values by which the temperature must rise or fall beyond T_{HIGH} or T_{LOW}, before $\overline{ALERT}$ deasserts.

Control Registers (MAX6635)

Seven registers control the operation of the MAX6635 (Figure 7 and Tables 2 through 7). The Pointer register is the first addressed and determines which of the other six registers is acted upon. The other six are the Temperature, Configuration, High-Temperature (T_{HIGH}), Low-Temperature (T_{LOW}), Maximum Temperature (T_{MAX}), and Hysteresis (T_{HYST}) registers. The temperature value is stored as 12 bits plus a sign bit, read only, and contains the latest temperature data. The true register length is 16 bits, with the lower three used as status bits. The digital temperature data contained in the temperature register is in °C, using a two's-complement format with 1LSB corresponding to 0.0625°C.

The Configuration register is 8 bits, read/write, and contains the SMBus timeout disable bit, fault queue enable bit, the temperature alarm output polarity select bits, the interrupt mode select bit, and the shutdown

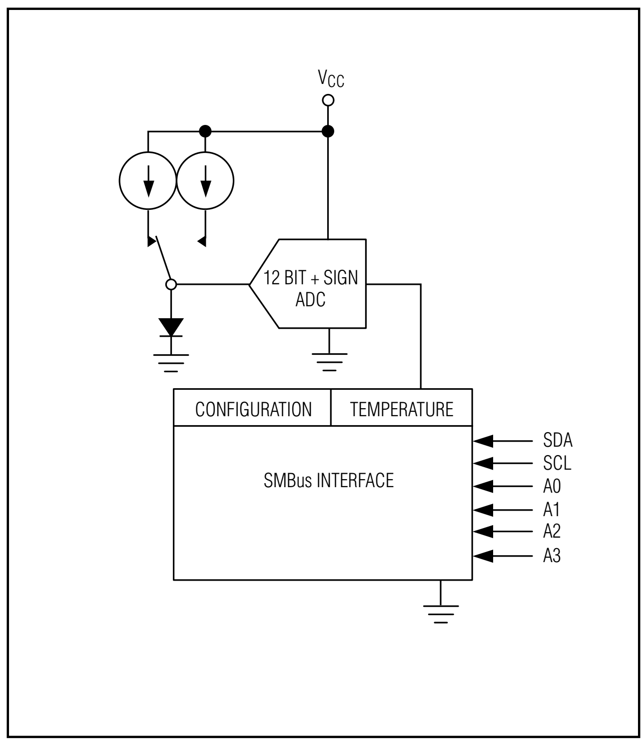


Figure 5. MAX6633 Functional Diagram

12-Bit Plus Sign Temperature Sensors with SMBus/I2C-Compatible Serial Interface

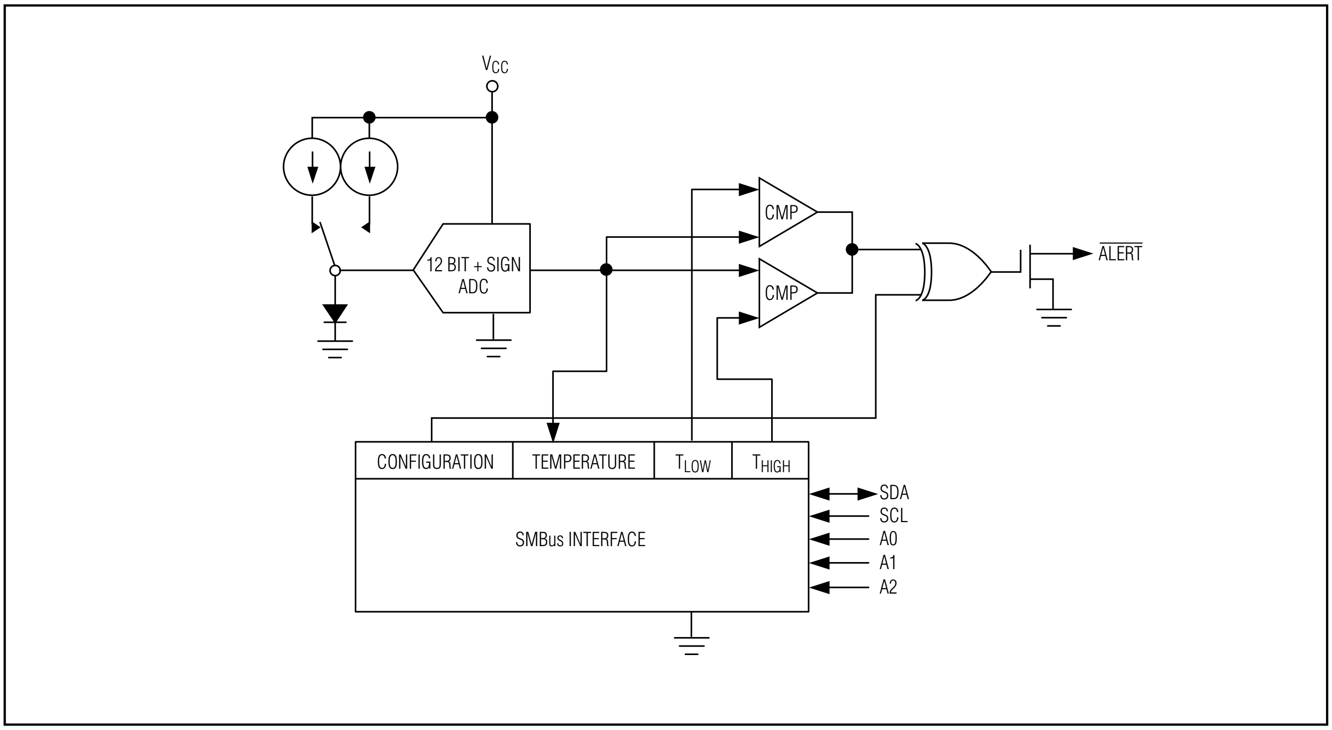


Figure 6. MAX6634 Functional Diagram

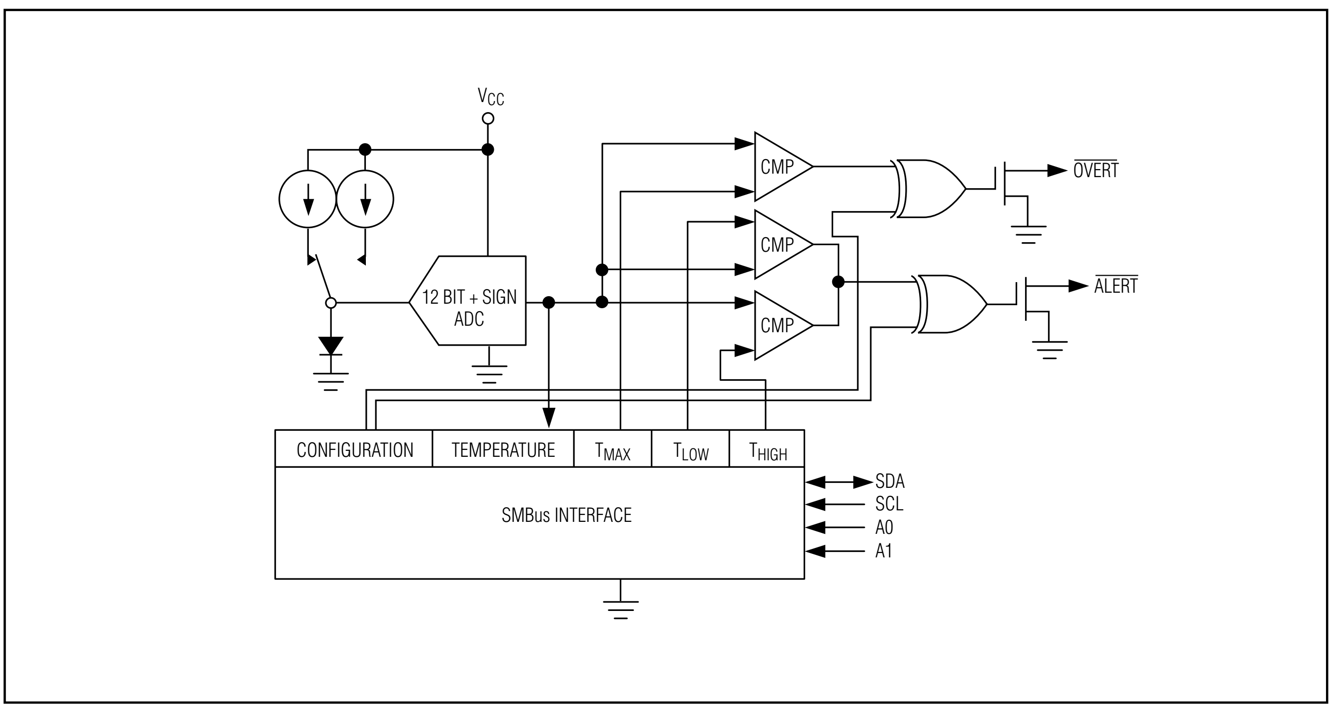


Figure 7. MAX6635 Functional Diagram

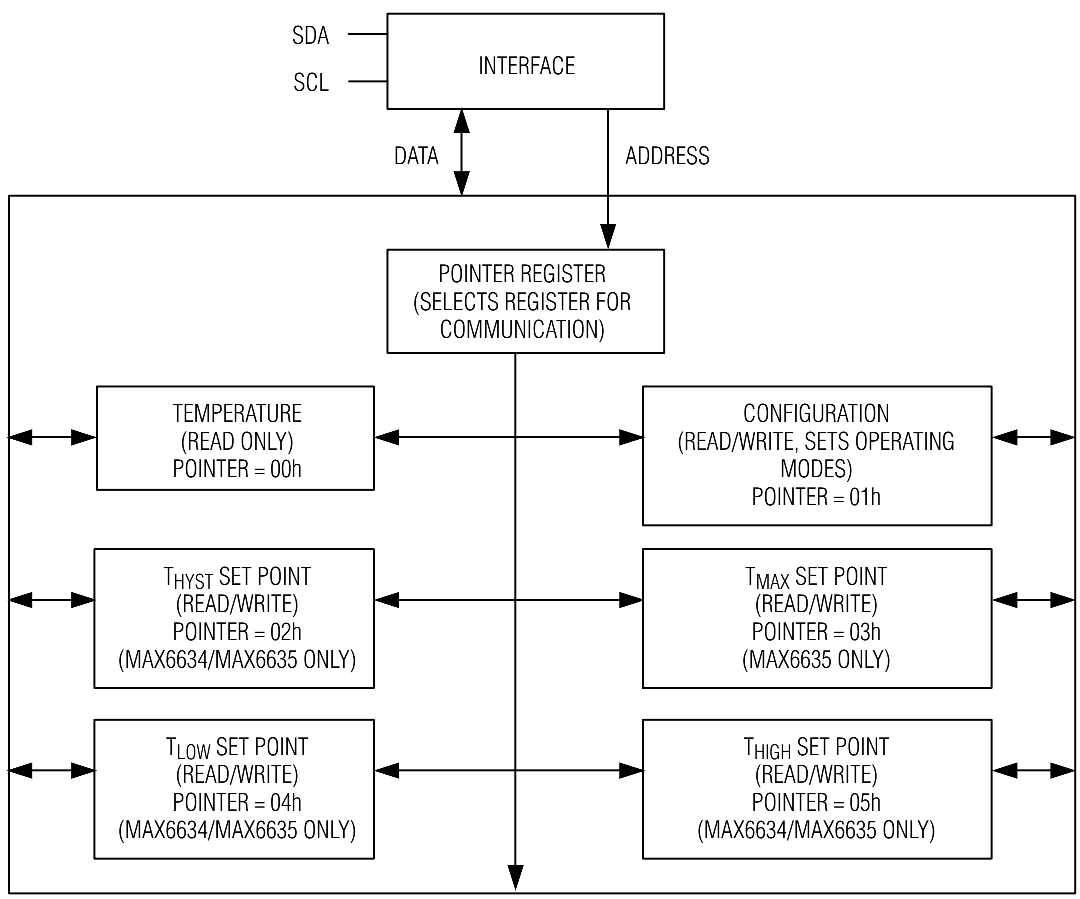


Figure 8. MAX6633/MAX6634/MAX6635 Programmer's Model

12-Bit Plus Sign Temperature Sensors with SMBus/I²C-Compatible Serial Interface

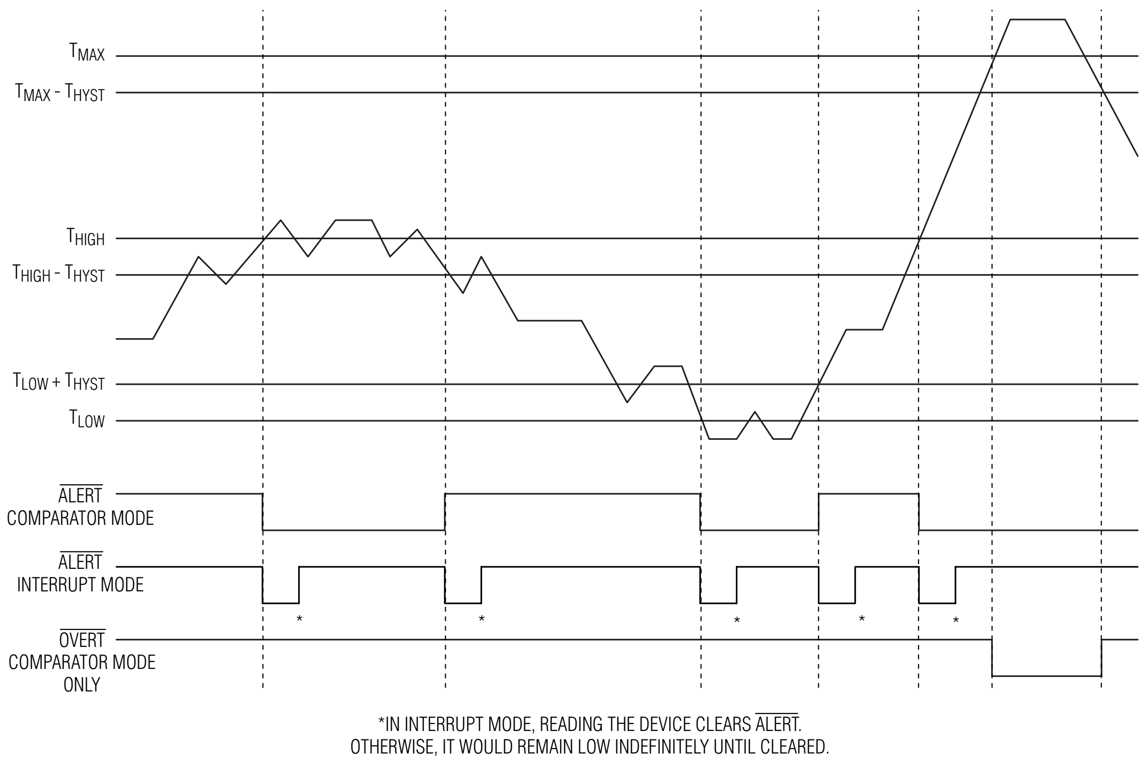


Figure 9. Alarm Output and Reset Diagram

bit. Registers T_{HIGH} and T_{LOW} are 16 bits, read/write, and contain values that trigger $\overline{ALERT}$ and $\overline{OVERT}$. Register T_{HYST} is 16 bits, read/write, and contains the values by which the temperature must rise or fall beyond T_{HIGH}, T_{LOW}, or T_{MAX}, before $\overline{ALERT}$ or $\overline{OVERT}$ deassert.

Temperature Conversion

An on-chip bandgap reference produces a signal proportional to absolute temperature (PTAT), as well as the temperature-stable reference voltage necessary for the analog-to-digital conversion. The PTAT signal is digitized by the on-board ADC to a resolution of 0.0625°C. The resulting digital value is placed in the Temperature register. The temperature conversion runs continuously and asynchronously from the serial interface at a rate of 500ms per conversion. When the Temperature register is read, the conversion in progress is aborted. The bus transaction is completed by a stop condition.

Fault Queue (MAX6634/MAX6635)

A programmable fault queue on the MAX6634/MAX6635 eliminates spurious alarm activity in noisy environments. The queue sets the number of consecutive out-of-tolerance temperature readings that must occur before the $\overline{ALERT}$ or $\overline{OVERT}$ alarm outputs are toggled. An out-of-tolerance reading is above T_{HIGH} or T_{MAX} or below T_{LOW}. The fault queue depth defaults to 1 at power-up and may be programmed—through the Configuration register—to four consecutive conversions. Any time the conversion result is in tolerance, and the particular alarm output is not asserted, the queue is cleared, even if it contains some out-of-tolerance counts. Additionally, the fault queue automatically clears at power-up and in shutdown. Whenever the fault queue is cleared, the alarm outputs are deasserted. Figure 9 is the alarm output and reset diagram.

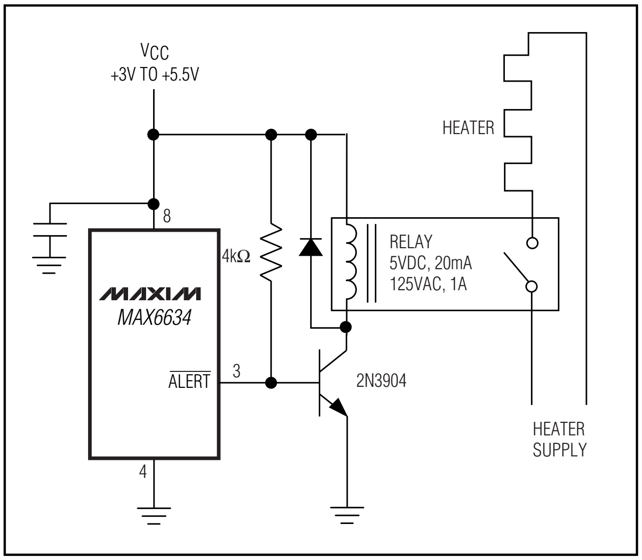


Figure 10. Simple Thermostat

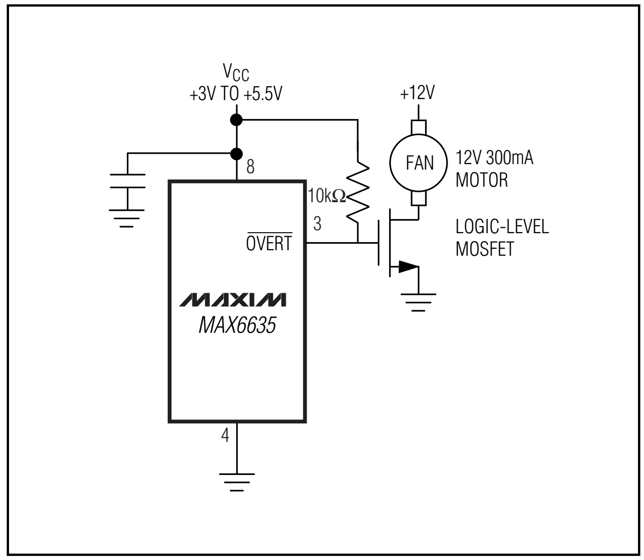


Figure 11. Fan Controller

Temperature Alert (MAX6634/MAX6635)

ALERT has programmable polarity and two modes: comparator and interrupt. Polarity and mode are selected through the Configuration register (Table 4). The ALERT output is open drain.

Interrupt Mode

With ALERT in interrupt mode, the MAX6634/MAX6635 look for a T_{HIGH} or a T_{LOW} fault. The ALERT pin asserts an alarm for an undertemperature fault, as well as for an overtemperature fault. Once either fault has occurred, it remains active until deasserted by a read of any register. The device then begins to look for a temperature change crossing the hysteresis level. The activation of ALERT is subject to the depth of the fault queue.

For example: If T_{HIGH} is set to 100°C, T_{HYST} is set to 20°C, and the fault queue depth is set to 4, ALERT does not assert until four consecutive conversions exceed 100°C. If the temperature is then read through the I2C-compatible interface, ALERT deasserts. ALERT asserts again when four consecutive conversions are less than 80°C.

Comparator Mode

In comparator mode, ALERT is asserted when the number of consecutive conversions exceeding the value in the T_{HIGH} register, or lower than the value in the T_{LOW} register, is equal to the depth of the fault queue. ALERT deasserts when the number of consecutive conversions less than T_{HIGH} - T_{HYST} or greater than T_{LOW} + T_{HYST} is equal to the depth of the fault queue.

For example: If T_{HIGH} is set to 100°C, T_{LOW} is set to 80°C, and the fault queue depth is set to four, ALERT does not assert until four consecutive conversions exceed 100°C, or are below 80°C. ALERT only deasserts if four consecutive conversions are less than T_{HIGH} - T_{HYST} or greater than T_{LOW} + T_{HYST}.

Comparator mode allows autonomous clearing of an ALERT fault without the intervention of a master and is ideal to use for driving a thermostat (Figure 10).

Overtemperature Alarm (MAX6635)

The MAX6635 also includes an overtemperature output that is always in comparator mode. Whenever the temperature exceeds a value in the programmable T_{MAX} register, OVERT is asserted. OVERT only deasserts after the temperature drops below T_{MAX} - T_{HYST}. When the fault queue is activated, OVERT is subject to that queue, which sets the number of faults that must occur before OVERT asserts or deasserts. This helps prevent spurious alarms in noisy environments.

Comparator mode also allows autonomous clearing of an OVERT fault without the intervention of a master and thus is ideal to use for driving a cooling fan (Figure 11). In this application, the polarity of OVERT is active high.

Shutdown

The MAX6633/MAX6634/MAX6635 feature a shutdown mode, accessible through the serial interface that saves power by turning off everything except the POR and the serial interface. Enter shutdown by programming the shutdown bit of the Configuration register high. While in shutdown, the Temperature register retains the last conversion result and can be read at any time. The ADC is turned off, reducing the device current draw to 30µA (max). The outputs of $\overline{ALERT}$ and $\overline{OVERT}$ are latched upon entering shutdown, and the fault queue is held in reset. After coming out of shutdown, the Temperature register continues to read the last converted temperature, until the next conversion result is available.

Thermal Considerations

The MAX6633/MAX6634/MAX6635 supply current is typically 200µA when the serial interface is inactive. 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 MAX6633/MAX6634/MAX6635 package and the monitored device or circuit. 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 MAX6633/MAX6634/MAX6635, and θ_{JA} is the package's thermal resistance.

The typical thermal resistance is 170°C/W for the 8-pin SO package. To limit the effects of self-heating, minimize the output currents. For example, if the MAX6634/MAX6635 sink 4mA with the maximum $\overline{ALERT}$ V_L specification of 0.8V, an additional 3.2mW of power is dissipated within the IC. This corresponds to a 0.54°C rise in the die temperature.

Applications Information

Figure 10 shows the MAX6634 used as a simple thermostat to control a heating element. Figure 11 shows the MAX6635 used as a temperature-triggered fan controller.

Chip Information

TRANSISTOR COUNT: 12,085

PROCESS: BiCMOS

Table 1. Address Selection

MAX6633				
A3	**A2**	**A1**	**A0**	**ADDRESS**
GND	GND	GND	GND	1000 000
GND	GND	GND	V_{CC}	1000 001
GND	GND	V_{CC}	GND	1000 010
GND	GND	V_{CC}	V_{CC}	1000 011
GND	V_{CC}	GND	GND	1000 100
GND	V_{CC}	GND	V_{CC}	1000 101
GND	V_{CC}	V_{CC}	GND	1000 110
GND	V_{CC}	V_{CC}	V_{CC}	1000 111
V_{CC}	GND	GND	GND	1001 000
V_{CC}	GND	GND	V_{CC}	1001 001
V_{CC}	GND	V_{CC}	GND	1001 010
V_{CC}	GND	V_{CC}	V_{CC}	1001 011
V_{CC}	V_{CC}	GND	GND	1001 100
V_{CC}	V_{CC}	GND	V_{CC}	1001 101
V_{CC}	V_{CC}	V_{CC}	GND	1001 110
V_{CC}	V_{CC}	V_{CC}	V_{CC}	1001 111
MAX6634				
	A2	**A1**	**A0**	**ADDRESS**
	GND	GND	GND	1001 000
	GND	GND	V_{CC}	1001 001
	GND	V_{CC}	GND	1001 010
	GND	V_{CC}	V_{CC}	1001 011
	V_{CC}	GND	GND	1001 100
	V_{CC}	GND	V_{CC}	1001 101
	V_{CC}	V_{CC}	GND	1001 110
	V_{CC}	V_{CC}	V_{CC}	1001 111
MAX6635				
		A1	**A0**	**ADDRESS**
		GND	GND	1001 000
		GND	V_{CC}	1001 001
		V_{CC}	GND	1001 010
		V_{CC}	V_{CC}	1001 011

Table 2. Pointer Register Bit Assignments

ADDRESS	DESCRIPTION	POR STATE
00h	Temperature register (READ only)	0000h
01h	Configuration-Byte register	00h
02h	T_{HYST} register	0100h
03h	T_{MAX} register	2800h
04h	T_{LOW} register	0500h
05h	T_{HIGH} register	2000h

Table 3. Temperature Register

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
MSB (Sign)	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	T_{MAX}	T_{HIGH}	T_{LOW}

D15: MSB is the first sign bit.

D2, D1, D0: Flag bits for T_{MAX}, T_{HIGH}, T_{LOW}.

1LSB = 0.0625°C.

Temperature is stored in two's complement format.

Table 4. Configuration Register

D7	D6	D5	D4	D3	D2	D1	D0
0	0	SMB Timeout Disable	Fault Queue Enable	$\overline{\text{ALERT}}$ Polarity	$\overline{\text{OVERT}}$ Polarity	Comparator or Interrupt	Shutdown

Power-on default = 0h.

D0: 0 = normal operation; 1 = shutdown.

D1: 0 = comparator mode; 1 = interrupt mode.

D2 to D3: 0 = active low; 1 = active high.

D5: 0 = normal SMBus operation; 1 = full I^2C compatibility.

D7 to D6: Reserved locations, always write zeros.

Table 5. Fault Queue Depth

D4	NO. OF FAULTS
0	1 (DEFAULT)
1	4

Table 6. Output Code vs. Temperature

TEMP. (°C)	DIGITAL OUTPUT CODE	
	BINARY	HEX
	MSB LSB	
+150.0000	0100 1011 0000 0XXX	4B00
+125.0000	0011 1110 1000 0XXX	3E80
+25.0000	0000 1100 1000 0XXX	0C80
+0.0625	0000 0000 0000 1XXX	0008
0.0000	0000 0000 0000 0XXX	0000
-0.0625	1111 1111 1111 1XXX	FFF8
-25.0000	1111 0011 0111 0XXX	F370
-55.0000	1110 0100 0111 0XXX	E470

Table 7. T_{HIGH}, T_{LOW}, T_{MAX}, and T_{HYST} Registers

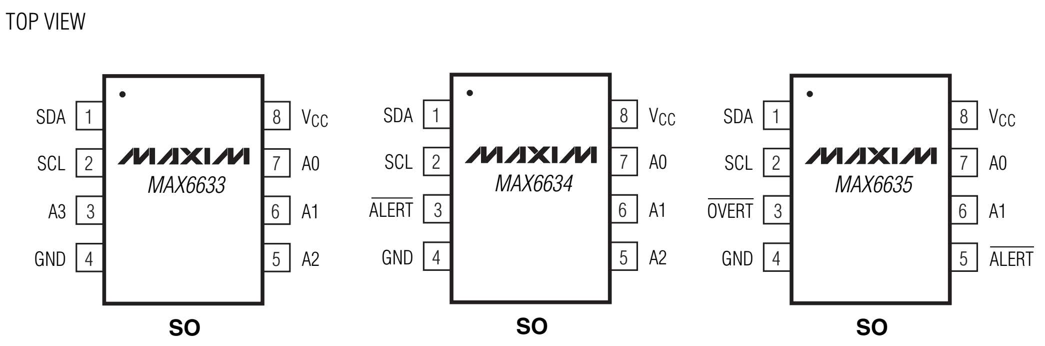
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
MSB (Sign)	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	LSB	0	0	0	0	0	0	0

D6 to D0: Reads all zeros, cannot be written.

1LSB = 1°C.

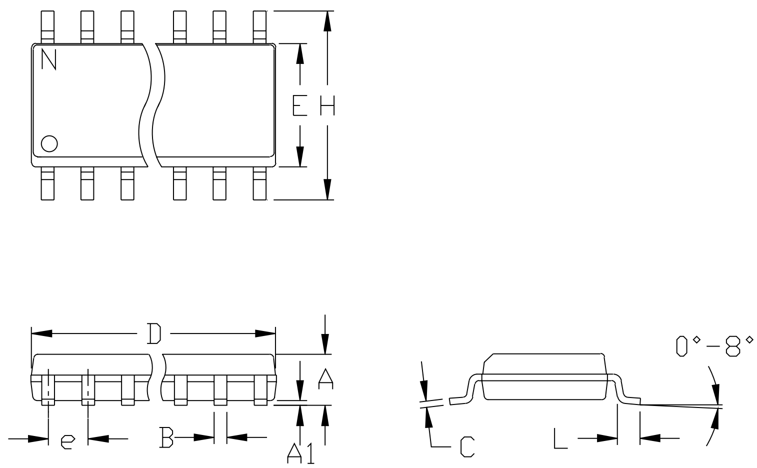
Power-On Default: T_{HIGH} = +64°C (2000h), T_{LOW} = +10°C (0500h), T_{MAX} = +80°C (2008h), T_{HYST} = 2°C (0100h).

Pin Configurations



12-Bit Plus Sign Temperature Sensors with SMBus/I2C-Compatible Serial Interface

Package Information



	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.014	0.019	0.35	0.49
C	0.007	0.010	0.19	0.25
e	0.050		1.27	
E	0.150	0.157	3.80	4.00
H	0.228	0.244	5.80	6.20
h	0.010	0.020	0.25	0.50
L	0.016	0.050	0.40	1.27

	INCHES		MILLIMETERS			
	MIN	MAX	MIN	MAX	N	MS012
D	0.189	0.197	4.80	5.00	8	A
D	0.337	0.344	8.55	8.75	14	B
D	0.386	0.394	9.80	10.00	16	C

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. LEADS TO BE COPLANAR WITHIN .102mm (.004")
4. CONTROLLING DIMENSION: MILLIMETER
5. MEETS JEDEC MS012-XX AS SHOWN IN ABOVE TABLE
6. N = NUMBER OF PINS

MAXIM 120 SAN GABRIEL DR. SUNNYVALE CA 94086 FAX (408) 737 7194
PROPRIETARY INFORMATION

TITLE: PACKAGE FAMILY OUTLINE: SOIC .150"

1/1

DOCUMENT CONTROL NUMBER: 21-0041 REV: A

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