Thermal Management

Product Guide

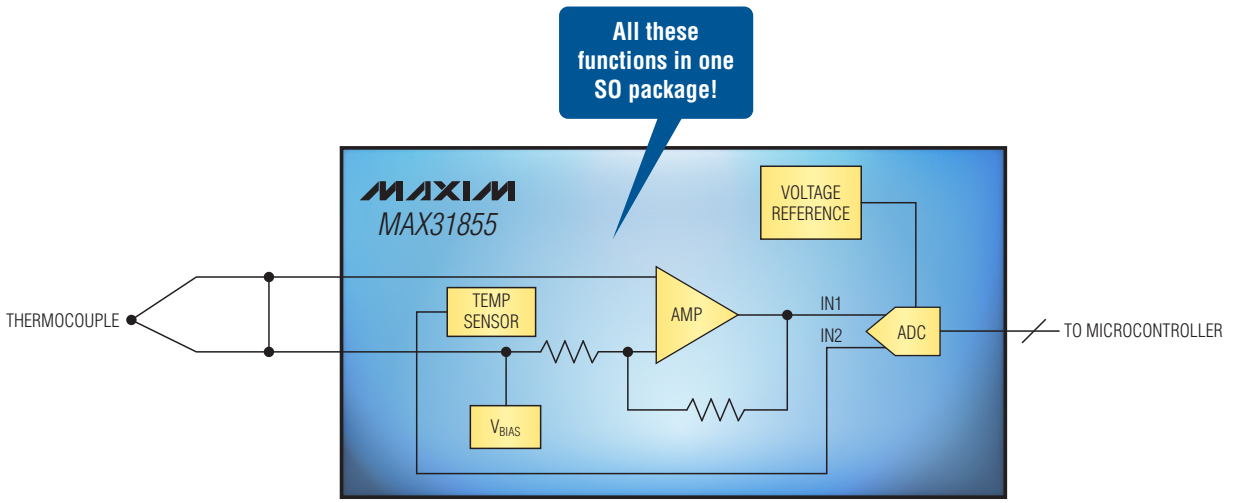
What's inside?

Edition 2, March 2011

MAXIM
INNOVATION DELIVERED®

Accurate Thermocouple-to-Digital Converter Simplifies Designs and Cuts System Cost

The MAX31855 integrates all the required functions of a discrete solution, including an ADC, precision amplifier, temperature sensor for cold-junction compensation, and a 3-wire interface. By combining these components in a single IC, the MAX31855 simplifies design, reduces development time, and saves both component cost and board space. The device also provides ±2.0°C accuracy for temperatures ranging from -200°C to +700°C for a K type thermocouple, with no calibration required. The MAX31855 is ideal for industrial and temperature controls, fuel cells, HVAC, and automotive applications.




Industrial Controls


HVAC Systems

Temperature Controllers

Improves and Speeds System Design

- Performs cold-junction compensation
- 14-bit, 0.25°C resolution
- Versions available for K, J, N, S, T, E, and R type thermocouples
- Simple SPI™-compatible interface
- Measures thermocouple inputs from -270°C to +1800°C

Integrated Solution Saves Space and Cuts BOM Cost

- Eliminates need for multiple discrete components
- Available in an 8-pin SO package

Simplified System Fault Management and Troubleshooting Improve Reliability

- Detects thermocouple shorts to GND or V_{CC}
- Detects open thermocouple

SPI is a trademark of Motorola, Inc.

Choosing the Right Fan Controller

Maxim offers over 20 products with fan-control functions. This design note helps you to narrow the choice in two simple steps.

Step 1: Start with the Fan

Fans are usually described by the number of wires. A 2-wire fan has just two power-supply leads. A 3-wire fan adds an output, usually a "tachometer" output that produces a square wave with a fixed number of pulses per fan revolution. The tachometer signal can monitor fan speed and serve as a feedback signal when closed-loop control of speed is necessary. A 4-wire fan also includes a speed-control input that accepts a PWM signal whose duty cycle controls the fan's speed.

Step 2: Pick the Speed-Adjustment Method

Typically, fan control reduces the audibility of fan noise, so the preferred approach is to gradually adjust fan speed in response to temperature changes.

If a 4-wire fan is used, it is easy to adjust the fan's speed: just drive the speed-control input with a PWM signal in the 20kHz to 40kHz range. In **Figure 1**, the MAX6639 fan controller regulates the speed of two fans by adjusting the PWM waveforms' duty cycles to produce the desired speed as indicated by the fans' outputs.

In contrast, 2- and 3-wire fans require a more complex control scheme. PWM drive works, but instead of driving the fan's speed-control input, the PWM signal drives a power-supply pass transistor. The optimum frequency is in the 30Hz range. Note that this approach can be noisy—each edge of the PWM waveform can cause an audible transient due to motion of the fan motor assembly. Also, some fan manufacturers recommend against PWM on the fan's power supply due to reliability concerns. Be sure to check with your fan vendor before proceeding with this approach.

Another way to control the speed of a 2- or 3-wire fan is to linearly vary the fan's power-supply voltage. You lose a bit of efficiency, but the approach is both quiet and reliable. A few fan controllers, such as the MAX6620 (**Figure 3**), can produce a variable fan supply voltage controlled over a bus such as I^2C. You can also generate an adjustable linear fan supply by using a PWM-output fan controller and adding a lowpass filter and power amplifier, as shown in Maxim application notes "Circuit Converts PWM to Amplified and Buffered Linear Signal" (www.maxim-ic.com/AN3149) and "Circuit Converts PWM Fan Drive to Linear and Reduces Acoustic Noise" (www.maxim-ic.com/AN3530).

If the fan will be used infrequently or located far from users, the acoustic noise may not be important. In this case, you can implement very simple, low-cost fan control using a temperature switch to turn a fan on and off. In the **Figure 2** example, the temperature switch's output directly drives the control input of a 4-wire fan. For 2- or 3-wire fans, the temperature switch in **Figure 4** drives the gate of a power transistor that enables or disables the fan's power supply. Note that switching the fan on and off suddenly is very audible and, therefore, is rarely appropriate for consumer or office equipment that will be located close to users.

Fan Control Type	2-Wire and 3-Wire Fans		4-Wire Fans	
	Control Method	Maxim Solution*	Control Method	Maxim Solution*
Linear Control	Linear fan controller	MAX6620 (Figure 3)	N/A	N/A
	PWM fan controller + lowpass filter + pass device	MAX6639, MAX6615, MAX6641 (refer to app notes 3149 and 3530)	N/A	N/A
PWM Control	Low-frequency PWM controller + pass device	MAX6639, MAX6615, MAX31782, MAX31785	High-frequency PWM controller	MAX6639 (Figure 1), MAX6615, MAX31782, MAX31785
On/Off (Noise and Power-Supply Stress Are Not Concerns)	Temperature switch + pass device	MAX6510 (Figure 4)	Temperature switch	MAX6510 (Figure 2)

*Single output configurable as an interrupt or square wave.

Choosing the Right Fan Controller (cont.)

Using a 4-Wire Fan

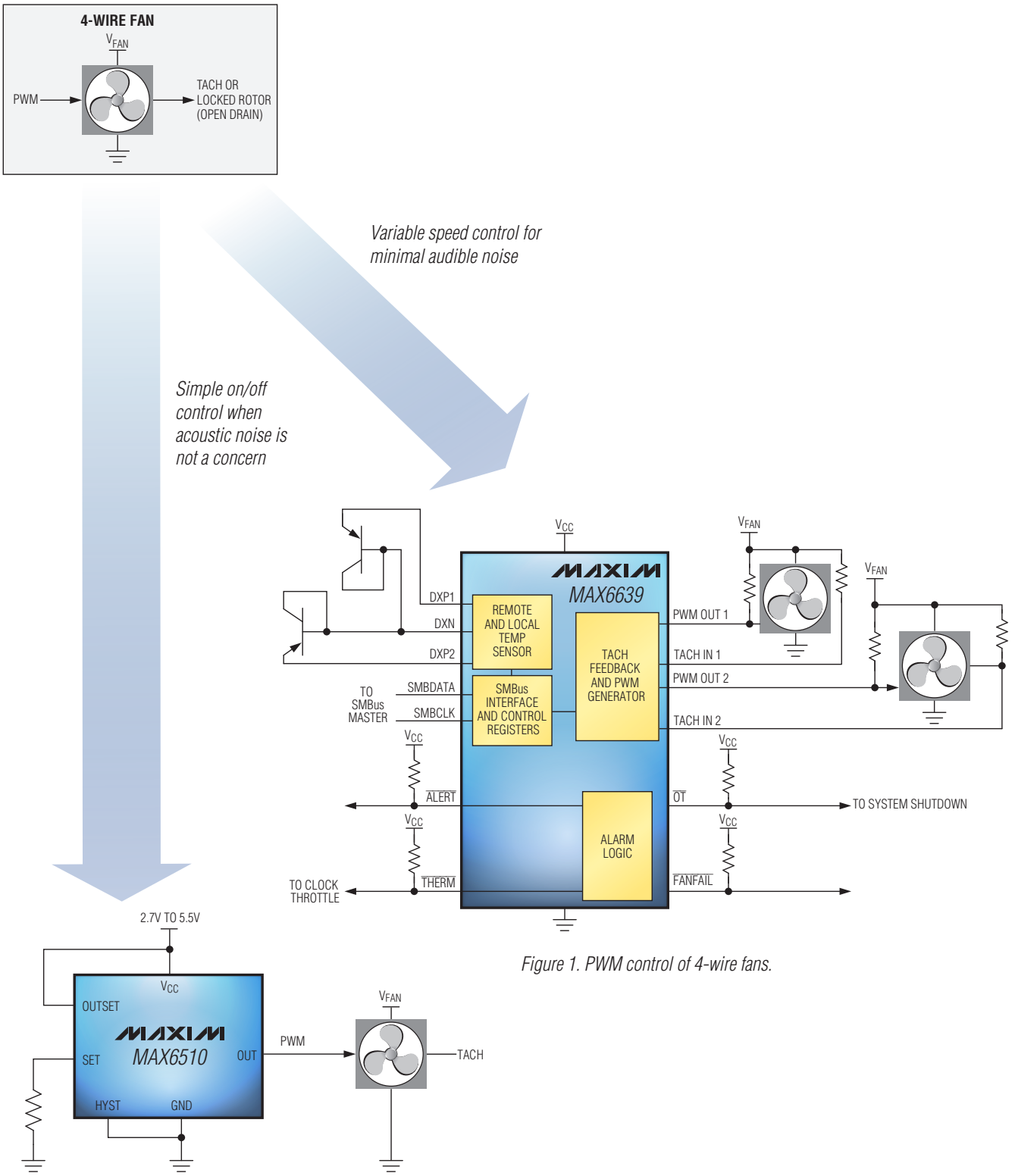


Figure 1. PWM control of 4-wire fans.

Figure 2. On/off control of a 4-wire fan with a temperature switch.

Choosing the Right Fan Controller (cont.)

Using a 2- or 3-Wire Fan

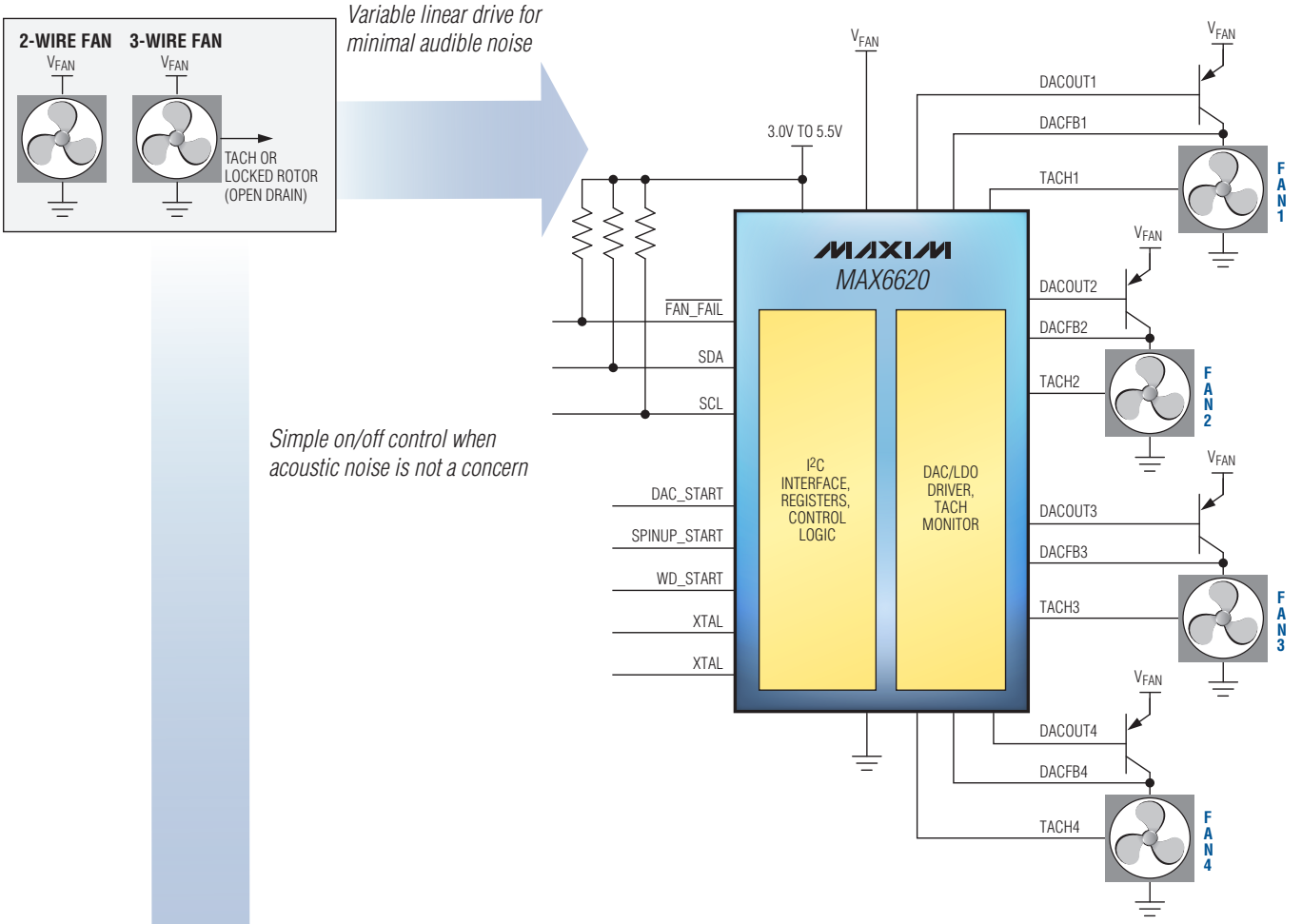


Figure 3. Fan-speed control of a 2- or 3-wire fan by varying the fan's power-supply voltages.

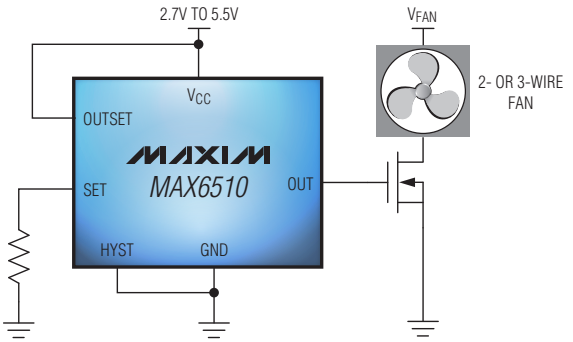
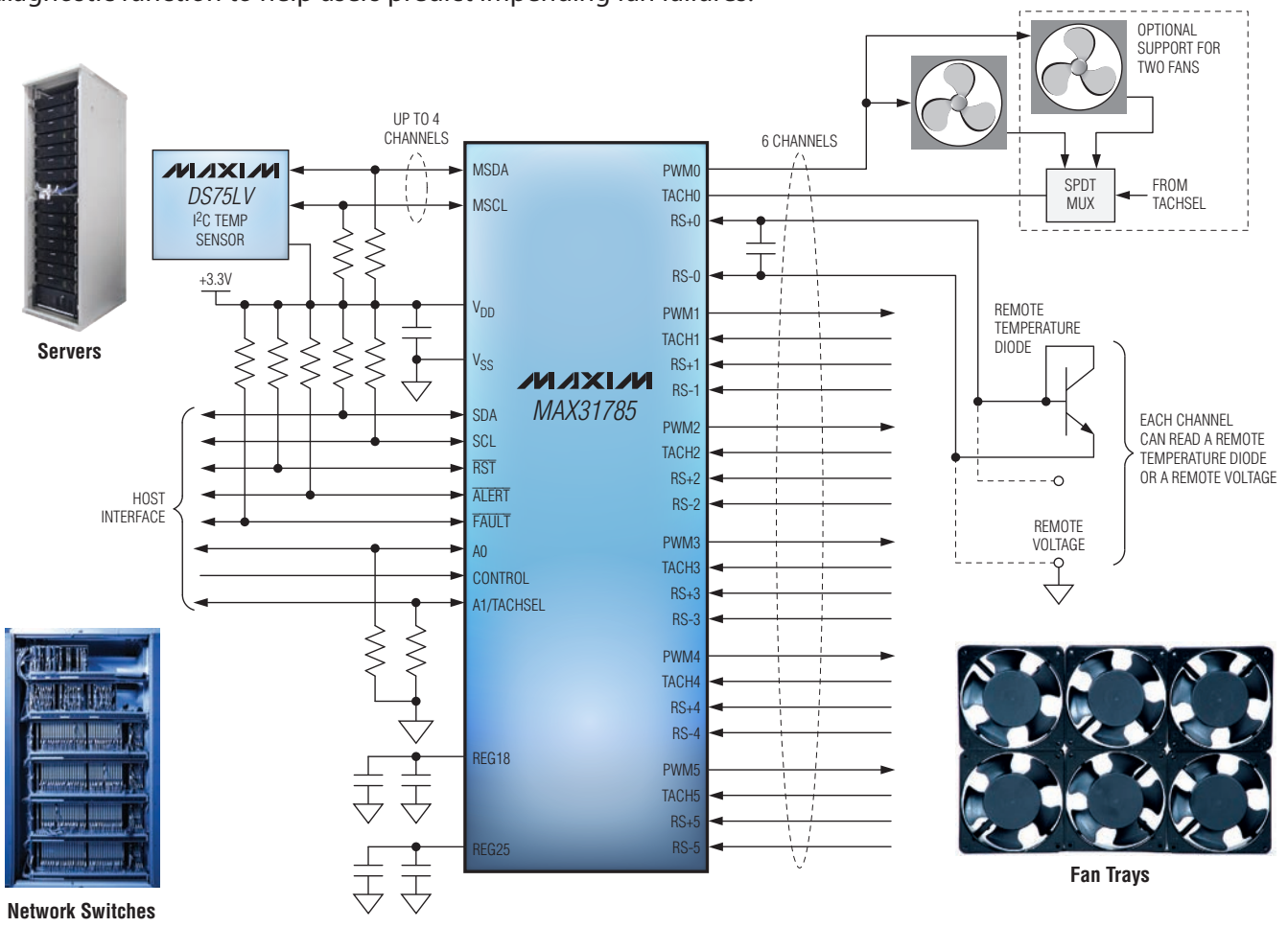


Figure 4. On/off control of a 2- or 3-wire fan using a temperature switch and pass transistor.

Industry's First 6-Channel, Intelligent Fan Controller Optimizes System Efficiency and Reliability

The MAX31785 saves system power by operating fans at the lowest possible speeds to reduce audible noise, extend fan life, and minimize system maintenance. This intelligent fan controller provides closed-loop fan control of six independent fans, based on the measurements of up to 11 available temperature-sensing sources. Alternately, an external host can manually command the fan speeds, while the component automatically adjusts them. To further improve system reliability, the MAX31785 contains a fan-health-diagnostic function to help users predict impending fan failures.



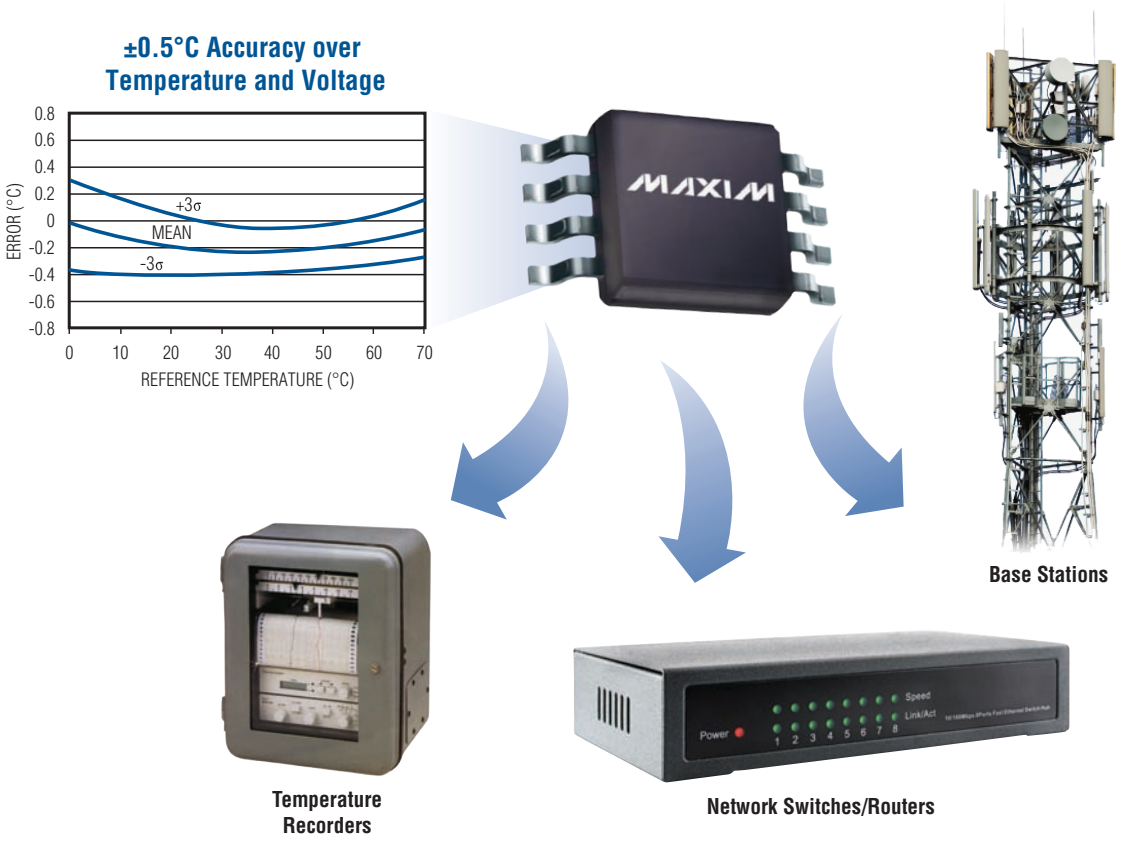
Integrates All Functions for Controlling Multiple Fans

- 6 independent channels of fan control support 3-wire and 4-wire fans
- User-selectable RPM- or PWM-based fan control eases system design
- Staggered fan spin-up eases power-supply stress
- 11 temperature-sensing sources monitor multiple hot spots
- Fault detection on all fans and temperature sensors improves reliability
- PMBus™-compliant command interface
- I²C/SMBus-compatible serial bus with bus timeout function
- Available in a 40-pin TQFN-EP package

PMBus is a trademark of SMIF, Inc.

Industry's Highest Accuracy Temp Sensors

We offer a broad range of temperature devices with an accuracy of ±0.5°C (max) over wide temperature and voltage ranges. Several popular digital-communication interfaces, including analog output, support a wide range of applications.

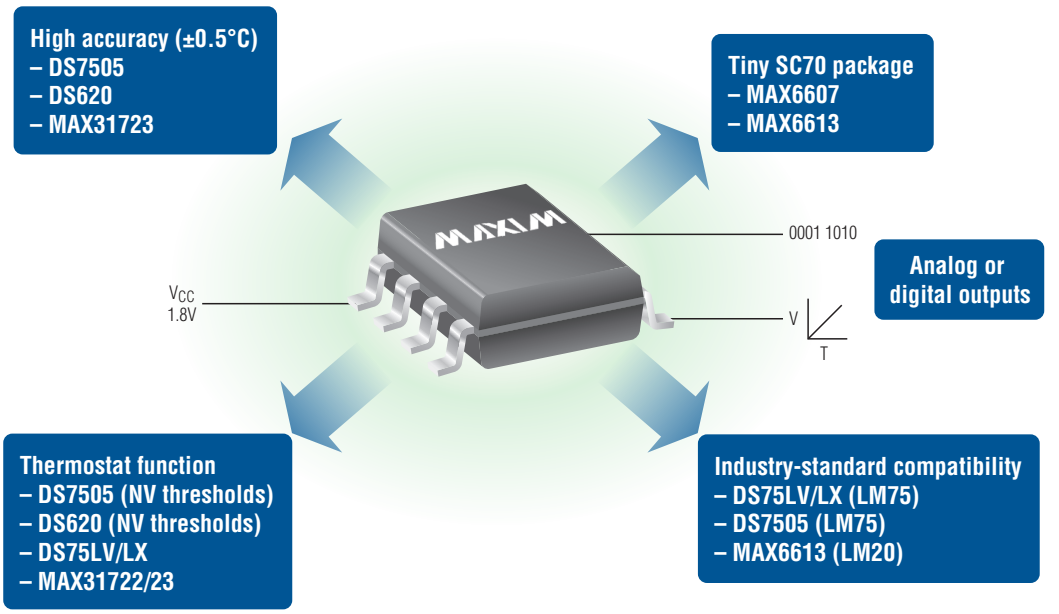


Highest Accuracy Temp Sensors

Part	Interface	Accuracy (°C)	Supply Voltage Range (V)	Package
DS18B20	1-Wire®	±0.5 (-10 to +85)	3.0 to 5.5	3-TO92, 8-µSOP (µMAX®), 8-SO
DS1620	3-wire	±0.5 (0 to +70)	2.7 to 5.5	8-SO
DS1631/DS1631A	2-wire			8-µSOP (µMAX), 8-SO
DS1626	3-wire			8-µSOP (µMAX)
DS620	2-wire		1.7 to 3.5	8-µSOP-EP (µMAX-EP)
DS600	Analog	±0.5 (-20 to +100)	2.7 to 5.5	8-µSOP-EP (µMAX-EP)
DS7505	2-wire	±0.5 (0 to +70)	1.7 to 3.7	8-µSOP (µMAX), 8-SO
MAX31723	SPI/3-wire	±0.5 (0 to +70)	1.7 to 3.7	8-µSOP (µMAX)

Most Complete Portfolio of Low-Voltage Temp Sensor ICs

Maxim offers a variety of temperature devices with supply voltages as low as 1.7V. Our portfolio includes both digital and analog sensors, with several accuracy grades to choose from. The low operating voltages simplify design in systems operating from commonly used low-voltage rails, as well as power-sensitive systems.



- Low supply voltage
  - 1.7V for digital temperature sensors
  - 1.8V for analog temperature sensors
- 2-wire, SPI/3-wire, and analog options
- -55°C to +125°C operating range (up to +130°C for the MAX6613)
- No external components required to measure temperature
- User-selectable 9- to 12-bit resolution
- Multiple packaging options, down to 5-pin SC70

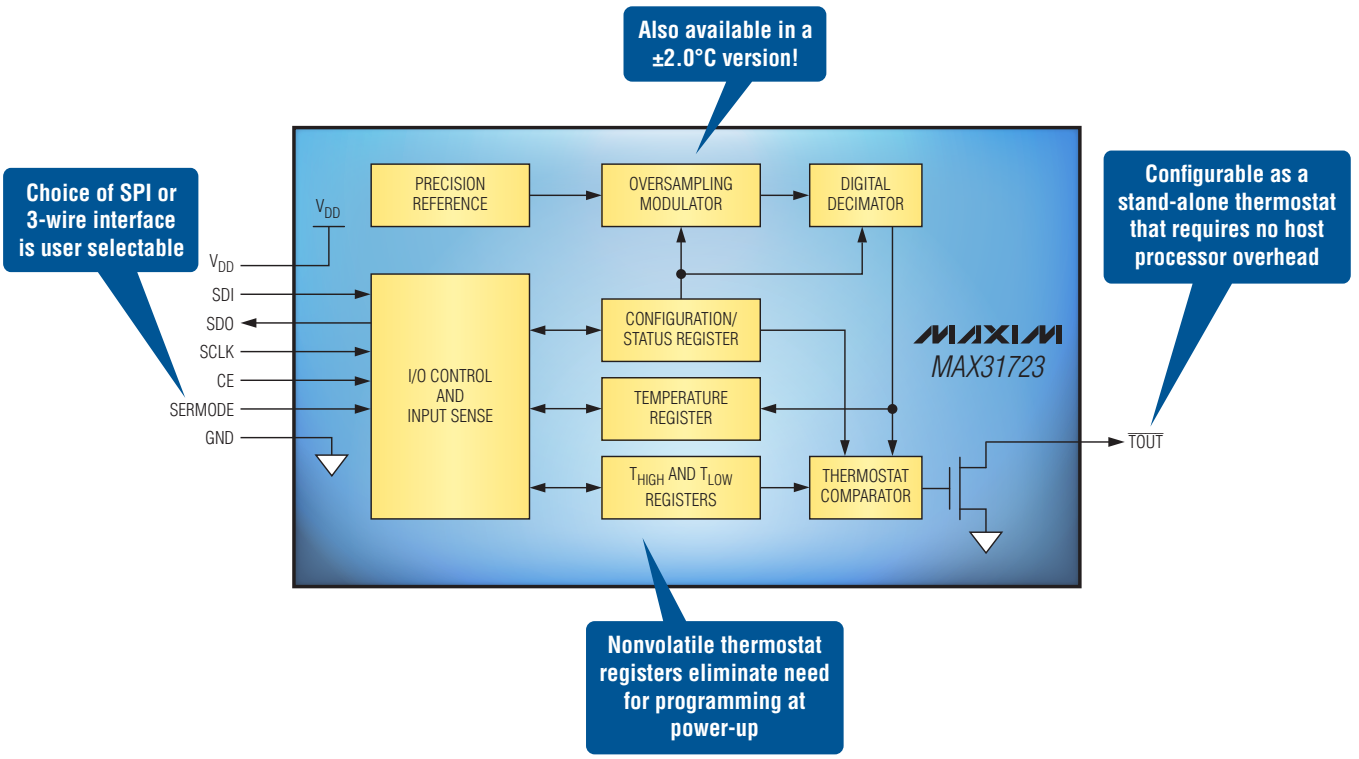
Low-Voltage Temperature Sensors

Part	Interface	Supply Voltage (V)	Accuracy (°C)	Package
DS7505	2-wire	1.7 to 3.7	±0.5 (0 to +70)	8-µSOP (µMAX), 8-SO
DS620		1.7 to 3.5	±0.5 (0 to +70)	8-µSOP-EP (µMAX-EP)
DS75LV		1.7 to 3.7	±2.0 (-25 to +100)	8-µSOP (µMAX), 8-SO
DS75LX		1.7 to 3.7	±2.0 (-25 to +100)	8-µSOP (µMAX), 8-SO
MAX6607	Analog	1.8 to 3.6	±3.5 (0 to +70)	5-SC70
MAX6608		1.8 to 3.6	±3.5 (0 to +70)	5-SOT23
MAX6613		1.8 to 5.5	±4.0 (0 to +50)	5-SC70
MAX31722	SPI/3-wire	1.7 to 3.7	±2.0 (-40 to +85)	8-µSOP (µMAX)
MAX31723		1.7 to 3.7	±0.5 (0 to +70)	8-µSOP (µMAX)

Industry's First SPI/3-Wire Temperature Sensor Operates from a Supply Voltage as Low as 1.7V

Accurate Temperature Sensor Enables Easy Implementation into Low-Power Systems

The MAX31723 SPI/3-wire temperature sensor provides measurements within ±0.5°C over a wide temperature range of 0° to +70°C. That accuracy, coupled with its low supply-voltage operation of 1.7V to 3.7V, aids designers in meeting error and power budgets.



Highly Versatile Temp Sensor Eases System Design

- Two accuracy versions
  - MAX31723: ±0.5°C from 0°C to +70°C; ±2.0°C from -55°C to +125°C
  - MAX31722: ±2.0°C from -40°C to +85°C; ±3.0°C from -55°C to +125°C
- Low 1.7V to 3.7V supply-voltage operating range
- Thermostat output with NV registers
- 9- to 12-bit resolution (0.5°C to 0.0625°C)
- -55°C to +125°C operating range
- SPI or 3-wire communication, user selectable
- Available in 8-pin µMAX package

Using Multichannel Temperature Sensors to Save Space and Cost

When a circuit board includes multiple hot spots, standard practice is to monitor the temperatures of those locations to avoid performance degradation and even catastrophic failure.

A conventional approach is shown in **Figure 1**, where a sensor is placed near each hot spot. Monitoring board hot spots can be done with standard local sensors (TS5–TS8). If a thermally sensitive component has a temperature-sensing transistor (also called a "thermal diode") integrated on the die of a high-temperature IC, a remote-temperature sensor can use the IC's thermal diode to accurately measure its die temperature (TS1–TS4).

Figure 2 shows the same board, but in this case, a single multichannel sensor IC monitors all of the hot spots. The circuit uses the MAX6581 (also see **Figure 3**), which can measure up to seven external temperatures as well as its own temperature. The device can monitor temperatures on ASICs, CPUs, and FPGAs using thermal diodes, or measure board hot spots using discrete diode-connected transistors and the internal local sensor.

Using a single IC to monitor several locations reduces sensor cost. It also simplifies the design by allowing several channels of temperature data to be read from a single I^2C slave address.

Features in Multichannel Temperature Sensors

- **Overtemperature Alarm Outputs.** These outputs are useful if you need a signal to indicate that one of the thermal channels has exceeded its temperature limit.
- **Bus Timeout.** Useful on I^2C and SMBus sensors, this timeout resets the bus if the IC holds the data line low for more than a preset limit (usually around 35ms), thus preventing the IC from locking up the bus.
- **Resistance Cancellation.** Excess resistance (more than a few ohms) in the remote-diode path will cause measurement errors. These errors are predictable if you know the resistance value. If you do not, resistance cancellation is helpful to eliminate series-resistance errors.
- **Beta Compensation.** Measurement errors can result when a target IC's thermal diode has very low beta (e.g., less than one). If your thermal diode's beta is low, a sensor with beta compensation will improve accuracy.
- **Thermistor Inputs.** A thermistor can be helpful for measuring temperature. For example, you can use a thermistor with long leads to monitor air temperature above the surface of a board.

Maintaining Good Measurement Accuracy

- If discrete diode-connected transistors are used, either pnps or npns will work. Use small-signal transistors with consistent beta greater than 50.
- Separate the thermal diode's signal traces from high-speed and high-current traces to avoid noise pickup.
- Use a filter capacitor at the thermal-diode inputs (DXP and DXN). See the sensor data sheet for the optimum value.
- Most multichannel sensors bias the thermal diode's cathode about 0.6V. If you want to measure the temperature of an IC with the thermal diode's cathode grounded, use one of Maxim's many multichannel sensors that specifies accuracy with a grounded cathode.

Using Multichannel Temperature Sensors (cont.)

Conventional Approach Using Multiple Sensors

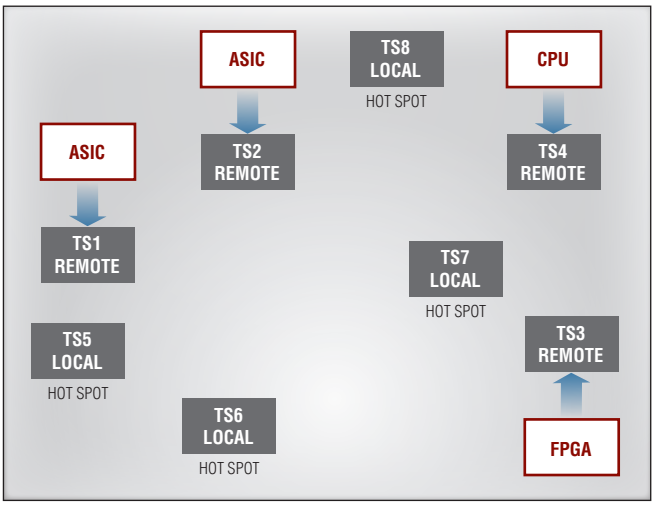


Figure 1. The conventional way to monitor multiple hot spots is to mount one temperature sensor at each location.

Improved Approach Using One Multichannel Sensor

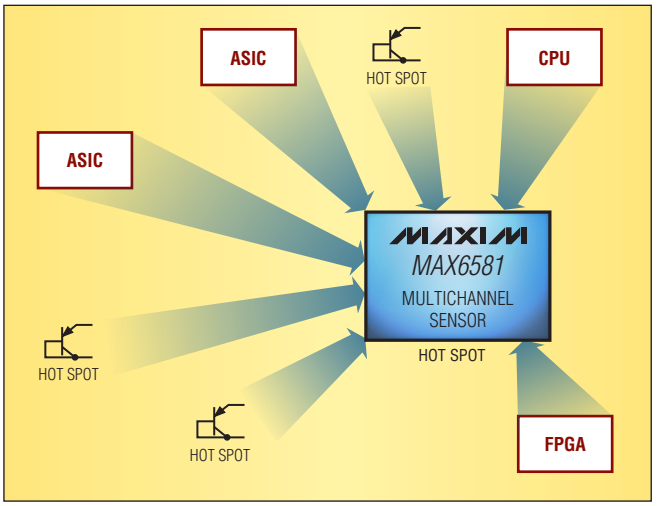


Figure 2. The MAX6581 can monitor up to seven external temperatures as well as its own die temperature. This approach saves space and cost by eliminating multiple discrete sensors.

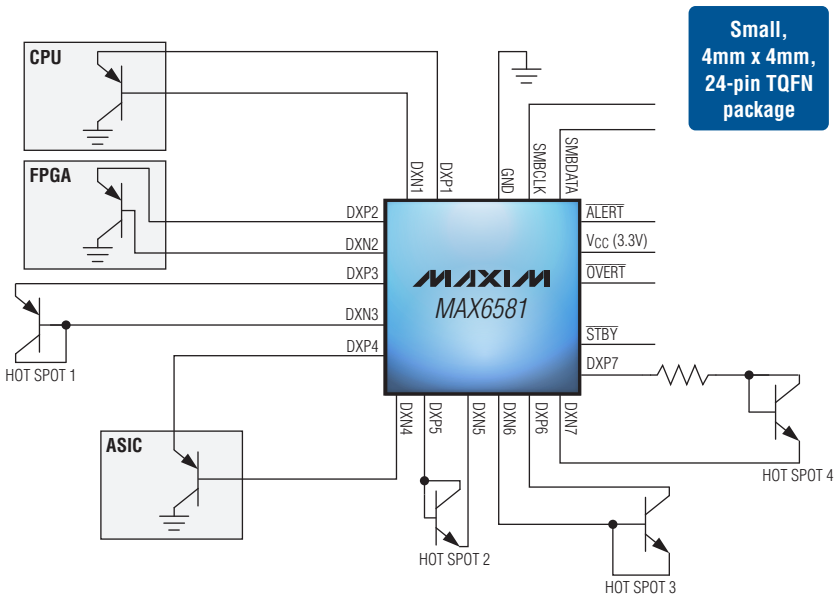


Figure 3. The MAX6581 monitors a total of eight temperature locations with ±1°C accuracy.

Highly Accurate MAX6581 Reduces Component Count

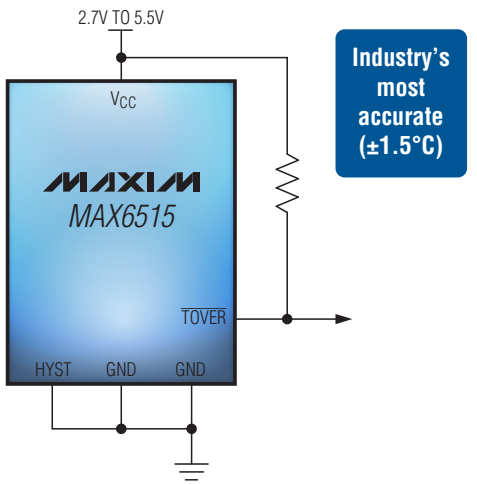
- 1 local and 7 remote temperature channels replace up to 8 individual sensors
- Remote-sensing channels monitor ASICs, FPGAs, CPUs, and board hot spots
- ±1°C remote-temperature accuracy (+60°C to +100°C)
- All remote channels have series-resistance cancellation

Industry's Most Comprehensive Portfolio of Temp Switches

Temperature switches provide simple protection from potentially damaging thermal conditions by generating an over- or undertemperature signal when the temperature is outside the safe operating range. Whatever kind of temperature switch you need—factory preset, resistor adjustable, pin strapped, or remote-diode sensing—Maxim has you covered.

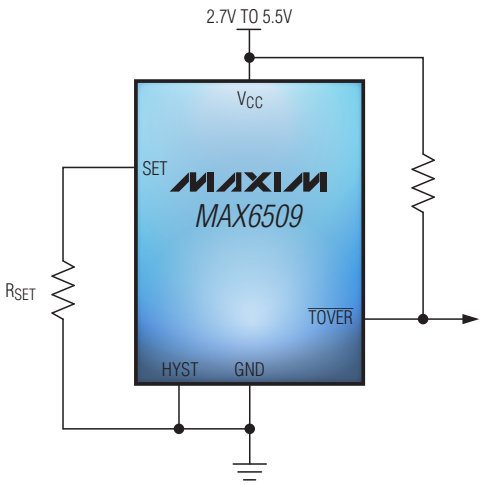
Factory-Preset Trip Thresholds

MAX6501–MAX6508
MAX6514–MAX6519



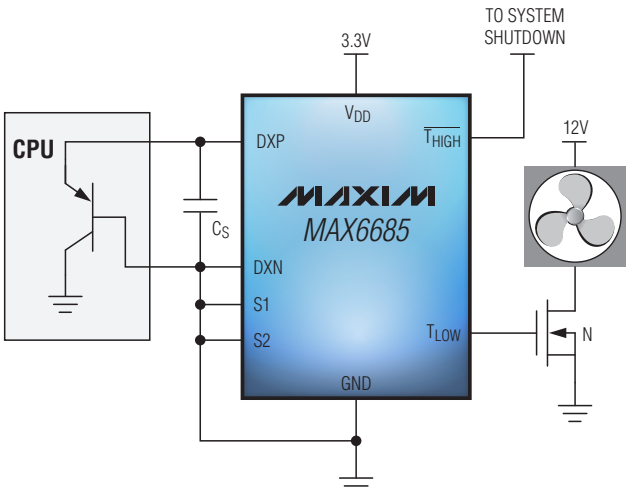
Resistor-Adjustable Trip Thresholds

MAX6509/MAX6510



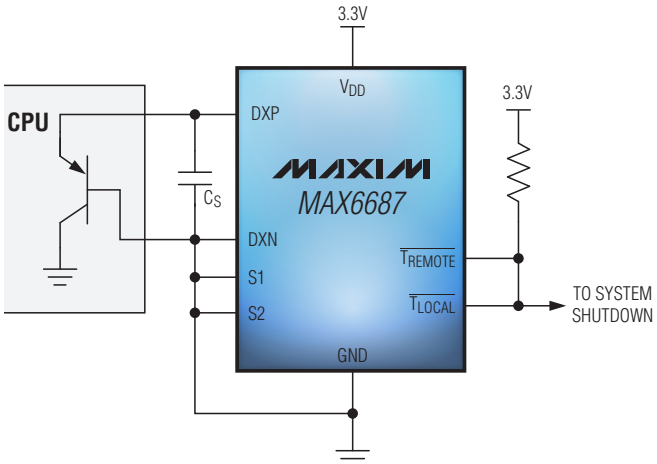
Remote with Preset or Pin-Strapped Thresholds

MAX6513 (Preset)
MAX6685/MAX6686 (Pin Strapped)



Local/Remote with Pin-Strapped Local Threshold

MAX6687/MAX6688



LM75-Compatible Temp Sensors—from Industry Standard to Best in the Industry

Maxim offers more than a dozen "LM75-compatible" temperature sensors that give you options ranging from industry-standard configurations to sensors with dramatically improved performance. Whether you need an alternate source for the standard LM75 or a temperature sensor that offers best-in-class performance, you will find what you are looking for at Maxim.

±0.5°C Accuracy and Nonvolatile Memory

If you need better accuracy than the LM75 can achieve, select the DS7505, a pin- and register-compatible upgrade with superior accuracy. The DS7505 features a maximum temperature-measurement error of ±0.5°C from 0°C to +70°C across its full power-supply range. The device operates from a 1.7V to 3.6V supply-voltage range, making it ideal for low-voltage systems.

The DS7505's conversion resolution is programmable from 0.5°C to 0.0625°C (9 to 12 bits). For systems that require the OS trip threshold to be the correct value at power-up, the DS7505's threshold is stored in nonvolatile memory. This is an especially powerful feature when using OS for system protection—for example, to disable the system's power supply when the measured temperature is too high.

Other Improvements

Maxim offers other LM75-compatible digital temperature sensors with a variety of improved features. Because temperature accuracy is guaranteed across the full supply-voltage range instead of just at 3.3V or 5.0V, all of these products have better accuracy than the LM75 in real systems.

An example is the DS75LX, which operates from power-supply voltages as low as 1.7V. This device is ideal for designs that require more than eight sensors on a single bus; its three address-selection inputs use three-state logic, resulting in 27 available slave addresses.

Products such as the MAX7501–MAX7504 offer another useful feature: an input that resets the I^2C interface. Pulling this input low returns the internal registers to their default values and resets the I^2C interface, thus allowing the I^2C master to reset any slaves on the board when a communications fault is detected.

Lastly, if you need a smaller footprint, choose the MAX6625, MAX6626, or DS1775. These devices are all register compatible with the LM75 and are available in space-saving, 3mm x 3mm SOT23 or TDFN packages.

Maxim's Industry-Standard, LM75-Compatible Temp Sensors

Maxim Sensor	Features	Benefits
DS7505	±0.5°C accuracy, NV memory, 1.7V to 3.6V supply range	Better accuracy, fail-safe overtemperature detection
DS75LV	1.7V to 3.7V supply range	Compatible with low-voltage, low-power designs
DS75LX	1.7V to 3.7V supply range, 27 I^2C addresses	Up to 27 sensors can be on a single bus
DS75	Fully compatible	Accuracy guaranteed across full supply voltage
MAX7500	Fully compatible	Accuracy guaranteed across full supply voltage
MAX7501–MAX7504	I^2C reset input	Allows controller to reset I^2C interface
MAX6625/MAX6626	3mm x 3mm, 6-pin TDFN package	Ideal for space-limited designs
DS1775	3mm x 3mm, 5-pin SOT23 package	Ideal for space-limited designs

www.maxim-ic.com/TempSensors

Remote Digital Temperature Sensors

www.maxim-ic.com/Thermal-Management

Part	Description	Interface	Remote Sensors	Local Sensor	Accuracy (°C)	Accuracy Range (°C)	Operating Temp Range (°C)	V_{CC} Supply Range (V)	I_{DD} (µA, max)	Package	Footprint (mm^2)	Price† ($)	EV Kit
MAX6627/28	Remote temp sensors with SPI interface	3-wire	1	—	±1	0 to +125	-55 to +125	3.0 to 5.5	400/50	8-TDFN, 8-SOT23	9	1.78	—
MAX6682	Thermistor-to-digital converter	3-wire	1	—	±3 LSB	—	-55 to +125	3.0 to 5.5	300	8-µMAX	15	1.89	—
MAX6581	8-channel, ±1°C accurate temp monitor	I^2C/SMBus	7	✓	±1	+60 to +100	-40 to +125	3.0 to 5.5	1000	24-TSSOP	16	*	—
MAX6602	5-channel temp monitor (4 remote, 1 local) with standby	I^2C/SMBus	4	✓	±1	+60 to +100	-40 to +125	3.0 to 5.5	1000	16-TSSOP	30	3.82	—
MAX6638	Remote/local temp monitor with 2 independent SMBus interfaces	I^2C/SMBus	1	✓	±2	+25 to +100	-40 to +125	3.0 to 5.5	950	16-TQFN	16	*	✓
MAX6642	Remote/local temp sensor with overtemp alarm	I^2C/SMBus	1	✓	±1	+60 to +100	-40 to +125	3.0 to 5.5	1000	6-TDFN	9	1.15	✓
MAX6646/47/49	Remote/local temp sensors with overtemp alarms	I^2C/SMBus	1	✓	±1	+60 to +145	-55 to +125	3.0 to 5.5	400	8-µMAX	15	1.96	—
MAX6648/92	Remote/local temp sensors with overtemp alarms	I^2C/SMBus	1	✓	±0.8	+25 to +125	-55 to +125	3.0 to 5.5	400	8-µMAX, 8-SO	15	1.96	—/✓
MAX6654	Remote/local temp sensor with resistance cancellation and overtemp alarm	I^2C/SMBus	1	✓	±2	+70 to +100	-55 to +125	3.0 to 5.5	1000	16-QSOP	30	2.37	✓
MAX6655/56	2-channel remote/local temp sensors and 4-channel voltage monitors	I^2C/SMBus	2	✓	±1.5	+60 to +100	-55 to +125	3.0 to 5.5	1000	16-QSOP	30	2.81	✓/—
MAX6657/58/59	Remote/local temp sensors with overtemp alarms	I^2C/SMBus	1	✓	±1	+60 to +100	-55 to +125	3.0 to 5.5	1000	8-SO, 16-QSOP	30	2.02	—
MAX6680/81	Fail-safe remote/local temp sensors with overtemp alarms	I^2C/SMBus	1	✓	±1	+60 to +100	-55 to +125	3.0 to 5.5	1000	16-QSOP	30	2.42	—/✓
MAX6689	7-channel temp monitor (6 remote, 1 local) with standby	I^2C/SMBus	6	✓	±1	+60 to +100	-40 to +125	3.0 to 5.5	1000	20-TSSOP, 20-QSOP	30	3.82	—
MAX6690	Remote/local temp sensor with resistance cancellation and overtemp alarm	I^2C/SMBus	1	✓	±2	+70 to +100	-55 to +125	3.0 to 5.5	70	16-QSOP	30	*	—
MAX6695/96	Dual remote/local temp sensors with fixed or pin-selectable SMBus address	I^2C/SMBus	2	✓	±1.5	+60 to +100	-40 to +125	3.0 to 5.5	1000	10-µMAX	15	2.42	✓/—
MAX6697	7-channel temp monitor (6 remote, 1 local)	I^2C/SMBus	6	✓	±1	+60 to +100	-40 to +125	3.0 to 5.5	1000	20-TSSOP, 20-QSOP	30	3.82	—
MAX6698	7-channel temp monitor (3 remote, 1 local, 3 thermistor)	I^2C/SMBus	6	✓	±1	+60 to +100	-40 to +125	3.0 to 5.5	1000	20-TSSOP, 20-QSOP	30	3.82	✓
MAX6699	5-channel temp monitor (4 remote, 1 local)	I^2C/SMBus	4	✓	±1	+60 to +100	-40 to +125	3.0 to 5.5	1000	16-TSSOP, 16-QSOP	30	3.82	—

Local Digital Temperature Sensors

Part	Description	Interface	Accuracy (°C)	Accuracy Range (°C)	Operating Temp Range (°C)	V_{CC} Supply Range (V)	I_{DD} (µA, max)	Package	Footprint (mm^2)	Price† ($)	EV Kit
DS1821	Programmable digital thermostat and thermometer	1-Wire	±1	0 to +85	-55 to +125	2.7 to 5.5	1000	8-SO, PR35	30	2.01	✓
DS1822	Econo 1-Wire digital thermometer	1-Wire	±2	-10 to +85	-55 to +125	3.0 to 5.5	1500	8-SO, TO-92	30	1.61	✓
DS1825	Precision 1-Wire digital thermometer with 4-bit ID	1-Wire	±0.5	-10 to +85	-55 to +125	3.0 to 3.7	1500	8-µMAX	15	1.70	✓
DS18B20	Precision digital thermometer	1-Wire	±0.5	-10 to +85	-55 to +125	3.0 to 5.5	1500	8-µSOP, 8-SO, TO-92	15	1.76	✓
DS18S20	Precision digital thermometer	1-Wire	±0.5	-10 to +85	-55 to +125	3.0 to 5.5	1500	8-SO, TO-92	30	2.09	✓
DS28EA00	Precision digital thermometer with sequence detect and GPIO	1-Wire	±0.5	-10 to +85	-40 to +85	3.0 to 5.5	1500	8-µSOP	15	2.25	✓
MAX6575	Temp sensor with single-wire time-delay interface	Single wire	±4.5	+85	-55 to +125	2.7 to 5.5	250	6-SOT23	9	0.79	—
MAX6576/77	Temp sensors with single-wire period output/frequency output	Single wire	±4.5/±3.5	+85	-55 to +125	2.7 to 5.5	250	6-SOT23	9	0.79	—
DS1620	Precision digital thermometer and thermostat	3-wire	±0.5	0 to +70	-55 to +125	2.7 to 5.5	1000	8-SO, 8-DIP	30	2.89	✓
DS1624	Precision digital thermometer and memory	3-wire	±0.5	0 to +70	-55 to +125	2.7 to 5.5	1000	8-SO, 8-DIP	30	3.75	✓
DS1626	Precision digital thermometer and thermostat	3-wire	±0.5	0 to +70	-55 to +125	2.7 to 5.5	1000	8-µMAX	15	1.66	✓
DS1720	Econo digital thermometer and thermostat	3-wire	±2.5	-55 to +125	-55 to +125	2.7 to 5.5	1000	8-SO	30	2.26	✓
DS1722	Digital thermometer	SPI/3-wire	±2	-40 to +85	-55 to +125	2.65 to 5.5	500	8-µMAX, 8-SO	15	1.10	✓
DS1726	Digital thermometer and thermostat	3-wire	±1	-10 to +85	-55 to +125	2.7 to 5.5	400	8-µMAX	15	1.61	—
MAX6629–32	Digital temp sensors with SPI interface	3-wire	±1	0 to +70	-55 to +150	3.0 to 5.5	400/50	6-TDFN, 6-SOT23	9	1.39	✓/—
MAX6662	12-bit + sign SPI temp sensor	3-wire	±1.6	0 to +70	-55 to +150	3.0 to 5.5	600	8-SO	30	1.44	—
DS1629	Digital thermometer and real-time clock (RTC)	I^2C/SMBus	±2	-10 to +85	-55 to +125	2.2 to 5.5	1000	8-SO	30	3.22	✓
DS1631	Precision digital thermometer and thermostat	I^2C/SMBus	±0.5	0 to +70	-55 to +125	2.2 to 5.5	1000	8-µMAX, 8-SO	30	1.66	✓
DS1721	Digital thermometer and thermostat	I^2C/SMBus	±1	-10 to +85	-55 to +125	2.7 to 5.5	1000	8-µMAX, 8-SO	30	1.61	✓
DS1731	Digital thermometer and thermostat	I^2C/SMBus	±1	-10 to +85	-55 to +125	2.2 to 5.5	1000	8-µMAX	15	1.61	✓
DS1775	Digital thermometer and thermostat	I^2C/SMBus	±2	-10 to +85	-55 to +125	2.7 to 5.5	1000	5-SOT23	9	0.88	✓
DS620	Low-voltage, precision digital thermometer and thermostat	I^2C/SMBus	±0.5	0 to +70	-55 to +125	1.7 to 3.5	800	8-µMAX	15	1.66	✓
DS75	Digital thermometer and thermostat	I^2C/SMBus	±2	-25 to +100	-55 to +125	2.7 to 5.5	1000	8-µMAX, 8-SO	15	0.90	✓
DS75LV	Low-voltage digital thermometer and thermostat	I^2C/SMBus	±2	-25 to +100	-55 to +125	1.7 to 3.7	1000	8-µMAX, 8-SO	15	0.90	✓
DS75LX	Digital thermometer and thermostat with extended addressing	I^2C/SMBus	±2	-25 to +100	-55 to +125	1.7 to 3.7	1000	8-µMAX, 8-SO	15	0.75	✓
LM75	Digital temp sensor and thermal watchdog (LM75 second source)	I^2C/SMBus	±2	-25 to +100	-55 to +125	3.0 to 5.5	500	8-µMAX, 8-SO	15	0.65	—
MAX6604	Temp monitor for DDR memory modules	I^2C/SMBus	±2	+40 to +125	-20 to +125	2.7 to 3.6	500	8-TDFN, 8-TSSOP	6	0.95	—
MAX6625/26	Digital temp sensors with overtemp alarm	I^2C/SMBus	±2	0 to +70	-55 to +125	3.0 to 5.5	1000	6-TDFN, 6-SOT23	9	0.90	—
MAX6633/34/35	Digital temp sensors with overtemp alarms and 4/3/2 address pins	I^2C/SMBus	±1.5	-20 to +125	-55 to +150	3.0 to 5.5	350	8-SO	30	1.28	—
MAX6652/83	Digital temp sensors and 4-channel voltage monitor	I^2C/SMBus	±3	-20 to +80	-40 to +125	2.7 to 5.5	500	10-µMAX	15	1.84	—
MAX7500–04	Digital temp sensors with overtemp alarm (LM75 compatible)	I^2C/SMBus	±2	-25 to +100	-55 to +125	3.0 to 5.5	500	8-µMAX, 8-SO	15	0.72	—
MAX31722	Low-voltage, SPI/3-wire temperature sensor	SPI/3-wire	±2	-40 to +85	-55 to +125	1.3 to 3.7	1200	8-µMAX	15	0.75	—
MAX31723	Low-voltage, SPI/3-wire precision temperature sensor	SPI/3-wire	±0.5	0 to +70	-55 to +125	1.3 to 3.7	1200	8-µMAX	15	1.40	—

†1000-up recommended resale. Prices provided are for design guidance and are FOB USA. International prices will differ due to local duties, taxes, and exchange rates. Not all packages are offered in 1k increments, and some may require minimum order quantities.
*Contact factory for pricing details.

Analog Temperature Sensors

www.maxim-ic.com/Thermal-Management

Part	Description	Accuracy (°C)	Accuracy Range (°C)	Operating Temp Range (°C)	V_{CC} Supply Range (V)	I_{DD} (µA, max)	Package	Footprint (mm^2)	Price† ($)	EV Kit
DS600	Precision analog temp sensor with temp switch	±0.5	-20 to +100	-40 to +125	2.7 to 5.5	140	8-µMAX	15	1.80	✓
MAX6605	Analog temp sensor in SC70	±3.8	-20 to +85	-55 to +125	2.7 to 5.5	10	5-SC70	4	0.40	—
MAX6607/08	1.8V analog temp sensors in SC70/SOT23	±5	-10 to +85	-20 to +85	1.8 to 3.6	15	5-SC70, 5-SOT23	4/9	0.59	—
MAX6610/11	Temp sensors with voltage reference in SOT23	±3.7	-20 to +85	-40 to +125	3.0 to 5.5	250	6-SOT23	9	0.80	—
MAX6612	High-slope analog temp sensor	±4.3	+60 to +100	-55 to +150	2.4 to 5.5	35	5-SC70	4	0.59	—
MAX6613	1.8V to 5.5V analog temp sensor	±4.4	-20 to +85	-55 to +130	1.8 to 5.5	13	5-SC70	4	0.35	—

Temperature Switches

Part	Description	Remote Sensors	Local Sensor	Accuracy (°C)	Accuracy Range (°C)	Operating Temp Range (°C)	V_{CC} Supply Range (V)	I_{DD} (µA, max)	Package	Footprint (mm^2)	Price† ($)	EV Kit
MAX6501–04	Temp switches with factory-set thresholds (in 10°C increments)	0	✓	±6	+75 to +125	-55 to +125	2.7 to 5.5	85	5-SOT23, 7-TO-220	9	0.67	—
MAX6505–08	Dual-output temp switches with factory-set thresholds (in 5°C increments)	0	✓	±3.5	0 to +95	-55 to +125	2.5 to 5.5	1	6-SOT23	9	0.79	—
MAX6509/10	Resistor-programmable temp switches	0	✓	±4.7	0 to +125	-55 to +125	2.5 to 5.5	0	5-SOT23, 6-SOT23	9	0.70	—
MAX6513	Remote temp switch with factory-set thresholds (in 10°C increments)	1	—	±5	-40 to +85	-40 to +85	3.0 to 5.5	600	6-TDFN	9	0.85	—
MAX6514/15	Temp switches with factory-set thresholds (in 10°C increments)	0	✓	±2.5	+75 to +115	-55 to +125	2.7 to 5.5	40	5-SOT23	9	0.75	—
MAX6516–19	Temp switches with analog outputs, factory-set thresholds (in 10°C increments)	0	✓	±2.5	+75 to +115	-55 to +125	2.7 to 5.5	40	5-SOT23	9	0.75	—
MAX6685/86	Dual-output remote-junction temp switches	1	—	±1.5	0 to +125	-40 to +125	3.0 to 5.5	800	8-µMAX	15	3.31	—
MAX6687	Dual-output remote-junction temp switch	1	✓	±3	0 to +85	-40 to +125	3.0 to 5.5	800	8-µMAX	15	3.31	—

Fan Controllers

Part	Description	Interface	Remote Sensors	Local Sensor	Fan Outputs	Tach Inputs	Operating Temp Range (°C)	V_{CC} Supply Range (V)	I_{DD} (µA, max)	Package	Footprint (mm^2)	Price† ($)	EV Kit
MAX6665	Temp switch with factory-programmed threshold and fan on/off driver	Analog	0	✓	1	—	-40 to +125	2.7 to 5.5	200	8-SO	30	1.32	—
DS1780	2-channel hardware monitor with DAC output	I^2C/SMBus	0	✓	1	—	-40 to +125	2.8 to 5.75	1000	24-TSSOP	52	2.21	✓
MAX6615/16	2-channel temp monitors/fan-speed controllers with thermistor inputs	I^2C/SMBus	2	✓	2	2	-40 to +125	3.0 to 5.5	—	16-QSOP/24-QSOP	30	1.95	—/✓
MAX6620	Quad linear fan controller with RPM control	I^2C/SMBus	0	—	4	4	-40 to +125	3.0 to 5.5	500	28-TQFN	25	2.50	✓
MAX6639	2-channel temp monitor with dual PWM fan-speed control	I^2C/SMBus	1	✓	2	2	-40 to +125	3.0 to 3.6	1000	16-TQFN, 16-QSOP	25	1.22	—/✓
MAX6650/51	Fan-speed regulators and monitors (single/quad)	I^2C/SMBus	0	—	1	1/4	-40 to +85	3.0 to 5.5	10,000	10-µMAX	15	2.10	—/✓
MAX6653/63/64	Local/remote temp monitors and PWM fan controllers	I^2C/SMBus	1	✓	1	1	-40 to +125	3.0 to 5.5	—	16-QSOP	30	2.02	✓/—
MAX6660	Remote temp monitor and fan-speed controller	I^2C/SMBus	1	—	1	1	-40 to +125	3.0 to 5.5	500	16-QSOP	30	3.26	✓
MAX6661	Remote-junction, temp-controlled fan-speed regulator	I^2C/SMBus	1	—	1	1	-40 to +125	3.0 to 5.5	700	16-QSOP	30	3.46	—
MAX6678	2-channel temp monitor with dual-PWM fan controller and 5 GPIOs	I^2C/SMBus	2	✓	2	—	-40 to +125	3.0 to 5.5	1000	20-TQFN, 20-QSOP	25	1.82	—
MAX6684	Fan-failure detector and power switch for 2-wire fans	Logic	0	—	1	—	-40 to +85	3.0 to 5.5	3400	8-SO	30	1.06	—
MAX31782	System management microcontroller	I^2C/SMBus	6	✓	6	6	-40 to +85	2.7 to 5.5	2340	40-TQFN	36	3.45	✓
MAX31785	6-channel intelligent fan controller	I^2C/SMBus	10	✓	6	6	-40 to +85	2.7 to 5.5	3000	40-TQFN	36	3.45	✓

Other Thermal Products

Part	Description	Interface	Operating Temp Range (°C)	V_{CC} Supply Range (V)	I_{DD} (µA, max)	Package	Footprint (mm^2)	Price† ($)	EV Kit
DS1682	Total-elapsed-time recorder with alarm	I^2C/SMBus	-40 to +85	2.5 to 5.5	300	8-SO	30	1.73	—
DS2422	1-Wire temp/data logger with 8KB data-log memory	1-Wire	-40 to +85	2.8 to 3.6	350	24-SO	166	27.25	—
MAX6603	2-channel platinum RTD-to-voltage signal conditioner	Analog	-40 to +125	3.0 to 5.5	5500	10-TDFN	9	1.50	✓
MAX6618	PECI-to-I^2C translator	I^2C/SMBus	-20 to +120	3.0 to 3.6	7000	10-µMAX	15	*	—
MAX6674/75	K-thermocouple-to-digital converters (0°C to +128°C and 0°C to +1024°C)	3-wire	-20 to +85	3.0 to 5.5	1500	8-SO	30	3.82	✓
MAX6684	Fan-failure detector and power switch for 2-wire fans	Logic	-40 to +85	3.0 to 5.5	3400	8-SO	30	1.06	—
MAX31855	Thermocouple-to-digital converter for K, J, N, T, R, E, and S type thermocouples	SPI	-40 to +125	3.0 to 3.6	1500	8-SO	30	3.10	✓

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