SUNSTAR传感与控制 http://www.sensor-ic.com/ TEL:0755-83376549 FAX:0755-83376182 E-MAIL:szss20@163.com

19-2660; Rev 1; 1/03

MAXIM

Low-Voltage, 1.8kHz PWM Output Temperature Sensors

General Description

The MAX6676/MAX6677 are high-accuracy, low-power temperature sensors with a single-wire output. The MAX6676/MAX6677 convert the ambient temperature into a ratiometric PWM output with temperature information contained in the duty cycle of the output square wave. The MAX6676 has an open-drain output and the MAX6677 has a push-pull output.

The MAX6676/MAX6677 are specified for operation with power-supply voltages from 1.8V to 3.6V, or from 3.6V to 5.5V (MAX6676 only). The typical unloaded supply current is 80µA. All devices feature a single-wire output that minimizes the number of pins necessary to interface with a microprocessor (µP). The output is a square wave with a nominal frequency of 1.8kHz (±20%) at +25°C. The output format is decoded as follows:

$$\text{Temperature (°C)} = 398.15 \times (t_1 / t_2) - 273.15$$

Where t_1 is fixed with a typical value of 0.24ms and t_2 is modulated by the temperature. The MAX6676/MAX6677 operate from -40°C to +125°C and are available in space-saving 6-pin SOT23 packages.

Applications

Process Control

Industrial

HVAC and Environmental Control

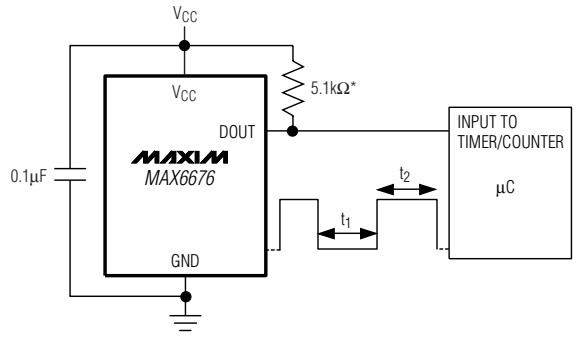
Automotive

Portable Devices

µP and µC Temperature Monitoring

Isolated Temperature Sensing

Typical Operating Circuit



*REQUIRED ONLY FOR MAX6676.

Features

- Simple Single-Wire, 1.8kHz PWM Output
- Operates Down to 1.8V
- High Accuracy
  ±1.5°C at T_A = +25°C
  ±3.0°C at T_A = 0°C to +85°C
- Operates from -40°C to +125°C
- Low 80µA Typical Current Consumption
- Small 6-Pin SOT23 Package

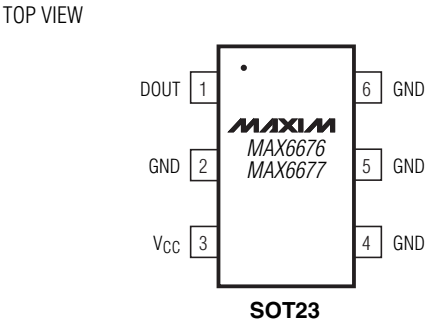
Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX6676AUT3-T	-40°C to +125°C	6 SOT23-6
MAX6676AUT5-T	-40°C to +125°C	6 SOT23-6
MAX6677AUT3-T	-40°C to +125°C	6 SOT23-6

Selector Guide

PART	OUTPUT TYPE	SUPPLY VOLTAGE RANGE (V)	TOP MARK
MAX6676AUT3	Open drain	1.8 to 3.6	ABBF
MAX6676AUT5	Open drain	3.6 to 5.5	ABBG
MAX6677AUT3	Push-pull	1.8 to 3.6	ABBH

Pin Configuration



SOT23

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.

SUNSTAR自动化 http://www.sensor-ic.com/ TEL: 0755-83376489 FAX:0755-83376182 E-MAIL:szss20@163.com

SUNSTAR传感与控制 http://www.sensor-ic.com/ TEL:0755-83376549 FAX:0755-83376182 E-MAIL:szss20@163.com

Low-Voltage, 1.8kHz PWM Output Temperature Sensors

ABSOLUTE MAXIMUM RATINGS

(Voltages Referenced to GND)
V_{CC} .....-0.3V to +6.0V
DOUT (MAX6676).....-0.3V to +6.0V
DOUT (MAX6677).....-0.3V to (V_{CC} + 0.3V)
DOUT Current .....-1mA to +50mA
ESD Protection (DOUT, Human Body Model) .....±2000V

Continuous Power Dissipation (T_A = +70°C)
6-Pin SOT23 (derate 8.7mW/°C above +70°C).....695.7mW
Operating Temperature Range .....-40°C to +125°C
Storage Temperature Range .....-65°C to +150°C
Junction Temperature .....+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} = 1.8V to 3.6V (MAX6676AUT3/MAX6677AUT3), V_{CC} = 3.6V to 5.5V (MAX6676AUT5), T_A = -40°C to +125°C, unless otherwise noted. Typical values are at V_{CC} = 3.0V (MAX6676AUT3/MAX6677AUT3), V_{CC} = 5.0V (MAX6676AUT5), T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage Range	V_{CC}	MAX6676AUT3/MAX6677AUT3	1.8		3.6	V
		MAX6676AUT5	3.6		5.5	
Supply Current	I_{CC}	R_L = ∞		80	200	µA
Temperature Error		T_A = +25°C	-1.5		+1.5	°C
		T_A = 0°C to +85°C	-3.0		+3.0	
		T_A = -20°C to +100°C	-4.2		+4.2	
		T_A = -40°C to +125°C	-5.5		+5.5	
Nominal t_1 Pulse Width				240		µs
Output High Voltage	V_{OH}	I_{OH} = 800µA, MAX6677	V_{CC} - 0.3			V
Output Leakage Current		V_{OUT} = V_{CC}		0.1		µA
Output Low Voltage	V_{OL}	I_{OL} = 3mA			0.3	V
Fall Time	t_F	C_L = 100pF, R_L = 10kΩ		20		ns
Rise Time	t_R	MAX6676, C_L = 15pF, R_L = 10kΩ		300		ns
		MAX6677, C_L = 100pF, R_L = 10kΩ		30		
Digital Output Capacitance	C_{OUT}			15		pF
Power-Supply Rejection Ratio	PSRR	V_{CC} = 1.8V - 3.6V	-1.2	+0.4	+1.2	°C/V

Note 1: Parts are tested at +25°C. Specifications are guaranteed by design over temperature.

SUNSTAR自动化 http://www.sensor-ic.com/ TEL: 0755-83376489 FAX:0755-83376182 E-MAIL:szss20@163.com

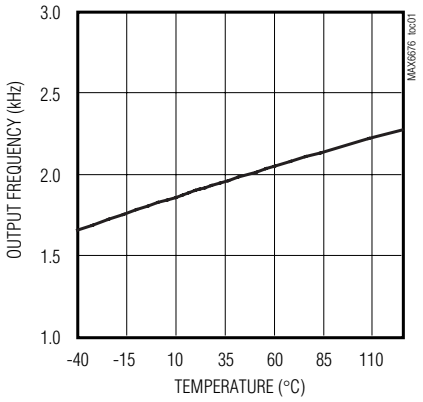
SUNSTAR传感与控制 http://www.sensor-ic.com/ TEL:0755-83376549 FAX:0755-83376182 E-MAIL:szss20@163.com

Low-Voltage, 1.8kHz PWM Output Temperature Sensors

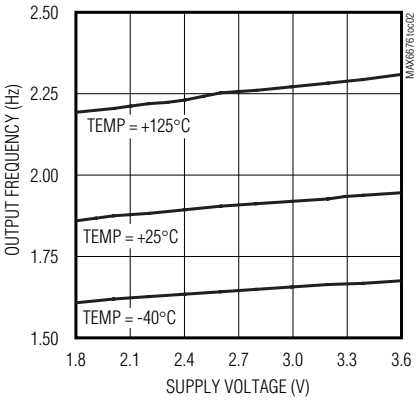
Typical Operating Characteristics

(V_{CC} = 3.0V, T_A = +25°C, unless otherwise noted.)

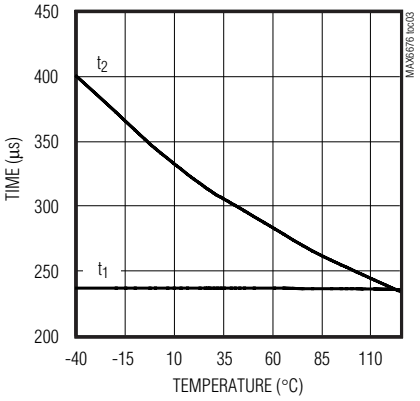
OUTPUT FREQUENCY vs. TEMPERATURE



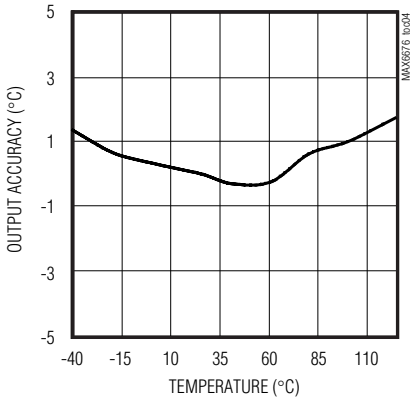
MAX6676AUT3 OUTPUT FREQUENCY vs. SUPPLY VOLTAGE



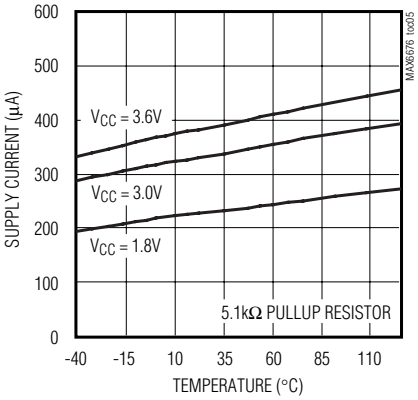
t_1 AND t_2 TIMES vs. TEMPERATURE



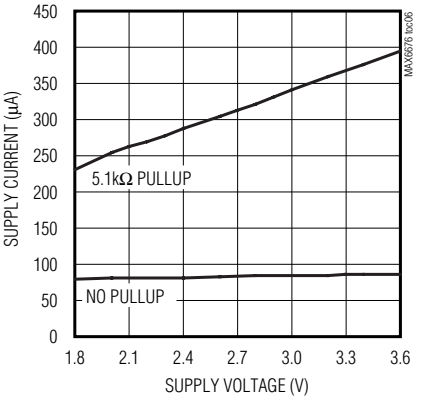
OUTPUT ACCURACY vs. TEMPERATURE



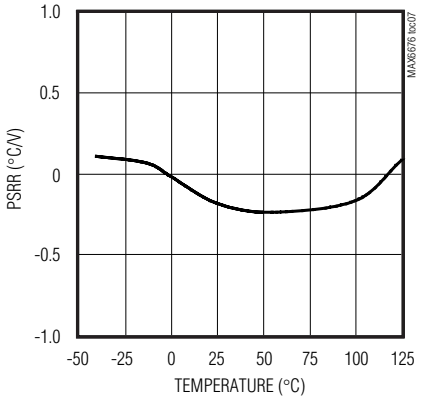
MAX6676AUT3 SUPPLY CURRENT vs. TEMPERATURE



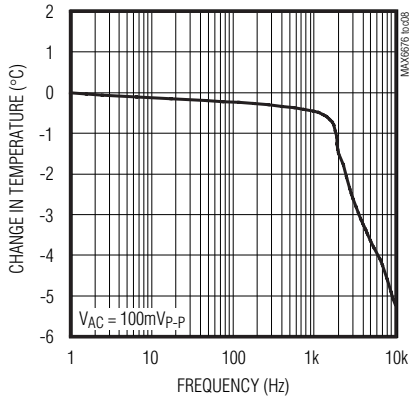
MAX6676AUT3 SUPPLY CURRENT vs. SUPPLY VOLTAGE



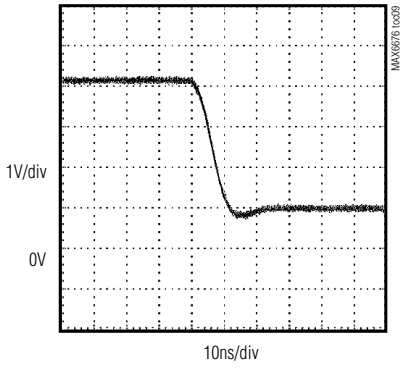
POWER-SUPPLY REJECTION RATIO vs. TEMPERATURE



POWER-SUPPLY REJECTION RATIO vs. FREQUENCY



OUTPUT FALL TIME (C_L = 100pF, R_L = 100kΩ)



SUNSTAR自动化 http://www.sensor-ic.com/ TEL: 0755-83376489 FAX:0755-83376182 E-MAIL:szss20@163.com

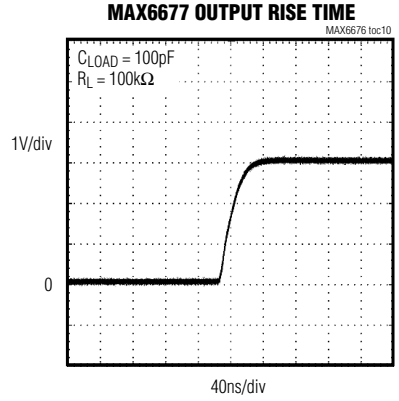
SUNSTAR传感与控制 http://www.sensor-ic.com/ TEL:0755-83376549 FAX:0755-83376182 E-MAIL:szss20@163.com

Low-Voltage, 1.8kHz PWM Output Temperature Sensors

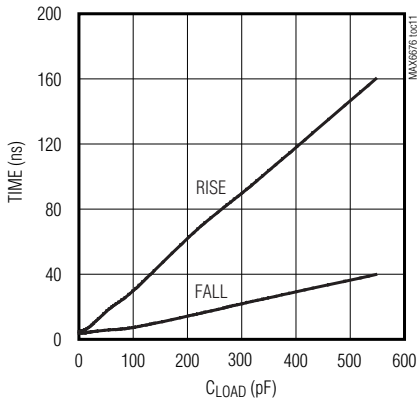
Typical Operating Characteristics (continued)

(V_{CC} = 3.0V, T_A = +25°C, unless otherwise noted.)

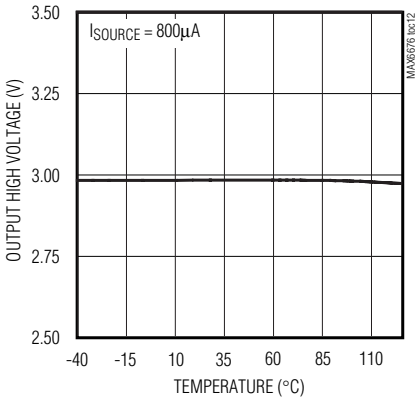
MAX6677 OUTPUT RISE TIME



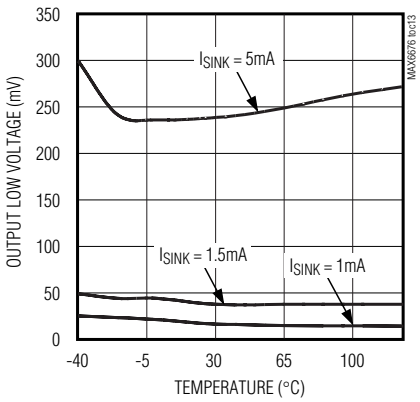
MAX6677 OUTPUT RISE AND FALL TIMES vs. CAPACITIVE LOAD



MAX6677 OUTPUT HIGH VOLTAGE vs. TEMPERATURE



MAX6677 OUTPUT LOW VOLTAGE vs. TEMPERATURE



SUNSTAR自动化 http://www.sensor-ic.com/ TEL: 0755-83376489 FAX:0755-83376182 E-MAIL:szss20@163.com

SUNSTAR传感与控制 http://www.sensor-ic.com/ TEL:0755-83376549 FAX:0755-83376182 E-MAIL:szss20@163.com

Low-Voltage, 1.8kHz PWM Output Temperature Sensors

Pin Description

PIN	NAME	FUNCTION
1	DOUT	Digital Output Pin. The duty cycle of the output waveform is modulated by temperature.
2, 4, 5, 6	GND	Ground. All four ground pins must be connected to GND.
3	V_{CC}	Supply Voltage. Bypass V_{CC} to GND with a 0.1µF capacitor.

Detailed Description

The MAX6676/MAX6677 are high-accuracy, low-current (80µA, typ) temperature sensors ideal for interfacing with µCs or µPs. The MAX6676/MAX6677 convert the ambient temperature into a ratiometric PWM output at a nominal frequency of 1.8kHz (±20%) at +25°C.

The time periods, t_1 (low) and t_2 (high) (Figure 1), are easily read by a µP's timer/counter port. To calculate the temperature, use the following expression:

$$\text{Temperature (°C)} = 398.15 \times (t_1 / t_2) - 273.15$$

The µC or µP measures the output of the MAX6676/MAX6677 by counting t_1 and t_2 and computing the temperature based on their ratio. The resolution of the count is a function of the processor clock frequency and the resolution of the counter. Always use the same clock for t_1 and t_2 counters so that the temperature is strictly based on a ratio of the two times, thus eliminating errors due to different clocks' frequencies.

The MAX6677 (Figure 2a) has a push-pull output with full CMOS output swings. The ability to source and sink current allows the MAX6677 to drive capacitive loads up to 100pF with less than 1°C error.

The MAX6676 (Figure 2b) has an open-drain output. The output capacitance should be minimized in MAX6676 applications because the sourcing current is set by the pullup resistor. If the output capacitance becomes too large, lengthy rise and fall times distort the pulse width, resulting in inaccurate measurements.

Applications Information

Accurate temperature monitoring requires a good thermal contact between the MAX6676/MAX6677 and the object being monitored. A precise temperature measurement depends on the thermal resistance between the object being monitored and the MAX6676/MAX6677 die. Heat flows in and out of plastic packages primarily through the leads. If the sensor is intended to measure the temperature of a heat-generating component on the circuit board, mount the device as close as possible to that component and share the ground traces (if they are not too noisy) with the component. This maximizes the heat transfer from the component to the sensor.

Power Supply from µP Port Pin

The low quiescent current of the MAX6676/MAX6677 enables them to be powered from a logic line, which meets the requirements for supply voltage range. This provides a simple shutdown function to totally eliminate quiescent current by taking the logic line low. The logic line must be able to withstand the 0.1µF power-supply bypass capacitance.

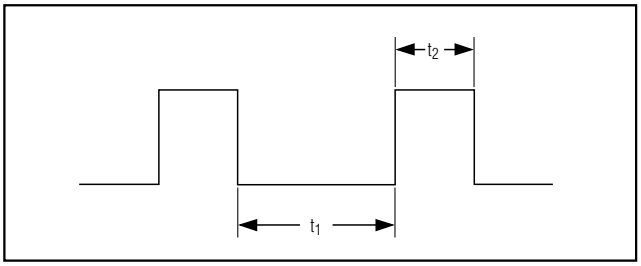


Figure 1. MAX6676/MAX6677 PWM Output

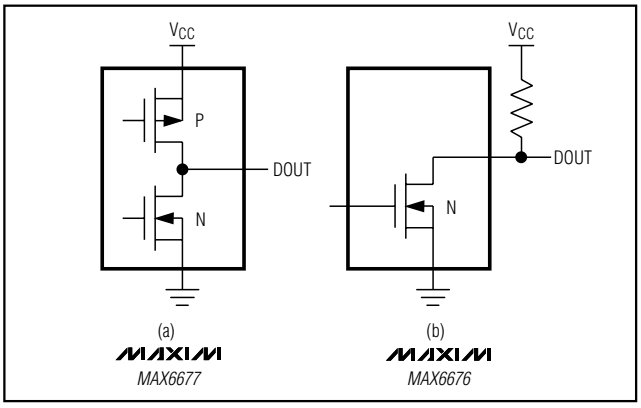


Figure 2. Output Configurations

SUNSTAR自动化 http://www.sensor-ic.com/ TEL: 0755-83376489 FAX:0755-83376182 E-MAIL:szss20@163.com

SUNSTAR传感与控制 http://www.sensor-ic.com/ TEL:0755-83376549 FAX:0755-83376182 E-MAIL:szss20@163.com

Low-Voltage, 1.8kHz PWM Output Temperature Sensors

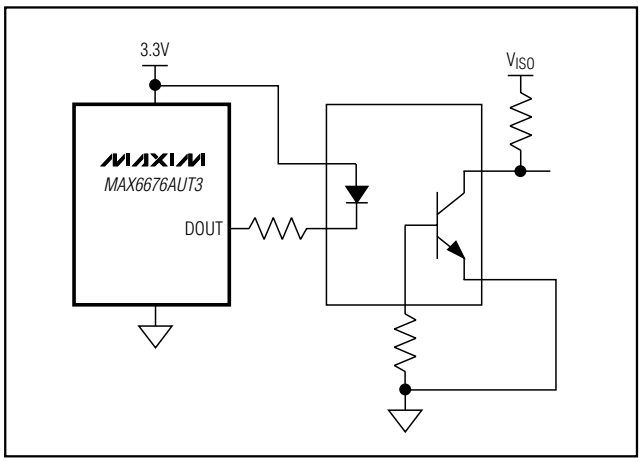


Figure 3. Galvanic Isolation Using an Optocoupler

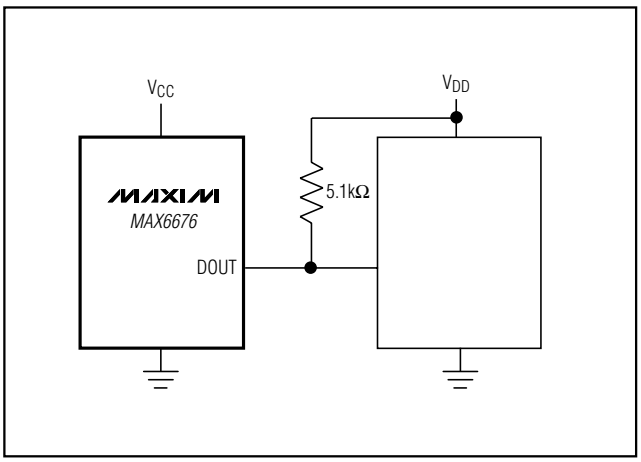


Figure 4. Low-Voltage Logic

Galvanic Isolation

Use an optocoupler to isolate the MAX6676/MAX6677 whenever a high common-mode voltage is present. Choose an optocoupler with equal turn-on and turn-off times. Unequal turn-on/turn-off times produce an error in the temperature reading (Figure 3).

Thermal Considerations

Self-heating may cause the temperature measurement accuracy of the MAX6676/MAX6677 to degrade in some applications. The quiescent dissipation and the power dissipated by the digital output may cause errors in obtaining the accurate temperature measurement. The temperature errors depend on the thermal conductivity of the package (SOT23, +140°C/W), the mounting technique, and the airflow. Static dissipation is typically 4.0µW operating at 5V with no load. For example, an out load of 3mA creates a maximum error of less than 0.1°C.

Multiple Logic Voltages

Use the MAX6676 open-drain output to drive devices operating at supply voltages other than the MAX6676's V_{CC}. As shown in Figure 4, connect a pullup resistor from the other supply voltage to the MAX6676 output. Limit the resistor's current to less than 1mA, thus maintaining an output low logic level of less than 200mV.

Chip Information

TRANSISTOR COUNT: 2096

PROCESS: BiCMOS

SUNSTAR自动化 http://www.sensor-ic.com/ TEL: 0755-83376489 FAX:0755-83376182 E-MAIL:szss20@163.com

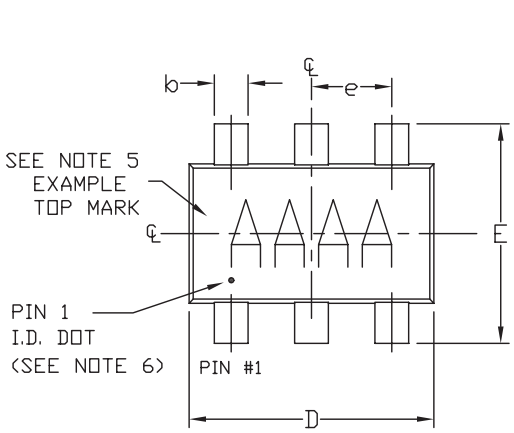
SUNSTAR传感与控制 http://www.sensor-ic.com/ TEL:0755-83376549 FAX:0755-83376182 E-MAIL:szss20@163.com

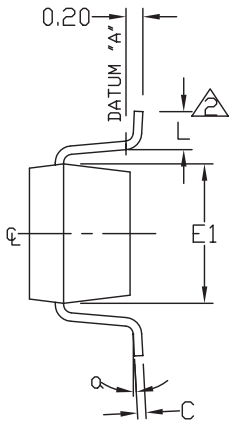
Low-Voltage, 1.8kHz PWM Output Temperature Sensors

Package Information

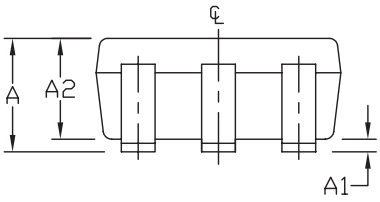
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to **www.maxim-ic.com/packages**.)

6LSOT.EPS





SYMBOL	MIN	MAX
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.35	0.50
C	0.08	0.20
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.75
L	0.35	0.55
e	0.95 REF	
a	0°	10°



NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. FOOT LENGTH MEASURED AT INTERCEPT POINT BETWEEN DATUM A & LEAD SURFACE.
3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR.
4. PACKAGE OUTLINE INCLUSIVE OF SOLDER PLATING.
5. PIN 1 IS LOWER LEFT PIN WHEN READING TOP MARK FROM LEFT TO RIGHT. (SEE EXAMPLE TOP MARK)
6. PIN 1 I.D. DOT IS 0.3 MM ø MIN. LOCATED ABOVE PIN 1.
7. MEETS JEDEC MO178.

MAXIM
PROPRIETARY INFORMATION

TITLE:
PACKAGE OUTLINE, SOT-23, 6L

APPROVAL	DOCUMENT CONTROL NO.	REV	
	21-0058	E	1/1

Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

© 2003 Maxim Integrated Products Printed USA MAXIM is a registered trademark of Maxim Integrated Products.

SUNSTAR自动化 http://www.sensor-ic.com/ TEL: 0755-83376489 FAX:0755-83376182 E-MAIL:szss20@163.com

SUNSTAR商斯达实业集团是集研发、生产、工程、销售、代理经销 、技术咨询、信息服务等为一体的高科技企业，是专业高科技电子产品生产厂家，是具有 10 多年历史的专业电子元器件供应商，是中国最早和最大的仓储式连锁规模经营大型综合电子零部件代理分销商之一,是一家专业代理和分銷世界各大品牌IC芯片和電子元器件的连锁经营綜合性国际公司。在香港、北京、深圳、上海、西安、成都等全国主要电子市场设有直属分公司和产品展示展销窗口门市部专卖店及代理分销商，已在全国范围内建成强大统一的供货和代理分销网络。 我们专业代理经销、开发生产电子元器件、集成电路、传感器、微波光电元器件、工控机/DOC/DOM电子盘、专用电路、单片机开发、MCU/DSP/ARM/FPGA软件硬件、二极管、三极管、模块等，是您可靠的一站式现货配套供应商、方案提供商、部件功能模块开发配套商。**专业以现代信息产业（计算机、通讯及传感器）三大支柱之一的传感器为主营业务，专业经营各类传感器的代理、销售生产、网络信息、科技图书资料及配套产品设计、工程开发。我们的专业网站——中国传感器科技信息网（全球传感器数据库） www.SENSOR-IC.COM 服务于全球高科技生产商及贸易商，为企业科技产品开发提供技术交流平台。欢迎各厂商互通有无、交换信息、交换链接、发布寻求代理信息。欢迎国外高科技传感器、变送器、执行器、自动控制产品厂商介绍产品到 中国，共同开拓市场。**本网站是关于各种传感器-变送器-仪器仪表及工业自动化大型专业网站,深入到工业控制、系统工程计 测计量、自动化、安防报警、消费电子等众多领域，把最新的传感器-变送器-仪器仪表买卖信息,最新技术供求,最新采购商,行业动态，发展方向，最新的技术应用和市场资讯及时的传递给广大科技开发、科学研究、产品设计人员。本网站已成功为石油、化工、电力、医药、生物、航空、航天、国防、能源、冶金、电子、工业、农业、交通、汽车、矿山、煤炭、纺织、信息、通信、IT、安防、环保、印刷、科研、气象、仪器仪表等领域从事科学研究、产品设计、开发、生产制造的科技人员、管理人员 、和采购人员提供满意服务。 **我公司专业开发生产、代理、经销、**销售各种传感器、变送器、敏感元器件、开关、执行器、仪器仪表、自动化控制系统： 专门从事设计、生产、销售各种传感器、变送器、各种测控仪表、热工仪表、现场控制器、计算机控制系统、数据采集系统、各类环境监控系统、专用控制系统应用软件以及嵌入式系统开发及应用等工作。如热敏电阻、压敏电阻、温度传感器、温度变送器、湿度传感器、 湿度变送器、气体传感器、 气体变送器、压力传感器、 压力变送、称重传感器、物（液）位传感器、物（液）位变送器、流量传感器、 流量变送器、电流（压）传感器、溶氧传感器、霍尔传感器 、图像传感器、超声波传感器、位移传感器、速度传感器、加速度传感器、扭距传感器、红外传感器、紫外传感器、 火焰传感器、激光传感器、振动传感器、轴角传感器、光电传感器、接近传感器、干簧管传感器、继电器传感器、微型电泵、磁敏（阻）传感器 、压力开关、接近开关、光电开关、色标传感器、光纤传感器、齿轮测速传感器、 时间继电器、计数器、计米器、温控仪、固态继电器、调压模块、电磁铁、电压表、电流表等特殊传感器 。 同时承接传感器应用电路、产品设计和自动化工程项目。

更多产品请看本公司产品专用销售网站:
商斯达中国传感器科技信息网：http://www.sensor-ic.com/
商斯达工控安防网：http://www.pc-ps.net/
商斯达电子 元器件网：http://www.sunstare.com/
商斯达微波光电产品网:HTTP://www.rfoe.net/
商斯达消费电子产品网://www.icasic.com/
商斯达军工产品网:http://www.junpinic.com/
商斯达实业科技产品网://www.sunstars.cn/传感器销售热线：

地址：深圳市福田区福华路福庆街鸿图大厦 1602 室
电话：0755-83607652 83376489 83376549 83370250 83370251 82500323
传真：0755-83376182 （0）13902971329 MSN: SUNS8888@hotmail.com
邮编：518033 E-mail:szss20@163.com QQ: 195847376
深圳赛格展销部：深圳华强北路赛格电子市场 2583 号 电话：0755-83665529 25059422
技术支持：0755-83394033 13501568376

欢迎索取免费详细资料、设计指南和光盘 ；产品凡多，未能尽录，欢迎来电查询。

北京分公司：北京海淀区知春路 132 号中发电子大厦 3097 号
TEL：010-81159046 82615020 13501189838 FAX：010-62543996
上海分公司：上海市北京东路 668 号上海賽格电子市场 D125 号
TEL：021-28311762 56703037 13701955389 FAX：021-56703037
西安分公司：西安高新开发区 20 所(中国电子科技集团导航技术研究所)
西安劳动南路 88 号电子商城二楼 D23 号
TEL：029-81022619 13072977981 FAX:029-88789382