



June 1999

LM66 Dual Output Internally Preset Thermostat

LM66 Dual Output Internally Preset Thermostat

General Description

The LM66 is a precision low power thermostat. Two stable temperature trip points (V_{T1} and V_{T2}) are generated by dividing down the LM66 1.250V bandgap voltage reference using a resistors divider network. The LM66 has two digital outputs. OUT1 goes LOW when the temperature exceeds T1 and goes HIGH when the the temperature goes below ($T1 - T_{HYST}$). Similarly, OUT2 goes LOW when the temperature exceeds T2 and goes HIGH when the temperature goes below ($T2 - T_{HYST}$). T_{HYST} is an internally set 5°C typical hysteresis.

The LM66 is currently available in an 8-lead small outline package.

Applications

- Microprocessor Thermal Management
- Appliances
- Portable Battery Powered 3.0V or 5V Systems
- Fan Control
- Industrial Process Control
- HVAC Systems
- Remote Temperature Sensing

- Electronic System Protection

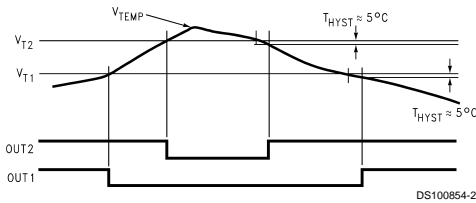
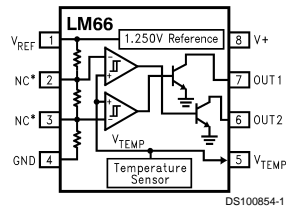
Features

- Digital outputs support TTL logic levels
- Internal temperature sensor
- 2 internal comparators with hysteresis
- Internal voltage reference
- Currently available in 8-pin SO plastic package

Key Specifications

- Power Supply Voltage 2.7V to 10V
- Power Supply Current 250 μ A (max)
- V_{REF} 1.250V \pm 1.4% (max)
- Hysteresis Temperature 5°C
- Internal Temperature Sensor
- Output Voltage $(+6.20 \text{ mV}/^\circ\text{C} \times T) + 400 \text{ mV}$
- Temperature Trip Point Accuracy $\pm 3^\circ\text{C}$ (max)
- T1 set point $+73^\circ\text{C}$
- T2 set point $+82^\circ\text{C}$

Simplified Block Diagram and Connection Diagram

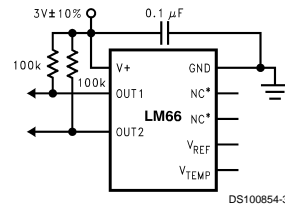


Ordering Information

TABLE 1.

Order Number	LM66CIM-RLSKB	LM66CIMX-RLSKB
NS Tackage Number	M08A	M08A
Transport Media	Bulk Rail	2500 Units Tape & Reel

Typical Application



Absolute Maximum Ratings (Note 1)		Vapor Phase (60 seconds)	215°C		
Input Voltage	12V	Infrared (15 seconds)	220°C		
Input Current at any pin (Note 2)	5 mA	Storage Temperature	-65°C to + 150°C		
Package Input Current (Note 2)	20 mA	Operating Ratings (Note 1)			
Package Dissipation at $T_A = 25^\circ\text{C}$ (Note 3)	900 mW	Operating Temperature Range	$T_{\text{MIN}} \leq T_A \leq T_{\text{MAX}}$		
ESD Susceptibility (Note 4)		LM66BIM, LM66CIM	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		
Human Body Model	1000V	Positive Supply Voltage (V^+)	+2.7V to +10V		
Machine Model	200V	Maximum V_{OUT1} and V_{OUT2}	+10V		
Soldering Information					
SO Package (Note 5) :					
LM66 Electrical Characteristics					
The following specifications apply for $V^+ = 2.7 V_{\text{DC}}$, and V_{REF} load current = 0 μA unless otherwise specified. Boldface limits apply for $T_A = T_J = T_{\text{MIN}}$ to T_{MAX} ; all other limits $T_A = T_J = 25^\circ\text{C}$ unless otherwise specified.					
Symbol	Parameter	Conditions	Typical (Note 6)	LM66CIM Limits (Note 7)	Units (Limits)
Temperature Sensor					
	Trip Point Accuracy (Includes V_{REF} , Comparator Offset, and Temperature Sensitivity errors)	$+25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		± 3	$^\circ\text{C}$ (max)
	Trip Point Hysteresis	$T_A = +73^\circ\text{C}$	6	4.5	$^\circ\text{C}$ (min)
		$T_A = +82^\circ\text{C}$	6	7.5	$^\circ\text{C}$ (max)
	Internal Temperature Sensitivity		+6.20		mV/ $^\circ\text{C}$
	Temperature Sensitivity Error	$+25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		± 3	$^\circ\text{C}$ (max)
		$-25^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		± 4	$^\circ\text{C}$ (max)
		$-40^\circ\text{C} \leq T_A \leq -25^\circ\text{C}$		± 3	$^\circ\text{C}$ (max)
	Output Impedance	$-1 \mu\text{A} \leq I_L \leq +40 \mu\text{A}$		1500	Ω (max)
	Line Regulation	$+3.0\text{V} \leq V^+ \leq +10\text{V}$, $+25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		± 0.36	mV/V (max)
		$+3.0\text{V} \leq V^+ \leq +10\text{V}$, $-40^\circ\text{C} \leq T_A < 25^\circ\text{C}$		± 0.61	mV/V (max)
		$+2.7\text{V} \leq V^+ \leq +3.3\text{V}$		± 2.3	mV (max)
V_{REF} Output					
V_{REF}	V_{REF} Nominal		1.250V		V
	V_{REF} Error			± 1.4	% (max)
				± 17.5	mV (max)
$\Delta V_{\text{REF}}/\Delta V^+$	Line Regulation	$+3.0\text{V} \leq V^+ \leq +10\text{V}$	0.13	0.21	mV/V (max)
		$+2.7\text{V} \leq V^+ \leq +3.3\text{V}$	0.15	1.5	mV (max)

LM66 Electrical Characteristics

The following specifications apply for $V^+ = 2.7 V_{DC}$, and V_{REF} load current = 50 μA unless otherwise specified. **Boldface limits apply for $T_A = T_J = T_{MIN}$ to T_{MAX}** ; all other limits $T_A = T_J = 25^\circ C$ unless otherwise specified.

Symbol	Parameter	Conditions	Typical (Note 6)	Limits (Note 7)	Units (Limits)
V* Power Supply					
I_S	Supply Current	$V^+ = +10V$		250	μA (max)
		$V^+ = +2.7V$		250	μA (max)
Digital Output(s)					
$I_{OUT("1")}$	Logical "1" Output Leakage Current	$V^+ = +5.0V$		1	μA (max)
$V_{OUT("0")}$	Logical "0" Output Voltage	$I_{OUT} = +50 \mu A$		0.4	V (max)

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

Note 2: When the input voltage (V_I) at any pin exceeds the power supply ($V_I < GND$ or $V_I > V^+$), the current at that pin should be limited to 5 mA. The 20 mA maximum package input current rating limits the number of pins that can safely exceed the power supplies with an input current of 5 mA to four.

Note 3: The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{Jmax} (maximum junction temperature), θ_{JA} (junction to ambient thermal resistance) and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is $P_D = (T_{Jmax} - T_A) / \theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower. For this device, $T_{Jmax} = 125^\circ C$. For this device the typical thermal resistance (θ_{JA}) of the different package types when board mounted follow:

Package Type	θ_{JA}
M08A	110°C/W

Note 4: The human body model is a 100 pF capacitor discharge through a 1.5 k Ω resistor into each pin. The machine model is a 200 pF capacitor discharged directly into each pin.

Note 5: See AN450 "Surface Mounting Methods and Their Effects on Product Reliability" or the section titled "Surface Mount" found in any post 1986 National Semiconductor Linear Data Book for other methods of soldering surface mount devices.

Note 6: Typicals are at $T_J = T_A = 25^\circ C$ and represent most likely parametric norm.

Note 7: Limits are guaranteed to National's AOQL (Average Outgoing Quality Level).

Part Number Template The series of digits labeled vw xy z in the part number LM66CIM-vw xy z, describe the set points and the function of OUT1 and OUT2 as follows:

The place holders v w describe the set point of T1 as shown in the following table.

The place holders xy describe the set point of T2 as shown in the following table. z=0 (Other assignments are reserved.)

For example the part number LM66CIM-RLSKB has: T1 = 73°C, T2 = 82°C, OUT1 and OUT2 set as active-low open-collector outputs with OUT1 mapped to pin 7 and OUT2 mapped to pin 6.

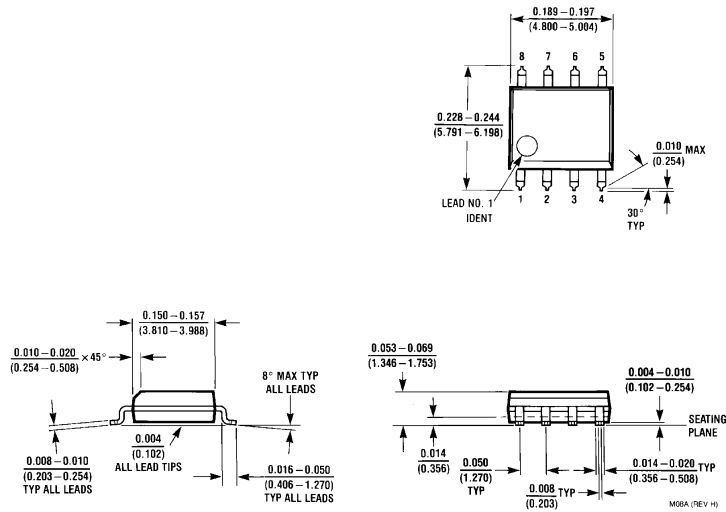
v, w, x and y	Temperature (°C)
B	-5
C	-4
D	-3
F	-2
G	-1
H	-0
J	1
K	2
L	3
N	4

v, w, x and y	Temperature (°C)
P	5
Q	6
R	7
S	8
T	9
V	10
X	11
Y	12
Z	13

The value of z describes the assignment/function of OUT1 and OUT2 as shown in the following table:

Active Low//High	Open Collector/Totem Pole	Mapping	Value of z	Function of OUT1 and OUT2
0	0	0	B	Active-Low, Open-Collector, OUT1 mapped to pin 7, OUT2 mapped to pin 6
0	0	1	C	Active-Low, Open-Collector, OUT1 mapped to pin 6, OUT2 mapped to pin 7
0	1	0	D	Active-Low, Totem Pole, OUT1 mapped to pin 7, OUT2 mapped to pin 6
0	1	1	F	Active-Low, Totem Pole, OUT1 mapped to pin 6, OUT2 mapped to pin 7
1	0	0	G	Active-High, Open-Collector, OUT1 mapped to pin 7, OUT2 mapped to pin 6
1	0	1	H	Active-High, Open-Collector, OUT1 mapped to pin 6, OUT2 mapped to pin 7
1	1	0	J	Active-High, Totem Pole, OUT1 mapped to pin 7, OUT2 mapped to pin 6
1	1	1	K	Active-High, Totem Pole, OUT1 mapped to pin 6, OUT2 mapped to pin 7

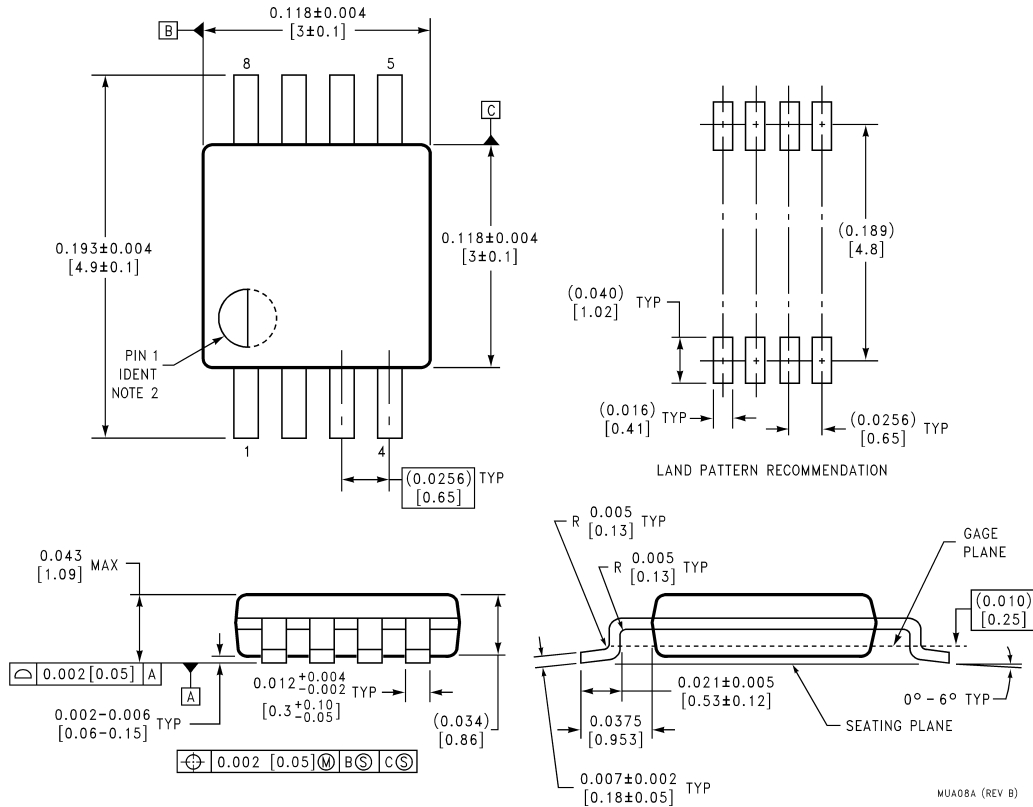
Physical Dimensions inches (millimeters) unless otherwise noted



**8-Lead (0.150" Wide) Molded Small Outline Package, JEDEC
Order Number LM66BIM, LM66BIMX, LM66CIM or LM66CIMX
NS Package Number M08A**

LM66 Dual Output Internally Preset Thermostat

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



8-Lead Molded Mini Small Outline Package (MSOP)
(JEDEC REGISTRATION NUMBER M0-187)
Order Number LM66BIMM, LM66BIMMX, LM66CIMM, or LM66CIMMX
NS Package Number MUA08A

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

National Semiconductor Corporation
 Americas
 Tel: 1-800-272-9959
 Fax: 1-800-737-7018
 Email: support@nsc.com
 www.national.com

National Semiconductor Europe
 Fax: +49 (0) 1 80-530 85 86
 Email: europe.support@nsc.com
 Deutsch Tel: +49 (0) 1 80-530 85 85
 English Tel: +49 (0) 1 80-532 78 32
 Français Tel: +49 (0) 1 80-532 93 58
 Italiano Tel: +49 (0) 1 80-534 16 80

National Semiconductor Asia Pacific Customer Response Group
 Tel: 65-2544466
 Fax: 65-2504466
 Email: sea.support@nsc.com

National Semiconductor Japan Ltd.
 Tel: 81-3-5639-7560
 Fax: 81-3-5639-7507

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.

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销世界各大品牌 IC 芯片和电子元器件的连锁经营综合性国际公司。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。我们公司专业生产、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/](http://www.rfoe.net/)

商斯达消费电子产品网：<http://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：<http://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: SUNS888@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 号上海赛格电子市场 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