LM27 SOT-23, ±3°C Accurate, 120°C-150°C Factory Preset Thermostat

Check for Samples: LM27

FEATURES

- **Internal Comparator with Pin Selectable 2°C or 10°C Hysteresis**
- **No External Components Required**
- **Open-drain or Push-pull Digital Output; Supports CMOS Logic Levels**
- **Internal Temperature Sensor with V_{TEMP} Output Pin**
- **V_{TEMP} Output Allows After-assembly System Testing**
- **Internal Voltage Reference and DAC for Trip-point Setting**
- **Currently Available in 5-pin SOT-23 Plastic Package**
- **Excellent Power Supply Noise Rejection**

APPLICATIONS

- **Microprocessor Thermal Management**
- **Appliances**
- **Portable Battery Powered Systems**
- **Fan Control**
- **Industrial Process Control**
- **HVAC Systems**
- **Electronic System Protection**

KEY SPECIFICATIONS

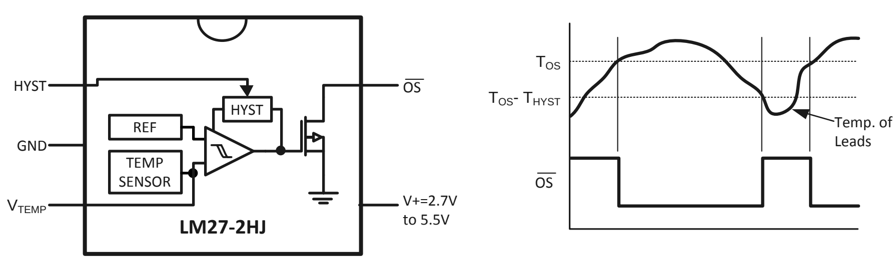
- **Power Supply Voltage 2.7V to 5.5V**
- **Power Supply Current 40µA (Max), 15µA (Typ)**
- **Hysteresis Temperature 2°C or 10°C (Typ)**
- **Temperature Trip Point Accuracy ±3°C (Max)**

DESCRIPTION

The LM27 is a precision, single digital-output, low-power thermostat comprised of an internal reference, DAC, temperature sensor and comparator. Utilizing factory programming, it can be manufactured with different trip points as well as different digital output functionality. The trip point (T_{OS}) can be preset at the factory to any temperature in the range of +120°C to +150°C in 1°C increments. The LM27 has one digital output (OS/$\overline{OS}$/US/$\overline{US}$), one digital input (HYST) and one analog output (V_{TEMP}). The digital output stage can be preset as either open-drain or push-pull. In addition, it can be factory programmed to be active HIGH or LOW. The digital output can be factory programmed to indicate an over temperature shutdown event (OS or $\overline{OS}$) or an under temperature shutdown event (US or $\overline{US}$). When preset as an overtemperature shutdown ($\overline{OS}$) it will go LOW to indicate that the die temperature is over the internally preset T_{OS} and go HIGH when the temperature goes below (T_{OS}–T_{HYST}). Similarly, when preprogrammed as an undertemperature shutdown (US) it will go HIGH to indicate that the temperature is below T_{US} and go LOW when the temperature is above (T_{US}+T_{HYST}). The typical hysteresis, T_{HYST}, can be set to 2°C or 10°C and is controlled by the state of the HYST pin. A V_{TEMP} analog output provides a voltage that is proportional to temperature and has a −10.7mV/°C output slope.

Currently, there are several standard parts available, see Table 1. For other part options, contact a Texas Instruments Distributor or Sales Representative for information on minimum order qualification. The LM27 is currently available in a 5-lead SOT-23 package.

Simplified Block Diagram and Connection Diagram LM27CIM5-2HJ (140°C Trip-Point)



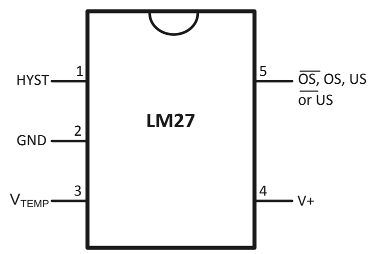
HYST=GND for 10°C Hysteresis
HYST=V+ for 2°C Hysteresis
V_{TEMP}=(-3.552x10^{-6}x(T-30)^2)+(-10.69576x10^{-3}x(T-30))+1.8386V

Table 1. Summary Table of Trip Point and Output Function Capabilities of Released Parts(1)

Orderable Device	Trip Point Temperature (°C)	Digital Output Function
LM27CIM5-ZHJ	120	Active-Low, Open-Drain, $\overline{OS}$ output
LM27CIM5-1HJ	130	Active-Low, Open-Drain, $\overline{OS}$ output
LM27CIM5-2HJ	140	Active-Low, Open-Drain, $\overline{OS}$ output

(1) Other device options have not been released to market, contact Texas Instruments for volume and other requirements for release.

Connection Diagram



PIN DESCRIPTIONS

Pin Number	Pin Name	Function	Connection
1	HYST	Hysteresis control, digital input	GND for 10°C or V^+ for 2°C
2	GND	Ground, connected to the back side of the die through lead frame.	System GND
3	V_{TEMP}	Analog output voltage proportional to temperature	Leave floating or connect to a high impedance node.
4	V^+	Supply input	2.7V to 5.5V with a 0.1µF bypass capacitor. For PSRR information see NOISE CONSIDERATIONS.
5(1)	$\overline{OS}$	Overtemperature Shutdown open-drain active low thermostat digital output	Controller interrupt, system or power supply shutdown; pull-up resistor ≥ 10kΩ
	OS	Overtemperature Shutdown totem-pull active high thermostat digital output	Controller interrupt, system or power supply shutdown
	$\overline{US}$	Undertemperature Shutdown open-drain active low thermostat digital output	System or power supply shutdown; pull-up resistor ≥ 10kΩ
	US	Undertemperature Shutdown totem-pull active high thermostat digital output	System or power supply shutdown

(1) Pin 5 functionality and trip point setting are programmed during LM27 manufacture.

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings[1]

Input Voltage			6.0V
Input Current at any pin[2]			5mA
Package Input Current[2]			20mA
Package Dissipation at T_A = 25°C[3]			500mW
Soldering Information[4]	SOT23 Package	Vapor Phase (60 seconds)	215°C
		Infrared (15 seconds)	220°C
Storage Temperature			−65°C to + 150°C
ESD Susceptibility[5]	Human Body Model		2500V
	Machine Model		250V

(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 ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The specified specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
(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 5mA. The 20mA maximum package input current rating limits the number of pins that can safely exceed the power supplies with an input current of 5mA to four. Under normal operating conditions the maximum current that pins 2, 4 or 5 can handle is limited to 5mA each.
(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} = 150°C. For this device the typical thermal resistance (θ_{JA}) of the different package types when board mounted refer to Table 2
(4) See http://www.ti.com/packaging for other recommendations and methods of soldering surface mount devices.
(5) The human body model is a 100pF capacitor discharge through a 1.5kΩ resistor into each pin. The machine model is a 200pF capacitor discharged directly into each pin.

Table 2.

Package Type	θ_{JA}
SOT23-5, DBV	250°C/W

Operating Ratings[1]

Specified Temperature Range	$T_{MIN} \le T_A \le T_{MAX}$
LM27CIM	−40°C ≤ T_A ≤ +150°C
Positive Supply Voltage (V^+)	+2.7V to +5.5V
Maximum V_{OUT}	+5.5V

(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 ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The specified specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

LM27 Electrical Characteristics

The following specifications apply for $V^+ = 2.7V_{DC}$ to $5.5V_{DC}$, and V_{TEMP} load current = 0µA unless otherwise specified. **Boldface limits apply for $T_A = T_J = T_{MIN}$ to T_{MAX};** all other limits $T_A = T_J = 25°C$ unless otherwise specified.

Symbol	Parameter	Conditions	Typical (1)	LM27CIM Limits (2)	Units (Limits)
Temperature Sensor					
	Trip Point Accuracy (Includes V_{REF}, DAC, Comparator Offset, and Temperature Sensitivity errors)	$+120°C<T_A<+150°C$		±3	°C (max)
	Trip Point Hysteresis	HYST = GND	10		°C
		HYST = V^+	2		°C
	V_{TEMP} Output Temperature Sensitivity		−10.82		mV/°C
	V_{TEMP} Temperature Sensitivity Error to Equation: $V_O = (-3.552\times10^{-6}\times(T-30)^2 + (-10.695\times10^{-3}\times(T-30)) + 1.8386V$ (1)	$-30°C \le T_A \le 150°C$, $2.7V \le V^+ \le 5.5V$		**±3**	°C (max)
		$-55°C \le T_A \le 150°C$, $4.5V \le V^+ \le 5.5V$		**±3**	°C (max)
		$T_A = 25°C$		±2.5	°C (max)
	V_{TEMP} Load Regulation	Source ≤ 1 µA	0.070		mV
		Sink ≤ 40 µA		**0.7**	mV (max)
	V_{TEMP} Line Regulation	$+2.7V \le V^+ \le +5.5V$, $-30°C \le T_A \le +120°C$	−0.2		mV/V
I_S	Supply Current		15	22 **40**	µA (max) µA (max)
Digital Output and Input					
$I_{OUT("1")}$	Logical “1” Output Leakage Current (3)	$V^+ = +5.0V$	0.001	**1**	µA (max)
$V_{OUT("0")}$	Logical “0” Output Voltage	I_{OUT} = +1.2mA and $V^+ \ge 2.7V$; I_{OUT} = +3.2mA and $V^+ \ge 4.5V$ (4)		**0.4**	V (max)
$V_{OUT("1")}$	Logical “1” Push-Pull Output Voltage	I_{SOURCE} = 500µA, $V^+ \ge 2.7V$		**0.8 × V⁺**	V (min)
		I_{SOURCE} = 800µA, $V^+ \ge 4.5V$		**V⁺ − 1.5**	V (min)
V_{IH}	HYST Input Logical ”1“ Threshold Voltage			**0.8 × V⁺**	V (min)
V_{IL}	HYST Input Logical ”0“ Threshold Voltage			**0.2 × V⁺**	V (max)

(1) Typicals are at $T_J = T_A = 25°C$ and represent most likely parametric norm.
(2) Limits are ensured to AOQL (Average Outgoing Quality Level).
(3) The 1µA limit is based on a testing limitation and does not reflect the actual performance of the part. Expect to see a doubling of the current for every 15°C increase in temperature. For example, the 1nA typical current at 25°C would increase to 16nA at 85°C.
(4) Care should be taken to include the effects of self heating when setting the maximum output load current. The power dissipation of the LM27 would increase by 1.28mW when I_{OUT}=3.2mA and V_{OUT}=0.4V. With a thermal resistance of 250°C/W, this power dissipation would cause an increase in the die temperature of about 0.32°C due to self heating. Self heating is not included in the trip point accuracy specification.

Part Number Template

The series of digits labeled xyz in the part number LM27CIM-xyz, describe the set point value and the function of the output as follows:

The place holders xy describe the set point temperature as shown in the following table.

x (10x)	y (1x)	Temperature (°C)
-	H	0
-	J	1
-	K	2
-	L	3
-	N	4
-	P	5
-	R	6
-	S	7
-	T	8
-	V	9
Z	-	12
1	-	13
2	-	14
3	-	15

The value of z describes the assignment/function of the output as shown in the following table:

Active-$\overline{\text{Low}}$/High	$\overline{\text{Open-Drain}}$/ Push-Pull	$\overline{\text{OS}}$/US	Value of z	Digital Output Function
0	0	0	J	Active-Low, Open-Drain, $\overline{\text{OS}}$ output
0	0	1	K	Active-Low, Open-Drain, $\overline{\text{US}}$ output
1	1	0	L	Active-High, Push-Pull, OS output
1	1	1	N	Active-High, Push-Pull, US output

For example:

- the part number LM27CIM5-2SJ has T_{OS} = 147°C, and programmed as an active-low open-drain overtemperature shutdown output.
- the part number LM27CIM5-ZLN has T_{US} = 123°C, and programmed as an active-high, push-pull undertemperature shutdown output.

Active-high open-drain and active-low push-pull options are available, please contact Texas Instruments for more information.

Note: Currently, there are several standard parts available, see Table 1. For other part options, contact a Texas Instruments Distributor or Sales Representative for information on minimum order qualification

FUNCTIONAL DESCRIPTION

LM27 OPTIONS — Output Pin Options Block Diagrams

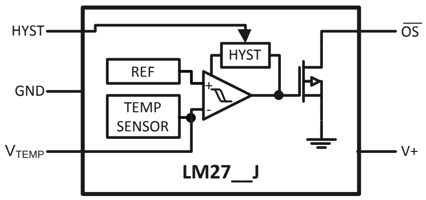


Figure 1. LM27-_ _J

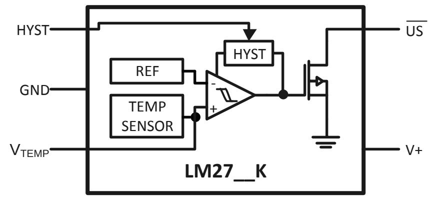


Figure 2. LM27-_ _K

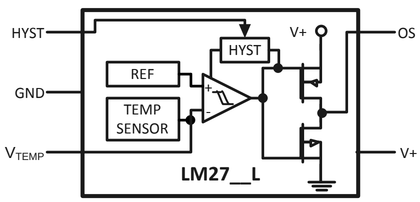


Figure 3. LM27-_ _L

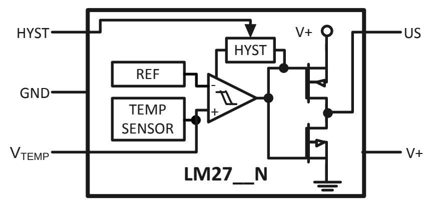


Figure 4. LM27-_ _N

The LM27 can be factory programmed to have a trip point anywhere in-between 120°C to 150°C.

Applications Hints

AFTER-ASSEMBLY PCB TESTING

The LM27's V_{TEMP} output allows after-assembly PCB testing by following a simple test procedure. Simply measuring the V_{TEMP} output voltage will verify that the LM27 has been assembled properly and that its temperature sensing circuitry is functional. The V_{TEMP} output has very weak drive capability that can be overdriven by 1.5mA. Therefore, one can simply force the V_{TEMP} voltage to cause the digital output to change state, thereby verifying that the comparator and output circuitry function after assembly. Here is a sample test procedure that can be used to test the LM27CIM5X-2HJ which has a 140°C trip point.

1. Turn on V^+ and measure V_{TEMP}. Then calculate the temperature reading of the LM27 using the equation:

$$V_O = (-3.552\times10^{-6}\times(T-30)^2) + (-10.69576\times10^{-3}\times(T-30)) + 1.8386\text{V} \quad (2)$$

or

$$T = -1475.49 + \sqrt{2.2668 \times 10^6 + \frac{1.8386 - V_{TEMP}}{3.552 \times 10^{-6}}} \quad (3)$$

2. Verify that the temperature measured in step one is within (±3°C + error of reference temperature sensor) of the ambient/board temperature. The ambient/board temperature (reference temperature) should be measured using an extremely accurate calibrated temperature sensor, which is in close proximity to and mounted on the same PCB as the LM27 perhaps even touching the GND lead of the LM27 if possible. The LM27 will sence the board temperature not the ambient temperature (see MOUNTING CONSIDERATIONS)
3.
   (a) Observe that $\overline{OS}$ is high.
   (b) Drive V_{TEMP} to ground.
   (c) Observe that $\overline{OS}$ is now low.
   (d) Release the V_{TEMP} pin.
   (e) Observe that $\overline{OS}$ is now high.
4.
   (a) Observe that $\overline{OS}$ is high.
   (b) Drive V_{TEMP} voltage down gradually.
   (c) When OS goes low, note the V_{TEMP} voltage.
   (d) V_{TEMP}Trig = V_{TEMP} at $\overline{OS}$ trigger (HIGH->LOW)
   (e) Calculate Ttrig using Equation 3.

5.
   (a) Gradually raise V_{TEMP} until OS goes HIGH. Note V_{TEMP}.
   (b) Calculate T_{HYST} using Equation 3.

V_{TEMP} LOADING

The V_{TEMP} output has very weak drive capability (1 µA source, 40 µA sink). So care should be taken when attaching circuitry to this pin. Capacitive loading may cause the V_{TEMP} output to oscillate. Simply adding a resistor in series as shown in Figure 6 will prevent oscillations from occurring. To determine the value of the resistor follow the guidelines given in Table 3. The same value resistor will work for either placement of the resistor. If an additional capacitive load is placed directly on the LM27 output, rather than across C_{LOAD}, it should be at least a factor of 10 smaller than C_{LOAD}.

Table 3. Resistive compensation for capacitive loading of V_{TEMP}

C_{LOAD}	R (Ω)
≤100pF	0
1nF	8200
10nF	3000
100nF	1000
≥1µF	430

Resistor placement for capacitive loading compensation of V_{TEMP}

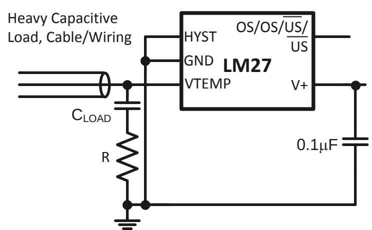


Figure 5. R in series with capacitor

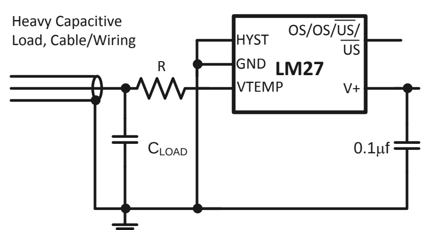


Figure 6. R in series with signal path

NOISE CONSIDERATIONS

The LM27 has excellent power supply noise rejection. Listed below is a variety of signals used to test the LM27 power supply rejection. False triggering of the output was not observed when these signals where coupled into the V+ pin of the LM27.

- square wave 400kHz, 1Vp-p
- square wave 2kHz, 200mVp-p
- sine wave 100Hz to 1MHz, 200mVp-p

Testing was done while maintaining the temperature of the LM27 one degree centigrade way from the trip point with the output not activated.

MOUNTING CONSIDERATIONS

The LM27 can be applied easily in the same way as other integrated-circuit temperature sensors. It can be glued or cemented to a surface. The temperature that the LM27 is sensing will be within about +0.06°C of the surface temperature to which the LM27's leads are attached to.

This presumes that the ambient air temperature is almost the same as the surface temperature; if the air temperature were much higher or lower than the surface temperature, the actual temperature measured would be at an intermediate temperature between the surface temperature and the air temperature.

To ensure good thermal conductivity, the backside of the LM27 die is directly attached to the GND pin (pin 2). The temperatures of the lands and traces to the other leads of the LM27 will also affect the temperature that is being sensed.

Alternatively, the LM27 can be mounted inside a sealed-end metal tube, and can then be dipped into a bath or screwed into a threaded hole in a tank. As with any IC, the LM27 and accompanying wiring and circuits must be kept insulated and dry, to avoid leakage and corrosion. This is especially true if the circuit may operate at cold temperatures where condensation can occur. Printed-circuit coatings and varnishes such as Humiseal and epoxy paints or dips are often used to ensure that moisture cannot corrode the LM27 or its connections.

The junction to ambient thermal resistance (θ_{JA}) is the parameter used to calculate the rise of a part's junction temperature due to its power dissipation. For the LM27 the equation used to calculate the rise in the die junction temperature is as follows:

$$T_J = T_A + \Theta_{JA}(V^+ I_Q + (V^+ - V_{TEMP})I_{L\_TEMP} + V_{DO}I_{DO}) \quad (4)$$

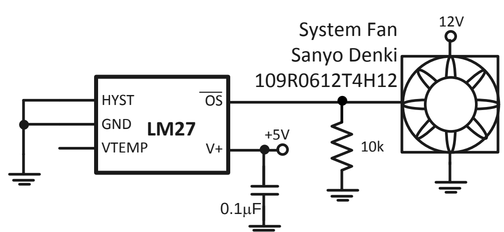
where T_A is the ambient temperature, V^+ is the power supply voltage, I_Q is the quiescent current, I_{L_TEMP} is the load current on the V_{TEMP} output, V_{DO} is the voltage on the digital output, and I_{DO} is the load current on the digital output. Since the LM27's junction temperature is the actual temperature being measured, care should be taken to minimize the load current that the LM27 is required to drive.

The tables shown in Table 4 summarize the thermal resistance for different conditions and the rise in die temperature of the LM27 without any loading on V_{TEMP} and a 10k pull-up resistor on an open-drain digital output with a 5.5V power supply.

Table 4. Thermal resistance (θ_{JA}) and temperature rise due to self heating (T_J–T_A)

	SOT23-5 no heat sink		SOT23-5 small heat sink	
	θ_{JA} (°C/W)	T_J–T_A (°C)	θ_{JA} (°C/W)	T_J–T_A (°C)
Still Air	250	0.11	TBD	TBD
Moving Air	TBD	TBD	TBD	TBD

Typical Applications



The fan's control pin has internal pull-up. The 10k pull-down sets a slow fan speed. When the output of the LM27 goes low, the fan will speed up.

Figure 7. Two Speed Fan Speed Control

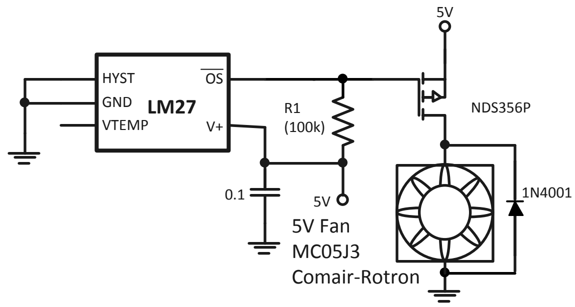


Figure 8. Fan High Side Drive

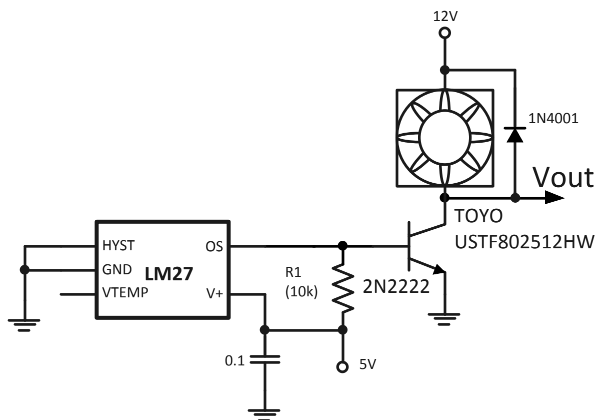


Figure 9. Fan Low Side Drive

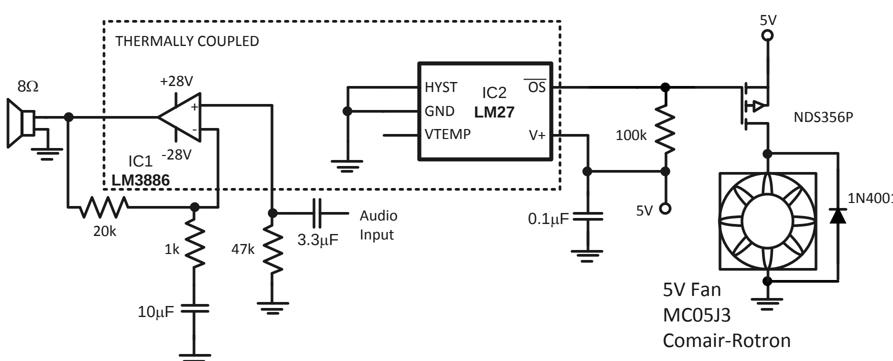


Figure 10. Audio Power Amplifier Thermal Protection

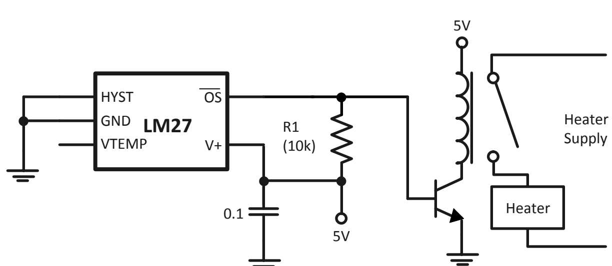


Figure 11. Simple Thermostat

REVISION HISTORY

Changes from Revision B (March 2013) to Revision C	Page
• Deleted layout of National Data Sheet to TI format	9

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM27-2PL MDA	ACTIVE	DIESALE	Y	0	7000	Green (RoHS & no Sb/Br)	Call TI	Level-1-NA-UNLIM	-40 to 85		Samples
LM27CIM5-1HJ/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	120 to 150	T1HJ	Samples
LM27CIM5-2HJ/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	120 to 150	T2HJ	Samples
LM27CIM5-ZHJ/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	120 to 150	TZHJ	Samples
LM27CIM5X-1HJ/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM		T1HJ	Samples
LM27CIM5X-2HJ/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM		T2HJ	Samples
LM27CIM5X-ZHJ/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM		TZHJ	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

[5] Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

[6] Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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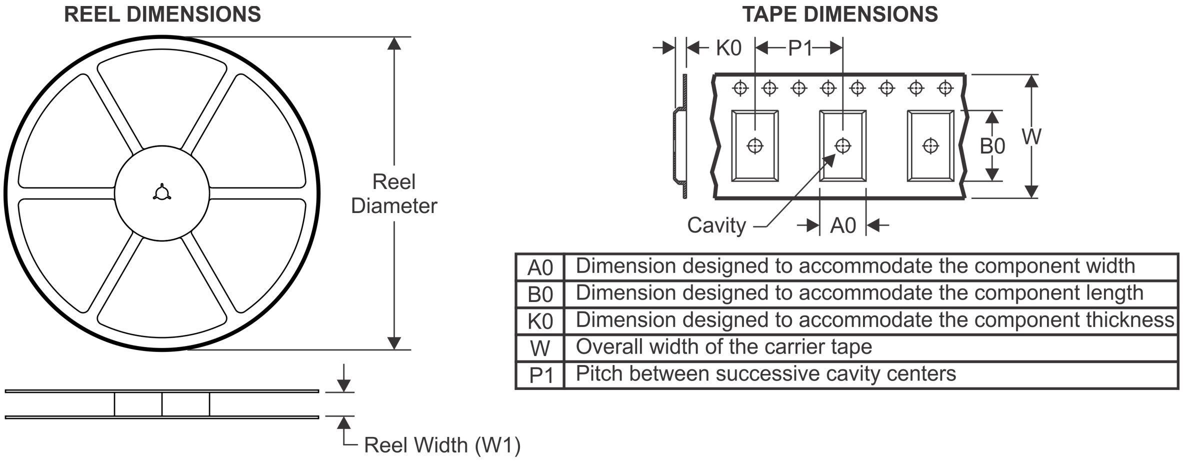
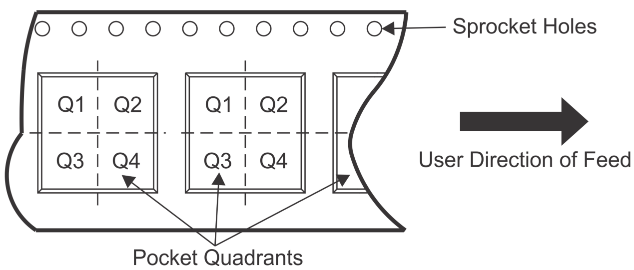
TAPE AND REEL INFORMATION



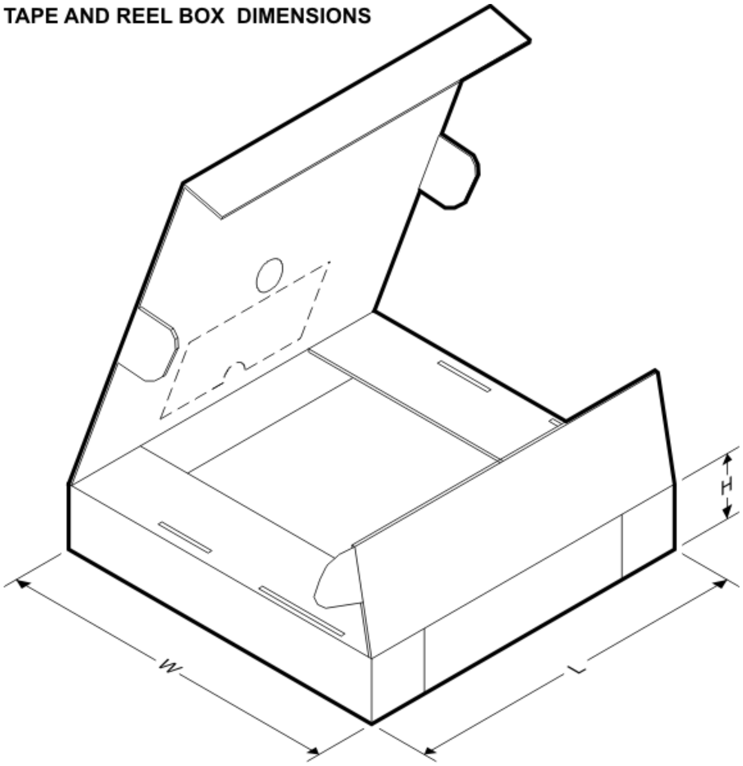
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM27CIM5-1HJ/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM27CIM5-2HJ/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM27CIM5-ZHJ/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM27CIM5X-1HJ/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM27CIM5X-2HJ/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM27CIM5X-ZHJ/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

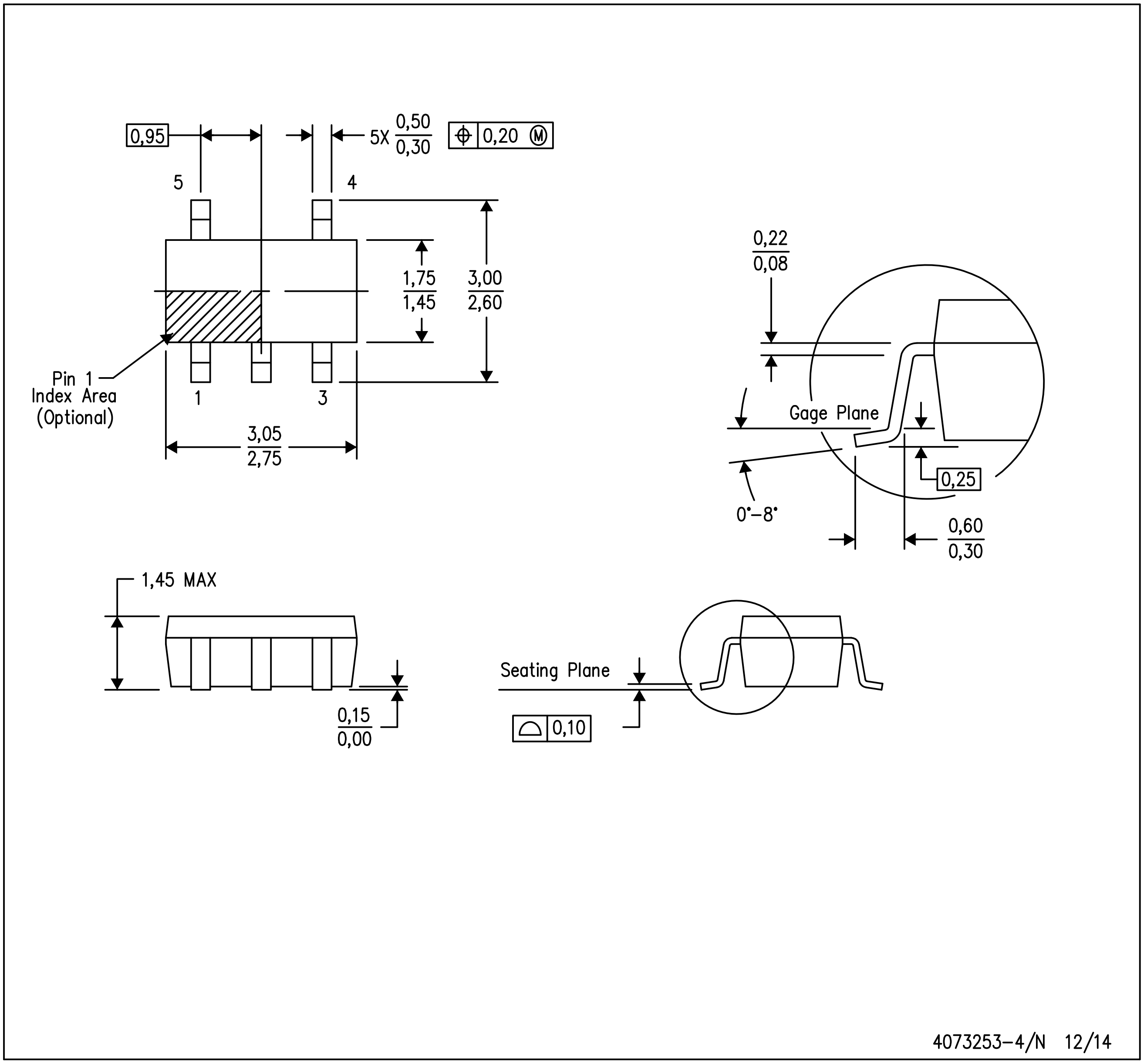
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

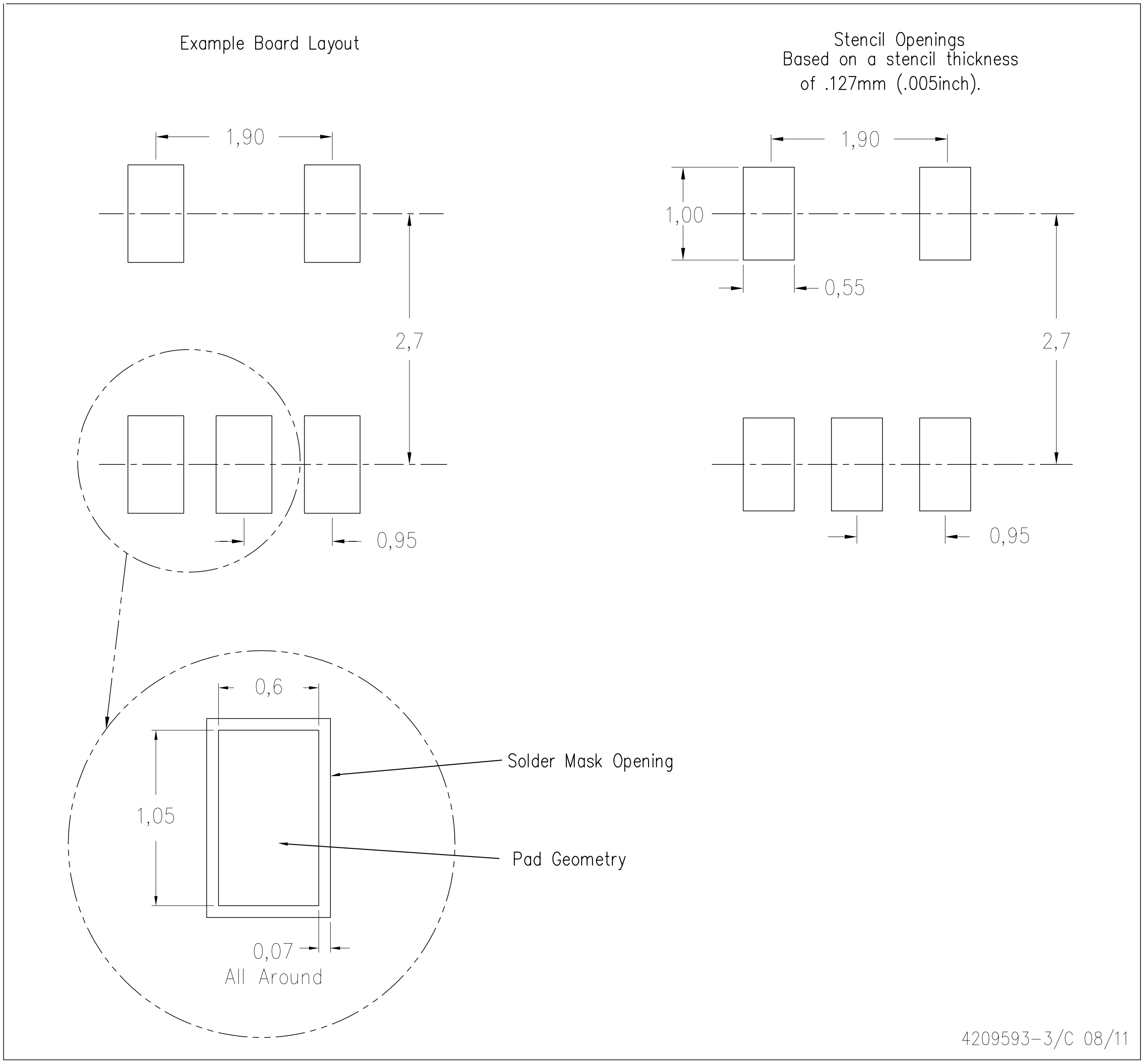
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM27CIM5-1HJ/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM27CIM5-2HJ/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM27CIM5-ZHJ/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM27CIM5X-1HJ/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM27CIM5X-2HJ/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM27CIM5X-ZHJ/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0

DBV (R-PDSO-G5) PLASTIC SMALL-OUTLINE PACKAGE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO-178 Variation AA.

DBV (R–PDSO–G5) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
D. Publication IPC–7351 is recommended for alternate designs.
E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC–7525 for other stencil recommendations.

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