LMT84 1.5V、SC70/TO-92/TO-92S、アナログ温度センサ

1 特長

- LMT84LPG (TO-92Sパッケージ)は高速な熱時定数、標準値10s (エアフロー1.2m/s)
- 非常に正確: ±0.4℃ (標準値)
- 低電圧1.5Vでの動作
- 平均センサ・ゲイン: -5.5mV/℃
- 低い静止電流: 5.4µA
- 広い温度範囲: -50℃～150℃
- 出力の短絡保護
- 駆動能力±50µAのプッシュプル出力
- 業界標準のLM20/19およびLM35温度センサとフットプリント互換
- コスト効率に優れたサーミスタの代替

2 アプリケーション

- インフォテインメントおよびクラスタ
- パワートレイン・システム
- 煙および熱感知器
- ドローン
- 家電製品

3 概要

LMT84は高精度のCMOS温度センサで、標準精度は±0.4℃ (最大値±2.7℃)で、リニアなアナログ出力電圧を持ち、この電圧は温度に反比例します。1.5Vの電源電圧で動作し、静止電流が5.4µA、パワーオン時間が0.7msで、効果的なパワーサイクリング・アーキテクチャを実現し、ドローンやセンサ・ノードなどバッテリ駆動のアプリケーションで消費電力を最小化できます。LMT84LPGスルーホールTO-92Sパッケージは熱時定数が高速で、煙および熱感知器など、オフボードで時間-温度の感度が高いアプリケーションに対応できます。広い動作範囲にわたる精度や、その他の特長から、LMT84はサーミスタの優れた代替となります。

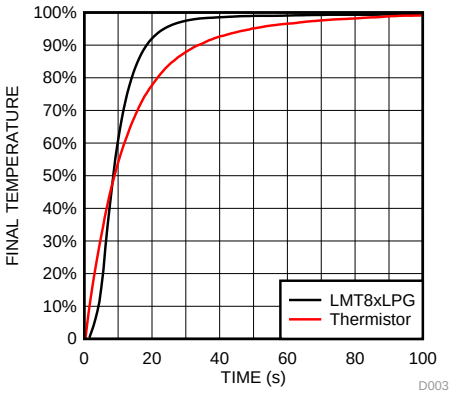
異なる平均センサ・ゲインおよび類似の精度を持つデバイスについては、「*類似の代替デバイス*」で、LMT8xファミリの他のデバイスを参照してください。

製品情報(1)

型番	パッケージ	本体サイズ(公称)
LMT84	SOT (5)	2.00mm×1.25mm
	TO-92 (3)	4.30mm×3.50mm
	TO-92S (3)	4.00mm×3.15mm

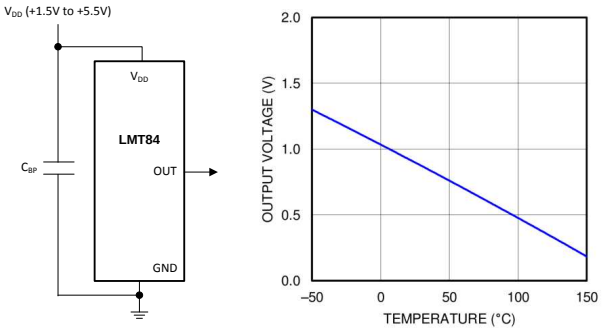
(1) 利用可能なすべてのパッケージについては、このデータシートの末尾にある注文情報を参照してください。

熱時定数



* 高速な熱応答NTC

出力電圧と温度との関係



目次

4 改訂履歴

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

Revision D (June 2017) から **Revision E** に変更 **Page**

- 車載用デバイスを単独のデータシート(SNIS178)に移動 ... 1
- Changed TO-92 GND pin number from: 1 to: 3 ... 4
- Changed TO-92 V_{DD} pin number from: 3 to: 1 ... 4

Revision C (October 2015) から **Revision D** に変更 **Page**

- データシートのテキストを最新のドキュメントおよび翻訳標準に更新 ... 1
- 「*特長*」の箇条書きにAEC-Q100車載用認定の項目を追加 ... 1
- 時定数のグラフを追加 ... 1
- 「*アプリケーション*」からディスク・ドライバ、ゲーム、ワイヤレス・トランシーバ、携帯電話を削除 ... 1
- Added LPG (TO-92S) package ... 4
- Added Figure 10 to *Typical Characteristics* ... 7

Revision B (May 2014) から **Revision C** に変更 **Page**

- TO-126パッケージへのすべての言及 削除 ... 1
- Added TO-92 LPM pin configuration graphic ... 4
- Changed Handling Ratings to ESD Ratings and moved Storage Temperature to Absolute Maximum Ratings table ... 5
- Changed KV to V ... 5
- Added layout recommendation for TO-92 LP and LPM packages ... 15

Revision A (June 2013) から **Revision B** に変更 **Page**

- 新しいTIの標準に準拠するようデータシートのフローとレイアウトを変更。「アプリケーションと実装」、「電源に関する推奨事項」、「レイアウト」、「デバイスおよびドキュメントのサポート」、「メカニカル、パッケージ、および注文情報」の各セクションを追加変更 ... 1
- ドキュメント全体を通してTO-92およびTO-126パッケージの情報を 追加 ... 1

- Changed from 450°C/W to 275 °C/W. New specification is derived using TI ' s latest methodology. 5
- Deleted Note: The input current is leakage only and is highest at high temperature. It is typically only 0.001 µA. The 1 µA limit is solely based on a testing limitation and does not reflect the actual performance of the part. 6

5 Device Comparison Tables

Table 1. Available Device Packages

ORDER NUMBER(1)	PACKAGE	PIN	BODY SIZE (NOM)	MOUNTING TYPE
LMT84DCK	SOT (AKA(2): SC70, DCK)	5	2.00 mm × 1.25 mm	Surface Mount
LMT84LP	TO-92 (AKA(2): LP)	3	4.30 mm × 3.50 mm	Through-hole; straight leads
LMT84LPG	TO-92S (AKA(2): LPG)	3	4.00 mm × 3.15 mm	Through-hole; straight leads
LMT84LPM	TO-92 (AKA(2): LPM)	3	4.30 mm × 3.50 mm	Through-hole; formed leads
LMT84DCK-Q1	SOT (AKA(2): SC70, DCK)	5	2.00 mm × 1.25 mm	Surface Mount

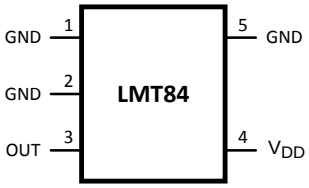
(1) For all available packages and complete order numbers, see the Package Option addendum at the end of the data sheet.
(2) AKA = Also Known As

Table 2. Comparable Alternative Devices

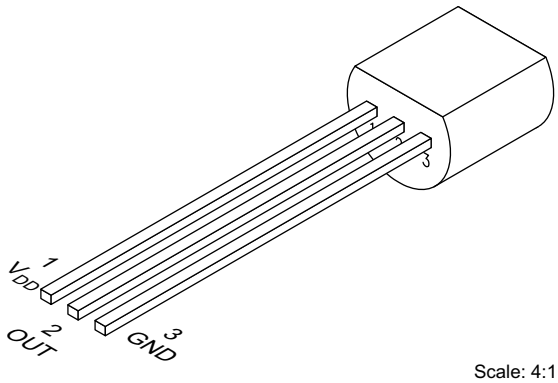
DEVICE NAME	AVERAGE OUTPUT SENSOR GAIN	POWER SUPPLY RANGE
LMT84	–5.5 mV/°C	1.5 V to 5.5 V
LMT85	–8.2 mV/°C	1.8 V to 5.5 V
LMT86	–10.9 mV/°C	2.2 V to 5.5 V
LMT87	–13.6 mV/°C	2.7 V to 5.5 V

6 Pin Configuration and Functions

DCK Package
5-Pin SOT (SC70)
(Top View)

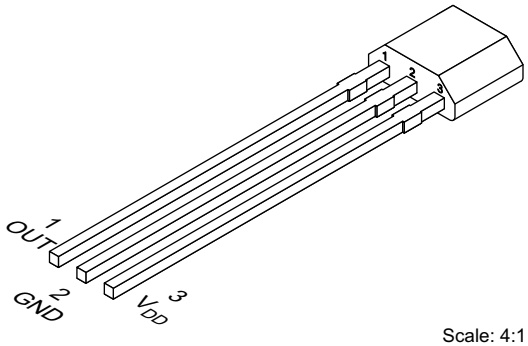


LP Package
3-Pin TO-92
(Top View)



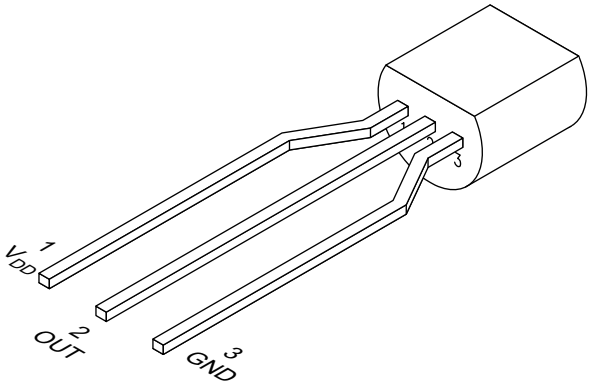
Scale: 4:1

LPG Package
3-Pin TO-92S
(Top View)



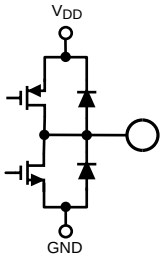
Scale: 4:1

LPM Package
3-Pin TO-92
(Top View)



Scale: 4:1

Pin Functions

PIN				TYPE	DESCRIPTION	
NAME	SOT (SC70)	TO-92	TO-92S		EQUIVALENT CIRCUIT	FUNCTION
GND	1, 2(1) , 5	3	2	Ground	N/A	Power Supply Ground
OUT	3	2	1	Analog Output		Outputs a voltage that is inversely proportional to temperature
V_{DD}	4	1	3	Power	N/A	Positive Supply Voltage

(1) Direct connection to the back side of the die

7 Specifications

7.1 Absolute Maximum Ratings

See (1)(2)

	MIN	MAX	UNIT
Supply voltage	–0.3	6	V
Voltage at output pin	–0.3	(V_{DD} + 0.5)	V
Output current	–7	7	mA
Input current at any pin(3)	–5	5	mA
Maximum junction temperature (T_{JMAX})		150	°C
Storage temperature T_{stg}	–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) *Soldering process must comply with Reflow Temperature Profile specifications. Refer to* www.ti.com/packaging.
(3) When the input voltage (V_I) at any pin exceeds power supplies (V_I < GND or V_I > V), the current at that pin should be limited to 5 mA.

7.2 ESD Ratings

			VALUE	UNIT
LMT84LP in TO-92/TO-92S package				
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)(2)	±2500	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101(3)	±1000	
LMT84DCK in SC70 package				
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per JESD22-A114(2)	±2500	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101(3)	±1000	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) The human body model is a 100-pF capacitor discharged through a 1.5-kΩ resistor into each pin.
(3) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

7.3 Recommended Operating Conditions

	MIN	MAX	UNIT
Specified temperature	$T_{MIN} \le T_A \le T_{MAX}$		°C
	−50 ≤ T_A ≤ 150		°C
Supply voltage (V_{DD})	1.5	5.5	V

7.4 Thermal Information(1)

THERMAL METRIC(2)		LMT84/ LMT84-Q1	LMT84LP	LMT84LPG	UNIT
		DCK (SOT/SC70)	LP/LPM (TO-92)	LPG (TO-92S)	
		5 PINS	3 PINS	3 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance (3)(4)	275	167	130.4	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	84	90	64.2	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	56	146	106.2	°C/W
ψ_{JT}	Junction-to-top characterization parameter	1.2	35	14.6	°C/W
ψ_{JB}	Junction-to-board characterization parameter	55	146	106.2	°C/W

(1) For information on self-heating and thermal response time see section Mounting and Thermal Conductivity.
(2) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report.
(3) The junction to ambient thermal resistance ($R_{\theta JA}$) under natural convection is obtained in a simulation on a JEDEC-standard, High-K board as specified in JESD51-7, in an environment described in JESD51-2. Exposed pad packages assume that thermal vias are included in the PCB, per JESD 51-5.
(4) Changes in output due to self heating can be computed by multiplying the internal dissipation by the thermal resistance.

7.5 Accuracy Characteristics

These limits do not include DC load regulation. These stated accuracy limits are with reference to the values in Table 3.

PARAMETER	TEST CONDITIONS	MIN(1)	TYP(2)	MAX(1)	UNIT
Temperature accuracy (3)	70°C to 150°C; V_{DD} = 1.5 V to 5.5 V	–2.7	±0.6	2.7	°C
	0°C to 70°C; V_{DD} = 1.5 V to 5.5 V	–2.7	±0.9	2.7	°C
	–50°C to +0°C; V_{DD} = 1.6 V to 5.5 V	–2.7	±0.9	2.7	°C
	–50°C to +150°C; V_{DD} = 2.3 V to 5.5 V		±0.4		°C

(1) Limits are specified to TI's AOQL (Average Outgoing Quality Level).
(2) Typicals are at $T_J = T_A$ = 25°C and represent most likely parametric norm.
(3) Accuracy is defined as the error between the measured and reference output voltages, tabulated in Table 3 at the specified conditions of supply gain setting, voltage, and temperature (expressed in °C). Accuracy limits include line regulation within the specified conditions. Accuracy limits do not include load regulation; they assume no DC load.

7.6 Electrical Characteristics

Unless otherwise noted, these specifications apply for V_{DD} = +1.5 V to +5.5 V. minimum and maximum limits apply for $T_A = T_J = T_{MIN}$ to T_{MAX}; typical values apply for $T_A = T_J$ = 25°C.

PARAMETER		TEST CONDITIONS	MIN(1)	TYP(2)	MAX (1)	UNIT
	Sensor gain			–5.5		mV/°C
	Load regulation (3)	Source ≤ 50 µA, (V_{DD} – V_{OUT}) ≥ 200 mV	–1	–0.22		mV
		Sink ≤ 50 µA, V_{OUT} ≥ 200 mV		0.26	1	mV
	Line regulation (4)			200		µV/V
I_S	Supply current	T_A = 30°C to 150°C, (V_{DD} – V_{OUT}) ≥ 100 mV		5.4	8.1	µA
		T_A = –50°C to 150°C, (V_{DD} – V_{OUT}) ≥ 100 mV		5.4	9	µA
C_L	Output load capacitance			1100		pF
	Power-on time (5)	C_L= 0 pF to 1100 pF		0.7	1.9	ms
	Output drive			±50		µA

(1) Limits are specific to TI's AOQL (Average Outgoing Quality Level).
(2) Typicals are at $T_J = T_A$ = 25°C and represent most likely parametric norm.
(3) Source currents are flowing out of the LMT84-xx. Sink currents are flowing into the LMT84-xx.
(4) Line regulation (DC) is calculated by subtracting the output voltage at the highest supply voltage from the output voltage at the lowest supply voltage. The typical DC line regulation specification does not include the output voltage shift discussed in *Output Voltage Shift*.
(5) Specified by design and characterization.

7.7 Typical Characteristics

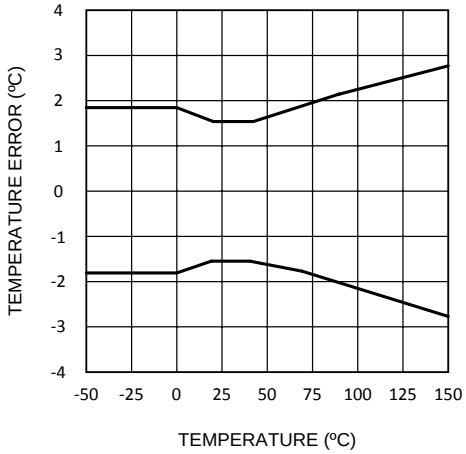


Figure 1. Temperature Error vs Temperature

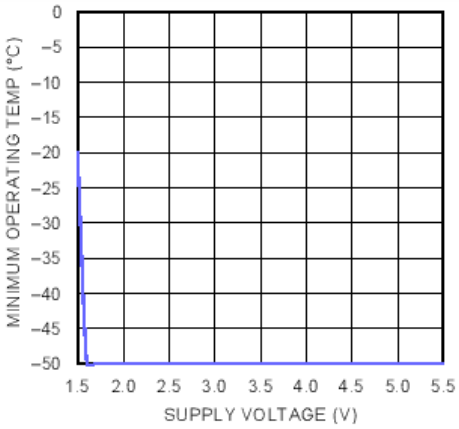


Figure 2. Minimum Operating Temperature vs Supply Voltage

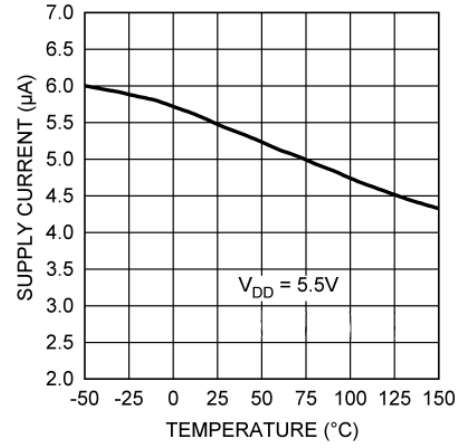


Figure 3. Supply Current vs Temperature

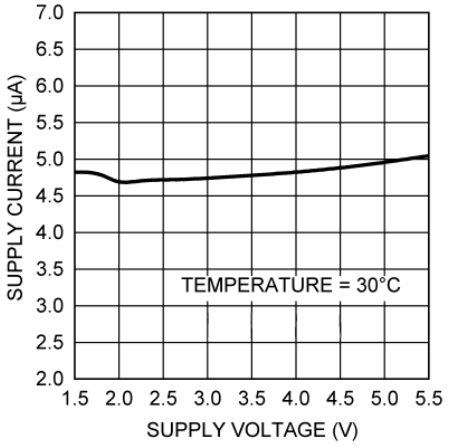


Figure 4. Supply Current vs Supply Voltage

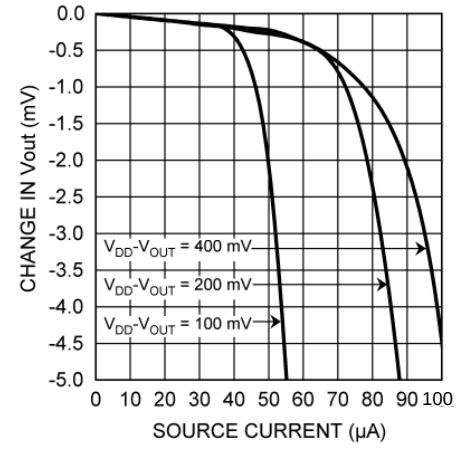


Figure 5. Load Regulation, Sourcing Current

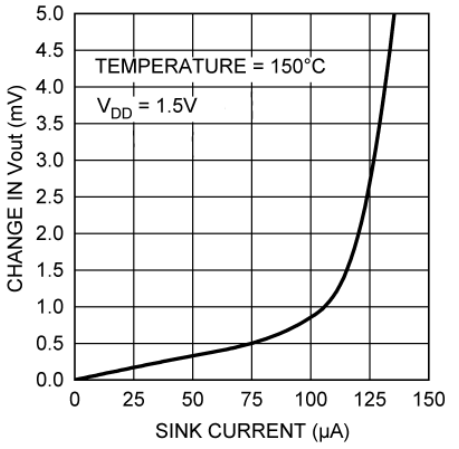


Figure 6. Load Regulation, Sinking Current

Typical Characteristics (continued)

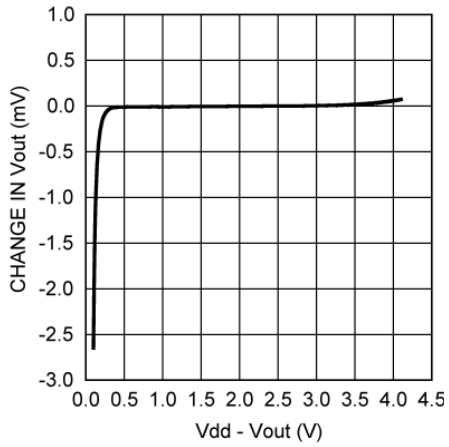


Figure 7. Change in Vout vs Overhead Voltage

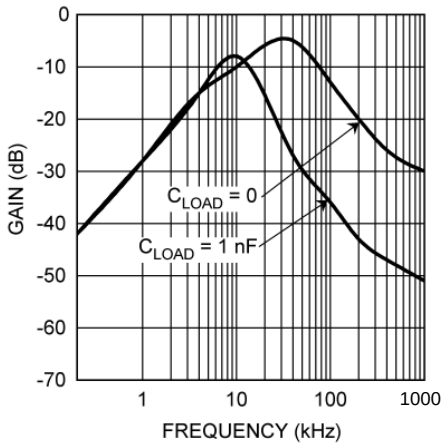


Figure 8. Supply-Noise Gain vs Frequency

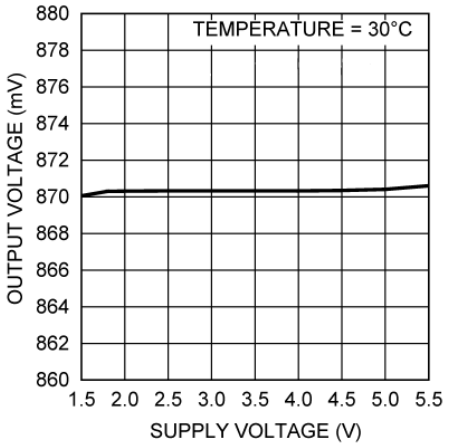


Figure 9. Output Voltage vs Supply Voltage

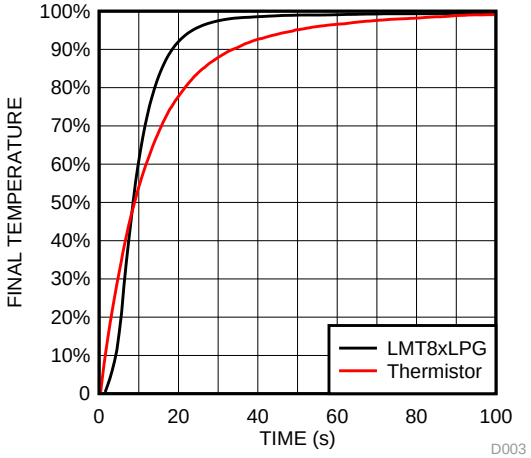


Figure 10. LMT84LPG Thermal Response vs Common Leaded Thermistor With 1.2-m/s Airflow

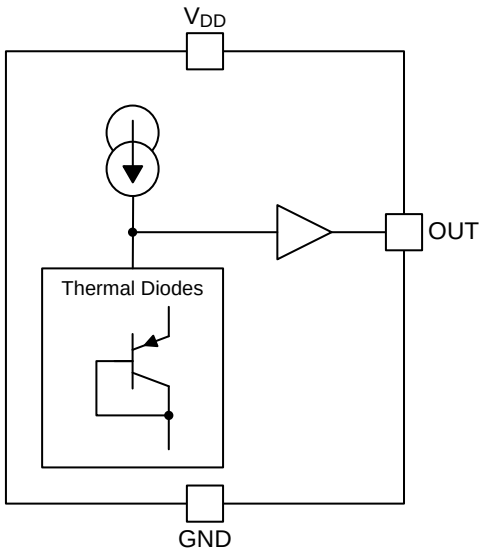
8 Detailed Description

8.1 Overview

The LMT84 is an analog output temperature sensor. The temperature-sensing element is comprised of a simple base emitter junction that is forward biased by a current source. The temperature-sensing element is then buffered by an amplifier and provided to the OUT pin. The amplifier has a simple push-pull output stage thus providing a low impedance output source.

8.2 Functional Block Diagram

Full-Range Celsius Temperature Sensor (−50°C to +150°C)



8.3 Feature Description

8.3.1 LMT84 Transfer Function

The output voltage of the LMT84, across the complete operating temperature range, is shown in Table 3. This table is the reference from which the LMT84 accuracy specifications (listed in the *Accuracy Characteristics* section) are determined. This table can be used, for example, in a host processor look-up table. A file containing this data is available for download at the LMT84 product folder under *Tools and Software Models*.

Table 3. LMT84 Transfer Table

TEMP (°C)	V_{OUT} (mV)	TEMP (°C)	V_{OUT} (mV)	TEMP (°C)	V_{OUT} (mV)	TEMP (°C)	V_{OUT} (mV)	TEMP (°C)	V_{OUT} (mV)
–50	1299	-10	1088	30	871	70	647	110	419
–49	1294	-9	1082	31	865	71	642	111	413
–48	1289	-8	1077	32	860	72	636	112	407
–47	1284	-7	1072	33	854	73	630	113	401
–46	1278	-6	1066	34	849	74	625	114	396
–45	1273	-5	1061	35	843	75	619	115	390
–44	1268	-4	1055	36	838	76	613	116	384
–43	1263	-3	1050	37	832	77	608	117	378
–42	1257	-2	1044	38	827	78	602	118	372
–41	1252	-1	1039	39	821	79	596	119	367
–40	1247	0	1034	40	816	80	591	120	361
–39	1242	1	1028	41	810	81	585	121	355
–38	1236	2	1023	42	804	82	579	122	349

Feature Description (continued)

Table 3. LMT84 Transfer Table (continued)

TEMP (°C)	V_{OUT} (mV)	TEMP (°C)	V_{OUT} (mV)	TEMP (°C)	V_{OUT} (mV)	TEMP (°C)	V_{OUT} (mV)	TEMP (°C)	V_{OUT} (mV)
–37	1231	3	1017	43	799	83	574	123	343
–36	1226	4	1012	44	793	84	568	124	337
–35	1221	5	1007	45	788	85	562	125	332
–34	1215	6	1001	46	782	86	557	126	326
–33	1210	7	996	47	777	87	551	127	320
–32	1205	8	990	48	771	88	545	128	314
–31	1200	9	985	49	766	89	539	129	308
–30	1194	10	980	50	760	90	534	130	302
–29	1189	11	974	51	754	91	528	131	296
–28	1184	12	969	52	749	92	522	132	291
–27	1178	13	963	53	743	93	517	133	285
–26	1173	14	958	54	738	94	511	134	279
–25	1168	15	952	55	732	95	505	135	273
–24	1162	16	947	56	726	96	499	136	267
–23	1157	17	941	57	721	97	494	137	261
–22	1152	18	936	58	715	98	488	138	255
–21	1146	19	931	59	710	99	482	139	249
–20	1141	20	925	60	704	100	476	140	243
–19	1136	21	920	61	698	101	471	141	237
–18	1130	22	914	62	693	102	465	142	231
–17	1125	23	909	63	687	103	459	143	225
–16	1120	24	903	64	681	104	453	144	219
–15	1114	25	898	65	676	105	448	145	213
–14	1109	26	892	66	670	106	442	146	207
–13	1104	27	887	67	664	107	436	147	201
–12	1098	28	882	68	659	108	430	148	195
–11	1093	29	876	69	653	109	425	149	189
								150	183

Although the LMT84 is very linear, the response does have a slight umbrella parabolic shape. This shape is very accurately reflected in Table 3. The transfer table can be calculated by using the parabolic equation (Equation 1).

$$V_{TEMP}(mV) = 870.6mV - \left[5.506\frac{mV}{°C}(T - 30°C)\right] - \left[0.00176\frac{mV}{°C^2}(T - 30°C)^2\right] \quad (1)$$

The parabolic equation is an approximation of the transfer table and the accuracy of the equation degrades slightly at the temperature range extremes. Equation 1 can be solved for T, resulting in:

$$T = \frac{5.506 - \sqrt{(-5.506)^2 + 4 \times 0.00176 \times (870.6 - V_{TEMP}(mV))}}{2 \times (-0.00176)} + 30 \quad (2)$$

For an even less accurate linear approximation, a line can easily be calculated over the desired temperature range from the table using the two-point equation (Equation 3):

$$V - V_1 = \left(\frac{V_2 - V_1}{T_2 - T_1}\right) \times (T - T_1)$$

where

- V is in mV,
- T is in °C,
- T_1 and V_1 are the coordinates of the lowest temperature,
- and T_2 and V_2 are the coordinates of the highest temperature. (3)

For example, if the user wanted to resolve this equation, over a temperature range of 20°C to 50°C, they would proceed as follows:

$$V - 925\ mV = \left(\frac{760\ mV - 925\ mV}{50^oC - 20^oC}\right) \times (T - 20^oC) \quad (4)$$

$$V - 925\ mV = (-5.50\ mV / {}^oC) \times (T - 20^oC) \quad (5)$$

$$V = (-5.50\ mV / {}^oC) \times T + 1035\ mV \quad (6)$$

Using this method of linear approximation, the transfer function can be approximated for one or more temperature ranges of interest.

8.4 Device Functional Modes

8.4.1 Mounting and Thermal Conductivity

The LMT84 can be applied easily in the same way as other integrated-circuit temperature sensors. It can be glued or cemented to a surface.

To ensure good thermal conductivity, the backside of the LMT84 die is directly attached to the GND pin. The temperatures of the lands and traces to the other leads of the LMT84 will also affect the temperature reading.

Alternatively, the LMT84 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 LMT84 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. If moisture creates a short circuit from the output to ground or V_{DD}, the output from the LMT84 will not be correct. Printed-circuit coatings are often used to ensure that moisture cannot corrode the leads or circuit traces.

The thermal resistance junction to ambient ($R_{\theta JA}$ or θ_{JA}) is the parameter used to calculate the rise of a device junction temperature due to its power dissipation. Use Equation 7 to calculate the rise in the LMT84 die temperature:

$$T_J = T_A + \theta_{JA}\left[(V_{DD}I_S) + (V_{DD} - V_O)\, I_L\right] \quad (7)$$

where

- T_A is the ambient temperature,
- I_S is the supply current,
- I_L is the load current on the output,
- and V_O is the output voltage.

For example, in an application where T_A = 30°C, V_{DD} = 5 V, I_S = 5.4 µA, V_{OUT} = 871 mV, and I_L = 2 µA, the junction temperature would be 30.015°C, showing a self-heating error of only 0.015°C. Because the junction temperature of the LMT84 device is the actual temperature being measured, take care to minimize the load current that the LMT84 is required to drive. *Thermal Information* shows the thermal resistance of the LMT84.

8.4.2 Output Noise Considerations

A push-pull output gives the LMT84 the ability to sink and source significant current. This is beneficial when, for example, driving dynamic loads like an input stage on an analog-to-digital converter (ADC). In these applications the source current is required to quickly charge the input capacitor of the ADC. The LMT84 is ideal for this and other applications which require strong source or sink current.

The LMT84 supply-noise gain (the ratio of the AC signal on V_{OUT} to the AC signal on V_{DD}) was measured during bench tests. The typical attenuation is shown in Figure 8 found in the *Typical Characteristics* section. A load capacitor on the output can help to filter noise.

For operation in very noisy environments, some bypass capacitance should be present on the supply within approximately 5 centimeters of the LMT84.

Device Functional Modes (continued)

8.4.3 Capacitive Loads

The LMT84 handles capacitive loading well. In an extremely noisy environment, or when driving a switched sampling input on an ADC, it may be necessary to add some filtering to minimize noise coupling. Without any precautions, the LMT84 can drive a capacitive load less than or equal to 1100 pF as shown in Figure 11. For capacitive loads greater than 1100 pF, a series resistor may be required on the output, as shown in Figure 12.

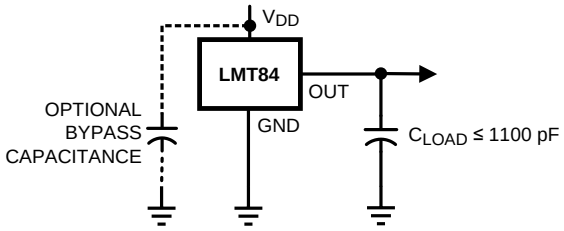


Figure 11. LMT84 No Decoupling Required for Capacitive Loads Less Than 1100 pF

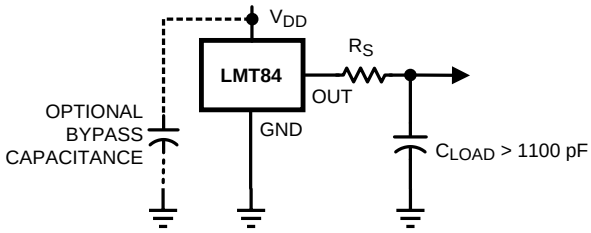


Figure 12. LMT84 With Series Resistor for Capacitive Loading Greater Than 1100 pF

Table 4. Recommended Series Resistor Values

C_{LOAD}	MINIMUM R_S
1.1 nF to 99 nF	3 kΩ
100 nF to 999 nF	1.5 kΩ
1 μF	800 Ω

8.4.4 Output Voltage Shift

The LMT84 is very linear over temperature and supply voltage range. Due to the intrinsic behavior of an NMOS or PMOS rail-to-rail buffer, a slight shift in the output can occur when the supply voltage is ramped over the operating range of the device. The location of the shift is determined by the relative levels of V_{DD} and V_{OUT}. The shift typically occurs when $V_{DD} – V_{OUT} = 1$ V.

This slight shift (a few millivolts) takes place over a wide change (approximately 200 mV) in V_{DD} or V_{OUT}. Because the shift takes place over a wide temperature change of 5°C to 20°C, V_{OUT} is always monotonic. The accuracy specifications in the *Accuracy Characteristics* table already include this possible shift.

9 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

9.1 Applications Information

The LMT84 features make it suitable for many general temperature-sensing applications. It can operate down to 1.5-V supply with 5.4-µA power consumption, making it ideal for battery-powered devices. Package options like the through-hole TO-92 package allow the LMT84 to be mounted onboard, off-board, to a heat sink, or on multiple unique locations in the same application.

9.2 Typical Applications

9.2.1 Connection to an ADC

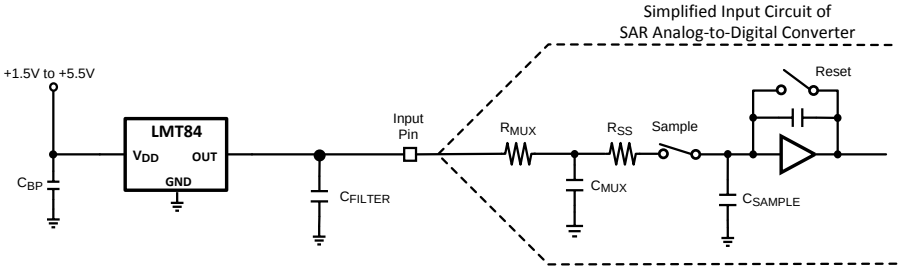


Figure 13. Suggested Connection to a Sampling Analog-to-Digital Converter Input Stage

9.2.1.1 Design Requirements

Most CMOS ADCs found in microcontrollers and ASICs have a sampled data comparator input structure. When the ADC charges the sampling cap, it requires instantaneous charge from the output of the analog source such as the LMT84 temperature sensor and many op amps. This requirement is easily accommodated by the addition of a capacitor (C_{FILTER}).

9.2.1.2 Detailed Design Procedure

The size of C_{FILTER} depends on the size of the sampling capacitor and the sampling frequency. Because not all ADCs have identical input stages, the charge requirements will vary. This general ADC application is shown as an example only.

9.2.1.3 Application Curve

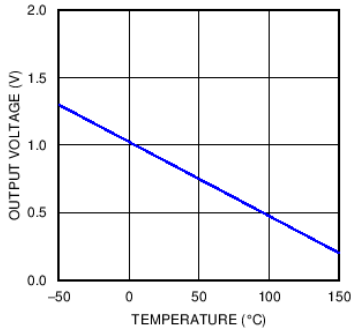


Figure 14. Analog Output Transfer Function

Typical Applications (continued)

9.2.2 Conserving Power Dissipation With Shutdown

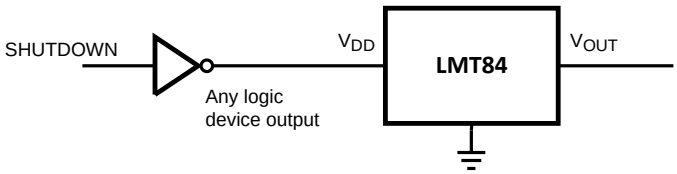


Figure 15. Simple Shutdown Connection of the LMT84

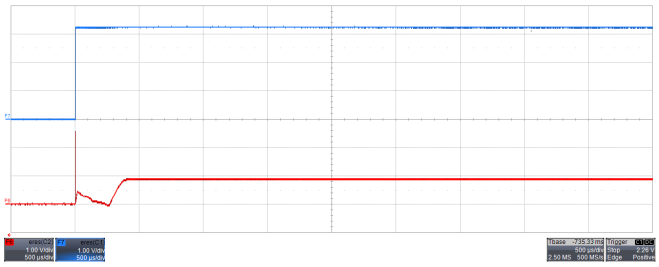
9.2.2.1 Design Requirements

Because the power consumption of the LMT84 is less than 9 µA, it can simply be powered directly from any logic gate output and therefore not require a specific shutdown pin. The device can even be powered directly from a microcontroller GPIO. In this way, it can easily be turned off for cases such as battery-powered systems where power savings are critical.

9.2.2.2 Detailed Design Procedure

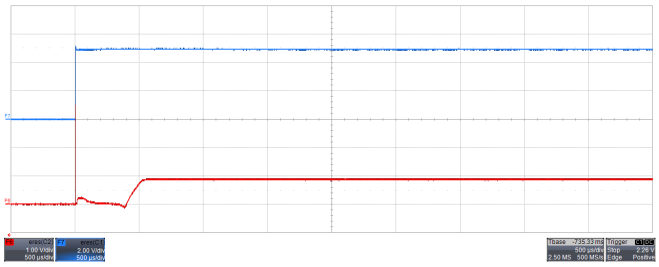
Simply connect the V_{DD} pin of the LMT84 directly to the logic shutdown signal from a microcontroller.

9.2.2.3 Application Curves



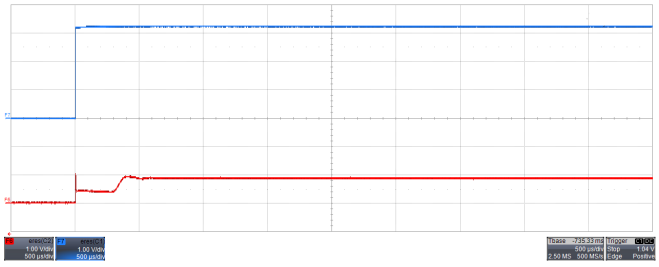
Time: 500 µs/div; Top trace: V_{DD} 1 V/div;
Bottom trace: OUT 1 V/div

Figure 16. Output Turnon Response Time Without a Capacitive Load and V_{DD}= 3.3 V



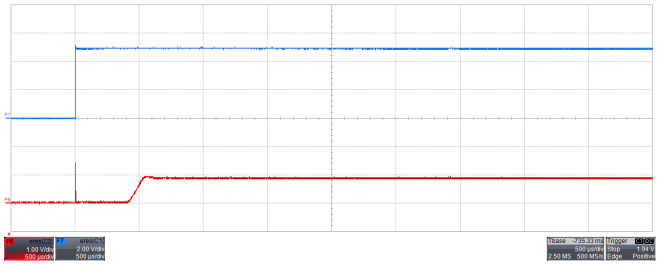
Time: 500 µs/div; Top trace: V_{DD} 2 V/div;
Bottom trace: OUT 1 V/div

Figure 17. Output Turnon Response Time Without a Capacitive Load and V_{DD}= 5 V



Time: 500 µs/div; Top trace: V_{DD} 1 V/div;
Bottom trace: OUT 1 V/div

Figure 18. Output Turnon Response Time With 1.1-Nf Capacitive Load and V_{DD}= 3.3 V



Time: 500 µs/div; Top trace: V_{DD} 2 V/div;
Bottom trace: OUT 1 V/div

Figure 19. Output Turnon Response Time With 1.1-Nf Capacitive Load and V_{DD}= 5 V

10 Power Supply Recommendations

The low supply current and supply range (1.5 V to 5.5 V) of the LMT84 allow the device to easily be powered from many sources. Power supply bypassing is optional and is mainly dependent on the noise on the power supply used. In noisy systems, it may be necessary to add bypass capacitors to lower the noise that is coupled to the output of the LMT84.

11 Layout

11.1 Layout Guidelines

The LMT84 is extremely simple to layout. If a power-supply bypass capacitor is used, is should be connected as shown in the *Layout Examples*.

11.2 Layout Examples

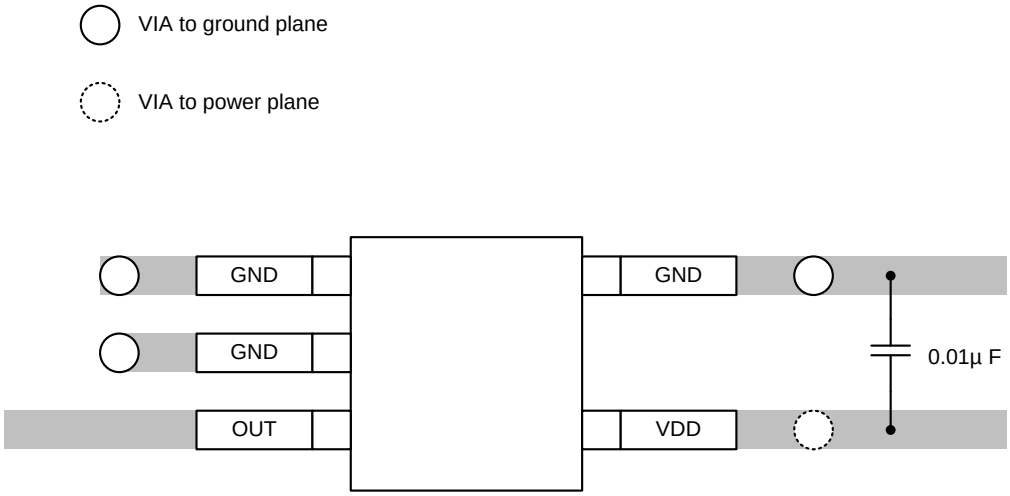


Figure 20. SC70 Package Recommended Layout

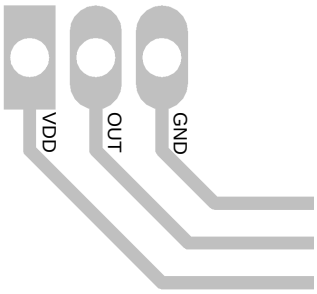


Figure 21. TO-92 LP Package Recommended Layout

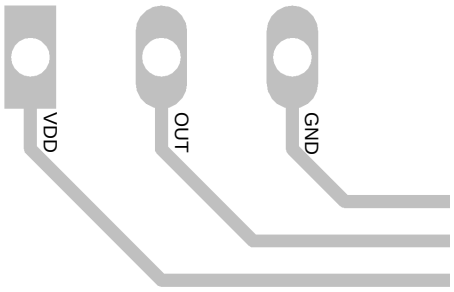


Figure 22. TO-92 LPM Package Recommended Layout

12 デバイスおよびドキュメントのサポート

12.1 ドキュメントの更新通知を受け取る方法

ドキュメントの更新についての通知を受け取るには、ti.comのデバイス製品フォルダを開いてください。右上の隅にある「*通知を受け取る*」をクリックして登録すると、変更されたすべての製品情報に関するダイジェストを毎週受け取れます。変更の詳細については、修正されたドキュメントに含まれている改訂履歴をご覧ください。

12.2 コミュニティ・リソース

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

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12.5 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

13 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。この情報は、そのデバイスについて利用可能な最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LMT84DCKR	Active	Production	SC70 (DCK) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-50 to 150	BNA
LMT84DCKR.A	Active	Production	SC70 (DCK) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-50 to 150	BNA
LMT84DCKR.B	Active	Production	SC70 (DCK) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-50 to 150	BNA
LMT84DCKT	Obsolete	Production	SC70 (DCK) | 5	-	-	Call TI	Call TI	-50 to 150	BNA
LMT84LP	Active	Production	TO-92 (LP) | 3	1800 | LARGE T&R	Yes	SN	N/A for Pkg Type	-50 to 150	LMT84
LMT84LP.A	Active	Production	TO-92 (LP) | 3	1800 | LARGE T&R	Yes	SN	N/A for Pkg Type	-50 to 150	LMT84
LMT84LP.B	Active	Production	TO-92 (LP) | 3	1800 | LARGE T&R	Yes	SN	N/A for Pkg Type	-50 to 150	LMT84
LMT84LPG	Active	Production	TO-92 (LPG) | 3	1000 | BULK	Yes	SN	N/A for Pkg Type	-50 to 150	LMT84
LMT84LPG.A	Active	Production	TO-92 (LPG) | 3	1000 | BULK	Yes	SN	N/A for Pkg Type	-50 to 150	LMT84
LMT84LPG.B	Active	Production	TO-92 (LPG) | 3	1000 | BULK	Yes	SN	N/A for Pkg Type	-50 to 150	LMT84
LMT84LPGM	Active	Production	TO-92 (LPG) | 3	3000 | AMMO	Yes	SN	N/A for Pkg Type	-50 to 150	LMT84
LMT84LPGM.A	Active	Production	TO-92 (LPG) | 3	3000 | AMMO	Yes	SN	N/A for Pkg Type	-50 to 150	LMT84
LMT84LPGM.B	Active	Production	TO-92 (LPG) | 3	3000 | AMMO	Yes	SN	N/A for Pkg Type	-50 to 150	LMT84
LMT84LPM	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-50 to 150	LMT84
LMT84LPM.A	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-50 to 150	LMT84
LMT84LPM.B	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-50 to 150	LMT84

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

OTHER QUALIFIED VERSIONS OF LMT84 :

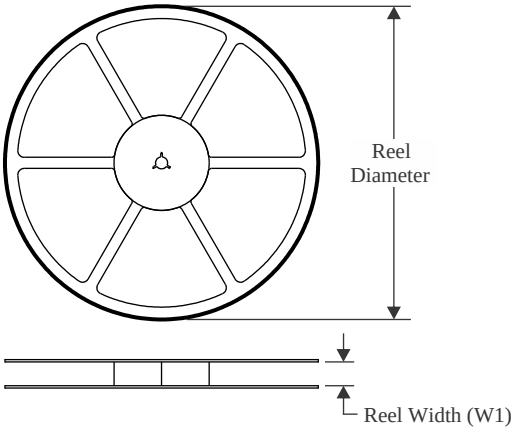
- Automotive : LMT84-Q1

NOTE: Qualified Version Definitions:

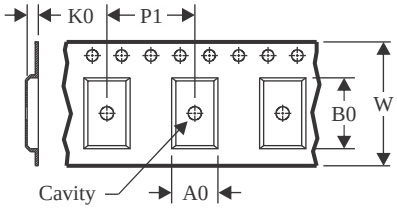
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

REEL DIMENSIONS

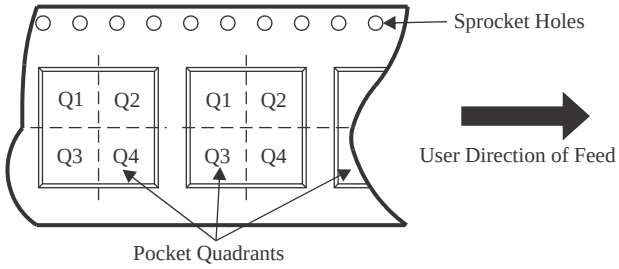


TAPE DIMENSIONS



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

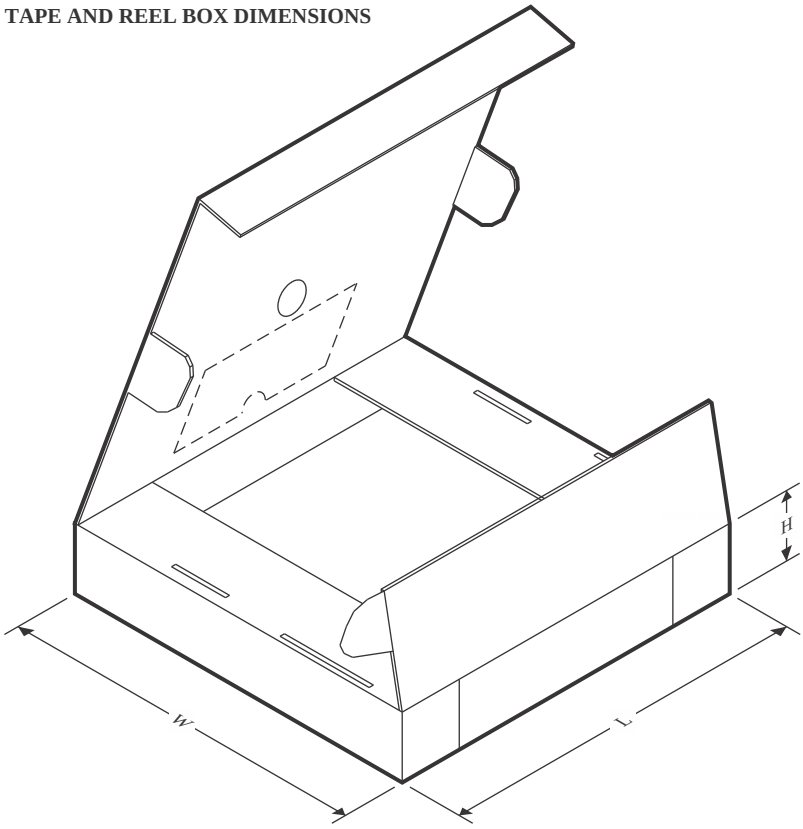
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
LMT84DCKR	SC70	DCK	5	3000	178.0	8.4	2.25	2.45	1.2	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

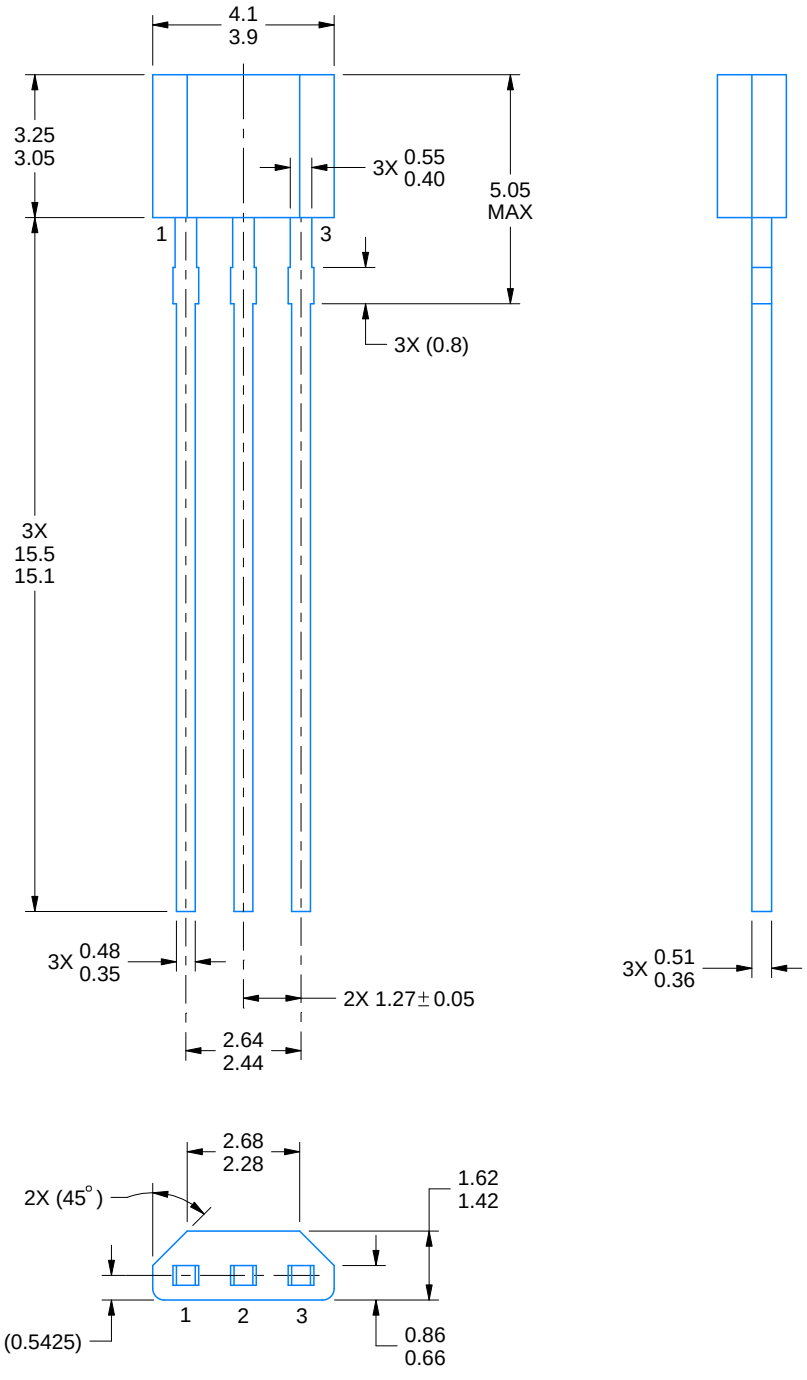
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LMT84DCKR	SC70	DCK	5	3000	208.0	191.0	35.0

PACKAGE OUTLINE

LPG0003A

TO-92 - 5.05 mm max height

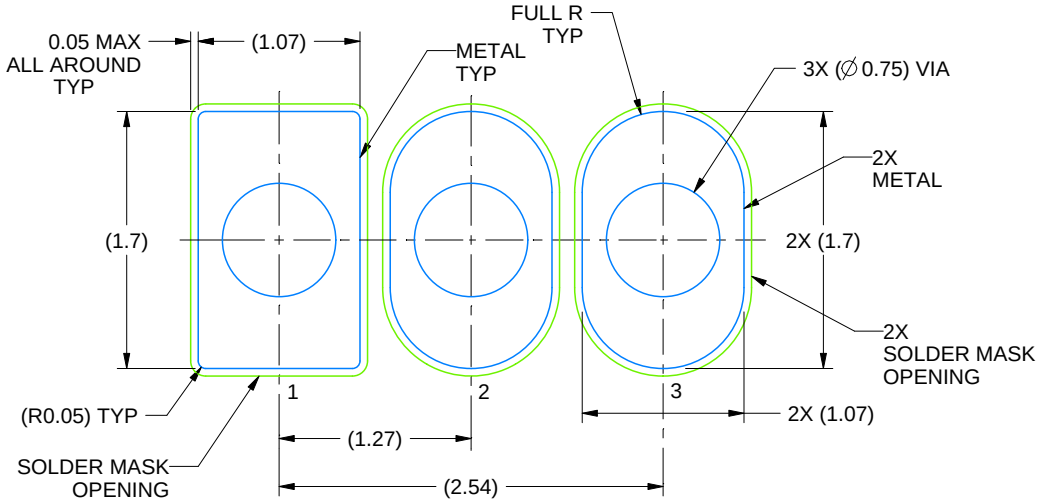
TRANSISTOR OUTLINE



4221343/C 01/2018

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.



LAND PATTERN EXAMPLE
NON-SOLDER MASK DEFINED
SCALE:20X

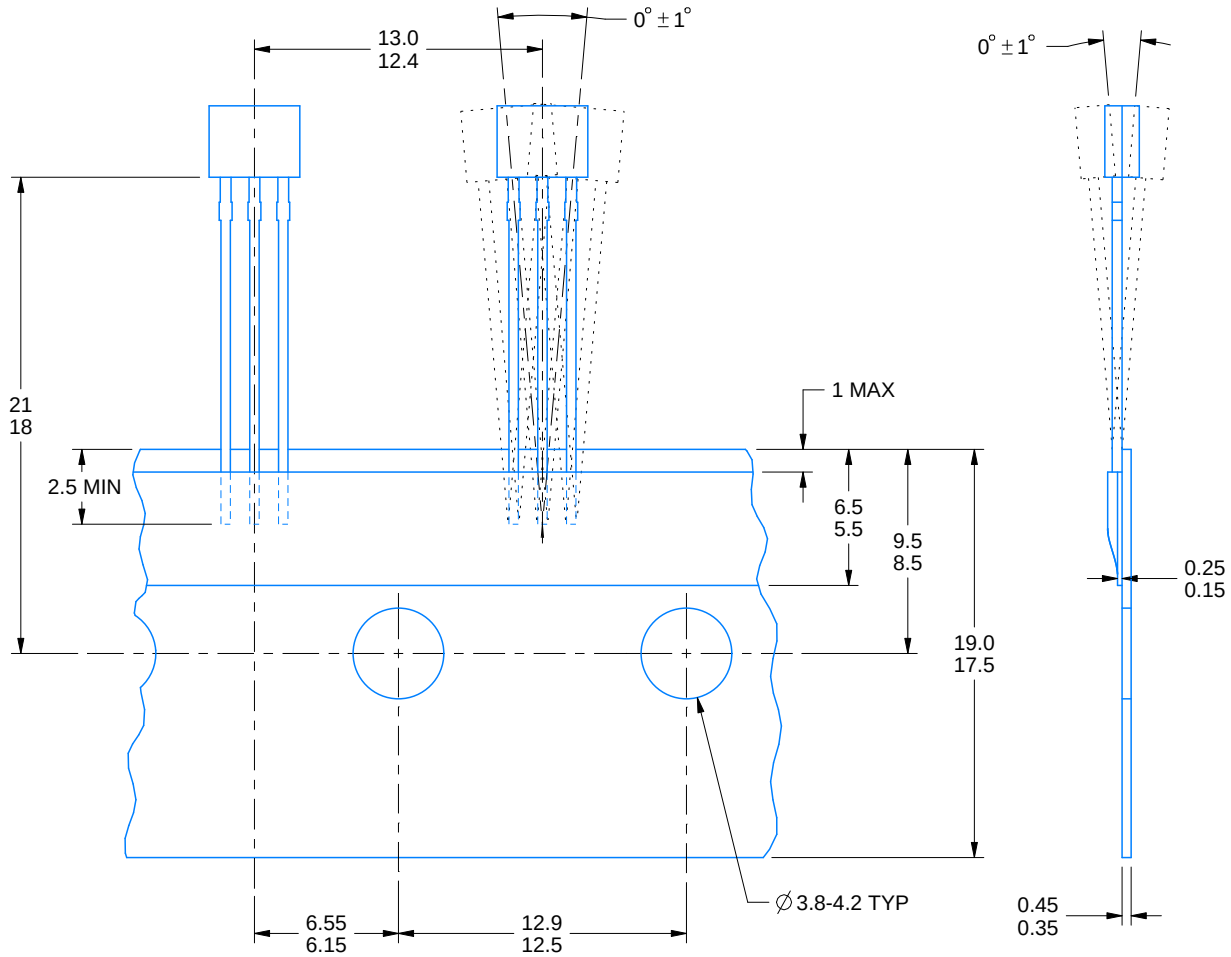
4221343/C 01/2018

TAPE SPECIFICATIONS

LPG0003A

TO-92 - 5.05 mm max height

TRANSISTOR OUTLINE



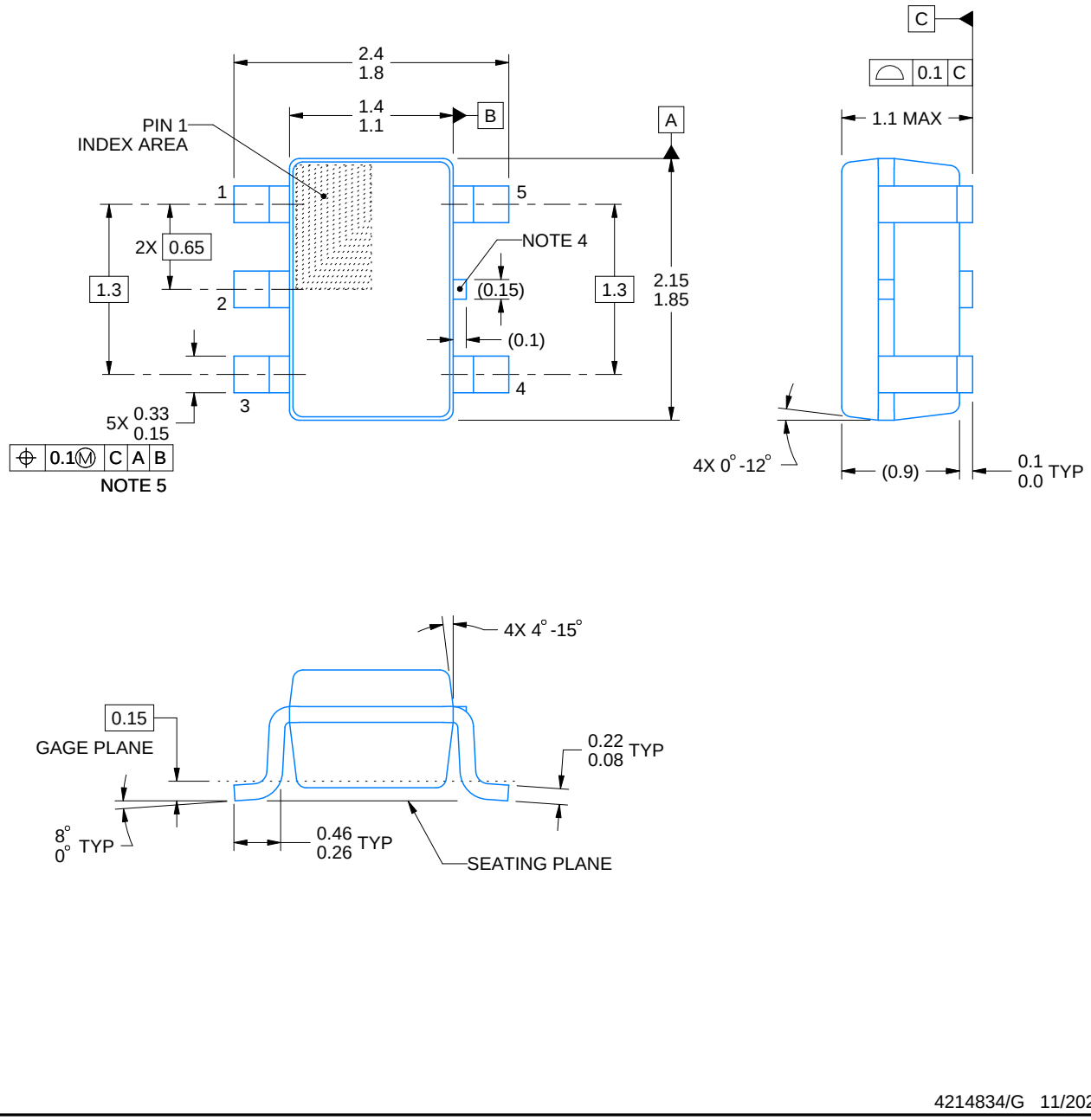
4221343/C 01/2018

PACKAGE OUTLINE

DCK0005A

SOT - 1.1 max height

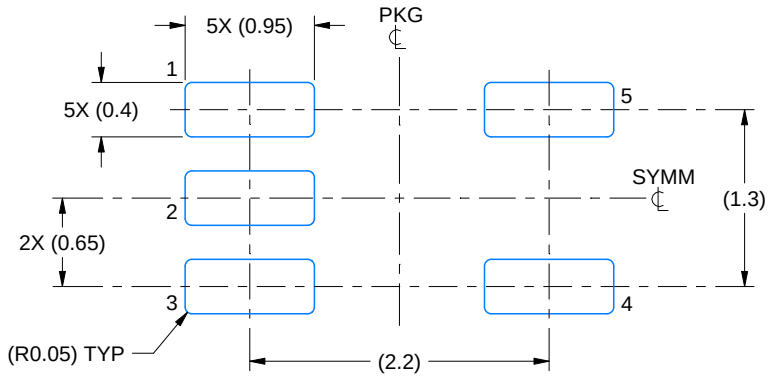
SMALL OUTLINE TRANSISTOR



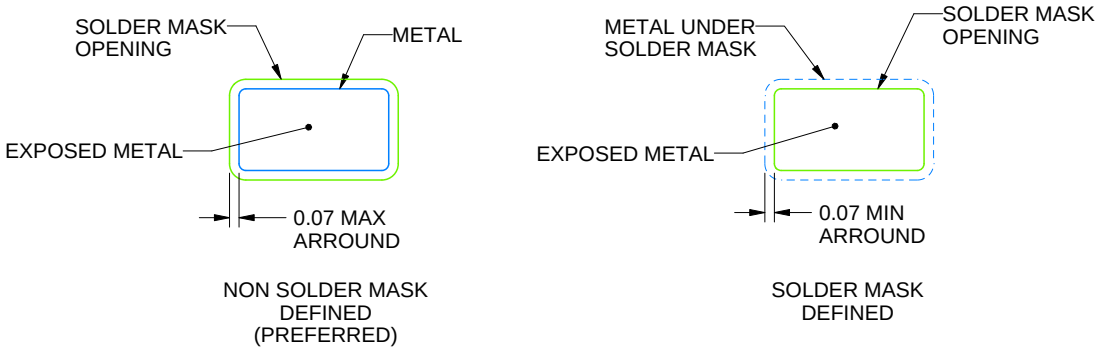
4214834/G 11/2024

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Refernce JEDEC MO-203.
4. Support pin may differ or may not be present.
5. Lead width does not comply with JEDEC.
6. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25mm per side



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:18X



SOLDER MASK DETAILS

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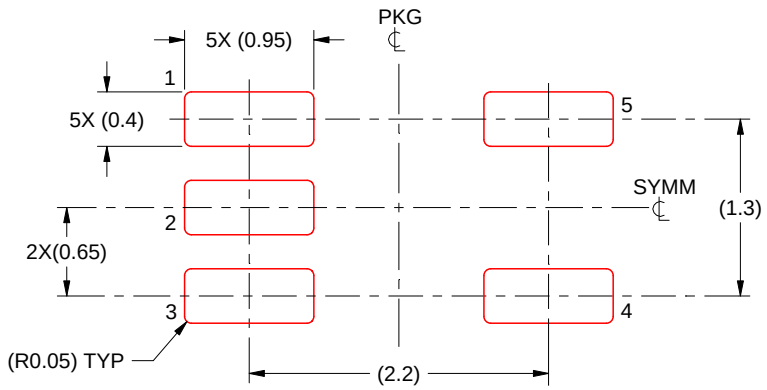
NOTES: (continued)

7. Publication IPC-7351 may have alternate designs.
8. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
BASED ON 0.125 THICK STENCIL
SCALE:18X

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NOTES: (continued)

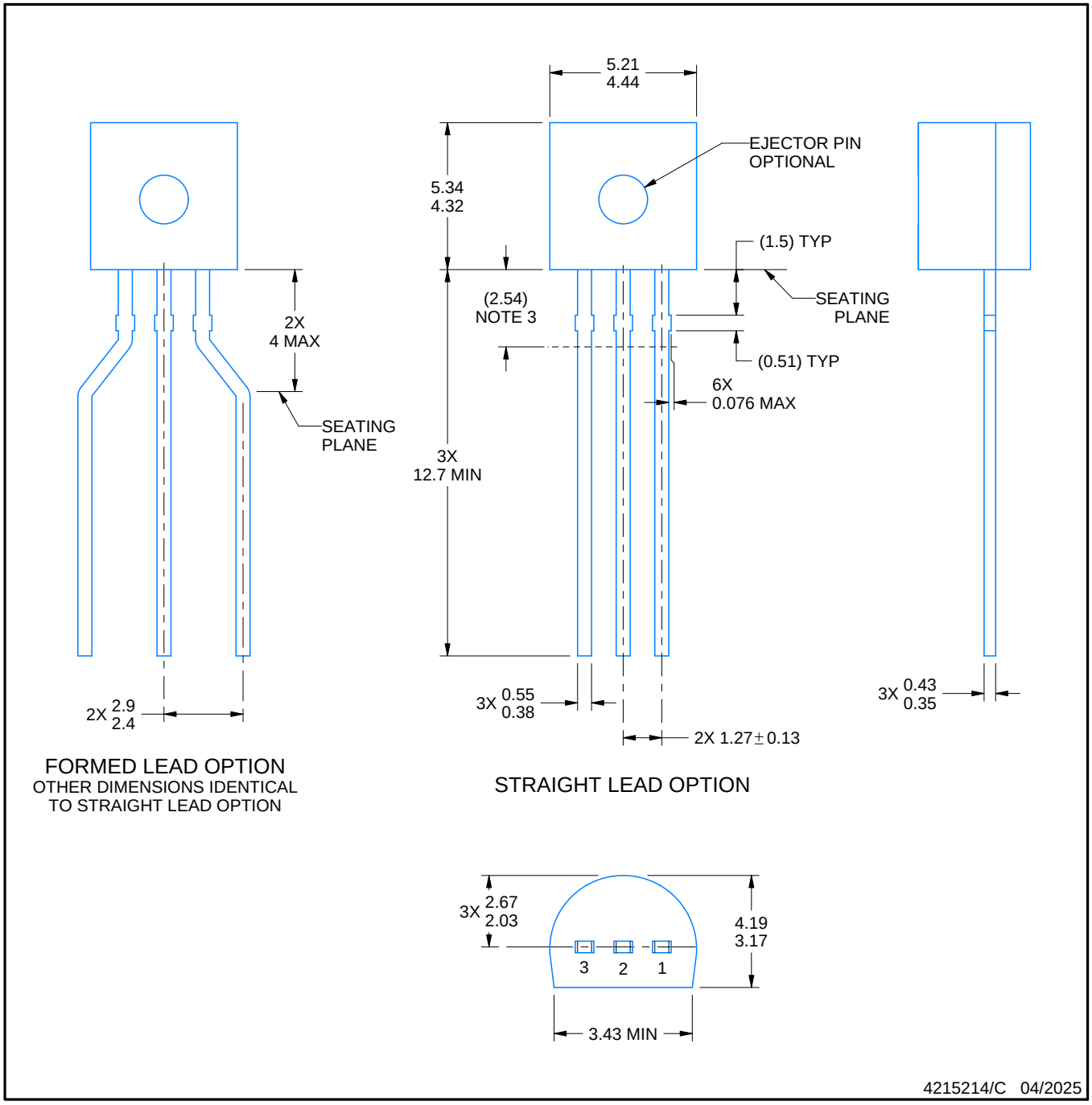
9. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
10. Board assembly site may have different recommendations for stencil design.

LP0003A

PACKAGE OUTLINE

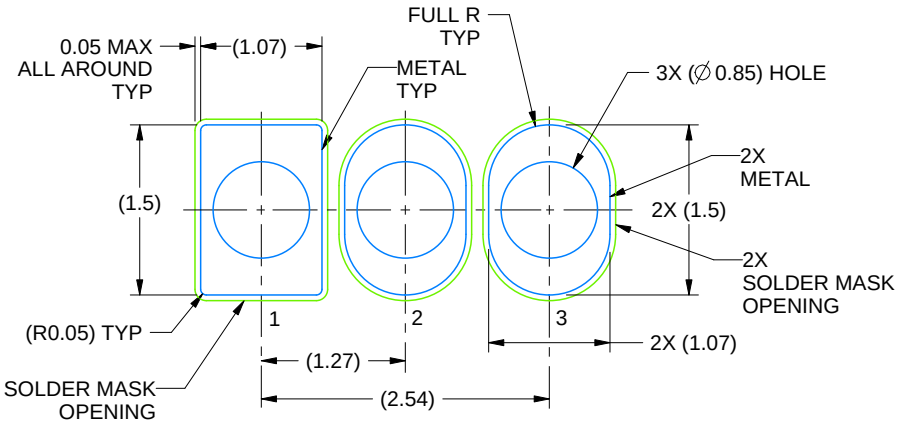
TO-92 - 5.34 mm max height

TO-92

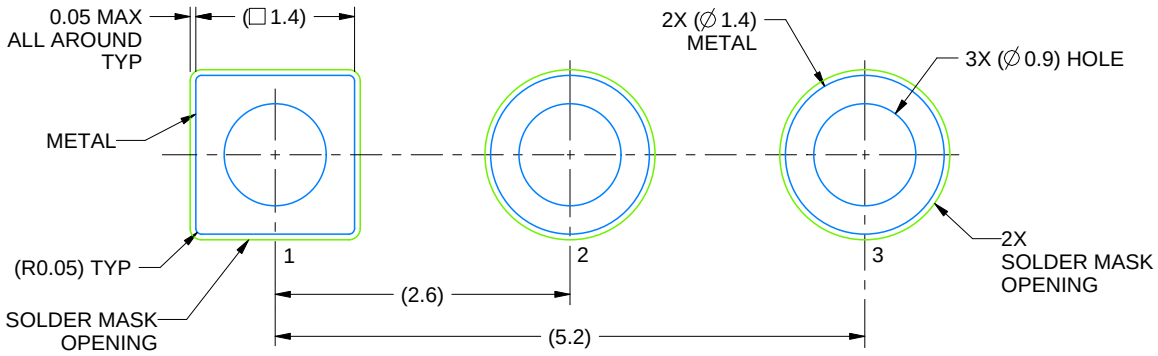


NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Lead dimensions are not controlled within this area.
4. Reference JEDEC TO-226, variation AA.
5. Shipping method:
   a. Straight lead option available in bulk pack only.
   b. Formed lead option available in tape and reel or ammo pack.
   c. Specific products can be offered in limited combinations of shipping medium and lead options.
   d. Consult product folder for more information on available options.



LAND PATTERN EXAMPLE
STRAIGHT LEAD OPTION
NON-SOLDER MASK DEFINED
SCALE:15X



LAND PATTERN EXAMPLE
FORMED LEAD OPTION
NON-SOLDER MASK DEFINED
SCALE:15X

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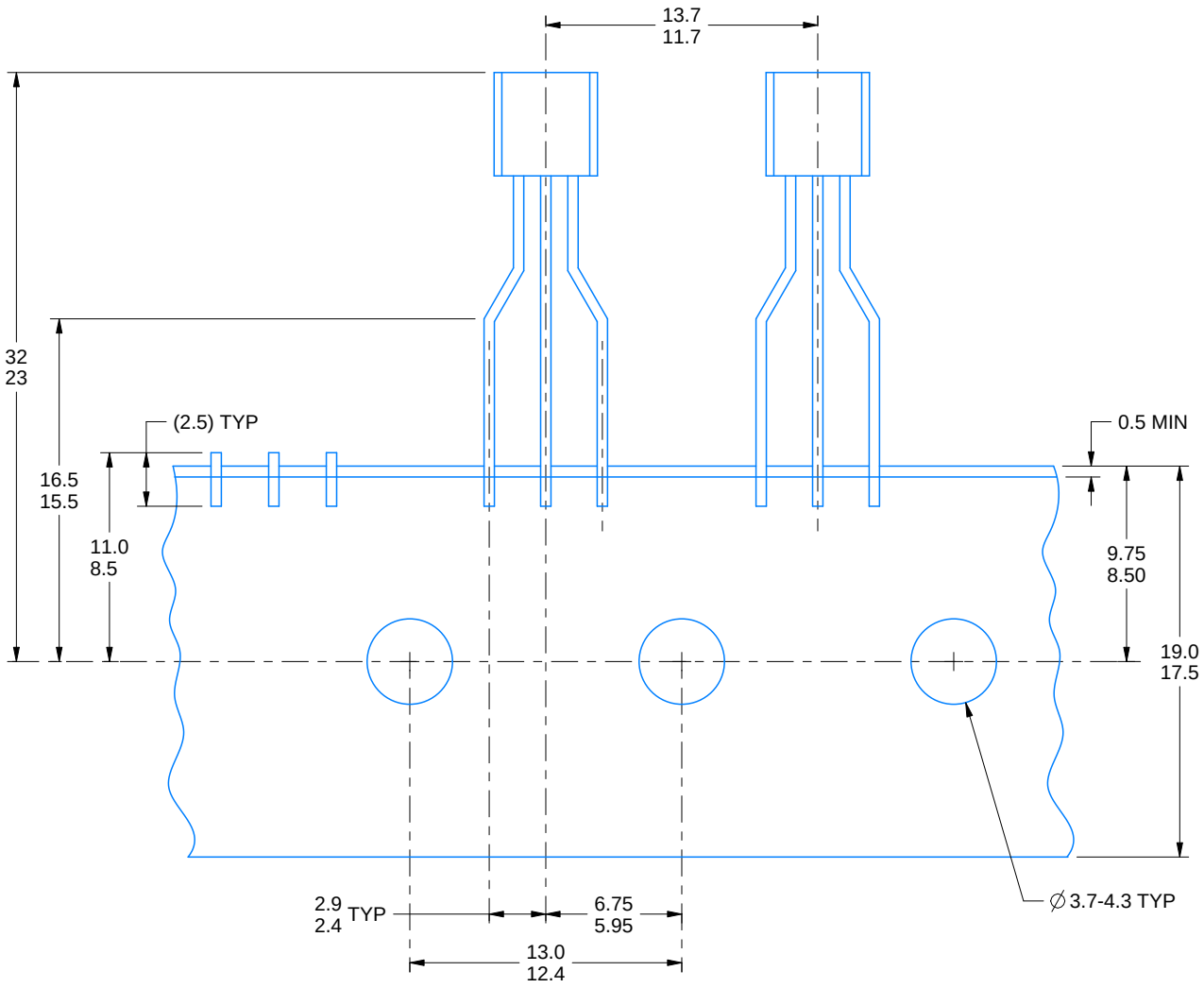
LP0003A

TO-92 - 5.34 mm max height

TO-92



FOR FORMED LEAD OPTION PACKAGE

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