LM35 高精度摂氏直読温度センサ

1 特長

- 摂氏温度に直接較正(摂氏直読)
- リニア、+10mV/℃のスケール係数
- 0.5℃精度を保証(25℃において)
- -55℃から150℃までの範囲全体が定格内
- リモート・アプリケーションに最適
- ウェハー・レベルのトリミングにより低コストを実現
- 4V～30Vで動作
- 消費電流60μA未満
- 低い自己発熱、無風状態で0.08℃
- 非直線性がわずか±¼℃ (標準値)
- 低インピーダンスの出力、1mA負荷で0.1Ω

2 アプリケーション

- 電源
- バッテリ管理
- HVAC (暖房、通気、エアコン)
- 家電製品

3 概要

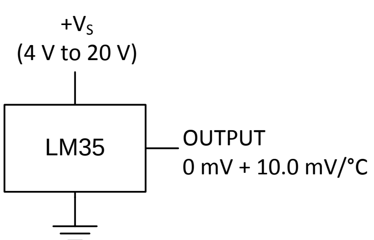
LM35シリーズは高精度の集積回路温度デバイスで、出力電圧が摂氏温度と正比例します。LM35デバイスには、ケルビン温度で較正されているリニア温度センサと比較して、使いやすい摂氏の数値を得るために、大きな定電圧を出力から減算する必要がないという利点があります。LM35デバイスは外部での較正やトリミングを必要とせず、室温で±¼℃、-55℃～150℃の温度範囲全体で±¾℃の精度(標準値)が維持されます。ウェハー・レベルでのトリミングと較正により、低コストが保証されます。出力インピーダンスの低さ、リニア出力、高精度な内蔵の較正により、LM35デバイスは読み出しまたは制御回路と非常に簡単に接続できます。このデバイスは、単一電源、または正と負の電源で使用できます。LM35の消費電流はわずか60μAであるため、自己発熱も極めて低く、無風状態で0.1℃未満です。LM35デバイスは-55℃～150℃の温度範囲での動作が定格内で、LM35Cデバイスは-40℃～110℃の範囲が定格内です(精度改善のためには-10℃)。LM35シリーズのデバイスは密封TOトランジスタ・パッケージで、LM35C、LM35CA、LM35Dデバイスはプラスチックの TO-92トランジスタ・パッケージで供給されます。LM35Dデバイスは、8リードの表面実装、スモール・アウトラインのパッケージと、プラスチックのTO-220パッケージで供給されます。

製品情報(1)

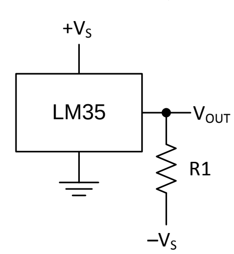
型番	パッケージ	本体サイズ(公称)
LM35	TO-CAN (3)	4.699mm×4.699mm
	TO-92 (3)	4.30mm×4.30mm
	SOIC (8)	4.90mm×3.91mm
	TO-220 (3)	14.986mm×10.16mm

(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。

基本的な摂氏温度センサ (2℃～150℃)



全範囲の摂氏温度センサ



$R_1 = –V_S$ / 50μAを選択
150℃においてV_{OUT} = 1500mV
25℃においてV_{OUT} = 250mV
–55℃においてV_{OUT} = –550mV

English Data Sheet: SNIS159

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4 改訂履歴

Revision G (August 2016) から **Revision H** に変更	**Page**
• Changed NDV Package (TO-CAN) pinout from bottom view back to top view; added textnote to pinout	3
• Added pin numbers to the TO-CAN (TO46) pinout	3

Revision F (January 2016) から **Revision G** に変更	**Page**
• Equation 1, changed From: 10 mV/°F To: 10mv/°C	13
• *Power Supply Recommendations*, changed From: "4-V to 5.5-V power supply" To: "4-V to 30-V power supply:	19

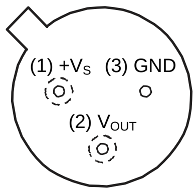
Revision E (January 2015) から **Revision F** に変更	**Page**
• Changed NDV Package (TO-CAN) pinout from Top View to Bottom View	3

Revision D (October 2013) から **Revision E** に変更	**Page**
• *「ピン構成および機能」セクション、「ESD定格」表、「機能説明」セクション、「デバイスの機能モード」セクション、「アプリケーションと実装」セクション、「電源に関する推奨事項」セクション、「レイアウト」セクション、「デバイスおよびドキュメントのサポート」セクション、「メカニカル、パッケージング、および注文情報」セクション* 追加	1

Revision C (July 2013) から **Revision D** に変更	**Page**
• *W*を*Ω*へ 変更	1
• Changed *W* to *Ω* in *Abs Max* tablenote.	4

5 Pin Configuration and Functions

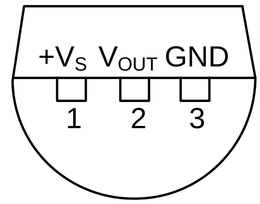
NDV Package
3-Pin TO-CAN
(Top View)



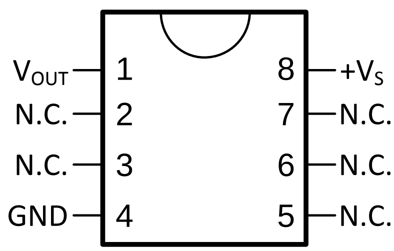
Case is connected to negative pin (GND)

Refer the second NDV0003H page for reference

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

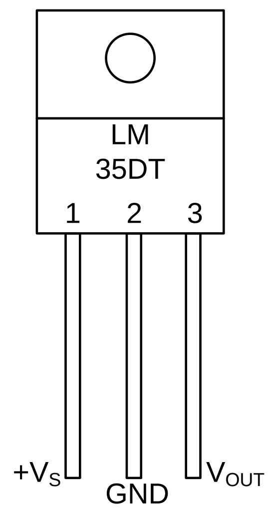


D Package
8-PIN SOIC
(Top View)



N.C. = No connection

NEB Package
3-Pin TO-220
(Top View)



Tab is connected to the negative pin (GND).

NOTE: The LM35DT pinout is different than the discontinued LM35DP

Pin Functions

PIN					TYPE	DESCRIPTION
NAME	**TO46**	**TO92**	**TO220**	**SO8**		
V_{OUT}	2	2	3	1	O	Temperature Sensor Analog Output
N.C.	—	—	—	2	—	No Connection
	—	—	—	3		
GND	3	3	2	4	GROUND	Device ground pin, connect to power supply negative terminal
N.C.	—	—	—	5	—	No Connection
	—	—	—	6		
	—	—	—	7		
$+V_S$	1	1	1	8	POWER	Positive power supply pin

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)[1][2]

		MIN	MAX	UNIT
Supply voltage		–0.2	35	V
Output voltage		–1	6	V
Output current			10	mA
Maximum Junction Temperature, $T_J$max			150	°C
Storage Temperature, T_{stg}	TO-CAN, TO-92 Package	–60	150	°C
	TO-220, SOIC Package	–65	150	

(1) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.
(2) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. DC and AC electrical specifications do not apply when operating the device beyond its rated operating conditions.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001[1]	±2500	V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	MAX	UNIT
Specified operating temperature: T_{MIN} to T_{MAX}	LM35, LM35A	–55	150	°C
	LM35C, LM35CA	–40	110	
	LM35D	0	100	
Supply Voltage ($+V_S$)		4	30	V

6.4 Thermal Information

THERMAL METRIC[1][2]		LM35				UNIT
		NDV	LP	D	NEB	
		3 PINS		8 PINS	3 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	400	180	220	90	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	24	—	—	—	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953.
(2) For additional thermal resistance information, see *Typical Application*.

6.5 Electrical Characteristics: LM35A, LM35CA Limits

Unless otherwise noted, these specifications apply: −55°C ≤ T_J ≤ 150°C for the LM35 and LM35A; −40°C ≤ T_J ≤ 110°C for the LM35C and LM35CA; and 0°C ≤ T_J ≤ 100°C for the LM35D. V_S = 5 Vdc and I_{LOAD} = 50 μA, in the circuit of Full-Range Centigrade Temperature Sensor. These specifications also apply from 2°C to T_{MAX} in the circuit of Figure 14.

PARAMETER	TEST CONDITIONS	LM35A			LM35CA			UNIT
		TYP	TESTED LIMIT(1)	DESIGN LIMIT(2)	TYP	TESTED LIMIT(1)	DESIGN LIMIT(2)	
Accuracy(3)	T_A = 25°C	±0.2	±0.5		±0.2	±0.5		°C
	T_A = –10°C	±0.3			±0.3		±1	
	T_A = T_{MAX}	±0.4	±1		±0.4	±1		
	T_A = T_{MIN}	±0.4	±1		±0.4		±1.5	
Nonlinearity(4)	T_{MIN} ≤ T_A ≤ T_{MAX}, –40°C ≤ T_J ≤ 125°C	±0.18		±0.35	±0.15		±0.3	°C
Sensor gain (average slope)	T_{MIN} ≤ T_A ≤ T_{MAX}	10	9.9		10		9.9	mV/°C
	–40°C ≤ T_J ≤ 125°C	10	10.1		10		10.1	
Load regulation(5) 0 ≤ I_L ≤ 1 mA	T_A = 25°C	±0.4	±1		±0.4	±1		mV/mA
	T_{MIN} ≤ T_A ≤ T_{MAX}, –40°C ≤ T_J ≤ 125°C	±0.5		±3	±0.5		±3	
Line regulation(5)	T_A = 25°C	±0.01	±0.05		±0.01	±0.05		mV/V
	4 V ≤ V_S ≤ 30 V, –40°C ≤ T_J ≤ 125°C	±0.02		±0.1	±0.02		±0.1	
Quiescent current(6)	V_S = 5 V, 25°C	56	67		56	67		μA
	V_S = 5 V, –40°C ≤ T_J ≤ 125°C	105		131	91		114	
	V_S = 30 V, 25°C	56.2	68		56.2	68		
	V_S = 30 V, –40°C ≤ T_J ≤ 125°C	105.5		133	91.5		116	
Change of quiescent current(5)	4 V ≤ V_S ≤ 30 V, 25°C	0.2	1		0.2	1		μA
	4 V ≤ V_S ≤ 30 V, –40°C ≤ T_J ≤ 125°C	0.5		2	0.5		2	
Temperature coefficient of quiescent current	–40°C ≤ T_J ≤ 125°C	0.39		0.5	0.39		0.5	μA/°C
Minimum temperature for rate accuracy	In circuit of Figure 14, I_L = 0	1.5		2	1.5		2	°C
Long term stability	T_J = T_{MAX}, for 1000 hours	±0.08			±0.08			°C

(1) Tested Limits are ensured and 100% tested in production.
(2) Design Limits are ensured (but not 100% production tested) over the indicated temperature and supply voltage ranges. These limits are not used to calculate outgoing quality levels.
(3) Accuracy is defined as the error between the output voltage and 10 mv/°C times the case temperature of the device, at specified conditions of voltage, current, and temperature (expressed in °C).
(4) Non-linearity is defined as the deviation of the output-voltage-versus-temperature curve from the best-fit straight line, over the rated temperature range of the device.
(5) Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output due to heating effects can be computed by multiplying the internal dissipation by the thermal resistance.
(6) Quiescent current is defined in the circuit of Figure 14.

6.6 Electrical Characteristics: LM35A, LM35CA

Unless otherwise noted, these specifications apply: −55°C ≤ T_J ≤ 150°C for the LM35 and LM35A; −40°C ≤ T_J ≤ 110°C for the LM35C and LM35CA; and 0°C ≤ T_J ≤ 100°C for the LM35D. V_S = 5 Vdc and I_{LOAD} = 50 μA, in the circuit of Full-Range Centigrade Temperature Sensor. These specifications also apply from 2°C to T_{MAX} in the circuit of Figure 14.

PARAMETER	TEST CONDITIONS		LM35A			LM35CA			UNIT
			MIN	TYP	MAX	TYP	TYP	MAX	
Accuracy[1]	T_A = 25°C			±0.2			±0.2		°C
		Tested Limit[2]			±0.5			±0.5	
		Design Limit[3]							
	T_A = –10°C			±0.3			±0.3		
		Tested Limit[2]							
		Design Limit[3]						±1	
	$T_A = T_{MAX}$			±0.4			±0.4		
		Tested Limit[2]			±1			±1	
		Design Limit[3]							
	$T_A = T_{MIN}$			±0.4			±0.4		
		Tested Limit[2]			±1				
		Design Limit[3]						±1.5	
Nonlinearity[4]	$T_{MIN} \le T_A \le T_{MAX}$, –40°C ≤ T_J ≤ 125°C			±0.18			±0.15		°C
		Tested Limit[2]							
		Design Limit[3]			±0.35			±0.3	
Sensor gain (average slope)	$T_{MIN} \le T_A \le T_{MAX}$			10			10		mV/°C
		Tested Limit[2]			9.9				
		Design Limit[3]						9.9	
	–40°C ≤ T_J ≤ 125°C			10			10		
		Tested Limit[2]			10.1				
		Design Limit[3]						10.1	
Load regulation[5] 0 ≤ I_L ≤ 1 mA	T_A = 25°C			±0.4			±0.4		mV/mA
		Tested Limit[2]			±1			±1	
		Design Limit[3]							
	$T_{MIN} \le T_A \le T_{MAX}$, –40°C ≤ T_J ≤ 125°C			±0.5			±0.5		
		Tested Limit[2]							
		Design Limit[3]			±3			±3	
Line regulation[5]	T_A = 25°C			±0.01			±0.01		mV/V
		Tested Limit[2]			±0.05			±0.05	
		Design Limit[3]							
	4 V ≤ V_S ≤ 30 V, –40°C ≤ T_J ≤ 125°C			±0.02			±0.02		
		Tested Limit[2]							
		Design Limit[3]			±0.1			±0.1	

(1) Accuracy is defined as the error between the output voltage and 10 mv/°C times the case temperature of the device, at specified conditions of voltage, current, and temperature (expressed in °C).
(2) Tested Limits are ensured and 100% tested in production.
(3) Design Limits are ensured (but not 100% production tested) over the indicated temperature and supply voltage ranges. These limits are not used to calculate outgoing quality levels.
(4) Non-linearity is defined as the deviation of the output-voltage-versus-temperature curve from the best-fit straight line, over the rated temperature range of the device.
(5) Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output due to heating effects can be computed by multiplying the internal dissipation by the thermal resistance.

Electrical Characteristics: LM35A, LM35CA (continued)

Unless otherwise noted, these specifications apply: −55°C ≤ T_J ≤ 150°C for the LM35 and LM35A; −40°C ≤ T_J ≤ 110°C for the LM35C and LM35CA; and 0°C ≤ T_J ≤ 100°C for the LM35D. V_S = 5 Vdc and I_{LOAD} = 50 µA, in the circuit of Full-Range Centigrade Temperature Sensor. These specifications also apply from 2°C to T_{MAX} in the circuit of Figure 14.

PARAMETER	TEST CONDITIONS		LM35A			LM35CA			UNIT
			MIN	TYP	MAX	TYP	TYP	MAX	
Quiescent current[6]	V_S = 5 V, 25°C			56			56		µA
		Tested Limit[2]			67			67	
		Design Limit[3]							
	V_S = 5 V, –40°C ≤ T_J ≤ 125°C			105			91		
		Tested Limit[2]							
		Design Limit[3]			131			114	
	V_S = 30 V, 25°C			56.2			56.2		
		Tested Limit[2]			68			68	
		Design Limit[3]							
	V_S = 30 V, –40°C ≤ T_J ≤ 125°C			105.5			91.5		
		Tested Limit[2]							
		Design Limit[3]			133			116	
Change of quiescent current[5]	4 V ≤ V_S ≤ 30 V, 25°C			0.2			0.2		µA
		Tested Limit[2]			1			1	
		Design Limit[3]							
	4 V ≤ V_S ≤ 30 V, –40°C ≤ T_J ≤ 125°C			0.5			0.5		
		Tested Limit[2]							
		Design Limit[3]			2			2	
Temperature coefficient of quiescent current	–40°C ≤ T_J ≤ 125°C			0.39			0.39		µA/°C
		Tested Limit[2]							
		Design Limit[3]			0.5			0.5	
Minimum temperature for rate accuracy	In circuit of Figure 14, I_L = 0			1.5			1.5		°C
		Tested Limit[2]							
		Design Limit[3]			2			2	
Long term stability	T_J = T_{MAX}, for 1000 hours			±0.08			±0.08		°C

(6) Quiescent current is defined in the circuit of Figure 14.

6.7 Electrical Characteristics: LM35, LM35C, LM35D Limits

Unless otherwise noted, these specifications apply: −55°C ≤ T_J ≤ 150°C for the LM35 and LM35A; −40°C ≤ T_J ≤ 110°C for the LM35C and LM35CA; and 0°C ≤ T_J ≤ 100°C for the LM35D. V_S = 5 Vdc and I_{LOAD} = 50 μA, in the circuit of Full-Range Centigrade Temperature Sensor. These specifications also apply from 2°C to T_{MAX} in the circuit of Figure 14.

PARAMETER	TEST CONDITIONS	LM35			LM35C, LM35D			UNIT
		TYP	TESTED LIMIT(1)	DESIGN LIMIT(2)	TYP	TESTED LIMIT(1)	DESIGN LIMIT(2)	
Accuracy, LM35, LM35C(3)	T_A = 25°C	±0.4	±1		±0.4	±1		°C
	T_A = –10°C	±0.5			±0.5		±1.5	
	$T_A = T_{MAX}$	±0.8	±1.5		±0.8		±1.5	
	$T_A = T_{MIN}$	±0.8		±1.5	±0.8		±2	
Accuracy, LM35D(3)	T_A = 25°C				±0.6	±1.5		°C
	$T_A = T_{MAX}$				±0.9		±2	
	$T_A = T_{MIN}$				±0.9		±2	
Nonlinearity(4)	$T_{MIN} \le T_A \le T_{MAX}$, –40°C ≤ T_J ≤ 125°C	±0.3		±0.5	±0.2		±0.5	°C
Sensor gain (average slope)	$T_{MIN} \le T_A \le T_{MAX}$, –40°C ≤ T_J ≤ 125°C	10	9.8		10		9.8	mV/°C
		10	10.2		10		10.2	
Load regulation(5) 0 ≤ I_L ≤ 1 mA	T_A = 25°C	±0.4	±2		±0.4	±2		mV/mA
	$T_{MIN} \le T_A \le T_{MAX}$, –40°C ≤ T_J ≤ 125°C	±0.5		±5	±0.5		±5	
Line regulation(5)	T_A = 25°C	±0.01	±0.1		±0.01	±0.1		mV/V
	4 V ≤ V_S ≤ 30 V, –40°C ≤ T_J ≤ 125°C	±0.02		±0.2	±0.02		±0.2	
Quiescent current(6)	V_S = 5 V, 25°C	56	80		56	80		μA
	V_S = 5 V, –40°C ≤ T_J ≤ 125°C	105		158	91		138	
	V_S = 30 V, 25°C	56.2	82		56.2	82		
	V_S = 30 V, –40°C ≤ T_J ≤ 125°C	105.5		161	91.5		141	
Change of quiescent current(5)	4 V ≤ V_S ≤ 30 V, 25°C	0.2	2		0.2	2		μA
	4 V ≤ V_S ≤ 30 V, –40°C ≤ T_J ≤ 125°C	0.5		3	0.5		**3**	
Temperature coefficient of quiescent current	–40°C ≤ T_J ≤ 125°C	0.39		0.7	0.39		0.7	μA/°C
Minimum temperature for rate accuracy	In circuit of Figure 14, I_L = 0	1.5		2	1.5		2	°C
Long term stability	$T_J = T_{MAX}$, for 1000 hours	±0.08			±0.08			°C

(1) Tested Limits are ensured and 100% tested in production.
(2) Design Limits are ensured (but not 100% production tested) over the indicated temperature and supply voltage ranges. These limits are not used to calculate outgoing quality levels.
(3) Accuracy is defined as the error between the output voltage and 10 mv/°C times the case temperature of the device, at specified conditions of voltage, current, and temperature (expressed in °C).
(4) Non-linearity is defined as the deviation of the output-voltage-versus-temperature curve from the best-fit straight line, over the rated temperature range of the device.
(5) Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output due to heating effects can be computed by multiplying the internal dissipation by the thermal resistance.
(6) Quiescent current is defined in the circuit of Figure 14.

6.8 Electrical Characteristics: LM35, LM35C, LM35D

Unless otherwise noted, these specifications apply: −55°C ≤ T_J ≤ 150°C for the LM35 and LM35A; −40°C ≤ T_J ≤ 110°C for the LM35C and LM35CA; and 0°C ≤ T_J ≤ 100°C for the LM35D. V_S = 5 Vdc and I_{LOAD} = 50 μA, in the circuit of Full-Range Centigrade Temperature Sensor. These specifications also apply from 2°C to T_{MAX} in the circuit of Figure 14.

PARAMETER	TEST CONDITIONS		LM35			LM35C, LM35D			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Accuracy, LM35, LM35C(1)	T_A = 25°C			±0.4			±0.4		°C
		Tested Limit(2)			±1			±1	
		Design Limit(3)							
	T_A = –10°C			±0.5			±0.5		
		Tested Limit(2)							
		Design Limit(3)						±1.5	
	T_A = T_{MAX}			±0.8			±0.8		
		Tested Limit(2)			±1.5				
		Design Limit(3)						±1.5	
	T_A = T_{MIN}			±0.8			±0.8		
		Tested Limit(2)							
		Design Limit(3)			±1.5			±2	
Accuracy, LM35D(1)	T_A = 25°C						±0.6		°C
		Tested Limit(2)						±1.5	
		Design Limit(3)							
	T_A = T_{MAX}						±0.9		
		Tested Limit(2)							
		Design Limit(3)						±2	
	T_A = T_{MIN}						±0.9		
		Tested Limit(2)							
		Design Limit(3)						±2	
Nonlinearity(4)	T_{MIN} ≤ T_A ≤ T_{MAX}, –40°C ≤ T_J ≤ 125°C			±0.3			±0.2		°C
		Tested Limit(2)							
		Design Limit(3)			±0.5			±0.5	
Sensor gain (average slope)	T_{MIN} ≤ T_A ≤ T_{MAX}, –40°C ≤ T_J ≤ 125°C			10			10		mV/°C
		Tested Limit(2)			9.8				
		Design Limit(3)						9.8	
				10			10		
		Tested Limit(2)			10.2				
		Design Limit(3)						10.2	
Load regulation(5) 0 ≤ I_L ≤ 1 mA	T_A = 25°C			±0.4			±0.4		mV/mA
		Tested Limit(2)			±2			±2	
		Design Limit(3)							
	T_{MIN} ≤ T_A ≤ T_{MAX}, –40°C ≤ T_J ≤ 125°C			±0.5			±0.5		
		Tested Limit(2)							
		Design Limit(3)			±5			±5	

(1) Accuracy is defined as the error between the output voltage and 10 mv/°C times the case temperature of the device, at specified conditions of voltage, current, and temperature (expressed in °C).
(2) Tested Limits are ensured and 100% tested in production.
(3) Design Limits are ensured (but not 100% production tested) over the indicated temperature and supply voltage ranges. These limits are not used to calculate outgoing quality levels.
(4) Non-linearity is defined as the deviation of the output-voltage-versus-temperature curve from the best-fit straight line, over the rated temperature range of the device.
(5) Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output due to heating effects can be computed by multiplying the internal dissipation by the thermal resistance.

Electrical Characteristics: LM35, LM35C, LM35D (continued)

Unless otherwise noted, these specifications apply: −55°C ≤ T_J ≤ 150°C for the LM35 and LM35A; −40°C ≤ T_J ≤ 110°C for the LM35C and LM35CA; and 0°C ≤ T_J ≤ 100°C for the LM35D. V_S = 5 Vdc and I_{LOAD} = 50 µA, in the circuit of Full-Range Centigrade Temperature Sensor. These specifications also apply from 2°C to T_{MAX} in the circuit of Figure 14.

PARAMETER	TEST CONDITIONS		LM35			LM35C, LM35D			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Line regulation[5]	T_A = 25°C			±0.01			±0.01		mV/V
		Tested Limit[2]			±0.1				
		Design Limit[3]						±0.1	
	4 V ≤ V_S ≤ 30 V, –40°C ≤ T_J ≤ 125°C			±0.02			±0.02		
		Tested Limit[2]							
		Design Limit[3]			±0.2			±0.2	
Quiescent current[6]	V_S = 5 V, 25°C			56			56		µA
		Tested Limit[2]			80			80	
		Design Limit[3]							
	V_S = 5 V, –40°C ≤ T_J ≤ 125°C			105			91		
		Tested Limit[2]							
		Design Limit[3]			158			138	
	V_S = 30 V, 25°C			56.2			56.2		
		Tested Limit[2]			82			82	
		Design Limit[3]							
	V_S = 30 V, –40°C ≤ T_J ≤ 125°C			105.5			91.5		
		Tested Limit[2]							
		Design Limit[3]			161			141	
Change of quiescent current[5]	4 V ≤ V_S ≤ 30 V, 25°C			0.2			0.2		µA
		Tested Limit[2]						2	
		Design Limit[3]			2				
	4 V ≤ V_S ≤ 30 V, –40°C ≤ T_J ≤ 125°C			0.5			0.5		
		Tested Limit[2]							
		Design Limit[3]			3			3	
Temperature coefficient of quiescent current	–40°C ≤ T_J ≤ 125°C			0.39			0.39		µA/°C
		Tested Limit[2]							
		Design Limit[3]			0.7			0.7	
Minimum temperature for rate accuracy	In circuit of Figure 14, I_L = 0			1.5			1.5		°C
		Tested Limit[2]							
		Design Limit[3]			2			2	
Long term stability	T_J = T_{MAX}, for 1000 hours			±0.08			±0.08		°C

(6) Quiescent current is defined in the circuit of Figure 14.

6.9 Typical Characteristics

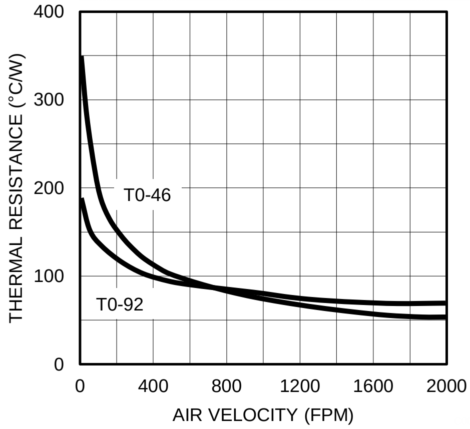


Figure 1. Thermal Resistance Junction To Air

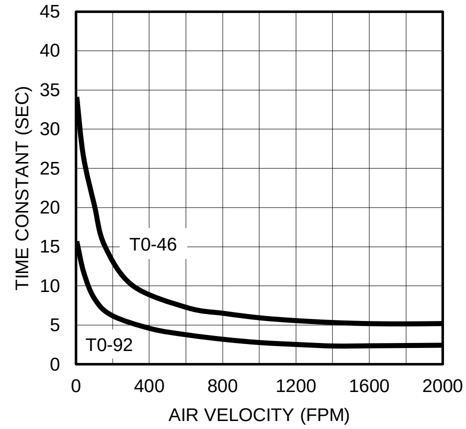


Figure 2. Thermal Time Constant

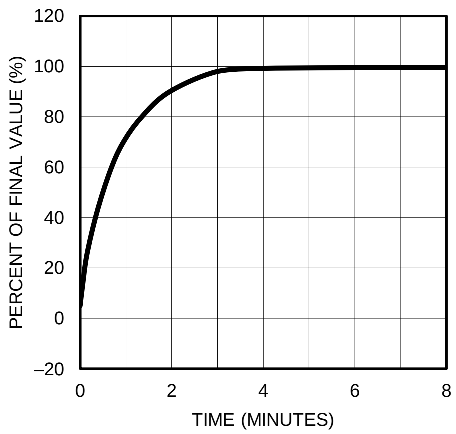


Figure 3. Thermal Response In Still Air

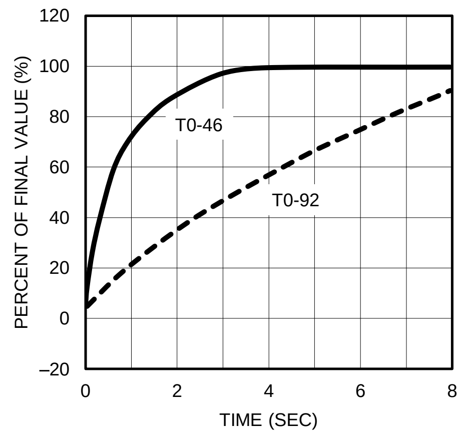


Figure 4. Thermal Response In Stirred Oil Bath

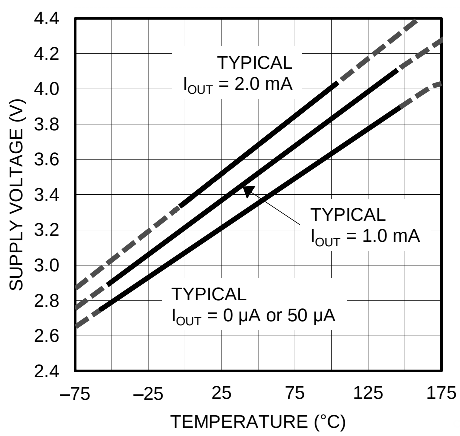


Figure 5. Minimum Supply Voltage vs Temperature

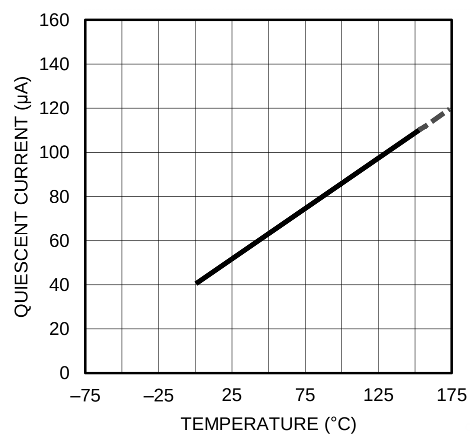


Figure 6. Quiescent Current vs Temperature (in Circuit of Figure 14)

Typical Characteristics (continued)

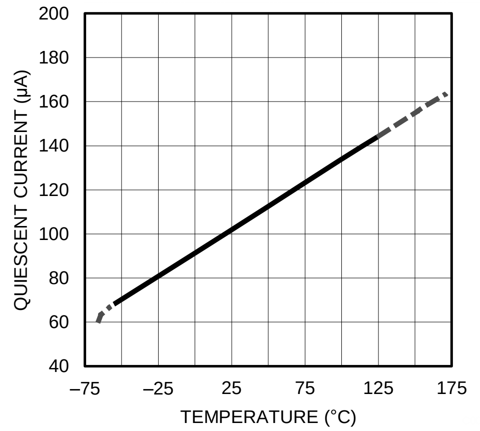


Figure 7. Quiescent Current vs Temperature (in Circuit of Full-Range Centigrade Temperature Sensor)

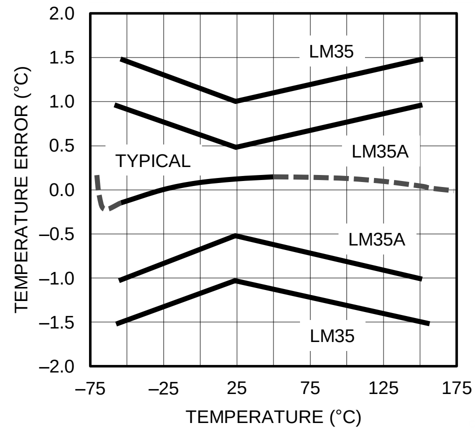


Figure 8. Accuracy vs Temperature (Ensured)

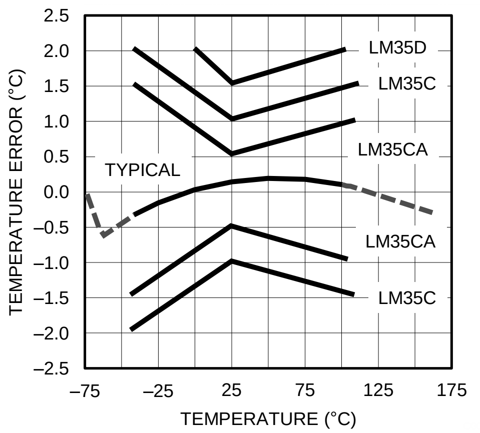


Figure 9. Accuracy vs Temperature (Ensured)

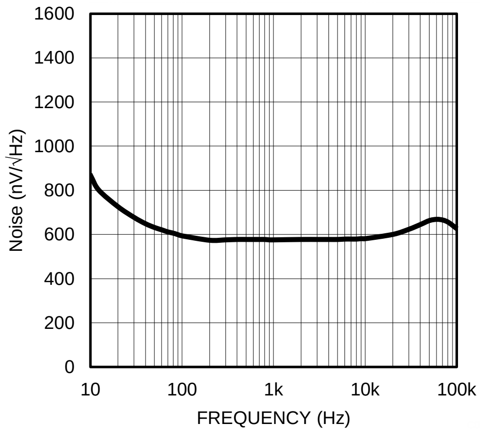


Figure 10. Noise Voltage

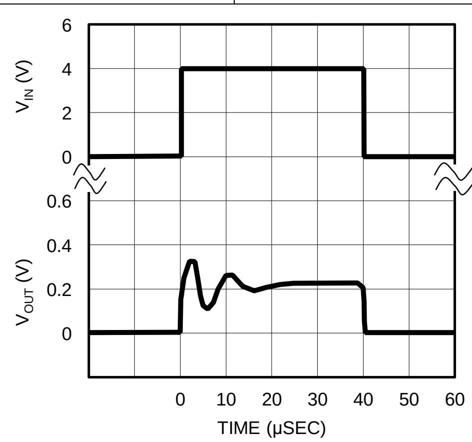


Figure 11. Start-Up Response

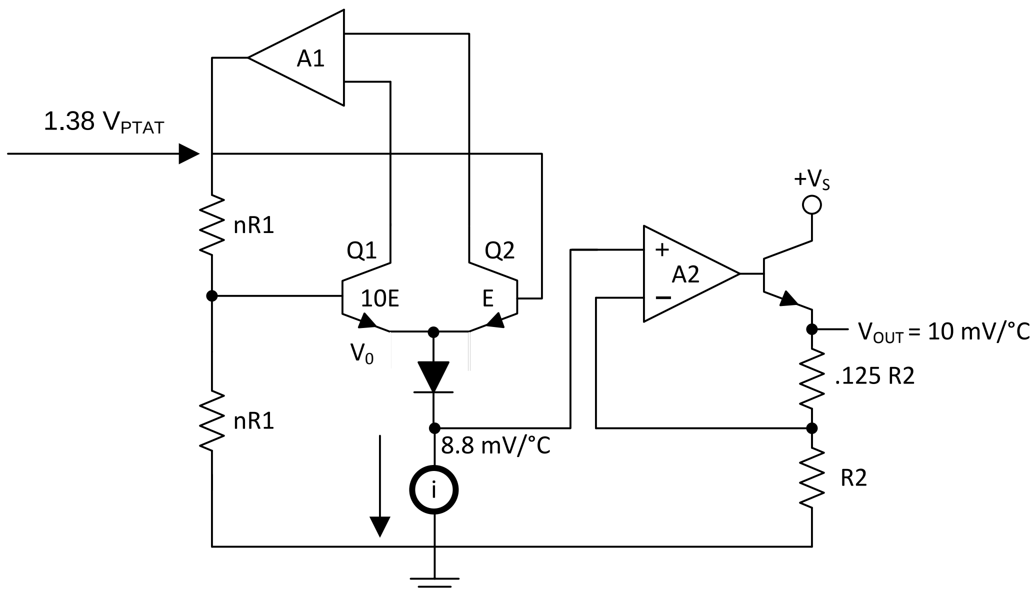
7 Detailed Description

7.1 Overview

The LM35-series devices are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ± ¼ °C at room temperature and ± ¾ °C over a full −55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the wafer level. The low output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 μA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a −55°C to 150°C temperature range, while the LM35C device is rated for a −40°C to 110°C range (−10° with improved accuracy). The temperature-sensing element is comprised of a delta-V BE architecture.

The temperature-sensing element is then buffered by an amplifier and provided to the VOUT pin. The amplifier has a simple class A output stage with typical 0.5-Ω output impedance as shown in the *Functional Block Diagram*. Therefore the LM35 can only source current and it's sinking capability is limited to 1 μA.

7.2 Functional Block Diagram



7.3 Feature Description

7.3.1 LM35 Transfer Function

The accuracy specifications of the LM35 are given with respect to a simple linear transfer function:

$V_{OUT} = 10\ \text{mv/°C} \times T$

where

- V_{OUT} is the LM35 output voltage
- T is the temperature in °C (1)

7.4 Device Functional Modes

The only functional mode of the LM35 is that it has an analog output directly proportional to temperature.

8 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.

8.1 Application Information

The features of the LM35 make it suitable for many general temperature sensing applications. Multiple package options expand on it's flexibility.

8.1.1 Capacitive Drive Capability

Like most micropower circuits, the LM35 device has a limited ability to drive heavy capacitive loads. Alone, the LM35 device is able to drive 50 pF without special precautions. If heavier loads are anticipated, isolating or decoupling the load with a resistor is easy (see Figure 12). The tolerance of capacitance can be improved with a series R-C damper from output to ground (see Figure 13).

When the LM35 device is applied with a 200-Ω load resistor as shown in Figure 16, Figure 17, or Figure 19, the device is relatively immune to wiring capacitance because the capacitance forms a bypass from ground to input and not on the output. However, as with any linear circuit connected to wires in a hostile environment, performance is affected adversely by intense electromagnetic sources (such as relays, radio transmitters, motors with arcing brushes, and SCR transients), because the wiring acts as a receiving antenna and the internal junctions act as rectifiers. For best results in such cases, a bypass capacitor from V_{IN} to ground and a series R-C damper, such as 75 Ω in series with 0.2 or 1 μF from output to ground, are often useful. Examples are shown in Figure 13, Figure 24, and Figure 25.

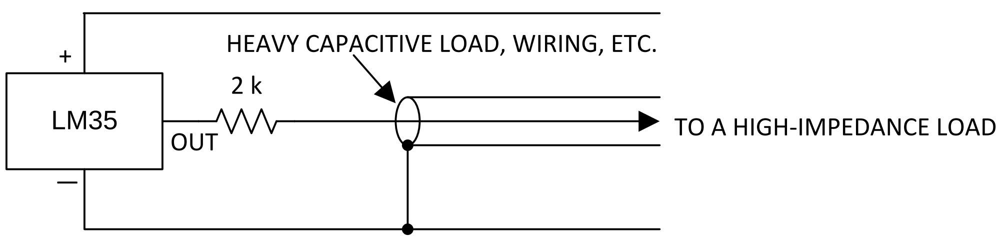


Figure 12. LM35 with Decoupling from Capacitive Load

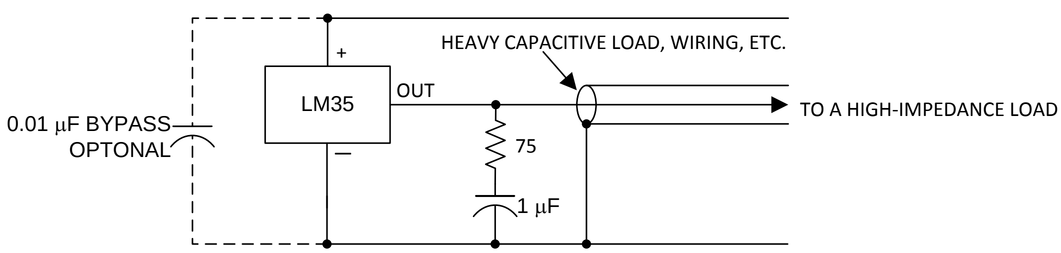


Figure 13. LM35 with R-C Damper

8.2 Typical Application

8.2.1 Basic Centigrade Temperature Sensor

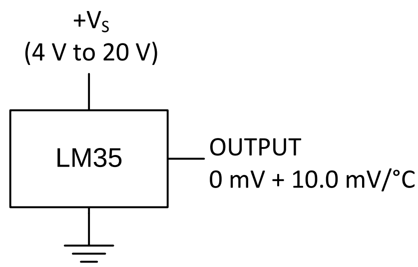


Figure 14. Basic Centigrade Temperature Sensor (2 °C to 150 °C)

8.2.1.1 Design Requirements

Table 1. Design Parameters

PARAMETER	VALUE
Accuracy at 25°C	±0.5°C
Accuracy from –55 °C to 150°C	±1°C
Temperature Slope	10 mV/°C

8.2.1.2 Detailed Design Procedure

Because the LM35 device is a simple temperature sensor that provides an analog output, design requirements related to layout are more important than electrical requirements. For a detailed description, refer to the *Layout*.

8.2.1.3 Application Curve

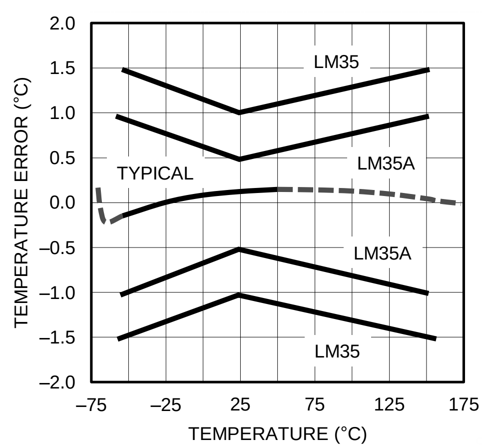


Figure 15. Accuracy vs Temperature (Ensured)

8.3 System Examples

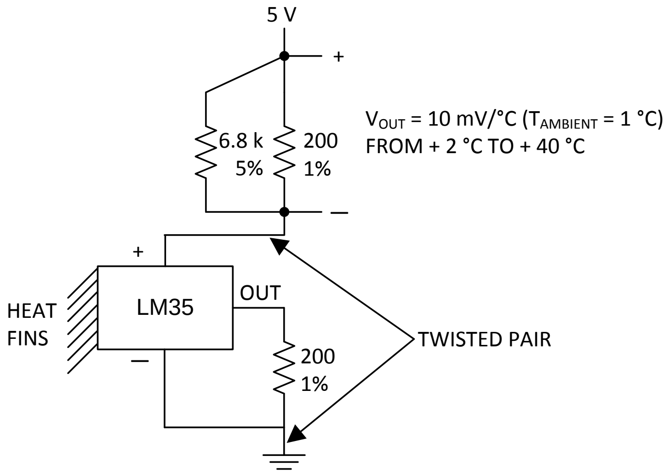


Figure 16. Two-Wire Remote Temperature Sensor (Grounded Sensor)

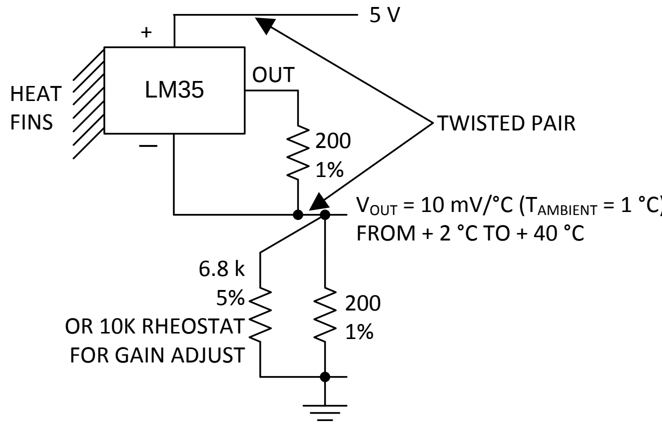


Figure 17. Two-Wire Remote Temperature Sensor (Output Referred to Ground)

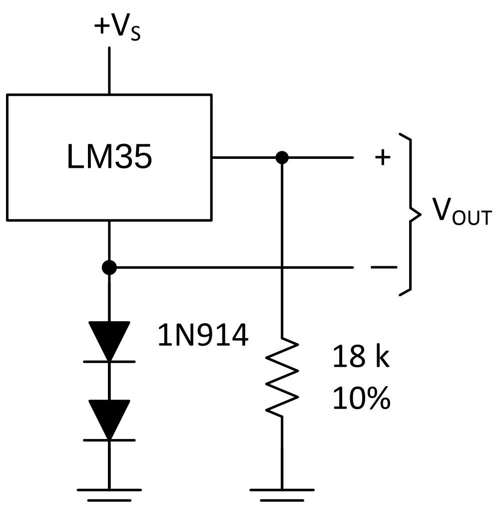


Figure 18. Temperature Sensor, Single Supply (−55° to +150°C)

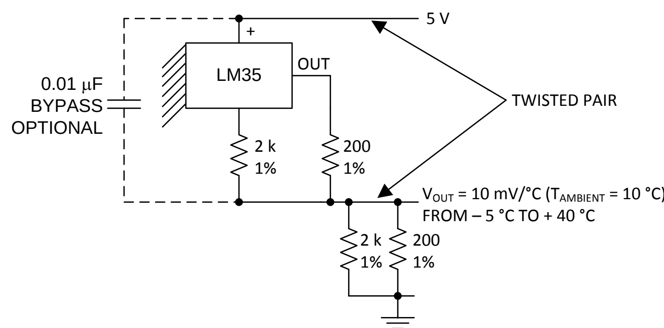


Figure 19. Two-Wire Remote Temperature Sensor (Output Referred to Ground)

System Examples (continued)

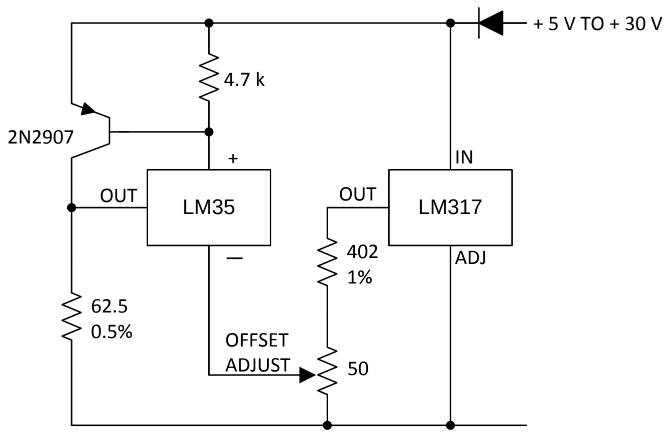


Figure 20. 4-To-20 mA Current Source (0°C to 100°C)

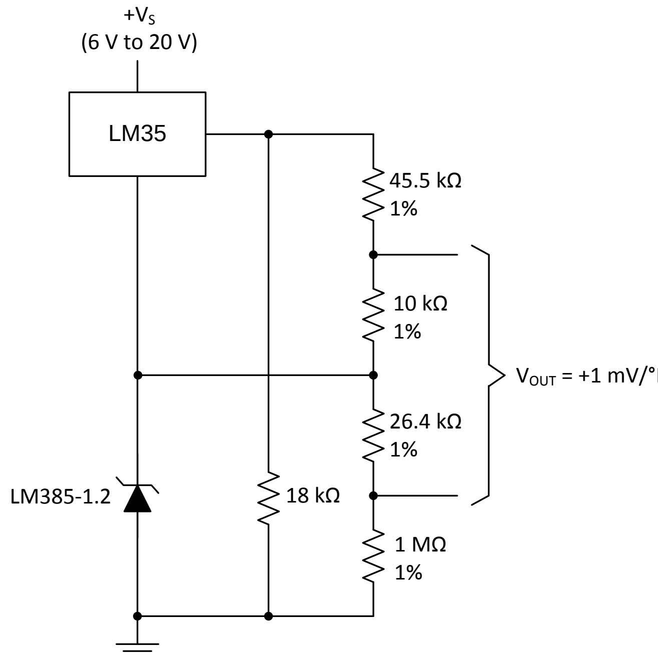


Figure 21. Fahrenheit Thermometer

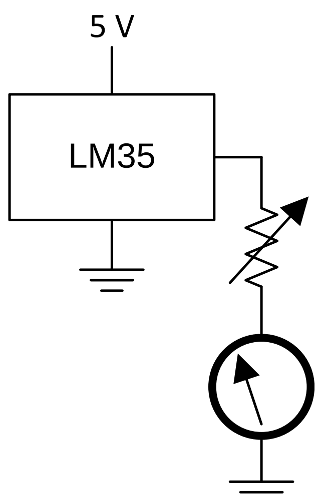


Figure 22. Centigrade Thermometer (Analog Meter)

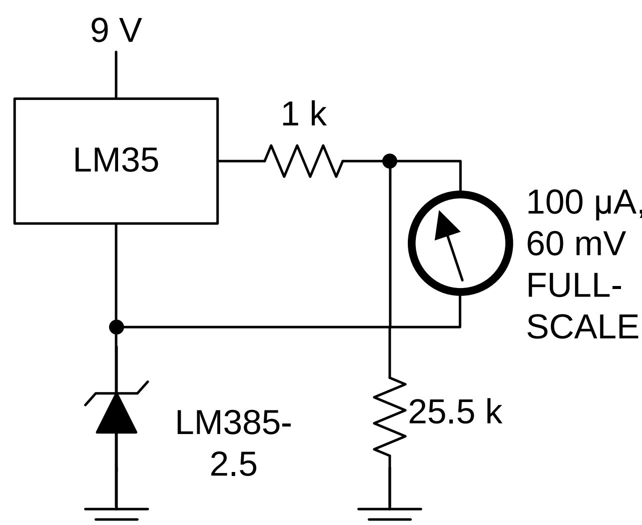


Figure 23. Fahrenheit Thermometer, Expanded Scale Thermometer (50°F to 80°F, for Example Shown)

System Examples (continued)

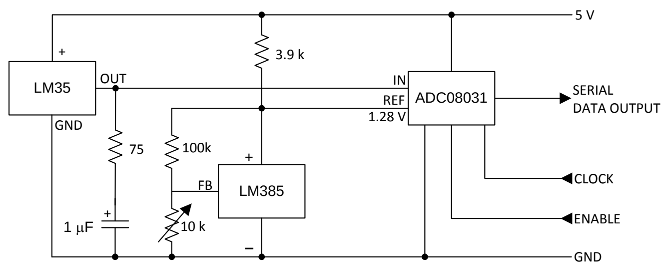


Figure 24. Temperature to Digital Converter (Serial Output) (128°C Full Scale)

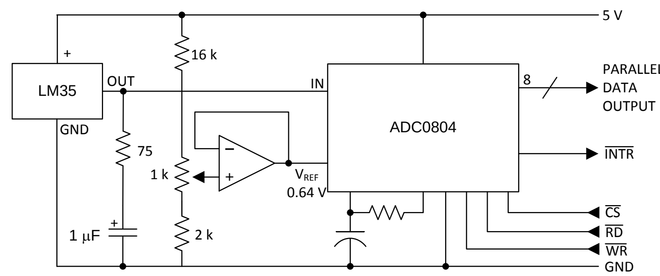
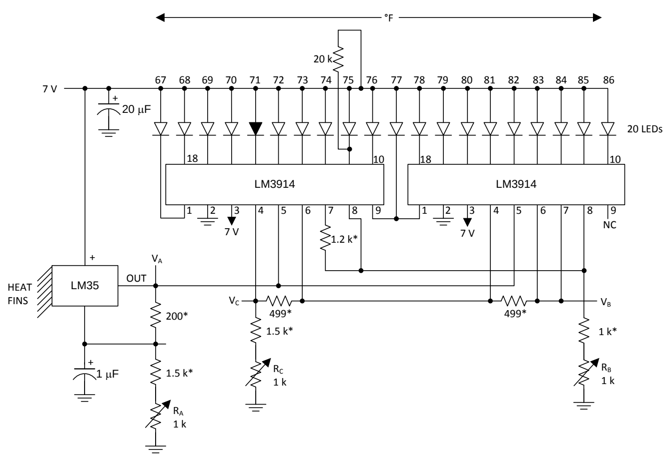
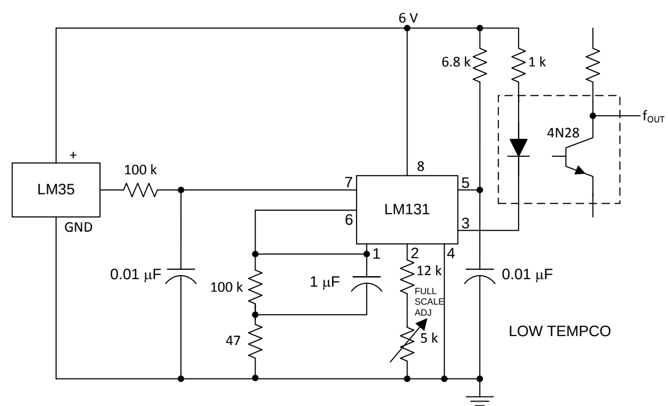


Figure 25. Temperature to Digital Converter (Parallel TRI-STATE Outputs for Standard Data Bus to µP Interface) (128°C Full Scale)





*=1% or 2% film resistor

Trim R_B for V_B = 3.075 V

Trim R_C for V_C = 1.955 V

Trim R_A for V_A = 0.075 V + 100 mV/°C ×$T_{ambient}$

Example, V_A = 2.275 V at 22°C

Figure 26. Bar-Graph Temperature Display (Dot Mode)

Figure 27. LM35 With Voltage-To-Frequency Converter and Isolated Output (2°C to 150°C; 20 to 1500 Hz)

9 Power Supply Recommendations

The LM35 device has a very wide 4-V to 30-V power supply voltage range, which makes it ideal for many applications. In noisy environments, TI recommends adding a 0.1 μF from V+ to GND to bypass the power supply voltage. Larger capacitances maybe required and are dependent on the power-supply noise.

10 Layout

10.1 Layout Guidelines

The LM35 is easily applied in the same way as other integrated-circuit temperature sensors. Glue or cement the device to a surface and the temperature should be within about 0.01°C of the surface temperature.

The 0.01°C proximity 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 of the LM35 die would be at an intermediate temperature between the surface temperature and the air temperature; this is especially true for the TO-92 plastic package. The copper leads in the TO-92 package are the principal thermal path to carry heat into the device, so its temperature might be closer to the air temperature than to the surface temperature.

Ensure that the wiring leaving the LM35 device is held at the same temperature as the surface of interest to minimize the temperature problem. The easiest fix is to cover up these wires with a bead of epoxy. The epoxy bead will ensure that the leads and wires are all at the same temperature as the surface, and that the temperature of the LM35 die is not affected by the air temperature.

The TO-46 metal package can also be soldered to a metal surface or pipe without damage. Of course, in that case the V− terminal of the circuit will be grounded to that metal. Alternatively, mount the LM35 inside a sealed-end metal tube, and then dip into a bath or screw into a threaded hole in a tank. As with any IC, the LM35 device 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 a conformal coating and epoxy paints or dips are often used to insure that moisture cannot corrode the LM35 device or its connections.

These devices are sometimes soldered to a small light-weight heat fin to decrease the thermal time constant and speed up the response in slowly-moving air. On the other hand, a small thermal mass may be added to the sensor, to give the steadiest reading despite small deviations in the air temperature.

Table 2. Temperature Rise of LM35 Due To Self-heating (Thermal Resistance, $R_{\theta JA}$)

	TO, no heat sink	TO[1], small heat fin	TO-92, no heat sink	TO-92[2], small heat fin	SOIC-8, no heat sink	SOIC-8[2], small heat fin	TO-220, no heat sink
Still air	400°C/W	100°C/W	180°C/W	140°C/W	220°C/W	110°C/W	90°C/W
Moving air	100°C/W	40°C/W	90°C/W	70°C/W	105°C/W	90°C/W	26°C/W
Still oil	100°C/W	40°C/W	90°C/W	70°C/W	—	—	—
Stirred oil	50°C/W	30°C/W	45°C/W	40°C/W	—	—	—
(Clamped to metal, Infinite heat sink)	(24°C/W)		—	—	(55°C/W)		—

(1) Wakefield type 201, or 1-in disc of 0.02-in sheet brass, soldered to case, or similar.
(2) TO-92 and SOIC-8 packages glued and leads soldered to 1-in square of 1/16-in printed circuit board with 2-oz foil or similar.

10.2 Layout Example

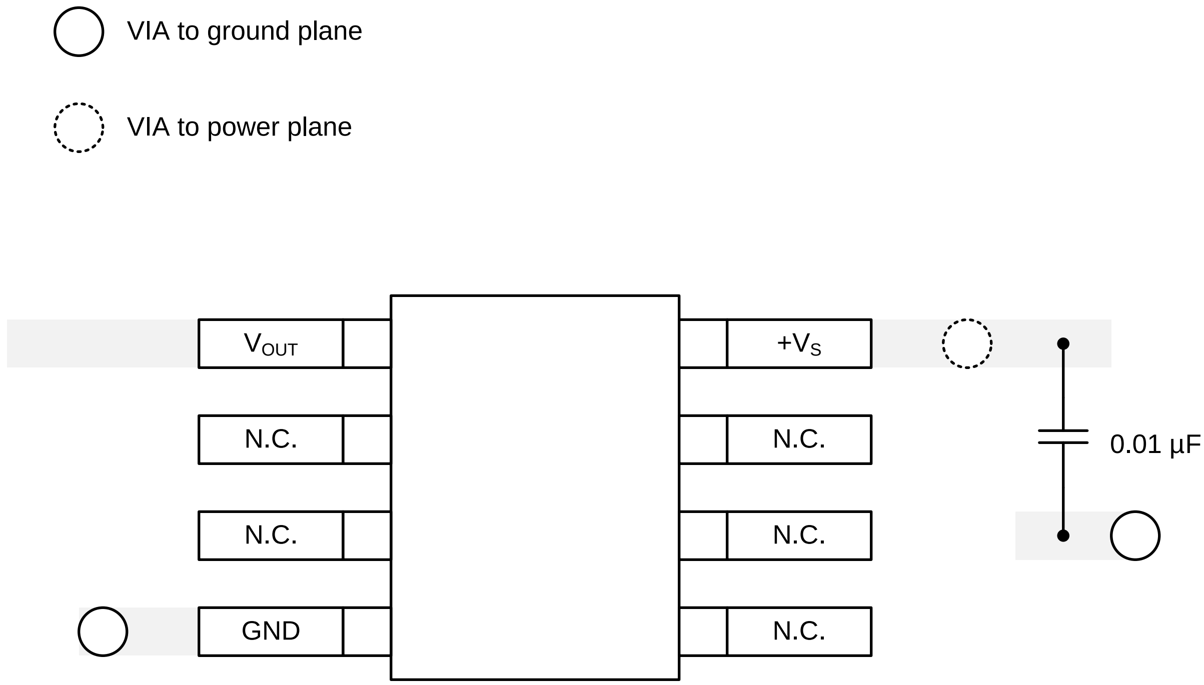


Figure 28. Layout Example

11 デバイスおよびドキュメントのサポート

11.1 ドキュメントの更新通知を受け取る方法

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11.2 コミュニティ・リソース

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11.5 Glossary

SLYZ022 — *TI Glossary*.

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

12 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)
LM35AH	Active	Production	TO (NDV) | 3	500 | SMALL T&R	No	Call TI	Level-1-NA-UNLIM	-55 to 150	(LM35AH, LM35AH)
LM35AH.B	Active	Production	TO (NDV) | 3	500 | SMALL T&R	-	Call TI	Call TI	-55 to 150	(LM35AH, LM35AH)
LM35AH/NOPB	Active	Production	TO (NDV) | 3	500 | SMALL T&R	Yes	Call TI	Level-1-NA-UNLIM	-55 to 150	(LM35AH, LM35AH)
LM35AH/NOPB.B	Active	Production	TO (NDV) | 3	500 | SMALL T&R	-	Call TI	Level-1-NA-UNLIM	-55 to 150	(LM35AH, LM35AH)
LM35CAH	Active	Production	TO (NDV) | 3	500 | OTHER	No	Call TI	Level-1-NA-UNLIM	-40 to 110	(LM35CAH, LM35CAH)
LM35CAH.B	Active	Production	TO (NDV) | 3	500 | OTHER	-	Call TI	Call TI	-55 to 150	(LM35CAH, LM35CAH)
LM35CAH/NOPB	Active	Production	TO (NDV) | 3	500 | SMALL T&R	Yes	Call TI	Level-1-NA-UNLIM	-40 to 110	(LM35CAH, LM35CAH)
LM35CAH/NOPB.B	Active	Production	TO (NDV) | 3	500 | SMALL T&R	-	Call TI	Level-1-NA-UNLIM	-55 to 150	(LM35CAH, LM35CAH)
LM35CAZ/LFT4	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-	LM35 CAZ
LM35CAZ/LFT4.B	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	-	SN	N/A for Pkg Type	-55 to 150	LM35 CAZ
LM35CAZ/NOPB	Active	Production	TO-92 (LP) | 3	1800 | BULK	Yes	SN	N/A for Pkg Type	-40 to 110	LM35 CAZ
LM35CAZ/NOPB.B	Active	Production	TO-92 (LP) | 3	1800 | BULK	-	SN	N/A for Pkg Type	-55 to 150	LM35 CAZ
LM35CH	Active	Production	TO (NDV) | 3	500 | OTHER	No	Call TI	Level-1-NA-UNLIM	-40 to 110	(LM35CH, LM35CH)
LM35CH.B	Active	Production	TO (NDV) | 3	500 | OTHER	-	Call TI	Call TI	-55 to 150	(LM35CH, LM35CH)
LM35CH/NOPB	Active	Production	TO (NDV) | 3	500 | SMALL T&R	Yes	Call TI	Level-1-NA-UNLIM	-40 to 110	(LM35CH, LM35CH)
LM35CH/NOPB.B	Active	Production	TO (NDV) | 3	500 | SMALL T&R	-	Call TI	Level-1-NA-UNLIM	-55 to 150	(LM35CH, LM35CH)
LM35CZ/LFT1	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-	LM35 CZ
LM35CZ/LFT1.B	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	-	SN	N/A for Pkg Type	-55 to 150	LM35 CZ
LM35CZ/NOPB	Active	Production	TO-92 (LP) | 3	1800 | BULK	Yes	SN	N/A for Pkg Type	-40 to 110	LM35 CZ
LM35CZ/NOPB.B	Active	Production	TO-92 (LP) | 3	1800 | BULK	-	SN	N/A for Pkg Type	-55 to 150	LM35 CZ

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)
LM35DH	Active	Production	TO (NDV) | 3	1000 | SMALL T&R	No	Call TI	Level-1-NA-UNLIM	0 to 70	(LM35DH, LM35DH)
LM35DH.B	Active	Production	TO (NDV) | 3	1000 | SMALL T&R	-	Call TI	Call TI	-55 to 150	(LM35DH, LM35DH)
LM35DH/NOPB	Active	Production	TO (NDV) | 3	1000 | SMALL T&R	Yes	Call TI	Level-1-NA-UNLIM	0 to 70	(LM35DH, LM35DH)
LM35DH/NOPB.B	Active	Production	TO (NDV) | 3	1000 | SMALL T&R	-	Call TI	Level-1-NA-UNLIM	-55 to 150	(LM35DH, LM35DH)
LM35DM	Last Time Buy	Production	SOIC (D) | 8	95 | TUBE	No	Call TI	Level-1-235C-UNLIM	0 to 100	LM35D M
LM35DMX	NRND	Production	SOIC (D) | 8	2500 | LARGE T&R	No	Call TI	Level-1-235C-UNLIM	0 to 100	LM35D M
LM35DMX.B	NRND	Production	SOIC (D) | 8	2500 | LARGE T&R	-	Call TI	Call TI	-55 to 150	LM35D M
LM35DMX/NOPB	Active	Production	SOIC (D) | 8	2500 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	0 to 100	LM35D M
LM35DMX/NOPB.B	Active	Production	SOIC (D) | 8	2500 | LARGE T&R	-	SN	Level-1-260C-UNLIM	-55 to 150	LM35D M
LM35DT	NRND	Production	TO-220 (NEB) | 3	45 | TUBE	No	Call TI	Level-1-NA-UNLIM	0 to 100	LM35DT
LM35DT.B	NRND	Production	TO-220 (NEB) | 3	45 | TUBE	-	Call TI	Call TI	-55 to 150	LM35DT
LM35DT/NOPB	Active	Production	TO-220 (NEB) | 3	45 | TUBE	Yes	SN	Level-1-NA-UNLIM	0 to 100	LM35DT
LM35DT/NOPB.B	Active	Production	TO-220 (NEB) | 3	45 | TUBE	-	SN	Level-1-NA-UNLIM	-55 to 150	LM35DT
LM35DZ/LFT1	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-	LM35 DZ
LM35DZ/LFT1.B	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	-	SN	N/A for Pkg Type	-55 to 150	LM35 DZ
LM35DZ/LFT4	Active	Production	TO-92 (LP) | 3	2000 | AMMO	Yes	SN	N/A for Pkg Type	-	LM35 DZ
LM35DZ/LFT4.B	Active	Production	TO-92 (LP) | 3	2000 | AMMO	-	SN	N/A for Pkg Type	-55 to 150	LM35 DZ
LM35DZ/NOPB	Active	Production	TO-92 (LP) | 3	1800 | BULK	Yes	SN	N/A for Pkg Type	0 to 100	LM35 DZ
LM35DZ/NOPB.B	Active	Production	TO-92 (LP) | 3	1800 | BULK	-	SN	N/A for Pkg Type	-55 to 150	LM35 DZ
LM35H	Active	Production	TO (NDV) | 3	500 | SMALL T&R	No	Call TI	Level-1-NA-UNLIM	-55 to 150	(LM35H, LM35H)
LM35H.B	Active	Production	TO (NDV) | 3	500 | SMALL T&R	-	Call TI	Call TI	-55 to 150	(LM35H, LM35H)
LM35H/NOPB	Active	Production	TO (NDV) | 3	500 | SMALL T&R	Yes	Call TI	Level-1-NA-UNLIM	-55 to 150	(LM35H, LM35H)
LM35H/NOPB.B	Active	Production	TO (NDV) | 3	500 | SMALL T&R	-	Call TI	Level-1-NA-UNLIM	-55 to 150	(LM35H, LM35H)

[(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.

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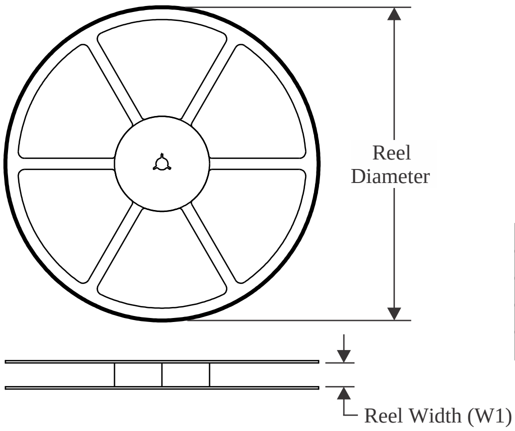
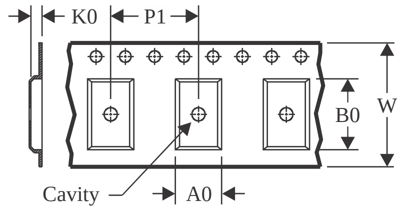
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

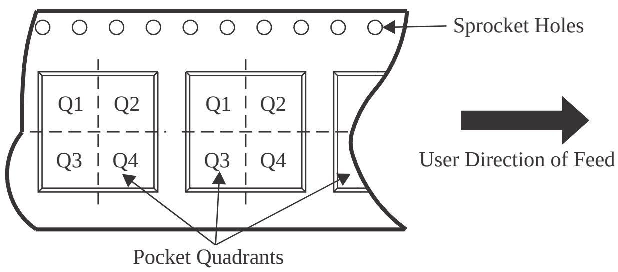


TAPE DIMENSIONS



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

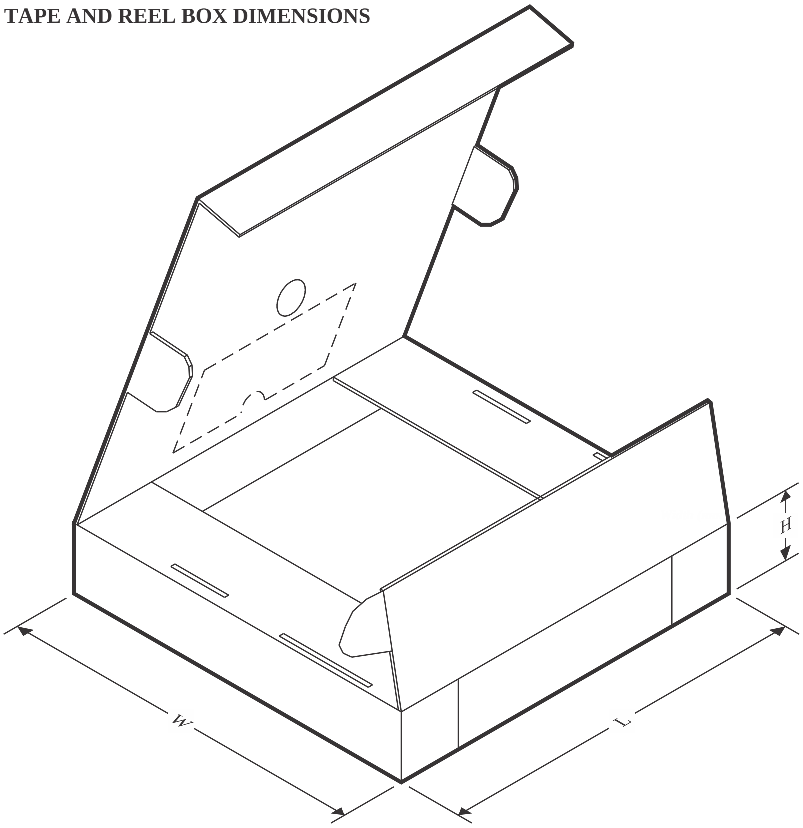
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
LM35DMX	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1

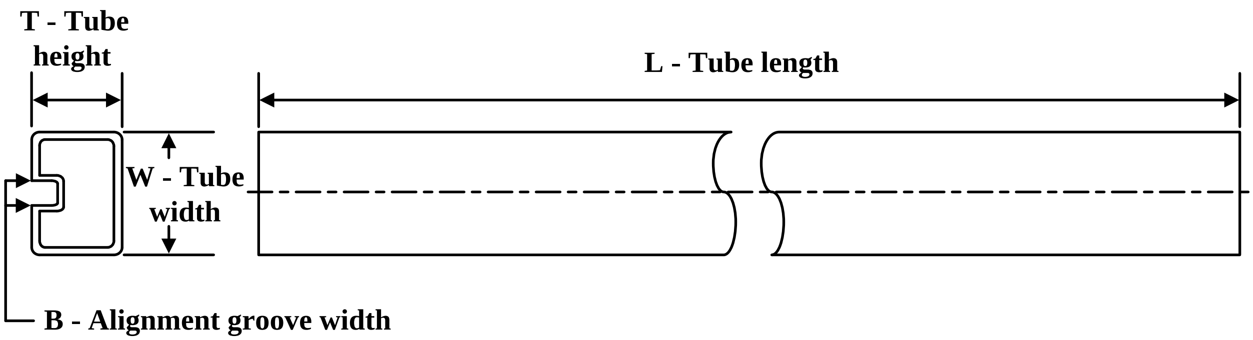
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

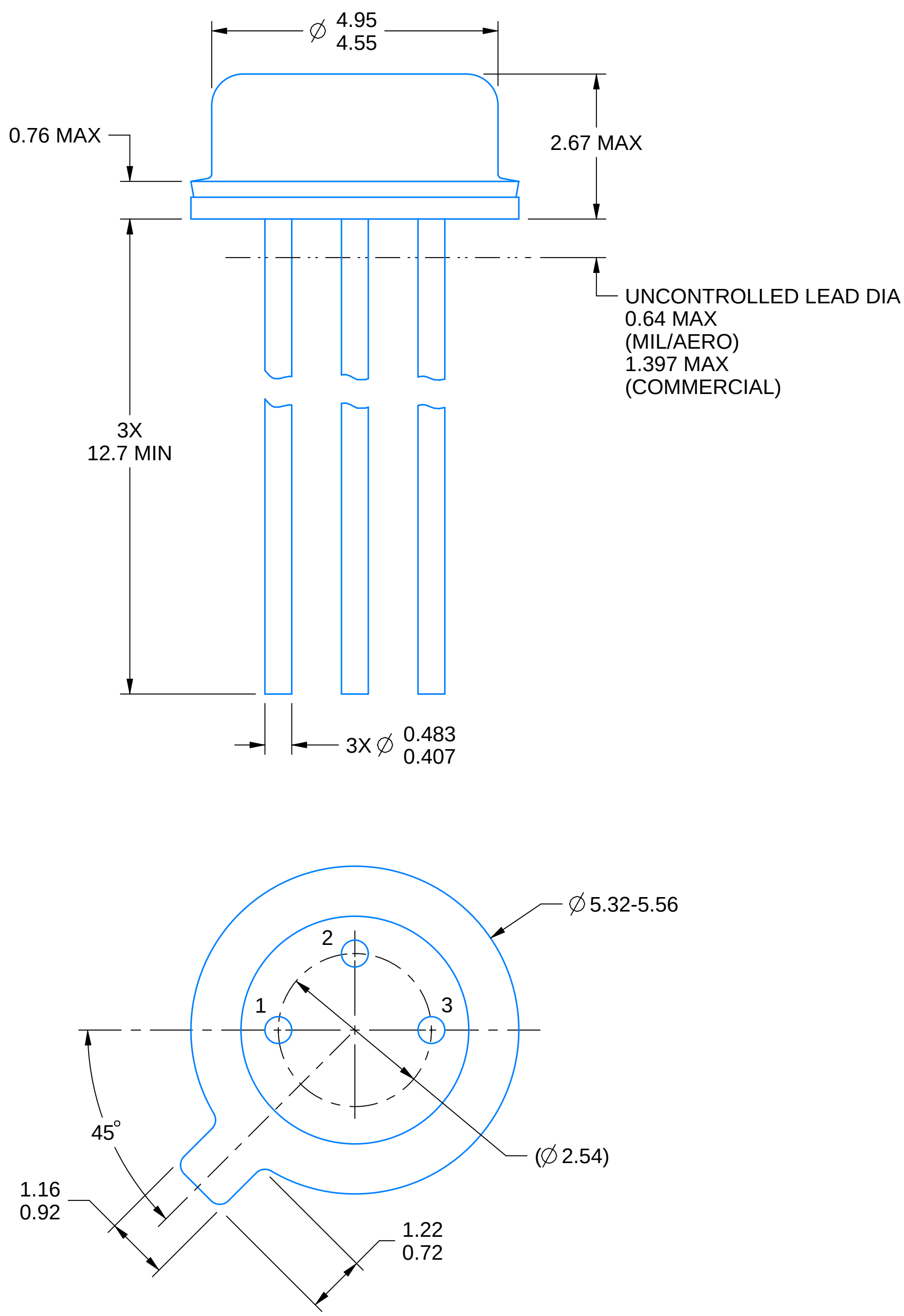
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM35DMX	SOIC	D	8	2500	367.0	367.0	35.0

TUBE



*All dimensions are nominal

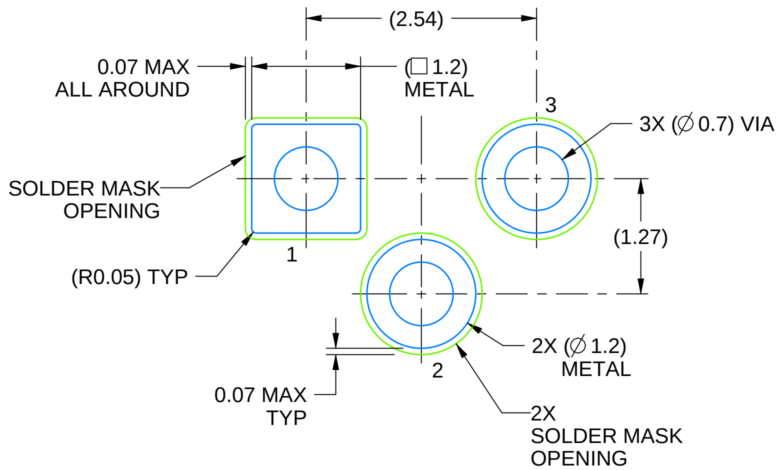
Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
LM35DM	D	SOIC	8	95	495	8	4064	3.05
LM35DM	D	SOIC	8	95	495	8	4064	3.05
LM35DT	NEB	TO-220	3	45	502	33	6985	4.06
LM35DT	NEB	TO-220	3	45	502	33	6985	4.06
LM35DT/NOPB	NEB	TO-220	3	45	502	33	6985	4.06



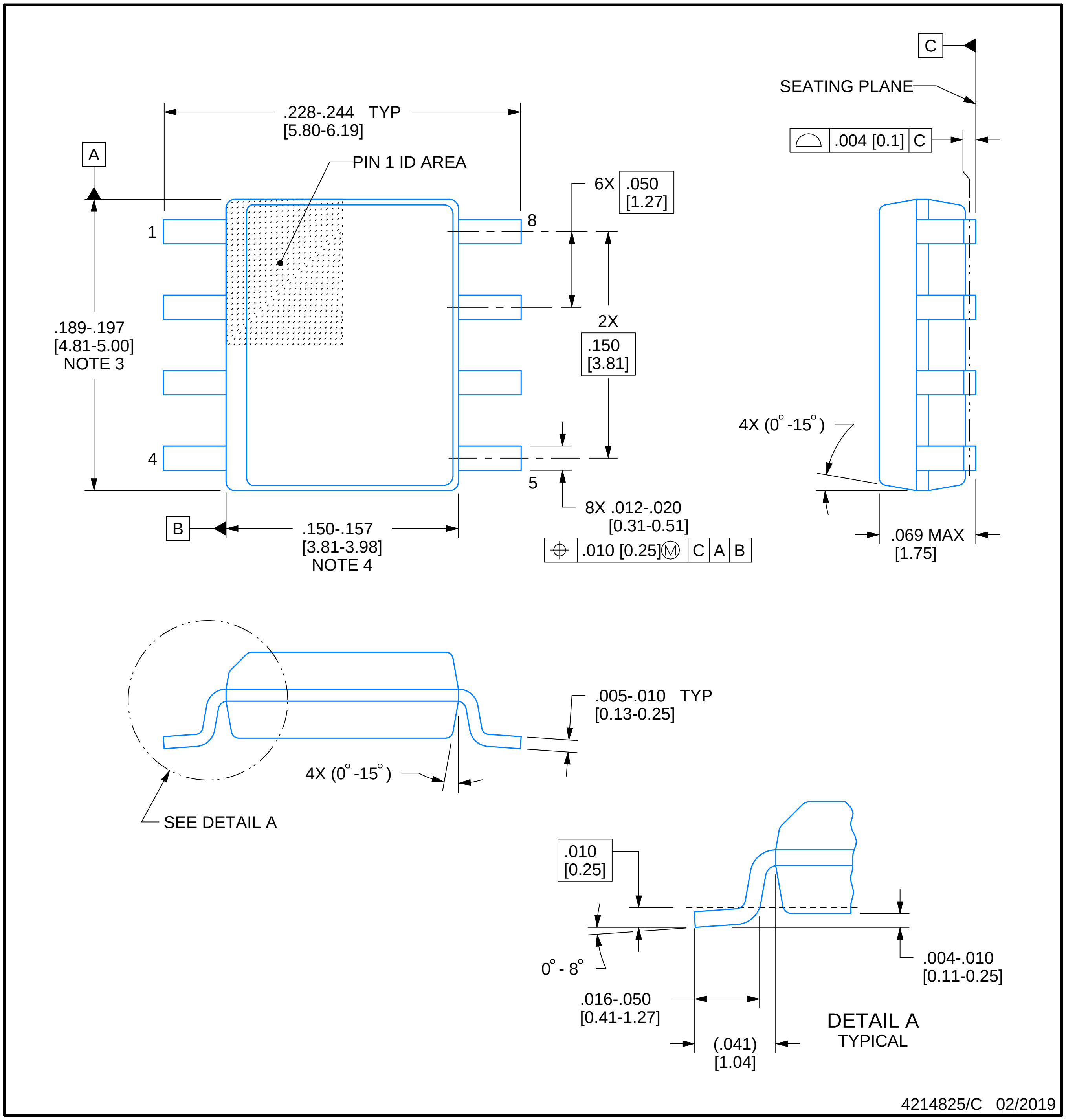
4219876/B 09/2024

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. Reference JEDEC registration TO-46.

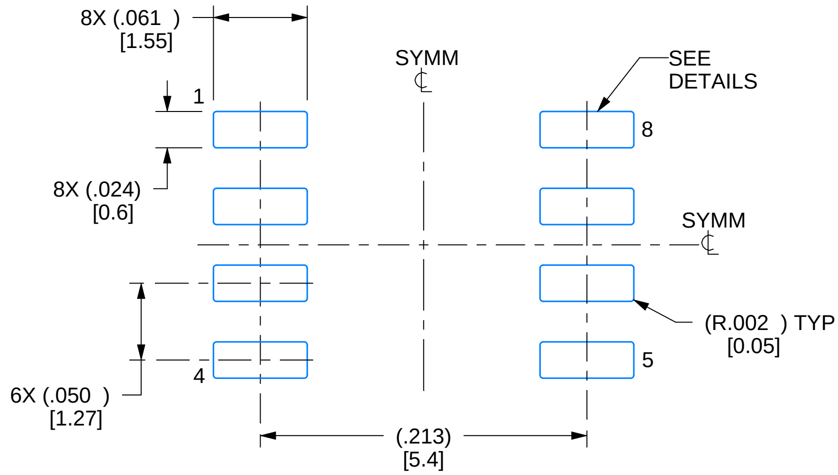


LAND PATTERN EXAMPLE
NON-SOLDER MASK DEFINED
SCALE:12X

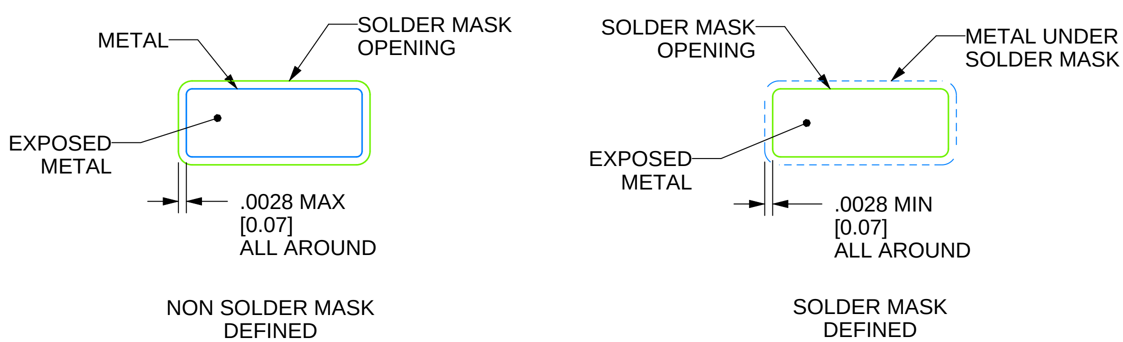


NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X

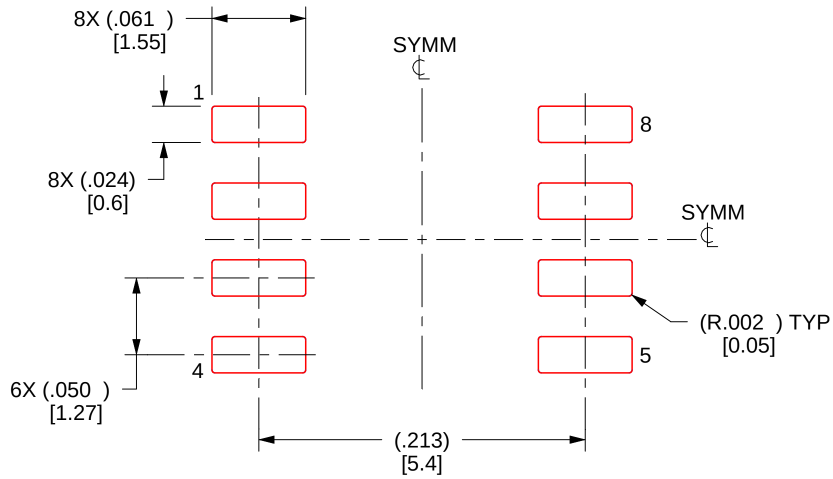


SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

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



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

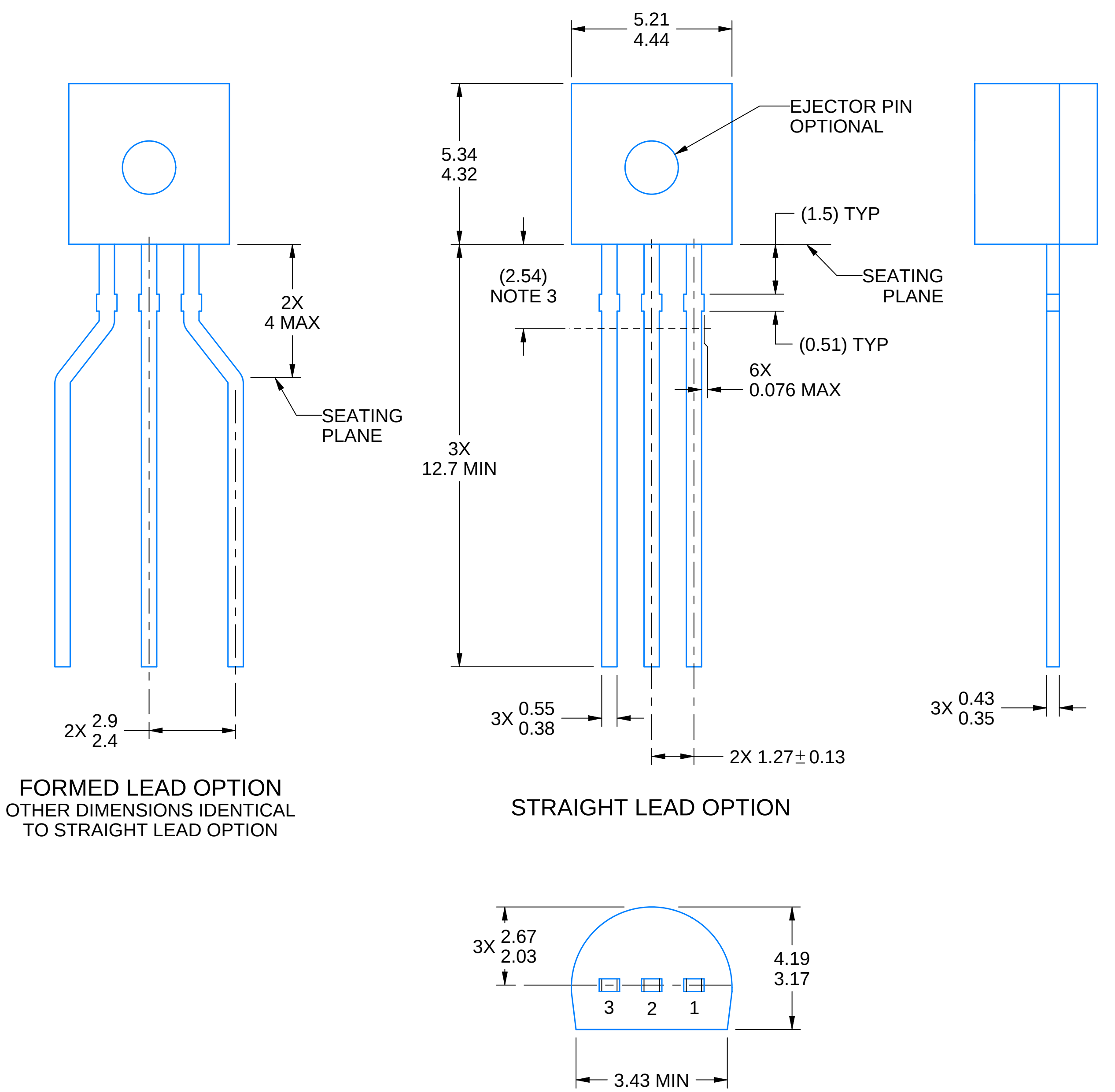
4214825/C 02/2019

NOTES: (continued)

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

PACKAGE OUTLINE

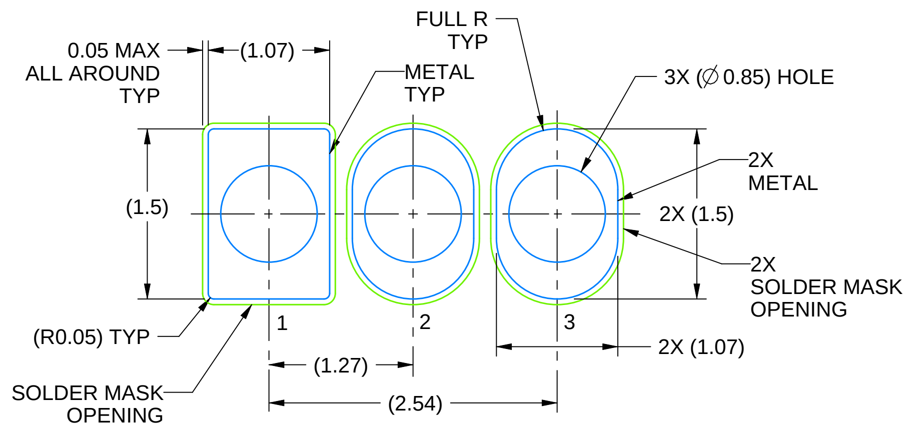
TO-92 - 5.34 mm max height



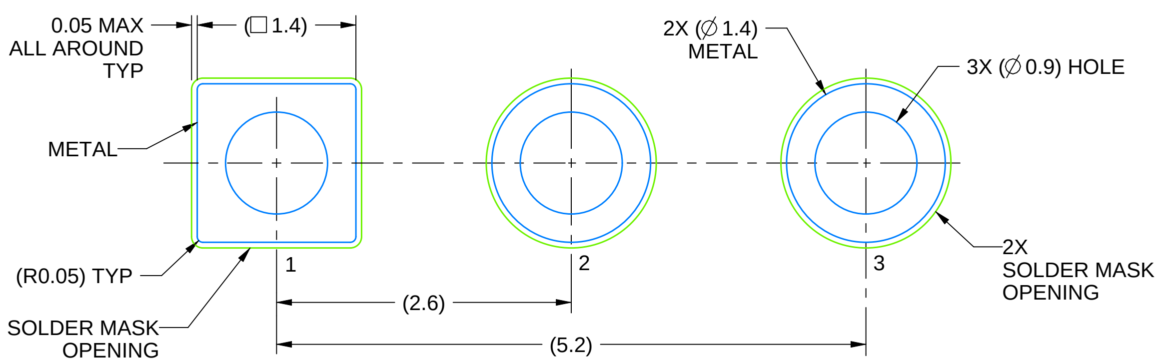
4215214/C 04/2025

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.

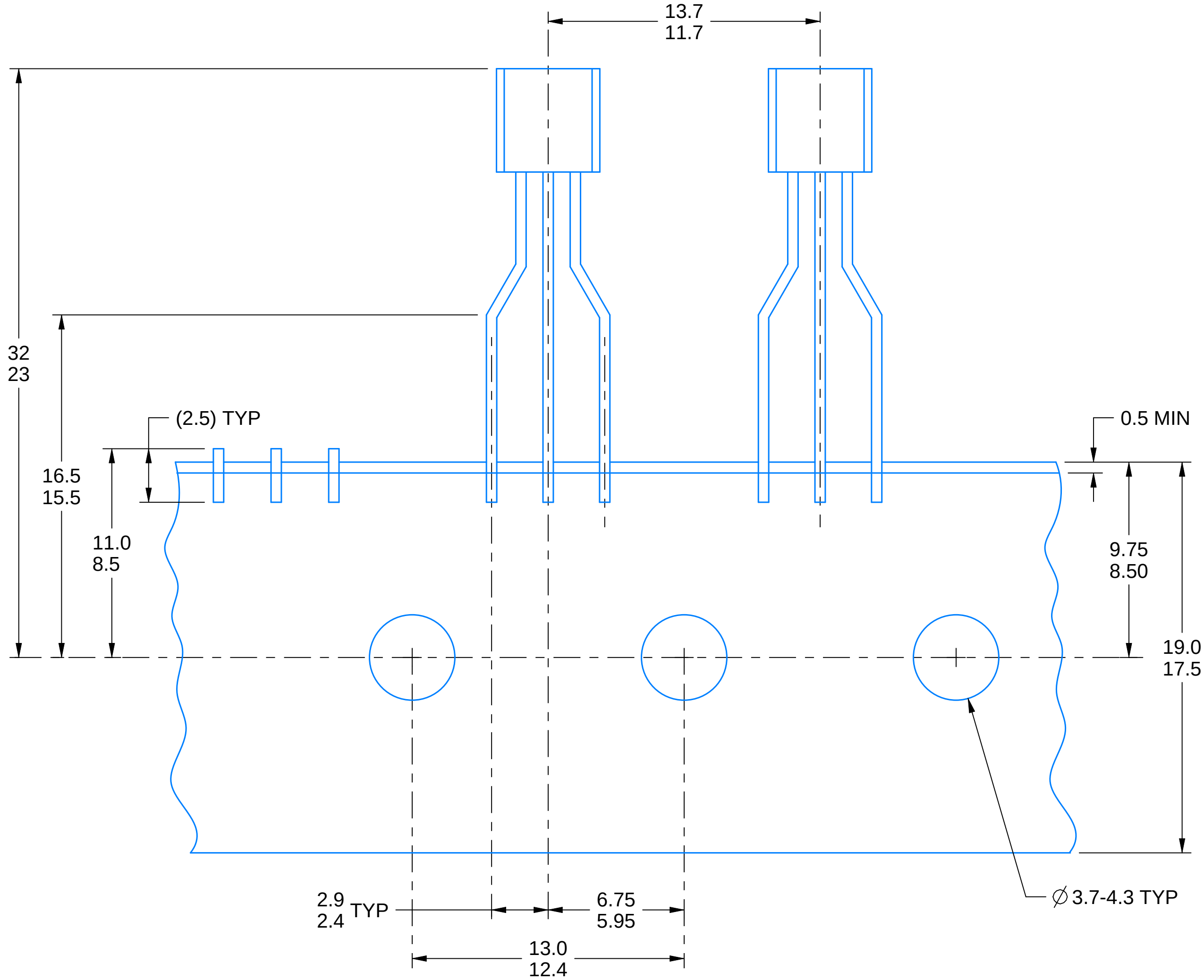


LAND PATTERN EXAMPLE
STRAIGHT LEAD OPTION
NON-SOLDER MASK DEFINED
SCALE:15X



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

4215214/C 04/2025



FOR FORMED LEAD OPTION PACKAGE

4215214/C 04/2025

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