TMP23x 低消費電力、高精度アナログ出力温度センサ

1 特長

- サーミスタに対するコスト効率の優れた代替
- 広い温度範囲にわたって厳密な精度を維持
  - ±2.5℃ (最大値):-40℃～+150℃ (TMP235)
  - ±2.5℃ (最大値):-10℃～+125℃ (TMP236)
- 2 つの精度レベルで供給
  - A2 レベル:±0.5℃ (標準値)
  - A4 レベル:±1℃ (標準値)
- 正の勾配のセンサ・ゲイン、オフセット (標準値)
  - 10mV/℃、0℃で500mV (TMP235)
  - 19.5mV/℃、0℃で400mV (TMP236)
- 広い動作電源電圧範囲
  - 2.3V～5.5V (TMP235)
  - 3.1V～5.5V (TMP236)
- 出力の短絡保護
- 低消費電力：9µA (標準値)
- 最大 1000pF の負荷を駆動できる強力な出力
- 供給されるパッケージ・オプション
  - 5 ピンの SC70 (DCK) 表面実装
  - 3 ピンの SOT-23 (DBZ) 表面実装
  - 業界標準の LMT8x-Q1 および LM20 温度センサとフットプリント互換

2 アプリケーション

- グリッド・インフラ
- ワイヤレスおよびテレコム・インフラ
- 車載用インフォテインメント
- ファクトリ・オートメーションとファクトリ制御
- 試験 / 測定機器

3 概要

TMP23x デバイスは、温度に比例する出力電圧を備えた高精度 CMOS IC リニア・アナログ温度センサのファミリであり、多様なアナログ温度センシング・アプリケーションで使用できます。これらの温度センサは、市販の類似のピン互換デバイスよりも高精度であり、0℃～+70℃の範囲で±0.5℃ (標準値) の精度を持っています。本シリーズの高い精度は、多くのアナログ温度センシング・アプリケーション向けに設計されたものです。TMP235デバイスは、-40℃～+150℃の温度範囲と、2.3V～5.5Vの電源電圧範囲の全体にわたって、10mV/℃の正の出力勾配を提供します。より高ゲインのTMP236センサは、-10℃～+125℃と、3.1V～5.5Vの電源電圧範囲について、19.5mV/℃の正の出力勾配を提供します。

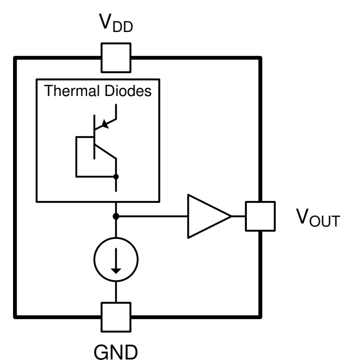
標準静止電流は9µA、標準の電源オン時間は800µsで、効果的な電源サイクリング・アーキテクチャにより、バッテリ駆動のデバイスで消費電力を最小化できます。Class-AB出力ドライバは最大出力が500µAと強力で、最大1000pFの容量性負荷を駆動でき、アナログ/デジタル・コンバータのサンプルおよびホールド入力と直接接続するよう設計されています。優れた精度と強力なリニア出力ドライバを備えたTMP23xアナログ出力温度センサは、パッシブなサーミスタに代わるコスト効率の優れた代替品となります。

製品情報(1)

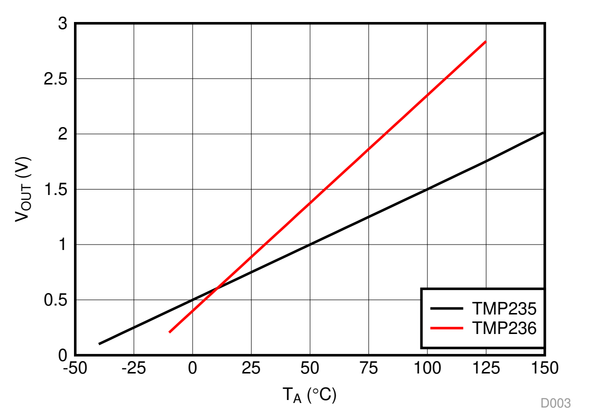
型番	パッケージ	本体サイズ(公称)
TMP235、TMP236	SC70 (5)	2.00mm×1.25mm
	SOT-23 (3)	2.92mm×1.30mm

(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。

機能ブロック図



出力電圧と周囲温度との関係



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 (August 2018) から **Revision E** に変更	**Page**
• Changed recommended operating temperature range from: –50°C to 150°C to: –40°C to 150°C	4
• Changed power supply bypassing recommendations on how to avoid noise effect on the device output	12

Revision C (August 2018) から **Revision D** に変更	**Page**
• DBZ (SOT-23)パッケージのステータスをプレビュー版から量産データに変更	1

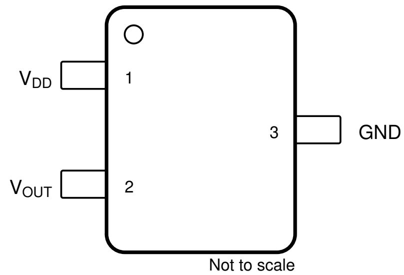
Revision B (February 2018) から **Revision C** に変更	**Page**
• DBZ (SOT-23)プレビュー版パッケージを追加	1
• Added TMP236 test conditions to the operating current parameters	5
• Added SOT-23 and SC70 package test conditions to the Accuracy Level 2 (A2) limits in the 0℃ to 70℃ range	5

Revision A (December 2017) から **Revision B** に変更	**Page**
• 標準精度仕様への言及を、「±1℃および±2℃」から「±0.5℃および±1℃」へ 変更	1
• Deleted erroneous AOQL footnote	5
• Changed specification limits indicated in 図 1	6
• Added *Device Functional Modes* section	10

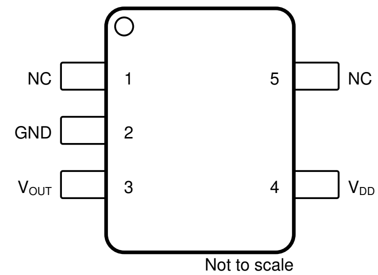
2017年9月発行のものから更新	**Page**
• ドキュメントのステータスを「事前情報」から「量産データ」に 変更	1

5 Pin Configuration and Functions

DBZ Package
3-Pin SOT-23
Top View



DCK Package
5-Pin SC70
Top View



NC- no internal connection

Pin Functions

NAME	PIN		TYPE	DESCRIPTION
	SOT-23	SC70		
GND	3	2	Ground	Power supply ground.
NC	—	5	—	No internal connection. This pin may be left floating or connected to GND.
NC	—	1	—	No internal connection. This pin may be left floating or connected to GND.
V_{OUT}	2	3	O	Outputs voltage proportional to temperature
V_{DD}	1	4	I	Positive supply input

6 Specifications

6.1 Absolute Maximum Ratings

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

	MIN	MAX	UNIT
Supply voltage, V_{DD}		+6	V
Output voltage, V_{OUT}	–0.3	(V_{DD} + 0.3)	V
Output current	–30	+30	mA
Latch-up current, each pin	–200	+200	mA
Junction temperature (T_J)		+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. Theseare stress ratings only, which do not imply functional operation of the device at these or anyother conditions beyond those indicated under *Recommended OperatingConditions*. Exposure to absolute-maximum-rated conditions for extended periods mayaffect device reliability.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM) per JESD22-A114 [1]	±4000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101 [2]	±1000	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
V_{DD}	Input voltage (TMP235)	2.3		5.5	V
	Input voltage (TMP236)	3.1		5.5	V
T_A	Operating free-air temperature	–40		150	°C

6.4 Thermal Information

THERMAL METRIC [1][2]		TMP235 DCK (SC70) PINS	TMP235 DBZ (SOT-23) PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance [3][4]	275	167	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	84	90	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	56	146	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	1.2	35	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	55	146	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report.
(2) For information on self-heating and thermal response time see *Layout Guidelines* section.
(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.

6.5 Electrical Characteristics

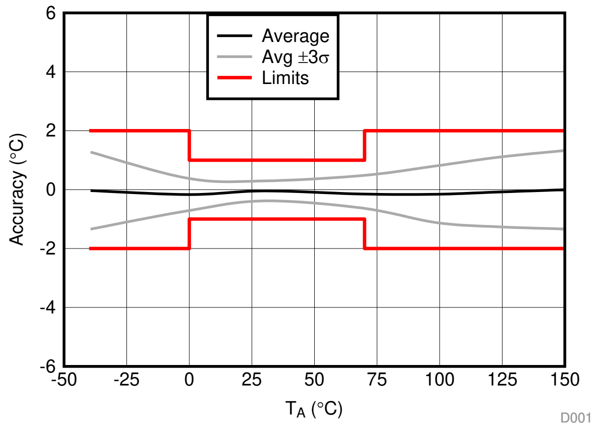
TMP235: V_{DD} = 2.3 V to 5.5 V, GND = Ground, T_A = –40°C to +125°C and no load (unless otherwise noted)
TMP236: V_{DD} = 3.1 V to 5.5 V, GND = Ground, T_A = –10°C to +125°C and no load (unless otherwise noted)

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
POWER SUPPLY							
I_{DD}	Operating current		T_A = 25°C, V_{DD} = 2.3 V, TMP235		9		µA
			T_A = 25°C, V_{DD} = 3.1 V, TMP236		10		
			T_A = –40°C to +125°C, TMP235			14.5	
			T_A = –10°C to +125°C, TMP236			15	
			T_A = 150°C, TMP235			17	
Δ°C/ ΔV_{DD}	Line regulation			–0.1	0.02	0.1	°C/V
SENSOR ACCURACY							
T_{ACY}	Temperature accuracy (1)		T_A = 25°C		±0.5		°C
			T_A = 0°C to 70°C (SC70 Package)	–1	±0.5	+1	
			T_A = 0°C to +70°C (SOT-23 Package)	–1.2	±0.5	+1.2	
			T_A = –40°C to +125°C (TMP235A2)	–2	±0.5	+2	
			T_A = –10°C to +125°C (TMP236A2)	–2	±0.5	+2	
			T_A = –40°C to +150°C (TMP235A2)	–2	±0.5	+2	
		Accuracy Level 4 (A4)	T_A = 25°C		±1		
			T_A = 0°C to 70°C	–2	±1	+2	
			T_A = –40°C to +125°C (TMP235A4)	–4	±1	+4	
			T_A = –10°C to +125°C (TMP236A4)	–4	±1	+4	
			T_A = –40°C to +150°C (TMP235A4)	–5	±1	+5	
SENSOR OUTPUT							
$V_{0°C}$	Output voltage offset at 0 °C		TMP235		500		mV
			TMP236		400		
T_C	Temperature coefficient (sensor gain)		TMP235		10		mV/°C
			TMP236		19.5		
V_{ONL}	Output nonlinearity (1)		T_A = 0 °C to 70 °C, no load		±0.5		°C
I_{OUT}	Output current					500	µA
Z_{OUT}	Output impedance		IOUT = 100 µA, f = 100 Hz		20		Ω
			IOUT = 100 µA, f = 500 Hz		50		
	Output load regulation		T_A = 0°C to 70°C, IOUT = 100 µA, $\Delta V_{OUT} / \Delta I_{OUT}$		1		Ω
t_{ON}	Turn on time		Time to reach accuracy within ±0.5°C		800		µs
C_{LOAD}	Typical load capacitance					1000	pF
t_{RES}	Thermal response to 63%	SC70	30°C (Air) to +125°C (Fluid Bath)		1.3		s

(1) Accuracy is defined as the error between the measured and reference output voltages, tabulated in the TMP235 Transfer Tableand TMP236 Transfer Table at the specified conditions of supply 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.

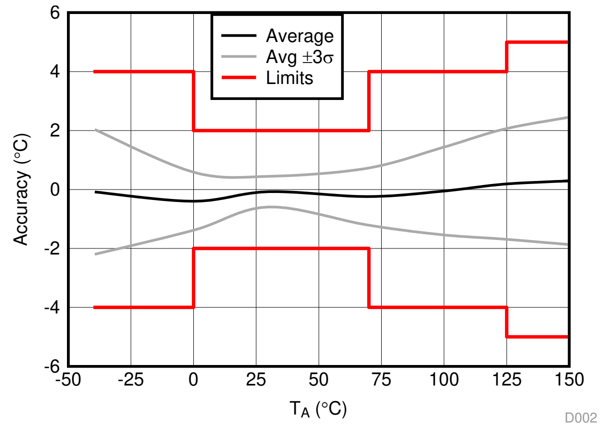
6.6 Typical Characteristics

at T_A = 25°C, (unless otherwise noted)



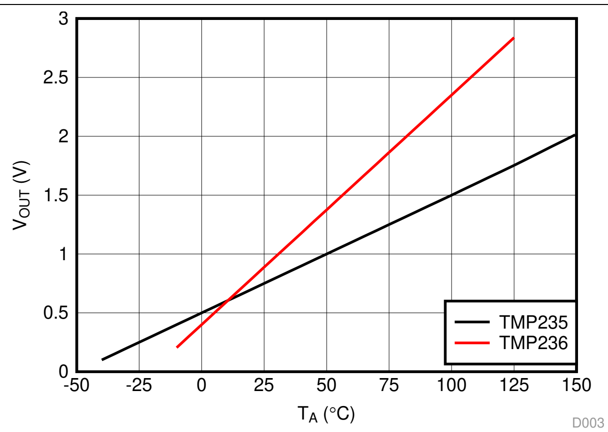
TMP235: V_{DD} = 2.3 to 5.5 V, I_{OUT} = 0 µA, C_{LOAD} = 1000 pF

図 1. Accuracy vs. T_A Temperature (A2 Accuracy Level)



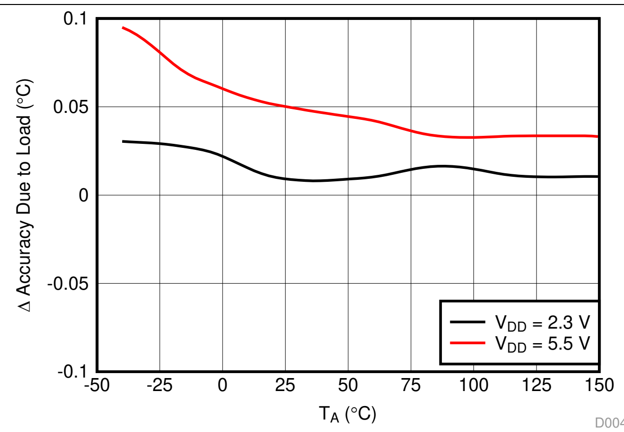
TMP235: V_{DD} = 2.3 to 5.5 V, I_{OUT} = 0 µA, C_{LOAD} = 1000 pF

図 2. Accuracy vs. T_A Temperature (A4 Accuracy Level)



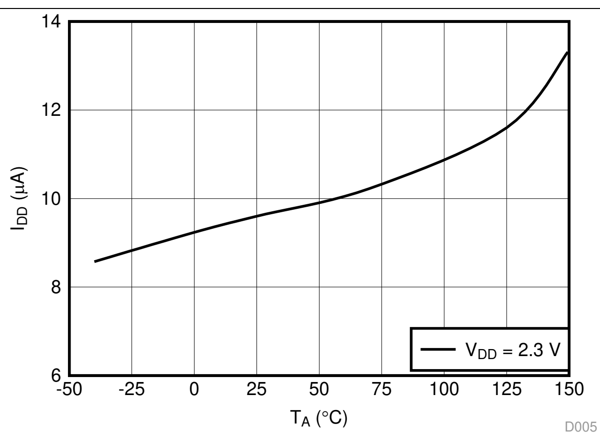
I_{OUT} = 0 µA, C_{LOAD} = 1000 pF

図 3. Output Voltage vs. Ambient Temperature



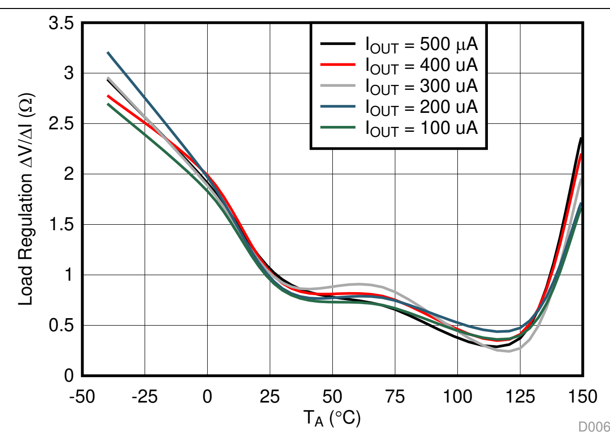
TMP235: I_{OUT} = from 0 µA to 100 µA, C_{LOAD} = 1000 pF

図 4. Changes in Accuracy vs. Ambient Temperature (Due to Load)



TMP235: I_{OUT} = 0 µA, C_{LOAD} = 1000 pF

図 5. Supply Current vs. Temperature

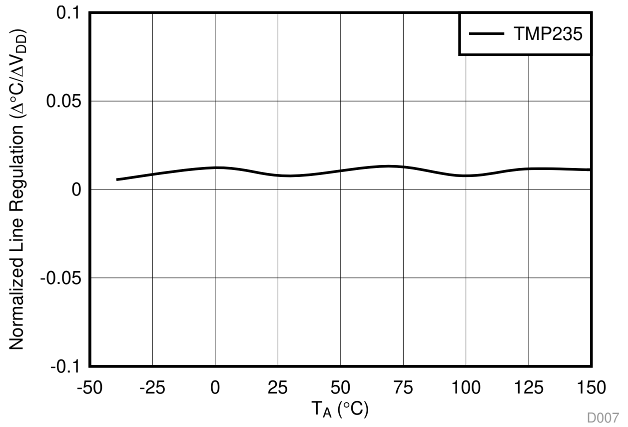


TMP235: V_{DD} = 2.3 V, C_{LOAD} = 1000 pF

図 6. Load Regulation vs. Ambient Temperature

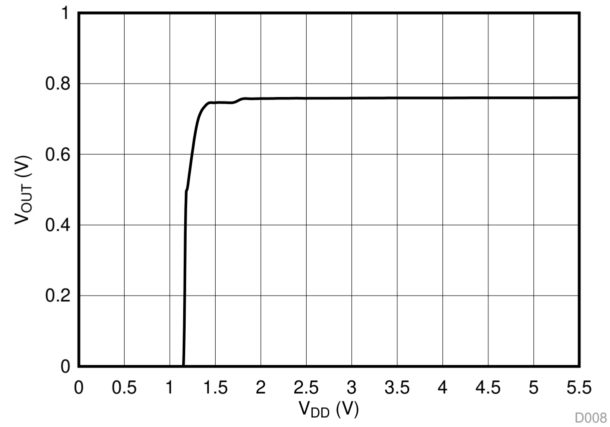
Typical Characteristics (continued)

at T_A = 25°C, (unless otherwise noted)



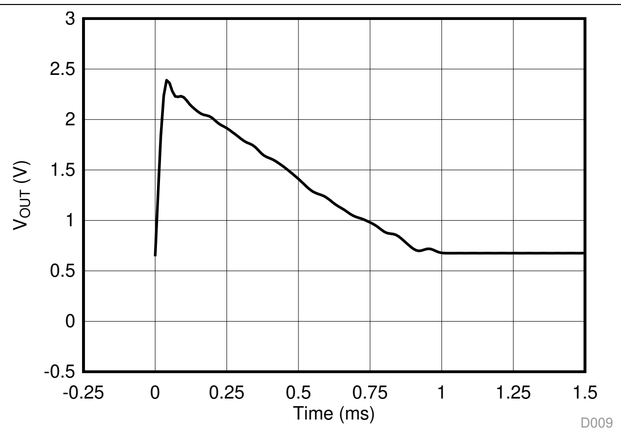
TMP235: V_{DD} = 2.3 to 5.5 V, I_{OUT} = 0 µA, C_{LOAD} = 1000 pF

図 7. Line Regulation (Δ°C / ΔV_{DD}) vs. Ambient Temperature



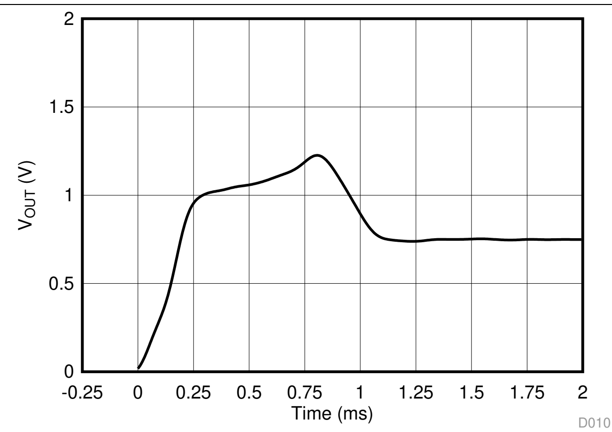
TMP235: T_A = 25°C

図 8. Output Voltage vs. Power Supply



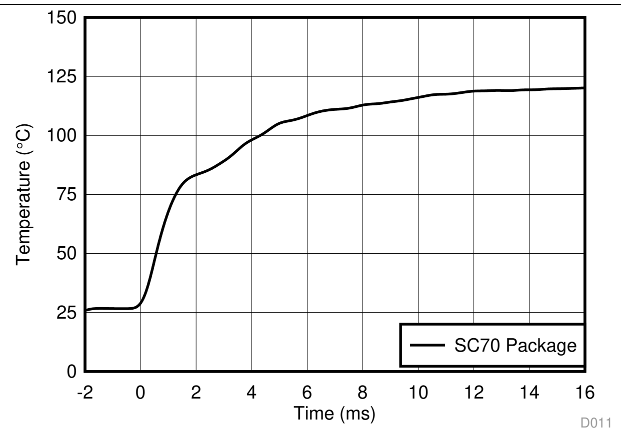
TMP235: T_A = 25°C

図 9. Output vs. Settling Time to Step V_{DD}



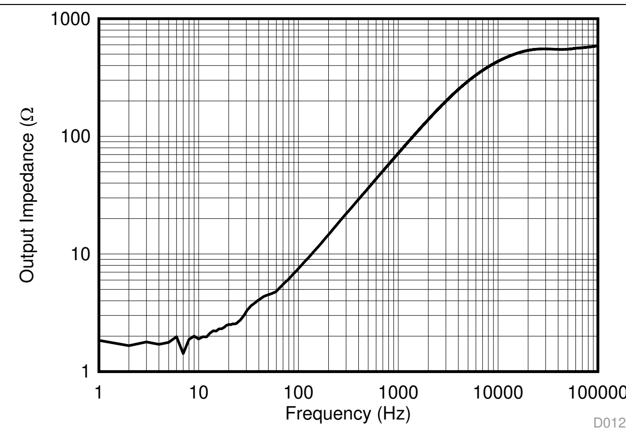
TMP235: T_A = 25°C, V_{DD} Ramp Rate = 5 V/ms

図 10. Output vs. Settling Time to Ramp V_{DD}



TMP235: 1 × 1 (inches) PCB, Air 26°C to Fluid Bath 123°C

図 11. Thermal Response (Air-to-Fluid Bath)



TMP235: T_A = 25°C, V_{DD} = 5 V, I_{OUT} = 100 µA

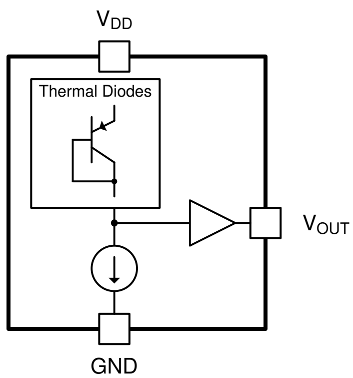
図 12. Output Impedance vs. Frequency

7 Detailed Description

7.1 Overview

The TMP23x devices are a family of linear analog temperature sensors with an output voltage proportional to temperature. These temperature sensors have an accuracy from 0°C to 70°C of ±1.25°C (TMP23xA2) and ±2°C (TMP23xA4). The TMP235 device provides a positive slope output of 10 mV/°C over the full –40°C to +150°C temperature range and a supply range from 2.3 V to 5.5 V. The higher gain TMP236 sensor provides a positive slope output of 19.5 mV/°C from –10°C to +125°C and a supply range from 3.1 V to 5.5 V. A class-AB output driver provides a maximum output of 500 µA to drive capacitive loads up to 1000 pF.

7.2 Functional Block Diagram



7.3 Feature Description

As shown in 図 3, the TMP23x devices are linear. A small V_{OUT} gain shift, however, is present at temperatures above 100°C. When small shifts are expected, a piecewise linear function provides the best accuracy and is used for the device accuracy specifications (see *Specifications*). Typical output voltages of the TMP23x devices across the full operating temperature range are listed in 表 3 and 表 4. The ideal linear columns represent the ideal linear V_{OUT} output response with respect to temperature, while the piecewise linear columns indicate the small voltage shift at elevated temperatures.

The piecewise linear function uses three temperature ranges listed in 表 1 and 表 2. In equation form, the voltage output V_{OUT} of the TMP23x is calculated by 式 1:

$$V_{OUT} = (T_A – T_{INFL}) \times T_C + V_{OFFS}$$

where

- V_{OUT} is the TMP23x voltage output for a given temperature
- T_A is the ambient temperature in °C
- T_{INFL} is the temperature inflection point for a piecewise segment in °C
- T_C is the TMP23x temperature coefficient or gain
- V_{OFFS} is the TMP23x voltage offset (1)

Therefore, the T_A temperature for a given V_{OUT} voltage output within a piecewise voltage range (V_{RANGE}) is calculated in 式 2. For applications where the accuracy enhancement above 100°C is not required, use the first row of 表 1 and 表 2 for all voltages.

$$T_A = (V_{OUT} – V_{OFFS}) / T_C + T_{INFL} \quad (2)$$

表 1. TMP235 Piecewise Linear Function Summary

T_A RANGE (°C)	V_{RANGE} (mV)	T_{INFL} (°C)	T_C (mV/°C)	V_{OFFS} (mV)
–40 to +100	< 1500	0	10	500
100 to 125	1500 to 1752.5	100	10.1	1500
125 to 150	> 1752.5	125	10.6	1752.5

表 2. TMP236 Piecewise Linear Function Summary

T_A RANGE (°C)	V_{RANGE} (mV)	T_{INFL} (°C)	T_C (mV/°C)	V_{OFFS} (mV)
–40 to +100	≤ 2350	0	19.5	400
100 to 125	> 2350	100	19.7	2350
125 to 150	—	—	—	—

表 3. TMP235 Transfer Table

TEMPERATURE (°C)	V_{OUT} (mV) IDEAL LINEAR VALUES	V_{OUT} (mV) PIECEWISE LINEAR VALUES
–40	100	100
–35	150	150
–30	200	200
–25	250	250
–20	300	300
–15	350	350
–10	400	400
–5	450	450
0	500	500
5	550	550
10	600	600
15	650	650
20	700	700
25	750	750
30	800	800
35	850	850
40	900	900
45	950	950
50	1000	1000
55	1050	1050
60	1100	1100
65	1150	1150
70	1200	1200
75	1250	1250
80	1300	1300
85	1350	1350
90	1400	1400
95	1450	1450
100	1500	1500
105	1550	1550.5
110	1600	1601
115	1650	1651.5
120	1700	1702
125	1750	1752.5
130	1800	1805.5
135	1850	1858.5
140	1900	1911.5
145	1950	1964.5
150	2000	2017.5

表 4. TMP236 Transfer Table

TEMPERATURE (°C)	V_{OUT} (mV) IDEAL LINEAR VALUES	V_{OUT} (mV) PIECEWISE LINEAR VALUES
–40	—	—
–35	—	—
–30	—	—
–25	—	—
–20	—	—
–15	—	—
–10	205	205
–5	303	303
0	400	400
5	498	498
10	595	595
15	693	693
20	790	790
25	888	888
30	985	985
35	1083	1083
40	1180	1180
45	1278	1278
50	1375	1375
55	1473	1473
60	1570	1570
65	1668	1668
70	1765	1765
75	1863	1863
80	1960	1960
85	2058	2058
90	2155	2155
95	2253	2253
100	2350	2350
105	2448	2448.5
110	2545	2547
115	2643	2645.4
120	2740	2743.9
125	2838	2842.4
130	—	—
135	—	—
140	—	—
145	—	—
150	—	—

7.4 Device Functional Modes

The singular functional mode of the TMP23x is 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 TMP235 make the series of devices designed for various general temperature-sensing applications. The TMP235 and TMP236 devices can operate down to a 2.3-V and a 3.1-V supply with 9-µA power consumption, respectively. As a result, the series is designed for battery-powered applications. The TMP23x series is mounted in two surface mount technology packages (SC70 and SOT-23.)

8.2 Typical Application

8.2.1 Connection to an ADC

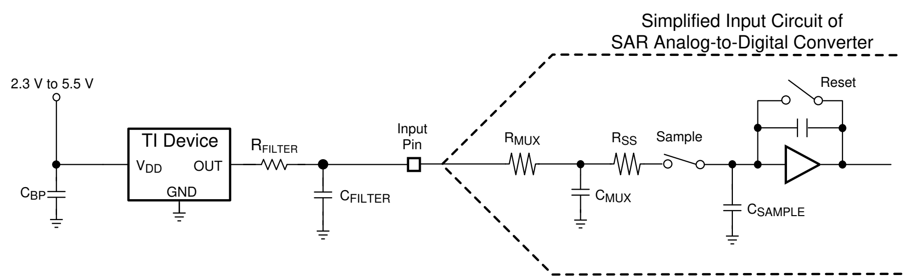


Figure 13. Suggested Connections to an ADC Input Stage

8.2.1.1 Design Requirements

See Figure 13 for suggested connections to an ADC input stage. Most CMOS-based ADCs have a sampled data comparator input structure. When the ADC charges the sampling capacitor (C_{SAMPLE}), the capacitor requires instantaneous charge from the output of the analog source temperature sensor, such as the TMP23x. Therefore, the output impedance of the temperature sensor can affect ADC performance. In most cases, adding an external capacitor (C_{FILTER}) mitigates design challenges. The TMP23x is specified and characterized with a 1000-pF maximum capacitive load (C_{LOAD}). Figure 13 shows C_{LOAD} as the sum of C_{FILTER} + C_{MUX} + C_{SAMPLE}. TI recommends maximizing the C_{FILTER} value while allowing for the maximum specified ADC input capacitance (C_{MUX} + C_{SAMPLE}) to limit the total C_{LOAD} at 1000 pF. In most cases, a 680-pF C_{FILTER} provides a reasonable allowance for ADC input capacitance to minimize ADC sampling error and reduce noise coupling. An optional series resistor (R_{FILTER}) and C_{FILTER} provides additional low-pass filtering to reject system level noise. TI recommends placing R_{FILTER} and C_{FILTER} as close as possible to the ADC input for optimal performance.

8.2.1.2 Detailed Design Procedure

Depending on the input characteristics of the ADC, an external C_{FILTER} may be required. The value of C_{FILTER} depends on the size of the sampling capacitor (C_{SAMPLE}) and the sampling frequency while observing a maximum C_{LOAD} of 1000 pF. The capacitor requirements can vary because the input stages of all ADCs are not identical. Figure 13 shows a general ADC application as an example only.

Typical Application (continued)

8.2.1.3 Application Curve

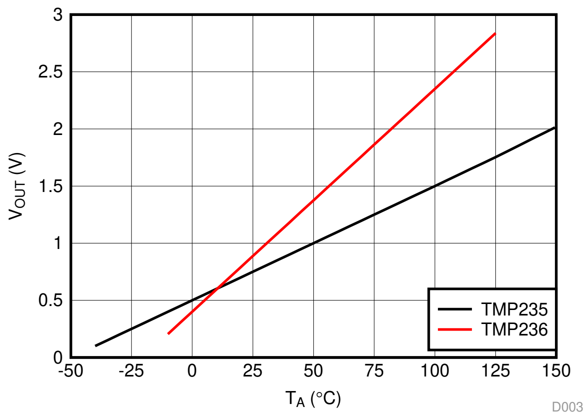


Figure 14. Output Voltage vs. Ambient

9 Power Supply Recommendations

The low supply current and supply range of the TMP23x allow the device to be easily powered from many sources.

Power supply bypassing is strongly recommended. In noisy environments, TI recommends to add a filter with 0.1-µF capacitor and 100-Ω resistor between external supply and V_{DD} to limit the power supply noise. Larger capacitances may be required and are dependent on the noise of the power supply.

10 Layout

10.1 Layout Guidelines

The layout of the TMP23x series is simple. If a power supply bypass capacitor is used, the capacitor must be connected as *Layout Examples* shows.

10.2 Layout Examples

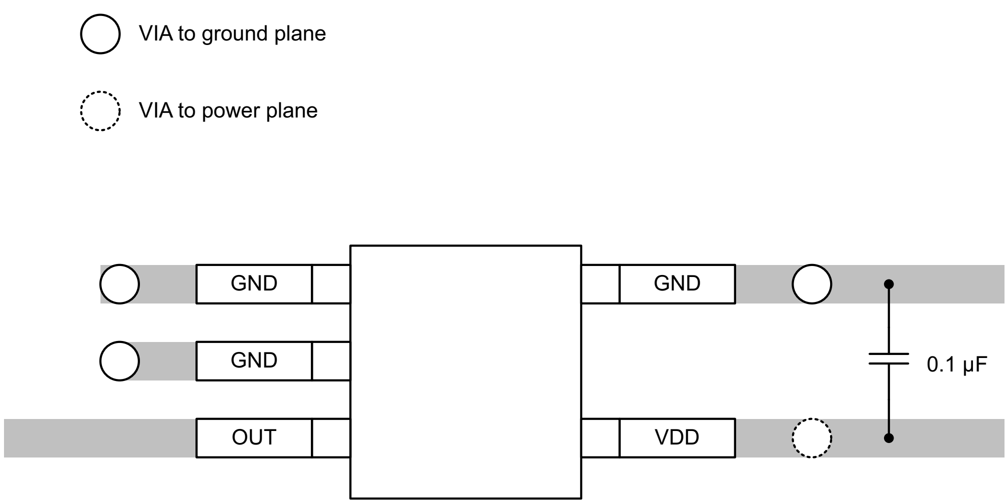


Figure 15. Recommended Layout: SC70 Package

11 デバイスおよびドキュメントのサポート

11.1 関連リンク

次の表に、クイック・アクセス・リンクを示します。カテゴリには、技術資料、サポートおよびコミュニティ・リソース、ツールとソフトウェア、およびご注文へのクイック・アクセスが含まれます。

表 5. 関連リンク

製品	プロダクト・フォルダ	ご注文はこちら	技術資料	ツールとソフトウェア	サポートとコミュニティ
TMP235	ここをクリック	ここをクリック	ここをクリック	ここをクリック	ここをクリック
TMP236	ここをクリック	ここをクリック	ここをクリック	ここをクリック	ここをクリック

11.2 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「アラートを受け取る」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。

11.3 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.

TI E2E™ Online Community ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

11.4 商標

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11.5 静電気放電に関する注意事項

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静電気放電はわずかな性能の低下から完全なデバイスの故障に至るまで、様々な損傷を与えます。高精度の集積回路は、損傷に対して敏感であり、極めてわずかなパラメータの変化により、デバイスに規定された仕様に適合しなくなる場合があります。

11.6 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)
TMP235A2DBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 150	2352
TMP235A2DBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 150	2352
TMP235A2DBZRG4.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	-	Call TI	Call TI	-40 to 150	2352
TMP235A2DBZT	Obsolete	Production	SOT-23 (DBZ) | 3	-	-	Call TI	Call TI	-40 to 150	2352
TMP235A2DCKR	Active	Production	SC70 (DCK) | 5	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 150	19L
TMP235A2DCKR.A	Active	Production	SC70 (DCK) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 150	19L
TMP235A2DCKT	Obsolete	Production	SC70 (DCK) | 5	-	-	Call TI	Call TI	-40 to 150	19L
TMP235A4DBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 150	2354
TMP235A4DBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 150	2354
TMP235A4DBZRG4	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 150	2354
TMP235A4DBZRG4.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 150	2354
TMP235A4DBZT	Obsolete	Production	SOT-23 (DBZ) | 3	-	-	Call TI	Call TI	-40 to 150	2354
TMP235A4DCKR	Active	Production	SC70 (DCK) | 5	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 150	19M
TMP235A4DCKR.A	Active	Production	SC70 (DCK) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 150	19M
TMP235A4DCKT	Obsolete	Production	SC70 (DCK) | 5	-	-	Call TI	Call TI	-40 to 150	19M
TMP236A2DBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-10 to 125	2362
TMP236A2DBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-10 to 125	2362
TMP236A2DBZT	Obsolete	Production	SOT-23 (DBZ) | 3	-	-	Call TI	Call TI	-10 to 125	2362
TMP236A2DCKR	Active	Production	SC70 (DCK) | 5	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-10 to 125	1BS
TMP236A2DCKR.A	Active	Production	SC70 (DCK) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-10 to 125	1BS
TMP236A2DCKT	Obsolete	Production	SC70 (DCK) | 5	-	-	Call TI	Call TI	-10 to 125	1BS
TMP236A4DBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-10 to 125	2364
TMP236A4DBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-10 to 125	2364
TMP236A4DBZT	Obsolete	Production	SOT-23 (DBZ) | 3	-	-	Call TI	Call TI	-10 to 125	2364

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)
TMP236A4DCKR	Active	Production	SC70 (DCK) | 5	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-10 to 125	1BT
TMP236A4DCKR.A	Active	Production	SC70 (DCK) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-10 to 125	1BT
TMP236A4DCKT	Obsolete	Production	SC70 (DCK) | 5	-	-	Call TI	Call TI	-10 to 125	1BT

(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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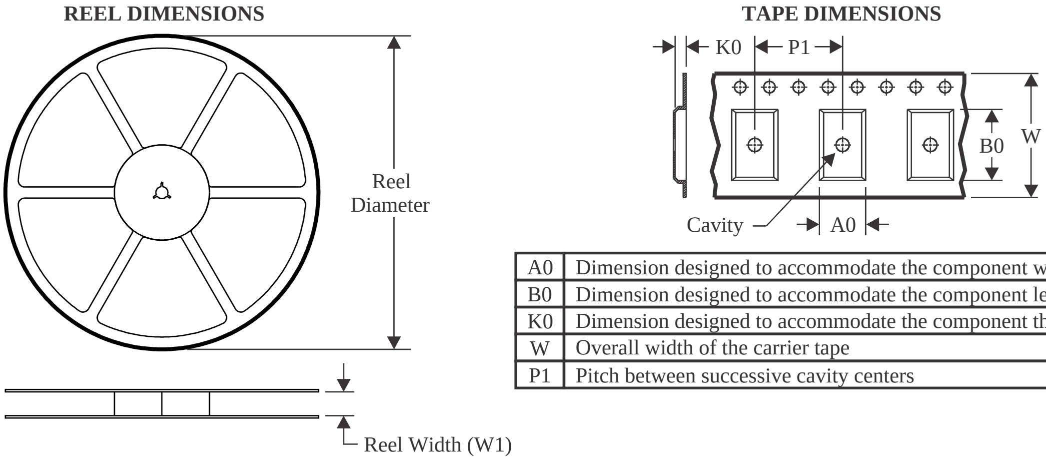
OTHER QUALIFIED VERSIONS OF TMP235, TMP236 :

- Automotive : TMP235-Q1, TMP236-Q1

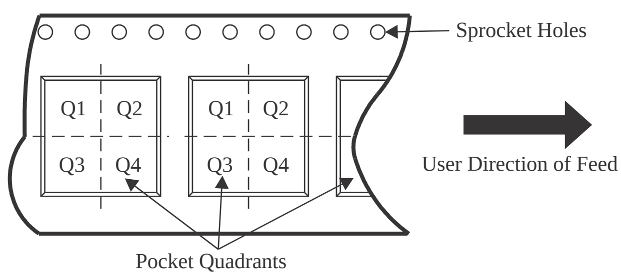
NOTE: Qualified Version Definitions:

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

TAPE AND REEL INFORMATION



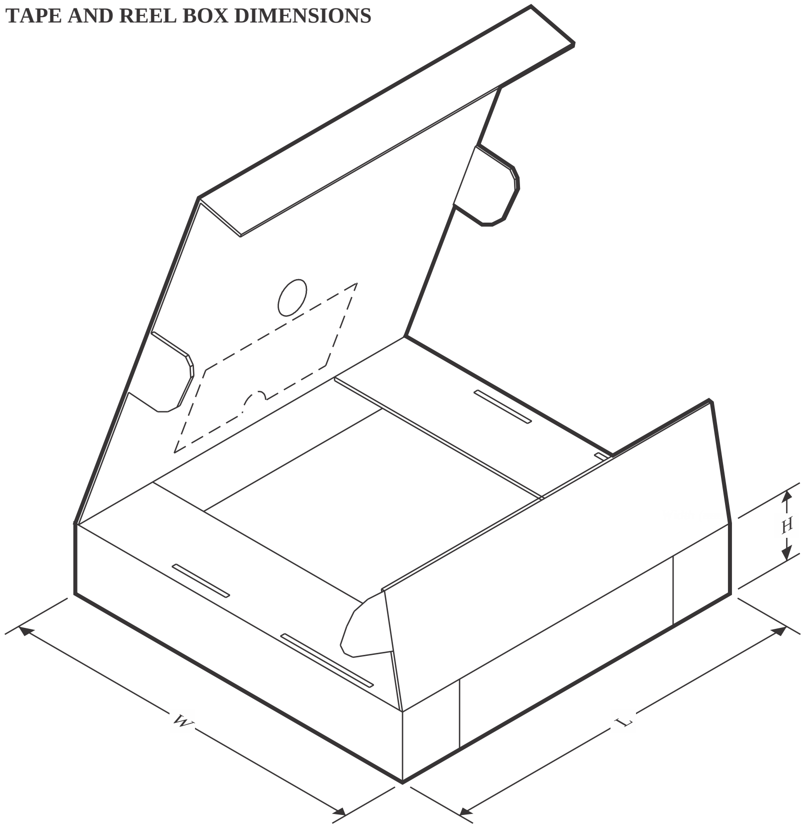
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers



*All dimensions are nominal

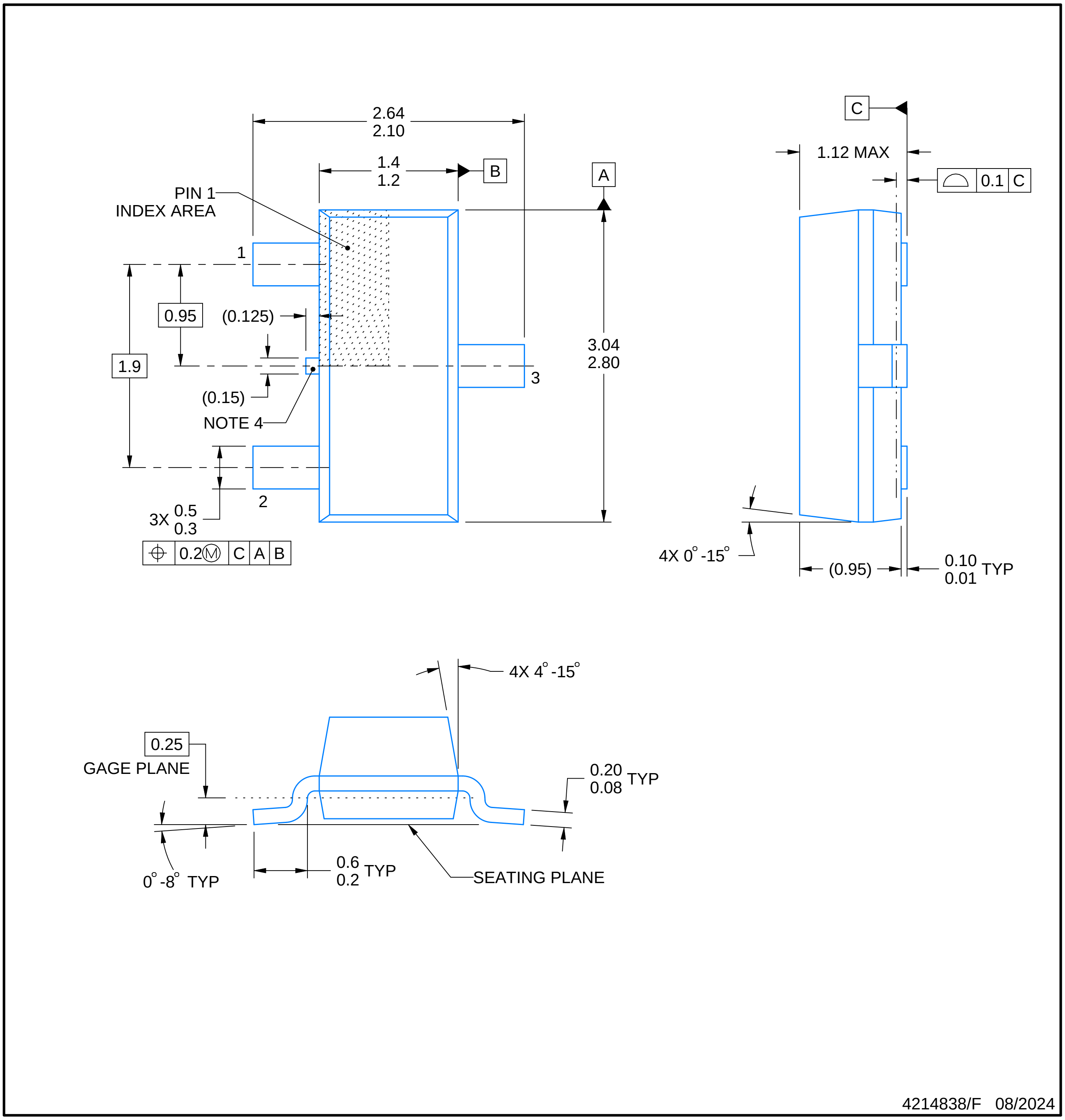
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TMP235A2DBZR	SOT-23	DBZ	3	3000	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
TMP235A2DCKR	SC70	DCK	5	3000	178.0	8.4	2.25	2.45	1.2	4.0	8.0	Q3
TMP235A4DBZR	SOT-23	DBZ	3	3000	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
TMP235A4DBZR	SOT-23	DBZ	3	3000	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
TMP235A4DBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TMP235A4DBZRG4	SOT-23	DBZ	3	3000	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
TMP235A4DCKR	SC70	DCK	5	3000	178.0	8.4	2.25	2.45	1.2	4.0	8.0	Q3
TMP236A2DBZR	SOT-23	DBZ	3	3000	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
TMP236A2DCKR	SC70	DCK	5	3000	180.0	8.4	2.3	2.5	1.2	4.0	8.0	Q3
TMP236A4DBZR	SOT-23	DBZ	3	3000	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
TMP236A4DCKR	SC70	DCK	5	3000	180.0	8.4	2.3	2.5	1.2	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS



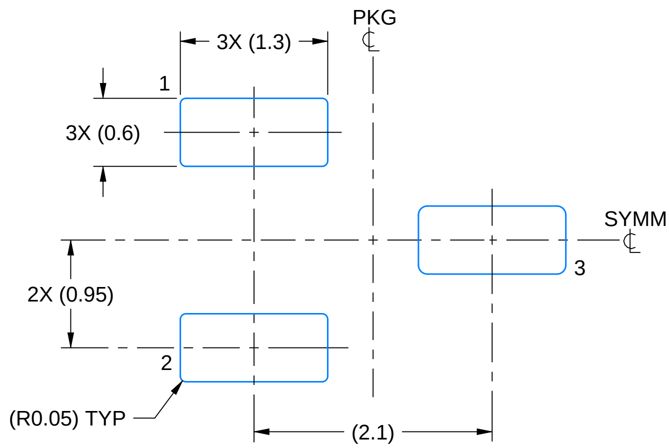
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TMP235A2DBZR	SOT-23	DBZ	3	3000	210.0	185.0	35.0
TMP235A2DCKR	SC70	DCK	5	3000	208.0	191.0	35.0
TMP235A4DBZR	SOT-23	DBZ	3	3000	210.0	185.0	35.0
TMP235A4DBZR	SOT-23	DBZ	3	3000	183.0	183.0	20.0
TMP235A4DBZR	SOT-23	DBZ	3	3000	180.0	180.0	18.0
TMP235A4DBZRG4	SOT-23	DBZ	3	3000	210.0	185.0	35.0
TMP235A4DCKR	SC70	DCK	5	3000	208.0	191.0	35.0
TMP236A2DBZR	SOT-23	DBZ	3	3000	210.0	185.0	35.0
TMP236A2DCKR	SC70	DCK	5	3000	210.0	185.0	35.0
TMP236A4DBZR	SOT-23	DBZ	3	3000	210.0	185.0	35.0
TMP236A4DCKR	SC70	DCK	5	3000	210.0	185.0	35.0

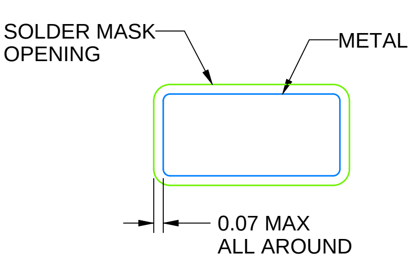


NOTES:

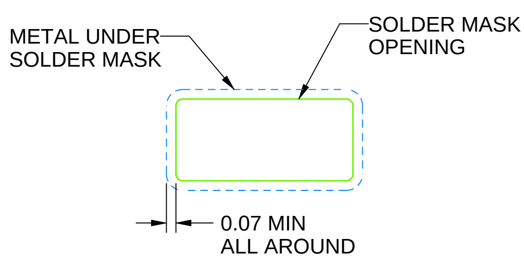
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration TO-236, except minimum foot length.
4. Support pin may differ or may not be present.
5. 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
SCALE:15X



NON SOLDER MASK DEFINED (PREFERRED)



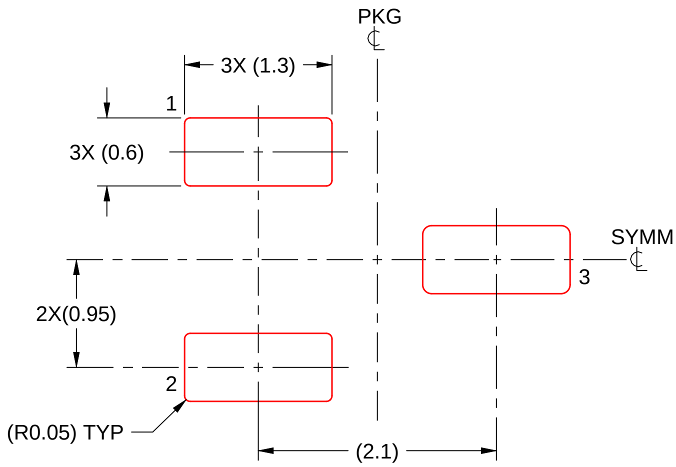
SOLDER MASK DEFINED

SOLDER MASK DETAILS

4214838/F 08/2024

NOTES: (continued)

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

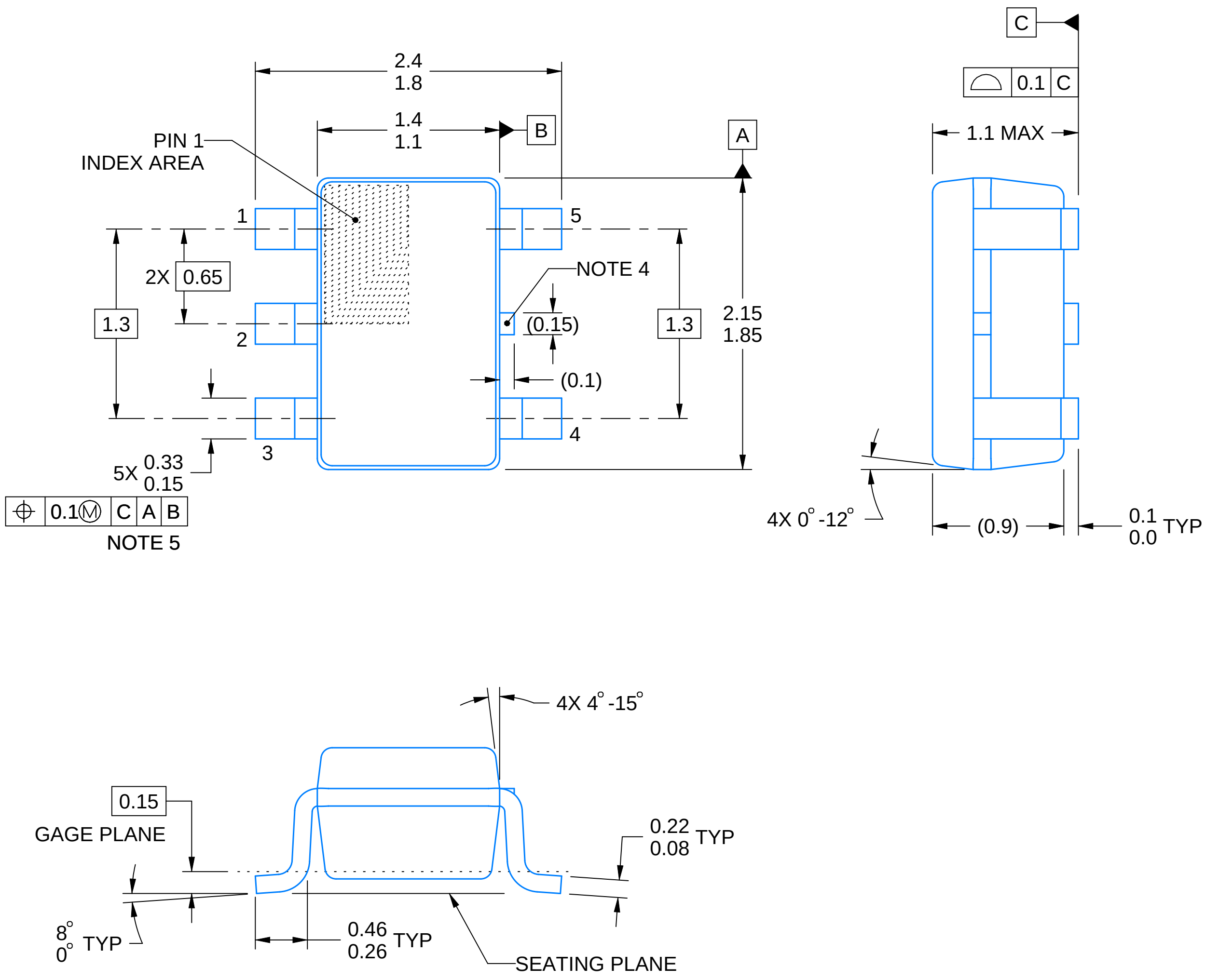


SOLDER PASTE EXAMPLE
BASED ON 0.125 THICK STENCIL
SCALE:15X

4214838/F 08/2024

NOTES: (continued)

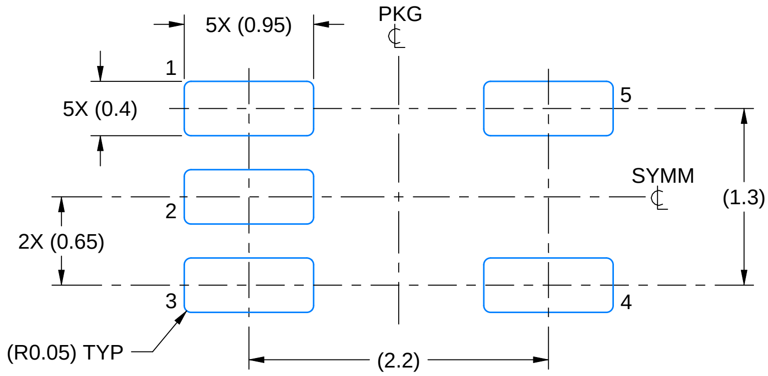
7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.



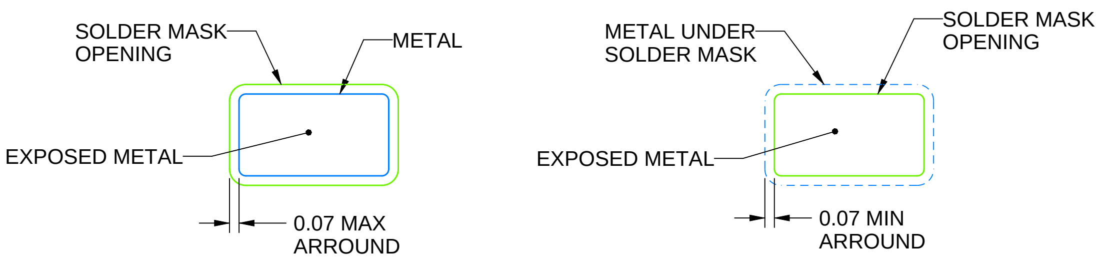
4214834/G 11/2024

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



NON SOLDER MASK
DEFINED
(PREFERRED)

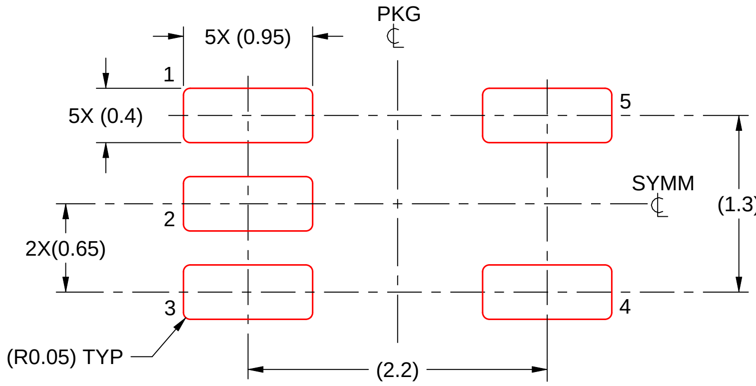
SOLDER MASK
DEFINED

SOLDER MASK DETAILS

4214834/G 11/2024

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

4214834/G 11/2024

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.

重要なお知らせと免責事項

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