

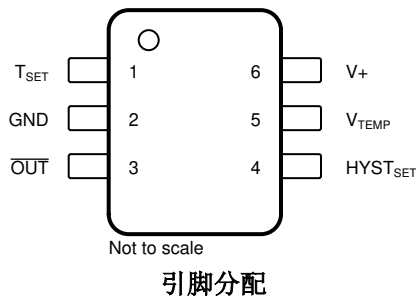
# TMP300 采用 SC70 封装的 1.8V 电阻器可编程温度开关和模拟输出温度传感器

## 1 特性

- 精度： $\pm 1^{\circ}\text{C}$ （ $+25^{\circ}\text{C}$  时的典型值）
- 可编程跳闸点
- 可编程迟滞： $5^{\circ}\text{C}/10^{\circ}\text{C}$
- 开漏输出
- 低功耗： $110\ \mu\text{A}$ （最大值）
- 宽电压范围： $+1.8\ \text{V}$  至  $+18\ \text{V}$
- 温度范围： $-40^{\circ}\text{C}$  至  $+125^{\circ}\text{C}$
- 模拟输出： $10\text{mV}/^{\circ}\text{C}$
- SC70-6 和 SOT23-6 封装

## 2 应用

- 电源系统
- 直流/直流模块
- 过热监控
- 电子保护系统



## 3 说明

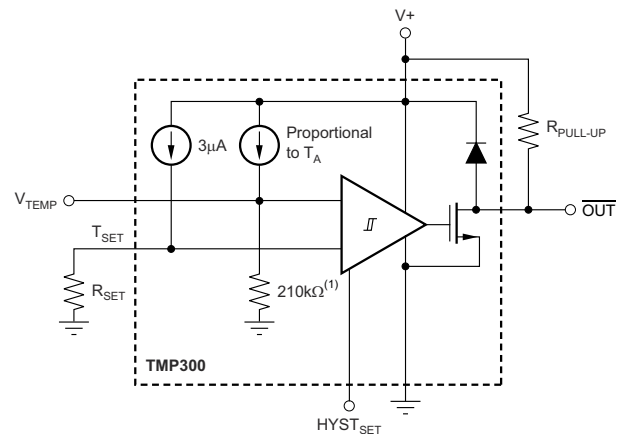
TMP300 是一款低功耗、电阻器可编程、数字输出温度开关。可通过添加外部电阻器设置器件阈值点。提供两种等级的迟滞。TMP300 有一个  $V_{\text{TEMP}}$  模拟输出，此输出可用作测试点或者用在温度补偿环路中。

TMP300 可采用两种微型封装并具有成熟的热特性、低电流消耗和低至  $1.8\ \text{V}$  的电源电压，专为需要简单可靠的热管理的功耗敏感型系统而设计。

### 封装信息<sup>(1)</sup>

器件型号	封装	封装尺寸 (标称值)
TMP300	SOT-23 (6)	2.90mm × 1.60mm
	SC70 (6)	2.00mm × 1.25mm

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。



注：薄膜电阻器精度误差大约为 10%，但是该精度误差在出厂时已经过校准。

### 应用原理图



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## 4 Revision History

<b>Changes from Revision E (December 2018) to Revision F (January 2023)</b>	<b>Page</b>
• 更新了整个文档的表、图和交叉参考的编号格式.....	1
• 将 <i>器件信息</i> 表更改为 <i>封装信息</i> .....	1
• Added parameter to the <i>Absolute Maximum Ratings</i> table: input current into any pin.....	4
<b>Changes from Revision D (January 2016) to Revision E (December 2018)</b>	<b>Page</b>
• Added <i>Pin Configuration and Functions</i> section .....	3
<b>Changes from Revision C (January 2011) to Revision D (January 2016)</b>	<b>Page</b>
• 添加了 <i>器件信息</i> 表、 <i>ESD</i> 等级表、 <i>特性说明</i> 部分、 <i>器件和文档支持</i> 部分以及 <i>机械、封装和可订购信息</i> 部分	1
• 更改了 <i>温度范围</i> 特性要点.....	1
• 向引脚排列部分添加了封装名称.....	1
• Deleted <i>Ordering Information</i> table .....	4
• Changed Temperature Range, <i>TA</i> , <i>Functional Range</i> parameter name in <i>Electrical Characteristics</i> table.....	5
• Added footnote 4 to <i>Electrical Characteristics</i> table .....	5
<b>Changes from Revision B (November 2008) to Revision C (January 2011)</b>	<b>Page</b>
• 删除了 <i>说明</i> 部分的第二句.....	1
• Added TMP300B grade device specifications to <i>Electrical Characteristics</i> table.....	5

## 5 Pin Configuration and Functions

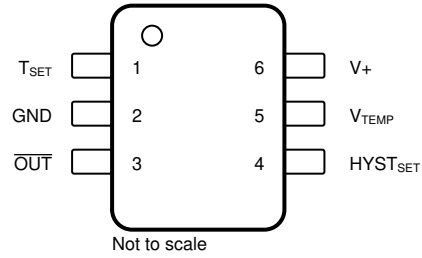


图 5-1. DCK and DBV Package 6-Pin SOT-23 and SC70 Top View

表 5-1. Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
T <sub>SET</sub>	1	I	Temperature set pin. Connects to a resistor to set the trip point
GND	2	—	Ground
OUT	3	O	Trip output
HYST <sub>SET</sub>	4	I	Hysteresis Set. Connect to Ground for 5°C hysteresis or connect to V+ for 10°C hysteresis
V <sub>TEMP</sub>	5	I	Analog Temperature output
V+	6	O	Supply voltage: 1.8 V to 18 V

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

		MIN	MAX	UNIT
V+	Supply voltage		+18	V
	Signal input pins, voltage <sup>(2)</sup>	- 0.5	(V+) + 0.5	V
	Signal input pins, current <sup>(2)</sup>	- 10	10	mA
	Input current into any pin		10	mA
I <sub>SC</sub>	Output short-circuit <sup>(3)</sup>	Continuous		
	Open-drain output		(V+) + 0.5	V
T <sub>A</sub>	Functional temperature	- 40	+150	°C
T <sub>stg</sub>	Storage temperature	- 55	+150	°C
T <sub>J</sub>	Junction temperature		+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) Input pins are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current limited to 10mA or less.
- (3) Short-circuit to ground.

### 6.2 ESD Ratings

			VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human-body model (HBM)	±4000	V
		Charged-device model (CDM)	±1000	

### 6.3 Electrical Characteristics

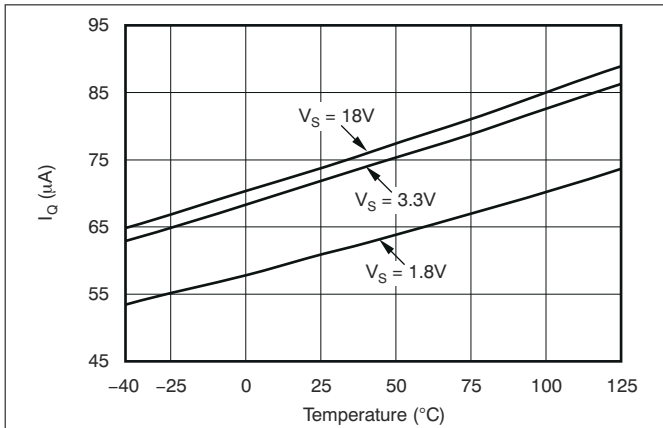
At  $V_S = 3.3\text{ V}$  and  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ , unless otherwise noted.

PARAMETER	TEST CONDITIONS	TMP300			TMP300B			UNIT	
		MIN <sup>(1)</sup>	TYP <sup>(1)</sup>	MAX <sup>(1)</sup>	MIN	TYP	MAX		
<b>TEMPERATURE MEASUREMENT</b>									
Measurement range	$V_S = 2.35\text{ V}$ to $18\text{ V}$	-40		+125	-40		+125	°C	
	$V_S = 1.8\text{ V}$ to $2.35\text{ V}$	-40		$100 \times (V_S - 0.95)$	-40		$100 \times (V_S - 0.95)$		
<b>TRIP POINT</b>									
Total accuracy	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$		$\pm 2$	$\pm 4$ <sup>(3)</sup>		$\pm 2$	$\pm 6$	°C	
R <sub>SET</sub> equation	$T_C$ is in °C		$R_{SET} = 10(50 + T_C)/3$			$R_{SET} = 10(50 + T_C)/3$			kΩ
<b>HYSTERESIS SET INPUT</b>									
LOW threshold				0.4			0.4	V	
HIGH threshold		$V_S - 0.4$			$V_S - 0.4$			V	
Threshold hysteresis	HYST <sub>SET</sub> = GND			5			5	°C	
	HYST <sub>SET</sub> = $V_S$			10			10		
<b>DIGITAL OUTPUT</b>									
Logic family			CMOS			CMOS			
Open-drain leakage current	OUT = $V_S$			10			10	μA	
$V_{OL}$ Logic levels	$V_S = 1.8\text{ V}$ to $18\text{ V}$ , $I_{SINK} = 5\text{ mA}$			0.3			0.3	V	
<b>ANALOG OUTPUT</b>									
Accuracy			$\pm 2$	$\pm 3$		$\pm 2$	$\pm 5$	°C	
Temperature sensitivity			10			10		mV/°C	
Output voltage	$T_A = +25^\circ\text{C}$	720	750	780	720	750	780	mV	
$V_{TEMP}$ pin output resistance			210			210		kΩ	
<b>POWER SUPPLY</b>									
$I_Q$ Quiescent current <sup>(2)</sup>	$V_S = 1.8\text{ V}$ to $18\text{ V}$ , $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$			110			110	μA	
<b>TEMPERATURE RANGE</b>									
$T_A$	Specified range	$V_S = 2.35\text{ V}$ to $18\text{ V}$	-40		+125	-40		+125	°C
		$V_S = 1.8\text{ V}$ to $2.35\text{ V}$	-40		$100 \times (V_S - 0.95)$	-40		$100 \times (V_S - 0.95)$	
	Functional range <sup>(4)</sup>	$V_S = 2.35\text{ V}$ to $18\text{ V}$	-40		+150	-40		+150	
		$V_S = 1.8\text{ V}$ to $2.35\text{ V}$	-50		$100 \times (V_S - 0.95)$	-50		$100 \times (V_S - 0.95)$	
$\theta_{JA}$ Thermal resistance	SC70			250			250	°C/W	
	SOT23-6			180			180		

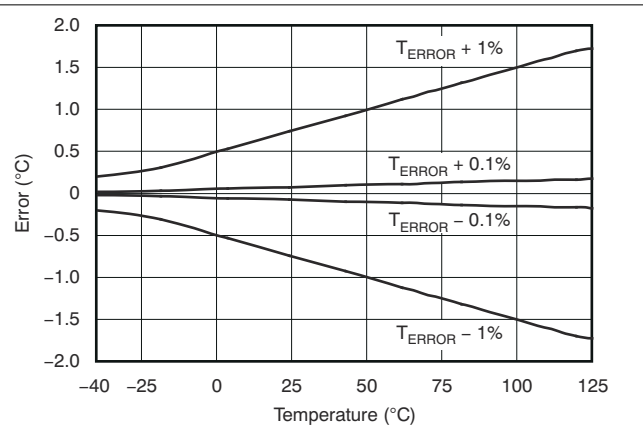
- (1) 100% of production is tested at  $T_A = +85^\circ\text{C}$ . Specifications over temperature range are ensured by design.
- (2) See [Fig 6-1](#) for typical quiescent current.
- (3) Shaded cells indicate characteristic performance difference.
- (4) The TMP300 is functional over this range and no indication of performance is implied.

## 6.4 Typical Characteristics

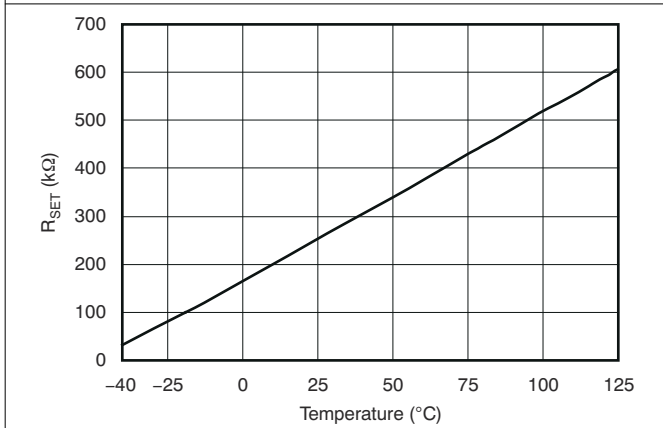
At  $V_S = 5\text{ V}$ , unless otherwise noted.



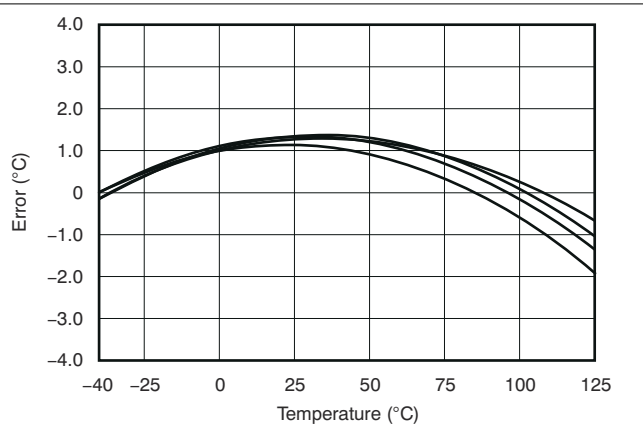
**图 6-1. Quiescent Current Over Temperature and Supply**



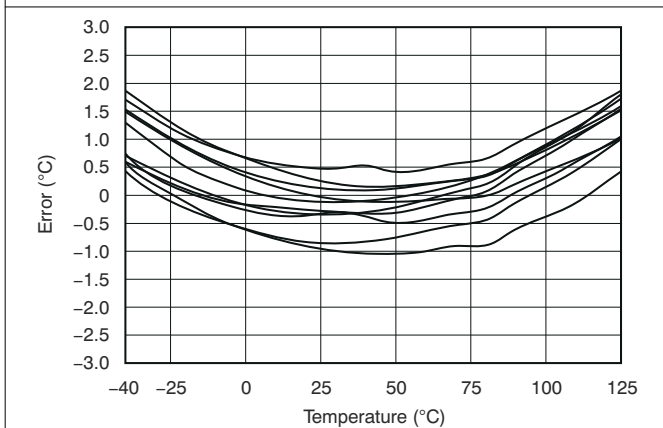
**图 6-2.  $R_{SET}$  Shift Resulting From  $R_{SET}$  Tolerance**



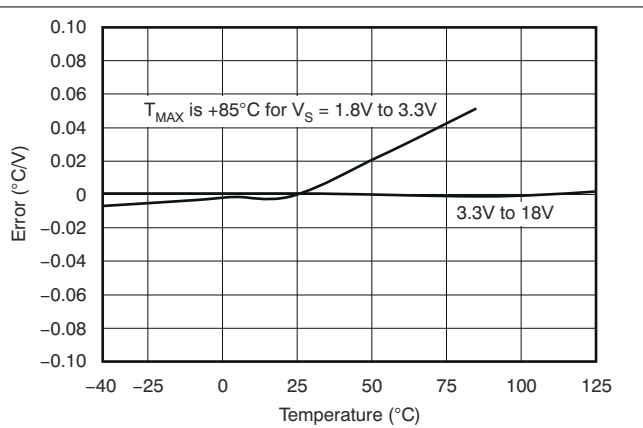
**图 6-3.  $R_{SET}$  vs Temperature**



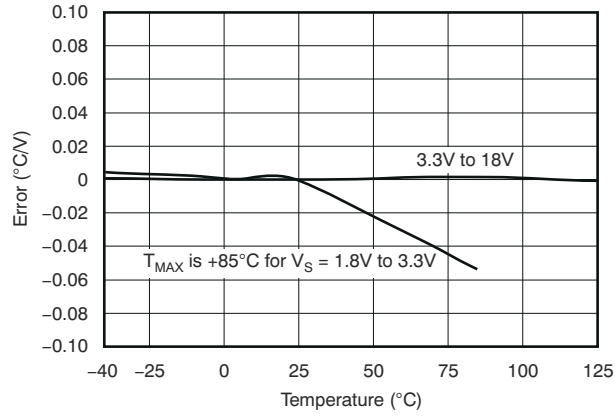
**图 6-4. Typical Trip Error**



**图 6-5. Typical Analog Output Error**



**图 6-6. Analog PSR Over Temperature**



**图 6-7. Trip PSR Over Temperature**

## 7 Detailed Description

### 7.1 Overview

The TMP300 is a thermal sensor designed for overtemperature protection circuits in electronic systems. The TMP300 uses a set resistor to program the trip temperature of the digital output. An additional high-impedance (210 kΩ) analog voltage output provides the temperature reading.

### 7.2 Feature Description

#### 7.2.1 Calculating R<sub>SET</sub>

The set resistor (R<sub>SET</sub>) provides a threshold voltage for the comparator input. The TMP300 trips when the V<sub>TEMP</sub> pin exceeds the T<sub>SET</sub> voltage. The value of the set resistor is determined by the analog output function and the 3-μA internal bias current.

To set the TMP300 to trip at a preset value, calculate the R<sub>SET</sub> resistor value according to [方程式 1](#) or [方程式 2](#):

$$R_{SET} = \frac{(T_{SET} \times 0.01 + 0.5)}{3e^{-6}} \quad (1)$$

where

- T<sub>SET</sub> is in °C; or

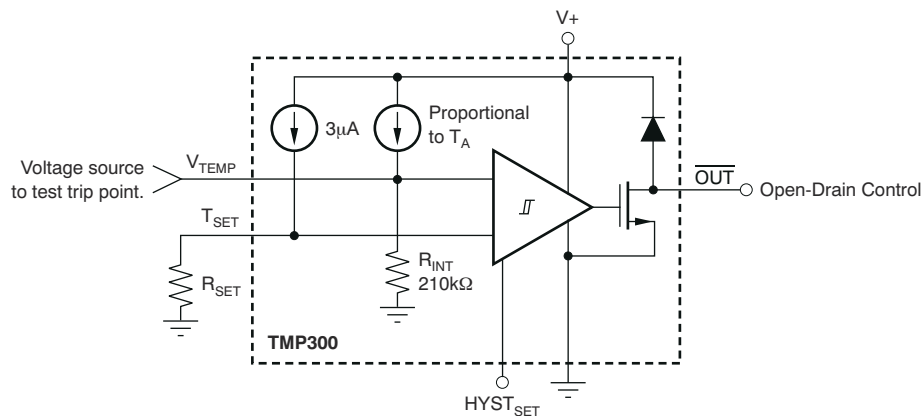
$$R_{SET} \text{ in } k\Omega = \frac{10(50 + T_{SET})}{3} \quad (2)$$

where

- T<sub>SET</sub> is in °C.

#### 7.2.2 Using V<sub>TEMP</sub> to Trip the Digital Output

The analog voltage output can also serve as a voltage input that forces a trip of the digital output to simulate a thermal event. This simulation facilitates easy system design and test of thermal safety circuits, as shown in [图 7-1](#).



**图 7-1. Applying Voltage to Trip Digital Output**



### 7.2.3 Analog Temperature Output

The analog out or  $V_{TEMP}$  pin is high-impedance (210 k $\Omega$ ). Avoid loading this pin to prevent degrading the analog out value or trip point. Buffer the output of this pin when used for direct thermal measurement. 图 7-2 shows buffering of the analog output signal.

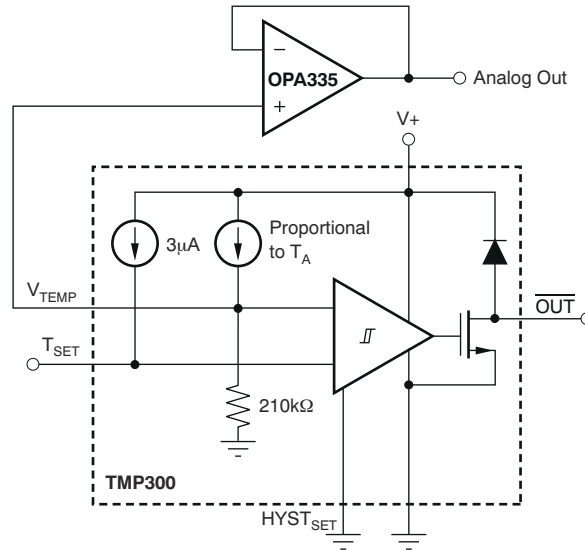


图 7-2. Buffering the Analog Output Signal

### 7.2.4 Using a DAC to Set the Trip Point

The trip point is easily converted by changing the digital-to-analog converter (DAC) code. This technique can be useful for control loops where a large thermal mass is being brought up to the set temperature and the  $\overline{OUT}$  pin is used to control the heating element. The analog output can be monitored in a control algorithm that adjusts the set temperature to prevent overshoot. 图 7-3 shows the trip set voltage error versus temperature, which shows error in  $^{\circ}\text{C}$  of the comparator input over temperature. 图 7-4 shows an alternative method of setting the trip point by using a DAC.

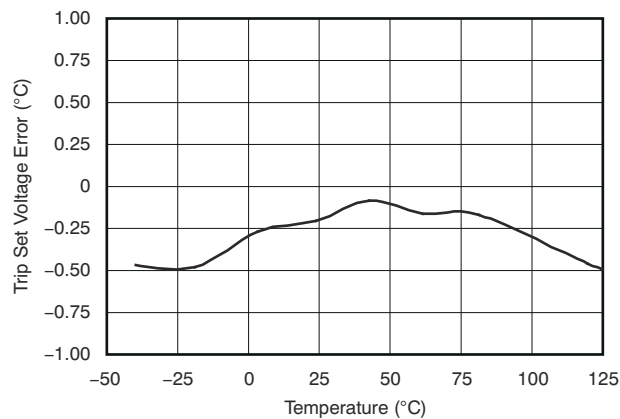


图 7-3. Trip Set Voltage Error vs Temperature

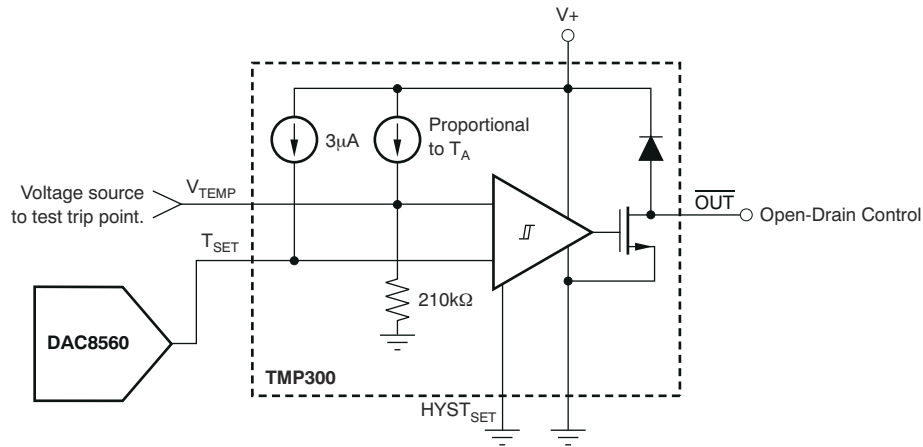
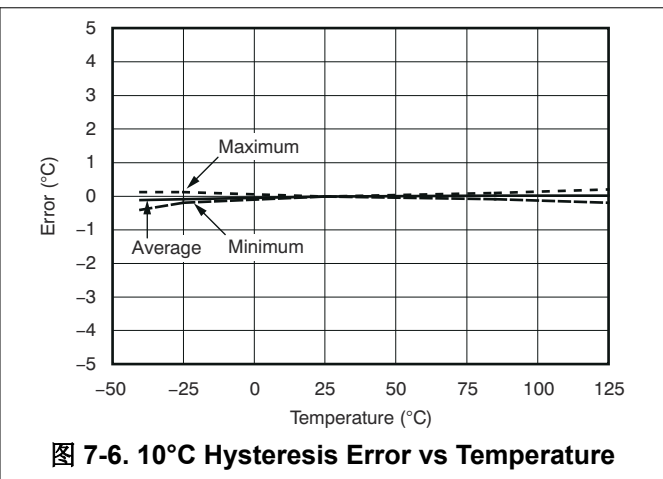
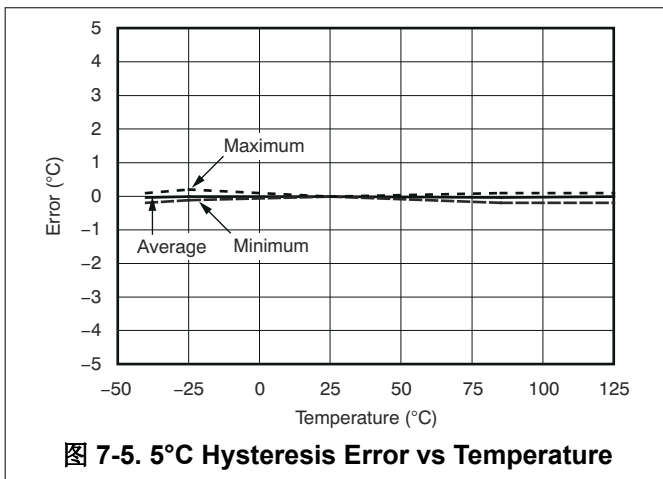


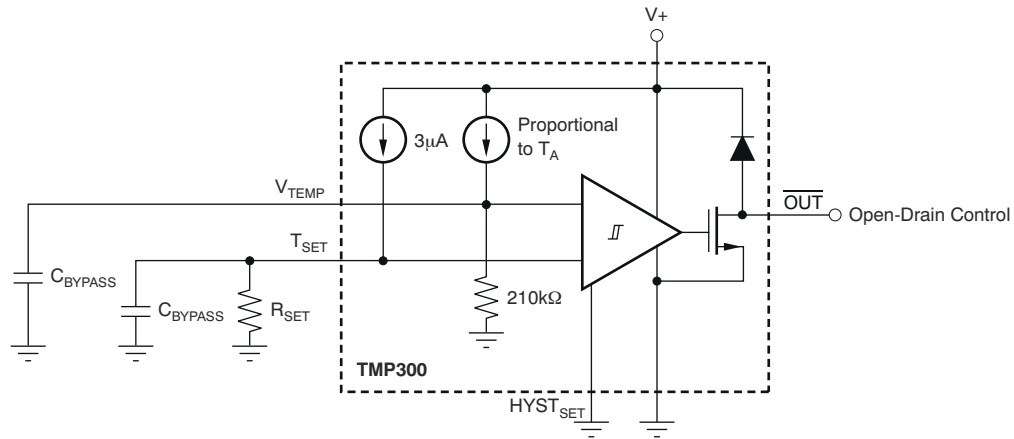
图 7-4. DAC Generates the Voltage-Driving T<sub>SET</sub> Pin

### 7.2.5 Hysteresis

The hysteresis pin has two settings. Grounding HYST<sub>SET</sub> results in 5°C of hysteresis. Connecting HYST<sub>SET</sub> to V<sub>S</sub> results in 10°C of hysteresis. 图 7-5 and 图 7-6 show the hysteresis error variation over temperature.



Use bypass capacitors on the supplies as well as on the  $R_{SET}$  and analog out ( $V_{TEMP}$ ) pins when in noisy environments, as shown in [图 7-7](#). These capacitors reduce premature triggering of the comparator.



**图 7-7. Bypass Capacitors Prevent Early Comparator Toggling Due to Circuit Board Noise**

## 8 Device and Documentation Support

### 8.1 接收文档更新通知

要接收文档更新通知，请导航至 [ti.com](http://ti.com) 上的器件产品文件夹。点击 [订阅更新](#) 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

### 8.2 支持资源

[TI E2E™ 支持论坛](#) 是工程师的重要参考资料，可直接从专家获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题可获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的《[使用条款](#)》。

### 8.3 Trademarks

TI E2E™ is a trademark of Texas Instruments.

所有商标均为其各自所有者的财产。

### 8.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 8.5 术语表

[TI 术语表](#) 本术语表列出并解释了术语、首字母缩略词和定义。

## 9 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

**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)
TMP300AIDBVR	NRND	Production	SOT-23 (DBV)   6	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	T300
TMP300AIDBVR.A	NRND	Production	SOT-23 (DBV)   6	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	T300
TMP300AIDCKR	NRND	Production	SC70 (DCK)   6	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	BPN
TMP300AIDCKR.A	NRND	Production	SC70 (DCK)   6	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	BPN
<a href="#">TMP300BIDBVR</a>	Active	Production	SOT-23 (DBV)   6	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	DUDC
TMP300BIDBVR.A	Active	Production	SOT-23 (DBV)   6	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	DUDC
<a href="#">TMP300BIDBVT</a>	Obsolete	Production	SOT-23 (DBV)   6	-	-	Call TI	Call TI	-40 to 125	DUDC
<a href="#">TMP300BIDCKR</a>	Active	Production	SC70 (DCK)   6	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	QWL
TMP300BIDCKR.A	Active	Production	SC70 (DCK)   6	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	QWL
<a href="#">TMP300BIDCKT</a>	Obsolete	Production	SC70 (DCK)   6	-	-	Call TI	Call TI	-40 to 125	QWL

(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.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative

and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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.

**OTHER QUALIFIED VERSIONS OF TMP300 :**

- Automotive : [TMP300-Q1](#)

NOTE: Qualified Version Definitions:

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

**TAPE AND REEL INFORMATION**

**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
TMP300AIDBVR	SOT-23	DBV	6	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TMP300AIDCKR	SC70	DCK	6	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TMP300BIDBVR	SOT-23	DBV	6	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TMP300BIDCKR	SC70	DCK	6	3000	179.0	8.4	2.2	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)
TMP300AIDBVR	SOT-23	DBV	6	3000	200.0	183.0	25.0
TMP300AIDCKR	SC70	DCK	6	3000	200.0	183.0	25.0
TMP300BIDBVR	SOT-23	DBV	6	3000	200.0	183.0	25.0
TMP300BIDCKR	SC70	DCK	6	3000	200.0	183.0	25.0



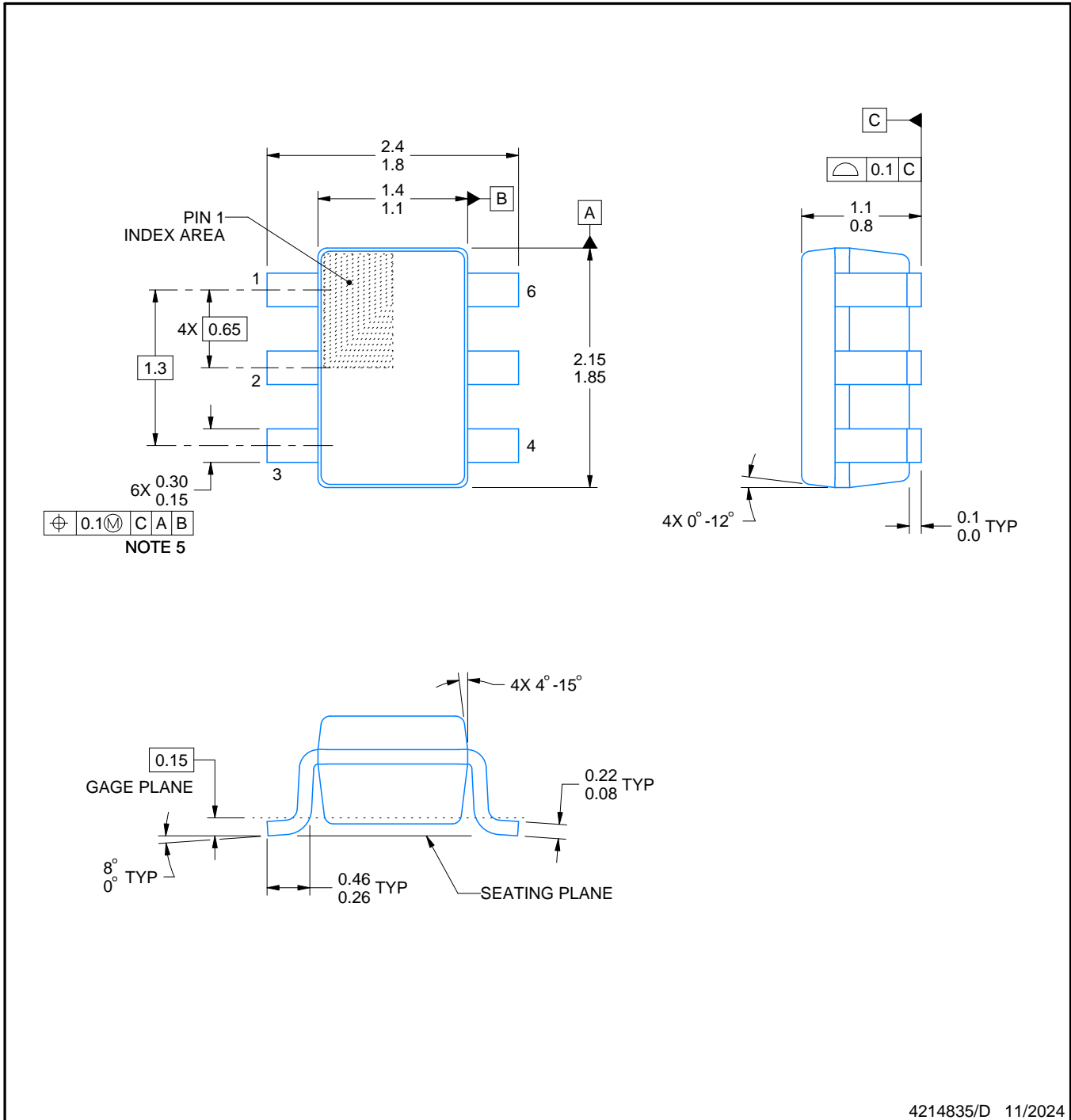
# DCK0006A



## PACKAGE OUTLINE

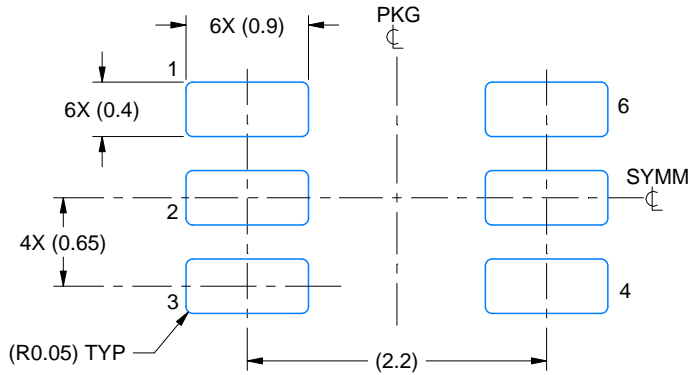
### SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR

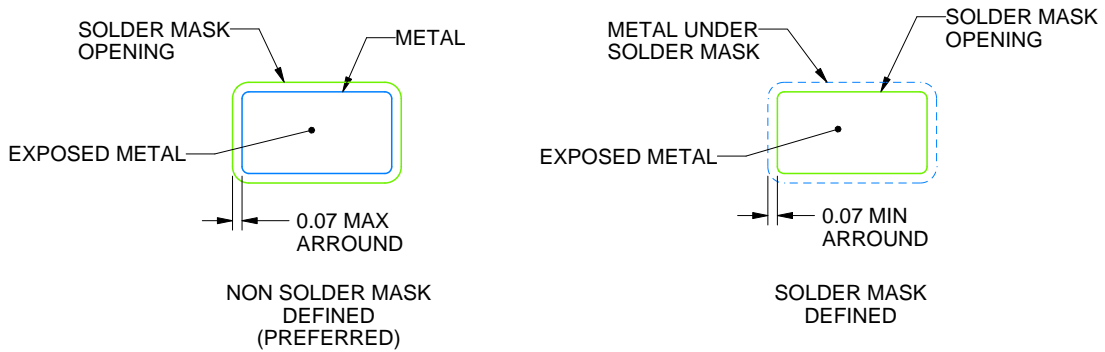


#### NOTES:

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. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
4. Falls within JEDEC MO-203 variation AB.



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:18X



SOLDER MASK DETAILS

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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:18X

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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.

# DBV0006A



# PACKAGE OUTLINE

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



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## 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. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.25 per side.
4. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
5. Reference JEDEC MO-178.

# EXAMPLE BOARD LAYOUT

DBV0006A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



SOLDER MASK DETAILS

4214840/G 08/2024

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.

# EXAMPLE STENCIL DESIGN

DBV0006A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



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

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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.

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