

## SM74611 智能旁路二极管

### 1 特性

- 最低反向电压 ( $V_R$ ): 30V
- 正向工作电流 ( $I_F$ ): 高达 15A
- 低平均正向电压: 8A 时为 26mV
- 功耗比肖特基二极管低
- 泄漏电流比肖特基二极管低
- 与传统的 D2PAK 肖特基二极管封装和引脚兼容
- 工作温度范围 ( $T_J$ ): -40°C 至 125°C

### 2 应用

- 用于光伏板的旁路二极管
- 用于微型逆变器和电源优化器的旁路二极管

### 3 说明

SM74611 是一款面向光伏应用的智能旁路二极管。该二极管可为正常工作期间被遮蔽的部分光伏板提供另外一条线串电流路径。如果没有旁路二极管，被遮蔽单元会因反向偏置单元功耗过大而呈现为过热点。

目前采用传统的 P-N 结二极管或肖特基二极管来缓解这一问题。遗憾的是，此类二极管的正向电压仍偏高（普通二极管约为 0.6V，而肖特基二极管为 0.4V）。当流过二极管的电流为 10A 时，功耗会高达 6W。这会导致二极管所在接线盒的内部温度升高并降低模块可靠性。

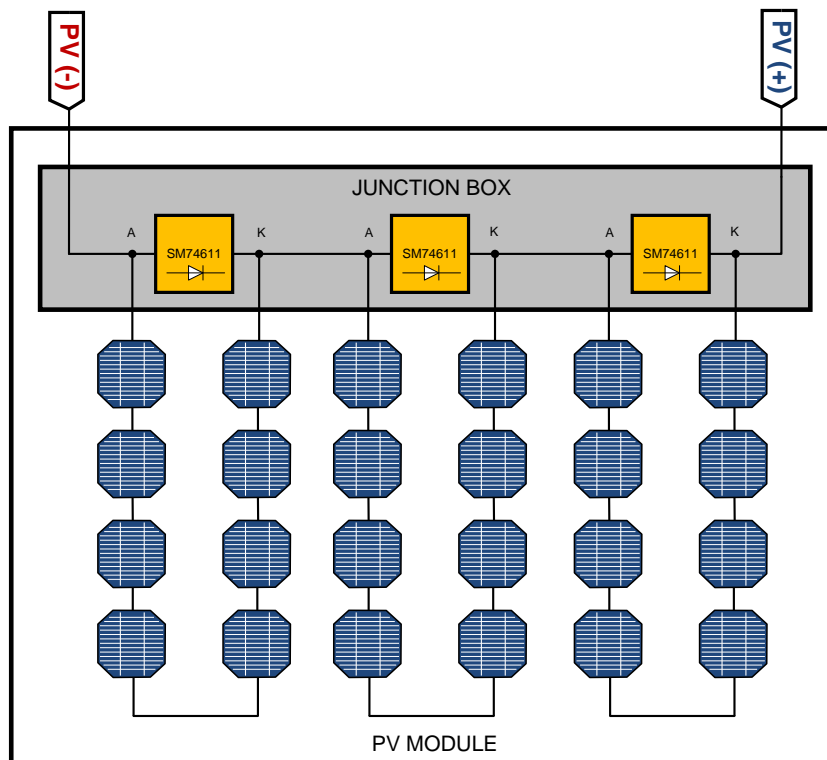
SM74611 的优势在于，正向压降比 P-N 结二极管和肖特基二极管低。该二极管在 8A 电流下的平均正向压降典型值为 26mV。此时的功耗典型值为 208mW，明显低于传统肖特基二极管的功耗典型值 3.2W。此外，SM74611 还与传统的 D2PAK 肖特基二极管封装和引脚兼容，可以直接替换许多应用中的二极管。

#### 器件信息<sup>(1)</sup>

器件型号	封装	封装尺寸 (标称值)
SM74611	DDPAK/TO-263 (KTT) (3)	10.16mm x 9.02mm

(1) 如需了解所有可用封装，请见数据表末尾的可订购产品附录。

#### 在接线盒中的典型应用



## 目录

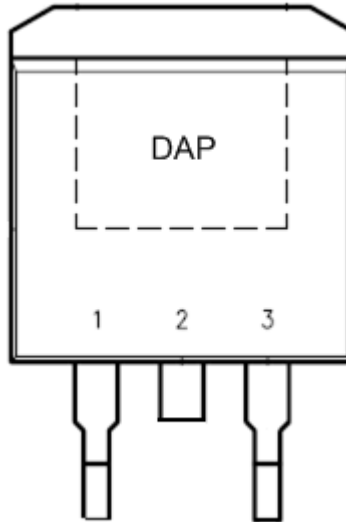
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## 4 修订历史记录

Changes from Original (December 2012) to Revision A	Page
• Added new junction temperature for $t \leq 1$ hour ..... 4	4
• Added Thermal Table ..... 4	4
• Changed typical characteristic curves ..... 5	5

## 5 Pin Configuration and Functions

DDPAK  
3 Pin (KTT)  
Top View



Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
ANODE	1,3 <sup>(1)</sup>	I	Connect both of these pins to the negative side of the PV cells
CATHODE	2,DAP <sup>(2)</sup>	O	Pin 2 and the DAP are shorted internally. Connect the DAP to the positive side of the PV cells

- (1) Pin 1 and Pin 3 should be connected together for proper operation  
(2) Package drawing at the end of datasheet is shown without Pin 2 being trimmed

## 6 Specifications

### 6.1 Absolute Maximum Ratings

 over operating free-air temperature range (unless otherwise noted) <sup>(1)</sup> <sup>(2)</sup>

	MIN	MAX	UNIT
Ambient Storage temperature, $T_{stg}$	-65	125	°C
DC Reverse Voltage		30	V
Forward Current		24	A
Junction Temperature, $t \leq 1$ hour		135	°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) System must be thermally managed so as not to exceed maximum junction temperature

### 6.2 ESD Ratings

		VALUE	UNIT
$V_{(ESD)}$ Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>	±1000	V
	Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup>	±250	

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. Pins listed as ±XXX V may actually have higher performance.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process. Pins listed as ±YYY V may actually have higher performance.

### 6.3 Recommended Operating Conditions <sup>(1)</sup>

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

		MIN	NOM	MAX	UNIT
DC Reverse Voltage				28	V
Junction Temperature Range ( $T_J$ )		-40		125	°C
Forward Current		0		15	A

- (1) System must be thermally managed so as not to exceed maximum junction temperature

### 6.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		SM74611	UNIT
		DDPAK (KTT)	
		3 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	40.4	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	42.6	
$R_{\theta JB}$	Junction-to-board thermal resistance	23.0	
$\Psi_{JT}$	Junction-to-top characterization parameter	9.8	
$\Psi_{JB}$	Junction-to-board characterization parameter	22.0	
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	0.5	

- (1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](#).

### 6.5 Electrical Characteristics

	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
$I_{F(AVG)}$	Forward Current				8	15	A
$V_{F(AVG)}$	Forward Voltage	$I_F = 8A$	$T_J = 25^\circ C$		26		mV

Electrical Characteristics (continued)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
P <sub>D</sub>	I <sub>F</sub> = 8A	T <sub>J</sub> = 25°C	208		mW
		T <sub>J</sub> = 125°C	450		
		-40°C to 125°C (1)		575	
		I <sub>F</sub> = 15A	T <sub>J</sub> = 25°C	695	
D	I <sub>F</sub> = 8A	T <sub>J</sub> = 25°C	99.5%		
		T <sub>J</sub> = 125°C	96.0%		
I <sub>R</sub>	V <sub>REVERSE</sub> = 28V	T <sub>J</sub> = 25°C	0.3		μA
		T <sub>J</sub> = 125°C	3.3		

(1) Limits -40°C to 125°C apply over the entire junction temperature range for operation. Limits appearing in normal type apply for T<sub>A</sub> = T<sub>J</sub> = 25°C.

6.6 Typical Characteristics

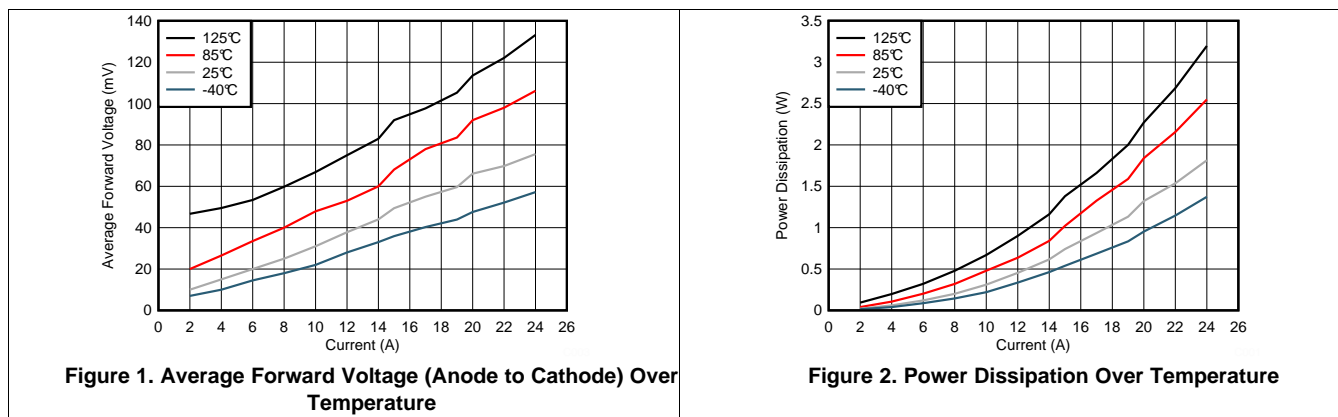


Figure 1. Average Forward Voltage (Anode to Cathode) Over Temperature

Figure 2. Power Dissipation Over Temperature

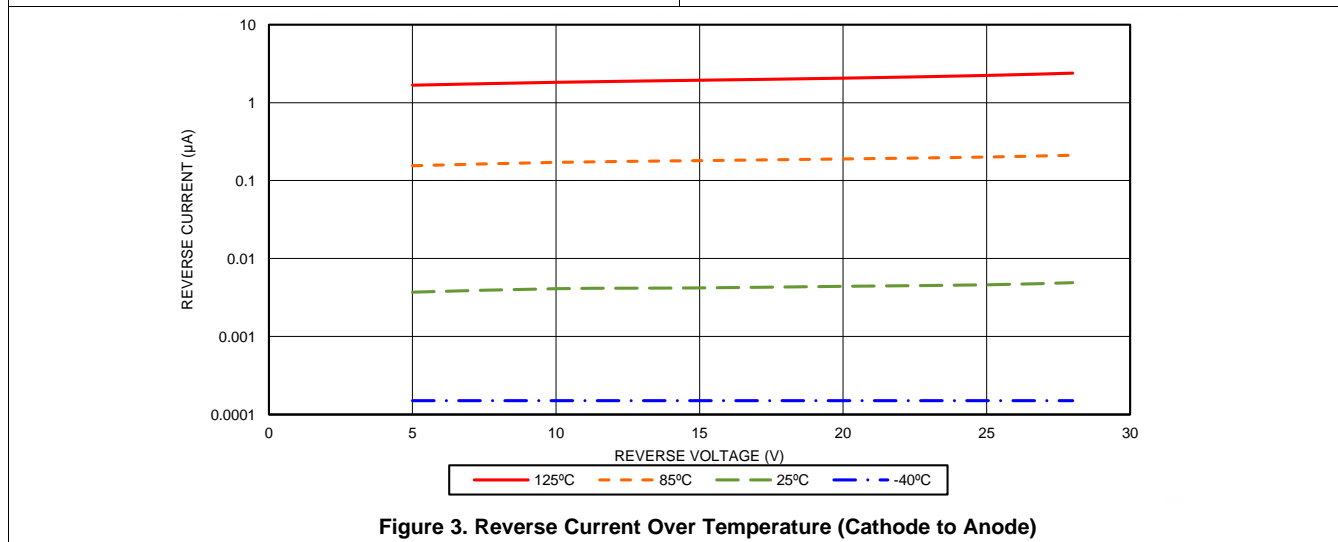


Figure 3. Reverse Current Over Temperature (Cathode to Anode)

## 7 Detailed Description

### 7.1 Overview

The SM74611 is designed for use as a bypass diode in photovoltaic modules. The SM74611 utilizes a charge pump to drive an N-channel FET to provide a resistive path for the bypass current to flow.

### 7.2 Functional Block Diagram

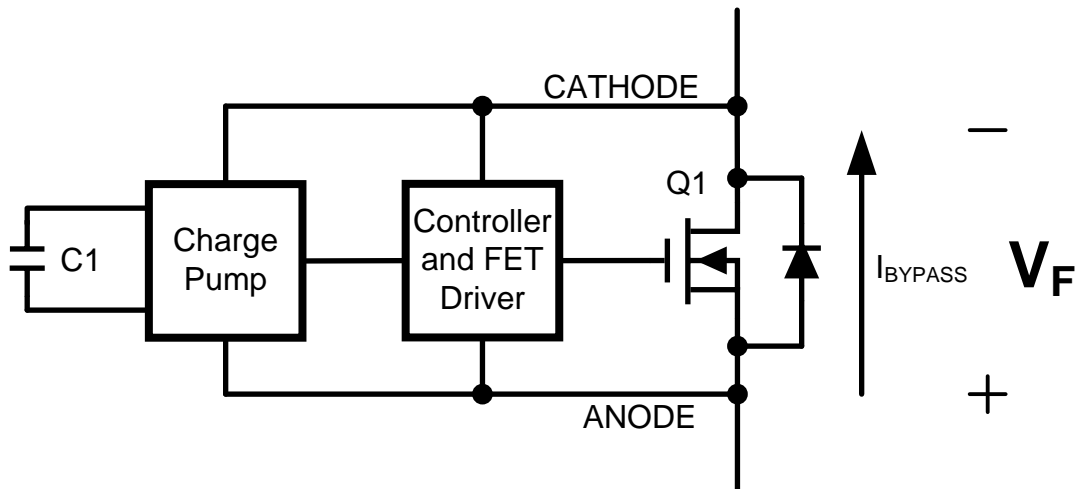


Figure 4. SM74611 Block Diagram

### 7.3 Feature Description

The operational description is described below. Please refer to [Figure 4](#) and [Figure 5](#).

#### From $t_0$ to $t_1$ :

When cells in the solar panels are shaded, the FET Q1 is off and the bypass current will flow through the body diode of the FET as shown on [Figure 4](#). This current will produce a voltage drop ( $V_F$ ) across ANODE and CATHODE terminal of the bypass diode. During this time, the charge pump circuitry is active and charging capacitor C1 to a higher voltage.

#### At $t_1$ :

Once the voltage on the capacitor reaches its predetermined voltage level, the charge pump is disabled and the capacitor voltage is used to drive the FET through the FET driver stage.

#### From $t_1$ to $t_2$ :

When the FET is active, it provides a low resistive path for the bypass current to flow thus minimizing the power dissipation across ANODE and CATHODE. Since the FET is active, the voltage across the ANODE and CATHODE is too low to operate the charge pump. During this time, the stored charge on C1 is used to supply the controller as well as drive the FET.

#### At $t_2$ :

When the voltage on the capacitor C1 reaches its predetermined lower level, the FET driver shuts off the FET. The bypass current will then begin to flow through the body diode of the FET, causing the FET body diode voltage drop of approximately 0.6V to appear across ANODE and CATHODE. The charge pump circuitry is re-activated and begins charging the capacitor C1. This cycle repeats until the shade on the panel is removed and the string current begins to flow through the PV cells instead of the body diode of the FET.

The key factor to minimizing the power dissipation on the device is to keep the FET on at a high duty cycle. The average forward voltage drop will then be reduced to a much lower voltage than for a Schottky or regular P-N junction diode.

Feature Description (continued)

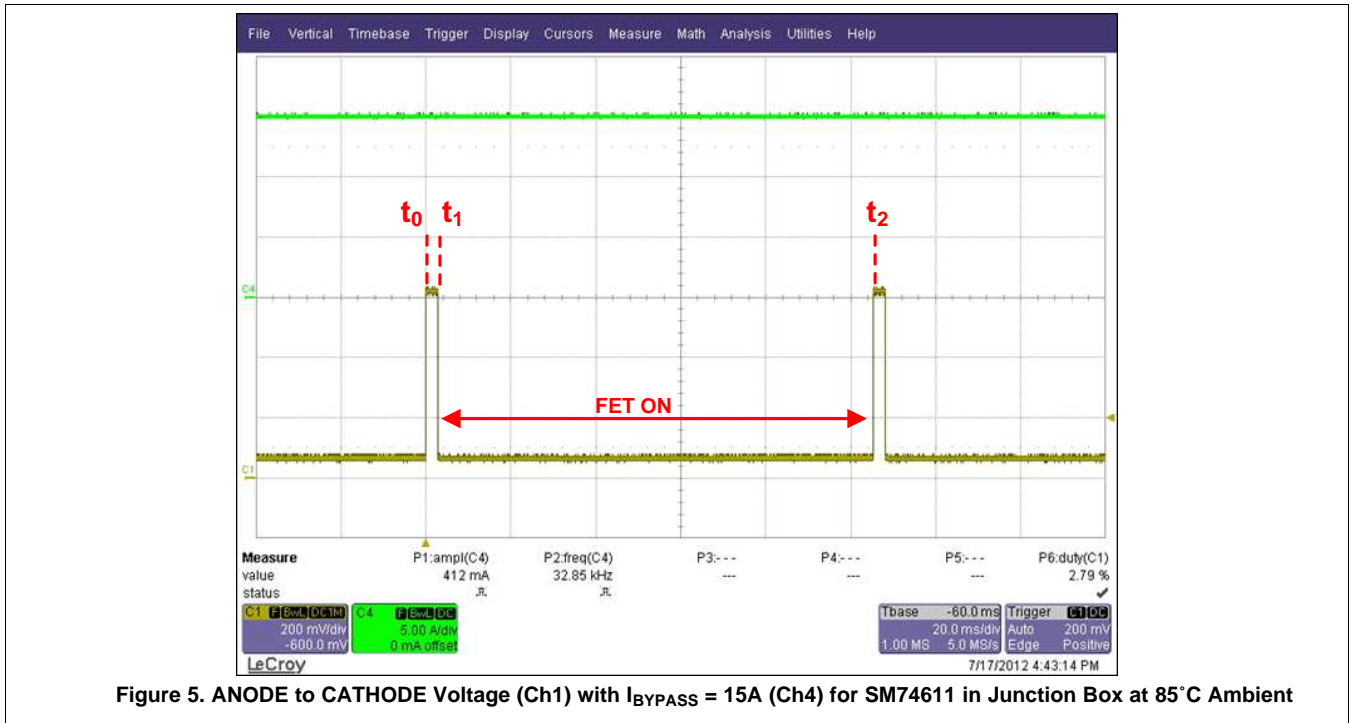


Figure 5. ANODE to CATHODE Voltage (Ch1) with  $I_{BYPASS} = 15A$  (Ch4) for SM74611 in Junction Box at 85°C Ambient

## 8 器件和文档支持

### 8.1 商标

All trademarks are the property of their respective owners.

### 8.2 静电放电警告



这些装置包含有限的内置 ESD 保护。存储或装卸时，应将导线一起截短或将装置放置于导电泡棉中，以防止 MOS 门极遭受静电损伤。

### 8.3 术语表

[SLYZ022](#) — TI 术语表。

这份术语表列出并解释术语、首字母缩略词和定义。

## 9 机械封装和可订购信息

以下页中包括机械封装和可订购信息。 这些信息是针对指定器件可提供的最新数据。 这些数据会在无通知且不对本文档进行修订的情况下发生改变。 欲获得该数据表的浏览器版本，请查阅左侧的导航栏。



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放大器和线性器件	<a href="http://www.ti.com.cn/amplifiers">www.ti.com.cn/amplifiers</a>	计算机及周边	<a href="http://www.ti.com.cn/computer">www.ti.com.cn/computer</a>
数据转换器	<a href="http://www.ti.com.cn/dataconverters">www.ti.com.cn/dataconverters</a>	消费电子	<a href="http://www.ti.com.cn/consumer-apps">www.ti.com.cn/consumer-apps</a>
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**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SM74611KTTR	ACTIVE	DDPAK/ TO-263	KTT	3	500	RoHS-Exempt & Green	SN	Level-3-245C-168 HR	-40 to 125	SM74611KTT	<b>Samples</b>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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

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

(6) Lead finish/Ball material - Orderable Devices 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.

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## 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
SM74611KTTR	DDPAK/ TO-263	KTT	3	500	330.0	24.4	10.6	15.8	4.9	16.0	24.0	Q2

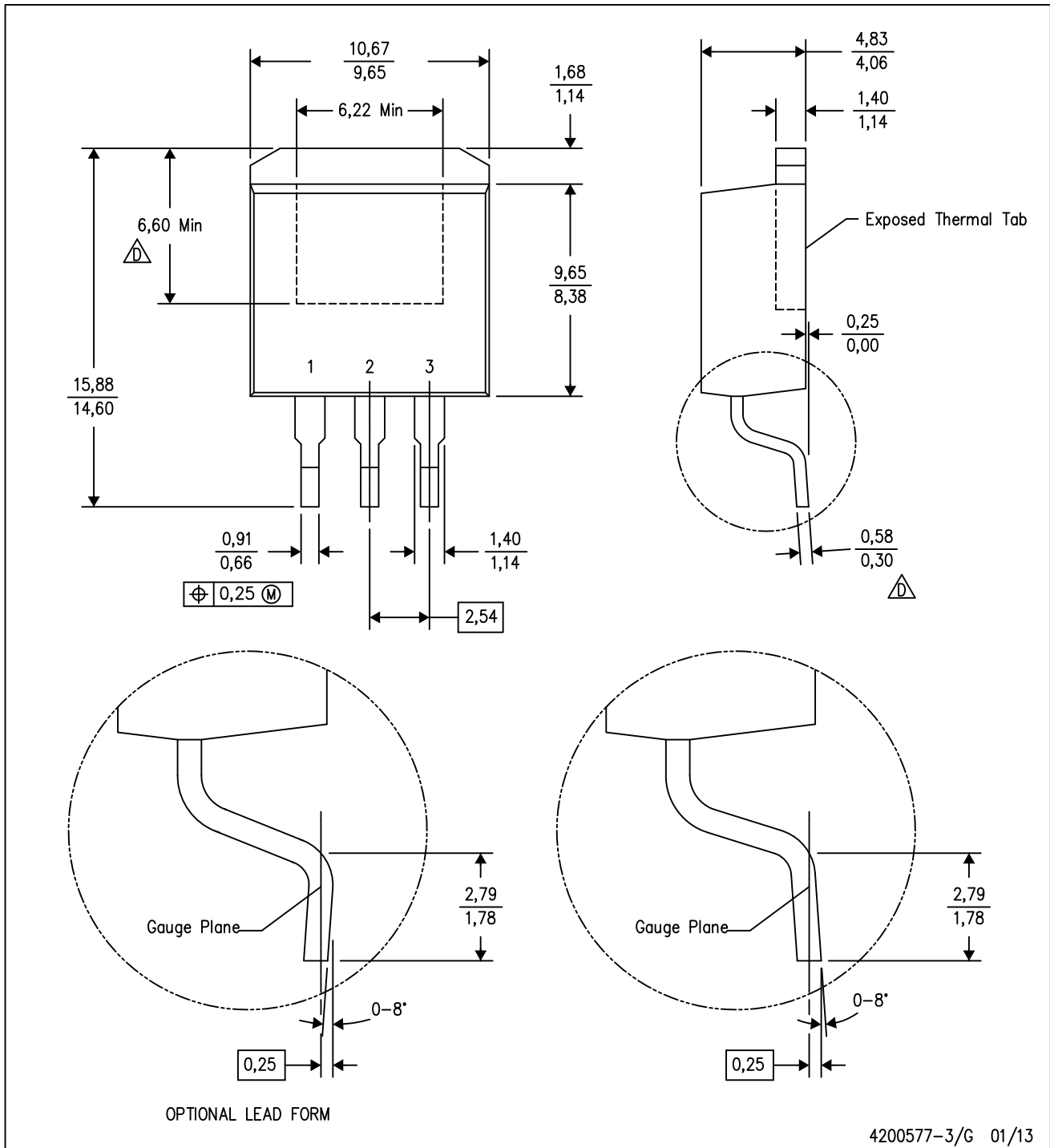
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SM74611KTTR	DDPAK/TO-263	KTT	3	500	340.0	340.0	38.0

KTT (R-PSFM-G3)

PLASTIC FLANGE-MOUNT PACKAGE



4200577-3/G 01/13

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion. Mold flash or protrusion not to exceed 0.005 (0,13) per side.
- Falls within JEDEC TO-263 variation AA, except minimum lead thickness and minimum exposed pad length.

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邮寄地址：上海市浦东新区世纪大道 1568 号中建大厦 32 楼，邮政编码：200122

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