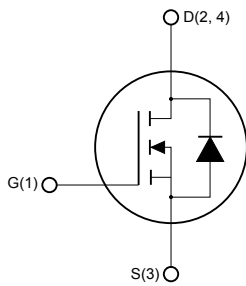


# Automotive-grade N-channel 60 V, 0.07 $\Omega$ typ., 4 A STripFET II Power MOSFET in a SOT-223 package




SOT-223



Int\_schem\_nTnZ\_SOT\_223

## Features

Order code	$V_{DS}$	$R_{DS(on)}$ max.	$I_D$
STN4NF06L	60 V	< 0.1 $\Omega$	4 A

- AEC-Q101 qualified 
- Exceptional dv/dt capability
- 100% avalanche tested
- Low gate charge

## Applications

- Switching applications

## Description

This Power MOSFET has been developed using STMicroelectronics' unique STripFET process, which is specifically designed to minimize input capacitance and gate charge. This renders the device suitable for use as primary switch in advanced high-efficiency isolated DC-DC converters for telecom and computer applications, and applications with low gate charge driving requirements.



### Product status link

[STN4NF06L](#)

### Product summary

<b>Order code</b>	STN4NF06L
<b>Marking</b>	4NF06L
<b>Package</b>	SOT-223
<b>Packing</b>	Tape and reel

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0\text{ V}$ )	60	V
$V_{GS}$	Gate-source voltage	$\pm 16$	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	4	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	2.9	A
$I_{DM}^{(2)}$	Drain current (pulsed)	16	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	3.3	W
	Derating Factor	0.026	W/ $^\circ\text{C}$
$dv/dt^{(3)}$	Peak diode recovery avalanche energy	10	V/ns
$E_{AS}^{(4)}$	Single pulse avalanche energy	200	mJ
$T_{stg}$	Storage temperature range	-55 to 150	$^\circ\text{C}$
$T_J$	Operating junction temperature range		

1. Current limited by the package.
2. Pulse width limited by safe operating area.
3.  $I_{SD} \leq 3\text{ A}$ ,  $di/dt \leq 150\text{ A}/\mu\text{s}$ ,  $V_{DD} = V_{(BR)DSS}$ ,  $T_J \leq T_J\text{ max}$ .
4. Starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $I_D = 4\text{ A}$ ,  $V_{DD} = 30\text{ V}$ .

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	38	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(2)}$		100	$^\circ\text{C}/\text{W}$
$T_J^{(3)}$	Maximum lead temperature for soldering purpose	260	$^\circ\text{C}$

1. When Mounted on FR-4 board with 1 inch<sup>2</sup> pad, 2 oz. of Cu. and  $t < 10\text{ s}$ .
2. When mounted on minimum recommended footprint.
3. For 10 s 1.6 mm from case.

## 2 Electrical characteristics

$T_C = 25\text{ °C}$  unless otherwise specified

**Table 3. On-/off-states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$	60			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 60\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 60\text{ V}$ , $T_C = 125\text{ °C}$			10	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 16\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	1		2.8	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 1.5\text{ A}$		0.07	0.10	$\Omega$
		$V_{GS} = 5\text{ V}$ , $I_D = 1.5\text{ A}$		0.085	0.12	

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	340		pF
$C_{oss}$	Output capacitance		-	63		pF
$C_{riss}$	Reverse transfer capacitance		-	30		pF
$Q_g$	Total gate charge	$V_{DD} = 48\text{ V}$ , $I_D = 3\text{ A}$	-	7	9	nC
$Q_{gs}$	Gate-source charge	$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 5\text{ V}$	-	1.5		nC
$Q_{gd}$	Gate-drain charge	(see Figure 14. Test circuit for gate charge behavior)	-	2.8		nC

**Table 5. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 30\text{ V}$ , $I_D = 1.5\text{ A}$ ,	-	9	-	ns
$t_r$	Rise time	$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 5\text{ V}$	-	25	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	20	-	ns
$t_f$	Fall time		-	10	-	ns

**Table 6. Source-drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		4	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		16	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 4\text{ A}$ , $V_{GS} = 0\text{ V}$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 4\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,	-	50		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 25\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$	-	88		nC
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	3.5		A

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

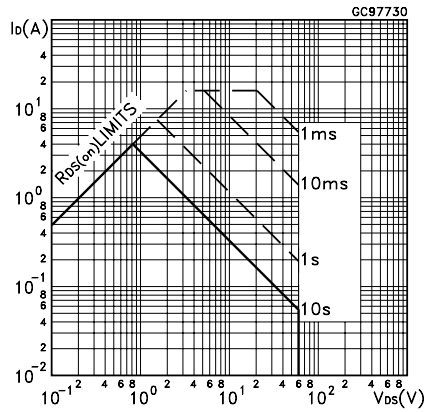


Figure 2. Thermal impedance

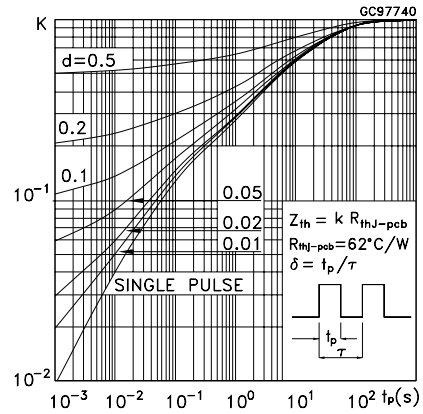


Figure 3. Output characteristics

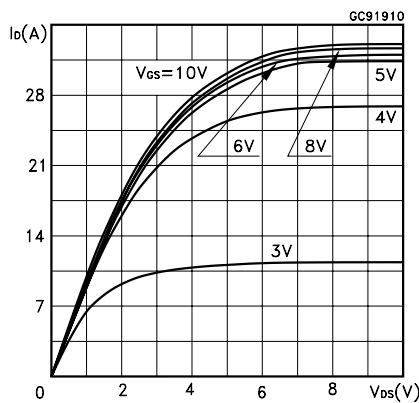


Figure 4. Transfer characteristics

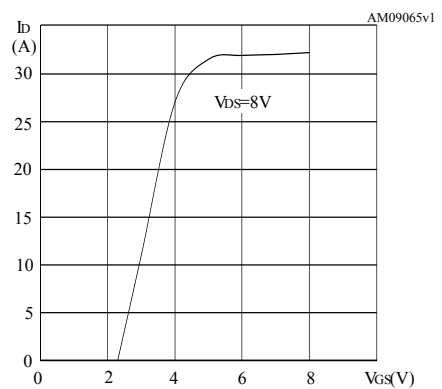


Figure 5. Static drain-source on resistance

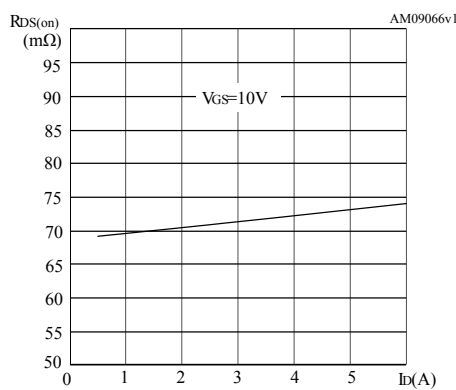
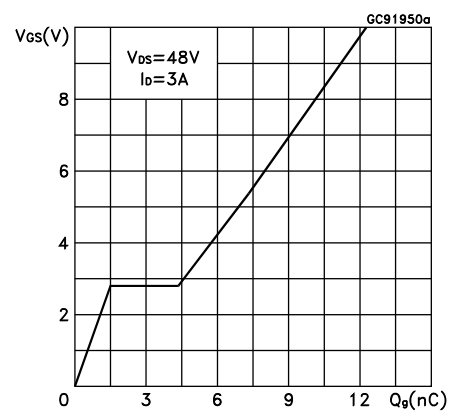
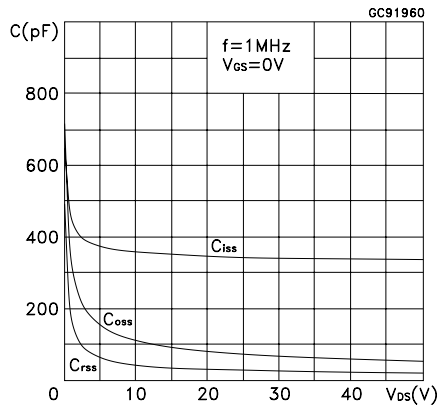


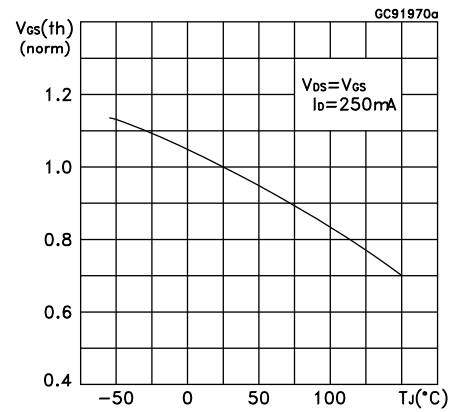
Figure 6. Gate charge vs. gate-source voltage



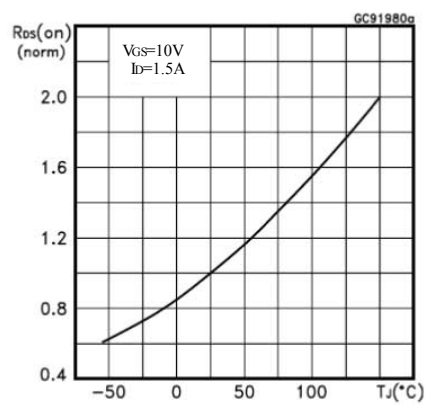
**Figure 7. Capacitance variations**



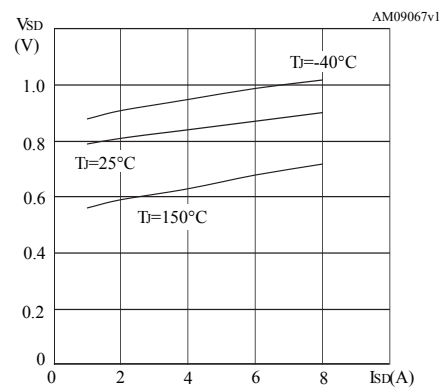
**Figure 8. Normalized gate threshold voltage vs temperature**



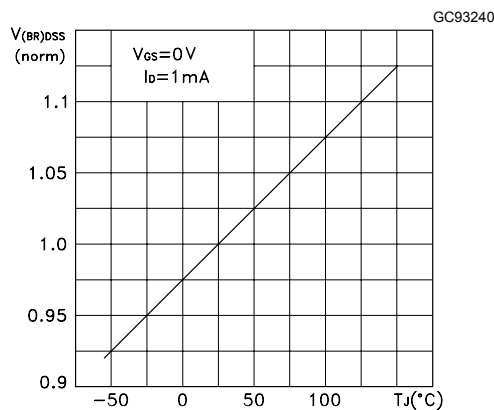
**Figure 9. Normalized on-resistance vs temperature**



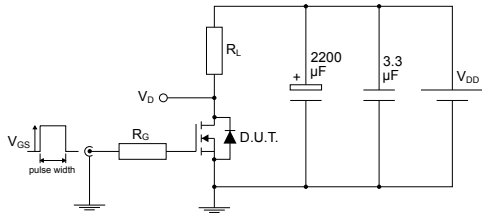
**Figure 10. Source-drain diode forward characteristics**



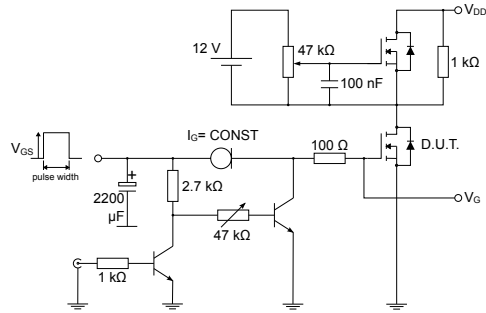
**Figure 11. Normalized breakdown voltage vs temperature**



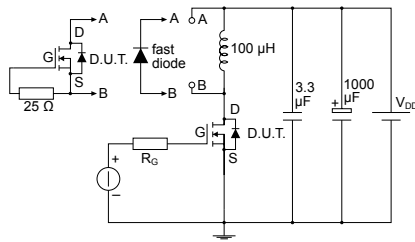
### 3 Test circuits

**Figure 12. Test circuit for resistive load switching times**


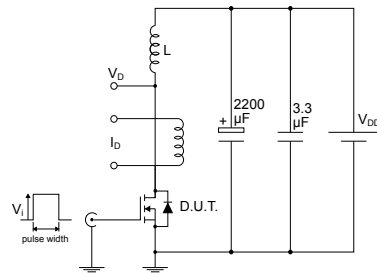
AM01468v1

**Figure 13. Test circuit for gate charge behavior**


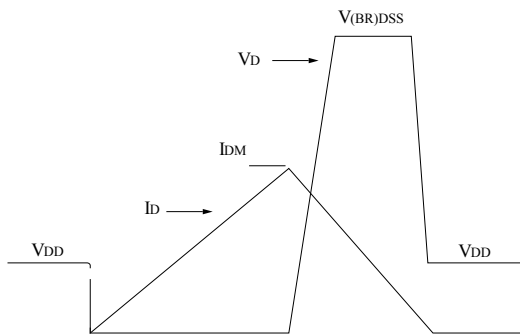
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**Figure 14. Test circuit for inductive load switching and diode recovery times**


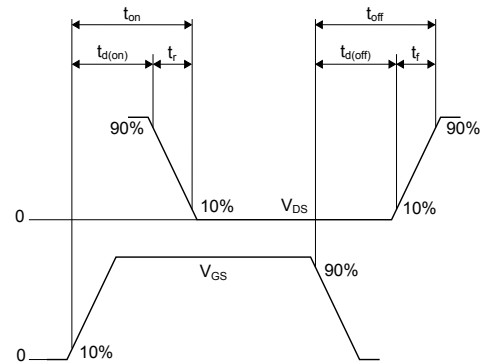
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**Figure 15. Unclamped inductive load test circuit**


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**Figure 16. Unclamped inductive waveform**


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**Figure 17. Switching time waveform**


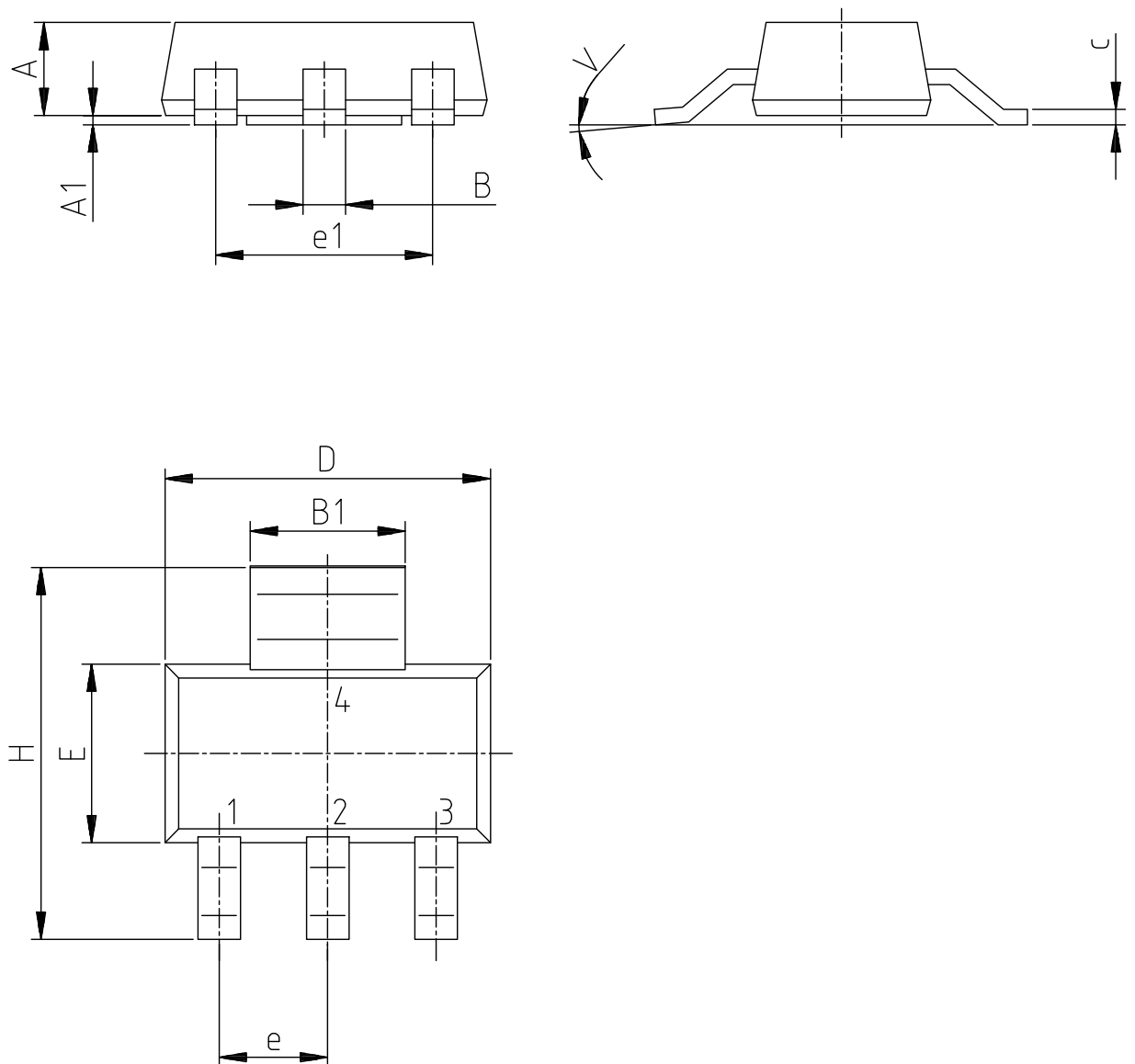
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## 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 SOT-223 package information

Figure 18. SOT-223 package outline



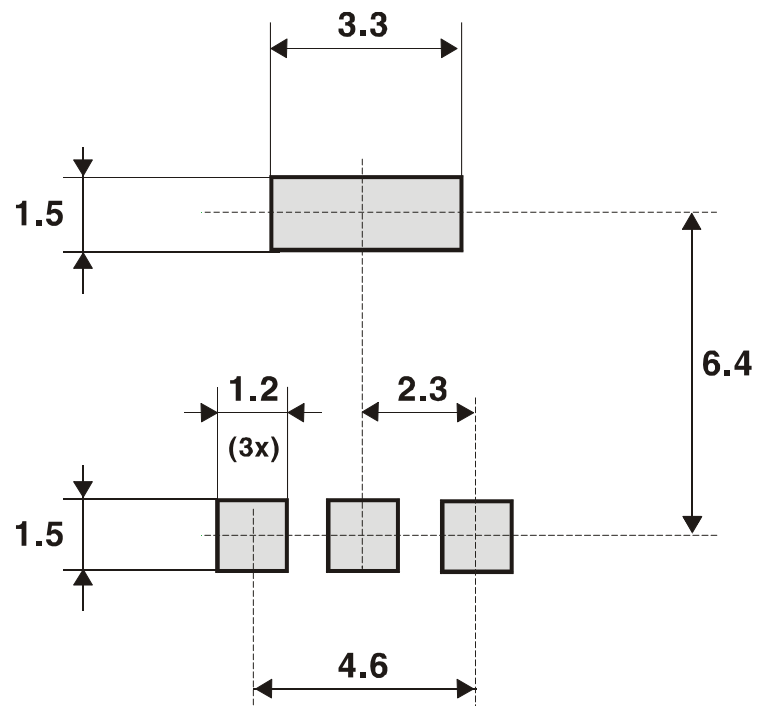
0046067\_15



Table 7. SOT-223 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			1.8
B	0.6	0.7	0.85
B1	2.9	3	3.15
c	0.24	0.26	0.35
D	6.3	6.5	6.7
e		2.3	
e1		4.6	
E	3.3	3.5	3.7
H	6.7	7	7.3
V			10 deg
A1	0.02		0.1

Figure 19. SOT-223 recommended footprint (dimensions are in mm)



0046067



**Table 8. SOT-223 tape and reel mechanical data**

Tape				Tape		
Dim.	mm			Dim.	mm	
	Min.	Typ.	Max.		Min.	Max.
A0	6.75	6.85	6.95	A		180
B0	7.30	7.40	7.50	N	60	
K0	1.80	1.90	2.00	W1		12.4
F	5.40	5.50	5.60	W2		18.4
E	1.65	1.75	1.85	W3	11.9	15.4
W	11.7	12.0	12.3			
P2	1.90	2.00	2.10	Base quantity pcs		1000
P0	3.90	4.00	4.10	Bulk quantity pcs		1000
P1	7.90	8.00	8.10			
T	0.25	0.30	0.35			
DΦ	1.50	1.55	1.60			
D1Φ	1.50	1.60	1.70			

## Revision history

**Table 9. Document revision history**

Date	Version	Changes
22-Apr-2008	1	Initial version.
29-Apr-2011	2	<i>Figure 5, Figure 7, Figure 11 and Figure 12</i> have been updated.
05-May-2020	3	Updated <a href="#">Section 4.1 SOT-223 package information</a> . Minor text changes.

## Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>2</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>3</b>
<b>2.1</b>	<b>Electrical characteristics (curves)</b> .....	<b>5</b>
<b>3</b>	<b>Test circuits</b> .....	<b>7</b>
<b>4</b>	<b>Package information</b> .....	<b>8</b>
<b>4.1</b>	<b>SOT-223 package information</b> .....	<b>8</b>
<b>4.2</b>	<b>SOT-223 packing information</b> .....	<b>10</b>
	<b>Revision history</b> .....	<b>12</b>

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