



## STN1N20

N-channel 200 V, 1.2  $\Omega$ , 1 A, SOT-223  
MESH OVERLAY™ Power MOSFET

### Features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STN1N20	200 V	< 1.5 $\Omega$	1 A

- 100% avalanche tested

### Application

- Switching applications

### Description

This device is an N-channel Power MOSFET developed using the latest high voltage MESH OVERLAY™ process. The new patented STrip layout coupled with the company's proprietary edge termination structure, makes it suitable in converters for lighting applications.

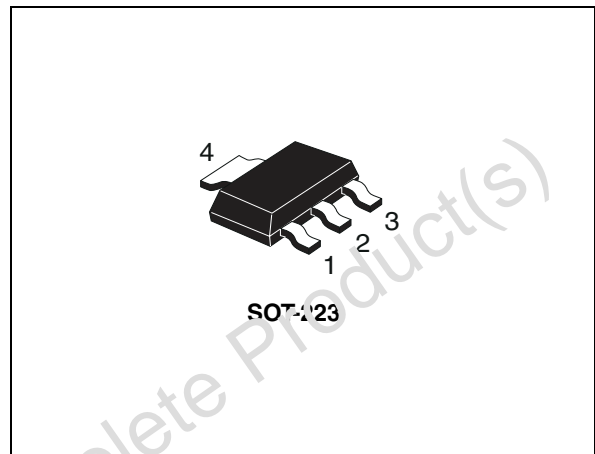


Figure 1. Internal schematic diagram

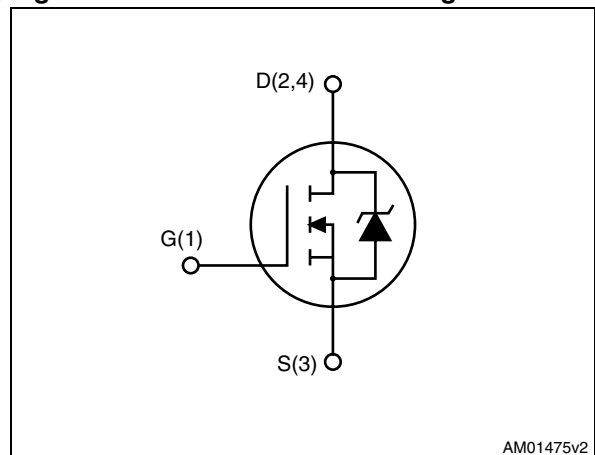


Table 1. Device summary

Order code	Marking	Package	Packaging
STN1N20	N1N20	SOT-223	Tape and reel

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS}=0$ )	200	V
$V_{GS}$	Gate-source voltage	$\pm 20$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	1	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	0.6	A
$I_{DM}^{(1)}$	Drain current (pulsed)	4	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	2.9	W
	Derating factor	0.023	W/ $^\circ\text{C}$
dv/dt	Peak diode recovery voltage slope	3	V/ns
$T_j$ $T_{stg}$	Operating junction temperature Storage temperature	-55 to 150	$^\circ\text{C}$

1. Pulse width limited by safe operating area

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-pcb}$	Thermal resistance junction-pcb max	43	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	60	$^\circ\text{C}/\text{W}$
$T_l$	Maximum lead temperature for soldering purpose	260	$^\circ\text{C}$

**Table 4. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Max current during repetitive or single pulse avalanche (pulse width limited by $T_{JMAX}$ )	1	A
$E_{AS}$	Single pulse avalanche energy <sup>(1)</sup>	10	mJ

1. Starting  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50\text{ V}$

## 2 Electrical characteristics

(T<sub>case</sub> = 25 °C unless otherwise specified)

**Table 5. On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source breakdown voltage (V <sub>GS</sub> = 0)	I <sub>D</sub> = 250 μA	200			V
I <sub>DSS</sub>	Zero gate voltage drain current (V <sub>GS</sub> = 0)	V <sub>DS</sub> = Max rating V <sub>DS</sub> = Max rating, T <sub>C</sub> =125 °C			1 10 J	μA μA
I <sub>GSS</sub>	Gate-body leakage current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ± 20 V			±100	nA
V <sub>GS(th)</sub>	Gate threshold voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	2	3	4	V
R <sub>DS(on)</sub>	Static drain-source on resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 0.5 A		1.2	1.5	Ω

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g <sub>fs</sub> (1)	Forward transconductance	V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)max</sub> , I <sub>D</sub> = 0.5 A	-	2.7		S
C <sub>iss</sub> C <sub>oss</sub> C <sub>rss</sub>	Input capacitance Output capacitance Reverse transfer capacitance	V <sub>DS</sub> = 25 V, f = 1 MHz, V <sub>GS</sub> = 0	-	206 40 15		pF pF pF
Q <sub>g</sub> C <sub>gs</sub> Q <sub>gd</sub>	Total gate charge Gate-source charge Gate-drain charge	V <sub>DD</sub> = 160 V, I <sub>D</sub> = 4 A, V <sub>GS</sub> = 10 V (see <a href="#">Figure 14</a> )	-	11 2.8 4	15.7	nC nC nC

1. Pulsed: pulse duration = 300 μs, duty cycle 1.5%

**Table 7. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>DD</sub> = 160 V, I <sub>D</sub> = 4 A, R <sub>G</sub> = 4.7 Ω, V <sub>GS</sub> = 10 V (see <a href="#">Figure 13</a> )		9		ns	
t <sub>r</sub>	Rise time			10		ns	
t <sub>d(off)</sub>	Turn-off delay time				25	-	ns
t <sub>f</sub>	Fall time				6		ns

**Table 8. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		1	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		4	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 1 \text{ A}, V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 4 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$	-	124		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 30 \text{ V}, T_j = 150 \text{ }^\circ\text{C}$	-	446		nC
$I_{RRM}$	Reverse recovery current	(see <a href="#">Figure 18</a> )	-	7.2		A

1. Pulse width limited by safe operating area.

2. Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

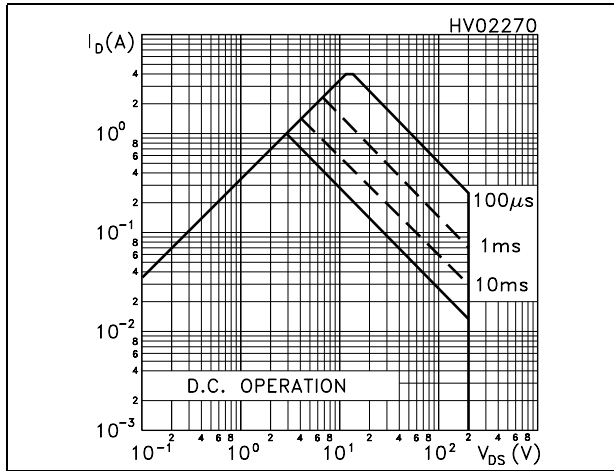


Figure 3. Thermal impedance

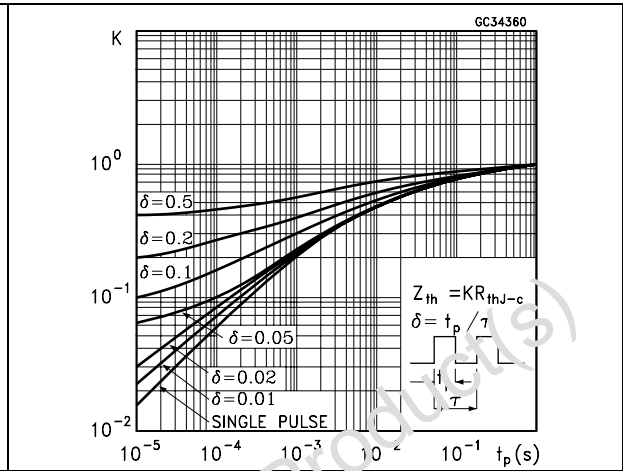


Figure 4. Output characteristics

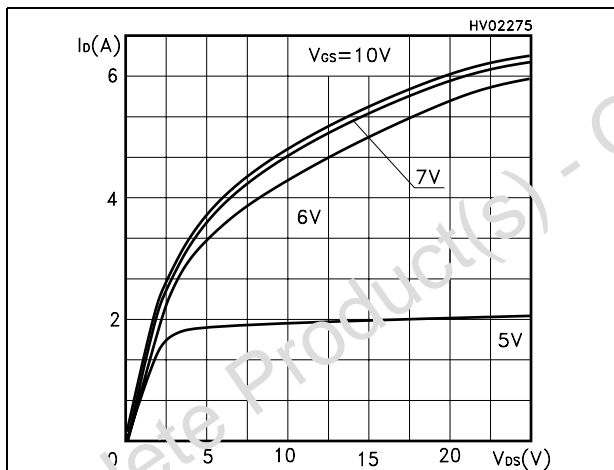


Figure 5. Transfer characteristics

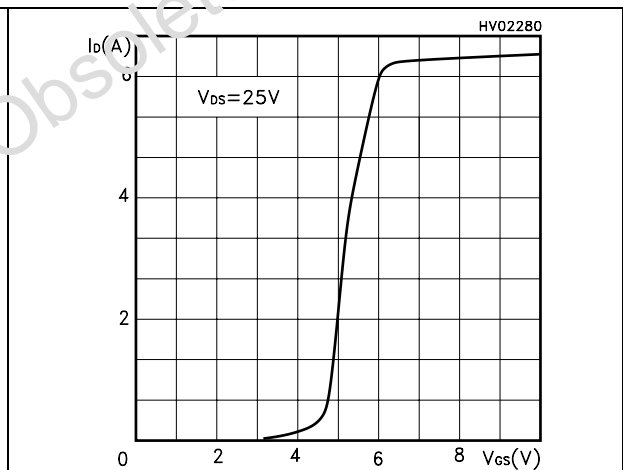


Figure 6. Transconductance

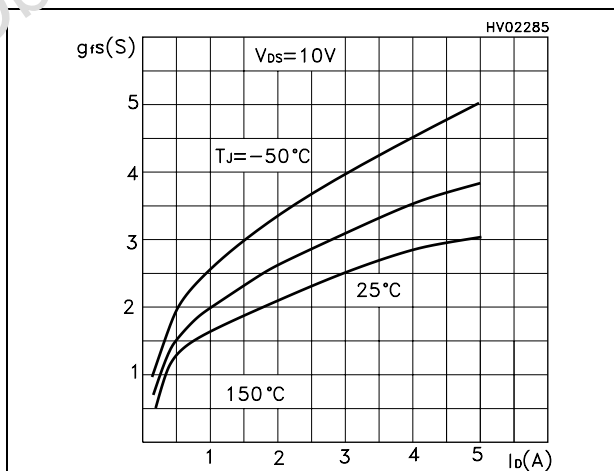


Figure 7. Static drain-source on resistance

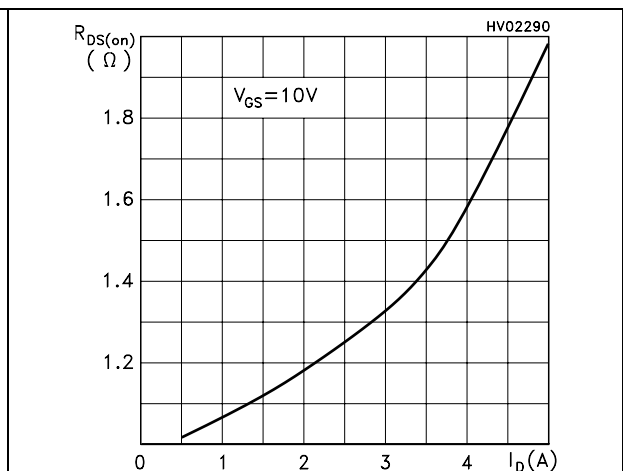


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

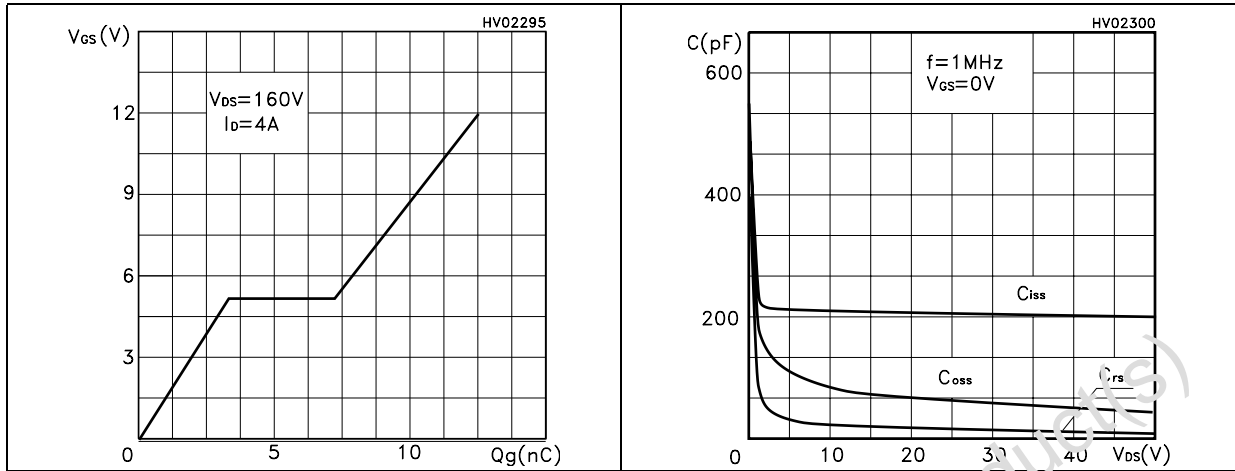


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

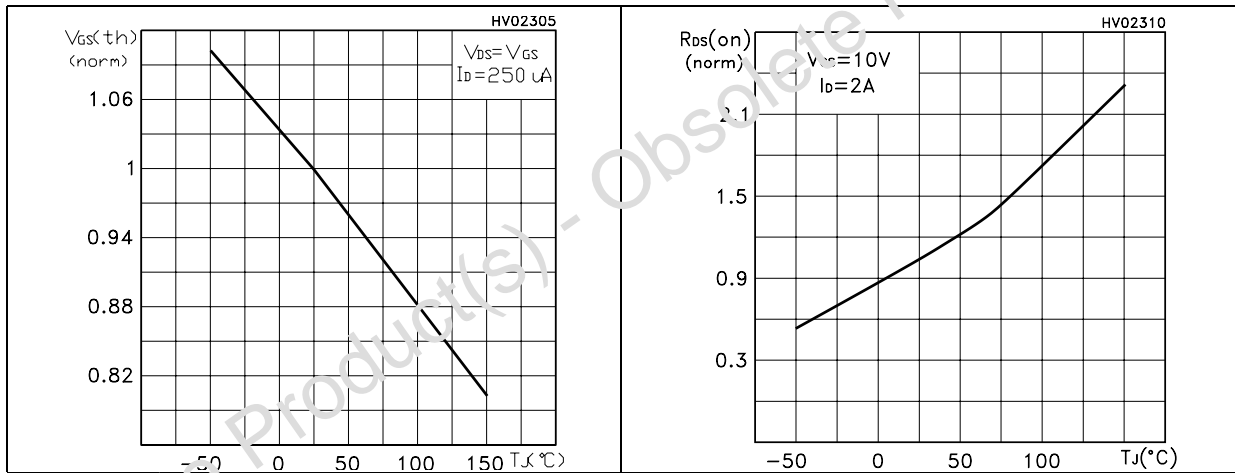
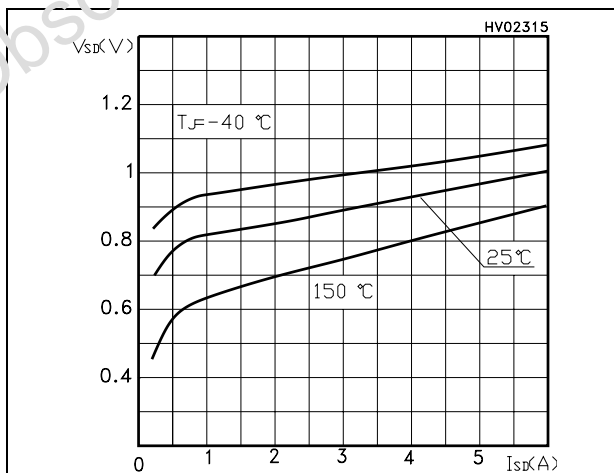
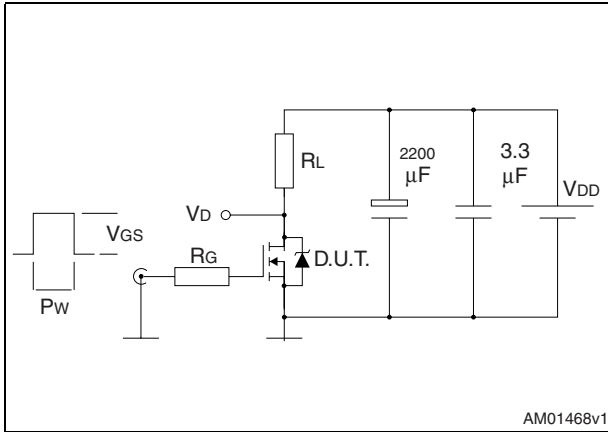


Figure 12. Source-drain diode forward characteristics

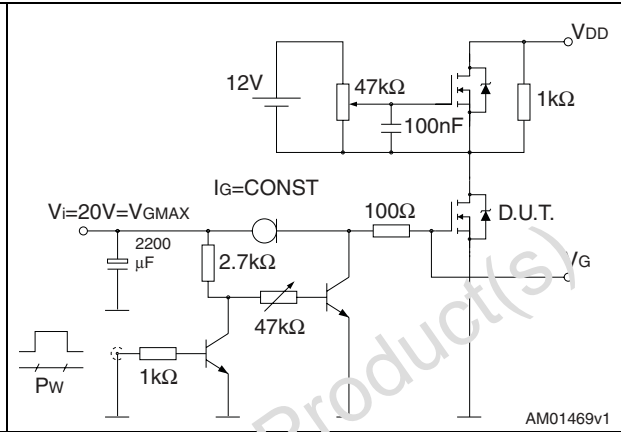


### 3 Test circuits

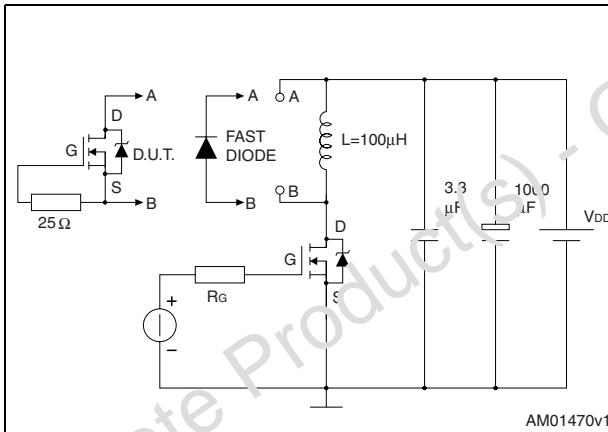
**Figure 13. Switching times test circuit for resistive load**



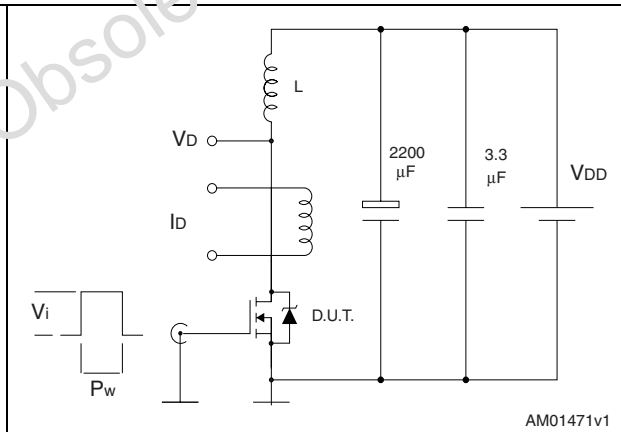
**Figure 14. Gate charge test circuit**



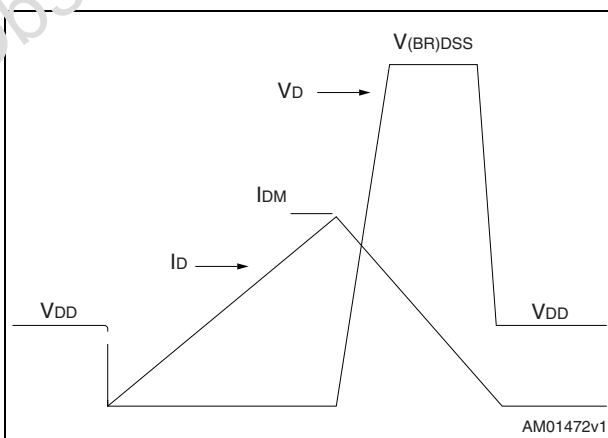
**Figure 15. Test circuit for inductive load switching and diode recovery times**



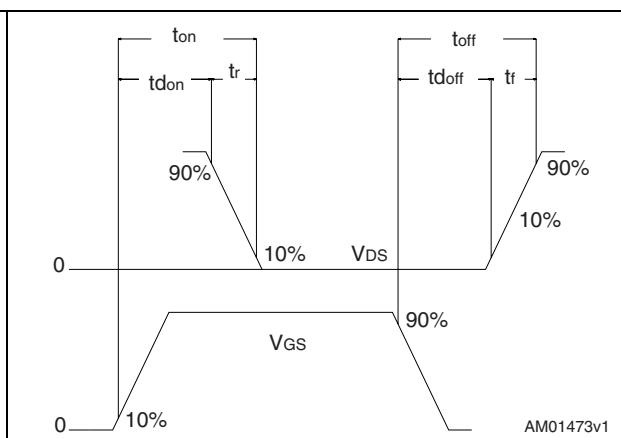
**Figure 16. Unclamped inductive load test circuit**



**Figure 17. Unclamped inductive waveform**



**Figure 18. Switching time waveform**





## 4 Package mechanical data

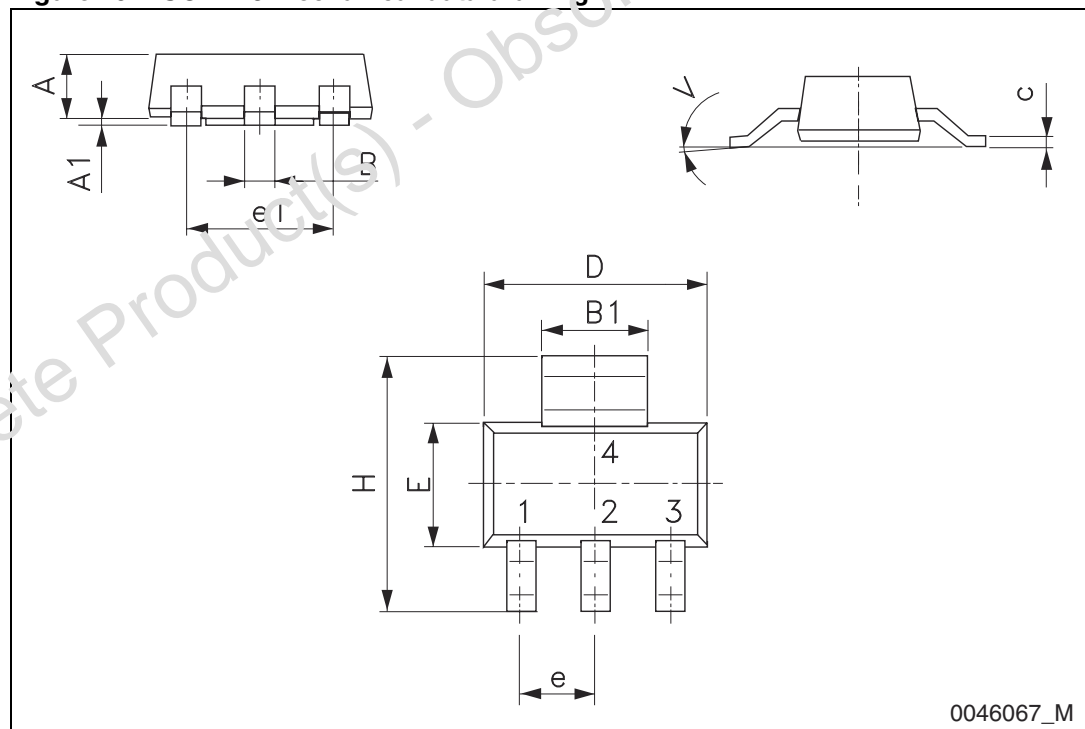
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Table 9. SOT-223 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			1.80
A1	0.02		0.1
B	0.60	0.70	0.85
B1	2.90	3.00	3.15
c	0.24	0.26	0.35
D	6.30	6.50	6.70
e		2.30	
e1		4.60	
E	3.30	3.50	3.70
H	6.70	7.00	7.30
V			10°

Figure 19. SOT-223 mechanical data drawing



0046067\_M

## 5 Revision history

Table 10. Document revision history

Date	Revision	Changes
21-Jun-2004	1	First release.
31-Mar-2009	2	Document status promoted from preliminary data to datasheet.
27-Jun-2011	3	Updated gate threshold voltage values on <a href="#">Table 5</a> and the package mechanical data <a href="#">Section 4</a> .

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