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STN3N40K3

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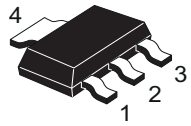
STN3N40K3

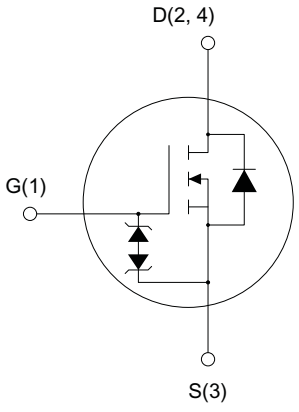
N-channel 400 V, 3 Ω typ., 1.8 A SuperMESH3™ Power MOSFET in a SOT-223 package

Datasheet - production data



SOT-223

Figure 1. Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)}$ max	I_D	P_{TOT}
STN3N40K3	400V	3.4 Ω	1.8 A	3.3W

- 100% avalanche tested
- Extremely high dv/dt capability
- Gate charge minimized
- Very low intrinsic capacitance
- Improved diode reverse recovery characteristics
- Zener-protected

Application

- Switching applications

Description

This SuperMESH3™ Power MOSFET is the result of improvements applied to STMicroelectronics' SuperMESH™ technology, combined with a new optimized vertical structure. This device boasts an extremely low on-resistance, superior dynamic performance and high avalanche capability, rendering it suitable for the most demanding applications.

Table 1. Device summary

Order code	Marking	Package	Packaging
STN3N40K3	3N40K3	SOT-223	Tape and reel

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain source voltage	400	V
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current continuous T_C = 25 °C	1.8 (1)	A
I_D	Drain current continuous T_C = 100 °C	1 (1)	A
I_{DM} (2)	Drain current pulsed	7.2	A
I_{AR} (3)	Avalanche current, repetitive or not repetitive	0.6	A
E_{AS} (4)	Single pulse avalanche energy	45	mJ
P_{TOT}	Total dissipation at T_{amb} = 25 °C	3.3	W
dv/dt (5)	Peak diode recovery voltage slope	12	V/ns
E_{SD}	Gate-source human body model (R = 1.5 kΩ, C = 100 pF)	1	kV
T_j T_{stg}	Operating junction temperature Storage temperature	-55 to 150	°C

1. Drain current limited by maximum junction temperature.
2. Pulse width limited by safe operating area.
3. Pulse width limited by $T_{Jmax.}$
4. Starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V.
5. Isd ≤ 1.8 A, di/dt ≤ 400 A/µs, V_{DD} ≤ 80% $V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}amb}$ (1)	Thermal resistance junction-amb max.	37.9	°C/W

1. When mounted on FR-4 board of 1 inch^2, 2oz Cu, t < 30 s

2 Electrical characteristics

(Tcase = 25 °C unless otherwise specified)

Table 4. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	I_D = 1 mA, V_{GS} = 0	400			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0, V_{DS} = 400 V			1	µA
		V_{GS} = 0, V_{DS} = 400 V, T_C = 125 °C			50	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0, V_{GS} = ± 20 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{GS} = V_{DS}, I_D = 50 µA	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 0.6 A		3.1	3.4	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0	-	165	-	pF
C_{oss}	Output capacitance		-	17	-	pF
C_{rss}	Reverse transfer capacitance		-	3	-	pF
$C_{oss(er)}$(1)	Equivalent output capacitance energy related	V_{DS}= 0 to 320 V, V_{GS}= 0	-	9	-	pF
$C_{oss(tr)}$(2)	Equivalent output capacitance time related		-	14	-	pF
R_g	Instrinsic gate resistance	f=1 MHz open drain	-	10	-	Ω
Q_g	Total gate charge	V_{DD} = 320 V, I_D = 1.8 A, V_{GS} = 10 V (see *Figure 18*)	-	11	-	nC
Q_{gs}	Gate-source charge		-	2	-	nC
Q_{gd}	Gate-drain charge		-	7	-	nC

1. Is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}
2. Is defined as a constant equivalent capacitance giving the same storage energy as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(on)}$	Turn on delay time	V_{DD} = 200 V, I_D = 0.6, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 17*)	-	7	-	ns
t_r	Rise time		-	8	-	ns
$t_{d(off)}$	Turn off delay time		-	18	-	ns
t_f	Fall time		-	14	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		1.8	A
I_{SDM} (1)	Source-drain current (pulsed)		-		7.2	A
V_{SD} (2)	Forward on voltage	I_{SD} = 0.6 A, V_{GS} = 0	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 1.8 A, di/dt = 100 A/µs V_{DD} = 60 V (see *Figure 20*)	-	145		ns
Q_r	Reverse recovery charge		-	490		nC
I_{RRM}	Reverse recovery current		-	7		A
t_{rr}	Reverse recovery time	I_{SD} = 1.8 A, di/dt = 100 A/µs V_{DD} = 60 V, T_j = 150 °C (see *Figure 20*)	-	166		ns
Q_{rr}	Reverse recovery charge		-	580		nC
I_{RRM}	Reverse recovery current		-	7		A

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300 µs, duty cycle 1.5%

2.1 Electrical characteristics

Figure 2. Safe operating area

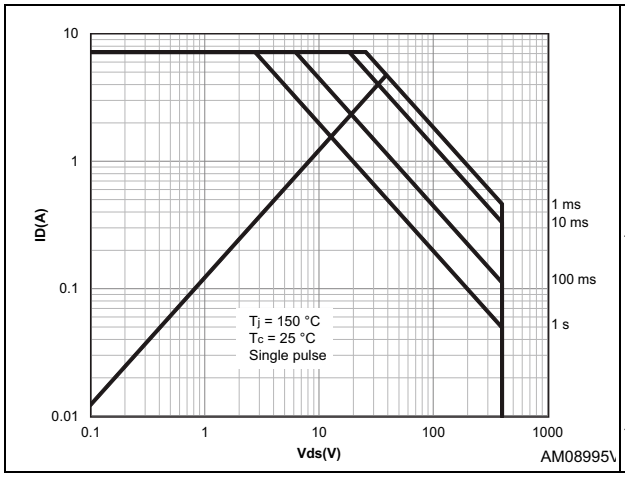


Figure 3. Thermal impedance

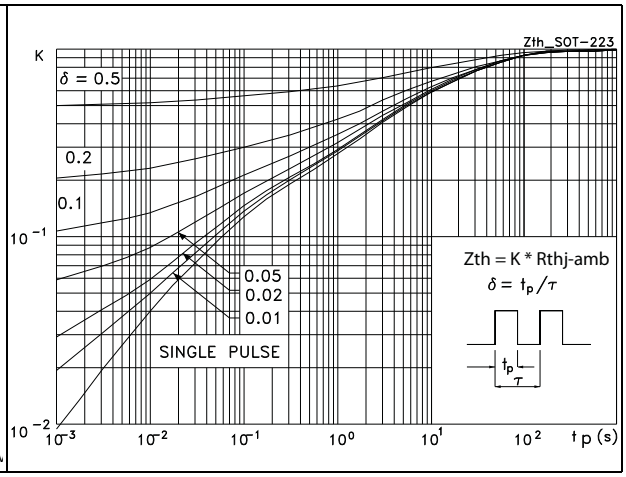


Figure 4. Output characteristics

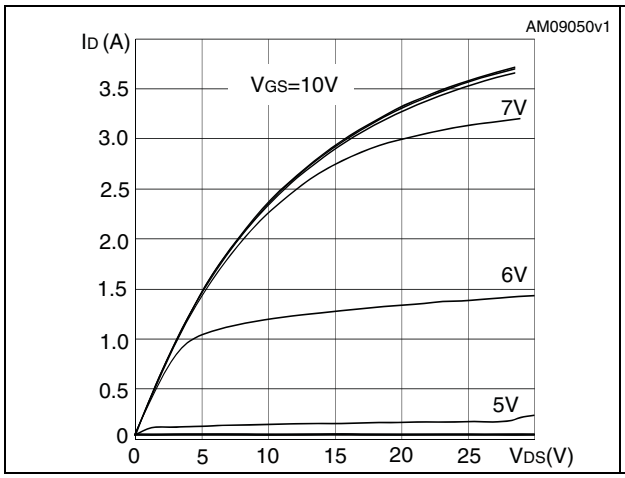


Figure 5. Transfer characteristics

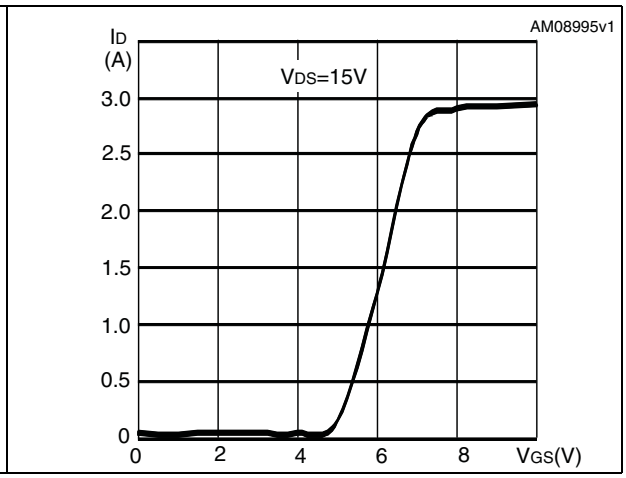


Figure 6. Gate charge vs gate-source voltage

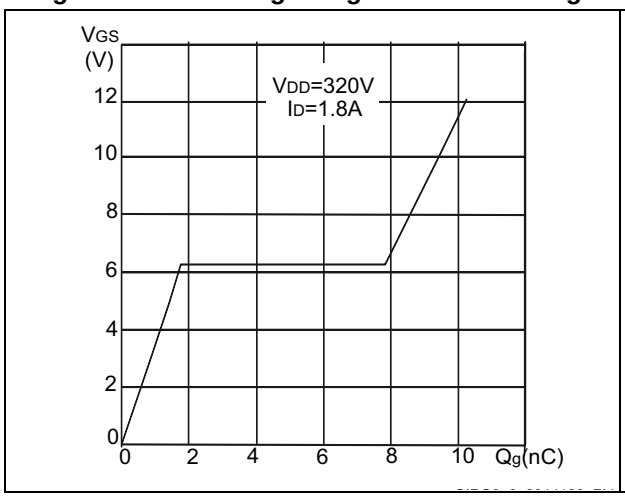


Figure 7. Static drain-source on resistance

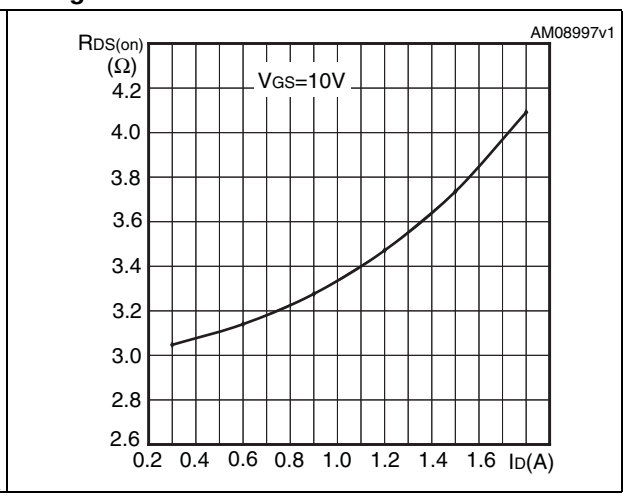


Figure 8. Capacitance variations

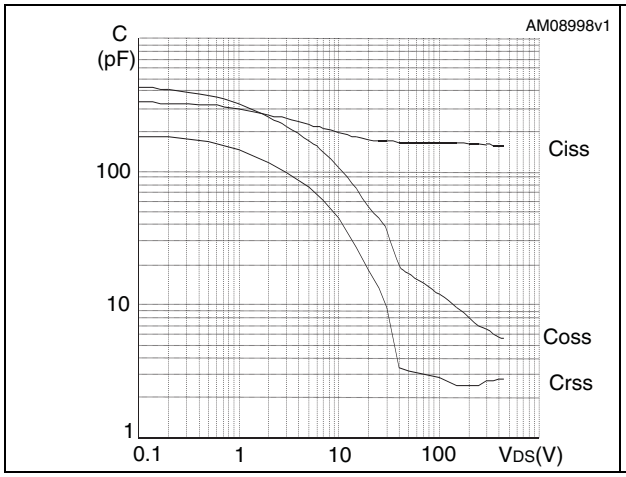


Figure 9. Output capacitance stored energy

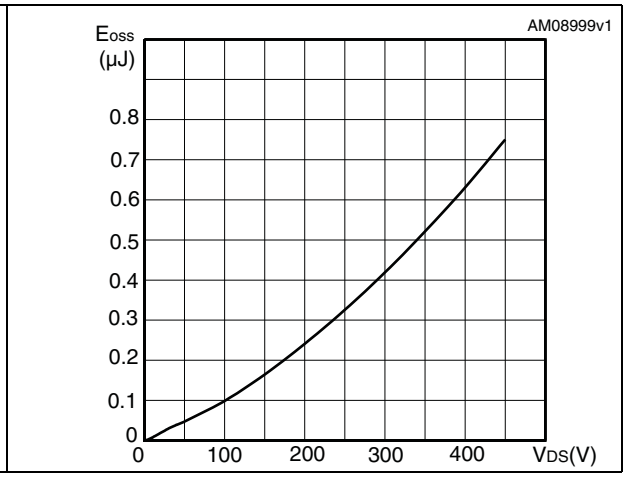


Figure 10. Normalized gate threshold voltage vs. temperature

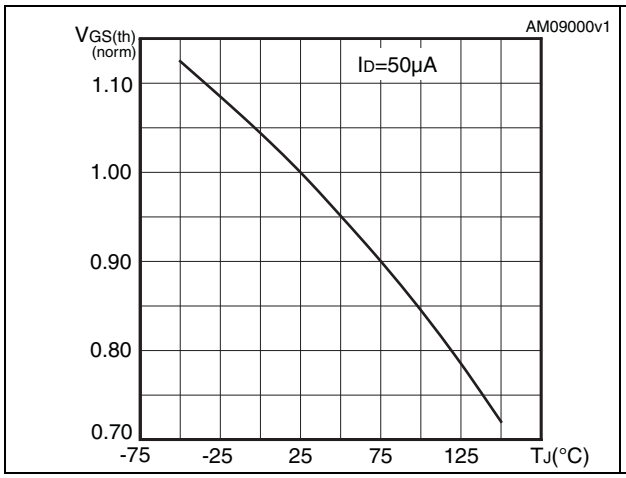


Figure 11. Normalized on resistance vs. temperature

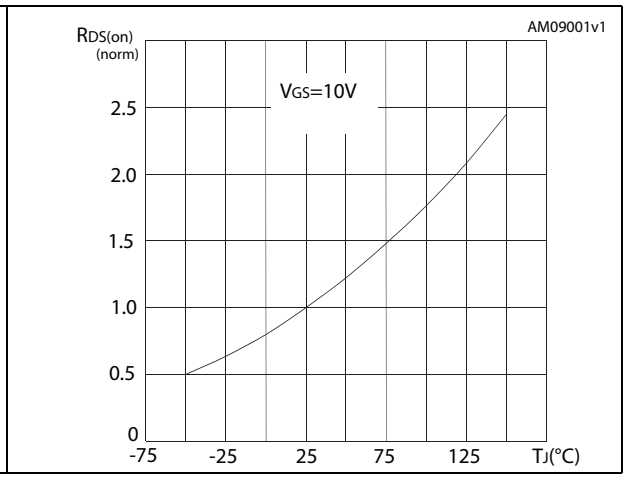


Figure 12. Source-drain diode forward characteristics

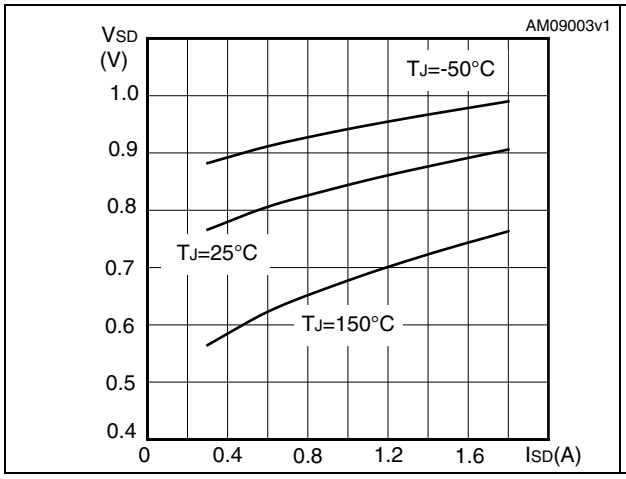


Figure 13. Normalized $V_{(BR)DSS}$ vs. temperature

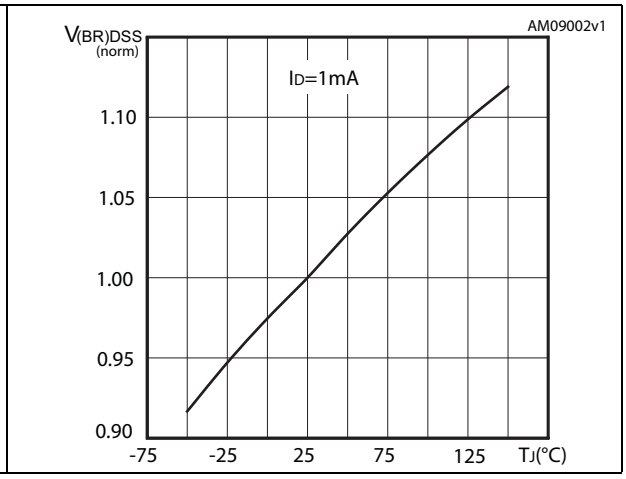
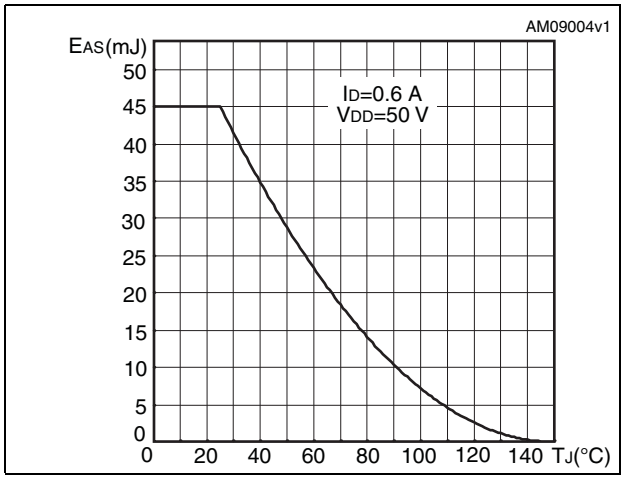


Figure 14. Maximum avalanche energy vs. starting Tj



3 Test circuits

Figure 15. Switching times test circuit for resistive load

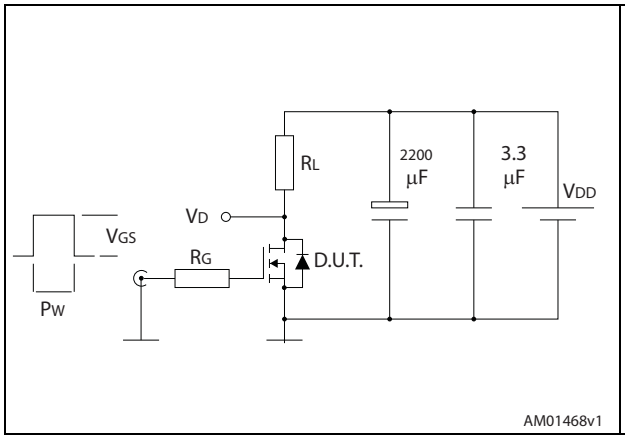


Figure 16. Gate charge test circuit

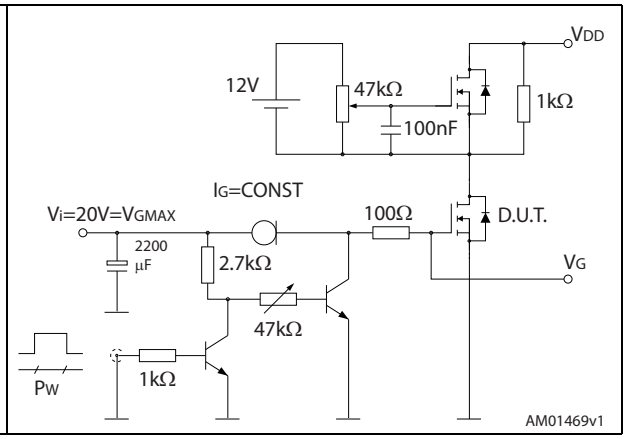


Figure 17. Switching times test circuit for resistive load

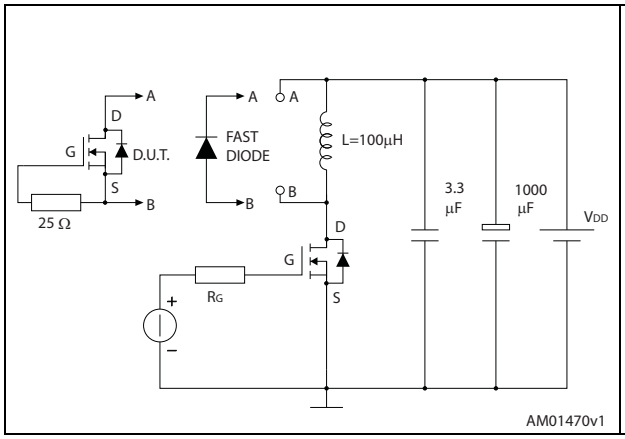


Figure 18. Gate charge test circuit

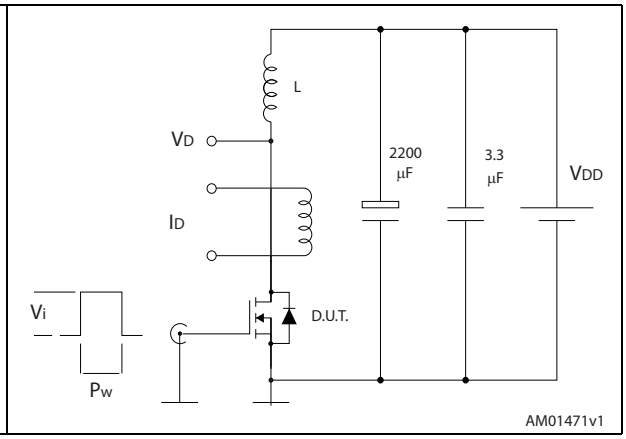


Figure 19. Unclamped inductive waveform

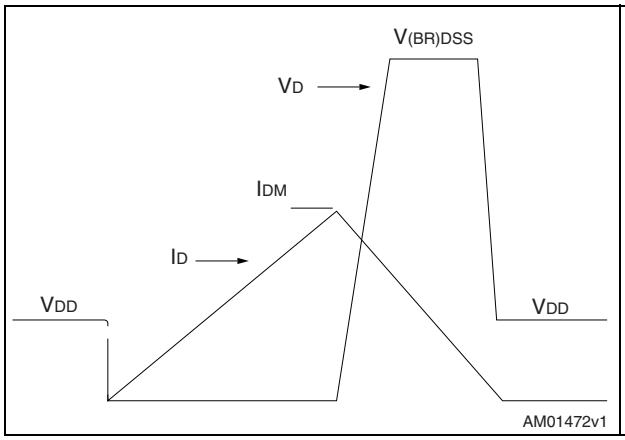
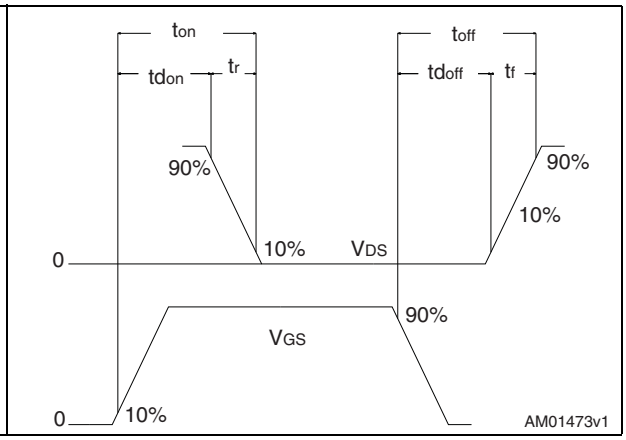


Figure 20. Switching time waveform



4 Package mechanical data

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. ECOPACK is an ST trademark.

Figure 21. SOT-223 mechanical data drawing

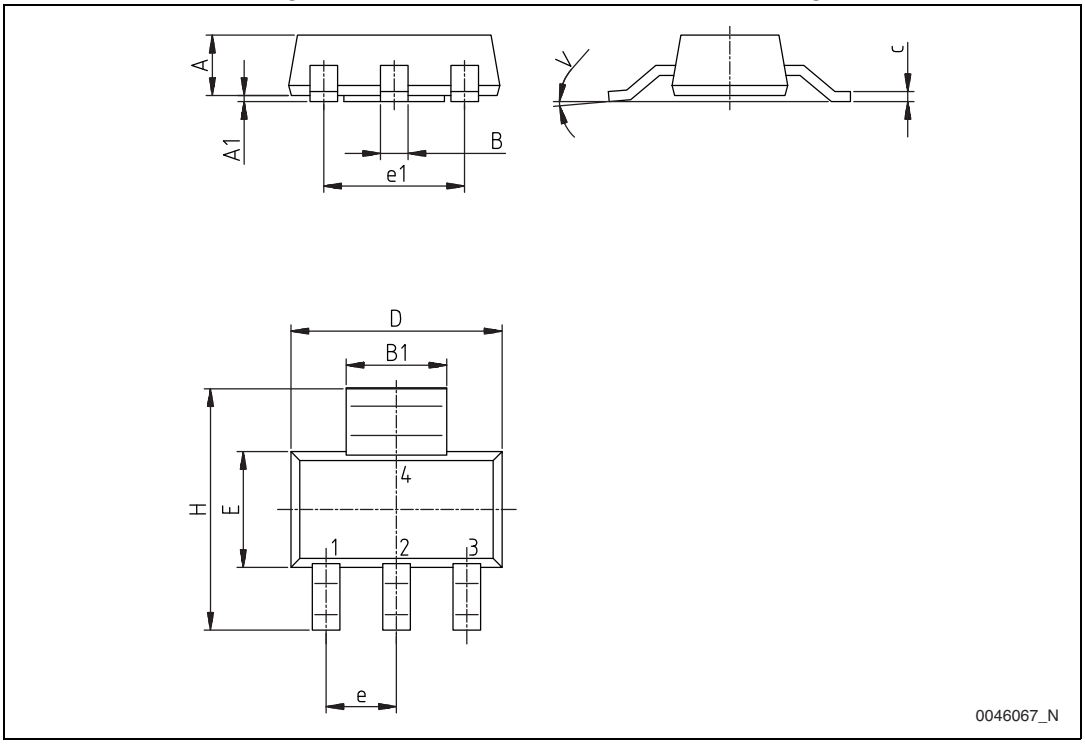
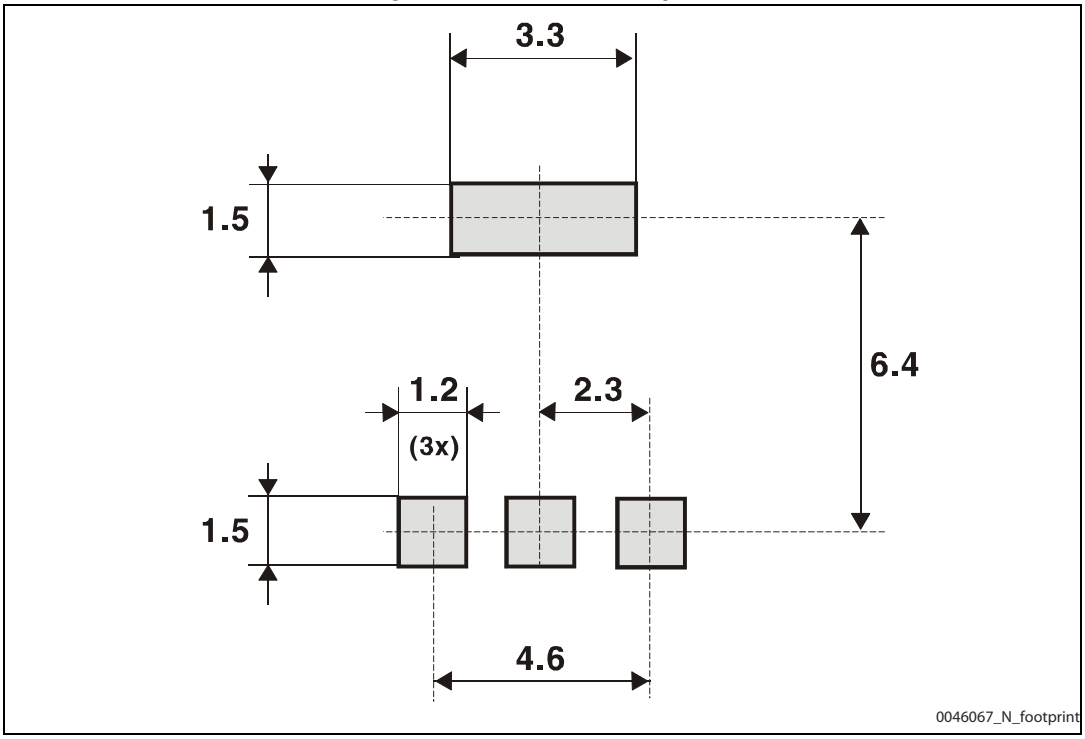


Table 8. SOT-223 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			1.80
A1	0.02		0.10
B	0.60	0.70	0.85
B1	2.9	3.0	3.15
c	0.24	0.26	0.35
D	6.30	6.50	6.70
e		2.30	6.70
e1		4.60	
E	3.30	3.50	3.70
H	6.70	7.0	7.30
V			10°

Figure 22. SOT-223 footprint



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
29-Jun-2010	1	First release.
08-Apr-2011	2	Document status promoted from preliminary data to datasheet.
06-Jun-2014	3	Updated silhouette, features and *Figure 1: Internal schematic diagram* in cover page. Updated *Table 2: Absolute maximum ratings*, *Table 3: Thermal data*, and *Table 4: On /off states*. Updated *Figure 2: Safe operating area* and *Figure 6: Gate charge vs gate-source voltage*. Updated *Section 4: Package mechanical data*. Minor text changes.

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