

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

Datasheet - production data

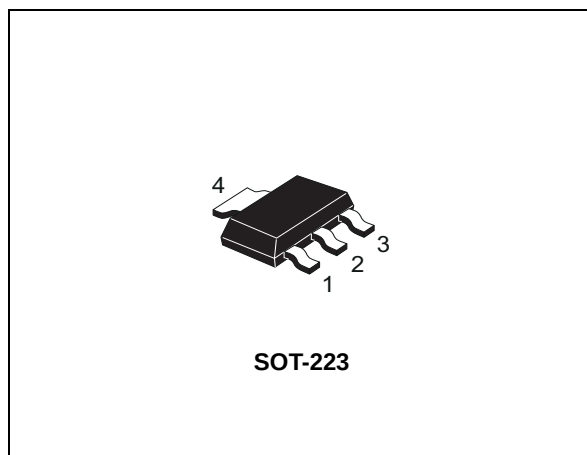
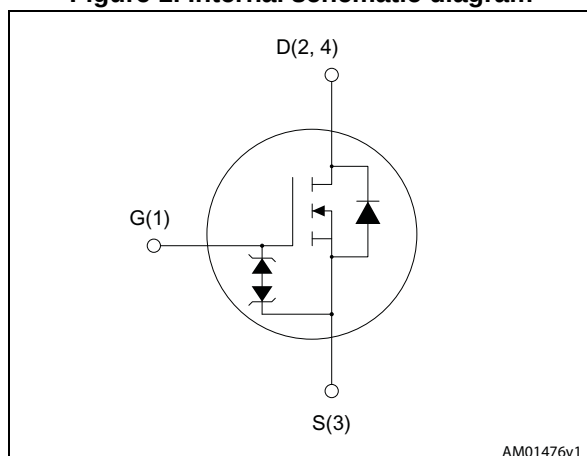


Figure 1. Internal schematic diagram



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** 3

2 **Electrical characteristics** 4

 2.1 Electrical characteristics 6

3 **Test circuits** 9

4 **Package mechanical data** 10

5 **Revision history** 13



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 $T_C = 25\text{ }^{\circ}\text{C}$	1.8 ⁽¹⁾	A
I_D	Drain current continuous $T_C = 100\text{ }^{\circ}\text{C}$	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 $T_{amb} = 25\text{ }^{\circ}\text{C}$	3.3	W
dv/dt ⁽⁵⁾	Peak diode recovery voltage slope	12	V/ns
E_{SD}	Gate-source human body model ($R = 1.5\text{ k}\Omega$, $C = 100\text{ pF}$)	1	kV
T_j T_{stg}	Operating junction temperature Storage temperature	-55 to 150	$^{\circ}\text{C}$

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 $T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$.
5. $I_{sd} \leq 1.8\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DD} \leq 80\% V_{(BR)DSS}$.

Table 3. Thermal data

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

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

2 Electrical characteristics

(T_{case} = 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	Intrinsic 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	$V_{DD} = 200\text{ V}$, $I_D = 0.6$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (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	$I_{SD} = 0.6\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 1.8\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 20)	-	145		ns
Q_r	Reverse recovery charge		-	490		nC
I_{RRM}	Reverse recovery current		-	7		A
t_{rr}	Reverse recovery time	$I_{SD} = 1.8\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (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

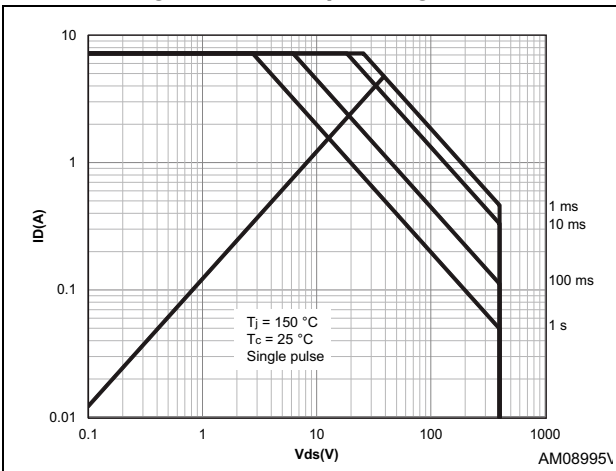


Figure 3. Thermal impedance

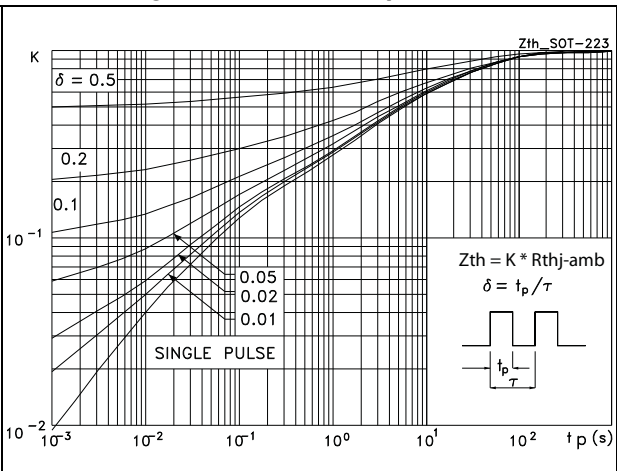


Figure 4. Output characteristics

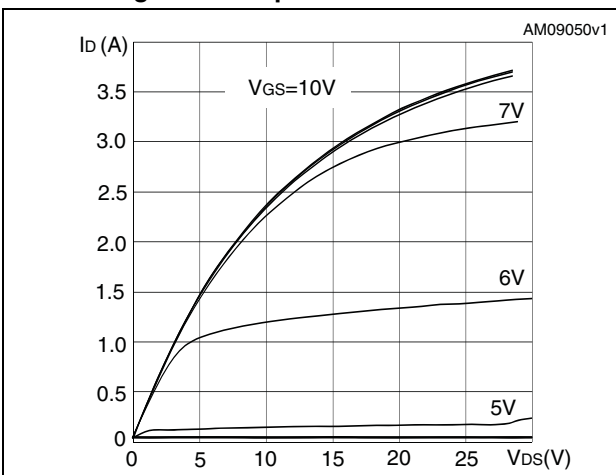


Figure 5. Transfer characteristics

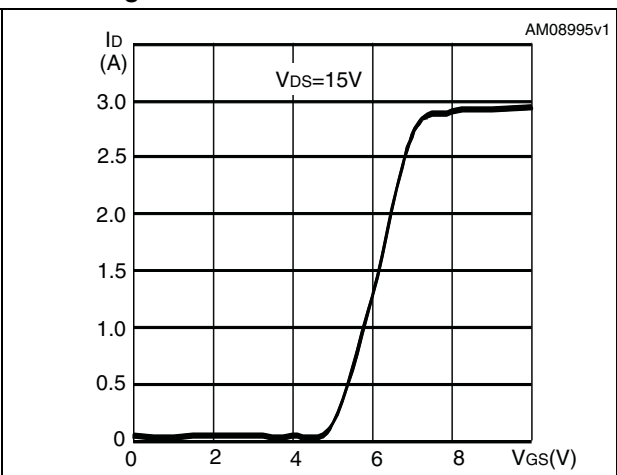


Figure 6. Gate charge vs gate-source voltage

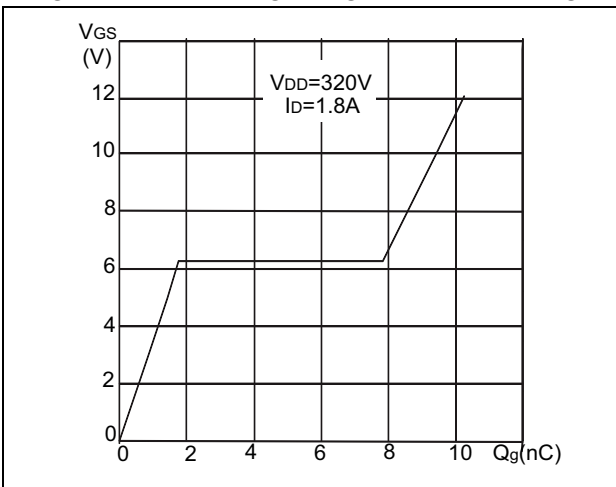


Figure 7. Static drain-source on resistance

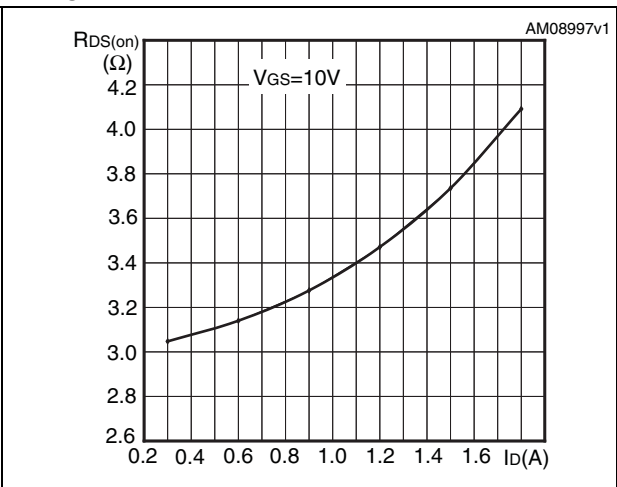


Figure 8. Capacitance variations

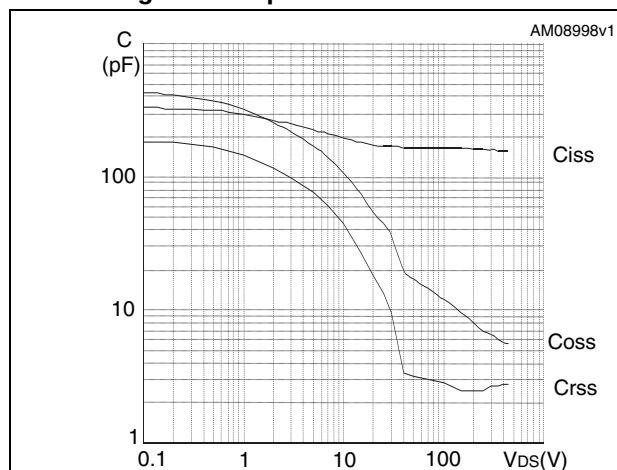


Figure 9. Output capacitance stored energy

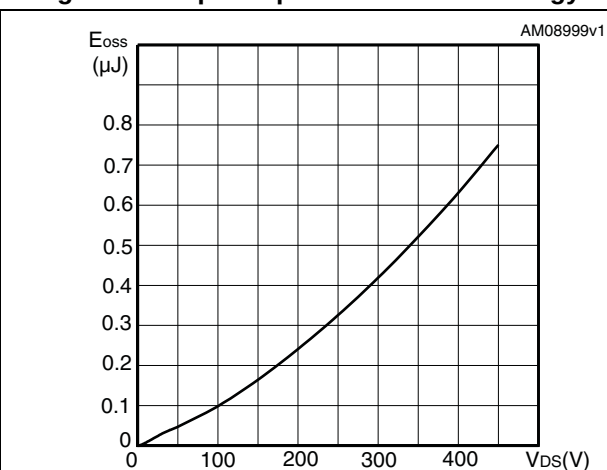


Figure 10. Normalized gate threshold voltage vs. temperature

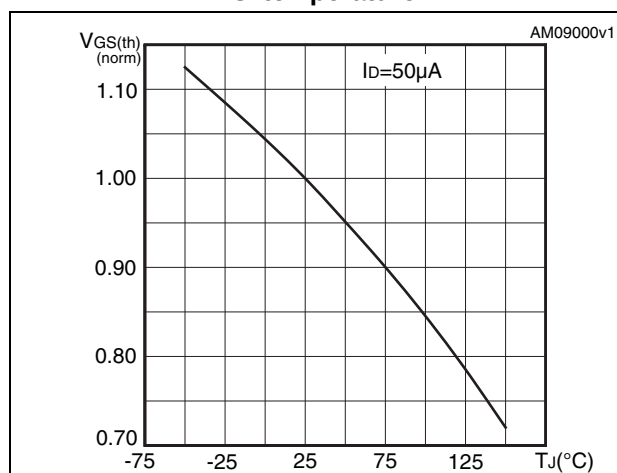


Figure 11. Normalized on resistance vs. temperature

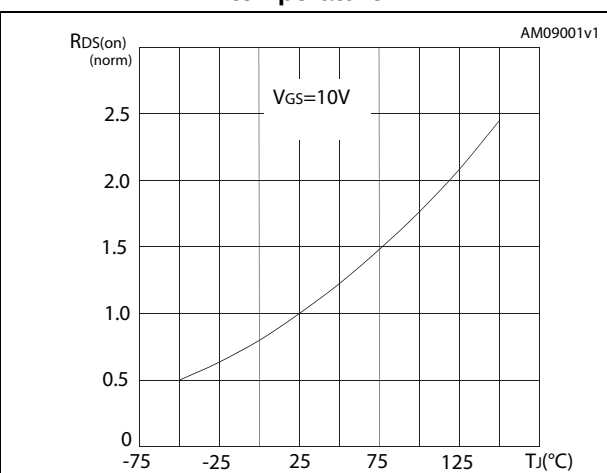


Figure 12. Source-drain diode forward characteristics

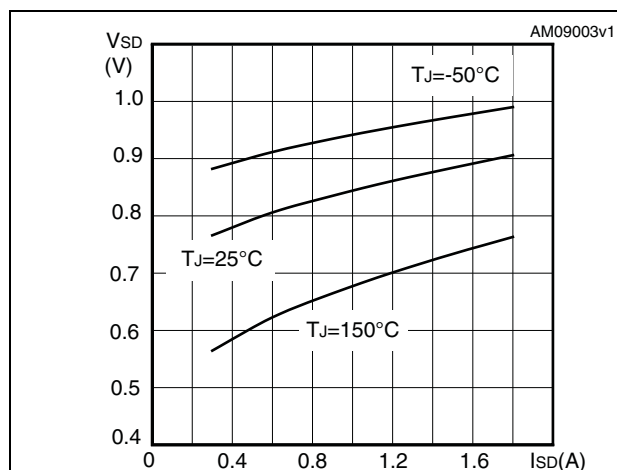
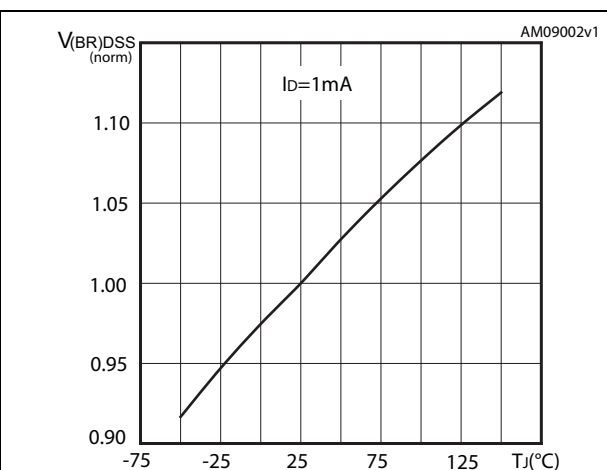
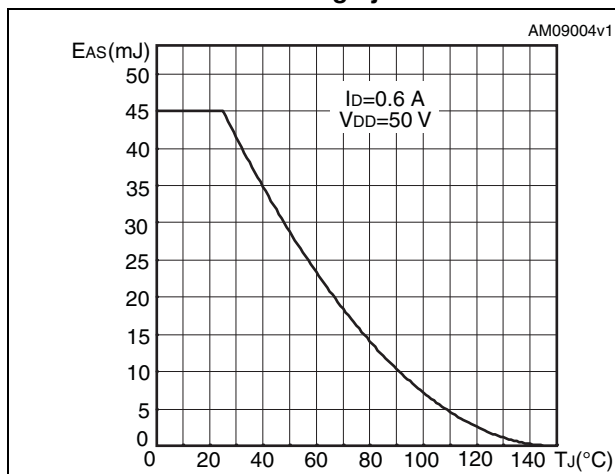
Figure 13. Normalized $V_{(BR)DSS}$ vs. temperature

Figure 14. Maximum avalanche energy vs.
starting T_J



3 Test circuits

Figure 15. Switching times test circuit for resistive load

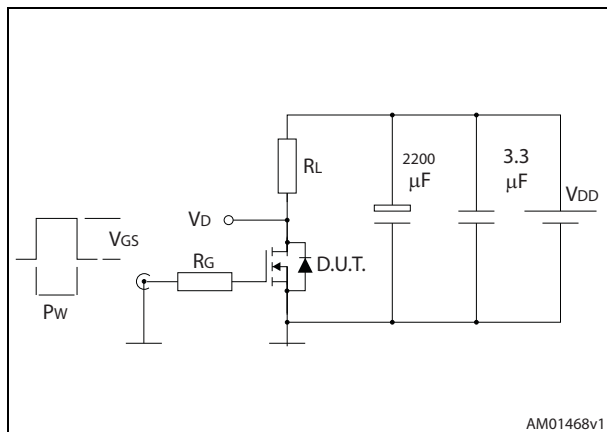


Figure 16. Gate charge test circuit

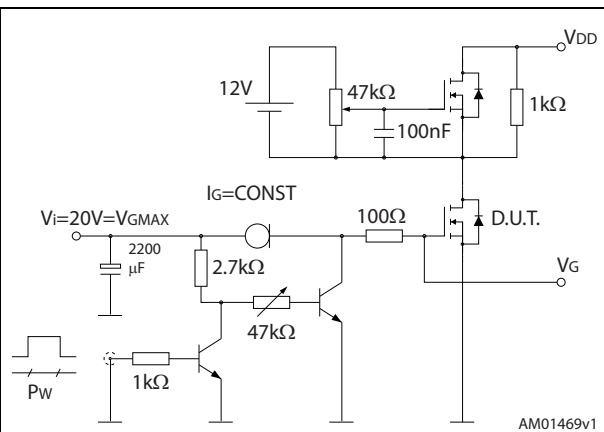


Figure 17. Switching times test circuit for resistive load

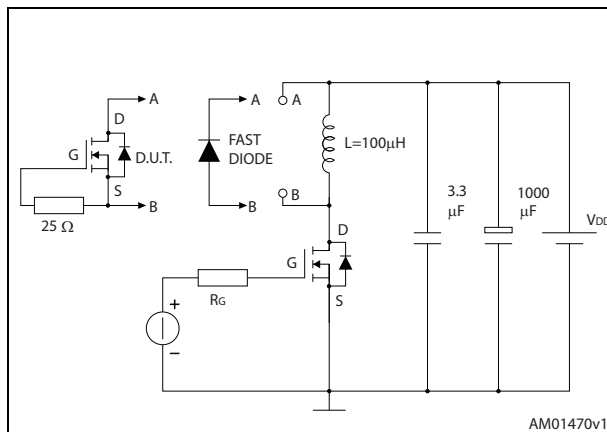


Figure 18. Gate charge test circuit

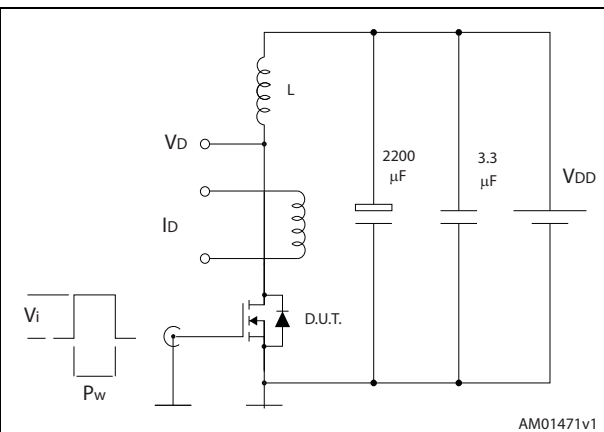


Figure 19. Unclamped inductive waveform

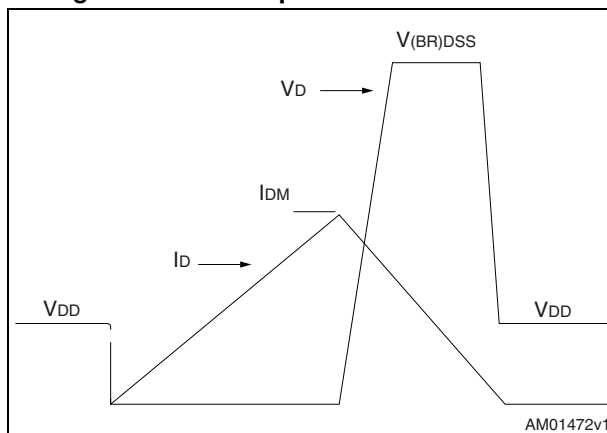
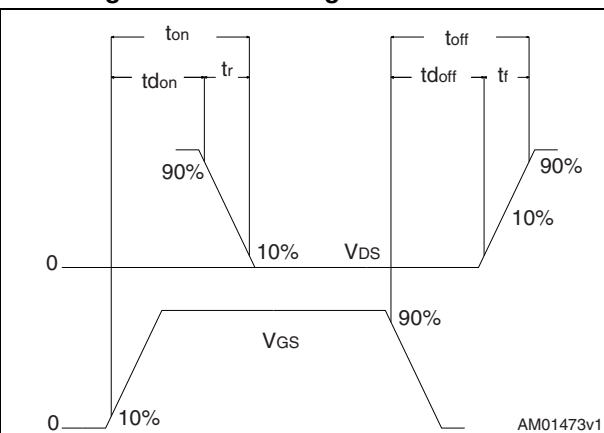


Figure 20. Switching time waveform



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

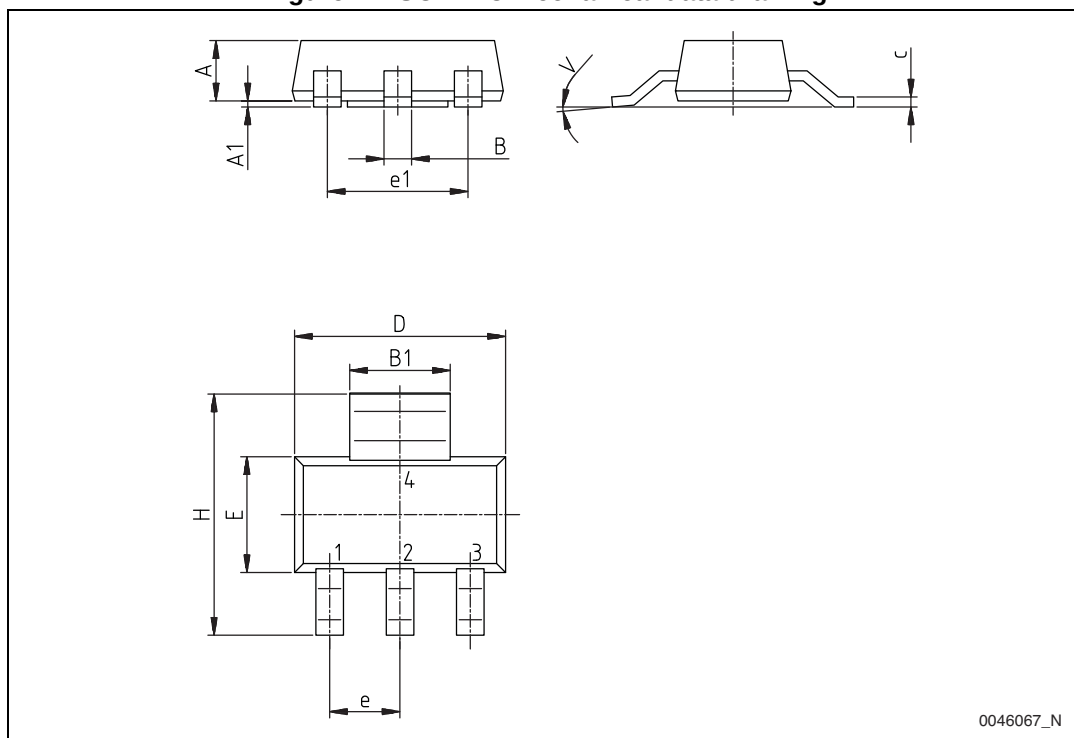
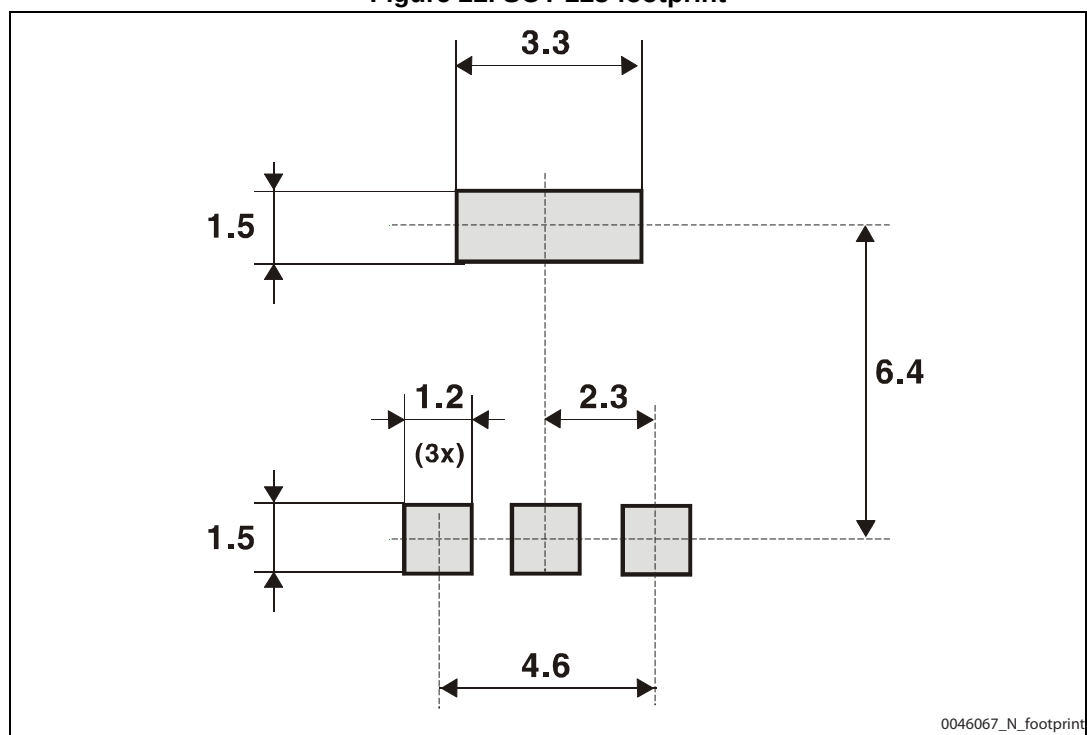


Table 8. SOT-223 mechanical data

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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