



## STN4NF06L

N-channel 60 V, 0.07  $\Omega$ , 4 A SOT-223  
STripFET™ II Power MOSFET

### Features

Order code	V <sub>DSS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STN4NF06L	60 V	< 0.1 $\Omega$	4 A

- Exceptional dv/dt capability
- Avalanche rugged technology
- 100% avalanche tested
- Low threshold drive

### Applications

- Switching application
  - Automotive

### Description

This device is a N-channel STripFET™ II Power MOSFET that is the latest development of STMicroelectronics unique “single feature size” strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

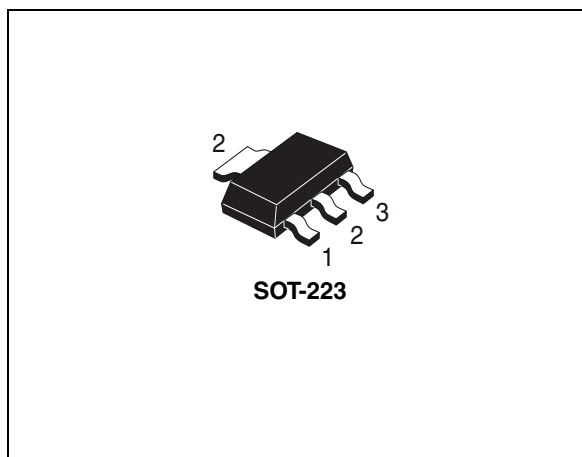


Figure 1. Internal schematic diagram

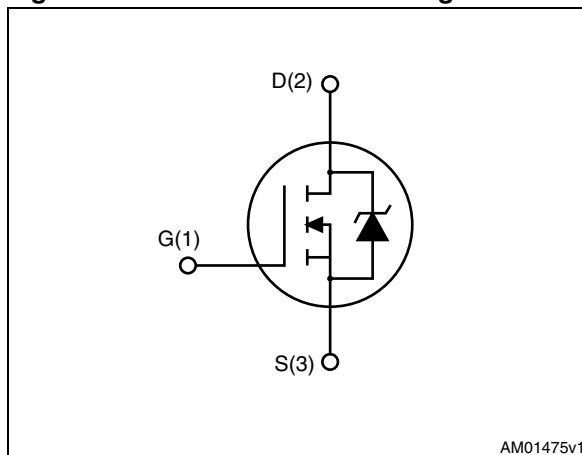


Table 1. Device summary

Order code	Marking	Package	Packaging
STN4NF06L	4NF06L	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 ( $V_{GS} = 0$ )	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
$I_D$	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 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 voltage slope	10	V/ns
$E_{AS}^{(4)}$	Single pulse avalanche energy	200	mJ
$T_J$ $T_{stg}$	Operating junction temperature Storage temperature	-55 to 150	$^\circ\text{C}$

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

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-PCB max.	38	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(2)}$	Thermal resistance junction-PCB max.	100	$^\circ\text{C}/\text{W}$
$T_1^{(3)}$	Maximum lead temperature for soldering purpose typ.	260	$^\circ\text{C}$

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

## 2 Electrical characteristics

( $T_{CASE} = 25\text{ °C}$  unless otherwise specified)

**Table 4. On/off states**

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

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15\text{ V}$ , $I_D = 1.5\text{ A}$	-	3		S
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	340		pF
$C_{oss}$	Output capacitance			63		pF
$C_{rss}$	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	$V_{GS} = 5\text{ V}$		1.5		nC
$Q_{gd}$	Gate-drain charge	(see Figure 15)		2.8		nC

1. Pulsed: pulse duration=300 $\mu\text{s}$ , duty cycle 1.5%

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time rise time	$V_{DD} = 30\text{ V}$ , $I_D = 1.5\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 5\text{ V}$ (see Figure 14)	-	9	-	ns
$t_r$				25		
$t_{d(off)}$	Turn-off delay time fall time	$V_{DD} = 30\text{ V}$ , $I_D = 1.5\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 5\text{ V}$ (see Figure 14)	-	20	-	ns
$t_f$				10		

**Table 7. 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	$I_{SD}=4\text{ A}$ , $V_{GS}=0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD}=4\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD}=25\text{ V}$ , $T_j=150\text{ }^\circ\text{C}$ <i>(see Figure 16)</i>	-	50		ns
$Q_{rr}$	Reverse recovery charge			88		nC
$I_{RRM}$	Reverse recovery current			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 2. Safe operating area

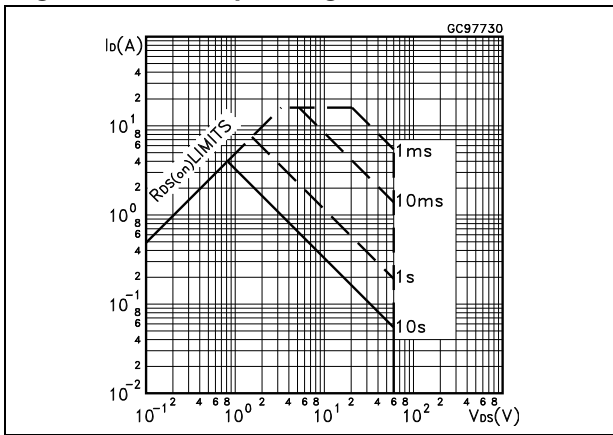


Figure 3. Thermal impedance

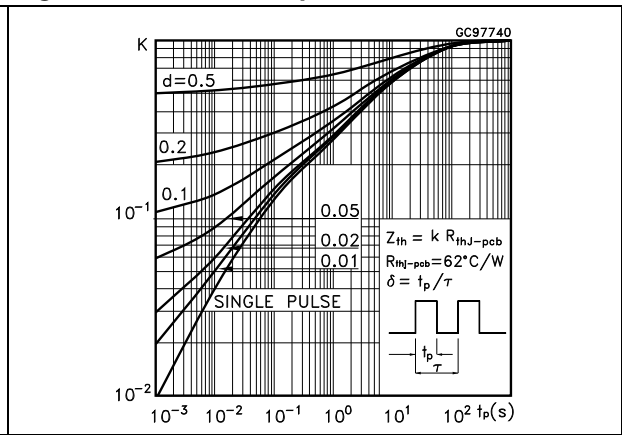


Figure 4. Output characteristics

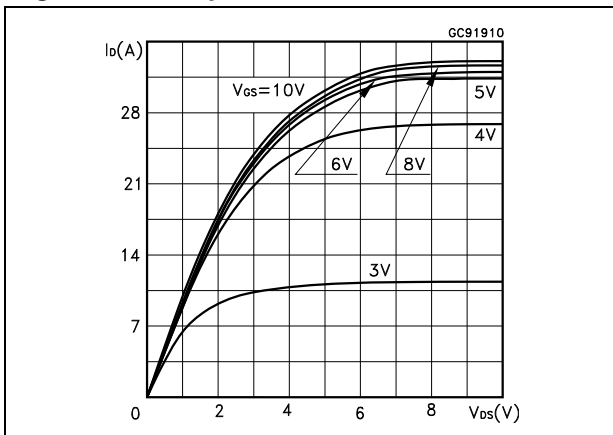


Figure 5. Transfer characteristics

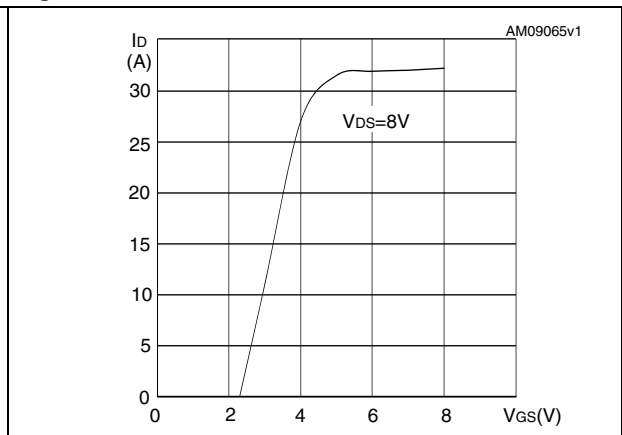


Figure 6. Transconductance

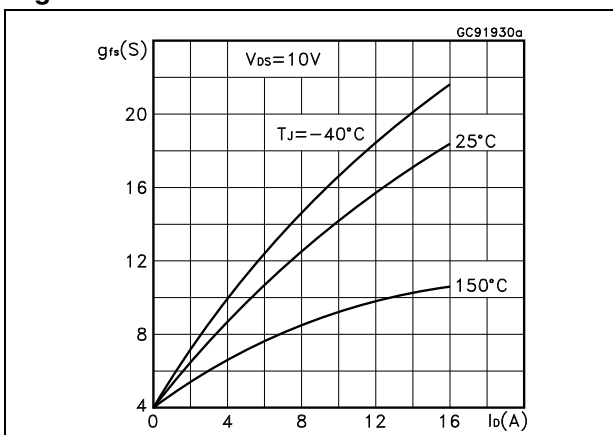


Figure 7. Static drain-source on resistance

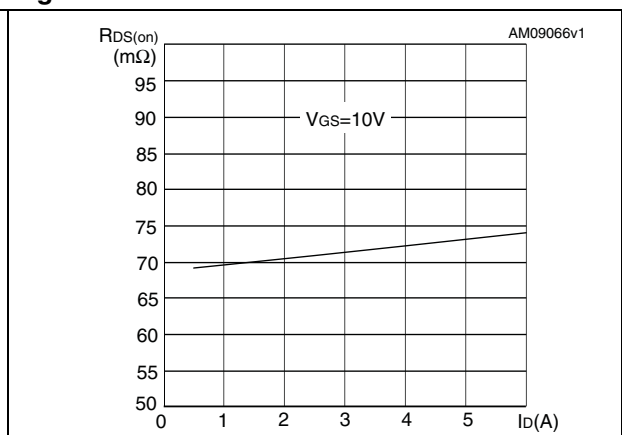


Figure 8. Gate charge vs. gate-source voltage Figure 9. Capacitance variations

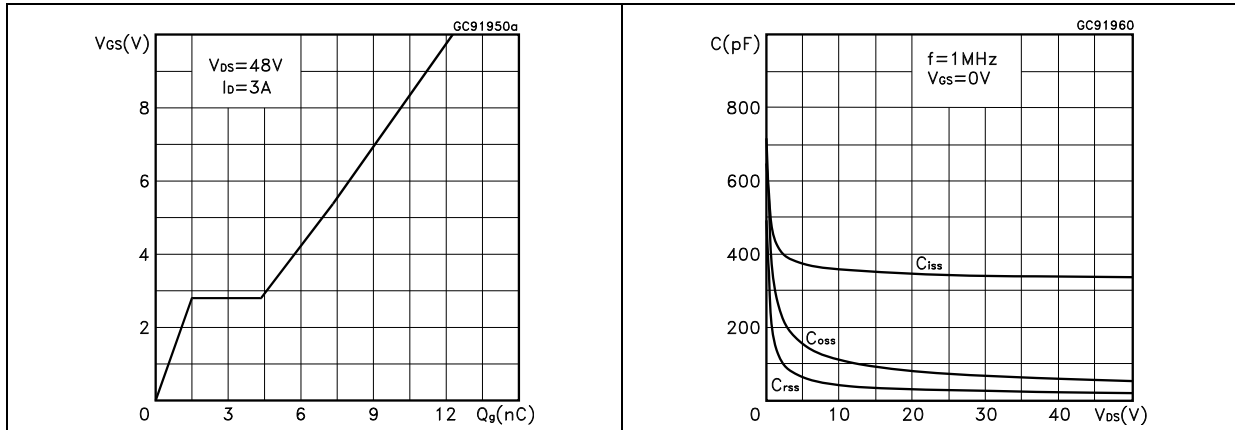


Figure 10. Normalized gate threshold voltage vs. temperature

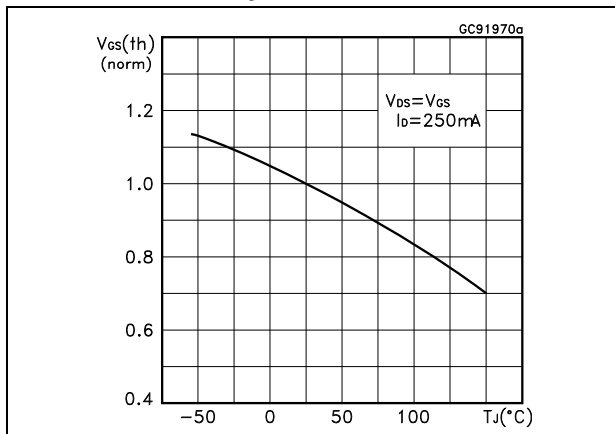


Figure 11. Normalized on resistance vs. temperature

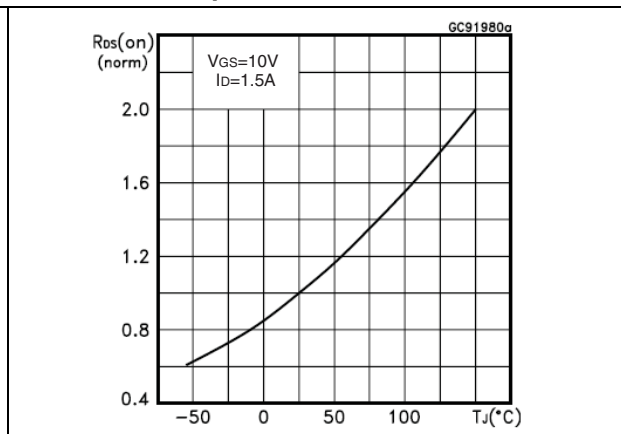


Figure 12. Source-drain diode forward characteristics

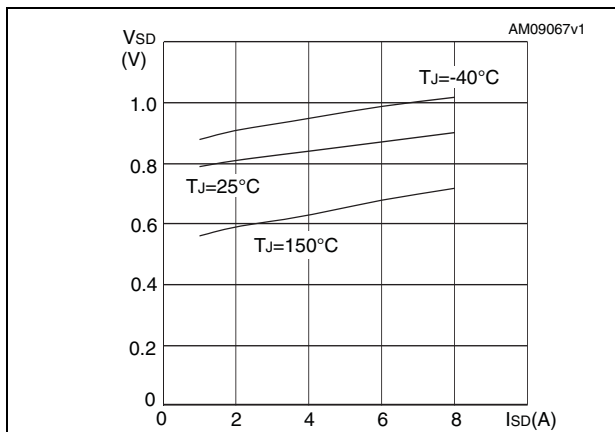
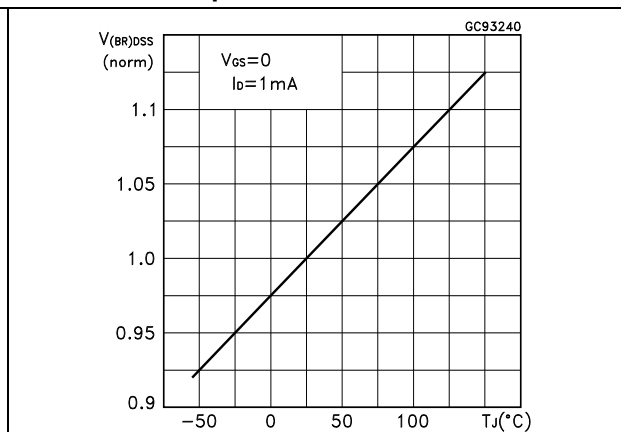
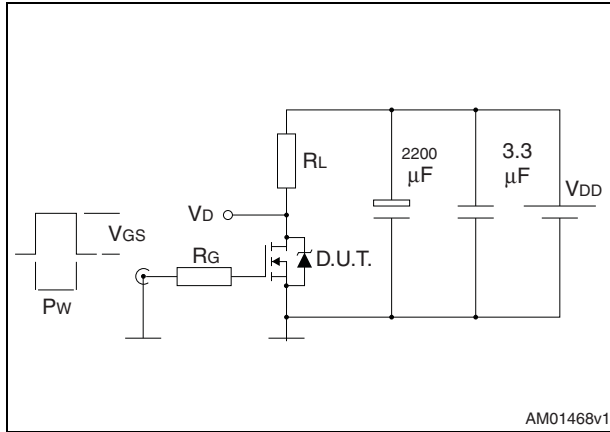


Figure 13. Normalized breakdown voltage vs. temperature

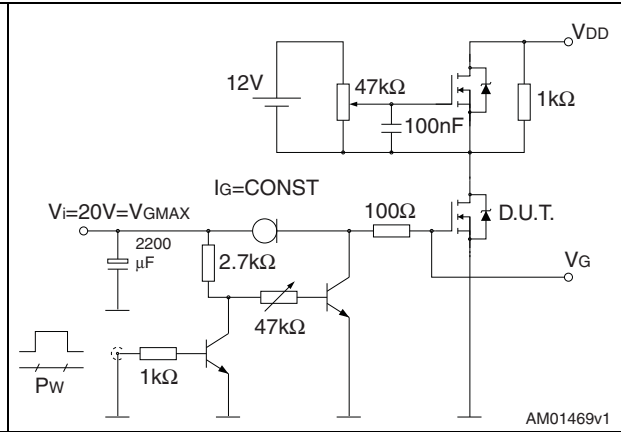


### 3 Test circuit

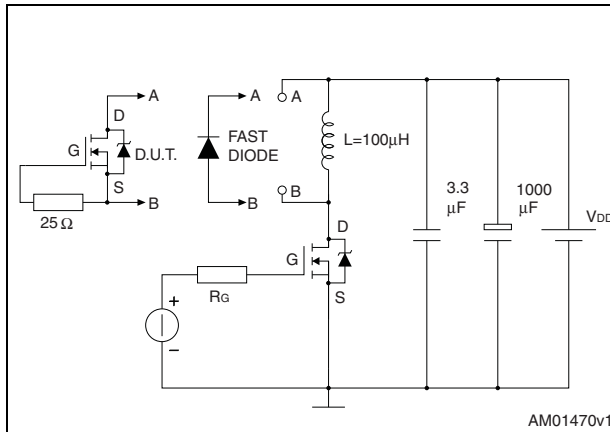
**Figure 14. Switching times test circuit for resistive load**



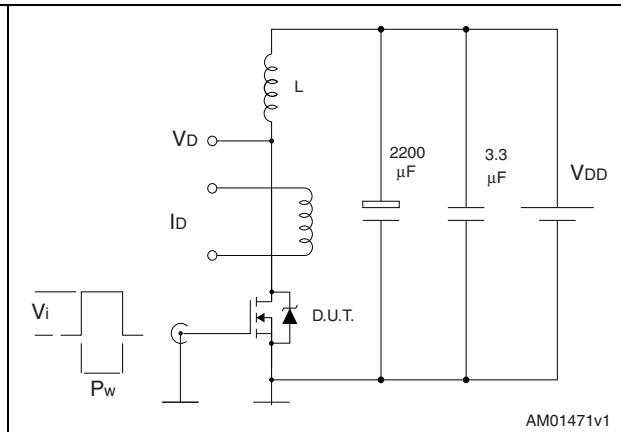
**Figure 15. Gate charge test circuit**



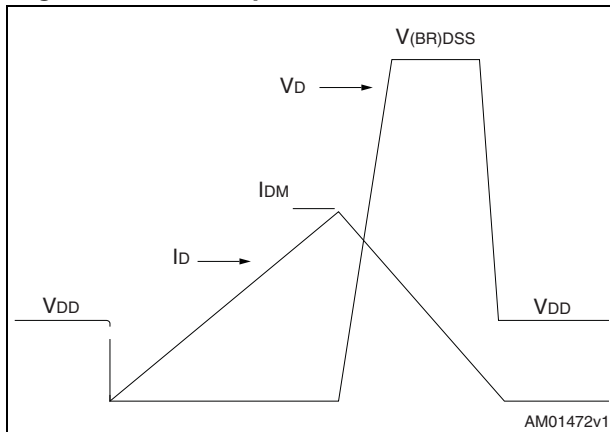
**Figure 16. Test circuit for inductive load switching and diode recovery times**



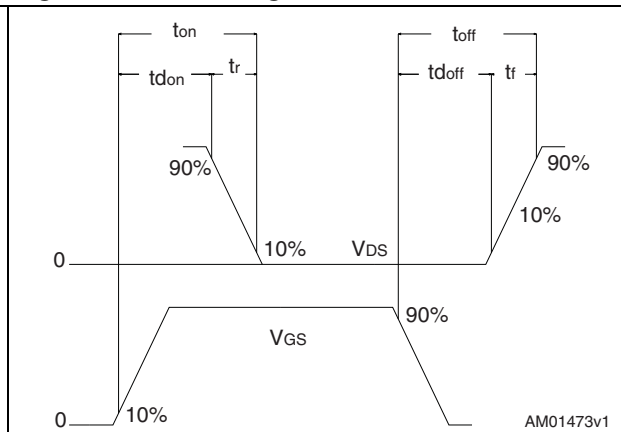
**Figure 17. Unclamped Inductive load test circuit**



**Figure 18. Unclamped inductive waveform**



**Figure 19. Switching time waveform**





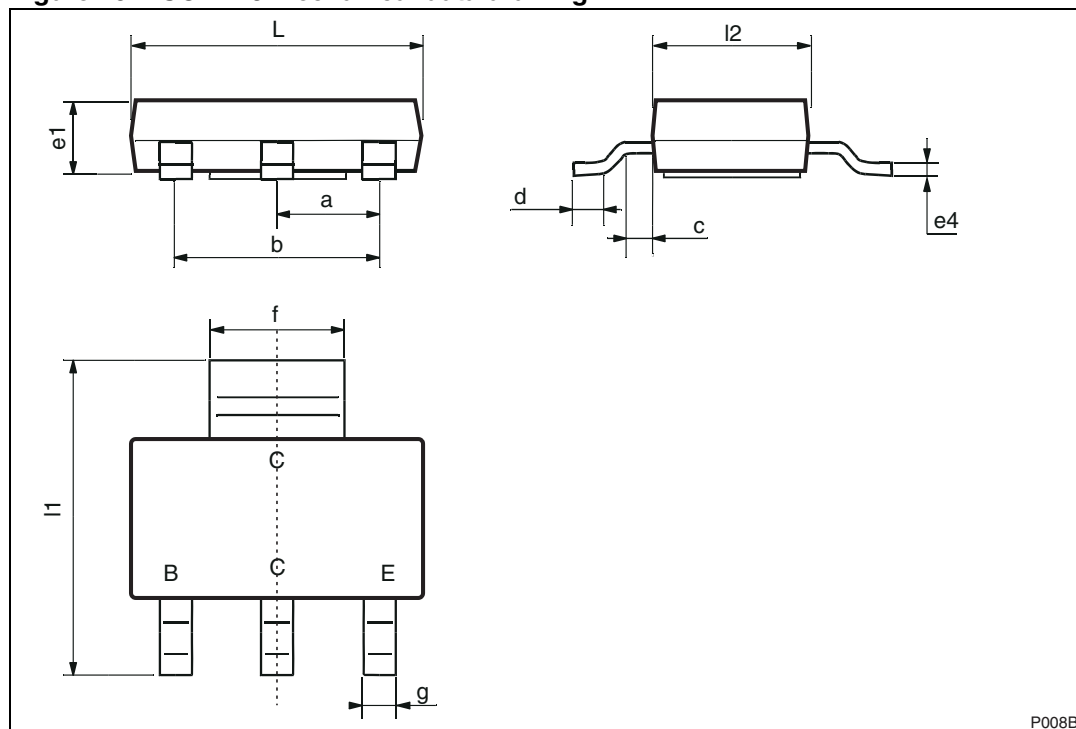
## 4 Package mechanical data

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

Table 8. SOT-223 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
a	2.27	2.3	2.33
b	4.57	4.6	4.63
c	0.2	0.4	0.6
d	0.63	0.65	0.67
e1	1.5	1.6	1.7
e4			0.32
f	2.9	3	3.1
g	0.67	0.7	0.73
l1	6.7	7	7.3
l2	3.5	3.5	3.7
L	6.3	6.5	6.7

Figure 20. SOT-223 mechanical data drawing



P008B

## 5 Revision history

**Table 9. Document revision history**

Date	Revision	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.

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