



## STS9NH3LL

N-channel 30 V - 0.018  $\Omega$  - 9 A - SO-8  
 low gate charge STripFET™ III Power MOSFET

### Features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STS9NH3LL	30 V	0.022 $\Omega$	9 A

- Optimal R<sub>DS(on)</sub> x Q<sub>g</sub> trade-off @ 4.5 V
- Conduction losses reduced
- Switching losses reduced

### Application

- Switching applications

### Description

This application specific Power MOSFET is the third generation of STMicroelectronics unique “single feature size” strip-based process. The resulting transistor shows the best trade-off between on-resistance and gate charge. When used as high and low side in buck regulators, it gives the best performance in terms of both conduction and switching losses. This is extremely important for motherboards where fast switching and high efficiency are of paramount importance.

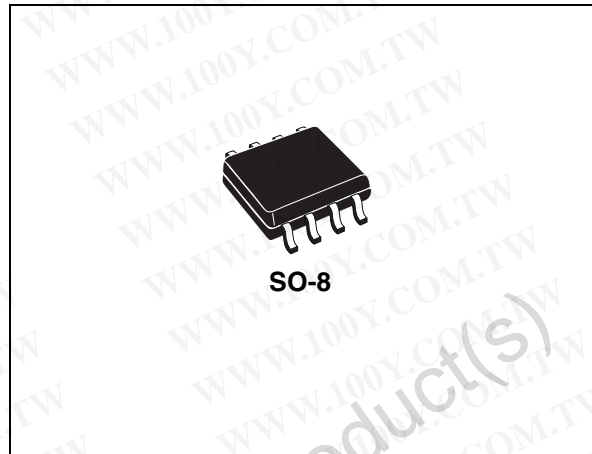


Figure 1. Internal schematic diagram

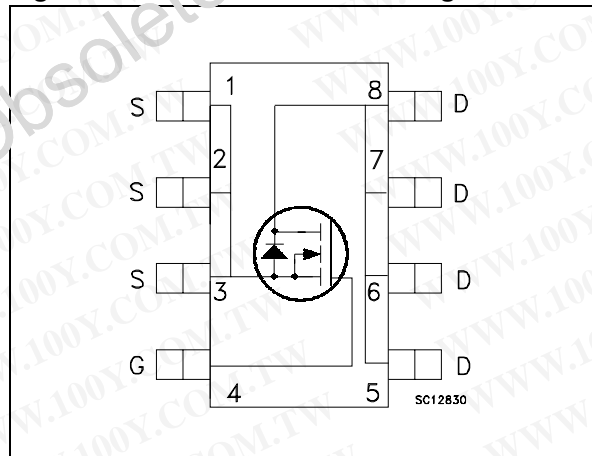


Table 1. Device summary

Order code	Marking	Package	Packaging
STS9NH3LL	S9NH3LL	SO-8	Tape & reel

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	30	V
$V_{GS}$	Gate-source voltage	$\pm 16$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	9	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	6	A
$I_{DM}^{(1)}$	Drain current (pulsed)	36	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	2.5	W
$E_{AS}^{(2)}$	Single pulse avalanche energy	100	mJ
$T_J$	Operating junction temperature	-55 to 150	$^\circ\text{C}$
$T_{stg}$	Storage temperature		

1. Pulse width limited by safe operating area

2. Starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $I_D = 6\text{ A}$ .

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-amb}^{(1)}$	Thermal resistance junction-ambient max	50	$^\circ\text{C/W}$

1. When mounted on 1 inch<sup>2</sup> FR-4 board, 2oz Cu ( $t < 10\text{ sec.}$ )

## 2 Electrical characteristics

( $T_{CASE}=25^{\circ}C$  unless otherwise specified)

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250 \mu A, V_{GS} = 0$	30			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating @ } 125^{\circ}C$			1 10	$\mu A$ $\mu A$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 16 V$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250 \mu A$	1			V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10 V, I_D = 4.5 A$ $V_{GS} = 4.5 V, I_D = 4.5 A$		0.018 0.020	0.022 0.025	$\Omega$ $\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 10 V, I_D = 4.5 A$		8.5		S
$C_{iss}$	Input capacitance	$V_{DS} = 25 V, f = 1 \text{ MHz}, V_{GS} = 0$		857		pF
$C_{oss}$	Output capacitance			147		pF
$C_{rss}$	Reverse transfer capacitance			20		pF
$Q_g$	Total gate charge	$V_{DD} = 15 V, I_D = 9 A$		7.0	10	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 4.5 V,$		2.5		nC
$Q_{gd}$	Gate-drain charge	(see Figure 16)		2.3		nC

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

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on delay time Rise time	$V_{DD}=15\text{ V}$ , $I_D=4.5\text{ A}$ , $R_G=4.7\ \Omega$ , $V_{GS}=4.5\text{ V}$ (see Figure 15)		12 14.5		ns ns
$t_{d(off)}$ $t_f$	Turn-off delay time Fall time	$V_{DD}=15\text{ V}$ , $I_D=4.5\text{ A}$ , $R_G=4.7\ \Omega$ , $V_{GS}=4.5\text{ V}$ (see Figure 15)		23 8		ns ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}^{(1)}$	Source-drain current Source-drain current (pulsed)				9 36	A A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}=4.5\text{ A}$ , $V_{GS}=0$			1.5	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD}=9\text{ A}$ , $di/dt=100\text{ A}/\mu\text{s}$ , $V_{DD}=15\text{ V}$ , $T_j=150\text{ }^\circ\text{C}$ (see Figure 17)		15 5.7 0.76		ns nC 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

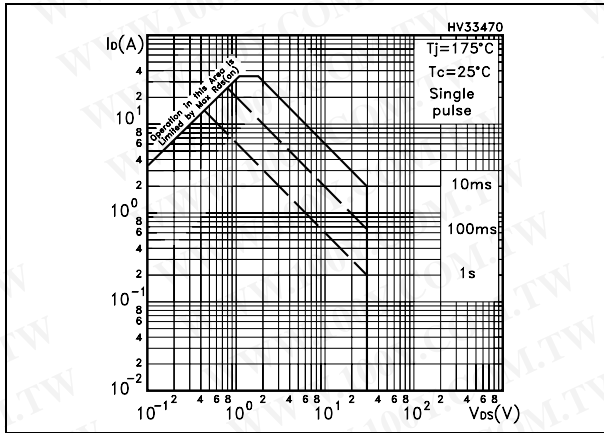


Figure 3. Thermal impedance

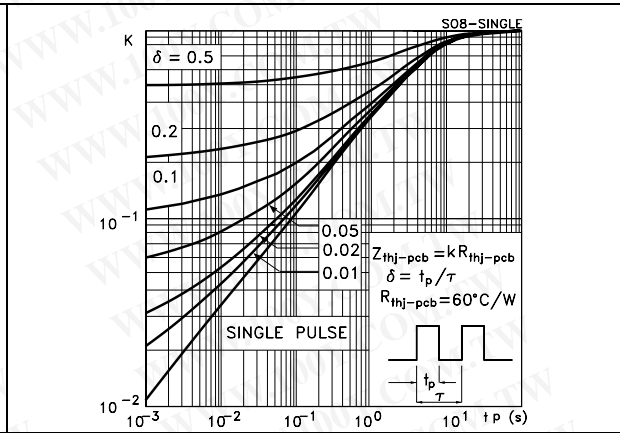


Figure 4. Output characteristics

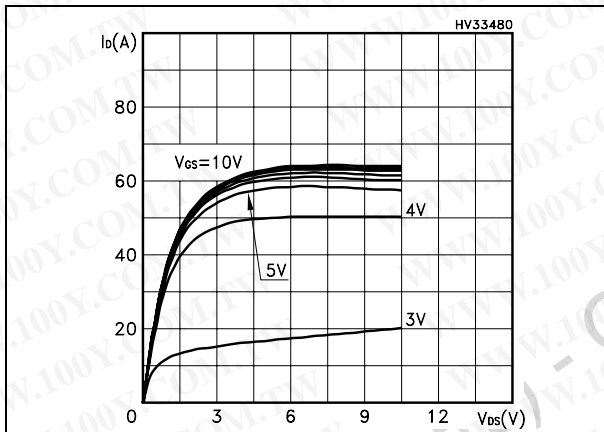


Figure 5. Transfer characteristics

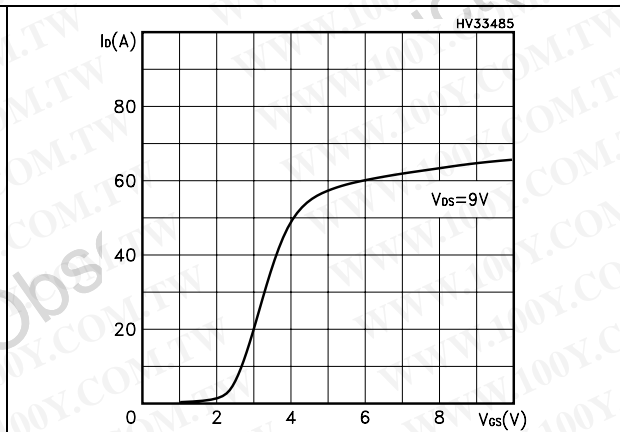


Figure 6. Transconductance

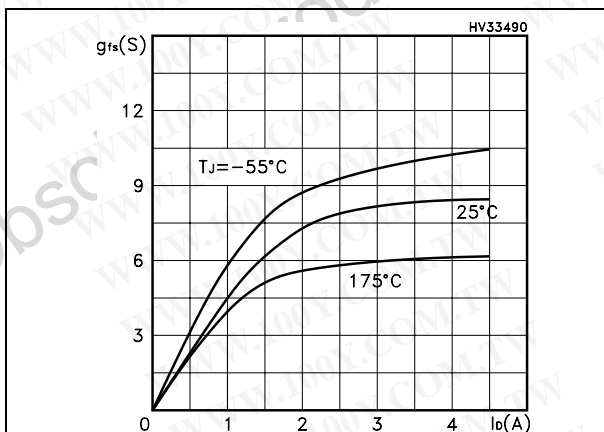


Figure 7. Static drain-source on resistance

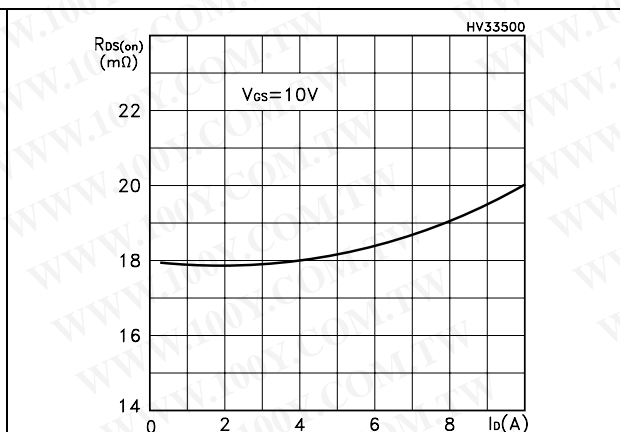


Figure 8. Gate charge vs gate-source voltage    Figure 9. Capacitance variations

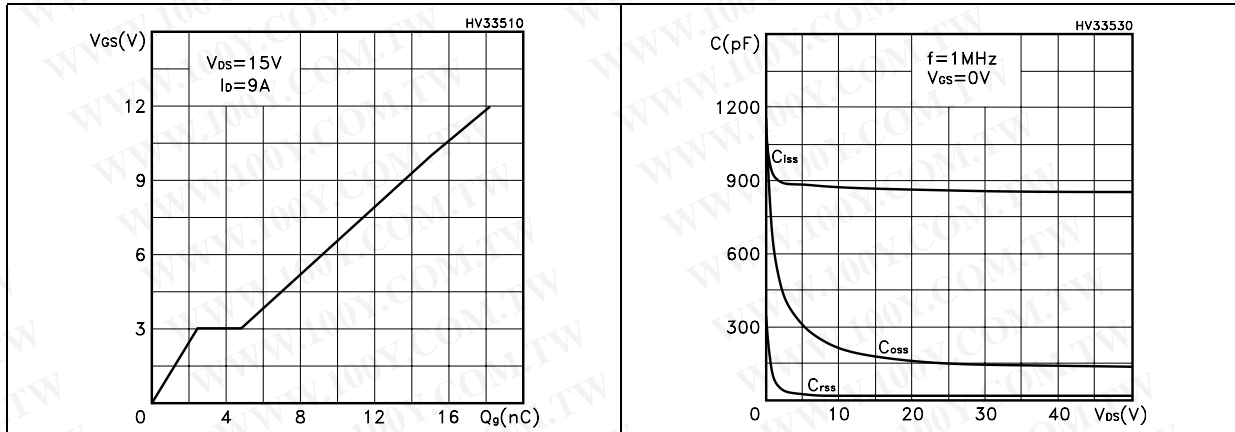


Figure 10. Normalized gate threshold voltage vs temperature    Figure 11. Normalized on resistance vs temperature

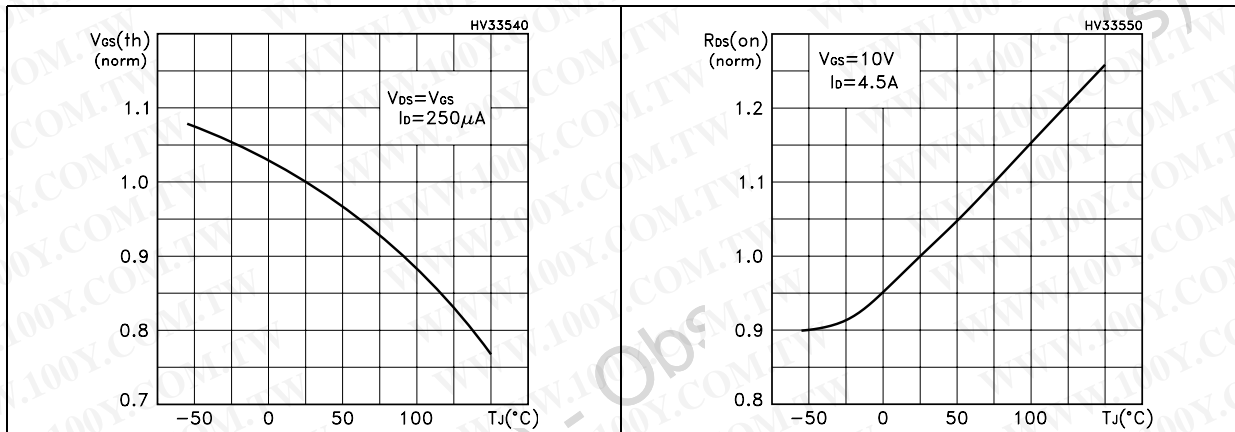


Figure 12. Source-drain diode forward characteristics    Figure 13. Normalized breakdown voltage vs temperature

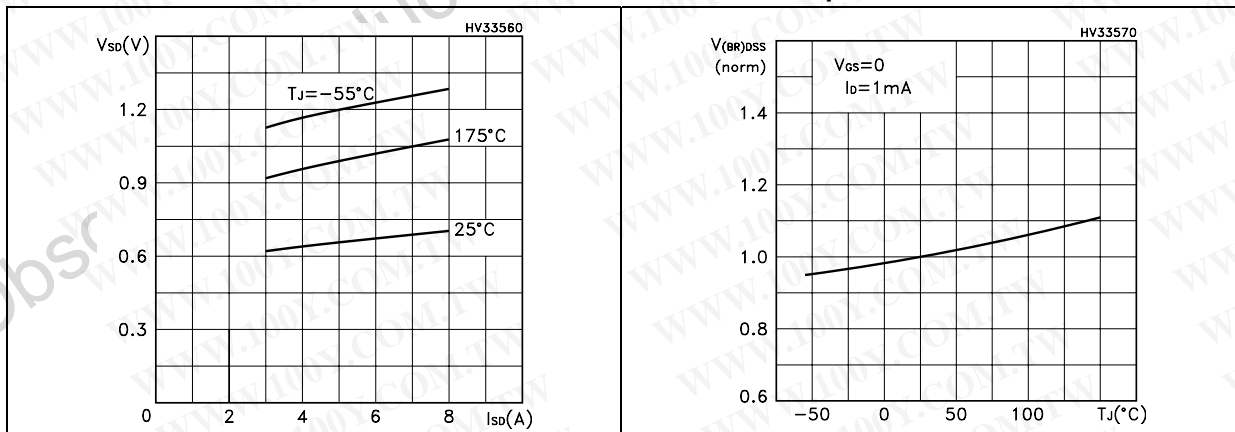
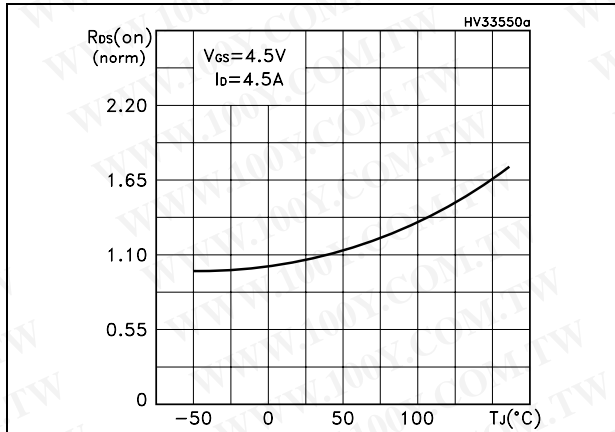


Figure 14. Normalized on resistance vs temperature ( $V_{GS} = 4.5V$ )



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### 3 Test circuit

Figure 15. Switching times test circuit for resistive load

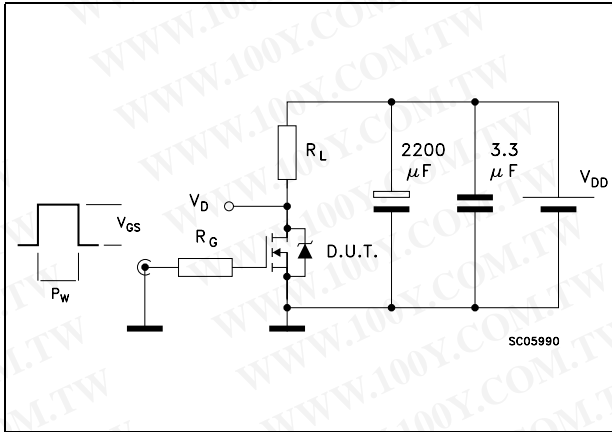


Figure 16. Gate charge test circuit

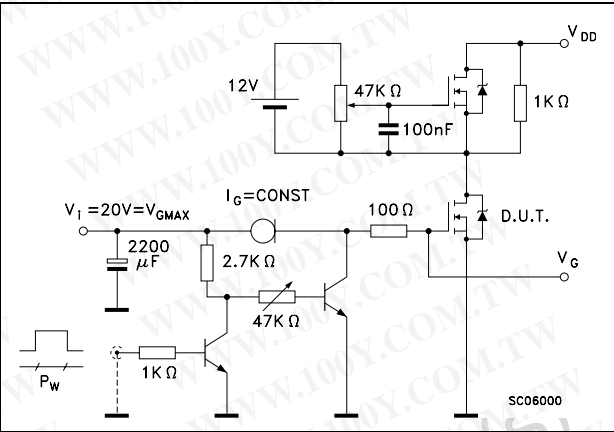


Figure 17. Test circuit for inductive load switching and diode recovery times

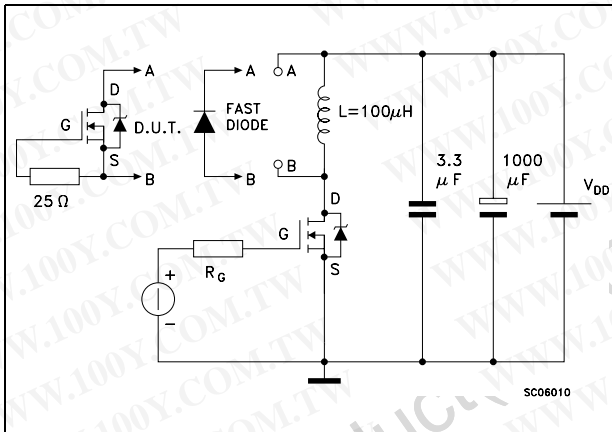


Figure 18. Unclamped inductive load test circuit

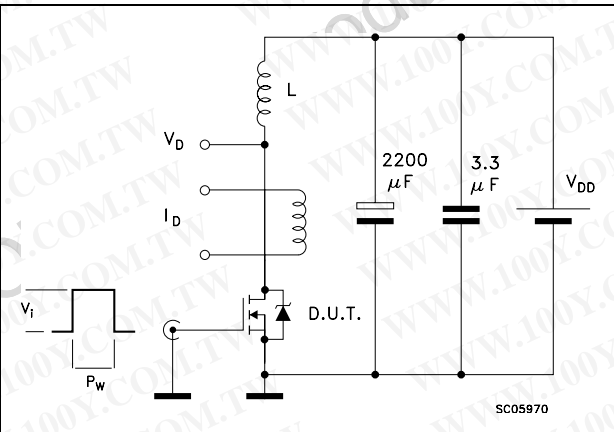


Figure 19. Unclamped inductive waveform

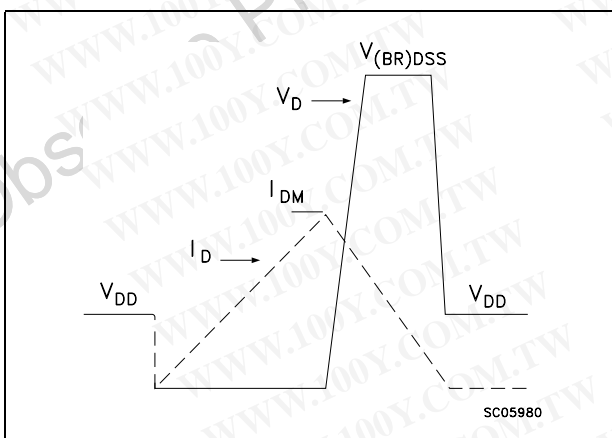
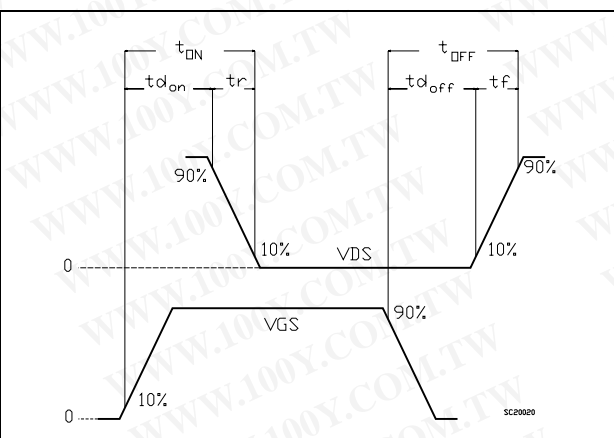


Figure 20. Switching time waveform



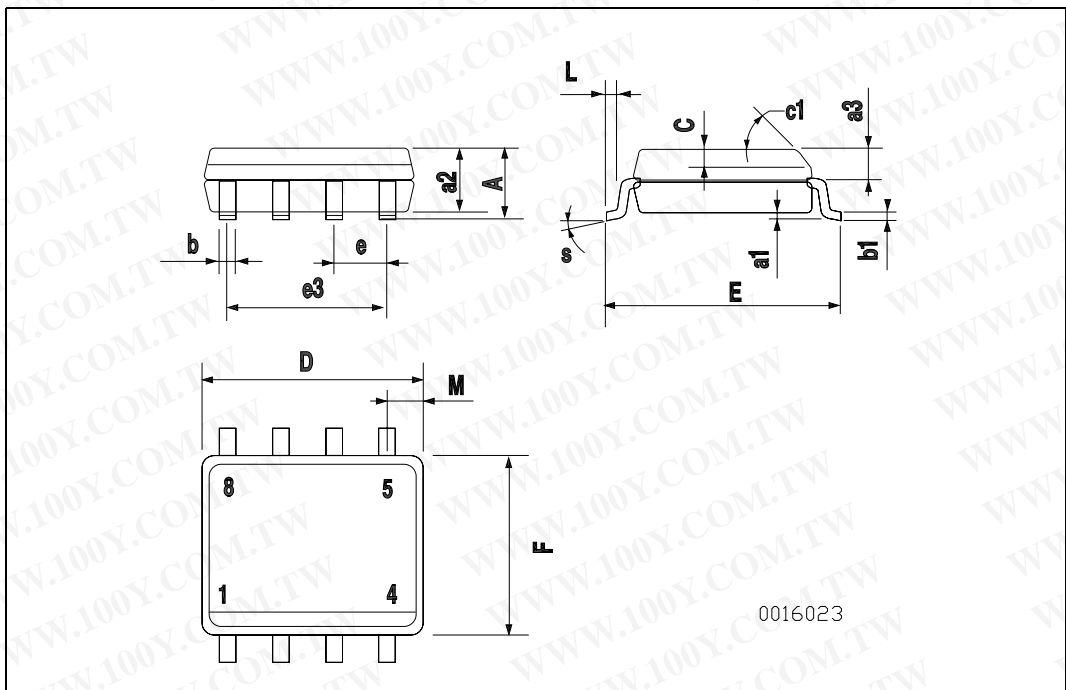
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com)

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**SO-8 MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.25	0.003		0.009
a2			1.65			0.064
a3	0.65		0.85	0.025		0.033
b	0.35		0.48	0.013		0.018
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.019
c1	45 (typ.)					
D	4.8		5.0	0.188		0.196
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F	3.8		4.0	0.14		0.157
L	0.4		1.27	0.015		0.050
M			0.6			0.023
S	8 (max.)					



## 5 Revision history

**Table 8. Document revision history**

Date	Revision	Changes
24-Jul-2006	1	Initial release.
15-May-2007	2	Update on <a href="#">Table 2</a> .
12-Dec-2007	3	<ul style="list-style-type: none"><li>– Inserted <a href="#">Figure 14: Normalized on resistance vs temperature (<math>V_{GS} = 4.5V</math>)</a></li><li>– Inserted new <math>E_{AS}</math> value on <a href="#">Table 2</a>.</li></ul>

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