



STW45NM60

N-channel 650V @ Tjmax - 0.09Ω - 45A - TO-247
MDmesh™ Power MOSFET

General features

Type	V _{DSS} (@Tjmax)	R _{DS(on)}	I _D
STW45NM60	650V	< 0.11Ω	45A

- High dv/dt and avalanche capabilities
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance
- Tight process control and high manufacturing yields

Description

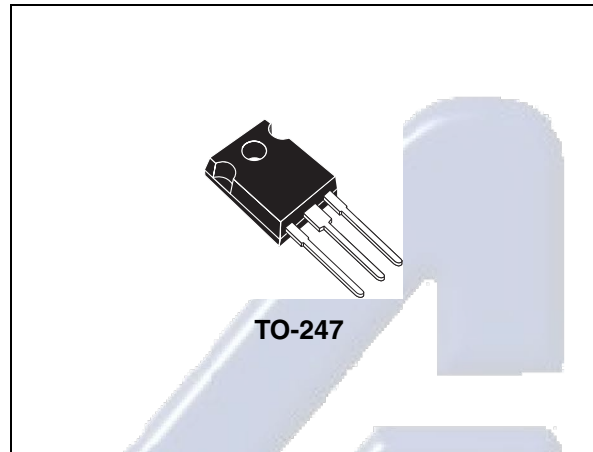
The MDmesh™ is a new revolutionary Power MOSFET technology that associates the multiple drain process with the Company's PowerMESH™ horizontal layout. The resulting product has an outstanding low on-resistance, impressively high dv/dt and excellent avalanche characteristics. The adoption of the Company's proprietary strip technique yields overall dynamic performance that is significantly better than that of similar competitor's products.

Applications

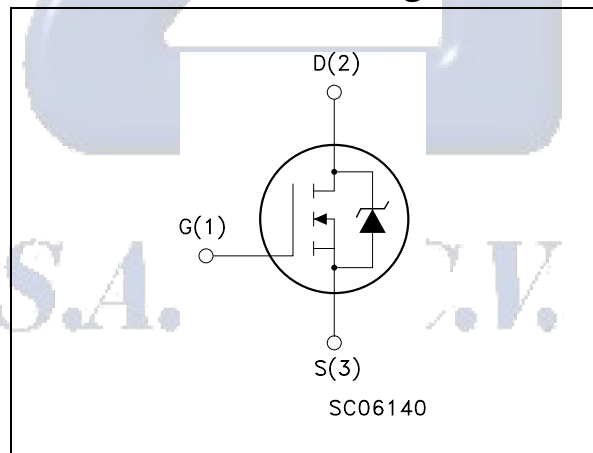
- Switching application

Order codes

Part number	Marking	Package	Packaging
STW45NM60	W45NM60	TO-247	Tube

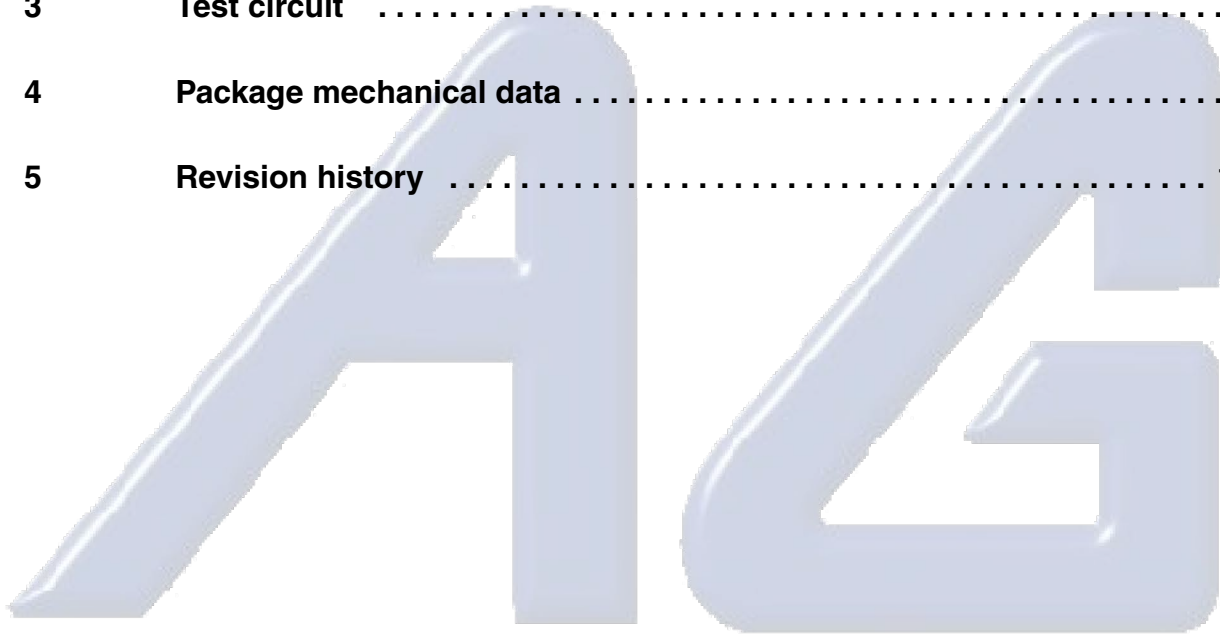


Internal schematic diagram



Contents

1	Electrical ratings	3
2	Electrical characteristics	4
	2.1 Electrical characteristics (curves)	6
3	Test circuit	8
4	Package mechanical data	9
5	Revision history	11



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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate- source voltage	± 30	V
I_D	Drain current (continuous) at $T_C = 25^\circ\text{C}$	45	A
I_D	Drain current (continuous) at $T_C = 100^\circ\text{C}$	28	A
$I_{DM}^{(1)}$	Drain current (pulsed)	180	A
P_{TOT}	Total dissipation at $T_C = 25^\circ\text{C}$	417	W
	Derating factor	3.33	W/°C
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature	-65 to 150	°C
T_j	Max. operating junction temperature	150	°C

1. Pulse width limited by safe operating area

2. $I_{SD} \leq 45\text{A}$, $di/dt \leq 400\text{A}/\mu\text{s}$, $V_{DD} \leq 80\% V_{(BR)DSS}$

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.3	°C/W
$R_{thj-amb}$	Thermal resistance junction-amb	30	°C/W
T_l	Maximum lead temperature for soldering purpose	300	°C

Table 3. Avalanche characteristics

Symbol	Parameter	Max value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	15	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 35\text{V}$)	850	mJ

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	$I_D = 250 \mu A, V_{GS} = 0$	600			V
I_{DSS}	Zero gate voltage	$V_{DS} = \text{Max rating}$			10	μA
	Drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max rating}, T_C = 125^{\circ}C$			100	μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 30V$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	3	4	5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10V, I_D = 22.5A$		0.09	0.11	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on)max}, I_D = 22.5A$		15		S
C_{iss} C_{oss} C_{rss}	Input capacitance	$V_{DS} = 25V, f = 1 \text{ MHz}, V_{GS} = 0$		3800		pF
	Output capacitance			1250		pF
	Reverse transfer capacitance			80		pF
$C_{oss eq.}^{(2)}$	Equivalent output capacitance	$V_{GS} = 0V, V_{DS} = 0V \text{ to } 480V$		340		pF
R_G	Gate input resistance	$f=1 \text{ MHz}$ Gate DC Bias = 0 test signal level = 20mV open drain		1.4		Ω
Q_g	Total gate charge	$V_{DD} = 400V, I_D = 45A,$ $V_{GS} = 10V$ <i>Figure 14</i>		96	134	nC
Q_{gs}	Gate-source charge			31		nC
Q_{gd}	Gate-drain charge			43		nC

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

2. $C_{oss eq.}$ 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}

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r	Turn-on delay time Rise time	$V_{DD} = 250V$, $I_D = 22.5A$ $R_G = 4.7\Omega$, $V_{GS} = 10V$ <i>Figure 13</i>		30 20		ns ns
$t_{r(Voff)}$ t_f t_c	Off-voltage rise time Fall time Cross-over time	$V_{DD} = 400V$, $I_D = 45A$, $R_G = 4.7\Omega$, $V_{GS} = 10V$ <i>Figure 13</i>		16 23 40		ns ns ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current				45	A
I_{SDM}	Source-drain current (pulsed)				180	A
$V_{SD}^{(1)}$	Forward on voltage	$I_{SD} = 45A$, $V_{GS} = 0$			1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD} = 45A$, $di/dt = 100A/\mu s$, $V_{DD} = 100V$, $T_j = 25^\circ C$ <i>Figure 15</i>		508 10 40		ns μC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD} = 45A$, $di/dt = 100A/\mu s$, $V_{DD} = 100V$, $T_j = 150^\circ C$ <i>Figure 15</i>		650 14 43		ns μC A

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

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2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

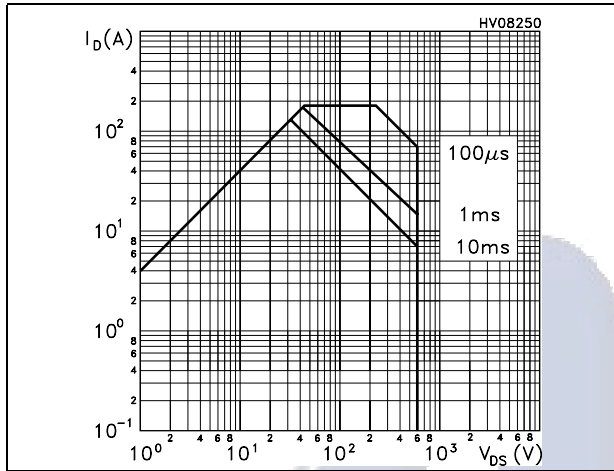


Figure 2. Thermal impedance

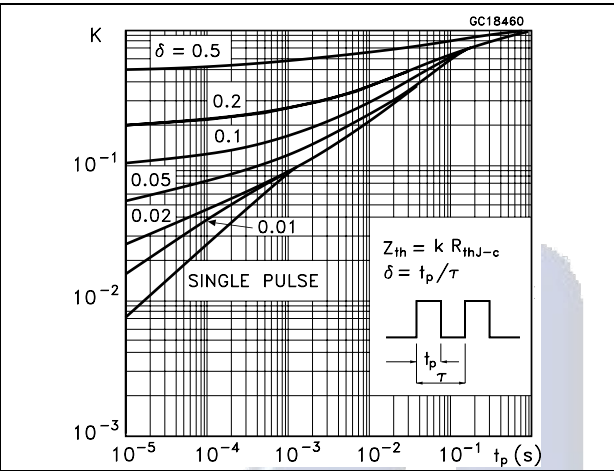


Figure 3. Output characteristics

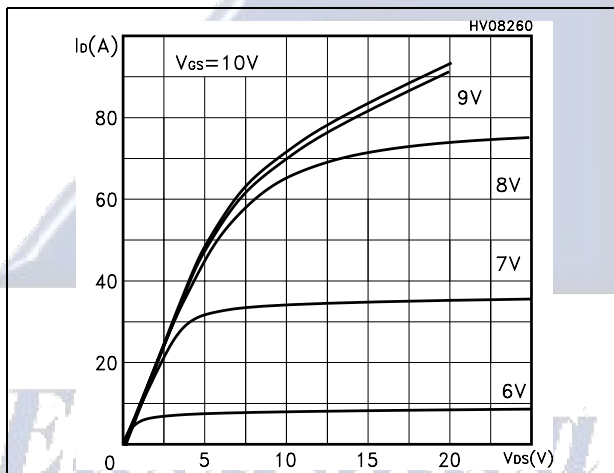


Figure 4. Transfer characteristics

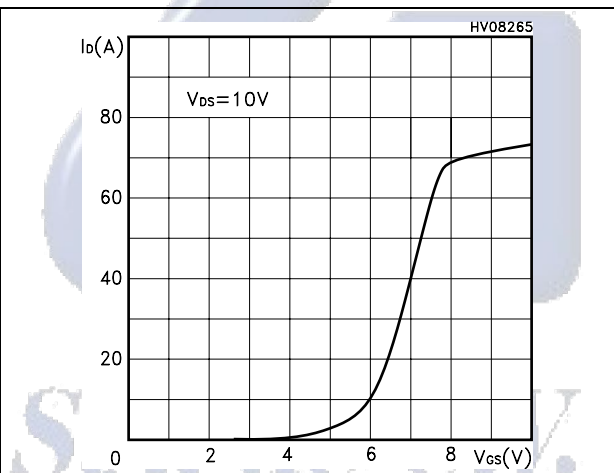


Figure 5. Transconductance

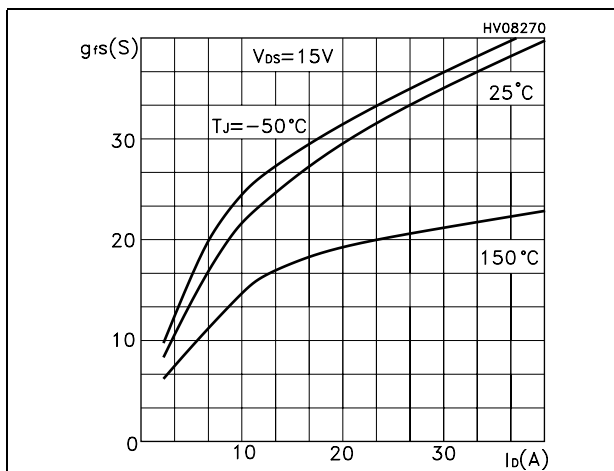
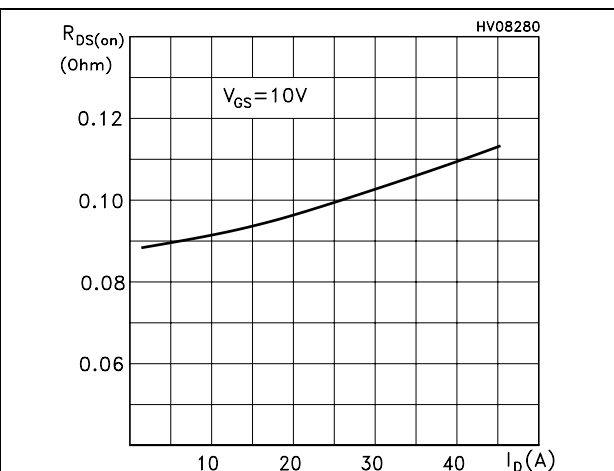


Figure 6. Static-drain source on resistance



STW45NM60

Electrical characteristics

Figure 7. Gate charge vs gate-source voltage Figure 8. Capacitance variations

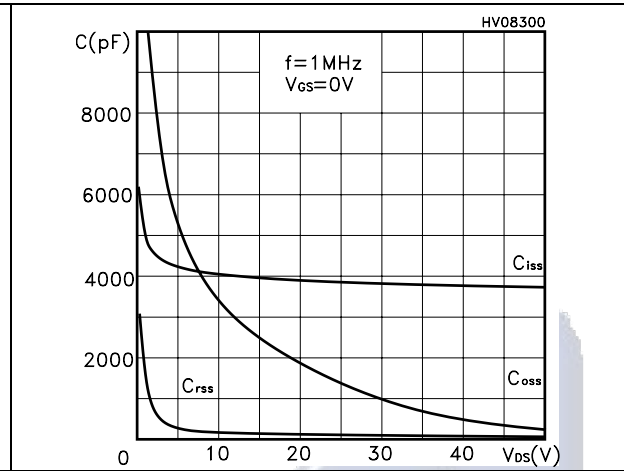
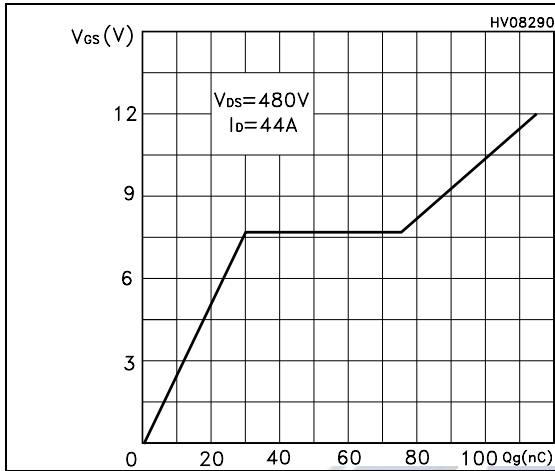


Figure 9. Normalized gate threshold voltage vs temperature

Figure 10. Normalized on resistance vs temperature

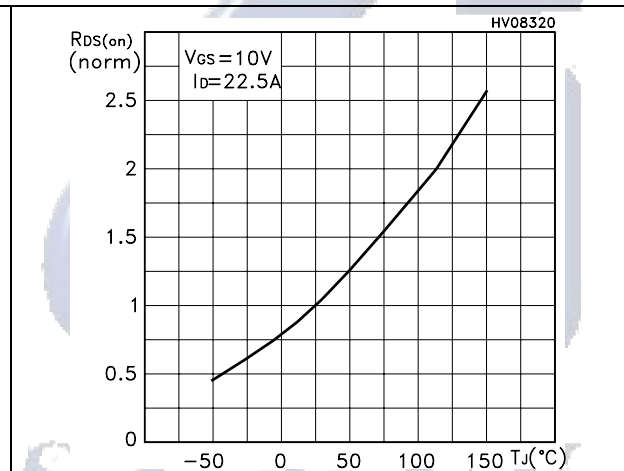
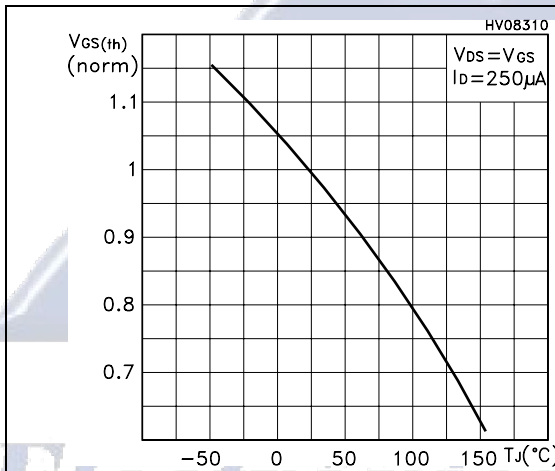
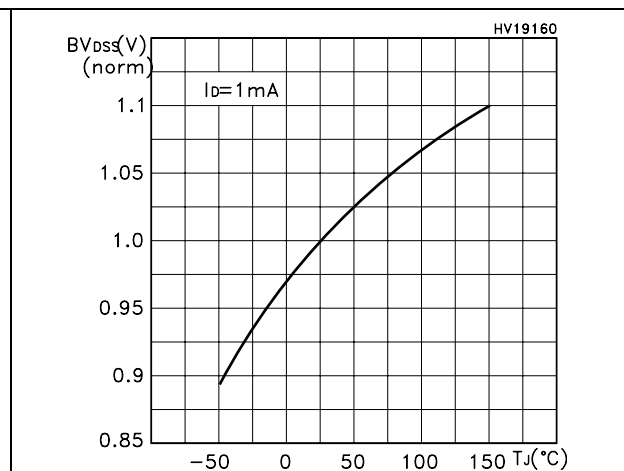
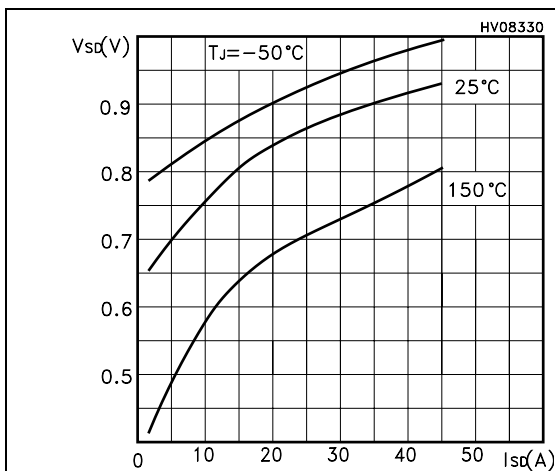


Figure 11. Source-drain diode forward characteristics

Figure 12. Normalized BV_{DSS} vs temperature



3 Test circuit

Figure 13. Switching times test circuit for resistive load

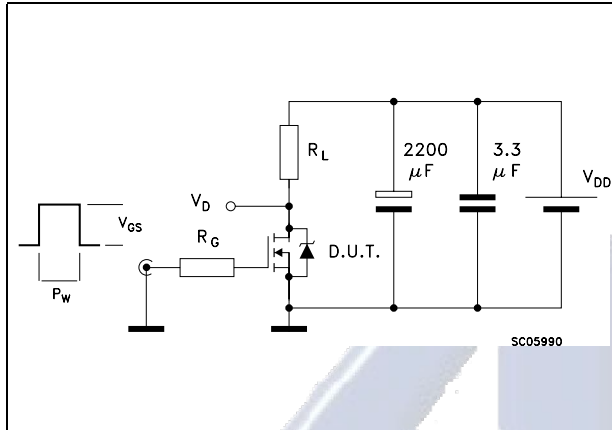


Figure 14. Gate charge test circuit

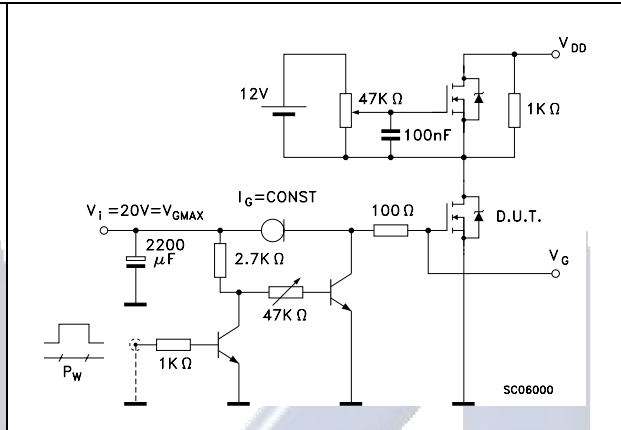


Figure 15. Test circuit for inductive load switching and diode recovery times

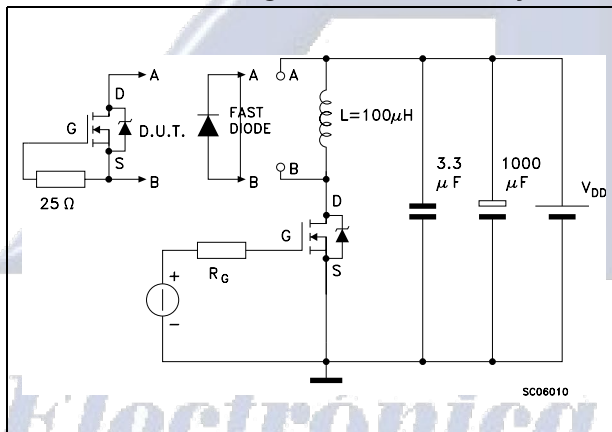


Figure 16. Unclamped inductive load test circuit

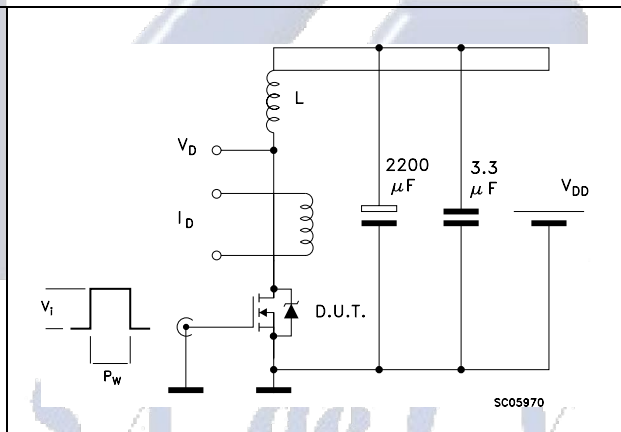


Figure 17. Unclamped inductive waveform

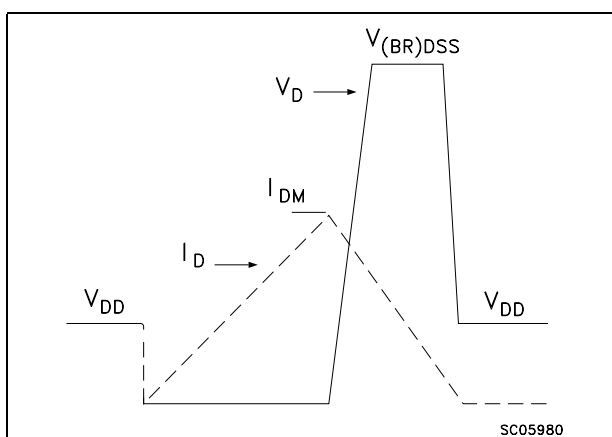
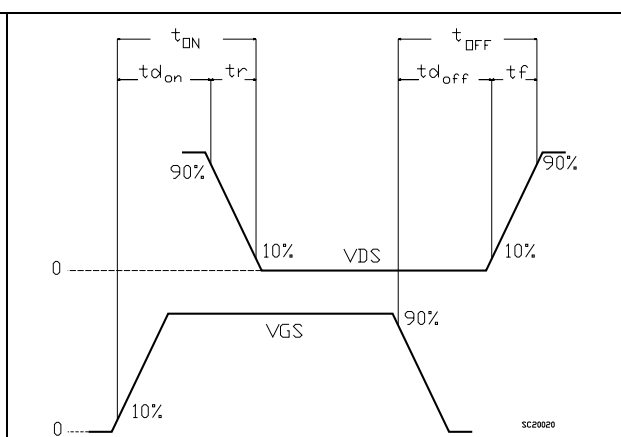


Figure 18. Switching time waveform



4 Package mechanical data

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.

AG

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5 Revision history

Table 8. Revision history

Date	Revision	Changes
05-Mar-2005	5	Complete document with curves
16-May-2006	6	The document has been reformatted
18-Dec-2006	7	Updates curves: Figure 1. , Figure 4. and Figure 6.



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