



STW45NM60D

N-channel 600 V, 0.09 Ω , 45 A TO-247
FDmesh™ Power MOSFET (with fast diode)

Features

Type	V _{DSS} (@T _{jmax})	R _{DS(on)}	I _D
STW45NM60D	650 V	< 0.11 Ω	45 A

- High dv/dt and avalanche capabilities
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Application

- Switching applications

Description

The FDmesh™ associates all advantages of reduced on-resistance and fast switching with an intrinsic fast-recovery body diode. It is therefore strongly recommended for bridge topologies, in particular ZVS phase-shift converters.

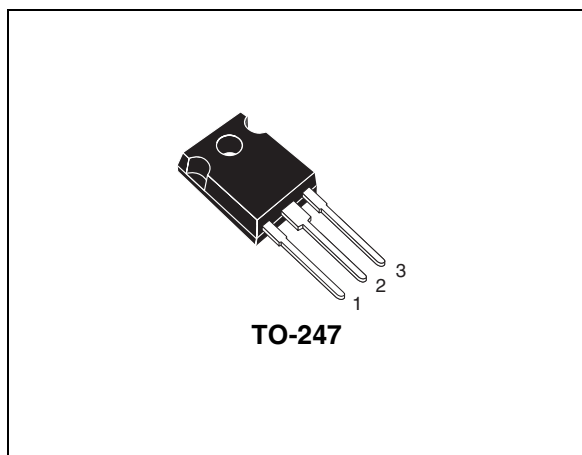


Figure 1. Internal schematic diagram

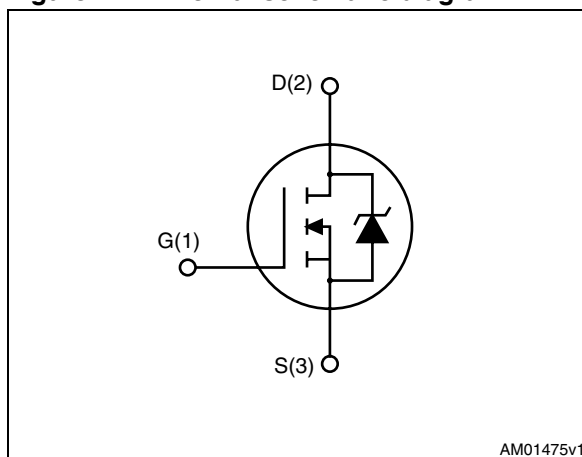


Table 1. Device summary

Order code	Marking	Package	Packaging
STW45NM60D	W45NM60D	TO-247	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	600	V
V_{GS}	Gate- source voltage	± 30	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	45	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	28	A
$I_{DM}^{(1)}$	Drain current (pulsed)	180	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	417	W
	Derating factor	3.33	W/ $^\circ\text{C}$
$dv/dt^{(2)}$	Peak diode recovery voltage slope	20	V/ns
T_{stg}	Storage temperature	-65 to 150	$^\circ\text{C}$
T_j	Max. operating junction temperature	150	$^\circ\text{C}$

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 3. Thermal data

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

Table 4. Avalanche characteristics

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

2 Electrical characteristics

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

Table 5. On/off states

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

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$, $I_D = 22.5\text{ A}$	-	30	-	S
C_{iss} C_{oss} C_{rss}	Input capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	3500	-	pF
	Output capacitance			1400		pF
	Reverse transfer capacitance			76		pF
$C_{oss\ eq.}^{(2)}$	Equivalent output capacitance	$V_{GS} = 0$, $V_{DS} = 0$ to 480 V	-	520	-	pF
R_G	Gate input resistance	f=1 MHz Gate DC Bias = 0 test signal level = 20 mV open drain	-	2	-	Ω
Q_g Q_{gs} Q_{gd}	Total gate charge	$V_{DD} = 480\text{ V}$, $I_D = 45\text{ A}$, $V_{GS} = 10\text{ V}$ <i>Figure 15</i>	-	96	-	nC
	Gate-source charge			20		nC
	Gate-drain charge			60		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 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$, $I_D = 22.5\text{ A}$ $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ <i>Figure 14</i>	-	25	-	ns
t_r	Rise time			70		ns
$t_{d(off)}$	Turn-off delay time		-	60	-	ns
t_f	Fall time			66		ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		45	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		180	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 45\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 45\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$ <i>Figure 16</i>	-	200		ns
Q_{rr}	Reverse recovery charge			2		μC
I_{RRM}	Reverse recovery current			17		A
t_{rr}	Reverse recovery time	$I_{SD} = 45\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ <i>Figure 16</i>	-	300		ns
Q_{rr}	Reverse recovery charge			4		μC
I_{RRM}	Reverse recovery current			23		A

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

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

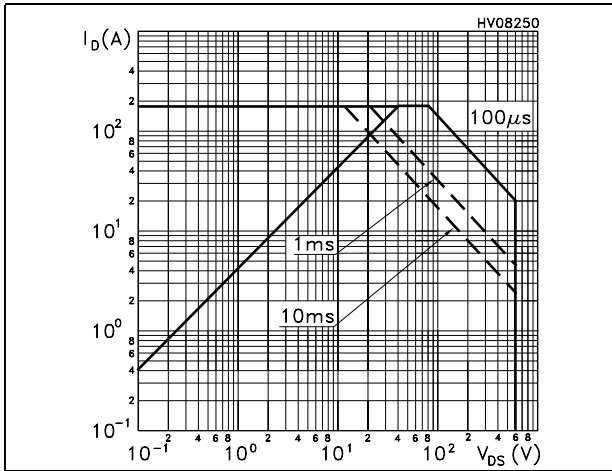


Figure 3. Thermal impedance

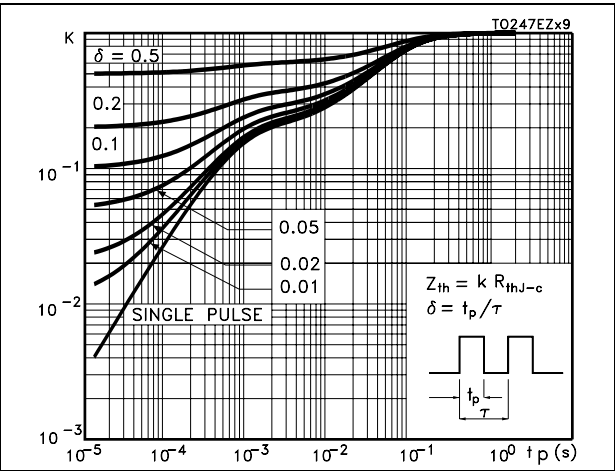


Figure 4. Output characteristics

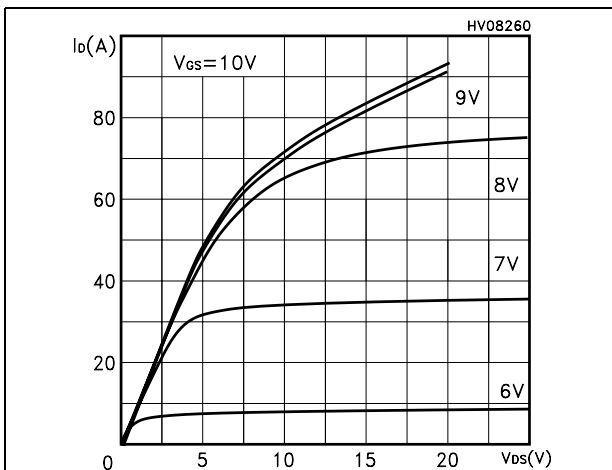


Figure 5. Transfer characteristics

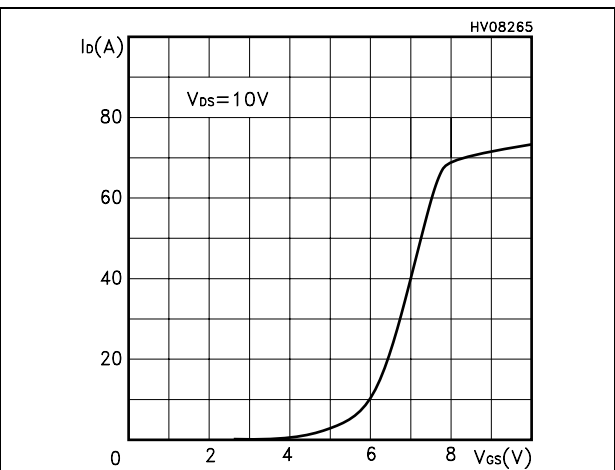


Figure 6. Transconductance

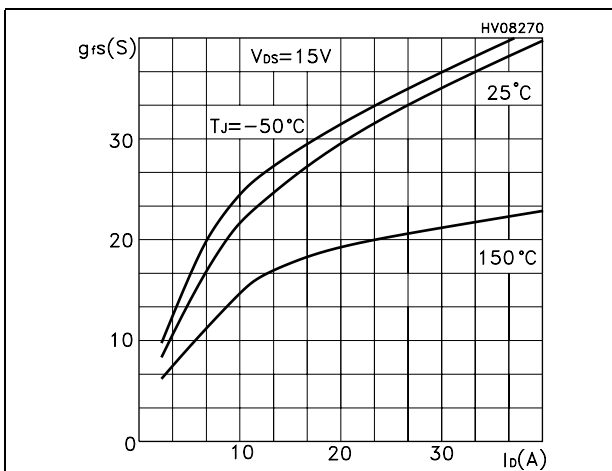


Figure 7. Static-drain source on resistance

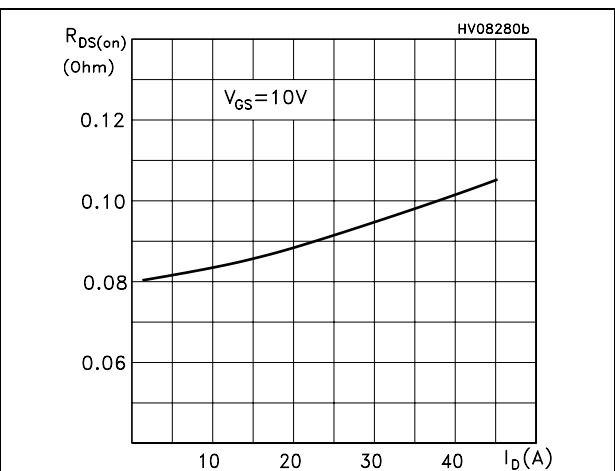


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

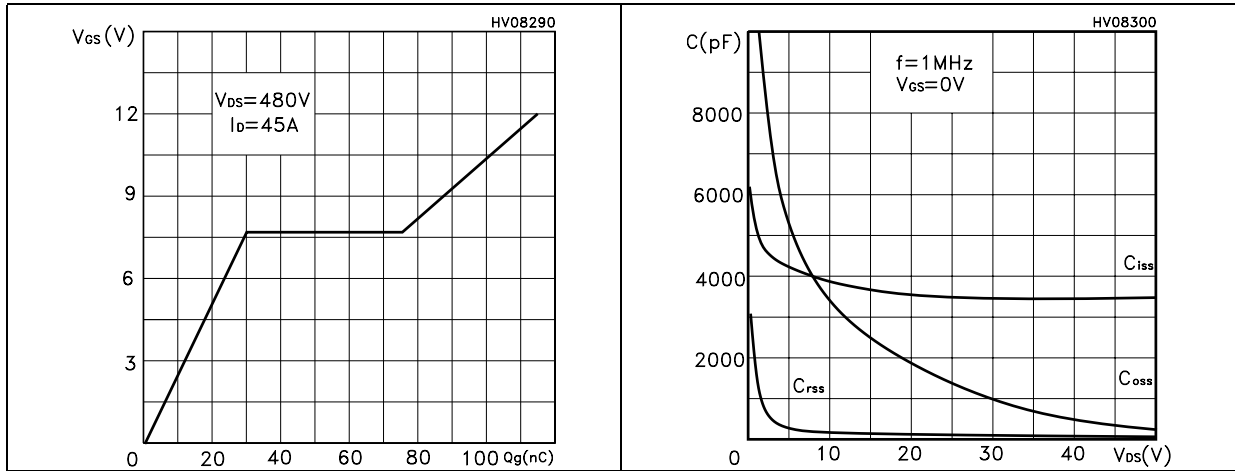


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

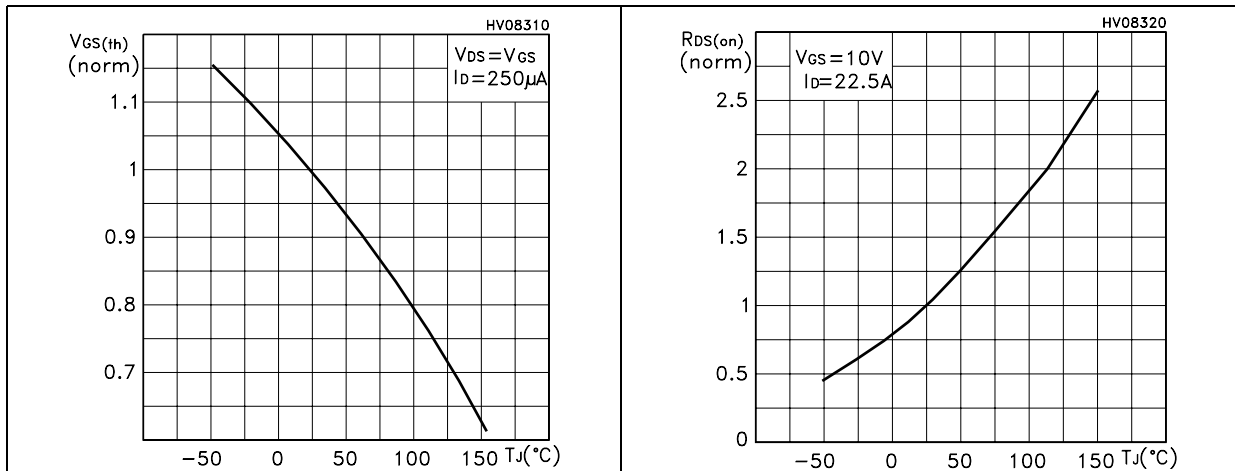
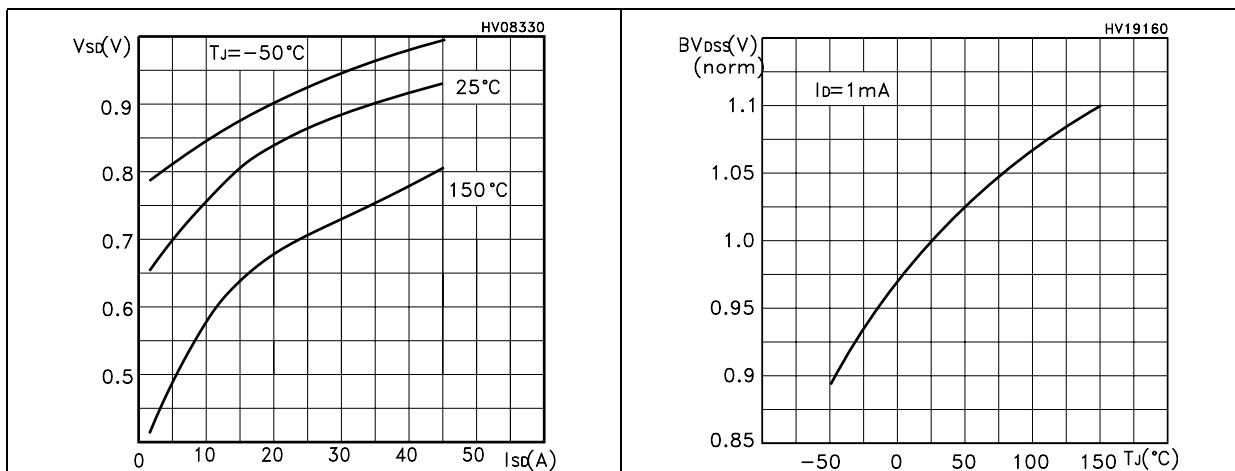


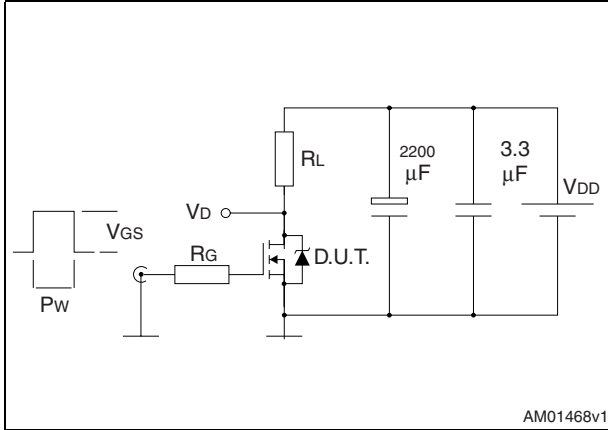
Figure 12. Source-drain diode forward characteristics Figure 13. Normalized BV_{DSS} vs temperature



Test circuit

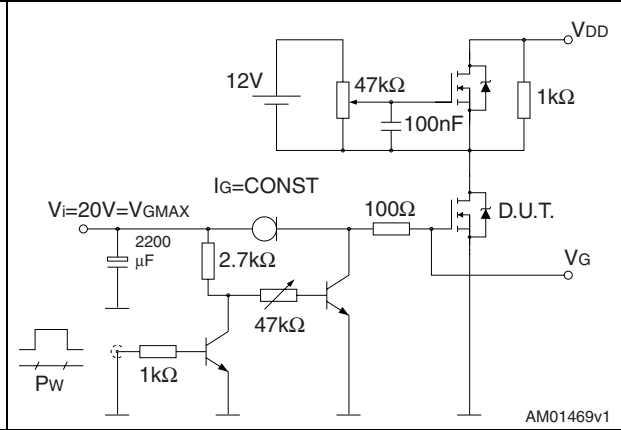
3 Test circuit

Figure 14. Switching times test circuit for resistive load



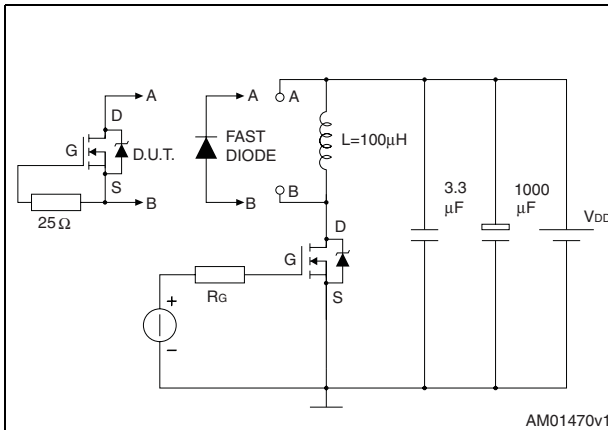
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Figure 15. Gate charge test circuit



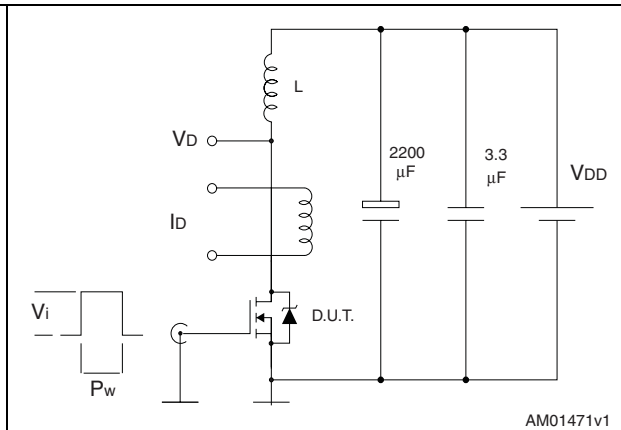
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Figure 16. Test circuit for inductive load switching and diode recovery times



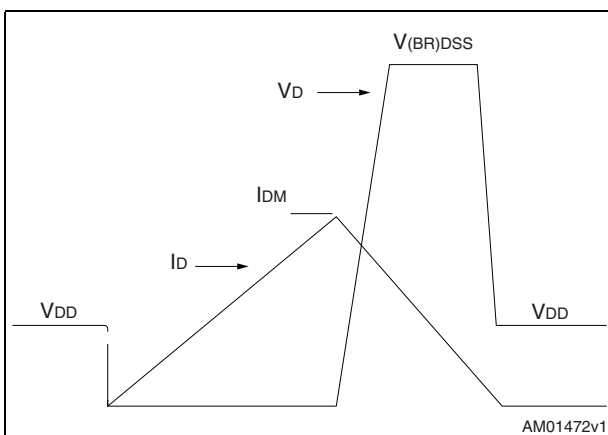
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Figure 17. Unclamped inductive load test circuit



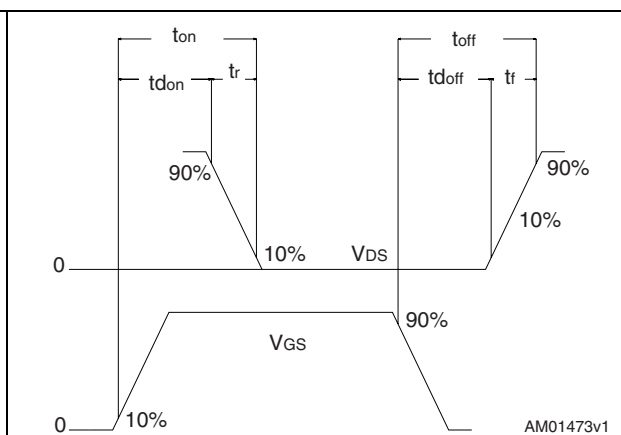
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Figure 18. Unclamped inductive waveform



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Figure 19. Switching time waveform



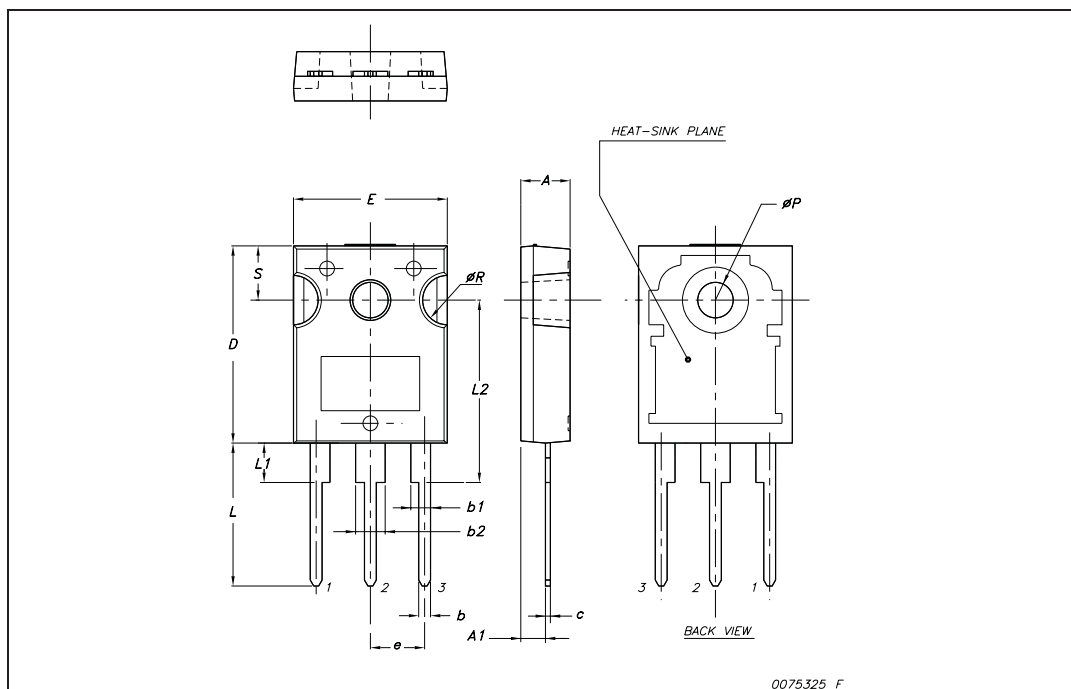
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4 Package mechanical data

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.

TO-247 Mechanical data

Dim.	mm.		
	Min.	Typ	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
$\varnothing P$	3.55		3.65
$\varnothing R$	4.50		5.50
S		5.50	



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
08-Jun-2009	1	First release

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