



STW77N65M5

N-channel 650 V, 0.033 Ω , 69 A, MDmesh™ V Power MOSFET
TO-247

Features

Type	V_{DSS} @ T_{jMAX}	$R_{DS(on)}$ max	I_D
STW77N65M5	710 V	< 0.038 Ω	69 A

- TO-247 worldwide best $R_{DS(on)}$
- Higher V_{DSS} rating
- Higher dv/dt capability
- Excellent switching performance
- Easy to drive
- 100% avalanche tested

Application

- Switching applications

Description

MDmesh V is a revolutionary Power MOSFET technology, which combines an innovative proprietary vertical process with the well known company's PowerMESH™ horizontal layout. The resulting product has an extremely low on-resistance, unmatched among silicon-based Power MOSFETs, making it especially suited for applications which require superior power density and outstanding efficiencies.

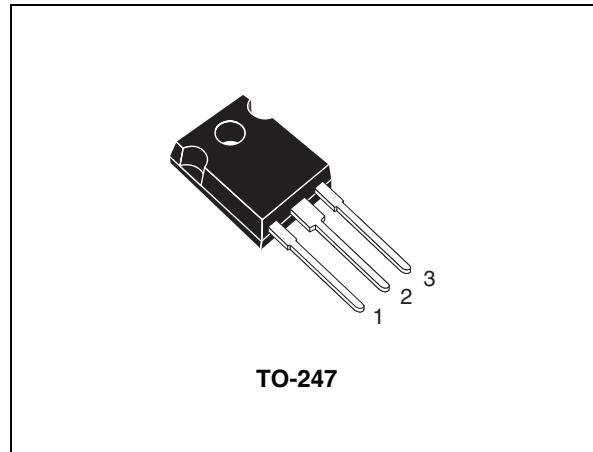


Figure 1. Internal schematic diagram

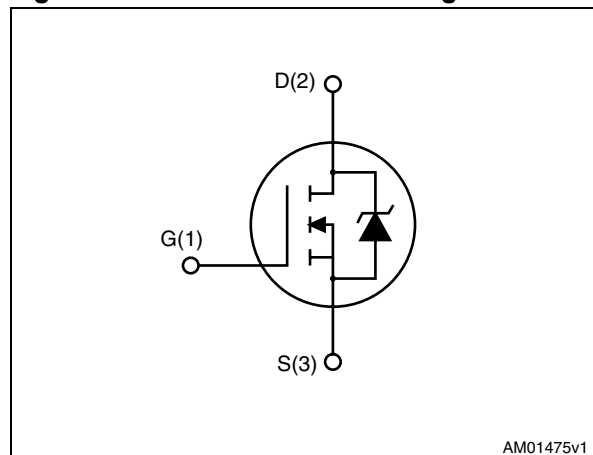


Table 1. Device summary

Order codes	Marking	Package	Packaging
STW77N65M5	77N65M5	TO-247	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate- source voltage	25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	69	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	41.5	A
$I_{DM}^{(1)}$	Drain current (pulsed)	276	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	400	W
I_{AR}	Max current during repetitive or single pulse avalanche (pulse width limited by T_{JMAX})	15	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	2000	mJ
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature	- 55 to 150	$^\circ\text{C}$
T_j	Max. operating junction temperature	150	$^\circ\text{C}$

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 69\text{ A}$, $di/dt = 400\text{ A}/\mu\text{s}$, peak $V_{DS} < V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.31	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	50	$^\circ\text{C}/\text{W}$
T_l	Maximum lead temperature for soldering purpose	300	$^\circ\text{C}$

2 Electrical characteristics

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

Table 4. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}, V_{GS} = 0$	650			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}, T_C = 125\text{ °C}$			1 100	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 25\text{ V}$			100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}, I_D = 34.5\text{ A}$		0.030	0.038	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz},$ $V_{GS} = 0$	-	9800	-	pF
C_{oss}	Output capacitance			200		pF
C_{rss}	Reverse transfer capacitance			6		pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{GS} = 0, V_{DS} = 0\text{ to }520\text{ V}$	-	590	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related	$V_{GS} = 0, V_{DS} = 0\text{ to }520\text{ V}$	-	1000	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz open drain}$	-	1.2	-	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}, I_D = 34.5\text{ A},$ $V_{GS} = 10\text{ V}$ (see Figure 16)	-	200	-	nC
Q_{gs}	Gate-source charge			60		nC
Q_{gd}	Gate-drain charge			70		nC

- $C_{oss\text{ eq.}}$ time related 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}
- $C_{oss\text{ eq.}}$ energy related is defined as a constant equivalent capacitance giving the same stored 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	$V_{DD} = 400\text{ V}$, $I_D = 40\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 17)	-	36	-	ns
t_r	Rise time			90		ns
$t_{d(off)}$	Turn-off-delay time			130		ns
t_f	Fall time			40		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		69	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				276	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 34.5\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 34.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ (see Figure 17)	-	540		ns
Q_{rr}	Reverse recovery charge			12		nC
I_{RRM}	Reverse recovery current			46		A
t_{rr}	Reverse recovery time	$I_{SD} = 34.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 17)	-	660		ns
Q_{rr}	Reverse recovery charge			18		nC
I_{RRM}	Reverse recovery current			55		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

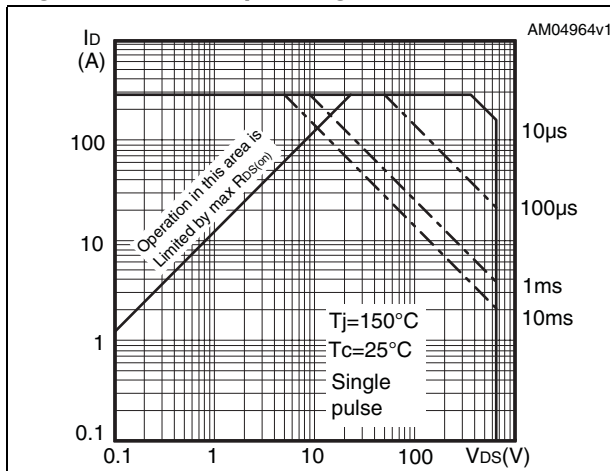


Figure 3. Thermal impedance

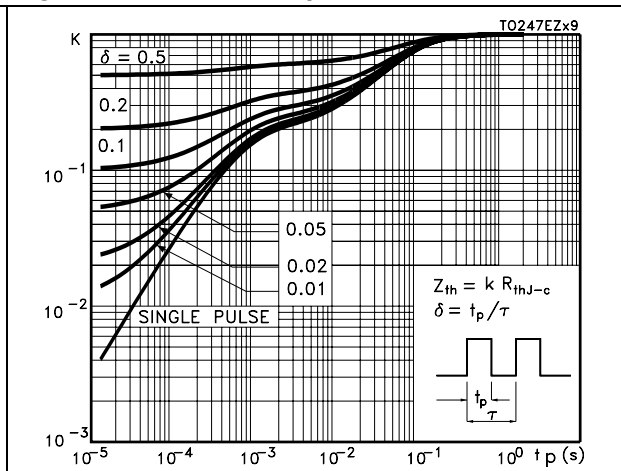


Figure 4. Output characteristics

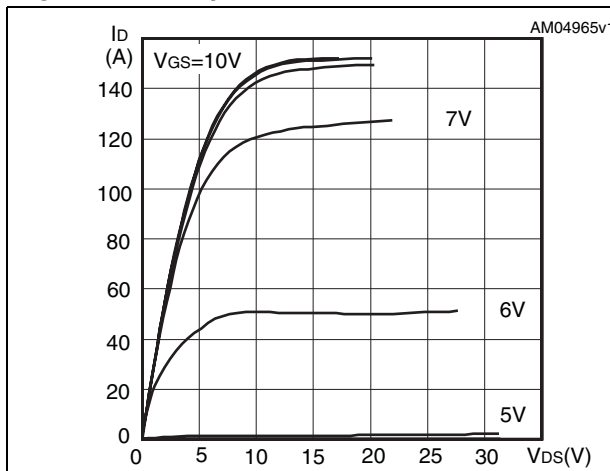


Figure 5. Transfer characteristics

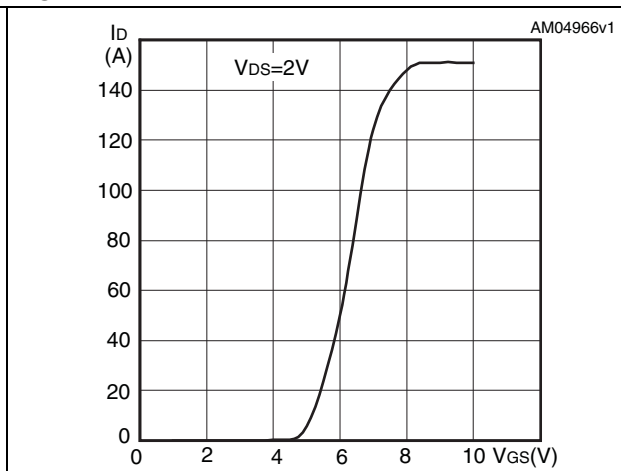


Figure 6. Gate charge vs gate-source voltage

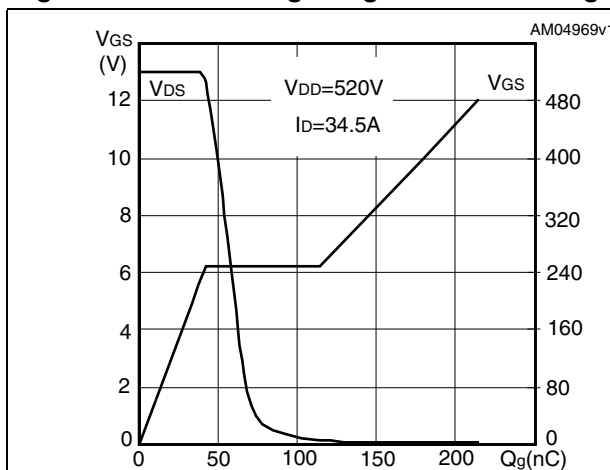


Figure 7. Static drain-source on resistance

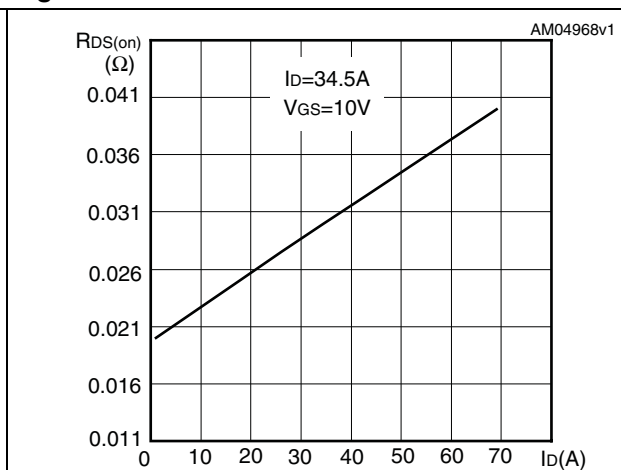


Figure 8. Capacitance variations

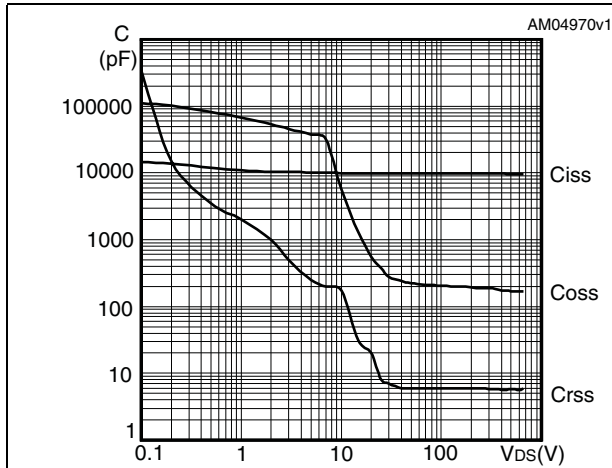


Figure 9. Output capacitance stored energy

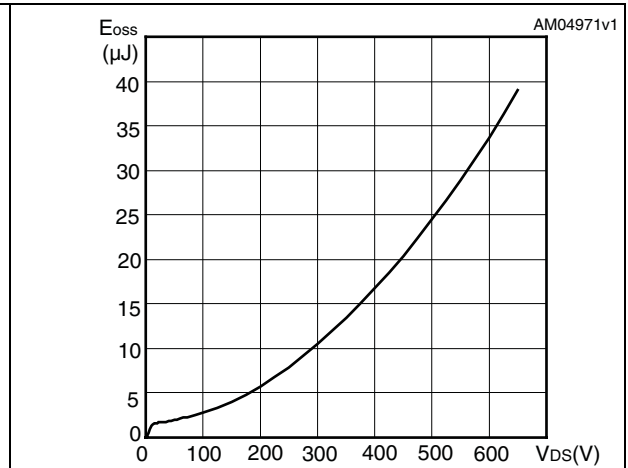


Figure 10. Normalized gate threshold voltage vs temperature

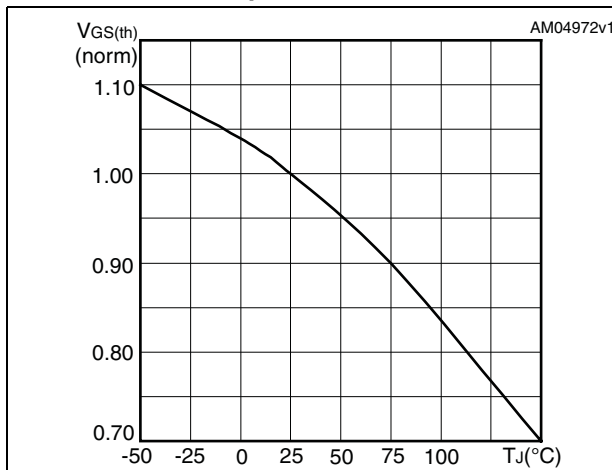


Figure 11. Normalized on resistance vs temperature

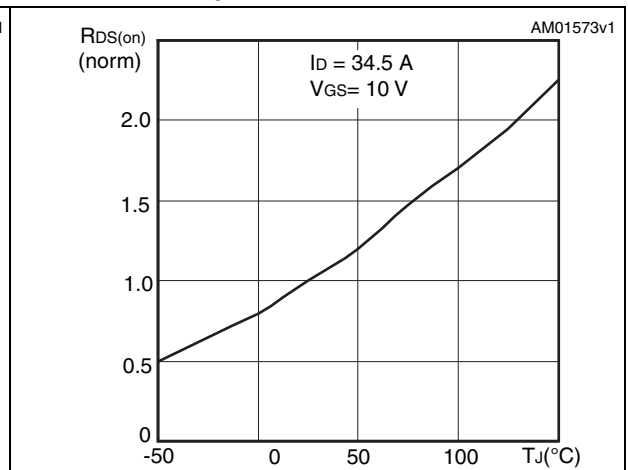


Figure 12. Source-drain diode forward characteristics

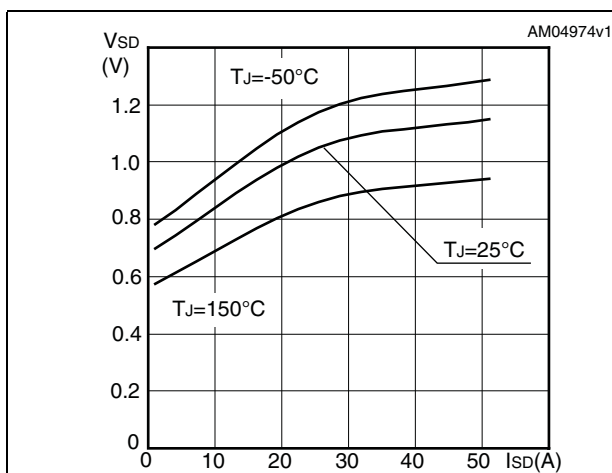


Figure 13. Normalized B_{VDSS} vs temperature

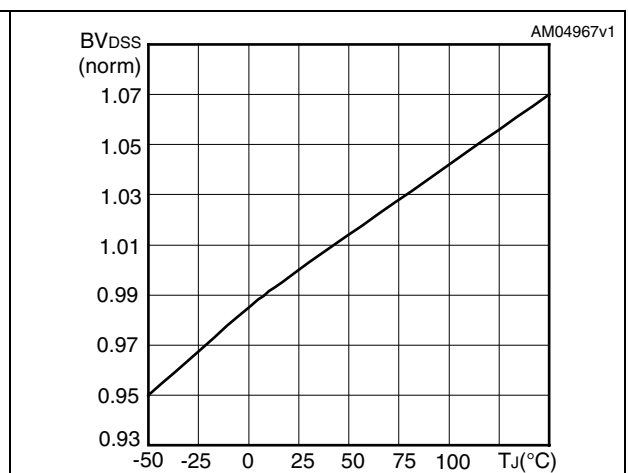
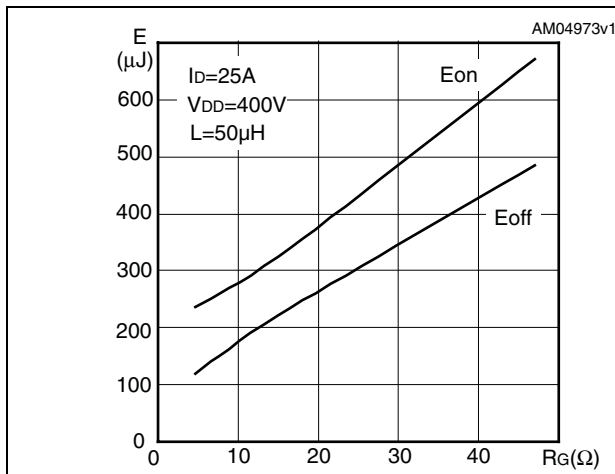


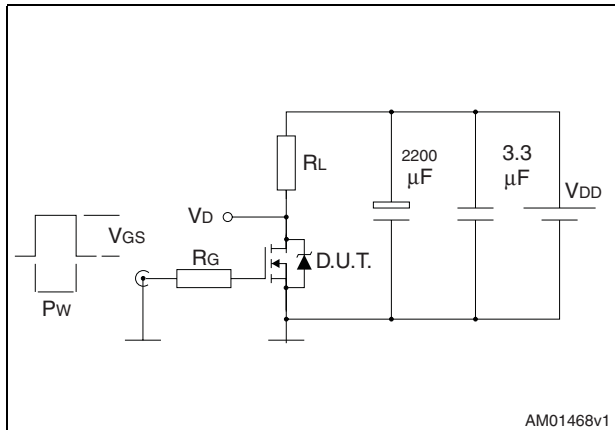
Figure 14. Switching losses vs gate resistance
(1)



1. E_{on} including reverse recovery of a SiC diode

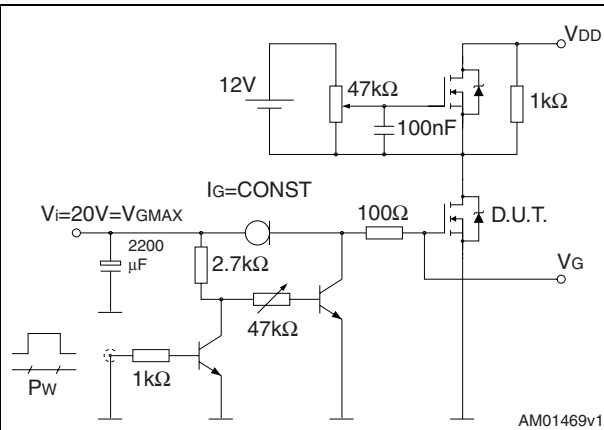
3 Test circuits

Figure 15. Switching times test circuit for resistive load



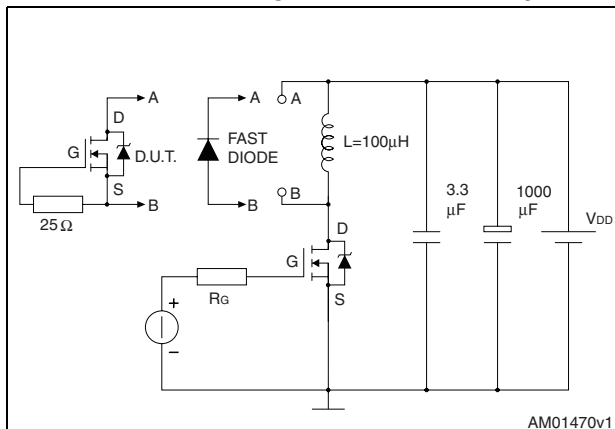
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Figure 16. Gate charge test circuit



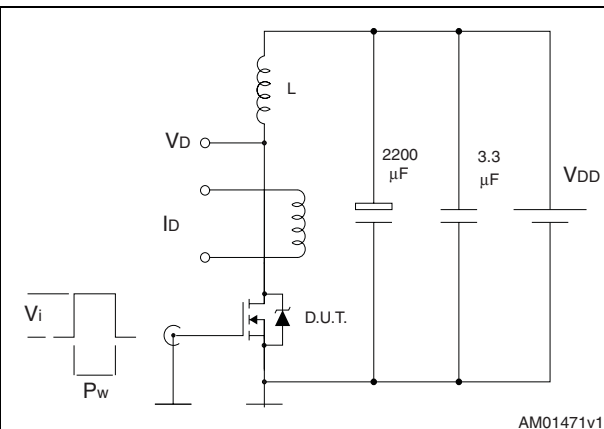
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Figure 17. Test circuit for inductive load switching and diode recovery times



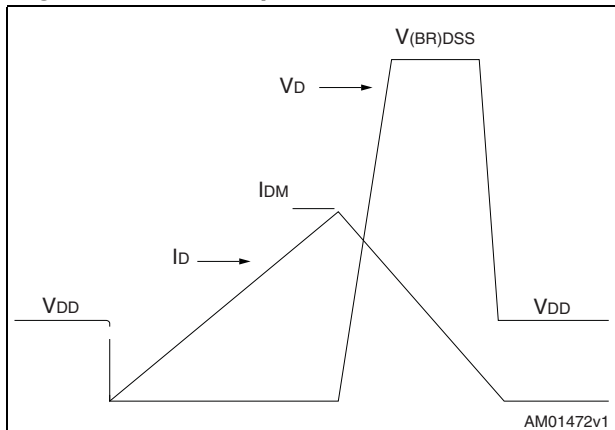
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Figure 18. Unclamped inductive load test circuit



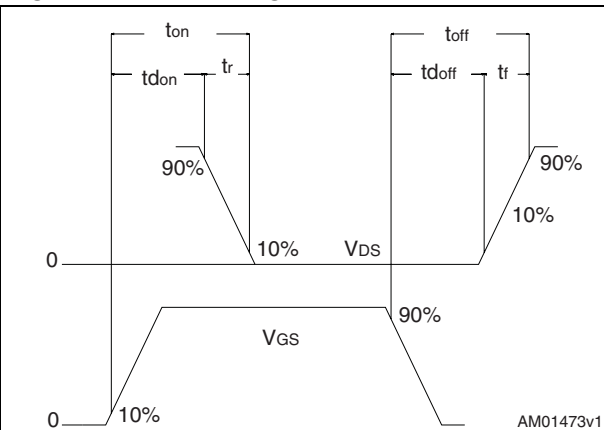
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Figure 19. Unclamped inductive waveform



AM01472v1

Figure 20. Switching time waveform



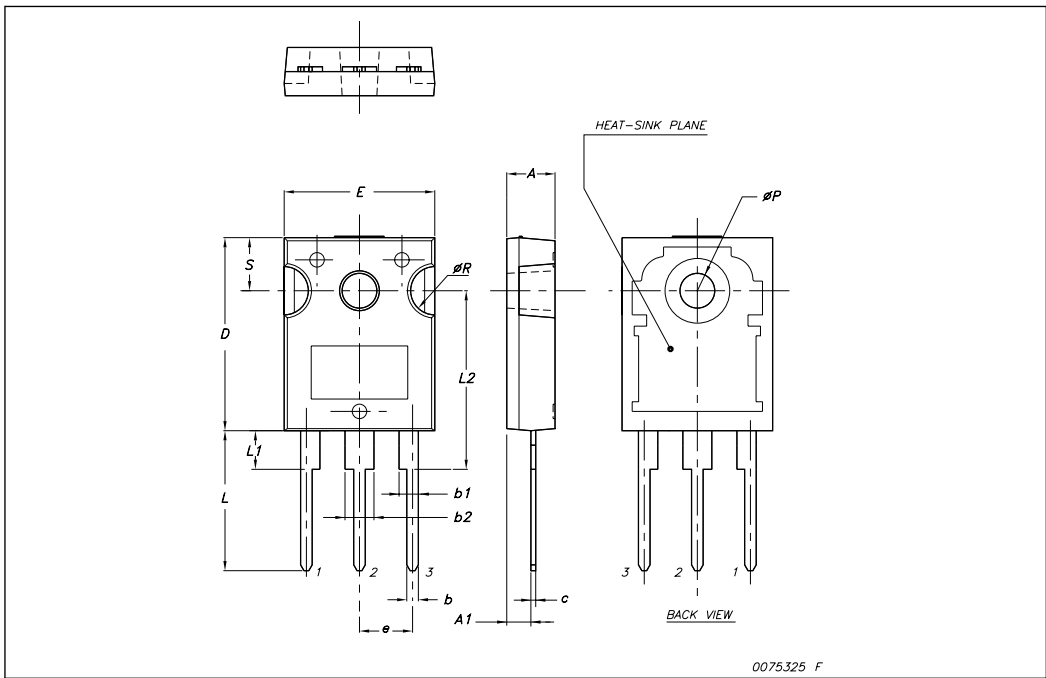
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4 Package mechanical data

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	
øP	3.55		3.65
øR	4.50		5.50
S		5.50	



5 Revision history

Table 8. Document revision history

Date	Revision	Changes
20-Jan-2009	1	First release.
14-Jul-2009	2	Document status promoted from preliminary data to datasheet.

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