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STW54NM65ND

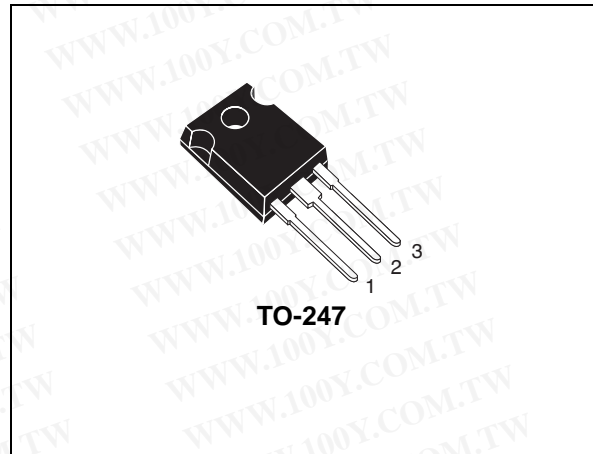
N-channel 650 V, 0.055 Ω typ., 49 A FDmesh™ II Power MOSFET (with fast diode) in a TO-247 package

Datasheet — production data

Features

Order code	V _{DSS} (@T _{jmax})	R _{DS(on)} max.	I _D
STW54NM65ND	710 V	< 0.065 Ω	49 A

- The worldwide best R_{DS(on)} * area amongst the fast recovery diode devices
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance
- Extremely high dv/dt and avalanche capabilities



Application

Switching applications

Description

The device is an N-channel FDmesh™ II Power MOSFET that belongs to the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip layout and 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

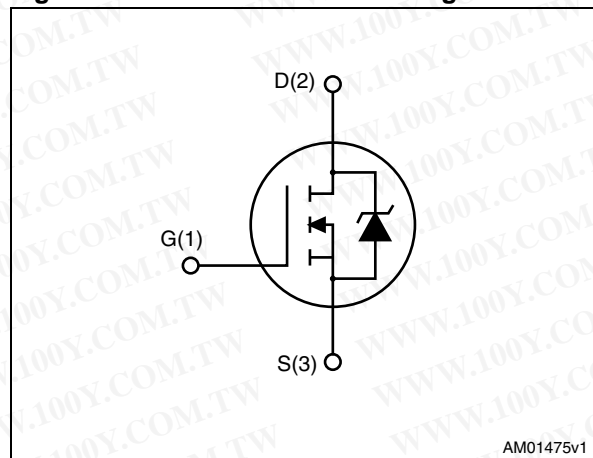


Table 1. Device summary

Order code	Marking	Package	Packaging
STW54NM65ND	54NM65ND	TO-247	Tube

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
2.1	Electrical characteristics (curves)	6
3	Test circuits	8
4	Package mechanical data	9
5	Revision history	12



1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	650	V
V_{GS}	Gate- source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	49	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	31	A
$I_{DM}^{(1)}$	Drain current (pulsed)	196	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	350	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	40	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. $I_{SD} \leq 49\text{ A}$, $di/dt \leq 600\text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.36	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	50	$^\circ\text{C}/\text{W}$
T_l	Maximum lead temperature for soldering purpose	300	$^\circ\text{C}$

Table 4. Avalanche characteristics

Symbol	Parameter	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 $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$)	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	$I_D = 1\text{ mA}, V_{GS} = 0$	650			V
$dv/dt^{(1)}$	Drain source voltage slope	$V_{DD} = 480\text{ V}, I_D = 49\text{ A}, V_{GS} = 10\text{ V}$		30		V/ns
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 650\text{ V}$ $V_{DS} = 650\text{ V}, T_C = 125\text{ °C}$			10 100	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{ V}$			± 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	$V_{GS} = 10\text{ V}, I_D = 24.5\text{ A}$		0.055	0.065	Ω

1. Characteristic value at turn off on inductive load.

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance			6200		pF
C_{oss}	Output capacitance	$V_{DS} = 50\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$	-	218	-	pF
C_{rss}	Reverse transfer capacitance			10		pF
$C_{oss\text{ eq.}}^{(1)}$	Output equivalent capacitance	$V_{DS}=0\text{ to }200\text{ V } V_{GS}=0$	-	850	-	pF
Q_g	Total gate charge	$V_{DD} = 520\text{ V}, I_D = 49\text{ A}, V_{GS} = 10\text{ V},$ (see Figure 14)	-	188	-	nC
Q_{gs}	Gate-source charge			32		nC
Q_{gd}	Gate-drain charge			100		nC
t_c	Crossing time	$V_{DD} = 520\text{ V}, I_D = 49\text{ A}, R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$		33		ns
t_r	Rise time			59		ns
$t_{d(off)}$	Turn-off delay time	(see Figure 17),		152		ns
t_f	Fall time	(see Figure 13)		98		ns
R_g	Gate input resistance	$f=1\text{ MHz}$ gate DC bias=0 Test signal level = 20 mV open drain	-	1.9	-	Ω

1. $C_{oss\text{ eq.}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DS} .

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_{SD}	Source-drain current		-		49	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		196	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 49 \text{ A}, V_{GS} = 0$	-		1.3	V
t_{rr}	Reverse recovery time	$I_{SD} = 49 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$		212		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60 \text{ V}$	-	2		μC
I_{RRM}	Reverse recovery current	<i>Figure 15</i>		19		A
t_{rr}	Reverse recovery time	$I_{SD} = 49 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$		296		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60 \text{ V}, T_j = 150 \text{ }^\circ\text{C}$	-	4		μC
I_{RRM}	Reverse recovery current	<i>Figure 15</i>		28		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

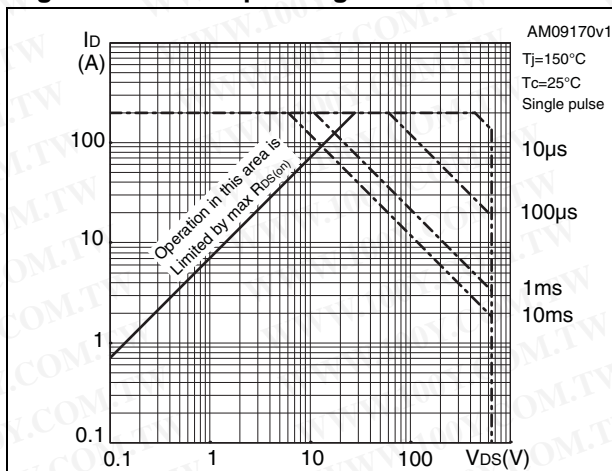


Figure 3. Thermal impedance

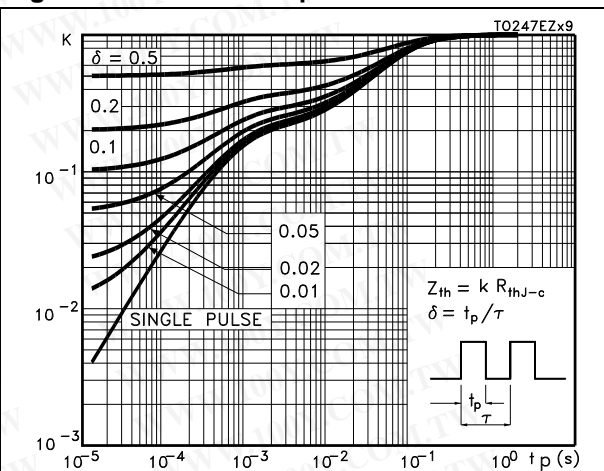


Figure 4. Output characteristics

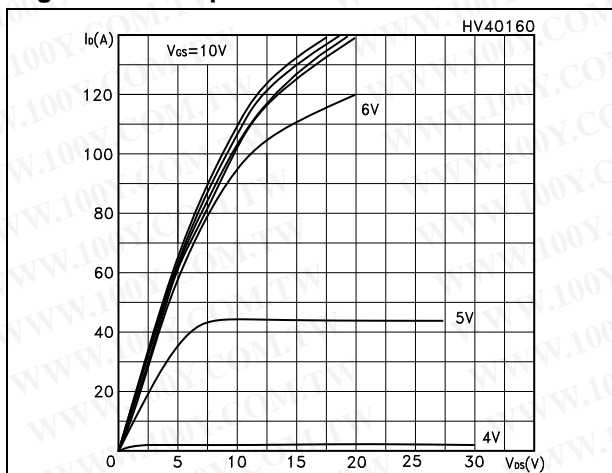


Figure 5. Transfer characteristics

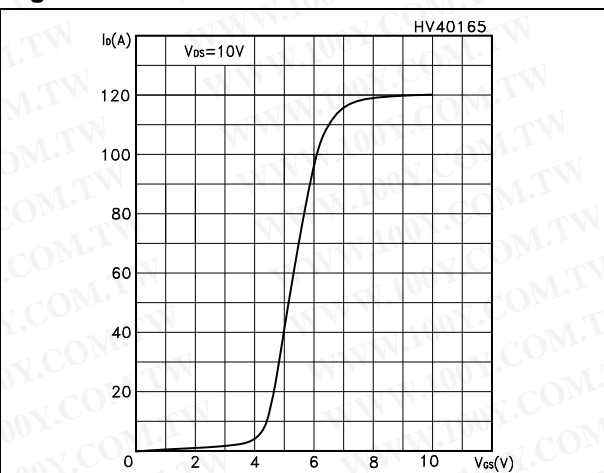


Figure 6. Normalized B_{VDS} vs temperature

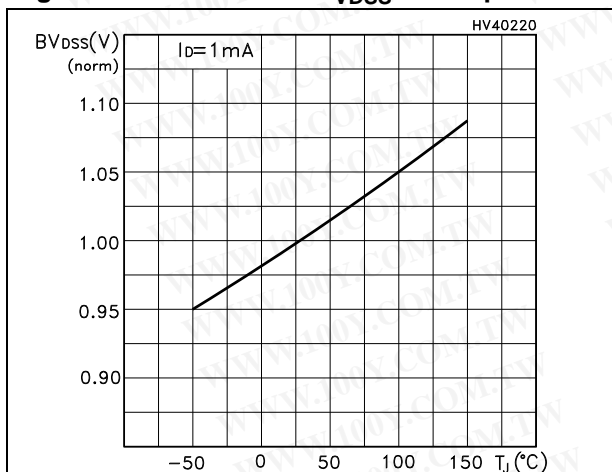


Figure 7. Static drain-source on-resistance

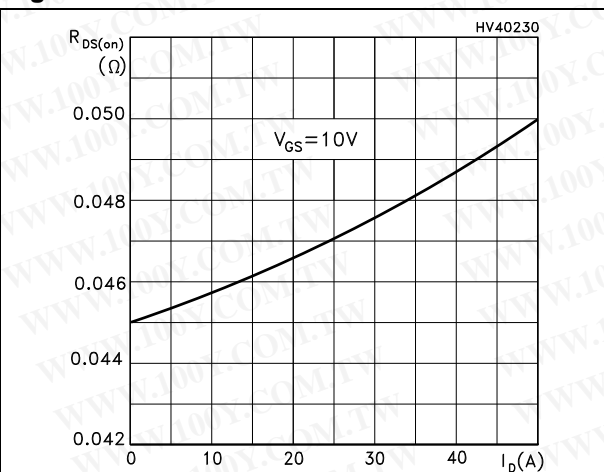


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

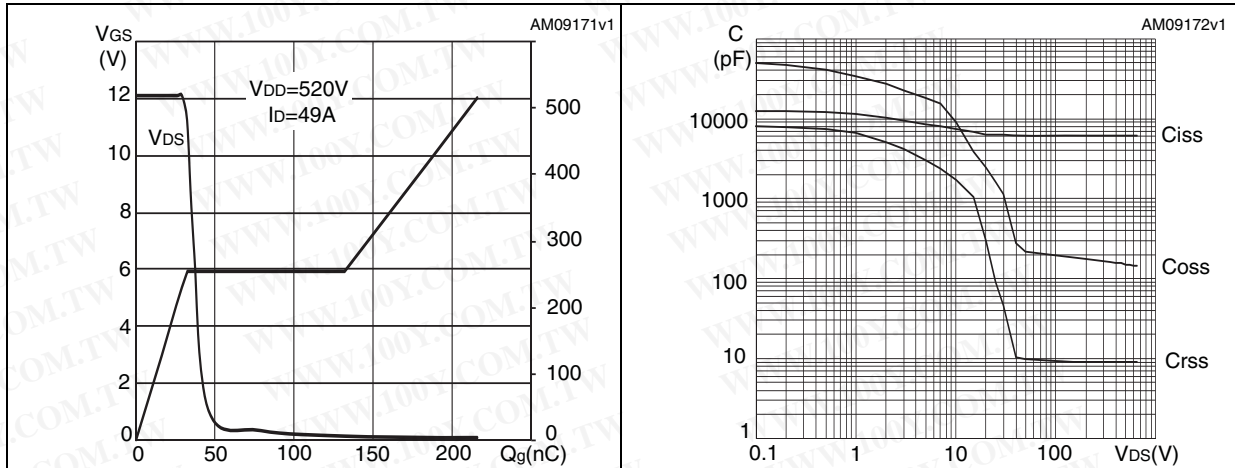


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

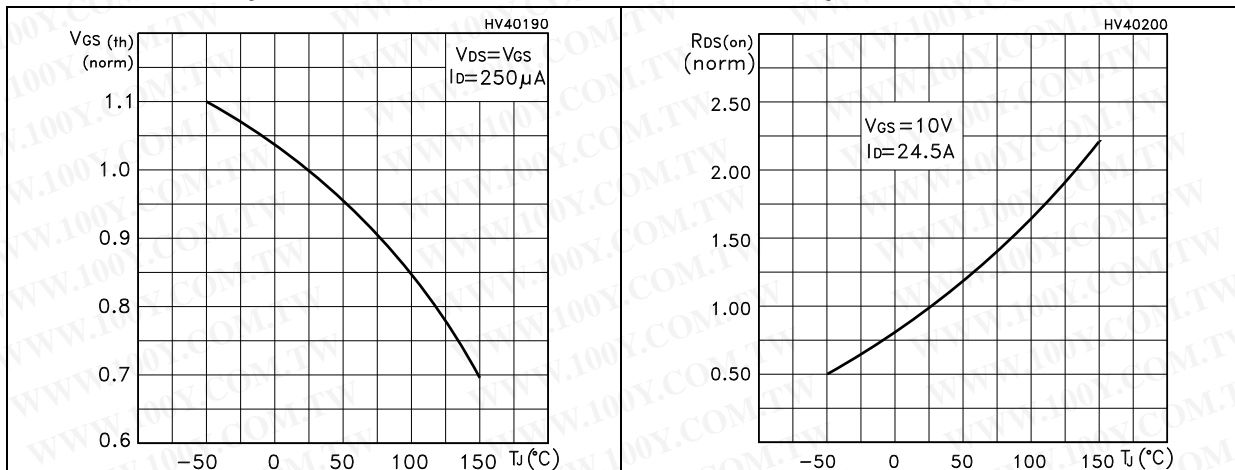
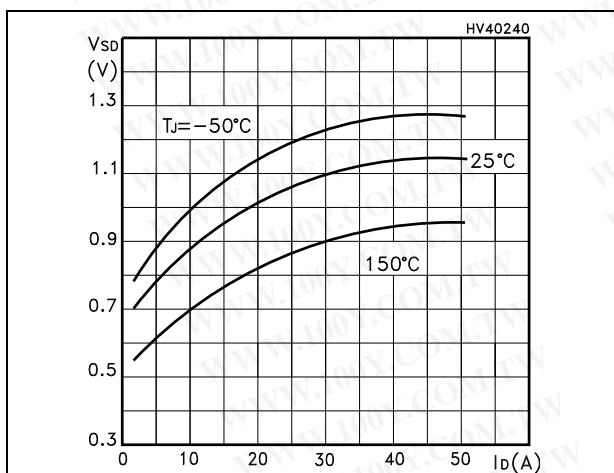


Figure 12. Source-drain diode forward characteristics



3 Test circuits

Figure 13. Switching times test circuit for resistive load

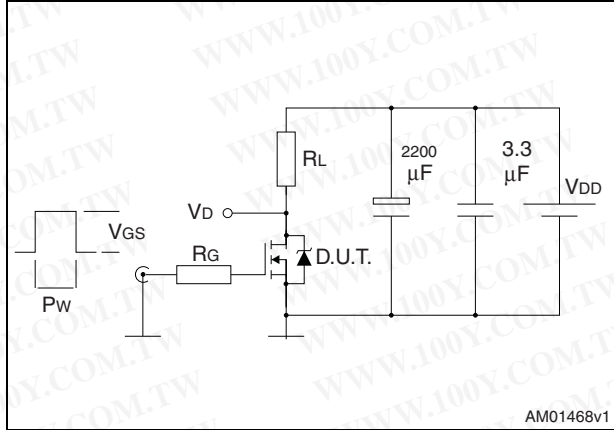


Figure 14. Gate charge test circuit

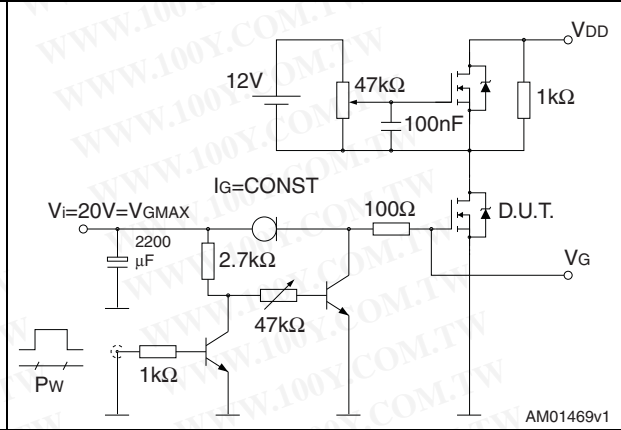


Figure 15. Test circuit for inductive load switching and diode recovery times

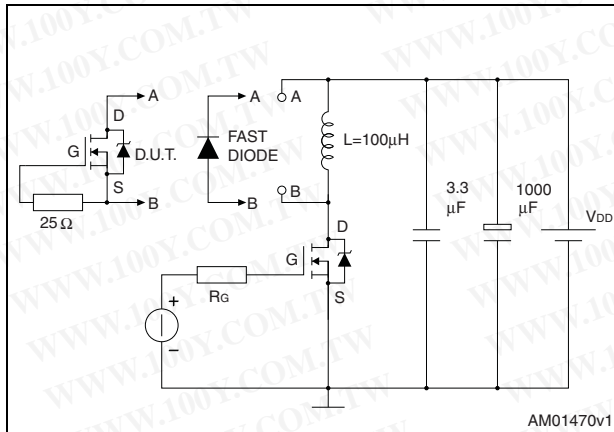


Figure 16. Unclamped inductive load test circuit

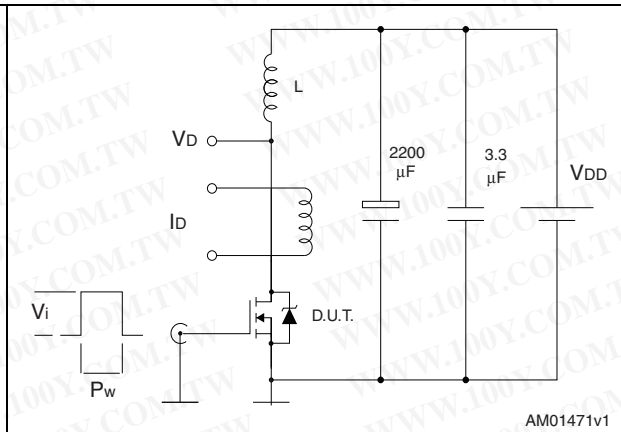


Figure 17. Unclamped inductive waveform

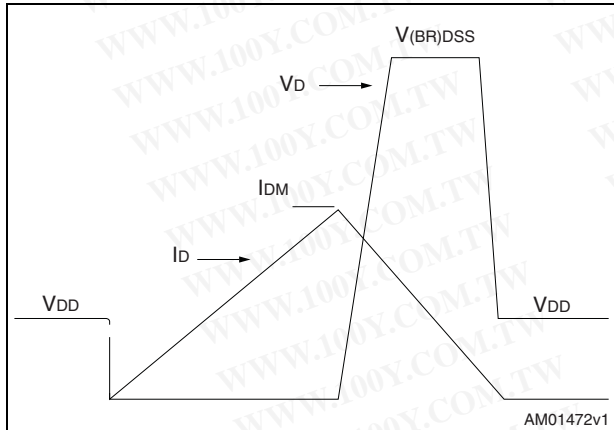
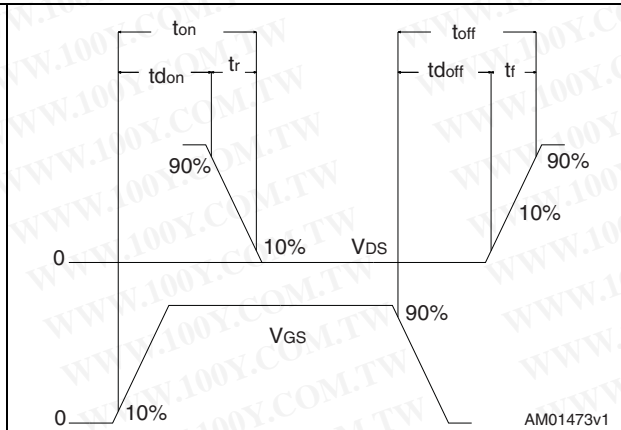


Figure 18. Switching time waveform



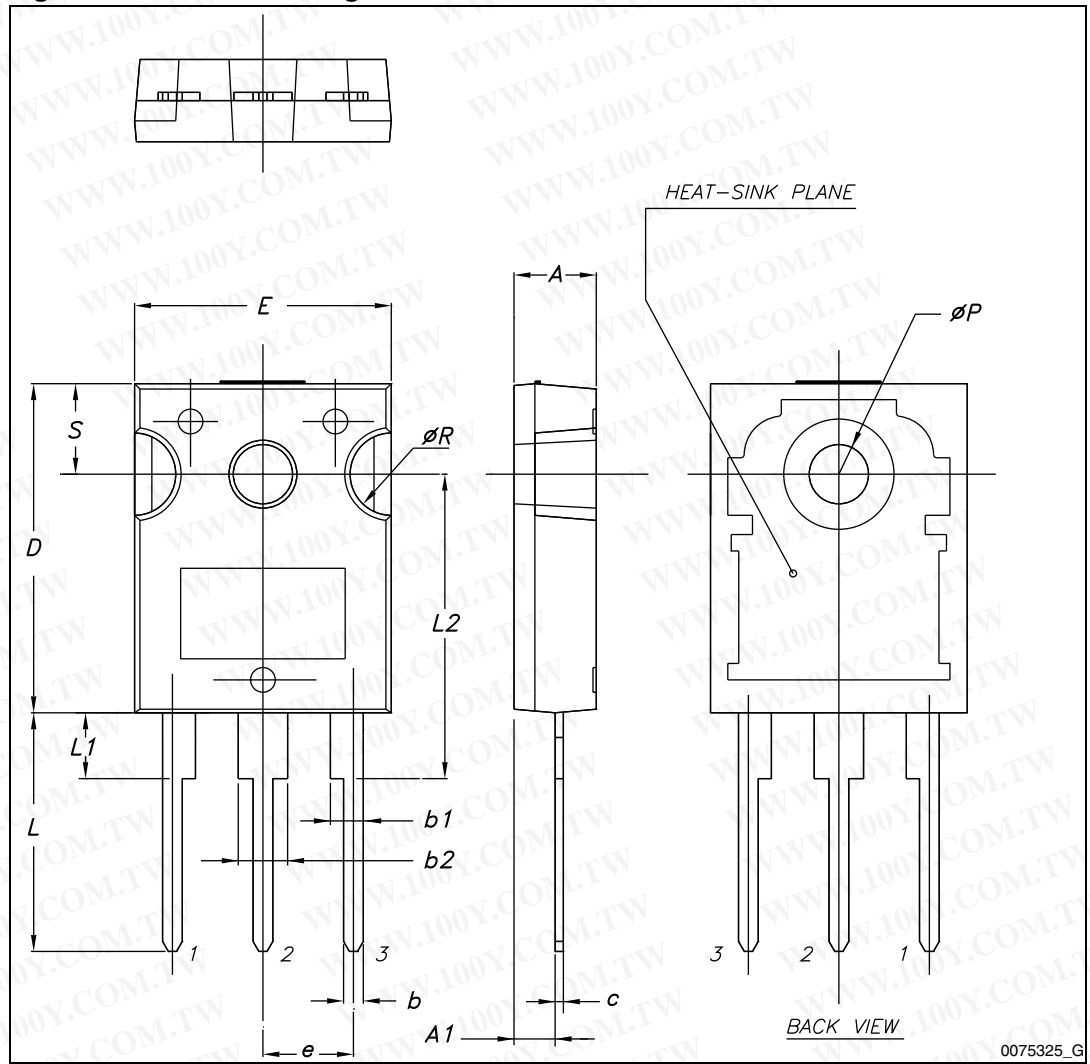
4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in 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.

Table 8. 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	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

Figure 19. TO-247 drawing



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
03-Jun-2011	1	Initial release
19-Dec-2012	2	Updated title on the cover page. Inserted dv/dt parameter in Table 5 . Updated Section 4: Package mechanical data .

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