



STW36NM60N

N-channel 600 V, 0.092 Ω , 29 A, MDmesh™ II Power MOSFET
in TO-247

Features

Order code	V _{DSS} @ T _{Jmax}	R _{DS(on)} max	I _D	P _W
STW36NM60N	650 V	< 0.105 Ω	29 A	210 W

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Application

- Switching applications
 - Automotive

Description

This device is made using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

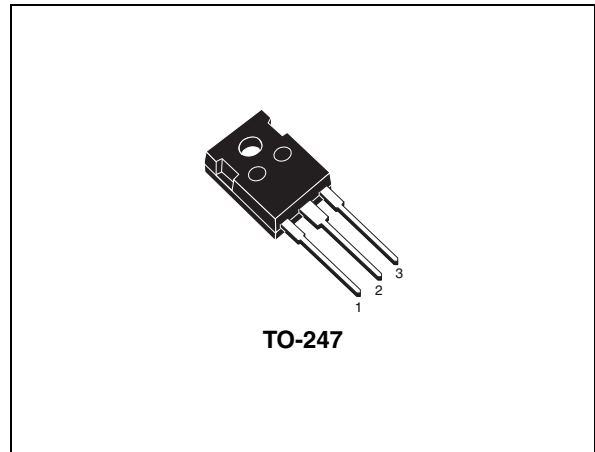


Figure 1. Internal schematic diagram

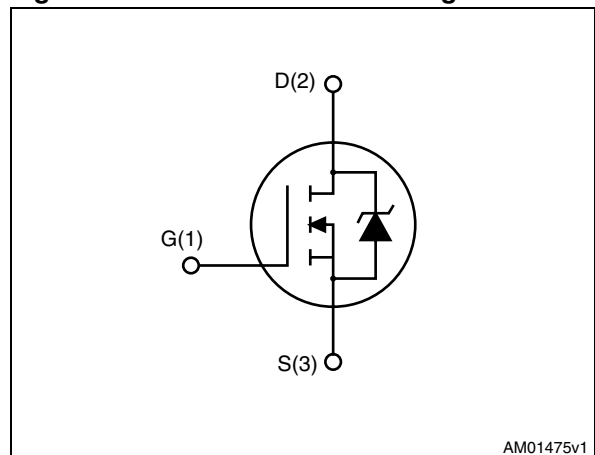


Table 1. Device summary

Order code	Marking	Package	Packaging
STW36NM60N	36NM60N	TO-247	Tape and reel

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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	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	29	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	18	A
$I_{DM}^{(1)}$	Drain current (pulsed)	116	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	210	W
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max.)	10.5	A
E_{AS}	Single pulse avalanche energy (Starting $T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$.)	345	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. $I_{SD} \leq 29\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS\text{ peak}} \leq V_{(BR)DSS}$, $V_{DD} = 80\% V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.6	$^{\circ}\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb max	30	$^{\circ}\text{C}/\text{W}$
T_l	Maximum lead temperature for soldering purposes	300	$^{\circ}\text{C}$

1. When mounted on FR-4 board of 1inch², 2oz Cu, $t < 10\text{ sec}$

2 Electrical characteristics

(T_{case} = 25°C unless otherwise specified)

Table 4. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1 \text{ mA}$, $V_{GS} = 0$	600			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}$, $T_C = 125^\circ\text{C}$			10 100	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	$V_{DS} = V_{GS}$, $I_D = 250 \mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10 \text{ V}$, $I_D = 14.5 \text{ A}$		0.092	0.105	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 100 \text{ V}$, $f = 1 \text{ MHz}$, $V_{GS} = 0$	-	2722 173 1.75	-	pF pF pF
$C_{oss \text{ eq.}}^{(1)}$	Equivalent Output capacitance	$V_{GS} = 0$, $V_{DS} = 0 \text{ to } 480 \text{ V}$	-	458	-	pF
R_g	Gate input resistance	$f = 1 \text{ MHz}$ Gate DC Bias=0 Test signal level = 20 mV open drain	-	2.9	-	Ω
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 480 \text{ V}$, $I_D = 29 \text{ A}$, $V_{GS} = 10 \text{ V}$ (see Figure 15)	-	83.6 14 45	-	nC nC nC

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 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$, $I_D = 14.5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14)	-	17	-	ns
t_r	Rise time			34		ns
$t_{d(off)}$	Turn-off-delay time			106		ns
t_f	Fall time			67		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_{SD}	Source-drain current		-		29	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				116	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 29\text{ A}$, $V_{GS} = 0$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 29\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 19)	-	408		ns
Q_{rr}	Reverse recovery charge			8		μC
I_{RRM}	Reverse recovery current			39		A
t_{rr}	Reverse recovery time	$I_{SD} = 29\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$ (see Figure 19)	-	480		ns
Q_{rr}	Reverse recovery charge			10		μC
I_{RRM}	Reverse recovery current			42		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

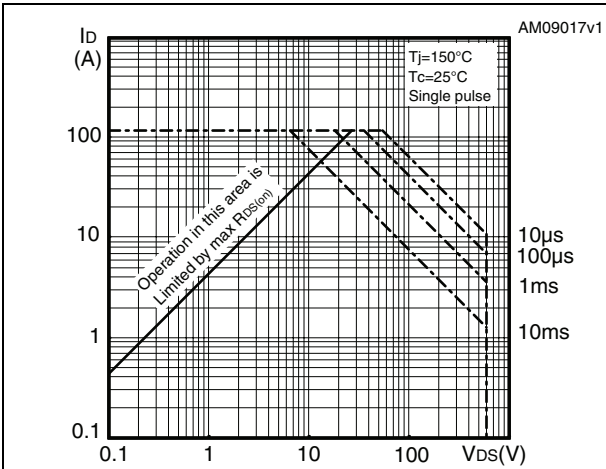


Figure 3. Thermal impedance

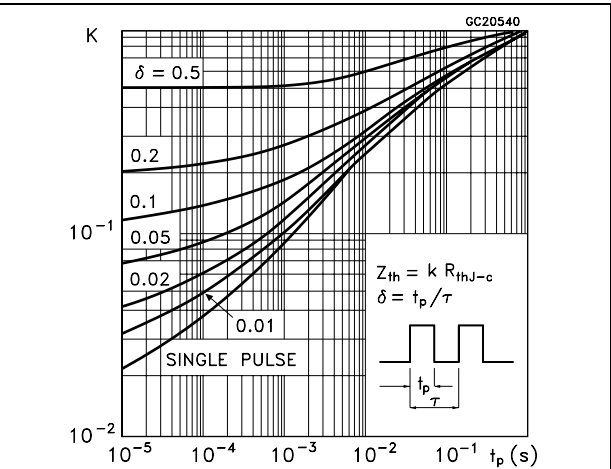


Figure 4. Output characteristics

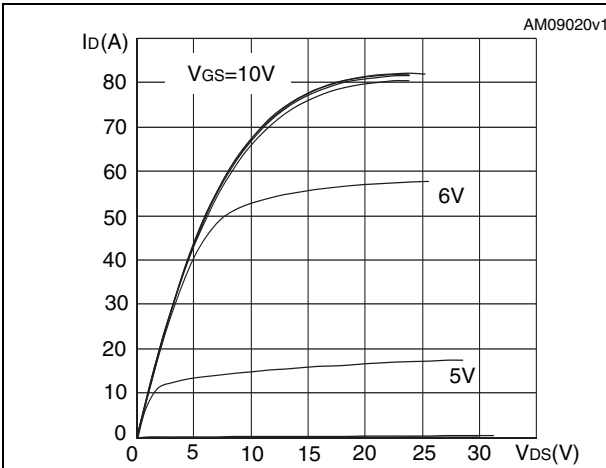


Figure 5. Transfer characteristics

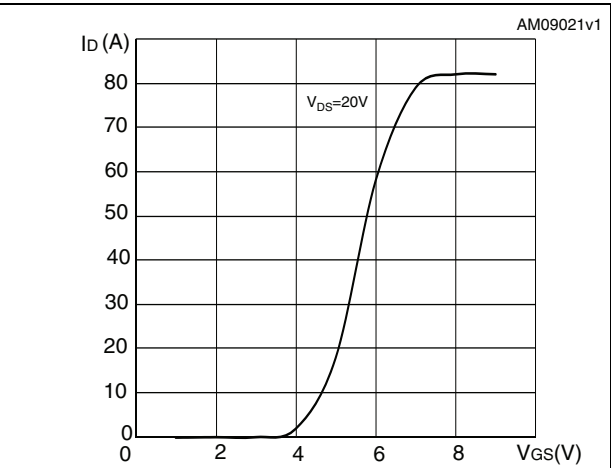


Figure 6. Gate charge vs gate-source voltage

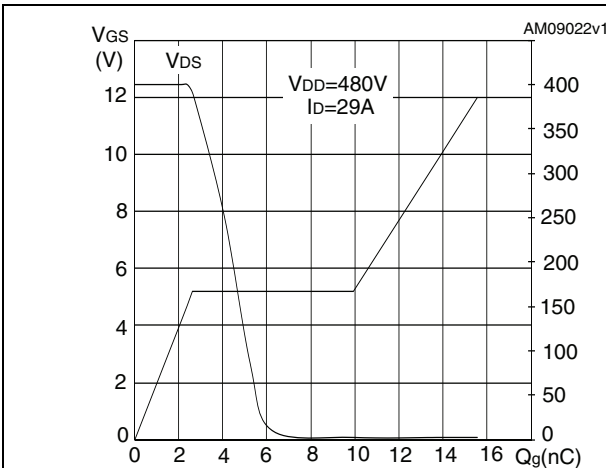


Figure 7. Static drain-source on resistance

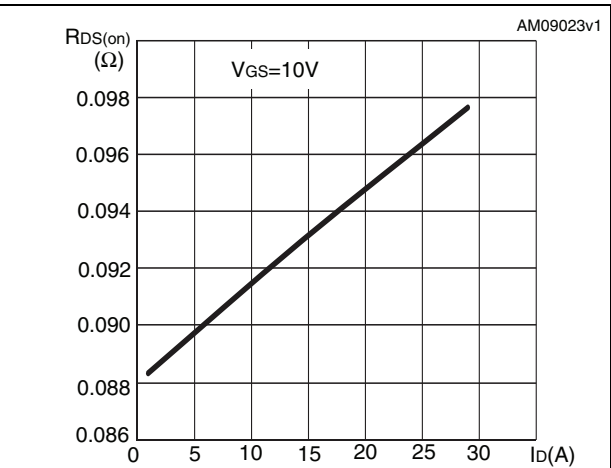


Figure 8. Capacitance variations

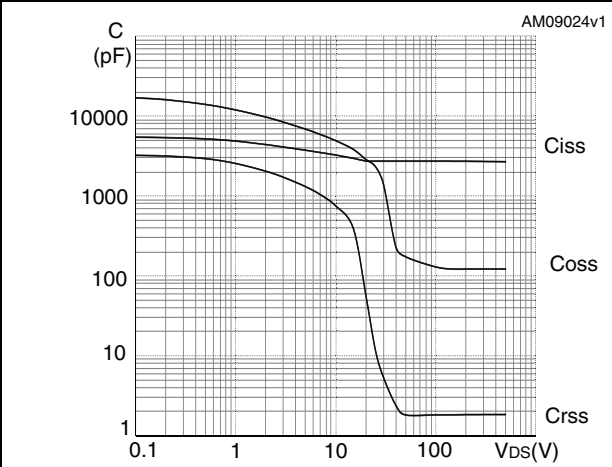


Figure 9. Output capacitance stored energy

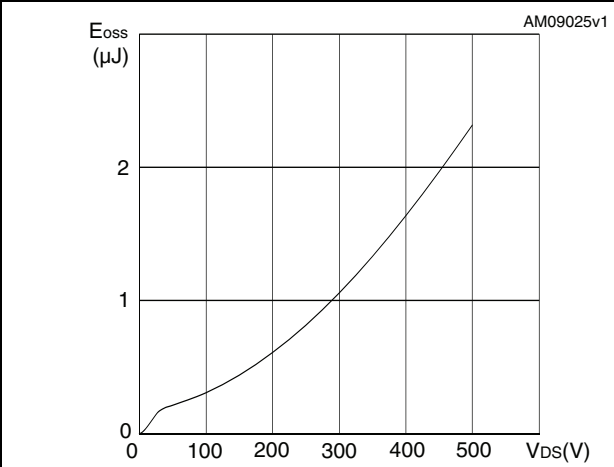


Figure 10. Normalized gate threshold voltage vs temperature

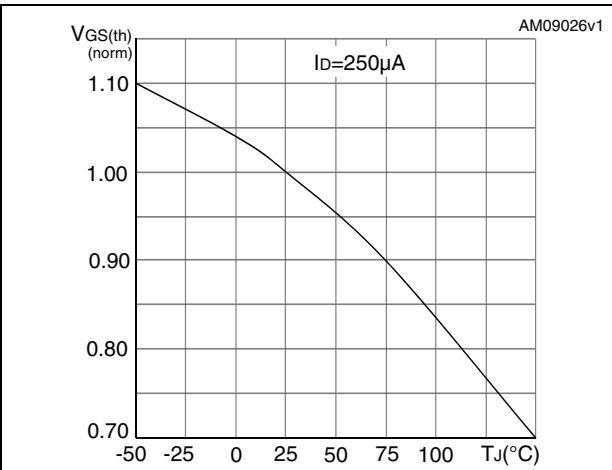


Figure 11. Normalized on resistance vs temperature

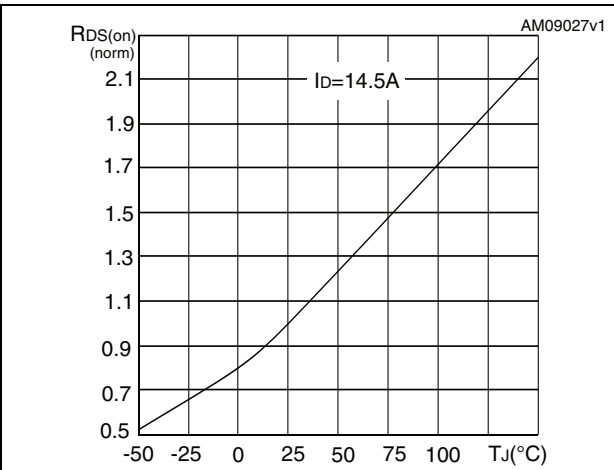


Figure 12. Normalized $B_{V_{DSS}}$ vs temperature

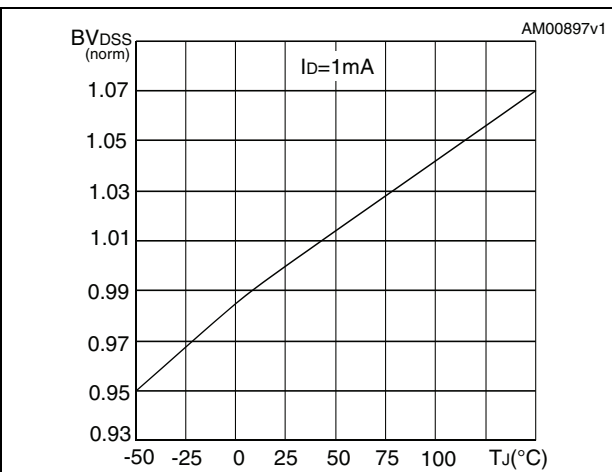
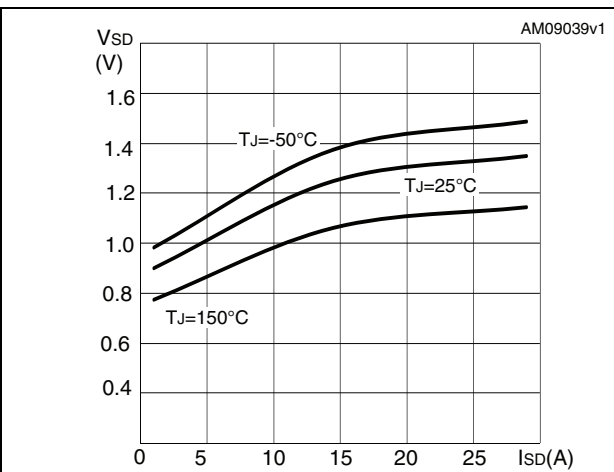


Figure 13. Source-drain diode forward characteristics



3 Test circuits

Figure 14. Switching times test circuit for resistive load

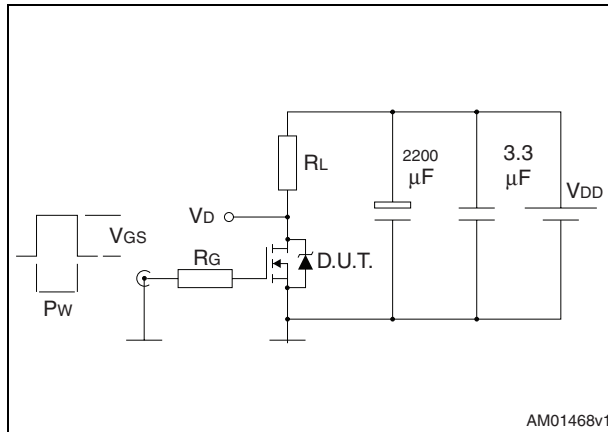


Figure 15. Gate charge test circuit

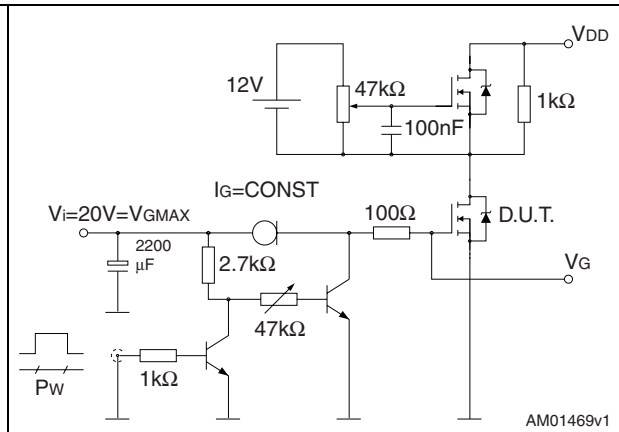


Figure 16. Test circuit for inductive load switching and diode recovery times

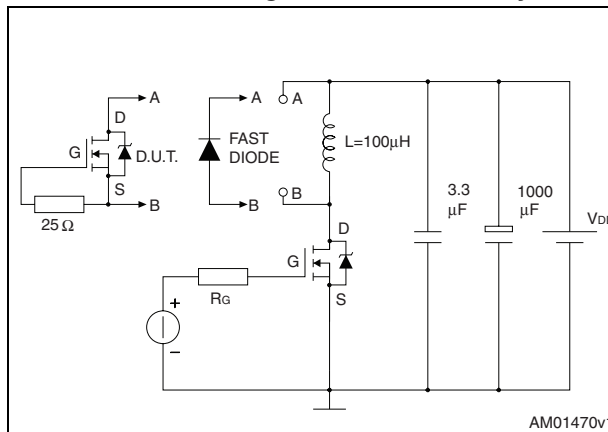


Figure 17. Unclamped inductive load test circuit

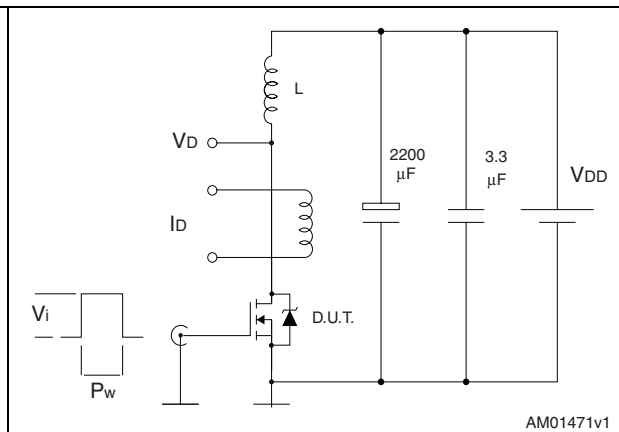


Figure 18. Unclamped inductive waveform

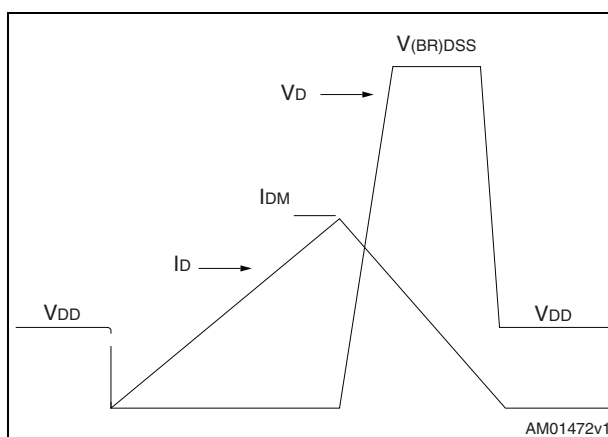
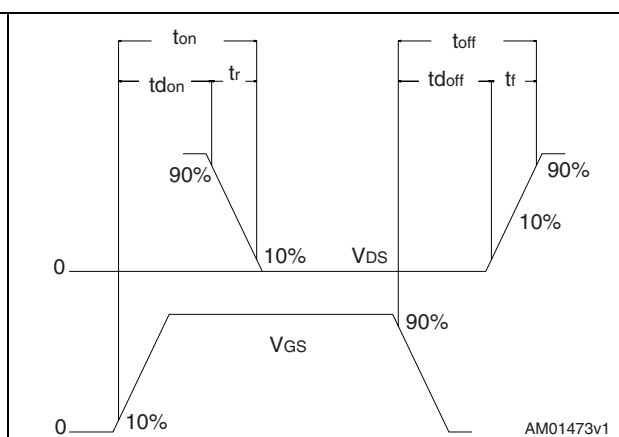


Figure 19. Switching time waveform



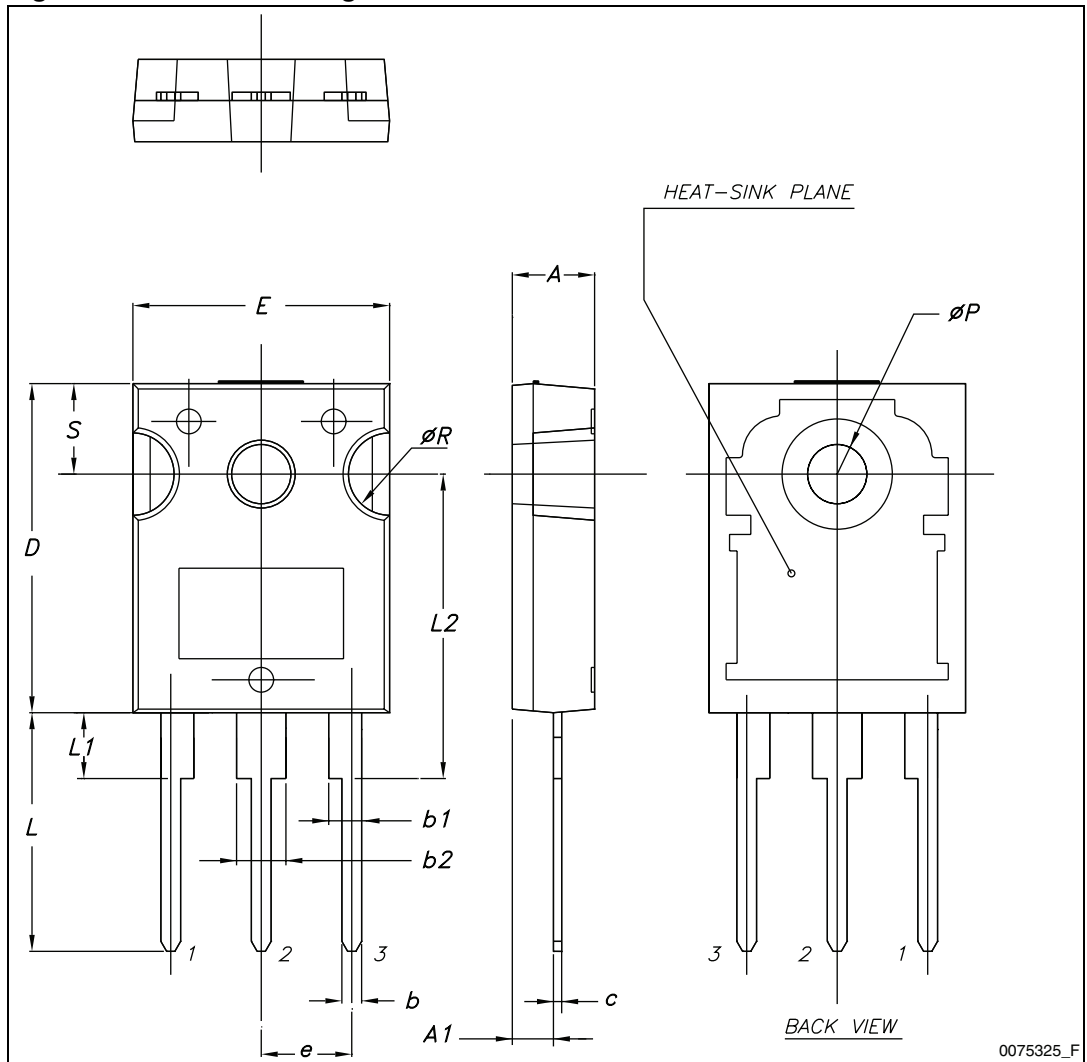
4 **Package mechanical data**

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		5.45	
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	

Figure 20. TO-247 drawing



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
21-Jun-2011	1	First release.

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