



STW48NM60N

N-channel 600 V, 0.055 Ω typ., 44 A MDmesh™ II Power MOSFET in a TO-247 package

Datasheet — production data

Features

Order codes	V _{DSS} @ T _{Jmax}	R _{DS(on)} max	I _D
STW48NM60N	650 V	< 0.07 Ω	44 A

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

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a 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.

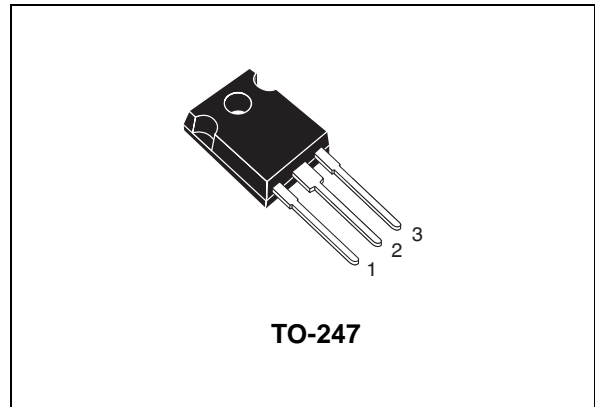


Figure 1. Internal schematic diagram

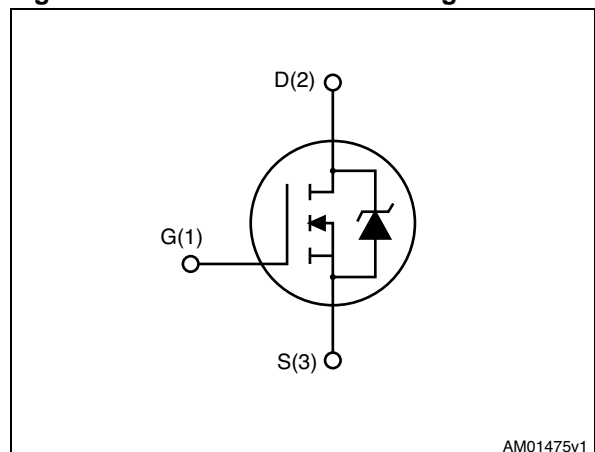


Table 1. Device summary

Order code	Marking	Package	Packaging
STW48NM60N	48NM60N	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	600	V
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	44	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	28	A
$I_{DM}^{(1)}$	Drain current (pulsed)	176	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	330	W
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	8	A
E_{AS}	Single pulse avalanche energy (starting $T_j=25\text{ }^\circ\text{C}$, $I_D=I_{AS}$, $V_{DD}=50\text{ V}$)	457	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. $I_{SD} \leq 44\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS\text{ peak}} \leq V_{(BR)DSS}$, $V_{DD} = 80\% V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.38	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	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

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

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage ($V_{GS} = 0$)	$I_D = 1\text{ mA}$	600			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 600\text{ V}$ $V_{DS} = 600\text{ V}, T_c = 125\text{ °C}$			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	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 20\text{ A}$		0.055	0.07	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}, f = 1\text{ MHz},$ $V_{GS} = 0$	-	4285	-	μF
C_{oss}	Output capacitance			212		μF
C_{rss}	Reverse transfer capacitance			9.5		pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0, V_{DS} = 0\text{ to }480\text{ V}$	-	600	-	μF
R_g	Intrinsic gate resistance	$f = 1\text{ MHz}, V_{GS} = 0$		1.6		Ω
Q_g	Total gate charge	$V_{DD} = 480\text{ V}, I_D = 44\text{ A},$ $V_{GS} = 10\text{ V},$ <i>(see Figure 15)</i>	-	124	-	nC
Q_{gs}	Gate-source charge			20		nC
Q_{gd}	Gate-drain charge			61.5		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	$V_{DD} = 300\text{ V}, I_D = 20\text{ A}$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ <i>(see Figure 14)</i>	-	99	-	ns
t_r	Rise time			18		ns
$t_{d(off)}$	Turn-off delay time			214		ns
t_f	Fall time			25.5		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		44	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		176	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 44 \text{ A}, V_{GS} = 0$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 44 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$	-	472		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 100 \text{ V}$	-	10.5		μC
I_{RRM}	Reverse recovery current	(see Figure 16)	-	44.5		A
t_{rr}	Reverse recovery time	$I_{SD} = 44 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$	-	568		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 100 \text{ V}, T_j = 150 \text{ }^\circ\text{C}$	-	14		μC
I_{RRM}	Reverse recovery current	(see Figure 16)	-	50		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

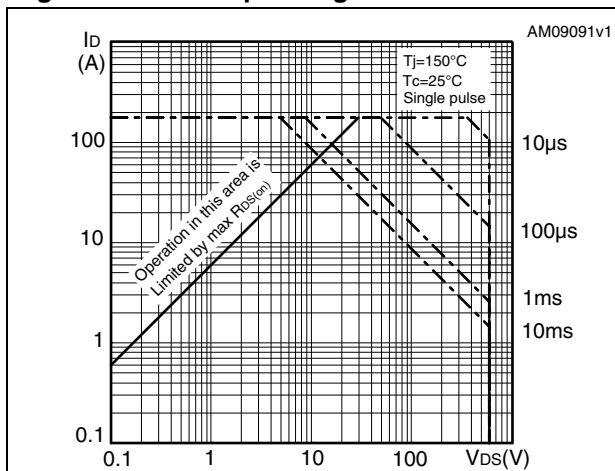


Figure 3. Thermal impedance

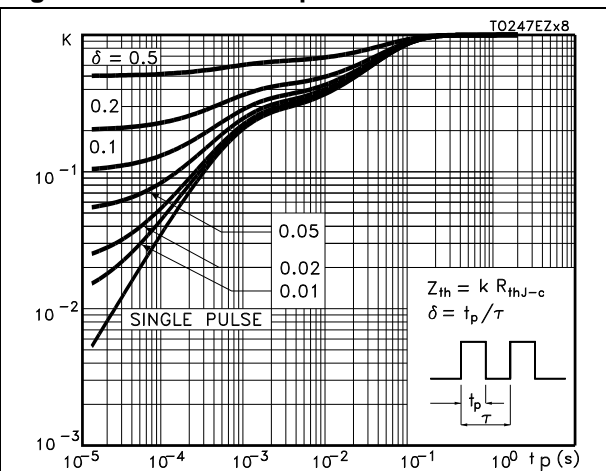


Figure 4. Output characteristics

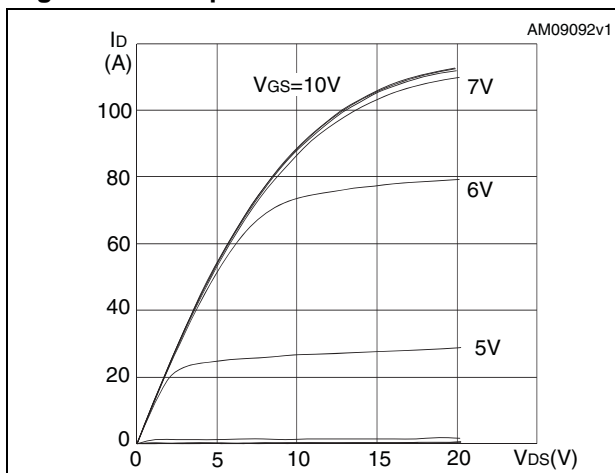


Figure 5. Transfer characteristics

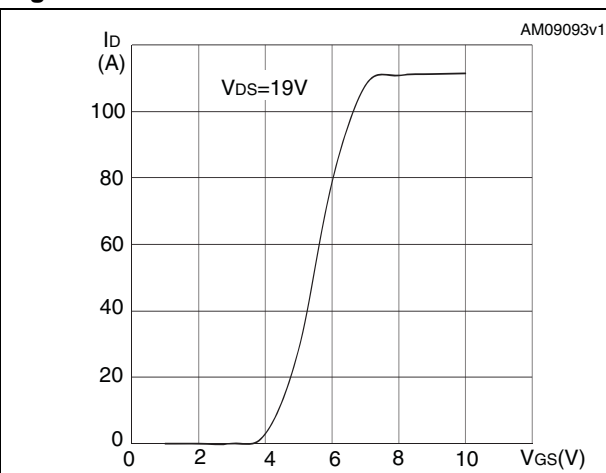


Figure 6. Normalized BV_{DSS} vs temperature

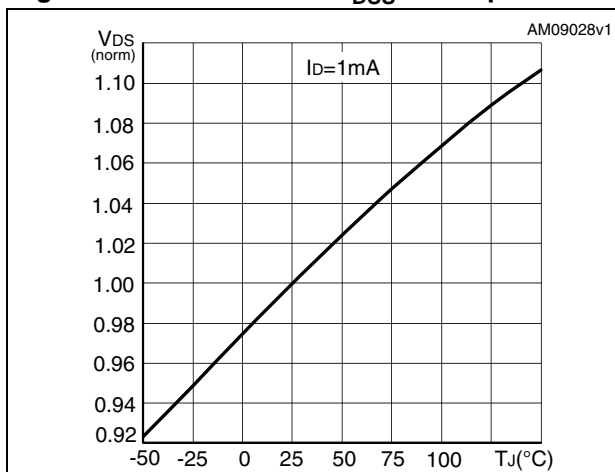


Figure 7. Static drain-source on-resistance

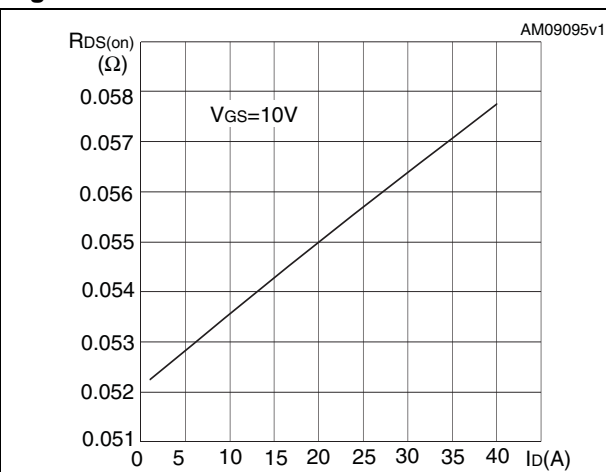


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

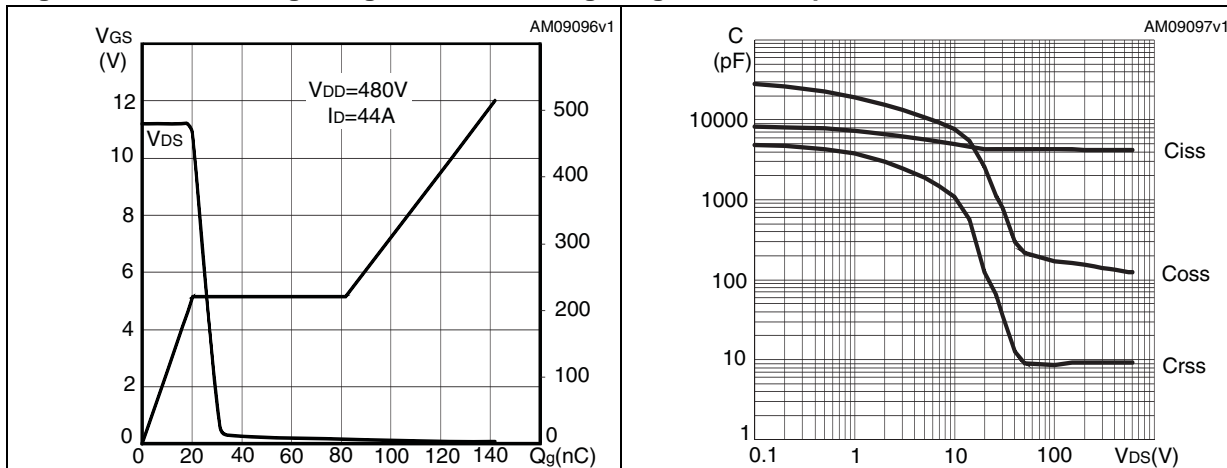


Figure 10. Output capacitance stored energy Figure 11. Normalized gate threshold voltage vs temperature

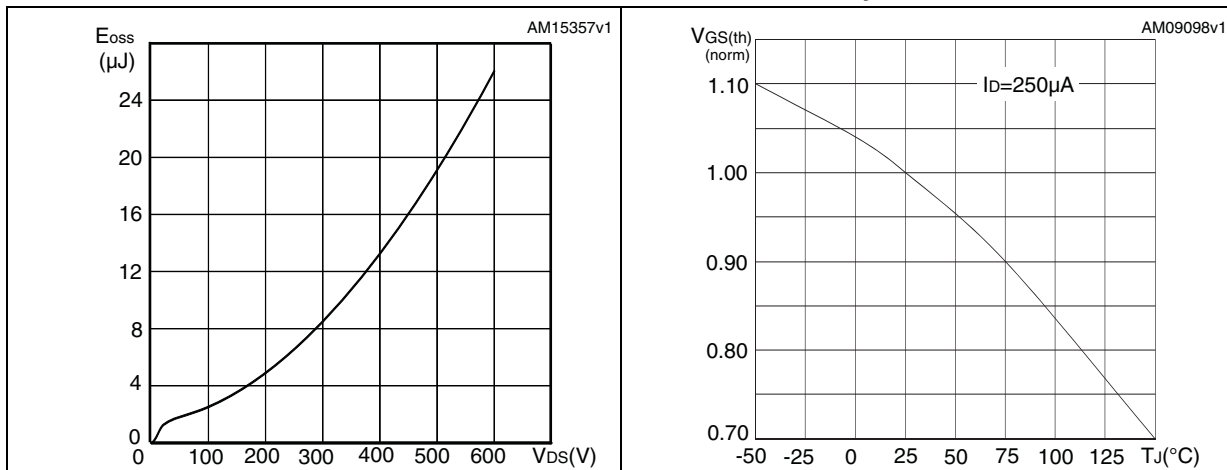
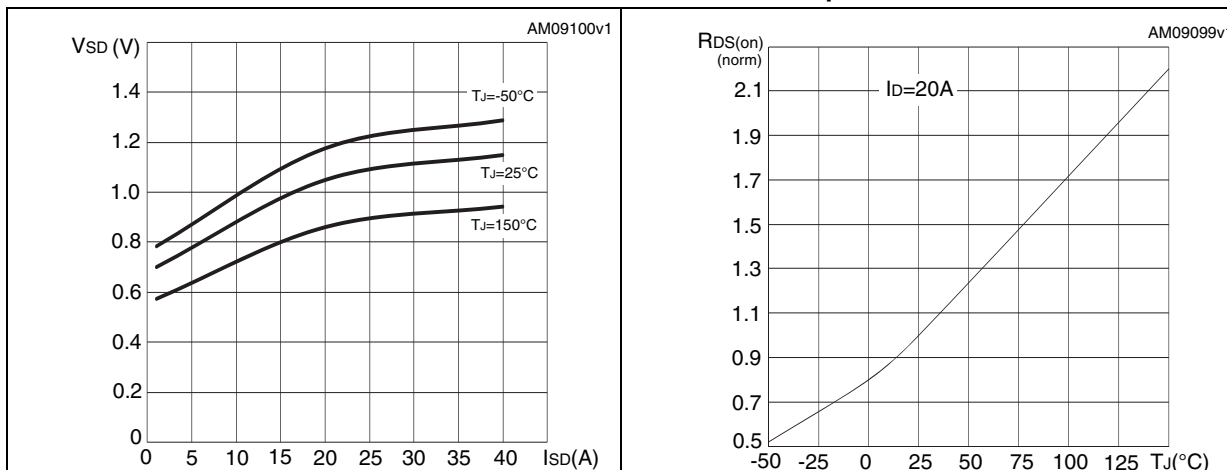


Figure 12. Source-drain diode forward characteristics Figure 13. Normalized on-resistance vs temperature



3 Test circuits

Figure 14. Switching times test circuit for resistive load



Figure 15. Gate charge test circuit

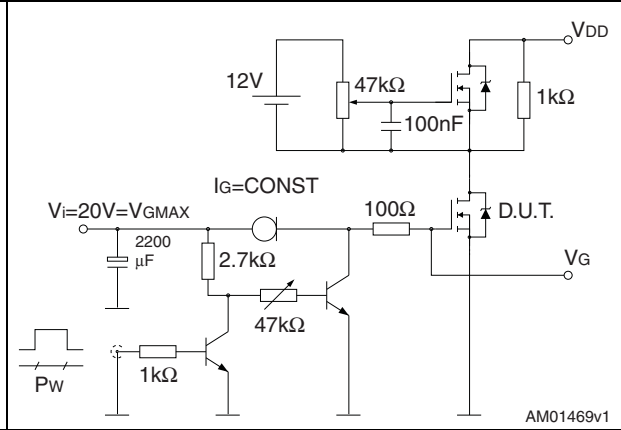


Figure 16. Test circuit for inductive load switching and diode recovery times



Figure 17. Unclamped inductive load test circuit



Figure 18. Unclamped inductive waveform

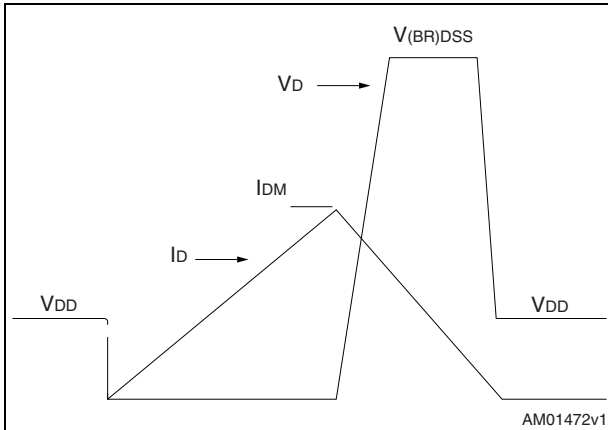
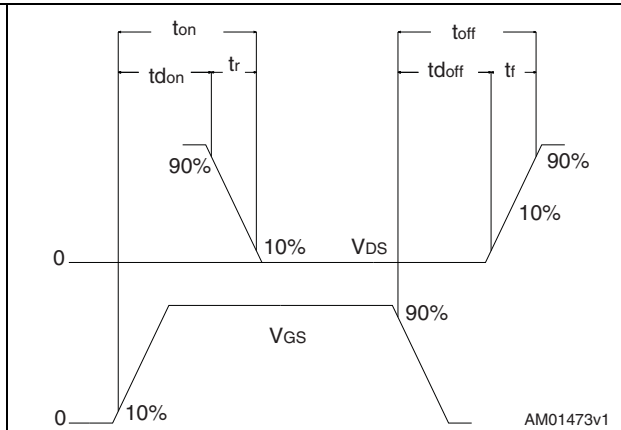


Figure 19. Switching time waveform



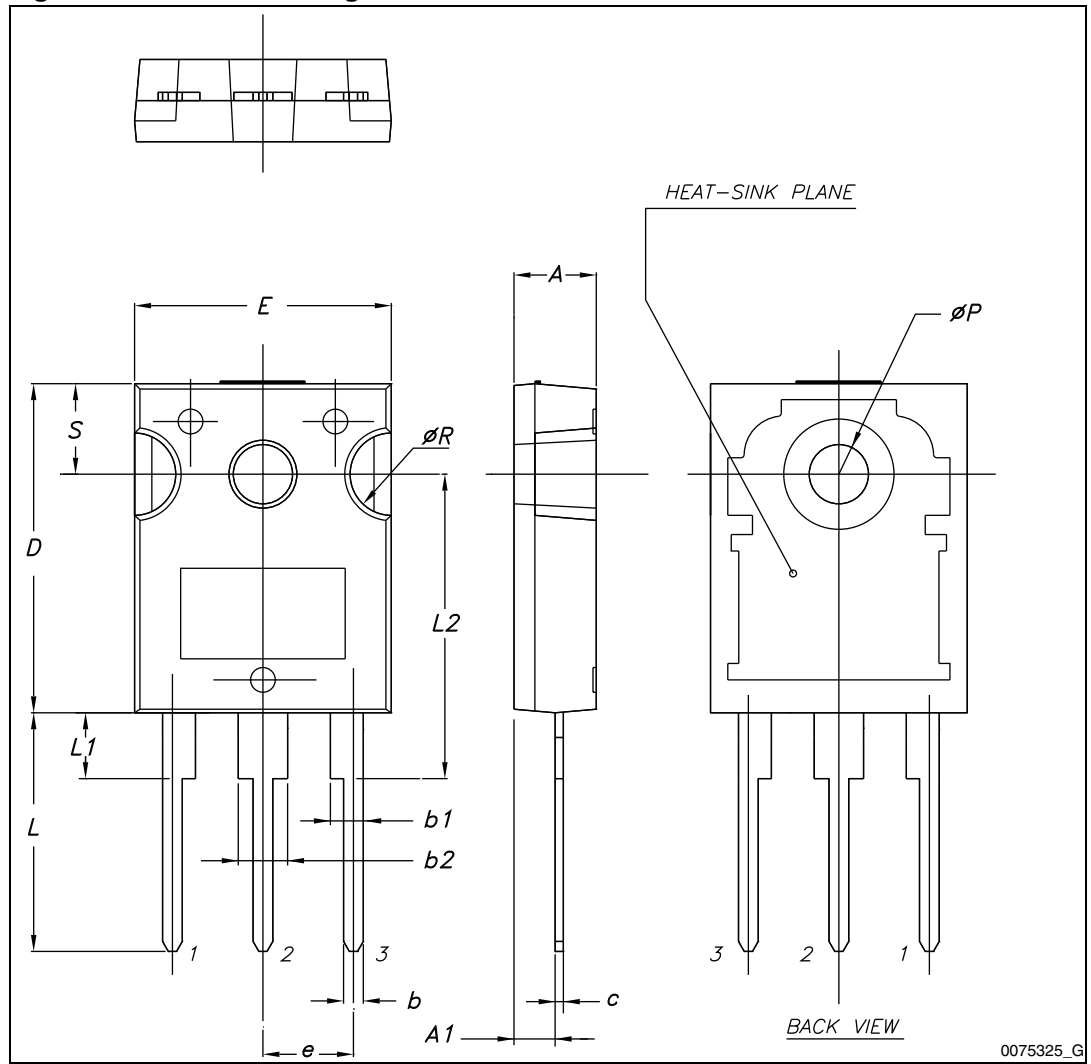
4 Package mechanical data

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	5.30	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 20. TO-247 drawing



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
06-Dec-2010	1	First release.
15-Apr-2011	2	Document status promoted from preliminary data to datasheet.
04-Jul-2011	3	Updated Figure 7 .
10-Oct-2012	4	– Modified: Figure 2 – Added: Figure 10 – Updated: Section 4: Package mechanical data
19-Feb-2013	5	Updated Table 7: Source drain diode .

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