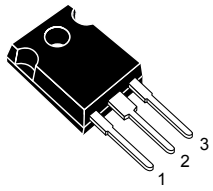
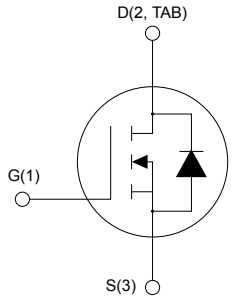
N-channel 600 V, 55 mΩ typ., 44 A MDmesh II Power MOSFET in a TO-247 package



TO-247



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STW48NM60N	600 V	70 mΩ	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.

Product status link
STW48NM60N

Product summary	
Order code	STW48NM60N
Marking	48NM60N
Package	TO-247
Packing	Tube

1 Electrical ratings

Table 1. 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 °C	44	A
I_D	Drain current (continuous) at T_C = 100 °C	28	A
I_{DM} (1)	Drain current (pulsed)	176	A
P_{TOT}	Total power dissipation at T_C = 25 °C	330	W
dv/dt (2)	Peak diode recovery voltage slope	15	V/ns
T_J	Operating junction temperature range	-55 to 150	°C
T_{stg}	Storage temperature range		

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 44 A, di/dt ≤ 400 A/µs, V_{DS} (peak) ≤ $V_{(BR)DSS}$, V_{DD} = 480 V.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	0.38	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	50	°C/W

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	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 °C, I_D = I_{AR}, V_{DD} = 50 V)	457	mJ

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 mA, V_{GS} = 0 V	600			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 600 V			1	µA
		V_{GS} = 0 V, V_{DS} = 600 V, T_C = 125 °C (1)			100	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0 V, V_{GS} = ±25 V			±100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 20 A		55	70	mΩ

1. *Specified by design, not tested in production.*

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0 V	-	4285	-	pF
C_{oss}	Output capacitance		-	212	-	pF
C_{rss}	Reverse transfer capacitance		-	9.5	-	pF
$C_{oss\ eq.}$ (1)	Equivalent capacitance time related	V_{DS} = 0 to 480 V, V_{GS} = 0 V	-	600	-	pF
R_g	Intrinsic gate resistance	f = 1 MHz open drain	-	1.6	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 44 A, V_{GS} = 0 to 10 V (see Figure 14. Test circuit for gate charge behavior)	-	124	-	nC
Q_{gs}	Gate-source charge		-	20	-	nC
Q_{gd}	Gate-drain charge		-	61.5	-	nC

1. *$C_{oss\ eq.}$ 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 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 20 A, R_G = 4.7 Ω V_{GS} = 10 V (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	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 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 44 A, di/dt = 100 A/µs, V_{DD} = 100 V (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	472		ns
Q_{rr}	Reverse recovery charge		-	10.5		µC
I_{RRM}	Reverse recovery current		-	44.5		A
t_{rr}	Reverse recovery time	I_{SD} = 44 A, di/dt = 100 A/µs, V_{DD} = 100 V T_J = 150 °C (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	568		ns
Q_{rr}	Reverse recovery charge		-	14		µC
I_{RRM}	Reverse recovery current		-	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 1. Safe operating area

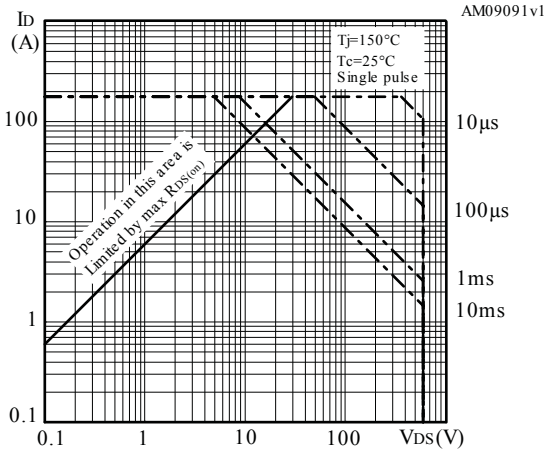


Figure 2. Normalized transient thermal impedance

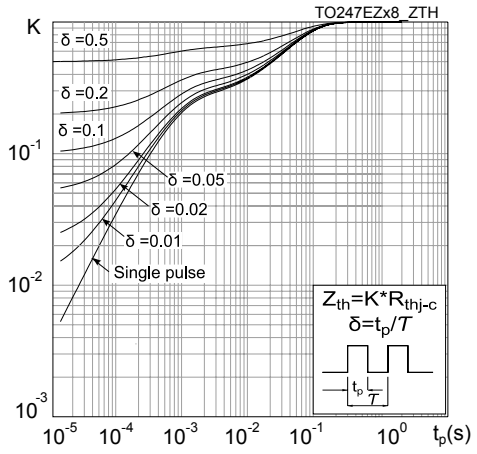


Figure 3. Typical output characteristics

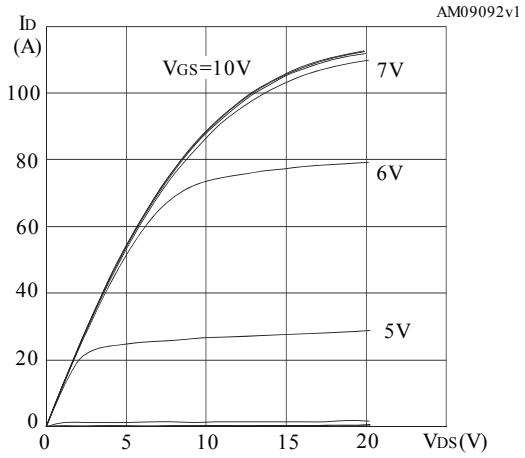


Figure 4. Typical transfer characteristics

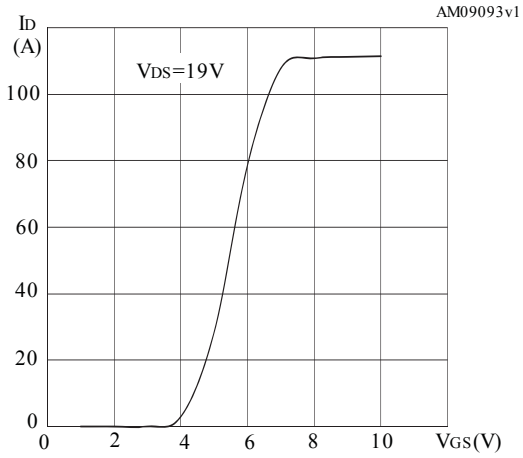


Figure 5. Typical gate charge characteristics

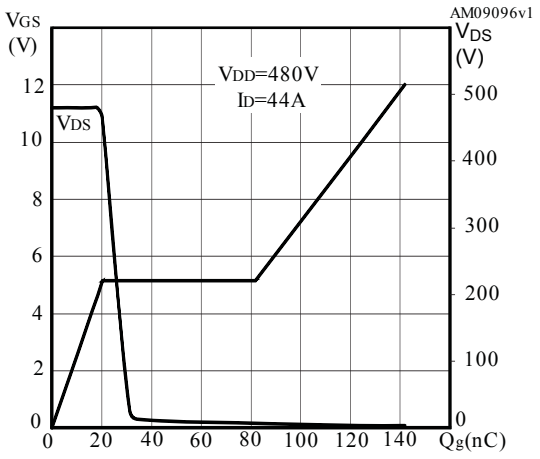


Figure 6. Typical capacitance characteristics

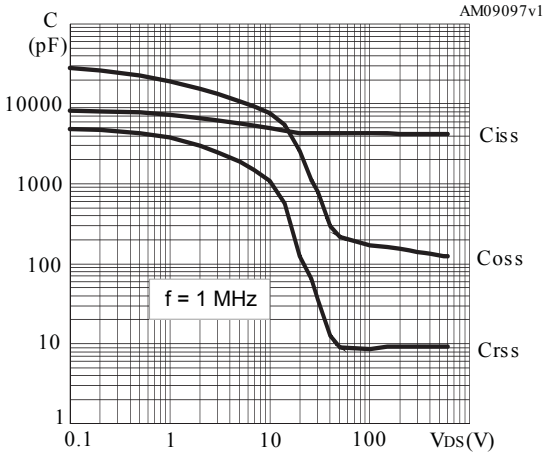


Figure 7. Typical drain-source on-resistance

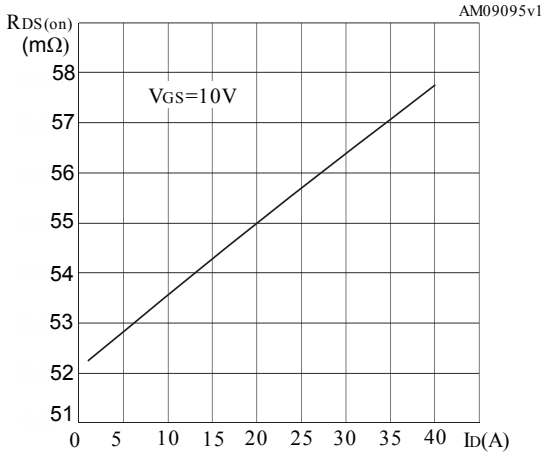


Figure 8. Normalized breakdown voltage vs temperature

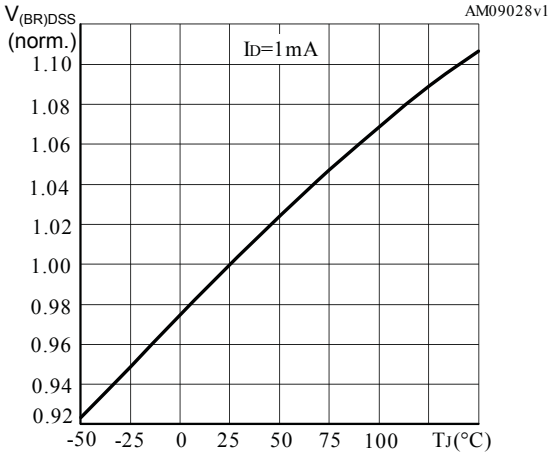


Figure 9. Typical output capacitance stored energy

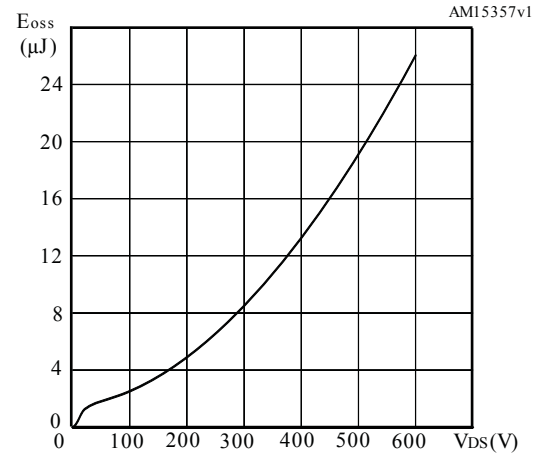


Figure 10. Normalized gate threshold vs temperature

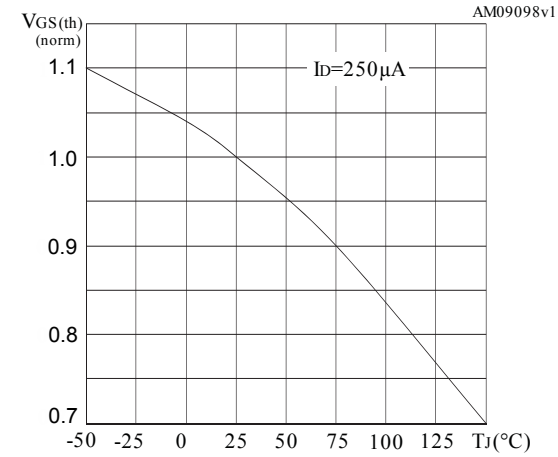


Figure 11. Normalized on-resistance vs temperature

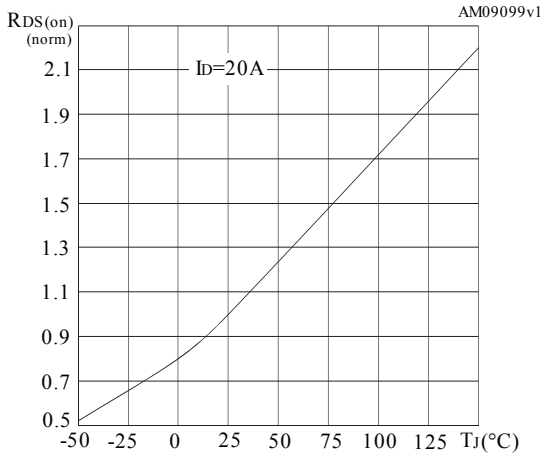
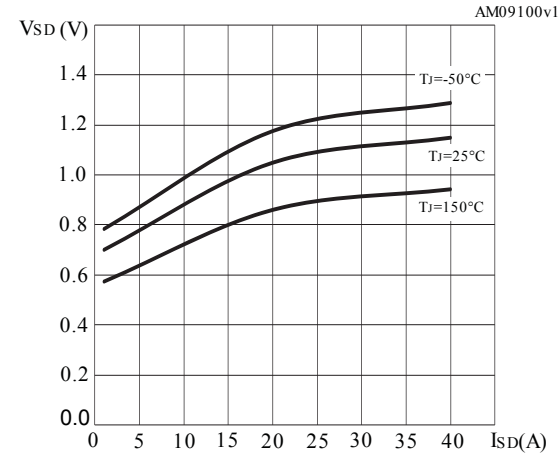


Figure 12. Typical reverse diode forward characteristics



3 Test circuits

Figure 13. Test circuit for resistive load switching times

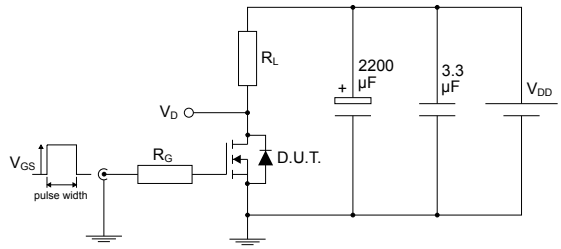


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Figure 14. Test circuit for gate charge behavior

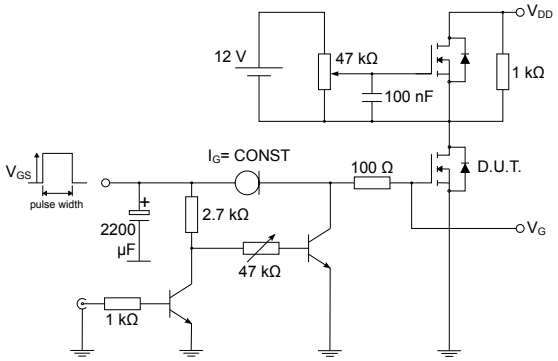

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Figure 15. Test circuit for inductive load switching and diode recovery times

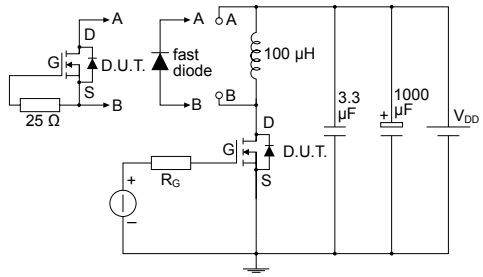

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Figure 16. Unclamped inductive load test circuit

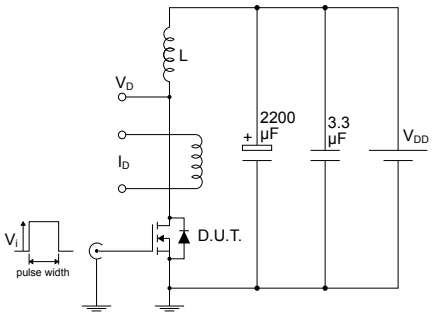

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Figure 17. Unclamped inductive waveform

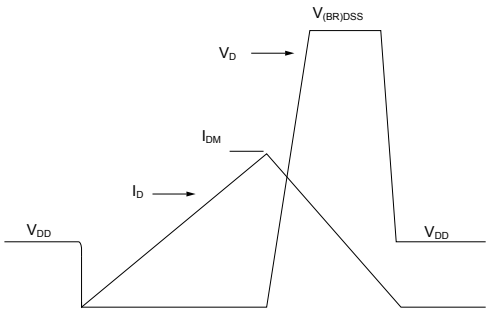

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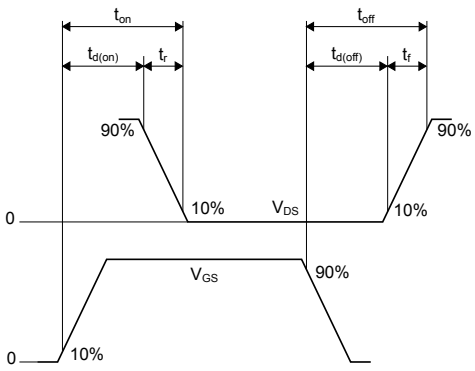
Figure 18. Switching time waveform



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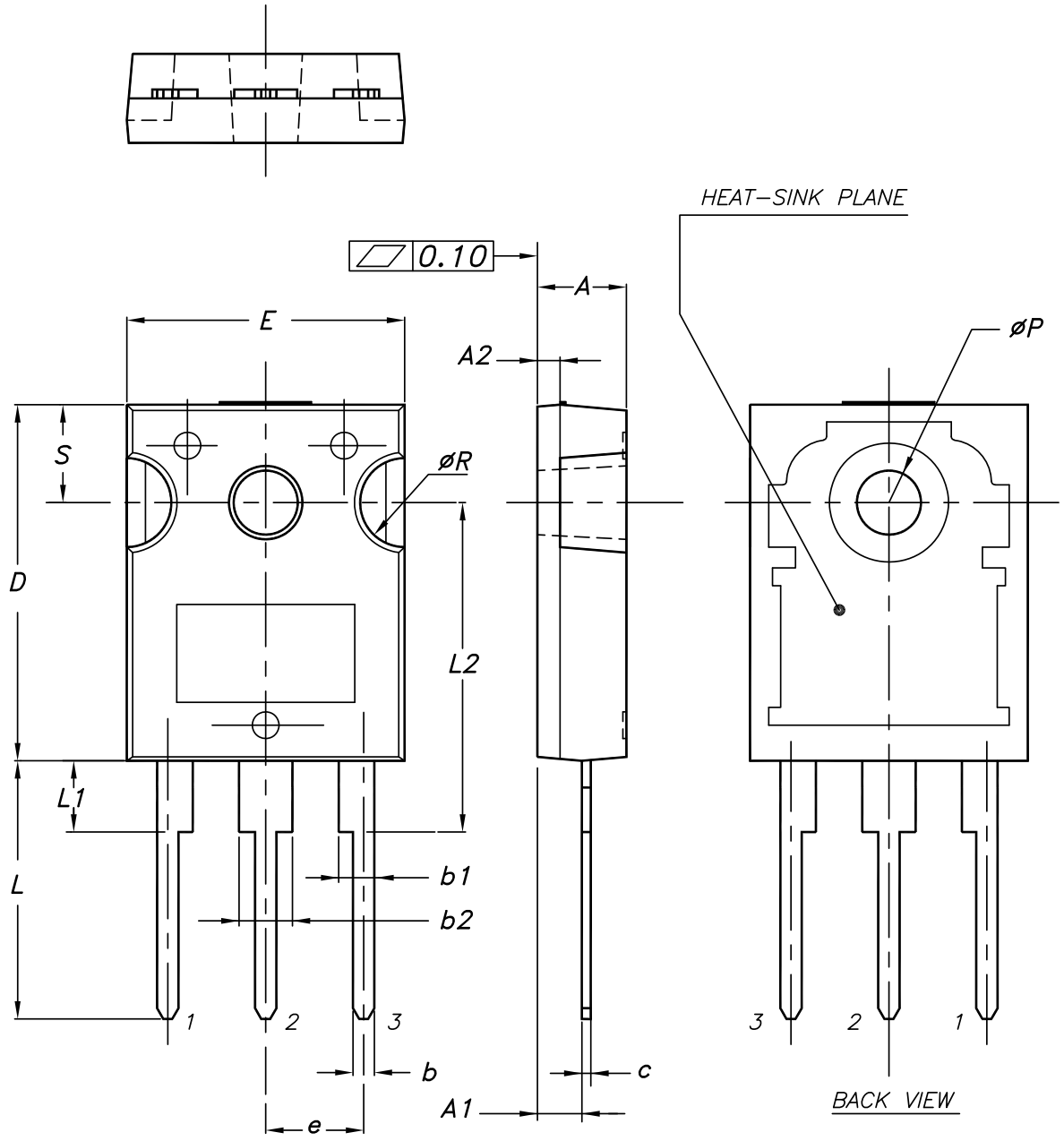
4 Package information

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.

4.1 TO-247 package information

Figure 19. TO-247 package outline



0075325_11

Table 8. **TO-247 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
A2		1.27	
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

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*.
15-Dec-2025	6	Updated Section 4.1: TO-247 package information. Minor text changes.

Contents

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