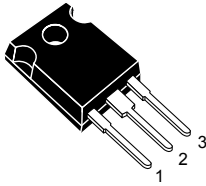
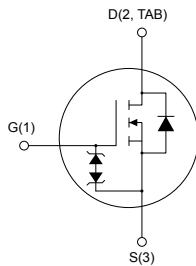


N-channel 1700 V, 2.3 Ω typ., 5 A, MDmesh™ K5 Power MOSFET in a TO-247 package


TO-247


AM01475V1


Product status link
[STW12N170K5](#)
Product summary

Order code	STW12N170K5
Marking	12N170K5
Package	TO-247
Packing	Tube

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STW12N170K5	1700 V	2.9 Ω	5 A	250 W

- Industry's lowest $R_{DS(on)}$ x area
- Industry's best FoM (figure of merit)
- Ultra-low gate charge
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

This very high voltage N-channel Power MOSFET is designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current at $T_C = 25\text{ }^\circ\text{C}$	5	A
	Drain current at $T_C = 100\text{ }^\circ\text{C}$	3	A
$I_{DM}^{(1)}$	Drain current (pulsed)	10	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	250	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	V/ns
T_J	Operating junction temperature range	-55 to 150	$^\circ\text{C}$
T_{stg}	Storage temperature range		

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 5\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, $V_{DS(peak)} \leq V_{(BR)DSS}$
3. $V_{DS} \leq 1360\text{ V}$

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.5	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-amb	50	$^\circ\text{C}/\text{W}$

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
$I_{AR}^{(1)}$	Maximum current during repetitive or single pulse avalanche	1.7	A
$E_{AS}^{(2)}$	Single pulse avalanche energy	1000	mJ

1. Pulse width limited by T_{Jmax}
2. Starting $T_J = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$

2 Electrical characteristics

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

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	1700			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 1700\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 1700\text{ V}$, $T_C = 125\text{ °C}^{(1)}$			50	μA
I_{GSS}	Gate body leakage current	$V_{DS} = 0$, $V_{GS} = \pm 20\text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on- resistance	$V_{GS} = 10\text{ V}$, $I_D = 2.5\text{ A}$		2.3	2.9	Ω

1. Defined by design, not subject to production test.

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{GS} = 0\text{ V}$, $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$	-	1380	-	pF
C_{oss}	Output capacitance		-	73	-	pF
C_{riss}	Reverse transfer capacitance		-	2.7	-	pF
$C_{o(tr)}^{(1)}$	Time-related equivalent capacitance	$V_{DS} = 0\text{ V to } 1360\text{ V}$, $V_{GS} = 0\text{ V}$	-	65	-	pF
$C_{o(er)}^{(2)}$	Energy-related equivalent capacitance		-	26	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	-	3.8	-	Ω
Q_g	Total gate charge	$V_{DD} = 1360\text{ V}$, $I_D = 5\text{ A}$ $V_{GS} = 0\text{ to } 10\text{ V}$ (see Figure 15. Test circuit for gate charge behavior)	-	37	-	nC
Q_{gs}	Gate-source charge		-	10	-	nC
Q_{gd}	Gate-drain charge		-	19	-	nC

1. This parameter 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} .
2. This parameter 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	$V_{DD} = 850\text{ V}$, $I_D = 2.5\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	22	-	ns
t_r	Rise time		-	7	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform)	-	74	-	ns
t_f	Fall time		-	51	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		5	A
I_{SDM}	Source-drain current (pulsed)		-		10	A
$V_{SD}^{(1)}$	Forward on voltage	$I_{SD} = 5\text{ A}, V_{GS} = 0\text{ V}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 5\text{ A}, V_{DD} = 60\text{ V},$ $di/dt = 100\text{ A}/\mu\text{s}$	-	350		ns
Q_{rr}	Reverse recovery charge		-	3.91		μC
I_{RRM}	Reverse recovery current	(see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	22.3		A
t_{rr}	Reverse recovery time	$I_{SD} = 5\text{ A}, V_{DD} = 60\text{ V},$ $di/dt = 100\text{ A}/\mu\text{s}, T_J = 150\text{ }^\circ\text{C}$	-	481		ns
Q_{rr}	Reverse recovery charge		-	5.07		μC
I_{RRM}	Reverse recovery current		(see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	21.0	

1. Pulsed: pulse duration = 300 μs , duty cycle 1.5%

Table 8. Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1\text{ mA}, I_D = 0\text{ A}$	30	-		V

The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

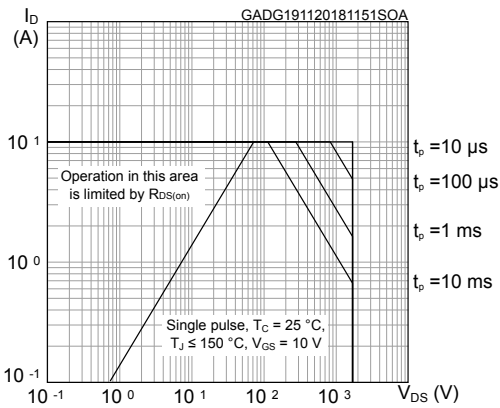


Figure 2. Thermal impedance

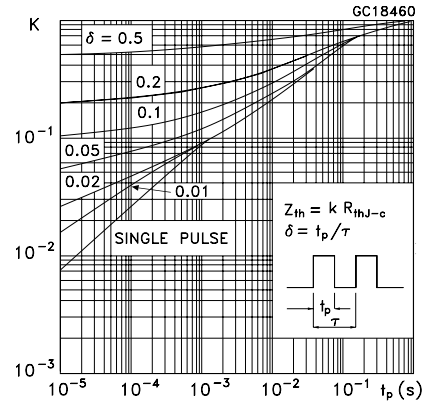


Figure 3. Output characteristics

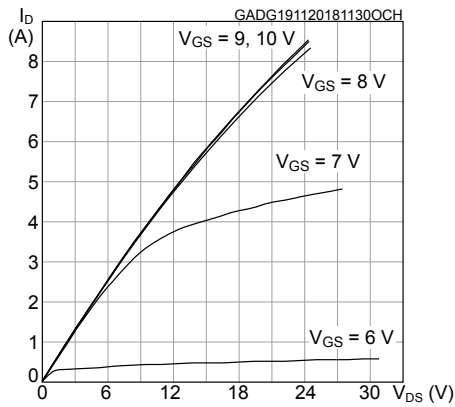


Figure 4. Transfer characteristics

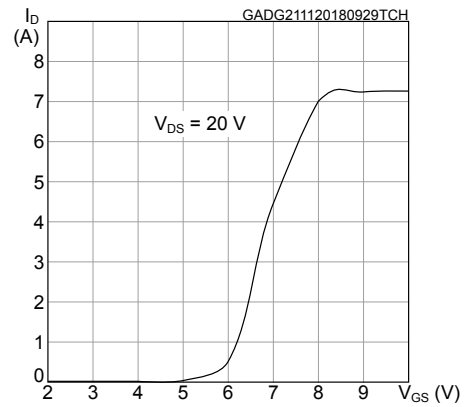


Figure 5. Gate charge vs gate-source voltage

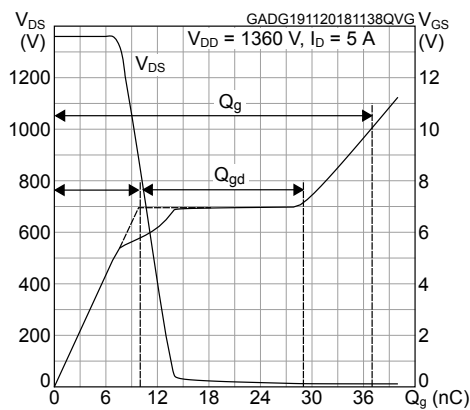


Figure 6. Static drain-source on-resistance

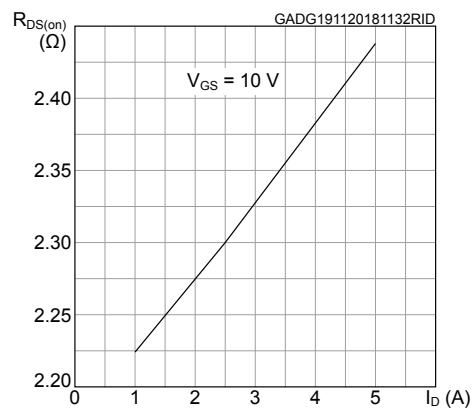


Figure 7. Normalized gate threshold voltage vs temperature

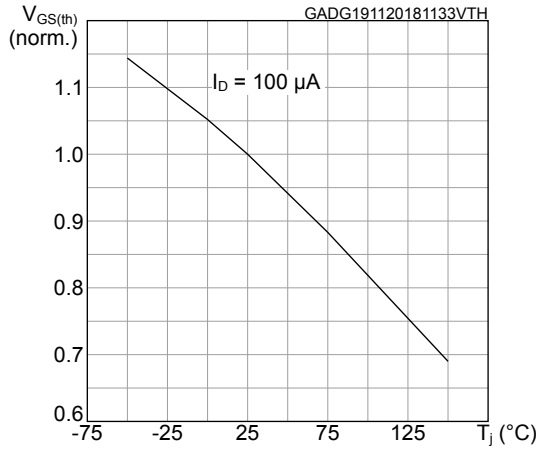


Figure 8. Normalized on-resistance vs temperature

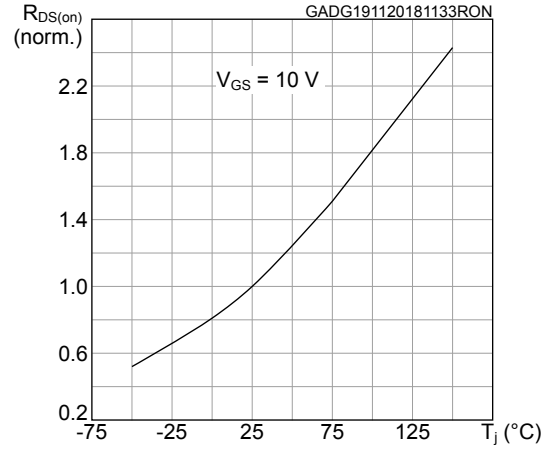


Figure 9. Normalized $V_{(BR)DSS}$ vs temperature

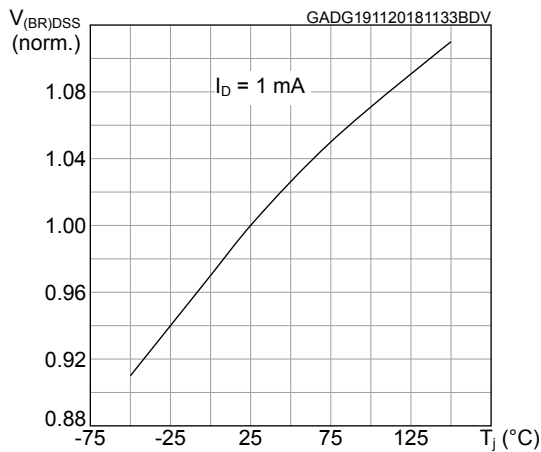


Figure 10. Source-drain diode forward characteristics

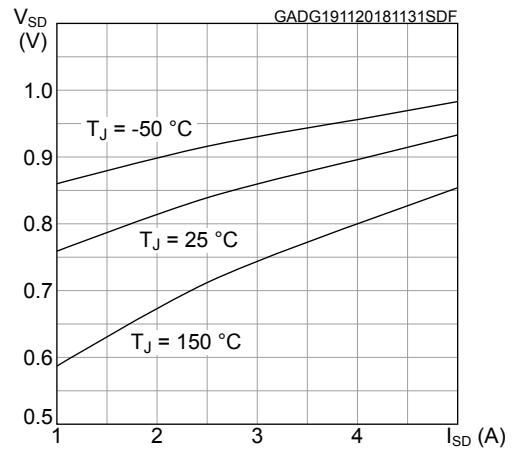


Figure 11. Capacitance variations

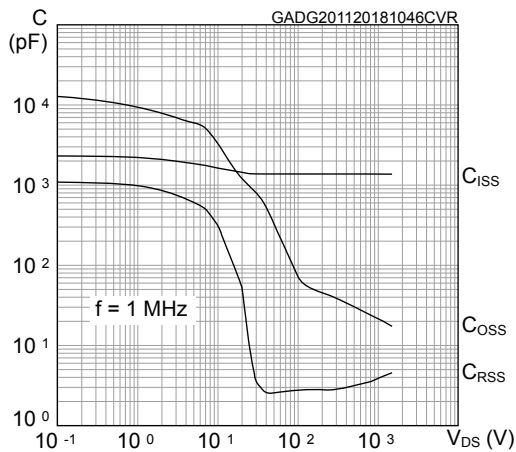


Figure 12. Maximum avalanche energy vs T_J

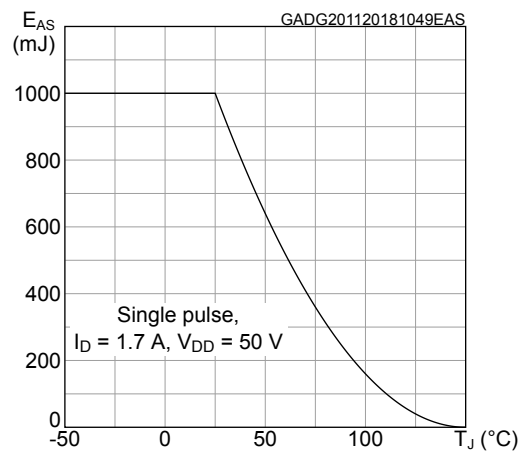
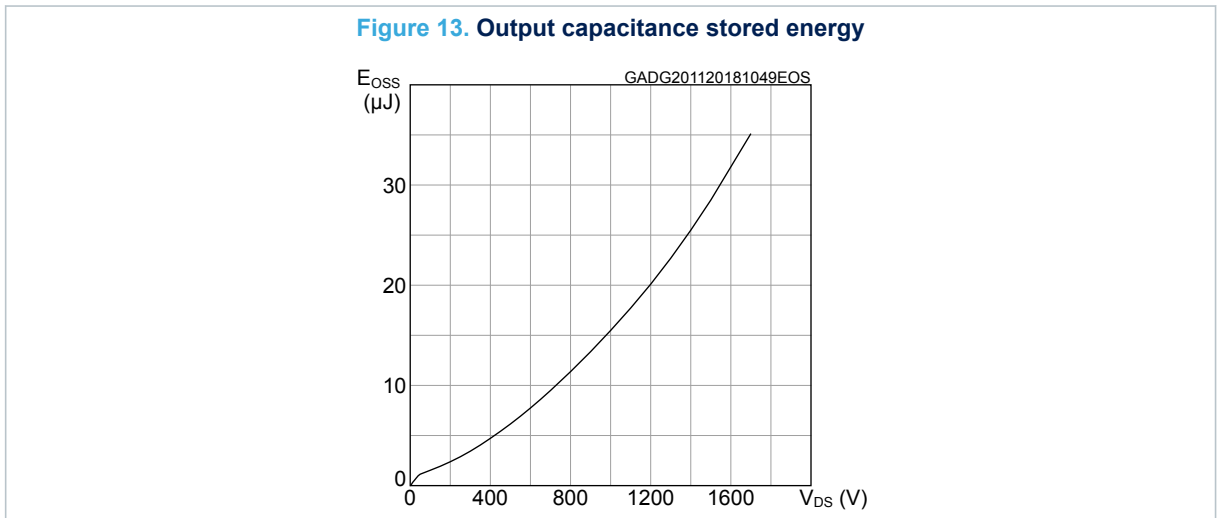
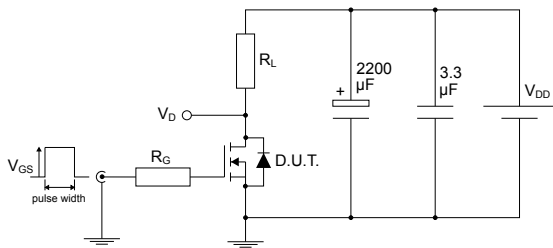


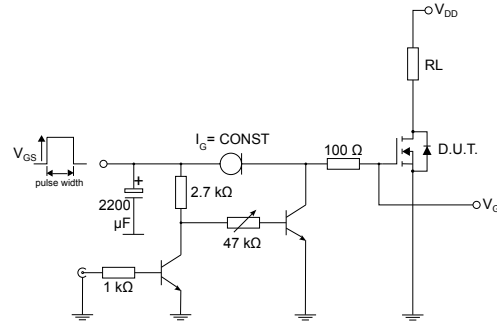
Figure 13. Output capacitance stored energy



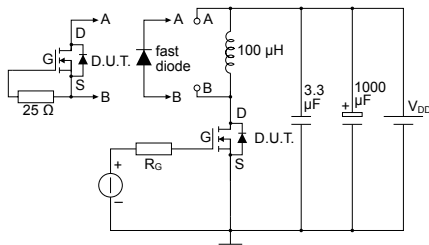
3 Test circuits

Figure 14. Test circuit for resistive load switching times


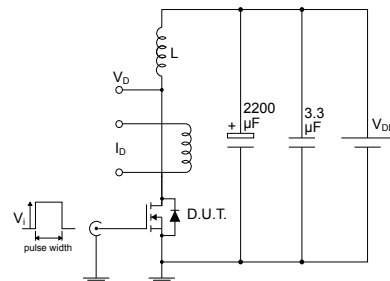
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Figure 15. Test circuit for gate charge behavior


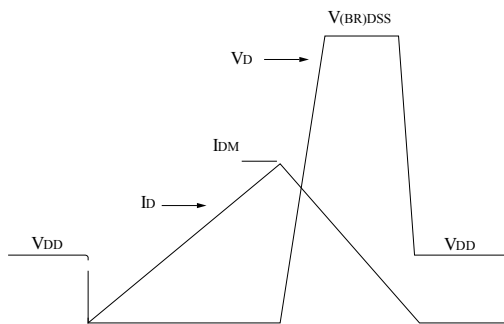
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Figure 16. Test circuit for inductive load switching and diode recovery times


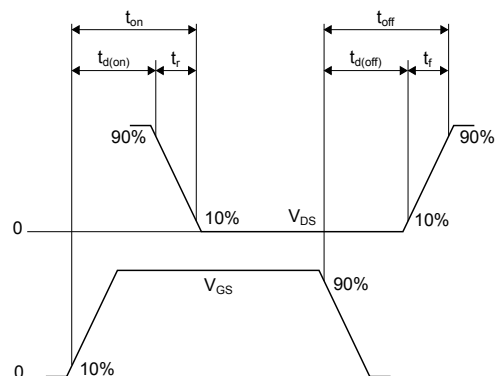
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Figure 17. Unclamped inductive load test circuit


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Figure 18. Unclamped inductive waveform


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Figure 19. Switching time waveform


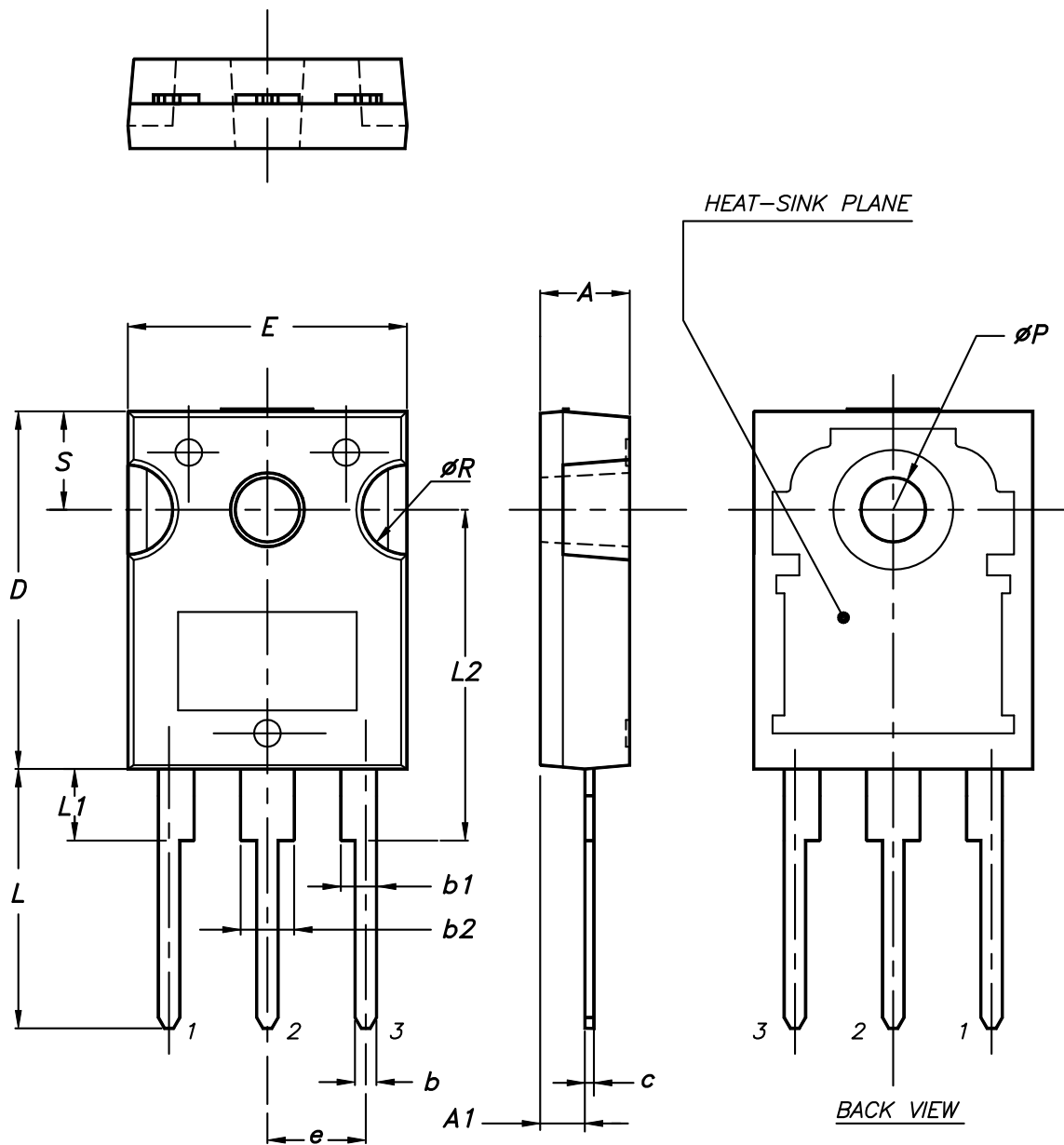
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4 Package information

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.

4.1 TO-247 package information

Figure 20. TO-247 package outline



0075325_9

Table 9. TO-247 package 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

Revision history

Table 10. Document revision history

Date	Version	Changes
20-Nov-2018	1	First release.

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