

N-channel 650 V, 0.087 Ω typ., 32 A MDmesh™ M2 Power MOSFET in a TO-247 package

Datasheet - production data

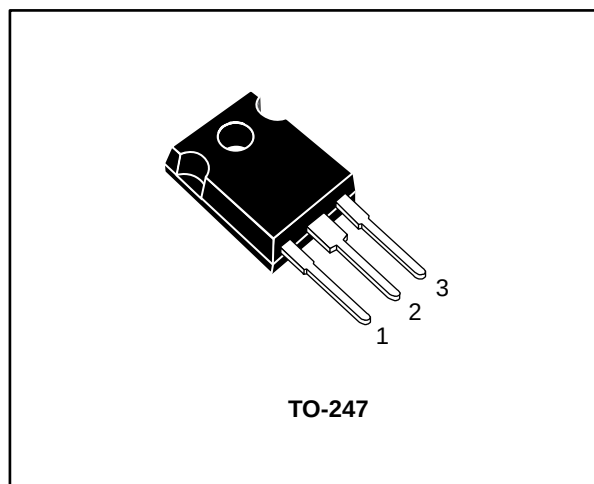
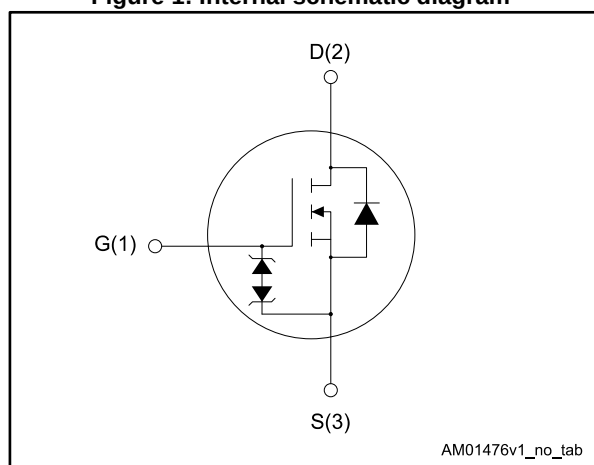


Figure 1: Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STW40N65M2	650 V	0.099 Ω	32 A

- Extremely low gate charge
- Excellent output capacitance (C_{oss}) profile
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using MDmesh™ M2 technology. Thanks to its strip layout and an improved vertical structure, the device exhibits low on-resistance and optimized switching characteristics, rendering it suitable for the most demanding high efficiency converters.

Table 1: Device summary

Order code	Marking	Package	Packaging
STW40N65M2	40N65M2	TO-247	Tube

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
	2.2 Electrical characteristics (curves).....	6
3	Test circuits	8
4	Package information	9
	4.1 TO-247 package information.....	9
5	Revision history	11

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	32	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	20	A
$I_{DM}^{(1)}$	Drain current (pulsed)	128	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	250	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature	- 55 to 150	$^{\circ}\text{C}$
T_j	Max. operating junction temperature	150	

Notes:

⁽¹⁾ Pulse width limited by safe operating area.

⁽²⁾ $I_{SD} \leq 32\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$

⁽³⁾ $V_{DS} \leq 520\text{ V}$

Table 3: Thermal data

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

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	3	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	820	mJ

2 Electrical characteristics

($T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

Table 5: On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	650			V
I_{DSS}	Zero gate voltage Drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}$			100	μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$			± 10	μA
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}$, $I_D = 16\text{ A}$		0.087	0.099	Ω

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	2355	-	pF
C_{oss}	Output capacitance		-	102	-	pF
C_{rss}	Reverse transfer capacitance		-	2.7	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ V to } 520\text{ V}$, $V_{GS} = 0\text{ V}$	-	380	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	4.5	-	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}$, $I_D = 32\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 15: "Gate charge test circuit")	-	56.5	-	nC
Q_{gs}	Gate-source charge		-	8	-	nC
Q_{gd}	Gate-drain charge		-	24	-	nC

Notes:

⁽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_{DSS}

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 325\text{ V}$, $I_D = 16\text{ A}$ $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14: "Switching times test circuit for resistive load" and Figure 19: "Switching time waveform")	-	15	-	ns
t_r	Rise time		-	10	-	ns
$t_{d(off)}$	Turn-off-delay time		-	96.5	-	ns
t_f	Fall time		-	12	-	ns

Table 8: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		32	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		128	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 32\text{ A}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 32\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	468		ns
Q_{rr}	Reverse recovery charge		-	8.7		μC
I_{RRM}	Reverse recovery current		-	37.5		A
t_{rr}	Reverse recovery time	$I_{SD} = 32\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	610		ns
Q_{rr}	Reverse recovery charge		-	11.7		μC
I_{RRM}	Reverse recovery current		-	39		A

Notes:⁽¹⁾Pulse width is limited by safe operating area⁽²⁾Pulse test: pulse duration = 300 μs , duty cycle 1.5%

2.2 Electrical characteristics (curves)

Figure 2: Safe operating area

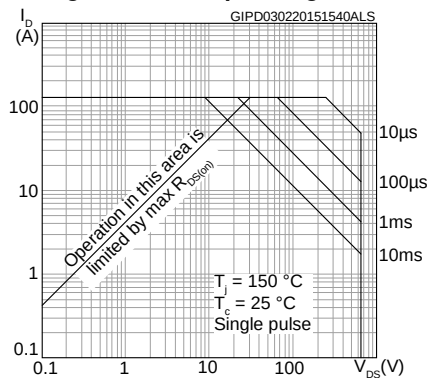


Figure 3: Thermal impedance

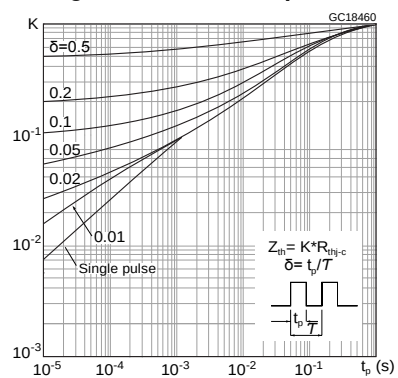


Figure 4: Output characteristics

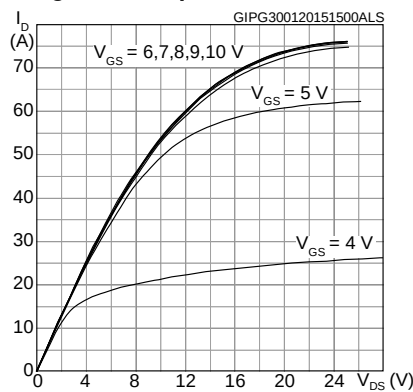


Figure 5: Transfer characteristics

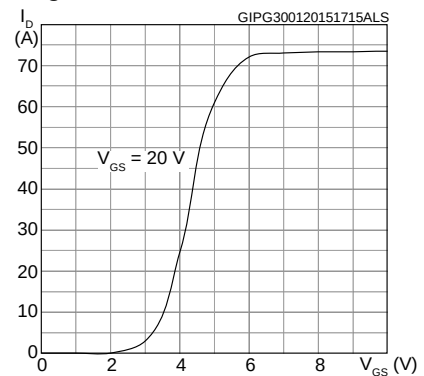


Figure 6: Normalized gate threshold voltage vs temperature

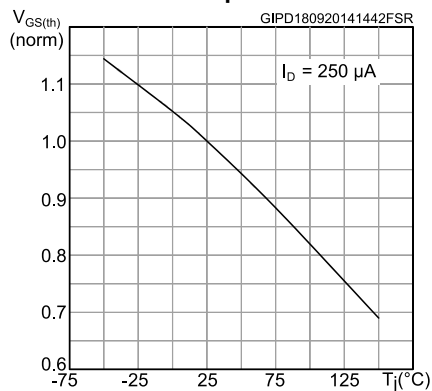
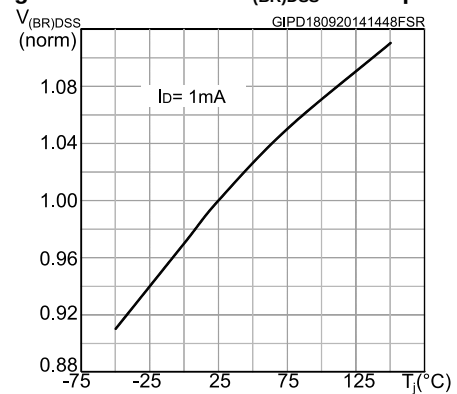
Figure 7: Normalized $V_{(BR)DSS}$ vs temperature

Figure 8: Static drain-source on-resistance

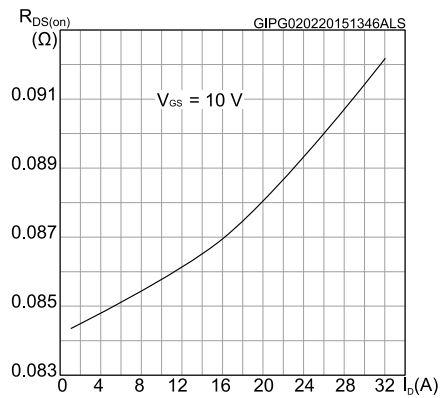


Figure 9: Normalized on-resistance vs. temperature

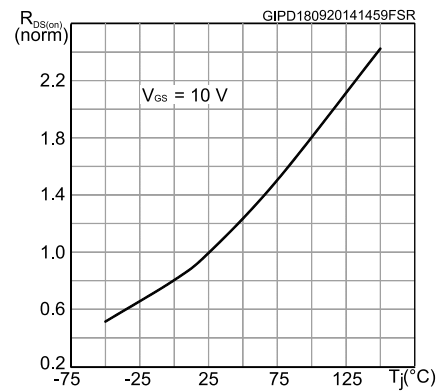


Figure 10: Gate charge vs. gate-source voltage

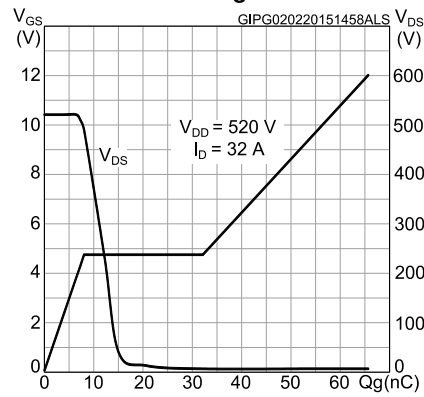


Figure 11: Capacitance variations

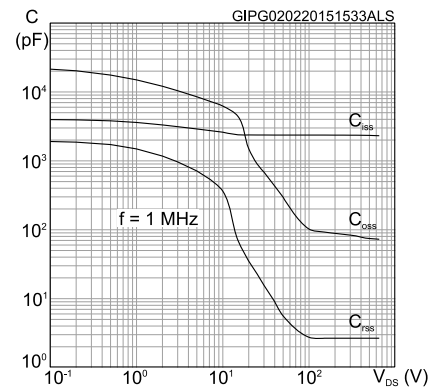


Figure 12: Output capacitance stored energy

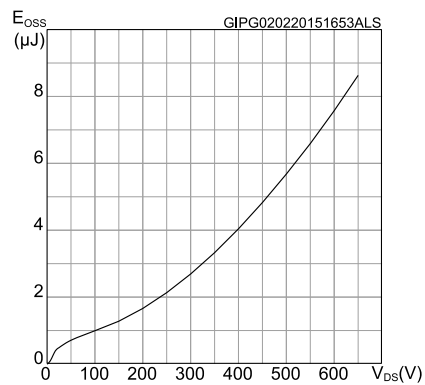
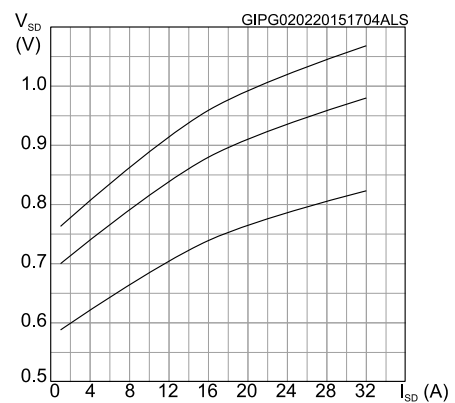
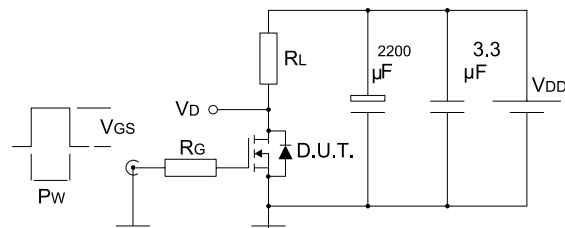


Figure 13: Source-drain diode forward characteristics



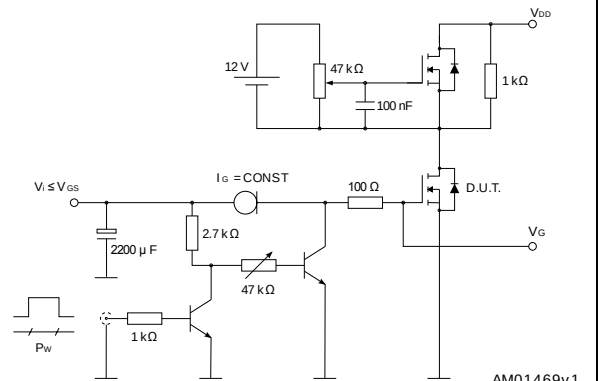
3 Test circuits

Figure 14: Switching times test circuit for resistive load



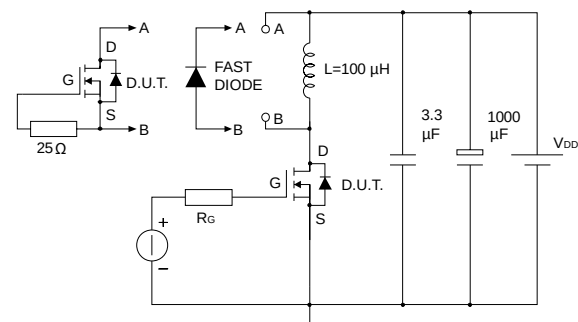
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Figure 15: Gate charge test circuit



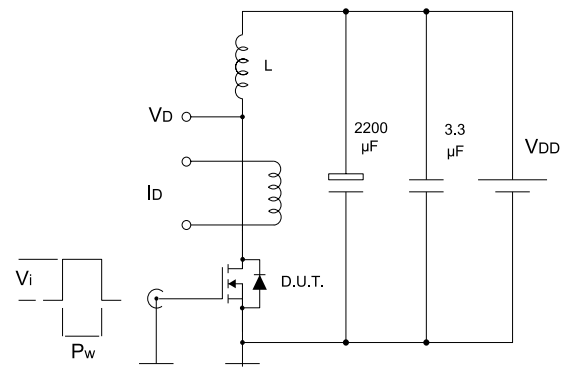
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Figure 16: Test circuit for inductive load switching and diode recovery times



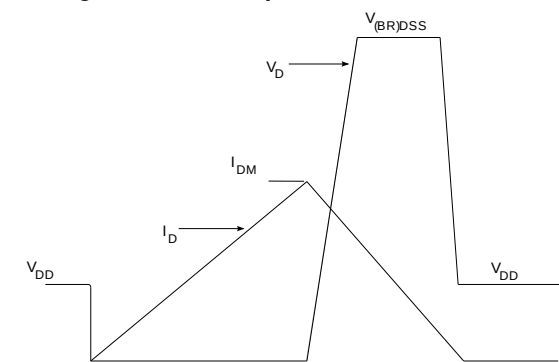
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Figure 17: Unclamped inductive load test circuit



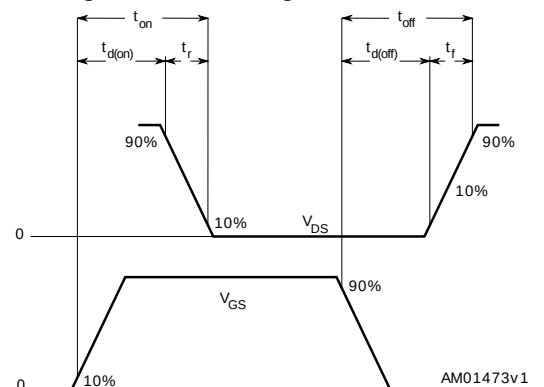
AM01471v1

Figure 18: Unclamped inductive waveform



AM01472v1

Figure 19: Switching time waveform



AM01473v1

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 drawing

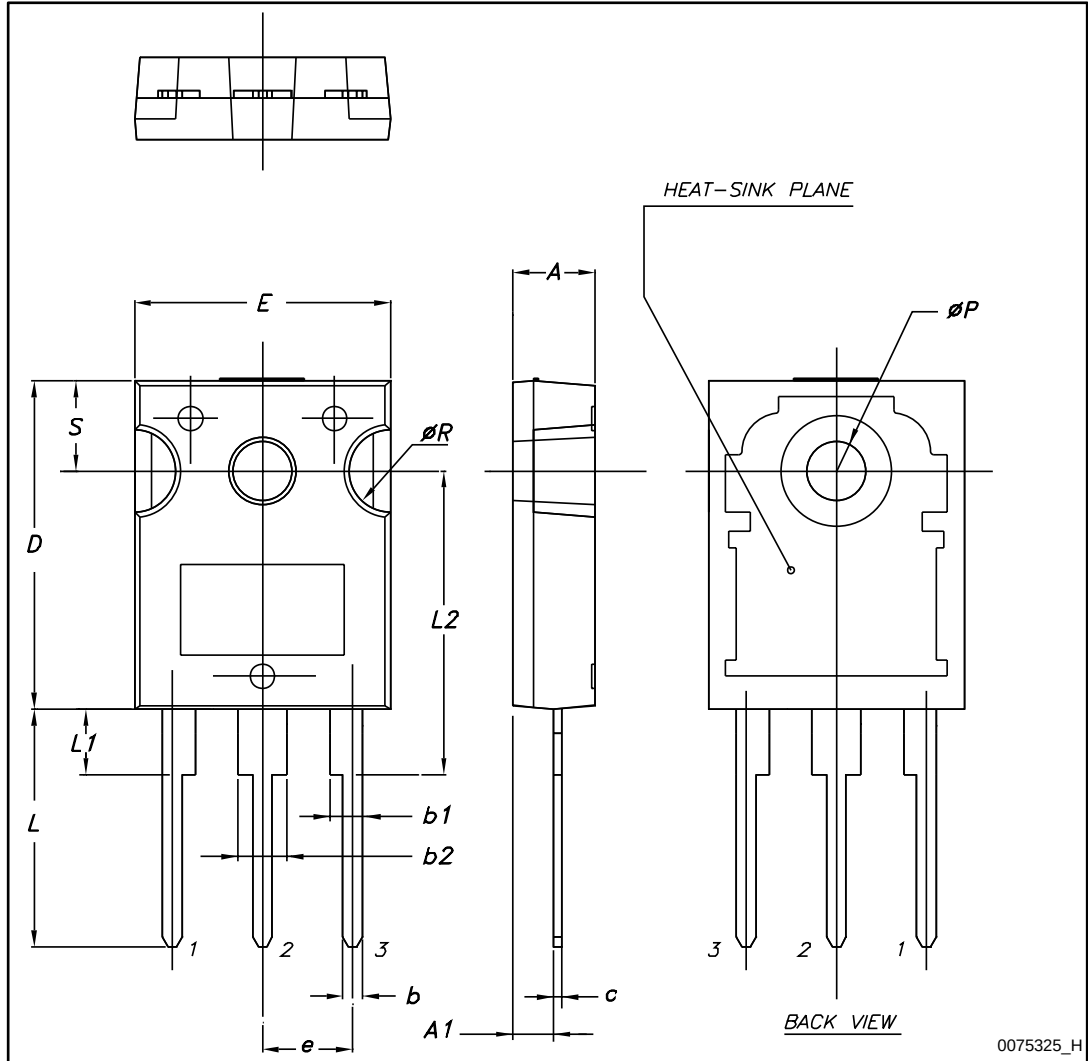


Table 9: TO-247 mechanical data

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

5 Revision history

Table 10: Document revision history

Date	Revision	Changes
09-Feb-2014	1	First release.

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