

N-channel 1500 V, 0.7 Ω typ., 14 A MDmesh™ K5 Power MOSFET in a TO-247 package

Datasheet - production data

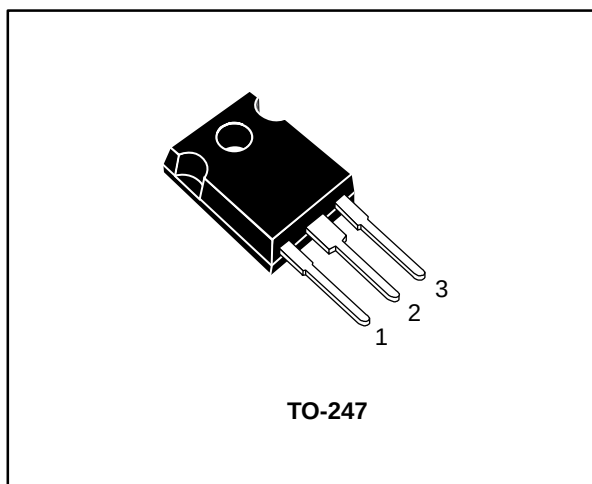
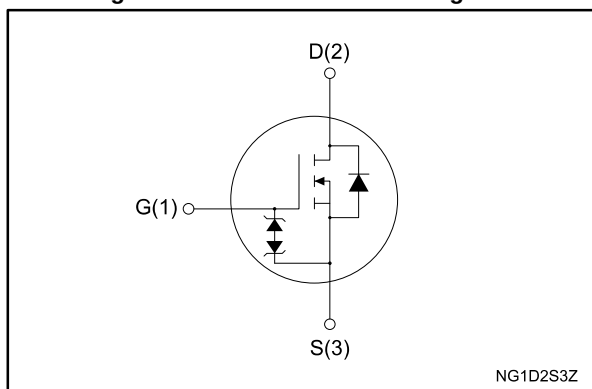


Figure 1: Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STW21N150K5	1500 V	0.9 Ω	14 A	446 W

- Industry's lowest $R_{DS(on)} \cdot \text{area}$
- Industry's best figure of merit (FoM)
- 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.

Table 1: Device summary

Order code	Marking	Package	Packing
STW21N150K5	21N150K5	TO-247	Tube

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1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current at $T_C = 25\text{ }^{\circ}\text{C}$	14	A
I_D	Drain current at $T_C = 100\text{ }^{\circ}\text{C}$	8.7	A
$I_{DM}^{(1)}$	Drain current (pulsed)	56	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	446	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	- 55 to 150	$^{\circ}\text{C}$
T_{stg}	Storage temperature		

Notes:

(1)Pulse width limited by safe operating area

(2) $I_{SD} \leq 14\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, $V_{Peak} \leq V_{(BR)DSS}$ (3) $V_{DS} \leq 1200\text{ V}$

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.28	$^{\circ}\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-amb	50	$^{\circ}\text{C}/\text{W}$

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
$I_{AR}^{(1)}$	Max current during repetitive or single pulse avalanche	5	A
$E_{AS}^{(2)}$	Single pulse avalanche energy	1100	mJ

Notes:(1)Pulse width limited by T_{Jmax} (2)Starting $T_J = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$

2 Electrical characteristics

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

Table 5: Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V _{(BR)DSS}	Drain-source breakdown voltage	V _{GS} = 0 V, I _D = 1 mA	1500			V
I _{DSS}	Zero gate voltage drain current	V _{GS} = 0 V, V _{DS} = 1500 V			1	μA
		V _{GS} = 0 V, V _{DS} = 1500 V, T _C = 125 °C			50	μA
I _{GSS}	Gate body leakage current	V _{DS} = 0, V _{GS} = ± 20 V			±10	μA
V _{GS(th)}	Gate threshold voltage	V _{DS} = V _{GS} , I _D = 100 μA	3	4	5	V
R _{DS(on)}	Static drain-source on-resistance	V _{GS} = 10 V, I _D = 7 A		0.7	0.9	Ω

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C _{iss}	Input capacitance	V _{GS} = 0 V, V _{DS} = 100 V, f = 1 MHz	-	3145	-	pF
C _{oss}	Output capacitance		-	172	-	pF
C _{rss}	Reverse transfer capacitance		-	1	-	pF
C _{o(tr)} ⁽¹⁾	Equivalent capacitance time related	V _{DS} = 0 V to 1200 V, V _{GS} = 0 V	-	161	-	pF
C _{o(er)} ⁽²⁾	Equivalent capacitance energy related		-	65	-	pF
R _G	Intrinsic gate resistance	f = 1 MHz, I _D = 0 A	-	2.4	-	Ω
Q _g	Total gate charge	V _{DD} = 1200 V, I _D = 7 A	-	89	-	nC
Q _{gs}	Gate-source charge	V _{GS} = 10 V	-	16	-	nC
Q _{gd}	Gate-drain charge	(see Figure 15: "Test circuit for gate charge behavior")	-	59	-	nC

Notes:

⁽¹⁾Time related 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⁾Energy related 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 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t _{d(on)}	Turn-on delay time	V _{DD} = 750 V, I _D = 3.5 A, R _G = 4.7 Ω V _{GS} = 10 V (see Figure 17: "Unclamped inductive load test circuit")	-	34	-	ns
t _r	Rise time		-	14	-	ns
t _{d(off)}	Turn-off delay time		-	134	-	ns
t _f	Fall time		-	26	-	ns

Table 8: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		7	A
I_{SDM}	Source-drain current (pulsed)		-		28	A
$V_{SD}^{(1)}$	Forward on voltage	$I_{SD} = 7\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 7\text{ A}$, $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$, (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	448		ns
Q_{rr}	Reverse recovery charge		-	8.24		μC
I_{RRM}	Reverse recovery current		-	36.8		A
t_{rr}	Reverse recovery time	$I_{SD} = 7\text{ A}$, $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times")	-	564		ns
Q_{rr}	Reverse recovery charge		-	9.48		μC
I_{RRM}	Reverse recovery current		-	33.6		A

Notes:

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

Table 9: 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)

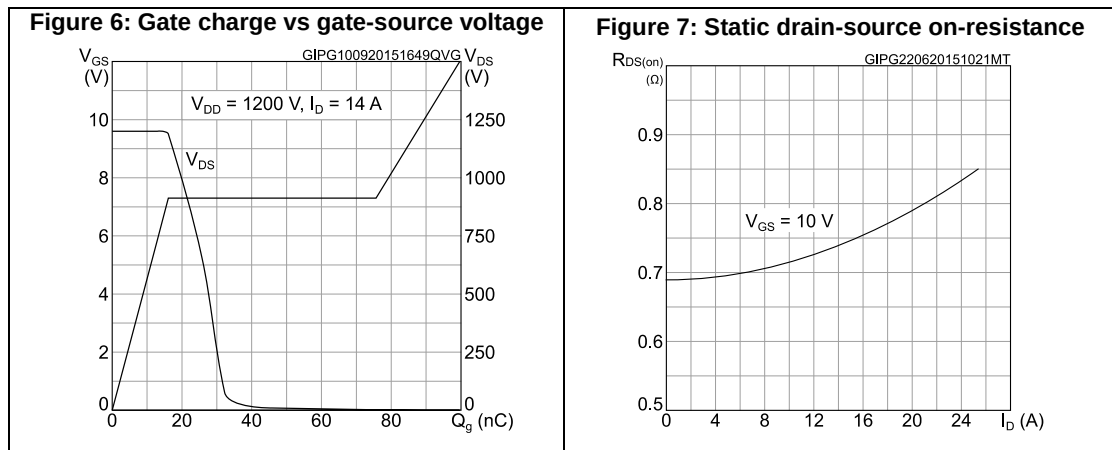
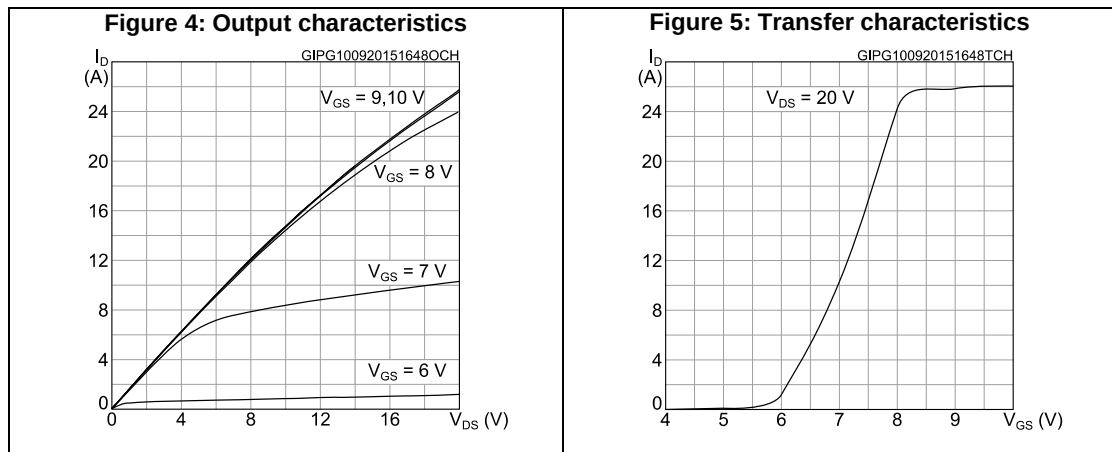
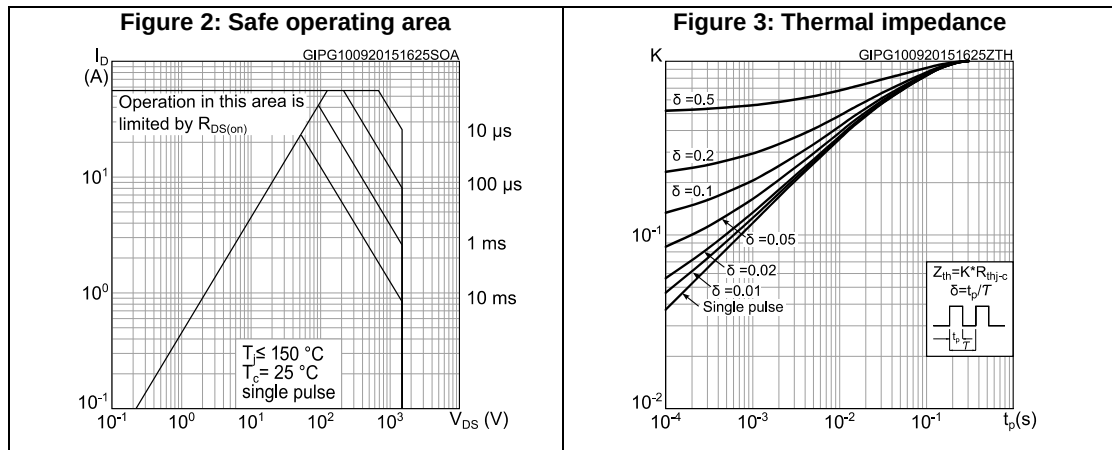


Figure 8: Capacitance variations

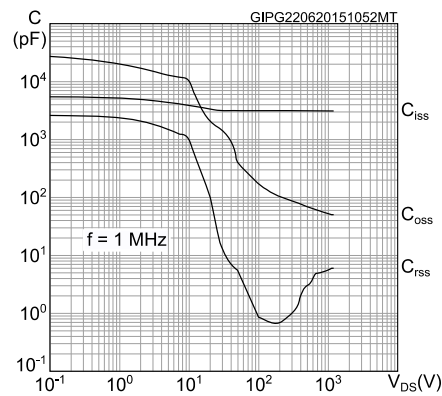


Figure 9: Normalized gate threshold voltage vs temperature

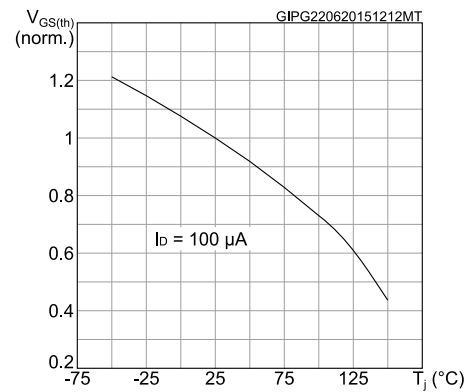


Figure 10: Normalized on-resistance vs temperature

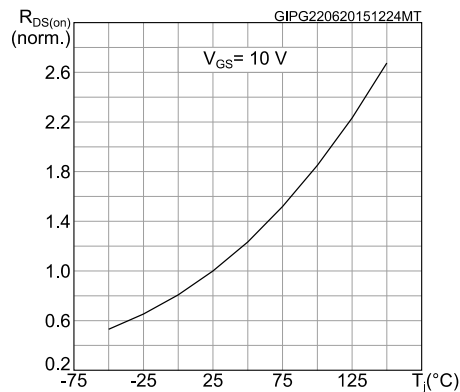


Figure 11: Normalized V(BR)DSS vs temperature

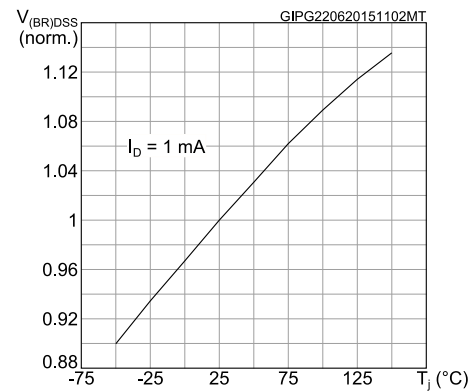


Figure 12: Maximum avalanche energy vs temperature

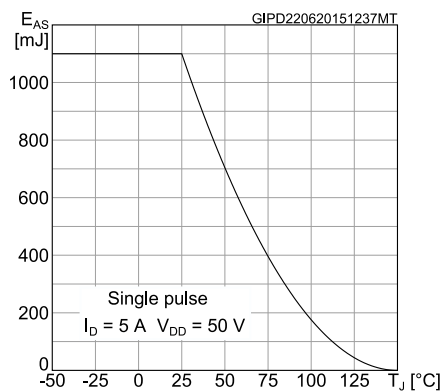
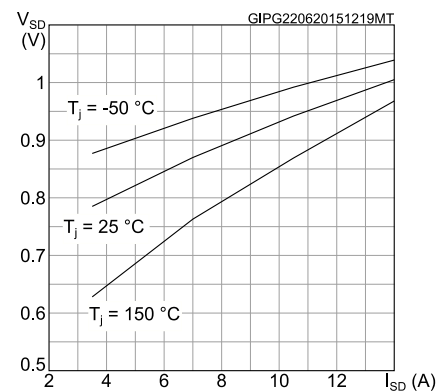
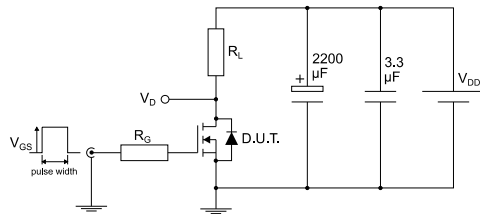


Figure 13: Source-drain diode forward characteristics



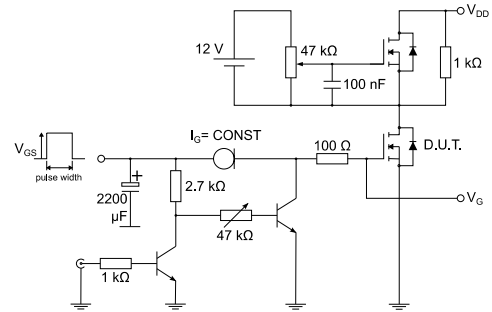
3 Test circuits

Figure 14: Test circuit for resistive load switching times



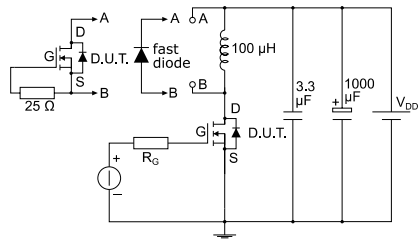
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Figure 15: Test circuit for gate charge behavior



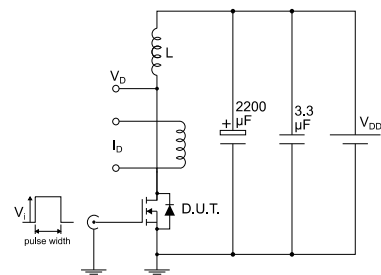
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Figure 16: Test circuit for inductive load switching and diode recovery times



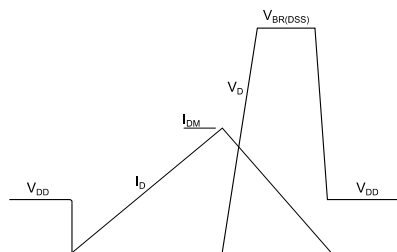
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Figure 17: Unclamped inductive load test circuit



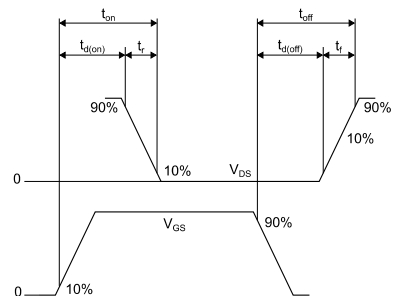
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Figure 18: Unclamped inductive waveform



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 package outline

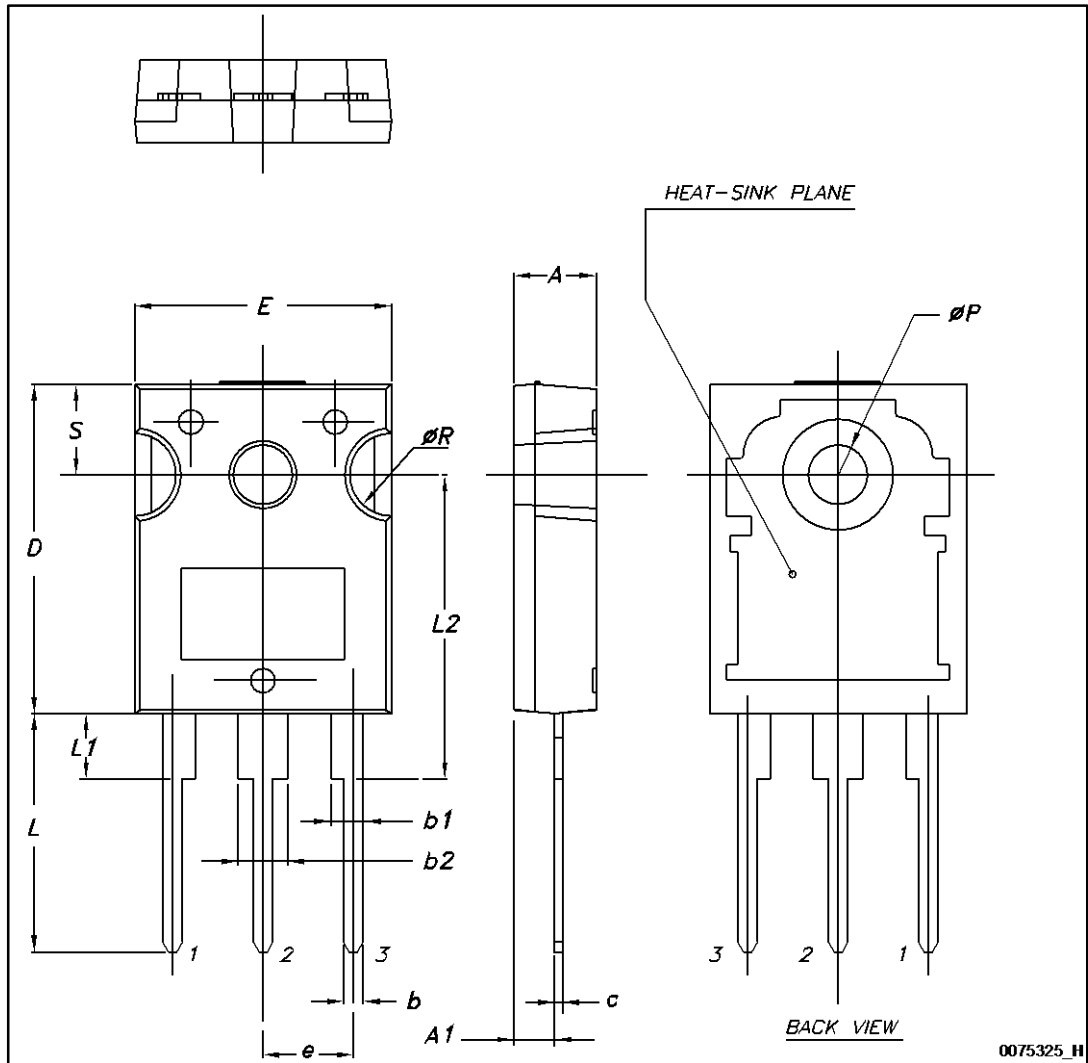


Table 10: TO-247 package mechanical data

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

5 Revision history

Table 11: Document revision history

Date	Revision	Changes
26-Aug-2015	1	First release.
10-Sep-2015	2	Text and formatting changes throughout document. Updated features on cover page. Updated sections <i>Electrical ratings</i> and <i>Electrical characteristics</i> . Added section <i>Electrical characteristics (curves)</i> . Updated section <i>TO-247 package information</i> .
01-Oct-2015	3	On cover page: - updated figure Internal schematic diagram In section Electrical characteristics: - updated and renamed table Static (was On/off states).

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