STW12N150K5

N-channel 1500 V, 1.6 Ω typ.,7 A MDmesh™ K5 Power MOSFET in a TO-247 package

Datasheet - production data

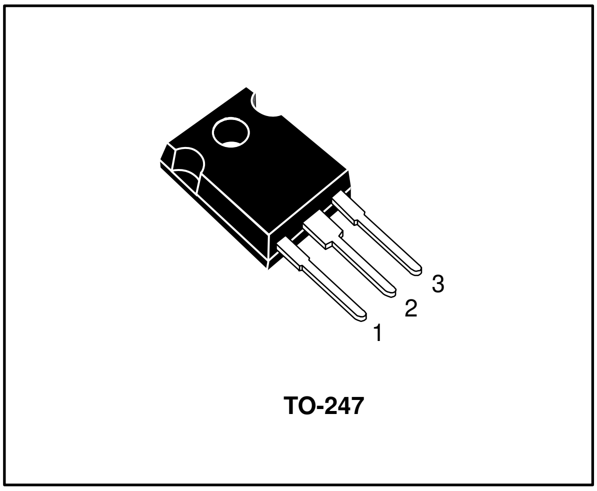
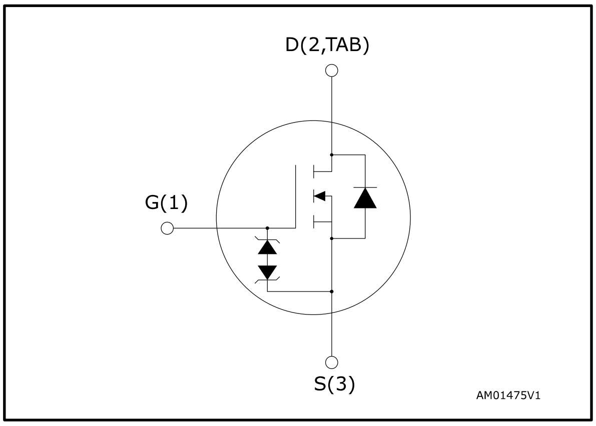


Figure 1: Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STW12N150K5	1500 V	1.9 Ω	7 A	250 W

- Industry's lowest $R_{DS(on)}$ * 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
STW12N150K5	12N150K5	TO-247	Tube

Contents

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 °C	7	A
I_D	Drain current at T_C = 100 °C	4	A
I_{DM}(1)	Drain current (pulsed)	28	A
P_{TOT}	Total dissipation at T_C = 25 °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	- 55 to 150	°C
T_{stg}	Storage temperature		

Notes:

(1) Pulse width limited by safe operating area

(2) $I_{SD} \leq 7$ A, di/dt ≤ 100 A/μs, $V_{Peak} \leq V_{(BR)DSS}$

(3) $V_{DS} \leq 1200$ V

Table 3: Thermal data

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

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Max current during repetitive or single pulse avalanche	2	A
E_{AS}	Single pulse avalanche energy	900	mJ

2 Electrical characteristics

(T_{CASE} = 25 °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 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, Tc=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 = 3.5 A		1.6	1.9	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 = 1MHz	-	1360	-	pF
C_{oss}	Output capacitance		-	80	-	pF
C_{rss}	Reverse transfer capacitance		-	0.7	-	pF
$C_{o(tr)}$(1)	Equivalent capacitance time related	V_{DS} = 0 V to 1200 V, V_{GS} = 0 V	-	82	-	pF
$C_{o(er)}$(2)	Equivalent capacitance energy related		-	32	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	3	-	Ω
Q_g	Total gate charge	V_{DD} = 1200V, I_D = 7 A V_{GS} = 10 V (see *Figure 16: "Gate charge test circuit"*)	-	47	-	nC
Q_{gs}	Gate-source charge		-	8	-	nC
Q_{gd}	Gate-drain charge		-	32	-	nC

Notes:

(1)Time related is defined as a constant equivalent capacitance giving the same charging time as Coss when VDS increases from 0 to 80% VDSS.

(2) Energy related is defined as a constant equivalent capacitance giving the same stored energy as Coss when VDS increases from 0 to 80% VDSS.

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 18: "Unclamped inductive load test circuit"*)	-	25	-	ns
t_r	Rise time		-	8	-	ns
$t_{d(off)}$	Turn-off delay time		-	90	-	ns
t_f	Fall time		-	37	-	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 A, V_{GS} = 0 V	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 7 A, V_{DD} = 60 V di/dt = 100 A/µs, (see *Figure 17: "Test circuit for inductive load switching and diode recovery times"*)	-	302		ns
Q_{rr}	Reverse recovery charge		-	3.71		µC
I_{RRM}	Reverse recovery current		-	24.6		A
t_{rr}	Reverse recovery time	I_{SD} = 7 A,V_{DD} = 60 V di/dt = 100 A/µs, Tj = 150 °C (see *Figure 17: "Test circuit for inductive load switching and diode recovery times"*)	-	432		ns
Q_{rr}	Reverse recovery charge		-	4.71		µC
I_{RRM}	Reverse recovery current		-	21.8		A

Notes:

(1)Pulsed: pulse duration = 300µs, 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} = ±1 mA, I_D = 0 A	30	-		V

The built-in back-to-back Zener diodes have been specifically designed to enhance the ESD capability of the device. The Zener voltage is appropriate for efficient and cost-effective intervention to protect the device integrity. These integrated Zener diodes thus eliminate the need for external components.

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

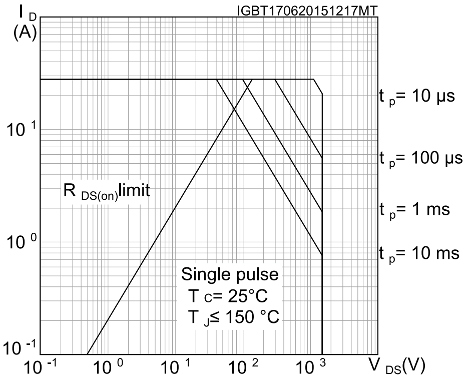


Figure 3: Thermal impedance

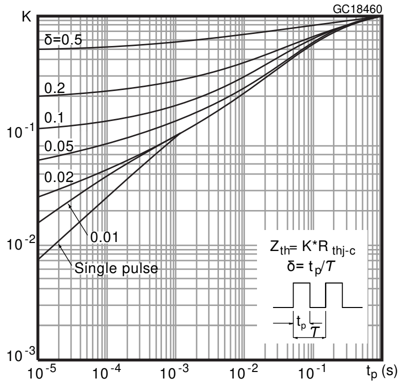


Figure 4: Output characteristics

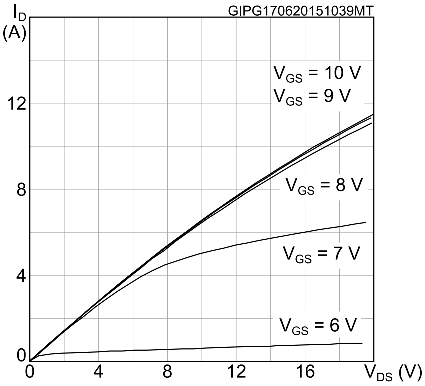


Figure 5: Transfer characteristics

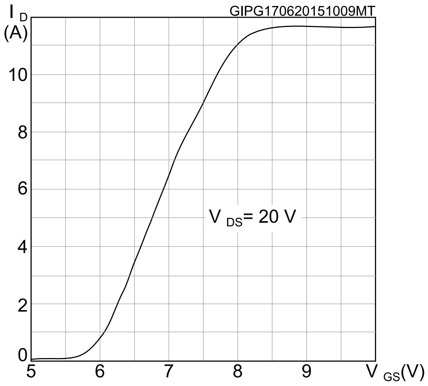


Figure 6: Gate charge vs gate-source voltage

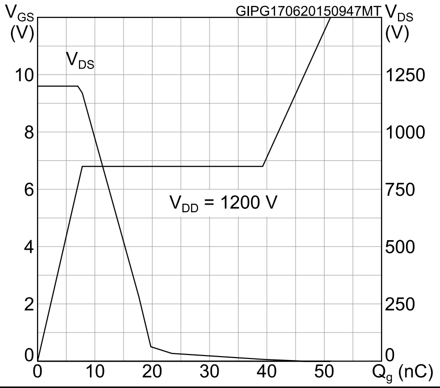


Figure 7: Static drain-source on-resistance

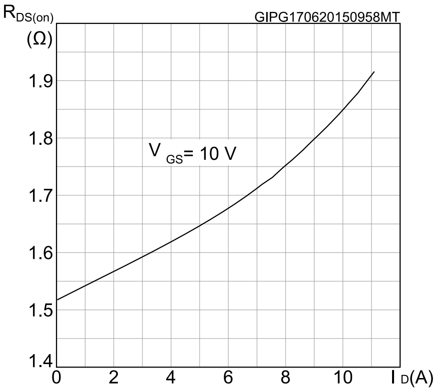


Figure 8: Capacitance variation

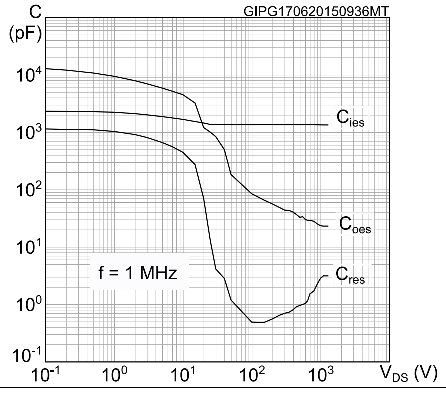


Figure 9: Output capacitance stored energy

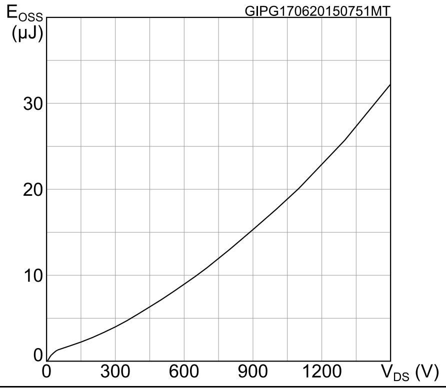


Figure 10: Normalized gate threshold voltage vs temperature

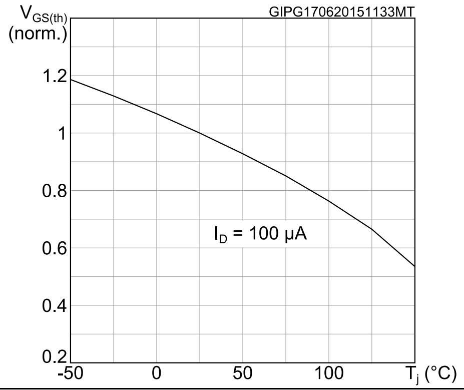


Figure 11: Normalized on-resistance vs temperature

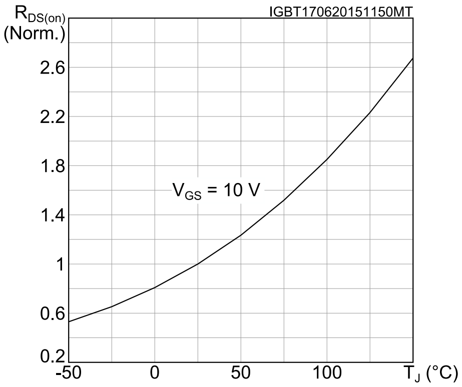


Figure 12: Normalized $V_{(BR)DSS}$ vs temperature

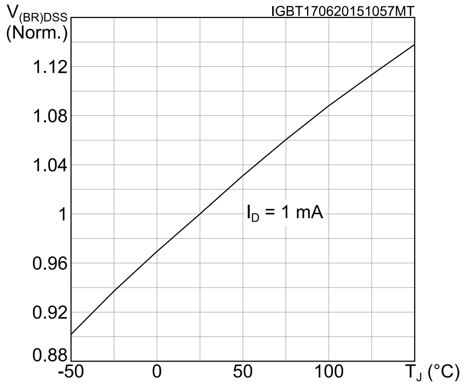


Figure 13: Source-drain diode forward characteristics

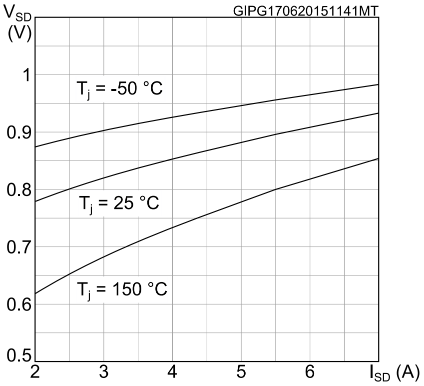
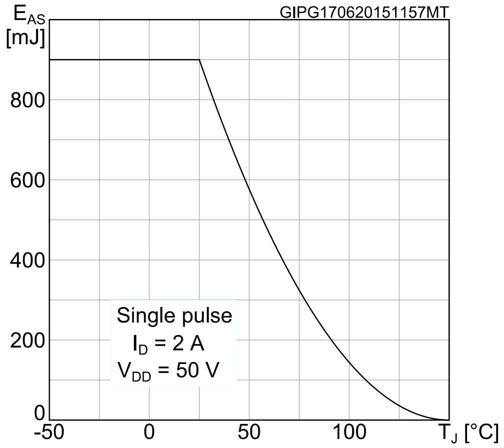


Figure 14: Maximum avalanche energy vs T_J



3 Test circuits

Figure 15: Switching times test circuit for resistive load

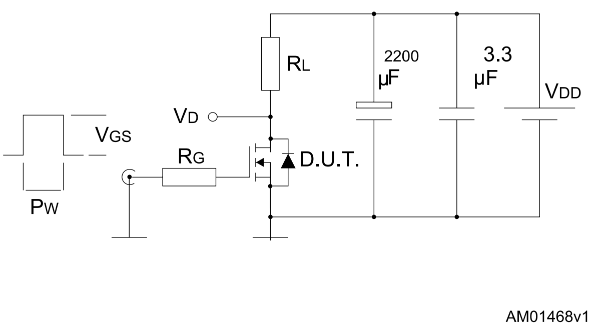


Figure 16: Gate charge test circuit

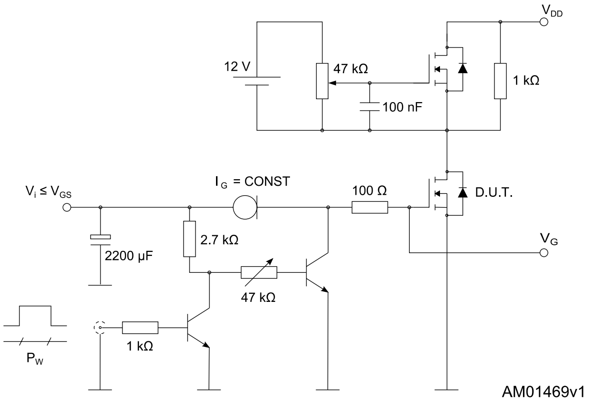


Figure 17: Test circuit for inductive load switching and diode recovery times

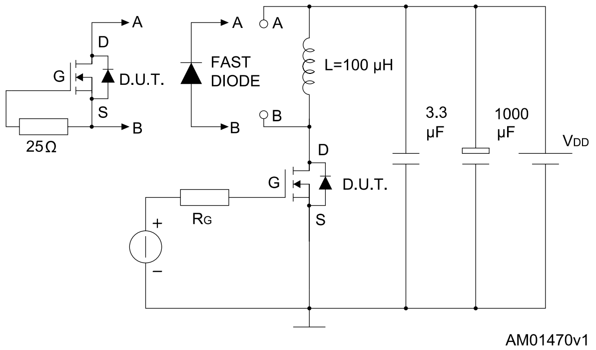


Figure 18: Unclamped inductive load test circuit

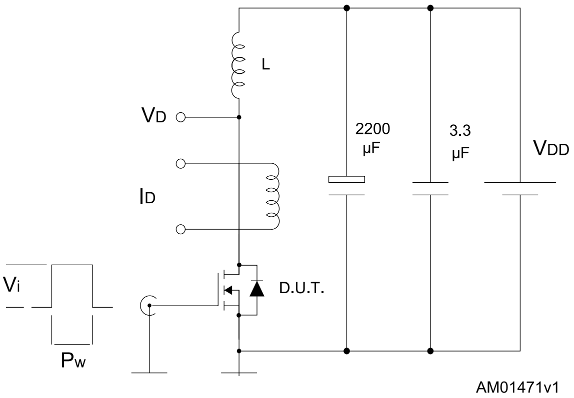


Figure 19: Unclamped inductive waveform

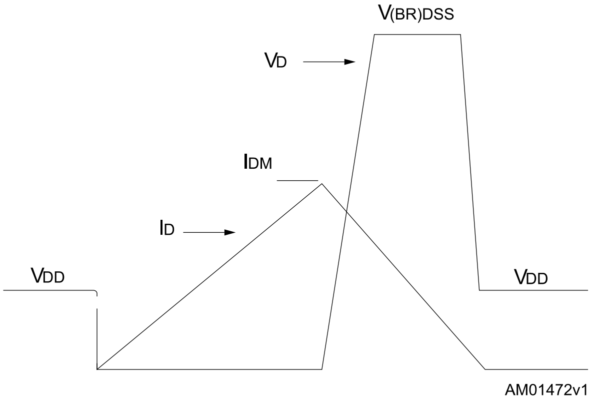
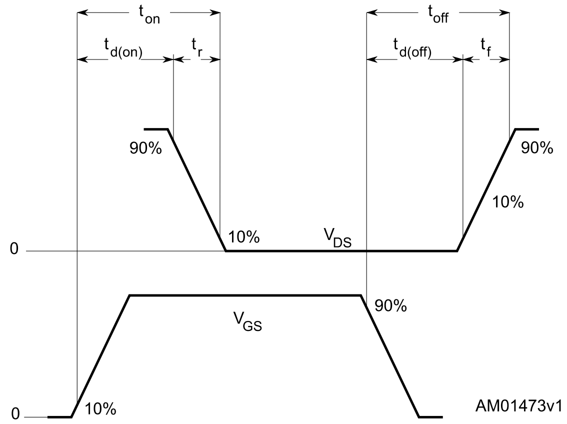


Figure 20: Switching time waveform



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 21: TO-247 package outline

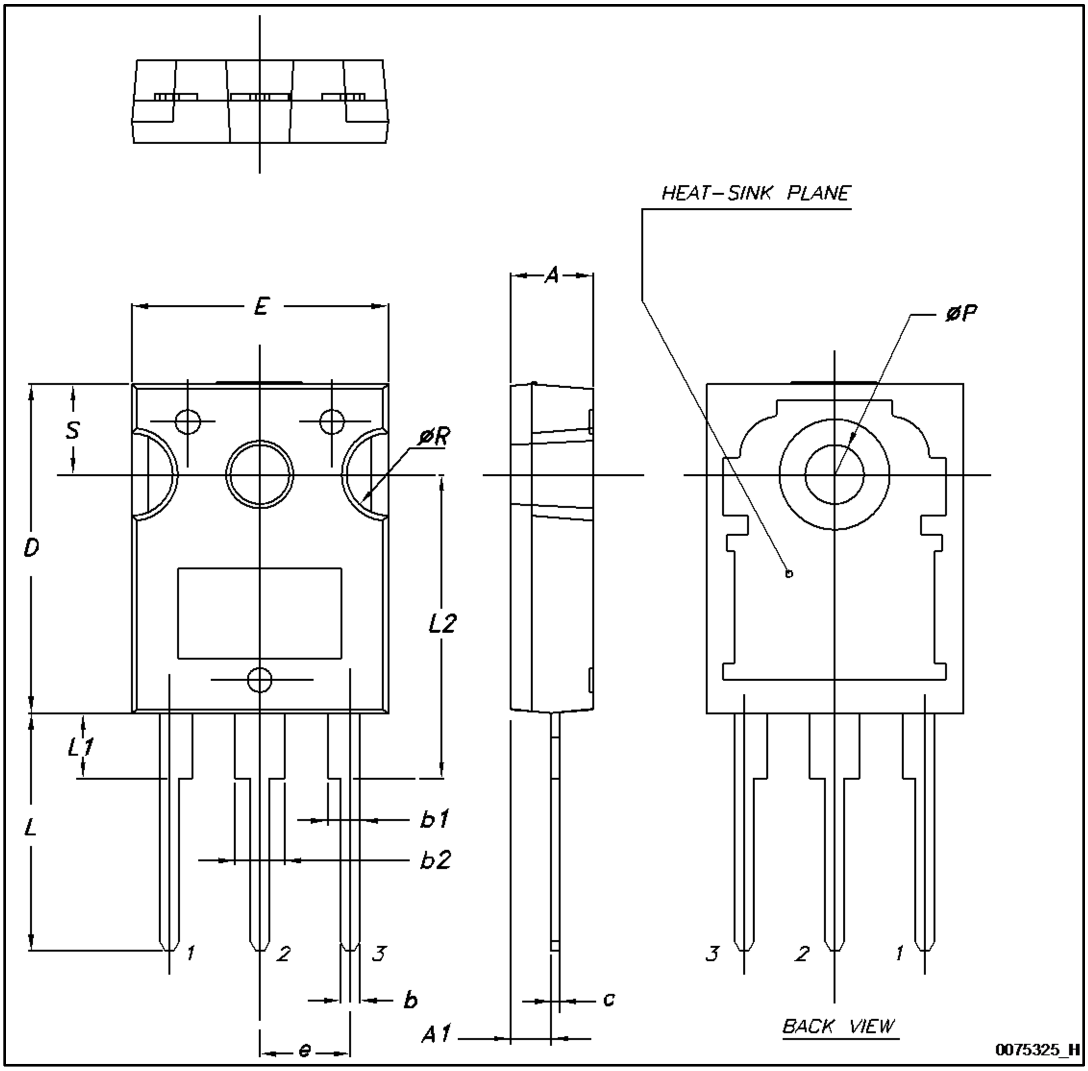


Table 10: TO-247 package mechanical data

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
11-May-2015	1	First release.
30-Jun-2015	2	Updated title and features in cover page. Updated *Section 4: "Electrical ratings"*, *Section 5: "Electrical characteristics"*. Added *Section 5.1: "Electrical characteristics (curves)"* . Minor text changes.
07-Jul-2015	3	Updated *Section 5.1: "Electrical characteristics (curves)"*. Minor text changes.