

Silicon carbide Power MOSFET 1200 V, 45 A, 90 mΩ (typ., $T_J = 150\text{ }^{\circ}\text{C}$) in an HiP247™ package

Datasheet - production data

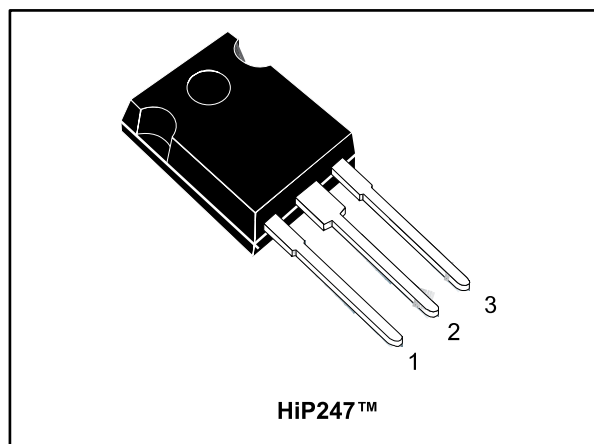
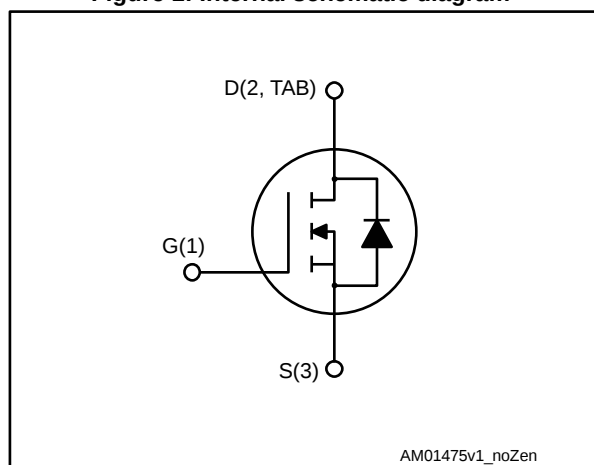


Figure 1: Internal schematic diagram



Features

- Very tight variation of on-resistance vs. temperature
- Very high operating junction temperature capability ($T_J = 200\text{ }^{\circ}\text{C}$)
- Very fast and robust intrinsic body diode
- Low capacitance

Applications

- Solar inverters, UPS
- Motor drives
- High voltage DC-DC converters
- Switch mode power supply

Description

This silicon carbide Power MOSFET is produced exploiting the advanced, innovative properties of wide bandgap materials. This results in unsurpassed on-resistance per unit area and very good switching performance almost independent of temperature. The outstanding thermal properties of the SiC material, combined with the device's housing in the proprietary HiP247™ package, allows designers to use an industry standard outline with significantly improved thermal capability. These features render the device perfectly suitable for high-efficiency and high power density applications.

Table 1: Device summary

Order code	Marking	Package	Packaging
SCT30N120	SCT30N120	HiP247™	Tube

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1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	1200	V
V_{GS}	Gate-source voltage	-10 to 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ °C}$ (limited by die)	45	A
I_D	Drain current (continuous) at $T_C = 25\text{ °C}$ (limited by package)	40	A
I_D	Drain current (continuous) at $T_C = 100\text{ °C}$	34	A
$I_{DM}^{(1)}$	Drain current (pulsed)	90	A
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	270	W
T_{stg}	Storage temperature range	-55 to 200	°C
T_j	Operating junction temperature range		°C

Notes:

⁽¹⁾Pulse width limited by safe operating area.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.65	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	40	°C/W

2 Electrical characteristics

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

Table 4: On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{DSS}	Zero gate voltage drain current	$V_{DS} = 1200\text{ V}; V_{GS} = 0\text{ V}$		1	25	μA
		$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}, T_J = 200\text{ °C}$		50		μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}; V_{GS} = -10\text{ to }22\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	1.8	3.5		V
$R_{DS(on)}$	Static drain-source on- resistance	$V_{GS} = 20\text{ V}, I_D = 20\text{ A}$		80	100	m Ω
		$V_{GS} = 20\text{ V}, I_D = 20\text{ A}, T_J = 150\text{ °C}$		90		m Ω
		$V_{GS} = 20\text{ V}, I_D = 20\text{ A}, T_J = 200\text{ °C}$		100		m Ω

Table 5: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 400\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	-	1700	-	pF
C_{oss}	Output capacitance		-	130	-	pF
C_{rss}	Reverse transfer capacitance		-	25	-	pF
Q_g	Total gate charge	$V_{DD} = 800\text{ V}, I_D = 20\text{ A}, V_{GS} = 0\text{ to }20\text{ V}$	-	105	-	nC
Q_{gs}	Gate-source charge		-	16	-	nC
Q_{gd}	Gate-drain charge		-	40	-	nC
R_g	Gate input resistance	$f = 1\text{ MHz}$ open drain	-	5	-	Ω

Table 6: Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on}	Turn-on switching energy	$V_{DD} = 800\text{ V}, I_D = 20\text{ A}, R_G = 6.8\text{ }\Omega, V_{GS} = -2\text{ to }20\text{ V}$	-	500	-	μJ
E_{off}	Turn-off switching energy		-	350	-	μJ
E_{on}	Turn-on switching energy	$V_{DD} = 800\text{ V}, I_D = 20\text{ A}, R_G = 6.8\text{ }\Omega, V_{GS} = -2\text{ to }20\text{ V}, T_J = 150\text{ °C}$	-	500	-	μJ
E_{off}	Turn-off switching energy		-	400	-	μJ

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 800\text{ V}, I_D = 20\text{ A}, R_G = 0\text{ }\Omega, V_{GS} = 0\text{ to }20\text{ V}$	-	19	-	ns
t_f	Fall time		-	28	-	ns
$t_{d(off)}$	Turn-off delay time		-	45	-	ns
t_r	Rise time		-	20	-	ns

Table 8: Reverse SiC diode characteristics

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
V_{SD}	Diode forward voltage	$I_F = 10\text{ A}$, $V_{GS} = 0\text{ V}$	-	3.5	-	V
t_{rr}	Reverse recovery time	$I_{SD} = 20\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 800\text{ V}$	-	140		ns
Q_{rr}	Reverse recovery charge		-	140	-	nC
I_{RRM}	Reverse recovery current		-	2	-	A

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

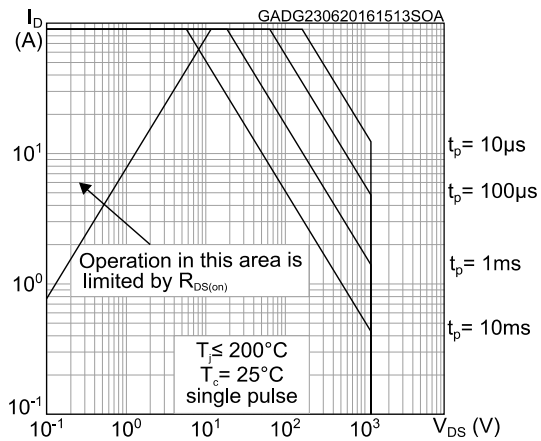


Figure 3: Thermal impedance

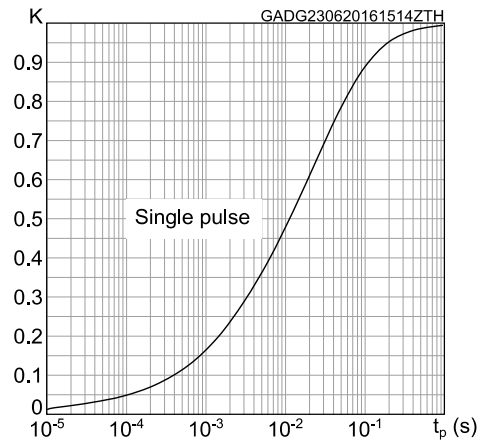
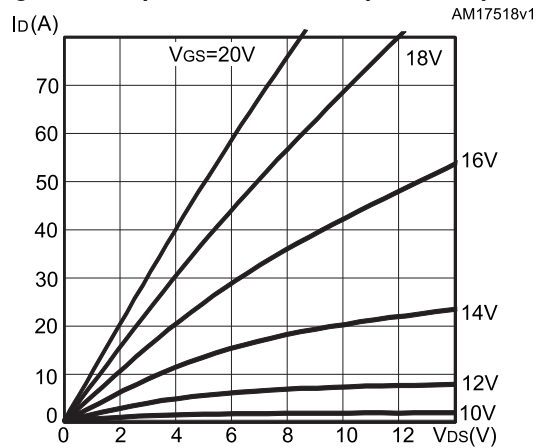
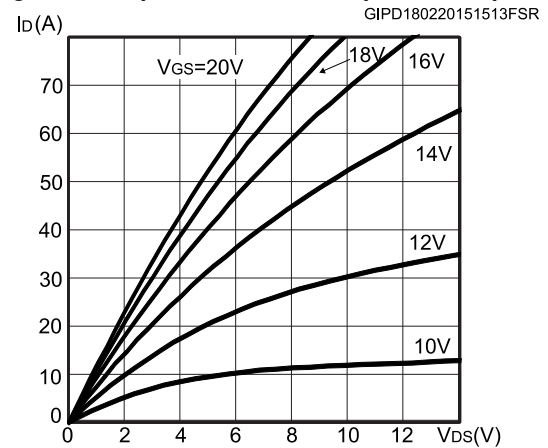
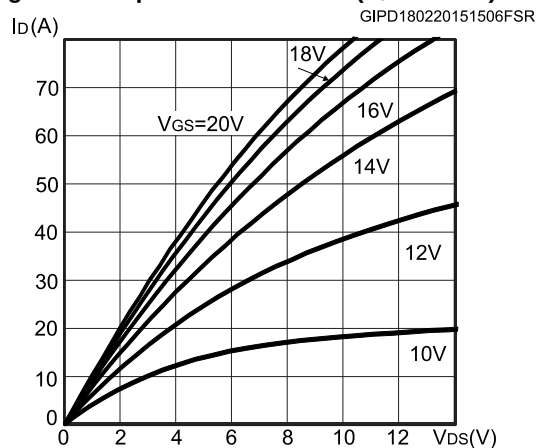
Figure 4: Output characteristics ($T_J = 25\text{ }^{\circ}\text{C}$)Figure 5: Output characteristics ($T_J = 150\text{ }^{\circ}\text{C}$)Figure 6: Output characteristics ($T_J = 200\text{ }^{\circ}\text{C}$)

Figure 7: Transfer characteristics

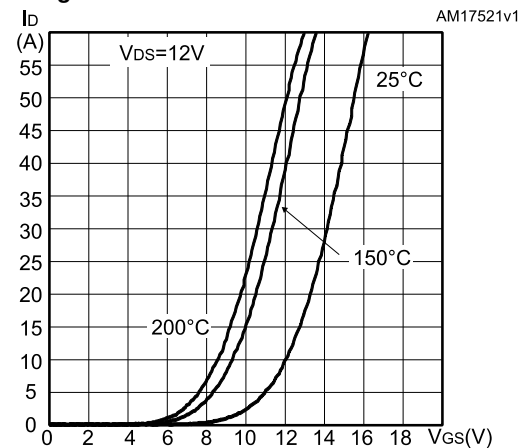


Figure 8: Power dissipation

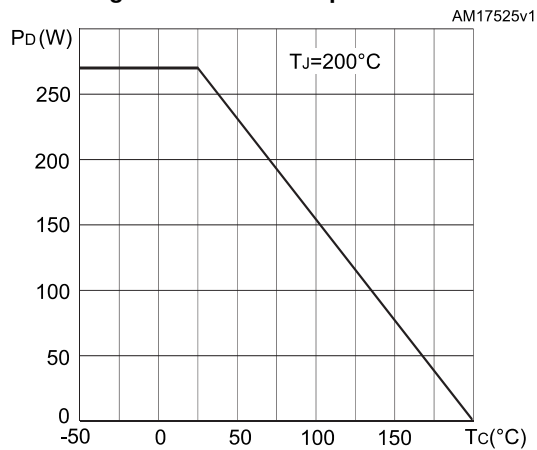


Figure 9: Gate charge vs gate-source voltage

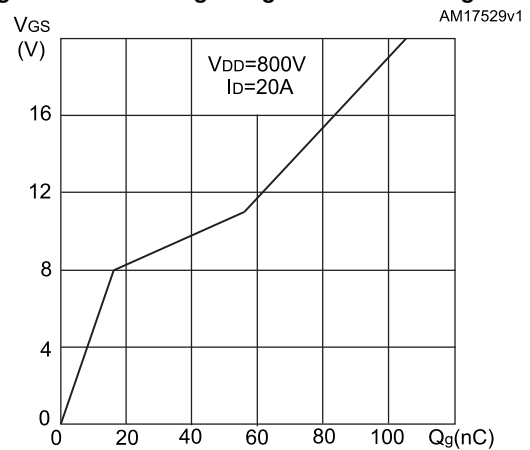


Figure 10: Capacitance variations

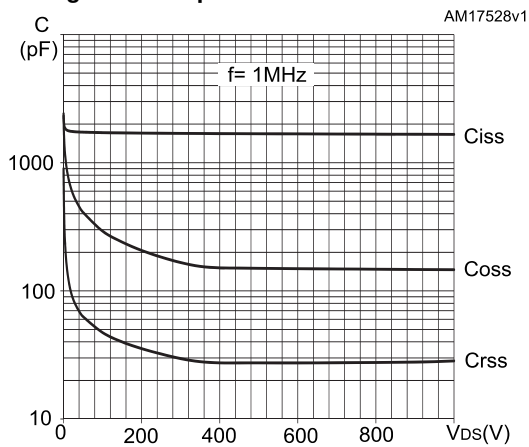


Figure 11: Switching energy vs. drain current

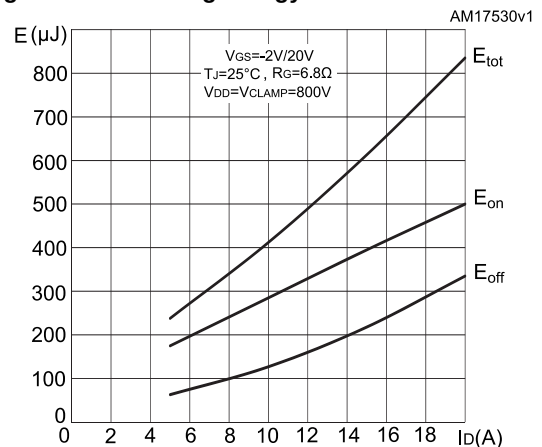


Figure 12: Switching energy vs. junction temperature

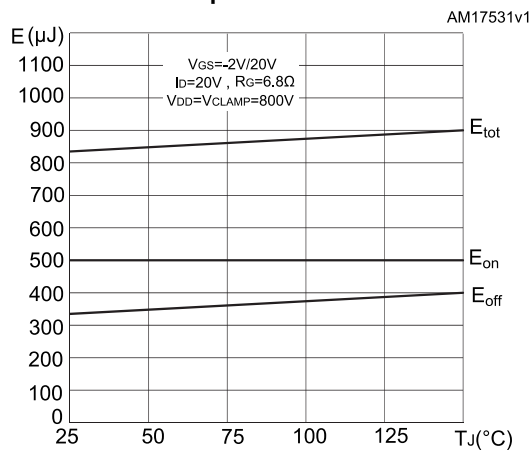
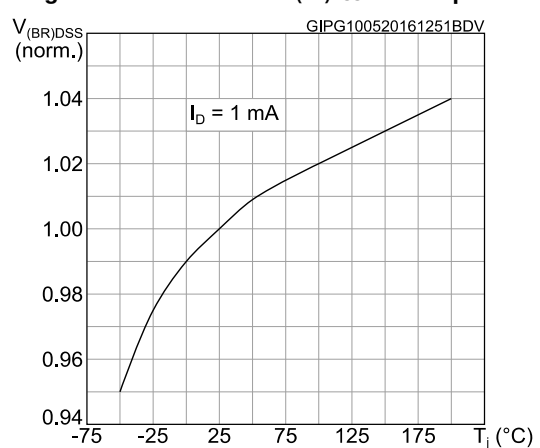
Figure 13: Normalized $V_{(BR)DSS}$ vs. temperature

Figure 14: Normalized gate threshold voltage vs. temperature

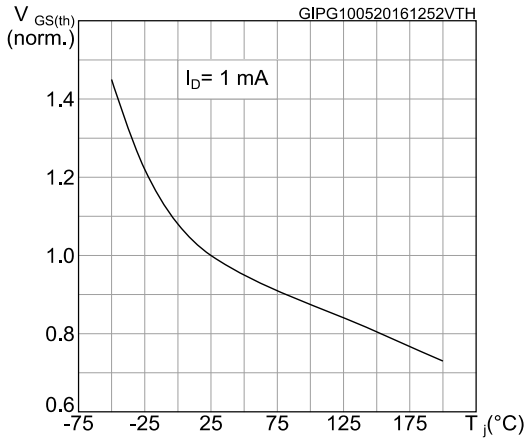


Figure 15: Normalized on-resistance vs. temperature

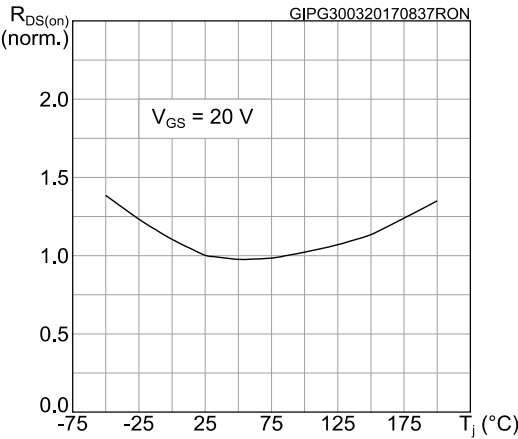


Figure 16: Body diode characteristics ($T_J = -50$ °C)

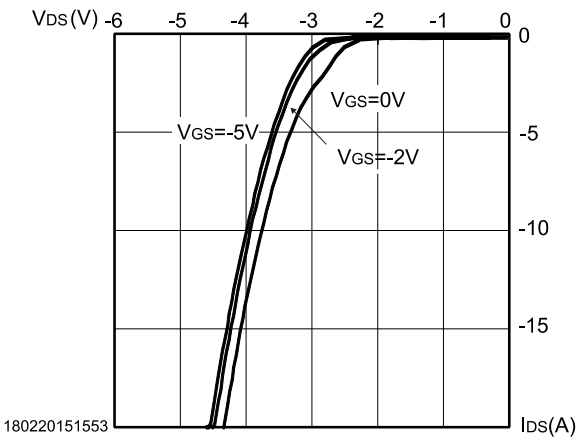


Figure 17: Body diode characteristics ($T_J = 25$ °C)

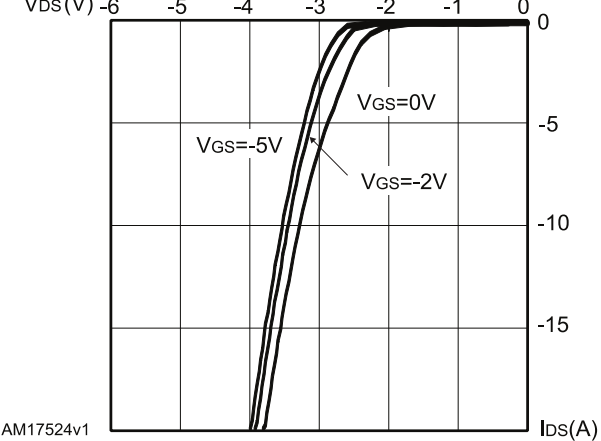


Figure 18: Body diode characteristics ($T_J = 150$ °C)

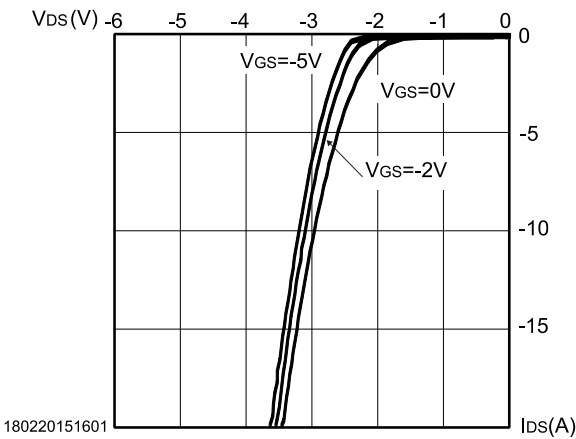


Figure 19: 3rd quadrant characteristics ($T_J = -50$ °C)

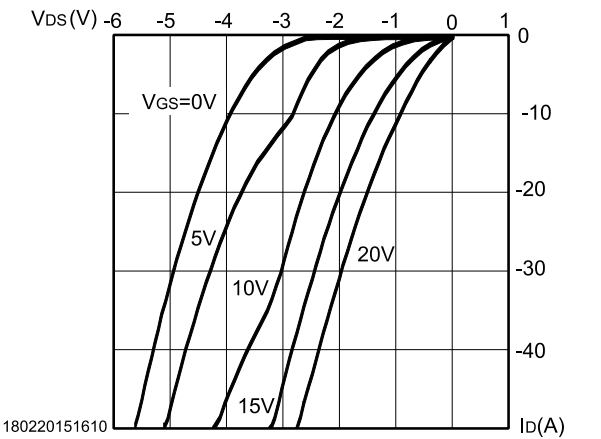


Figure 20: 3rd quadrant characteristics ($T_J = 25\text{ }^{\circ}\text{C}$)

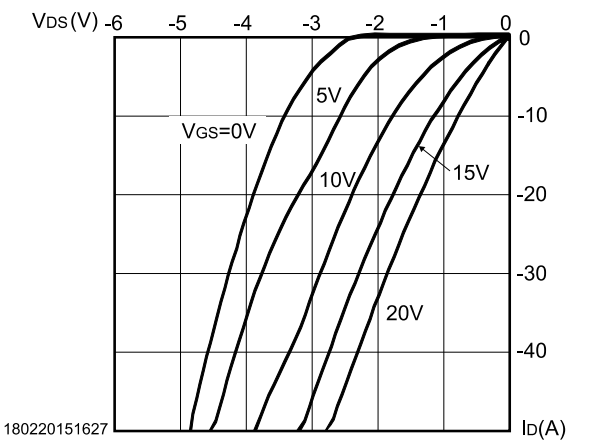
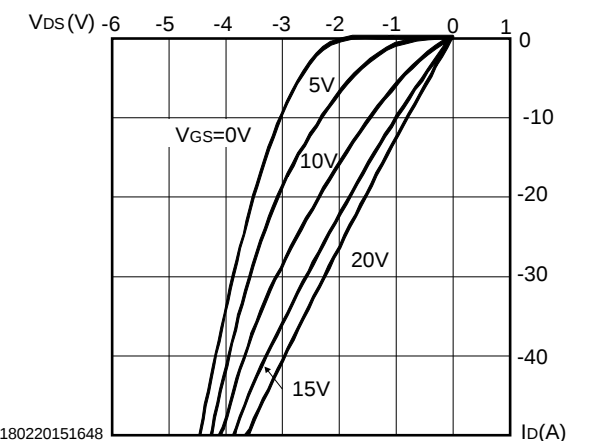


Figure 21: 3rd quadrant characteristics ($T_J = 150\text{ }^{\circ}\text{C}$)



3 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.

3.1 HiP247 package information

Figure 22: HiP247™ package outline

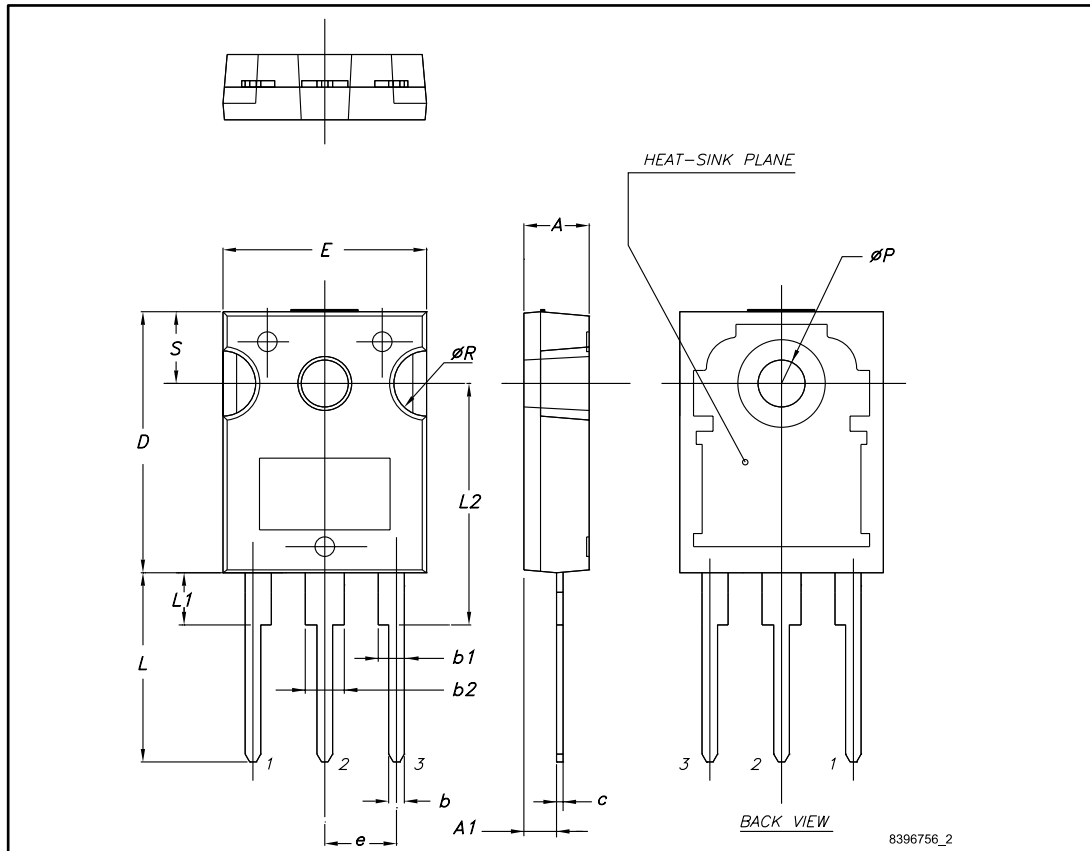


Table 9: HiP247™ package mechanical data

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

4 Revision history

Table 10: Document revision history

Date	Revision	Changes
10-May-2012	1	First release
21-May-2013	2	Updated trr value in Table8. Updated dynamic parameters in Table5, VGS(th) in Table4 and Eon in Table6.
24-Jun-2013	3	Document status promoted from target to preliminary data. Added: Section2.1: Electrical characteristics (curves)
11-Jul-2013	4	Updated Figure6: Output characteristics (TJ=200°C) and Figure7: Transfer characteristics.
18-Dec-2013	5	Updated parameters in Table2: Absolute maximum ratings and Table4: On/off states.
27-May-2014	6	Added Table7: Switching times. Updated Section3: Package mechanical data. Minor text changes.
25-Sep-2014	7	Document status promoted from preliminary to production data.
17-Feb-2015	8	Updated title in cover page.
20-Feb-2015	9	Updated Section2.1: Electrical characteristics (curves).
24-Jul-2016	10	Updated title and features in cover page. Updated Figure 2: "Safe operating area" and Figure 3: "Thermal impedance". Minor text changes.
11-May-2017	11	Updated Table 4: "On/off states" and Section 2.1: "Electrical characteristics (curves)" . Minor text changes.

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