

## Silicon carbide Power MOSFET: 45 A, 1200 V, 90 mΩ (typ., T<sub>J</sub>=150 °C), N-channel in HiP247™

Datasheet - production data

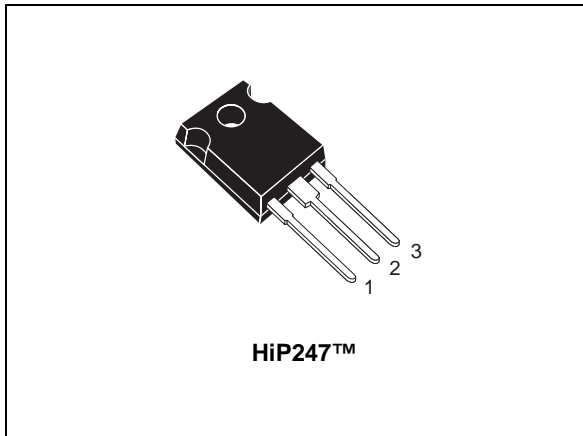
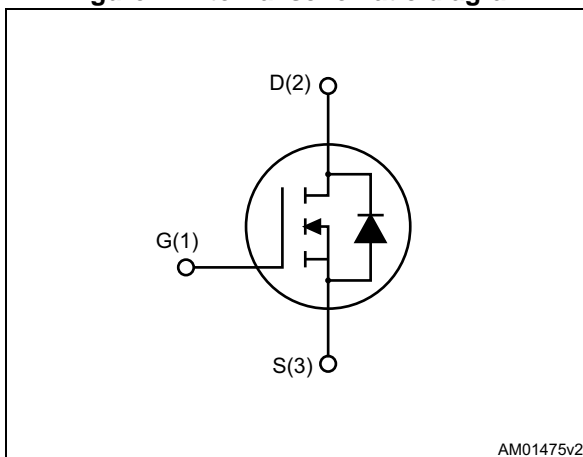


Figure 1. Internal schematic diagram



### Features

- Very tight variation of on-resistance vs. temperature
- Slight variation of switching losses vs. temperature
- Very high operating temperature capability (200 °C)
- Very fast and robust intrinsic body diode
- Low capacitance
- Easy to drive

### 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

*Note:* The device meets ECOPACK standards, an environmentally-friendly grade of products commonly referred to as "halogen-free". See [Section 3: Package mechanical data](#).

# Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>3</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>4</b>
	2.1 Electrical characteristics (curves) .....	6
<b>3</b>	<b>Package mechanical data</b> .....	<b>10</b>
<b>4</b>	<b>Revision history</b> .....	<b>12</b>

# 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/+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	-55 to 200	°C
$T_j$	Operating junction temperature		°C

1. Pulse width limited by safe operating area.

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
Rthj-case	Thermal resistance junction-case max	0.65	°C/W
Rthj-amb	Thermal resistance junction-ambient max	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 ( $V_{GS} = 0$ )	$V_{DS} = 1200\text{ V}$		1	100	$\mu\text{A}$
		$V_{DS} = 1200\text{ V}, T_J = 200\text{ °C}$		50		$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = +22 / -10\text{ V}$			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 $\Omega$
		$V_{GS} = 20\text{ V}, I_D = 20\text{ A}, T_J = 150\text{ °C}$		90		m $\Omega$
		$V_{GS} = 20\text{ V}, I_D = 20\text{ A}, T_J = 200\text{ °C}$		100		m $\Omega$

**Table 5. Dynamic**

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

Table 6. Switching energy (inductive load)

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

Table 7. Switching times

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

Table 8. Reverse SiC diode characteristics

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$V_{SD}$	Diode forward voltage	$I_F = 10\text{ A}$ , $V_{GS} = 0$	-	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

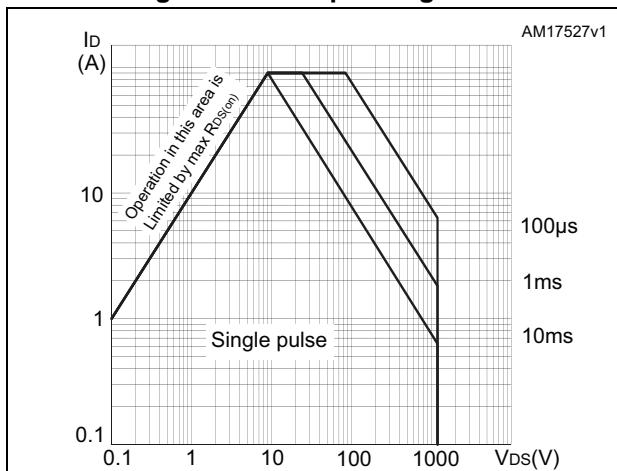


Figure 3. Thermal impedance

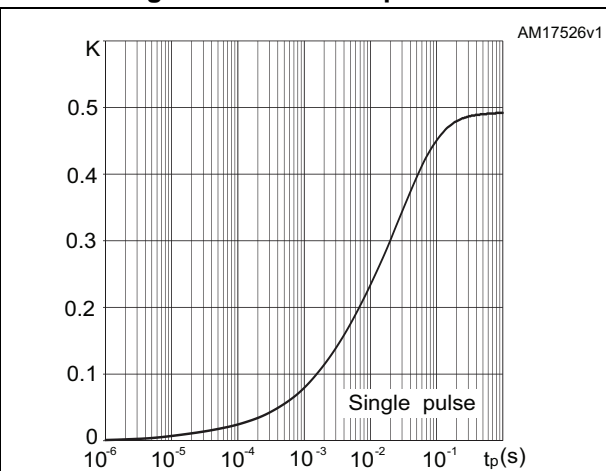


Figure 4. Output characteristics ( $T_J=25^\circ\text{C}$ )

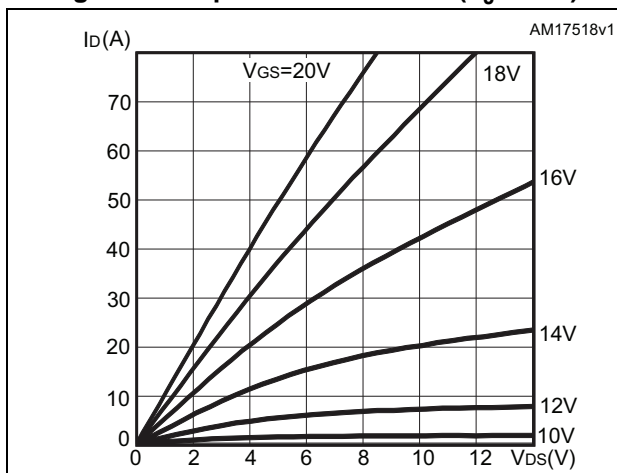


Figure 5. Output characteristics ( $T_J=150^\circ\text{C}$ )

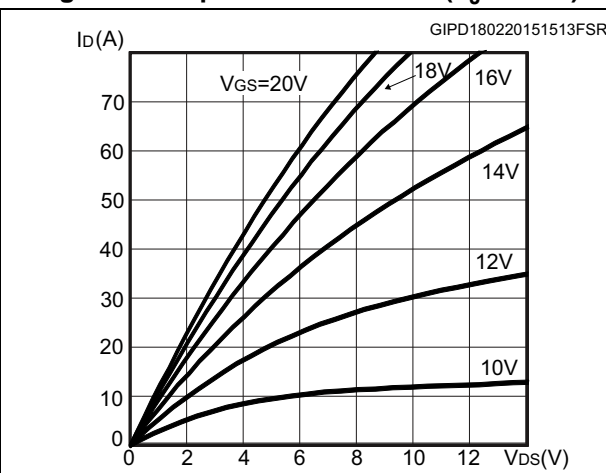


Figure 6. Output characteristics ( $T_J=200^\circ\text{C}$ )

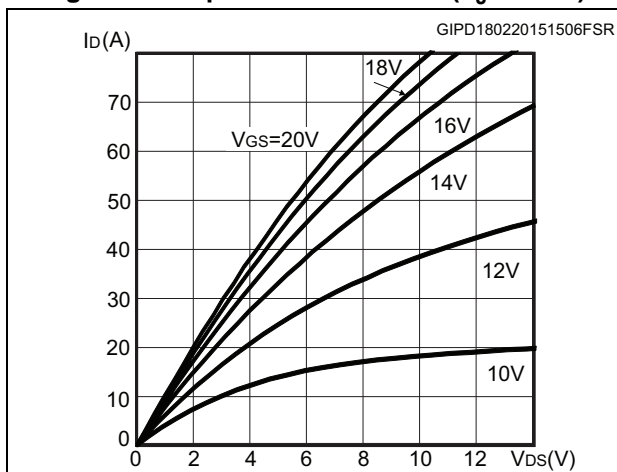


Figure 7. Transfer characteristics

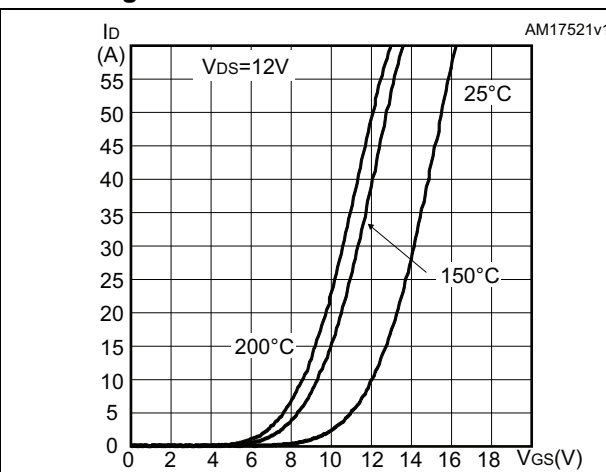


Figure 8. Power dissipation

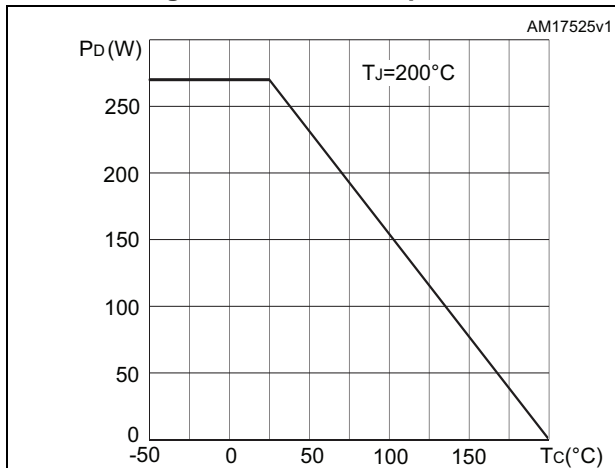


Figure 9. Gate charge vs gate-source voltage

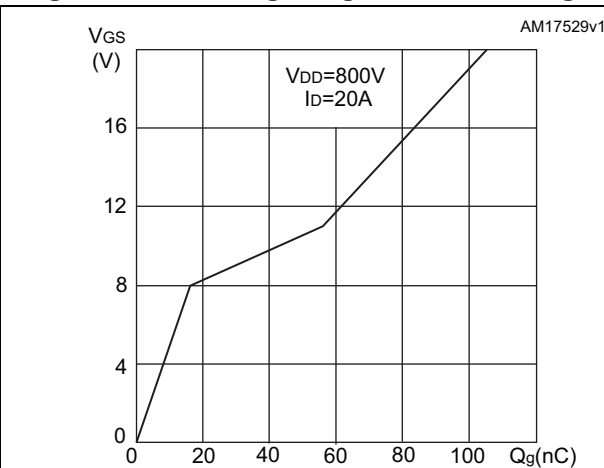


Figure 10. Capacitance variations

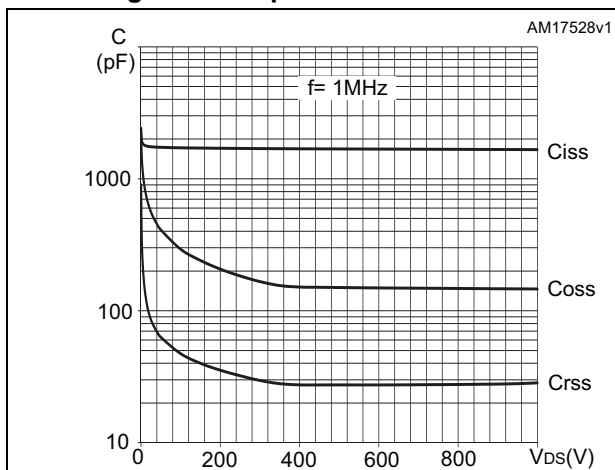


Figure 11. Switching energy vs. drain current

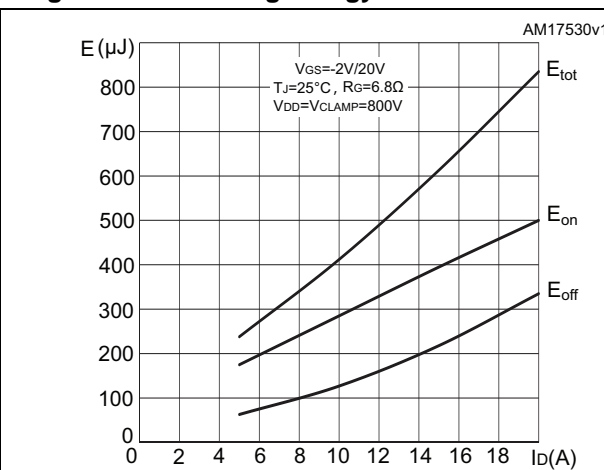


Figure 12. Switching energy vs. junction temperature

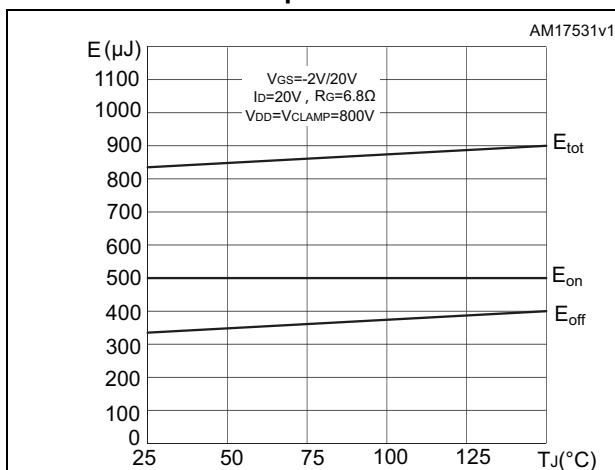


Figure 13. Normalized  $V_{(BR)DSS}$  vs. temperature

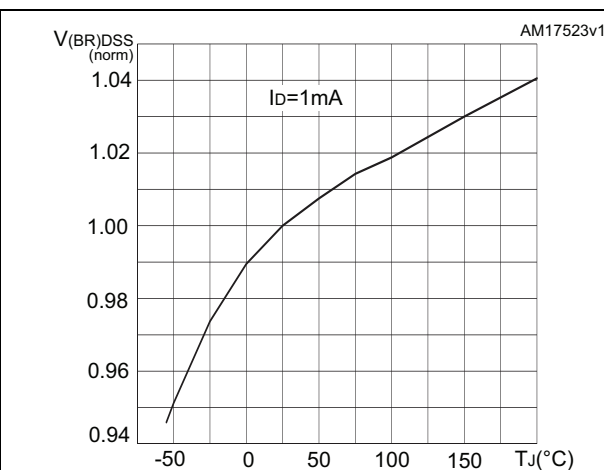


Figure 14. Normalized gate threshold voltage vs. temperature

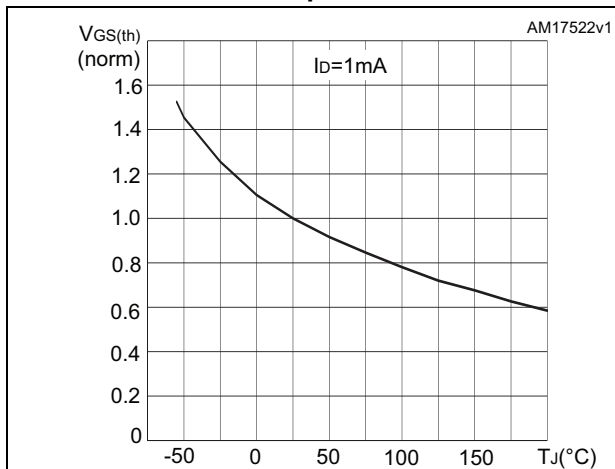


Figure 15. Normalized on-resistance vs. temperature

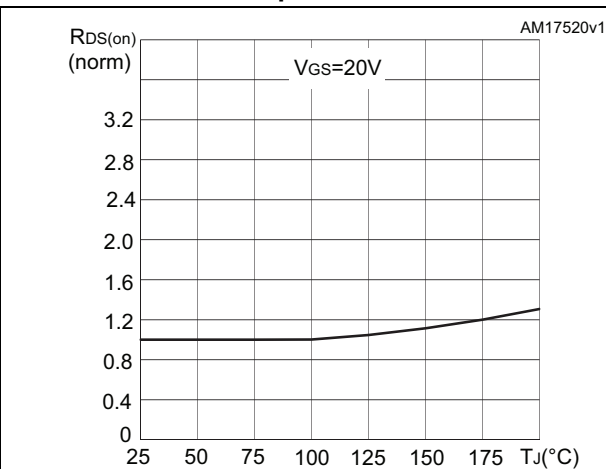


Figure 16. Body diode characteristics ( $T_J = -50^\circ\text{C}$ )

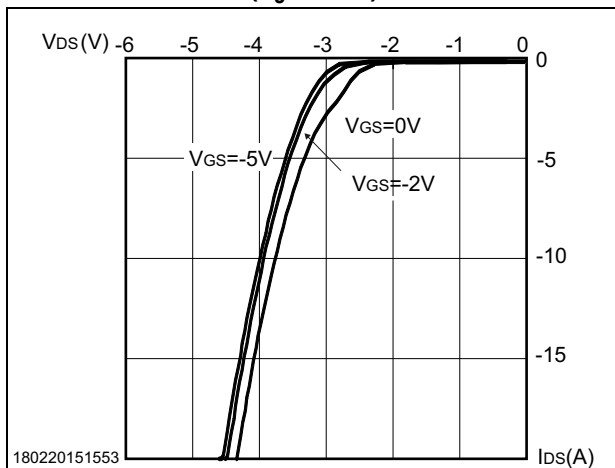


Figure 17. Body diode characteristics ( $T_J = 25^\circ\text{C}$ )

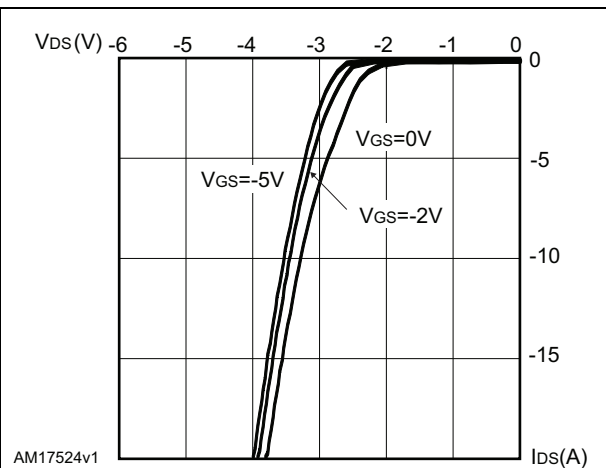


Figure 18. Body diode characteristics ( $T_J = 150^\circ\text{C}$ )

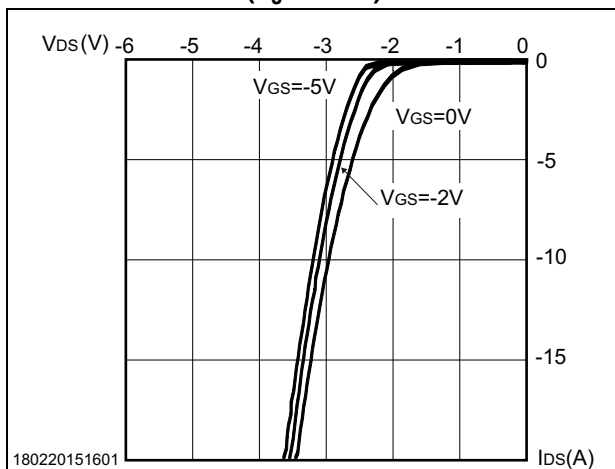


Figure 19. 3<sup>rd</sup> quadrant characteristics ( $T_J = -50^\circ\text{C}$ )

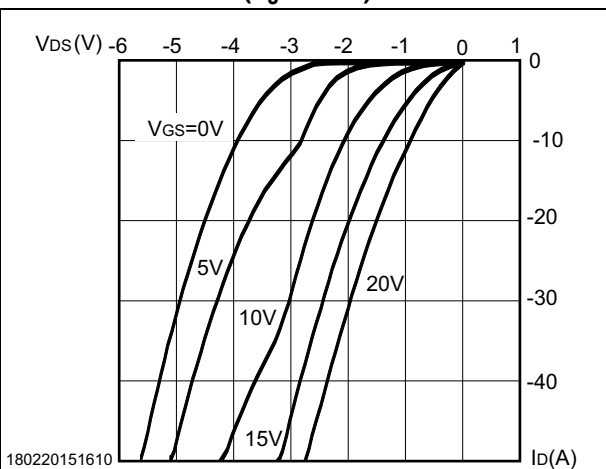




Figure 20. 3<sup>rd</sup> quadrant characteristics (T<sub>J</sub>=25°C)

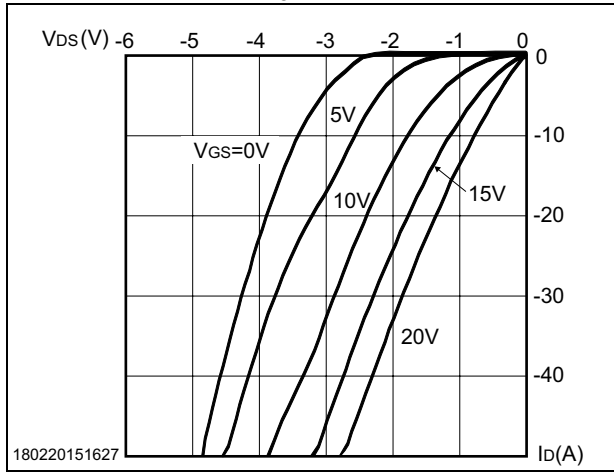
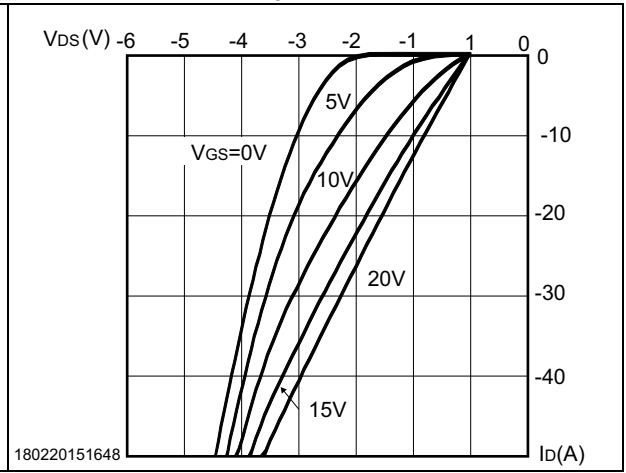


Figure 21. 3<sup>rd</sup> quadrant characteristics (T<sub>J</sub>=150°C)



### 3 Package mechanical data

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](http://www.st.com). ECOPACK® is an ST trademark.

Figure 22. HiP247™ outline

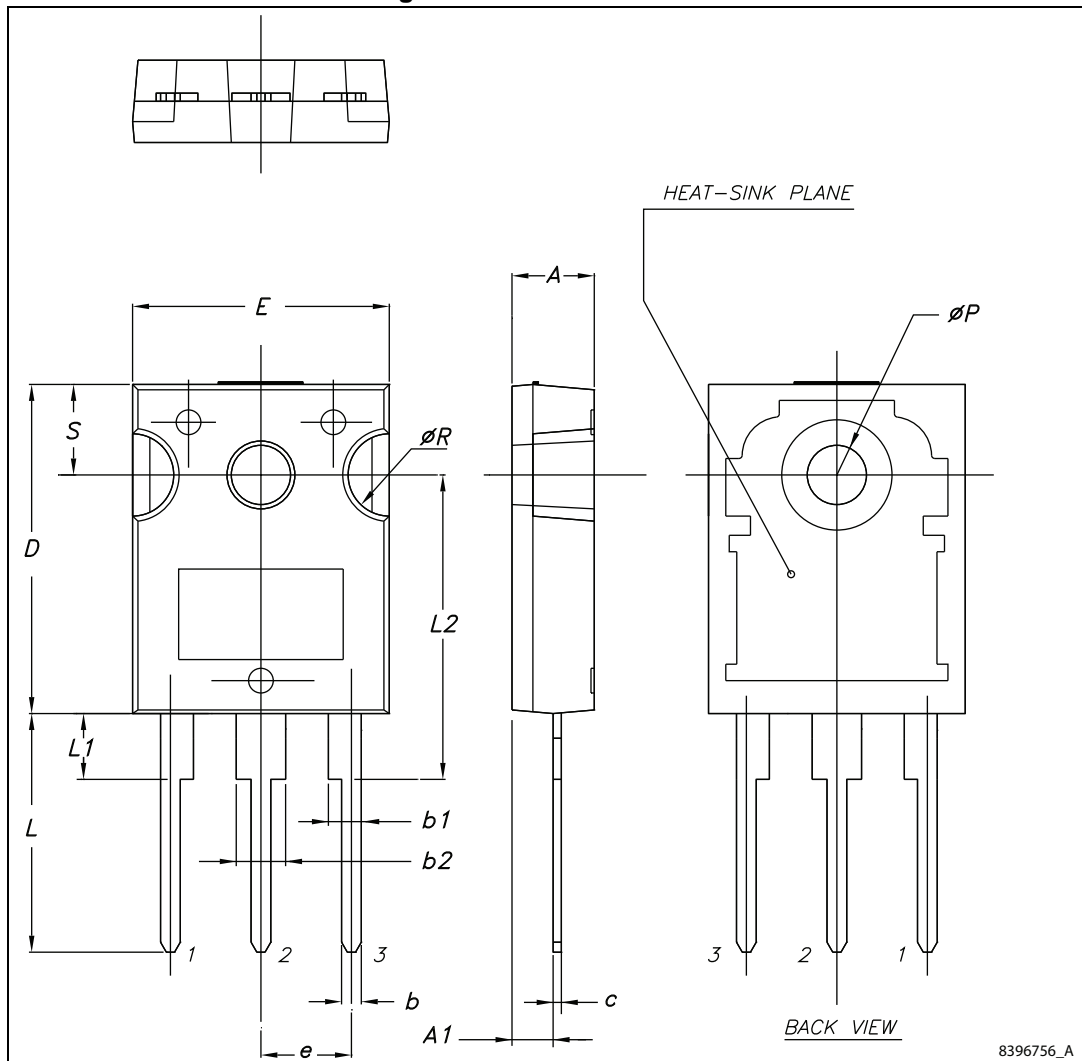


Table 9. HiP247™ mechanical data

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 $t_{rr}$ value in <a href="#">Table 8</a> . Updated dynamic parameters in <a href="#">Table 5</a> , $V_{GS(th)}$ in <a href="#">Table 4</a> and $E_{on}$ in <a href="#">Table 6</a> .
24-Jun-2013	3	Document status promoted from target to preliminary data. Added: <a href="#">Section 2.1: Electrical characteristics (curves)</a>
11-Jul-2013	4	Updated <a href="#">Figure 6: Output characteristics (<math>T_J=200^{\circ}C</math>)</a> and <a href="#">Figure 7: Transfer characteristics</a> .
18-Dec-2013	5	Updated parameters in <a href="#">Table 2: Absolute maximum ratings</a> and <a href="#">Table 4: On/off states</a> .
27-May-2014	6	Added <a href="#">Table 7: Switching times</a> . Updated <a href="#">Section 3: Package mechanical data</a> . 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 <a href="#">Section 2.1: Electrical characteristics (curves)</a> .

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