

Silicon carbide Power MOSFET: 45 A, 1200 V, 90 mΩ (typ., T_J=150 °C), N-channel in HiP247™

Datasheet - production data

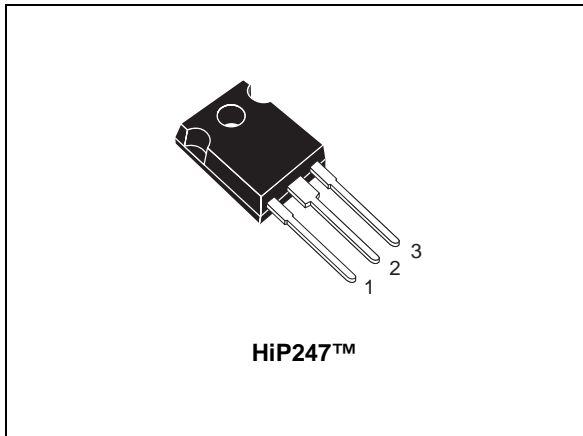
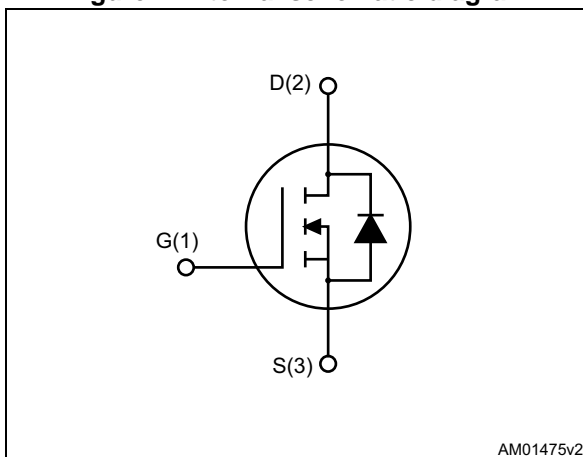


Figure 1. Internal schematic diagram



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

1	Electrical ratings	3
2	Electrical characteristics	4
2.1	Electrical characteristics (curves)	6
3	Package mechanical data	10
4	Revision history	12

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	μA
		$V_{DS} = 1200\text{ V}, T_J = 200\text{ °C}$		50		μA
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 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	$V_{DS} = 400\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$	-	1700	-	pF
C_{oss}	Output capacitance		-	130	-	pF
C_{riss}	Reverse transfer capacitance		-	25	-	pF
Q_g	Total gate charge	$V_{DD} = 800\text{ V}, I_D = 20\text{ A}, V_{GS} = 0 / 20\text{ V}$	-	105	-	nC
Q_{gs}	Gate-source charge		-	16	-	nC
Q_{gd}	Gate-drain charge		-	40	-	nC
R_g	Gate input resistance		f=1 MHz open drain	-	5	-

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	-	μJ
E_{off}	Turn-off switching losses	$R_G = 6.8\ \Omega$, $V_{GS} = -2/20\text{ V}$	-	350	-	μJ
E_{on}	Turn-on switching losses	$V_{DD} = 800\text{ V}$, $I_D = 20\text{ A}$	-	500	-	μJ
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	-	μJ

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

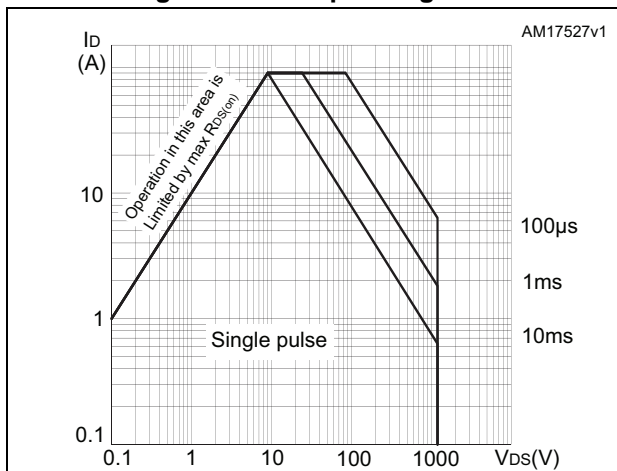


Figure 3. Thermal impedance

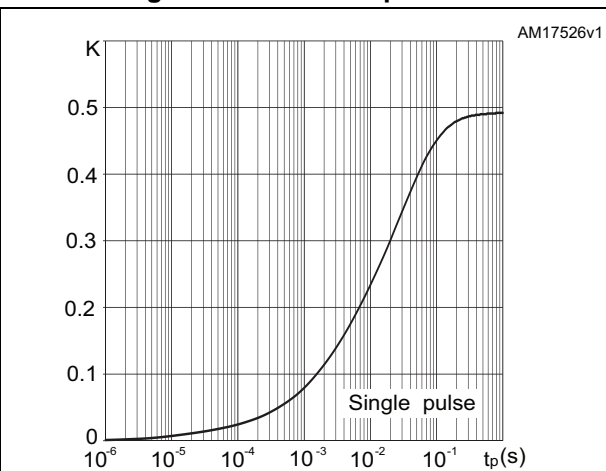


Figure 4. Output characteristics ($T_J=25^\circ\text{C}$)

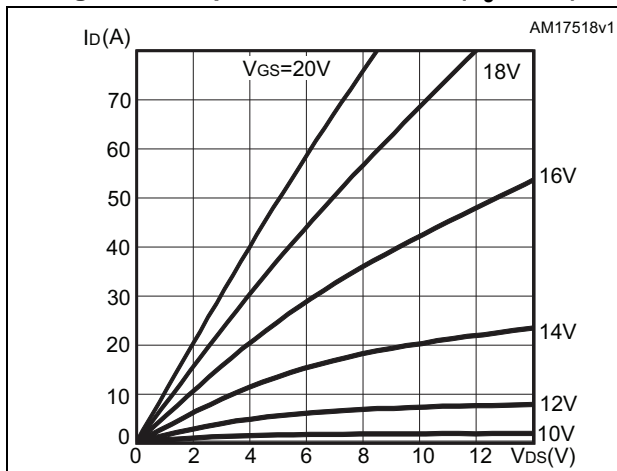


Figure 5. Output characteristics ($T_J=150^\circ\text{C}$)

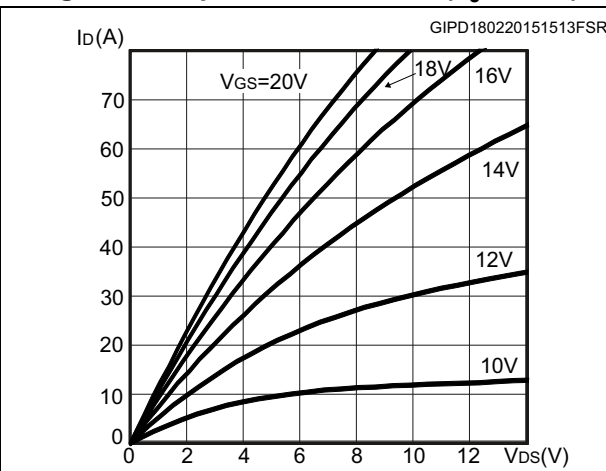


Figure 6. Output characteristics ($T_J=200^\circ\text{C}$)

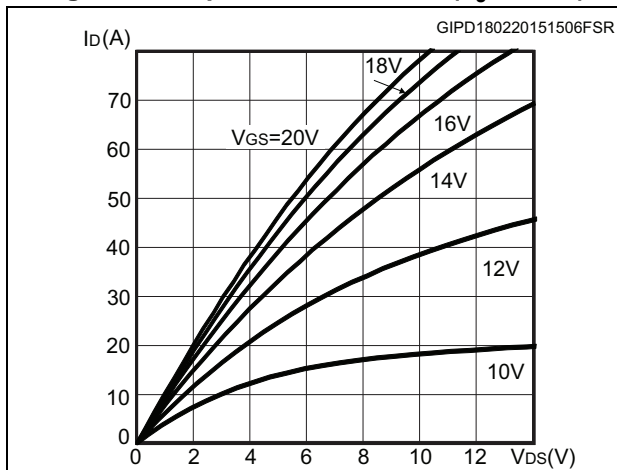


Figure 7. Transfer characteristics

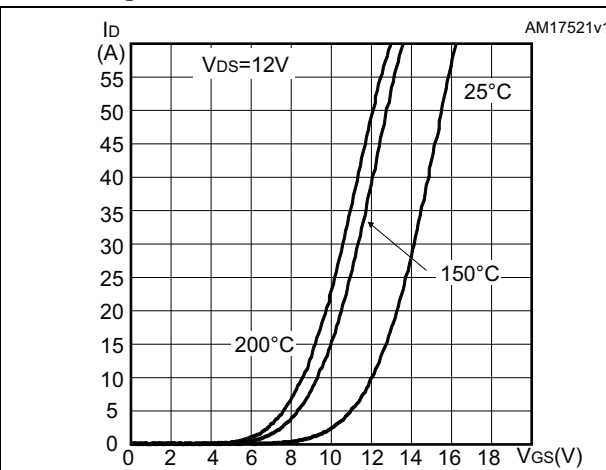


Figure 8. Power dissipation

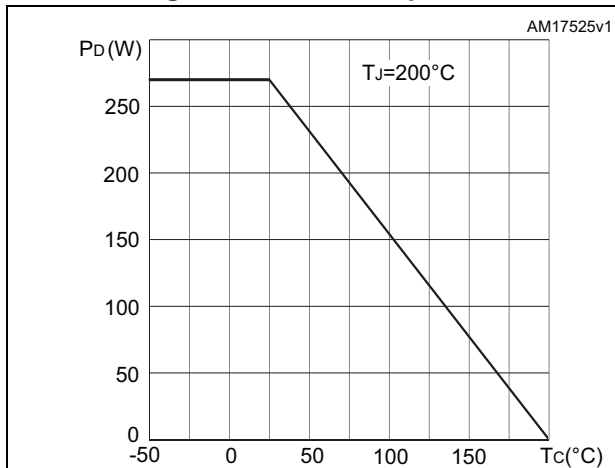


Figure 9. Gate charge vs gate-source voltage

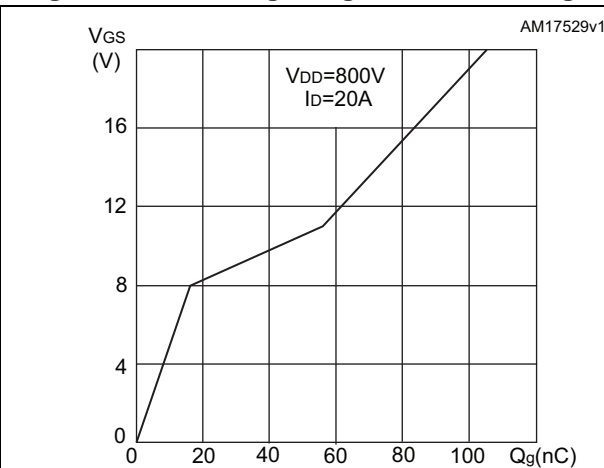


Figure 10. Capacitance variations

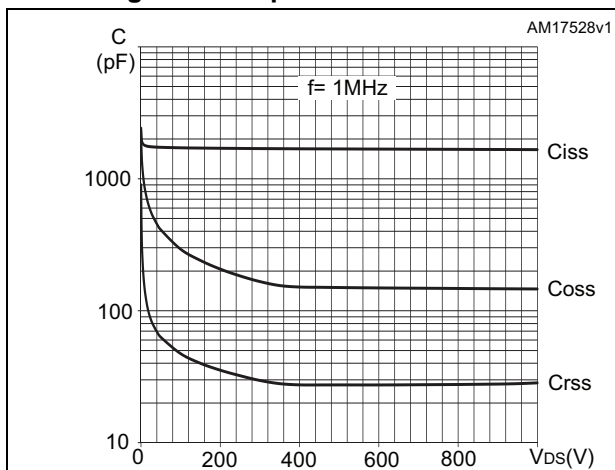


Figure 11. Switching energy vs. drain current

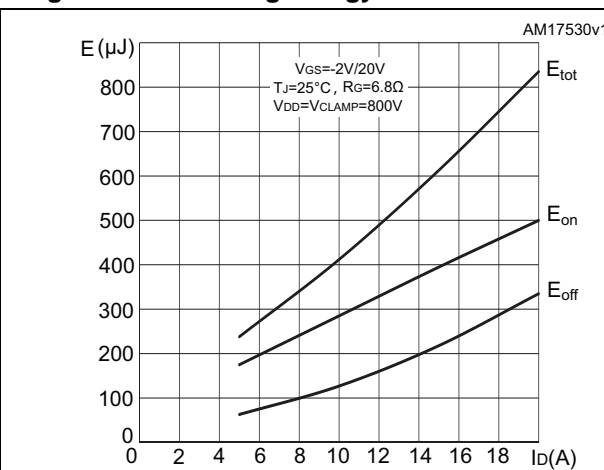


Figure 12. Switching energy vs. junction temperature

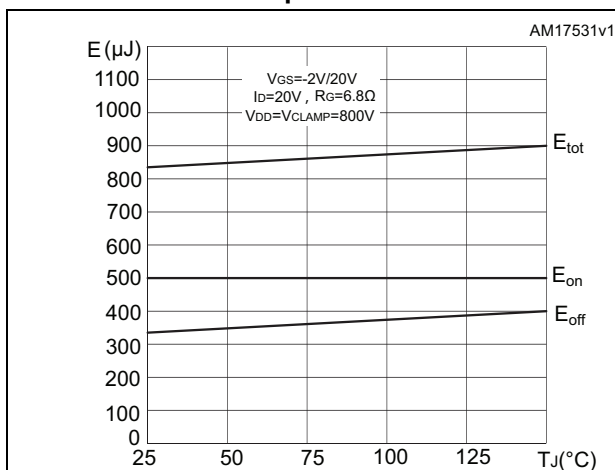


Figure 13. Normalized $V_{(BR)DSS}$ vs. temperature

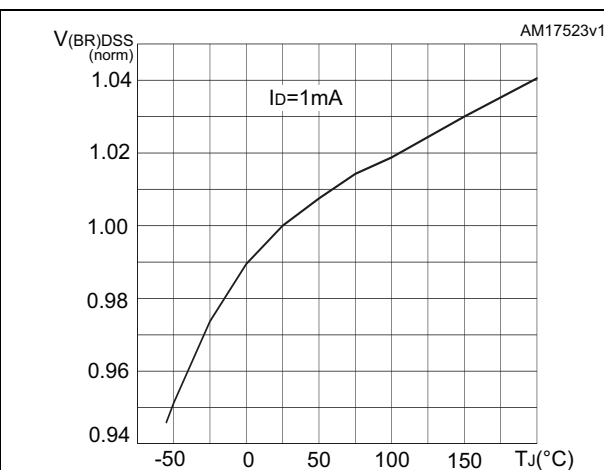


Figure 14. Normalized gate threshold voltage vs. temperature

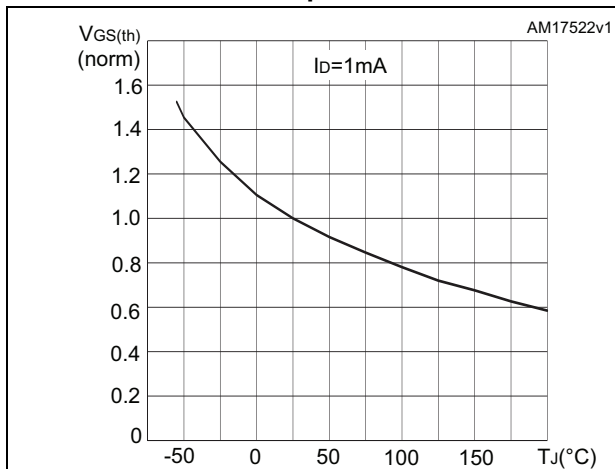


Figure 15. Normalized on-resistance vs. temperature

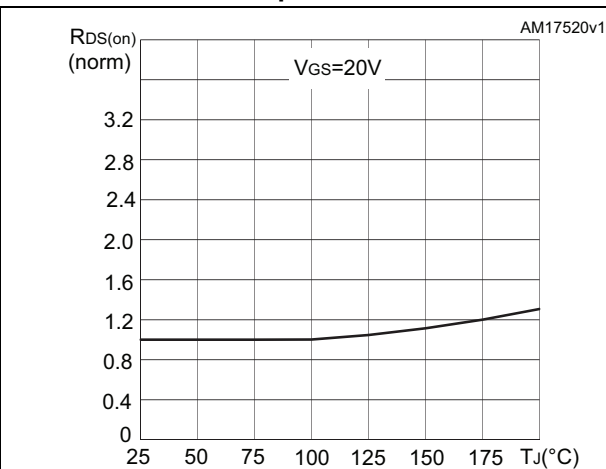


Figure 16. Body diode characteristics ($T_J = -50^\circ\text{C}$)

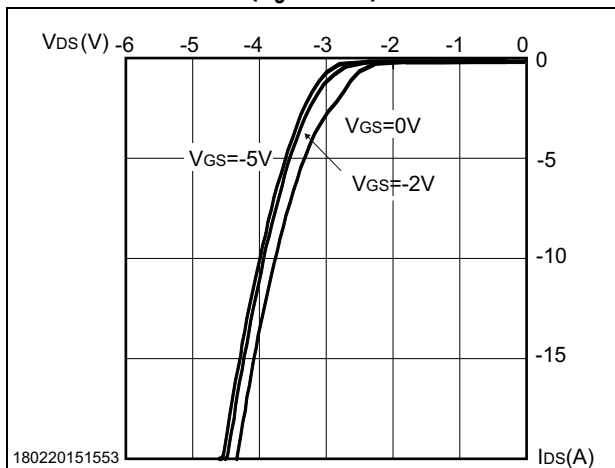


Figure 17. Body diode characteristics ($T_J = 25^\circ\text{C}$)

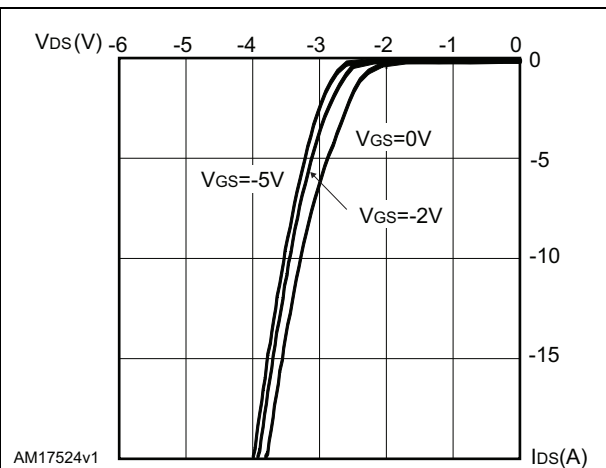


Figure 18. Body diode characteristics ($T_J = 150^\circ\text{C}$)

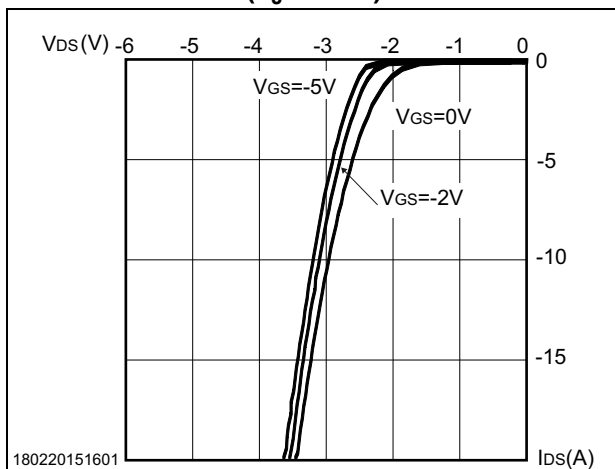


Figure 19. 3rd quadrant characteristics ($T_J = -50^\circ\text{C}$)

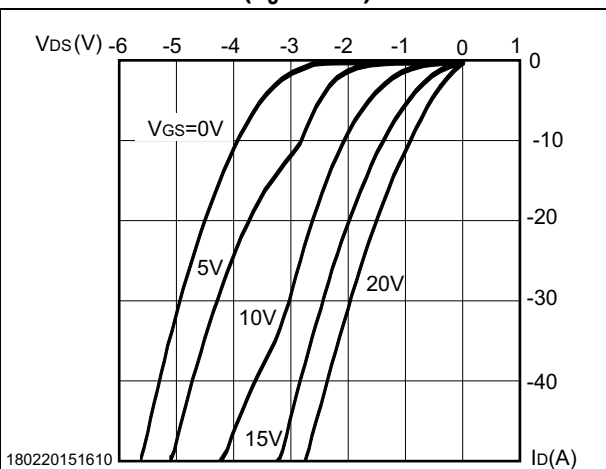


Figure 20. 3rd quadrant characteristics (T_J=25°C)

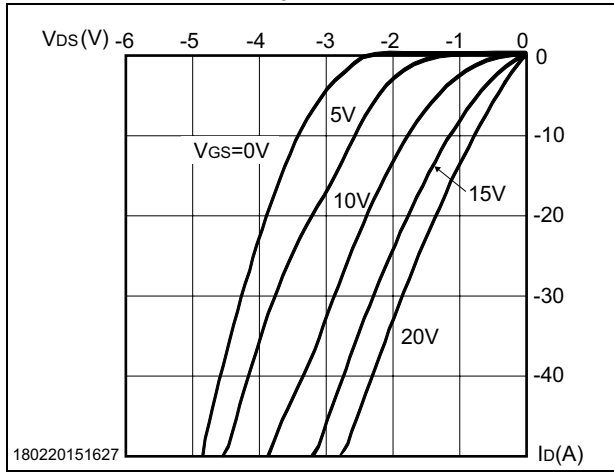
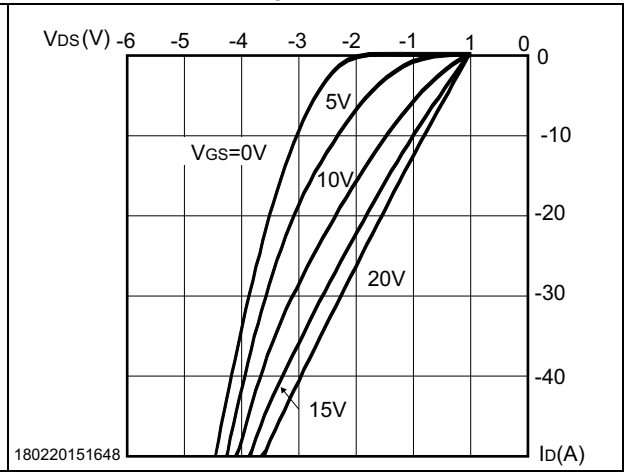


Figure 21. 3rd quadrant characteristics (T_J=150°C)



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. ECOPACK[®] is an ST trademark.

Figure 22. HiP247™ outline

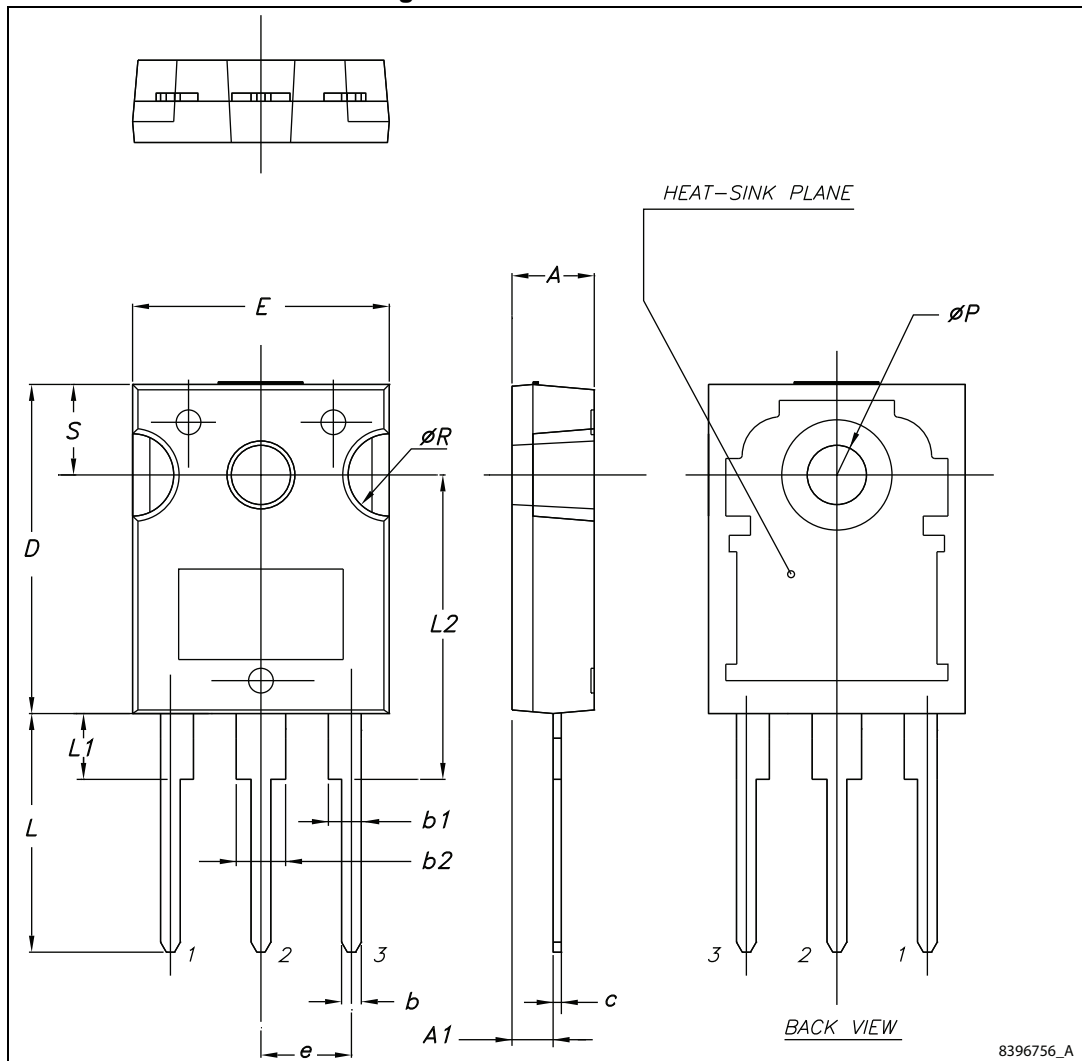


Table 9. HiP247™ mechanical data

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

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