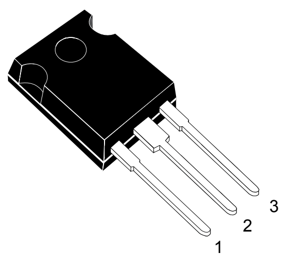
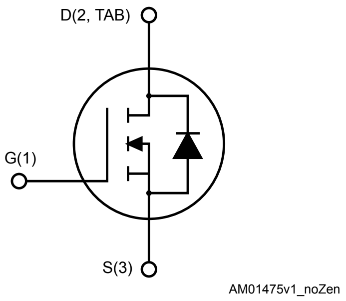
Silicon carbide Power MOSFET 1200 V, 20 A, 189 mΩ (typ., T_J = 150 °C) in an HiP247 package



HiP247



Product status link
SCT20N120

Product summary	
Order code	SCT20N120
Marking	SCT20N120
Package	HiP247
Packing	Tube

Features

- Very tight variation of on-resistance vs. temperature
- Very high operating junction temperature capability (T_J = 200 °C)
- Very fast and robust intrinsic body diode
- Low capacitance

Applications

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

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.

1 Electrical ratings

Table 1. 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 °C	20	A
I_D	Drain current (continuous) at T_C = 100 °C	16	A
I_{DM} (1)	Drain current (pulsed)	45	A
P_{TOT}	Total power dissipation at T_C = 25 °C	175	W
T_{stg}	Storage temperature range	-55 to 200	°C
T_j	Operating junction temperature range		°C

1. *Pulse width limited by safe operating area.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case	1	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	40	°C/W

2 Electrical characteristics

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

Table 3. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 1200 V			100	µA
		V_{GS} = 0 V, V_{DS} = 1200 V, T_J = 200 °C		50		
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = -10 to 22 V			100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 1 mA	2	3.5		V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 20 V, I_D = 10 A		169	239	mΩ
		V_{GS} = 20 V, I_D = 10 A, T_J = 150 °C		189		
		V_{GS} = 20 V, I_D = 10 A, T_J = 200 °C		220		

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 400 V, f = 1 MHz, V_{GS} = 0 V	-	650	-	pF
C_{oss}	Output capacitance		-	65	-	pF
C_{rss}	Reverse transfer capacitance		-	14	-	pF
Q_g	Total gate charge	V_{DD} = 800 V, I_D = 10 A, V_{GS} = 0 to 20 V	-	45	-	nC
Q_{gs}	Gate-source charge		-	7	-	nC
Q_{gd}	Gate-drain charge		-	11.7	-	nC
R_g	Gate input resistance	f=1 MHz, I_D = 0 A	-	7	-	Ω

Table 5. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on}	Turn-on switching energy	V_{DD} = 800 V, I_D = 10 A, R_G= 6.8 Ω, V_{GS} = -2 to 20 V	-	160	-	µJ
E_{off}	Turn-off switching energy		-	90	-	µJ
E_{on}	Turn-on switching energy	V_{DD} = 800 V, I_D = 10 A, R_G= 6.8 Ω, V_{GS} = -2 to 20 V, T_J= 150 °C	-	165	-	µJ
E_{off}	Turn-off switching energy		-	100	-	µJ

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)V}$	Turn-on delay time	V_{DD} = 800 V, I_D = 10 A, R_G = 0 Ω, V_{GS} = 0 to 20 V	-	10	-	ns
$t_{f(V)}$	Fall time		-	17	-	ns
$t_{d(off)V}$	Turn-off delay time		-	27	-	ns
$t_{r(V)}$	Rise time		-	16	-	ns

Table 7. Reverse SiC diode characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{SD}	Diode forward voltage	I_F = 5 A, V_{GS} = -5 V	-	3.6	-	V
t_{rr}	Reverse recovery time	I_{SD} =10 A, V_{GS} = -5 V, V_R = 800 V, dif/dt = 1650 A/µs	-	15	-	ns
Q_{rr}	Reverse recovery charge		-	75	-	nC
I_{rrm}	Peak reverse recovery current		-	8	-	A

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

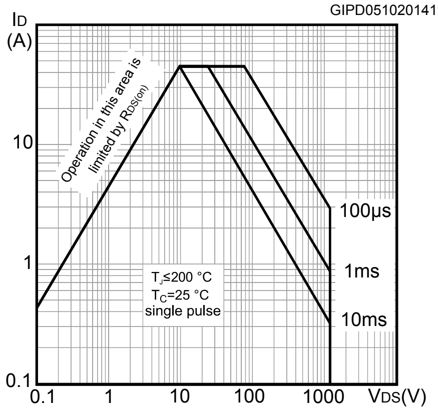


Figure 2. Typical thermal impedance

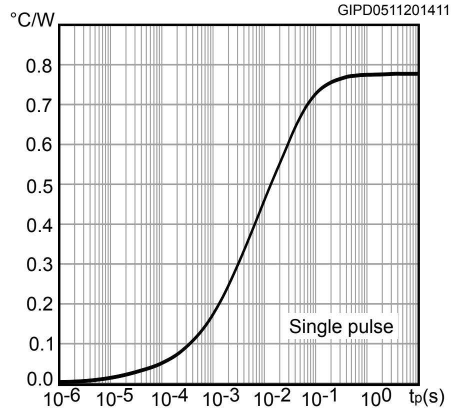


Figure 3. Output characteristics @ T_J = 25 °C

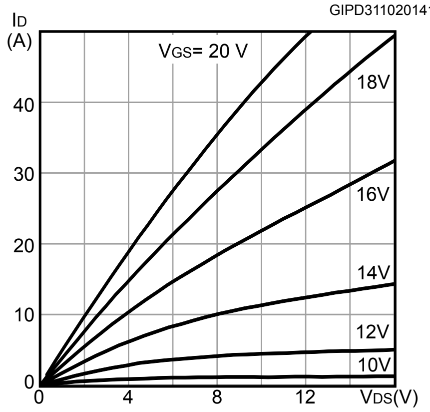


Figure 4. Output characteristics @ T_J = 200 °C

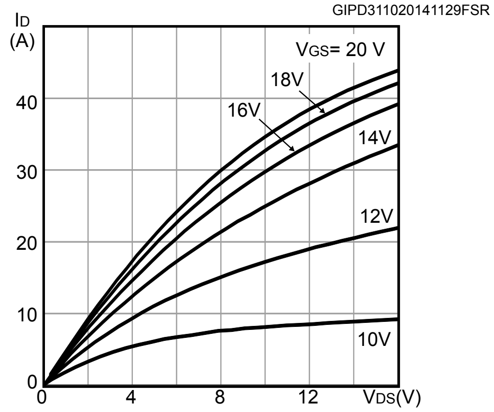


Figure 5. Transfer characteristics

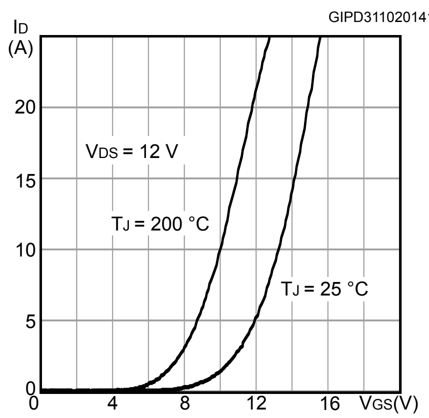


Figure 6. Body diode characteristics @ T_J = -50 °C

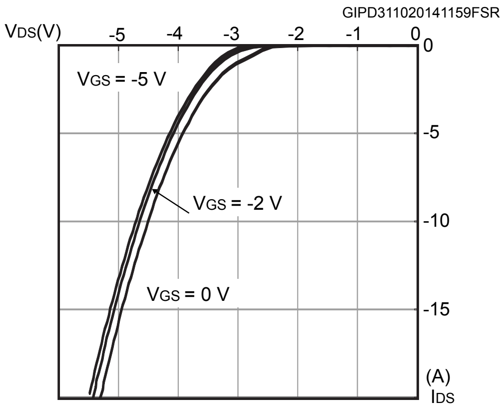


Figure 7. Body diode characteristics @ T_J = 25 °C

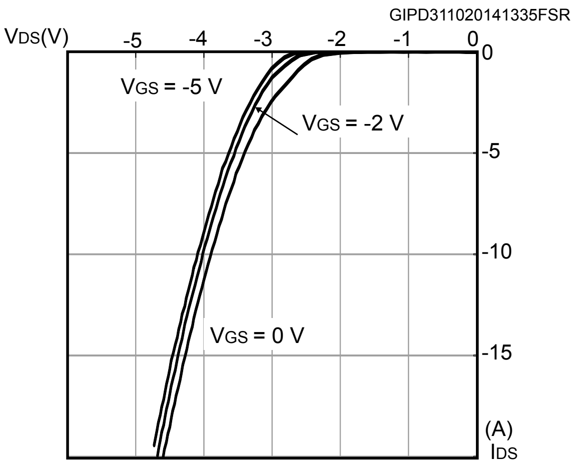


Figure 8. Body diode characteristics @ T_J = 150 °C

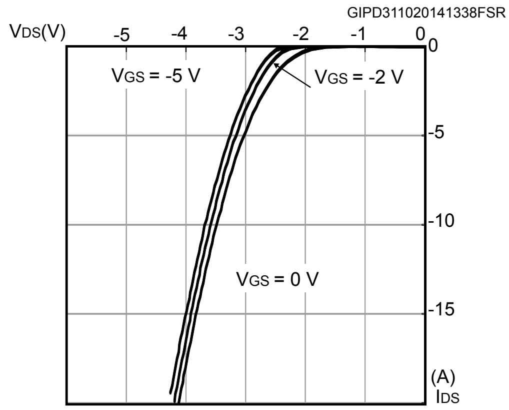


Figure 9. 3rd quadrant characteristics @ T_J = -50 °C

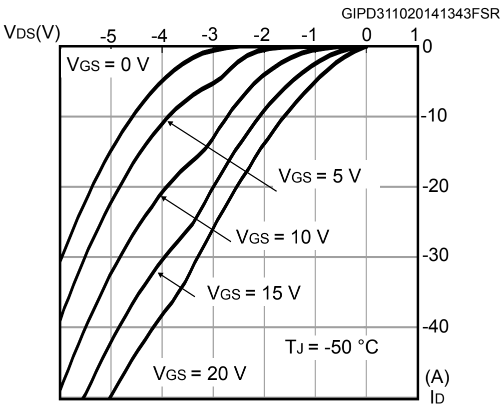


Figure 10. 3rd quadrant characteristics @ T_J = 25 °C

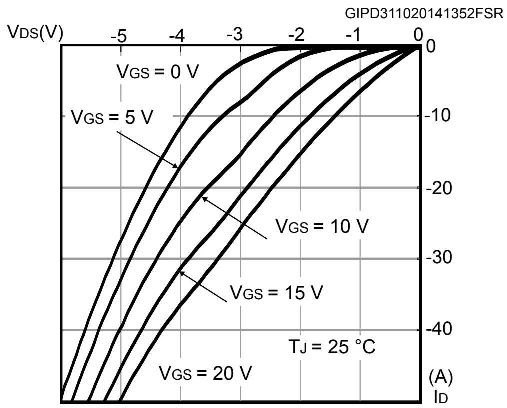


Figure 11. 3rd quadrant characteristics @ T_J = 150 °C

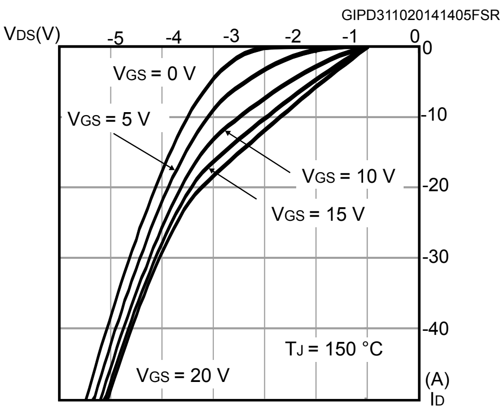


Figure 12. Normalized gate threshold vs. temperature

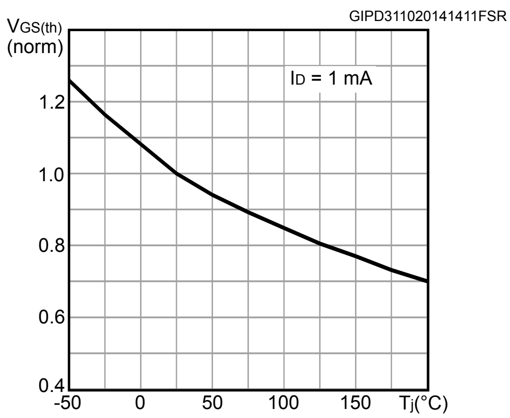


Figure 13. Normalized $R_{DS(on)}$ vs. temperature

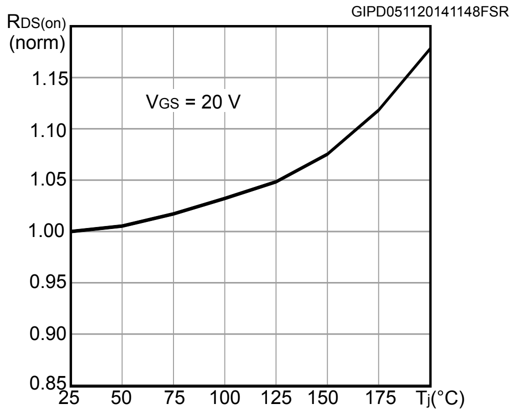
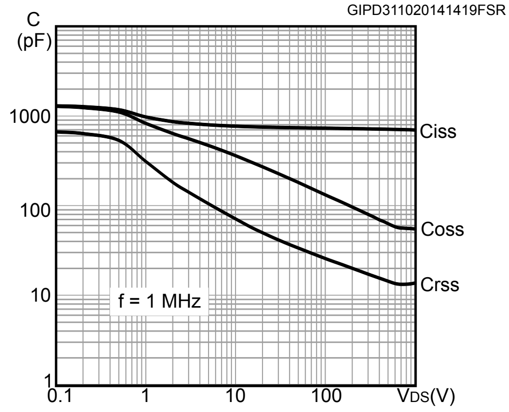


Figure 14. Capacitances variation



3 Test circuits

Figure 15. Switching test waveforms for transition times

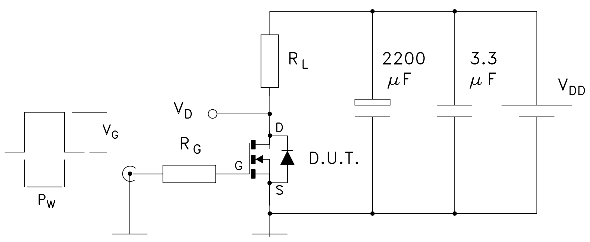


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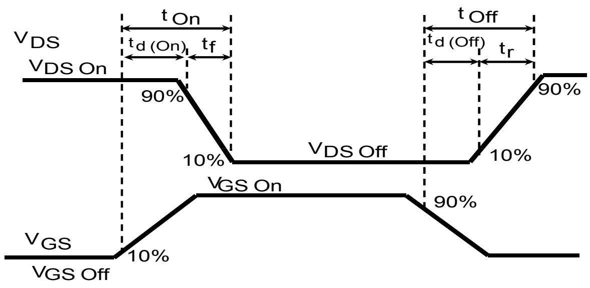
Figure 16. Clamped inductive switching waveform



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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 HiP247 package information

Figure 17. HiP247 package outline

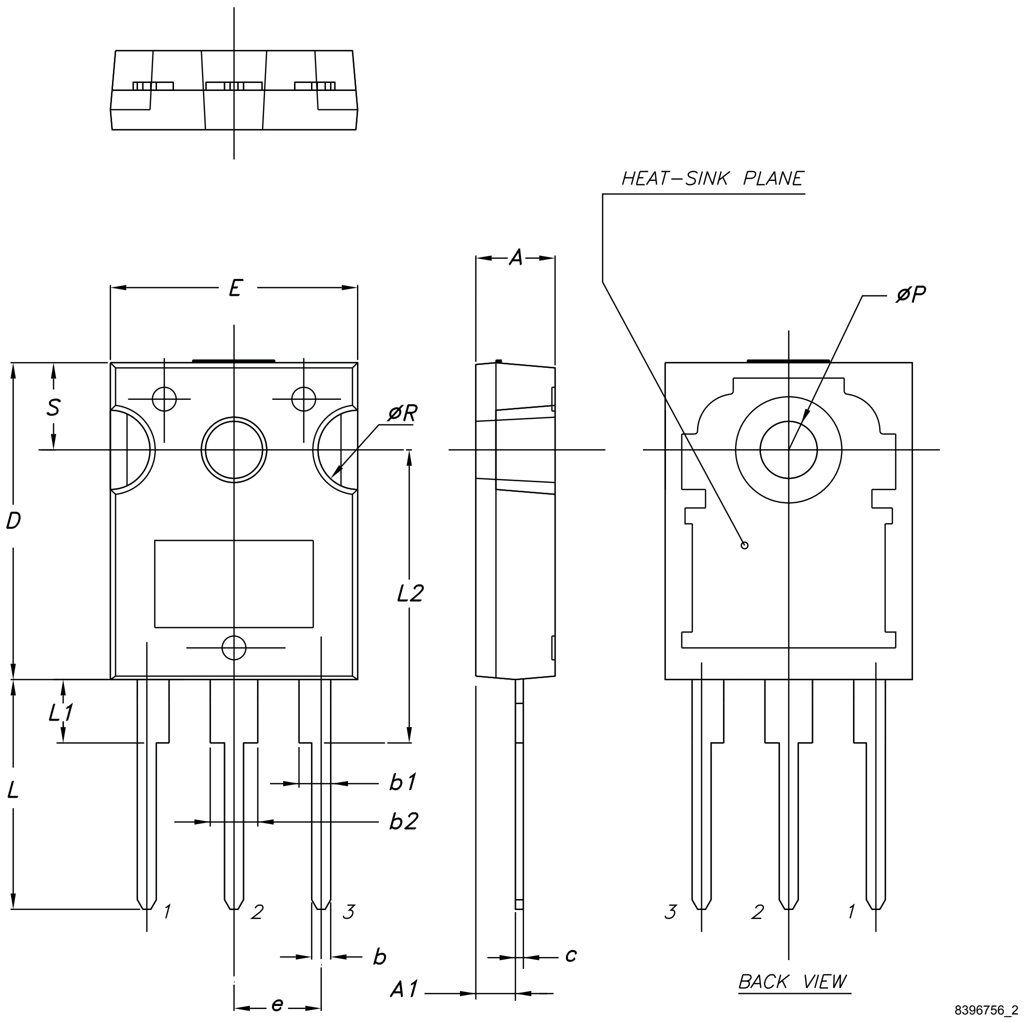

Table 8. HiP247 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.85	5.00	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	
∅P	3.55		3.65
∅R	4.50		5.50
S	5.30	5.50	5.70

Revision history

Table 9. Document revision history

Date	Revision	Changes
07-Nov-2014	1	First release
17-Feb-2015	2	Updated title in cover page.
20-Feb-2015	3	Updated *Figure 3: Thermal impedance.* Minor text changes.
17-Dec-2015	4	Updated title in cover page and *Table 4: On/off states*.
17-Sep-2019	5	Updated Figure 1. Safe operating area and Section 4.1 HiP247 package information. Minor text changes.

Contents