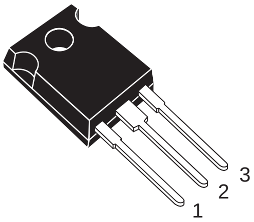
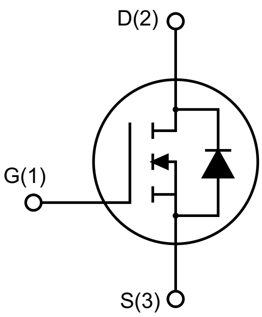
Silicon carbide Power MOSFET: 20 A, 1200 V, 189 mΩ (typ., T_J=150 °C), N-channel in a HiP247™

Datasheet - production data



HiP247™

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 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.

Table 1. Device summary

Order code	Marking	Package	Packaging
SCT20N120	SCT20N120	HiP247™	Tube

Note: The device meets ECOPACK standards, an environmentally-friendly grade of products commonly referred to as "halogen-free". See Section 4: Package mechanical data.

Contents

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 °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 dissipation at T_C = 25 °C	175	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	1	°C/W
Rthj-amb	Thermal resistance junction-ambient max	40	°C/W

2 Electrical characteristics

(T_{CASE} = 25 °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 V V_{DS} = 1200 V, T_J = 200 °C		 50	100	µA µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = +22 /-10 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		mΩ
		V_{GS} = 20 V, I_D = 10 A, T_J = 200 °C		220		mΩ

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 400 V, f = 1 MHz, V_{GS} = 0	-	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 / 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 open drain	-	7	-	Ω

Table 6. Switching energy (inductive load)

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

Table 7. 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} = 0/20 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 8. 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 2. Safe operating area

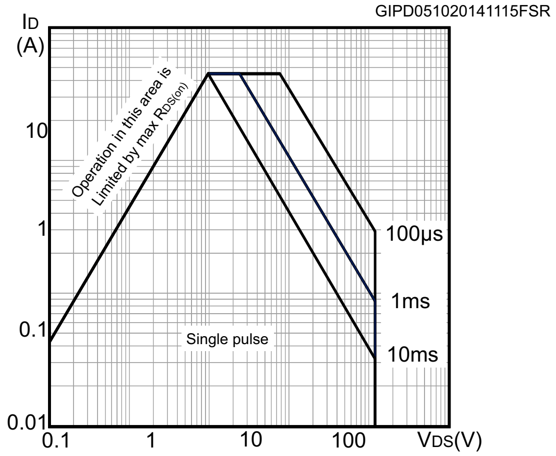


Figure 3. Thermal impedance

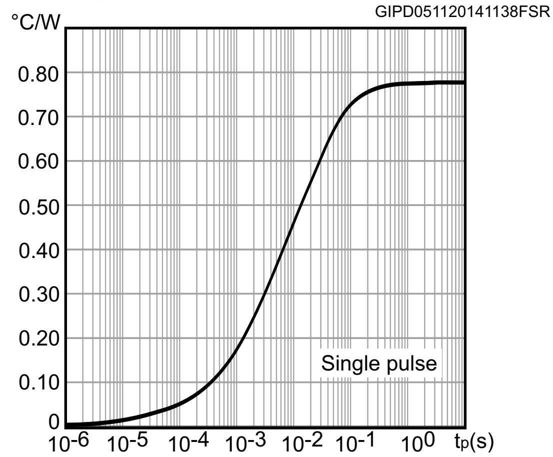


Figure 4. Output characteristics @ T_J = 25 °C

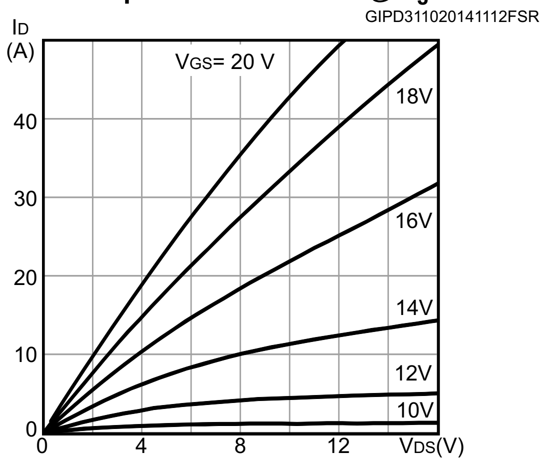


Figure 5. Output characteristics @ T_J = 200 °C

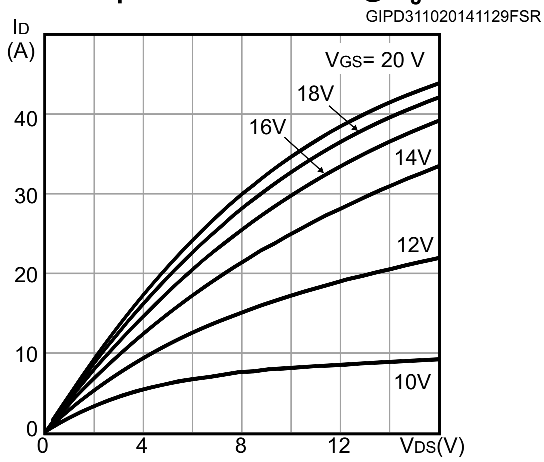


Figure 6. Transfer characteristics

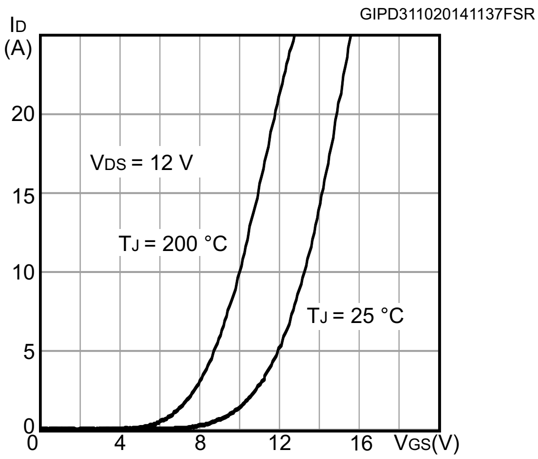


Figure 7. Body diode characteristics @ T_J = -50 °C

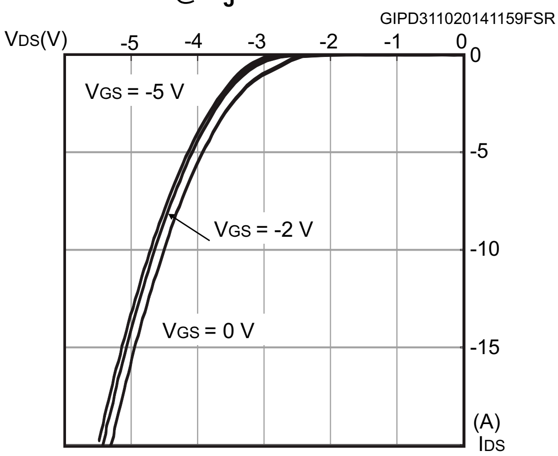


Figure 8. Body diode characteristics @ T_J = 25 °C

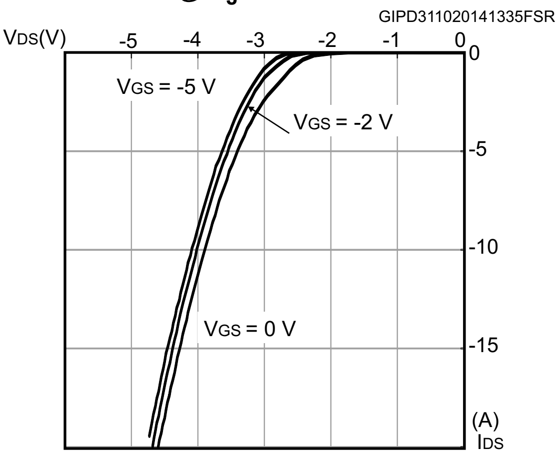


Figure 9. Body diode characteristics @ T_J = 150 °C

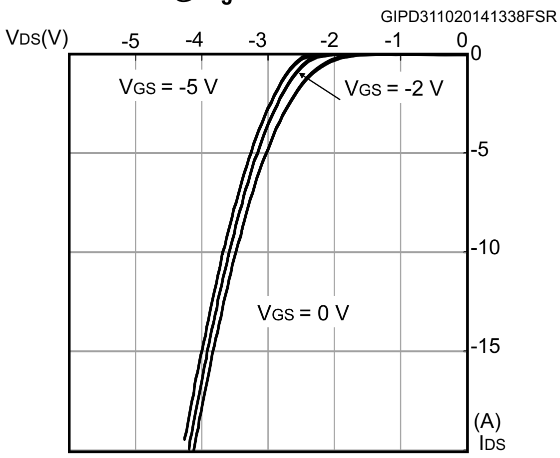


Figure 10. 3rd quadrant characteristics @ T_J = -50 °C

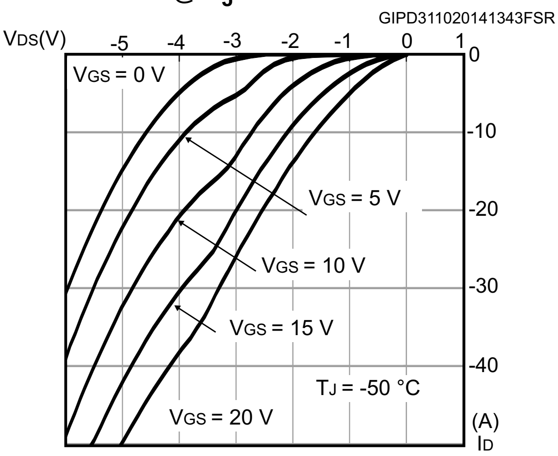


Figure 11. 3rd quadrant characteristics @ T_J = 25 °C

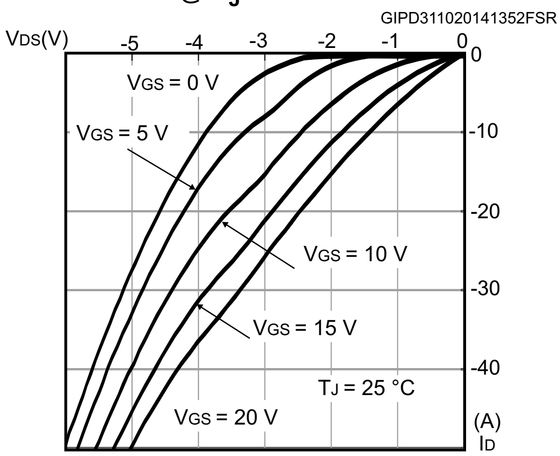


Figure 12. 3rd quadrant characteristics @ T_J = 150 °C

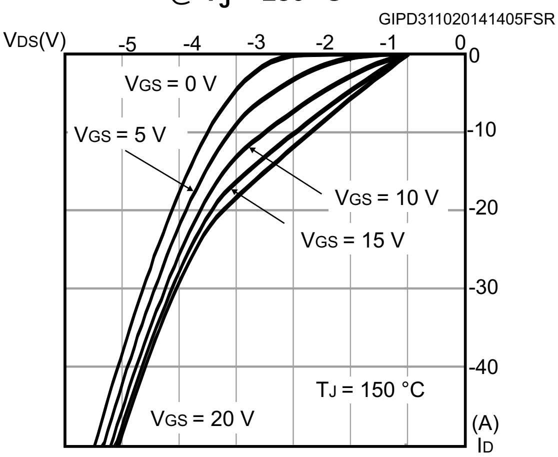


Figure 13. Normalized V_{TH} vs. temperature

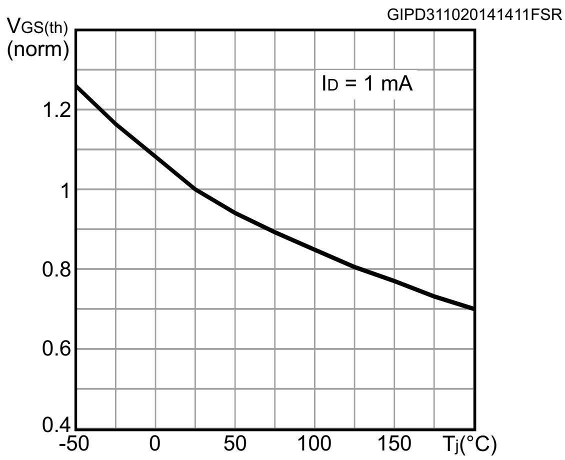


Figure 14. Normalized $R_{DS(on)}$ vs. temperature

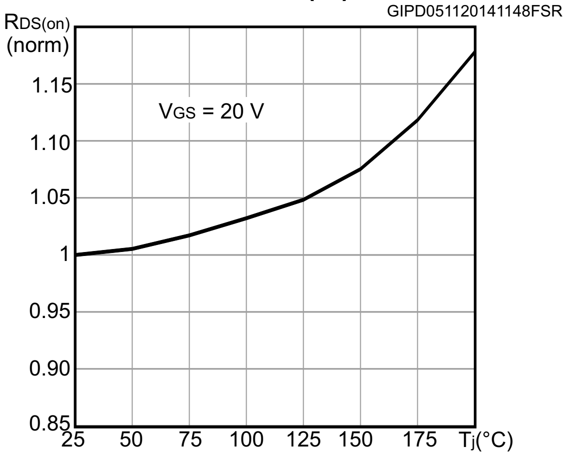
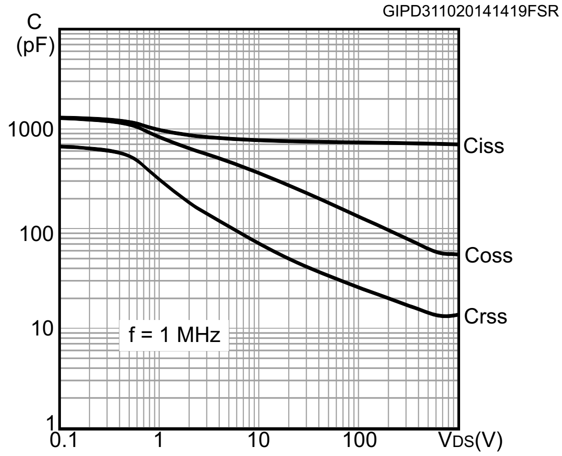


Figure 15. Capacitances variation



3 Test circuits

Figure 16. Switching test waveforms for transition times

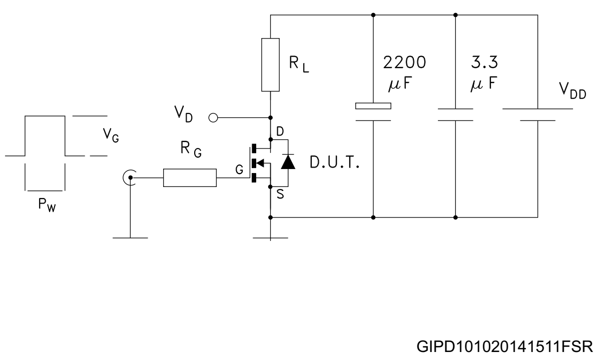
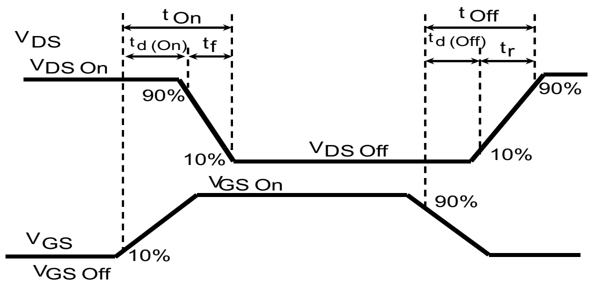


Figure 17. Clamped inductive switching waveform



4 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 18. HiP247™ drawing

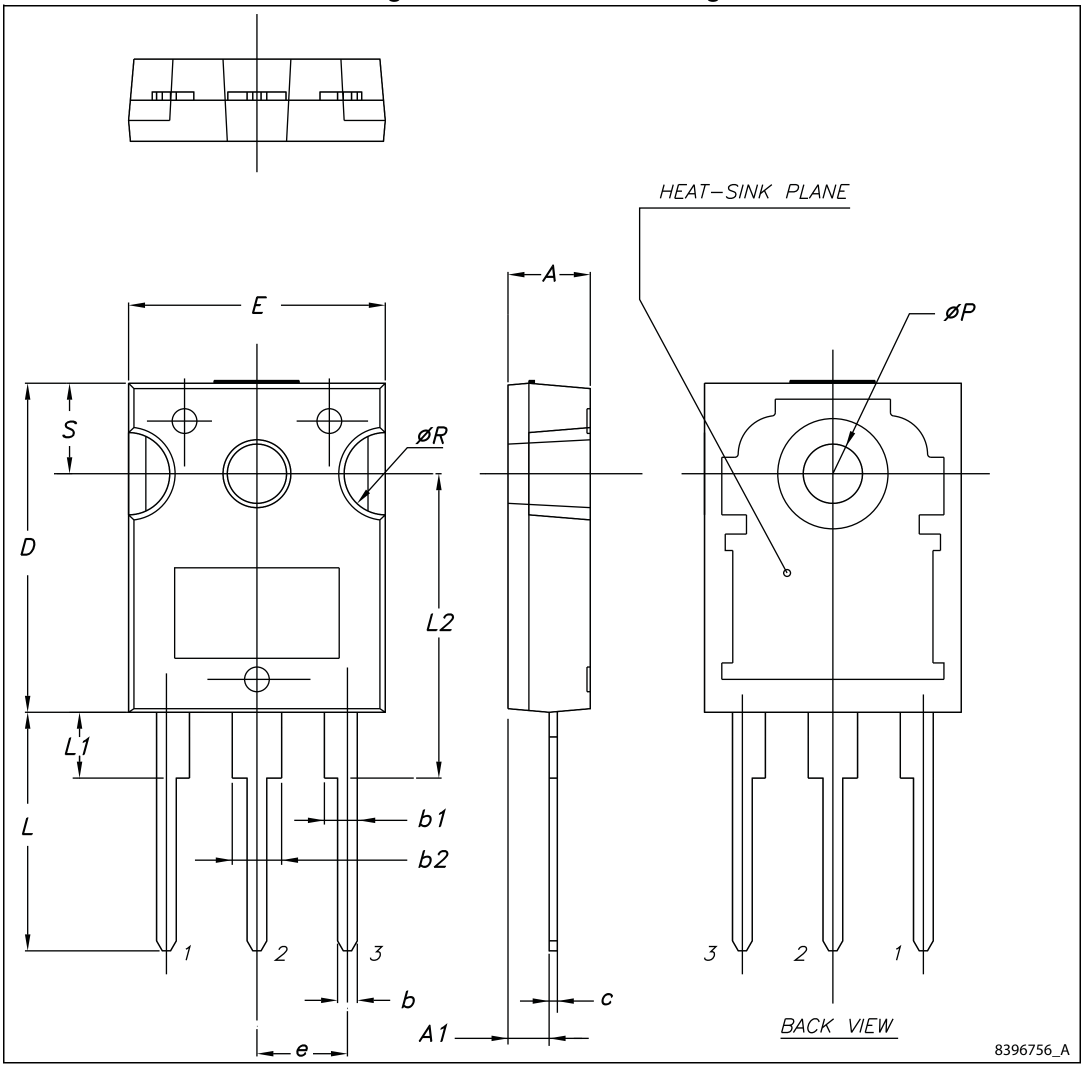


Table 9. HiP247™ mechanical data

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	
∅P	3.55		3.65
∅R	4.50		5.50
S	5.30	5.50	5.70

5 Revision history

Table 10. 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*.