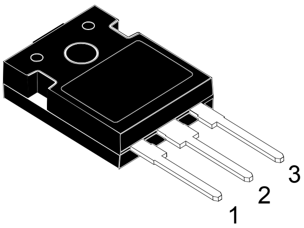
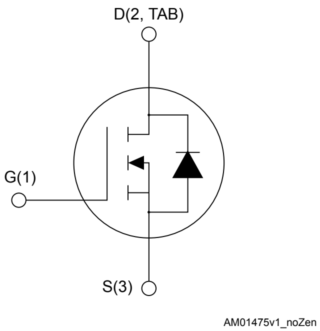
Automotive-grade silicon carbide Power MOSFET 1700 V, 64 mΩ typ., 43 A in an HiP247 package



HiP247



Product status link
SCT20N170AG

Product summary	
Order code	SCT20N170AG
Marking	SCT20N170AG
Package	HiP247
Packing	Tube

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
SCT20N170AG	1700 V	86 mΩ	43 A

- AEC-Q101 rev. C qualified
- Very fast and robust intrinsic body diode
- Low capacitances
- Very high operating junction temperature capability (T_J = 200 °C)

Applications

- Main inverter (electric traction)
- DC/DC converter for EV/HEV
- On board charger (OBC)

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	1700	V
V_{GS}	Gate-source voltage	-10 to 22	V
I_D	Drain current (continuous) at T_C = 25 °C	43	A
	Drain current (continuous) at T_C = 100 °C	32	
I_{DM} (1)	Drain current (pulsed)	129	A
P_{TOT}	Total power dissipation at T_C = 25 °C	313	W
T_{stg}	Storage temperature range	-55 to 200	°C
T_J	Operating junction temperature range		°C

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

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	0.56	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	40	°C/W

2 Electrical characteristics

T_C = 25 °C unless otherwise specified.

Table 3. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	1700			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 1700 V			10	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = -10 V to 22 V			±100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 1 mA	1.8	3.0		V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 20 V, I_D = 20 A		64	86	mΩ
		V_{GS} = 20 V, I_D = 20 A, T_J = 150 °C		104		
		V_{GS} = 20 V, I_D = 20 A, T_J = 200 °C		134		

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	-	1568	-	pF
C_{oss}	Output capacitance		-	141	-	pF
C_{rss}	Reverse transfer capacitance		-	21	-	pF
R_G	Gate input resistance	f = 1 MHz, I_D = 0 A	-	6.9	-	Ω
Q_g	Total gate charge	V_{DS} = 1000 V, I_D = 25 A, V_{GS} = -5 to 20 V	-	101	-	nC
Q_{gs}	Gate-source charge		-	48	-	nC
Q_{gd}	Gate-drain charge		-	23	-	nC

Table 5. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on}	Turn-on switching energy	V_{DD} = 1000 V, I_D = 25 A R_G = 4.7 Ω, V_{GS} = 0 V to 20 V	-	623	-	µJ
E_{off}	Turn-off switching energy		-	180	-	µJ
$E+_{on}$	Turn-on switching energy	V_{DD} = 1000 V, I_D = 25 A, R_G = 4.7 Ω, V_{GS} = 0 V to 20 V, T_J = 200 °C	-	1162	-	µJ
E_{off}	Turn-off switching energy		-	183	-	µJ

Table 6. Reverse SiC diode characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{SD}	Diode forward voltage	I_F = 25 A, V_{GS} = 0 V	-	3.8	-	V
t_{rr}	Reverse recovery time	I_{SD} = 25 A, V_{GS} = 0 V, di/dt = 100 A/µs, V_{DD} = 1000 V	-	13	-	ns
Q_{rr}	Reverse recovery charge		-	280	-	nC
I_{RRM}	Reverse recovery current		-	37	-	A

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

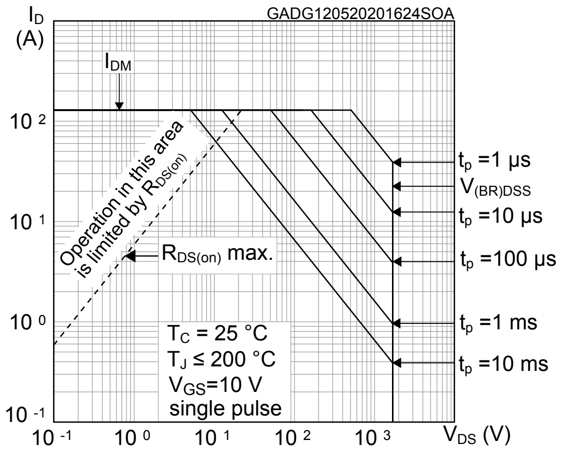


Figure 2. Maximum transient thermal impedance

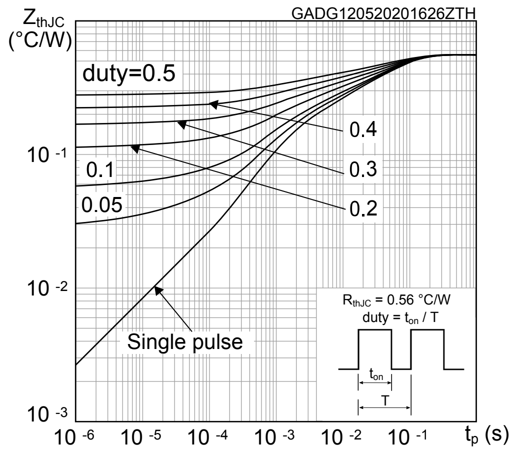


Figure 3. Typical output characteristics (T_J = 25 °C)

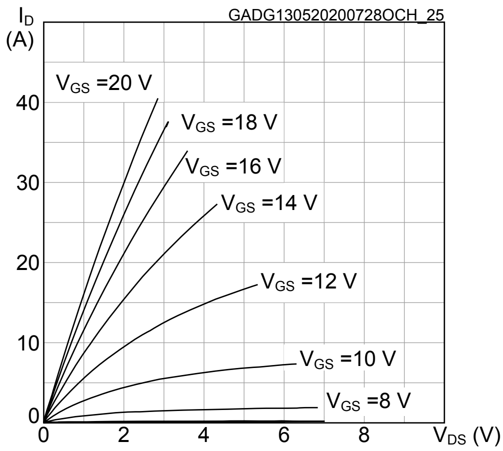


Figure 4. Typical output characteristics (T_J = 200 °C)

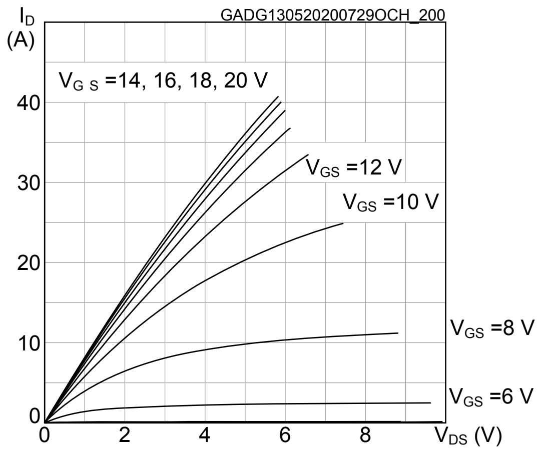


Figure 5. Typical transfer characteristics

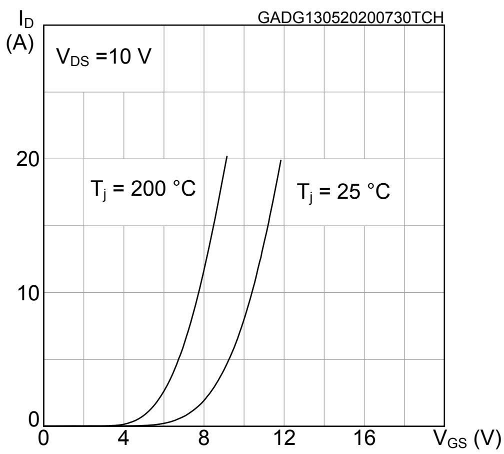


Figure 6. Total power dissipation

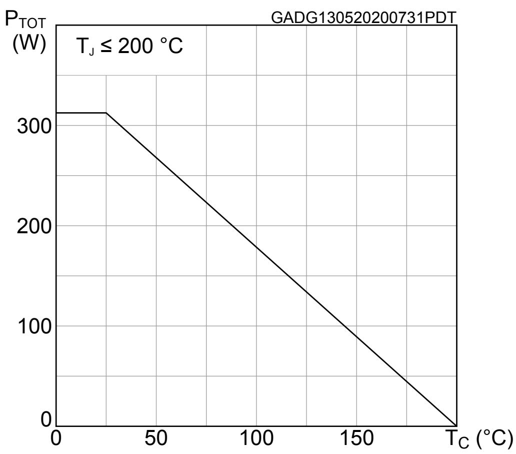


Figure 7. Typical gate charge characteristics

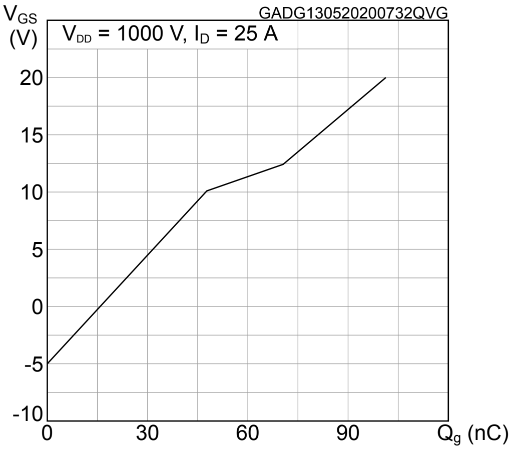


Figure 8. Typical capacitance characteristics

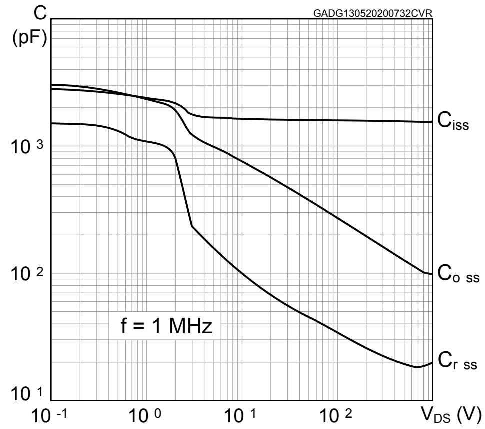


Figure 9. Typical switching energy vs I_D

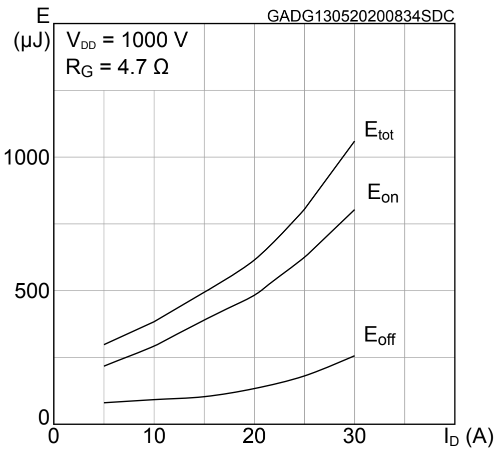


Figure 10. Typical switching energy vs temperature

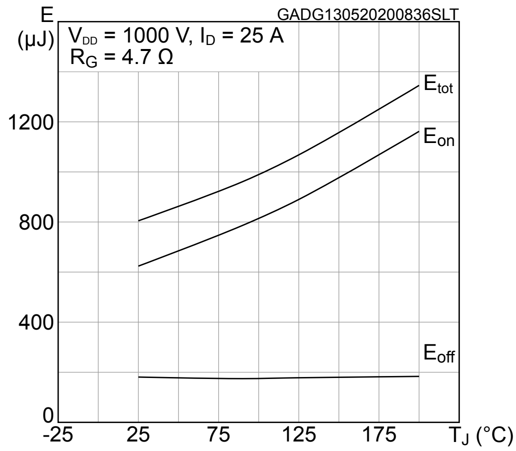


Figure 11. Typical switching energy vs R_G

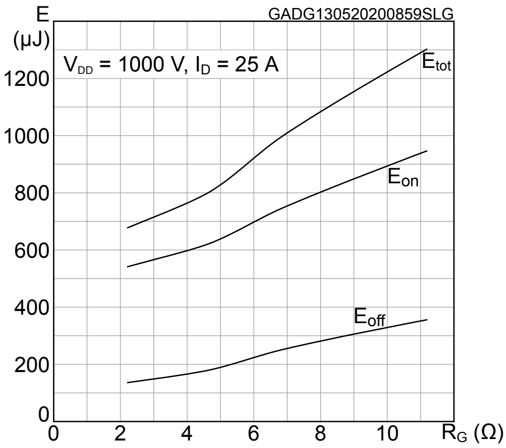


Figure 12. Typical drain-source on-resistance

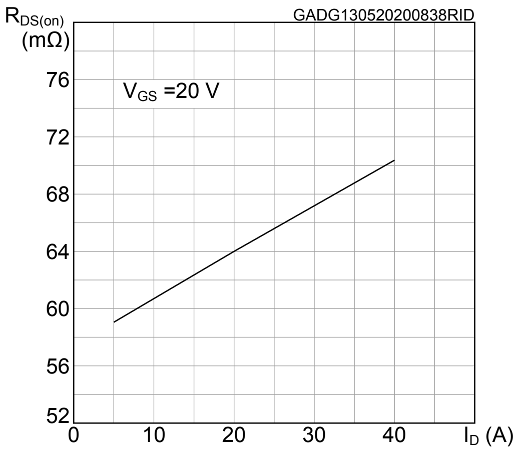


Figure 13. Normalized breakdown voltage vs temperature

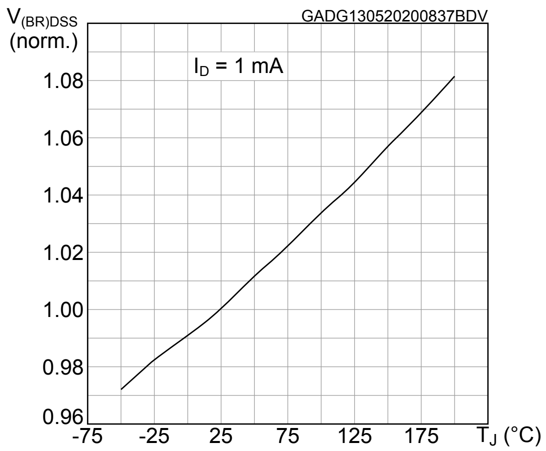


Figure 14. Normalized gate threshold vs temperature

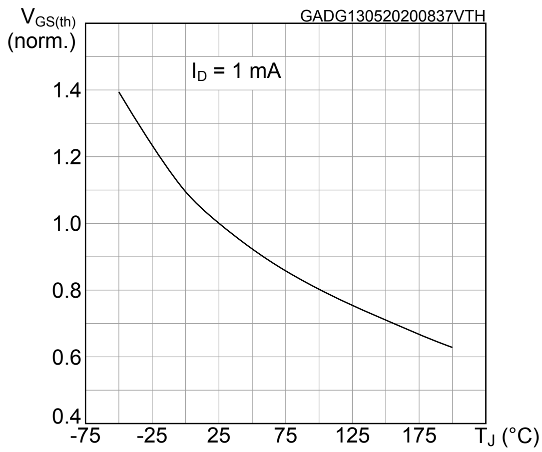


Figure 15. Normalized on-resistance vs temperature

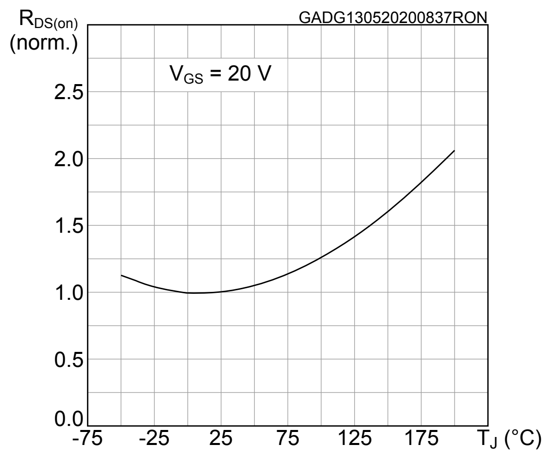


Figure 16. Typical reverse conduction characteristics (T_J = 25 °C)

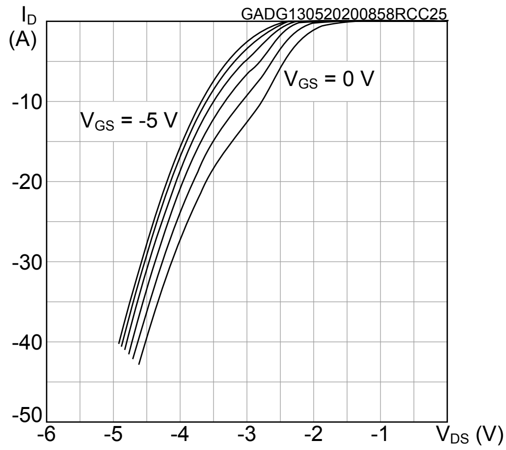
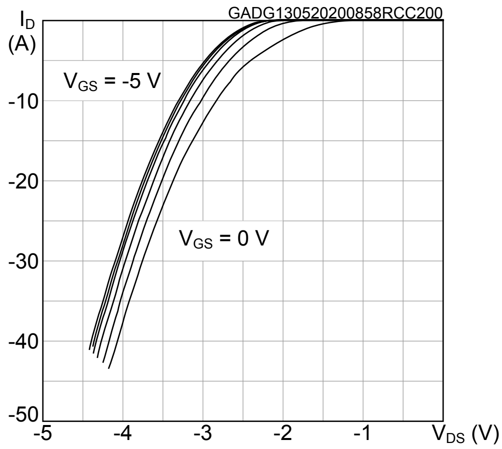


Figure 17. Typical reverse conduction characteristics (T_J = 200 °C)



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 18. HiP247 package outline

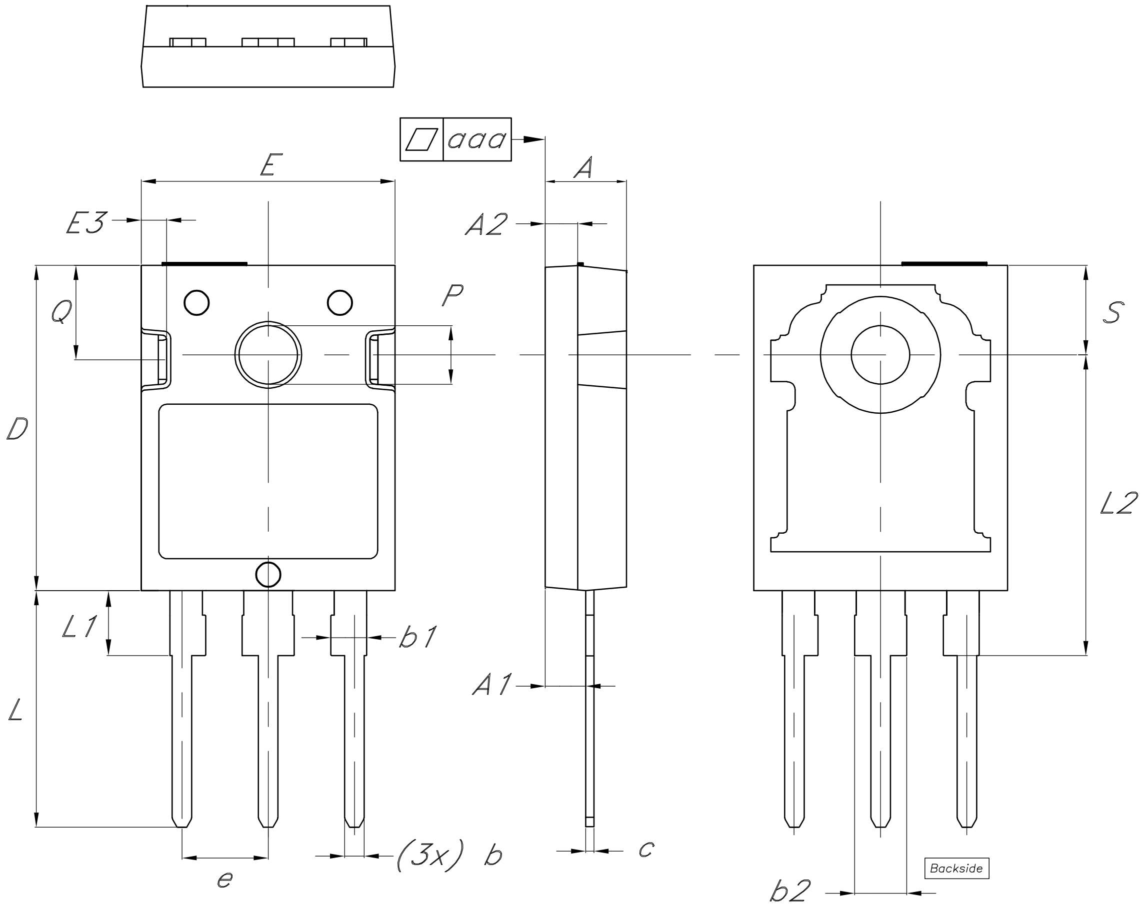


Table 7. **HiP247 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.85	5.00	5.15
A1	2.20		2.60
A2	1.90	2.00	2.10
b	1.00		1.40
b1	2.00		2.40
b2	3.00		3.40
c	0.40		0.80
D	19.85	20.00	20.15
E	15.45	15.60	15.75
E3	1.45		1.65
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2	18.30	18.50	18.70
P	3.55		3.65
Q	5.65		5.95
S	5.30	5.50	5.70
aaa		0.04	0.10

Revision history

Table 8. Document revision history

Date	Revision	Changes
12-May-2020	1	First release.
8-Jun-2020	2	Modified title.
31-Jul-2020	3	Modified Table 3. On/off states. Minor text changes.
24-Jun-2021	4	Updated Features in cover page. Minor text changes.

Contents