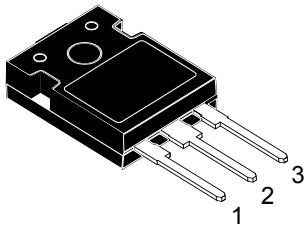
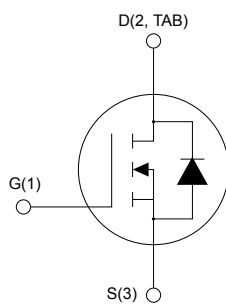


## Automotive-grade silicon carbide Power MOSFET 1200 V, 75 mΩ typ., 33 A in an HiP247 package



**HiP247**


AM01475v1\_no2en



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
SCTW40N120G2VAG	1200 V	105 mΩ	33 A

- AEC-Q101 qualified 
- Very fast and robust intrinsic body diode
- Extremely low gate charge and input capacitance
- Very high operating junction temperature capability (T<sub>J</sub> = 200 °C)

### Applications

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

### Description

This silicon carbide Power MOSFET device has been developed using ST's advanced and innovative 2<sup>nd</sup> generation SiC MOSFET technology. The device features remarkably low on-resistance per unit area and very good switching performance. The variation of switching loss is almost independent of junction temperature.

#### Product status link

[SCTW40N120G2VAG](#)

#### Product summary

<b>Order code</b>	SCTW40N120G2VAG
<b>Marking</b>	SCT40N120G2VAG
<b>Package</b>	HiP247
<b>Packing</b>	Tube

# 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 22	V
	Gate-source voltage (recommended operating values)	-5 to 18	
	Gate-source voltage (pulsed, $t_p = 25$ ns repetitive overshoot during switching for an accumulated time of 10 h)	-11 to 25	
$I_D$	Drain current (continuous) at $T_C = 25$ °C	33	A
	Drain current (continuous) at $T_C = 100$ °C	25	
$I_{DM}^{(1)}$	Drain current (pulsed)	100	A
$P_{TOT}$	Total power dissipation at $T_C = 25$ °C	290	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
$R_{thJC}$	Thermal resistance, junction-to-case	0.6	°C/W
$R_{thJA}$	Thermal resistance, junction-to-ambient	40	°C/W

## 2 Electrical characteristics

$T_C = 25\text{ °C}$  unless otherwise specified.

**Table 3. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	1200			V
$I_{DSS}$	Zero gate voltage drain current	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$			10	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}, V_{GS} = -10\text{ to }22\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	1.9	3.2	5.0	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 18\text{ V}, I_D = 20\text{ A}$		75	105	m $\Omega$
		$V_{GS} = 18\text{ V}, I_D = 20\text{ A}, T_J = 200\text{ °C}$		195		

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 800\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	-	1230	-	pF
$C_{oss}$	Output capacitance		-	56	-	pF
$C_{riss}$	Reverse transfer capacitance		-	15	-	pF
$Q_g$	Total gate charge	$V_{DS} = 800\text{ V}, V_{GS} = -5\text{ to }18\text{ V}, I_D = 20\text{ A}$	-	63	-	nC
$Q_{gs}$	Gate-source charge		-	15	-	nC
$Q_{gd}$	Gate-drain charge		-	20	-	nC
$R_G$	Gate input resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	1	-	$\Omega$

**Table 5. Switching energy**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}$	Turn-on switching energy	$V_{DD} = 800\text{ V}, I_D = 20\text{ A},$	-	235	-	$\mu\text{J}$
$E_{off}$	Turn-off switching energy	$R_G = 4.7\ \Omega, V_{GS} = -5\text{ to }18\text{ V}$	-	77	-	$\mu\text{J}$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 800\text{ V}, I_D = 20\text{ A},$ $R_G = 4.7\ \Omega, V_{GS} = -5\text{ to }18\text{ V}$	-	11	-	ns
$t_r$	Rise time		-	5	-	ns
$t_{d(off)}$	Turn-off-delay time		-	18	-	ns
$t_f$	Fall time		-	13	-	ns

**Table 7. Reverse SiC diode characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{SD}$	Diode forward voltage	$I_{SD} = 20 \text{ A}$ , $V_{GS} = 0 \text{ V}$	-	3.4	-	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 20 \text{ A}$ , $di/dt = 2000 \text{ A}/\mu\text{s}$ , $V_{DD} = 800 \text{ V}$ , $V_{GS} = -5 \text{ to } 18 \text{ V}$	-	19	-	ns
$Q_{rr}$	Reverse recovery charge		-	132	-	nC
$I_{RRM}$	Reverse recovery current		-	20	-	A

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

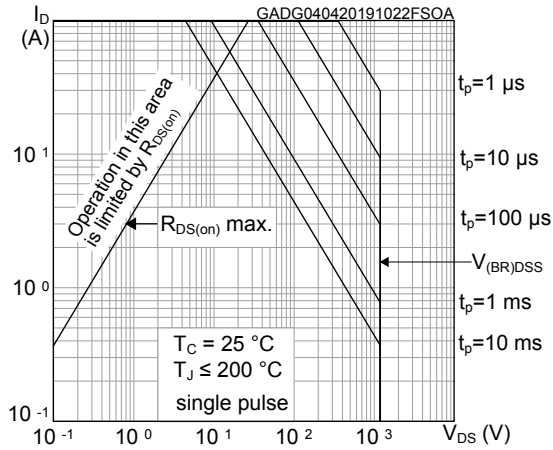


Figure 2. Maximum transient thermal impedance

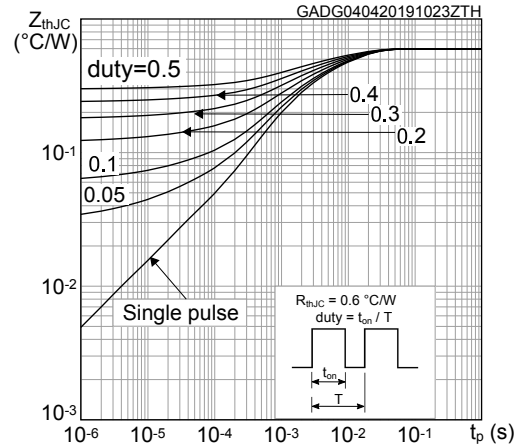


Figure 3. Output characteristics ( $T_J = -50 \text{ }^\circ\text{C}$ )

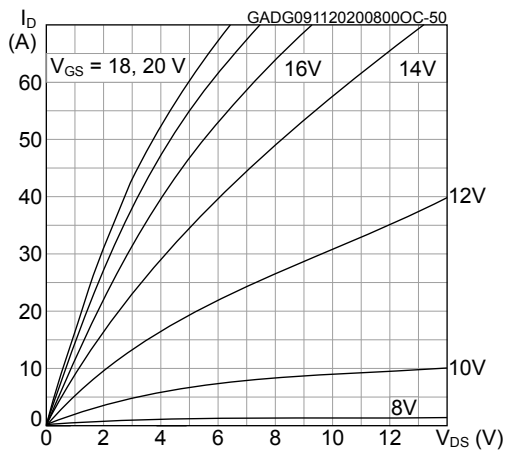


Figure 4. Output characteristics ( $T_J = 25 \text{ }^\circ\text{C}$ )

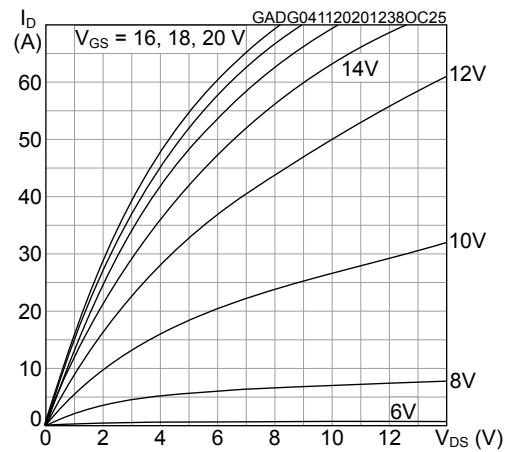


Figure 5. Output characteristics ( $T_J = 200 \text{ }^\circ\text{C}$ )

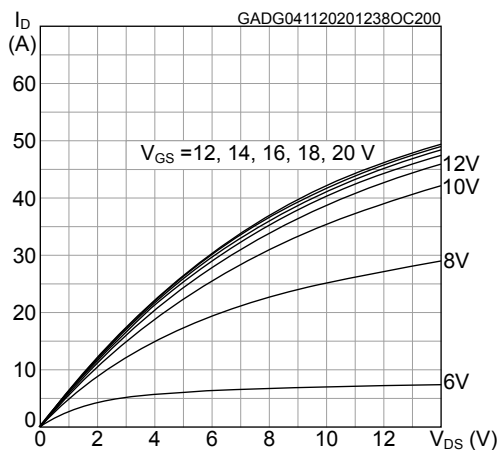
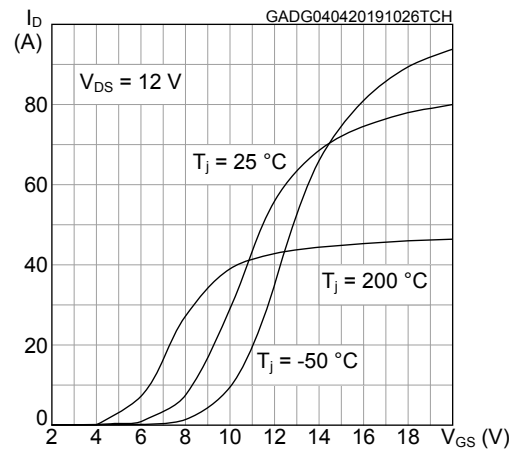
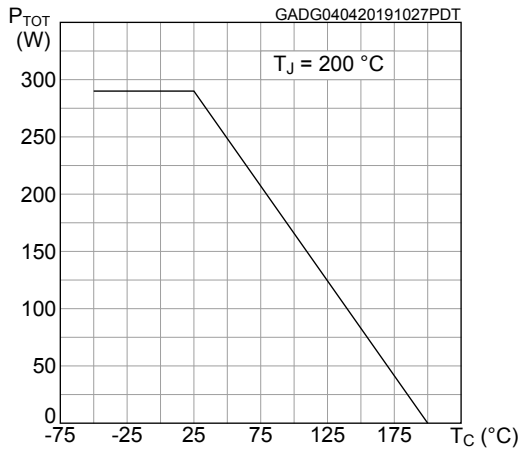


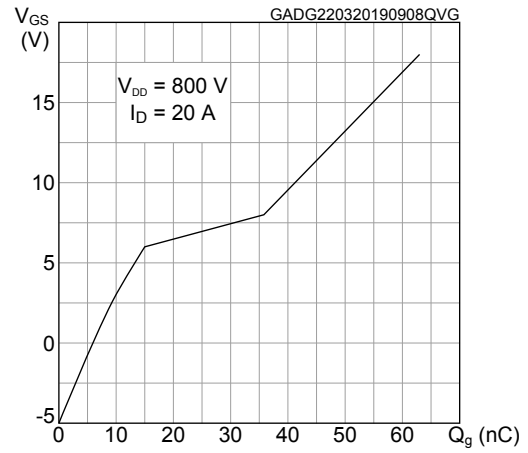
Figure 6. Transfer characteristics



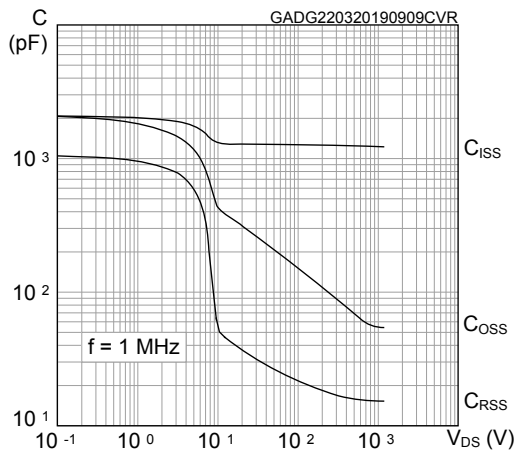
**Figure 7. Total power dissipation**



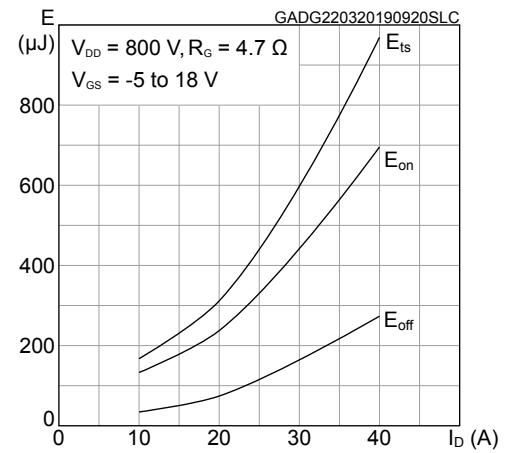
**Figure 8. Gate charge vs gate-source voltage**



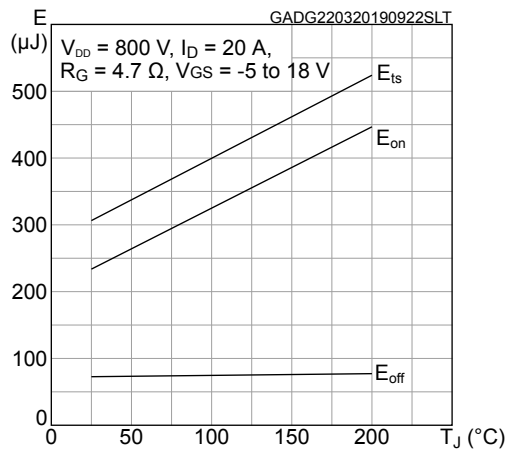
**Figure 9. Capacitance variations**



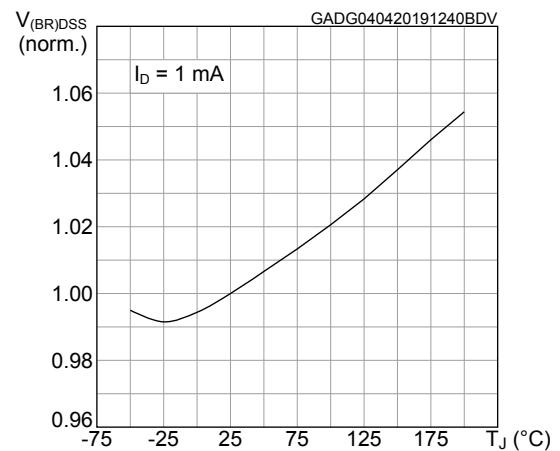
**Figure 10. Switching energy vs drain current**



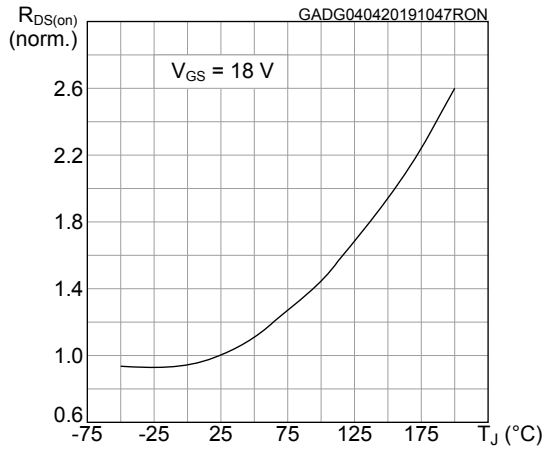
**Figure 11. Switching energy vs junction temperature**



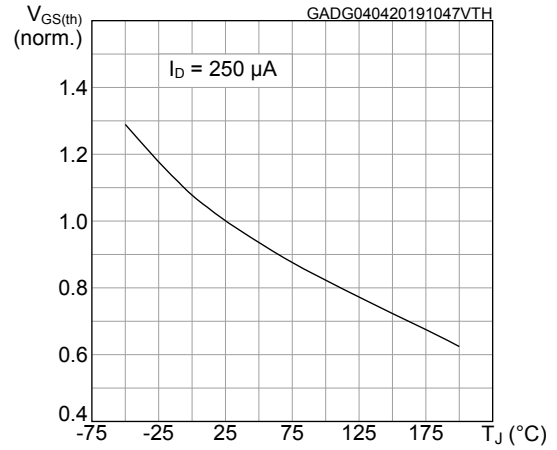
**Figure 12. Normalized  $V_{(BR)DSS}$  vs temperature**



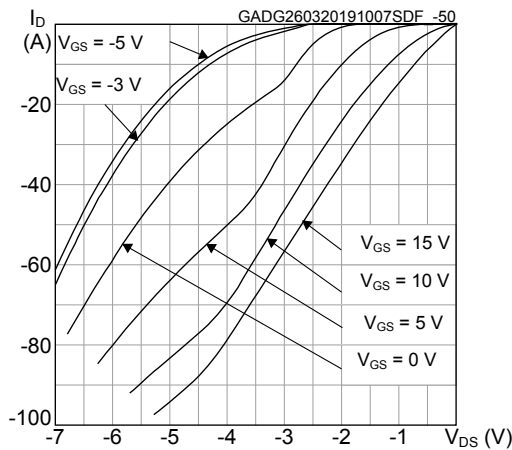
**Figure 13. Normalized on-resistance vs temperature**



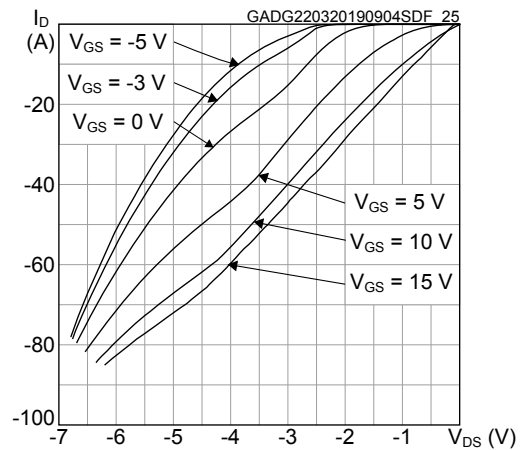
**Figure 14. Normalized gate threshold voltage vs temperature**



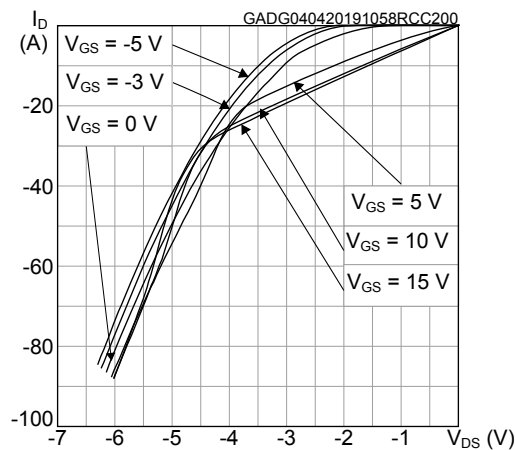
**Figure 15. Reverse conduction characteristics (T<sub>J</sub> = -50 °C)**



**Figure 16. Reverse conduction characteristics (T<sub>J</sub> = 25 °C)**



**Figure 17. Reverse conduction characteristics (T<sub>J</sub> = 200 °C)**

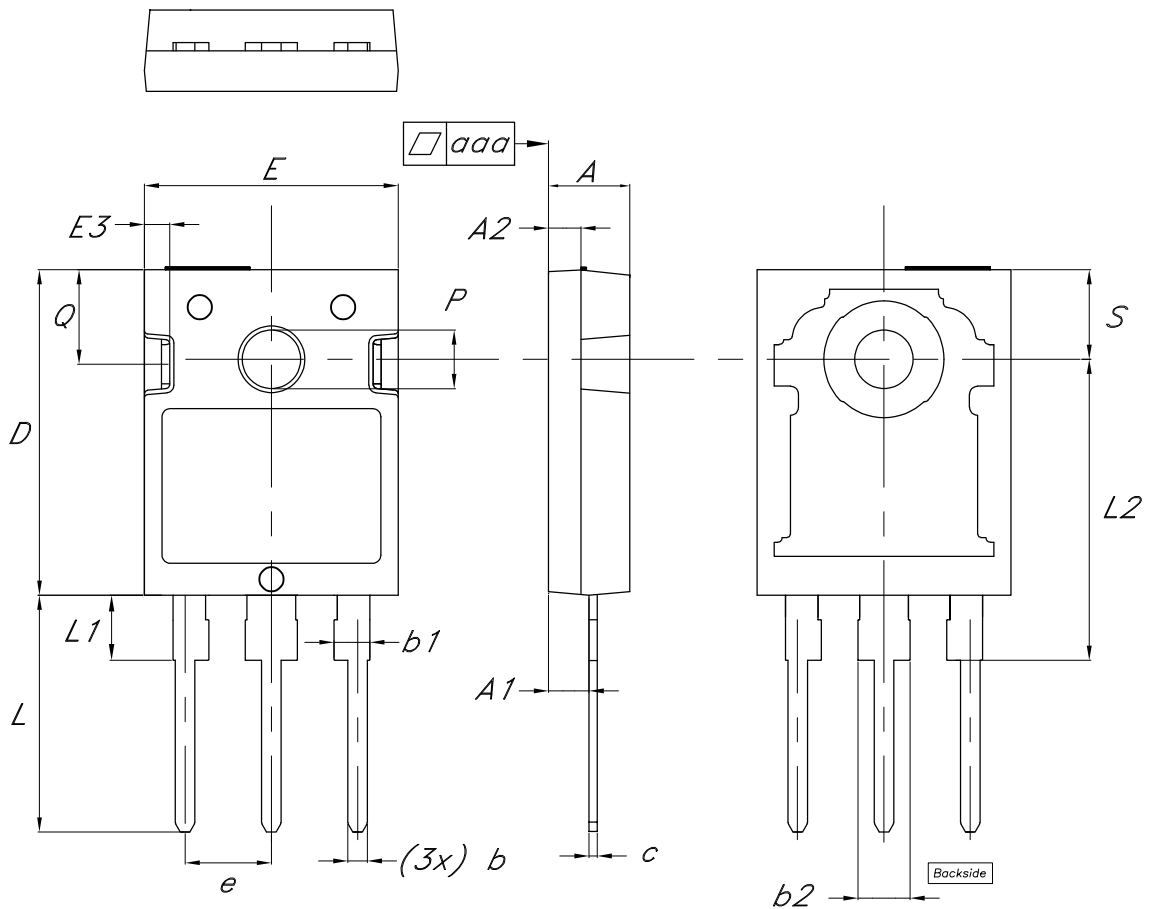


### 3 Package information

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

#### 3.1 HiP247 package information

Figure 18. HiP247 package outline



8581091\_4



**Table 8. 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 9. Document revision history**

Date	Revision	Changes
09-Apr-2019	1	First release.
21-Jul-2020	2	Updated <i>Table 3. On/off states</i> and <i>Table 7. Reverse SiC diode characteristics</i> . Updated <i>Section 3 Package information</i> .
12-Nov-2020	3	Updated <i>Section 2.1 Electrical characteristics (curves)</i> . Minor text changes.
06-Sep-2021	4	Modified <i>Table 5. Switching energy (inductive load)</i> . Updated <i>Section 3.1 HiP247 package information</i> .
23-Nov-2021	5	Modified <i>Table 1. Absolute maximum ratings</i> . Modified <i>Figure 1. Safe operating area</i> and <i>Figure 2. Maximum transient thermal impedance</i> .

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