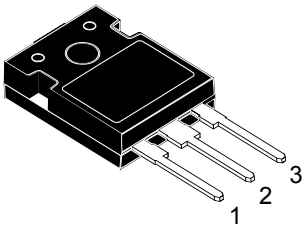
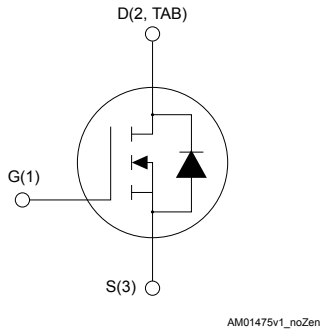
Automotive-grade silicon carbide Power MOSFET 1200 V, 12 A, 520 mΩ (typ., T_J = 150 °C) in an HiP247 package



HiP247



Features

- AEC-Q101 qualified
- Very tight variation of on-resistance vs. temperature
- Very high operating temperature capability (T_J = 200 °C)
- Very fast and robust intrinsic body diode
- Low capacitance

Applications

- Motor drives
- EV chargers
- 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.

Product status link
SCT10N120AG

Product summary	
Order code	SCT10N120AG
Marking	SCT10N120AG
Package	HiP247
Packing	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 25	V
I_D	Drain current (continuous) at T_C = 25 °C	12	A
I_D	Drain current (continuous) at T_C = 100 °C	10	A
I_{DM} (1)	Drain current (pulsed)	24	A
P_{TOT}	Total power dissipation at T_C = 25 °C	150	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	1.17	°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
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	1200			V
I_{DSS}	Zero gate voltage drain current	V_{DS} = 1200 V, V_{GS} = 0 V			10	µA
		V_{DS} = 1200 V, V_{GS} = 0 V, T_J = 200 °C (1)			100	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = -10 to 25 V			100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	1.8	3.5		V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 20 V, I_D = 6 A		500	690	mΩ
		V_{GS} = 20 V, I_D = 6 A, T_J = 150 °C		520		mΩ
		V_{GS} = 20 V, I_D = 6 A, T_J = 200 °C		580		mΩ

1. *Defined by design, not subject to production test.*

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	-	290	-	pF
C_{oss}	Output capacitance		-	30	-	pF
C_{rss}	Reverse transfer capacitance		-	9	-	pF
Q_g	Total gate charge	V_{DD} = 800 V, I_D = 6 A, V_{GS} = 0 to 20 V	-	22	-	nC
Q_{gs}	Gate-source charge		-	3	-	nC
Q_{gd}	Gate-drain charge		-	10	-	nC
R_g	Gate input resistance	f=1 MHz, I_D=0 A	-	8	-	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 = 6 A, R_G= 10 Ω, V_{GS} = -5 to 20 V	-	90	-	µJ
E_{off}	Turn-off switching energy		-	30	-	µJ
E_{on}	Turn-on switching energy	V_{DD} = 800 V, I_D = 6 A, R_G= 10 Ω, V_{GS} = -5 to 20 V, T_J= 150 °C	-	104	-	µJ
E_{off}	Turn-off switching energy		-	33	-	µJ

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 800 V, I_D = 6 A, R_G = 10 Ω, V_{GS} = -5 to 20 V	-	7	-	ns
t_f	Fall time		-	17	-	ns
$t_{d(off)}$	Turn-off delay time		-	14	-	ns
t_r	Rise time		-	12	-	ns

Table 7. Reverse SiC diode characteristics

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
V_{SD}	Diode forward voltage	I_F = 6 A, V_{GS} = 0 V	-	4.3	-	V
t_{rr}	Reverse recovery time	I_{SD} = 6 A, di/dt = 2000 A/µs V_{DD} = 800 V, T_J=150 °C	-	16	-	ns
Q_{rr}	Reverse recovery charge		-	107	-	nC
I_{RRM}	Reverse recovery current		-	12	-	A

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

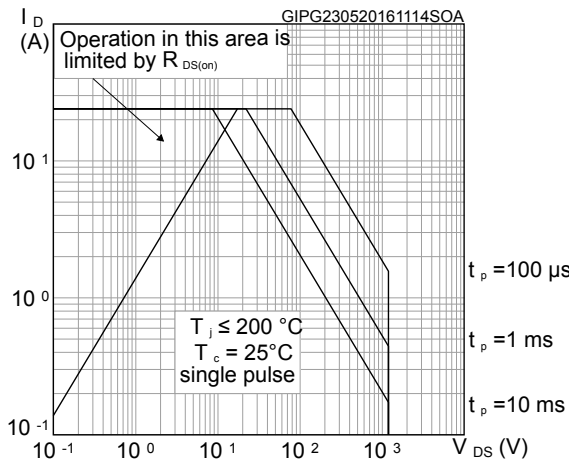


Figure 2. Thermal impedance

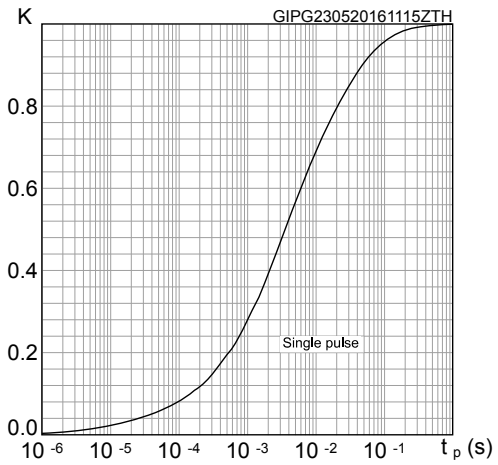


Figure 3. Output characteristics (T_J= 25 °C)

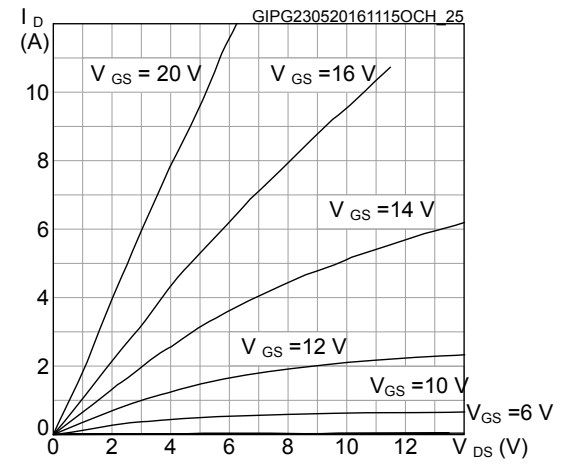


Figure 4. Output characteristics (T_J= 150 °C)

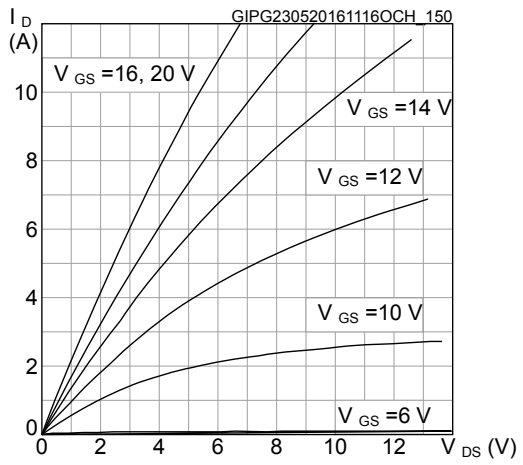


Figure 5. Output characteristics (T_J= 200 °C)

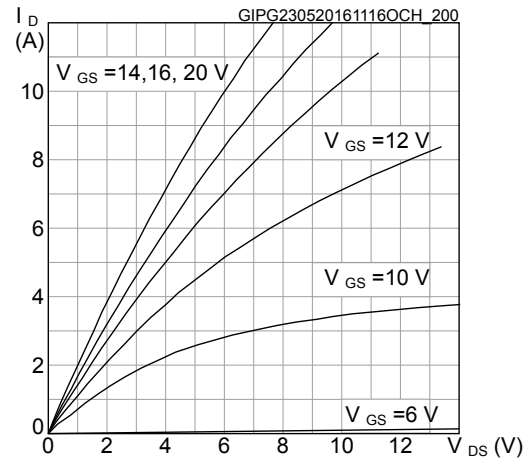


Figure 6. Transfer characteristics

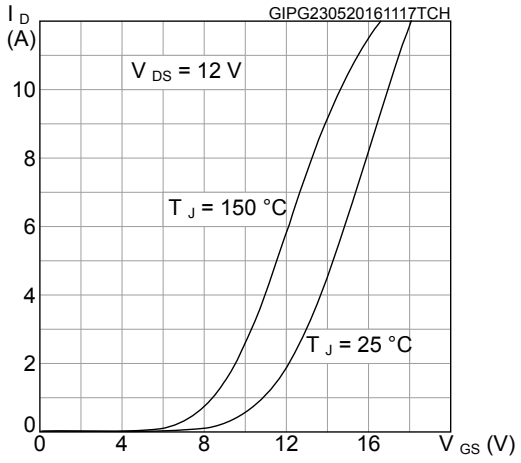


Figure 7. Power dissipation

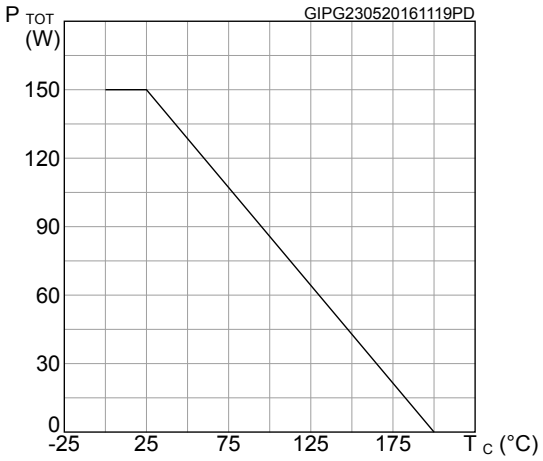


Figure 8. Gate charge vs gate-source voltage

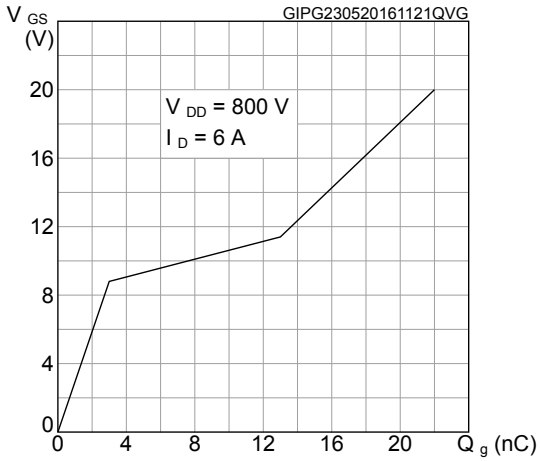


Figure 9. Capacitance variations

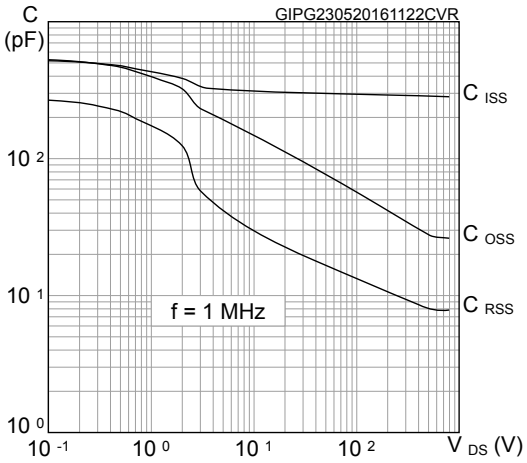


Figure 10. Switching energy vs. drain current

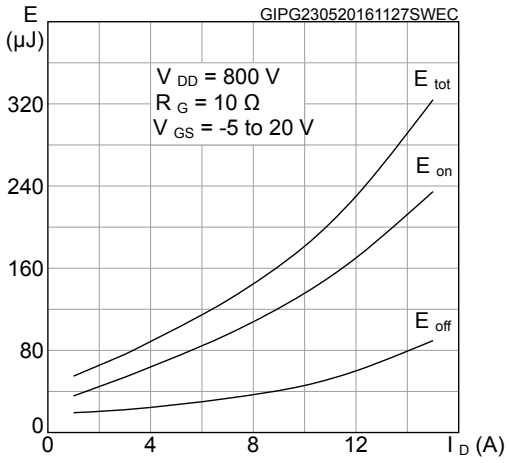


Figure 11. Switching energy vs. junction temperature

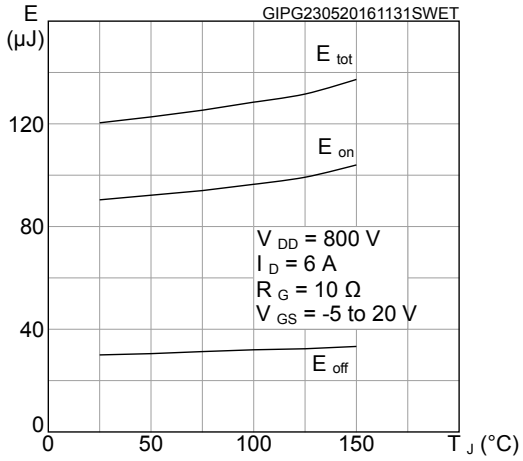


Figure 12. Normalized $V_{(BR)DSS}$ vs. temperature

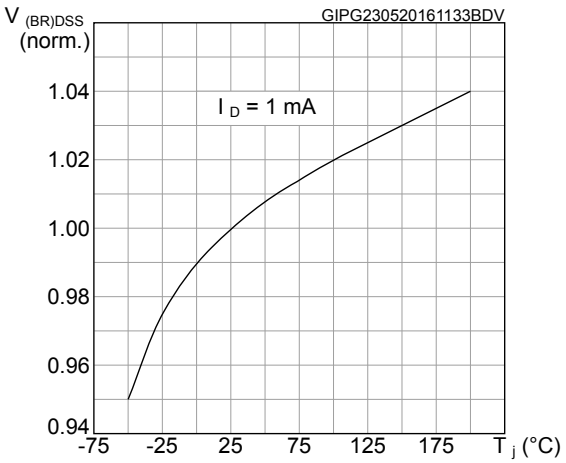


Figure 13. Normalized gate threshold voltage vs. temperature

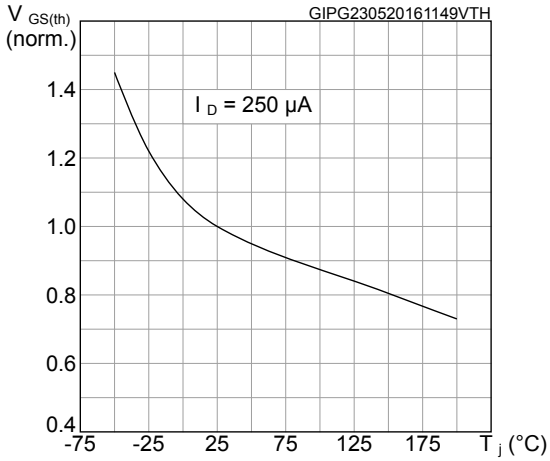


Figure 14. Normalized on-resistance vs. temperature

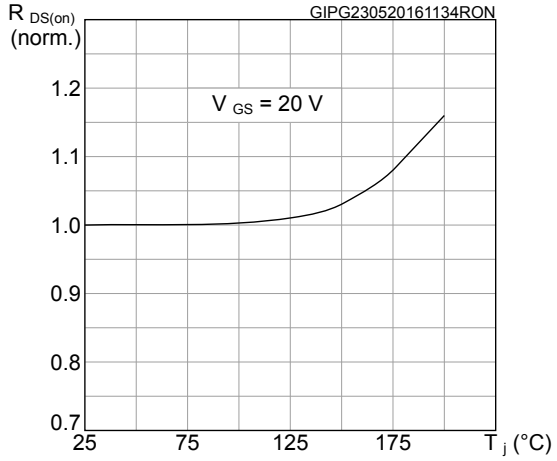


Figure 15. Body diode characteristics (T_J= -50 °C)

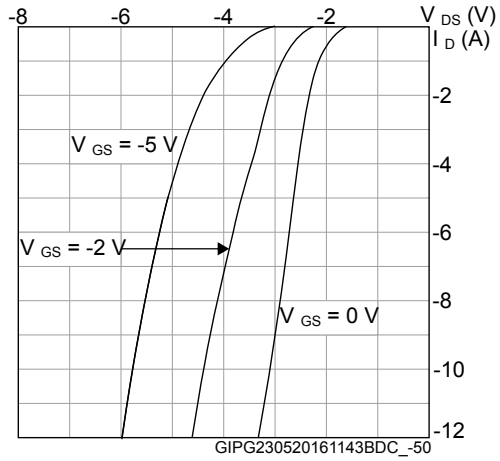


Figure 16. Body diode characteristics (T_J= 25 °C

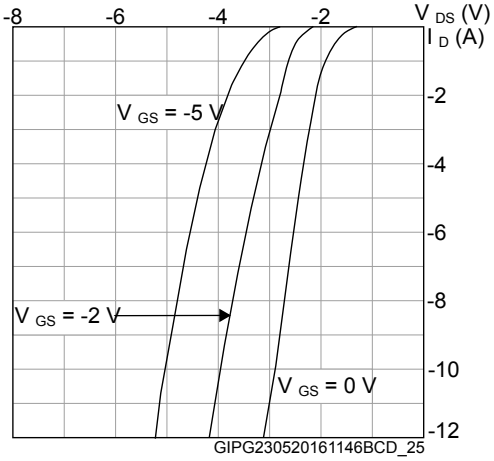


Figure 17. **Body diode characteristics (T_J= 150 °C)**

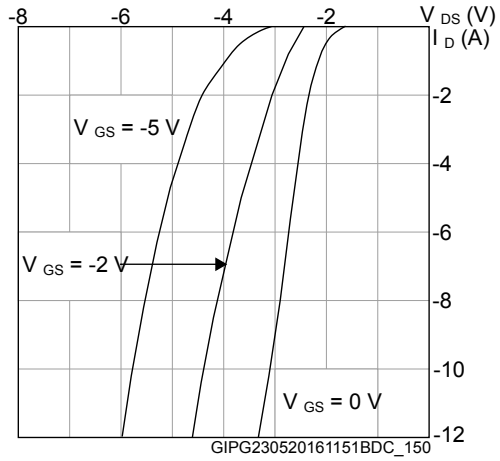


Figure 18. **3rd quadrant characteristics (T_J= -50 °C)**

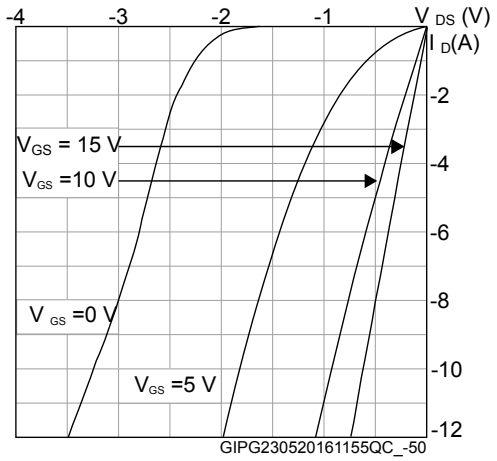


Figure 19. **3rd quadrant characteristics (T_J= 25 °C)**

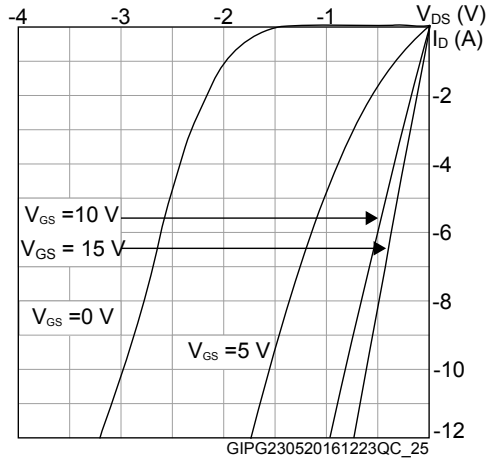
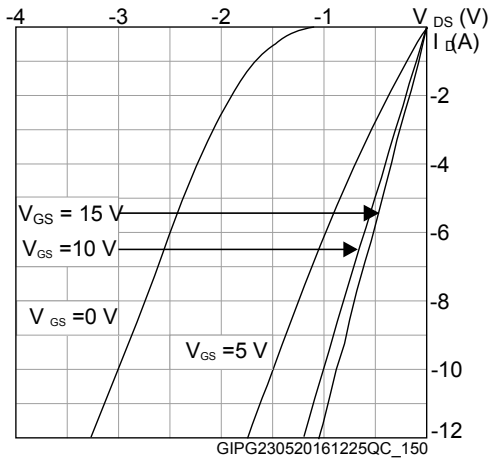


Figure 20. **3rd quadrant characteristics (T_J= 150 °C)**



3 Test circuits

Figure 21. Switching test waveforms for transition times

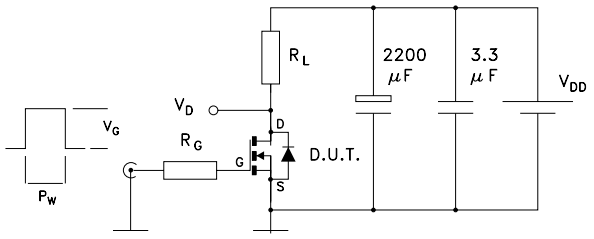


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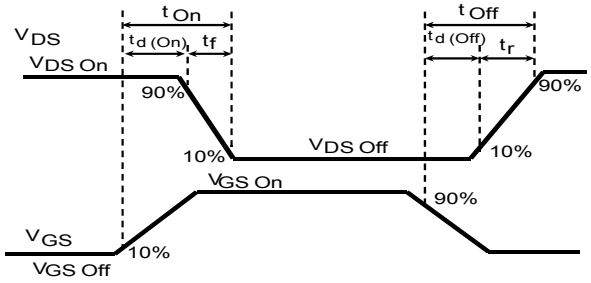
Figure 22. Clamped inductive switching waveform



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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 23. HiP247 package outline

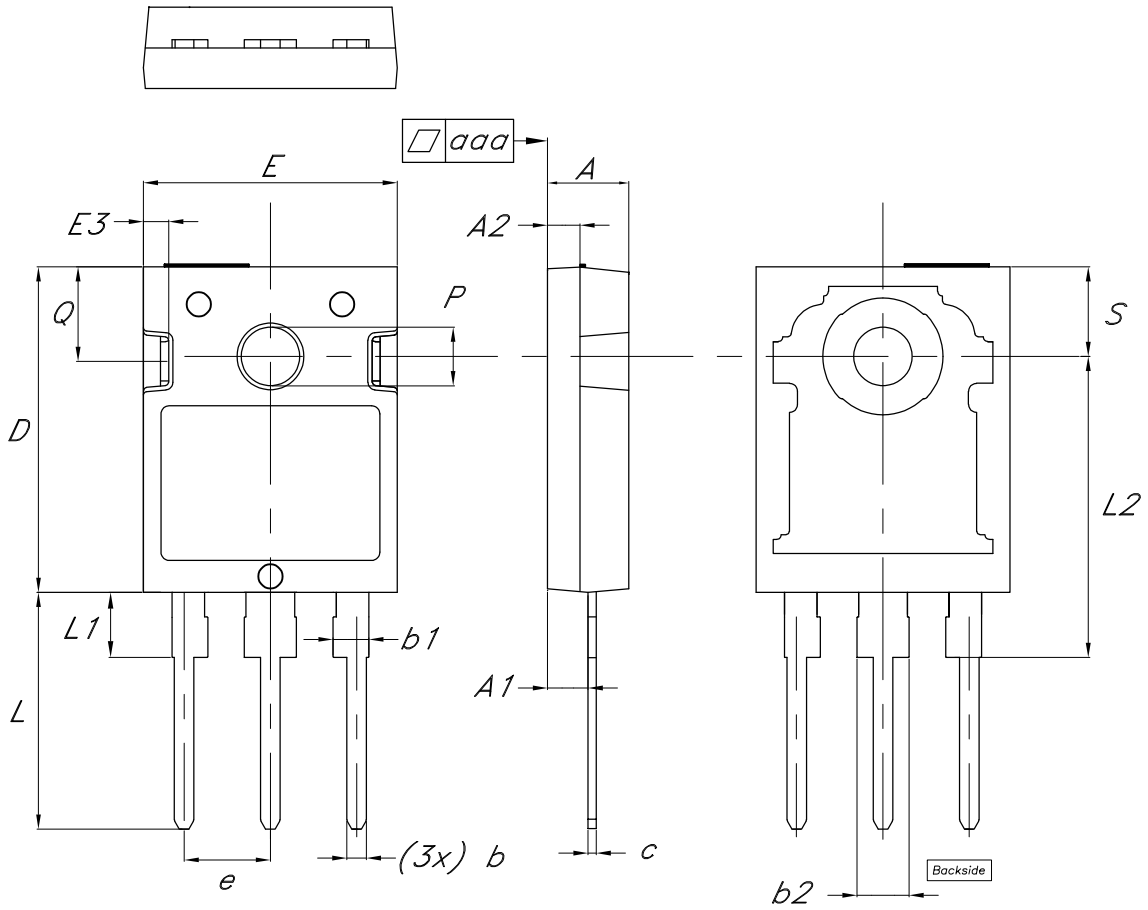

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Table 8. **HiP247 package mechanical data**

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
20-Mar-2018	1	First release
01-Mar-2019	2	Updated *Table 3. On/off states*. Updated package information.
21-Sep-2022	3	Updated Section 4.1 HiP247 package information. Minor text changes.

Contents