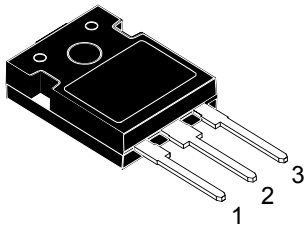
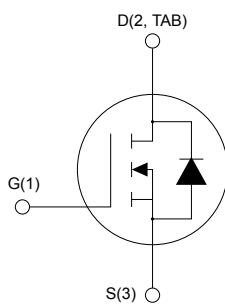


Automotive-grade silicon carbide Power MOSFET 1200 V, 75 mΩ typ., 33 A in an HiP247 package



HiP247


AM01475v1_no2en



Features

| Order code | V _{DS} | R _{DS(on)} max. | I _D |
|-----------------|-----------------|--------------------------|----------------|
| 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_J = 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 2nd 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

| | |
|-------------------|-----------------|
| Order code | SCTW40N120G2VAG |
| Marking | SCT40N120G2VAG |
| 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 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

$T_C = 25\text{ }^\circ\text{C}$ 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 | μA |
| I_{GSS} | Gate-body leakage current | $V_{DS} = 0\text{ V}, V_{GS} = -10\text{ to }22\text{ V}$ | | | ± 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 Ω |
| | | $V_{GS} = 18\text{ V}, I_D = 20\text{ A}, T_J = 200\text{ }^\circ\text{C}$ | | 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_{rSS} | 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 | - | Ω |

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 | - | μJ |
| E_{off} | Turn-off switching energy | $R_G = 4.7\text{ }\Omega, V_{GS} = -5\text{ to }18\text{ V}$ | - | 77 | - | μJ |

Table 6. Switching times

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

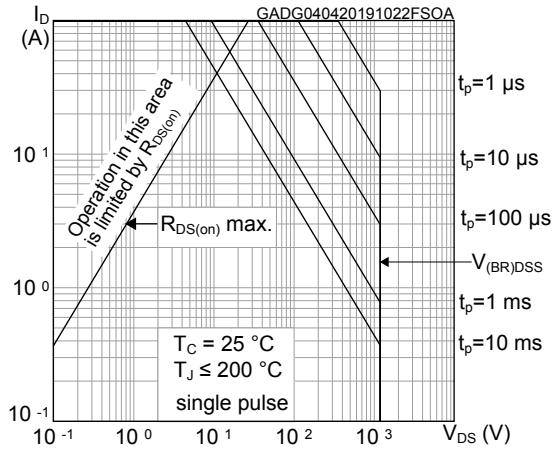


Figure 2. Maximum transient thermal impedance

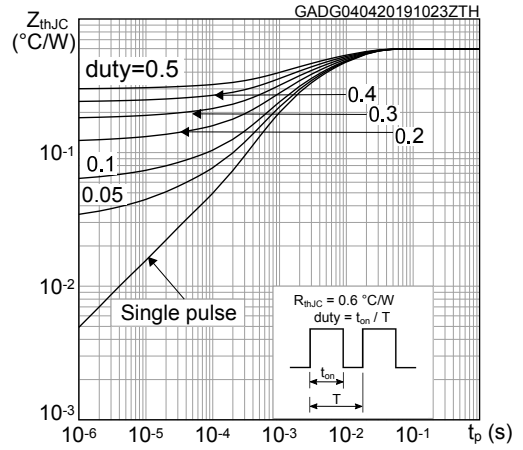


Figure 3. Output characteristics ($T_J = -50\text{ °C}$)

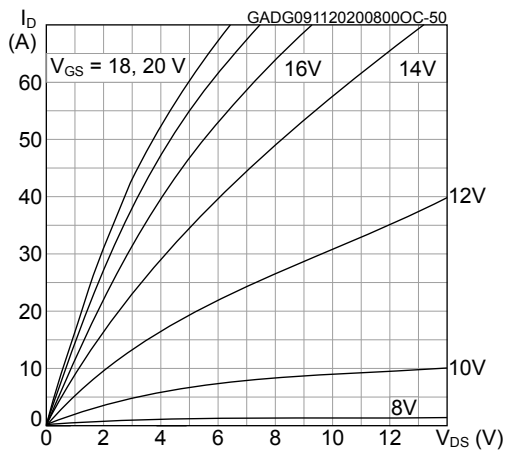


Figure 4. Output characteristics ($T_J = 25\text{ °C}$)

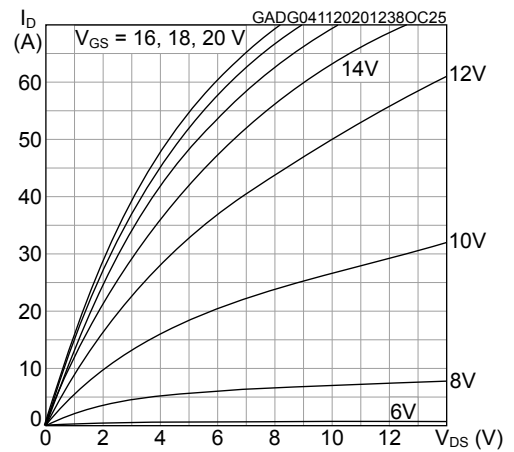


Figure 5. Output characteristics ($T_J = 200\text{ °C}$)

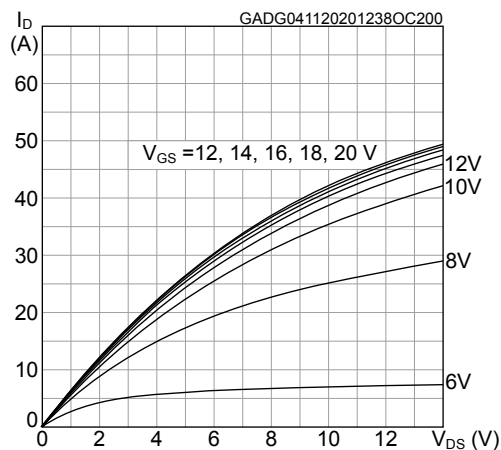


Figure 6. Transfer characteristics

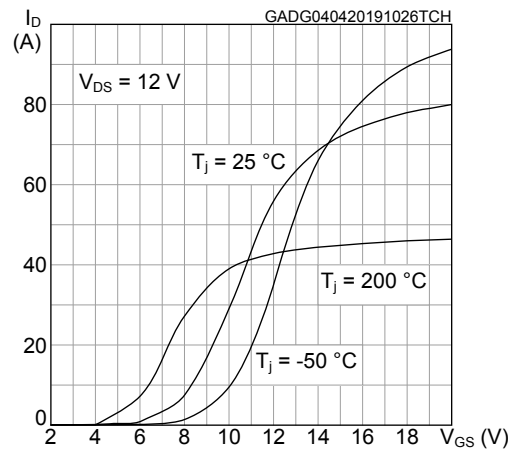


Figure 7. Total power dissipation

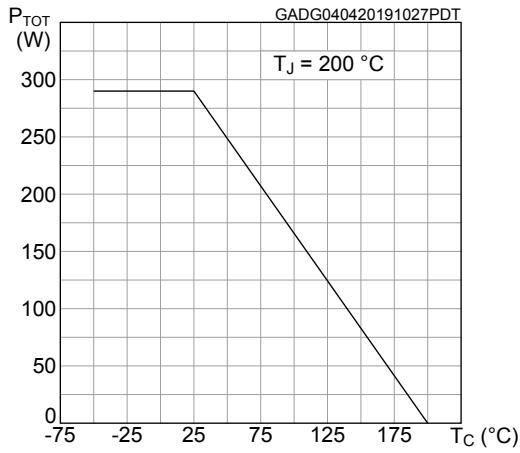


Figure 8. Gate charge vs gate-source voltage

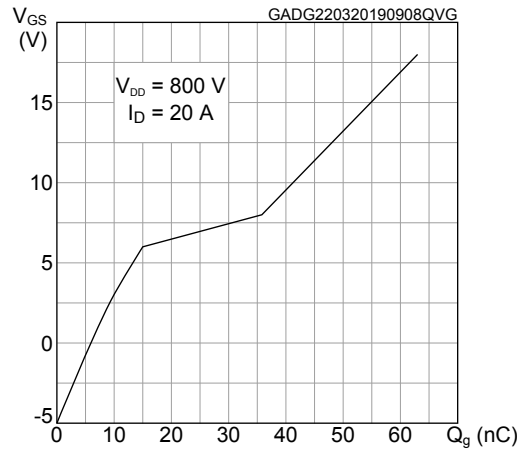


Figure 9. Capacitance variations

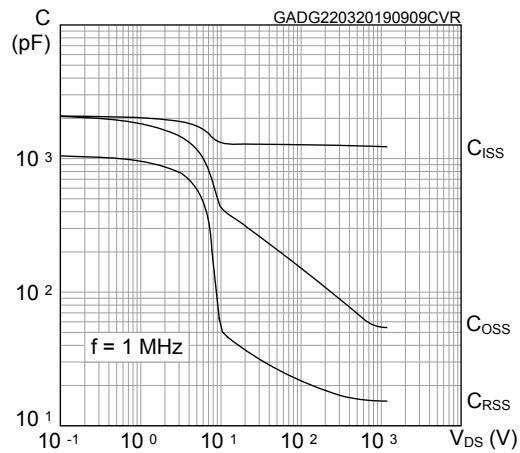


Figure 10. Switching energy vs drain current

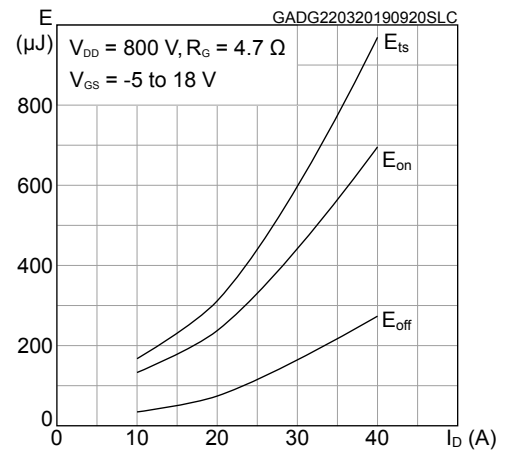


Figure 11. Switching energy vs junction temperature

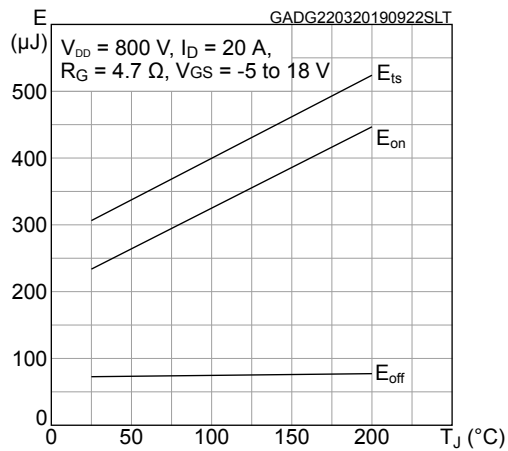


Figure 12. Normalized $V_{(BR)DSS}$ vs temperature

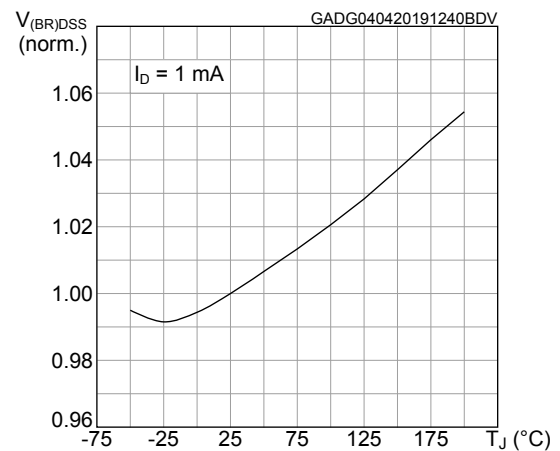


Figure 13. Normalized on-resistance vs temperature

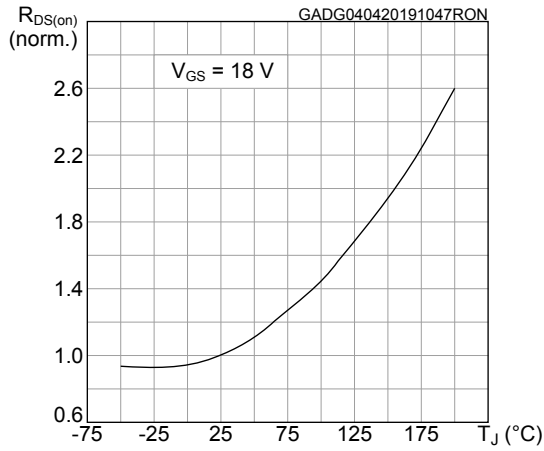


Figure 14. Normalized gate threshold voltage vs temperature

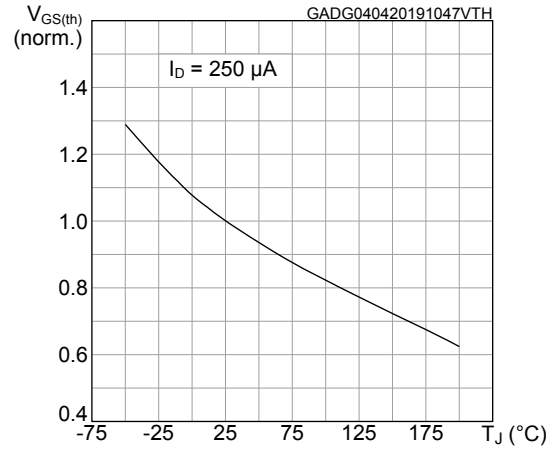


Figure 15. Reverse conduction characteristics ($T_J = -50\text{ °C}$)

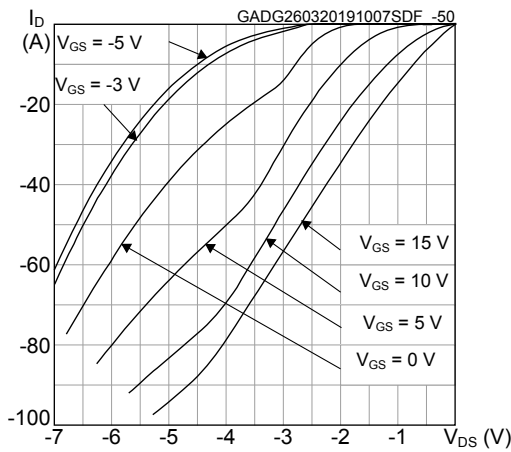


Figure 16. Reverse conduction characteristics ($T_J = 25\text{ °C}$)

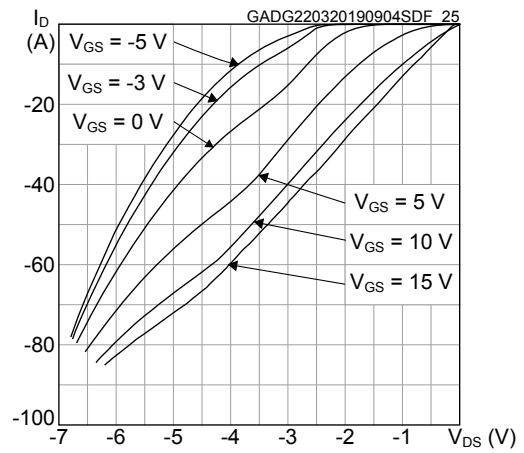
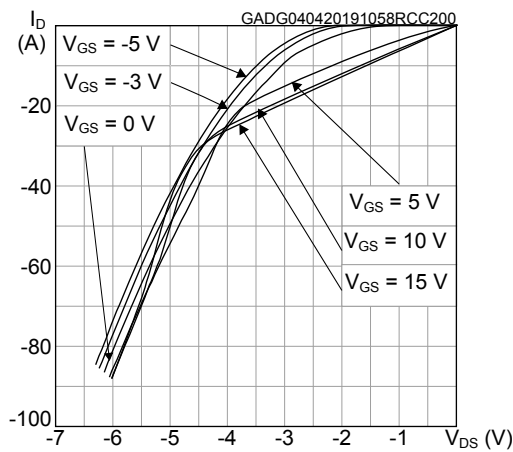


Figure 17. Reverse conduction characteristics ($T_J = 200\text{ °C}$)

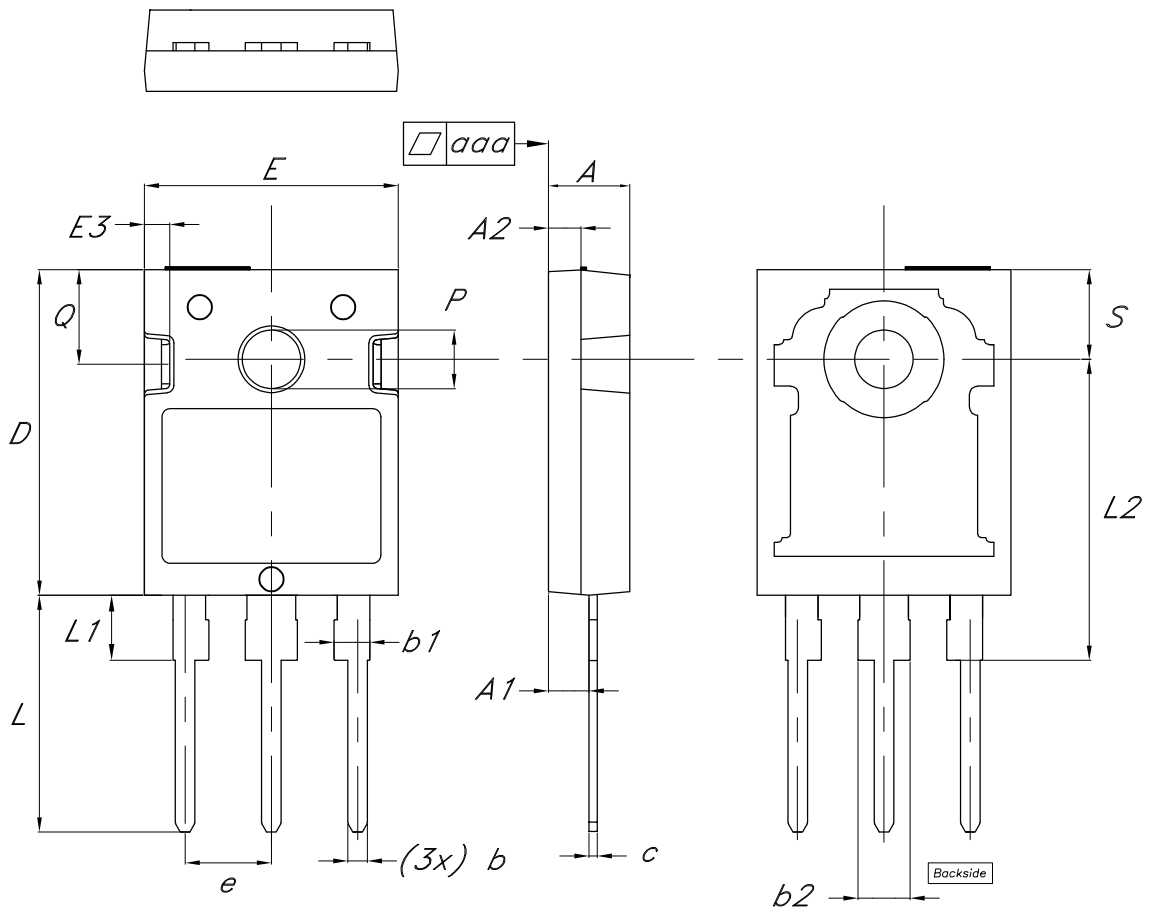


3 Package information

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



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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| | Revision history | 10 |

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