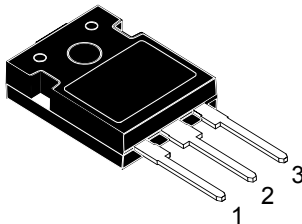
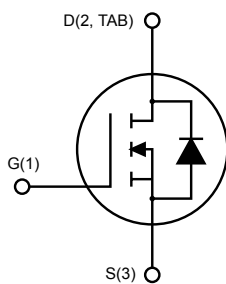



Automotive-grade silicon carbide Power MOSFET 1200 V, 20 A, 189 mΩ (typ., $T_J=150\text{ °C}$), in an HiP247 package


HiP247


AM01475v1_noZen



Features

- AEC-Q101 qualified 
- Very tight variation of on-resistance vs. temperature
- Very high operating temperature capability ($T_J = 200\text{ °C}$)
- 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

[SCT20N120AG](#)

Product summary

| | |
|------------|-------------|
| Order code | SCT20N120AG |
| Marking | |
| 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 $T_C = 25\text{ °C}$ | 20 | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ °C}$ | 16 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 45 | A |
| P_{TOT} | Total power dissipation at $T_C = 25\text{ °C}$ | 153 | 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 |
|----------------|-------------------------------------|-------|------|
| $R_{thj-case}$ | Thermal resistance junction-case | 1.14 | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-ambient | 40 | °C/W |

2 Electrical characteristics

($T_{CASE} = 25\text{ °C}$ 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 | $V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}$ | | | 10 | μA |
| | | $V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}, T_J = 200\text{ °C}$ | | 50 | | |
| I_{GSS} | Gate-body leakage current | $V_{DS} = 0\text{ V}, V_{GS} = -10\text{ to }25\text{ V}$ | | | 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 1\text{ mA}$ | 2 | 3.5 | | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS} = 20\text{ V}, I_D = 10\text{ A}$ | | 169 | 239 | m Ω |
| | | $V_{GS} = 20\text{ V}, I_D = 10\text{ A}, T_J = 150\text{ °C}$ | | 189 | | |
| | | $V_{GS} = 20\text{ V}, I_D = 10\text{ A}, T_J = 200\text{ °C}$ | | 220 | | |

Table 4. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|--|------------------------------------|------|------|------|
| C_{iss} | Input capacitance | $V_{DS} = 400\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$ | - | 650 | - | pF |
| C_{oss} | Output capacitance | | - | 65 | - | pF |
| C_{rSS} | Reverse transfer capacitance | | - | 14 | - | pF |
| Q_g | Total gate charge | $V_{DD} = 800\text{ V}, I_D = 10\text{ A}, V_{GS} = 0\text{ to }20\text{ V}$ | - | 45 | - | nC |
| Q_{gs} | Gate-source charge | | - | 7 | - | nC |
| Q_{gd} | Gate-drain charge | | - | 11.7 | - | nC |
| R_g | Gate input resistance | | $f=1\text{ MHz}, I_D = 0\text{ A}$ | - | 7 | - |

Table 5. Switching energy (inductive load)

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

Table 6. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|---------------------|---|------|------|------|------|
| $t_{d(on)V}$ | Turn-on delay time | $V_{DD} = 800\text{ V}$, $I_D = 10\text{ A}$, $R_G = 0\ \Omega$, $V_{GS} = 0\text{ to }20\text{ V}$ | - | 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 7. Reverse SiC diode characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|-------------------------------|---|------|------|------|------|
| V_{SD} | Diode forward voltage | $I_F = 5\text{ A}$, $V_{GS} = -5\text{ V}$ | - | 3.6 | - | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 10\text{ A}$, $V_{GS} = -5\text{ V}$, $V_R = 800\text{ V}$, $di/dt = 1650\text{ A}/\mu\text{s}$ | - | 15 | - | ns |
| Q_{rr} | Reverse recovery charge | | - | 75 | - | nC |
| I_{rrm} | Peak reverse recovery current | | - | 8 | - | A |

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

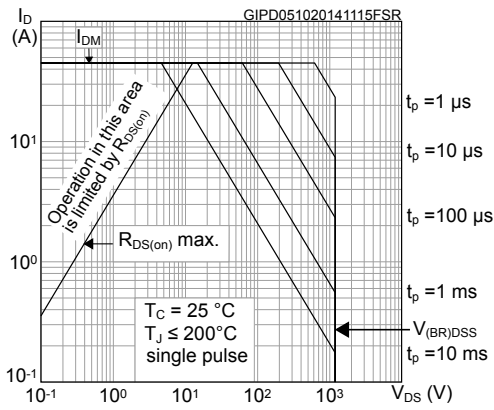


Figure 2. Maximum transient thermal impedance

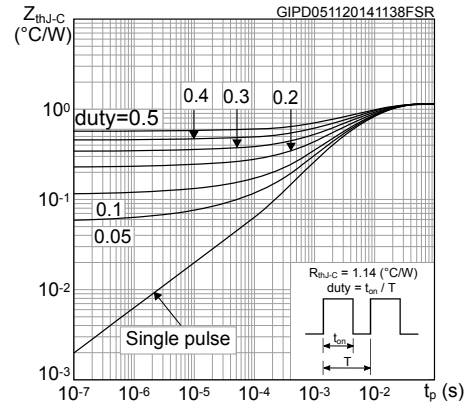


Figure 3. Output characteristics @ $T_J = 25 \text{ }^\circ\text{C}$

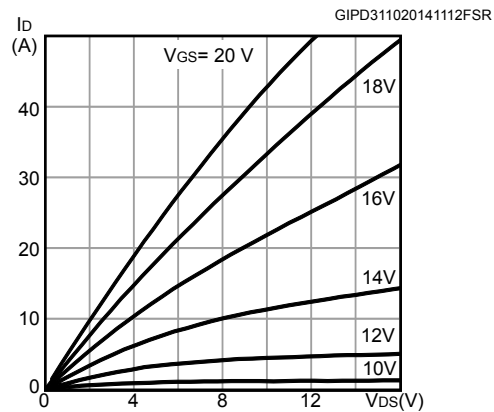


Figure 4. Output characteristics @ $T_J = 200 \text{ }^\circ\text{C}$

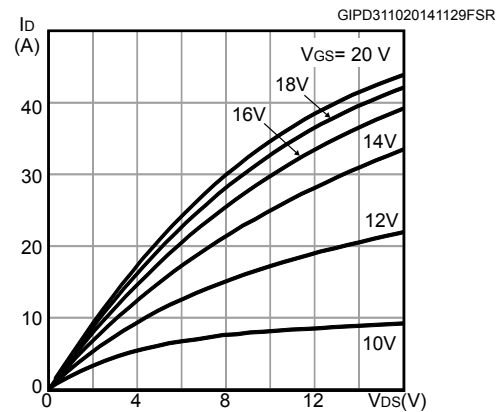


Figure 5. Transfer characteristics

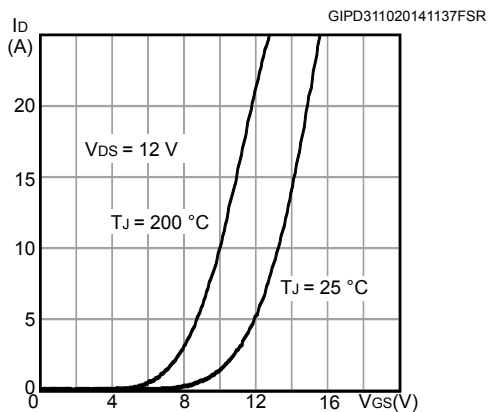


Figure 6. Body diode characteristics @ $T_J = -50 \text{ }^\circ\text{C}$

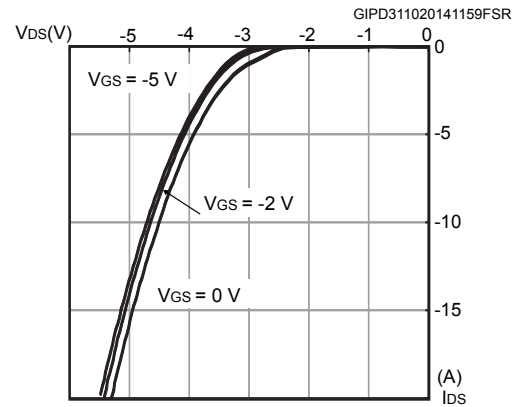


Figure 7. Body diode characteristics @ $T_J = 25\text{ }^\circ\text{C}$

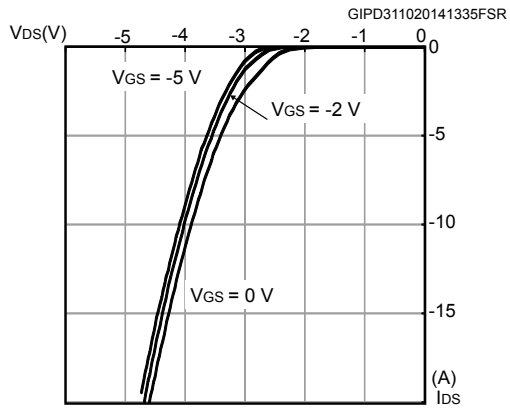


Figure 8. Body diode characteristics @ $T_J = 150\text{ }^\circ\text{C}$

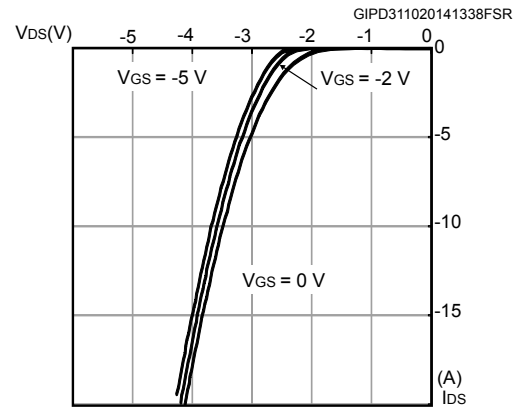


Figure 9. 3rd quadrant characteristics @ $T_J = -50\text{ }^\circ\text{C}$

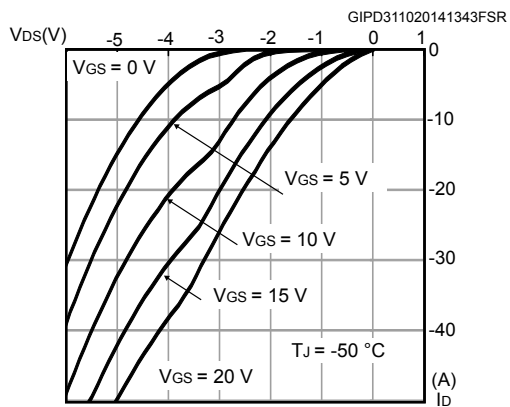


Figure 10. 3rd quadrant characteristics @ $T_J = 25\text{ }^\circ\text{C}$

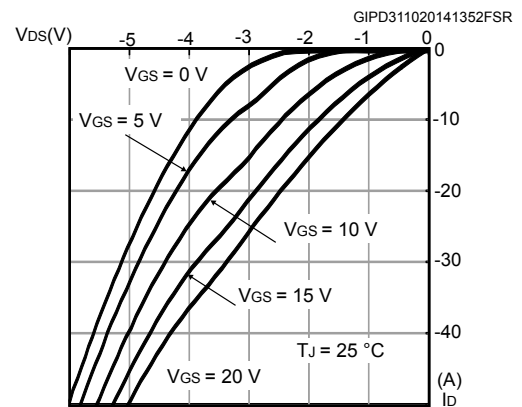


Figure 11. 3rd quadrant characteristics @ $T_J = 150\text{ }^\circ\text{C}$

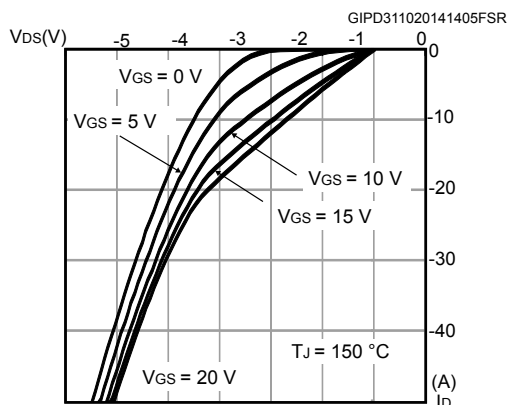


Figure 12. Normalized gate threshold vs. temperature

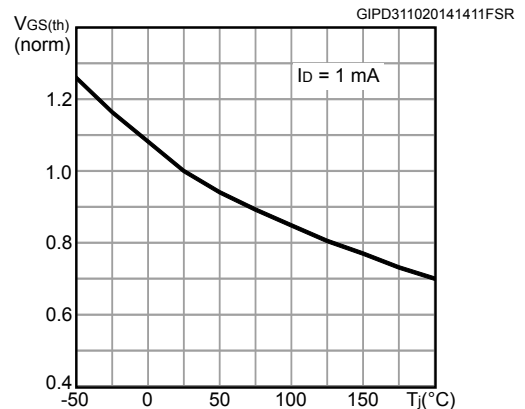


Figure 13. Normalized $R_{DS(on)}$ vs. temperature

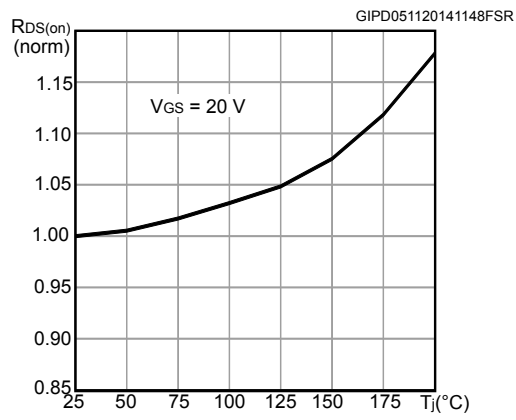
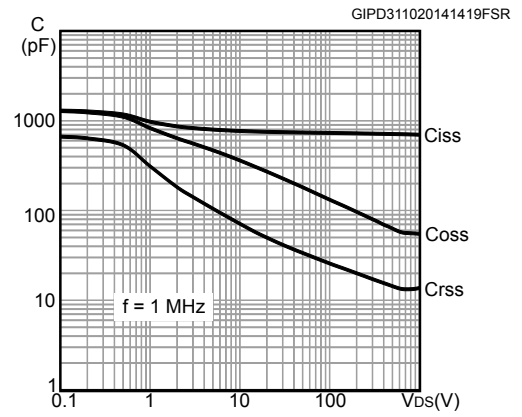
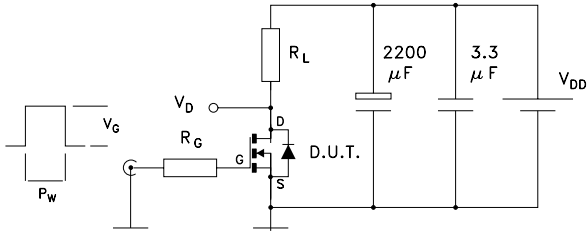


Figure 14. Capacitances variation



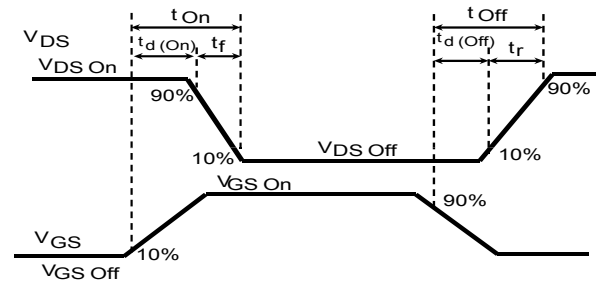
3 Test circuits

Figure 15. Switching test waveforms for transition times



GIPD101020141511FSR

Figure 16. Clamped inductive switching waveform



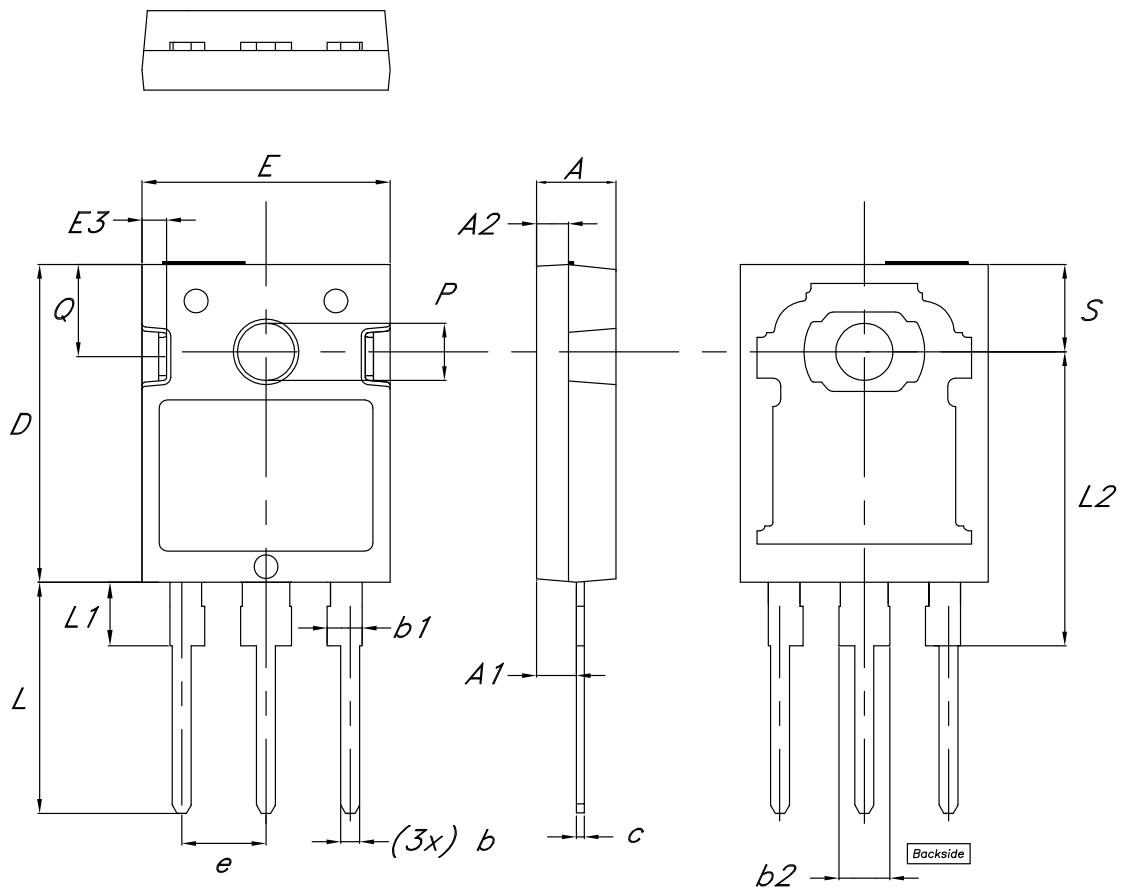
GIPD101020141502FSR

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 17. HiP247 package outline



8581091_2

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 |

Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 21-Mar-2018 | 1 | First release |
| 01-Mar-2019 | 2 | Updated <i>Table 3. On/off states</i> . Updated package information. |
| 21-Oct-2019 | 3 | Updated <i>Table 1. Absolute maximum ratings</i> , <i>Table 2. Thermal data</i> , <i>Figure 1. Safe operating area</i> and <i>Figure 2. Maximum transient thermal impedance</i> . Minor text changes. |

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