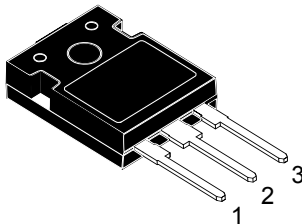
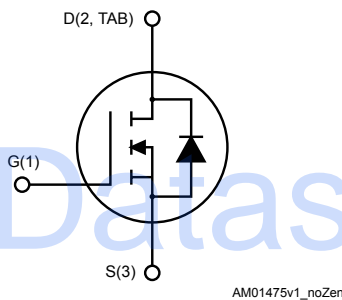



## Automotive-grade silicon carbide Power MOSFET 1200 V, 20 A, 189 mΩ (typ., $T_J=150\text{ °C}$ ), in an HiP247™ package


**HiP247™**


### Features

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

|                   |             |
|-------------------|-------------|
| <b>Order code</b> | SCT20N120AG |
| <b>Marking</b>    |             |
| <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 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 $T_C = 25\text{ °C}$     | 175        | 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     | °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   | $\mu\text{A}$ |
|               |                                   | $V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}, T_J = 200\text{ °C}$ |      | 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 $\Omega$    |
|               |                                   | $V_{GS} = 20\text{ V}, I_D = 10\text{ A}, T_J = 150\text{ °C}$     |      | 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  | -    | $\mu\text{J}$ |
| $E_{off}$ | Turn-off switching energy | $R_G = 6.8\ \Omega, V_{GS} = -2\text{ to }20\text{ V}$                      | -    | 90   | -    | $\mu\text{J}$ |
| $E_{on}$  | Turn-on switching energy  | $V_{DD} = 800\text{ V}, I_D = 10\text{ A}$                                  | -    | 165  | -    | $\mu\text{J}$ |
| $E_{off}$ | Turn-off switching energy | $R_G = 6.8\ \Omega, V_{GS} = -2\text{ to }20\text{ V}, T_J = 150\text{ °C}$ | -    | 100  | -    | $\mu\text{J}$ |

**Table 6. Switching times**

| Symbol        | Parameter           | Test conditions   | Min. | Typ. | Max. | Unit |
|---------------|---------------------|---|------|------|------|------|
| $t_{d(on)V}$  | Turn-on delay time  | $V_{DD} = 800\text{ V}$ , $I_D = 10\text{ A}$ , $R_G = 0\ \Omega$ ,<br>$V_{GS} = 0\text{ to }20\text{ V}$ | -    | 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         | $I_{SD} = 10\text{ A}$ , $V_{GS} = -5\text{ V}$ , $V_R = 800\text{ V}$ ,<br>$diff/dt = 1650\text{ A}/\mu\text{s}$ | -    | 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

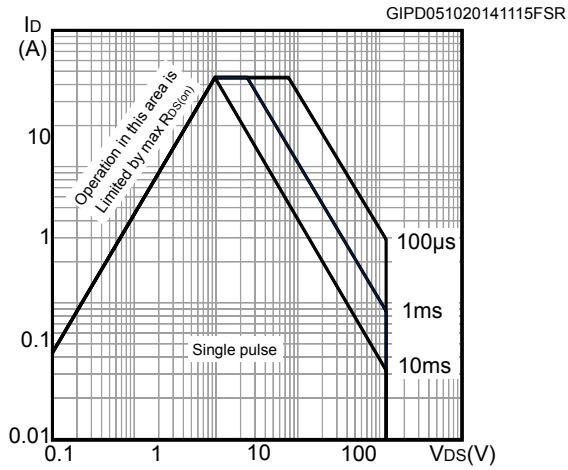


Figure 2. Thermal impedance

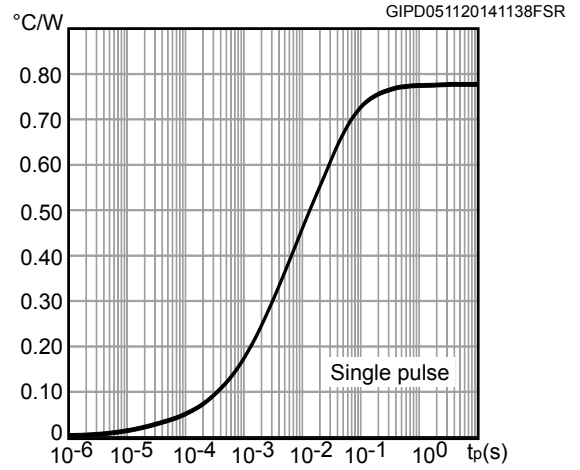


Figure 3. Output characteristics @  $T_J = 25\text{ }^\circ\text{C}$

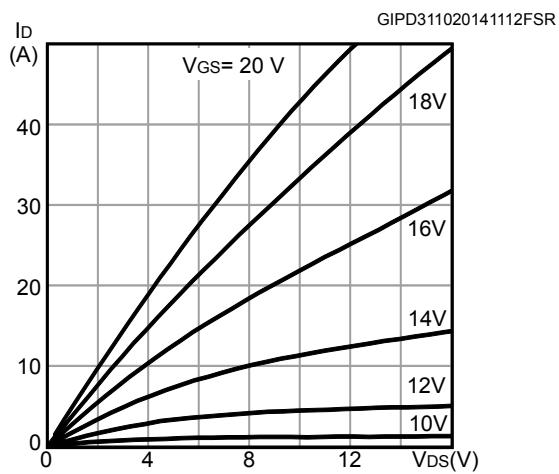


Figure 4. Output characteristics @  $T_J = 200\text{ }^\circ\text{C}$

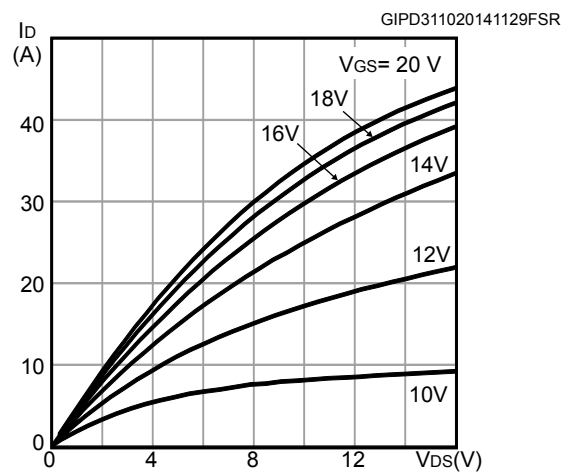


Figure 5. Transfer characteristics

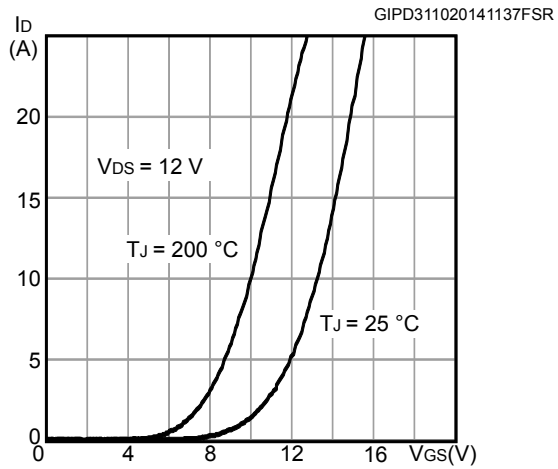


Figure 6. Body diode characteristics @  $T_J = -50 \text{ }^\circ\text{C}$

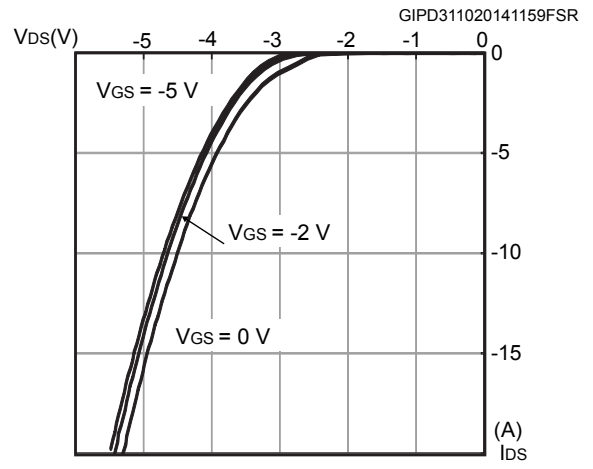


Figure 7. Body diode characteristics @  $T_J = 25 \text{ }^\circ\text{C}$

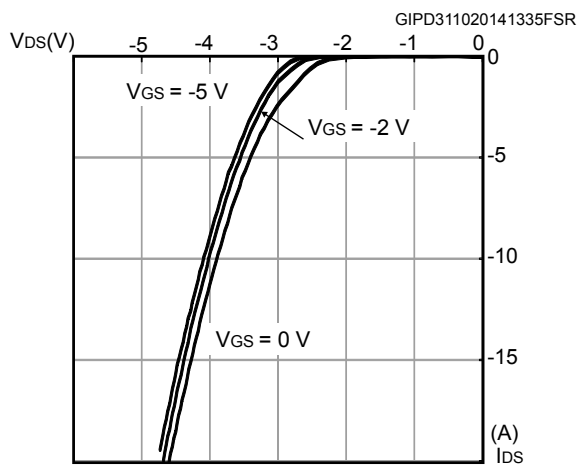


Figure 8. Body diode characteristics @  $T_J = 150 \text{ }^\circ\text{C}$

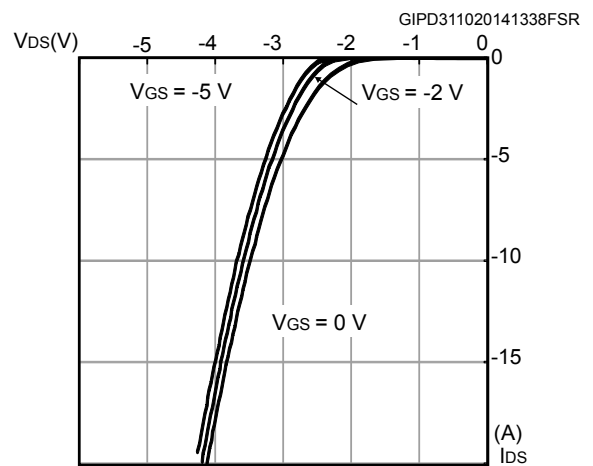


Figure 9. 3<sup>rd</sup> quadrant characteristics @  $T_J = -50 \text{ }^\circ\text{C}$

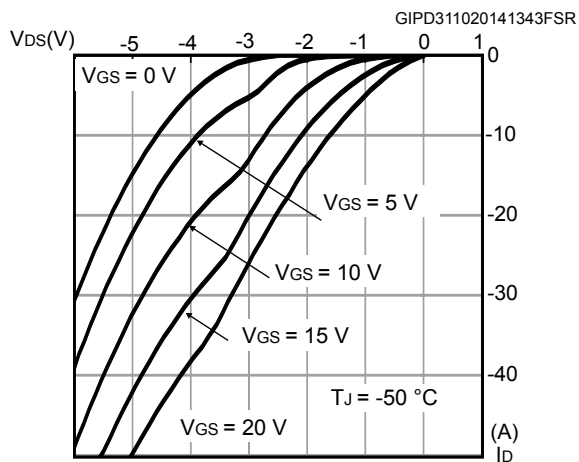
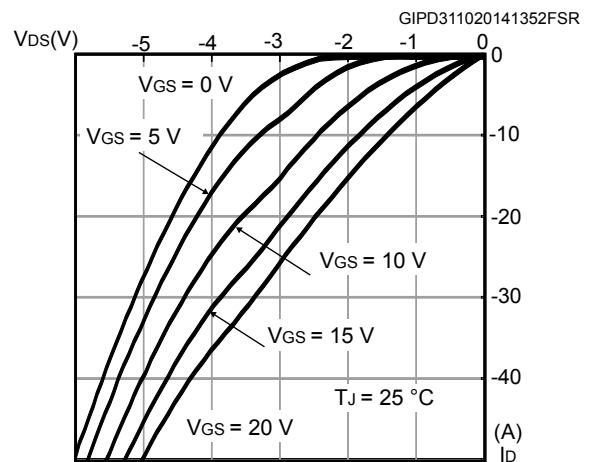
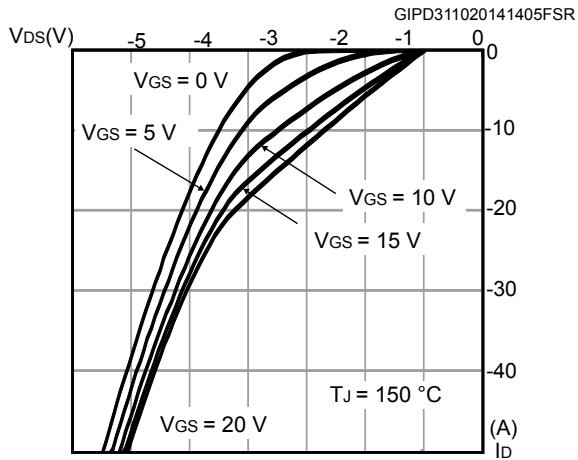


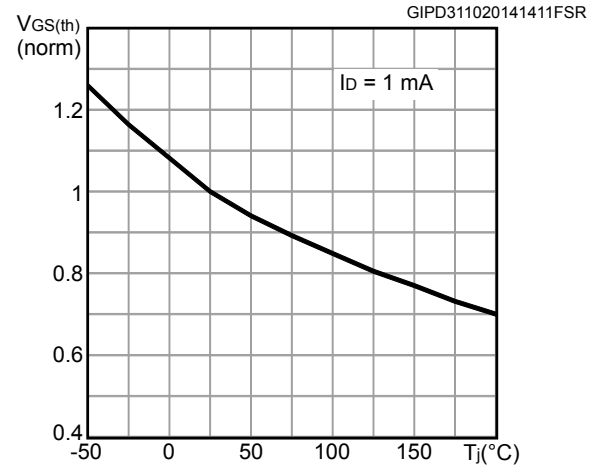
Figure 10. 3<sup>rd</sup> quadrant characteristics @  $T_J = 25 \text{ }^\circ\text{C}$



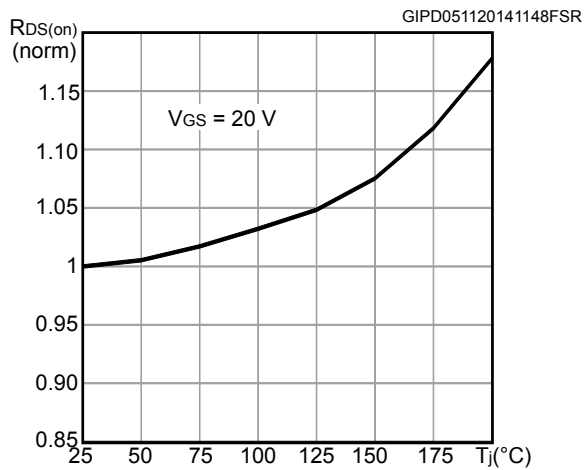
**Figure 11. 3<sup>rd</sup> quadrant characteristics @  $T_J = 150\text{ }^\circ\text{C}$**



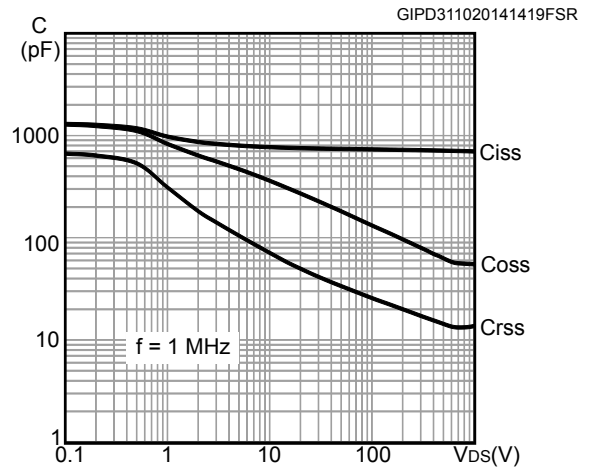
**Figure 12. Normalized  $V_{TH}$  vs. temperature**



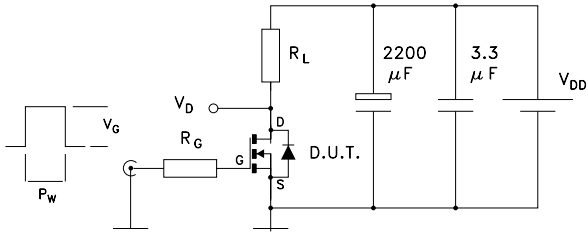
**Figure 13. Normalized  $R_{DS(on)}$  vs. temperature**



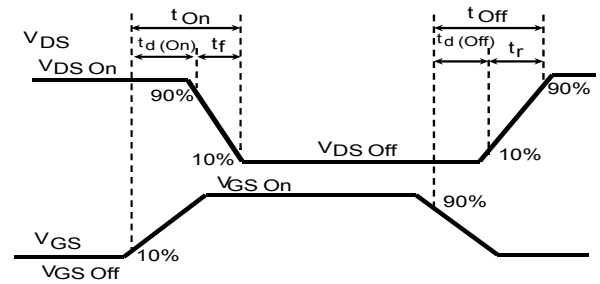
**Figure 14. Capacitances variation**



### 3 Test circuits

**Figure 15. Switching test waveforms for transition times**


GIPD101020141511FSR

**Figure 16. Clamped inductive switching waveform**


GIPD101020141502FSR

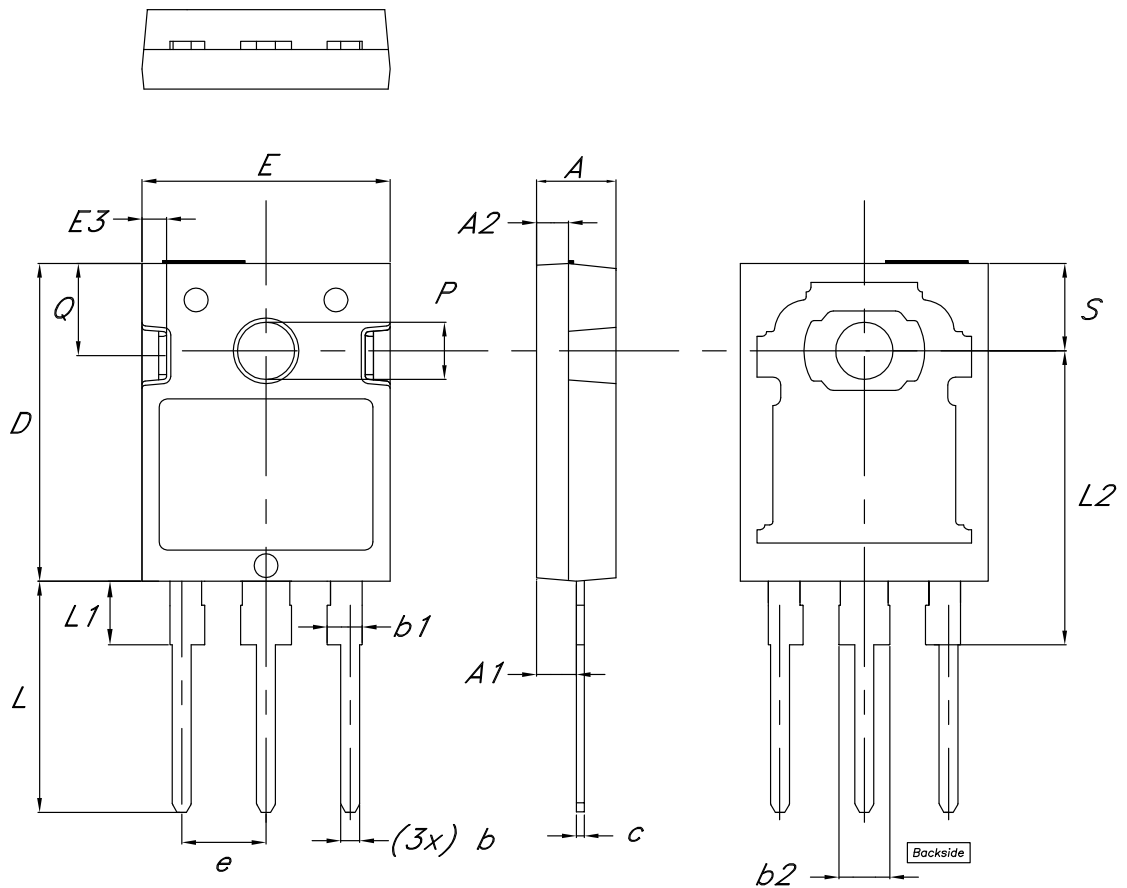


## 4 Package information

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](http://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 <a href="#">Table 3. On/off states</a> . Updated package information. |

## Contents

|            |  |           |
|------------|--|-----------|
| <b>1</b>   | <b>Electrical ratings</b> .....                  | <b>2</b>  |
| <b>2</b>   | <b>Electrical characteristics</b> .....          | <b>3</b>  |
| <b>2.1</b> | <b>Electrical characteristics (curves)</b> ..... | <b>5</b>  |
| <b>3</b>   | <b>Test circuits</b> .....                       | <b>8</b>  |
| <b>4</b>   | <b>Package information</b> .....                 | <b>9</b>  |
| <b>4.1</b> | <b>HiP247 package information</b> .....          | <b>9</b>  |
|            | <b>Revision history</b> .....                    | <b>11</b> |

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