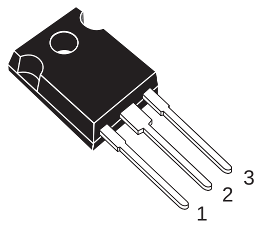
# SCT30N120

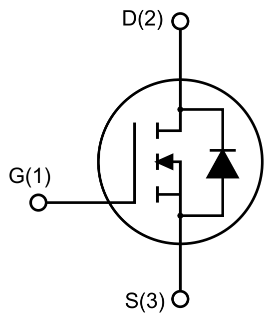
## Silicon carbide Power MOSFET: 45 A, 1200 V, 90 mΩ (typ., $T_J$=150 °C), N-channel in HiP247™

**Datasheet - production data**




**HiP247™**

**Figure 1. Internal schematic diagram**




## Features

- Very tight variation of on-resistance vs. temperature
- Slight variation of switching losses vs. temperature
- Very high operating temperature capability (200 °C)
- Very fast and robust intrinsic body diode
- Low capacitance
- Easy to drive

## Applications

- Solar inverters, UPS
- Motor drives
- High voltage DC-DC converters
- Switch mode power supply

## 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.

**Table 1. Device summary**

| Order code | Marking | Package | Packaging |
|---|---|---|---|
| SCT30N120 | SCT30N120 | HiP247™ | Tube |

*Note: The device meets ECOPACK standards, an environmentally-friendly grade of products commonly referred to as "halogen-free". See Section 3: Package mechanical data.*

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-source voltage | 1200 | V |
| $V_{GS}$ | Gate-source voltage | -10/+25 | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C (limited by die) | 45 | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C (limited by package) | 40 | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100 °C | 34 | A |
| $I_{DM}$ (1) | Drain current (pulsed) | 90 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 270 | W |
| $T_{stg}$ | Storage temperature | -55 to 200 | °C |
| $T_j$ | Operating junction temperature | | °C |

1. Pulse width limited by safe operating area.

**Table 3. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| Rthj-case | Thermal resistance junction-case max | 0.65 | °C/W |
| Rthj-amb | Thermal resistance junction-ambient max | 40 | °C/W |

# 2 Electrical characteristics

($T_{CASE}$ = 25 °C unless otherwise specified).

**Table 4. On/off states**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{DSS}$ | Zero gate voltage drain current ($V_{GS}$ = 0) | $V_{DS}$ = 1200 V<br>$V_{DS}$ = 1200 V, $T_J$ = 200 °C | | 1<br>50 | 100 | µA<br>µA |
| $I_{GSS}$ | Gate-body leakage current ($V_{DS}$ = 0) | $V_{GS}$ = +22 / -10 V | | | 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 1 mA | 1.8 | 3.5 | | V |
| $R_{DS(on)}$ | Static drain-source on- resistance | $V_{GS}$ = 20 V, $I_D$ = 20 A | | 80 | 100 | mΩ |
| | | $V_{GS}$ = 20 V, $I_D$ = 20 A, $T_J$ = 150 °C | | 90 | | mΩ |
| | | $V_{GS}$ = 20 V, $I_D$ = 20 A, $T_J$ = 200 °C | | 100 | | mΩ |

**Table 5. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 400 V, f = 1 MHz, $V_{GS}$ = 0 | - | 1700 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 130 | - | pF |
| $C_{rss}$ | Reverse transfer capacitance | | - | 25 | - | pF |
| $Q_g$ | Total gate charge | $V_{DD}$ = 800 V, $I_D$ = 20 A, $V_{GS}$ = 0 / 20 V | - | 105 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 16 | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 40 | - | nC |
| $R_g$ | Gate input resistance | f=1 MHz open drain | - | 5 | - | Ω |

**Table 6. Switching energy (inductive load)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $E_{on}$ | Turn-on switching losses | $V_{DD}$ = 800 V, $I_D$ = 20 A<br>$R_G$= 6.8 Ω, $V_{GS}$ = -2/20 V | - | 500 | - | µJ |
| $E_{off}$ | Turn-off switching losses | | - | 350 | - | µJ |
| $E_{on}$ | Turn-on switching losses | $V_{DD}$ = 800 V, $I_D$ = 20 A<br>$R_G$= 6.8 Ω, $V_{GS}$ = -2/20 V<br>$T_J$= 150 °C | - | 500 | - | µJ |
| $E_{off}$ | Turn-off switching losses | | - | 400 | - | µJ |

**Table 7. Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)V}$ | Turn-on delay time | $V_{DD}$ = 800 V, $I_D$ = 20 A,<br>$R_G$ = 0 Ω, $V_{GS}$ = 0/20 V | - | 19 | - | ns |
| $t_{f(V)}$ | Fall time | | - | 28 | - | ns |
| $t_{d(off)V}$ | Turn-off delay time | | - | 45 | - | ns |
| $t_{r(V)}$ | Rise time | | - | 20 | - | ns |

**Table 8. Reverse SiC diode characteristics**

| Symbol | Parameter | Test conditions | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{SD}$ | Diode forward voltage | $I_F$ = 10 A, $V_{GS}$ = 0 | - | 3.5 | - | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 20 A, di/dt = 100 A/µs<br>$V_{DD}$ = 800 V | - | 140 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 140 | - | nC |
| $I_{RRM}$ | Reverse recovery current | | - | 2 | - | A |

## 2.1 Electrical characteristics (curves)

**Figure 2. Safe operating area**

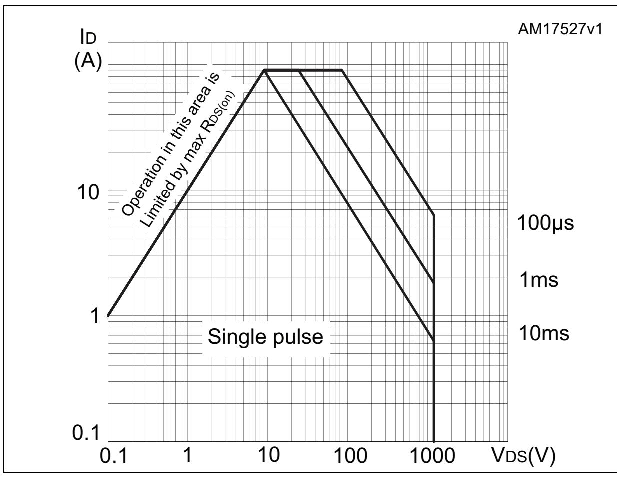



**Figure 3. Thermal impedance**

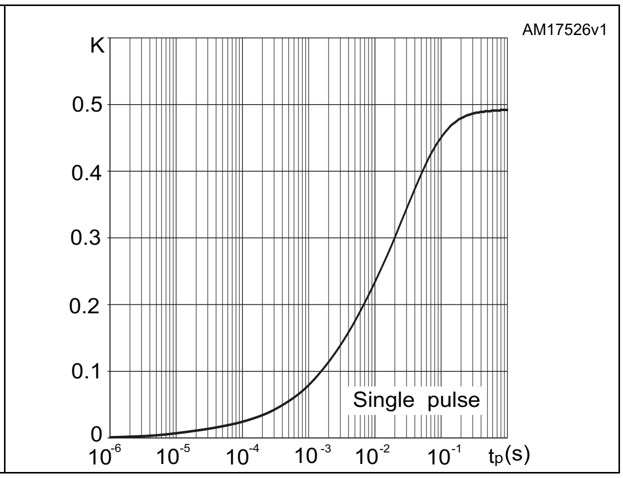



**Figure 4. Output characteristics ($T_J$=25°C)**

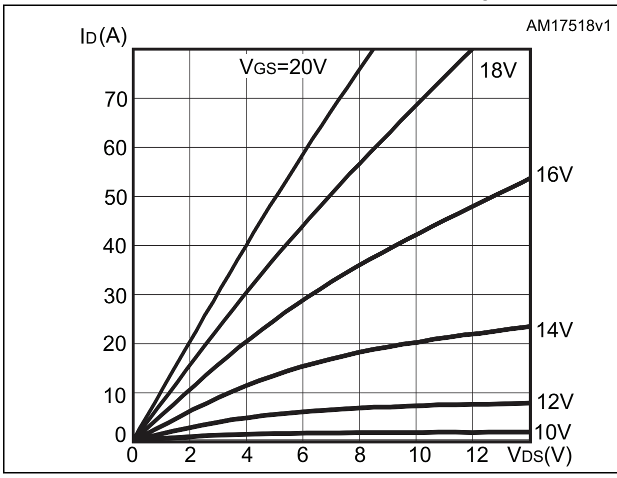



**Figure 5. Output characteristics ($T_J$=150°C)**

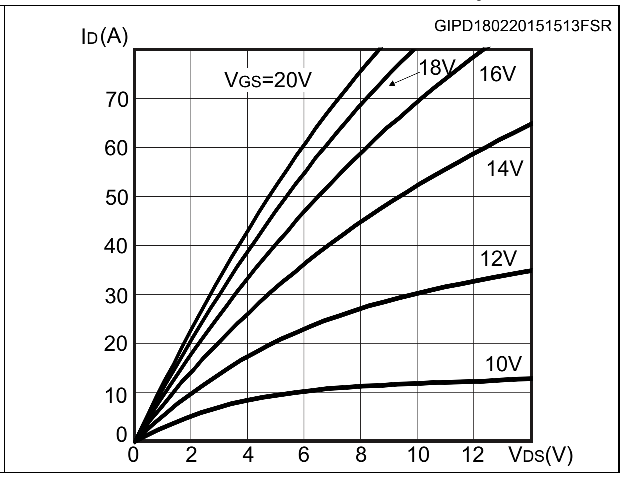



**Figure 6. Output characteristics ($T_J$=200°C)**

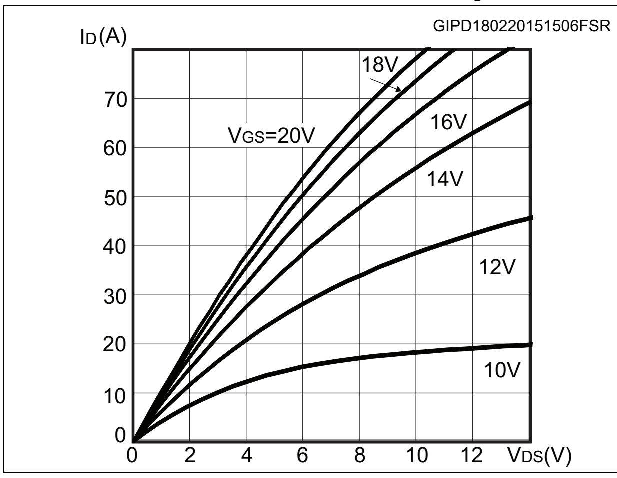



**Figure 7. Transfer characteristics**

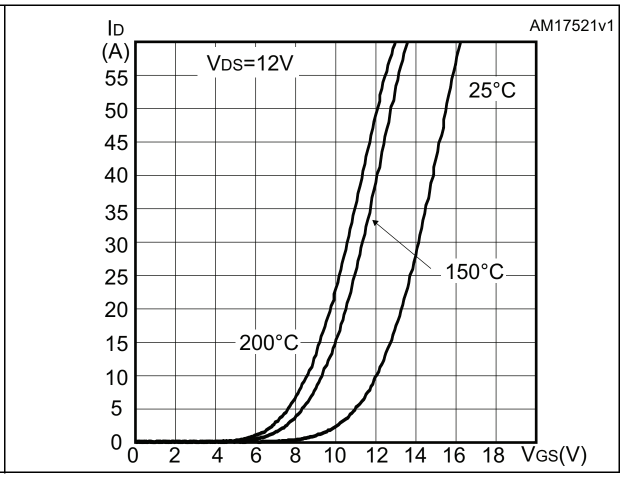


**Figure 8. Power dissipation**

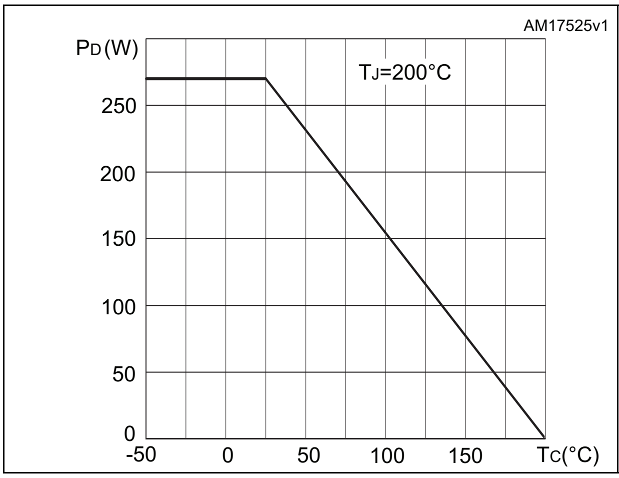



**Figure 9. Gate charge vs gate-source voltage**

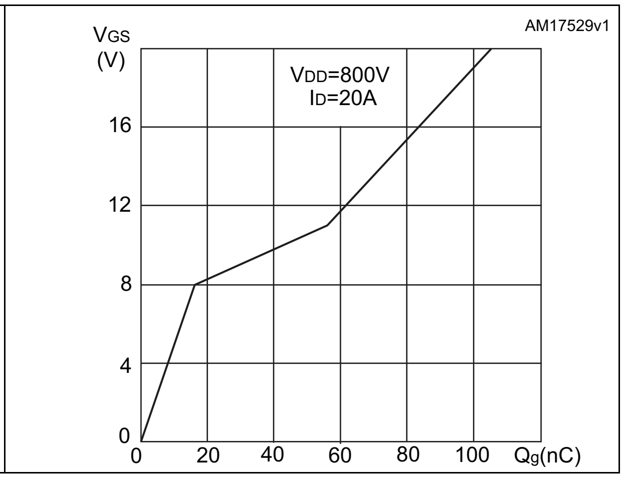



**Figure 10. Capacitance variations**

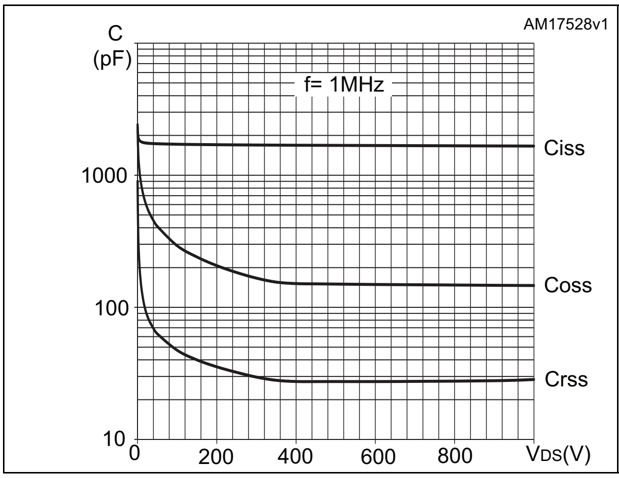



**Figure 11. Switching energy vs. drain current**

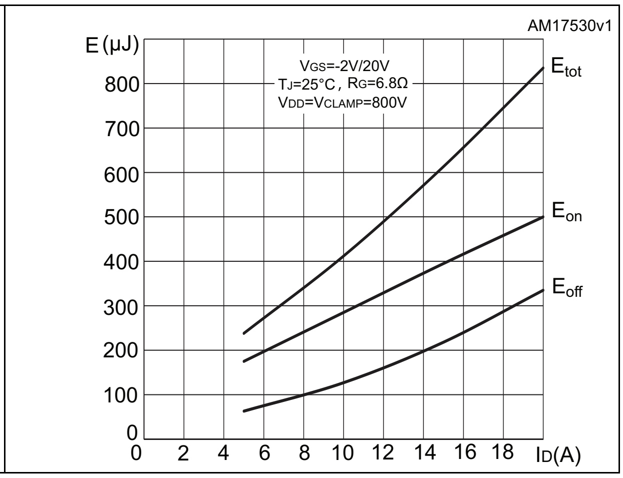



**Figure 12. Switching energy vs. junction temperature**

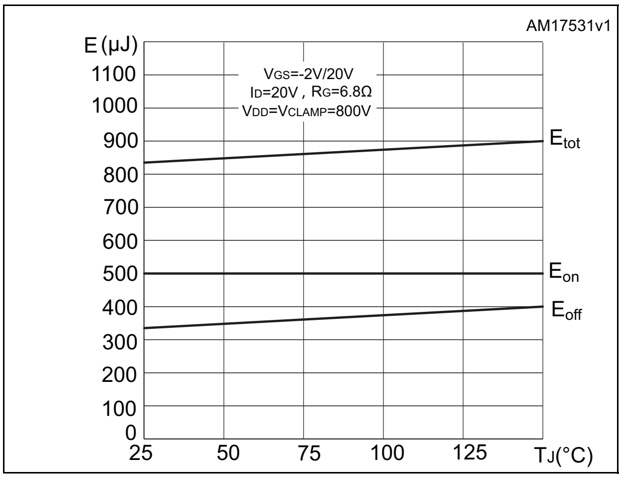



**Figure 13. Normalized $V_{(BR)DSS}$ vs. temperature**

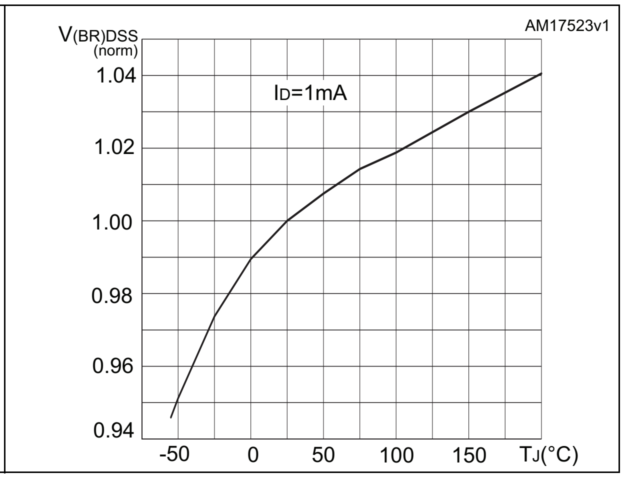


**Figure 14. Normalized gate threshold voltage vs. temperature**

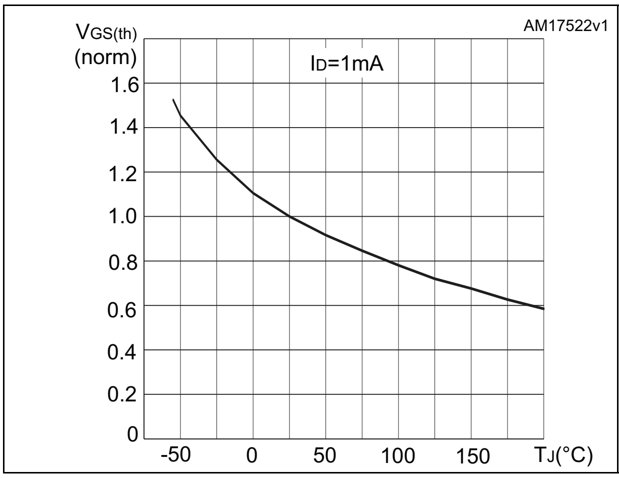



**Figure 15. Normalized on-resistance vs. temperature**

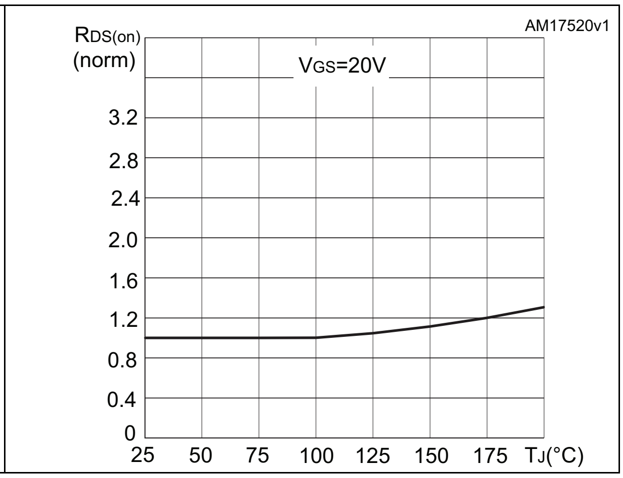



**Figure 16. Body diode characteristics ($T_J$=-50°C)**

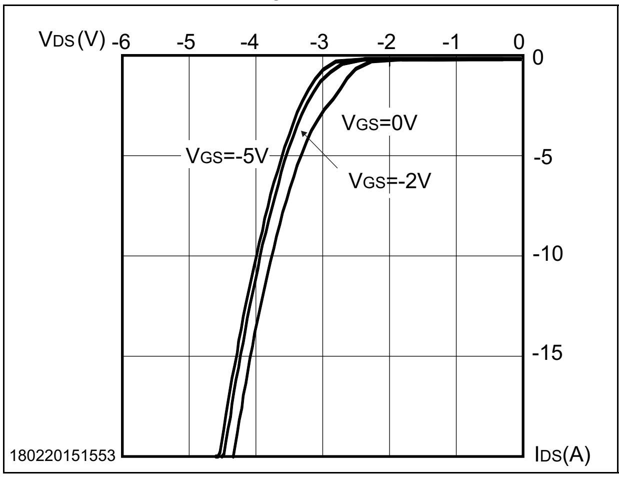



**Figure 17. Body diode characteristics ($T_J$=25°C)**

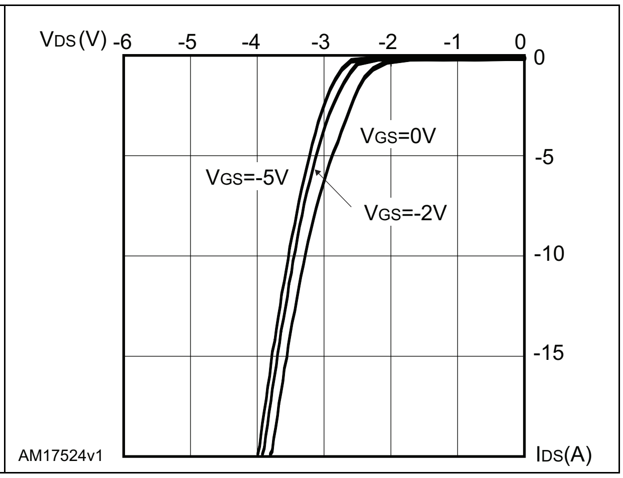



**Figure 18. Body diode characteristics ($T_J$=150°C)**

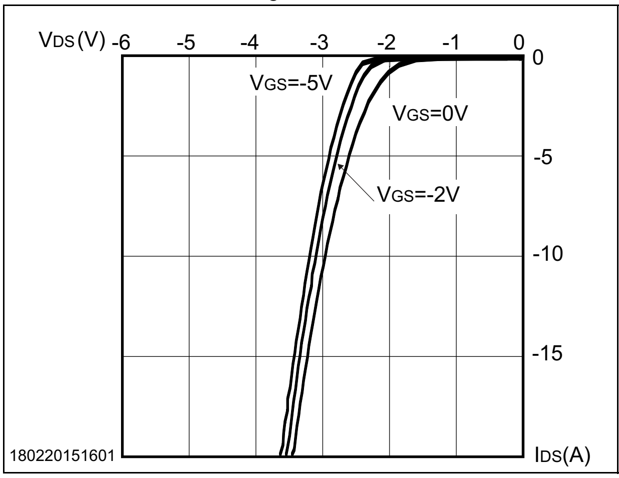



**Figure 19. 3rd quadrant characteristics ($T_J$=-50°C)**

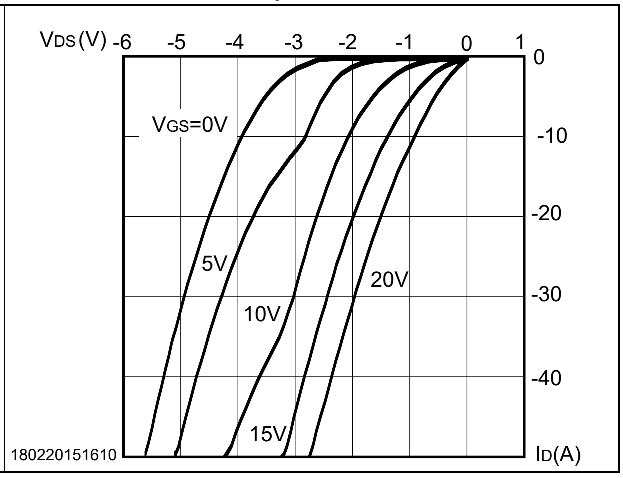


**Figure 20. 3rd quadrant characteristics ($T_J$=25°C)**

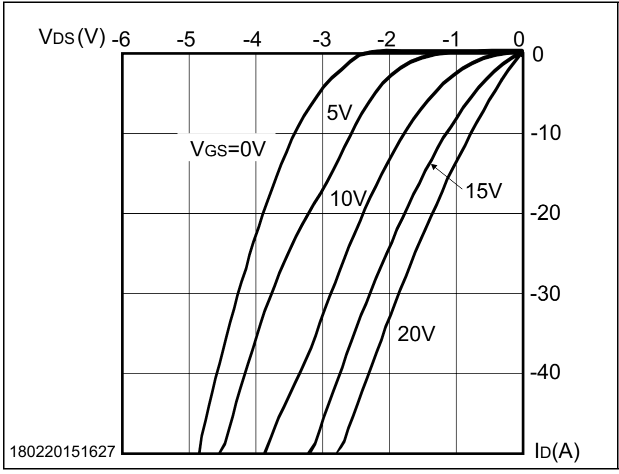
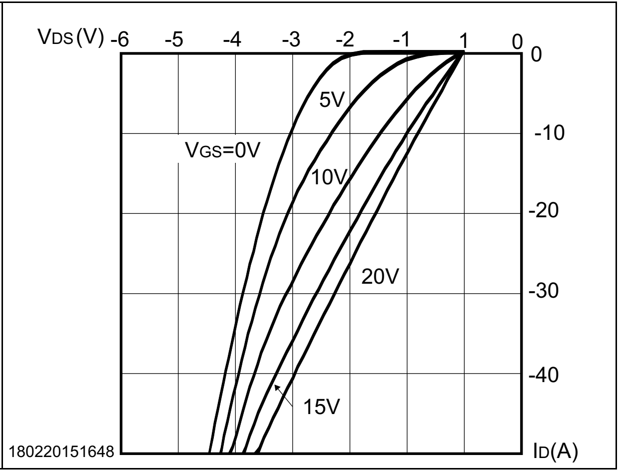



**Figure 21. 3rd quadrant characteristics ($T_J$=150°C)**



# 3 Package mechanical data

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.

**Figure 22. HiP247™ outline**

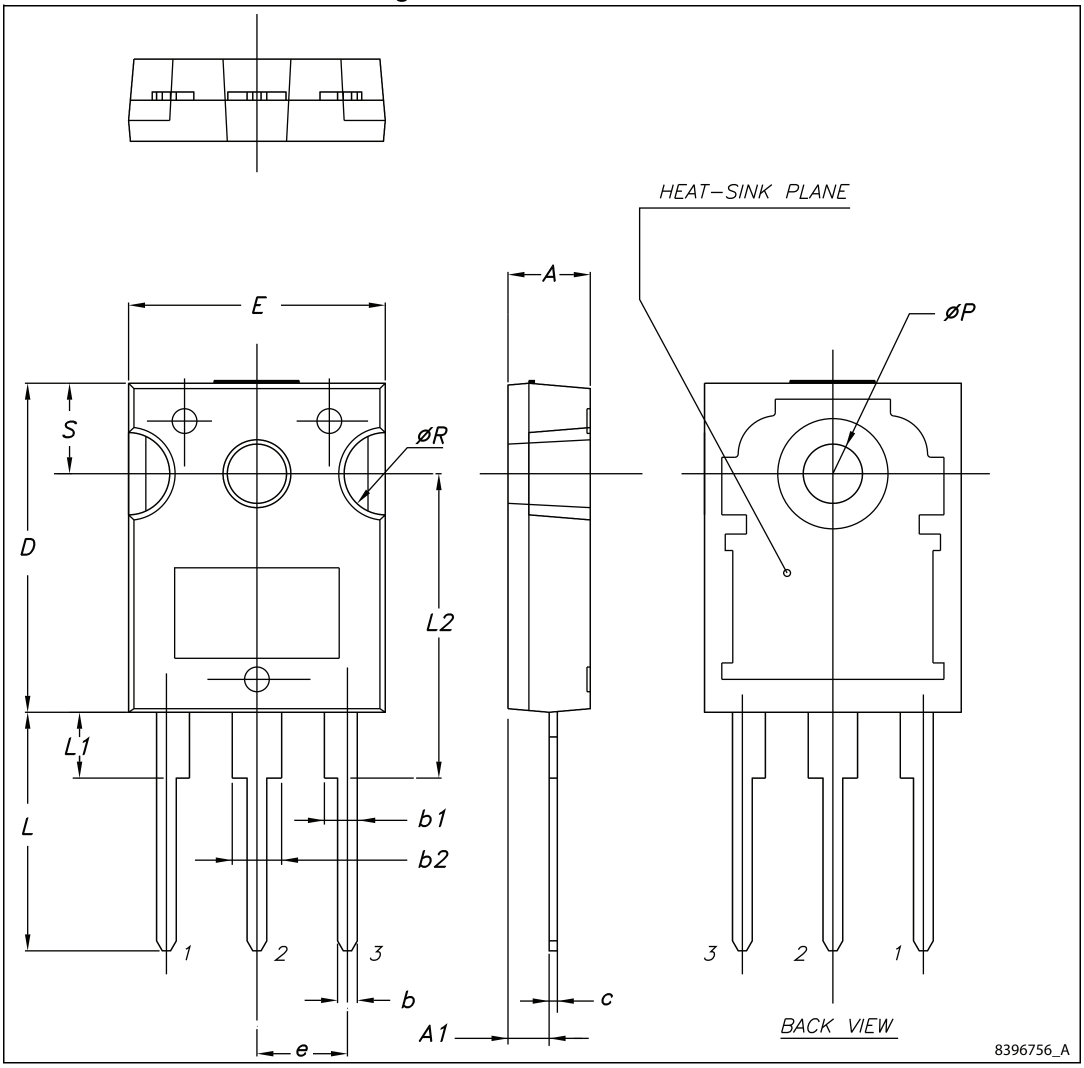


**Table 9. HiP247™ mechanical data**

| Dim. | mm. | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.85 | | 5.15 |
| A1 | 2.20 | | 2.60 |
| b | 1.0 | | 1.40 |
| b1 | 2.0 | | 2.40 |
| b2 | 3.0 | | 3.40 |
| c | 0.40 | | 0.80 |
| D | 19.85 | | 20.15 |
| E | 15.45 | | 15.75 |
| e | 5.30 | 5.45 | 5.60 |
| L | 14.20 | | 14.80 |
| L1 | 3.70 | | 4.30 |
| L2 | | 18.50 | |
| ∅P | 3.55 | | 3.65 |
| ∅R | 4.50 | | 5.50 |
| S | 5.30 | 5.50 | 5.70 |

# 4 Revision history

**Table 10. Document revision history**

| Date | Revision | Changes |
| --- | --- | --- |
| 10-May-2012 | 1 | First release |
| 21-May-2013 | 2 | Updated $t_{rr}$ value in *Table 8*.<br>Updated dynamic parameters in *Table 5*, $V_{GS(th)}$ in *Table 4* and $E_{on}$ in *Table 6*. |
| 24-Jun-2013 | 3 | Document status promoted from target to preliminary data.<br>Added: *Section 2.1: Electrical characteristics (curves)* |
| 11-Jul-2013 | 4 | Updated *Figure 6: Output characteristics ($T_J$=200°C)* and *Figure 7: Transfer characteristics*. |
| 18-Dec-2013 | 5 | Updated parameters in *Table 2: Absolute maximum ratings* and *Table 4: On/off states*. |
| 27-May-2014 | 6 | Added *Table 7: Switching times*.<br>Updated *Section 3: Package mechanical data*.<br>Minor text changes. |
| 25-Sep-2014 | 7 | Document status promoted from preliminary to production data. |
| 17-Feb-2015 | 8 | Updated title in cover page. |
| 20-Feb-2015 | 9 | Updated *Section 2.1: Electrical characteristics (curves)*. |

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