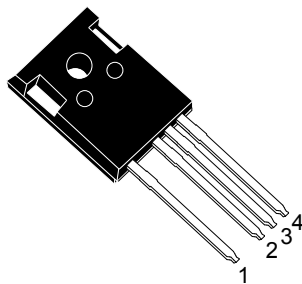
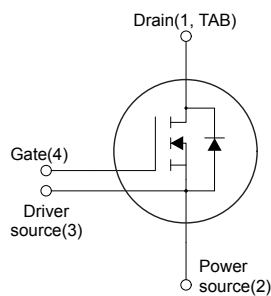


## Automotive-grade silicon carbide Power MOSFET 1200 V, 45 mΩ typ., 52 A in an HiP247-4 package



**HiP247-4**


ND1TPS2DS3G4



### Features

| Order code       | $V_{DS}$ | $R_{DS(on)}$ max. | $I_D$ |
|------------------|----------|-------------------|-------|
| SCTWA60N12G2-4AG | 1200 V   | 58 mΩ             | 52 A  |

- AEC-Q101 qualified 
- Very fast and robust intrinsic body diode
- Extremely low gate charge and input capacitance
- Very high operating junction temperature capability ( $T_J = 200\text{ °C}$ )
- Source sensing pin for increased efficiency

### 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 2<sup>nd</sup> 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

[SCTWA60N12G2-4AG](#)

#### Product summary

|                   |                  |
|-------------------|------------------|
| <b>Order code</b> | SCTWA60N12G2-4AG |
| <b>Marking</b>    | SCT60N120G2AG    |
| <b>Package</b>    | HiP247-4         |
| <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 22  | V    |
|                | Gate-source voltage (recommended operational values) | -5 to 18   |      |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ °C}$   | 52         | A    |
|                | Drain current (continuous) at $T_C = 100\text{ °C}$  | 39         |      |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                               | 156        | A    |
| $P_{TOT}$      | Total power dissipation at $T_C = 25\text{ °C}$      | 388        | W    |
| $T_{stg}$      | Storage temperature range                            | -55 to 200 | °C   |
| $T_J$          | Operating junction temperature range                 |            | °C   |

1. Pulse width is limited by safe operating area.

**Table 2. Thermal data**

| Symbol     | Parameter                               | Value | Unit |
|------------|---|-------|------|
| $R_{thJC}$ | Thermal resistance, junction-to-case    | 0.45  | °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   | $V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}$                              |      |      | 10        | $\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current         | $V_{DS} = 0\text{ V}, V_{GS} = -10\text{ to }22\text{ V}$                  |      |      | $\pm 100$ | nA            |
| $V_{GS(th)}$  | Gate threshold voltage            | $V_{DS} = V_{GS}, I_D = 1\text{ mA}$                                       | 1.9  | 3.1  | 5.0       | V             |
| $R_{DS(on)}$  | Static drain-source on-resistance | $V_{GS} = 18\text{ V}, I_D = 30\text{ A}$                                  |      | 45   | 58        | m $\Omega$    |
|               |                                   | $V_{GS} = 18\text{ V}, I_D = 30\text{ A}, T_J = 200\text{ }^\circ\text{C}$ |      | 113  |           |               |

**Table 4. Dynamic**

| Symbol    | Parameter                    | Test conditions   | Min. | Typ. | Max. | Unit     |
|-----------|------------------------------|---|------|------|------|----------|
| $C_{iss}$ | Input capacitance            | $V_{DS} = 800\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$                | -    | 2086 | -    | pF       |
| $C_{oss}$ | Output capacitance           |   | -    | 90   | -    | pF       |
| $C_{rss}$ | Reverse transfer capacitance |   | -    | 18   | -    | pF       |
| $R_g$     | Gate input resistance        | $f = 1\text{ MHz}, I_D = 0\text{ A}$  | -    | 1    | -    | $\Omega$ |
| $Q_g$     | Total gate charge            | $V_{DS} = 800\text{ V}, V_{GS} = -5\text{ to }18\text{ V}, I_D = 30\text{ A}$ | -    | 101  | -    | nC       |
| $Q_{gs}$  | Gate-source charge           |   | -    | 36   | -    | nC       |
| $Q_{gd}$  | Gate-drain charge            |   | -    | 23   | -    | nC       |

**Table 5. Switching energy (inductive load)**

| Symbol    | Parameter                 | Test conditions  | Min. | Typ. | Max. | Unit          |
|-----------|---------------------------|--|------|------|------|---------------|
| $E_{on}$  | Turn-on switching energy  | $V_{DD} = 800\text{ V}, I_D = 30\text{ A}$                     | -    | 490  | -    | $\mu\text{J}$ |
| $E_{off}$ | Turn-off switching energy | $R_G = 4.7\text{ }\Omega, V_{GS} = -5\text{ V to }18\text{ V}$ | -    | 97   | -    | $\mu\text{J}$ |

**Table 6. Switching times**

| Symbol       | Parameter           | Test conditions   | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 800\text{ V}, I_D = 30\text{ A},$<br>$R_G = 2.2\text{ }\Omega, V_{GS} = -5\text{ to }18\text{ V}$ | -    | 12   | -    | ns   |
| $t_r$        | Rise time           |   | -    | 12   | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |   | -    | 24   | -    | ns   |
| $t_f$        | Fall time           |   | -    | 10   | -    | ns   |

**Table 7. Reverse SiC diode characteristics**

| Symbol    | Parameter                | Test conditions   | Min. | Typ. | Max. | Unit |
|-----------|--------------------------|---|------|------|------|------|
| $V_{SD}$  | Diode forward voltage    | $I_{SD} = 30\text{ A}$ , $V_{GS} = 0\text{ V}$  | -    | 3.5  | -    | V    |
| $t_{rr}$  | Reverse recovery time    | $I_{SD} = 30\text{ A}$ , $V_{GS} = 0\text{ V}$ ,<br>$di/dt = 2000\text{ A}/\mu\text{s}$ , $V_{DD} = 800\text{ V}$ | -    | 57   | -    | ns   |
| $Q_{rr}$  | Reverse recovery charge  |   | -    | 238  | -    | nC   |
| $I_{RRM}$ | Reverse recovery current |   | -    | 17   | -    | A    |

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

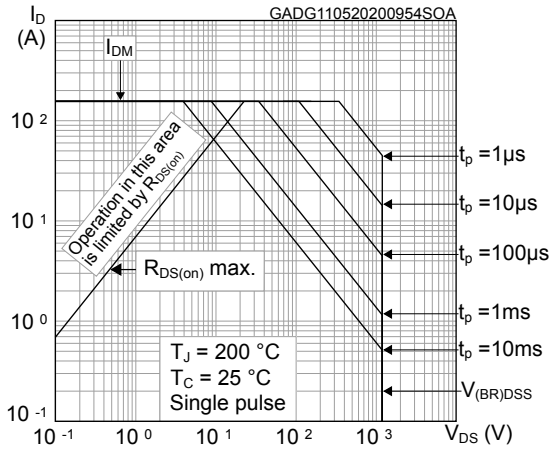


Figure 2. Maximum transient thermal impedance

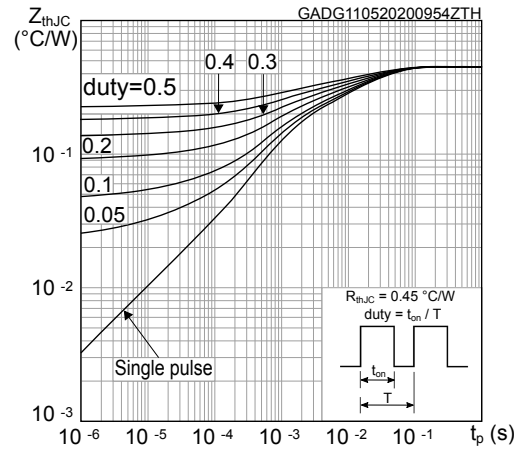


Figure 3. Typical output characteristics ( $T_J = 25\text{ °C}$ )

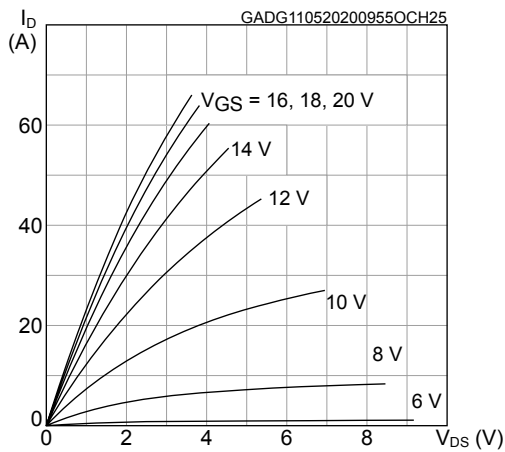


Figure 4. Typical output characteristics ( $T_J = 200\text{ °C}$ )

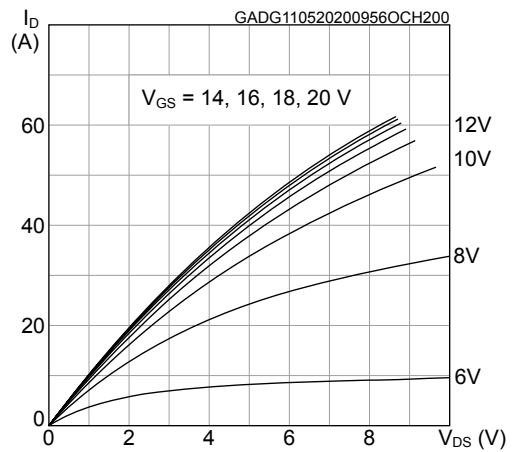


Figure 5. Typical transfer characteristics

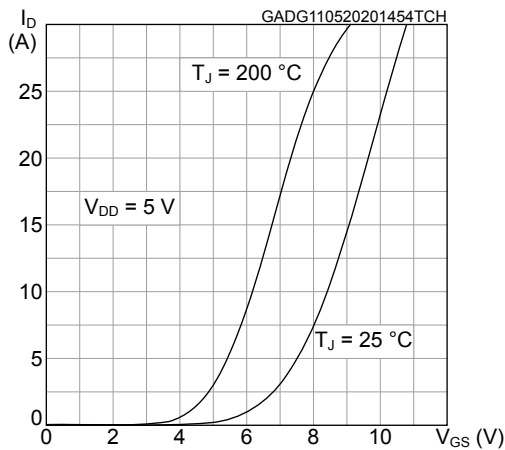
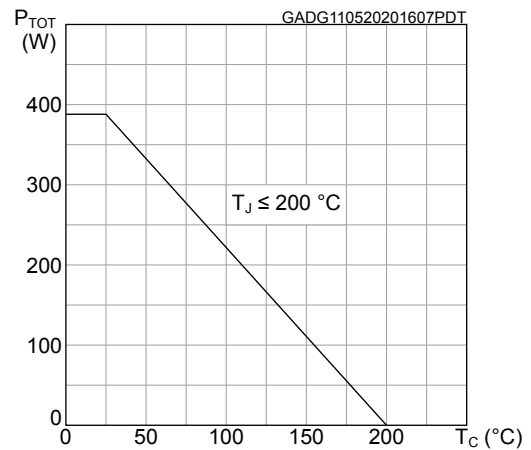
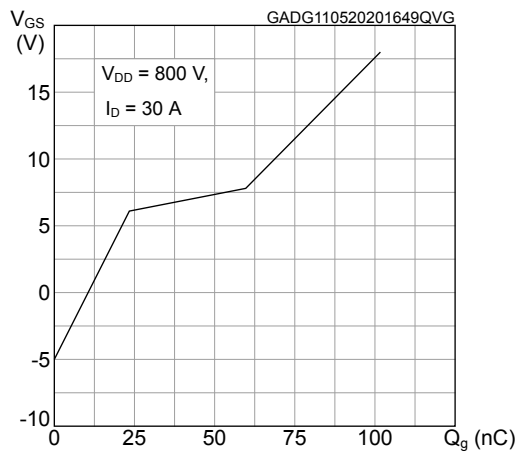


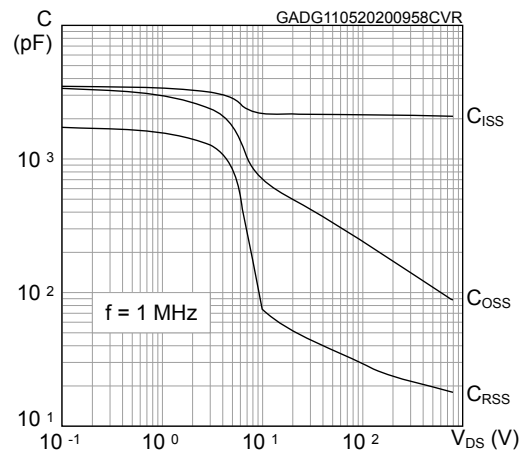
Figure 6. Total power dissipation



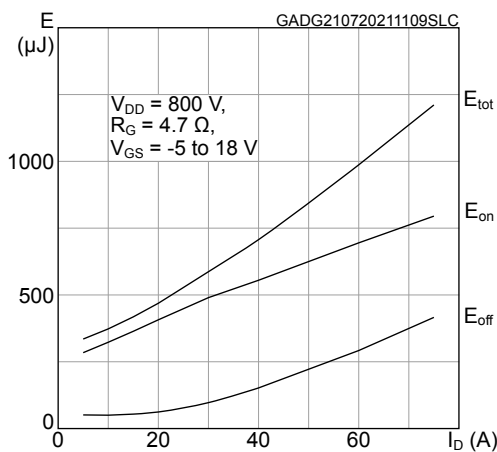
**Figure 7. Typical gate charge characteristics**



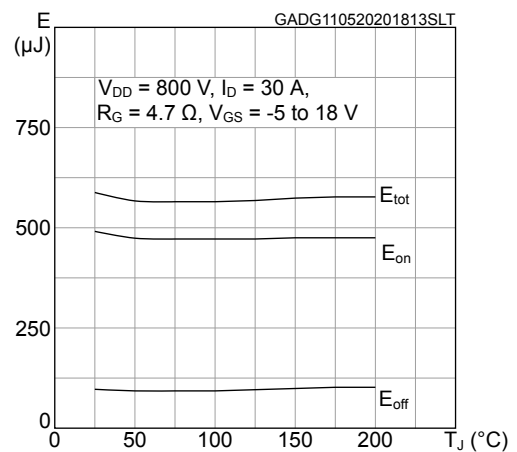
**Figure 8. Typical capacitance characteristics**



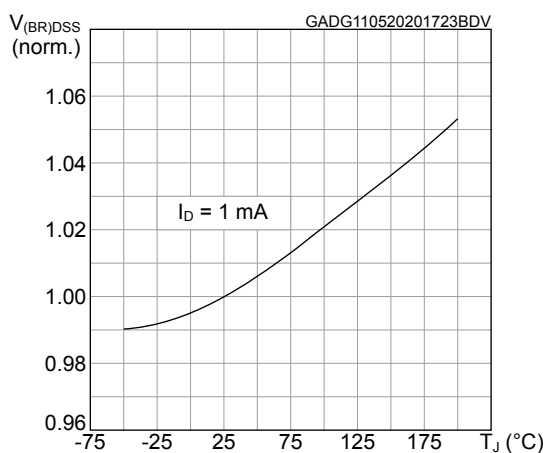
**Figure 9. Typical switching energy vs drain current**



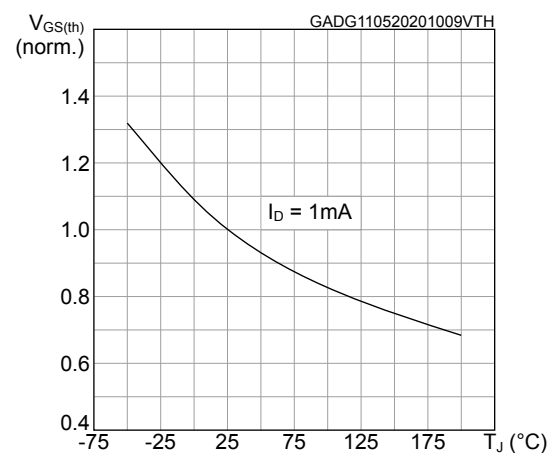
**Figure 10. Typical switching energy vs temperature**



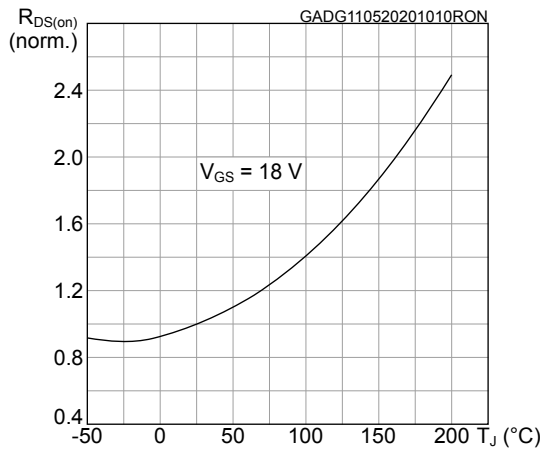
**Figure 11. Normalized breakdown voltage vs temperature**



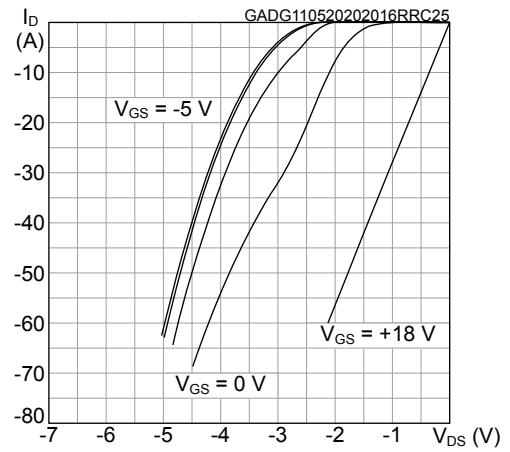
**Figure 12. Normalized gate threshold vs temperature**



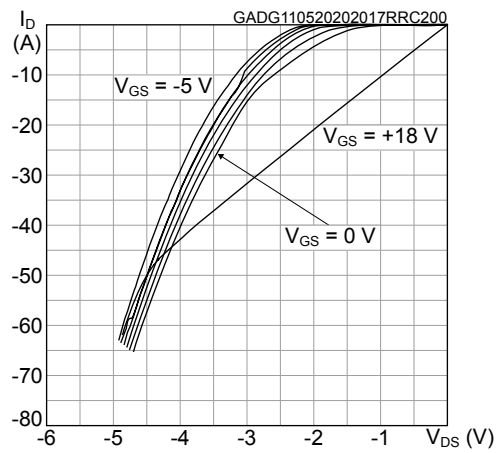
**Figure 13. Normalized on-resistance vs temperature**



**Figure 14. Typical reverse conduction characteristics ( $T_J = 25\text{ °C}$ )**



**Figure 15. Typical reverse conduction characteristics ( $T_J = 200\text{ °C}$ )**

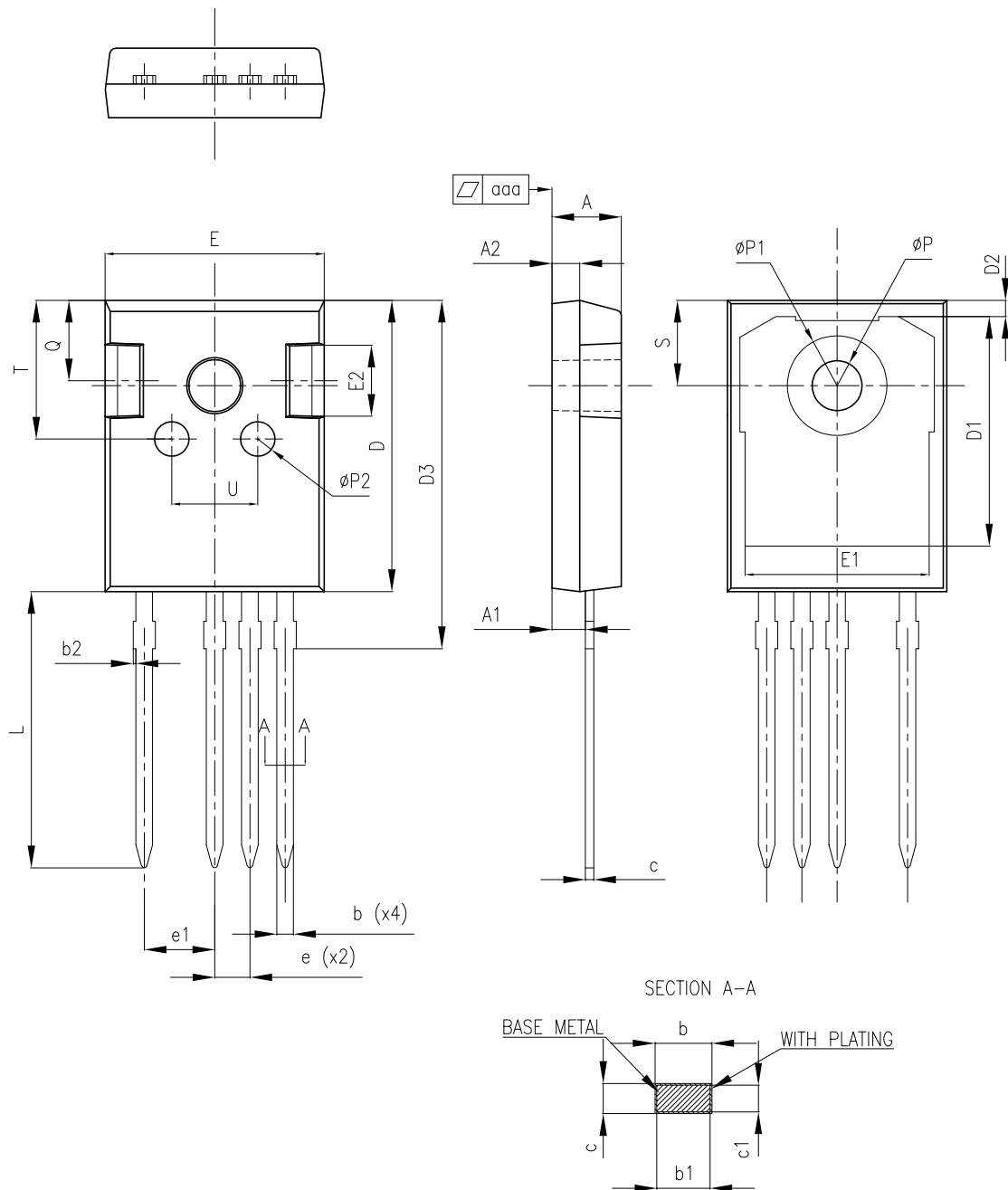


### 3 Package information

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](http://www.st.com). ECOPACK is an ST trademark.

#### 3.1 HiP247-4 package information

Figure 16. HiP247-4 package outline





**Table 8. HiP247-4 mechanical data**

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.90  | 5.00  | 5.10  |
| A1   | 2.31  | 2.41  | 2.51  |
| A2   | 1.90  | 2.00  | 2.10  |
| b    | 1.16  |       | 1.29  |
| b1   | 1.15  | 1.20  | 1.25  |
| b2   | 0     |       | 0.20  |
| c    | 0.59  |       | 0.66  |
| c1   | 0.58  | 0.60  | 0.62  |
| D    | 20.90 | 21.00 | 21.10 |
| D1   | 16.25 | 16.55 | 16.85 |
| D2   | 1.05  | 1.20  | 1.35  |
| D3   | 24.97 | 25.12 | 25.27 |
| E    | 15.70 | 15.80 | 15.90 |
| E1   | 13.10 | 13.30 | 13.50 |
| E2   | 4.90  | 5.00  | 5.10  |
| E3   | 2.40  | 2.50  | 2.60  |
| e    | 2.44  | 2.54  | 2.64  |
| e1   | 4.98  | 5.08  | 5.18  |
| L    | 19.80 | 19.92 | 20.10 |
| P    | 3.50  | 3.60  | 3.70  |
| P1   |       |       | 7.40  |
| P2   | 2.40  | 2.50  | 2.60  |
| Q    | 5.60  |       | 6.00  |
| S    |       | 6.15  |       |
| T    | 9.80  |       | 10.20 |
| U    | 6.00  |       | 6.40  |
| aaa  |       | 0.04  | 0.10  |

## Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes   |
|-------------|----------|---|
| 17-Dec-2020 | 1        | First release.  |
| 21-Jul-2021 | 2        | Modified Table 5. Switching energy (inductive load), Table 6. Switching times, Table 7. Reverse SiC diode characteristics.<br>Modified Figure 9. Typical switching energy vs drain current and Figure 10. Typical switching energy vs temperature.<br>Minor text changes. |

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