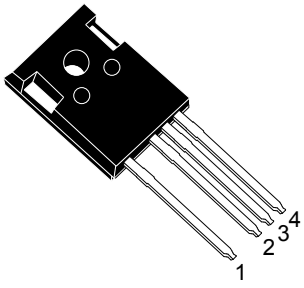
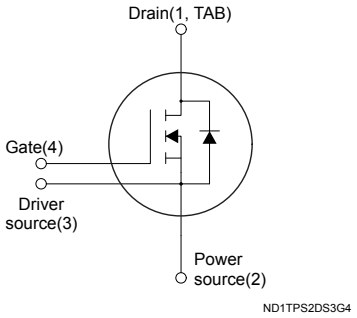
# SCTWA90N65G2V-4

Datasheet

## Silicon carbide Power MOSFET 650 V, 18 mΩ typ., 119 A in an HiP247-4 package




**HiP247-4**




## Features

| Order code | $V_{DS}$ | $R_{DS(on)}$ max. | $I_D$ |
|---|---|---|---|
| SCTWA90N65G2V-4 | 650 V | 24 mΩ | 119 A |

- High speed switching performance
- Very high operating junction temperature capability ($T_J$ = 200 °C)
- Very fast and robust intrinsic body diode
- Extremely low gate charge and input capacitances
- Source sensing pin for increased efficiency

## Applications

- Switching mode power supply
- DC-DC converters
- Industrial motor control

## 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 |
|---|
| SCTWA90N65G2V-4 |

| Product summary | |
|---|---|
| **Order code** | SCTWA90N65G2V-4 |
| **Marking** | SCT90N65G2V |
| **Package** | HiP247-4 |
| **Packing** | Tube |

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-source voltage | 650 | V |
| $V_{GS}$ | Gate-source voltage | -10 to 22 | V |
| | Gate-source voltage (recommended operating values) | -5 to 18 | |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 119 | A |
| | Drain current (continuous) at $T_C$ = 100 °C | 90 | |
| $I_{DM}$ (1) | Drain current (pulsed) | 220 | A |
| $P_{TOT}$ | Total power dissipation at $T_C$ = 25 °C | 565 | 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 | 0.31 | °C/W |
| $R_{thJA}$ | Thermal resistance, junction-to-ambient | 40 | °C/W |

# 2 Electrical characteristics

($T_{CASE}$ = 25 °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 V, $I_D$ = 1 mA | 650 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{DS}$ = 650 V, $V_{GS}$ = 0 V | | | 10 | µA |
| $I_{GSS}$ | Gate-body leakage current | $V_{DS}$ = 0 V, $V_{GS}$ = -10 to 22 V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 1 mA | 1.9 | 3.2 | 5.0 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 18 V, $I_D$ = 50 A | | 18 | 24 | mΩ |
| | | $V_{GS}$ = 18 V, $I_D$ = 50 A, $T_J$ = 200 °C | | 30 | | |

**Table 4. Dynamic, based on HiP247 package option**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 400 V, f = 1 MHz, $V_{GS}$ = 0 V | - | 3380 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 294 | - | |
| $C_{rss}$ | Reverse transfer capacitance | | - | 49 | - | |
| $Q_g$ | Total gate charge | $V_{DD}$ = 400 V, $I_D$ = 50 A, $V_{GS}$ = -5 V to 18 V | - | 157 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 43 | - | |
| $Q_{gd}$ | Gate-drain charge | | - | 42 | - | |
| $R_g$ | Gate input resistance | f = 1 MHz, $I_D$ = 0 A | - | 1 | - | Ω |

**Table 5. Switching energy (inductive load), based on HiP247 package option**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $E_{on}$ | Turn-on switching energy | $V_{DD}$ = 400 V, $I_D$ = 50 A, $R_G$ = 2.2 Ω, $V_{GS}$ = -5 to 18 V | - | 130 | - | µJ |
| $E_{off}$ | Turn-off switching energy | | - | 210 | - | |
| $E_{on}$ | Turn-on switching energy | $V_{DD}$ = 400 V, $I_D$ = 50 A, $R_G$ = 2.2 Ω, $V_{GS}$ = -5 to 18 V, $T_J$= 200 °C | - | 135 | - | |
| $E_{off}$ | Turn-off switching energy | | - | 200 | - | |

**Table 6. Switching times, based on HiP247 package option**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ = 400 V, $I_D$ = 50 A, $R_G$ = 2.2 Ω, $V_{GS}$ = -5 V to 18 V, | - | 26 | - | ns |
| $t_f$ | Fall time | | - | 16 | - | |
| $t_{d(off)}$ | Turn-off delay time | | - | 58 | - | |
| $t_r$ | Rise time | | - | 38 | - | |

**Table 7. Reverse SiC diode characteristics, based on HiP247 package option**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{SD}$ | Forward on voltage | $I_F$ = 30 A, $V_{GS}$ = 0 V | - | 2.5 | - | V |
| $t_{rr}$ | Reverse recovery time | $I_F$ = 50 A, di/dt = 4000 A/µs, $V_{GS}$ = $V_{GS}$ = -5 V to 18 V, $V_{DD}$ = 400 V, $T_J$ = 25 °C | - | 17 | - | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 308 | - | nC |
| $I_{RRM}$ | Reverse recovery current | | - | 30 | - | A |

## 2.1 Electrical characteristics (curves), based on HiP247 package option

**Figure 1. Safe operating area**

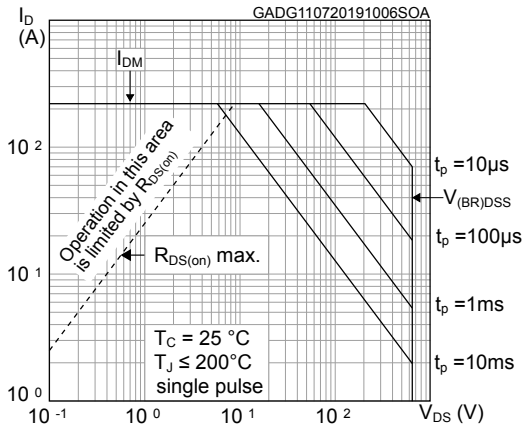



**Figure 2. Maximum transient thermal impedance**

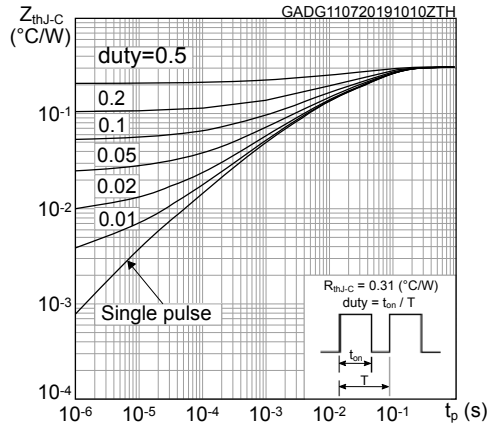



**Figure 3. Typical output characteristics ($T_J$ = -50 °C)**

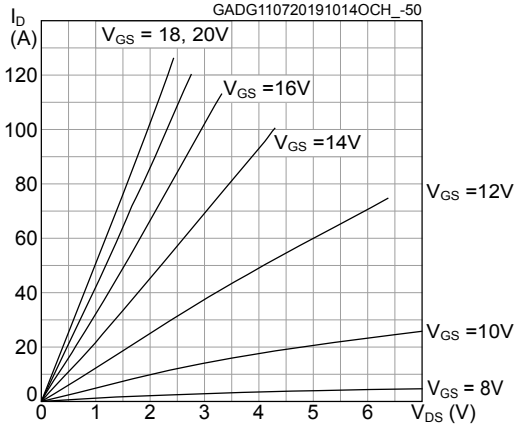



**Figure 4. Typical output characteristics ($T_J$ = 25 °C)**

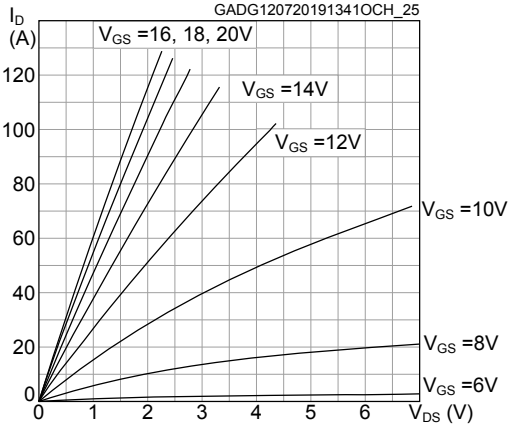



**Figure 5. Typical output characteristics ($T_J$ = 200 °C)**

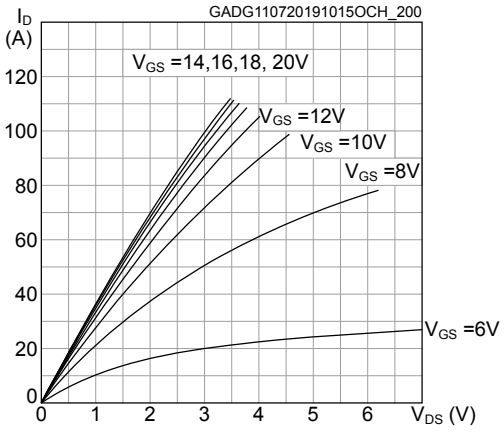



**Figure 6. Typical transfer characteristics**

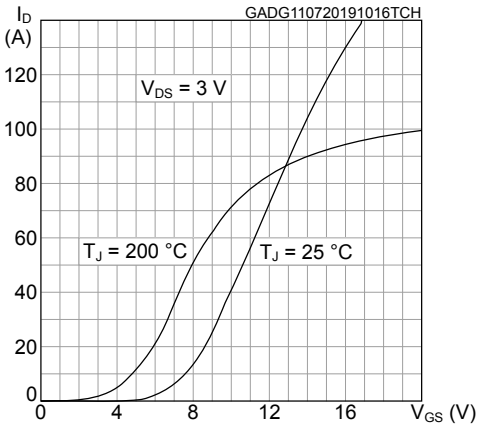


**Figure 7. Typical capacitances**

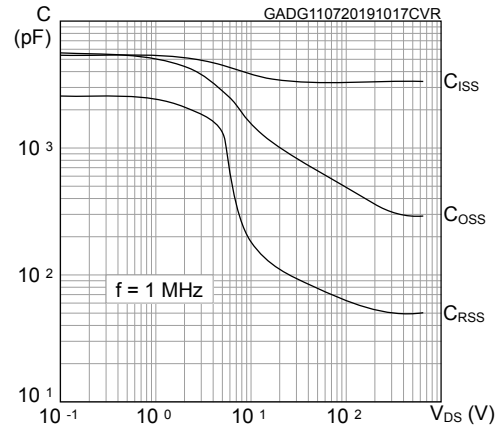



**Figure 8. Typical gate charge**

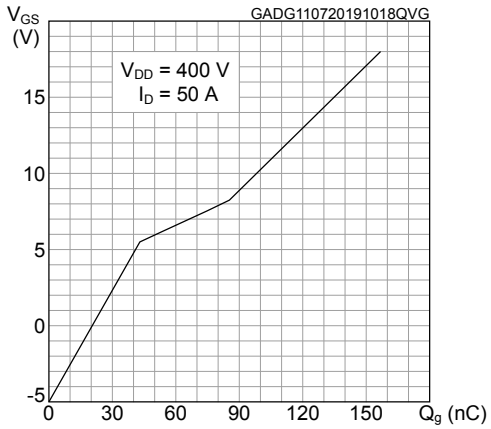



**Figure 9. Maximum total power dissipation**

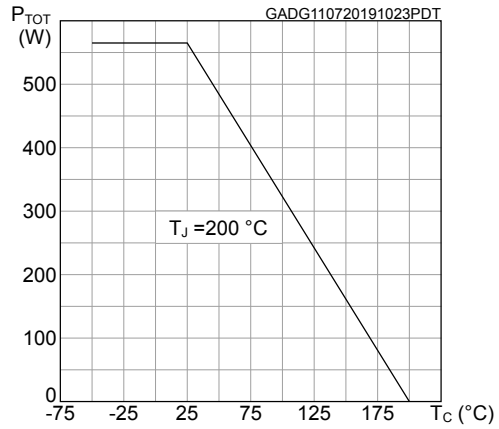



**Figure 10. Typical drain-source on-resistance**

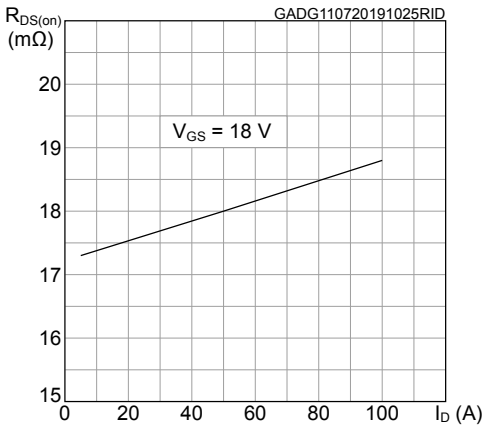



**Figure 11. Normalized on-resistance vs temperature**

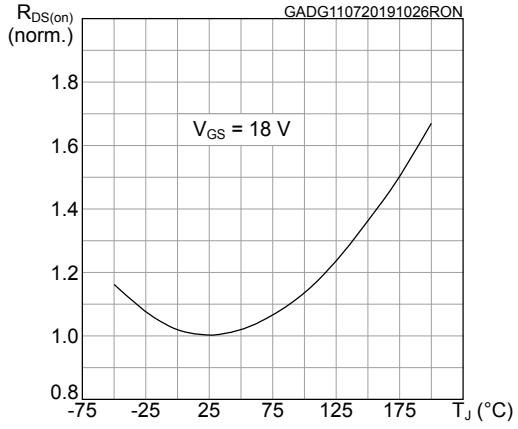



**Figure 12. Normalized gate threshold voltage vs temperature**

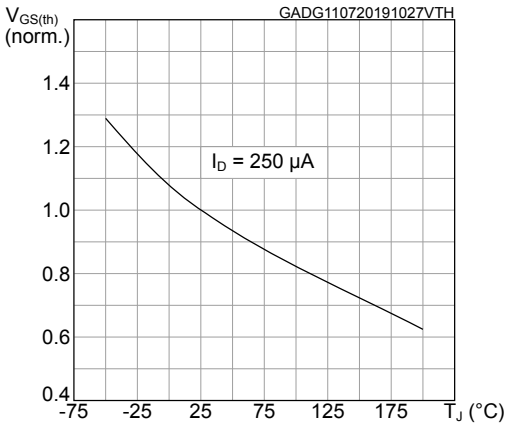


**Figure 13. Normalized breakdown voltage vs temperature**

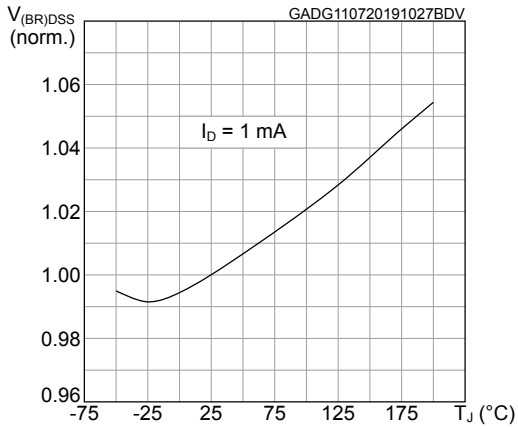



**Figure 14. Typical switching energy vs drain current**

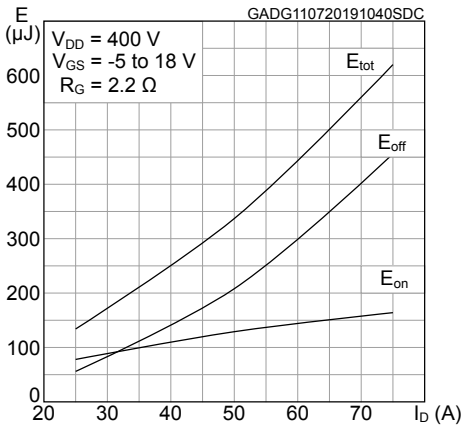



**Figure 15. Typical switching energy vs temperature**

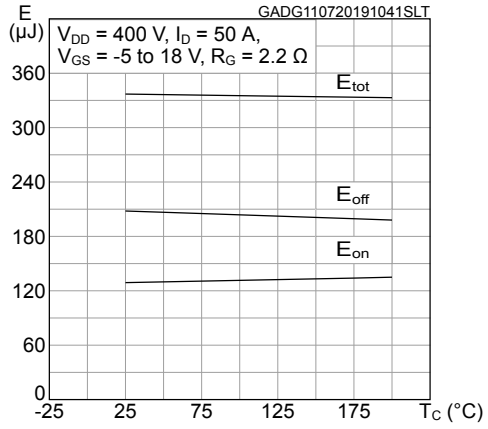



**Figure 16. Typical reverse conduction characteristics ($T_J$ = -50 °C)**

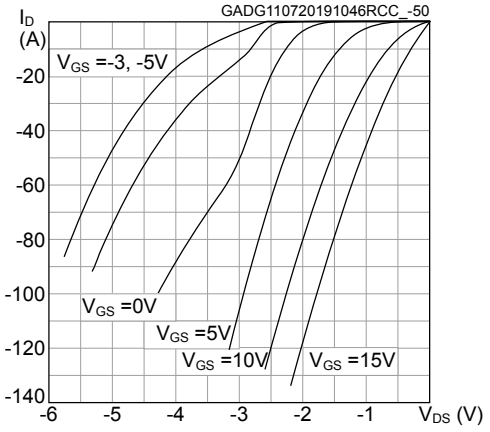



**Figure 17. Typical reverse conduction characteristics ($T_J$ = 25 °C)**

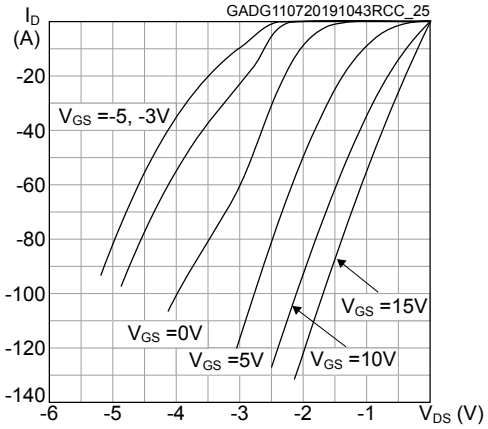
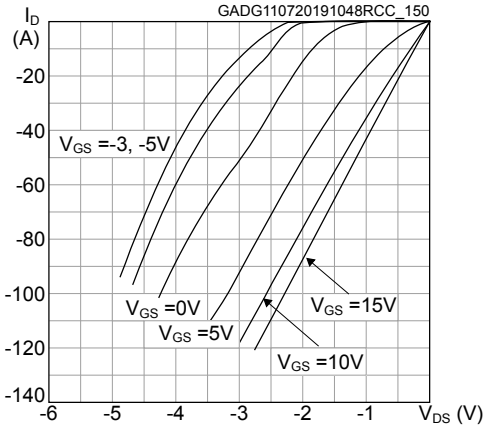



**Figure 18. Typical reverse conduction characteristics ($T_J$ = 150 °C)**



# 3 Test circuits

**Figure 19. Switching times test circuit for resistive load**

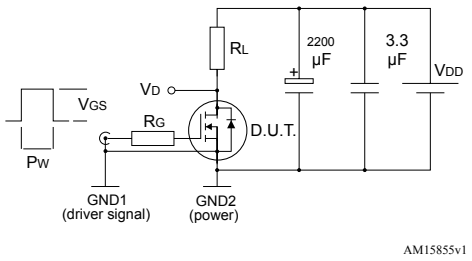



**Figure 20. Test circuit for gate charge behavior**

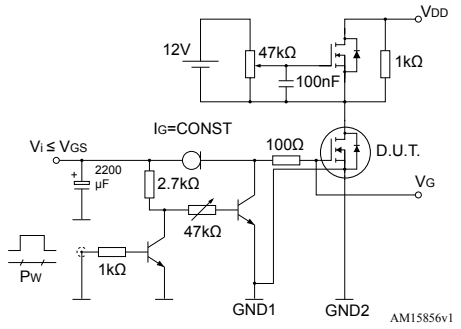



**Figure 21. Test circuit for inductive load switching and diode recovery times**

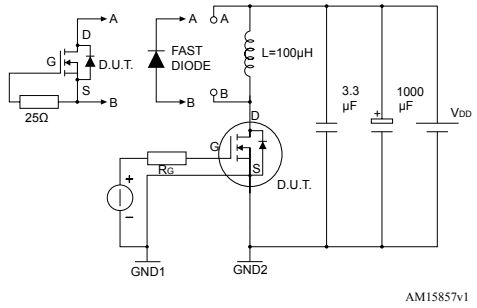



**Figure 22. Unclamped inductive load test circuit**

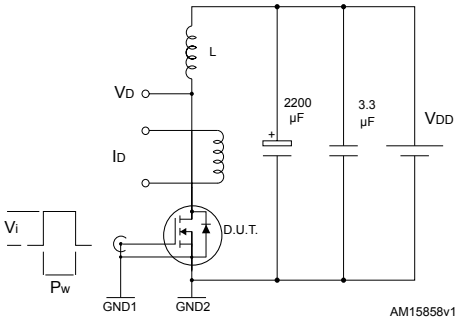



**Figure 23. Unclamped inductive waveform**

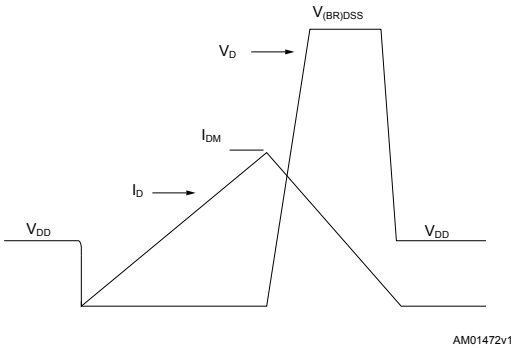
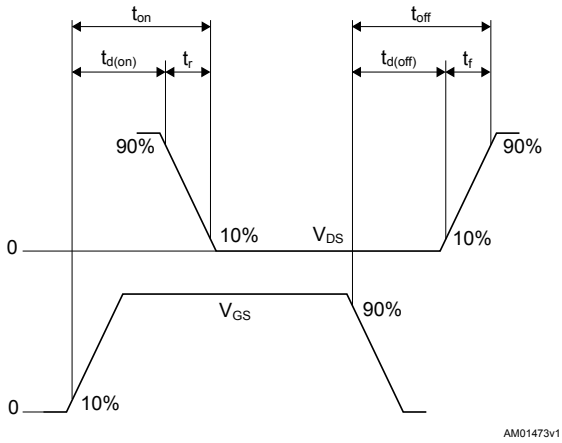



**Figure 24. Switching time waveform**



# 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 HiP247-4 package information

**Figure 25. HiP247-4 package outline**

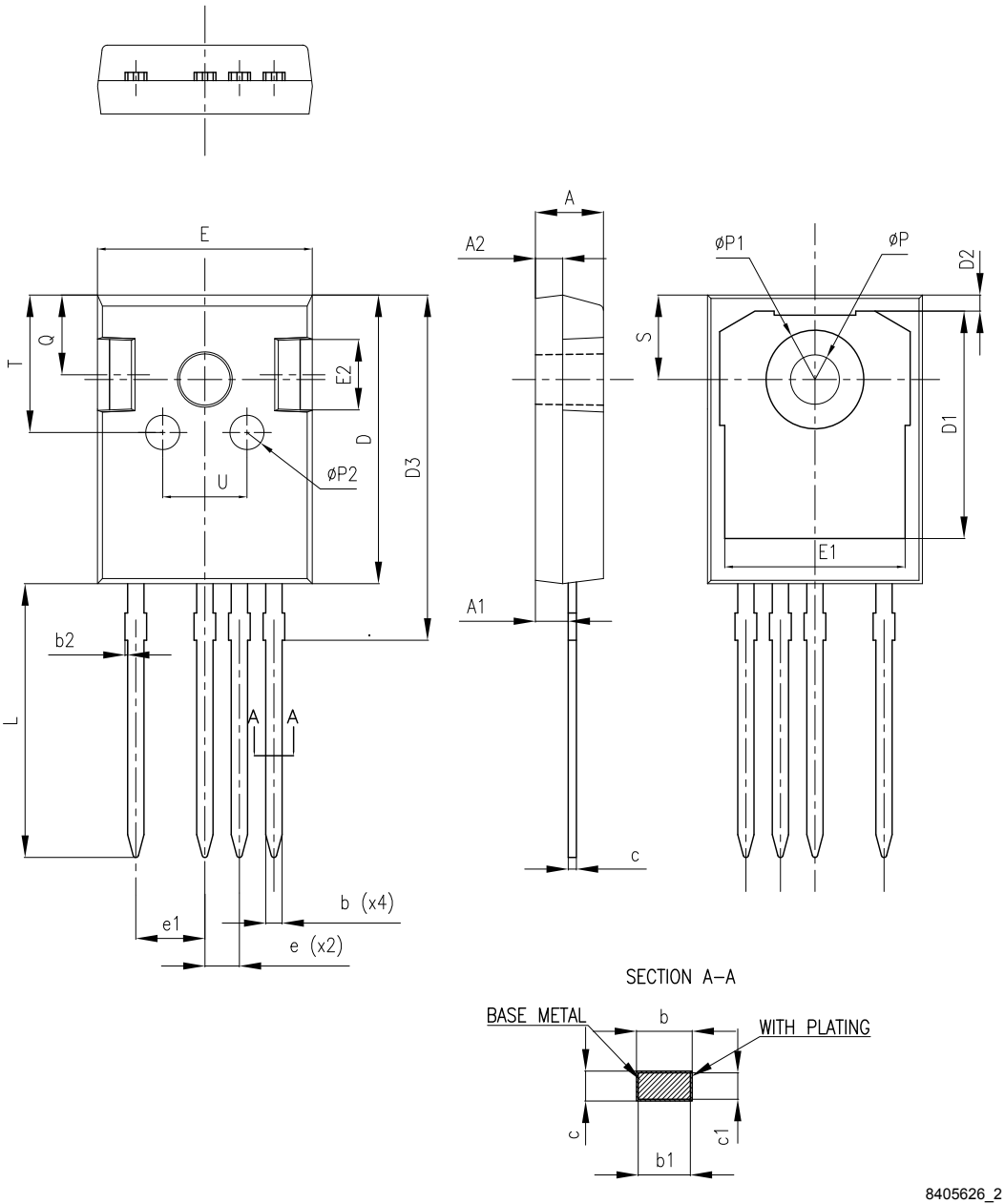


Table 8. **HiP247-4 mechanical data**

| 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 |

## Revision history

Table 9. **Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 25-Nov-2020 | 1 | First release. |

# Contents