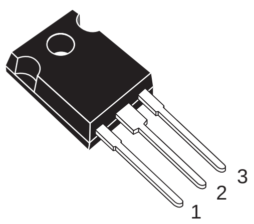
# STW62N65M5

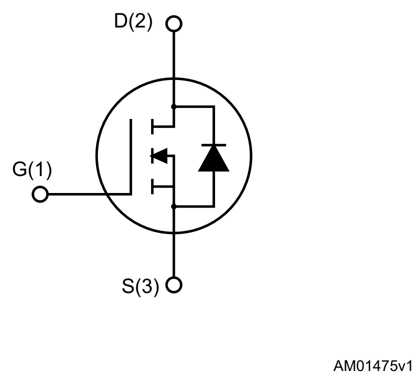
## Automotive-grade N-channel 650 V, 0.041 Ω typ., 46 A MDmesh™ M5 Power MOSFET in a TO-247 package

**Datasheet - production data**




**TO-247**

**Figure 1. Internal schematic diagram**




## Features

| Order code | $V_{DS}$ @ $T_{Jmax}$ | $R_{DS(on)}$ max | $I_D$ |
|---|---|---|---|
| STW62N65M5 | 710 V | 0.049 Ω | 46 A |

- Designed for automotive applications and AEC-Q101 qualified
- Extremely low $R_{DS(on)}$
- Low gate charge and input capacitance
- Excellent switching performance
- 100% avalanche tested

## Applications

- Switching applications

## Description

This device is an N-channel Power MOSFET based on MDmesh™ M5 innovative vertical process technology combined with the well-known PowerMESH™ horizontal layout. The resulting product offers extremely low on-resistance, making it particularly suitable for applications requiring high power and superior efficiency.

**Table 1. Device summary**

| Order code | Marking | Package | Packaging |
|---|---|---|---|
| STW62N65M5 | 62N65M5 | TO-247 | Tube |

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{GS}$ | Gate-source voltage | ± 25 | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 46 | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100 °C | 26 | A |
| $I_{DM}$ (1) | Drain current (pulsed) | 184 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 330 | W |
| dv/dt (2) | Peak diode recovery voltage slope | 15 | V/ns |
| dv/dt (3) | MOSFET dv/dt ruggedness | 50 | V/ns |
| $T_{stg}$ | Storage temperature | - 55 to 150 | °C |
| $T_j$ | Max. operating junction temperature | 150 | °C |

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 46$ A, di/dt $\leq$ 200 A/µs; $V_{DS\ peak} < V_{(BR)DSS}$, $V_{DD}$=400 V
3. $V_{DS} \leq 520$ V

**Table 3. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thj\text{-}case}$ | Thermal resistance junction-case max | 0.38 | °C/W |
| $R_{thj\text{-}amb}$ | Thermal resistance junction-ambient max | 50 | °C/W |

**Table 4. Avalanche characteristics**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $I_{AR}$ | Avalanche current, repetitive or not repetitive (pulse width limited by $T_{jmax}$) | 12 | A |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_j$ = 25 °C, $I_D$ = $I_{AR}$, $V_{DD}$ = 50 V) | 1400 | mJ |

# 2 Electrical characteristics

($T_C$ = 25 °C unless otherwise specified)

**Table 5. On /off states**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS}$ = 0, $I_D$ = 1 mA | 650 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{GS}$ = 0, $V_{DS}$ = 650 V | | | 1 | µA |
| | | $V_{GS}$ = 0, $V_{DS}$ = 650 V, $T_C$=125 °C | | | 100 | µA |
| $I_{GSS}$ | Gate-body leakage current | $V_{DS}$ = 0, $V_{GS}$ = ± 25 V | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 23 A | | 0.041 | 0.049 | Ω |

**Table 6. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{GS}$ = 0, $V_{DS}$ = 100 V, f = 1 MHz, | - | 6420 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 170 | - | pF |
| $C_{rss}$ | Reverse transfer capacitance | | - | 11 | - | pF |
| $C_{o(tr)}$(1) | Equivalent capacitance time related | $V_{GS}$ = 0, $V_{DS}$ = 0 to 520 V | - | 536 | - | pF |
| $C_{o(er)}$(2) | Equivalent capacitance energy related | | - | 146 | - | pF |
| $R_G$ | Intrinsic gate resistance | f = 1 MHz, $I_D$ = 0 | - | 1.2 | - | Ω |
| $Q_g$ | Total gate charge | $V_{DD}$ = 520 V, $I_D$ = 23 A, $V_{GS}$ = 10 V (see *Figure 16*) | - | 142 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 34 | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 58 | - | nC |

1. Time related is defined as a constant equivalent capacitance giving the same charging time as $C_{oss}$ when $V_{DS}$ increases from 0 to 80% $V_{DSS}$
2. Energy related is defined as a constant equivalent capacitance giving the same stored energy as $C_{oss}$ when $V_{DS}$ increases from 0 to 80% $V_{DSS}$

**Table 7. Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| $t_{d(V)}$ | Voltage delay time | $V_{DD}$ = 400 V, $I_D$ = 30 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V (see *Figure 17* and *Figure 20*) | - | 101 | - | ns |
| $t_{r(V)}$ | Voltage rise time | | - | 11 | - | ns |
| $t_{c(off)}$ | Crossing time | | - | 14 | - | ns |
| $t_{f(i)}$ | Current fall time | | - | 8 | - | ns |

**Table 8. Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 46 | A |
| $I_{SDM}$ (1) | Source-drain current (pulsed) | | | | 184 | A |
| $V_{SD}$ (2) | Forward on voltage | $V_{GS}$ = 0, $I_{SD}$ = 46 A | - | | 1.5 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 46 A, di/dt = 100 A/µs $V_{DD}$ = 100 V (see *Figure 17*) | - | 448 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 10 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 43 | | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 46 A, di/dt = 100 A/µs $V_{DD}$ = 100 V, $T_j$ = 150 °C (see *Figure 17*) | - | 548 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 14 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 51 | | A |

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300 µs, duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

**Figure 2. Safe operating area**

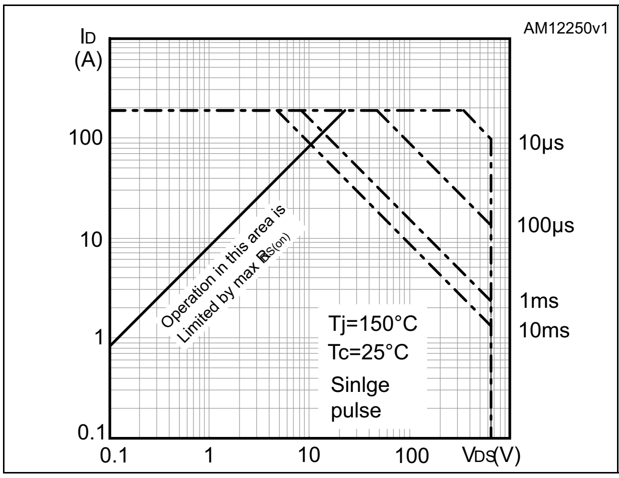



**Figure 3. Thermal impedance**

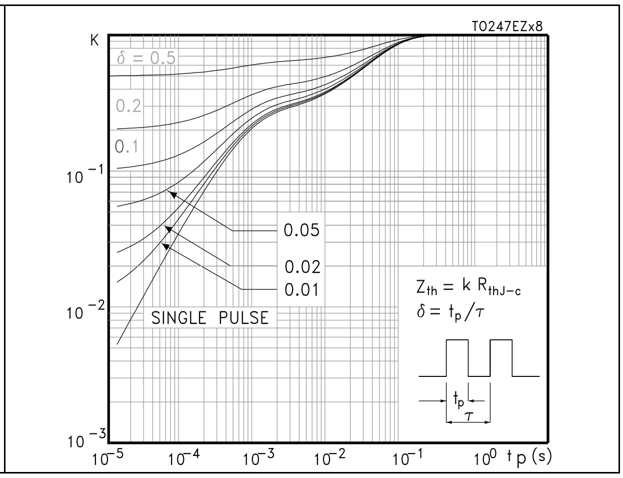



**Figure 4. Output characteristics**

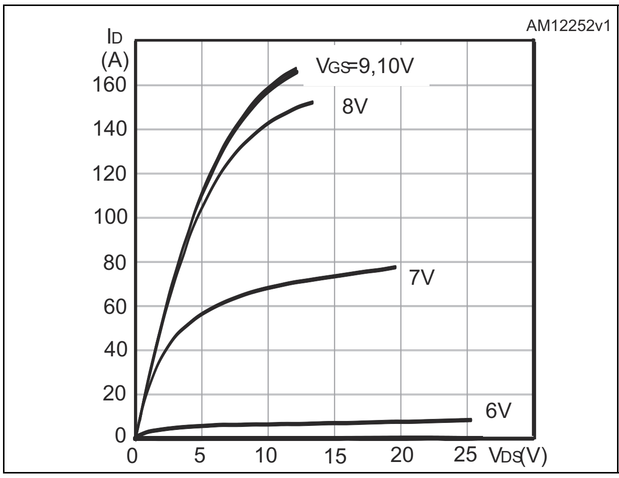



**Figure 5. Transfer characteristics**

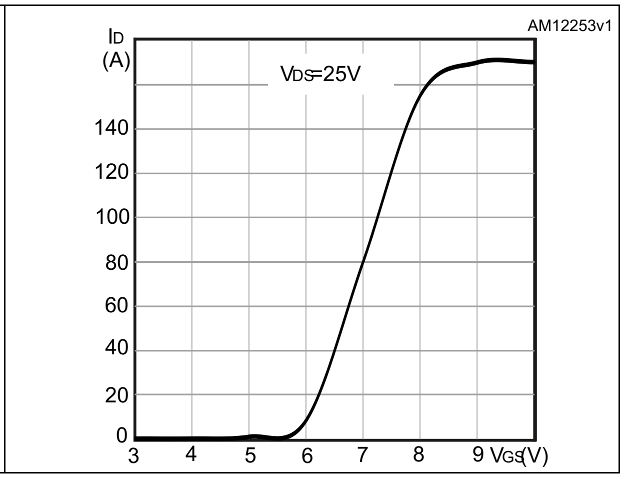



**Figure 6. Gate charge vs gate-source voltage**

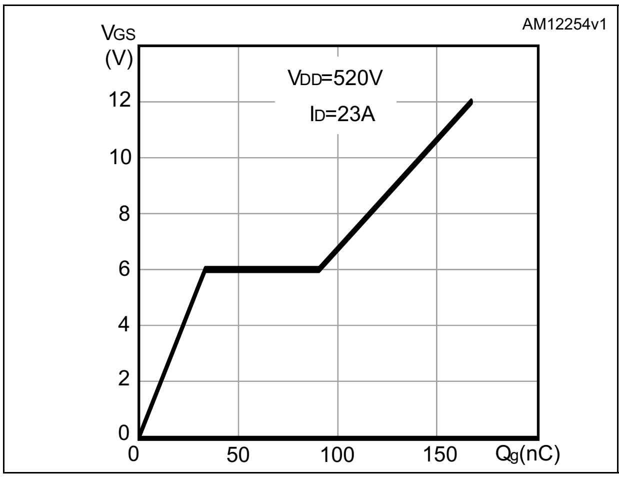



**Figure 7. Static drain-source on-resistance**

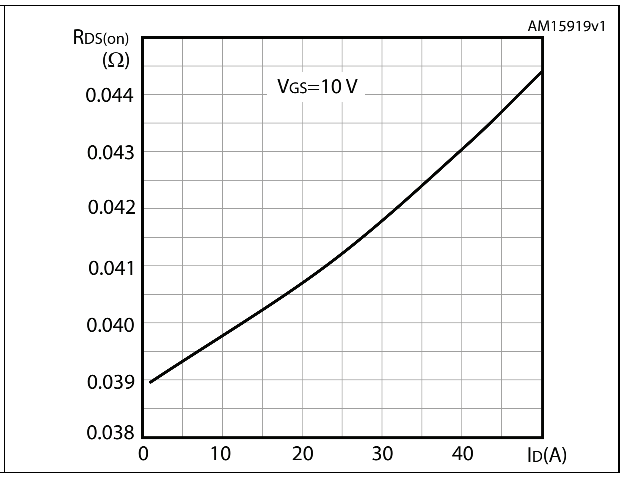


**Figure 8. Capacitance variations**

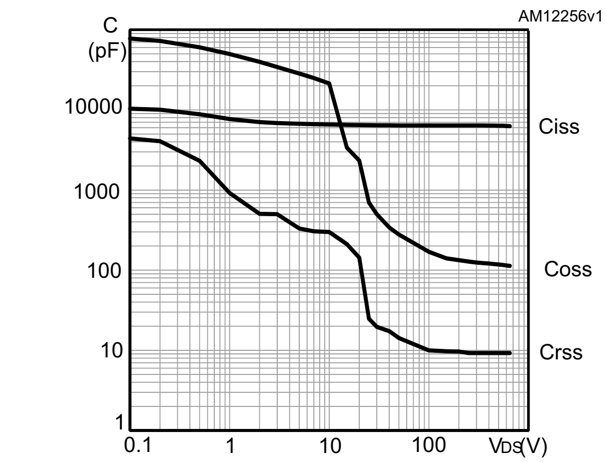



**Figure 9. Output capacitance stored energy**

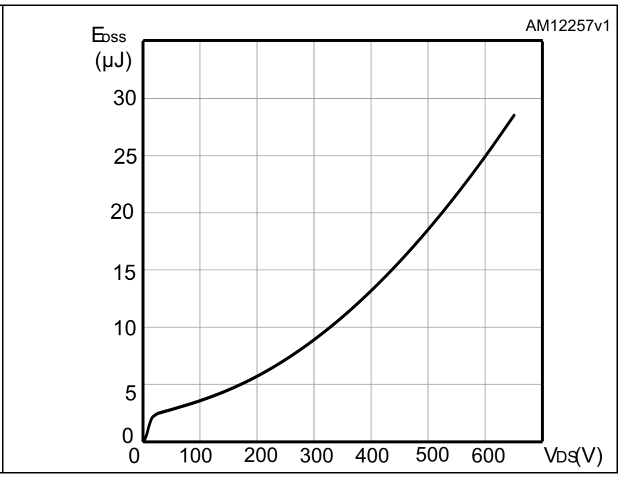



**Figure 10. Normalized gate threshold voltage vs temperature**

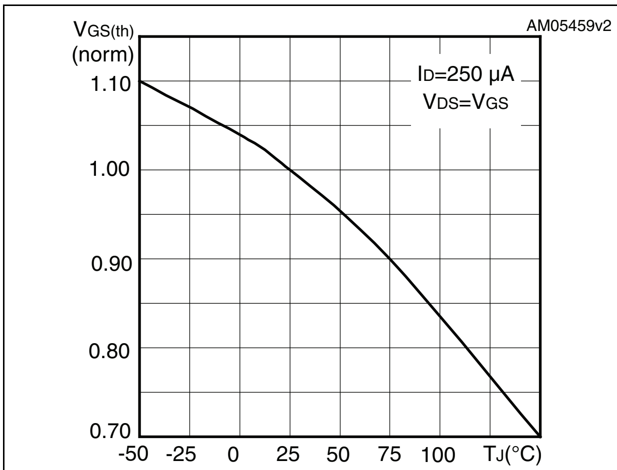



**Figure 11. Normalized on-resistance vs temperature**

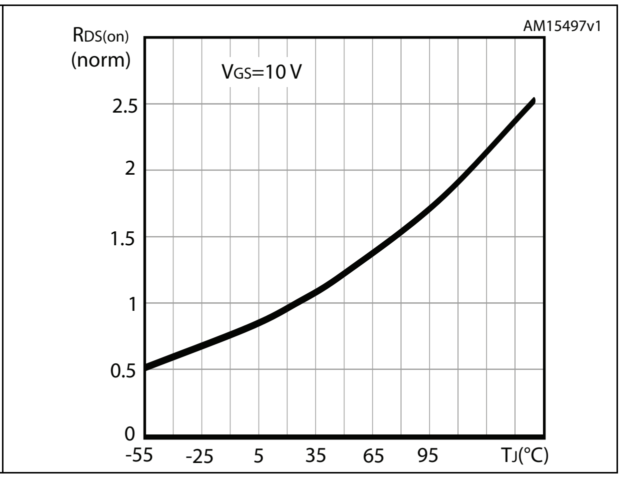



**Figure 12. Source-drain diode forward characteristics**

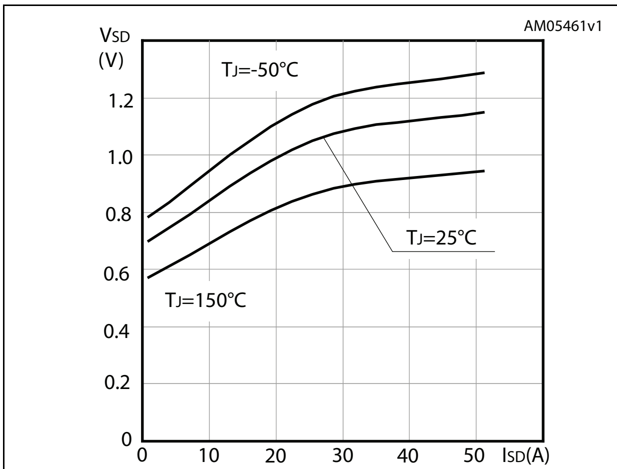



**Figure 13. Normalized $V_{(BR)DSS}$ vs temperature**

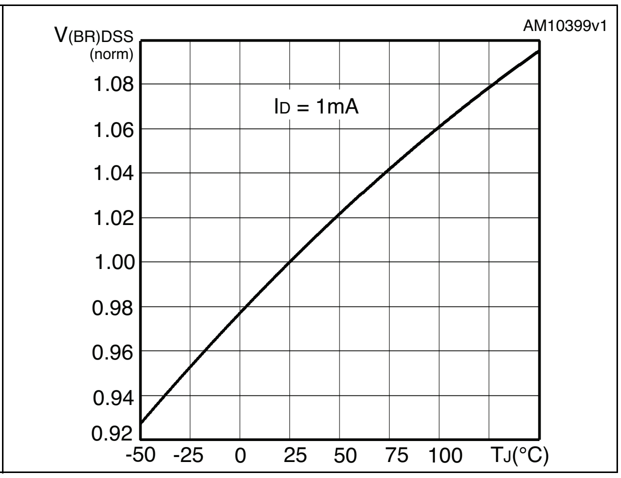
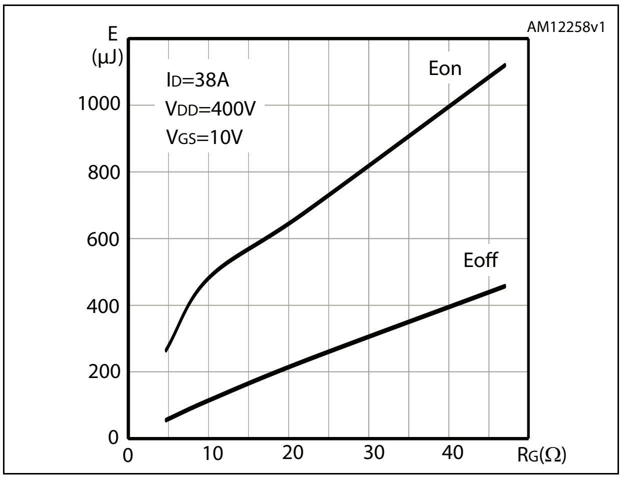


**Figure 14. Switching losses vs gate resistance[(1)]**




1. Eon including reverse recovery of a SiC diode

# 3 Test circuits

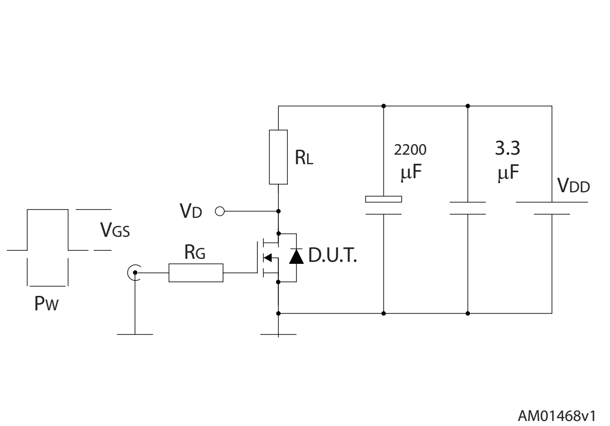



Figure 15. Switching times test circuit for resistive load

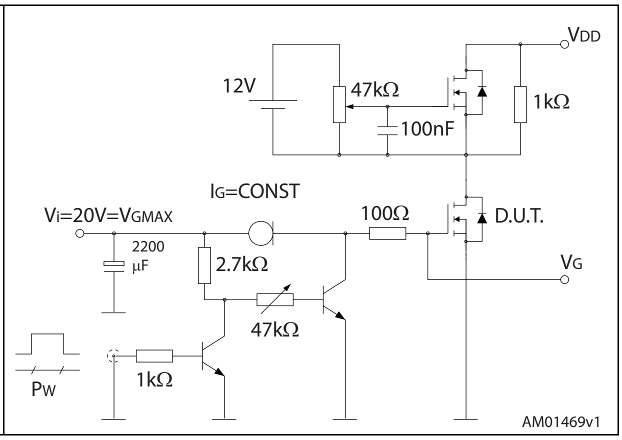



Figure 16. Gate charge test circuit

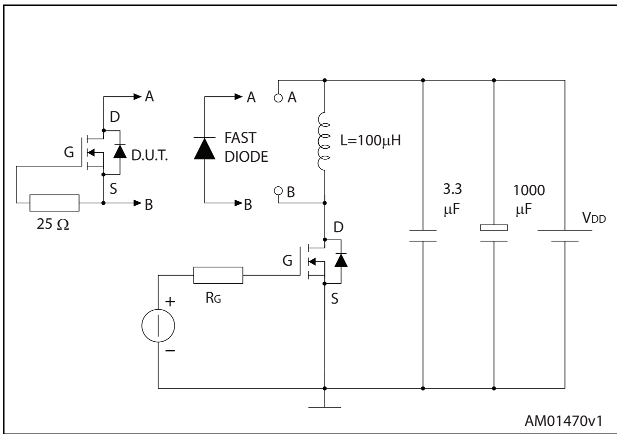



Figure 17. Test circuit for inductive load switching and diode recovery times

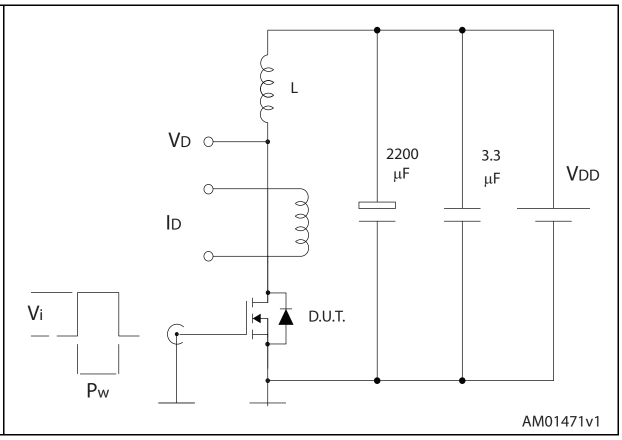



Figure 18. Unclamped inductive load test circuit

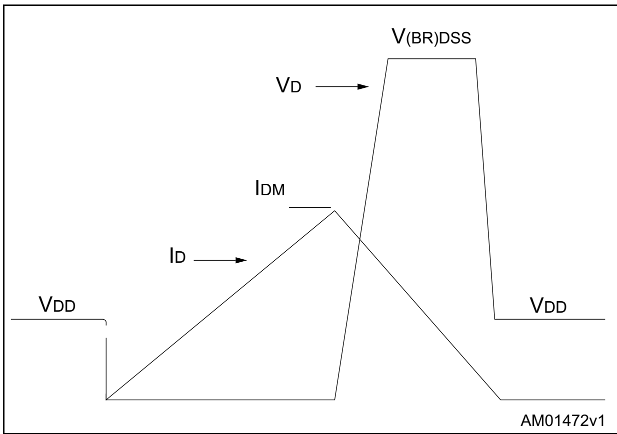



Figure 19. Unclamped inductive waveform

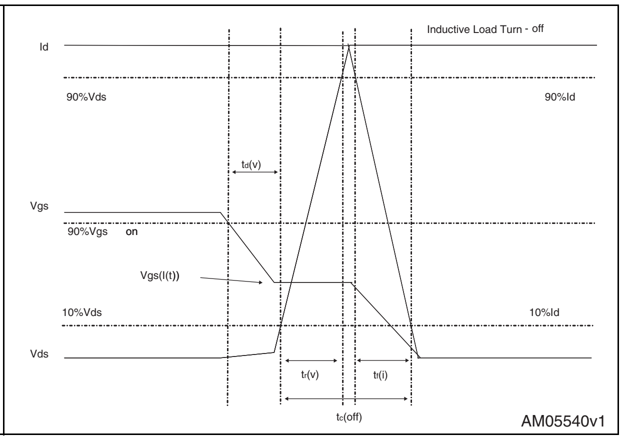



Figure 20. Switching time waveform

# 4 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 21. TO-247 drawing**

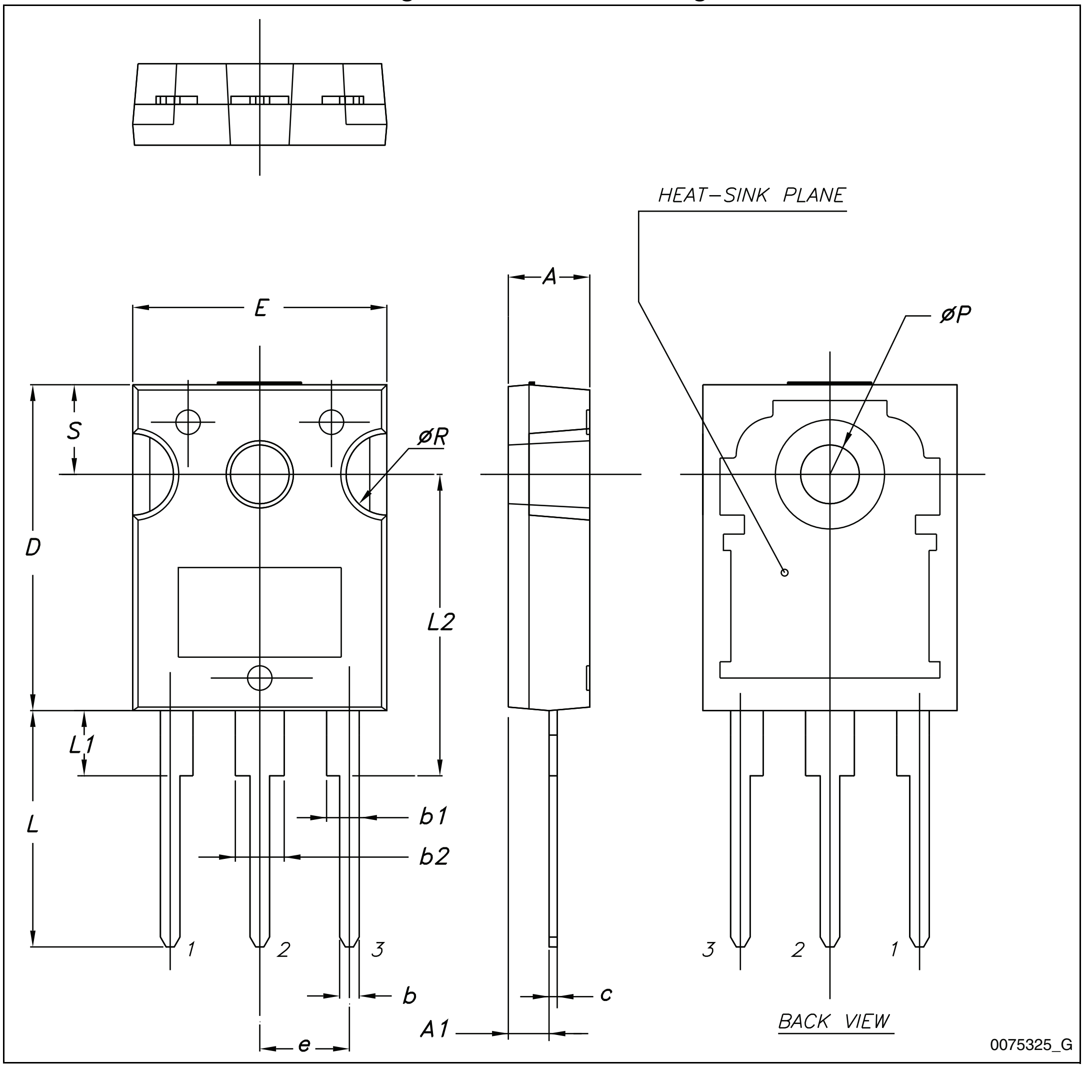


Table 9. TO-247 mechanical data

| 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 |

# 5 Revision history

**Table 10. Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 19-Jun-2013 | 1 | First release. |
| 23-May-2014 | 2 | – Modified: *Features* in cover page<br>– Minor text changes |
| 25-Jul-2014 | 3 | – Modified: note *2* in *Table 2*<br>– Modified: symbol, parameters, $t_{c(off)}$ and $t_{f(i)}$ in *Table 7*<br>– Minor text changes |