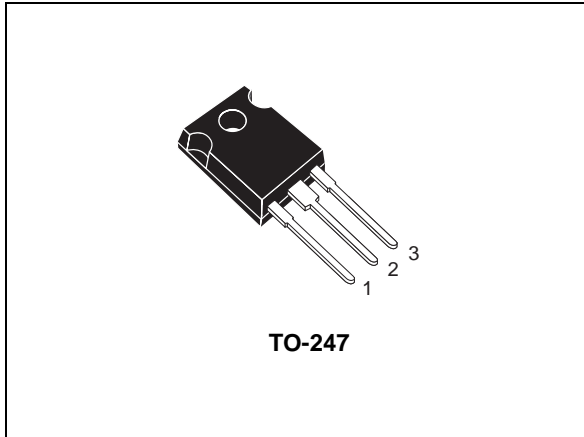


## Automotive-grade N-channel 650 V, 0.041 $\Omega$ typ., 46 A MDmesh™ M5 Power MOSFET in a TO-247 package

Datasheet - production data



### Features

| Order code | $V_{DS} @ T_{Jmax}$ | $R_{DS(on) max}$ | $I_D$ |
|------------|---------------------|------------------|-------|
| STW62N65M5 | 710 V               | 0.049 $\Omega$   | 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.

Figure 1. Internal schematic diagram

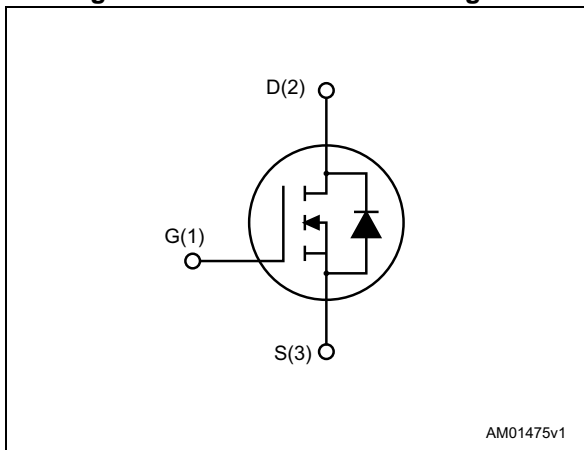


Table 1. Device summary

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

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol         | Parameter   | Value       | Unit             |
|----------------|---|-------------|------------------|
| $V_{GS}$       | Gate-source voltage   | $\pm 25$    | V                |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$  | 46          | A                |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 26          | A                |
| $I_{DM}^{(1)}$ | Drain current (pulsed)  | 184         | A                |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$           | 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 | $^\circ\text{C}$ |
| $T_j$          | Max. operating junction temperature                             | 150         | $^\circ\text{C}$ |

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

**Table 3. Thermal data**

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

**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 $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ ) | 1400  | mJ   |

## 2 Electrical characteristics

( $T_C = 25\text{ °C}$  unless otherwise specified)

**Table 5. On /off states**

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

**Table 6. Dynamic**

| Symbol            | Parameter                             | Test conditions  | Min. | Typ. | Max. | Unit     |
|-------------------|---------------------------------------|--|------|------|------|----------|
| $C_{iss}$         | Input capacitance                     | $V_{GS} = 0, V_{DS} = 100\text{ V}, f = 1\text{ MHz},$ | -    | 6420 | -    | pF       |
| $C_{oss}$         | Output capacitance                    |  | -    | 170  | -    | pF       |
| $C_{rss}$         | Reverse transfer capacitance          |  | -    | 11   | -    | pF       |
| $C_{o(tr)}^{(1)}$ | Equivalent capacitance time related   | $V_{GS} = 0, V_{DS} = 0\text{ to }520\text{ V}$        | -    | 536  | -    | pF       |
| $C_{o(er)}^{(2)}$ | Equivalent capacitance energy related |  | -    | 146  | -    | pF       |
| $R_G$             | Intrinsic gate resistance             | $f = 1\text{ MHz}, I_D = 0$                            | -    | 1.2  | -    | $\Omega$ |
| $Q_g$             | Total gate charge                     | $V_{DD} = 520\text{ V}, I_D = 23\text{ A},$            | -    | 142  | -    | nC       |
| $Q_{gs}$          | Gate-source charge                    | $V_{GS} = 10\text{ V}$                                 | -    | 34   | -    | nC       |
| $Q_{gd}$          | Gate-drain charge                     | (see <a href="#">Figure 16</a> )                       | -    | 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 | $V_{DD} = 400\text{ V}$ , $I_D = 30\text{ A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 17</a> and<br><a href="#">Figure 20</a> ) | -    | 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            | $V_{GS} = 0$ , $I_{SD} = 46\text{ A}$  | -    |      | 1.5  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 46\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 100\text{ V}$ (see <a href="#">Figure 17</a> )  | -    | 448  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |  | -    | 10   |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |  | -    | 43   |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 46\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 100\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 17</a> ) | -    | 548  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |  | -    | 14   |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |  | -    | 51   |      | A             |

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

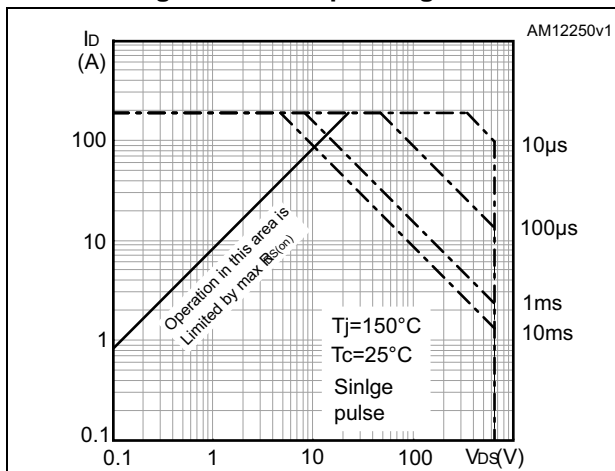


Figure 3. Thermal impedance

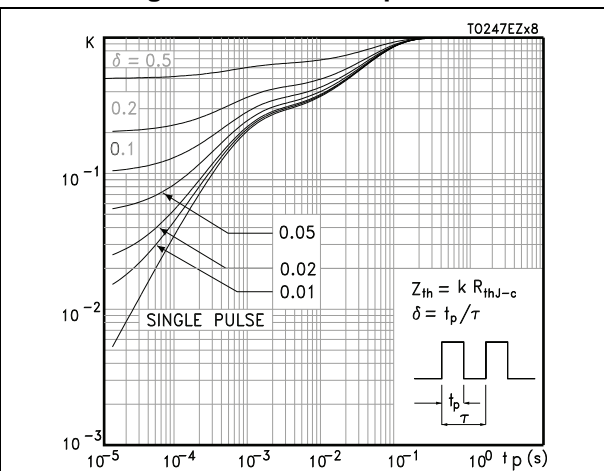


Figure 4. Output characteristics

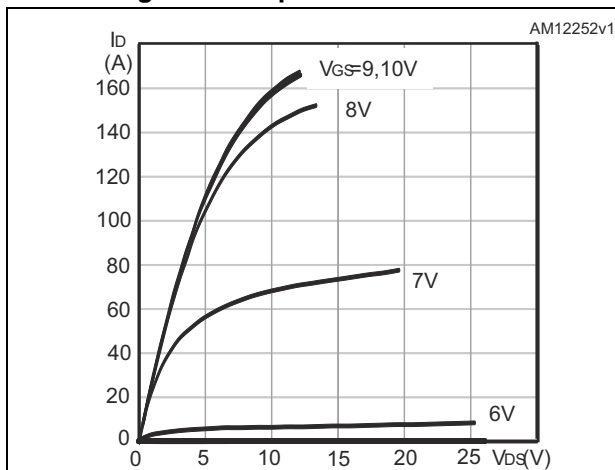


Figure 5. Transfer characteristics

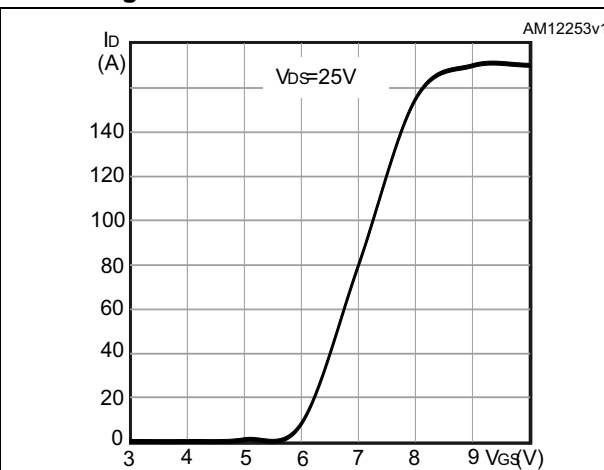


Figure 6. Gate charge vs gate-source voltage

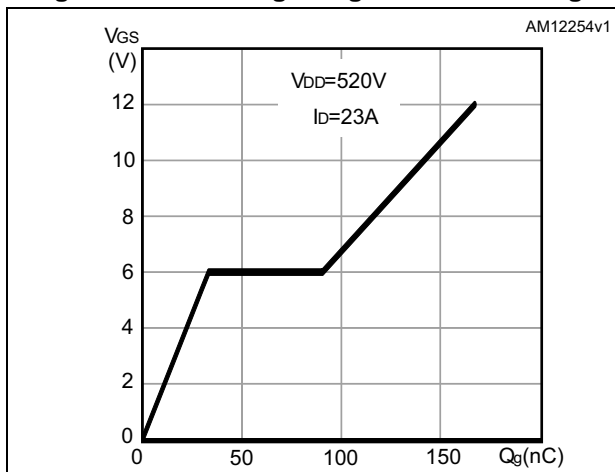


Figure 7. Static drain-source on-resistance

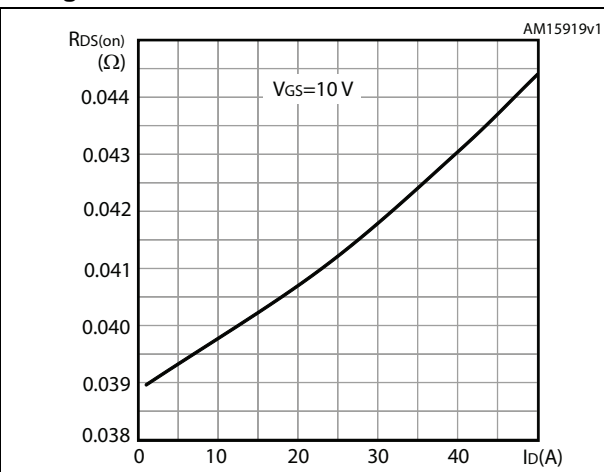


Figure 8. Capacitance variations

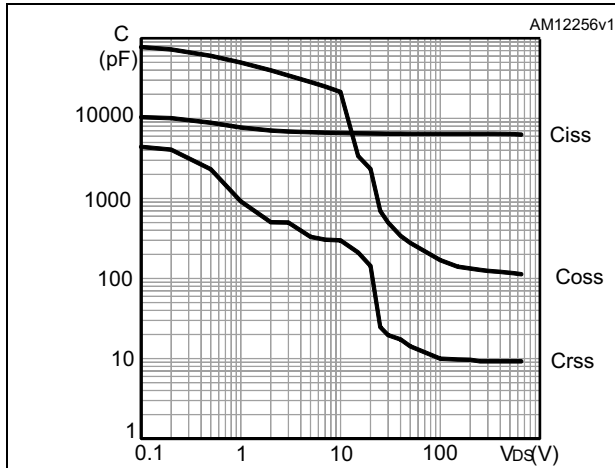


Figure 9. Output capacitance stored energy

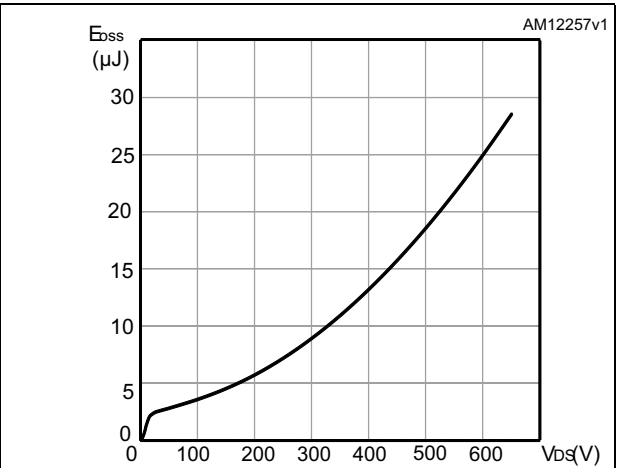


Figure 10. Normalized gate threshold voltage vs temperature

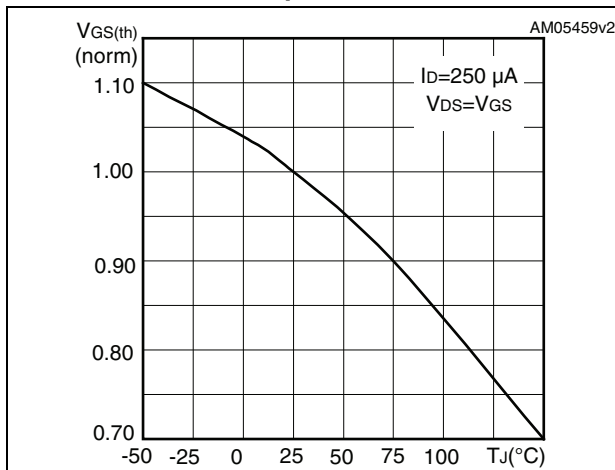


Figure 11. Normalized on-resistance vs temperature

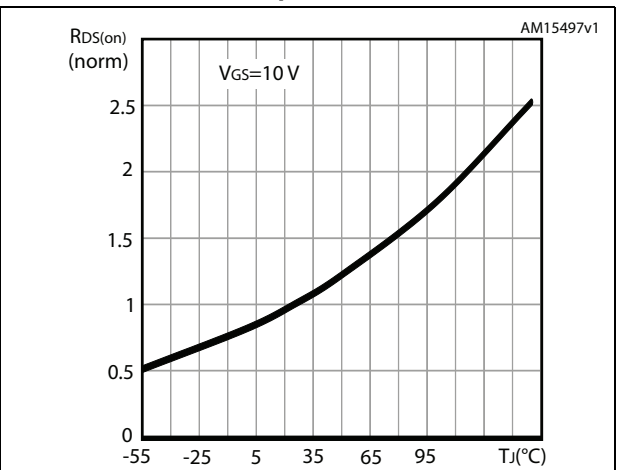


Figure 12. Source-drain diode forward characteristics

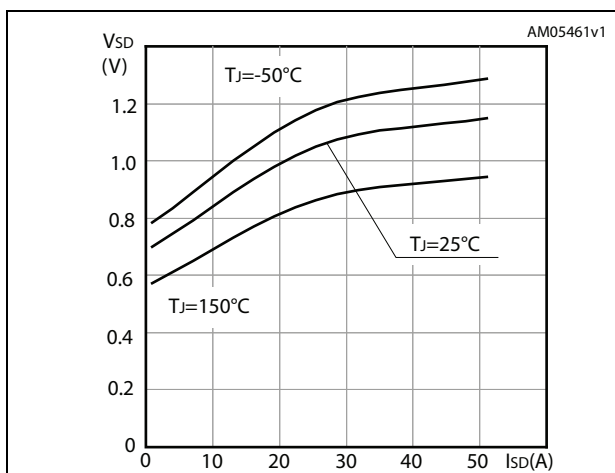


Figure 13. Normalized V(BR)DSS vs temperature

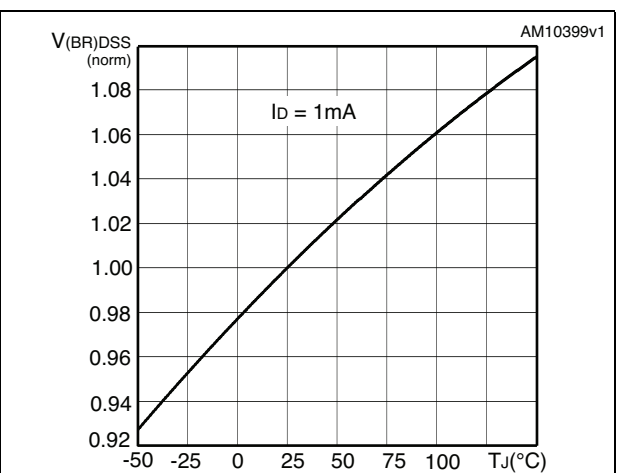
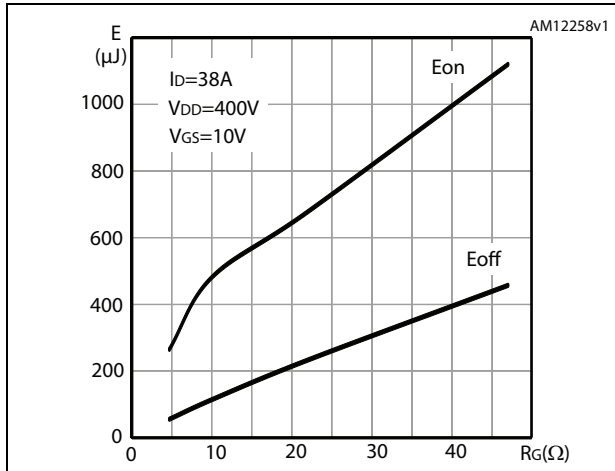


Figure 14. Switching losses vs gate resistance<sup>(1)</sup>



1.  $E_{on}$  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

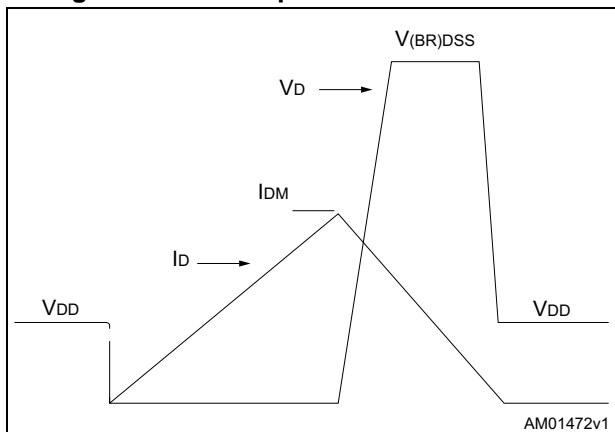
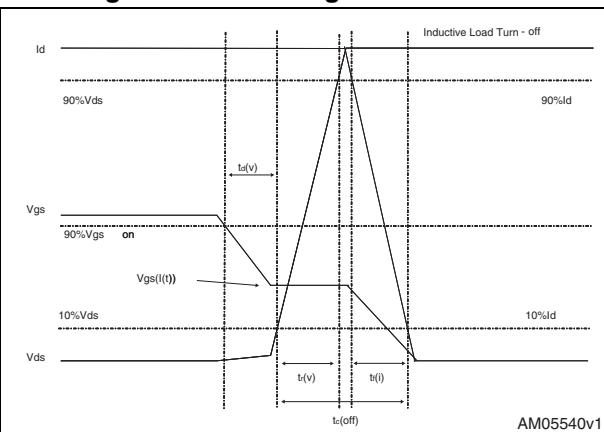


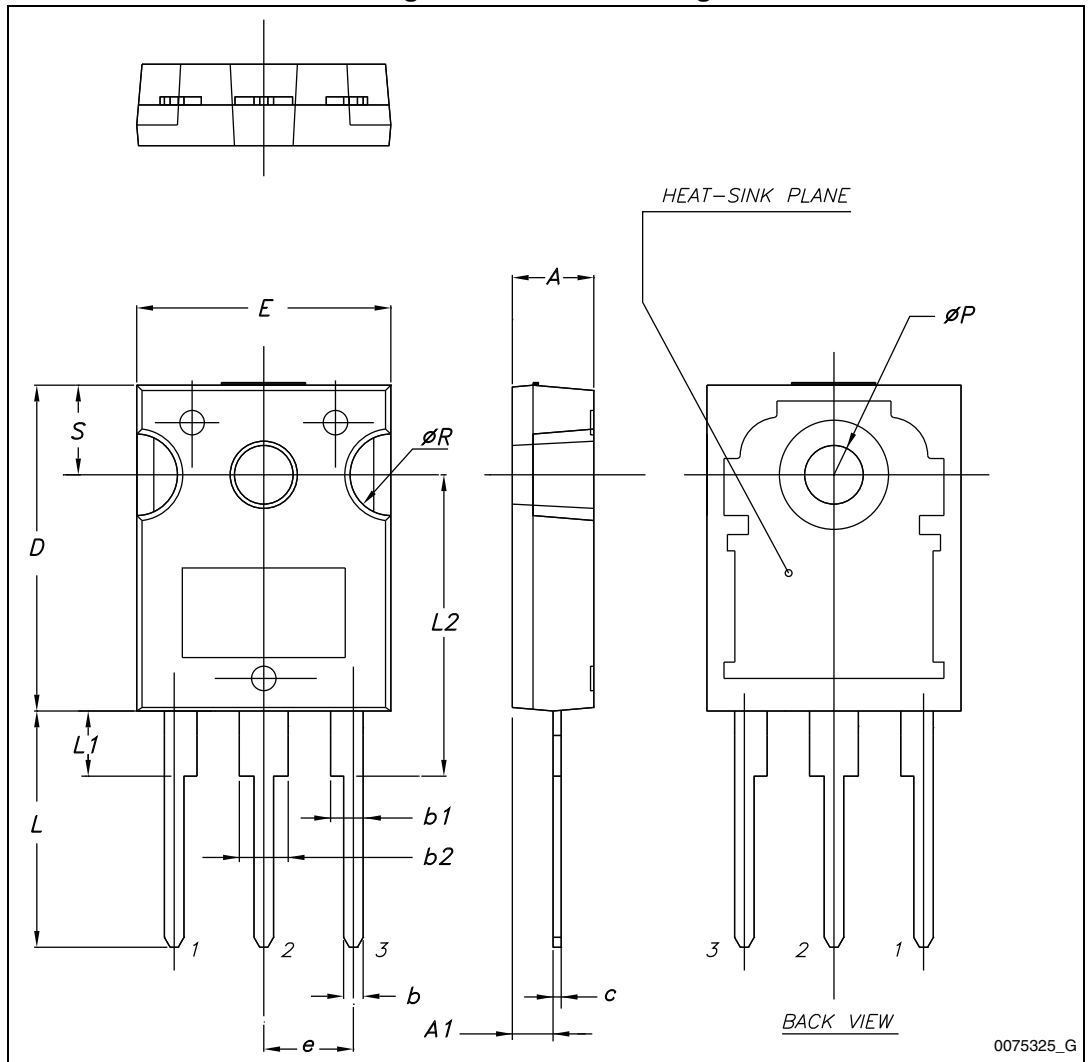
Figure 20. Switching time waveform



## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

Figure 21. TO-247 drawing



0075325\_G

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 |       |
| ØP   | 3.55  |       | 3.65  |
| ØR   | 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: <i>Features</i> in cover page<br>– Minor text changes  |
| 25-Jul-2014 | 3        | – Modified: <i>note 2</i> in <i>Table 2</i><br>– Modified: symbol, parameters, $t_{c(off)}$ and $t_{f(i)}$ in <i>Table 7</i><br>– Minor text changes |

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