

## N-channel 600 V, 0.085 $\Omega$ typ., 34 A MDmesh™ DM2 Power MOSFET in a TO-247 package

Datasheet - production data

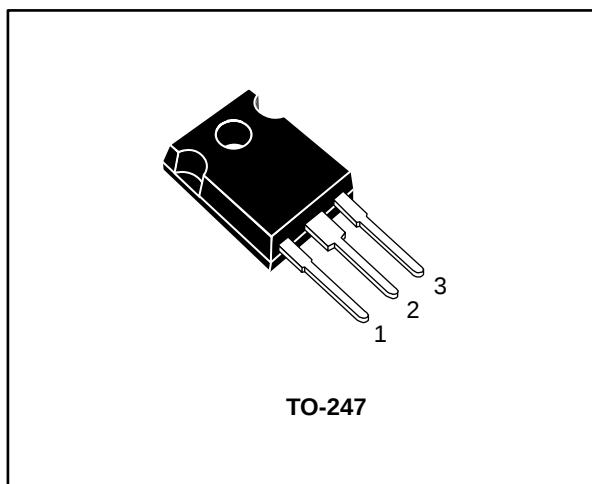
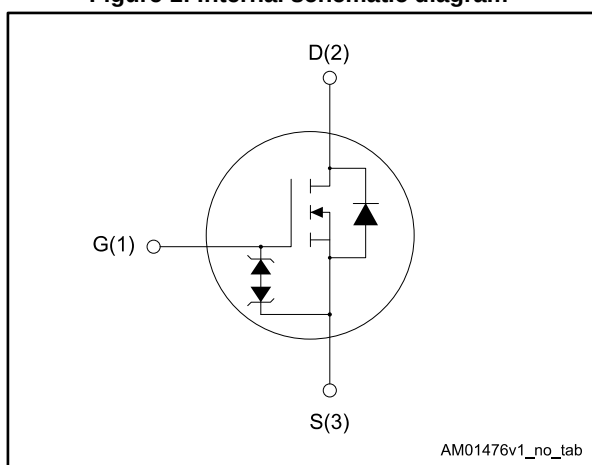


Figure 1: Internal schematic diagram



### Features

| Order code  | $V_{DS} @ T_{Jmax.}$ | $R_{DS(on) max.}$ | $I_D$ | $P_{TOT}$ |
|-------------|----------------------|-------------------|-------|-----------|
| STW43N60DM2 | 650 V                | 0.093 $\Omega$    | 34 A  | 250 W     |

- Fast-recovery body diode
- Extremely low gate charge and input capacitance
- Low on-resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected

### Applications

- Switching applications

### Description

This high voltage N-channel Power MOSFET is part of the MDmesh™ DM2 fast recovery diode series. It offers very low recovery charge ( $Q_{rr}$ ) and time ( $t_{rr}$ ) combined with low  $R_{DS(on)}$ , rendering it suitable for the most demanding high efficiency converters and ideal for bridge topologies and ZVS phase-shift converters.

Table 1: Device summary

| Order code  | Marking  | Package | Packing |
|-------------|----------|---------|---------|
| STW43N60DM2 | 43N60DM2 | TO-247  | Tube    |

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## 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 $T_{case} = 25\text{ }^{\circ}\text{C}$  | 34         | A                  |
|                | Drain current (continuous) at $T_{case} = 100\text{ }^{\circ}\text{C}$ | 21         |                    |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                                 | 136        | A                  |
| $P_{TOT}$      | Total dissipation at $T_{case} = 25\text{ }^{\circ}\text{C}$           | 250        | W                  |
| $dv/dt^{(2)}$  | Peak diode recovery voltage slope                                      | 50         | V/ns               |
| $dv/dt^{(3)}$  | MOSFET $dv/dt$ ruggedness                                              | 50         |                    |
| $T_{stg}$      | Storage temperature                                                    | -55 to 150 | $^{\circ}\text{C}$ |
| $T_j$          | Operating junction temperature                                         |            |                    |

**Notes:**

<sup>(1)</sup> Pulse width is limited by safe operating area.

<sup>(2)</sup>  $I_{SD} \leq 34\text{ A}$ ,  $di/dt=900\text{ A}/\mu\text{s}$ ;  $V_{DS\text{ peak}} < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$ .

<sup>(3)</sup>  $V_{DS} \leq 480\text{ V}$ .

Table 3: Thermal data

| Symbol         | Parameter                           | Value | Unit                        |
|----------------|-------------------------------------|-------|-----------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case    | 0.50  | $^{\circ}\text{C}/\text{W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-ambient | 50    |                             |

Table 4: Avalanche characteristics

| Symbol         | Parameter                                       | Value | Unit |
|----------------|-------------------------------------------------|-------|------|
| $I_{AR}$       | Avalanche current, repetitive or not repetitive | 6     | A    |
| $E_{AS}^{(1)}$ | Single pulse avalanche energy                   | 800   | mJ   |

**Notes:**

<sup>(1)</sup> starting  $T_j = 25\text{ }^{\circ}\text{C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50\text{ V}$ .

## 2 Electrical characteristics

( $T_{\text{case}} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified)

**Table 5: Static**

| Symbol                      | Parameter                         | Test conditions                                                                                                    | Min. | Typ.  | Max.    | Unit          |
|-----------------------------|-----------------------------------|--------------------------------------------------------------------------------------------------------------------|------|-------|---------|---------------|
| $V_{(\text{BR})\text{DSS}}$ | Drain-source breakdown voltage    | $V_{\text{GS}} = 0\text{ V}$ , $I_{\text{D}} = 1\text{ mA}$                                                        | 600  |       |         | V             |
| $I_{\text{DSS}}$            | Zero gate voltage drain current   | $V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 600\text{ V}$                                                      |      |       | 1       | $\mu\text{A}$ |
|                             |                                   | $V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 600\text{ V}$ ,<br>$T_{\text{case}} = 125\text{ }^{\circ}\text{C}$ |      |       | 100     |               |
| $I_{\text{GSS}}$            | Gate-body leakage current         | $V_{\text{DS}} = 0\text{ V}$ , $V_{\text{GS}} = \pm 25\text{ V}$                                                   |      |       | $\pm 5$ | $\mu\text{A}$ |
| $V_{\text{GS(th)}}$         | Gate threshold voltage            | $V_{\text{DS}} = V_{\text{GS}}$ , $I_{\text{D}} = 250\text{ }\mu\text{A}$                                          | 3    | 4     | 5       | V             |
| $R_{\text{DS(on)}}$         | Static drain-source on-resistance | $V_{\text{GS}} = 10\text{ V}$ , $I_{\text{D}} = 17\text{ A}$                                                       |      | 0.085 | 0.093   | $\Omega$      |

**Table 6: Dynamic**

| Symbol                     | Parameter                     | Test conditions                                                                                                                                               | Min. | Typ. | Max. | Unit     |
|----------------------------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|----------|
| $C_{\text{iss}}$           | Input capacitance             | $V_{\text{DS}} = 100\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{\text{GS}} = 0\text{ V}$                                                                         | -    | 2500 | -    | pF       |
| $C_{\text{oss}}$           | Output capacitance            |                                                                                                                                                               | -    | 120  | -    |          |
| $C_{\text{rss}}$           | Reverse transfer capacitance  |                                                                                                                                                               | -    | 3    | -    |          |
| $C_{\text{oss eq.}}^{(1)}$ | Equivalent output capacitance | $V_{\text{DS}} = 0\text{ to }480\text{ V}$ , $V_{\text{GS}} = 0\text{ V}$                                                                                     | -    | 200  | -    | pF       |
| $R_{\text{G}}$             | Intrinsic gate resistance     | $f = 1\text{ MHz}$ , $I_{\text{D}} = 0\text{ A}$                                                                                                              | -    | 4    | -    | $\Omega$ |
| $Q_{\text{g}}$             | Total gate charge             | $V_{\text{DD}} = 480\text{ V}$ , $I_{\text{D}} = 34\text{ A}$ ,<br>$V_{\text{GS}} = 10\text{ V}$ (see <a href="#">Figure 15: "Gate charge test circuit"</a> ) | -    | 56   | -    | nC       |
| $Q_{\text{gs}}$            | Gate-source charge            |                                                                                                                                                               | -    | 13   | -    |          |
| $Q_{\text{gd}}$            | Gate-drain charge             |                                                                                                                                                               | -    | 30   | -    |          |

**Notes:**

<sup>(1)</sup>  $C_{\text{oss eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{\text{oss}}$  when  $V_{\text{DS}}$  increases from 0 to 80%  $V_{\text{DSS}}$ .

**Table 7: Switching times**

| Symbol              | Parameter           | Test conditions                                                                                                                                                                                                                                                                     | Min. | Typ. | Max. | Unit |
|---------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{\text{d(on)}}$  | Turn-on delay time  | $V_{\text{DD}} = 300\text{ V}$ , $I_{\text{D}} = 25\text{ A}$<br>$R_{\text{G}} = 4.7\text{ }\Omega$ , $V_{\text{GS}} = 10\text{ V}$<br>(see <a href="#">Figure 14: "Switching times test circuit for resistive load"</a> and <a href="#">Figure 19: "Switching time waveform"</a> ) | -    | 29   | -    | ns   |
| $t_{\text{r}}$      | Rise time           |                                                                                                                                                                                                                                                                                     | -    | 27   | -    |      |
| $t_{\text{d(off)}}$ | Turn-off delay time |                                                                                                                                                                                                                                                                                     | -    | 85   | -    |      |
| $t_{\text{f}}$      | Fall time           |                                                                                                                                                                                                                                                                                     | -    | 6    | -    |      |

Table 8: Source-drain diode

| Symbol          | Parameter                     | Test conditions                                                                                                                                                                                                                          | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                                                                                                                          | -    |      | 34   | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                                                                                                                          | -    |      | 136  | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $V_{GS} = 0\text{ V}$ , $I_{SD} = 34\text{ A}$                                                                                                                                                                                           | -    |      | 1.6  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 34\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$ (see <a href="#">Figure 16: "Test circuit for inductive load switching and diode recovery times"</a> )                                        | -    | 120  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                                                          | -    | 0.6  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                                                          | -    | 10.4 |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 34\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 16: "Test circuit for inductive load switching and diode recovery times"</a> ) | -    | 240  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                                                          | -    | 2.4  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                                                          | -    | 20.5 |      | A             |

**Notes:**

<sup>(1)</sup> Pulse width is limited by safe operating area.

<sup>(2)</sup> Pulse test: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

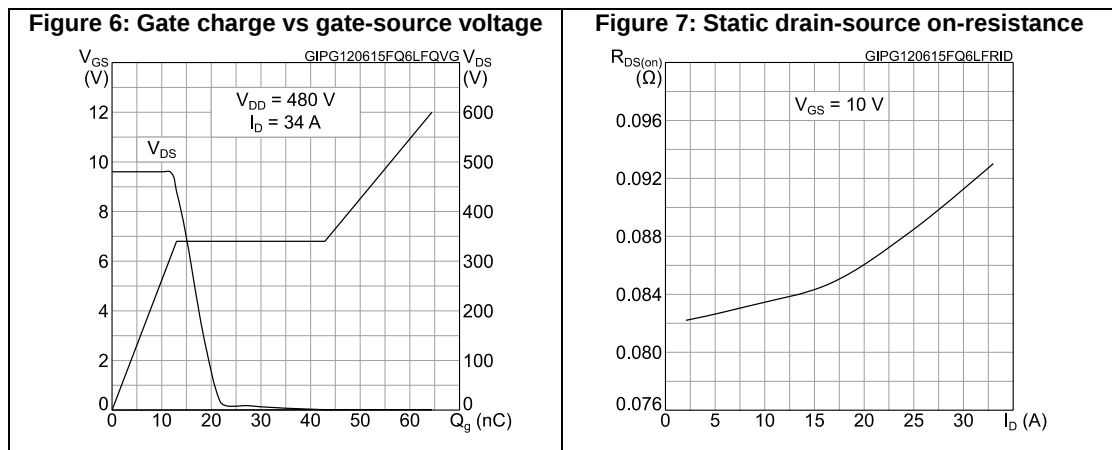
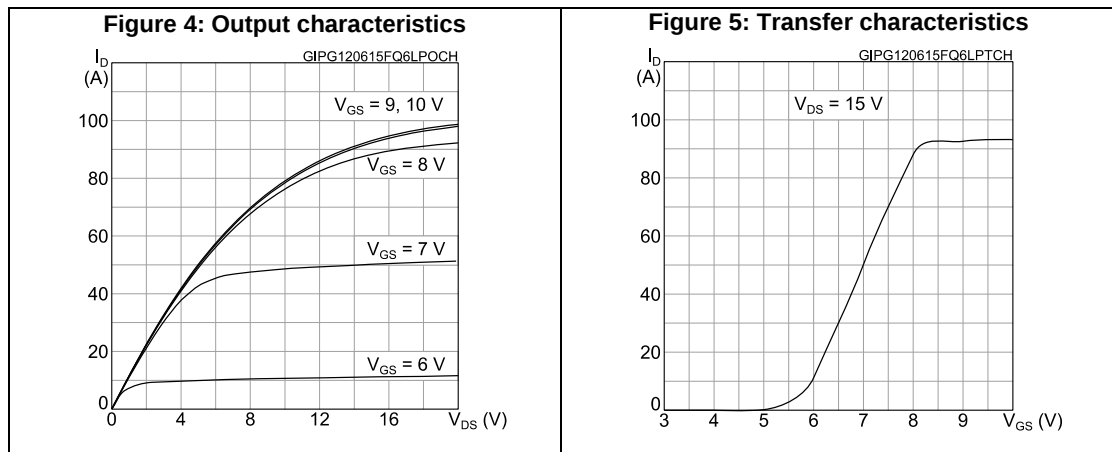
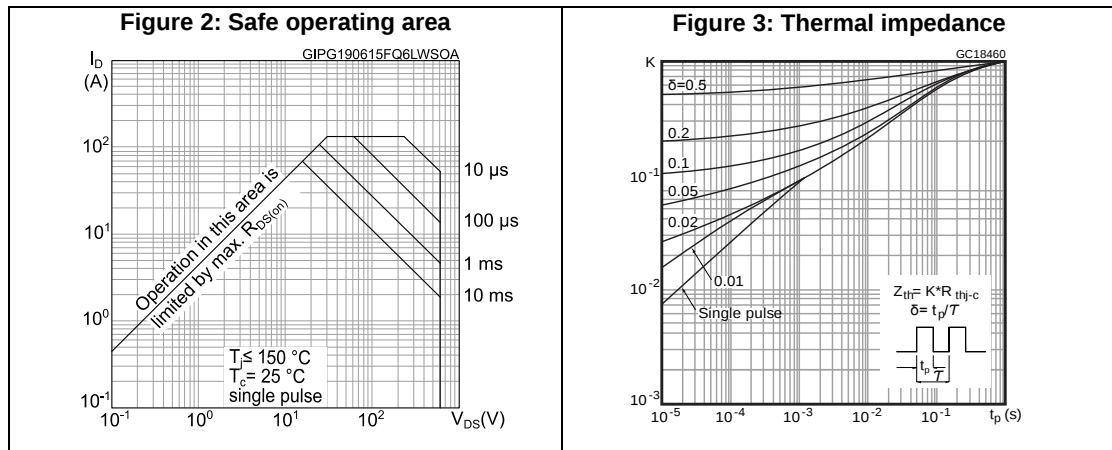


Figure 8: Capacitance variations

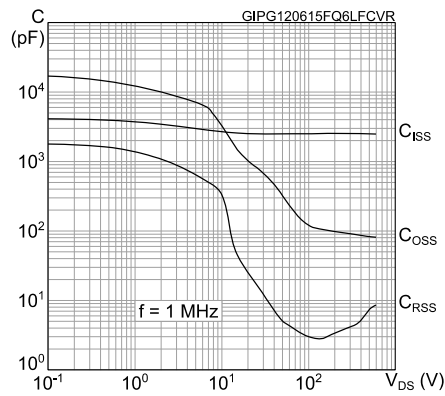


Figure 9: Normalized gate threshold voltage vs temperature

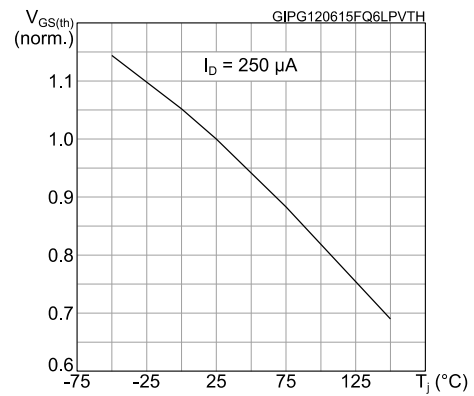


Figure 10: Normalized on-resistance vs temperature

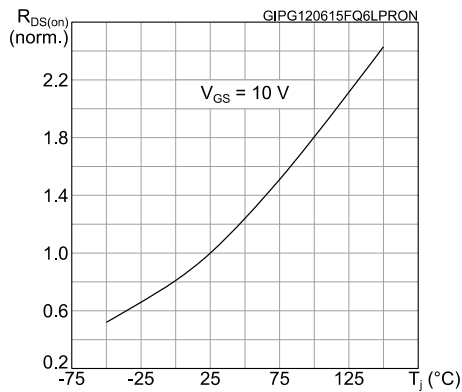
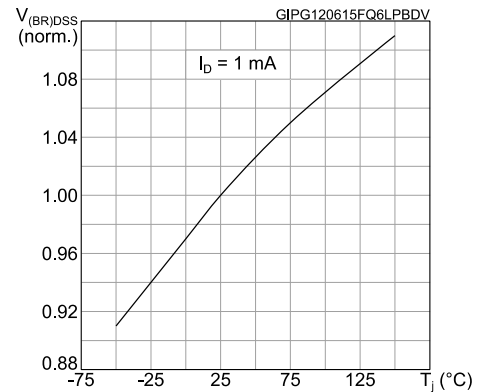
Figure 11: Normalized  $V_{(BR)DSS}$  vs temperature

Figure 12: Output capacitance stored energy

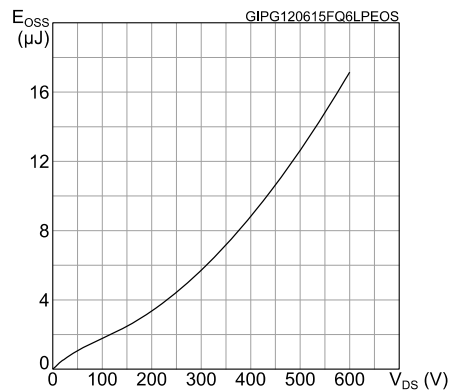
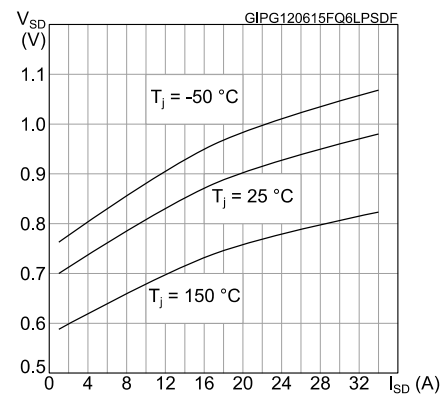
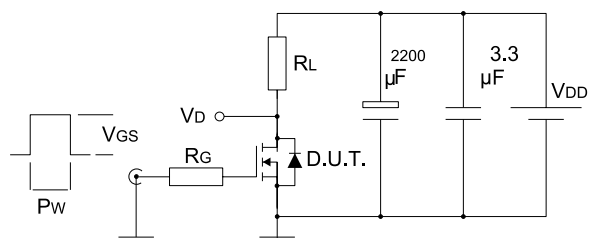


Figure 13: Source-drain diode forward characteristics



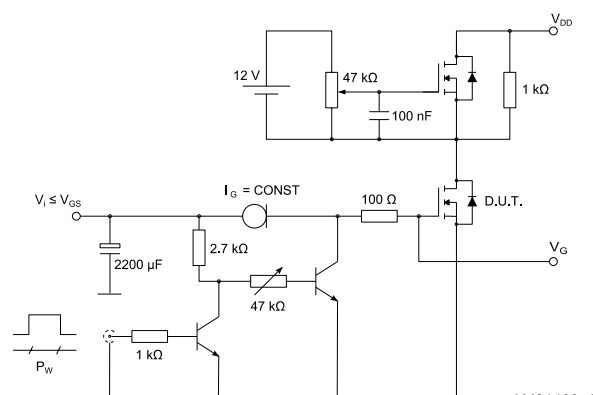
### 3 Test circuits

**Figure 14: Switching times test circuit for resistive load**



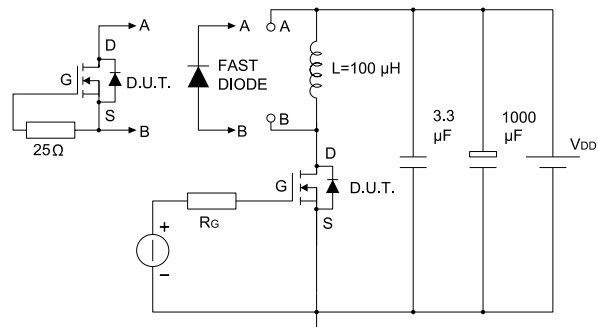
AM01468v1

**Figure 15: Gate charge test circuit**



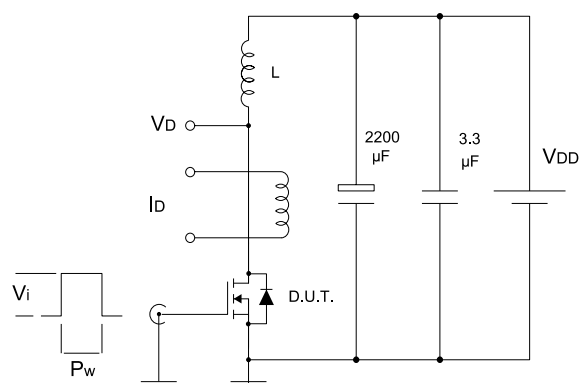
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**Figure 16: Test circuit for inductive load switching and diode recovery times**



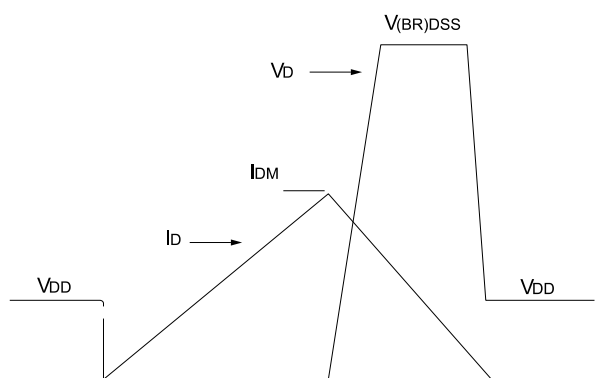
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**Figure 17: Unclamped inductive load test circuit**



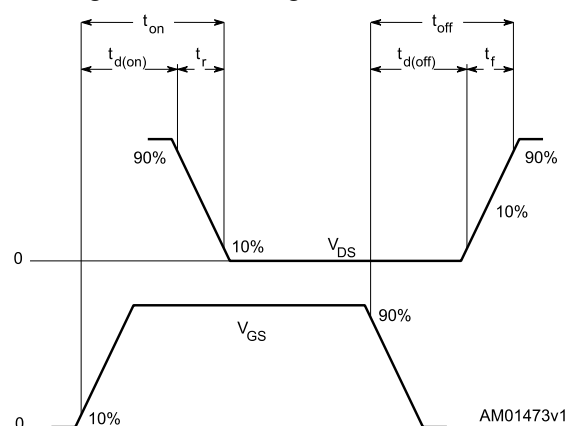
AM01471v1

**Figure 18: Unclamped inductive waveform**



AM01472v1

**Figure 19: Switching time waveform**



AM01473v1

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

### 4.1 TO-247 package information

Figure 20: TO-247 package outline

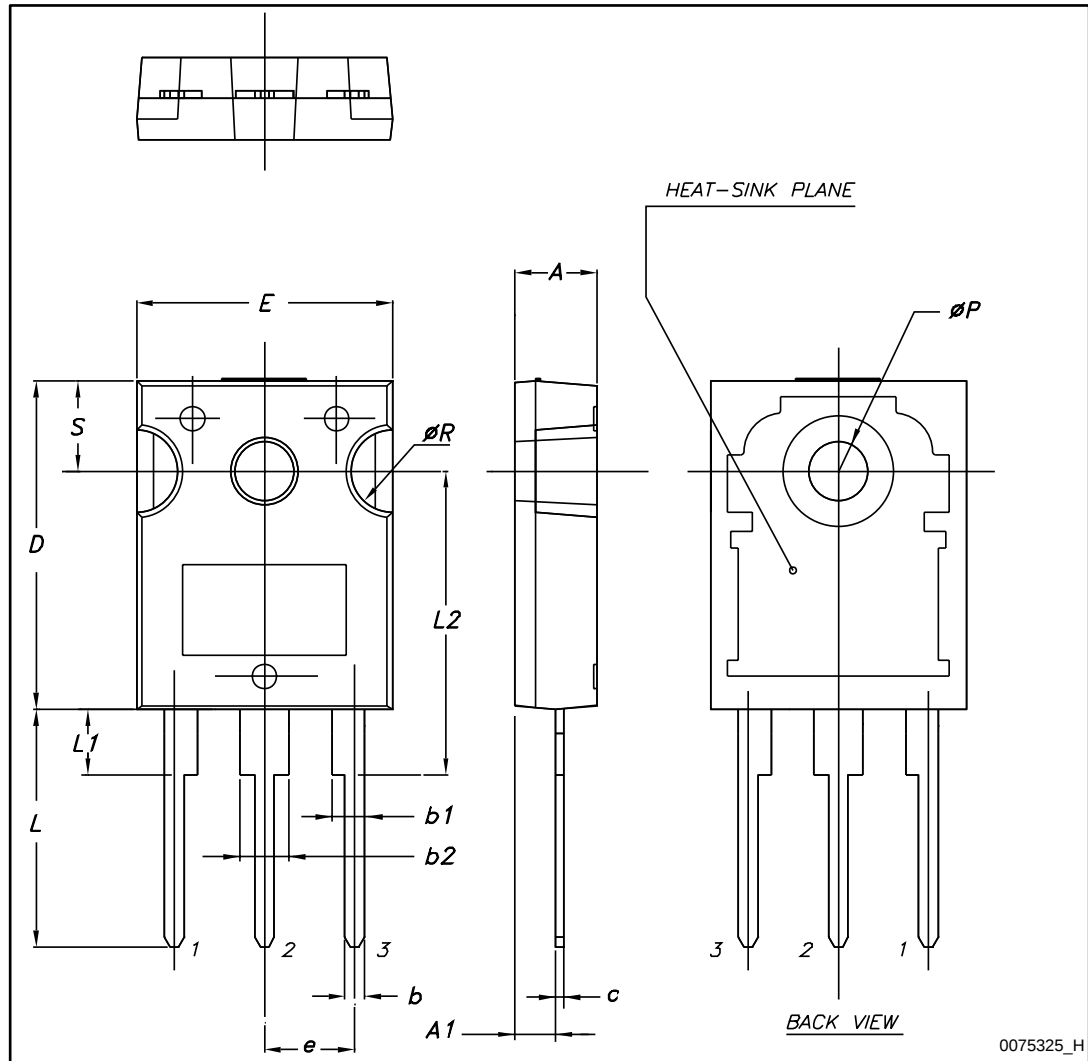


Table 9: TO-247 package mechanical data

| 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-2015 | 1        | Initial release.<br>Part number STW43N60DM2 previously included in DocID026790                                                                                                                                                                                                                                                                                                                         |
| 02-Jul-2015 | 2        | On cover page:<br>- updated title<br>In section <i>Electrical characteristics</i> :<br>- updated tables <i>Static</i> , <i>Dynamic</i> , <i>Switching times</i> and <i>Source-drain diode</i><br>In section <i>Electrical characteristics (curves)</i> :<br>- updated figures <i>Gate charge vs gate-source voltage</i> , <i>Static drain-source on-resistance</i> , and <i>Capacitance variations</i> |

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