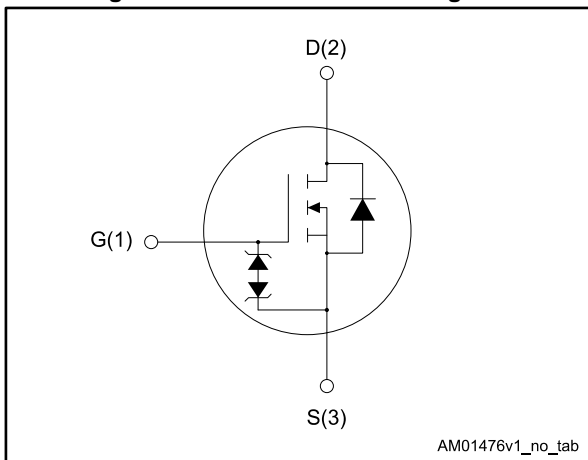


## N-channel 600 V, 0.175 $\Omega$ typ., 18 A MDmesh™ DM2 Power MOSFET in a TO-220FP package

Datasheet - production data



Figure 1: Internal schematic diagram



### Features

| Order code  | V <sub>DS</sub> @ T <sub>Jmax</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> |
|-------------|-------------------------------------|--------------------------|----------------|
| STF24N60DM2 | 650 V                               | 0.200 $\Omega$           | 18 A           |

- 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 |
|-------------|----------|----------|---------|
| STF24N60DM2 | 24N60DM2 | TO-220FP | 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                |
| $I_D^{(1)}$       | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$  | 18         | A                |
|                   | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$   | 11         |                  |
| $I_{DM}^{(2)(1)}$ | Drain current (pulsed)  | 72         | A                |
| $P_{TOT}$         | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$   | 30         | W                |
| $dv/dt^{(3)}$     | Peak diode recovery voltage slope   | 40         | V/ns             |
| $dv/dt^{(4)}$     | MOSFET $dv/dt$ ruggedness   | 50         |                  |
| $V_{ISO}$         | Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ ; $T_C = 25\text{ }^\circ\text{C}$ ) | 2500       | V                |
| $T_{stg}$         | Storage temperature range   | -55 to 150 | $^\circ\text{C}$ |
| $T_j$             | Max. operating junction temperature range   |            |                  |

**Notes:**

(1) Limited by package.

(2) Pulse width is limited by safe operating area.

(3)  $I_{SD} \leq 18\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{S}$ ,  $V_{DS(\text{peak})} < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$ .

(4)  $V_{DS} \leq 480\text{ V}$ .

Table 3: Thermal data

| Symbol                | Parameter                                | Value | Unit                      |
|-----------------------|--|-------|---------------------------|
| $R_{thj\text{-case}}$ | Thermal resistance junction-case max.    | 4.2   | $^\circ\text{C}/\text{W}$ |
| $R_{thj\text{-amb}}$  | Thermal resistance junction-ambient max. | 62.5  |                           |

Table 4: Avalanche characteristics

| Symbol   | Parameter  | Value | Unit |
|----------|--|-------|------|
| $I_{AR}$ | Avalanche current, repetitive or not repetitive (pulse width limited by $T_{Jmax}$ )                                 | 3.5   | A    |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ ; $V_{DD} = 50\text{ V}$ ) | 180   | mJ   |

## 2 Electrical characteristics

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

**Table 5: On /off states**

| Symbol        | Parameter                         | Test conditions   | Min. | Typ.  | Max.     | Unit          |
|---------------|-----------------------------------|---|------|-------|----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage    | $V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$   | 600  |       |          | V             |
| $I_{DSS}$     | Zero gate voltage drain current   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$   |      |       | 1.5      | $\mu\text{A}$ |
|               |                                   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$ ,<br>$T_C = 125\text{ °C}$ <sup>(1)</sup> |      |       | 100      | $\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current         | $V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 25\text{ V}$  |      |       | $\pm 10$ | $\mu\text{A}$ |
| $V_{GS(th)}$  | 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 | $V_{GS} = 10\text{ V}$ , $I_D = 9\text{ A}$   |      | 0.175 | 0.200    | $\Omega$      |

**Notes:**

<sup>(1)</sup>Defined by design, not subject to production test.

**Table 6: Dynamic**

| Symbol                     | Parameter                     | Test conditions  | Min. | Typ. | Max. | Unit     |
|----------------------------|-------------------------------|--|------|------|------|----------|
| $C_{iss}$                  | Input capacitance             | $V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0\text{ V}$  | -    | 1055 | -    | pF       |
| $C_{oss}$                  | Output capacitance            |  | -    | 56   | -    | pF       |
| $C_{rss}$                  | Reverse transfer capacitance  |  | -    | 2.4  | -    | pF       |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ to }480\text{ V}$ , $V_{GS} = 0\text{ V}$  | -    | 259  | -    | pF       |
| $R_G$                      | Intrinsic gate resistance     | $f = 1\text{ MHz}$ , $I_D = 0\text{ A}$  | -    | 7    | -    | $\Omega$ |
| $Q_g$                      | Total gate charge             | $V_{DD} = 480\text{ V}$ , $I_D = 18\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 15: "Test circuit for gate charge behavior"</a> ) | -    | 29   | -    | nC       |
| $Q_{gs}$                   | Gate-source charge            |  | -    | 6    | -    | nC       |
| $Q_{gd}$                   | Gate-drain charge             |  | -    | 12   | -    | nC       |

**Notes:**

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

Table 7: Switching times

| Symbol       | Parameter           | Test conditions   | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 300\text{ V}$ , $I_D = 9\text{ A}$<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 14</a> : "Test circuit for resistive load switching times" and <a href="#">Figure 19</a> : "Switching time waveform") | -    | 15   | -    | ns   |
| $t_r$        | Rise time           |   | -    | 8.7  | -    | ns   |
| $t_{d(off)}$ | Turn-off-delay time |   | -    | 60   | -    | ns   |
| $t_f$        | Fall time           |   | -    | 15   | -    | ns   |

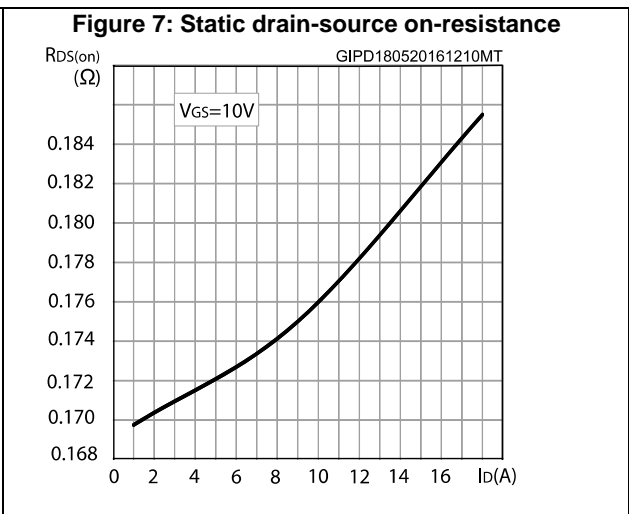
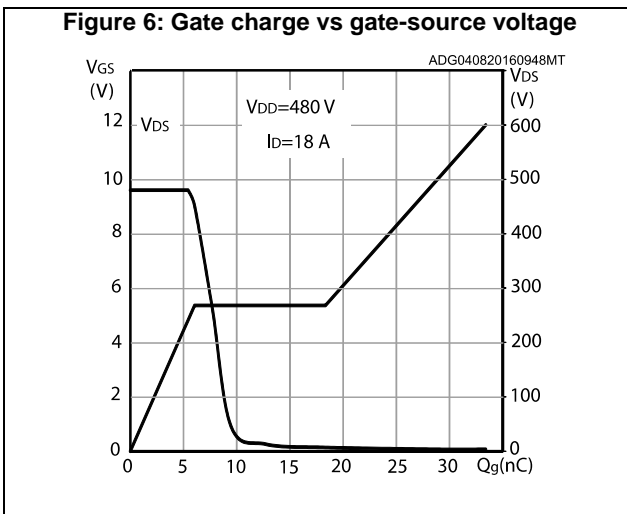
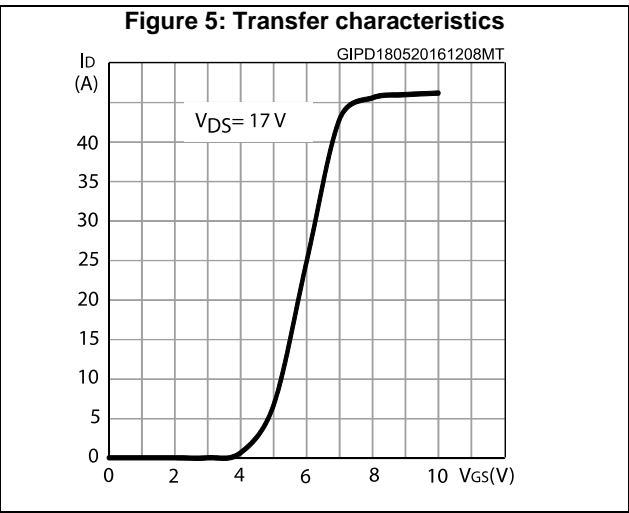
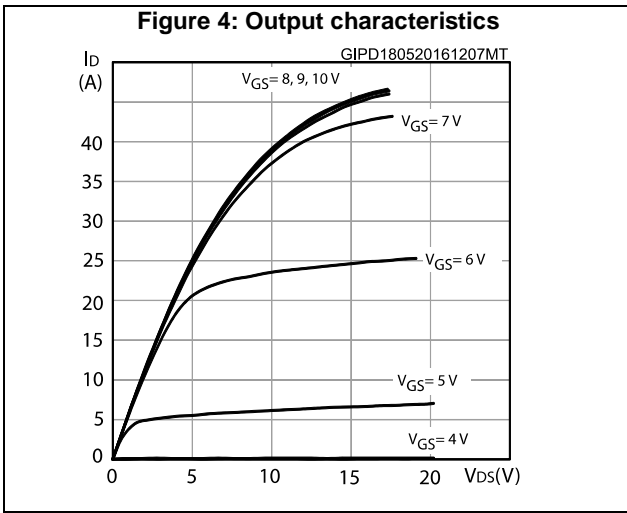
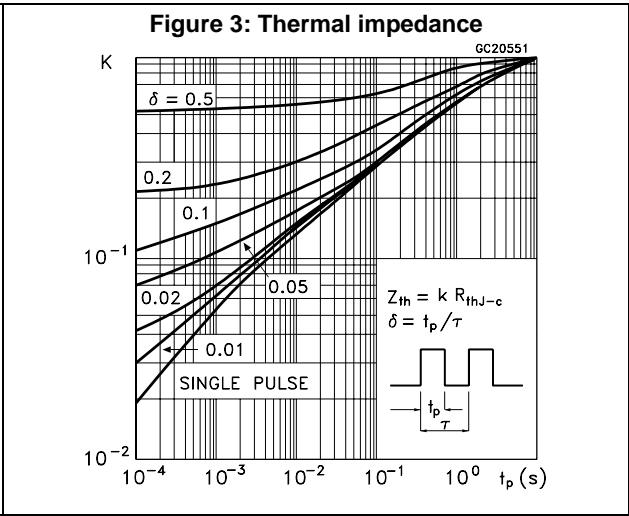
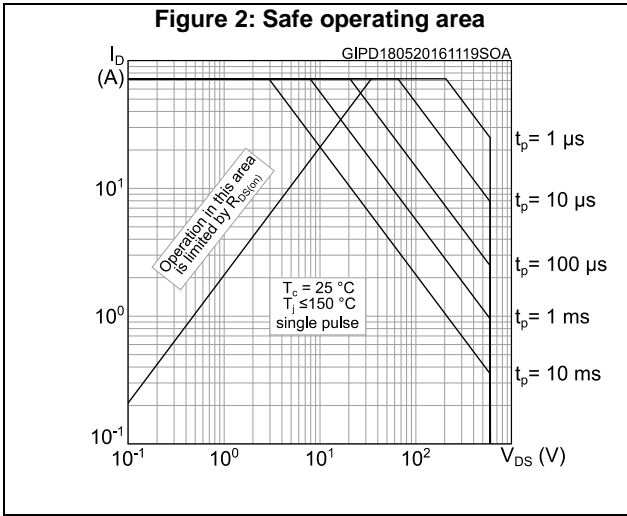
Table 8: Source-drain diode

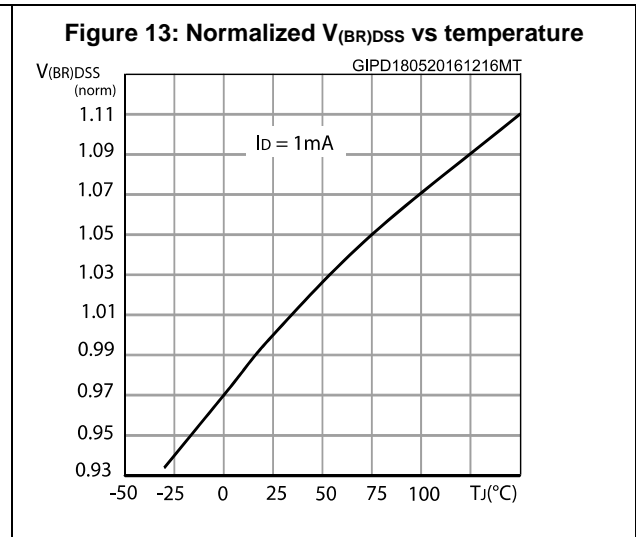
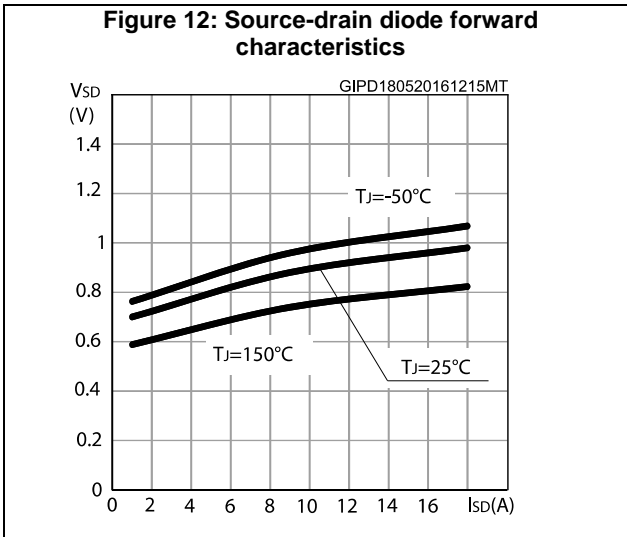
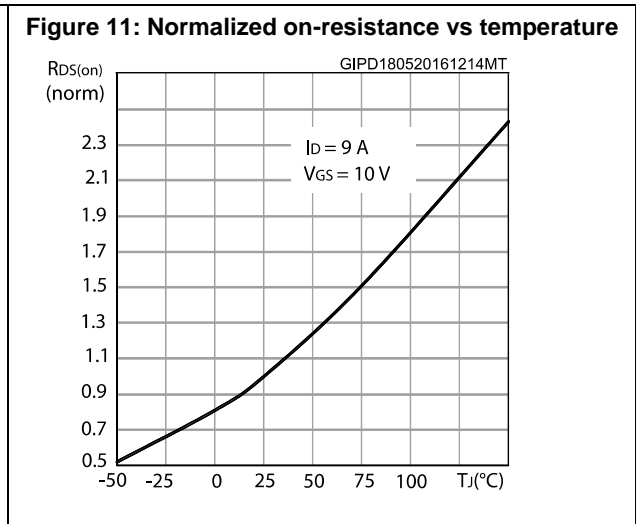
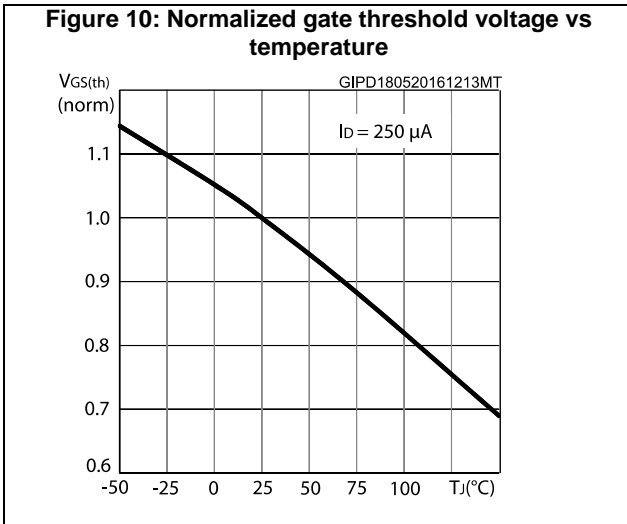
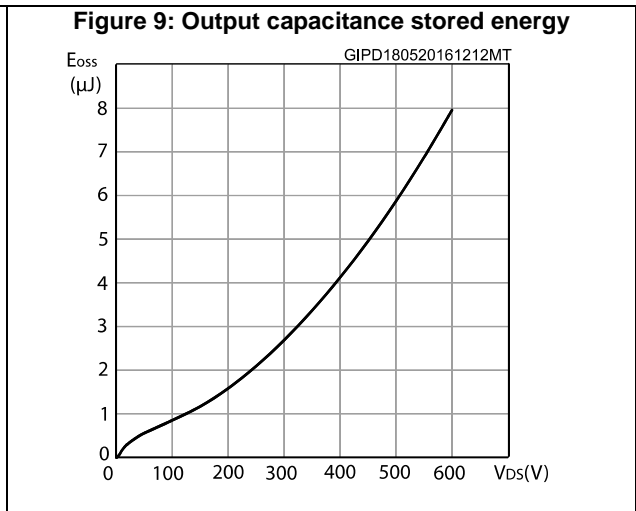
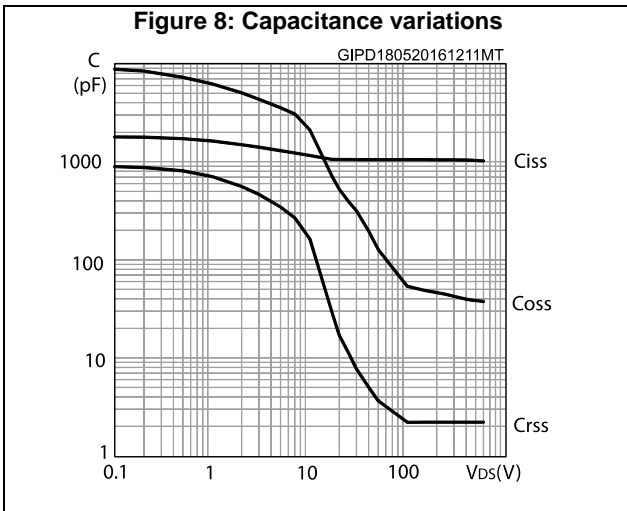
| Symbol          | Parameter                     | Test conditions  | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|------|
| $I_{SD}$        | Source-drain current          |  | -    |      | 18   | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |  | -    |      | 72   | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $V_{GS} = 0\text{ V}$ , $I_{SD} = 18\text{ A}$   | -    |      | 1.6  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 18\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$ (see <a href="#">Figure 16</a> : "Test circuit for inductive load switching and diode recovery times")                                     | -    | 155  |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |  | -    | 956  |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |  | -    | 12.5 |      | A    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 18\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 16</a> : "Test circuit for inductive load switching and diode recovery times") | -    | 200  |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |  | -    | 1450 |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |  | -    | 13   |      | A    |

**Notes:**

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

## 2.1 Electrical characteristics (curves)





### 3 Test circuits

**Figure 14: Test circuit for resistive load switching times**



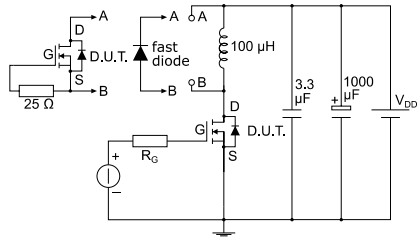
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**Figure 15: Test circuit for gate charge behavior**



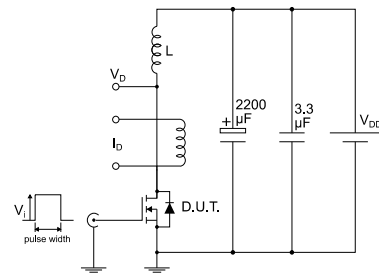
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**Figure 16: Test circuit for inductive load switching and diode recovery times**



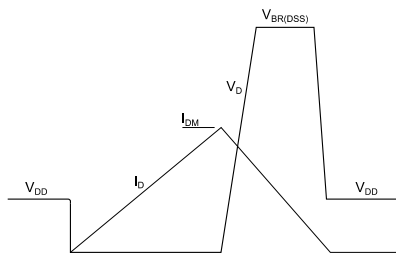
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**Figure 17: Unclamped inductive load test circuit**



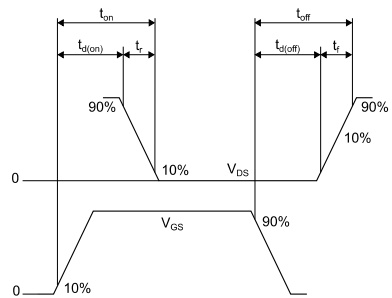
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**Figure 18: Unclamped inductive waveform**



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**Figure 19: Switching time waveform**



AM01473v1

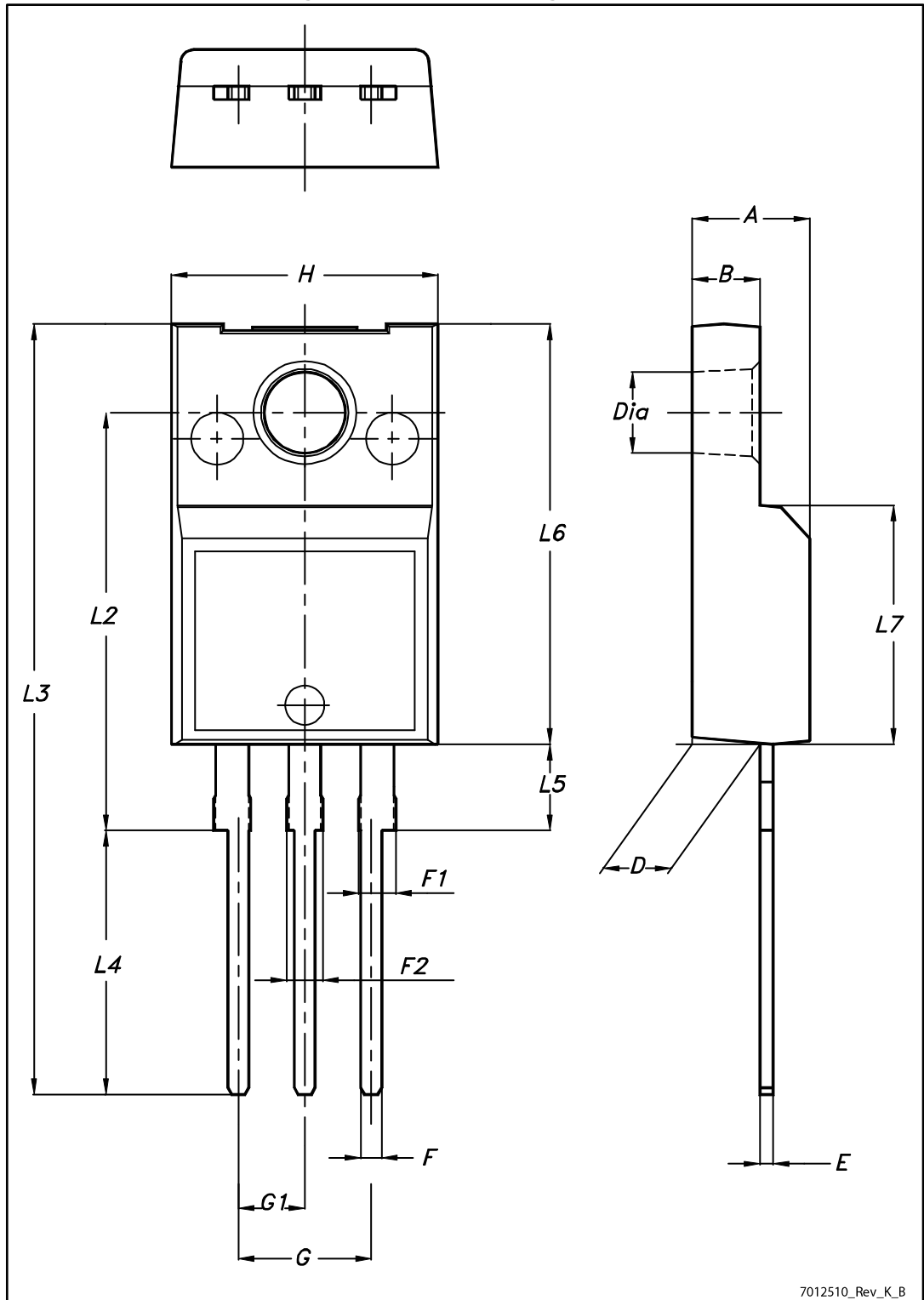


## 4 Package information

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-220FP package information

Figure 20: TO-220FP package outline



7012510\_Rev\_K\_B



Table 9: TO-220FP package mechanical data

| Dim. | mm   |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 4.4  |      | 4.6  |
| B    | 2.5  |      | 2.7  |
| D    | 2.5  |      | 2.75 |
| E    | 0.45 |      | 0.7  |
| F    | 0.75 |      | 1    |
| F1   | 1.15 |      | 1.70 |
| F2   | 1.15 |      | 1.70 |
| G    | 4.95 |      | 5.2  |
| G1   | 2.4  |      | 2.7  |
| H    | 10   |      | 10.4 |
| L2   |      | 16   |      |
| L3   | 28.6 |      | 30.6 |
| L4   | 9.8  |      | 10.6 |
| L5   | 2.9  |      | 3.6  |
| L6   | 15.9 |      | 16.4 |
| L7   | 9    |      | 9.3  |
| Dia  | 3    |      | 3.2  |

## 5 Revision history

**Table 10: Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 12-Nov-2013 | 1        | First release.   |
| 21-Jan-2014 | 2        | <ul style="list-style-type: none"> <li>– Modified: <math>dv/dt</math> value in Table 2</li> <li>– Modified: <math>I_{AR}</math> value in Table 4</li> <li>– Modified: <math>I_{DSS}</math> and <math>V_{GS(th)}</math> in Table 5</li> <li>– Minor text changes</li> </ul>                           |
| 03-Mar-2014 | 3        | <ul style="list-style-type: none"> <li>– Modified: Figure 1</li> <li>– Modified: <math>P_{TOT}</math> value and note 1 in Table 2</li> <li>– Modified: <math>R_{thj-case}</math> value in Table 3</li> <li>– Modified: <math>I_{AR}</math> value in Table 4</li> <li>– Minor text changes</li> </ul> |
| 05-Mar-2015 | 4        | <ul style="list-style-type: none"> <li>– Document status promoted from preliminary to production data.</li> <li>– Updated title, features and description in cover page.</li> </ul>  |
| 20-Sep-2016 | 5        | <ul style="list-style-type: none"> <li>Updated <a href="#">Figure 2: "Safe operating area"</a>.</li> <li>Minor text changes</li> </ul>   |

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