

## N-channel 600 V, 0.395 $\Omega$ typ., 9 A MDmesh™ M2 Power MOSFET in a TO-220FP package

Datasheet - production data

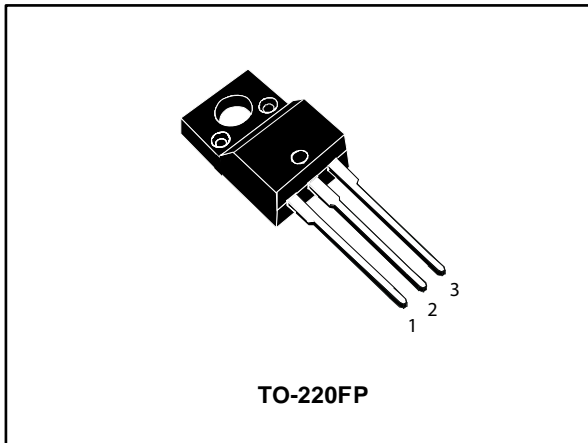


Figure 1: Internal schematic diagram

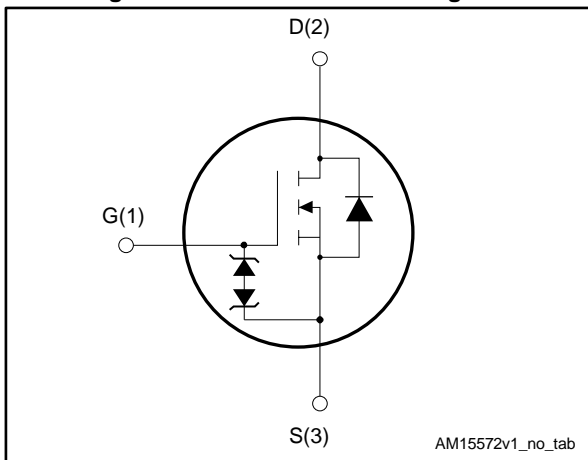


Table 1: Device summary

| Order code | Marking | Package  | Packing |
|------------|---------|----------|---------|
| STF12N60M2 | 12N60M2 | TO-220FP | Tube    |

### Features

| Order code | V <sub>DS</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> | P <sub>TOT</sub> |
|------------|-----------------|--------------------------|----------------|------------------|
| STF12N60M2 | 600 V           | 0.450 $\Omega$           | 9 A            | 25 W             |

- Extremely low gate charge
- Excellent output capacitance (C<sub>oss</sub>) profile
- 100% avalanche tested
- Zener-protected

### Applications

- Switching applications

### Description

This device is an N-channel Power MOSFET developed using MDmesh™ M2 technology. Thanks to its strip layout and an improved vertical structure, the device exhibits low on-resistance and optimized switching characteristics, rendering it suitable for the most demanding high efficiency converters.

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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 $T_{case} = 25\text{ °C}$   | 9          | A    |
|                | Drain current (continuous) at $T_{case} = 100\text{ °C}$  | 5.7        |      |
| $I_{DM}^{(2)}$ | Drain current (pulsed)  | 36         | A    |
| $P_{TOT}$      | Total dissipation at $T_{case} = 25\text{ °C}$  | 25         | W    |
| $dv/dt^{(3)}$  | Peak diode recovery voltage slope   | 15         | V/ns |
| $dv/dt^{(4)}$  | MOSFET $dv/dt$ ruggedness   | 50         |      |
| $V_{ISO}$      | Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ ; $T_C = 25\text{ °C}$ ) | 2.5        | kV   |
| $T_{stg}$      | Storage temperature   | -55 to 150 | °C   |
| $T_j$          | Maximum junction temperature  | 150        |      |

**Notes:**

- (1) Limited by maximum junction temperature.  
 (2) Pulse width is limited by safe operating area.  
 (3)  $I_{SD} \leq 9\text{ A}$ ,  $di/dt=400\text{ A}/\mu\text{s}$ ;  $V_{DS(peak)} < V_{(BR)DSS}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$ .  
 (4)  $V_{DS} \leq 480\text{ V}$ .

**Table 3: Thermal data**

| Symbol         | Parameter                           | Value | Unit |
|----------------|-------------------------------------|-------|------|
| $R_{thj-case}$ | Thermal resistance junction-case    | 5     | °C/W |
| $R_{thj-amb}$  | Thermal resistance junction-ambient | 62.5  |      |

**Table 4: Avalanche characteristics**

| Symbol         | Parameter                                       | Value | Unit |
|----------------|---|-------|------|
| $I_{AR}^{(1)}$ | Avalanche current, repetitive or not repetitive | 2.6   | A    |
| $E_{AR}^{(2)}$ | Single pulse avalanche energy                   | 117   | mJ   |

**Notes:**

- (1) Pulse width limited by  $T_{jmax}$ .  
 (2) starting  $T_j = 25\text{ °C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50\text{ V}$ .

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

**Table 5: Static**

| 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        | $\mu\text{A}$ |
|               |                                   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$ ,<br>$T_{\text{case}} = 125\text{ °C}$ |      |       | 100      |               |
| $I_{GSS}$     | 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            | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                     | 2    | 3     | 4        | V             |
| $R_{DS(on)}$  | Static drain-source on-resistance | $V_{GS} = 10\text{ V}$ , $I_D = 4.5\text{ A}$  |      | 0.395 | 0.450    | $\Omega$      |

**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>$V_{GS} = 0\text{ V}$   | -    | 538  | -    | $\text{pF}$ |
| $C_{oss}$                  | Output capacitance            |   | -    | 29   | -    |             |
| $C_{rss}$                  | Reverse transfer capacitance  |   | -    | 1.1  | -    |             |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ to }480\text{ V}$ , $V_{GS} = 0\text{ V}$   | -    | 106  | -    | $\text{pF}$ |
| $R_G$                      | Intrinsic gate resistance     | $f = 1\text{ MHz}$ , $I_D = 0\text{ A}$   | -    | 7    | -    | $\Omega$    |
| $Q_g$                      | Total gate charge             | $V_{DD} = 400\text{ V}$ , $I_D = 9\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ (see <a href="#">Figure 15: "Gate charge test circuit"</a> ) | -    | 16   | -    | $\text{nC}$ |
| $Q_{gs}$                   | Gate-source charge            |   | -    | 2.3  | -    |             |
| $Q_{gd}$                   | Gate-drain charge             |   | -    | 8.5  | -    |             |

**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  | $V_{DD} = 300\text{ V}$ , $I_D = 4.5\text{ A}$<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 14: "Switching times test circuit for resistive load"</a> and <a href="#">Figure 19: "Switching time waveform"</a> ) | -    | 9.2  | -    | $\text{ns}$ |
| $t_r$        | Rise time           |   | -    | 9.2  | -    |             |
| $t_{d(off)}$ | Turn-off delay time |   | -    | 56   | -    |             |
| $t_f$        | Fall time           |   | -    | 18   | -    |             |

Table 8: Source-drain diode

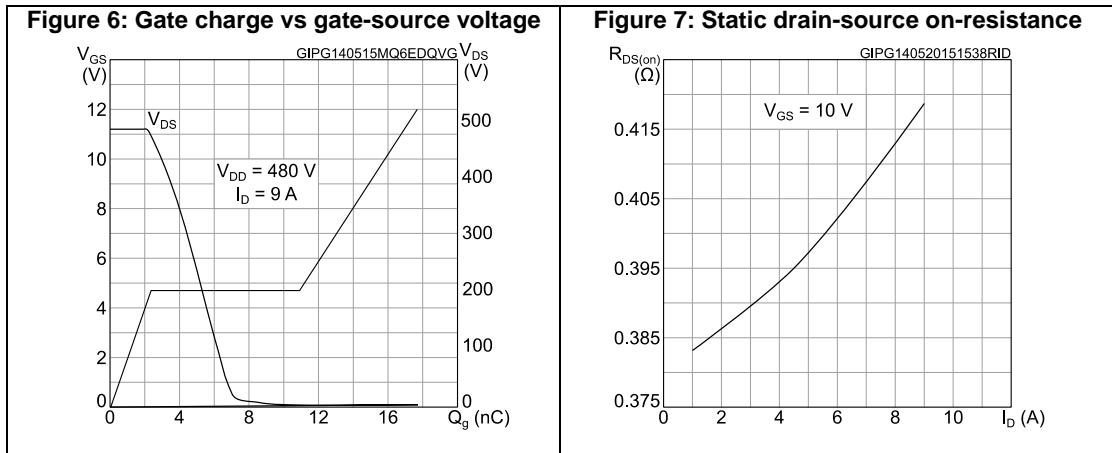
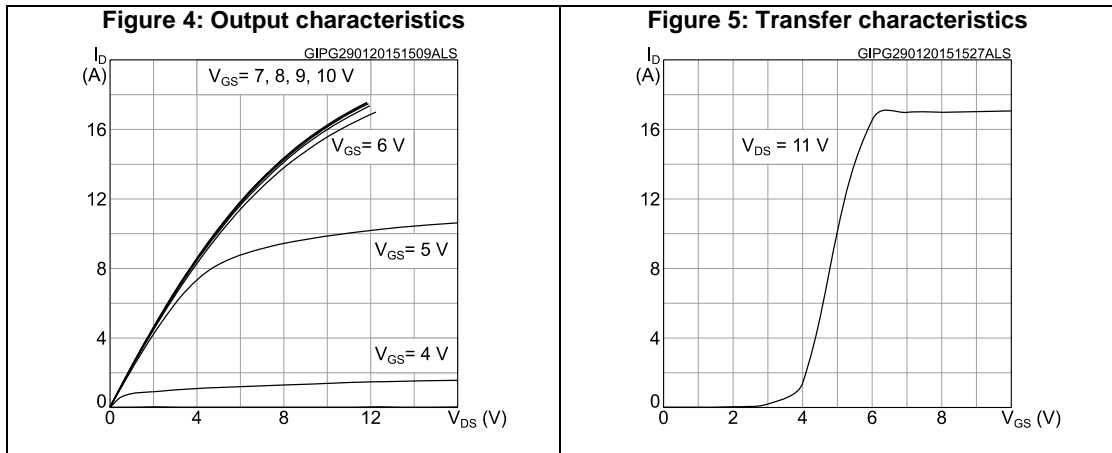
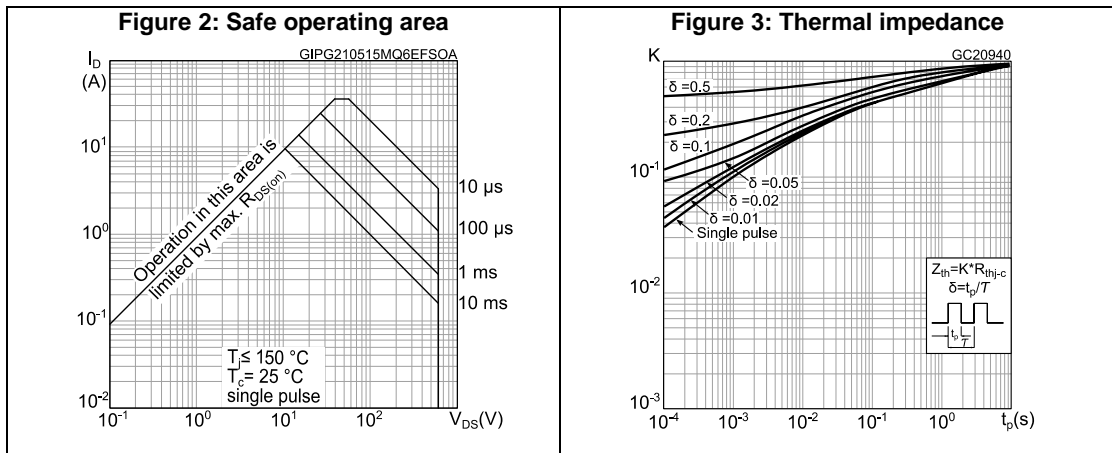
| Symbol          | Parameter                     | Test conditions   | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|---|------|------|------|---------------|
| $I_{SD}$        | Source-drain current          |   | -    |      | 9    | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |   | -    |      | 36   | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $V_{GS} = 0\text{ V}$ , $I_{SD} = 9\text{ A}$   | -    |      | 1.6  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 9\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 60\text{ V}$ (see <a href="#">Figure 16</a> :<br>"Test circuit for inductive load switching and diode recovery times")                                  | -    | 284  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |   | -    | 2.4  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |   | -    | 20.5 |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 9\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<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") | -    | 454  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |   | -    | 4.8  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |   | -    | 21   |      | A             |

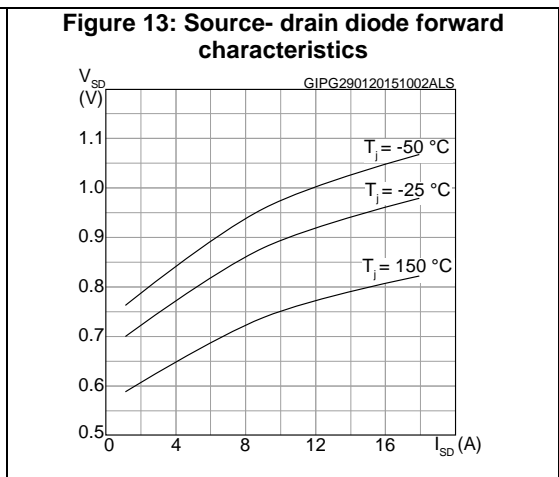
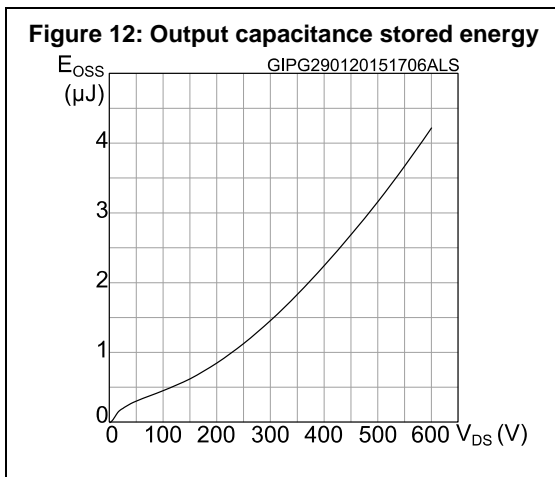
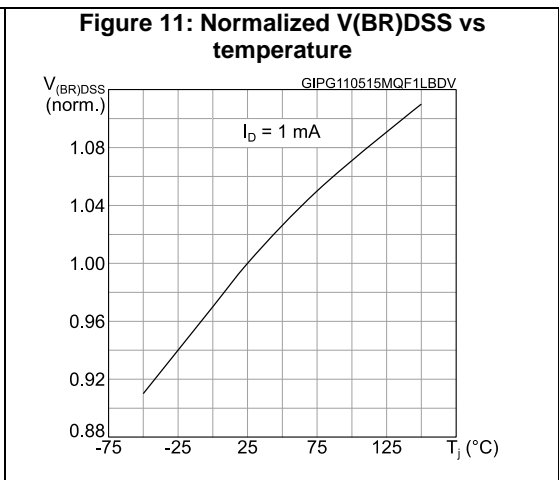
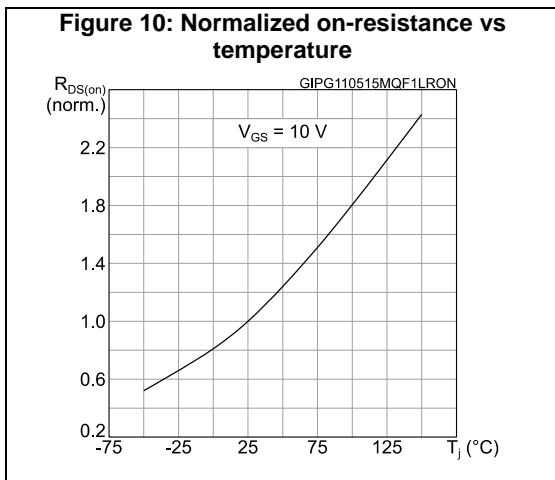
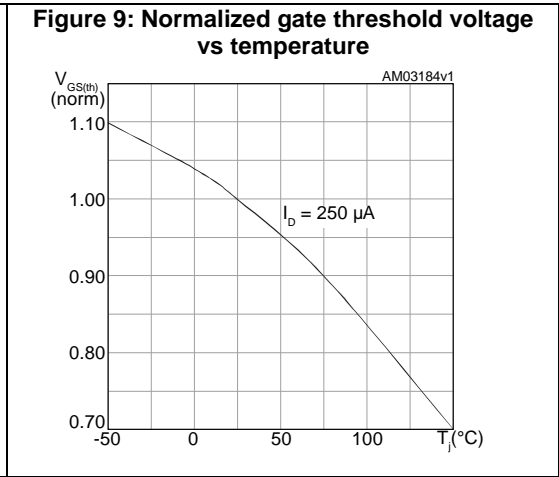
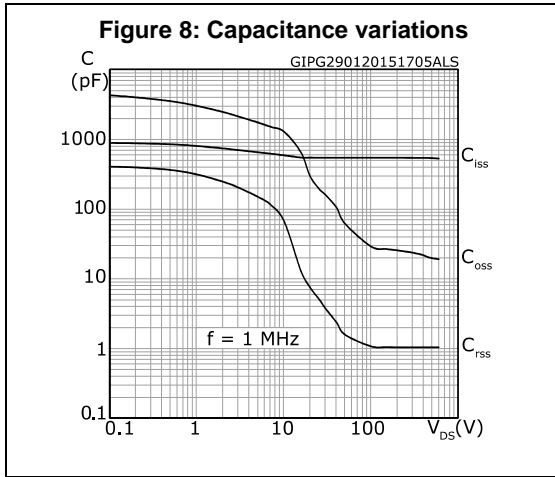
**Notes:**

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

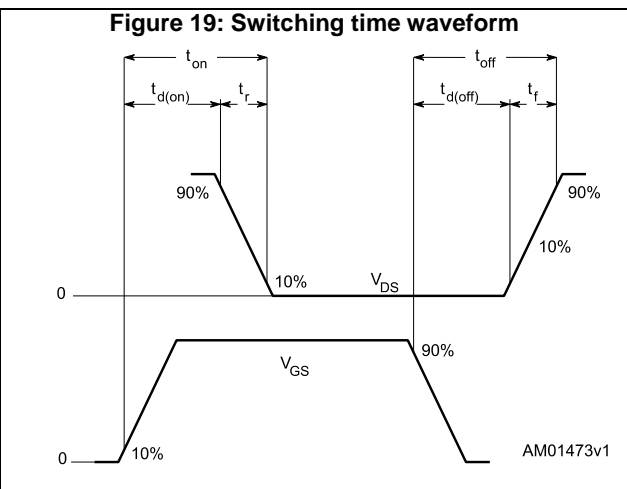
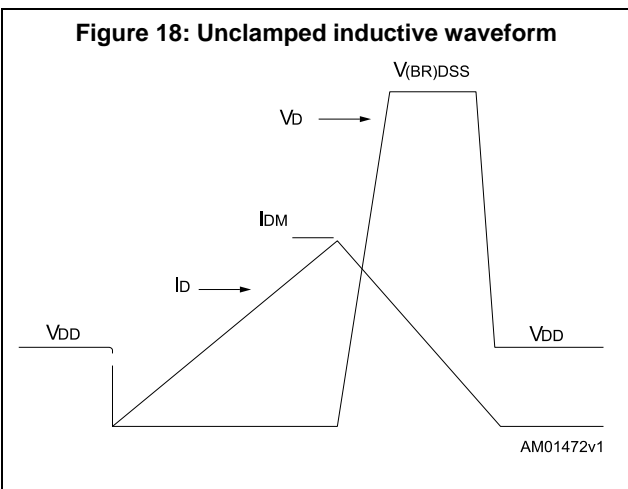
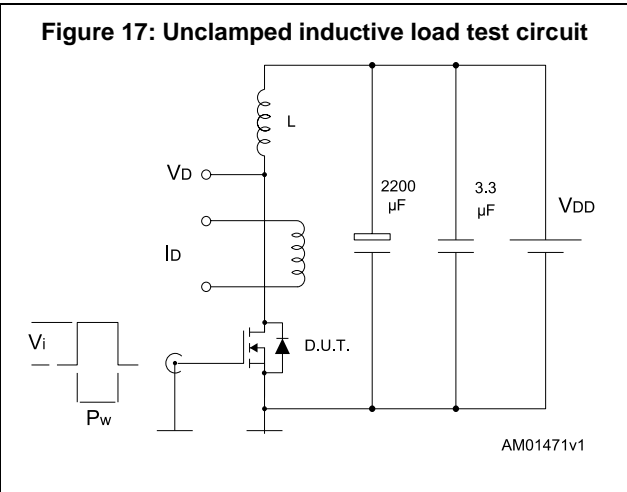
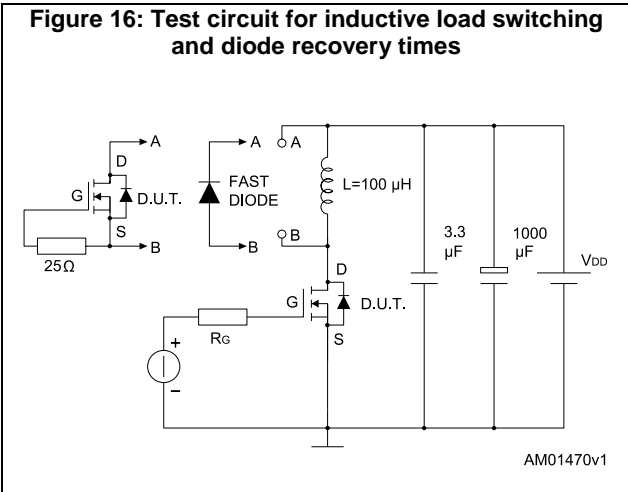
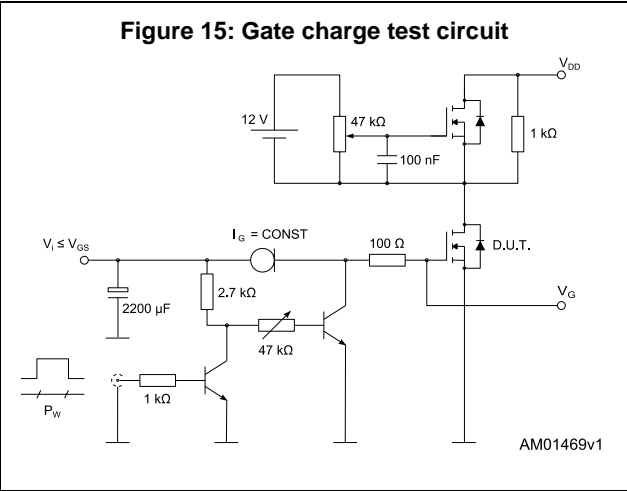
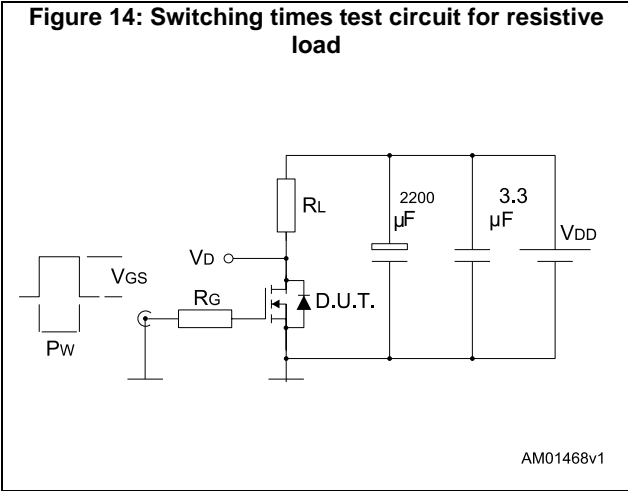
(2) Pulse test: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)





### 3 Test circuits



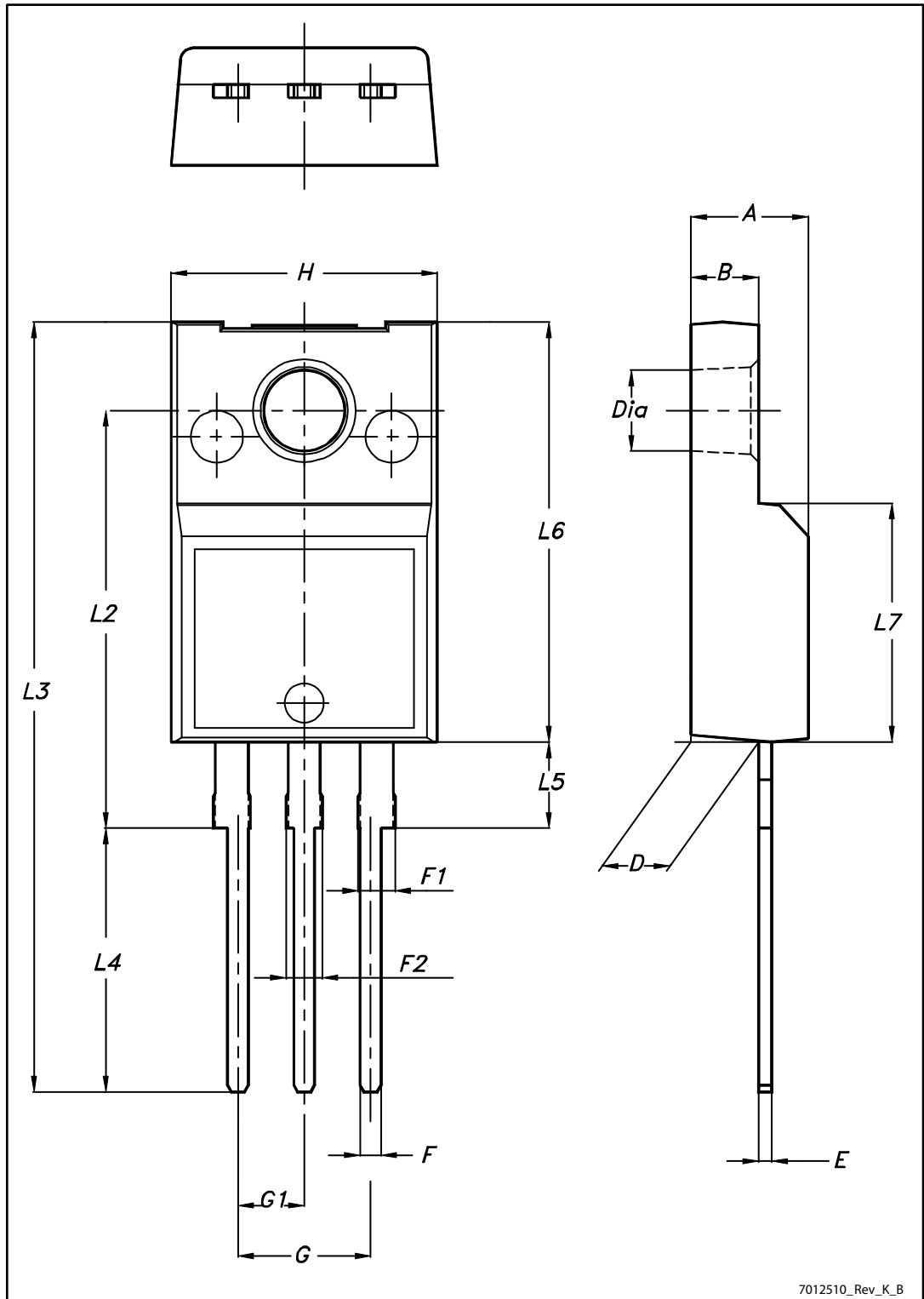


## 4 Package information

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        |
|-------------|----------|----------------|
| 22-May-2015 | 1        | First release. |

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