

## N-channel 600 V, 0.135 $\Omega$ typ., 20 A MDmesh™ II Power MOSFET in a TO-220FP package

Datasheet - production data

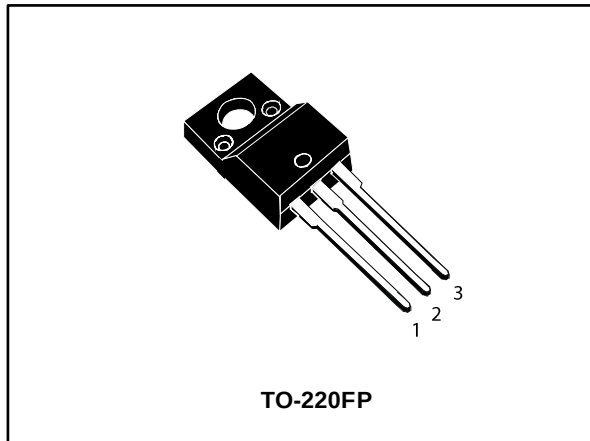
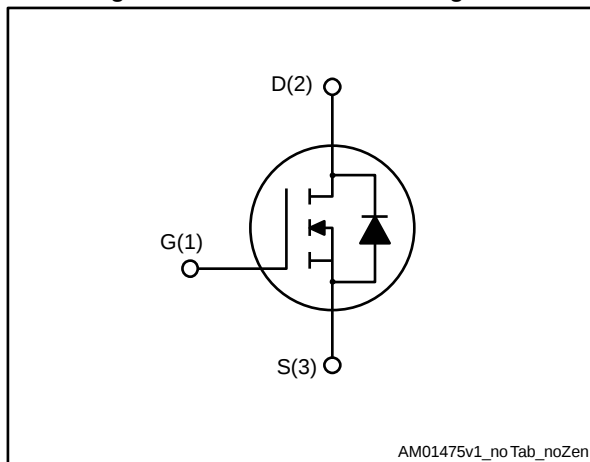


Figure 1: Internal schematic diagram



### Features

| Order code | V <sub>DS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> |
|------------|-----------------|-------------------------|----------------|
| STF26NM60N | 600 V           | 0.165 $\Omega$          | 20 A           |

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

### Applications

- Switching applications

### Description

This device is an N-channel Power MOSFET developed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

Table 1: Device summary

| Order code | Marking | Package  | Packaging |
|------------|---------|----------|-----------|
| STF26NM60N | 26NM60N | TO-220FP | Tube      |

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## Contents

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# 1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol            | Parameter                                                                                                                                | Value      | Unit             |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------|
| $V_{DS}$          | Drain-source voltage                                                                                                                     | 600        | V                |
| $V_{GS}$          | Gate-source voltage                                                                                                                      | $\pm 30$   | V                |
| $I_D^{(1)}$       | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$                                                                           | 20         | A                |
| $I_D^{(1)}$       | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$                                                                          | 12.6       | A                |
| $I_{DM}^{(1)(2)}$ | Drain current (pulsed)                                                                                                                   | 80         | A                |
| $P_{TOT}$         | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$                                                                                    | 35         | W                |
| $dv/dt^{(3)}$     | Peak diode recovery voltage slope                                                                                                        | 15         | V/ns             |
| $V_{ISO}$         | Insulation withstand voltage (RMS) from all three leads to external heat sink<br>( $t = 1\text{ s}$ ; $T_C = 25\text{ }^\circ\text{C}$ ) | 2500       | V                |
| $T_{stg}$         | Storage temperature range                                                                                                                | -55 to 150 | $^\circ\text{C}$ |
| $T_j$             | Operating junction temperature range                                                                                                     |            |                  |

**Notes:**<sup>(1)</sup>Limited by package.<sup>(2)</sup>Pulse width limited by safe operating area.<sup>(3)</sup> $I_{SD} \leq 20\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS(peak)} \leq V_{(BR)DSS}$ ,  $V_{DD} \leq 80\% V_{(BR)DSS}$ 

Table 3: Thermal data

| Symbol         | Parameter                           | Value | Unit                      |
|----------------|-------------------------------------|-------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case    | 3.6   | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-ambient | 62.5  | $^\circ\text{C}/\text{W}$ |

Table 4: Avalanche characteristics

| Symbol   | Parameter                                                                                                               | Value | Unit |
|----------|-------------------------------------------------------------------------------------------------------------------------|-------|------|
| $I_{AS}$ | Single pulse avalanche current (pulse width limited by $T_{jmax}$ )                                                     | 6     | A    |
| $E_{AS}$ | Single pulse avalanche energy<br>(starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ ) | 610   | mJ   |

## 2 Electrical characteristics

(T<sub>CASE</sub> = 25 °C unless otherwise specified)

Table 5: On/off states

| Symbol               | Parameter                         | Test conditions                                                                        | Min. | Typ.  | Max.  | Unit |
|----------------------|-----------------------------------|----------------------------------------------------------------------------------------|------|-------|-------|------|
| V <sub>(BR)DSS</sub> | Drain-source breakdown voltage    | I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0 V                                           | 600  |       |       | V    |
| I <sub>DSS</sub>     | Zero gate voltage drain current   | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 600 V                                         |      |       | 1     | μA   |
|                      |                                   | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 600 V, T <sub>C</sub> = 125 °C <sup>(1)</sup> |      |       | 100   |      |
| I <sub>GSS</sub>     | Gate-body leakage current         | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±25 V                                         |      |       | ±0.1  | μA   |
| V <sub>GS(th)</sub>  | Gate threshold voltage            | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                            | 2    | 3     | 4     | V    |
| R <sub>DS(on)</sub>  | Static drain-source on-resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 10 A                                          |      | 0.135 | 0.165 | Ω    |

**Notes:**

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

Table 6: Dynamic

| Symbol                              | Parameter                     | Test conditions                                                                                                                                     | Min. | Typ. | Max. | Unit |
|-------------------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| C <sub>iss</sub>                    | Input capacitance             | V <sub>DS</sub> = 50 V, f = 1 MHz, V <sub>GS</sub> = 0 V                                                                                            | -    | 1800 | -    | pF   |
| C <sub>oss</sub>                    | Output capacitance            |                                                                                                                                                     | -    | 115  | -    | pF   |
| C <sub>rss</sub>                    | Reverse transfer capacitance  |                                                                                                                                                     | -    | 6    | -    | pF   |
| C <sub>oss eq.</sub> <sup>(1)</sup> | Equivalent output capacitance | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 0 to 480 V                                                                                                 | -    | 310  | -    | pF   |
| Q <sub>g</sub>                      | Total gate charge             | V <sub>DD</sub> = 480 V, I <sub>D</sub> = 20 A, V <sub>GS</sub> = 10 V<br>(see <a href="#">Figure 14: "Test circuit for gate charge behavior"</a> ) | -    | 60   | -    | nC   |
| Q <sub>gs</sub>                     | Gate-source charge            |                                                                                                                                                     | -    | 8.5  | -    | nC   |
| Q <sub>gd</sub>                     | Gate-drain charge             |                                                                                                                                                     | -    | 30   | -    | nC   |
| R <sub>G</sub>                      | Gate input resistance         | f = 1 MHz, I <sub>D</sub> = 0 A                                                                                                                     | -    | 2.8  | -    | Ω    |

**Notes:**

<sup>(1)</sup>C<sub>oss eq.</sub> is defined as a constant equivalent capacitance giving the same charging time as C<sub>oss</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DS</sub>

Table 7: Switching times

| Symbol              | Parameter           | Test conditions                                                                                                                                                                                                                                | Min. | Typ. | Max. | Unit |
|---------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| t <sub>d(on)</sub>  | Turn-on delay time  | V <sub>DD</sub> = 300 V, I <sub>D</sub> = 10 A, R <sub>G</sub> = 4.7 Ω, V <sub>GS</sub> = 10 V<br>(see <a href="#">Figure 13: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 18: "Switching time waveform"</a> ) | -    | 13   | -    | ns   |
| t <sub>r</sub>      | Rise time           |                                                                                                                                                                                                                                                | -    | 25   | -    | ns   |
| t <sub>d(off)</sub> | Turn-off delay time |                                                                                                                                                                                                                                                | -    | 85   | -    | ns   |
| t <sub>f</sub>      | Fall time           |                                                                                                                                                                                                                                                | -    | 50   | -    | ns   |

Table 8: Source-drain diode

| Symbol          | Parameter                     | Test conditions                                                                                                                                                                                                                  | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}^{(1)}$  | Source-drain current          |                                                                                                                                                                                                                                  | -    |      | 20   | A             |
| $I_{SDM}^{(2)}$ | Source-drain current (pulsed) |                                                                                                                                                                                                                                  | -    |      | 80   | A             |
| $V_{SD}^{(3)}$  | Forward on voltage            | $I_{SD} = 20\text{ A}$ , $V_{GS} = 0\text{ V}$                                                                                                                                                                                   | -    |      | 1.5  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 20\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 60\text{ V}$<br>(see <a href="#">Figure 15: "Test circuit for inductive load switching and diode recovery times"</a> )                                  | -    | 370  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                                                  | -    | 5.8  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                                                  | -    | 31.6 |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 20\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 15: "Test circuit for inductive load switching and diode recovery times"</a> ) | -    | 450  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                                                  | -    | 7.5  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                                                  | -    | 32.5 |      | A             |

**Notes:**

<sup>(1)</sup>Pulse width limited by package.

<sup>(2)</sup>Pulse width limited by safe operating area.

<sup>(3)</sup>Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

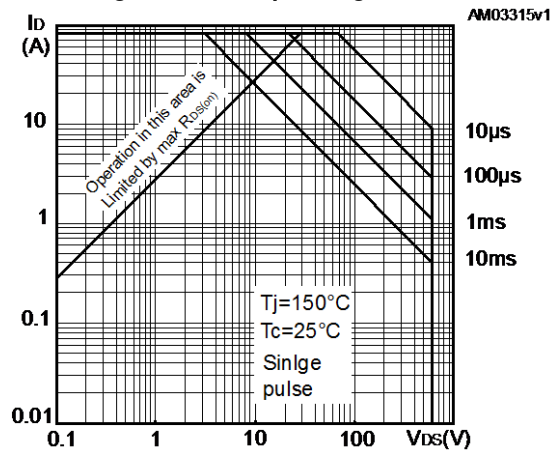


Figure 3: Thermal impedance

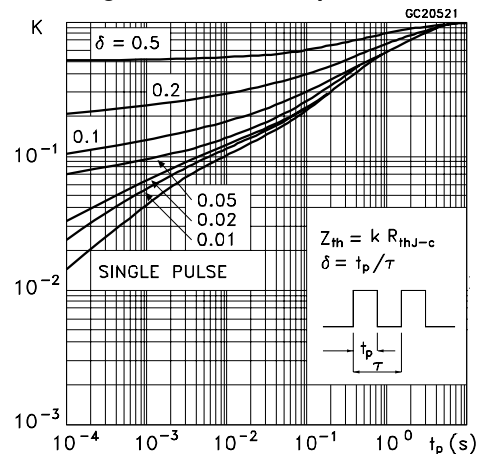


Figure 4: Output characteristics

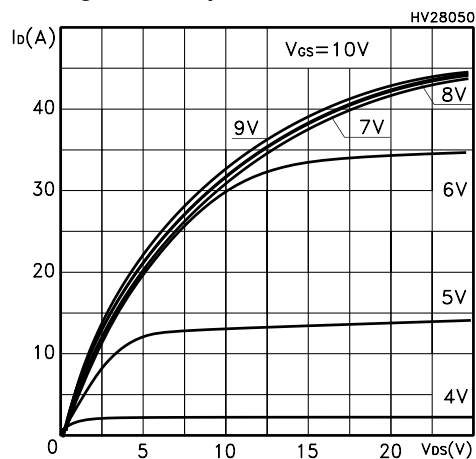


Figure 5: Transfer characteristics

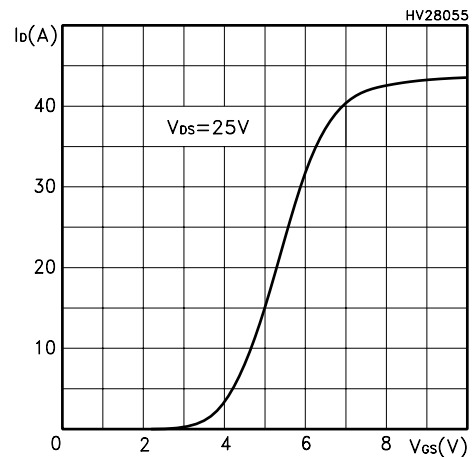


Figure 6: Gate charge vs gate-source voltage

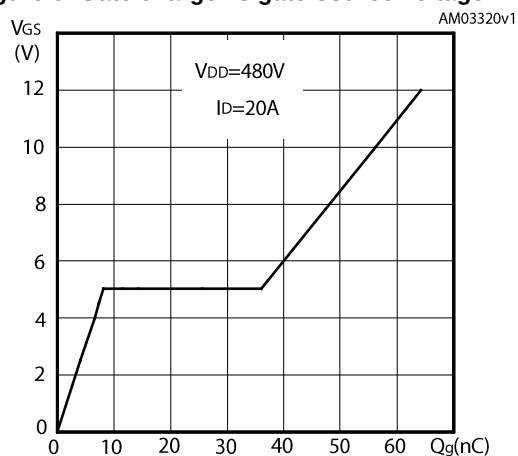


Figure 7: Static drain-source on-resistance

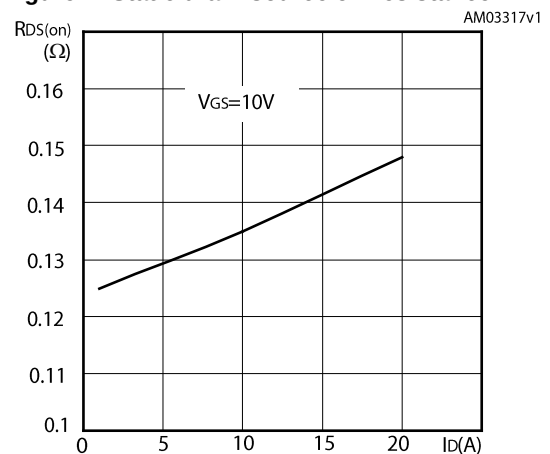


Figure 8: Capacitance variations

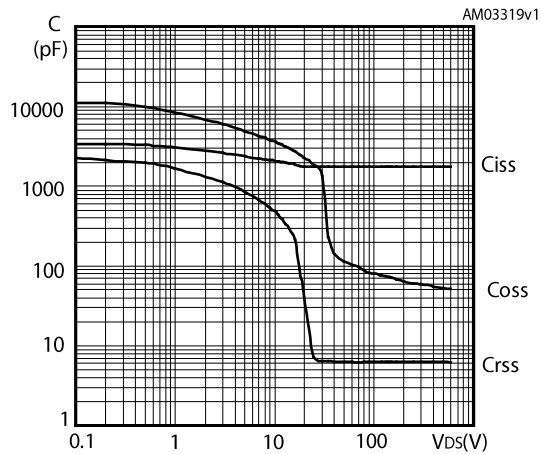


Figure 9: Source-drain diode forward characteristics

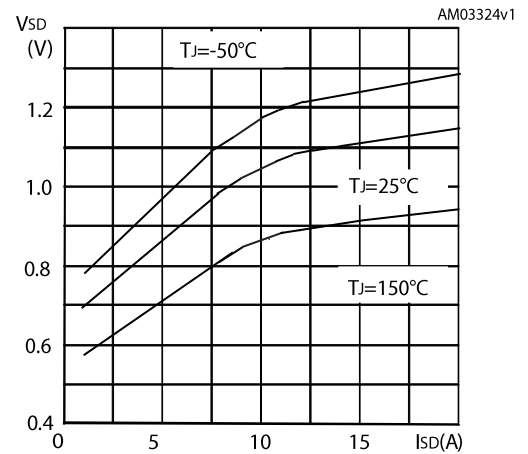


Figure 10: Normalized gate threshold voltage vs temperature

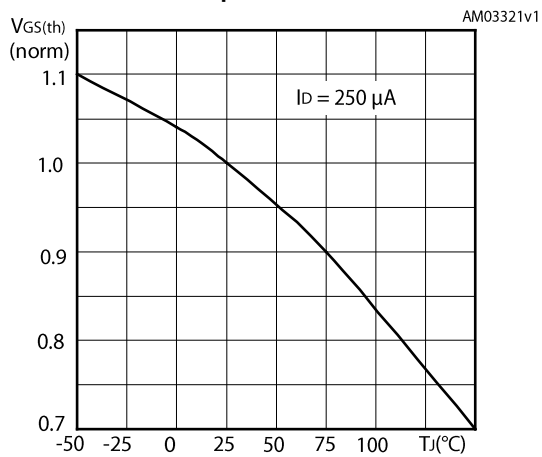


Figure 11: Normalized on-resistance vs temperature

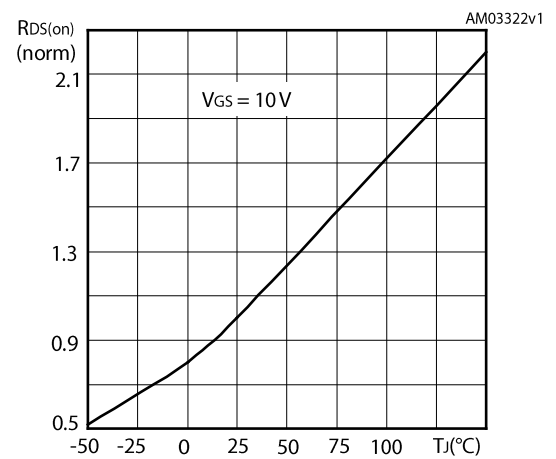
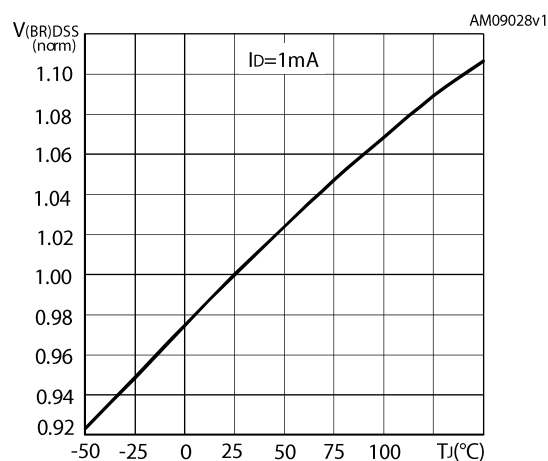


Figure 12: Normalized V(BR)DSS vs temperature



### 3 Test circuits

**Figure 13: Test circuit for resistive load switching times**



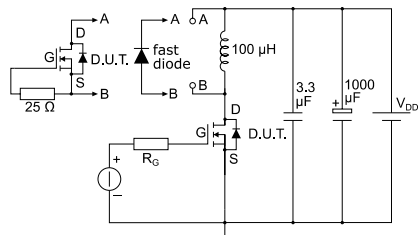
AM01468v1

**Figure 14: Test circuit for gate charge behavior**



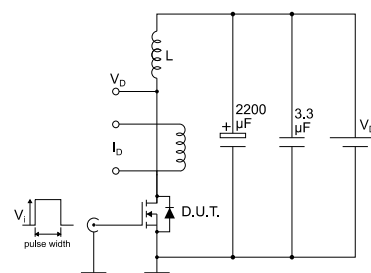
AM01469v1

**Figure 15: Test circuit for inductive load switching and diode recovery times**



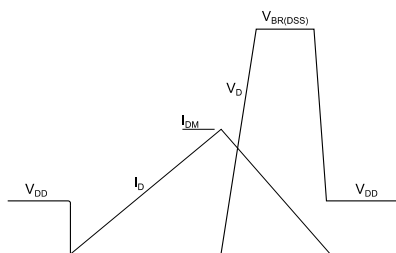
AM01470v1

**Figure 16: Unclamped inductive load test circuit**



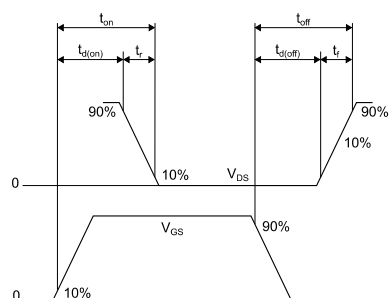
AM01471v1

**Figure 17: Unclamped inductive waveform**



AM01472v1

**Figure 18: 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 19: TO-220FP package outline**

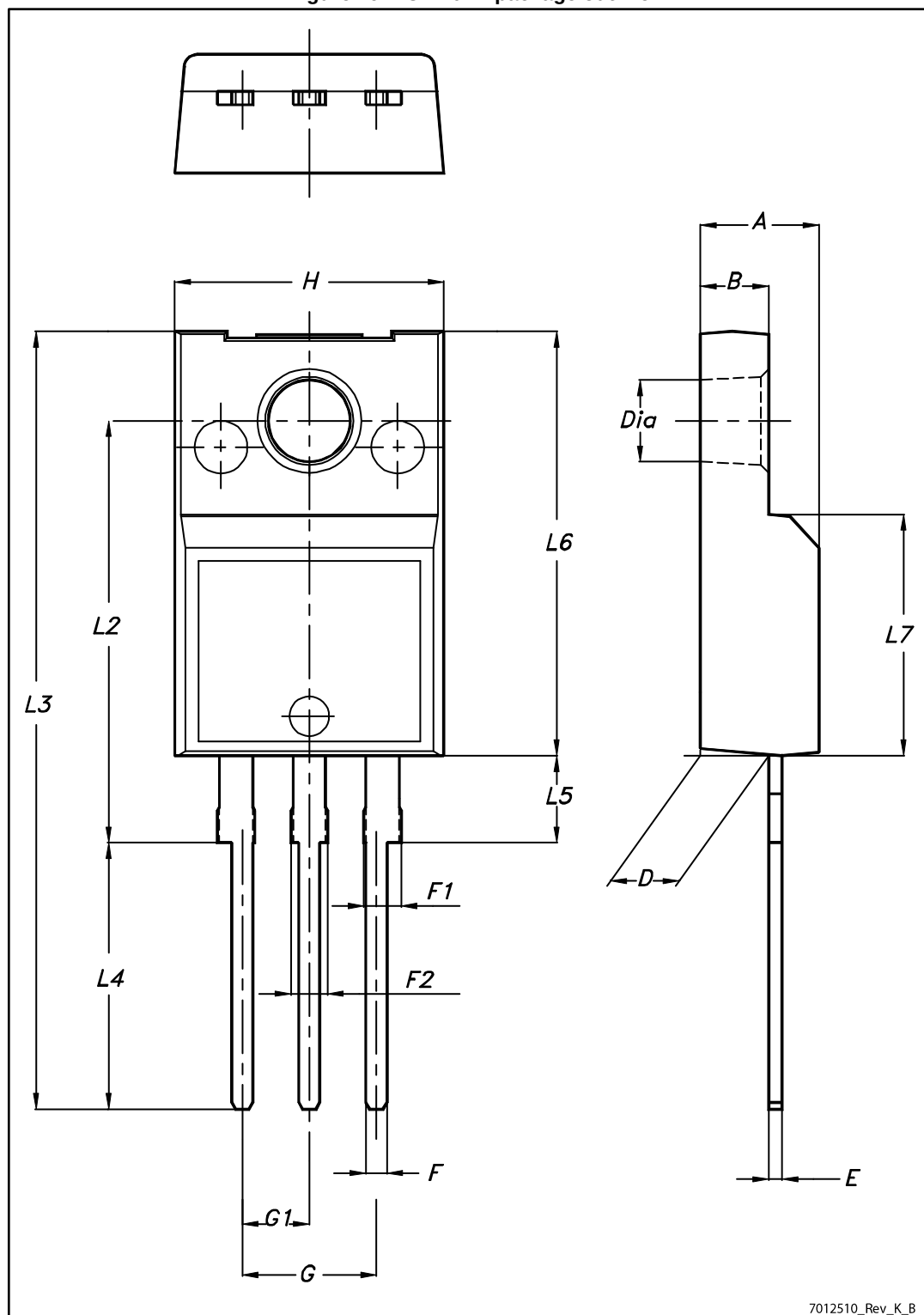


Table 9: TO-220FP package mechanical data

| 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                                                                |
|-------------|----------|------------------------------------------------------------------------|
| 13-Dec-2016 | 1        | First release. Part number previously included in datasheet DocID15642 |

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