# STF26N60M2, STFI26N60M2

## N-channel 600 V, 0.14 Ω typ., 20 A MDmesh™ M2 Power MOSFETs in TO-220FP and I²PAKFP packages

Datasheet - production data

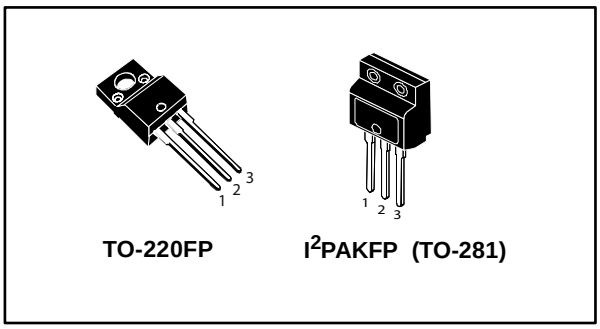
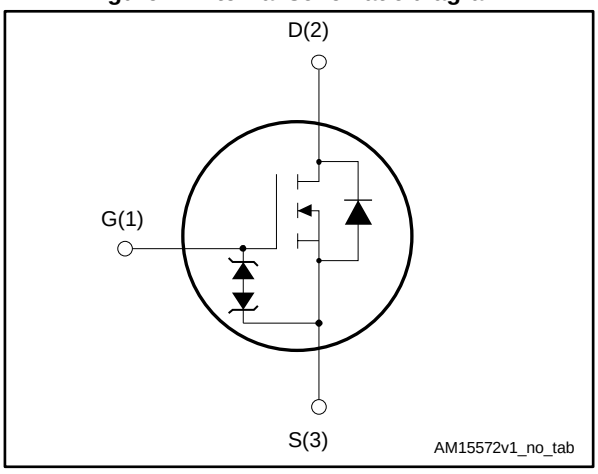



**Figure 1: Internal schematic diagram**




## Features

| Order code | $V_{DS}$ @ $T_{Jmax}$ | $R_{DS(on)}$ max. | $I_D$ | $P_{TOT}$ |
|---|---|---|---|---|
| STF26N60M2 | 650 V | 0.165 Ω | 20 A | 30 W |
| STFI26N60M2 | | | | |

- Extremely low gate charge
- Excellent output capacitance ($C_{OSS}$) profile
- 100% avalanche tested
- Zener-protected

## Applications

- Switching applications
- LCC converters, resonant converters

## Description

These devices are N-channel Power MOSFETs developed using MDmesh™ M2 technology. Thanks to their strip layout and improved vertical structure, these devices exhibit low on-resistance and optimized switching characteristics, rendering them suitable for the most demanding high efficiency converters.

**Table 1: Device summary**

| Order code | Marking | Package | Packing |
|---|---|---|---|
| STF26N60M2 | 26N60M2 | TO-220FP | Tube |
| STFI26N60M2 | | I²PAKFP | |

# Contents

# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{GS}$ | Gate-source voltage | ±25 | V |
| $I_D$ (1) | Drain current (continuous) at $T_{case}$ = 25 °C | 20 | A |
| | Drain current (continuous) at $T_{case}$ = 100 °C | 13 | |
| $I_{DM}$ (2) | Drain current (pulsed) | 80 | A |
| $P_{TOT}$ | Total dissipation at $T_{case}$ = 25 °C | 30 | 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 s; $T_C$ = 25 °C) | 2.5 | kV |
| $T_{stg}$ | Storage temperature | -55 to 150 | °C |
| $T_j$ | Operating junction temperature | | |

**Notes:**

(1) Limited by maximum junction temperature.

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

(3) $I_{SD}$ ≤ 20 A, di/dt=400 A/µs; $V_{DS(peak)}$ < $V_{(BR)DSS}$, $V_{DD}$ = 80% $V_{(BR)DSS}$.

(4) $V_{DS}$ ≤ 480 V.

**Table 3: Thermal data**

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

**Table 4: Avalanche characteristics**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $I_{AR}$ (1) | Avalanche current, repetitive or not repetitive | 3.8 | A |
| $E_{AR}$ (2) | Single pulse avalanche energy | 250 | mJ |

**Notes:**

(1) Pulse width limited by $T_{jmax}$.

(2) starting $T_j$ = 25 °C, $I_D$ = $I_{AR}$, $V_{DD}$ = 50 V.

# 2 Electrical characteristics

($T_{case}$ = 25 °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 V, $I_D$ = 1 mA | 600 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{GS}$ = 0 V, $V_{DS}$ = 600 V | | | 1 | µA |
| | | $V_{GS}$ = 0 V, $V_{DS}$ = 600 V, $T_{case}$ = 125 °C | | | 100 | |
| $I_{GSS}$ | Gate-body leakage current | $V_{DS}$ = 0 V, $V_{GS}$ = ±25 V | | | ±10 | µA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2 | 3 | 4 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 10 A | | 0.14 | 0.165 | Ω |

**Table 6: Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 100 V, f = 1 MHz, $V_{GS}$ = 0 V | - | 1360 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 88 | - | |
| $C_{rss}$ | Reverse transfer capacitance | | - | 2 | - | |
| $C_{oss\ eq.}$ (1) | Equivalent output capacitance | $V_{DS}$ = 0 to 480 V, $V_{GS}$ = 0 V | - | 124 | - | pF |
| $R_G$ | Intrinsic gate resistance | f = 1 MHz, $I_D$ = 0 A | - | 4 | - | Ω |
| $Q_g$ | Total gate charge | $V_{DD}$ = 480 V, $I_D$ = 20 A, $V_{GS}$ = 10 V (see *Figure 15: "Gate charge test circuit"*) | - | 34 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 5.6 | - | |
| $Q_{gd}$ | Gate-drain charge | | - | 16.3 | - | |

**Notes:**

(1) $C_{oss\ eq.}$ 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 V, $I_D$ = 10 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V (see *Figure 14: "Switching times test circuit for resistive load"* and *Figure 19: "Switching time waveform"*) | - | 20.2 | - | ns |
| $t_r$ | Rise time | | - | 8 | - | |
| $t_{d(off)}$ | Turn-off delay time | | - | 66 | - | |
| $t_f$ | Fall time | | - | 10 | - | |

**Table 8: Source-drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 20 | A |
| $I_{SDM}$ (1) | Source-drain current (pulsed) | | - | | 80 | A |
| $V_{SD}$ (2) | Forward on voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 20 A | - | | 1.6 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 20 A, di/dt = 100 A/µs, $V_{DD}$ = 60 V (see *Figure 16: "Test circuit for inductive load switching and diode recovery times"*) | - | 360 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 5 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 27 | | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 20 A, di/dt = 100 A/µs, $V_{DD}$ = 60 V, $T_j$ = 150 °C (see *Figure 16: "Test circuit for inductive load switching and diode recovery times"*) | - | 556 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 8 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 29 | | A |

**Notes:**

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

(2) Pulse test: pulse duration = 300 µs, duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

**Figure 2: Safe operating area**

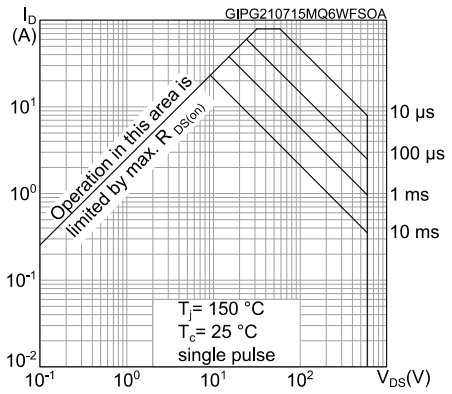



**Figure 3: Thermal impedance**

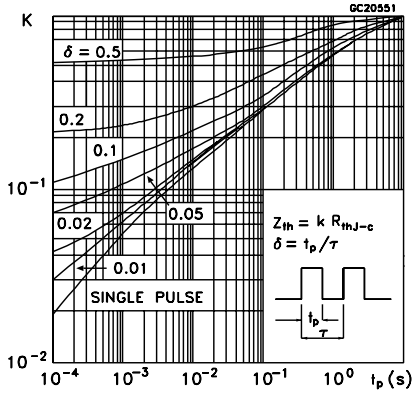



**Figure 4: Output characteristics**

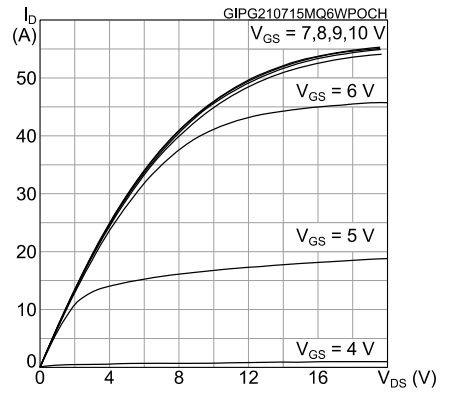



**Figure 5: Transfer characteristics**

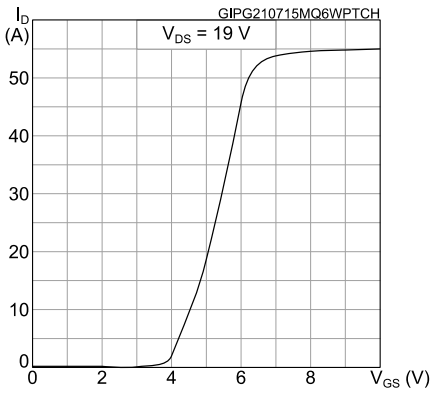



**Figure 6: Gate charge vs gate-source voltage**

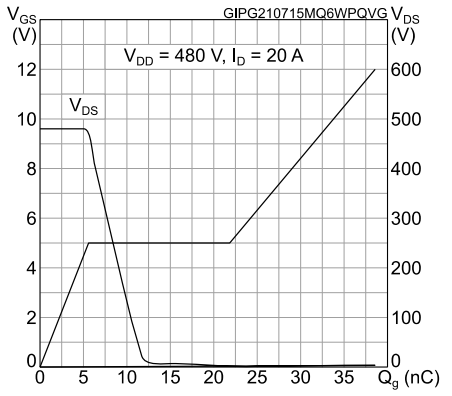



**Figure 7: Static drain-source on-resistance**

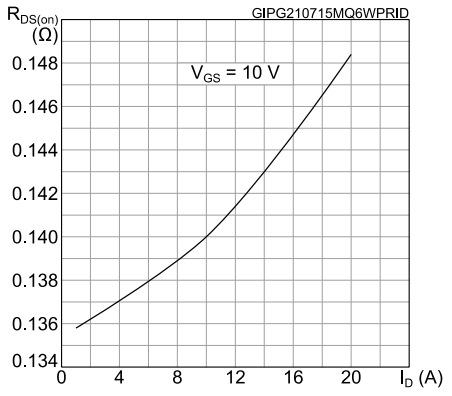


**Figure 8: Capacitance variations**

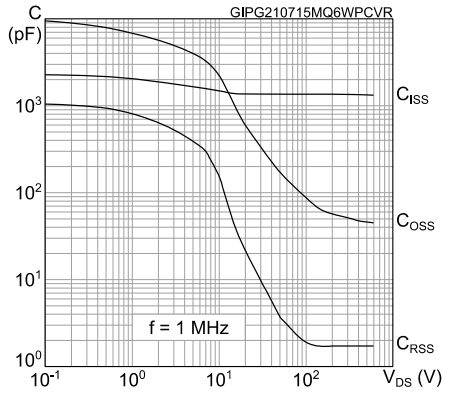



**Figure 9: Normalized gate threshold voltage vs temperature**

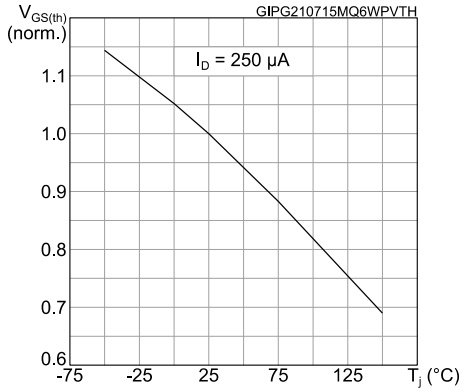



**Figure 10: Normalized on-resistance vs temperature**

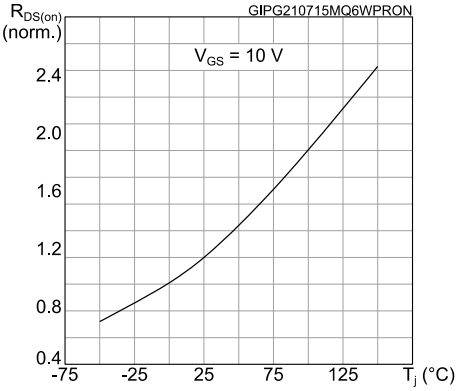



**Figure 11: Normalized V(BR)DSS vs temperature**

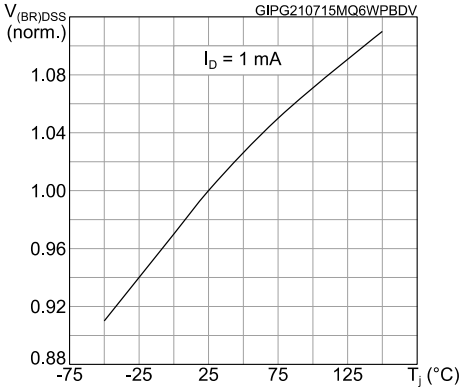



**Figure 12: Output capacitance stored energy**

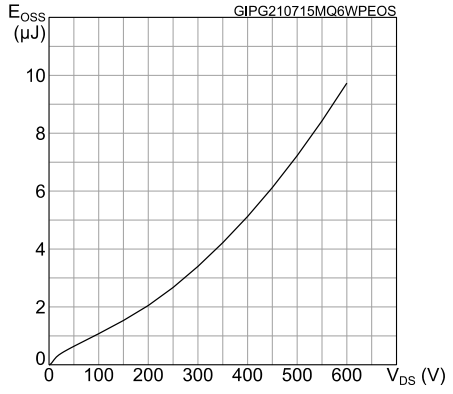
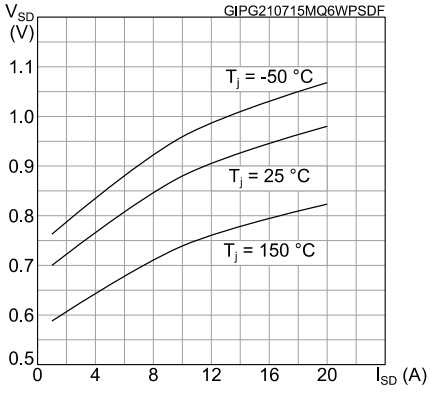



**Figure 13: Source-drain diode forward characteristics**



# 3 Test circuits

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

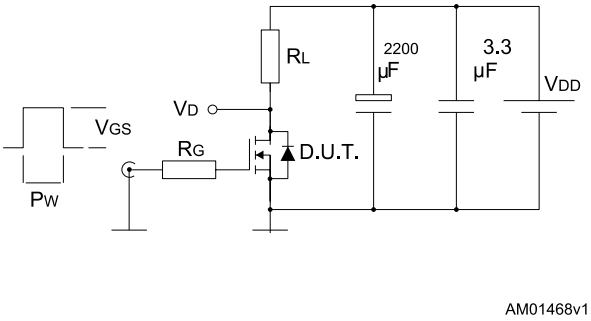



**Figure 15: Gate charge test circuit**

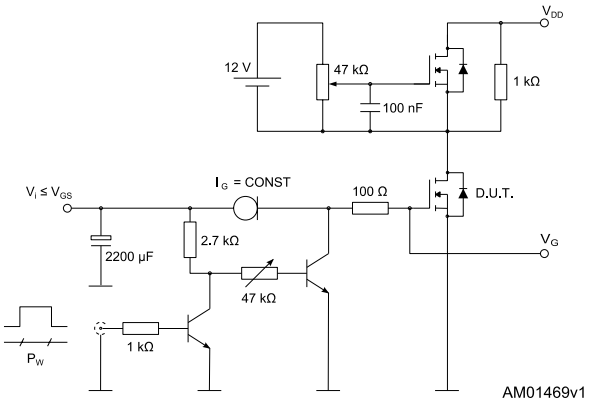



**Figure 16: Test circuit for inductive load switching and diode recovery times**

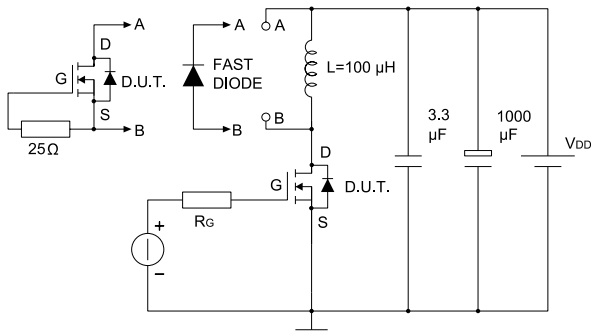



**Figure 17: Unclamped inductive load test circuit**

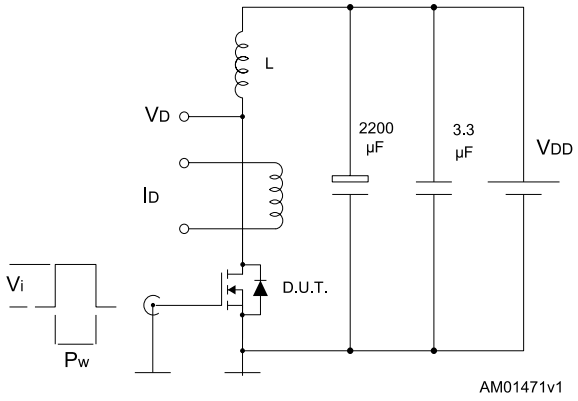



**Figure 18: Unclamped inductive waveform**

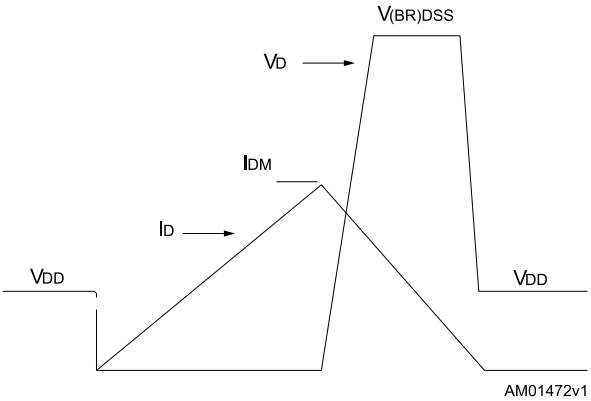
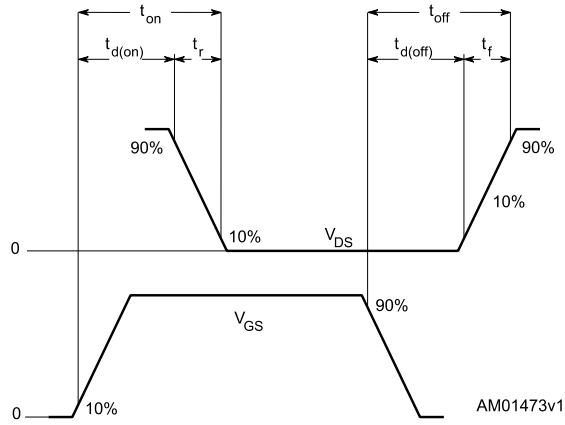



**Figure 19: Switching time waveform**



# 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***. ECOPACK® is an ST trademark.

## 4.1 TO-220FP package information

**Figure 20: TO-220FP package outline**

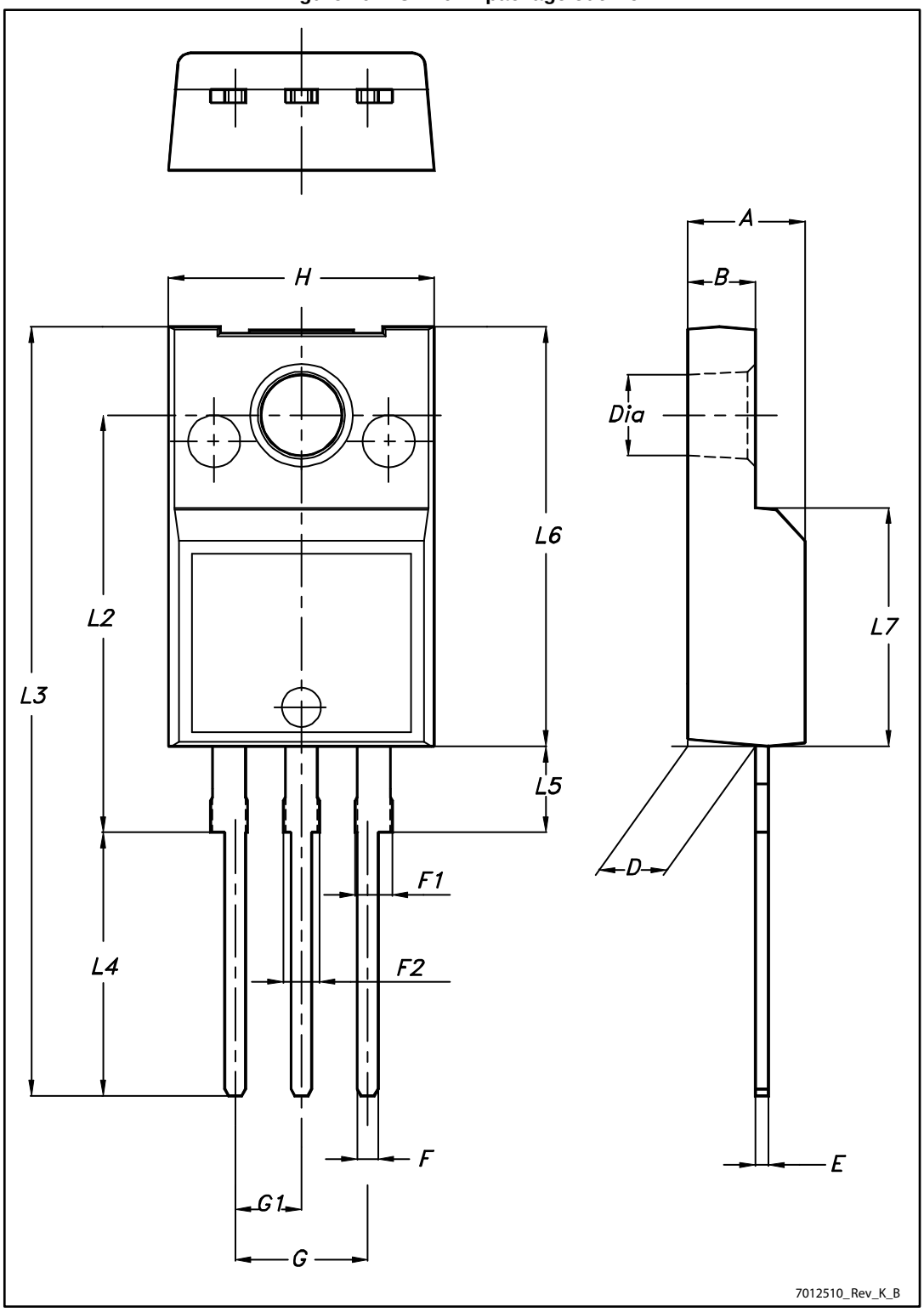


Table 9: TO-220FP package mechanical data

| 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 |

## 4.2 I²PAKFP (TO-281) package information

**Figure 21: I²PAKFP (TO-281) package outline**

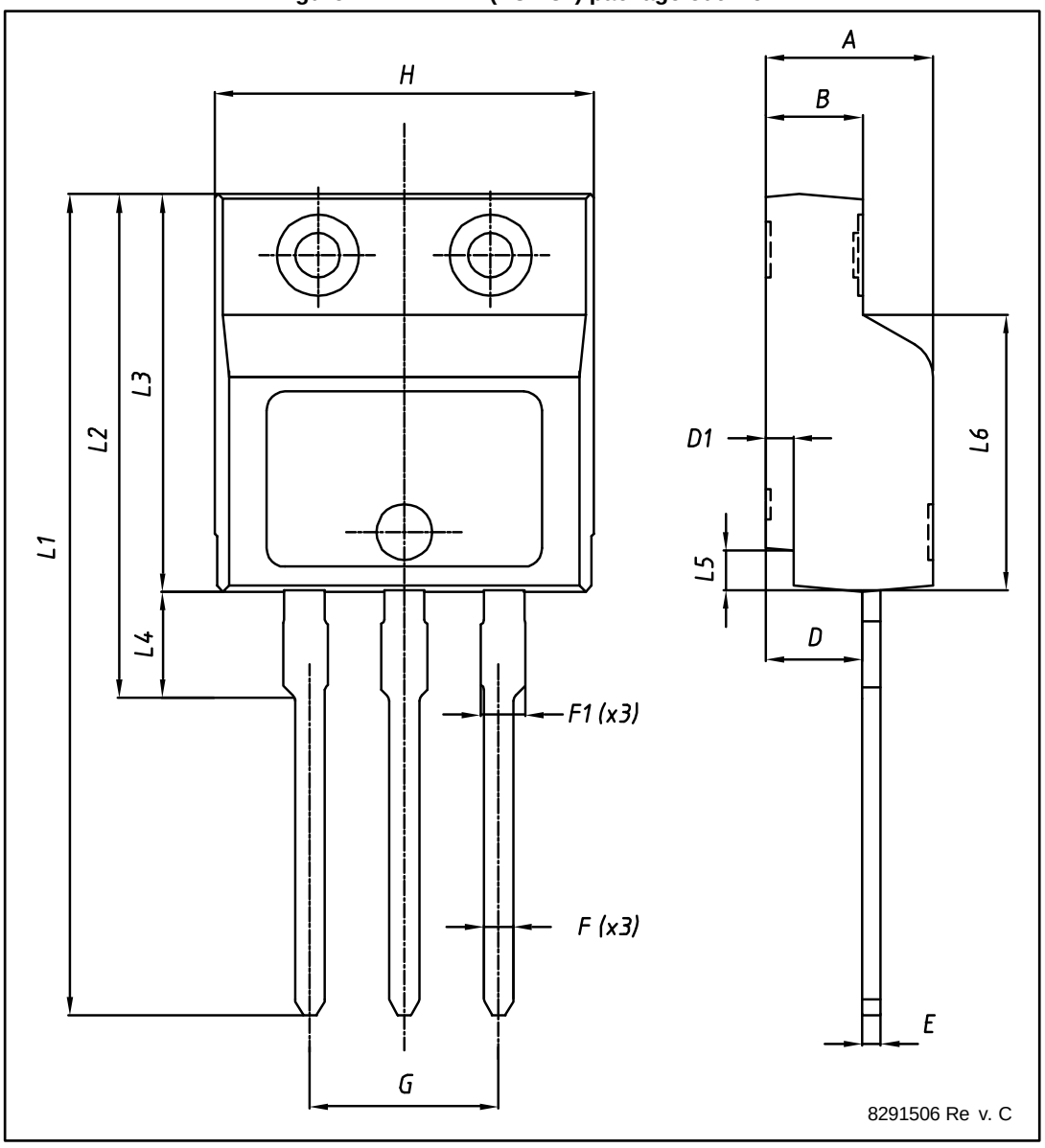


Table 10: I²PAKFP (TO-281) mechanical data

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.40 | - | 4.60 |
| B | 2.50 | | 2.70 |
| D | 2.50 | | 2.75 |
| D1 | 0.65 | | 0.85 |
| E | 0.45 | | 0.70 |
| F | 0.75 | | 1.00 |
| F1 | | | 1.20 |
| G | 4.95 | | 5.20 |
| H | 10.00 | | 10.40 |
| L1 | 21.00 | | 23.00 |
| L2 | 13.20 | | 14.10 |
| L3 | 10.55 | | 10.85 |
| L4 | 2.70 | | 3.20 |
| L5 | 0.85 | | 1.25 |
| L6 | 7.50 | 7.60 | 7.70 |

# 5 Revision history

**Table 11: Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 05-Mar-2015 | 1 | First release. |
| 30-July-2015 | 2 | Text and formatting changes throughout document<br>Datasheet promoted from preliminary data to production data<br>In Section *Electrical characteristics*:<br>- updated and renamed table *Static* (was On/off states)<br>- updated table *Dynamic*, *Switching times* and *Source-drain diode*<br>- added section *Electrical characteristics (curves)* |

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