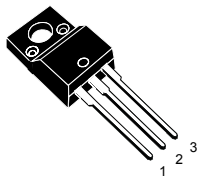
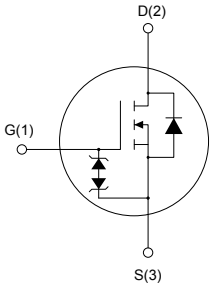
# N-channel 800 V, 1.3 Ω typ., 4.5 A MDmesh K5 Power MOSFET in a TO-220FP package




TO-220FP




AM01476v1

## Features

| Order code | $V_{DS}$ | $R_{DS(on)}$ max. | $I_D$ |
|---|---|---|---|
| STF6N80K5 | 800 V | 1.6 Ω | 4.5 A |

- Ultra-low gate charge
- Very low FoM (figure of merit)
- Zener-protected
- 100% avalanche tested

## Applications

- Switching applications

## Description

This very high voltage N-channel Power MOSFET is designed using MDmesh K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

| Product status link |
|---|
| STF6N80K5 |

| Product summary | |
|---|---|
| **Order code** | STF6N80K5 |
| **Marking** | 6N80K5 |
| **Package** | TO-220FP |
| **Packing** | Tube |

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-source voltage | 800 | V |
| $V_{GS}$ | Gate-source voltage | ±30 | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 4.5 | A |
| | Drain current (continuous) at $T_C$ = 100 °C | 2.8 | |
| $I_{DM}$(1) | Drain current (pulsed) | 18 | A |
| $P_{TOT}$ | Total power dissipation at $T_C$ = 25 °C | 25 | W |
| $V_{ISO}$ | Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; $T_C$ = 25 °C) | 2.5 | kV |
| dv/dt(2) | Peak diode recovery voltage slope | 4.5 | V/ns |
| dv/dt(3) | MOSFET dv/dt ruggedness | 50 | V/ns |
| $T_{stg}$ | Storage temperature range | -55 to 150 | °C |
| $T_J$ | Operating junction temperature range | | °C |

1. *Pulse width is limited by safe operating area.*
2. *$I_{SD}$ ≤ 4.5 A, di/dt = 100 A/µs, $V_{DS}$ (peak) < $V_{(BR)DSS}$.*
3. *$V_{DD}$ ≤ 640 V.*

**Table 2. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thJC}$ | Thermal resistance, junction-to-case | 5 | °C/W |
| $R_{thJA}$ | Thermal resistance, junction-to-ambient | 62.5 | °C/W |

**Table 3. Avalanche characteristics**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $I_{AR}$ | Avalanche current, repetitive or non-repetitive (pulse width limited by $T_J$ max.) | 1.5 | A |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_J$ = 25 °C, $I_D$ = $I_{AR}$, $V_{DD}$ = 50 V) | 85 | mJ |

# 2 Electrical characteristics

$T_C$ = 25 °C unless otherwise specified.

**Table 4. Static**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS}$ = 0 V, $I_D$ = 1 mA | 800 | - | - | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{GS}$ = 0 V, $V_{DS}$ = 800 V | - | - | 1 | µA |
| | | $V_{GS}$ = 0 V, $V_{DS}$ = 800 V, $T_C$ = 125 °C(1) | - | - | 50 | |
| $I_{GSS}$ | Gate-body leakage current | $V_{DS}$ = 0 V, $V_{GS}$ = ±20 V | - | - | ±10 | µA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 100 µA | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 2 A | - | 1.3 | 1.6 | Ω |

1. *Specified by design, not tested in production.*

**Table 5. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 100 V, f = 1 MHz, $V_{GS}$ = 0 V | - | 270 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 25 | - | pF |
| $C_{rss}$ | Reverse transfer capacitance | | - | 0.7 | - | pF |
| $C_{o(tr)}$(1) | Equivalent output capacitance time related | $V_{DS}$ = 0 to 640 V, $V_{GS}$ = 0 V | - | 38 | - | pF |
| $C_{o(er)}$(2) | Equivalent output capacitance energy related | | - | 16 | - | pF |
| $R_g$ | Intrinsic gate resistance | f = 1 MHz, $I_D$ = 0 A | - | 7.5 | - | Ω |
| $Q_g$ | Total gate charge | $V_{DD}$ = 640 V, $I_D$ = 4.5 A, $V_{GS}$ = 0 to 10 V (see the Figure 14. Test circuit for gate charge behavior) | - | 13 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 2.1 | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 9.6 | - | nC |

1. *$C_{o(tr)}$ is a constant capacitance value that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.*
2. *$C_{o(er)}$ is a constant capacitance value that gives the same stored energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.*

**Table 6. Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ = 400 V, $I_D$ = 2.25 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V (see the Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform) | - | 16 | - | ns |
| $t_r$ | Rise time | | - | 7.5 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 28.5 | - | ns |
| $t_f$ | Fall time | | - | 16 | - | ns |

**Table 7. Source-drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | - | 4.5 | A |
| $I_{SDM}$(1) | Source-drain current (pulsed) | | - | - | 18 | A |
| $V_{SD}$(2) | Forward on voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 4.5 A | - | - | 1.5 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 4.5 A, di/dt = 100 A/µs, $V_{DD}$ = 60 V (see the Figure 15. Test circuit for inductive load switching and diode recovery times) | - | 280 | - | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 2.2 | - | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 15.5 | - | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 4.5 A, di/dt = 100 A/µs, $V_{DD}$ = 60 V, $T_J$ = 150 °C (see the Figure 15. Test circuit for inductive load switching and diode recovery times) | - | 450 | - | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 3.15 | - | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 14 | - | A |

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 1. Safe operating area**

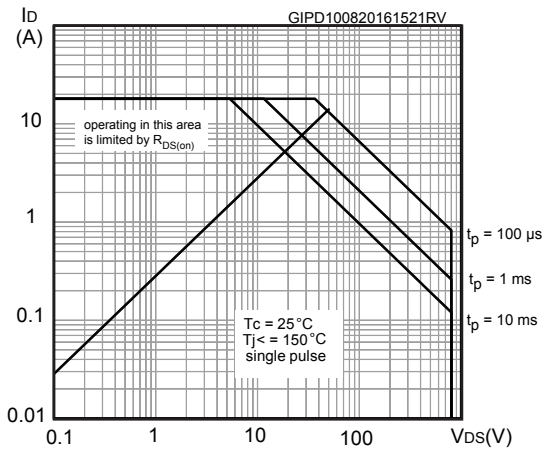



**Figure 2. Normalized transient thermal impedance**

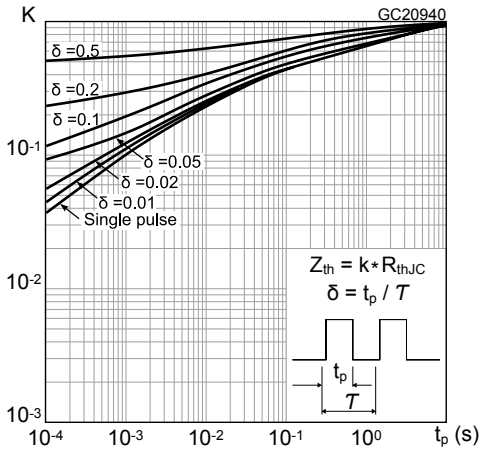



**Figure 3. Typical output characteristics**

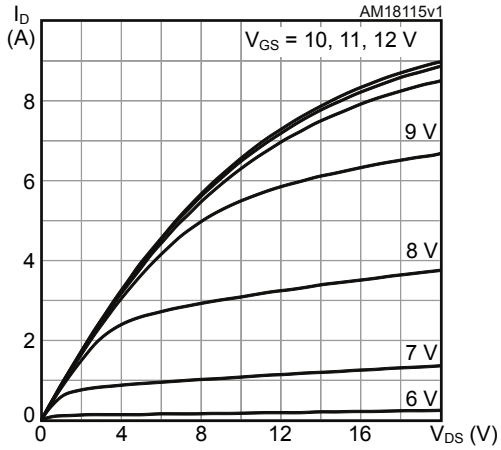



**Figure 4. Typical transfer characteristics**

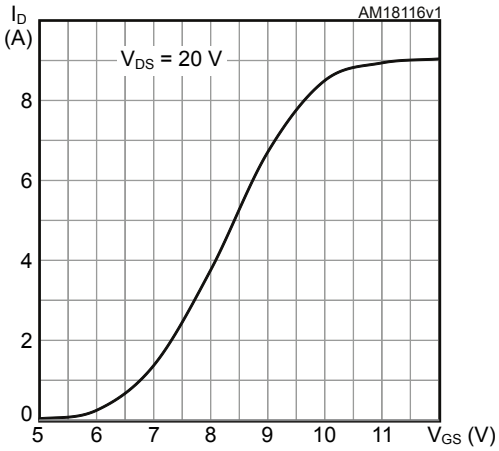



**Figure 5. Typical gate charge characteristics**

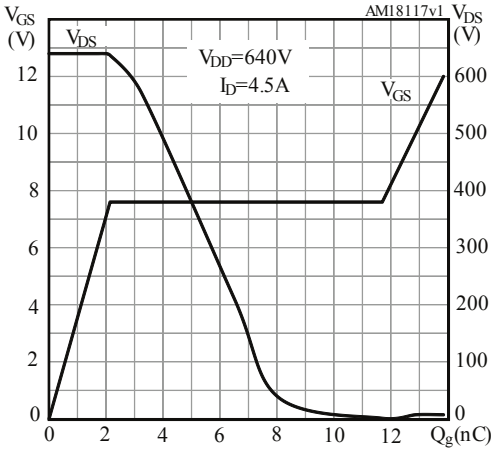



**Figure 6. Typical drain-source on-resistance**

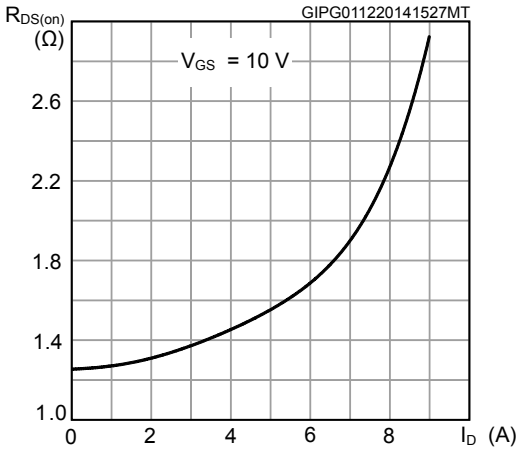


**Figure 7. Typical capacitance characteristics**

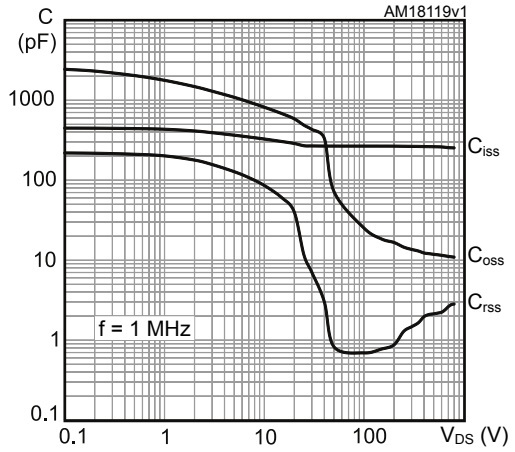



**Figure 8. Typical output capacitance stored energy**

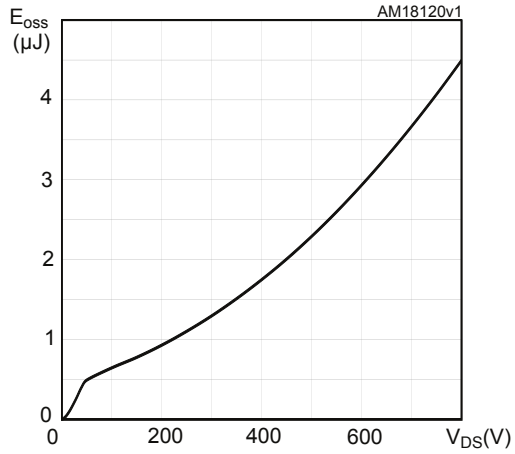



**Figure 9. Normalized gate threshold vs temperature**

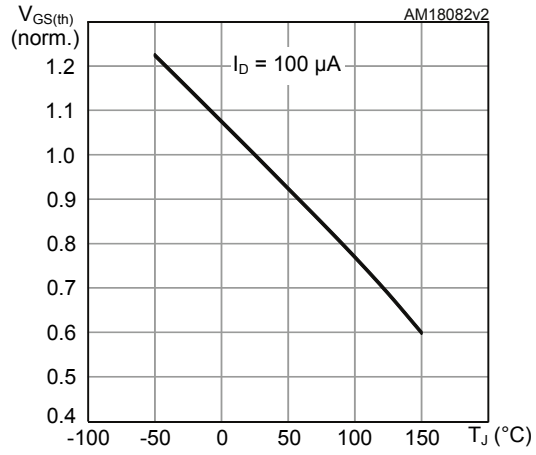



**Figure 10. Normalized on-resistance vs temperature**

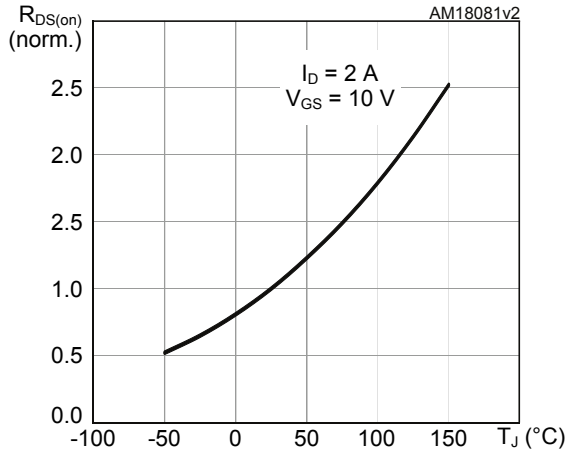



**Figure 11. Normalized breakdown voltage vs temperature**

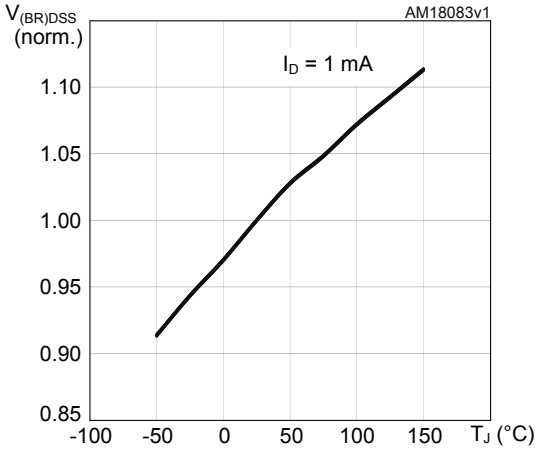
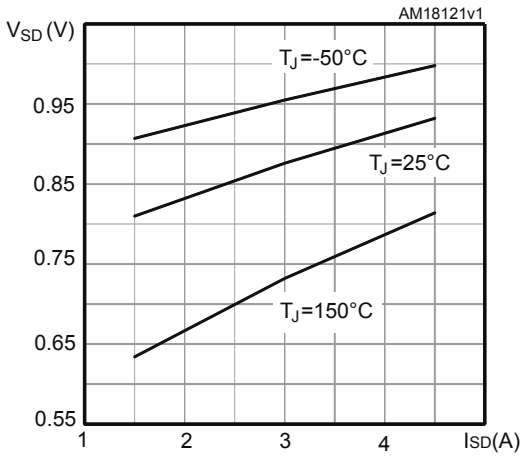
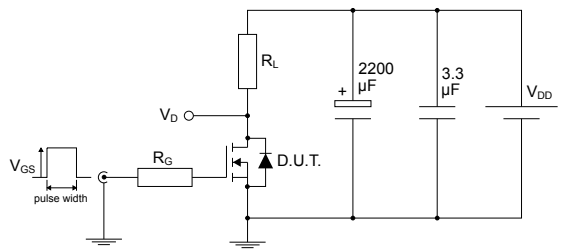



**Figure 12. Typical reverse diode forward characteristics**



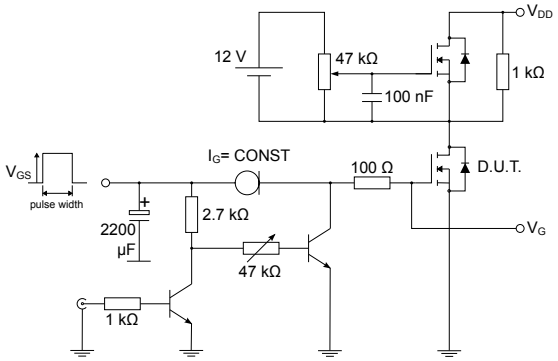
# 3 Test circuits

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



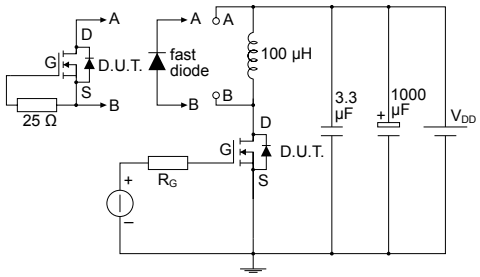

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**Figure 14. Test circuit for gate charge behavior**



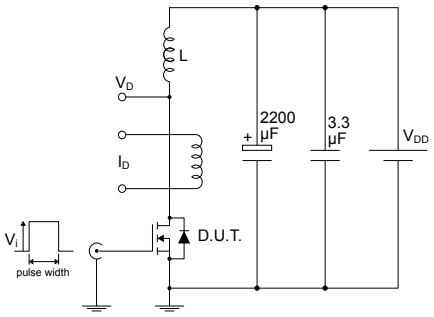

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**Figure 15. Test circuit for inductive load switching and diode recovery times**



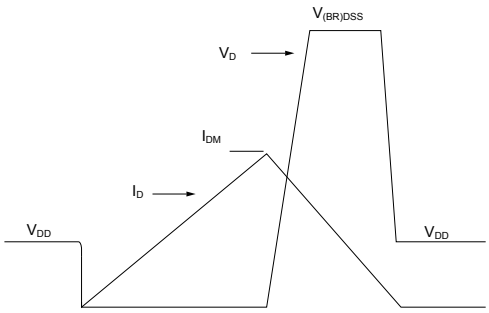

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**Figure 16. Unclamped inductive load test circuit**



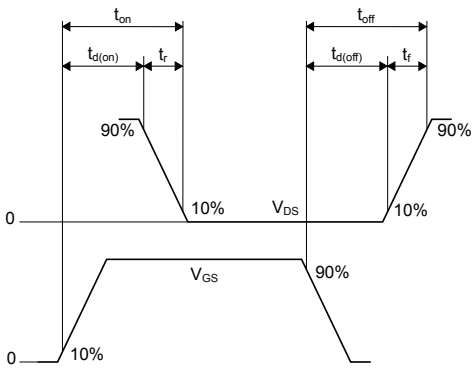

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**Figure 17. Unclamped inductive waveform**




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**Figure 18. Switching time waveform**



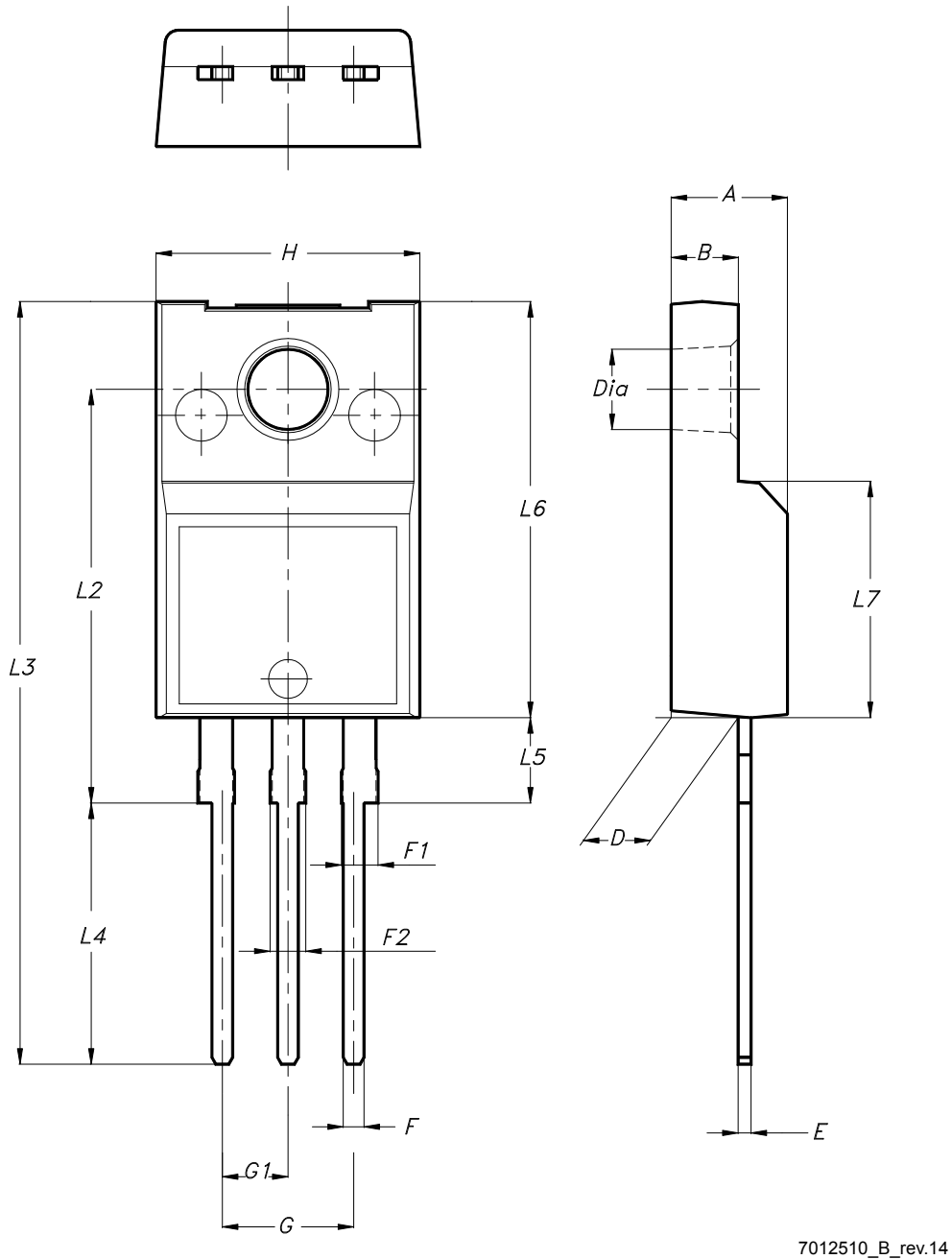

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# 4 Package information

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 type B package information

**Figure 19. TO-220FP type B package outline**




7012510_B_rev.14

Table 8. **TO-220FP type B package mechanical data**

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| B | 2.50 | | 2.70 |
| D | 2.50 | | 2.75 |
| E | 0.45 | | 0.70 |
| F | 0.75 | | 1.00 |
| F1 | 1.15 | | 1.70 |
| F2 | 1.15 | | 1.70 |
| G | 4.95 | | 5.20 |
| G1 | 2.40 | | 2.70 |
| H | 10.00 | | 10.40 |
| L2 | | 16.00 | |
| L3 | 28.60 | | 30.60 |
| L4 | 9.80 | | 10.60 |
| L5 | 2.90 | | 3.60 |
| L6 | 15.90 | | 16.40 |
| L7 | 9.00 | | 9.30 |
| Dia | 3.00 | | 3.20 |

## Revision history

Table 9. **Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 28-May-2013 | 1 | First release. |
| 05-Mar-2014 | 2 | Datasheet status promoted from preliminary data to production data.<br>Added: I2PAKFP package.<br>Modified: $E_{AS}$ value in *Table 2*.<br>Added: MOSFET dv/dt ruggedness test condition and *note 4* in *Table 2*.<br>Modified: $R_G$ value in *Table 5*.<br>Modified: the entire typical values in *Table 5*, *6* and *7*.<br>Added: *Section 2.1: Electrical characteristics (curves)*.<br>Minor text changes. |
| 05-Dec-2014 | 3 | Updated title, features and description in cover page.<br>Updated *Section 2.1: Electrical characteristics (curves)* and *Section 4: Package information*.<br>Minor text changes. |
| 06-Sep-2016 | 4 | Updated *Table 2: Absolute maximum ratings*, *Table 4: On/off states*, *Table 5: Dynamic*, *Table 6: Switching times* and *Table 7: Source drain diode*.<br>Updated *Figure 2: Safe operating area* and *Figure 3: Thermal impedance*.<br>Minor text changes. |
| 27-Mar-2026 | 5 | Removed order code STFI6N80K5.<br>Updated Section 4: Package information.<br>Minor text changes. |

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