

N-channel 650 V, 1.15 Ω typ., 4 A MDmesh™ M6 Power MOSFET in a TO-220FP package

Datasheet - production data

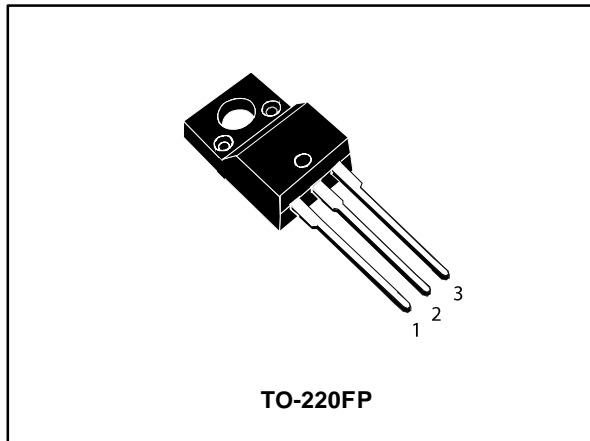
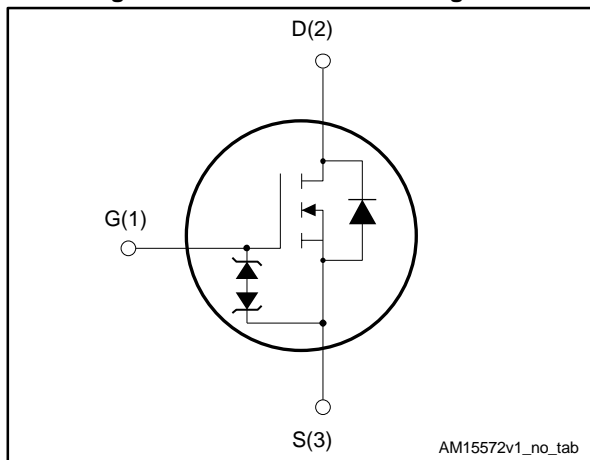


Figure 1: Internal schematic diagram



Features

| Order code | V _{DS} | R _{DS(on)} max. | I _D |
|------------|-----------------|--------------------------|----------------|
| STF5N65M6 | 650 V | 1.3 Ω | 4 A |

- Reduced switching losses
- Lower R_{DS(on)} x area vs previous generation
- Low gate input resistance
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

The new MDmesh™ M6 technology incorporates the most recent advancements to the well-known and consolidated MDmesh family of SJ MOSFETs. STMicroelectronics builds on the previous generation of MDmesh devices through its new M6 technology, which combines excellent R_{DS(on)} * area improvement with one of the most effective switching behaviors available, as well as a user-friendly experience for maximum end-application efficiency.

Table 1: Device summary

| Order code | Marking | Package | Packing |
|------------|---------|----------|---------|
| STF5N65M6 | 5N65M6 | TO-220FP | Tube |

Contents

| | | |
|----------|--|-----------|
| 1 | Electrical ratings | 3 |
| 2 | Electrical characteristics | 4 |
| | 2.1 Electrical characteristics (curves)..... | 6 |
| 3 | Test circuits | 8 |
| 4 | Package information | 9 |
| | 4.1 TO-220FP package information | 10 |
| 5 | Revision history | 12 |

1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|--------------------------------|---|------------|------|
| V _{GS} | Gate-source voltage | ± 25 | V |
| I _D | Drain current (continuous) at T _C = 25 °C | 4 | A |
| I _D | Drain current (continuous) at T _C = 100 °C | 2.5 | A |
| I _{DM} ⁽¹⁾ | Drain current (pulsed) | 16 | A |
| P _{TOT} | Total dissipation at T _C = 25 °C | 20 | W |
| dv/dt ⁽²⁾ | Peak diode recovery voltage slope | 5 | V/ns |
| dv/dt ⁽³⁾ | 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 _J | Operating junction temperature range | -55 to 150 | °C |
| T _{stg} | Storage temperature range | | |

Notes:

⁽¹⁾Pulse width limited by safe operating area

⁽²⁾I_{SD} ≤ 4 A, di/dt = 400 A/μs; V_{DS peak} < V_{(BR)DSS}, V_{DD} = 400 V

⁽³⁾V_{DS} ≤ 520 V

Table 3: Thermal data

| Symbol | Parameter | Value | Unit |
|-----------------------|-------------------------------------|-------|------|
| R _{thj-case} | Thermal resistance junction-case | 6.25 | °C/W |
| R _{thj-amb} | Thermal resistance junction-ambient | 62.5 | |

Table 4: Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|-----------------|---|-------|------|
| I _{AR} | Avalanche current, repetitive or not repetitive (pulse width limited by T _{Jmax}) | 1 | A |
| E _{as} | Single pulse avalanche energy (starting T _J =25°C, I _D = I _{AR} , V _{DD} =50 V) | 90 | mJ |

2 Electrical characteristics

$T_C = 25\text{ °C}$ unless otherwise specified

Table 5: On/off-state

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|-----------------------------------|---|------|------|---------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS} = 0, I_D = 1\text{ mA}$ | 650 | | | V |
| I_{DSS} | Zero gate voltage drain current | $V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}$ | | | 1 | μA |
| | | $V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}; T_C = 125\text{ °C}^{(1)}$ | | | 100 | μA |
| I_{GSS} | Gate body leakage current | $V_{DS} = 0\text{ V}, V_{GS} = \pm 25\text{ V}$ | | | ± 5 | μA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | 2.25 | 3 | 3.75 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS} = 10\text{ V}, I_D = 2\text{ A}$ | | 1.15 | 1.3 | Ω |

Notes:

⁽¹⁾Defined by design, not subject to production test.

Table 6: Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------------|-------------------------------|---|------|------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$ | - | 170 | - | pF |
| C_{oss} | Output capacitance | | - | 20 | - | pF |
| C_{rss} | Reverse transfer capacitance | | - | 1 | - | pF |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ to }520\text{ V}, V_{GS} = 0\text{ V}$ | - | 35 | - | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}, I_D = 0\text{ A}$ | - | 5 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 350\text{ V}, I_D = 1\text{ A}, V_{GS} = 10\text{ V},$ (see Figure 15: "Test circuit for gate charge behavior") | - | 5.1 | - | nC |
| Q_{gs} | Gate-source charge | | - | 0.8 | - | nC |
| Q_{gd} | Gate-drain charge | | - | 2 | - | nC |

Notes:

⁽¹⁾ $C_{oss\text{ eq.}}$ 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 | $V_{DD} = 325\text{ V}, I_D = 2\text{ A}, R_G = 4.7\text{ }\Omega,$ $V_{GS} = 10\text{ V}$ (see Figure 14: "Test circuit for resistive load switching times" and Figure 19: "Switching time waveform") | - | 6.5 | - | ns |
| t_r | Rise time | | - | 5.9 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 17.4 | - | ns |
| t_f | Fall time | | - | 15.2 | - | ns |

Table 8: Source-drain diode

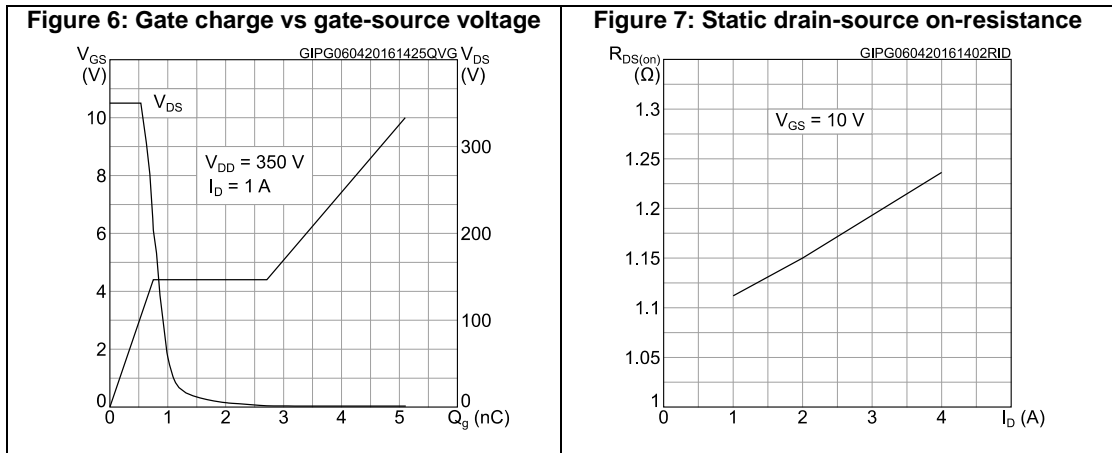
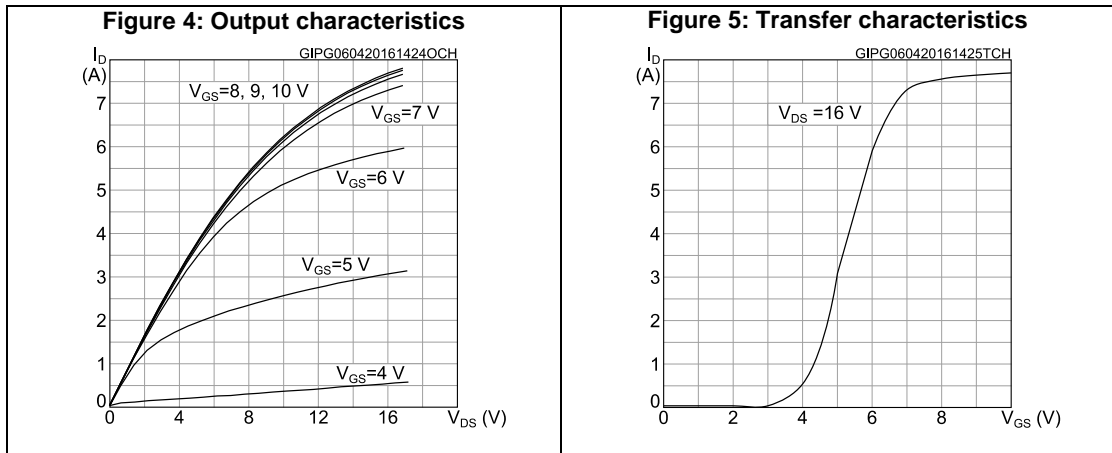
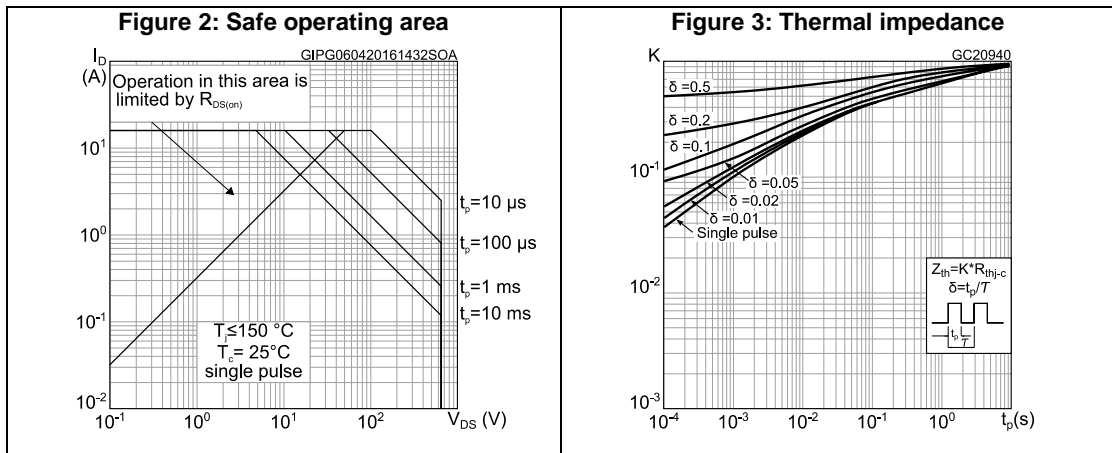
| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 4 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 16 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 4 \text{ A}$, $V_{GS} = 0 \text{ V}$ | - | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 4 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$, (see Figure 19 : "Switching time waveform") | - | 222 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 1.24 | | μC |
| I_{RRM} | Reverse recovery current | | - | 11.2 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 4 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$, $T_j = 150 \text{ }^\circ\text{C}$ (see Figure 19 : "Switching time waveform") | - | 264 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 1.39 | | μC |
| I_{RRM} | Reverse recovery current | | - | 10.5 | | A |

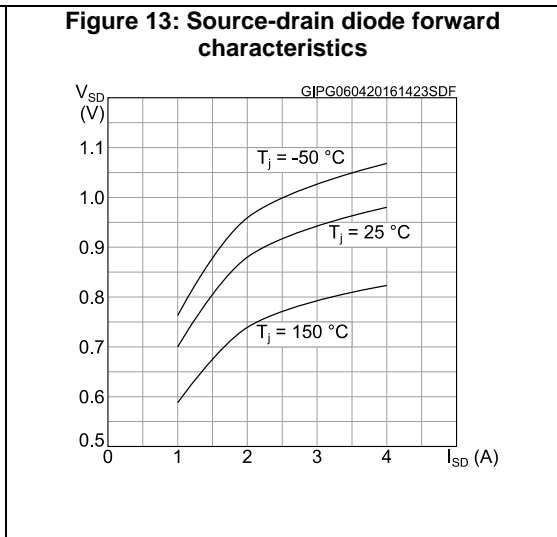
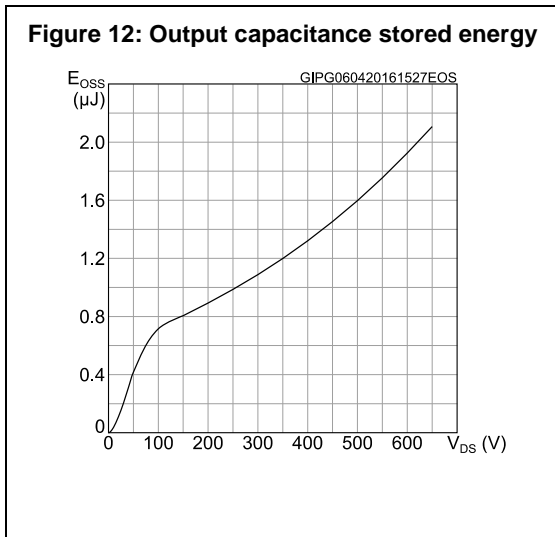
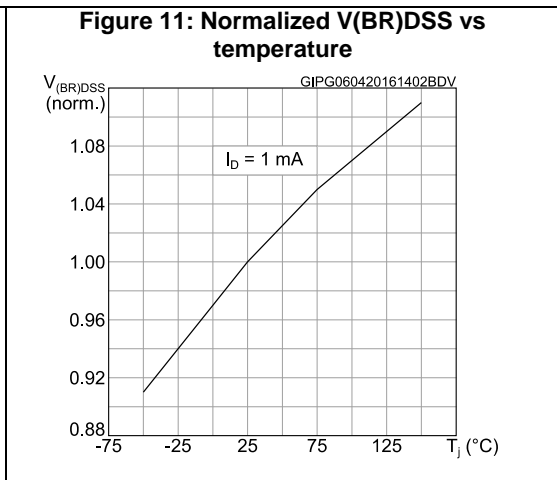
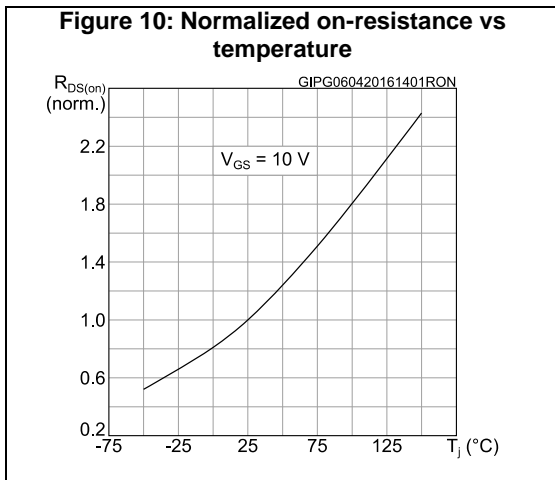
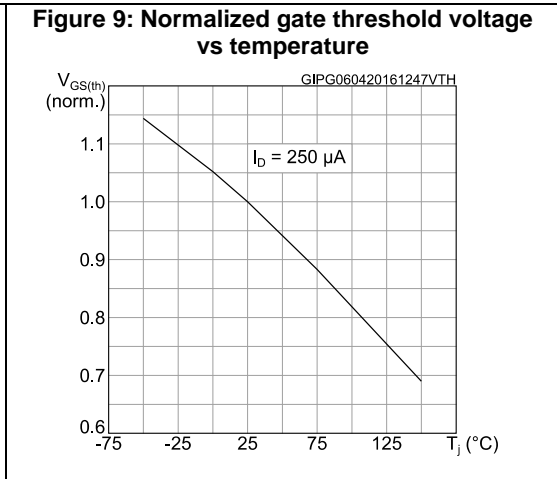
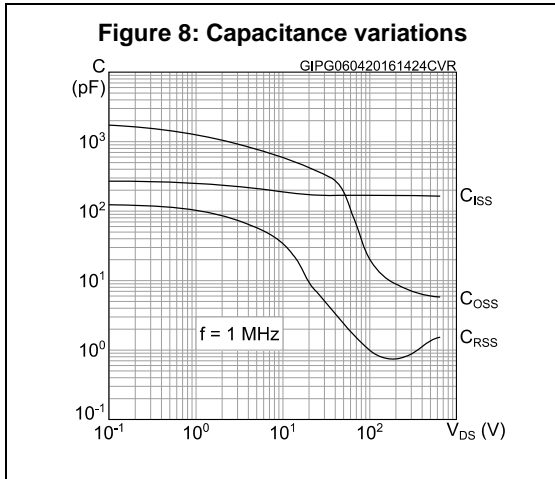
Notes:

(1) Pulse width limited by safe operating area

(2) Pulsed: pulse duration = 300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)





3 Test circuits

Figure 14: Test circuit for resistive load switching times



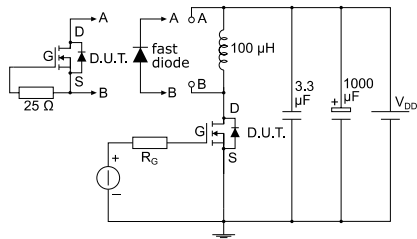
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Figure 15: Test circuit for gate charge behavior



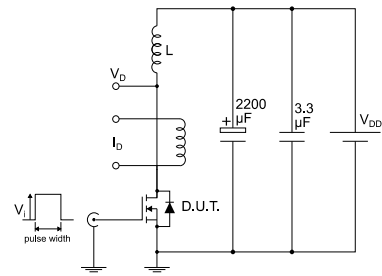
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Figure 16: Test circuit for inductive load switching and diode recovery times



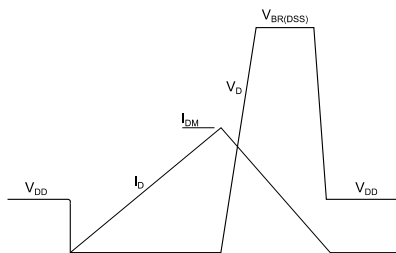
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Figure 17: Unclamped inductive load test circuit



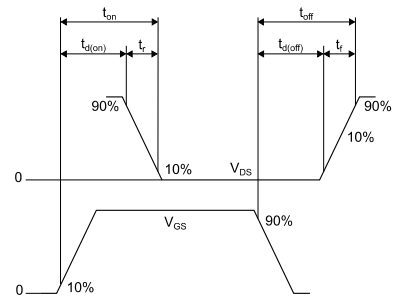
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Figure 18: Unclamped inductive waveform



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Figure 19: Switching time waveform



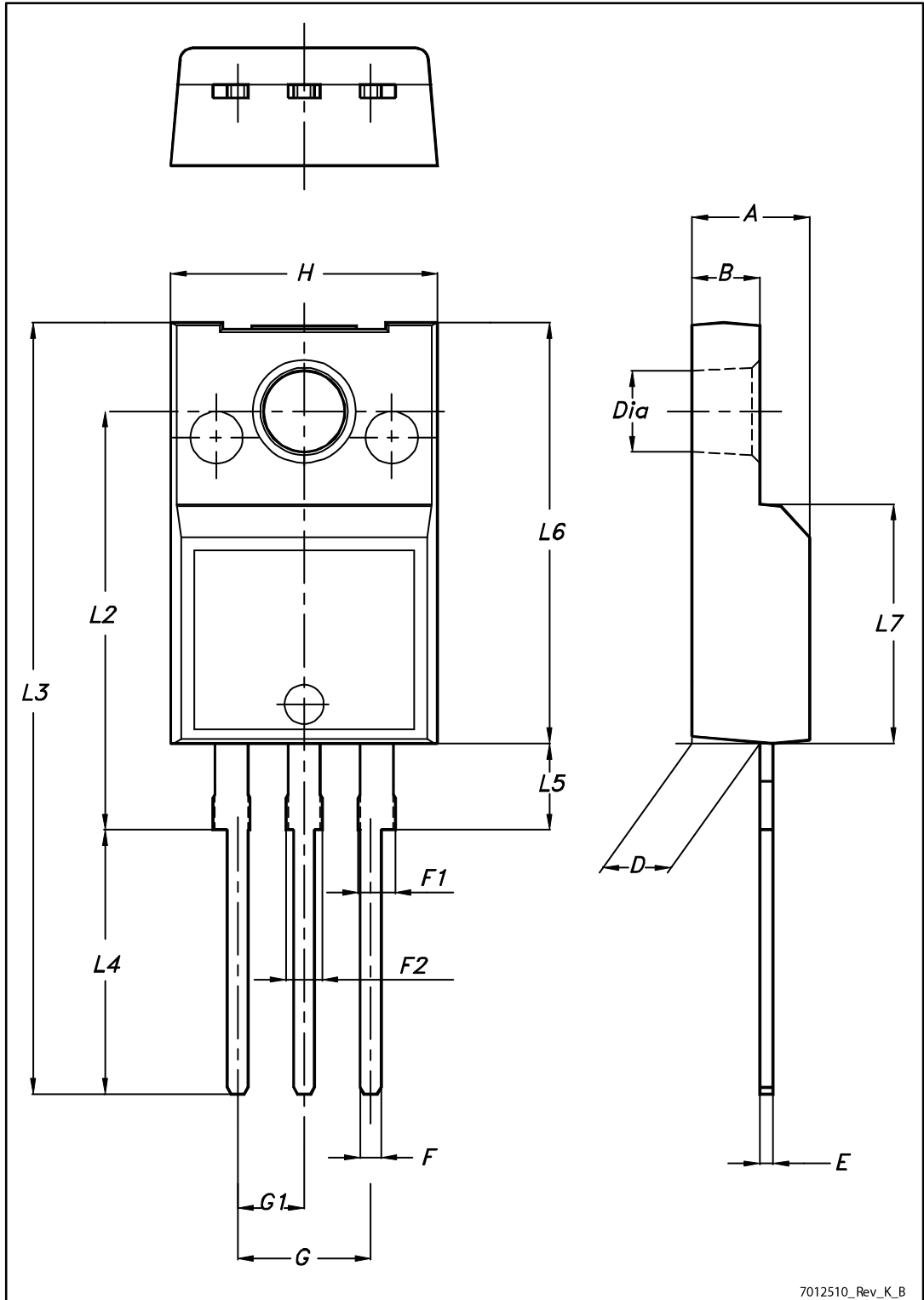
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4 Package information

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



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 |
|-------------|----------|------------------|
| 05-May-2016 | 1 | Initial release. |

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