

N-channel 600 V, 0.35 Ω typ., 11 A MDmesh™ M2 Power MOSFET in a TO-220FP ultra narrow leads package

Datasheet - production data

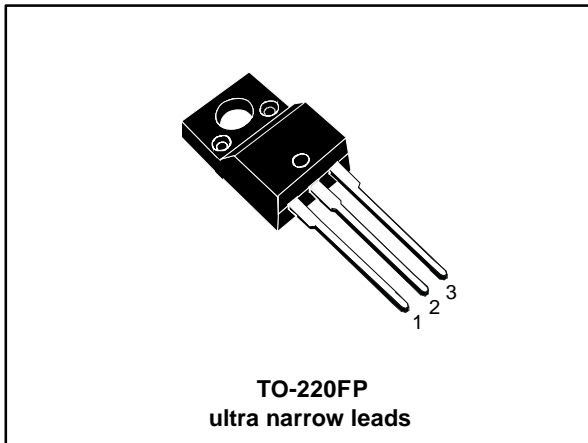
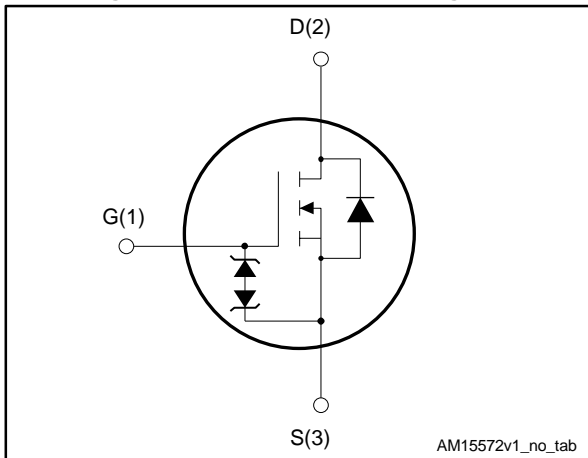


Figure 1: Internal schematic diagram



Features

| Order code | V _{DS} @ T _{Jmax} | R _{DS(on)} max | I _D |
|-------------|-------------------------------------|-------------------------|----------------|
| STFU13N60M2 | 650 V | 0.38 Ω | 11 A |

- Extremely low gate charge
- Lower R_{DS(on)} x area vs previous generation
- Low gate input resistance
- 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.

Table 1: Device summary

| Order code | Marking | Package | Packaging |
|-------------|---------|--------------------------------|-----------|
| STFU13N60M2 | 13N60M2 | TO-220FP ultra narrow leads | Tube |

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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 | 11 ⁽¹⁾ | A |
| I _D | Drain current (continuous) at T _C = 100 °C | 7 | A |
| I _{DM} ⁽²⁾ | Drain current (pulsed) | 44 | A |
| P _{TOT} | Total 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) | 2500 | V |
| dv/dt ⁽³⁾ | Peak diode recovery voltage slope | 15 | V/ns |
| dv/dt ⁽⁴⁾ | MOSFET dv/dt ruggedness | 50 | |
| T _{stg} | Storage temperature | - 55 to 150 | °C |
| T _j | Max. operating junction temperature | | |

Notes:

(1)Limited by maximum junction temperature.

(2)Pulse width limited by safe operating area.

(3)|I_{SD} ≤ 11 A, di/dt ≤ 400 A/μs; V_{DSpk} < V_{(BR)DSS}, V_{DD} = 400 V

(4)V_{DS} ≤ 480 V

Table 3: Thermal data

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

Table 4: Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|-----------------|---|-------|------|
| I _{AR} | Avalanche current, repetitive or not repetitive (pulse width limited by T _{jmax}) | 2.8 | A |
| E _{AS} | Single pulse avalanche energy (starting T _j = 25°C, I _D = I _{AR} ; V _{DD} = 50 V) | 125 | mJ |

2 Electrical characteristics

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

Table 5: On /off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|--|------|------|----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D = 1\text{ mA}$, $V_{GS} = 0\text{ V}$ | 600 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = 600\text{ V}$ | | | 1 | μA |
| | | $V_{DS} = 600\text{ V}$, $T_C = 125\text{ °C}$ | | | 100 | μA |
| I_{GSS} | Gate-body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 25\text{ V}$ | | | ± 10 | μA |
| $V_{GS(th)}$ | 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 | $V_{GS} = 10\text{ V}$, $I_D = 5.5\text{ A}$ | | 0.35 | 0.38 | Ω |

Table 6: Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------------|-------------------------------|--|------|------|------|----------|
| C_{ISS} | Input capacitance | $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$ | - | 580 | - | pF |
| C_{OSS} | Output capacitance | | - | 32 | - | pF |
| C_{RSS} | Reverse transfer capacitance | | - | 1.1 | - | pF |
| $C_{OSS\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ to }480\text{ V}$, $V_{GS} = 0\text{ V}$ | - | 120 | - | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}$ open drain | - | 6.6 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 480\text{ V}$, $I_D = 11\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 15: "Test circuit for gate charge behavior") | - | 17 | - | nC |
| Q_{gs} | Gate-source charge | | - | 2.5 | - | nC |
| Q_{gd} | Gate-drain charge | | - | 9 | - | 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 | $V_{DD} = 300\text{ V}$, $I_D = 5.5\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14: "Test circuit for resistive load switching times" and Figure 19: "Switching time waveform") | - | 11 | - | ns |
| t_r | Rise time | | - | 10 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 41 | - | ns |
| t_f | Fall time | | - | 9.5 | - | ns |

Table 8: Source drain diode

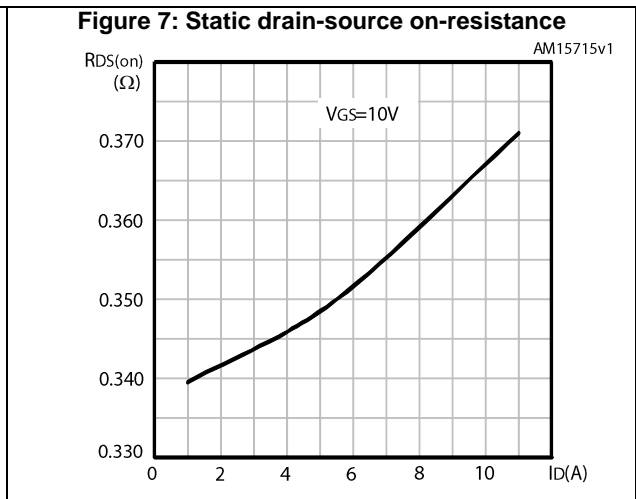
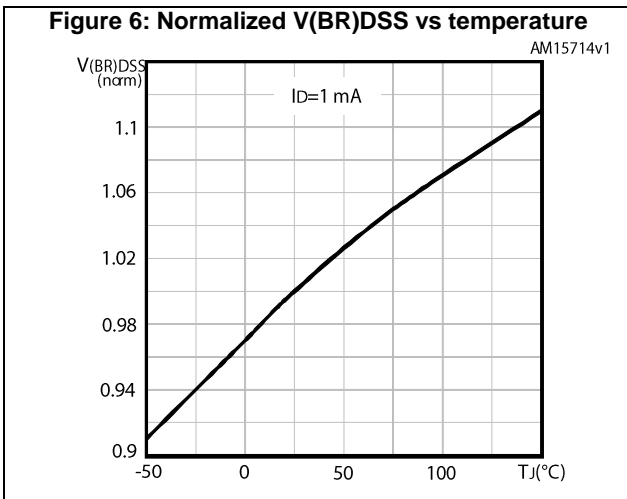
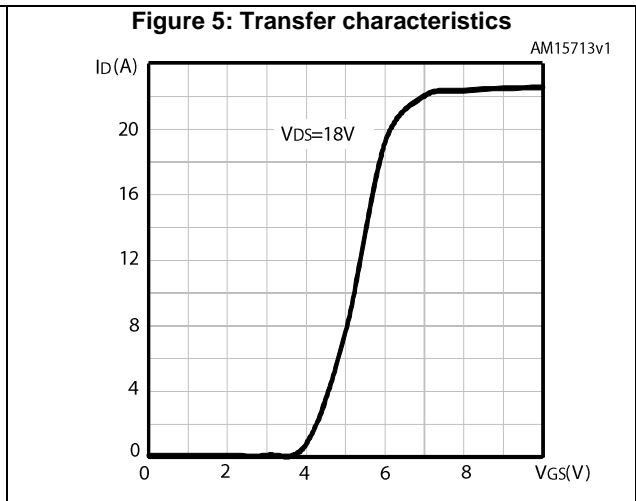
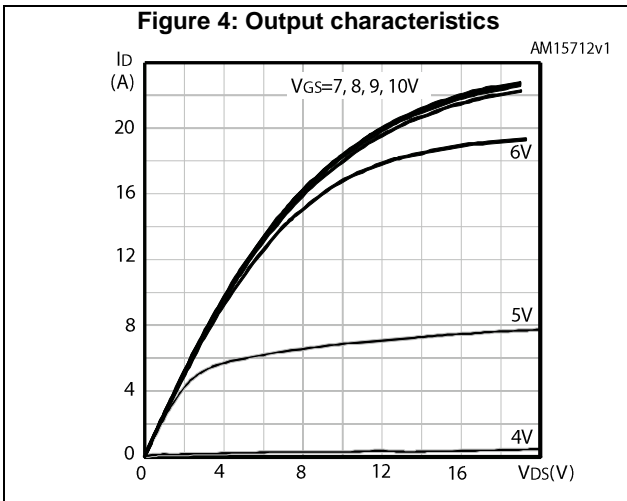
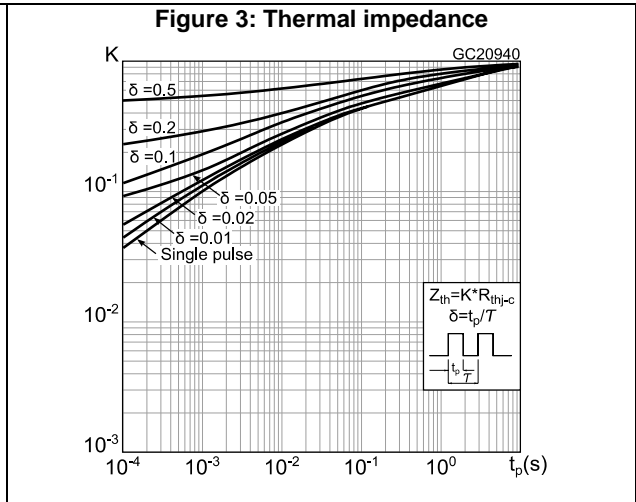
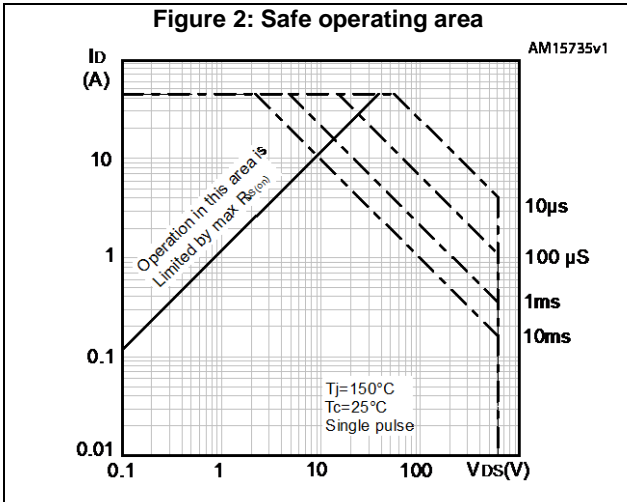
| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 11 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 44 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 11 \text{ A}$, $V_{GS} = 0 \text{ V}$ | - | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 11 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times") | - | 297 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 2.8 | | μC |
| I_{RRM} | Reverse recovery current | | - | 18.5 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 11 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$, $T_j = 150 \text{ }^\circ\text{C}$, (see Figure 16: "Test circuit for inductive load switching and diode recovery times") | - | 394 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 3.8 | | μC |
| I_{RRM} | Reverse recovery current | | - | 19 | | A |

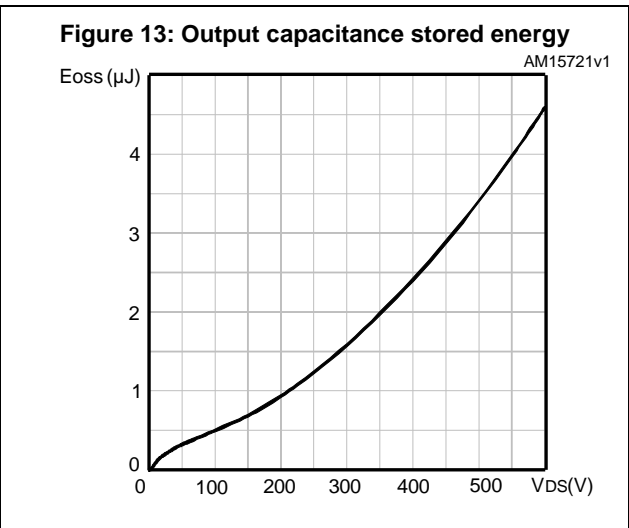
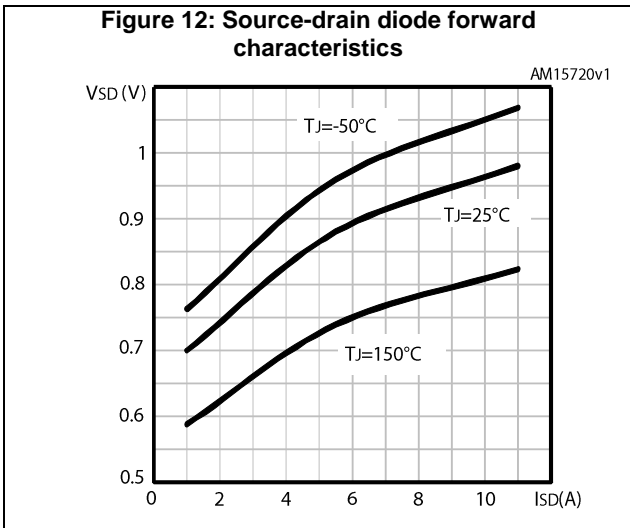
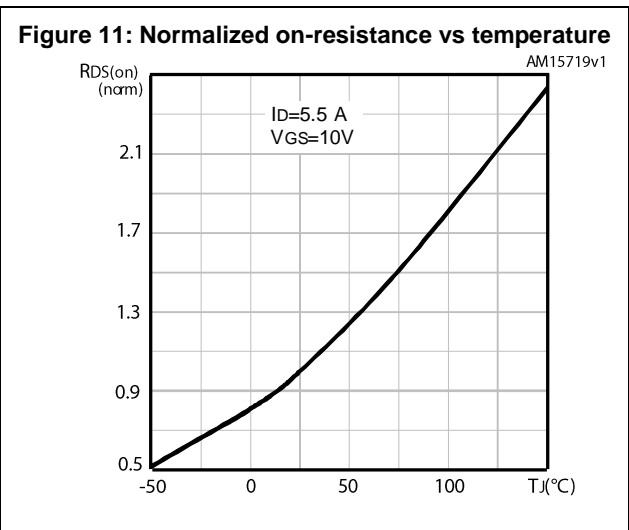
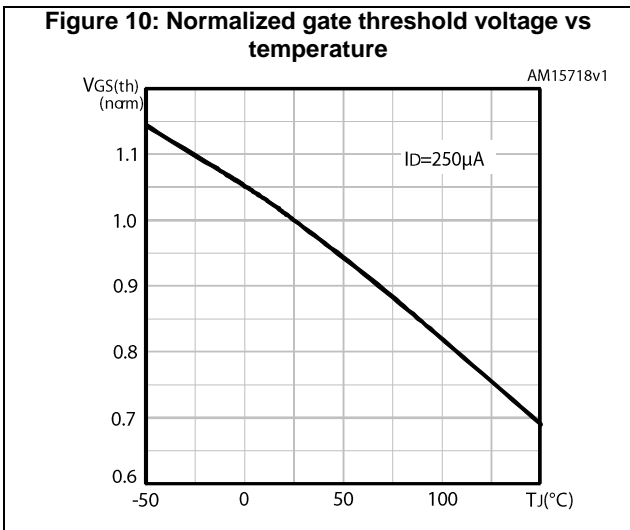
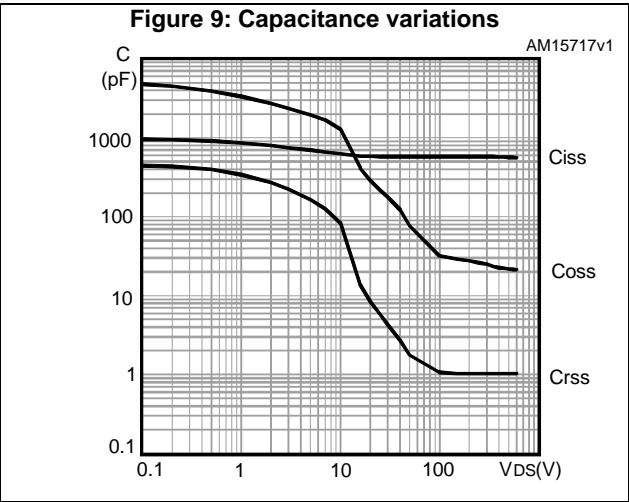
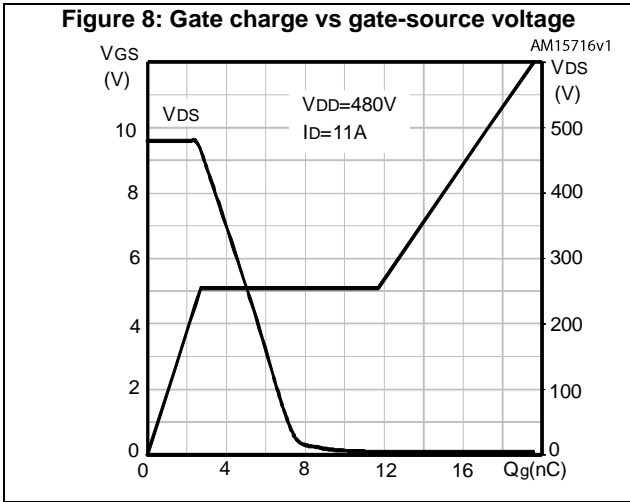
Notes:

(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 circuit

Figure 14: Test circuit for resistive load switching times



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Figure 15: Test circuit for gate charge behavior



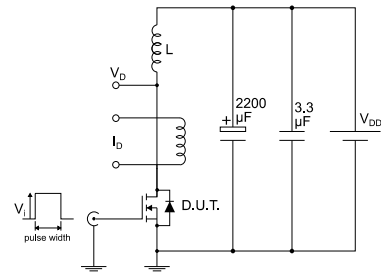
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Figure 16: Test circuit for inductive load switching and diode recovery times



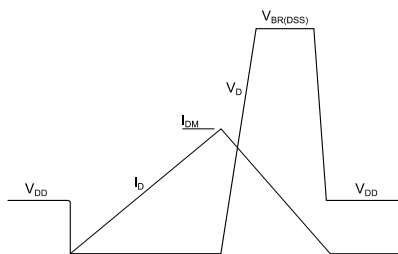
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Figure 17: Unclamped inductive load test circuit



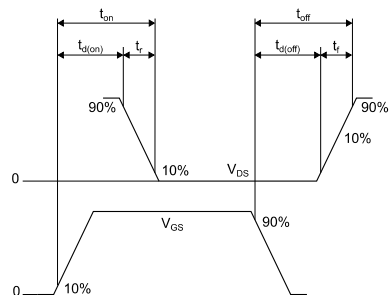
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Figure 18: Unclamped inductive waveform



AM01472v1

Figure 19: Switching time waveform



AM01473v1

4 Package mechanical data

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 ultra narrow leads package outline

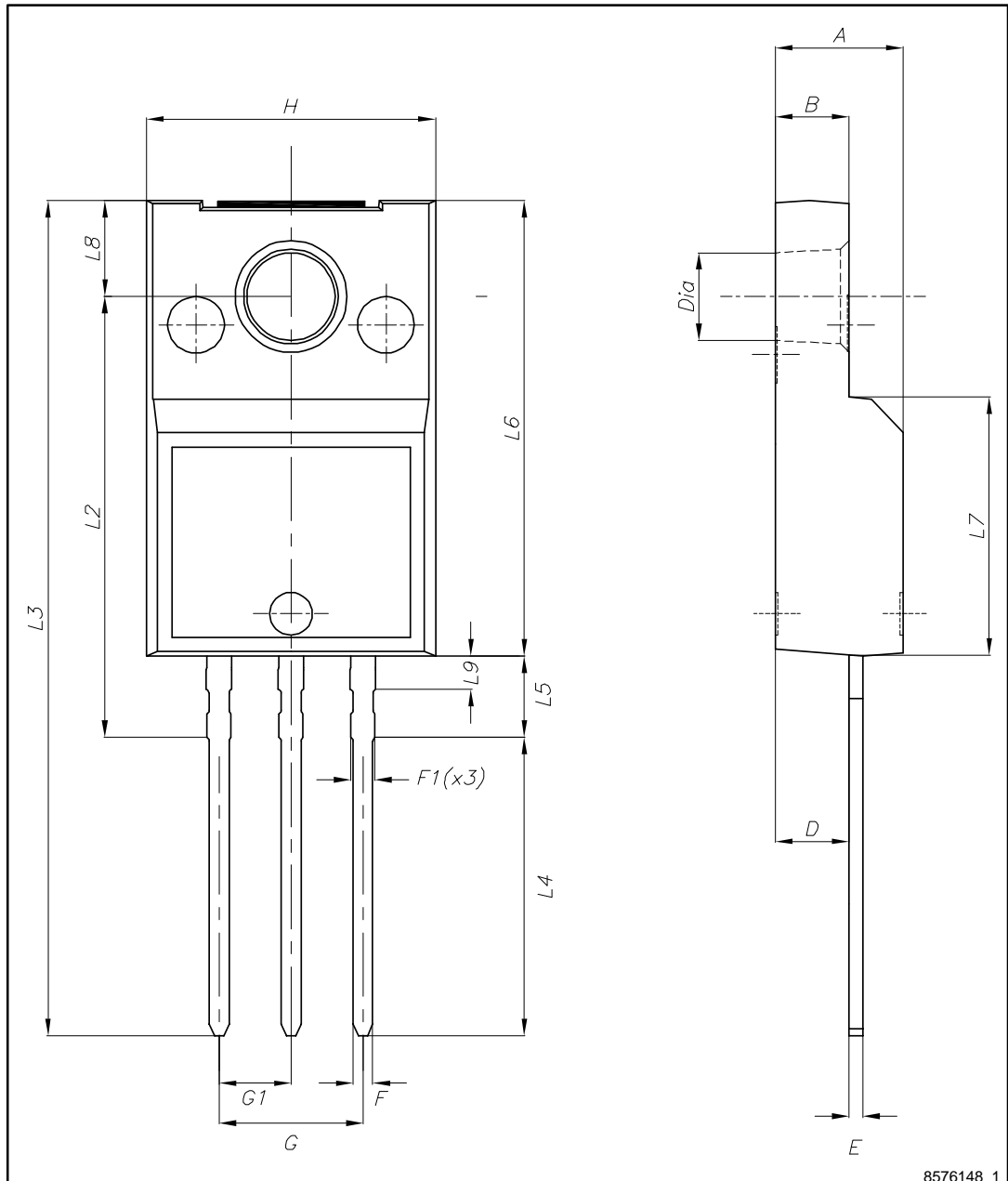


Table 9: TO-220FP ultra narrow leads mechanical data

| Dim. | mm | | |
|------|-------|------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| B | 2.50 | | 2.70 |
| D | 2.50 | | 2.75 |
| E | 0.45 | | 0.60 |
| F | 0.65 | | 0.75 |
| F1 | - | | 0.90 |
| G | 4.95 | | 5.20 |
| G1 | 2.40 | 2.54 | 2.70 |
| H | 10.00 | | 10.40 |
| L2 | 15.10 | | 15.90 |
| L3 | 28.50 | | 30.50 |
| L4 | 10.20 | | 11.00 |
| L5 | 2.50 | | 3.10 |
| L6 | 15.60 | | 16.40 |
| L7 | 9.00 | | 9.30 |
| L8 | 3.20 | | 3.60 |
| L9 | - | | 1.30 |
| Dia. | 3.00 | | 3.20 |

5 Revision history

Table 10: Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 09-Mar-2015 | 1 | Initial release |
| 15-Sep-2015 | 2 | Document status changed from preliminary to production data. |

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