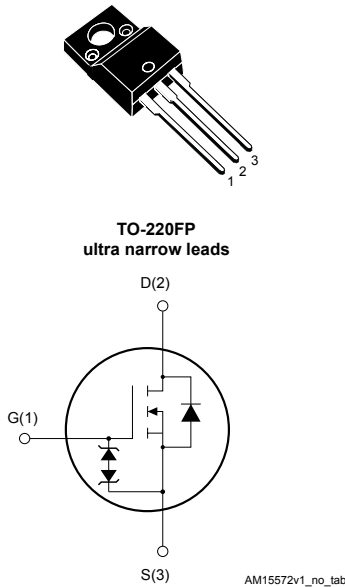


N-channel 600 V, 0.175 Ω typ., 18 A MDmesh™ M2 EP Power MOSFET in a TO-220FP ultra narrow leads package



Features

| Order code | $V_{DS} @ T_{Jmax}$ | $R_{DS(on)}$ max. | I_D |
|----------------|---------------------|-------------------|-------|
| STFU25N60M2-EP | 650 V | 0.188 Ω | 18 A |

- Extremely low gate charge
- Excellent output capacitance (C_{OSS}) profile
- Very low turn-off switching losses
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications
- Tailored for Very high frequency converters ($f > 150$ kHz)

Description

This device is an N-channel Power MOSFET developed using MDmesh™ M2 enhanced performance (EP) technology. Thanks to its strip layout and an improved vertical structure, the device exhibits low on-resistance, optimized switching characteristics with very low turn-off switching losses, rendering it suitable for the most demanding very high frequency converters.

Product status link

[STFU25N60M2-EP](#)

Product summary

| | |
|-------------------|--------------------------------|
| Order code | STFU25N60M2-EP |
| Marking | 25N60M2EP |
| Package | TO-220FP ultra narrow leads |
| Packing | Tube |

1 Electrical ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|------------|------------------|
| V_{GS} | Gate-source voltage | ± 25 | V |
| $I_D^{(1)}$ | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 18 | A |
| $I_D^{(1)}$ | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 11.3 | A |
| $I_{DM}^{(2)}$ | Drain current (pulsed) | 72 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 30 | W |
| $dv/dt^{(3)}$ | Peak diode recovery voltage slope | 15 | V/ns |
| $dv/dt^{(4)}$ | MOSFET dv/dt ruggedness | 50 | V/ns |
| V_{ISO} | Insulation withstand voltage (RMS) from all three leads to external heat sink ($t = 1\text{ s}$, $T_C = 25\text{ }^\circ\text{C}$) | 2500 | V |
| T_{stg} | Storage temperature range | -55 to 150 | $^\circ\text{C}$ |
| T_j | Operating junction temperature range | | |

- Limited by maximum junction temperature
- Pulse width limited by safe operating area
- $I_{SD} \leq 18\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS\ peak} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$
- $V_{DS} \leq 480\text{ V}$

Table 2. Thermal data

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

Table 3. Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|----------|--|-------|------|
| I_{AR} | Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax}) | 3.5 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$) | 200 | mJ |

2 Electrical characteristics

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

Table 4. On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|-----------------------------------|---|------|-------|----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$ | 600 | | | V |
| I_{DSS} | Zero gate voltage drain current | $V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}$ | | | 1 | μA |
| | | $V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}, T_C = 125\text{ °C}^{(1)}$ | | | 100 | μA |
| I_{GSS} | Gate-body leakage current | $V_{DS} = 0\text{ V}, V_{GS} = \pm 25\text{ V}$ | | | ± 10 | μA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | 3.25 | 4 | 4.75 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS} = 10\text{ V}, I_D = 9\text{ A}$ | | 0.175 | 0.188 | Ω |

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

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------------|-------------------------------|---|------|------|------|----------|
| C_{iss} | Input capacitance | | - | 1090 | - | pF |
| C_{oss} | Output capacitance | $V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$ | - | 56 | - | pF |
| C_{rss} | Reverse transfer capacitance | | - | 1.6 | - | pF |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ to }480\text{ V}, V_{GS} = 0\text{ V}$ | - | 255 | - | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}, I_D = 0\text{ A}$ | - | 7 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 480\text{ V}, I_D = 18\text{ A},$ $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 15. Test circuit for gate charge behavior) | - | 29 | - | nC |
| Q_{gs} | Gate-source charge | | - | 6 | - | nC |
| Q_{gd} | Gate-drain charge | | - | 12 | - | nC |

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 6. Switching energy

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------|---|---|------|------|------|---------------|
| $E_{(off)}$ | Turn-off energy (from 90% V_{GS} to 0% I_D) | $V_{DD} = 400\text{ V}, I_D = 2\text{ A},$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ | - | 7 | - | μJ |
| | | $V_{DD} = 400\text{ V}, I_D = 4\text{ A},$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ | - | 8 | - | μJ |

Table 7. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD} = 300\text{ V}$, $I_D = 9\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform) | - | 15 | - | ns |
| t_r | Rise time | | - | 10 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 61 | - | ns |
| t_f | Fall time | | - | 16 | - | ns |

Table 8. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 18 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 72 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $V_{GS} = 0\text{ V}$, $I_{SD} = 18\text{ A}$ | - | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 18\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$ (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 | $I_{SD} = 18\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16. Test circuit for inductive load switching and diode recovery times) | - | 28 | | A |
| t_{rr} | Reverse recovery time | | - | 445 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 6.5 | | μC |
| I_{RRM} | Reverse recovery current | | - | 29 | | A |

1. Pulse width is limited by safe operating area
2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

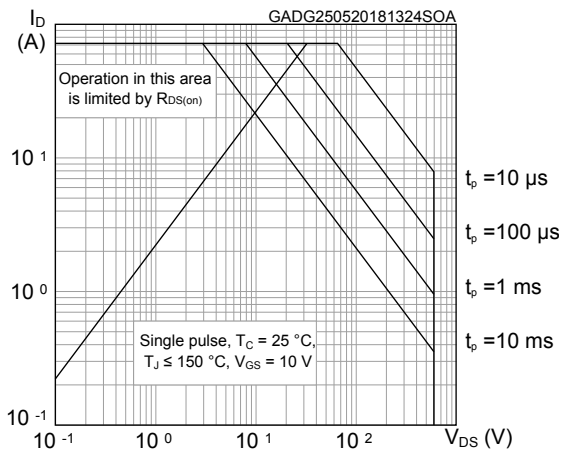


Figure 2. Thermal impedance

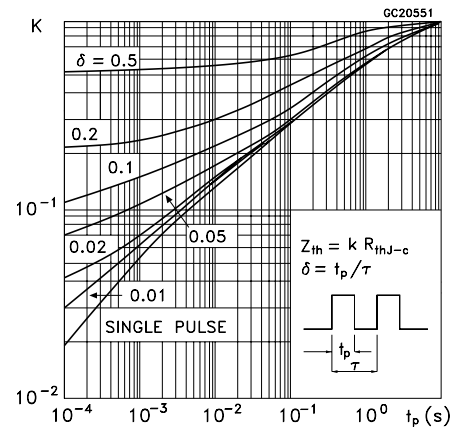


Figure 3. Output characteristics

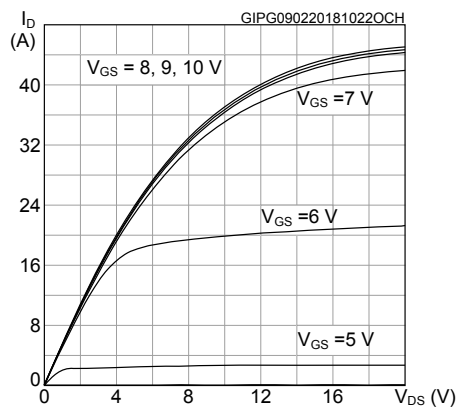


Figure 4. Transfer characteristics

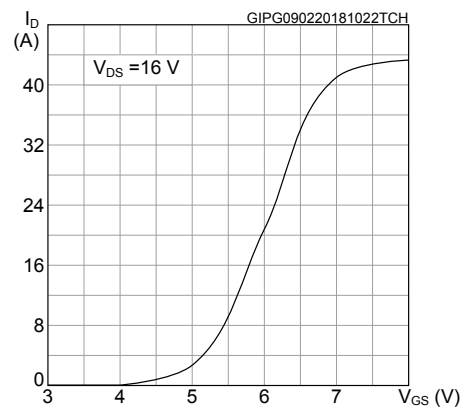


Figure 5. Gate charge vs gate-source voltage

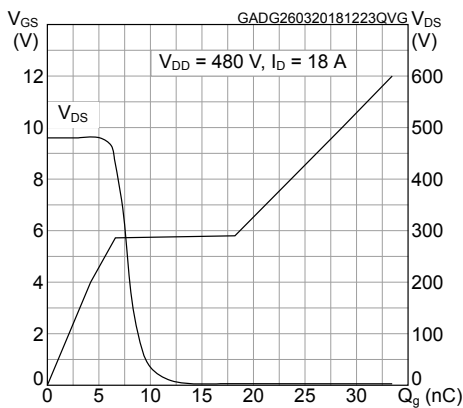


Figure 6. Static drain-source on-resistance

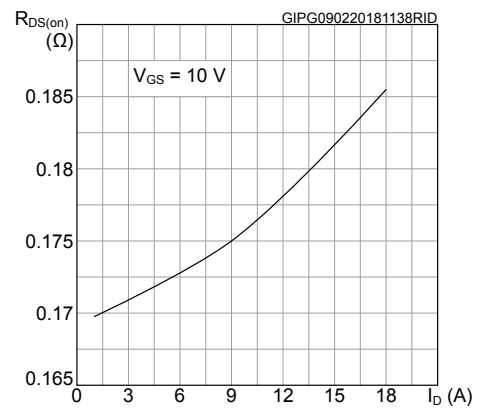


Figure 7. Capacitance variations

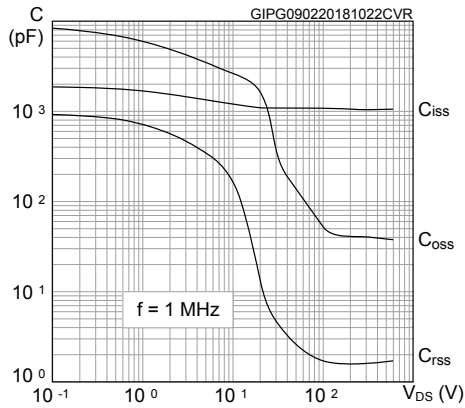


Figure 8. Output capacitance stored energy

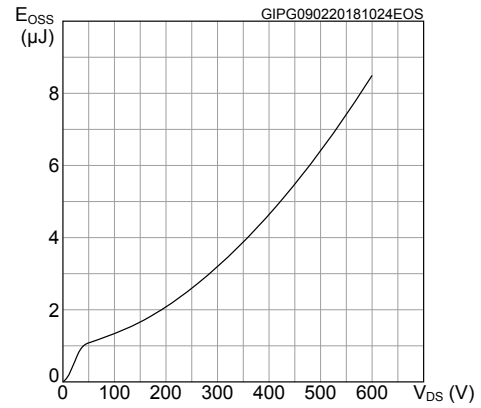


Figure 9. Turn-off switching energy vs drain current

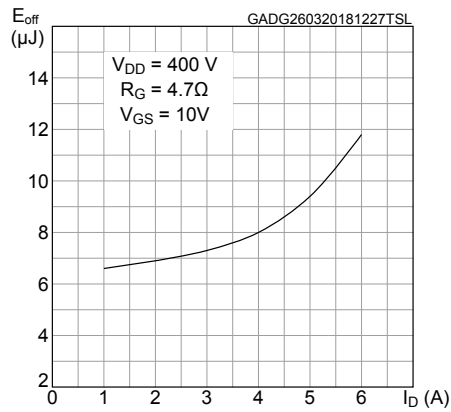


Figure 10. Normalized gate threshold voltage vs temperature

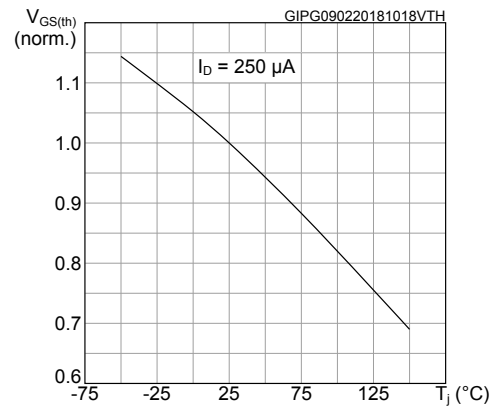


Figure 11. Normalized on-resistance vs temperature

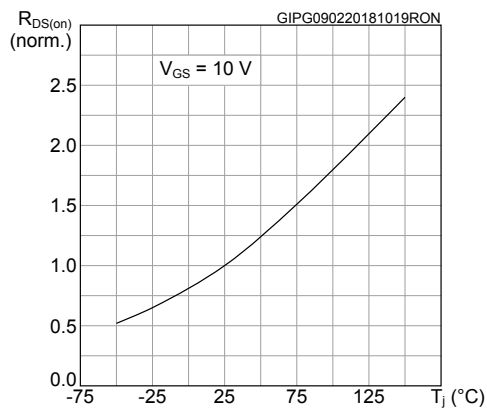


Figure 12. Normalized $V_{(BR)DSS}$ vs temperature

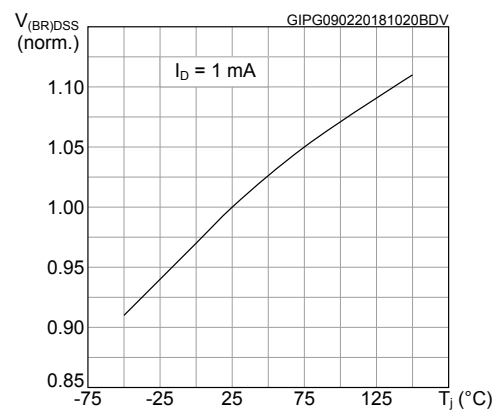
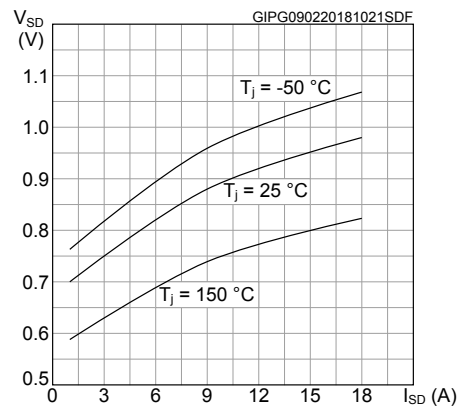
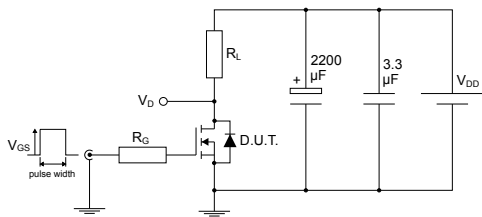


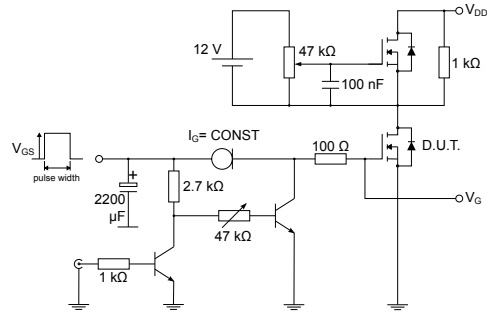
Figure 13. Source-drain diode forward characteristics



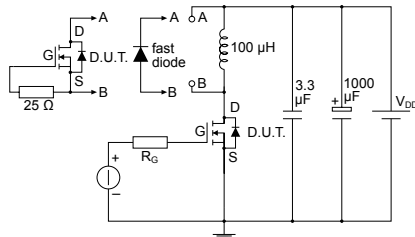
3 Test circuits

Figure 14. Test circuit for resistive load switching times


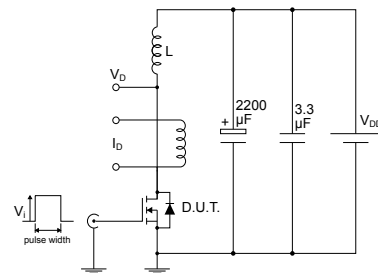
AM01468v1

Figure 15. Test circuit for gate charge behavior


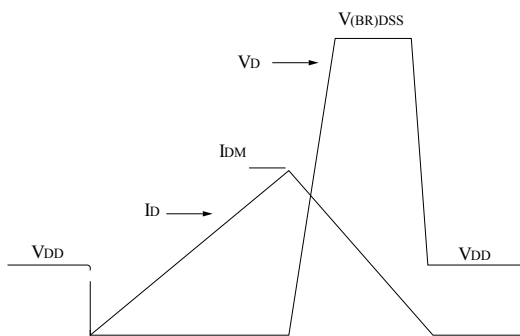
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Figure 16. Test circuit for inductive load switching and diode recovery times


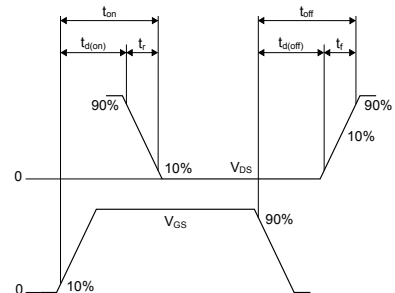
AM01470v1

Figure 17. Unclamped inductive load test circuit


AM01471v1

Figure 18. Unclamped inductive waveform


AM01472v1

Figure 19. Switching time waveform


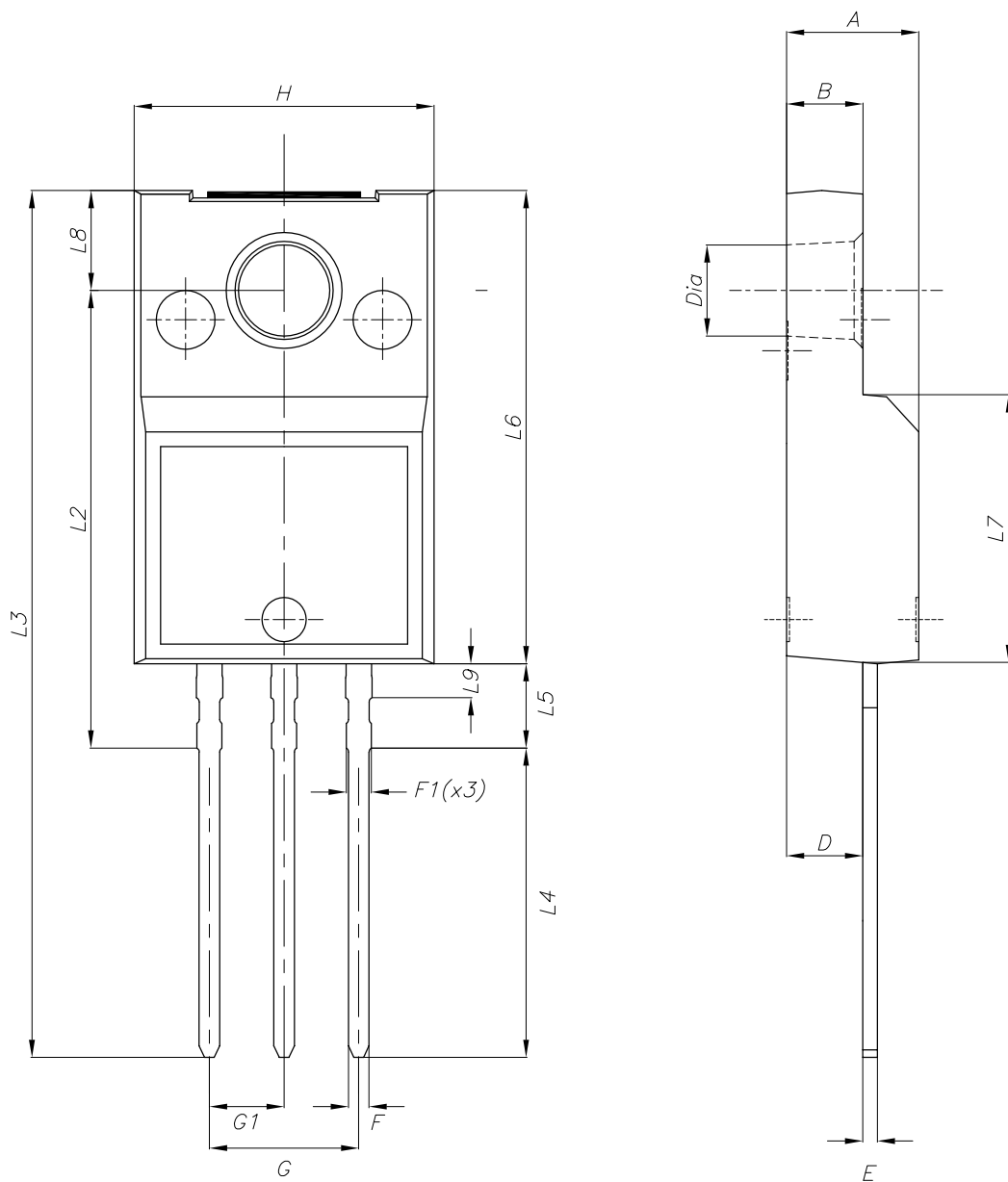
AM01473v1

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. ECOPACK® is an ST trademark.

4.1 TO-220FP ultra narrow leads package information

Figure 20. TO-220FP ultra narrow leads package outline



8576148_1

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 |

Revision history

Table 10. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 20-Jun-2017 | 1 | First release. |
| 07-Nov-2017 | 2 | Updated <i>Figure 12. Source-drain diode forward characteristics</i> . Minor text changes. |
| 16-Feb-2018 | 3 | Removed maturity status indication from cover page. Production data. Modified <i>Table 1. Absolute maximum ratings, Table 5. Dynamic</i> . Modified <i>Figure 7. Capacitance variations</i> . Minor text changes. |
| 28-May-2018 | 4 | Updated Table 1. Absolute maximum ratings . Updated Section 2 Electrical characteristics and Section 2.1 Electrical characteristics (curves) . Minor text changes |

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