

N-channel 600 V, 0.255 Ω typ., 13 A MDmesh II Plus™ low Q_g Power MOSFET in a TO-220FP package

Datasheet – production data

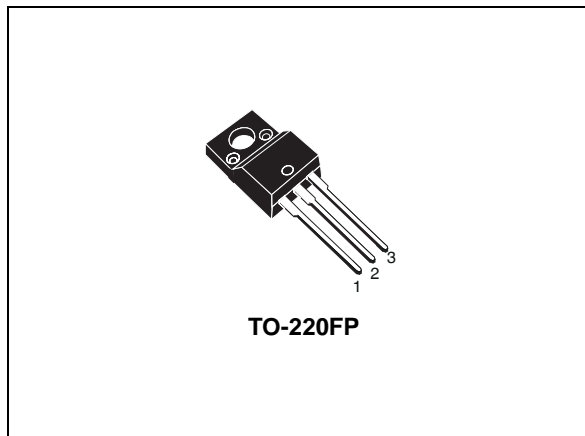
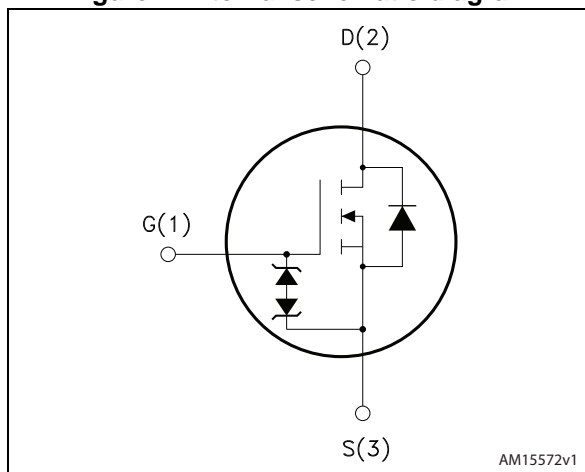


Figure 1. Internal schematic diagram



Features

| Order code | $V_{DS} @ T_{Jmax}$ | $R_{DS(on) max}$ | I_D |
|------------|---------------------|------------------|-------|
| STF18N60M2 | 650 V | 0.28 Ω | 13 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
- LLC converters, resonant converters

Description

This device is an N-channel Power MOSFET developed using a new generation of MDmesh™ technology: MDmesh II Plus™ low Q_g . This revolutionary Power MOSFET associates a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

Table 1. Device summary

| Order code | Marking | Package | Packaging |
|------------|---------|----------|-----------|
| STF18N60M2 | 18N60M2 | TO-220FP | Tube |

Contents

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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 $T_C = 25\text{ °C}$ | 13 ⁽¹⁾ | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ °C}$ | 8 ⁽¹⁾ | A |
| $I_{DM}^{(2)}$ | Drain current (pulsed) | 52 ⁽¹⁾ | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ °C}$ | 25 | 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 s, $T_C = 25\text{ °C}$) | 2500 | V |
| T_{stg} | Storage temperature | - 55 to 150 | °C |
| T_j | Max. operating junction temperature | | |

1. Limited by maximum junction temperature
2. Pulse width limited by safe operating area
3. $I_{SD} \leq 13\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$; $V_{DS\ peak} < V_{(BR)DSS}$, $V_{DD}=400\text{ V}$.
4. $V_{DS} \leq 480\text{ V}$

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}) | 3 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j=25\text{ °C}$, $I_D=I_{AR}$; $V_{DD}=50$) | 135 | 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 | $I_D = 1\text{ mA}$, $V_{GS} = 0$ | 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 | $V_{GS} = 10\text{ V}$, $I_D = 6.5\text{ A}$ | | 0.255 | 0.28 | Ω |

Table 6. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------------|-------------------------------|---|------|-------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$ | - | 791 | - | pF |
| C_{oss} | Output capacitance | | - | 40 | - | pF |
| C_{riss} | Reverse transfer capacitance | | - | 5.6 | - | pF |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ to }480\text{ V}$, $V_{GS} = 0$ | - | 164.5 | - | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}$, $I_D = 0$ | - | 5.6 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 480\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 15) | - | 21.5 | - | nC |
| Q_{gs} | Gate-source charge | | - | 3.2 | - | nC |
| Q_{gd} | Gate-drain charge | | - | 11.3 | - | 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 7. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD} = 300\text{ V}$, $I_D = 6.5\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14 and Figure 19) | - | 12 | - | ns |
| t_r | Rise time | | - | 9 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 47 | - | ns |
| t_f | Fall time | | - | 10.6 | - | ns |

Table 8. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 13 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 52 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 13 \text{ A}, V_{GS} = 0$ | - | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 13 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$ (see Figure 16) | - | 305 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 3.3 | | μC |
| I_{RRM} | Reverse recovery current | | - | 22 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 13 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}, T_j = 150 \text{ }^\circ\text{C}$ (see Figure 16) | - | 417 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 4.6 | | μC |
| I_{RRM} | Reverse recovery current | | - | 22 | | A |

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

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

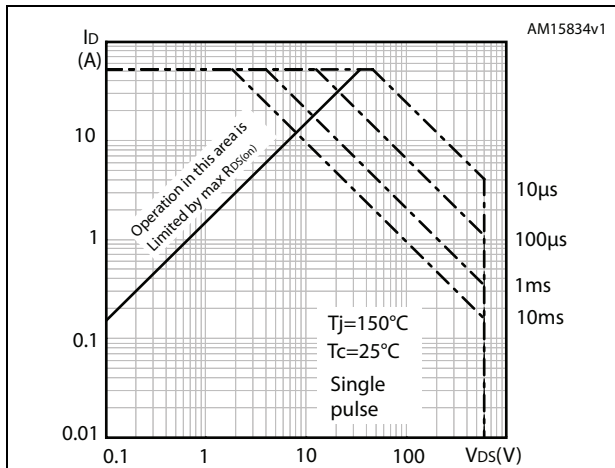


Figure 3. Thermal impedance

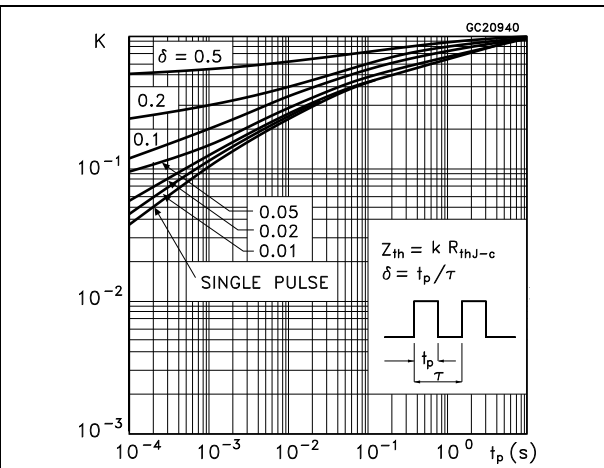


Figure 4. Output characteristics

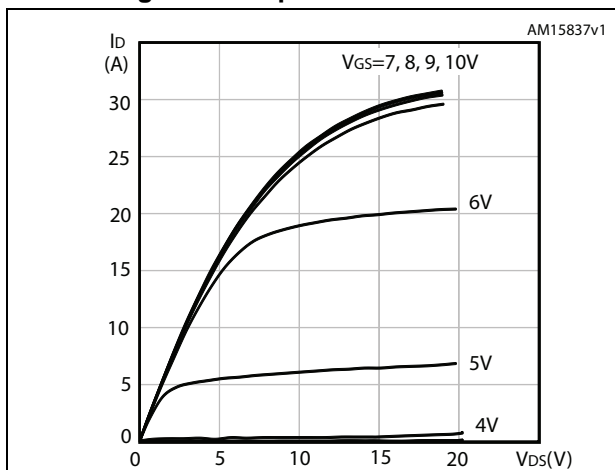


Figure 5. Transfer characteristics

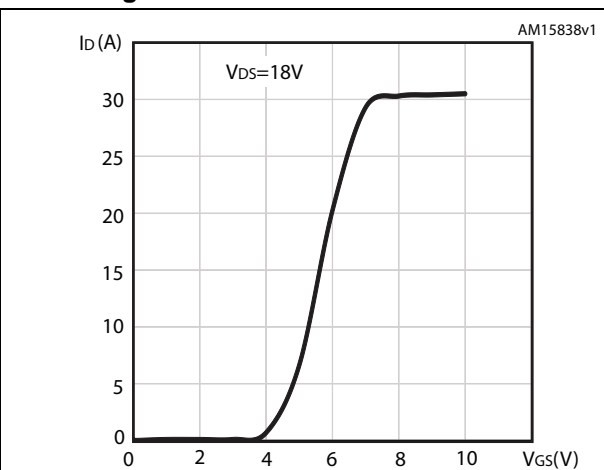


Figure 6. Gate charge vs gate-source voltage

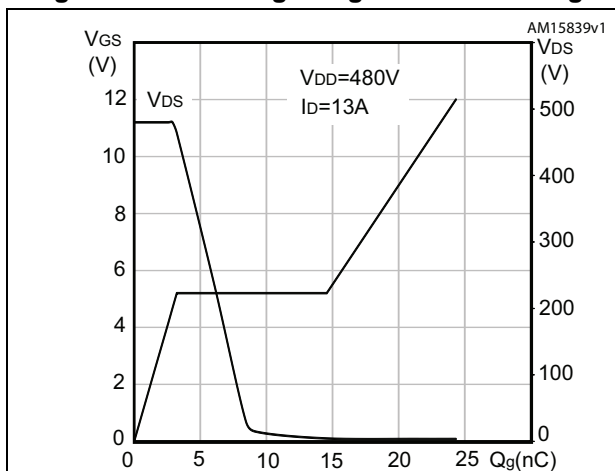


Figure 7. Static drain-source on-resistance

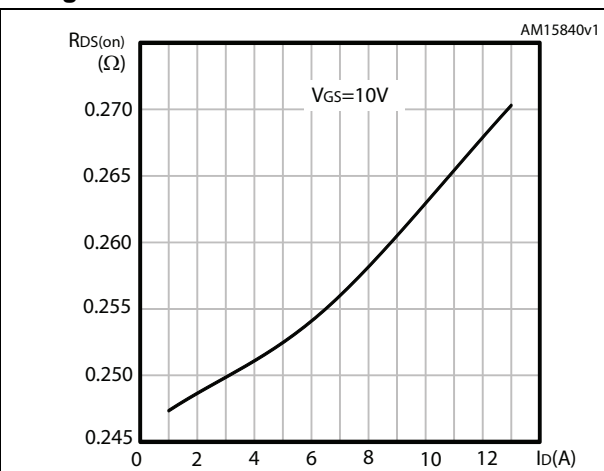


Figure 8. Capacitance variations

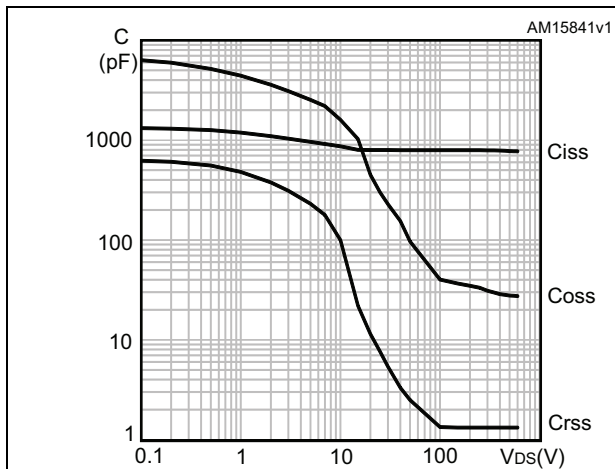


Figure 9. Normalized gate threshold voltage vs. temperature

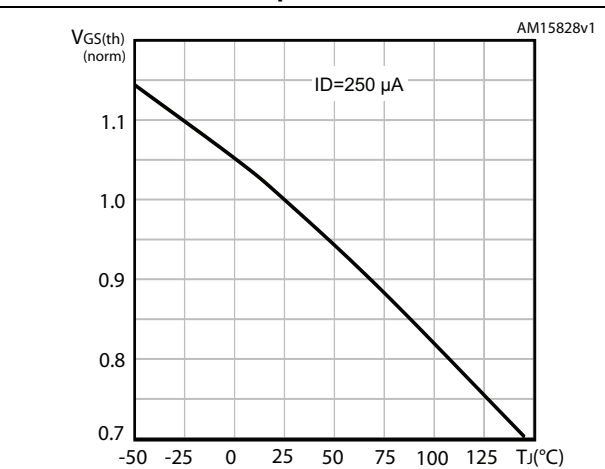


Figure 10. Normalized on-resistance vs temperature

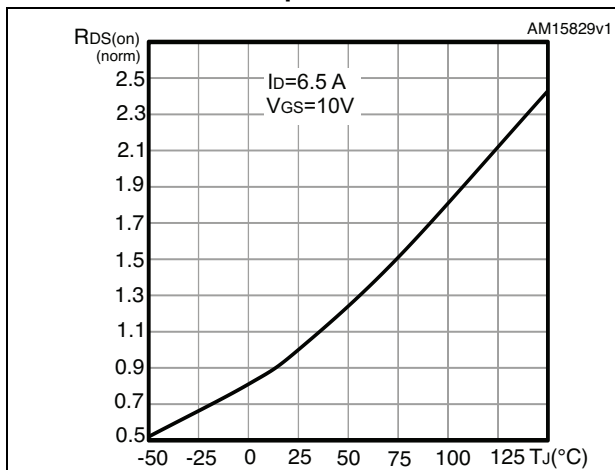


Figure 11. Source-drain diode forward characteristics

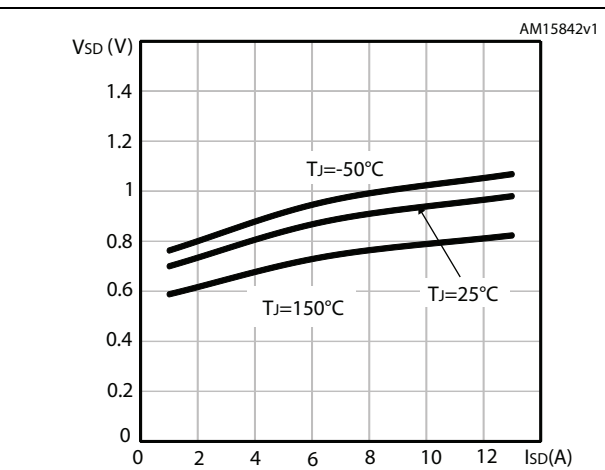


Figure 12. Normalized V(BR)DSS vs temperature

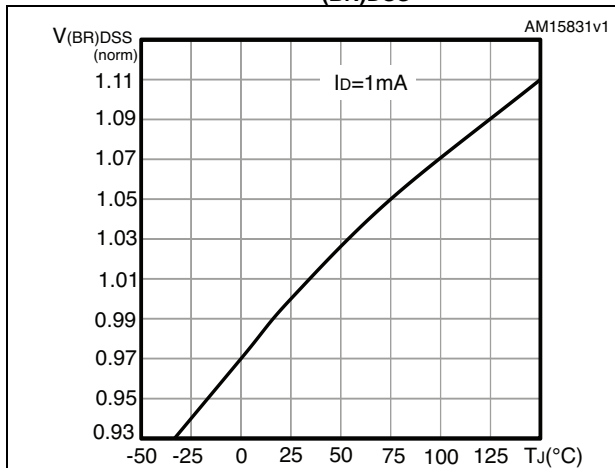
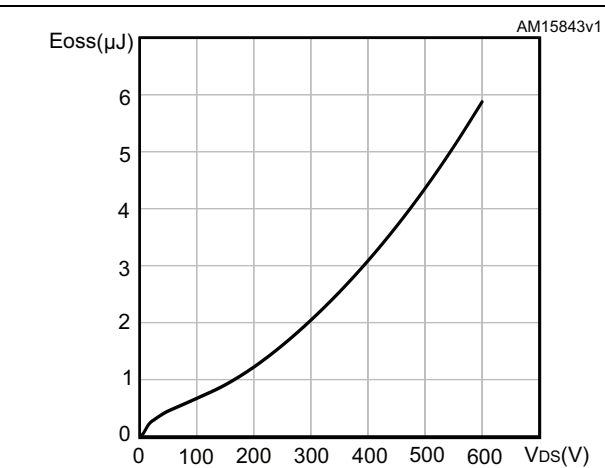


Figure 13. Output capacitance stored energy



3 Test circuits

Figure 14. Switching times test circuit for resistive load

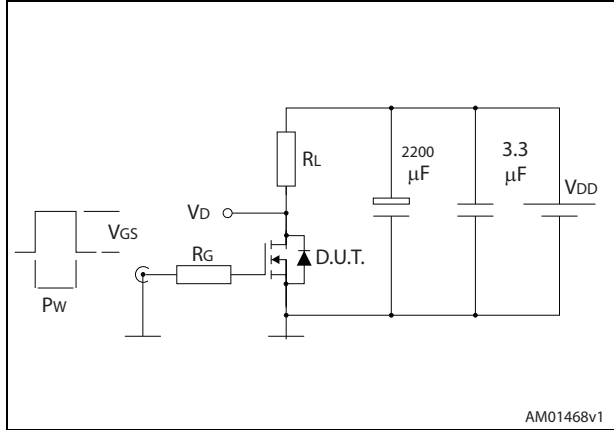


Figure 15. Gate charge test circuit

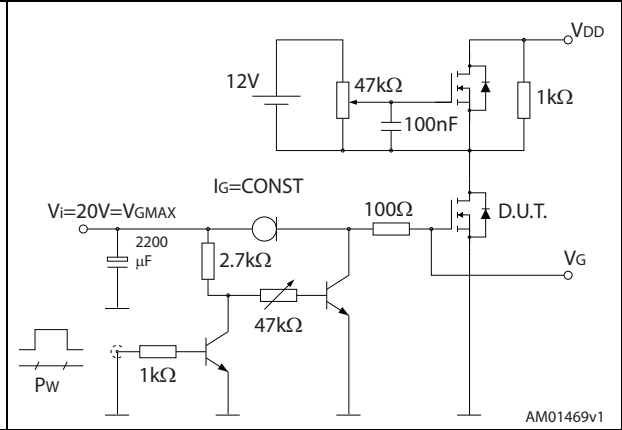


Figure 16. Test circuit for inductive load switching and diode recovery times

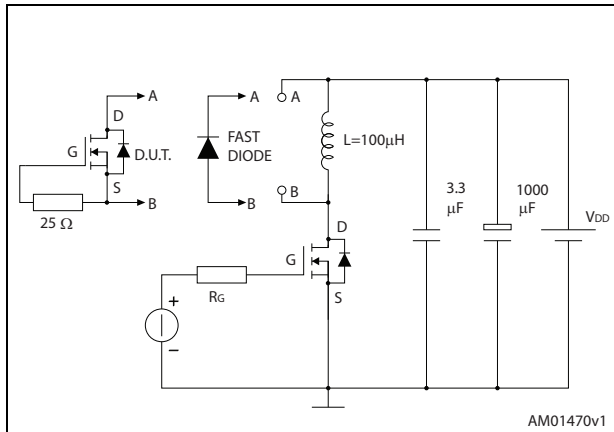


Figure 17. Unclamped inductive load test circuit

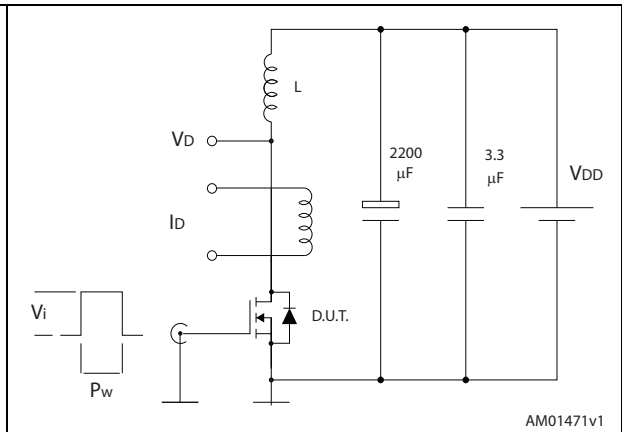


Figure 18. Unclamped inductive waveform

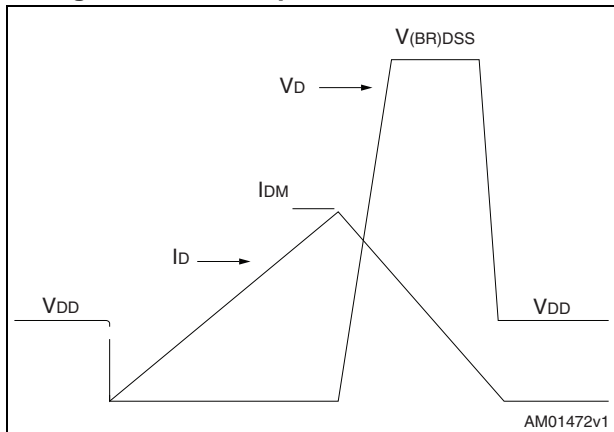
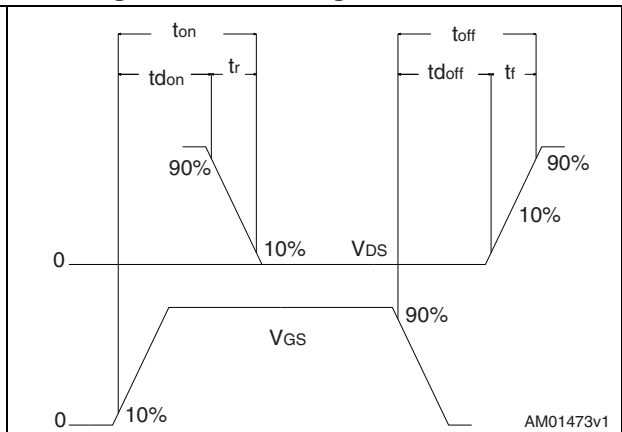


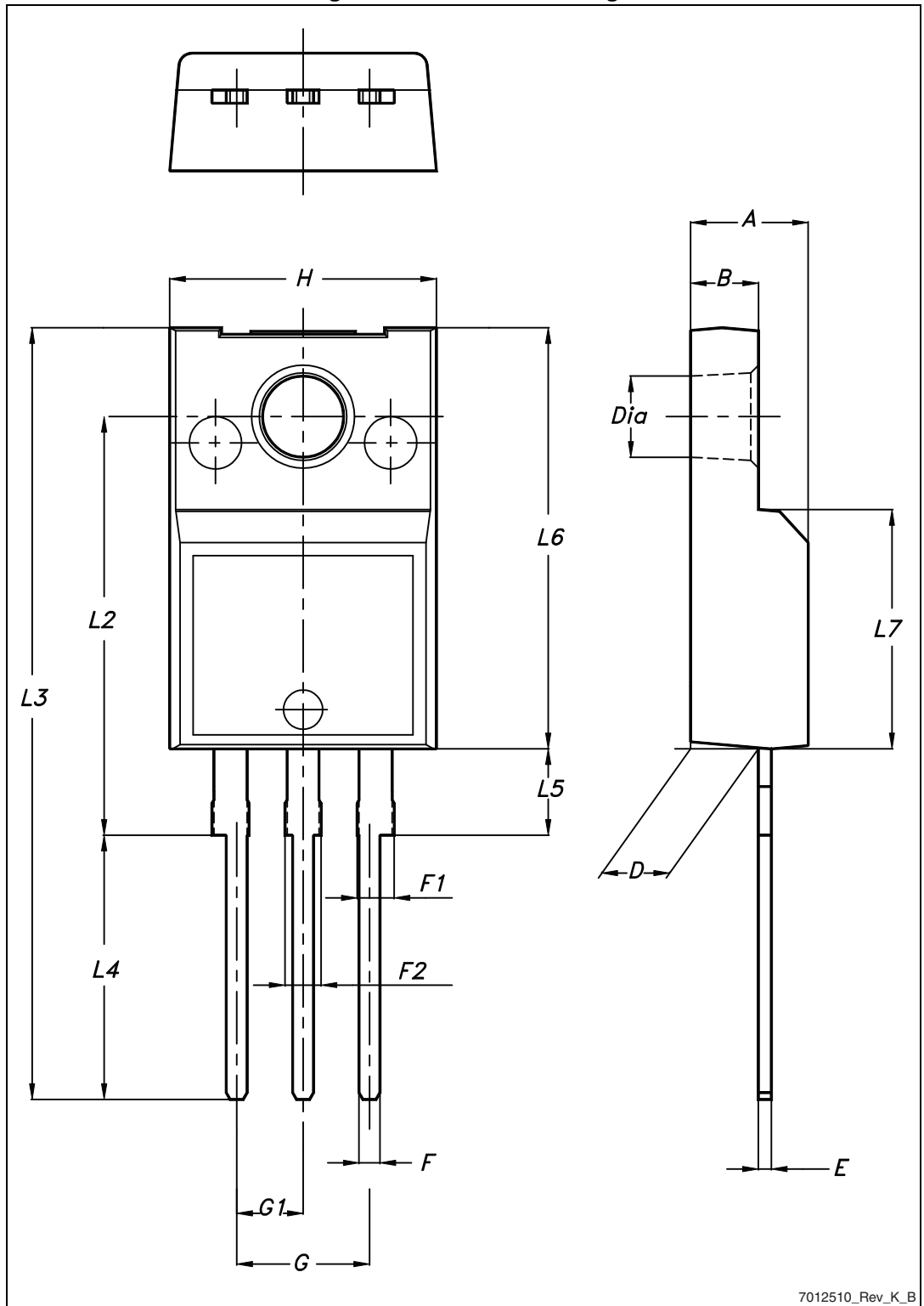
Figure 19. Switching time waveform



4 Package mechanical data

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Figure 20. TO-220FP drawing



7012510_Rev_K_B

Table 9. TO-220FP 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 |
|-------------|----------|---|
| 04-Jun-2013 | 1 | First release. |
| 05-Jun-2013 | 2 | <ul style="list-style-type: none">– Added: note 2 in Table 2– Modified: typical value for C_{iss}, $C_{oss\ eq}$, Q_g, Q_{gs}, Q_{gd}– Modified: Figure 10 and 11– Minor text changes |
| 28-Feb-2014 | 3 | <ul style="list-style-type: none">– Modified: note 1 in Table 2– $R_{thj-case}$ value in Table 3– Minor text changes |

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