

STF19NM50N, STP19NM50N, STW19NM50N

N-channel 500 V, 0.2 Ω typ., 14 A MDmesh™ II Power MOSFETs
in TO-220FP, TO-220 and TO-247 packages

Datasheet - production data

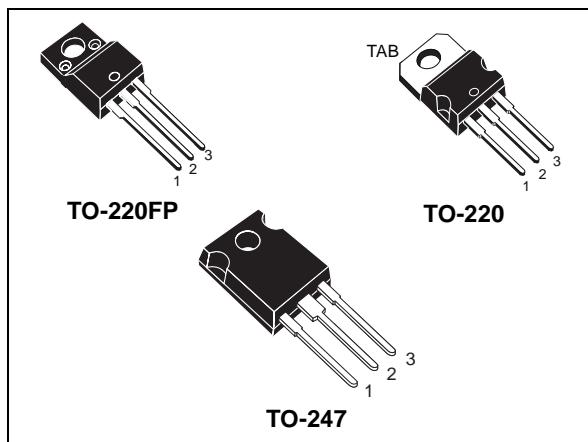
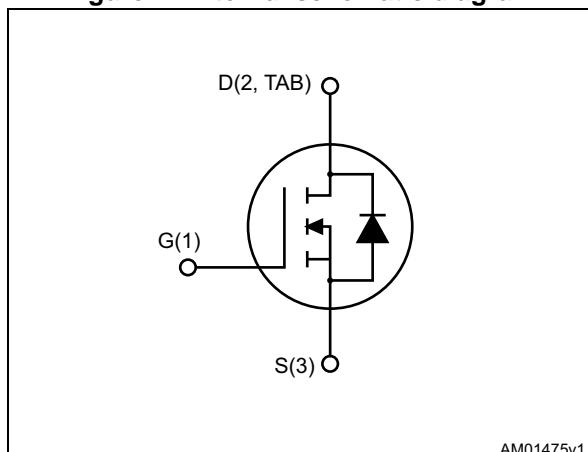


Figure 1. Internal schematic diagram



Features

| Order codes | V _{DS} @ T _{Jmax} | R _{DS(on)} max | I _D |
|-------------|-------------------------------------|-------------------------|----------------|
| STF19NM50N | 550 V | 0.25 Ω | 14 A |
| STP19NM50N | | | |
| STW19NM50N | | | |

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using the second generation of MDmesh™ technology. 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 codes | Marking | Packages | Packaging |
|-------------|---------|----------|-----------|
| STF19NM50N | 19NM50N | TO-220FP | Tube |
| STP19NM50N | | TO-220 | |
| STW19NM50N | | TO-247 | |

Contents

| | | |
|----------|-------------------------------------|-----------|
| 1 | Electrical ratings | 3 |
| 2 | Electrical characteristics | 4 |
| 2.1 | Electrical characteristics (curves) | 6 |
| 3 | Test circuits | 9 |
| 4 | Package mechanical data | 10 |
| 5 | Revision history | 17 |

1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | | Unit |
|----------------|---|-------------|----------|-------------------|------------------|
| | | TO-220 | TO-247 | TO-220FP | |
| V_{DS} | Drain-source voltage | 500 | | | V |
| V_{GS} | Gate-source voltage | | ± 25 | | V |
| I_D | Drain current (continuous) at $T_C = 25^\circ\text{C}$ | 14 | | 14 ⁽¹⁾ | A |
| I_D | Drain current (continuous) at $T_C = 100^\circ\text{C}$ | 10 | | 10 ⁽¹⁾ | A |
| $I_{DM}^{(2)}$ | Drain current (pulsed) | 56 | | 56 ⁽¹⁾ | A |
| P_{TOT} | Total dissipation at $T_C = 25^\circ\text{C}$ | 110 | | 30 | W |
| $dv/dt^{(3)}$ | Peak diode recovery voltage slope | | 15 | | V/ns |
| V_{ISO} | Insulation withstand voltage (RMS) from all three leads to external heat sink ($t = 1 \text{ s}; T_C = 25^\circ\text{C}$) | | | 2500 | V |
| T_{stg} | Storage temperature | - 55 to 150 | | | $^\circ\text{C}$ |
| T_j | Max. operating junction temperature | 150 | | | $^\circ\text{C}$ |

1. Limited by maximum junction temperature
2. Pulse width limited by safe operating area
3. $I_{SD} \leq 14 \text{ A}$, $di/dt \leq 400 \text{ A}/\mu\text{s}$, V_{DS} peak $\leq V_{(\text{BR})DSS}$, $V_{DD} = 80\% V_{(\text{BR})DSS}$.

Table 3. Thermal data

| Symbol | Parameter | Value | | | Unit |
|----------------|---|--------|--------|----------|---------------------------|
| | | TO-220 | TO-247 | TO-220FP | |
| $R_{thj-case}$ | Thermal resistance junction-case max | 1.14 | | 4.17 | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max | 62.5 | 50 | 62.5 | $^\circ\text{C}/\text{W}$ |

Table 4. Avalanche characteristics

| Symbol | Parameter | Value | | Unit |
|----------|---|-------|-----|------|
| I_{AR} | Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max) | 6 | | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j = 25^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50 \text{ V}$) | | 208 | mJ |

2 Electrical characteristics

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

Table 5. On /off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------------|--|---|------|------|-----------|--------------------------------|
| $V_{(\text{BR})\text{DSS}}$ | Drain-source breakdown voltage | $I_D = 1 \text{ mA}, V_{GS} = 0$ | 500 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = 500 \text{ V}$ $V_{DS} = 500 \text{ V}, T_C = 125^\circ\text{C}$ | | | 1 100 | μA μA |
| I_{GSS} | Gate-body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 25 \text{ V}$ | | | ± 100 | nA |
| $V_{GS(\text{th})}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 250 \mu\text{A}$ | 2 | 3 | 4 | V |
| $R_{\text{DS(on)}}$ | Static drain-source on-resistance | $V_{GS} = 10 \text{ V}, I_D = 7 \text{ A}$ | | 0.2 | 0.25 | Ω |

Table 6. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------------------|-------------------------------|---|------|------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 50 \text{ V}, f = 1 \text{ MHz}, V_{GS} = 0$ | - | 1000 | - | pF |
| C_{oss} | Output capacitance | | - | 72 | - | pF |
| C_{rss} | Reverse transfer capacitance | | - | 3 | - | pF |
| $C_{\text{oss eq}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0 \text{ to } 400 \text{ V}, V_{GS} = 0$ | - | 202 | - | pF |
| R_G | Intrinsic gate resistance | $f = 1 \text{ MHz}, I_D = 0$ | - | 4.4 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 400 \text{ V}, I_D = 14 \text{ A}, V_{GS} = 10 \text{ V}$ (see Figure 17) | - | 34 | - | nC |
| Q_{gs} | Gate-source charge | | - | 5 | - | nC |
| Q_{gd} | Gate-drain charge | | - | 18 | - | nC |

- $C_{\text{oss eq}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DS}

Table 7. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max | Unit |
|---------------------|---------------------|--|------|------|-----|------|
| $t_{d(\text{on})}$ | Turn-on delay time | $V_{DD} = 250 \text{ V}, I_D = 7 \text{ A}, R_G = 4.7 \Omega, V_{GS} = 10 \text{ V}$ (see Figure 18) | - | 12 | - | ns |
| t_r | Rise time | | - | 16 | - | ns |
| $t_{d(\text{off})}$ | Turn-off-delay time | | - | 61 | - | ns |
| t_f | Fall time | | - | 17 | - | ns |

Table 8. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 14 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 56 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 14 \text{ A}, V_{GS} = 0$ | - | | 1.5 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 14 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$ (see <i>Figure 21</i>) | - | 296 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 3.5 | | μC |
| I_{RRM} | Reverse recovery current | | - | 23 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 14 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}, T_j = 150 \text{ }^\circ\text{C}$ (see <i>Figure 21</i>) | - | 346 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 4 | | μC |
| I_{RRM} | Reverse recovery current | | - | 24 | | 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 for TO-220FP

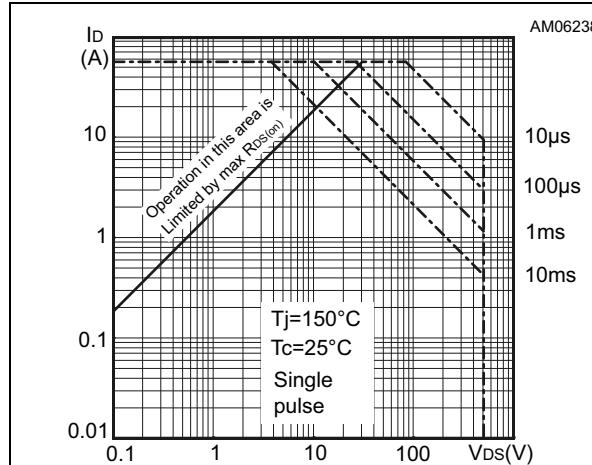


Figure 3. Thermal impedance for TO-220FP

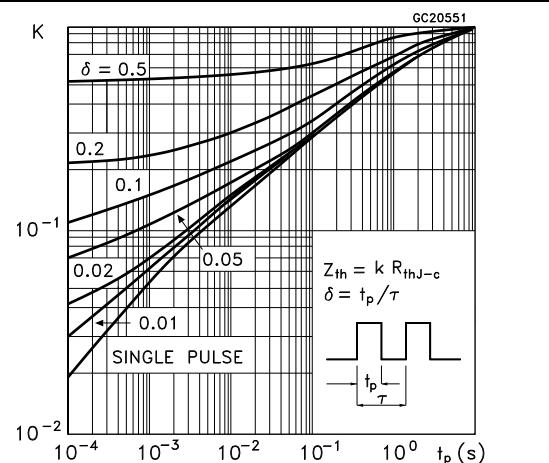


Figure 4. Safe operating area for TO-220

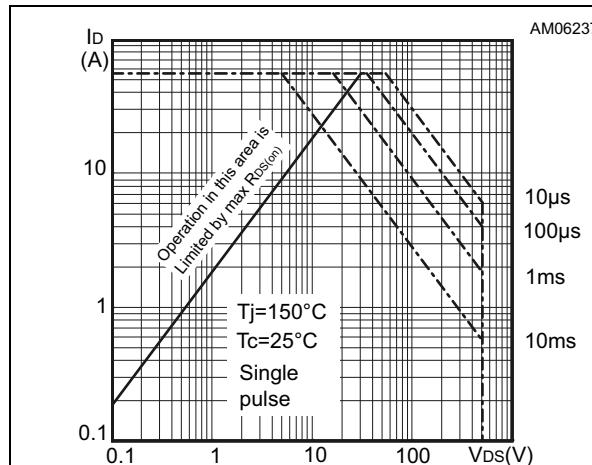


Figure 5. Thermal impedance for TO-220

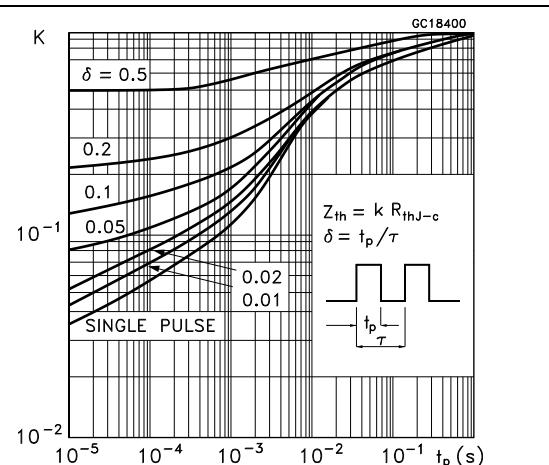


Figure 6. Safe operating area for TO-247

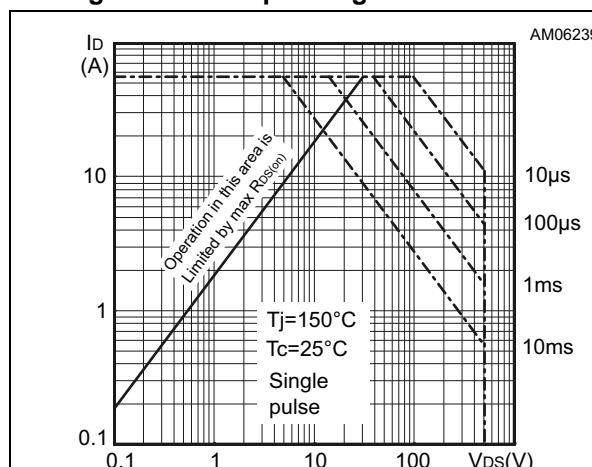


Figure 7. Thermal impedance for TO-247

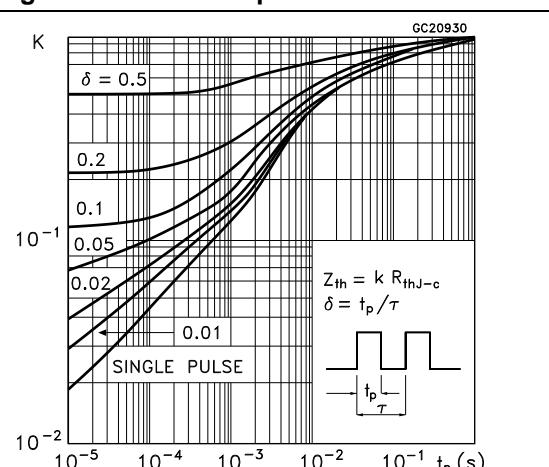


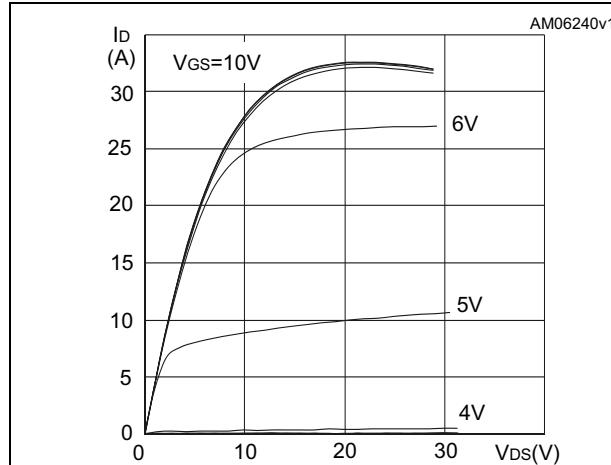
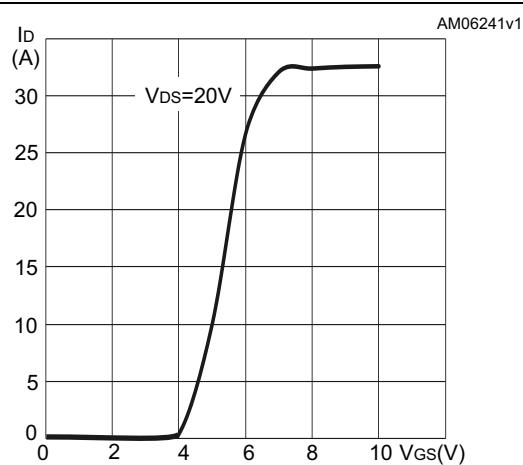
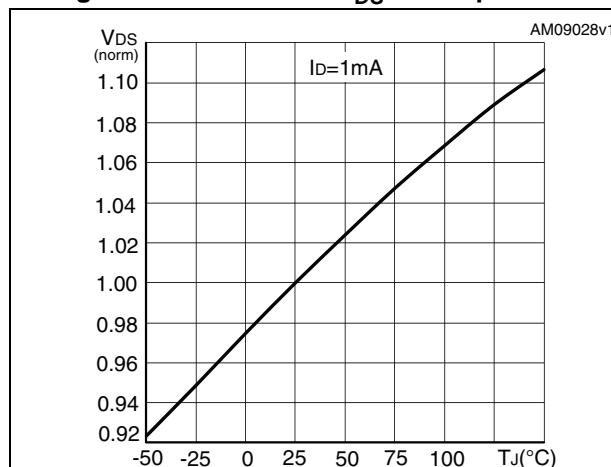
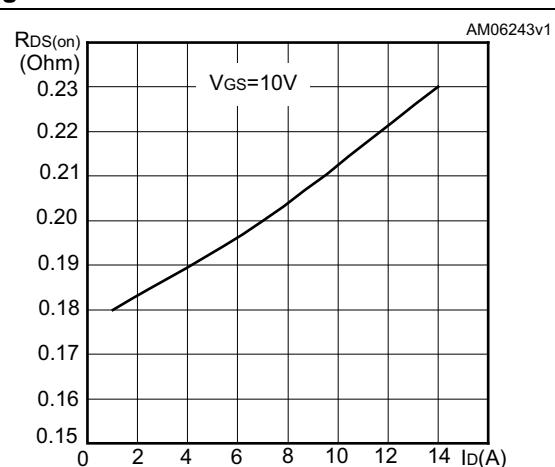
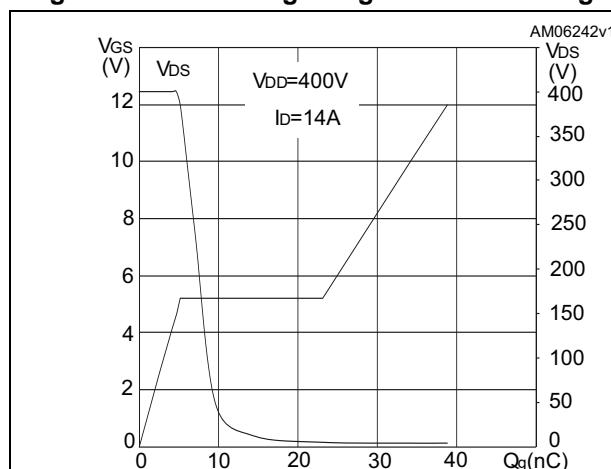
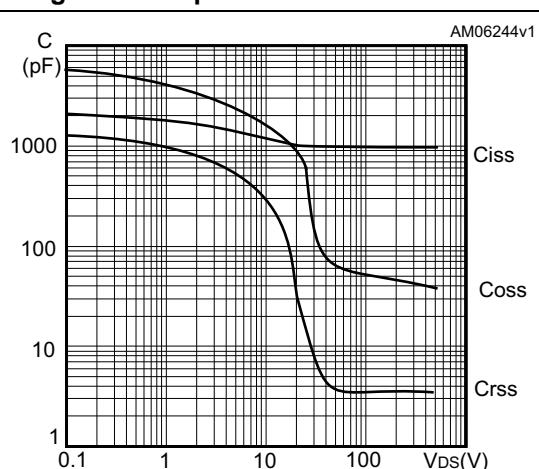
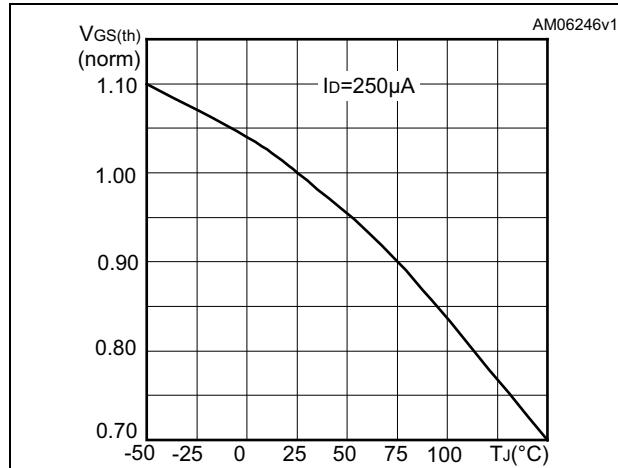
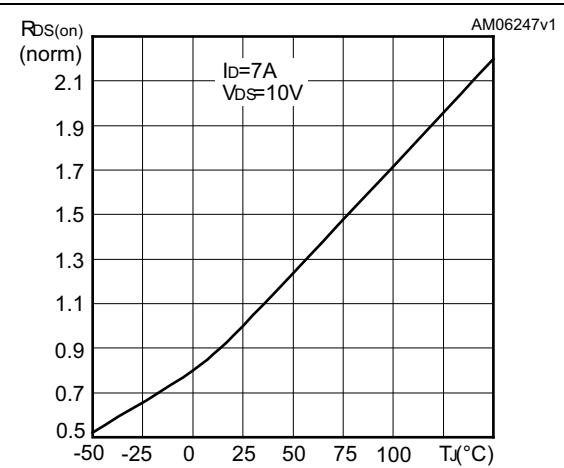
Figure 8. Output characteristics**Figure 9. Transfer characteristics****Figure 10. Normalized V_{DS} vs temperature****Figure 11. Static drain-source on resistance****Figure 12. Gate charge vs gate-source voltage****Figure 13. Capacitance variations**

Figure 14. Normalized gate threshold voltage vs temperature**Figure 15. Normalized on-resistance vs temperature**

3 Test circuits

Figure 16. Switching times test circuit for resistive load



Figure 17. Gate charge test circuit

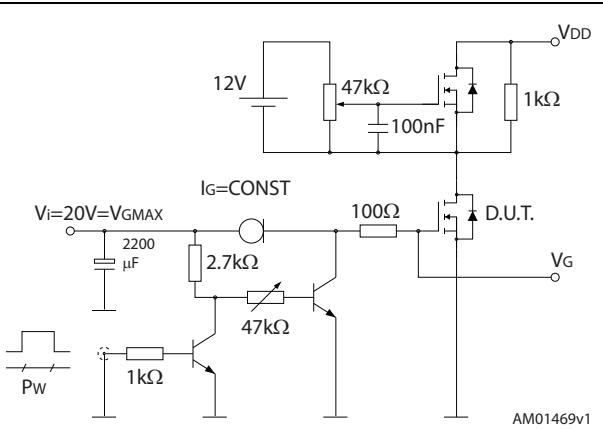


Figure 18. Test circuit for inductive load switching and diode recovery times



Figure 19. Unclamped inductive load test circuit

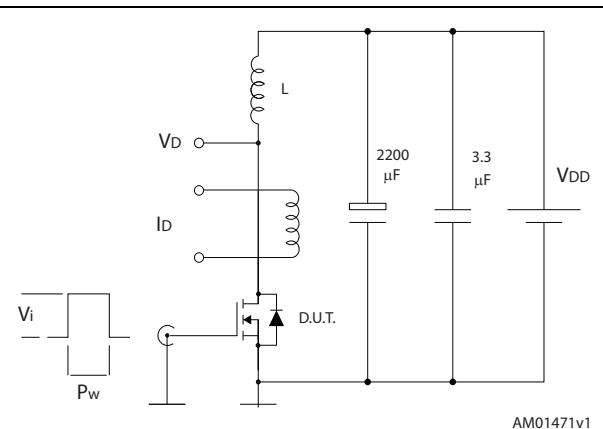


Figure 20. Unclamped inductive waveform

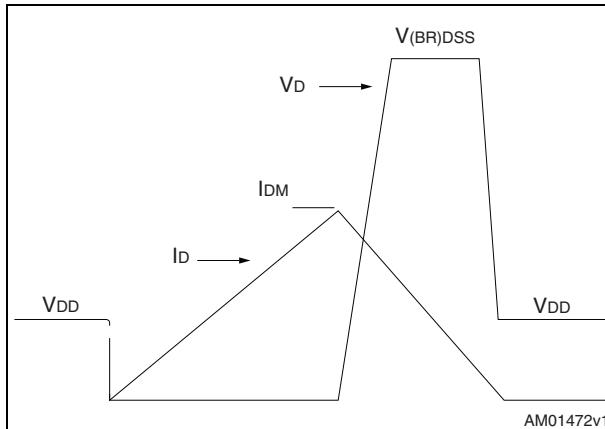
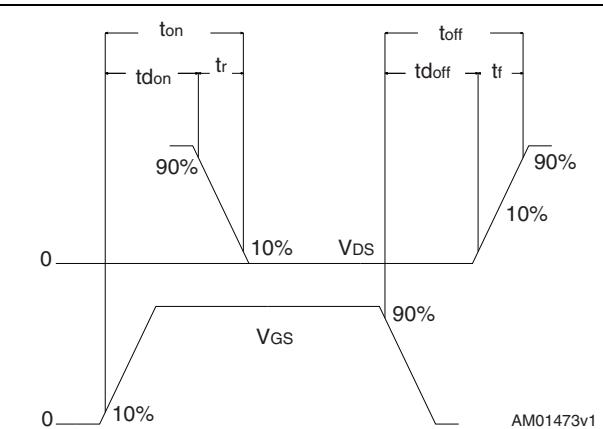


Figure 21. Switching time waveform



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.

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 |

Figure 22. TO-220FP drawing

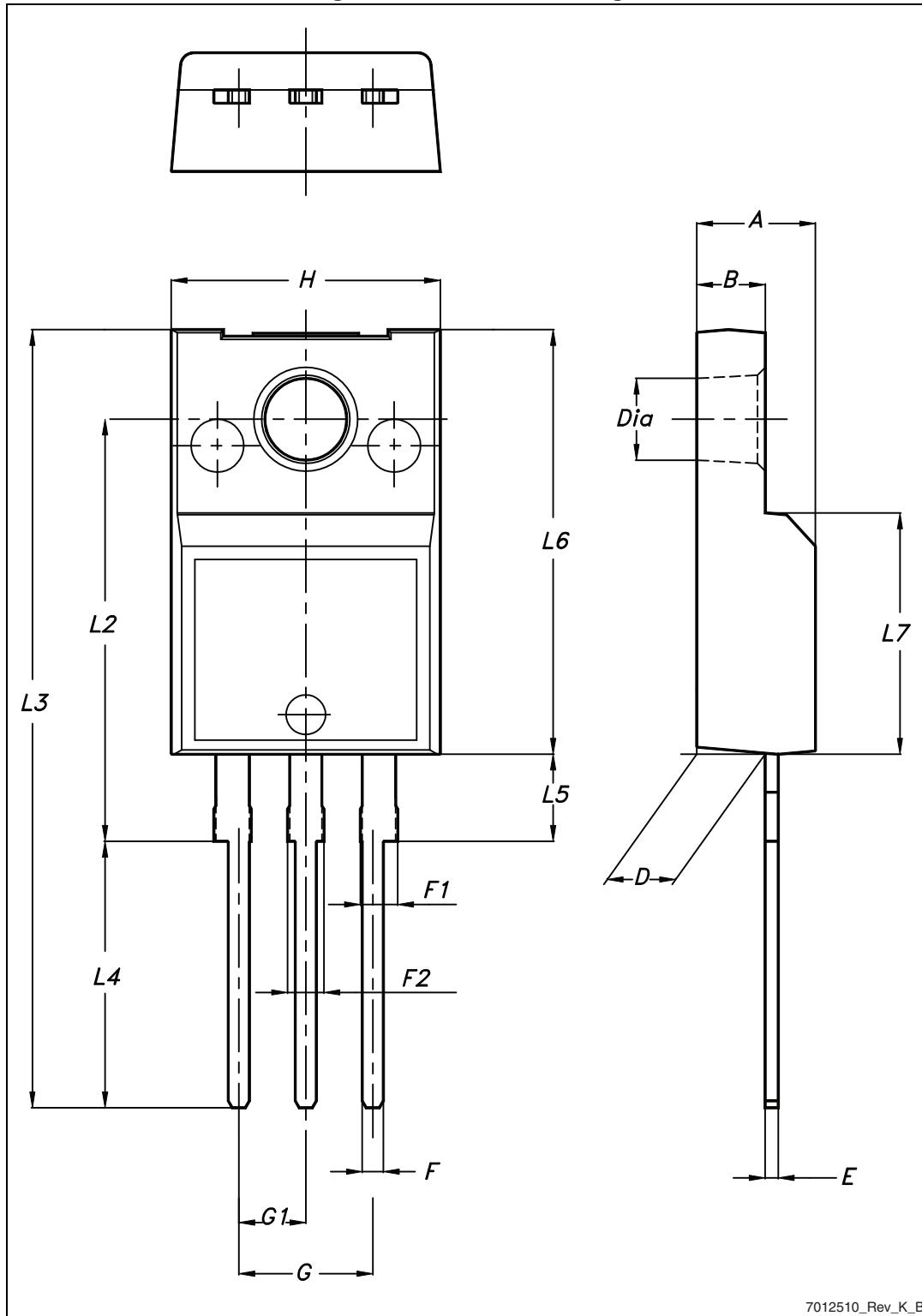


Table 10. TO-220 type A mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.70 |
| c | 0.48 | | 0.70 |
| D | 15.25 | | 15.75 |
| D1 | | 1.27 | |
| E | 10 | | 10.40 |
| e | 2.40 | | 2.70 |
| e1 | 4.95 | | 5.15 |
| F | 1.23 | | 1.32 |
| H1 | 6.20 | | 6.60 |
| J1 | 2.40 | | 2.72 |
| L | 13 | | 14 |
| L1 | 3.50 | | 3.93 |
| L20 | | 16.40 | |
| L30 | | 28.90 | |
| ØP | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |

Figure 23. TO-220 type A drawing

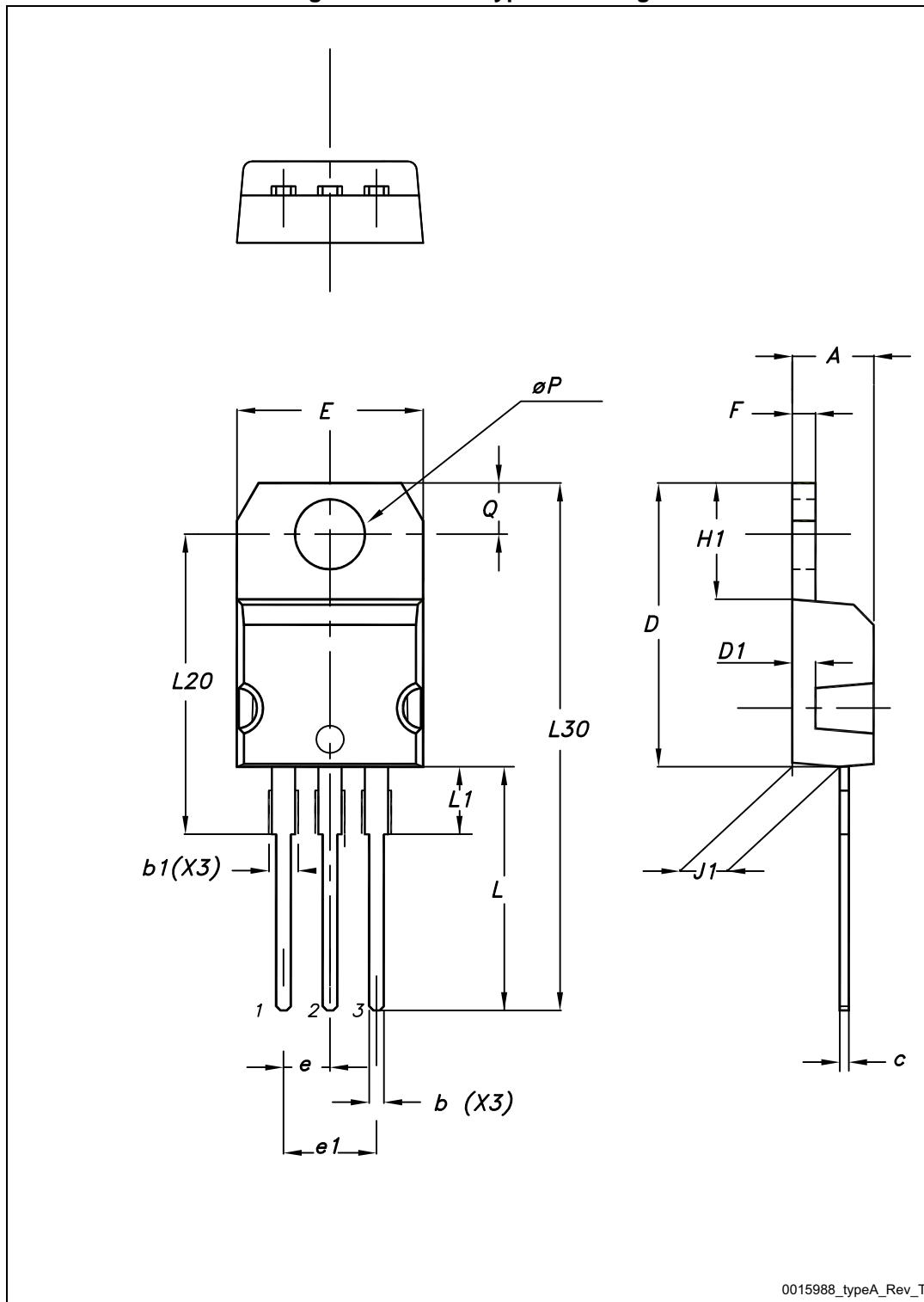
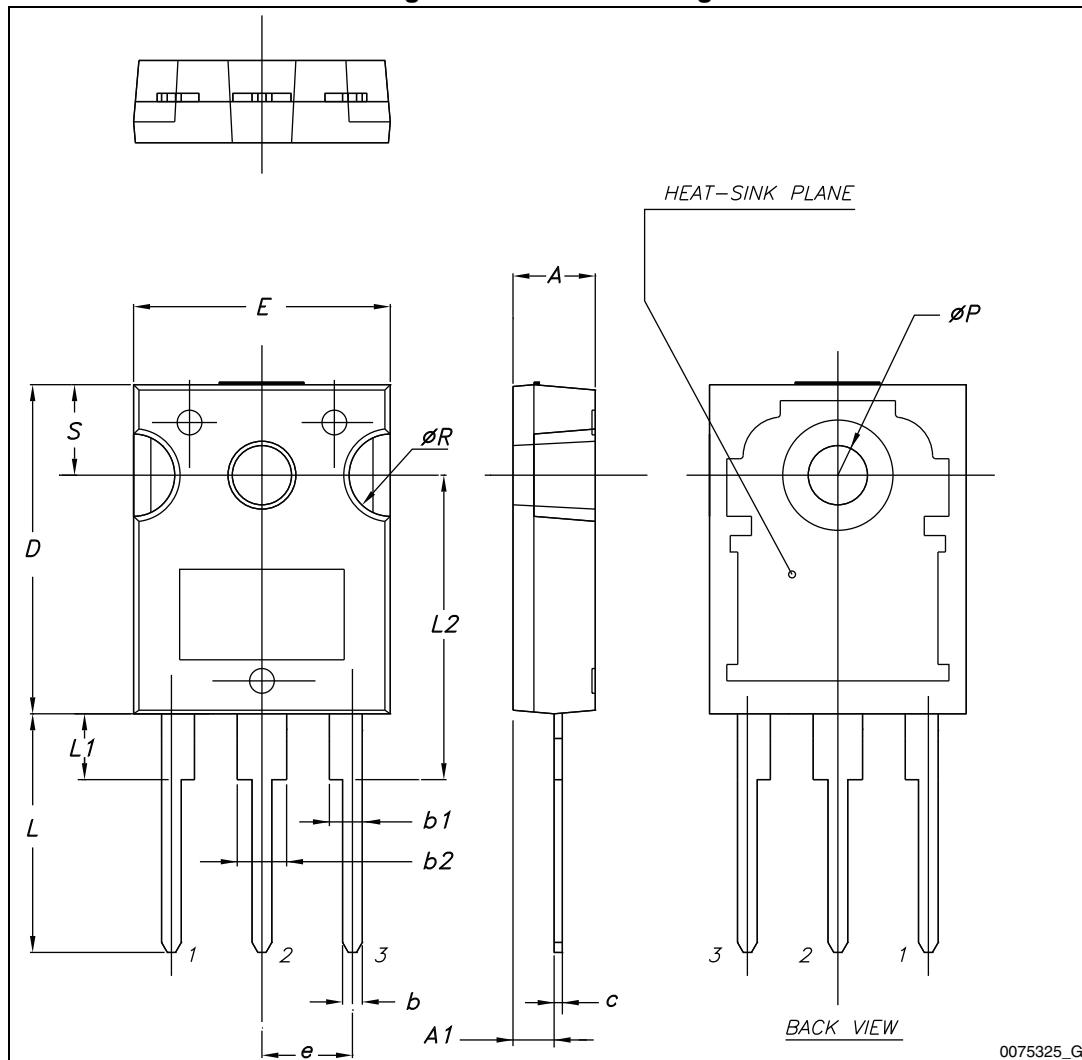


Table 11. TO-247 mechanical data

| Dim. | mm. | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.85 | | 5.15 |
| A1 | 2.20 | | 2.60 |
| b | 1.0 | | 1.40 |
| b1 | 2.0 | | 2.40 |
| b2 | 3.0 | | 3.40 |
| c | 0.40 | | 0.80 |
| D | 19.85 | | 20.15 |
| E | 15.45 | | 15.75 |
| e | 5.30 | 5.45 | 5.60 |
| L | 14.20 | | 14.80 |
| L1 | 3.70 | | 4.30 |
| L2 | | 18.50 | |
| ØP | 3.55 | | 3.65 |
| ØR | 4.50 | | 5.50 |
| S | 5.30 | 5.50 | 5.70 |

Figure 24. TO-247 drawing



5 Revision history

Table 12. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 09-Feb-2010 | 1 | First release |
| 03-Sep-2013 | 2 | <ul style="list-style-type: none">– Updated: <i>Section 2.1: Electrical characteristics (curves)</i>– Updated: <i>Section 4: Package mechanical data</i>– Minor text changes. |

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Телефон: +7 812 627 14 35

Электронная почта: sales@st-electron.ru

Адрес: 198099, Санкт-Петербург,
Промышленная ул, дом № 19, литер Н,
помещение 100-Н Офис 331