



STB35N65M5, STF35N65M5, STI35N65M5 STP35N65M5, STW35N65M5

N-channel 650 V, 0.085 Ω , 27 A, MDmesh™ V Power MOSFET
in D²PAK, TO-220FP, I²PAK, TO-220, TO-247

Features

| Type | V _{DSS} @ T _{JMAX} | R _{DS(on)} max. | I _D |
|------------|---|--------------------------|---------------------|
| STB35N65M5 | 710 V | < 0.098 Ω | 27 A |
| STF35N65M5 | 710 V | < 0.098 Ω | 27 A ⁽¹⁾ |
| STI35N65M5 | 710 V | < 0.098 Ω | 27 A |
| STP35N65M5 | 710 V | < 0.098 Ω | 27 A |
| STW35N65M5 | 710 V | < 0.098 Ω | 27 A |

1. Limited only by maximum temperature allowed

- Worldwide best R_{DS(on)}* area
- Higher V_{DSS} rating
- Excellent switching performance
- Easy to drive
- 100% avalanche tested
- High dv/dt capability

Applications

- Switching applications

Description

These devices are N-channel MDmesh™ V Power MOSFETs based on an innovative proprietary vertical process technology, which is combined with STMicroelectronics' well-known PowerMESH™ horizontal layout structure. The resulting product has extremely low on-resistance, which is unmatched among silicon-based Power MOSFETs, making it especially suitable for applications which require superior power density and outstanding efficiency.

Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|-------------|---------|--------------------|---------------|
| STB35N65M5 | 35N65M5 | D ² PAK | Tape and reel |
| STF35N65M5 | 35N65M5 | TO-220FP | Tube |
| STI35N65M5 | 35N65M5 | I ² PAK | Tube |
| STP35N65M5 | 35N65M5 | TO-220 | Tube |
| STW35N65M5 | 35N65M5 | TO-247 | Tube |

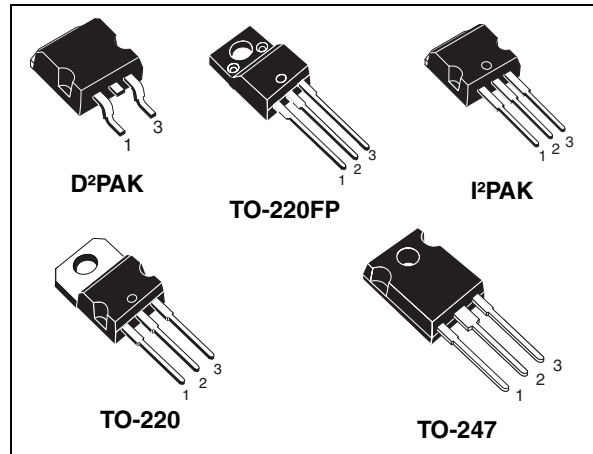
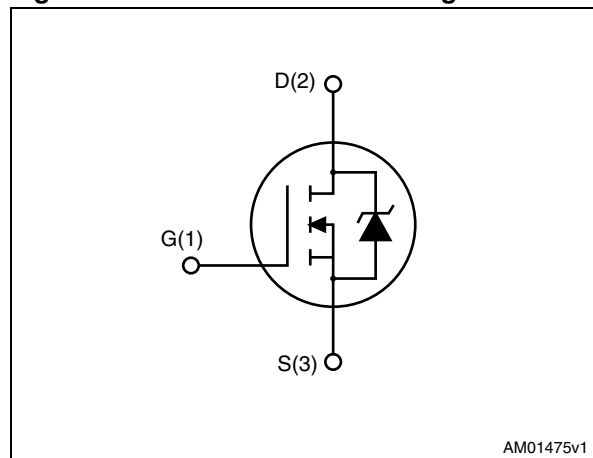


Figure 1. Internal schematic diagram



AM01475v1

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|--------------------------------|--|--|--------------------|------|
| | | TO-220, D ² PAK TO-247, I ² PAK | TO-220FP | |
| V _{GS} | Gate-source voltage | ±25 | | V |
| I _D | Drain current (continuous) at T _C = 25 °C | 27 | 27 ⁽¹⁾ | A |
| I _D | Drain current (continuous) at T _C = 100 °C | 17 | 17 ⁽¹⁾ | A |
| I _{DM} ⁽²⁾ | Drain current (pulsed) | 108 | 108 ⁽¹⁾ | A |
| P _{TOT} | Total dissipation at T _C = 25 °C | 160 | 40 | W |
| I _{AR} | Max current during repetitive or single pulse avalanche (pulse width limited by T _{JMAX}) | 9 | | A |
| E _{AS} | Single pulse avalanche energy (starting T _j = 25°C, I _D = I _{AR} , V _{DD} = 50V) | 800 | | mJ |
| 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 s; T _C =25 °C) | | 2500 | V |
| T _{stg} | Storage temperature | - 55 to 150 | | °C |
| T _j | Max. operating junction temperature | 150 | | °C |

- Limited only by maximum temperature allowed
- Pulse width limited by safe operating area
- I_{SD} ≤ 27 A, di/dt = 400 A/μs, peak V_{DS} < V_{(BR)DSS}

Table 3. Thermal data

| Symbol | Parameter | Value | | | | | Unit |
|-----------------------|--|--------------------|----------|--------------------|--------|--------|------|
| | | D ² PAK | TO-220FP | I ² PAK | TO-220 | TO-247 | |
| R _{thj-case} | Thermal resistance junction-case max | 0.78 | 3.1 | 0.78 | | | °C/W |
| R _{thj-amb} | Thermal resistance junction-ambient max | | 62.5 | | | 50 | °C/W |
| R _{thj-pcb} | Thermal resistance junction-pcb max | 30 | | | | | °C/W |
| T _l | Maximum lead temperature for soldering purpose | | 300 | | | | °C |

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 | $I_D = 1\text{ mA}, V_{GS} = 0$ | 650 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}, T_C = 125\text{ °C}$ | | | 1 100 | μA μA |
| I_{GSS} | Gate-body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 25\text{ V}$ | | | 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10\text{ V}, I_D = 13.5\text{ A}$ | | 0.085 | 0.098 | Ω |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|---|---|------|-------------------|------|----------------|
| C_{iss} C_{oss} C_{rss} | Input capacitance Output capacitance Reverse transfer capacitance | $V_{DS} = 100\text{ V}, f = 1\text{ MHz},$ $V_{GS} = 0$ | - | 3750 84 5.5 | - | pF pF pF |
| $C_{o(tr)}^{(1)}$ | Equivalent capacitance time related | $V_{GS} = 0, V_{DS} = 0\text{ to }520\text{ V}$ | - | 220 | - | pF |
| $C_{o(er)}^{(2)}$ | Equivalent capacitance energy related | $V_{GS} = 0, V_{DS} = 0\text{ to }520\text{ V}$ | - | 75 | - | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz open drain}$ | - | 1.6 | - | Ω |
| Q_g Q_{gs} Q_{gd} | Total gate charge Gate-source charge Gate-drain charge | $V_{DD} = 520\text{ V}, I_D = 13.5\text{ A},$ $V_{GS} = 10\text{ V}$ (see Figure 20) | - | 83 19 35 | - | nC nC nC |

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

Table 6. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(off)}$ | Turn-off delay time | $V_{DD} = 400\text{ V}$, $I_D = 16\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 21) | | 60 | | ns |
| t_r | Rise time | | | 12 | | ns |
| t_c | Cross time | | - | 28 | - | ns |
| t_f | Fall time | | | 16 | | ns |

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 27 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | | | 108 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 27\text{ A}$, $V_{GS} = 0$ | - | | 1.5 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 27\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 24) | - | 360 | | ns |
| Q_{rr} | Reverse recovery charge | | | 7 | | μC |
| I_{RRM} | Reverse recovery current | | | 36 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 27\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ (see Figure 24) | - | 425 | | ns |
| Q_{rr} | Reverse recovery charge | | | 8 | | μC |
| I_{RRM} | Reverse recovery current | | | 38 | | 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-220, D²PAK

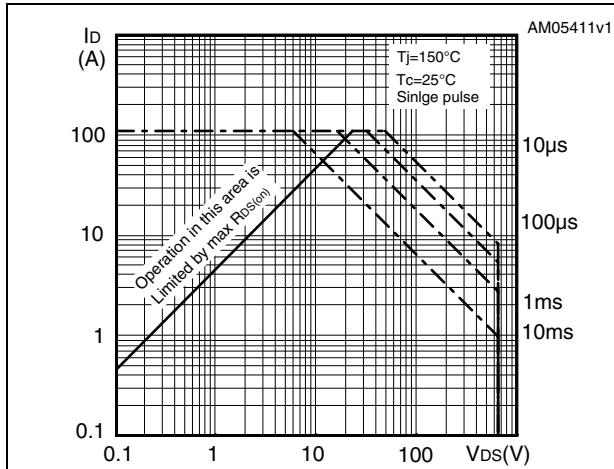


Figure 3. Thermal impedance for TO-220, D²PAK

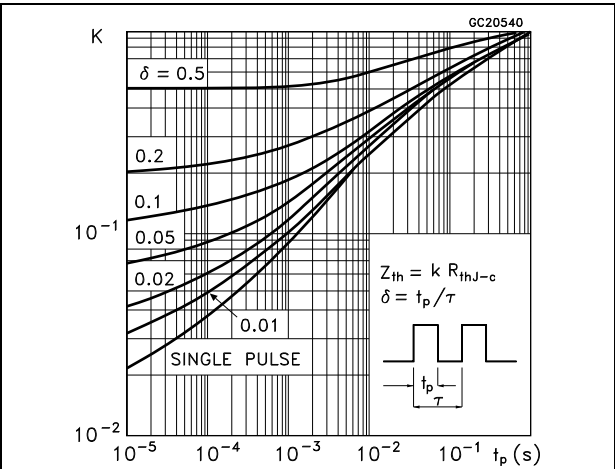


Figure 4. Safe operating area for TO-220FP

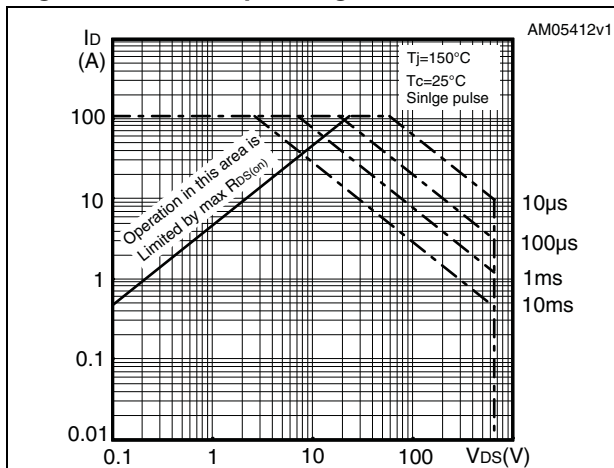


Figure 5. Thermal impedance for TO-220FP

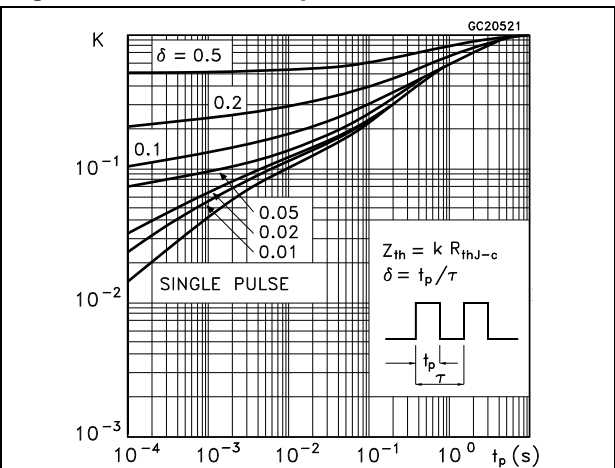


Figure 6. Safe operating area for TO-247

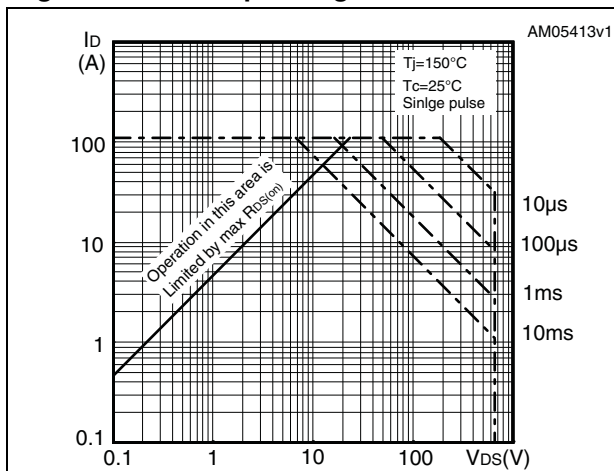


Figure 7. Thermal impedance for TO-247

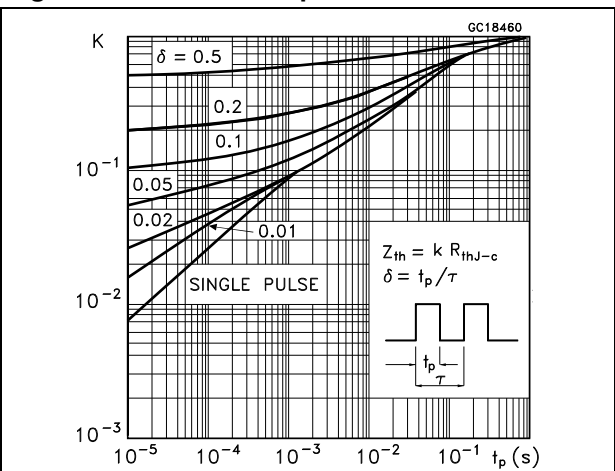


Figure 8. Output characteristics

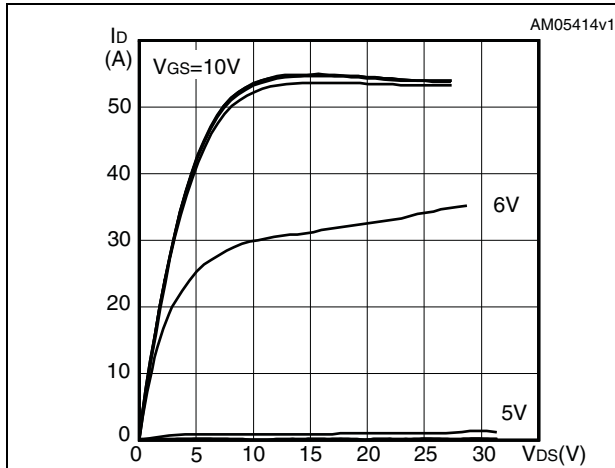


Figure 9. Transfer characteristics

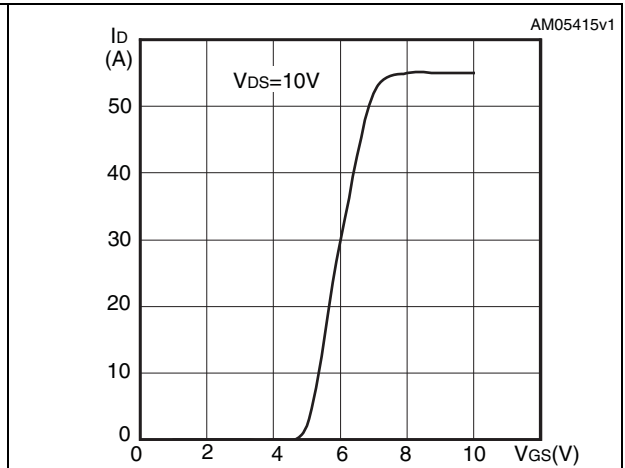


Figure 10. Gate charge vs gate-source voltage

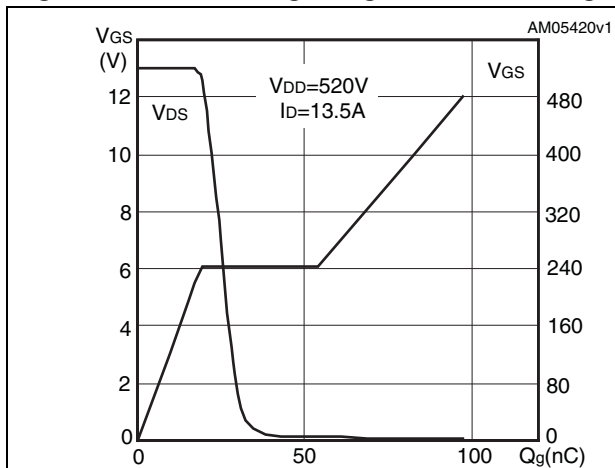


Figure 11. Static drain-source on resistance

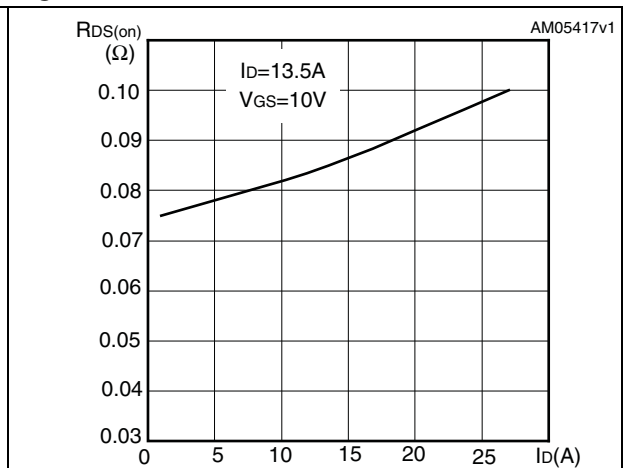


Figure 12. Capacitance variations

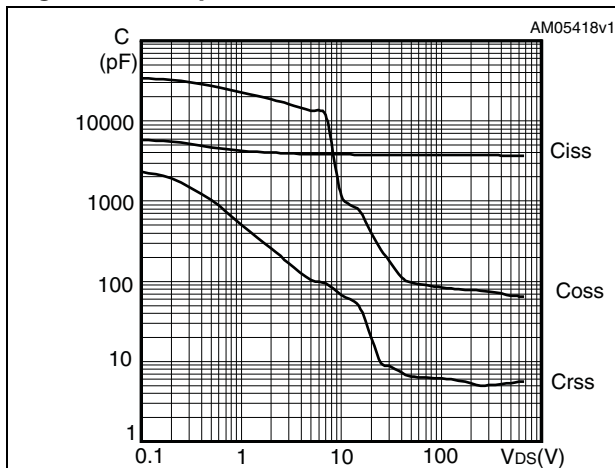


Figure 13. Output capacitance stored energy

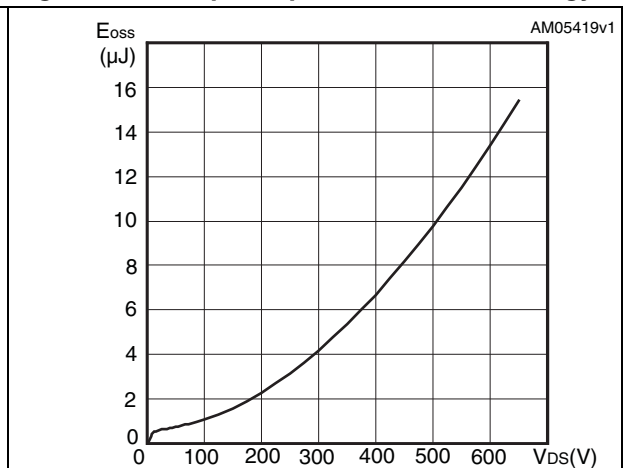


Figure 14. Normalized gate threshold voltage vs temperature

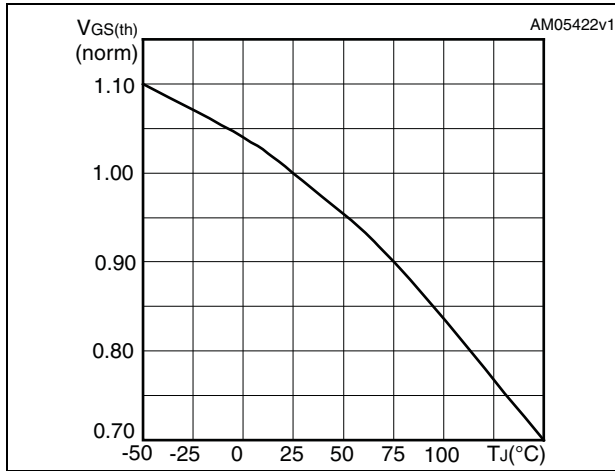


Figure 15. Normalized on resistance vs temperature

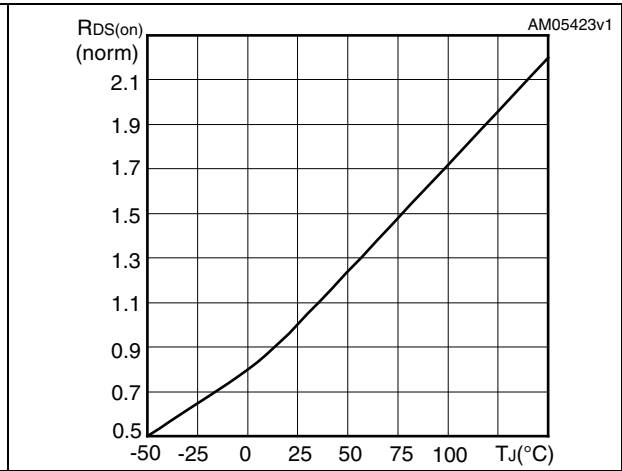


Figure 16. Source-drain diode forward characteristics

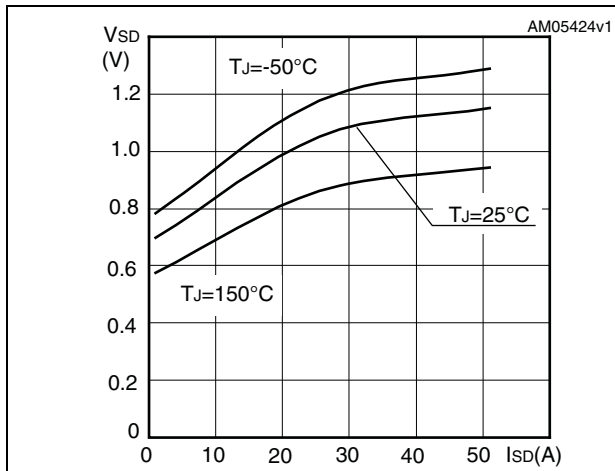


Figure 17. Normalized B_VDSS vs temperature

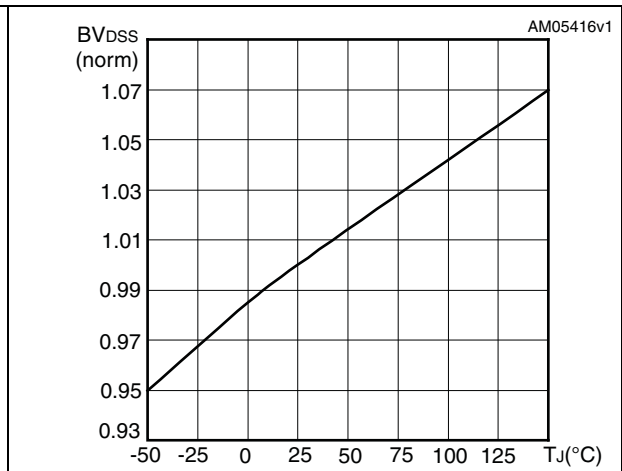
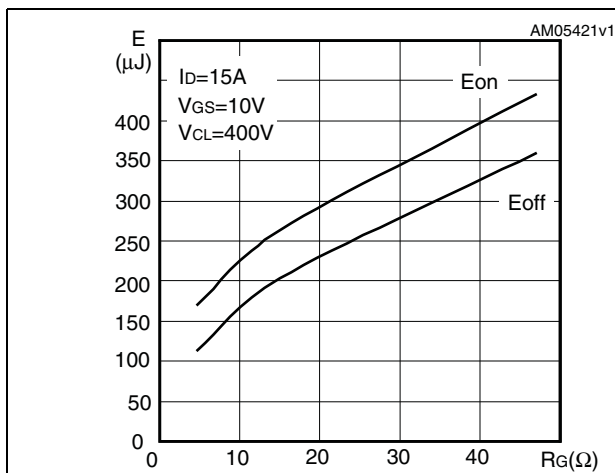


Figure 18. Switching losses vs gate resistance (1)



1. Eon including reverse recovery of a SiC diode

3 Test circuits

Figure 19. Switching times test circuit for resistive load

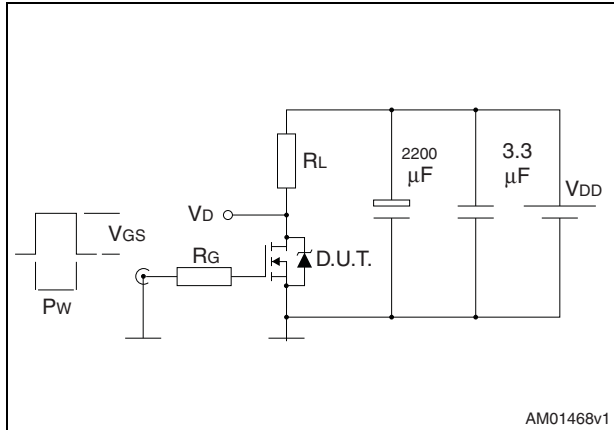


Figure 20. Gate charge test circuit

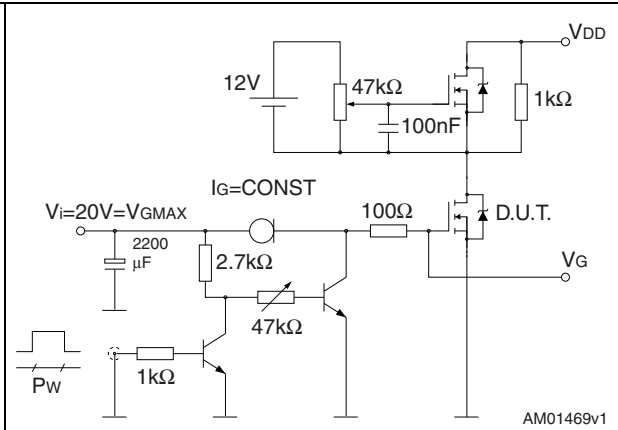


Figure 21. Test circuit for inductive load switching and diode recovery times

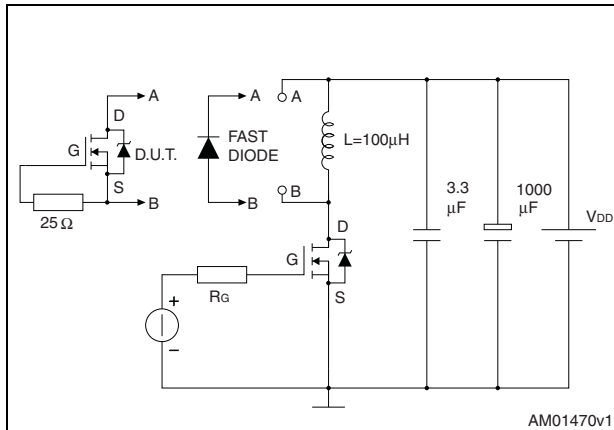


Figure 22. Unclamped inductive load test circuit

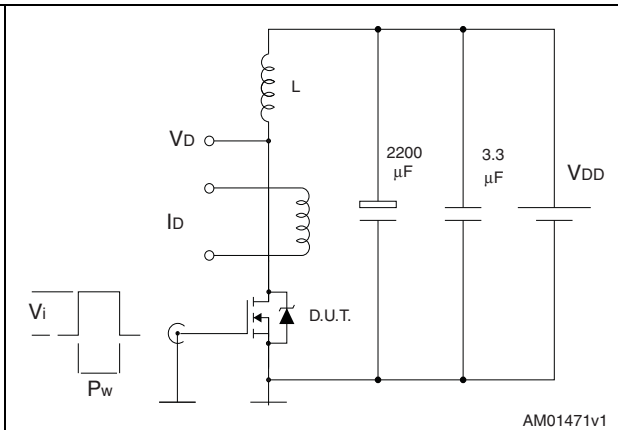


Figure 23. Unclamped inductive waveform

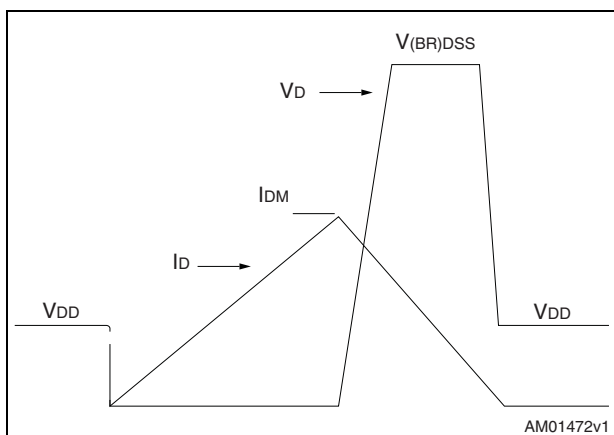
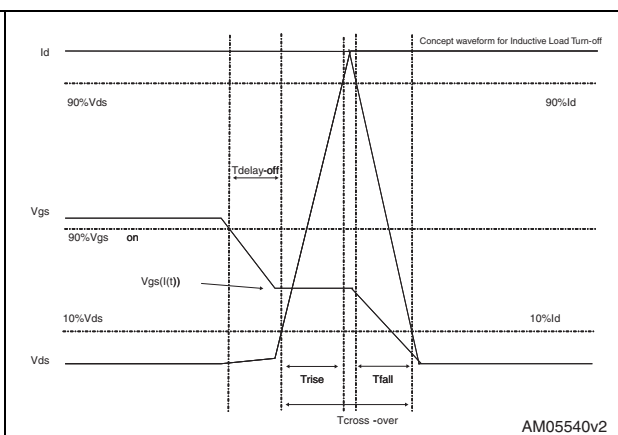


Figure 24. Switching time waveform



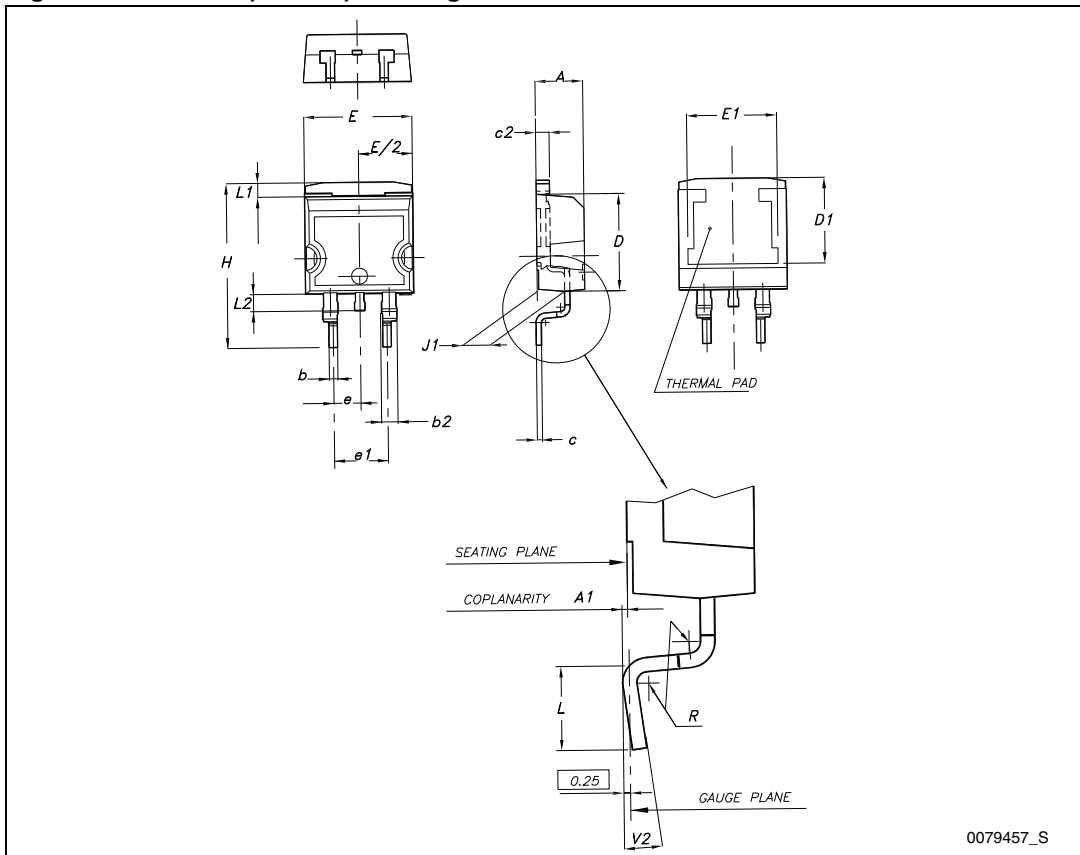
4 Package mechanical data

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 8. D²PAK (TO-263) mechanical data

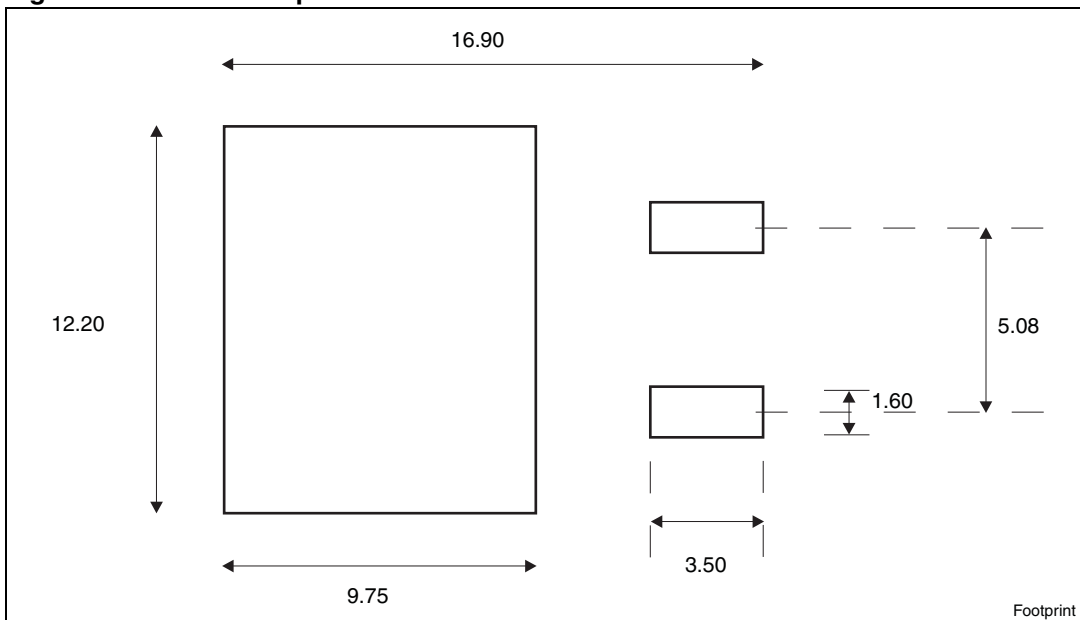
| Dim. | mm | | |
|------|------|------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| A1 | 0.03 | | 0.23 |
| b | 0.70 | | 0.93 |
| b2 | 1.14 | | 1.70 |
| c | 0.45 | | 0.60 |
| c2 | 1.23 | | 1.36 |
| D | 8.95 | | 9.35 |
| D1 | 7.50 | | |
| E | 10 | | 10.40 |
| E1 | 8.50 | | |
| e | | 2.54 | |
| e1 | 4.88 | | 5.28 |
| H | 15 | | 15.85 |
| J1 | 2.49 | | 2.69 |
| L | 2.29 | | 2.79 |
| L1 | 1.27 | | 1.40 |
| L2 | 1.30 | | 1.75 |
| R | | 0.4 | |
| V2 | 0° | | 8° |

Figure 25. D²PAK (TO-263) drawing



0079457_S

Figure 26. D²PAK footprint^(a)



a. All dimensions are in millimeters

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 27. TO-220FP drawing

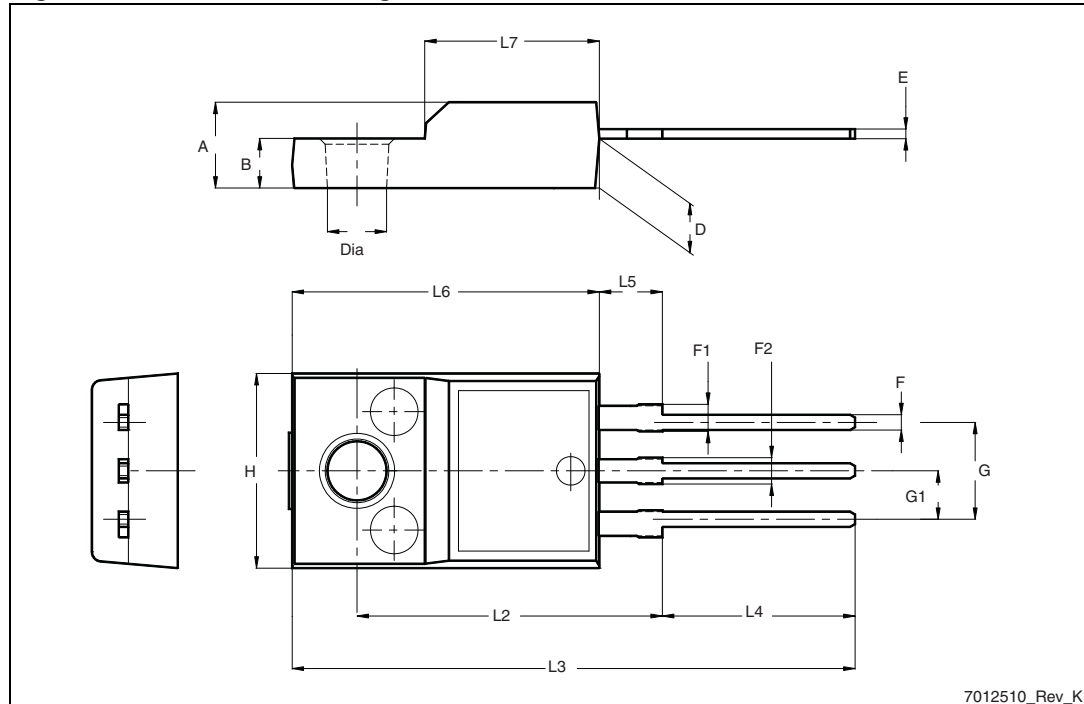
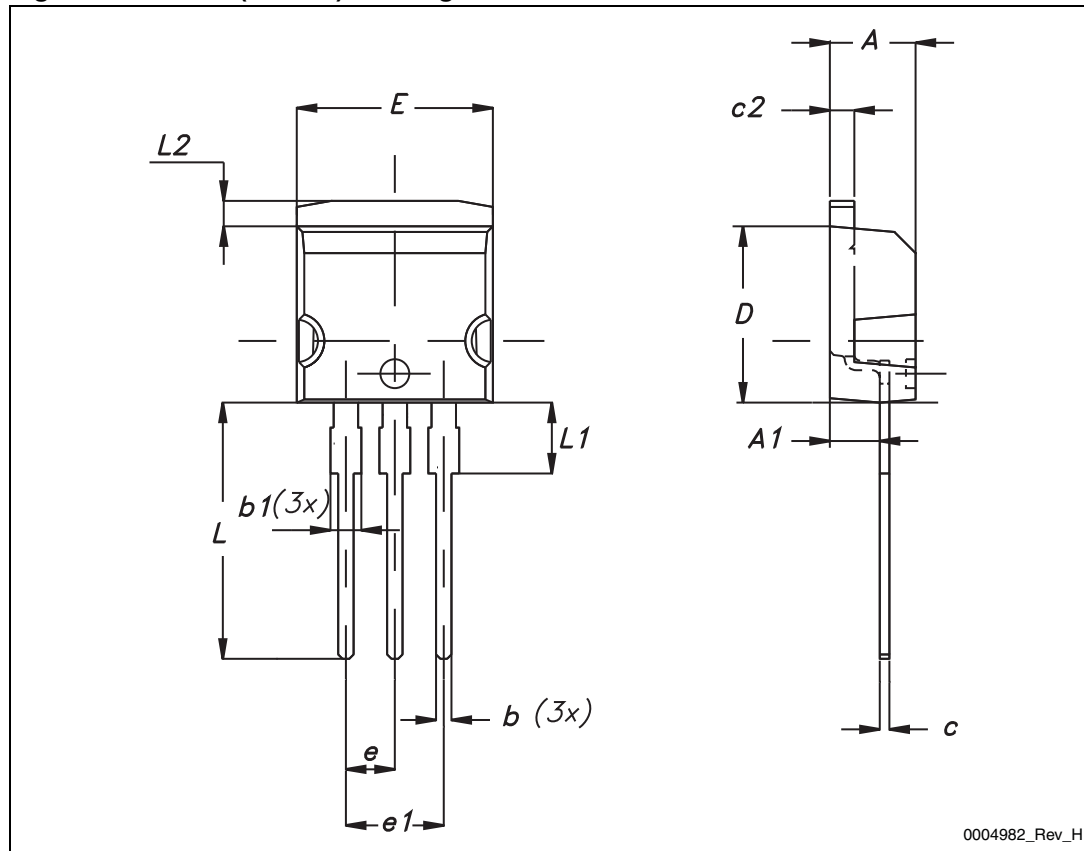


Table 10. I²PAK (TO-262) mechanical data

| DIM. | mm. | | |
|------|------|-----|-------|
| | min. | typ | max. |
| A | 4.40 | | 4.60 |
| A1 | 2.40 | | 2.72 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.70 |
| c | 0.49 | | 0.70 |
| c2 | 1.23 | | 1.32 |
| D | 8.95 | | 9.35 |
| e | 2.40 | | 2.70 |
| e1 | 4.95 | | 5.15 |
| E | 10 | | 10.40 |
| L | 13 | | 14 |
| L1 | 3.50 | | 3.93 |
| L2 | 1.27 | | 1.40 |

Figure 28. I²PAK (TO-262) drawing



0004982_Rev_H

Table 11. 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 29. TO-220 type A drawing

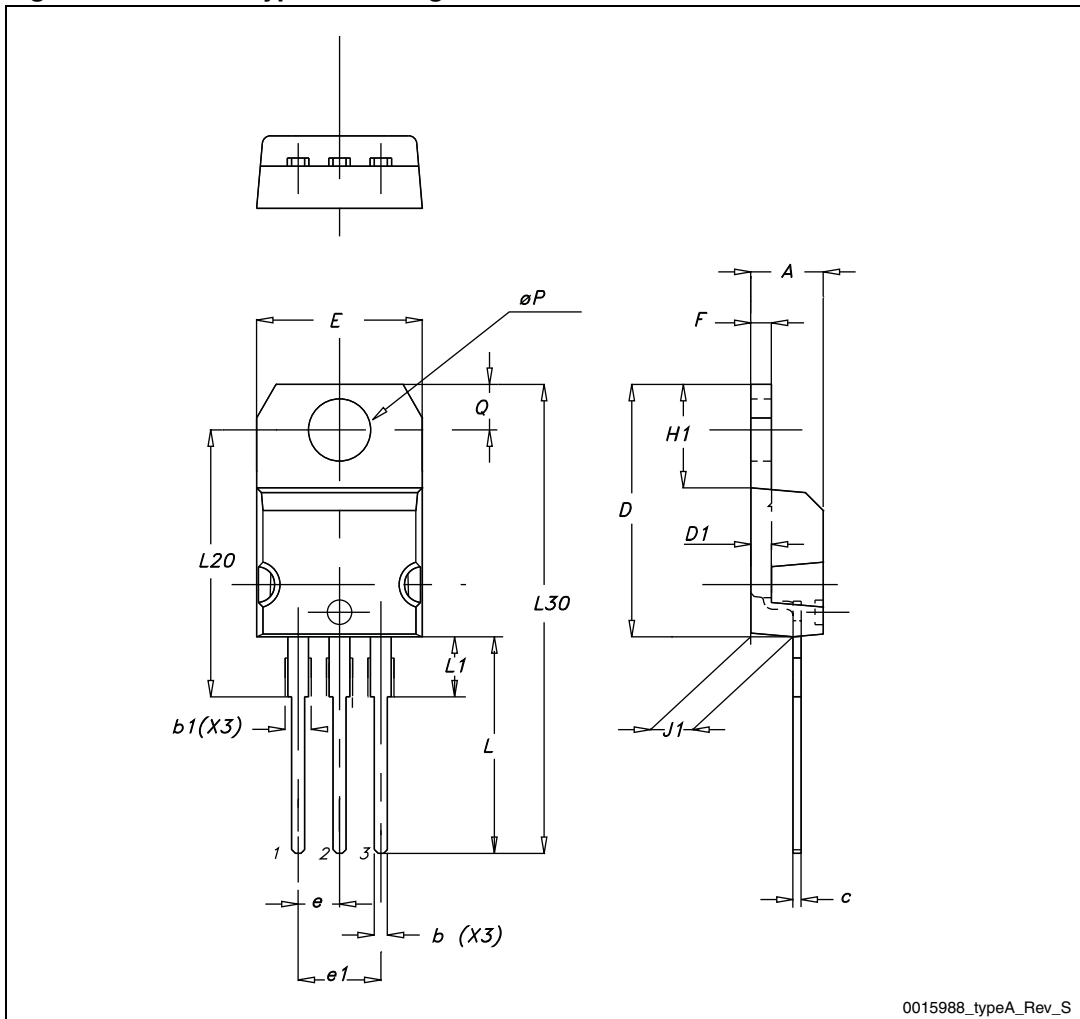
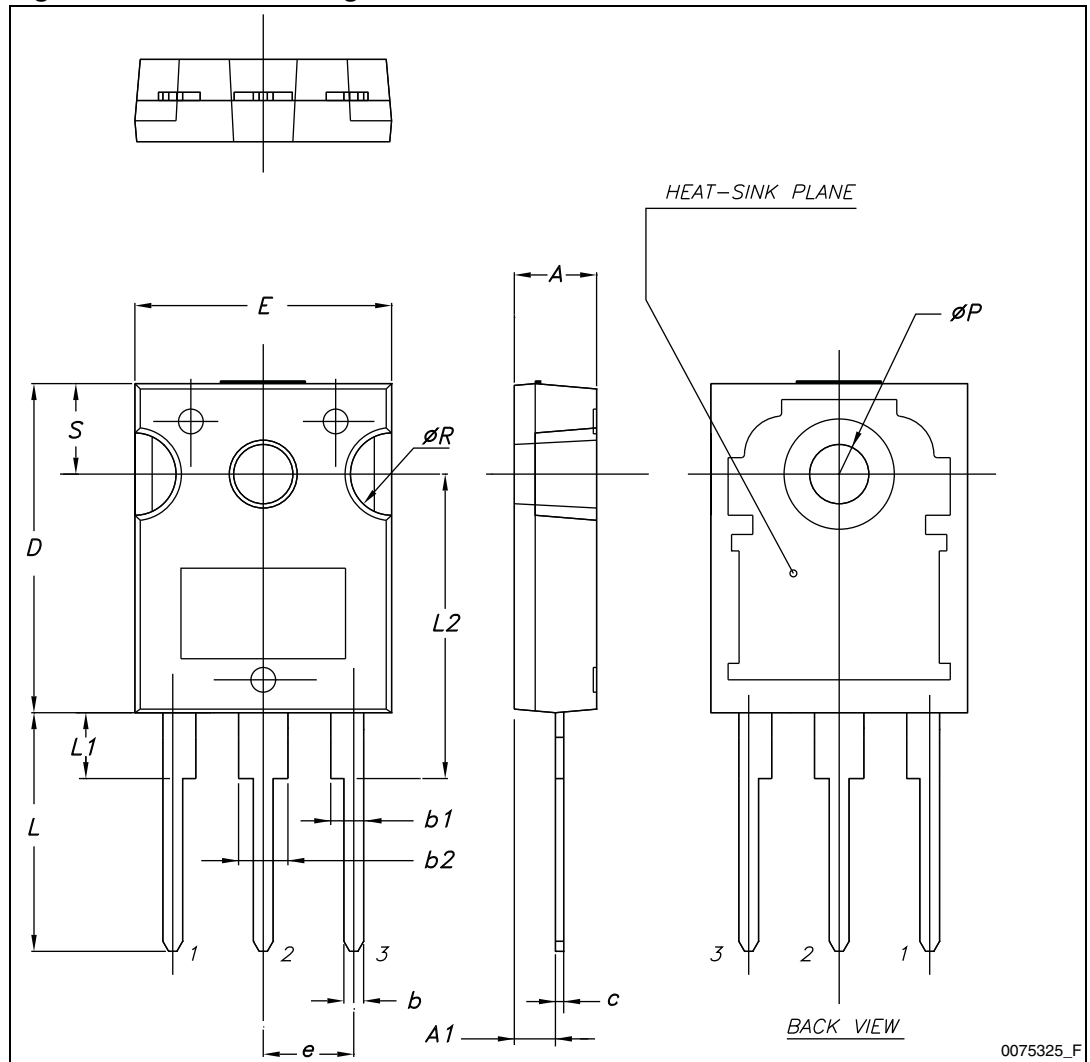


Table 12. TO-247 mechanical data

| 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 | | 5.45 | |
| L | 14.20 | | 14.80 |
| L1 | 3.70 | | 4.30 |
| L2 | | 18.50 | |
| ØP | 3.55 | | 3.65 |
| ØR | 4.50 | | 5.50 |
| S | | 5.50 | |

Figure 30. TO-247 drawing



0075325_F

5 Packaging mechanical data

Table 13. D²PAK (TO-263) tape and reel mechanical data

| Tape | | | Reel | | |
|------|------|------|------|----------|------|
| Dim. | mm | | Dim. | mm | |
| | Min. | Max. | | Min. | Max. |
| A0 | 10.5 | 10.7 | A | | 330 |
| B0 | 15.7 | 15.9 | B | 1.5 | |
| D | 1.5 | 1.6 | C | 12.8 | 13.2 |
| D1 | 1.59 | 1.61 | D | 20.2 | |
| E | 1.65 | 1.85 | G | 24.4 | 26.4 |
| F | 11.4 | 11.6 | N | 100 | |
| K0 | 4.8 | 5.0 | T | | 30.4 |
| P0 | 3.9 | 4.1 | | | |
| P1 | 11.9 | 12.1 | | Base qty | 1000 |
| P2 | 1.9 | 2.1 | | Bulk qty | 1000 |
| R | 50 | | | | |
| T | 0.25 | 0.35 | | | |
| W | 23.7 | 24.3 | | | |

Figure 31. Tape

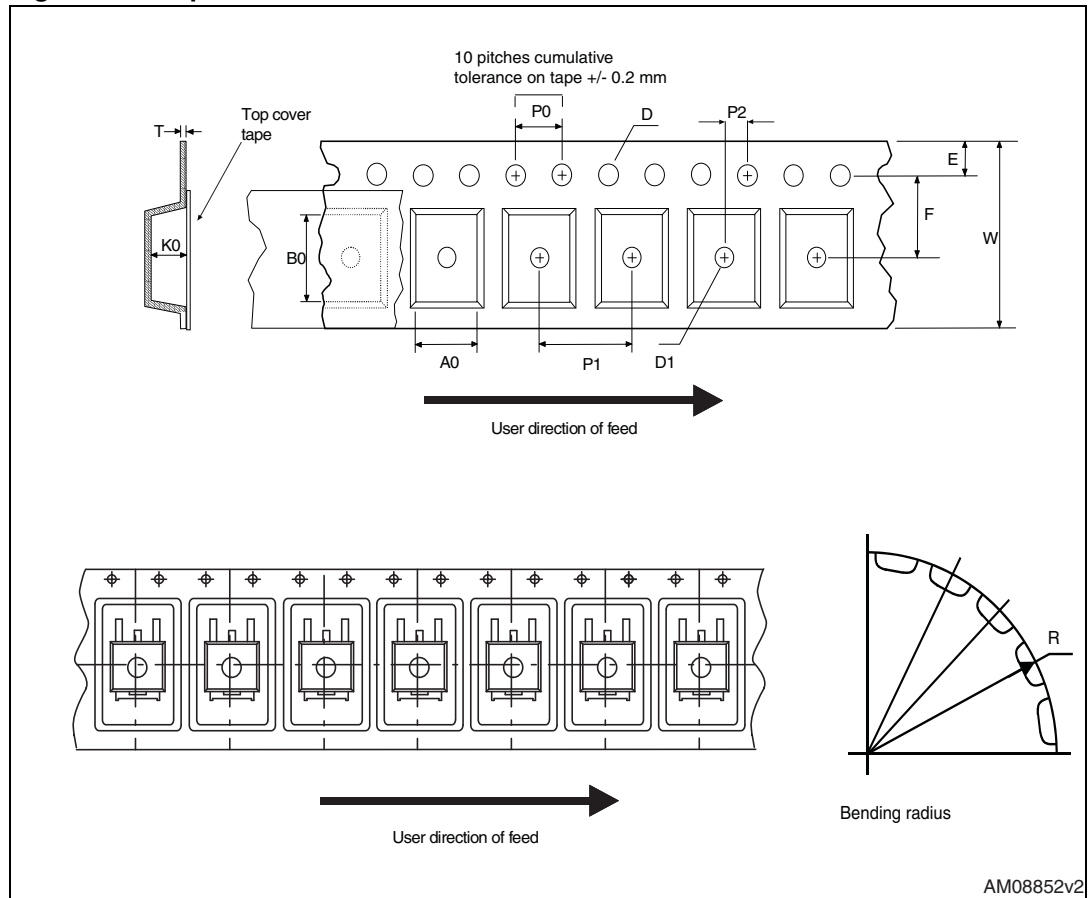
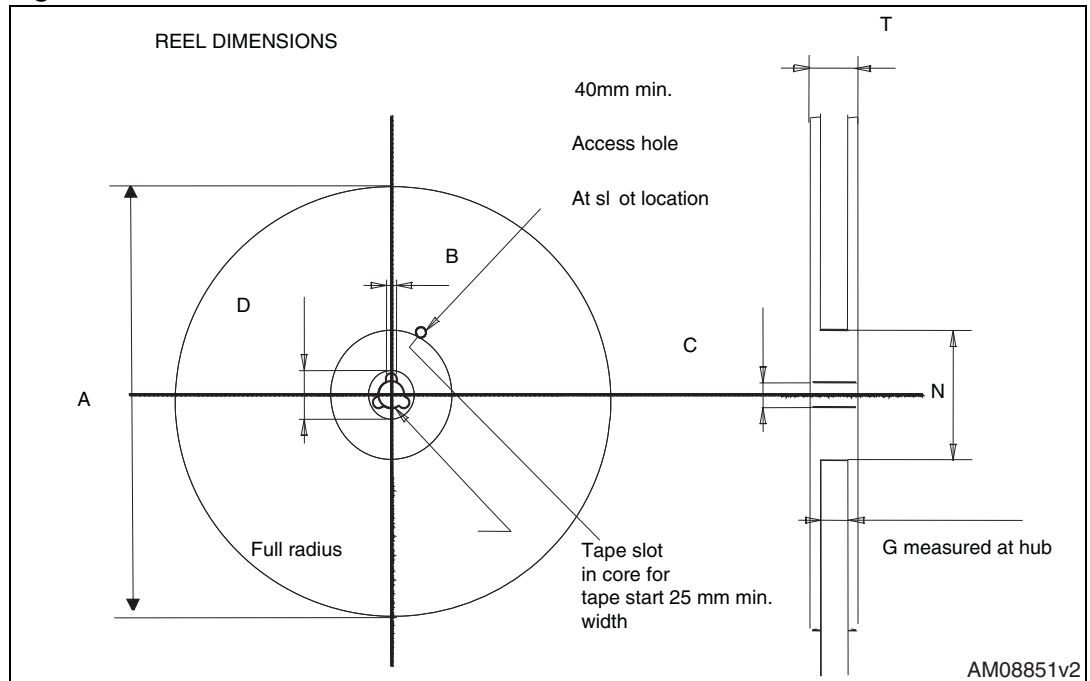


Figure 32. Reel



6 Revision history

Table 14. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 29-Jul-2009 | 1 | First release |
| 01-Sep-2009 | 2 | <i>Figure 10</i> has been updated |
| 06-Oct-2011 | 3 | <p>$C_{o(er)}$ and $C_{o(tr)}$ values changed in <i>Table 5: Dynamic</i> <i>Table 6: Switching times</i> parameters updates <i>Figure 24: Switching time waveform</i> has been corrected Minor text changes <i>Section 4: Package mechanical data</i> has been modified. Added:</p> <ul style="list-style-type: none"> – <i>Table 8: D²PAK (TO-263) mechanical data, Figure 25: D²PAK (TO-263) drawing</i> and <i>Figure 26: D²PAK footprint</i>; – <i>Table 9: TO-220FP mechanical data,</i>and <i>Figure 27: TO-220FP drawing</i>; – <i>Table 10: I²PAK (TO-262) mechanical data,</i>and <i>Figure 28: I²PAK (TO-262) drawing</i>; – <i>Table 11: TO-220 type A mechanical data,</i>and <i>Figure 29: TO-220 type A drawing</i>; – <i>Table 12: TO-247 mechanical data,</i>and <i>Figure 30: TO-247 drawing</i>; <p><i>Section 5: Packaging mechanical data</i> has been modified. Added:</p> <ul style="list-style-type: none"> – <i>Table 13: D²PAK (TO-263) tape and reel mechanical data, Figure 31: Tape</i> and <i>Figure 32: Reel</i>; |

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