



STB26NM60N, STF26NM60N, STI26NM60N STP26NM60N, STW26NM60N

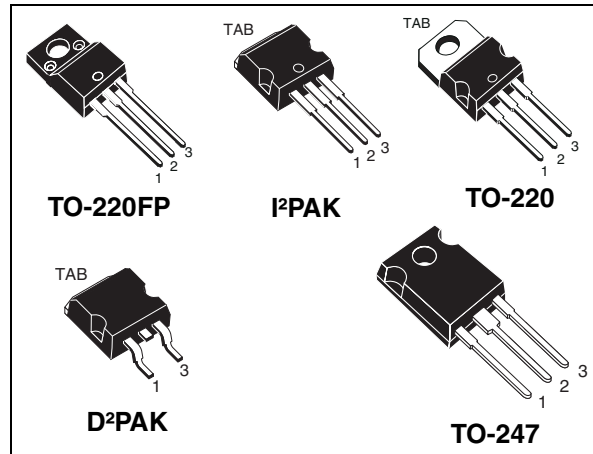
N-channel 600 V, 0.135 Ω typ., 20 A MDmesh™ II Power MOSFET
in D²PAK, I²PAK, TO-220, TO-220FP and TO-247 packages

Datasheet — production data

Features

| Type | V _{DSS} | R _{DS(on)} max | I _D |
|------------|------------------|----------------------------|----------------|
| STB26NM60N | 600 V | < 0.165 Ω | 20 A |
| STF26NM60N | 600 V | < 0.165 Ω | 20 A |
| STI26NM60N | 600 V | < 0.165 Ω | 20 A |
| STP26NM60N | 600 V | < 0.165 Ω | 20 A |
| STW26NM60N | 600 V | < 0.165 Ω | 20 A |

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



Application

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET applies a new vertical structure to the company's strip layout to yield a device with one of the world's lowest on-resistance and gate charge, making it suitable for the most demanding high-efficiency converters.

Figure 1. Internal schematic diagram

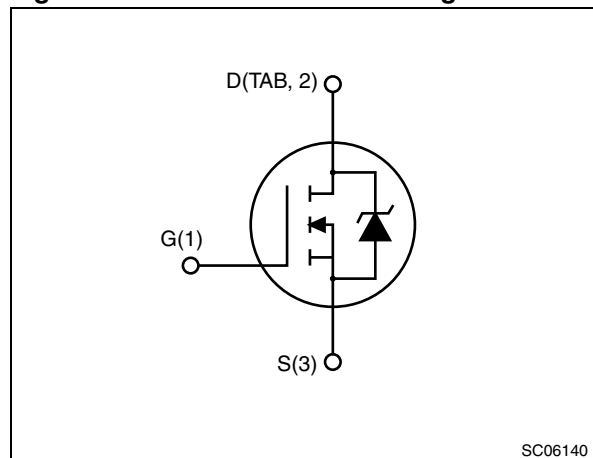


Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|-------------|---------|--------------------|---------------|
| STB26NM60N | 26NM60N | D ² PAK | Tape and reel |
| STF26NM60N | | TO-220FP | Tube |
| STI26NM60N | | I ² PAK | |
| STP26NM60N | | TO-220 | |
| STW26NM60N | | TO-247 | |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|--------------------------------|--|---|---------------------|------|
| | | D ² PAK, I ² PAK, TO-220, TO-247 | TO-220FP | |
| V _{DS} | Drain-source voltage | 600 | | V |
| V _{GS} | Gate-source voltage | ± 25 | | V |
| I _D | Drain current (continuous) at T _C = 25 °C | 20 | 20 ⁽¹⁾ | A |
| I _D | Drain current (continuous) at T _C = 100 °C | 12.6 | 12.6 ⁽¹⁾ | A |
| I _{DM} ⁽²⁾ | Drain current (pulsed) | 80 | 80 ⁽¹⁾ | A |
| P _{TOT} | Total dissipation at T _C = 25 °C | 140 | 35 | W |
| | Derating factor | 1.12 | 0.28 | W/°C |
| 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 by maximum junction temperature.
- Pulse width limited by safe operating area.
- I_{SD} ≤ 20 A, di/dt ≤ 400 A/μs, V_{DSpeak} ≤ V_{(BR)DSS}, V_{DD} = 80% V_{(BR)DSS}

Table 3. Thermal data

| Symbol | Parameter | Value | | | | | Unit |
|-------------------------------------|---|--------|--------|--------------------|--------------------|----------|------|
| | | TO-247 | TO-220 | I ² PAK | D ² PAK | TO-220FP | |
| R _{thj-case} | Thermal resistance junction-case max | 0.89 | | | | 3.6 | °C/W |
| R _{thj-amb} | Thermal resistance junction-ambient max | 50 | 62.5 | | | 62.5 | °C/W |
| R _{thj-pcb} ⁽¹⁾ | Thermal resistance junction-pcb max | | | | 30 | | °C/W |

- When mounted on FR-4 board of 1inch², 2oz Cu, t < 10 sec.

Table 4. Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|----------|---|-------|------|
| I_{AS} | Avalanche current, repetitive or not-repetitive (pulse width limited by T_J max) | 6 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_J=25\text{ °C}$, $I_D=I_{AS}$, $V_{DD}=50\text{ V}$) | 610 | mJ |

2 Electrical characteristics

(T_{CASE} = 25 °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 mA, V _{GS} = 0 | 600 | | | V |
| I _{DSS} | Zero gate voltage drain current (V _{GS} = 0) | V _{DS} = 600 V V _{DS} = 600 V, T _C = 125 °C | | | 1 100 | μA μA |
| I _{GSS} | Gate-body leakage current (V _{DS} = 0) | V _{GS} = ± 25 V | | | ±0.1 | μA |
| V _{GS(th)} | Gate threshold voltage | V _{DS} = V _{GS} , I _D = 250 μA | 2 | 3 | 4 | V |
| R _{DS(on)} | Static drain-source on-resistance | V _{GS} = 10 V, I _D = 10 A | | 0.135 | 0.165 | Ω |

Table 6. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--|---|---|------|--------------------|------|----------------|
| C _{iss} C _{oss} C _{rss} | Input capacitance Output capacitance Reverse transfer capacitance | V _{DS} = 50 V, f = 1 MHz, V _{GS} = 0 | - | 1800 115 1.1 | - | pF pF pF |
| C _{oss eq.} (1) | Equivalent output capacitance | V _{GS} = 0, V _{DS} = 0 to 480 V | - | 310 | - | pF |
| Q _g Q _{gs} Q _{gd} | Total gate charge Gate-source charge Gate-drain charge | V _{DD} = 480 V, I _D = 20 A, V _{GS} = 10 V, (see Figure 19) | - | 60 8.5 30 | - | nC nC nC |
| R _g | Gate input resistance | f=1 MHz Gate DC Bias=0 Test signal level = 20 mV open drain | - | 2.8 | - | Ω |

1. C_{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(on)} t _r t _{d(off)} t _f | Turn-on delay time Rise time Turn-off delay time Fall time | V _{DD} = 300 V, I _D = 10 A R _G = 4.7 Ω V _{GS} = 10 V (see Figure 18) | - | 13 25 85 50 | - | ns ns ns ns |

Table 8. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max | Unit |
|-----------------|-------------------------------|--|------|------|-----|---------------|
| I_{SD} | Source-drain current | | - | | 20 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 80 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 20\text{ A}, V_{GS} = 0$ | - | | 1.5 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 20\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$ | - | 370 | | ns |
| Q_{rr} | Reverse recovery charge | $V_{DD} = 60\text{ V}$ | - | 5.8 | | μC |
| I_{RRM} | Reverse recovery current | (see Figure 20) | - | 31.6 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 20\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$ | - | 450 | | ns |
| Q_{rr} | Reverse recovery charge | $V_{DD} = 60\text{ V}, T_j = 150\text{ }^\circ\text{C}$ | - | 7.5 | | μC |
| I_{RRM} | Reverse recovery current | (see Figure 20) | - | 32.5 | | 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 and I²PAK

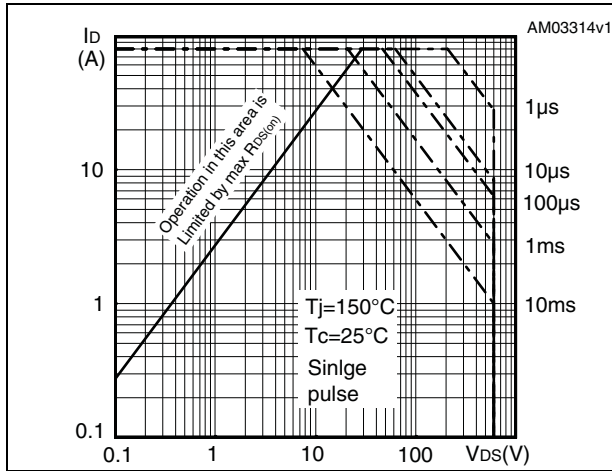


Figure 3. Thermal impedance for TO-220, D²PAK and I²PAK

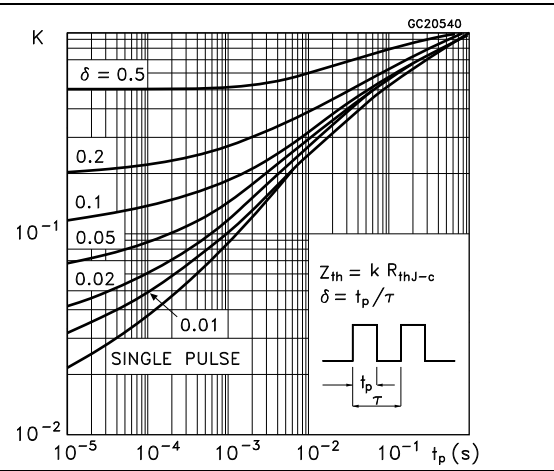


Figure 4. Safe operating area for TO-220FP

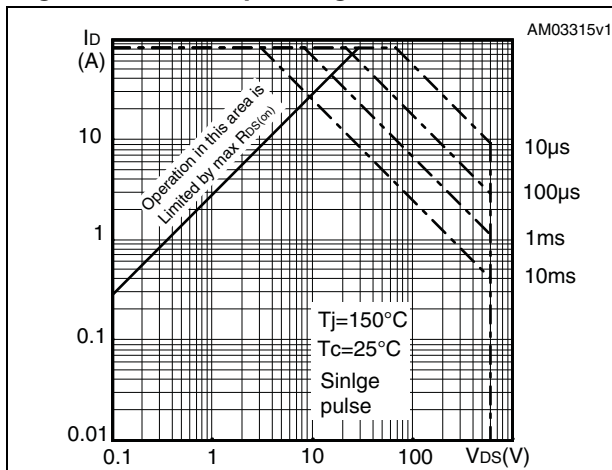


Figure 5. Thermal impedance for TO-220FP

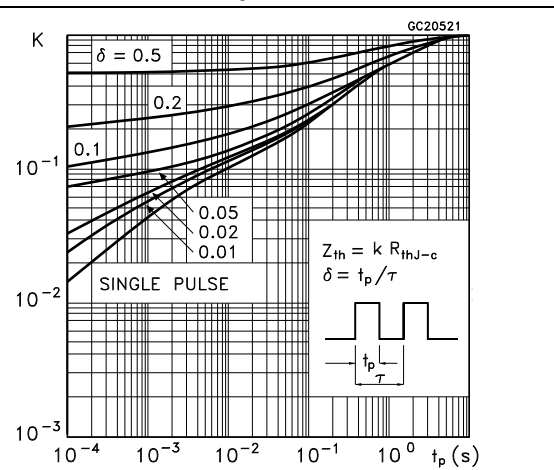


Figure 6. Safe operating area for TO-247

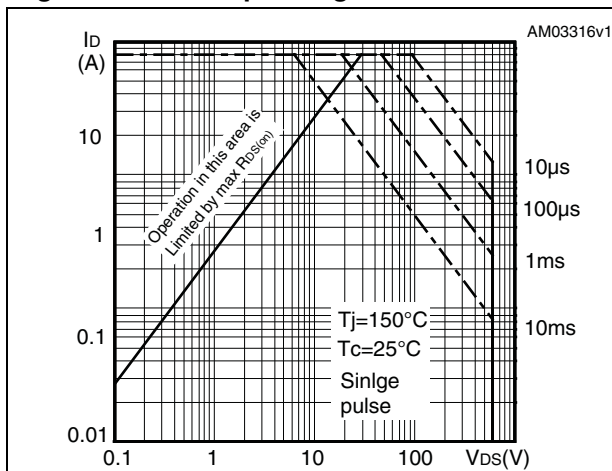


Figure 7. Thermal impedance for TO-247

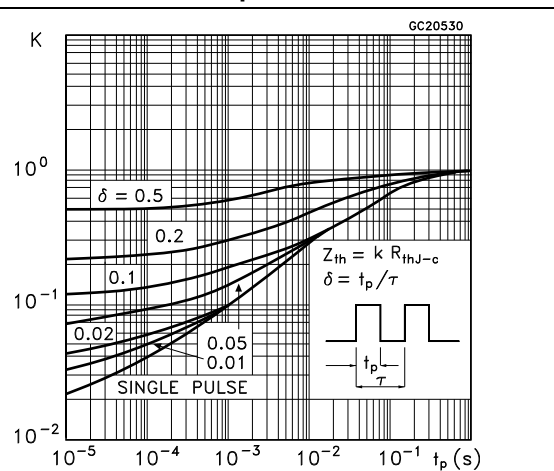


Figure 8. Output characteristics

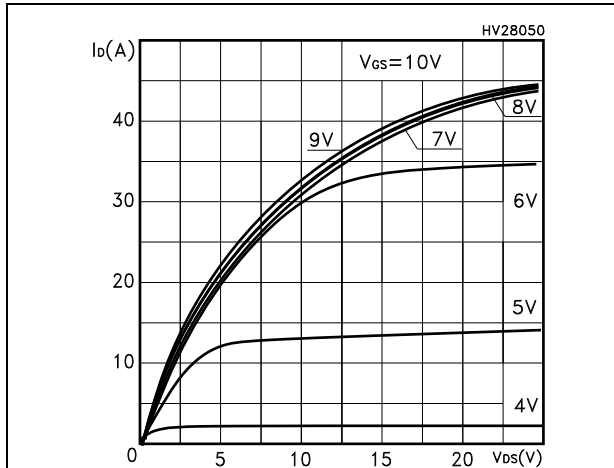


Figure 9. Transfer characteristics

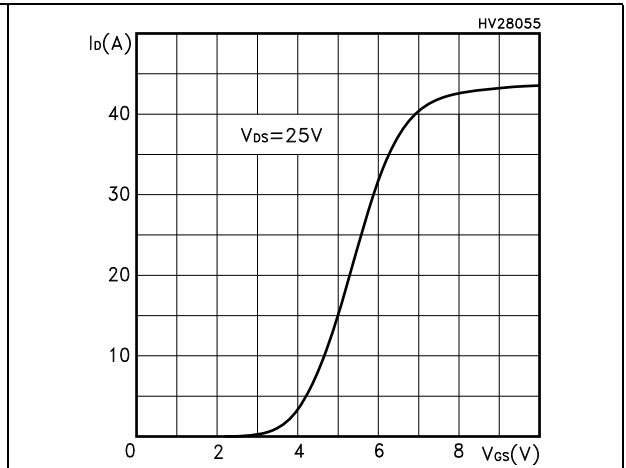


Figure 10. Transconductance

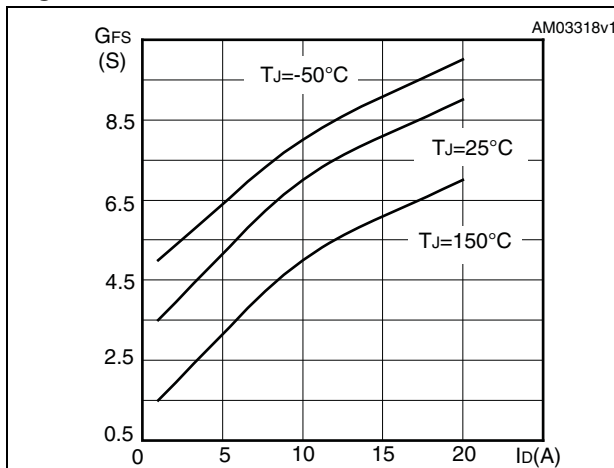


Figure 11. Static drain-source on-resistance

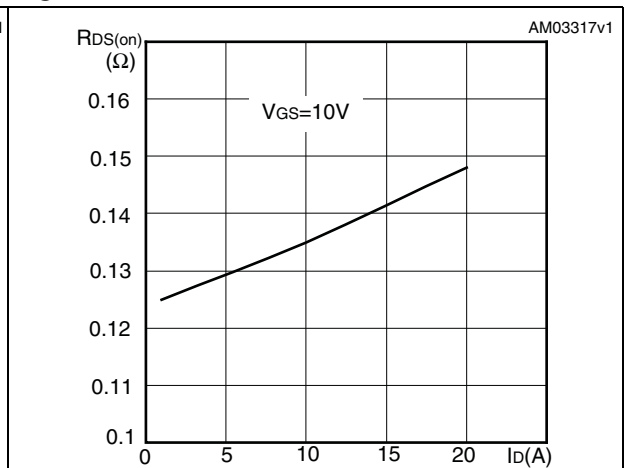


Figure 12. Gate charge vs gate-source voltage

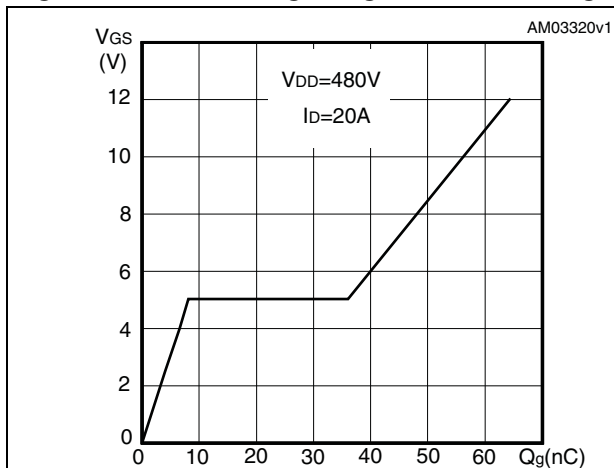


Figure 13. Capacitance variations

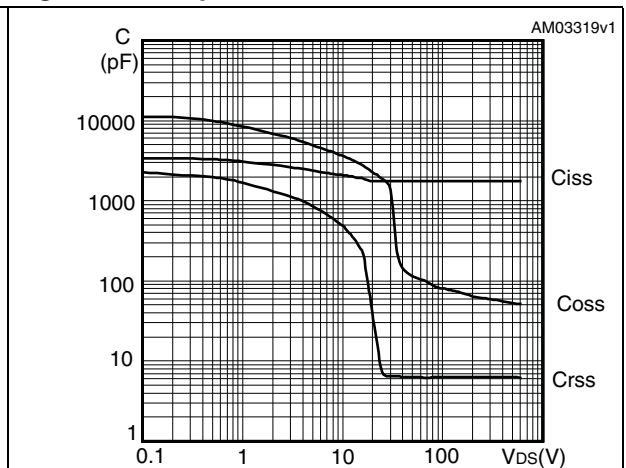


Figure 14. Normalized gate threshold voltage vs temperature

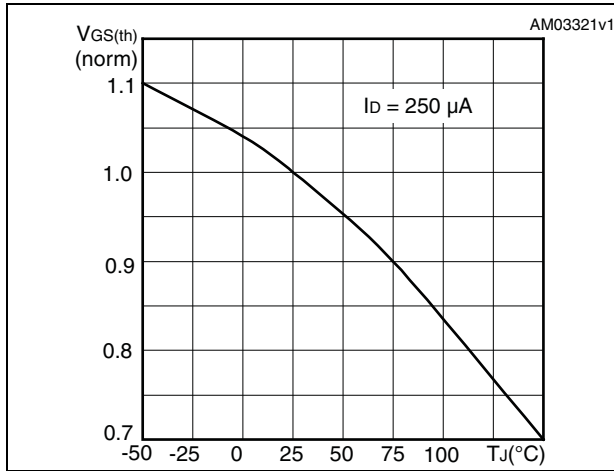


Figure 15. Normalized on resistance vs temperature

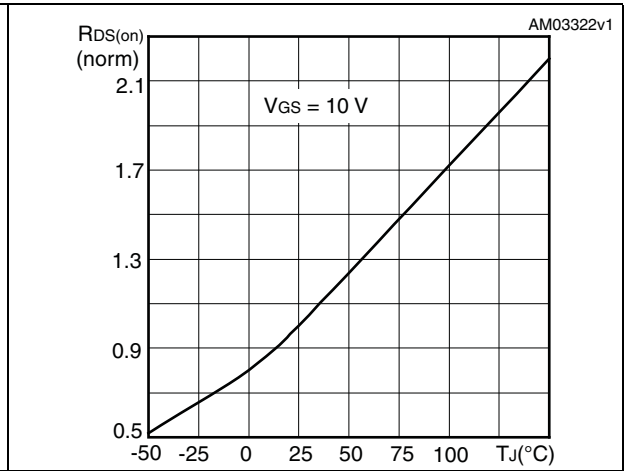


Figure 16. Source-drain diode forward characteristics

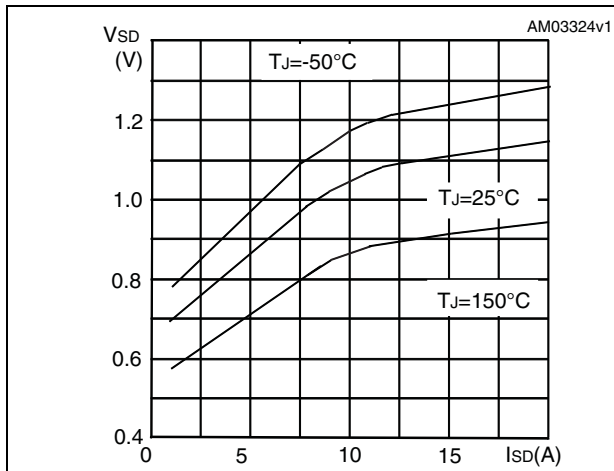
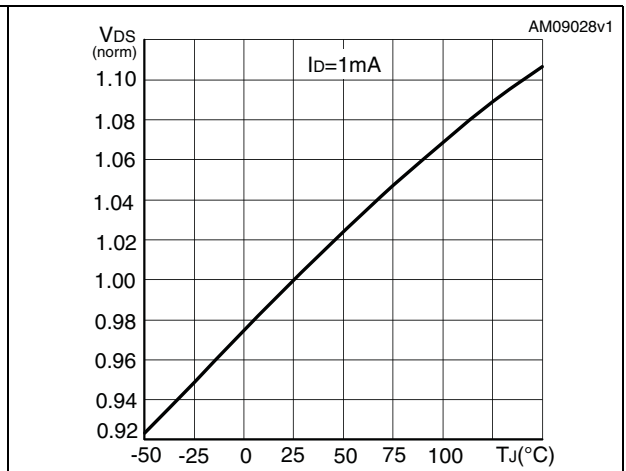
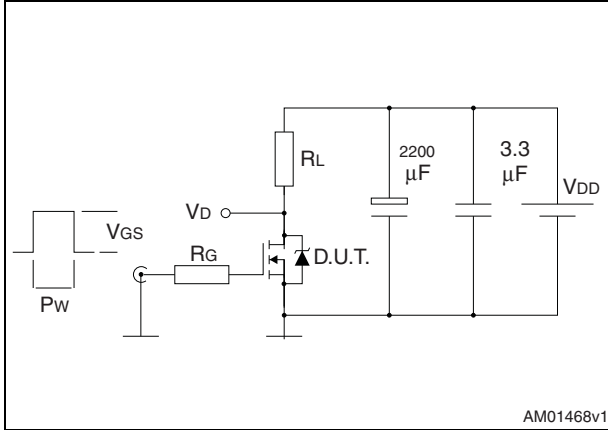


Figure 17. Normalized B_{VDSS} vs temperature



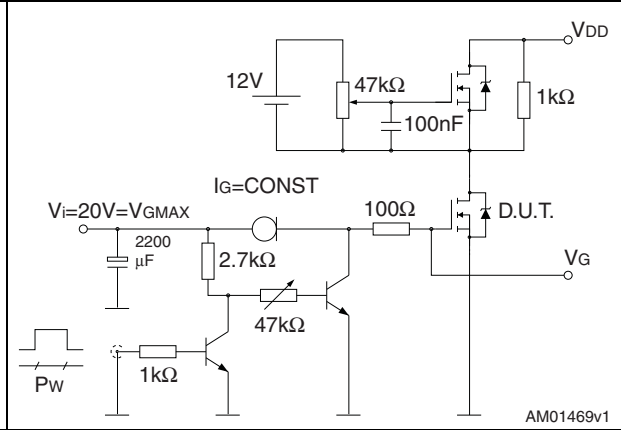
3 Test circuits

Figure 18. Switching times test circuit for resistive load



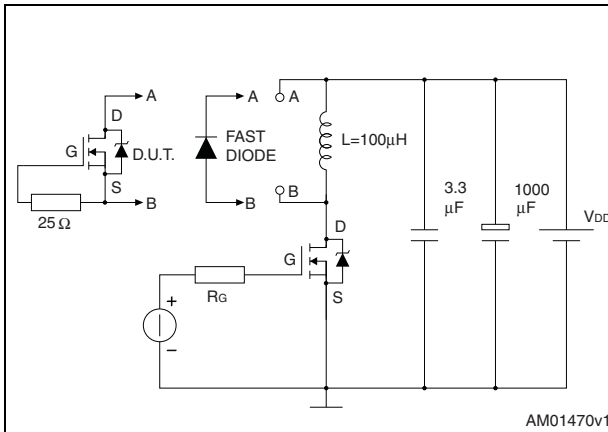
AM01468v1

Figure 19. Gate charge test circuit



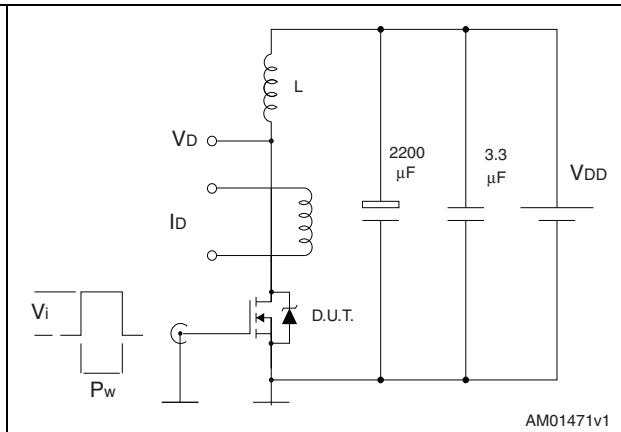
AM01469v1

Figure 20. Test circuit for inductive load switching and diode recovery times



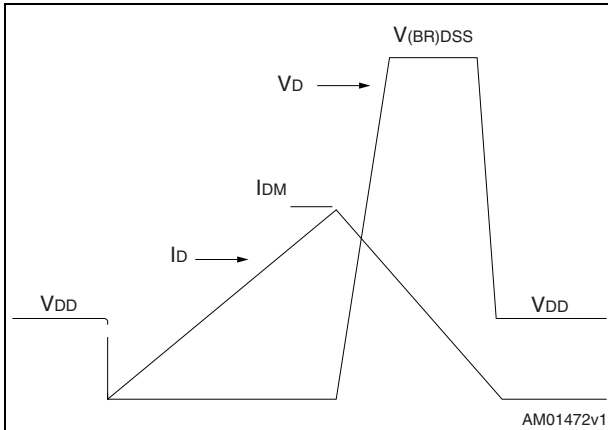
AM01470v1

Figure 21. Unclamped inductive load test circuit



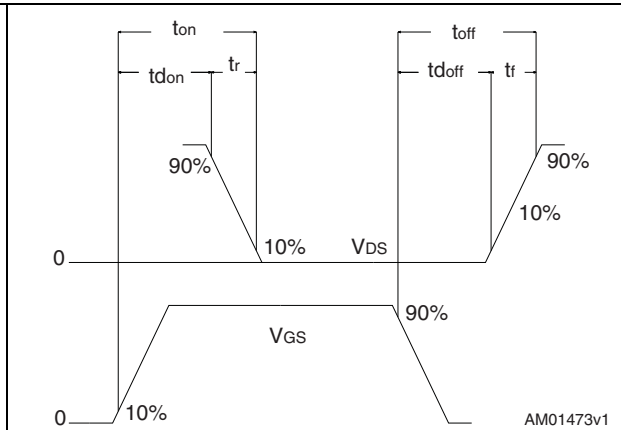
AM01471v1

Figure 22. Unclamped inductive waveform



AM01472v1

Figure 23. Switching time waveform



AM01473v1

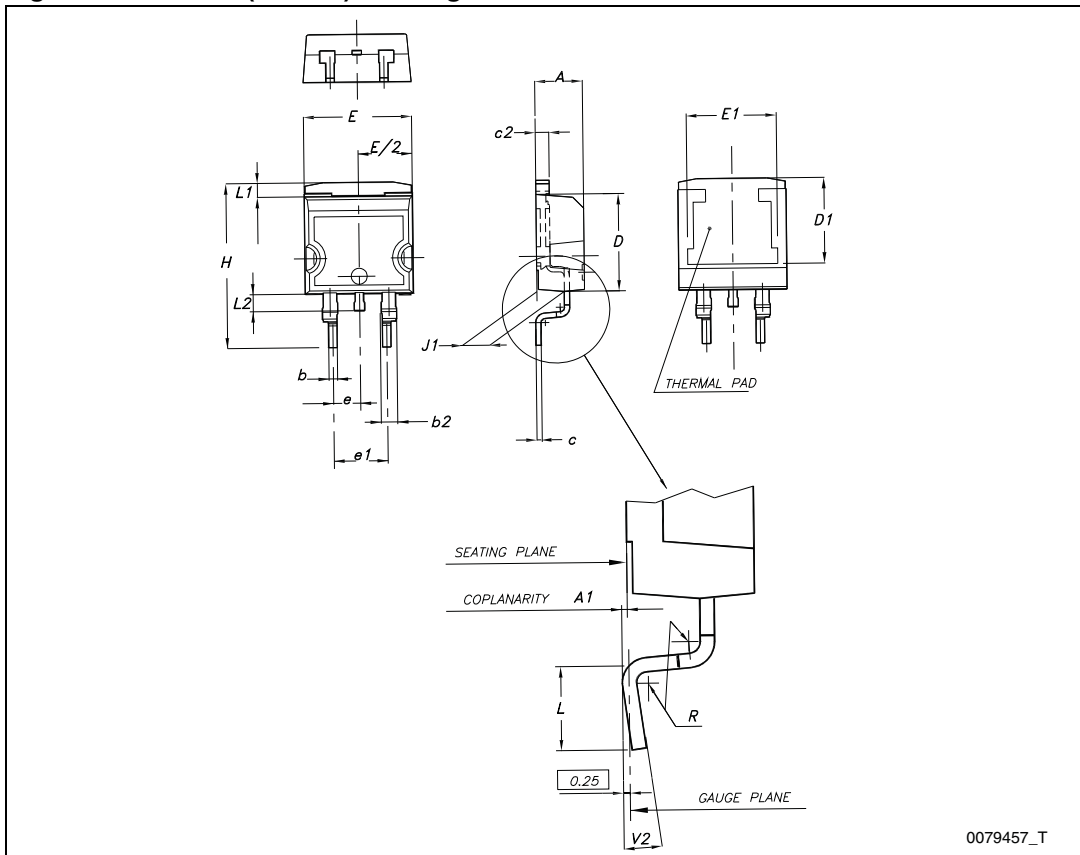
4 Package mechanical data

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.

Table 9. D²PAK (TO-263) mechanical data

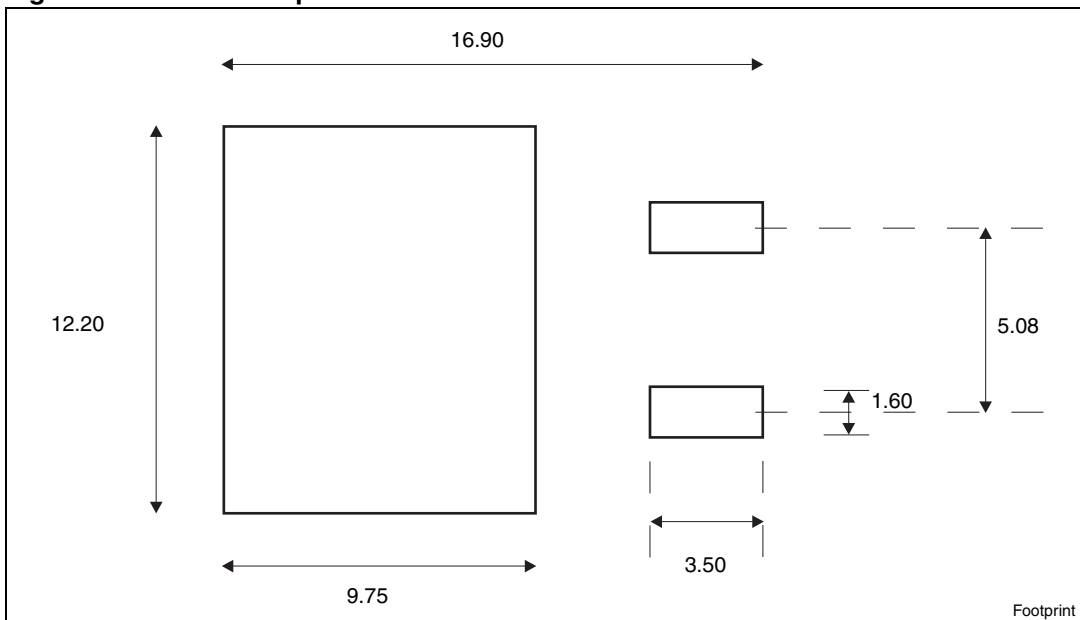
| Dim. | mm | | |
|------|------|------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| A1 | 0.03 | | 0.23 |
| b | 0.70 | | 0.93 |
| b2 | 1.14 | | 1.70 |
| c | 0.45 | | 0.60 |
| c2 | 1.23 | | 1.36 |
| D | 8.95 | | 9.35 |
| D1 | 7.50 | | |
| E | 10 | | 10.40 |
| E1 | 8.50 | | |
| e | | 2.54 | |
| 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 24. D²PAK (TO-263) drawing



0079457_T

Figure 25. D²PAK footprint^(a)



a. All dimension are in millimeters

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 26. I²PAK (TO-262) drawing

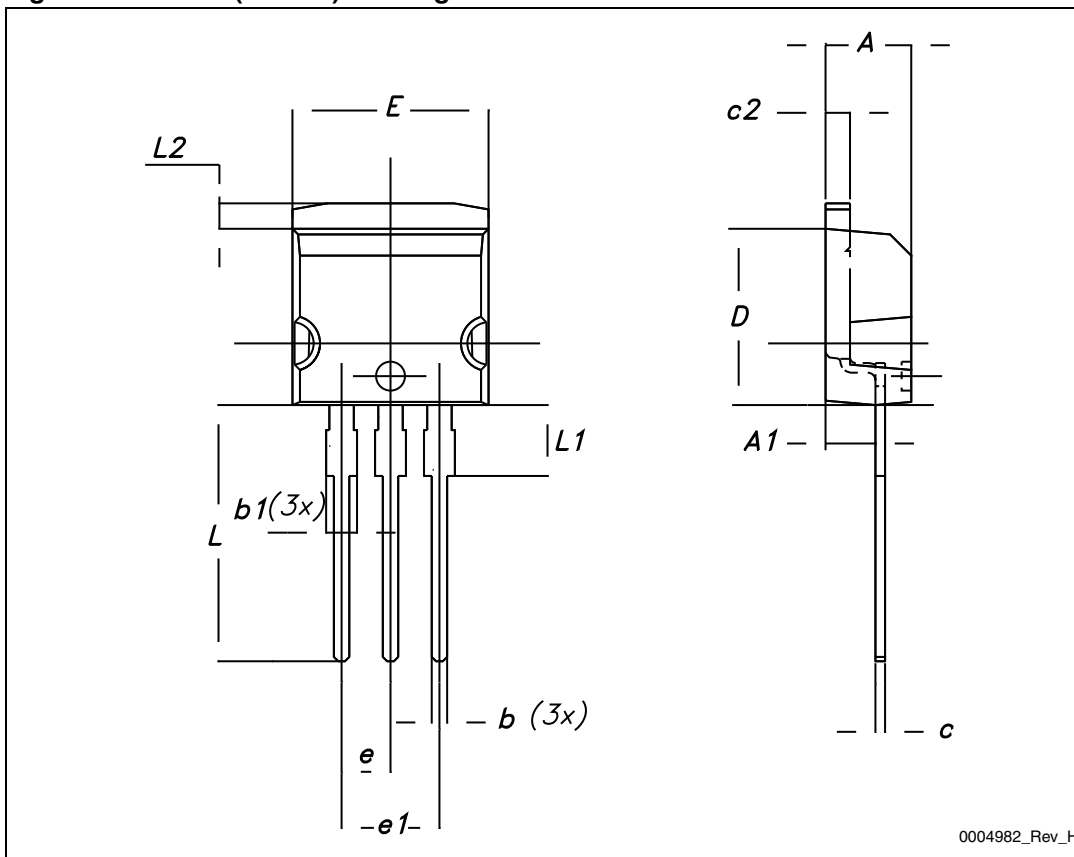


Table 11. TO-220 type A mechanical data

| 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 27. TO-220 type A drawing

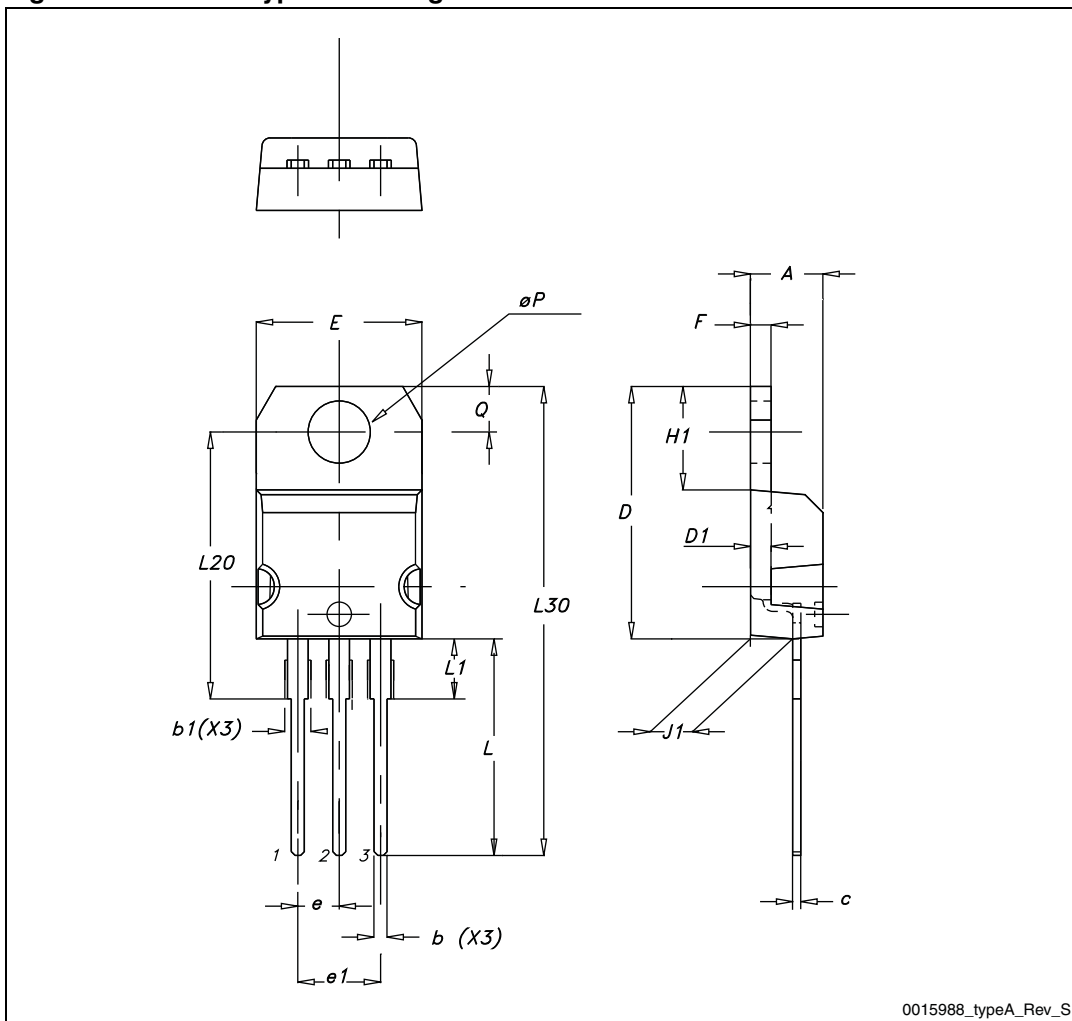
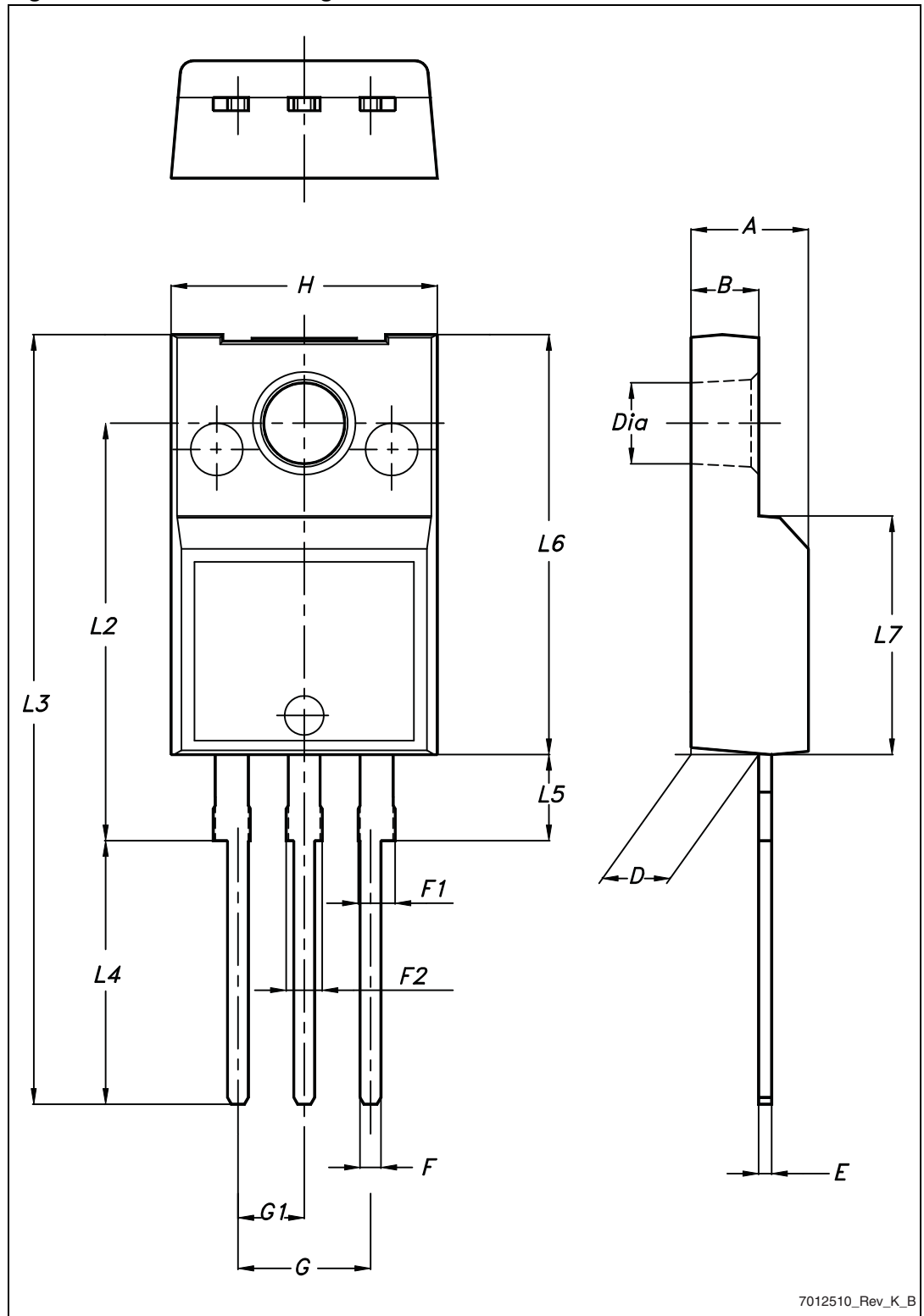


Table 12. TO-220FP mechanical data

| 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 28. TO-220FP drawing



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 29. Tape

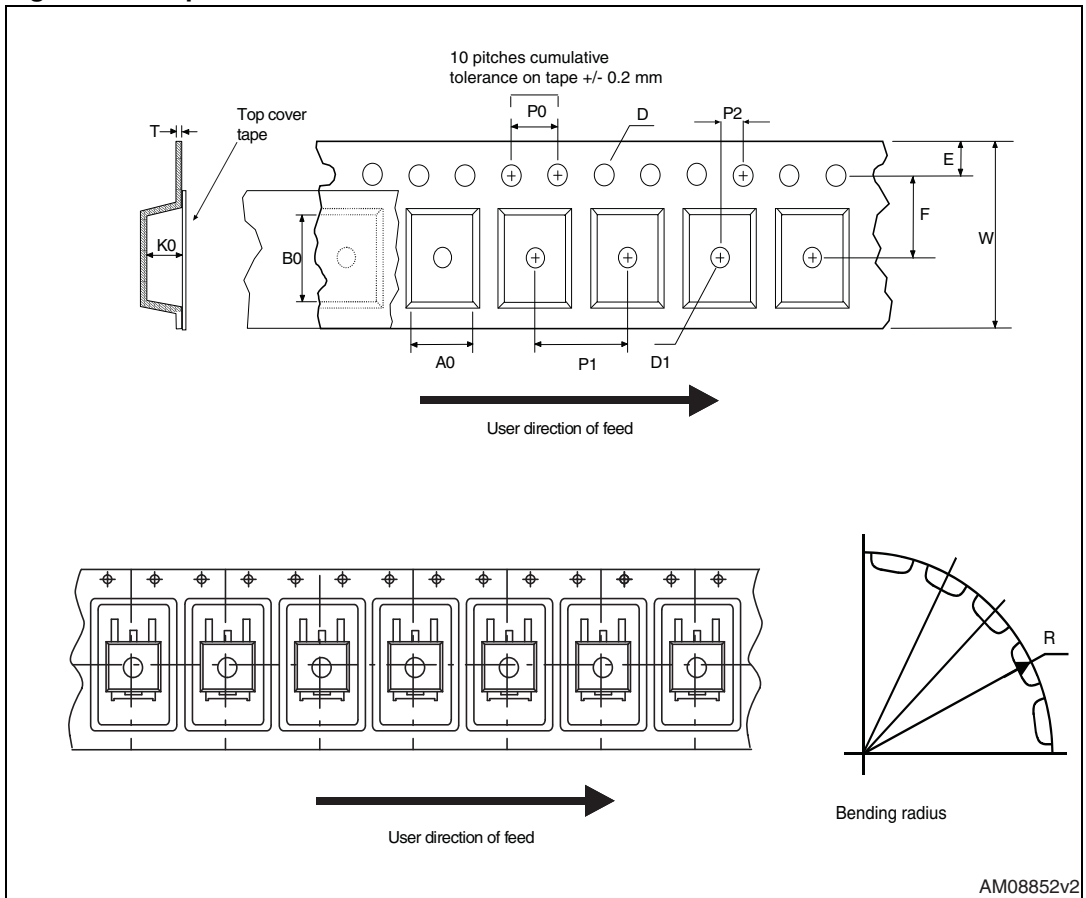
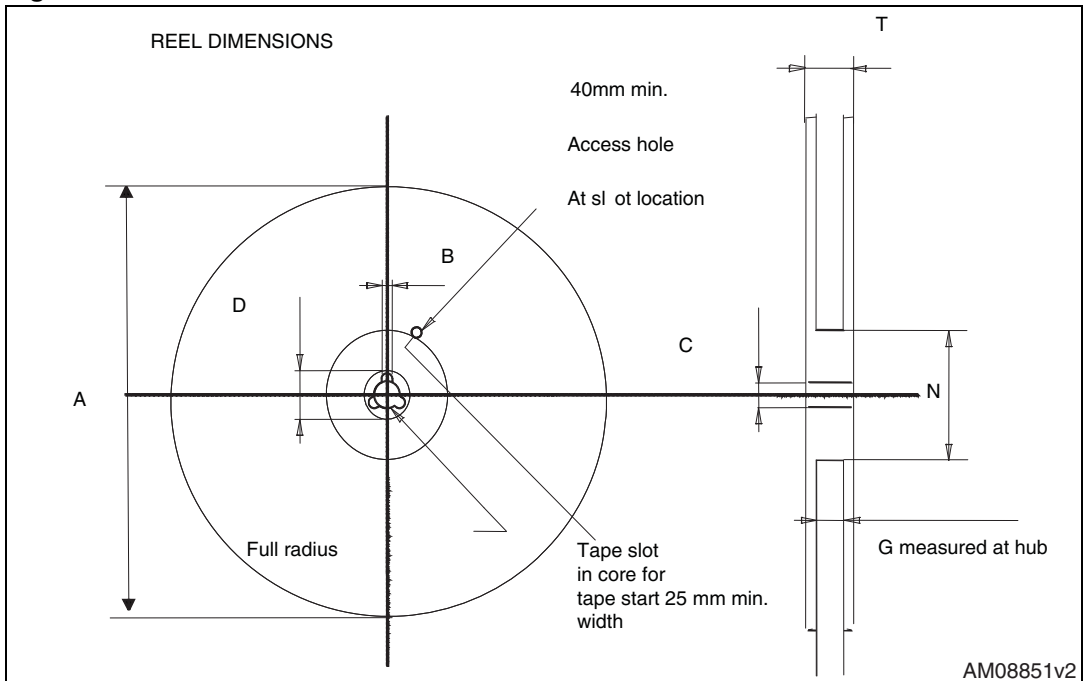


Figure 30. Reel



6 Revision history

Table 14. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 29-Apr-2009 | 1 | First release |
| 17-Dec-2009 | 2 | Added new package, mechanical data: D ² PAK |
| 20-Jun-2011 | 3 | Inserted device in I ² PAK. |
| 13-Mar-2012 | 4 | Updated P _{TOT} and derating factor in Table 2 . Update R _{thj-case} for TO-220FP in Table 3 . Update Figure 12 and Figure 17 . Update Section 5: Packaging mechanical data . |
| 20-Jun-2012 | 5 | Updated title on the coverpage. Minor text changes. |

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