



STB11N65M5, STD11N65M5 STF11N65M5, STP11N65M5

N-channel 650 V, 0.43 Ω , 9 A MDmesh™ V Power MOSFET
in D²PAK, DPAK, TO-220FP and TO-220 packages

Preliminary data

Features

| Order code | V _{DSS} @ T _{Jmax} | R _{DS(on)} max | I _D |
|------------|---|----------------------------|----------------|
| STB11N65M5 | 710 V | < 0.48 Ω | 9 A |
| STD11N65M5 | | | |
| STF11N65M5 | | | |
| STP11N65M5 | | | |

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

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.

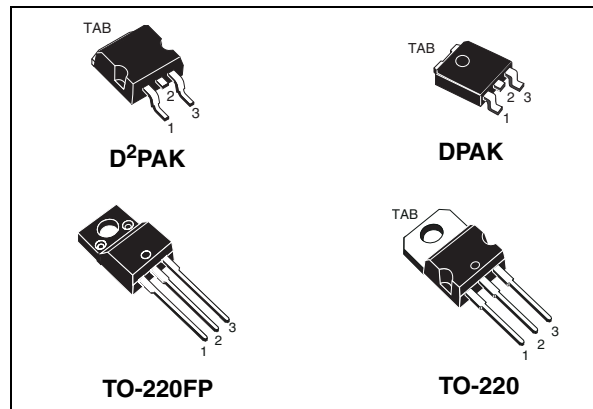
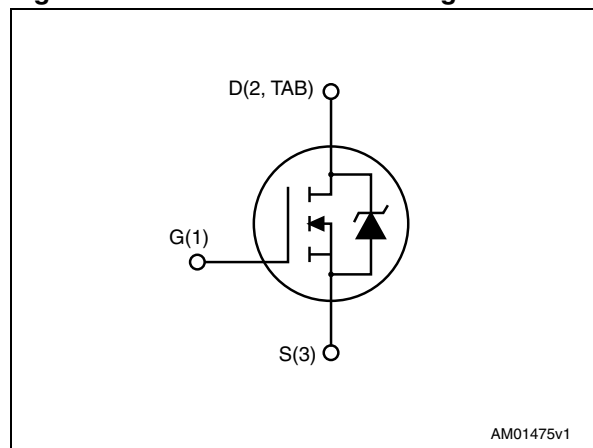


Figure 1. Internal schematic diagram



AM01475v1

Table 1. Device summary

| Order code | Marking | Package | Packaging |
|------------|---------|--------------------|---------------|
| STB11N65M5 | 11N65M5 | D ² PAK | Tape and reel |
| STD11N65M5 | | DPAK | |
| STF11N65M5 | | TO-220FP | Tube |
| STP11N65M5 | | TO-220 | |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|--------------------------------|---|--------------------------------------|--------------------|------|
| | | D ² PAK DPAK TO-220 | TO-220FP | |
| V _{GS} | Gate-source voltage | ± 25 | | V |
| I _D | Drain current (continuous) at T _C = 25 °C | 9 | 9 ⁽¹⁾ | A |
| I _D | Drain current (continuous) at T _C = 100 °C | 5.6 | 5.6 ⁽¹⁾ | A |
| I _{DM} ⁽¹⁾ | Drain current (pulsed) | 36 | 36 ⁽¹⁾ | A |
| P _{TOT} | Total dissipation at T _C = 25 °C | 85 | 25 | W |
| dv/dt ⁽²⁾ | 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 |

1. Limited by maximum junction temperature.

2. I_{SD} ≤ 9 A, di/dt ≤ 400 A/μs; V_{DD} < 80 % V_{(BR)DSS}

Table 3. Thermal data

| Symbol | Parameter | Value | | | | Unit |
|-------------------------------------|---|--------------------|------|----------|--------|------|
| | | D ² PAK | DPAK | TO-220FP | TO-220 | |
| R _{thj-case} | Thermal resistance junction-case max | 1.47 | | 5.0 | 1.47 | °C/W |
| R _{thj-pcb} ⁽¹⁾ | Thermal resistance junction-pcb max | 30 | 50 | | | °C/W |
| R _{thj-amb} | Thermal resistance junction-ambient max | | | 62.5 | | °C/W |

1. When mounted on 1 inch² FR-4, 2 Oz copper board.

Table 4. Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|-----------------|---|-------|------|
| I _{AR} | Avalanche current, repetitive or not repetitive (pulse width limited by T _{jmax}) | TBD | A |
| E _{AS} | Single pulse avalanche energy (starting t _j =25°C, I _d = I _{AR} ; V _{dd} =50) | TBD | 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 | $I_D = 1\text{ mA}$, $V_{GS} = 0$ | 650 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = 650\text{ V}$ $V_{DS} = 650\text{ V}$, $T_C = 125\text{ °C}$ | | | 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 | $V_{GS} = 10\text{ V}$, $I_D = 4.5\text{ A}$ | | 0.43 | 0.48 | 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 | $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$ | - | 620 20 4 | - | pF pF pF |
| $C_{o(tr)}^{(1)}$ | Equivalent capacitance time related | $V_{DS} = 0\text{ to }520\text{ V}$, $V_{GS} = 0$ | - | TBD | - | pF |
| $C_{o(er)}^{(2)}$ | Equivalent capacitance energy related | | - | TBD | - | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}$ open drain | - | 2.6 | - | Ω |
| Q_g Q_{gs} Q_{gd} | Total gate charge Gate-source charge Gate-drain charge | $V_{DD} = 520\text{ V}$, $I_D = 4.5\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 3) | - | 17 6 7 | - | nC nC nC |

1. 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}
2. 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 7. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max | Unit |
|--------------|--------------------|--|------|------|-----|------|
| $t_{d(on)}$ | Voltage delay time | $V_{DD} = 400\text{ V}$, $I_D = 7.5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 4 and Figure 7) | - | TBD | - | ns |
| t_r | Voltage rise time | | | TBD | | ns |
| t_f | Current fall time | | | TBD | | ns |
| $t_{c(off)}$ | Crossing time | | | TBD | | ns |

Table 8. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 9 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | | | 36 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 9\text{ A}$, $V_{GS} = 0$ | - | | 1.5 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 9\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ (see Figure 7) | - | TBD | | ns |
| Q_{rr} | Reverse recovery charge | | | TBD | | μC |
| I_{RRM} | Reverse recovery current | | | TBD | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 9\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 7) | - | TBD | | ns |
| Q_{rr} | Reverse recovery charge | | | TBD | | μC |
| I_{RRM} | Reverse recovery current | | | TBD | | A |

1. Pulse width limited by safe operating area.

2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%

3 Test circuits

Figure 2. Switching times test circuit for resistive load

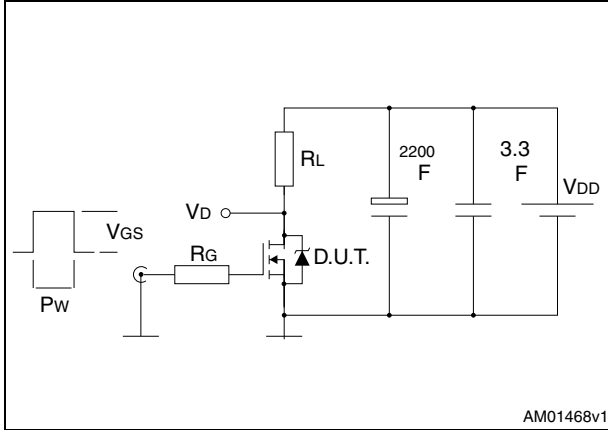


Figure 3. Gate charge test circuit

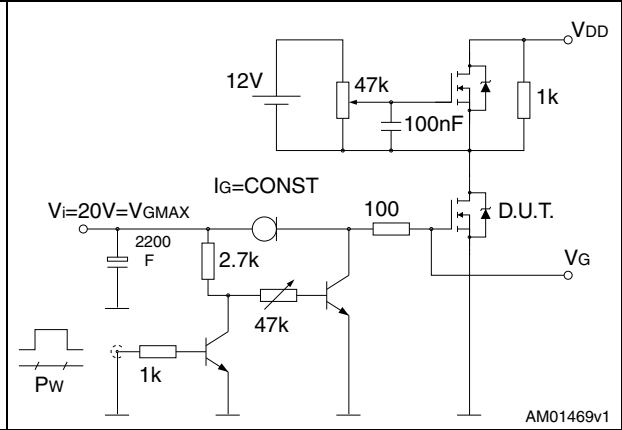


Figure 4. Test circuit for inductive load switching and diode recovery times

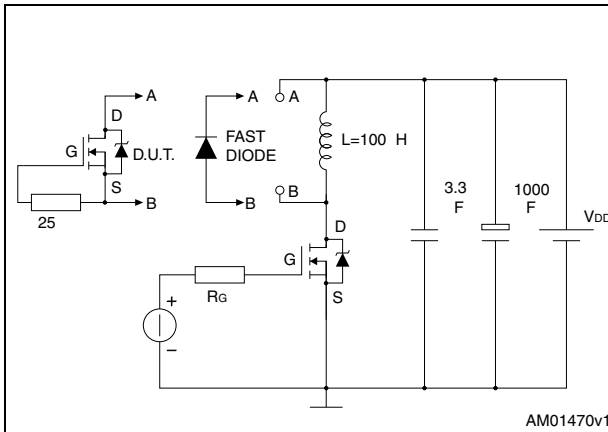


Figure 5. Unclamped inductive load test circuit

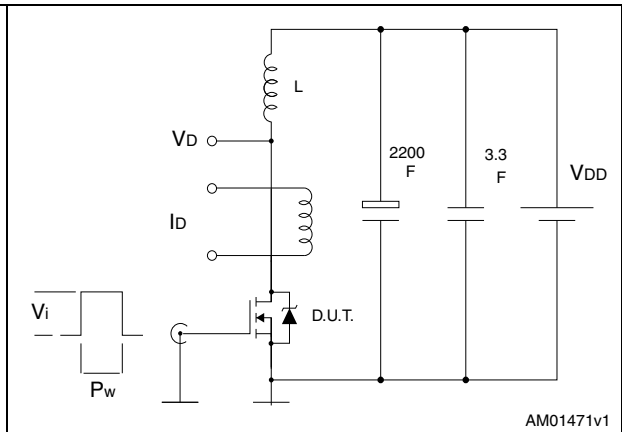


Figure 6. Unclamped inductive waveform

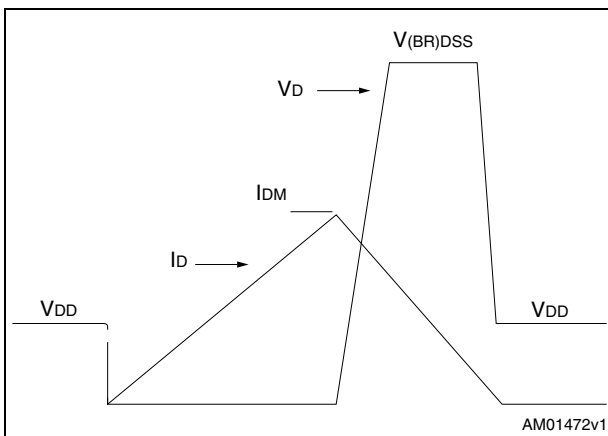
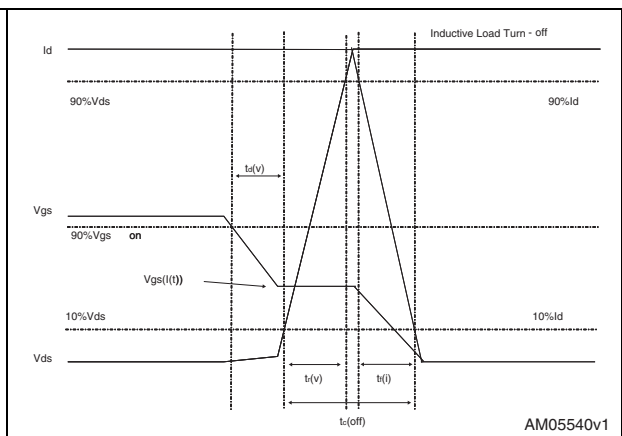


Figure 7. Switching time waveform



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. 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 8. D²PAK (TO-263) drawing

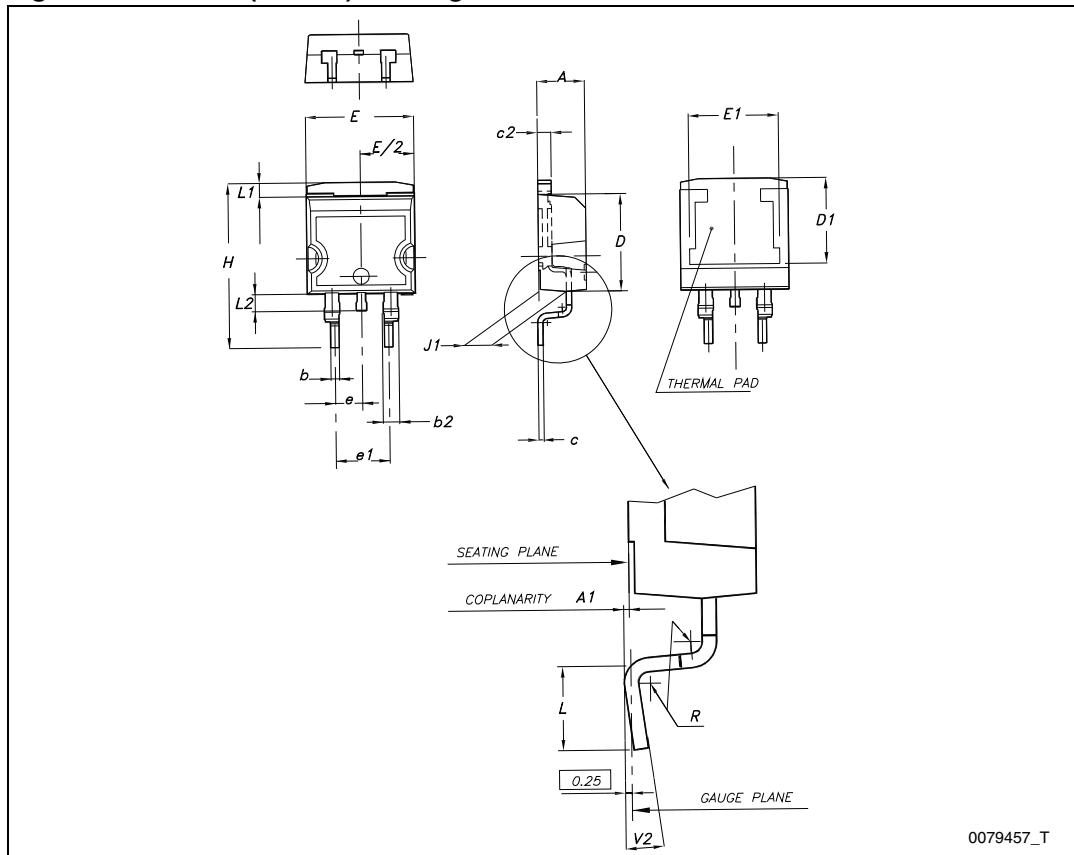
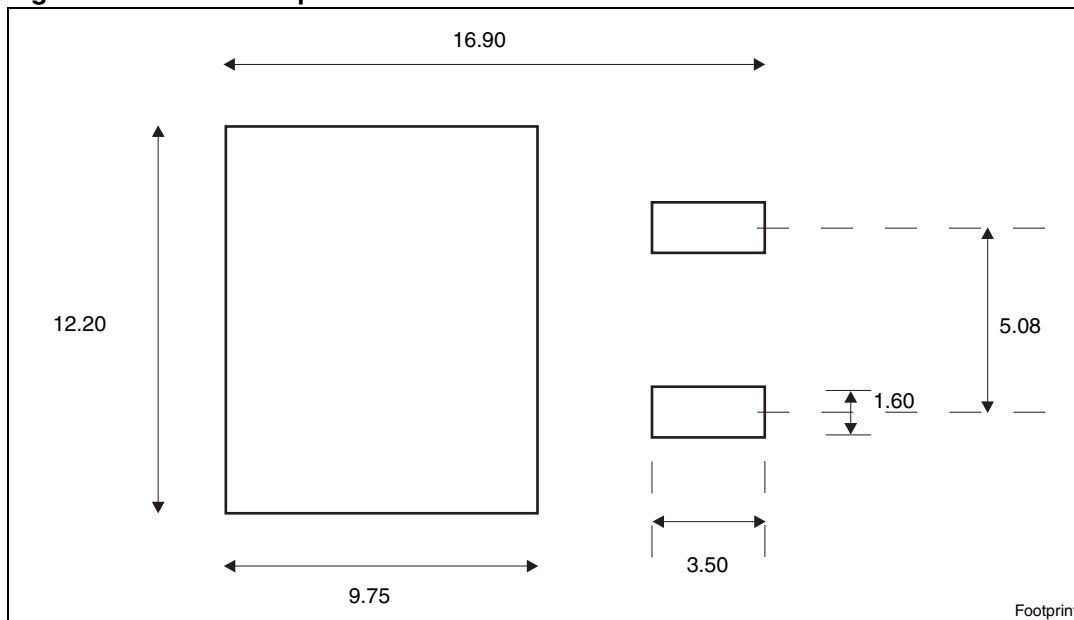


Figure 9. D²PAK footprint^(a)



a. All dimension are in millimeters

Table 10. DPAK (TO-252) mechanical data

| Dim. | mm | | |
|------|------|------|-------|
| | Min. | Typ. | Max. |
| A | 2.20 | | 2.40 |
| A1 | 0.90 | | 1.10 |
| A2 | 0.03 | | 0.23 |
| b | 0.64 | | 0.90 |
| b4 | 5.20 | | 5.40 |
| c | 0.45 | | 0.60 |
| c2 | 0.48 | | 0.60 |
| D | 6.00 | | 6.20 |
| D1 | | 5.10 | |
| E | 6.40 | | 6.60 |
| E1 | | 4.70 | |
| e | | 2.28 | |
| e1 | 4.40 | | 4.60 |
| H | 9.35 | | 10.10 |
| L | 1 | | 1.50 |
| L1 | | 2.80 | |
| L2 | | 0.80 | |
| L4 | 0.60 | | 1 |
| R | | 0.20 | |
| V2 | 0° | | 8° |

Figure 10. DPAK (TO-252) drawing

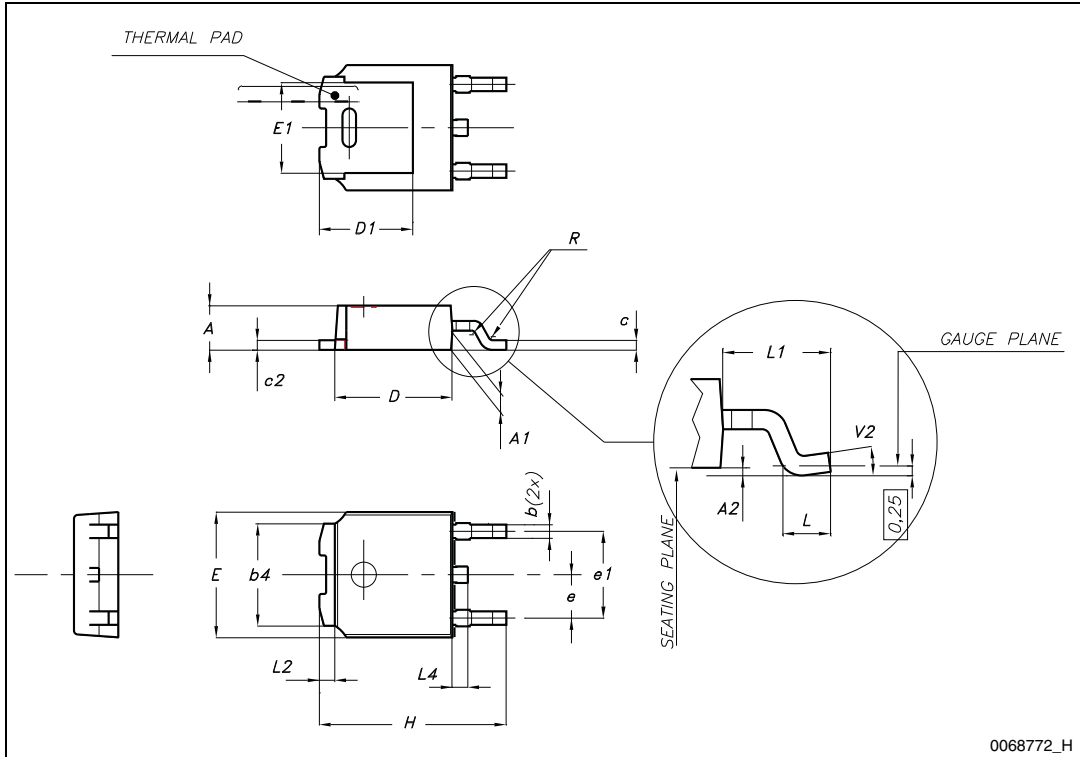
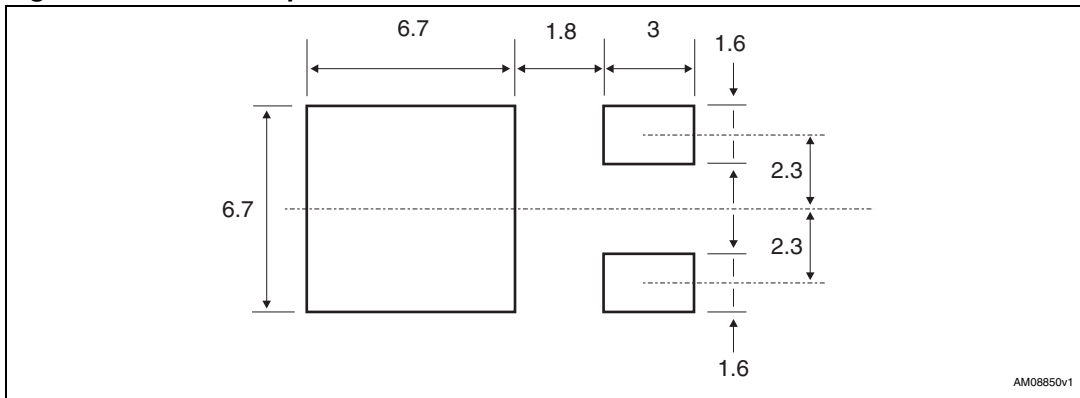


Figure 11. DPAK footprint^(b)



b. All dimensions are in millimeters

Table 11. 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 12. TO-220FP drawing

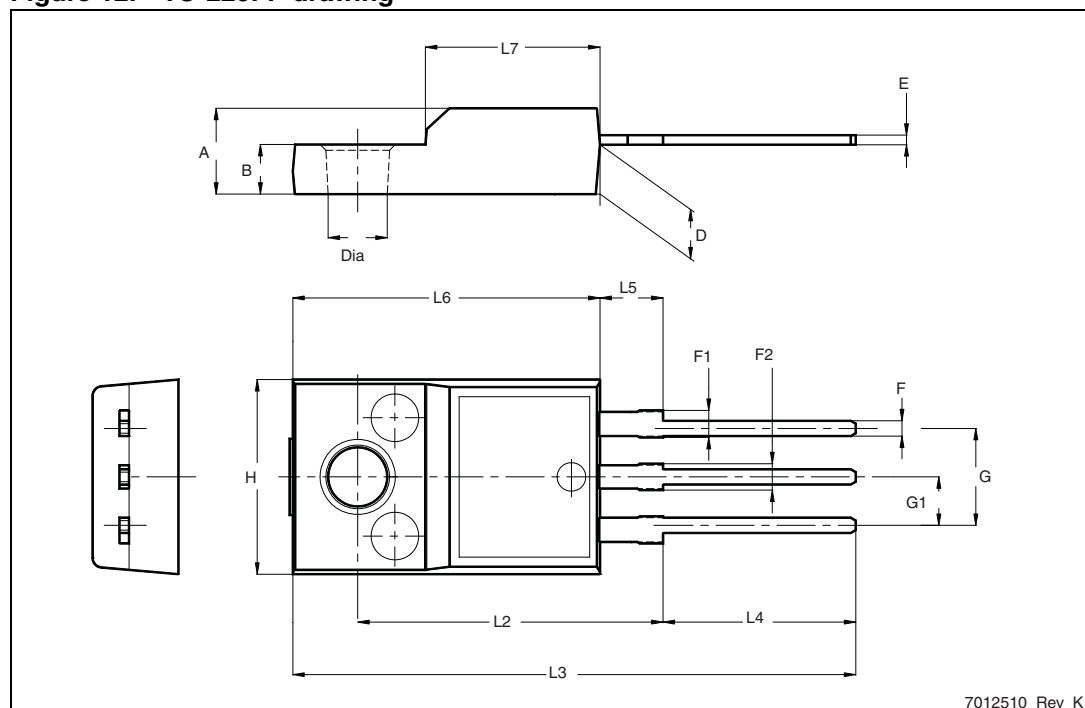
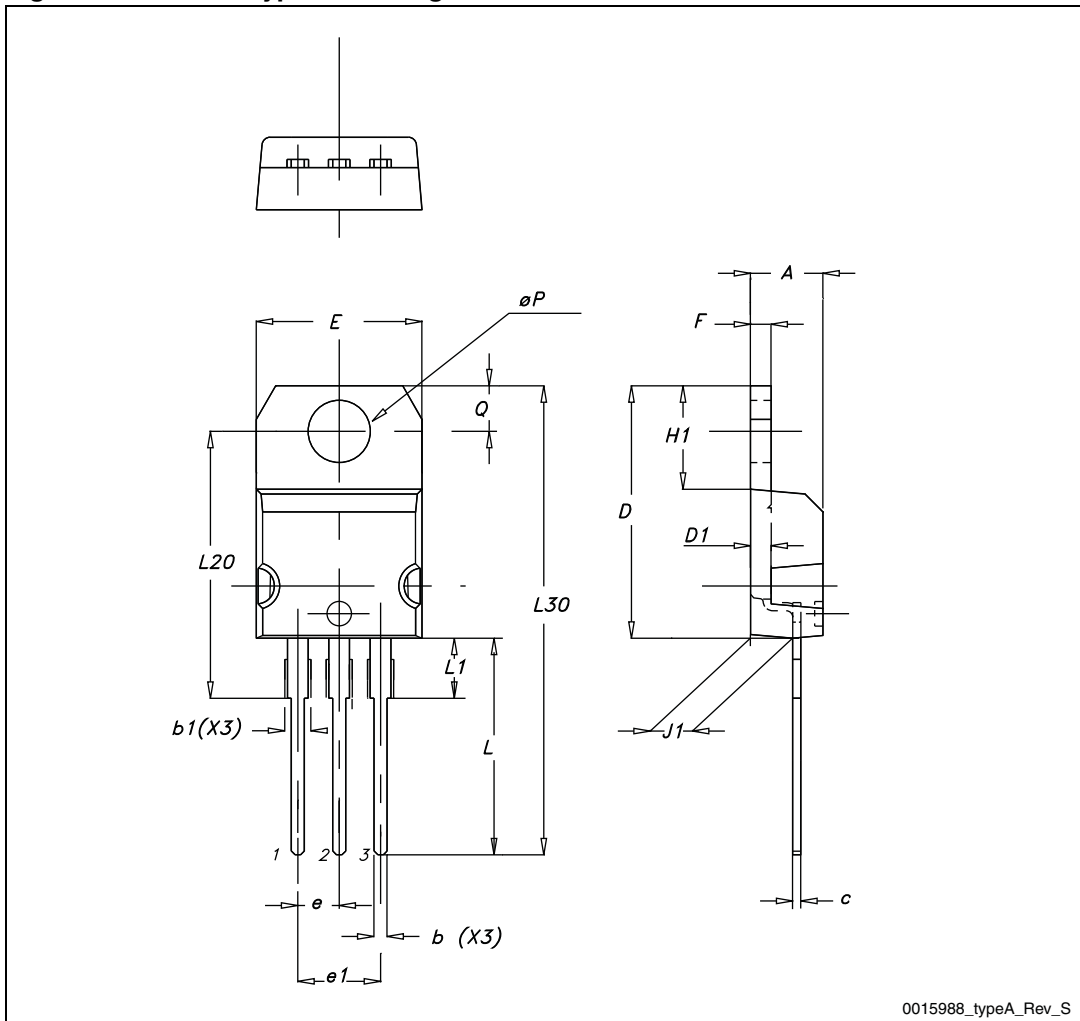


Table 12. TO-220 type A mechanical data

| 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 13. TO-220 type A drawing



5 Packaging mechanical data

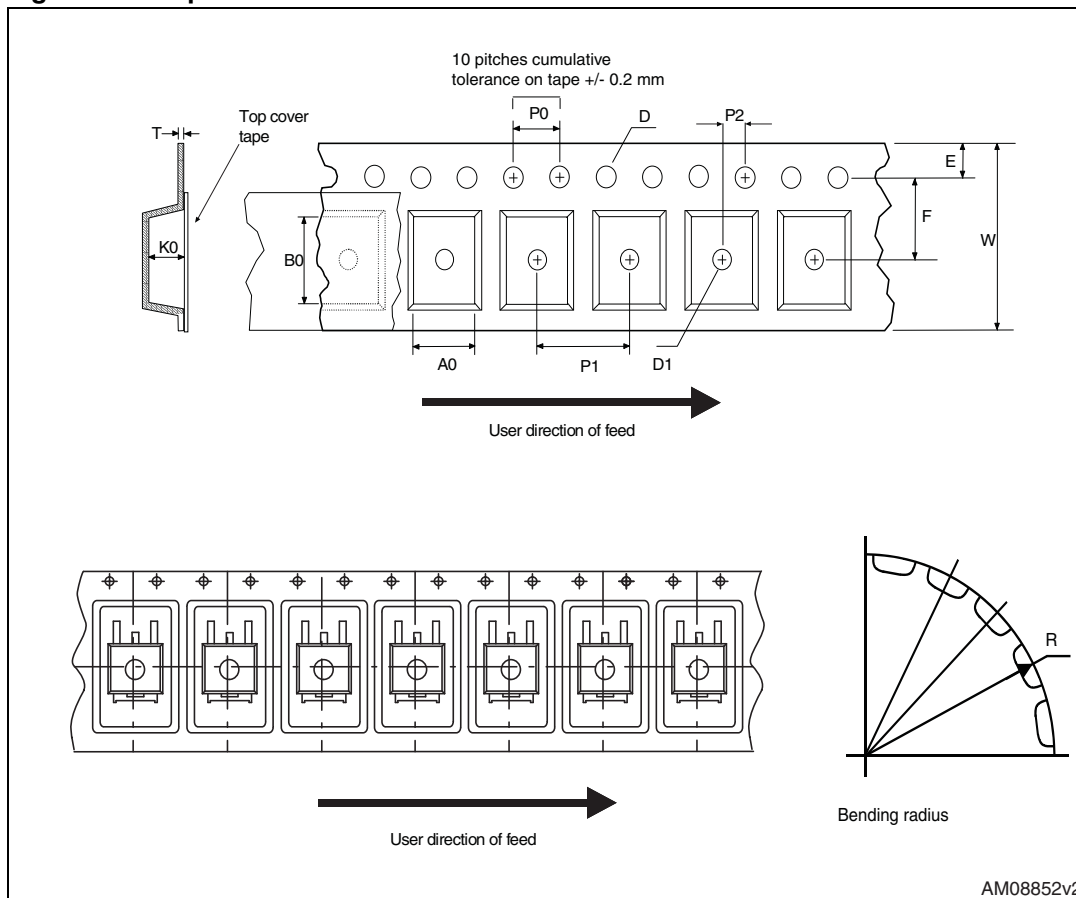
Table 13. DPAK (TO-252) tape and reel mechanical data

| Tape | | | Reel | | |
|------|------|------|-----------|------|------|
| Dim. | mm | | Dim. | mm | |
| | Min. | Max. | | Min. | Max. |
| A0 | 6.8 | 7 | A | | 330 |
| B0 | 10.4 | 10.6 | B | 1.5 | |
| B1 | | 12.1 | C | 12.8 | 13.2 |
| D | 1.5 | 1.6 | D | 20.2 | |
| D1 | 1.5 | | G | 16.4 | 18.4 |
| E | 1.65 | 1.85 | N | 50 | |
| F | 7.4 | 7.6 | T | | 22.4 |
| K0 | 2.55 | 2.75 | | | |
| P0 | 3.9 | 4.1 | Base qty. | | 2500 |
| P1 | 7.9 | 8.1 | Bulk qty. | | 2500 |
| P2 | 1.9 | 2.1 | | | |
| R | 40 | | | | |
| T | 0.25 | 0.35 | | | |
| W | 15.7 | 16.3 | | | |

Table 14. D²PAK (TO-263) tape and reel mechanical data

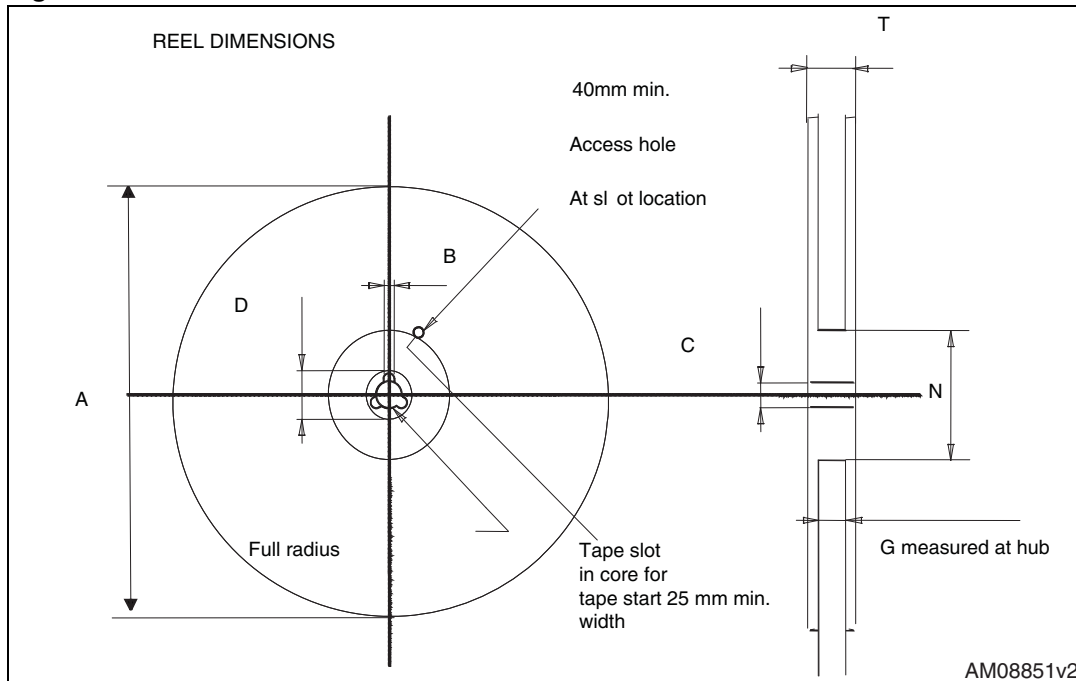
| Tape | | | Reel | | |
|------|------|------|------|----------|------|
| Dim. | mm | | Dim. | mm | |
| | Min. | Max. | | Min. | Max. |
| A0 | 10.5 | 10.7 | A | | 330 |
| B0 | 15.7 | 15.9 | B | 1.5 | |
| D | 1.5 | 1.6 | C | 12.8 | 13.2 |
| D1 | 1.59 | 1.61 | D | 20.2 | |
| E | 1.65 | 1.85 | G | 24.4 | 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 14. Tape



AM08852v2

Figure 15. Reel



AM08851v2

6 Revision history

Table 15. Document revision history

| Date | Revision | Changes |
|-------------|----------|----------------|
| 23-Feb-2012 | 1 | First release. |

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