



STB57N65M5, STF57N65M5, STI57N65M5, STP57N65M5

N-channel 650 V, 0.056 Ω typ., 42 A MDmesh™ V Power MOSFET in I²PAK, TO-220, TO-220FP and D²PAK packages

Datasheet — production data

Features

| Order codes | V _{DSS} @ T _{Jmax} | R _{DS(on)} max | I _D |
|--|--------------------------------------|-------------------------|----------------|
| STB57N65M5 STF57N65M5 STI57N65M5 STP57N65M5 | 710 V | < 0.063 Ω | 42 A |

- Worldwide best R_{DS(on)}*area amongst the silicon based devices
- Higher V_{DSS} rating, high dv/dt capability
- Excellent switching performance
- Easy to drive, 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.

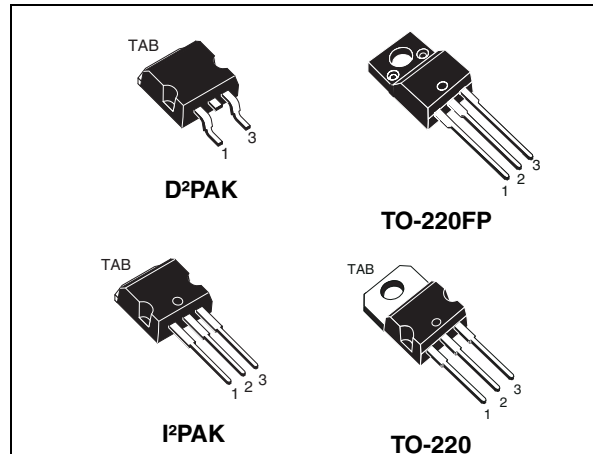


Figure 1. Internal schematic diagram

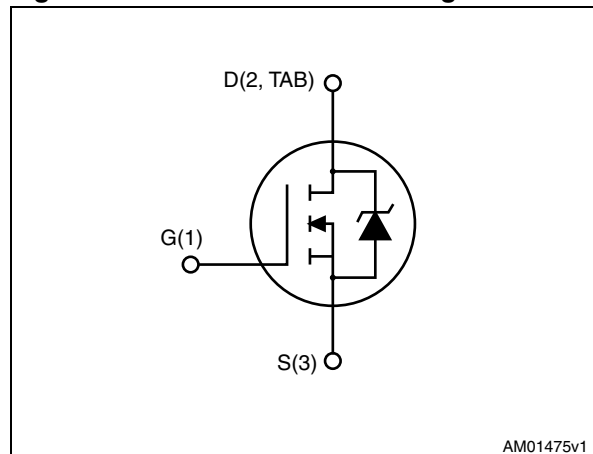


Table 1. Device summary

| Order codes | Marking | Packages | Packaging |
|--|---------|--|---------------------------------------|
| STB57N65M5 STF57N65M5 STI57N65M5 STP57N65M5 | 57N65M5 | D ² PAK TO-220FP I ² PAK TO-220 | Tape and reel Tube Tube Tube |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|--------------------------------|--|---|---------------------|------|
| | | TO-220, D ² PAK, I ² PAK | TO-220FP | |
| V _{GS} | Gate- source voltage | ± 25 | | V |
| I _D | Drain current (continuous) at T _C = 25 °C | 42 | 42 ⁽¹⁾ | A |
| I _D | Drain current (continuous) at T _C = 100 °C | 26.5 | 26.5 ⁽¹⁾ | A |
| I _{DM} ⁽²⁾ | Drain current (pulsed) | 168 | 168 ⁽¹⁾ | A |
| P _{TOT} | Total dissipation at T _C = 25 °C | 250 | 40 | W |
| I _{AR} | Max current during repetitive or single pulse avalanche (pulse width limited by T _{JMAX}) | 11 | | A |
| E _{AS} | Single pulse avalanche energy (starting T _J = 25°C, I _D = I _{AR} , V _{DD} = 50V) | 960 | | 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 |

1. Limited by maximum junction temperature.

2. Pulse width limited by safe operating area.

3. I_{SD} ≤ 42 A, di/dt ≤ 400 A/μs, V_{Peak} < V_{(BR)DSS}, V_{DD} = 400 V

Table 3. Thermal data

| Symbol | Parameter | Value | | | | Unit |
|-----------------------|--|--------------------|--------------------|--------|----------|------|
| | | D ² PAK | I ² PAK | TO-220 | TO-220FP | |
| R _{thj-case} | Thermal resistance junction-case max | 0.50 | | | 3.1 | °C/W |
| R _{thj-amb} | Thermal resistance junction-ambient max | | 62.5 | | 62.5 | °C/W |
| R _{thj-pcb} | Thermal resistance junction-pcb max ⁽¹⁾ | 30 | | | | °C/W |

1. When mounted on 1inch² FR-4 board, 2 oz Cu.

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 ($V_{GS} = 0$) | $V_{DS} = 650\text{ V}$ $V_{DS} = 650\text{ V}$, $T_C = 125\text{ °C}$ | | | 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 | $V_{GS} = 10\text{ V}$, $I_D = 21\text{ A}$ | | 0.056 | 0.063 | Ω |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------|--|---|------|------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$ | - | 4200 | - | pF |
| C_{oss} | Output capacitance | | | 115 | | pF |
| C_{rss} | Reverse transfer capacitance | | | 9 | | pF |
| $C_{o(er)}^{(1)}$ | Equivalent output capacitance energy related | $V_{GS} = 0$, $V_{DS} = 0$ to 80% $V_{(BR)DSS}$ | - | 93 | - | pF |
| $C_{o(tr)}^{(2)}$ | Equivalent output capacitance time related | $V_{GS} = 0$, $V_{DS} = 0$ to 80% $V_{(BR)DSS}$ | - | 303 | - | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}$ open drain | - | 1.3 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 520\text{ V}$, $I_D = 21\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 18) | - | 98 | - | nC |
| Q_{gs} | Gate-source charge | | | 23 | | nC |
| Q_{gd} | Gate-drain charge | | | 40 | | nC |

1. $C_{o(er)}$ is a constant capacitance value that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}

2. $C_{o(tr)}$ is a constant capacitance value that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}

Table 6. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|--------------------|---|------|------|------|------|
| $t_{d(V)}$ | Voltage delay time | $V_{DD} = 400\text{ V}$, $I_D = 28\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 19) | | 73 | | ns |
| $t_{r(V)}$ | Voltage rise time | | - | 15 | - | ns |
| $t_{f(i)}$ | Current fall time | | 12 | | | ns |
| $t_{c(off)}$ | Crossing time | | 19 | | | ns |

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 42 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | | | 168 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 42\text{ A}$, $V_{GS} = 0$ | - | | 1.5 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 42\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ (see Figure 19) | - | 418 | | ns |
| Q_{rr} | Reverse recovery charge | | | 8 | | μC |
| I_{RRM} | Reverse recovery current | | | 40 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 42\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 19) | - | 528 | | ns |
| Q_{rr} | Reverse recovery charge | | | 12 | | μC |
| I_{RRM} | Reverse recovery current | | | 44 | | 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 D²PAK, I²PAK and TO-220

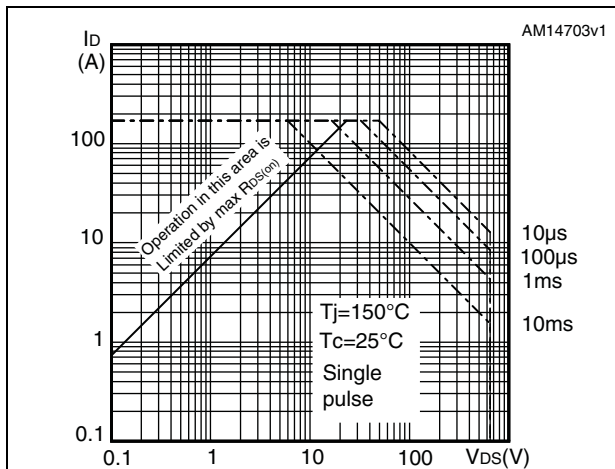


Figure 3. Thermal impedance for D²PAK, I²PAK and TO-220

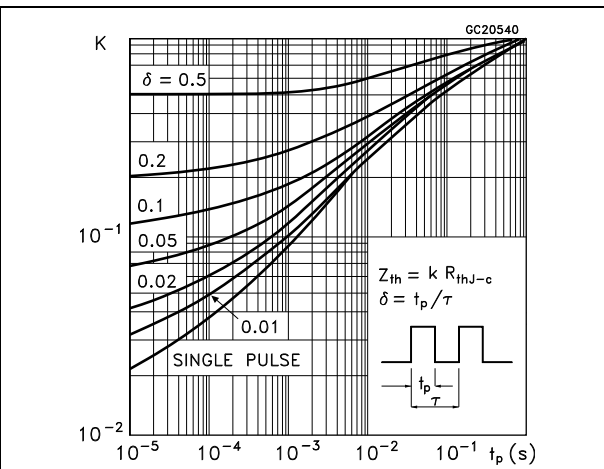


Figure 4. Safe operating area for TO-220FP

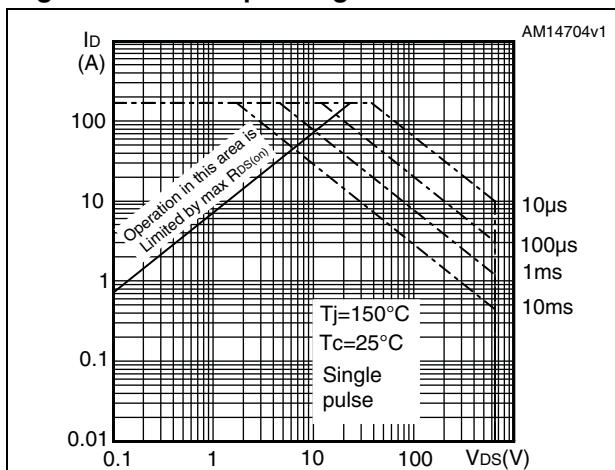


Figure 5. Thermal impedance for TO-220FP

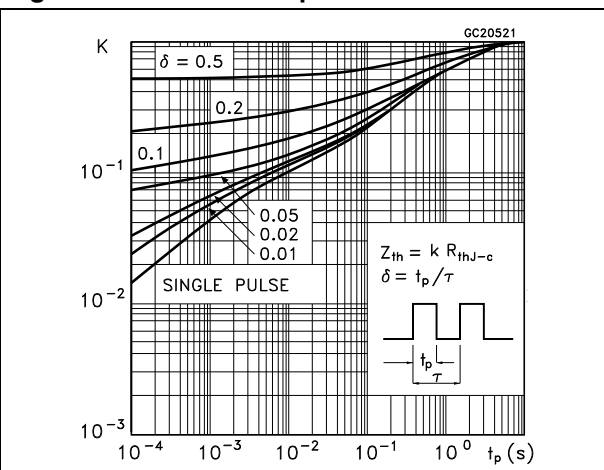


Figure 6. Output characteristics

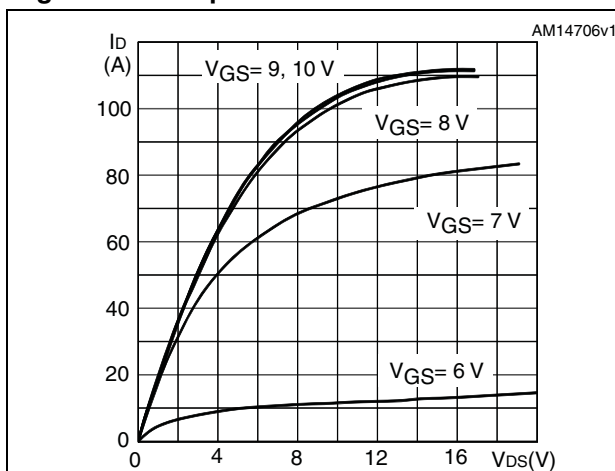


Figure 7. Transfer characteristics

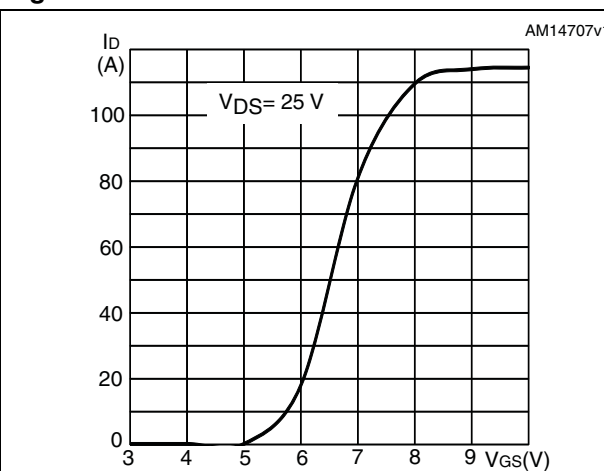


Figure 8. Gate charge vs gate-source voltage Figure 9. Static drain-source on-resistance

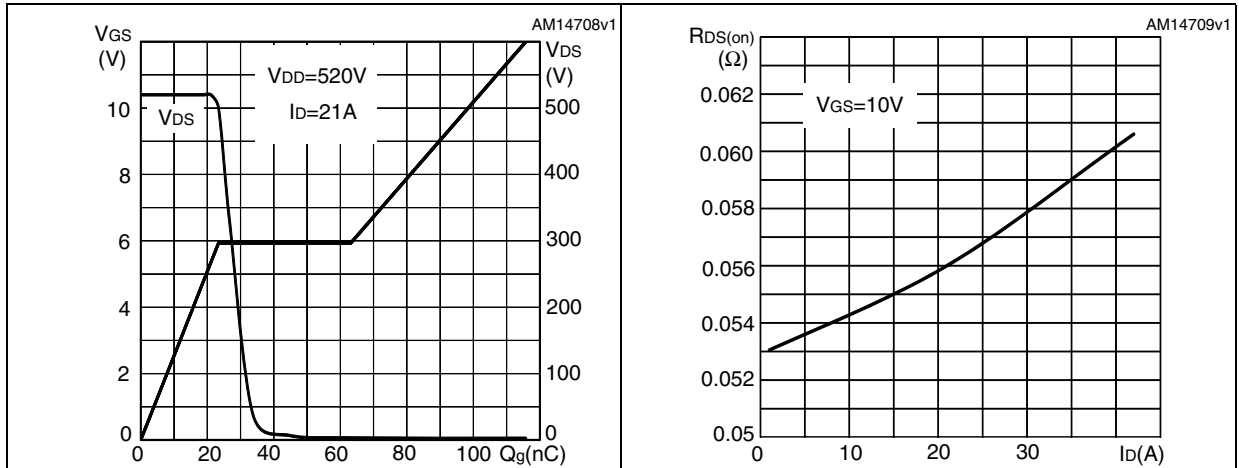


Figure 10. Capacitance variations Figure 11. Output capacitance stored energy

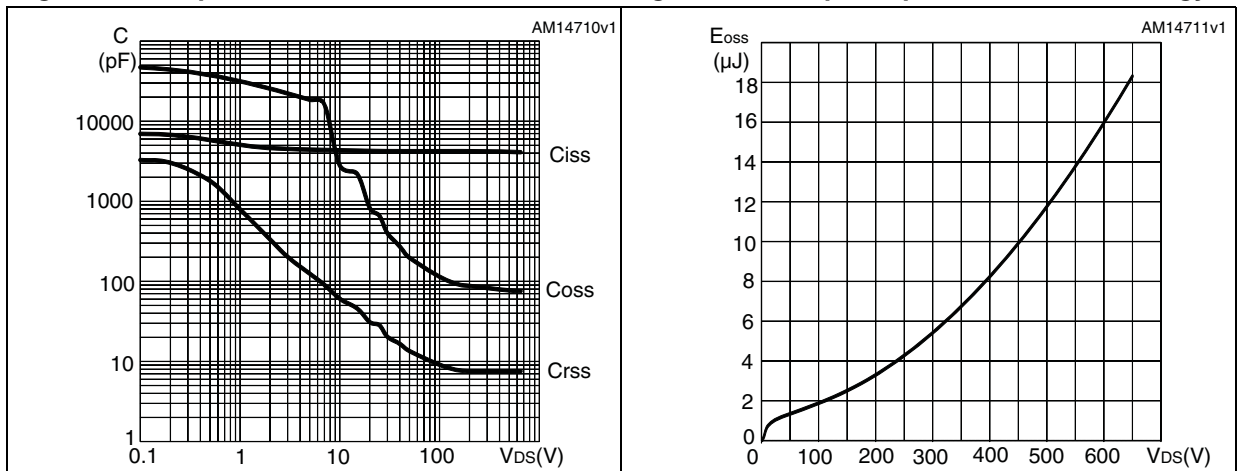


Figure 12. Normalized gate threshold voltage vs temperature Figure 13. Normalized on-resistance vs temperature

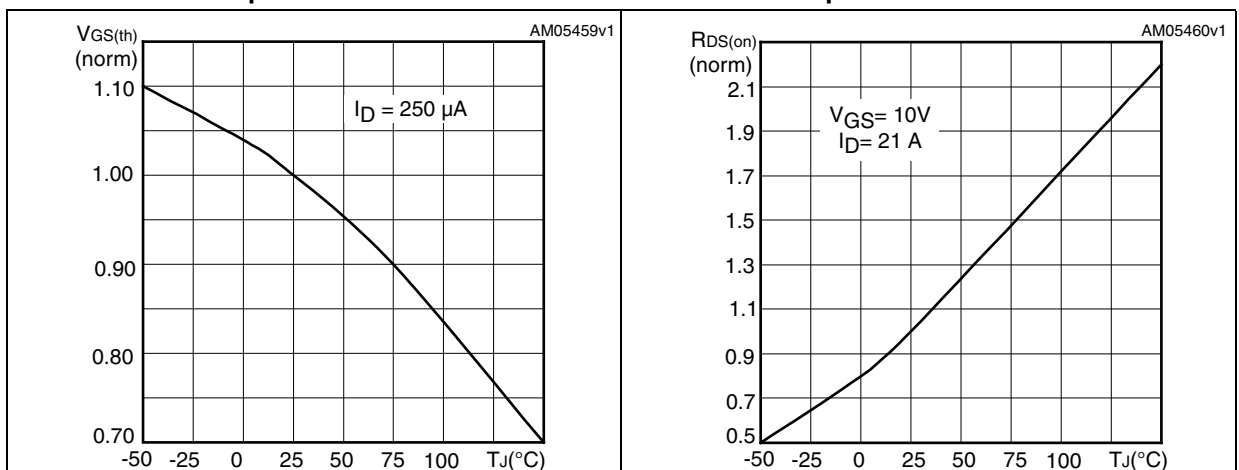


Figure 14. Source-drain diode forward characteristics

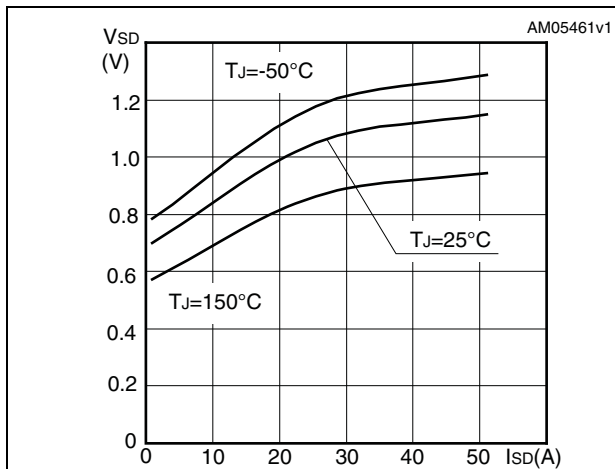


Figure 15. Normalized B_{VDSS} vs temperature

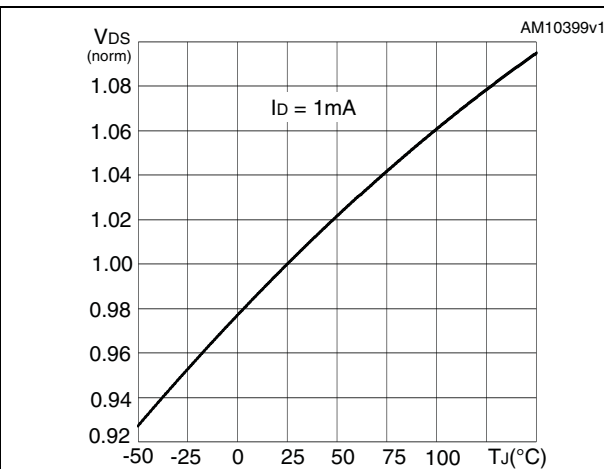
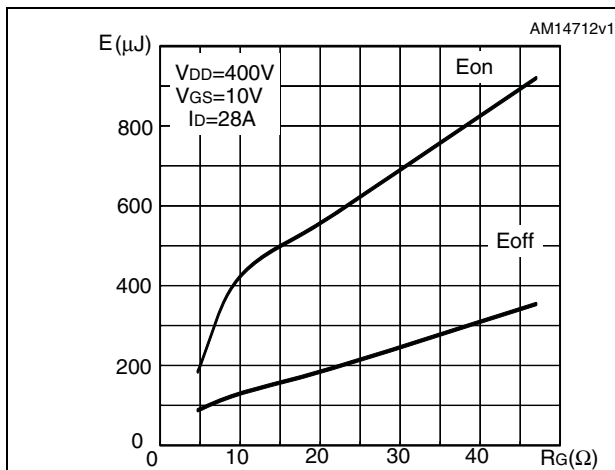


Figure 16. Switching losses vs gate resistance (1)



1. Eon including reverse recovery of a SiC diode

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 23. D²PAK (TO-263) drawing

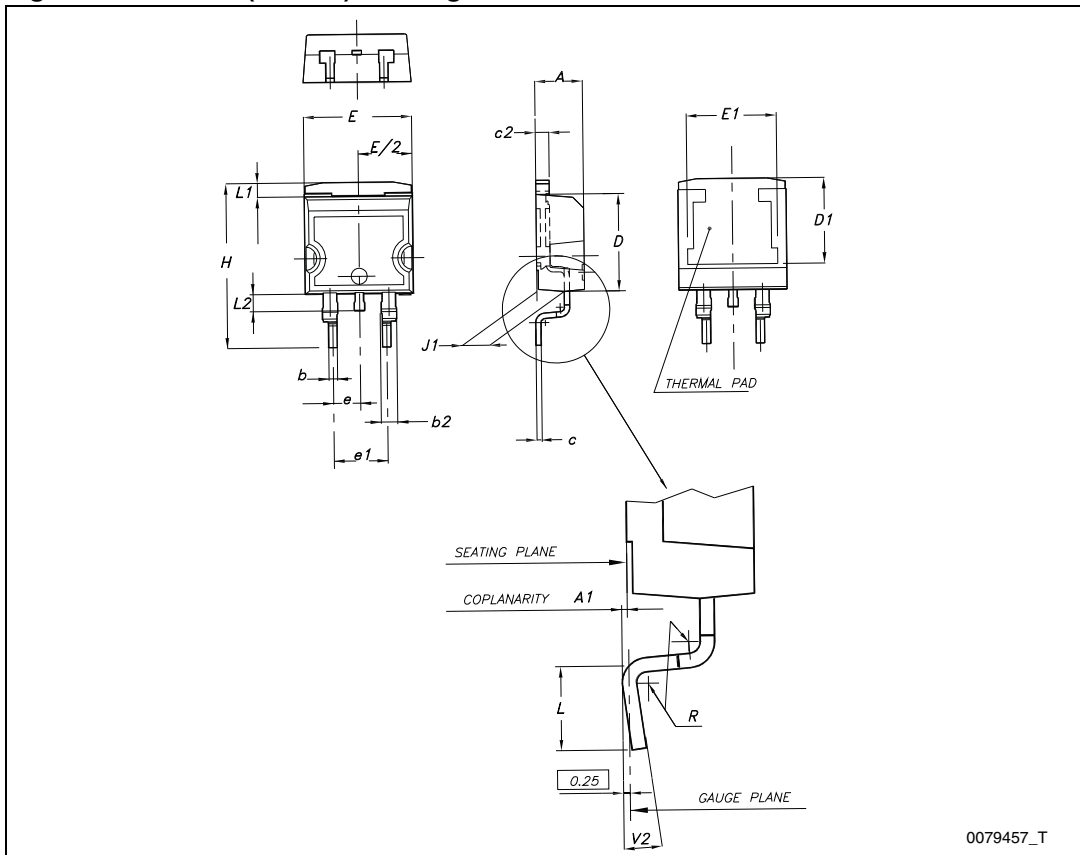
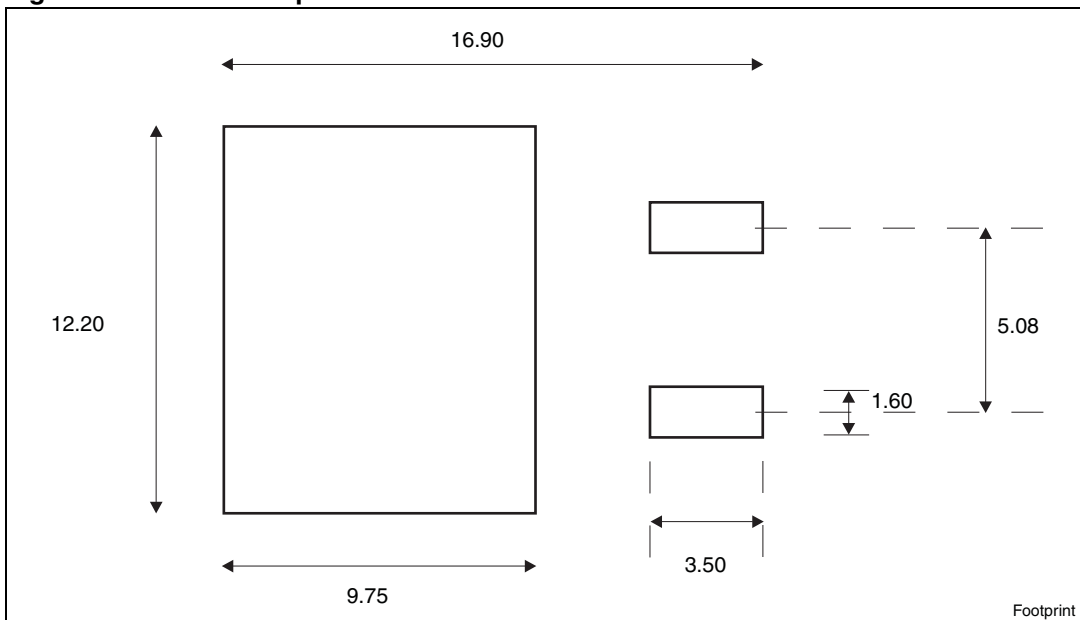


Figure 24. D²PAK footprint^(a)

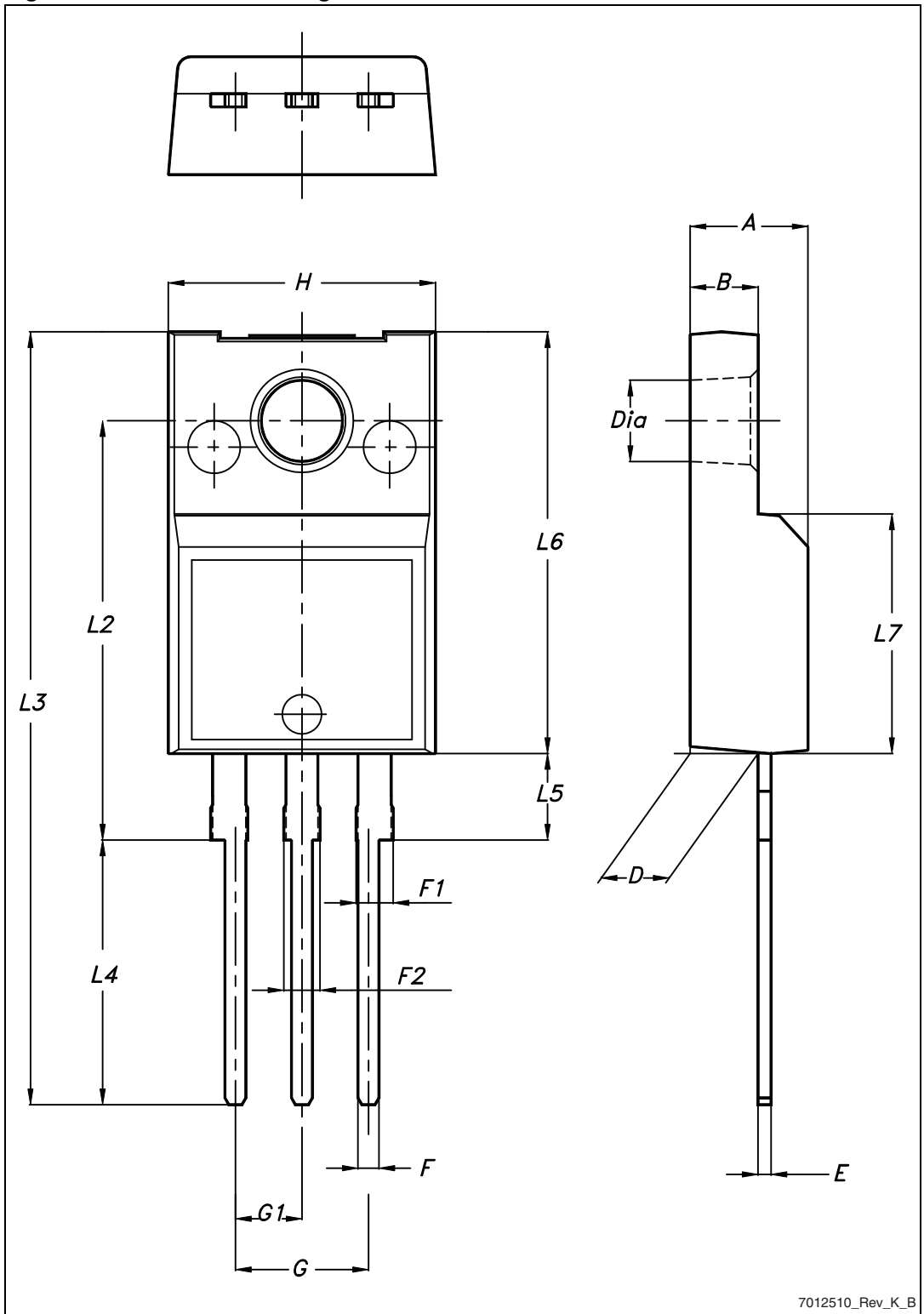


a. All dimension are in millimeters

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 25. TO-220FP drawing



7012510_Rev_K_B

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 |

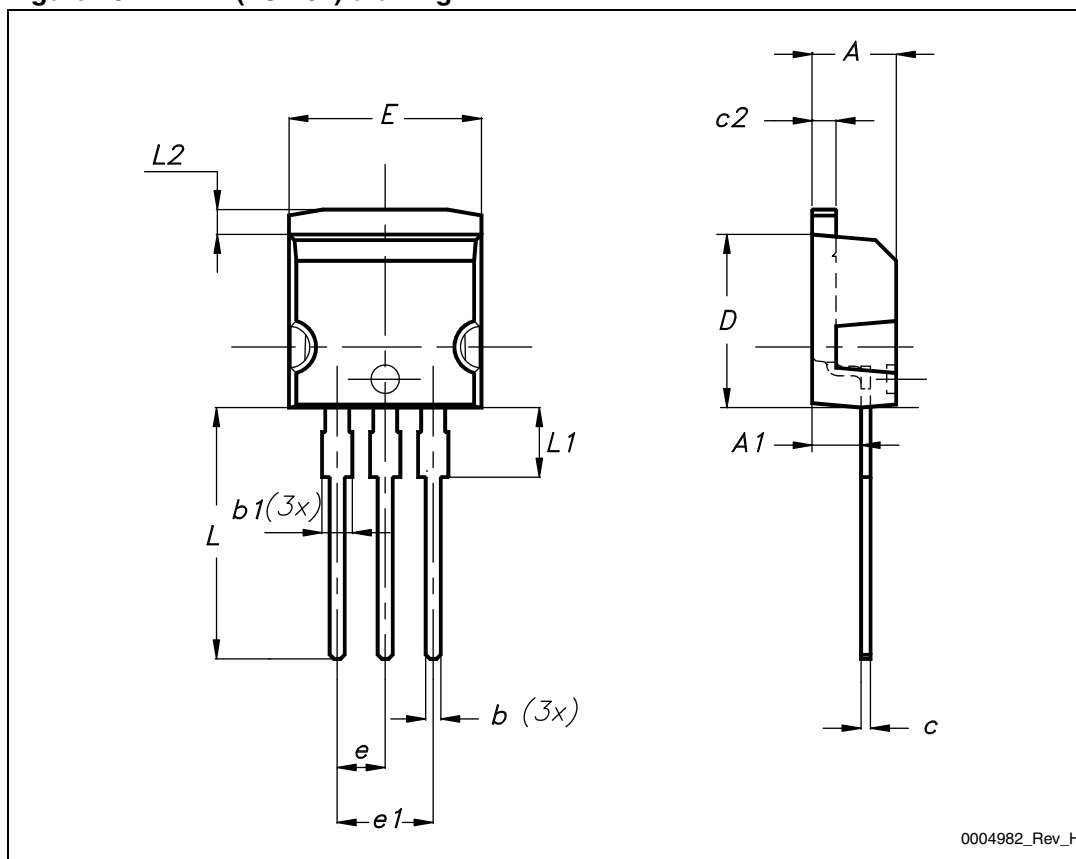
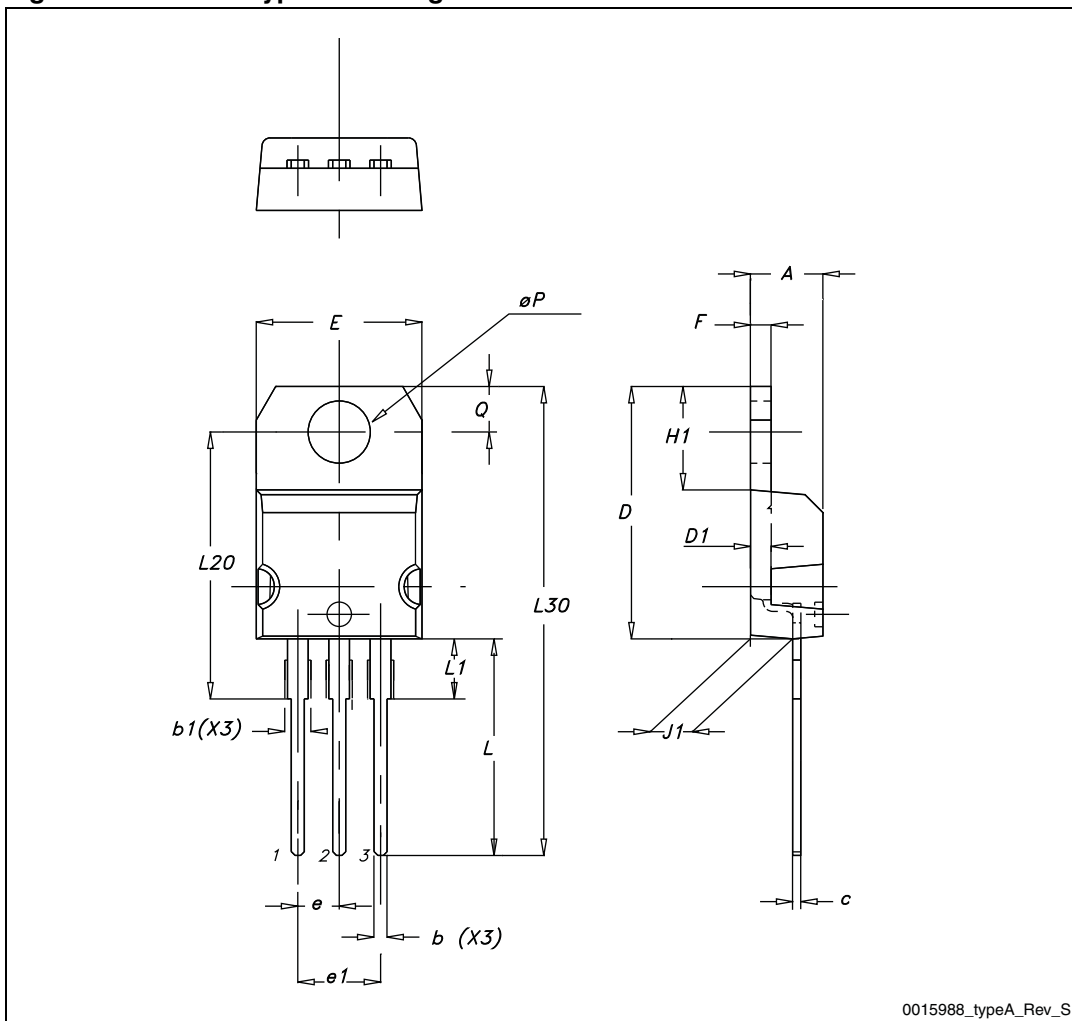
Figure 26. I²PAK (TO-262) drawing

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



0015988_typeA_Rev_S

5 Packaging mechanical data

Table 12. 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 28. Tape

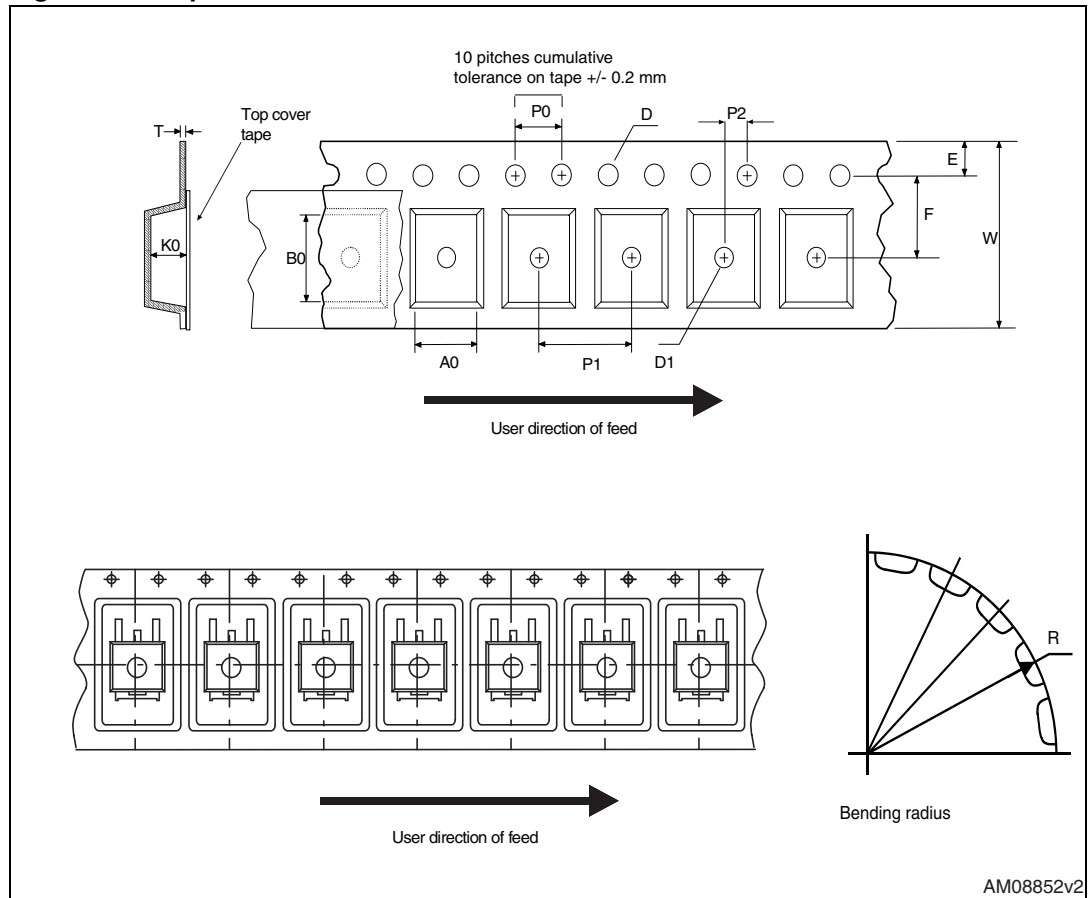
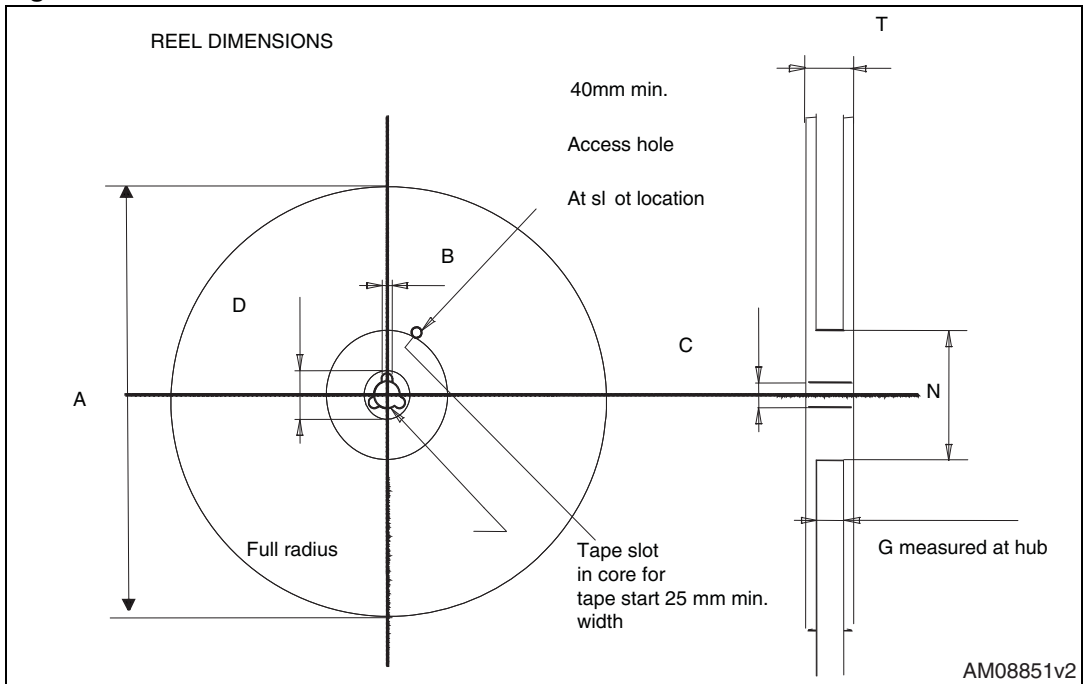


Figure 29. Reel



6 Revision history

Table 13. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 06-Apr-2012 | 1 | First release. |
| 04-Jul-2012 | 2 | Document status promoted from preliminary to production data. Added Section 2.1: Electrical characteristics (curves) . |
| 21-Aug-2012 | 3 | Updated symbols and parameters in Table 6: Switching times . Minor text change on the cover page. |
| 04-Dec-2012 | 4 | The part number STW57N65M5 has been moved to a separate datasheet. |

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