# STB120NF10T4, STP120NF10, STW120NF10

## N-channel 100 V, 9.0 mΩ typ., 110 A STripFET™ II Power MOSFETs in D²PAK, TO-220 and TO-247 packages

Datasheet - production data

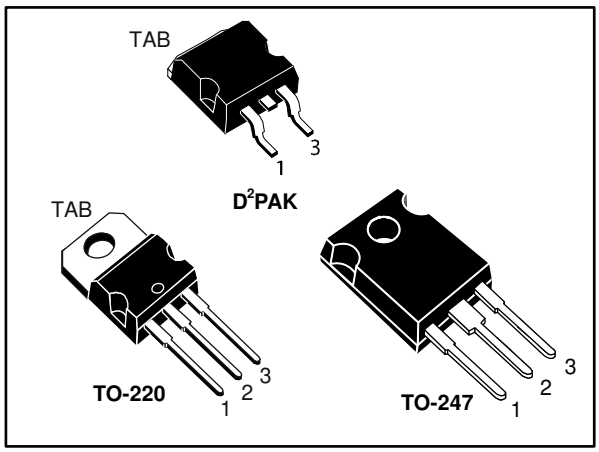
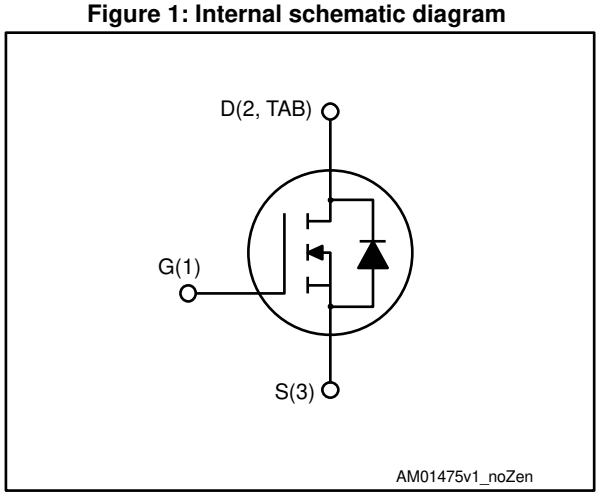



**Figure 1: Internal schematic diagram**




## Features

| Order code | $V_{DS}$ | $R_{DS(on)}$ max. | $I_D$ |
|---|---|---|---|
| STB120NF10T4 | 100 V | 10.5 mΩ | 110 A |
| STP120NF10 | | | |
| STW120NF10 | | | |

- Exceptional dv/dt capability
- 100% avalanche tested
- Low gate charge

## Applications

- Switching applications

## Description

These Power MOSFETs have been developed using STMicroelectronics' unique STripFET process, which is specifically designed to minimize input capacitance and gate charge. This renders the devices suitable for use as primary switch in advanced high-efficiency isolated DC-DC converters for telecom and computer applications, and applications with low gate charge driving requirements.

**Table 1: Device summary**

| Order code | Marking | Package | Packing |
|---|---|---|---|
| STB120NF10T4 | B120NF10 | D²PAK | Tape and reel |
| STP120NF10 | P120NF10 | TO-220 | Tube |
| STW120NF10 | 120NF10 | TO-247 | |



This is information on a product in full production. www.st.com

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# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-source voltage | 100 | V |
| $V_{GS}$ | Gate-source voltage | ±20 | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 110 | A |
| | Drain current (continuous) at $T_C$ = 100 °C | 77 | A |
| $I_{DM}$(1) | Drain current (pulsed) | 440 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 312 | W |
| dv/dt(2) | Peak diode recovery voltage slope | 10 | V/ns |
| $E_{AS}$(3) | Single pulse avalanche energy | 550 | mJ |
| $T_j$ | Operating junction temperature range | -55 to 175 | °C |
| $T_{stg}$ | Storage temperature range | | |

**Notes:**

(1)Pulse width is limited by safe operating area.

(2)$I_{SD}$ ≤ 110 A, di/dt ≤ 300 A/µs, $V_{DD}$ = 80% $V_{(BR)DSS}$

(3)Starting $T_j$ =25 °C, $I_D$ = 60 A, $V_{DD}$ = 50 V

**Table 3: Thermal data**

| Symbol | Parameter | Value | | | Unit |
|---|---|---|---|---|---|
| | | TO-220 | TO-247 | D²PAK | |
| $R_{thj\text{-}case}$ | Thermal resistance junction-case | 0.48 | | | °C/W |
| $R_{thj\text{-}amb}$ | Thermal resistance junction-ambient | 62.5 | | | °C/W |
| $R_{thj\text{-}pcb}$ | Thermal resistance junction-pcb(1) | | | 35 | °C/W |

**Notes:**

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

# 2 Electrical characteristics

($T_{CASE}$= 25 °C unless otherwise specified)

**Table 4: On/off states**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS}$ = 0 V, $I_D$ = 250 µA | 100 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{GS}$ = 0 V, $V_{DS}$ = 100 V | | | 1 | µA |
| | | $V_{GS}$ = 0 V, $V_{DS}$= 100 V, $T_c$ = 125 °C(1) | | | 10 | µA |
| $I_{GSS}$ | Gate-source leakage current | $V_{DS}$ = 0 V, $V_{GS}$ = ±20 V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2 | | 4 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 60 A | | 9.0 | 10.5 | mΩ |

**Notes:**

(1)Defined by design, not subject to production test.

**Table 5: Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 25 V, f = 1 MHz, $V_{GS}$= 0 V | - | 5200 | | pF |
| $C_{oss}$ | Output capacitance | | | 785 | | pF |
| $C_{rss}$ | Reverse transfer capacitance | | | 325 | | pF |
| $Q_g$ | Total gate charge | $V_{DD}$ = 80 V, $I_D$= 120 A, $V_{GS}$ = 0 to 10 V (see *Figure 14: "Test circuit for gate charge behavior"*) | - | 172 | 233(1) | nC |
| $Q_{gs}$ | Gate-source charge | | | 32 | | nC |
| $Q_{gd}$ | Gate-drain charge | | | 64 | | nC |

**Notes:**

(1)Defined by design, not subject to production test.

**Table 6: Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ = 50 V, $I_D$ = 60 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V (see *Figure 13: "Test circuit for resistive load switching times"* and *Figure 18: "Switching time waveform"*) | - | 25 | - | ns |
| $t_r$ | Rise time | | - | 90 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 132 | - | ns |
| $t_f$ | Fall time | | - | 68 | - | ns |

**Table 7: Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source drain current | | - | | 110 | A |
| $I_{SDM}$(1) | Source-drain current (pulsed) | | - | | 440 | A |
| $V_{SD}$(2) | Forward on voltage | $I_{SD}$ = 120 A, $V_{GS}$= 0 V | - | | 1.3 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 120 A, di/dt = 100 A/µs, $V_{DD}$ = 40 V, $T_j$ = 150 °C (see *Figure 15: "Test circuit for inductive load switching and diode recovery times"*) | - | 152 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 760 | | nC |
| $I_{RRM}$ | Reverse recovery current | | - | 10 | | A |

**Notes:**

(1)Pulse width is 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**

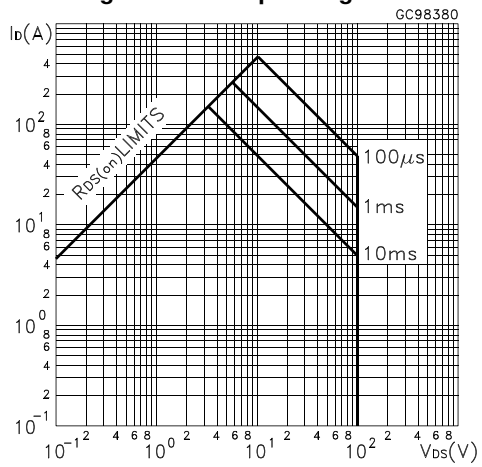



**Figure 3: Thermal impedance**

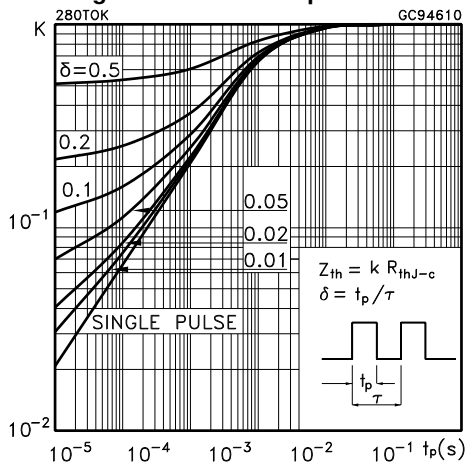



**Figure 4: Output characteristics**

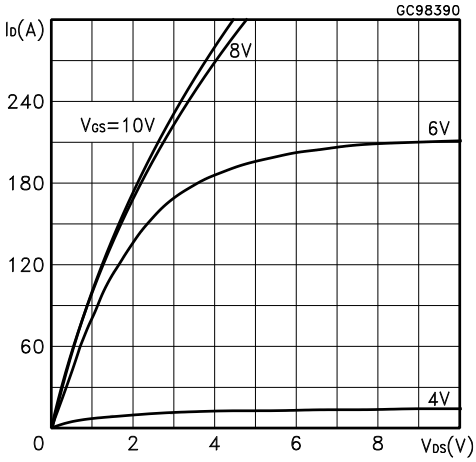



**Figure 5: Transfer characteristics**

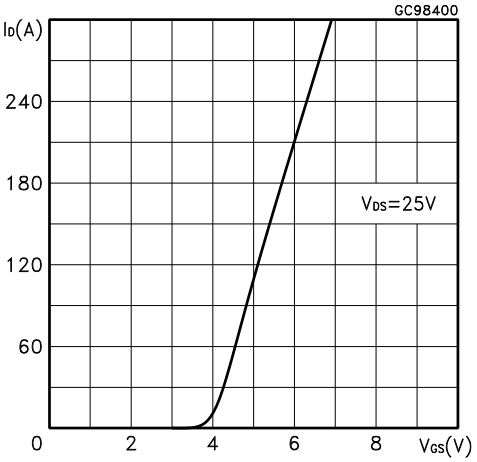



**Figure 6: Normalized $V_{(BR)DSS}$ vs temperature**

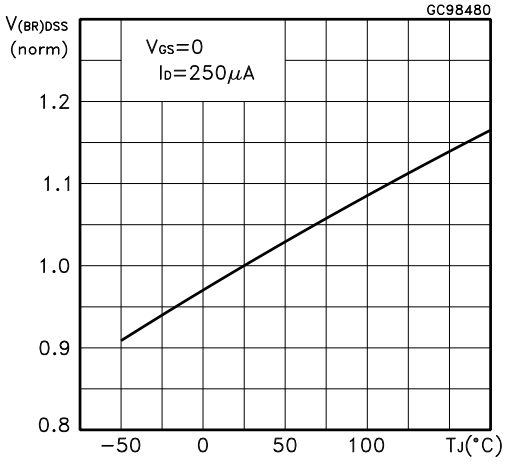



**Figure 7: Static drain-source on-resistance**

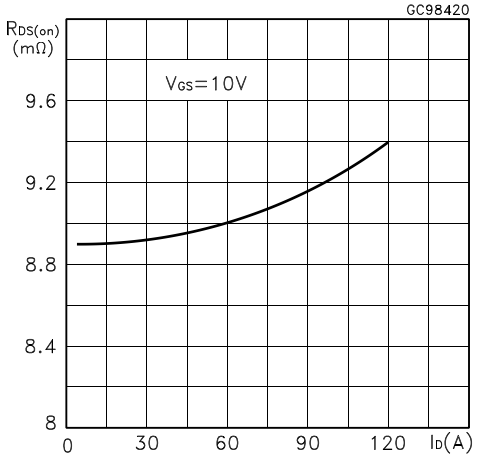


**Figure 8: Gate charge vs gate-source voltage**

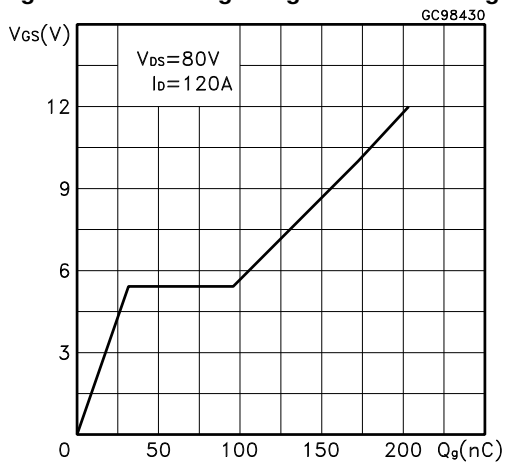



**Figure 9: Capacitance variations**

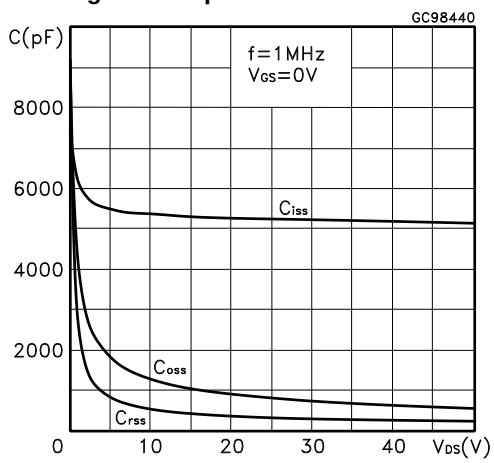



**Figure 10: Normalized gate threshold voltage vs temperature**

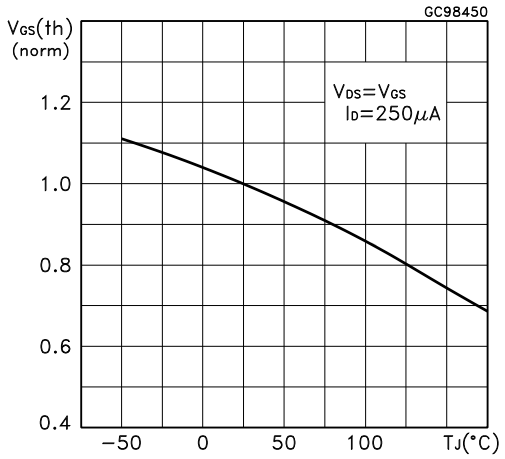



**Figure 11: Normalized on-resistance vs temperature**

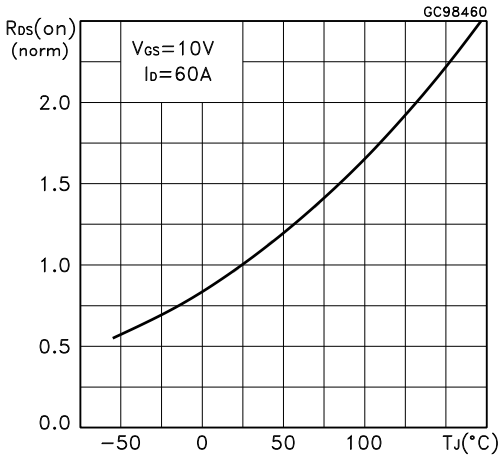
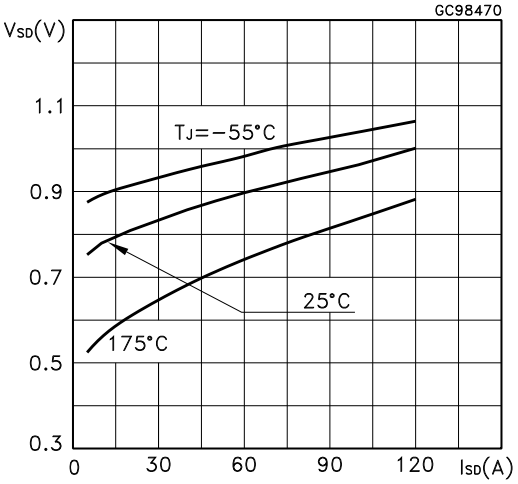



**Figure 12: Source-drain diode forward characteristics**



# 3 Test circuits

**Figure 13: Test circuit for resistive load switching times**

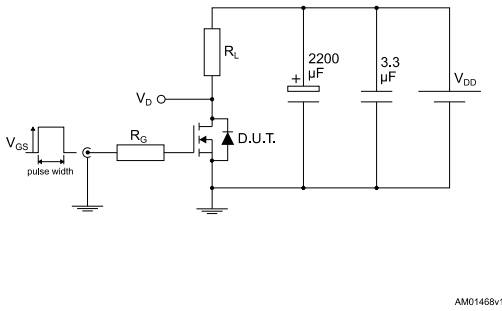



**Figure 14: Test circuit for gate charge behavior**

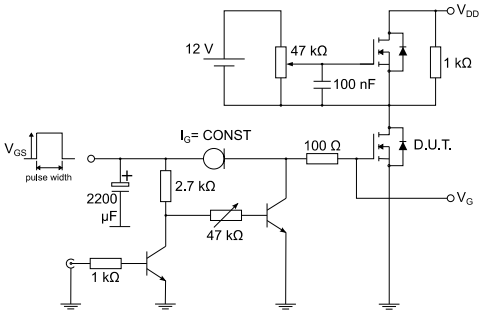



**Figure 15: Test circuit for inductive load switching and diode recovery times**

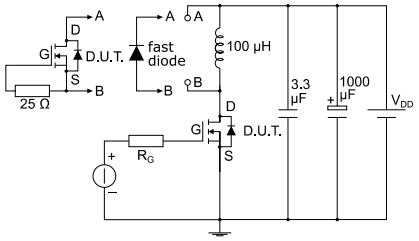



**Figure 16: Unclamped inductive load test circuit**

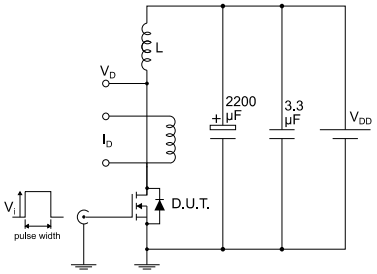



**Figure 17: Unclamped inductive waveform**

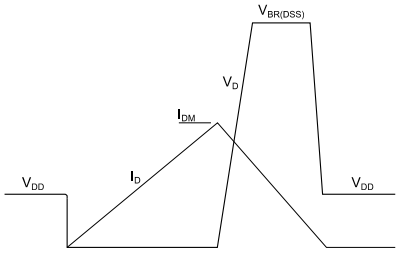
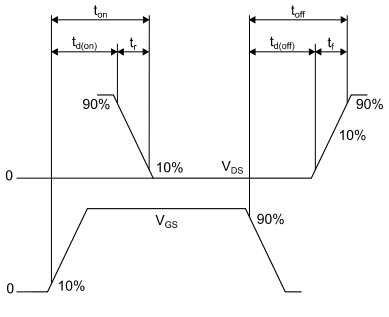



**Figure 18: Switching time waveform**



# 4 Package information

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.

## 4.1 D²PAK (TO-263) type A2 package information

**Figure 19: D²PAK (TO-263) type A2 package outline**

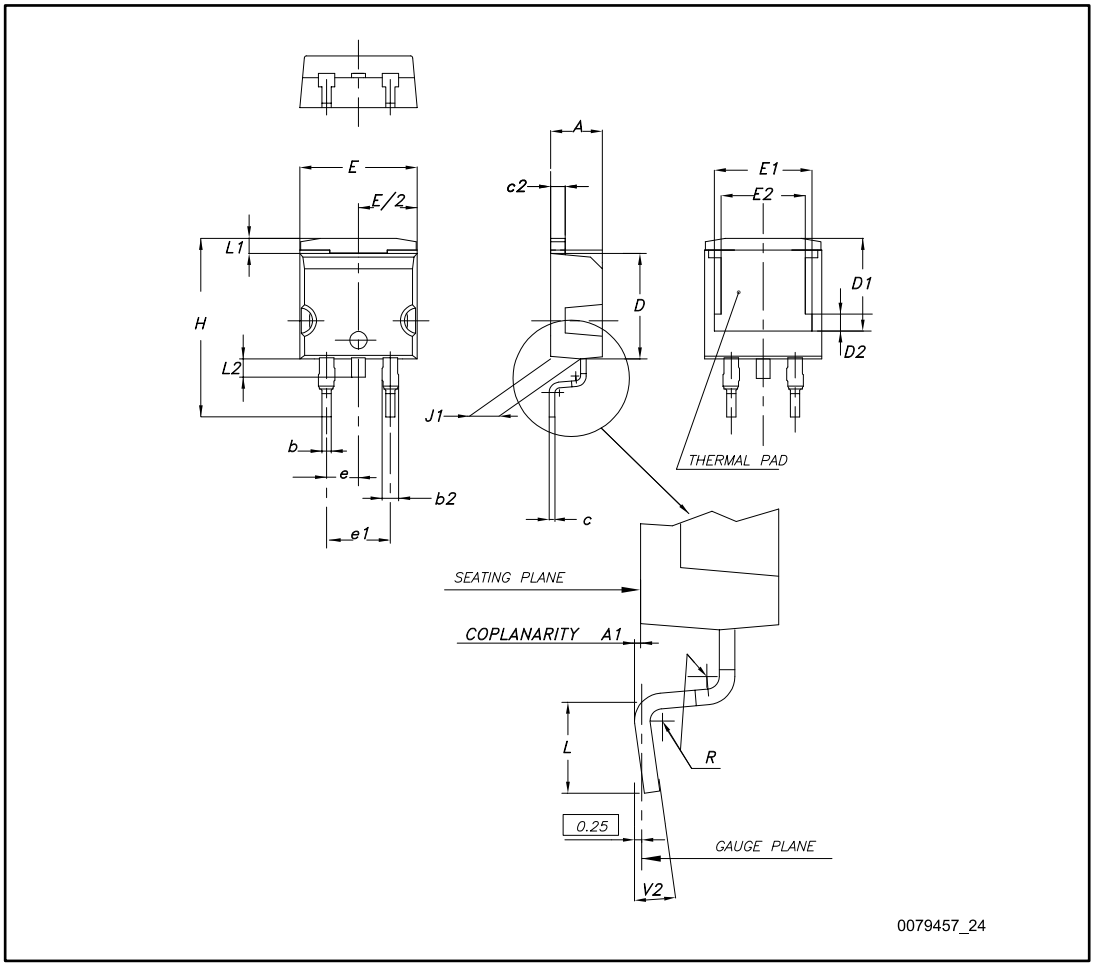
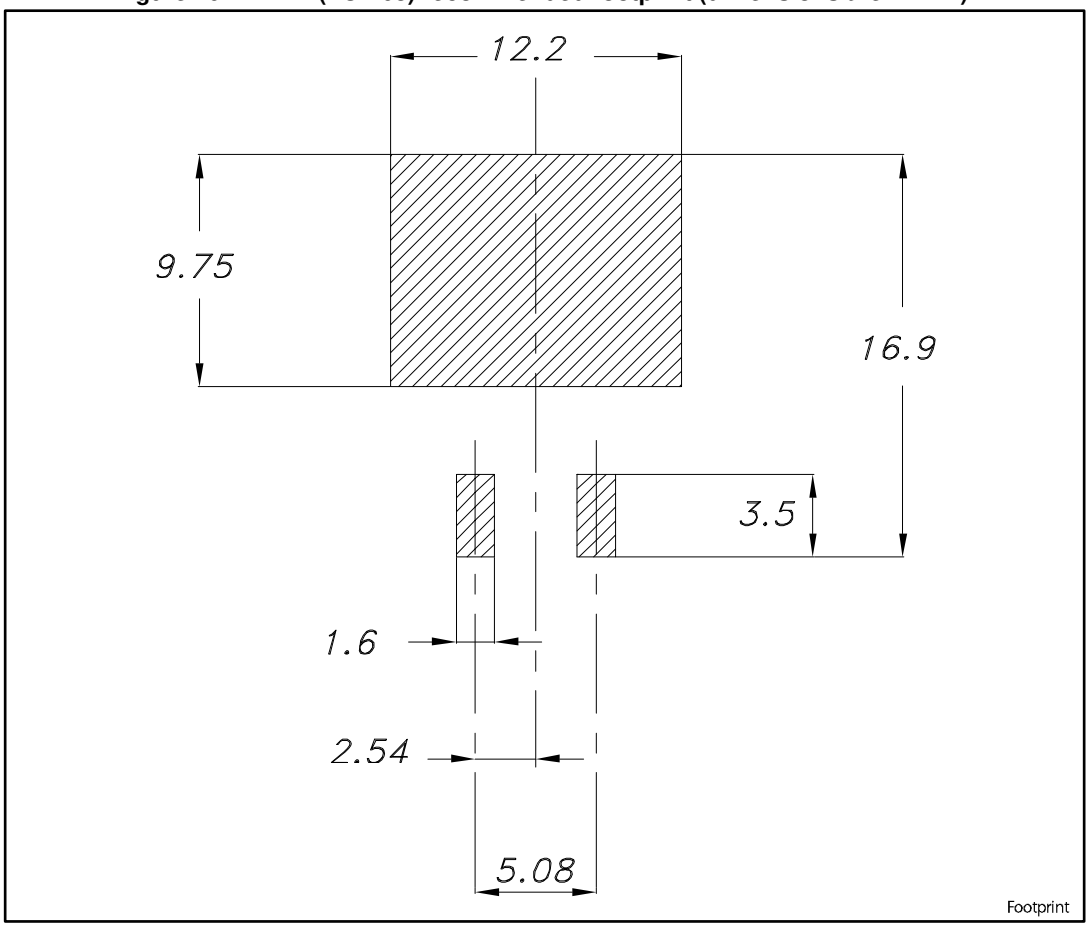


Table 8: D²PAK (TO-263) type A2 package mechanical data

| 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 | 7.75 | 8.00 |
| D2 | 1.10 | 1.30 | 1.50 |
| E | 10.00 | | 10.40 |
| E1 | 8.70 | 8.90 | 9.10 |
| E2 | 7.30 | 7.50 | 7.70 |
| e | | 2.54 | |
| e1 | 4.88 | | 5.28 |
| H | 15.00 | | 15.85 |
| J1 | 2.49 | | 2.69 |
| L | 2.29 | | 2.79 |
| L1 | 1.27 | | 1.40 |
| L2 | 1.30 | | 1.75 |
| R | | 0.40 | |
| V2 | 0° | | 8° |

Figure 20: D²PAK (TO-263) recommended footprint (dimensions are in mm)



## 4.2 D²PAK packing information

**Figure 21: D²PAK tape outline**

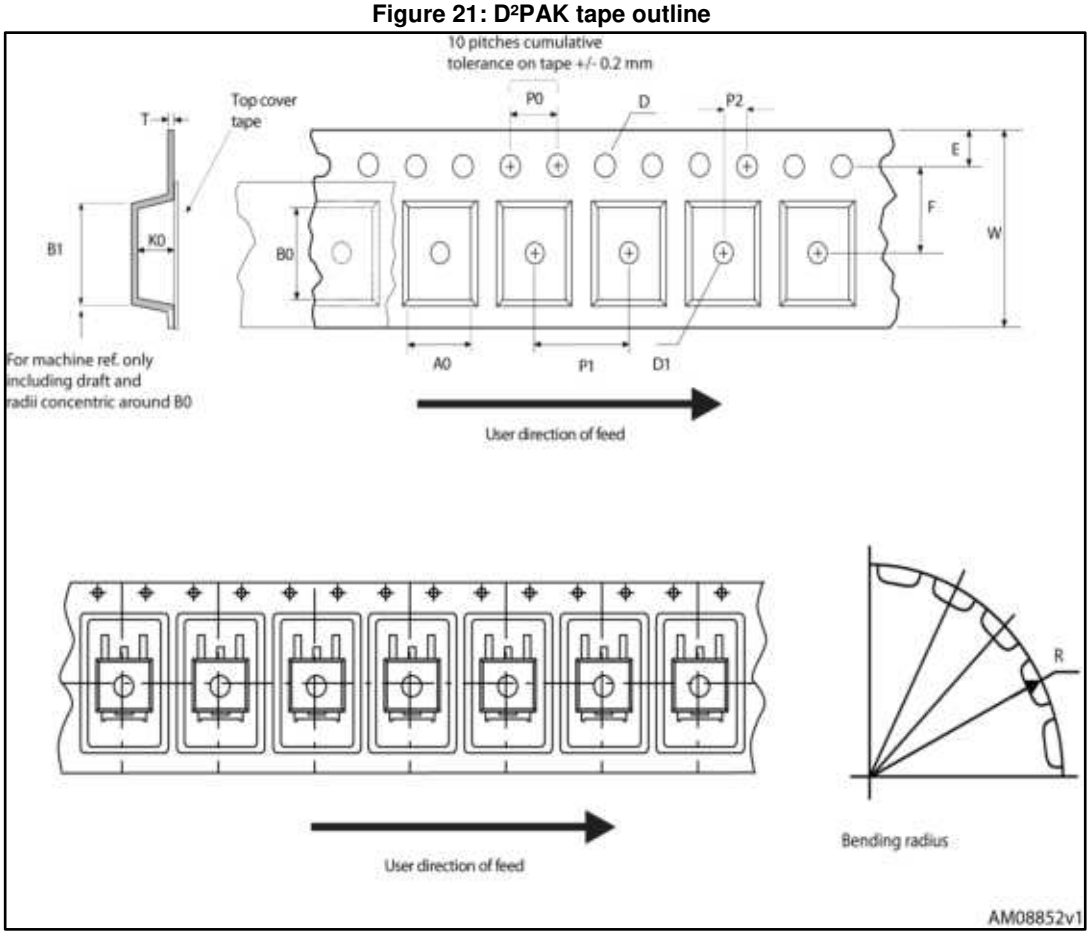


Figure 22: D²PAK reel outline

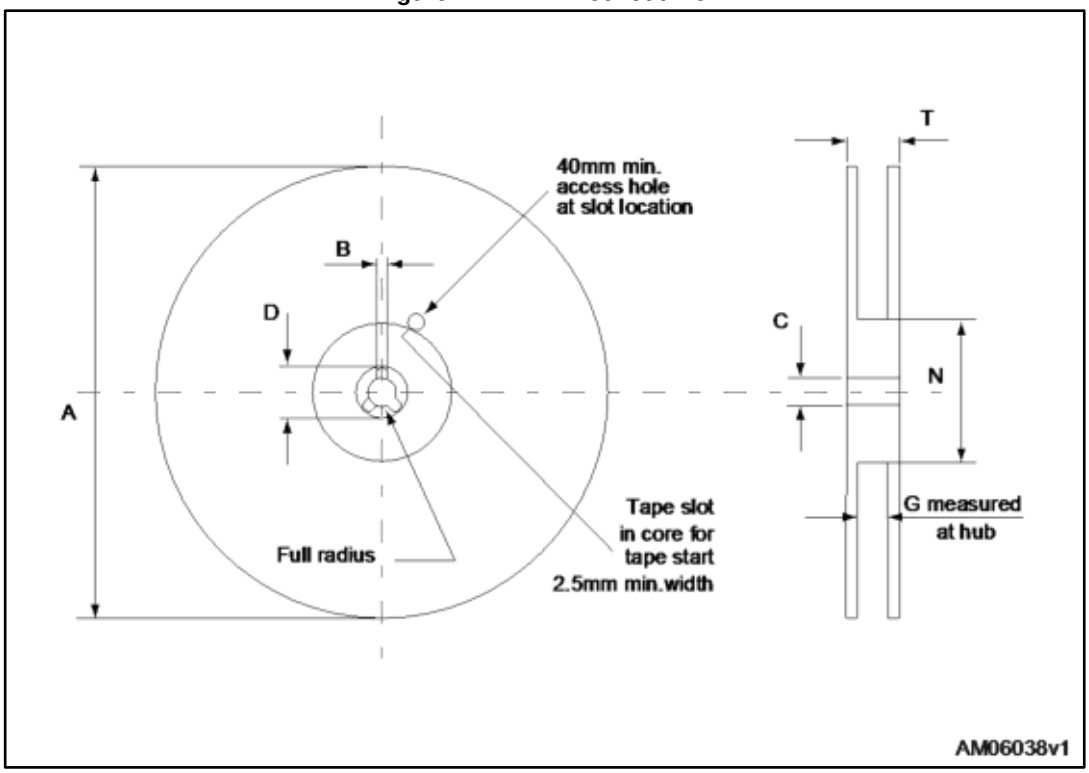



Table 9: D²PAK tape and reel mechanical data

| 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 quantity | | 1000 |
| P2 | 1.9 | 2.1 | Bulk quantity | | 1000 |
| R | 50 | | | | |
| T | 0.25 | 0.35 | | | |
| W | 23.7 | 24.3 | | | |

## 4.3 TO-220 package information

Figure 23: TO-220 type A package outline

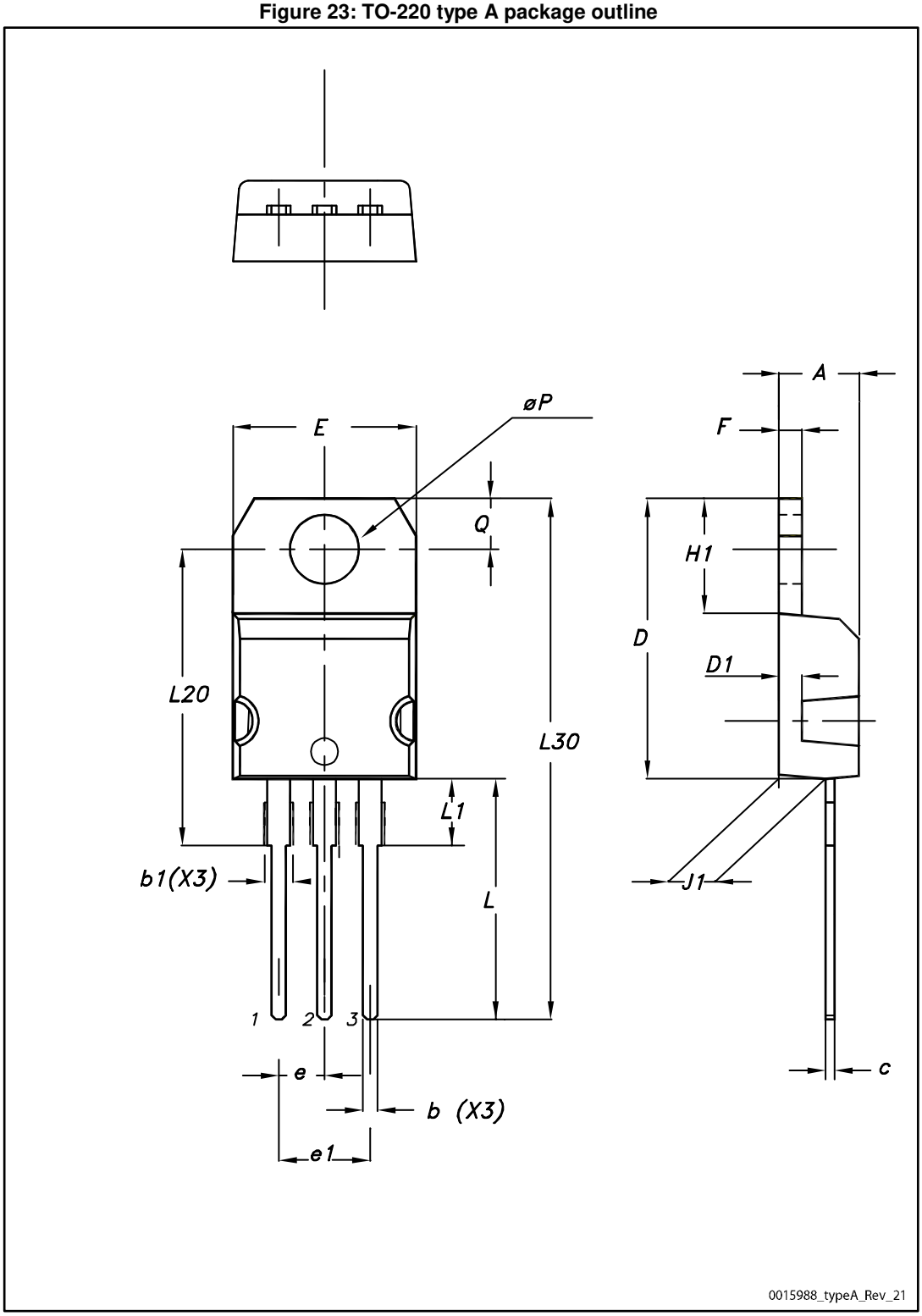


Table 10: TO-220 type A package mechanical data

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.55 |
| c | 0.48 | | 0.70 |
| D | 15.25 | | 15.75 |
| D1 | | 1.27 | |
| E | 10.00 | | 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 | 13.00 | | 14.00 |
| L1 | 3.50 | | 3.93 |
| L20 | | 16.40 | |
| L30 | | 28.90 | |
| øP | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |

## 4.4 TO-247 package information

Figure 24: TO-247 package outline

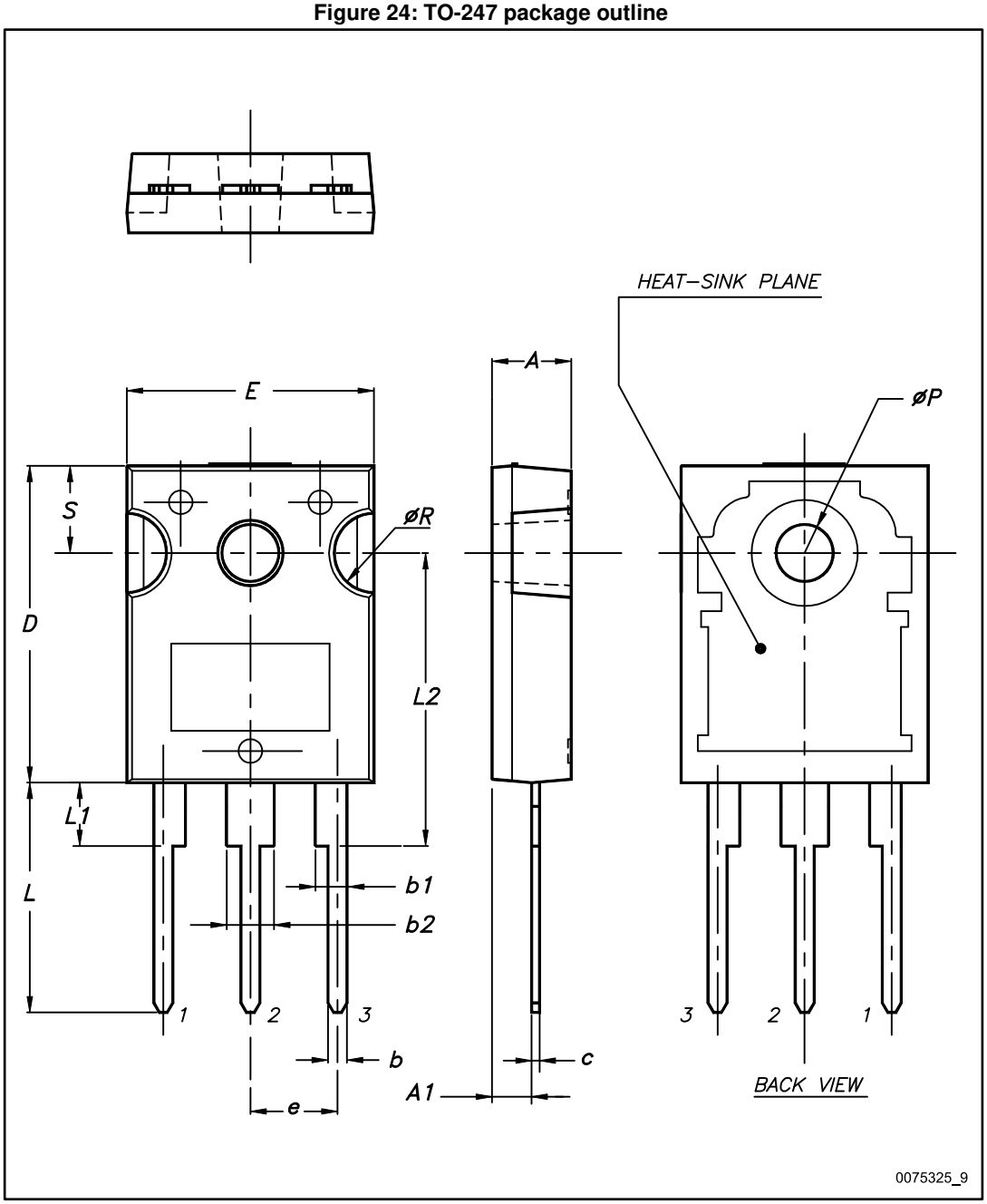


Table 11: TO-247 package mechanical data

| 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 |

# 5 Revision history

Table 12: Document revision history

| Date | Revision | Changes |
|---|---|---|
| 20-Mar-2006 | 2 | Preliminary datasheet |
| 31-Mar-2006 | 3 | Typing error |
| 19-Jun-2006 | 4 | New template, no content change |
| 28-Jun-2006 | 5 | New $I_D$ value on *Table 2* |
| 05-Oct-2006 | 6 | New value on *Table 7* |
| 11-May-2011 | 7 | Added new package and mechanical data: TO-220FP |
| 03-Nov-2017 | 8 | Part number STF120NF10 has been moved to a separate datasheet.<br>Updated features, description and device summary on cover page.<br>Updated *Table 2: "Absolute maximum ratings"*, *Table 3: "Thermal data"* and *Table 4: "On/off states"*.<br>Updated *Section 4: "Package information"*.<br>Minor text changes |

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