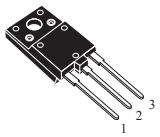
# STFW3N150, STH3N150-2
# STP3N150, STW3N150

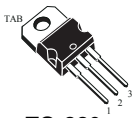
Datasheet

## N-channel 1500 V, 2.5 A, 6 Ω typ., PowerMESH Power MOSFETs in TO-3PF, H²PAK-2, TO-220 and TO247 packages

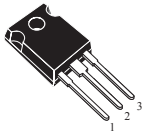


TO-3PF

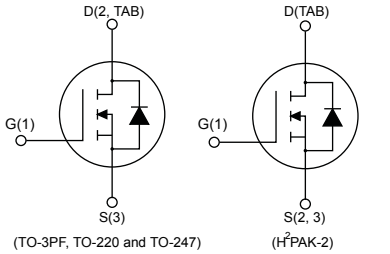
H²PAK-2



TO-220



TO-247




## Features

| Order codes | $V_{DS}$ | $R_{DS(on)}$ max. | $I_D$ | $P_{TOT}$ |
|---|---|---|---|---|
| STFW3N150 | 1500 V | 9 Ω | 2.5 A | 63 W |
| STH3N150-2 | | | | 140 W |
| STP3N150 | | | | |
| STW3N150 | | | | |

- 100% avalanche tested
- Intrinsic capacitances and Qg minimized
- High speed switching
- Fully isolated TO-3PF plastic package, creepage distance path is 5.4 mm (typ.)

## Applications

- Switching applications

## Description

These Power MOSFETs are designed using the STMicroelectronics consolidated strip-layout-based MESH OVERLAY process. The result is a product that matches or improves on the performance of comparable standard parts from other manufacturers.

| Product status link |
|---|
| STFW3N150 |
| STH3N150-2 |
| STP3N150 |
| STW3N150 |

# 1 Electrical ratings

Table 1.

| Symbol | Parameter | Value | | | | Unit |
|---|---|---|---|---|---|---|
| | | TO-3PF | $H^2PAK$-2 | TO-220 | TO-247 | |
| $V_{DS}$ | Drain-source voltage | 1500 | | | | V |
| $V_{GS}$ | Gate-source voltage | ±30 | | | | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 2.5(1) | 2.5 | | | A |
| | Drain current (continuous) at $T_C$ = 100 °C | 1.6(1) | 1.6 | | | |
| $I_{DM}$(2) | Drain current (pulsed) | 10 | | | | A |
| $P_{TOT}$ | Total power dissipation at $T_C$ = 25 °C | 63 | 140 | | | W |
| $V_{ISO}$ | Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; $T_C$ = 25 °C) | 3.5 | | | | kV |
| | Derating factor | 0.5 | 1.12 | | | W/°C |
| $T_{stg}$ | Storage temperature range | -55 to 150 | | | | °C |
| $T_J$ | Operating junction temperature range | | | | | |

1. *Limited by maximum junction temperature.*
2. *Pulse width limited by safe operating area.*

Table 2. **Thermal data**

| Symbol | Parameter | Value | | | | Unit |
|---|---|---|---|---|---|---|
| | | TO-3PF | $H^2PAK$-2 | TO-220 | TO-247 | |
| $R_{thj\text{-}case}$ | Thermal resistance junction-case | 2 | 0.89 | | | °C/W |
| $R_{thj\text{-}amb}$ | Thermal resistance junction-ambient | 50 | | 62.5 | 50 | °C/W |
| $R_{thj\text{-}pcb}$(1) | Thermal resistance junction-pcb | | 35 | | | °C/W |

1. *When mounted on 1 inch$^2$ FR-4 board, 2 oz Cu.*

Table 3.

| Symbol | Parameter | Max value | Unit |
|---|---|---|---|
| $I_{AR}$ | Avalanche current, repetitive or not-repetitive (pulse width limited by $T_J$ max) | 2.5 | A |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_J$ = 25 °C, $I_D$ = $I_{AR}$, $V_{DD}$ = 50 V) | 450 | mJ |

# 2 Electrical characteristics

($T_C$ = 25 °C unless otherwise specified)

**Table 4. Static**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS}$ = 0 V, $I_D$ = 1 mA | 1500 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{GS}$ = 0 V, $V_{DS}$ = 1500 V | | | 10 | µA |
| | | $V_{GS}$ = 0 V, $V_{DS}$ = 1500 V, $T_C$ = 125 °C (1) | | | 500 | |
| $I_{GSS}$ | Gate-body leakage current | $V_{DS}$ = 0 V, $V_{GS}$ = ±30 V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 1.3 A | | 6 | 9 | Ω |

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 | - | 939 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 102 | - | |
| $C_{rss}$ | Reverse transfer capacitance | | - | 13.2 | - | |
| $C_{oss\ eq.}$ (1) | Equivalent output capacitance | $V_{DS}$ = 0 to 1200 V, $V_{GS}$ = 0 V | - | 100 | - | pF |
| $R_g$ | Gate input resistance | f = 1 MHz, gate DC Bias = 0, test signal level = 20 mV, $I_D$ = 0 A | - | 4 | - | Ω |
| $Q_g$ | Total gate charge | $V_{DD}$ = 1200 V, $I_D$ = 2.5 A, $V_{GS}$ = 0 to 10 V (see Figure 18. Test circuit for gate charge behavior) | - | 29.3 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 4.6 | - | |
| $Q_{gd}$ | Gate-drain charge | | - | 17 | - | |

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% $V_{DSS}$.*

**Table 6. Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ = 750 V, $I_D$ = 1.25 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V (see Figure 17. Test circuit for resistive load switching times and Figure 22. Switching time waveform) | - | 24 | - | ns |
| $t_r$ | Rise time | | - | 47 | - | |
| $t_{d(off)}$ | Turn-off delay time | | - | 45 | - | |
| $t_f$ | Fall time | | - | 61 | - | |

**Table 7. Source-drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 2.5 | A |
| $I_{SDM}$ (1) | Source-drain current (pulsed) | | - | | 10 | A |
| $V_{SD}$ (2) | Forward on voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 2.5 A | - | | 1.6 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 2.5 A, di/dt = 100 A/µs, $V_{DD}$ = 60 V (see Figure 19. Test circuit for inductive load switching and diode recovery times) | - | 410 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 2.4 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 11.7 | | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 2.5 A, di/dt = 100 A/µs, $V_{DD}$ = 60 V, $T_J$ = 150 °C (see Figure 19. Test circuit for inductive load switching and diode recovery times) | - | 540 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 3.3 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 12.3 | | A |

1. *Pulse width is limited by safe operating area.*
2. *Pulse test: pulse duration = 300 µs, duty cycle 1.5%.*

## 2.1 Electrical characteristics (curves)

**Figure 1. Safe operating area for TO-3PF**

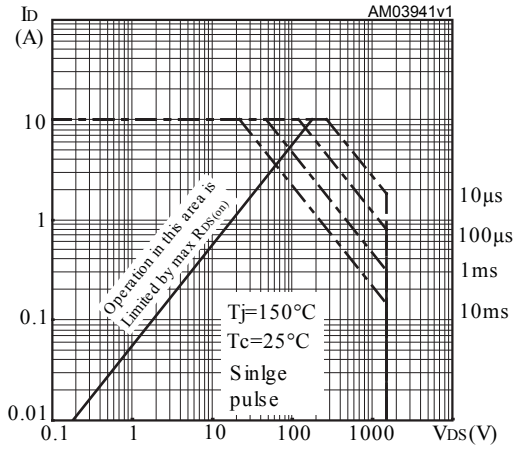



**Figure 2. Thermal impedance for TO-3PF**

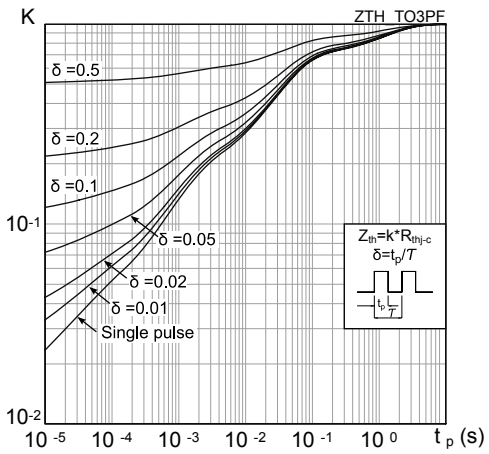



**Figure 3. Safe operating area for H²PAK-2 and TO-220**

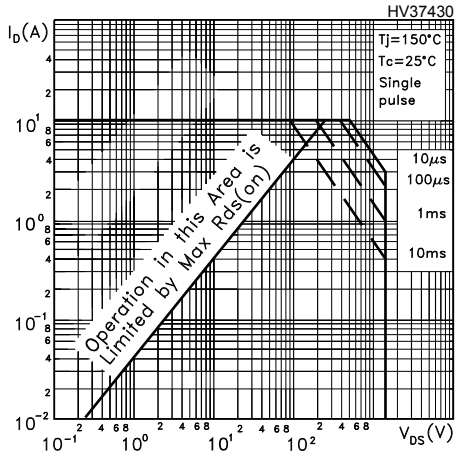



**Figure 4. Thermal impedance for H²PAK-2 and TO-220**

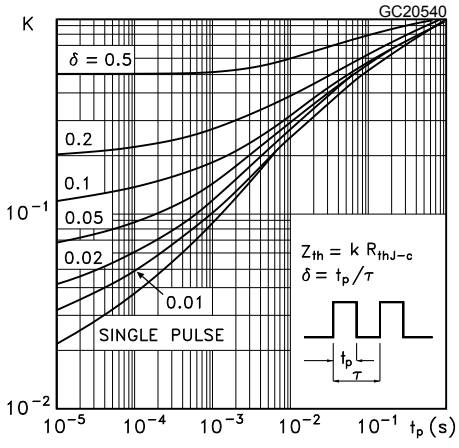



**Figure 5. Safe operating area for TO-247**

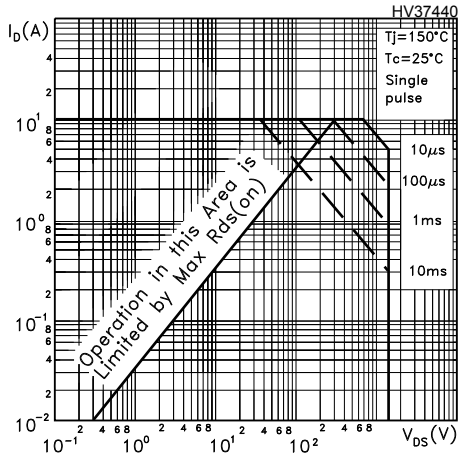



**Figure 6. Thermal impedance for TO-247**

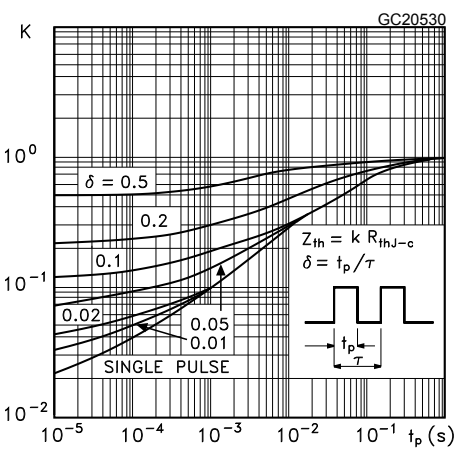


**Figure 7. Output characteristics**

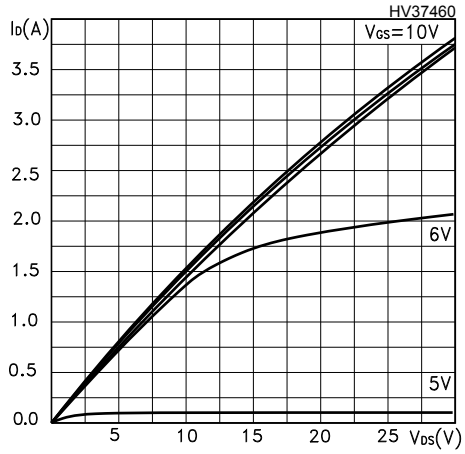



**Figure 8. Transfer characteristics**

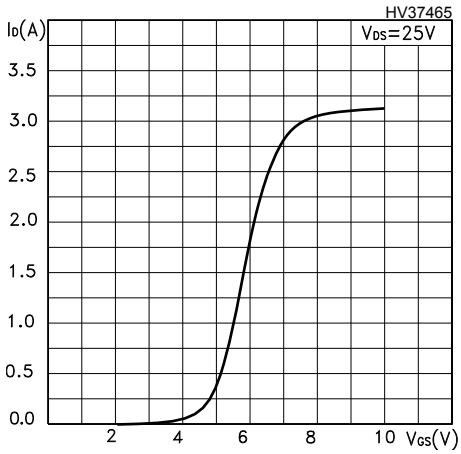



**Figure 9. Normalized $V_{(BR)DSS}$ vs temperature**

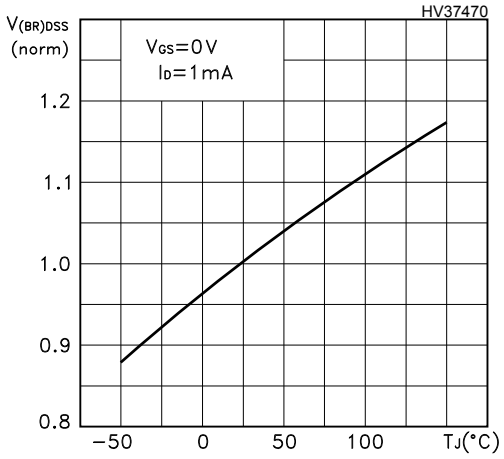



**Figure 10. Static drain-source on-resistance**

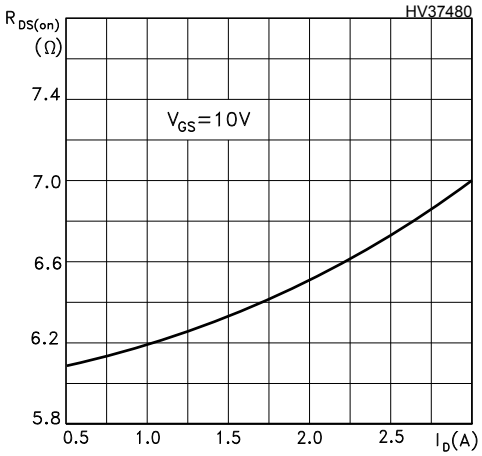



**Figure 11. Gate charge vs gate-source voltage**

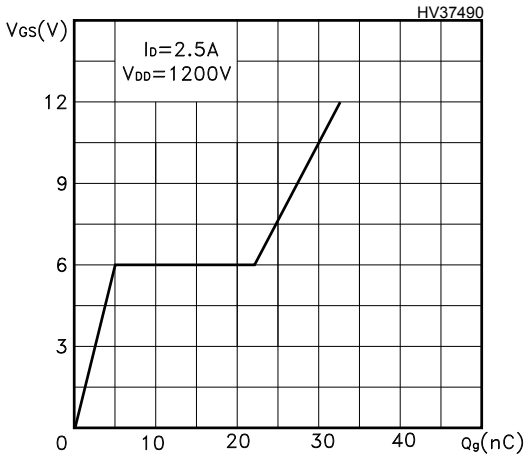



**Figure 12. Capacitance variations**

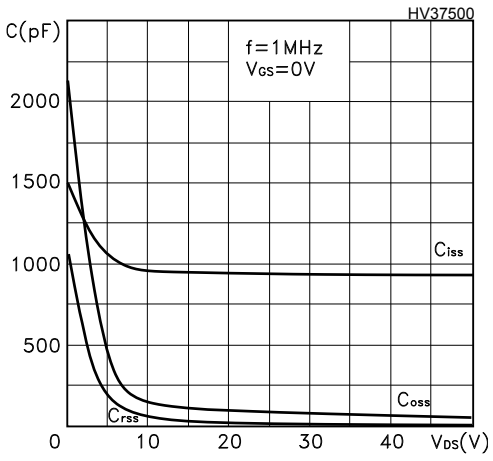


**Figure 13. Normalized gate threshold voltage vs temperature**

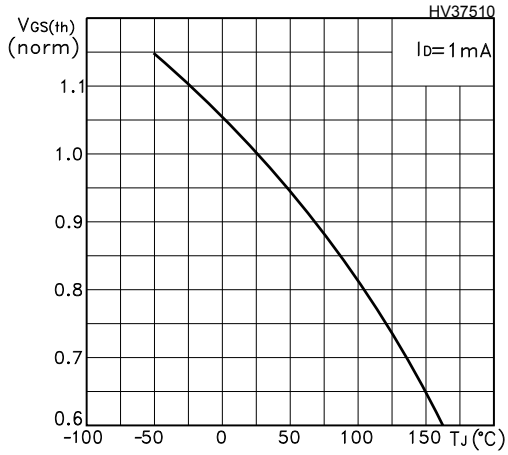



**Figure 14. Normalized on resistance vs temperature**

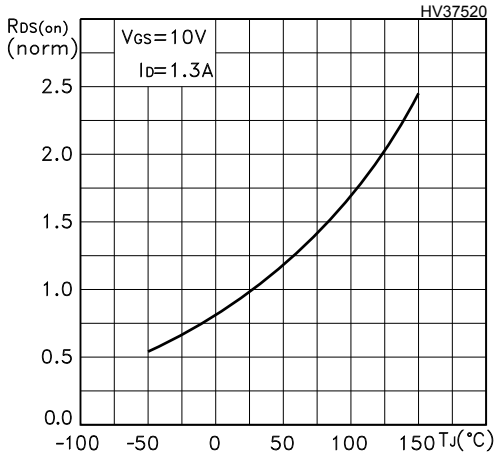



**Figure 15. Source-drain diode forward characteristics**

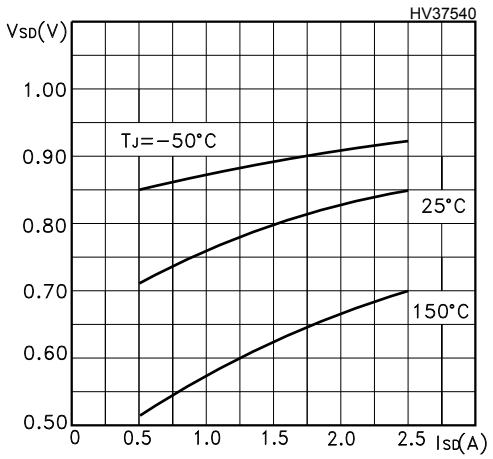
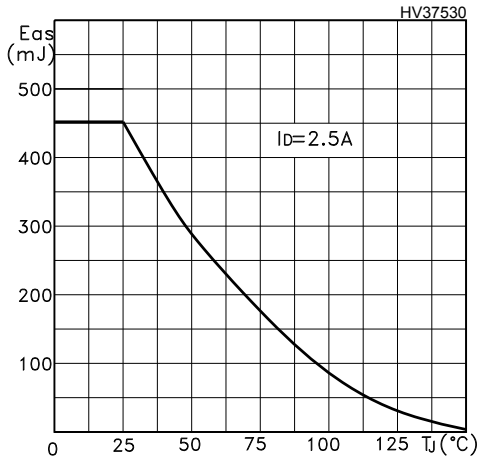



**Figure 16. Maximum avalanche energy vs $T_J$**



# 3 Test circuits

**Figure 17. Test circuit for resistive load switching times**

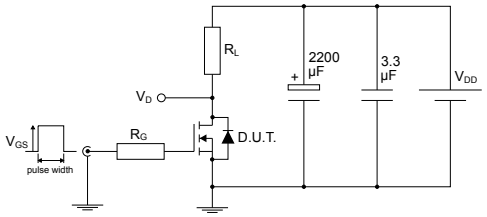



**Figure 18. Test circuit for gate charge behavior**

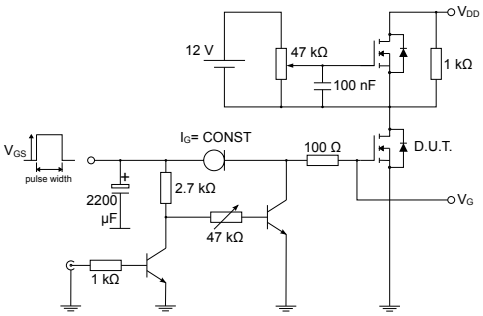



**Figure 19. Test circuit for inductive load switching and diode recovery times**

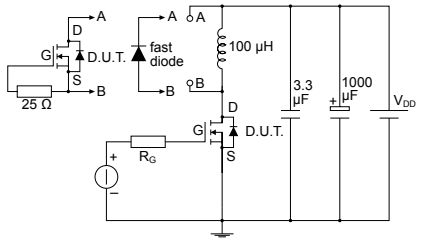



**Figure 20. Unclamped inductive load test circuit**

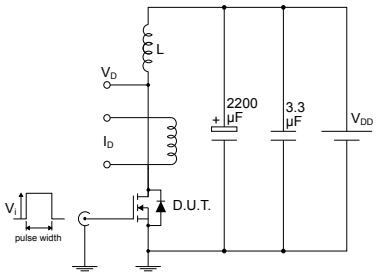



**Figure 21. Unclamped inductive waveform**

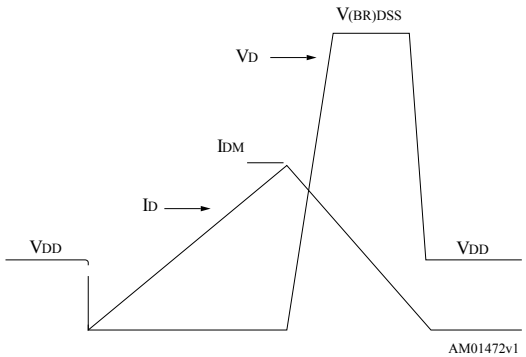
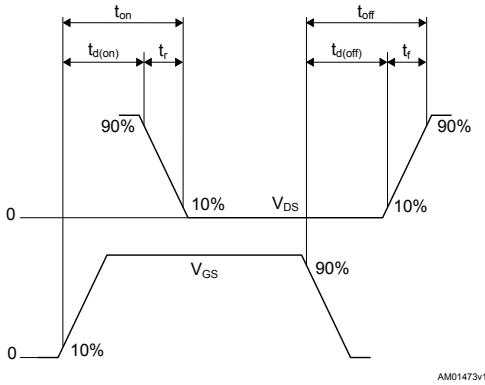



**Figure 22. Switching time waveform**



# 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 TO-220 type A package information

Figure 23. **TO-220 type A package outline**

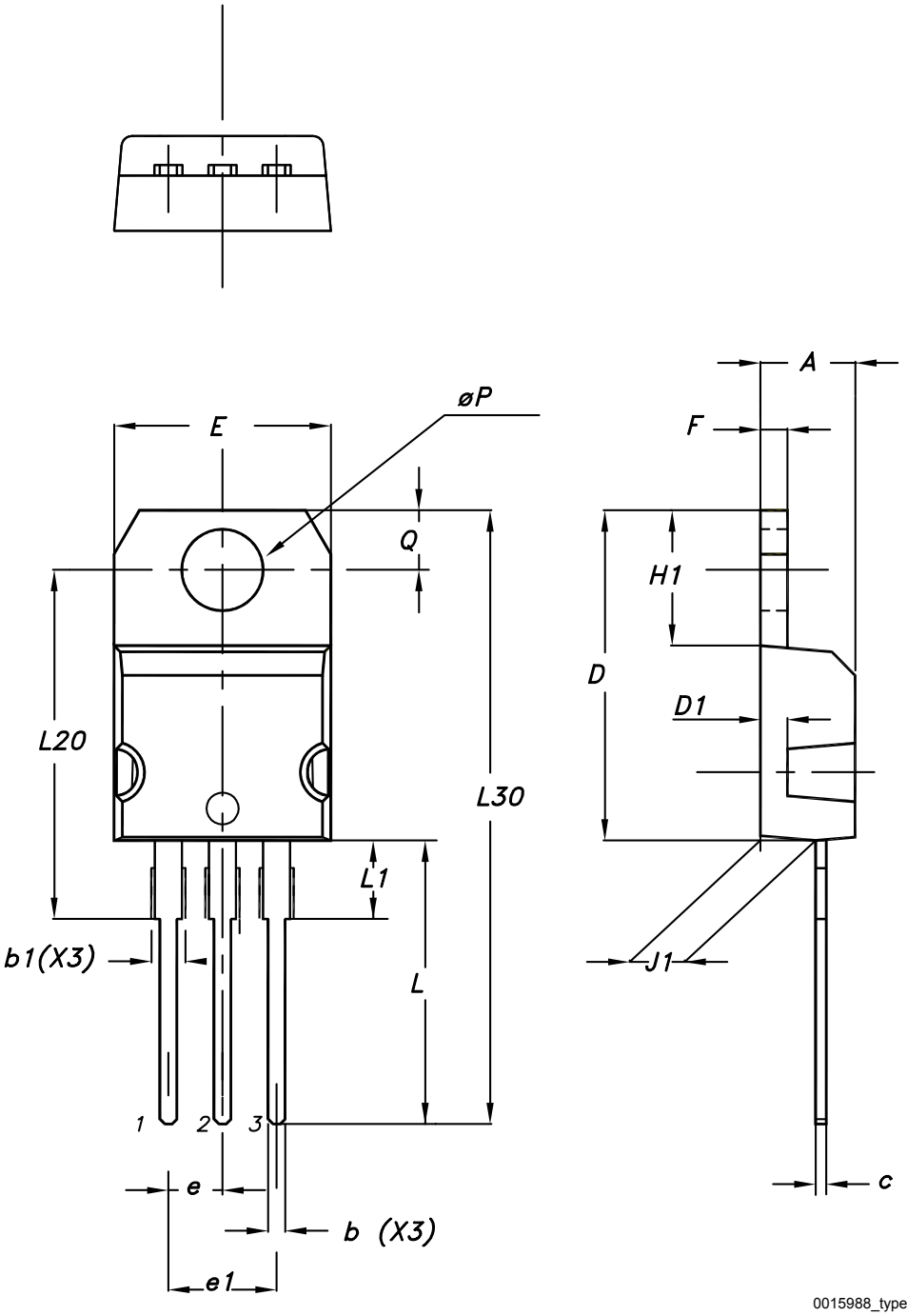


Table 8. **TO-220 type A package mechanical data**

| 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 |
| Slug flatness | | 0.03 | 0.10 |

## 4.2 H²PAK-2 package information

Figure 24. **H²PAK-2 package outline**

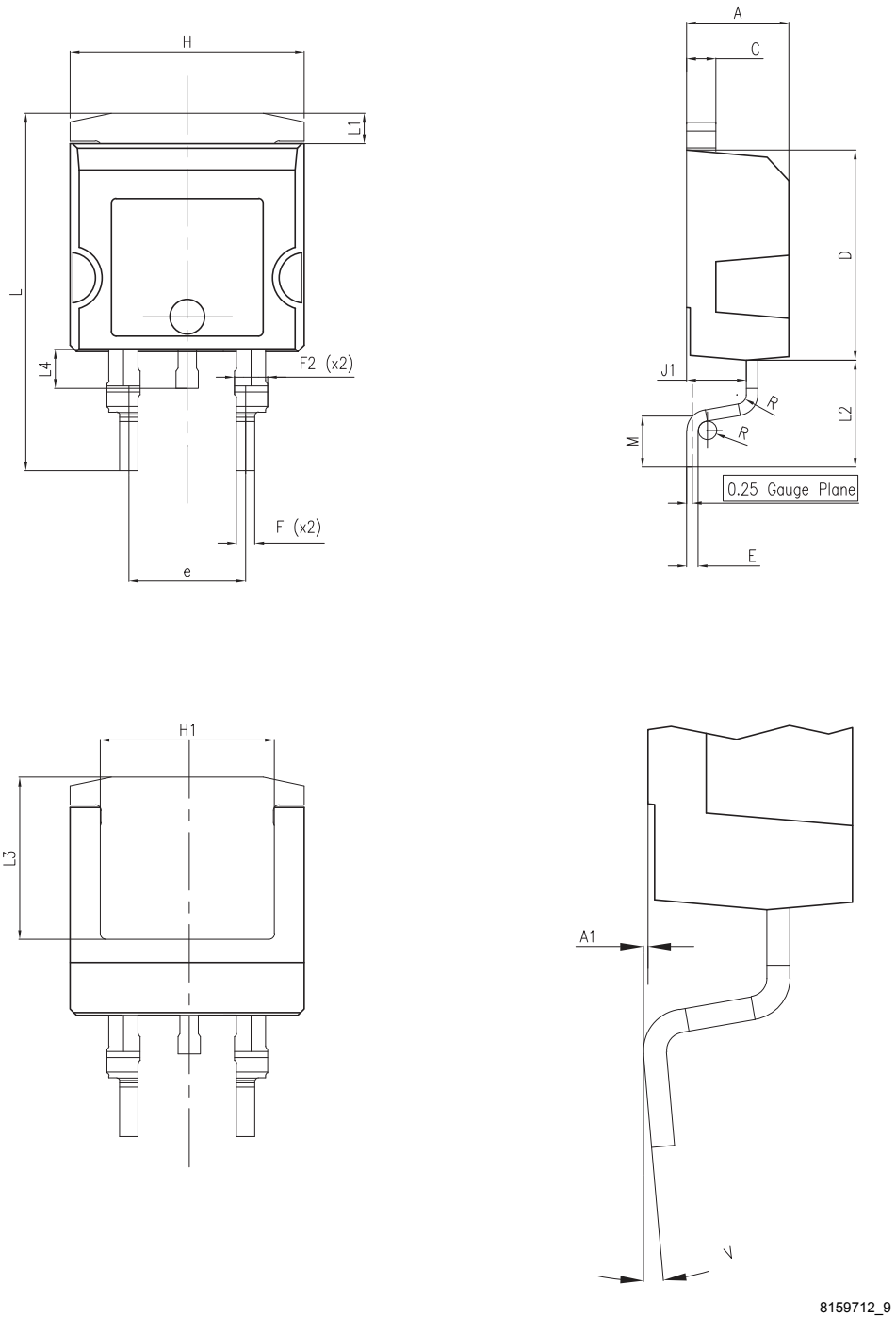
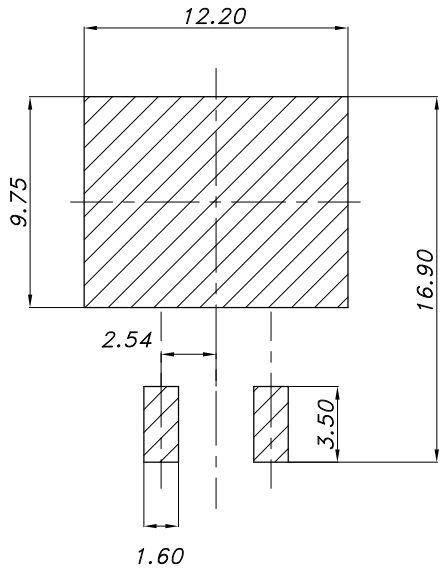


**Table 9. H²PAK-2 package mechanical data**

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.30 | | 4.70 |
| A1 | 0.03 | | 0.20 |
| C | 1.17 | | 1.37 |
| D | 8.95 | | 9.35 |
| e | 4.98 | | 5.18 |
| E | 0.50 | | 0.90 |
| F | 0.78 | | 0.85 |
| F2 | 1.14 | | 1.70 |
| H | 10.00 | | 10.40 |
| H1 | 7.40 | - | 7.80 |
| J1 | 2.49 | | 2.69 |
| L | 15.30 | | 15.80 |
| L1 | 1.27 | | 1.40 |
| L2 | 4.93 | | 5.23 |
| L3 | 6.85 | | 7.25 |
| L4 | 1.50 | | 1.70 |
| M | 2.60 | | 2.90 |
| R | 0.20 | | 0.60 |
| V | 0° | | 8° |

**Figure 25. H²PAK-2 recommended footprint**




*Note: Dimensions are in mm.*

## 4.3 TO-247 package information

Figure 26. **TO-247 package outline**

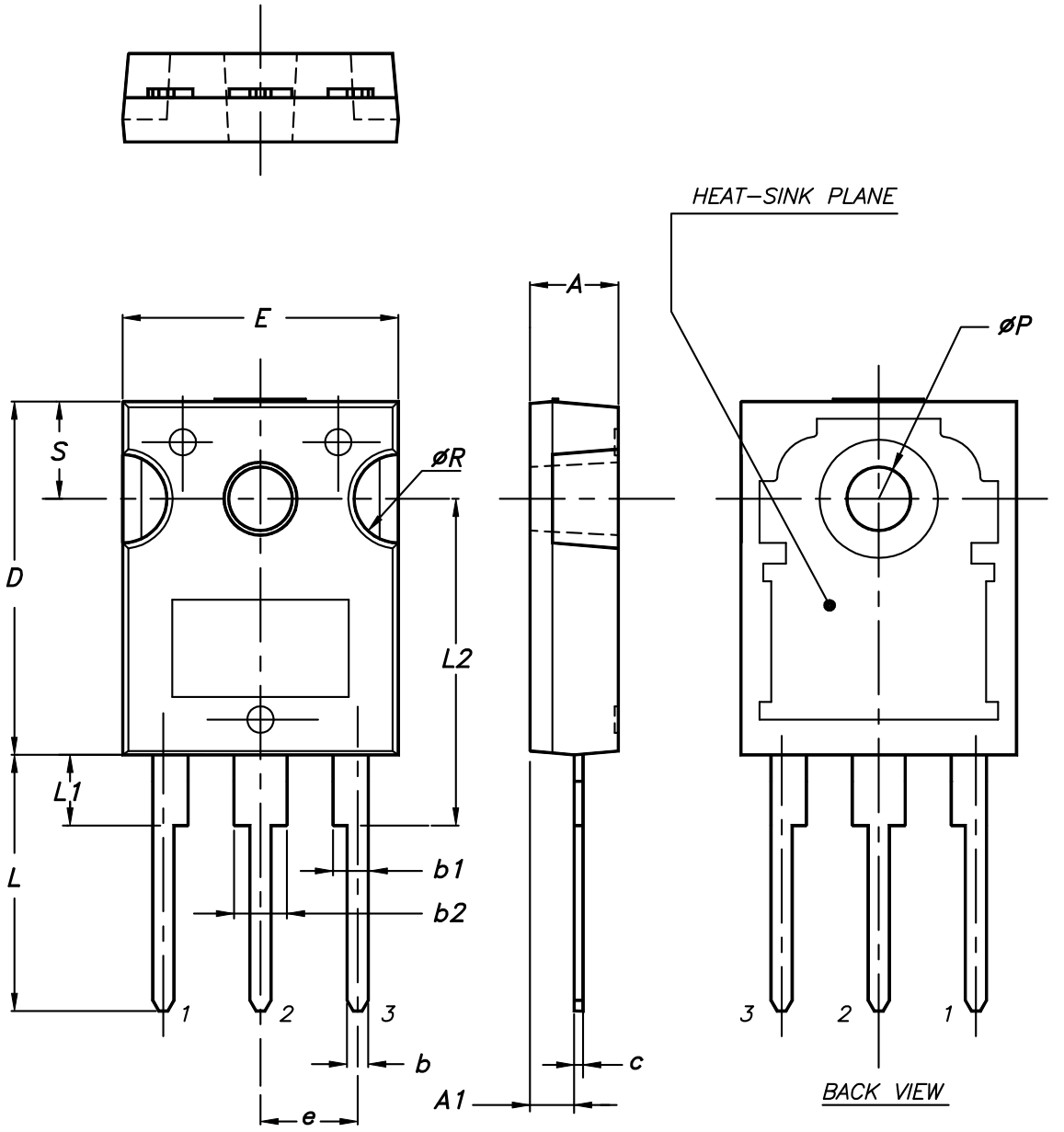


Table 10. **TO-247 package mechanical data**

| 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 |

## 4.4 TO-3PF package information

Figure 27. **TO-3PF package outline**

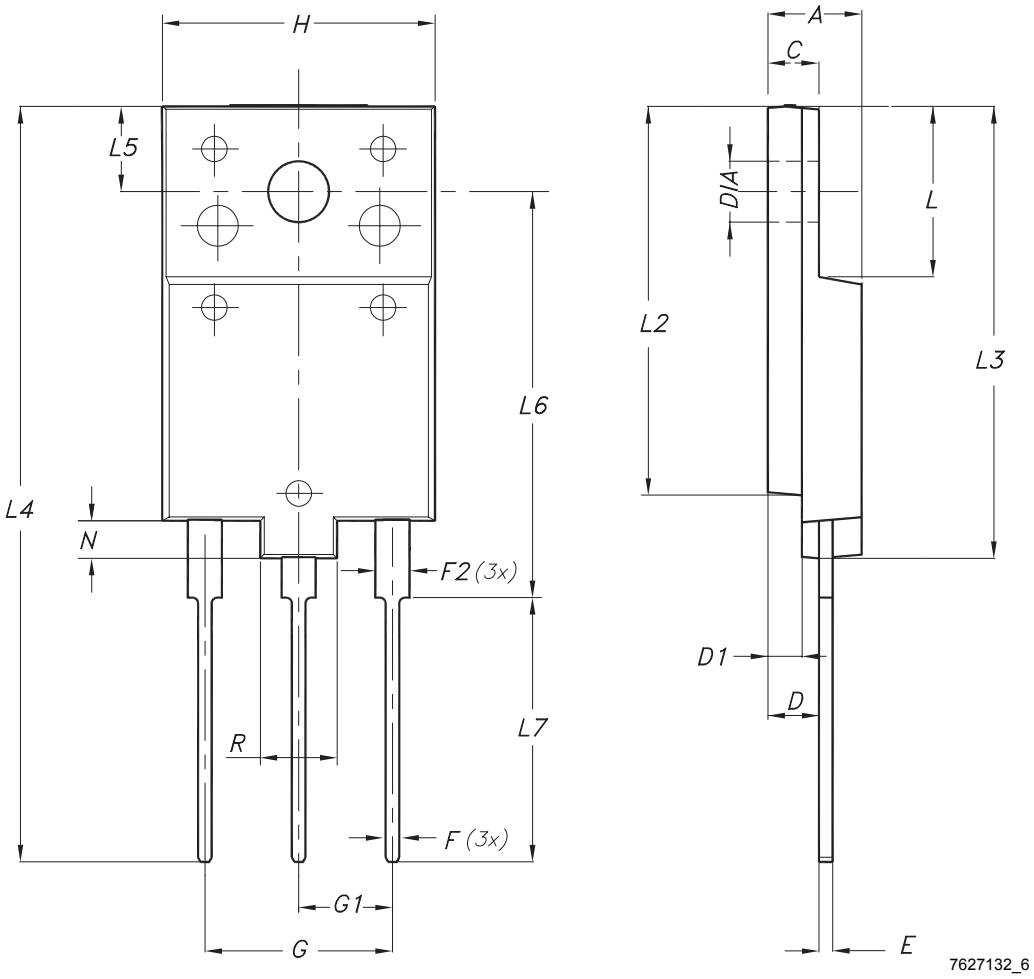
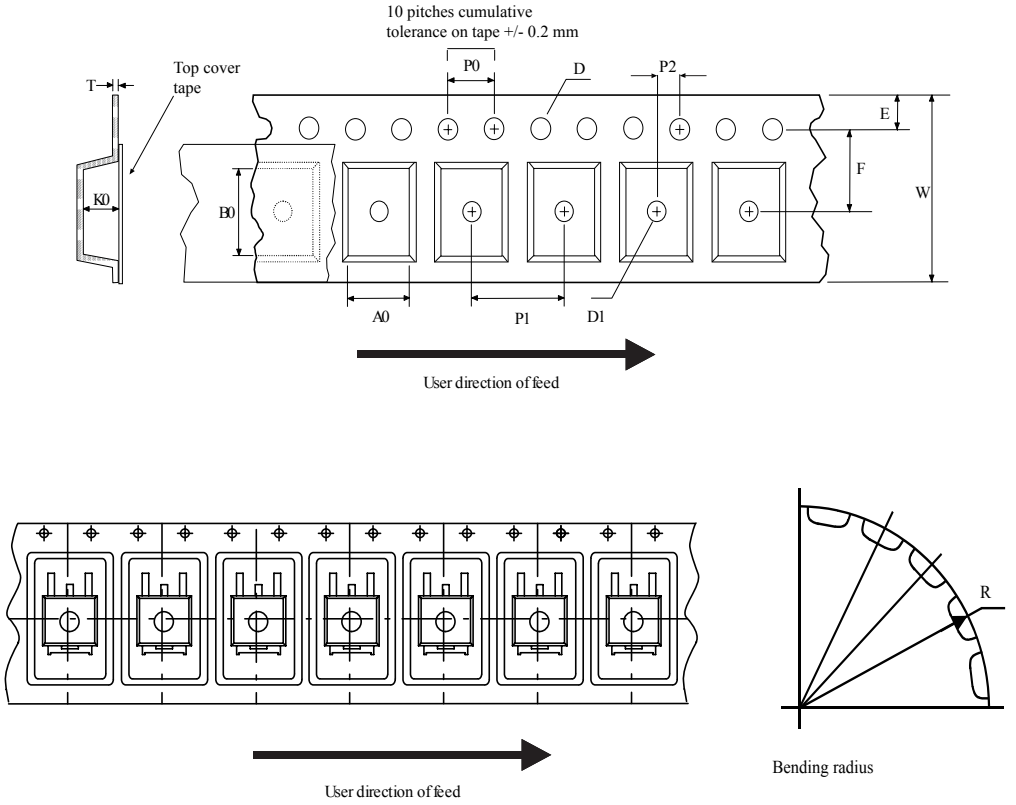


Table 11. **TO-3PF mechanical data**

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 5.30 | | 5.70 |
| C | 2.80 | | 3.20 |
| D | 3.10 | | 3.50 |
| D1 | 1.80 | | 2.20 |
| E | 0.80 | | 1.10 |
| F | 0.65 | | 0.95 |
| F2 | 1.80 | | 2.20 |
| G | 10.30 | | 11.50 |
| G1 | | 5.45 | |
| H | 15.30 | | 15.70 |
| L | 9.80 | 10.00 | 10.20 |
| L2 | 22.80 | | 23.20 |
| L3 | 26.30 | | 26.70 |
| L4 | 43.20 | | 44.40 |
| L5 | 4.30 | | 4.70 |
| L6 | 24.30 | | 24.70 |
| L7 | 14.60 | | 15.00 |
| N | 1.80 | | 2.20 |
| R | 3.80 | | 4.20 |
| Dia | 3.40 | | 3.80 |

## 4.5 Packing information

Figure 28. **Tape outline**




AM08852v2

Figure 29. **Reel outline**

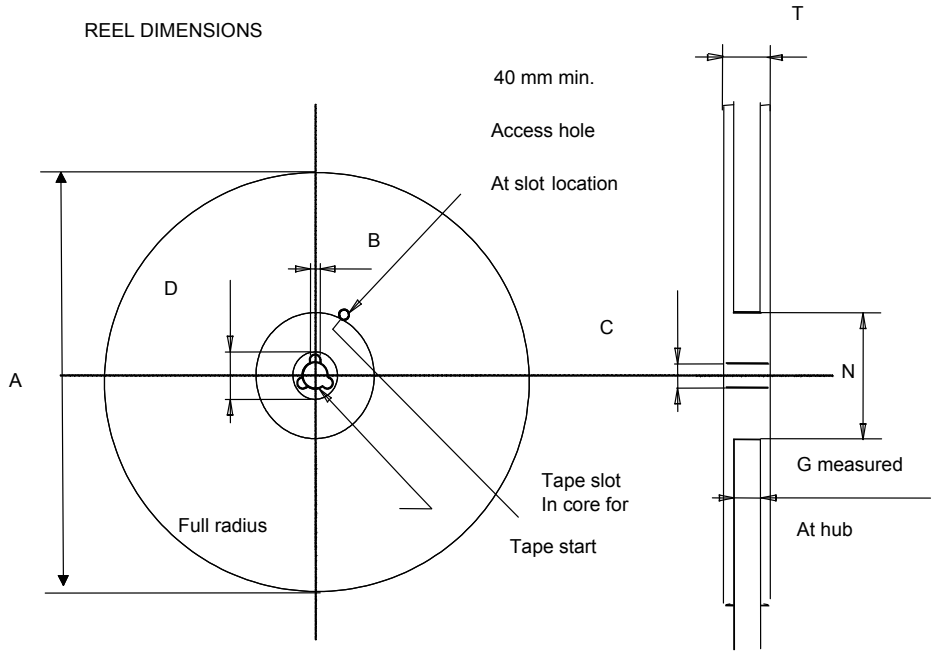



Table 12. **Tape and reel mechanical data**

| 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 | | | |

# 5 Ordering information

Table 13. **Order codes**

| Order codes | Marking | Package | Packing |
|---|---|---|---|
| STFW3N150 | 3N150 | TO-3PF | Tube |
| STH3N150-2 | H3N150 | $H^2$PAK-2 | Tape and reel |
| STP3N150 | P3N150 | TO-220 | Tube |
| STW3N150 | 3N150 | TO-247 | |

## Revision history

Table 14. **Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 12-Jan-2007 | 1 | First release |
| 17-Apr-2007 | 2 | Added new value on *Table 6*. |
| 14-May-2007 | 3 | The document has been reformatted |
| 29-Aug-2007 | 4 | RDS(on) value changed, updated *Figure 15* |
| 09-Apr-2008 | 5 | Added new package: TO-3PF |
| 13-Feb-2009 | 6 | Added PTOT value for TO-3PF (*Table 2: Absolute maximum ratings*) |
| 01-Dec-2009 | 7 | – Document status promoted from preliminary data to datasheet<br>– Removed TO-220FH package and mechanical data |
| 10-Dec-2009 | 8 | Corrected VISO value in *Table 2: Absolute maximum ratings* |
| 29-Jun-2010 | 9 | Corrected unit in *Table 3*. |
| 08-Feb-2013 | 10 | – Minor text changes<br>– Modified: *Table 3*<br>– Changed: *Figure 1*<br>– Added: $H^2PAK$-2 package |
| 18-Feb-2014 | 11 | – Modified: *Figure 1*<br>– Updated: *Figure 18*, *19*, *20* and *21*<br>– Updated: *Figure 27* and *Table 11*<br>– Updated: *Section 4: Package mechanical data*<br>– Minor text changes |
| 12-May-2020 | 12 | Updated Section 5 Ordering information.<br>Minor text changes. |

# Contents

单击下面可查看定价，库存，交付和生命周期等信息

>>STMicro(意法半导体)