# STB270N4F3
# STI270N4F3

## N-channel 40 V, 1.6 mΩ, 160 A, D²PAK, I²PAK STripFET™ III Power MOSFET

## Features

| Type | $V_{DSS}$ | $R_{DS(on)}$ max | $I_D$ | $P_{TOT}$ |
|---|---|---|---|---|
| STB270N4F3 | 40 V | < 2.0 mΩ | 160 A | 330 W |
| STI270N4F3 | 40 V | < 2.6 mΩ | 120 A | 330 W |

- 100% avalanche tested
- Standard threshold drive


D²PAK I²PAK

## Applications

- High current, switching application
  - Automotive

## Description

This STripFET™ III Power MOSFET technology is among the latest improvements, which have been especially tailored to minimize on-state resistance providing superior switching performances.

**Figure 1. Internal schematic diagram**

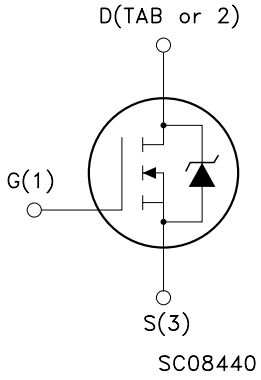



**Table 1. Device summary**

| Order codes | Marking | Package | Packaging |
|---|---|---|---|
| STB270N4F3 | 270N4F3 | D²PAK | Tape and reel |
| STI270N4F3 | 270N4F3 | I²PAK | Tube |

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| | | I²PAK | D²PAK | |
| $V_{DS}$ | Drain-source voltage ($V_{GS}$ = 0) | 40 | | V |
| $V_{GS}$ | Gate-source voltage | ± 20 | | V |
| $I_D$(1) | Drain current (continuous) at $T_C$ = 25 °C | 120 | 160 | A |
| $I_D$(1) | Drain current (continuous) at $T_C$=100 °C | 120 | 160 | A |
| $I_{DM}$(2) | Drain current (pulsed) | 480 | 640 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 330 | | W |
| | Derating factor | 2.2 | | W/°C |
| dv/dt(3) | Peak diode recovery voltage slope | 3.5 | | V/n |
| $E_{AS}$(4) | Single pulse avalanche energy | 1 | | J |
| $T_J$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature | -55 to 175 | | °C |

1. Current limited by package
2. Pulse width limited by safe operating area
3. $I_{SD} \leq 120$ A, di/dt $\leq$ 200 A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$
4. Starting $T_j$=25 °C, $I_D$ =80 A, $V_{DD}$= 32 V

**Table 3. Thermal data**

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| | | I²PAK | D²PAK | |
| $R_{thj\text{-}case}$ | Thermal resistance junction-case max | 0.45 | | °C/W |
| $R_{thj\text{-}pcb}$(1) | Thermal resistance junction-pcb max | | 35 | °C/W |
| $R_{thj\text{-}a}$ | Thermal resistance junction-ambient max | 62.5 | | °C/W |
| $T_l$ | Maximum lead temperature for soldering purpose (for 10 sec, 1.6 mm from case) | 300 | | °C |

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

# 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 | $I_D$ = 250 µA, $V_{GS}$= 0 | | 40 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current ($V_{GS}$ = 0) | $V_{DS}$ = Max rating,<br>$V_{DS}$ = Max rating @125 °C | | | | 10<br>100 | µA<br>µA |
| $I_{GSS}$ | Gate body leakage current ($V_{DS}$ = 0) | $V_{GS}$ = ±20 V | | | | ±200 | 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, $I_D$= 80 A | **I²PAK** | | 2.1 | 2.6 | mΩ |
| | | | **D²PAK** | | 1.6 | 2.0 | mΩ |

**Table 5. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $g_{fs}$ (1) | Forward transconductance | $V_{DS}$ =15 V, $I_D$ = 80 A | - | 200 | | S |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS}$ =25 V, f=1 MHz, $V_{GS}$=0 | - | 7400<br>1800<br>47 | | pF<br>pF<br>pF |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total gate charge<br>Gate-source charge<br>gate-drain charge | $V_{DD}$=20 V, $I_D$ = 160 A<br>$V_{GS}$ =10 V<br>*(see Figure 14)* | - | 110<br>27<br>25 | 150 | nC<br>nC<br>nC |

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

**Table 6. Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$<br>$t_r$ | Turn-on delay time<br>Rise time | $V_{DD}$=20 V, $I_D$= 80 A,<br>$R_G$=4.7 Ω, $V_{GS}$=10 V<br>*(see Figure 16)* | - | 22<br>180 | - | ns<br>ns |
| $t_{d(off)}$<br>$t_f$ | Turn-off delay time<br>Fall time | $V_{DD}$=20 V, $I_D$= 80 A,<br>$R_G$=4.7 Ω, $V_{GS}$=10 V<br>*(see Figure 16)* | - | 110<br>45 | - | ns<br>ns |

**Table 7. Source drain diode**

| Symbol | Parameter | | Test conditions | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | **D²PAK** | | - | | 160 | A |
| | | **I²PAK** | | - | | 120 | A |
| $I_{SDM}$(1) | Source-drain current (pulsed) | **D²PAK** | | - | | 640 | A |
| | | **I²PAK** | | - | | 480 | A |
| $V_{SD}$(2) | Forward on voltage | | $I_{SD}$=80 A, $V_{GS}$=0 | - | | 1.5 | V |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | | $I_{SD}$=160 A,<br>di/dt = 100 A/µs,<br>$V_{DD}$=32 V, Tj=150 °C<br>*(see Figure 15)* | - | 70<br>225<br>3.2 | | ns<br>nC<br>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**

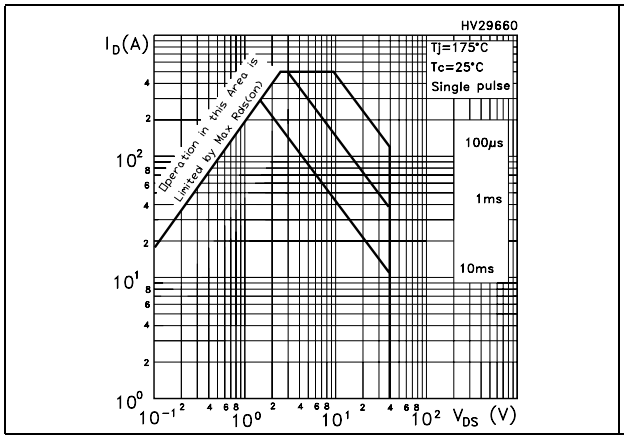



**Figure 3. Thermal impedance**

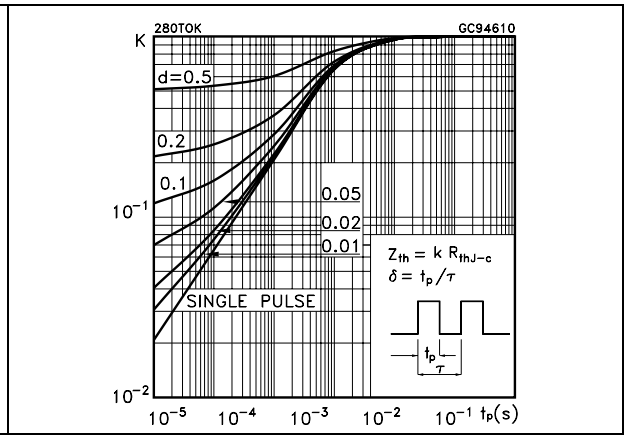



**Figure 4. Output characteristics**

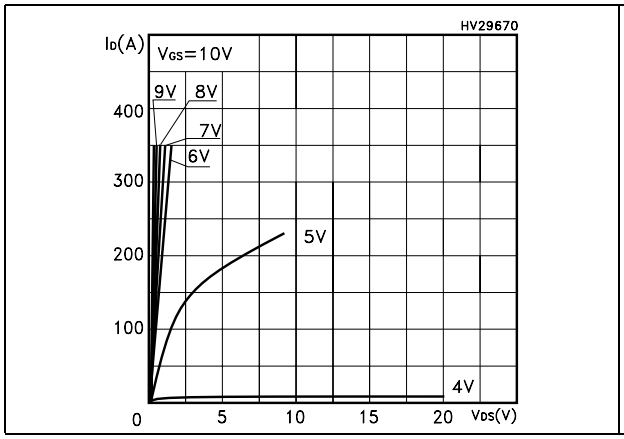



**Figure 5. Transfer characteristics**

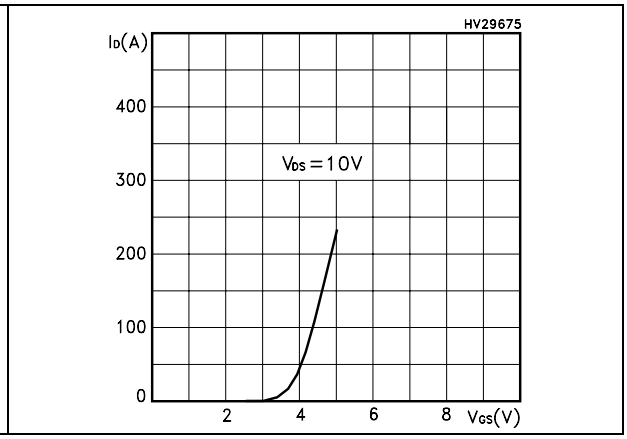



**Figure 6. Static drain-source on resistance**

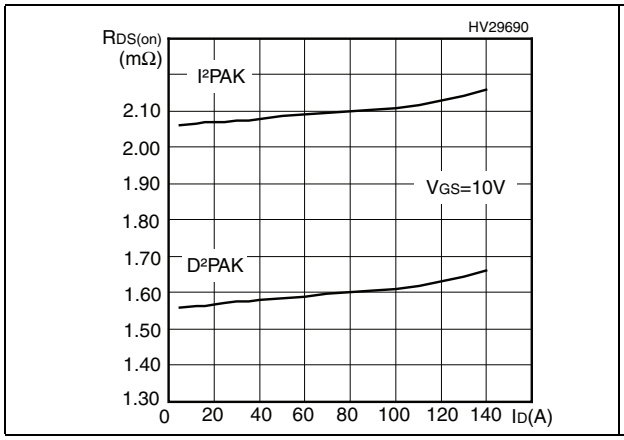



**Figure 7. Normalized $B_{VDSS}$ vs temperature**

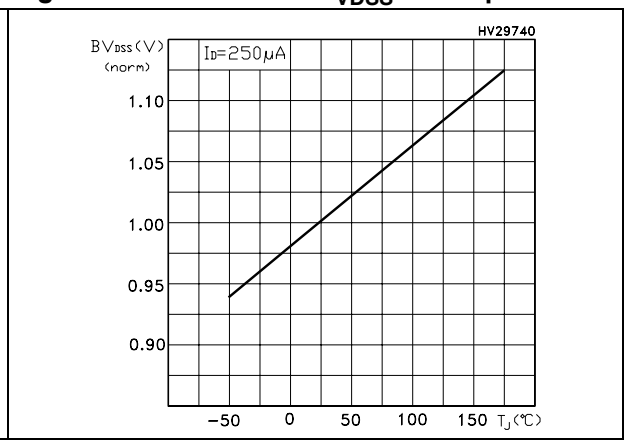


**Figure 8. Gate charge vs gate-source voltage**

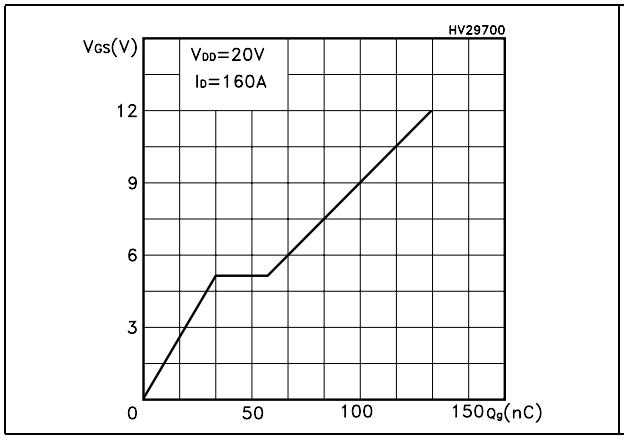



**Figure 9. Capacitance variations**

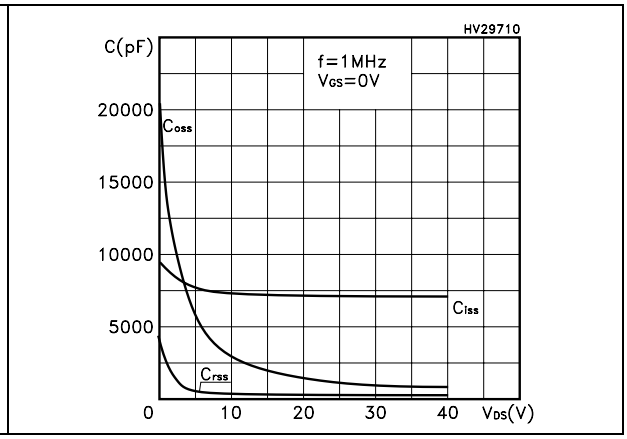



**Figure 10. Normalized gate threshold voltage vs temperature**

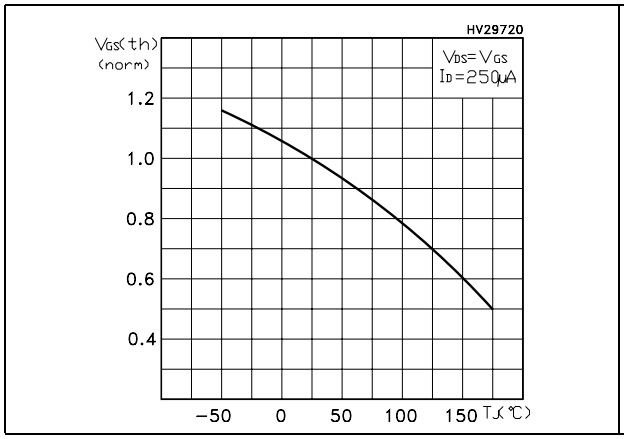



**Figure 11. Normalized on resistance vs temperature**

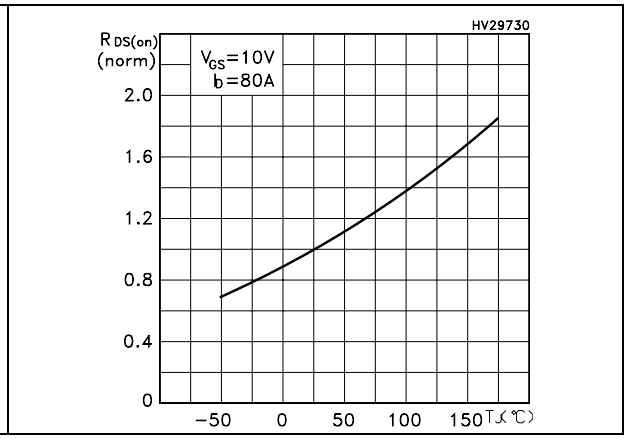
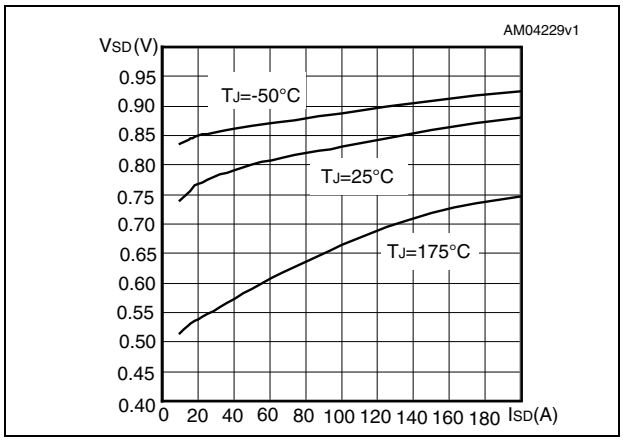



**Figure 12. Source-drain diode forward characteristics**



# 3 Test circuit

**Figure 13. Switching times test circuit for resistive load**

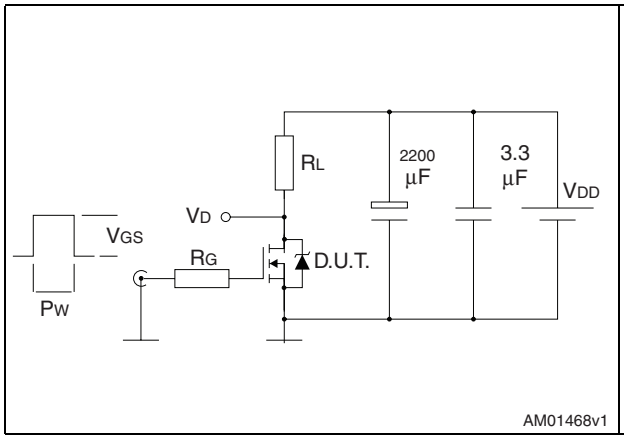



**Figure 14. Gate charge test circuit**

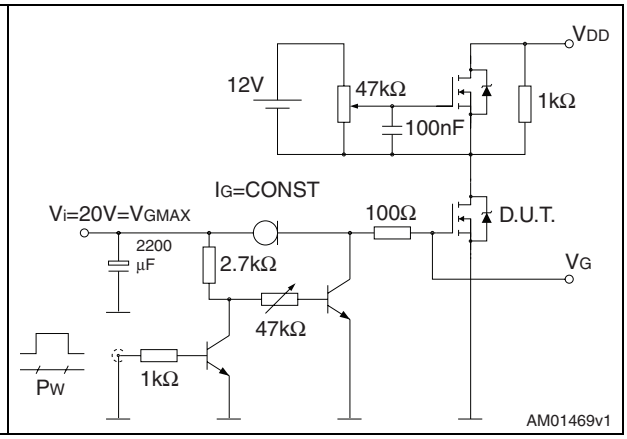



**Figure 15. Test circuit for inductive load switching and diode recovery times**

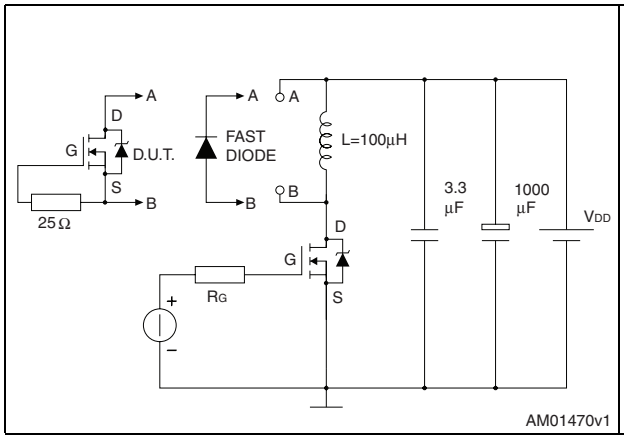



**Figure 16. Unclamped inductive load test circuit**

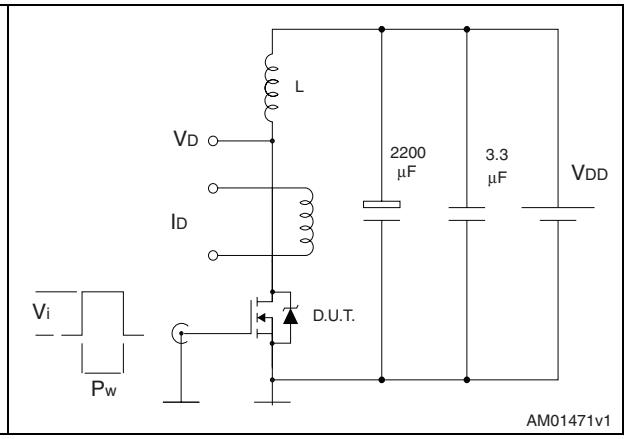



**Figure 17. Unclamped inductive waveform**

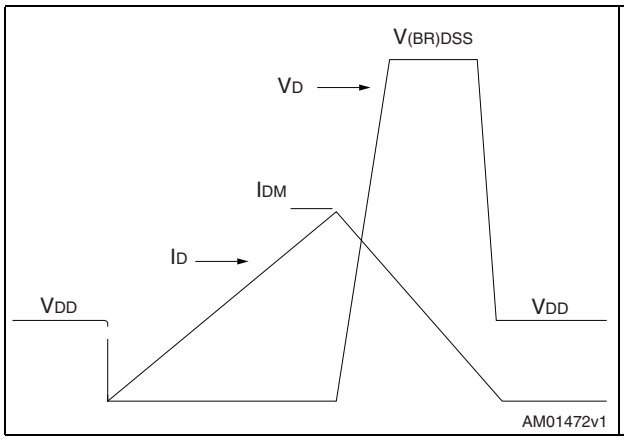
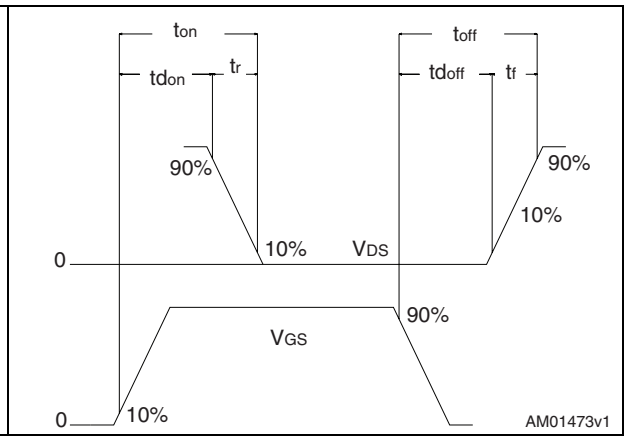



**Figure 18. Switching time waveform**

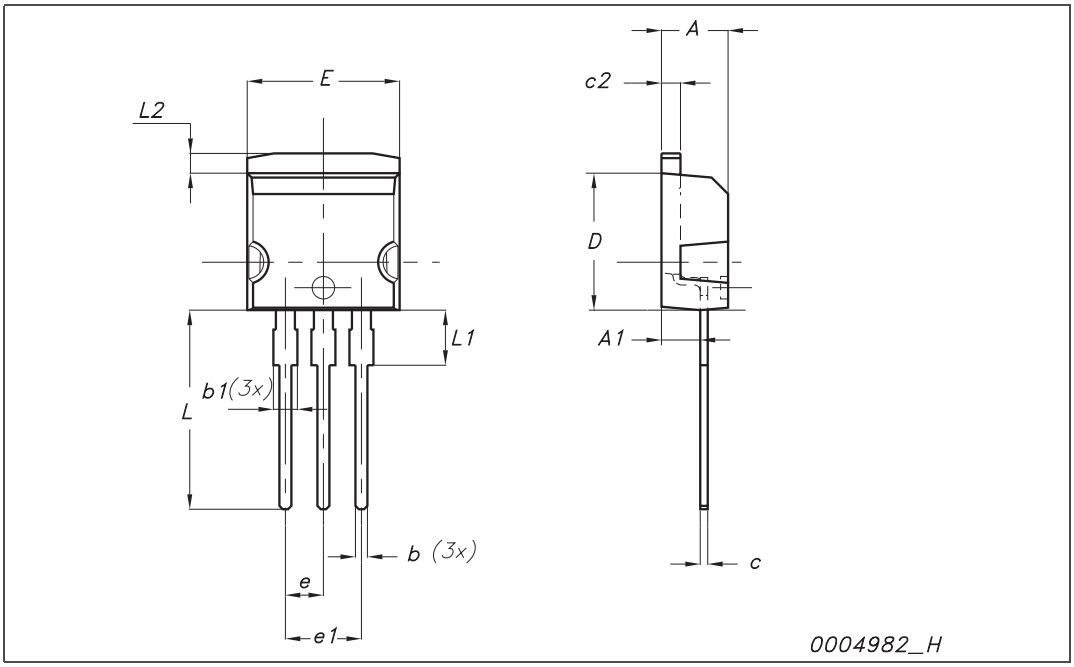


# 4 Package mechanical data

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.

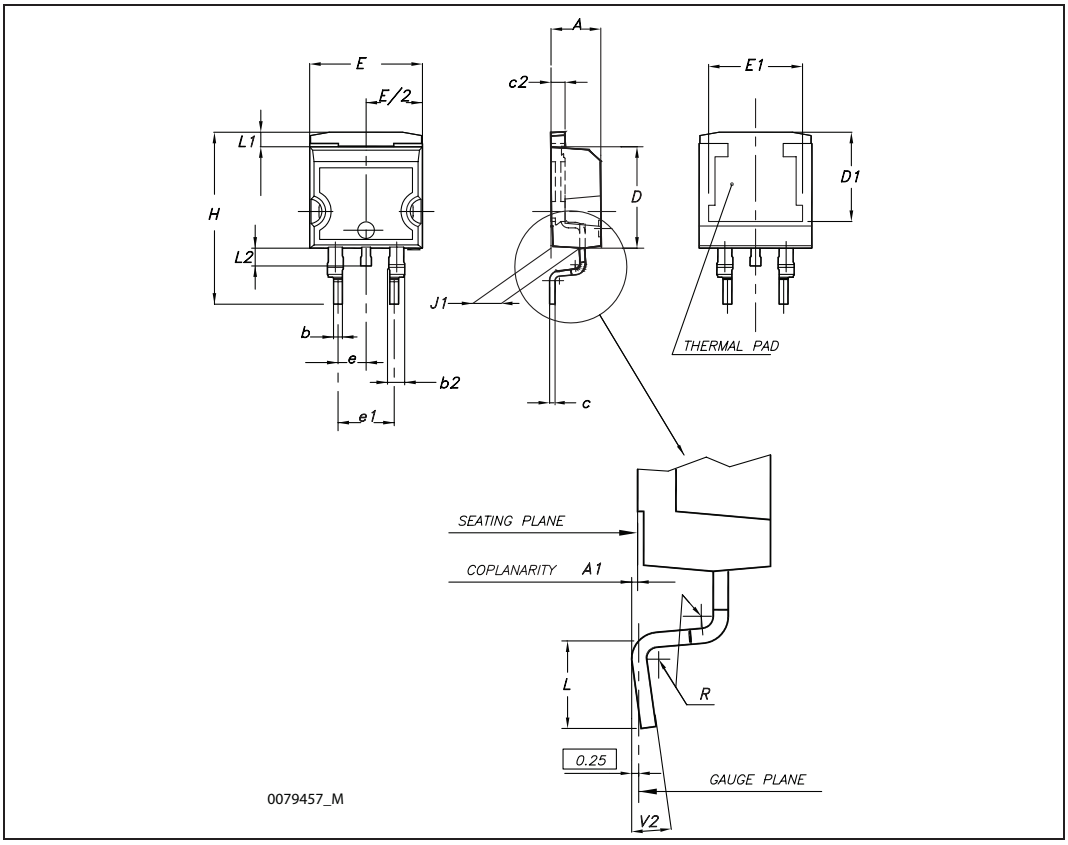
## I²PAK (TO-262) mechanical data

| Dim | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | Min | Typ | Max | Min | Typ | Max |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| A1 | 2.40 | | 2.72 | 0.094 | | 0.107 |
| b | 0.61 | | 0.88 | 0.024 | | 0.034 |
| b1 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| c | 0.49 | | 0.70 | 0.019 | | 0.027 |
| c2 | 1.23 | | 1.32 | 0.048 | | 0.052 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| e | 2.40 | | 2.70 | 0.094 | | 0.106 |
| e1 | 4.95 | | 5.15 | 0.194 | | 0.202 |
| E | 10 | | 10.40 | 0.393 | | 0.410 |
| L | 13 | | 14 | 0.511 | | 0.551 |
| L1 | 3.50 | | 3.93 | 0.137 | | 0.154 |
| L2 | 1.27 | | 1.40 | 0.050 | | 0.055 |



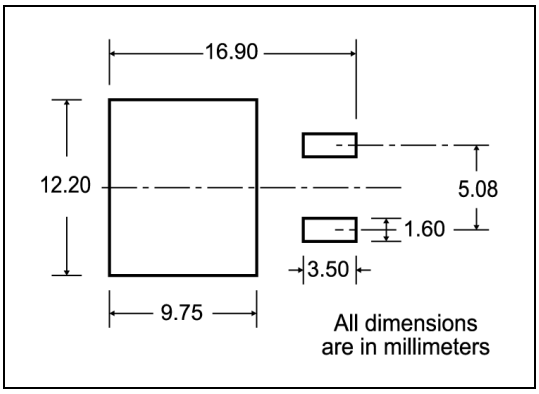
## D²PAK (TO-263) mechanical data

| Dim | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | Min | Typ | Max | Min | Typ | Max |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| A1 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| b | 0.70 | | 0.93 | 0.027 | | 0.037 |
| b2 | 1.14 | | 1.70 | 0.045 | | 0.067 |
| c | 0.45 | | 0.60 | 0.017 | | 0.024 |
| c2 | 1.23 | | 1.36 | 0.048 | | 0.053 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| D1 | 7.50 | | | 0.295 | | |
| E | 10 | | 10.40 | 0.394 | | 0.409 |
| E1 | 8.50 | | | 0.334 | | |
| e | | 2.54 | | | 0.1 | |
| e1 | 4.88 | | 5.28 | 0.192 | | 0.208 |
| H | 15 | | 15.85 | 0.590 | | 0.624 |
| J1 | 2.49 | | 2.69 | 0.099 | | 0.106 |
| L | 2.29 | | 2.79 | 0.090 | | 0.110 |
| L1 | 1.27 | | 1.40 | 0.05 | | 0.055 |
| L2 | 1.30 | | 1.75 | 0.051 | | 0.069 |
| R | | 0.4 | | | 0.016 | |
| V2 | 0° | | 8° | 0° | | 8° |

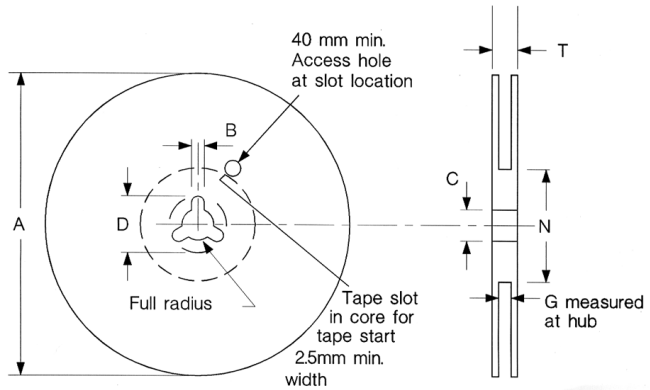


# 5 Packaging mechanical data

## D²PAK FOOTPRINT




## TAPE AND REEL SHIPMENT



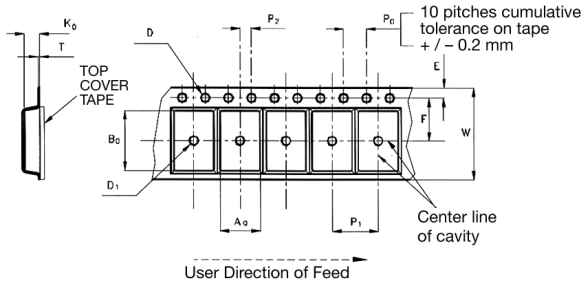

REEL MECHANICAL DATA

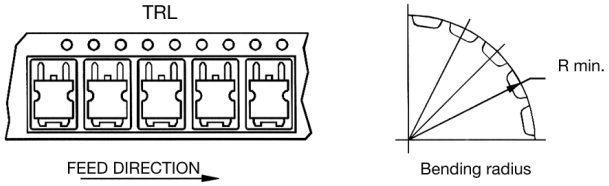
| DIM. | mm | | inch | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A | | 330 | | 12.992 |
| B | 1.5 | | 0.059 | |
| C | 12.8 | 13.2 | 0.504 | 0.520 |
| D | 20.2 | | 0795 | |
| G | 24.4 | 26.4 | 0.960 | 1.039 |
| N | 100 | | 3.937 | |
| T | | 30.4 | | 1.197 |

| BASE QTY | BULK QTY |
|---|---|
| 1000 | 1000 |

TAPE MECHANICAL DATA

| DIM. | mm | | inch | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A0 | 10.5 | 10.7 | 0.413 | 0.421 |
| B0 | 15.7 | 15.9 | 0.618 | 0.626 |
| D | 1.5 | 1.6 | 0.059 | 0.063 |
| D1 | 1.59 | 1.61 | 0.062 | 0.063 |
| E | 1.65 | 1.85 | 0.065 | 0.073 |
| F | 11.4 | 11.6 | 0.449 | 0.456 |
| K0 | 4.8 | 5.0 | 0.189 | 0.197 |
| P0 | 3.9 | 4.1 | 0.153 | 0.161 |
| P1 | 11.9 | 12.1 | 0.468 | 0.476 |
| P2 | 1.9 | 2.1 | 0.075 | 0.082 |
| R | 50 | | 1.574 | |
| T | 0.25 | 0.35 | 0.0098 | 0.0137 |
| W | 23.7 | 24.3 | 0.933 | 0.956 |




* on sales type

# 6 Revision history

**Table 8. Revision history**

| Date | Revision | Changes |
|---|---|---|
| 07-Feb-2007 | 1 | Initial release. |
| 02-Apr-2008 | 2 | Some value changes on *Table 2* |
| 06-May-2009 | 3 | Changed: *Description* and *Figure 12: Source-drain diode forward characteristics* |
| 14-Jul-2009 | 4 | Removed package and mechanical data: TO-220 |

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