# STD6N62K3 - STF6N62K3
# STP6N62K3 - STU6N62K3

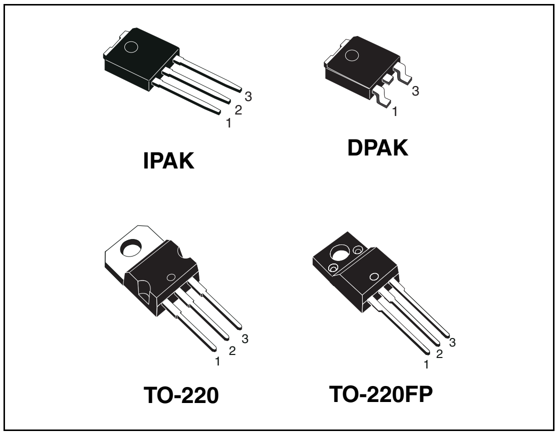
N-channel 620 V, 1.1 Ω, 5.5 A, IPAK, DPAK, TO-220,TO-220FP
SuperMESH3™ Power MOSFET

## Features

| Type | $V_{DSS}$ | $R_{DS(on)}$ max | $I_D$ | Pw |
|---|---|---|---|---|
| STD6N62K3 | 620 V | < 1.28 Ω | 5.5 A | 90 W |
| STF6N62K3 | 620 V | < 1.28 Ω | 5.5 A[1] | 25 W |
| STP6N62K3 | 620 V | < 1.28 Ω | 5.5 A | 90 W |
| STU6N62K3 | 620 V | < 1.28 Ω | 5.5 A | 90 W |

1. Limited by package

- 100% avalanche tested
- Extremely high dv/dt capability
- Gate charge minimized
- Very low intrinsic capacitances
- Improved diode reverse recovery characteristics
- Zener-protected




## Application

- Switching applications

## Description

The new SuperMESH3™ series is obtained through the combination of a further fine tuning of ST's well established strip-based PowerMESH™ layout with a new optimization of the vertical structure. In addition to reducing on-resistance significantly versus previous generation, special attention has been taken to ensure a very good dv/dt capability and higher margin in breakdown voltage for the most demanding application.

**Figure 1. Internal schematic diagram**

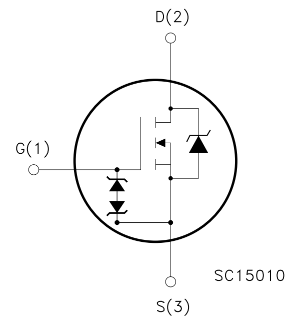



**Table 1. Device summary**

| Order codes | Marking | Package | Packaging |
|---|---|---|---|
| STD6N62K3 | 6N62K3 | DPAK | Tape and reel |
| STF6N62K3 | 6N62K3 | TO-220FP | Tube |
| STP6N62K3 | 6N62K3 | TO-220 | Tube |
| STU6N62K3 | 6N62K3 | IPAK | Tube |

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | | | | Unit |
|---|---|---|---|---|---|---|
| | | TO-220 | DPAK | IPAK | TO-220FP | |
| $V_{DS}$ | Drain-source voltage ($V_{GS}$ = 0) | 620 | | | | V |
| $V_{GS}$ | Gate- source voltage | ± 30 | | | | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 5.5 | | | 5.5 (1) | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100 °C | 3.465 | | | 3.465 (1) | A |
| $I_{DM}$ (2) | Drain current (pulsed) | 22 | | | 22 (1) | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 90 | | | 25 | W |
| | Derating factor | 0.72 | | | 0.2 | W/°C |
| $V_{ESD(G-S)}$ | Gate source ESD(HBM-C = 100 pF, R = 1.5 kΩ) | 2500 | | | | V |
| dv/dt (3) | Peak diode recovery voltage slope | 9 | | | | 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 package
2. Pulse width limited by safe operating area
3. $I_{SD}$ ≤ 5.5 A, di/dt ≤ 200 A/µs, $V_{DD}$ = 80% $V_{(BR)DSS}$

**Table 3. Thermal data**

| Symbol | Parameter | TO-220 | DPAK | IPAK | TO-220FP | Unit |
|---|---|---|---|---|---|---|
| $R_{thj-case}$ | Thermal resistance junction-case max | 1.39 | | | 5 | °C/W |
| $R_{thj-pcb}$ | Thermal resistance junction-pcb max | -- | 50 | -- | -- | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max | 62.5 | 100 | | 62.5 | °C/W |
| $T_l$ | Maximum lead temperature for soldering purpose | 300 | | | | °C |

**Table 4. Avalanche characteristics**

| Symbol | Parameter | Max value | Unit |
|---|---|---|---|
| $I_{AR}$ | Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max) | 5.5 | A |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_j$ = 25°C, $I_D$ = $I_{AR}$, $V_{DD}$ = 50V) | 140 | mJ |

# 2 Electrical characteristics

($T_C$ = 25 °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 mA, $V_{GS}$ = 0 | 620 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current ($V_{GS}$ = 0) | $V_{DS}$ = Max rating<br>$V_{DS}$ = Max rating, $T_C$=125 °C | | | 1<br>50 | µA<br>µA |
| $I_{GSS}$ | Gate-body leakage current ($V_{DS}$ = 0) | $V_{GS}$ = ± 20 V | | | ± 10 | µA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 50 µA | 3 | 3.75 | 4.5 | V |
| $R_{DS(on}$ | Static drain-source on resistance | $V_{GS}$ = 10 V, $I_D$ = 2.8 A | | 1.1 | 1.28 | Ω |

**Table 6. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $g_{fs}$ (1) | Forward transconductance | $V_{DS}$ = 15 V, $I_D$ = 2.8 A | | 4.1 | | S |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS}$ = 50 V, f = 1 MHz, $V_{GS}$ = 0 | | 706<br>66<br>8.4 | | pF<br>pF<br>pF |
| $C_{OSS\ eq}$(1) | Equivalent output capacitance | $V_{GS}$ = 0, $V_{DS}$ = 0 to 496 V | | 60 | | pF |
| $R_G$ | Intrinsic gate resistance | f = 1 MHz open drain | | 7 | | Ω |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total gate charge<br>Gate-source charge<br>Gate-drain charge | $V_{DD}$ = 496 V, $I_D$ = 5.5 A,<br>$V_{GS}$ = 10 V<br>(see *Figure 17*) | | 25.7<br>4.6<br>14.4 | | nC<br>nC<br>nC |

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 7. Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$<br>$t_r$<br>$t_{d(off)}$<br>$t_f$ | Turn-on delay time<br>Rise time<br>Turn-off-delay time<br>Fall time | $V_{DD}$ = 310 V, $I_D$ = 2.75 A,<br>$R_G$ = 4.7 Ω, $V_{GS}$ = 10 V<br>(see *Figure 16*) | | 13<br>12.5<br>27<br>19 | | ns<br>ns<br>ns<br>ns |

**Table 8. Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$<br>$I_{SDM}$ (1) | Source-drain current<br>Source-drain current (pulsed) | | | | 5.5<br>22 | A<br>A |
| $V_{SD}$ (2) | Forward on voltage | $I_{SD}$ = 5.5 A, $V_{GS}$ = 0 | | | 1.6 | V |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD}$ = 5.5 A, di/dt = 100 A/µs<br>$V_{DD}$ = 30 V (see *Figure 21*) | | 190<br>970<br>10.5 | | ns<br>nC<br>A |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD}$ = 5.5 A, di/dt = 100 A/µs<br>$V_{DD}$ = 30 V, $T_j$ = 150 °C<br>(see *Figure 21*) | | 255<br>1520<br>12 | | ns<br>nC<br>A |

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

**Table 9. Gate-source Zener diode**

| Symbol | Parameter | Test conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $BV_{GSO}$(1) | Gate-source breakdown voltage | Igs=± 1 mA (open drain) | 30 | | | V |

1. The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components

## 2.1 Electrical characteristics (curves)

**Figure 2. Safe operating area for TO-220, IPAK, DPAK**

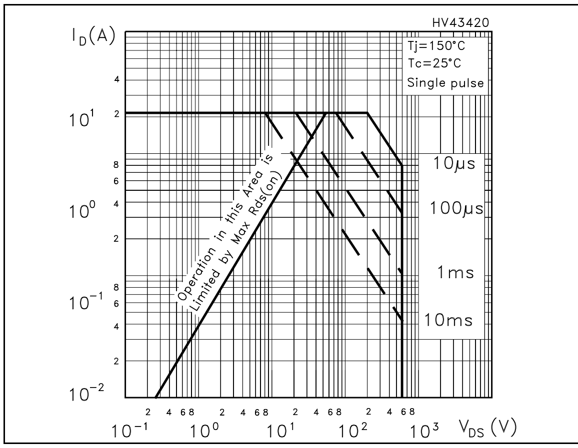



**Figure 3. Thermal impedance for TO-220, IPAK, DPAK**

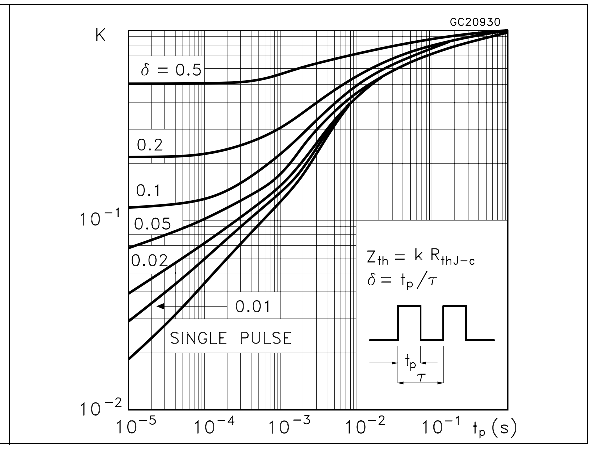



**Figure 4. Safe operating area for TO-220FP**

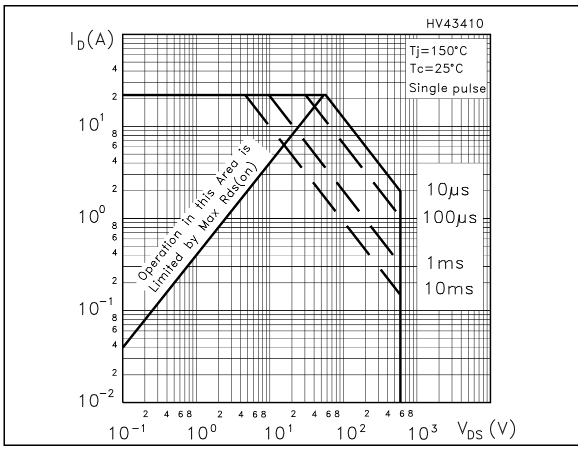



**Figure 5. Thermal impedance for TO-220FP**

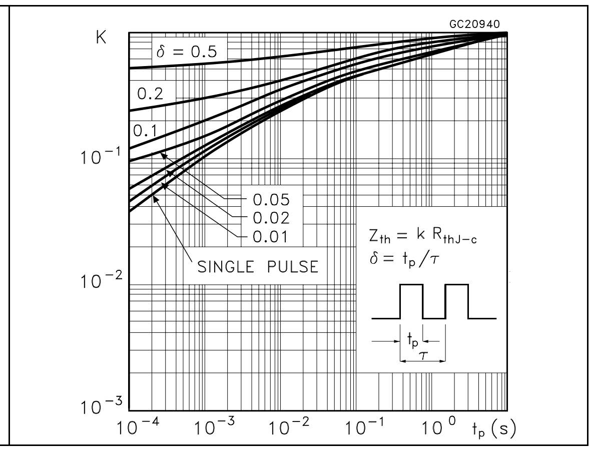



**Figure 6. Output characteristics**

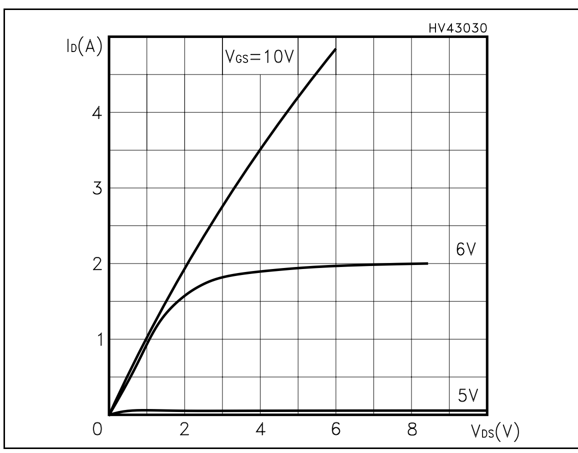



**Figure 7. Transfer characteristics**

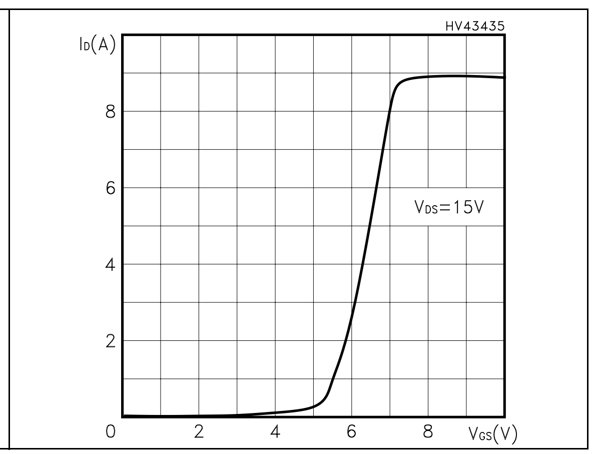


**Figure 8. Normalized $BV_{DSS}$ vs temperature**

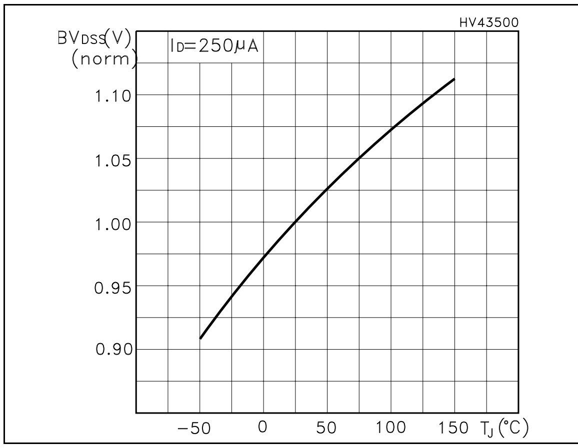



**Figure 9. Static drain-source on resistance**

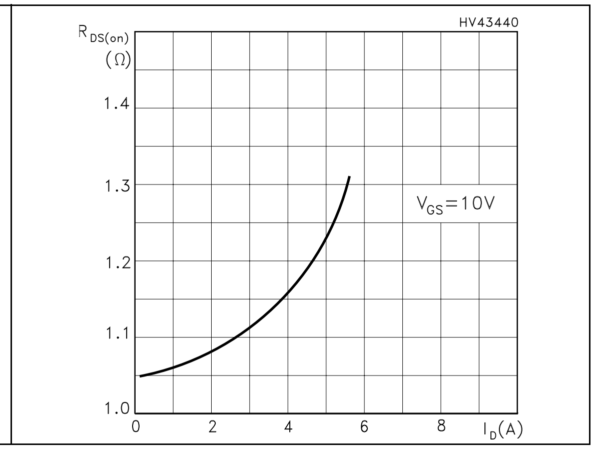



**Figure 10. Gate charge vs gate-source voltage**

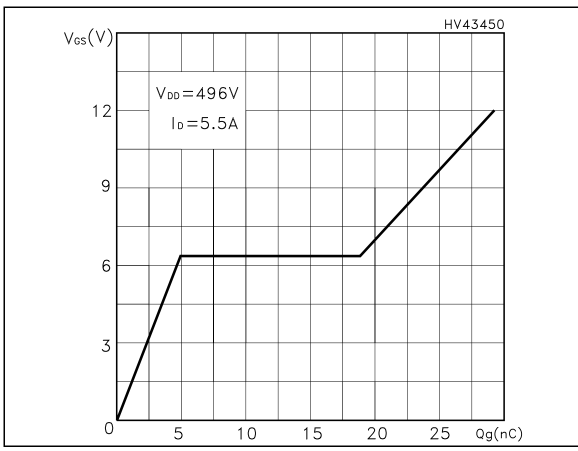



**Figure 11. Capacitance variations**

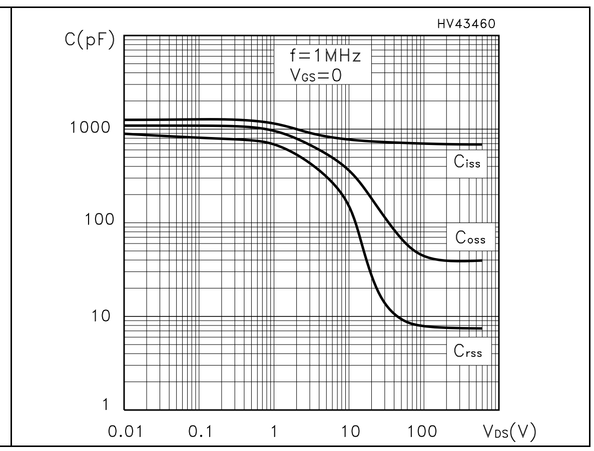



**Figure 12. Normalized gate threshold voltage vs temperature**

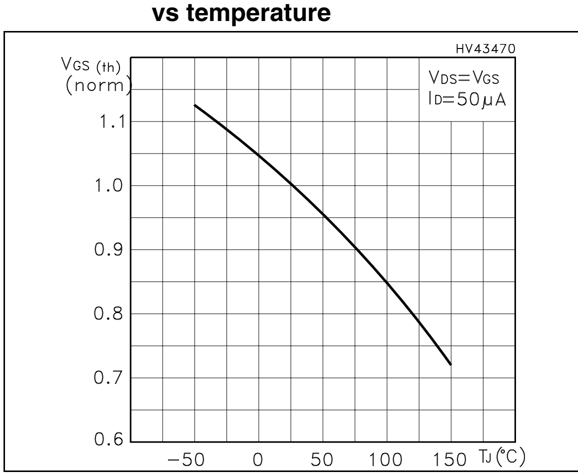



**Figure 13. Normalized on resistance vs temperature**

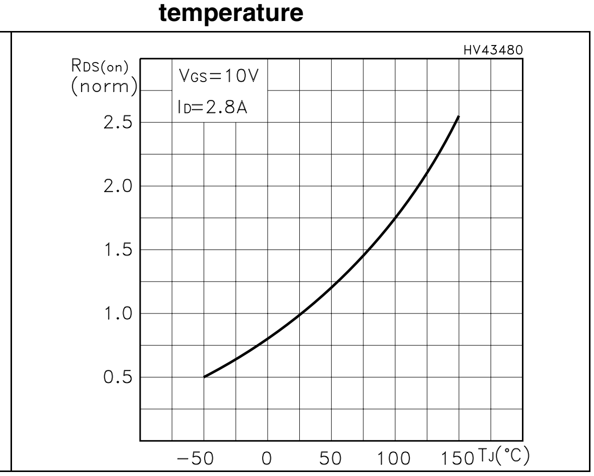


Figure 14. Source-drain diode forward characteristics

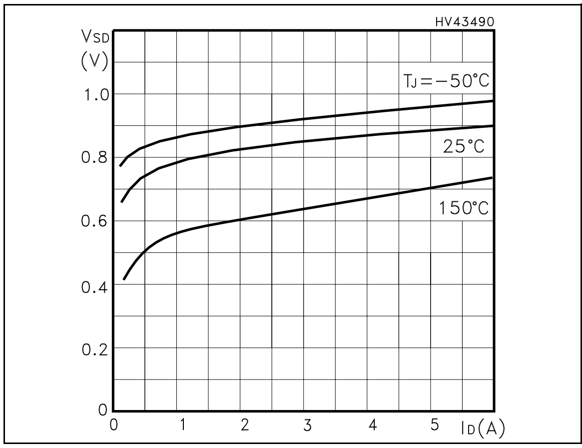
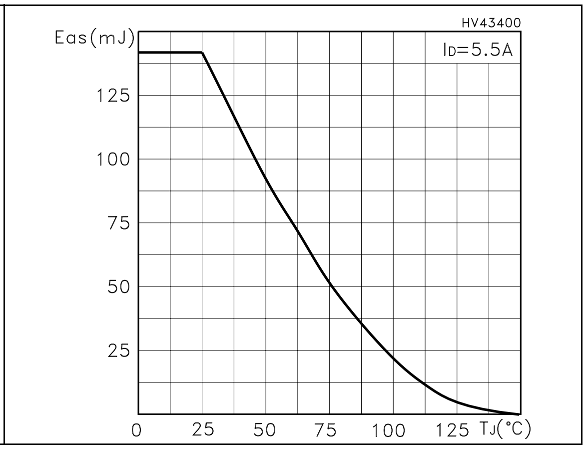



Figure 15. Maximum avalanche energy vs temperature



# 3 Test circuits

**Figure 16. Switching times test circuit for resistive load**

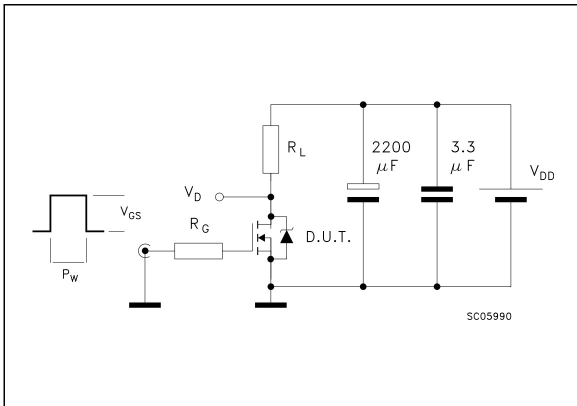



**Figure 17. Gate charge test circuit**

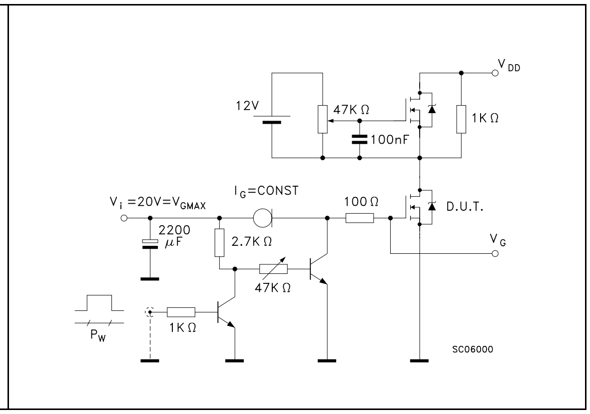



**Figure 18. Test circuit for inductive load switching and diode recovery times**

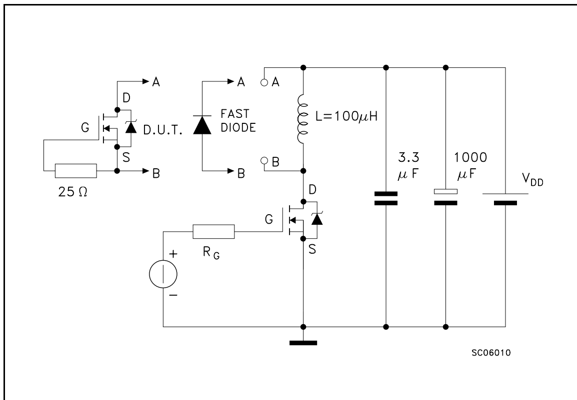



**Figure 19. Unclamped Inductive load test circuit**

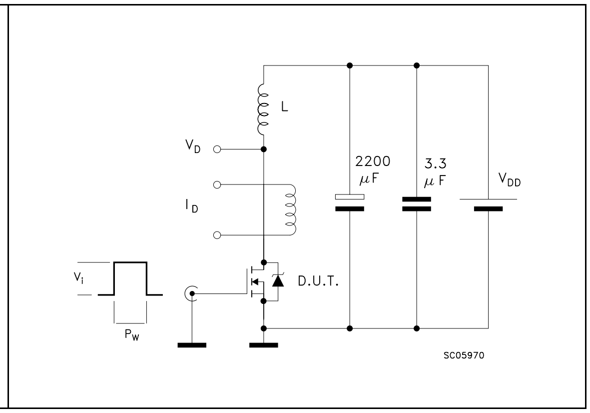



**Figure 20. Unclamped inductive waveform**

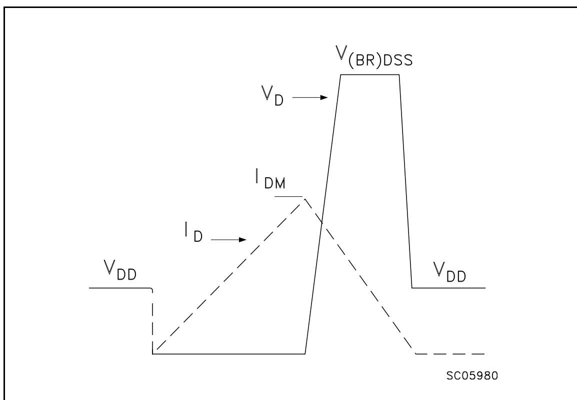
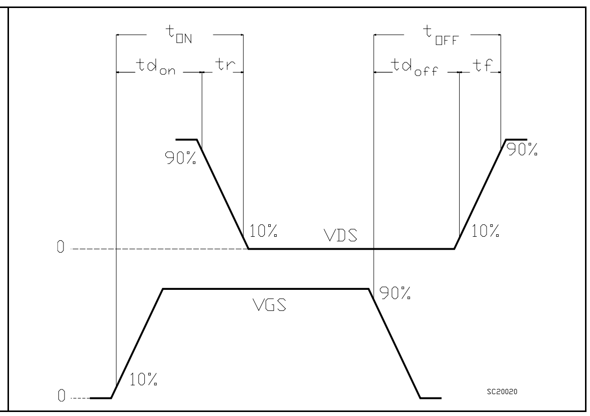



**Figure 21. Switching time waveform**

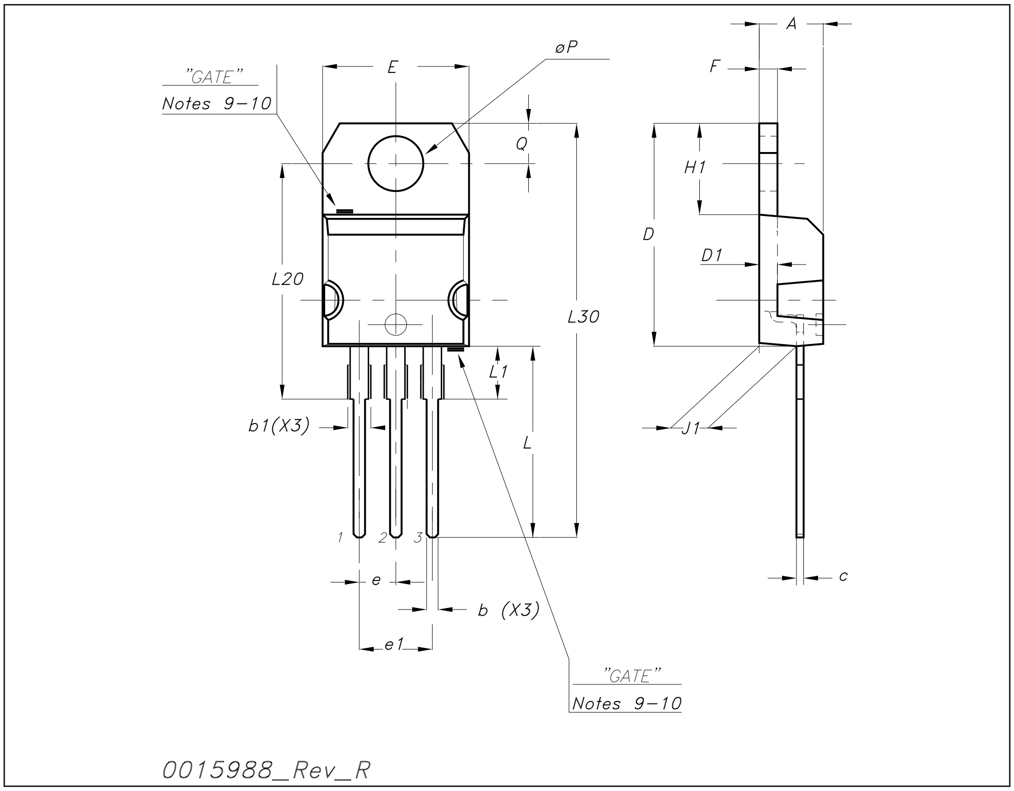


# 4 Package mechanical data

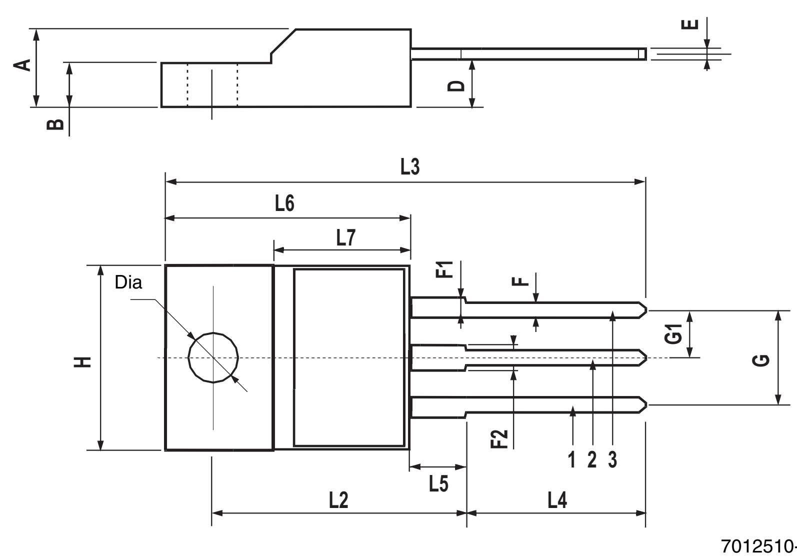
In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: *www.st.com*

**TO-220 mechanical data**

| Dim | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | Min | Typ | Max | Min | Typ | Max |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| b | 0.61 | | 0.88 | 0.024 | | 0.034 |
| b1 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| c | 0.48 | | 0.70 | 0.019 | | 0.027 |
| D | 15.25 | | 15.75 | 0.6 | | 0.62 |
| D1 | | 1.27 | | | 0.050 | |
| E | 10 | | 10.40 | 0.393 | | 0.409 |
| e | 2.40 | | 2.70 | 0.094 | | 0.106 |
| e1 | 4.95 | | 5.15 | 0.194 | | 0.202 |
| F | 1.23 | | 1.32 | 0.048 | | 0.051 |
| H1 | 6.20 | | 6.60 | 0.244 | | 0.256 |
| J1 | 2.40 | | 2.72 | 0.094 | | 0.107 |
| L | 13 | | 14 | 0.511 | | 0.551 |
| L1 | 3.50 | | 3.93 | 0.137 | | 0.154 |
| L20 | | 16.40 | | | 0.645 | |
| L30 | | 28.90 | | | 1.137 | |
| ∅P | 3.75 | | 3.85 | 0.147 | | 0.151 |
| Q | 2.65 | | 2.95 | 0.104 | | 0.116 |

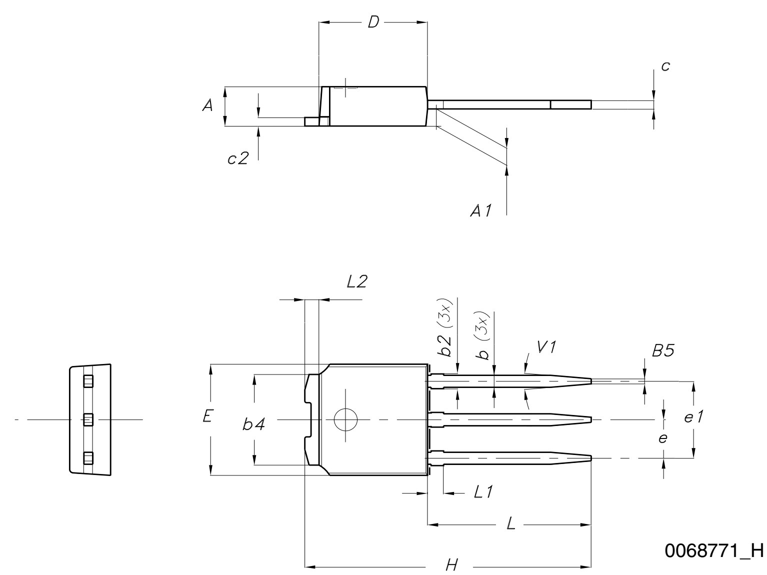


| TO-220FP mechanical data | | | | | | |
|---|---|---|---|---|---|---|
| Dim. | mm. | | | inch | | |
| | Min. | Typ | Max. | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| B | 2.5 | | 2.7 | 0.098 | | 0.106 |
| D | 2.5 | | 2.75 | 0.098 | | 0.108 |
| E | 0.45 | | 0.70 | 0.017 | | 0.027 |
| F | 0.75 | | 1.00 | 0.030 | | 0.039 |
| F1 | 1.15 | | 1.50 | 0.045 | | 0.067 |
| F2 | 1.15 | | 1.50 | 0.045 | | 0.067 |
| G | 4.95 | | 5.20 | 0.195 | | 0.204 |
| G1 | 2.40 | | 2.70 | 0.094 | | 0.106 |
| H | 10 | | 10.40 | 0.393 | | 0.409 |
| L2 | | 16 | | | 0.630 | |
| L3 | 28.6 | | 30.6 | 1.126 | | 1.204 |
| L4 | 9.80 | | 10.60 | 0.385 | | 0.417 |
| L5 | 2.9 | | 3.6 | 0.114 | | 0.141 |
| L6 | 15.90 | | 16.40 | 0.626 | | 0.645 |
| L7 | 9 | | 9.30 | 0.354 | | 0.366 |
| Dia | 3 | | 3.2 | 0.118 | | 0.126 |



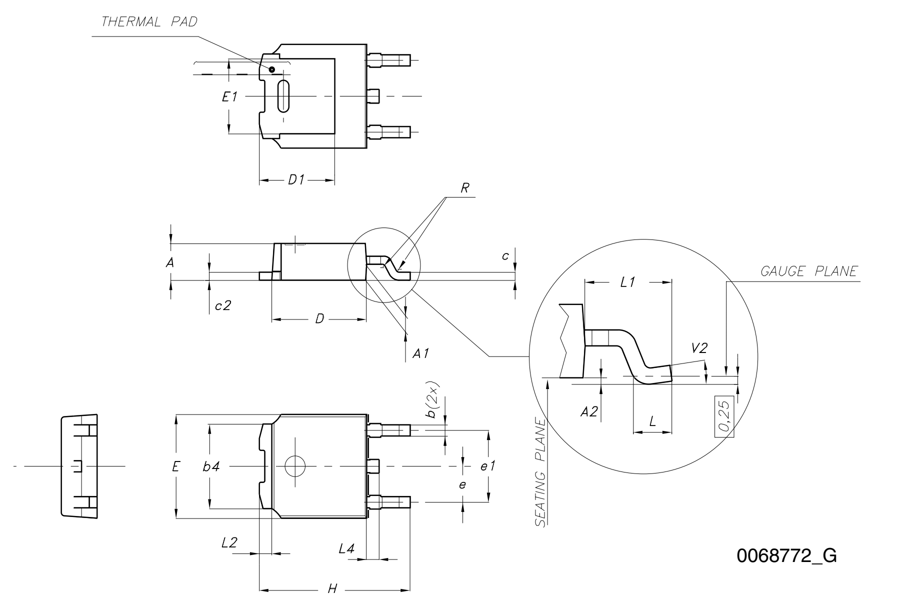
## TO-251 (IPAK) mechanical data

| DIM. | mm. | | |
|---|---|---|---|
| | min. | typ | max. |
| A | 2.20 | | 2.40 |
| A1 | 0.90 | | 1.10 |
| b | 0.64 | | 0.90 |
| b2 | | | 0.95 |
| b4 | 5.20 | | 5.40 |
| c | 0.45 | | 0.60 |
| c2 | 0.48 | | 0.60 |
| D | 6.00 | | 6.20 |
| E | 6.40 | | 6.60 |
| e | | 2.28 | |
| e1 | 4.40 | | 4.60 |
| H | | 16.10 | |
| L | 9.00 | | 9.40 |
| (L1) | 0.80 | | 1.20 |
| L2 | | 0.80 | |
| V1 | | 10 ° | |



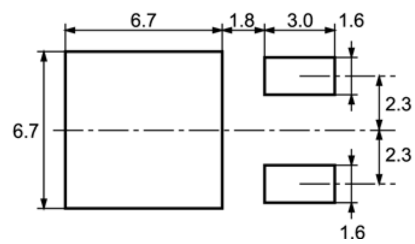
## TO-252 (DPAK) mechanical data

| 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 | | |
| L1 | | 2.80 | |
| L2 | | 0.80 | |
| L4 | 0.60 | | 1 |
| R | | 0.20 | |
| V2 | 0 ° | | 8 ° |



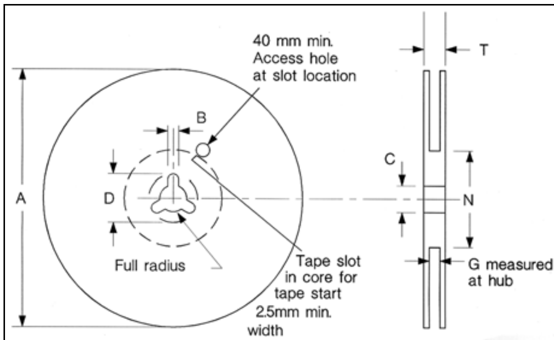
# 5 Package mechanical data

## DPAK FOOTPRINT




All dimensions are in millimeters

## TAPE AND REEL SHIPMENT



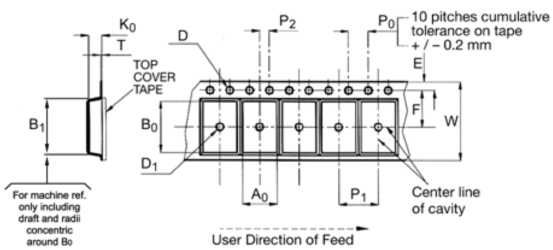

REEL MECHANICAL DATA

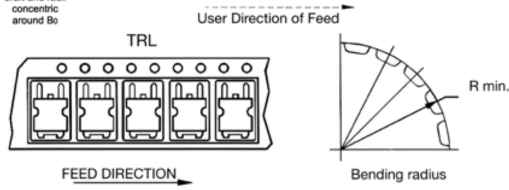
| DIM. | mm | | inch | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A | | 330 | | 12.992 |
| B | 1.5 | | 0.059 | |
| C | 12.8 | 13.2 | 0.504 | 0.520 |
| D | 20.2 | | 0.795 | |
| G | 16.4 | 18.4 | 0.645 | 0.724 |
| N | 50 | | 1.968 | |
| T | | 22.4 | | 0.881 |

| BASE QTY | BULK QTY |
|---|---|
| 2500 | 2500 |

TAPE MECHANICAL DATA

| DIM. | mm | | inch | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A0 | 6.8 | 7 | 0.267 | 0.275 |
| B0 | 10.4 | 10.6 | 0.409 | 0.417 |
| B1 | | 12.1 | | 0.476 |
| D | 1.5 | 1.6 | 0.059 | 0.063 |
| D1 | 1.5 | | 0.059 | |
| E | 1.65 | 1.85 | 0.065 | 0.073 |
| F | 7.4 | 7.6 | 0.291 | 0.299 |
| K0 | 2.55 | 2.75 | 0.100 | 0.108 |
| P0 | 3.9 | 4.1 | 0.153 | 0.161 |
| P1 | 7.9 | 8.1 | 0.311 | 0.319 |
| P2 | 1.9 | 2.1 | 0.075 | 0.082 |
| R | 40 | | 1.574 | |
| W | 15.7 | 16.3 | 0.618 | 0.641 |



# 6 Revision history

Table 10. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 19-May-2006 | 1 | First release |