



STB50NF25 STP50NF25

N-channel 250V - 0.055Ω - 45A - D²PAK - TO-220
low gate charge STripFET™ Power MOSFET

Features

| Type | V _{DSS} | R _{DS(on)} Max | I _D | P _W |
|-----------|------------------|----------------------------|----------------|----------------|
| STP50NF25 | 250 V | <0.069 Ω | 45 A | 160 W |
| STB50NF25 | 250 V | <0.069 Ω | 45 A | 160 W |

- 100% avalanche tested
- Gate charge minimized
- Low intrinsic capacitances

Application

Switching applications

Description

This Power MOSFET series realized with STMicroelectronics unique STripFET™ process has specifically been designed to minimize on-resistance and gate charge. It is therefore suitable as primary side switch allowing high efficiencies.

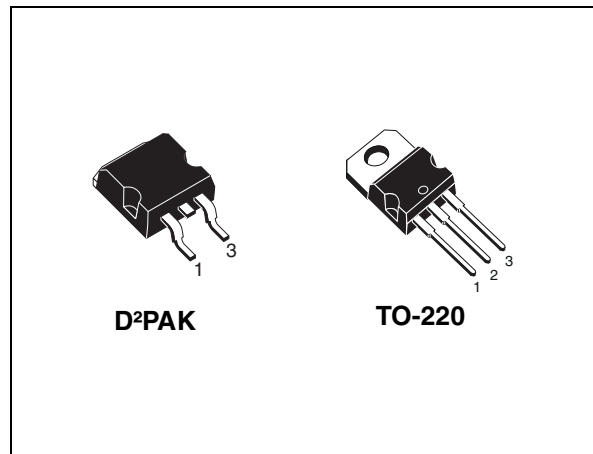


Figure 1. Internal schematic diagram

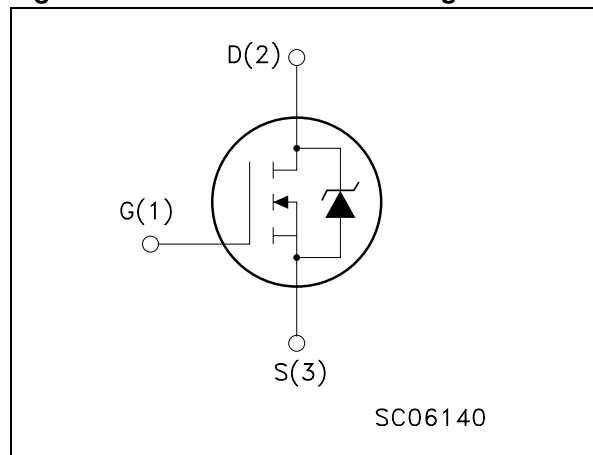


Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|-------------|---------|--------------------|-------------|
| STP50NF25 | 50NF25 | TO-220 | Tube |
| STB50NF25 | 50NF25 | D ² PAK | Tape & reel |

Contents

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|--------------------|---|------------|---------------------|
| V_{DS} | Drain-source voltage | 250 | V |
| V_{GS} | Gate-source voltage | ± 20 | V |
| $I_D^{(1)}$ | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 45 | A |
| $I_D^{(1)}$ | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 28 | A |
| $I_{DM}^{(2)}$ | Drain current (pulsed) | 180 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 160 | W |
| | Derating factor | 1.28 | W/ $^\circ\text{C}$ |
| $dv/dt^{(3)}$ | Peak diode recovery voltage slope | 10 | V/ns |
| T_j T_{stg} | Operating junction temperature Storage temperature | -55 to 150 | $^\circ\text{C}$ |

1. Value limited by wire bonding
2. Pulse width limited by safe operating area
3. $I_{SD} \leq 45\text{ A}$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$

Table 3. Thermal data

| Symbol | Parameter | Value | Unit |
|-----------|--|-------|---------------------------|
| Rthj-case | Thermal resistance junction-case max | 0.78 | $^\circ\text{C}/\text{W}$ |
| Rthj-amb | Thermal resistance junction-amb max | 62.5 | $^\circ\text{C}/\text{W}$ |
| T_l | Maximum lead temperature for soldering purpose | 300 | $^\circ\text{C}$ |

Table 4. Avalanche data

| Symbol | Parameter | Value | Unit |
|----------------|---|-------|------|
| $I_{AR}^{(1)}$ | Avalanche current, repetitive or not-repetitive | 32 | A |
| $E_{AS}^{(2)}$ | Single pulse avalanche energy | 160 | mJ |

1. Pulse width limited by T_{jmax}
2. Starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$

2 Electrical characteristics

($T_{CASE}=25^{\circ}C$ unless otherwise specified)

Table 5. On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|---|------|-------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D = 1 \text{ mA}, V_{GS} = 0$ | 250 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = \text{Max rating},$ $V_{DS} = \text{Max rating @ } 125^{\circ}C$ | | | 1 10 | μA μA |
| I_{GSS} | Gate body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 20 \text{ V}$ | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 250 \mu\text{A}$ | 2 | 3 | 4 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10 \text{ V}, I_D = 22 \text{ A}$ | | 0.055 | 0.069 | Ω |

Table 6. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------|------------------------------|---|------|------|------|----------|
| $g_{fs}^{(1)}$ | Forward transconductance | $V_{DS} = 10 \text{ V}, I_D = 22 \text{ A}$ | | 20 | | S |
| C_{iss} | Input capacitance | $V_{DS} = 25 \text{ V}, f = 1 \text{ MHz},$ $V_{GS} = 0$ | | 2670 | | pF |
| C_{oss} | Output capacitance | | | 465 | | pF |
| C_{rss} | Reverse transfer capacitance | | | 70.5 | | pF |
| Q_g | Total gate charge | $V_{DD} = 200 \text{ V}, I_D = 45 \text{ A}$ $V_{GS} = 10 \text{ V}$ <i>(see Figure 14)</i> | | 68.2 | | nC |
| Q_{gs} | Gate-source charge | | | 12.2 | | nC |
| Q_{gd} | Gate-drain charge | | | 33.4 | | nC |
| R_G | Gate input resistance | f=1 MHz Gate Bias, Bias=0 Test signal level=20 mV open drain | | 1.1 | | Ω |

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

Table 7. Switching times

| Symbol | Parameter | Test conditions | Min | Typ | Max | Unit |
|-----------------------|------------------------------------|--|-----|----------|-----|----------|
| $t_{d(on)}$ t_r | Turn-on delay time Rise time | $V_{DD} = 125\text{ V}$, $I_D = 22\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 13) | | 45 26 | | ns ns |
| $t_{d(off)}$ t_f | Off-voltage rise time Fall time | $V_{DD} = 125\text{ V}$, $I_D = 22\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 13) | | 63 20 | | ns ns |

Table 8. Source drain diode

| Symbol | Parameter | Test conditions | Min | Typ | Max | Unit |
|-----------------------------------|--|--|-----|------------------|-----------|--------------------------|
| I_{SD} I_{SDM} | Source-drain current Source-drain current (pulsed) | | | | 45 180 | A A |
| V_{SD} | Forward on voltage | $I_{SD} = 45\text{ A}$, $V_{GS} = 0$ | | | 1.5 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse recovery time Reverse recovery charge Reverse recovery current | $I_{SD} = 45\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see Figure 18) | | 198 1.5 15 | | ns μC A |
| t_{rr} Q_{rr} I_{RRM} | Reverse recovery time Reverse recovery charge Reverse recovery current | $I_{SD} = 45\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 18) | | 256 2.2 17 | | ns μC A |

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

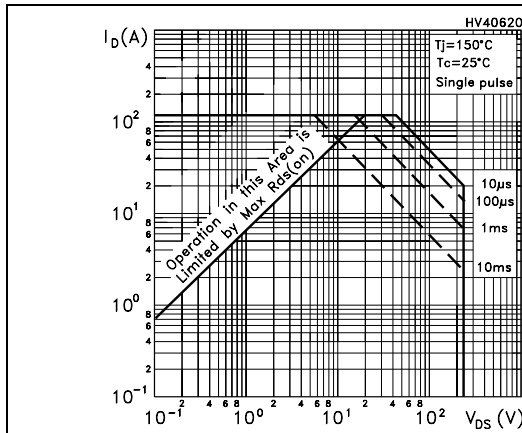


Figure 3. Thermal impedance

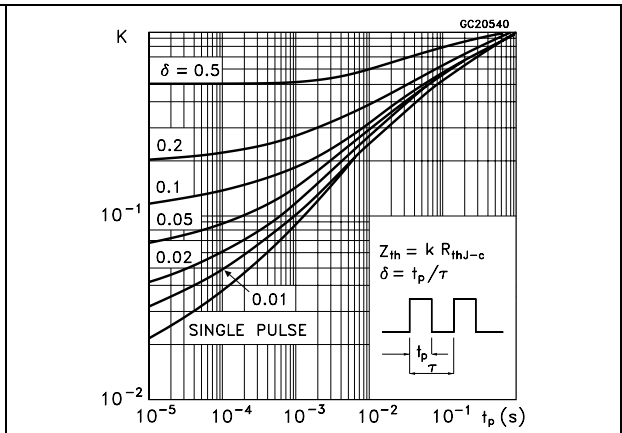


Figure 4. Output characteristics

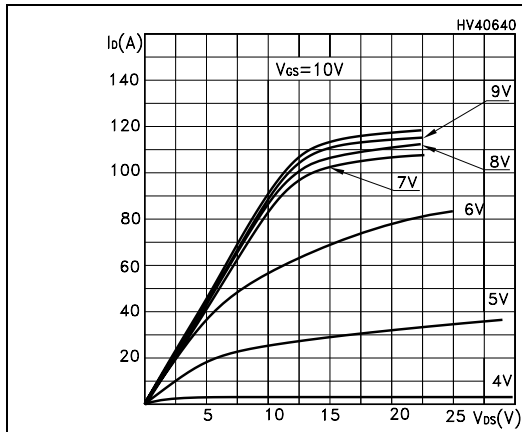


Figure 5. Transfer characteristics

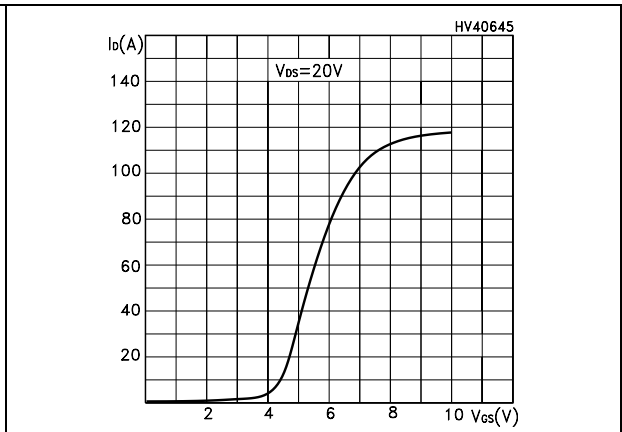


Figure 6. Normalized $B_{V_{DS}}$ vs temperature

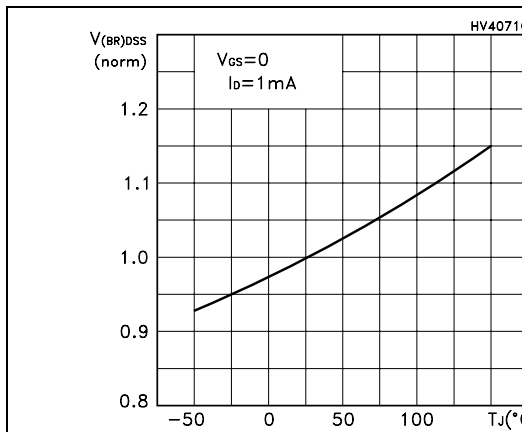


Figure 7. Static drain-source on resistance

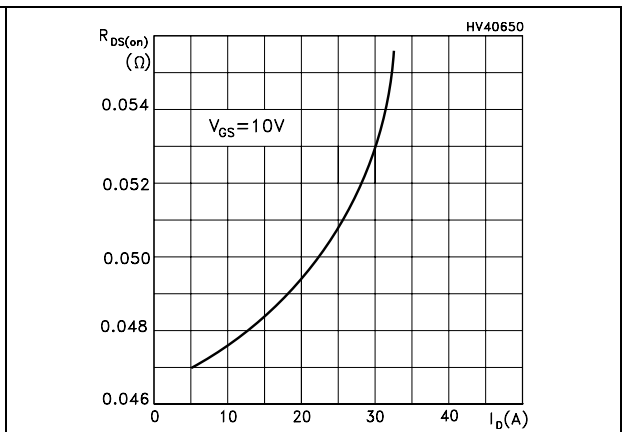


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

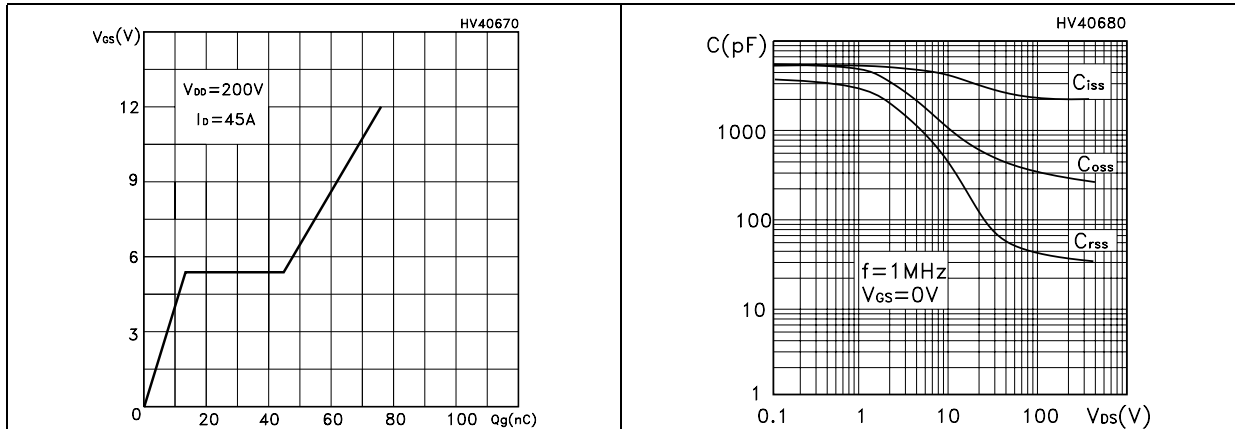


Figure 10. Normalized gate threshold voltage vs temperature

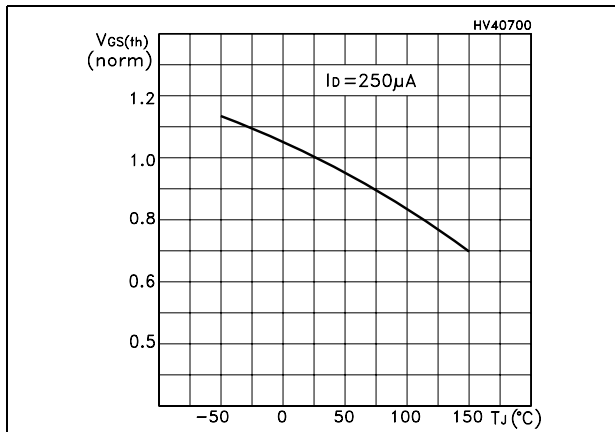


Figure 11. Normalized on resistance vs temperature

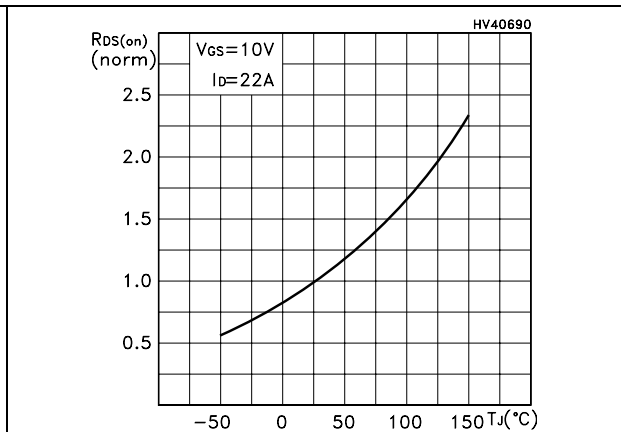
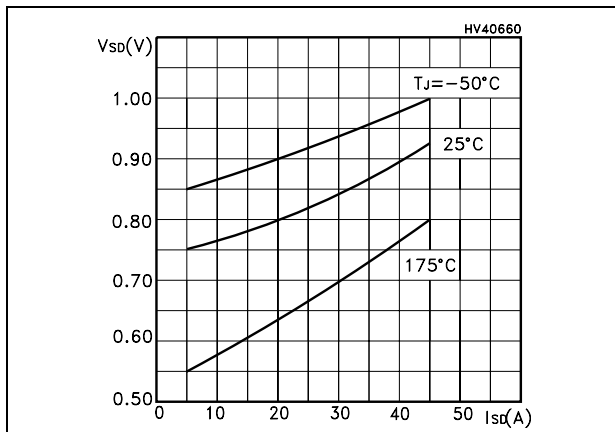


Figure 12. Source-drain diode forward characteristics



3 Test circuit

Figure 13. Switching times test circuit for resistive load

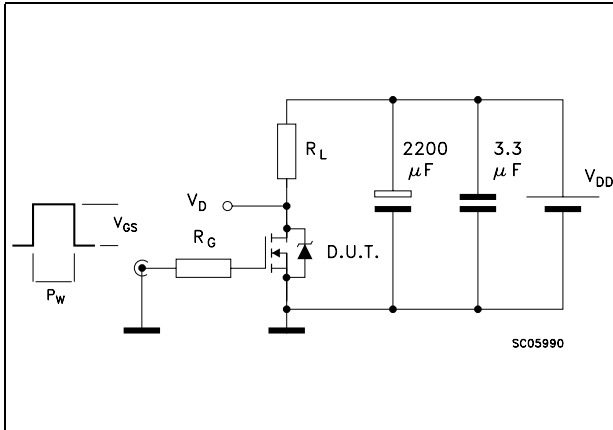


Figure 14. Gate charge test circuit

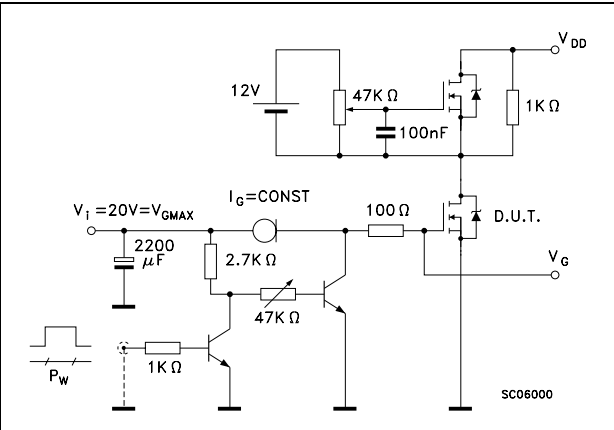


Figure 15. Test circuit for inductive load switching and diode recovery times

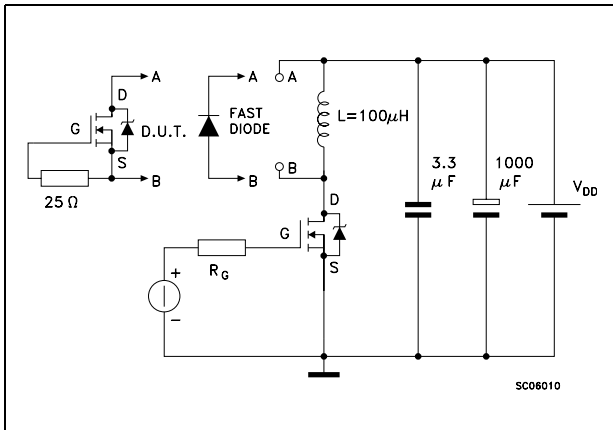


Figure 16. Unclamped Inductive load test circuit

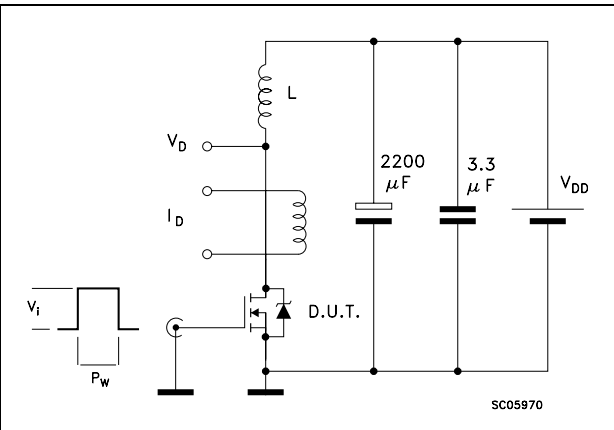


Figure 17. Unclamped inductive waveform

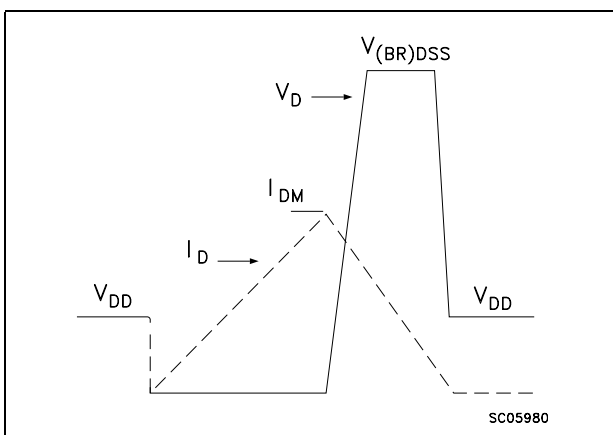
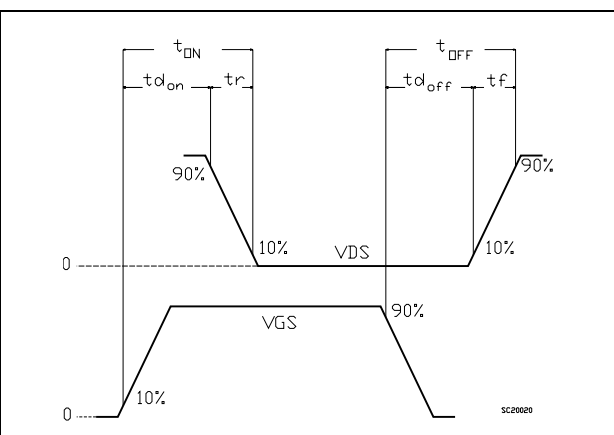


Figure 18. Switching time waveform

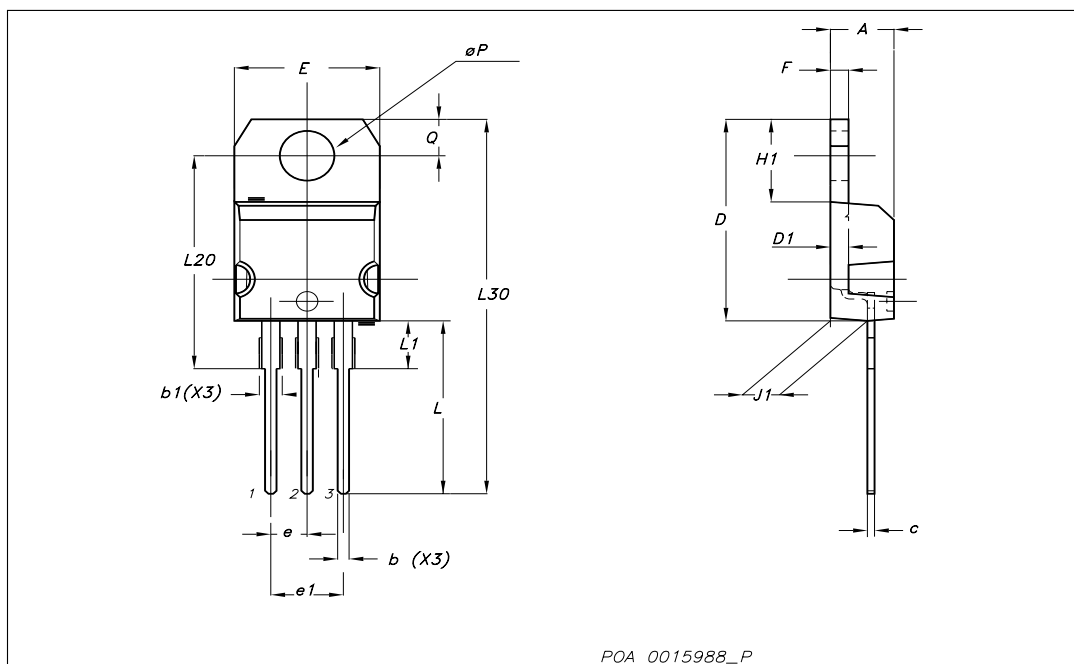


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in 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

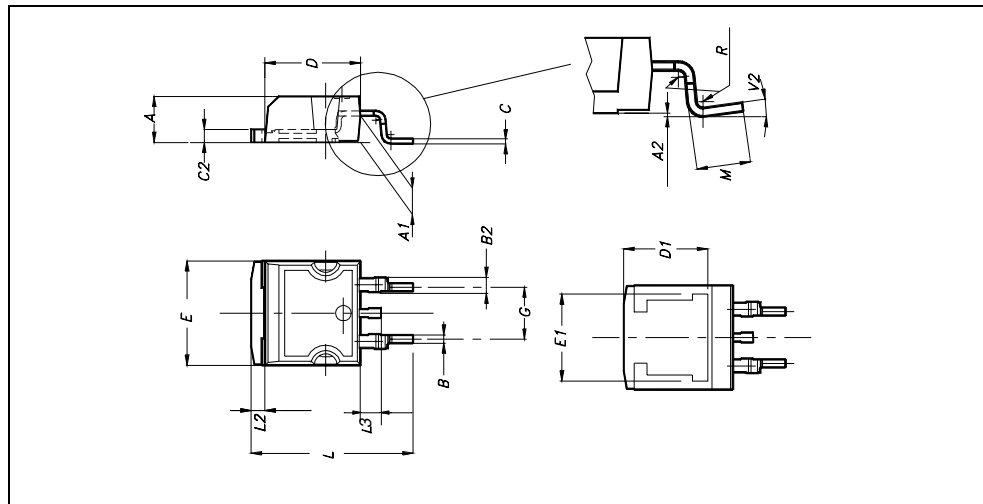
TO-220 mechanical data

| 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 | 0.49 | | 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 |



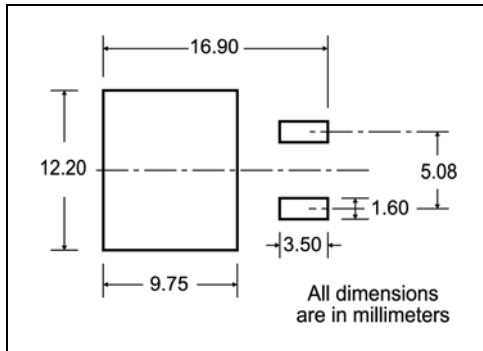
D²PAK MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|------|------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| A1 | 2.49 | | 2.69 | 0.098 | | 0.106 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.7 | | 0.93 | 0.027 | | 0.036 |
| B2 | 1.14 | | 1.7 | 0.044 | | 0.067 |
| C | 0.45 | | 0.6 | 0.017 | | 0.023 |
| C2 | 1.23 | | 1.36 | 0.048 | | 0.053 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| D1 | | 8 | | | 0.315 | |
| E | 10 | | 10.4 | 0.393 | | |
| E1 | | 8.5 | | | 0.334 | |
| G | 4.88 | | 5.28 | 0.192 | | 0.208 |
| L | 15 | | 15.85 | 0.590 | | 0.625 |
| L2 | 1.27 | | 1.4 | 0.050 | | 0.055 |
| L3 | 1.4 | | 1.75 | 0.055 | | 0.068 |
| M | 2.4 | | 3.2 | 0.094 | | 0.126 |
| R | | 0.4 | | | 0.015 | |
| V2 | 0° | | 4° | | | |



5 Packaging mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT

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 |

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 | 24.4 | 26.4 | 0.960 | 1.039 |
| N | 100 | | 3.937 | |
| T | | 30.4 | | 1.197 |

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

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.

* on sales type

6 Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 07-Mar-2007 | 1 | First release |
| 10-Mar-2007 | 2 | Typo mistake on page 1 (marking) |
| 13-Apr-2007 | 3 | Corrected value on Table 6 . |
| 14-Nov-2007 | 4 | Added new section: <i>Electrical characteristics (curves)</i> |

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