



# STP36NF06L STB36NF06L

N-channel 60V - 0.032Ω - 30A - TO-220 - D<sup>2</sup>PAK  
STripFET™ II Power MOSFET

## General features

| Type       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|------------|------------------|---------------------|----------------|
| STP36NF06L | 60V              | < 0.04Ω             | 30A            |
| STB36NF06L | 60V              | < 0.04Ω             | 30A            |

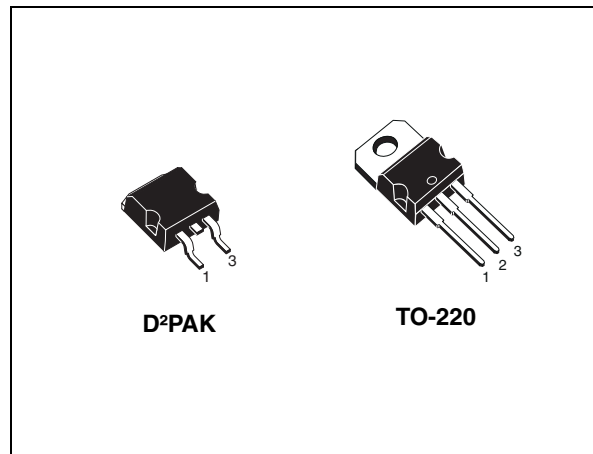
- Exceptional dv/dt capability
- 100% avalanche tested
- Low threshold drive

## Description

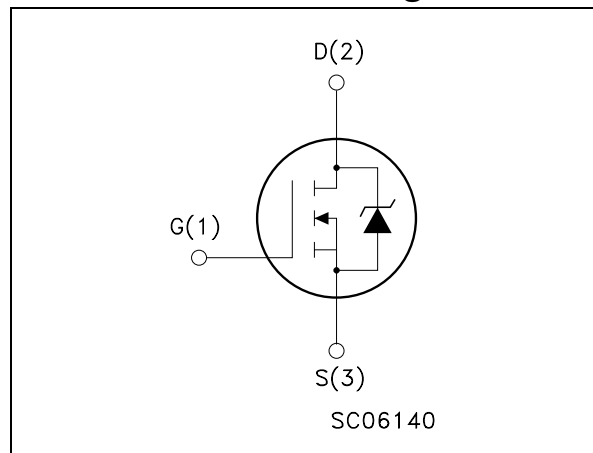
This Power MOSFET is the latest development of STMicroelectronics unique “Single Feature Size™” strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

## Applications

- Switching application



## Internal schematic diagram



## Order codes

| Sales type | Marking  | Package            | Packaging   |
|------------|----------|--------------------|-------------|
| STP36NF06L | P36NF06L | TO-220             | Tube        |
| STB36NF06L | B36NF06  | D <sup>2</sup> PAK | Tape & reel |

## Contents:

|          |   |           |
|----------|---|-----------|
| <b>1</b> | <b>Electrical ratings</b> .....           | <b>3</b>  |
| <b>2</b> | <b>Electrical characteristics</b> .....   | <b>4</b>  |
| 2.1      | Electrical characteristics (curves) ..... | 6         |
| <b>3</b> | <b>Test circuit</b> .....                 | <b>8</b>  |
| <b>4</b> | <b>Package mechanical data</b> .....      | <b>9</b>  |
| <b>5</b> | <b>Packaging mechanical data</b> .....    | <b>12</b> |
| <b>6</b> | <b>Revision history</b> .....             | <b>13</b> |

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol             | Parameter   | Value      | Unit          |
|--------------------|---|------------|---------------|
| $V_{DS}$           | Drain-source Voltage ( $V_{GS}=0$ )                   | 60         | V             |
| $V_{DGR}$          | Drain-gate voltage ( $R_{GS}=20K\Omega$ )             | 60         | V             |
| $V_{GS}$           | Gate-source voltage                                   | $\pm 18$   | V             |
| $I_D$              | Drain-current (continuous) at $T_c=25^\circ C$        | 30         | A             |
| $I_D$              | Drain-current (continuous) at $T_c=100^\circ C$       | 21         | A             |
| $I_{DM}^{(1)}$     | Drain-current (pulsed)                                | 120        | A             |
| $P_{TOT}$          | Total dissipation at $T_c=25^\circ C$                 | 70         | W             |
|                    | Derating factor                                       | 0.47       | W/ $^\circ C$ |
| $dv/dt^{(2)}$      | Peak diode recovery voltage slope                     | 10         | V/ns          |
| $E_{AS}^{(3)}$     | Single pulse avalanche energy                         | 225        | mJ            |
| $T_j$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature | -55 to 175 | $^\circ C$    |

1. Pulse width limited by safe operating area.
2.  $I_{SD} \leq 30A$ ,  $di/dt \leq 400A/\mu s$ ,  $V_{DD} \leq V_{(BR)DSS}$ .  $T_j \leq T_{jmax}$
3. Starting  $T_j=25^\circ C$ ,  $I_D=15A$ ,  $V_{DD}=30V$

**Table 2. Thermal resistance**

| Symbol         | Parameter  | Value | Unit         |
|----------------|--|-------|--------------|
| $R_{thj-case}$ | Thermal resistance junction-case max               | 2.14  | $^\circ C/W$ |
| $R_{thj-amb}$  | Thermal resistance junction-ambient (free air) max | 62.5  | $^\circ C/W$ |
| $T_l$          | Maximum lead temperature for soldering purpose     | 300   | $^\circ C$   |

## 2 Electrical characteristics

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

**Table 3. Static**

| Symbol        | Parameter                                      | Test conditions  | Min. | Typ.           | Max.         | Unit                 |
|---------------|--|--|------|----------------|--------------|----------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                 | $I_D=250\mu A, V_{GS}=0$   | 60   |                |              | V                    |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS}=0$ ) | $V_{DS}=\text{Max rating}$<br>$V_{DS}=\text{Max rating } T_c=125^{\circ}C$ |      |                | 1<br>10      | $\mu A$<br>$\mu A$   |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS}=0$ )       | $V_{GS}=\pm 18V$   |      |                | $\pm 100$    | nA                   |
| $V_{GS(th)}$  | Gate Threshold Voltage                         | $V_{DS}=V_{GS}, I_D=250\mu A$  | 1    |                | 2.5          | V                    |
| $R_{DS(on)}$  | Static drain-source on resistance              | $V_{GS}=10V, I_D=15A$<br>$V_{GS}=5V, I_D=15A$                              |      | 0.032<br>0.045 | 0.04<br>0.05 | $\Omega$<br>$\Omega$ |

**Table 4. Dynamic**

| Symbol    | Parameter                    | Test conditions                      | Min | Typ | Max | Unit |
|-----------|------------------------------|--------------------------------------|-----|-----|-----|------|
| gfs       | Forward transconductance     | $V_{DS}=15V, I_D=15A$                |     | 15  |     | S    |
| $C_{iss}$ | Input capacitance            | $V_{DS}=25V, f=1MHz, V_{GS}=0$       |     | 660 |     | pF   |
| $C_{oss}$ | Output capacitance           |                                      |     | 170 |     | pF   |
| $C_{rss}$ | Reverse transfer capacitance |                                      |     | 70  |     | pF   |
| $Q_g$     | Total gate charge            | $V_{DD}=30V, I_D=30A$<br>$V_{GS}=5V$ |     | 13  | 17  | nC   |
| $Q_{gs}$  | Gate-source charge           |                                      |     | 4.2 |     | nC   |
| $Q_{gd}$  | Gate-drain charge            |                                      |     | 7.8 |     | nC   |

**Table 5. Switching on/off (inductive load)**

| Symbol                | Parameter                        | Test conditions   | Min. | Typ.     | Max. | Unit     |
|-----------------------|----------------------------------|---|------|----------|------|----------|
| $t_{d(on)}$<br>$t_r$  | Turn-on delay Time<br>Rise time  | $V_{DD}=30V$ , $I_D=15A$<br>$R_G=4.7\Omega$ , $V_{GS}=5V$<br>(see <a href="#">Figure 14</a> ) |      | 10<br>80 |      | ns<br>ns |
| $t_{d(off)}$<br>$t_f$ | Turn-off delay time<br>Fall time | $V_{DD}=30V$ , $I_D=15A$<br>$R_G=4.7\Omega$ , $V_{GS}=5V$<br>(see <a href="#">Figure 14</a> ) |      | 19<br>13 |      | ns<br>ns |

**Table 6. Source Drain Diode**

| Symbol          | Parameter                     | Test conditions   | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|------|
| $I_{SD}$        | Source-drain current          |   |      |      | 30   | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |   |      |      | 120  | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD}=24A$ , $V_{GS}=0$   |      |      | 1.5  | V    |
| $t_{rr}$        | Reverse recovery time         |   |      | 55   |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       | $I_{SD}=20A$ , $V_{DD}=20V$ ,<br>$di/dt=100A/\mu s$ , $T_j=150^\circ C$ |      | 107  |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |   |      | 3.9  |      | A    |

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration=300 $\mu s$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

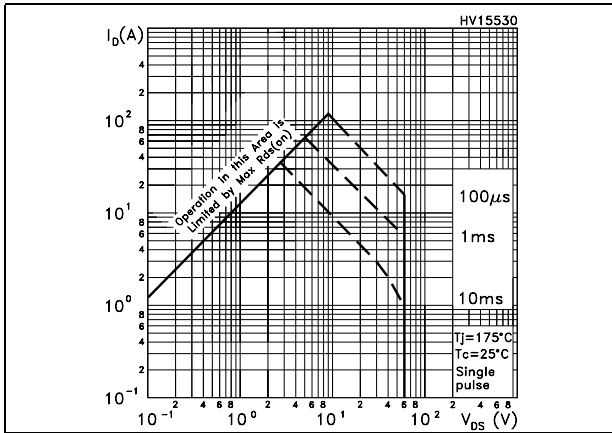


Figure 2. Thermal impedance

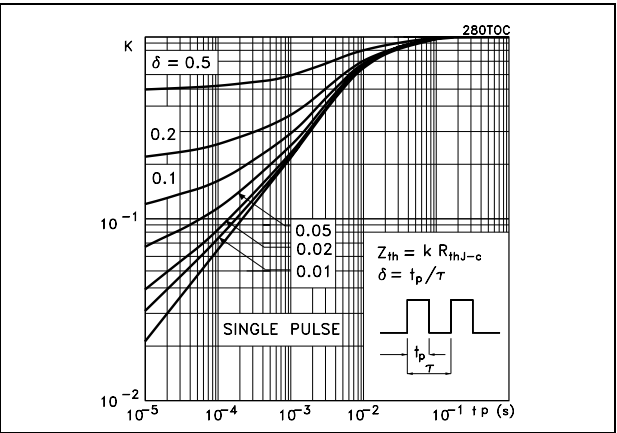


Figure 3. Output characteristics

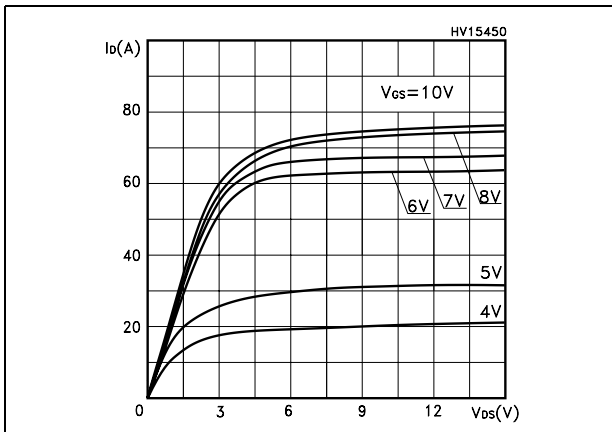


Figure 4. Transfer characteristics

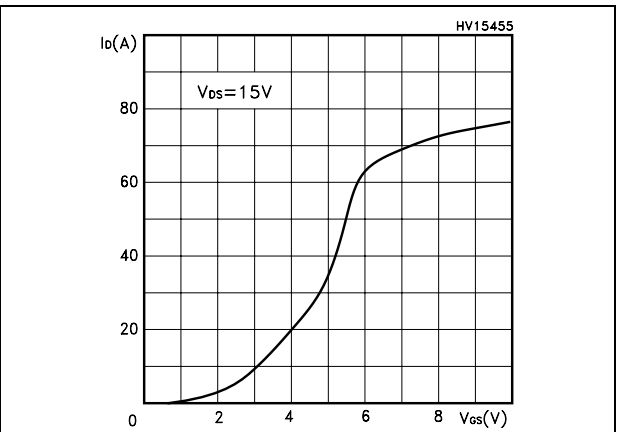


Figure 5. Transconductance

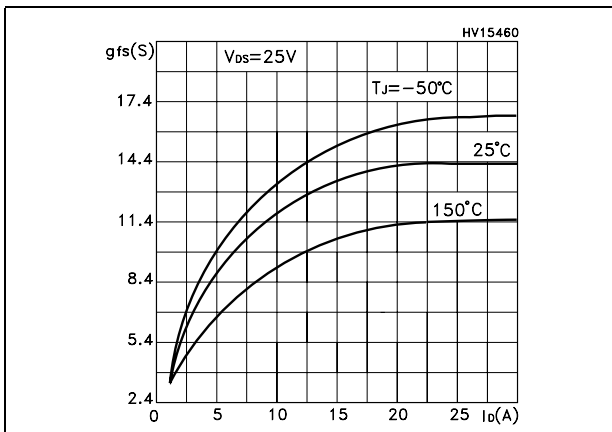


Figure 6. Static drain-source on resistance

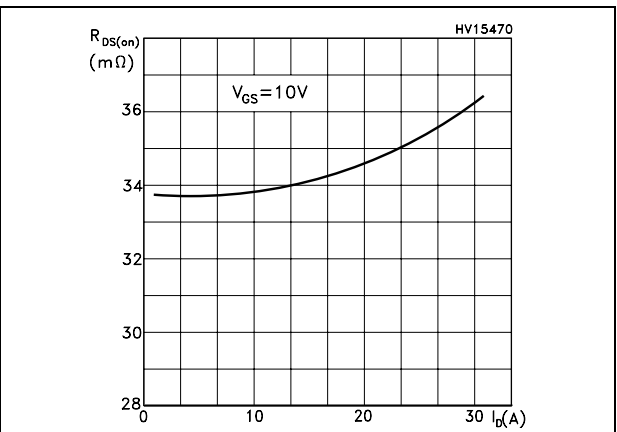


Figure 7. Gate charge vs gate-source voltage Figure 8. Capacitance variations

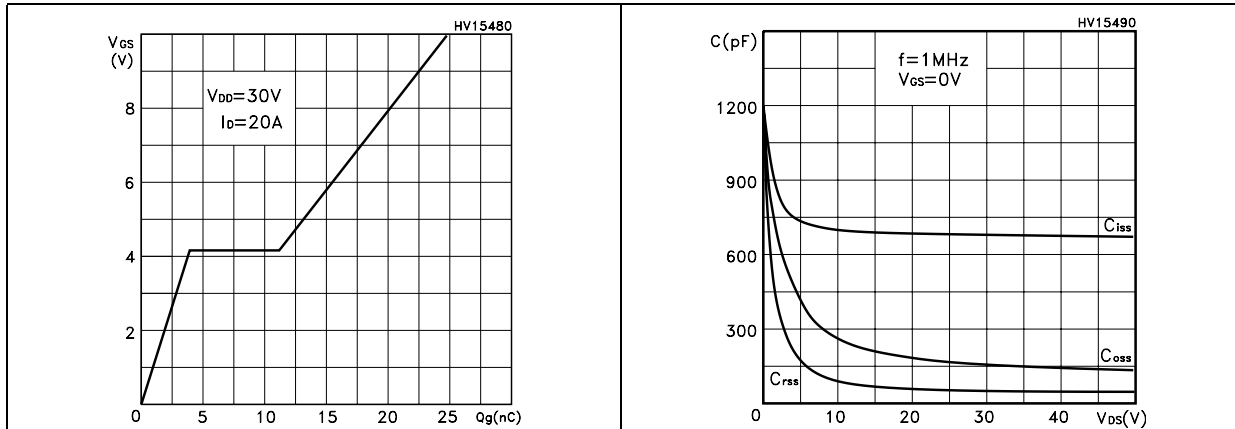


Figure 9. Normalized gate threshold voltage vs temperature Figure 10. Normalized on resistance vs temperature

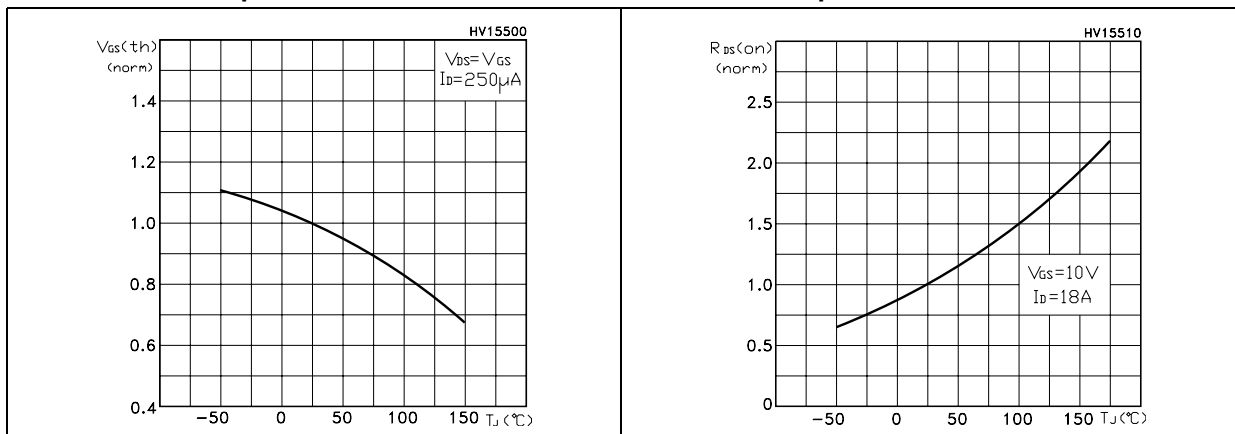
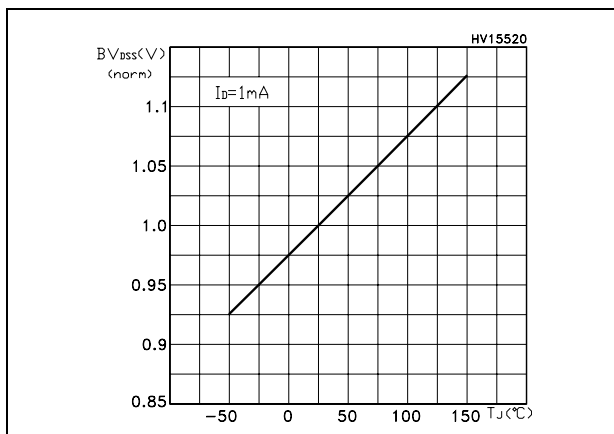


Figure 11. Normalized  $B_{V_{DSS}}$  vs temperature



### 3 Test circuit

Figure 12. Unclamped inductive load test circuit

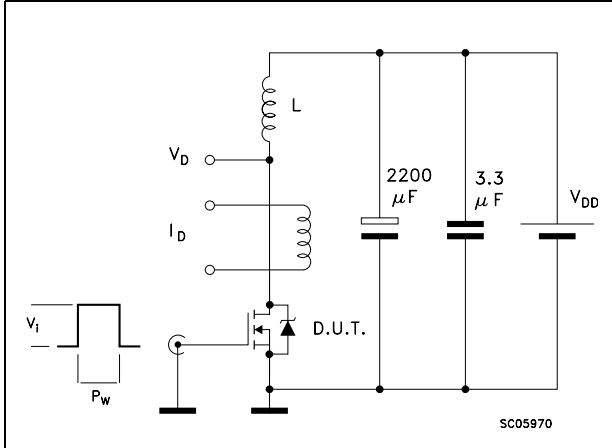


Figure 13. Unclamped inductive waveform

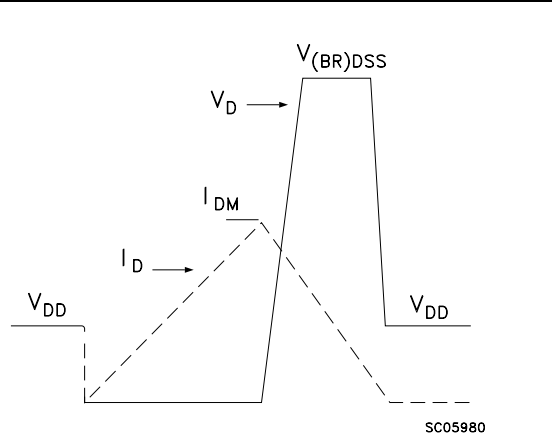


Figure 14. Switching times test circuit for resistive load

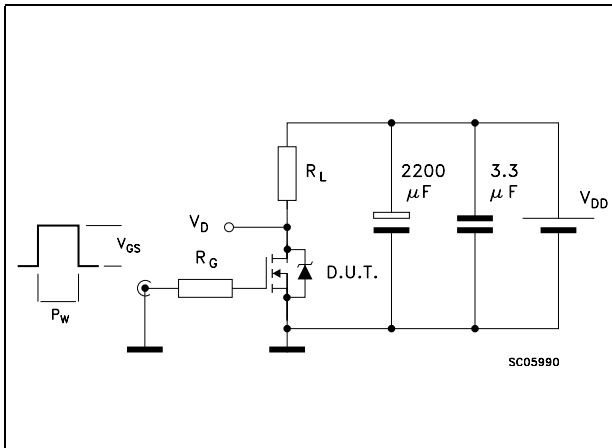


Figure 15. Gate charge test circuit

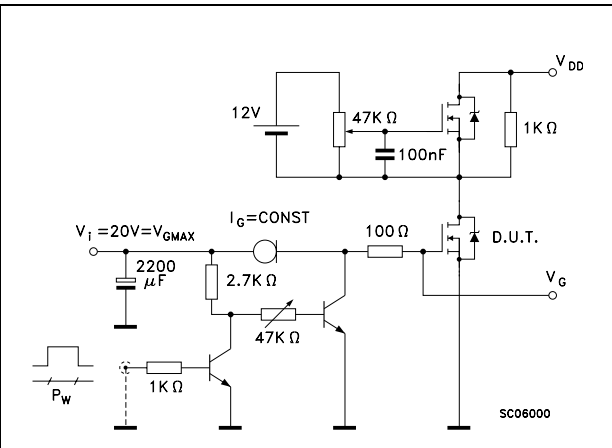


Figure 16. Test circuit for inductive load switching and diode recovery times

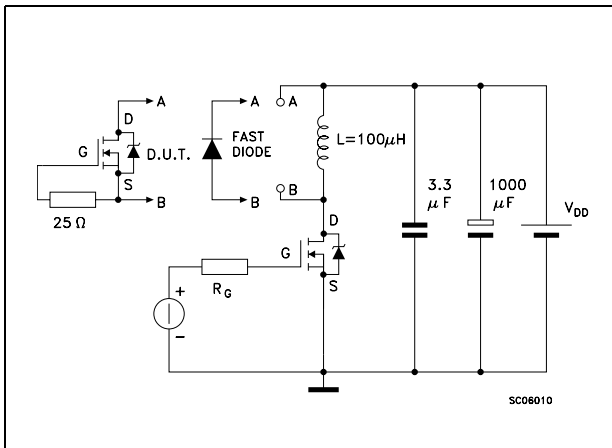
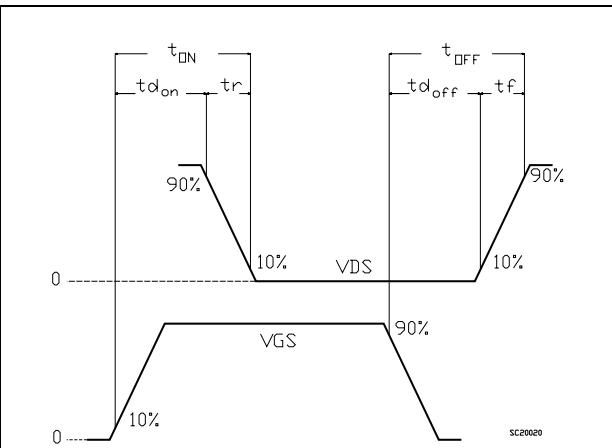


Figure 17. Switching time waveform



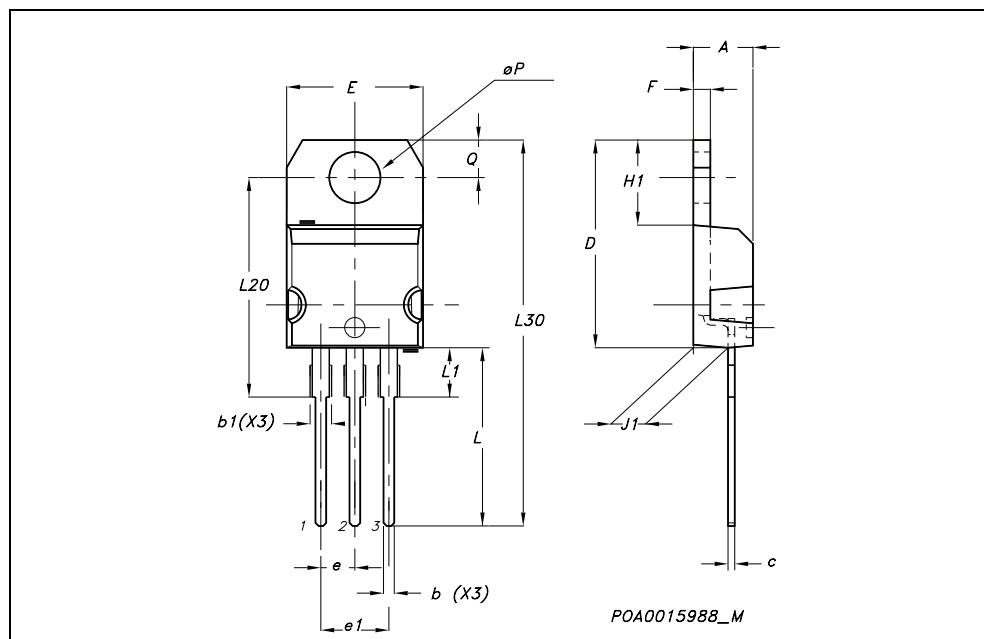


## 4 Package mechanical data

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](http://www.st.com)

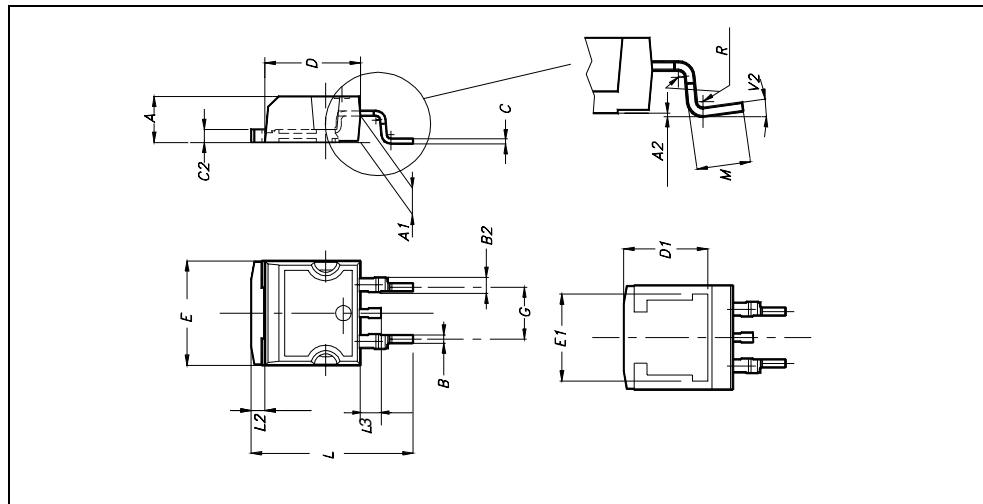
**TO-220 MECHANICAL DATA**

| 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   | 1.15  |       | 1.70  | 0.045 |       | 0.066 |
| c    | 0.49  |       | 0.70  | 0.019 |       | 0.027 |
| D    | 15.25 |       | 15.75 | 0.60  |       | 0.620 |
| 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 |       | 0.052 |
| 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 |       |
| øP   | 3.75  |       | 3.85  | 0.147 |       | 0.151 |
| Q    | 2.65  |       | 2.95  | 0.104 |       | 0.116 |



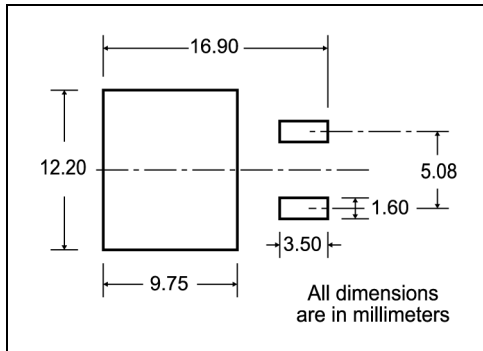
|   |
|---|
| <b>D<sup>2</sup>PAK MECHANICAL DATA</b> |
|---|

| 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

## D<sup>2</sup>PAK 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

User Direction of Feed

FEED DIRECTION

Bending radius R min.

\* on sales type

## 6 Revision history

**Table 7. Revision history**

| <b>Date</b> | <b>Revision</b> | <b>Changes</b>                  |
|-------------|-----------------|---------------------------------|
| 14-Jun-2003 | 1               | First release                   |
| 13-Mar-2006 | 2               | Complete version                |
| 26-Jun-2006 | 3               | New template, no content change |

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