



# THE DATASHEET OF STF20NF06L





# STB20NF06L - STF20NF06L STP20NF06L

N-channel 60V - 0.06Ω - 20A - D<sup>2</sup>PAK/TO-220/TO-220FP  
STripFET™ II Power MOSFET

## General features

| Type       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub>     |
|------------|------------------|---------------------|--------------------|
| STB20NF06L | 60V              | <0.07Ω              | 20A                |
| STF20NF06L | 60V              | <0.07Ω              | 20A <sup>(1)</sup> |
| STP20NF06L | 60V              | <0.07Ω              | 20A                |

1. Refer to SOA for the max allowable current value on FP-type due to R<sub>th</sub> value

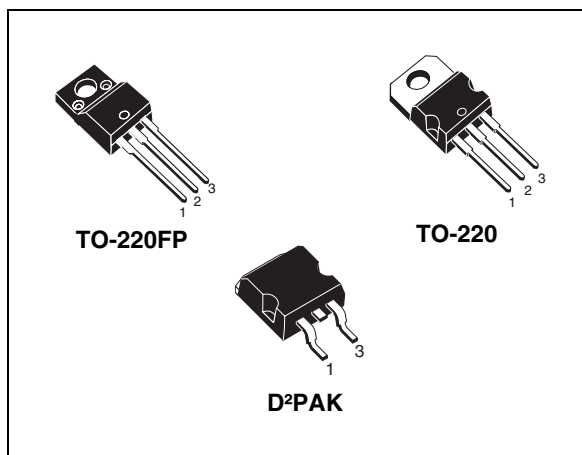
- Avalanche rugged technology
- 100% avalanche tested
- 175°C operating temperature
- High dv/dt capability
- application oriented characterization

## Description

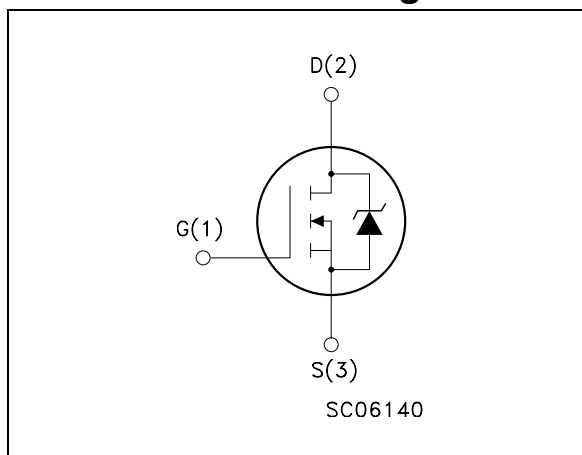
This Power MOSFET is the latest development of STMicroelectronics unique “single feature size”™ strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing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

## Applications

- Switching application



## Internal schematic diagram



## Order codes

| Part number  | Marking  | Package            | Packaging   |
|--------------|----------|--------------------|-------------|
| STB20NF06LT4 | B20NF06L | D <sup>2</sup> PAK | Tape & reel |
| STF20NF06L   | F20NF06L | TO-220FP           | Tube        |
| STP20NF06L   | P20NF06L | TO-220             | Tube        |

# Contents

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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol                         | Parameter  | Value                     |                   | Unit |
|--------------------------------|--|---------------------------|-------------------|------|
|                                |  | TO-220/D <sup>2</sup> PAK | TO-220FP          |      |
| V <sub>DS</sub>                | Drain-source voltage (V <sub>GS</sub> = 0)           | 60                        |                   | V    |
| V <sub>GS</sub>                | Gate- source voltage                                 | ± 18                      |                   | V    |
| I <sub>D</sub>                 | Drain current (continuous) at T <sub>C</sub> = 25°C  | 20                        | 20 <sup>(1)</sup> | A    |
| I <sub>D</sub>                 | Drain current (continuous) at T <sub>C</sub> = 100°C | 14                        | 14 <sup>(1)</sup> | A    |
| I <sub>DM</sub> <sup>(2)</sup> | Drain current (pulsed)                               | 80                        | 80 <sup>(1)</sup> | A    |
| P <sub>tot</sub>               | Total dissipation at T <sub>C</sub> = 25°C           | 60                        | 28                | W    |
|                                | Derating Factor                                      | 0.4                       | 0.18              | W/°C |
| dv/dt <sup>(3)</sup>           | Peak diode recovery voltage slope                    | 9                         |                   | V/ns |
| E <sub>AS</sub> <sup>(4)</sup> | Single pulse avalanche energy                        | 120                       |                   | mJ   |
| T <sub>stg</sub>               | Storage temperature                                  | -55 to 175                |                   | °C   |
| T <sub>j</sub>                 | Max. operating junction temperature                  |                           |                   |      |

1. Refer to SOA for the max allowable current value on FP-type due to R<sub>th</sub> value
2. Pulse width limited by safe operating area.
3. I<sub>SD</sub> ≤ 20A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>J</sub> ≤ T<sub>JMAX</sub>
4. Starting T<sub>j</sub> = 25 °C, I<sub>D</sub> = 10A, V<sub>DD</sub> = 30V

**Table 2. Thermal data**

| Symbol                | Parameter   | TO-220/D <sup>2</sup> PAK | TO-220FP | Unit |
|-----------------------|---|---------------------------|----------|------|
| R <sub>thj-case</sub> | Thermal resistance junction-case max  | 2.5                       | 5.35     | °C/W |
| R <sub>thj-amb</sub>  | Thermal resistance junction-ambient max                                     | 62.5                      |          | °C/W |
| T <sub>l</sub>        | Maximum lead temperature for soldering purpose (for 10sec. 1.6mm from case) | 300                       |          | °C/W |

## 2 Electrical characteristics

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

**Table 3. On/off states**

| 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>$V_{DS} = \text{Max rating, @ } 125^{\circ}C$ |      |                | 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                           | $V_{DS} = V_{GS}, I_D = 250\mu A$   | 2    | 3              | 4              | V                    |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10V, I_D = 10A$<br>$V_{GS} = 5V, I_D = 10A$                         |      | 0.060<br>0.075 | 0.070<br>0.085 | $\Omega$<br>$\Omega$ |

**Table 4. Dynamic**

| Symbol         | Parameter                    | Test conditions                           | Min. | Typ. | Max. | Unit |
|----------------|------------------------------|---|------|------|------|------|
| $g_{fs}^{(1)}$ | Forward transconductance     | $V_{DS} = 15V, I_D = 8A$                  |      | 10   |      | S    |
| $C_{iss}$      | Input capacitance            | $V_{DS} = 25V, f = 1MHz,$<br>$V_{GS} = 0$ |      | 400  |      | pF   |
| $C_{oss}$      | Output capacitance           |   |      | 100  |      | pF   |
| $C_{rss}$      | Reverse transfer capacitance |   |      | 40   |      | pF   |
| $Q_g$          | Total gate charge            | $V_{DD} = 30V, I_D = 20A,$                |      | 7.5  |      | nC   |
| $Q_{gs}$       | Gate-source charge           | $V_{GS} = 10V$                            |      | 2.5  |      | nC   |
| $Q_{gd}$       | Gate-drain charge            | (see <a href="#">Figure 16</a> )          |      | 4.2  |      | nC   |

1. Pulsed: Pulse duration = 300  $\mu s$ , duty cycle 1.5 %.

**Table 5. Switching times**

| Symbol       | Parameter           | Test conditions  | Min. | Typ. | Max. | Unit |
|--------------|---------------------|--|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 30V, I_D = 10A$<br>$R_G = 4.7\Omega, V_{GS} = 10V$<br>(see <a href="#">Figure 15</a> ) |      | 12   |      | ns   |
| $t_r$        | Rise time           |  |      | 30   |      | ns   |
| $t_{d(off)}$ | Turn-off delay time |  |      |      | 20   | ns   |
| $t_f$        | Fall time           |  |      |      | 6    | ns   |

**Table 6. Source drain diode**

| Symbol          | Parameter                     | Test conditions  | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|------|
| $I_{SD}$        | Source-drain current          |  |      |      | 20   | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |  |      |      | 80   | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 20A, V_{GS} = 0$   |      |      | 1.5  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 20A, di/dt = 100A/\mu s,$<br>$V_{DD} = 20V, T_j = 150^\circ C$<br>(see <a href="#">Figure 17</a> ) |      | 50   |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |  |      | 65   |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |  |      | 3    |      | 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 for TO-220/D<sup>2</sup>PAK

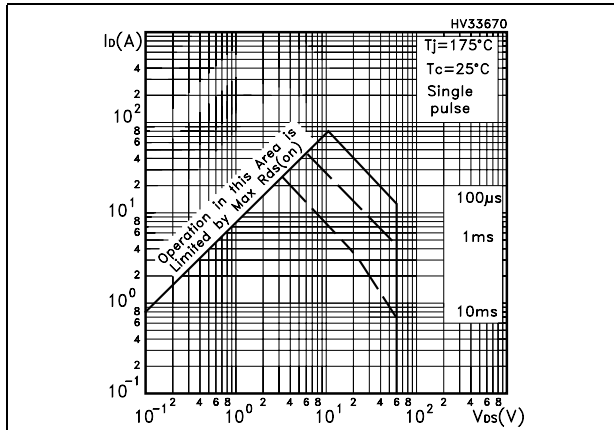


Figure 2. Thermal impedance for TO-220/D<sup>2</sup>PAK

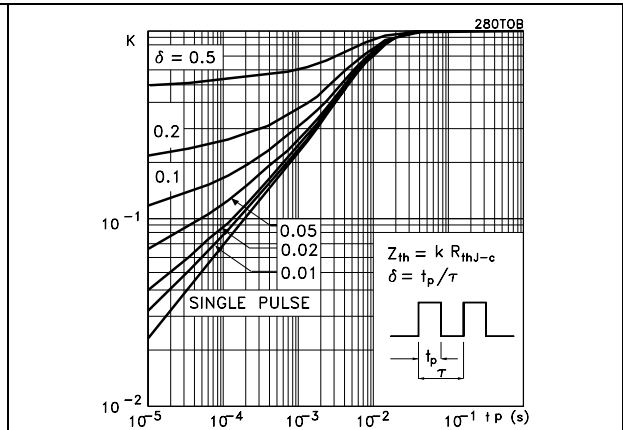


Figure 3. Safe operating area for TO-220FP

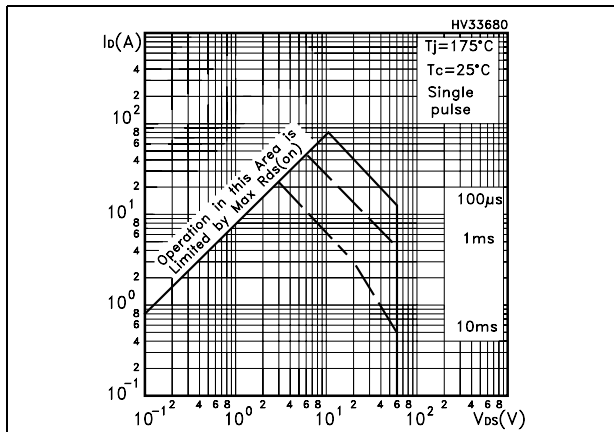


Figure 4. Thermal impedance for TO-220FP

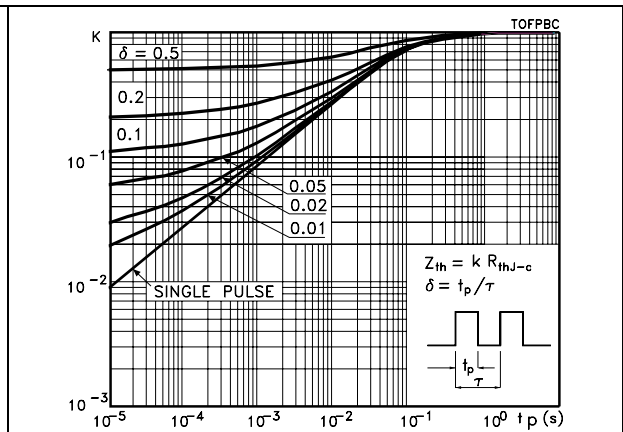


Figure 5. Output characteristics

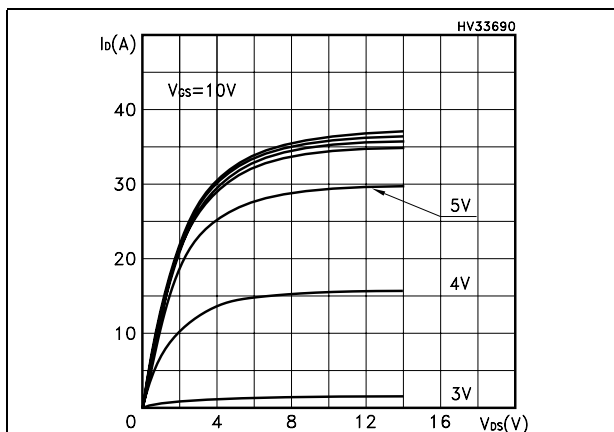


Figure 6. Transfer characteristics

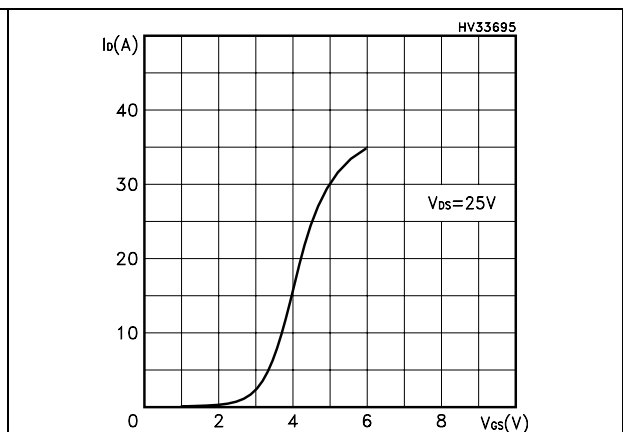


Figure 7. Transconductance

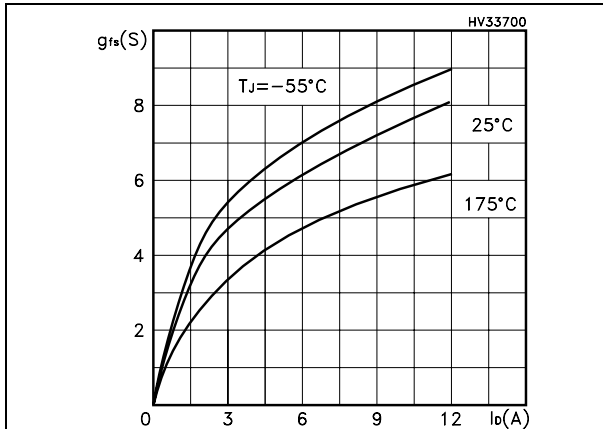


Figure 8. Static drain-source on resistance

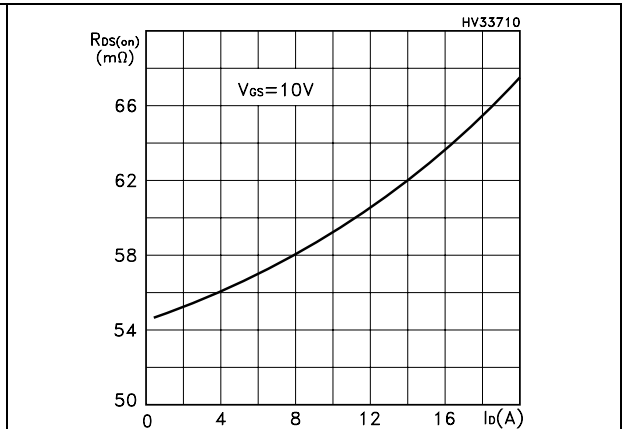


Figure 9. Gate charge vs gate-source voltage

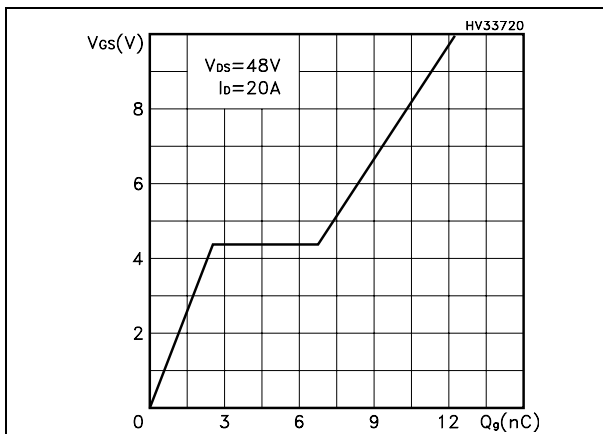


Figure 10. Capacitance variations

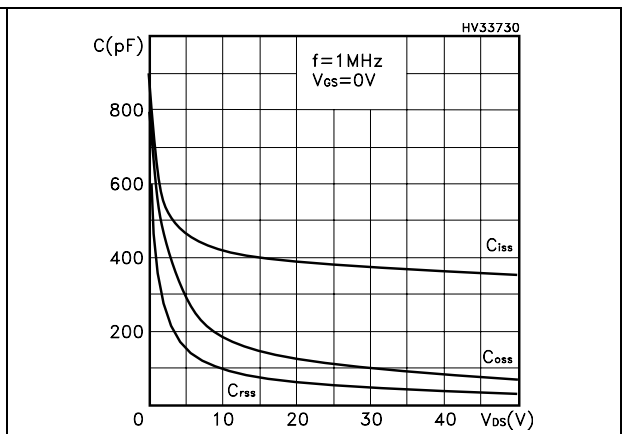


Figure 11. Normalized gate threshold voltage vs temperature

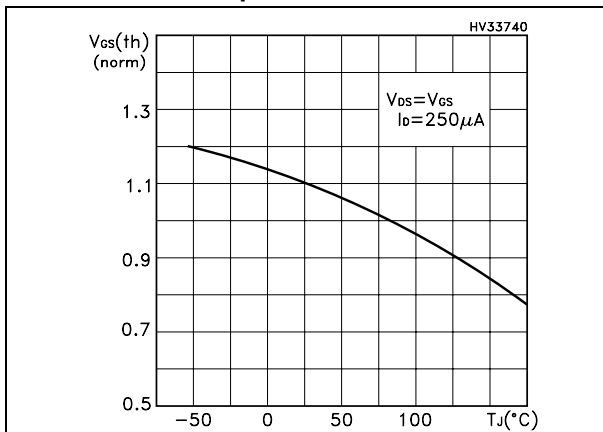


Figure 12. Normalized on resistance vs temperature

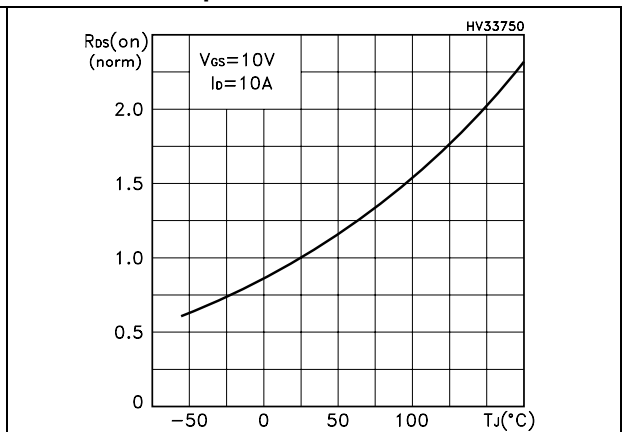


Figure 13. Source-drain diode forward characteristics

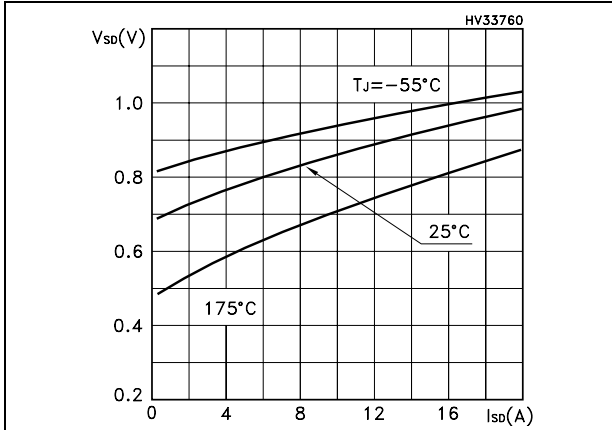
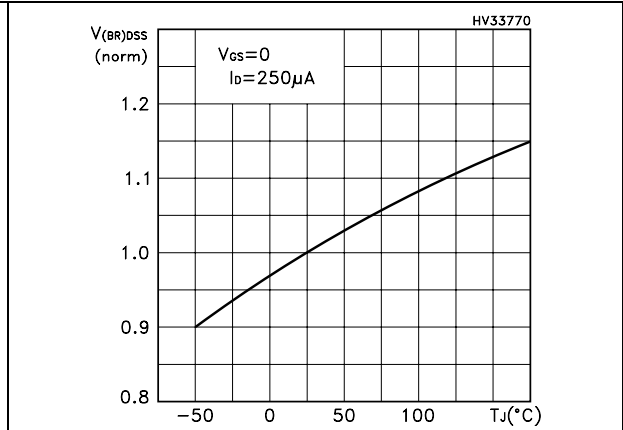


Figure 14. Normalized breakdown voltage temperature



### 3 Test circuit

Figure 15. Switching times test circuit for resistive load



Figure 16. Gate charge test circuit

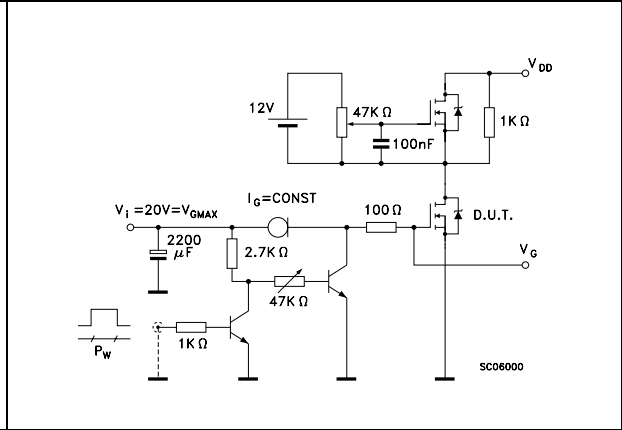


Figure 17. Test circuit for inductive load switching and diode recovery times

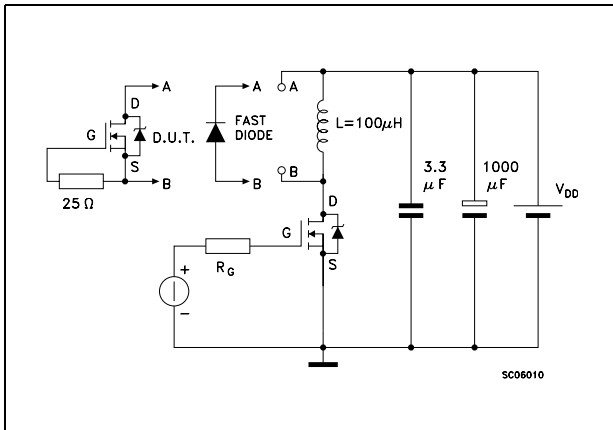


Figure 18. Unclamped Inductive load test circuit

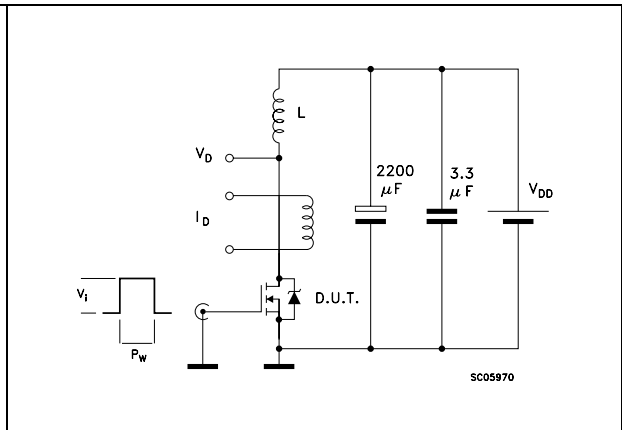


Figure 19. Unclamped inductive waveform

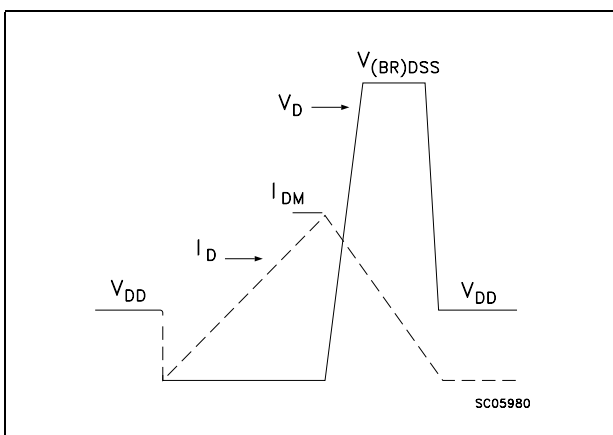
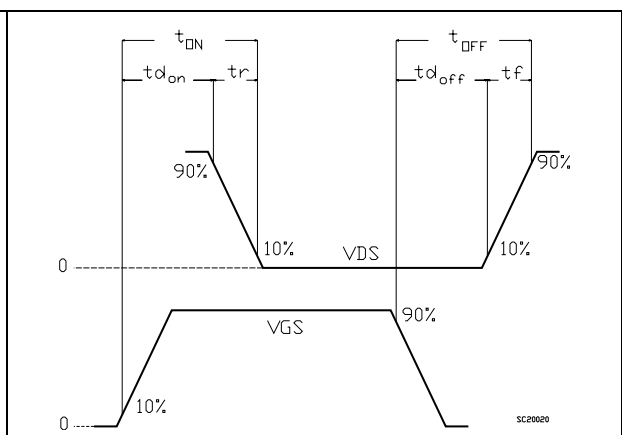


Figure 20. Switching time waveform

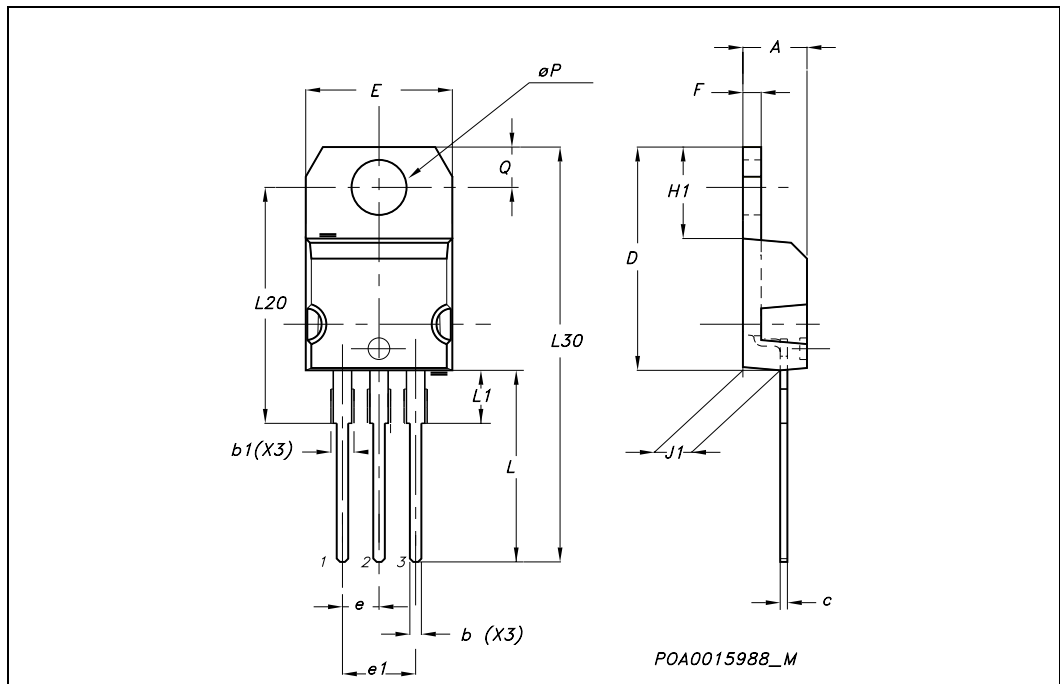


## 4 Package mechanical data

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)

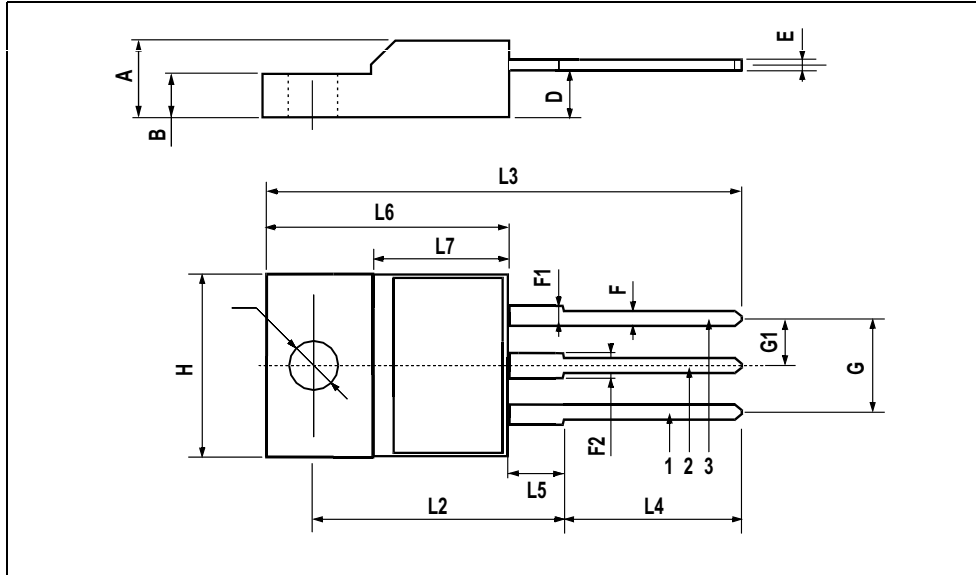
## TO-220 MECHANICAL DATA

| 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 |



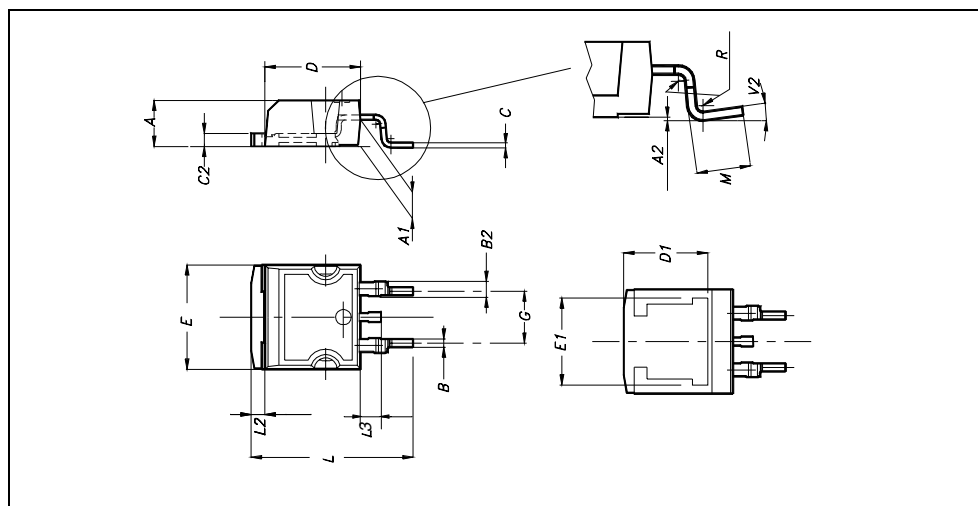
**TO-220FP MECHANICAL DATA**

| DIM. | mm.  |     |      | inch  |       |       |
|------|------|-----|------|-------|-------|-------|
|      | MIN. | TYP | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 4.4  |     | 4.6  | 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 |     | 0.7  | 0.017 |       | 0.027 |
| F    | 0.75 |     | 1    | 0.030 |       | 0.039 |
| F1   | 1.15 |     | 1.7  | 0.045 |       | 0.067 |
| F2   | 1.15 |     | 1.7  | 0.045 |       | 0.067 |
| G    | 4.95 |     | 5.2  | 0.195 |       | 0.204 |
| G1   | 2.4  |     | 2.7  | 0.094 |       | 0.106 |
| H    | 10   |     | 10.4 | 0.393 |       | 0.409 |
| L2   |      | 16  |      |       | 0.630 |       |
| L3   | 28.6 |     | 30.6 | 1.126 |       | 1.204 |
| L4   | 9.8  |     | 10.6 | .0385 |       | 0.417 |
| L5   | 2.9  |     | 3.6  | 0.114 |       | 0.141 |
| L6   | 15.9 |     | 16.4 | 0.626 |       | 0.645 |
| L7   | 9    |     | 9.3  | 0.354 |       | 0.366 |
| Ø    | 3    |     | 3.2  | 0.118 |       | 0.126 |



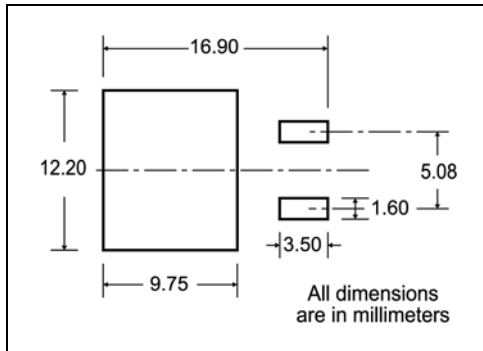
D<sup>2</sup>PAK MECHANICAL DATA

| 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 Packing 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     |

\* on sales type

## 6 Revision history

Table 7. Revision history

| Date        | Revision | Changes                                   |
|-------------|----------|---|
| 09-Dec-2004 | 1        | First release                             |
| 27-Jul-2006 | 2        | New template, inserted D <sup>2</sup> PAK |

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