



# STP20NF06 STF20NF06

N-channel 60V - 0.06 $\Omega$  - 20A - TO-220/TO-220FP  
STripFET™ II Power MOSFET

## Features

| Type      | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub>     |
|-----------|------------------|---------------------|--------------------|
| STP20NF06 | 60V              | <0.07 $\Omega$      | 20A                |
| STF20NF06 | 60V              | <0.07 $\Omega$      | 20A <sup>(1)</sup> |

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

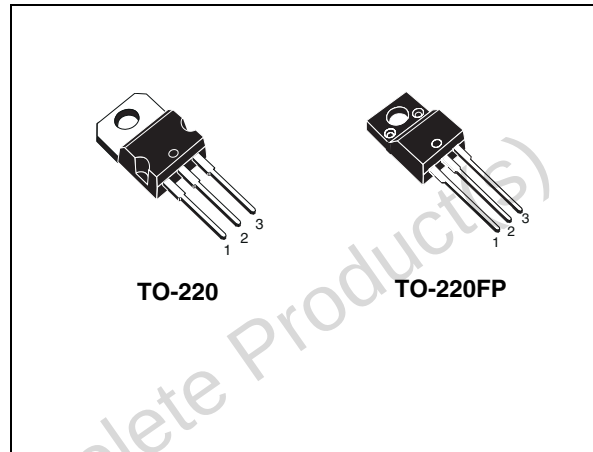
This Power MOSFET is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing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

## Application

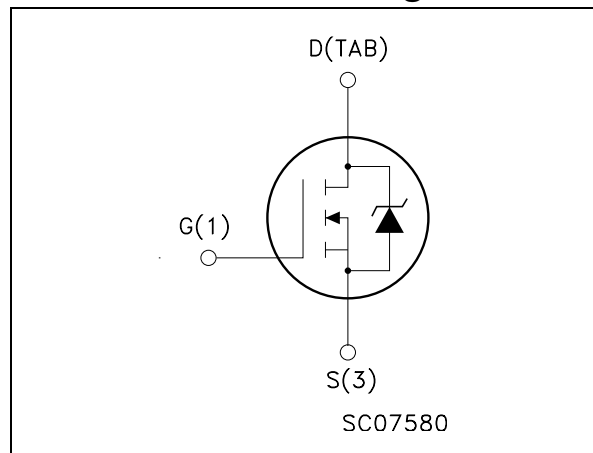
- Switching applications

## Order codes

| Part number | Marking | Package  | Packaging |
|-------------|---------|----------|-----------|
| STP20NF06   | P20NF06 | TO-220   | Tube      |
| STF20NF06   | F20NF06 | TO-220FP | Tube      |



## Internal schematic diagram



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Obsolete Product(s) - Obsolete Product(s)

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol         | Parameter                                                                                                      | Value      |                   | Unit |
|----------------|----------------------------------------------------------------------------------------------------------------|------------|-------------------|------|
|                |                                                                                                                | TO-220     | TO-220FP          |      |
| $V_{DS}$       | Drain-source voltage ( $V_{GS} = 0$ )                                                                          | 60         |                   | V    |
| $V_{GS}$       | Gate- source voltage                                                                                           | $\pm 20$   |                   | V    |
| $I_D$          | Drain current (continuous) at $T_C = 25^\circ\text{C}$                                                         | 20         | 20 <sup>(1)</sup> | A    |
| $I_D$          | Drain current (continuous) at $T_C = 100^\circ\text{C}$                                                        | 14         | 14 <sup>(1)</sup> | A    |
| $I_{DM}^{(2)}$ | Drain current (pulsed)                                                                                         | 80         | 80 <sup>(1)</sup> | A    |
| $P_{tot}$      | Total dissipation at $T_C = 25^\circ\text{C}$                                                                  | 60         | 28                | W    |
|                | Derating factor                                                                                                | 0.4        | 0.18              | W/°C |
| $dv/dt^{(3)}$  | Peak diode recovery voltage slope                                                                              | 9          |                   | V/ns |
| $E_{AS}^{(4)}$ | Single pulse avalanche energy                                                                                  | 120        |                   | mJ   |
| $V_{ISO}$      | Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t=1s; T_C=25^\circ\text{C}$ ) | --         | 2500              | V    |
| $T_{stg}$      | Storage temperature                                                                                            | -55 to 175 |                   | °C   |
| $T_j$          | Max. operating junction temperature                                                                            |            |                   |      |

1. Refer to SOA for the max allowable current value on FP-type due to  $R_{th}$  value

2. Pulse width limited by safe operating area.

3.  $I_{SD} \leq 20\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{JMAX}$

4. Starting  $T_j = 25^\circ\text{C}$ ,  $I_D = 10\text{A}$ ,  $V_{DD} = 30\text{V}$

**Table 2. Thermal data**

| Symbol         | Parameter                                      | TO-220 | TO-220FP | Unit |
|----------------|------------------------------------------------|--------|----------|------|
| $R_{thj-case}$ | Thermal resistance junction-case max           | 2.5    | 5.35     | °C/W |
| $R_{thj-amb}$  | Thermal resistance junction-ambient max        | 62.5   |          | °C/W |
| $T_J$          | Maximum lead temperature for soldering purpose | 300    |          | °C   |

## 2 Electrical characteristics

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

**Table 3. On/off states**

| Symbol        | Parameter                                        | Test conditions                                                                                 | Min. | Typ. | Max.      | Unit                           |
|---------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------|------|------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 250\mu\text{A}$ , $V_{GS} = 0$                                                           | 60   |      |           | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{max ratings}$<br>$V_{DS} = \text{max ratings}$ ,<br>$T_C = 125^{\circ}\text{C}$ |      |      | 1<br>10   | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{V}$                                                                       |      |      | $\pm 100$ | 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                | $V_{GS} = 10\text{V}$ , $I_D = 10\text{A}$                                                      |      | 0.06 | 0.07      | $\Omega$                       |

**Table 4. Dynamic**

| Symbol                                        | Parameter                                                               | Test conditions                                                                                                             | Min. | Typ.               | Max. | Unit                 |
|-----------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------|--------------------|------|----------------------|
| $g_{fs}^{(1)}$                                | Forward transconductance                                                | $V_{DS} = 15\text{V}$ , $I_D = 8\text{A}$                                                                                   |      | 10                 |      | S                    |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$           | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$ ,<br>$V_{GS} = 0$                                                                 |      | 400<br>100<br>40   |      | pF<br>pF<br>pF       |
| $t_{d(on)}$<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     | $V_{DD} = 30\text{V}$ , $I_D = 10\text{A}$<br>$R_G = 4.7\Omega$ , $V_{GS} = 10\text{V}$<br>(see <a href="#">Figure 15</a> ) |      | 5<br>15<br>15<br>5 |      | ns<br>ns<br>ns<br>ns |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$                 | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 30\text{V}$ , $I_D = 20\text{A}$ ,<br>$V_{GS} = 10\text{V}$<br>(see <a href="#">Figure 16</a> )                   |      | 14<br>3<br>5.5     | 18   | nC<br>nC<br>nC       |

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

**Table 5. Source drain diode**

| Symbol                            | Parameter                                                                    | Test conditions                                                                                                        | Min. | Typ.            | Max.     | Unit          |
|-----------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------|-----------------|----------|---------------|
| $I_{SD}$<br>$I_{SDM}^{(1)}$       | Source-drain current<br>Source-drain current<br>(pulsed)                     |                                                                                                                        |      |                 | 20<br>80 | A<br>A        |
| $V_{SD}^{(2)}$                    | Forward on voltage                                                           | $I_{SD} = 20A$ , $V_{GS} = 0$                                                                                          |      |                 | 1.5      | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 20A$ ,<br>$di/dt = 100A/\mu s$ ,<br>$V_{DD} = 20V$ , $T_j = 150^\circ C$<br>(see <a href="#">Figure 17</a> ) |      | 50<br>88<br>3.2 |          | ns<br>nC<br>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

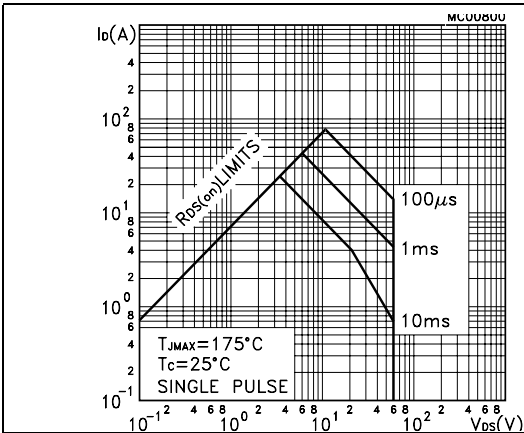


Figure 2. Thermal impedance for TO-220

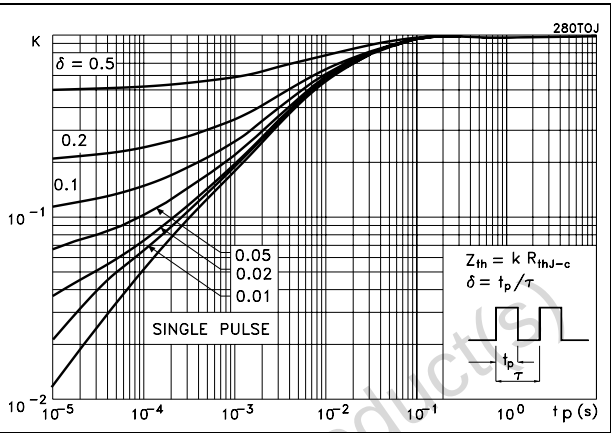


Figure 3. Safe operating area for TO-220FP

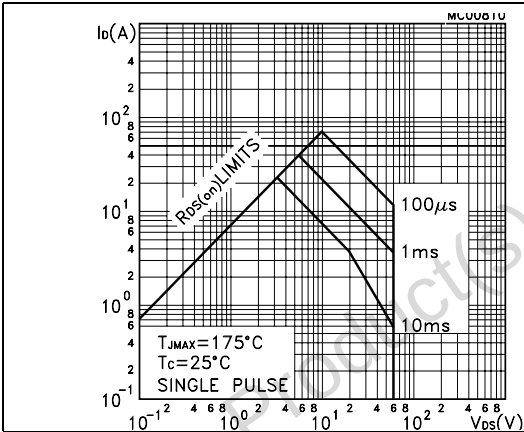


Figure 4. Thermal impedance for TO-220FP

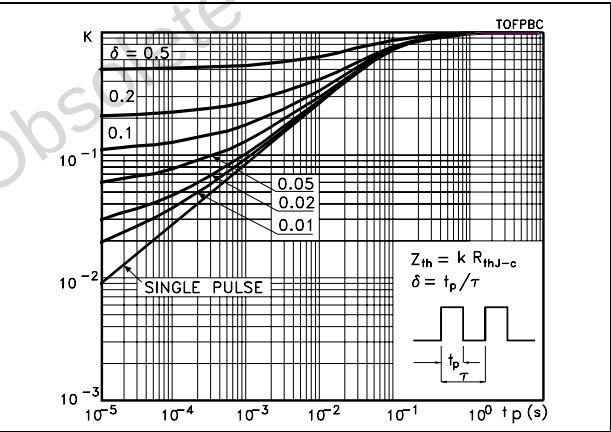


Figure 5. Output characteristics

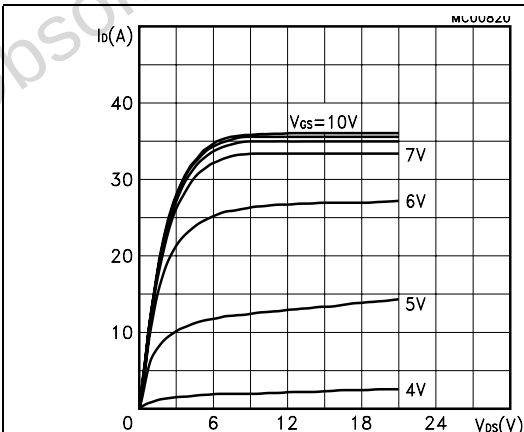


Figure 6. Transfer characteristics

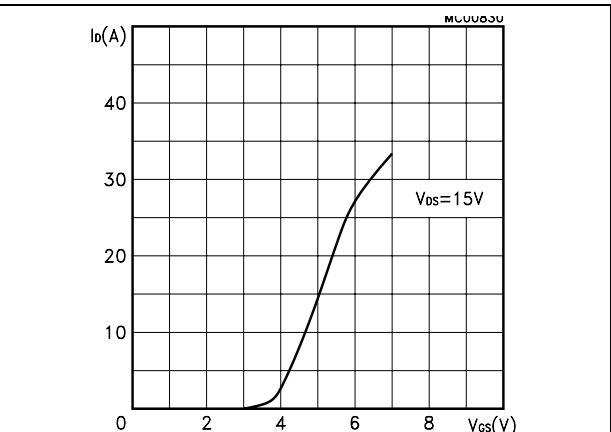


Figure 7. Transconductance

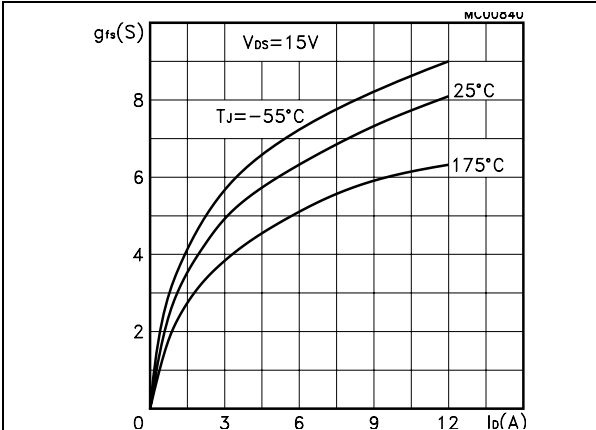


Figure 8. Static drain-source on resistance

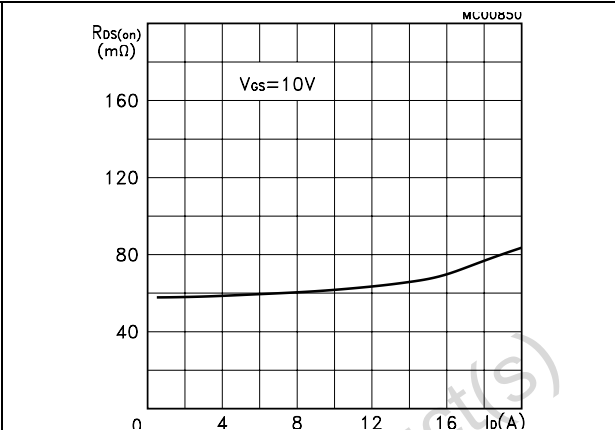


Figure 9. Gate charge vs. gate-source voltage Figure 10. Capacitance variations

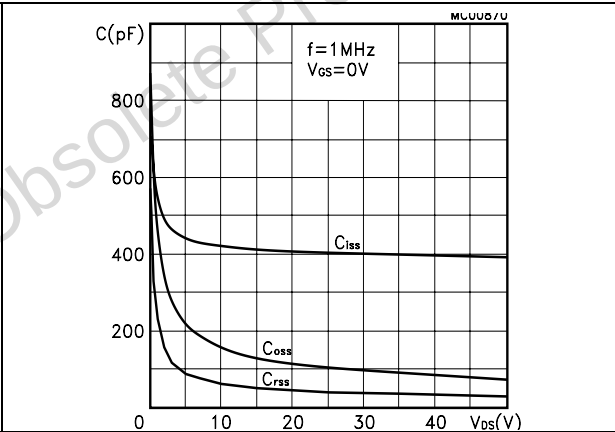
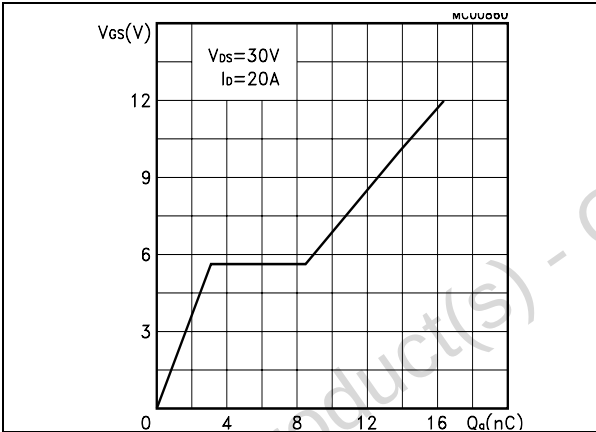


Figure 11. Normalized gate threshold voltage vs. temperature

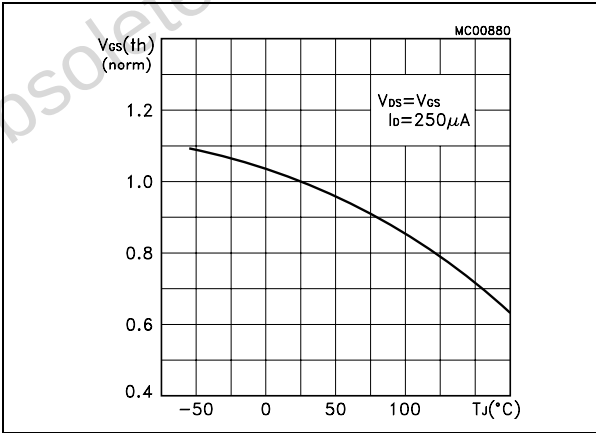


Figure 12. Normalized on resistance vs. temperature

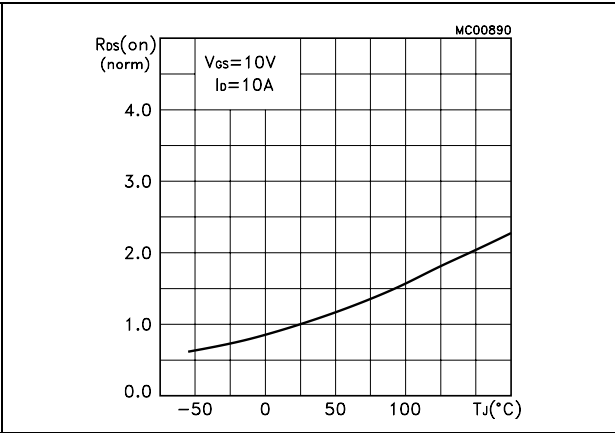


Figure 13. Source-drain diode forward characteristics

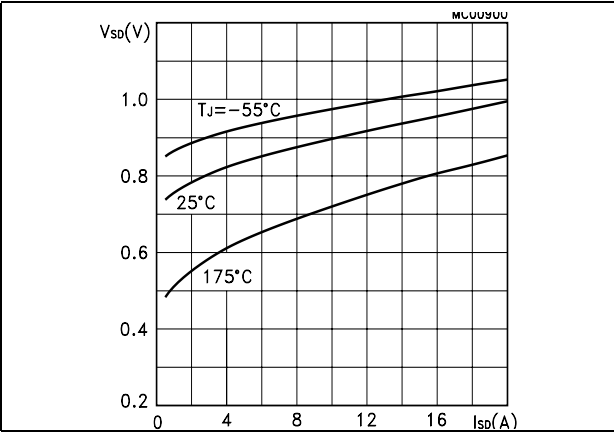
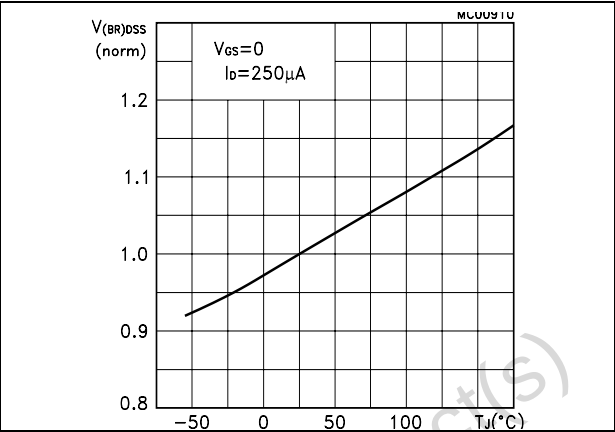


Figure 14. Normalized  $B_{V_{DSS}}$  vs. temperature





### 3 Test circuit

Figure 15. Switching times test circuit for resistive load

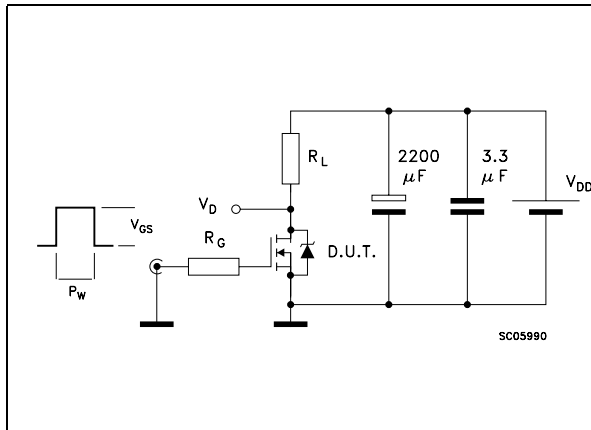


Figure 16. Gate charge test circuit

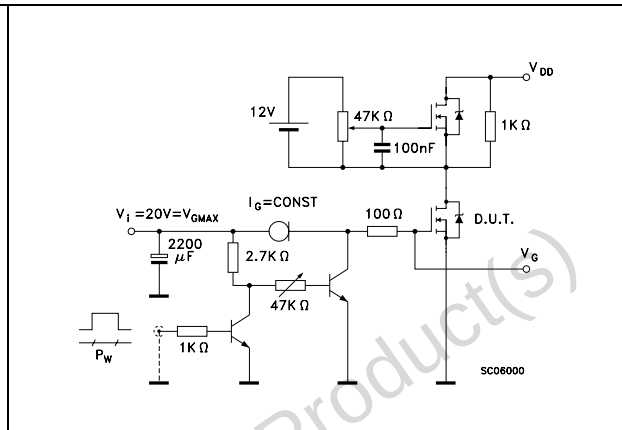


Figure 17. Test circuit for inductive load switching and diode recovery times

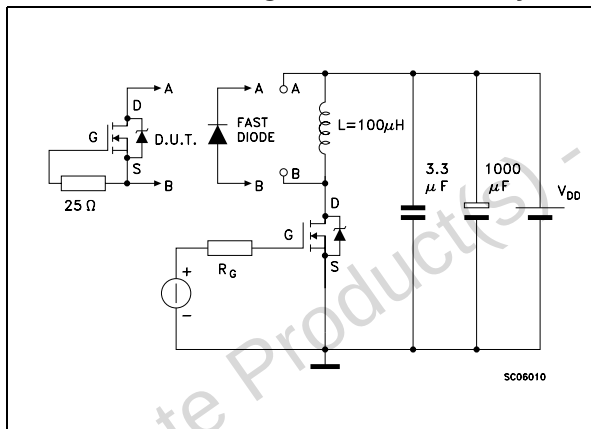


Figure 18. Unclamped Inductive load test circuit

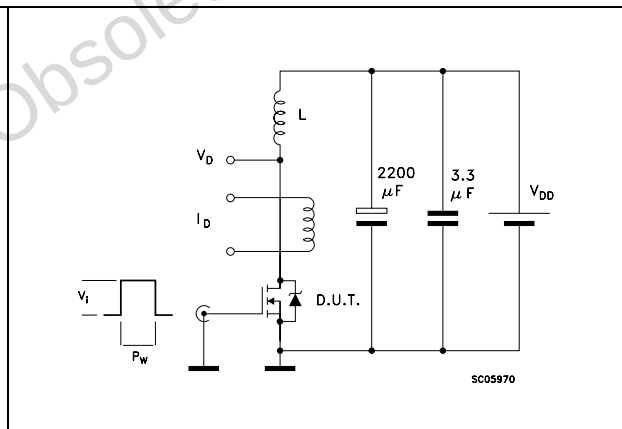


Figure 19. Unclamped inductive waveform

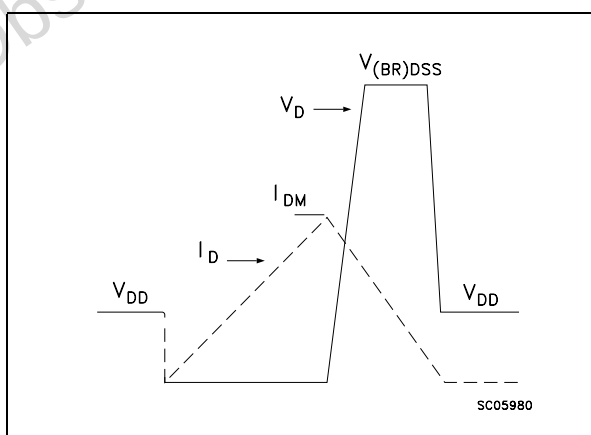
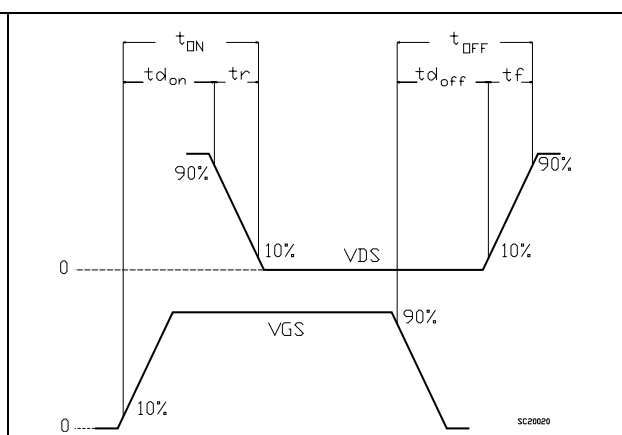


Figure 20. Switching time waveform



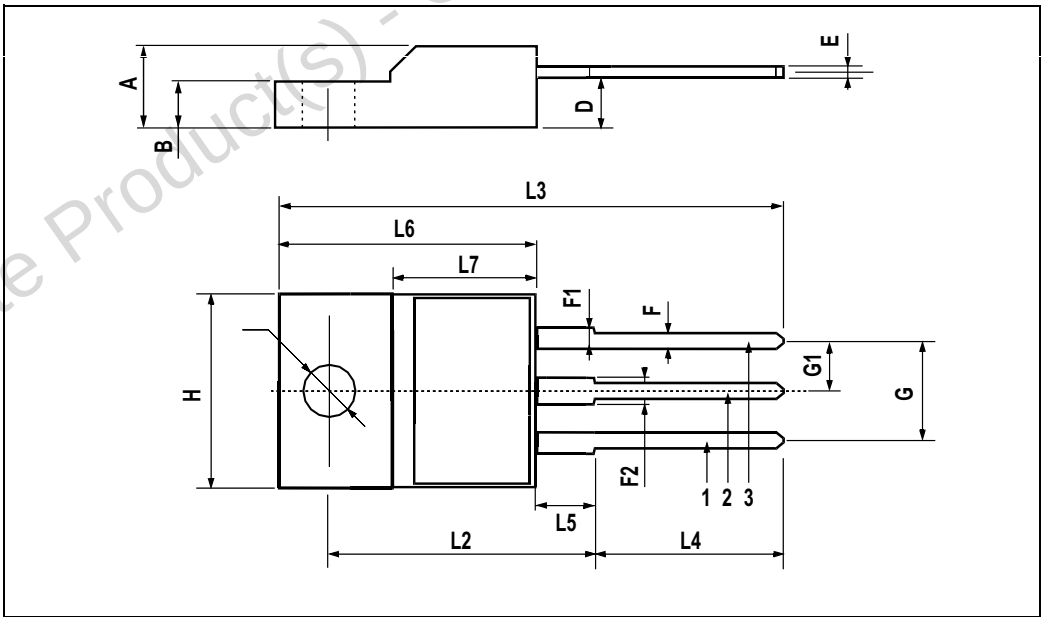
## 4 Package mechanical data

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)

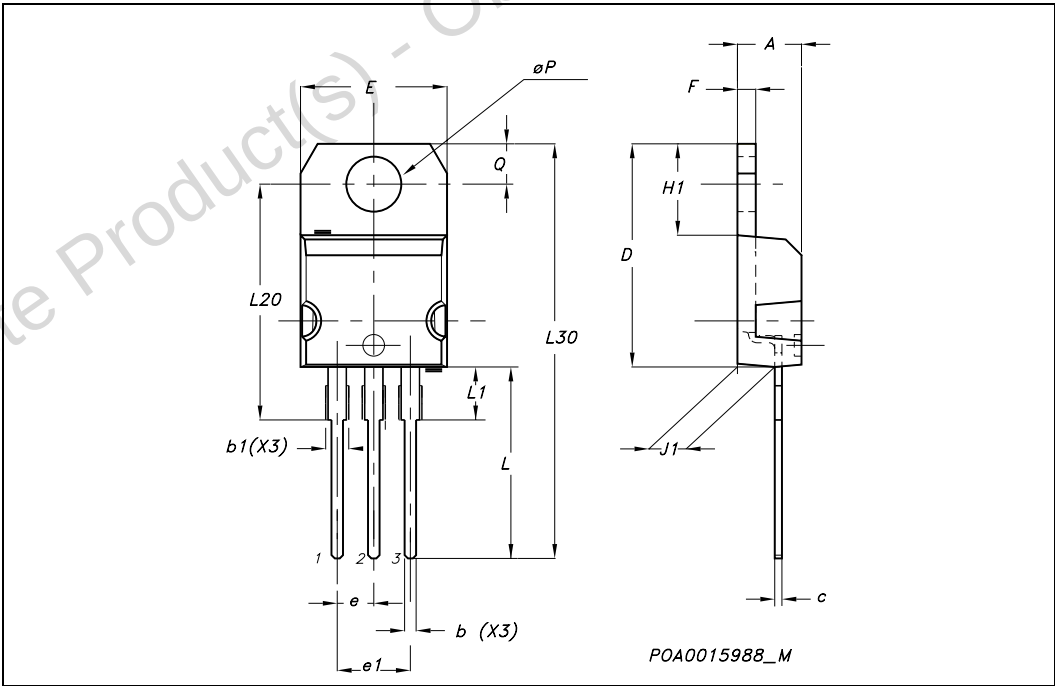
Obsolete Product(s) - Obsolete Product(s)

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 |



| 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 |



## 5 Revision history

**Table 6. Revision history**

| Date        | Revision | Changes                           |
|-------------|----------|-----------------------------------|
| 07-Dec-2004 | 1        | First version                     |
| 09-Aug-2006 | 2        | The document has been reformatted |
| 30-May-2007 | 3        | Modified part number              |

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