



# STF40NF03L STP40NF03L

N-channel 30 V, 0.018  $\Omega$ , 40 A TO-220, TO-220FP  
STripFET™ Power MOSFET

## Features

| Type       | V <sub>DSS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> |
|------------|------------------|-------------------------|----------------|
| STF40NF03L | 30 V             | 0.022 $\Omega$          | 23 A           |
| STP40NF03L | 30 V             | 0.022 $\Omega$          | 40 A           |

- Low threshold device

## Application

- Switching applications

## 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.

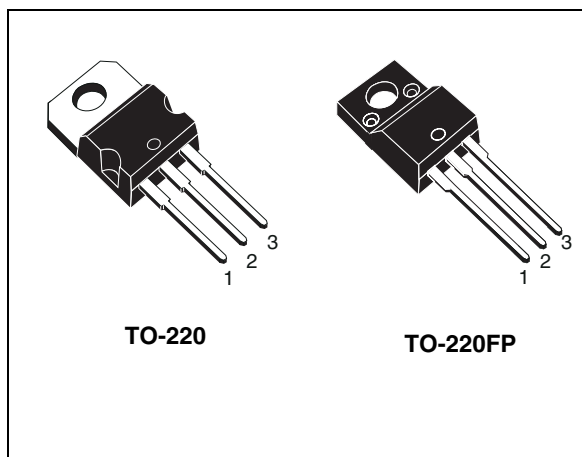


Figure 1. Internal schematic diagram

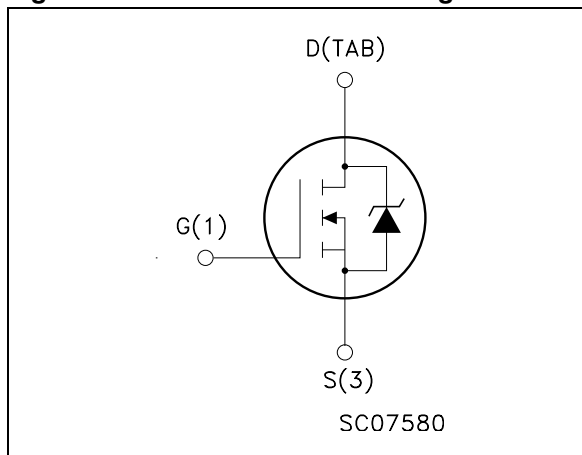


Table 1. Device summary

| Order codes | Marking  | Package  | Packaging |
|-------------|----------|----------|-----------|
| STF40NF03L  | F40NF03L | TO-220FP | Tube      |
| STP40NF03L  | P40NF03L | TO-220   | Tube      |

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# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol         | Parameter  | Value      |          | Unit                |
|----------------|--|------------|----------|---------------------|
|                |  | TO-220     | TO-220FP |                     |
| $V_{DS}$       | Drain-source voltage ( $V_{GS} = 0$ )  | 30         |          | V                   |
| $V_{GS}$       | Gate- source voltage   | $\pm 16$   |          | V                   |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$   | 40         | 23       | A                   |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$  | 28         | 16       | A                   |
| $I_{DM}^{(1)}$ | Drain current (pulsed)   | 160        | 92       | A                   |
| $P_{tot}$      | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$  | 70         | 25       | W                   |
|                | Derating factor  | 0.46       |          | W/ $^\circ\text{C}$ |
| $V_{ISO}$      | Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t=1\text{ s}; T_C=25\text{ }^\circ\text{C}$ ) |            | 2500     | V                   |
| $E_{AS}^{(2)}$ | Single pulse avalanche energy  | 250        |          | mJ                  |
| $T_{stg}$      | Storage temperature  | -55 to 175 |          | $^\circ\text{C}$    |
| $T_j$          | Max. operating junction temperature  |            |          |                     |

1. Pulse width limited by safe operating area.

2. Starting  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = 20\text{ A}$ ,  $V_{DD} = 15\text{ V}$

**Table 3. Thermal data**

| Symbol        | Parameter                                      | Package  | Value |      | Unit                      |
|---------------|--|----------|-------|------|---------------------------|
|               |  |          | Typ.  | Max. |                           |
| $R_{thj-c}$   | Thermal resistance junction-case               | TO-220   | 1.8   | 2.1  | $^\circ\text{C}/\text{W}$ |
|               |  | TO-220FP |       | 6    |                           |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max        |          |       | 62.5 | $^\circ\text{C}/\text{W}$ |
| $T_J$         | Maximum lead temperature for soldering purpose |          |       | 300  | $^\circ\text{C}$          |

## 2 Electrical characteristics

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

**Table 4. On/off states**

| Symbol        | Parameter  | Test conditions   | Min. | Typ.           | Max.           | Unit                           |
|---------------|--|---|------|----------------|----------------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0$   | 30   |                |                | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{max ratings}$<br>$V_{DS} = \text{max ratings}$ ,<br>$T_C = 125\text{ °C}$     |      |                | 1<br>10        | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 16\text{ V}$  |      |                | $\pm 100$      | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$  | 1    | 1.7            | 2.5            | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 20\text{ A}$<br>$V_{GS} = 4.5\text{ V}$ , $I_D = 20\text{ A}$ |      | 0.018<br>0.028 | 0.022<br>0.035 | $\Omega$<br>$\Omega$           |

**Table 5. Dynamic**

| Symbol  | Parameter   | Test conditions   | Min. | Typ.                 | Max. | Unit                 |
|---|---|---|------|----------------------|------|----------------------|
| $g_{fs}^{(1)}$                                | Forward transconductance  | $V_{DS} = 10\text{ V}$ , $I_D = 20\text{ A}$  | -    | 20                   | -    | 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>$V_{GS} = 0$   | -    | 770<br>255<br>60     | -    | 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     | $V_{DD} = 15\text{ V}$ , $I_D = 20\text{ A}$<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 4.5\text{ V}$<br>(see <a href="#">Figure 16</a> ) | -    | 14<br>80<br>25<br>16 | -    | 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            | $V_{DD} = 15\text{ V}$ , $I_D = 40\text{ A}$ ,<br>$V_{GS} = 4.5\text{ V}$<br>(see <a href="#">Figure 17</a> )                           | -    | 10.5<br>4<br>4.5     | 15   | nC<br>nC<br>nC       |

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

**Table 6. 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)                     |  | -    |                 | 40<br>160 | A<br>A        |
| $V_{SD}^{(2)}$                    | Forward on voltage   | $I_{SD} = 40\text{ A}$ , $V_{GS} = 0$  | -    |                 | 1.5       | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 40\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 15\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 18</a> ) | -    | 34.5<br>30<br>2 |           | ns<br>nC<br>A |

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

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220

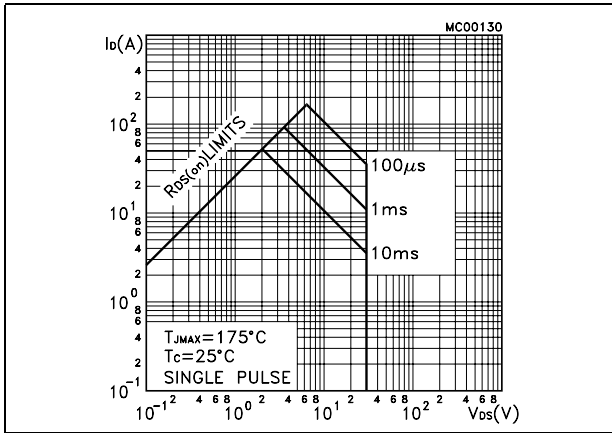


Figure 3. Thermal impedance for TO-220

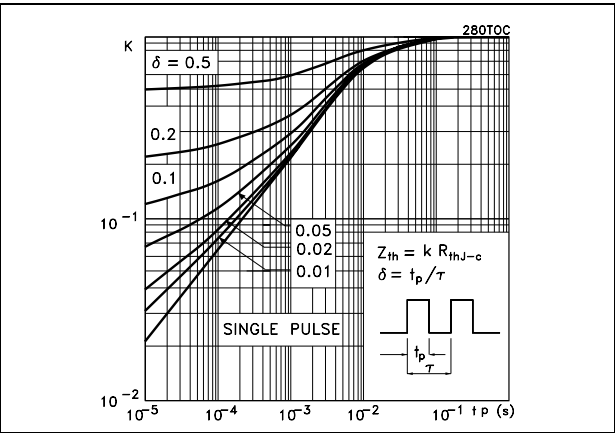


Figure 4. Safe operating area for TO-220FP

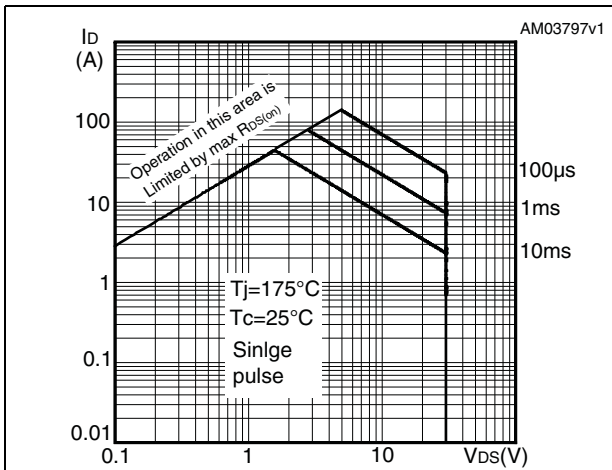


Figure 5. Thermal impedance for TO-220FP

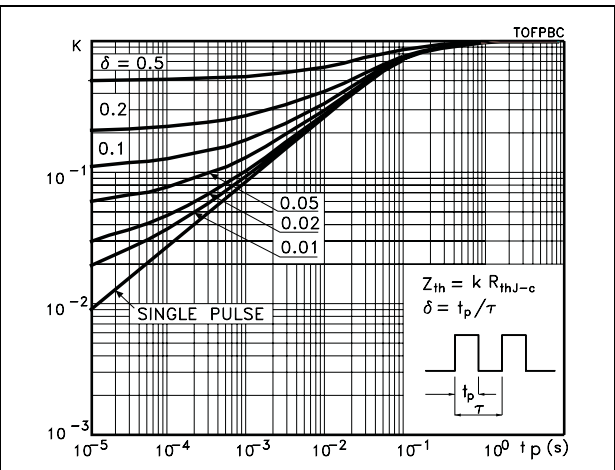


Figure 6. Output characteristics

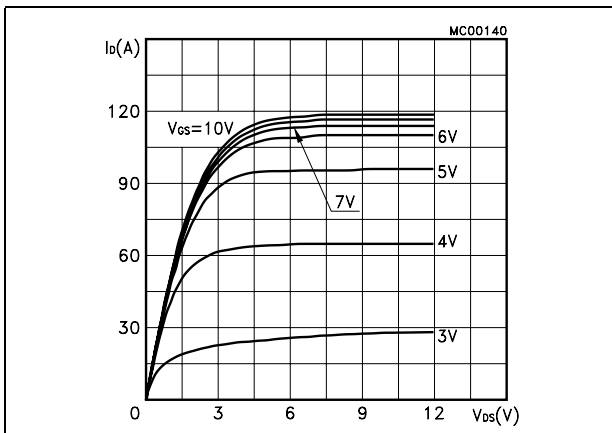


Figure 7. Transfer characteristics

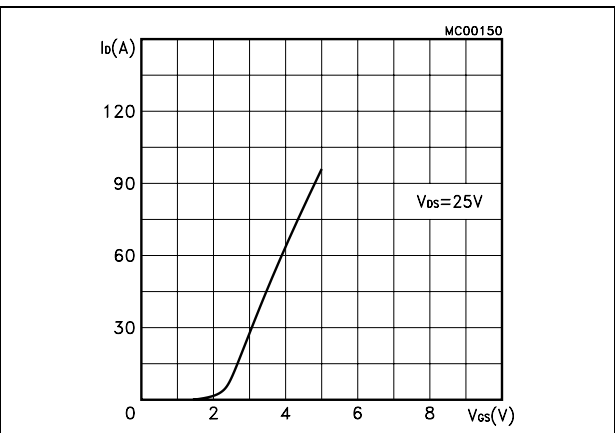


Figure 8. Transconductance

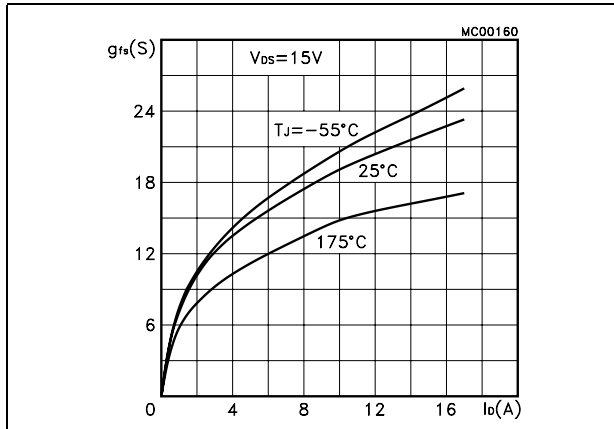


Figure 9. Static drain-source on resistance

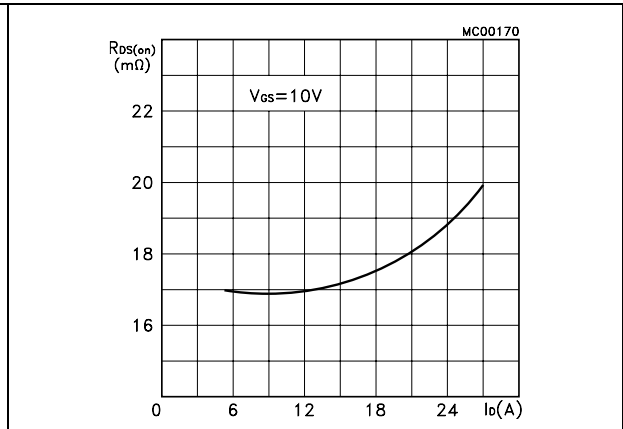


Figure 10. Gate charge vs. gate-source voltage Figure 11. Capacitance variations

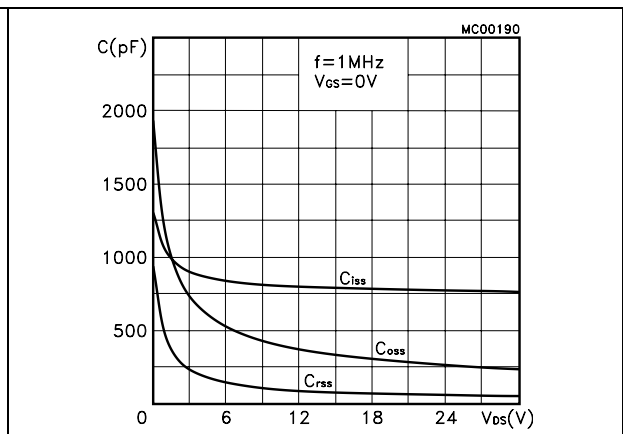
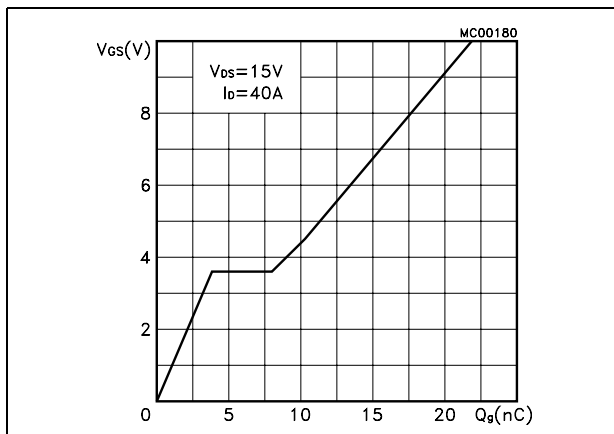


Figure 12. Normalized gate threshold voltage vs. temperature

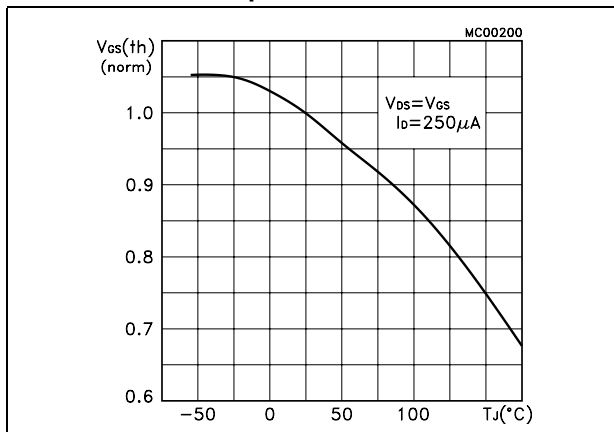


Figure 13. Normalized on resistance vs. temperature

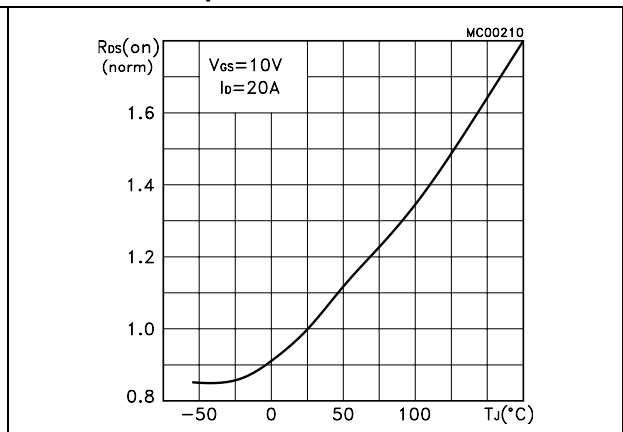


Figure 14. Source-drain diode forward characteristics

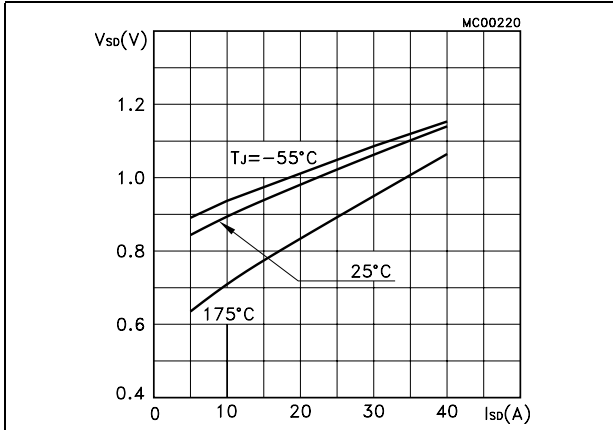
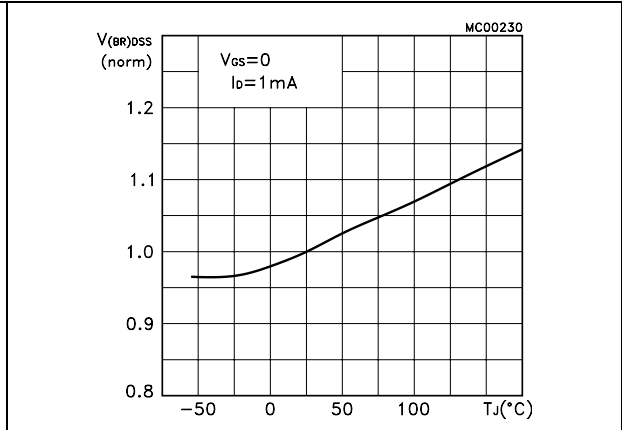


Figure 15. Normalized  $B_{VDSS}$  vs. temperature





### 3 Test circuits

Figure 16. Switching times test circuit for resistive load

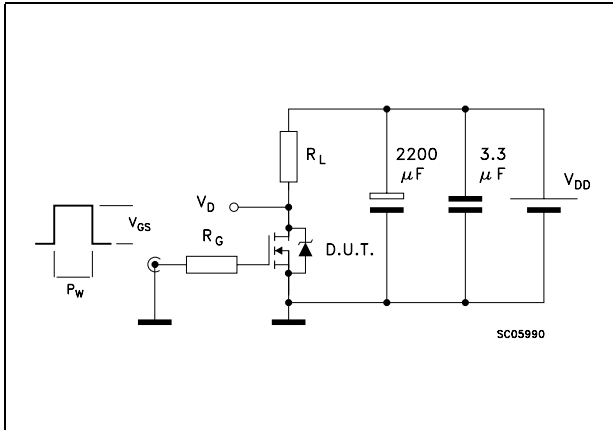


Figure 17. Gate charge test circuit

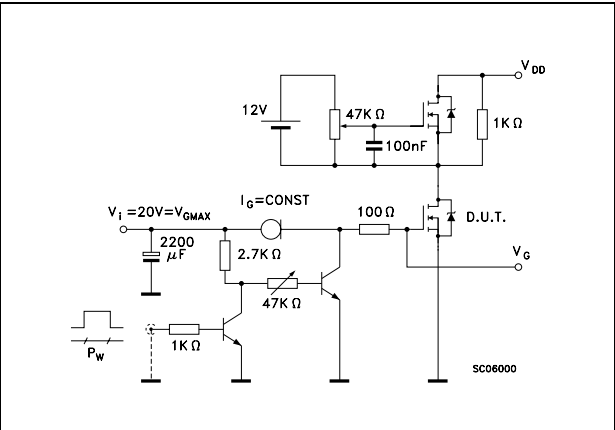


Figure 18. Test circuit for inductive load switching and diode recovery times

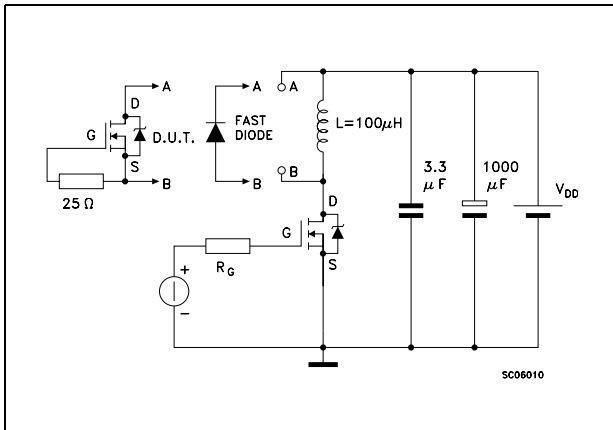


Figure 19. Unclamped inductive load test circuit

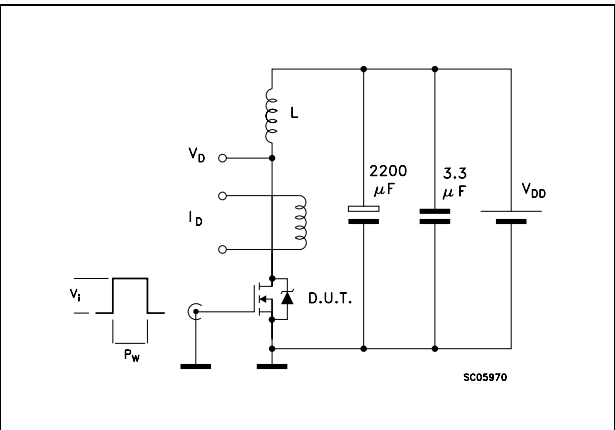


Figure 20. Unclamped inductive waveform

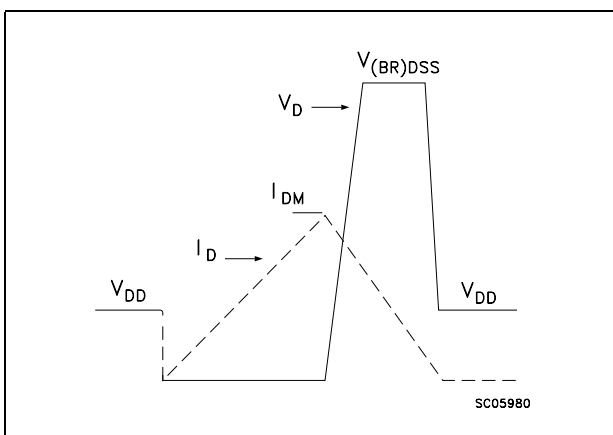
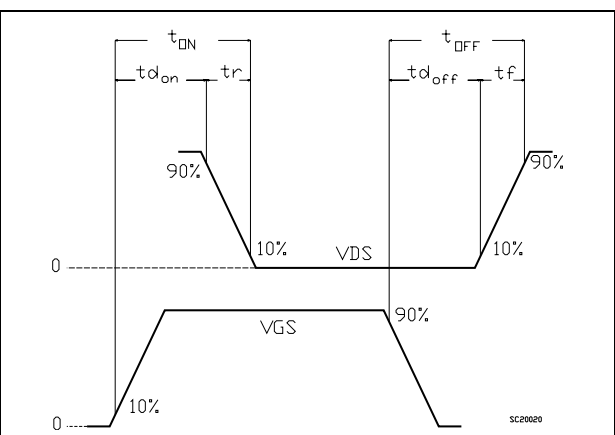


Figure 21. Switching time waveform

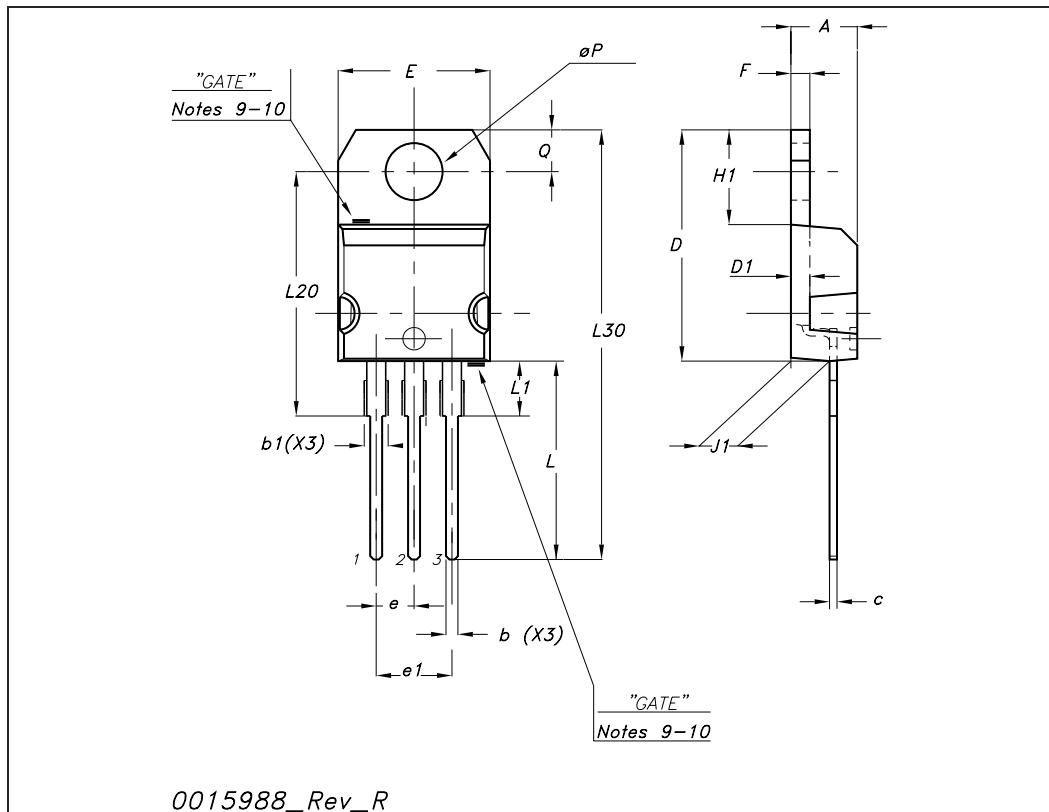


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

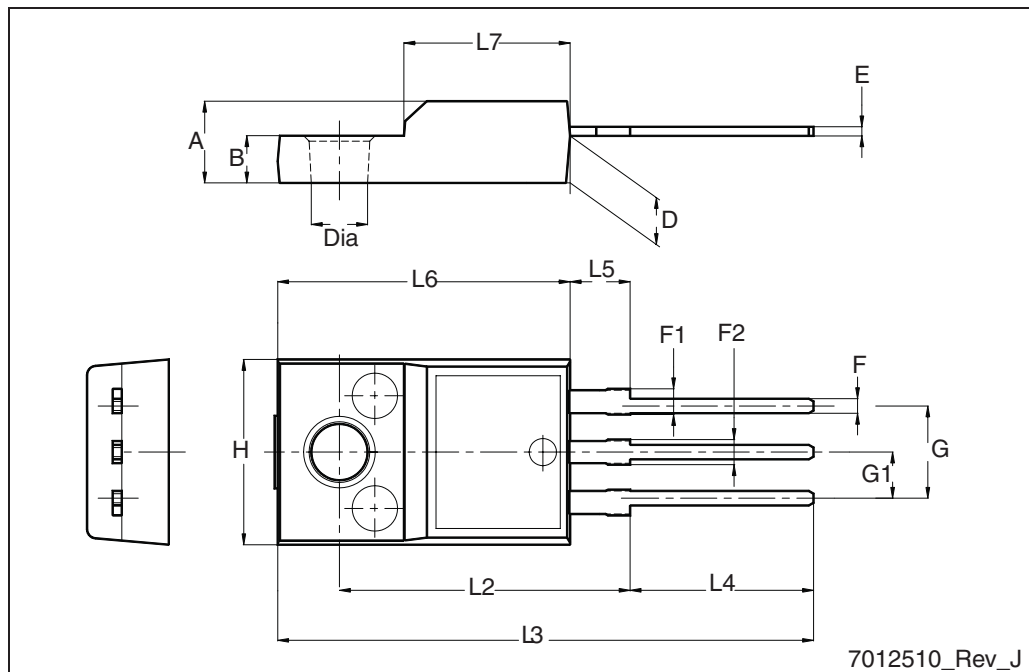
TO-220 mechanical data

| 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   |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 4.4  |      | 4.6  |
| B    | 2.5  |      | 2.7  |
| D    | 2.5  |      | 2.75 |
| E    | 0.45 |      | 0.7  |
| F    | 0.75 |      | 1    |
| F1   | 1.15 |      | 1.70 |
| F2   | 1.15 |      | 1.5  |
| G    | 4.95 |      | 5.2  |
| G1   | 2.4  |      | 2.7  |
| H    | 10   |      | 10.4 |
| L2   |      | 16   |      |
| L3   | 28.6 |      | 30.6 |
| L4   | 9.8  |      | 10.6 |
| L5   | 2.9  |      | 3.6  |
| L6   | 15.9 |      | 16.4 |
| L7   | 9    |      | 9.3  |
| Dia  | 3    |      | 3.2  |



## 5 Revision history

**Table 7. Document revision history**

| Date        | Revision | Changes   |
|-------------|----------|---|
| 09-Sep-2004 | 1        | Preliminary version   |
| 21-Jun-2005 | 2        | Complete version with curves  |
| 16-Aug-2006 | 3        | New template, no content change   |
| 21-Feb-2007 | 4        | Typo mistake on page 1  |
| 20-Nov-2008 | 5        | <a href="#">Figure 9: Static drain-source on resistance</a> has been corrected. |
| 14-Apr-2009 | 6        | The device in TO-220FP has been added   |
| 03-Feb-2010 | 7        | Updated <a href="#">Table 3: Thermal data</a> .                                 |
| 22-Feb-2010 | 8        | Updated <a href="#">Table 3: Thermal data</a> .                                 |

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