



# 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.

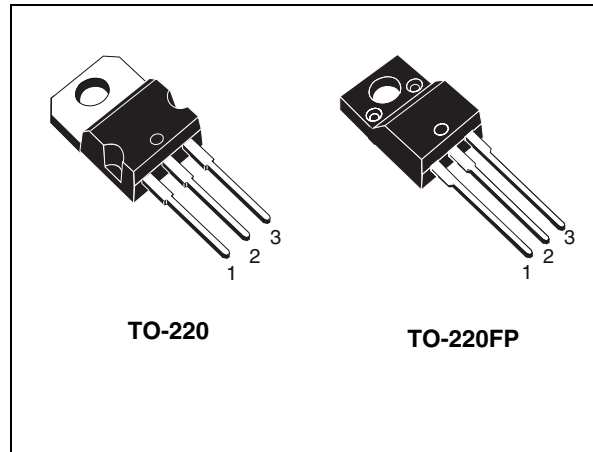


Figure 1. Internal schematic diagram

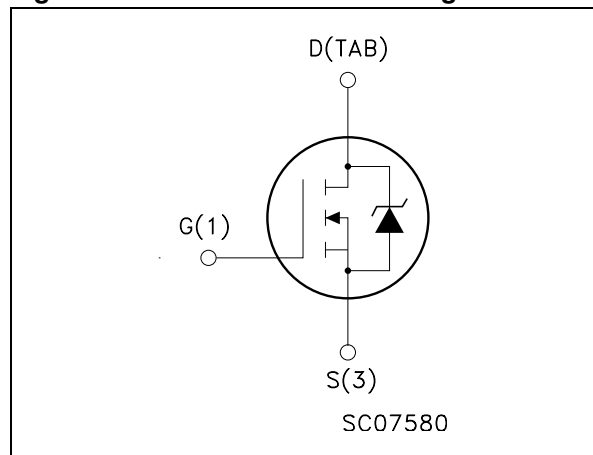


Table 1. Device summary

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

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

1. Pulse width limited by safe operating area.

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

**Table 3. Thermal data**

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

## 2 Electrical characteristics

( $T_{CASE}=25\text{ }^{\circ}\text{C}$  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>$T_C = 125\text{ }^{\circ}\text{C}$ |      |                | 1<br>10        | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 16\text{ V}$                                                                              |      |                | $\pm 100$      | 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

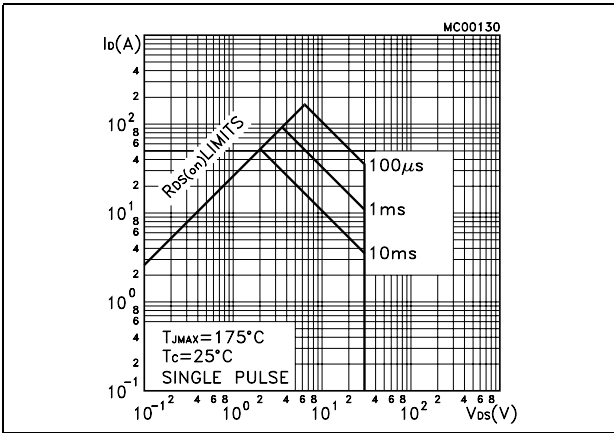


Figure 3. Thermal impedance for TO-220

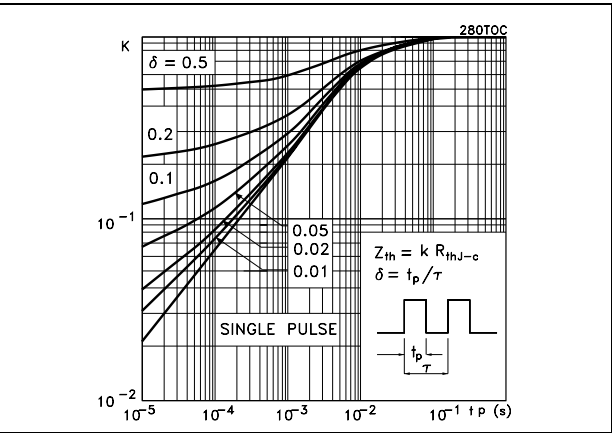


Figure 4. Safe operating area for TO-220FP

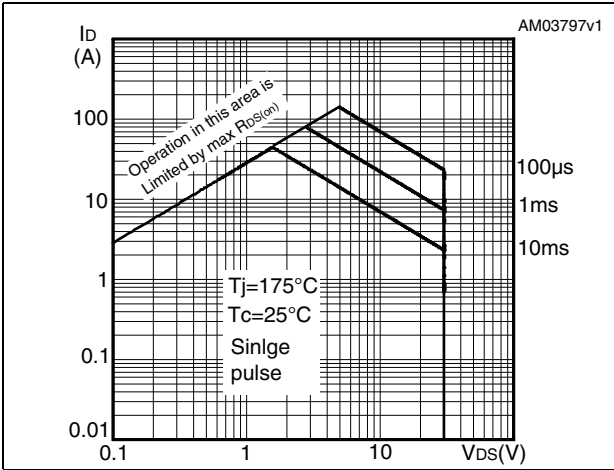


Figure 5. Thermal impedance for TO-220FP

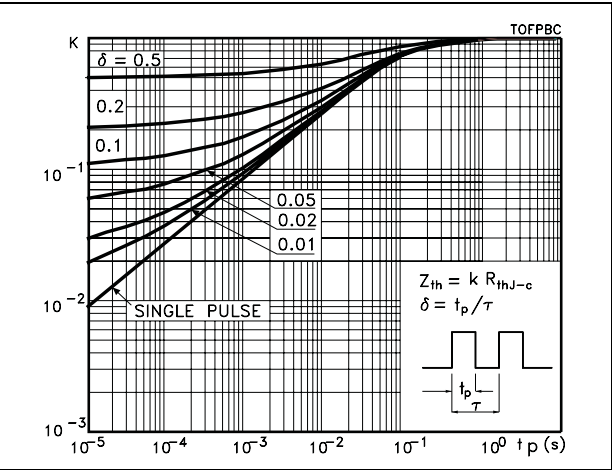


Figure 6. Output characteristics

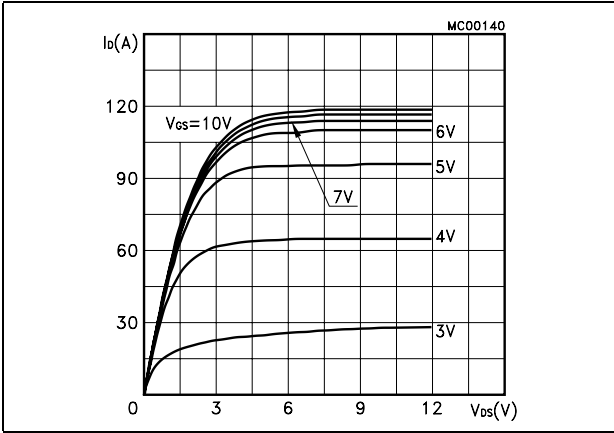


Figure 7. Transfer characteristics

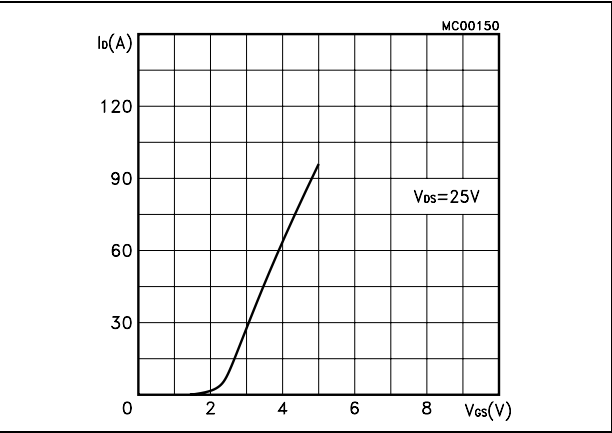


Figure 8. Transconductance

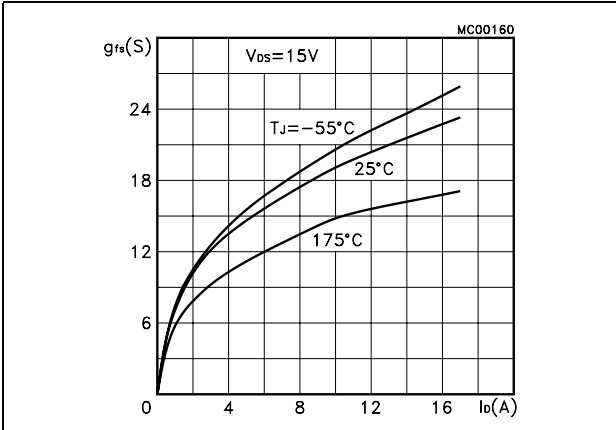


Figure 9. Static drain-source on resistance

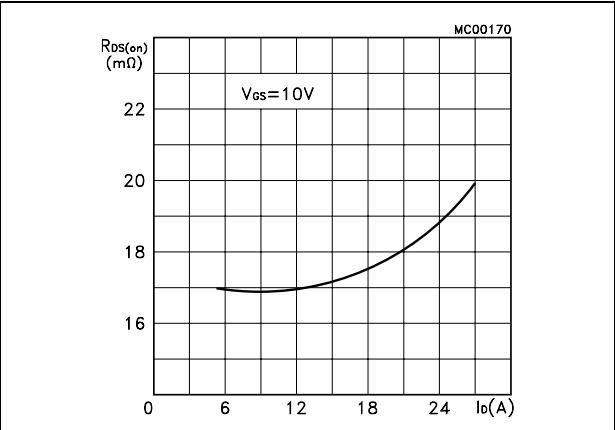


Figure 10. Gate charge vs. gate-source voltage

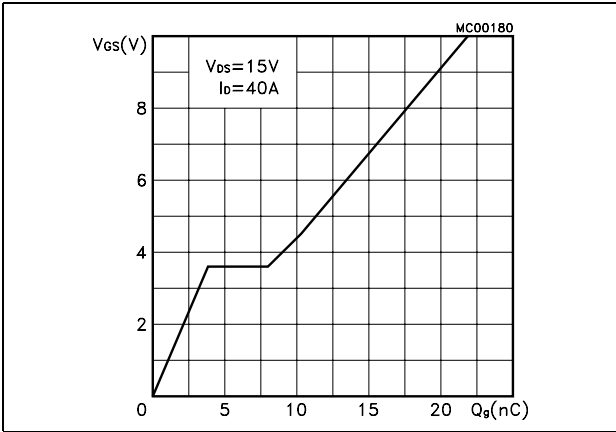


Figure 11. Capacitance variations

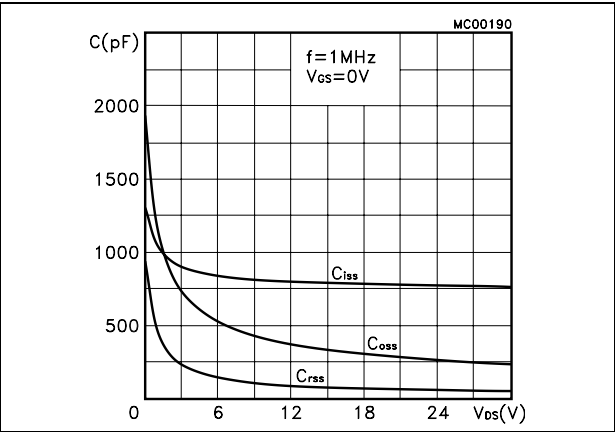


Figure 12. Normalized gate threshold voltage vs. temperature

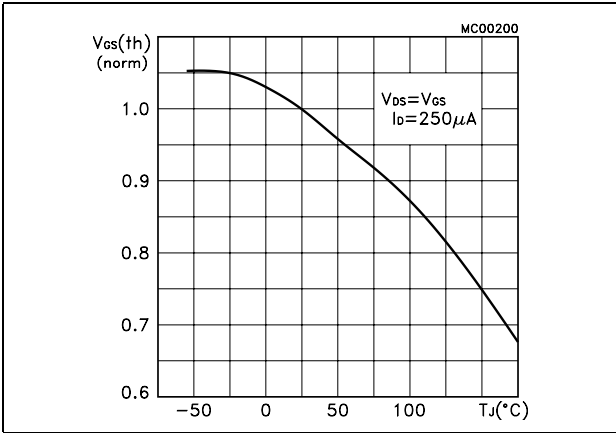


Figure 13. Normalized on resistance vs. temperature

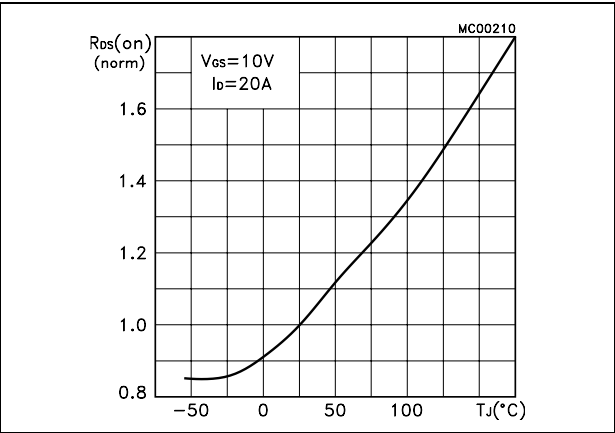


Figure 14. Source-drain diode forward characteristics

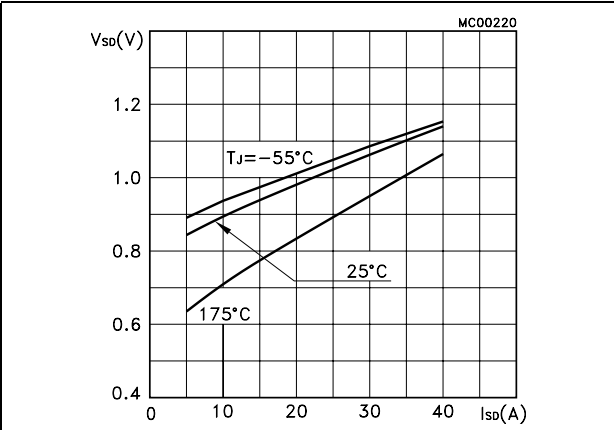
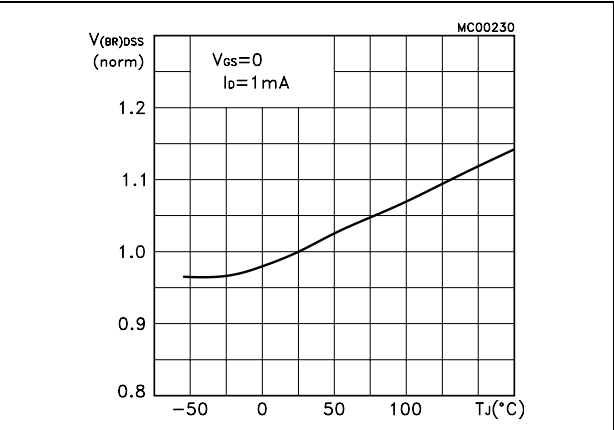
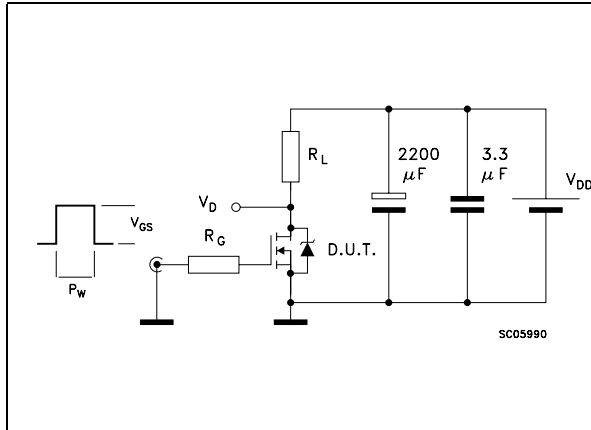


Figure 15. Normalized  $B_{VDSS}$  vs. temperature

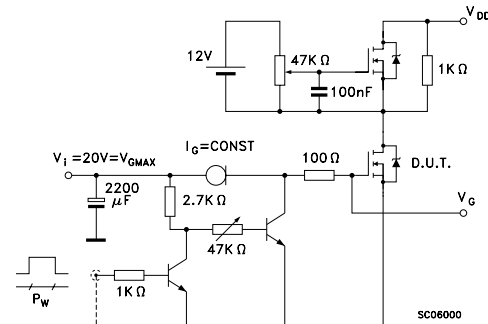


### 3 Test circuits

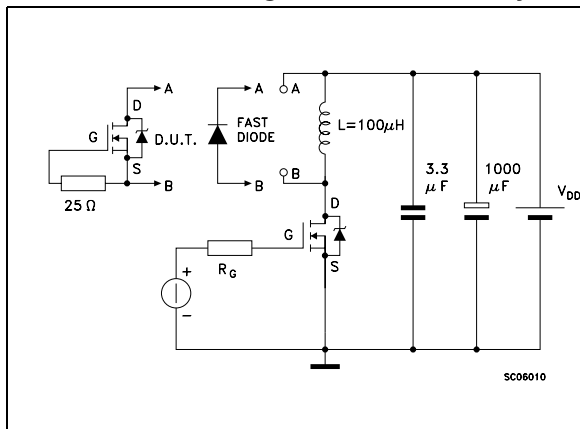
**Figure 16. Switching times test circuit for resistive load**



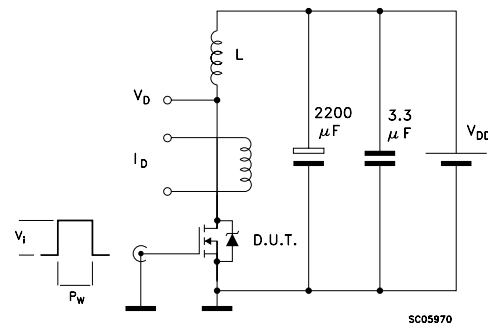
**Figure 17. Gate charge test circuit**



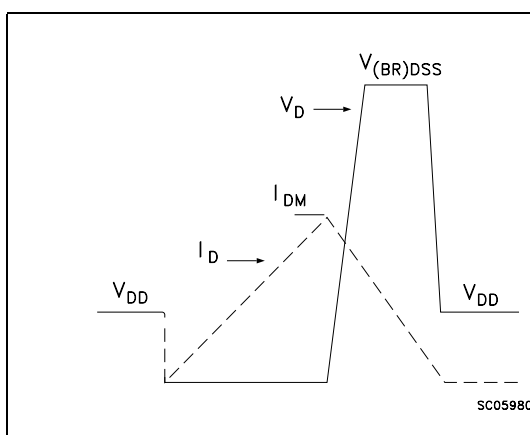
**Figure 18. Test circuit for inductive load switching and diode recovery times**



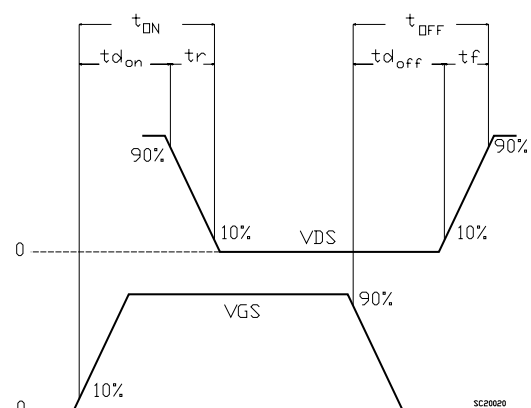
**Figure 19. Unclamped inductive load test circuit**



**Figure 20. Unclamped inductive waveform**



**Figure 21. Switching time waveform**

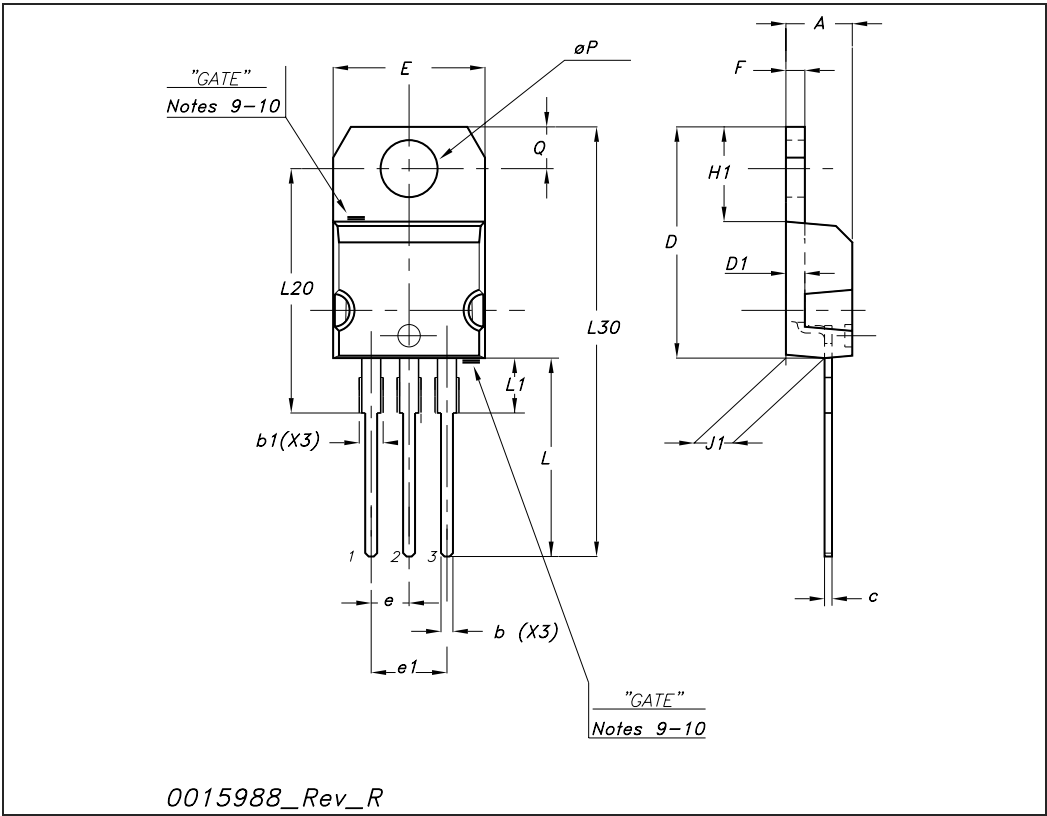


## 4 Package mechanical data

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.

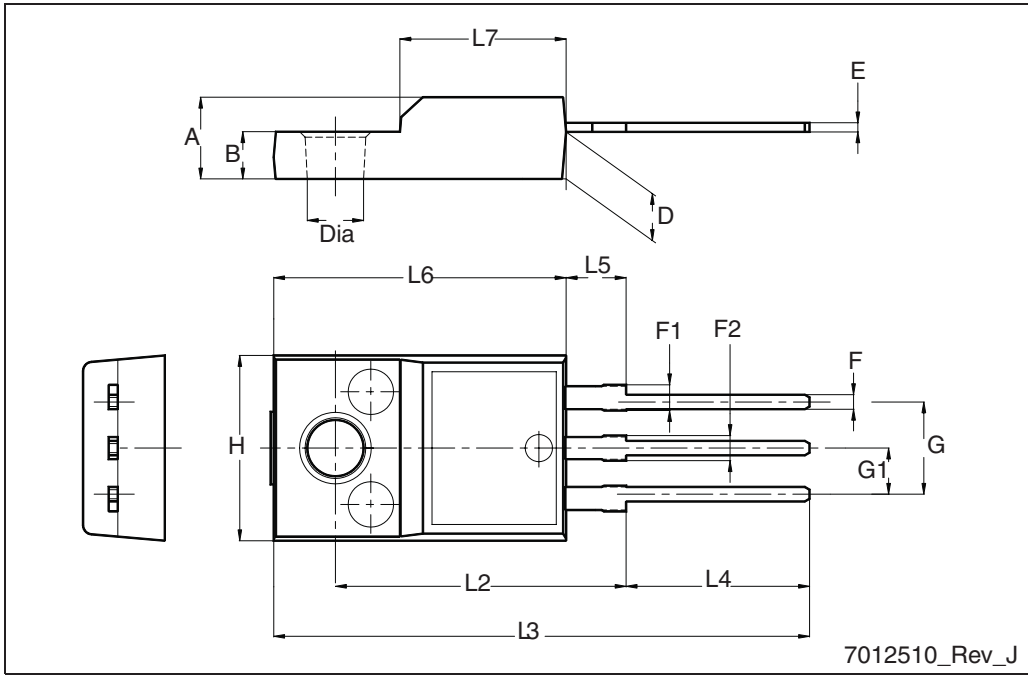
TO-220 mechanical data

| 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 |       |
| ØP  | 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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