



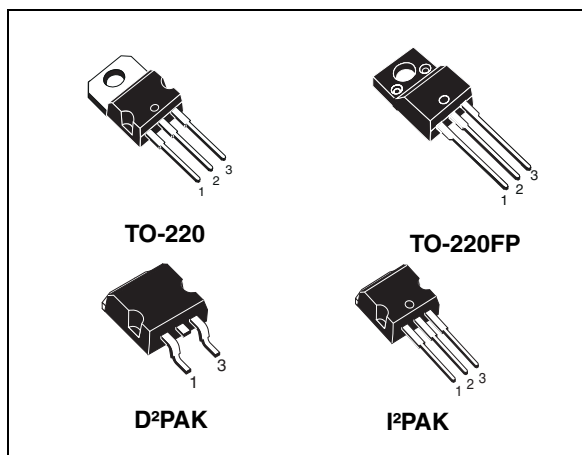
# STP12NM50 - STP12NM50FP STB12NM50 - STB12NM50-1

N-channel 550V @  $t_{jmax}$  -  $0.30\Omega$  - 12A TO-220/FP/D<sup>2</sup>/I<sup>2</sup>PAK  
MDmesh™ Power MOSFET

## General features

| Type        | V <sub>DSS</sub><br>(@T <sub>jmax</sub> ) | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-------------|-------------------------------------------|---------------------|----------------|
| STB12NM50   | 550V                                      | <0.35Ω              | 12A            |
| STB12NM50-1 | 550V                                      | <0.35Ω              | 12A            |
| STP12NM50   | 550V                                      | <0.35Ω              | 12A            |
| STP12NM50FP | 550V                                      | <0.35Ω              | 12A            |

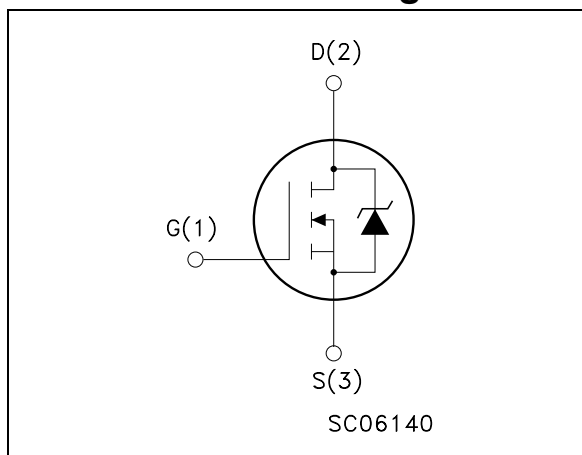
- High dv/dt and avalanche capabilities
- Low input capacitance and gate charge
- 100% avalanche tested
- Low gate input resistance
- Tight process control and high manufacturing yields



## Description

The MDmesh™ is a new revolutionary MOSFET technology that associates the Multiple Drain process with the Company's PowerMESH™ horizontal layout. The resulting product has an outstanding low on-resistance, impressively high dv/dt and excellent avalanche characteristics. The adoption of the Company's proprietary strip technique yields overall dynamic performance that is significantly better than that of similar competition's products.

## Internal schematic diagram



## Applications

- Switching application

## Order codes

| Part number | Marking   | Package            | Packaging   |
|-------------|-----------|--------------------|-------------|
| STB12NM50T4 | B12NM50   | D <sup>2</sup> PAK | Tape & reel |
| STB12NM50-1 | B12NM50   | I <sup>2</sup> PAK | Tube        |
| STP12NM50   | P12NM50   | TO-220             | Tube        |
| STP12NM50FP | P12NM50FP | TO-220FP           | Tube        |

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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol                             | Parameter                                             | Value                                             |                    | Unit |
|------------------------------------|-------------------------------------------------------|---------------------------------------------------|--------------------|------|
|                                    |                                                       | TO-220-<br>/D <sup>2</sup> PAK/I <sup>2</sup> PAK | TO-220FP           |      |
| V <sub>GS</sub>                    | Gate-source voltage                                   | ± 30                                              |                    | V    |
| I <sub>D</sub>                     | Drain current (continuous) at T <sub>C</sub> = 25°C   | 12                                                | 12 <sup>(1)</sup>  | A    |
| I <sub>D</sub>                     | Drain current (continuous) at T <sub>C</sub> =100°C   | 7.5                                               | 7.5 <sup>(1)</sup> | A    |
| I <sub>DM</sub> <sup>(2)</sup>     | Drain current (pulsed)                                | 48                                                | 48 <sup>(1)</sup>  | A    |
| P <sub>TOT</sub>                   | Total dissipation at T <sub>C</sub> = 25°C            | 160                                               | 35                 | W    |
|                                    | Derating Factor                                       | 1.28                                              | 0.28               | W/°C |
| V <sub>ISO</sub>                   | Insulation withstand voltage (DC)                     | --                                                | 2500               | V    |
| dv/dt <sup>(3)</sup>               | Peak diode recovery voltage slope                     | 15                                                |                    | V/ns |
| T <sub>J</sub><br>T <sub>stg</sub> | Operating junction temperature<br>Storage temperature | -65 to 150                                        |                    | °C   |

1. Limited only by maximum temperature allowed

2. Pulse width limited by safe operating area

3. I<sub>SD</sub> ≤ 2A, di/dt ≤ 400A/μs, V<sub>DD</sub> = 80%V<sub>(BR)DSS</sub>

**Table 2. Thermal data**

| Symbol                | Parameter                                      | Value                                            |          | Unit |
|-----------------------|------------------------------------------------|--------------------------------------------------|----------|------|
|                       |                                                | TO-220/D <sup>2</sup> PAK/<br>I <sup>2</sup> PAK | TO-220FP |      |
| R <sub>thj-case</sub> | Thermal resistance junction-case Max           | 0.78                                             | 3.57     | °C/W |
| R <sub>thj-a</sub>    | Thermal resistance junction-ambient Max        | 62.5                                             |          | °C/W |
| T <sub>I</sub>        | Maximum lead temperature for soldering purpose | 300                                              |          | °C   |

**Table 3. Avalanche characteristics**

| Symbol          | Parameter                                                                                                             | Value | Unit |
|-----------------|-----------------------------------------------------------------------------------------------------------------------|-------|------|
| I <sub>AS</sub> | Avalanche current, repetitive or not-repetitive (pulse width limited by T <sub>J</sub> Max)                           | 6     | A    |
| E <sub>AS</sub> | Single pulse avalanche energy (starting T <sub>J</sub> =25°C, I <sub>d</sub> =I <sub>ar</sub> , V <sub>dd</sub> =50V) | 400   | mJ   |

## 2 Electrical characteristics

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

**Table 4. On/off states**

| Symbol        | Parameter                                        | Test conditions                                                                       | Min. | Typ. | Max.      | Unit                           |
|---------------|--------------------------------------------------|---------------------------------------------------------------------------------------|------|------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 250\ \mu\text{A}$ , $V_{GS} = 0$                                               | 500  |      |           | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max rating}$ ,<br>$V_{DS} = \text{Max rating @ } 125^{\circ}\text{C}$ |      |      | 1<br>10   | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 30\text{V}$                                                             |      |      | $\pm 100$ | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 50\ \mu\text{A}$                                           | 3    | 4    | 5         | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{V}$ , $I_D = 6\text{A}$                                             |      | 0.30 | 0.35      | $\Omega$                       |

**Table 5. Dynamic**

| Symbol                              | Parameter                                                               | Test conditions                                                                                                | Min. | Typ.              | Max. | Unit           |
|-------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|------|-------------------|------|----------------|
| $g_{fs}^{(1)}$                      | Forward transconductance                                                | $V_{DS} = 15\text{V}$ , $I_D = 6\text{A}$                                                                      |      | 5.5               |      | S              |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS} = 25\text{V}$ , $f = 1\ \text{MHz}$ , $V_{GS} = 0$                                                     |      | 1000<br>250<br>20 |      | pF<br>pF<br>pF |
| $C_{oss\ eq}^{(2)}$                 | Equivalent output capacitance                                           | $V_{GS} = 0$ , $V_{DS} = 0\text{V to } 400\text{V}$                                                            |      | 90                |      | pF             |
| $t_{d(on)}$<br>$t_r$                | Turn-on Delay Time<br>Rise Time                                         | $V_{DD} = 250\text{V}$ , $I_D = 6\text{A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{V}$<br>(see Figure 14) |      | 20<br>10          |      | ns<br>ns       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$       | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 400\text{V}$ , $I_D = 12\text{A}$<br>$V_{GS} = 10\text{V}$<br>(see Figure 15)                        |      | 28<br>8<br>18     | 39   | nC<br>nC<br>nC |
| $R_g$                               | Gate input resistance                                                   | $f = 1\text{MHz}$ Gate DC Bias=0<br>test signal level=20mV<br>open drain                                       |      | 1.6               |      | $\Omega$       |

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

2.  $C_{oss\ eq}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

**Table 6. Source drain diode**

| Symbol                            | Parameter                                                                    | Test conditions                                                                                   | Min | Typ.                | Max | Unit               |
|-----------------------------------|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----|---------------------|-----|--------------------|
| $I_{SD}$                          | Source-drain current                                                         |                                                                                                   |     |                     | 11  | A                  |
| $I_{SDM}^{(1)}$                   | Source-drain current (pulsed)                                                |                                                                                                   |     |                     | 48  | A                  |
| $V_{SD}^{(2)}$                    | Forward on voltage                                                           | $I_{SD}=12A$ , $V_{GS}=0$                                                                         |     |                     | 1.5 | V                  |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD}=12A$ ,<br>$di/dt = 100A/\mu s$ ,<br>$V_{DD}=100V$ , $T_j=25^{\circ}C$<br>(see Figure 16)  |     | 270<br>2.23<br>16.5 |     | ns<br>$\mu C$<br>A |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD}=12A$ ,<br>$di/dt = 100A/\mu s$ ,<br>$V_{DD}=100V$ , $T_j=150^{\circ}C$<br>(see Figure 16) |     | 340<br>3<br>18      |     | ns<br>$\mu C$<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

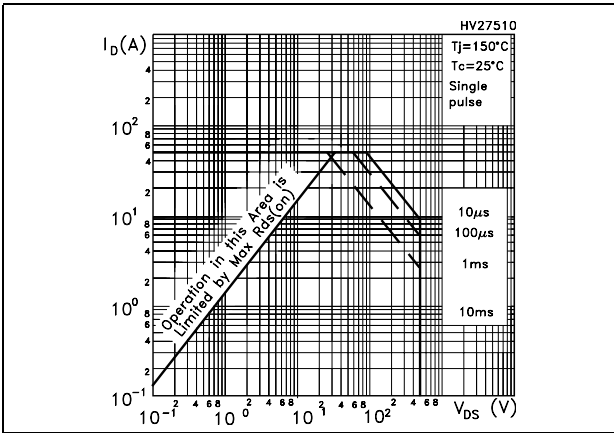


Figure 2. Thermal impedance

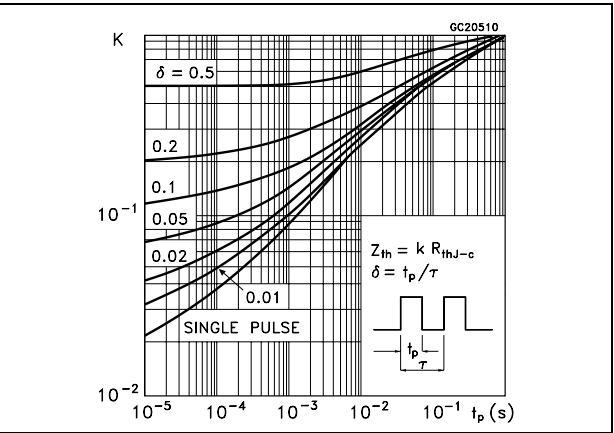


Figure 3. Safe operating area for TO-220FP

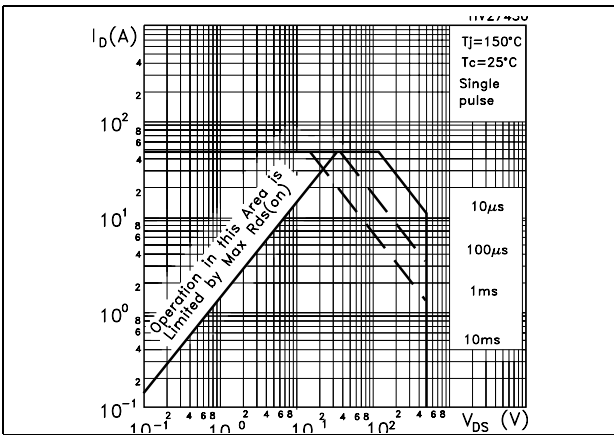


Figure 4. Thermal impedance for TO-220FP

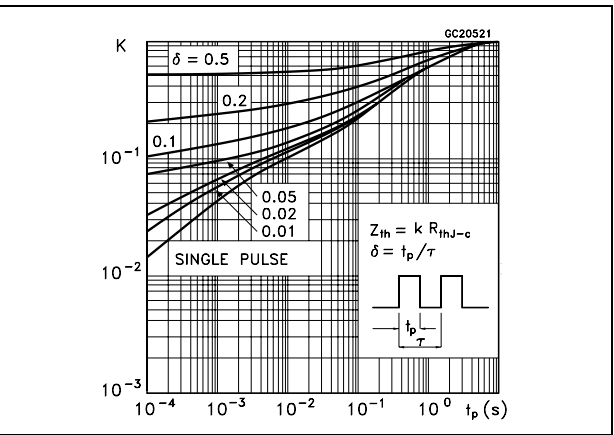


Figure 5. Output characteristics

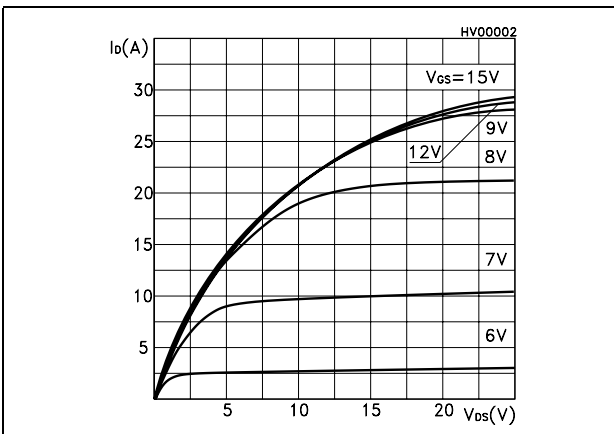


Figure 6. Transfer characteristics

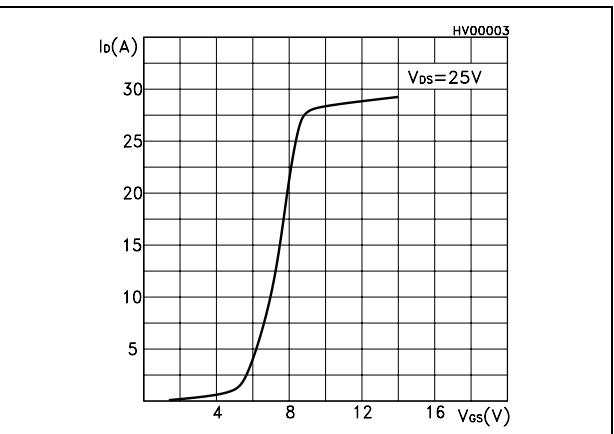


Figure 7. Transconductance

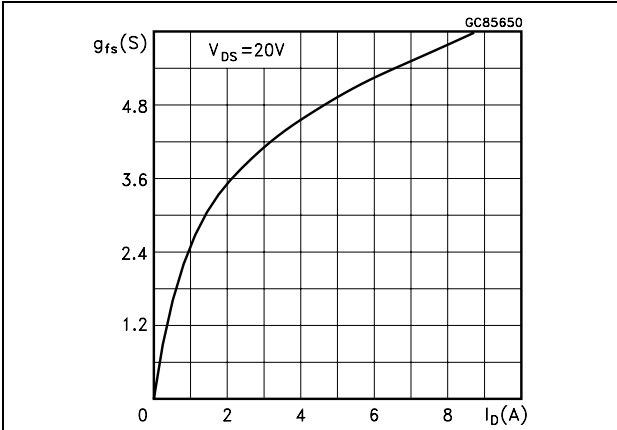


Figure 8. Static drain-source on resistance

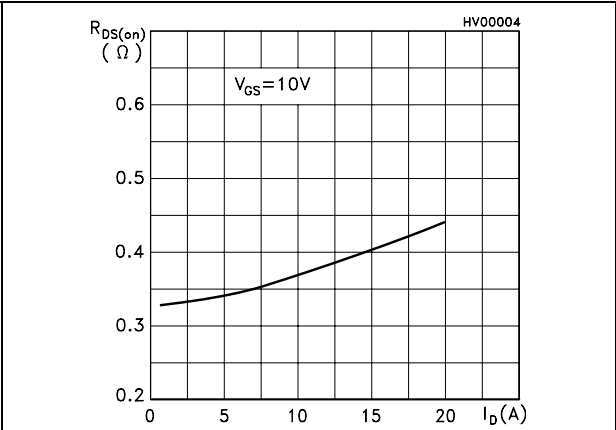


Figure 9. Gate charge vs gate-source voltage

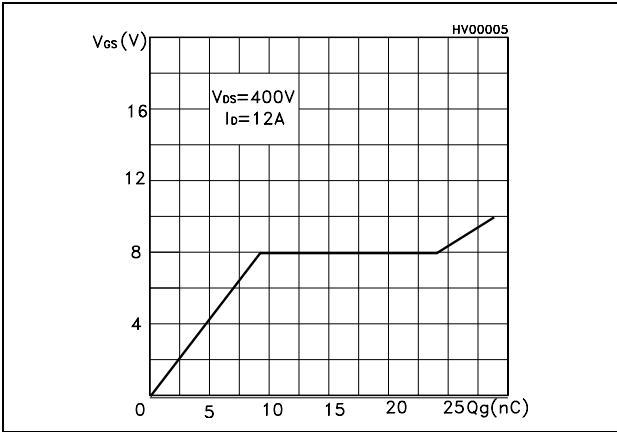


Figure 10. Capacitance variations

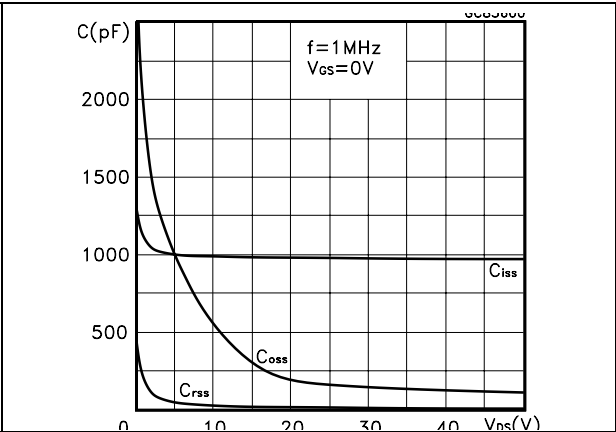


Figure 11. Normalized gate threshold voltage vs temperature

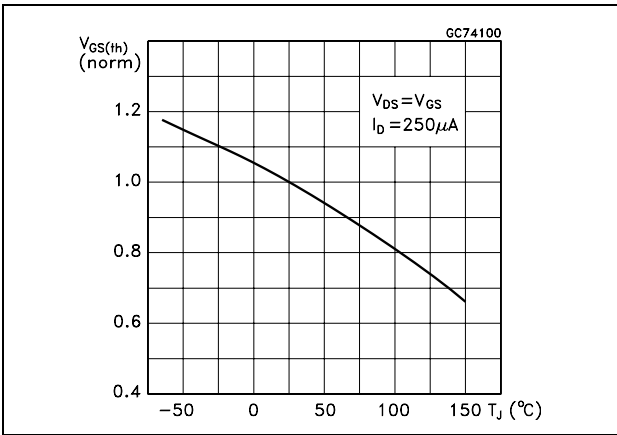


Figure 12. Normalized on resistance vs temperature

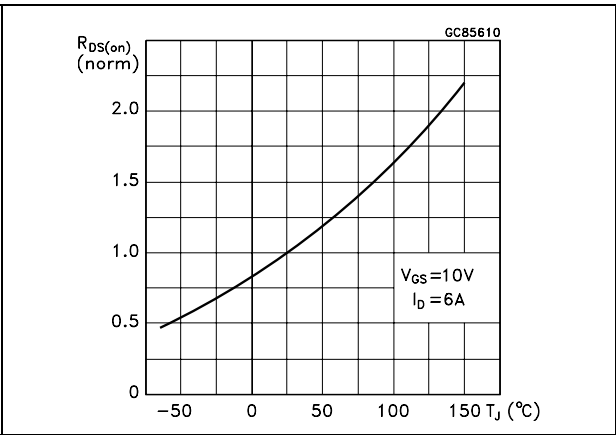
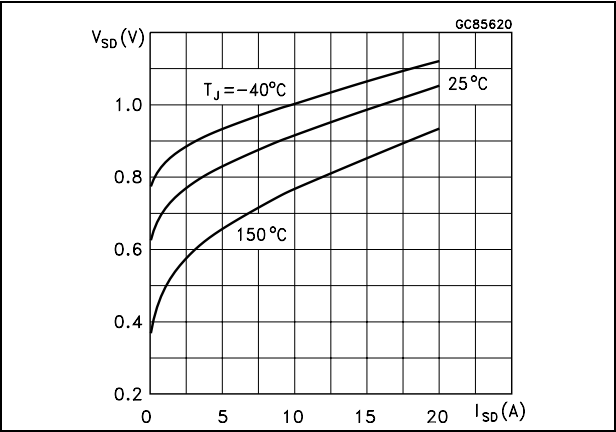


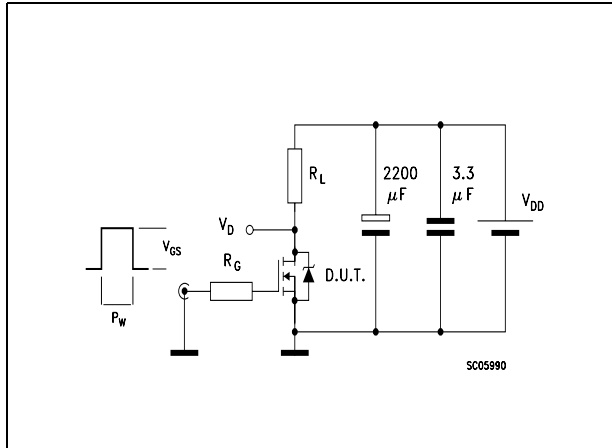
Figure 13. Source-drain diode forward characteristics



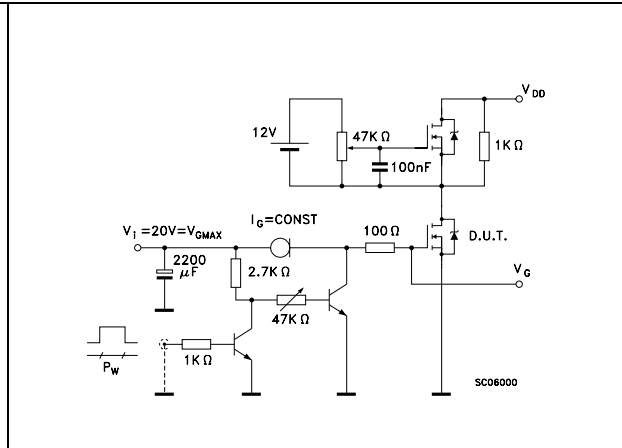


### 3 Test circuit

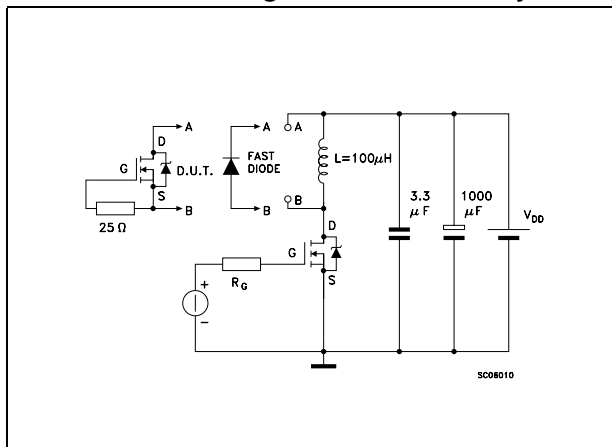
**Figure 14. Switching times test circuit for resistive load**



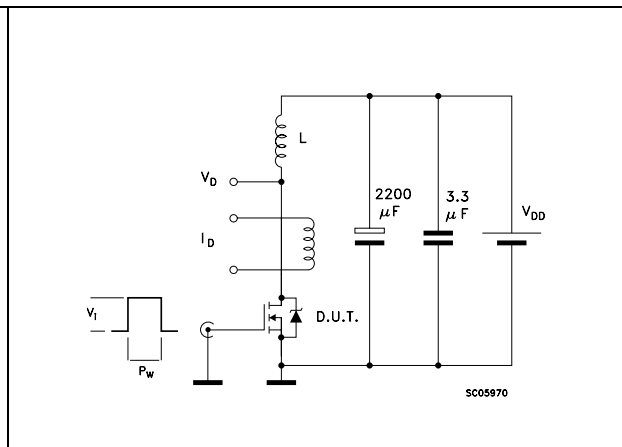
**Figure 15. Gate charge test circuit**



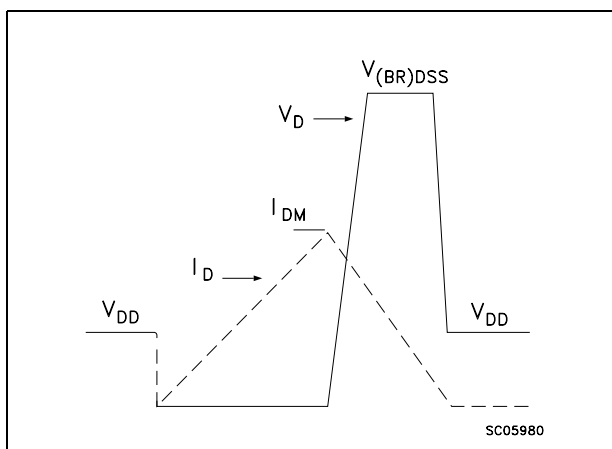
**Figure 16. Test circuit for inductive load switching and diode recovery times**



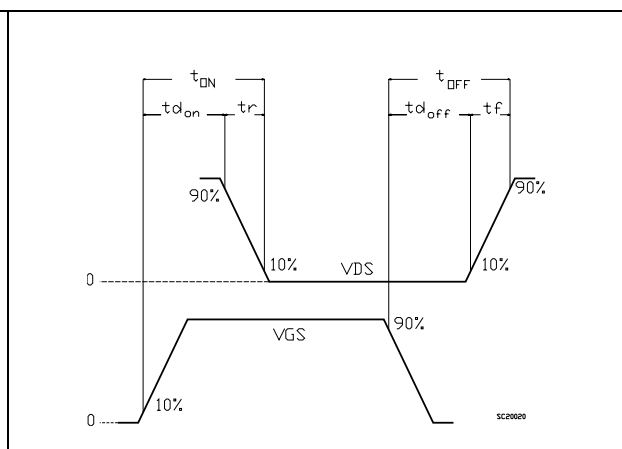
**Figure 17. Unclamped Inductive load test circuit**



**Figure 18. Unclamped inductive waveform**



**Figure 19. Switching time waveform**

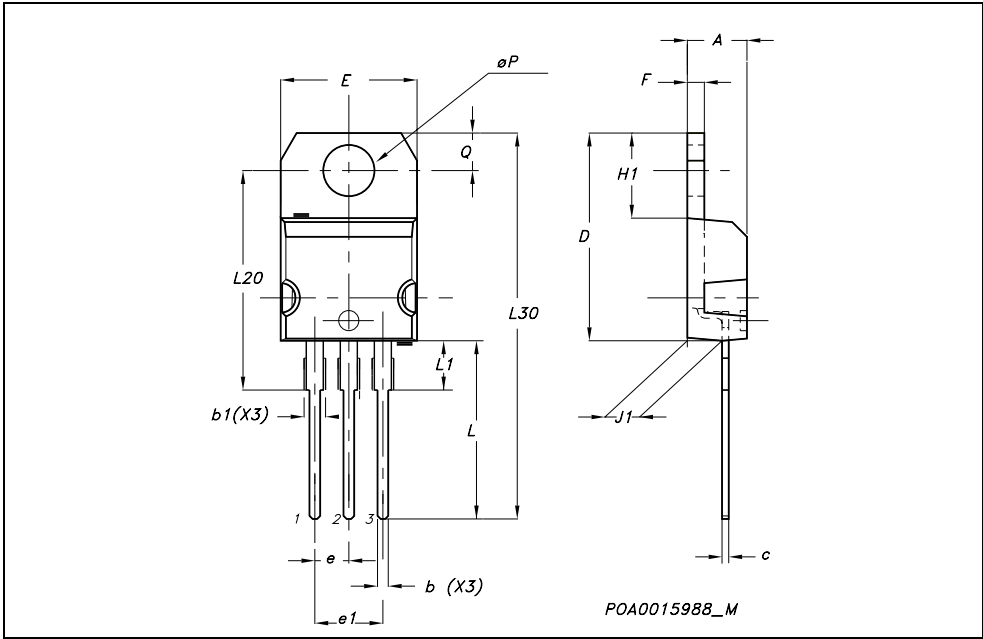


## 4 Package mechanical data

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)

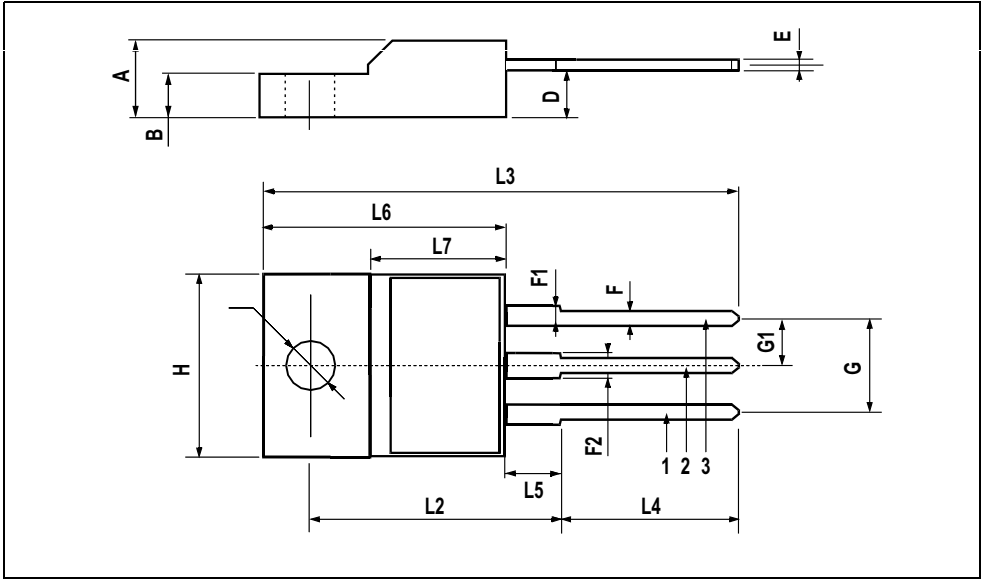
TO-220 MECHANICAL DATA

| 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 |



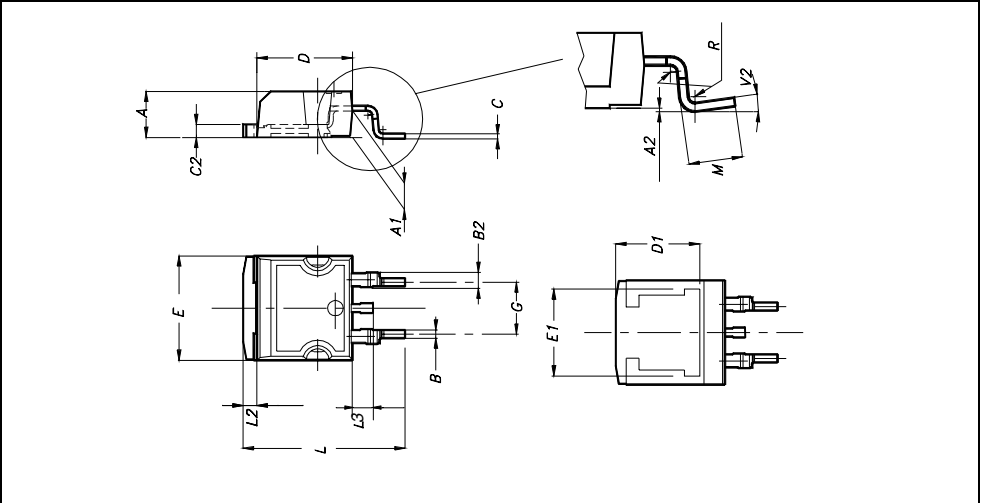
TO-220FP MECHANICAL DATA

| 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 |



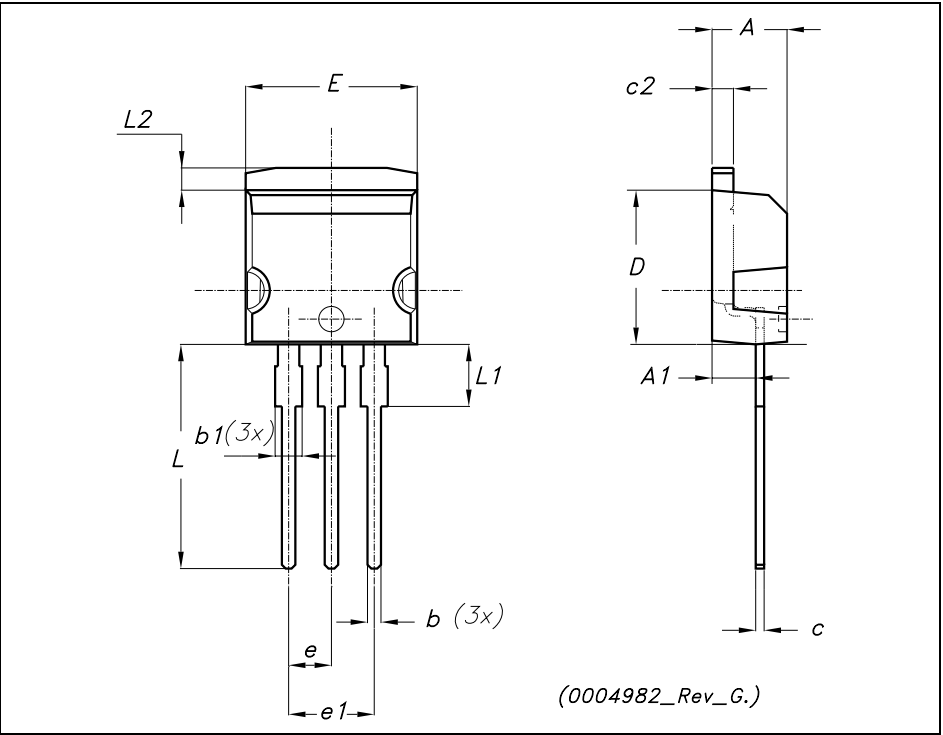
D<sup>2</sup>PAK MECHANICAL DATA

| 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°    |       |       |       |



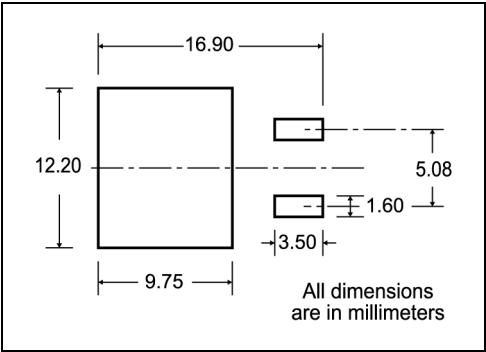
TO-262 (I<sup>2</sup>PAK) MECHANICAL DATA

| DIM. | mm.  |     |       | inch  |      |       |
|------|------|-----|-------|-------|------|-------|
|      | MIN. | TYP | MAX.  | MIN.  | TYP. | MAX.  |
| A    | 4.40 |     | 4.60  | 0.173 |      | 0.181 |
| A1   | 2.40 |     | 2.72  | 0.094 |      | 0.107 |
| b    | 0.61 |     | 0.88  | 0.024 |      | 0.034 |
| b1   | 1.14 |     | 1.70  | 0.044 |      | 0.066 |
| c    | 0.49 |     | 0.70  | 0.019 |      | 0.027 |
| c2   | 1.23 |     | 1.32  | 0.048 |      | 0.052 |
| D    | 8.95 |     | 9.35  | 0.352 |      | 0.368 |
| e    | 2.40 |     | 2.70  | 0.094 |      | 0.106 |
| e1   | 4.95 |     | 5.15  | 0.194 |      | 0.202 |
| E    | 10   |     | 10.40 | 0.393 |      | 0.410 |
| L    | 13   |     | 14    | 0.511 |      | 0.551 |
| L1   | 3.50 |     | 3.93  | 0.137 |      | 0.154 |
| L2   | 1.27 |     | 1.40  | 0.050 |      | 0.055 |

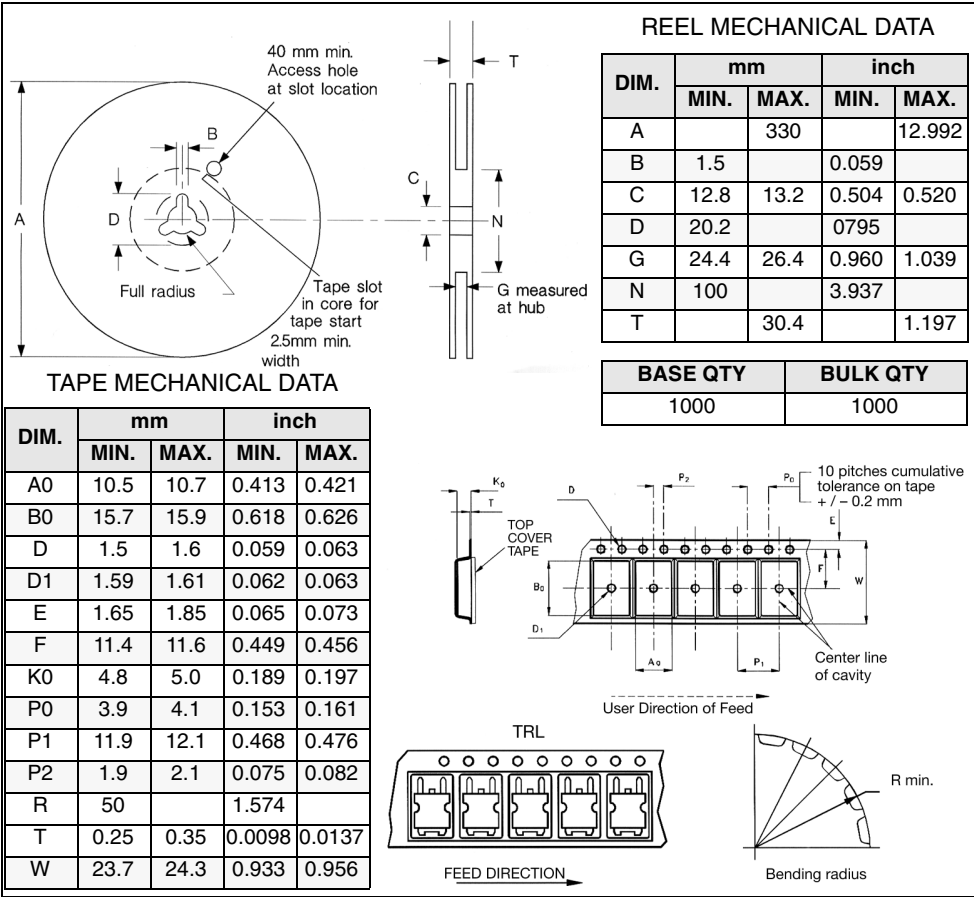


# 5 Packaging mechanical data

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



## TAPE AND REEL SHIPMENT



\* on sales type

## 6 Revision history

**Table 7. Revision history**

| Date        | Revision | Changes                                         |
|-------------|----------|-------------------------------------------------|
| 14-Mar-2004 | 8        | Preliminary version                             |
| 15-Feb-2006 | 9        | New voltage value on first page at $t_{jmax}$ . |
| 05-Apr-2006 | 10       | Inserted ecopack indication                     |
| 27-Jul-2006 | 11       | New template, no content change                 |



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