



# STF8NK100Z STP8NK100Z

N-CHANNEL 1000V - 1.60Ω - 6.5A - TO-220 - TO-220FP  
Zener-Protected SuperMESH™ MOSFET

## General features

| Type       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub>          | P <sub>w</sub> |
|------------|------------------|---------------------|-------------------------|----------------|
| STF8NK100Z | 1000 V           | <1.85Ω              | 6.5 A <sup>Note 1</sup> | 40 W           |
| STP8NK100Z | 1000 V           | <1.85Ω              | 6.5 A                   | 160 W          |

- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE RATED
- IMPROVED ESD CAPABILITY
- VERY LOW INTRINSIC CAPACITANCE

## Description

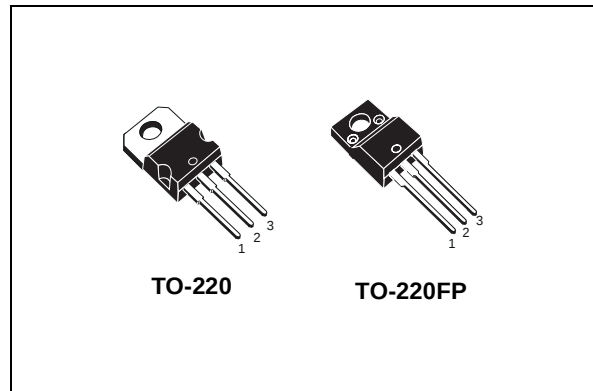
The SuperMESH™ series is obtained through an extreme optimization of ST's well established stripbased PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications. Such series complements ST full range of high voltage MOSFETs including revolutionary MDmesh™ products.

## Applications

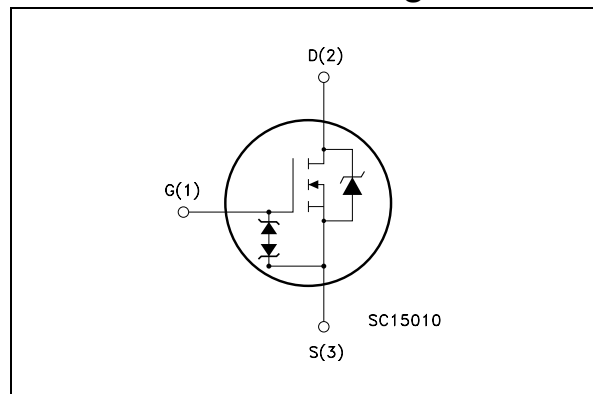
- HIGH CURRENT, SWITCHING APPLICATION
- IDEAL FOR OFF-LINE POWER SUPPLIES

## Order codes

| Sales Type | Marking  | Package  | Packaging |
|------------|----------|----------|-----------|
| STF8NK100Z | F8NK100Z | TO-220FP | TUBE      |
| STP8NK100Z | P8NK100Z | TO-220   | TUBE      |



## Internal schematic diagram



# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol                 | Parameter                                               | Value      |          | Unit                |
|------------------------|---------------------------------------------------------|------------|----------|---------------------|
|                        |                                                         | TO-220     | TO-220FP |                     |
| $V_{DS}$               | Drain-source Voltage ( $V_{GS}=0$ )                     | 1000       |          | V                   |
| $V_{DGR}$              | Drain-gate Voltage                                      | 1000       |          | V                   |
| $V_{GS}$               | Gate-Source Voltage                                     | $\pm 30$   |          | V                   |
| $I_D$ <i>Note 1</i>    | Drain Current (continuous) at $T_C = 25^\circ\text{C}$  | 6.5        | 6.5      | A                   |
| $I_D$                  | Drain Current (continuous) at $T_C = 100^\circ\text{C}$ | 4.3        | 4.3      | A                   |
| $I_{DM}$ <i>Note 2</i> | Drain Current (pulsed)                                  | 16         | 16       | A                   |
| $P_{TOT}$              | Total Dissipation at $T_C = 25^\circ\text{C}$           | 160        | 40       | W                   |
|                        | Derating Factor                                         | 1.28       | 0.32     | W/ $^\circ\text{C}$ |
| $V_{ESD(G-S)}$         | Gate source ESD (HBM-C=100pF, R=1.5K $\Omega$ )         | 4000       |          | V                   |
| dv/dt <i>Note 3</i>    | Peak Diode Recovery voltage slope                       | 4.5        |          | V/ns                |
| $V_{ISO}$              | Insulation Withstand Voltage (DC)                       | --         | 2500     | V                   |
| $T_j$<br>$T_{stg}$     | Operating Junction Temperature<br>Storage Temperature   | -55 to 150 |          | $^\circ\text{C}$    |

**Table 2. Thermal data**

|           |                                                | TO-220 | TO-220FP |                           |
|-----------|------------------------------------------------|--------|----------|---------------------------|
| Rthj-case | Thermal Resistance Junction-case Max           | 0.78   | 3.1      | $^\circ\text{C}/\text{W}$ |
| Rthj-a    | Thermal Resistance Junction-ambient Max        | 62.5   |          | $^\circ\text{C}/\text{W}$ |
| $T_l$     | Maximum Lead Temperature For Soldering Purpose | 300    |          | $^\circ\text{C}$          |

**Table 3. Avalanche Characteristics**

| Symbol   | Parameter                                                                                                   | Value | Unit |
|----------|-------------------------------------------------------------------------------------------------------------|-------|------|
| $I_{AR}$ | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by $T_j$ max)                          | 6.5   | A    |
| $E_{AS}$ | Single Pulse Avalanche Energy (starting $T_j = 25^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{V}$ ) | 320   | mJ   |

## 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                   | $I_D = 1\text{mA}$ , $V_{GS} = 0$                                                            | 1000 |      |          | V                              |
| $I_{DSS}$     | Zero Gate Voltage Drain Current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max Rating}$ ,<br>$V_{DS} = \text{Max Rating}$ , $T_c = 125^{\circ}\text{C}$ |      |      | 1<br>50  | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate Body Leakage Current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{V}$                                                                    |      |      | $\pm 10$ | $\mu\text{A}$                  |
| $V_{GS(th)}$  | Gate Threshold Voltage                           | $V_{DS} = V_{GS}$ , $I_D = 100\text{ }\mu\text{A}$                                           | 3    | 3.75 | 4.5      | V                              |
| $R_{DS(on)}$  | Static Drain-Source On Resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 3.15\text{ A}$                                               |      | 1.60 | 1.85     | $\Omega$                       |

**Table 5. Dynamic**

| Symbol                                         | Parameter                                                               | Test Conditions                                                                          | Min. | Typ.              | Max. | Unit           |
|------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------|------|-------------------|------|----------------|
| $g_{fs}$ <a href="#">Note 6</a>                | Forward Transconductance                                                | $V_{DS} = 15\text{V}$ , $I_D = 3.15\text{ A}$                                            |      | 7                 |      | S              |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$            | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | $V_{DS} = 25\text{V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$                                |      | 2180<br>174<br>36 |      | pF<br>pF<br>pF |
| $C_{oss\text{ eq.}}$<br><a href="#">Note 5</a> | Equivalent Output Capacitance                                           | $V_{GS} = 0\text{V}$ , $V_{DS} = 0\text{ to }800\text{V}$                                |      | 83                |      | pF             |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$                  | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge            | $V_{DD} = 800\text{V}$ , $I_D = 6.3\text{A}$<br>$V_{GS} = 10\text{V}$<br>(see Figure 17) |      | 73<br>12<br>40    | 102  | nC<br>nC<br>nC |

**Table 6. Switching times**

| Symbol                | Parameter                       | Test Conditions                                                                                            | Min. | Typ.     | Max. | Unit     |
|-----------------------|---------------------------------|------------------------------------------------------------------------------------------------------------|------|----------|------|----------|
| $t_{d(on)}$<br>$t_r$  | Turn-on Delay Time<br>Rise Time | $V_{DD}=500\text{ V}$ , $I_D=3.15\text{ A}$ ,<br>$R_G=4.7\Omega$ , $V_{GS}=10\text{ V}$<br>(see Figure 18) |      | 28<br>19 |      | ns<br>ns |
| $t_{d(off)}$<br>$t_f$ | Turn-off Delay Time<br>FallTime | $V_{DD}=500\text{ V}$ , $I_D=3.15\text{ A}$ ,<br>$R_G=4.7\Omega$ , $V_{GS}=10\text{ V}$<br>(see Figure 18) |      | 59<br>30 |      | ns<br>ns |

**Table 7. Source drain diode**

| Symbol                              | Parameter                                                                    | Test Conditions                                                                                                | Min. | Typ.             | Max.      | Unit                     |
|-------------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|------|------------------|-----------|--------------------------|
| $I_{SD}$<br>$I_{SDM}$ <i>Note 3</i> | Source-drain Current<br>Source-drain Current (pulsed)                        |                                                                                                                |      |                  | 6.5<br>26 | A<br>A                   |
| $V_{SD}$ <i>Note 2</i>              | Forward on Voltage                                                           | $I_{SD}=6.3\text{ A}$ , $V_{GS}=0$                                                                             |      |                  | 1.6       | V                        |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$   | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_{SD}=6.3\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD}=50\text{ V}$ , $T_j=25^\circ\text{C}$  |      | 620<br>5.3<br>17 |           | ns<br>$\mu\text{C}$<br>A |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$   | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_{SD}=6.3\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD}=50\text{ V}$ , $T_j=150^\circ\text{C}$ |      | 840<br>7.5<br>18 |           | ns<br>$\mu\text{C}$<br>A |

**Table 8. Gate-source zener diode**

| Symbol                      | Parameter                        | Test Conditions                         | Min. | Typ. | Max. | Unit |
|-----------------------------|----------------------------------|-----------------------------------------|------|------|------|------|
| $BV_{GSO}$<br><i>Note 4</i> | Gate-Source Breakdown<br>Voltage | $I_{gs} = \pm 1\text{ mA}$ (Open Drain) | 30   |      |      | V    |

(1) Limited only by maximum temperature allowed

(2)  $I_{SD} \leq 6.5\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DS} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{jmax}$

(3) Pulse width limited by safe operating area

(4) The built-in-back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

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

(6) Pulsed: pulse duration = 300 $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 1. Safe Operating Area for TO-220

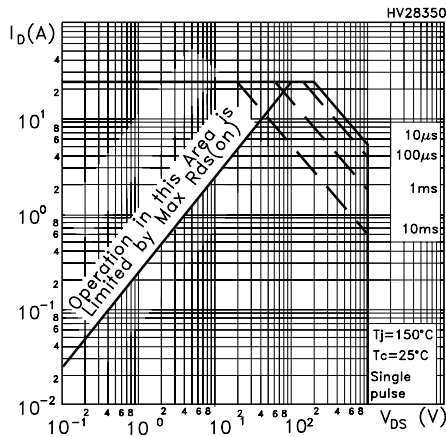


Figure 2. Thermal Impedance for TO-220

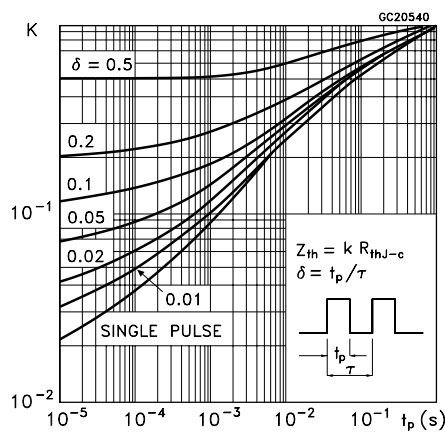


Figure 3. Safe Operating Area for TO-220FP

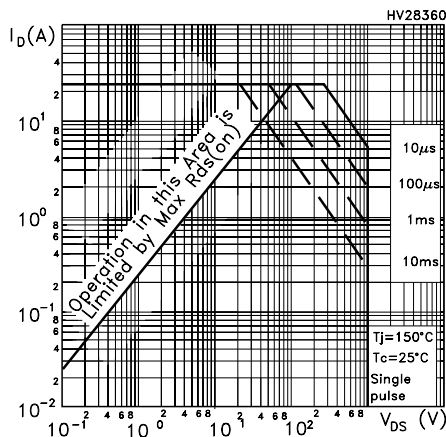


Figure 4. Thermal Impedance for TO-220FP

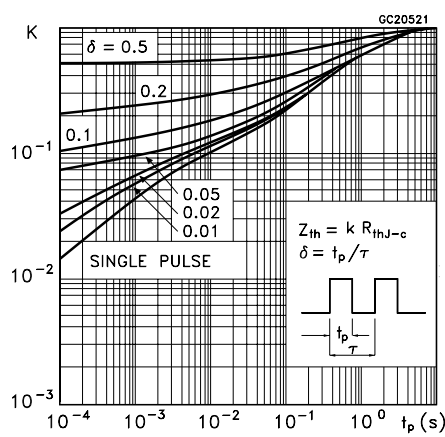


Figure 5. Output Characteristics

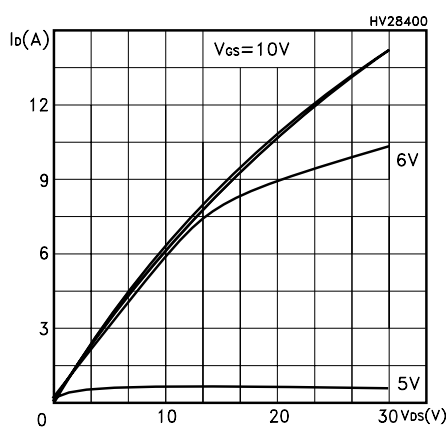


Figure 6. Transfer Characteristics

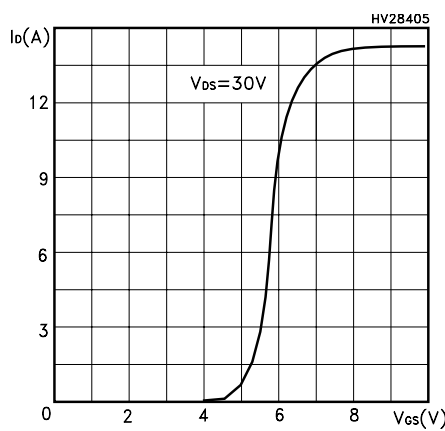


Figure 7. Transconductance

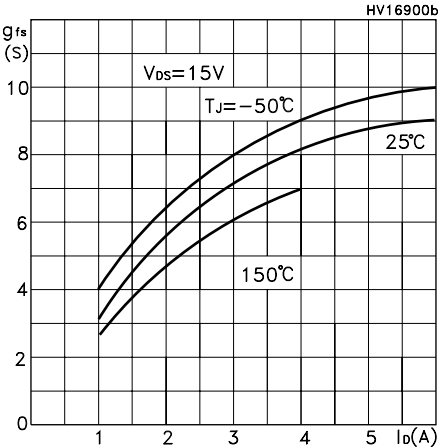


Figure 8. Static Drain-source on Resistance

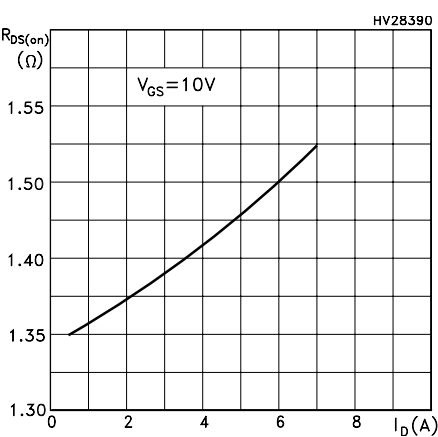


Figure 9. Gate Charge vs Gate-source Volatge Figure 10. Capacitance Variations

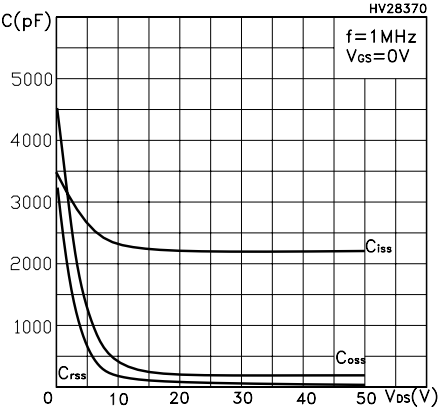
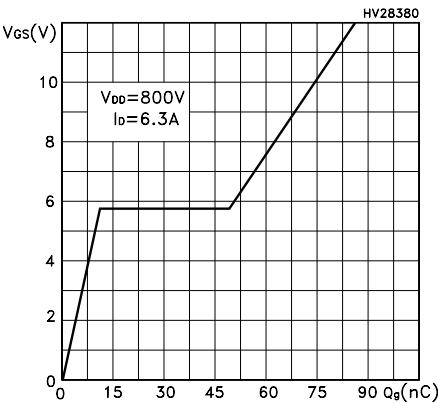


Figure 11. Normalized Gate Threshold Voltage vs. Temperature Figure 12. Normalized On Resistance vs. Temperature

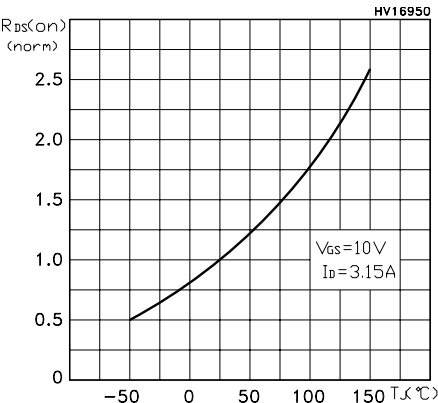
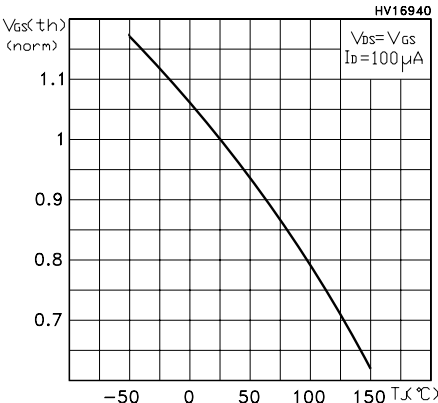


Figure 13. Source-drain Diode Forward Characteristics

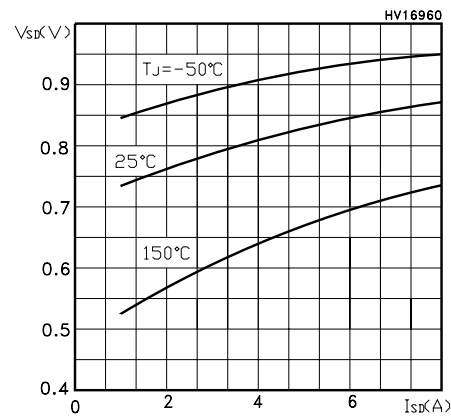


Figure 14. Normalized BVDSS vs Temperature

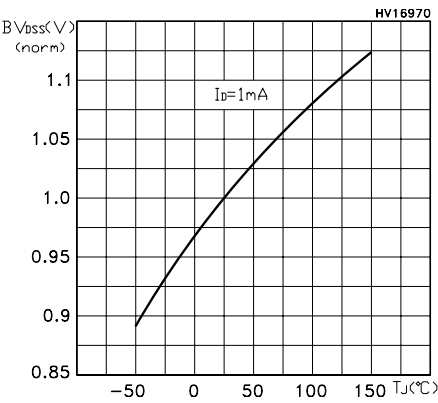
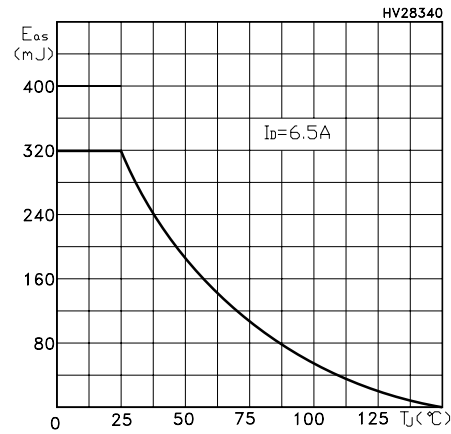
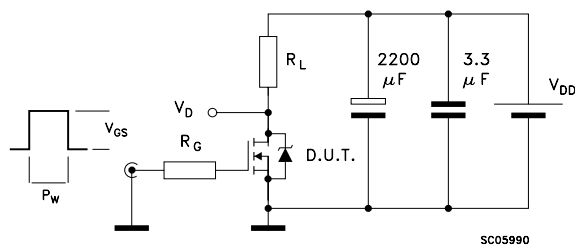


Figure 15. Maximum Avalanche Energy vs Temperature

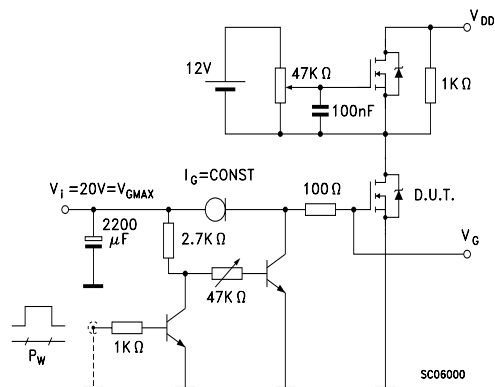


### 3 Test circuits

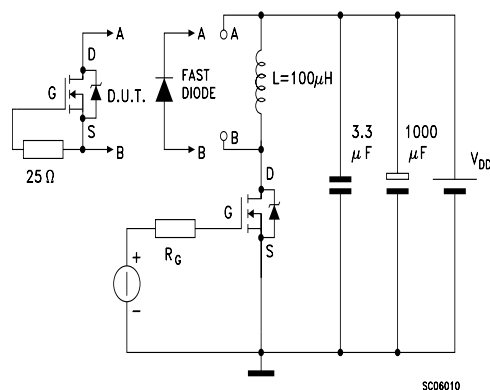
**Figure 16. Switching Times Test Circuit For Resistive Load**



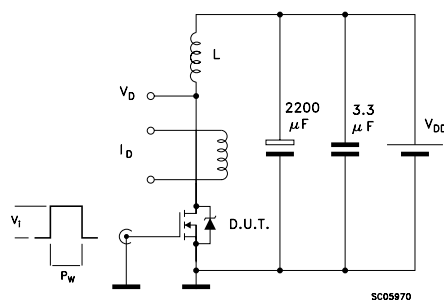
**Figure 17. Gate Charge Test Circuit**



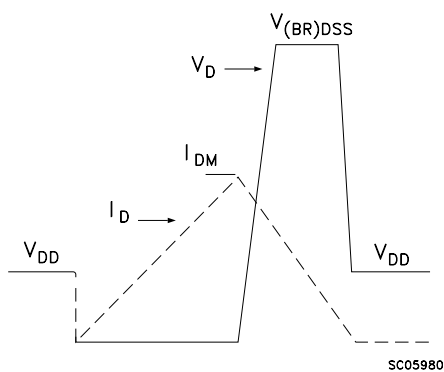
**Figure 18. Test Circuit For Inductive Load Switching and Diode Recovery Times**



**Figure 20. Unclamped Inductive Load Test Circuit**



**Figure 19. Unclamped Inductive Waveform**

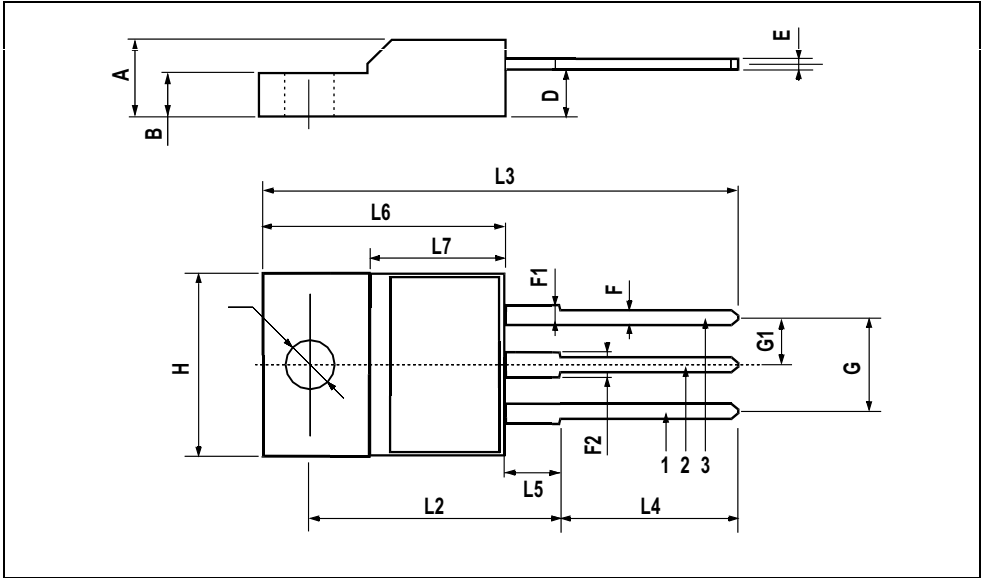


## 4 Package mechanical data

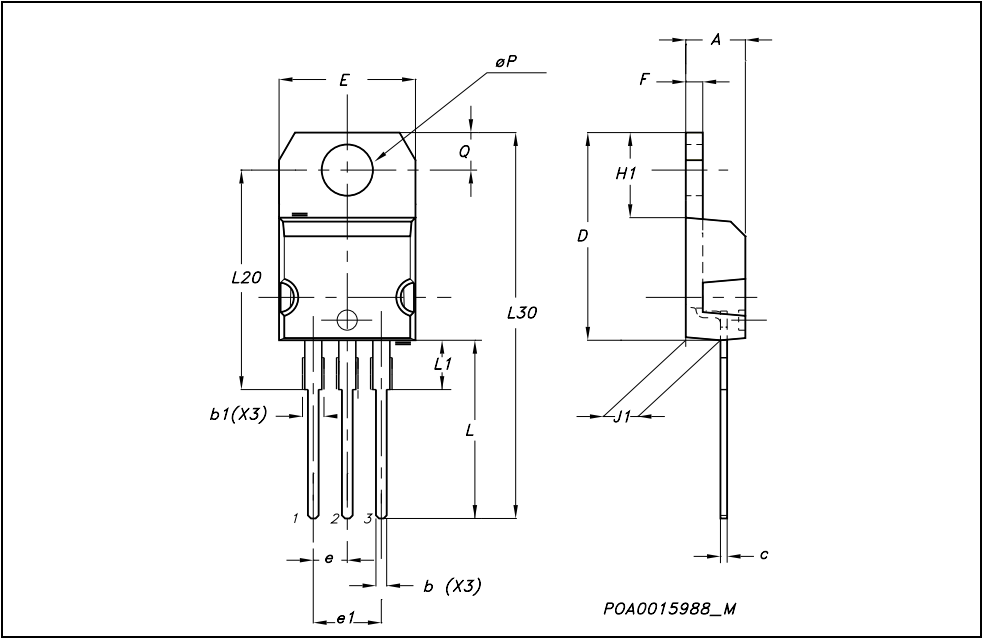
In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings 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-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

| Date        | Revision | Changes       |
|-------------|----------|---------------|
| 04-Nov-2005 | 1        | First release |

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