



## STP75NS04Z

N-channel Clamped - 7mΩ - 80A - TO-220  
Fully protected MESH Overlay™ III Power MOSFET

### General features

| Type       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|------------|------------------|---------------------|----------------|
| STP75NS04Z | Clamped          | < 11mΩ              | 80A            |

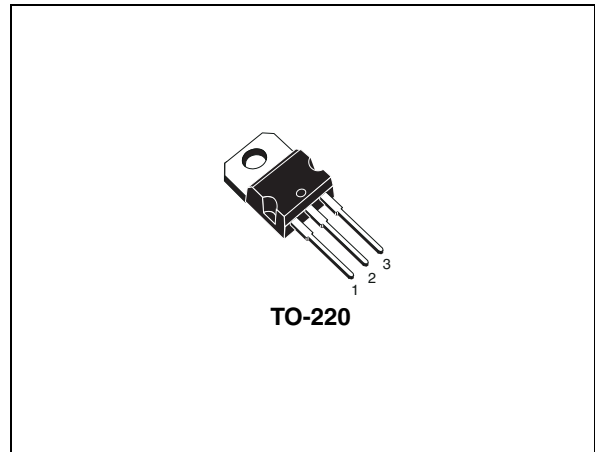
- Low capacitance and gate charge
- 100% avalanche tested
- 175°C maximum junction temperature

### Description

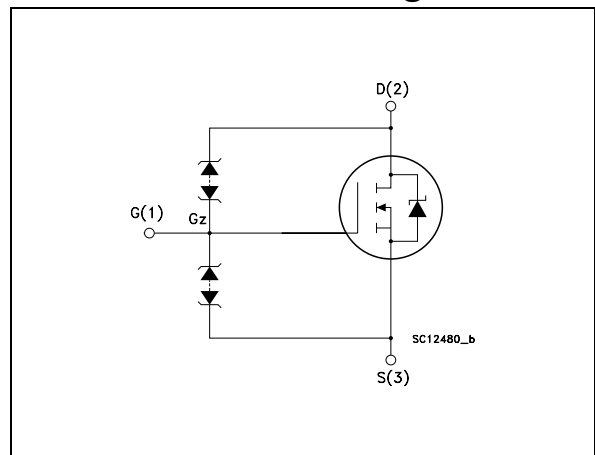
This fully clamped MOSFET is produced by using the latest advanced Company's Mesh Overlay process which is based on a novel strip layout. The inherent benefits of a new technology coupled with the extra clamping capabilities make this product particularly suitable for the harshest operation conditions such as those encoured in power tools. Any other application requiring extra ruggedness is also recommended.

### Applications

- Switching application
- Power tools



### Internal schematic diagram



### Order codes

| Part number | Marking  | Package | Packaging |
|-------------|----------|---------|-----------|
| STP75NS04Z  | P75NS04Z | TO-220  | Tube      |

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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol             | Parameter                                               | Value      | Unit                |
|--------------------|---------------------------------------------------------|------------|---------------------|
| $V_{DS}$           | Drain-source voltage ( $V_{GS} = 0$ )                   | Clamped    | V                   |
| $V_{DG}$           | Drain-gate voltage ( $V_{GS} = 0$ )                     | Clamped    | V                   |
| $V_{GS}$           | Gate-source voltage                                     | Clamped    | V                   |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C = 25^\circ\text{C}$  | 80         | A                   |
| $I_D$              | Drain current (continuous) at $T_C = 100^\circ\text{C}$ | 63         | A                   |
| $I_{DG}$           | Drain gate current (continuos)                          | $\pm 50$   | mA                  |
| $I_{GS}$           | Gate source current (continuos)                         | $\pm 50$   | mA                  |
| $I_{DM}^{(2)}$     | Drain current (pulsed)                                  | 320        | A                   |
| $P_{TOT}$          | Total dissipation at $T_C = 25^\circ\text{C}$           | 110        | W                   |
|                    | Derating factor                                         | 0.73       | W/ $^\circ\text{C}$ |
| $V_{ESD}$          | Gate-source ESD (HBM-C=100pF, R=1.5K $\Omega$ )         | $\pm 8$    | kV                  |
| $T_j$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature   | -55 to 175 | $^\circ\text{C}$    |

1. Current limited by wire bonding
2. Pulse with limited by safe operating area

**Table 2. Thermal data**

| Symbol         | Parameter                                      | Value | Unit                      |
|----------------|------------------------------------------------|-------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case Max           | 1.36  | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$  | 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 data**

| Symbol   | Parameter                                                                                             | Value | Unit |
|----------|-------------------------------------------------------------------------------------------------------|-------|------|
| $E_{AS}$ | Single pulse avalanche energy (starting $T_j=25^\circ\text{C}$ , $I_D=I_{AR}$ , $V_{DD}=25\text{V}$ ) | 470   | 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                   | $I_D = 1\text{mA}$ , $V_{GS} = 0$          | 33   |      |      | V                |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 16\text{V}$                      |      |      | 1    | $\mu\text{A}$    |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 10\text{V}$                  |      |      | 2    | $\mu\text{A}$    |
| $V_{GSS}$     | Gate threshold breakdown voltage                 | $I_{GS} = \pm 100\mu\text{A}$              | 18   |      |      | V                |
| $V_{GS(th)}$  | 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                | $V_{GS} = 10\text{V}$ , $I_D = 40\text{A}$ |      | 7    | 11   | $\text{m}\Omega$ |

**Table 5. Dynamic**

| Symbol                              | Parameter                                                               | Test conditions                                                                          | Min. | Typ.               | Max. | Unit           |
|-------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------|------|--------------------|------|----------------|
| $g_{fs}^{(1)}$                      | Forward transconductance                                                | $V_{DS} = 15\text{V}$ , $I_D = 15\text{A}$                                               |      | 50                 |      | 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>$V_{GS} = 0$                              |      | 1860<br>628<br>196 |      | pF<br>pF<br>pF |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$       | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 20\text{V}$ , $I_D = 80\text{A}$ ,<br>$V_{GS} = 10\text{V}$<br>(see Figure 13) |      | 50<br>14<br>16     |      | nC<br>nC<br>nC |

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

**Table 6. Switching on/off**

| Symbol                | Parameter                        | Test conditions                                                                          | Min. | Typ.      | Max. | Unit     |
|-----------------------|----------------------------------|------------------------------------------------------------------------------------------|------|-----------|------|----------|
| $t_{d(on)}$<br>$t_r$  | Turn-on delay time<br>Rise time  | $V_{DD} = 20V$ , $I_D = 40A$<br>$R_G = 4.7 \Omega$ , $V_{GS} = 10V$ ,<br>(see Figure 12) |      | 16<br>248 |      | ns<br>ns |
| $t_{d(off)}$<br>$t_f$ | Turn-off delay time<br>Fall time | $V_{DD} = 20V$ , $I_D = 40A$<br>$R_G = 4.7 \Omega$ , $V_{GS} = 10V$ ,<br>(see Figure 12) |      | 53<br>85  |      | ns<br>ns |

**Table 7. Source drain diode**

| Symbol                            | Parameter                                                                    | Test conditions                                                                                    | Min. | Typ.            | Max.      | Unit          |
|-----------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|------|-----------------|-----------|---------------|
| $I_{SD}$<br>$I_{SDM}^{(1)}$       | Source-drain current<br>Source-drain current (pulsed)                        |                                                                                                    |      |                 | 80<br>320 | A<br>A        |
| $V_{SD}^{(2)}$                    | Forward on Voltage                                                           | $I_{SD} = 80A$ , $V_{GS} = 0$                                                                      |      |                 | 1.5       | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 80A$ , $di/dt = 100A/\mu s$ ,<br>$V_{DD} = 30V$ , $T_j = 150^\circ C$<br>(see Figure 17) |      | 53<br>91<br>3.4 |           | 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

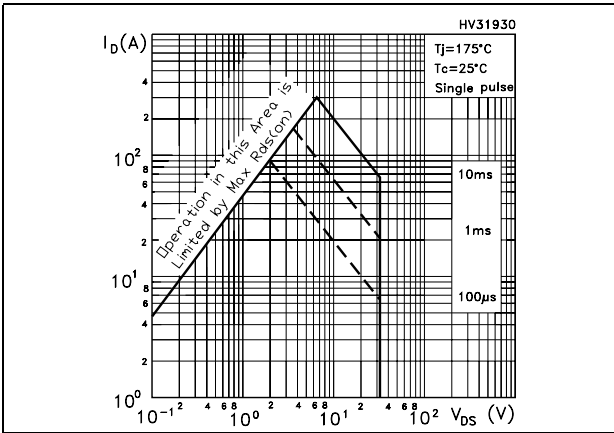


Figure 2. Thermal impedance

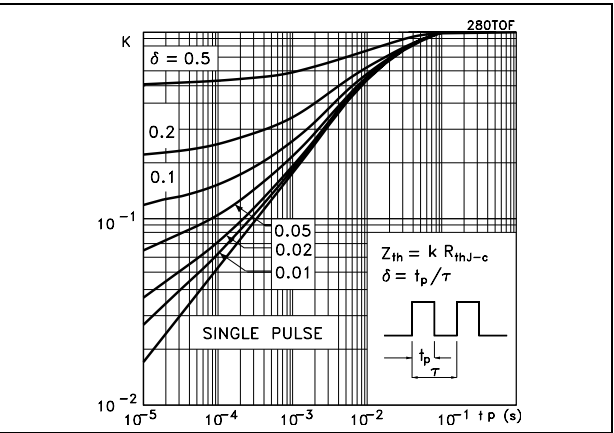


Figure 3. Output characteristics

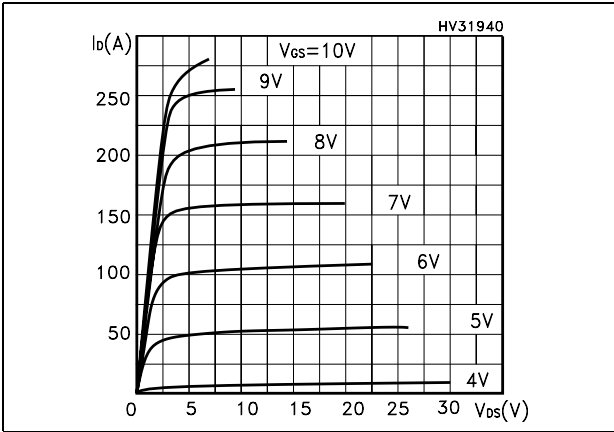


Figure 4. Transfer characteristics

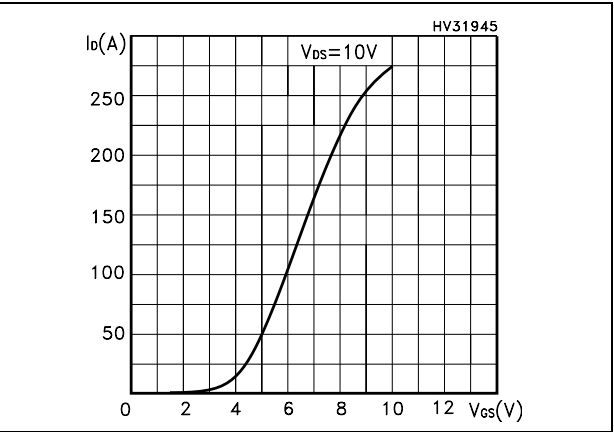


Figure 5. Normalized B\_VDSS vs temperature

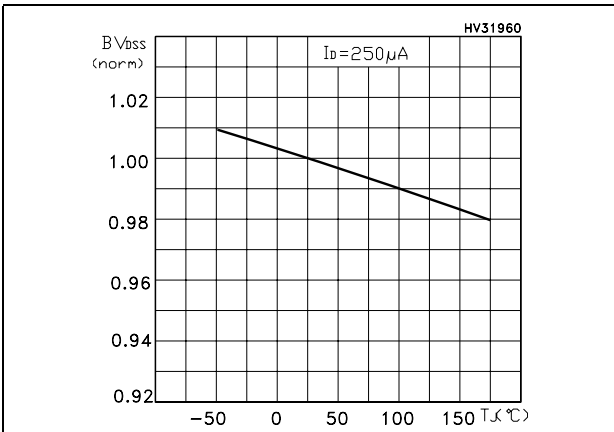


Figure 6. Static drain-source on resistance

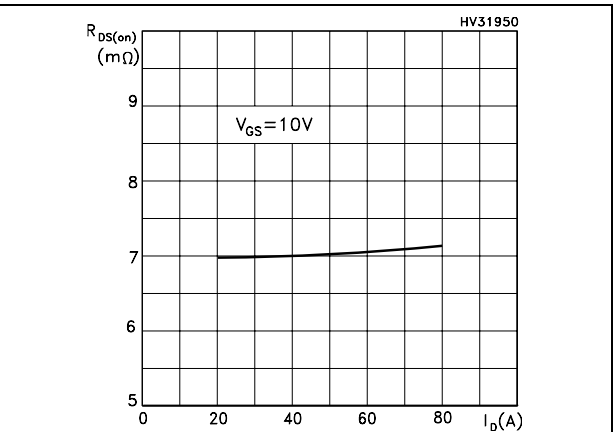


Figure 7. Gate charge vs gate-source voltage    Figure 8. Capacitance variations

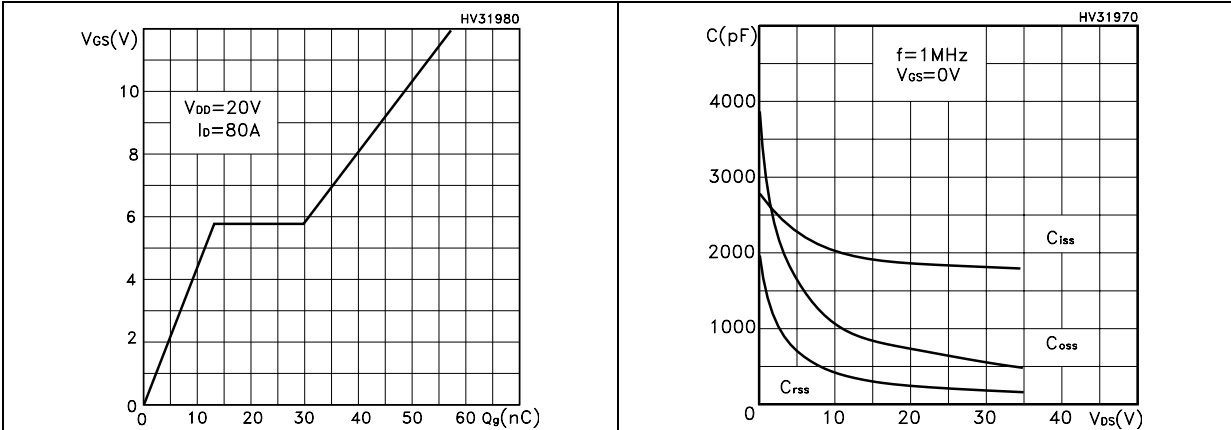


Figure 9. Normalized gate threshold voltage vs temperature    Figure 10. Normalized on resistance vs temperature

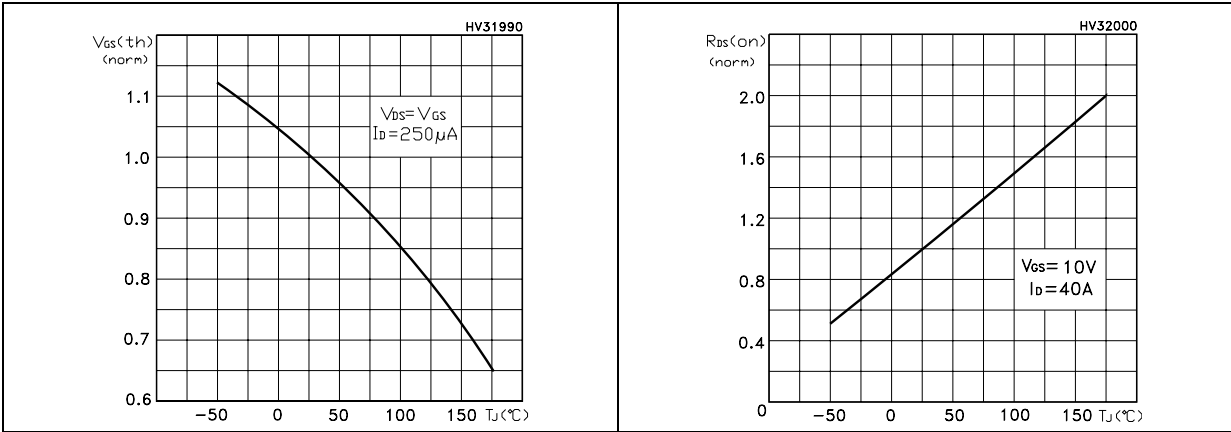
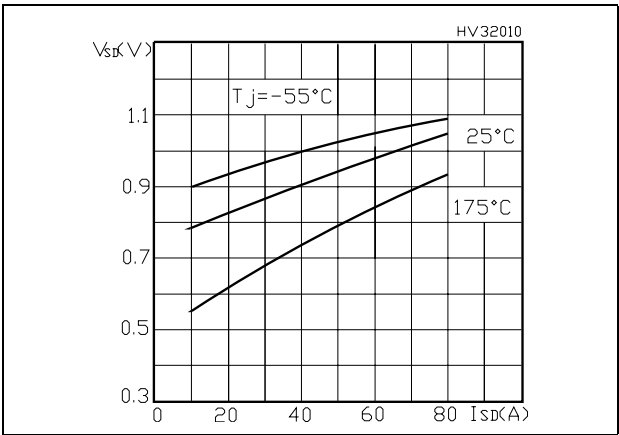
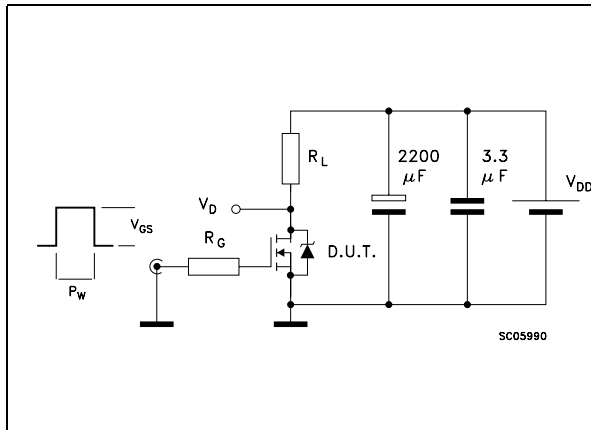


Figure 11. Source-drain diode forward characteristics

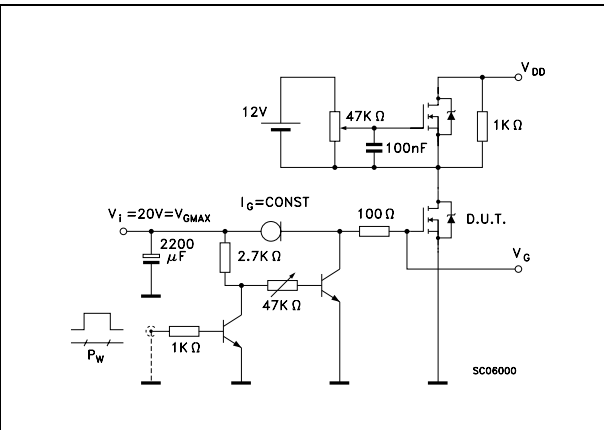


### 3 Test circuit

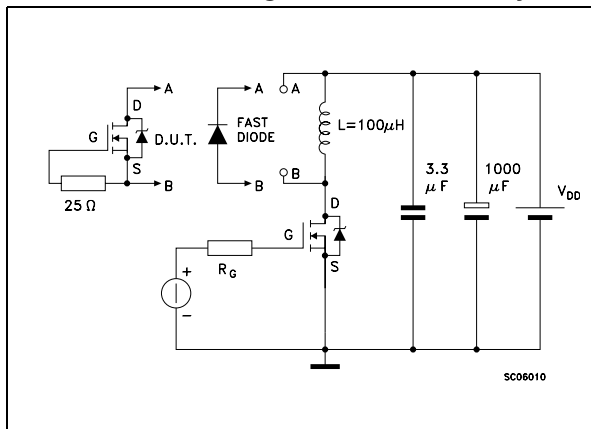
**Figure 12. Switching times test circuit for resistive load**



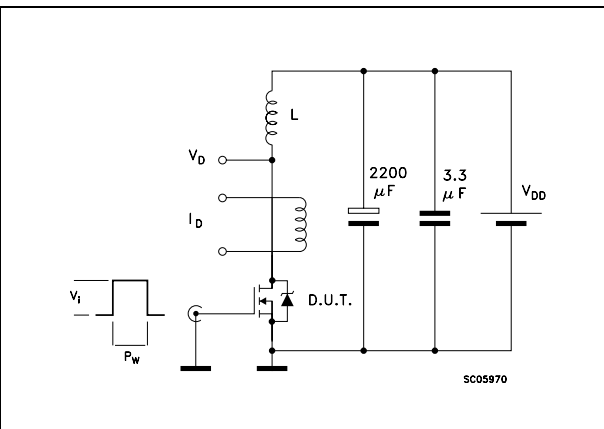
**Figure 13. Gate charge test circuit**



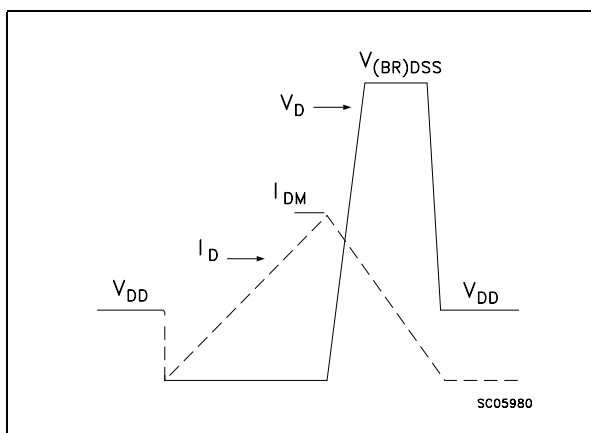
**Figure 14. Test circuit for inductive load switching and diode recovery times**



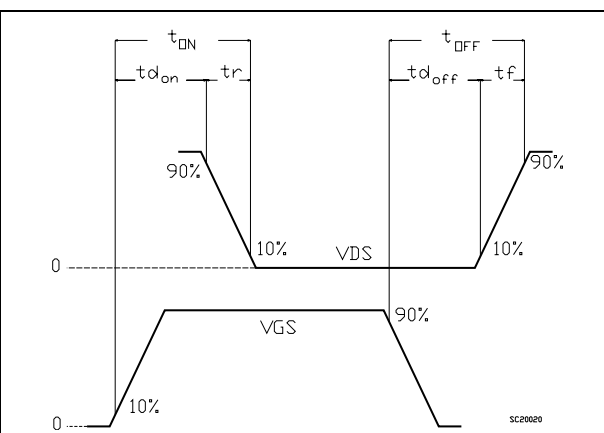
**Figure 15. Unclamped inductive load test circuit**



**Figure 16. Unclamped inductive waveform**



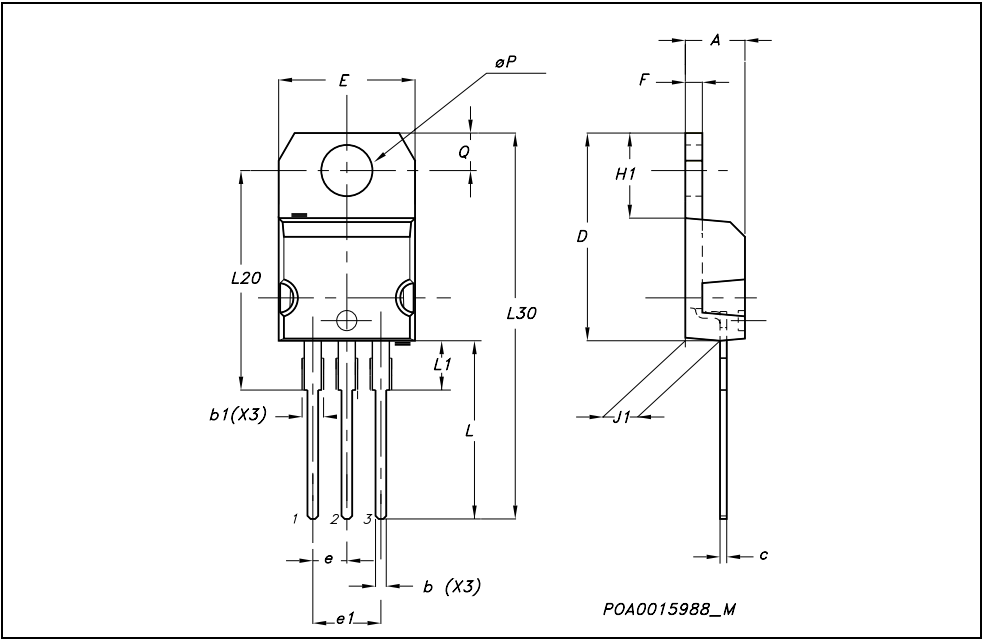
**Figure 17. Switching time waveform**



## 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 |



## 5 Revision history

**Table 8. Revision history**

| Date        | Revision | Changes       |
|-------------|----------|---------------|
| 06-Jun-2006 | 1        | First release |

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