



# STP62NS04Z

N-channel clamped 12.5 mΩ, 62 A, TO-220  
fully protected MESH OVERLAY™ Power MOSFET

## Features

| Type       | V <sub>DSS</sub> | R <sub>DS(on) max</sub> | I <sub>D</sub> |
|------------|------------------|-------------------------|----------------|
| STP62NS04Z | Clamped          | < 0.015 Ω               | 62 A           |

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

## Application

- Switching applications

## Description

Fully clamped MOSFET is produced by using ST's most advanced MESH OVERLAY™ process based on strip layout. The inherent benefits of this new technology coupled with the extra clamping capabilities make this product particularly suitable for the harshest operating conditions such as those encountered in the automotive environment. It is also recommended for any other application requiring extra ruggedness.

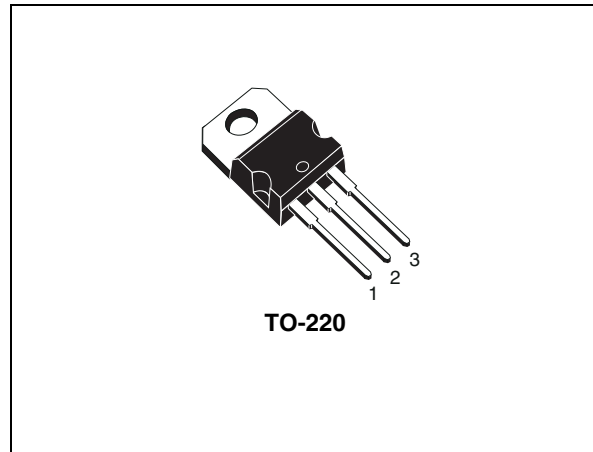


Figure 1. Internal schematic diagram

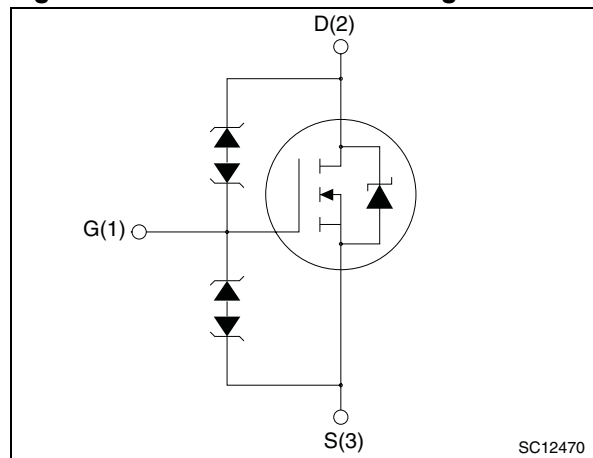


Table 1. Device summary

| Order code | Marking  | Package | Packaging |
|------------|----------|---------|-----------|
| STP62NS04Z | P62NS04Z | TO-220  | Tube      |

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol             | Parameter  | Value      | Unit                |
|--------------------|--|------------|---------------------|
| $V_{DS}$           | Drain-source voltage ( $V_{GS} = 0$ )                          | Clamped    | V                   |
| $V_{GS}$           | Gate-source voltage  | Clamped    | V                   |
| $I_D$              | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 62         | A                   |
| $I_D$              | Drain current (continuous) at $T_C=100\text{ }^\circ\text{C}$  | 37.5       | A                   |
| $I_{DG}$           | Drain gate current (continuous)                                | $\pm 50$   | mA                  |
| $I_{GS}$           | Gate sourcecurrent (continuous)                                | $\pm 50$   | mA                  |
| $I_{DM}^{(1)}$     | Drain current (pulsed)   | 248        | A                   |
| $P_{TOT}$          | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$          | 110        | W                   |
|                    | Derating factor  | 0.74       | W/ $^\circ\text{C}$ |
| $dv/dt^{(2)}$      | Peak diode recovery voltage slope                              | 8          | V/ns                |
| $E_{AS}^{(3)}$     | Single pulse avalanche energy                                  | 500        | mJ                  |
| $V_{ESD}$          | ESD (HBM - C = 100 pF, R = 1.5 k $\Omega$ )                    | 8          | V                   |
| $T_J$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature          | -55 to 175 | $^\circ\text{C}$    |

1. Pulse width limited by safe operating area
2.  $I_{SD} \leq 40\text{ A}$ ,  $di/dt \leq 100\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq T_{JMAX}$
3. Starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $I_D = 20\text{ A}$ ,  $V_{DD} = 20\text{ V}$

**Table 3. Thermal data**

| Symbol      | Parameter                                      | Value | Unit                      |
|-------------|--|-------|---------------------------|
| $R_{thj-c}$ | Thermal resistance junction-casemax            | 1.36  | $^\circ\text{C}/\text{W}$ |
| $R_{thj-a}$ | Thermal resistance junction-ambient max        | 62.5  | $^\circ\text{C}/\text{W}$ |
| $T_l$       | Maximum lead temperature for soldering purpose | 300   | $^\circ\text{C}$          |

## 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                   | $I_D = 1\text{ mA}$ , $V_{GS} = 0$                 | 33   |      |      | V                |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 16\text{ V}$                             |      |      | 10   | $\mu\text{A}$    |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 10\text{ V}$                         |      |      | 10   | $\mu\text{A}$    |
| $V_{GSS}$     | Gate-source breakdown voltage                    | $I_{GS} = 100\text{ }\mu\text{A}$                  | 18   |      |      | V                |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$ | 2    |      | 4    | V                |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 30\text{ A}$       |      | 12.5 | 15   | $\text{m}\Omega$ |

**Table 5. Dynamic**

| Symbol         | Parameter                    | Test conditions  | Min. | Typ. | Max. | Unit |
|----------------|------------------------------|--|------|------|------|------|
| $g_{fs}^{(1)}$ | Forward transconductance     | $V_{DS} = 15\text{ V}$ , $I_D = 30\text{ A}$                           | -    | 20   |      | S    |
| $C_{iss}$      | Input capacitance            | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0$          | -    | 1330 |      | pF   |
| $C_{oss}$      | Output capacitance           |  |      | 420  |      | pF   |
| $C_{rss}$      | Reverse transfer capacitance |  |      | 135  |      | pF   |
| $Q_g$          | Total gate charge            | $V_{DD} = 20\text{ V}$ , $I_D = 40\text{ A}$<br>$V_{GS} = 10\text{ V}$ | -    | 34   | 47   | nC   |
| $Q_{gs}$       | Gate-source charge           |  |      | 10   |      | nC   |
| $Q_{gd}$       | Gate-drain charge            |  |      | 11.5 |      | nC   |

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

**Table 6. Switching times**

| Symbol        | Parameter             | Test conditions   | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|---|------|------|------|------|
| $t_{d(on)}$   | Turn-on delay time    | $V_{DD} = 20\text{ V}$ , $I_D = 20\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br><i>Figure 14 on page 8</i>  | -    | 13   |      | ns   |
| $t_r$         | Rise time             |   |      | 104  |      | ns   |
| $t_{d(off)}$  | Turn-off delay time   |   |      | 41   | -    | ns   |
| $t_f$         | Fall time             |   |      | 42   |      | ns   |
| $t_{r(Voff)}$ | Off-voltage rise time | $V_{clamp} = 30\text{ V}$ , $I_D = 40\text{ A}$<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br><i>Figure 14 on page 8</i> | -    | 30   |      | ns   |
| $t_f$         | Fall time             |   |      | 54   |      | ns   |
| $t_c$         | Cross-over time       |   |      | 90   |      | ns   |

**Table 7. Source drain diode**

| Symbol          | Parameter                     | Test conditions   | Min | Typ. | Max | Unit |
|-----------------|-------------------------------|---|-----|------|-----|------|
| $I_{SD}$        | Source-drain current          |   | -   |      | 62  | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |   | -   |      | 248 | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 62 \text{ A}$ , $V_{GS} = 0$  | -   |      | 1.5 | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 40 \text{ A}$ ,<br>$di/dt = 100 \text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 20 \text{ V}$ , $T_J = 150 \text{ }^\circ\text{C}$<br><a href="#">Figure 16 on page 8</a> | -   | 45   |     | ns   |
| $Q_{rr}$        | Reverse recovery charge       |   |     | 65   |     | nC   |
| $I_{RRM}$       | Reverse recovery current      |   |     | 2.9  |     | 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

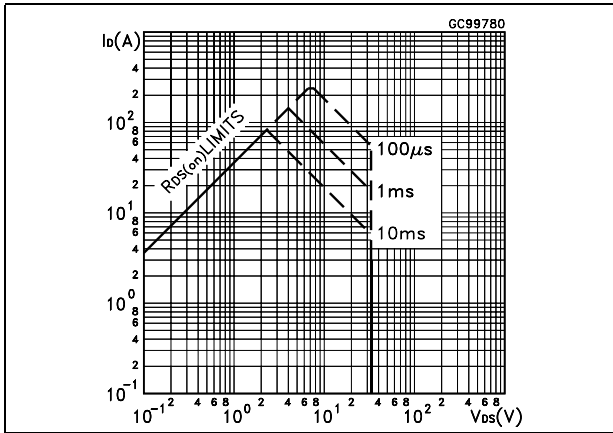


Figure 3. Thermal impedance

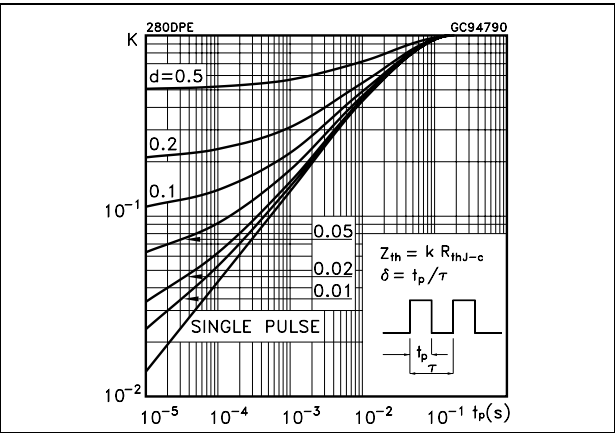


Figure 4. Output characteristics

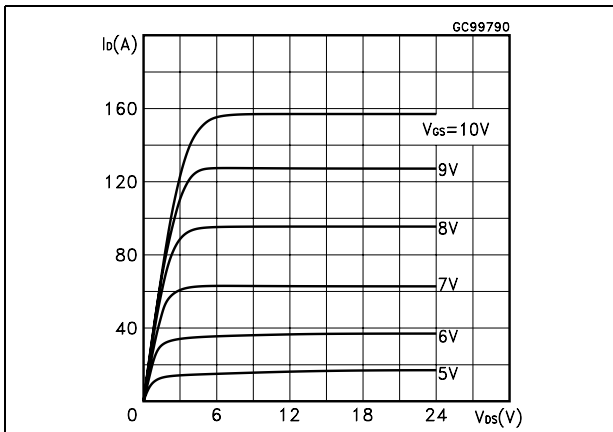


Figure 5. Transfer characteristics

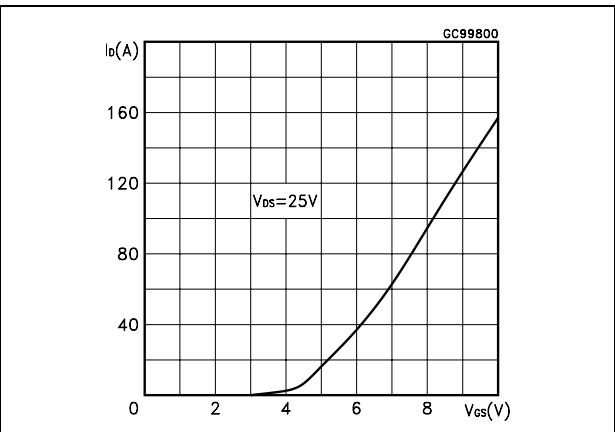


Figure 6. Transconductance

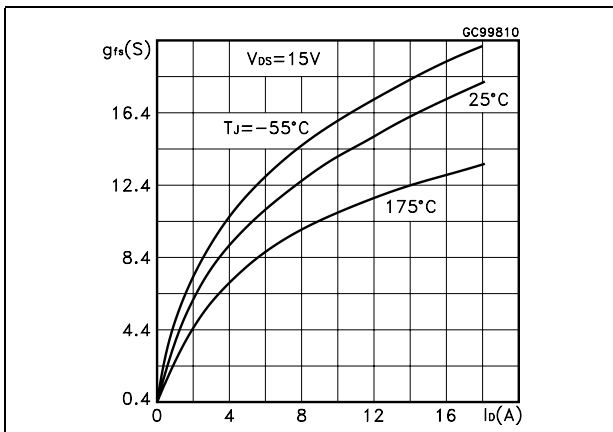


Figure 7. Static drain-source on resistance

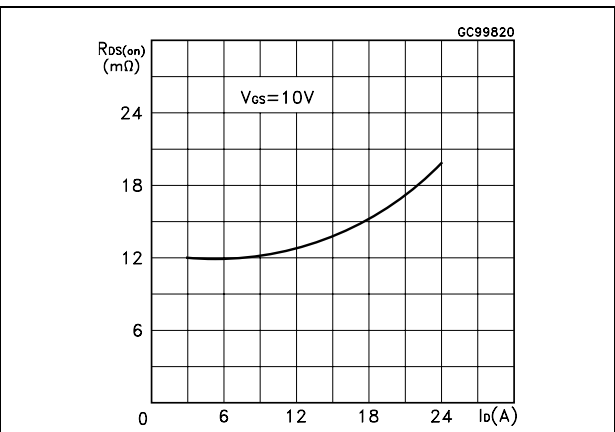


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

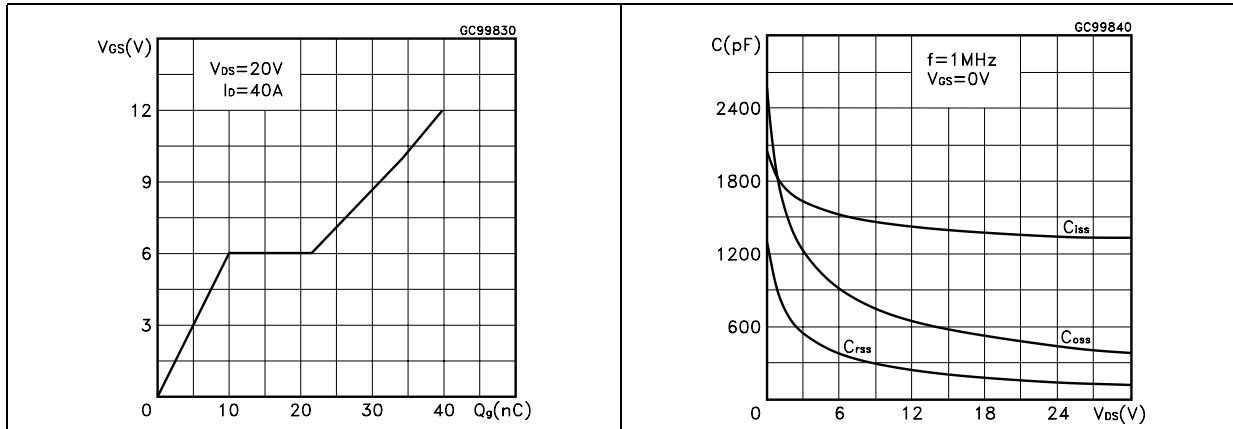


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

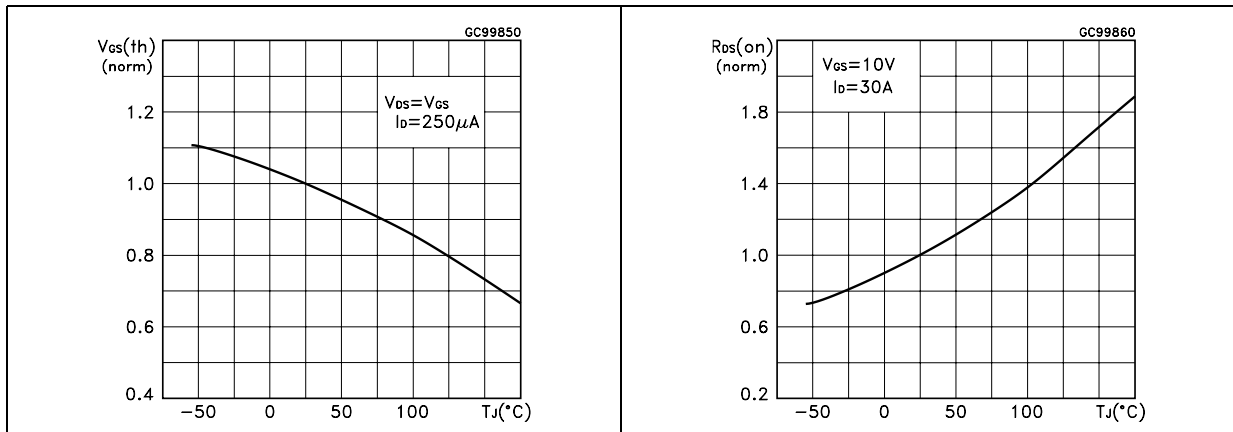
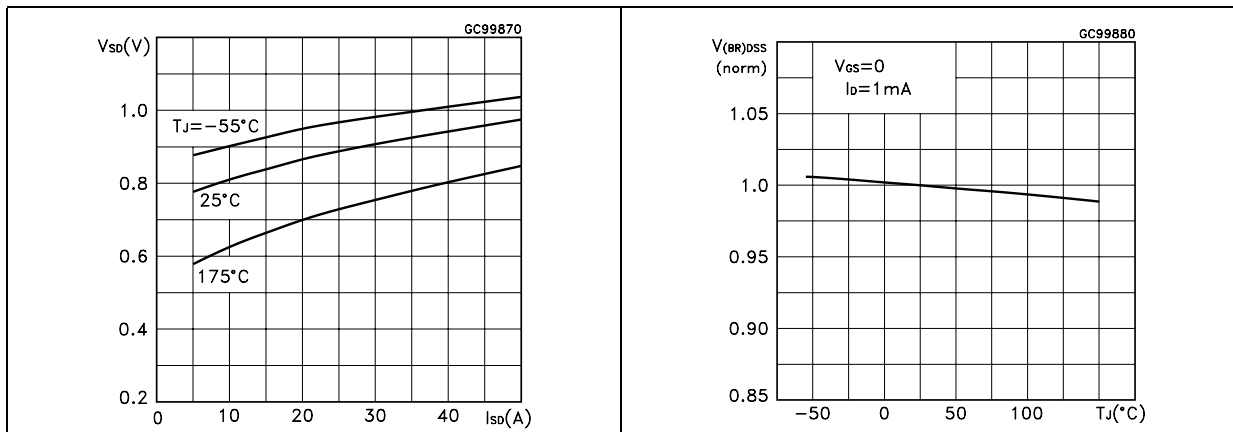
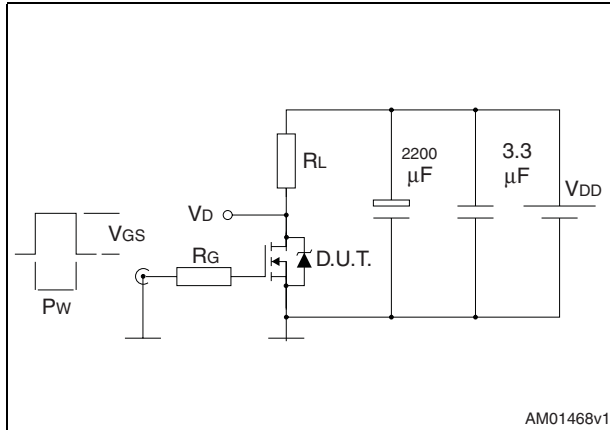


Figure 12. Source-drain diode forward characteristics Figure 13. Normalized  $B_{VDSS}$  vs temperature



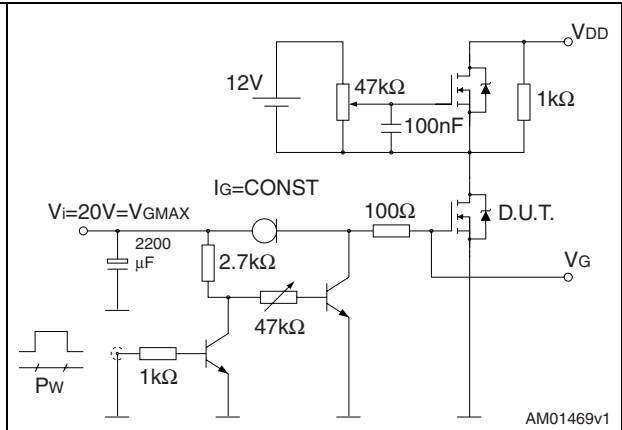
### 3 Test circuits

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



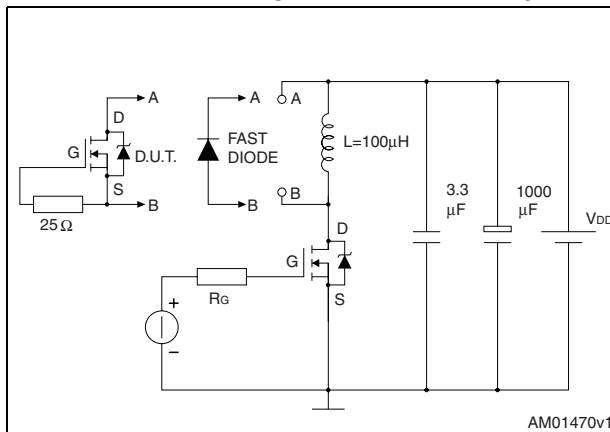
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**Figure 15. Gate charge test circuit**



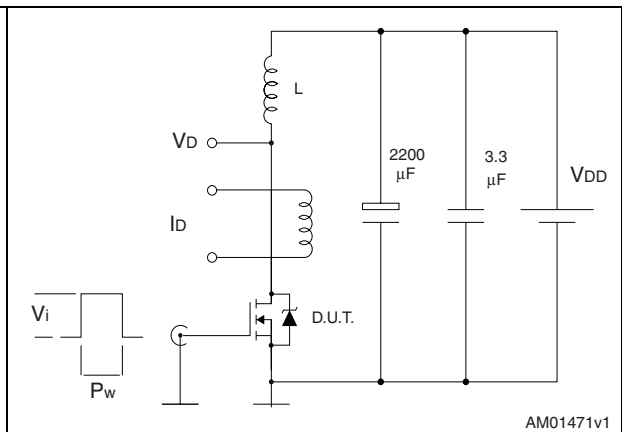
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**Figure 16. Test circuit for inductive load switching and diode recovery times**



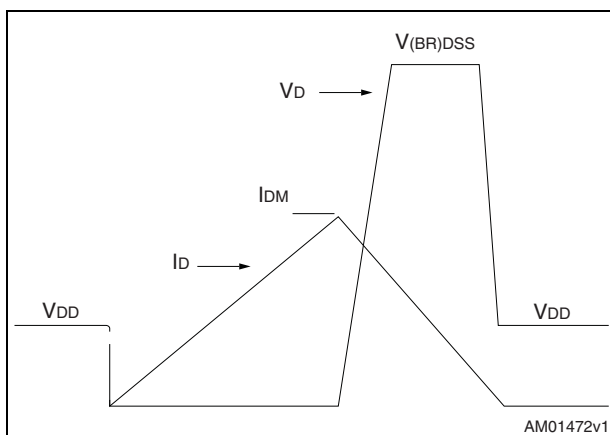
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**Figure 17. Unclamped inductive load test circuit**



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**Figure 18. Unclamped inductive waveform**



AM01472v1

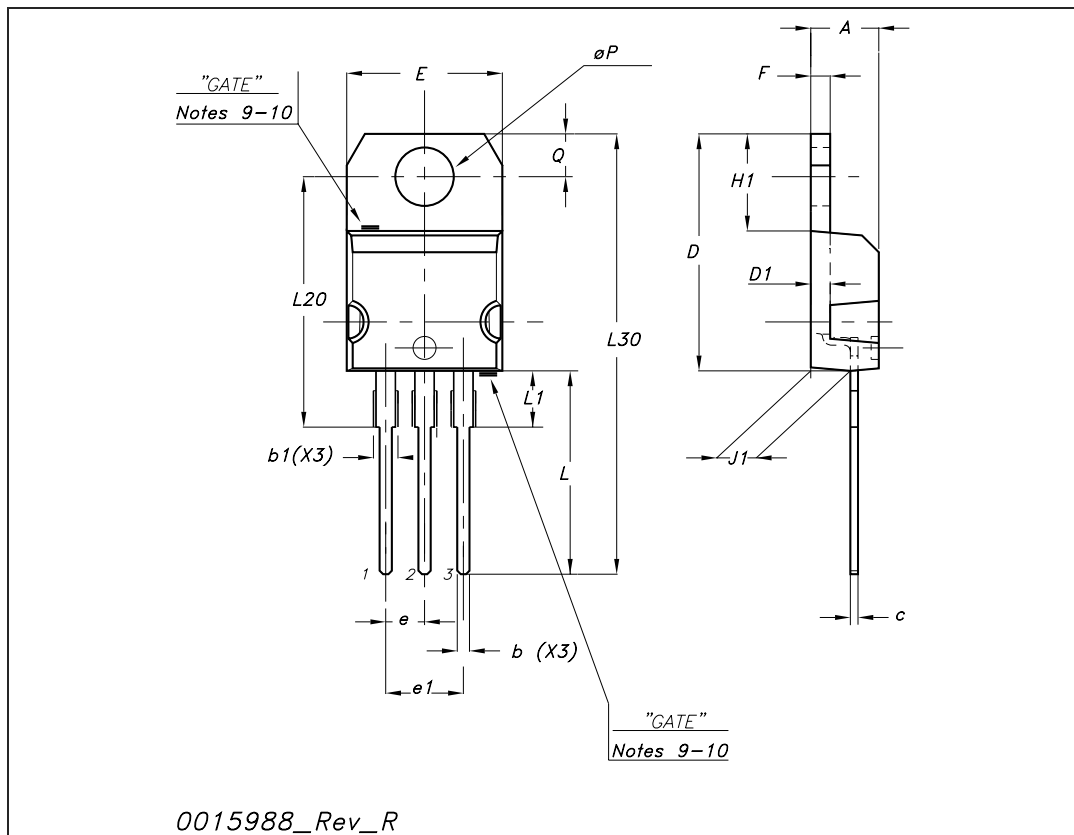


## 4 Package mechanical data

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 |



## 5 Revision history

**Table 8. Document revision history**

| <b>Date</b> | <b>Revision</b> | <b>Changes</b>                             |
|-------------|-----------------|--|
| 21-Jun-2004 | 2               | Preliminary datasheet                      |
| 22-Aug-2005 | 3               | Complete document with curves              |
| 21-Jan-2006 | 4               | New ECOPAK label                           |
| 02-Oct-2006 | 5               | New template, no content change            |
| 14-May-2009 | 6               | Updated scheme in <a href="#">Figure 1</a> |

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