



# STC5NF20V

N-channel 20V - 0.030Ω - 5A - TSSOP8  
2.7V-drive STripFET™ II Power MOSFET

## Features

| Type      | V <sub>DSS</sub> | R <sub>DS(on)</sub>                        | I <sub>D</sub> |
|-----------|------------------|--------------------------------------------|----------------|
| STC5NF20V | 20V              | < 0.040 Ω (@ 4.5 V)<br>< 0.045 Ω (@ 2.7 V) | 5A             |

- Ultra low threshold gate drive (2.7V)
- Standard outline for easy automated surface mount assembly

## 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

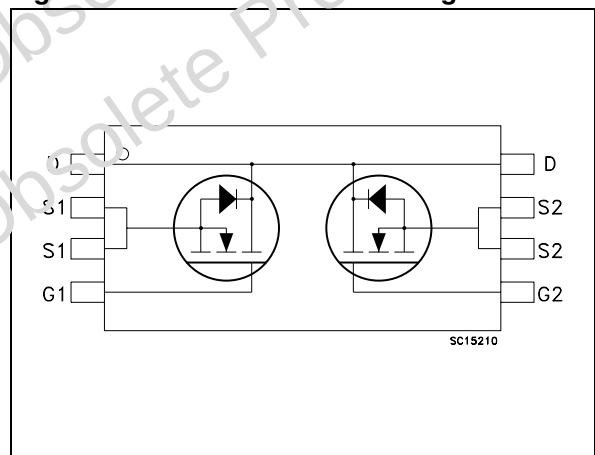


Table 1. Device summary

| Order code | Marking | Package | Packaging   |
|------------|---------|---------|-------------|
| STC5NF20V  | 5N20V   | TSSOP8  | Tape & reel |

Contents

1      **Electrical ratings** ..... 3

2      **Electrical characteristics** ..... 4

      2.1      Electrical characteristics (curves) ..... 6

3      **Test circuit** ..... 8

4      **Package mechanical data** ..... 9

5      **Revision history** ..... 11

Obsolete Product(s) - Obsolete Product(s)

Obsolete Product(s) - Obsolete Product(s)

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol         | Parameter                                         | Value      | Unit       |
|----------------|---------------------------------------------------|------------|------------|
| $V_{DS}$       | Drain-source voltage ( $V_{GS} = 0$ )             | 20         | V          |
| $V_{DGR}$      | Drain-gate voltage ( $R_{GS} = 20K\Omega$ )       | 20         | V          |
| $V_{GS}$       | Gate-source voltage                               | $\pm 12$   | V          |
| $I_D$          | Drain current (continuous) at $T_C = 25^\circ C$  | 5          | A          |
| $I_D$          | Drain current (continuous) at $T_C = 100^\circ C$ | 3          | A          |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                            | 20         | A          |
| $P_{TOT}$      | Total dissipation at $T_C = 25^\circ C$           | 1.5        | W          |
| $T_{stg}$      | Storage temperature                               | -55 to 150 | $^\circ C$ |
| $T_J$          | Max. Operating junction temperature               | -55 to 150 | $^\circ C$ |

1. Pulse width limited by safe operating area

**Table 3. Thermal data**

| Symbol        | Parameter                           | Value               | Unit         |
|---------------|-------------------------------------|---------------------|--------------|
| $R_{thJ-PBC}$ | Thermal resistance junction-PBC Max | 100 <sup>(1)</sup>  | $^\circ C/W$ |
| $R_{thJ-PBC}$ | Thermal resistance junction-PBC Max | 83.5 <sup>(2)</sup> | $^\circ C/W$ |

1. When Mounted on FR-4 board with 1 inch<sup>2</sup> pad, 2 oz. of Cu. and  $t = 10$  sec.

2. When Mounted on minimum recommended footprint

## 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                   | $I_D = 250\mu\text{A}$ , $V_{GS} = 0$                                                        | 20   |                |                | 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 ( $V_{DS} = 0$ )       | $V_{GS} = \pm 12\text{V}$                                                                    |      |                | $\pm 100$      | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\mu\text{A}$                                                   | 0.6  |                |                | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 4.5\text{V}$ , $I_D = 2.5\text{A}$<br>$V_{GS} = 2.7\text{V}$ , $I_D = 2.5\text{A}$ |      | 0.030<br>0.037 | 0.040<br>0.045 | $\Omega$<br>$\Omega$           |

**Table 5. Dynamic**

| Symbol         | Parameter                    | Test conditions                                                       | Min. | Typ. | Max. | Unit |
|----------------|------------------------------|-----------------------------------------------------------------------|------|------|------|------|
| $g_{fs}^{(1)}$ | Forward transconductance     | $V_{DS} = 15\text{V}$ , $I_D = 2.5\text{A}$                           |      | 9.5  |      | S    |
| $C_{iss}$      | Input capacitance            | $V_{DS} = 15\text{V}$ , $f = 1\text{MHz}$ ,<br>$V_{GS} = 0$           |      | 460  |      | pF   |
| $C_{oss}$      | Output capacitance           |                                                                       |      | 200  |      | pF   |
| $C_{rss}$      | Reverse transfer capacitance |                                                                       |      | 50   |      | pF   |
| $Q_g$          | Total gate charge            | $V_{DD} = 10\text{V}$ , $I_D = 4.5\text{A}$<br>$V_{GS} = 4.5\text{V}$ |      | 8.5  | 11.5 | nC   |
| $Q_{gs}$       | Gate-source charge           |                                                                       |      | 1.8  |      | nC   |
| $Q_{gd}$       | Gate-drain charge            |                                                                       |      | 2.4  |      | 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    | $V_{DD} = 10\text{V}$ , $I_D = 2.5\text{A}$ ,<br>$R_G = 4.7\Omega$ , $V_{GS} = 4.5\text{V}$<br><a href="#">Figure 14 on page 8</a> |      | 7    |      | ns   |
| $t_r$        | Rise time             |                                                                                                                                    |      | 33   |      | ns   |
| $t_{d(off)}$ | Turn-off delay time   |                                                                                                                                    |      | 27   |      | ns   |
| $t_f$        | Fall time             |                                                                                                                                    |      | 10   |      | ns   |
| $t_{d(off)}$ | Off-voltage rise time | $V_{clamp} = 16\text{V}$ , $I_D = 5\text{A}$<br>$R_G = 4.7\Omega$ , $V_{GS} = 4.5\text{V}$<br><a href="#">Figure 16 on page 8</a>  |      | 26   |      | ns   |
| $t_f$        | Fall time             |                                                                                                                                    |      | 11   |      | ns   |
| $t_c$        | Cross-over time       |                                                                                                                                    |      | 21   |      | ns   |

**Table 7. Source drain diode**

| Symbol                            | Parameter                                                                    | Test conditions                                                                                                     | Min. | Typ.          | Max | Unit               |
|-----------------------------------|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------|---------------|-----|--------------------|
| $I_{SD}$                          | Source-drain current                                                         |                                                                                                                     |      |               | 5   | A                  |
| $I_{SDM}^{(1)}$                   | Source-drain current (pulsed)                                                |                                                                                                                     |      |               | 20  | A                  |
| $V_{SD}^{(2)}$                    | Forward on voltage                                                           | $I_{SD} = 5A, V_{GS} = 0$                                                                                           |      |               | 1.2 | V                  |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 5A,$<br>$di/dt = 100A/\mu s,$<br>$V_{DD} = 10V, T_J = 150^\circ C$<br><a href="#">Figure 16 on page 8</a> |      | 26<br>13<br>1 |     | 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 2. Safe operating area

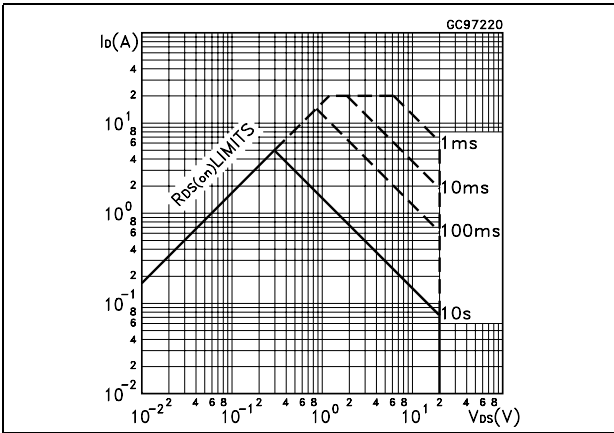


Figure 3. Thermal impedance

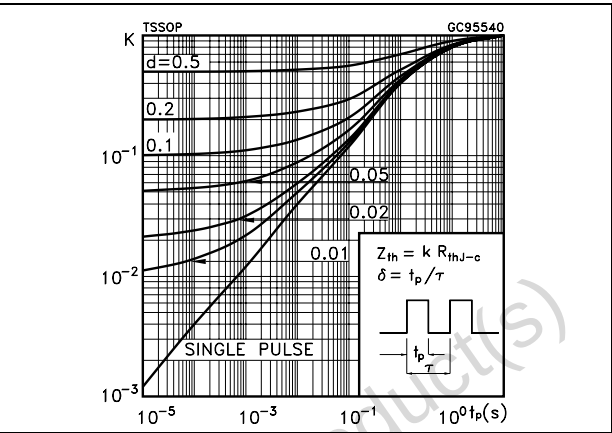


Figure 4. Output characteristics

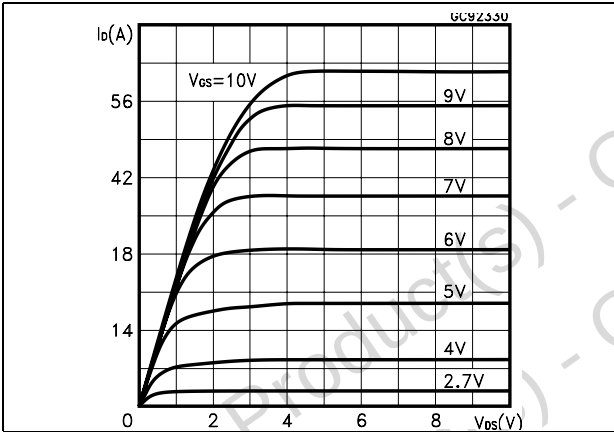


Figure 5. Transfer characteristics

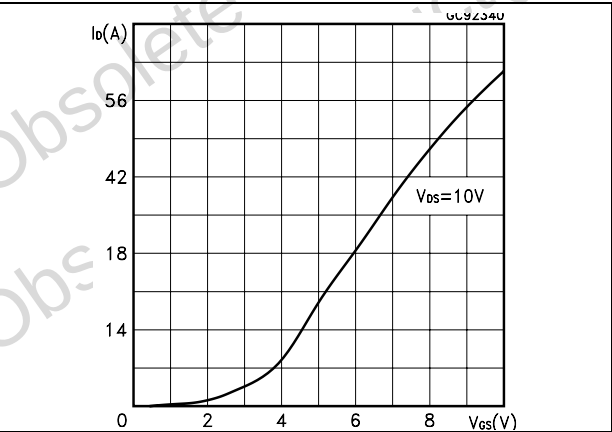


Figure 6. Transconductance

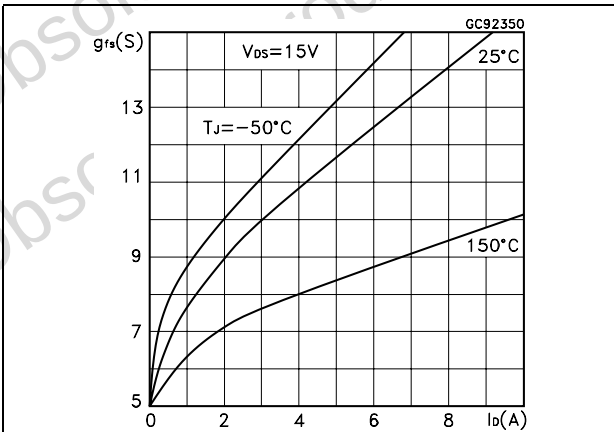


Figure 7. Static drain-source on resistance

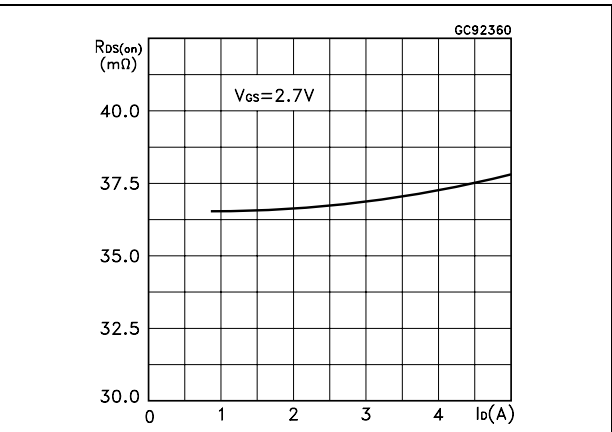


Figure 8. Gate charge vs. gate-source voltage Figure 9. Capacitance variations

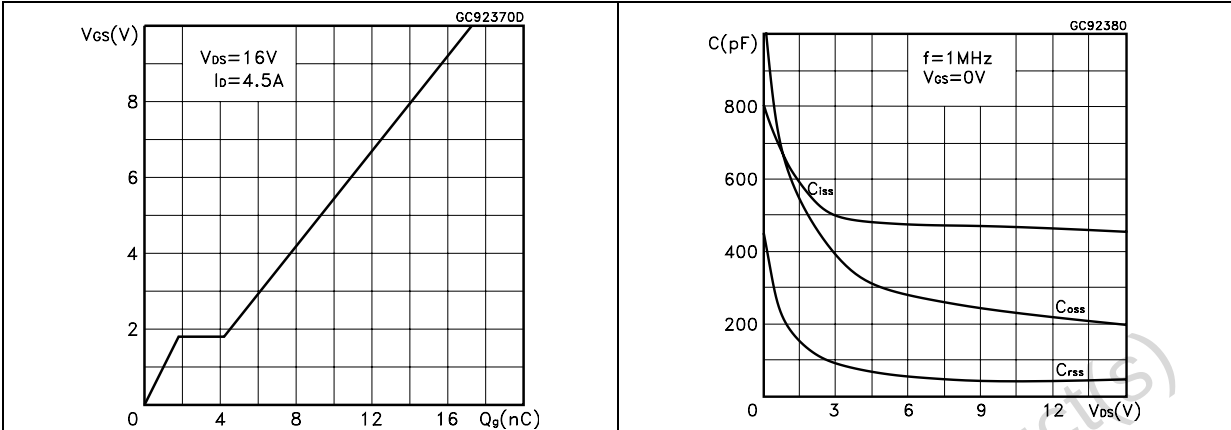


Figure 10. Normalized gate threshold voltage vs. temperature Figure 11. Normalized on resistance vs. temperature

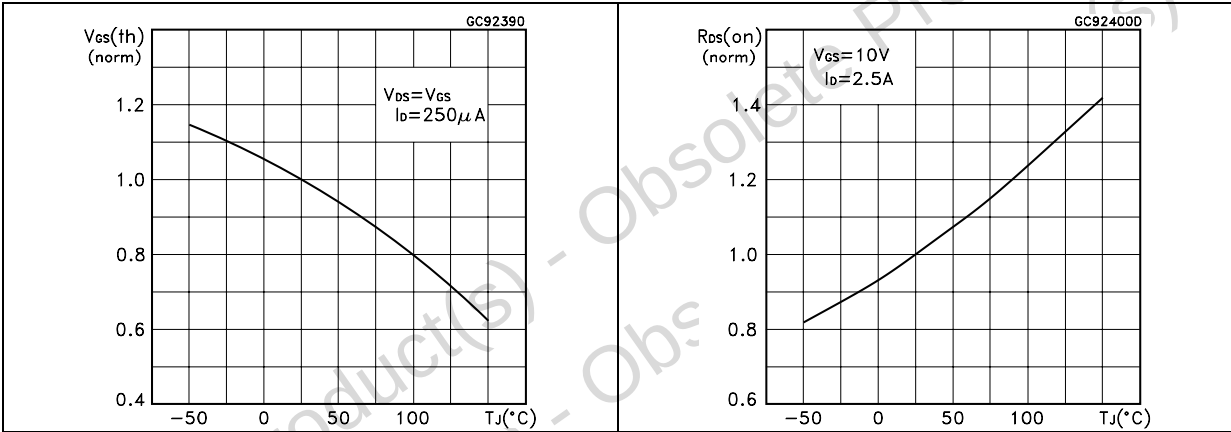
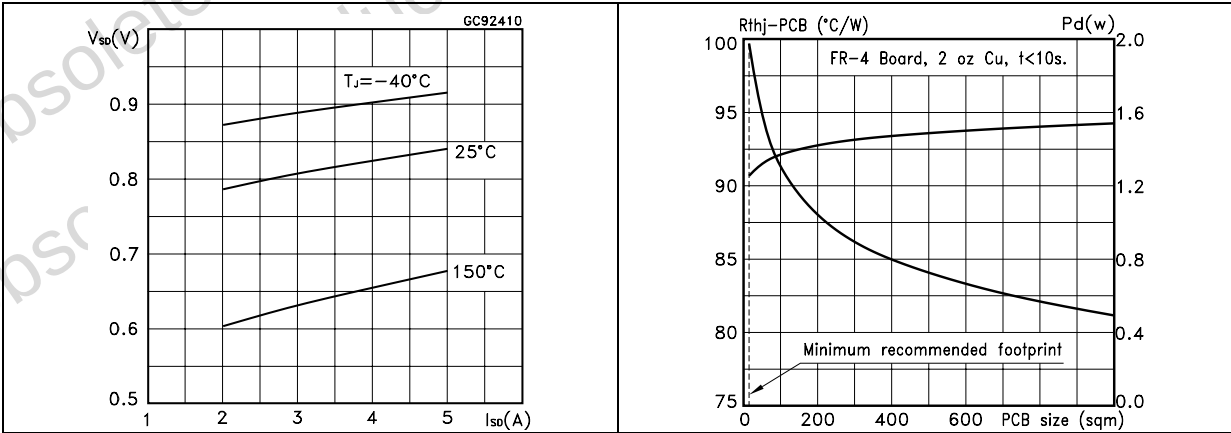
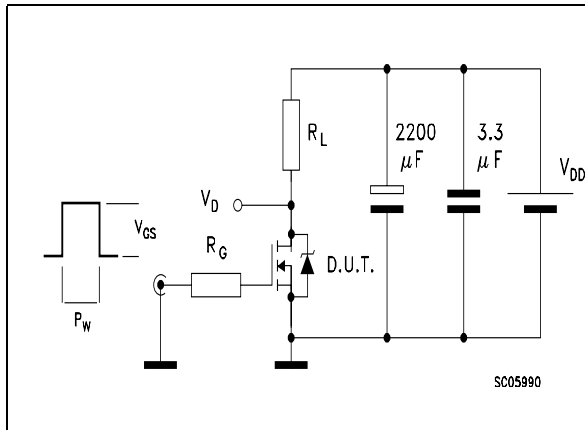


Figure 12. Source-drain diode forward characteristics Figure 13. Thermal resistance and max power

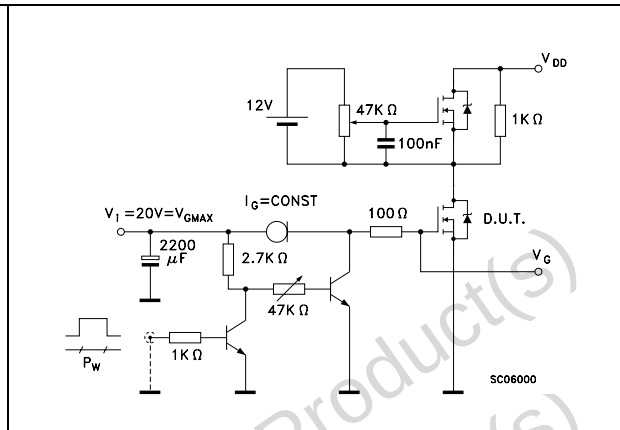


### 3 Test circuit

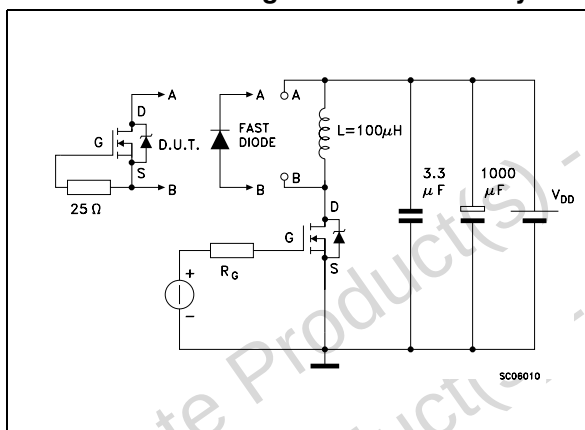
**Figure 14. Switching times test circuit for resistive load**



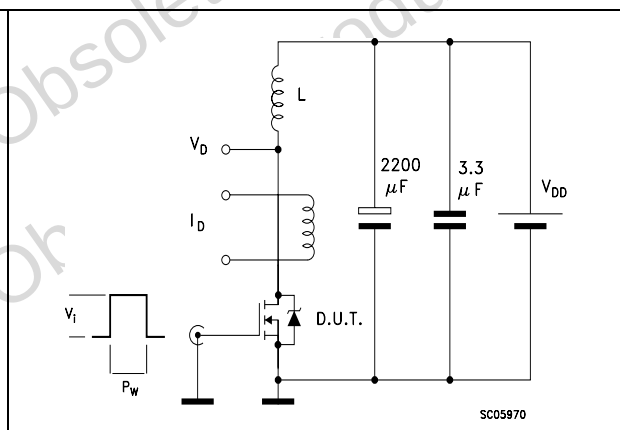
**Figure 15. Gate charge test circuit**



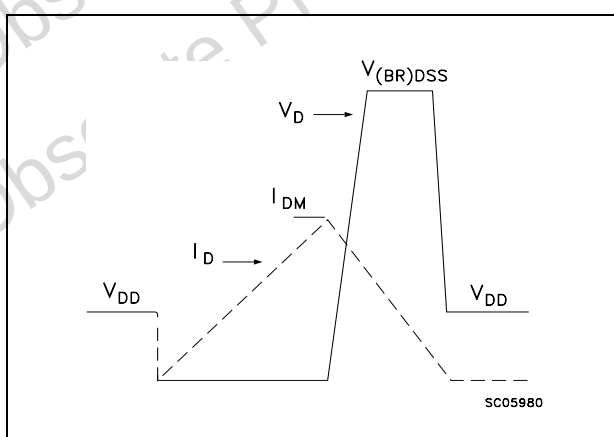
**Figure 16. Test circuit for inductive load switching and diode recovery times**



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



**Figure 18. Unclamped inductive waveform**





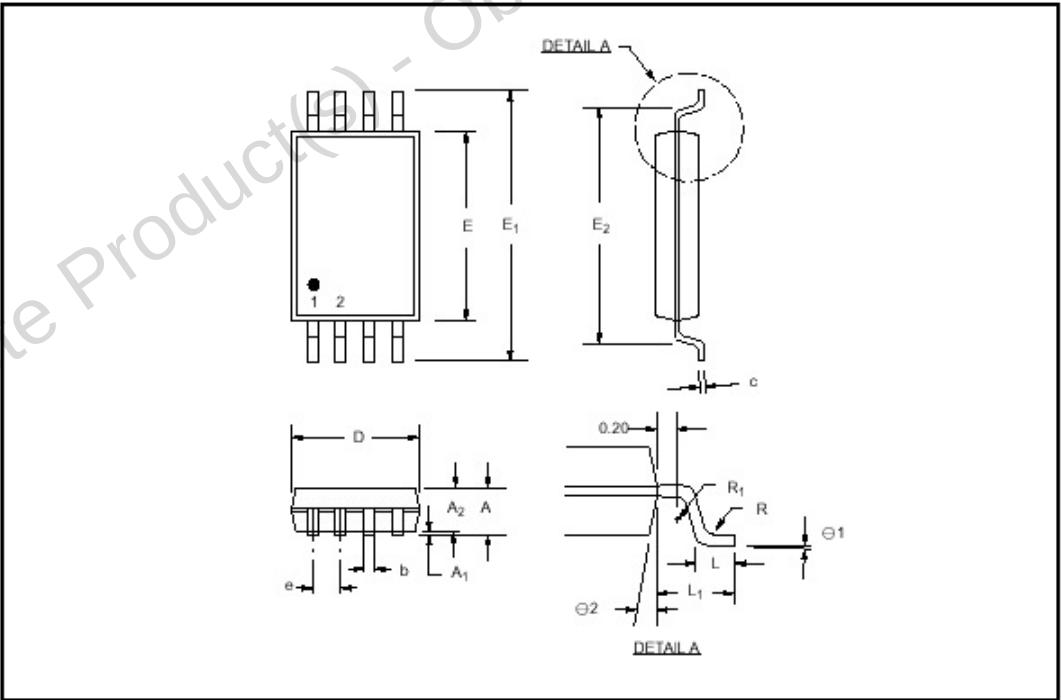
## 4 Package mechanical data

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)

Obsolete Product(s) - Obsolete Product(s)  
Obsolete Product(s) - Obsolete Product(s)

TSSOP8 MECHANICAL DATA

| DIM. | mm.  |       |      | inch   |       |        |
|------|------|-------|------|--------|-------|--------|
|      | MIN. | TYP   | MAX. | MIN.   | TYP.  | MAX.   |
| A    | 1.05 |       | 1.20 | 0.041  |       | 0.047  |
| A1   | 0.05 |       | 0.15 | 0.002  |       | 0.006  |
| A2   | 0.80 |       | 1.05 | 0.032  |       | 0.041  |
| b    | 0.19 |       | 0.30 | 0.008  |       | 0.012  |
| c    |      | 0.127 |      |        | 0.005 |        |
| D    | 2.90 |       | 3.10 | 0.114  |       | 0.122  |
| E    | 4.30 |       | 4.50 | 0.170  |       | 0.177  |
| E1   | 6.20 |       | 6.60 | 0.240  |       | 0.260  |
| E2   | 5.14 |       | 5.24 | 0.202  |       | 0.206  |
| e    |      | 0.65  |      |        | 0.025 |        |
| L    | 0.45 |       | 0.75 | 0.018  |       | 0.030  |
| L1   | 0.90 |       | 1.10 | 0.0355 |       | 0.0433 |
| R    | 0.09 |       |      | 0.004  |       |        |
| R1   | 0.09 |       |      | 0.004  |       |        |
| θ1   | 0°   |       | 8°   | 0°     |       | 8°     |
| θ2   |      |       | 12°  |        |       |        |



## 5 Revision history

**Table 8. Document revision history**

| Date        | Revision | Changes                                        |
|-------------|----------|------------------------------------------------|
| 09-Sep-2004 | 3        | Initial electronic version                     |
| 03-Aug-2006 | 4        | The document has been reformatted, SOA updated |
| 01-Feb-2007 | 5        | Typo mistake on <a href="#">Table 2</a> .      |
| 25-Oct-2007 | 6        | Update marking on <a href="#">Table 1</a>      |

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2007 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)