



## STS5NF60L

N-channel 60V - 0.045Ω - 5A - SO-8  
STripFET™ Power MOSFET

### General features

| Type      | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-----------|------------------|---------------------|----------------|
| STS5NF60L | 60V              | <0.055Ω             | 5A             |

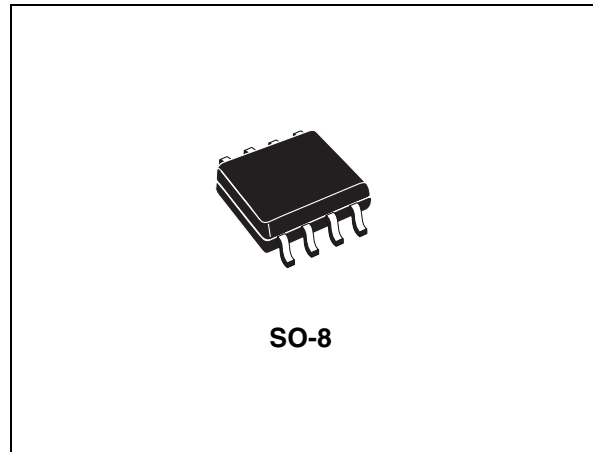
- Standard outline for easy automated surface mount assembly
- Low threshold drive

### Description

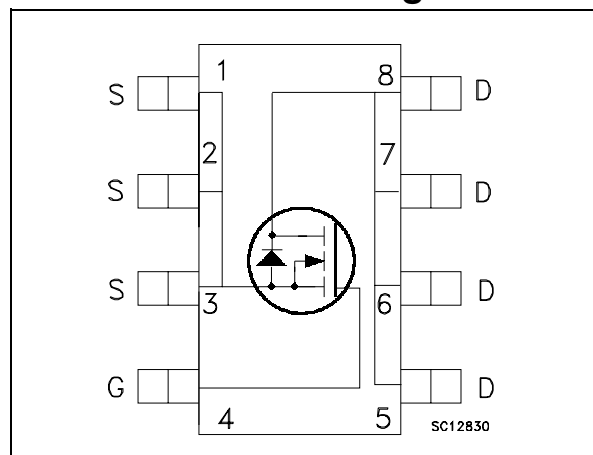
This Power MOSFET is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

### Applications

- Switching application



### Internal schematic diagram



### Order codes

| Part number | Marking | Package | Packaging |
|-------------|---------|---------|-----------|
| STS5NF60L   | S5NF60L | SO-8    | Tape&reel |

## Contents

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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol         | Parameter   | Value      | Unit |
|----------------|---|------------|------|
| $V_{DS}$       | Drain-source voltage ( $v_{GS} = 0$ )                   | 60         | V    |
| $V_{GS}$       | Gate- source voltage                                    | $\pm 20$   | V    |
| $I_D$          | Drain current (continuous) at $T_C = 25^\circ\text{C}$  | 5          | A    |
| $I_D$          | Drain current (continuous) at $T_C = 100^\circ\text{C}$ | 3          | A    |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                  | 20         | A    |
| $P_{TOT}$      | Total dissipation at $T_C = 25^\circ\text{C}$           | 2.5        | W    |
|                | Derating factor   | 0.02       | W/°C |
| $dv/dt^{(2)}$  | Peak diode recovery voltage slope                       | 5.5        | V/ns |
| $T_{stg}$      | Storage Temperature                                     | -55 to 150 | °C   |
| $T_j$          | Max operating junction temperature                      | 150        | °C   |

1. Pulse width limited by safe operating area

2.  $I_{SD} \leq 5\text{A}$ ,  $di/dt \leq 100\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{JMAX}$

**Table 2. Thermal data**

|             |  |     |      |
|-------------|--|-----|------|
| $R_{thj-a}$ | <sup>(1)</sup> Thermal resistance junction-ambient Max | 50  | °C/W |
| $T_l$       | Maximum lead temperature for soldering purpose<br>Typ  | 150 | °C   |

1. Mounted on FR-4 board (t 10 sec.).

## 2 Electrical characteristics

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

**Table 3. On/off states**

| Symbol        | Parameter                                  | Test conditions                                  | Min. | Typ.  | Max.      | Unit     |
|---------------|--|--|------|-------|-----------|----------|
| $V_{(BR)DSS}$ | Drain-source Breakdown voltage             | $I_D = 250 \mu A, V_{GS} = 0$                    | 60   |       |           | V        |
| $I_{DSS}$     | Zero gate voltage                          | $V_{DS} = \text{Max rating}$                     |      |       | 1         | $\mu A$  |
|               | Drain current ( $V_{GS} = 0$ )             | $V_{DS} = \text{Max rating}, T_C = 125^{\circ}C$ |      |       | 10        | $\mu A$  |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ ) | $V_{GS} = \pm 20V$                               |      |       | $\pm 100$ | nA       |
| $V_{GS(th)}$  | Gate threshold voltage                     | $V_{DS} = V_{GS}, I_D = 250\mu A$                | 1    | 1.7   | 2.5       | V        |
| $R_{DS(on)}$  | Static drain-source on resistance          | $V_{GS} = 10V, I_D = 2.5A$                       |      | 0.045 | 0.055     | $\Omega$ |
|               |  | $V_{GS} = 4.5V, I_D = 2.5A$                      |      | 0.050 | 0.065     | $\Omega$ |

**Table 4. Dynamic**

| Symbol         | Parameter                    | Test conditions  | Min. | Typ. | Max. | Unit |
|----------------|------------------------------|--|------|------|------|------|
| $g_{fs}^{(1)}$ | Forward transconductance     | $V_{DS} = 15V, I_D = 2.5 A$                              |      | 7    |      | S    |
| $C_{iss}$      | Input capacitance            | $V_{DS} = 25V, f = 1 \text{ MHz}, V_{GS} = 0$            |      | 1250 |      | pF   |
| $C_{oss}$      | Output capacitance           |  |      | 130  |      | pF   |
| $C_{rss}$      | Reverse transfer capacitance |  |      | 26   |      | pF   |
| $Q_g$          | Total gate charge            | $V_{DD} = 48V, I_D = 5A, V_{GS} = 5V$<br>(see Figure 13) |      | 17   |      | nC   |
| $Q_{gs}$       | Gate-source charge           |  |      | 4.5  |      | nC   |
| $Q_{gd}$       | Gate-drain charge            |  |      | 6    |      | nC   |

1. Pulsed: Pulse duration = 300  $\mu s$ , duty cycle 1.5.

**Table 5. Switching times**

| Symbol                | Parameter           | Test conditions  | Min.   | Typ. | Max. | Unit |
|-----------------------|---------------------|--|--|------|------|------|
| $t_{d(on)}$<br>$t_r$  | Turn-on delay time  | $V_{DD} = 30 V, I_D = 2.5A, R_G = 4.7\Omega, V_{GS} = 4.5V$<br>(see Figure 12) |  | 13   |      | ns   |
|                       | Rise time           |  |  | 28   |      | ns   |
| $t_{d(off)}$<br>$t_f$ | Turn-off Delay Time |  | $V_{DD} = 30 V, I_D = 2.5A, R_G = 4.7\Omega, V_{GS} = 4.5V$<br>(see Figure 12) |      | 45   |      |
|                       | Fall Time           |  |  | 10   |      | ns   |

**Table 6. 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    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 5A, V_{DD} = 40V$<br>$di/dt = 100A/\mu s,$<br>$T_j = 150^\circ C$<br>(see Figure 14) |     | 85   |     | ns   |
| $Q_{rr}$        | Reverse recovery charge       |  |     | 85   |     | nC   |
| $I_{RRM}$       | Reverse recovery current      |  |     | 2    |     | 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

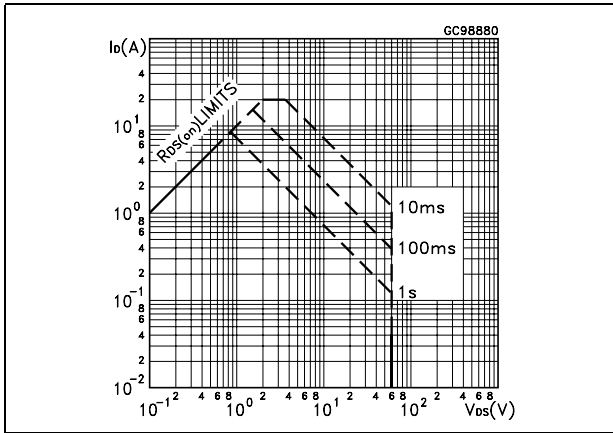


Figure 2. Thermal impedance

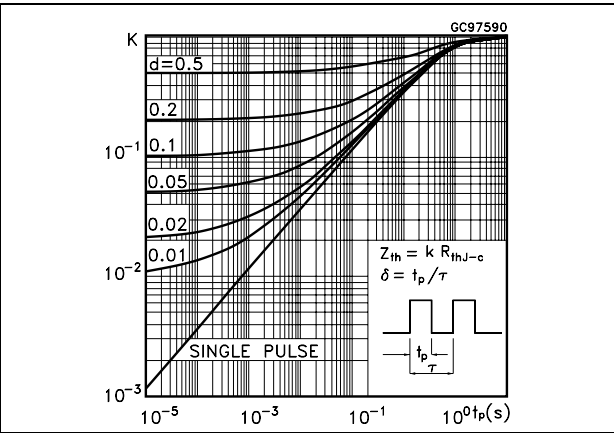


Figure 3. Output characteristics

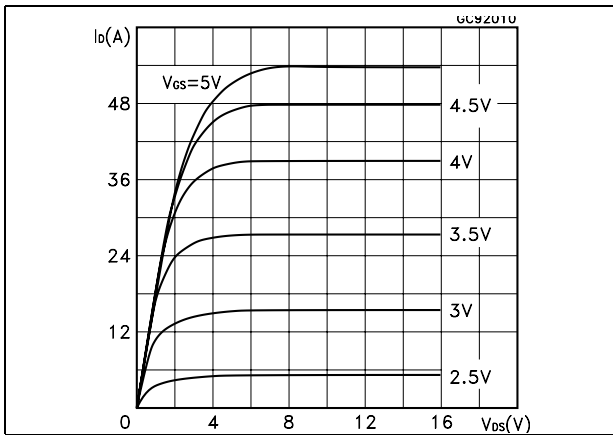


Figure 4. Transfer characteristics

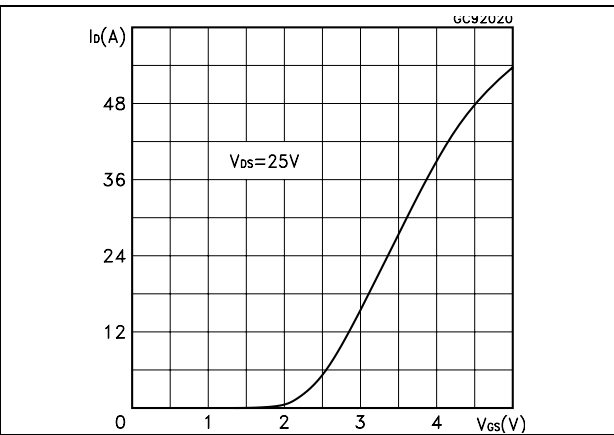


Figure 5. Transconductance

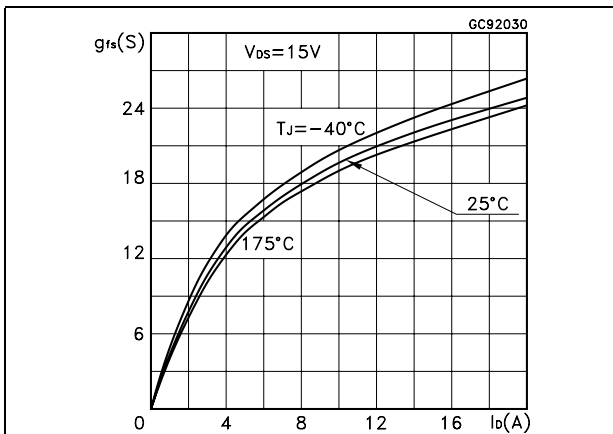


Figure 6. Static drain-source on resistance

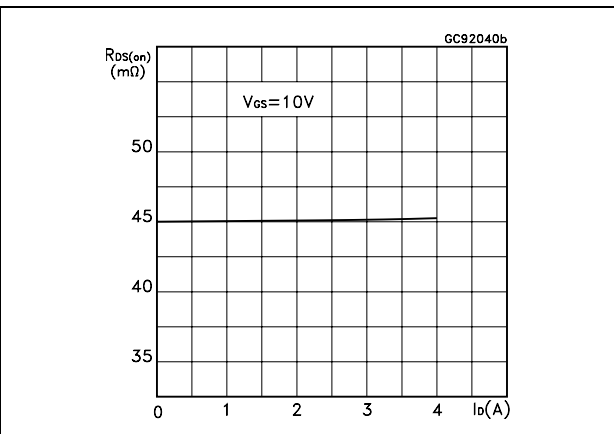


Figure 7. Gate charge vs. gate-source voltage Figure 8. Capacitance variations

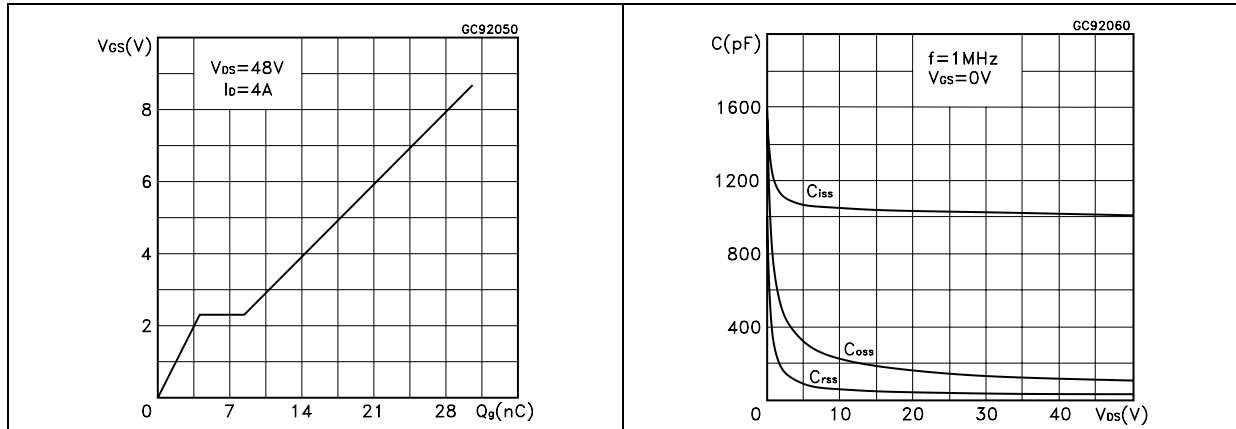


Figure 9. Normalized gate threshold voltage vs. temperature Figure 10. Normalized on resistance vs. temperature

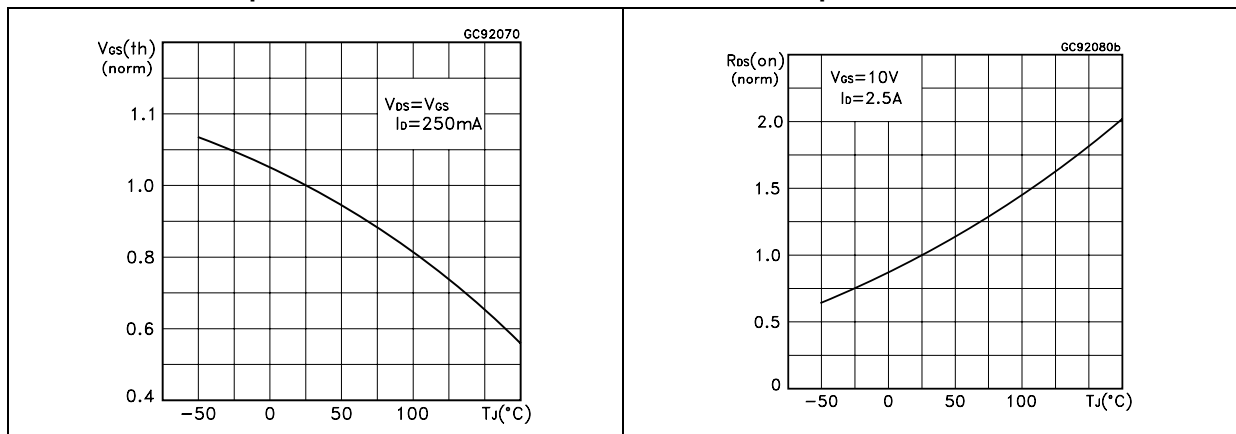
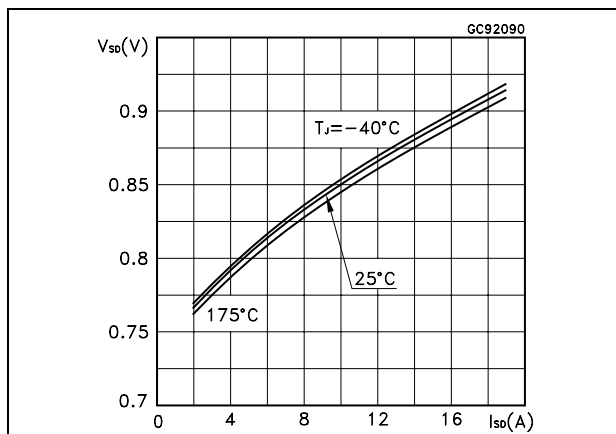


Figure 11. Source-drain diode forward characteristics



### 3 Test circuit

Figure 12. Switching times test circuit for resistive load

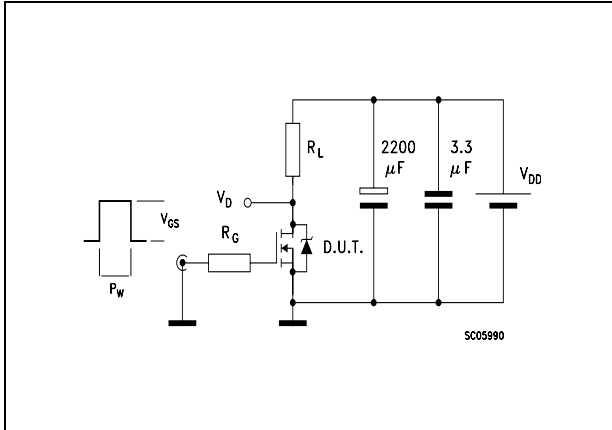


Figure 13. Gate charge test circuit

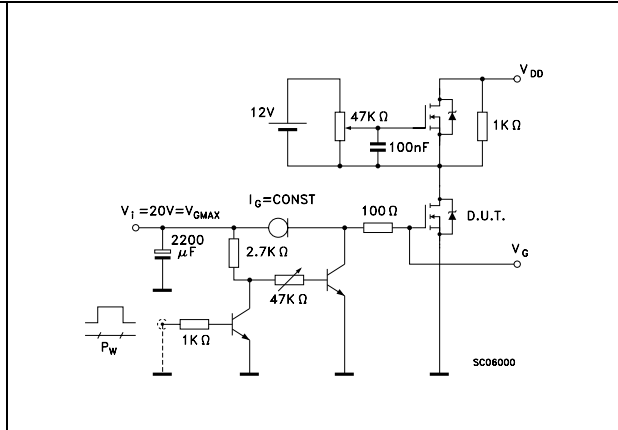


Figure 14. Test circuit for inductive load switching and diode recovery times

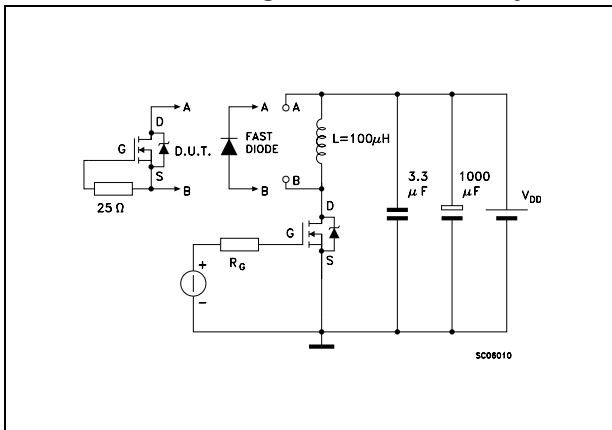


Figure 15. Unclamped Inductive load test circuit

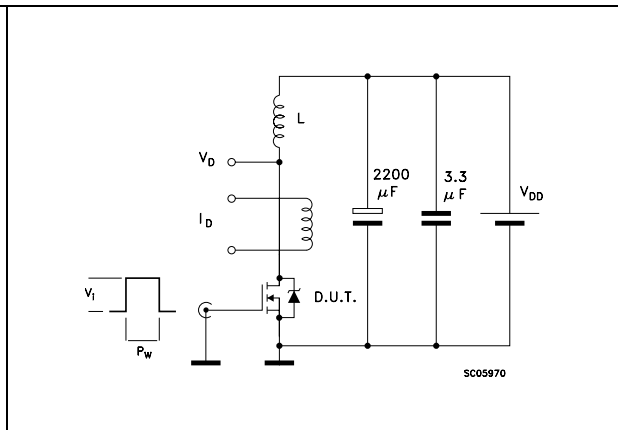


Figure 16. Unclamped inductive waveform

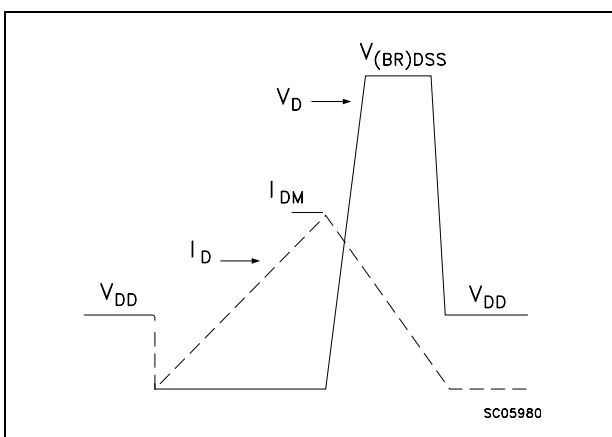
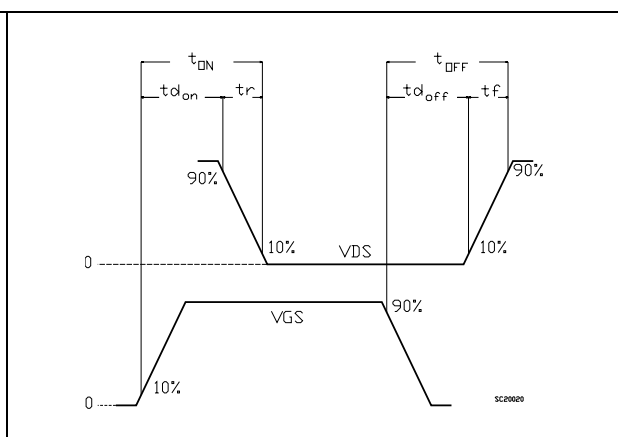


Figure 17. Switching time waveform



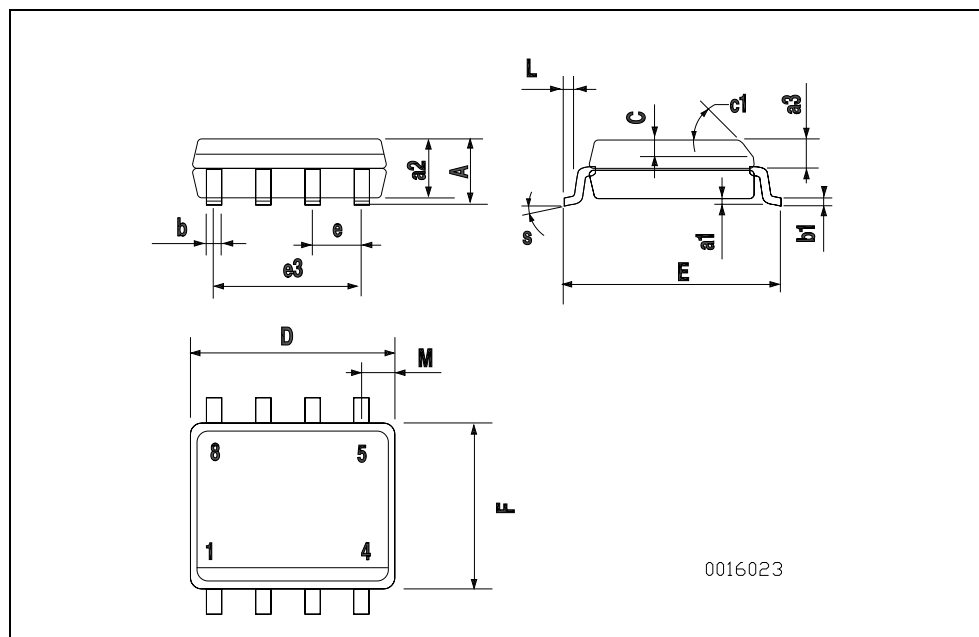


## 4 Package mechanical data

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)

**SO-8 MECHANICAL DATA**

| DIM. | mm.       |      |      | inch  |       |       |
|------|-----------|------|------|-------|-------|-------|
|      | MIN.      | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |           |      | 1.75 |       |       | 0.068 |
| a1   | 0.1       |      | 0.25 | 0.003 |       | 0.009 |
| a2   |           |      | 1.65 |       |       | 0.064 |
| a3   | 0.65      |      | 0.85 | 0.025 |       | 0.033 |
| b    | 0.35      |      | 0.48 | 0.013 |       | 0.018 |
| b1   | 0.19      |      | 0.25 | 0.007 |       | 0.010 |
| C    | 0.25      |      | 0.5  | 0.010 |       | 0.019 |
| c1   | 45 (typ.) |      |      |       |       |       |
| D    | 4.8       |      | 5.0  | 0.188 |       | 0.196 |
| E    | 5.8       |      | 6.2  | 0.228 |       | 0.244 |
| e    |           | 1.27 |      |       | 0.050 |       |
| e3   |           | 3.81 |      |       | 0.150 |       |
| F    | 3.8       |      | 4.0  | 0.14  |       | 0.157 |
| L    | 0.4       |      | 1.27 | 0.015 |       | 0.050 |
| M    |           |      | 0.6  |       |       | 0.023 |
| S    | 8 (max.)  |      |      |       |       |       |



## 5 Revision history

Table 7. Revision history

| Date        | Revision | Changes                                   |
|-------------|----------|---|
| 21-Jun-2004 | 2        | First release                             |
| 06-Nov-2006 | 3        | The document has been reformatted         |
| 30-Jan-2007 | 4        | Typo mistake on <a href="#">Table 1</a> . |

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