



## STS5DNF20V

N-channel 20V - 0.030Ω - 5A SO-8  
2.7V - drive STripFET™ II Power MOSFET

### General features

| Type       | V <sub>DSS</sub> | R <sub>DS(on)</sub>                | I <sub>D</sub> |
|------------|------------------|------------------------------------|----------------|
| STS5DNF20V | 20V              | <0.040Ω (@ 4.5)<br><0.045Ω (@ 2.7) | 5A             |

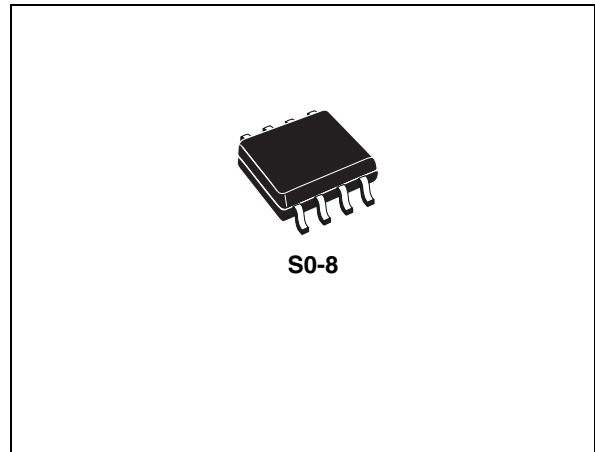
- Ultra low threshold gate drive (2.7 V)
- Standard outline for easy automated surface mount assembly

### 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.

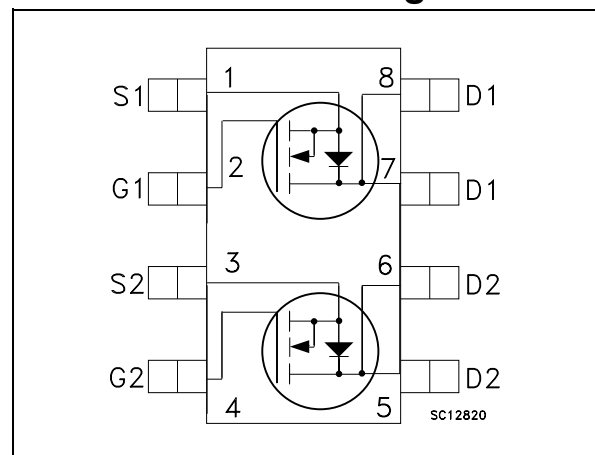
### Applications

- Switching application



SO-8

### Internal schematic diagram



### Order codes

| Part number | Marking  | Package | Packaging   |
|-------------|----------|---------|-------------|
| STS5DNF20V  | S5DNF20V | SO-8    | Tape & reel |

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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol         | Parameter                                                         | Value    | Unit |
|----------------|-------------------------------------------------------------------|----------|------|
| $V_{DS}$       | Drain-source voltage ( $v_{gs} = 0$ )                             | 20       | V    |
| $V_{GS}$       | Gate- source voltage                                              | $\pm 12$ | 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 $T_C = 25^\circ\text{C}$<br>dual operation   | 1.6      | W    |
| $P_{TOT}$      | Total dissipation at $T_C = 25^\circ\text{C}$<br>single operation | 2        | W    |

1. Pulse width limited by safe operating area

**Table 2. Thermal data**

|             |                                                         |            |                    |
|-------------|---------------------------------------------------------|------------|--------------------|
| $R_{thj-a}$ | Thermal resistance junction-ambient<br>single operation | 62.5       | $^\circ\text{C/W}$ |
|             | Thermal resistance junction-ambient<br>dual operation   | 78         | $^\circ\text{C/W}$ |
| $T_J$       | Max. operating junction temperature                     | -55 to 150 | $^\circ\text{C}$   |
| $T_{stg}$   | Storage temperature                                     | -55 to 150 | $^\circ\text{C}$   |

## 2 Electrical characteristics

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

**Table 3. On/off states**

| Symbol        | Parameter                                        | Test conditions                                                                               | Min. | Typ.           | Max.           | Unit                           |
|---------------|--------------------------------------------------|-----------------------------------------------------------------------------------------------|------|----------------|----------------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown voltage                   | $I_D = 250\ \mu\text{A}$ , $V_{GS} = 0$                                                       | 20   |                |                | V                              |
| $I_{DSS}$     | Zero gate voltage Drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max rating}$<br>$V_{DS} = \text{Max rating}$ ,<br>$T_C = 125^{\circ}\text{C}$ |      |                | 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 4. Dynamic**

| Symbol         | Parameter                    | Test conditions                                                                          | Min. | Typ. | Max. | Unit |
|----------------|------------------------------|------------------------------------------------------------------------------------------|------|------|------|------|
| $g_{fs}^{(1)}$ | Forward transconductance     | $V_{DS} = 15\text{V}$ , $I_D = 2.5\text{A}$                                              |      | 10   |      | S    |
| $C_{iss}$      | Input capacitance            | $V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$ ,<br>$V_{GS} = 0$                              |      | 460  |      | pF   |
| $C_{oss}$      | Output capacitance           |                                                                                          |      | 200  |      | pF   |
| $C_{rss}$      | Reverse transfer capacitance |                                                                                          |      | 50   |      | pF   |
| $Q_g$          | Total gate charge            | $V_{DD} = 16\text{V}$ , $I_D = 5\text{A}$ ,<br>$V_{GS} = 4.5\text{V}$<br>(see Figure 13) |      | 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 5. Switching times**

| Symbol                | Parameter                        | Test conditions                                                                                                | Min. | Typ.     | Max. | Unit     |
|-----------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------|------|----------|------|----------|
| $t_{d(on)}$<br>$t_r$  | Turn-on delay time<br>Rise time  | $V_{DD} = 10\text{V}$ , $I_D = 2.5\text{A}$ ,<br>$R_G = 4.7\Omega$ , $V_{GS} = 4.5\text{V}$<br>(see Figure 12) |      | 7<br>33  |      | ns<br>ns |
| $t_{d(off)}$<br>$t_f$ | Turn-off Delay Time<br>Fall 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>(see Figure 12) |      | 27<br>10 |      | ns<br>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         | $I_{SD} = 5A, V_{DD} = 10V$<br>$di/dt = 100A/\mu s,$<br>$T_j = 150^\circ C$<br>(see Figure 14) |     | 26   |     | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                |     | 13   |     | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                |     | 1    |     | 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

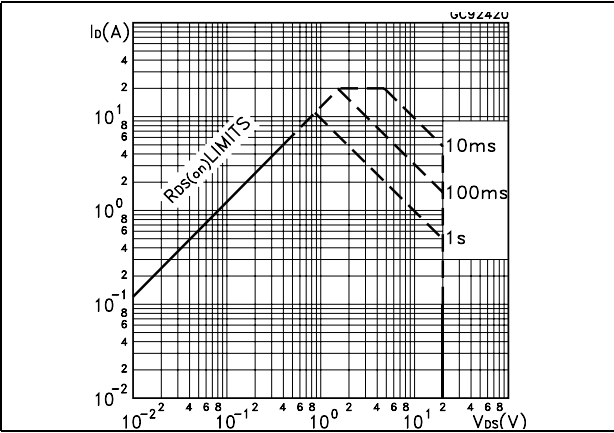


Figure 2. Thermal impedance

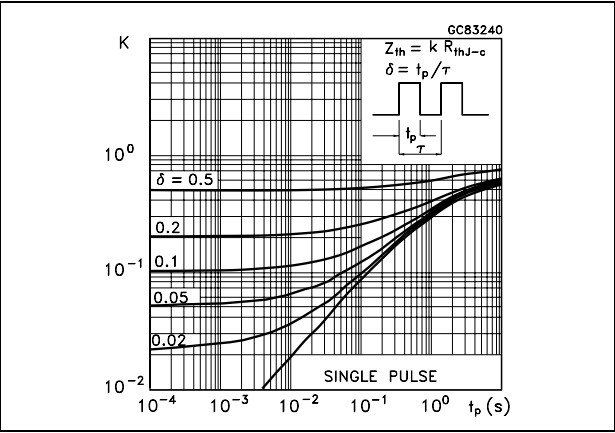


Figure 3. Output characteristics

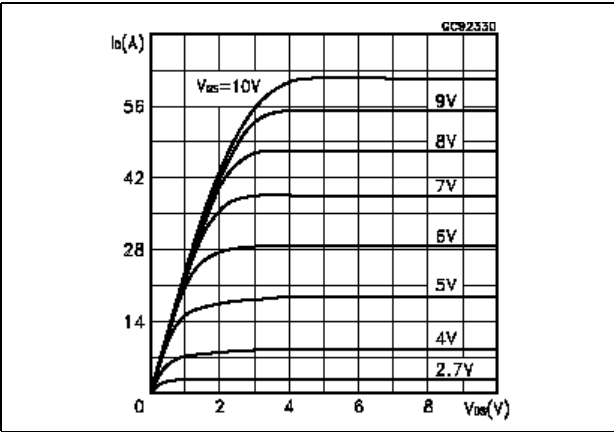


Figure 4. Transfer characteristics

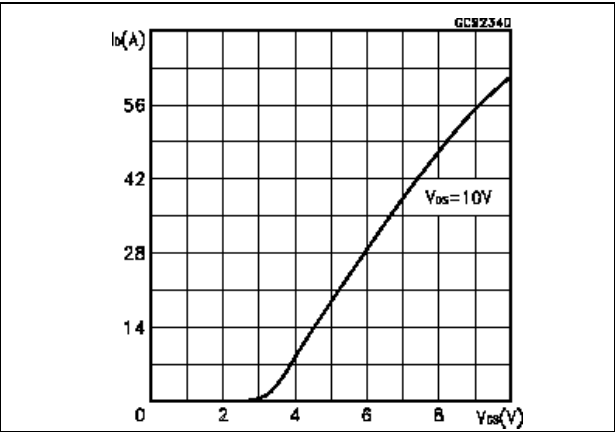


Figure 5. Transconductance

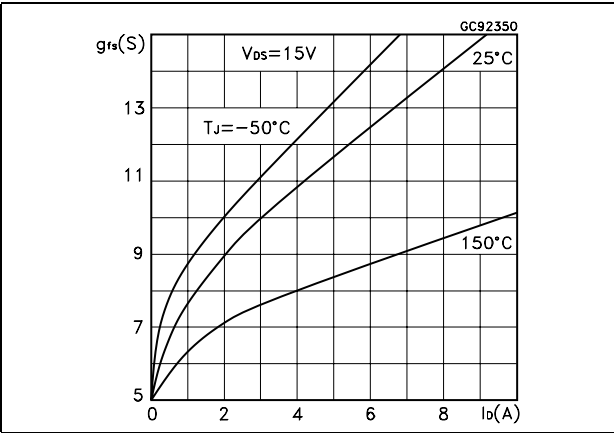


Figure 6. Static drain-source on resistance

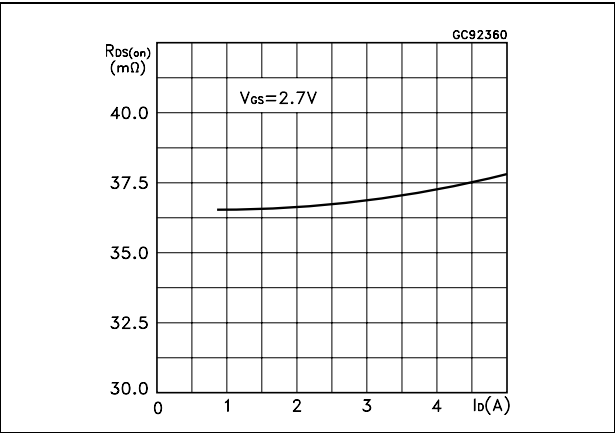


Figure 7. Gate charge vs gate-source voltage    Figure 8. Capacitance variations

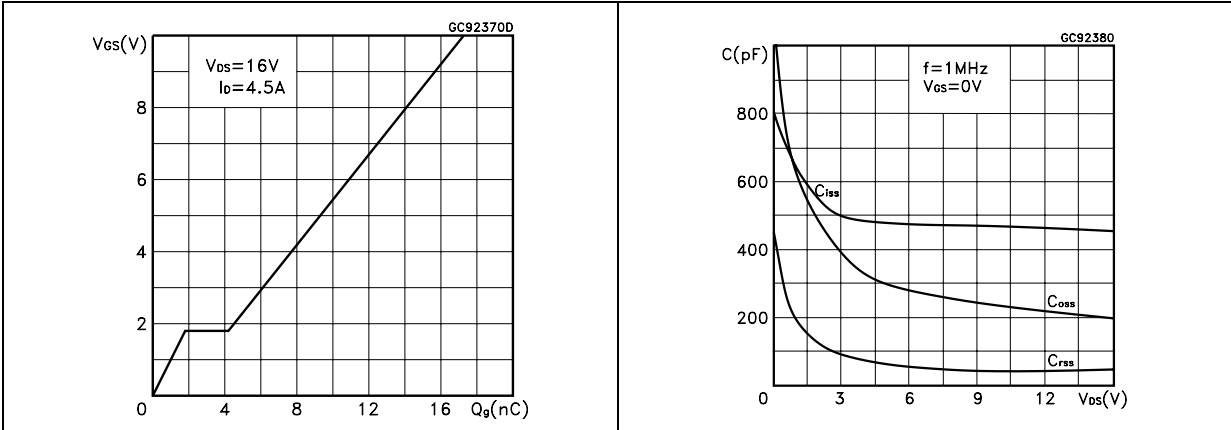


Figure 9. Normalized gate threshold voltage vs temperature    Figure 10. Normalized on resistance vs temperature

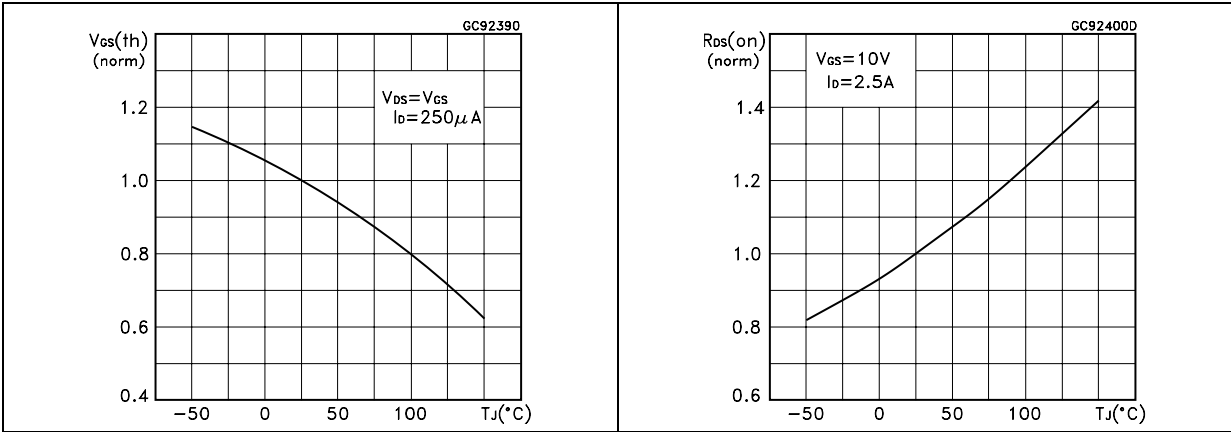
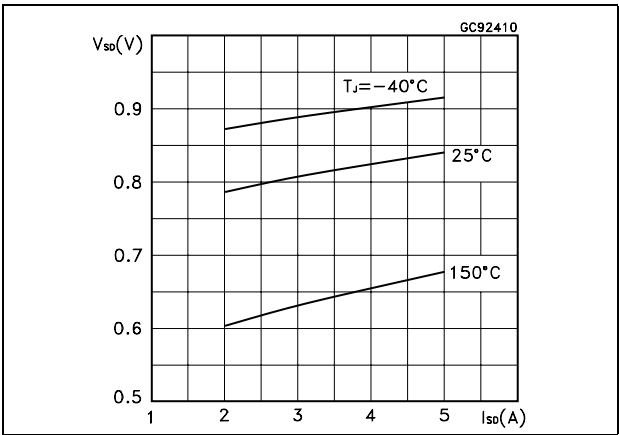


Figure 11. Source-drain diode forward characteristics



### 3 Test circuit

Figure 12. Switching times test circuit for resistive load

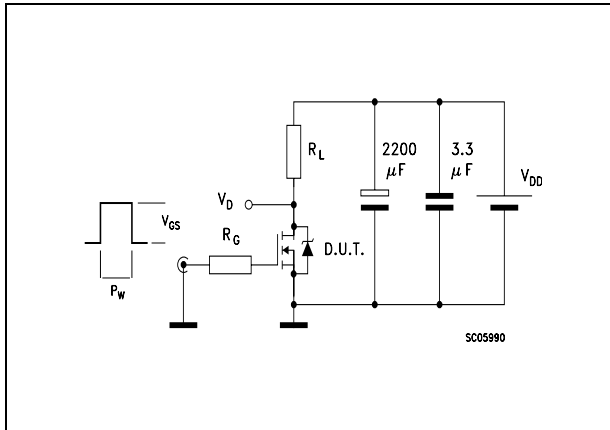


Figure 13. Gate charge test circuit

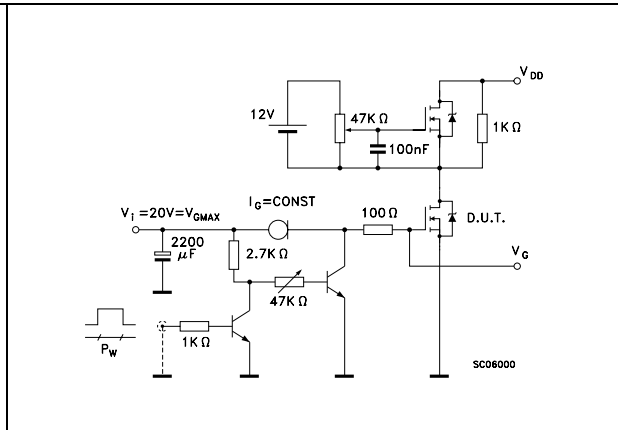


Figure 14. Test circuit for inductive load switching and diode recovery times

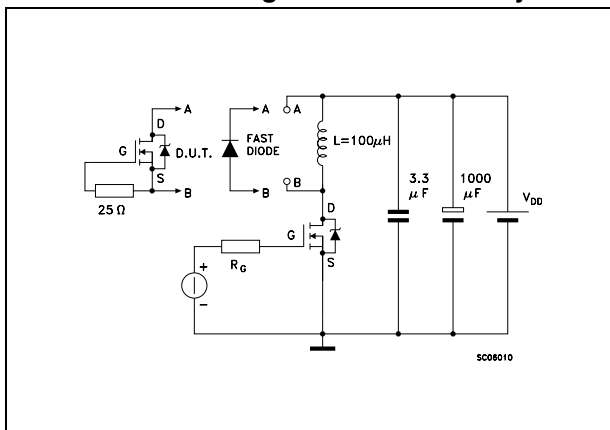


Figure 15. Unclamped Inductive load test circuit

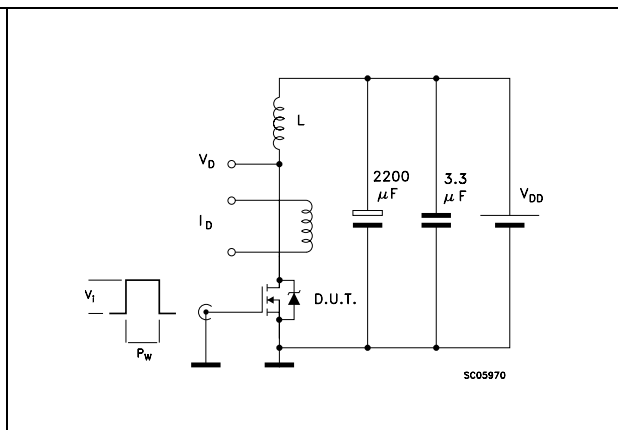


Figure 16. Unclamped inductive waveform

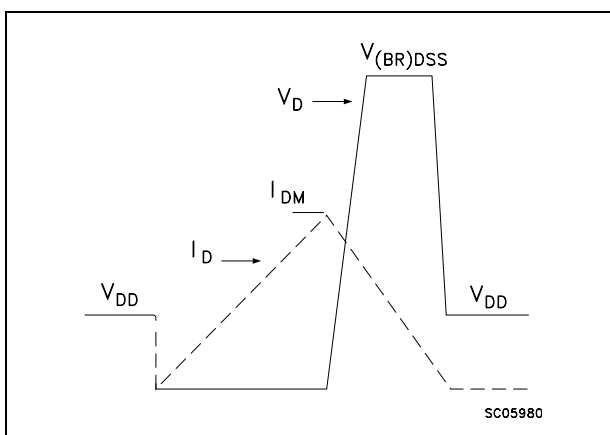
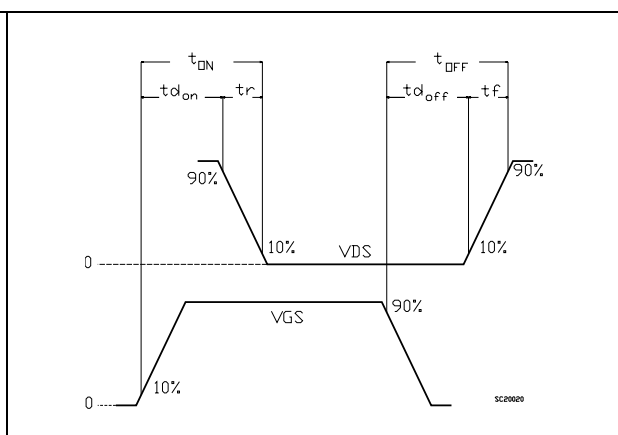


Figure 17. Switching time waveform

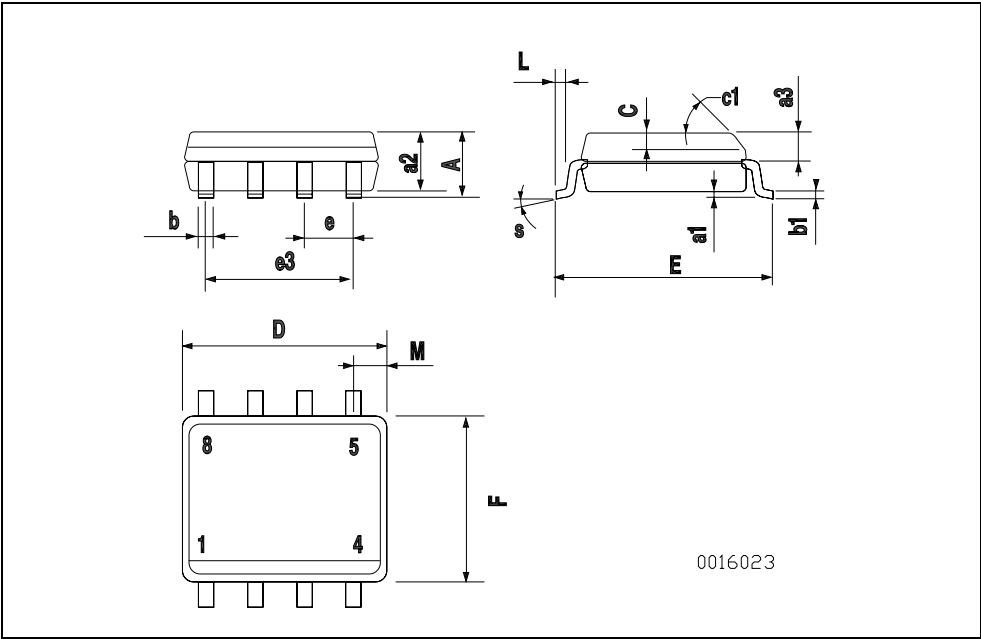




## 4 Package mechanical data

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**

| <b>Date</b> | <b>Revision</b> | <b>Changes</b>                    |
|-------------|-----------------|-----------------------------------|
| 21-Jun-2004 | 4               | Complete document                 |
| 13-Nov-2006 | 5               | The document has been reformatted |

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