



# STN4NF20L

N-channel 200 V, 1.1  $\Omega$ , 1 A SOT-223  
low gate charge STripFET™ II Power MOSFET

## Features

| Order code | V <sub>DSS</sub> | R <sub>DS(on)</sub><br>max. | I <sub>D</sub> |
|------------|------------------|-----------------------------|----------------|
| STN4NF20L  | 200 V            | < 1.5 $\Omega$              | 1 A            |

- 100% avalanche tested
- Low gate charge
- Exceptional dv/dt capability

## Application

Switching applications

## Description

This N-channel 200 V realized with STMicroelectronics unique STripFET™ process has specifically been designed to minimize input capacitance and gate charge. It is therefore suitable as primary switch in advanced high efficiency isolated DC-DC converters.

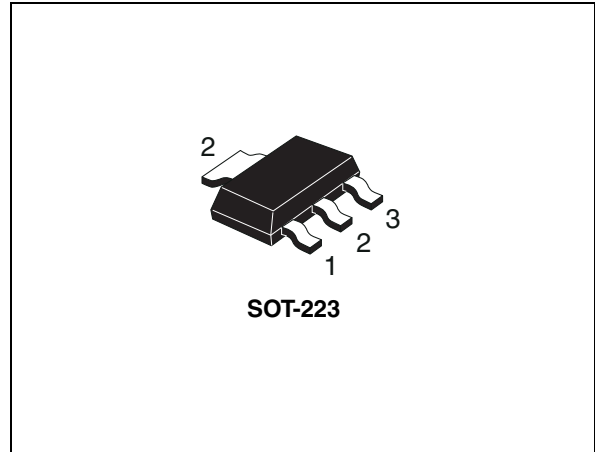


Figure 1. Internal schematic diagram

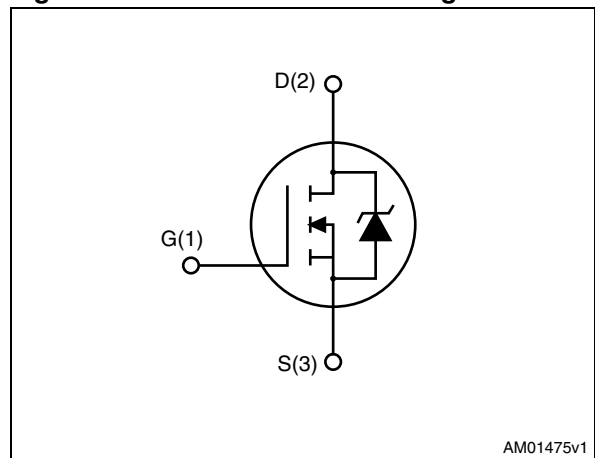


Table 1. Device summary

| Order code | Marking | Package | Packaging     |
|------------|---------|---------|---------------|
| STN4NF20L  | 4NF20L  | SOT-223 | Tape and reel |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol             | Parameter                                                    | Value       | Unit               |
|--------------------|--------------------------------------------------------------|-------------|--------------------|
| $V_{GS}$           | Gate-source voltage                                          | $\pm 20$    | V                  |
| $I_D$              | Drain current continuous $T_C = 25\text{ }^{\circ}\text{C}$  | 1           | A                  |
| $I_D$              | Drain current continuous $T_C = 100\text{ }^{\circ}\text{C}$ | 0.63        | A                  |
| $I_{DM}^{(1)}$     | Drain current pulsed                                         | 4           | A                  |
| $P_{TOT}^{(2)}$    | Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$      | 3.3         | W                  |
| $dv/dt^{(3)}$      | Peak diode recovery voltage slope                            | 20          | V/ns               |
| $T_j$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature        | - 55 to 150 | $^{\circ}\text{C}$ |

1. Pulse width limited by safe operating area.
2. This value is rated according to  $R_{thj-amb} \leq 10\text{ sec.}$
3.  $I_{sd} \leq 1\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 80\% V_{(BR)DSS}$ .

**Table 3. Thermal data**

| Symbol              | Parameter                              | Value | Unit                        |
|---------------------|----------------------------------------|-------|-----------------------------|
| $R_{thj-amb}^{(1)}$ | Thermal resistance junction to ambient | 38    | $^{\circ}\text{C}/\text{W}$ |
| $R_{thj-amb}^{(2)}$ |                                        | 62.5  | $^{\circ}\text{C}/\text{W}$ |

1. When mounted on 1 inch<sup>2</sup> FR-4 board, 2 oz. Cu, ( $t < 10\text{ sec.}$ ).
2. When mounted on 1 inch<sup>2</sup> FR-4 board, 2 oz. Cu, ( $t > 10\text{ sec.}$ ).

**Table 4. Thermal data**

| Symbol   | Parameter                                                      | Value | Unit |
|----------|----------------------------------------------------------------|-------|------|
| $I_{AR}$ | Avalanche current, repetitive or not repetitive <sup>(1)</sup> | 1     | A    |
| $E_{AS}$ | Single pulse avalanche energy <sup>(2)</sup>                   | 90    | mJ   |

1. Pulse width limited by  $T_{JMAX}$ .
2. Starting  $T_j = 25\text{ }^{\circ}\text{C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50\text{ V}$ .

## 2 Electrical characteristics

(T<sub>case</sub> = 25 °C unless otherwise specified)

**Table 5. On /off states**

| Symbol        | Parameter                                        | Test conditions                                                                                   | Min. | Typ.        | Max.        | Unit                           |
|---------------|--------------------------------------------------|---------------------------------------------------------------------------------------------------|------|-------------|-------------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 1 \text{ mA}$ , $V_{GS} = 0$                                                               | 200  |             |             | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max rating}$<br>$V_{DS} = \text{Max rating}$ , $T_C = 125 \text{ °C}$             |      |             | 1<br>50     | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20 \text{ V}$ , $V_{DS} = 0$                                                        |      |             | $\pm 100$   | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{GS} = V_{DS}$ , $I_D = 250 \mu\text{A}$                                                       | 1    | 2           | 3           | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10 \text{ V}$ , $I_D = 0.5 \text{ A}$<br>$V_{GS} = 5 \text{ V}$ , $I_D = 0.5 \text{ A}$ |      | 1.1<br>1.13 | 1.5<br>1.55 | $\Omega$<br>$\Omega$           |

**Table 6. Dynamic**

| Symbol                              | Parameter                                                               | Test conditions                                                                                                 | Min. | Typ.              | Max. | Unit           |
|-------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------|-------------------|------|----------------|
| $C_{iss}$<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>$V_{GS} = 0$                                                 | -    | 150<br>30<br>4    | -    | pF<br>pF<br>pF |
| $R_g$                               | Intrinsic gate resistance                                               | $f = 1 \text{ MHz}$ open drain                                                                                  | -    | 5.5               | -    | $\Omega$       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$       | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 160 \text{ V}$ , $I_D = 1 \text{ A}$ ,<br>$V_{GS} = 10 \text{ V}$<br>(see <a href="#">Figure 13</a> ) | -    | 0.9<br>2.6<br>6.9 | -    | nC<br>nC<br>nC |

**Table 7. Switching times**

| Symbol                                       | Parameter                                                                     | Test conditions                                                                                                                        | Min. | Typ.                     | Max | Unit                 |
|----------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------|-----|----------------------|
| $t_{d(v)}$<br>$t_r$<br>$t_f$<br>$t_{c(off)}$ | Voltage delay time<br>Voltage rise time<br>Current fall time<br>Crossing time | $V_{DD} = 100 \text{ V}$ , $I_D = 0.5 \text{ A}$ ,<br>$R_G = 4.7 \Omega$ , $V_{GS} = 10 \text{ V}$<br>(see <a href="#">Figure 12</a> ) | -    | 3.6<br>2<br>10.4<br>15.4 | -   | ns<br>ns<br>ns<br>ns |

**Table 8. Source drain diode**

| Symbol                            | Parameter                                                                    | Test conditions                                                                                                                                              | Min. | Typ.             | Max.   | Unit          |
|-----------------------------------|------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------|--------|---------------|
| $I_{SD}$<br>$I_{SDM}^{(1)}$       | Source-drain current<br>Source-drain current<br>(pulsed)                     |                                                                                                                                                              | -    |                  | 1<br>4 | A<br>A        |
| $V_{SD}^{(2)}$                    | Forward on voltage                                                           | $I_{SD} = 1\text{ A}$ , $V_{GS} = 0$                                                                                                                         | -    |                  | 1.6    | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 1\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 60\text{ V}$<br>(see <a href="#">Figure 14</a> )                                     | -    | 51<br>90<br>3.5  |        | ns<br>nC<br>A |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 1\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 14</a> ) | -    | 56<br>105<br>3.7 |        | ns<br>nC<br>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

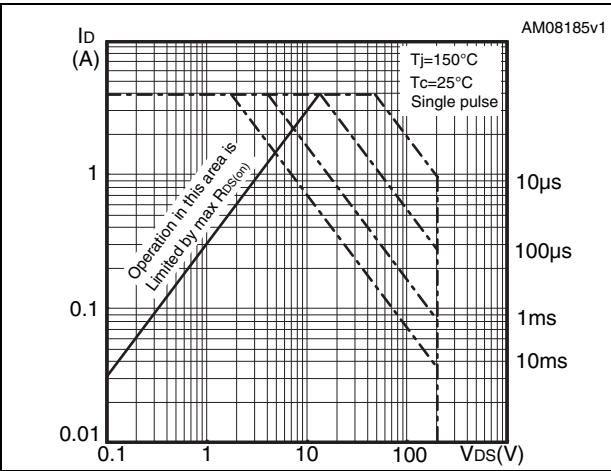


Figure 3. Thermal impedance

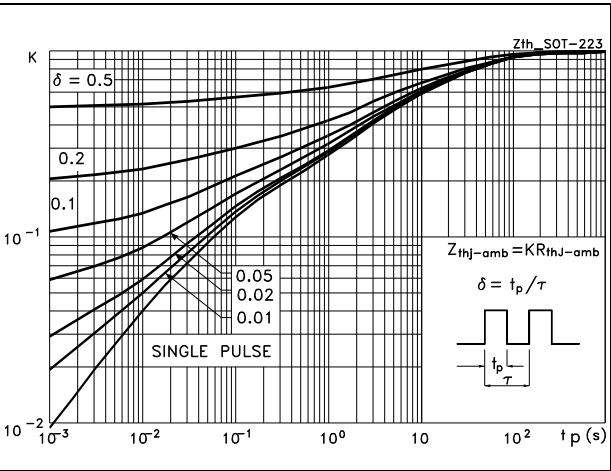


Figure 4. Output characteristics

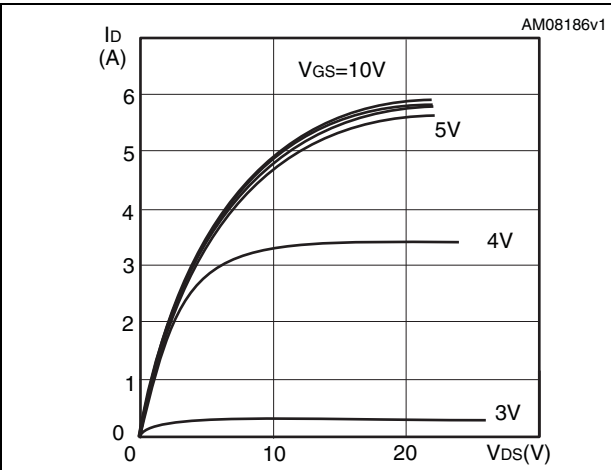


Figure 5. Transfer characteristics

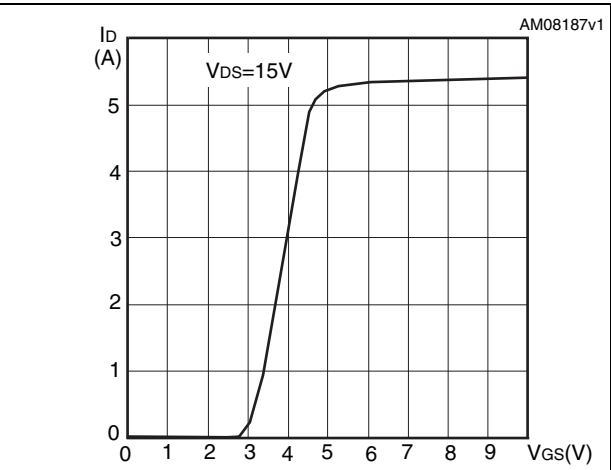


Figure 6. Normalized BVDS vs temperature

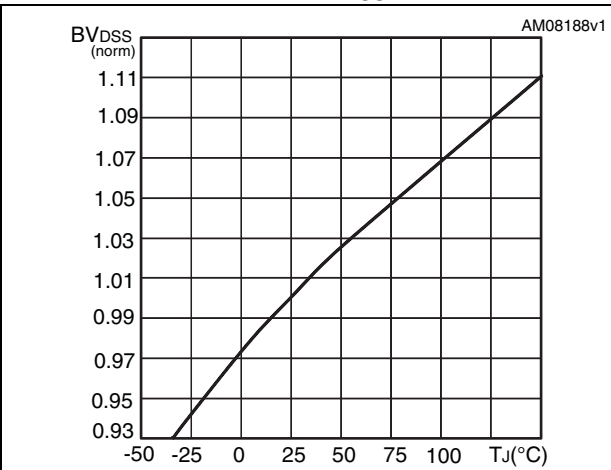


Figure 7. Static drain-source on resistance

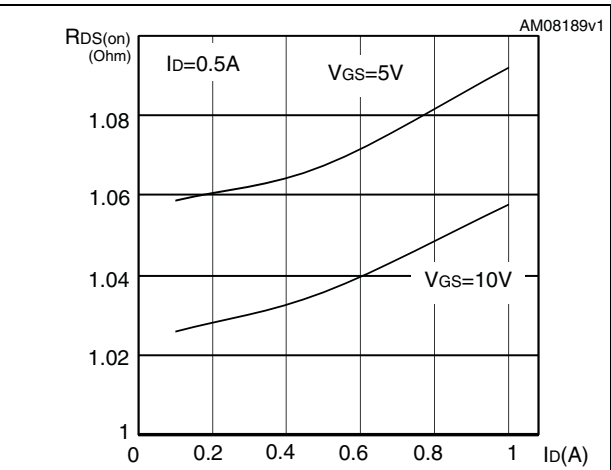


Figure 8. Gate charge vs gate-source voltage

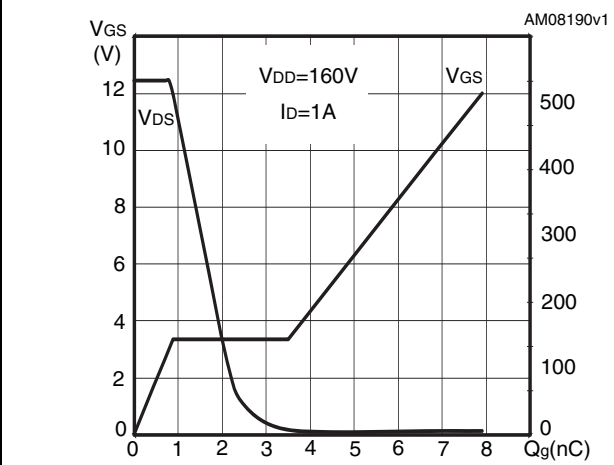


Figure 9. Capacitance variations

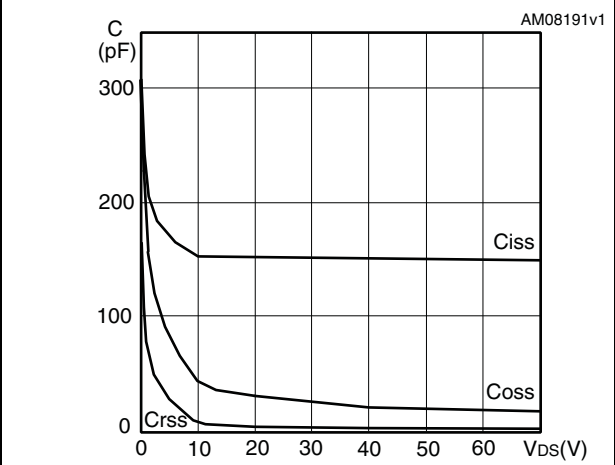


Figure 10. Normalized gate threshold voltage vs temperature

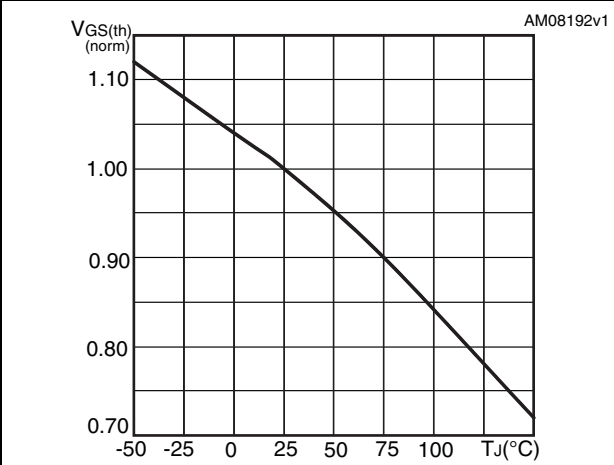
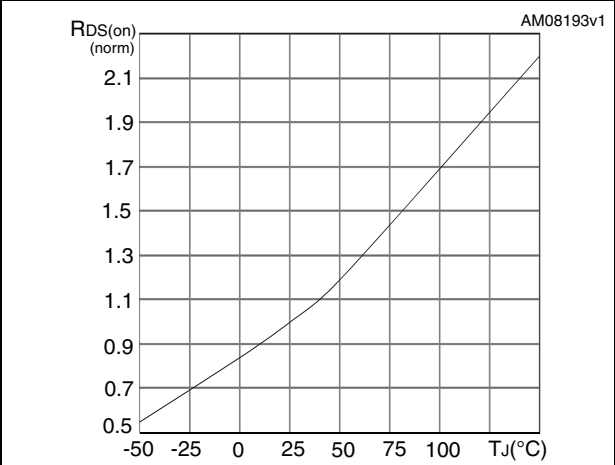
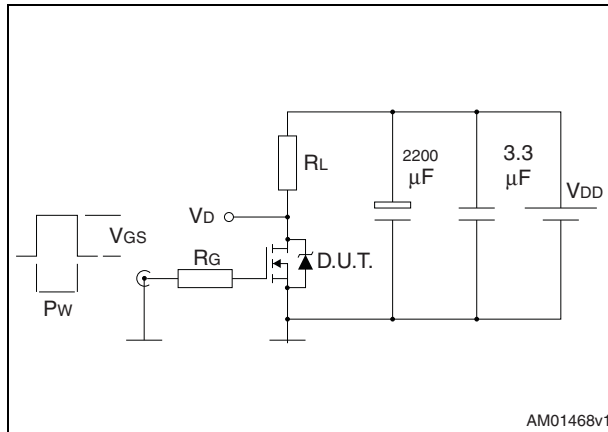


Figure 11. Normalized on resistance vs temperature

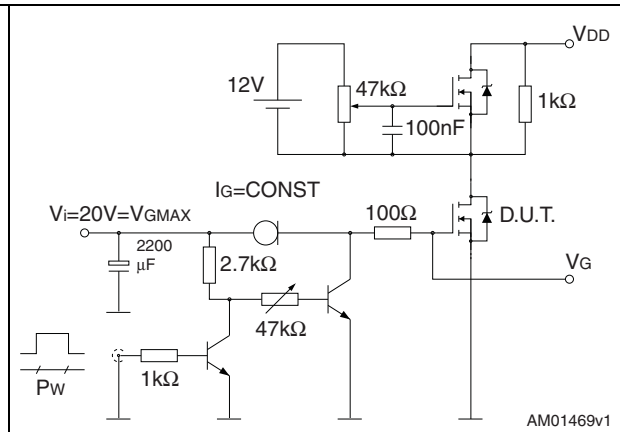


### 3 Test circuits

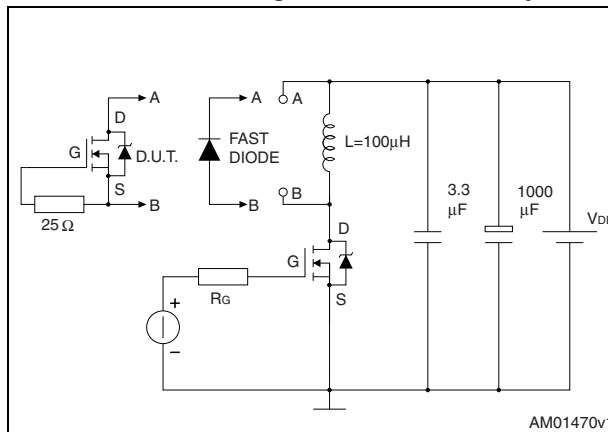
**Figure 12. Switching times test circuit for resistive load**



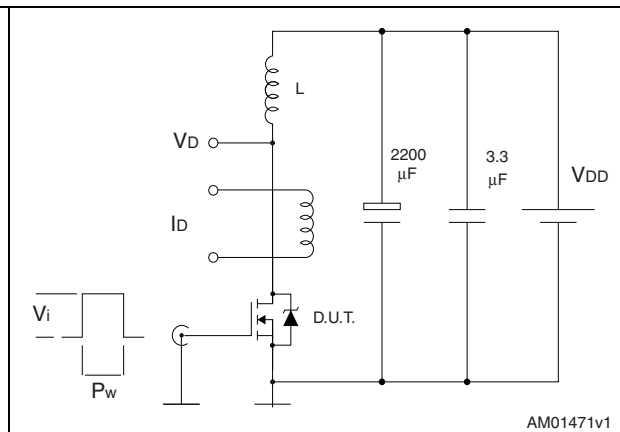
**Figure 13. Gate charge test circuit**



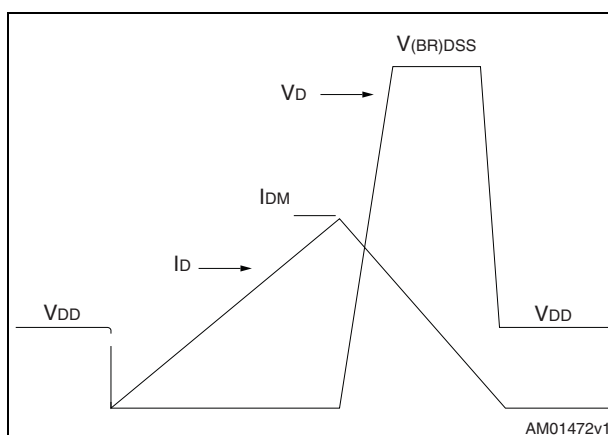
**Figure 14. Test circuit for inductive load switching and diode recovery times**



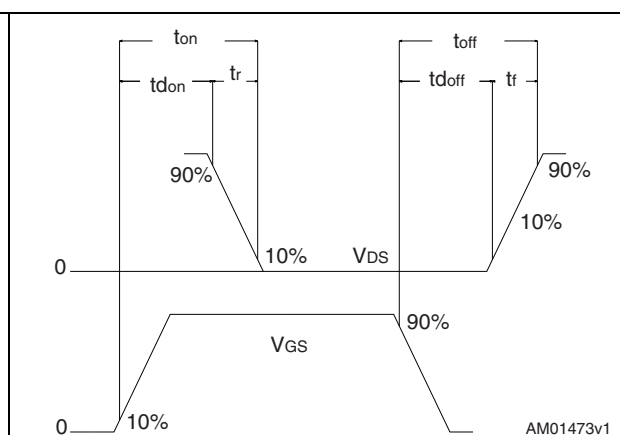
**Figure 15. Unclamped inductive load test circuit**



**Figure 16. Unclamped inductive waveform**



**Figure 17. Switching time waveform**

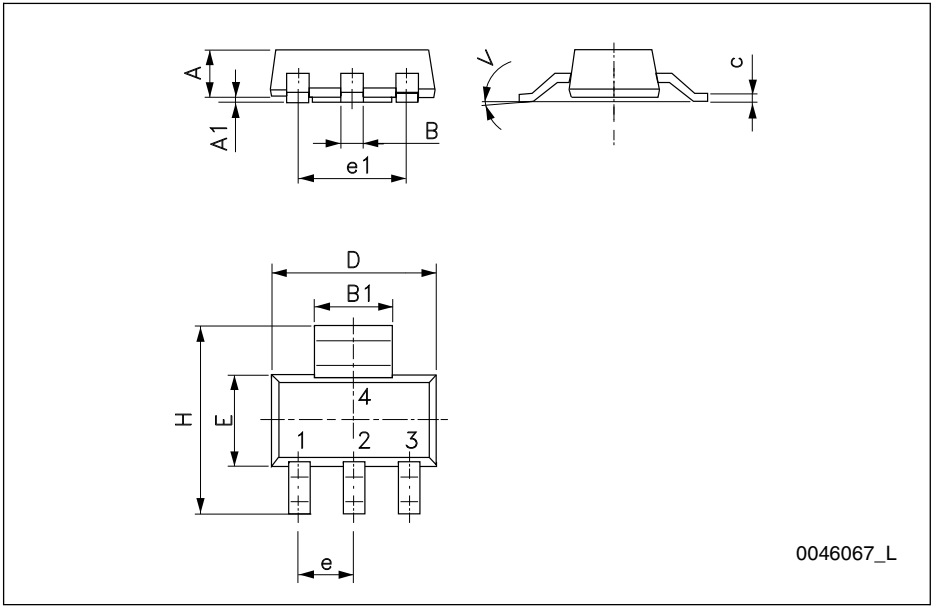




## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

| SOT-223 mechanical data |      |      |      |
|-------------------------|------|------|------|
| DIM.                    | mm.  |      |      |
|                         | min. | typ  | max. |
| A                       |      |      | 1.80 |
| A1                      | 0.02 |      | 0.1  |
| B                       | 0.60 | 0.70 | 0.85 |
| B1                      | 2.90 | 3.00 | 3.15 |
| c                       | 0.24 | 0.26 | 0.35 |
| D                       | 6.30 | 6.50 | 6.70 |
| e                       |      | 2.30 |      |
| e1                      |      | 4.60 |      |
| E                       | 3.30 | 3.50 | 3.70 |
| H                       | 6.70 | 7.00 | 7.30 |
| V                       |      |      | 10 ° |



## 5 Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes                                                      |
|-------------|----------|--------------------------------------------------------------|
| 29-Apr-2010 | 1        | First release.                                               |
| 11-Oct-2010 | 2        | Document status promoted from preliminary data to datasheet. |

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