



## STD55N4F5

N-channel 40 V, 7.3 m $\Omega$ , 40 A, DPAK  
STripFET™ V Power MOSFET

### Features

| Type      | V <sub>DSS</sub> | R <sub>DS(on) max</sub> | I <sub>D</sub> | P <sub>w</sub> |
|-----------|------------------|-------------------------|----------------|----------------|
| STD55N4F5 | 40 V             | < 8.5 m $\Omega$        | 55 A           | 60 W           |

- Standard threshold drive
- 100% avalanche tested
- Surface mounting DPAK (TO-252)

### Applications

- Switching applications
  - Automotive

### Description

The STD55N4F5 is a N-channel STripFET™ V. This Power MOSFET technology is among the latest improvements, which have been especially tailored to achieve very low on-state resistance providing also one of the best-in-class figure of merit (FOM).

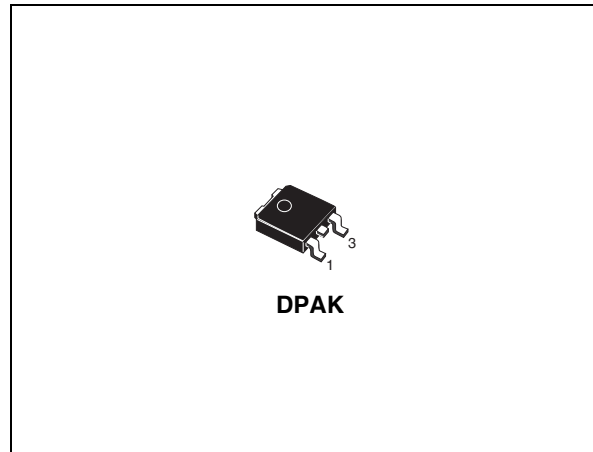


Figure 1. Internal schematic diagram

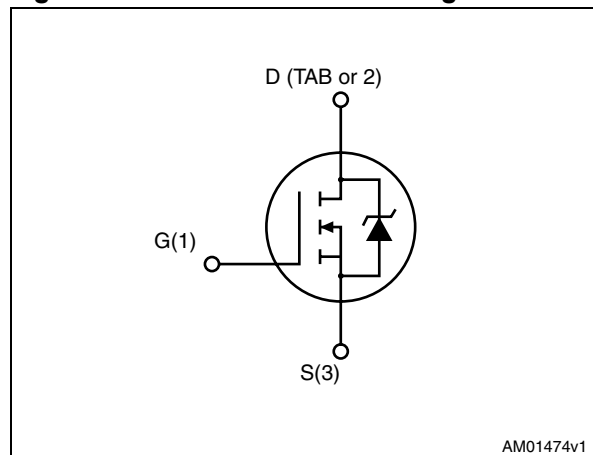


Table 1. Device summary

| Order code | Marking | Package | Packaging     |
|------------|---------|---------|---------------|
| STD55N4F5  | 55N4F5  | DPAK    | Tape and reel |

# Contents

|          |   |           |
|----------|---|-----------|
| <b>1</b> | <b>Electrical ratings</b> .....           | <b>3</b>  |
| <b>2</b> | <b>Electrical characteristics</b> .....   | <b>4</b>  |
| 2.1      | Electrical characteristics (curves) ..... | 6         |
| <b>3</b> | <b>Test circuits</b> .....                | <b>8</b>  |
| <b>4</b> | <b>Package mechanical data</b> .....      | <b>9</b>  |
| <b>5</b> | <b>Packaging mechanical data</b> .....    | <b>11</b> |
| <b>6</b> | <b>Revision history</b> .....             | <b>12</b> |

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol             | Parameter   | Value       | Unit                |
|--------------------|---|-------------|---------------------|
| $V_{DS}$           | Drain-source voltage ( $V_{GS}=0$ )                             | 40          | V                   |
| $V_{GS}$           | Gate-source voltage   | $\pm 20$    | V                   |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$  | 55          | A                   |
| $I_D$              | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 39          | A                   |
| $I_{DM}^{(2)}$     | Drain current (pulsed)  | 220         | A                   |
| $P_{TOT}$          | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$           | 60          | W                   |
|                    | Derating factor   | 0.4         | W/ $^\circ\text{C}$ |
| $dv/dt^{(3)}$      | Peak diode recovery voltage slope                               | 15          | V/ns                |
| $E_{AS}^{(4)}$     | Single pulse avalanche energy                                   | 100         | mJ                  |
| $T_j$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature           | - 55 to 175 | $^\circ\text{C}$    |

1. Current limited by package
2. Pulse width limited by safe operating area
3.  $I_{SD} \leq 55\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{jmax}$
4. Starting  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = 27.5\text{ A}$ ,  $V_{DD} = 25\text{ V}$

**Table 3. Thermal resistance**

| Symbol              | Parameter                               | Value | Unit                      |
|---------------------|---|-------|---------------------------|
| $R_{thj-case}$      | Thermal resistance junction-case max    | 2.5   | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-ambient max | 50    | $^\circ\text{C}/\text{W}$ |

1. When mounted on 1inch<sup>2</sup> FR-4 2Oz Cu board

## 2 Electrical characteristics

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

**Table 4. Static**

| Symbol        | Parameter  | Test conditions  | Min. | Typ. | Max.    | Unit               |
|---------------|--|--|------|------|---------|--------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 250\ \mu A, V_{GS} = 0$   | 40   |      |         | 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>10 | $\mu A$<br>$\mu A$ |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$   |      |      | 100     | nA                 |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}, I_D = 250\ \mu A$  | 2    |      | 4       | V                  |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}, I_D = 27.5\text{ A}$  |      | 7.3  | 8.5     | m $\Omega$         |

**Table 5. Dynamic**

| Symbol    | Parameter                    | Test conditions                                      | Min | Typ. | Max. | Unit |
|-----------|------------------------------|--|-----|------|------|------|
| $C_{iss}$ | Input capacitance            | $V_{DS} = 25\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$ | -   | 1600 | -    | pF   |
| $C_{oss}$ | Output capacitance           |  |     | 230  |      | pF   |
| $C_{rss}$ | Reverse transfer capacitance |  |     | 30   |      | pF   |
| $Q_g$     | Total gate charge            | $V_{DD} = 20\text{ V}, I_D = 27.5\text{ A}$          | -   | 25   | -    | nC   |
| $Q_{gs}$  | Gate-source charge           | $V_{GS} = 10\text{ V}$                               |     | 7    |      | nC   |
| $Q_{gd}$  | Gate-drain charge            | <a href="#">Figure 14</a>                            |     | 6    |      | nC   |

**Table 6. Switching on/off (resistive load)**

| Symbol                | Parameter                        | Test conditions  | Min. | Typ.     | Max. | Unit     |
|-----------------------|----------------------------------|--|------|----------|------|----------|
| $t_{d(on)}$<br>$t_r$  | Turn-on delay time<br>Rise time  | $V_{DD}=20\text{ V}$ , $I_D=27.5\text{ A}$ ,<br>$R_G=4.7\ \Omega$ , $V_{GS}=10\text{ V}$<br><i>Figure 16</i> | -    | 15<br>15 | -    | ns<br>ns |
| $t_{d(off)}$<br>$t_f$ | Turn-off delay time<br>Fall time | $V_{DD}=20\text{ V}$ , $I_D=27.5\text{ A}$ ,<br>$R_G=4.7\ \Omega$ , $V_{GS}=10\text{ V}$<br><i>Figure 16</i> | -    | 25<br>6  | -    | ns<br>ns |

**Table 7. Source drain diode**

| Symbol          | Parameter                     | Test conditions  | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|------|
| $I_{SD}$        | Source-drain current          |  | -    |      | 55   | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |  | -    |      | 220  | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD}=55\text{ A}$ , $V_{GS}=0$  | -    |      | 1.5  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD}=55\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 32\text{ V}$ , $T_j=150\text{ }^\circ\text{C}$<br><i>Figure 15</i> | -    | 40   |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |  | -    | 55   |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |  | -    | 3    |      | 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

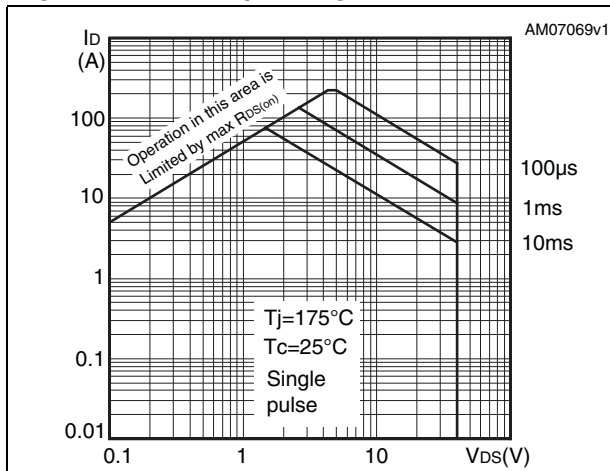


Figure 3. Thermal impedance

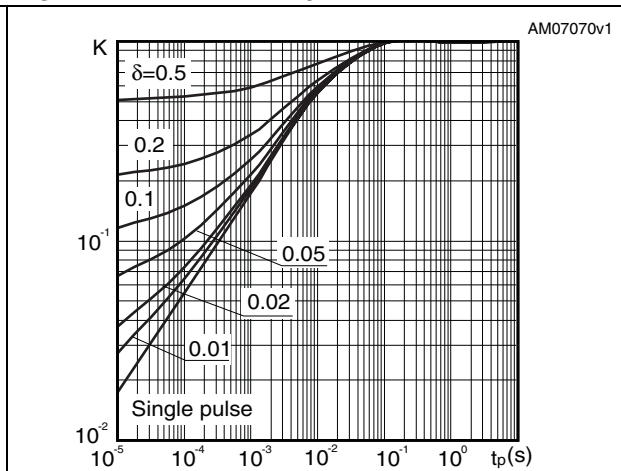


Figure 4. Output characteristics

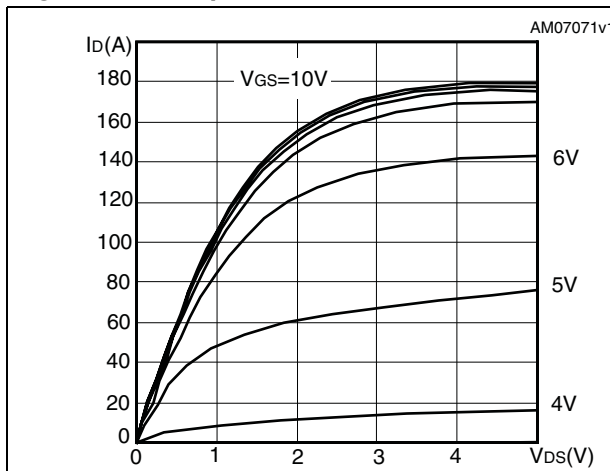


Figure 5. Transfer characteristics

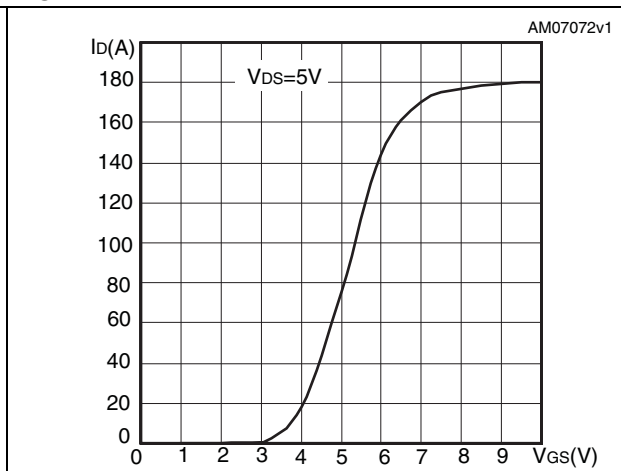


Figure 6. Normalized  $B_{V_{DS}}$  vs temperature

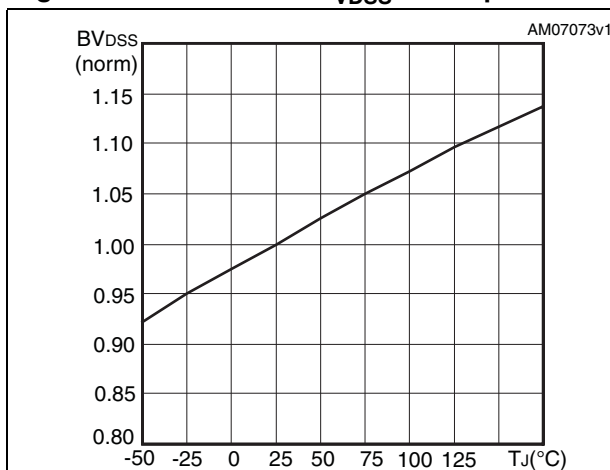


Figure 7. Static drain-source on resistance

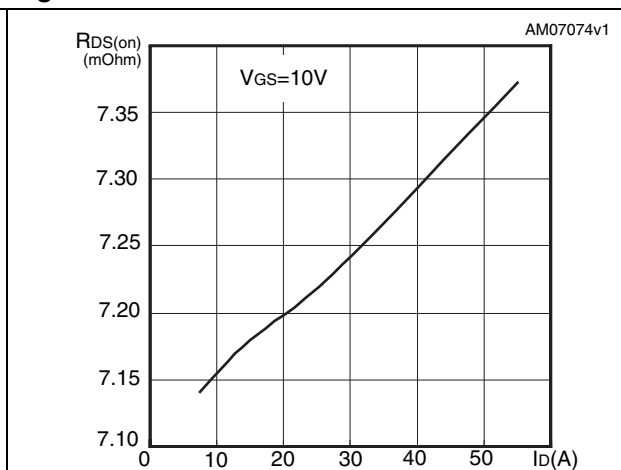


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

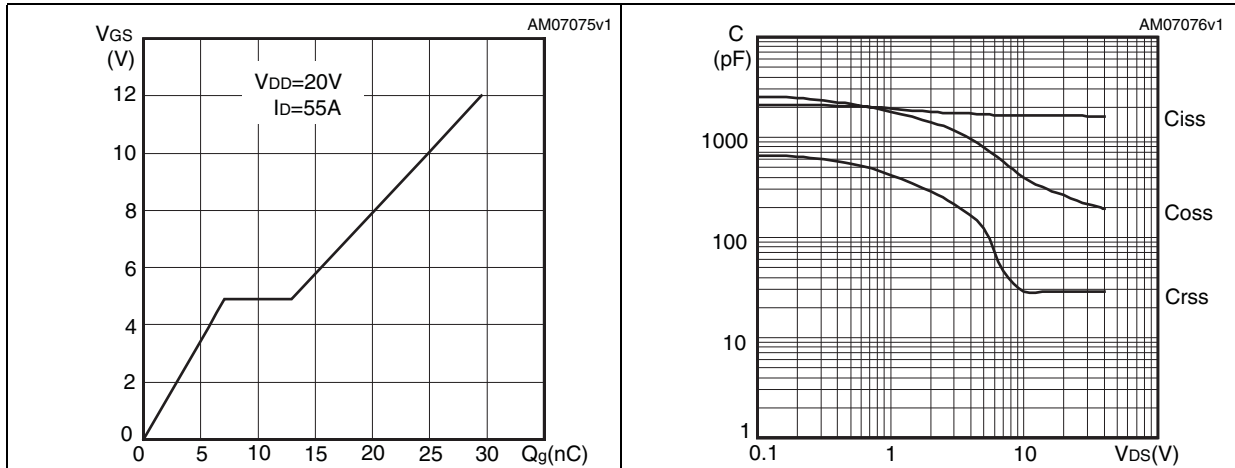


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

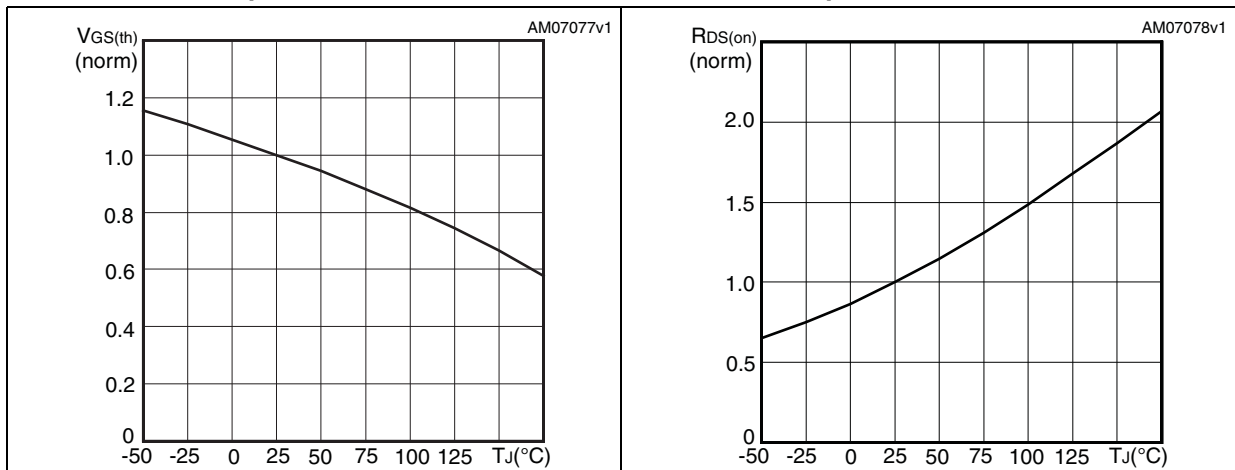
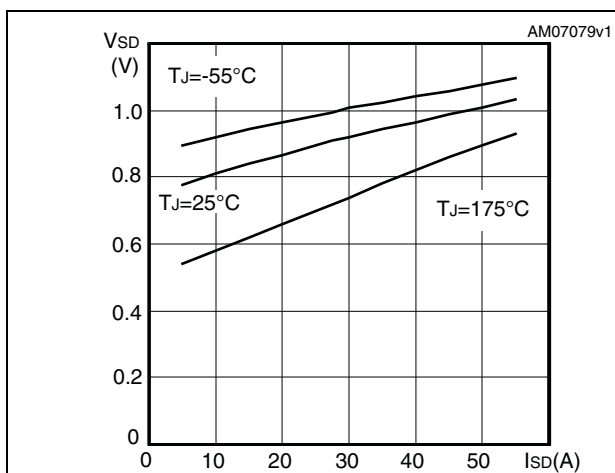
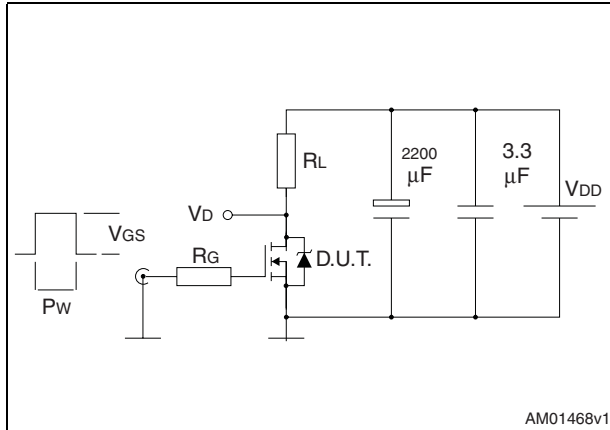


Figure 12. Source-drain diode forward characteristics

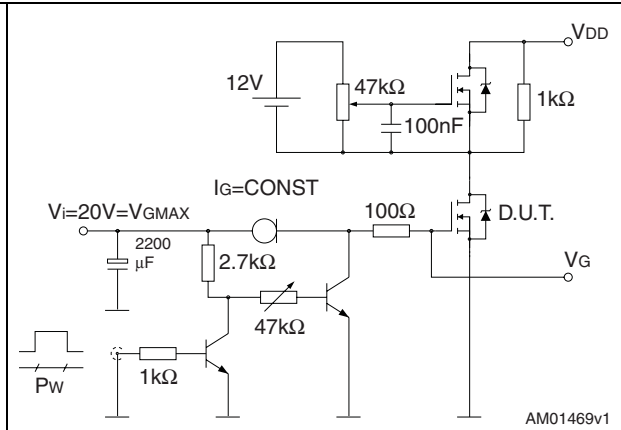


### 3 Test circuits

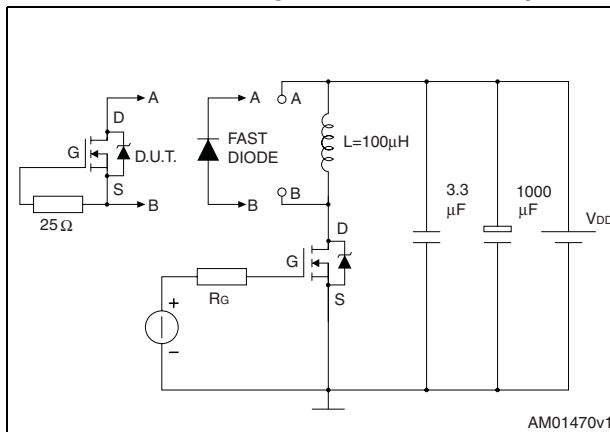
**Figure 13. Switching times test circuit for resistive load**



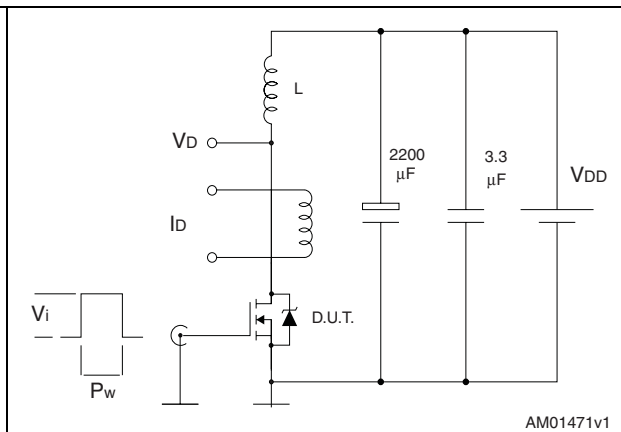
**Figure 14. Gate charge test circuit**



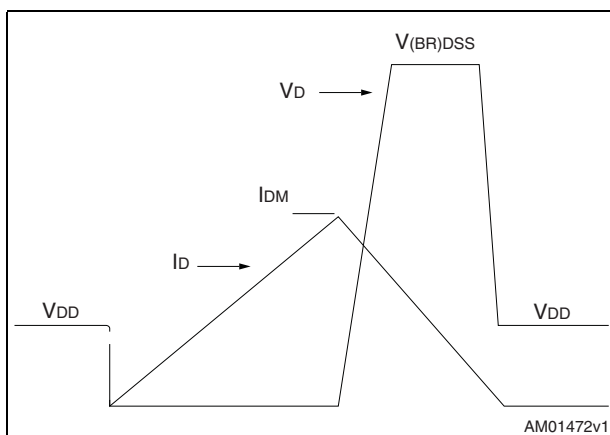
**Figure 15. Test circuit for inductive load switching and diode recovery times**



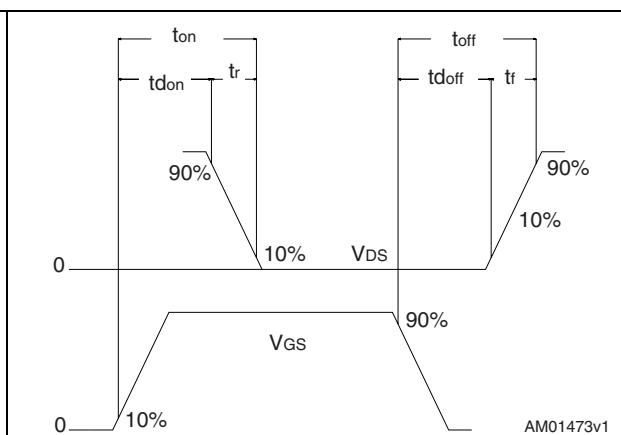
**Figure 16. Unclamped inductive load test circuit**



**Figure 17. Unclamped inductive waveform**



**Figure 18. Switching time waveform**



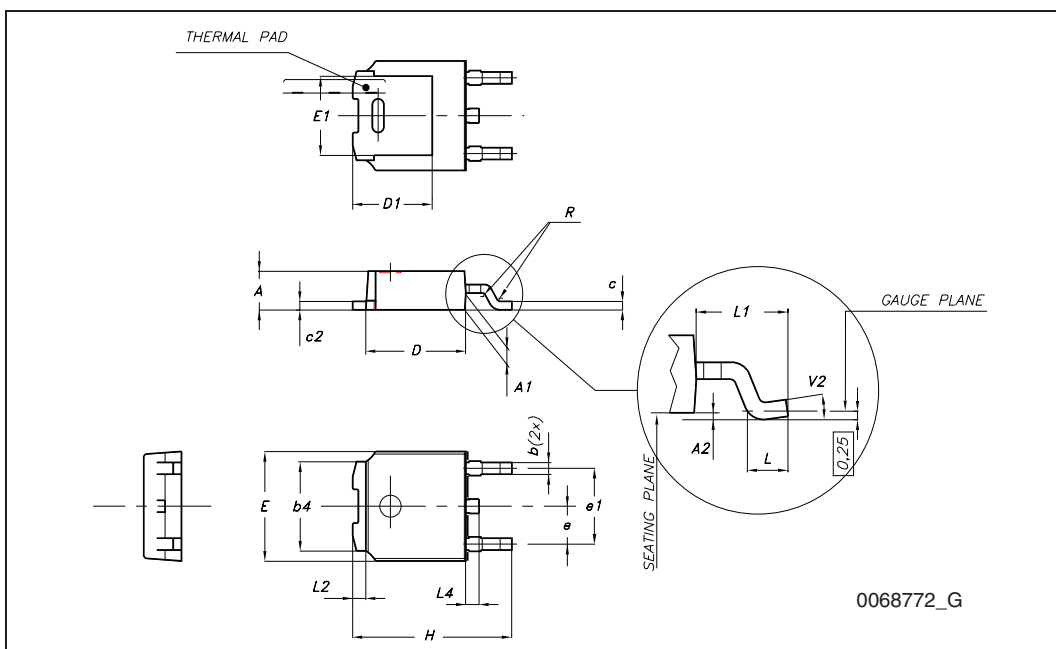


## 4 Package mechanical data

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.

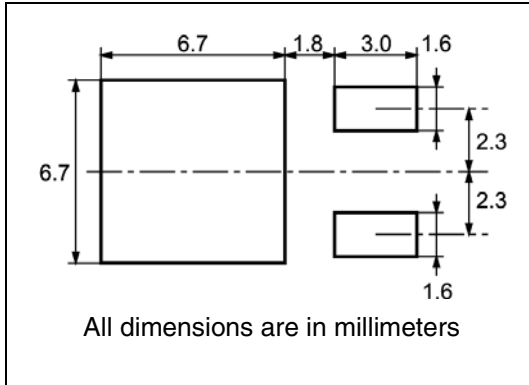
TO-252 (DPAK) mechanical data

| DIM. | mm.  |      |       |
|------|------|------|-------|
|      | min. | typ  | max.  |
| A    | 2.20 |      | 2.40  |
| A1   | 0.90 |      | 1.10  |
| A2   | 0.03 |      | 0.23  |
| b    | 0.64 |      | 0.90  |
| b4   | 5.20 |      | 5.40  |
| c    | 0.45 |      | 0.60  |
| c2   | 0.48 |      | 0.60  |
| D    | 6.00 |      | 6.20  |
| D1   |      | 5.10 |       |
| E    | 6.40 |      | 6.60  |
| E1   |      | 4.70 |       |
| e    |      | 2.28 |       |
| e1   | 4.40 |      | 4.60  |
| H    | 9.35 |      | 10.10 |
| L    | 1    |      |       |
| L1   |      | 2.80 |       |
| L2   |      | 0.80 |       |
| L4   | 0.60 |      | 1     |
| R    |      | 0.20 |       |
| V2   | 0°   |      | 8°    |



# 5 Packaging mechanical data

## DPAK FOOTPRINT



## TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

G measured at hub

### REEL MECHANICAL DATA

| DIM. | mm   |      | inch  |        |
|------|------|------|-------|--------|
|      | MIN. | MAX. | MIN.  | MAX.   |
| A    |      | 330  |       | 12.992 |
| B    | 1.5  |      | 0.059 |        |
| C    | 12.8 | 13.2 | 0.504 | 0.520  |
| D    | 20.2 |      | 0.795 |        |
| G    | 16.4 | 18.4 | 0.645 | 0.724  |
| N    | 50   |      | 1.968 |        |
| T    |      | 22.4 |       | 0.881  |

### TAPE MECHANICAL DATA

| DIM. | mm   |      | inch  |       |
|------|------|------|-------|-------|
|      | MIN. | MAX. | MIN.  | MAX.  |
| A0   | 6.8  | 7    | 0.267 | 0.275 |
| B0   | 10.4 | 10.6 | 0.409 | 0.417 |
| B1   |      | 12.1 |       | 0.476 |
| D    | 1.5  | 1.6  | 0.059 | 0.063 |
| D1   | 1.5  |      | 0.059 |       |
| E    | 1.65 | 1.85 | 0.065 | 0.073 |
| F    | 7.4  | 7.6  | 0.291 | 0.299 |
| K0   | 2.55 | 2.75 | 0.100 | 0.108 |
| P0   | 3.9  | 4.1  | 0.153 | 0.161 |
| P1   | 7.9  | 8.1  | 0.311 | 0.319 |
| P2   | 1.9  | 2.1  | 0.075 | 0.082 |
| R    | 40   |      | 1.574 |       |
| W    | 15.7 | 16.3 | 0.618 | 0.641 |

TOP COVER TAPE

User Direction of Feed

Center line of cavity

Bending radius R min.

For machine ref. only including draft and radii concentric around B0

10 pitches cumulative tolerance on tape +/- 0.2 mm

FEED DIRECTION

TRL

## 6 Revision history

**Table 8. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 06-May-2009 | 1        | First release  |
| 10-Jul-2009 | 2        | – Document status promoted from target specification to preliminary data<br>– $R_{DS(on)}$ max value changed |
| 22-Jun-2010 | 3        | Document status promoted from preliminary data to datasheet  |

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