



# STD60NF55LA

N-channel 55 V, 0.012  $\Omega$ , 60 A DPAK  
STripFET™ II Power MOSFET

## Features

| Order code  | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-------------|------------------|---------------------|----------------|
| STD60NF55LA | 55V              | <0.015 $\Omega$     | 60A            |

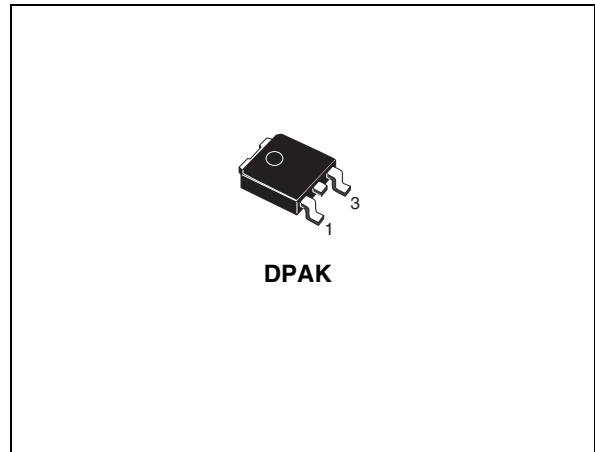
- Low threshold drive

## Applications

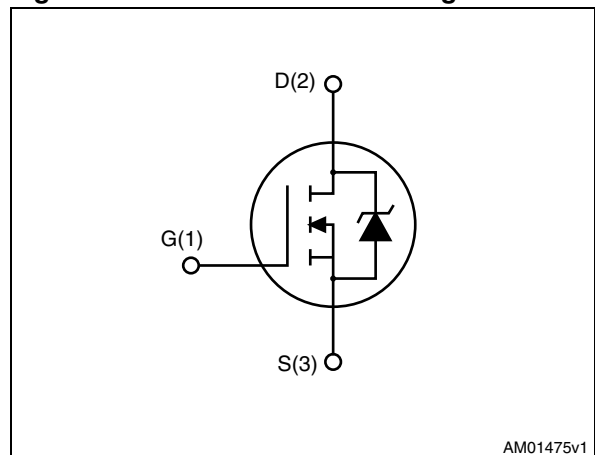
- Switching application
- Automotive

## Description

This Power MOSFET has been developed using STMicroelectronics' unique STripFET process, which is specifically designed to minimize input capacitance and gate charge. This renders the device suitable for use as primary switch in advanced high-efficiency isolated DC-DC converters for telecom and computer applications, and applications with low gate charge driving requirements.



**Figure 1. Internal schematic diagram**



**Table 1. Device summary**

| Order code  | Marking   | Package | Packaging     |
|-------------|-----------|---------|---------------|
| STD60NF55LA | D60NF55LA | DPAK    | Tape and reel |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol         | Parameter                                                         | Value      | Unit                  |
|----------------|-------------------------------------------------------------------|------------|-----------------------|
| $V_{DS}$       | Drain-source voltage                                              | 55         | V                     |
| $V_{GS}$       | Gate- source voltage                                              | $\pm 15$   | V                     |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$  | 60         | A                     |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$ | 42         | A                     |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                            | 240        | A                     |
| $P_{tot}$      | Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$           | 110        | W                     |
|                | Derating factor                                                   | 0.73       | W/ $^{\circ}\text{C}$ |
| $dv/dt^{(2)}$  | Peak diode recovery voltage slope                                 | 16         | V/ns                  |
| $E_{AS}^{(3)}$ | Single pulse avalanche energy                                     | 400        | mJ                    |
| $T_{stg}$      | Storage temperature                                               | -55 to 175 | $^{\circ}\text{C}$    |
| $T_j$          | Max. operating junction temperature                               |            |                       |

1. Pulse width limited by safe operating area.

2.  $I_{SD} \leq 40\text{ A}$ ,  $di/dt \leq 350\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{JMAX}$ .

3. Starting  $T_j = 25\text{ }^{\circ}\text{C}$ ,  $I_D = 17.5\text{ A}$ ,  $V_{DD} = 24\text{ V}$

**Table 3. Thermal data**

| Symbol         | Parameter                                  | Value | Unit                        |
|----------------|--------------------------------------------|-------|-----------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max       | 1.36  | $^{\circ}\text{C}/\text{W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-to ambient max | 100   | $^{\circ}\text{C}/\text{W}$ |

## 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                   | $I_D = 250\ \mu\text{A}$ , $V_{GS} = 0$                                                                    | 55   |                |                | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 55\ \text{V}$<br>$V_{DS} = 55\ \text{V}$ , $T_C = 125^{\circ}\text{C}$                           |      |                | 1<br>10        | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 15\ \text{V}$                                                                                |      |                | $\pm 100$      | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$                                                               | 1    |                | 2              | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\ \text{V}$ , $I_D = 30\ \text{A}$<br>$V_{GS} = 5\ \text{V}$ , $I_D = 30\ \text{A}$            |      | 0.012<br>0.014 | 0.015<br>0.017 | $\Omega$<br>$\Omega$           |
| $I_{D(on)}$   | On state drain current                           | $V_{GS} = 3.5\ \text{V}$ , $V_{DS} \geq 12\ \text{V}$<br>$-55^{\circ}\text{C} < T_J < 150^{\circ}\text{C}$ | 35   |                |                | A                              |

**Table 5. Dynamic**

| Symbol                                        | Parameter                                                               | Test conditions                                                                                                                      | Min. | Typ.                  | Max. | Unit                 |
|-----------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------|------|----------------------|
| $g_{fs}^{(1)}$                                | Forward transconductance                                                | $V_{DS} = 10\ \text{V}$ , $I_D = 30\ \text{A}$                                                                                       | -    | 35                    |      | S                    |
| $C_{iss}$<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>$V_{GS} = 0$                                                                      | -    | 1950<br>390<br>130    |      | pF<br>pF<br>pF       |
| $t_{d(on)}$<br>$t_r$<br>$t_{d(off)}$<br>$t_f$ | Turn-on delay time<br>Rise time<br>Turn-off delay time<br>Fall time     | $V_{DD} = 25\ \text{V}$ , $I_D = 30\ \text{A}$<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 4.5\ \text{V}$<br>(see <a href="#">Figure 14</a> ) | -    | 30<br>180<br>80<br>35 |      | ns<br>ns<br>ns<br>ns |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$                 | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 40\ \text{V}$ , $I_D = 60\ \text{A}$ ,<br>$V_{GS} = 5\ \text{V}$ , $R_G = 4.7\ \Omega$<br>(see <a href="#">Figure 15</a> ) | -    | 40<br>10<br>20        | 56   | nC<br>nC<br>nC       |

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

**Table 6. 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)                     |                                                                                                                                                                    | -    |                | 60<br>240 | A<br>A        |
| $V_{SD}^{(2)}$                    | Forward on voltage                                                           | $I_{SD} = 60\text{ A}$ , $V_{GS} = 0$                                                                                                                              | -    |                | 1.3       | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 40\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 25\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 16</a> ) | -    | 65<br>130<br>4 |           | 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

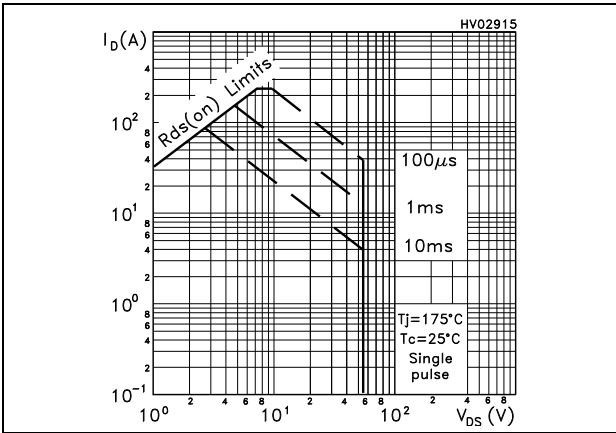


Figure 3. Thermal impedance

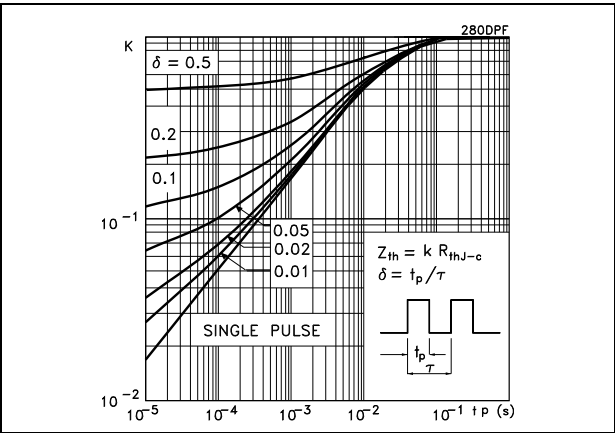


Figure 4. Output characteristics

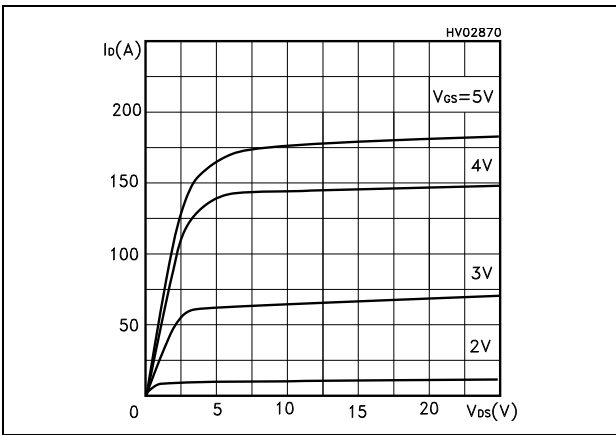


Figure 5. Transfer characteristics

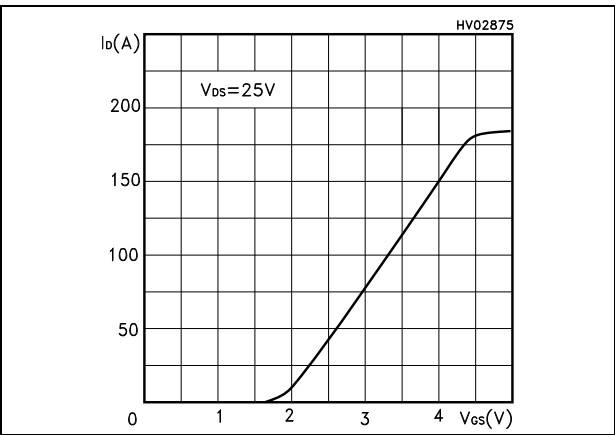


Figure 6. Transconductance

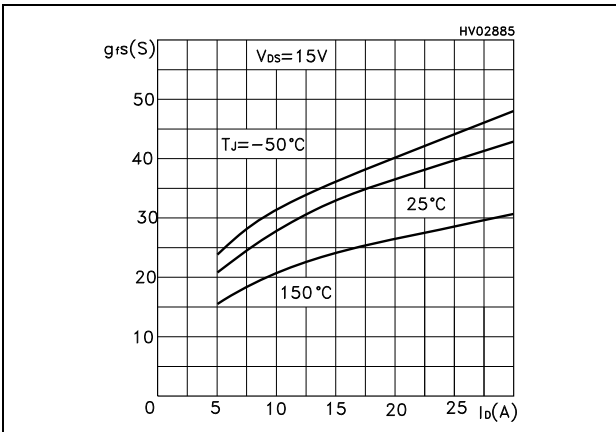


Figure 7. Static drain-source on resistance

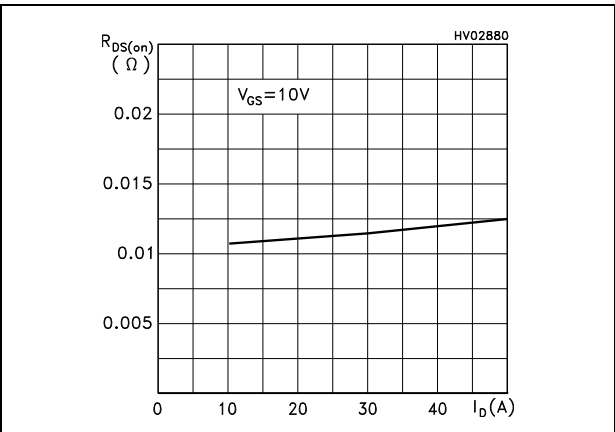


Figure 8. Gate charge vs gate-source voltage    Figure 9. Capacitance variations

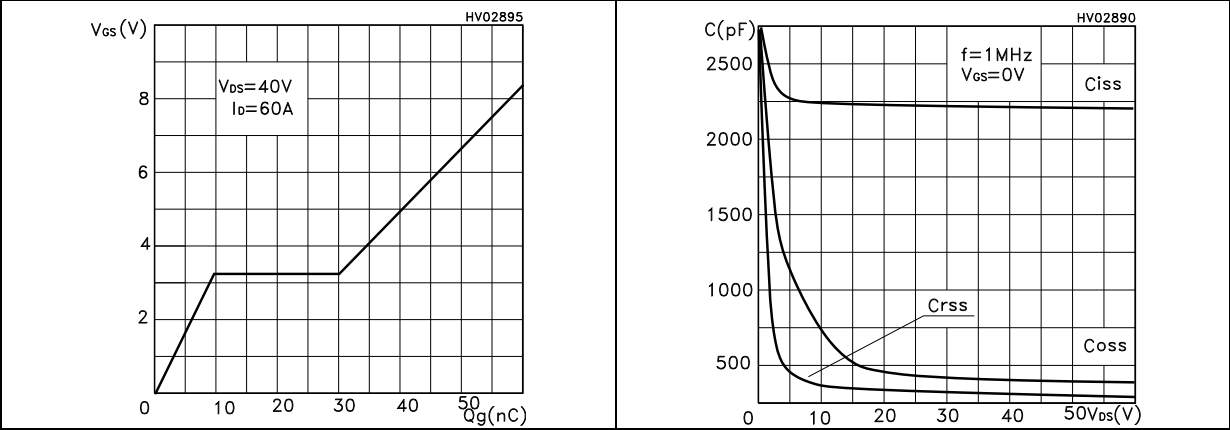


Figure 10. Normalized gate threshold voltage vs temperature    Figure 11. Normalized on resistance vs temperature

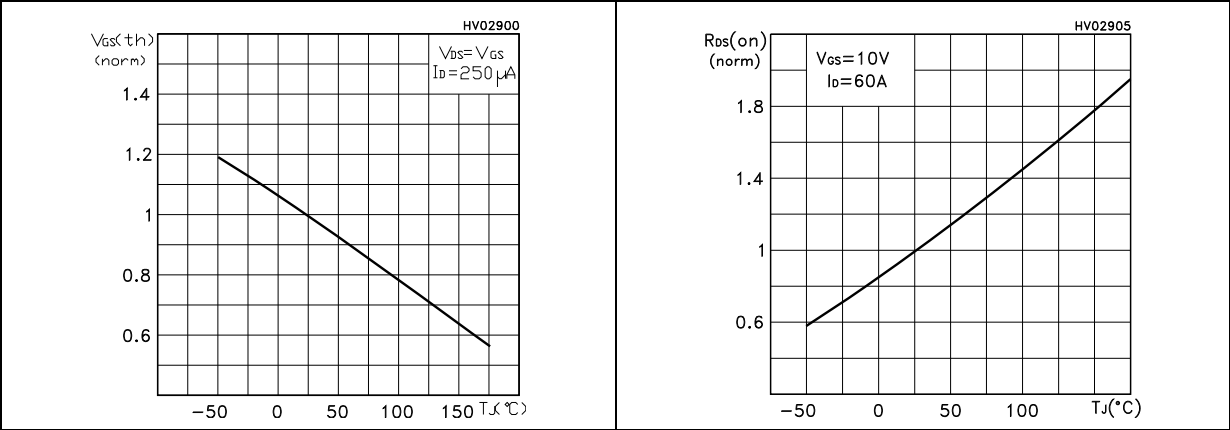


Figure 12. Source-drain diode forward characteristics

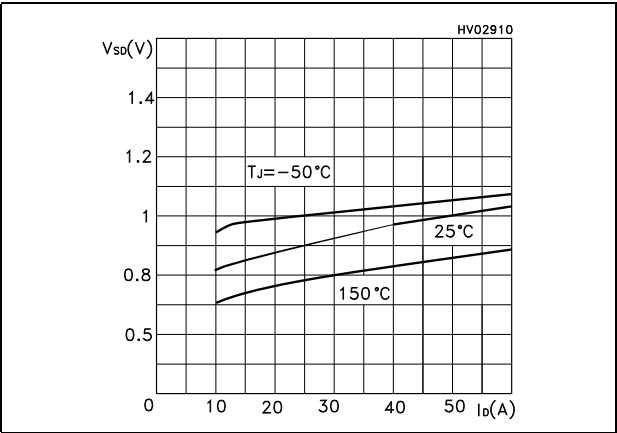
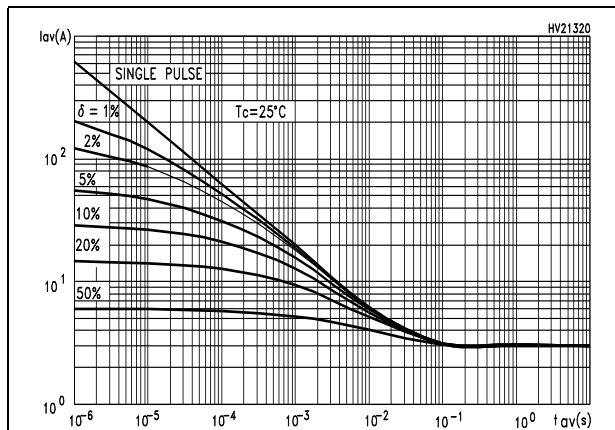


Figure 13. Allowable  $I_{AV}$  vs time in avalanche

The previous curve gives the safe operating area for unclamped inductive loads, single pulse or repetitive, under the following conditions:

$$P_{D(AVE)} = 0.5 * (1.3 * BV_{DSS} * I_{AV})$$

$$E_{AS(AR)} = P_{D(AVE)} * t_{AV}$$

Where:

$I_{AV}$  is the allowable current in avalanche,

$P_{D(AVE)}$  is the average power dissipation in avalanche (single pulse)

$t_{AV}$  is the time in avalanche.

To derate above 25°C, at fixed  $I_{AV}$ , the following equation must be applied:

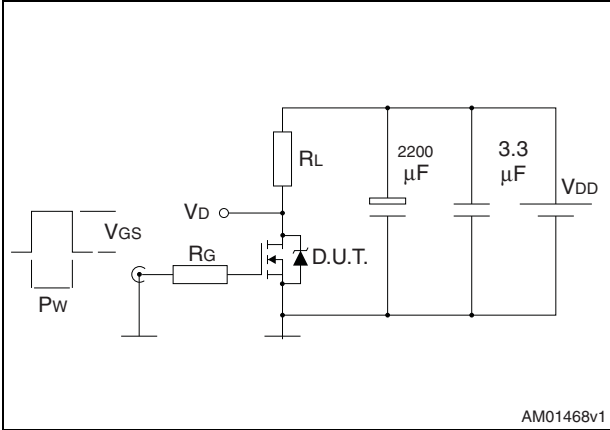
$$I_{AV} = 2 * (T_{jmax} - T_{CASE}) / (1.3 * BV_{DSS} * Z_{th})$$

Where:

$Z_{th} = K * R_{th}$  is the value coming from normalized thermal response at fixed pulse width equal to  $T_{AV}$

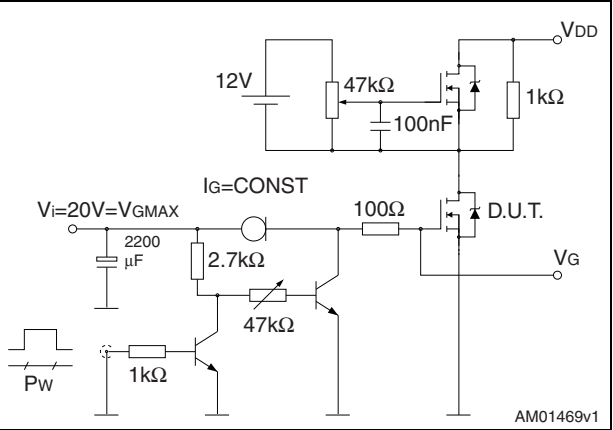
# 3 Test circuit

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



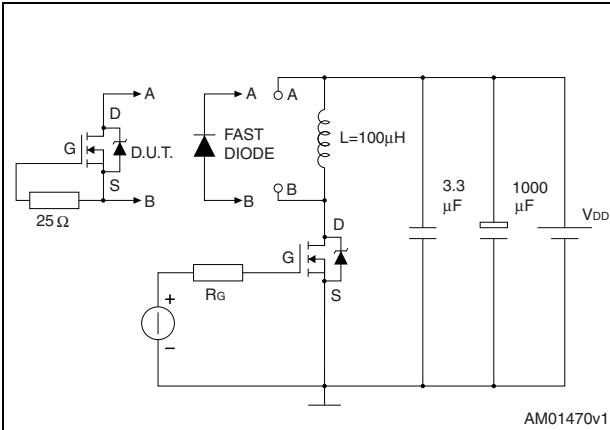
AM01468v1

**Figure 15. Gate charge test circuit**



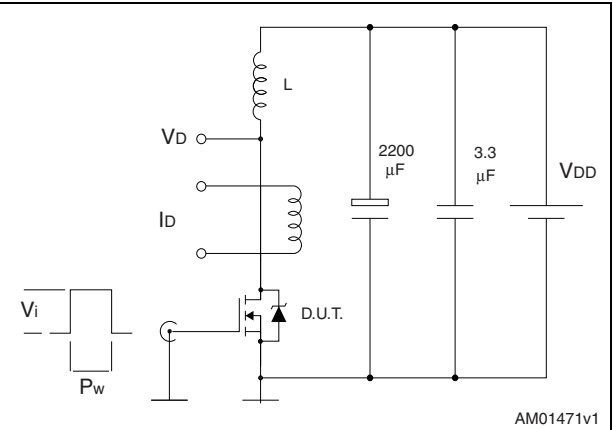
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**Figure 16. Test circuit for inductive load switching and diode recovery times**



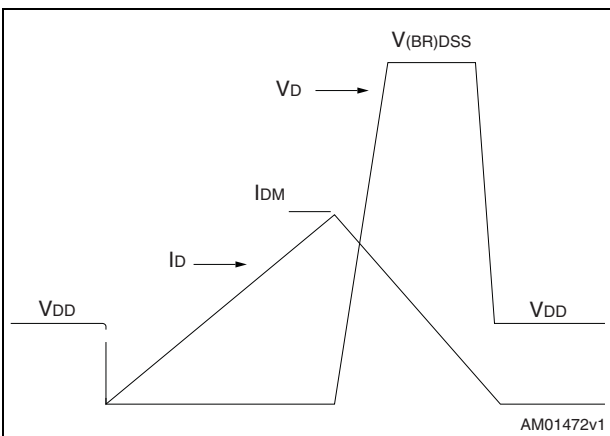
AM01470v1

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



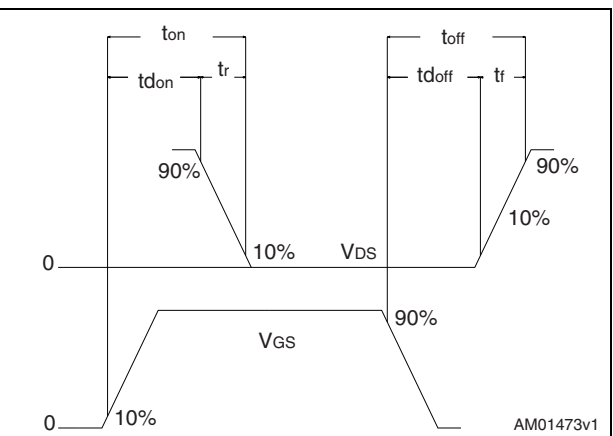
AM01471v1

**Figure 18. Unclamped inductive waveform**



AM01472v1

**Figure 19. Switching time waveform**



AM01473v1

## 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.

Table 7. DPAK (TO-252) 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    |      | 1.50  |
| L1   |      | 2.80 |       |
| L2   |      | 0.80 |       |
| L4   | 0.60 |      | 1     |
| R    |      | 0.20 |       |
| V2   | 0°   |      | 8°    |

Figure 20. DPAK (TO-252) drawing

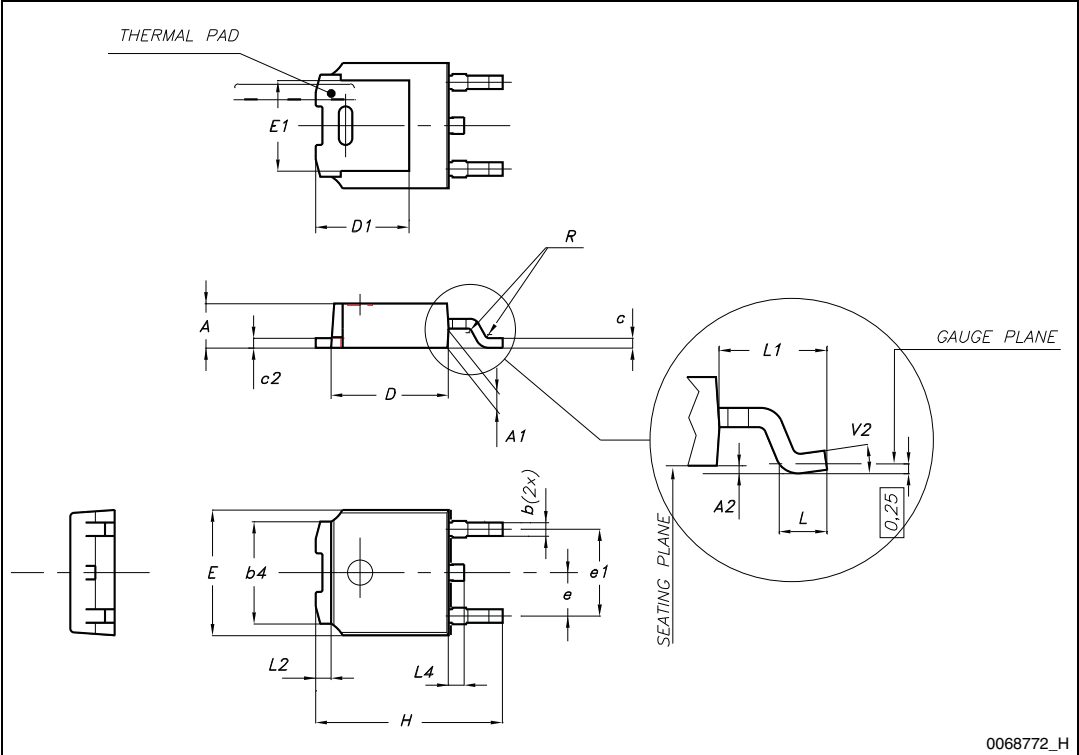
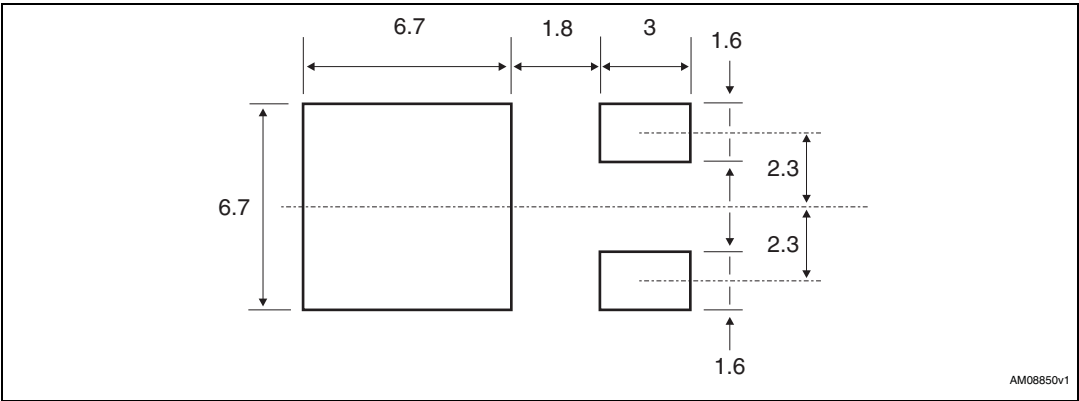


Figure 21. DPAK footprint<sup>(a)</sup>



a. All dimension are in millimeters

## 5 Packing mechanical data

**Table 8. DPAK (TO-252) tape and reel mechanical data**

| Tape |      |      | Reel      |      |      |
|------|------|------|-----------|------|------|
| Dim. | mm   |      | Dim.      | mm   |      |
|      | Min. | Max. |           | Min. | Max. |
| A0   | 6.8  | 7    | A         |      | 330  |
| B0   | 10.4 | 10.6 | B         | 1.5  |      |
| B1   |      | 12.1 | C         | 12.8 | 13.2 |
| D    | 1.5  | 1.6  | D         | 20.2 |      |
| D1   | 1.5  |      | G         | 16.4 | 18.4 |
| E    | 1.65 | 1.85 | N         | 50   |      |
| F    | 7.4  | 7.6  | T         |      | 22.4 |
| K0   | 2.55 | 2.75 |           |      |      |
| P0   | 3.9  | 4.1  | Base qty. |      | 2500 |
| P1   | 7.9  | 8.1  | Bulk qty. |      | 2500 |
| P2   | 1.9  | 2.1  |           |      |      |
| R    | 40   |      |           |      |      |
| T    | 0.25 | 0.35 |           |      |      |
| W    | 15.7 | 16.3 |           |      |      |

Figure 22. Tape for DPAK (TO-252)

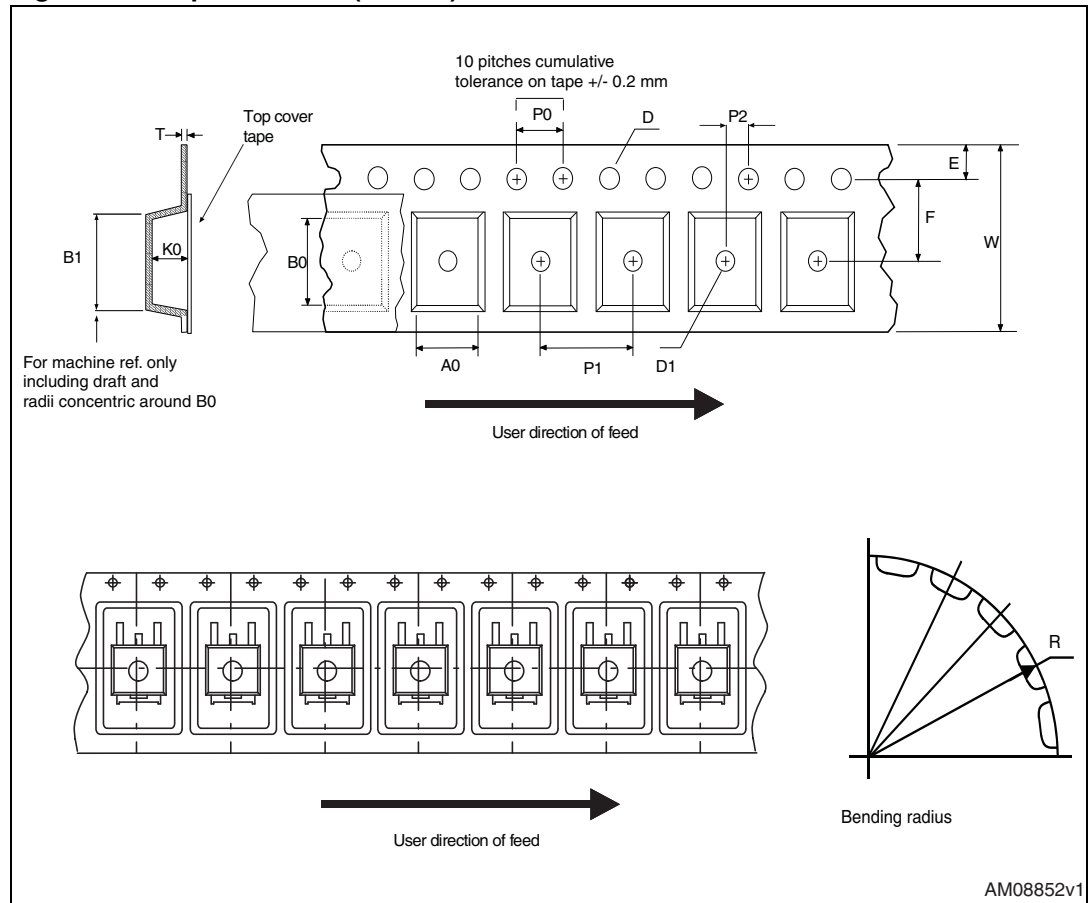
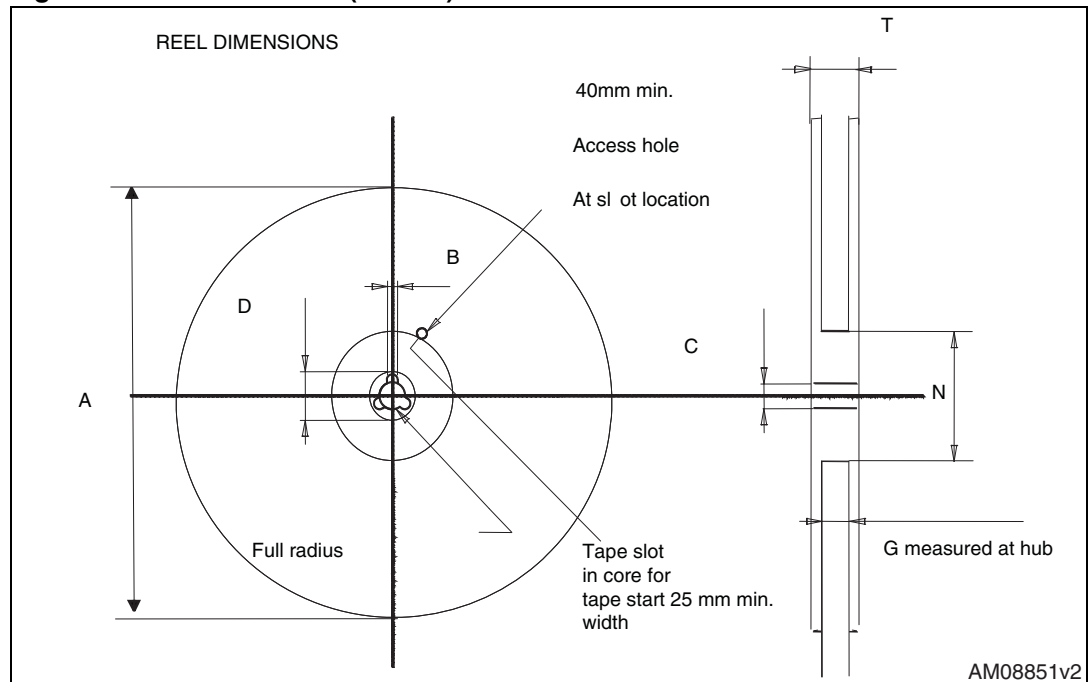


Figure 23. Reel for DPAK (TO-252)



## 6 Revision history

**Table 9. Revision history**

| Date        | Revision | Changes                                                               |
|-------------|----------|-----------------------------------------------------------------------|
| 11-May-2005 | 1        | First release                                                         |
| 31-Jan-2006 | 2        | New template                                                          |
| 05-Oct-2011 | 3        | <i>Section : Applications</i> has been modified<br>Minor text changes |

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