



# STD75N3LLH6, STP75N3LLH6 STU75N3LLH6, STU75N3LLH6-S

N-channel 30 V, 0.0042  $\Omega$ , 75 A, DPAK, TO-220, IPAK, Short IPAK  
STripFET™ VI DeepGATE™ Power MOSFET

## Features

| Order codes   | V <sub>DSS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> |
|---------------|------------------|-------------------------|----------------|
| STD75N3LLH6   | 30 V             | < 0.0055 Ω              | 75 A           |
| STP75N3LLH6   |                  | < 0.0059 Ω              |                |
| STU75N3LLH6   |                  |                         |                |
| STU75N3LLH6-S |                  |                         |                |

- R<sub>DS(on)</sub> \* Q<sub>g</sub> industry benchmark
- Extremely low on-resistance R<sub>DS(on)</sub>
- High avalanche ruggedness
- Low gate drive power losses

## Application

Switching applications

## Description

This N-Channel Power MOSFET product utilizes the 6<sup>th</sup> generation of design rules of ST's proprietary STripFET™ technology, with a new gate structure. The resulting Power MOSFET exhibits the lowest R<sub>DS(on)</sub> in all packages.

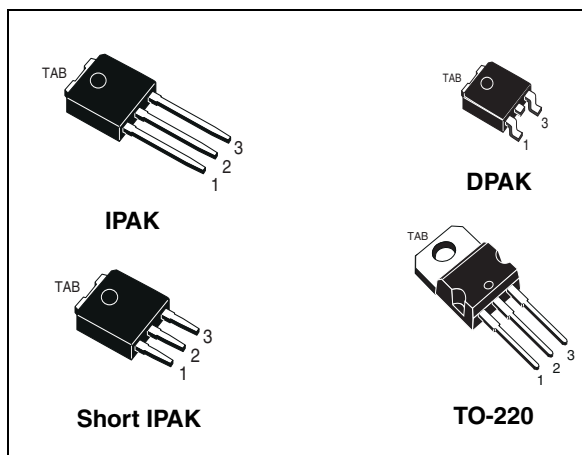


Figure 1. Internal schematic diagram

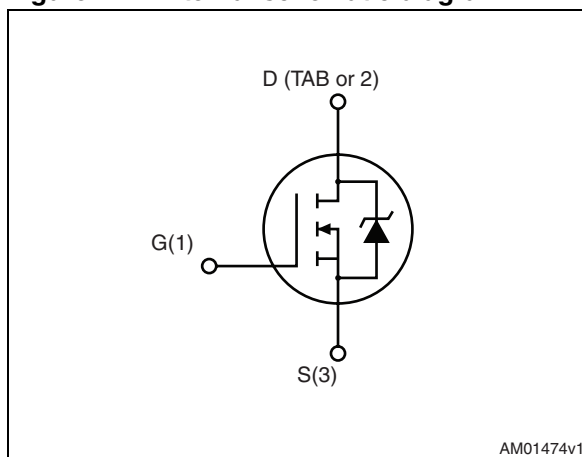


Table 1. Device summary

| Order codes   | Marking  | Package    | Packaging     |
|---------------|----------|------------|---------------|
| STD75N3LLH6   | 75N3LLH6 | DPAK       | Tape and reel |
| STP75N3LLH6   |          | TO-220     | Tube          |
| STU75N3LLH6   |          | IPAK       |               |
| STU75N3LLH6-S |          | Short IPAK |               |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol             | Parameter                                                         | Value      | Unit                  |
|--------------------|-------------------------------------------------------------------|------------|-----------------------|
| $V_{DS}$           | Drain-source voltage ( $V_{GS} = 0$ )                             | 30         | V                     |
| $V_{GS}$           | Gate-source voltage                                               | $\pm 20$   | V                     |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$  | 75         | A                     |
| $I_D$              | Drain current (continuous) at $T_C = 70\text{ }^{\circ}\text{C}$  | 56         | A                     |
| $I_D$              | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$ | 47         | A                     |
| $I_{DM}^{(2)}$     | Drain current (pulsed)                                            | 300        | A                     |
| $P_{TOT}$          | Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$           | 60         | W                     |
|                    | Derating factor                                                   | 0.4        | W/ $^{\circ}\text{C}$ |
| $T_j$<br>$T_{stg}$ | Operating junction temperature<br>storage temperature             | -55 to 175 | $^{\circ}\text{C}$    |

1. The value is rated according to Rthj-case
2. Pulse width limited by safe operating area

**Table 3. Thermal data**

| Symbol                              | Parameter                                               | Value |        |      |            | Unit |
|-------------------------------------|---------------------------------------------------------|-------|--------|------|------------|------|
|                                     |                                                         | DPAK  | TO-220 | IPAK | Short IPAK |      |
| R <sub>thj-case</sub>               | Thermal resistance junction-case (drain) (steady state) | 2.5   |        |      |            | °C/W |
| R <sub>thj-amb</sub>                | Thermal resistance junction-amb max                     | 100   | 62.5   | 100  |            | °C/W |
| R <sub>thj-pcb</sub> <sup>(1)</sup> | Thermal resistance junction-pcb max                     | 35    |        |      |            | °C/W |
| T <sub>J</sub>                      | Maximum lead temperature for soldering purpose          | 275   | 300    | 275  |            | °C   |

1. When mounted on FR-4 board of 1in<sup>2</sup>, 2oz Cu. t < 10 sec

## 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 ( $V_{GS} = 0$ )  | $I_D = 250\ \mu\text{A}$                                                         | 30   |        |           | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 30\ \text{V}$<br>$V_{DS} = 30\ \text{V}$ $T_C = 125\ ^{\circ}\text{C}$ |      |        | 1<br>10   | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\ \text{V}$                                                      |      |        | $\pm 100$ | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$                                     | 1    | 1.7    | 2.5       | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\ \text{V}$ , $I_D = 37.5\ \text{A}$<br>SMD version                  |      | 0.0042 | 0.0055    | $\Omega$                       |
|               |                                                  | $V_{GS} = 10\ \text{V}$ , $I_D = 37.5\ \text{A}$                                 |      | 0.0046 | 0.0059    | $\Omega$                       |
|               |                                                  | $V_{GS} = 4.5\ \text{V}$ , $I_D = 37.5\ \text{A}$<br>SMD version                 |      | 0.0065 | 0.008     | $\Omega$                       |
|               |                                                  | $V_{GS} = 4.5\ \text{V}$ , $I_D = 37.5\ \text{A}$                                |      | 0.0069 | 0.0084    | $\Omega$                       |

**Table 5. Dynamic**

| Symbol    | Parameter                           | Test conditions                                                                                                  | Min. | Typ. | Max. | Unit     |
|-----------|-------------------------------------|------------------------------------------------------------------------------------------------------------------|------|------|------|----------|
| $C_{iss}$ | Input capacitance                   | $V_{DS} = 25\ \text{V}$ , $f = 1\ \text{MHz}$ ,<br>$V_{GS} = 0$                                                  | 1350 | 1690 | 2030 | pF       |
| $C_{oss}$ | Output capacitance                  |                                                                                                                  | 230  | 290  | 350  | pF       |
| $C_{rss}$ | Reverse transfer capacitance        |                                                                                                                  | 140  | 176  | 210  | pF       |
| $Q_g$     | Total gate charge                   | $V_{DD} = 15\ \text{V}$ , $I_D = 75\ \text{A}$ ,<br>$V_{GS} = 4.5\ \text{V}$<br>(see <a href="#">Figure 14</a> ) |      | 17   | 23.8 | nC       |
| $Q_{gs}$  | Gate-source charge                  |                                                                                                                  |      | 8    | 11.2 | nC       |
| $Q_{gd}$  | Gate-drain charge                   |                                                                                                                  |      | 6    | 8.4  | nC       |
| $Q_{gs1}$ | Pre $V_{th}$ gate-to-source charge  | $V_{DD} = 15\ \text{V}$ , $I_D = 75\ \text{A}$<br>$V_{GS} = 5\ \text{V}$<br>( <a href="#">Figure 19</a> )        |      | 3.9  | 5.5  | nC       |
| $Q_{gs2}$ | Post $V_{th}$ gate-to-source charge |                                                                                                                  |      | 4.1  | 5.7  | nC       |
| $R_G$     | Gate input resistance               | $f = 1\ \text{MHz}$ gate bias<br>Bias=0 test signal<br>level=20 mV open drain                                    | 1.25 | 1.7  | 2    | $\Omega$ |

**Table 6. Switching times**

| Symbol       | Parameter           | Test conditions                                                                                                                 | Min. | Typ. | Max | Unit |
|--------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------|------|------|-----|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 15\text{ V}$ , $I_D = 37.5\text{ A}$<br>$R_G = 4.7\ \Omega$ $V_{GS} = 5\text{ V}$<br>(see <a href="#">Figure 13</a> ) | -    | 9.5  | -   | ns   |
| $t_r$        | Rise time           |                                                                                                                                 |      | 30   |     | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                                                 |      | 37   |     | ns   |
| $t_f$        | Fall time           |                                                                                                                                 |      | 12   |     | ns   |

**Table 7. Source drain diode**

| Symbol          | Parameter                     | Test conditions                                                                                                                | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                | -    |      | 75   | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                |      |      | 300  | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 37.5\text{ A}$ , $V_{GS} = 0$                                                                                        | -    |      | 1.1  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 75\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 24\text{ V}$<br>(see <a href="#">Figure 15</a> ) | -    | 24   |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                |      | 16.8 |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                |      | 1.4  |      | 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

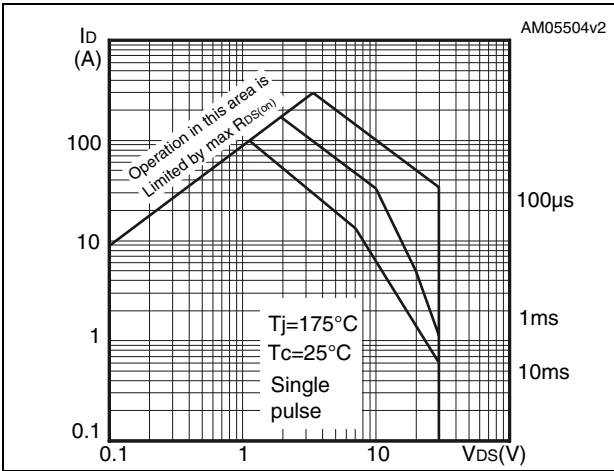


Figure 3. Thermal impedance

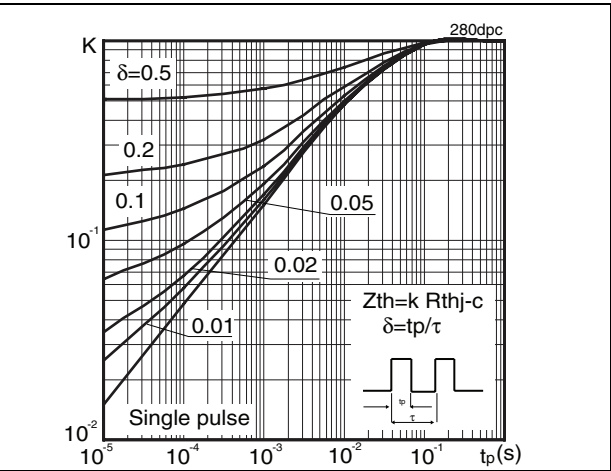


Figure 4. Output characteristics

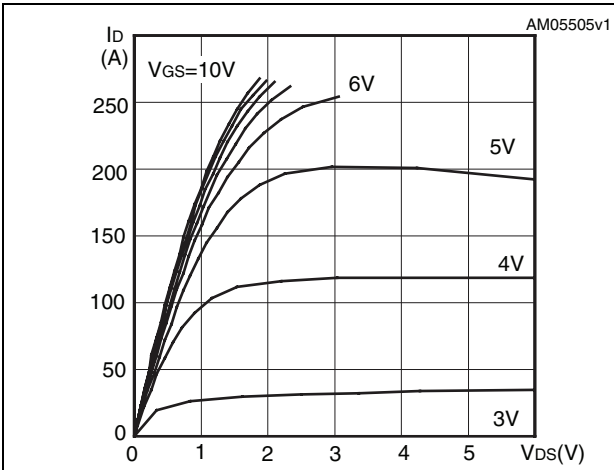


Figure 5. Transfer characteristics

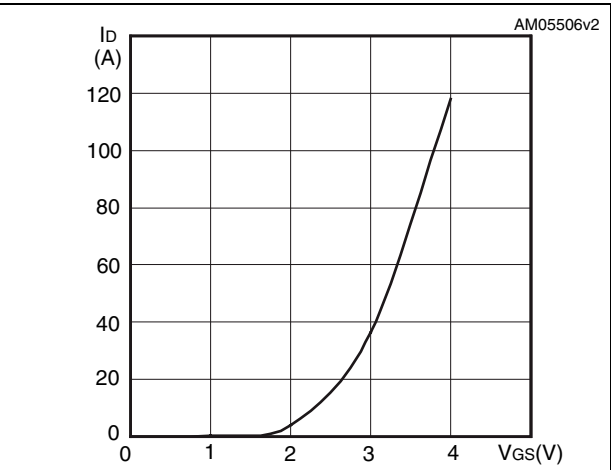


Figure 6. Normalized  $BV_{DSS}$  vs temperature

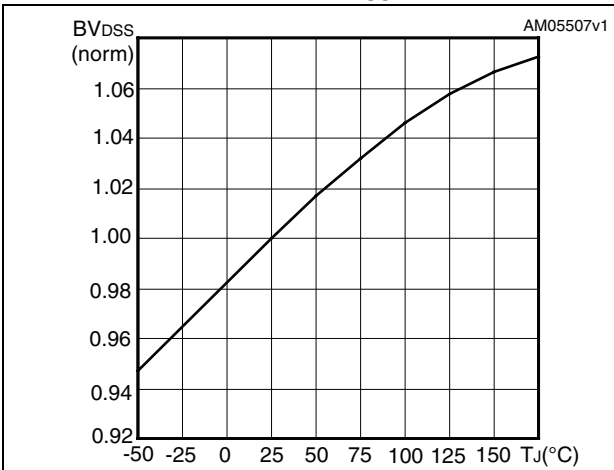


Figure 7. Static drain-source on resistance

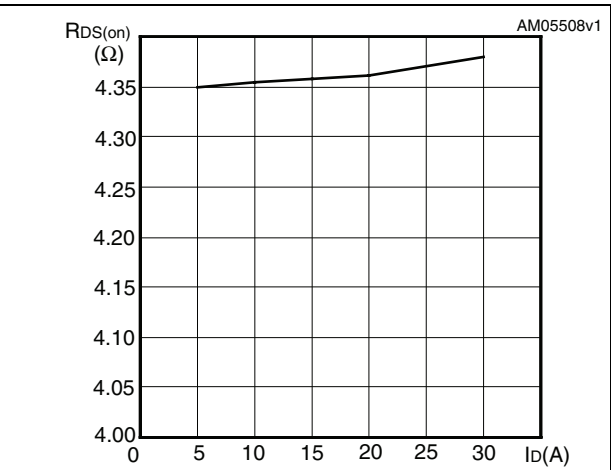


Figure 8. Gate charge vs gate-source voltage

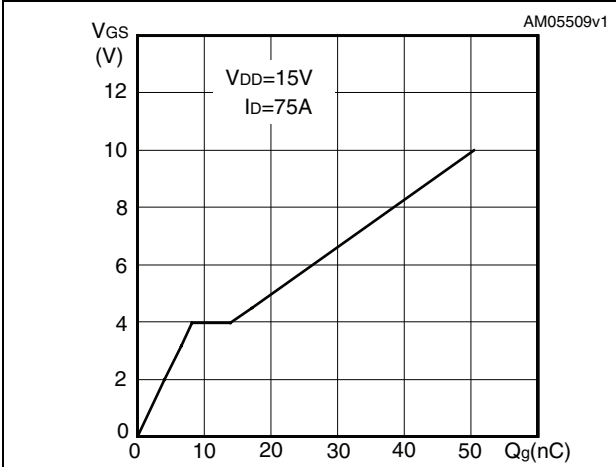


Figure 9. Capacitance variations

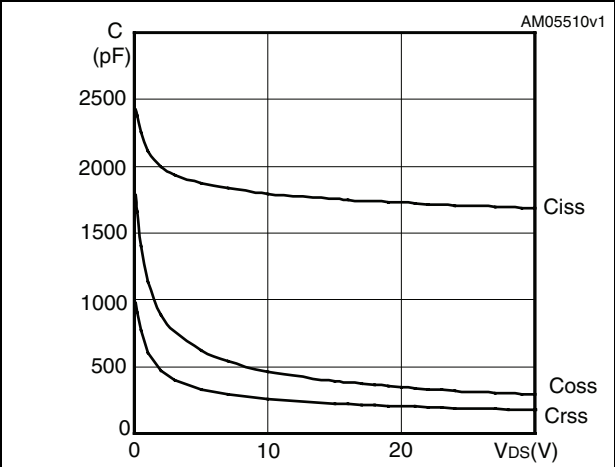


Figure 10. Normalized gate threshold voltage vs temperature

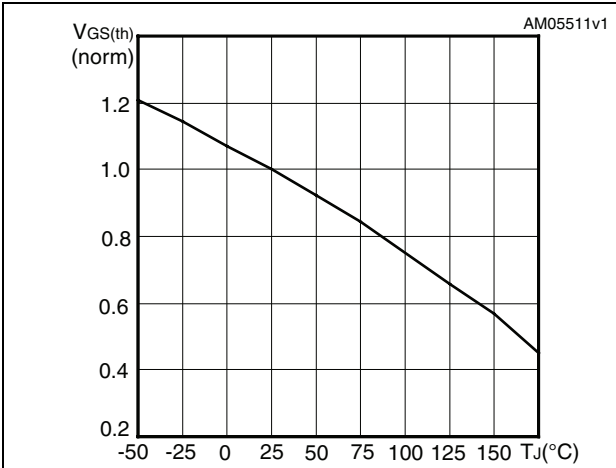


Figure 11. Normalized on resistance vs temperature

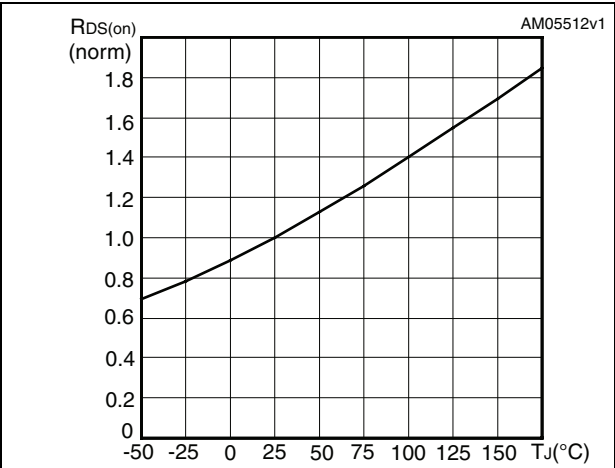
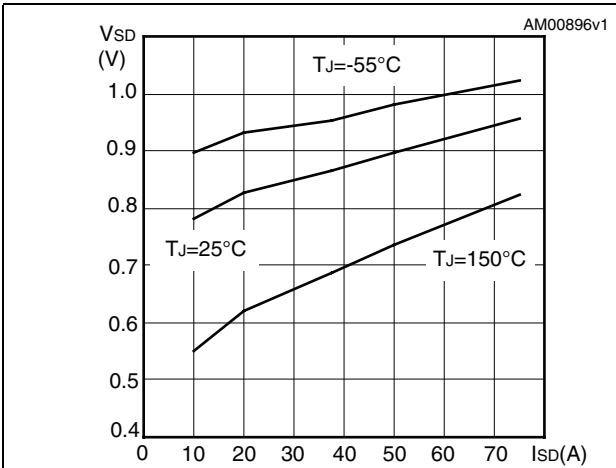
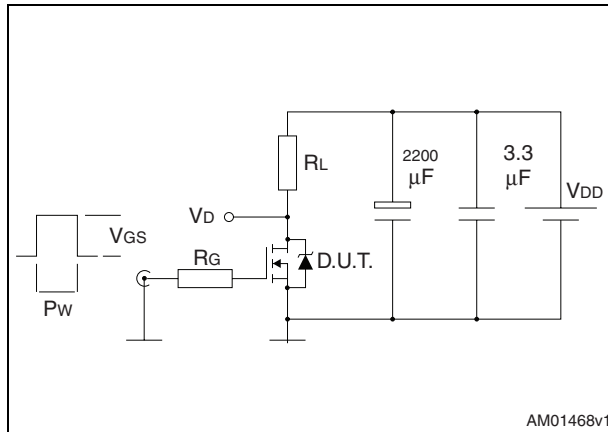


Figure 12. Source-drain diode forward characteristics

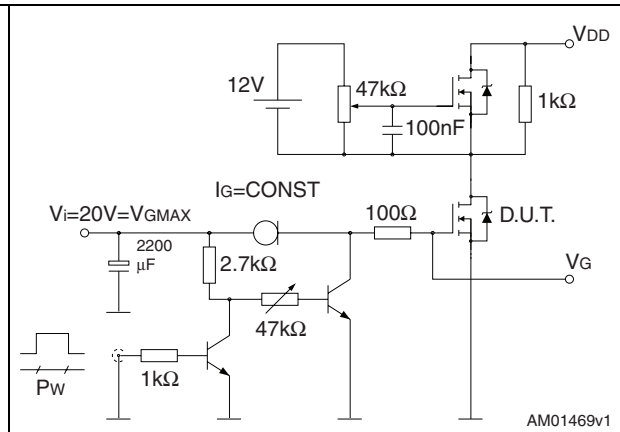


### 3 Test circuits

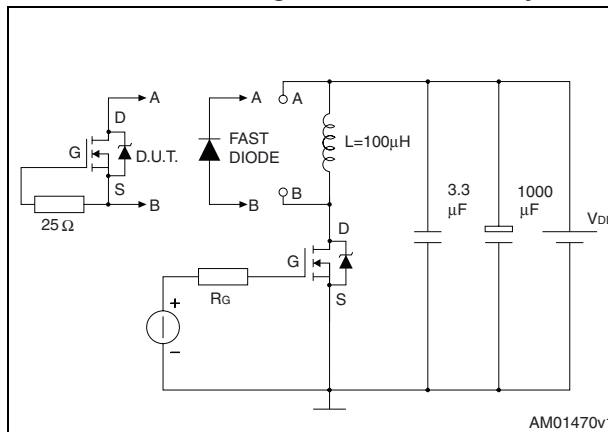
**Figure 13. Switching times test circuit for resistive load**



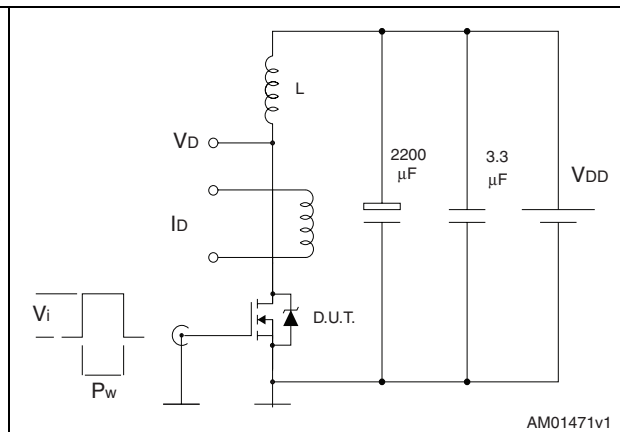
**Figure 14. Gate charge test circuit**



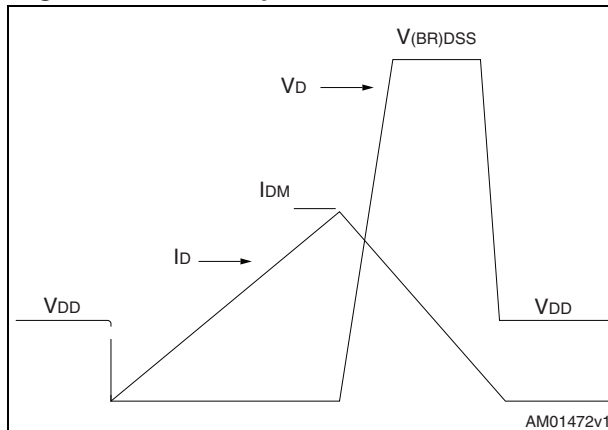
**Figure 15. Test circuit for inductive load switching and diode recovery times**



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



**Figure 17. Unclamped inductive waveform**



**Figure 18. Switching time waveform**

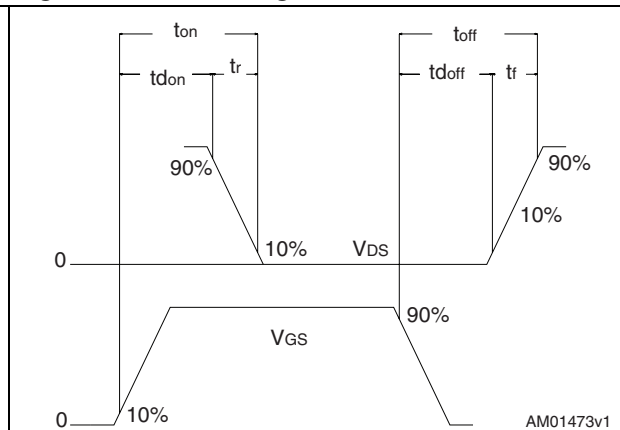
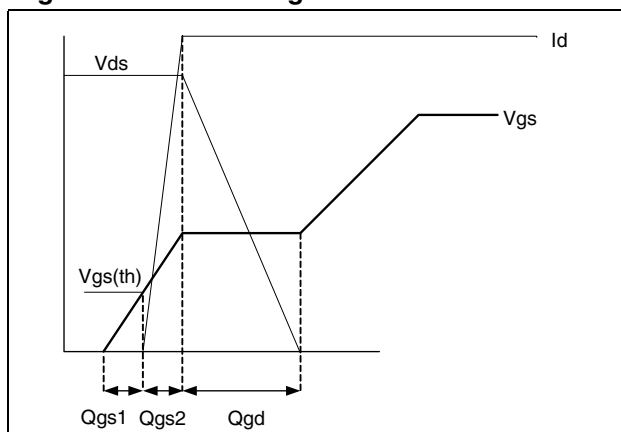




Figure 19. Gate charge waveform



## 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.

Table 8. Short IPAK mechanical dimensions

| Dim. | mm   |      |       |
|------|------|------|-------|
|      | Min  | Typ  | Max   |
| A    | 2.20 |      | 2.40  |
| A1   | 0.90 |      | 1.10  |
| b    | 0.64 |      | 0.90  |
| b2   |      |      | 0.95  |
| b4   | 5.20 |      | 5.40  |
| c    | 0.45 |      | 0.60  |
| c2   | 0.48 |      | 0.60  |
| D    | 6.00 |      | 6.20  |
| E    | 6.40 |      | 6.60  |
| e    |      | 2.25 |       |
| e1   | 4.40 |      | 4.60  |
| H    | 9.80 |      | 10.40 |
| L    | 3.00 |      | 3.40  |
| L1   | 0.80 |      | 1.20  |
| L2   |      | 0.80 | 1.00  |

Figure 20. Short IPAK mechanical drawing

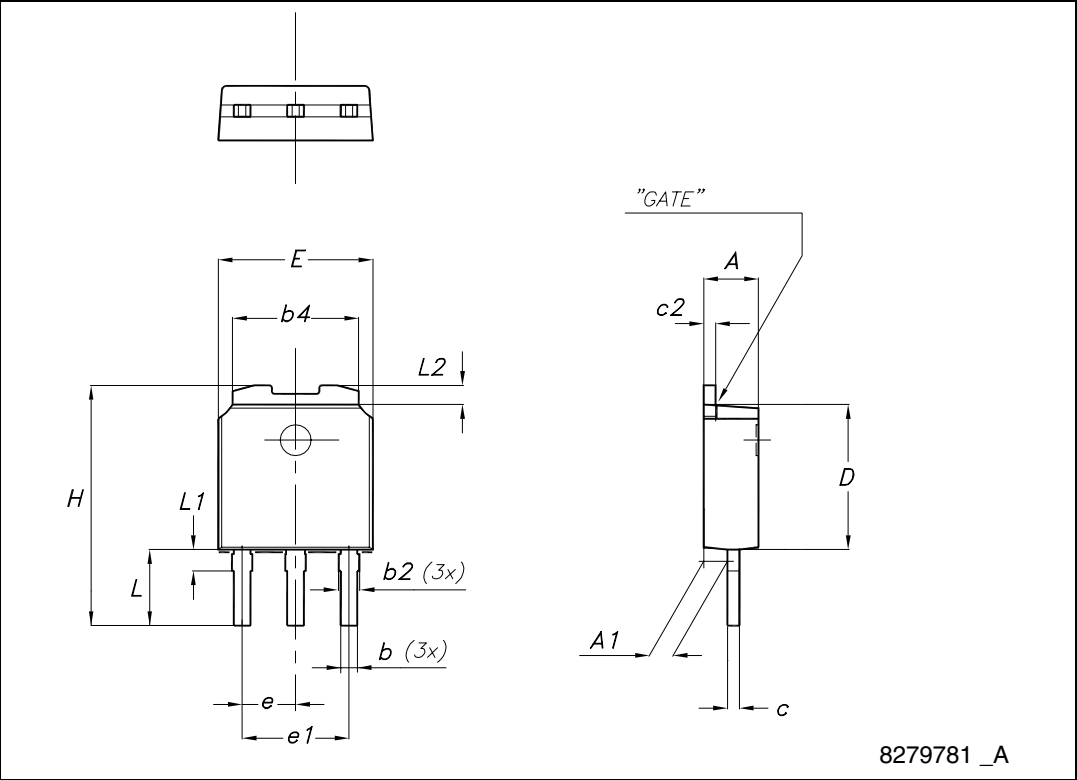
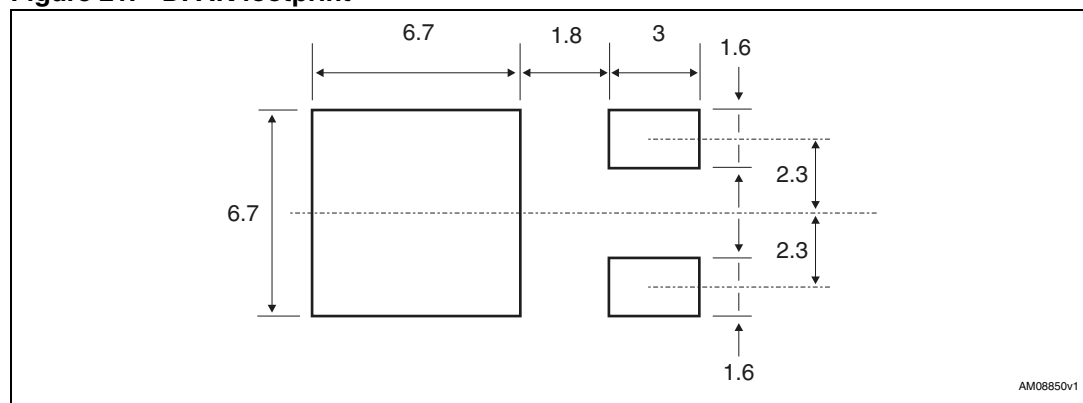


Table 9. DPAK (TO-252) mechanical data

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

a. All dimension are in millimeters

Figure 22. DPAK (TO-252) drawing

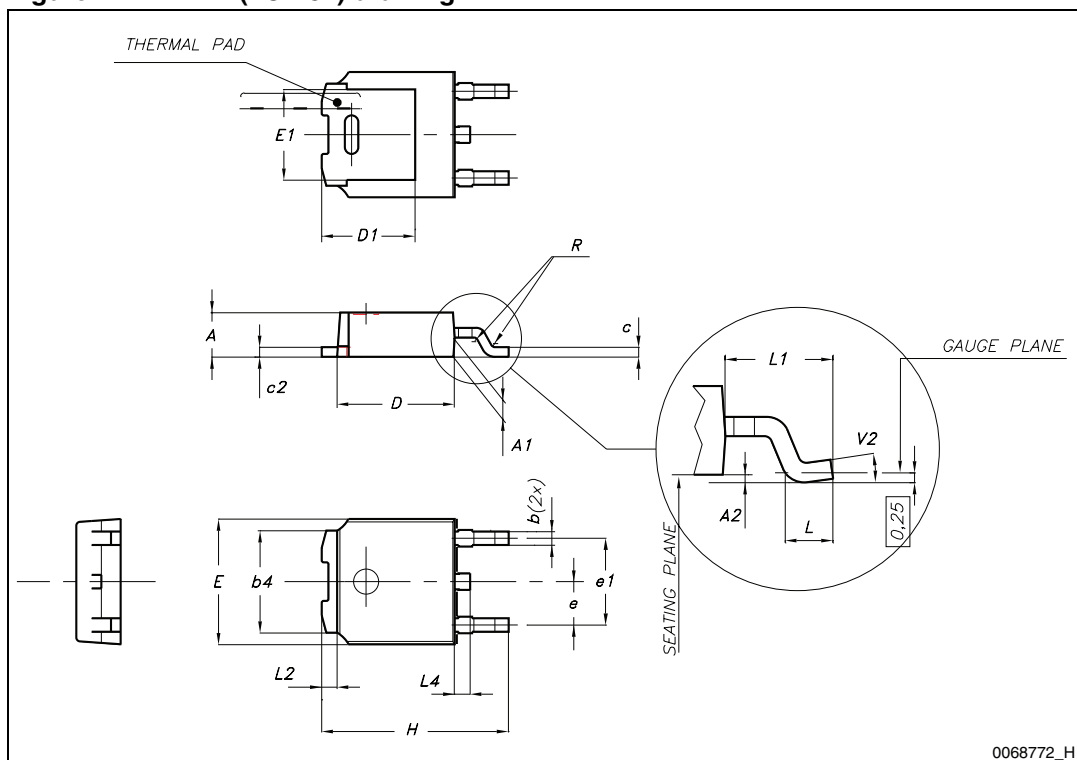


Table 10. IPAK (TO-251) mechanical data

| DIM. | mm.  |       |      |
|------|------|-------|------|
|      | min. | typ   | max. |
| A    | 2.20 |       | 2.40 |
| A1   | 0.90 |       | 1.10 |
| b    | 0.64 |       | 0.90 |
| b2   |      |       | 0.95 |
| b4   | 5.20 |       | 5.40 |
| B5   |      | 0.3   |      |
| c    | 0.45 |       | 0.60 |
| c2   | 0.48 |       | 0.60 |
| D    | 6.00 |       | 6.20 |
| E    | 6.40 |       | 6.60 |
| e    |      | 2.28  |      |
| e1   | 4.40 |       | 4.60 |
| H    |      | 16.10 |      |
| L    | 9.00 |       | 9.40 |
| L1   | 0.80 |       | 1.20 |
| L2   |      | 0.80  | 1.00 |
| V1   |      | 10 °  |      |

Figure 23. IPAK (TO-251) drawing

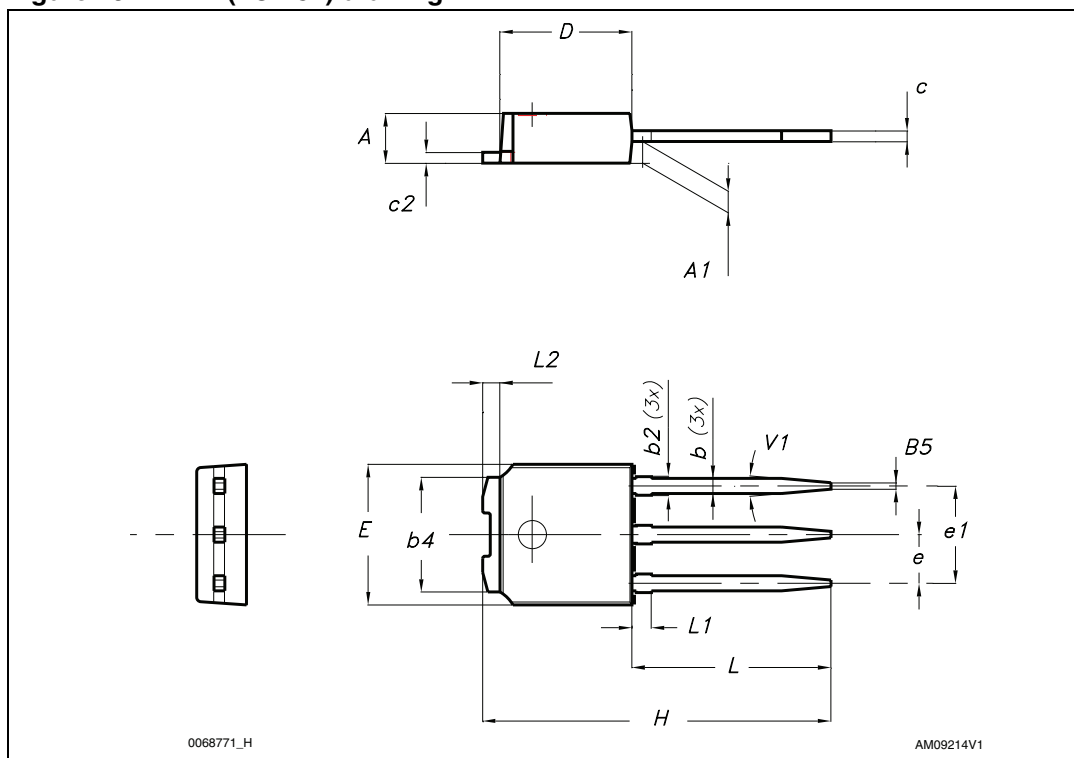
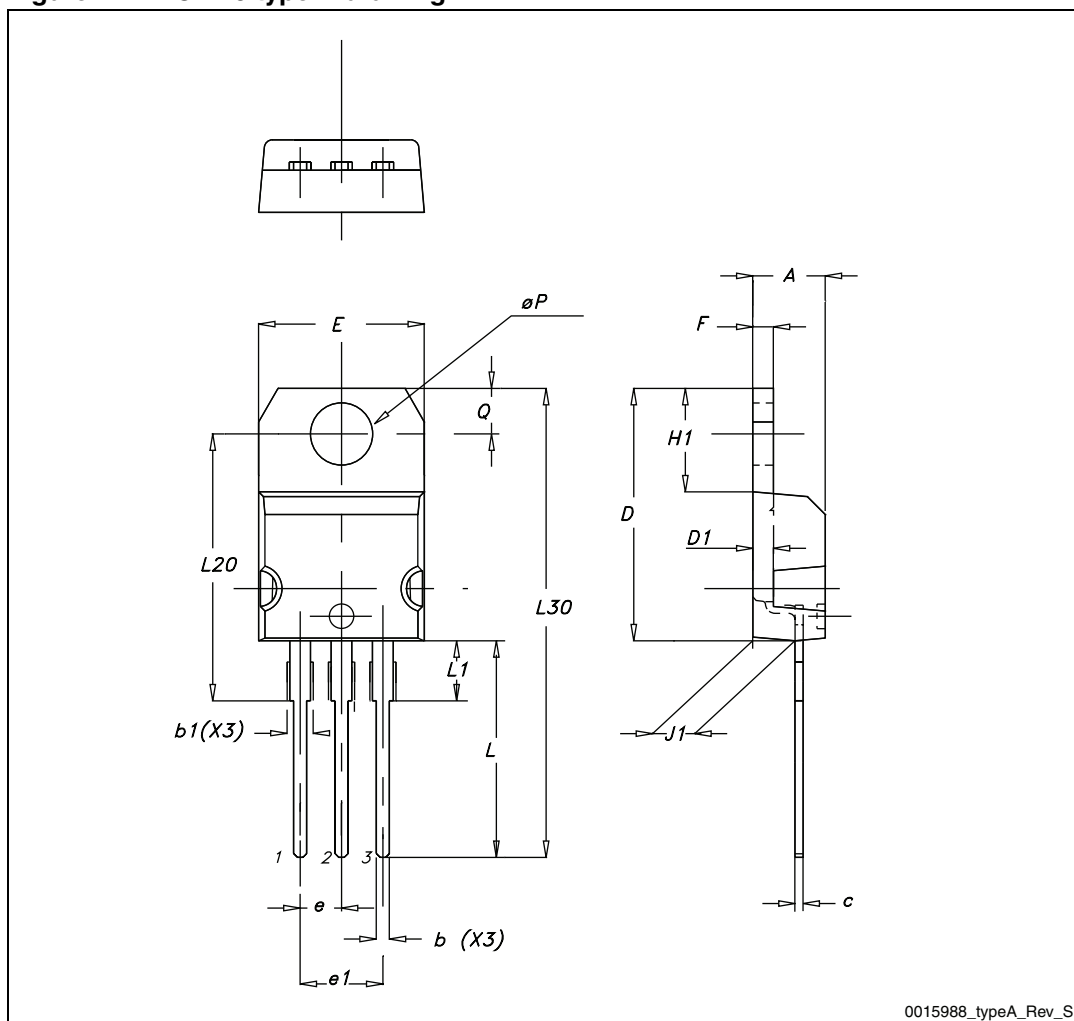


Table 11. TO-220 type A mechanical data

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.40  |       | 4.60  |
| b    | 0.61  |       | 0.88  |
| b1   | 1.14  |       | 1.70  |
| c    | 0.48  |       | 0.70  |
| D    | 15.25 |       | 15.75 |
| D1   |       | 1.27  |       |
| E    | 10    |       | 10.40 |
| e    | 2.40  |       | 2.70  |
| e1   | 4.95  |       | 5.15  |
| F    | 1.23  |       | 1.32  |
| H1   | 6.20  |       | 6.60  |
| J1   | 2.40  |       | 2.72  |
| L    | 13    |       | 14    |
| L1   | 3.50  |       | 3.93  |
| L20  |       | 16.40 |       |
| L30  |       | 28.90 |       |
| ØP   | 3.75  |       | 3.85  |
| Q    | 2.65  |       | 2.95  |



Figure 24. TO-220 type A drawing



## 5 Packaging mechanical data

**Table 12. 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 25. Tape for DPAK (TO-252)

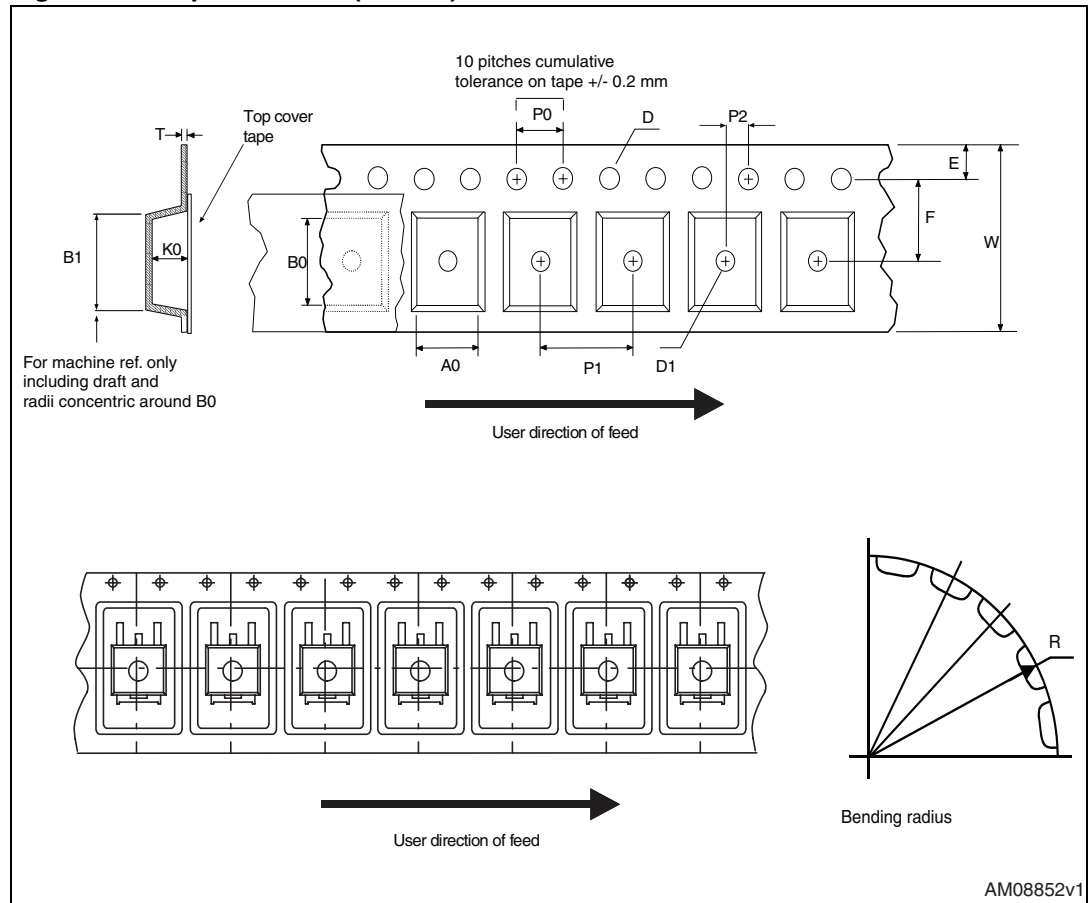
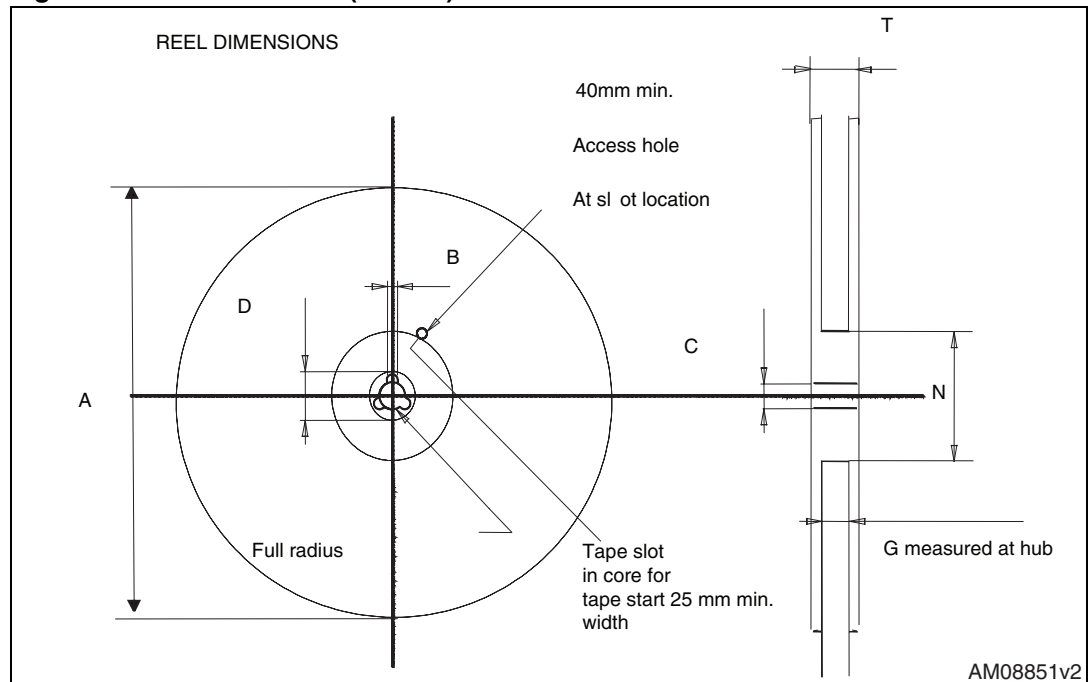


Figure 26. Reel for DPAK (TO-252)



## 6 Revision history

**Table 13. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                |
|-------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01-Jul-2009 | 1        | First issue.                                                                                                                                                                                                                                                           |
| 02-Oct-2009 | 2        | <ul style="list-style-type: none"><li>– Added device in Short IPAK.</li><li>– Document status promoted from preliminary data to datasheet.</li></ul>                                                                                                                   |
| 19-Apr-2011 | 3        | <ul style="list-style-type: none"><li>– Added max values in <a href="#">Table 5: Dynamic</a>.</li><li>– Added new package and mechanical data.</li><li>– Inserted new <math>I_D</math> value @ 70 °C (see <a href="#">Table 2: Absolute maximum ratings</a>)</li></ul> |
| 04-Jul-2011 | 4        | Updated: mechanical data                                                                                                                                                                                                                                               |

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