



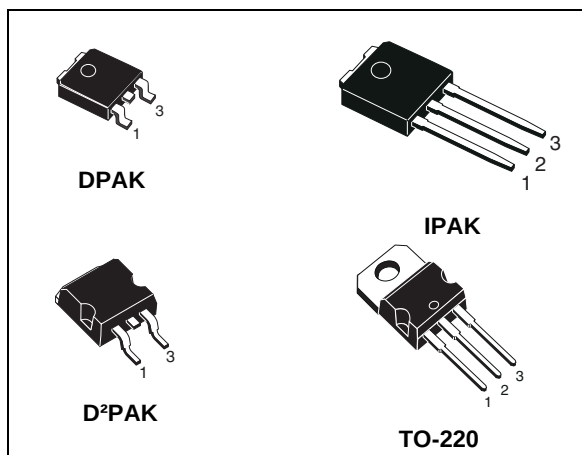
# STB95N3LLH6, STD95N3LLH6 STP95N3LLH6, STU95N3LLH6

N-channel 30 V, 0.0037  $\Omega$ , 80 A, D<sup>2</sup>PAK, DPAK, IPAK, TO-220  
STripFET™ VI DeepGATE™ Power MOSFET

## Features

| Type        | V <sub>DSS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> |
|-------------|------------------|-------------------------|----------------|
| STB95N3LLH6 | 30 V             | 0.0042 $\Omega$         | 80 A           |
| STD95N3LLH6 | 30 V             | 0.0042 $\Omega$         | 80 A           |
| STP95N3LLH6 | 30 V             | 0.0042 $\Omega$         | 80 A           |
| STU95N3LLH6 | 30 V             | 0.0047 $\Omega$         | 80 A           |

- 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 product utilizes the 6th 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

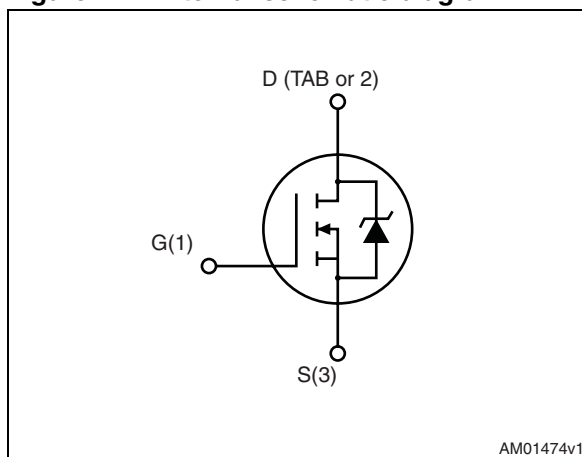


Table 1. Device summary

| Order codes | Marking  | Package            | Packaging     |
|-------------|----------|--------------------|---------------|
| STB95N3LLH6 | 95N3LLH6 | D <sup>2</sup> PAK | Tape and reel |
| STD95N3LLH6 | 95N3LLH6 | DPAK               | Tape and reel |
| STP95N3LLH6 | 95N3LLH6 | TO-220             | Tube          |
| STU95N3LLH6 | 95N3LLH6 | IPAK               | Tube          |

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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 $T_C = 25\text{ }^{\circ}\text{C}$  | 80         | A                     |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$ | 61         | A                     |
| $I_{DM}^{(2)}$ | Drain current (pulsed)                                            | 320        | A                     |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$           | 70         | W                     |
|                | Derating factor                                                   | 0.47       | W/ $^{\circ}\text{C}$ |
| $E_{AS}^{(3)}$ | Single pulse avalanche energy                                     | 150        | mJ                    |
| $T_{stg}$      | Storage temperature                                               | -55 to 175 | $^{\circ}\text{C}$    |
| $T_j$          | Max. operating junction temperature                               | 175        | $^{\circ}\text{C}$    |

1. Limited by wire bonding
2. Pulse width limited by safe operating area
3. Starting  $T_j = 25^{\circ}\text{C}$ ,  $I_{AV} = 55\text{ A}$ ,  $L = 0.1\text{ mH}$

**Table 3. Thermal data**

| Symbol              | Parameter                                      | Value              |      |      |        | Unit                 |
|---------------------|------------------------------------------------|--------------------|------|------|--------|----------------------|
|                     |                                                | D <sup>2</sup> PAK | DPAK | IPAK | TO-220 |                      |
| $R_{thj-case}$      | Thermal resistance junction-case max           | 2.14               |      |      |        | $^{\circ}\text{C/W}$ |
| $R_{thj-amb}$       | Thermal resistance junction-ambient max        |                    | 100  |      | 62.5   | $^{\circ}\text{C/W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb max            | 35                 | 35   |      |        | $^{\circ}\text{C/W}$ |
| $T_l$               | Maximum lead temperature for soldering purpose | 275                |      |      | 300    | $^{\circ}\text{C}$   |

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

## 2 Electrical characteristics

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

**Table 4. Static**

| Symbol        | Parameter                                        | Test conditions                                                                        | Min. | Typ.   | Max.      | Unit                           |
|---------------|--------------------------------------------------|----------------------------------------------------------------------------------------|------|--------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown Voltage                   | $I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0$                                          | 30   |        |           | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 30\text{ V}$<br>$V_{DS} = 30\text{ V}$ , $T_c = 125\text{ }^{\circ}\text{C}$ |      |        | 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                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                     | 1    |        | 2.5       | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 40\text{ A}$<br>SMD version                            |      | 0.0037 | 0.0042    | $\Omega$                       |
|               |                                                  | $V_{GS} = 10\text{ V}$ , $I_D = 40\text{ A}$                                           |      | 0.0042 | 0.0047    | $\Omega$                       |
|               |                                                  | $V_{GS} = 4.5\text{ V}$ , $I_D = 40\text{ A}$<br>SMD version                           |      | 0.0055 | 0.007     | $\Omega$                       |
|               |                                                  | $V_{GS} = 4.5\text{ V}$ , $I_D = 40\text{ A}$                                          |      | 0.006  | 0.0075    | $\Omega$                       |

**Table 5. 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>$V_{GS} = 0$                                        | -   | 2200<br>400<br>280 | -    | pF<br>pF<br>pF |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$       | Total gate charge<br>Gate-source charge<br>Gate-drain charge              | $V_{DD} = 15\text{ V}$ , $I_D = 80\text{ A}$<br>$V_{GS} = 4.5\text{ V}$<br><a href="#">Figure 13</a> | -   | 20<br>8.2<br>7.5   | -    | nC<br>nC<br>nC |
| $Q_{gs1}$<br>$Q_{gs2}$              | Pre $V_{th}$ gate-to-source charge<br>Post $V_{th}$ gate-to-source charge | $V_{DD} = 15\text{ V}$ , $I_D = 80\text{ A}$<br><a href="#">Figure 18</a>                            | -   | 3.4<br>6.2         | -    | nC<br>nC       |
| $R_G$                               | Gate input resistance                                                     | $f = 1\text{ MHz}$ gate bias<br>Bias = 0 test signal<br>level = 20 mV<br>open drain                  | -   | 1                  | -    | $\Omega$       |

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

| Symbol                | Parameter                        | Test conditions                                                                                                            | Min. | Typ.         | Max. | Unit     |
|-----------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------|------|--------------|------|----------|
| $t_{d(on)}$<br>$t_r$  | Turn-on delay time<br>Rise time  | $V_{DD} = 15\text{ V}$ , $I_D = 40\text{ A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 5\text{ V}$<br><a href="#">Figure 12</a> | -    | 19<br>91     | -    | ns<br>ns |
| $t_{d(off)}$<br>$t_f$ | Turn-off delay time<br>Fall time | $V_{DD} = 15\text{ V}$ , $I_D = 40\text{ A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 5\text{ V}$<br><a href="#">Figure 12</a> | -    | 24.5<br>23.4 | -    | ns<br>ns |

**Table 7. Source drain diode**

| Symbol                            | Parameter                                                                    | Test conditions                                                                                                         | Min. | Typ.                | Max.      | Unit          |
|-----------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------|---------------------|-----------|---------------|
| $I_{SD}$<br>$I_{SDM}^{(1)}$       | Source-drain current<br>Source-drain current (pulsed)                        |                                                                                                                         | -    |                     | 80<br>320 | A<br>A        |
| $V_{SD}^{(2)}$                    | Forward on voltage                                                           | $I_{SD} = 40\text{ A}$ , $V_{GS} = 0$                                                                                   | -    |                     | 1.1       | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 80\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 24\text{ V}$<br><a href="#">Figure 14</a> | -    | 28.6<br>22.8<br>1.6 |           | 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

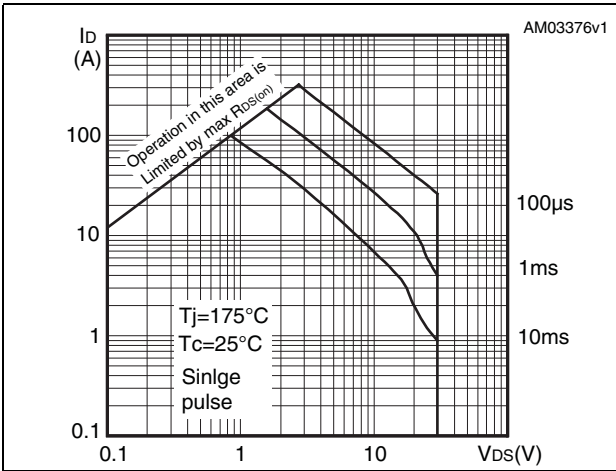


Figure 3. Thermal impedance

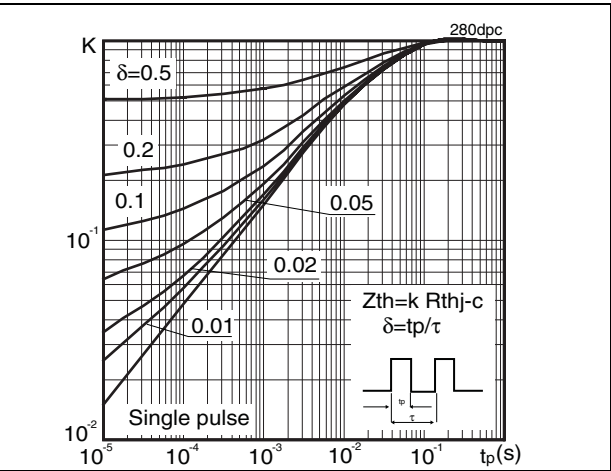


Figure 4. Output characteristics

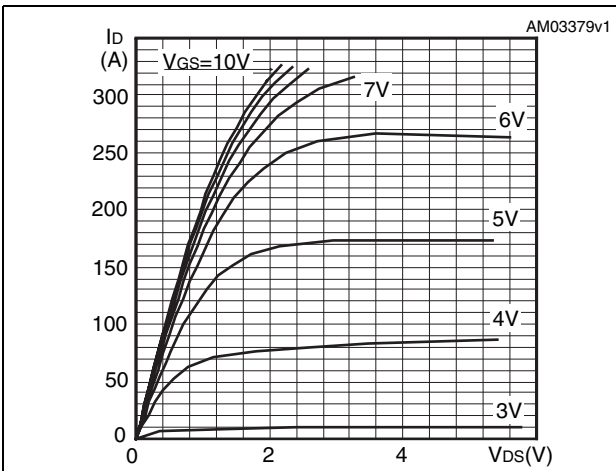


Figure 5. Transfer characteristics

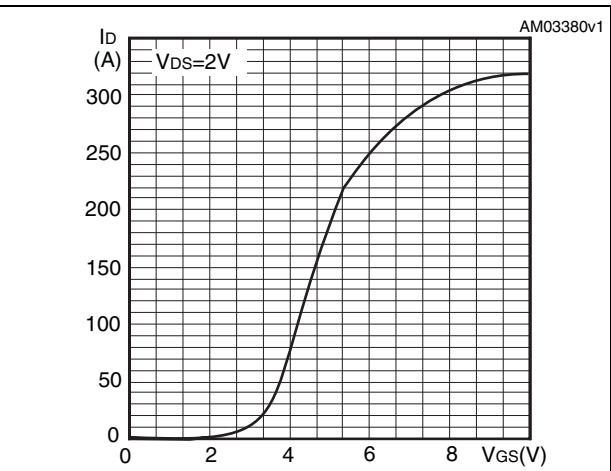


Figure 6. Normalized BV<sub>DSS</sub> vs temperature

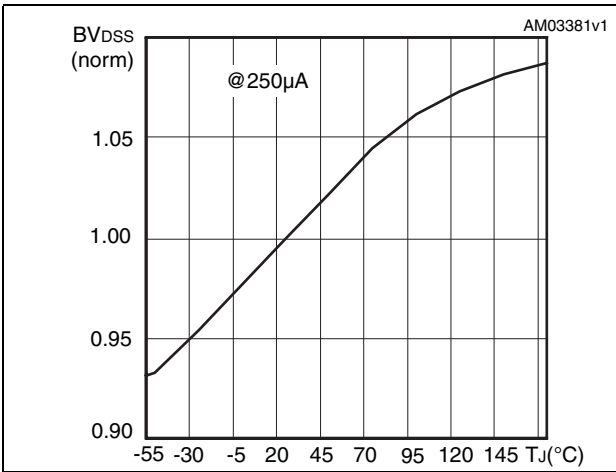


Figure 7. Static drain source on resistance

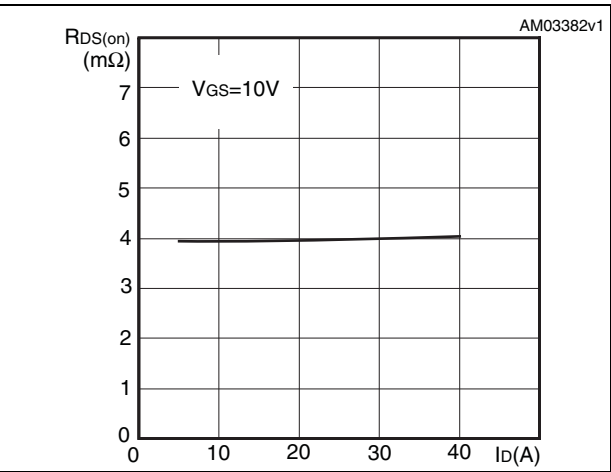


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

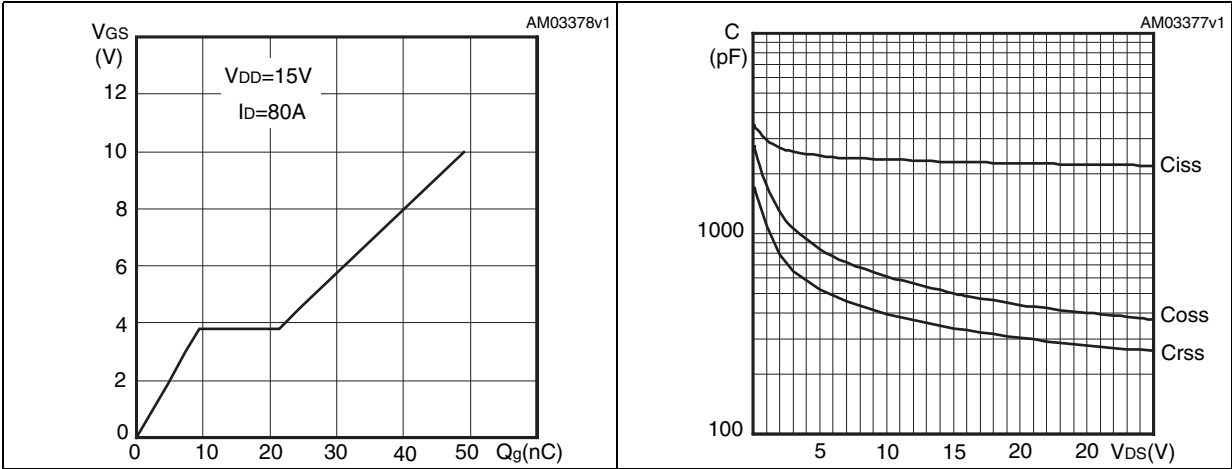
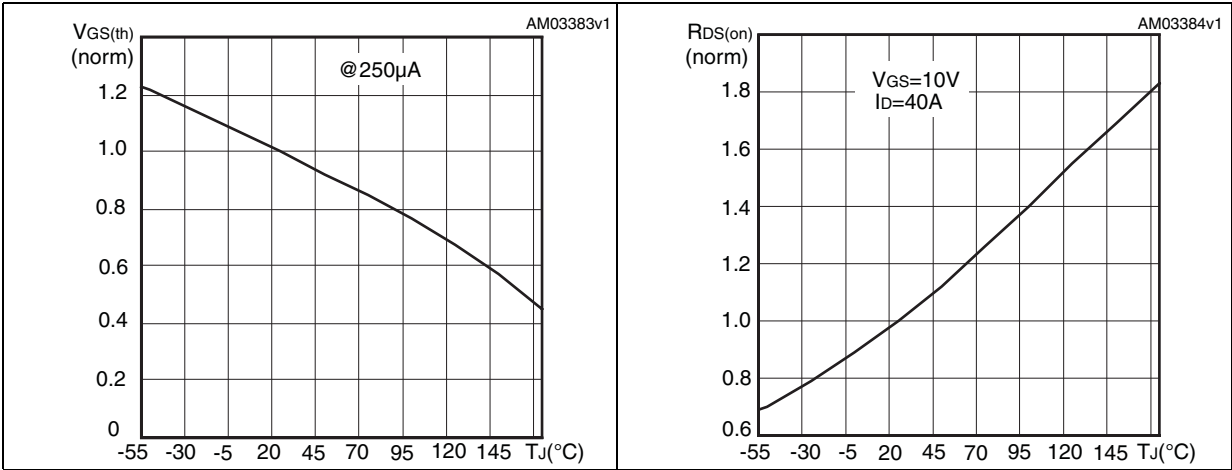


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature



### 3 Test circuits

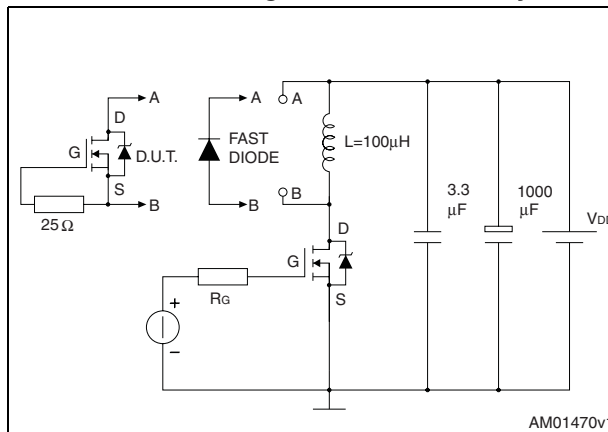
**Figure 12. Switching times test circuit for resistive load**



**Figure 13. Gate charge test circuit**



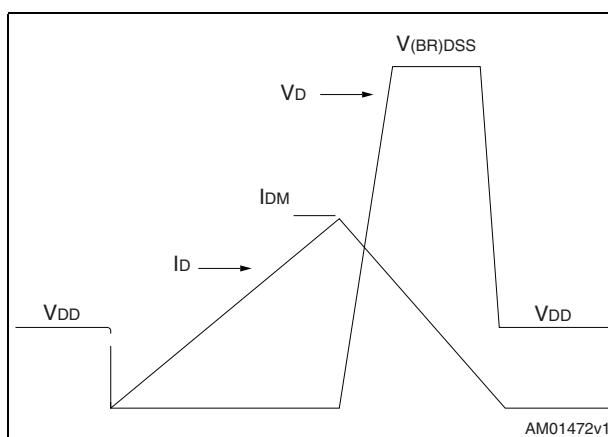
**Figure 14. Test circuit for inductive load switching and diode recovery times**



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



**Figure 16. Unclamped inductive waveform**



**Figure 17. Switching time waveform**

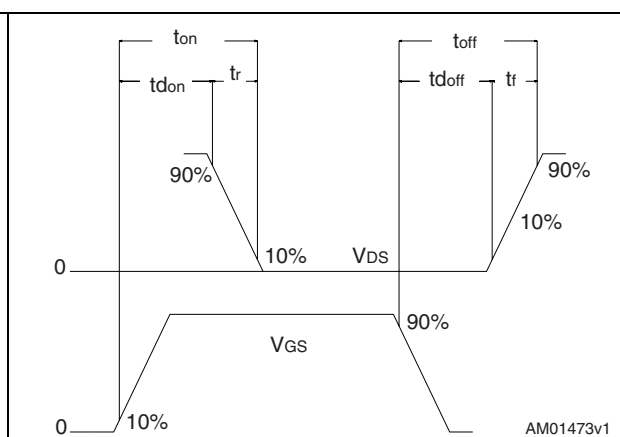
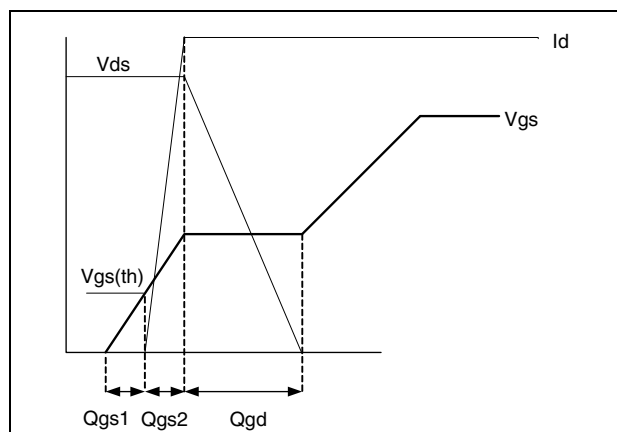


Figure 18. Gate charge waveform

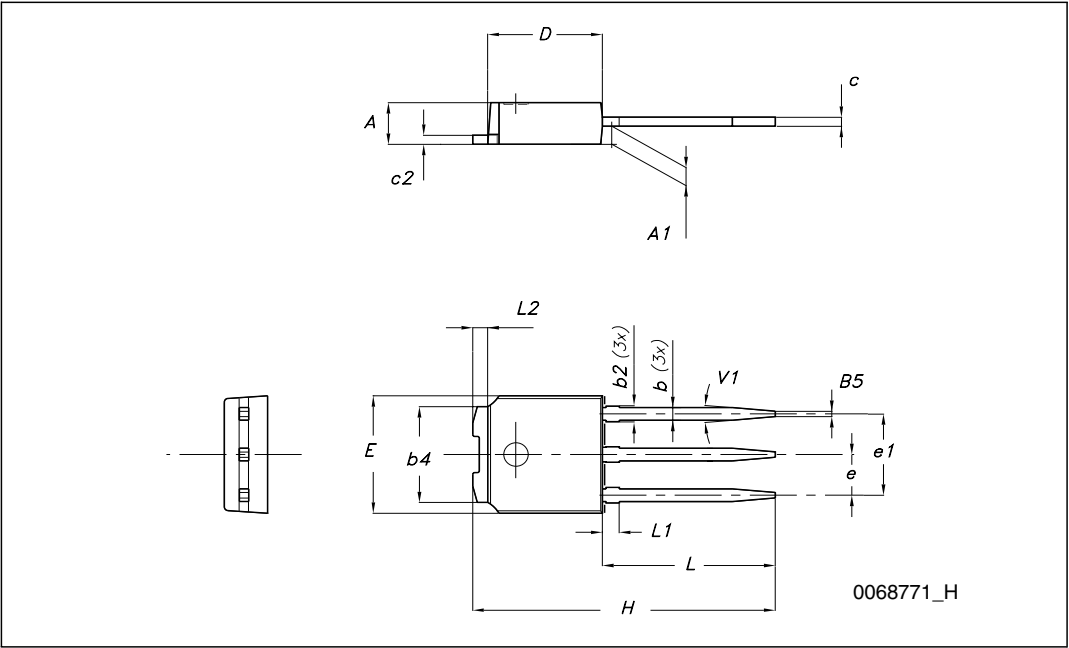


## 4      **Package mechanical data**

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.

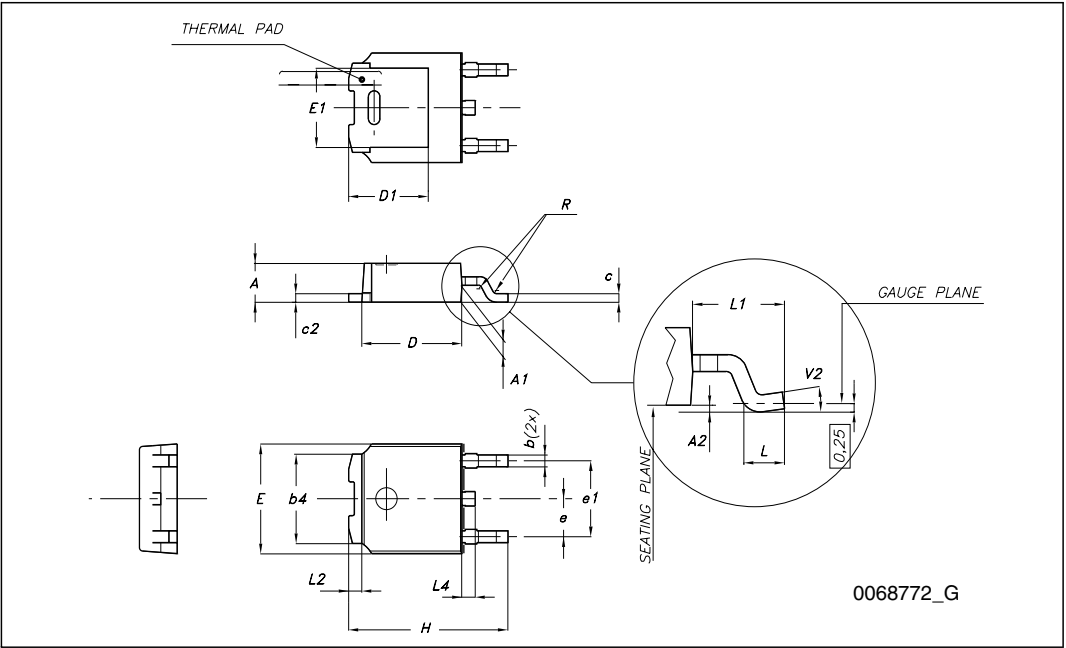
TO-251 (IPAK) mechanical data

| 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 |
| 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  |      |
| V1   |      | 10°   |      |



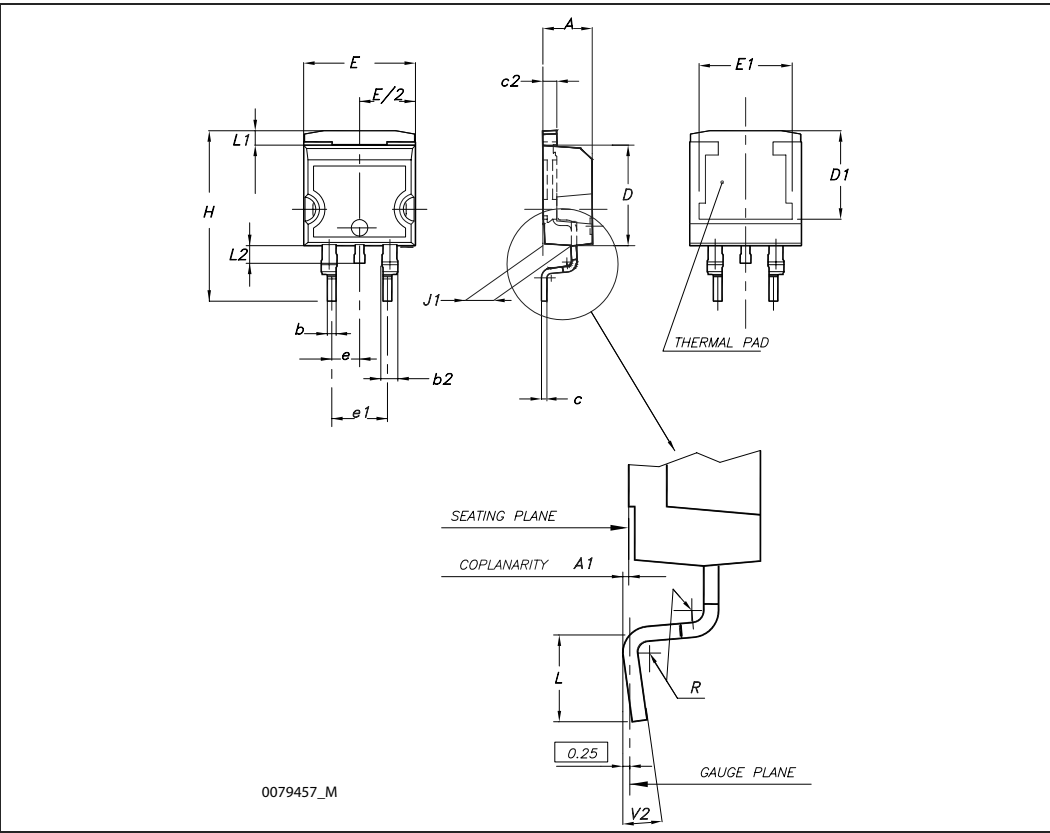
TO-252 (DPAK) mechanical data

| 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°    |



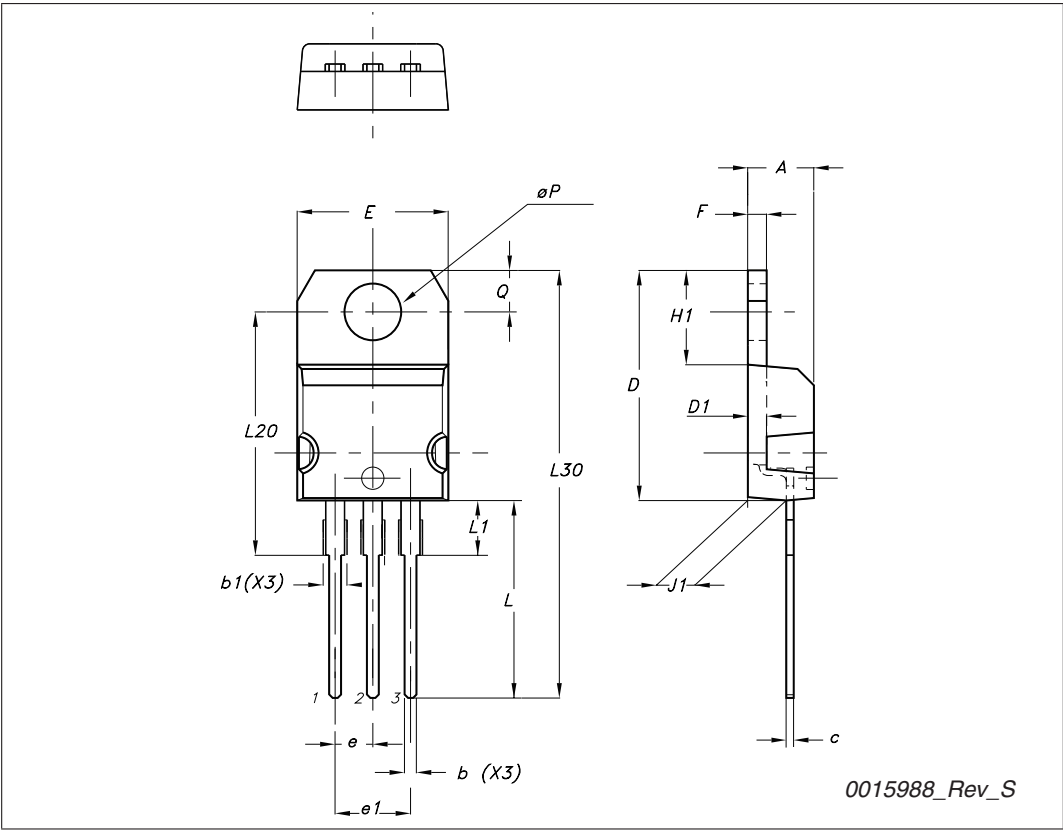
D<sup>2</sup>PAK (TO-263) mechanical data

| Dim | mm   |      |       | inch  |       |       |
|-----|------|------|-------|-------|-------|-------|
|     | Min  | Typ  | Max   | Min   | Typ   | Max   |
| A   | 4.40 |      | 4.60  | 0.173 |       | 0.181 |
| A1  | 0.03 |      | 0.23  | 0.001 |       | 0.009 |
| b   | 0.70 |      | 0.93  | 0.027 |       | 0.037 |
| b2  | 1.14 |      | 1.70  | 0.045 |       | 0.067 |
| c   | 0.45 |      | 0.60  | 0.017 |       | 0.024 |
| c2  | 1.23 |      | 1.36  | 0.048 |       | 0.053 |
| D   | 8.95 |      | 9.35  | 0.352 |       | 0.368 |
| D1  | 7.50 |      |       | 0.295 |       |       |
| E   | 10   |      | 10.40 | 0.394 |       | 0.409 |
| E1  | 8.50 |      |       | 0.334 |       |       |
| e   |      | 2.54 |       |       | 0.1   |       |
| e1  | 4.88 |      | 5.28  | 0.192 |       | 0.208 |
| H   | 15   |      | 15.85 | 0.590 |       | 0.624 |
| J1  | 2.49 |      | 2.69  | 0.099 |       | 0.106 |
| L   | 2.29 |      | 2.79  | 0.090 |       | 0.110 |
| L1  | 1.27 |      | 1.40  | 0.05  |       | 0.055 |
| L2  | 1.30 |      | 1.75  | 0.051 |       | 0.069 |
| R   |      | 0.4  |       |       | 0.016 |       |
| V2  | 0°   |      | 8°    | 0°    |       | 8°    |



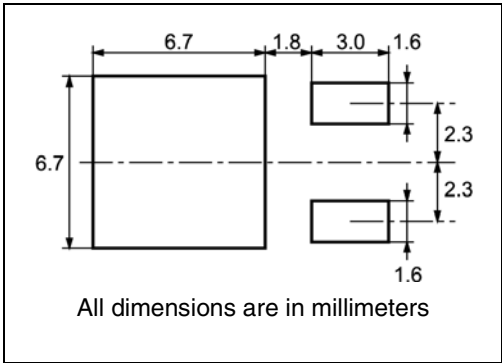
TO-220 type A mechanical data

| 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  |

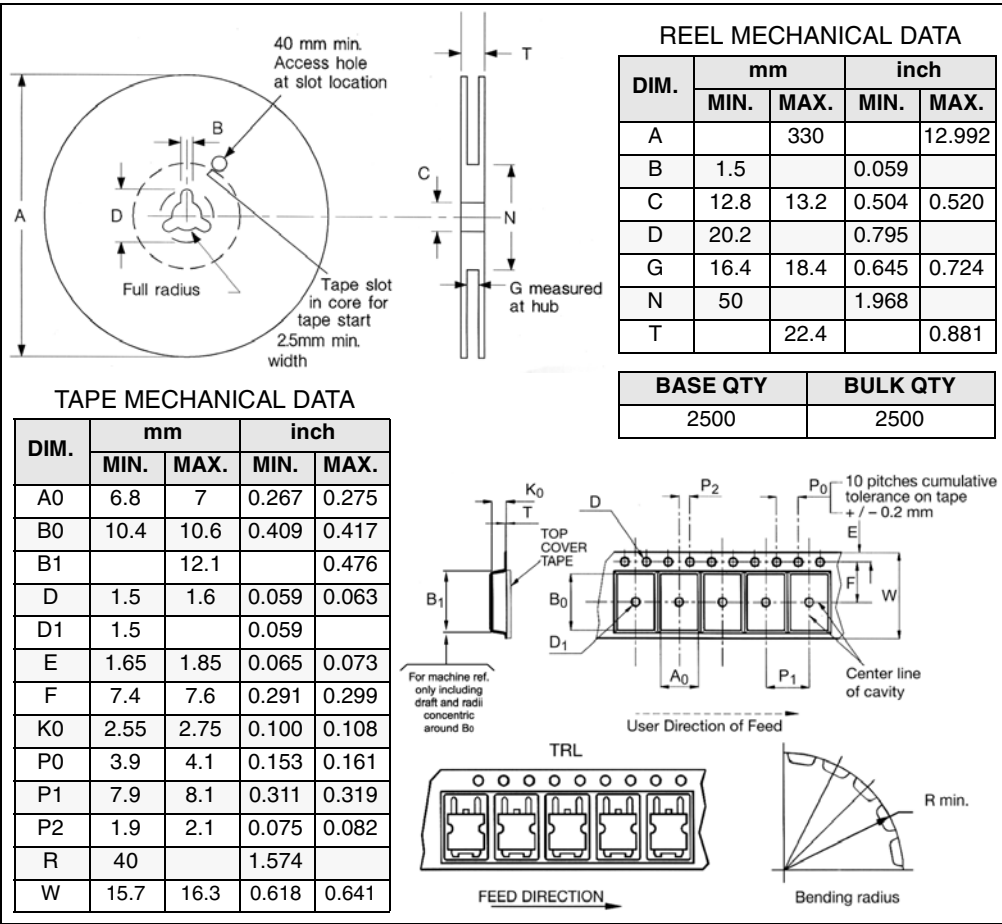


# 5 Packaging mechanical data

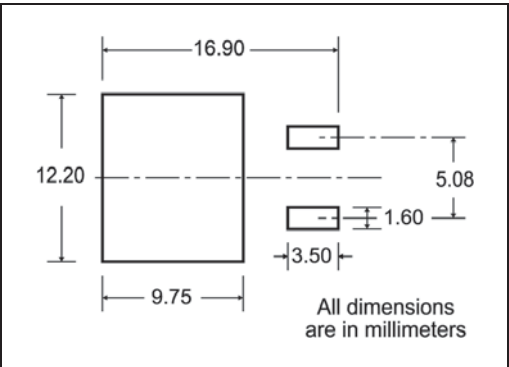
## DPAK FOOTPRINT



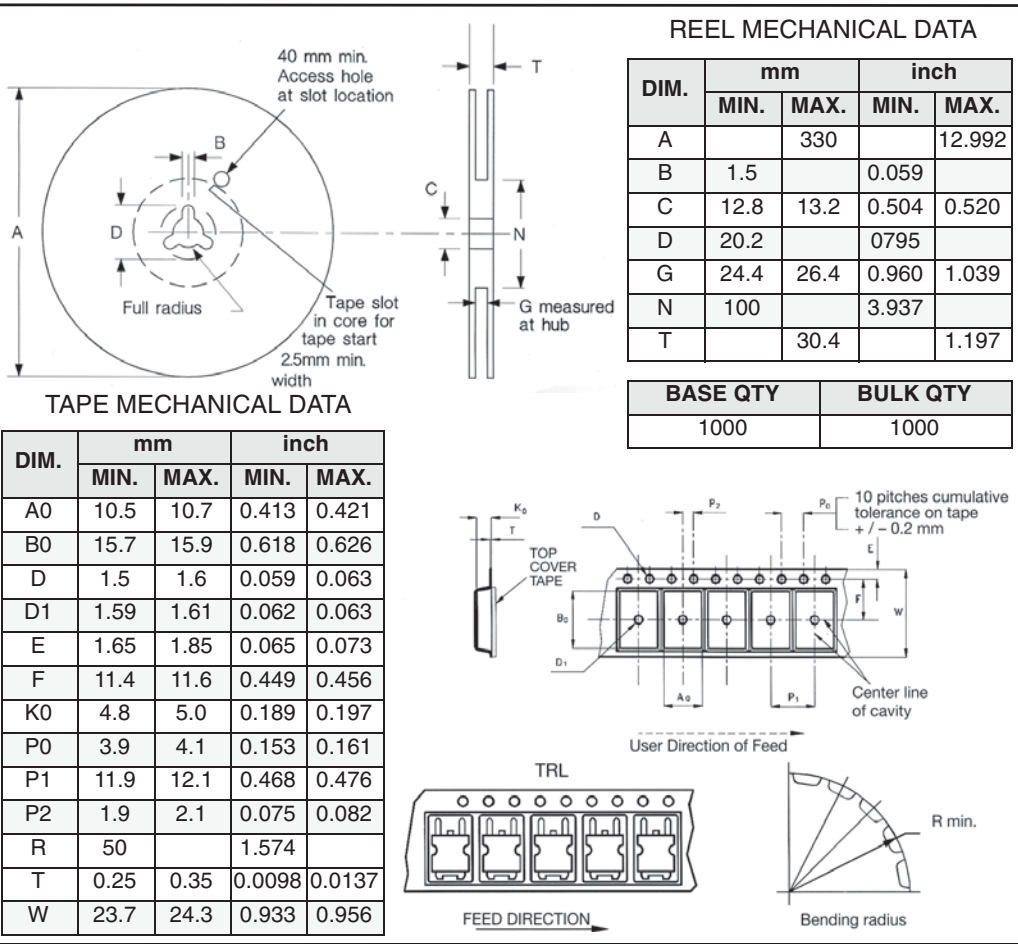
## TAPE AND REEL SHIPMENT



# D<sup>2</sup>PAK FOOTPRINT



# TAPE AND REEL SHIPMENT



## 6 Revision history

**Table 8. Document revision history**

| Date        | Revision | Changes                                                                                                                    |
|-------------|----------|----------------------------------------------------------------------------------------------------------------------------|
| 01-Dec-2008 | 1        | First release                                                                                                              |
| 20-May-2009 | 2        | – Document status promoted from preliminary data to datasheet.<br>– Added new package, mechanical data: D <sup>2</sup> PAK |
| 10-Nov-2009 | 3        | Added new device in TO-220                                                                                                 |

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