



# STD150N3LLH6 STP150N3LLH6, STU150N3LLH6

N-channel 30 V, 0.0024  $\Omega$  , 80 A, 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> |
|--------------|------------------|-------------------------|----------------|
| STD150N3LLH6 | 30 V             | 0.0028 $\Omega$         | 80 A           |
| STP150N3LLH6 | 30 V             | 0.0033 $\Omega$         | 80 A           |
| STu150N3LLH6 | 30 V             | 0.0033 $\Omega$         | 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.

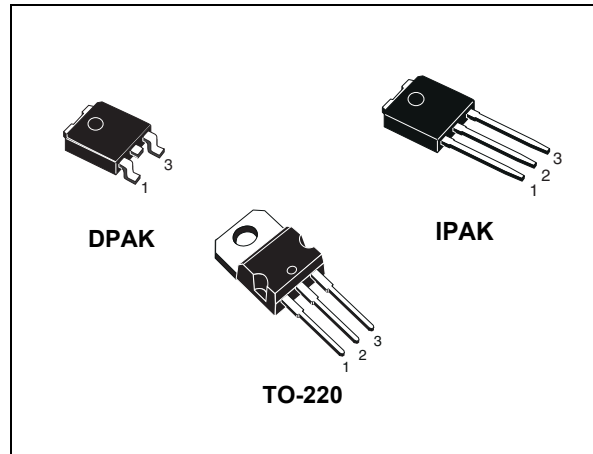


Figure 1. Internal schematic diagram

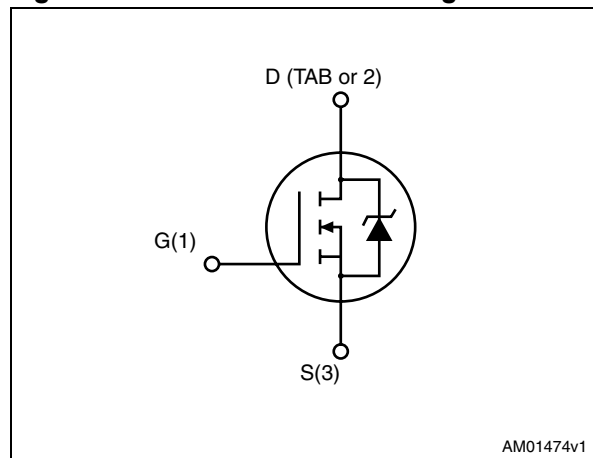


Table 1. Device summary

| Order codes  | Marking   | Package | Packaging     |
|--------------|-----------|---------|---------------|
| STD150N3LLH6 | 150N3LLH6 | DPAK    | Tape and reel |
| STP150N3LLH6 | 150N3LLH6 | TO-220  | Tube          |
| STU150N3LLH6 | 150N3LLH6 | 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 $T_C = 100\text{ }^\circ\text{C}$ | 80         | A                   |
| $I_{DM}^{(2)}$ | Drain current (pulsed)  | 320        | A                   |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$           | 110        | W                   |
|                | Derating factor   | 0.73       | W/ $^\circ\text{C}$ |
| $E_{AS}^{(3)}$ | Single pulse avalanche energy                                   | 525        | 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  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = 40\text{ A}$ ,  $V_{DD} = 25\text{ V}$

**Table 3. Thermal resistance**

| 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-case max           | 100   | $^\circ\text{C}/\text{W}$ |
| $T_j$          | Maximum lead temperature for soldering purpose | 275   | $^\circ\text{C}$          |

## 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                   | $I_D = 250\ \mu\text{A}$ , $V_{GS} = 0$                                  | 30   |        |           | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 30\text{ V}$<br>$V_{DS} = 30\text{ V}$ , $T_c = 125\text{ °C}$ |      |        | 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    |        | 2.5       | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 40\text{ A}$<br>SMD version              |      | 0.0024 | 0.0028    | $\Omega$                       |
|               |  | $V_{GS} = 10\text{ V}$ , $I_D = 40\text{ A}$                             |      | 0.0029 | 0.0033    | $\Omega$                       |
|               |  | $V_{GS} = 4.5\text{ V}$ , $I_D = 40\text{ A}$<br>SMD version             |      | 0.0034 | 0.0045    | $\Omega$                       |
|               |  | $V_{GS} = 4.5\text{ V}$ , $I_D = 40\text{ A}$                            |      | 0.0039 | 0.0049    | $\Omega$                       |

**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>$V_{GS} = 0$                       | -   | 4040 | -    | pF       |
| $C_{oss}$ | Output capacitance           |   |     | 740  |      | pF       |
| $C_{rss}$ | Reverse transfer capacitance |   |     | 425  |      | pF       |
| $Q_g$     | Total gate charge            | $V_{DD} = 15\text{ V}$ , $I_D = 80\text{ A}$  | -   | 40   | -    | nC       |
| $Q_{gs}$  | Gate-source charge           | $V_{GS} = 4.5\text{ V}$   |     | 16.3 |      | nC       |
| $Q_{gd}$  | Gate-drain charge            | (see Figure 14)   |     | 15.8 |      | nC       |
| $R_G$     | Gate input resistance        | $f = 1\text{ MHz}$ gate bias<br>Bias = 0 test signal<br>level = 20 mV<br>open drain | -   | 1.4  | -    | $\Omega$ |

**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>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br><i>(see Figure 15)</i> | -    | 17<br>18 | -    | 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>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br><i>(see Figure 15)</i> | -    | 75<br>46 | -    | ns<br>ns |

**Table 7. Source drain diode**

| Symbol                            | Parameter  | Test conditions  | Min. | Typ.            | Max. | Unit          |
|-----------------------------------|--|--|------|-----------------|------|---------------|
| $I_{SD}$                          | Source-drain current   |  | -    |                 | 80   | A             |
| $I_{SDM}^{(1)}$                   | Source-drain current (pulsed)  |  | -    |                 | 320  | 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><i>(see Figure 17)</i> | -    | 34<br>35<br>2.1 |      | 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

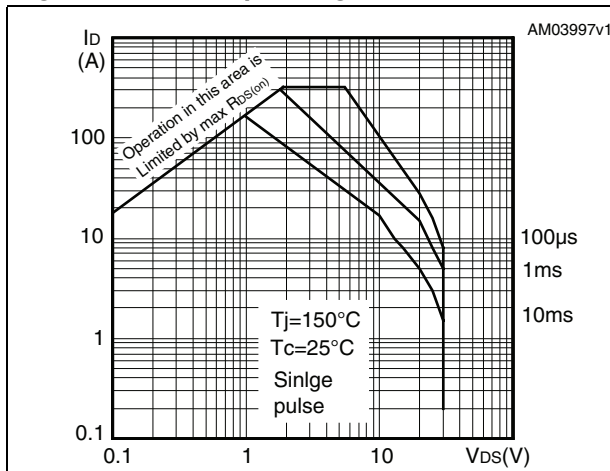


Figure 3. Thermal impedance

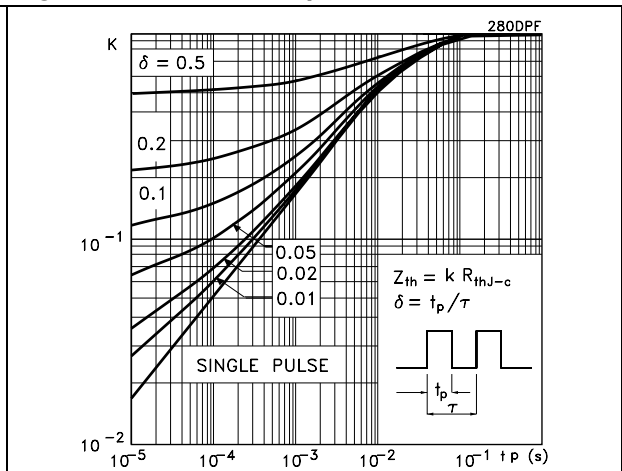


Figure 4. Output characteristics

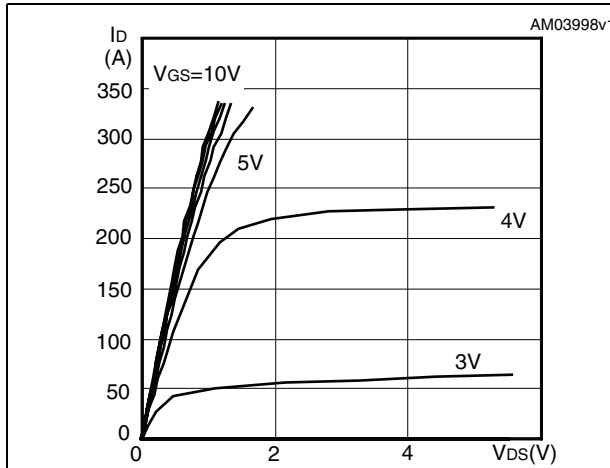


Figure 5. Transfer characteristics

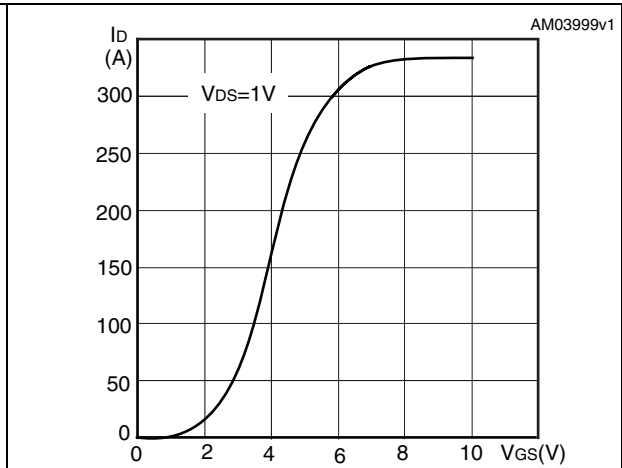


Figure 6. Normalized  $BV_{DSS}$  vs temperature

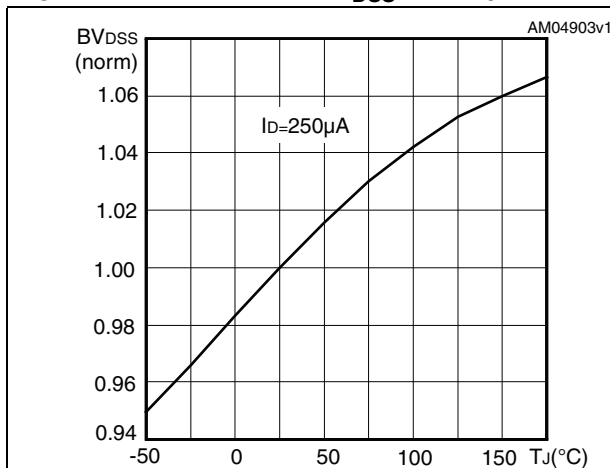


Figure 7. Static drain-source on resistance

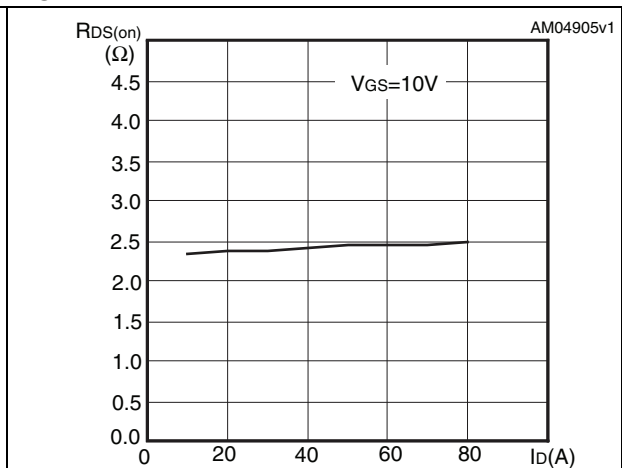


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

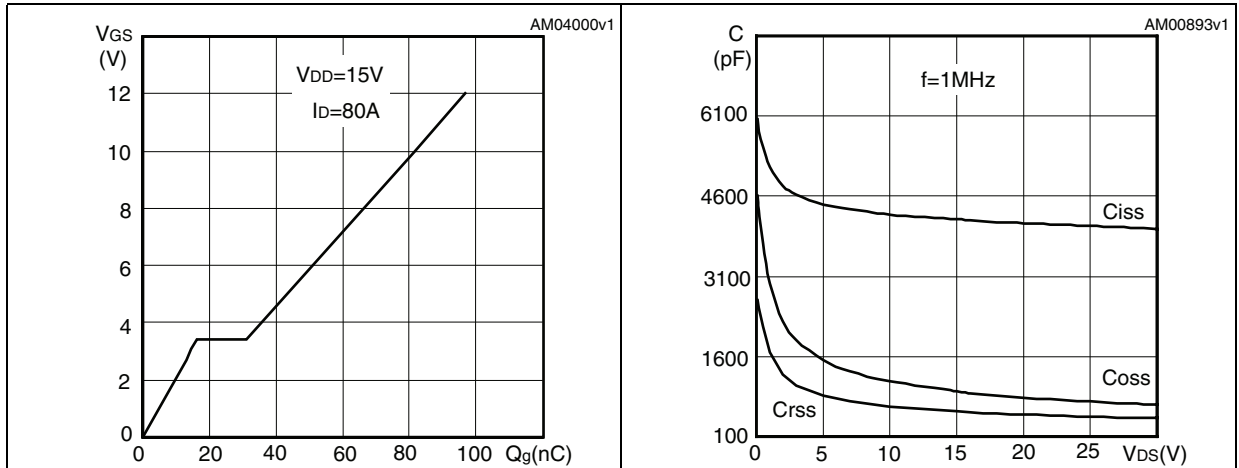


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

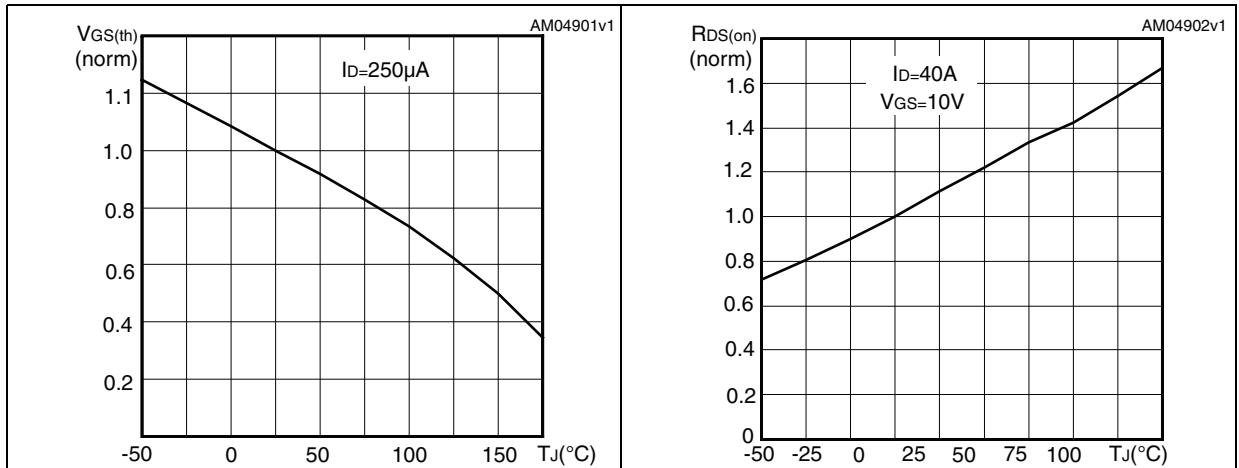
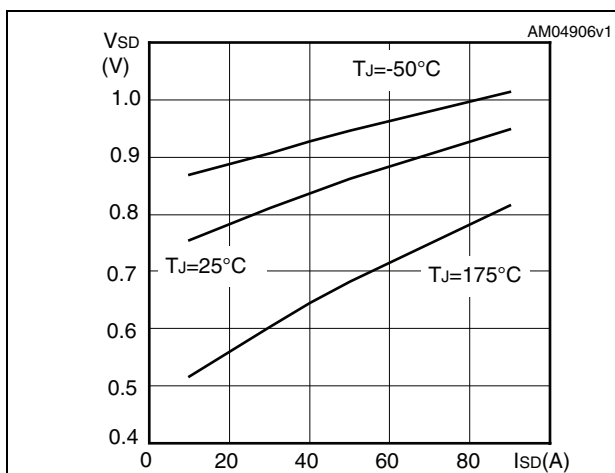
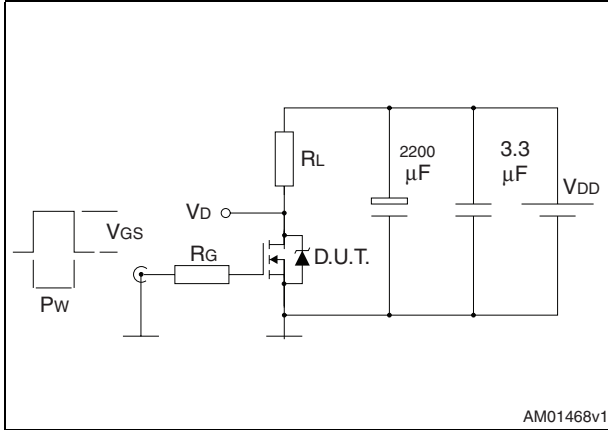


Figure 12. Source-drain diode forward characteristics



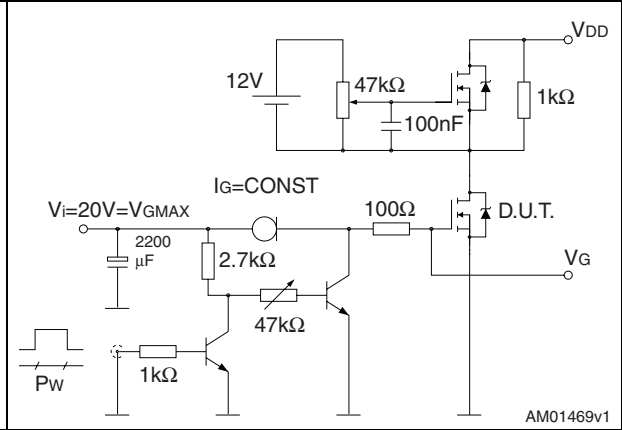
### 3 Test circuit

Figure 13. Switching times test circuit for resistive load



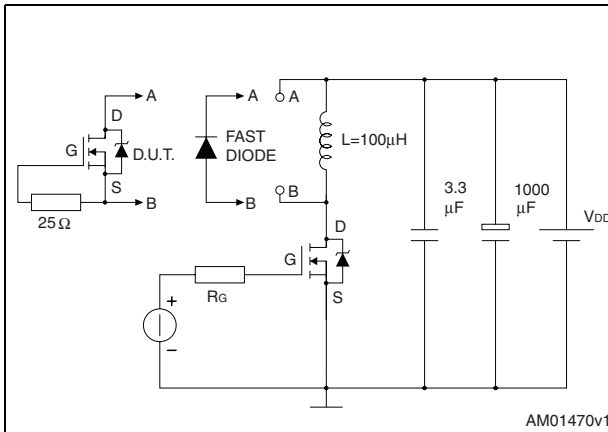
AM01468v1

Figure 14. Gate charge test circuit



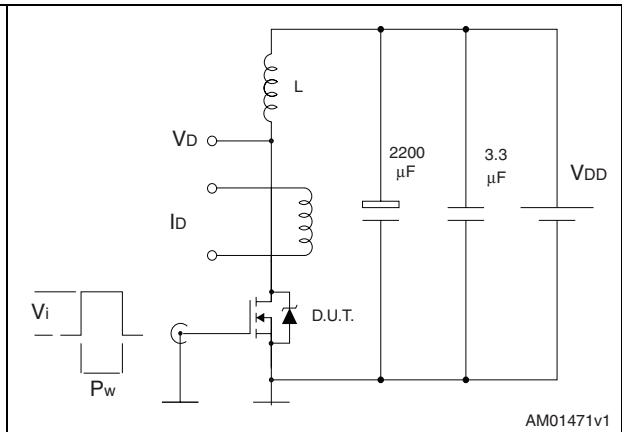
AM01469v1

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



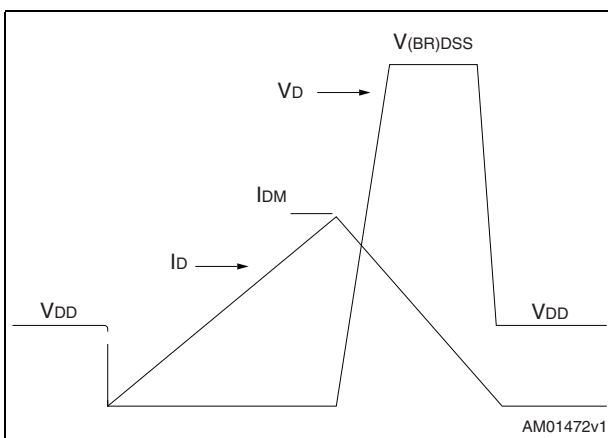
AM01470v1

Figure 16. Unclamped Inductive load test circuit



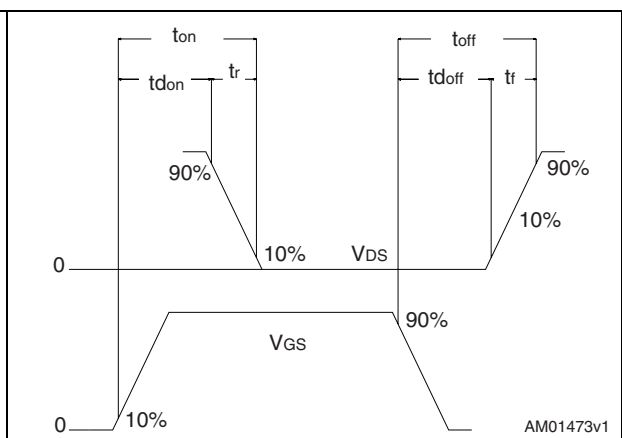
AM01471v1

Figure 17. Unclamped inductive waveform



AM01472v1

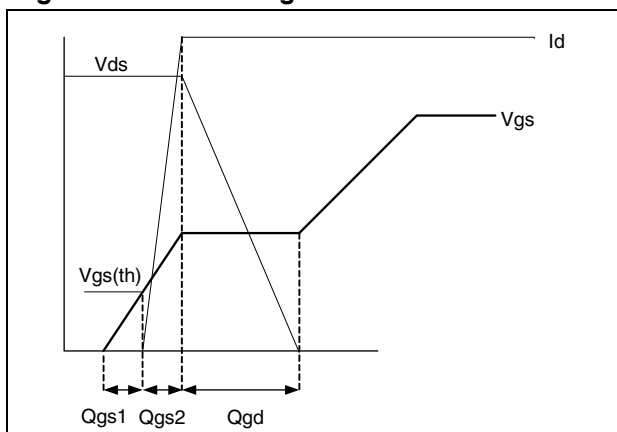
Figure 18. Switching time waveform



AM01473v1



Figure 19. Gate charge waveform

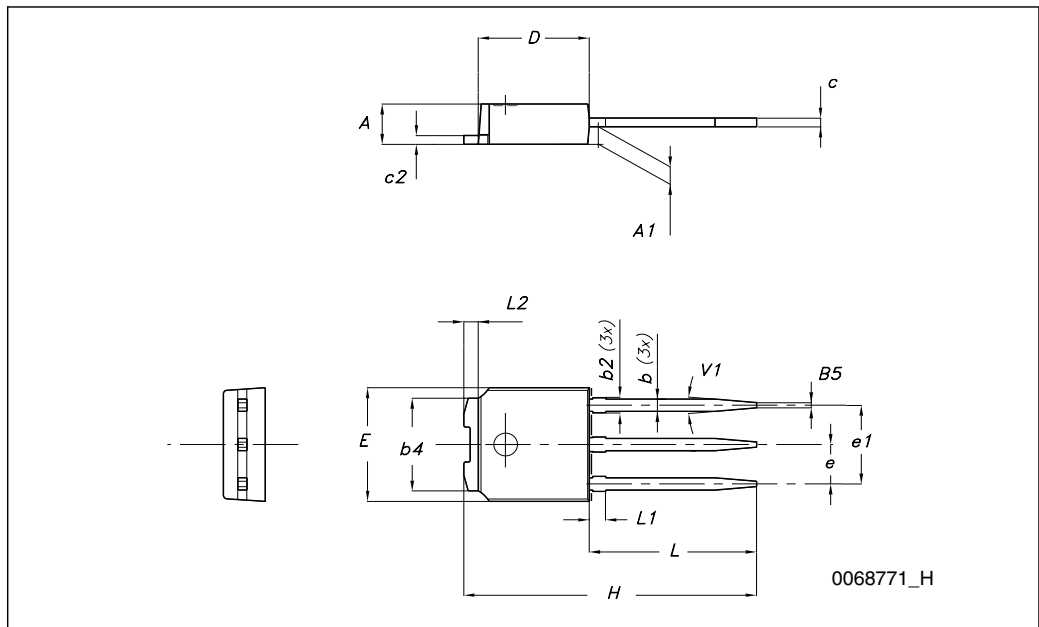


## 4 Package mechanical data

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

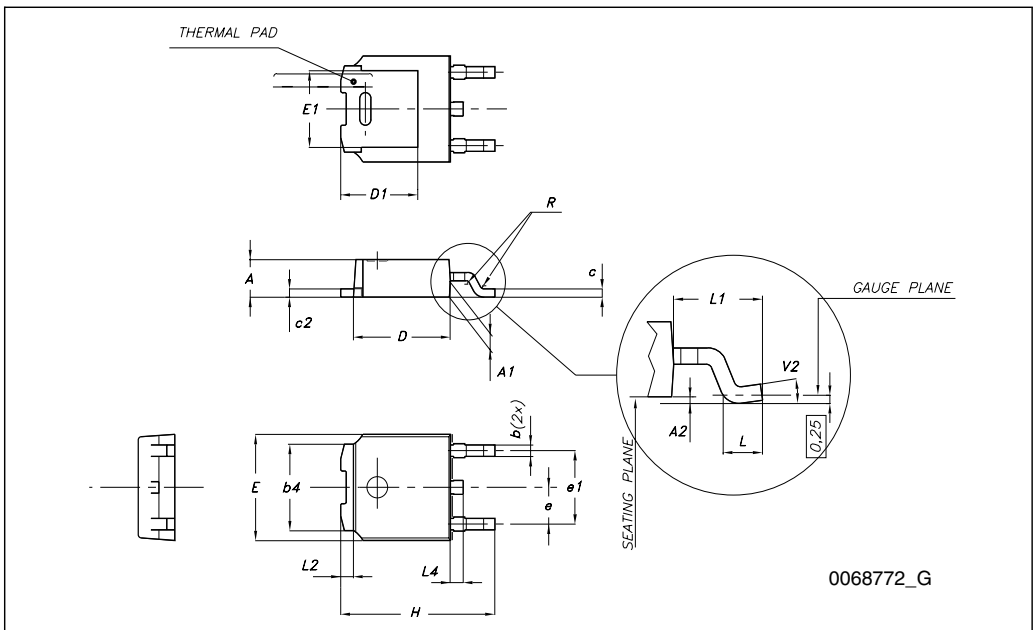
**TO-251 (IPAK) mechanical data**

| 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°   |      |



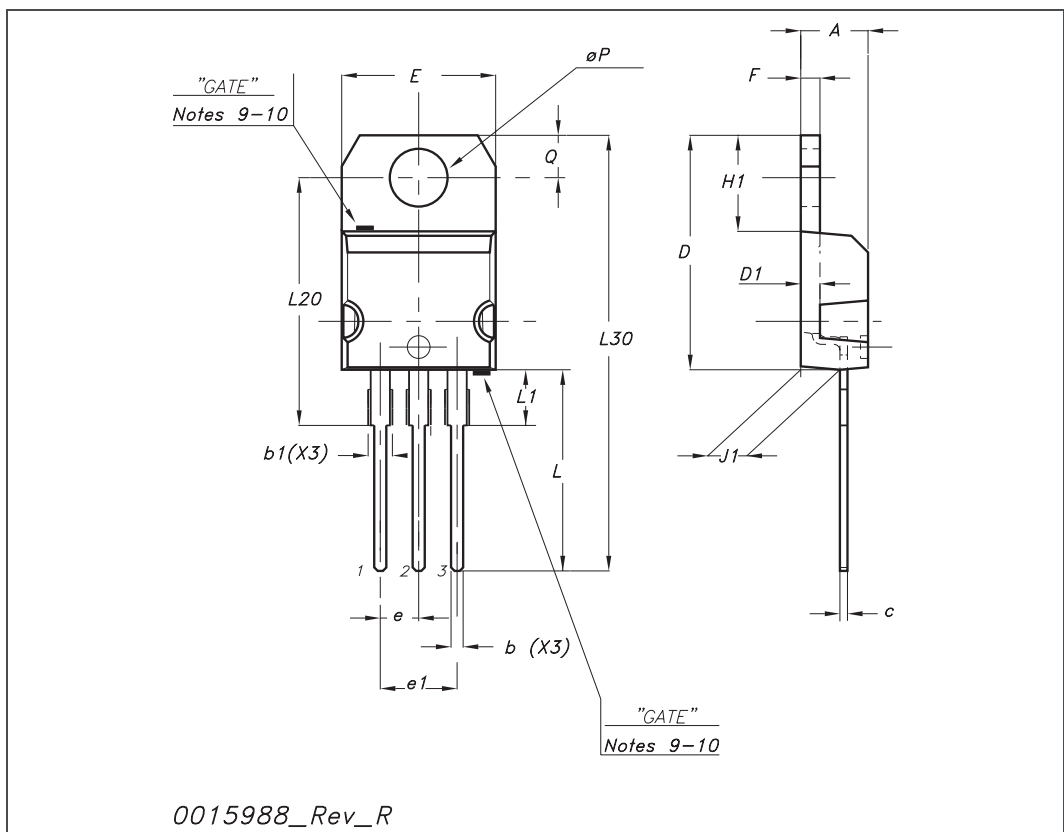
**TO-252 (DPAK) mechanical data**

| 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°    |



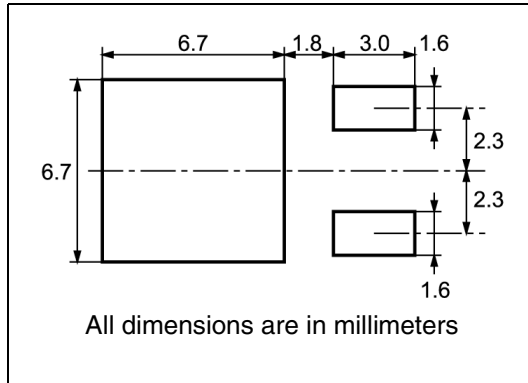
TO-220 mechanical data

| Dim | mm    |       |       | inch  |       |       |
|-----|-------|-------|-------|-------|-------|-------|
|     | Min   | Typ   | Max   | Min   | Typ   | Max   |
| A   | 4.40  |       | 4.60  | 0.173 |       | 0.181 |
| b   | 0.61  |       | 0.88  | 0.024 |       | 0.034 |
| b1  | 1.14  |       | 1.70  | 0.044 |       | 0.066 |
| c   | 0.48  |       | 0.70  | 0.019 |       | 0.027 |
| D   | 15.25 |       | 15.75 | 0.6   |       | 0.62  |
| D1  |       | 1.27  |       |       | 0.050 |       |
| E   | 10    |       | 10.40 | 0.393 |       | 0.409 |
| e   | 2.40  |       | 2.70  | 0.094 |       | 0.106 |
| e1  | 4.95  |       | 5.15  | 0.194 |       | 0.202 |
| F   | 1.23  |       | 1.32  | 0.048 |       | 0.051 |
| H1  | 6.20  |       | 6.60  | 0.244 |       | 0.256 |
| J1  | 2.40  |       | 2.72  | 0.094 |       | 0.107 |
| L   | 13    |       | 14    | 0.511 |       | 0.551 |
| L1  | 3.50  |       | 3.93  | 0.137 |       | 0.154 |
| L20 |       | 16.40 |       |       | 0.645 |       |
| L30 |       | 28.90 |       |       | 1.137 |       |
| ∅P  | 3.75  |       | 3.85  | 0.147 |       | 0.151 |
| Q   | 2.65  |       | 2.95  | 0.104 |       | 0.116 |



# 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 |

### BASE QTY

|      |
|------|
| 2500 |
|------|

### BULK QTY

|      |
|------|
| 2500 |
|------|

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

10 pitches cumulative tolerance on tape +/- 0.2 mm

User Direction of Feed

Center line of cavity

FEED DIRECTION

Bending radius R min.

## 6 Revision history

**Table 8. Document revision history**

| Date        | Revision | Changes   |
|-------------|----------|---|
| 01-Dec-2008 | 1        | First release   |
| 20-Jul-2009 | 2        | – Document status promoted from preliminary data to datasheet<br>– Added new package, mechanical data: TO-220 |
| 10-Sep-2009 | 3        | $Q_{gs}$ and $Q_{gd}$ values have been modified on <a href="#">Table 5: Dynamic</a>                           |

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