



# STB11NM80, STF11NM80 STI11NM80, STP11NM80, STW11NM80

N-channel 800 V, 0.35  $\Omega$ , 11 A MDmesh™ Power MOSFET  
in D<sup>2</sup>PAK, TO-220FP, I<sup>2</sup>PAK, TO-220, TO-247

## Features

| Order codes | V <sub>DSS</sub> | R <sub>DS(on) max</sub> | R <sub>DS(on)</sub> *Q <sub>g</sub> | I <sub>D</sub> |
|-------------|------------------|-------------------------|-------------------------------------|----------------|
| STB11NM80   | 800 V            | < 0.40 $\Omega$         | 14 $\Omega$ *nC                     | 11 A           |
| STF11NM80   |                  |                         |                                     |                |
| STI11NM80   |                  |                         |                                     |                |
| STP11NM80   |                  |                         |                                     |                |
| STW11NM80   |                  |                         |                                     |                |

- Low input capacitance and gate charge
- Low gate input resistance
- Best R<sub>DS(on)</sub>\*Q<sub>g</sub> in the industry

## Applications

- Switching applications

## Description

These N-channel Power MOSFETs are developed using STMicroelectronics' revolutionary MDmesh™ technology, which associates the multiple drain process with the company's PowerMESH™ horizontal layout. These devices offer extremely low on-resistance, high dv/dt and excellent avalanche characteristics. Utilizing ST's proprietary strip technique, these Power MOSFETs boast an overall dynamic performance which is superior to similar products on the market.

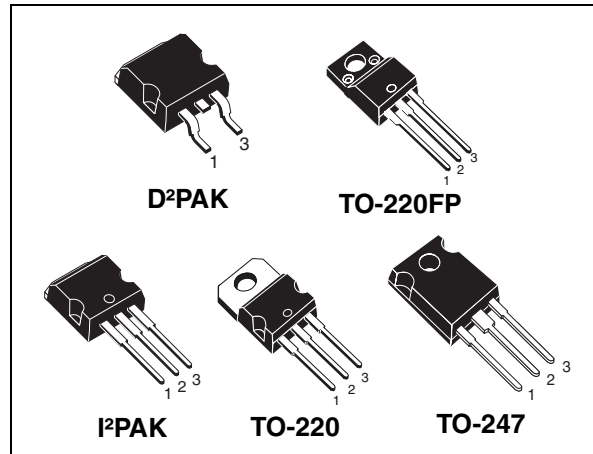


Figure 1. Internal schematic diagram

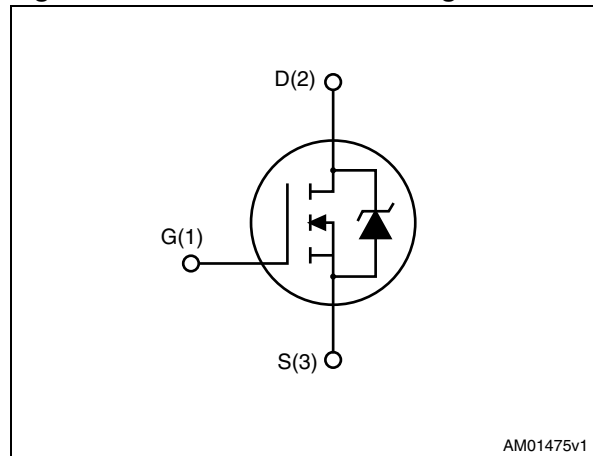


Table 1. Device summary

| Order codes | Marking | Package            | Packaging     |
|-------------|---------|--------------------|---------------|
| STB11NM80   | B11NM80 | D <sup>2</sup> PAK | Tape and reel |
| STF11NM80   | F11NM80 | TO-220FP           | Tube          |
| STI11NM80   | I11NM80 | I <sup>2</sup> PAK |               |
| STP11NM80   | P11NM80 | TO-220             |               |
| STW11NM80   | W11NM80 | TO-247             |               |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol                             | Parameter   | Value  |                   | Unit |
|------------------------------------|---|--|-------------------|------|
|                                    |   | D <sup>2</sup> PAK, I <sup>2</sup> PAK<br>TO-220, TO-247 | TO-220FP          |      |
| V <sub>DS</sub>                    | Drain-source voltage (V <sub>GS</sub> = 0)            | 800  |                   | V    |
| V <sub>GS</sub>                    | Gate-source voltage                                   | ±30  |                   | V    |
| I <sub>D</sub>                     | Drain current (continuous) at T <sub>C</sub> = 25 °C  | 11   | 11 <sup>(1)</sup> | A    |
| I <sub>D</sub>                     | Drain current (continuous) at T <sub>C</sub> =100 °C  | 8  | 8 <sup>(1)</sup>  | A    |
| I <sub>DM</sub> <sup>(2)</sup>     | Drain current (pulsed)                                | 44   | 44 <sup>(1)</sup> | A    |
| P <sub>TOT</sub>                   | Total dissipation at T <sub>C</sub> = 25 °C           | 150  | 35                | W    |
|                                    | Derating factor                                       | 1.2  | 0.28              | W/°C |
| V <sub>ISO</sub>                   | Insulation withstand voltage (DC)                     |  | 2500              | V    |
| T <sub>J</sub><br>T <sub>stg</sub> | Operating junction temperature<br>Storage temperature | -65 to 150   |                   | °C   |

- Limited only by the maximum temperature allowed
- Pulse width limited by safe operating area

**Table 3. Thermal data**

| Symbol                              | Parameter                                      | Value              |          |                    |        |        | Unit |
|-------------------------------------|--|--------------------|----------|--------------------|--------|--------|------|
|                                     |  | D <sup>2</sup> PAK | TO-220FP | I <sup>2</sup> PAK | TO-220 | TO-247 |      |
| R <sub>thj-case</sub>               | Thermal resistance junction-case max           | 0.83               | 3.6      | 0.83               |        |        | °C/W |
| R <sub>thj-a</sub>                  | Thermal resistance junction-ambient max        |                    | 62.5     |                    | 50     |        | °C/W |
| R <sub>thj-pcb</sub> <sup>(1)</sup> | Thermal resistance junction-pcb max            | 30                 |          |                    |        |        | °C/W |
| T <sub>l</sub>                      | Maximum lead temperature for soldering purpose |                    | 300      |                    |        |        | °C   |

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

**Table 4. Avalanche characteristics**

| Symbol          | Parameter  | Value | Unit |
|-----------------|--|-------|------|
| I <sub>AS</sub> | Avalanche current, repetitive or not-repetitive (pulse width limited by T <sub>J</sub> max)                                | 2.5   | A    |
| E <sub>AS</sub> | Single pulse avalanche energy (starting T <sub>J</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V) | 400   | mJ   |

## 2 Electrical characteristics

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

**Table 5. On/off states**

| Symbol        | Parameter  | Test conditions   | Min. | Typ. | Max.      | Unit                           |
|---------------|--|---|------|------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage ( $V_{GS} = 0$ )  | $I_D = 250\ \mu\text{A}$  | 800  |      |           | V                              |
| $dv/dt^{(1)}$ | Drain source voltage slope                       | $V_{DD} = 640\text{ V}$ , $I_D = 11\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ | 30   |      |           | V/ns                           |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 800\text{ V}$ ,<br>$V_{DS} = 800\text{ V @ }125\text{ °C}$      |      |      | 10<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 30\text{ V}$  |      |      | 100       | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$                              | 3    | 4    | 5         | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 5.5\text{ A}$                             |      | 0.35 | 0.40      | $\Omega$                       |

1. Characteristic value at turn off on inductive load

**Table 6. Dynamic**

| Symbol  | Parameter   | Test conditions  | Min. | Typ.                 | Max. | Unit                 |
|---|---|--|------|----------------------|------|----------------------|
| $g_{fs}^{(1)}$                                | Forward transconductance  | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$ ,<br>$I_D = 7.5\text{ A}$  | -    | 8                    | -    | 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>$V_{GS} = 0$  | -    | 1630<br>750<br>30    | -    | pF<br>pF<br>pF       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$                 | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 640\text{ V}$ , $I_D = 11\text{ A}$<br>$V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 18</a> )                          | -    | 43.6<br>11.6<br>21   | -    | nC<br>nC<br>nC       |
| $R_g$   | Gate input resistance   | $f = 1\text{ MHz}$ Gate DC Bias = 0<br>Test signal level = 20 mV<br>open drain   | -    | 2.7                  | -    | $\Omega$             |
| $t_{d(on)}$<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     | $V_{DD} = 400\text{ V}$ , $I_D = 5.5\text{ A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 17</a> ) | -    | 22<br>17<br>46<br>15 | -    | ns<br>ns<br>ns<br>ns |

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

Table 7. Source drain diode

| Symbol          | Parameter                     | Test conditions   | Min. | Typ.  | Max. | Unit          |
|-----------------|-------------------------------|---|------|-------|------|---------------|
| $I_{SD}$        | Source-drain current          |   | -    |       | 11   | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |   |      |       | 44   | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD}=11\text{ A}$ , $V_{GS}=0$   | -    |       | 0.86 | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD}=11\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD}= 50\text{ V}$                                   | -    | 612   |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |   |      | 7.22  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |   |      | 23.6  |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD}=11\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD}= 50\text{ V}$ , $T_j=150\text{ }^\circ\text{C}$ | -    | 970   |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |   |      | 11.25 |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |   |      | 23.2  |      | 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 for D<sup>2</sup>PAK, I<sup>2</sup>PAK, TO-220, TO-247

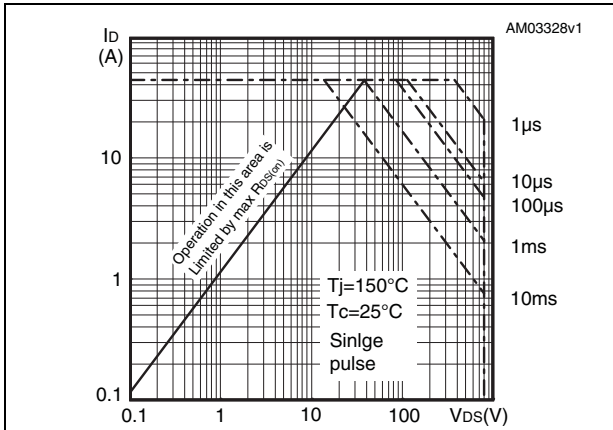


Figure 3. Thermal impedance for D<sup>2</sup>PAK, I<sup>2</sup>PAK, TO-220, TO-247

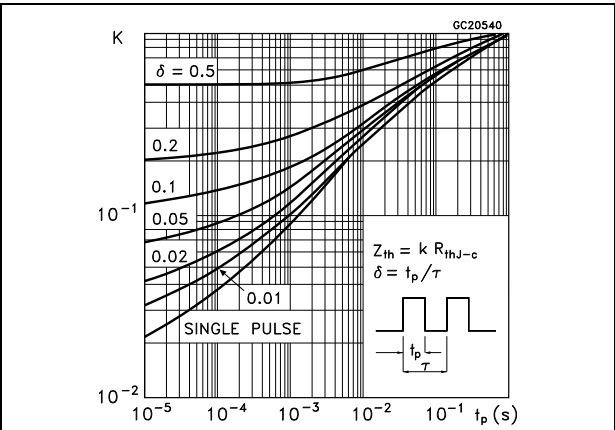


Figure 4. Safe operating area for TO-220FP

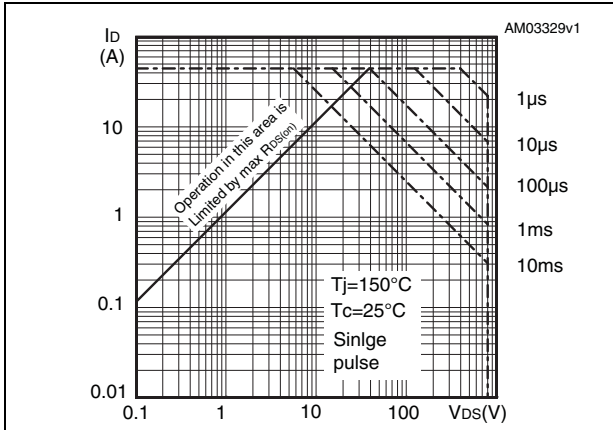


Figure 5. Thermal impedance for TO-220FP

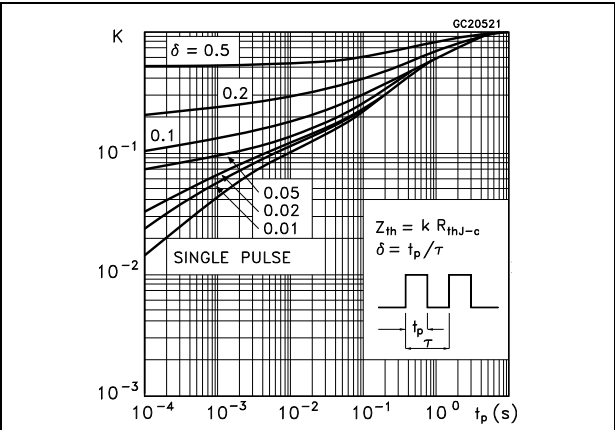


Figure 6. Output characteristics

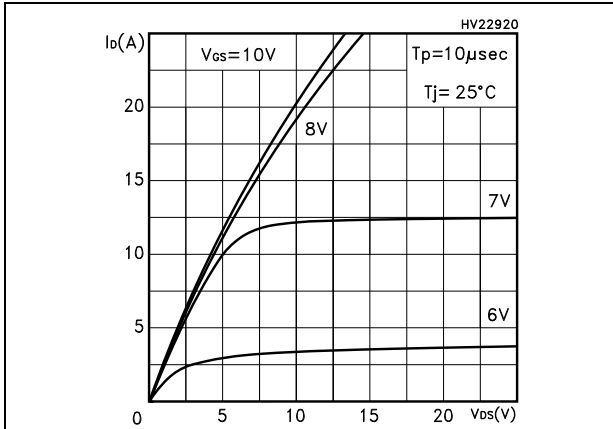


Figure 7. Output characteristics @ Tj=150 °C

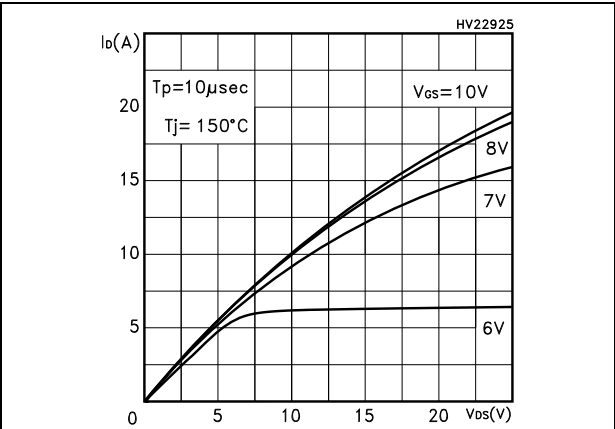


Figure 8. Transfer characteristics

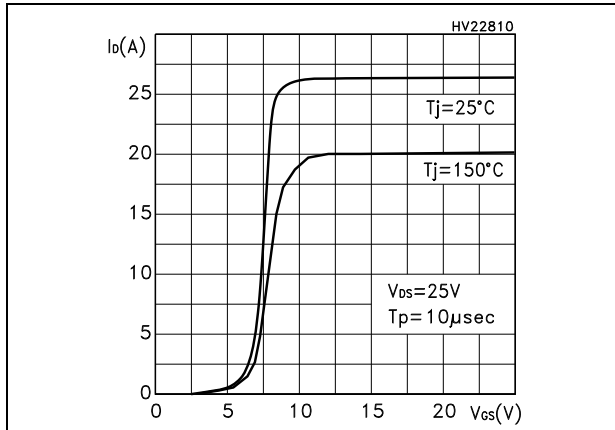


Figure 9. Transconductance

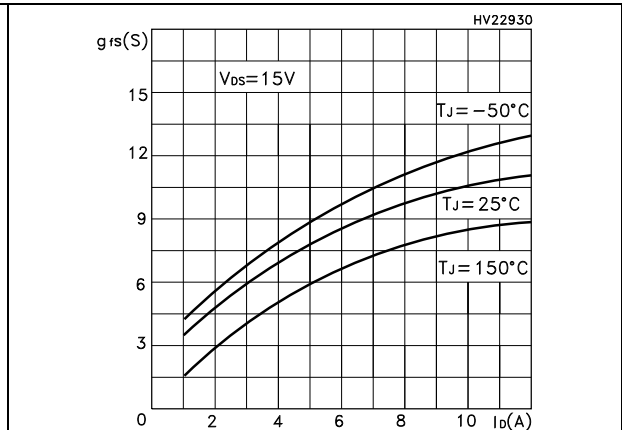


Figure 10. Gate charge vs gate-source voltage Figure 11. Capacitance variations

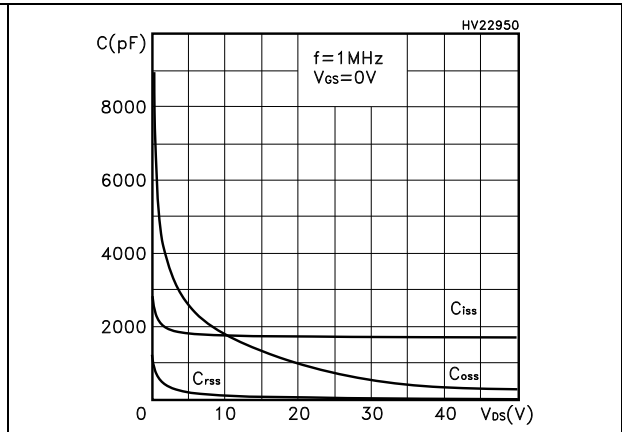
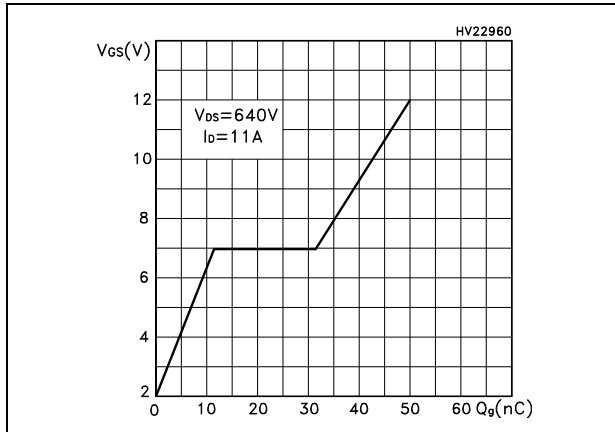


Figure 12. Normalized gate threshold voltage vs temperature Figure 13. Static drain-source on resistance vs temperature

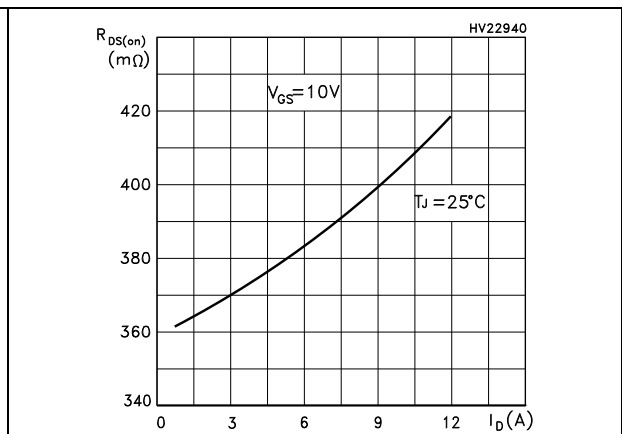
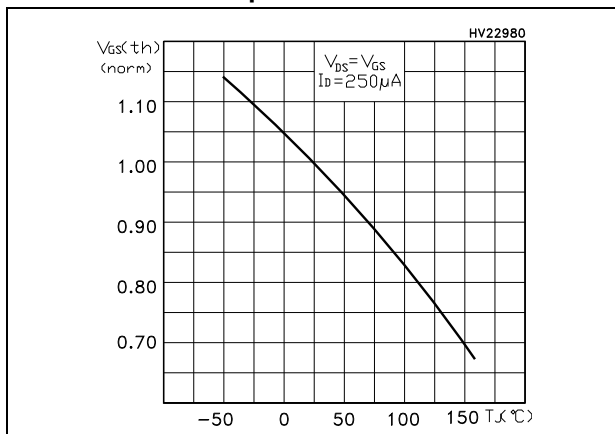


Figure 14. Source-drain diode forward characteristics

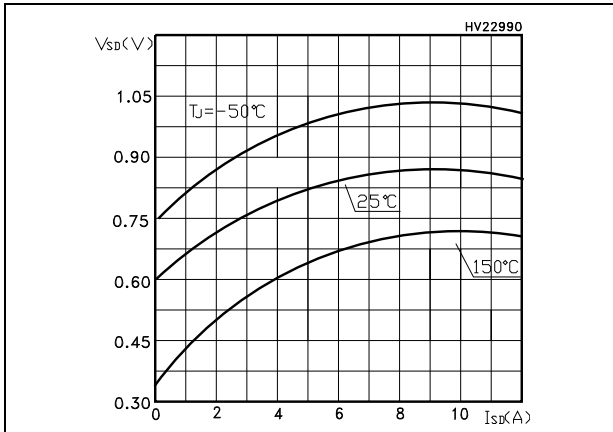


Figure 15. Normalized on resistance vs temperature

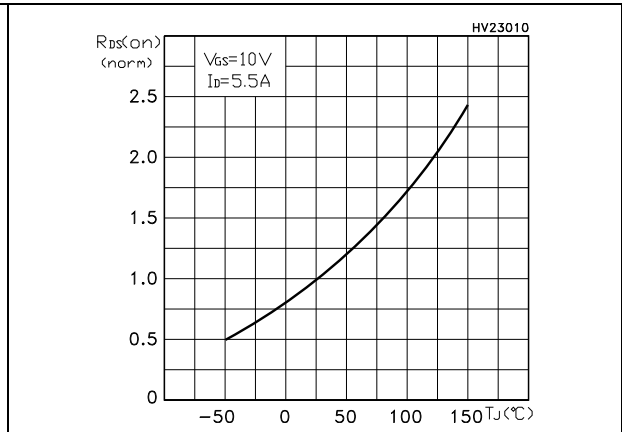
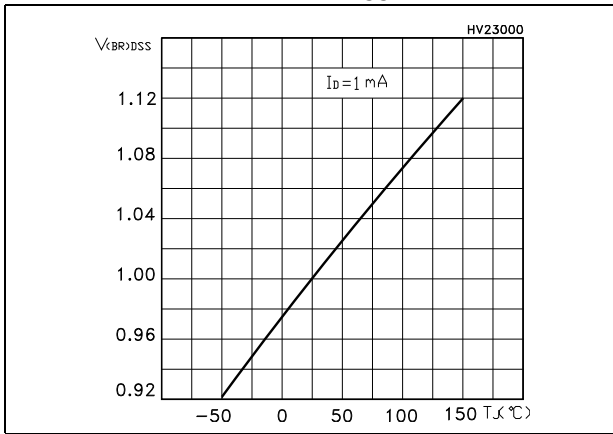


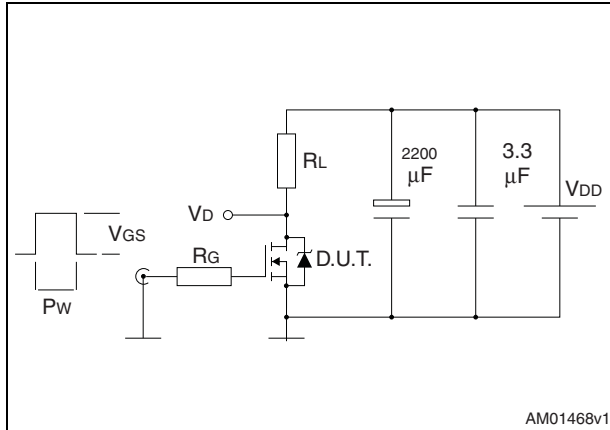
Figure 16. Normalized  $B_{V_{DSS}}$  vs temperature





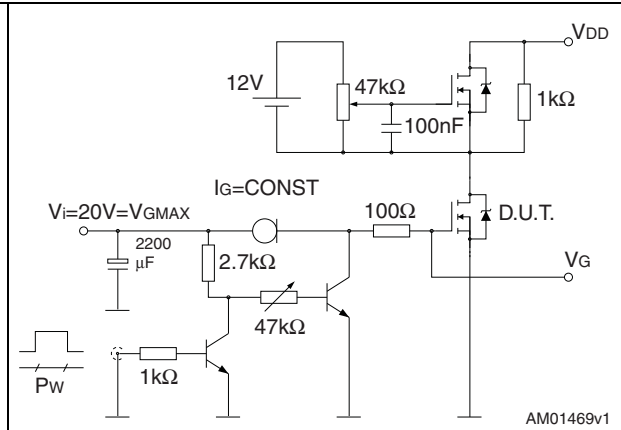
### 3 Test circuits

**Figure 17. Switching times test circuit for resistive load**



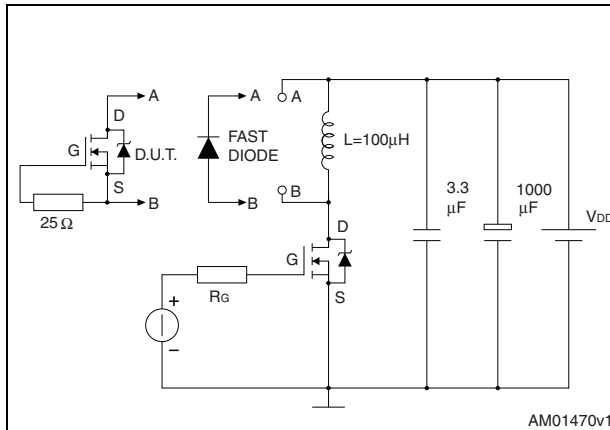
AM01468v1

**Figure 18. Gate charge test circuit**



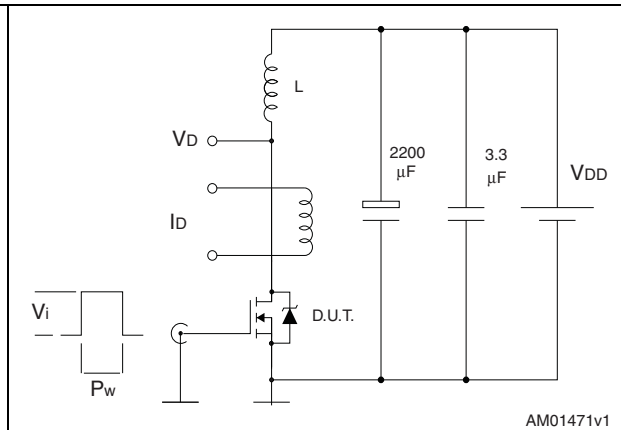
AM01469v1

**Figure 19. Test circuit for inductive load switching and diode recovery times**



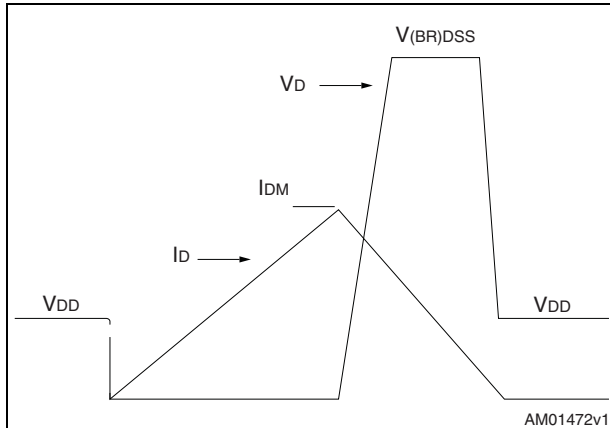
AM01470v1

**Figure 20. Unclamped inductive load test circuit**



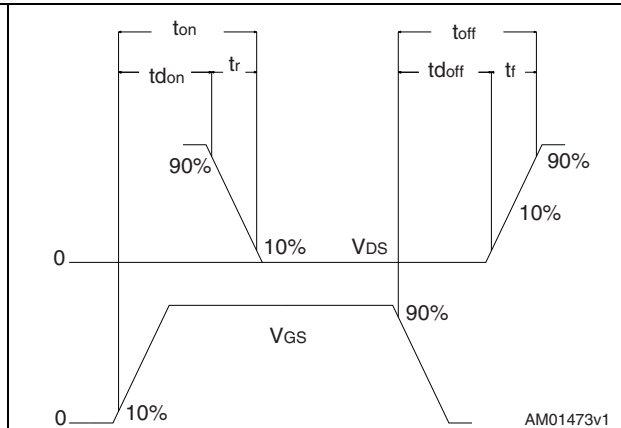
AM01471v1

**Figure 21. Unclamped inductive waveform**



AM01472v1

**Figure 22. Switching time waveform**



AM01473v1

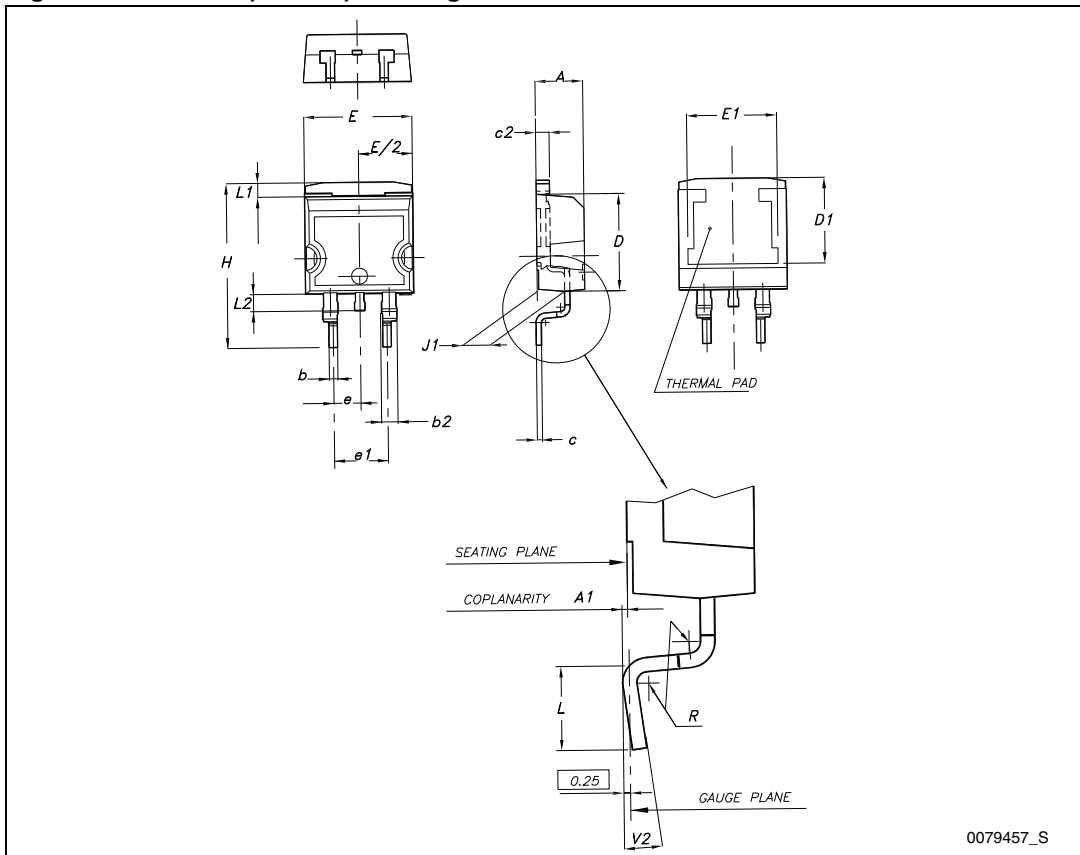
## 4 Package mechanical data

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.

Table 8. D<sup>2</sup>PAK (TO-263) mechanical data

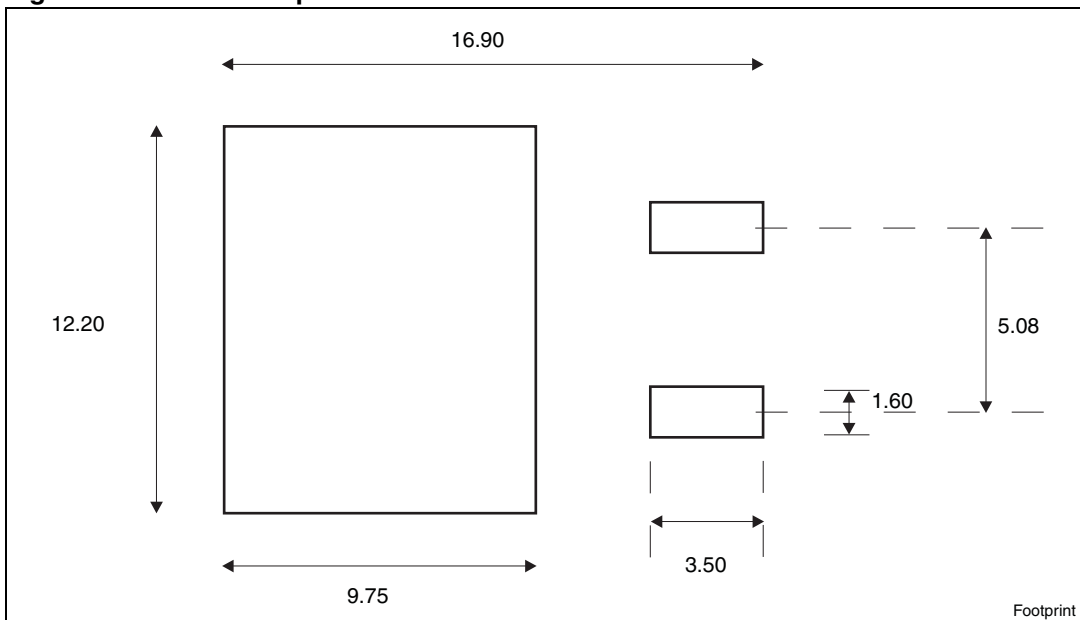
| Dim. | mm   |      |       |
|------|------|------|-------|
|      | Min. | Typ. | Max.  |
| A    | 4.40 |      | 4.60  |
| A1   | 0.03 |      | 0.23  |
| b    | 0.70 |      | 0.93  |
| b2   | 1.14 |      | 1.70  |
| c    | 0.45 |      | 0.60  |
| c2   | 1.23 |      | 1.36  |
| D    | 8.95 |      | 9.35  |
| D1   | 7.50 |      |       |
| E    | 10   |      | 10.40 |
| E1   | 8.50 |      |       |
| e    |      | 2.54 |       |
| e1   | 4.88 |      | 5.28  |
| H    | 15   |      | 15.85 |
| J1   | 2.49 |      | 2.69  |
| L    | 2.29 |      | 2.79  |
| L1   | 1.27 |      | 1.40  |
| L2   | 1.30 |      | 1.75  |
| R    |      | 0.4  |       |
| V2   | 0°   |      | 8°    |

Figure 23. D<sup>2</sup>PAK (TO-263) drawing



0079457\_S

Figure 24. D<sup>2</sup>PAK footprint<sup>(a)</sup>



a. All dimension are in millimeters

Table 9. TO-220FP mechanical data

| Dim. | mm   |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 4.4  |      | 4.6  |
| B    | 2.5  |      | 2.7  |
| D    | 2.5  |      | 2.75 |
| E    | 0.45 |      | 0.7  |
| F    | 0.75 |      | 1    |
| F1   | 1.15 |      | 1.70 |
| F2   | 1.15 |      | 1.70 |
| G    | 4.95 |      | 5.2  |
| G1   | 2.4  |      | 2.7  |
| H    | 10   |      | 10.4 |
| L2   |      | 16   |      |
| L3   | 28.6 |      | 30.6 |
| L4   | 9.8  |      | 10.6 |
| L5   | 2.9  |      | 3.6  |
| L6   | 15.9 |      | 16.4 |
| L7   | 9    |      | 9.3  |
| Dia  | 3    |      | 3.2  |

Figure 25. TO-220FP drawing

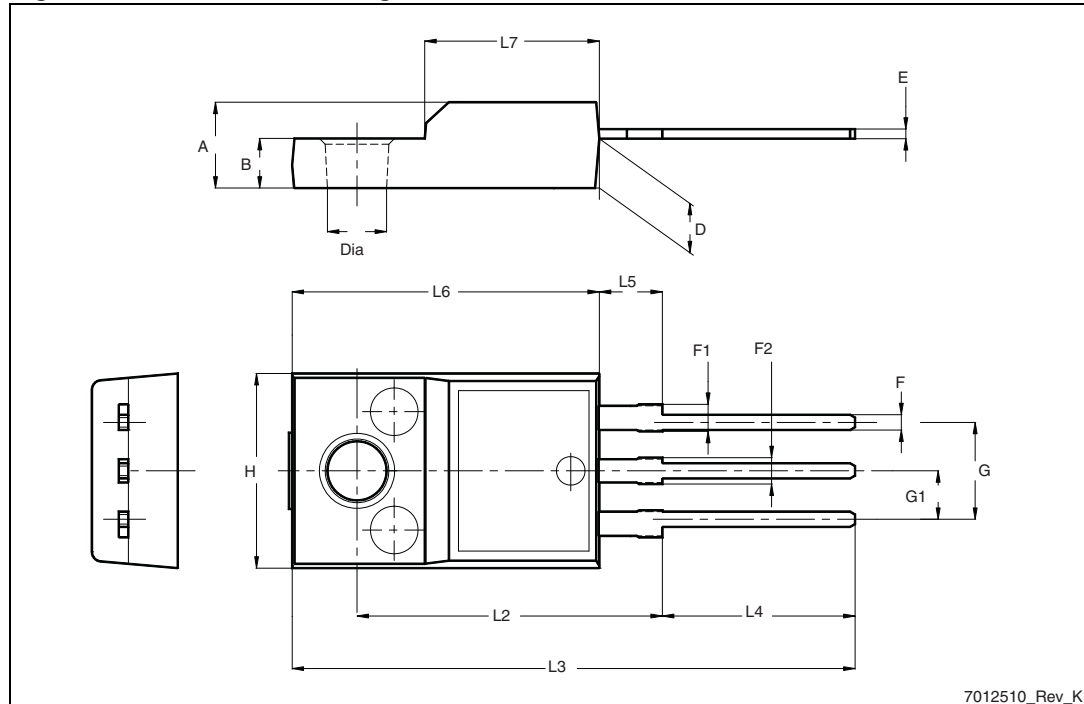


Table 10. I<sup>2</sup>PAK (TO-262) mechanical data

| DIM. | mm.  |     |       |
|------|------|-----|-------|
|      | min. | typ | max.  |
| A    | 4.40 |     | 4.60  |
| A1   | 2.40 |     | 2.72  |
| b    | 0.61 |     | 0.88  |
| b1   | 1.14 |     | 1.70  |
| c    | 0.49 |     | 0.70  |
| c2   | 1.23 |     | 1.32  |
| D    | 8.95 |     | 9.35  |
| e    | 2.40 |     | 2.70  |
| e1   | 4.95 |     | 5.15  |
| E    | 10   |     | 10.40 |
| L    | 13   |     | 14    |
| L1   | 3.50 |     | 3.93  |
| L2   | 1.27 |     | 1.40  |

Figure 26. I<sup>2</sup>PAK (TO-262) drawing

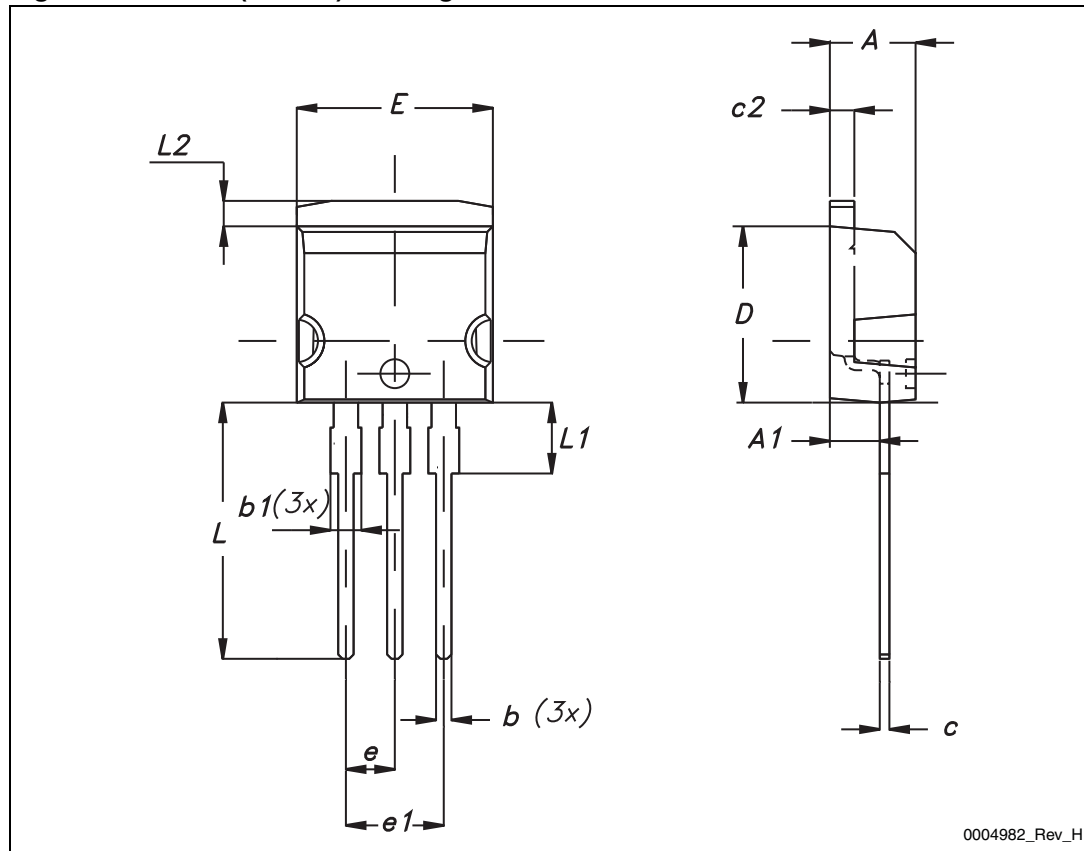
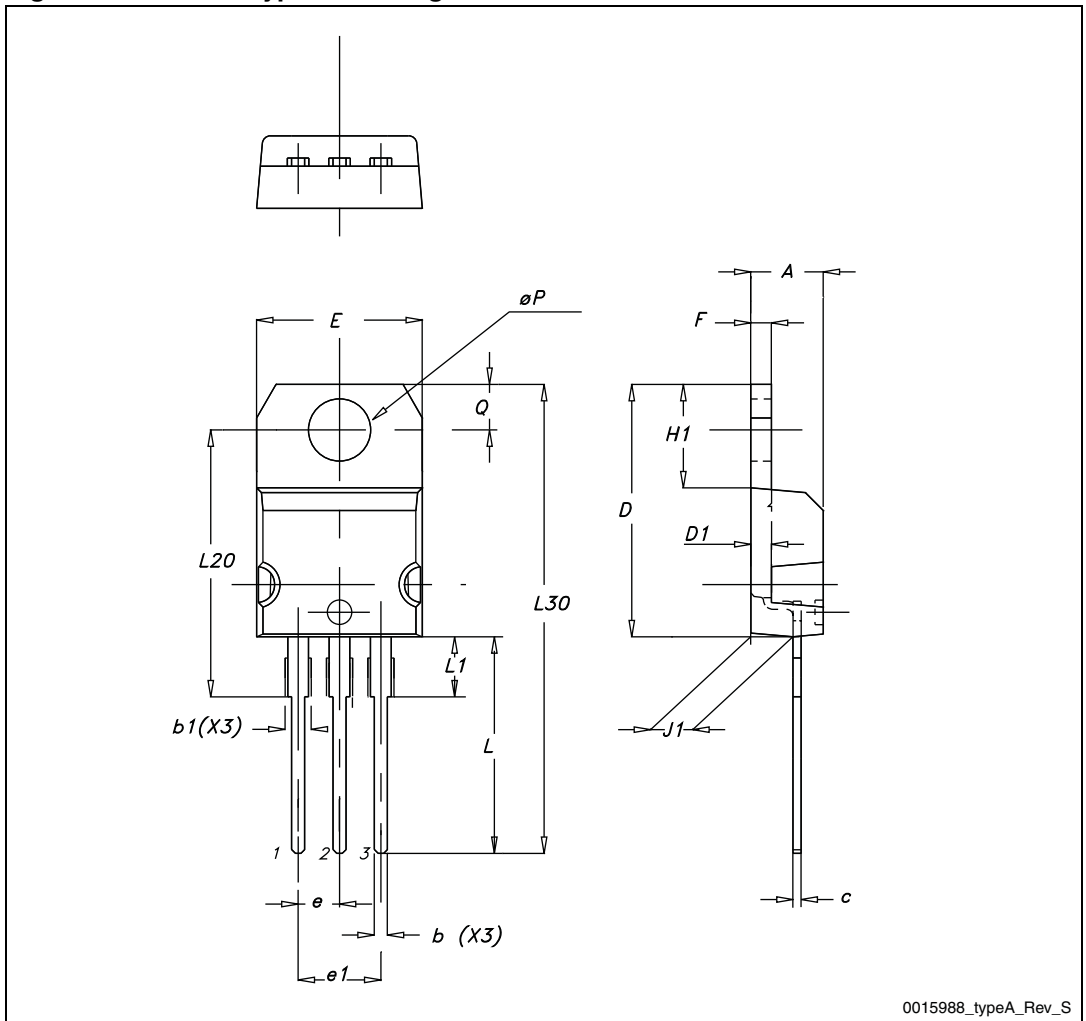


Table 11. TO-220 type A mechanical data

| 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 27. TO-220 type A drawing



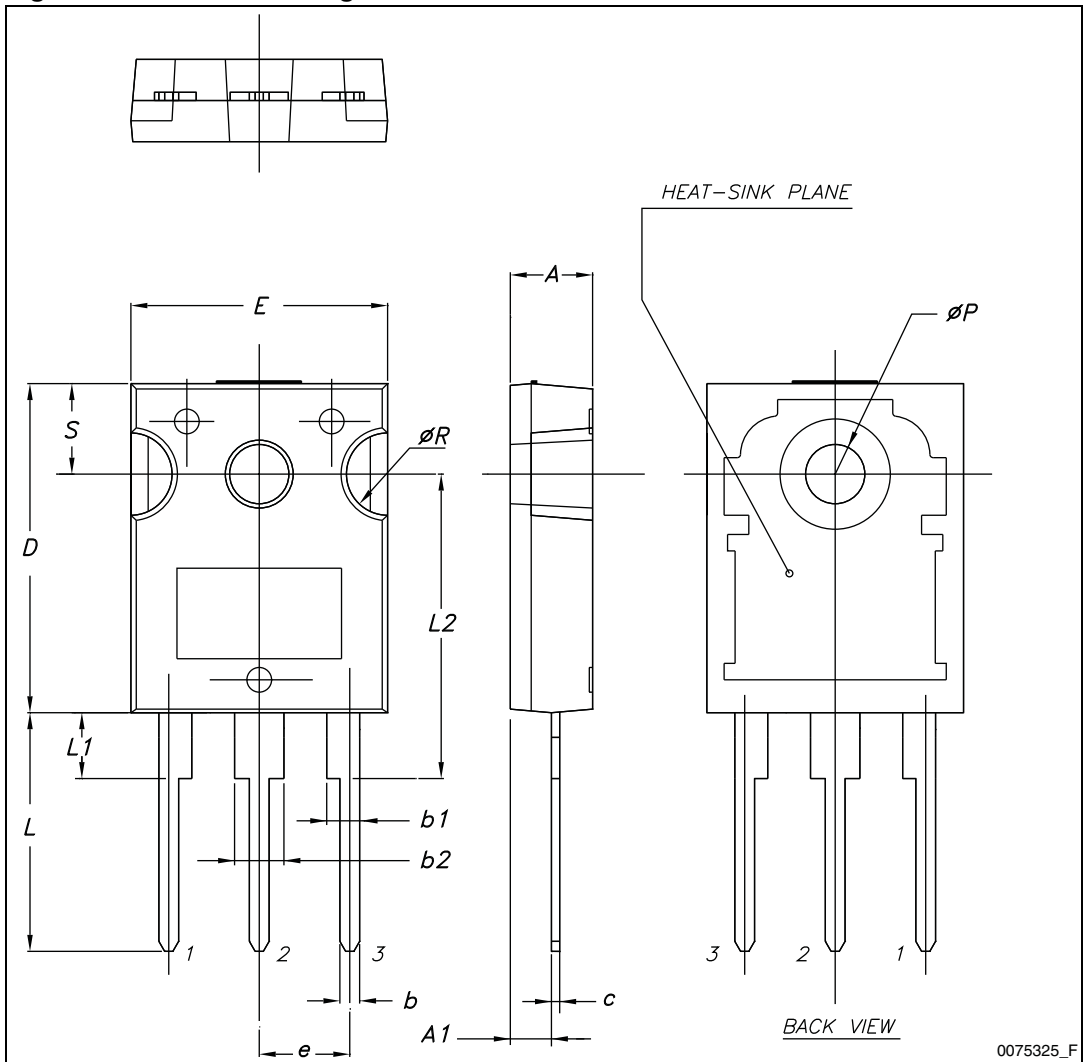
0015988\_typeA\_Rev\_S



Table 12. TO-247 mechanical data

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.85  |       | 5.15  |
| A1   | 2.20  |       | 2.60  |
| b    | 1.0   |       | 1.40  |
| b1   | 2.0   |       | 2.40  |
| b2   | 3.0   |       | 3.40  |
| c    | 0.40  |       | 0.80  |
| D    | 19.85 |       | 20.15 |
| E    | 15.45 |       | 15.75 |
| e    |       | 5.45  |       |
| L    | 14.20 |       | 14.80 |
| L1   | 3.70  |       | 4.30  |
| L2   |       | 18.50 |       |
| ØP   | 3.55  |       | 3.65  |
| ØR   | 4.50  |       | 5.50  |
| S    |       | 5.50  |       |

Figure 28. TO-247 drawing



## 5 Packaging mechanical data

Table 13. D<sup>2</sup>PAK (TO-263) tape and reel mechanical data

| Tape |      |      | Reel     |      |      |
|------|------|------|----------|------|------|
| Dim. | mm   |      | Dim.     | mm   |      |
|      | Min. | Max. |          | Min. | Max. |
| A0   | 10.5 | 10.7 | A        |      | 330  |
| B0   | 15.7 | 15.9 | B        | 1.5  |      |
| D    | 1.5  | 1.6  | C        | 12.8 | 13.2 |
| D1   | 1.59 | 1.61 | D        | 20.2 |      |
| E    | 1.65 | 1.85 | G        | 24.4 | 26.4 |
| F    | 11.4 | 11.6 | N        | 100  |      |
| K0   | 4.8  | 5.0  | T        |      | 30.4 |
| P0   | 3.9  | 4.1  |          |      |      |
| P1   | 11.9 | 12.1 | Base qty |      | 1000 |
| P2   | 1.9  | 2.1  | Bulk qty |      | 1000 |
| R    | 50   |      |          |      |      |
| T    | 0.25 | 0.35 |          |      |      |
| W    | 23.7 | 24.3 |          |      |      |

Figure 29. Tape

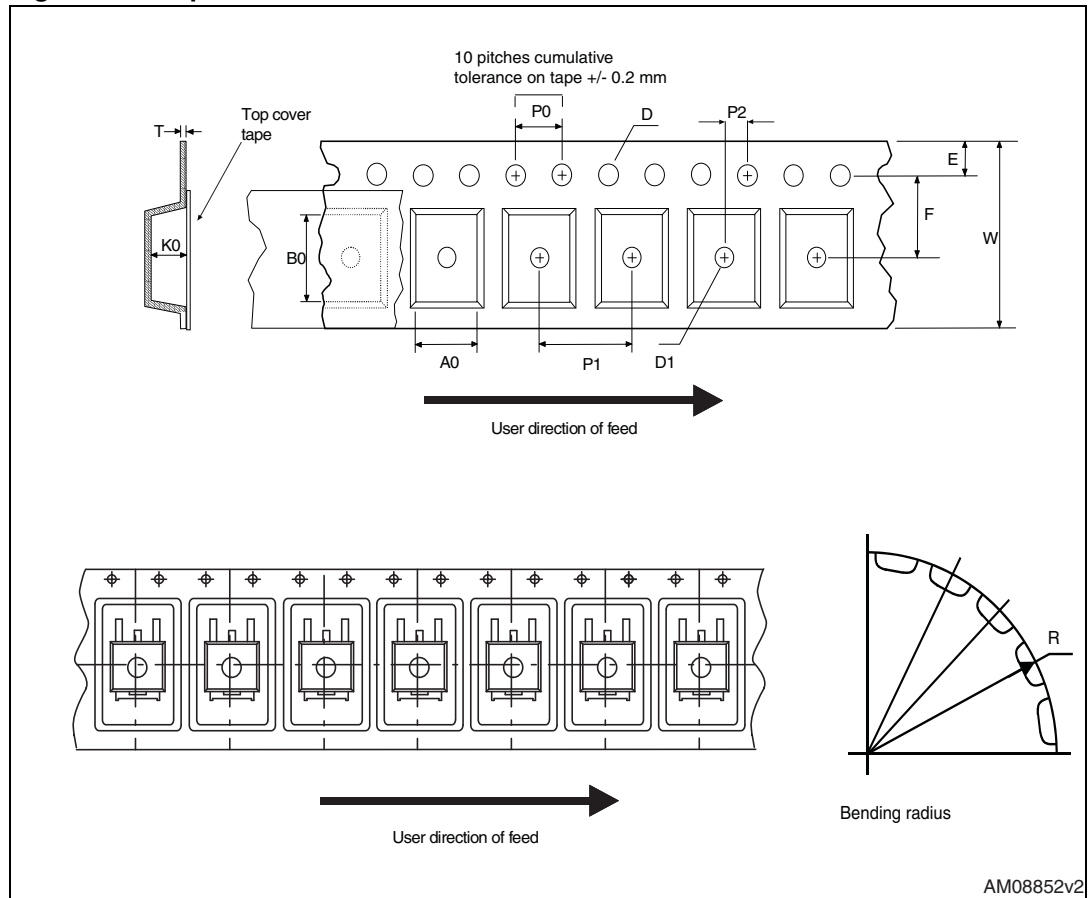
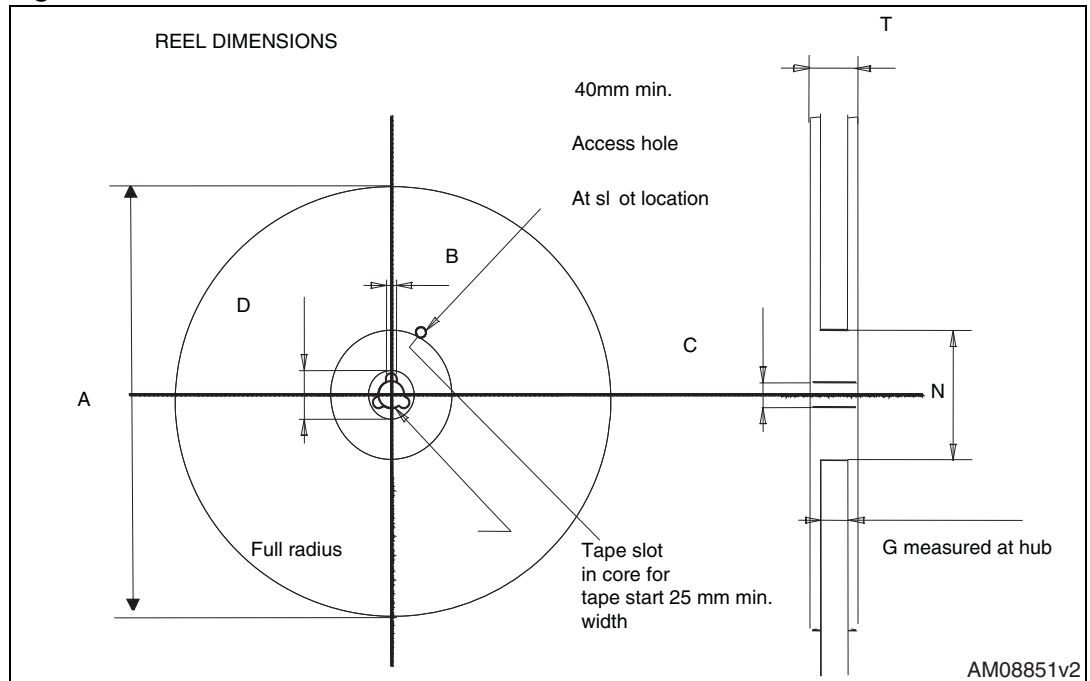


Figure 30. Reel



## 6 Revision history

**Table 14. Document revision history**

| Date        | Revision | Changes   |
|-------------|----------|---|
| 30-Sep-2004 | 4        | Preliminary version   |
| 26-Nov-2005 | 5        | Complete version  |
| 07-Apr-2006 | 6        | Modified value on <a href="#">Figure 8</a>  |
| 15-May-2006 | 7        | New dv/dt value on <a href="#">Table 5</a>  |
| 20-Jul-2006 | 8        | The document has been reformatted   |
| 20-Dec-2007 | 9        | Updated I <sub>D</sub> value on <a href="#">Table 2: Absolute maximum ratings</a> |
| 24-Mar-2010 | 10       | Inserted dv/dt value in <a href="#">Table 2: Absolute maximum ratings</a>         |
| 12-Sep-2011 | 11       | Added new package and mechanical data : I <sup>2</sup> PAK<br>Minor text changes  |

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