

N-channel 800 V, 0.3  $\Omega$  typ., 14 A MDmesh™ K5 Power MOSFETs  
in D<sup>2</sup>PAK, TO-220FP, TO-220 and TO-247 packages

Datasheet – production data

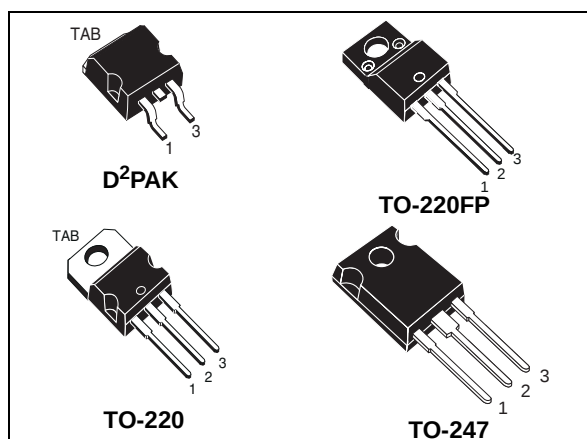
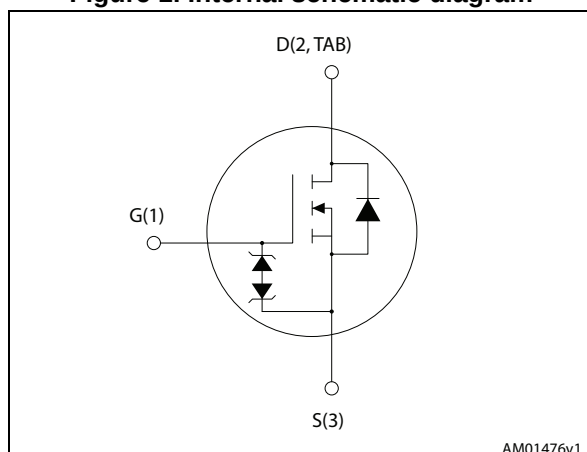


Figure 1. Internal schematic diagram



## Features

| Order code | V <sub>DS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> | P <sub>TOT</sub> |
|------------|-----------------|-------------------------|----------------|------------------|
| STB15N80K5 | 800 V           | 0.375 $\Omega$          | 14 A           | 190 W            |
| STF15N80K5 |                 |                         |                | 35 W             |
| STP15N80K5 |                 |                         |                | 190 W            |
| STW15N80K5 |                 |                         |                |                  |

- Industry's lowest R<sub>DS(on)</sub> x area
- Industry's best figure of merit (FoM)
- Ultra low gate charge
- 100% avalanche tested
- Zener-protected

## Applications

- Switching applications

## Description

These very high voltage N-channel Power MOSFETs are designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

Table 1. Device summary

| Order code | Marking | Package            | Packaging     |
|------------|---------|--------------------|---------------|
| STB15N80K5 | 15N80K5 | D <sup>2</sup> PAK | Tape and reel |
| STF15N80K5 |         | TO-220FP           | Tube          |
| STP15N80K5 |         | TO-220             |               |
| STW15N80K5 |         | TO-247             |               |

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# 1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol                             | Parameter                                                                                                                 | Value                                 |                    | Unit |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------------------|------|
|                                    |                                                                                                                           | D <sup>2</sup> PAK,<br>TO-220, TO-247 | TO-220FP           |      |
| V <sub>GS</sub>                    | Gate- source voltage                                                                                                      | ± 30                                  |                    | V    |
| I <sub>D</sub>                     | Drain current (continuous) at T <sub>C</sub> = 25 °C                                                                      | 14                                    | 14 <sup>(1)</sup>  | A    |
| I <sub>D</sub>                     | Drain current (continuous) at T <sub>C</sub> = 100 °C                                                                     | 8.8                                   | 8.8 <sup>(1)</sup> | A    |
| I <sub>DM</sub> <sup>(2)</sup>     | Drain current (pulsed)                                                                                                    | 56                                    | 56 <sup>(1)</sup>  | A    |
| P <sub>TOT</sub>                   | Total dissipation at T <sub>C</sub> = 25 °C                                                                               | 190                                   | 35                 | W    |
| I <sub>AR</sub>                    | Max current during repetitive or single pulse avalanche (pulse width limited by T <sub>jmax</sub> )                       | 4                                     |                    | A    |
| E <sub>AS</sub>                    | Single pulse avalanche energy (starting T <sub>J</sub> = 25 °C, I <sub>D</sub> =I <sub>AS</sub> , V <sub>DD</sub> = 50 V) | 150                                   |                    | mJ   |
| V <sub>iso</sub>                   | Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T <sub>C</sub> =25 °C)              |                                       | 2500               | V    |
| dv/dt <sup>(3)</sup>               | Peak diode recovery voltage slope                                                                                         | 4.5                                   |                    | V/ns |
| T <sub>j</sub><br>T <sub>stg</sub> | Operating junction temperature<br>Storage temperature                                                                     | -55 to 150                            |                    | °C   |

1. Limited by package.

2. Pulse width limited by safe operating area.

3. I<sub>SD</sub> ≤ 14 A, di/dt ≤ 100 A/μs, V<sub>Peak</sub> ≤ V<sub>(BR)DSS</sub>

Table 3. Thermal data

| Symbol                              | Parameter                            | Value  |        |                    |          | Unit |
|-------------------------------------|--------------------------------------|--------|--------|--------------------|----------|------|
|                                     |                                      | TO-220 | TO-247 | D <sup>2</sup> PAK | TO-220FP |      |
| R <sub>thj-case</sub>               | Thermal resistance junction-case max | 0.66   |        |                    | 3.6      | °C/W |
| R <sub>thj-amb</sub>                | Thermal resistance junction-amb max  | 62.5   | 50     |                    | 62.5     |      |
| R <sub>thj-pcb</sub> <sup>(1)</sup> | Thermal resistance junction-pcb max  |        |        | 30                 |          |      |

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

## 2 Electrical characteristics

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

**Table 4. On/off states**

| Symbol        | Parameter                                        | Test conditions                                               | Min. | Typ. | Max.     | Unit          |
|---------------|--------------------------------------------------|---------------------------------------------------------------|------|------|----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage ( $V_{GS} = 0$ )  | $I_D = 1\text{ mA}$                                           | 800  |      |          | V             |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 800\text{ V}$                                       |      |      | 1        | $\mu\text{A}$ |
|               |                                                  | $V_{DS} = 800\text{ V}$ , $T_C = 125\text{ }^{\circ}\text{C}$ |      |      | 50       | $\mu\text{A}$ |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$                                    |      |      | $\pm 10$ | $\mu\text{A}$ |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 100\text{ }\mu\text{A}$            | 3    | 4    | 5        | V             |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 7\text{ A}$                   |      | 0.3  | 0.375    | $\Omega$      |

**Table 5. Dynamic**

| Symbol            | Parameter                             | Test conditions                                                                                             | Min. | Typ. | Max. | Unit     |
|-------------------|---------------------------------------|-------------------------------------------------------------------------------------------------------------|------|------|------|----------|
| $C_{iss}$         | Input capacitance                     | $V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$                                                 | -    | 1100 | -    | pF       |
| $C_{oss}$         | Output capacitance                    |                                                                                                             | -    | 85   | -    | pF       |
| $C_{rss}$         | Reverse transfer capacitance          |                                                                                                             | -    | 1.5  | -    | pF       |
| $C_{o(tr)}^{(1)}$ | Equivalent capacitance time related   | $V_{GS} = 0$ , $V_{DS} = 0\text{ to }640\text{ V}$                                                          | -    | 113  | -    | pF       |
| $C_{o(er)}^{(2)}$ | Equivalent capacitance energy related |                                                                                                             | -    | 49   | -    | pF       |
| $R_G$             | Intrinsic gate resistance             | $f = 1\text{ MHz}$ , $I_D = 0$                                                                              | -    | 4.5  | -    | $\Omega$ |
| $Q_g$             | Total gate charge                     | $V_{DD} = 640\text{ V}$ , $I_D = 14\text{ A}$<br>$V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 20</a> ) | -    | 32   | -    | nC       |
| $Q_{gs}$          | Gate-source charge                    |                                                                                                             | -    | 6    | -    | nC       |
| $Q_{gd}$          | Gate-drain charge                     |                                                                                                             | -    | 22   | -    | nC       |

1. Time related is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$
2. Energy related is defined as a constant equivalent capacitance giving the same stored energy as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

Table 6. Switching times

| Symbol       | Parameter           | Test conditions                                                                                                                                           | Min. | Typ. | Max. | Unit |
|--------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 400\text{ V}$ , $I_D = 7\text{ A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 19</a> and <a href="#">24</a> ) | -    | 19   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                                                           | -    | 17.6 | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                                                                           | -    | 44   | -    | ns   |
| $t_f$        | Fall time           |                                                                                                                                                           | -    | 10   | -    | ns   |

Table 7. Source drain diode

| Symbol         | Parameter                     | Test conditions                                                                                                                                                  | Min. | Typ. | Max. | Unit          |
|----------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$       | Source-drain current          |                                                                                                                                                                  | -    |      | 14   | A             |
| $I_{SDM}$      | Source-drain current (pulsed) |                                                                                                                                                                  | -    |      | 56   | A             |
| $V_{SD}^{(1)}$ | Forward on voltage            | $I_{SD} = 14\text{ A}$ , $V_{GS} = 0$                                                                                                                            | -    |      | 1.5  | V             |
| $t_{rr}$       | Reverse recovery time         | $I_{SD} = 14\text{ A}$ , $V_{DD} = 60\text{ V}$<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>(see <a href="#">Figure 21</a> )                                      | -    | 445  |      | ns            |
| $Q_{rr}$       | Reverse recovery charge       |                                                                                                                                                                  | -    | 8.2  |      | $\mu\text{C}$ |
| $I_{RRM}$      | Reverse recovery current      |                                                                                                                                                                  | -    | 37   |      | A             |
| $t_{rr}$       | Reverse recovery time         | $I_{SD} = 14\text{ A}$ , $V_{DD} = 60\text{ V}$<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$T_J = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 21</a> ) | -    | 580  |      | ns            |
| $Q_{rr}$       | Reverse recovery charge       |                                                                                                                                                                  | -    | 10   |      | $\mu\text{C}$ |
| $I_{RRM}$      | Reverse recovery current      |                                                                                                                                                                  | -    | 35   |      | A             |

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

Table 8. Gate-source Zener diode

| Symbol        | Parameter                     | Test conditions                        | Min. | Typ. | Max. | Unit |
|---------------|-------------------------------|----------------------------------------|------|------|------|------|
| $V_{(BR)GSO}$ | Gate-source breakdown voltage | $I_{GS} = \pm 1\text{ mA}$ , $I_D = 0$ | 30   | -    | -    | V    |

The built-in back-to-back Zener diodes have been specifically designed to enhance the ESD capability of the device. The Zener voltage is appropriate for efficient and cost-effective intervention to protect the device integrity. These integrated Zener diodes thus eliminate the need for external components.

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for D<sup>2</sup>PAK and TO-220

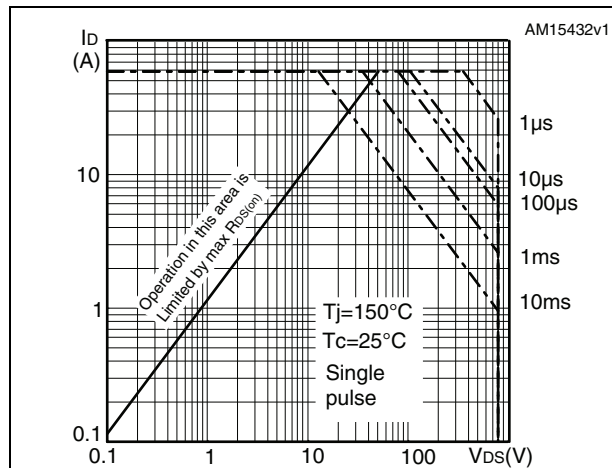


Figure 3. Thermal impedance for D<sup>2</sup>PAK and TO-220

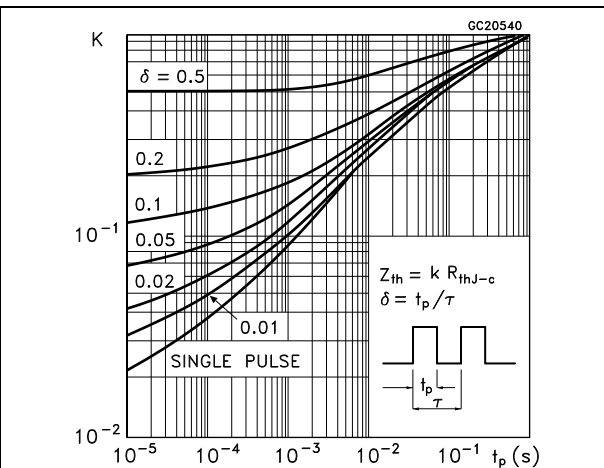


Figure 4. Safe operating area for TO-220FP

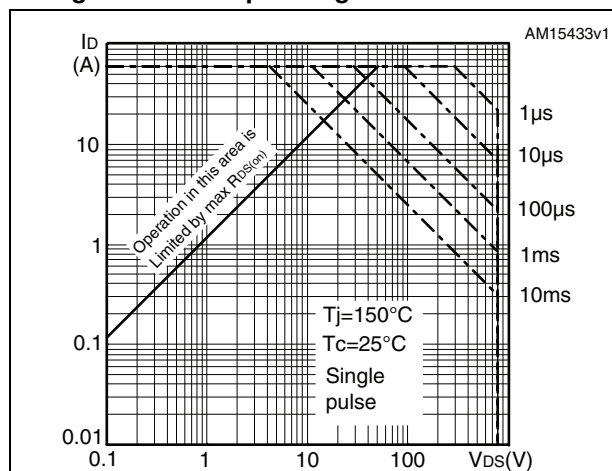


Figure 5. Thermal impedance for TO-220FP

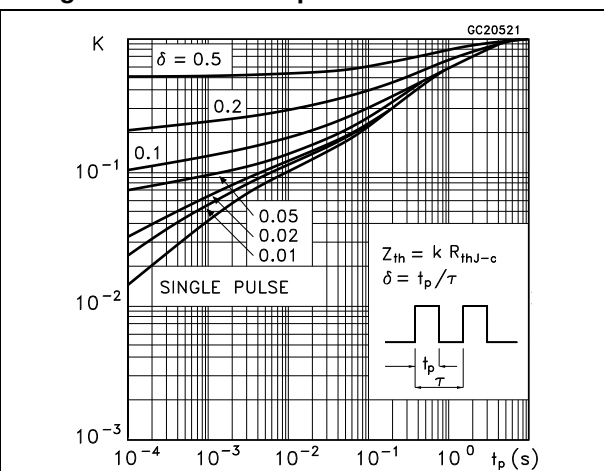


Figure 6. Safe operating area for TO-247

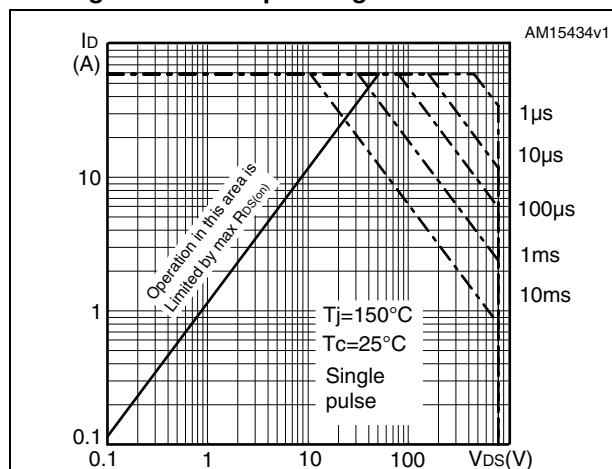


Figure 7. Thermal impedance for TO-247

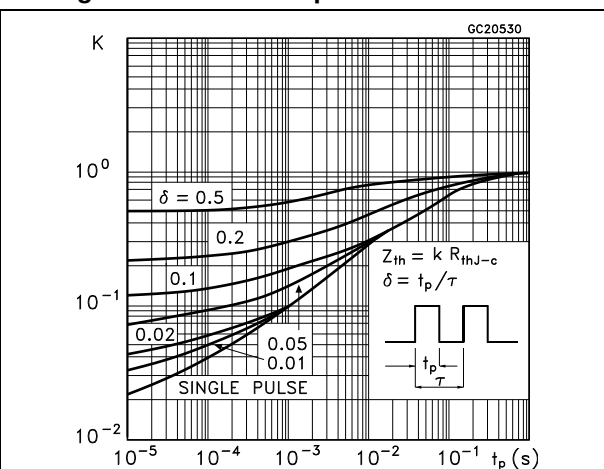


Figure 8. Output characteristics

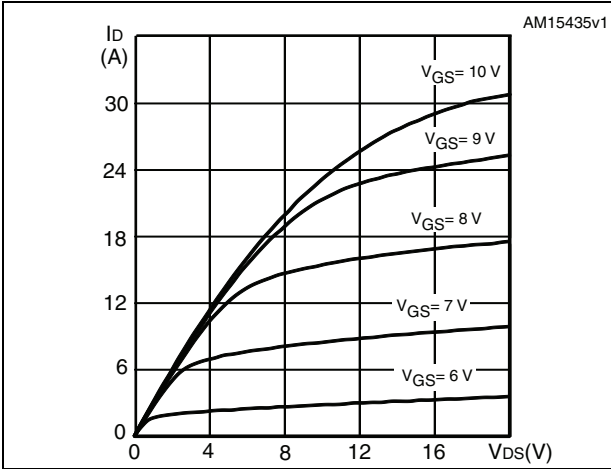


Figure 9. Transfer characteristics

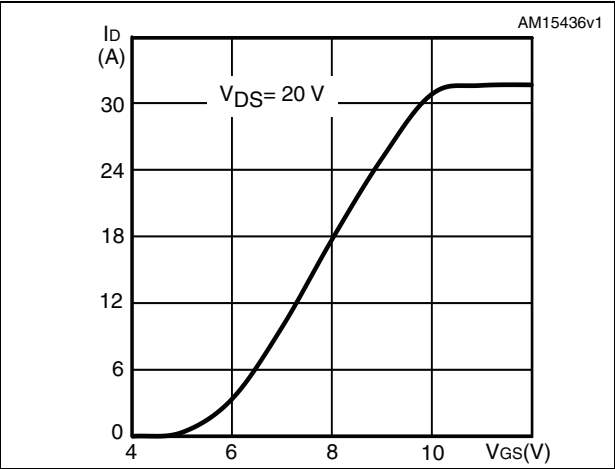


Figure 10. Gate charge vs gate-source voltage

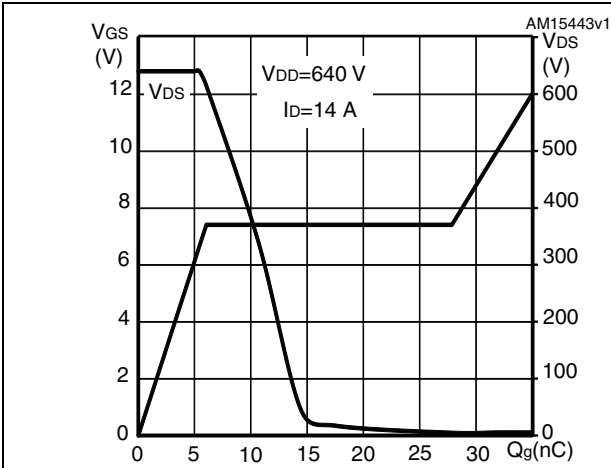


Figure 11. Static drain-source on-resistance

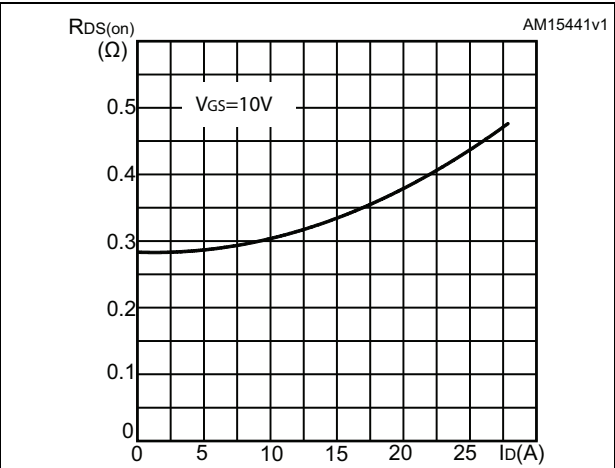


Figure 12. Capacitance variations

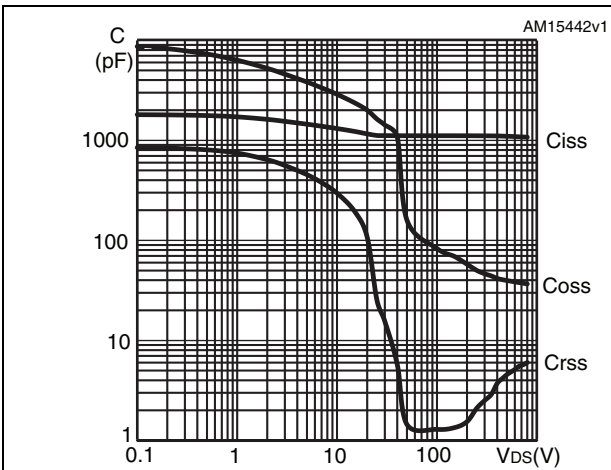


Figure 13. Source-drain diode forward characteristics

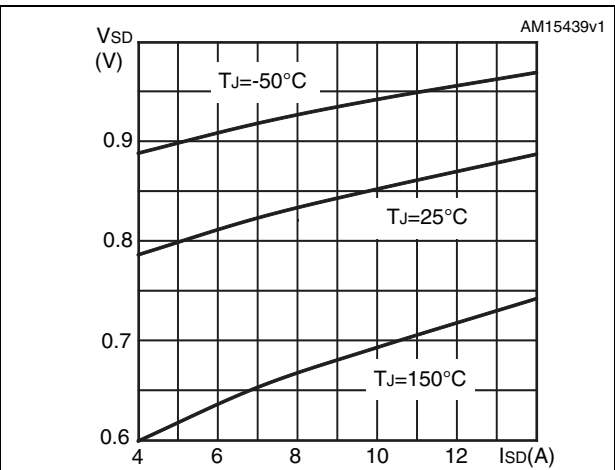


Figure 14. Normalized gate threshold voltage vs temperature

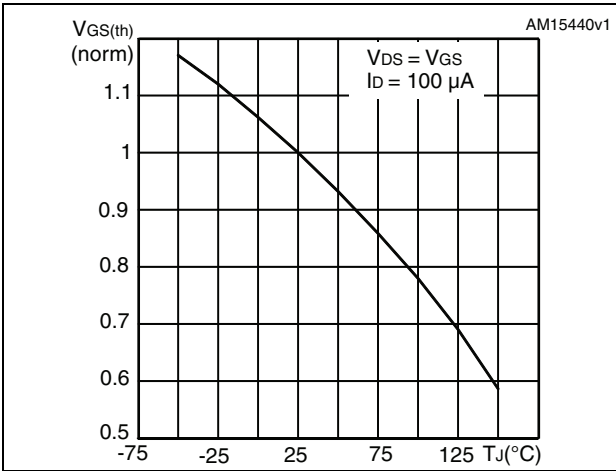


Figure 15. Normalized on-resistance vs temperature

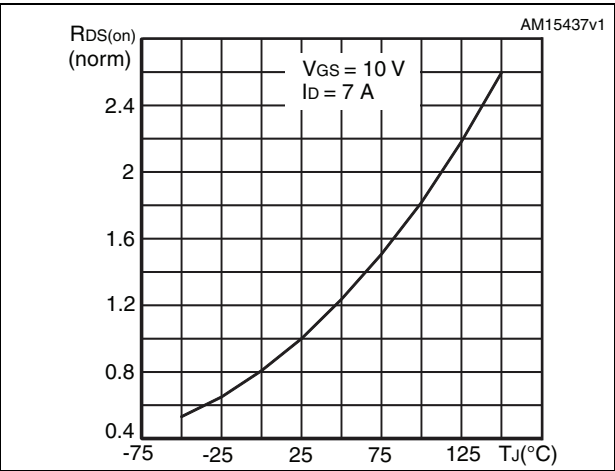


Figure 16. Output capacitance stored energy

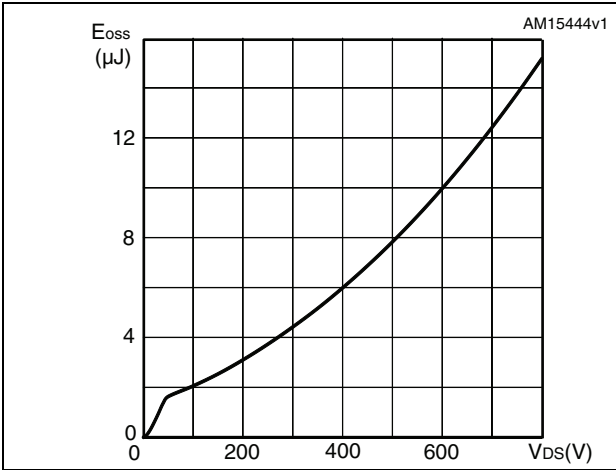


Figure 17. Normalized  $V_{DS}$  vs temperature

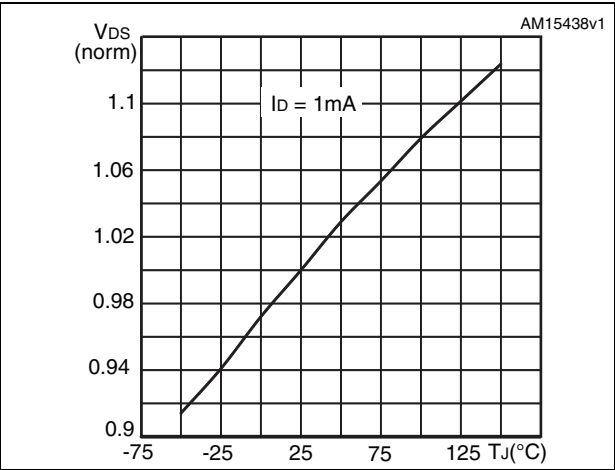
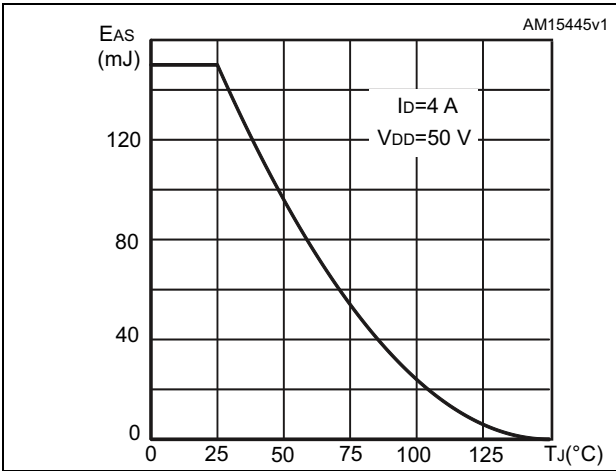


Figure 18. Maximum avalanche energy vs temperature



### 3 Test circuits

Figure 19. Switching times test circuit for resistive load

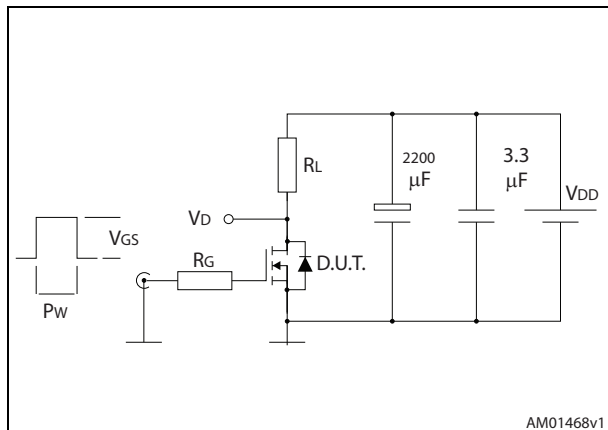


Figure 20. Gate charge test circuit



Figure 21. Test circuit for inductive load switching and diode recovery times

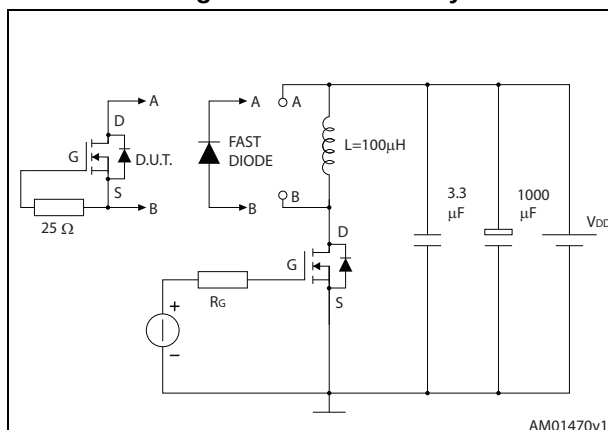


Figure 22. Unclamped inductive load test circuit

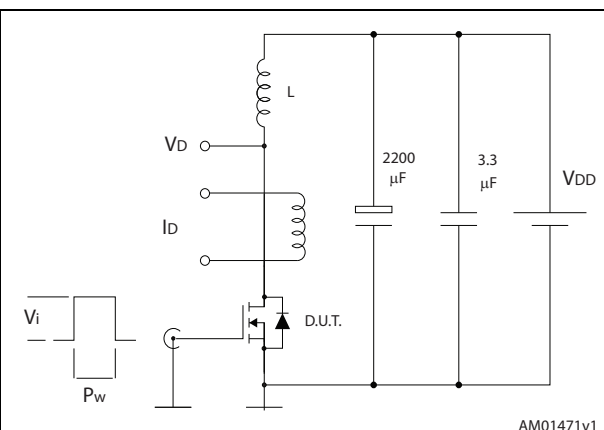


Figure 23. Unclamped inductive waveform

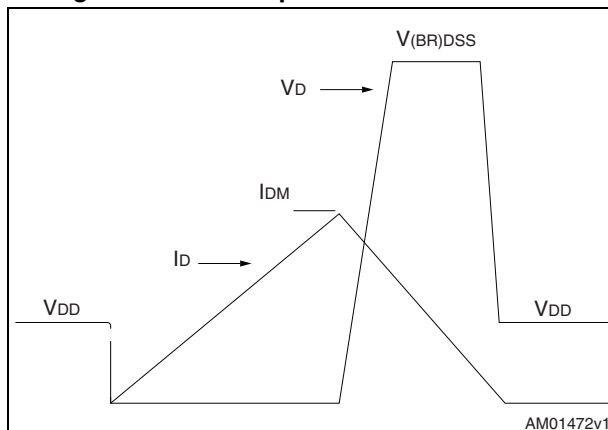
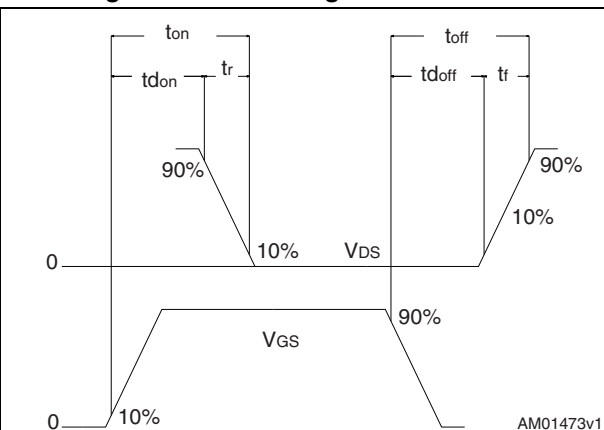


Figure 24. Switching time waveform



## 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<sup>®</sup> is an ST trademark.

## 4.1 STB15N80K5, D<sup>2</sup>PAK (TO-263)

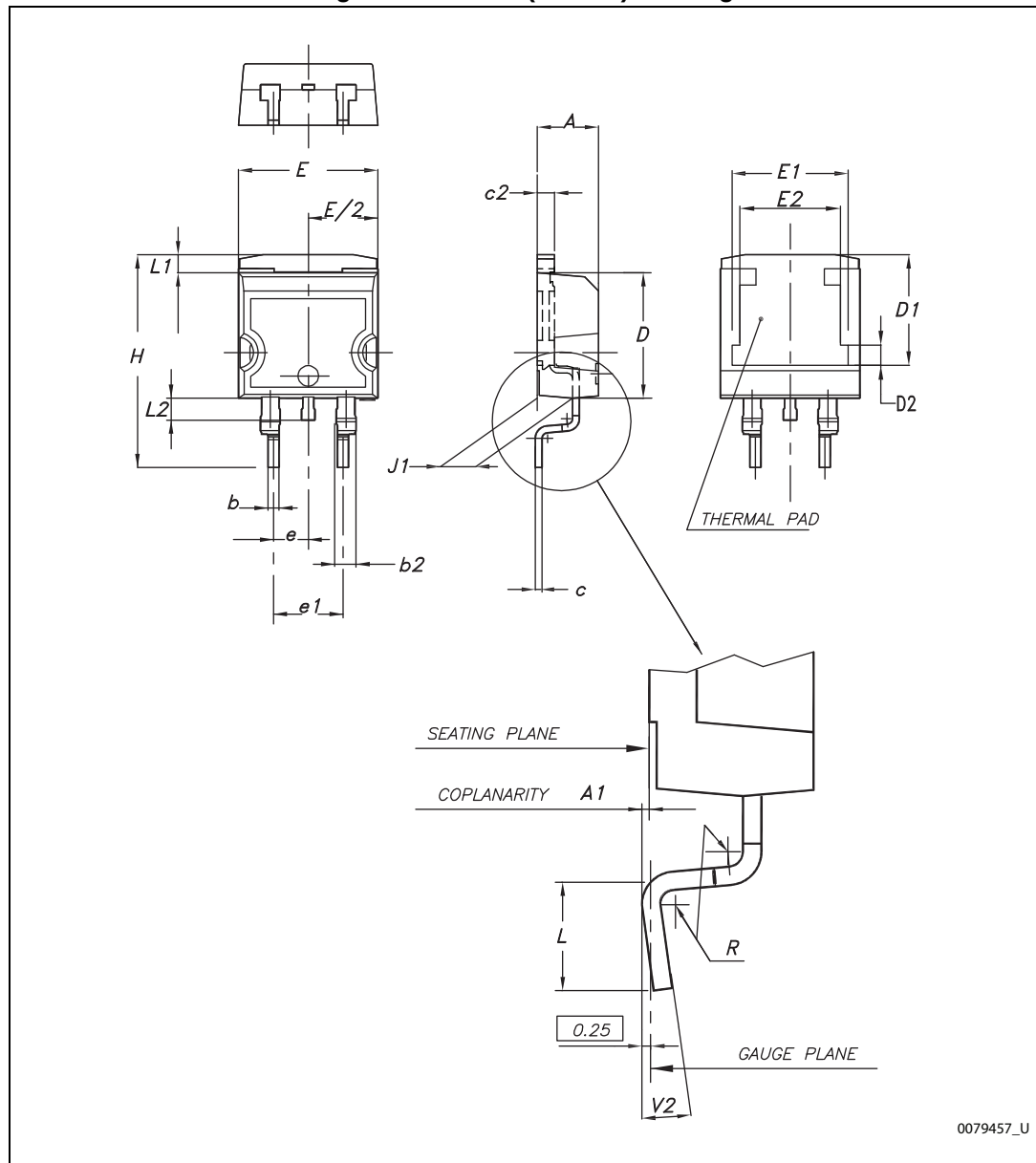
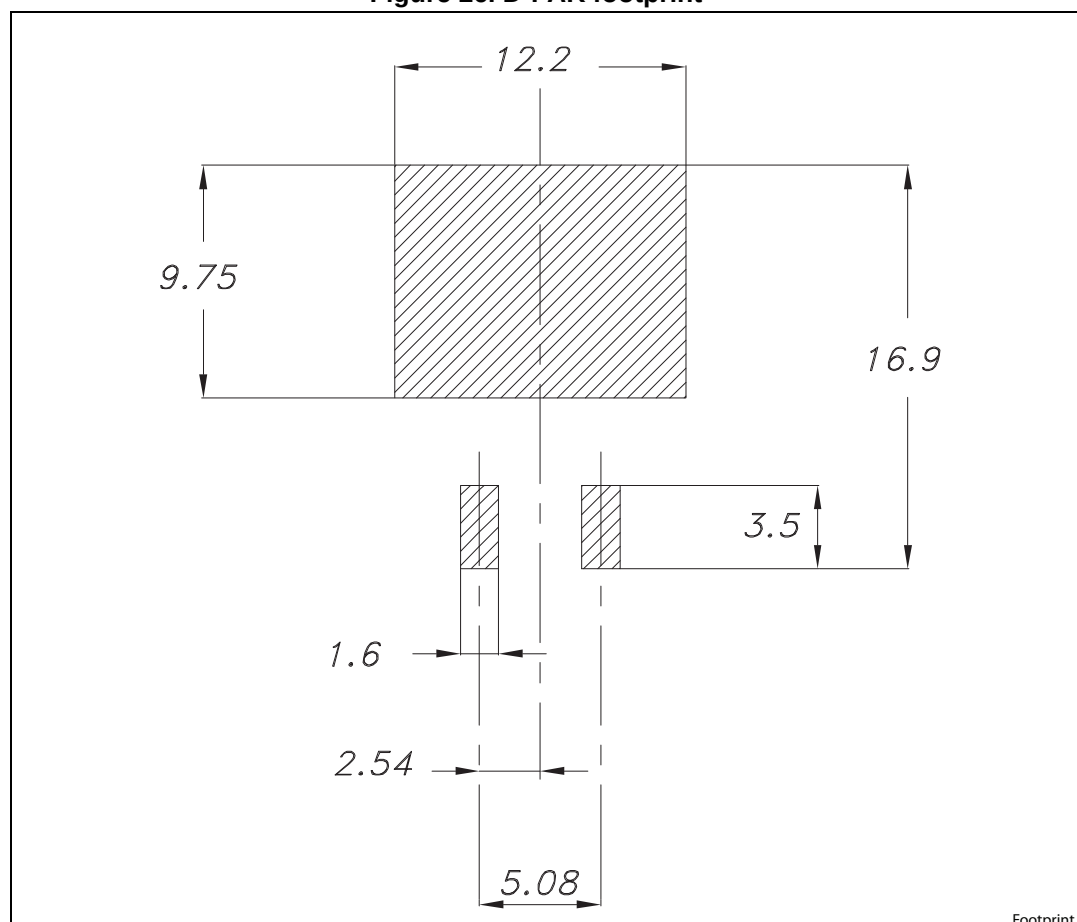
Figure 25. D<sup>2</sup>PAK (TO-263) drawing

Table 9. 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 | 7.75 | 8.00  |
| D2   | 1.10 | 1.30 | 1.50  |
| E    | 10   |      | 10.40 |
| E1   | 8.50 | 8.70 | 8.90  |
| E2   | 6.85 | 7.05 | 7.25  |
| 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 26. D<sup>2</sup>PAK footprint<sup>(a)</sup>

a. All dimension are in millimeters

## 4.2 STP15N80K5, TO-220

Figure 27. TO-220 type A drawing

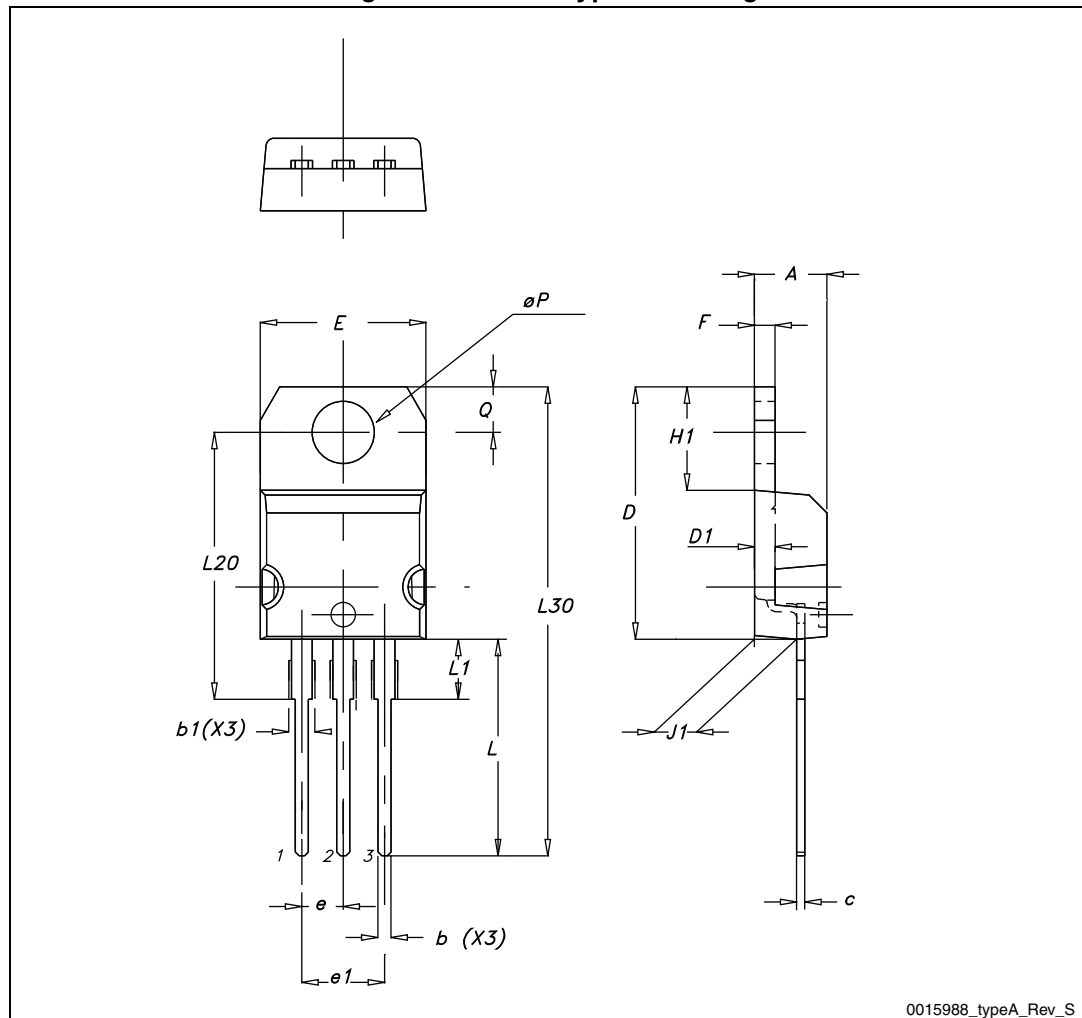


Table 10. TO-220 type A mechanical data

| 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  |

### 4.3 STF15N80K5, TO-220FP

Figure 28. TO-220FP drawing

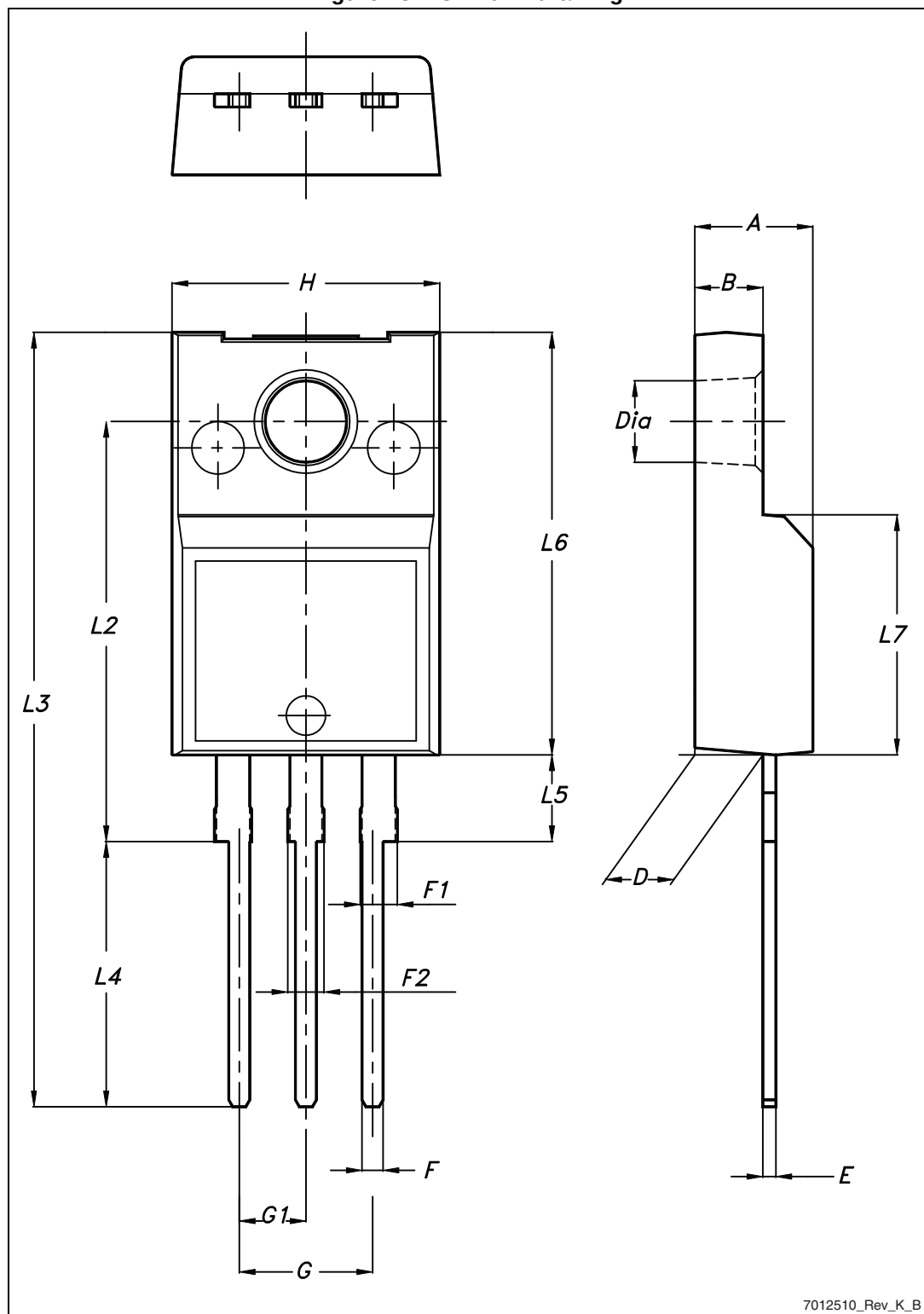


Table 11. TO-220FP mechanical data

| 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  |

## 4.4 STW15N80K5, TO-247

Figure 29. TO-247 drawing

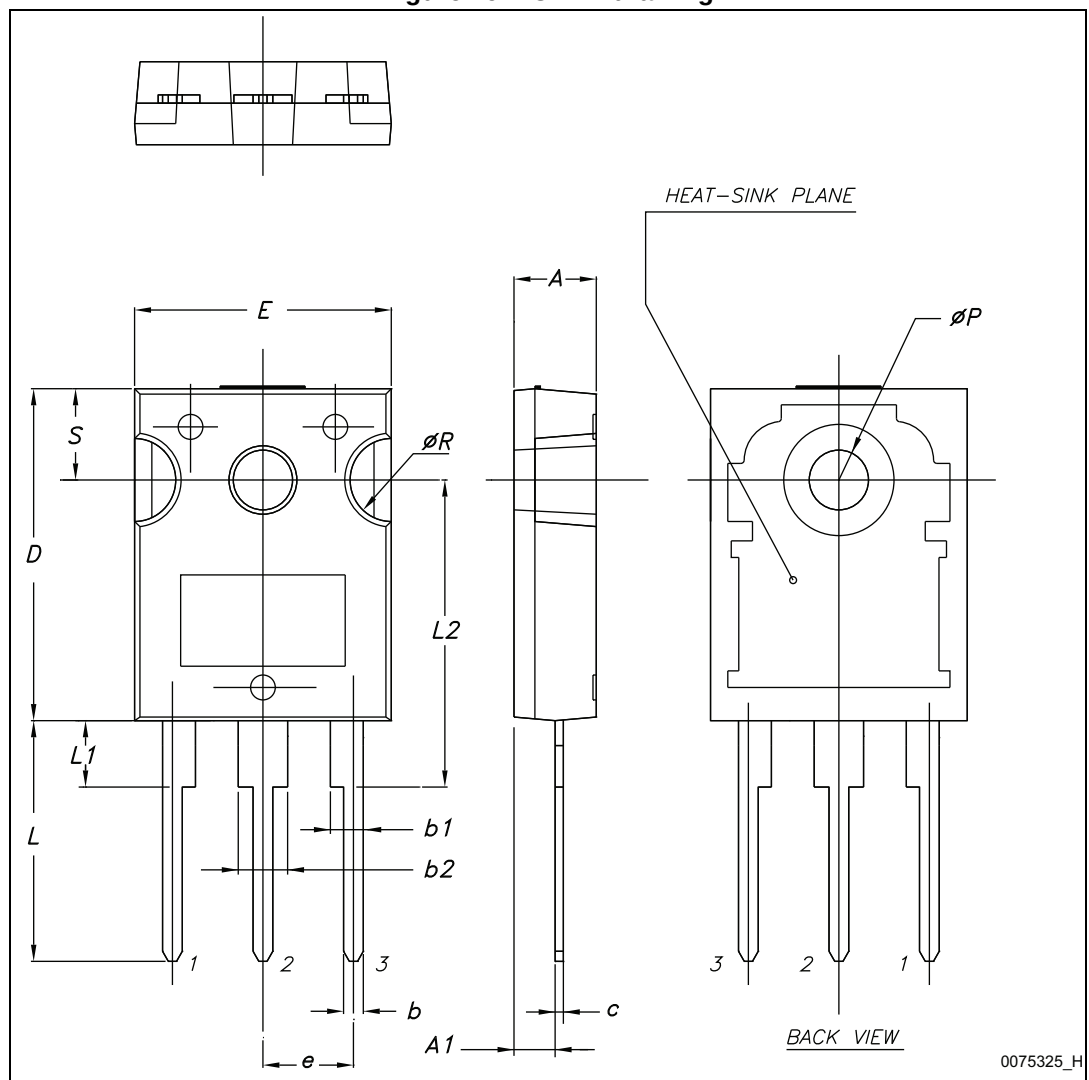


Table 12. TO-247 mechanical data

| 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    | 5.30  | 5.45  | 5.60  |
| L    | 14.20 |       | 14.80 |
| L1   | 3.70  |       | 4.30  |
| L2   |       | 18.50 |       |
| ØP   | 3.55  |       | 3.65  |
| ØR   | 4.50  |       | 5.50  |
| S    | 5.30  | 5.50  | 5.70  |

## 5 Packaging information

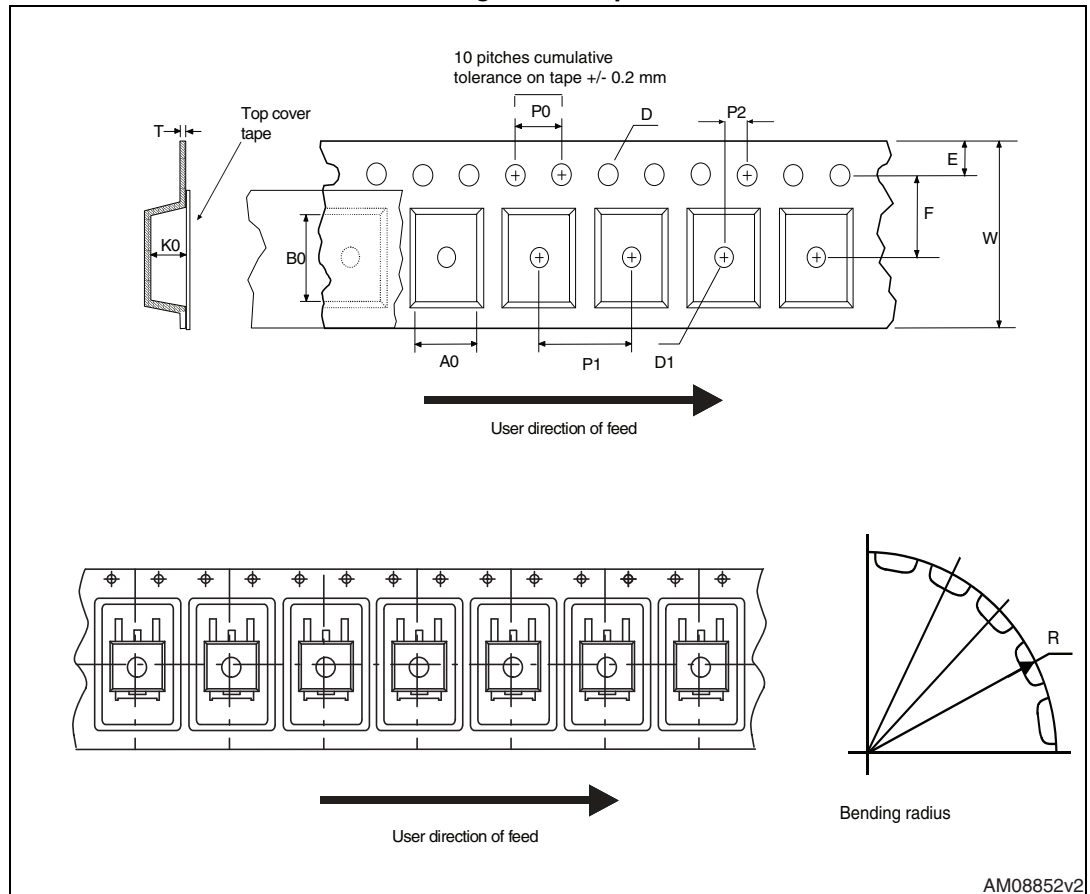
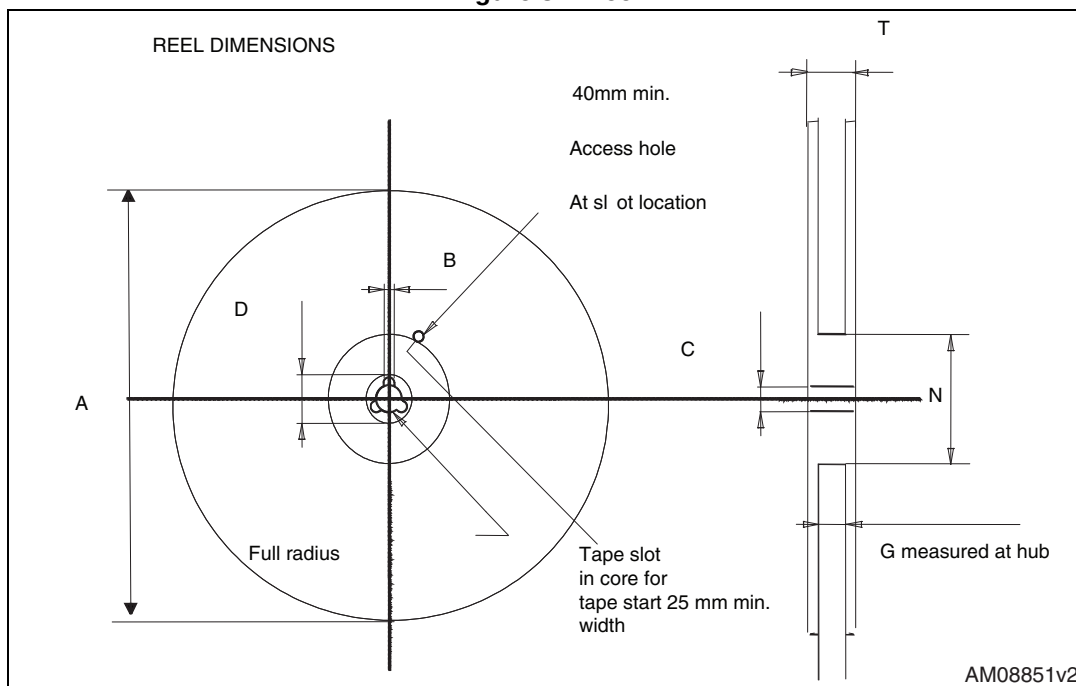
**Figure 30. Tape**

Figure 31. Reel

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 |          |      |      |

## 6 Revision history

**Table 14. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18-Jul-2012 | 1        | First release.                                                                                                                                                                                                                                                                                                                                                                      |
| 31-Oct-2012 | 2        | <ul style="list-style-type: none"><li>– Inserted: <math>I_{AR}</math>, <math>E_{AS}</math> and <math>dv/dt</math> values in <a href="#">Table 2</a></li><li>– Inserted: <a href="#">Table 5</a>, <a href="#">6</a> and <a href="#">7</a> typical values</li><li>– Inserted: <a href="#">Section 2.1: Electrical characteristics (curves)</a></li><li>– Minor text changes</li></ul> |
| 31-Oct-2014 | 3        | <p>Updated title, description and features</p> <p>Updated <a href="#">Static drain-source on-resistance</a></p> <p>Minor text changes</p>                                                                                                                                                                                                                                           |

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