

## Automotive-grade N-channel 100 V, 180 A, 3.9 mΩ typ., STripFET™ F3 Power MOSFET in an H<sup>2</sup>PAK-2 package

Datasheet - production data

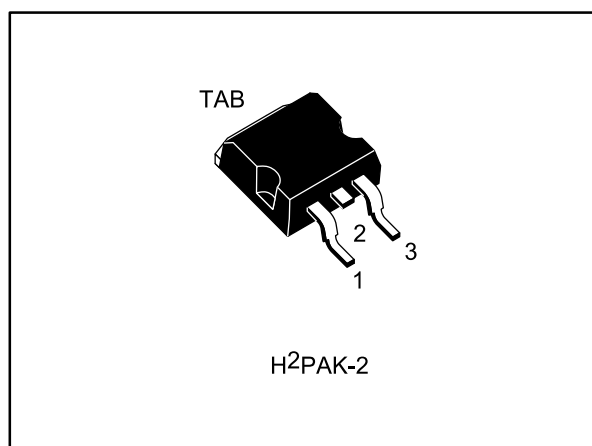
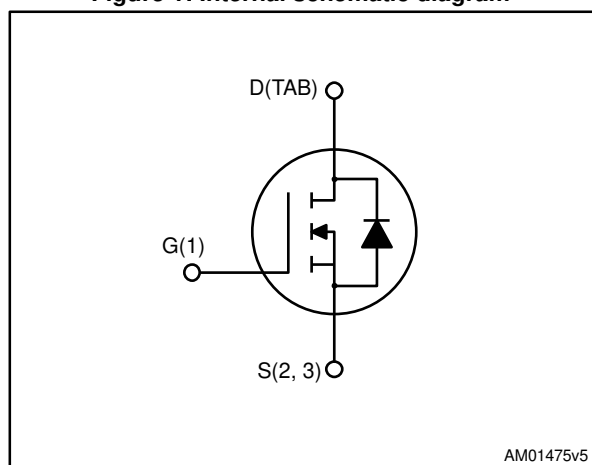


Figure 1: Internal schematic diagram



### Features

| Order code    | V <sub>DS</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> |
|---------------|-----------------|--------------------------|----------------|
| STH185N10F3-2 | 100 V           | 4.5 mΩ                   | 180 A          |

- AEC-Q101 qualified
- Ultra low on-resistance
- 100% avalanche tested



### Applications

- Switching applications

### Description

This device is an N-channel Power MOSFET developed using STripFET™ F3 technology. It is designed to minimize on-resistance and gate charge to provide superior switching performance.

Table 1: Device summary

| Order code    | Marking  | Packages             | Packing       |
|---------------|----------|----------------------|---------------|
| STH185N10F3-2 | 185N10F3 | H <sup>2</sup> PAK-2 | Tape and reel |

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## Contents

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# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

| Symbol         | Parameter                                              | Value       | Unit             |
|----------------|--------------------------------------------------------|-------------|------------------|
| $V_{DS}$       | Drain-source voltage                                   | 100         | V                |
| $V_{GS}$       | Gate-source voltage                                    | $\pm 20$    | V                |
| $I_D^{(1)}$    | Drain current (continuous) at $T_C = 25^\circ\text{C}$ | 180         | A                |
| $I_D^{(1)}$    | Drain current (continuous) at $T_C=100^\circ\text{C}$  | 120         | A                |
| $I_{DM}^{(2)}$ | Drain current (pulsed)                                 | 720         | A                |
| $P_{TOT}$      | Total dissipation at $T_C = 25^\circ\text{C}$          | 315         | W                |
| $dv/dt$        | Peak diode recovery voltage slope                      | 20          | V/ns             |
| $E_{AS}^{(3)}$ | Single pulse avalanche energy                          | 350         | mJ               |
| $T_j$          | Operating junction temperature range                   | - 55 to 175 | $^\circ\text{C}$ |
| $T_{stg}$      | Storage temperature range                              |             |                  |

**Notes:**

<sup>(1)</sup>Current limited by package.

<sup>(2)</sup>Pulse width limited by safe operating area.

<sup>(3)</sup>Starting  $T_j = 25^\circ\text{C}$ ,  $I_D = 80\text{ A}$ ,  $V_{DD} = 50\text{ V}$ .

**Table 3: Thermal data**

| Symbol              | Parameter                        | Value | Unit               |
|---------------------|----------------------------------|-------|--------------------|
| $R_{thj-case}$      | Thermal resistance junction-case | 0.48  | $^\circ\text{C/W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb  | 35    | $^\circ\text{C/W}$ |

**Notes:**

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

## 2 Electrical characteristics

(T<sub>CASE</sub> = 25 °C unless otherwise specified)

**Table 4: On/off states**

| Symbol               | Parameter                         | Test conditions                                                                        | Min. | Typ. | Max. | Unit |
|----------------------|-----------------------------------|----------------------------------------------------------------------------------------|------|------|------|------|
| V <sub>(BR)DSS</sub> | Drain-source breakdown voltage    | V <sub>GS</sub> = 0, I <sub>D</sub> = 250 μA                                           | 100  |      |      | V    |
| I <sub>DSS</sub>     | Zero gate voltage drain current   | V <sub>GS</sub> = 0, V <sub>DS</sub> = 100 V,                                          |      |      | 10   | μA   |
|                      |                                   | V <sub>GS</sub> = 0, V <sub>DS</sub> = 100 V, <sup>(1)</sup><br>T <sub>C</sub> = 125°C |      |      | 100  | μA   |
| I <sub>GSS</sub>     | Gate body leakage current         | V <sub>DS</sub> = 0, V <sub>GS</sub> = ±20 V                                           |      |      | ±200 | nA   |
| V <sub>GS(th)</sub>  | Gate threshold voltage            | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                            | 2    |      | 4    | V    |
| R <sub>DS(on)</sub>  | Static drain-source on-resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 60 A                                          |      | 3.9  | 4.5  | mΩ   |

**Notes:**

<sup>(1)</sup>Defined by design, not subject to production test

**Table 5: Dynamic**

| Symbol           | Parameter                    | Test conditions                                                           | Min. | Typ.  | Max. | Unit |
|------------------|------------------------------|---------------------------------------------------------------------------|------|-------|------|------|
| C <sub>iss</sub> | Input capacitance            | V <sub>GS</sub> = 0, V <sub>DS</sub> = 25 V,<br>f = 1 MHz                 | -    | 6665  | -    | pF   |
| C <sub>oss</sub> | Output capacitance           |                                                                           | -    | 786   | -    | pF   |
| C <sub>rss</sub> | Reverse transfer capacitance |                                                                           | -    | 49    | -    | pF   |
| Q <sub>g</sub>   | Total gate charge            | V <sub>DD</sub> = 50 V, I <sub>D</sub> = 120 A,                           | -    | 114.6 | -    | nC   |
| Q <sub>gs</sub>  | Gate-source charge           | V <sub>GS</sub> = 10 V                                                    | -    | 38.8  | -    | nC   |
| Q <sub>gd</sub>  | Gate-drain charge            | (see <a href="#">Figure 14: "Test circuit for gate charge behavior"</a> ) | -    | 31.9  | -    | nC   |

**Table 6: Switching times**

| Symbol              | Parameter           | Test conditions                                                                                                                                                                                                                                | Min. | Typ. | Max. | Unit |
|---------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| t <sub>d(on)</sub>  | Turn-on delay time  | V <sub>DD</sub> = 50 V, I <sub>D</sub> = 60 A<br>R <sub>G</sub> = 4.7 Ω V <sub>GS</sub> = 10 V<br>(see <a href="#">Figure 13: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 18: "Switching time waveform"</a> ) | -    | 25.6 | -    | ns   |
| t <sub>r</sub>      | Rise time           |                                                                                                                                                                                                                                                | -    | 97.1 | -    | ns   |
| t <sub>d(off)</sub> | Turn-off delay time |                                                                                                                                                                                                                                                | -    | 99.9 | -    | ns   |
| t <sub>f</sub>      | Fall time           |                                                                                                                                                                                                                                                | -    | 6.9  | -    | ns   |

Table 7: Source drain diode

| Symbol          | Parameter                     | Test conditions                                                                                                                                                                                                                      | Min. | Typ.  | Max. | Unit |
|-----------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|------|------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                                                                                                                      | -    |       | 180  | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                                                                                                                      | -    |       | 720  | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $V_{GS} = 0, I_{SD} = 120 \text{ A}$                                                                                                                                                                                                 | -    |       | 1.5  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 120 \text{ A}$ ,<br>$di/dt = 100 \text{ A}/\mu\text{s}$ , $V_{DD} = 80 \text{ V}$ ,<br>$T_j = 150^\circ\text{C}$<br>(see <a href="#">Figure 15: "Test circuit for inductive load switching and diode recovery times"</a> ) | -    | 83.4  |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                                                      | -    | 295.7 |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                                                      | -    | 7.1   |      | A    |

**Notes:**

(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

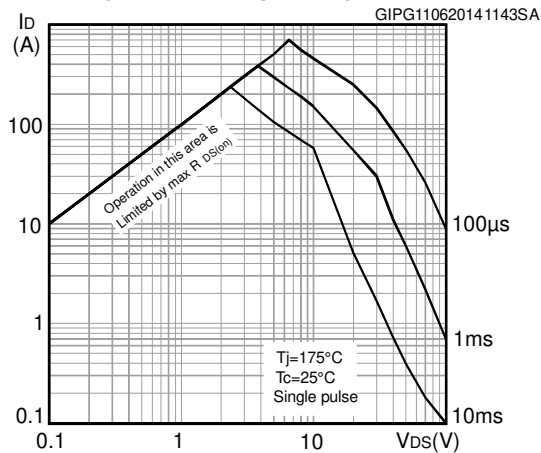


Figure 3: Thermal impedance

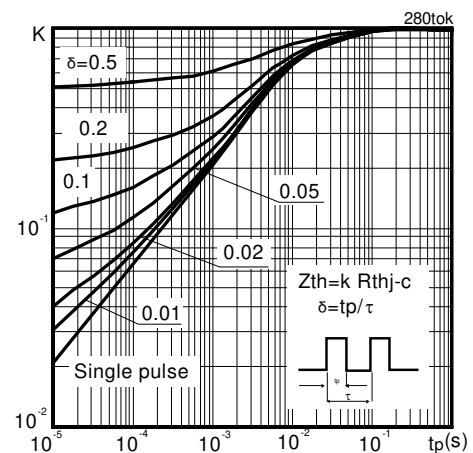


Figure 4: Output characteristics

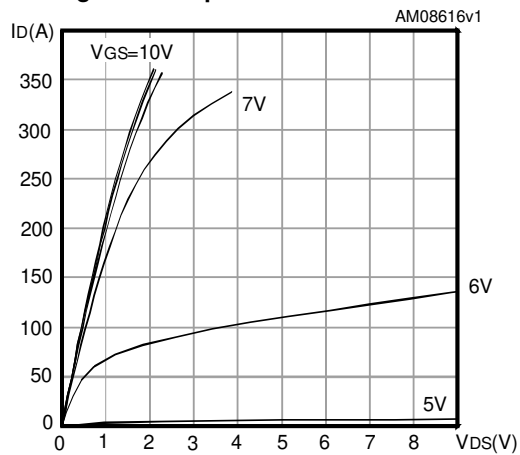


Figure 5: Transfer characteristics

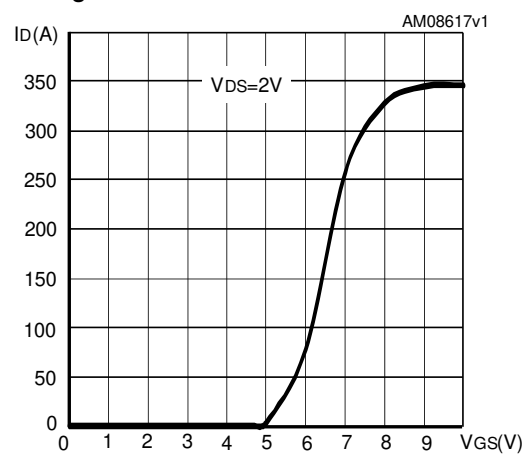


Figure 6: Normalized V(BR)DSS vs temperature

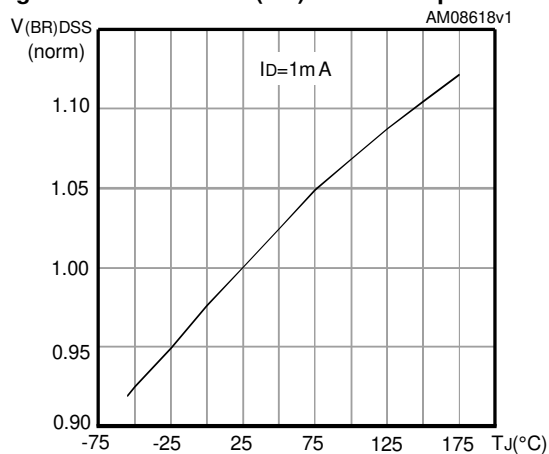


Figure 7: Static drain-source on-resistance

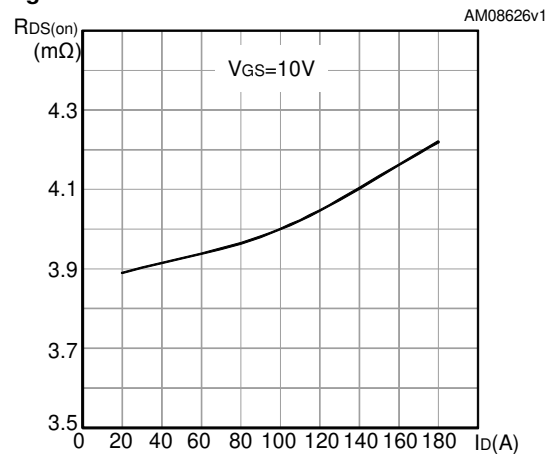


Figure 8: Gate charge vs gate-source voltage

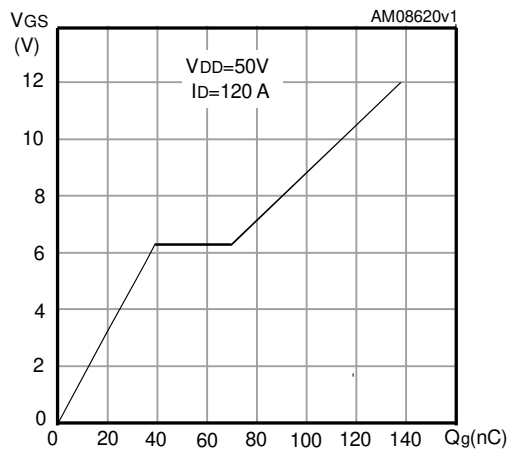


Figure 9: Capacitance variations

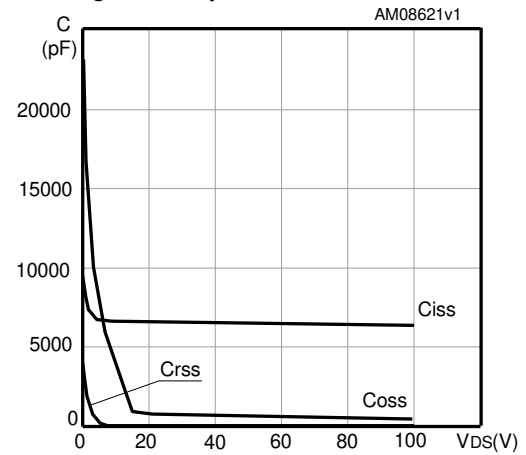


Figure 10: Normalized gate threshold voltage vs temperature

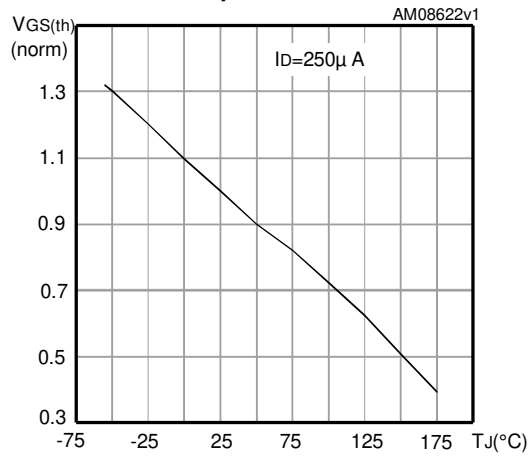


Figure 11: Normalized on-resistance vs temperature

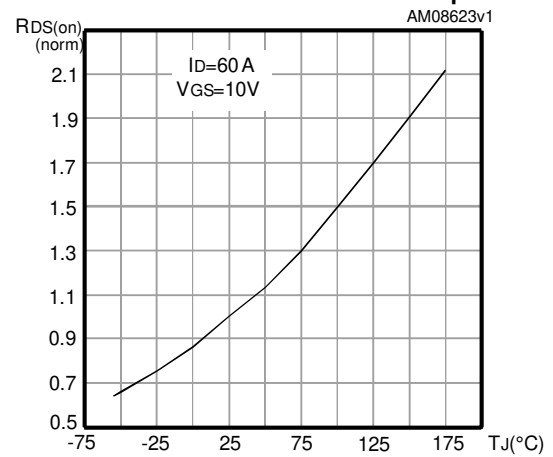
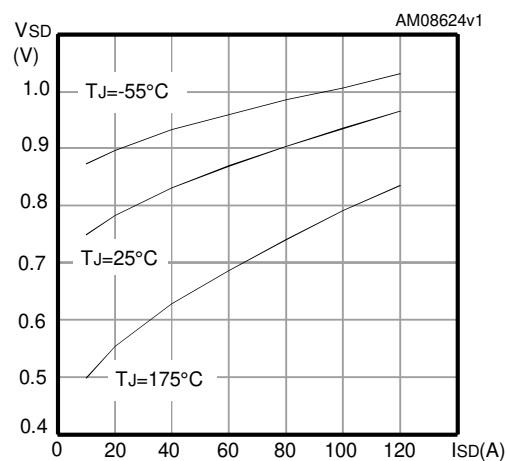
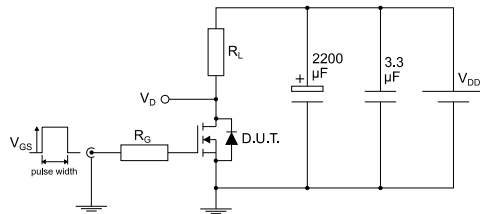


Figure 12: Source-drain diode forward characteristics



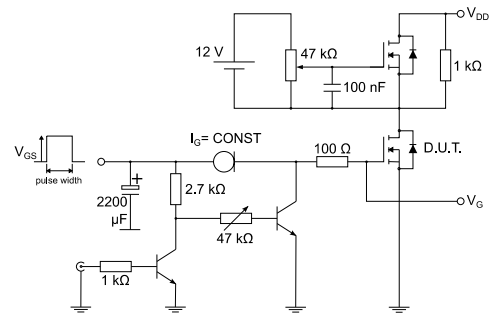
### 3 Test circuits

**Figure 13: Test circuit for resistive load switching times**



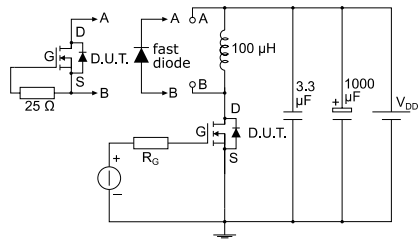
AM01468v1

**Figure 14: Test circuit for gate charge behavior**



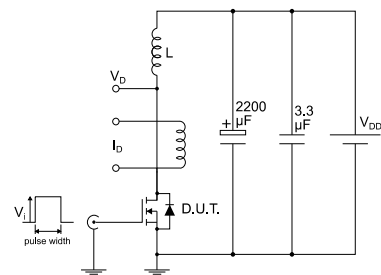
AM01469v1

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



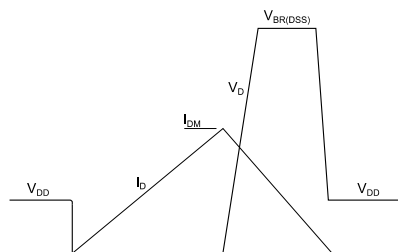
AM01470v1

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



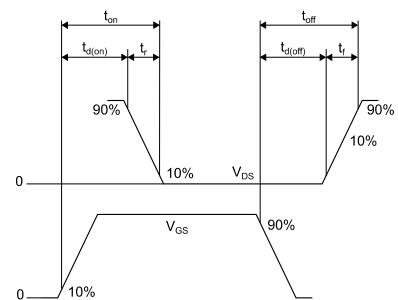
AM01471v1

**Figure 17: Unclamped inductive waveform**



AM01472v1

**Figure 18: Switching time waveform**



AM01473v1

## 4 Package information

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.

## 4.1 H<sup>2</sup>PAK-2 package information

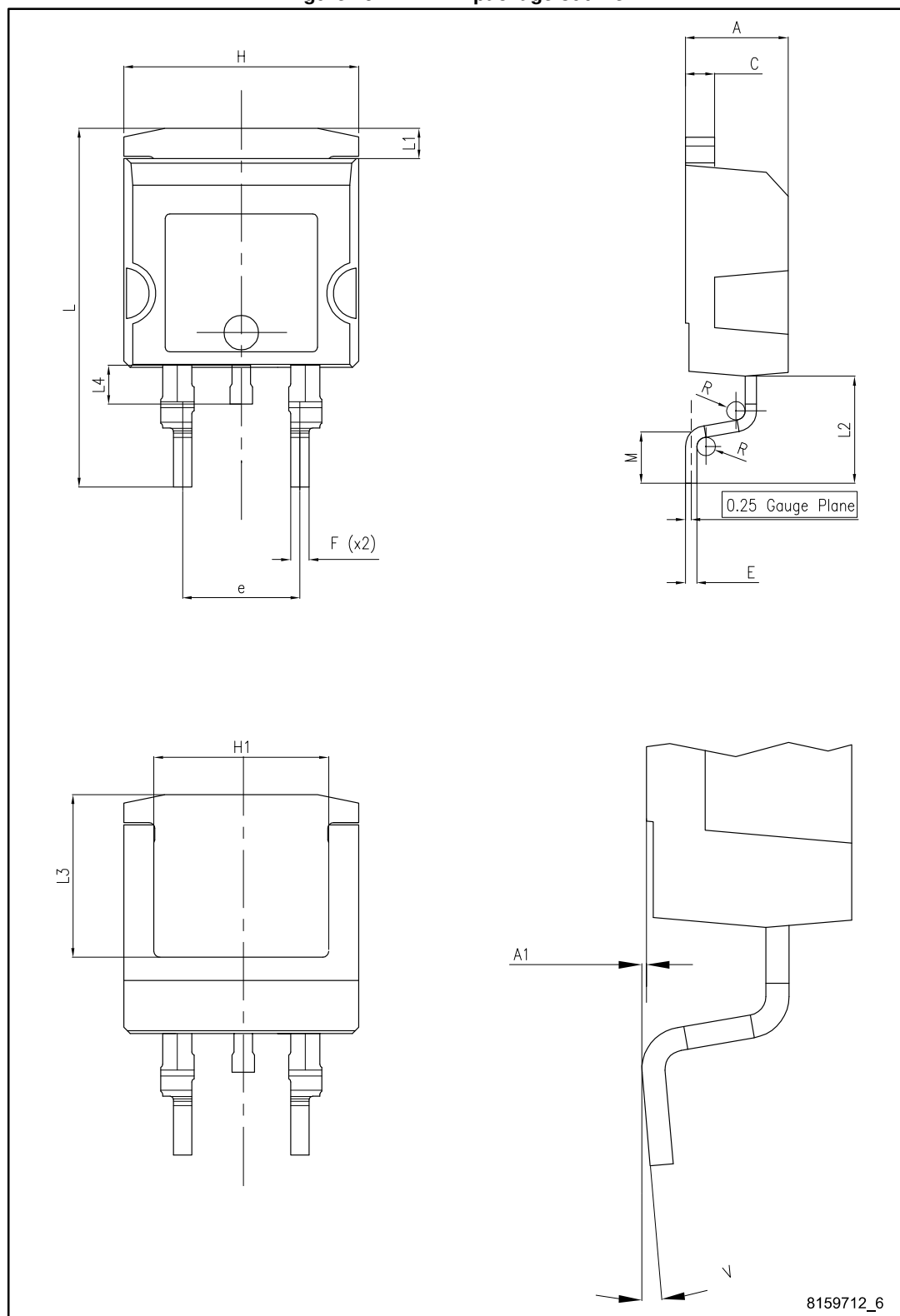
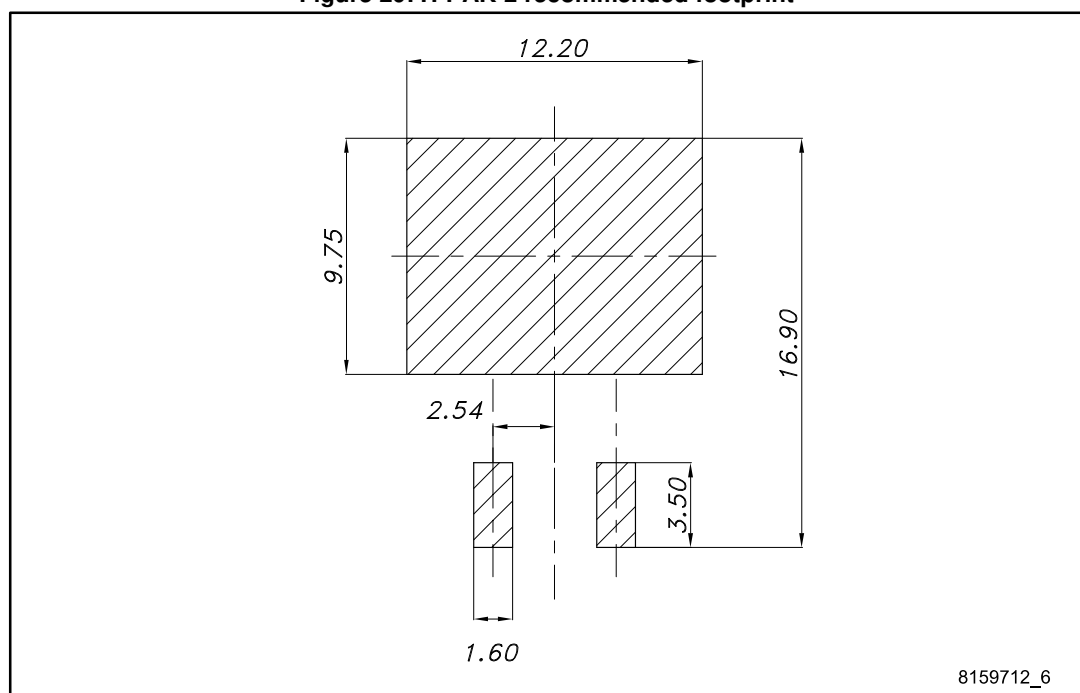
Figure 19: H<sup>2</sup>PAK-2 package outline

Table 8: H<sup>2</sup>PAK-2 package mechanical data

| Dim. | mm    |      |       |
|------|-------|------|-------|
|      | Min.  | Typ. | Max.  |
| A    | 4.30  |      | 4.70  |
| A1   | 0.03  |      | 0.20  |
| C    | 1.17  |      | 1.37  |
| e    | 4.98  |      | 5.18  |
| E    | 0.50  |      | 0.90  |
| F    | 0.78  |      | 0.85  |
| H    | 10.00 |      | 10.40 |
| H1   | 7.40  |      | 7.80  |
| L    | 15.30 |      | 15.80 |
| L1   | 1.27  |      | 1.40  |
| L2   | 4.93  |      | 5.23  |
| L3   | 6.85  |      | 7.25  |
| L4   | 1.5   |      | 1.7   |
| M    | 2.6   |      | 2.9   |
| R    | 0.20  |      | 0.60  |
| V    | 0°    |      | 8°    |

Figure 20: H<sup>2</sup>PAK-2 recommended footprint



## 4.2 H<sup>2</sup>PAK packing information

Figure 21: Tape outline

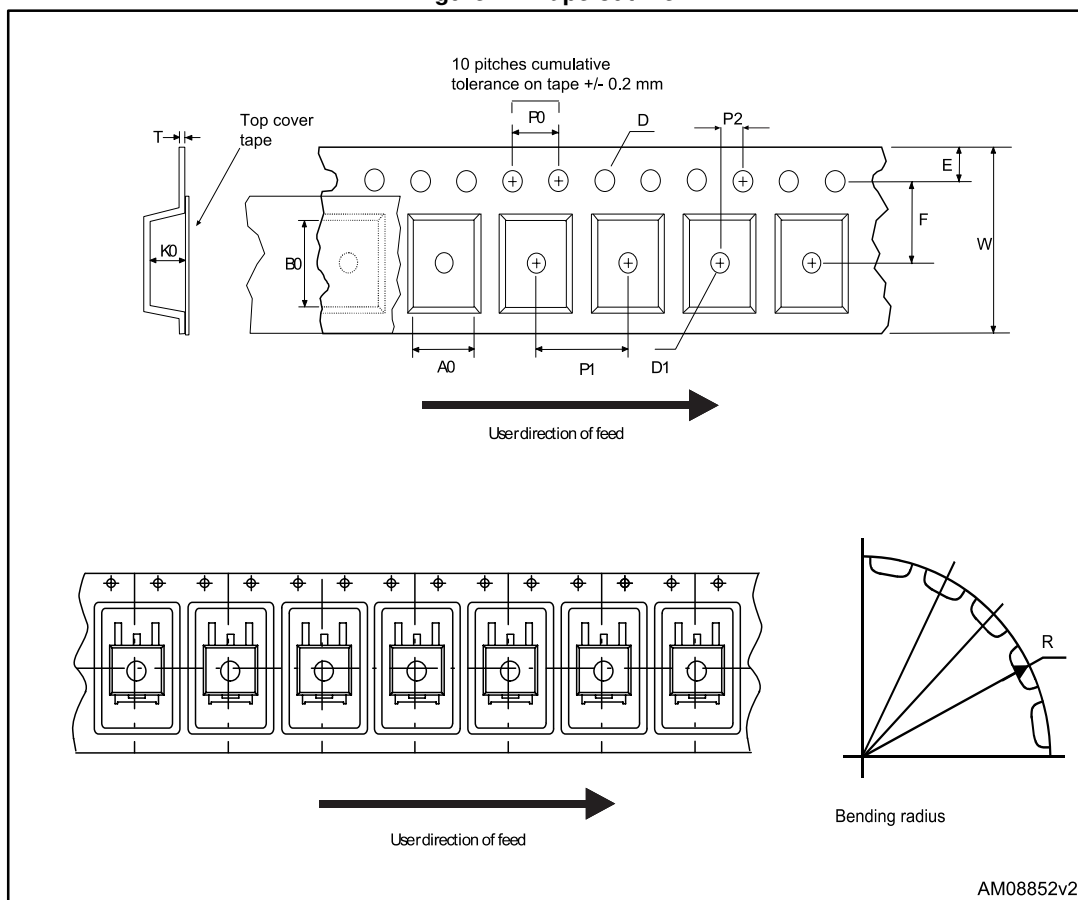


Figure 22: Reel outline

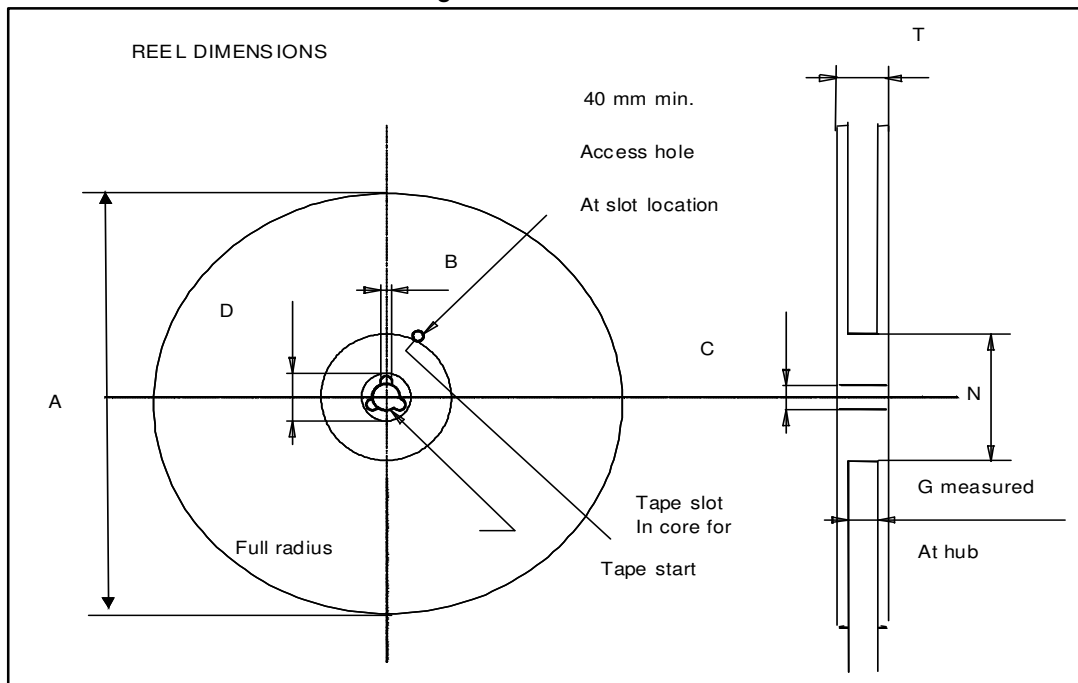


Table 9: Tape and reel mechanical data

| 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 quantity |      | 1000 |
| P2   | 1.9  | 2.1  | Bulk quantity |      | 1000 |
| R    | 50   |      |               |      |      |
| T    | 0.25 | 0.35 |               |      |      |
| W    | 23.7 | 24.3 |               |      |      |

## 5 Revision history

Table 10: Document revision history

| Date        | Revision | Changes                                                                                                                     |
|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------|
| 23-Sep-2014 | 1        | First version.                                                                                                              |
| 02-Sep-2016 | 2        | Updated Safe operating area.<br>Updated H <sup>2</sup> PAK package information<br>Minor text changes.                       |
| 06-Oct-2016 | 3        | Updated Features.<br>Updated <a href="#">Section 9.1: "H<sup>2</sup>PAK-2 package information"</a> .<br>Minor text changes. |

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