

## N-channel 40 V, 0.0018 mΩ typ., 120 A, STripFET™ VI DeepGATE™ Power MOSFET in a H<sup>2</sup>PAK-2 package

Datasheet - production data

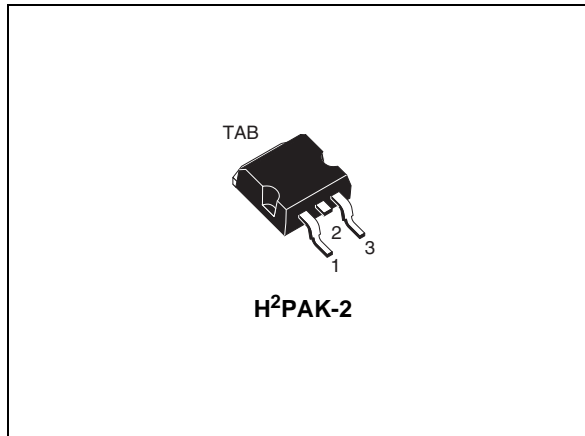
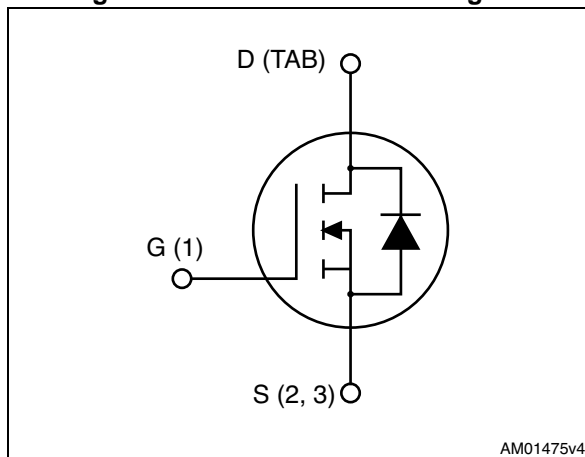


Figure 1. Internal schematic diagram



### Features

| Order code    | V <sub>DS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> | P <sub>TOT</sub> |
|---------------|-----------------|-------------------------|----------------|------------------|
| STH160N4LF6-2 | 40 V            | 0.0022 Ω                | 120 A          | 150 W            |

- R<sub>DS(on)</sub> \* Q<sub>g</sub> industry benchmark
- Extremely low on-resistance R<sub>DS(on)</sub>
- Logic level drive
- High avalanche ruggedness
- 100% avalanche tested

### Applications

- Switching applications

### Description

This device is an N-channel Power MOSFET developed using the 6<sup>th</sup> generation of STripFET™ DeepGATE™ technology, with a new gate structure. The resulting Power MOSFET exhibits the lowest R<sub>DS(on)</sub> in all packages.

Table 1. Device summary

| Order code    | Marking  | Package              | Packaging     |
|---------------|----------|----------------------|---------------|
| STH160N4LF6-2 | 160N4LF6 | 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                                                                 | 40         | V                   |
| $V_{GS}$       | Gate-source voltage                                                                  | $\pm 20$   | V                   |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$                       | 120        | A                   |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$                      | 100        | A                   |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                                               | 480        | A                   |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$                                | 150        | W                   |
|                | Derating factor                                                                      | 1          | W/ $^\circ\text{C}$ |
| $I_{AS}$       | Avalanche current, repetitive or not-repetitive (pulse width limited by $T_{jmax}$ ) | 60         | A                   |
| $E_{AS}$       | Single pulse avalanche energy                                                        | 323        | mJ                  |
| $T_{stg}$      | Storage temperature                                                                  | -55 to 175 | $^\circ\text{C}$    |
| $T_j$          | Operating junction temperature                                                       |            |                     |

1. Pulse width is limited by safe operating area

**Table 3. Thermal resistance**

| Symbol         | Parameter                               | Value | Unit                      |
|----------------|-----------------------------------------|-------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max    | 1.0   | $^\circ\text{C}/\text{W}$ |
| $R_{thj-a}$    | Thermal resistance junction-ambient max | 62.5  | $^\circ\text{C}/\text{W}$ |

## 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 ( $V_{GS} = 0$ )  | $I_D = 250\ \mu A$                          | 40   | -      |           | V        |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 20\text{ V}$                      |      | -      | 1         | $\mu A$  |
|               |                                                  | $V_{DS} = 20\text{ V}, T_C = 125\text{ °C}$ |      |        | 10        | $\mu A$  |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$                  |      | -      | $\pm 100$ | nA       |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}, I_D = 250\ \mu A$         | 1    | -      |           | V        |
| $R_{DS(on)}$  | Static drain-source on-resistance                | $V_{GS} = 10\text{ V}, I_D = 60\text{ A}$   |      | 0.0018 | 0.0022    | $\Omega$ |
|               |                                                  | $V_{GS} = 5\text{ V}, I_D = 60\text{ A}$    |      | 0.002  | 0.0027    | $\Omega$ |

**Table 5. Dynamic**

| Symbol    | Parameter                    | Test conditions                                               | Min | Typ. | Max. | Unit |
|-----------|------------------------------|---------------------------------------------------------------|-----|------|------|------|
| $C_{ISS}$ | Input capacitance            | $V_{DS} = 20\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$ | -   | 8130 | -    | pF   |
| $C_{OSS}$ | Output capacitance           |                                                               | -   | 770  | -    | pF   |
| $C_{RSS}$ | Reverse transfer capacitance |                                                               | -   | 670  | -    | pF   |
| $Q_g$     | Total gate charge            | $V_{DD} = 20\text{ V}, I_D = 60\text{ A}$                     | -   | 181  | -    | nC   |
| $Q_{gs}$  | Gate-source charge           | $V_{GS} = 10\text{ V}$                                        | -   | 22   | -    | nC   |
| $Q_{gd}$  | Gate-drain charge            | (see <a href="#">Figure 14</a> )                              | -   | 46   | -    | nC   |

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

| Symbol       | Parameter           | Test conditions                                                                                                        | Min. | Typ. | Max. | Unit |
|--------------|---------------------|------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 20\text{ V}, I_D = 60\text{ A}, R_G = 4.7\ \Omega, V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 15</a> ) | -    | 20   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                        | -    | 131  | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                                        | -    | 205  | -    | ns   |
| $t_f$        | Fall time           |                                                                                                                        | -    | 116  | -    | ns   |

Table 7. Source drain diode

| Symbol          | Parameter                     | Test conditions                                                                                                                 | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                 | -    |      | 120  | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                 | -    |      | 480  | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 120\text{ A}$ , $V_{GS} = 0$                                                                                          | -    |      | 0.97 | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 120\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 32\text{ V}$<br>(see <a href="#">Figure 17</a> ) | -    | 57   |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                 | -    | 53   |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                 | -    | 1.86 |      | 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

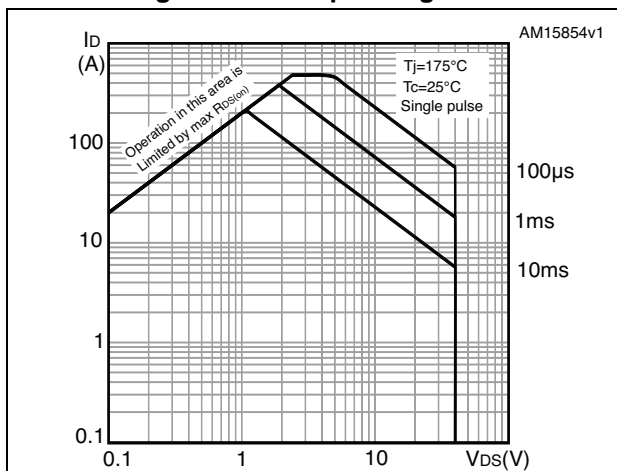


Figure 3. Thermal impedance

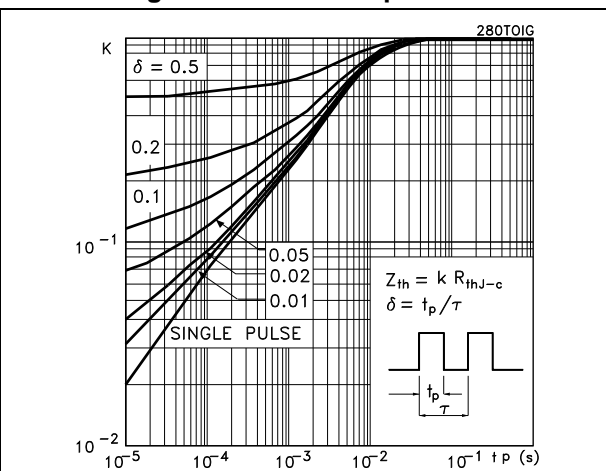


Figure 4. Output characteristics

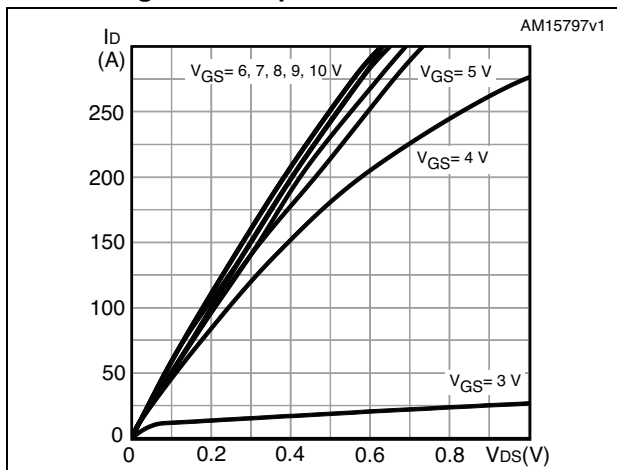


Figure 5. Transfer characteristics

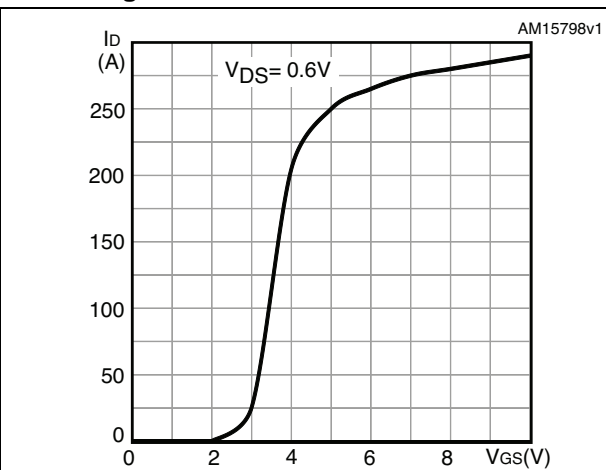


Figure 6. Gate charge vs gate-source voltage

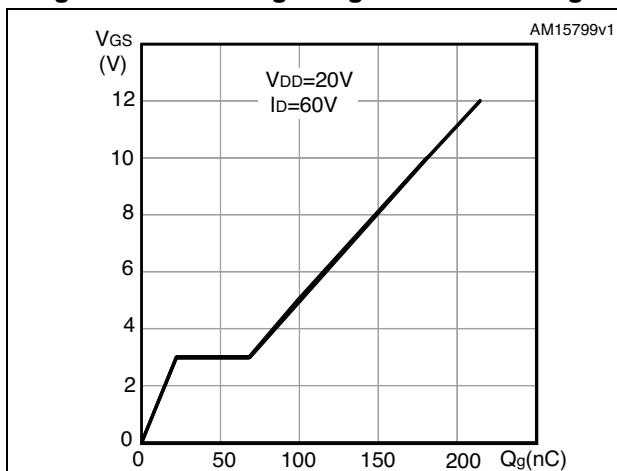


Figure 7. Static drain-source on-resistance

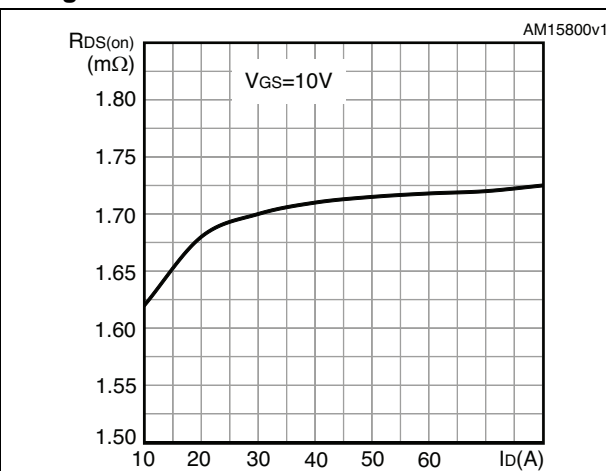


Figure 8. Capacitance variations

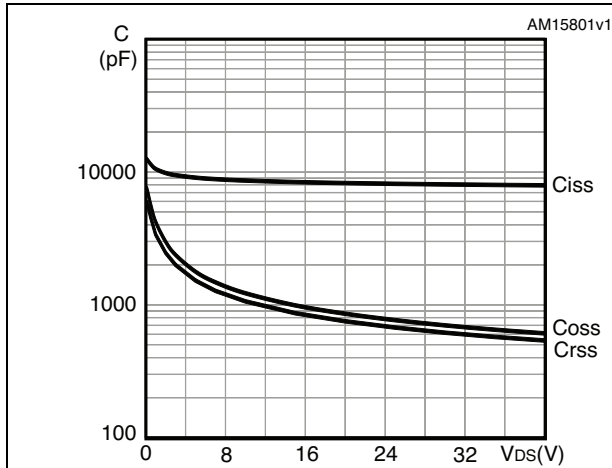


Figure 9. Normalized  $V_{(BR)DSS}$  vs temperature

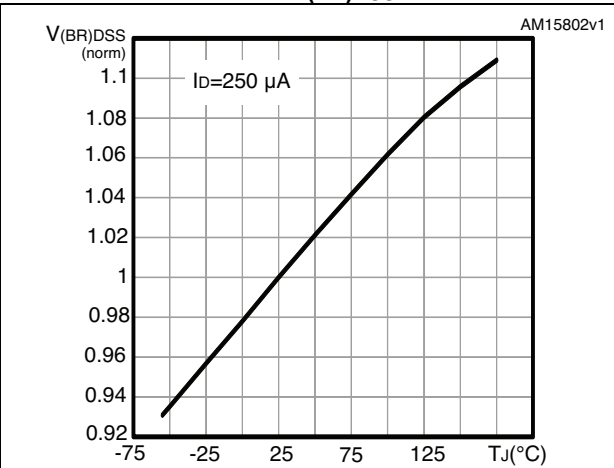


Figure 10. Normalized gate threshold voltage vs temperature

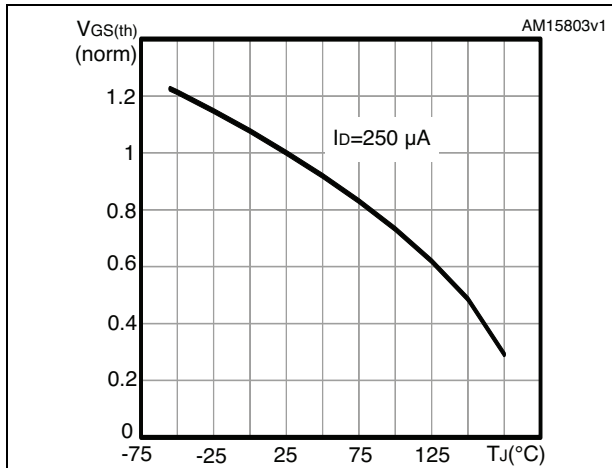


Figure 11. Normalized on-resistance vs temperature

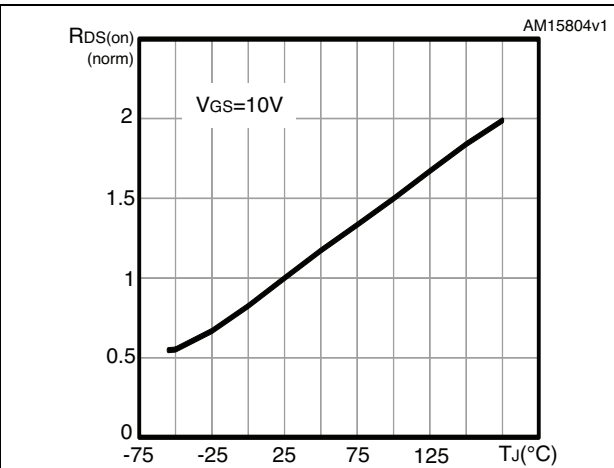
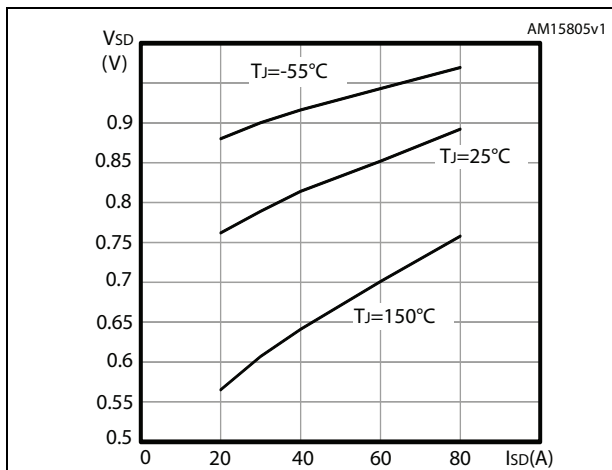


Figure 12. Source-drain diode forward characteristics



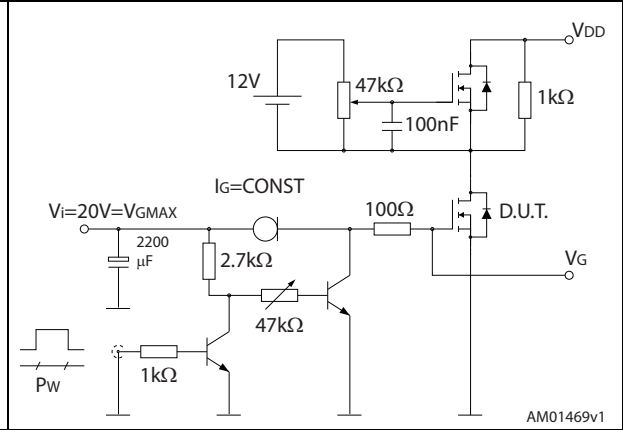
### 3 Test circuits

Figure 13. Switching times test circuit for resistive load



AM01468v1

Figure 14. Gate charge test circuit



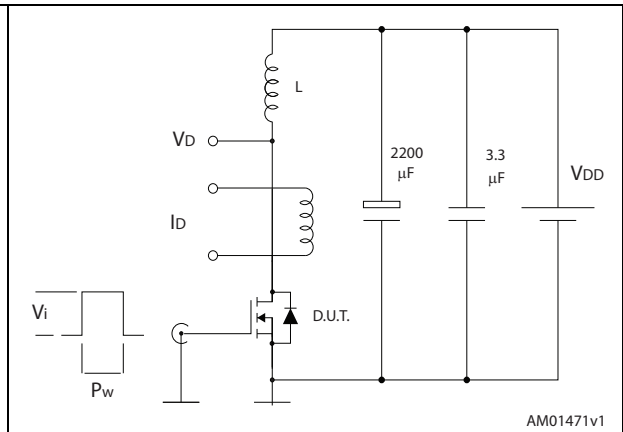
AM01469v1

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



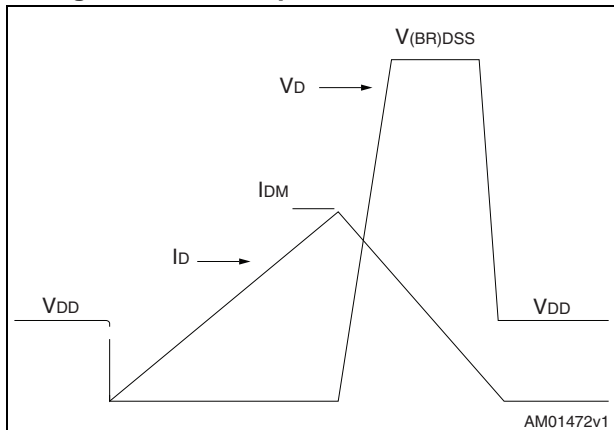
AM01470v1

Figure 16. Unclamped inductive load test circuit



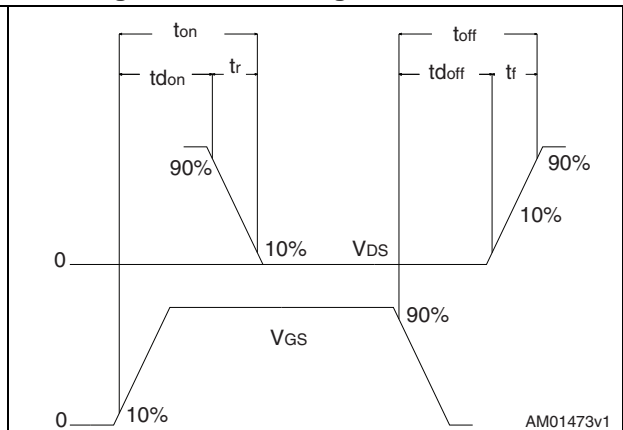
AM01471v1

Figure 17. Unclamped inductive waveform



AM01472v1

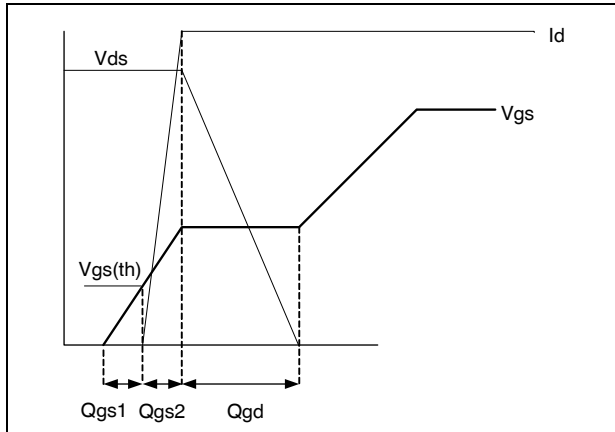
Figure 18. Switching time waveform



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<sup>®</sup> is an ST trademark.

Figure 20. H<sup>2</sup>PAK-2 drawing

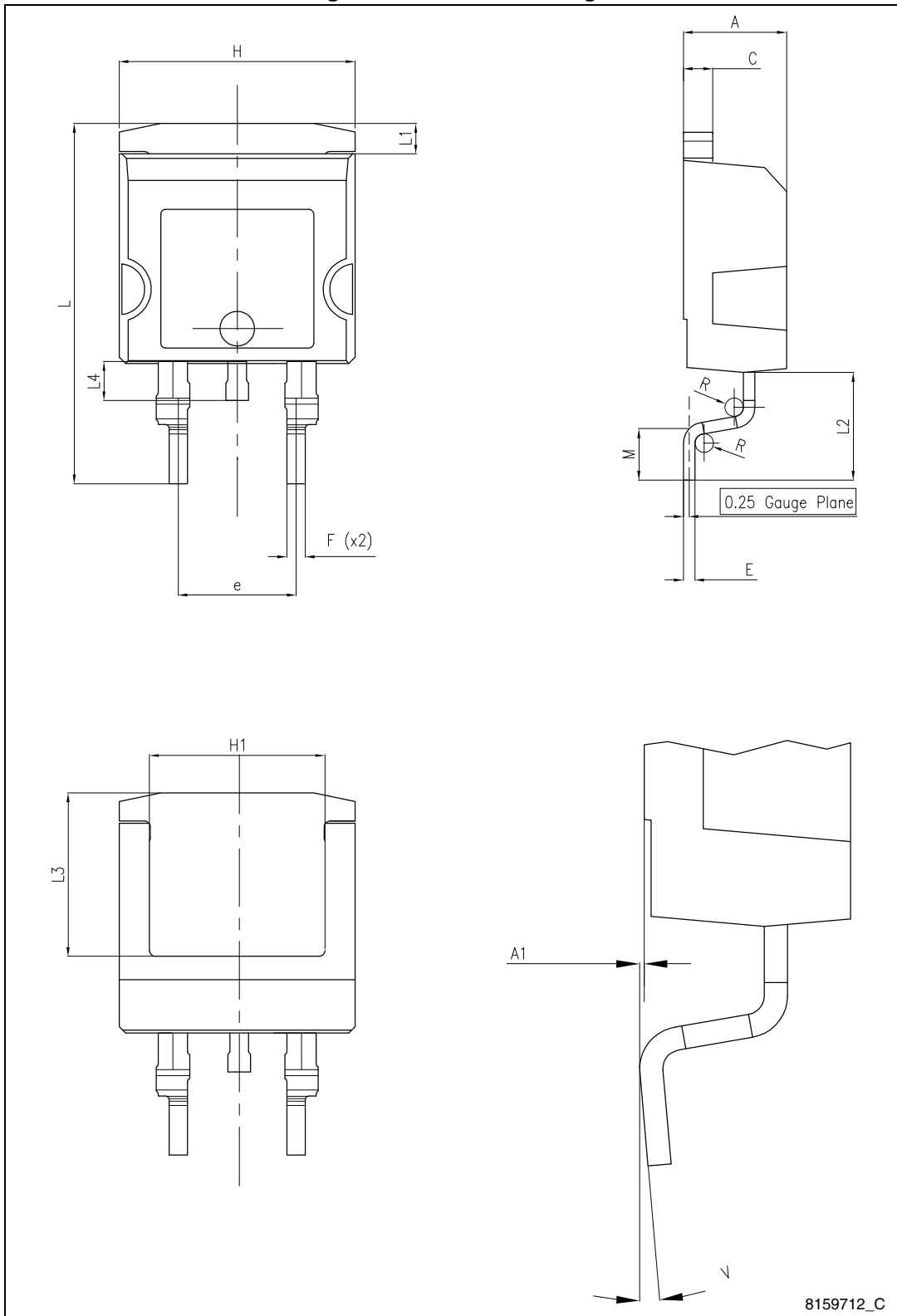
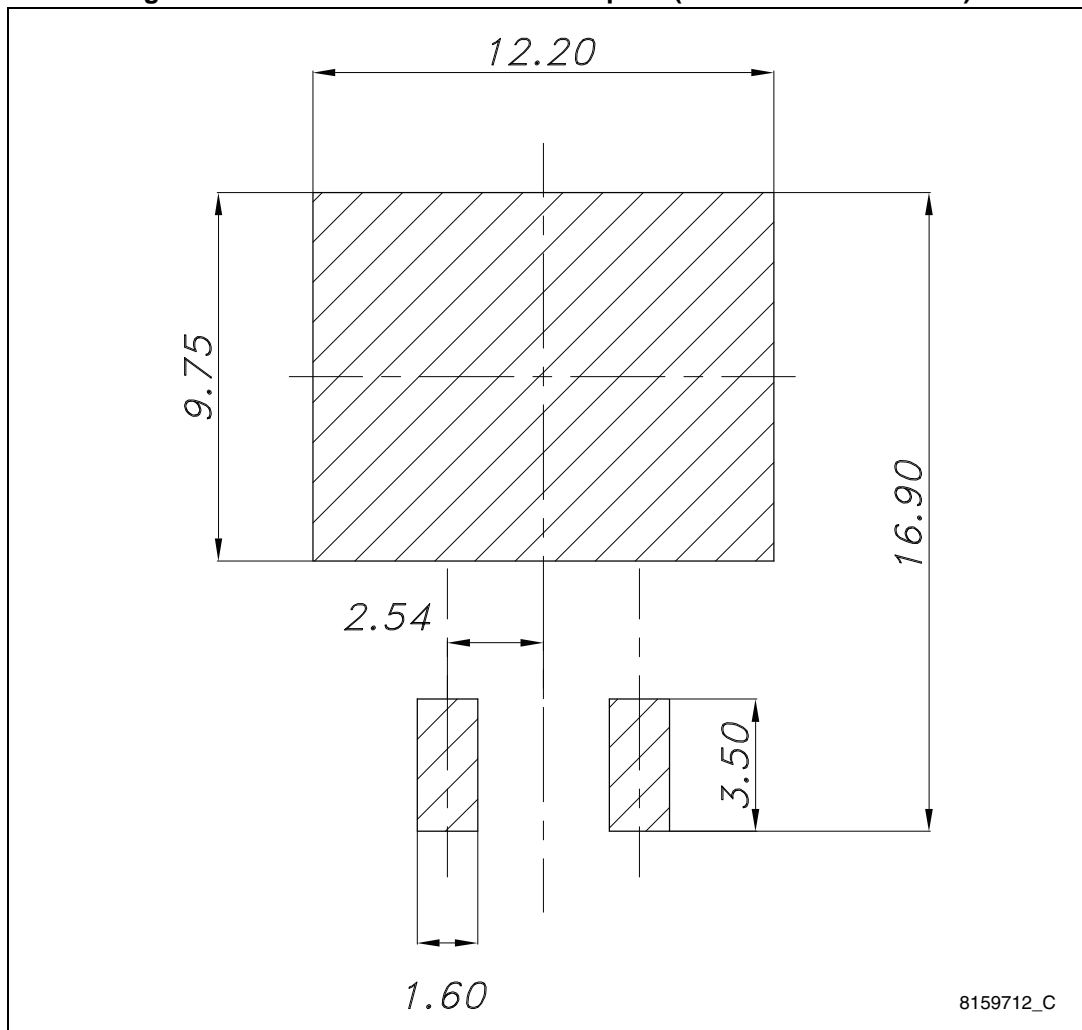


Table 8. H<sup>2</sup>PAK-2 mechanical data

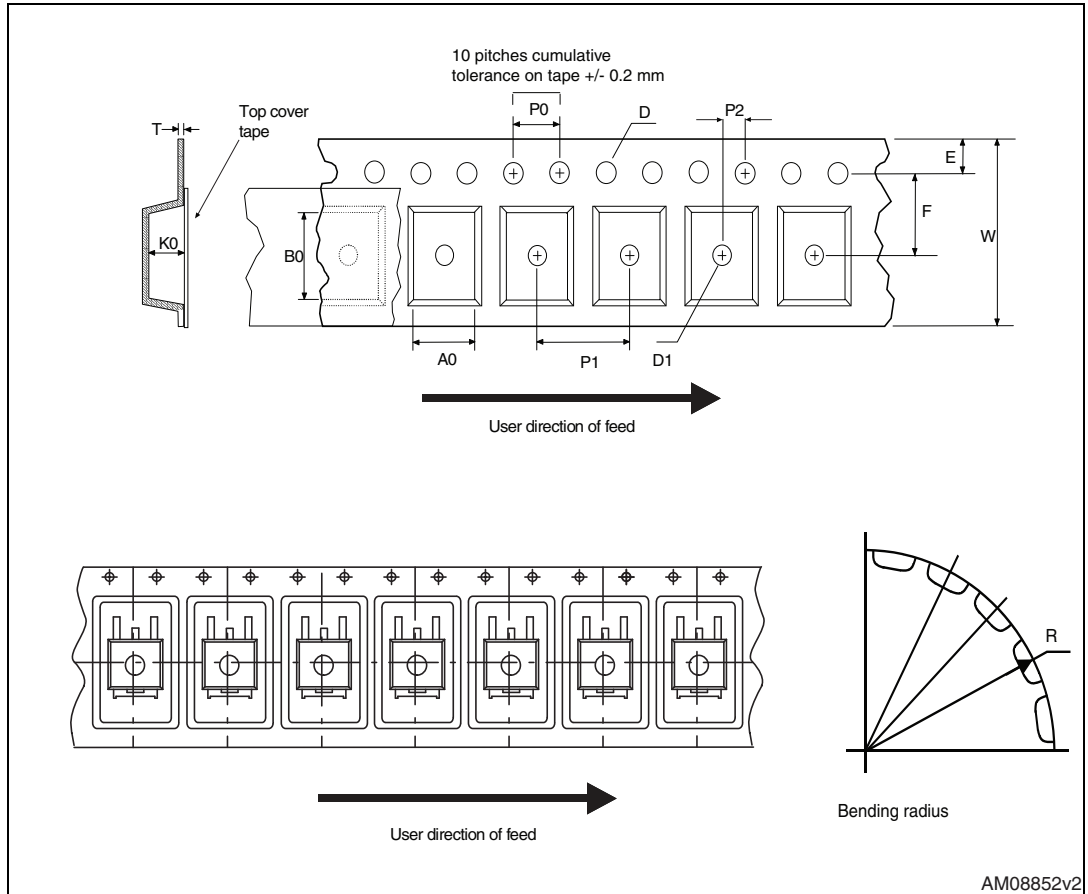
| Dim. | mm    |      |       |
|------|-------|------|-------|
|      | Min.  | Typ. | Max.  |
| A    | 4.30  |      | 4.80  |
| A1   | 0.03  |      | 0.20  |
| C    | 1.17  |      | 1.37  |
| e    | 4.98  |      | 5.18  |
| E    | 0.50  |      | 0.90  |
| F    | 0.78  |      | 0.85  |
| H    | 10.00 |      | 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 21. H<sup>2</sup>PAK-2 recommended footprint (dimensions are in mm)



# 5 Packaging mechanical data

Figure 22. Tape



AM08852v2

Figure 23. Reel

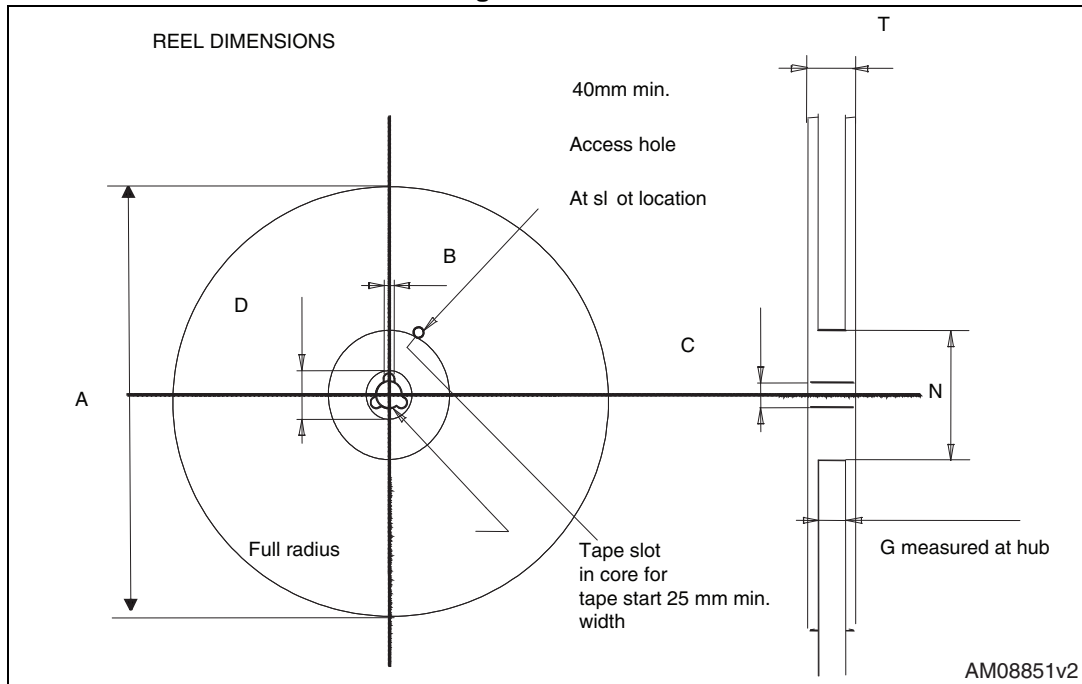


Table 9. H<sup>2</sup>PAK-2 leads tape and reel mechanical data

| 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 10. Document revision history

| Date        | Revision | Changes        |
|-------------|----------|----------------|
| 24-Apr-2014 | 1        | First release. |



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