



## STH90N55F4-2

N-channel 55 V, 0.0064  $\Omega$ , 90 A, H<sup>2</sup>PAK  
STripFET™ DeepGATE™ Power MOSFET

### Features

| Type         | V <sub>DSS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> |
|--------------|------------------|-------------------------|----------------|
| STH90N55F4-2 | 55 V             | < 0.008 $\Omega$        | 90 A           |

- Exceptional dv/dt capability
- Extremely low on-resistance R<sub>DS(on)</sub>
- 100% avalanche tested

### Applications

- Switching applications

### Description

The device is N-channel Power MOSFETs developed using ST's STripFET™ DeepGATE™ technology. The device has a new gate structure and is specially designed to minimize on-state resistance to provide superior switching performance.

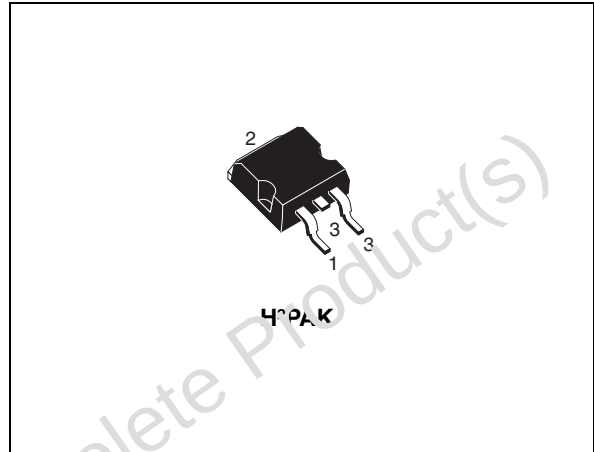


Figure 1. Internal schematic diagram

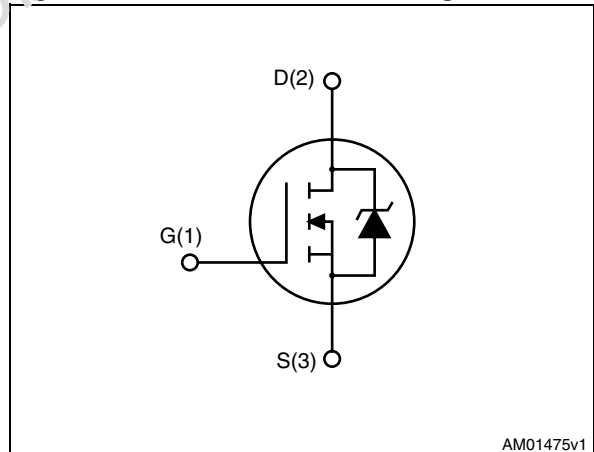


Table 1. Device summary

| Order code   | Marking | Packages           | Packaging     |
|--------------|---------|--------------------|---------------|
| STH90N55F4-2 | 90N55F4 | H <sup>2</sup> PAK | Tape and reel |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol         | Parameter                                                         | Value       | Unit                  |
|----------------|-------------------------------------------------------------------|-------------|-----------------------|
| $V_{DS}$       | Drain-source voltage ( $V_{GS} = 0$ )                             | 55          | V                     |
| $V_{GS}$       | Gate-source voltage                                               | $\pm 20$    | V                     |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$  | 90          | A                     |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$ | 65          | A                     |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                            | 360         | A                     |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$           | 150         | W                     |
|                | Derating factor                                                   | 1           | W/ $^{\circ}\text{C}$ |
| $E_{AS}^{(2)}$ | Single pulse avalanche energy                                     | 250         | mJ                    |
| $T_{stg}$      | Storage temperature                                               | - 55 to 175 | $^{\circ}\text{C}$    |
| $T_j$          | Max. operating junction temperature                               |             |                       |

1. Pulse width limited by safe operating area

2. Starting  $T_j = 25\text{ }^{\circ}\text{C}$ ,  $I_D = 32.5\text{ A}$ ,  $V_{DD} = 45\text{ V}$

**Table 3. Thermal data**

| Symbol         | Parameter                                      | Value | Unit                        |
|----------------|------------------------------------------------|-------|-----------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max           | 1     | $^{\circ}\text{C}/\text{W}$ |
| $R_{thj-a}$    | Thermal resistance junction-ambient max        | 62.5  | $^{\circ}\text{C}/\text{W}$ |
| $T_l$          | Maximum lead temperature for soldering purpose | 300   | $^{\circ}\text{C}$          |

## 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                   | $I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0$                                                      | 55   |        |          | V                              |
| $I_{DSS}$     | Zero gate voltage Drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{max rating}$<br>$V_{DS} = \text{max rating}$ , $T_C = 125\text{ }^{\circ}\text{C}$ |      |        | 1<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$                                                                         |      |        | 100      | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                                 | 2    |        | 4        | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 45\text{ A}$                                                       |      | 0.0064 | 0.008    | $\Omega$                       |

**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>$V_{GS} = 0$                                           | -    | 4800 | -    | pF   |
| $C_{oss}$ | Output capacitance           |                                                                                                         |      | 350  |      | pF   |
| $C_{rss}$ | Reverse transfer capacitance |                                                                                                         |      | 210  |      | pF   |
| $Q_g$     | Total gate charge            | $V_{DD} = 27.5\text{ V}$ , $I_D = 90\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$<br><a href="#">Figure 14</a> | -    | 90   | -    | nC   |
| $Q_{gs}$  | Gate-source charge           |                                                                                                         |      | 25   |      | nC   |
| $Q_{gd}$  | Gate-drain charge            |                                                                                                         |      | 26   |      | nC   |

**Table 6. Switching times**

| Symbol       | Parameter           | Test conditions                                                                                                                     | Min. | Typ. | Max. | Unit |
|--------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 27.5\text{ V}$ , $I_D = 90\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br><a href="#">Figure 13</a> | -    | 20   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                                     |      | 60   |      | ns   |
| $t_{d(off)}$ | Turn-off-delay time | $V_{DD} = 27.5\text{ V}$ , $I_D = 90\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br><a href="#">Figure 13</a> | -    | 55   | -    | ns   |
| $t_f$        | Fall time           |                                                                                                                                     |      | 30   |      | ns   |

**Table 7. Source drain diode**

| Symbol          | Parameter                     | Test conditions                                                                                                                                           | Min. | Typ. | Max | Unit |
|-----------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|-----|------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                                           | -    |      | 90  | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                                           | -    |      | 360 | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 90\text{ A}$ , $V_{GS} = 0$                                                                                                                     | -    |      | 1.5 | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 90\text{ A}$ , $V_{DD} = 44\text{ V}$<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$T_j = 150\text{ }^\circ\text{C}$<br><a href="#">Figure 15</a> | -    | 50   |     | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                           |      | 105  |     | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                           |      | 4    |     | 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

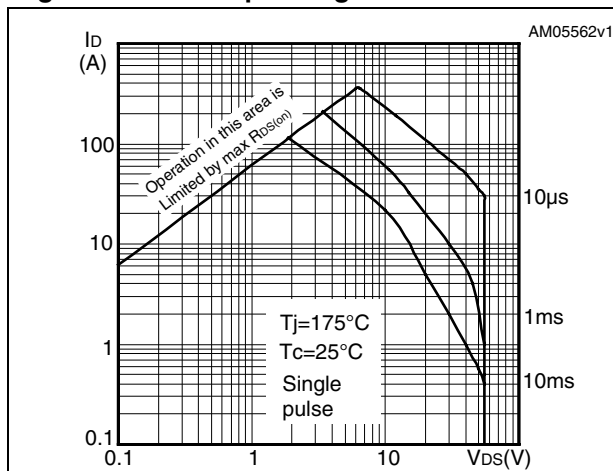


Figure 3. Thermal impedance

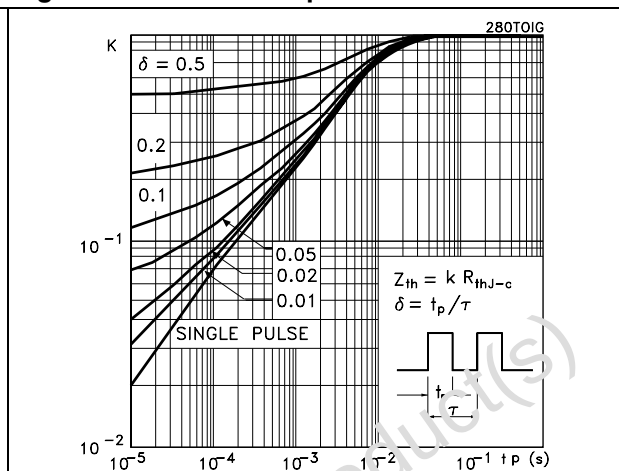


Figure 4. Output characteristics

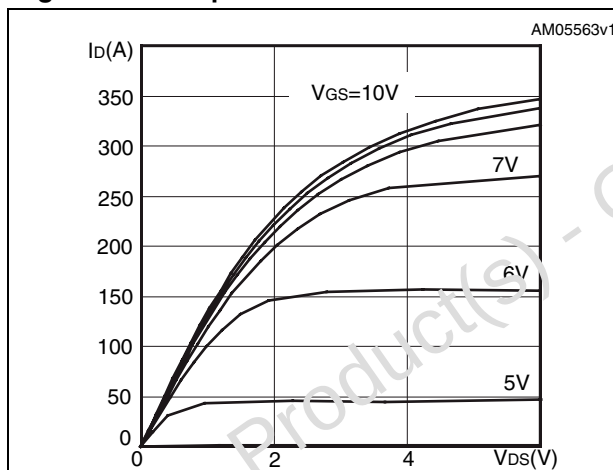


Figure 5. Transfer characteristics

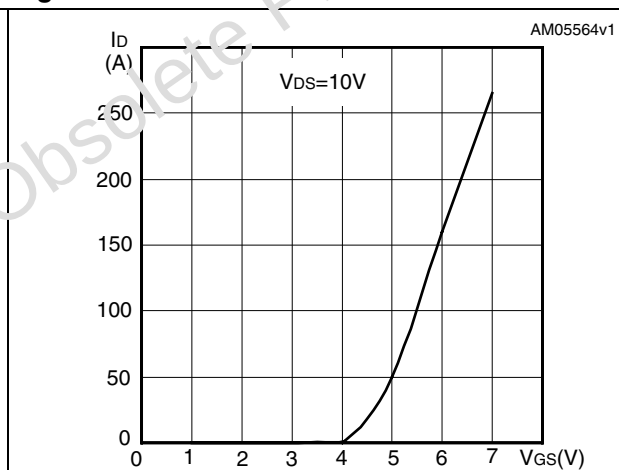
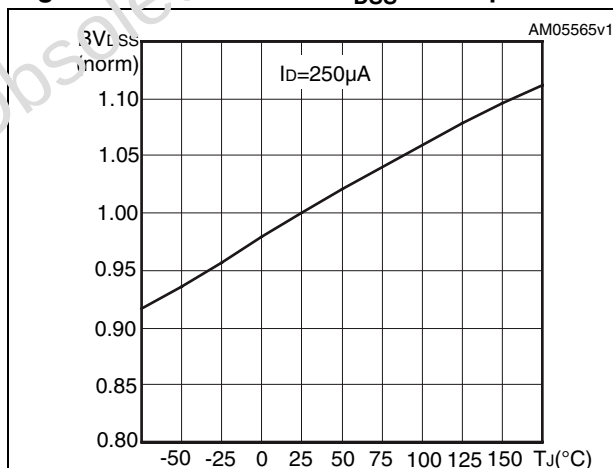
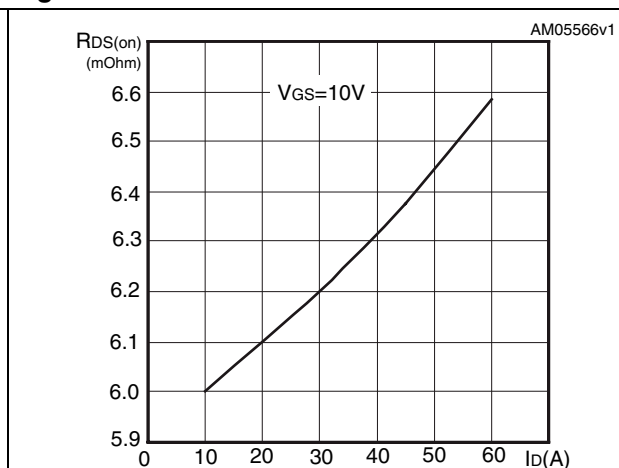
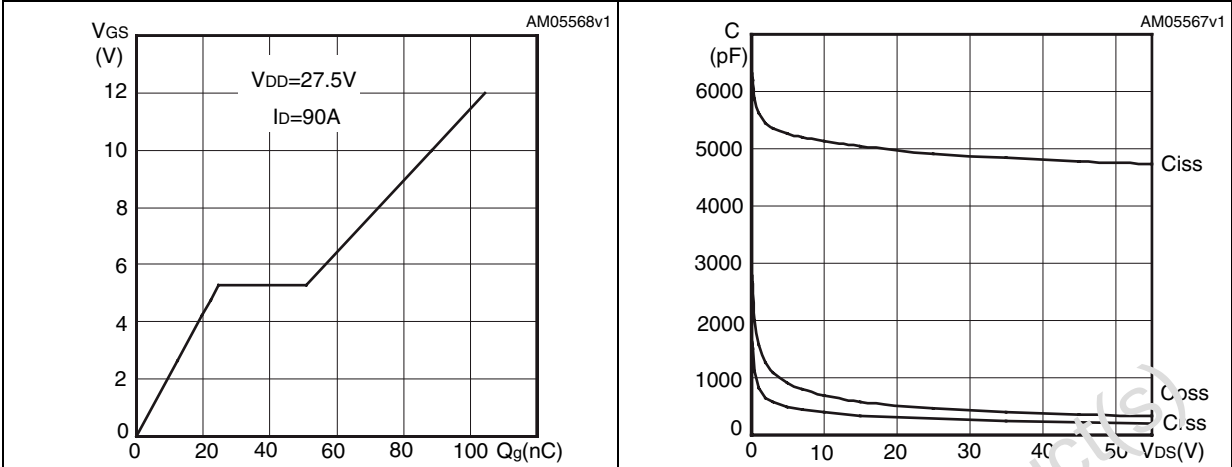
Figure 6. Normalized  $BV_{DSS}$  vs temperature

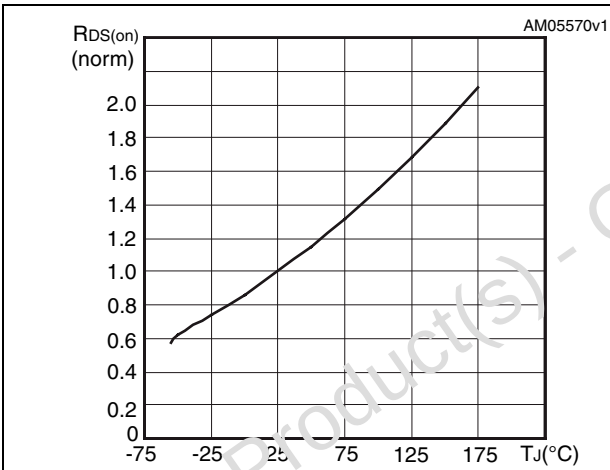
Figure 7. Static drain-source on resistance



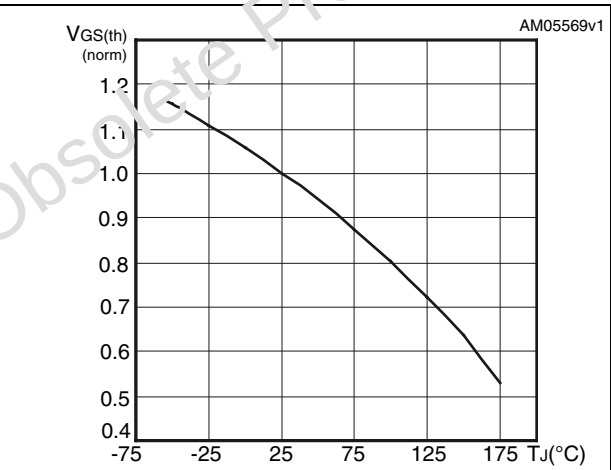
**Figure 8. Gate charge vs gate-source voltage** **Figure 9. Capacitance variations**



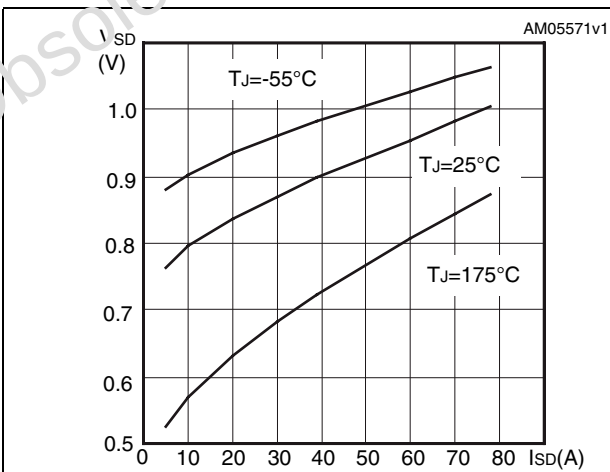
**Figure 10. Normalized on resistance vs temperature**



**Figure 11. Normalized gate threshold voltage vs temperature**

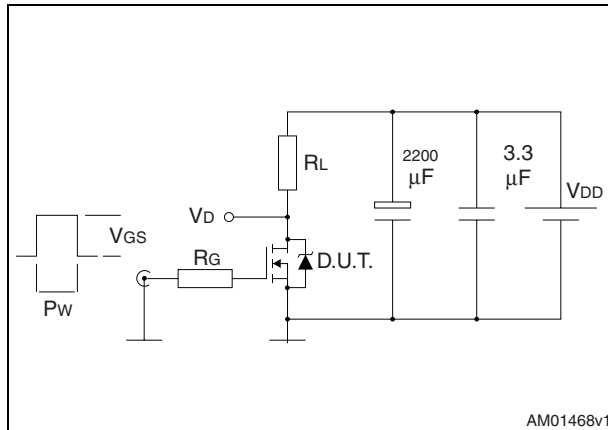


**Figure 12. Source-drain diode forward characteristics**

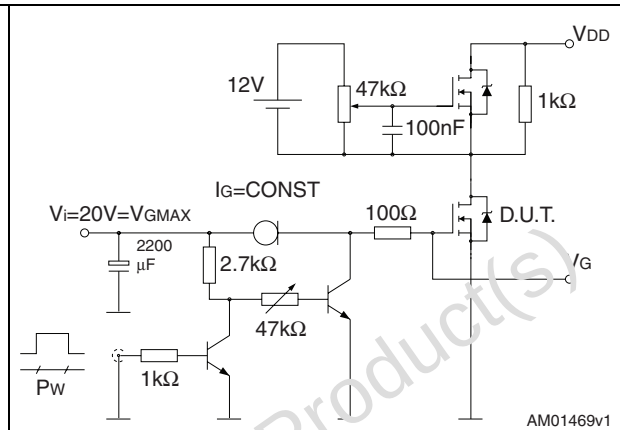


### 3 Test circuits

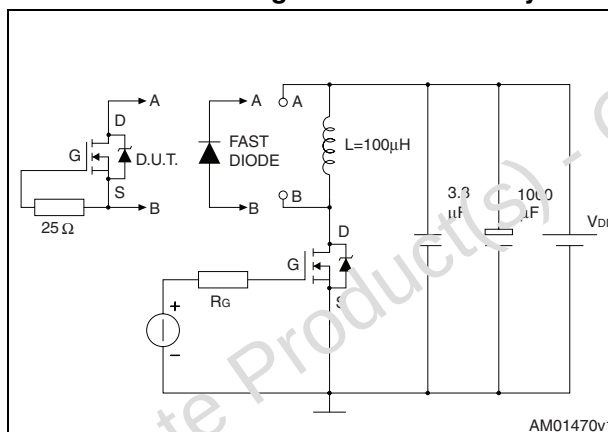
**Figure 13. Switching times test circuit for resistive load**



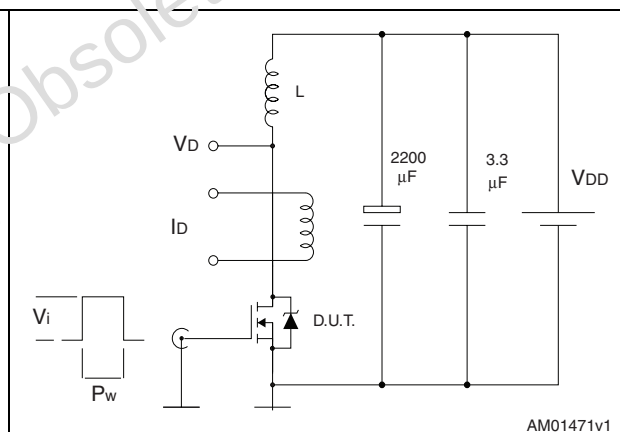
**Figure 14. Gate charge test circuit**



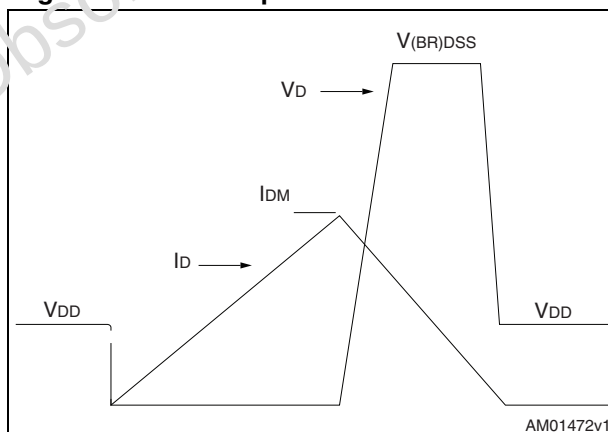
**Figure 15. Test circuit for inductive load switching and diode recovery times**



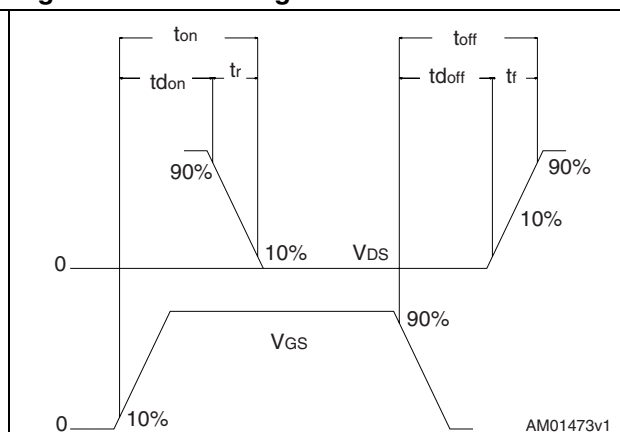
**Figure 16. Uncamped inductive load test circuit**



**Figure 17. Unclamped inductive waveform**



**Figure 18. Switching time waveform**



## 4 Package mechanical data

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.

Obsolete Product(s) - Obsolete Product(s)

Table 8. H<sup>2</sup>PAK 2 leads 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  |      | 7.50  |
| 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 19. H<sup>2</sup>PAK 2 leads drawing

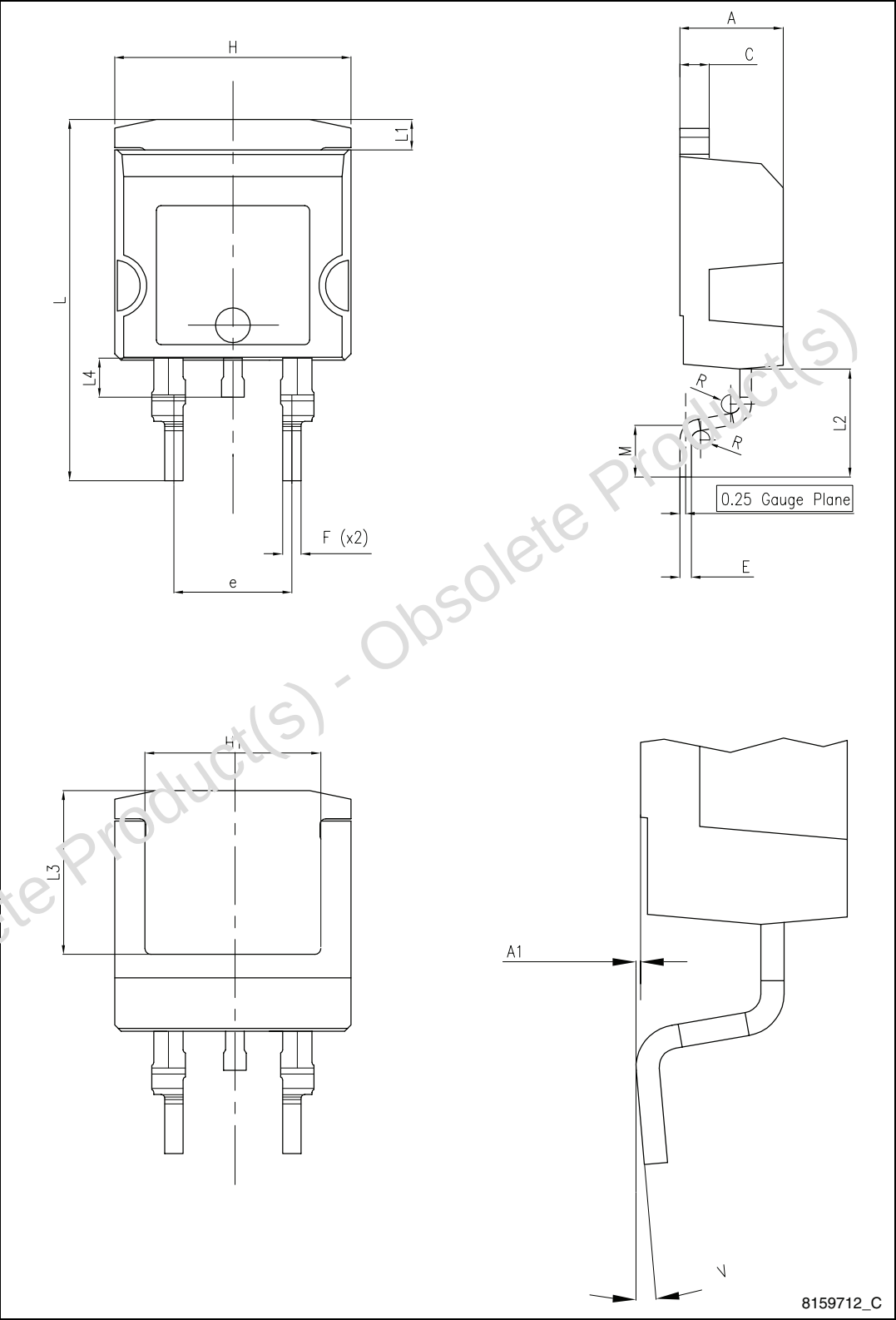
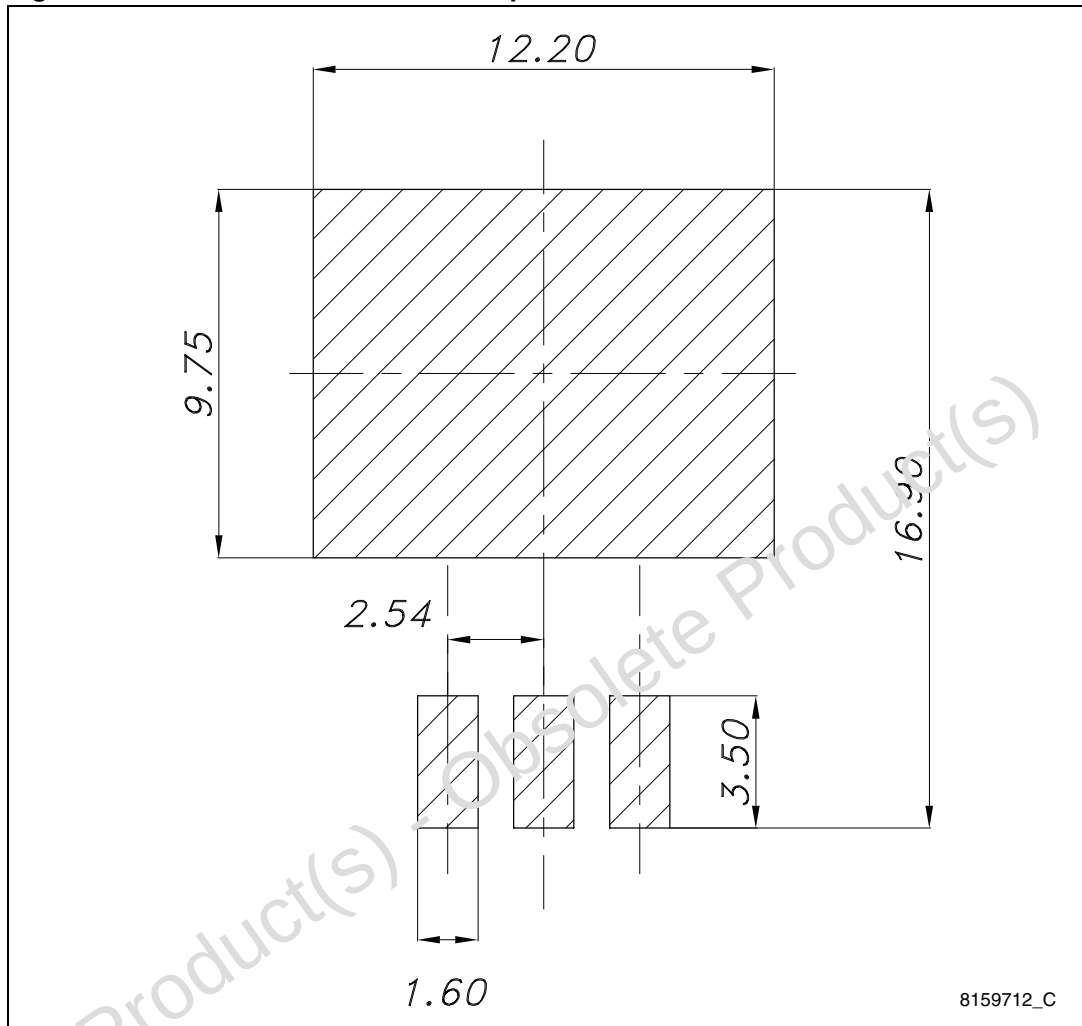


Figure 20. H<sup>2</sup>PAK 2 recommended footprint

## 5 Packaging mechanical data

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 |          |      |      |

Figure 21. Tape

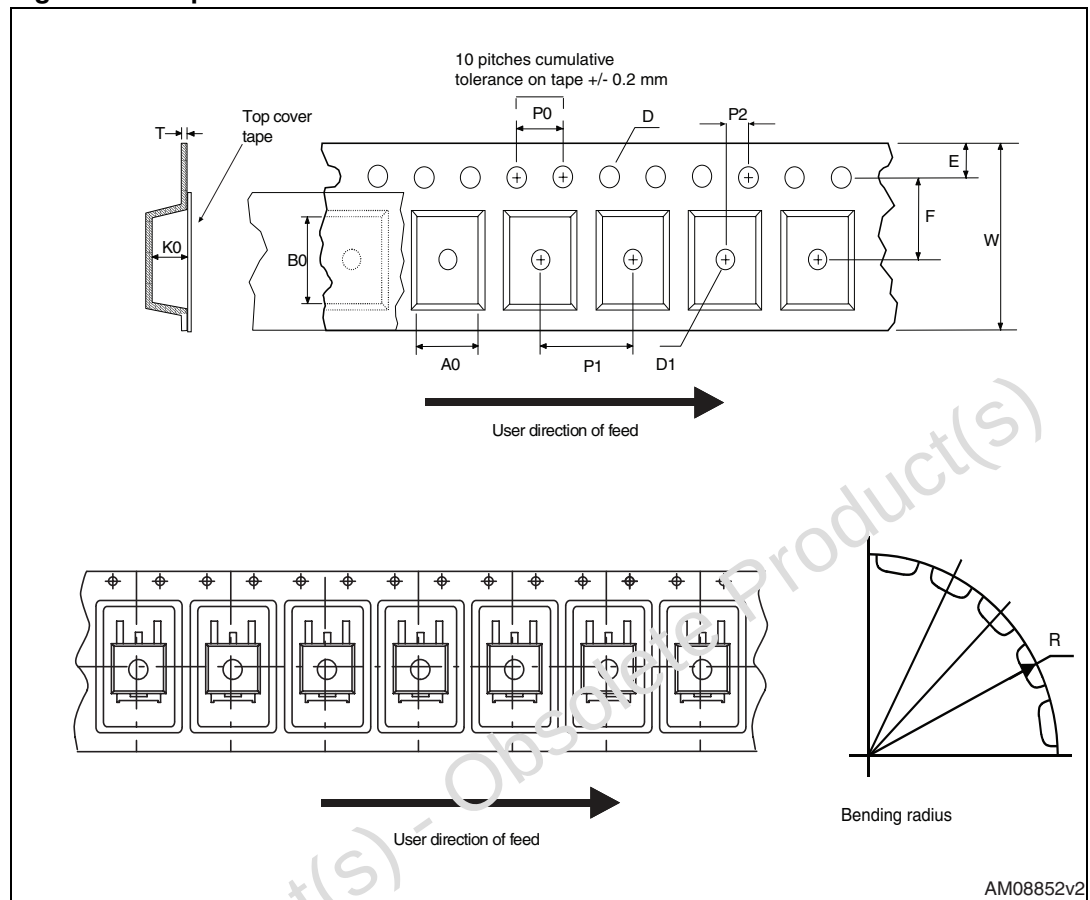
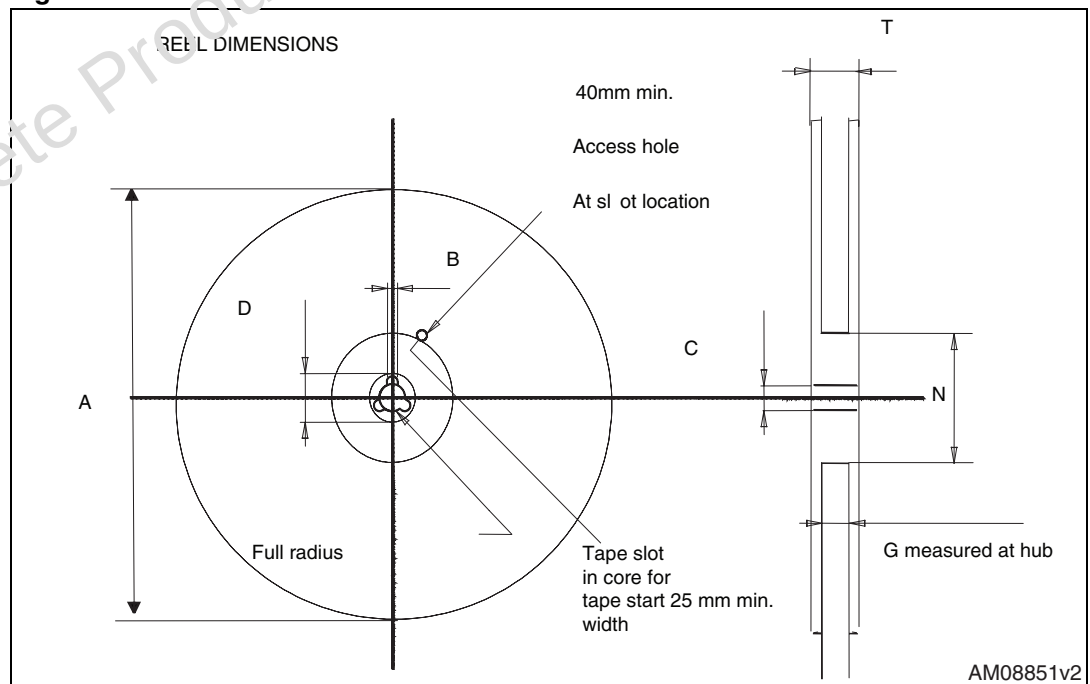


Figure 22. Reel



## 6 Revision history

**Table 10. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                  |
|-------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 08-Jun-2009 | 1        | First release                                                                                                                                                                                                            |
| 01-Mar-2010 | 2        | <ul style="list-style-type: none"><li>– Document status promoted from preliminary data to datasheet.</li><li>– Removed package D<sup>2</sup>PAK</li><li>– Added new package, mechanical data: H<sup>2</sup>PAK</li></ul> |
| 16-Mar-2011 | 3        | Updated <a href="#">Table 5</a> and <a href="#">Table 6</a> .                                                                                                                                                            |
| 11-Aug-2011 | 4        | <ul style="list-style-type: none"><li>– The part number STP90N55F4 has been moved to a separate datasheet</li><li>– Minor text changes</li></ul>                                                                         |

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