

## Automotive-grade N-channel 40 V, 1.4 mΩ typ., 180 A STripFET™ F3 Power MOSFET in H<sup>2</sup>PAK-6 package

Datasheet – production data

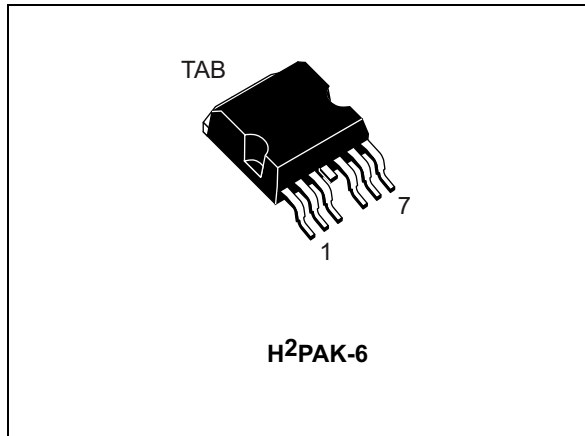
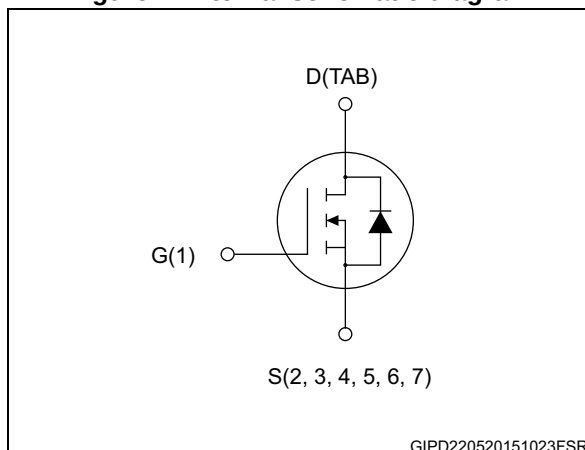


Figure 1. Internal schematic diagram



### Features

| Order codes  | V <sub>DS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> |
|--------------|-----------------|-------------------------|----------------|
| STH270N4F3-6 | 40 V            | 1.7 mΩ                  | 180 A          |

- Designed for automotive applications and AEC-Q101 qualified
- Conduction losses reduced
- Low profile, very low parasitic inductance, high current package

### 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 | Package              | Packaging     |
|--------------|---------|----------------------|---------------|
| STH270N4F3-6 | 270N4F3 | H <sup>2</sup> PAK-6 | Tape and reel |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol         | Parameter                                                       | Value       | Unit             |
|----------------|-----------------------------------------------------------------|-------------|------------------|
| $V_{DS}$       | Drain-source voltage                                            | 40          |                  |
| $V_{GS}$       | Gate-source voltage                                             | $\pm 20$    | V                |
| $I_D^{(1)}$    | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$  | 180         | A                |
| $I_D^{(1)}$    | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 180         | A                |
| $I_{DM}^{(2)}$ | Drain current (pulsed)                                          | 720         | A                |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$           | 300         | W                |
| $E_{AS}^{(3)}$ | Single pulse avalanche energy                                   | 1000        | mJ               |
| $T_{stg}$      | Storage temperature                                             | - 55 to 175 | $^\circ\text{C}$ |
| $T_j$          | Operating junction temperature                                  |             | $^\circ\text{C}$ |

1. Current limited by package.
2. Pulse width limited by safe operating area
3. Starting  $T_J=25^\circ\text{C}$ ,  $I_D=80\text{ A}$ ,  $V_{DD}=32\text{ V}$

**Table 3. Thermal data**

| Symbol              | Parameter                            | Value | Unit               |
|---------------------|--------------------------------------|-------|--------------------|
| $R_{thj-case}$      | Thermal resistance junction-case max | 0.5   | $^\circ\text{C/W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb max  | 35    | $^\circ\text{C/W}$ |

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

## 2 Electrical characteristics

( $T_C = 25\text{ }^{\circ}\text{C}$  unless otherwise specified)

**Table 4. On /off states**

| Symbol        | Parameter                         | Test conditions                                                       | Min. | Typ. | Max.      | Unit          |
|---------------|-----------------------------------|-----------------------------------------------------------------------|------|------|-----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage    | $V_{GS} = 0, I_D = 250\text{ }\mu\text{A}$                            | 40   |      |           | V             |
| $I_{DSS}$     | Zero gate voltage drain current   | $V_{GS} = 0, V_{DS} = 40\text{ V}$                                    |      |      | 10        | $\mu\text{A}$ |
|               |                                   | $V_{GS} = 0, V_{DS} = 40\text{ V}, T_C = 125\text{ }^{\circ}\text{C}$ |      |      | 100       | $\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current         | $V_{DS} = 0, V_{GS} = \pm 20\text{ V}$                                |      |      | $\pm 200$ | 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 | $V_{GS} = 10\text{ V}, I_D = 80\text{ A}$                             |      | 1.4  | 1.7       | m $\Omega$    |

**Table 5. Dynamic**

| Symbol    | Parameter                    | Test conditions                                                                                      | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|------------------------------------------------------------------------------------------------------|------|------|------|------|
| $C_{iss}$ | Input capacitance            | $V_{DS} = 25\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$                                                 | -    | 7400 | -    | pF   |
| $C_{oss}$ | Output capacitance           |                                                                                                      | -    | 1800 | -    | pF   |
| $C_{rss}$ | Reverse transfer capacitance |                                                                                                      | -    | 50   | -    | pF   |
| $Q_g$     | Total gate charge            | $V_{DD} = 20\text{ V}, I_D = 160\text{ A}, V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 14</a> ) | -    | 110  | 150  | nC   |
| $Q_{gs}$  | Gate-source charge           |                                                                                                      | -    | 30   | -    | nC   |
| $Q_{gd}$  | Gate-drain charge            |                                                                                                      | -    | 25   | -    | nC   |

**Table 6. Switching times**

| Symbol       | Parameter           | Test conditions                                                                                                             | Min. | Typ. | Max. | Unit |
|--------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 20\text{ V}, I_D = 80\text{ A}, R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 2</a> ) | -    | 25   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                             | -    | 180  | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                                             | -    | 110  | -    | ns   |
| $t_f$        | Fall time           |                                                                                                                             | -    | 45   | -    | ns   |

Table 7. Source drain diode

| Symbol          | Parameter                     | Test conditions                                                                                                                                                | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{SD}^{(1)}$  | Source-drain current          |                                                                                                                                                                | -    |      | 180  | A    |
| $I_{SDM}^{(2)}$ | Source-drain current (pulsed) |                                                                                                                                                                | -    |      | 720  | A    |
| $V_{SD}^{(3)}$  | Forward on voltage            | $I_{SD} = 180\text{ A}$ , $V_{GS} = 0$                                                                                                                         | -    |      | 1.5  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 160\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 32\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 15</a> ) | -    | 70   |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                | -    | 225  |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                | -    | 3.2  |      | A    |

1. Current limited by package
2. Pulse width limited by safe operating area.
3. Pulsed: pulse duration=300  $\mu\text{s}$ , duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

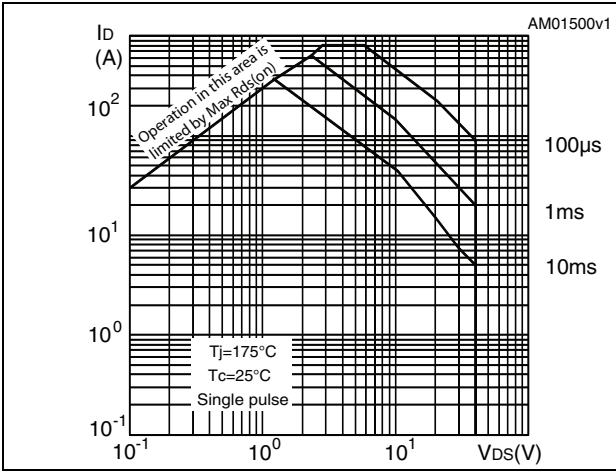


Figure 3. Thermal impedance

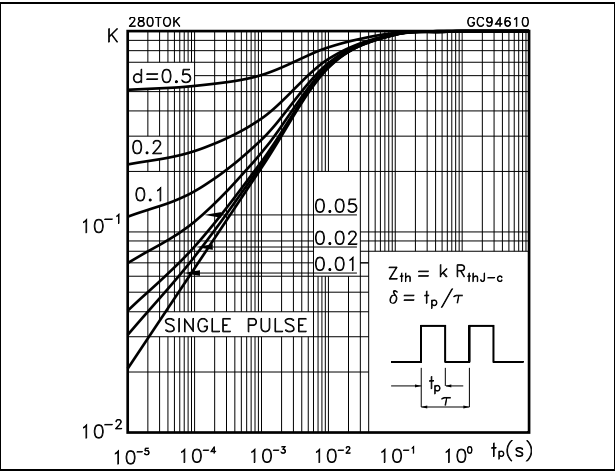


Figure 4. Output characteristics

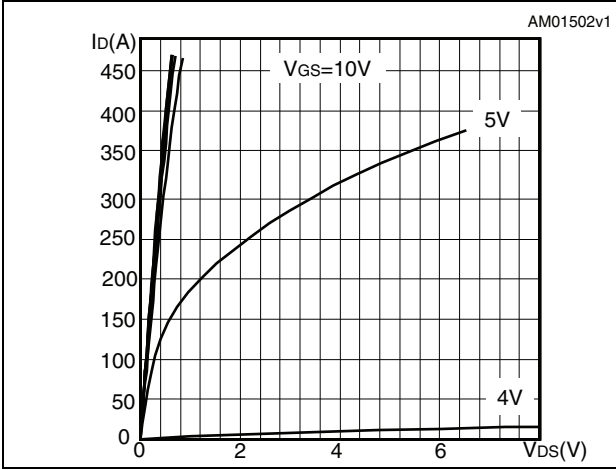


Figure 5. Transfer characteristics

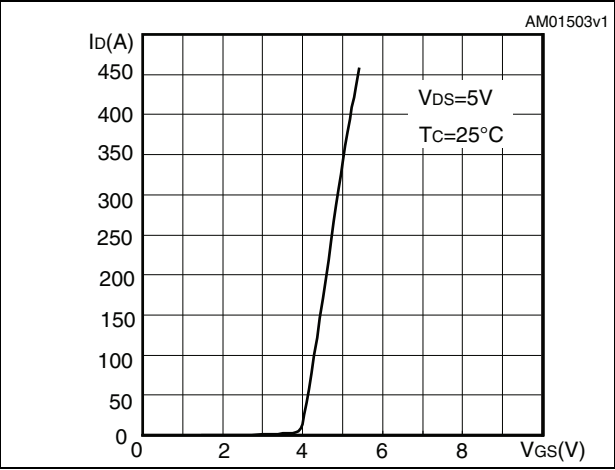


Figure 6. Gate charge vs gate-source voltage

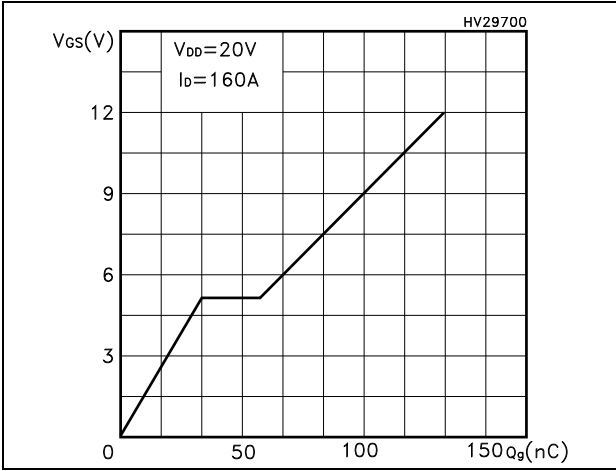


Figure 7. Static drain-source on-resistance

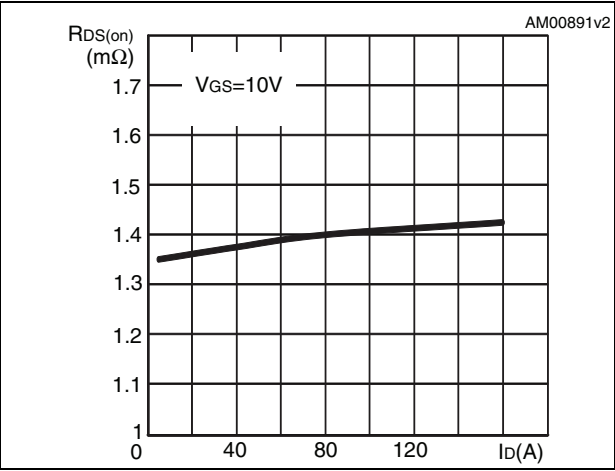


Figure 8. Capacitance variations

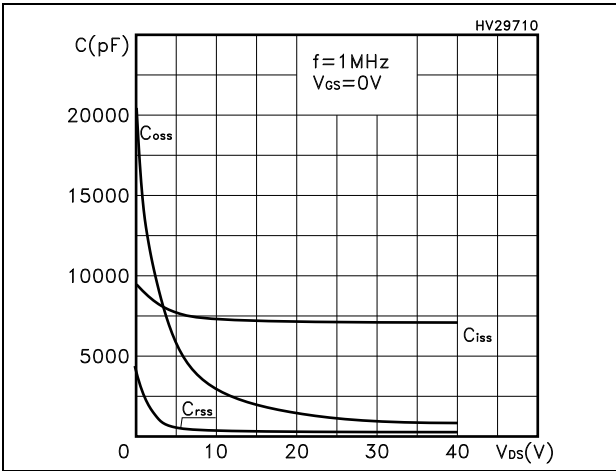


Figure 9. Normalized gate threshold voltage vs temperature

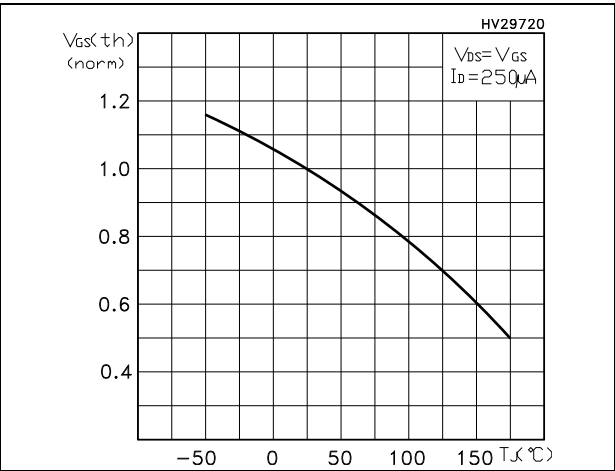


Figure 10. Normalized on-resistance vs temperature

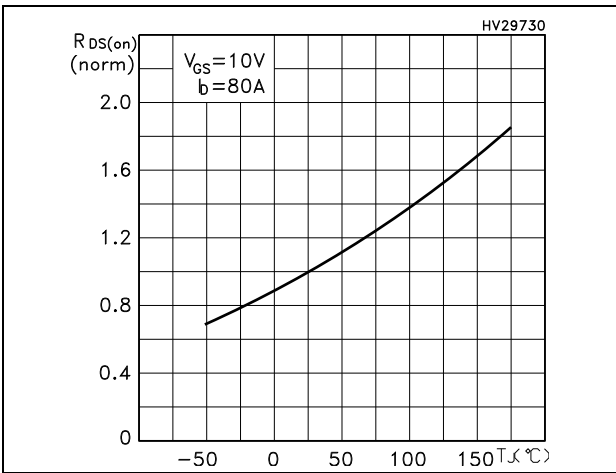


Figure 11. Normalized  $V_{(BR)DSS}$  vs temperature

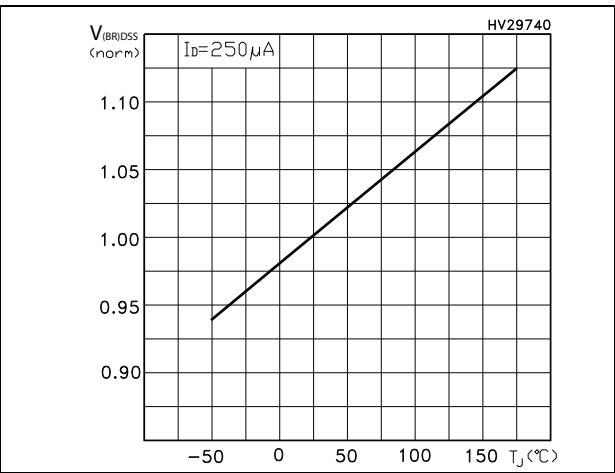
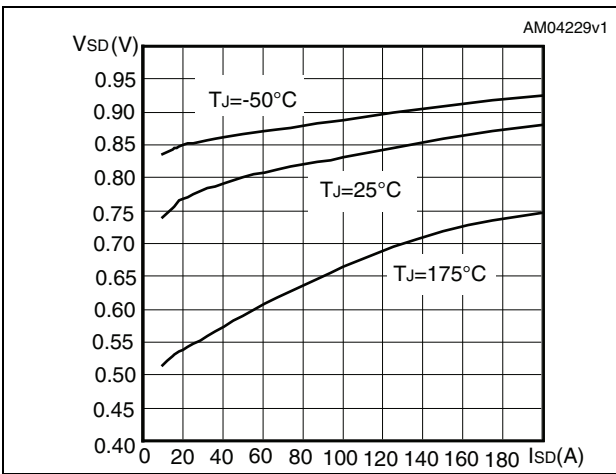
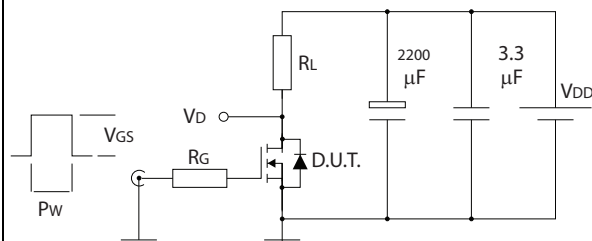


Figure 12. Drain-source diode forward characteristics



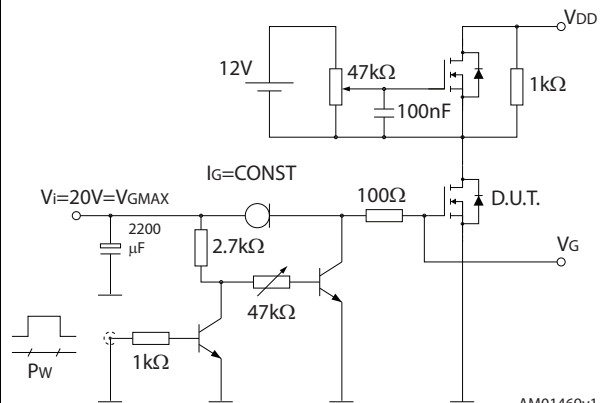
### 3 Test circuits

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



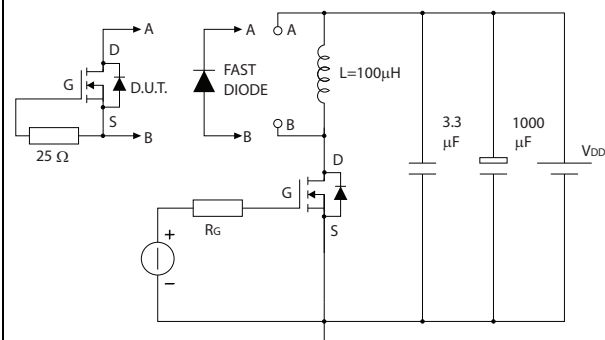
AM01468v1

**Figure 14. Gate charge test circuit**



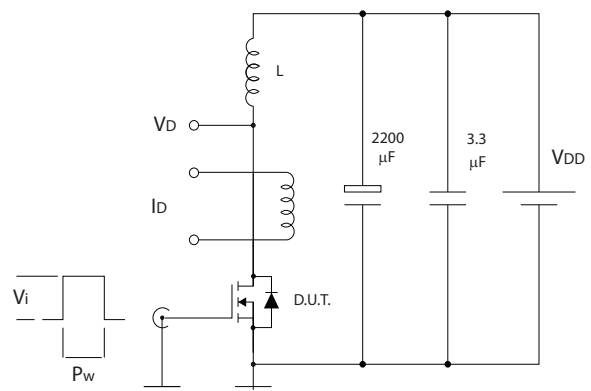
AM01469v1

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



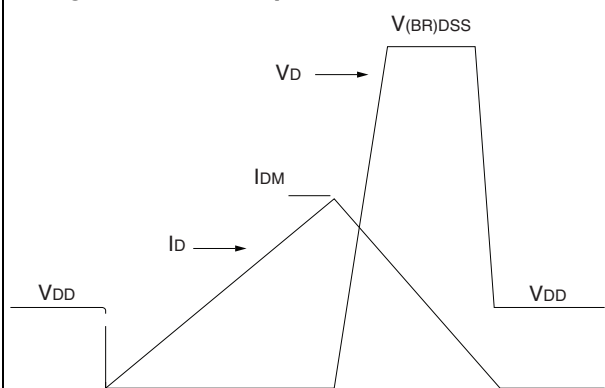
AM01470v1

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



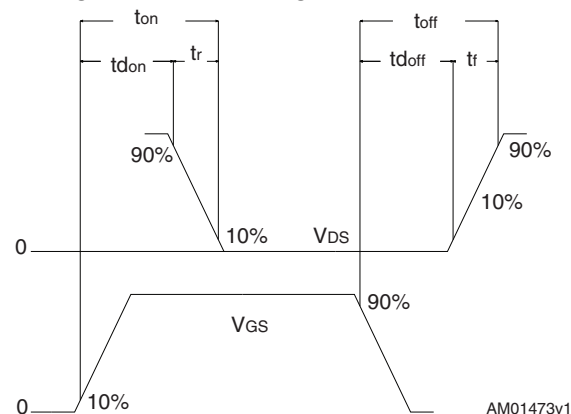
AM01471v1

**Figure 17. Unclamped inductive waveform**



AM01472v1

**Figure 18. Switching time waveform**



AM01473v1

## 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-6 package information

Figure 19. H<sup>2</sup>PAK-6 package outline

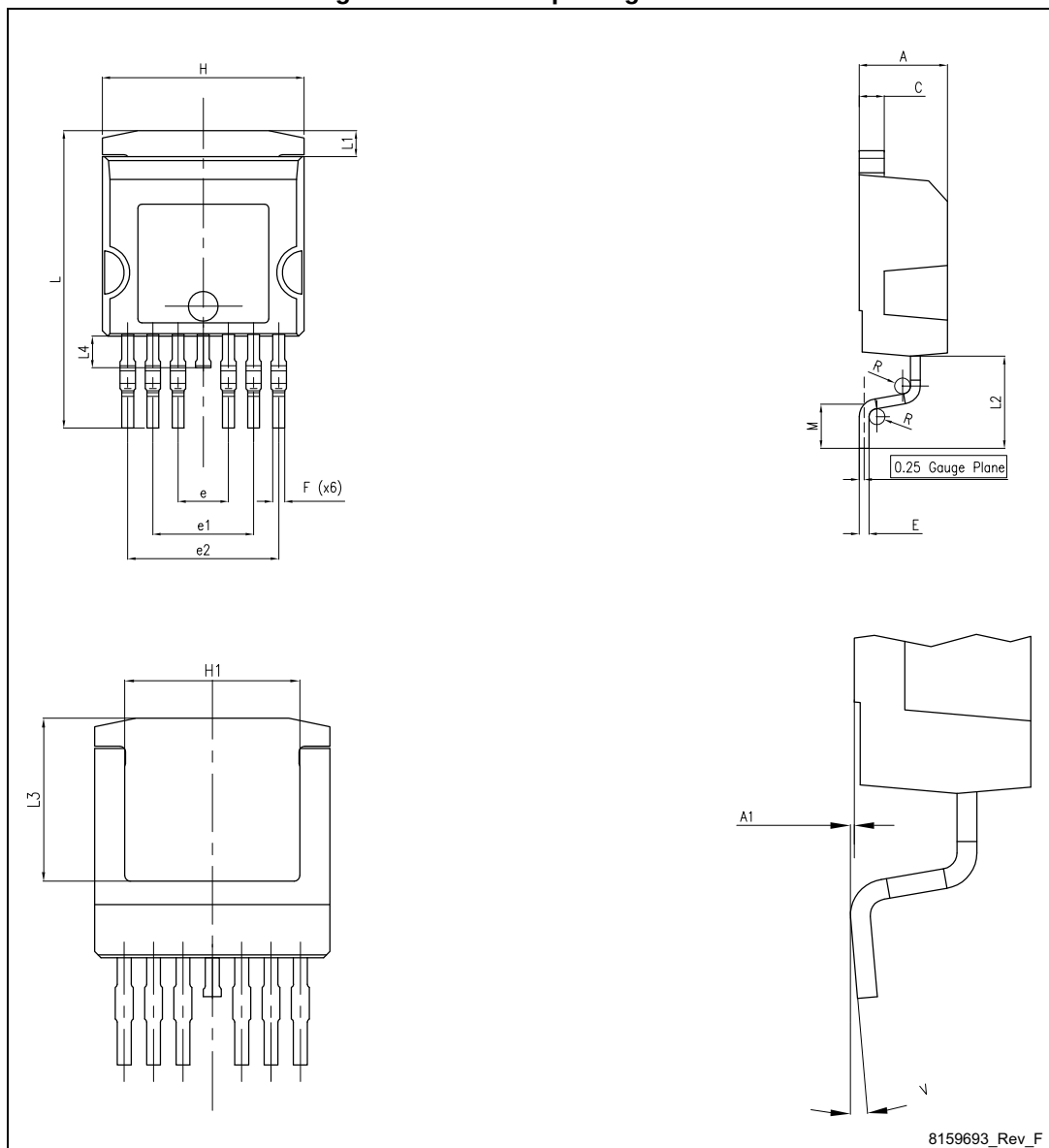
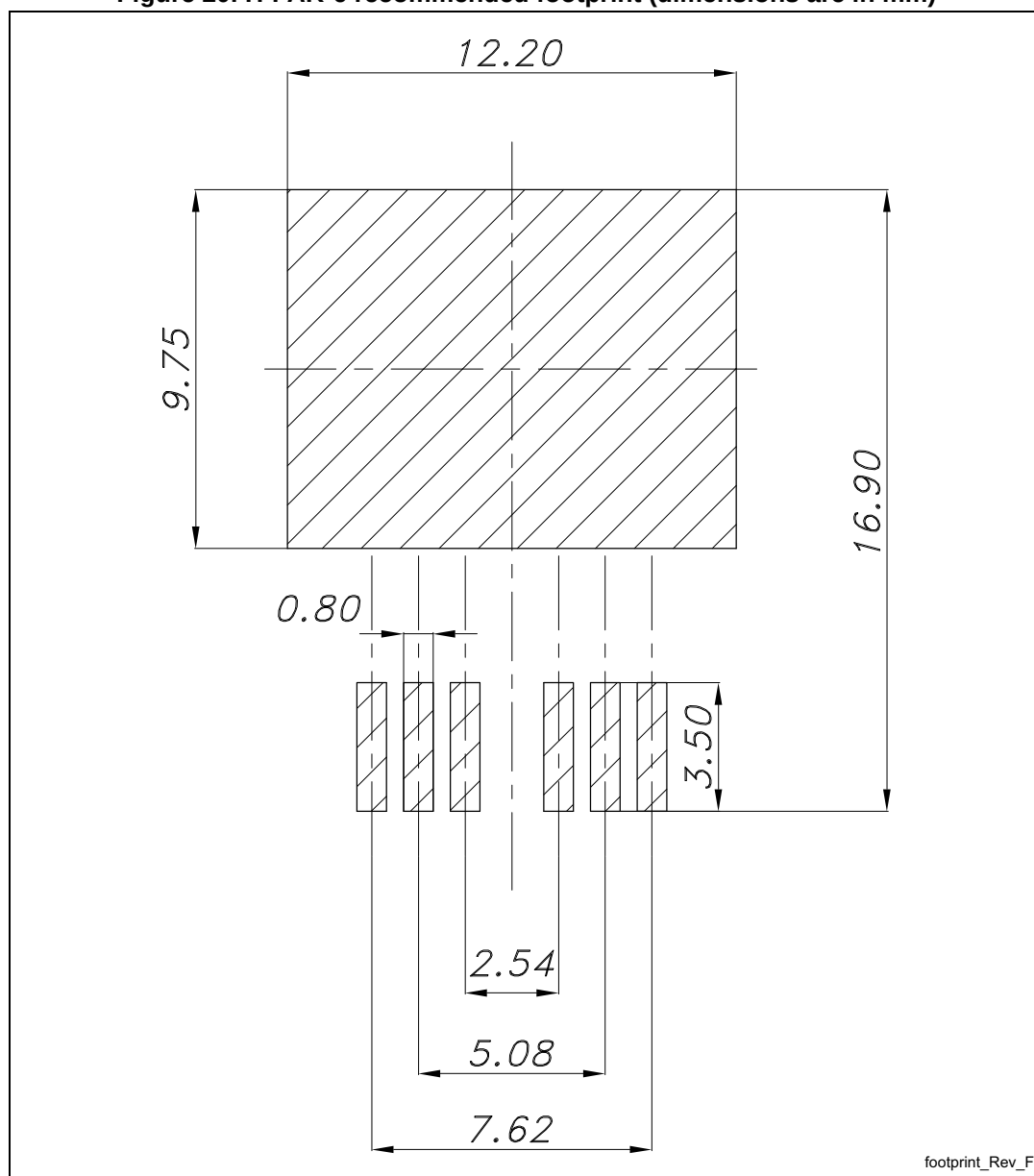


Table 8. H<sup>2</sup>PAK-6 package mechanical data

| Dim. | mm    |      |       |
|------|-------|------|-------|
|      | Min.  | Typ. | Max.  |
| A    | 4.30  | -    | 4.80  |
| A1   | 0.03  |      | 0.20  |
| C    | 1.17  |      | 1.37  |
| e    | 2.34  |      | 2.74  |
| e1   | 4.88  |      | 5.28  |
| e2   | 7.42  |      | 7.82  |
| E    | 0.45  |      | 0.60  |
| F    | 0.50  |      | 0.70  |
| H    | 10.00 |      | 10.40 |
| H1   | 7.40  |      | 7.80  |
| L    | 14.75 |      | 15.25 |
| L1   | 1.27  |      | 1.40  |
| L2   | 4.35  |      | 4.95  |
| L3   | 6.85  |      | 7.25  |
| L4   | 1.5   |      | 1.75  |
| M    | 1.90  |      | 2.50  |
| R    | 0.20  |      | 0.60  |
| V    | 0°    |      | 8°    |

Figure 20. H<sup>2</sup>PAK-6 recommended footprint (dimensions are in mm)



5 Packing information

Figure 21. Tape

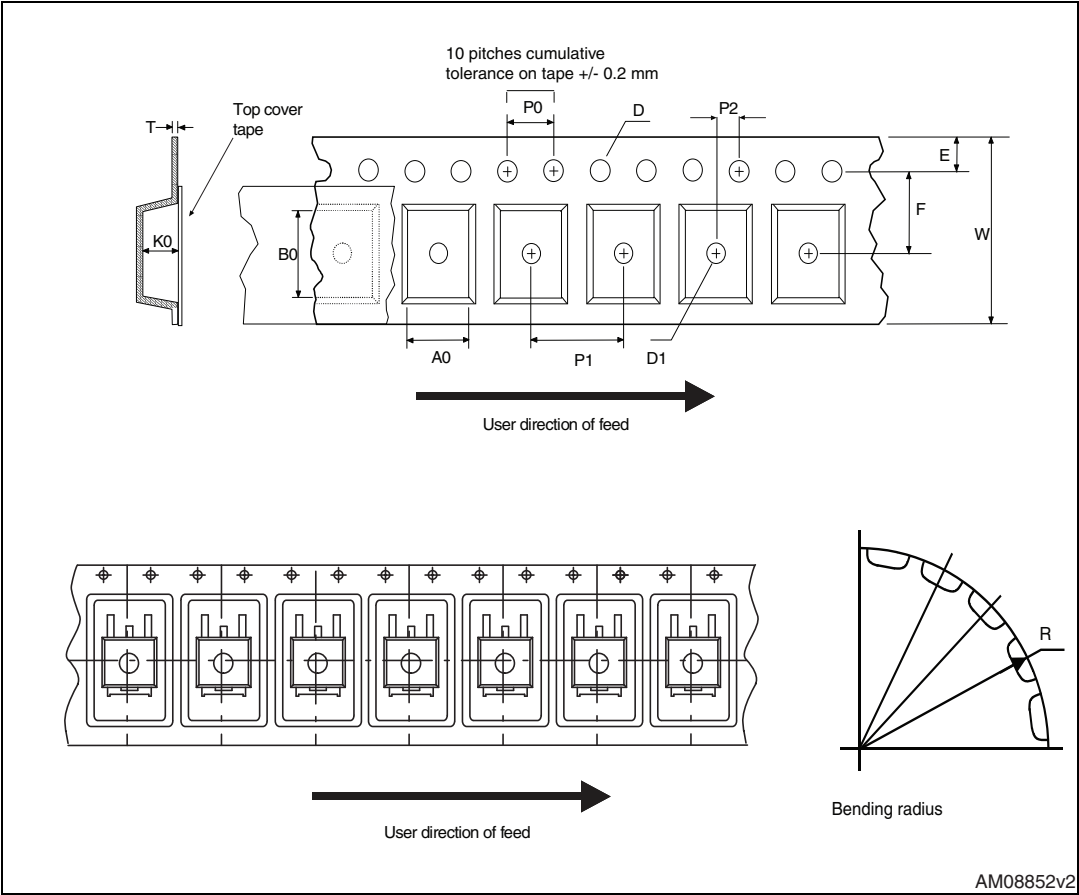
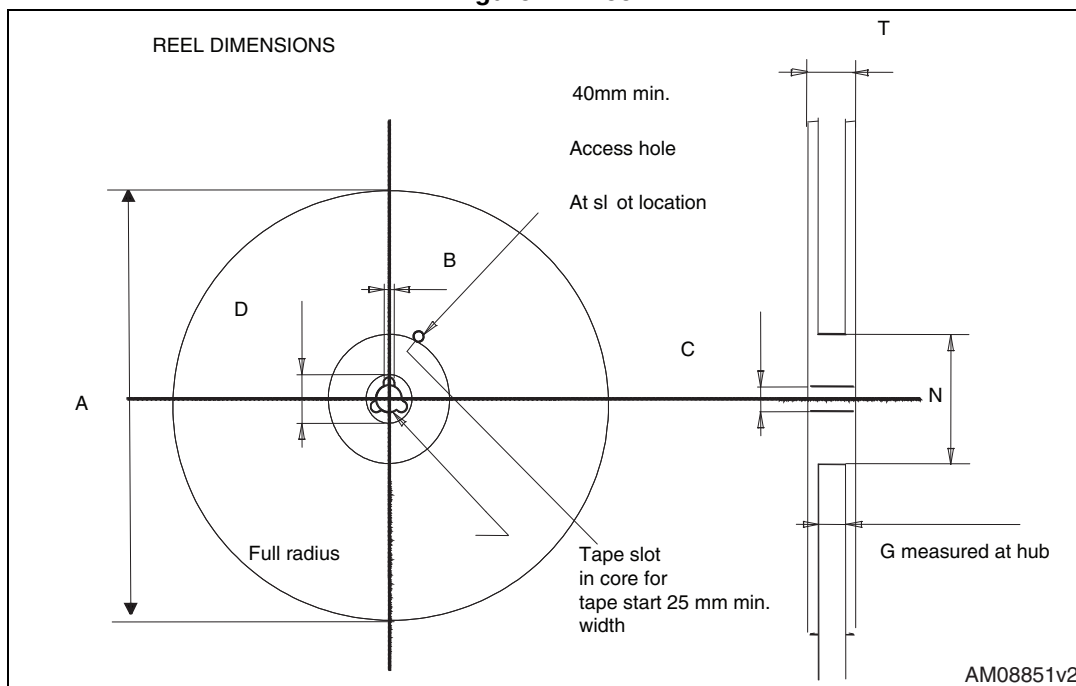


Figure 22. Reel


Table 9. H<sup>2</sup>PAK-2 and H<sup>2</sup>PAK-6 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                                                                    |
|-------------|----------|----------------------------------------------------------------------------|
| 22-May-2015 | 1        | First release.<br>Part number previously included in datasheet DocID16957. |

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