

## Automotive-grade N-channel 40 V, 0.85 mΩ typ., 180 A STripFET™ VI DeepGATE™ Power MOSFETs

Datasheet - production data

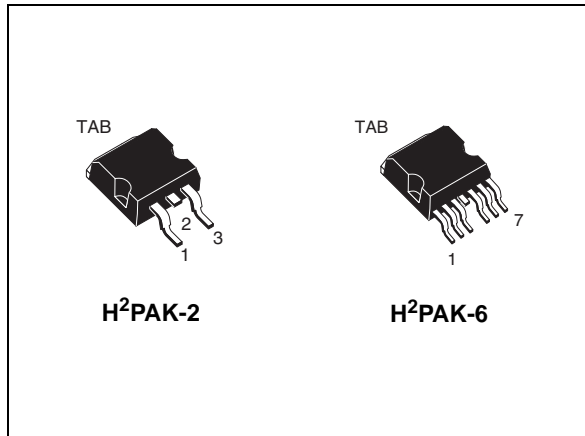
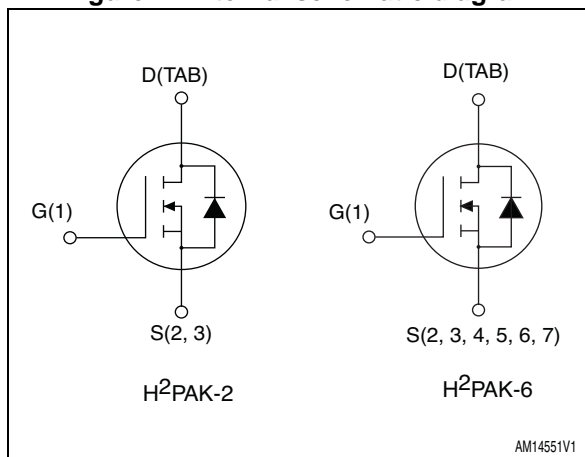


Figure 1. Internal schematic diagram



### Features

Order codes	V <sub>DS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STH400N4F6-2	40 V	1.15 mΩ	180 A
STH400N4F6-6			

- Designed for automotive applications and AEC-Q101 qualified
- Low gate charge
- Very low on-resistance
- High avalanche ruggedness

### Applications

- Switching applications

### Description

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

Table 1. Device summary

Order codes	Marking	Package	Packaging
STH400N4F6-2	400N4F6	H <sup>2</sup> PAK-2	Tape and reel
STH400N4F6-6		H <sup>2</sup> PAK-6	

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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
$I_D^{(1)}$	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
$I_{DM}^{(1)}$	Drain current (pulsed)	720	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	300	W
	Derating factor	2	W/ $^\circ\text{C}$
$T_{stg}$	Storage temperature	- 55 to 175	$^\circ\text{C}$
$T_j$	Operating junction temperature		

1. Current limited by package

**Table 3. Thermal data**

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

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

## 2 Electrical characteristics

( $T_{CASE} = 25\text{ °C}$  unless otherwise specified)

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage ( $V_{GS} = 0$ )	$I_D = 250\ \mu A$	40			V
$I_{DSS}$	Zero gate voltage Drain current ( $V_{GS} = 0$ )	$V_{DS} = 40\text{ V}$			1	$\mu A$
		$V_{DS} = 40\text{ V}, T_C = 125\text{ °C}$			100	$\mu A$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu A$	3		4.5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 60\text{ A}$		0.85	1.15	m $\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$	-	20500	-	pF
$C_{oss}$	Output capacitance		-	1990	-	pF
$C_{rss}$	Reverse transfer capacitance		-	1790	-	pF
$Q_g$	Total gate charge	$V_{DD} = 20\text{ V}, I_D = 150\text{ A}, V_{GS} = 10\text{ V}$	-	404	-	nC
$Q_{gs}$	Gate-source charge		-	110	-	nC
$Q_{gd}$	Gate-drain charge		-	130	-	nC

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 20\text{ V}, I_D = 90\text{ A}, R_G = 4.7\ \Omega, V_{GS} = 10\text{ V}$	-	71	-	ns
$t_r$	Rise time		-	184	-	ns
$t_{d(off)}$	Turn-off-delay time		-	285	-	ns
$t_f$	Fall time		-	168	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}^{(1)}$	Source-drain current		-		180	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		720	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 180 \text{ A}, V_{GS} = 0$	-		1.3	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 180 \text{ A}, V_{DD} = 32 \text{ V}$ $di/dt = 100 \text{ A}/\mu\text{s},$ $T_j = 25 \text{ }^\circ\text{C}$	-	58		ns
$Q_{rr}$	Reverse recovery charge		-	392		nC
$I_{RRM}$	Reverse recovery current		-	3.2		A

1. Limited by package, current allowed by silicon 360 A
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

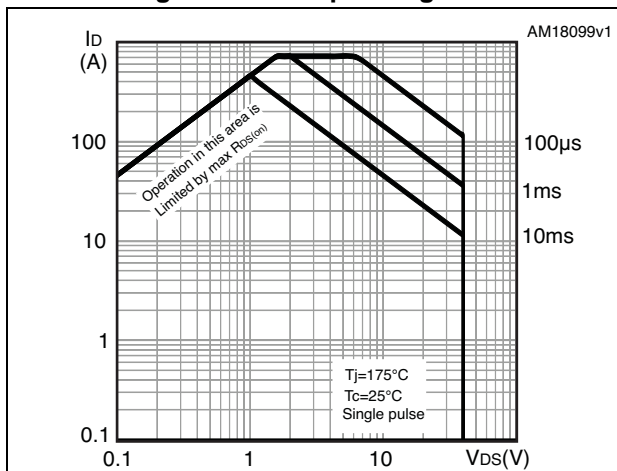


Figure 3. Thermal impedance

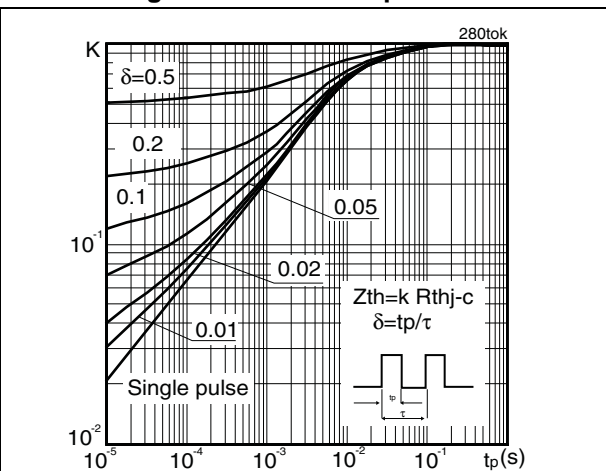


Figure 4. Output characteristics

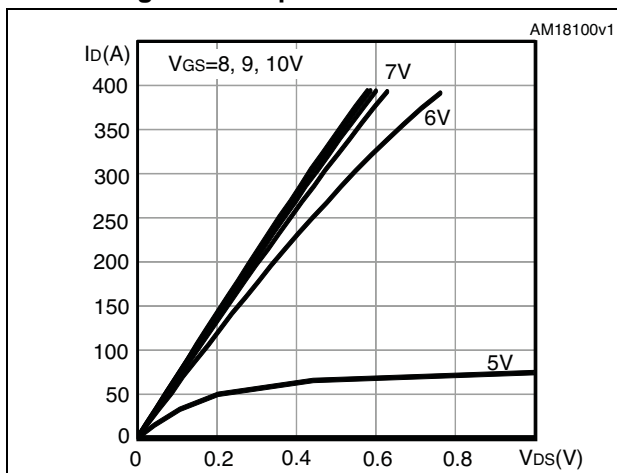


Figure 5. Transfer characteristics

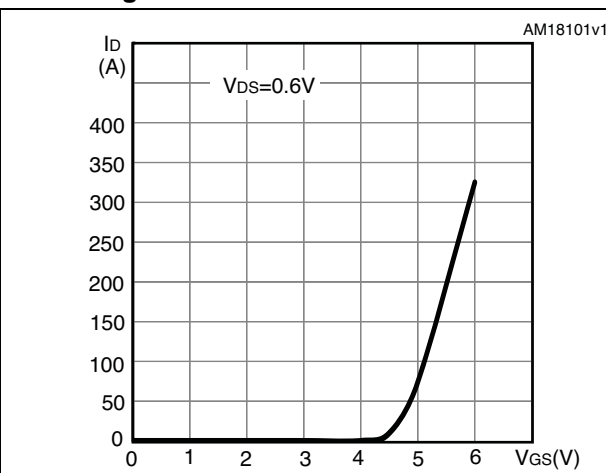


Figure 6. Gate charge vs gate-source voltage

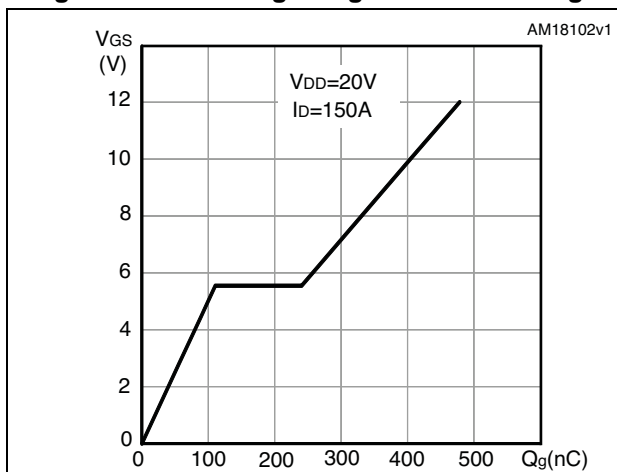


Figure 7. Static drain-source on-resistance

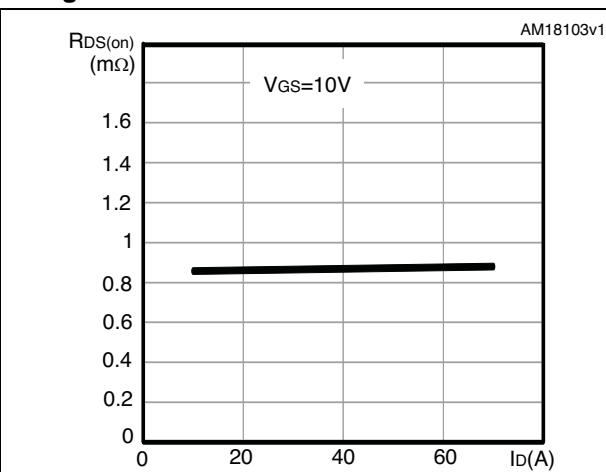


Figure 8. Capacitance variations

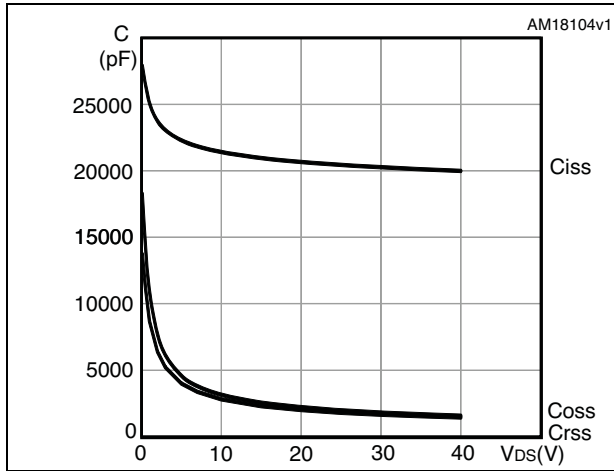


Figure 9. Normalized gate threshold voltage vs temperature

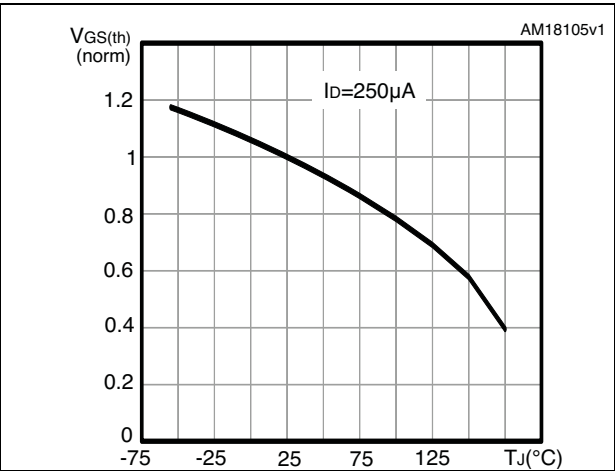


Figure 10. Normalized on-resistance vs temperature

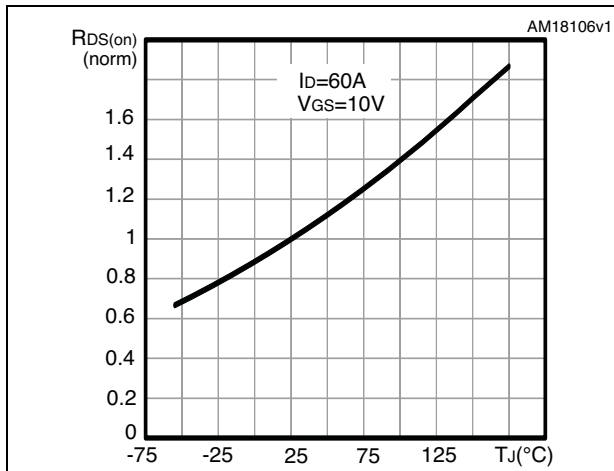


Figure 11. Normalized V(BR)DSS vs temperature

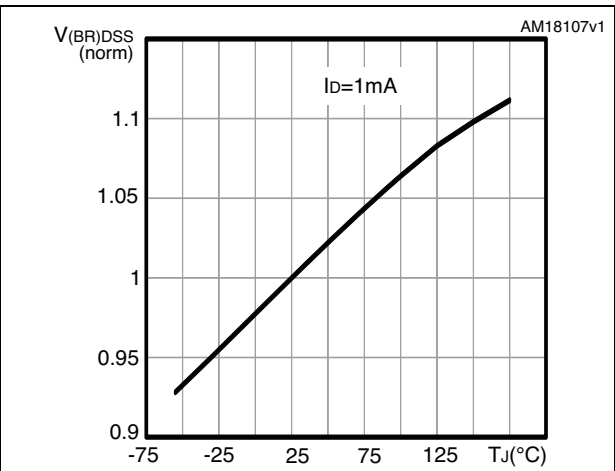
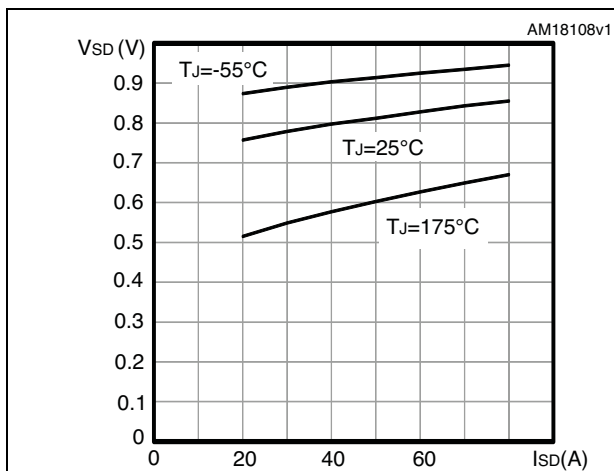


Figure 12. Source-drain diode forward characteristics



### 3 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 13. H<sup>2</sup>PAK-2 drawing

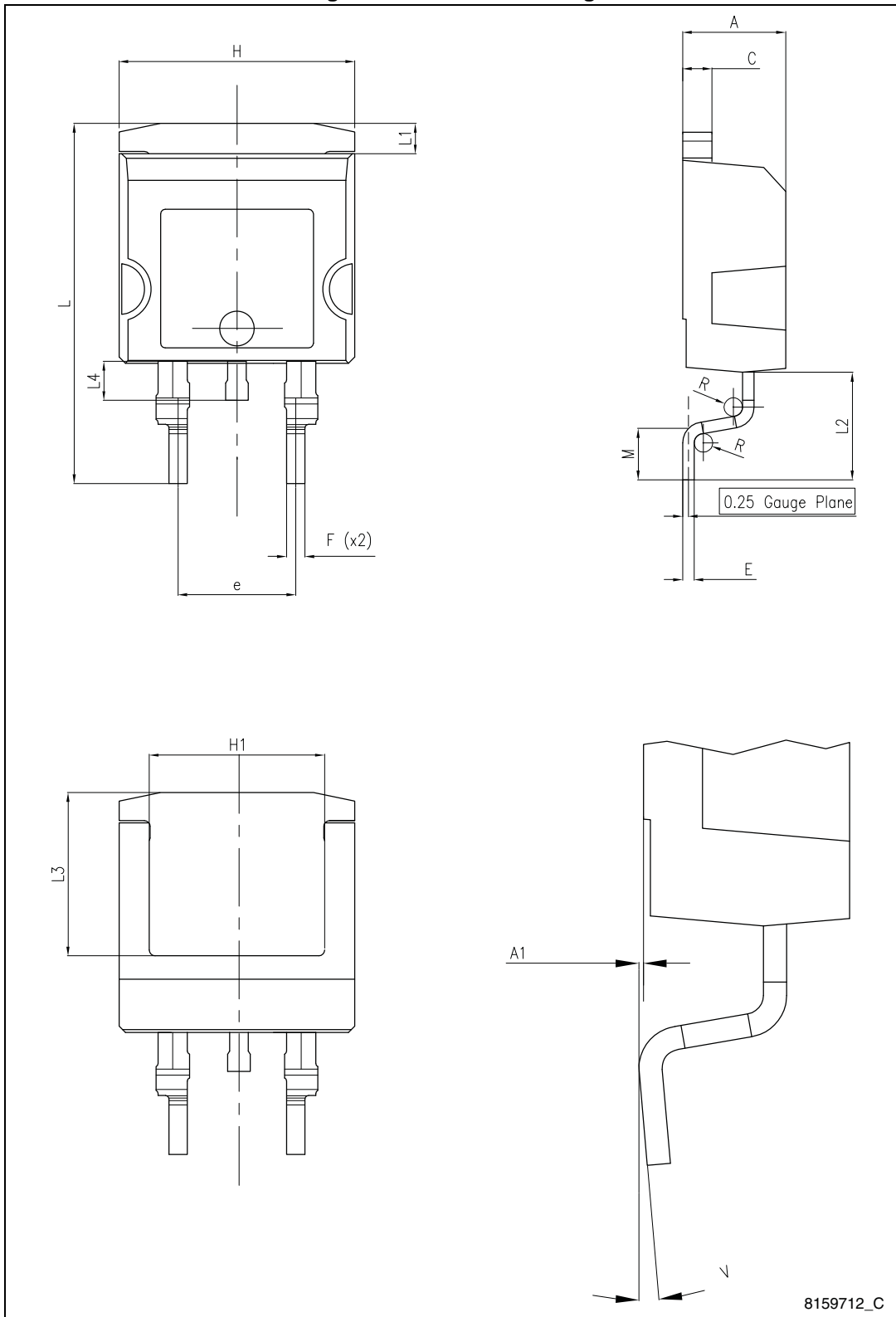


Table 8. H<sup>2</sup>PAK-2 mechanical data

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 14. H<sup>2</sup>PAK-2 recommended footprint (dimensions in mm)

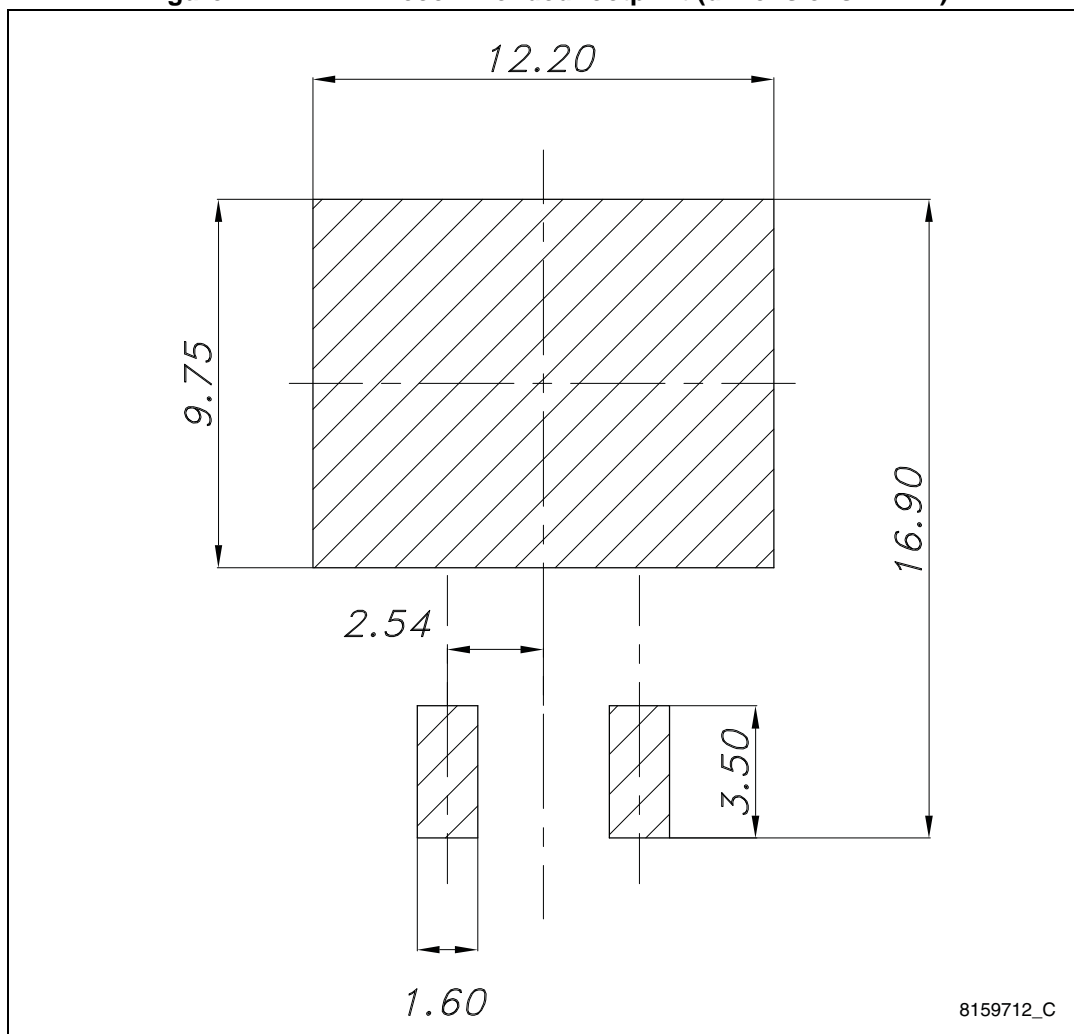


Figure 15. H<sup>2</sup>PAK-6 drawing

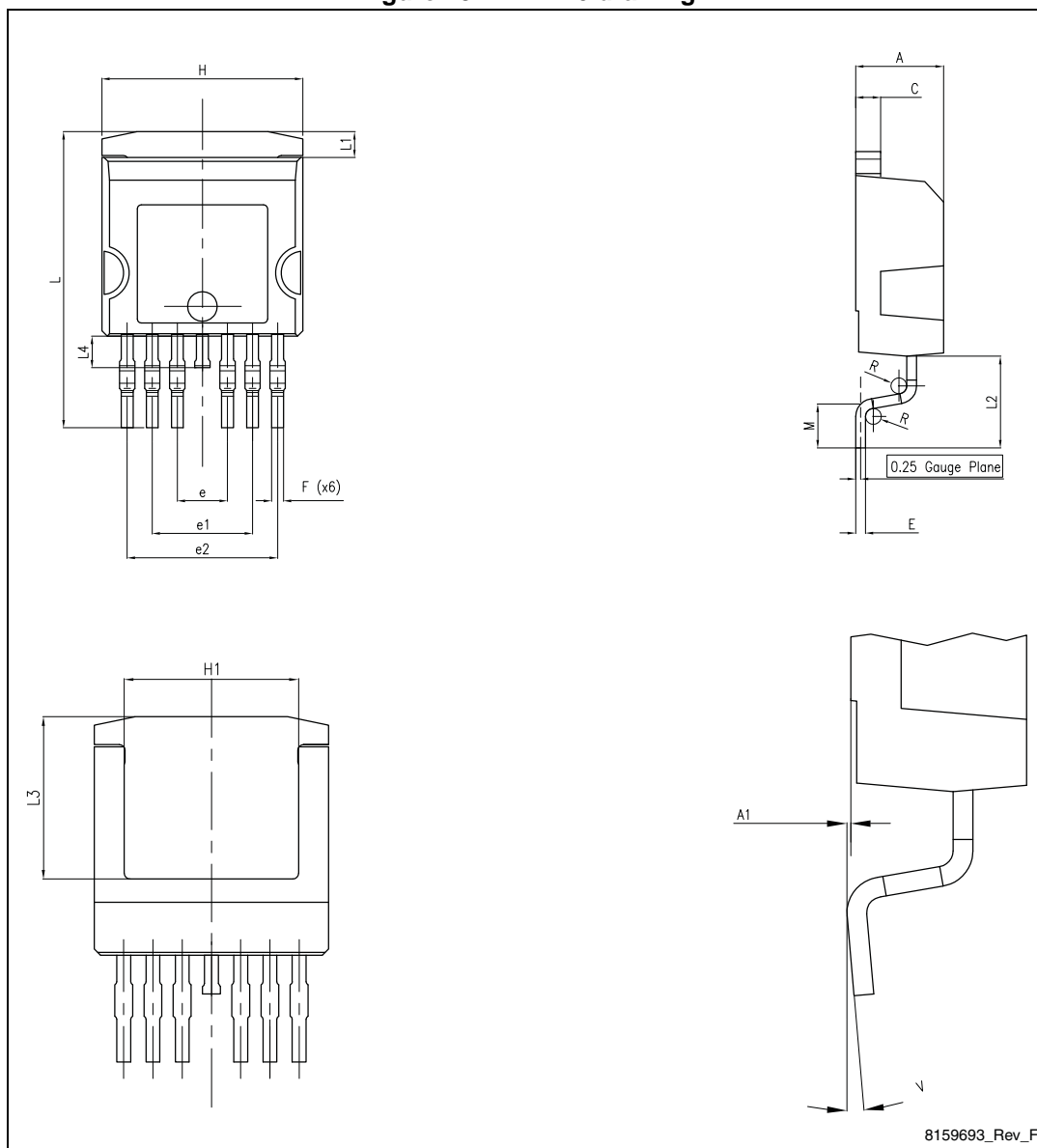
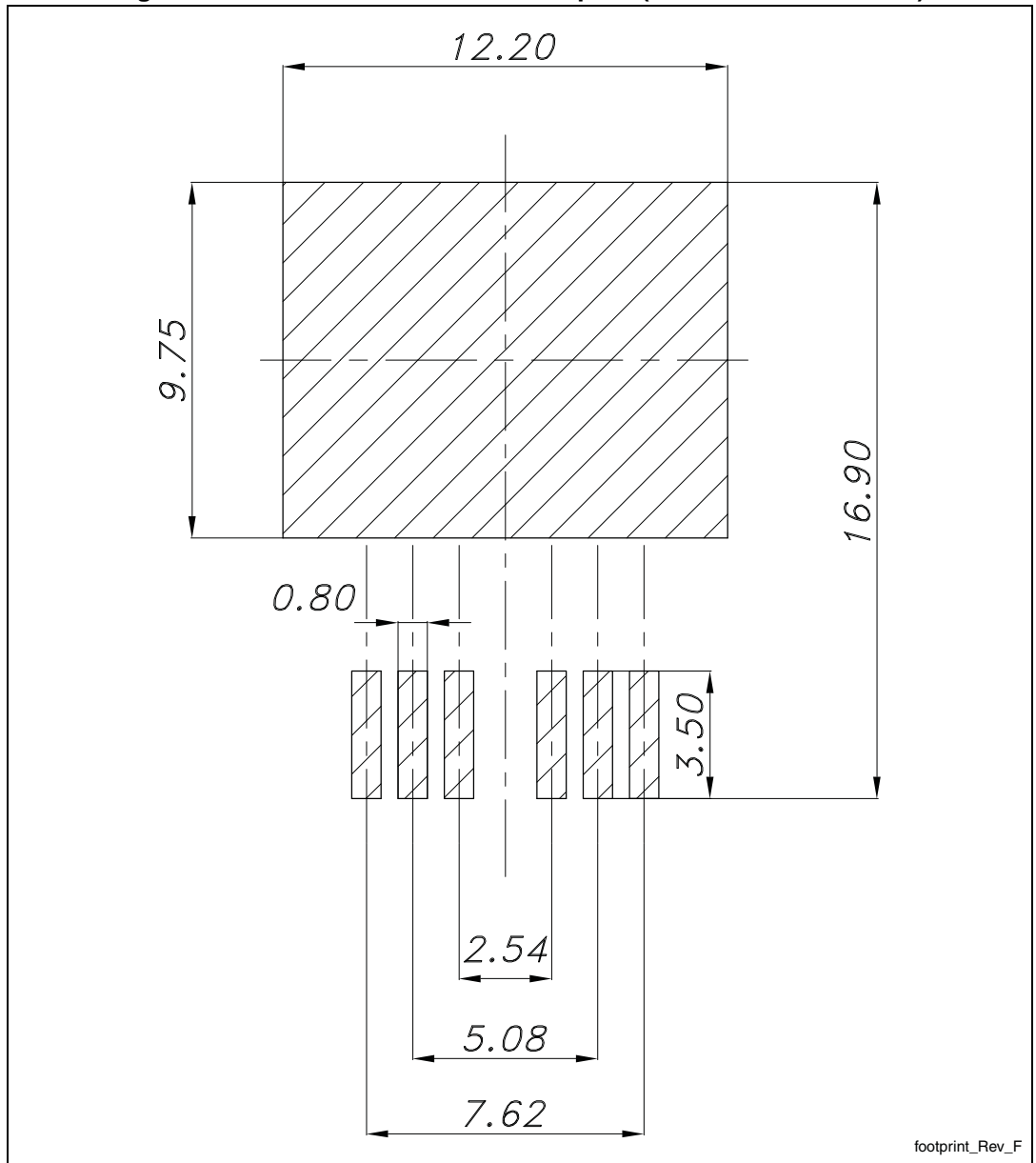


Table 9. H<sup>2</sup>PAK-6 mechanical data

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



footprint\_Rev\_F

# 4 Packaging mechanical data

Figure 17. Tape dimension

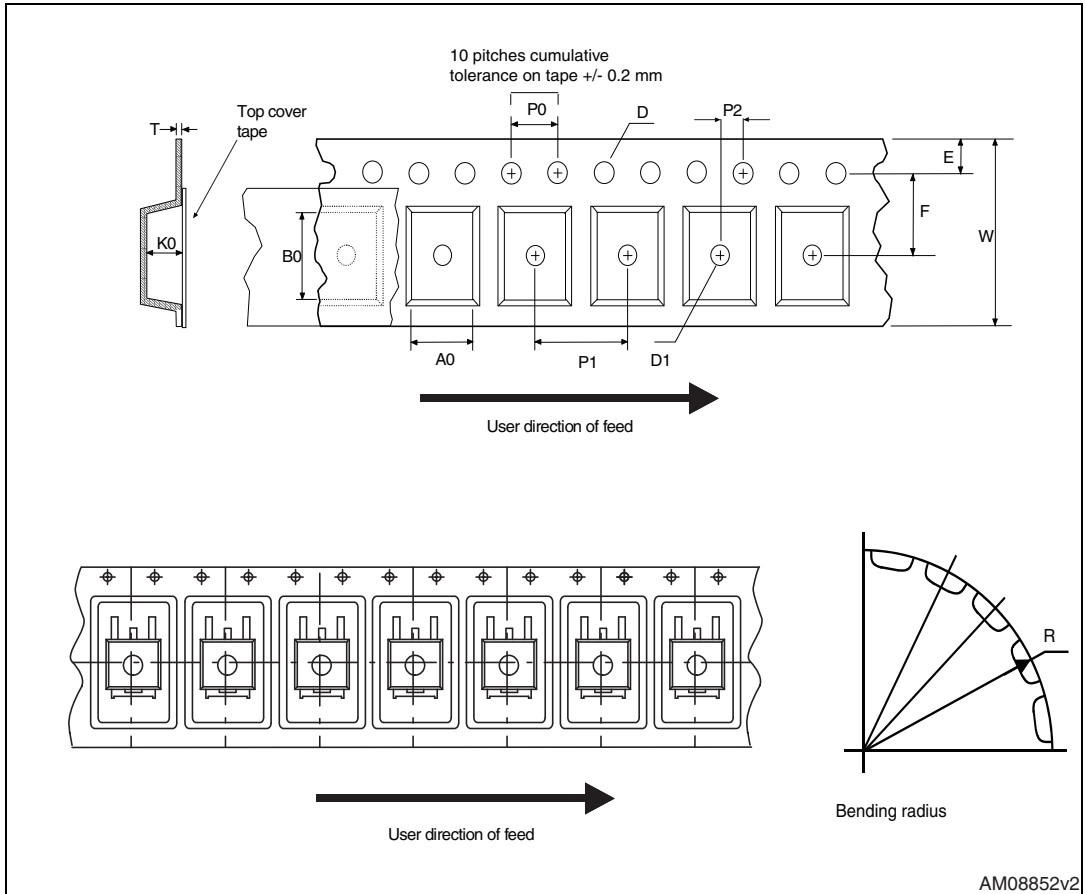


Figure 18. Reel dimension

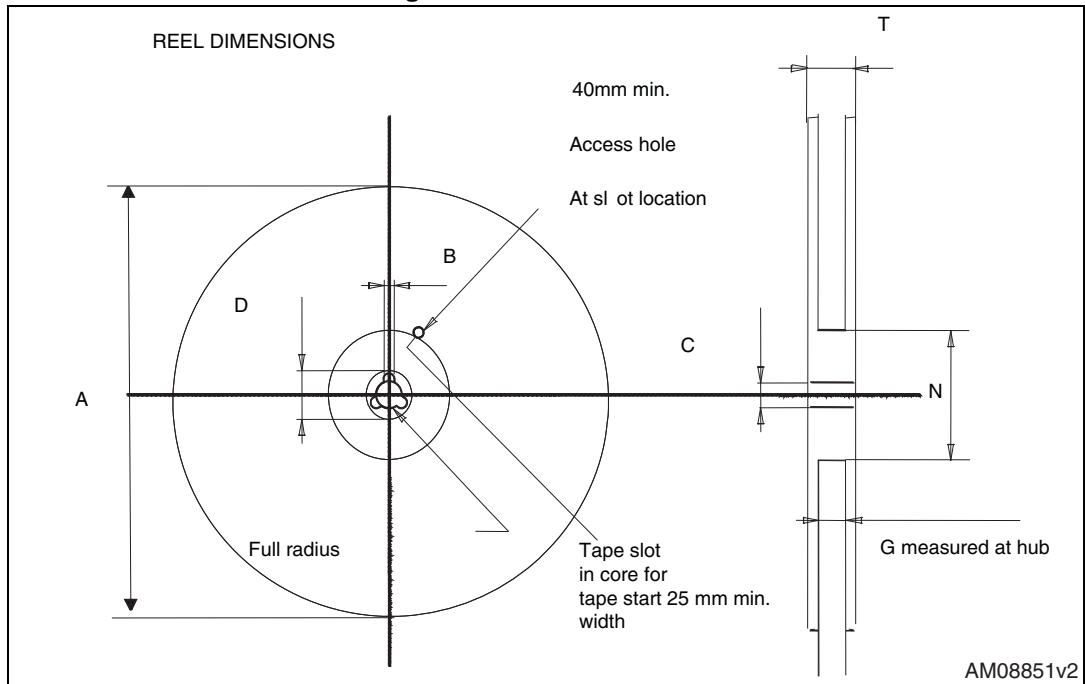


Table 10. H<sup>2</sup>PAK-2 and H<sup>2</sup>PAK-6 tape and reel mechanical data

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			



## 5 Revision history

Table 11. Document revision history

Date	Revision	Changes
08-Aug-2012	1	First release.
18-Feb-2014	2	<ul style="list-style-type: none"><li>– Document status promoted from preliminary data to production data</li><li>– Modified: <math>R_{DS(on)}</math> typical value in <a href="#">Table 4</a></li><li>– Modified: the entire typical values in <a href="#">Table 5, 6</a></li><li>– Modified: <math>V_{SD}</math> max value and typical values in <a href="#">Table 7</a></li><li>– Added: <a href="#">Section 2.1: Electrical characteristics (curves)</a></li><li>– Updated: <a href="#">Section 3: Package mechanical data</a></li><li>– Minor text changes</li></ul>

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