

Automotive-grade N-channel 40 V, 0.8 mΩ typ., 200 A STripFET™ F7 Power MOSFETs in H²PAK-2 and H²PAK-6 packages

Datasheet - production data

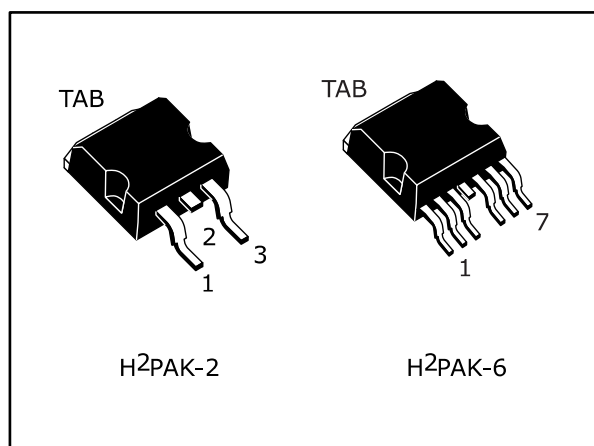
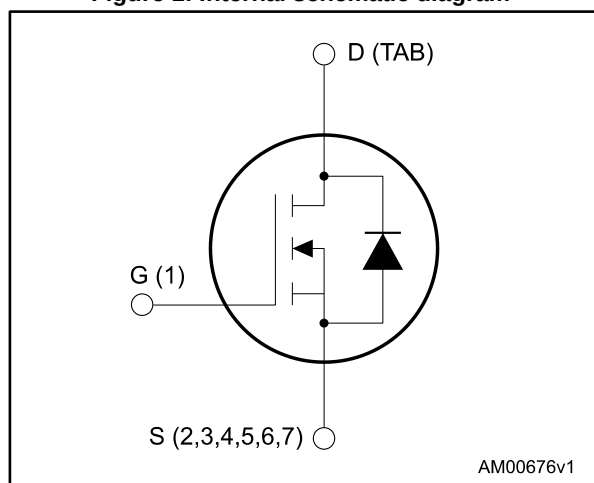


Figure 1: Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D	P _{TOT}
STH410N4F7-2AG	40 V	1.1 mΩ	200 A	365 W
STH410N4F7-6AG				

- Designed for automotive applications and AEC-Q101 qualified
- Among the lowest R_{DS(on)} on the market
- Excellent figure of merit (FoM)
- Low C_{rss}/C_{iss} ratio for EMI immunity
- High avalanche ruggedness

Applications

- Switching applications

Description

This N-channel Power MOSFET utilizes STripFET™ F7 technology with an enhanced trench gate structure that results in very low on-state resistance, while also reducing internal capacitance and gate charge for faster and more efficient switching.

Table 1: Device summary

Order code	Marking	Package	Packing
STH410N4F7-2AG	410N4F7	H ² PAK-2	Tape And Reel
STH410N4F7-6AG		H ² 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	±20	V
$I_D^{(1)}$	Drain current (continuous) at $T_{case} = 25\text{ °C}$	200	A
	Drain current (continuous) at $T_{case} = 100\text{ °C}$	200	
$I_{DM}^{(2)}$	Drain current (pulsed)	800	A
P_{TOT}	Total dissipation at $T_{case} = 25\text{ °C}$	365	W
$E_{AS}^{(3)}$	Single pulse avalanche energy	1.9	J
T_{stg}	Storage temperature range	-55 to 175	°C
T_j	Operating junction temperature range		

Notes:

⁽¹⁾ Current is limited by package, the current capability of the silicon is 420 A at 25 °C.

⁽²⁾ Pulse width is limited by safe operating area.

⁽³⁾ $T_j \leq 175\text{ °C}$, $I_{av}=80A$

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.41	°C/W
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	35	

Notes:

⁽¹⁾ When mounted on a 1-inch² FR-4 board, 2oz Cu.

2 Electrical characteristics

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

Table 4: Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$V_{\text{GS}} = 0\text{ V}$, $I_{\text{D}} = 250\text{ }\mu\text{A}$	40			V
I_{DSS}	Zero gate voltage drain current	$V_{\text{GS}} = 0\text{ V}$, $V_{\text{DS}} = 40\text{ V}$			10	μA
		$V_{\text{GS}} = 0\text{ V}$, $V_{\text{DS}} = 40\text{ V}$, $T_{\text{case}} = 125\text{ }^{\circ}\text{C}$			100	
I_{GSS}	Gate-body leakage current	$V_{\text{DS}} = 0\text{ V}$, $V_{\text{GS}} = 20\text{ V}$			200	nA
$V_{\text{GS(th)}}$	Gate threshold voltage	$V_{\text{DS}} = V_{\text{GS}}$, $I_{\text{D}} = 250\text{ }\mu\text{A}$	2.5		4.5	V
$R_{\text{DS(on)}}$	Static drain-source on-resistance	$V_{\text{GS}} = 10\text{ V}$, $I_{\text{D}} = 90\text{ A}$		0.8	1.1	m Ω

Table 5: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{\text{DS}} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{\text{GS}} = 0\text{ V}$	-	11500	-	pF
C_{oss}	Output capacitance		-	3500	-	
C_{rss}	Reverse transfer capacitance		-	390	-	
Q_{g}	Total gate charge	$V_{\text{DD}} = 20\text{ V}$, $I_{\text{D}} = 180\text{ A}$, $V_{\text{GS}} = 10\text{ V}$ (see Figure 14: "Test circuit for gate charge behavior")	-	141	-	nC
Q_{gs}	Gate-source charge		-	65	-	
Q_{gd}	Gate-drain charge		-	27	-	

Table 6: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{\text{d(on)}}$	Turn-on delay time	$V_{\text{DD}} = 20\text{ V}$, $I_{\text{D}} = 90\text{ A}$ $R_{\text{G}} = 4.7\text{ }\Omega$, $V_{\text{GS}} = 10\text{ V}$ (see Figure 13: "Test circuit for resistive load switching times" and Figure 18: "Switching time waveform")	-	35	-	ns
t_{r}	Rise time		-	198	-	
$t_{\text{d(off)}}$	Turn-off delay time		-	108	-	
t_{f}	Fall time		-	44.2	-	

Table 7: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}^{(1)}$	Source-drain current		-		200	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 90\text{ A}$	-		1.3	V
t_{rr}	Reverse recovery time	$I_{SD} = 180\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 32\text{ V}$, $T_j = 25\text{ °C}$ (see Figure 15: "Test circuit for inductive load switching and diode recovery times")	-	74.4		ns
Q_{rr}	Reverse recovery charge		-	115		nC
I_{RRM}	Reverse recovery current		-	3.1		A

Notes:

⁽¹⁾ Limited by package, 420 A current allowed by silicon.

⁽²⁾ Pulse test: pulse duration = 300 μs , duty cycle 1.5%.

2.2 Electrical characteristics (curves)

Figure 2: Safe operating area

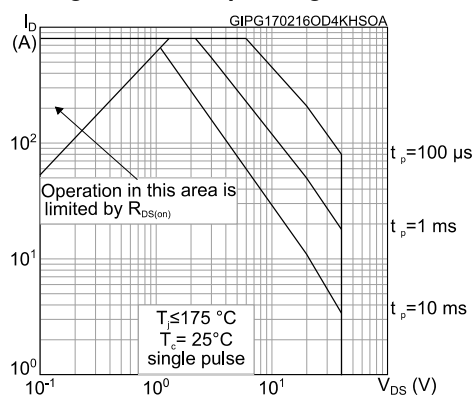


Figure 3: Thermal impedance

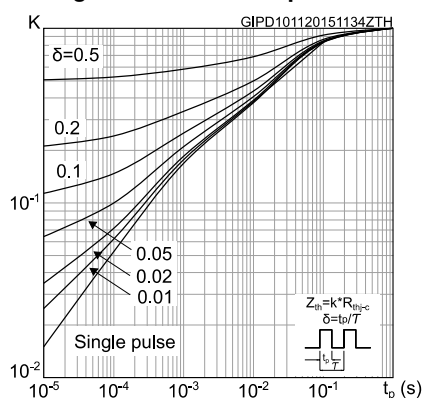


Figure 4: Output characteristics

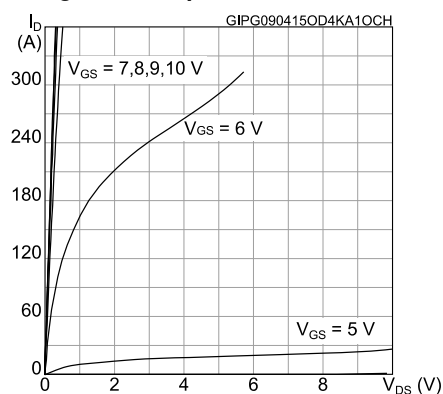


Figure 5: Transfer characteristics

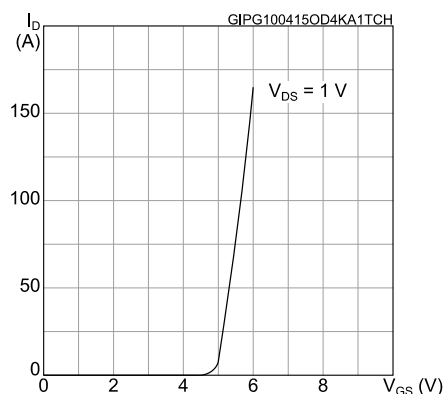


Figure 6: Gate charge vs gate-source voltage

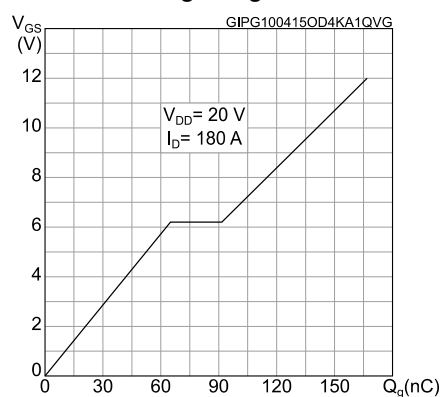


Figure 7: Static drain-source on-resistance

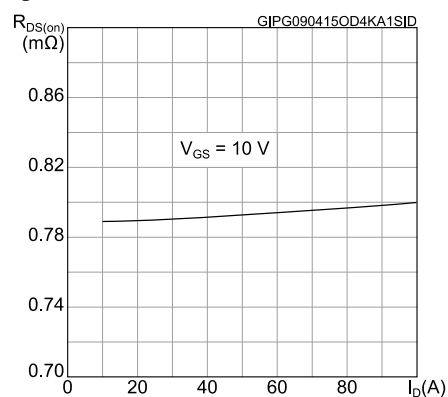


Figure 8: Capacitance variations

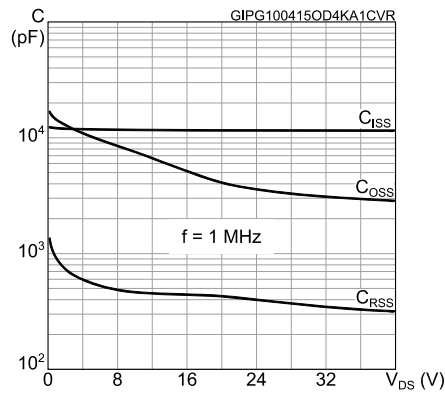


Figure 9: Normalized gate threshold voltage vs temperature

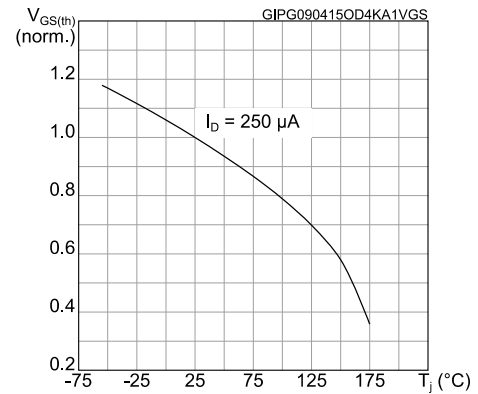


Figure 10: Normalized on-resistance vs temperature

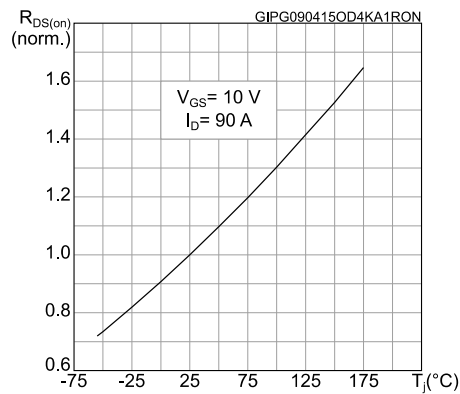


Figure 11: Normalized $V_{(BR)DSS}$ vs temperature

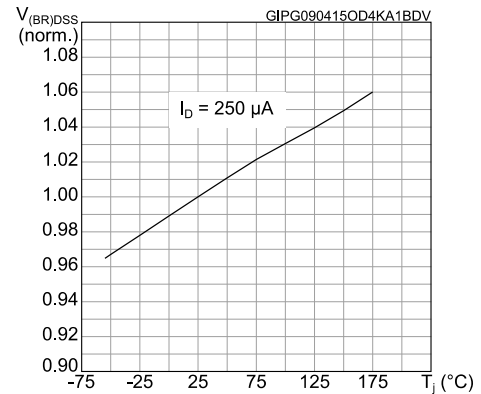
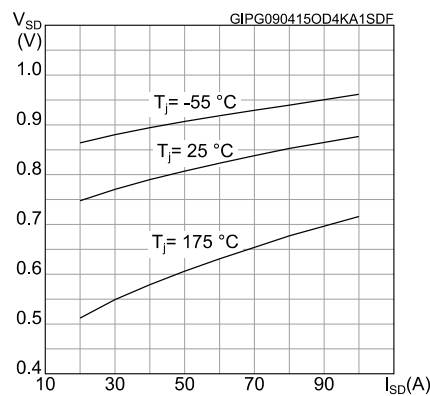
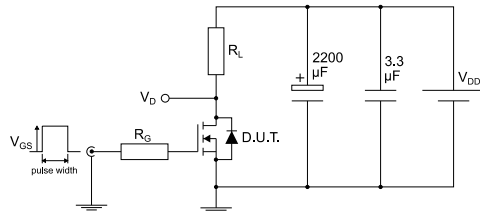


Figure 12: Source-drain diode forward characteristics



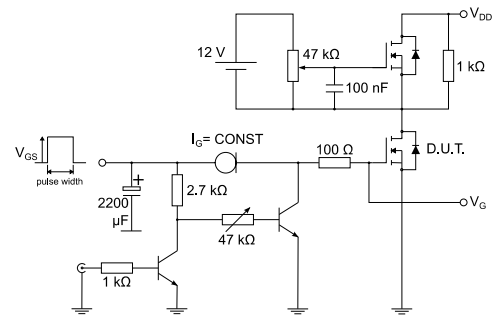
3 Test circuits

Figure 13: Test circuit for resistive load switching times



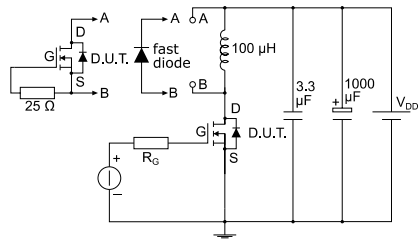
AM01468v1

Figure 14: Test circuit for gate charge behavior



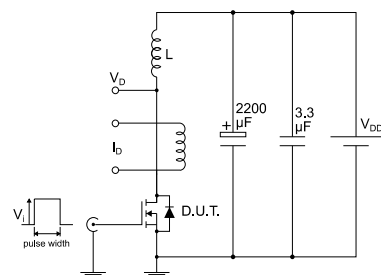
AM01469v1

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



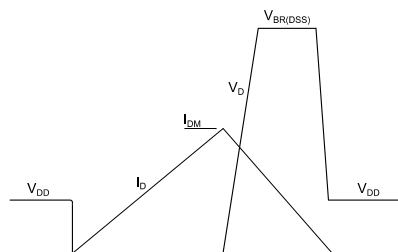
AM01470v1

Figure 16: Unclamped inductive load test circuit



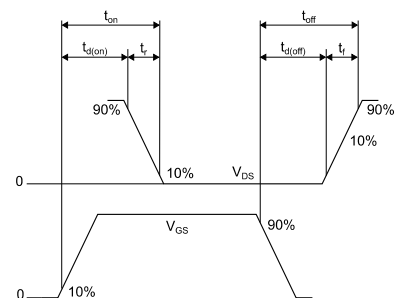
AM01471v1

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**. ECOPACK[®] is an ST trademark.

4.1 H²PAK-2 package information

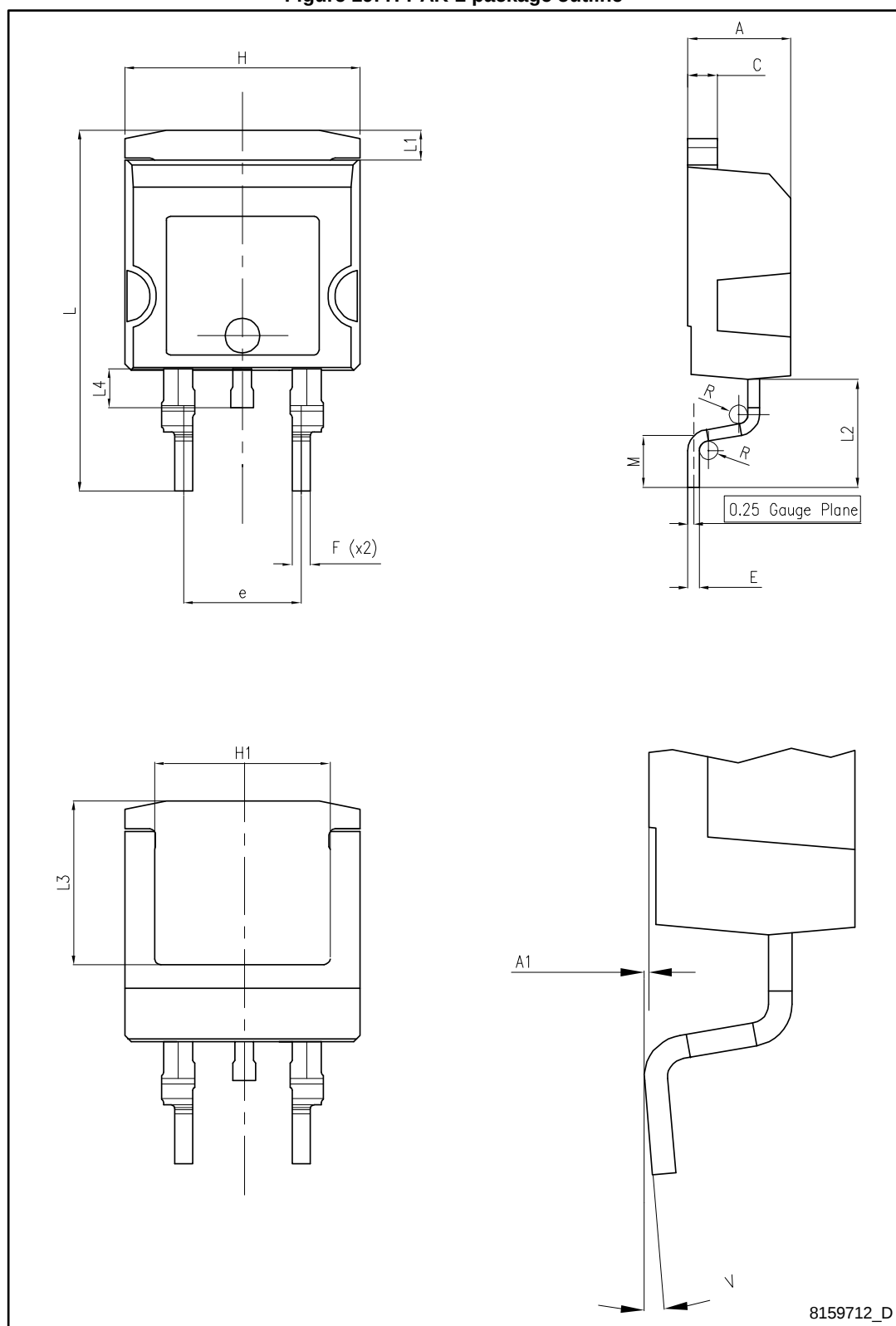
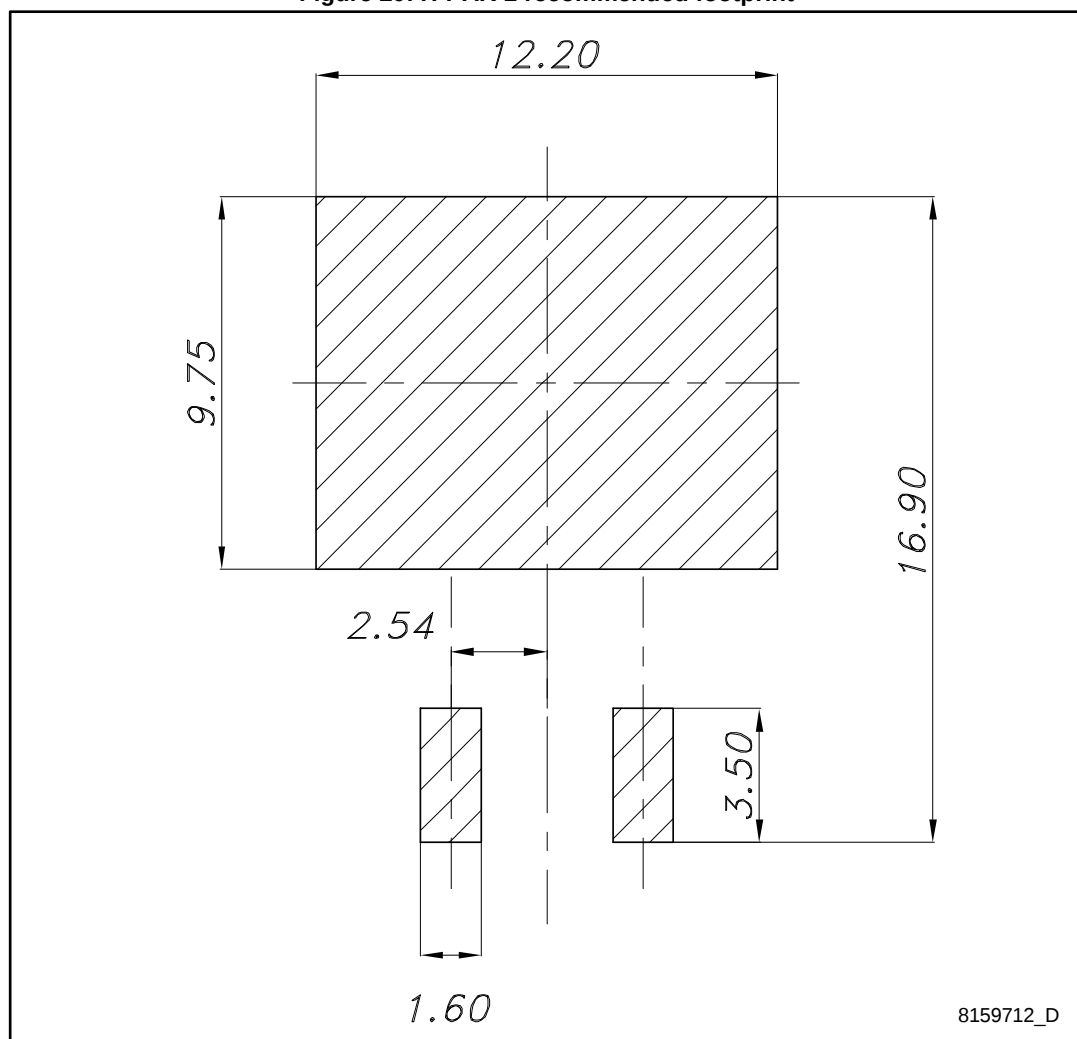
Figure 19: H²PAK-2 package outline

Table 8: H²PAK-2 package 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 20: H²PAK-2 recommended footprint

4.2 H²PAK-6 package information

Figure 21: H²PAK-6 package outline

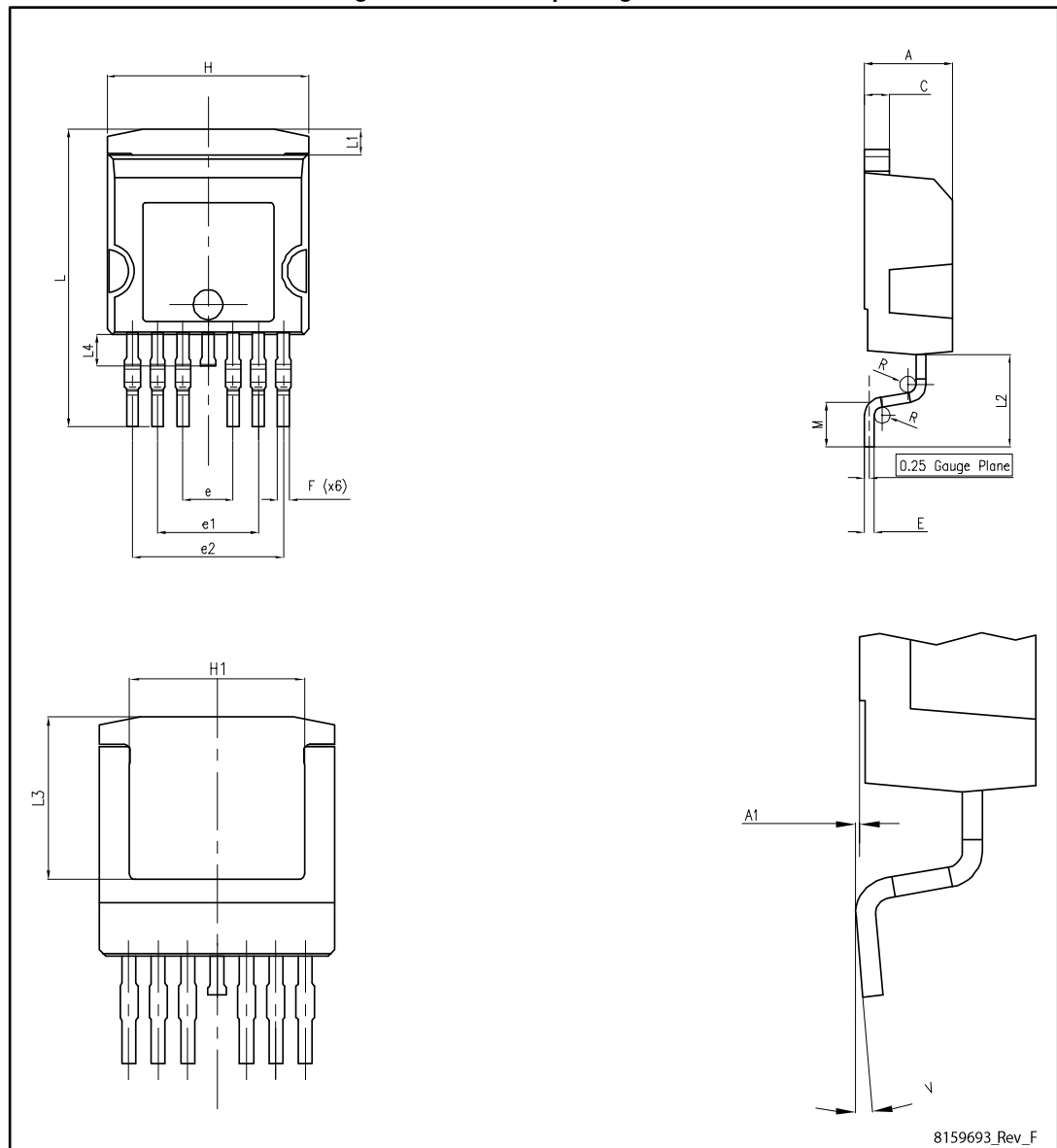
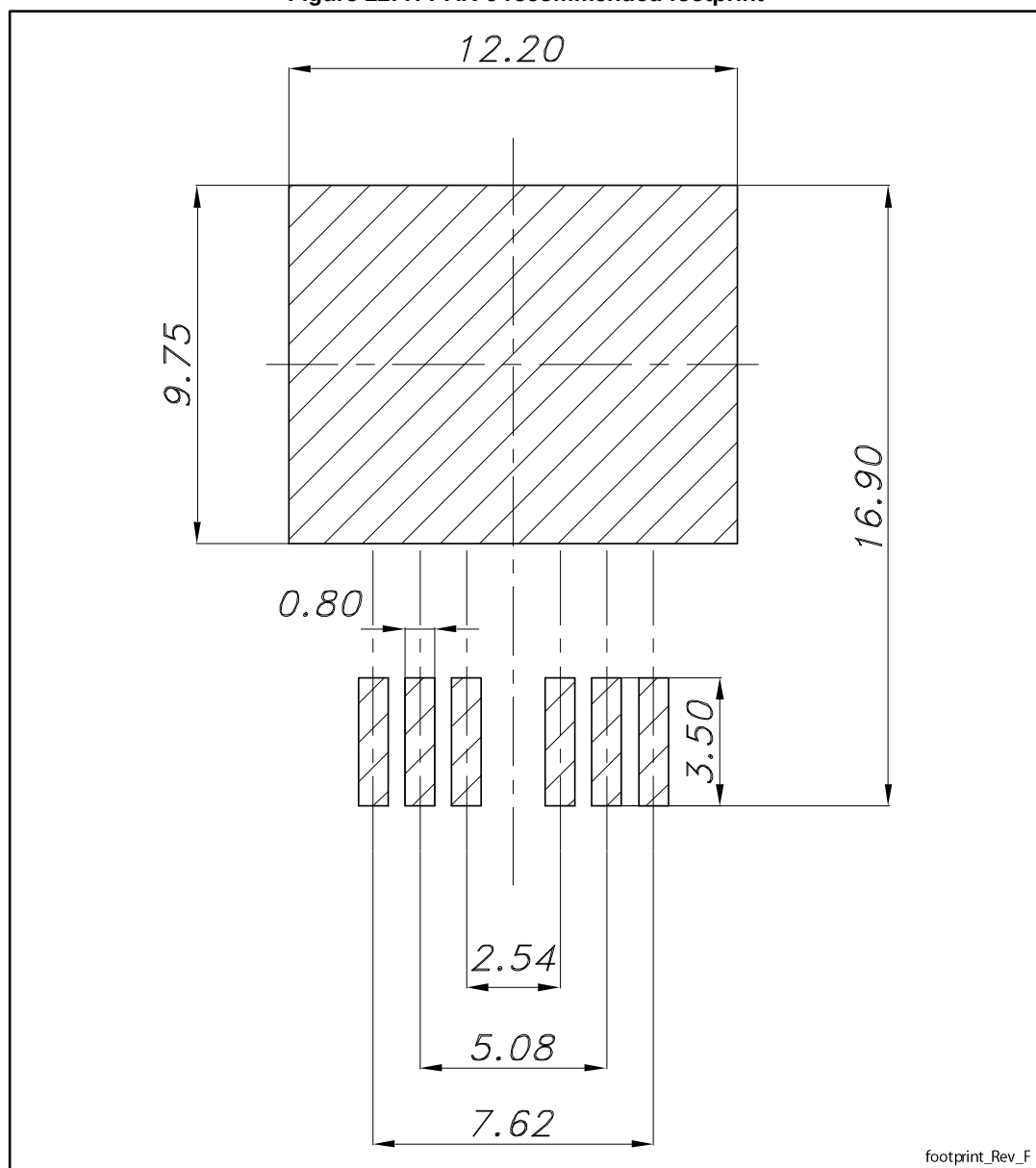


Table 9: H²PAK-6 package mechanical data

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 22: H²PAK-6 recommended footprint



Dimensions are in mm.

4.3 H²PAK packing information

Figure 23: Tape outline

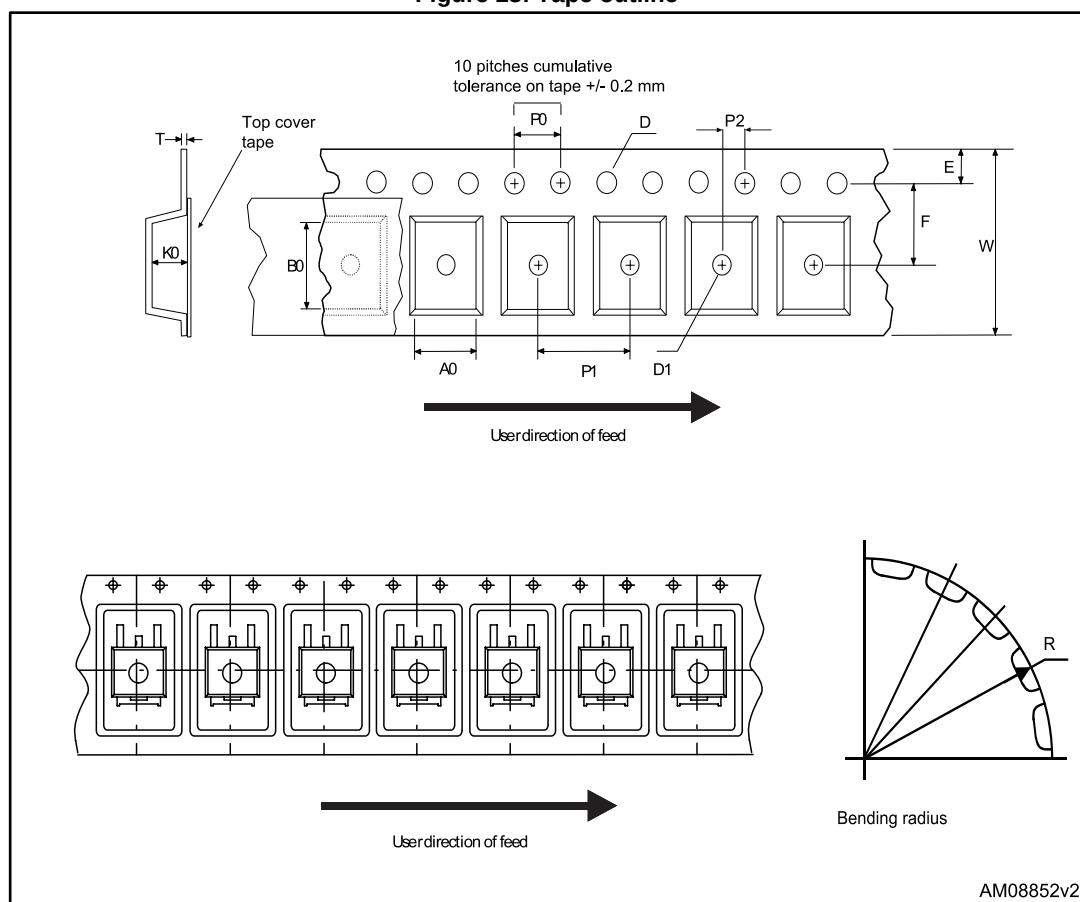


Figure 24: Reel outline

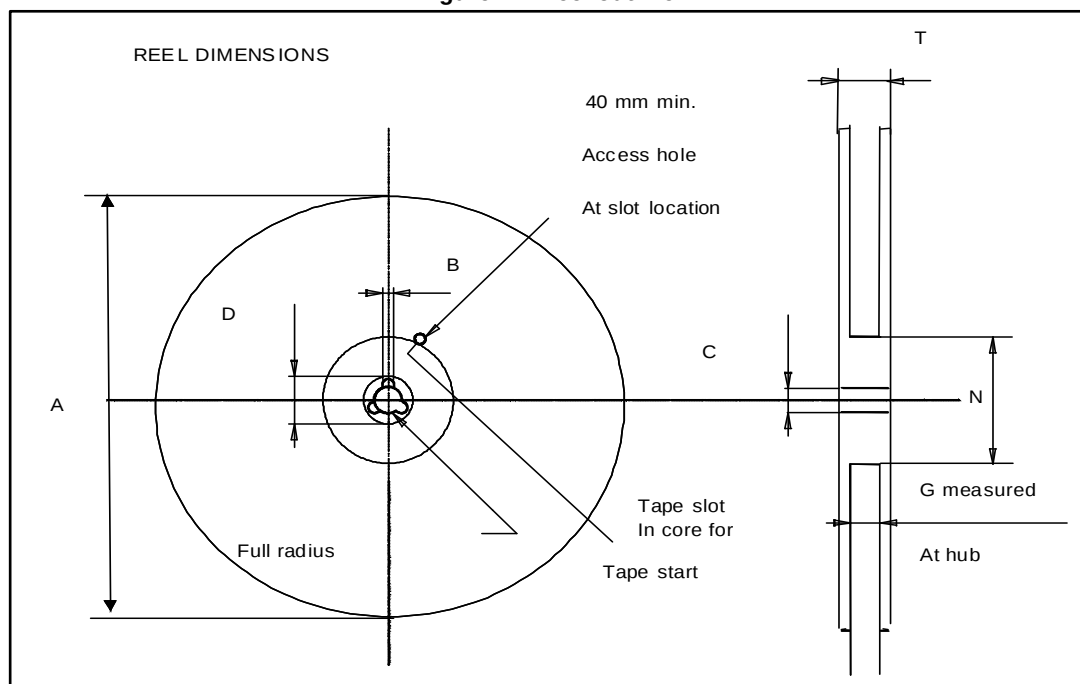


Table 10: Tape and reel mechanical data

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 11: Document revision history

Date	Revision	Changes
10-Apr-2015	1	First release.
13-May-2015	2	Updated Static.
04-Dec-2015	3	Updated note 1 in Table 2: "Absolute maximum ratings", Figure 2: "Safe operating area" and Figure 3: "Thermal impedance".
17-Feb-2016	4	Modified: <i>Table 2: "Absolute maximum ratings"</i> , <i>Table 4: "Static"</i> Modified: <i>Figure 2: "Safe operating area"</i> Minor text changes

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