STH400N4F6-2, STH400N4F6-6

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

Datasheet - production data

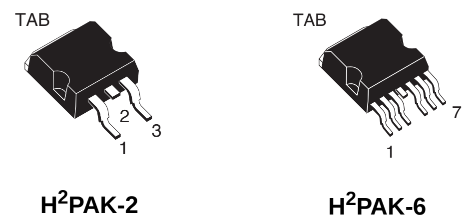
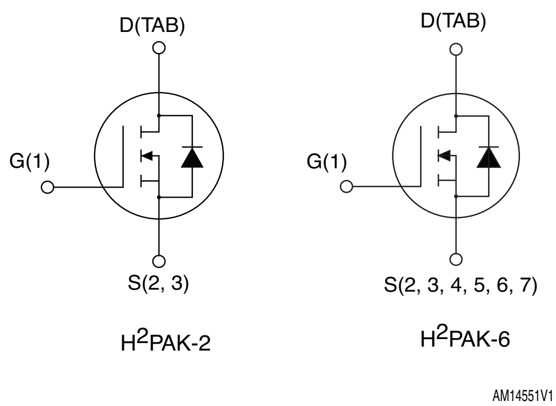


Figure 1. Internal schematic diagram



Features

Order codes	V_{DS}	$R_{DS(on)}$ max	I_D
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 6th generation of STripFET™ DeepGATE™ technology, with a new gate structure. The resulting Power MOSFETs exhibits the lowest $R_{DS(on)}$ in all packages.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STH400N4F6-2	400N4F6	H^2PAK-2	Tape and reel
STH400N4F6-6		H^2PAK-6	

Contents

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_C = 25 °C	180	A
I_D (1)	Drain current (continuous) at T_C = 100 °C	180	A
I_{DM} (1)	Drain current (pulsed)	720	A
P_{TOT}	Total dissipation at T_C = 25 °C	300	W
	Derating factor	2	W/°C
T_{stg}	Storage temperature	- 55 to 175	°C
T_j	Operating junction temperature		

1. Current limited by package

Table 3. Thermal data

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

1. When mounted on FR-4 board of 1 inch², 2 oz Cu.

2 Electrical characteristics

(T_{CASE} = 25 °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 μA	40			V
I_{DSS}	Zero gate voltage Drain current (V_{GS} = 0)	V_{DS} = 40 V			1	μA
		V_{DS} = 40 V, T_C=125 °C			100	μA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 20 V			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 μA	3		4.5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 60 A		0.85	1.15	mΩ

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 25 V, f = 1 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 V, I_D = 150 A, V_{GS} = 10 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 V, I_D = 90 A R_G = 4.7 Ω V_{GS} = 10 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 A, V_{GS} = 0	-		1.3	V
t_{rr}	Reverse recovery time	I_{SD} = 180 A, V_{DD} = 32 V di/dt = 100 A/μs, T_j = 25 °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 μs, duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

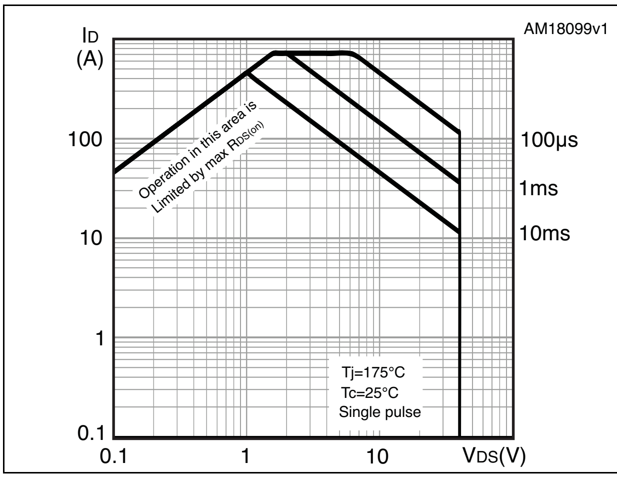


Figure 3. Thermal impedance

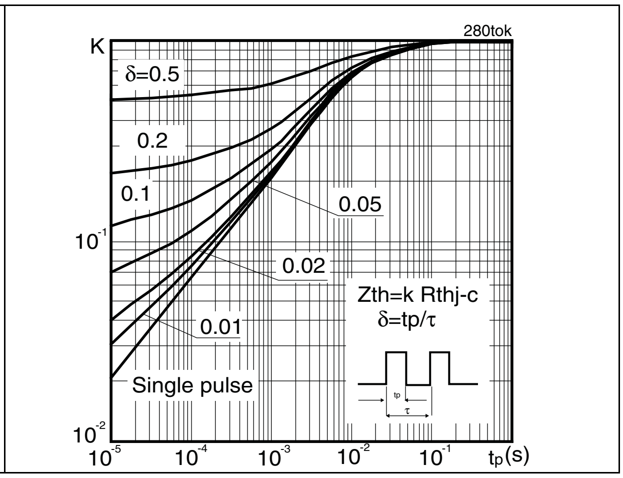


Figure 4. Output characteristics

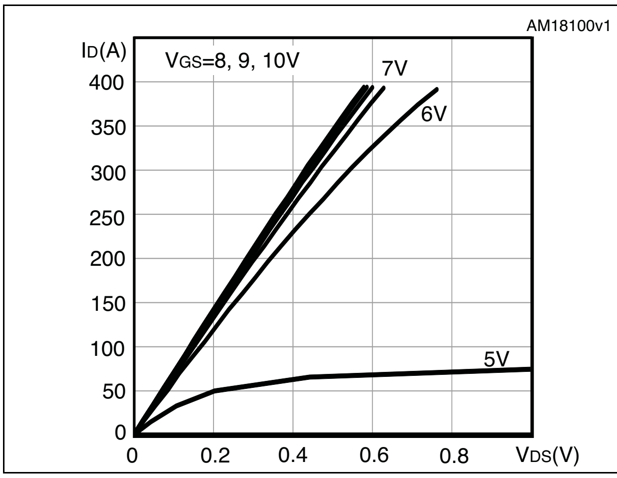


Figure 5. Transfer characteristics

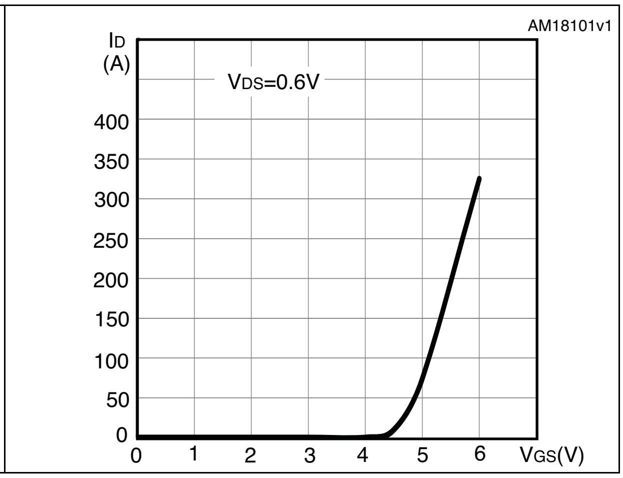


Figure 6. Gate charge vs gate-source voltage

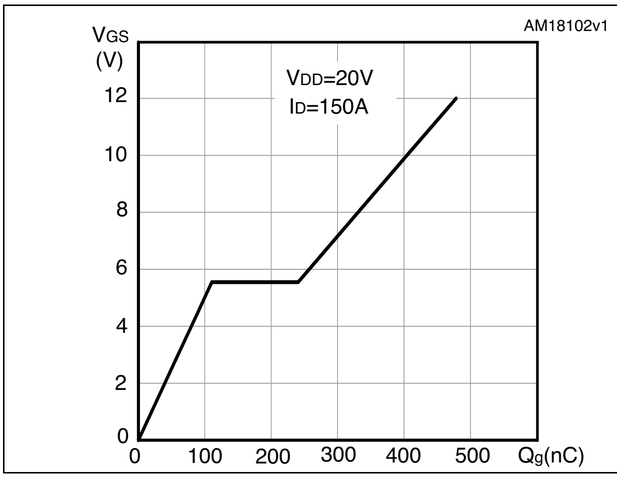


Figure 7. Static drain-source on-resistance

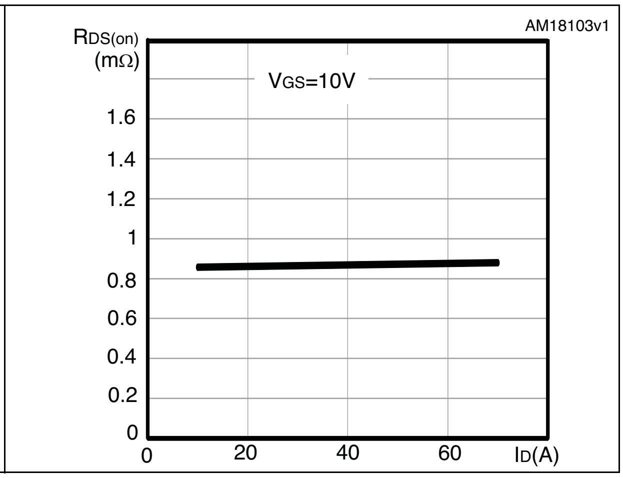


Figure 8. Capacitance variations

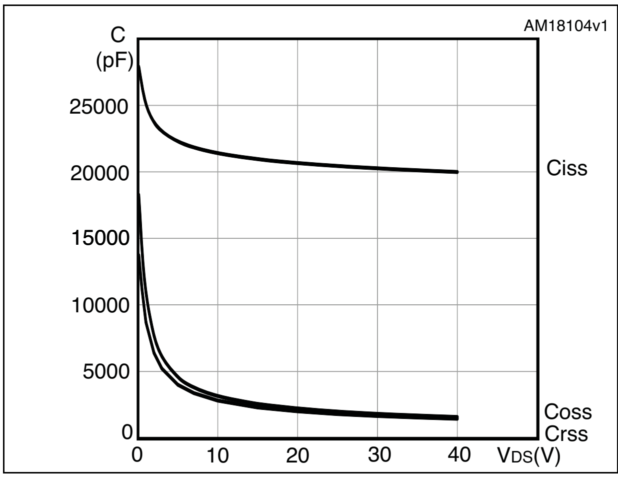


Figure 9. Normalized gate threshold voltage vs temperature

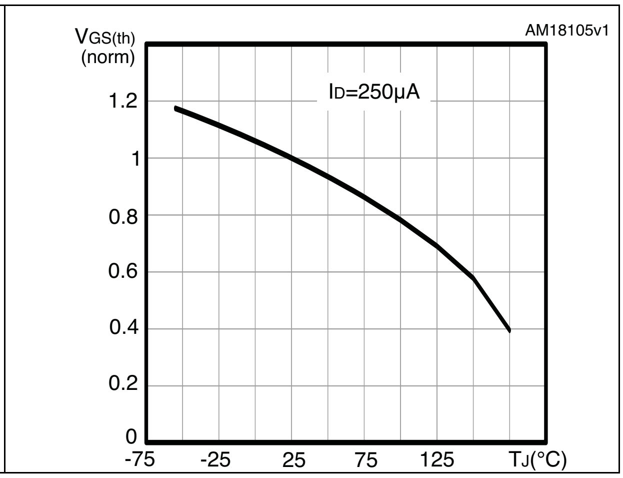


Figure 10. Normalized on-resistance vs temperature

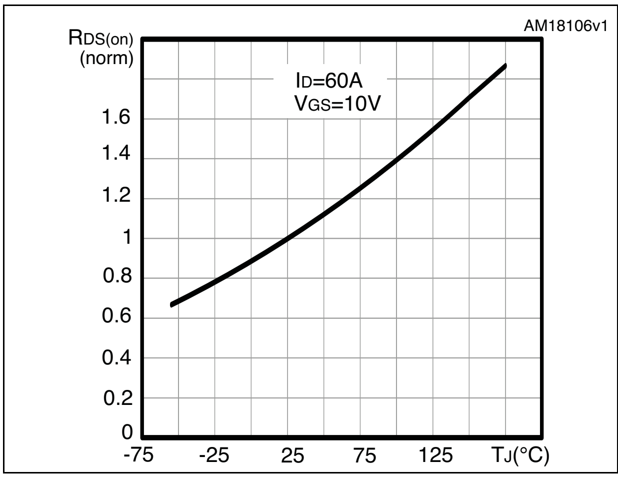


Figure 11. Normalized $V_{(BR)DSS}$ vs temperature

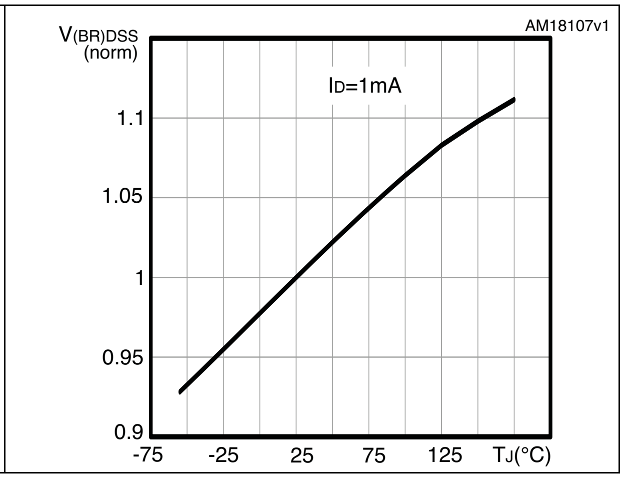
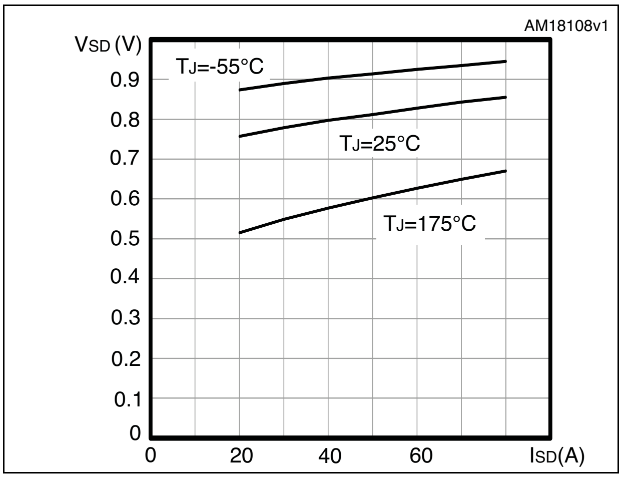


Figure 12. Source-drain diode forward characteristics



3 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® 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.

Figure 13. H²PAK-2 drawing

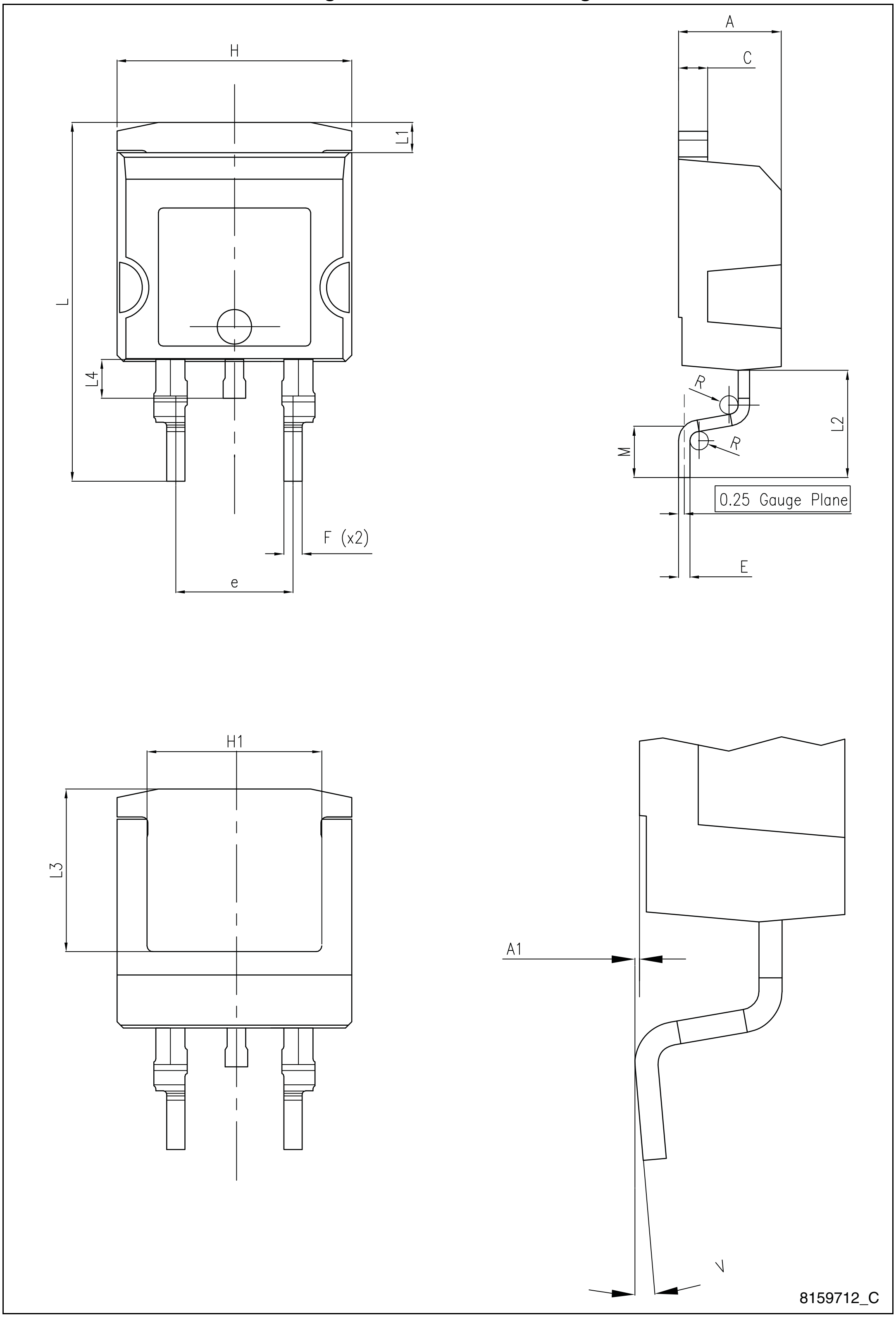


Table 8. H²PAK-2 mechanical data

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. H²PAK-2 recommended footprint (dimensions in mm)

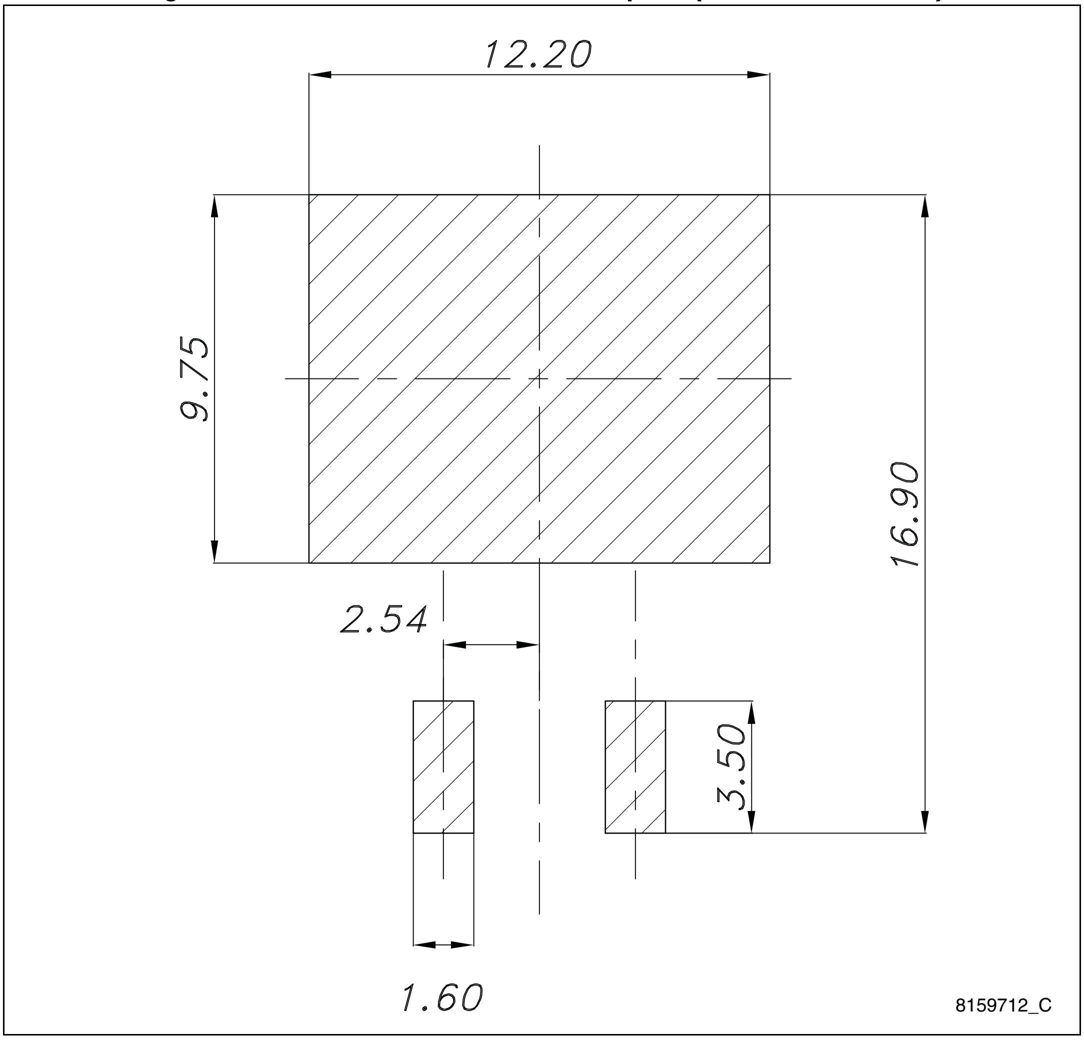


Figure 15. H²PAK-6 drawing

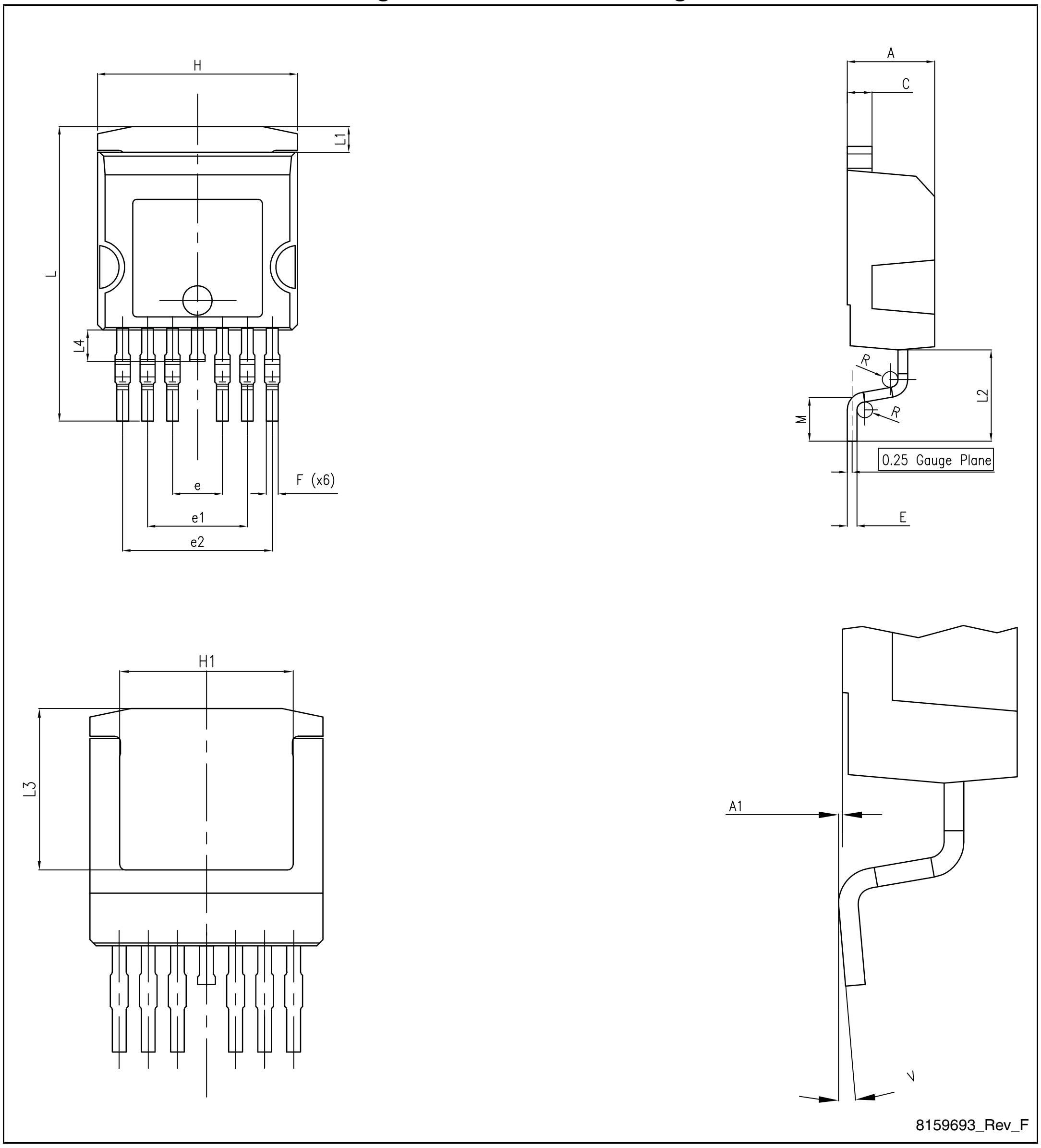
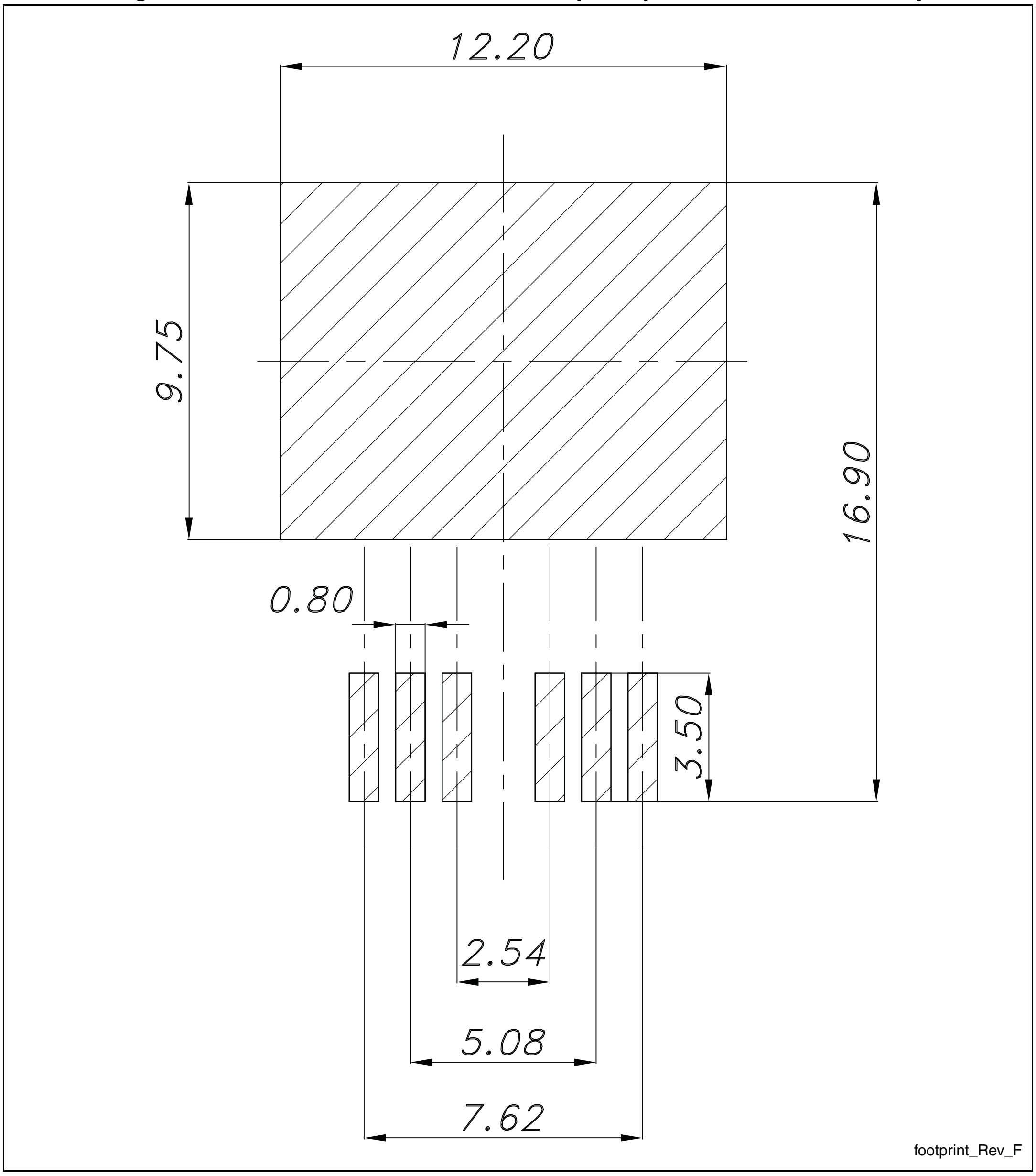


Table 9. H²PAK-6 mechanical data

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. H²PAK-6 recommended footprint (dimensions are in mm)



4 Packaging mechanical data

Figure 17. Tape dimension

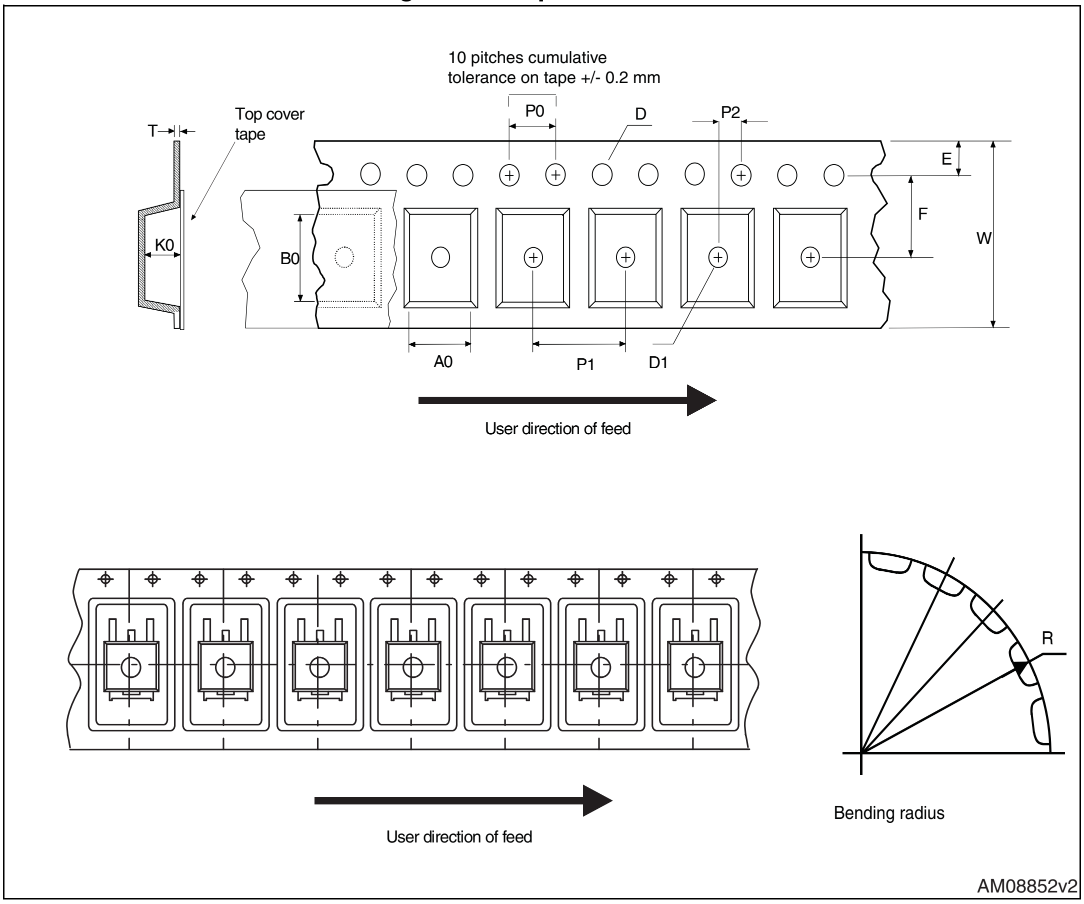


Figure 18. Reel dimension

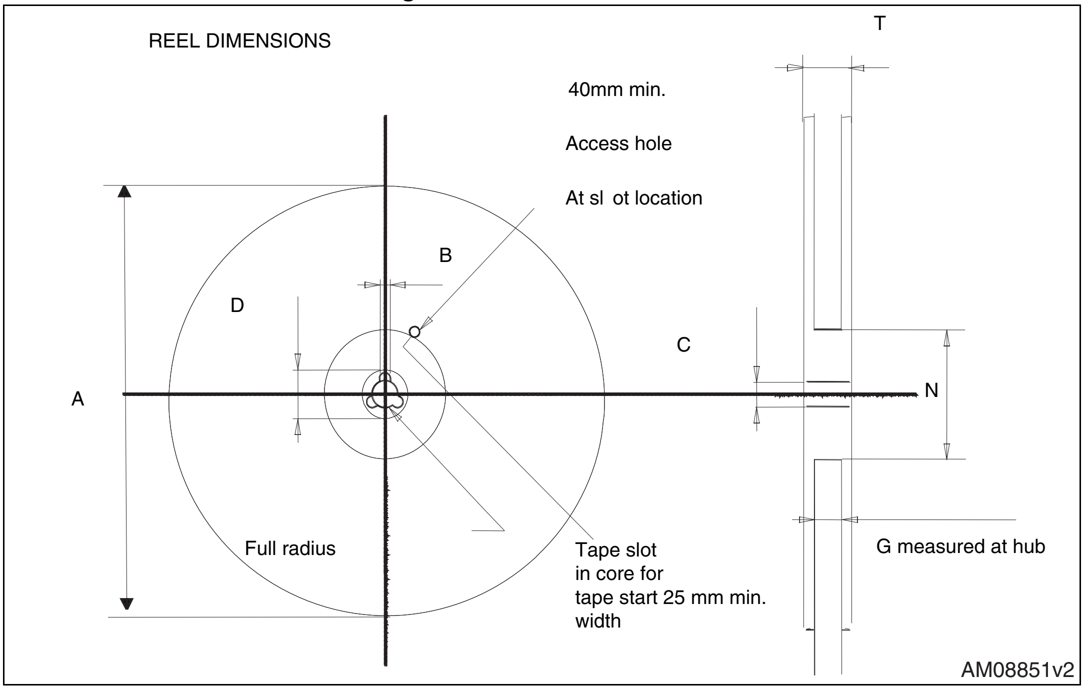


Table 10. H²PAK-2 and H²PAK-6 tape and reel mechanical data

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	– Document status promoted from preliminary data to production data – Modified: $R_{DS(on)}$ typical value in *Table 4* – Modified: the entire typical values in *Table 5*, *6* – Modified: V_{SD} max value and typical values in *Table 7* – Added: *Section 2.1: Electrical characteristics (curves)* – Updated: *Section 3: Package mechanical data* – Minor text changes