

## Automotive-grade N-channel 40 V, 1.1 mΩ typ., 200 A STripFET™ F6 Power MOSFETs in H<sup>2</sup>PAK-2 and H<sup>2</sup>PAK-6

Datasheet - production data

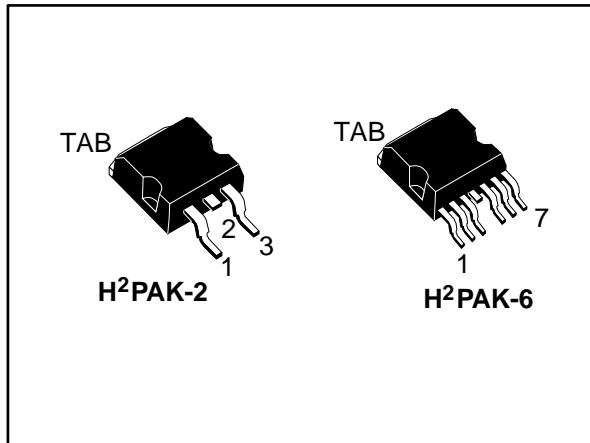
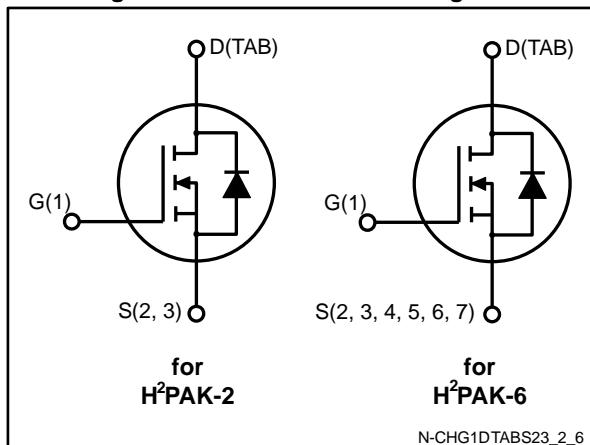


Figure 1: Internal schematic diagram



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STH320N4F6-2	40 V	1.3 mΩ	200 A
STH320N4F6-6			

- AEC-Q101 qualified
- Very low on-resistance
- Very low gate charge
- High avalanche ruggedness
- Low gate drive power loss



### Applications

- Switching applications

### Description

These devices are N-channel Power MOSFETs developed using the STripFET™ F6 technology with a new trench gate structure. The resulting Power MOSFETs exhibit very low R<sub>DS(on)</sub> in all packages.

Table 1: Device summary

Order code	Marking	Package	Packaging
STH320N4F6-2	320N4F6	H <sup>2</sup> PAK-2	Tape and reel
STH320N4F6-6		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 $T_C = 25\text{ }^\circ\text{C}$	200	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	200	A
$I_{DM}^{(2)}$	Drain current (pulsed)	800	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	340	W
$I_{AS}$	Not-repetitive avalanche current	160	A
$E_{AS}$	Single pulse avalanche energy	920	mJ
$T_{stg}$	Storage temperature range	- 55 to 175	$^\circ\text{C}$
$T_j$	Operating junction temperature range		

**Notes:**

<sup>(1)</sup>Current value is limited by package.

<sup>(2)</sup>Pulse width is limited by safe operating area.

**Table 3: Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.44	$^\circ\text{C/W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	35	$^\circ\text{C/W}$

**Notes:**

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

## 2 Electrical characteristics

(T<sub>CASE</sub> = 25 °C unless otherwise specified)

**Table 4: On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source breakdown voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	40			V
I <sub>DSS</sub>	Zero gate voltage drain current	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 40 V			1	μA
		V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 40 V, T <sub>C</sub> = 125 °C <sup>(1)</sup>			100	μA
I <sub>GSS</sub>	Gate-body leakage current	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±20 V			±100	nA
V <sub>GS(th)</sub>	Gate threshold voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	2		4	V
R <sub>DS(on)</sub>	Static drain-source on-resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 80 A		1.1	1.3	mΩ

**Notes:**

<sup>(1)</sup>Defined by design, not subject to production test.

**Table 5: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C <sub>iss</sub>	Input capacitance	V <sub>DS</sub> = 15 V, f = 1 MHz, V <sub>GS</sub> = 0 V	-	13800	-	pF
C <sub>oss</sub>	Output capacitance		-	1870	-	pF
C <sub>rss</sub>	Reverse transfer capacitance		-	1095	-	pF
Q <sub>g</sub>	Total gate charge	V <sub>DD</sub> = 20 V, I <sub>D</sub> = 160 A, V <sub>GS</sub> = 0 to 10 V (see <a href="#">Figure 14: "Test circuit for gate charge behavior"</a> )	-	240	-	nC
Q <sub>gs</sub>	Gate-source charge		-	59	-	nC
Q <sub>gd</sub>	Gate-drain charge		-	75.2	-	nC

**Table 6: Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t <sub>d(on)</sub>	Turn-on delay time	V <sub>DD</sub> = 20 V, I <sub>D</sub> = 80 A, R <sub>G</sub> = 4.7 Ω, V <sub>GS</sub> = 10 V (see <a href="#">Figure 13: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 18: "Switching time waveform"</a> )	-	28	-	ns
t <sub>r</sub>	Rise time		-	98	-	ns
t <sub>d(off)</sub>	Turn-off-delay time		-	190	-	ns
t <sub>f</sub>	Fall time		-	95	-	ns

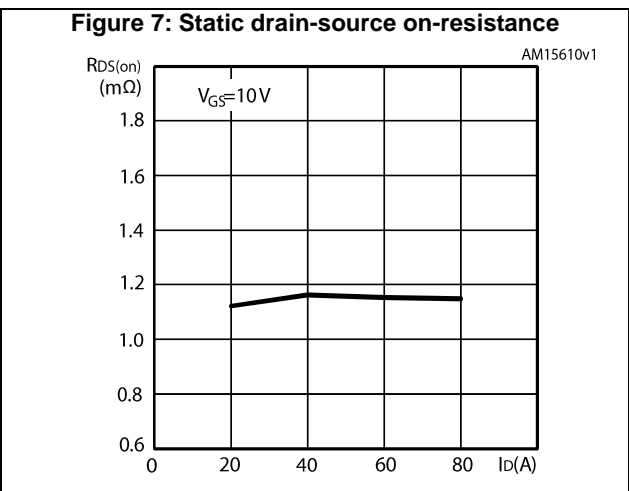
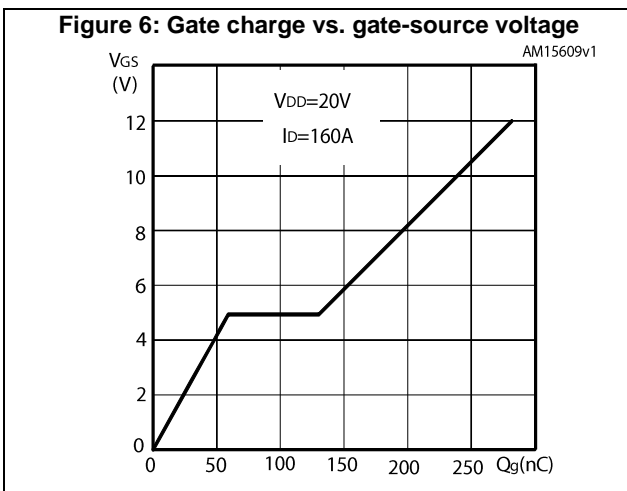
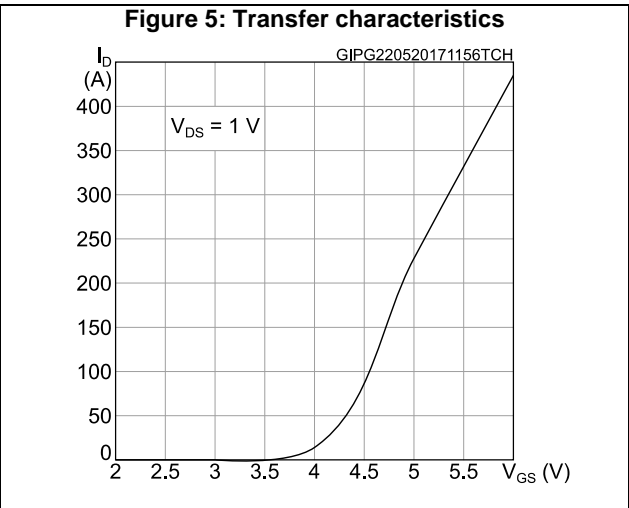
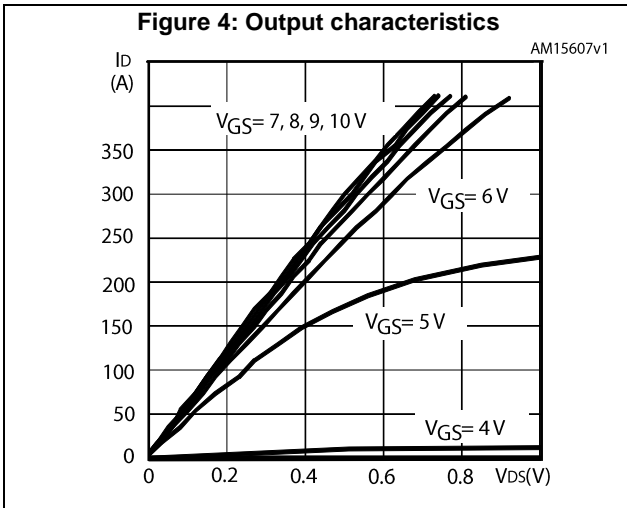
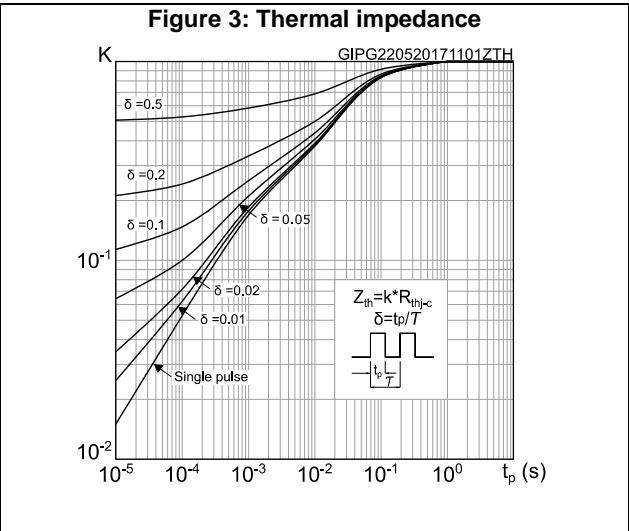
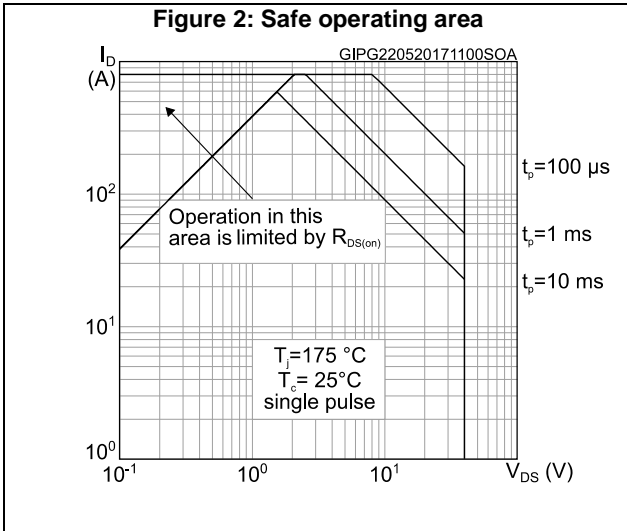
Table 7: Source drain diode

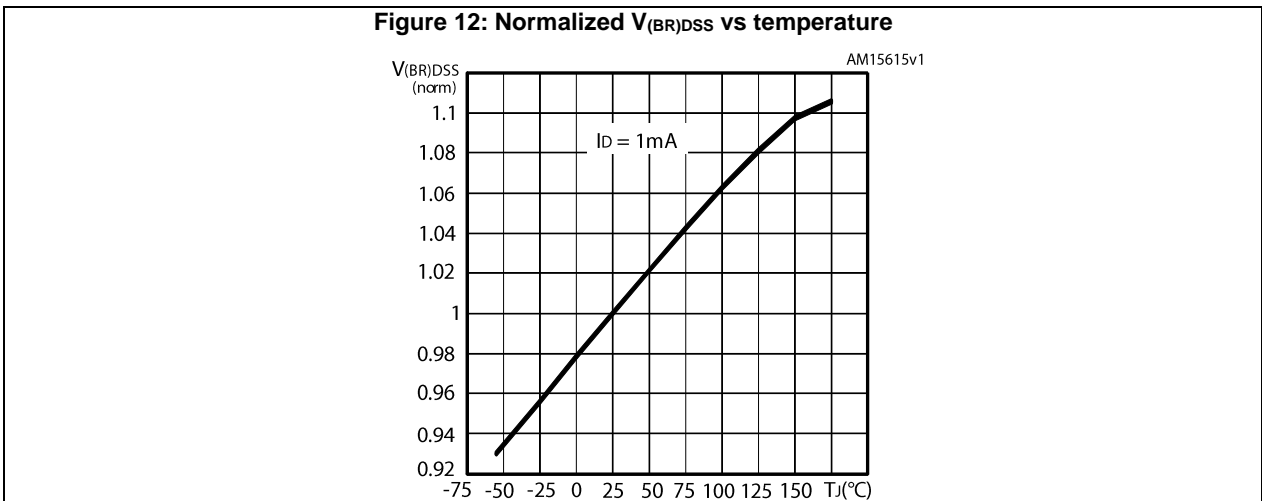
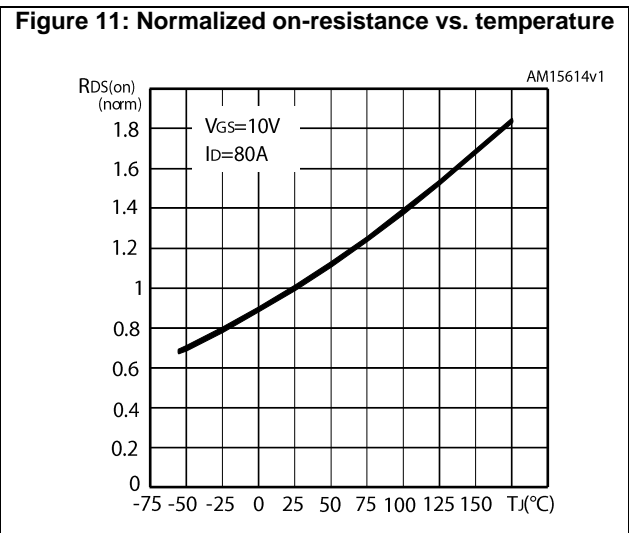
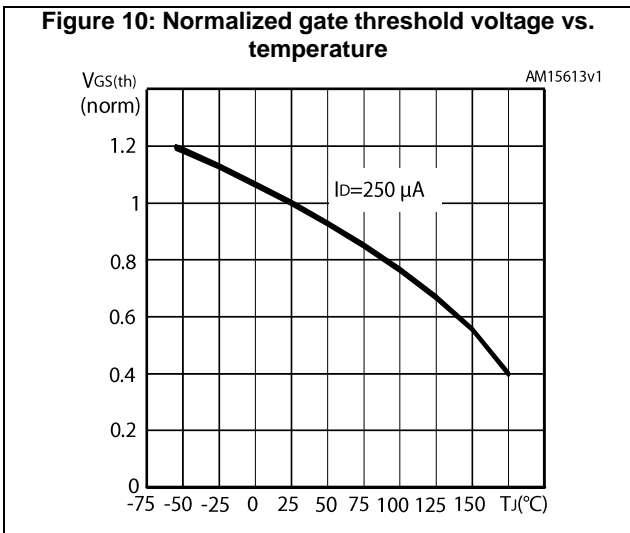
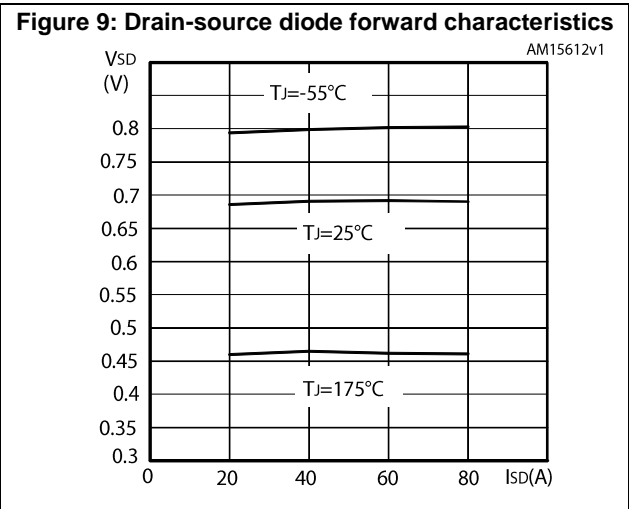
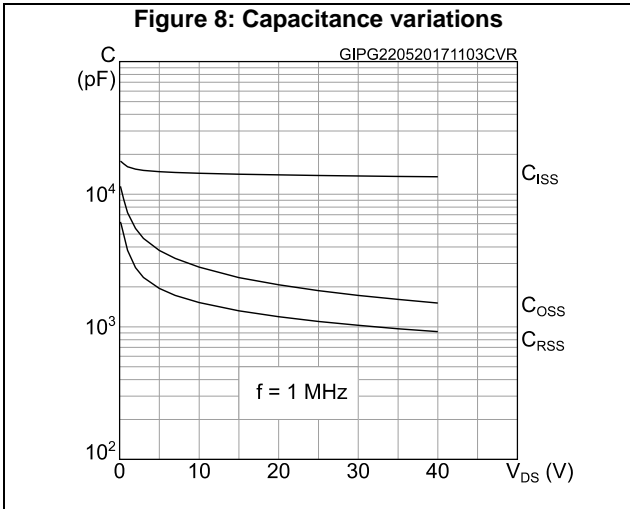
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}^{(1)}$	Source-drain current		-		200	A
$I_{SDM}^{(2)}$	Source-drain current (pulsed)		-		800	A
$V_{SD}^{(3)}$	Forward on voltage	$I_{SD} = 80\text{ A}$ , $V_{GS} = 0\text{ V}$	-		1.1	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 160\text{ A}$ , $V_{DD} = 32\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 15: "Test circuit for inductive load switching and diode recovery times"</a> )	-	58.7		ns
$Q_{rr}$	Reverse recovery charge		-	99.2		nC
$I_{RRM}$	Reverse recovery current		-	3.38		A

**Notes:**

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

## 2.1 Electrical characteristics (curves)





### 3 Test circuits

**Figure 13: Test circuit for resistive load switching times**



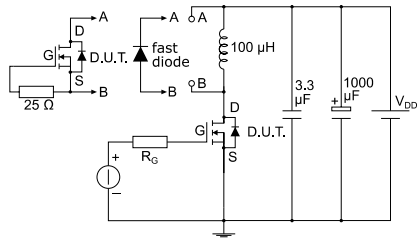
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**Figure 14: Test circuit for gate charge behavior**



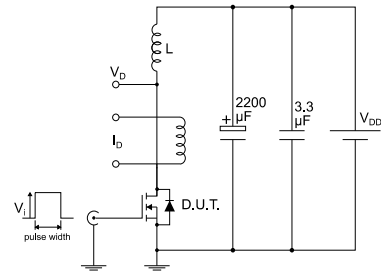
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**Figure 15: Test circuit for inductive load switching and diode recovery times**



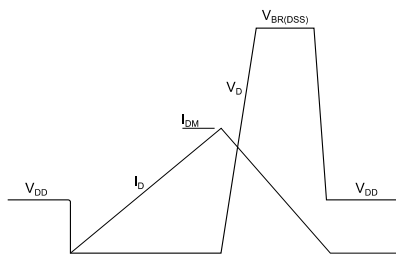
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**Figure 16: Unclamped inductive load test circuit**



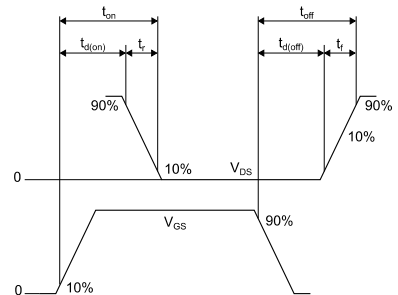
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**Figure 17: Unclamped inductive waveform**



AM01472v1

**Figure 18: Switching time waveform**



AM01473v1



## 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.

### 4.1 H<sup>2</sup>PAK-2 mechanical data

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

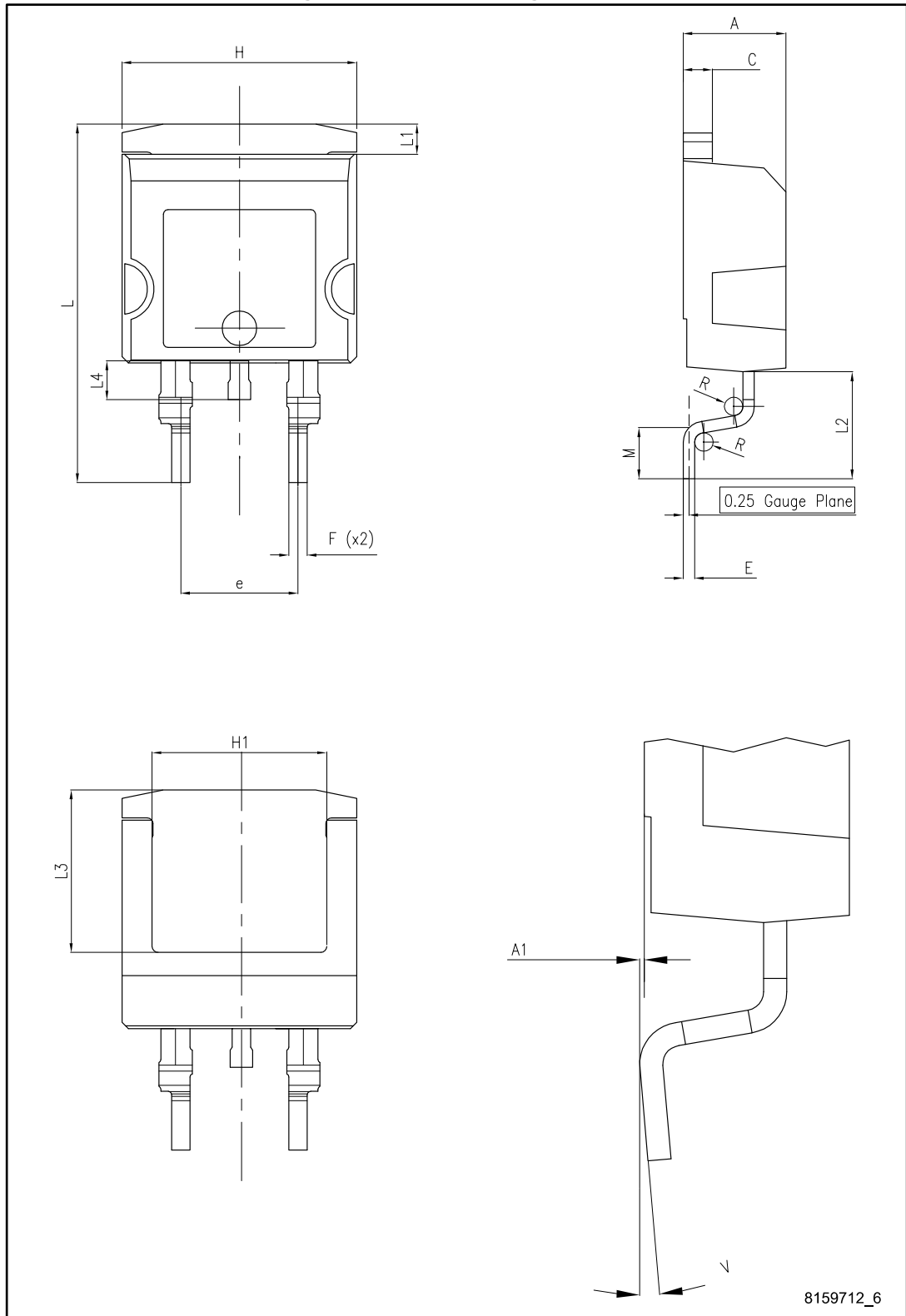
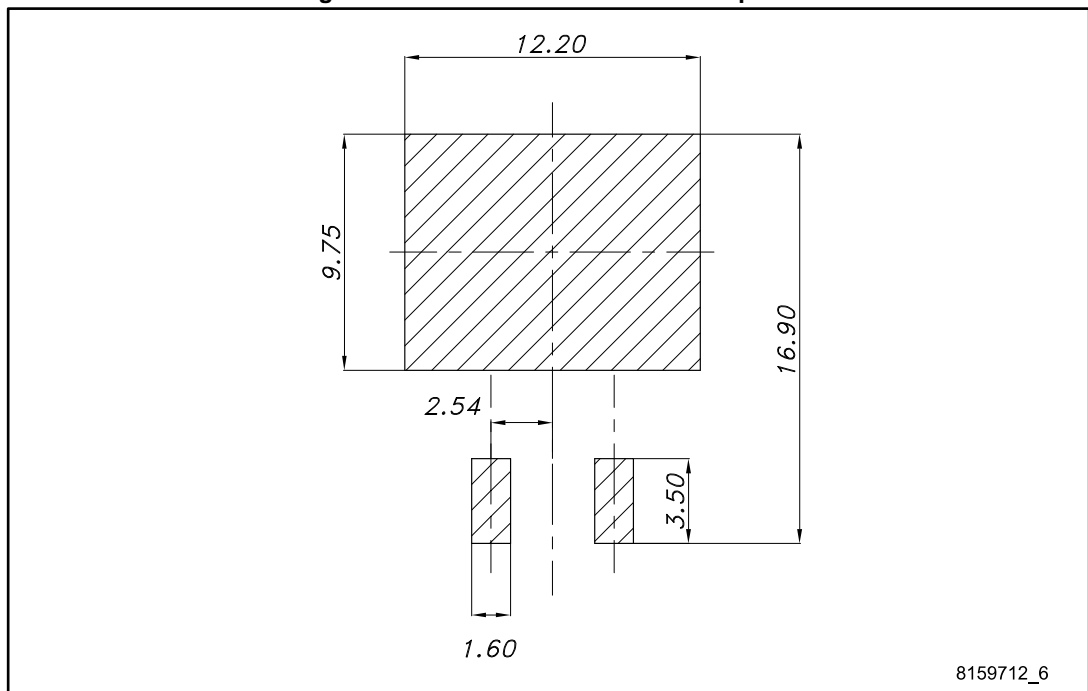


Table 8: H<sup>2</sup>PAK-2 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.30		4.70
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: H<sup>2</sup>PAK-2 recommended footprint



8159712\_6

### 4.2 H<sup>2</sup>PAK-6 mechanical data

Figure 21: H<sup>2</sup>PAK-6 package outline

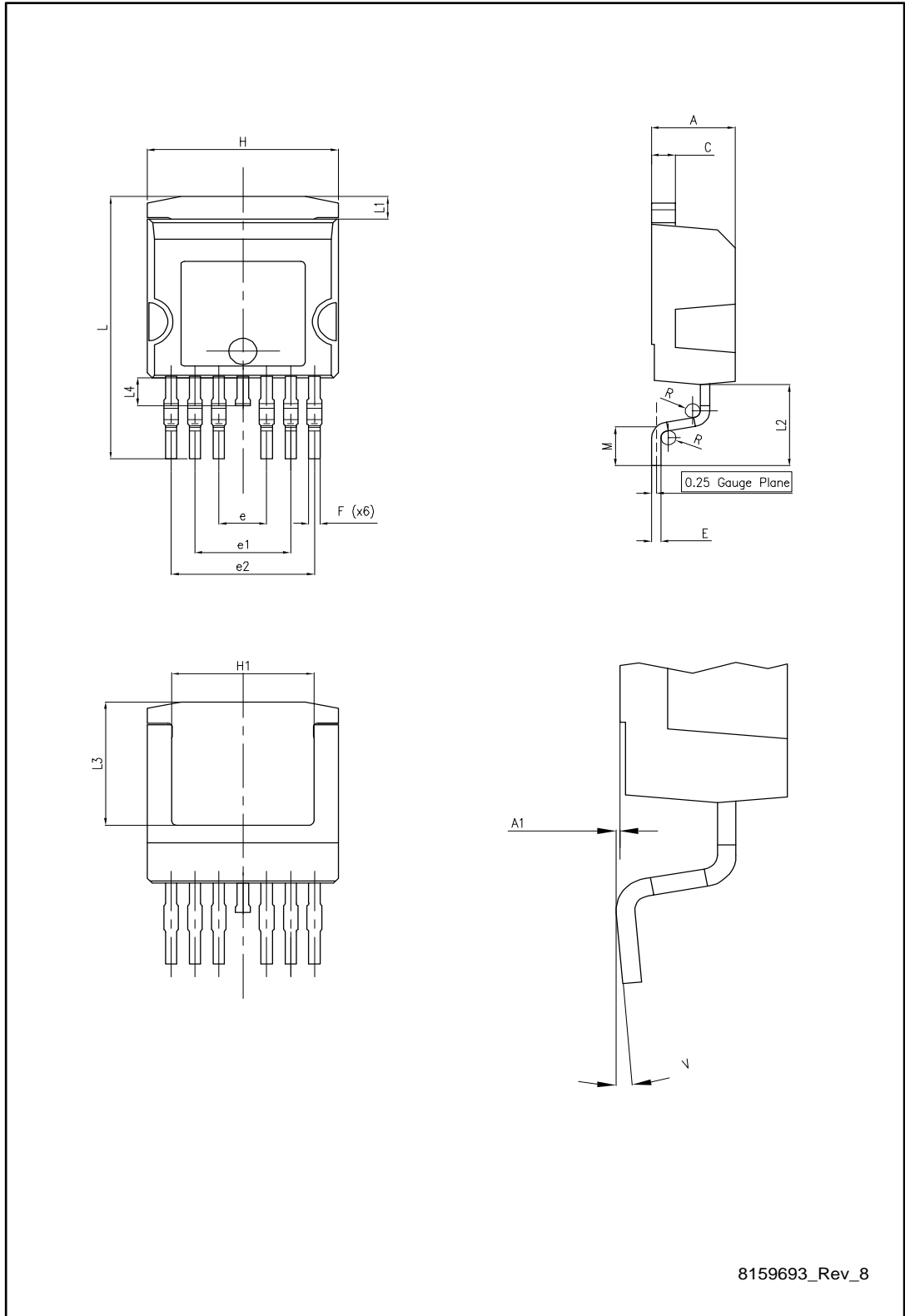
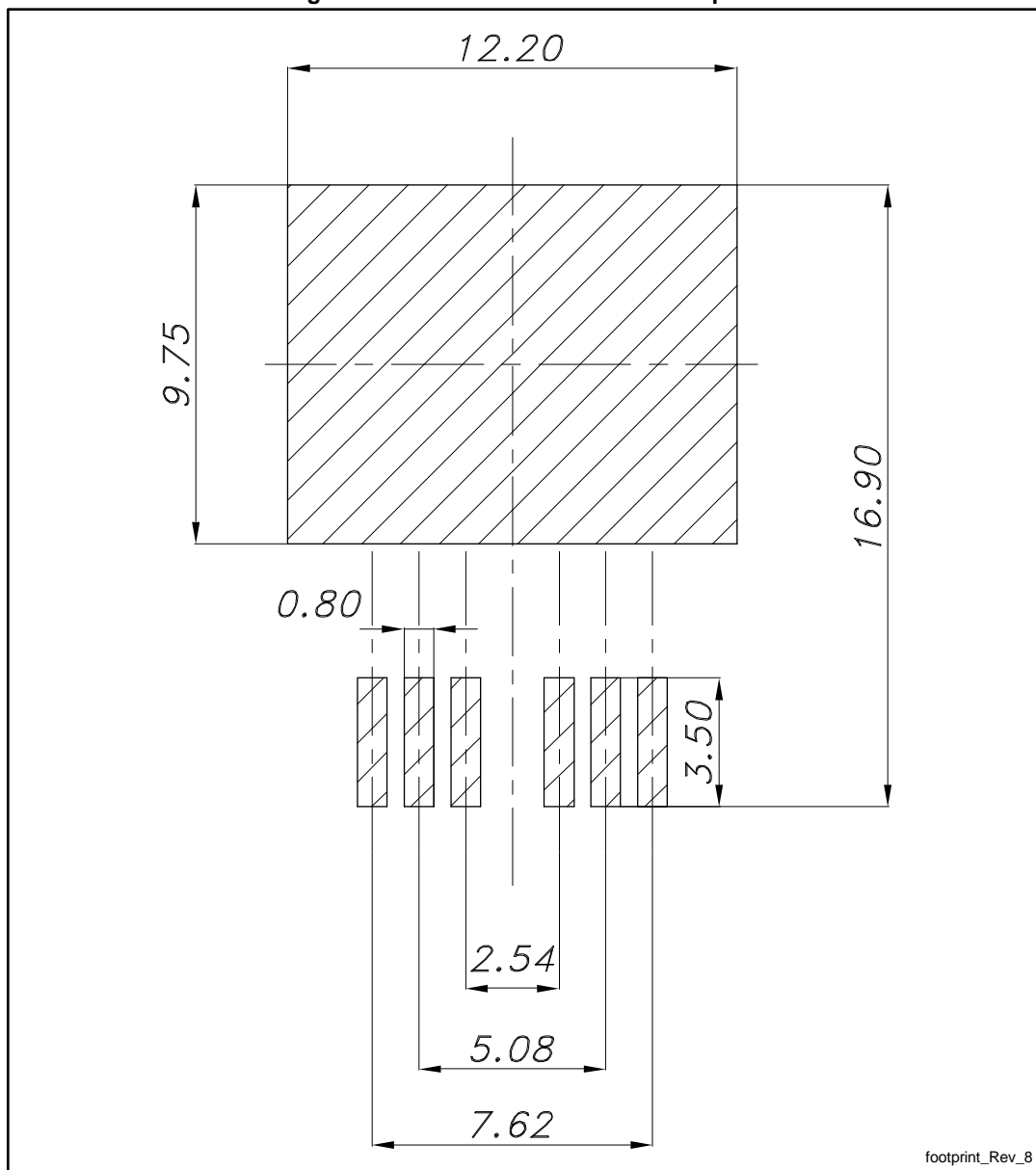


Table 9: H<sup>2</sup>PAK-6 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.30		4.70
A1	0.03		0.20
C	1.17		1.37
e	2.34	2.54	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	1.50		1.75
M	1.90		2.50
R	0.20		0.60
V	0°		8°

Figure 22: H<sup>2</sup>PAK-6 recommended footprint



Dimensions are in mm.

### 4.3 Packaging information

Figure 23: Tape outline

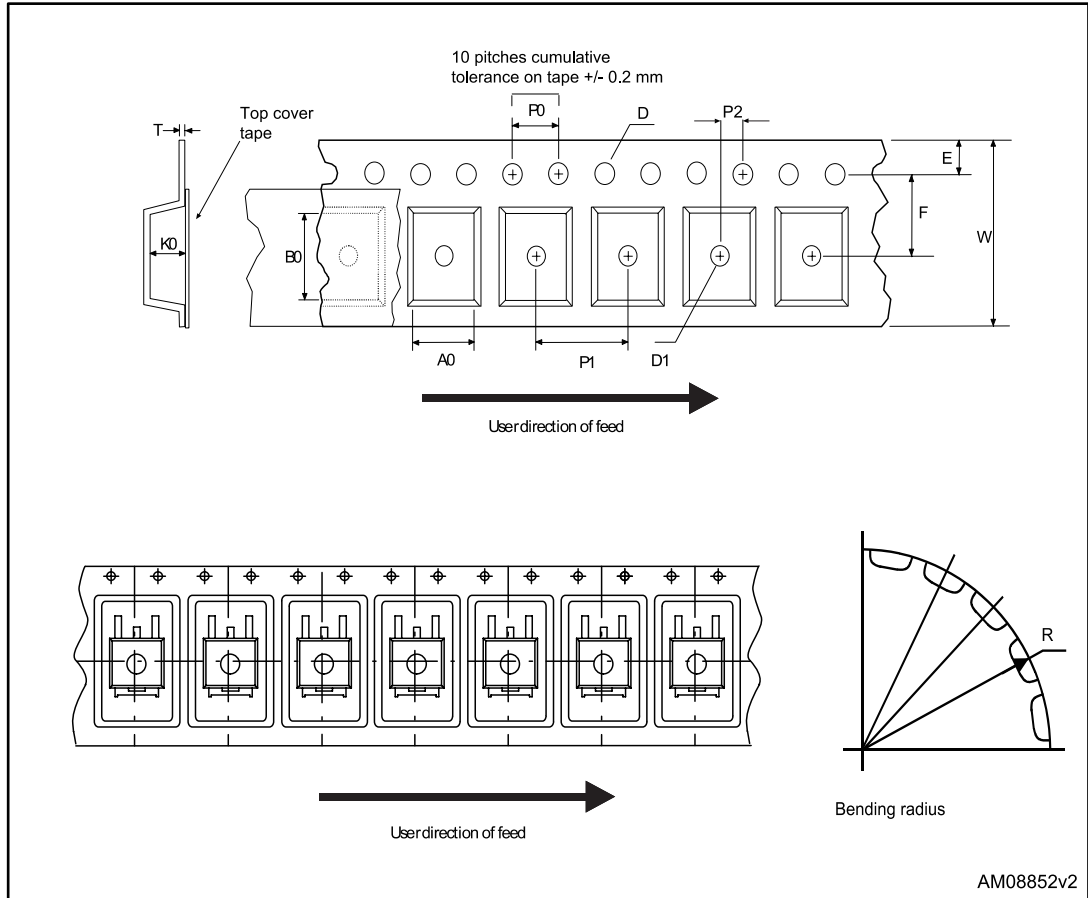


Figure 24: Reel outline

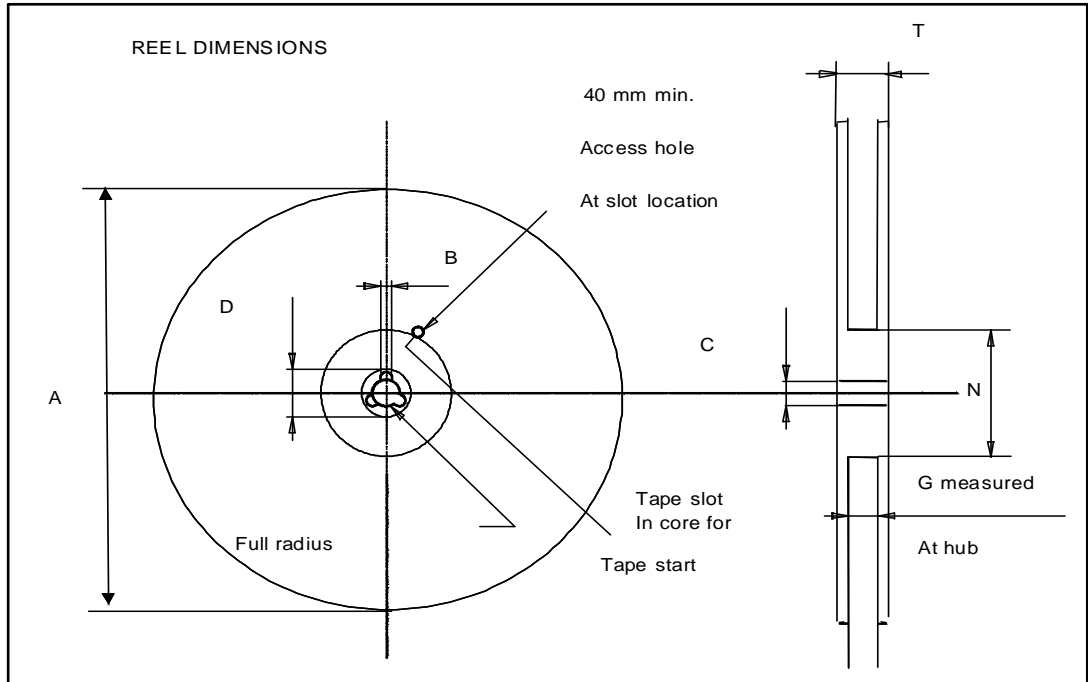


Table 10: Tape and reel mechanical data

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
01-Feb-2013	1	First release.
12-May-2017	2	Modified title and features on cover page. Updated Section 4: "Package mechanical data". Modified Figure 2: "Safe operating area", Figure 3: "Thermal impedance", Figure 5: "Transfer characteristics" and Figure 8: "Capacitance variations". Minor text changes.
29-May-2017	3	Modified <i>Table 2: "Absolute maximum ratings"</i> . Minor text changes.

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