

# BGA5H1BN6

## 18dB High Gain Low Noise Amplifier for LTE Highband

### Features

- Operating frequencies: 2300 - 2690 MHz
- Insertion power gain: 18.1 dB
- Insertion Loss in bypass mode: 5.2 dB
- Low noise figure: 0.7 dB
- Low current consumption: 8.5 mA
- Multi-state control: Bypass- and high gain-Mode
- Ultra small TSNP-6-10 leadless package
- RF output internally matched to 50 Ohm
- Low external component count



### Application

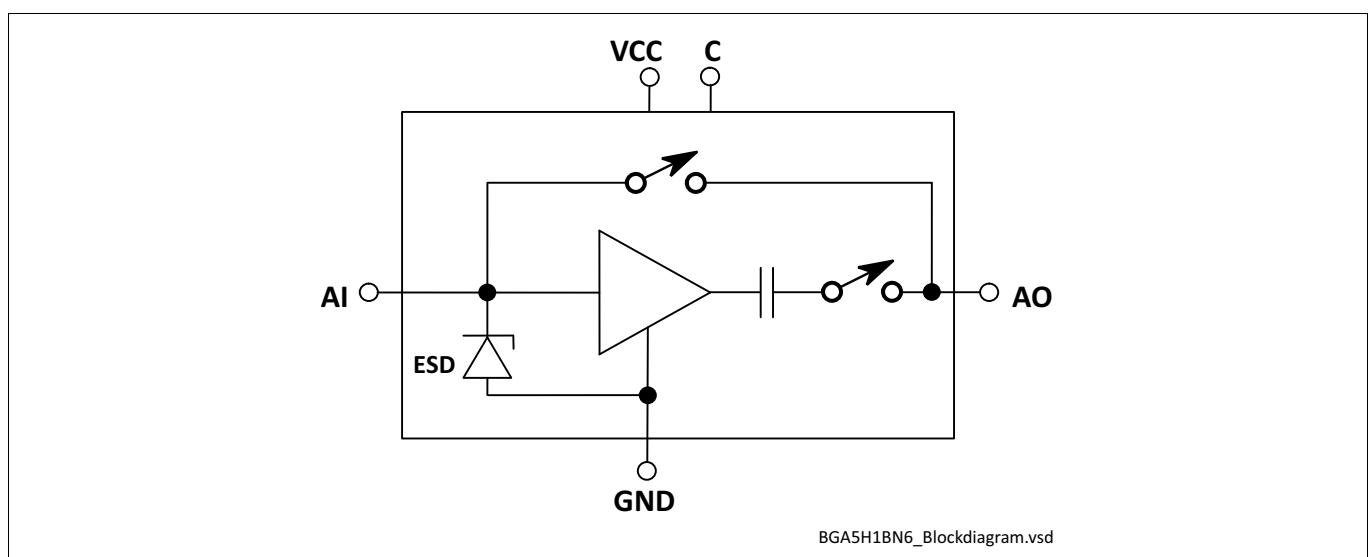
The LTE data rate can be significantly improved by using the Low Noise Amplifier. The integrated bypass function increases the overall system dynamic range and leads to more flexibility in the RF front-end.

In high gain mode the LNA offers best Noise Figure to ensure high data rates even on the LTE cell edge. Closer to the basestation the bypass mode can be activated reducing current consumption.

### Product Validation

Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

### Block diagram

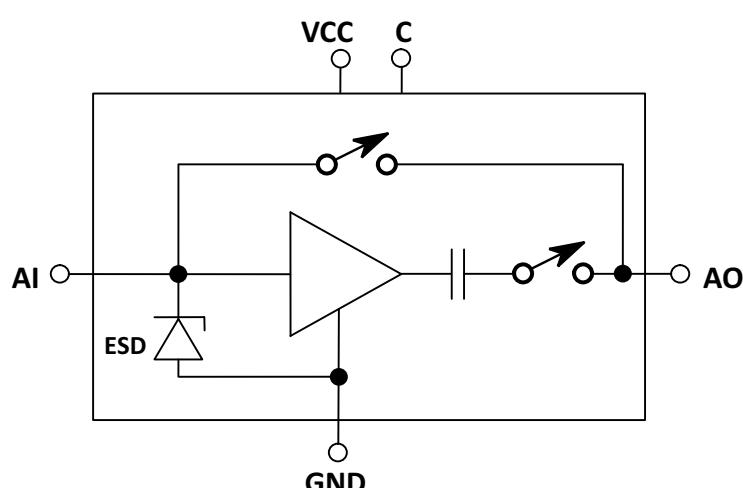


**Table of Contents**

<b>Table of Contents</b> .....	<b>2</b>
<b>1 Features</b> .....	<b>3</b>
<b>2 Maximum Ratings</b> .....	<b>5</b>
<b>3 Electrical Characteristics</b> .....	<b>6</b>
<b>4 Application Information</b> .....	<b>8</b>
<b>5 Package Information</b> .....	<b>9</b>

**Features****1 Features**

- Insertion power gain: 18.1 dB
- Insertion Loss in bypass mode: 5.2 dB
- Low noise figure: 0.7 dB
- Low current consumption: 8.5 mA
- Operating frequencies: 2300 - 2690 MHz
- Multi-state control: Bypass- and High gain-Mode
- Supply voltage: 1.5 V to 3.6 V
- Ultra small TSNP-6-10 leadless package (footprint: 0.7 x 1.1 mm<sup>2</sup>)
- B9HF Silicon Germanium technology
- RF output internally matched to 50 Ohm
- Low external component count
- Pb-free (RoHS compliant) package

**Figure 1 Block Diagram**

Product Name	Marking	Package
BGA5H1BN6	4	TSNP-6-10

**Features****Description**

The BGA5H1BN6 is a front-end low noise amplifier for LTE which covers a wide frequency range from 2300 MHz to 2690 MHz. The LNA provides 18.1 dB gain and 0.7 dB noise figure at a current consumption of 8.5 mA in the application configuration described in [Chapter 4](#). In bypass mode the LNA provides an insertion loss of 5.2 dB. The BGA5H1BN6 is based upon Infineon Technologies' B9HF Silicon Germanium technology. It operates from 1.5 V to 3.6 V supply voltage. The device features a single-line two-state control (Bypass- and High gain-Mode). OFF-state can be enabled by powering down VCC.

**Pin Definition and Function****Table 1 Pin Definition and Function**

Pin No.	Name	Function
1	GND	Ground
2	VCC	DC supply
3	AO	LNA output
4	GND	Ground
5	AI	LNA input
6	C	Control

## Maximum Ratings

## 2 Maximum Ratings

**Table 2 Maximum Ratings**

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Voltage at pin VCC	$V_{CC}$	-0.3	–	3.6	V	1)
Voltage at pin AI	$V_{AI}$	-0.3	–	0.9	V	–
Voltage at pin AO	$V_{AO}$	-0.3	–	$V_{CC} + 0.3$	V	–
Voltage at pin C	$V_C$	-0.3	–	$V_{CC} + 0.3$	V	–
Voltage at pin GND	$V_{GND}$	-0.3	–	0.3	V	–
Current into pin VCC	$I_{CC}$	–	–	16	mA	–
RF input power	$P_{IN}$	–	–	+25	dBm	–
Total power dissipation, $T_S < 148^\circ\text{C}^2)$	$P_{tot}$	–	–	60	mW	–
Junction temperature	$T_J$	–	–	150	$^\circ\text{C}$	–
Ambient temperature range	$T_A$	-40	–	85	$^\circ\text{C}$	–
Storage temperature range	$T_{STG}$	-55	–	150	$^\circ\text{C}$	–

1) All voltages refer to GND-Node unless otherwise noted

2)  $T_S$  is measured on the ground lead at the soldering point

**Attention: Stresses above the max. values listed here may cause permanent damage to the device.**  
**Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit. Exposure to conditions at or below absolute maximum rating but above the specified maximum operation conditions may affect device reliability and life time. Functionality of the device might not be given under these conditions.**

## Electrical Characteristics

## 3 Electrical Characteristics

**Table 3 Electrical Characteristics  $V_{CC} = 1.8V^1)$**  $T_A = 25^\circ C, V_{CC} = 1.8 V, V_{C,BP} = 1.8 V, V_{C,OFF} = 0 V, f = 2300 - 2690 \text{ MHz}$ 

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage	$V_{CC}$	1.5	1.8	3.6	V	–
Control voltages	$V_C$	1.0	–	$V_{CC}$	V	High gain mode
		0	–	0.4	V	Bypass mode
Supply current	$I_{CC}$	–	8.5	10.3	mA	High gain mode
		–	85	120	$\mu\text{A}$	Bypass mode
Insertion power gain $f = 2500 \text{ MHz}$	$ S_{21} ^2$	16.4	18.1	19.8	dB	High gain mode
		-6.5	-5.2	-3.9	dB	Bypass mode
Noise figure <sup>2)</sup> $f = 2500 \text{ MHz}, Z_S = 50 \Omega$	$NF$	–	0.7	1.2	dB	High gain mode
		–	5.2	6.5	dB	Bypass mode
Input return loss <sup>3)</sup> $f = 2500 \text{ MHz}$	$RL_{IN}$	7	10	–	dB	High gain mode
		5	8	–	dB	Bypass mode
Output return loss <sup>3)</sup> $f = 2500 \text{ MHz}$	$RL_{OUT}$	10	20	–	dB	High gain mode
		3	5	–	dB	Bypass mode
Reverse isolation <sup>3)</sup> $f = 2500 \text{ MHz}$	$1/ S_{12} ^2$	25	36	–	dB	High gain mode
		3.9	5.2	–	dB	Bypass mode
Power on time <sup>4)6)</sup>	$t_S$	–	3	7	$\mu\text{s}$	OFF to High gain mode
Inband input 1dB-compression point, $f = 2500 \text{ MHz}^3)$	$IP_{1\text{dB}}$	-21	-17	–	dBm	High gain mode
		-7	-3	–	dBm	Bypass mode
Inband input 3 <sup>rd</sup> -order intercept point <sup>3)5)</sup> $f_1 = 2500 \text{ MHz}, f_2 = f_1 +/- 1 \text{ MHz}$	$IIP_3$	-12	-7	–	dBm	High gain mode
		1	6	–	dBm	Bypass mode
Stability <sup>6)</sup>	$k$	>1	–	–		$f = 20 \text{ MHz} \dots 10 \text{ GHz}$

1) Based on the application described in [Chapter 4](#)

2) PCB losses are subtracted

3) Verification based on AQL; not 100% tested in production

4) Gain changed to &gt;90% of gain difference (in dB)

5) Input power HG = -30 dBm for each tone; input power BP = -10 dBm for each tone

6) Guaranteed by device design; not tested in production

## Electrical Characteristics

**Table 4 Electrical Characteristics  $V_{CC} = 2.8V^1)$**  $T_A = 25^\circ C, V_{CC} = 2.8 V, V_{C,BP} = 2.8 V, V_{C,OFF} = 0 V, f = 2300 - 2690 \text{ MHz}$ 

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage	$V_{CC}$	1.5	2.8	3.6	V	-
Control voltages	$V_C$	1.0	-	$V_{CC}$	V	High gain mode
		0	-	0.4	V	Bypass mode
Supply current	$I_{CC}$	-	9.8	11.6	mA	High gain mode
		-	87	120	$\mu\text{A}$	Bypass mode
Insertion power gain $f = 2500 \text{ MHz}$	$ S_{21} ^2$	16.6	18.3	20.0	dB	High gain mode
		-6.5	-5.2	-3.9	dB	Bypass mode
Noise figure <sup>2)</sup> $f = 2500 \text{ MHz}, Z_S = 50 \Omega$	$NF$	-	0.7	1.2	dB	High gain mode
		-	5.2	6.5	dB	Bypass mode
Input return loss <sup>3)</sup> $f = 2500 \text{ MHz}$	$RL_{IN}$	7	10	-	dB	High gain mode
		5	8	-	dB	Bypass mode
Output return loss <sup>3)</sup> $f = 2500 \text{ MHz}$	$RL_{OUT}$	10	19	-	dB	High gain mode
		3	5	-	dB	Bypass mode
Reverse isolation <sup>3)</sup> $f = 2500 \text{ MHz}$	$1/ S_{12} ^2$	25	36	-	dB	High gain mode
		3.9	5.2	-	dB	Bypass mode
Power on time <sup>4)6)</sup>	$t_S$	-	3	7	$\mu\text{s}$	OFF to High gain mode
Inband input 1dB-compression point, $f = 2500 \text{ MHz}^3)$	$IP_{1\text{dB}}$	-20	-16	-	dBm	High gain mode
		-6	-2	-	dBm	Bypass mode
Inband input 3 <sup>rd</sup> -order intercept point <sup>3)5)</sup> $f_1 = 2500 \text{ MHz}, f_2 = f_1 +/- 1 \text{ MHz}$	$IIP_3$	-11	-6	-	dBm	High gain mode
		1	6	-	dBm	Bypass mode
Stability <sup>6)</sup>	$k$	$> 1$	-	-		$f = 20 \text{ MHz} \dots 10 \text{ GHz}$

1) Based on the application described in [Chapter 4](#)

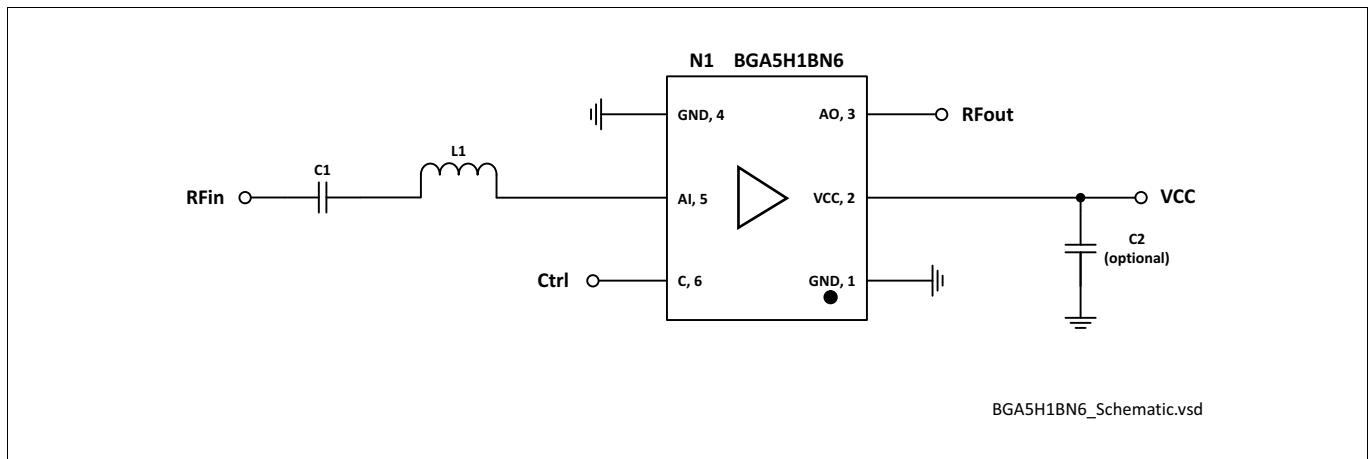
2) PCB losses are subtracted

3) Verification based on AQL; not 100% tested in production

4) Gain changed to &gt;90% of gain difference (in dB)

5) Input power HG = -30 dBm for each tone; input power BP = -10 dBm for each tone

6) Guaranteed by device design; not tested in production

**Application Information****4 Application Information****Application Board Configuration****Figure 2 Application Schematic BGA5H1BN6****Table 5 Bill of Materials**

Name	Value	Package	Manufacturer	Function
C1	1nF	0402	Various	Input matching
C2 (optional)	$\geq 1nF$	0402	Various	RF bypass <sup>1)</sup>
L1	3.6nH	0402	Murata LQW15 type	Input matching
N1	BGA5H1BN6	TSNP-6-10	Infineon	SiGe LNA

1) RF bypass recommended to mitigate power supply noise

A list of all application notes is available at <http://www.infineon.com/lteina>

## Package Information

## 5 Package Information

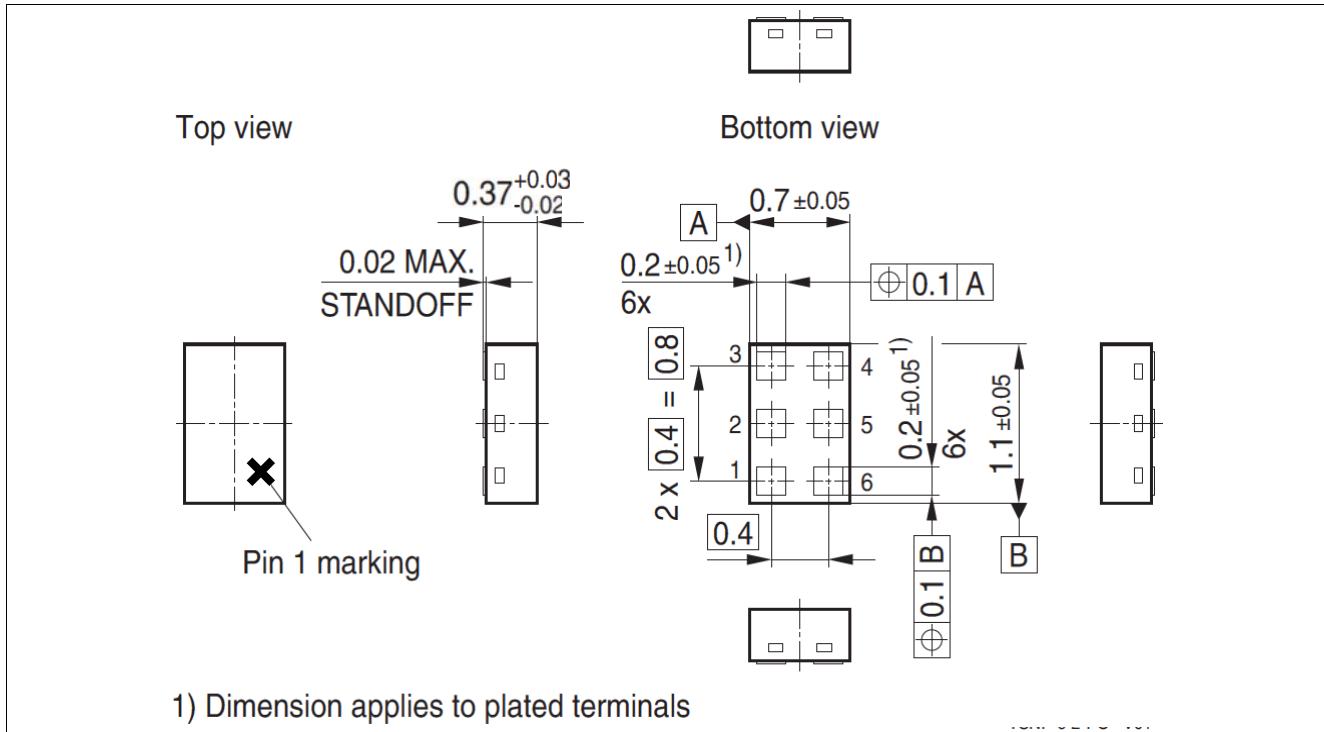


Figure 3 TSNP-6-10 Package Outline (top, side and bottom views)

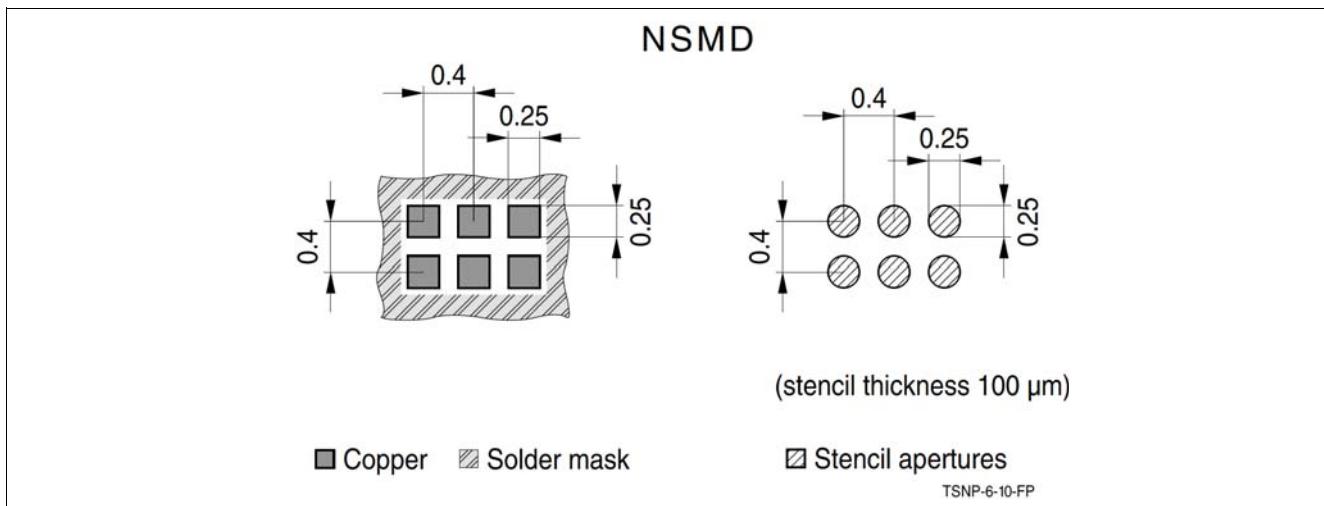


Figure 4 Footprint Recommendation TSNP-6-10

## Package Information

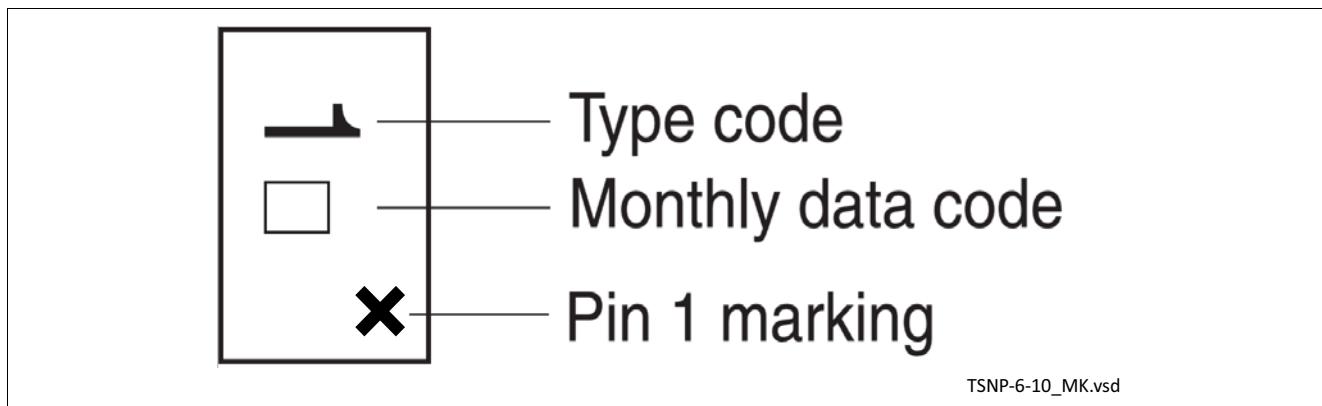


Figure 5 Marking Layout TSNP-6-10 (top view)

Month	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
01	a	p	A	P	a	p	A	P	a	p	A	P
02	b	q	B	Q	b	q	B	Q	b	q	B	Q
03	c	r	C	R	c	r	C	R	c	r	C	R
04	d	s	D	S	d	s	D	S	d	s	D	S
05	e	t	E	T	e	t	E	T	e	t	E	T
06	f	u	F	U	f	u	F	U	f	u	F	U
07	g	v	G	V	g	v	G	V	g	v	G	V
08	h	x	H	X	h	x	H	X	h	x	H	X
09	j	y	J	Y	j	y	J	Y	j	y	J	Y
10	k	z	K	Z	k	z	K	Z	k	z	K	Z
11	l	2	L	4	l	2	L	4	l	2	L	4
12	n	3	N	5	n	3	N	5	n	3	N	5

Figure 6 Date Code Marking TSNP-6-10

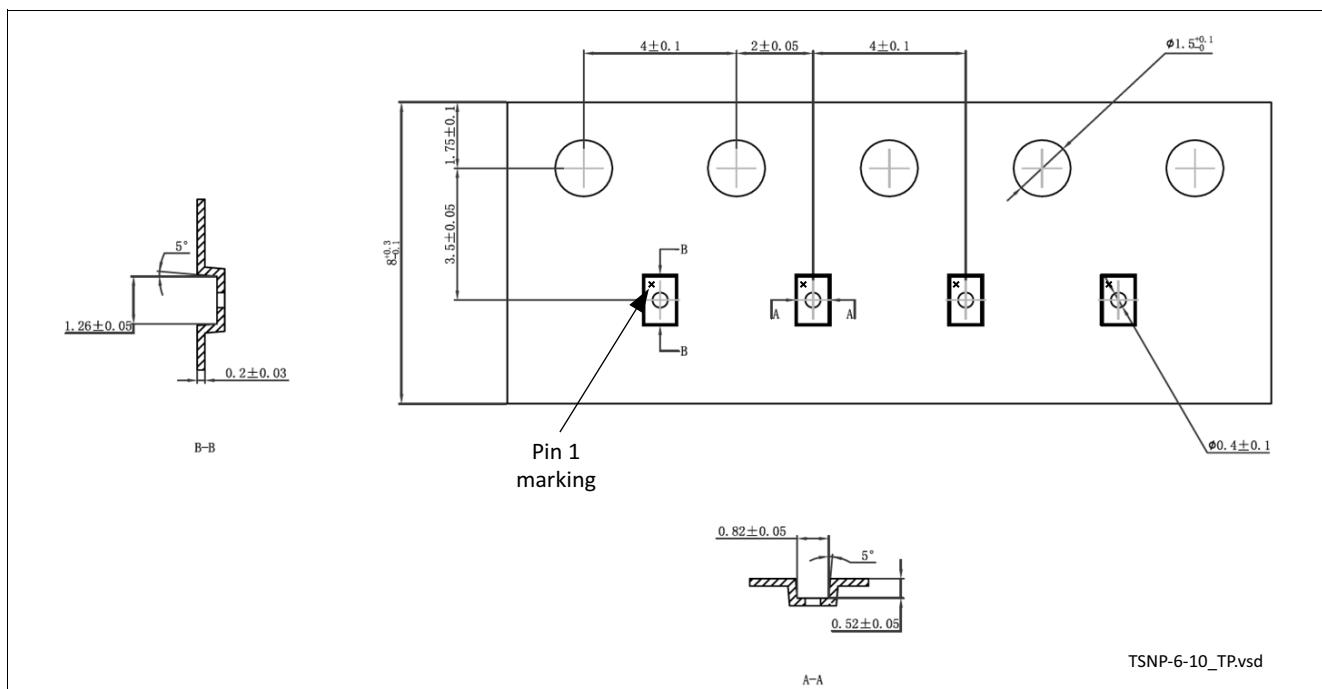


Figure 7 Tape &amp; Reel Dimensions TSNP-6-10 (reel diameter 180 mm, pieces/reel 12000)

**Revision History**

Page or Item	Subjects (major changes since previous revision)
--------------	--------------------------------------------------

**Revision 2.2, 2018-03-15**

5	Update Maximum Ratings

## Other Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

**Edition 2018-03-15**

**Published by**

**Infineon Technologies AG  
81726 Munich, Germany**

**© 2018 Infineon Technologies AG.  
All Rights Reserved.**

**Do you have a question about any aspect of this document?**

**Email: [erratum@infineon.com](mailto:erratum@infineon.com)**

## IMPORTANT NOTICE

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office ([www.infineon.com](http://www.infineon.com)).

## WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.