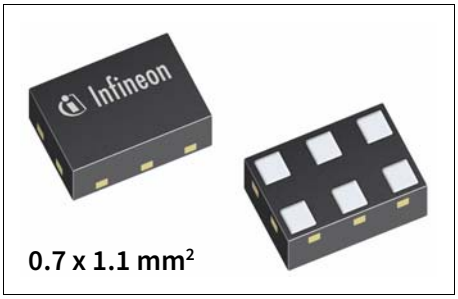
BGA8U1BN6

Low Noise Amplifier for Ultra High Band 4-6GHz (f.e. LTE - U/ LAA with bypass)

Features

- Operating frequencies: 4.0 - 6.0 GHz
- Insertion power gain: 13.7 dB
- Insertion Loss in bypass mode: 7.5 dB
- Low noise figure: 1.6 dB
- Low current consumption: 4.5 mA
- Multi-state control: OFF-, bypass- and high gain-Mode
- Ultra small TSNP-6-2 leadless package
- RF input and RF output internally matched to 50 Ohm, no external components necessary



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.

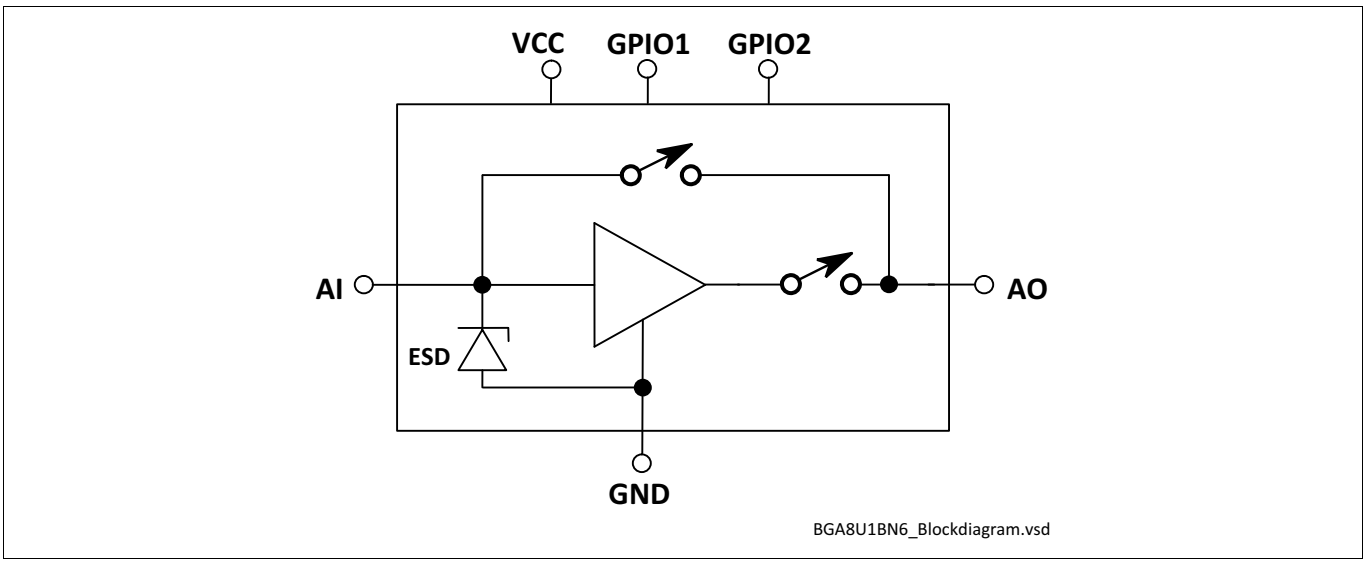
In high gain mode the LNA offers best Noise Figure to ensure high data rates even on the LTE cell edge. Closer to the basestation the bypass mode can be activated reducing current consumption.

The BGA8U1BN6 is designed for the inlicensed LTE spectrum (4-6GHz) part of the 3GPP Release 13.

Product Validation

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

Block diagram



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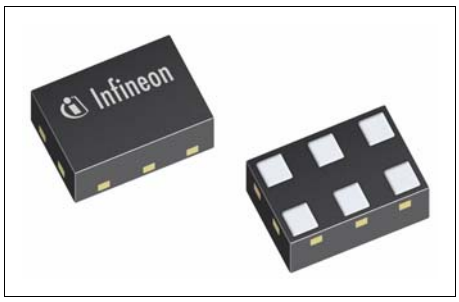
1 Features



- Insertion power gain: 13.7 dB
- Insertion Loss in bypass mode: 7.5 dB
- Low noise figure: 1.6 dB
- Low current consumption: 4.5 mA
- Operating frequencies: 4.0 - 6.0 GHz
- Multi-state control: OFF-, bypass- and high gain-Mode
- Supply voltage: 1.6 V to 3.1 V
- Ultra small TSNP-6-2 leadless package (footprint: 0.7 x 1.1 mm^2)
- B9HF Silicon Germanium technology
- RF input and RF output internally matched to 50 Ohm
- No external SMD components necessary
- 2kV HBM ESD protection (including AI-pin)
- Pb-free (RoHS compliant) package

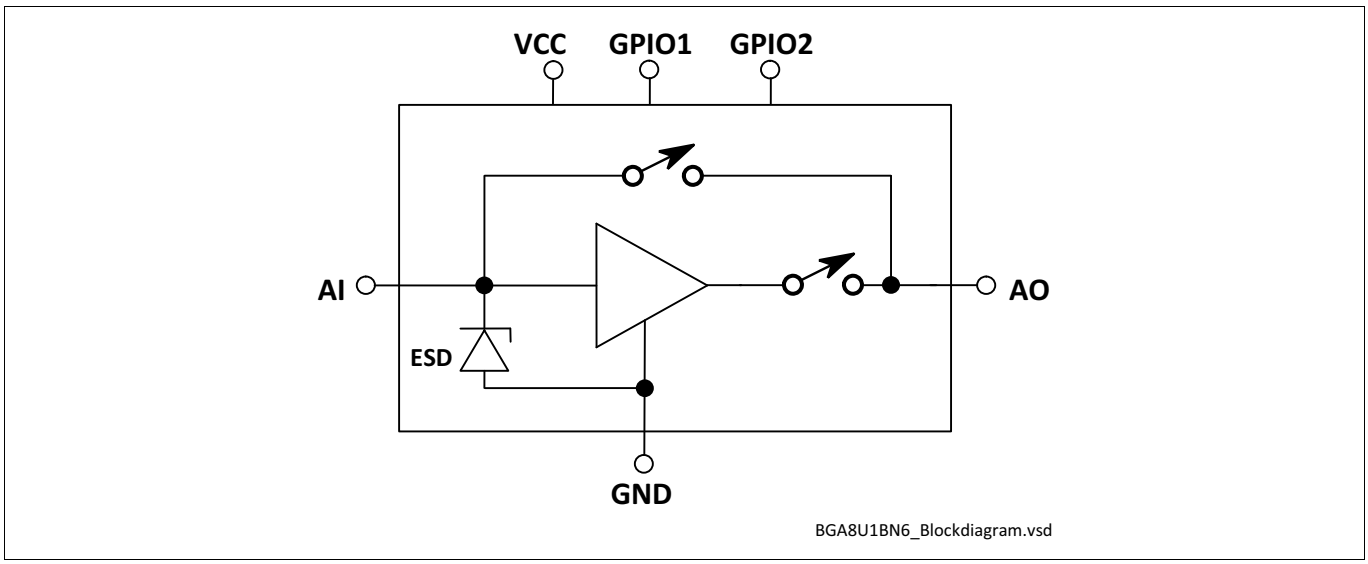


Figure 1 Block Diagram

Product Name	Marking	Package
BGA8U1BN6	Y	TSNP-6-2

Features

Description

The BGA8U1BN6 is a front-end low noise amplifier for LTE which covers a wide frequency range from 4.0 GHz to 6.0 GHz. The LNA provides 13.7 dB gain and 1.6 dB noise figure at a current consumption of 4.5 mA in the application configuration described in **Chapter 4**. In bypass mode the LNA provides an insertion loss of 7.5 dB. The BGA8U1BN6 is based upon Infineon Technologies' B7HF Silicon Germanium technology. It operates from 1.6 V to 3.1 V supply voltage. The device features a multi-state control (OFF-, bypass- and high gain-Mode).

Pin Definition and Function

Table 1 Pin Definition and Function

Pin No.	Name	Function
1	GPIO2	Control pin 2
2	VCC	DC supply
3	AO	LNA output
4	GPIO1	Control pin 1
5	GND	Ground
6	AI	LNA input

Control Table

Table 2 Control Table

	GPIO1	GPIO2
OFF	Low	Low
	High	Low
Bypass mode	Low	High
High gain mode	High	High

2 Maximum Ratings

Table 3 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 GPIO pins	V_{GPIO}	-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 °C 2)	P_{tot}	–	–	60	mW	–
Junction temperature	T_J	–	–	150	°C	–
Ambient temperature range	T_A	-40	–	85	°C	–
Storage temperature range	T_{STG}	-65	–	150	°C	–
ESD capability all pins	V_{ESD_HBM}	-2000	-	+2000	V	according to JS-001

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.***

3 Electrical Characteristics

Table 4 Electrical Characteristics[1)]

T_A = 25 °C, V_{CC} = 1.8 V, $V_{GPIOx,ON}$ = 1.8 V, $V_{GPIOx,OFF}$ = 0 V, f = 4000 - 6000 MHz

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	1.6	1.8	3.1	V	–
Control voltages	V_{GPIOx}	1.0	–	V_{CC}	V	High
		0	–	0.4	V	Low
Supply current	I_{CC}	–	4.3	5.3	mA	High gain mode
		–	85	120	µA	Bypass mode
		–	0.1	2	µA	OFF-Mode
Insertion power gain f = 5500 MHz	$\|S_{21}\|^2$	10.9	13.4	15.9	dB	High gain mode
		-9.5	-7.5	-5.5	dB	Bypass mode
Noise figure[2)] f = 5500 MHz, Z_S = 50 Ω	NF	–	1.65	2.55	dB	High gain mode
		–	7.5	9.5	dB	Bypass mode
Input return loss[3)] f = 5500 MHz	RL_{IN}	9	13	–	dB	High gain mode
		7	11	–	dB	Bypass mode
Output return loss[3)] f = 5500 MHz	RL_{OUT}	12	20	–	dB	High gain mode
		3	4	–	dB	Bypass mode
Reverse isolation[3)] f = 5500 MHz	$1/\|S_{12}\|^2$	20	28	–	dB	High gain mode
		5.5	7.5	–	dB	Bypass mode
Transient time C_1 = 1 nF[4)6)]	t_S	–	0.3	3	µs	High gain- to bypass-mode
		–	12	15	µs	Bypass- to High gain-mode
Transient time C_1 = 33 pF[4)6)]	t_S	–	0.3	3	µs	High gain- to bypass-mode
		–	1	3	µs	Bypass- to High gain-mode
Inband input 1dB-compression point, f = 5500 MHz[3)]	IP_{1dB}	-22	-18	–	dBm	High gain mode
		-8	-4	–	dBm	Bypass mode
Inband input 3rd-order intercept point[3)5)] f_1 = 5500 MHz, f_2 = f_1 +/- 1 MHz	IIP_3	-16	-11	–	dBm	High gain mode C_1 = 1 nF
		-1	4	–	dBm	Bypass mode C_1 = 1 nF
Phase discontinuity between ON- and bypass-mode[3)]		-6	–	6	°	Part to part variation after compensation in Base Band with constant value
Stability[6)]	k	> 1	–	–		f = 20 MHz ... 10 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) To be within 1 dB of the final gain
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

Table 5 Electrical Characteristics[1)]

T_A = 25 °C, V_{CC} = 2.8 V, $V_{GPIOx,ON}$ = 2.8 V, $V_{GPIOx,OFF}$ = 0 V, f = 4000 - 6000 MHz

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	1.6	2.8	3.1	V	–
Control voltages	V_{GPIOx}	1.0	–	V_{CC}	V	High
		0	–	0.4	V	Low
Supply current	I_{CC}	–	4.5	5.5	mA	High gain mode
		–	85	120	µA	Bypass mode
		–	0.1	2	µA	OFF-Mode
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Input return loss[3)] f = 5500 MHz	RL_{IN}	9	13	–	dB	High gain mode
		7	11	–	dB	Bypass mode
Output return loss[3)] f = 5500 MHz	RL_{OUT}	12	20	–	dB	High gain mode
		3	4	–	dB	Bypass mode
Reverse isolation[3)] f = 5500 MHz	$1/\|S_{12}\|^2$	20	28	–	dB	High gain mode
		5.5	7.5	–	dB	Bypass mode
Transient time C_1 = 1 nF[4)6)]	t_S	–	0.3	3	µs	High gain- to bypass-mode
		–	7	10	µs	Bypass- to High gain-mode
Transient time C_1 = 33 pF[4)6)]	t_S	–	0.3	3	µs	High gain- to bypass-mode
		–	0.9	3	µs	Bypass- to High gain-mode
Inband input 1dB-compression point, f = 5500 MHz[3)]	IP_{1dB}	-22	-18	–	dBm	High gain mode
		-8	-4	–	dBm	Bypass mode
Inband input 3rd-order intercept point[3)5)] f_1 = 5500 MHz, f_2 = f_1 +/- 1 MHz	IIP_3	-15	-10	–	dBm	High gain mode C_1 = 1 nF
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Phase discontinuity between ON- and bypass-mode[3)]		-6	–	6	°	Part to part variation after compensation in Base Band with constant value
Stability[6)]	k	> 1	–	–		f = 20 MHz ... 10 GHz

1) Based on the application described in chapter 4
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1 Application Information

Application Board Configuration

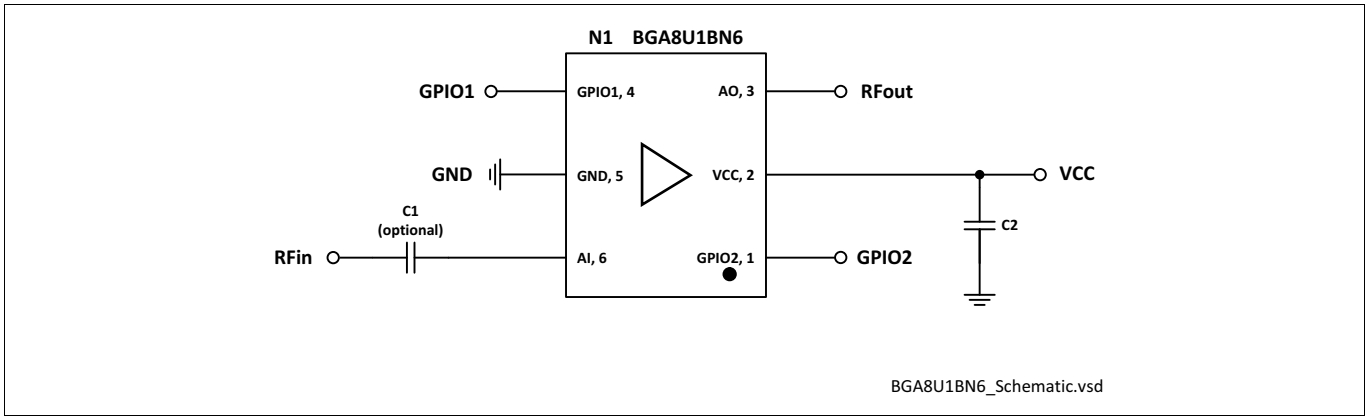

Figure 1 Application Schematic BGA8U1BN6

Table 1 Bill of Materials

Name	Value	Package	Manufacturer	Function
C1 (optional)	1nF/33pF	0402	Various	DC block[1)]
C2 (optional)	≥ 1nF	0402	Various	RF bypass[2)]
N1	BGA8U1BN6	TSNP-6-2	Infineon	SiGe LNA

1) No external DC block is needed if there is pre-filter implemented. DC block capacitor of less or equal than 100 pF is recommended to reduce the switching time during the mode transition.

2) RF bypass recommended to mitigate power supply noise

A list of all application notes is available at **http://www.infineon.com/ltelna**

1 Package Information

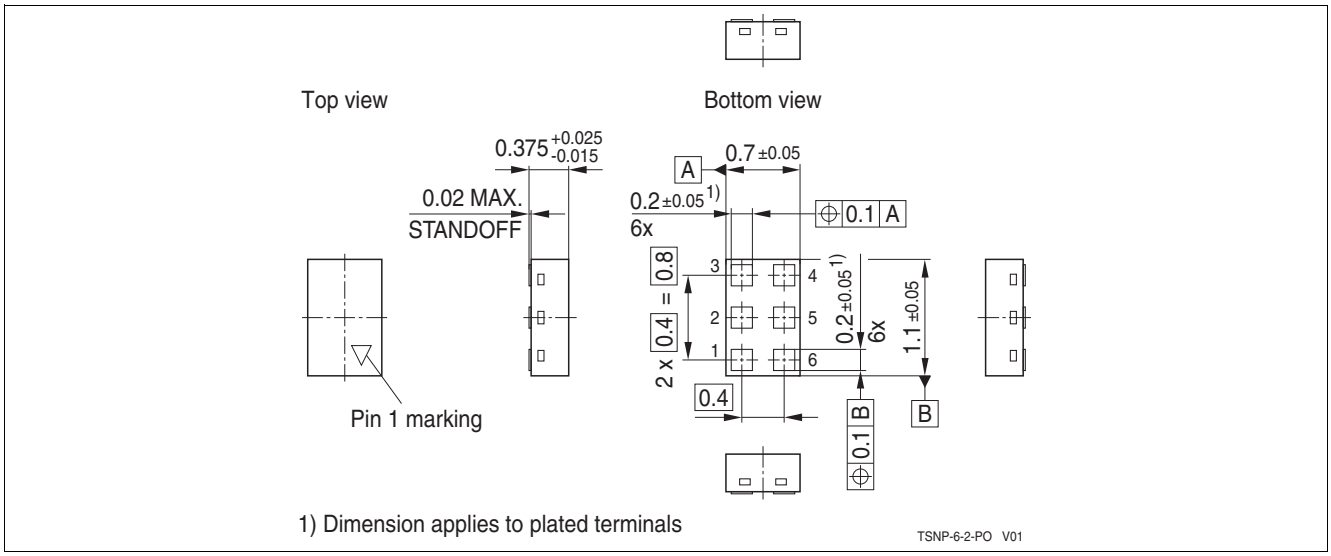

Figure 1 TSNP-6-2 Package Outline (top, side and bottom views)

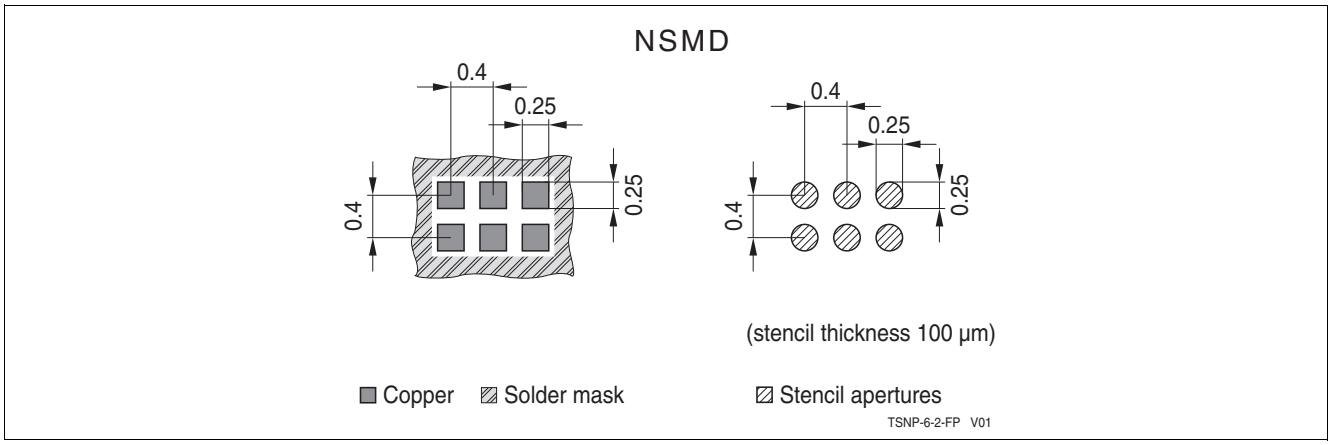

Figure 2 Footprint Recommendation TSNP-6-2

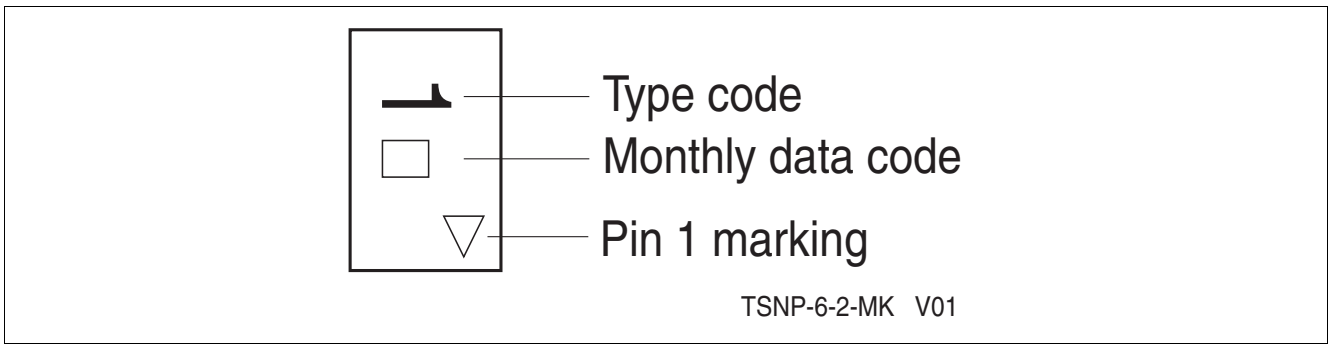

Figure 3 Marking Layout (top view)

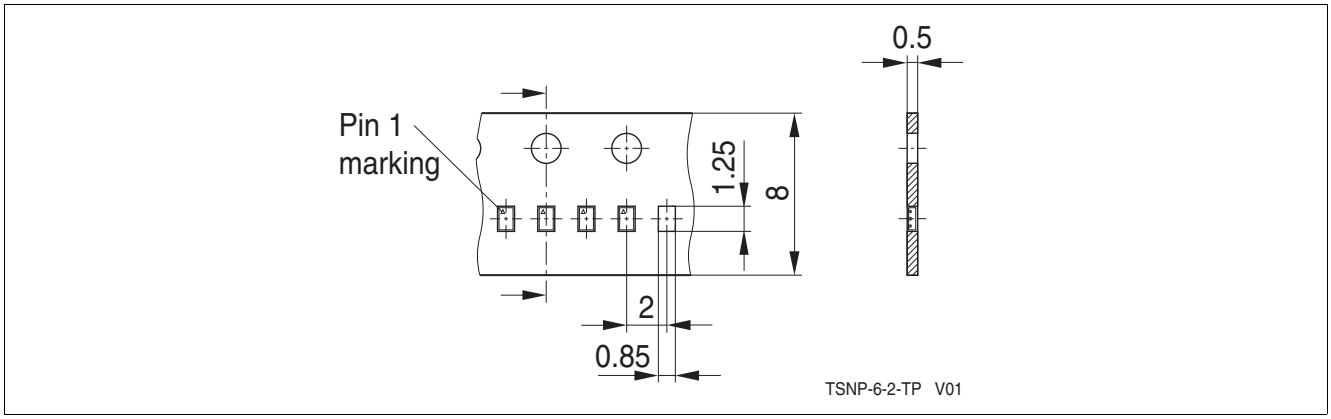

Figure 4 Tape & Reel Dimensions (reel diameter 180 mm, pieces/reel 15000)

Revision History	
Page or Item	**Subjects (major changes since previous revision)**
Revision 3.2, 2021-04-19	
6	Add Electrical Characterisation for Vcc=1.8V
7	Update Transient Time Information
8	Update Application Information

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Edition 2021-04-19
Published by
Infineon Technologies AG
81726 Munich, Germany

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