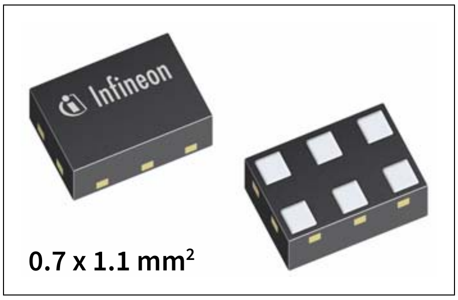
BGA824N6

Silicon Germanium Low Noise Amplifier for Global Navigation Satellite Systems (GNSS)

Features

- Operating frequencies: 1164 - 1615 MHz
- Insertion power gain: 17.0 dB
- Input 1 dB compression point: -6 dBm
- Low noise figure: 0.55 dB
- Low current consumption: 3.8 mA
- Digital on/off switch (1V logic level high)
- Ultra small TSNP-6-2 and TSNP-6-10 leadless package
- RF output internally matched to 50 Ohm
- Low external component count



Application

Ideal for all Global Navigation Satellite Systems (GNSS) like GPS, GLONASS, Beidou, Galileo and others.

Product Validation

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

Block diagram

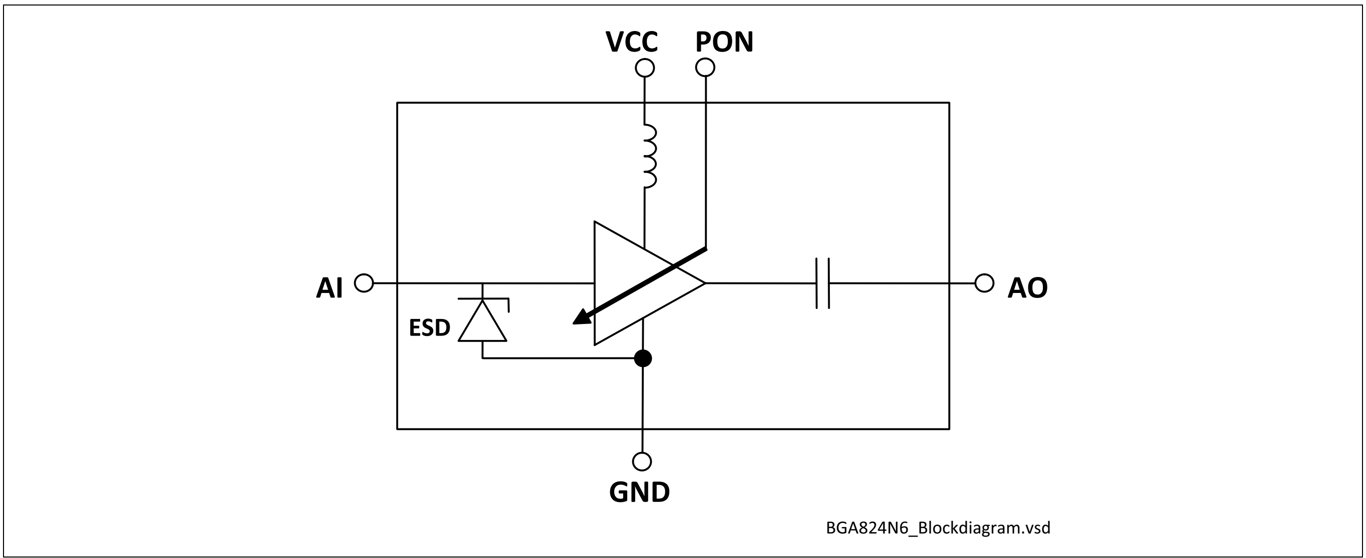
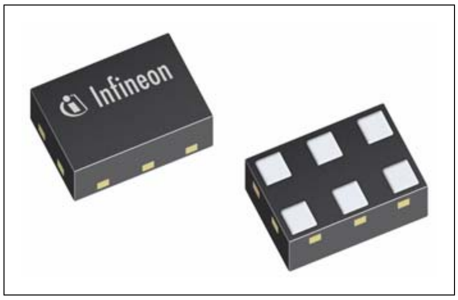


Table of Contents

1 Features

- Insertion power gain: 17.0 dB
- Out-of-band input 3rd order intercept point: +7 dBm
- Input 1 dB compression point: -6 dBm
- Low noise figure: 0.55 dB
- Low current consumption: 3.8 mA
- Operating frequencies: 1164 - 1615 MHz
- Digital on/off switch (1V logic level high)
- Supply voltage: 1.5 V to 3.6 V
- Ultra small TSNP-6-2 and TSNP-6-10 leadless package (footprint: 0.7 x 1.1 mm^2)
- B7HF Silicon Germanium technology
- RF output internally matched to 50 Ohm
- Low external component count
- 2kV HBM ESD protection (including AI-pin)
- Pb-free (RoHS compliant) package



RoHS

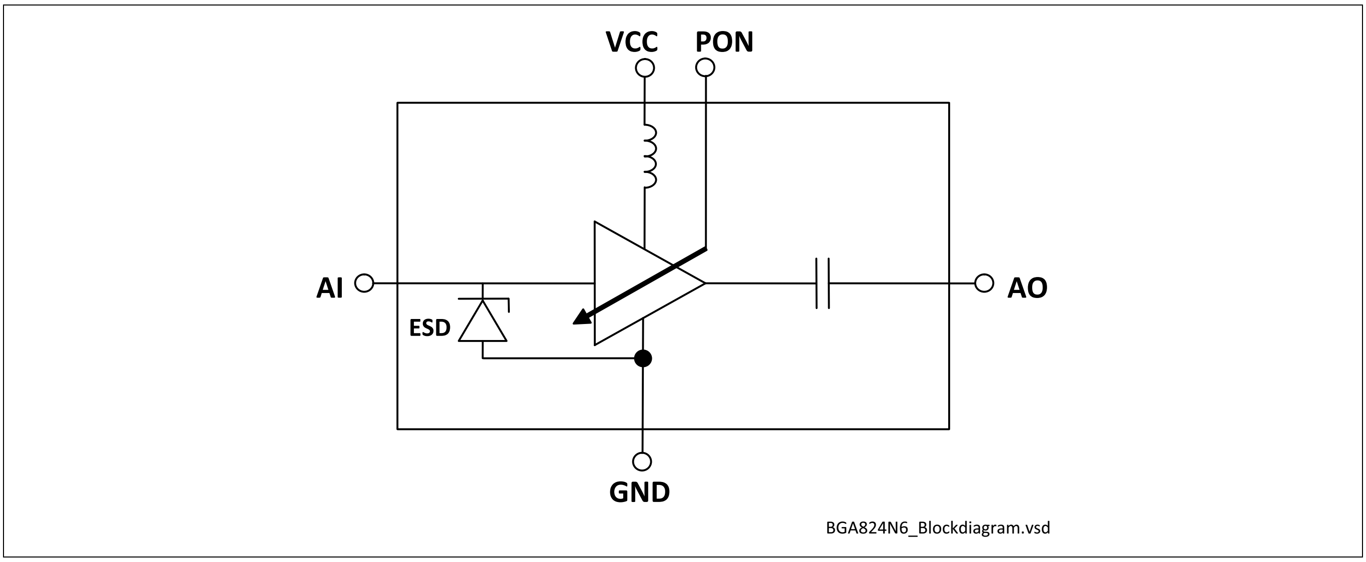


Figure 1 Block Diagram

Product Name	Marking	Package
BGA824N6	F	TSNP-6-2/TSNP-6-10

Features

Description

The BGA824N6 is a front-end low noise amplifier for Global Navigation Satellite Systems (GNSS) from 1164 MHz to 1615 MHz like GPS, GLONASS, Beidou, Galileo and others. The LNA provides 17.0 dB gain and 0.55 dB noise figure at a current consumption of 3.8 mA in the application configuration described in **Chapter 4**. The BGA824N6 is based upon Infineon Technologies' B7HF Silicon Germanium technology. It operates from 1.5 V to 3.6 V supply voltage.

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	PON	Power on control

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 PON	V_{PON}	-0.3	–	V_{CC} + 0.3	V	–
Voltage at pin GNDRF	V_{GNDRF}	-0.3	–	0.3	V	–
Current into pin VCC	I_{CC}	–	–	23	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}	-55	–	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.***

Thermal Resistance

Table 3 Thermal Resistance

Parameter	Symbol	Value	Unit
Junction - soldering point[1)]	R_{thJS}	25	K/W

1) For calculation of R_{thJA} please refer to Application Note Thermal Resistance

3 Electrical Characteristics

Table 4 Electrical Characteristics f = 1550 - 1615 MHz, V_{CC} = 1.8V[1)]

T_A = 25 °C, V_{CC} = 1.8 V, $V_{PON,ON}$ = 1.8 V, $V_{PON,OFF}$ = 0 V, f = 1550 - 1615 MHz

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	1.5	1.8	3.6	V	–
Supply current	I_{CC}	–	3.8	4.8	mA	ON-mode
		–	0.2	3	µA	OFF-mode
Power On voltage	V_{PON}	1.0	–	Vcc	V	ON-mode
		0	–	0.4	V	OFF-mode
Power On current	I_{PON}	–	5	10	µA	ON-mode
		–	–	1	µA	OFF-mode
Insertion power gain f = 1575 MHz	$\|S_{21}\|^2$	16.0	17.0	18.0	dB	–
Noise figure[2)] f = 1575 MHz	NF	–	0.55	1.1	dB	–
Input return loss[3)] f = 1575 MHz	RL_{IN}	10	14	–	dB	–
Output return loss[3)] f = 1575 MHz	RL_{OUT}	10	17	–	dB	–
Reverse isolation[3)] f = 1575 MHz	$1/\|S_{12}\|^2$	19	23	–	dB	–
Power gain settling time[4)5)]	t_S	–	5	8	µs	OFF- to ON-mode
		–	5	8	µs	ON- to OFF-mode
		–	1.2	3	µs	OFF- to ON-mode[6)]
		–	0.9	3	µs	ON- to OFF-mode[6)]
Inband input 1dB-compression point[3)] f = 1575 MHz	IP_{1dB}	-13	-9	–	dBm	–
Inband input 3rd-order intercept point[3)7)]	IIP_3	-3	+2	–	dBm	f_1 = 1575 MHz $f_2 = f_1$ +/- 1 MHz
Out-of-band input 3rd-order intercept point[5)8)]	IIP_{3OOB}	+2	+7	–	dBm	f_1 = 1712.7 MHz f_2 = 1850 MHz
Stability[5)]	k	> 1	–	–		f = 20 MHz ... 10 GHz

1) Based on the application described in Figure 2 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 OFF- to ON-mode; to be within 3 dB of the final gain ON- to OFF-mode
5) Guaranteed by device design; not tested in production
6) 120 pF DC block capacitor at RF input
7) Input power = -30 dBm for each tone
8) Input power = -20 dBm for each tone

Table 5 Electrical Characteristics f = 1550 - 1615 MHz, V_{CC} = 2.8V[1)]

T_A = 25 °C, V_{CC} = 2.8 V, $V_{PON,ON}$ = 2.8 V, $V_{PON,OFF}$ = 0 V, f = 1550 - 1615 MHz

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	1.5	2.8	3.6	V	–
Supply current	I_{CC}	–	3.9	4.9	mA	ON-mode
		–	0.2	3	µA	OFF-mode
Power On voltage	V_{PON}	1.0	–	Vcc	V	ON-mode
		0	–	0.4	V	OFF-mode
Power On current	I_{PON}	–	10	15	µA	ON-mode
		–	–	1	µA	OFF-mode
Insertion power gain f = 1575 MHz	$\|S_{21}\|^2$	16.1	17.1	18.1	dB	–
Noise figure[2)] f = 1575 MHz	NF	–	0.55	1.1	dB	–
Input return loss[3)] f = 1575 MHz	RL_{IN}	10	15	–	dB	–
Output return loss[3)] f = 1575 MHz	RL_{OUT}	10	18	–	dB	–
Reverse isolation[3)] f = 1575 MHz	$1/\|S_{12}\|^2$	19	23	–	dB	–
Power gain settling time[4)5)]	t_S	–	5	8	µs	OFF- to ON-mode
		–	5	8	µs	ON- to OFF-mode
		–	1.2	3	µs	OFF- to ON-mode[6)]
		–	0.9	3	µs	ON- to OFF-mode[6)]
Inband input 1dB-compression point[3)] f = 1575 MHz	IP_{1dB}	-10	-6	–	dBm	–
Inband input 3rd-order intercept point[3)7)]	IIP_3	-2	+3	–	dBm	f_1 = 1575 MHz $f_2 = f_1$ +/- 1 MHz
Out-of-band input 3rd-order intercept point[5)8)]	IIP_{3OOB}	+2	+7	–	dBm	f_1 = 1712.7 MHz f_2 = 1850 MHz
Stability[5)]	k	> 1	–	–		f = 20 MHz ... 10 GHz

1) Based on the application described in Figure 2 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 OFF- to ON-mode; to be within 3 dB of the final gain ON- to OFF-mode
5) Guaranteed by device design; not tested in production
6) 120 pF DC block capacitor at RF input
7) Input power = -30 dBm for each tone
8) Input power = -20 dBm for each tone

Table 6 Electrical Characteristics f = 1164 - 1300 MHz, V_{CC} = 1.8V[1]

T_A = 25 °C, V_{CC} = 1.8 V, $V_{PON,ON}$ = 1.8 V, $V_{PON,OFF}$ = 0 V, f = 1164 - 1300 MHz

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	1.5	1.8	3.6	V	–
Supply current	I_{CC}	–	3.8	4.8	mA	ON-mode
		–	0.2	3	µA	OFF-mode
Power On voltage	V_{PON}	1.0	–	Vcc	V	ON-mode
		0	–	0.4	V	OFF-mode
Power On current	I_{PON}	–	5	10	µA	ON-mode
		–	–	1	µA	OFF-mode
Insertion power gain f = 1214 MHz	$\|S_{21}\|^2$	16.4	17.9	19.4	dB	–
Noise figure[2] f = 1214 MHz	NF	–	0.70	1.25	dB	–
Input return loss[3] f = 1214 MHz	RL_{IN}	10	15	–	dB	–
Output return loss[3] f = 1214 MHz	RL_{OUT}	10	18	–	dB	–
Reverse isolation[3] f = 1214 MHz	$1/\|S_{12}\|^2$	19	25	–	dB	–
Power gain settling time[4)5]	t_S	–	5	8	µs	OFF- to ON-mode
		–	5	8	µs	ON- to OFF-mode
		–	1.2	3	µs	OFF- to ON-mode[6]
		–	0.9	3	µs	ON- to OFF-mode[6]
Inband input 1dB-compression point[3] f = 1214 MHz	IP_{1dB}	-16	-12	–	dBm	–
Inband input 3rd-order intercept point[3,7]	IIP_3	-11	-6	–	dBm	f_1 = 1214 MHz $f_2 = f_1$ +/- 1 MHz
Out-of-band input 3rd-order intercept point[5,8]	IIP_{3OOB}	-3	+1.3		dBm	f_1 = 1850 MHz f_2 = 2500 MHz
Stability[5]	k	> 1	–	–		f = 20 MHz ... 10 GHz

1) Based on the application described in Figure 3 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 OFF- to ON-mode; to be within 3 dB of the final gain ON- to OFF-mode
5) Guaranteed by device design; not tested in production
6) 120 pF DC block capacitor at RF input
7) Input power = -30 dBm for each tone
8) Input power = -25 dBm for each tone

Table 7 Electrical Characteristics f = 1164 - 1300 MHz, V_{CC} = 2.8V[1)]

T_A = 25 °C, V_{CC} = 2.8 V, $V_{PON,ON}$ = 2.8 V, $V_{PON,OFF}$ = 0 V, f = 1164 - 1300 MHz

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	1.5	2.8	3.6	V	–
Supply current	I_{CC}	–	3.9	4.8	mA	ON-mode
		–	0.2	3	µA	OFF-mode
Power On voltage	V_{PON}	1.0	–	Vcc	V	ON-mode
		0	–	0.4	V	OFF-mode
Power On current	I_{PON}	–	10	15	µA	ON-mode
		–	–	1	µA	OFF-mode
Insertion power gain f = 1214 MHz	$\|S_{21}\|^2$	16.5	18.0	19.5	dB	–
Noise figure[2)] f = 1214 MHz	NF	–	0.70	1.25	dB	–
Input return loss[3)] f = 1214 MHz	RL_{IN}	10	16	–	dB	–
Output return loss[3)] f = 1214 MHz	RL_{OUT}	10	18	–	dB	–
Reverse isolation[3)] f = 1214 MHz	$1/\|S_{12}\|^2$	19	26	–	dB	–
Power gain settling time[4)5)]	t_S	–	5	8	µs	OFF- to ON-mode
		–	5	8	µs	ON- to OFF-mode
		–	1.2	3	µs	OFF- to ON-mode[6)]
		–	0.9	3	µs	ON- to OFF-mode[6)]
Inband input 1dB-compression point[3)] f = 1214 MHz	IP_{1dB}	-13	-9	–	dBm	–
Inband input 3rd-order intercept point[3)7)]	IIP_3	-10	-5	–	dBm	f_1 = 1214 MHz $f_2 = f_1$ +/- 1 MHz
Out-of-band input 3rd-order intercept point[5)8)]	IIP_{3OOB}	-3	+1.3		dBm	f_1 = 1850 MHz f_2 = 2500 MHz
Stability[5)]	k	> 1	–	–		f = 20 MHz ... 10 GHz

1) Based on the application described in Figure 3 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 OFF- to ON-mode; to be within 3 dB of the final gain ON- to OFF-mode
5) Guaranteed by device design; not tested in production
6) 120 pF DC block capacitor at RF input
7) Input power = -30 dBm for each tone
8) Input power = -25 dBm for each tone

4 Application Information

Application Board Configuration f = 1550 - 1615 MHz

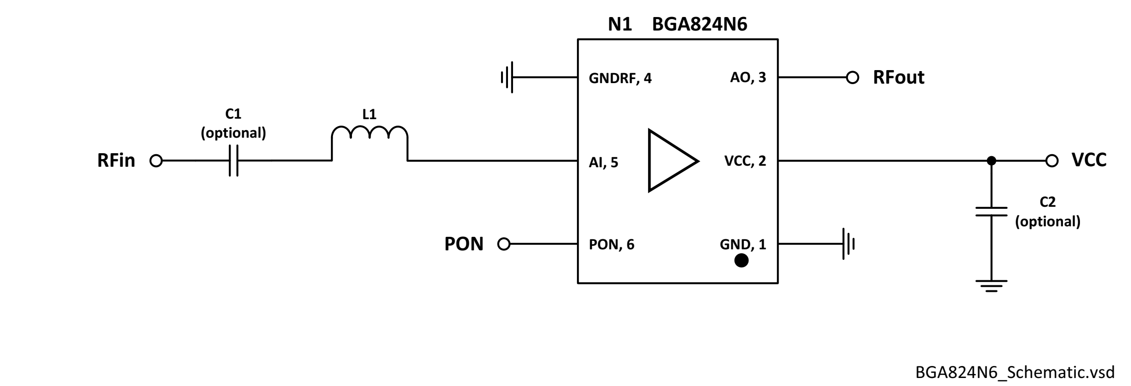


Figure 2 Application Schematic BGA824N6 f = 1550 - 1615 MHz

Table 8 Bill of Materials

Name	Value	Package	Manufacturer	Function
C1 (optional)	1nF	0402	Various	DC block[1)]
C2 (optional)	≥ 10nF[2)]	0402	Various	RF bypass [3)]
L1	6.8nH	0402	Murata LQW type	Input matching
N1	BGA824N6	TSNP-6-2 and TSNP-6-10	Infineon	SiGe LNA

1) DC block might be realized with pre-filter in GNSS application
2) For data sheet characteristics 1µF used
3) RF bypass recommended to mitigate power supply noise

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

Application Board Configuration f = 1164 - 1300 MHz

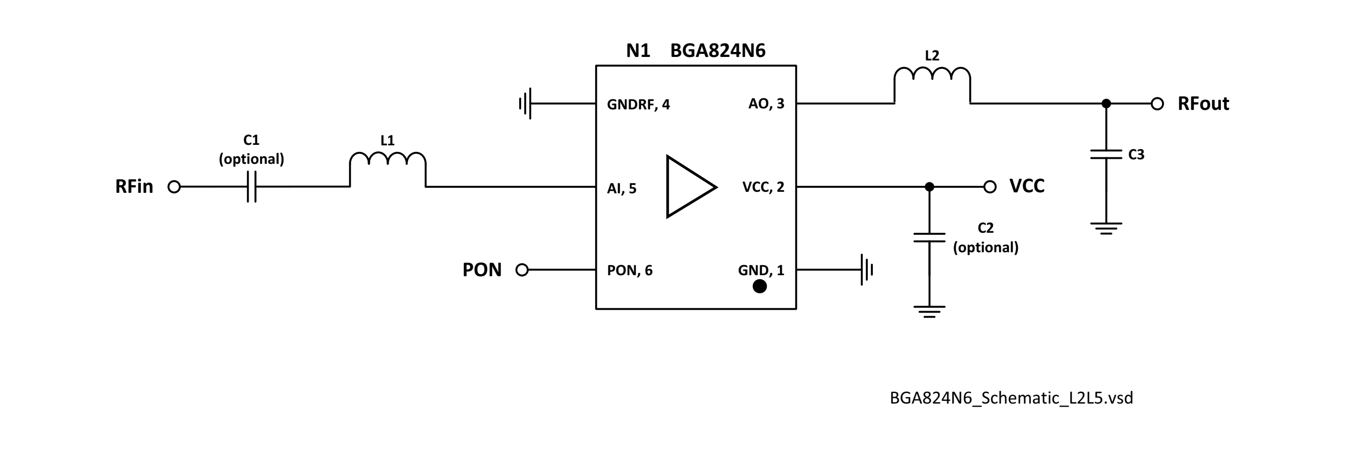


Figure 3 Application Schematic BGA824N6 f = 1164 - 1300 MHz

Table 9 Bill of Materials

Name	Value	Package	Manufacturer	Function
C1 (optional)	1nF	0402	Various	DC block[1)]
C2 (optional)	≥ 10nF[2)]	0402	Various	RF bypass [3)]
C3	3.9pF	0402	Various	Output matching
L1	12nH	0402	Murata LQW type	Input matching
L2	3.9nH	0402	Murata LQW type	Output matching
N1	BGA824N6	TSNP-6-2 and TSNP-6-10	Infineon	SiGe LNA

1) DC block might be realized with pre-filter in GNSS application
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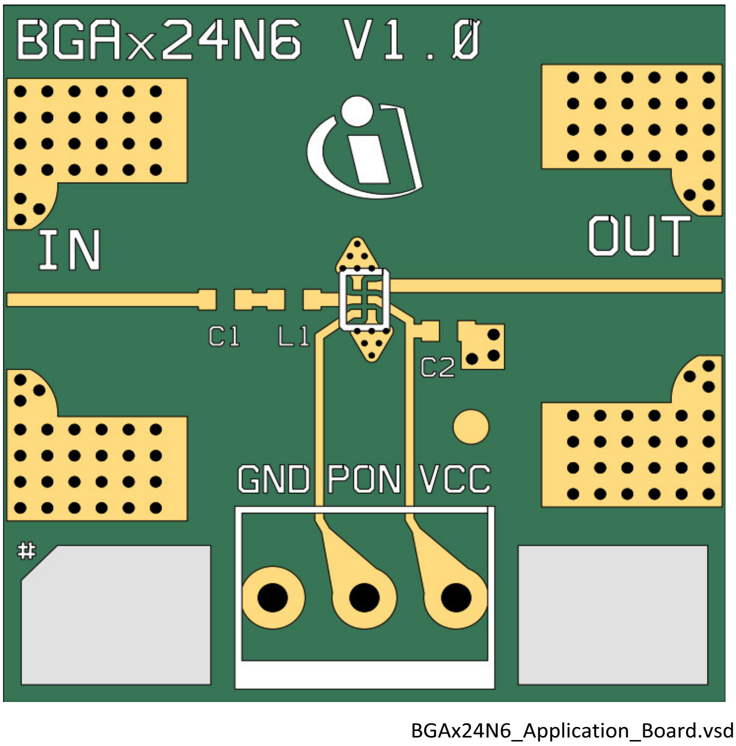

Figure 4 Drawing of Application Board

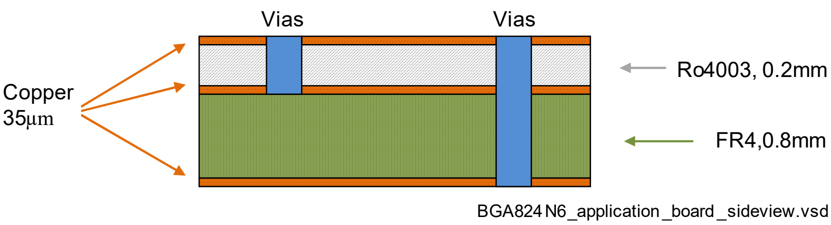

Figure 5 Application Board Cross-Section

5 Package Information

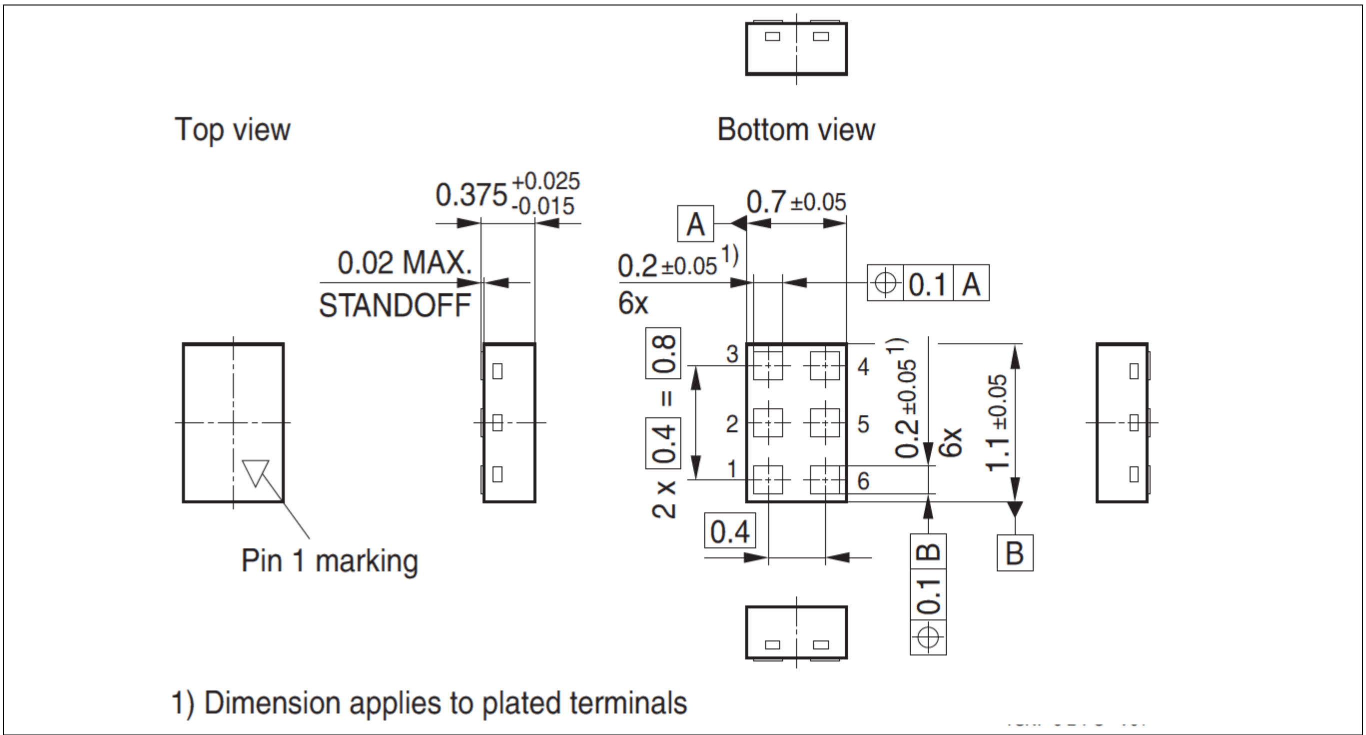

Figure 6 **TSNP-6-2 Package Outline** (top, side and bottom views)

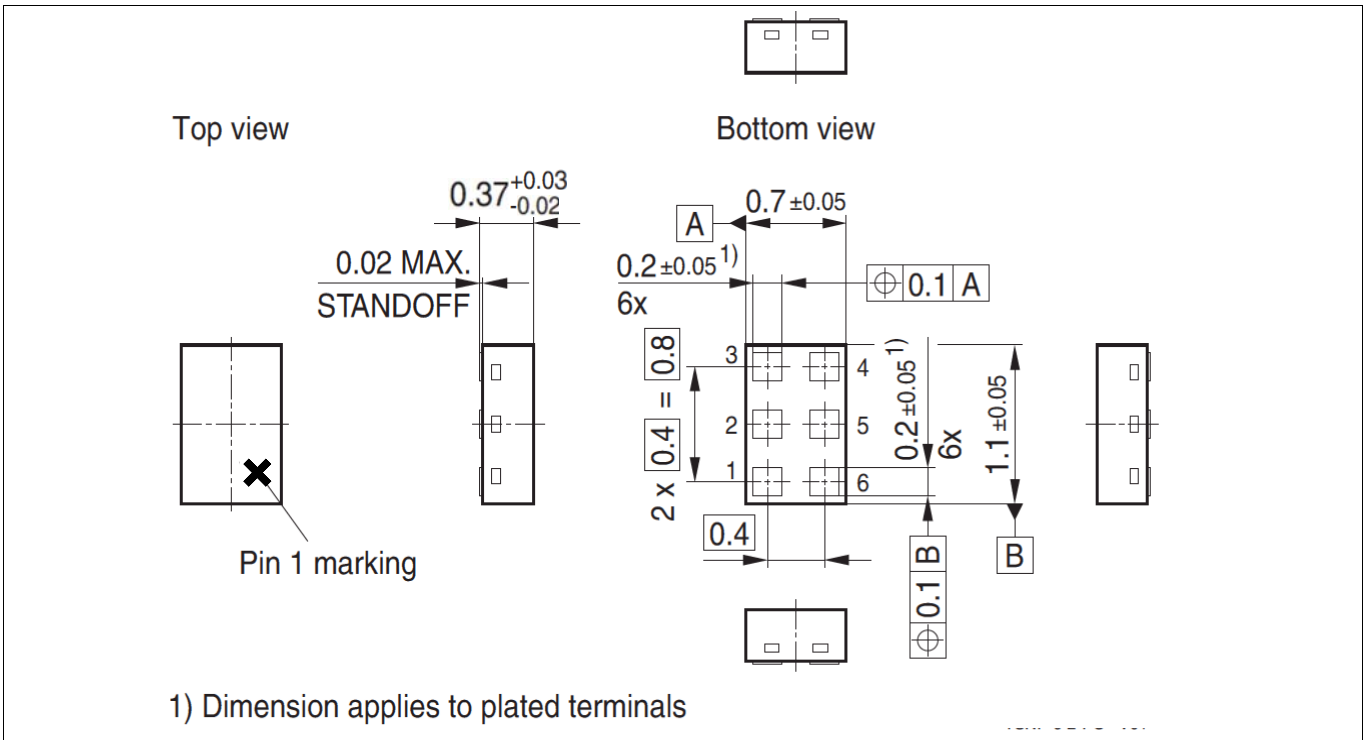

Figure 7 **TSNP-6-10 Package Outline** (top, side and bottom views)

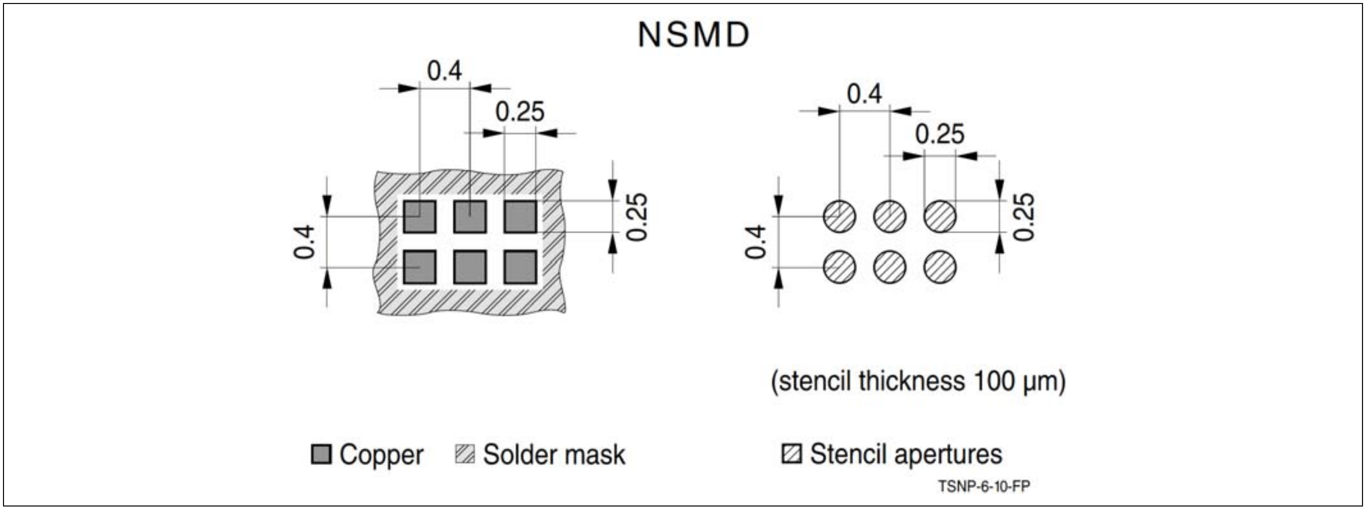

Figure 8 Footprint Recommendation TSNP-6-2 and TSNP-6-10

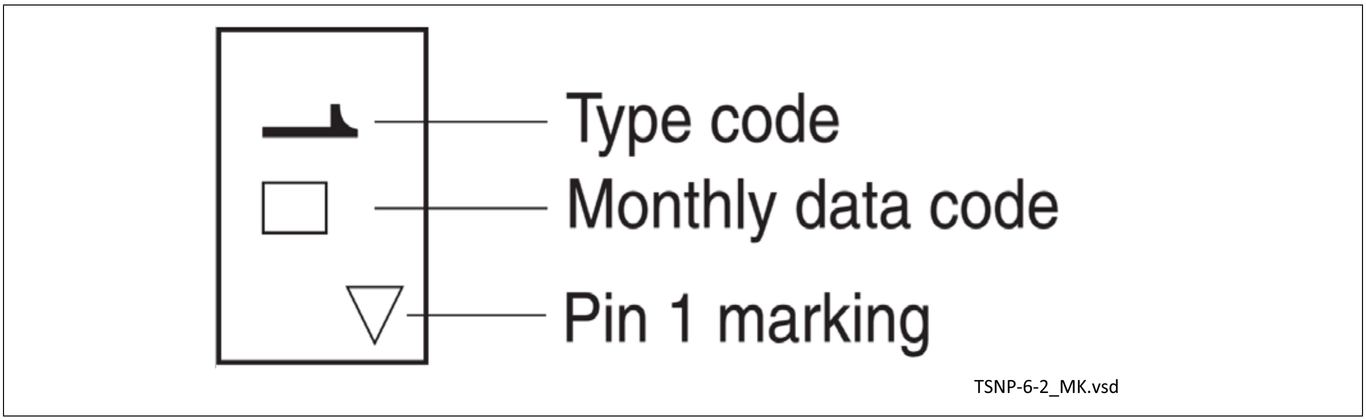

Figure 9 Marking Layout TSNP-6-2 (top view)

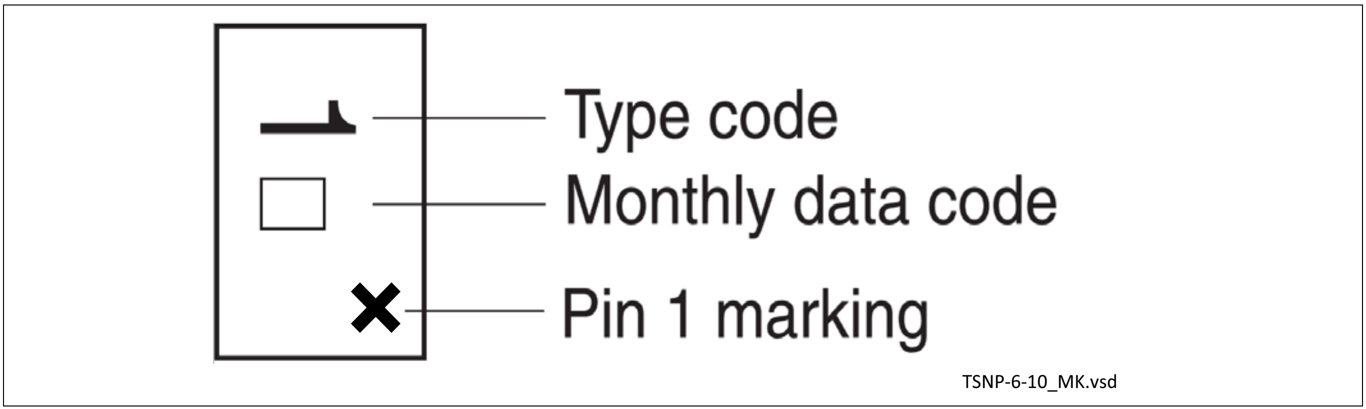

Figure 10 Marking Layout TSNP-6-10 (top view)

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 11 Date Code Marking TSNP-6-2 and TSNP-6-10

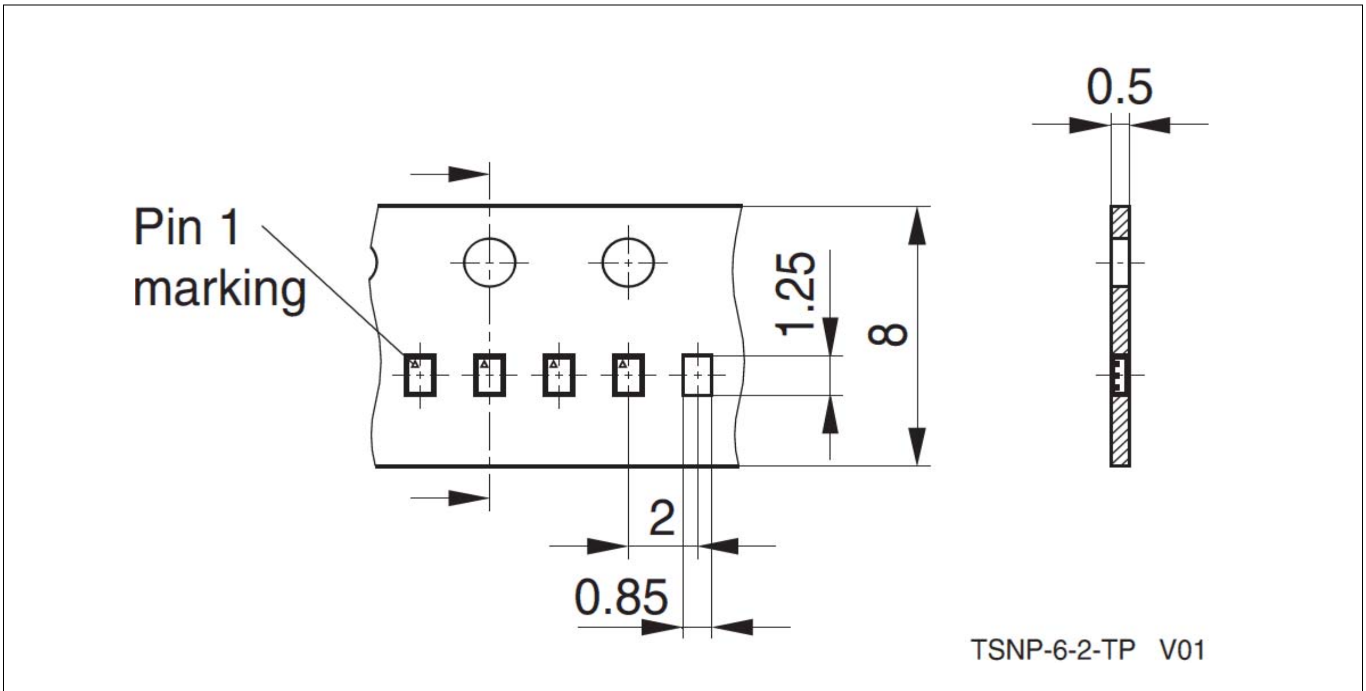

Figure 12 Tape & Reel Dimensions TSNP-6-2 (reel diameter 180 mm, pieces/reel 15000)

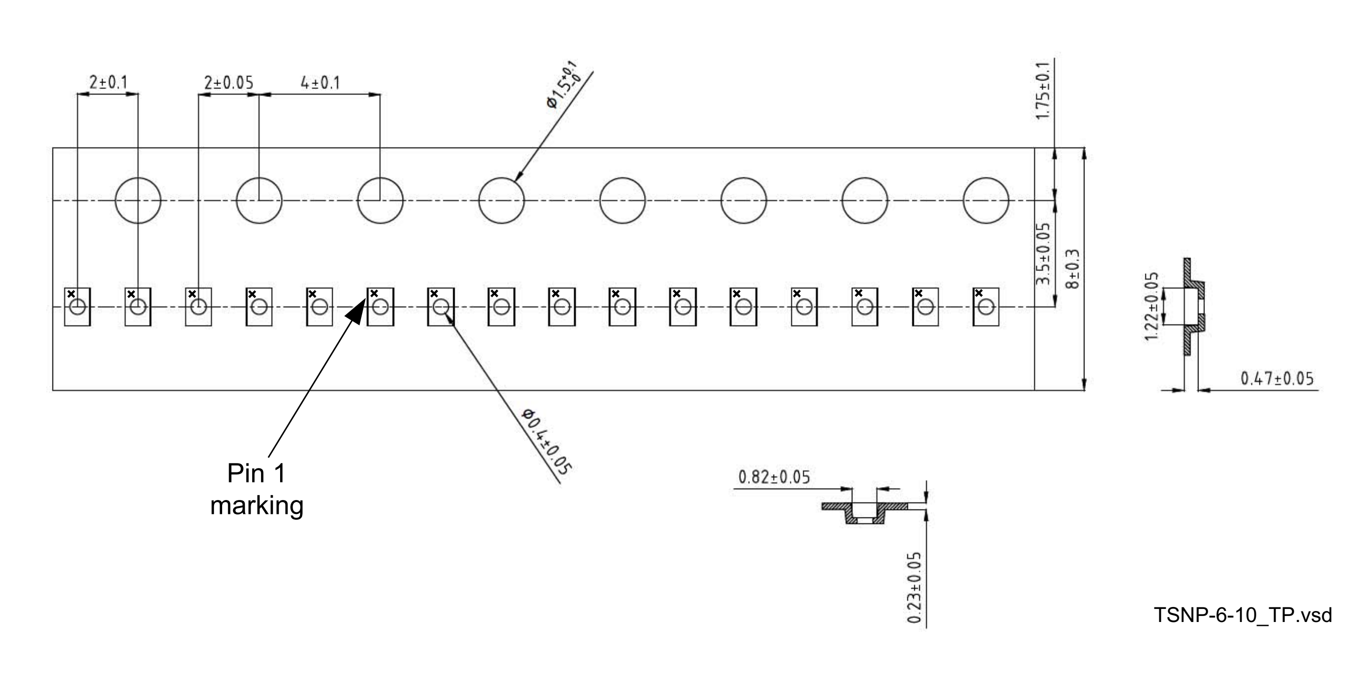

Figure 13 Tape & Reel Dimensions TSNP-6-10 (reel diameter 180 mm, pieces/reel 12000)

Revision History	
Page or Item	**Subjects (major changes since previous revision)**
Revision 3.4, 2021-04-26	
16	Carrier Tape Drawing updated

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