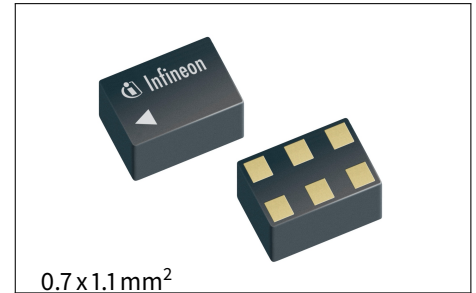


# BGA125N6

## Ultra Low Current Low Noise Amplifier for L2/L5 GNSS Applications

### Features

- Operation frequencies: 1164 to 1300 MHz
- Ultra low current consumption: 1.3 mA
- Wide supply voltage range: 1.1 V to 2.8 V
- High insertion power gain: 20.0 dB
- Low noise figure: 0.80 dB
- 2 kV HBM ESD protection (including AI pin)
- Ultra small and RoHS/WEEE compliant package



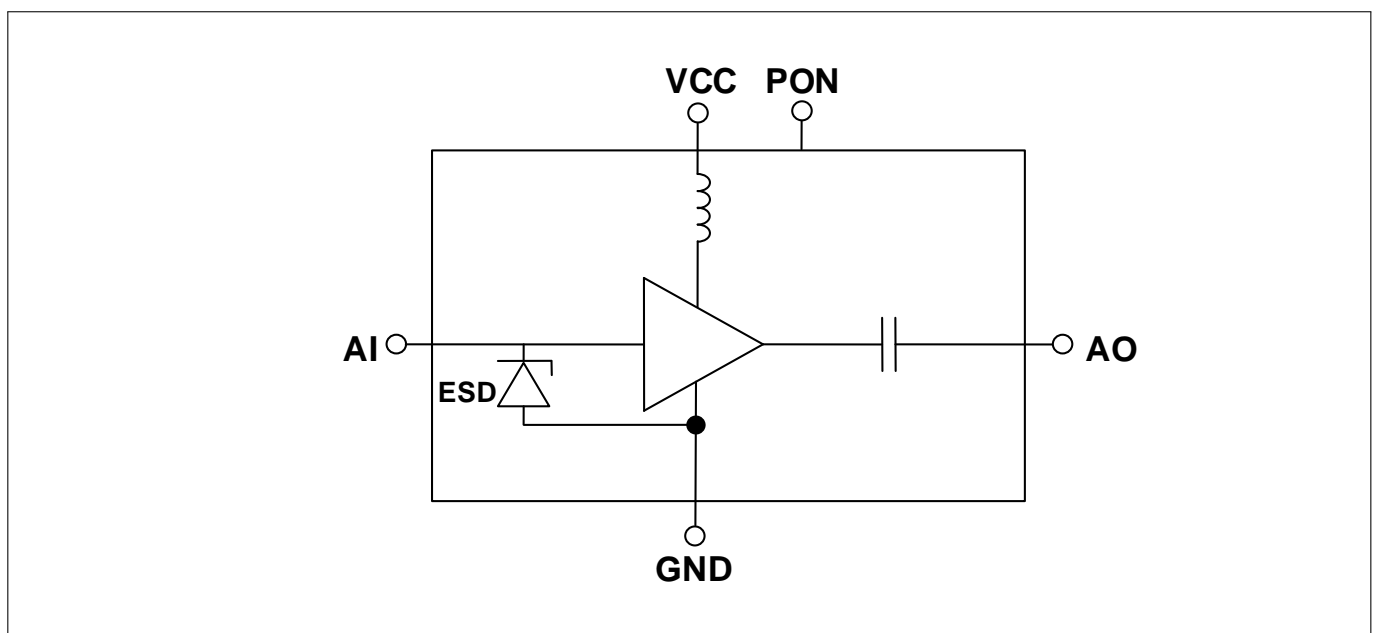
### Potential Application

The BGA125N6 is designed to enhance GNSS signal sensitivity for band L2/L5 especially in wearables and mobile cellular IoT applications. With the very good performance it ensures high system sensitivity. The ultra low power consumption of 1.5mW preserves valuable battery power, ideal for small battery powered GNSS devices. The wide supply voltage range from 1.1 V to 2.8 V ensure flexible design and high compatibility. Besides GPS L2 and L5, the GNSS LNA also covers Galileo E5a, E5b, E6, Glonass G3, G2, Beidou B3, B2 and IRNSS/NAVIC bands.

### Product Validation

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

### Block diagram



# **BGA125N6**

## **Ultra Low Current Low Noise Amplifier for L2/L5 GNSS Applications**

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## **Table of Contents**

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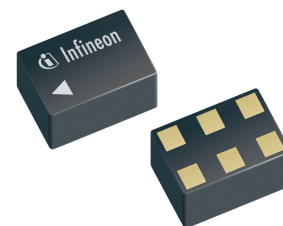
# BGA125N6

## Ultra Low Current Low Noise Amplifier for L2/L5 GNSS Applications

### Features

## 1 Features

- Operation frequencies: 1164 to 1300 MHz
- Ultra low current consumption: 1.3 mA
- Wide supply voltage range: 1.1 V to 2.8 V
- High insertion power gain: 20.0 dB
- Low noise figure: 0.80 dB
- 2 kV HBM ESD protection (including AI pin)
- Only one external matching component needed
- Ultra small TSNP-6-2 leadless package (footprint: 0.7 x 1.1 mm<sup>2</sup>)
- RoHS/WEEE compliant package

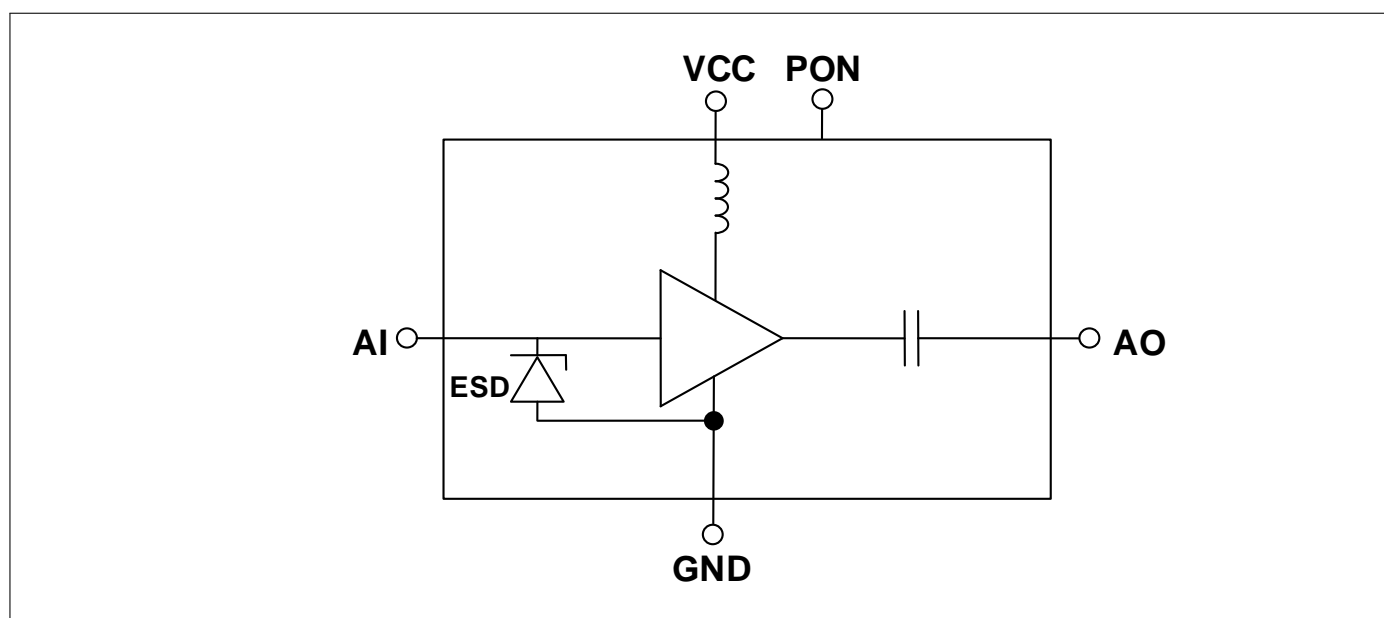


## Description

The BGA125N6 is designed to enhance GNSS signal sensitivity for band L2/L5 especially in wearables and mobile cellular IoT applications. With the very good performance it ensures high system sensitivity. The ultra low power consumption of 1.5mW preserves valuable battery power, ideal for small battery powered GNSS devices. The wide supply voltage range from 1.1 V to 2.8 V ensure flexible design and high compatibility. Besides GPS L2 and L5, the GNSS LNA also covers Galileo E5a, E5b, E6, Glonass G3, G2, Beidou B3, B2 and IRNSS/NAVIC bands. The BGA125N6 LNA is manufactured in Infineon's patented bipolar technology.

The device has a very small size of only 0.7 x 1.1 mm<sup>2</sup> and a maximum height of 0.375 mm.

The device configuration is shown in Fig. 1.



**Figure 1:** BGA125N6 Block diagram

Product Name	Marking	Package
BGA125N6	7	PG-TSNP-6-2

# BGA125N6

## Ultra Low Current Low Noise Amplifier for L2/L5 GNSS Applications

### Maximum Ratings

## 2 Maximum Ratings

Table 1: Maximum Ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Voltage at pin VCC	$V_{CC}$	-0.3	–	2.8	V	<sup>1</sup>
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 GND	$V_{GND}$	-0.3	–	0.3	V	–
Current into pin VCC	$I_{CC}$	–	–	9	mA	–
RF input power	$P_{IN}$	–	–	+25	dBm	CW signal, VSWR 10:1, tested at device level, VCC/VPON typ, 25°C, for 30s and all modes <sup>2</sup>
Total power dissipation	$P_{tot}$	–	–	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, HBM	$V_{ESD\_HBM}$	-2000	–	+2000	V	<sup>3</sup>

<sup>1</sup>All voltages refer to GND-Nodes unless otherwise noted

<sup>2</sup>RF input power higher than +10dBm exceeding operating range

<sup>3</sup>Human Body Model ANSI/ESDA/JEDEC JS-001 ( $R = 1.5\text{ k}\Omega$ ,  $C = 100\text{ pF}$ )

**Warning: 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.**

# BGA125N6

## Ultra Low Current Low Noise Amplifier for L2/L5 GNSS Applications

### Electrical Characteristics

## 3 Electrical Characteristics

**Table 3: Electrical Characteristics at  $T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 1.2\text{ V}$ ,  $f = 1164\text{--}1300\text{ MHz}$**

Parameter <sup>1</sup>	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Voltage	$V_{CC}$	1.1	1.2	2.8	V	–
Supply Current	$I_{CC}$	–	1.3	1.65	mA	ON-Mode
		–	0.2	3	$\mu\text{A}$	OFF-Mode
Power on Voltage	$V_{PON}$	1.1	–	$V_{CC}$	V	ON-Mode
		0.0	–	0.4	V	OFF-Mode
Power on Current	$I_{PON}$	–	1.5	3	$\mu\text{A}$	ON-Mode
		–	–	1	$\mu\text{A}$	OFF-Mode
Insertion Power Gain $f = 1176\text{ MHz}$	$ S_{21} ^2$	17.6	19.6	21.6	dB	ON-Mode
Noise Figure <sup>2</sup> $f = 1176\text{ MHz}$ $Z_S = 50\Omega$	$NF$	–	0.85	1.25	dB	ON-Mode
Input return loss <sup>3</sup> $f = 1176\text{ MHz}$	$RL_{IN}$	8.5	11	–	dB	ON-Mode
Output return loss <sup>3</sup> $f = 1176\text{ MHz}$	$RL_{OUT}$	10	15	–	dB	ON-Mode
Reverse isolation <sup>3</sup> $f = 1176\text{ MHz}$	$1/ S_{21} ^2$	25	40	–	dB	ON-Mode
Power up settling time <sup>4 5</sup>	$t_S$	–	9	12	$\mu\text{s}$	OFF- to ON-Mode
Inband input 1dB-compression point <sup>3</sup> $f = 1176\text{ MHz}$	$IP_{1dB}$	-21	-17	–	dBm	ON-Mode
Inband input 3rd-order intercept point <sup>3 6</sup>	$IIP_3$	-20	-15	–	dBm	ON-Mode
Out of band input 3rd-order intercept point <sup>5 7</sup>	$IIP_{3OOb}$	-3	2	–	dBm	ON-Mode
Stability <sup>5</sup>	$k$	>1	–	–		$f=20\text{ MHz--}10\text{ GHz}$

<sup>1</sup>Based on application described in chapter 4

<sup>2</sup>PCB losses are substrated

<sup>3</sup>Verification based on AQL; not 100% tested in production

<sup>4</sup>LNA gain changed to 90% of final gain value (in dB)

<sup>5</sup>Guaranteed by device design; not tested in production

<sup>6</sup>Inband @ 1176 MHz, Input power = -30 dBm for each tone, 1 MHz tone distance

<sup>7</sup> $f_1 = 1785\text{ MHz}$ ,  $f_2 = 2401\text{ MHz}$ , Input power = -20 dBm for each tone

## Electrical Characteristics

Table 4: Electrical Characteristics at  $T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 1.8\text{ V}$ ,  $f = 1164\text{--}1300\text{ MHz}$ 

Parameter <sup>1</sup>	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Voltage	$V_{CC}$	1.1	1.8	2.8	V	–
Supply Current	$I_{CC}$	–	1.35	1.7	mA	ON-Mode
		–	0.2	3	$\mu\text{A}$	OFF-Mode
Power on Voltage	$V_{PON}$	1.1	–	$V_{CC}$	V	ON-Mode
		0.0	–	0.4	V	OFF-Mode
Power on Current	$I_{PON}$	–	1.5	3	$\mu\text{A}$	ON-Mode
		–	–	1	$\mu\text{A}$	OFF-Mode
Insertion Power Gain $f = 1176\text{ MHz}$	$ S_{21} ^2$	18.0	20.0	22.0	dB	ON-Mode
Noise Figure <sup>2</sup> $f = 1176\text{ MHz}$ $Z_S = 50\Omega$	$NF$	–	0.80	1.20	dB	ON-Mode
Input return loss <sup>3</sup> $f = 1176\text{ MHz}$	$RL_{IN}$	8.5	11	–	dB	ON-Mode
Output return loss <sup>3</sup> $f = 1176\text{ MHz}$	$RL_{OUT}$	10	14	–	dB	ON-Mode
Reverse isolation <sup>3</sup> $f = 1176\text{ MHz}$	$1/ S_{21} ^2$	25	40	–	dB	ON-Mode
Power up settling time <sup>4 5</sup>	$t_S$	–	8	11	$\mu\text{s}$	OFF- to ON-Mode
Inband input 1dB-compression point <sup>3</sup> $f = 1176\text{ MHz}$	$IIP_{1dB}$	-19	-15	–	dBm	ON-Mode
Inband input 3rd-order intercept point <sup>3 6</sup>	$IIP_3$	-20	-15	–	dBm	ON-Mode
Out of band input 3rd-order intercept point <sup>5 7</sup>	$IIP_{3OOB}$	-3	2	–	dBm	ON-Mode
Stability <sup>5</sup>	$k$	>1	–	–		$f=20\text{ MHz--}10\text{ GHz}$

<sup>1</sup>Based on application described in chapter 4<sup>2</sup>PCB losses are substrated<sup>3</sup>Verification based on AQL; not 100% tested in production<sup>4</sup>LNA gain changed to 90% of final gain value (in dB)<sup>5</sup>Guaranteed by device design; not tested in production<sup>6</sup>Inband @ 1176 MHz, Input power = -30 dBm for each tone, 1 MHz tone distance<sup>7</sup> $f_1 = 1785\text{ MHz}$ ,  $f_2 = 2401\text{ MHz}$ , Input power = -20 dBm for each tone

### Electrical Characteristics

**Table 5: Electrical Characteristics at  $T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $f = 1164\text{--}1300\text{ MHz}$**

Parameter <sup>1</sup>	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Voltage	$V_{CC}$	1.1	2.8	2.8	V	–
Supply Current	$I_{CC}$	–	1.45	1.8	mA	ON-Mode
		–	0.2	3	$\mu\text{A}$	OFF-Mode
Power on Voltage	$V_{PON}$	1.1	–	$V_{CC}$	V	ON-Mode
		0.0	–	0.4	V	OFF-Mode
Power on Current	$I_{PON}$	–	1.5	3	$\mu\text{A}$	ON-Mode
		–	–	1	$\mu\text{A}$	OFF-Mode
Insertion Power Gain $f = 1176\text{ MHz}$	$ S_{21} ^2$	18.7	20.2	22.2	dB	ON-Mode
Noise Figure <sup>2</sup> $f = 1176\text{ MHz}$ $Z_S = 50\Omega$	$NF$	–	0.80	1.20	dB	ON-Mode
Input return loss <sup>3</sup> $f = 1176\text{ MHz}$	$RL_{IN}$	8.5	11	–	dB	ON-Mode
Output return loss <sup>3</sup> $f = 1176\text{ MHz}$	$RL_{OUT}$	10	15	–	dB	ON-Mode
Reverse isolation <sup>3</sup> $f = 1176\text{ MHz}$	$1/ S_{21} ^2$	25	40	–	dB	ON-Mode
Power up settling time <sup>4 5</sup>	$t_S$	–	8	11	$\mu\text{s}$	OFF- to ON-Mode
Inband input 1dB-compression point <sup>3</sup> $f = 1176\text{ MHz}$	$IP_{1dB}$	-16	-12	–	dBm	ON-Mode
Inband input 3rd-order intercept point <sup>3 6</sup>	$IIP_3$	-19	-14	–	dBm	ON-Mode
Out of band input 3rd-order intercept point <sup>5 7</sup>	$IIP_{3OoB}$	-3	2	–	dBm	ON-Mode
Stability <sup>5</sup>	$k$	>1	–	–		$f=20\text{ MHz--}10\text{ GHz}$

<sup>1</sup>Based on application described in chapter 4

<sup>2</sup>PCB losses are substrated

<sup>3</sup>Verification based on AQL; not 100% tested in production

<sup>4</sup>LNA gain changed to 90% of final gain value (in dB)

<sup>5</sup>Guaranteed by device design; not tested in production

<sup>6</sup>Inband @ 1176 MHz, Input power = -30 dBm for each tone, 1 MHz tone distance

<sup>7</sup> $f_1 = 1785\text{ MHz}$ ,  $f_2 = 2401\text{ MHz}$ , Input power = -20 dBm for each tone

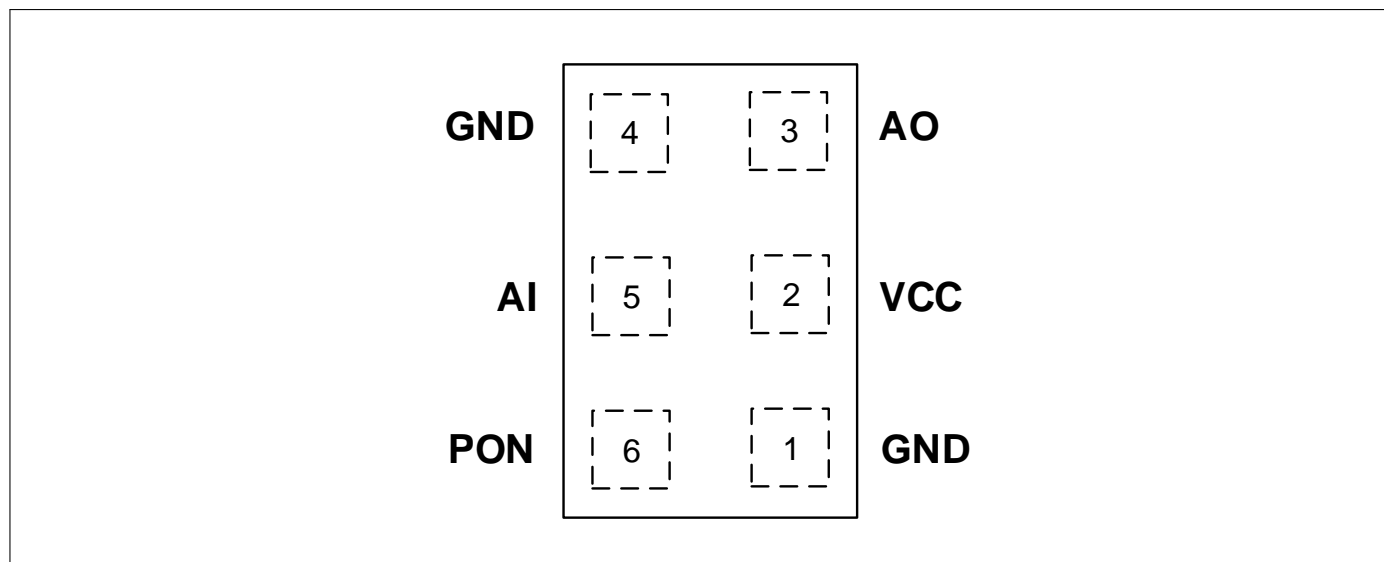
# BGA125N6

## Ultra Low Current Low Noise Amplifier for L2/L5 GNSS Applications

### Application Information

## 4 Application Information

### Pin Configuration and Function



**Figure 2:** BGA125N6 Pin Configuration (top view)

**Table 6: 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

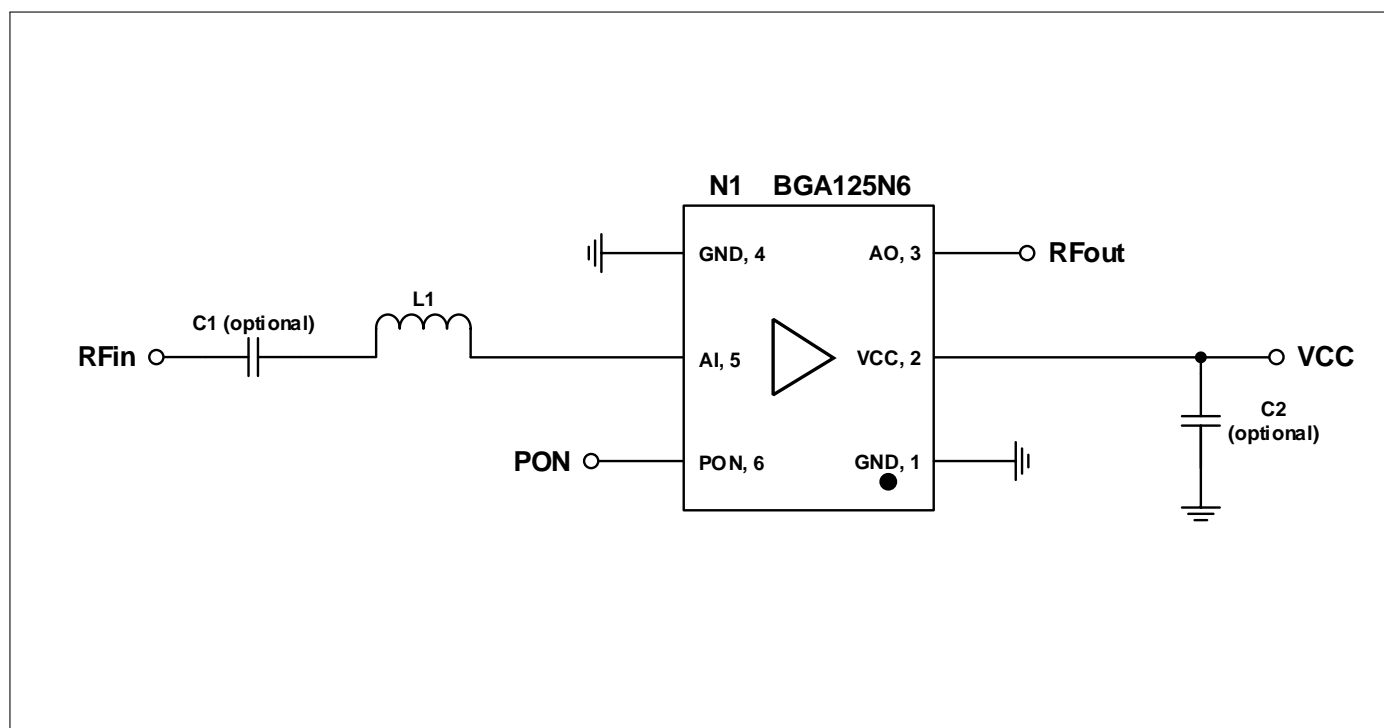


# BGA125N6

## Ultra Low Current Low Noise Amplifier for L2/L5 GNSS Applications

### Application Information

### Application Board Configuration



**Figure 3:** BGA125N6 Application Schematic

**Table 7: Bill of Materials Table**

Name	Value	Package	Manufacturer	Function
C1 (optional)	1nF	0402	Various	DC block <sup>1</sup>
C2 (optional)	≥ 1nF	0402	Various	RF bypass <sup>2</sup>
L1	16nH	0402	Murata LQW15 type	Input matching
N1	BGA125N6	PG-TSMP-6-2	Infineon	GNSS LNA

<sup>1</sup>DC block might be realized with pre-filter in GNSS applications.

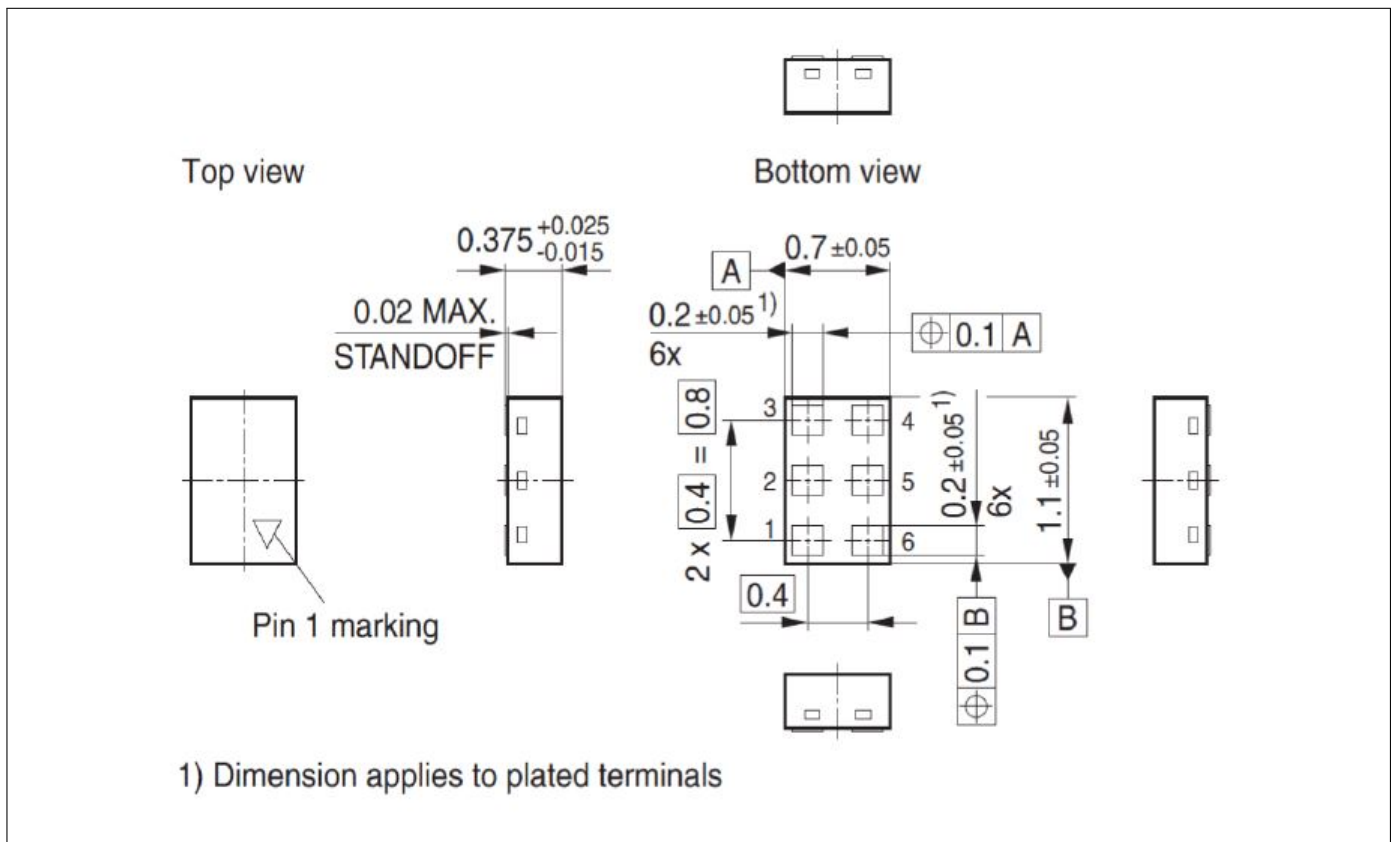
<sup>2</sup>RF bypass recommended to mitigate power supply noise.

# BGA125N6

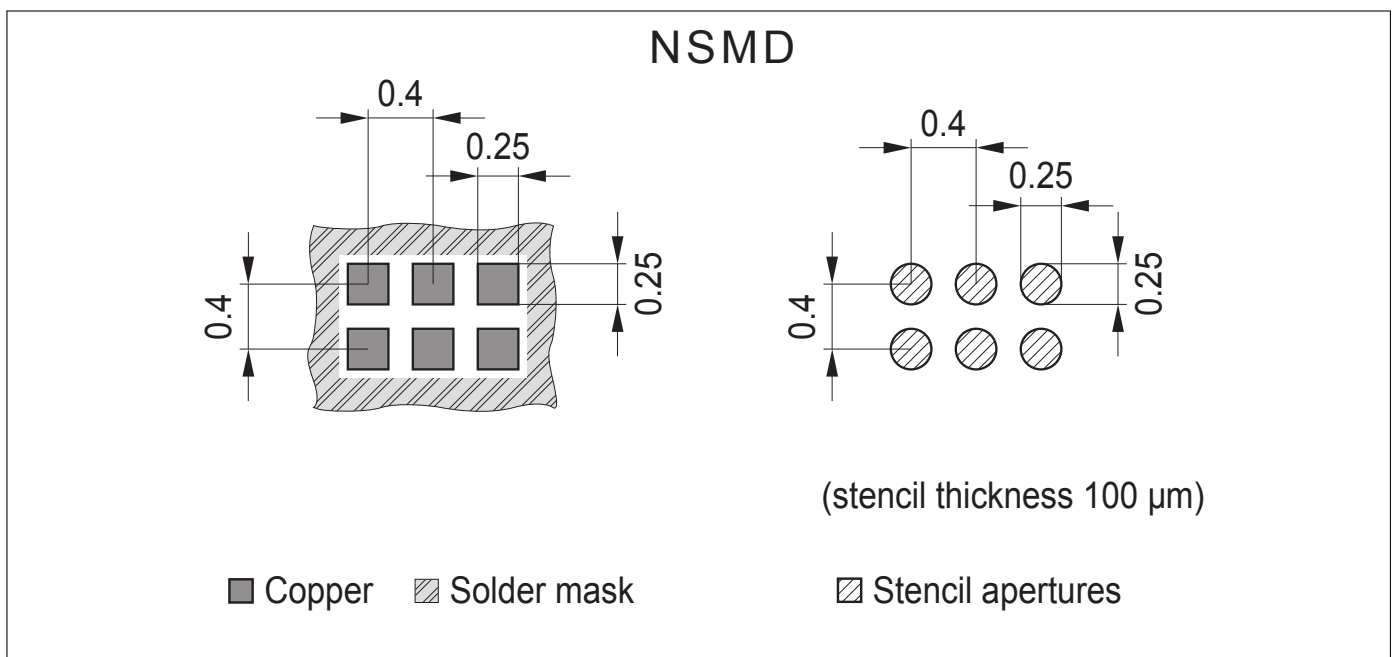
## Ultra Low Current Low Noise Amplifier for L2/L5 GNSS Applications

### Package Information

## 5 Package Information



**Figure 4:** PG-TSNP-6-2 Package Outline (0.7mm x 1.1mm x 0.375mm)

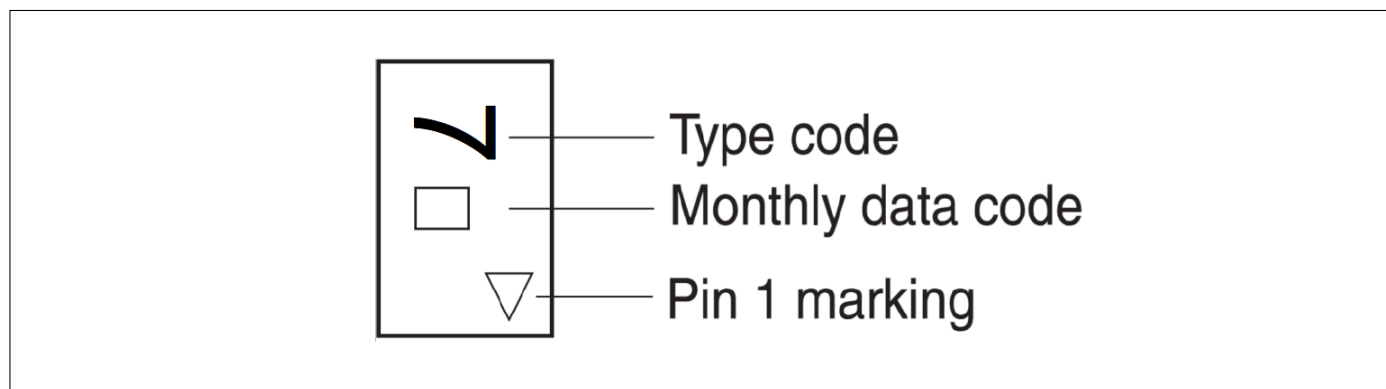


**Figure 5:** Footprint Recommendation

# BGA125N6

## Ultra Low Current Low Noise Amplifier for L2/L5 GNSS Applications

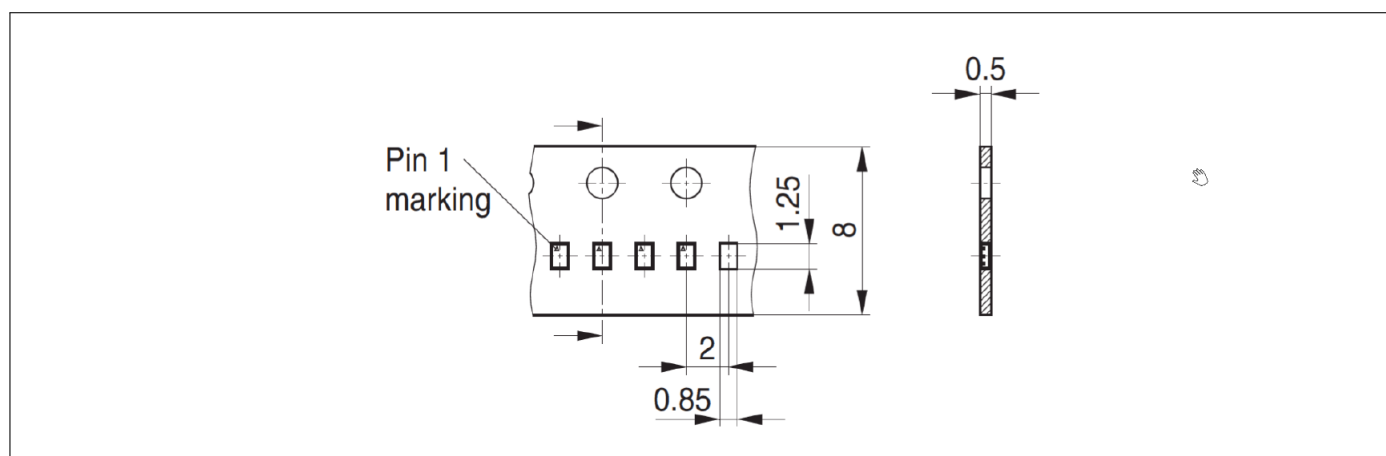
### Package Information



**Figure 6:** Marking Specification (top view)

**Table 8: Monthly Date Code Marking**

Month	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
1	a	p	A	P	a	p	A	P	a	p	A	P
2	b	q	B	Q	b	q	B	Q	b	q	B	Q
3	c	r	C	R	c	r	C	R	c	r	C	R
4	d	s	D	S	d	s	D	S	d	s	D	S
5	e	t	E	T	e	t	E	T	e	t	E	T
6	f	u	F	U	f	u	F	U	f	u	F	U
7	g	v	G	V	g	v	G	V	g	v	G	V
8	h	x	H	X	h	x	H	X	h	x	H	X
9	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 7:** PG-TSMP-6-2 Carrier Tape

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**Revision History**

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<b>Page or Item</b>	<b>Subjects (major changes since previous revision)</b>
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**Revision 2.2, 2022-03-04**

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**Revision History**

all	Update max VCC limit
3	Update RF input power conditions

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