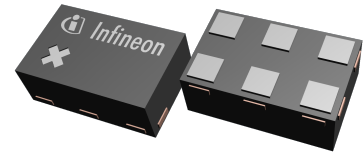


# BGA535N6

## Broadband low power LNA for L1/L2/L5 GNSS applications

### Features

- Operation frequencies 1164 to 1615 MHz
- Multiple operating modes for different applications
- Current consumption down to 1.5 mA
- Wide supply voltage range 1.1 V to 3.3 V
- High insertion power gain up to 18 dB
- Low noise figure down to 0.7 dB
- 2 kV HBM ESD protection (including AI pin)
- Broadband design provides best sensitivity for GNSS signals within 1164 to 1615 MHz with the same matching
- extended temperature range -40...105 °C



### Potential application

BGA535N6 enhances GNSS signal sensitivity for band L1/L2/L5 especially in wearables and industrial applications. It offers 2 different operating modes:

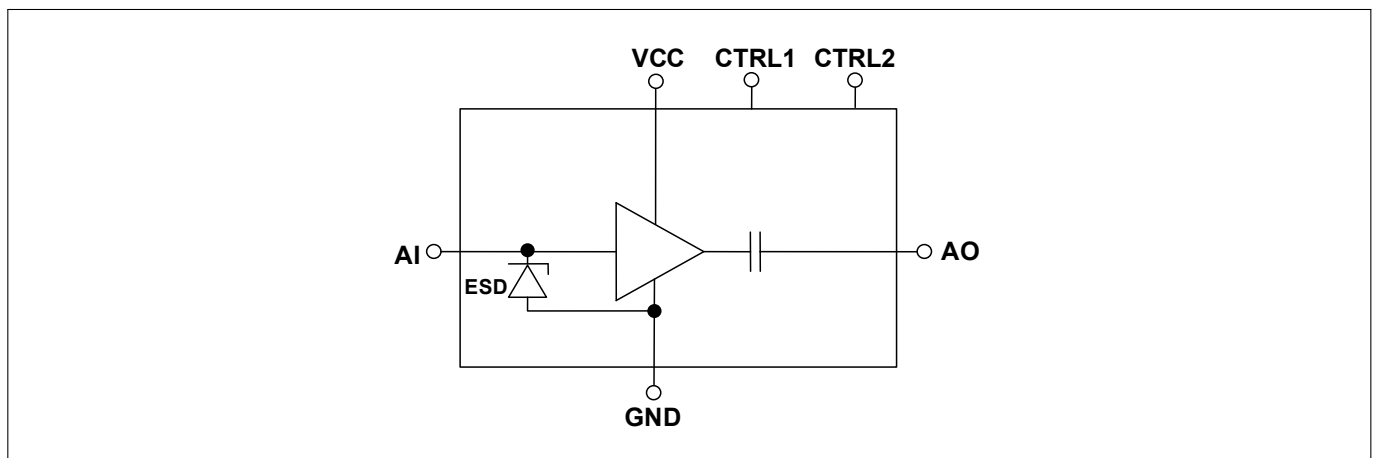
- Low power mode
- Standard mode

The broadband design provides best sensitivity for GNSS signals within 1164 to 1615 MHz with the same matching. Simplified dual-band GNSS system designs with one RF-path are enabled by BGA535N6.

### Product validation

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

### Block diagram



Product Name	Marking	Package	Ordering Information
BGA535N6	9	PG-TSNP-6-10	BGA535N6 E6327

**Table of contents**

<b>Table of contents</b>	<b>1</b>
<b>1 Absolute maximum ratings</b>	<b>2</b>
<b>2 Electrical characteristics</b>	<b>3</b>
<b>3 Application information</b>	<b>8</b>
<b>4 Package information</b>	<b>10</b>

**Absolute maximum ratings****1 Absolute maximum ratings****Table 1: Absolute maximum ratings**

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Voltage at pin VCC	$V_{CC}$	-0.3	–	3.6	V	<sup>1</sup>
Voltage at pin AI	$V_{AI}$	–	–	–	V	<sup>2</sup>
Voltage at pin AO	$V_{AO}$	-0.3	–	$V_{CC} + 0.3$	V	$V_{CC} + 0.3$ must not exceed 3.6 V
Voltage at pin CTRL1/CTRL2	$V_{CTRL}$	-0.3	–	$V_{CC} + 0.3$	V	–
Current into pin VCC	$I_{CC}$	–	–	10	mA	–
Junction temperature	$T_J$	–	–	150	°C	–
Ambient temperature range	$T_A$	-40	–	105	°C	–
Storage temperature range	$T_{STG}$	-55	–	150	°C	–
ESD capability, HBM	$V_{ESD\_HBM}$	-2000	–	+2000	V	<sup>3</sup>
ESD capability, CDM	$V_{ESD\_CDM}$	-1000	–	+1000	V	<sup>4</sup>
RF input power	$P_{IN}$	–	–	+25	dBm	CW signal, VSWR 10:1, (refer to 50 Ohm), device level, VCC/VCTRL type, 25 °C, for 30s and all modes.

<sup>1</sup>All voltages refer to GND-Nodes unless otherwise noted<sup>2</sup>No external DC Voltage allowed<sup>3</sup>Human Body Model ANSI/ESDA/JEDEC JS-001 ( $R = 1.5\text{ k}\Omega$ ,  $C = 100\text{ pF}$ )<sup>4</sup>Field-Induced Charged-Device Model ANSI/ESDA/JEDEC JS-002. Simulates charging/discharging events that occur in production equipment and processes. Potential for CDM ESD events occurs whenever there is metal-to-metal contact in manufacturing.

**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.**

## Electrical characteristics

**2 Electrical characteristics****Table 2: Operation ranges at  $T_A = 25\text{ °C}$ ,  $f = \text{L1/L2/L5}$** 

Parameter <sup>1</sup>	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Supply voltage	$V_{CC}$	1.1	–	3.3	V	–
Control input voltage	$V_{IH}$	$0.7 * V_{CC}$	–	VCC	V	logic H
	$V_{IL}$	0	–	$0.3 * V_{CC}$	V	logic L
Stability	$k$	>1	–	–		$f=20\text{ MHz}-10\text{ GHz}$ (all modes)
Transient time	$t_s$	–	30	32	ns	Low power mode to Off mode Standard mode to Off mode
		–	21.7	23.5	$\mu\text{s}$	C1=1nF Off to Low power mode Off to standard mode
		–	733	847	ns	C1=10pF Off to Low power mode Off to standard mode

<sup>1</sup>Based on application described in chapter 3

**Electrical characteristics****Table 3: Electrical characteristics at  $T_A = 25\text{ °C}$ , Low power mode,  $f = 1164\text{--}1300\text{ MHz}$** 

Parameter <sup>1</sup>	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Supply current	$I_{CC}$	-	1.5	1.8	mA	Low power mode, VCC=1.8V
		-	-	1	μA	Off mode
Insertion power gain <sup>1</sup> $f = 1176\text{ MHz}$	$ S_{21} ^2$	14.5	15.5	16.5	dB	VCC=1.2V
		14.5	15.5	16.5	dB	VCC=1.8V
		14.5	15.5	16.5	dB	VCC=2.8V
Noise figure <sup>2</sup> $f = 1176\text{ MHz}$	NF	-	0.9	1.2	dB	VCC=1.2V
		-	0.9	1.2	dB	VCC=1.8V
		-	0.9	1.2	dB	VCC=2.8V
Input return loss <sup>3</sup> $f = 1176\text{ MHz}$	$RL_{IN}$	8	9.5	-	dB	VCC=1.2V
		7.5	9	-	dB	VCC=1.8V
		7.5	9	-	dB	VCC=2.8V
Output return loss <sup>3</sup> $f = 1176\text{ MHz}$	$RL_{OUT}$	9	11	-	dB	VCC=1.2V
		9	11	-	dB	VCC=1.8V
		9	11	-	dB	VCC=2.8V
Reverse isolation <sup>3</sup> $f = 1176\text{ MHz}$	$1/ S_{12} ^2$	30	33	-	dB	VCC=1.2V
		30	34	-	dB	VCC=1.8V
		30	34	-	dB	VCC=2.8V
Inband input 1dB-compression point <sup>3</sup> $f = 1176\text{ MHz}$	$IP_{1dB}$	-17	-14	-	dBm	VCC=1.2V
		-13	-10	-	dBm	VCC=1.8V
		-9	-6	-	dBm	VCC=2.8V
Out of band input 3rd-order intercept point <sup>3</sup>	$IIP_{300B}$	-7	-4.5	-	dBm	VCC=1.2V, $f_1 = 1785\text{ MHz}, f_2 = 2401\text{ MHz},$ $P_1=P_2=-20\text{ dBm}$
		-7.5	-5	-	dBm	VCC=1.8V, $f_1 = 1785\text{ MHz}, f_2 = 2401\text{ MHz},$ $P_1=P_2=-20\text{ dBm}$
		-8	-5.5	-	dBm	VCC=2.8V, $f_1 = 1785\text{ MHz}, f_2 = 2401\text{ MHz},$ $P_1=P_2=-20\text{ dBm}$

<sup>1</sup>Based on application described in chapter 3<sup>2</sup>PCB losses are subtracted<sup>3</sup>Verification based on AQL; not 100% tested in production

**Electrical characteristics****Table 4: Electrical characteristics at  $T_A = 25\text{ °C}$ , Standard mode,  $f = 1164\text{--}1300\text{ MHz}$** 

Parameter <sup>1</sup>	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Supply current	$I_{CC}$	-	2.3	2.4	mA	Standard mode, VCC=1.8V
		-	-	1	μA	Off mode
Insertion power gain <sup>1</sup> $f = 1176\text{ MHz}$	$ S_{21} ^2$	16.8	17.8	18.8	dB	VCC=1.2V
		16.8	17.9	18.8	dB	VCC=1.8V
		16.8	17.8	18.8	dB	VCC=2.8V
Noise figure <sup>2</sup> $f = 1176\text{ MHz}$	NF	-	0.8	1.1	dB	VCC=1.2V
		-	0.8	1.1	dB	VCC=1.8V
		-	0.8	1.1	dB	VCC=2.8V
Input return loss <sup>3</sup> $f = 1176\text{ MHz}$	$RL_{IN}$	8	11	-	dB	VCC=1.2V
		7.5	10.5	-	dB	VCC=1.8V
		7.5	10.5	-	dB	VCC=2.8V
Output return loss <sup>3</sup> $f = 1176\text{ MHz}$	$RL_{OUT}$	9	11	-	dB	VCC=1.2V
		9	11	-	dB	VCC=1.8V
		9	11	-	dB	VCC=2.8V
Reverse isolation <sup>3</sup> $f = 1176\text{ MHz}$	$1/ S_{12} ^2$	30	34	-	dB	VCC=1.2V
		30	34	-	dB	VCC=1.8V
		30	34	-	dB	VCC=2.8V
Inband input 1dB-compression point <sup>3</sup> $f = 1176\text{ MHz}$	$IP_{1dB}$	-19	-16.5	-	dBm	VCC=1.2V
		-15	-12	-	dBm	VCC=1.8V
		-11	-8.5	-	dBm	VCC=2.8V
Out of band input 3rd-order intercept point <sup>3</sup>	$IIP_{300B}$	-2	0.5	-	dBm	VCC=1.2V, $f_1 = 1785\text{ MHz}, f_2 = 2401\text{ MHz},$ $P_1=P_2=-20\text{ dBm}$
		-5	-2.5	-	dBm	VCC=1.8V, $f_1 = 1785\text{ MHz}, f_2 = 2401\text{ MHz},$ $P_1=P_2=-20\text{ dBm}$
		-5	-2.5	-	dBm	VCC=2.8V, $f_1 = 1785\text{ MHz}, f_2 = 2401\text{ MHz},$ $P_1=P_2=-20\text{ dBm}$

<sup>1</sup>Based on application described in chapter 3<sup>2</sup>PCB losses are subtracted<sup>3</sup>Verification based on AQL; not 100% tested in production

**Electrical characteristics****Table 5: Electrical characteristics at  $T_A = 25\text{ }^\circ\text{C}$ , Low power mode,  $f = 1550\text{--}1615\text{ MHz}$** 

Parameter <sup>1</sup>	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Supply current	$I_{CC}$	-	1.5	1.8	mA	Standard mode, VCC=1.8V
		-	-	1	$\mu\text{A}$	Off mode
Insertion power gain <sup>1</sup> $f = 1575\text{ MHz}$	$ S_{21} ^2$	13	14	15	dB	VCC=1.2V
		13.5	14.5	15.5	dB	VCC=1.8V
		14	15	16	dB	VCC=2.8V
Noise figure <sup>2</sup> $f = 1575\text{ MHz}$	NF	-	1	1.3	dB	VCC=1.2V
		-	1	1.3	dB	VCC=1.8V
		-	1	1.3	dB	VCC=2.8V
Input return loss <sup>3</sup> $f = 1575\text{ MHz}$	$RL_{IN}$	8.5	11.5	-	dB	VCC=1.2V
		10.5	13.7	-	dB	VCC=1.8V
		11	14	-	dB	VCC=2.8V
Output return loss <sup>3</sup> $f = 1575\text{ MHz}$	$RL_{OUT}$	11	13	-	dB	VCC=1.2V
		11.5	13.5	-	dB	VCC=1.8V
		12	14	-	dB	VCC=2.8V
Reverse isolation <sup>3</sup> $f = 1575\text{ MHz}$	$1/ S_{12} ^2$	30	36	-	dB	VCC=1.2V
		30	36	-	dB	VCC=1.8V
		30	36	-	dB	VCC=2.8V
Inband input 1dB-compression point <sup>3</sup> $f = 1575\text{ MHz}$	$IP_{1dB}$	-14	-12	-	dBm	VCC=1.2V
		-10.5	-8.5	-	dBm	VCC=1.8V
		-6.5	-4.5	-	dBm	VCC=2.8V
Out of band input 3rd-order intercept point <sup>3</sup>	$IIP_{3OoB}$	-7.5	-5	-	dBm	VCC=1.2V, $f_1 = 1713\text{ MHz}, f_2 = 1850\text{ MHz},$ $P_1=P_2=-20\text{ dBm}$
		-10	-7.5	-	dBm	VCC=1.8V, $f_1 = 1713\text{ MHz}, f_2 = 1850\text{ MHz},$ $P_1=P_2=-20\text{ dBm}$
		-11	-8.5	-	dBm	VCC=2.8V, $f_1 = 1713\text{ MHz}, f_2 = 1850\text{ MHz},$ $P_1=P_2=-20\text{ dBm}$

<sup>1</sup>Based on application described in chapter 3<sup>2</sup>PCB losses are subtracted<sup>3</sup>Verification based on AQL; not 100% tested in production

**Electrical characteristics****Table 6: Electrical characteristics at  $T_A = 25\text{ °C}$ , Standard mode,  $f = 1550\text{--}1615\text{ MHz}$** 

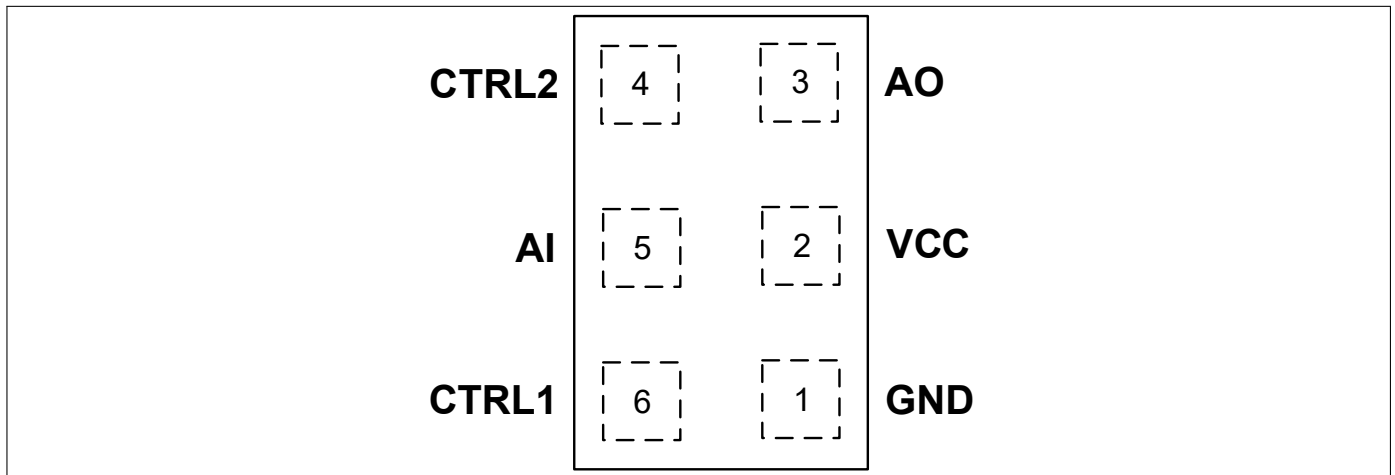
Parameter <sup>1</sup>	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Supply current	$I_{CC}$	-	2.3	2.4	mA	Standard mode, VCC=1.8V
		-	-	1	μA	Off Mode
Insertion power gain <sup>1</sup> $f = 1575\text{ MHz}$	$ S_{21} ^2$	15.5	16.5	17.5	dB	VCC=1.2V
		16	17	18	dB	VCC=1.8V
		16	17	18	dB	VCC=2.8V
Noise figure <sup>2</sup> $f = 1575\text{ MHz}$	NF	-	0.85	1.15	dB	VCC=1.2V
		-	0.85	1.15	dB	VCC=1.8V
		-	0.85	1.15	dB	VCC=2.8V
Input return loss <sup>3</sup> $f = 1575\text{ MHz}$	$RL_{IN}$	15.5	18.5	-	dB	VCC=1.2V
		16.5	19	-	dB	VCC=1.8V
		16.5	19	-	dB	VCC=2.8V
Output return loss <sup>3</sup> $f = 1575\text{ MHz}$	$RL_{OUT}$	11	13	-	dB	VCC=1.2V
		11.5	13.5	-	dB	VCC=1.8V
		12	14	-	dB	VCC=2.8V
Reverse isolation <sup>3</sup> $f = 1575\text{ MHz}$	$1/ S_{12} ^2$	30	35	-	dB	VCC=1.2V
		30	35	-	dB	VCC=1.8V
		30	35	-	dB	VCC=2.8V
Inband input 1dB-compression point <sup>3</sup> $f = 1575\text{ MHz}$	$IP_{1dB}$	-17	-15	-	dBm	VCC=1.2V
		-13	-11	-	dBm	VCC=1.8V
		-9	-6.7	-	dBm	VCC=2.8V
Out of band input 3rd-order intercept point <sup>3</sup>	$IIP_{300B}$	-7.5	-5	-	dBm	VCC=1.2V, $f_1 = 1713\text{ MHz}, f_2 = 1850\text{ MHz},$ $P_1=P_2=-20\text{ dBm}$
		-5.5	-3	-	dBm	VCC=1.8V, $f_1 = 1713\text{ MHz}, f_2 = 1850\text{ MHz},$ $P_1=P_2=-20\text{ dBm}$
		-7.5	-5	-	dBm	VCC=2.8V, $f_1 = 1713\text{ MHz}, f_2 = 1850\text{ MHz},$ $P_1=P_2=-20\text{ dBm}$

<sup>1</sup>Based on application described in chapter 3<sup>2</sup>PCB losses are subtracted<sup>3</sup>Verification based on AQL; not 100% tested in production



### 3 Application information

#### Pin configuration and function



**Figure 1:** BGA535N6 pin configuration (top view)

**Table 7: Pin definition and function**

Pin No.	Name	Function
1	GND	Ground
2	VCC	DC supply
3	AO	LNA output
4	CTRL2	Control pin 2
5	AI	LNA input
6	CTRL1	Control pin 1

**Table 8: Gain mode selection truth table**

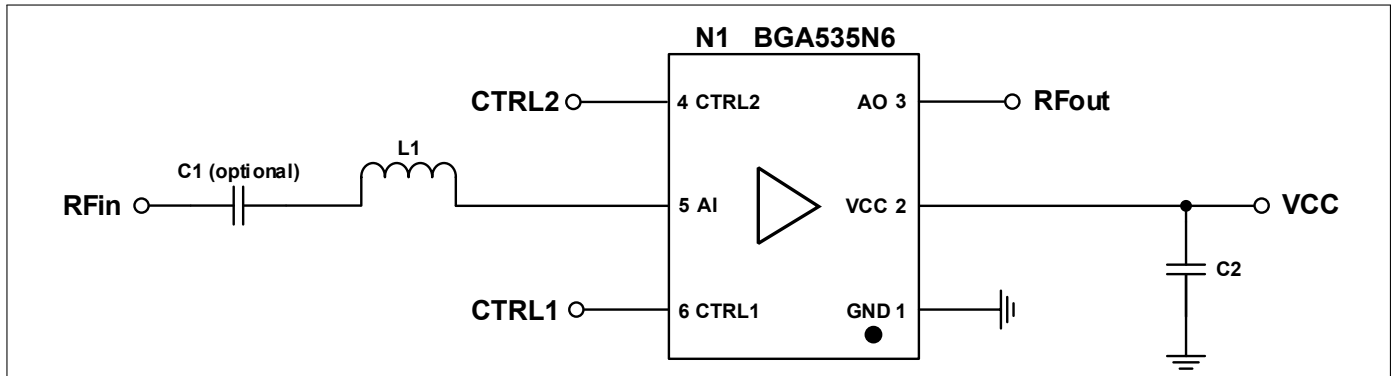
Control voltage $V_{CTRL1}$	Control voltage $V_{CTRL2}$	Gain mode
High	Low	Standard mode
High	High	Low power mode
Low	Low	Off mode

# BGA535N6

## Broadband low power LNA for L1/L2/L5 GNSS applications

### Application information

### Application board configuration



**Figure 2:** BGA535N6 Application schematic for L1/L2/L5

**Table 9: Bill of materials table**

Name	Value	Package	Manufacturer	Function
C1	1nF	0402	Various	DC block
C2	68pF	0402	Various	bypass
L1	see matching table	0402	Murata LQW15 type	Input matching
N1	BGA535N6	PG-TSNP-6-10	Infineon Technologies	GNSS LNA

**Table 10: Matching table**

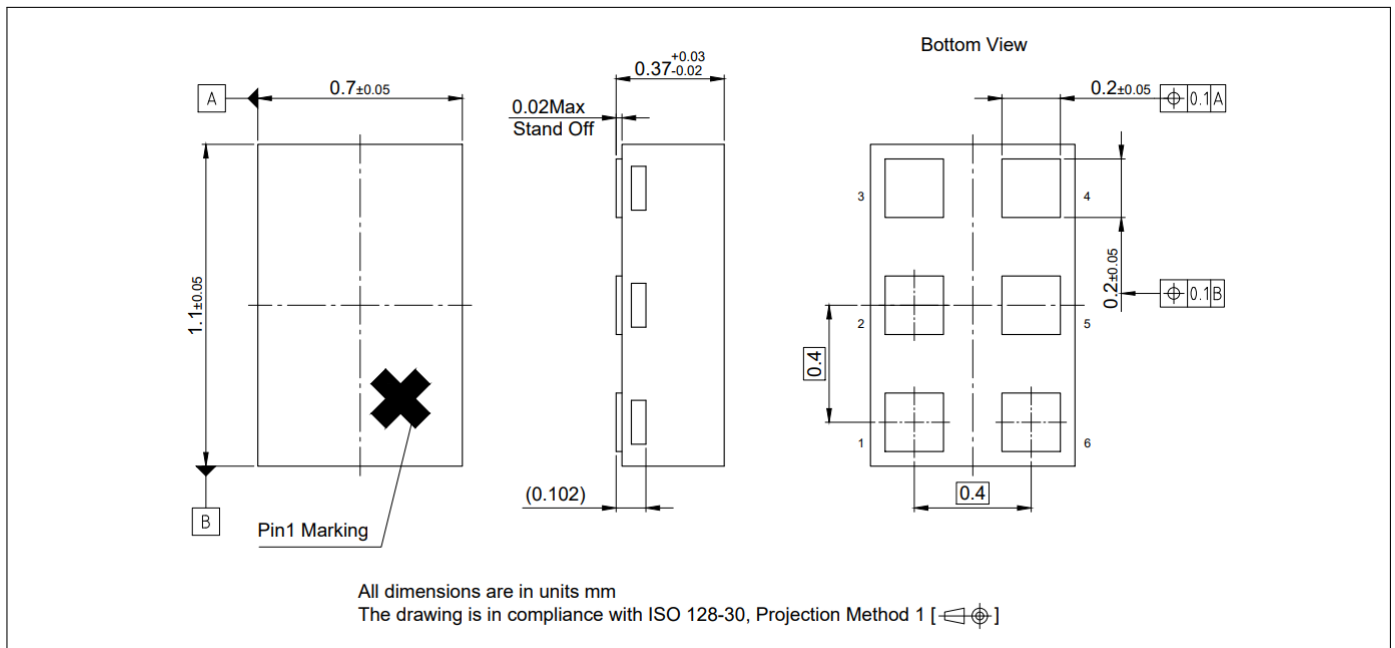
Band	Operation mode	Matching inductor
L1 & L2/L5	Low power - 1.5mA	12 nH
	Standard - 2.3mA	11 nH

# BGA535N6

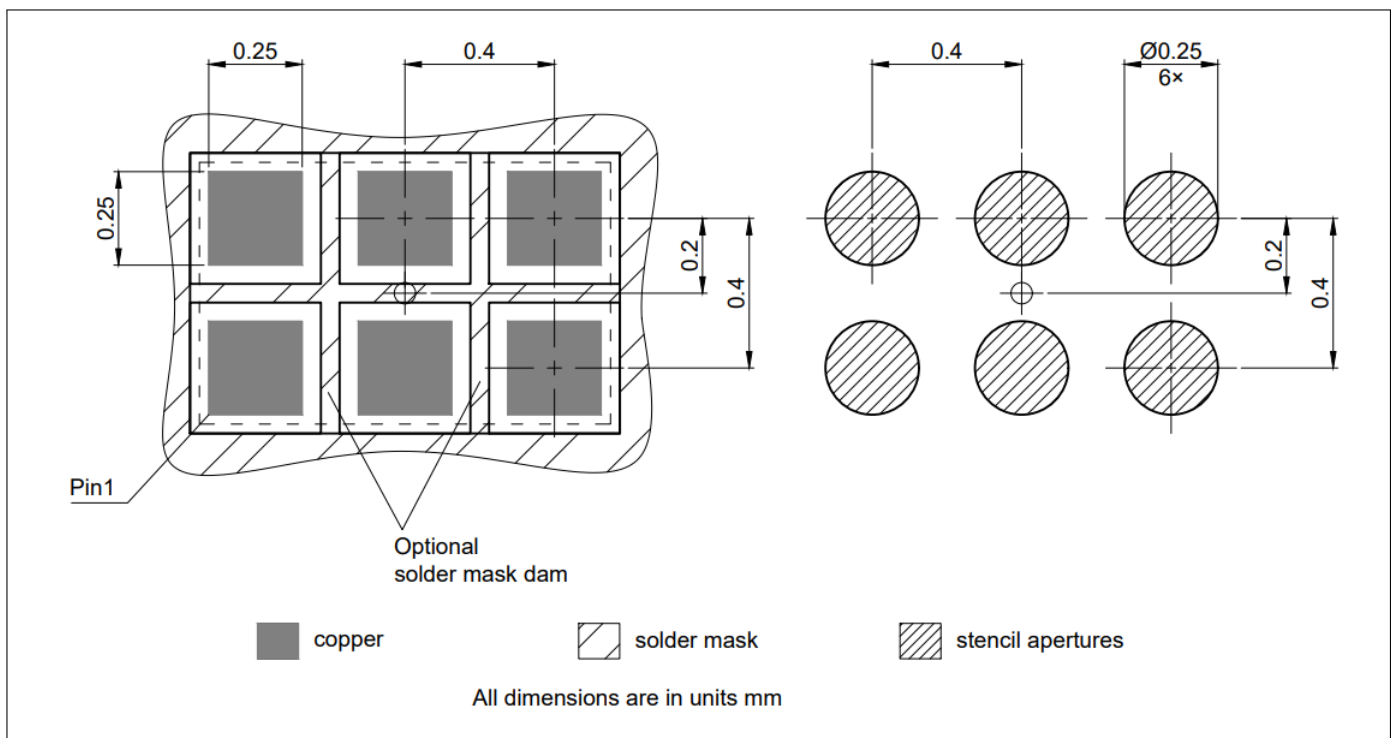
## Broadband low power LNA for L1/L2/L5 GNSS applications

### Package information

## 4 Package information

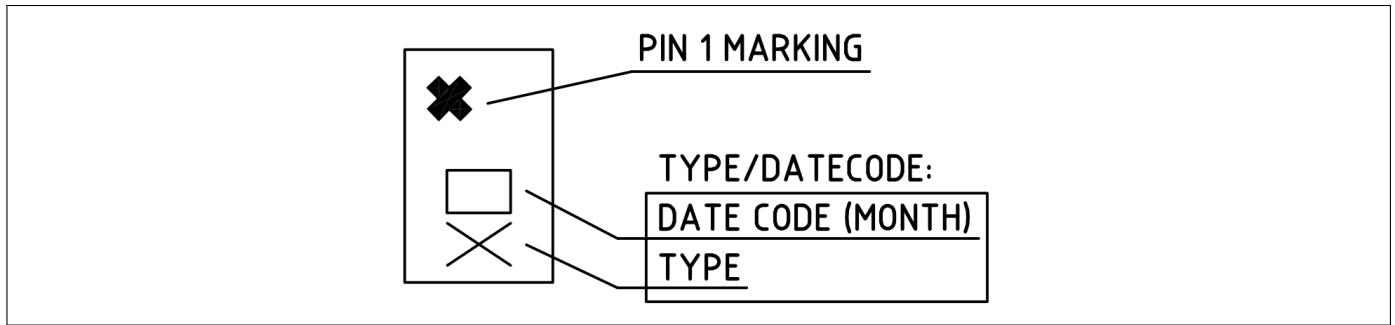


**Figure 3:** PG-TSNP-6-10 package outline (0.7mm x 1.1mm x 0.37mm)



**Figure 4:** Footprint recommendation

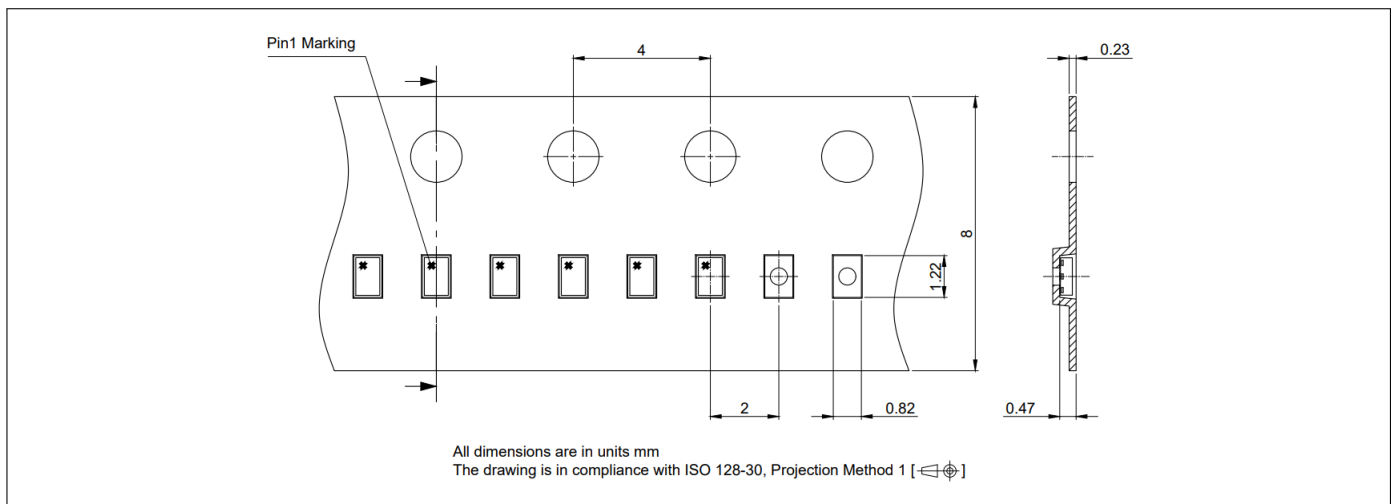
**Package information**



**Figure 5:** Marking specification (top view)

**Table 11: 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 6:** PG-TSNP-6-10 carrier tape



---

**Revision history**

---

-

Page or item	Subjects (major changes since previous revision)
<b>Revision 1.1, 2024-03-27</b>	

**Revision history**

	Final data sheet update

## Trademarks

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

**Edition 2024-03-27**  
**Published by**  
**Infineon Technologies AG**  
**81726 Munich, Germany**

**© 2024 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)**

**Document reference**  
**Doc\_Number**

## 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.