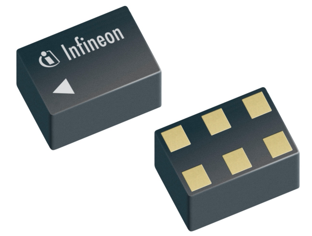
BGA123N6

Ultra Low Current Low Noise Amplifier for GNSS Applications

Features

- Operation frequencies: 1550 to 1615 MHz
- Ultra low current consumption: 1.3 mA
- Wide supply voltage range: 1.1 V to 3.3 V
- High insertion power gain: 19.0 dB
- Low noise figure: 0.75 dB
- 2 kV HBM ESD protection (inluding AI pin)
- Ultra small and RoHS/WEEE compliant package



$0.7 \times 1.1\ mm^2$

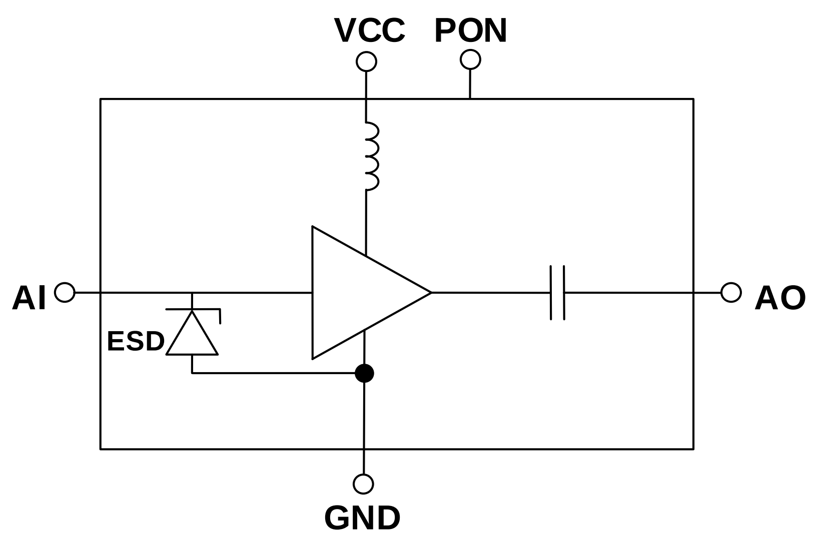
Potential Application

The BGA123N6 is designed to enhance GNSS signal sensitivity 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 3.3 V ensure flexible design and high compatibility. It supports all GNSS systems including GPS, GLONASS, Beidou and Galileo.

Product Validation

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

Block diagram



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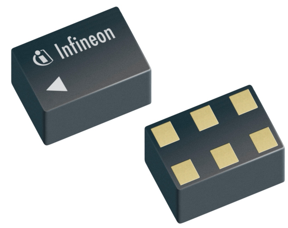
1 Features



- Operation frequencies: 1550 to 1615 MHz
- Ultra low current consumption: 1.3 mA
- Wide supply voltage range: 1.1 V to 3.3 V
- High insertion power gain: 19.0 dB
- Low noise figure: 0.75 dB
- 2 kV HBM ESD protection (inluding AI pin)
- Only one external matching component needed
- Ultra small TSNP-6-2 leadless package (footprint: 0.7 x 1.1 mm^2)
- RoHS/WEEE compliant package

RoHS Halogen-Free Lead-Free Green

Description

The BGA123N6 is designed to enhance GNSS signal sensitivity 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 3.3 V ensure flexible design and high compatibility. It supports all GNSS systems including GPS, GLONASS, Beidou and Galileo. The BGA123N6 LNA is manufactured in Infineon's patented bipolar technology.
The device has a very small size of only 0.7 x 1.1 mm^2 and a maximum height of 0.375 mm.
The device configuration is shown in Fig. 1.

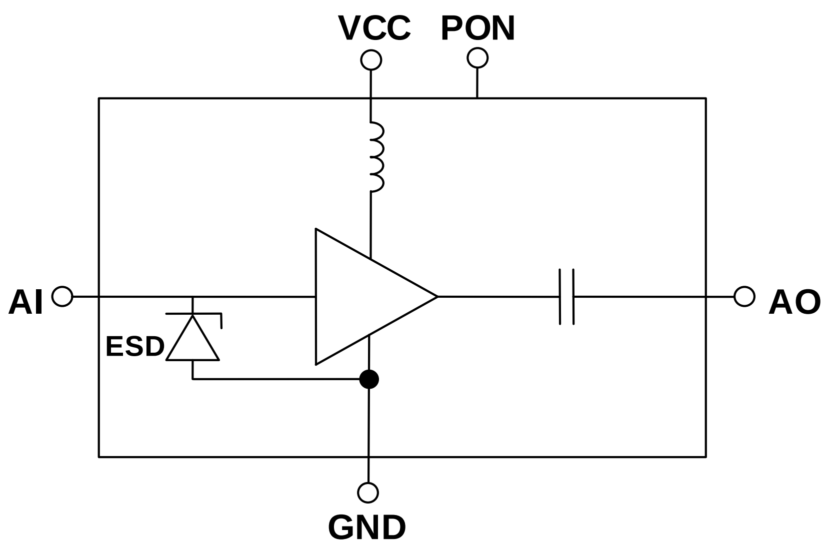


Figure 1: BGA123N6 Block diagram

Product Name	Marking	Package
BGA123N6	6	PG-TSNP-6-2

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	–	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 GND	V_{GND}	-0.3	–	0.3	V	–
Current into pin VCC	I_{CC}	–	–	9	mA	–
RF input power	P_{IN}	–	–	+25	dBm	[2]
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	[3]

[1] All voltages refer to GND-Nodes unless otherwise noted
[2] Tested at max VCC/VPON, 85°C and for 60 minutes
[3] Human Body Model ANSI/ESDA/JEDEC JS-001 ($R = 1.5\,\mathrm{k}\Omega$, $C = 100$ 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 belowabsolute 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 3: Electrical Characteristics at T_A = 25 °C, V_{CC} = 1.2 V, f = 1550– 1615 MHz

Parameter[1]	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{CC}	1.1	1.2	3.3	V	–
Supply Current	I_{CC}	–	1.3	1.65	mA	ON-Mode
		–	0.2	3	µA	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	µA	ON-Mode
		–	–	1	µA	OFF-Mode
Insertion Power Gain f = 1575 MHz	$\|S_{21}\|^2$	16.7	18.7	20.7	dB	ON-Mode
Noise Figure[2] f = 1575 MHz Z_S = 50Ω	NF	–	0.80	1.20	dB	ON-Mode
Input return loss[3] f = 1575 MHz	RL_{IN}	9	12	–	dB	ON-Mode
Output return loss[3] f = 1575 MHz	RL_{OUT}	10	18	–	dB	ON-Mode
Reverse isolation[3] f = 1575 MHz	$1/\|S_{21}\|^2$	25	40	–	dB	ON-Mode
Power up settling time[4][5]	t_S	–	8	11	µs	OFF- to ON-Mode
Inband input 1dB-compression point[3] f = 1575 MHz	IP_{1dB}	-23	-19	–	dBm	ON-Mode
Inband input 3rd-order intercept point[3][6]	IIP_3	-18	-13	–	dBm	ON-Mode
Out of band input 3rd-order intercept point[5][7]	IIP_{3OOB}	-14	-9	–	dBm	ON-Mode
Stability[5]	k	>1	–	–		f=20 MHz–10 GHz

[1] Based on application described in chapter 4
[2] PCB losses are substrated
[3] Verification based on AQL; not 100% tested in production
[4] LNA gain changed to 90% of final gain value (in dB)
[5] Guaranteed by device design; not tested in production
[6] Inband @ 1575 MHz, Input power = −30 dBm for each tone, 1 MHz tone distance
[7] f1 = 1712.7 MHz, f2 = 1850 MHz, Input power = −20 dBm for each tone

Table 4: Electrical Characteristics at T_A = 25 °C, V_{CC} = 1.8 V, f = 1550– 1615 MHz

Parameter[1]	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{CC}	1.1	1.8	3.3	V	–
Supply Current	I_{CC}	–	1.35	1.7	mA	ON-Mode
		–	0.2	3	µA	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}	–	3	6	µA	ON-Mode
		–	–	1	µA	OFF-Mode
Insertion Power Gain f = 1575 MHz	$\|S_{21}\|^2$	17.0	19.0	21.0	dB	ON-Mode
Noise Figure[2] f = 1575 MHz Z_S = 50Ω	NF	–	0.75	1.15	dB	ON-Mode
Input return loss[3] f = 1575 MHz	RL_{IN}	9	12	–	dB	ON-Mode
Output return loss[3] f = 1575 MHz	RL_{OUT}	10	17	–	dB	ON-Mode
Reverse isolation[3] f = 1575 MHz	$1/\|S_{21}\|^2$	25	40	–	dB	ON-Mode
Power up settling time[4 5]	t_S	–	7	10	µs	OFF- to ON-Mode
Inband input 1dB-compression point[3] f = 1575 MHz	IP_{1dB}	-19	-15	–	dBm	ON-Mode
Inband input 3rd-order intercept point[3 6]	IIP_3	-17	-12	–	dBm	ON-Mode
Out of band input 3rd-order intercept point[5 7]	IIP_{3OOB}	-12	-7	–	dBm	ON-Mode
Stability[5]	k	>1	–	–		f=20 MHz–10 GHz

[1] Based on application described in chapter 4
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[6] Inband @ 1575 MHz, Input power = −30 dBm for each tone, 1 MHz tone distance
[7] f1 = 1712.7 MHz, f2 = 1850 MHz, Input power = −20 dBm for each tone

Table 5: Electrical Characteristics at T_A = 25 °C, V_{CC} = 2.8 V, f = 1550– 1615 MHz

Parameter[1]	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{CC}	1.1	2.8	3.3	V	–
Supply Current	I_{CC}	–	1.45	1.8	mA	ON-Mode
		–	0.2	3	µA	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}	–	5	10	µA	ON-Mode
		–	–	1	µA	OFF-Mode
Insertion Power Gain f = 1575 MHz	$\|S_{21}\|^2$	17.2	19.2	21.2	dB	ON-Mode
Noise Figure[2] f = 1575 MHz Z_S = 50Ω	NF	–	0.75	1.15	dB	ON-Mode
Input return loss[3] f = 1575 MHz	RL_{IN}	9	12	–	dB	ON-Mode
Output return loss[3] f = 1575 MHz	RL_{OUT}	10	17	–	dB	ON-Mode
Reverse isolation[3] f = 1575 MHz	$1/\|S_{21}\|^2$	25	30	–	dB	ON-Mode
Power up settling time[4,5]	t_S	–	7	10	µs	OFF- to ON-Mode
Inband input 1dB-compression point[3] f = 1575 MHz	IP_{1dB}	-16	-12	–	dBm	ON-Mode
Inband input 3rd-order intercept point[3,6]	IIP_3	-16	-11	–	dBm	ON-Mode
Out of band input 3rd-order intercept point[5,7]	IIP_{3OOB}	-11	-6	–	dBm	ON-Mode
Stability[5]	k	>1	–	–		f=20 MHz–10 GHz

[1] Based on application described in chapter 4
[2] PCB losses are substrated
[3] Verification based on AQL; not 100% tested in production
[4] LNA gain changed to 90% of final gain value (in dB)
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[6] Inband @ 1575 MHz, Input power = −30 dBm for each tone, 1 MHz tone distance
[7] f1 = 1712.7 MHz, f2 = 1850 MHz, Input power = −20 dBm for each tone

4 Application Information

Pin Configuration and Function

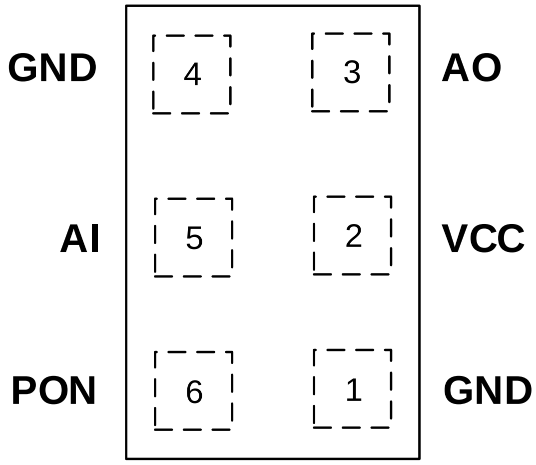

Figure 2: BGA123N6 Pin Configuration (top view)

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

Application Board Configuration

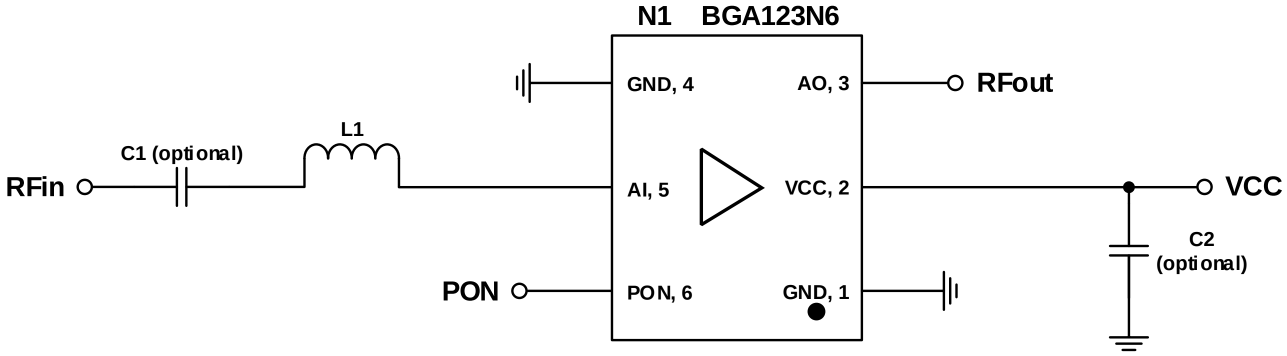

Figure 3: BGA123N6 Application Schematic

Table 7: Bill of Materials Table

Name	Value	Package	Manufacturer	Function
C1 (optional)	1nF	0402	Various	DC block[1]
C2 (optional)	$\geq$ 1nF	0402	Various	RF bypass[2]
L1	10nH	0402	Murata LQW15 type	Input matching
N1	BGA123N6	PG-TSNP-6-2	Infineon	GNSS LNA

[1] DC block might be realized with pre-filter in GNSS applications.
[2] RF bypass recommended to mitigate power supply noise.

5 Package Information

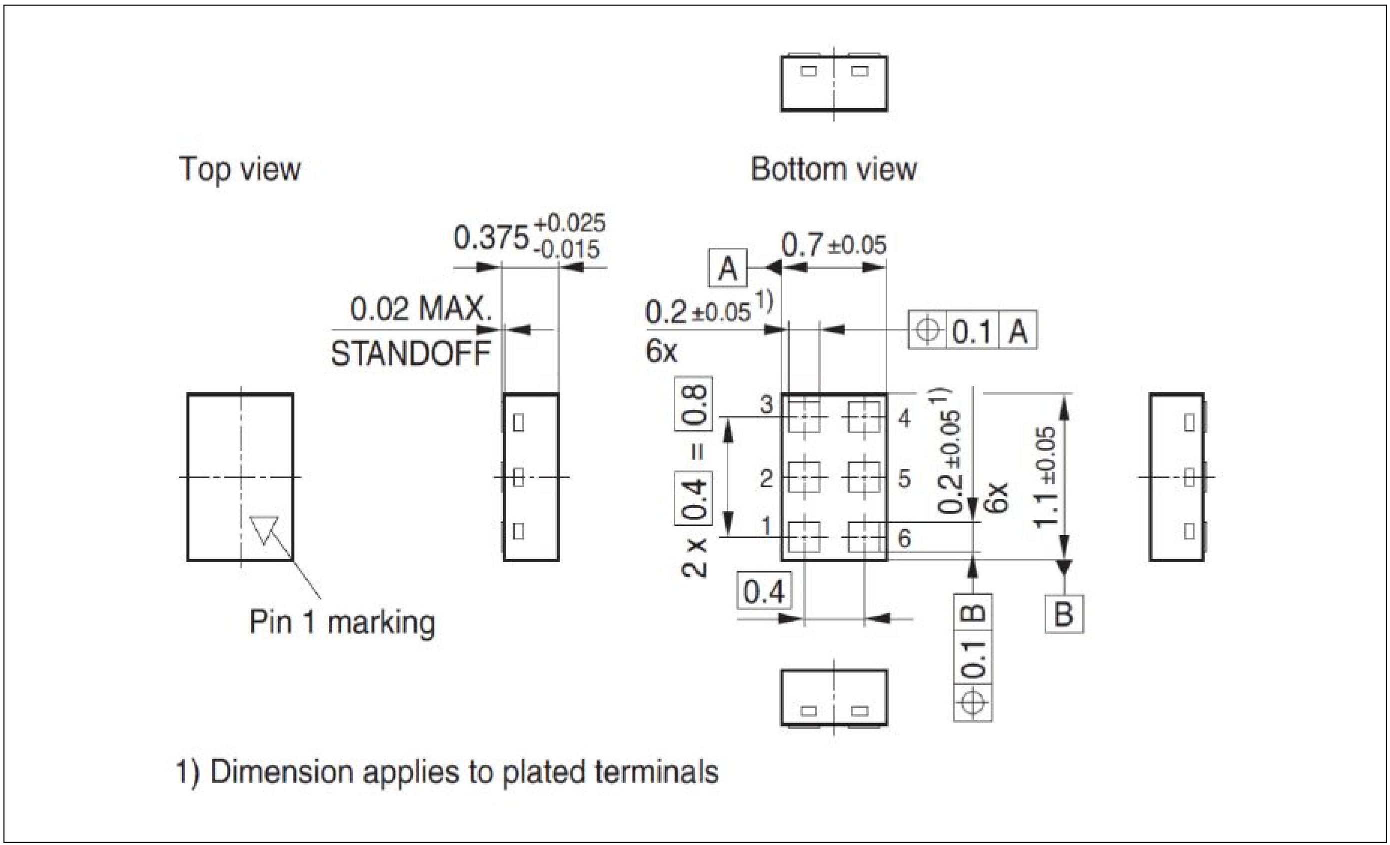

Figure 4: PG-TSNP-6-2 Package Outline (0.7mm x 1.1mm x 0.375mm)

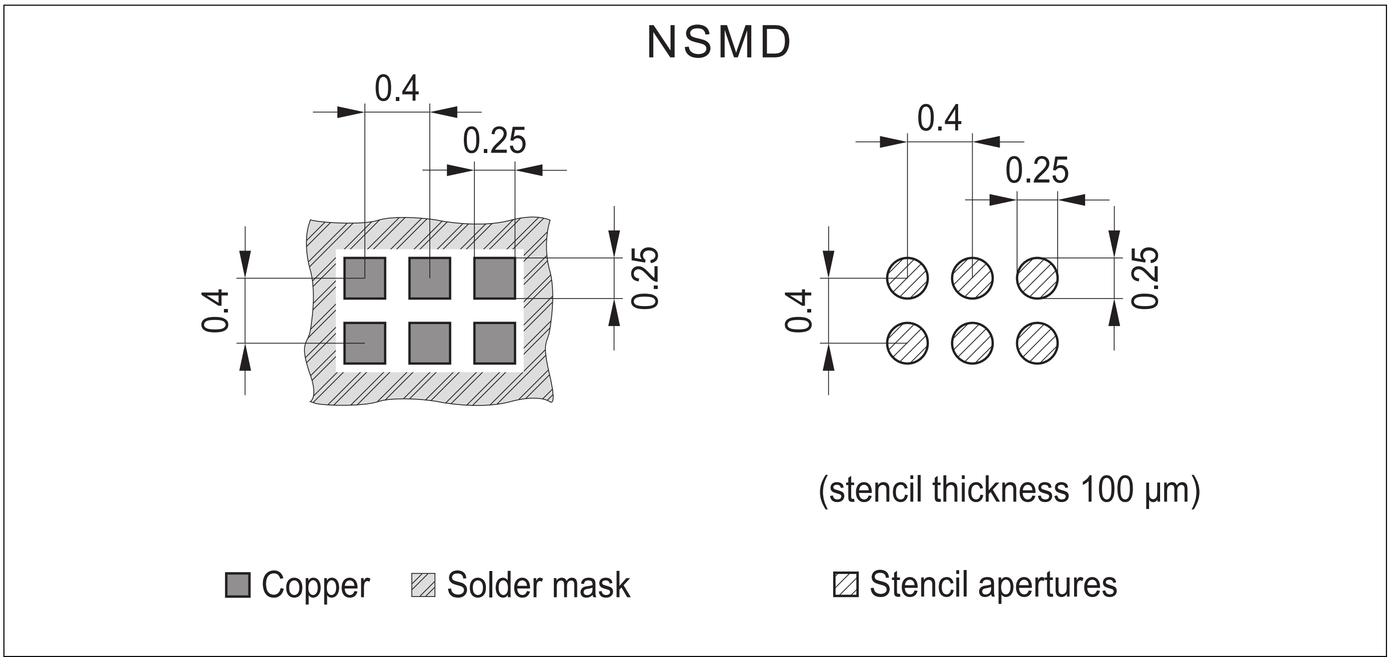

Figure 5: Footprint Recommendation

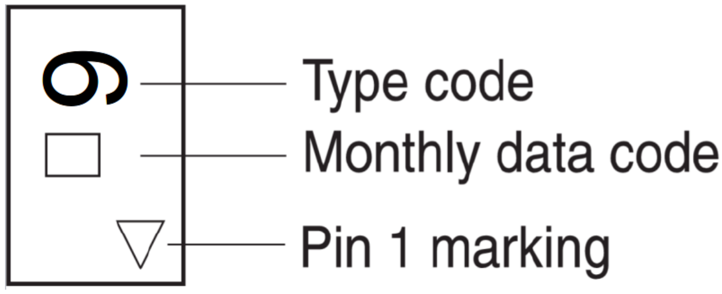

Figure 6: Marking Specification (top view)

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

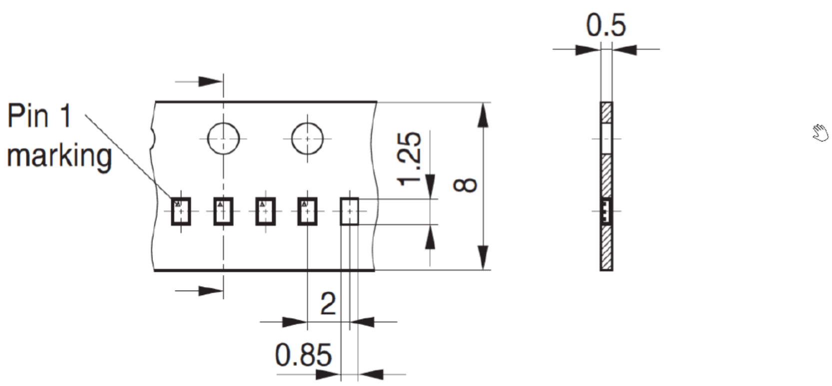

Figure 7: PG-TSNP-6-2 Carrier Tape

Revision History	
–	
Page or Item	**Subjects (major changes since previous revision)**
Revision 2.1, 2021-02-22	
Revision History	
7	Figure 2 changed to top view

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