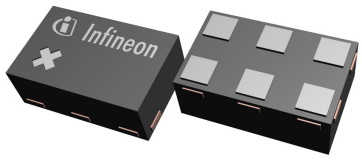
BGA9H1BN6

Highband High Performance LNA with Power-Save-Mode

Features

- Operating frequencies: 2.3 to 2.7 GHz
- Insertion power gain: 20.3 dB
- Insertion loss in bypass mode: 4.3 dB
- Low noise figure: 0.6 dB
- Low current consumption: Min. 2.2 mA
- Multi-state control to save power



0.7 x 1.1 mm^2

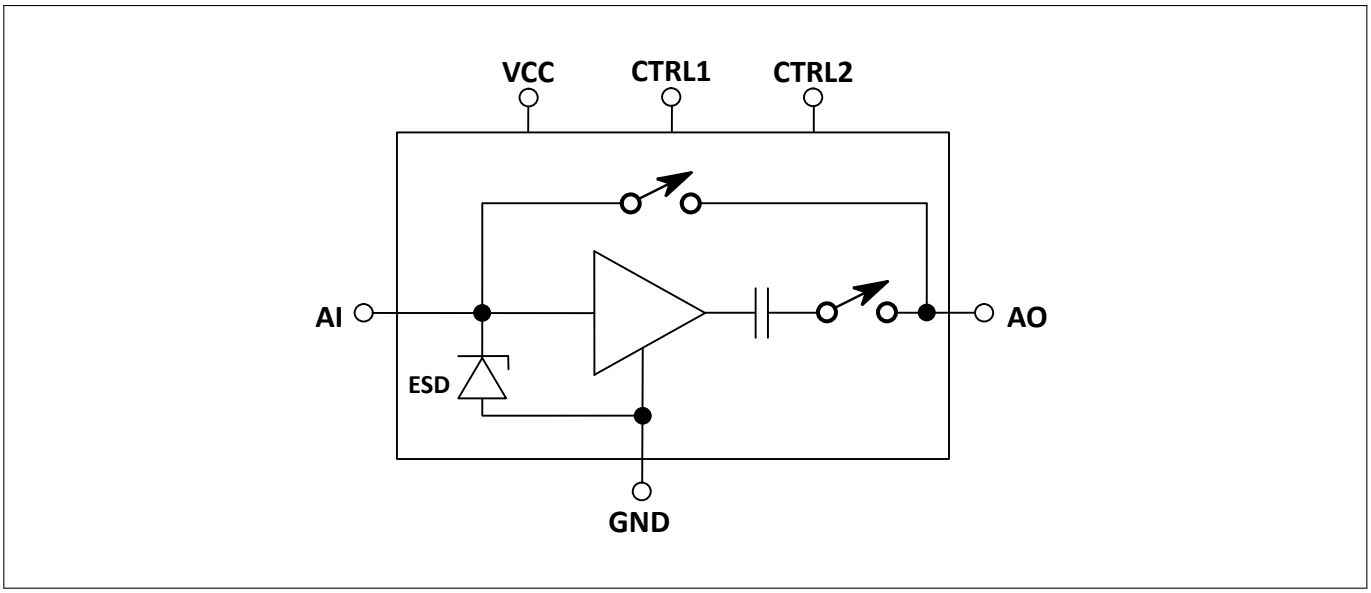
Potential Applications

The BGA9H1BN6 is designed for 4G and 5G applications covering 3GPP bands between 2.3 and 2.7 GHz (optimized for band n41). As a result of a high gain and an ultra-low noise figure performance of the LNA the system sensitivity is significantly improved compared to conventional LNAs. The GPIO interface provides a straightforward control over multiple operation modes. Next to the high gain mode and bypass mode, a power-save and a high performance mode can be selected to increase system dynamic. Due to the low-power mode with 2.2 mA current consumption and 1.2V operation voltage the overall power consumption is extremely low. The BGA9H1BN6 is suitable to be implemented in small battery powered devices like wearables or smartphones.

Product Validation

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

Block diagram



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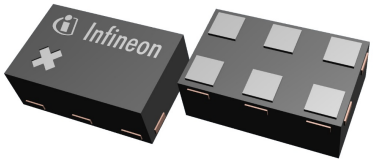
1 Features



- Insertion power gain: Max. 20.3 dB
- Insertion loss in bypass mode: 4.3 dB
- Low noise figure: 0.6 dB
- Low current consumption: Min. 2.2 mA
- Operating frequencies: 2.3 to 2.7 GHz
- Multi-state control
- Supply voltage: 1.1 V to 3.3 V
- Ultra small TSNP-6-10 leadless package (footprint: 0.7 x 1.1 x 0.37 mm^3)
- Silicon germanium BiCMOS technology
- RF output internally matched to 50 Ohm
- Only one external matching component
- RoHS and WEEE compliant package

RoHS Halogen-Free Lead-Free Green

Description

The BGA9H1BN6 is a low noise amplifier for 4G and 5G which covers a wide frequency range from 2.3 GHz to 2.7 GHz. The LNA provides up to 20.3 dB gain and 0.6 dB noise figure at a current consumption of 5.5 mA in the application configuration described in Chapter 4. With the multi-state feature the gain can be adjusted to increase system dynamic and covers a power-saving option. The two-line-state control is fully backwards compatible to a standard GPIO controlled LNA. The BGA9H1BN6 supports ultra-low bypass current of 0.6 µA and 1.2 V operating voltage to reduce power consumption. It operates from 1.1 V to 3.3 V supply voltage over temperature. The compact 6 pin TSNP-6 package with the dimension of 1.1 x 0.7 mm^2 helps to save space on the PCB.

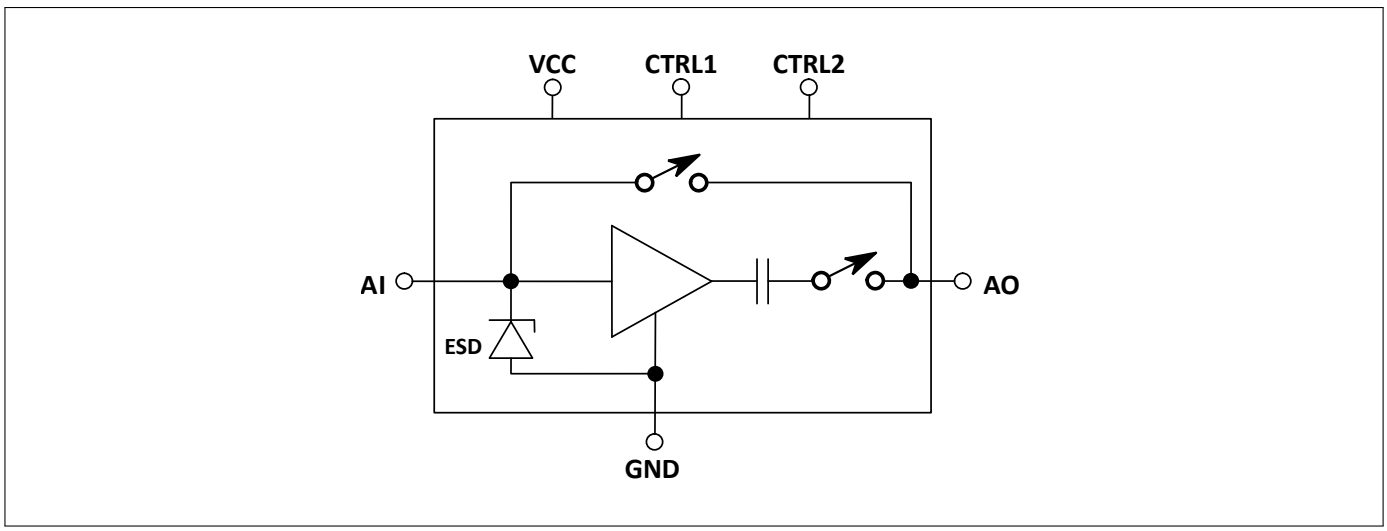


Figure 1: BGA9H1BN6 Block diagram

Product Name	Marking	Package
BGA9H1BN6	H	PG-TSNP-6-10

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}	–	–	–	V	[2]
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 pins CTRL1/CTRL2	$V_{CTRL1,2}$	-0.3	–	V_{CC} + 0.3	V	–
Voltage at pin GND	V_{GND}	-0.3	–	0.3	V	–
Current into pin VCC	I_{CC}	–	–	27	mA	–
RF input power	P_{IN}	–	–	+25	dBm	–
Total power dissipation	P_{tot}	–	–	100	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] No external DC voltage allowed
[3] Human Body Model ANSI/ESDA/JEDEC JS-001 (R = 1.5 kΩ, 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 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 3: Electrical Characteristics at T_A = 25 °C, V_{CC} = 1.8 V, $V_{CTRL1/2}$ = 0/1.8 V

Parameter[1]	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{CC}	1.1	1.8	3.3	V	ON-Mode
Supply Current	I_{CC}	4.2	5.5	6.8	mA	High performance mode
		3.2	4.2	5.2	mA	High gain mode
		1.6	2.2	2.8	mA	Power save mode
		0.0003	0.0006	0.001	mA	Bypass mode
Insertion power gain f = 2600 MHz	$\|S_{21}\|^2$	18.8	20.3	21.8	dB	High performance mode
		18.0	19.5	21.0	dB	High gain mode
		15.1	16.6	18.1	dB	Power save mode
		-5.6	-4.5	-3.6	dB	Bypass mode
Noise Figure f = 2600 MHz, Z_S = 50Ω	NF	–	0.6	1.1	dB	High performance mode
		–	0.6	1.1	dB	High gain mode
		–	0.8	1.3	dB	Power save mode
		–	4.6	5.6	dB	Bypass mode
Input return loss[2] f = 2600 MHz	RL_{IN}	9	13	–	dB	High performance mode
		8	12	–	dB	High gain mode
		5	8	–	dB	Power save mode
		4	6	–	dB	Bypass mode
Output return loss f = 2600 MHz	RL_{OUT}	10	22	–	dB	High performance mode
		10	21	–	dB	High gain mode
		10	20	–	dB	Power save mode
		3	5	–	dB	Bypass mode
Reverse Isolation f = 2600 MHz	$1/\|S_{12}\|^2$	25	30	–	dB	High performance mode
		24	29	–	dB	High gain mode
		24	29	–	dB	Power save mode
		3.6	4.6	–	dB	Bypass mode
Inband input 1dB-compression point f = 2600 MHz	IP_{1dB}	-21	-17	–	dBm	High performance mode
		-20	-16	–	dBm	High gain mode
		-14	-10	–	dBm	Power save mode
		+1	+5	–	dBm	Bypass mode
Inband input 3rd-order intercept point[3]	IIP_3	-12	-7	–	dBm	High performance mode
		-12	-7	–	dBm	High gain mode
		-16	-11	–	dBm	Power save mode
		+17	+22	–	dBm	Bypass mode
Stability	k	> 1	–	–		f = 20 MHz - 10 GHz

[1] Based on application described in chapter 4
[2] Can be tuned by using different external matching components
[3] Input power = −30 dBm for each tone / −15 dBm for bypass mode, f_1 = 2600 MHz, $f_2 = f_1 + 1$ MHz

Table 4: Switching times at T_A = 25 °C, V_{CC} = 1.8 V, $V_{CTRL1/2}$ = 0/1.8 V, f = 2300 – 2700 MHz

Parameter[1]	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Power up settling time [2]	t_{PUP}	–	–	< 1	µs	
Gain settling time[3]	t_{GST}	–	–	< 1	µs	For all gain modes

[1]Based on application described in chapter 4 unless otherwise noted
[2]Time between V_{CC} is at steady state and RF signal is within 1 dB gain error of steady state gain
[3]Time between change of control signal and RF signal is within 1 dB gain error of steady state gain

4 Application Information

Pin Configuration and Function

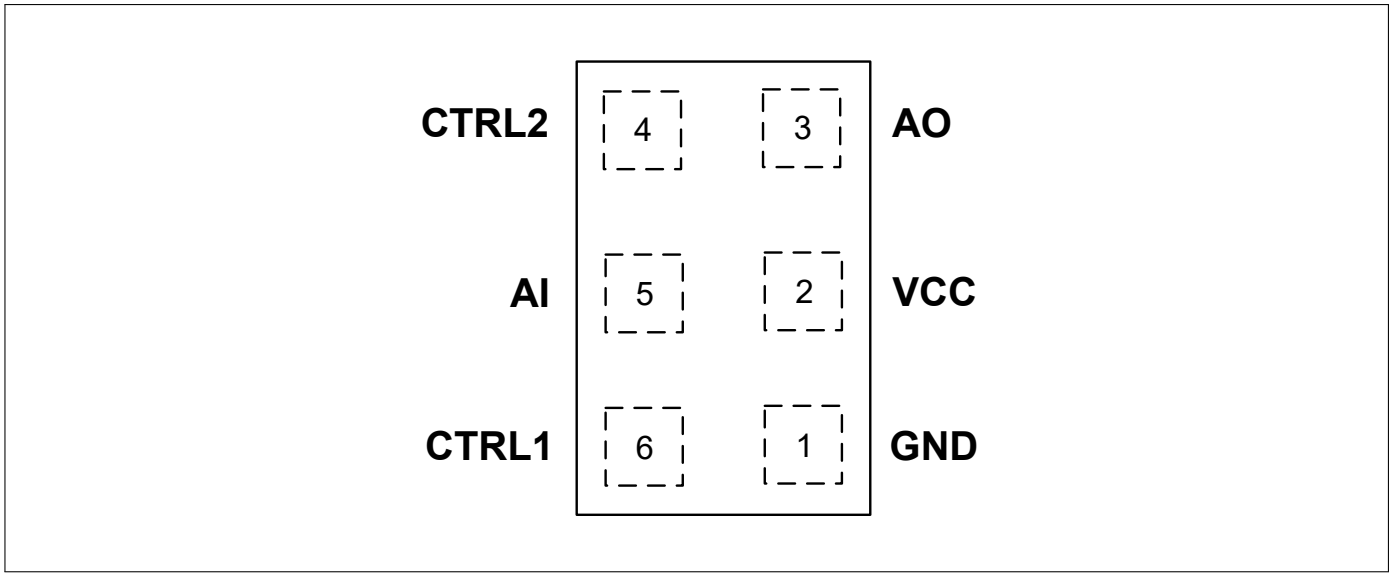


Figure 2: BGA9H1BN6 Pin Configuration (top view)

Table 5: 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 6: Gain mode selection truth table

Control voltage V_{CTRL1}	Control voltage V_{CTRL2}	Gain Mode
Low	High	High performance mode
High	Low	High gain mode
High	High	Power save mode
Low	Low	Bypass mode

Application Board Configuration

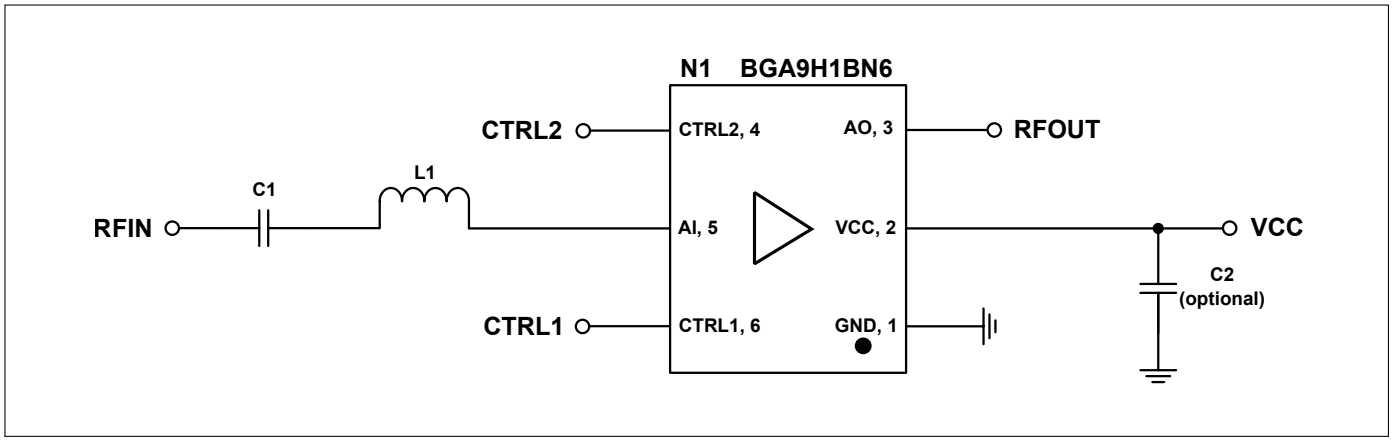


Figure 3: BGA9H1BN6 Application Schematic

Table 7: Bill of Materials Table

Name	Value	Package	Manufacturer	Function
C1	22 pF	0201	Various	DC block
C2 (optional)	$\geq$ 10 nF	0201	Various	RF bypass[1]
L1	4.7 nH	0201	muRata LQP03TN type	Input matching
N1	BGA9H1BN6	PG-TSNP-6-10	Infineon	SiGe BiCMOS LNA

[1]RF bypass recommended to mitigate power supply noise.

5 Package Information

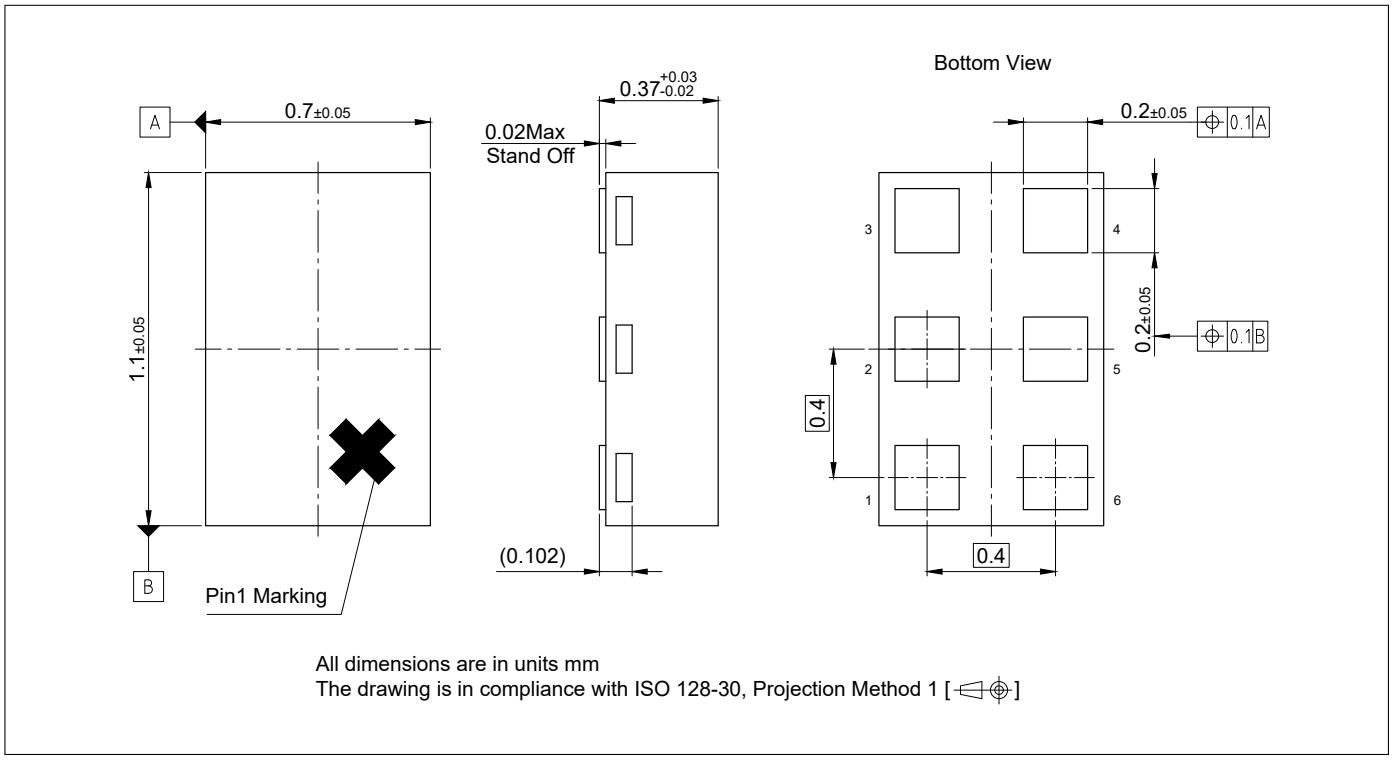


Figure 4: PG-TSNP-6-10 Package Outline (0.7mm x 1.1mm x 0.37mm)

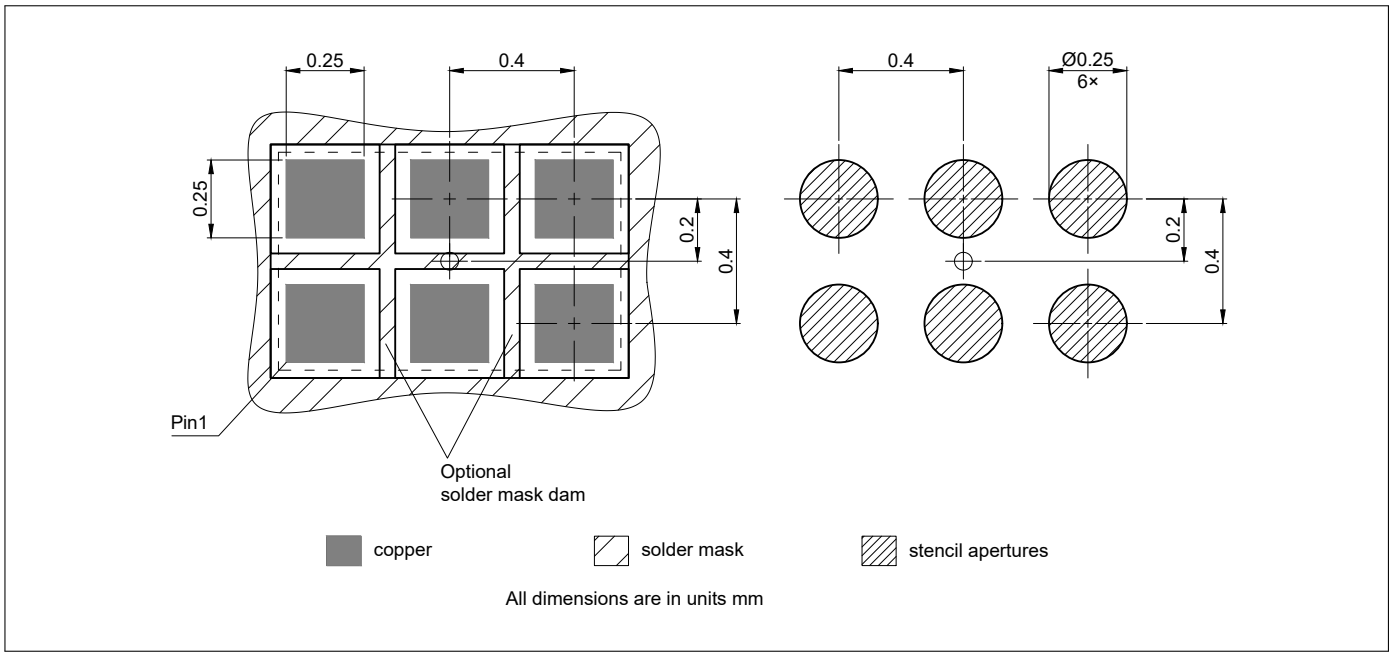


Figure 5: Footprint Recommendation

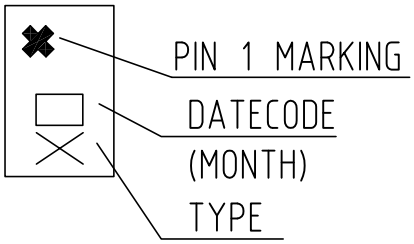


Figure 6: Marking Specification (top view)

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

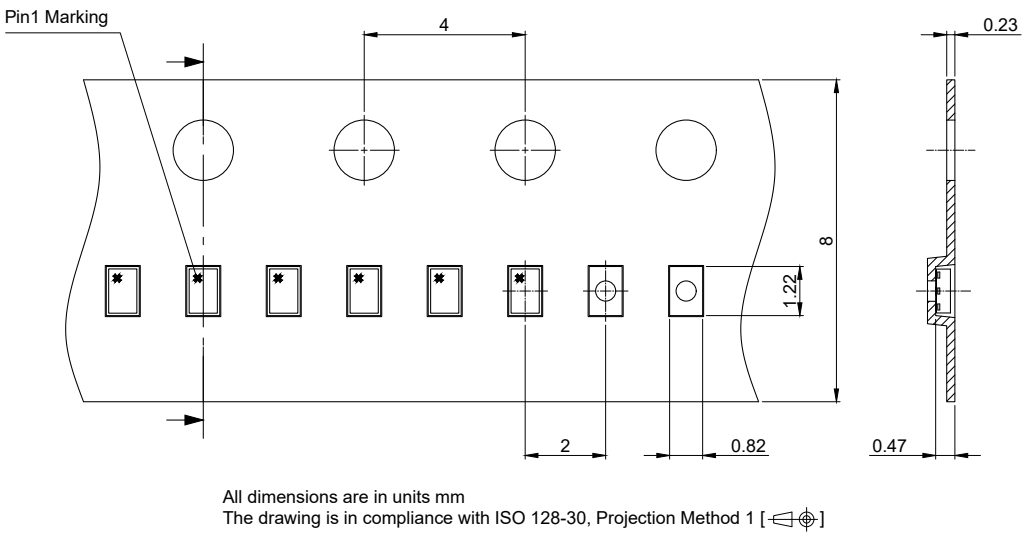


Figure 7: PG-TSNP-6-10 Carrier Tape

Revision History	
Page or Item	**Subjects (major changes since previous revision)**
Revision 2.0, 2021-10-14	
all	Initial version of final datasheet

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