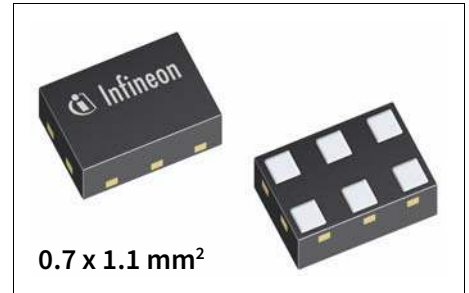


# BGA8U1BN6

## Low Noise Amplifier for Ultra High Band 4-6GHz (f.e. LTE - U/ LAA with bypass)

### Features

- Operating frequencies: 4.0 - 6.0 GHz
- Insertion power gain: 13.7 dB
- Insertion Loss in bypass mode: 7.5 dB
- Low noise figure: 1.6 dB
- Low current consumption: 4.5 mA
- Multi-state control: OFF-, bypass- and high gain-Mode
- Ultra small TSNP-6-2 leadless package
- RF input and RF output internally matched to 50 Ohm, no external components necessary



### Application

The LTE data rate can be significantly improved by using the Low Noise Amplifier. The integrated bypass function increases the overall system dynamic range and leads to more flexibility in the RF front-end.

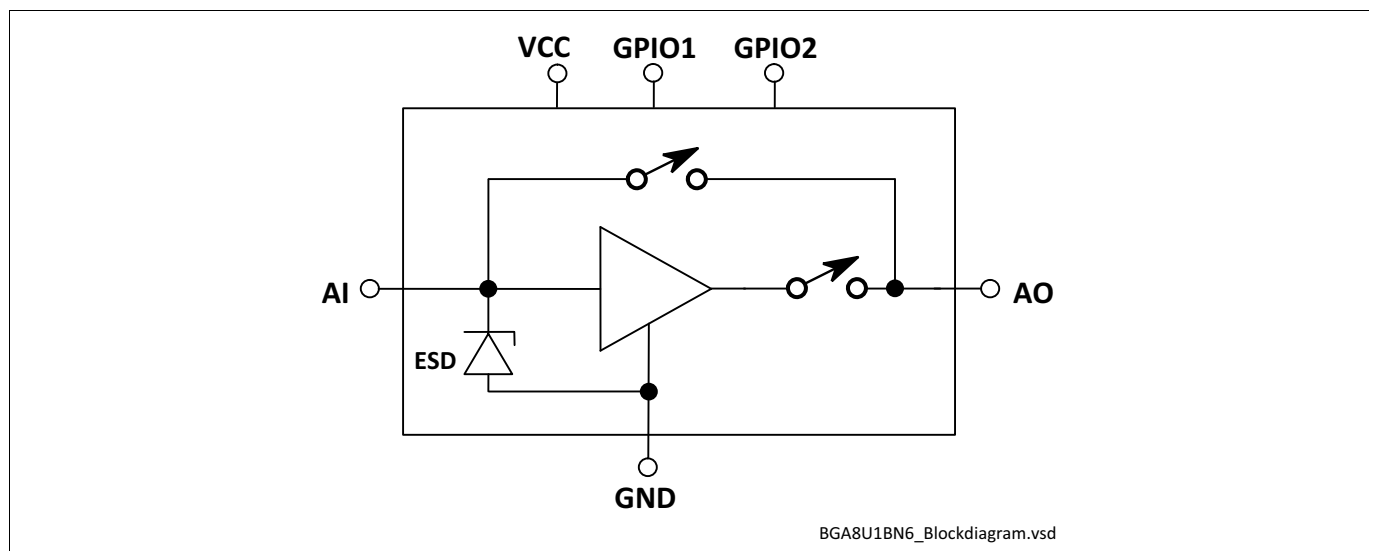
In high gain mode the LNA offers best Noise Figure to ensure high data rates even on the LTE cell edge. Closer to the basestation the bypass mode can be activated reducing current consumption.

The BGA8U1BN6 is designed for the inclicensed LTE spectrum (4-6GHz) part of the 3GPP Release 13.

### Product Validation

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

### Block diagram





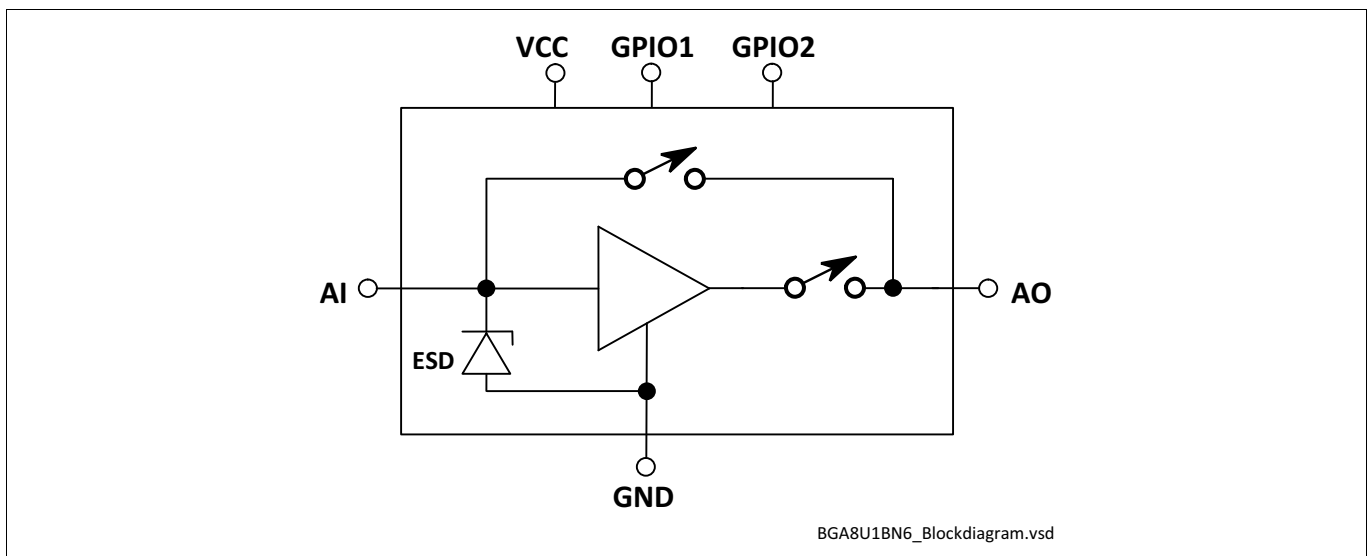
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**Features****1 Features**

- Insertion power gain: 13.7 dB
- Insertion Loss in bypass mode: 7.5 dB
- Low noise figure: 1.6 dB
- Low current consumption: 4.5 mA
- Operating frequencies: 4.0 - 6.0 GHz
- Multi-state control: OFF-, bypass- and high gain-Mode
- Supply voltage: 1.6 V to 3.1 V
- Ultra small TSNP-6-2 leadless package (footprint: 0.7 x 1.1 mm<sup>2</sup>)
- B9HF Silicon Germanium technology
- RF input and RF output internally matched to 50 Ohm
- No external SMD components necessary
- 2kV HBM ESD protection (including AI-pin)
- Pb-free (RoHS compliant) package

**Figure 1 Block Diagram**

Product Name	Marking	Package
BGA8U1BN6	Y	TSNP-6-2

**Features****Description**

The BGA8U1BN6 is a front-end low noise amplifier for LTE which covers a wide frequency range from 4.0 GHz to 6.0 GHz. The LNA provides 13.7 dB gain and 1.6 dB noise figure at a current consumption of 4.5 mA in the application configuration described in [Chapter 4](#). In bypass mode the LNA provides an insertion loss of 7.5 dB. The BGA8U1BN6 is based upon Infineon Technologies' B7HF Silicon Germanium technology. It operates from 1.6 V to 3.1 V supply voltage. The device features a multi-state control (OFF-, bypass- and high gain-Mode).

**Pin Definition and Function****Table 1 Pin Definition and Function**

Pin No.	Name	Function
1	GPIO2	Control pin 2
2	VCC	DC supply
3	AO	LNA output
4	GPIO1	Control pin 1
5	GND	Ground
6	AI	LNA input

**Control Table****Table 2 Control Table**

	GPIO1	GPIO2
OFF	Low	Low
	High	Low
Bypass mode	Low	High
High gain mode	High	High

## Maximum Ratings

## 2 Maximum Ratings

Table 3 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 GPIO pins	$V_{GPIO}$	-0.3	–	$V_{CC} + 0.3$	V	–
Voltage at pin GND	$V_{GND}$	-0.3	–	0.3	V	–
Current into pin VCC	$I_{CC}$	–	–	16	mA	–
RF input power	$P_{IN}$	–	–	+25	dBm	–
Total power dissipation, $T_S < 148\text{ °C}^2)$	$P_{tot}$	–	–	60	mW	–
Junction temperature	$T_J$	–	–	150	°C	–
Ambient temperature range	$T_A$	-40	–	85	°C	–
Storage temperature range	$T_{STG}$	-65	–	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.

## Electrical Characteristics

## 3 Electrical Characteristics

Table 4 Electrical Characteristics<sup>1)</sup>
 $T_A = 25\text{ °C}$ ,  $V_{CC} = 1.8\text{ V}$ ,  $V_{GPIOx,ON} = 1.8\text{ V}$ ,  $V_{GPIOx,OFF} = 0\text{ V}$ ,  $f = 4000 - 6000\text{ MHz}$ 

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage	$V_{CC}$	1.6	1.8	3.1	V	–
Control voltages	$V_{GPIOx}$	1.0	–	$V_{CC}$	V	High
		0	–	0.4	V	Low
Supply current	$I_{CC}$	–	4.3	5.3	mA	High gain mode
		–	85	120	$\mu\text{A}$	Bypass mode
		–	0.1	2	$\mu\text{A}$	OFF-Mode
Insertion power gain $f = 5500\text{ MHz}$	$ S_{21} ^2$	10.9	13.4	15.9	dB	High gain mode
		-9.5	-7.5	-5.5	dB	Bypass mode
Noise figure <sup>2)</sup> $f = 5500\text{ MHz}$ , $Z_S = 50\ \Omega$	NF	–	1.65	2.55	dB	High gain mode
		–	7.5	9.5	dB	Bypass mode
Input return loss <sup>3)</sup> $f = 5500\text{ MHz}$	$RL_{IN}$	9	13	–	dB	High gain mode
		7	11	–	dB	Bypass mode
Output return loss <sup>3)</sup> $f = 5500\text{ MHz}$	$RL_{OUT}$	12	20	–	dB	High gain mode
		3	4	–	dB	Bypass mode
Reverse isolation <sup>3)</sup> $f = 5500\text{ MHz}$	$1/ S_{12} ^2$	20	28	–	dB	High gain mode
		5.5	7.5	–	dB	Bypass mode
Transient time $C_1 = 1\text{ nF}$ <sup>4)6)</sup>	$t_s$	–	0.3	3	$\mu\text{s}$	High gain- to bypass-mode
		–	12	15	$\mu\text{s}$	Bypass- to High gain-mode
Transient time $C_1 = 33\text{ pF}$ <sup>4)6)</sup>	$t_s$	–	0.3	3	$\mu\text{s}$	High gain- to bypass-mode
		–	1	3	$\mu\text{s}$	Bypass- to High gain-mode
Inband input 1dB-compression point, $f = 5500\text{ MHz}$ <sup>3)</sup>	$IP_{1dB}$	-22	-18	–	dBm	High gain mode
		-8	-4	–	dBm	Bypass mode
Inband input 3 <sup>rd</sup> -order intercept point <sup>3)5)</sup> $f_1 = 5500\text{ MHz}$ , $f_2 = f_1 \pm 1\text{ MHz}$	$IIP_3$	-16	-11	–	dBm	High gain mode $C_1 = 1\text{ nF}$
		-1	4	–	dBm	Bypass mode $C_1 = 1\text{ nF}$
Phase discontinuity between ON- and bypass-mode <sup>3)</sup>		-6	–	6	°	Part to part variation after compensation in Base Band with constant value
Stability <sup>6)</sup>	$k$	> 1	–	–		$f = 20\text{ MHz} \dots 10\text{ GHz}$

1) Based on the application described 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

5) Input power HG = -30 dBm for each tone; input power BP = -10 dBm for each tone

6) Guaranteed by device design; not tested in production

## Electrical Characteristics

Table 5 Electrical Characteristics<sup>1)</sup>
 $T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $V_{GPIOx,ON} = 2.8\text{ V}$ ,  $V_{GPIOx,OFF} = 0\text{ V}$ ,  $f = 4000 - 6000\text{ MHz}$ 

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage	$V_{CC}$	1.6	2.8	3.1	V	–
Control voltages	$V_{GPIOx}$	1.0	–	$V_{CC}$	V	High
		0	–	0.4	V	Low
Supply current	$I_{CC}$	–	4.5	5.5	mA	High gain mode
		–	85	120	$\mu\text{A}$	Bypass mode
		–	0.1	2	$\mu\text{A}$	OFF-Mode
Insertion power gain $f = 5500\text{ MHz}$	$ S_{21} ^2$	11.2	13.7	16.2	dB	High gain mode
		-9.5	-7.5	-5.5	dB	Bypass mode
Noise figure <sup>2)</sup> $f = 5500\text{ MHz}$ , $Z_S = 50\ \Omega$	$NF$	–	1.6	2.5	dB	High gain mode
		–	7.5	9.5	dB	Bypass mode
Input return loss <sup>3)</sup> $f = 5500\text{ MHz}$	$RL_{IN}$	9	13	–	dB	High gain mode
		7	11	–	dB	Bypass mode
Output return loss <sup>3)</sup> $f = 5500\text{ MHz}$	$RL_{OUT}$	12	20	–	dB	High gain mode
		3	4	–	dB	Bypass mode
Reverse isolation <sup>3)</sup> $f = 5500\text{ MHz}$	$1/ S_{12} ^2$	20	28	–	dB	High gain mode
		5.5	7.5	–	dB	Bypass mode
Transient time $C_1 = 1\text{ nF}$ <sup>4)6)</sup>	$t_S$	–	0.3	3	$\mu\text{s}$	High gain- to bypass-mode
		–	7	10	$\mu\text{s}$	Bypass- to High gain-mode
Transient time $C_1 = 33\text{ pF}$ <sup>4)6)</sup>	$t_S$	–	0.3	3	$\mu\text{s}$	High gain- to bypass-mode
		–	0.9	3	$\mu\text{s}$	Bypass- to High gain-mode
Inband input 1dB-compression point, $f = 5500\text{ MHz}$ <sup>3)</sup>	$IP_{1dB}$	-22	-18	–	dBm	High gain mode
		-8	-4	–	dBm	Bypass mode
Inband input 3 <sup>rd</sup> -order intercept point <sup>3)5)</sup> $f_1 = 5500\text{ MHz}$ , $f_2 = f_1 \pm 1\text{ MHz}$	$IIP_3$	-15	-10	–	dBm	High gain mode $C_1 = 1\text{ nF}$
		-1	4	–	dBm	Bypass mode $C_1 = 1\text{ nF}$
Phase discontinuity between ON- and bypass-mode <sup>3)</sup>		-6	–	6	$^\circ$	Part to part variation after compensation in Base Band with constant value
Stability <sup>6)</sup>	$k$	> 1	–	–		$f = 20\text{ MHz} \dots 10\text{ GHz}$

1) Based on the application described 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

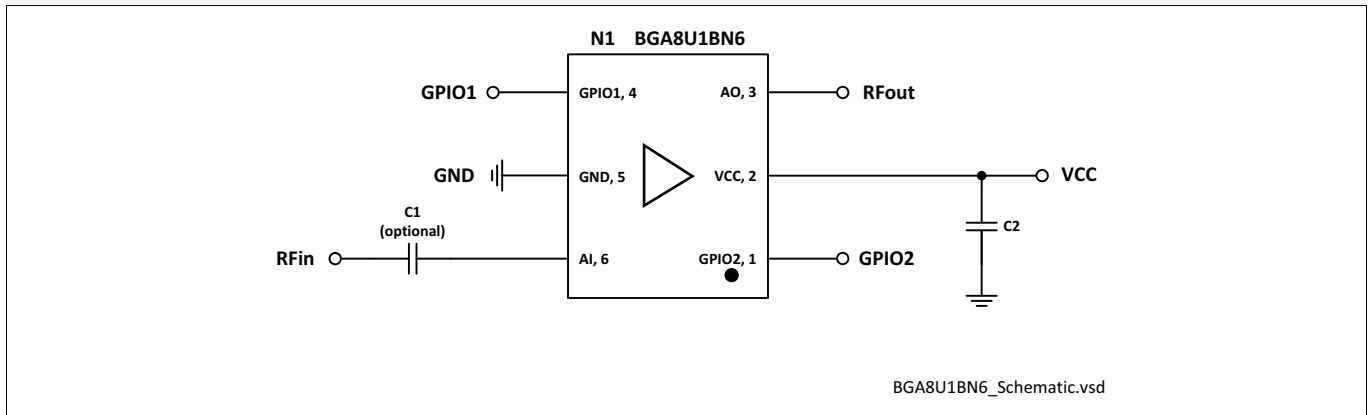
5) Input power HG = -30 dBm for each tone; input power BP = -10 dBm for each tone

6) Guaranteed by device design; not tested in production

**Application Information**

# 1 Application Information

## Application Board Configuration



**Figure 1 Application Schematic BGA8U1BN6**

**Table 1 Bill of Materials**

Name	Value	Package	Manufacturer	Function
C1 (optional)	1nF/33pF	0402	Various	DC block <sup>1)</sup>
C2 (optional)	≥ 1nF	0402	Various	RF bypass <sup>2)</sup>
N1	BGA8U1BN6	TSNP-6-2	Infineon	SiGe LNA

1) No external DC block is needed if there is pre-filter implemented. DC block capacitor of less or equal than 100 pF is recommended to reduce the switching time during the mode transition.

2) RF bypass recommended to mitigate power supply noise

A list of all application notes is available at <http://www.infineon.com/ltelna>



Package Information

1 Package Information

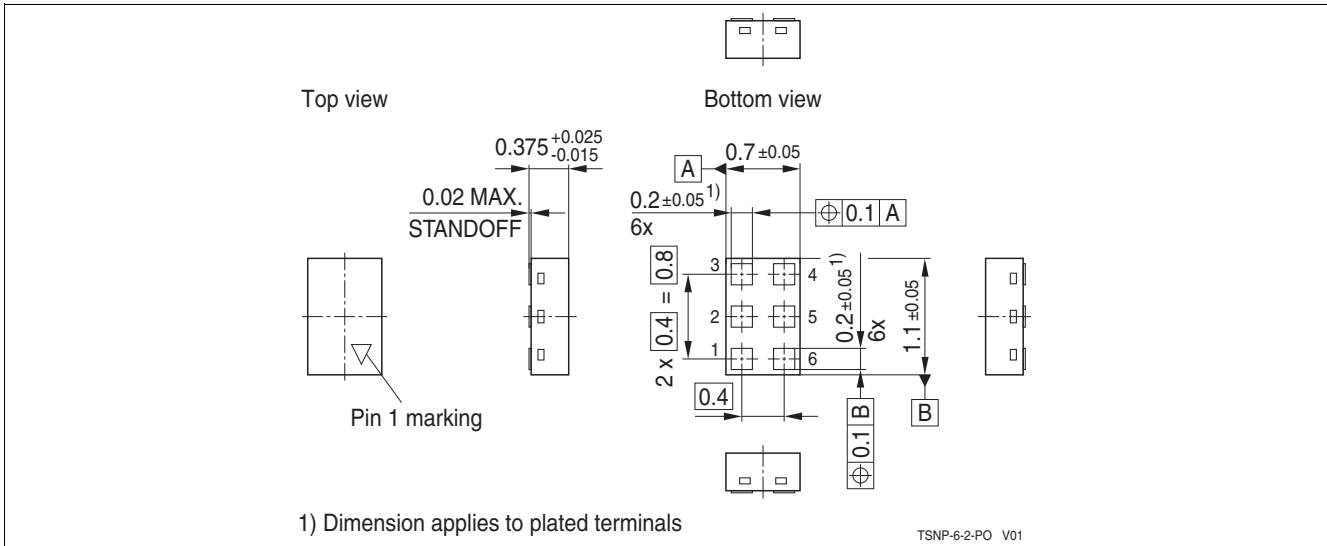


Figure 1 TSNP-6-2 Package Outline (top, side and bottom views)

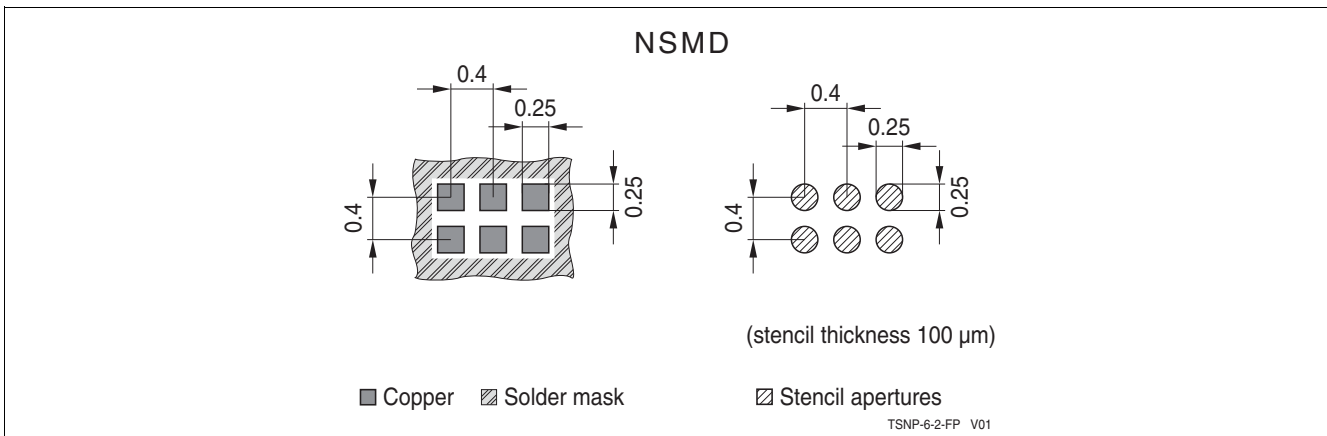


Figure 2 Footprint Recommendation TSNP-6-2

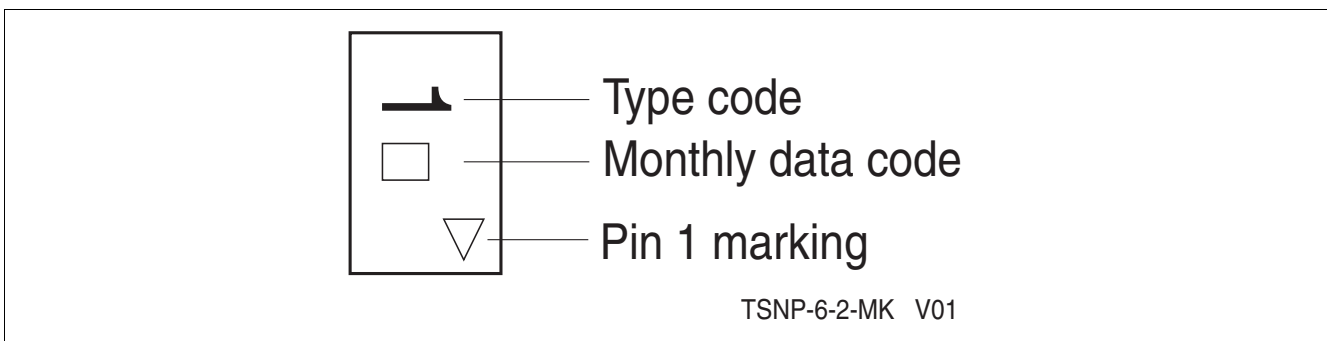
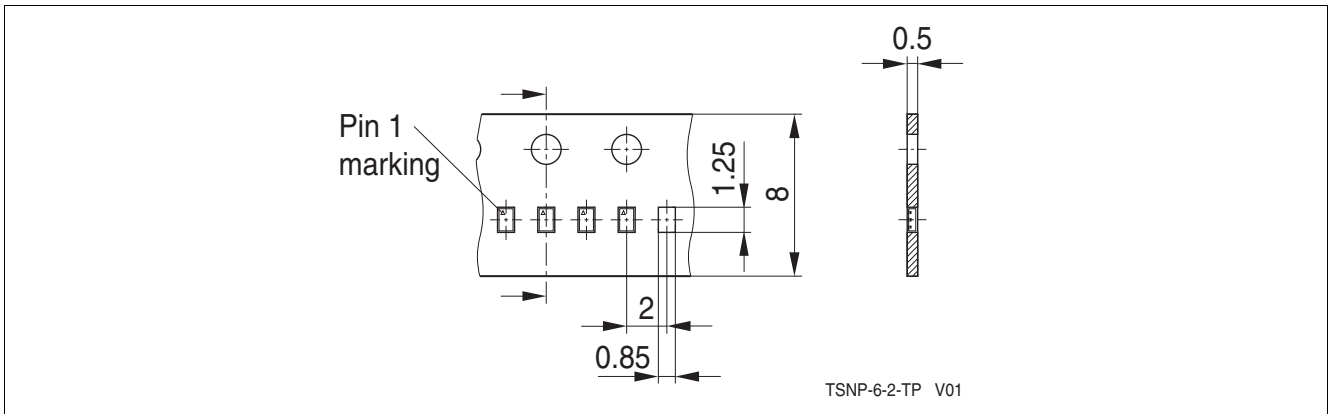


Figure 3 Marking Layout (top view)

**Package Information**



**Figure 4 Tape & Reel Dimensions (reel diameter 180 mm, pieces/reel 15000)**

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**Revision History**

<b>Page or Item</b>	<b>Subjects (major changes since previous revision)</b>
---------------------	---

**Revision 3.2, 2021-04-19**

6	Add Electrical Characterisation for Vcc=1.8V
7	Update Transient Time Information
8	Update Application Information

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