

# BGA824N6

Silicon Germanium Low Noise Amplifier  
for Global Navigation Satellite Systems (GNSS)

## Data Sheet

Revision 3.0, 2013-06-24

RF & Protection Devices

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## Revision History

| Page or Item | Subjects (major changes since previous revision) |
|--------------|--------------------------------------------------|
|--------------|--------------------------------------------------|

### Revision 3.0, 2013-06-24

|     |                                         |
|-----|-----------------------------------------|
| all | "Preliminary" status removed            |
| 9   | Thermal Resistance $R_{thJS}$ specified |
| 13  | Drawing of application board updated    |

### Revision 2.0, 2013-02-04

|              |                                            |
|--------------|--------------------------------------------|
| all          | Preliminary Data Sheet                     |
| 14, 15       | Package drawings and information completed |
| 7, 8, 10, 11 | Electrical Characteristics adjusted        |

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Last Trademarks Update 2011-11-11

## Table of Contents

|          |                                         |    |
|----------|-----------------------------------------|----|
|          | <b>Table of Contents</b> .....          | 4  |
|          | <b>List of Figures</b> .....            | 5  |
|          | <b>List of Tables</b> .....             | 6  |
|          | <b>Features</b> .....                   | 7  |
| <b>1</b> | <b>Maximum Ratings</b> .....            | 9  |
| <b>2</b> | <b>Electrical Characteristics</b> ..... | 10 |
| <b>3</b> | <b>Application Information</b> .....    | 12 |
| <b>4</b> | <b>Package Information</b> .....        | 14 |

## List of Figures

|          |                                                                           |    |
|----------|---------------------------------------------------------------------------|----|
| Figure 1 | Block Diagram . . . . .                                                   | 7  |
| Figure 2 | Application Schematic BGA824N6 . . . . .                                  | 12 |
| Figure 3 | Drawing of Application Board . . . . .                                    | 13 |
| Figure 4 | Application Board Cross-Section . . . . .                                 | 13 |
| Figure 5 | TSNP-6-2 Package Outline (top, side and bottom views) . . . . .           | 14 |
| Figure 6 | Footprint Recommendation TSNP-6-2 . . . . .                               | 14 |
| Figure 7 | Marking Layout (top view). . . . .                                        | 14 |
| Figure 8 | Tape & Reel Dimensions (reel diameter 180 mm, pieces/reel 15000). . . . . | 15 |

## List of Tables

|         |                                                                                                                                                                                                                  |    |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Table 1 | Pin Definition and Function .....                                                                                                                                                                                | 8  |
| Table 2 | Maximum Ratings .....                                                                                                                                                                                            | 9  |
| Table 3 | Thermal Resistance .....                                                                                                                                                                                         | 9  |
| Table 4 | Electrical Characteristics: $T_A = 25\text{ °C}$ , $V_{CC} = 1.8\text{ V}$ , $V_{PON,ON} = 1.8\text{ V}$ , $V_{PON,OFF} = 0\text{ V}$ ,<br>$f = 1550 - 1615\text{ MHz}$ (GPS / Glonass / Beidou / Galileo) ..... | 10 |
| Table 5 | Electrical Characteristics: $T_A = 25\text{ °C}$ , $V_{CC} = 2.8\text{ V}$ , $V_{PON,ON} = 2.8\text{ V}$ , $V_{PON,OFF} = 0\text{ V}$ ,<br>$f = 1550 - 1615\text{ MHz}$ (GPS / Glonass / Beidou / Galileo) ..... | 11 |
| Table 6 | Bill of Materials .....                                                                                                                                                                                          | 12 |

## Silicon Germanium Low Noise Amplifier for Global Navigation Satellite Systems (GNSS)

**BGA824N6**

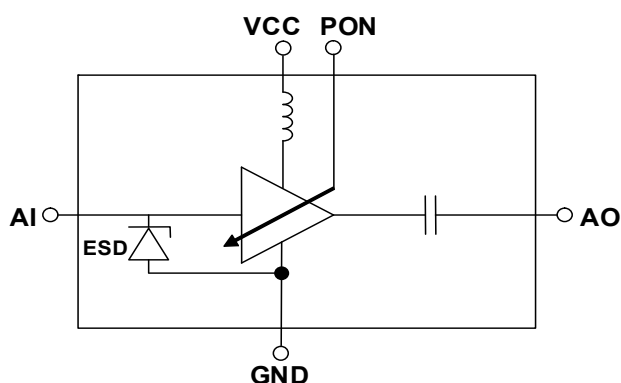
### Features

- High insertion power gain: 17.0 dB
- Out-of-band input 3rd order intercept point: +7 dBm
- Input 1 dB compression point: -6 dBm
- Low noise figure: 0.55 dB
- Low current consumption: 3.8 mA
- Operating frequencies: 1550 - 1615 MHz
- Supply voltage: 1.5 V to 3.3 V
- Digital on/off switch (1V logic high level)
- Ultra small TSNP-6-2 leadless package (footprint: 0.7 x 1.1 mm<sup>2</sup>)
- B7HF Silicon Germanium technology
- RF output internally matched to 50  $\Omega$
- Only 1 external SMD component necessary
- 2kV HBM ESD protection (including AI-pin)
- Pb-free (RoHS compliant) package



### Application

- Ideal for all Global Navigation Satellite Systems (GNSS) like GPS, GLONASS, Beidou, Galileo and others.



BGA824N6\_Blockdiagram.vsd

**Figure 1 Block Diagram**

| Product Name | Marking | Package  |
|--------------|---------|----------|
| BGA824N6     | F       | TSNP-6-2 |

**Description**

The BGA824N6 is a front-end low noise amplifier for Global Navigation Satellite Systems (GNSS) from 1550 MHz to 1615 MHz like GPS, GLONASS, Beidou, Galileo and others. The LNA provides 17.0 dB gain and 0.55 dB noise figure at a current consumption of 3.8 mA in the application configuration described in [Chapter 3](#). The BGA824N6 is based upon Infineon Technologies' B7HF Silicon Germanium technology. It operates from 1.5 V to 3.6 V supply voltage.

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

# 1 Maximum Ratings

**Table 2 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 GNDRF                                   | $V_{GNDRF}$    | -0.3   | –    | 0.3            | V    | –                        |
| Current into pin VCC                                   | $I_{CC}$       | –      | –    | 16             | mA   | –                        |
| RF input power                                         | $P_{IN}$       | –      | –    | 0              | dBm  | –                        |
| Total power dissipation,<br>$T_S < 148\text{ °C}^{2)}$ | $P_{tot}$      | –      | –    | 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           | V    | according to JESD22A-114 |

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. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.**

## Thermal Resistance

**Table 3 Thermal Resistance**

| Parameter                                | Symbol     | Value | Unit |
|------------------------------------------|------------|-------|------|
| Junction - soldering point <sup>1)</sup> | $R_{thJS}$ | 25    | K/W  |

1) For calculation of  $R_{thJA}$  please refer to Application Note Thermal Resistance

## 2 Electrical Characteristics

**Table 4** Electrical Characteristics:<sup>1)</sup>  $T_A = 25\text{ °C}$ ,  $V_{CC} = 1.8\text{ V}$ ,  $V_{PON,ON} = 1.8\text{ V}$ ,  $V_{PON,OFF} = 0\text{ V}$ ,  
 $f = 1550 - 1615\text{ MHz}$  (GPS / Glonass / Beidou / Galileo)

| Parameter                                                              | Symbol         | Values |       |          | Unit | Note / Test Condition                                   |
|------------------------------------------------------------------------|----------------|--------|-------|----------|------|---------------------------------------------------------|
|                                                                        |                | Min.   | Typ.  | Max.     |      |                                                         |
| Supply voltage                                                         | $V_{CC}$       | 1.5    | –     | 3.3      | V    | –                                                       |
| Supply current                                                         | $I_{CC}$       | –      | 3.8   | 4.8      | mA   | ON-mode                                                 |
|                                                                        |                | –      | 0.2   | 3        | μA   | OFF-mode                                                |
| Power On voltage                                                       | $V_{pon}$      | 1.0    | –     | $V_{CC}$ | V    | ON-mode                                                 |
|                                                                        |                | 0      | –     | 0.4      | V    | OFF-mode                                                |
| Power On current                                                       | $I_{pon}$      | –      | 5     | 10       | μA   | ON-mode                                                 |
|                                                                        |                | –      | –     | 1        | μA   | OFF-mode                                                |
| Insertion power gain                                                   | $ S_{21} ^2$   | –      | 17.0  | –        | dB   | –                                                       |
| Noise figure <sup>2)</sup>                                             | $NF$           | –      | 0.55  | –        | dB   | $Z_S = 50\text{ }\Omega$                                |
| Input return loss                                                      | $RL_{in}$      | –      | 14    | –        | dB   | –                                                       |
| Output return loss                                                     | $RL_{out}$     | –      | 17    | –        | dB   | –                                                       |
| Reverse isolation                                                      | $1/ S_{12} ^2$ | –      | 23    | –        | dB   | –                                                       |
| Power gain settling time <sup>3)</sup>                                 | $t_S$          | –      | 5     | –        | μs   | OFF- to ON-mode                                         |
|                                                                        |                | –      | 5     | –        | μs   | ON- to OFF-mode                                         |
| Inband input 1dB-compression point                                     | $IP_{1dB}$     | –      | -9    | –        | dBm  | –                                                       |
| Inband input 3 <sup>rd</sup> -order intercept point <sup>4)</sup>      | $IIP_3$        | –      | +2    | –        | dBm  | $f_1 = 1575\text{ MHz}$<br>$f_2 = f_1 \pm 1\text{ MHz}$ |
| Out-of-band input 3 <sup>rd</sup> -order intercept point <sup>5)</sup> | $IIP_{3oob}$   | –      | +7    | –        | dBm  | $f_1 = 1712.7\text{ MHz}$<br>$f_2 = 1850\text{ MHz}$    |
| Stability                                                              | $k$            | –      | > 1.2 | –        |      | $f = 20\text{ MHz} \dots 10\text{ GHz}$                 |

1) Based on the application described in chapter 3

2) PCB losses are subtracted

3) To be within 1 dB of the final gain OFF- to ON-mode; to be within 3 dB of the final gain ON- to OFF-mode

4) Input power = -30 dBm for each tone

5) Input power = -20 dBm for each tone

## Electrical Characteristics

**Table 5** Electrical Characteristics:<sup>1)</sup>  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $V_{PON,ON} = 2.8\text{ V}$ ,  $V_{PON,OFF} = 0\text{ V}$ ,  
 $f = 1550 - 1615\text{ MHz}$  (GPS / Glonass / Beidou / Galileo)

| Parameter                                                              | Symbol         | Values |       |          | Unit | Note / Test Condition                                  |
|------------------------------------------------------------------------|----------------|--------|-------|----------|------|--------------------------------------------------------|
|                                                                        |                | Min.   | Typ.  | Max.     |      |                                                        |
| Supply voltage                                                         | $V_{CC}$       | 1.5    | –     | 3.3      | V    | –                                                      |
| Supply current                                                         | $I_{CC}$       | –      | 3.9   | 4.9      | mA   | ON-mode                                                |
|                                                                        |                | –      | 0.2   | 3        | μA   | OFF-mode                                               |
| Power On voltage                                                       | $V_{pon}$      | 1.0    | –     | $V_{CC}$ | V    | ON-mode                                                |
|                                                                        |                | 0      | –     | 0.4      | V    | OFF-mode                                               |
| Power On current                                                       | $I_{pon}$      | –      | 10    | 15       | μA   | ON-mode                                                |
|                                                                        |                | –      | –     | 1        | μA   | OFF-mode                                               |
| Insertion power gain                                                   | $ S_{21} ^2$   | –      | 17.1  | –        | dB   | –                                                      |
| Noise figure <sup>2)</sup>                                             | $NF$           | –      | 0.55  | –        | dB   | $Z_S = 50\text{ }\Omega$                               |
| Input return loss                                                      | $RL_{in}$      | –      | 15    | –        | dB   | –                                                      |
| Output return loss                                                     | $RL_{out}$     | –      | 18    | –        | dB   | –                                                      |
| Reverse isolation                                                      | $1/ S_{12} ^2$ | –      | 23    | –        | dB   | –                                                      |
| Power gain settling time <sup>3)</sup>                                 | $t_S$          | –      | 5     | –        | μs   | OFF- to ON-mode                                        |
|                                                                        |                | –      | 5     | –        | μs   | ON- to OFF-mode                                        |
| Inband input 1dB-compression point                                     | $IP_{1dB}$     | –      | -6    | –        | dBm  | –                                                      |
| Inband input 3 <sup>rd</sup> -order intercept point <sup>4)</sup>      | $IIP_3$        | –      | +3    | –        | dBm  | $f_1 = 1575\text{ MHz}$<br>$f_2 = f_1 +/-1\text{ MHz}$ |
| Out-of-band input 3 <sup>rd</sup> -order intercept point <sup>5)</sup> | $IIP_{3oob}$   | –      | +7    | –        | dBm  | $f_1 = 1712.7\text{ MHz}$<br>$f_2 = 1850\text{ MHz}$   |
| Stability                                                              | $k$            | –      | > 1.2 | –        |      | $f = 20\text{ MHz} \dots 10\text{ GHz}$                |

1) Based on the application described in chapter 3

2) PCB losses are subtracted

3) To be within 1 dB of the final gain OFF- to ON-mode; to be within 3 dB of the final gain ON- to OFF-mode

4) Input power = -30 dBm for each tone

5) Input power = -20 dBm for each tone

### 3 Application Information

#### Application Board Configuration

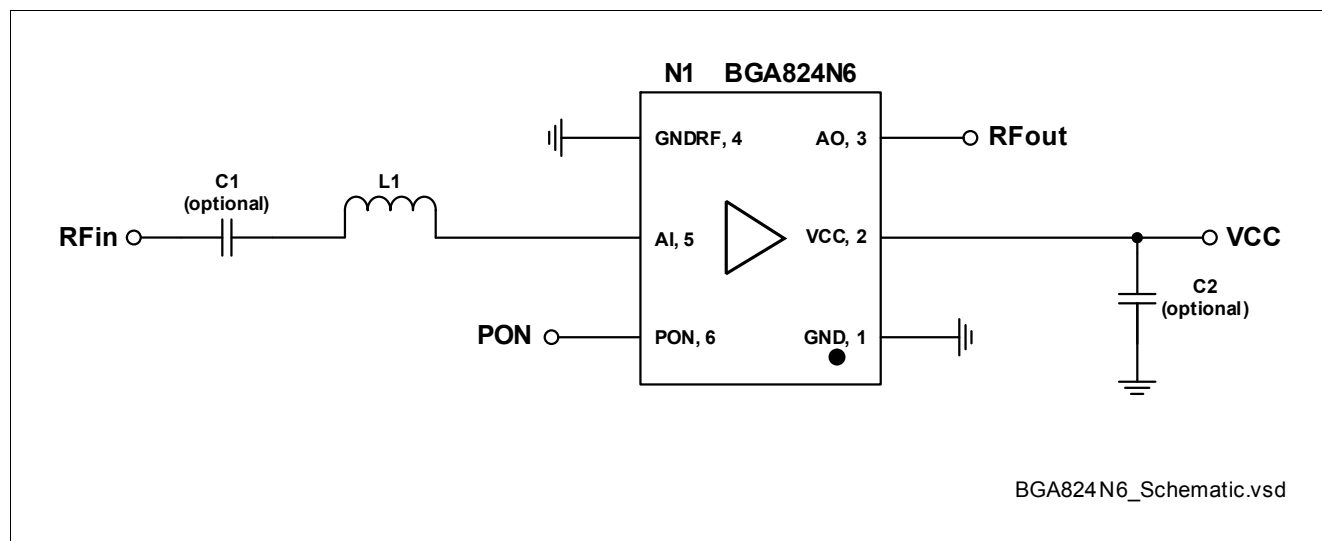


Figure 2 Application Schematic BGA824N6

Table 6 Bill of Materials

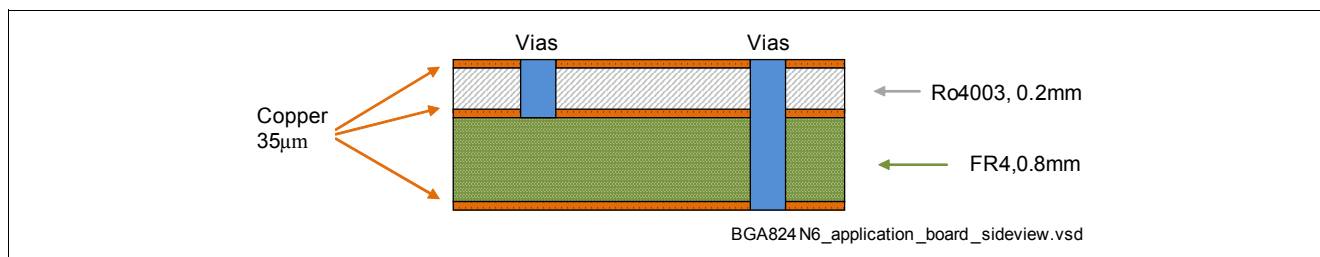
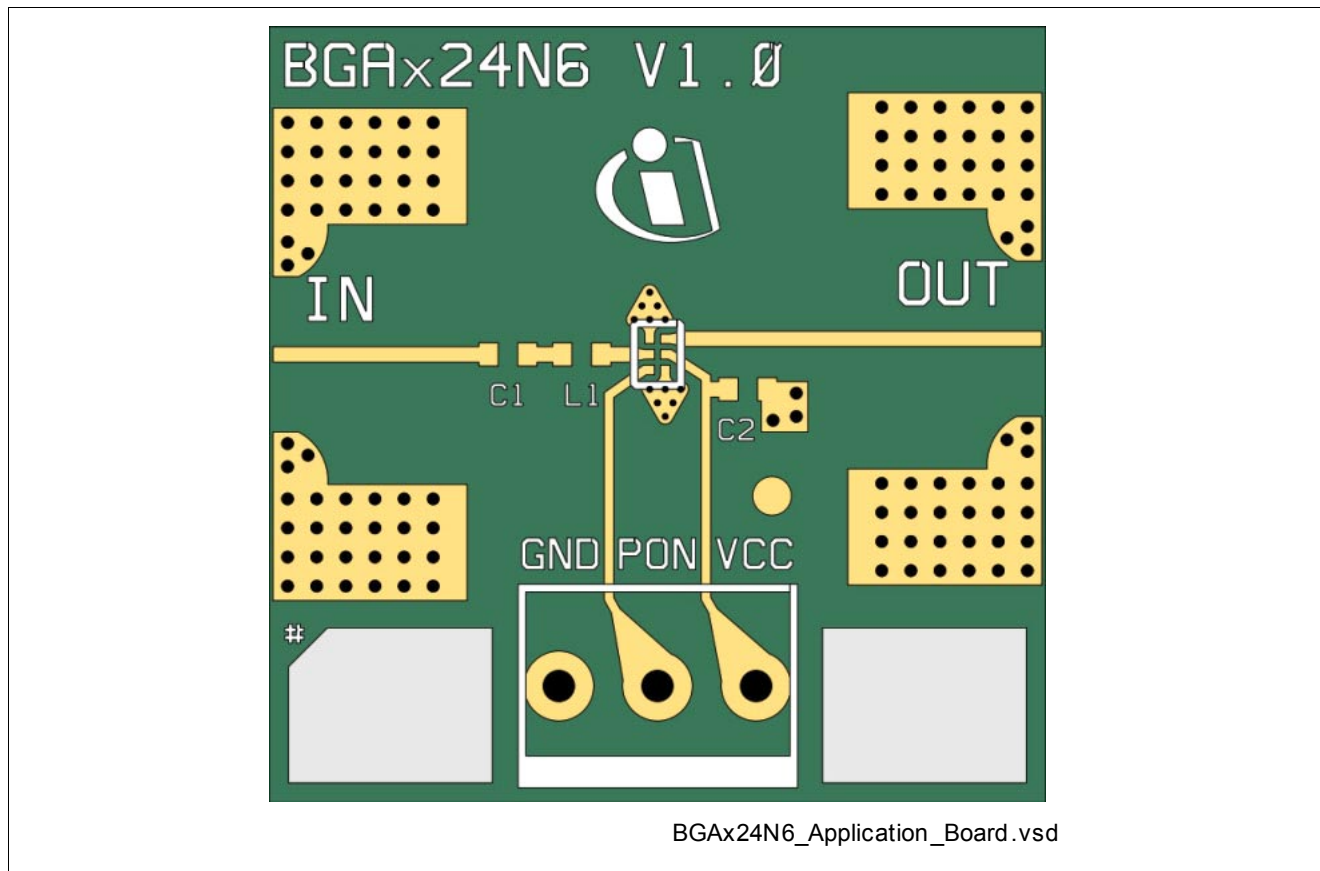
| Name          | Value                | Package  | Manufacturer    | Function                |
|---------------|----------------------|----------|-----------------|-------------------------|
| C1 (optional) | 1nF                  | 0402     | Various         | DC block <sup>1)</sup>  |
| C2 (optional) | > 10nF <sup>2)</sup> | 0402     | Various         | RF bypass <sup>3)</sup> |
| L1            | 6.8nH                | 0402     | Murata LQW type | Input matching          |
| N1            | BGA824N6             | TSNP-6-2 | Infineon        | SiGe LNA                |

1) DC block might be realized with pre-filter in GNSS applications

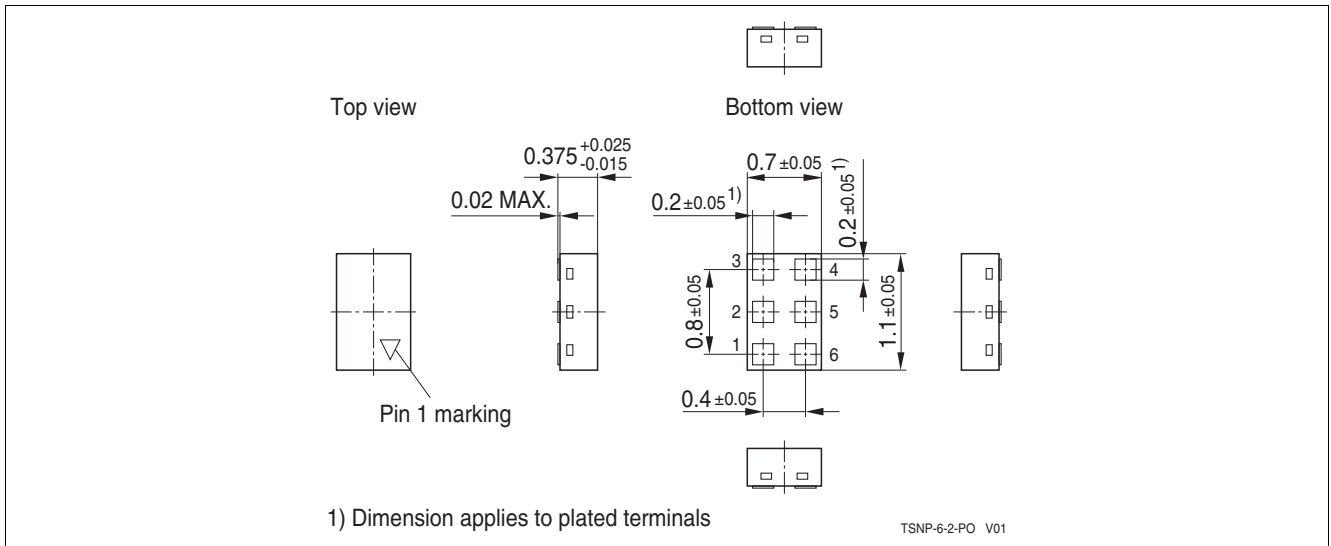
2) For data sheet characteristics 1μF used

3) RF bypass recommended to mitigate power supply noise

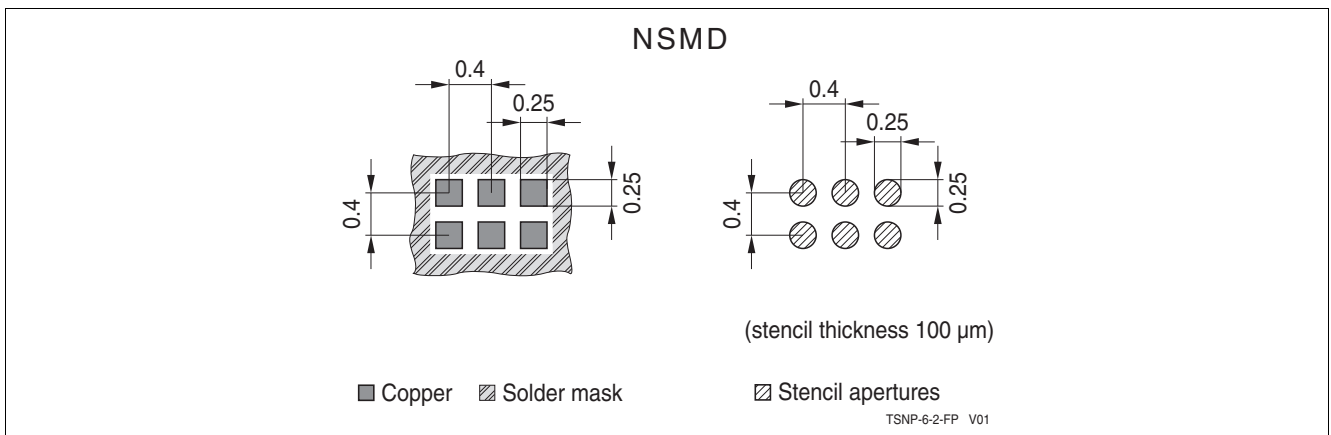
A list of all application notes is available at <http://www.infineon.com/gpslna.appnotes>.



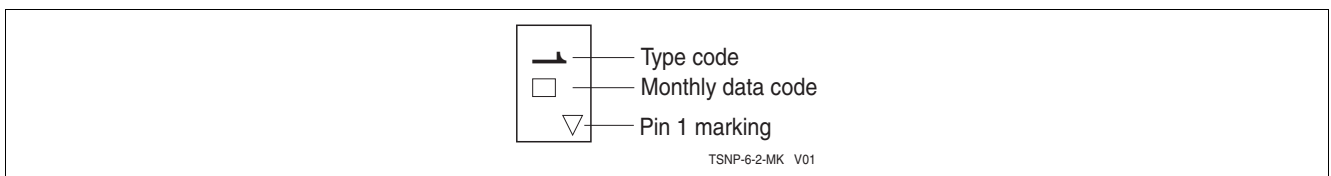
## 4 Package Information



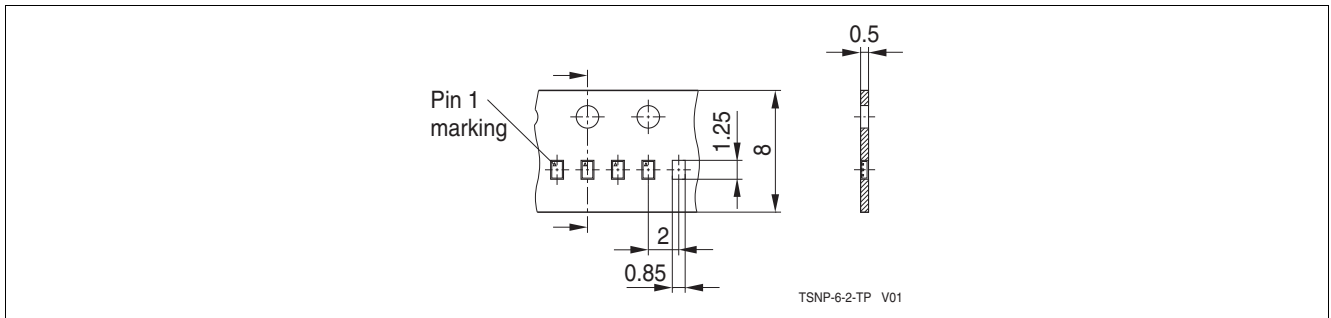
**Figure 5 TSNP-6-2 Package Outline (top, side and bottom views)**



**Figure 6 Footprint Recommendation TSNP-6-2**



**Figure 7 Marking Layout (top view)**



**Figure 8** Tape & Reel Dimensions (reel diameter 180 mm, pieces/reel 15000)

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