# BGA7H1BN6

Silicon Germanium Low Noise Amplifier for LTE

## Data Sheet

Revision 3.5, 2020-09-16

RF & Protection Devices

**Edition 2020-09-16**

**Published by**
**Infineon Technologies AG**
**81726 Munich, Germany**

| Revision History | |
|---|---|
| **Page or Item** | **Subjects (major changes since previous revision)** |
| **Revision 3.5, 2020-09-16** | |
| 3 | Trademarks updated |
| 11 | Frequencies updated in Table 4 |
| | |

**Other Trademarks**

# Table of Contents

# List of Figures

# List of Tables

## Silicon Germanium Low Noise Amplifier for LTE **BGA7H1BN6**

## Features

- Insertion power gain: 12.3 dB
- Low noise figure: 0.85 dB
- Low current consumption: 4.3 mA
- Insertion Loss in bypass mode: -3.1 dB
- Operating frequencies: 1805 - 2690 MHz
- Two-state control: Bypass- and High gain-Mode
- Supply voltage: 1.5 V to 3.6 V
- Digital on/off switch (1V logic high level)
- Ultra small TSNP-6-2 leadless package (footprint: 0.7 x 1.1 $mm^2$)
- B7HF Silicon Germanium technology
- RF output internally matched to 50 Ω
- Only 1 external SMD component necessary
- Pb-free (RoHS compliant) package

RoHS

### Product Validation

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

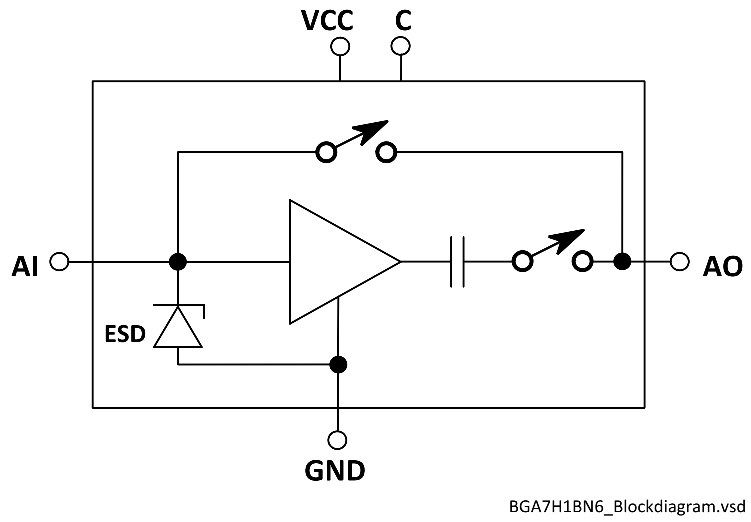


**Figure 1 Block Diagram**

| Product Name | Marking | Package |
|---|---|---|
| BGA7H1BN6 | L | TSNP-6-2 |

### Description

The BGA7H1BN6 is a front-end low noise amplifier for LTE which covers a wide frequency range from 1805 MHz to 2690 MHz. The LNA provides 12.3 dB gain and 0.85 dB noise figure at a current consumption of 4.3 mA in the application configuration described in **Chapter 3**. In bypass mode the LNA provides an insertion loss of -3.1dB. The BGA7H1BN6 is based upon Infineon Technologies‘ B7HF Silicon Germanium technology. It operates from 1.5 V to 3.6 V supply voltage. The device features a single-line two-state control (Bypass- and High gain-Mode). OFF-state can be enabled by powering down Vcc.

### 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 | C | 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 | – | 5.0 | 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 C | $V_C$ | -0.3 | – | $V_{CC}$ + 0.3 | V | – |
| Voltage at GND pins | $V_{GND}$ | -0.3 | – | 0.3 | V | – |
| Current into pin VCC | $I_{CC}$ | – | – | 50 | mA | – |
| RF input power | $P_{IN}$ | – | – | +25 | dBm | – |
| Total power dissipation, $T_S$ < 148 °C[2] | $P_{tot}$ | – | – | 250 | mW | – |
| Junction temperature | $T_J$ | – | – | 150 | °C | – |
| Ambient temperature range | $T_A$ | -40 | – | 85 | °C | – |
| Storage temperature range | $T_{STG}$ | -65 | – | 150 | °C | – |

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.*

# 2 Electrical Characteristics

## 2.1 Measured RF Characteristics Highband

**Table 3 Electrical Characteristics:[1) $T_A$ = 25 °C, $V_{CC}$ = 2.8 V, $V_{C,ON}$ = 2.8 V, $V_{C,BYP}$ = 0 V, $f$ = 2300 - 2690 MHz**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Supply voltage | $V_{CC}$ | 1.5 | – | 3.6 | V | – |
| Supply current | $I_{CC}$ | – | 4.3 | 5.3 | mA | High gain mode |
| | | – | 87 | 120 | µA | Bypass mode |
| | | – | 110 | 150 | µA | Bypass mode / $V_{CC}$ = 5.0 V |
| Control voltage | $V_C$ | 1.0 | – | $V_{CC}$ | V | High gain mode |
| | | 0 | – | 0.4 | V | Bypass mode |
| Insertion power gain $f$ = 2500 MHz | $\|S_{21}\|^2$ | 9.5 | 11.0 | 12.5 | dB | High gain mode |
| | | -4.5 | -3.5 | -2.5 | dB | Bypass mode |
| Noise figure[2) $Z_S$ = 50 Ω | $NF$ | – | 0.9 | 1.5 | dB | High gain mode |
| | | – | 2.7 | 3.7 | dB | Bypass mode |
| Input return loss $f$ = 2500 MHz | $RL_{in}$ | 9 | 12 | – | dB | High gain mode |
| | | 5 | 8 | – | dB | Bypass mode |
| Output return loss $f$ = 2500 MHz | $RL_{out}$ | 10 | 15 | – | dB | High gain mode |
| | | 4 | 6 | – | dB | Bypass mode |
| Reverse isolation | $1/\|S_{12}\|^2$ | 16 | 20 | – | dB | High gain mode |
| | | -4.5 | -3.5 | – | dB | Bypass mode |
| Power gain settling time[3) | $t_S$ | – | 3 | 6 | µs | OFF- to ON-mode |
| Inband input 1dB-compression point, $f$ = 2500 MHz | $IP_{1dB}$ | -5 | -1 | – | dBm | High gain mode |
| | | +1 | +5 | – | dBm | Bypass mode |
| Inband input 3rd-order intercept point[4) $f_1$ = 2500 MHz, $f_2 = f_1$ + 1 MHz | $IIP_3$ | 0 | +5 | – | dBm | High gain mode |
| | | +11 | +16 | – | dBm | Bypass mode |
| Phase shift | $PS$ | -5 | 0 | 5 | ° | High gain mode and bypass mode |
| Stability | $k$ | > 1 | – | – | | $f$ = 20 MHz ... 10 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
4) High gain mode: Input power = -30 dBm for each tone / Bypass mode: Input power = -10 dBm for each tone

## 2.2 Measured RF Characteristics Midband

**Table 4 Electrical Characteristics:**[1] $T_A$ **= 25 °C,** $V_{CC}$ **= 2.8 V,** $V_{C,ON}$ **= 2.8 V,** $V_{C,BYP}$ **= 0 V,** $f$ **= 1805 - 2200 MHz**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Supply voltage | $V_{CC}$ | 1.5 | – | 3.6 | V | – |
| Supply current | $I_{CC}$ | – | 4.3 | 5.3 | mA | High gain mode |
| | | – | 87 | 120 | µA | Bypass mode |
| | | – | 110 | 150 | µA | Bypass mode / $V_{CC}$ = 5.0 V |
| Control voltage | $V_C$ | 1.0 | – | $V_{CC}$ | V | High gain mode |
| | | 0 | – | 0.4 | V | Bypass mode |
| Insertion power gain $f$ = 2000 MHz | $\|S_{21}\|^2$ | 10.8 | 12.3 | 13.8 | dB | High gain mode |
| | | -4.1 | -3.1 | -2.1 | dB | Bypass mode |
| Noise figure[2] $Z_S$ = 50 Ω | $NF$ | – | 0.85 | 1.4 | dB | High gain mode |
| | | – | 1.7 | 2.7 | dB | Bypass mode |
| Input return loss $f$ = 2000 MHz | $RL_{in}$ | 5 | 8 | – | dB | High gain mode |
| | | 6 | 9 | – | dB | Bypass mode |
| Output return loss $f$ = 2000 MHz | $RL_{out}$ | 10 | 13 | – | dB | High gain mode |
| | | 5 | 7 | – | dB | Bypass mode |
| Reverse isolation | $1/\|S_{12}\|^2$ | 18 | 22 | – | dB | High gain mode |
| | | -4.1 | -3.1 | – | dB | Bypass mode |
| Power gain settling time[3] | $t_S$ | – | 3 | 6 | µs | OFF- to ON-mode |
| Inband input 1dB-compression point, $f$ = 2000 MHz | $IP_{1dB}$ | -7 | -3 | – | dBm | High gain mode |
| | | -1 | +3 | – | dBm | Bypass mode |
| Inband input 3rd-order intercept point[4] $f_1$ = 2000 MHz, $f_2$ = $f_1$ + 1 MHz | $IIP_3$ | -3 | +2 | – | dBm | High gain mode |
| | | +10 | +15 | – | dBm | Bypass mode |
| Phase shift | $PS$ | -5 | 0 | 5 | ° | High gain mode and bypass mode |
| Stability | $k$ | > 1 | – | – | | $f$ = 20 MHz ... 10 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
4) High gain mode: Input power = -30 dBm for each tone / Bypass mode: Input power = -10 dBm for each tone

# 3 Application Information

## 3.1 Application Circuit Schematic Highband

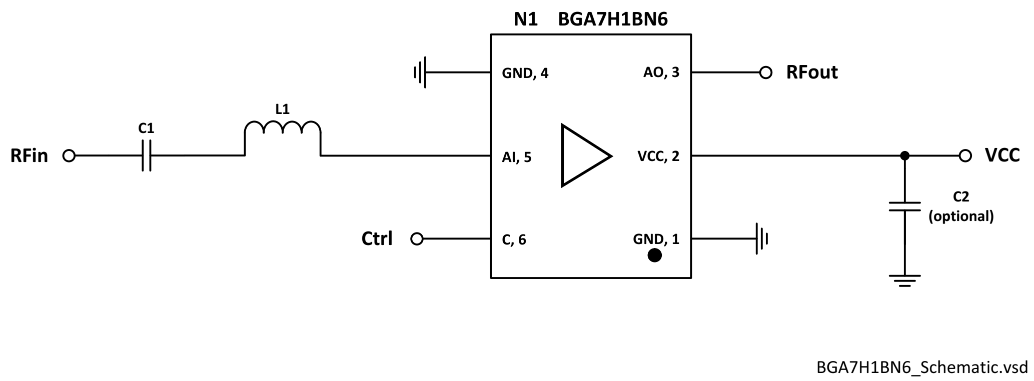


Figure 2 Application Schematic BGA7H1BN6

Table 5 Bill of Materials

| Name | Value | Package | Manufacturer | Function |
|---|---|---|---|---|
| C1 | 1nF | 0402 | Various | DC block [1] |
| C2 (optional) | ≥ 1nF | 0402 | Various | RF bypass [2] |
| L1 | 3.4nH | 0402 | Murata LQW type | Input matching |
| N1 | BGA7H1BN6 | TSNP-6-2 | Infineon | SiGe LNA |

1) DC block might be necessary due to internal LNA bias voltage @ AI (LNA Analog Input pin). The DC block can be realized with pre-filter (e.g. SAW)

2) RF bypass recommended to mitigate power supply noise

*Note: No external DC blocking capacitor at RFout is required in typical applications as long as no DC is applied.*

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

## 3.2 Application Circuit Schematic Midband

### Application Board Configuration

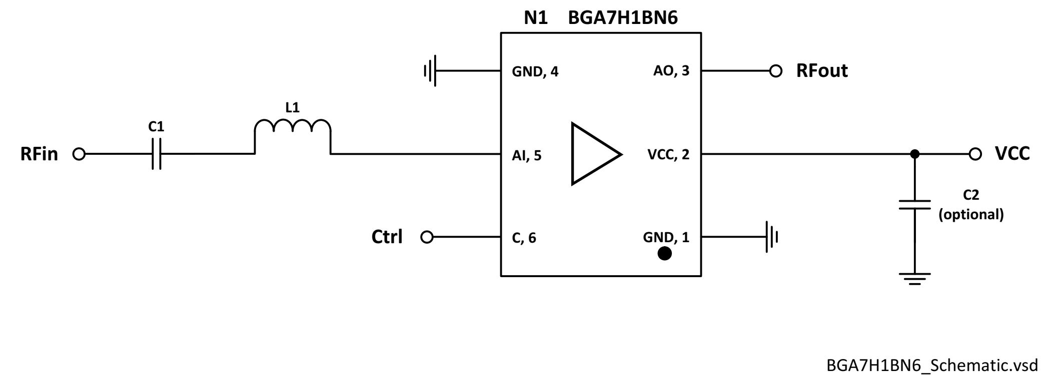


**Figure 3 Application Schematic BGA7H1BN6**

**Table 6 Bill of Materials**

| Name | Value | Package | Manufacturer | Function |
|---|---|---|---|---|
| C1 | 1nF | 0402 | Various | DC block 1) |
| C2 (optional) | ≥ 1nF | 0402 | Various | RF bypass 2) |
| L1 | 4.7nH | 0402 | Murata LQW type | Input matching |
| N1 | BGA7H1BN6 | TSNP-6-2 | Infineon | SiGe LNA |

1) DC block might be necessary due to internal LNA bias voltage @ AI (LNA Analog Input pin). The DC block can be realized with pre-filter (e.g. SAW)

2) RF bypass recommended to mitigate power supply noise

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

# 4 Package Information

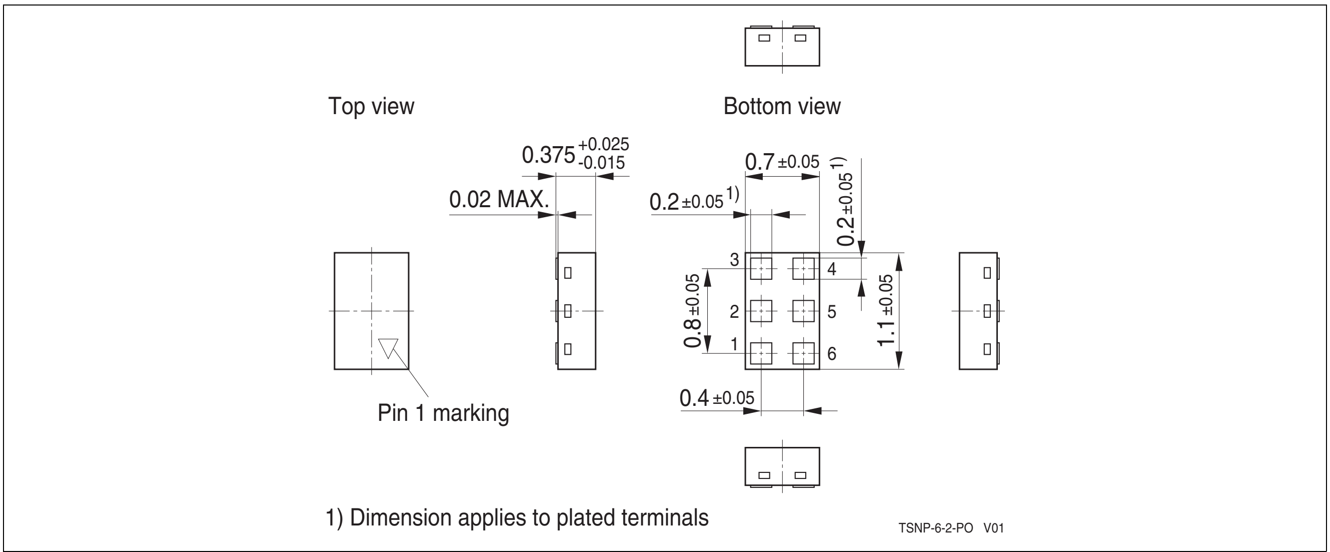


**Figure 4 TSNP-6-2 Package Outline** (top, side and bottom views)

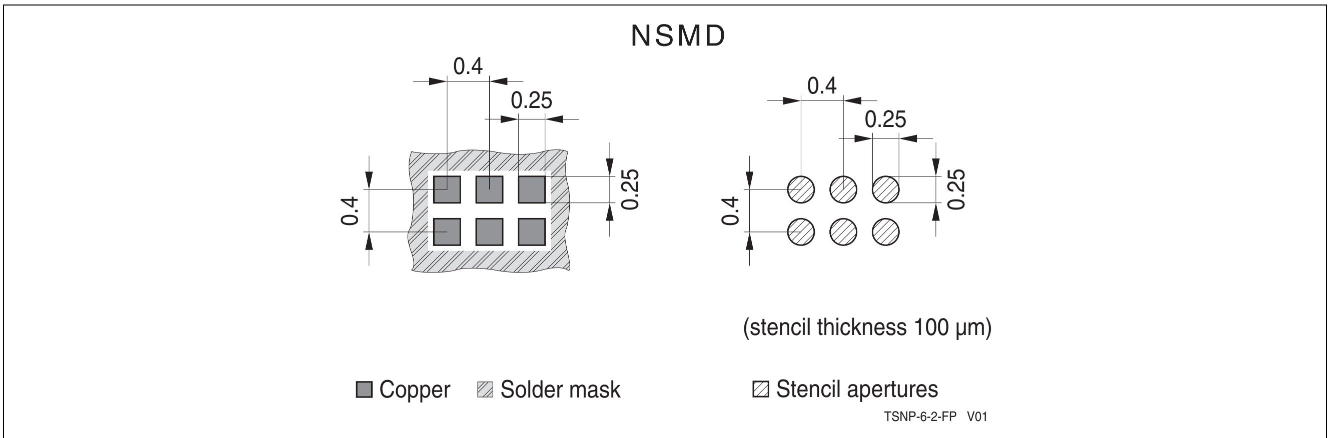


**Figure 5 Footprint Recommendation TSNP-6-2**

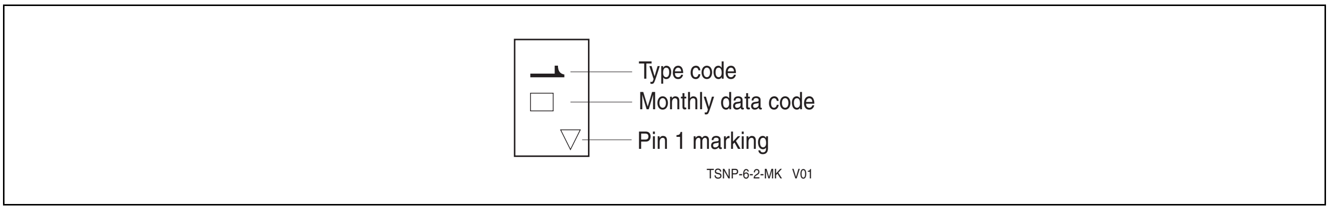


**Figure 6 Marking Layout** (top view)

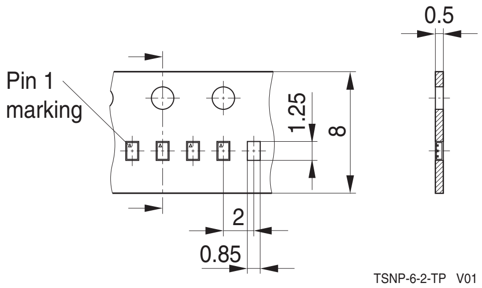


**Figure 7 Tape & Reel Dimensions (reel diameter 180 mm, pieces/reel 15000)**

w w w . i n f i n e o n . c o m

Published by Infineon Technologies AG