

# BGA748N16

High Linearity Quad-Band UMTS LNA (2100, 1900, 900, 800 MHz)

## Data Sheet

Revision 3.0, 2010-11-08

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**BGA748N16 High Linearity Quad-Band UMTS LNA (2100, 1900, 900, 800 MHz)**

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**Previous Revision:**

Page	Subjects (major changes since last revision)

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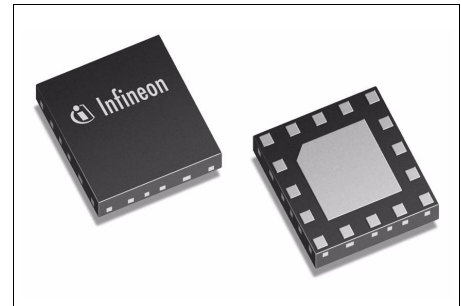
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## 1 Features

Main features:

- Gain: 16 / -8 dB typ. in high / low gain mode (all bands)
- Noise figure: 1.1 dB typ. in high gain mode
- Supply current: 4.0 / 0.75 mA typ in high / low gain mode (all bands)
- Standby mode (< 2  $\mu$ A typ.)
- Output internally matched to 50  $\Omega$
- Inputs pre-matched to 50  $\Omega$
- 2 kV HBM ESD protection
- Low external component count
- Small leadless TSNP-16-1 package (2.3 x 2.3 x 0.39 mm)
- Pb-free (RoHS compliant) package



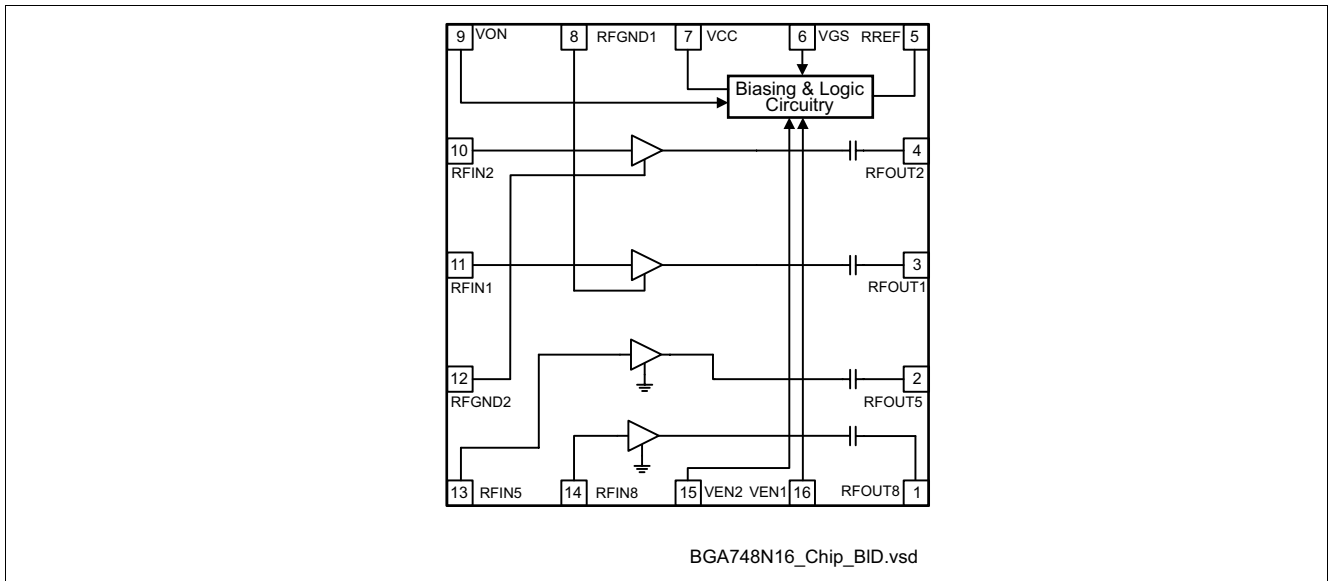
### Description

The BGA748N16 is a highly flexible, high linearity quad-band (2100, 1900, 900, 800 MHz) low noise amplifier MMIC for worldwide use. Based on Infineon's proprietary and cost-effective SiGe:C technology, the BGA748N16 uses an advanced biasing concept in order to achieve high linearity.

The device features dynamic gain control, temperature stabilization, standby mode and 2 kV ESD protection on-chip as well as matching off chip. Because the matching is off chip, different UMTS bands can be easily applied.

*Note: UMTS bands I / II / V / VIII is the standard band combination for this product requiring no external output matching network.*

Product Name	Package	Chip	Marking
BGA748N16	TSNP-16-1	T1541	BGA748



**Figure 1** Block Diagram of Quad-Band LNA



## 2 Electrical Characteristics

### 2.1 Absolute Maximum Ratings

**Table 1 Absolute Maximum Ratings**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply voltage	$V_{CC}$	-0.3	–	3.6	V	–
Supply current	$I_{CC}$	–	–	10	mA	–
Pin voltage	$V_{PIN}$	-0.3	–	$V_{CC}+0.3$	V	All pins except RF input pins.
Pin voltage RF Input Pins	$V_{RFIN}$	-0.3	–	0.9	V	–
RF input power	$P_{RFIN}$	–	–	4	dBm	–
Junction temperature	$T_j$	–	–	150	°C	–
Ambient temperature range	$T_A$	-30	–	85	°C	–
Storage temperature range	$T_{stg}$	-65	–	150	°C	–

**Attention: Stresses exceeding 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.**

### 2.2 Thermal Resistance

**Table 2 Thermal Resistance**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance junction to soldering point	$R_{thJS}$	–	–	67	K/W	–

### 2.3 ESD Integrity

**Table 3 ESD Integrity**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
ESD hardness HBM <sup>1)</sup>	$V_{ESD-HBM}$	–	2000	–	V	All pins

1) According to JESD22-A114

## 2.4 DC Characteristics

**Table 4 DC Characteristics,  $T_A = -30 \dots 85 \text{ }^\circ\text{C}$**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply voltage	$V_{CC}$	2.6	2.8	3.0	V	–
Supply current high gain mode	$I_{CCHG}$	–	4.4 3.8	–	mA	Band 1 All other bands
Supply current low gain mode	$I_{CCLG}$	–	0.75	–	mA	All bands
Supply current standby mode	$I_{CCOFF}$	–	0.1	2.0	$\mu\text{A}$	–
Logic level high	$V_{HI}$	1.5	2.8	–	V	All logic pins
Logic level low	$V_{LO}$	–	0.0	0.5	V	
Logic currents	$I_{LO}$	–	0.1	–	$\mu\text{A}$	All logic pins
	$I_{HI}$	–	5.0	–	$\mu\text{A}$	

## 2.5 Band Select / Gain Control Truth Table

**Table 5 Band Select Truth Table,  $V_{CC} = 2.8 \text{ V}$**

	Band 1	Band 2	Band 5	Band 8	Stand-by
VEN1	H	H	L	L	L
VEN2	H	L	H	L	L
VON	H	H	H	H	L

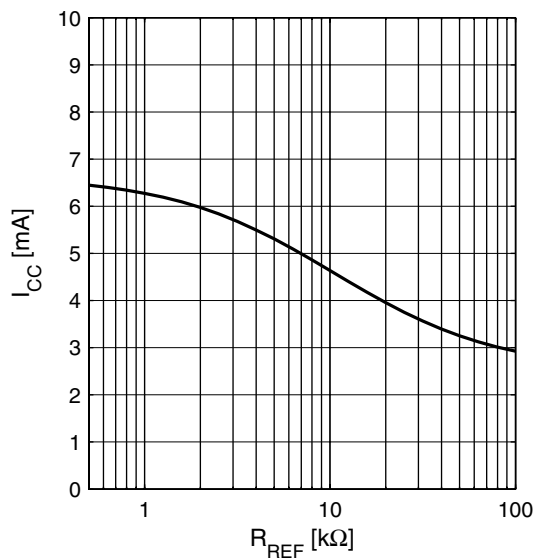
**Table 6 Gain Control Truth Table,  $V_{CC} = 2.8 \text{ V}$**

	High Gain	Low Gain
VGS	H	L

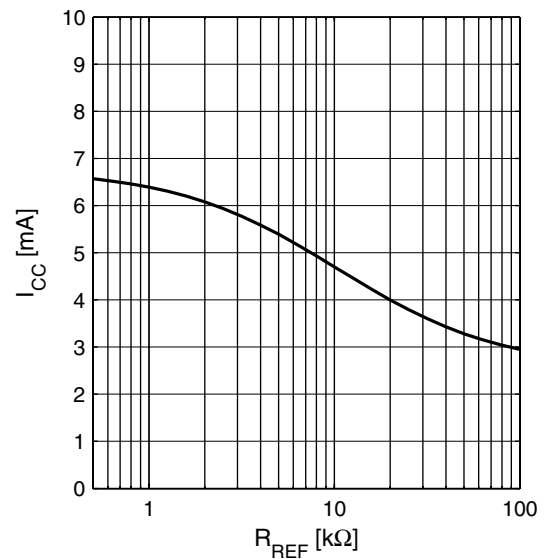
## 2.6 Supply Current Characteristics

Supply current high gain mode versus resistance of reference resistor  $R_{REF}$  (see Figure 2 on Page 25; low gain mode supply current is independent of reference resistor).

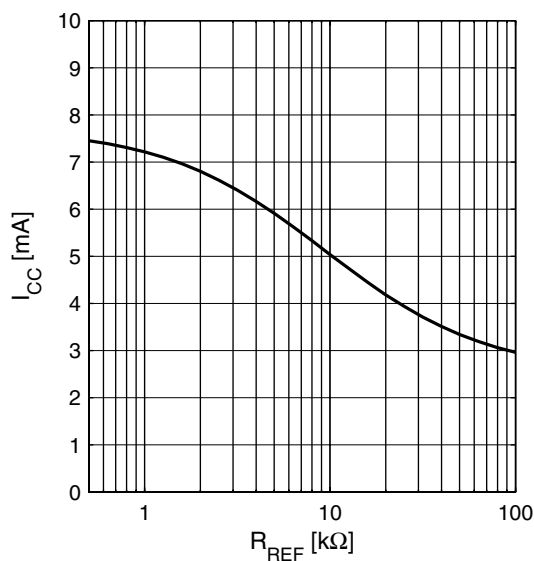
**Supply Current Band 5**  $I_{CC} = f(R_{REF})$   
 $V_{CC} = 2.8\text{ V}$ ,  $T_A = 25\text{ }^\circ\text{C}$



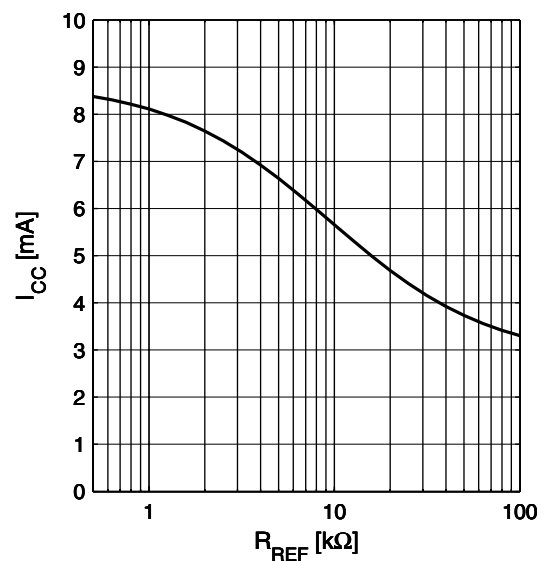
**Supply Current Band 8**  $I_{CC} = f(R_{REF})$   
 $V_{CC} = 2.8\text{ V}$ ,  $T_A = 25\text{ }^\circ\text{C}$



**Supply Current Band 2**  $I_{CC} = f(R_{REF})$   
 $V_{CC} = 2.8\text{ V}$ ,  $T_A = 25\text{ }^\circ\text{C}$



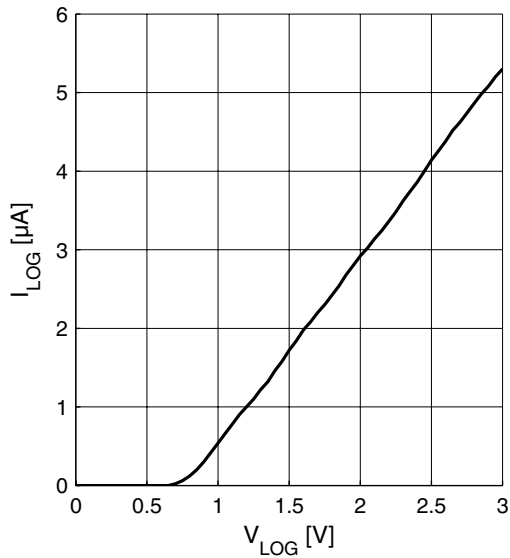
**Supply Current Band 1**  $I_{CC} = f(R_{REF})$   
 $V_{CC} = 2.8\text{ V}$ ,  $T_A = 25\text{ }^\circ\text{C}$



## 2.7 Logic Signal Characteristics

Current consumption of logic inputs VEN1, VEN2, VGS, VON

**Logic currents**  $I_{\text{LOG}} = f(V_{\text{LOG}})$   
 $V_{\text{CC}} = 2.8 \text{ V}$ ,  $T_{\text{A}} = 25 \text{ }^\circ\text{C}$



## 2.8 Switching Times

**Table 7** Typical Switching Times;  $T_{\text{A}} = -30 \dots 85 \text{ }^\circ\text{C}$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gainstep settling time	$t_{\text{GS}}$	–	1	–	µs	Switching LG ↔ HG all bands
Bandselect settling time	$t_{\text{BS}}$	–	1	–	µs	Switching from any band to a different band (pins VEN1,2)
Power on settling time	$t_{\text{ON}}$	–	1	–	µs	Switching from standby mode to ON mode (pin VON)

## 2.9 Measured RF Characteristics UMTS Band V

**Table 8** Typical Characteristics 880 MHz Band,  $T_A = -30\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)}$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		869	–	894	MHz	–
Current consumption	$I_{CCHG}$	–	3.1	–	mA	High gain mode
	$I_{CCLG}$	–	0.70	–	mA	Low gain mode
Gain	$S_{21HG}$	–	16.5	–	dB	High gain mode
	$S_{21LG}$	–	-7.8	–	dB	Low gain mode
Reverse Isolation <sup>2)</sup>	$S_{12HG}$	–	-38	–	dB	High gain mode
	$S_{12LG}$	–	-7.8	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	0.9	–	dB	High gain mode
	$NF_{LG}$	–	7.8	–	dB	Low gain mode
Input return loss <sup>2)</sup>	$S_{11HG}$	–	-15	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-17	–	dB	50 $\Omega$ , low gain mode
Output return loss <sup>2)</sup>	$S_{22HG}$	–	-15	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-11	–	dB	50 $\Omega$ , low gain mode
Stability factor <sup>3)</sup>	$k$	–	>2.5	–		DC to 8 GHz; all gain modes
Input compression point <sup>2)</sup>	$IP_{1dBHG}$	–	-7	–	dBm	High gain mode
	$IP_{1dB LG}$	–	1	–	dBm	Low gain mode
Inband IIP3 <sup>2)</sup> $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-7	–	dBm	High gain mode
	$IIP3_{LG}$	–	14	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 2 on Page 25

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

## 2.10 Measured RF Characteristics UMTS Band V

**Table 9** Typical Characteristics 880 MHz Band,  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)}$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		869	–	894	MHz	–
Current consumption	$I_{CCHG}$	–	3.8	–	mA	High gain mode
	$I_{CCLG}$	–	0.75	–	mA	Low gain mode
Gain	$S_{21HG}$	–	16.2	–	dB	High gain mode
	$S_{21LG}$	–	-8.0	–	dB	Low gain mode
Reverse Isolation <sup>2)</sup>	$S_{12HG}$	–	-38	–	dB	High gain mode
	$S_{12LG}$	–	-8.0	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	1.2	–	dB	High gain mode
	$NF_{LG}$	–	8.0	–	dB	Low gain mode
Input return loss <sup>2)</sup>	$S_{11HG}$	–	-14	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-15	–	dB	50 $\Omega$ , low gain mode
Output return loss <sup>2)</sup>	$S_{22HG}$	–	-20	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-11	–	dB	50 $\Omega$ , low gain mode
Stability factor <sup>3)</sup>	$k$	–	>2.7	–		DC to 8 GHz; all gain modes
Input compression point <sup>2)</sup>	$IP_{1dBHG}$	–	-7	–	dBm	High gain mode
	$IP_{1dBLG}$	–	-1	–	dBm	Low gain mode
Inband IIP3 <sup>2)</sup> $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-6	–	dBm	High gain mode
	$IIP3_{LG}$	–	12	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 2 on Page 25

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

## 2.11 Measured RF Characteristics UMTS Band V

**Table 10** Typical Characteristics 880 MHz Band,  $T_A = 85\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)}$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		869	–	894	MHz	–
Current consumption	$I_{CCHG}$	–	4.6	–	mA	High gain mode
	$I_{CCLG}$	–	0.80	–	mA	Low gain mode
Gain	$S_{21HG}$	–	15.6	–	dB	High gain mode
	$S_{21LG}$	–	-8.5	–	dB	Low gain mode
Reverse Isolation <sup>2)</sup>	$S_{12HG}$	–	-38	–	dB	High gain mode
	$S_{12LG}$	–	-8.5	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	1.7	–	dB	High gain mode
	$NF_{LG}$	–	8.5	–	dB	Low gain mode
Input return loss <sup>2)</sup>	$S_{11HG}$	–	-17	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-14	–	dB	50 $\Omega$ , low gain mode
Output return loss <sup>2)</sup>	$S_{22HG}$	–	-20	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-11	–	dB	50 $\Omega$ , low gain mode
Stability factor <sup>3)</sup>	$k$	–	>3.2	–		DC to 8 GHz; all gain modes
Input compression point <sup>2)</sup>	$IP_{1dBHG}$	–	-8	–	dBm	High gain mode
	$IP_{1dBLG}$	–	-4	–	dBm	Low gain mode
Inband IIP3 <sup>2)</sup> $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-6	–	dBm	High gain mode
	$IIP3_{LG}$	–	6	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 2 on Page 25

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

## 2.12 Measured RF Characteristics UMTS Band VIII

**Table 11 Typical Characteristics 940 MHz Band,  $T_A = -30\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^1$**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		925	–	960	MHz	–
Current consumption	$I_{CCHG}$	–	3.1	–	mA	High gain mode
	$I_{CCLG}$	–	0.70	–	mA	Low gain mode
Gain	$S_{21HG}$	–	16.5	–	dB	High gain mode
	$S_{21LG}$	–	-7.8	–	dB	Low gain mode
Reverse Isolation <sup>2)</sup>	$S_{12HG}$	–	-35	–	dB	High gain mode
	$S_{12LG}$	–	-7.8	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	0.9	–	dB	High gain mode
	$NF_{LG}$	–	7.8	–	dB	Low gain mode
Input return loss <sup>2)</sup>	$S_{11HG}$	–	-15	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-13	–	dB	50 $\Omega$ , low gain mode
Output return loss <sup>2)</sup>	$S_{22HG}$	–	-19	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-13	–	dB	50 $\Omega$ , low gain mode
Stability factor <sup>3)</sup>	$k$	–	>2.5	–		DC to 8 GHz; all gain modes
Input compression point <sup>2)</sup>	$IP_{1dBHG}$	–	-7	–	dBm	High gain mode
	$IP_{1dBLG}$	–	3	–	dBm	Low gain mode
Inband IIP3 <sup>2)</sup> $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-7	–	dBm	High gain mode
	$IIP3_{LG}$	–	14	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 2 on Page 25

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.



### 2.13 Measured RF Characteristics UMTS Band VIII

**Table 12 Typical Characteristics 940 MHz Band,  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)}$**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		925	–	960	MHz	–
Current consumption	$I_{CCHG}$	–	3.8	–	mA	High gain mode
	$I_{CCLG}$	–	0.75	–	mA	Low gain mode
Gain	$S_{21HG}$	–	16.2	–	dB	High gain mode
	$S_{21LG}$	–	-8.0	–	dB	Low gain mode
Reverse Isolation <sup>2)</sup>	$S_{12HG}$	–	-36	–	dB	High gain mode
	$S_{12LG}$	–	-8.0	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	1.2	–	dB	High gain mode
	$NF_{LG}$	–	8.0	–	dB	Low gain mode
Input return loss <sup>2)</sup>	$S_{11HG}$	–	-16	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-13	–	dB	50 $\Omega$ , low gain mode
Output return loss <sup>2)</sup>	$S_{22HG}$	–	-28	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-12	–	dB	50 $\Omega$ , low gain mode
Stability factor <sup>3)</sup>	$k$	–	>2.8	–		DC to 8 GHz; all gain modes
Input compression point <sup>2)</sup>	$IP_{1dBHG}$	–	-6	–	dBm	High gain mode
	$IP_{1dBLG}$	–	1	–	dBm	Low gain mode
Inband IIP3 <sup>2)</sup> $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-6	–	dBm	High gain mode
	$IIP3_{LG}$	–	12	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 2 on Page 25

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

## 2.14 Measured RF Characteristics UMTS Band VIII

**Table 13 Typical Characteristics 940 MHz Band,  $T_A = 85\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)}$**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		925	–	960	MHz	–
Current consumption	$I_{CCHG}$	–	4.6	–	mA	High gain mode
	$I_{CCLG}$	–	0.80	–	mA	Low gain mode
Gain	$S_{21HG}$	–	15.6	–	dB	High gain mode
	$S_{21LG}$	–	-8.5	–	dB	Low gain mode
Reverse Isolation <sup>2)</sup>	$S_{12HG}$	–	-36	–	dB	High gain mode
	$S_{12LG}$	–	-8.5	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	1.7	–	dB	High gain mode
	$NF_{LG}$	–	8.5	–	dB	Low gain mode
Input return loss <sup>2)</sup>	$S_{11HG}$	–	-17	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-12	–	dB	50 $\Omega$ , low gain mode
Output return loss <sup>2)</sup>	$S_{22HG}$	–	-26	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-12	–	dB	50 $\Omega$ , low gain mode
Stability factor <sup>3)</sup>	$k$	–	>3.2	–		DC to 8 GHz; all gain modes
Input compression point <sup>2)</sup>	$IP_{1dBHG}$	–	-9	–	dBm	High gain mode
	$IP_{1dBLG}$	–	-3	–	dBm	Low gain mode
Inband IIP3 <sup>2)</sup> $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-5	–	dBm	High gain mode
	$IIP3_{LG}$	–	5	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 2 on Page 25

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

## 2.15 Measured RF Characteristics UMTS Band II

**Table 14** Typical Characteristics 1960 MHz Band,  $T_A = -30\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)}$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		1930	–	1990	MHz	–
Current consumption	$I_{CCHG}$	–	3.1	–	mA	High gain mode
	$I_{CCLG}$	–	0.70	–	mA	Low gain mode
Gain	$S_{21HG}$	–	17.1	–	dB	High gain mode
	$S_{21LG}$	–	-7.8	–	dB	Low gain mode
Reverse Isolation <sup>2)</sup>	$S_{12HG}$	–	-35	–	dB	High gain mode
	$S_{12LG}$	–	-7.8	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	0.8	–	dB	High gain mode
	$NF_{LG}$	–	7.8	–	dB	Low gain mode
Input return loss <sup>2)</sup>	$S_{11HG}$	–	-21	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-24	–	dB	50 $\Omega$ , low gain mode
Output return loss <sup>2)</sup>	$S_{22HG}$	–	-29	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-15	–	dB	50 $\Omega$ , low gain mode
Stability factor <sup>3)</sup>	$k$	–	>2.3	–		DC to 8 GHz; all gain modes
Input compression point <sup>2)</sup>	$IP_{1dBHG}$	–	-8	–	dBm	High gain mode
	$IP_{1dB LG}$	–	2	–	dBm	Low gain mode
Inband IIP3 <sup>2)</sup> $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-8	–	dBm	High gain mode
	$IIP3_{LG}$	–	17	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 2 on Page 25

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

## 2.16 Measured RF Characteristics UMTS Band II

**Table 15** Typical Characteristics 1960 MHz Band,  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)}$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		1930	–	1990	MHz	–
Current consumption	$I_{CCHG}$	–	4.0	–	mA	High gain mode
	$I_{CCLG}$	–	0.75	–	mA	Low gain mode
Gain	$S_{21HG}$	–	16.5	–	dB	High gain mode
	$S_{21LG}$	–	-8.0	–	dB	Low gain mode
Reverse Isolation <sup>2)</sup>	$S_{12HG}$	–	-36	–	dB	High gain mode
	$S_{12LG}$	–	-8.0	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	1.1	–	dB	High gain mode
	$NF_{LG}$	–	8.0	–	dB	Low gain mode
Input return loss <sup>2)</sup>	$S_{11HG}$	–	-20	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-17	–	dB	50 $\Omega$ , low gain mode
Output return loss <sup>2)</sup>	$S_{22HG}$	–	-32	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-15	–	dB	50 $\Omega$ , low gain mode
Stability factor <sup>3)</sup>	$k$	–	>2.6	–		DC to 8 GHz; all gain modes
Input compression point <sup>2)</sup>	$IP_{1dBHG}$	–	-8	–	dBm	High gain mode
	$IP_{1dB LG}$	–	2	–	dBm	Low gain mode
Inband IIP3 <sup>2)</sup> $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-7	–	dBm	High gain mode
	$IIP3_{LG}$	–	17	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 2 on Page 25

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

## 2.17 Measured RF Characteristics UMTS Band II

**Table 16** Typical Characteristics 1960 MHz Band,  $T_A = 85\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)}$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		1930	–	1990	MHz	–
Current consumption	$I_{CCHG}$	–	4.9	–	mA	High gain mode
	$I_{CCLG}$	–	0.80	–	mA	Low gain mode
Gain	$S_{21HG}$	–	15.9	–	dB	High gain mode
	$S_{21LG}$	–	-8.5	–	dB	Low gain mode
Reverse Isolation <sup>2)</sup>	$S_{12HG}$	–	-36	–	dB	High gain mode
	$S_{12LG}$	–	-8.5	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	1.5	–	dB	High gain mode
	$NF_{LG}$	–	8.5	–	dB	Low gain mode
Input return loss <sup>2)</sup>	$S_{11HG}$	–	-17	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-14	–	dB	50 $\Omega$ , low gain mode
Output return loss <sup>2)</sup>	$S_{22HG}$	–	-23	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-16	–	dB	50 $\Omega$ , low gain mode
Stability factor <sup>3)</sup>	$k$	–	>3.1	–		DC to 8 GHz; all gain modes
Input compression point <sup>2)</sup>	$IP_{1dBHG}$	–	-9	–	dBm	High gain mode
	$IP_{1dBLG}$	–	0	–	dBm	Low gain mode
Inband IIP3 <sup>2)</sup> $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-6	–	dBm	High gain mode
	$IIP3_{LG}$	–	10	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 2 on Page 25

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

## 2.18 Measured RF Characteristics UMTS Band I

**Table 17 Typical Characteristics 2140 MHz Band,  $T_A = -30\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^1$**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		2110	–	2170	MHz	–
Current consumption	$I_{CCHG}$	–	3.6	–	mA	High gain mode
	$I_{CCLG}$	–	0.70	–	mA	Low gain mode
Gain	$S_{21HG}$	–	18.0	–	dB	High gain mode
	$S_{21LG}$	–	-7.8	–	dB	Low gain mode
Reverse Isolation <sup>2)</sup>	$S_{12HG}$	–	-36	–	dB	High gain mode
	$S_{12LG}$	–	-7.8	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	0.8	–	dB	High gain mode
	$NF_{LG}$	–	7.8	–	dB	Low gain mode
Input return loss <sup>2)</sup>	$S_{11HG}$	–	-18	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-18	–	dB	50 $\Omega$ , low gain mode
Output return loss <sup>2)</sup>	$S_{22HG}$	–	-18	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-10	–	dB	50 $\Omega$ , low gain mode
Stability factor <sup>3)</sup>	$k$	–	>2.2	–		DC to 8 GHz; all gain modes
Input compression point <sup>2)</sup>	$IP_{1dBHG}$	–	-9	–	dBm	High gain mode
	$IP_{1dBLG}$	–	1	–	dBm	Low gain mode
Inband IIP3 <sup>2)</sup> $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-8	–	dBm	High gain mode
	$IIP3_{LG}$	–	16	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 2 on Page 25

2) Verification based on AQL; random production test..

3) Guaranteed by device design; not tested in production.

## 2.19 Measured RF Characteristics UMTS Band I

**Table 18 Typical Characteristics 2140 MHz Band,  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)}$**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		2110	–	2170	MHz	–
Current consumption	$I_{CCHG}$	–	4.4	–	mA	High gain mode
	$I_{CCLG}$	–	0.75	–	mA	Low gain mode
Gain	$S_{21HG}$	–	17.4	–	dB	High gain mode
	$S_{21LG}$	–	-8.0	–	dB	Low gain mode
Reverse Isolation <sup>2)</sup>	$S_{12HG}$	–	-36	–	dB	High gain mode
	$S_{12LG}$	–	-8.0	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	1.1	–	dB	High gain mode
	$NF_{LG}$	–	8.0	–	dB	Low gain mode
Input return loss <sup>2)</sup>	$S_{11HG}$	–	-20	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-17	–	dB	50 $\Omega$ , low gain mode
Output return loss <sup>2)</sup>	$S_{22HG}$	–	-19	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-11	–	dB	50 $\Omega$ , low gain mode
Stability factor <sup>3)</sup>	$k$	–	>2.4	–		DC to 8 GHz; all gain modes
Input compression point <sup>2)</sup>	$IP_{1dBHG}$	–	-10	–	dBm	High gain mode
	$IP_{1dBLG}$	–	2	–	dBm	Low gain mode
Inband IIP3 <sup>2)</sup> $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-6	–	dBm	High gain mode
	$IIP3_{LG}$	–	16	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 2 on Page 25

2) Verification based on AQL; random production test..

3) Guaranteed by device design; not tested in production.

## 2.20 Measured RF Characteristics UMTS Band I

**Table 19 Typical Characteristics 2140 MHz Band,  $T_A = 85\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)}$**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		2110	–	2170	MHz	–
Current consumption	$I_{CCHG}$	–	5.3	–	mA	High gain mode
	$I_{CCLG}$	–	0.80	–	mA	Low gain mode
Gain	$S_{21HG}$	–	16.8	–	dB	High gain mode
	$S_{21LG}$	–	-8.5	–	dB	Low gain mode
Reverse Isolation <sup>2)</sup>	$S_{12HG}$	–	-36	–	dB	High gain mode
	$S_{12LG}$	–	-8.5	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	1.4	–	dB	High gain mode
	$NF_{LG}$	–	8.5	–	dB	Low gain mode
Input return loss <sup>2)</sup>	$S_{11HG}$	–	-23	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-16	–	dB	50 $\Omega$ , low gain mode
Output return loss <sup>2)</sup>	$S_{22HG}$	–	-17	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-11	–	dB	50 $\Omega$ , low gain mode
Stability factor <sup>3)</sup>	$k$	–	>2.7	–		DC to 8 GHz; all gain modes
Input compression point <sup>2)</sup>	$IP_{1dBHG}$	–	-11	–	dBm	High gain mode
	$IP_{1dBLG}$	–	1	–	dBm	Low gain mode
Inband IIP3 <sup>2)</sup> $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-5	–	dBm	High gain mode
	$IIP3_{LG}$	–	11	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 2 on Page 25

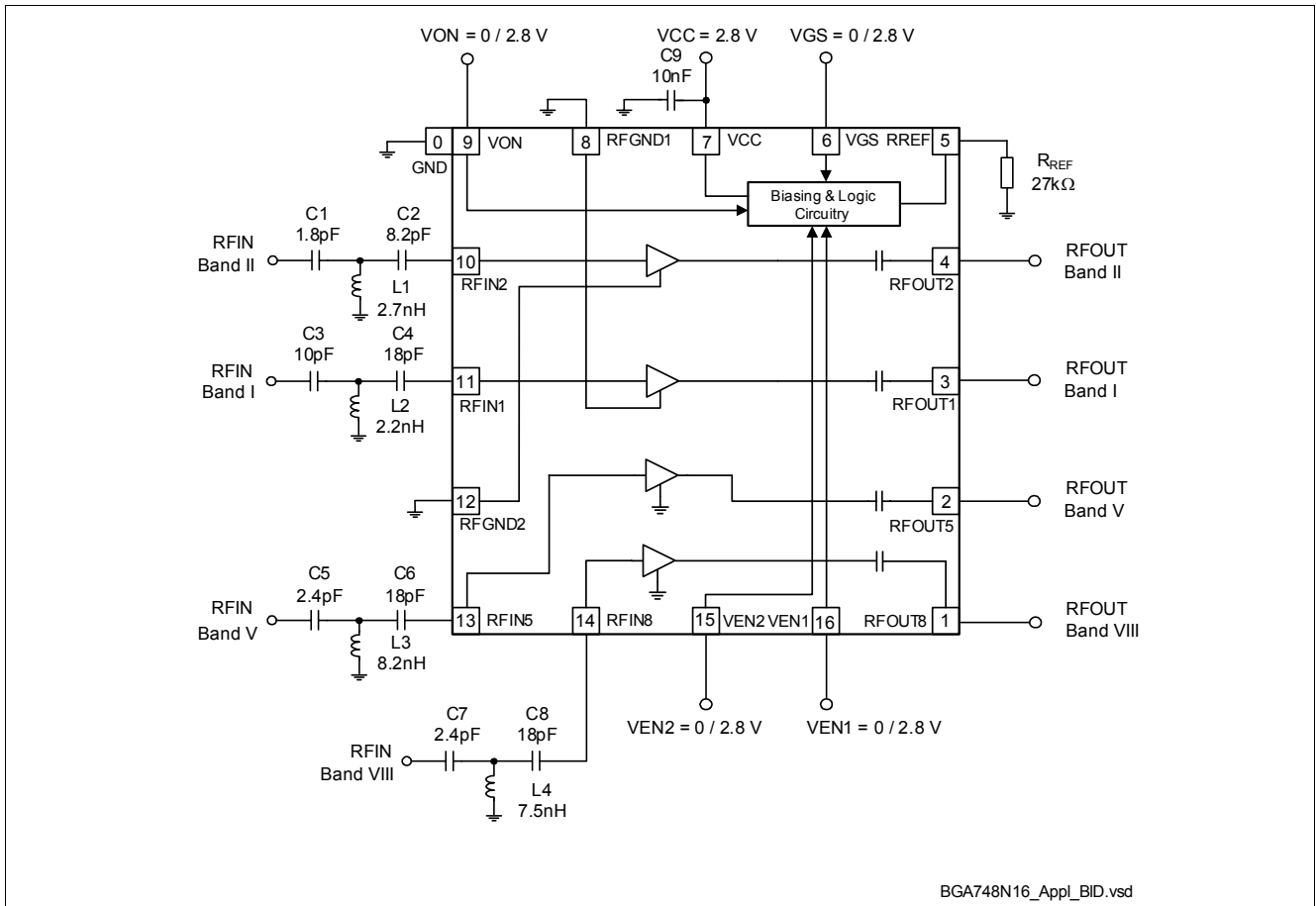
2) Verification based on AQL; random production test..

3) Guaranteed by device design; not tested in production.



### 3 Application Circuit and Block Diagram

#### 3.1 UMTS Bands I, II, V and VIII Application Circuit Schematic



**Figure 2 Application Circuit with Chip Outline (Top View)**

*Note: Package paddle (Pin 0) has to be RF grounded.*

**Table 20 Bill of Materials**

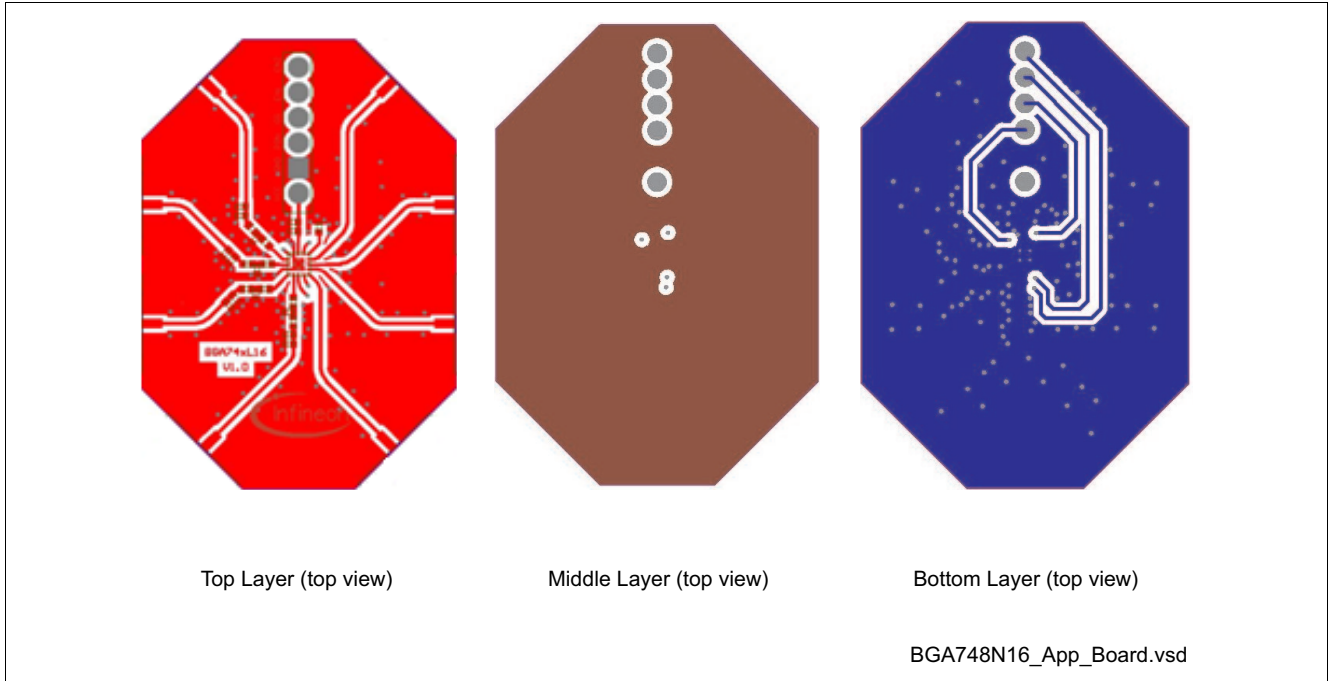
Part Number	Part Type	Manufacturer	Size	Comment
L1 ... L4	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C9	Chip capacitor	Various	0402	
R <sub>REF</sub>	Chip resistor	Various	0402	

### 3.2 Pin Description

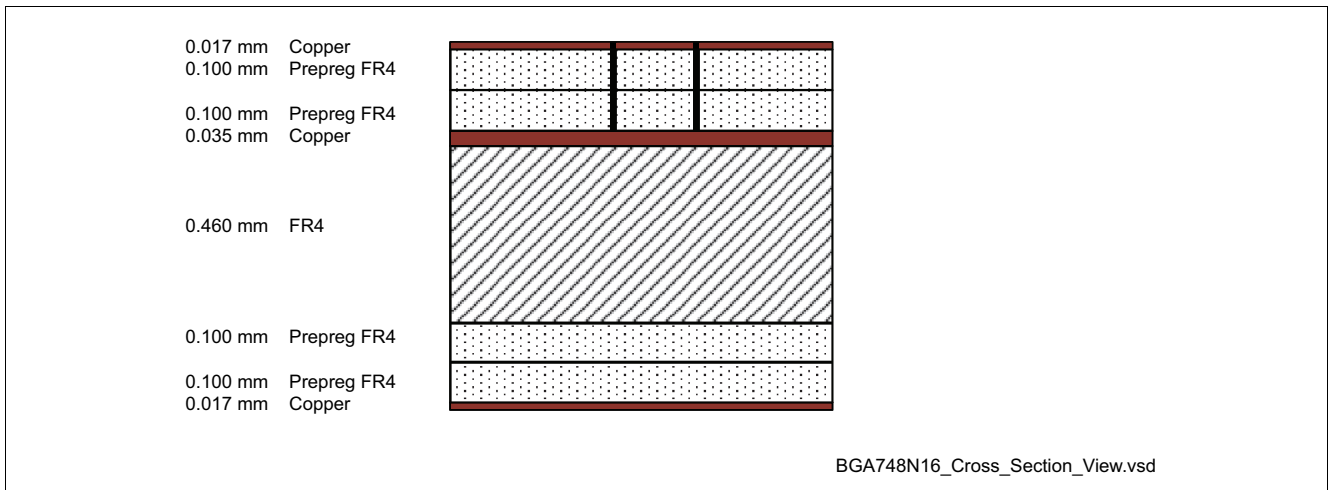
**Table 21 Pin Definition and Function**

Pin No.	Name	Function
0	GND	Ground connection for LNA and control circuitry (package paddle)
1	RFOUT8	LNA output UMTS band VIII
2	RFOUT5	LNA output UMTS band V
3	RFOUT1	LNA output UMTS band I
4	RFOUT2	LNA output UMTS band II
5	RREF	Bias current reference resistor (high gain mode)
6	VGS	Gain step control voltage
7	VCC	Supply voltage
8	RFGND1	LNA emitter ground UMTS band I
9	VON	Power on control voltage
10	RFIN2	LNA input UMTS band II
11	RFIN1	LNA input UMTS band I
12	RFGND2	LNA emitter ground UMTS band II
13	RFIN5	LNA input UMTS band V
14	RFIN8	LNA input UMTS band VIII
15	VEN2	Band select control voltage
16	VEN1	Band select control voltage

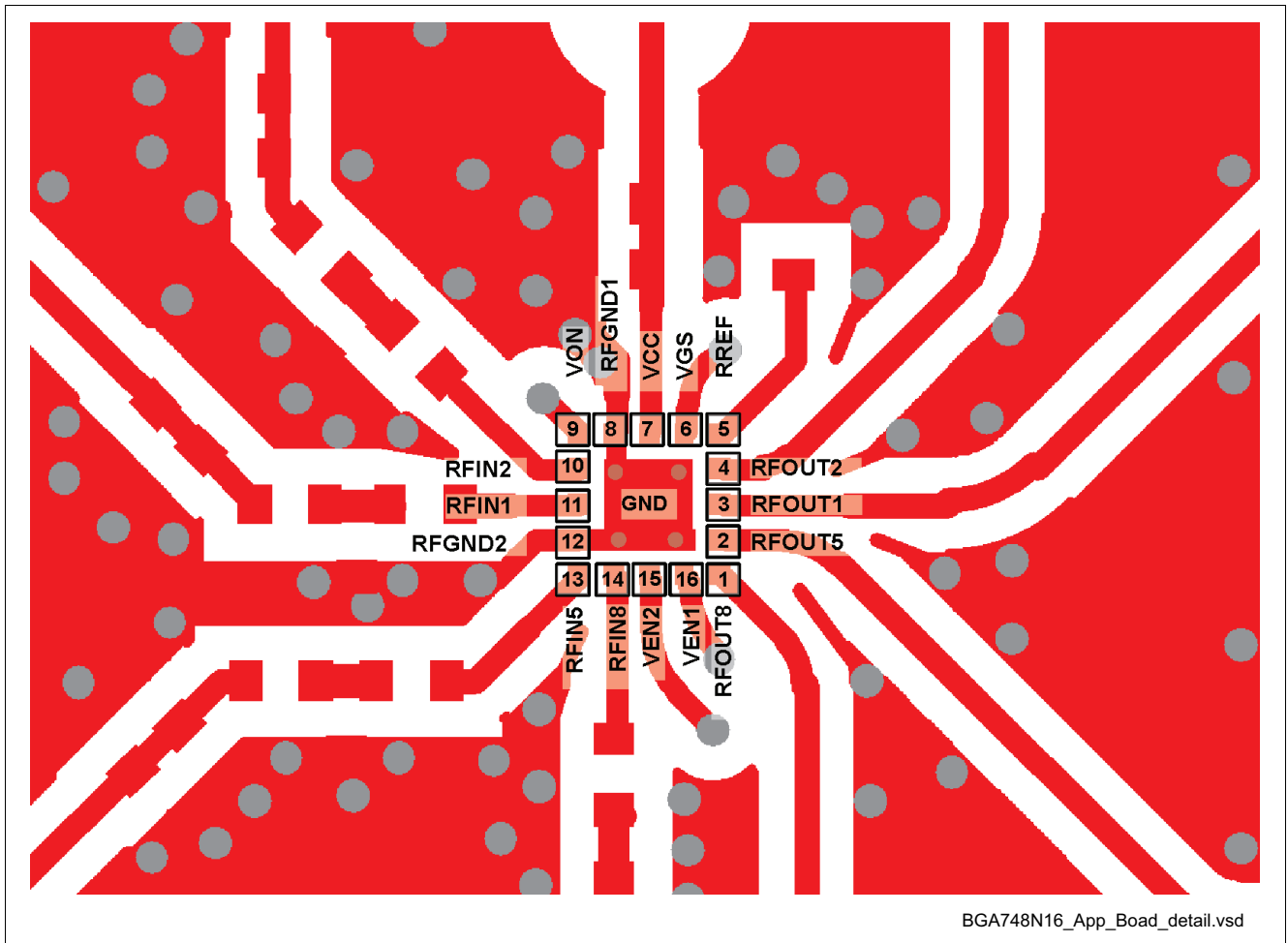
### 3.3 Application Board



Note: Top layer thickness: 0.2 mm, bottom layer thickness: 0.8 mm, 17 mm Cu metallization, gold plated. Board size: 32 x 45mm.



**Figure 3 Cross-Section View of Application Board**



**Figure 4** Detail of Application Board Layout

*Note: In order to achieve the same performance as given in this datasheet please follow the suggested PCB-layout as closely as possible. The position of the GND vias is critical for RF performance.*

## 4 Physical Characteristics

### 4.1 Package Footprint

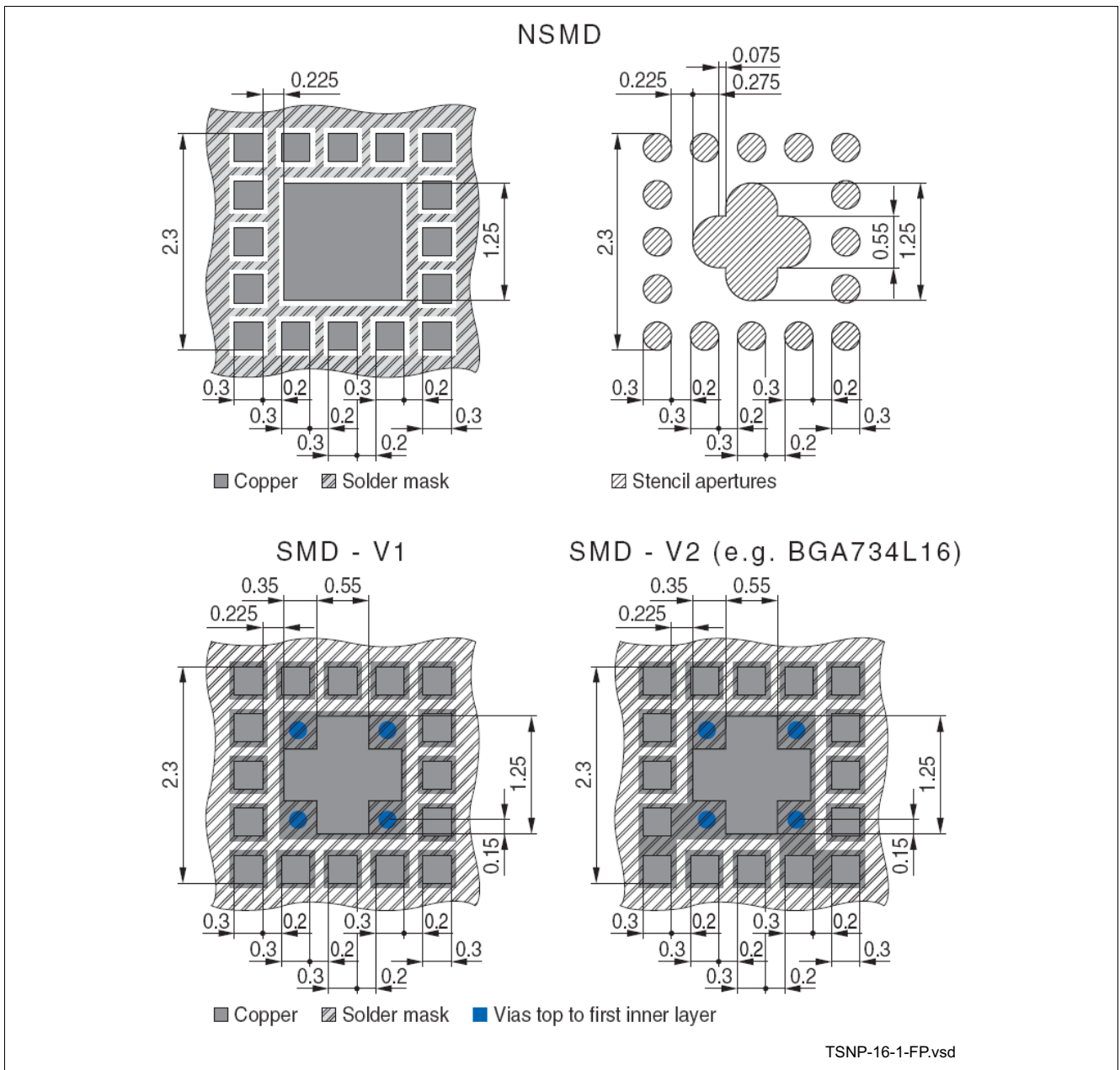


Figure 5 Recommended Footprint and Stencil Layout for the TSNP-16-1 Package

## 4.2 Package Dimensions

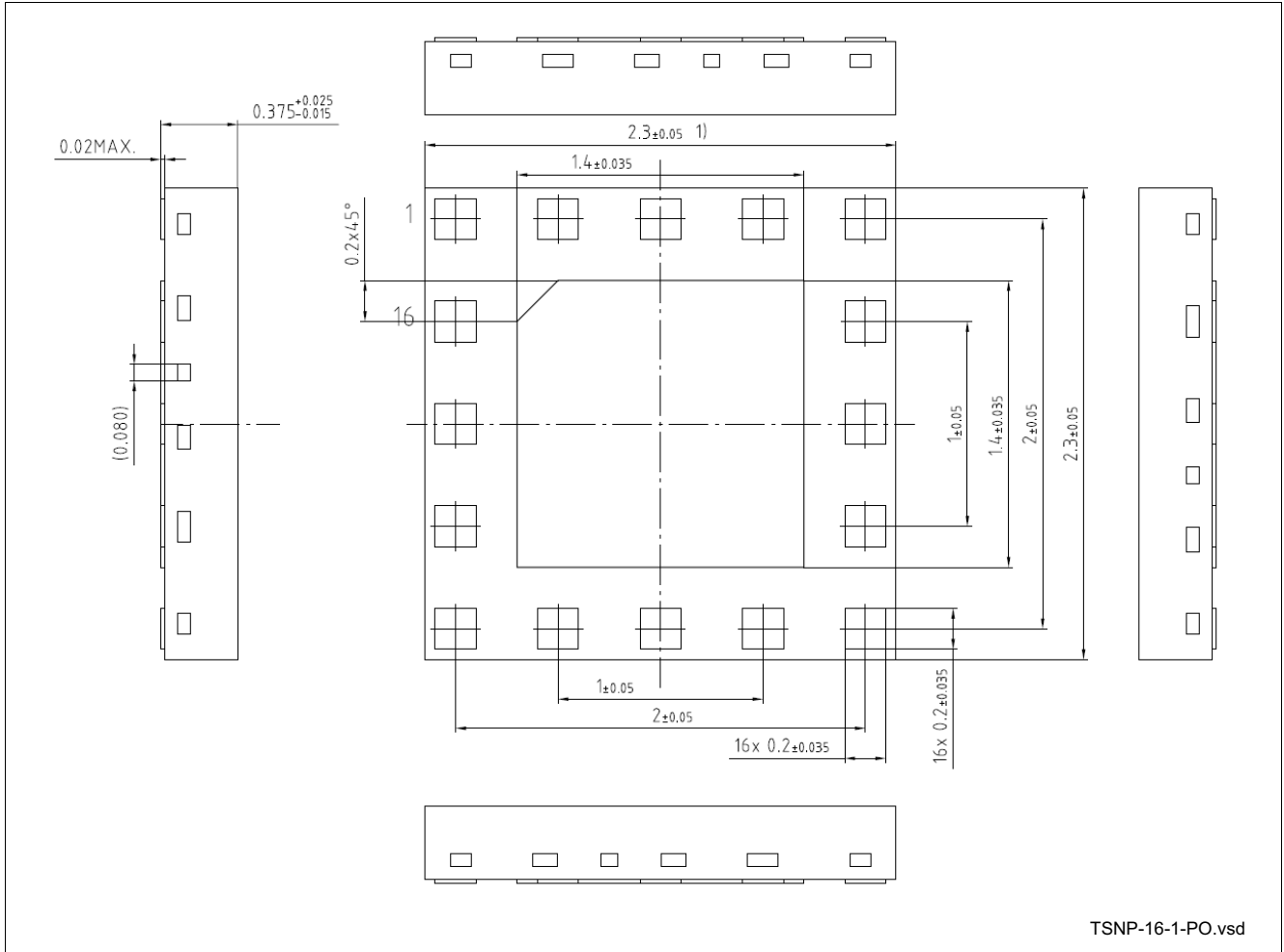


Figure 6 Package Outline (Top, Side and Bottom View)

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