BGA713N7

Single-Band UMTS LNA (700, 800 MHz)

Data Sheet

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BGA713N7 Single-Band UMTS LNA (700, 800 MHz)

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Page	Subjects (major changes since last revision)
25	Footprint recommendation drawing added
26	Marking pattern drawing updated

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1 Features

Main features:

- Gain: 15.5 / -10 dB in high / low gain mode
- Noise figure: 1.1 dB in high gain mode
- Supply current: 4.8 / 0.5 mA in high / low gain mode
- Standby mode (< 2 µA typ.)
- Output internally matched to 50 Ω
- Inputs pre-matched to 50 Ω
- 2 kV HBM ESD protection
- Low external component count
- Small leadless TSNP-7-1 package (2.0 x 1.3 x 0.39 mm)
- Pb-free (RoHS compliant) package

RoHS

Description

The BGA713N7 is a low current single-band low noise amplifier MMIC for UMTS bands XII, XIII, XIV, XVII and XX. The LNA is based upon Infineon's proprietary and cost-effective SiGe:C technology and comes in a low profile TSNP-7-1 leadless green package. This document specifies electrical parameters, pinout, application circuit and packaging of the chip.

Product Name	Package	Chip	Marking
BGA713N7	TSNP-7-1	T1533	B3

Figure 1 Block Diagram of Single-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 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.

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}	–	150	–	K/W	–

2.3 ESD Integrity

Table 3 ESD Integrity

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
ESD hardness HBM[1)]	$V_{ESD\text{-}HBM}$	–	2000	–	V	All pins

1) According to JESD22-A114

2.4 DC Characteristics

Table 4 DC Characteristics, T_A = 25 °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}	–	4.8	–	mA	–
Supply current low gain mode	I_{CCLG}	–	0.50	–	mA	–
Supply current standby mode	I_{CCOFF}	–	0.1	–	µA	–
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_{HI}	–	5.0	–	µA	All logic pins
	I_{LO}	–	0.1	–	µA	

2.5 Band Select / Gain Control Truth Table

Table 5 Truth Table

Control Voltage		State	
		Bands XII, XIII, XIV, XVII and XX	
VEN	VGS	HG	LG
H	L	OFF	ON
H	H	ON	OFF
L	L	STANDBY[1)]	
L	H		

1) In order to achieve minimum standby current it is encouraged to apply logic low-level at the VGS pin in standby mode although this is not mandatory.

2.6 Switching Time

Table 6 Typical switching times; T_A = -30 ... 85 °C

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Settling time gainstep	t_{GS}	–	1	–	µs	Switching LG ↔ HG

2.7 Supply Current and Power Gain Characteristics

Supply current high gain mode versus resistance of reference resistor R_{REF} see Figure 3 on Page 20; low gain mode supply current is independent of reference resistor).

Supply Current I_{CC} = f (R_{REF})
V_{CC} = 2.8 V

Power Gain $|S_{21}|$ = f (R_{REF})
V_{CC} = 2.8 V

2.8 Logic Signal Characteristics

Current consumption of logic inputs VEN, VGS

Logic currents I_{EN} = f (V_{EN})
V_{CC} = 2.8 V

Logic currents I_{GS} = f (V_{GS})
V_{CC} = 2.8 V

2.9 Measured RF Characteristics UMTS Bands XII / XVII

Table 7 Typical Characteristics 700 MHz Band, T_A = 25 °C, V_{CC} = 2.8 V, R_{REF} = 5.6 kΩ[1)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range band XII		728		746	MHz	
Pass band range band XVII		734		746	MHz	
Current consumption	I_{CCHG}	–	4.8	–	mA	High gain mode
	I_{CCLG}	–	0.50	–	mA	Low gain mode
Gain	S_{21HG}	–	15.3	–	dB	High gain mode
	S_{21LG}	–	-9.9	–	dB	Low gain mode
Reverse isolation[2)]	S_{12HG}	–	-40	–	dB	High gain mode
	S_{12LG}	–	-9.9	–	dB	Low gain mode
Noise figure	NF_{HG}	–	1.1	–	dB	High gain mode
	NF_{LG}	–	9.9	–	dB	Low gain mode
Input return loss[2)]	S_{11HG}	–	-13	–	dB	50 Ω, high gain mode
	S_{11LG}	–	-14	–	dB	50 Ω, low gain mode
Output return loss[2)]	S_{22HG}	–	-27	–	dB	50 Ω, high gain mode
	S_{22LG}	–	-19	–	dB	50 Ω, low gain mode
Stability factor[3)]	k	–	>2.2	–		DC to 8 GHz; all gain modes
Input compression point[2)]	IP_{1dBHG}	–	-7	–	dBm	High gain mode
	IP_{1dBLG}	–	-12	–	dBm	Low gain mode
Inband IIP3[2)] f_1 - f_2 = 1 MHz P_{f1} = P_{f2} = -37 dBm	$IIP3_{HG}$ $IIP3_{LG}$	–	-8 -2	–	dBm	High gain mode Low gain mode

1) Performance based on application circuit in Figure 2 on Page 19
2) Verification based on AQL; not 100% tested in production
3) Guaranteed by device design; not tested in production

2.10 Measured RF Characteristics UMTS Bands XIII / XIV

Table 8 Typical Characteristics 700 MHz Band, T_A = 25 °C, V_{CC} = 2.8 V, R_{REF} = 5.6 kΩ[1)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range band XIII		746		756	MHz	
Pass band range band XIV		758		768	MHz	
Current consumption	I_{CCHG}	–	4.8	–	mA	High gain mode
	I_{CCLG}	–	0.50	–	mA	Low gain mode
Gain	S_{21HG}	–	15.5	–	dB	High gain mode
	S_{21LG}	–	-9.8	–	dB	Low gain mode
Reverse isolation[2)]	S_{12HG}	–	-39	–	dB	High gain mode
	S_{12LG}	–	-9.8	–	dB	Low gain mode
Noise figure	NF_{HG}	–	1.1	–	dB	High gain mode
	NF_{LG}	–	9.8	–	dB	Low gain mode
Input return loss[2)]	S_{11HG}	–	-15	–	dB	50 Ω, high gain mode
	S_{11LG}	–	-12	–	dB	50 Ω, low gain mode
Output return loss[2)]	S_{22HG}	–	-15	–	dB	50 Ω, high gain mode
	S_{22LG}	–	-20	–	dB	50 Ω, low gain mode
Stability factor[3)]	k	–	>2.3	–		DC to 8 GHz; all gain modes
Input compression point[2)]	IP_{1dBHG}	–	-7	–	dBm	High gain mode
	IP_{1dBLG}	–	-11	–	dBm	Low gain mode
Inband IIP3[2)] f_1 - f_2 = 1 MHz P_{f1} = P_{f2} = -37 dBm	$IIP3_{HG}$ $IIP3_{LG}$	–	-7 -2	–	dBm	High gain mode Low gain mode

1) Performance based on application circuit in Figure 3 on Page 20
2) Verification based on AQL; not 100% tested in production
3) Guaranteed by device design; not tested in production

2.11 Measured RF Characteristics UMTS Band XX

Table 9 Typical Characteristics 800 MHz Band, T_A = 25 °C, V_{CC} = 2.8 V, R_{REF} = 5.6 kΩ[1)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		791		821	MHz	
Current consumption	I_{CCHG}	–	4.8	–	mA	High gain mode
	I_{CCLG}	–	0.50	–	mA	Low gain mode
Gain	S_{21HG}	–	15.9	–	dB	High gain mode
	S_{21LG}	–	-8.4	–	dB	Low gain mode
Reverse isolation[2)]	S_{12HG}	–	-38	–	dB	High gain mode
	S_{12LG}	–	-8.4	–	dB	Low gain mode
Noise figure	NF_{HG}	–	1.0	–	dB	High gain mode
	NF_{LG}	–	8.4	–	dB	Low gain mode
Input return loss[2)]	S_{11HG}	–	-16	–	dB	50 Ω, high gain mode
	S_{11LG}	–	-11	–	dB	50 Ω, low gain mode
Output return loss[2)]	S_{22HG}	–	-13	–	dB	50 Ω, high gain mode
	S_{22LG}	–	-27	–	dB	50 Ω, low gain mode
Stability factor[3)]	k	–	>2.3	–		DC to 8 GHz; all gain modes
Input compression point[2)]	IP_{1dBHG}	–	-6	–	dBm	High gain mode
	IP_{1dBLG}	–	-10	–	dBm	Low gain mode
Inband IIP3[2)] f_1 - f_2 = 1 MHz P_{f1} = P_{f2} = -37 dBm	$IIP3_{HG}$ $IIP3_{LG}$	–	-8 -1	–	dBm	High gain mode Low gain mode

1) Performance based on application circuit in Figure 4 on Page 21
2) Verification based on AQL; not 100% tested in production
3) Guaranteed by device design; not tested in production

2.12 Measured Performance Band XIII High Gain Mode vs. Frequency

T_A = 25 °C, V_{CC} = 2.8 V, V_{GS} = 2.8 V, V_{EN} = 2.8 V, R_{REF} = 5.6 kΩ

Power Gain $|S_{21}|$ = f (f)

Power Gain wideband $|S_{21}|$ = f (f)

Matching $|S_{11}|$ = f (f), $|S_{22}|$ = f (f)

Noise Figure NF = f (f)

2.13 Measured Performance Band XIII High Gain Mode vs. Temperature

V_{CC} = 2.8 V, V_{GS} = 2.8 V, V_{EN} = 2.8 V, f = 750 MHz, R_{REF} = 5.6 kΩ

Power Gain $|S_{21}|$ = f (T_A)

Supply Current I_{CC} = f (T_A)

Input Compression $P1dB$ = f (T_A)

Noise Figure NF = f (T_A)

2.14 Measured Performance Band XIII Low Gain Mode vs. Frequency

T_A = 25 °C, V_{CC} = 2.8 V, V_{GS} = 0 V, V_{EN} = 2.8 V, R_{REF} = 5.6 kΩ

Power Gain $|S_{21}|$ = f (f)

Power Gain wideband $|S_{21}|$ = f (f)

Matching $|S_{11}|$ = f (f), $|S_{22}|$ = f (f)

Noise Figure NF = f (f)

2.15 Measured Performance Band XIII Low Gain Mode vs. Temperature

V_{CC} = 2.8 V, V_{GS} = 0 V, V_{EN} = 2.8 V, f = 750 MHz, R_{REF} = 5.6 kΩ

Power Gain $|S_{21}|$ = f (T_A)

Supply Current I_{CC} = f (T_A)

Input Compression $P1dB$ = f (T_A)

Noise Figure NF = f (T_A)

3 Application Circuit and Block Diagram

3.1 UMTS Bands XII and XVII Application Circuit Schematic

Figure 2 Application Circuit with Chip Outline (top view)

Note: Package paddle (Pin 7) has to be RF grounded.

Table 10 Parts List

Part Number	Part Type	Manufacturer	Size	Comment
L1 ... L2	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C4	Chip capacitor	Various	0402	
RREF	Chip resistor	Various	0402	

3.2 UMTS Bands XIII and XIV Application Circuit Schematic

Figure 3 Application Circuit with Chip Outline (top view)

Note: Package paddle (Pin 7) has to be RF grounded.

Table 11 Parts List

Part Number	Part Type	Manufacturer	Size	Comment
L1 ... L2	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C4	Chip capacitor	Various	0402	
RREF	Chip resistor	Various	0402	

3.3 UMTS Bands XX Application Circuit Schematic

Figure 4 Application Circuit with Chip Outline (top view)

Note: Package paddle (Pin 7) has to be RF grounded.

Table 12 Parts List

Part Number	Part Type	Manufacturer	Size	Comment
L1 ... L2	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C4	Chip capacitor	Various	0402	
RREF	Chip resistor	Various	0402	

3.4 Pin Description

Table 13 Pin Definition and Function

Pin No.	Name	Pin Type	Buffer Type	Function
1	RFIN			LNA input
2	VEN			Band select control
3	VGS			Gain step control
4	VCC			Supply voltage
5	RREF			Bias current reference resistor (high gain mode)
6	RFOUT			LNA output
7	GND			Ground Package paddle; ground connection and control circuitry

3.5 Application Board

Figure 5 Application Board Layout on 3-layer FR4

Note: Top layer thickness: 0.2 mm, bottom layer thickness: 0.8 mm, 17 mm Cu metallization, gold plated. Board size: 21 x 18 mm.

Figure 6 Cross-Section view of Application Board

Figure 7 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 8 Footprint Recommendation 1 for the TSNP-7-1 Package

Figure 9 Footprint Recommendation 2 for the TSNP-7-1 Package

4.2 Package Dimensions

Figure 10 Package Outline (top, side and bottom view)

Figure 11 Tape & Reel Dimensions

4.3 Product Marking Pattern

Figure 12 Marking Pattern (top view)

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