



**THE DATASHEET OF  
BGA711L7E6327XTSA1**



# BGA711L7

Single-Band UMTS LNA  
(2100, 1900 MHz)

RF & Protection Devices



Never stop thinking

**Edition 2009-05-27**

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**BGA711L7**

**Revision History: 2009-05-27, V3.2**

**Previous Version: 2008-11-05, V3.1**

<b>Page</b>	<b>Subjects (major changes since last revision)</b>
7	Updated DC Characteristics (added limits)
9, 10, 11	Updated footnotes
18	Updated value of C4 at Application Circuit Schematic for band II

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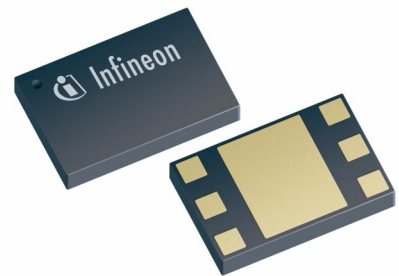
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## 1 Description

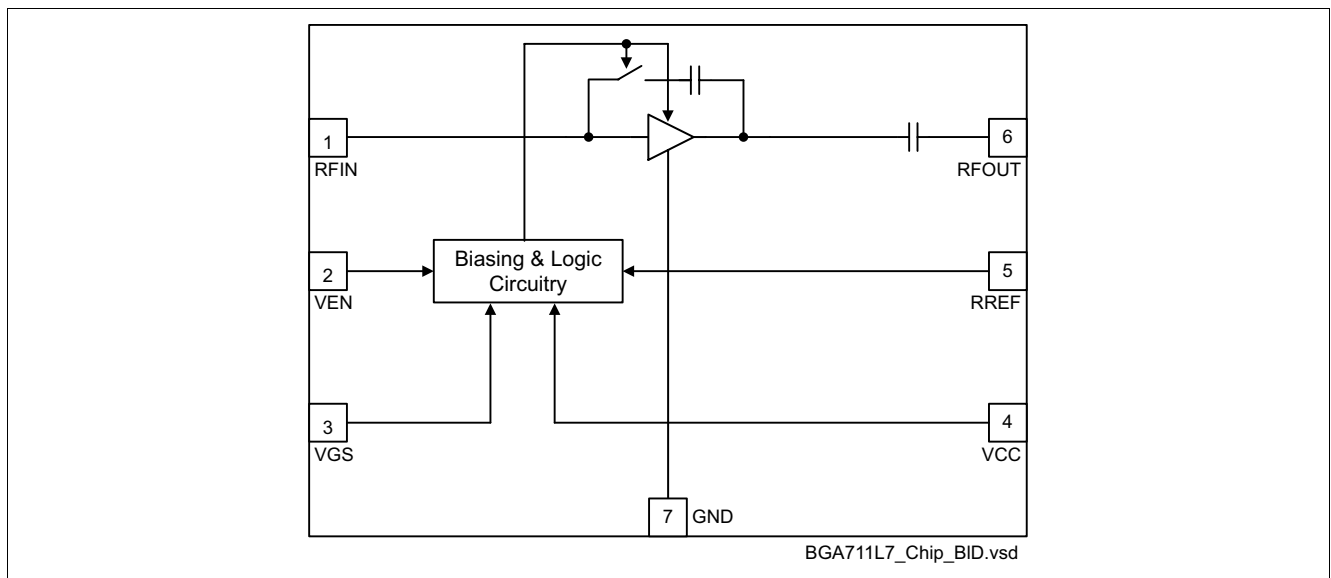
The BGA711L7 is a low current single-band low noise amplifier MMIC for UMTS bands I, IV and X. The LNA is based upon Infineon's proprietary and cost-effective SiGe:C technology and comes in a low profile TSLP-7-1 leadless green package. Because the matching is off chip, the 2100 MHz path can be easily converted into a 1900 MHz path by optimizing the input and output matching network. This document specifies the electrical parameters, pinout, application circuit and packaging of the chip.

### Features

- Gain: 17 / -8 dB in high / low gain mode
- Noise figure: 1.1 dB in high gain mode
- Supply current: 3.6 / 0.5 mA in high / low gain mode
- 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 TSLP-7-1 package (2.0 x 1.3 x 0.39 mm)
- Pb-free (RoHS compliant) package



**TSLP-7-1 package**



**Figure 1 Block diagram of single-band LNA**

Type	Package	Marking	Chip
BGA711L7	TSLP-7-1	B1	T1531

## 2 Electrical Characteristics

### 2.1 Absolute Maximum Ratings

Table 1 Absolute Maximum Ratings

Parameter	Symbol	Values		Unit	Note / Test Condition
		Min.	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 pin
Pin voltage RF Input Pin	$V_{RFIN}$	-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	

### 2.2 Thermal Resistance

Table 2 Thermal Resistance

Parameter	Symbol	Value	Unit	Note / Test Conditions
Thermal resistance junction to soldering point	$R_{thJS}$	240	K/W	

### 2.3 ESD Integrity

Table 3 ESD Integrity

Parameter	Symbol	Value (typ.)	Unit	Note / Test Conditions
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,  $T_A = 25\text{ °C}$**

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	$I_{CCHG}$		3.6		mA	
Supply current low gain mode	$I_{CCLG}$		500		$\mu\text{A}$	
Supply current standby mode	$I_{CCOFF}$		0.1	2.0	$\mu\text{A}$	
Logic level high	$V_{HI}$	1.5	2.8		V	VEN and VGS
Logic level low	$V_{LO}$	-0.2	0.0	0.5	V	
Logic currents VEN	$I_{ENL}$			0.1	$\mu\text{A}$	VEN
	$I_{ENH}$		5.0	6.0	$\mu\text{A}$	
Logic currents VGS	$I_{GSL}$			0.1	$\mu\text{A}$	VGS
	$I_{GSH}$		5.0	6.0	$\mu\text{A}$	

## 2.5 Gain Mode Select Truth Table

**Table 5 Truth Table**

Control Voltage		State	
		Bands I, II, IV and X	
VEN	VGS	HG	LG
H	L	OFF	ON
H	H	ON	OFF
L	L	STANDBY <sup>1)</sup>	
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. Details see section 2.4.

## 2.6 Switching Times

**Table 6 Typical switching times;  $T_A = -30 \dots 85\text{ °C}$**

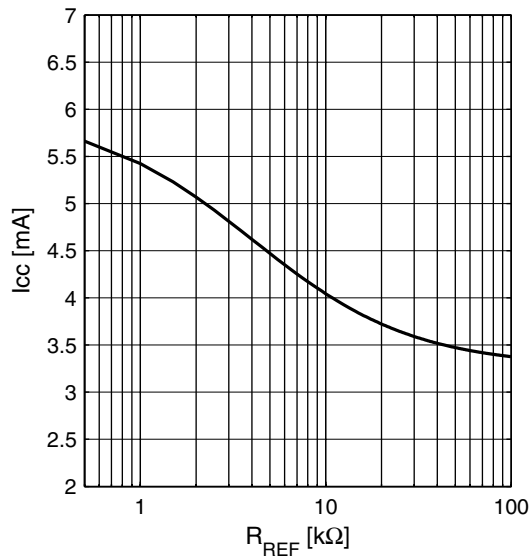
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Settling time gainstep	$t_{GS}$		1		$\mu\text{s}$	Switching LG $\leftrightarrow$ HG

Supply current and Power gain characteristics;  $T_A = 25\text{ }^\circ\text{C}$

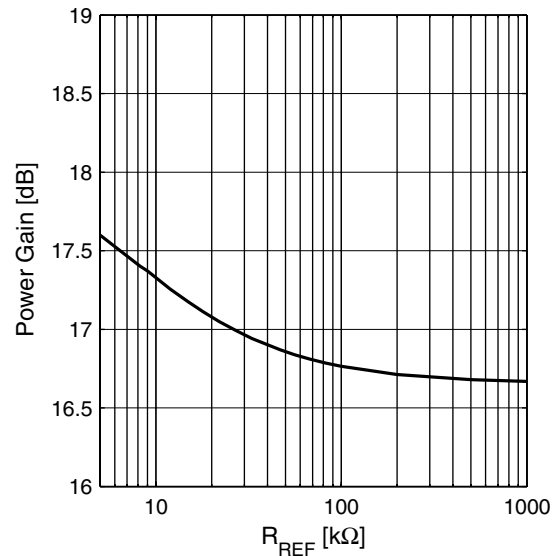
## 2.7 Supply current and Power gain characteristics; $T_A = 25\text{ }^\circ\text{C}$

Supply current and Power gain high gain mode versus reference resistor  $R_{REF}$  (see [Figure 2 on page 17](#) for reference resistor; low gain mode supply current is independent of reference resistor).

**Supply Current**  $I_{CC} = f(R_{REF})$   
 $V_{CC} = 2.8\text{ V}$



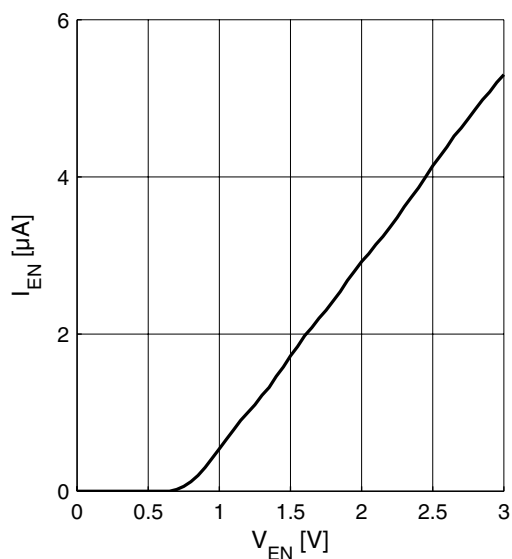
**Power Gain**  $|S_{21}| = f(R_{REF})$   
 $V_{CC} = 2.8\text{ V}$



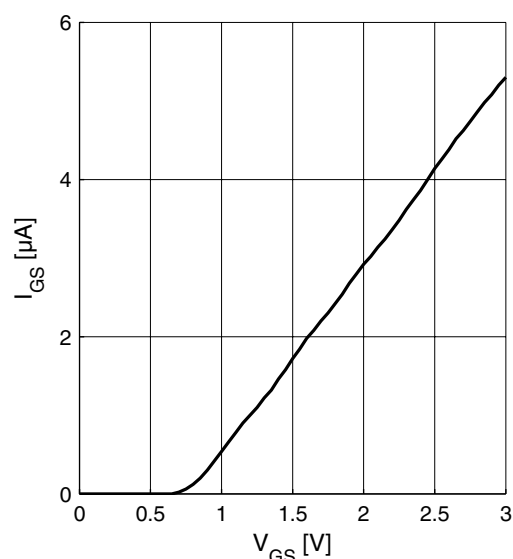
## 2.8 Logic Signal Characteristics; $T_A = 25\text{ }^\circ\text{C}$

Current consumption of logic inputs  $V_{EN}$ ,  $V_{GS}$

**Logic currents**  $I_{EN} = f(V_{EN})$   
 $V_{CC} = 2.8\text{ V}$



**Logic currents**  $I_{GS} = f(V_{GS})$   
 $V_{CC} = 2.8\text{ V}$



**Measured RF Characteristics UMTS Bands I / IV / X (with reference resistor)**

**2.9 Measured RF Characteristics UMTS Bands I / IV / X (with reference resistor)**

**Table 7 Typical Characteristics 2100 MHz Band  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $R_{REF} = 27\text{ k}\Omega$**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range band I / X		2110		2170	MHz	
Pass band range band IV		2110		2155	MHz	
Current consumption	$I_{CCHG}$		3.6		mA	High gain mode
	$I_{CCLG}$		0.5		mA	Low gain mode
Gain	$S_{21HG}$		17.0		dB	High gain mode
	$S_{21LG}$		-7.6		dB	Low gain mode
Reverse Isolation <sup>1)</sup>	$S_{12HG}$		-36		dB	High gain mode
	$S_{12LG}$		-8		dB	Low gain mode
Noise figure	$NF_{HG}$		1.1		dB	High gain mode
	$NF_{LG}$		7.8		dB	Low gain mode
Input return loss <sup>1)</sup>	$S_{11HG}$		-20		dB	50 $\Omega$ , high gain mode
	$S_{11LG}$		-15		dB	50 $\Omega$ , low gain mode
Output return loss <sup>1)</sup>	$S_{22HG}$		-19		dB	50 $\Omega$ , high gain mode
	$S_{22LG}$		-17		dB	50 $\Omega$ , low gain mode
Stability factor <sup>2)</sup>	$k$		>2.3			DC to 10 GHz; all gain modes
Input compression point <sup>1)</sup>	$IP_{1dBHG}$		-8		dBm	High gain mode
	$IP_{1dBLG}$		-2		dBm	Low gain mode
Inband IIP3 <sup>1)</sup> $f_1 - f_2 = 1\text{ MHz}$ $P_{f1} = P_{f2} = -37\text{ dBm}$	$IIP3_{HG}$		-2		dBm	High gain mode
	$IIP3_{LG}$		7			Low gain mode

1) Verification based on AQL; not 100% tested in production

2) Guaranteed by device design; not tested in production

**Measured RF Characteristics UMTS Bands I / IV / X (without ref. resistor)**

**2.10 Measured RF Characteristics UMTS Bands I / IV / X (without ref. resistor)**

**Table 8 Typical Characteristics 2100 MHz Band  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $R_{REF} = n/c$**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range band I / X		2110		2170	MHz	
Pass band range band IV		2110		2155	MHz	
Current consumption	$I_{CCHG}$		3.3		mA	High gain mode
	$I_{CCLG}$		0.5		mA	Low gain mode
Gain	$S_{21HG}$		16.7		dB	High gain mode
	$S_{21LG}$		-7.7		dB	Low gain mode
Reverse Isolation <sup>1)</sup>	$S_{12HG}$		-36		dB	High gain mode
	$S_{12LG}$		-8		dB	Low gain mode
Noise figure	$NF_{HG}$		1.1		dB	High gain mode
	$NF_{LG}$		8.1		dB	Low gain mode
Input return loss <sup>1)</sup>	$S_{11HG}$		-21		dB	50 $\Omega$ , high gain mode
	$S_{11LG}$		-14		dB	50 $\Omega$ , low gain mode
Output return loss <sup>1)</sup>	$S_{22HG}$		-19		dB	50 $\Omega$ , high gain mode
	$S_{22LG}$		-18		dB	50 $\Omega$ , low gain mode
Stability factor <sup>2)</sup>	$k$		>2.3			DC to 10 GHz; all gain modes
Input compression point <sup>1)</sup>	$IP_{1dBHG}$		-8		dBm	High gain mode
	$IP_{1dB LG}$		-2		dBm	Low gain mode
Inband IIP3 <sup>1)</sup> $f_1 - f_2 = 1\text{ MHz}$ $P_{f1} = P_{f2} = -37\text{ dBm}$	$IIP3_{HG}$		-2		dBm	High gain mode
	$IIP3_{LG}$		7			Low gain mode

1) Verification based on AQL; not 100% tested in production

2) Guaranteed by device design; not tested in production

**Measured RF Characteristics UMTS Band II (with reference resistor)**

**2.11 Measured RF Characteristics UMTS Band II (with reference resistor)**

**Table 9 Typical Characteristics 1900 MHz Band  $T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $R_{REF} = 27\text{ k}\Omega$**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range band II		1930		1990	MHz	
Current consumption	$I_{CCHG}$		3.6		mA	High gain mode
	$I_{CCLG}$		0.5		mA	Low gain mode
Gain	$S_{21HG}$		17.2		dB	High gain mode
	$S_{21LG}$		-9.2		dB	Low gain mode
Reverse Isolation <sup>1)</sup>	$S_{12HG}$		-38.6		dB	High gain mode
	$S_{12LG}$		-9.2		dB	Low gain mode
Noise figure	$NF_{HG}$		1.1		dB	High gain mode
	$NF_{LG}$		9.4		dB	Low gain mode
Input return loss <sup>1)</sup>	$S_{11HG}$		-14		dB	50 $\Omega$ , high gain mode
	$S_{11LG}$		-15		dB	50 $\Omega$ , low gain mode
Output return loss <sup>1)</sup>	$S_{22HG}$		-15		dB	50 $\Omega$ , high gain mode
	$S_{22LG}$		-18		dB	50 $\Omega$ , low gain mode
Stability factor <sup>2)</sup>	$k$		>2.2			DC to 10 GHz; all gain modes
Input compression point <sup>1)</sup>	$IP_{1dBHG}$		-7		dBm	High gain mode
	$IP_{1dB LG}$		-3		dBm	Low gain mode
Inband IIP3 <sup>1)</sup> $f_1 - f_2 = 1\text{ MHz}$ $P_{f1} = P_{f2} = -37\text{ dBm}$	$IIP3_{HG}$		-3		dBm	High gain mode
	$IIP3_{LG}$		2			Low gain mode

1) Verification based on AQL; not 100% tested in production

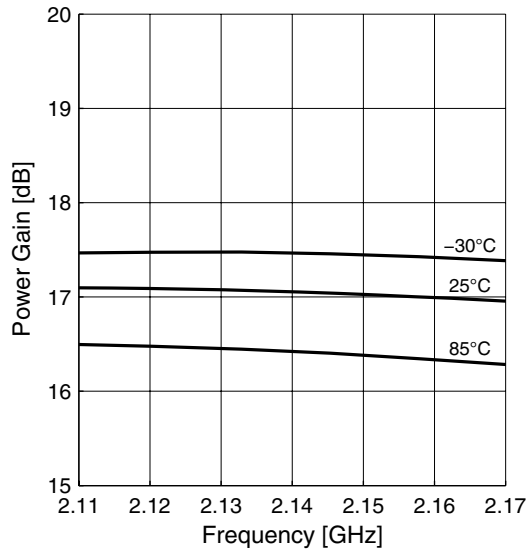
2) Guaranteed by device design; not tested in production

**Measured Performance High Band (Band I) High Gain Mode vs. Frequency**

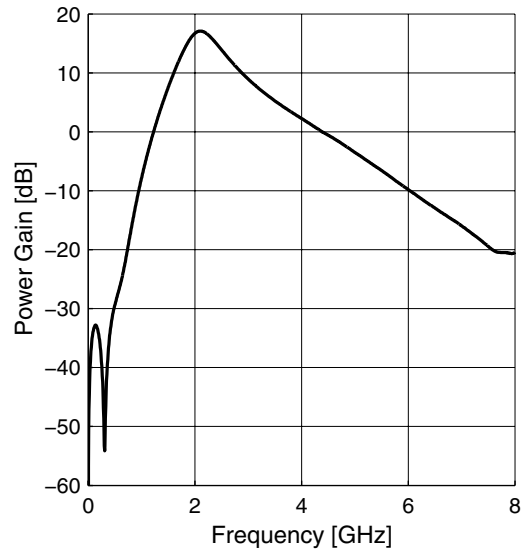
**2.12 Measured Performance High Band (Band I) High Gain Mode vs. Frequency**

$T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $V_{GS} = 2.8\text{ V}$ ,  $V_{EN} = 2.8\text{ V}$ ,  $R_{REF} = 27\text{ k}\Omega$

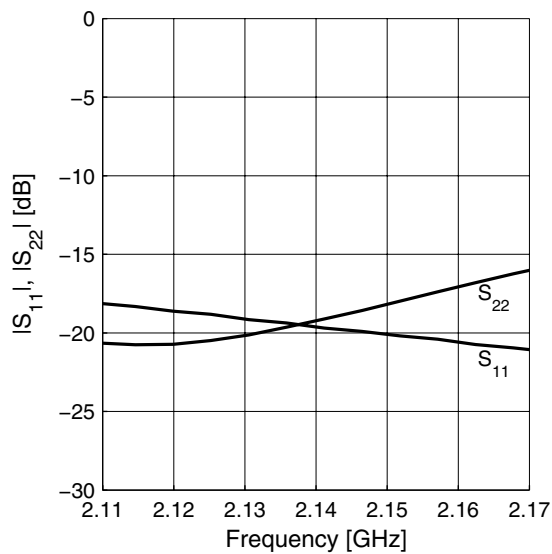
**Power Gain  $|S_{21}| = f(f)$**



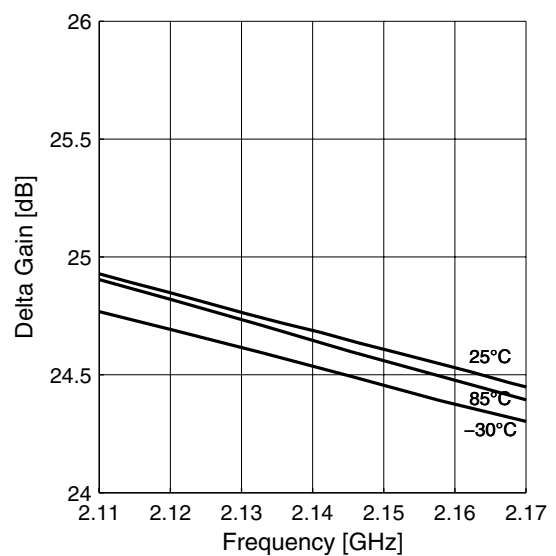
**Power Gain wideband  $|S_{21}| = f(f)$**



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

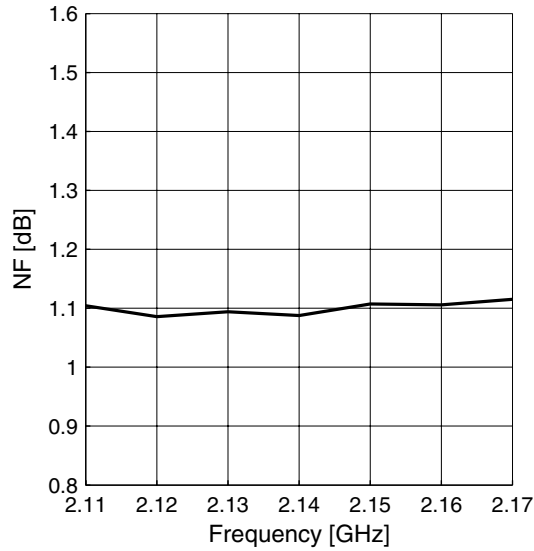


**Gainstep HG-LG  $|\Delta S_{21}| = f(f)$**

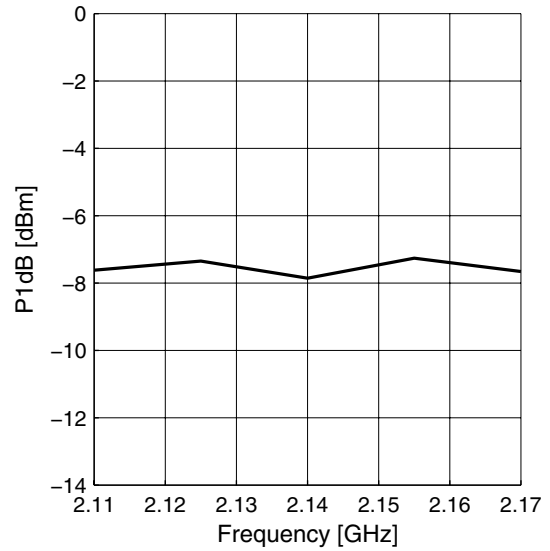


**Measured Performance High Band (Band I) High Gain Mode vs. Temperature**

**Noise Figure  $NF = f(f)$**



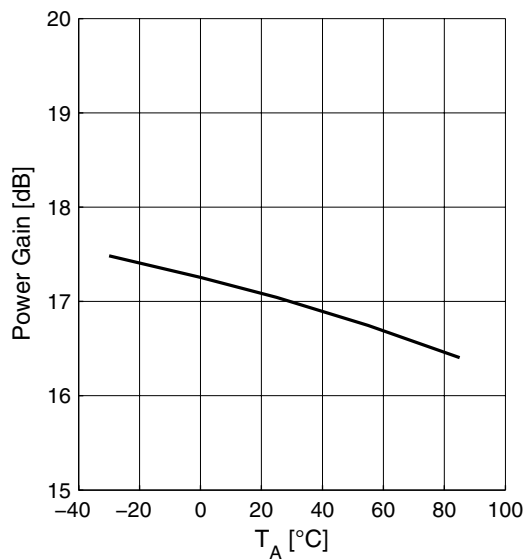
**Input Compression  $P1dB = f(f)$**



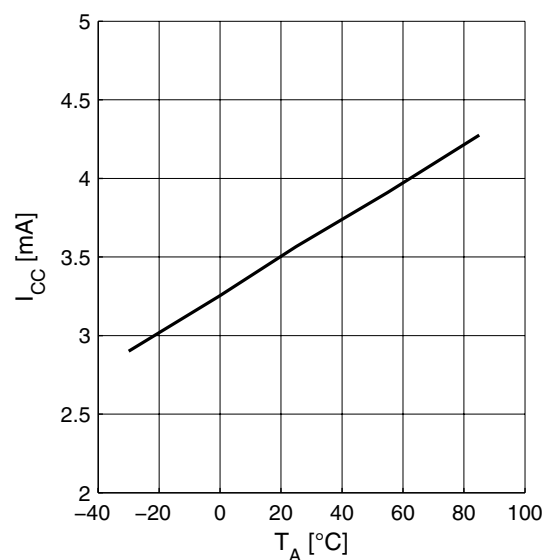
**2.13 Measured Performance High Band (Band I) High Gain Mode vs. Temperature**

$V_{CC} = 2.8 \text{ V}$ ,  $V_{GS} = 2.8 \text{ V}$ ,  $V_{EN} = 2.8 \text{ V}$ ,  $f = 2140 \text{ MHz}$ ,  $R_{REF} = 27 \text{ k}\Omega$

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

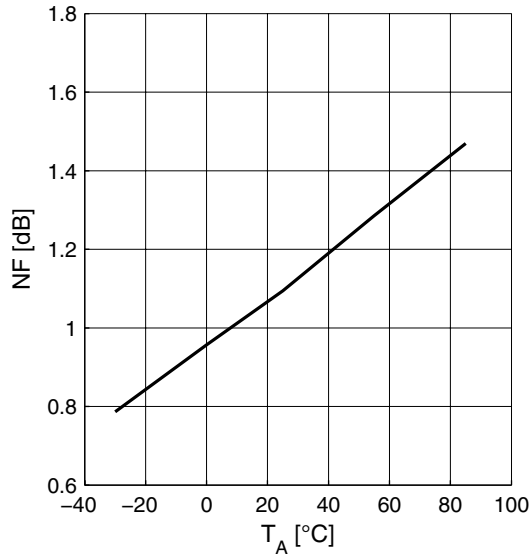


**Supply Current  $I_{CC} = f(T_A)$**

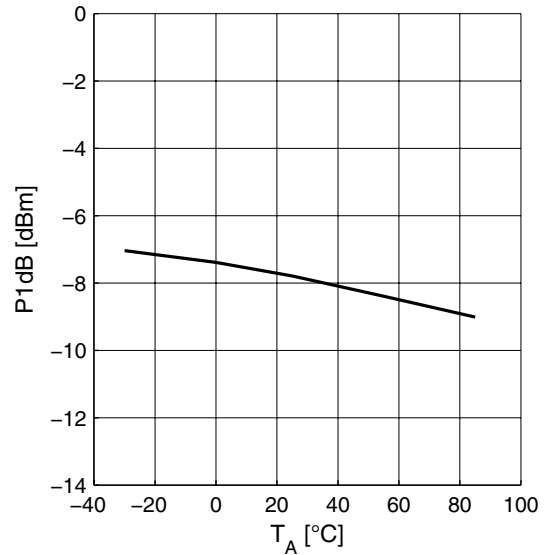


**Measured Performance High Band (Band I) Low Gain Mode vs. Frequency**

**Noise Figure  $NF = f(T_A)$**



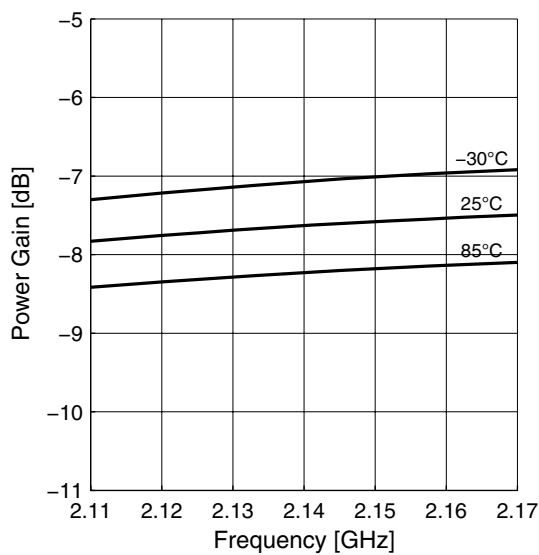
**Input Compression  $P1dB = f(T_A)$**



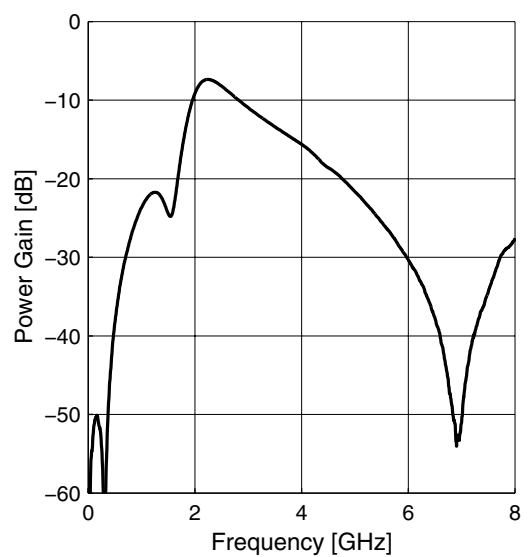
**2.14 Measured Performance High Band (Band I) Low Gain Mode vs. Frequency**

$T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $V_{GS} = 0\text{ V}$ ,  $V_{EN} = 2.8\text{ V}$ ,  $R_{REF} = 27\text{ k}\Omega$

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

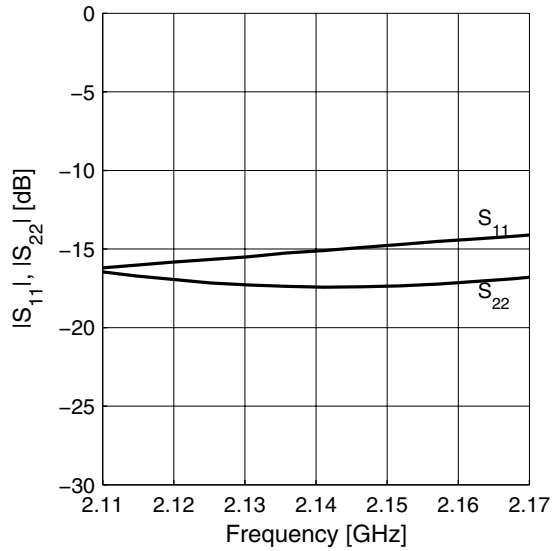


**Power Gain wideband  $|S_{21}| = f(f)$**

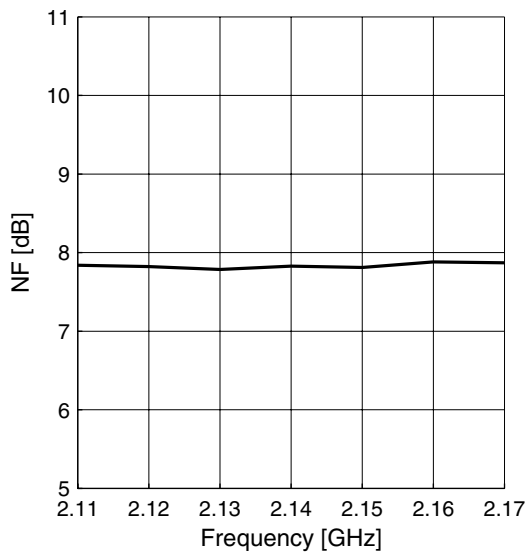


**Measured Performance High Band (Band I) Low Gain Mode vs. Frequency**

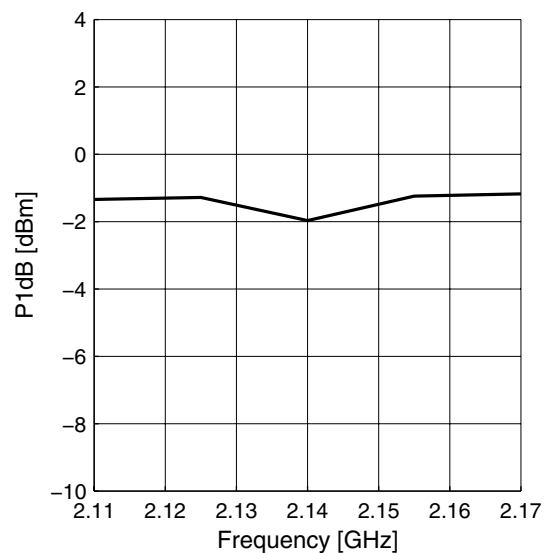
**Matching**  $|S_{11}| = f(f)$ ,  $|S_{22}| = f(f)$



**Noise Figure**  $NF = f(f)$



**Input Compression**  $P1dB = f(f)$

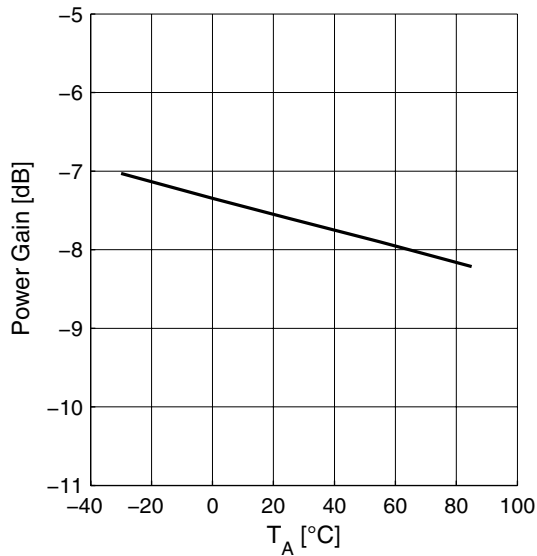


**Measured Performance High Band (Band I) Low Gain Mode vs. Temperature**

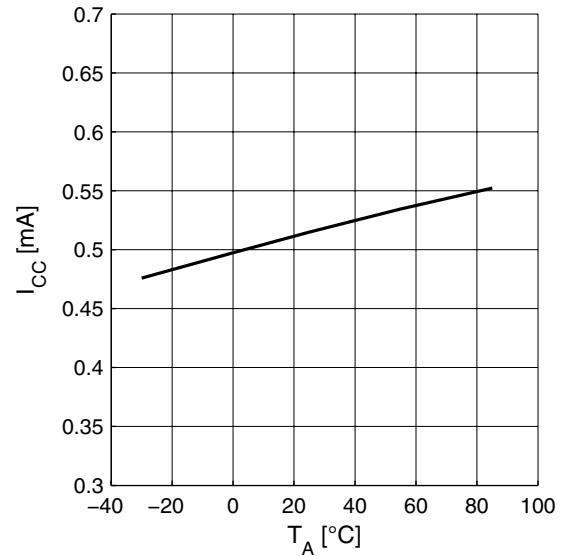
**2.15 Measured Performance High Band (Band I) Low Gain Mode vs. Temperature**

$V_{CC} = 2.8\text{ V}$ ,  $V_{GS} = 0\text{ V}$ ,  $V_{EN} = 2.8\text{ V}$ ,  $f = 2140\text{ MHz}$ ,  $R_{REF} = 27\text{ k}\Omega$

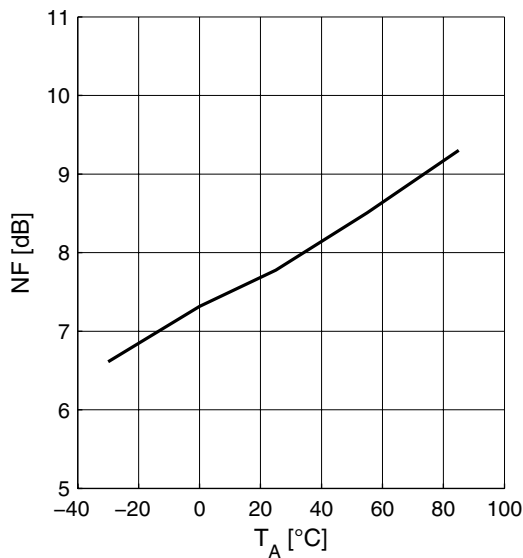
**Power Gain  $|S_{21}| = f(T_A)$**



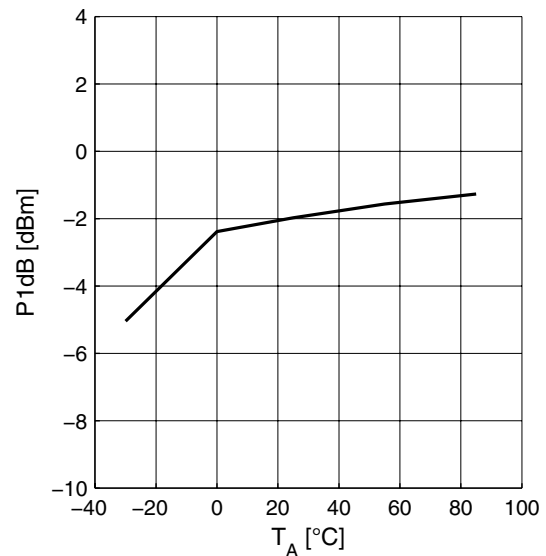
**Supply Current  $I_{CC} = f(T_A)$**



**Noise Figure  $NF = f(T_A)$**

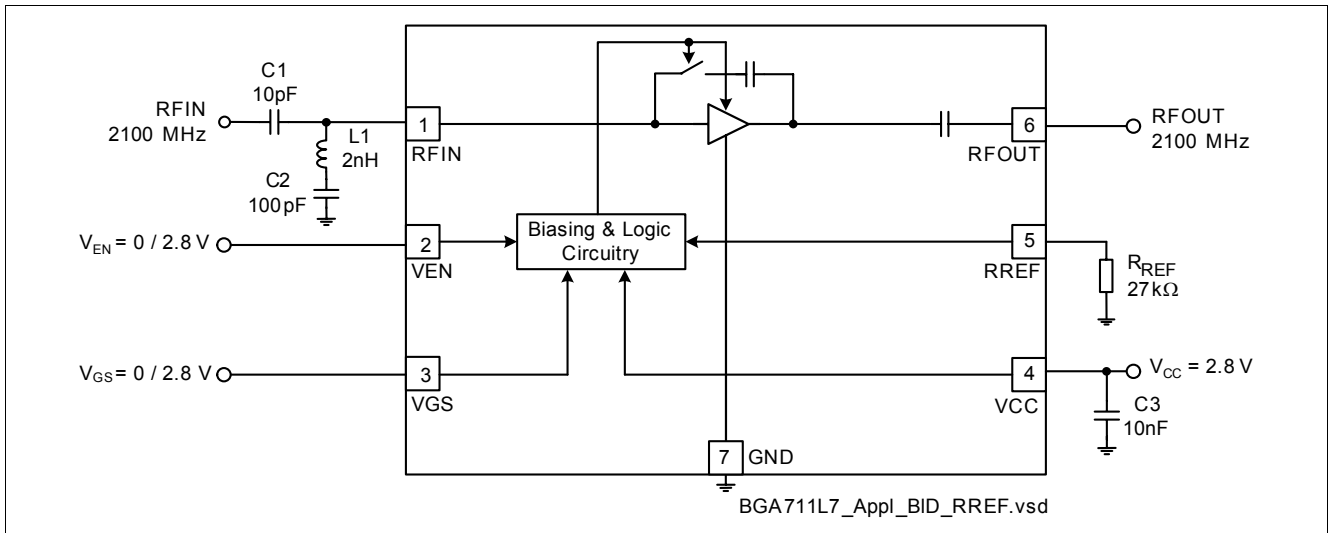


**Input Compression  $P1dB = f(T_A)$**



### 3 Application Circuit and Block Diagram

#### 3.1 UMTS bands I, IV and X Application Circuit Schematic



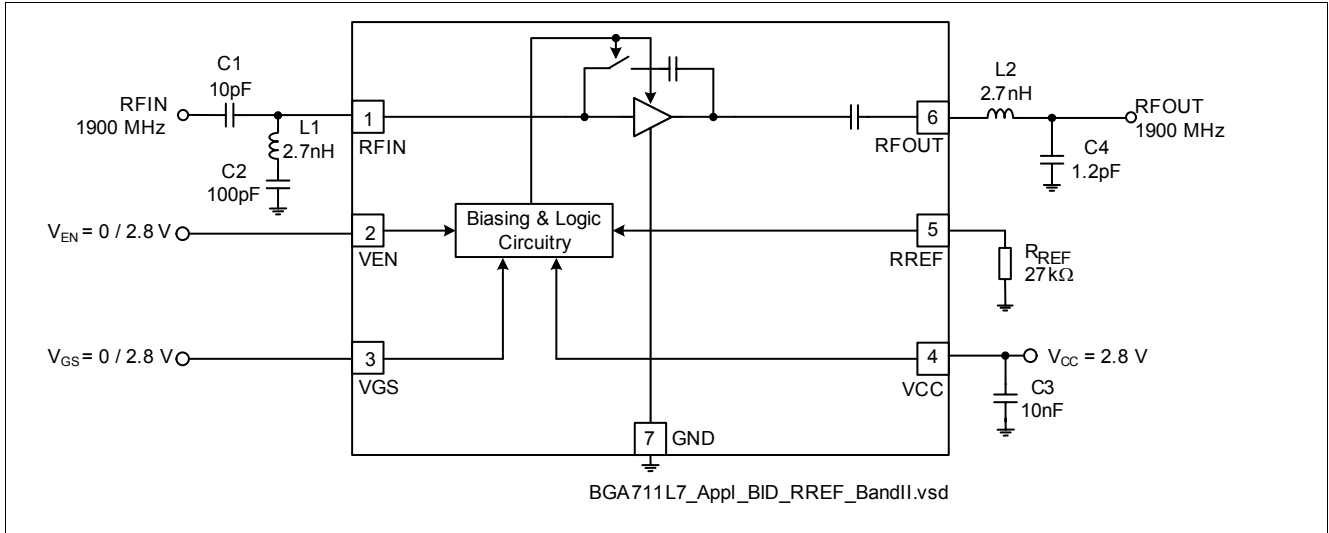
**Figure 2 Application circuit with chip outline (top view)**

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

**Table 10 Parts List**

Part Number	Part Type	Manufacturer	Size	Comment
L1	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C3	Chip capacitor	Various	0402	
R <sub>REF</sub>	Chip resistor	Various	0402	

### 3.2 UMTS band II Application Circuit Schematic



**Figure 3 Application circuit with chip outline (top view)**

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

**Table 11 Parts List**

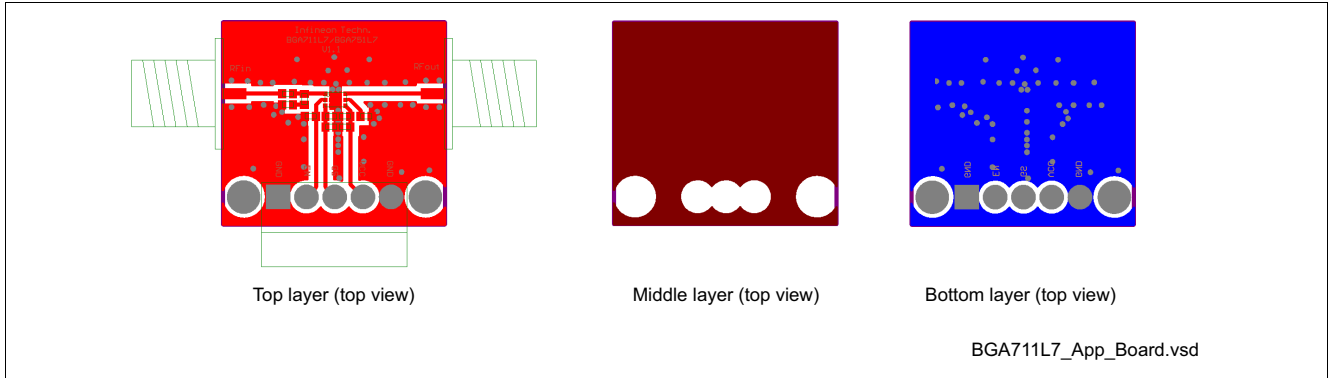
Part Number	Part Type	Manufacturer	Size	Comment
L1, L2	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C4	Chip capacitor	Various	0402	
R <sub>REF</sub>	Chip resistor	Various	0402	

### 3.3 Pin Definition

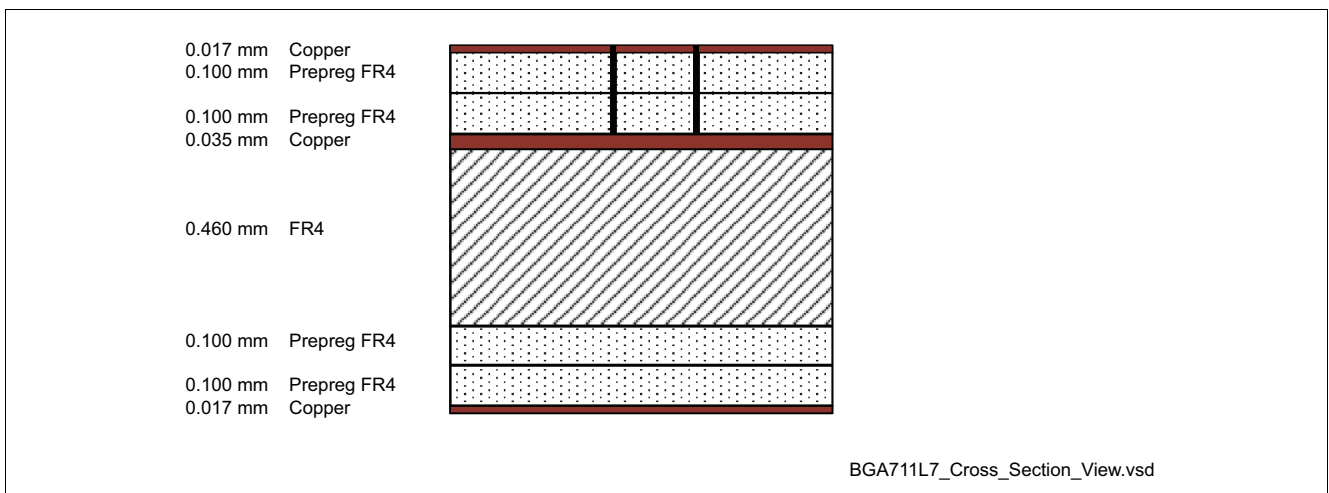
**Table 12 Pin Definition and Function**

Pin Number	Symbol	Function
1	RFIN	LNA input (2100/1900 MHz)
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 (2100/1900 MHz)
7	GND	Package paddle; ground connection for LNA and control circuitry

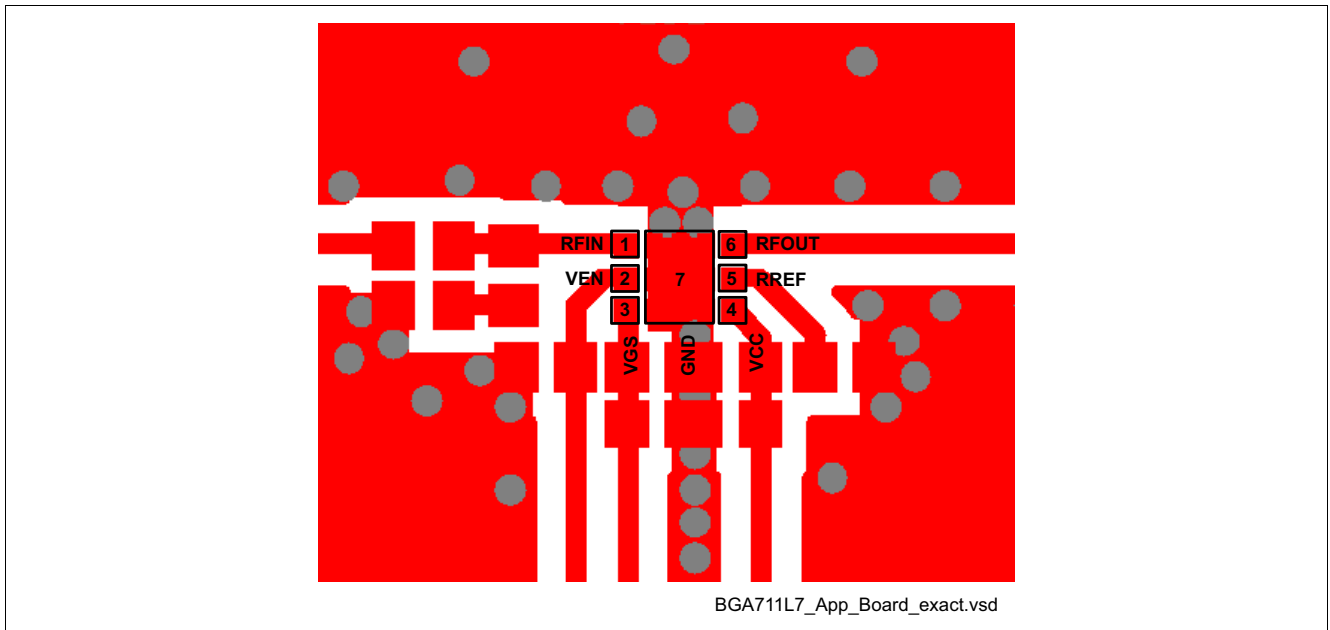
### 3.4 Application Board



**Figure 4** Application board layout on 3-layer FR4. Top layer thickness: 0.2 mm, bottom layer thickness: 0.8 mm, 17  $\mu\text{m}$  Cu metallization, gold plated. Board size: 21 x 19 mm



**Figure 5** Cross-section view of application board

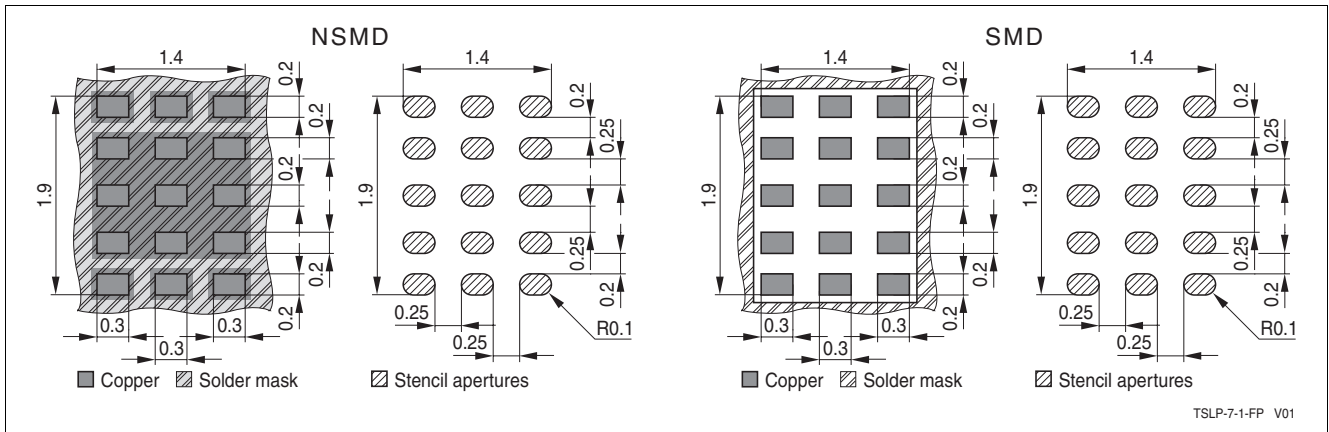


**Figure 6** Detail of application board layout

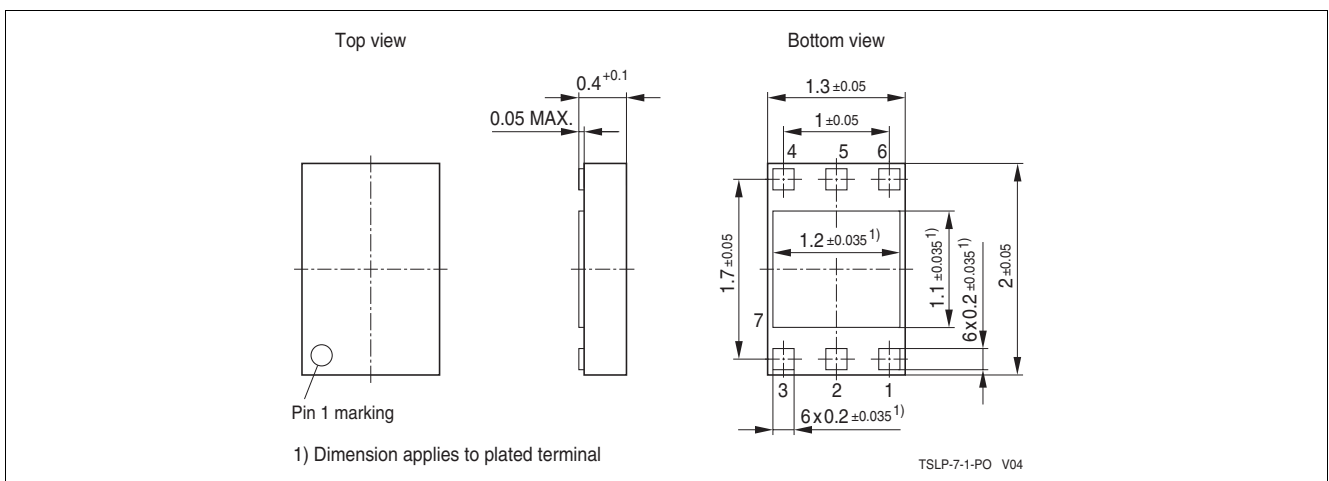
*Note: In order to achieve the same performance as given in this datasheet please follow the suggested PCB-layout as closely as possible. The position of the GND vias is critical for RF performance.*

## 4 Physical Characteristics

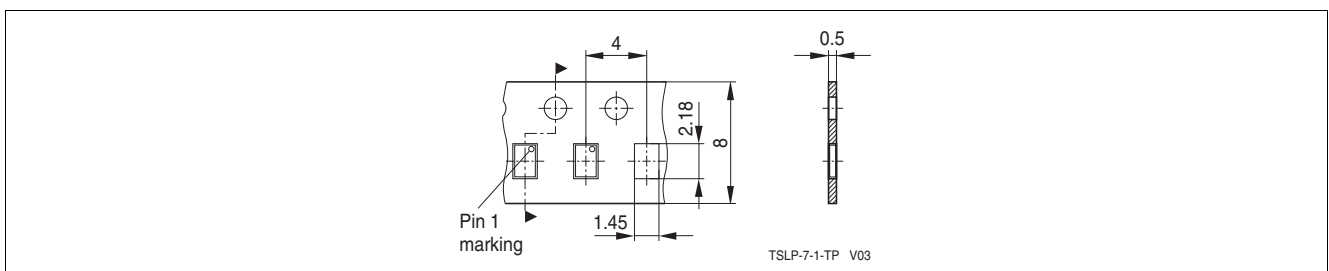
### 4.1 Package Dimensions



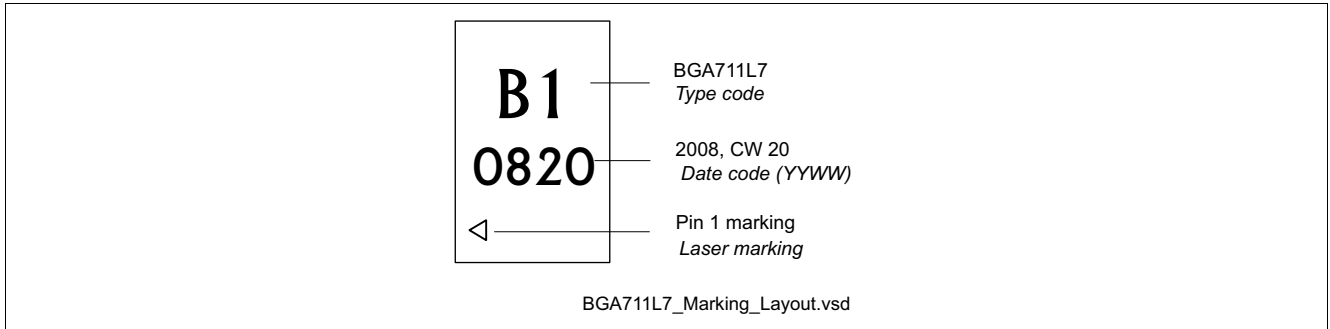
**Figure 7 Recommended footprint and stencil layout for the TSLP-7-1 package**



**Figure 8 Package outline (top, side and bottom view)**



**Figure 9 Tape & Reel Dimensions**





**Figure 10** Marking Layout

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