

# BGA711N7

SiGe Bipolar 3G/3.5G/4G Single-Band LNA

## Data Sheet

Revision 3.1, 2013-01-31

**Edition 2013-01-31**

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

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**BGA711N7 SiGe Bipolar 3G/3.5G/4G Single-Band LNA**

**Revision History: 2013-01-31, Revision 3.1**

**Previous Revision: 2012-10-31, Revision 3.0**

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

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## 1 Features

Main features:

- Gain: 17 / -8 dB in high / low gain mode (f.e. at 2.14GHz)
- Noise figure: 1.1 dB in high gain mode (f.e. at 2.14GHz)
- 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 TSNP-7-1 package (2.0 x 1.3 x 0.39 mm)
- Pb-free (RoHS compliant) package



### Description

The BGA711N7 is a low current single-band low noise amplifier MMIC for 3G, 3.5G and 4G. 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. Because the matching is off chip, the RF path can be easily converted into a 1.8GHz to 2.7GHz path by optimizing the input and output matching network. This document specifies the electrical parameters, pinout, application circuit and packaging of the chip.



Product Name	Package	Chip	Marking
BGA711N7	TSNP-7-1	T1531	B1

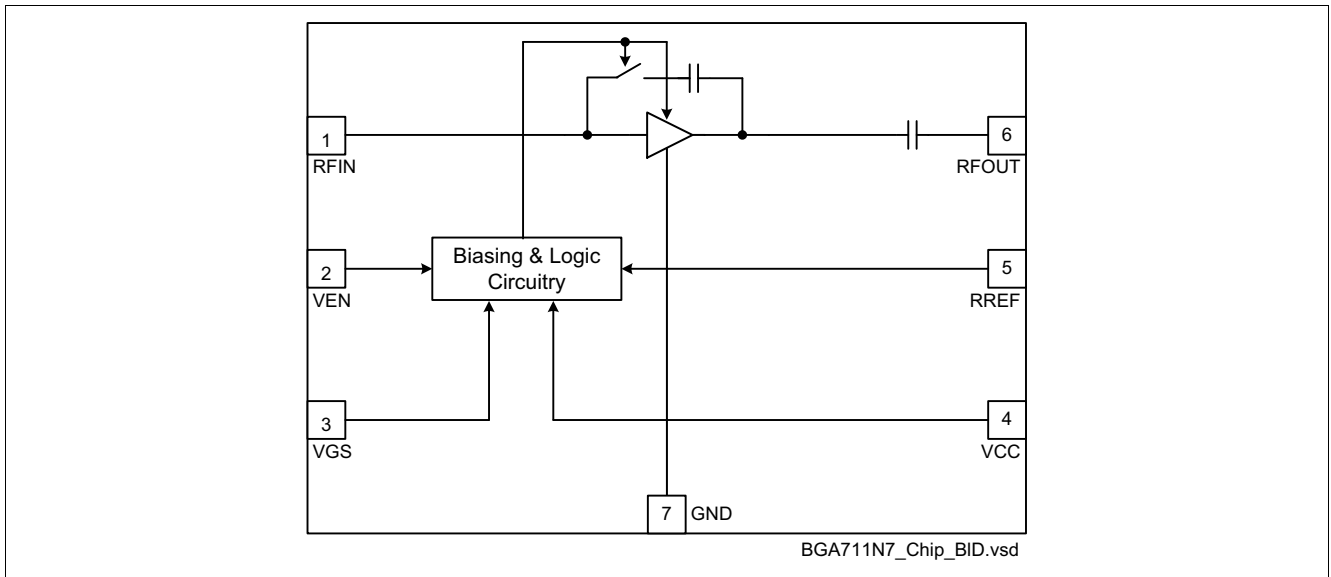


Figure 1 Block Diagram of Single-Band LNA



## 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	$R_{thJS}$	–	240	–	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,  $T_A = 25\text{ °C}$**

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	Typical value with 27k $\Omega$ reference resistor
Supply current low gain mode	$I_{CCLG}$	–	0.5	–	mA	
Supply current standby mode	$I_{CCOFF}$	–	0.1	2.0	$\mu$ A	–
Logic level high	$V_{HI}$	1.4	2.8	–	V	All logic pins
Logic level low	$V_{LO}$	-0.2	0.0	0.5	V	
Logic currents	$I_{LO}$	–	–	0.1	$\mu$ A	All logic pins
	$I_{HI}$	–	5.0	6.0	$\mu$ A	

## 2.5 Gain Mode Select Truth Table

**Table 5 Truth Table**

Control Voltage		State	
		All Bands	
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;  $T_A = -30 \dots 85\text{ °C}$**

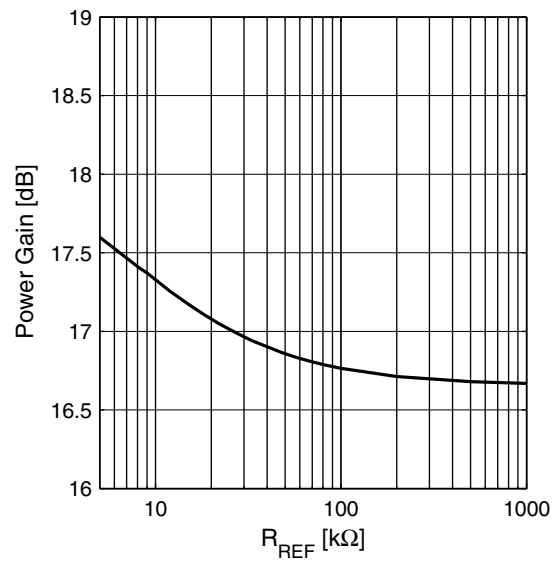
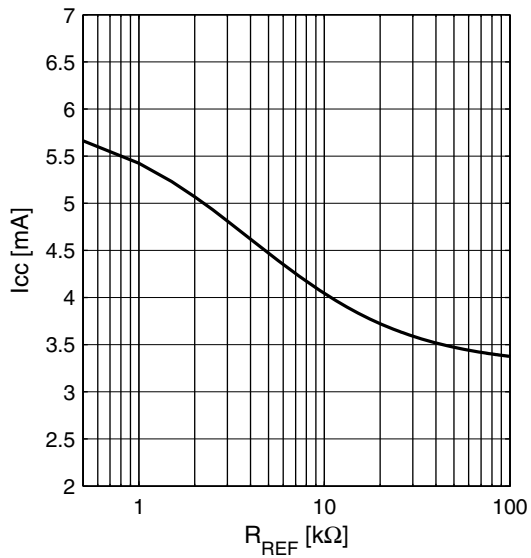
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Settling time gainstep	$t_{GS}$	–	1	–	$\mu$ s	Switching LG $\leftrightarrow$ HG

## 2.7 Supply Current Characteristics

Supply current and Power gain high gain mode versus reference resistor (resistor R1 in Figure 3.3 on Page 34); low gain mode supply current is independent of reference resistor).

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

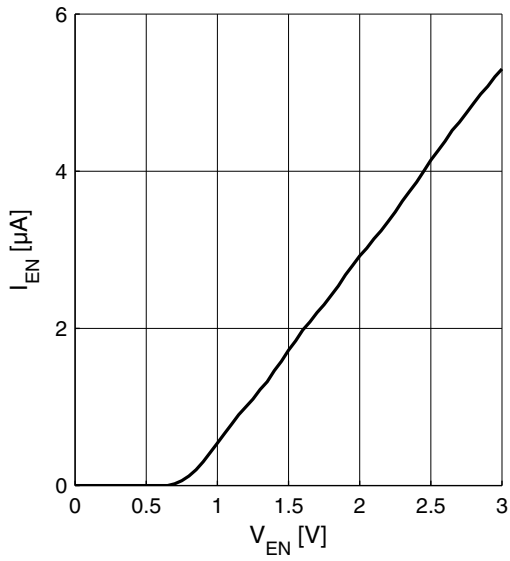
**Power Gain**  $|S_{21}| = f(R_{REF})$   
 $V_{CC} = 2.8\text{ V}$ ,  $T_A = 25\text{ °C}$



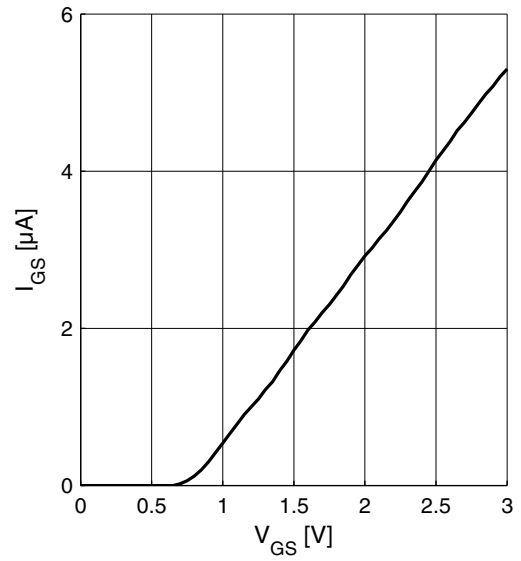
## 2.8 Logic Signal Characteristics

Current consumption of logic inputs VEN, VGS

**Logic Current  $I_{EN} = f(V_{EN})$**   
 $V_{CC} = 2.8 \text{ V}$ ,  $T_A = 25 \text{ }^\circ\text{C}$



**Logic Current  $I_{GS} = f(V_{GS})$**   
 $V_{CC} = 2.8 \text{ V}$ ,  $T_A = 25 \text{ }^\circ\text{C}$



## 2.9 Measured RF Characteristics 1800 MHz Band

**Table 7** Typical Characteristics 1800 MHz Band,  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)2)}$ ,  $R_{REF} = n/c$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		1800	–	1900	MHz	F.e. band 3 and 9
Current consumption	$I_{CCHG}$	–	3.2	–	mA	High gain mode
	$I_{CCLG}$	–	0.5	–	mA	Low gain mode
Gain	$S_{21HG}$	–	16.5	–	dB	High gain mode
	$S_{21LG}$	–	-11.2	–	dB	Low gain mode
Reverse Isolation	$S_{12HG}$	–	-40.1	–	dB	High gain mode
	$S_{12LG}$	–	-11.2	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	1.1	–	dB	High gain mode
	$NF_{LG}$	–	11.5	–	dB	Low gain mode
Input return loss	$S_{11HG}$	–	-16.2	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-15.4	–	dB	50 $\Omega$ , low gain mode
Output return loss	$S_{22HG}$	–	-18.0	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-22.9	–	dB	50 $\Omega$ , low gain mode
Stability factor	$k$	–	>2.4	–		DC to 8 GHz; all gain modes
Input compression point	$IP_{1dBHG}$	–	-6.3	–	dBm	High gain mode
	$IP_{1dBLG}$	–	-3.0	–	dBm	Low gain mode
Inband IIP3 $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-3.4	–	dBm	High gain mode
	$IIP3_{LG}$	–	2.6	–		Low gain mode

1) Performance based on application circuit in Figure 2 on Page 32

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

## 2.10 Measured RF Characteristics 1900 MHz Band

**Table 8** Typical Characteristics 1900 MHz Band,  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)}$ ,  $R_{REF} = 27\text{ k}\Omega$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		1900	–	2000	MHz	F.e. band 2
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>2)</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>3)</sup>	$k$	–	>2.2	–		DC to 8 GHz; all gain modes
Input compression point <sup>1)</sup>	$IP_{1dBHG}$	–	-7	–	dBm	High gain mode
	$IP_{1dBLG}$	–	-3	–	dBm	Low gain mode
Inband IIP3 <sup>1)</sup> $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-3	–	dBm	High gain mode
	$IIP3_{LG}$	–	2	–		Low gain mode

1) Performance based on application circuit in Figure 3 on Page 33

2) Verification based on AQL; random production test.

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

## 2.11 Measured RF Characteristics 2000/2100 MHz Band

**Table 9** Typical Characteristics 2000/2100 MHz Band,  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)}$ ,  $R_{REF} = 27\text{ k}\Omega$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		2000	–	2200	MHz	F.e. band 1, 4 and 10
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>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
	$NF_{LG}$	–	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>3)</sup>	$k$	–	>2.3	–		DC to 8 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> $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-2	–	dBm	High gain mode
	$IIP3_{LG}$	–	7	–		Low gain mode

1) Performance based on application circuit in Figure 4 on Page 34

2) Verification based on AQL; random production test.

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

## 2.12 Measured RF Characteristics 2200/2300 MHz Band

**Table 10** Typical Characteristics 2200/2300 MHz Band,  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)2)}$ ,  $R_{REF} = 8.2\text{ k}\Omega$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range band XL		2200	–	2400	MHz	F.e. band 40
Current consumption	$I_{CCHG}$	–	4.2	–	mA	High gain mode
	$I_{CCLG}$	–	0.53	–	mA	Low gain mode
Gain	$S_{21HG}$	–	16.8	–	dB	High gain mode
	$S_{21LG}$	–	-7.2	–	dB	Low gain mode
Reverse Isolation	$S_{12HG}$	–	-35	–	dB	High gain mode
	$S_{12LG}$	–	-7.0	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	1.2	–	dB	High gain mode
	$NF_{LG}$	–	7.0	–	dB	Low gain mode
Input return loss	$S_{11HG}$	–	-23	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-12	–	dB	50 $\Omega$ , low gain mode
Output return loss	$S_{22HG}$	–	-15	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-12	–	dB	50 $\Omega$ , low gain mode
Stability factor	$k$	–	>2.3	–		DC to 8 GHz; all gain modes
Input compression point	$IP_{1dBHG}$	–	-11	–	dBm	High gain mode
	$IP_{1dBLG}$	–	-2	–	dBm	Low gain mode
Inband IIP3 $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-2	–	dBm	High gain mode
	$IIP3_{LG}$	–	7	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 5 on Page 35

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



### 2.13 Measured RF Characteristics 2400/2500 MHz Band

**Table 11 Typical Characteristics 2400/2500 MHz Band,  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)2)}$ ,  $R_{REF} = 10\text{ k}\Omega$**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range band XL		2400	–	2600	MHz	–
Current consumption	$I_{CCHG}$	–	4.1	–	mA	High gain mode
	$I_{CCLG}$	–	0.55	–	mA	Low gain mode
Gain	$S_{21HG}$	–	16.5	–	dB	High gain mode
	$S_{21LG}$	–	-7.0	–	dB	Low gain mode
Reverse Isolation	$S_{12HG}$	–	-35	–	dB	High gain mode
	$S_{12LG}$	–	-7.0	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	1.2	–	dB	High gain mode
	$NF_{LG}$	–	7.1	–	dB	Low gain mode
Input return loss	$S_{11HG}$	–	-20	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-14	–	dB	50 $\Omega$ , low gain mode
Output return loss	$S_{22HG}$	–	-20	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-12	–	dB	50 $\Omega$ , low gain mode
Stability factor	$k$	–	>2.3	–		DC to 8 GHz; all gain modes
Input compression point	$IP_{1dBHG}$	–	-6	–	dBm	High gain mode
	$IP_{1dBLG}$	–	0	–	dBm	Low gain mode
Inband IIP3 $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-2	–	dBm	High gain mode
	$IIP3_{LG}$	–	6	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 6 on Page 36

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

## 2.14 Measured RF Characteristics 2600 MHz Band

**Table 12** Typical Characteristics 2600 MHz Band,  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)2)}$ ,  $R_{REF} = 8.2\text{ k}\Omega$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		2550	–	2650	MHz	F.e. band 38
Current consumption	$I_{CCHG}$	–	4.2	–	mA	High gain mode
	$I_{CCLG}$	–	0.53	–	mA	Low gain mode
Gain	$S_{21HG}$	–	15.5	–	dB	High gain mode
	$S_{21LG}$	–	-6.9	–	dB	Low gain mode
Reverse Isolation	$S_{12HG}$	–	-34	–	dB	High gain mode
	$S_{12LG}$	–	-7.0	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	1.2	–	dB	High gain mode
	$NF_{LG}$	–	6.8	–	dB	Low gain mode
Input return loss	$S_{11HG}$	–	-15	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-11	–	dB	50 $\Omega$ , low gain mode
Output return loss	$S_{22HG}$	–	-15	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-13	–	dB	50 $\Omega$ , low gain mode
Stability factor	$k$	–	>2.3	–		DC to 8 GHz; all gain modes
Input compression point	$IP_{1dBHG}$	–	-10	–	dBm	High gain mode
	$IP_{1dBLG}$	–	-2	–	dBm	Low gain mode
Inband IIP3 $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-2	–	dBm	High gain mode
	$IIP3_{LG}$	–	7	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 7 on Page 37

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

## 2.15 Measured RF Characteristics 2650 MHz Band

**Table 13** Typical Characteristics 2650 MHz Band,  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}^{1)2)}$ ,  $R_{REF} = 8.2\text{ k}\Omega$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range band VII		2600	–	2700	MHz	–
Current consumption	$I_{CCHG}$	–	4.2	–	mA	High gain mode
	$I_{CCLG}$	–	0.53	–	mA	Low gain mode
Gain	$S_{21HG}$	–	15.7	–	dB	High gain mode
	$S_{21LG}$	–	-7.1	–	dB	Low gain mode
Reverse Isolation	$S_{12HG}$	–	-34	–	dB	High gain mode
	$S_{12LG}$	–	-7.0	–	dB	Low gain mode
Noise figure	$NF_{HG}$	–	1.2	–	dB	High gain mode
	$NF_{LG}$	–	6.8	–	dB	Low gain mode
Input return loss	$S_{11HG}$	–	-20	–	dB	50 $\Omega$ , high gain mode
	$S_{11LG}$	–	-10	–	dB	50 $\Omega$ , low gain mode
Output return loss	$S_{22HG}$	–	-20	–	dB	50 $\Omega$ , high gain mode
	$S_{22LG}$	–	-11	–	dB	50 $\Omega$ , low gain mode
Stability factor	$k$	–	>2.3	–		DC to 8 GHz; all gain modes
Input compression point	$IP_{1dBHG}$	–	-10	–	dBm	High gain mode
	$IP_{1dBLG}$	–	-2	–	dBm	Low gain mode
Inband IIP3 $f_1 - f_2 = 1\text{ MHz}$	$IIP3_{HG}$	–	-2	–	dBm	High gain mode
	$IIP3_{LG}$	–	7	–	dBm	Low gain mode

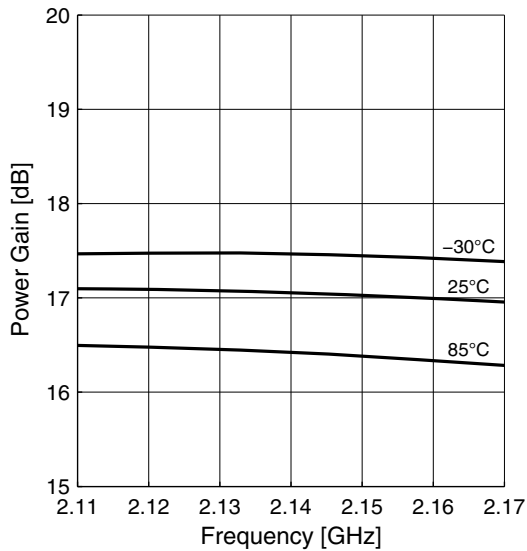
1) Performance based on application circuit in Figure 8 on Page 38

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

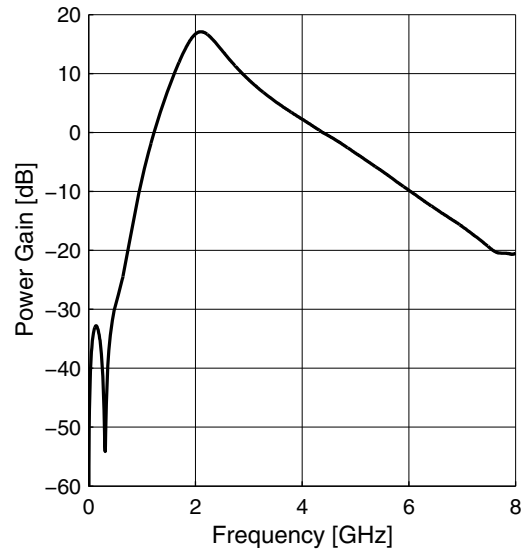
**2.16 Measured Performance Band 1 Application High Gain Mode vs. Frequency**

$T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $V_{GS} = 2.8\text{ V}$ ,  $V_{EN} = 2.8\text{ V}$

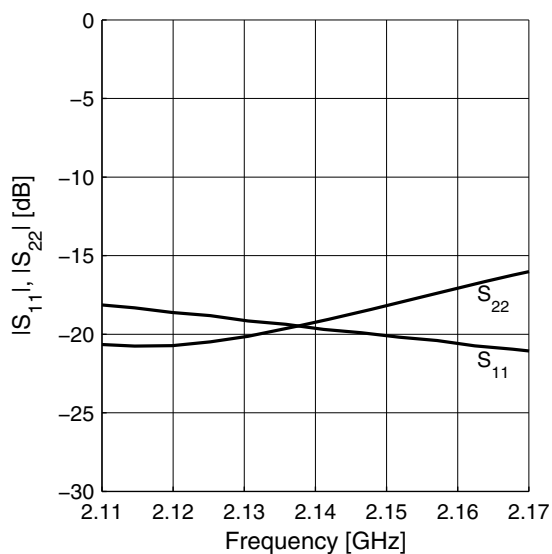
**Power Gain**  $|S_{21}| = f(f)$



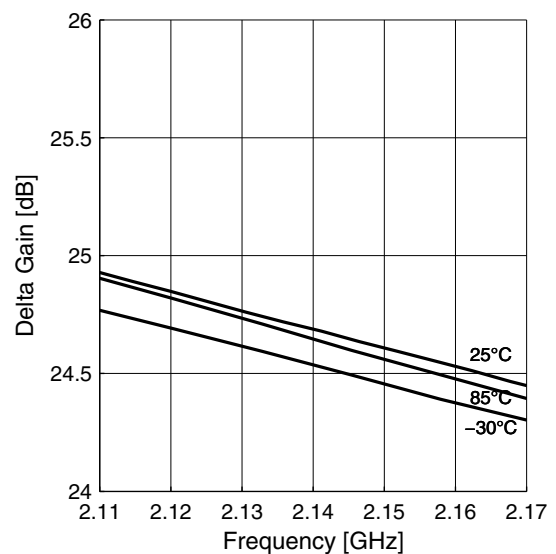
**Power Gain wideband**  $|S_{21}| = f(f)$



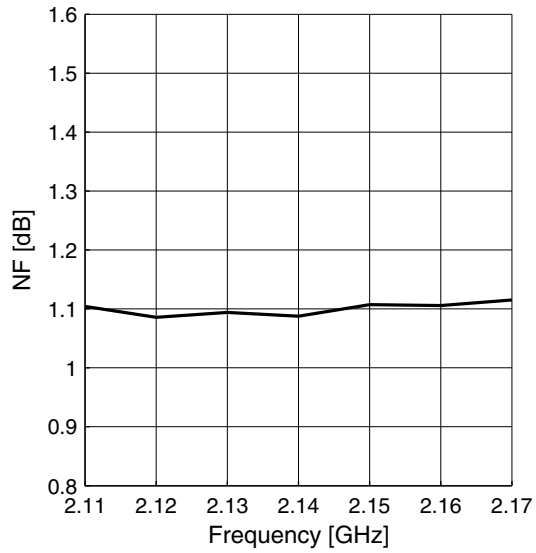
**Matching**  $|S_{11}| = f(f)$ ,  $|S_{22}| = f(f)$



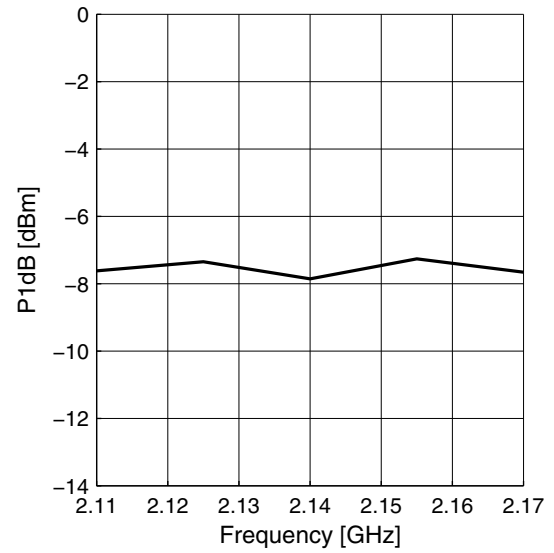
**Gainstep HG-LG**  $|\Delta S_{21}| = f(f)$



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



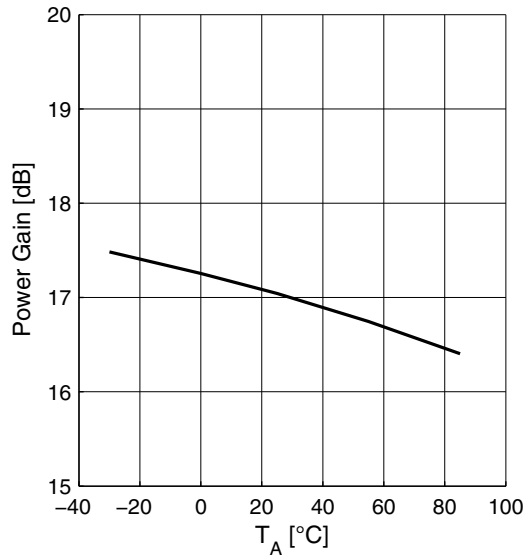
**Input Compression  $P1dB = f(f)$**



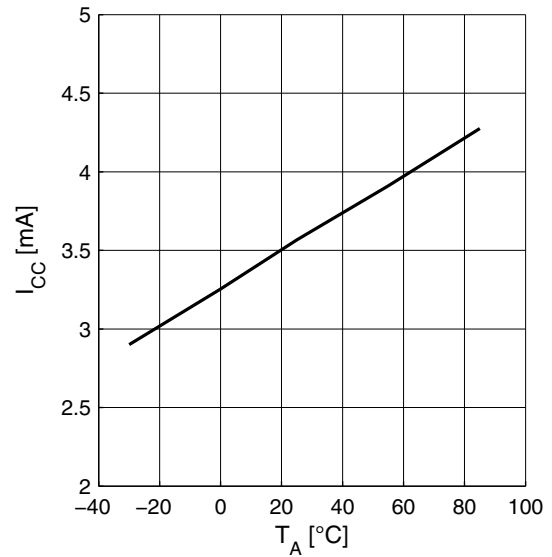
### 2.17 Measured Performance Band 1 Application High Gain Mode vs. Temperature

$T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $V_{GS} = 2.8\text{ V}$ ,  $V_{EN} = 2.8\text{ V}$ ,  $f = 2140\text{ MHz}$

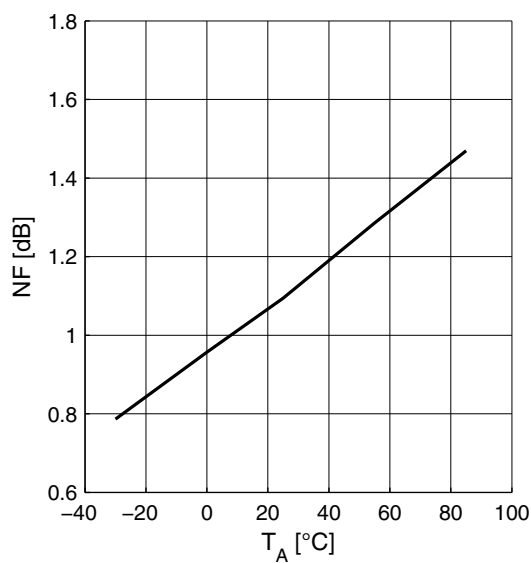
Power Gain  $|S_{21}| = f(T_A)$



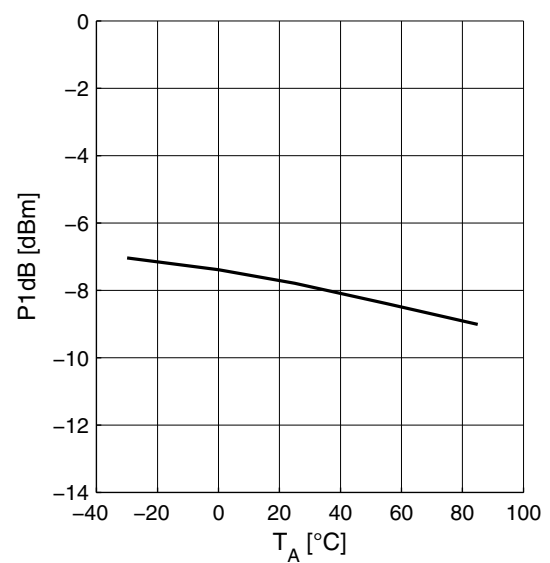
Supply Current  $I_{CC} = f(T_A)$



Noise Figure  $NF = f(T_A)$



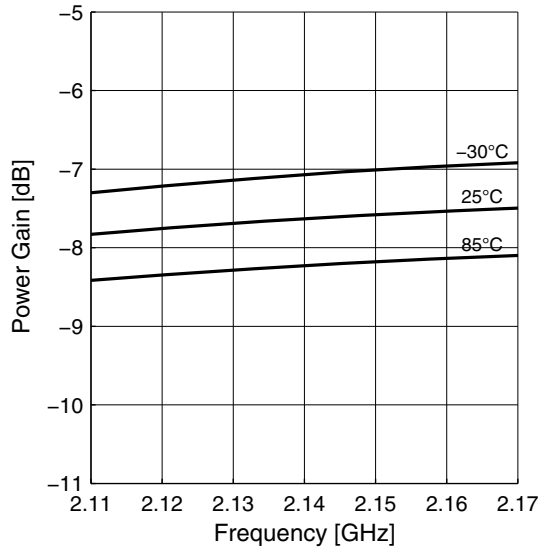
Input Compression  $P1dB = f(T_A)$



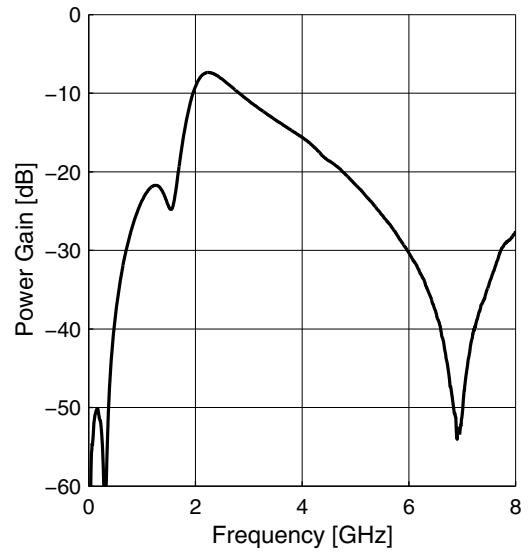
### 2.18 Measured Performance Band 1 Application Low Gain Mode vs. Frequency

$T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $V_{GS} = 0\text{ V}$ ,  $V_{EN} = 2.8\text{ V}$

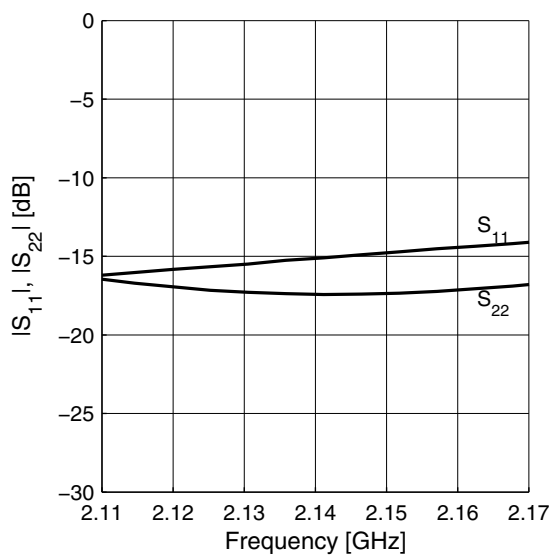
Power Gain  $|S_{21}| = f(f)$



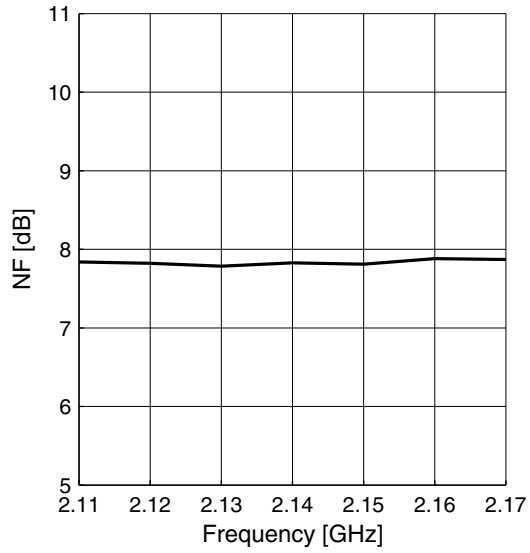
Power Gain wideband  $|S_{21}| = f(f)$



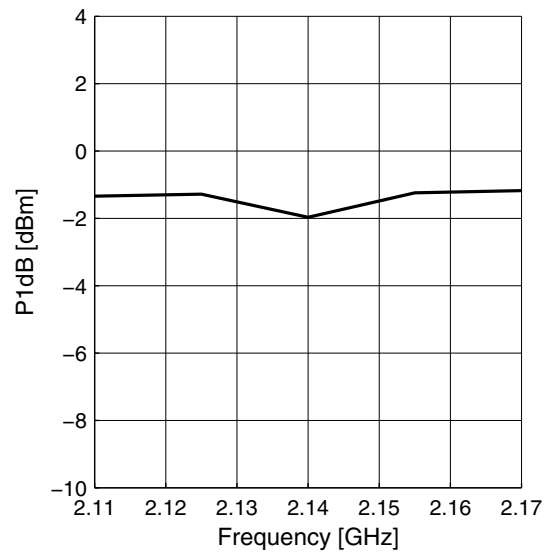
Matching  $|S_{11}| = f(f)$ ,  $|S_{22}| = f(f)$



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



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

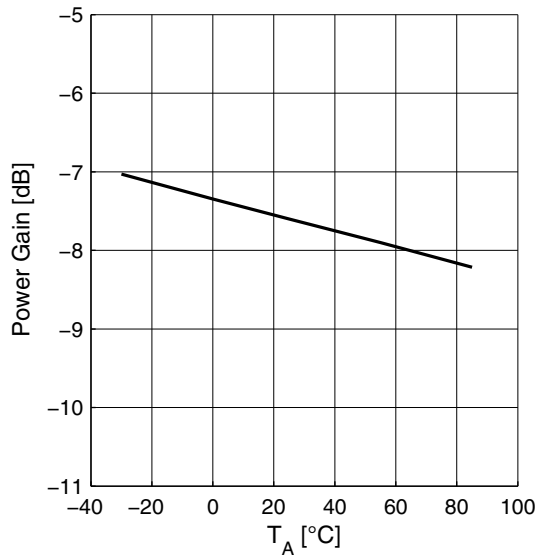




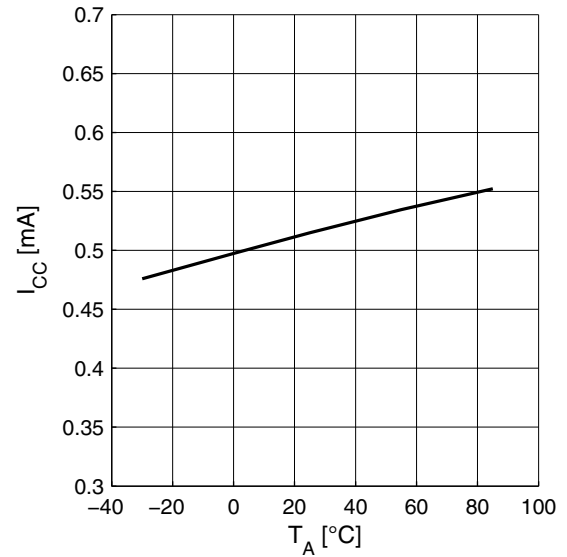
### 2.19 Measured Performance Band 1 Application Low Gain Mode vs. Temperature

$T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $V_{GS} = 0\text{ V}$ ,  $V_{EN} = 2.8\text{ V}$ ,  $f = 2140\text{ MHz}$

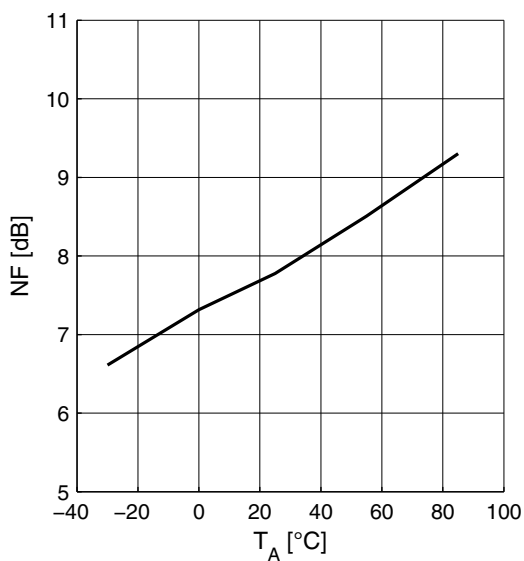
Power Gain  $|S_{21}| = f(T_A)$



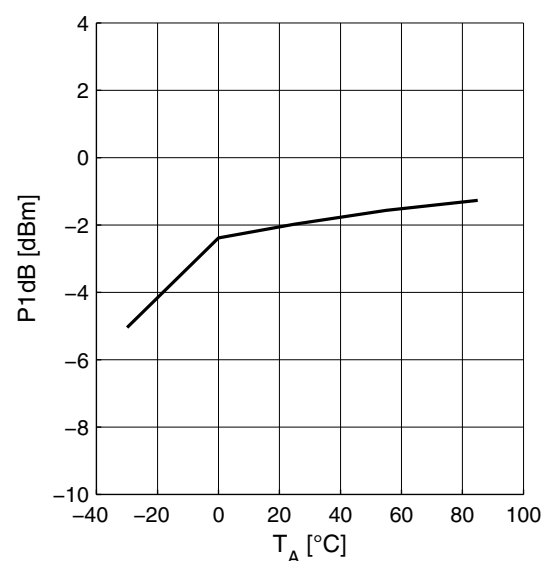
Supply Current  $I_{CC} = f(T_A)$



Noise Figure  $NF = f(T_A)$



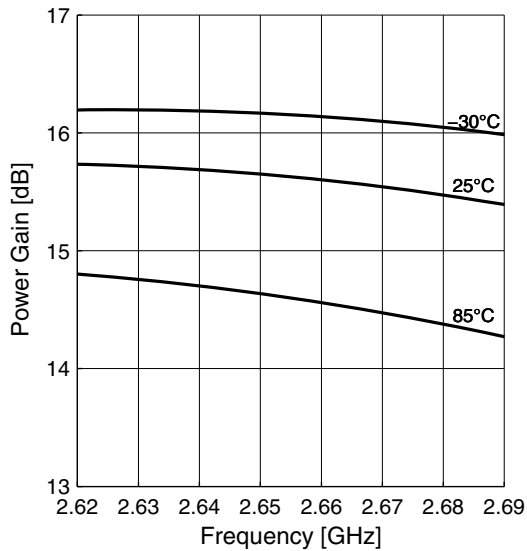
Input Compression  $P1dB = f(T_A)$



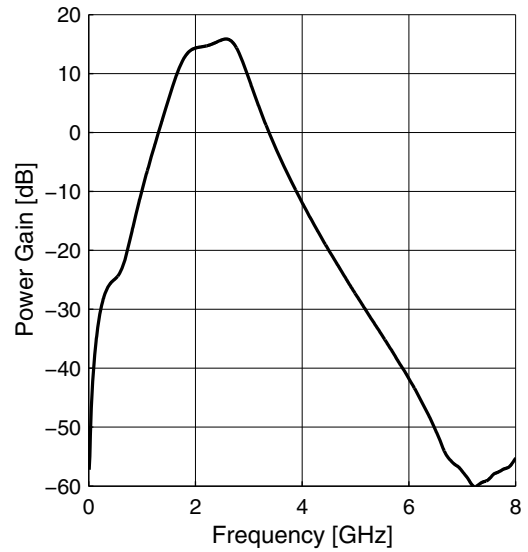
## 2.20 Measured Performance Band 7 Application High Gain Mode vs. Frequency

$T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $V_{GS} = 2.8\text{ V}$ ,  $V_{EN} = 2.8\text{ V}$

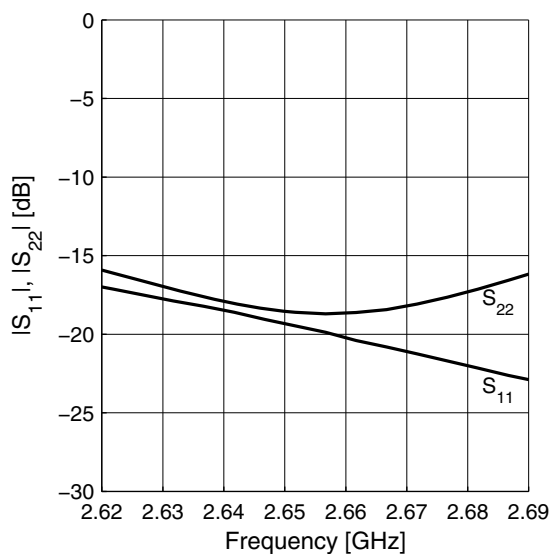
Power Gain  $|S_{21}| = f(f)$



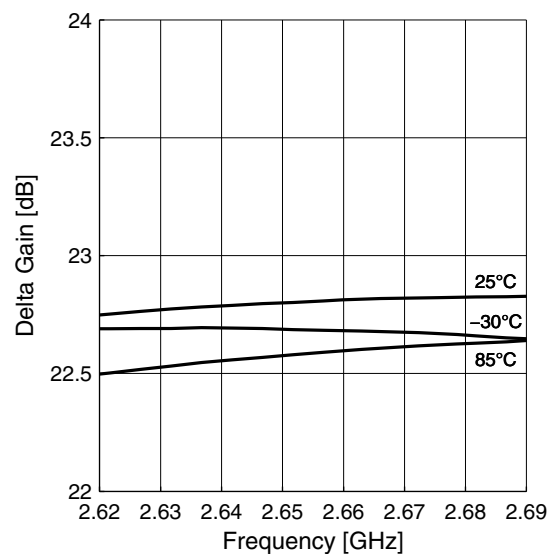
Power Gain wideband  $|S_{21}| = f(f)$



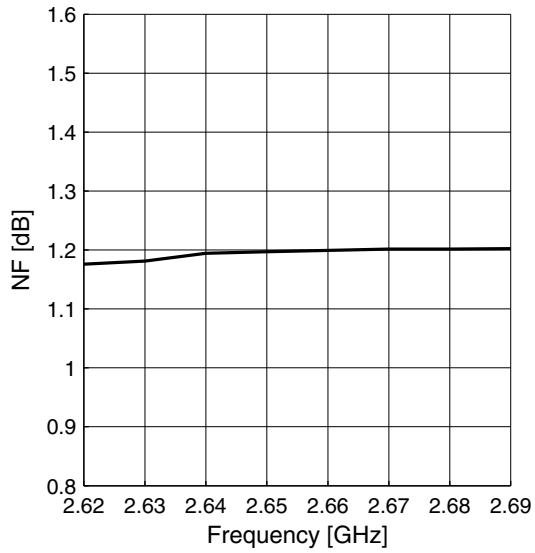
Matching  $|S_{11}| = f(f)$ ,  $|S_{22}| = f(f)$



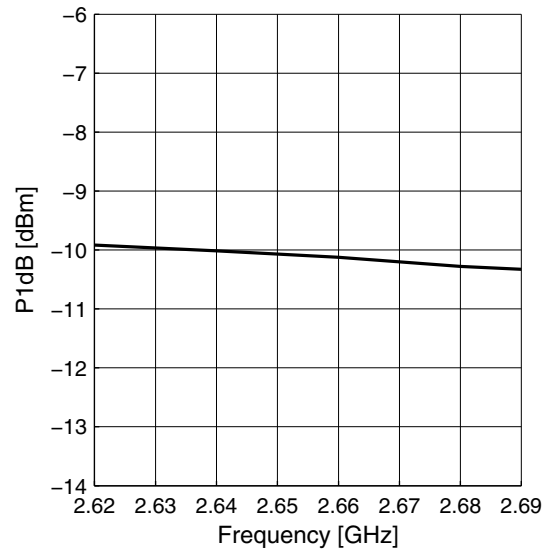
Gainstep HG-LG  $\Delta S_{21} = f(f)$



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



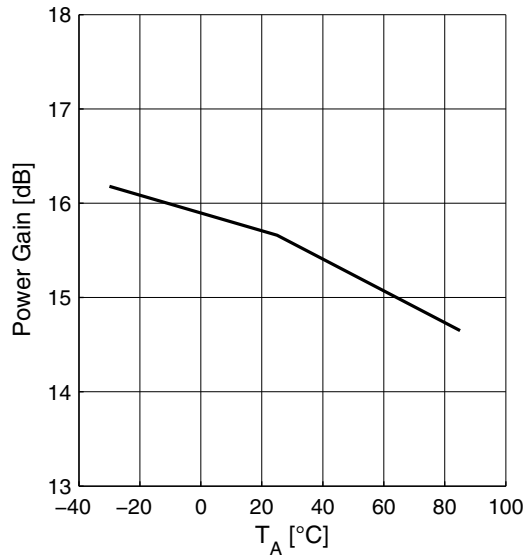
**Input Compression  $P1dB = f(f)$**



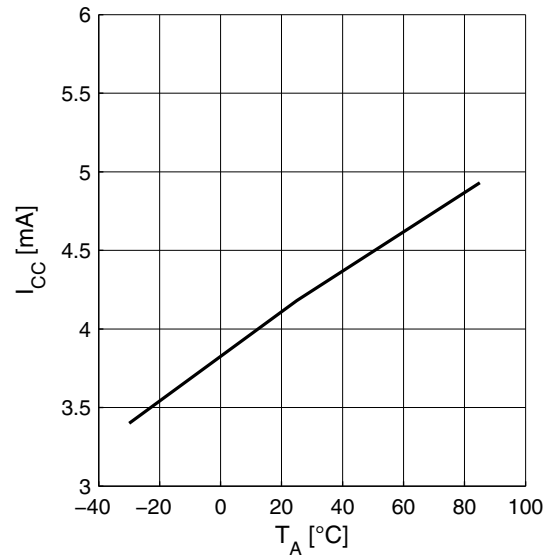
## 2.21 Measured Performance Band 7 Application High Gain Mode vs. Temperature

$T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $V_{GS} = 2.8\text{ V}$ ,  $V_{EN} = 2.8\text{ V}$ ,  $f = 2650\text{ MHz}$

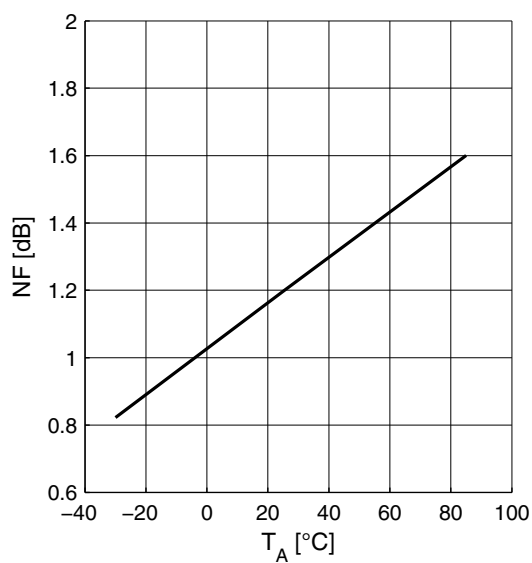
Power Gain  $|S_{21}| = f(T_A)$



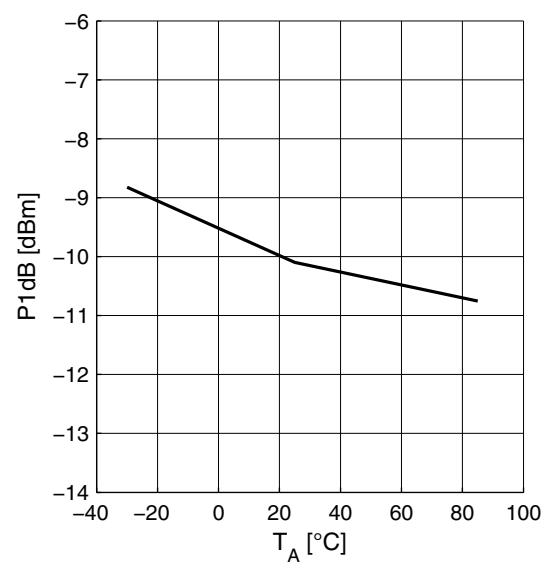
Supply Current  $I_{CC} = f(T_A)$



Noise Figure  $NF = f(T_A)$



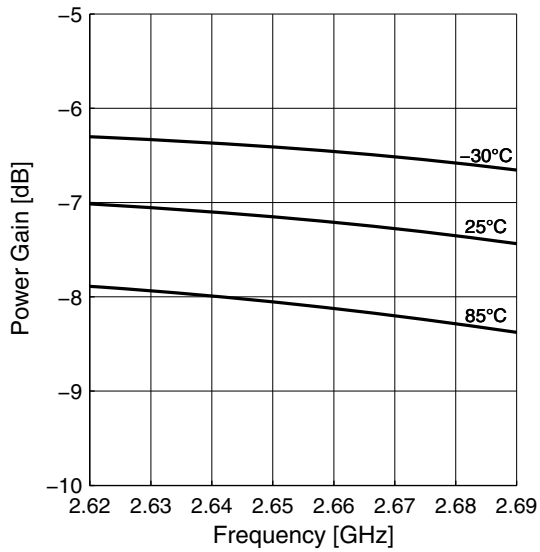
Input Compression  $P1dB = f(T_A)$



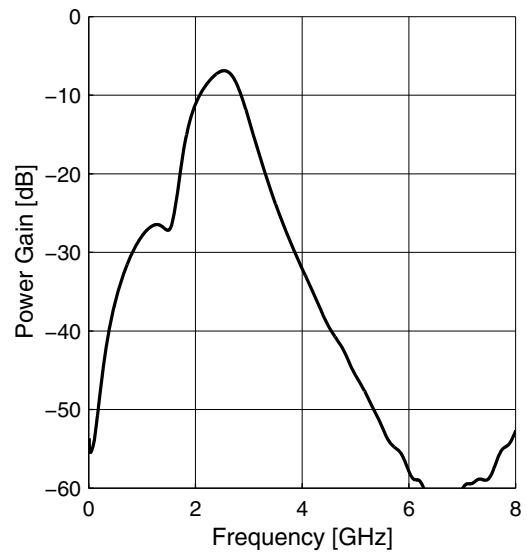
### 2.22 Measured Performance Band 7 Application Low Gain Mode vs. Frequency

$T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $V_{GS} = 0\text{ V}$ ,  $V_{EN} = 2.8\text{ V}$

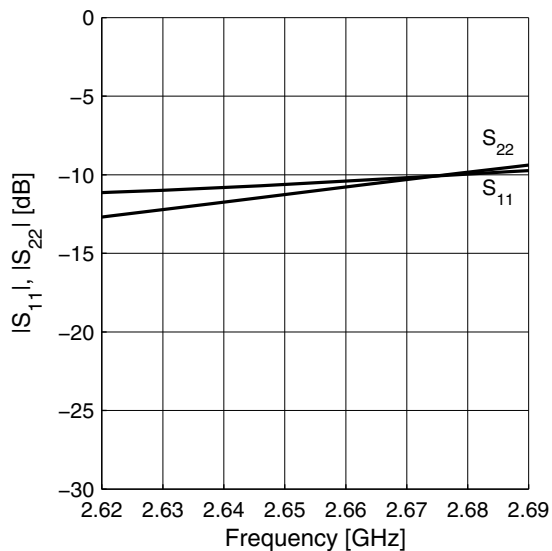
Power Gain  $|S_{21}| = f(f)$



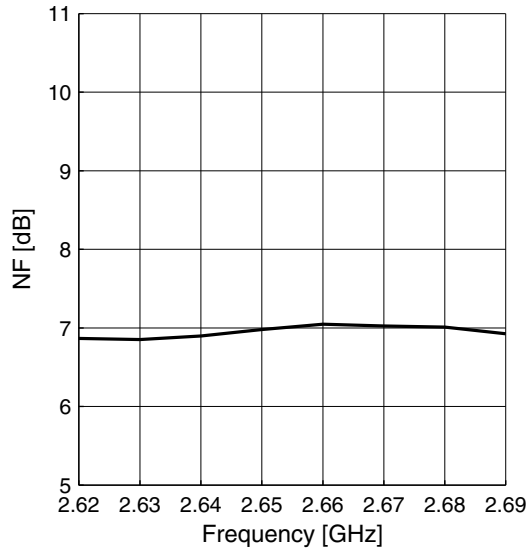
Power Gain wideband  $|S_{21}| = f(f)$



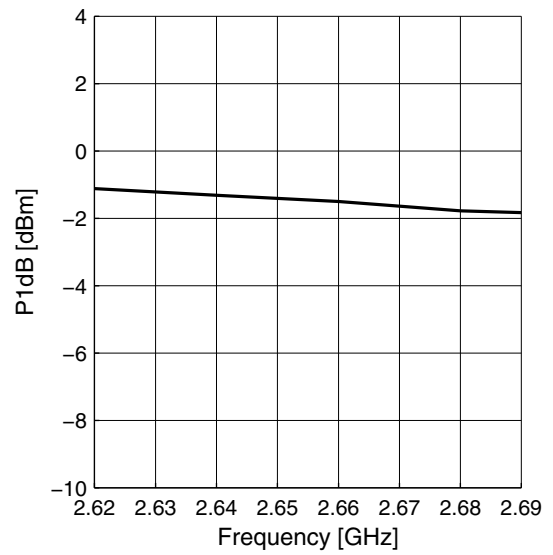
Matching  $|S_{11}| = f(f)$ ,  $|S_{22}| = f(f)$



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



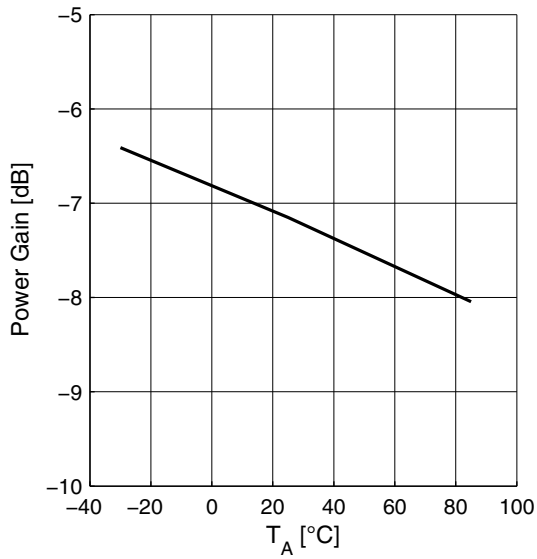
**Input Compression  $P1dB = f(f)$**



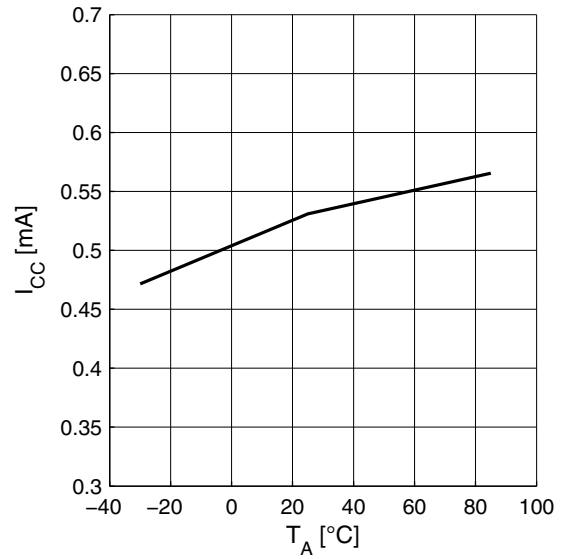
### 2.23 Measured Performance Band 7 Application Low Gain Mode vs. Temperature

$T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $V_{GS} = 0\text{ V}$ ,  $V_{EN} = 2.8\text{ V}$ ,  $f = 2650\text{ MHz}$

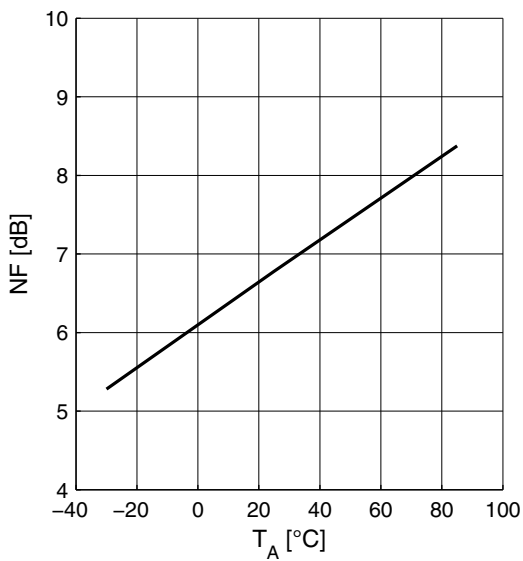
Power Gain  $|S_{21}| = f(T_A)$



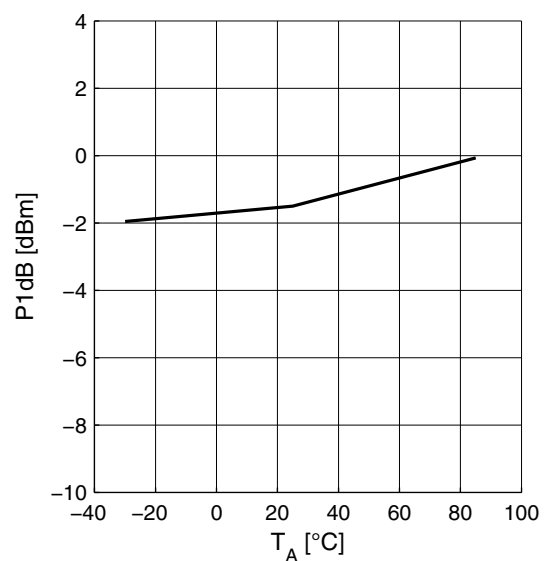
Supply Current  $I_{CC} = f(T_A)$



Noise Figure  $NF = f(T_A)$

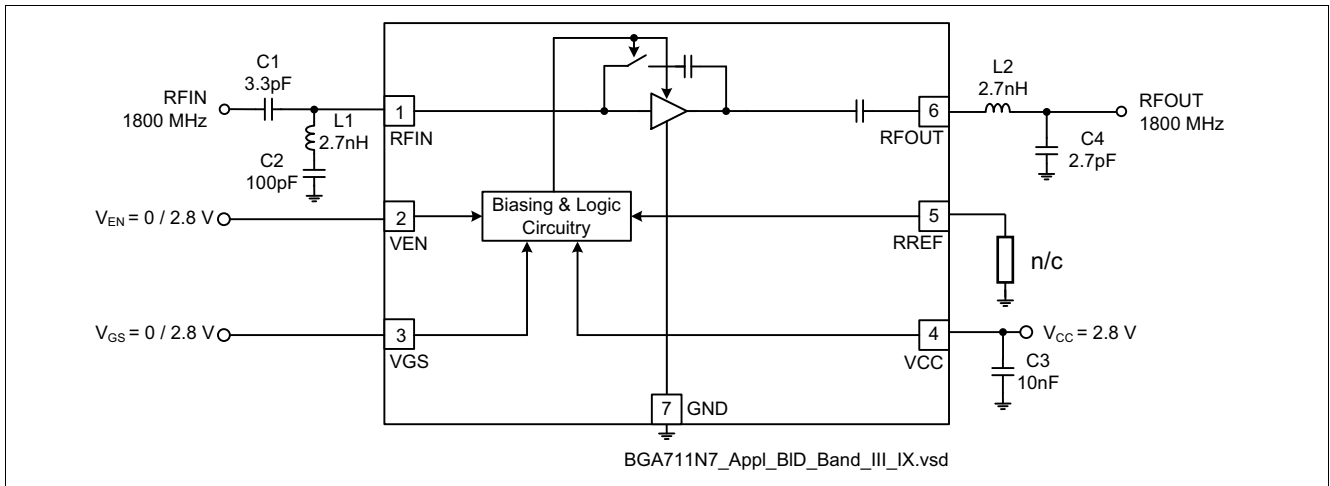


Input Compression  $P1dB = f(T_A)$



### 3 Application Circuit and Block Diagram

#### 3.1 1800 MHz Band Application Circuit Schematic



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

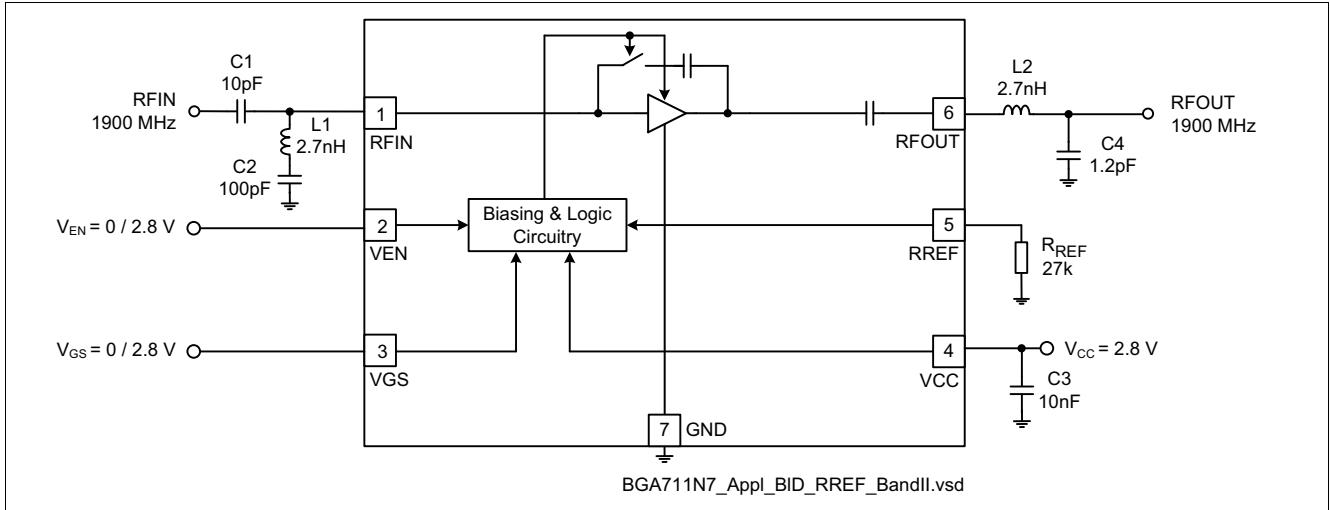
*Note: Package paddle (Pin 0) has to be RF grounded.*

**Table 14 Bill of Materials**

Part Number	Part Type	Manufacturer	Size	Comment
L1, L2	Chip inductor	Various	0402	Wirewound, $Q \approx 50$
C1 ... C4	Chip capacitor	Various	0402	



### 3.2 1900 MHz Band Application Circuit Schematic



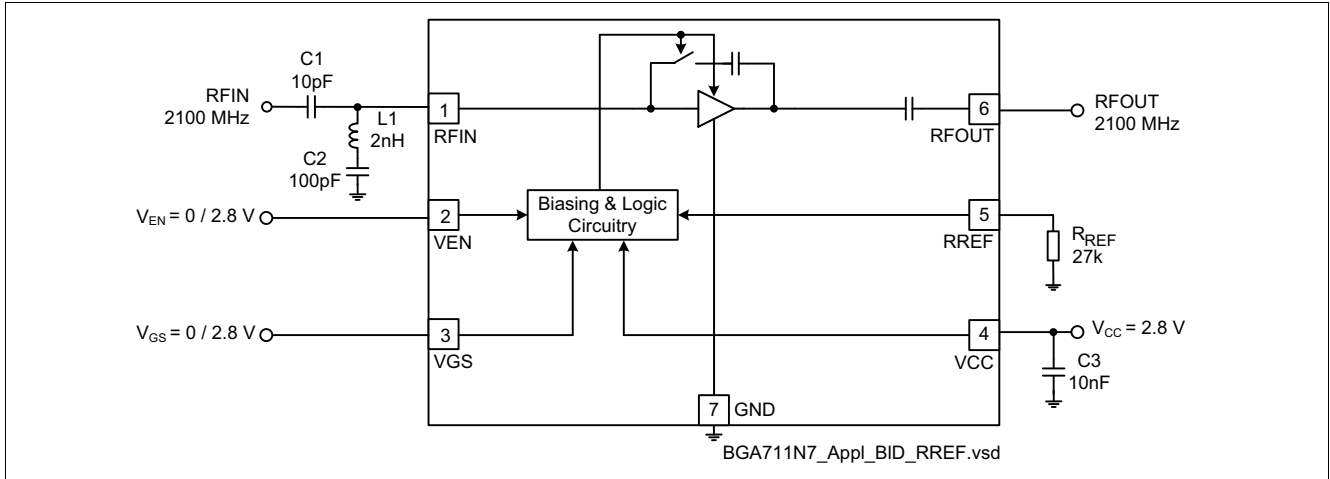
**Figure 3 Application Circuit with Chip Outline (Top View)**

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

**Table 15 Bill of Materials**

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

### 3.3 2000/2100 MHz Band Application Circuit Schematic



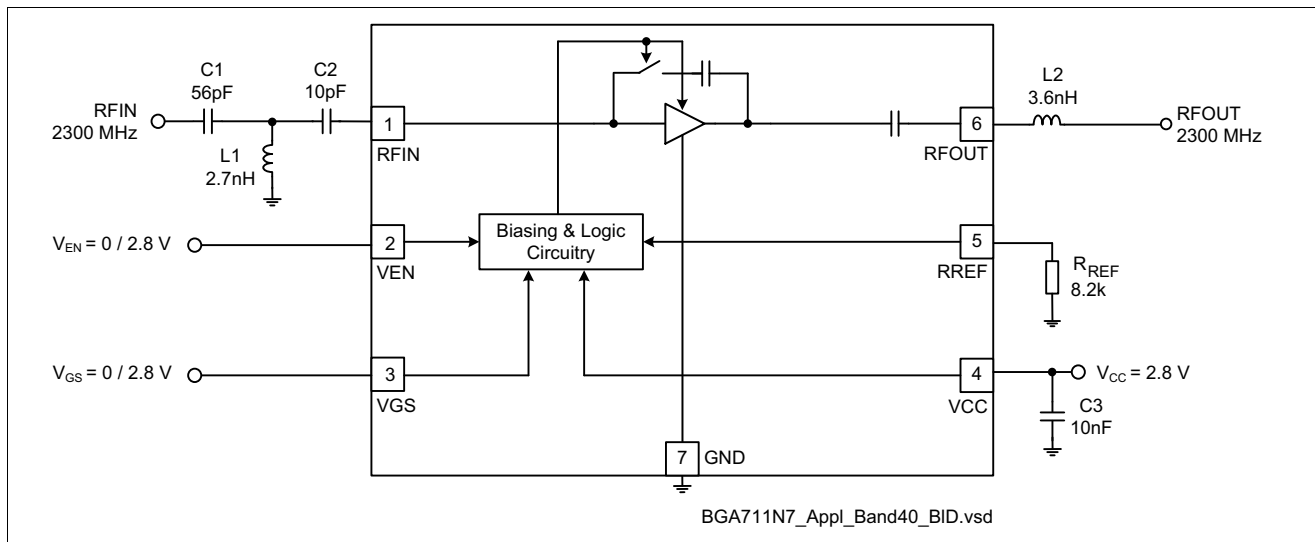
**Figure 4 Application Circuit with Chip Outline (Top View)**

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

**Table 16 Bill of Materials**

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	

### 3.4 2200/2300 MHz Band Application Circuit Schematic



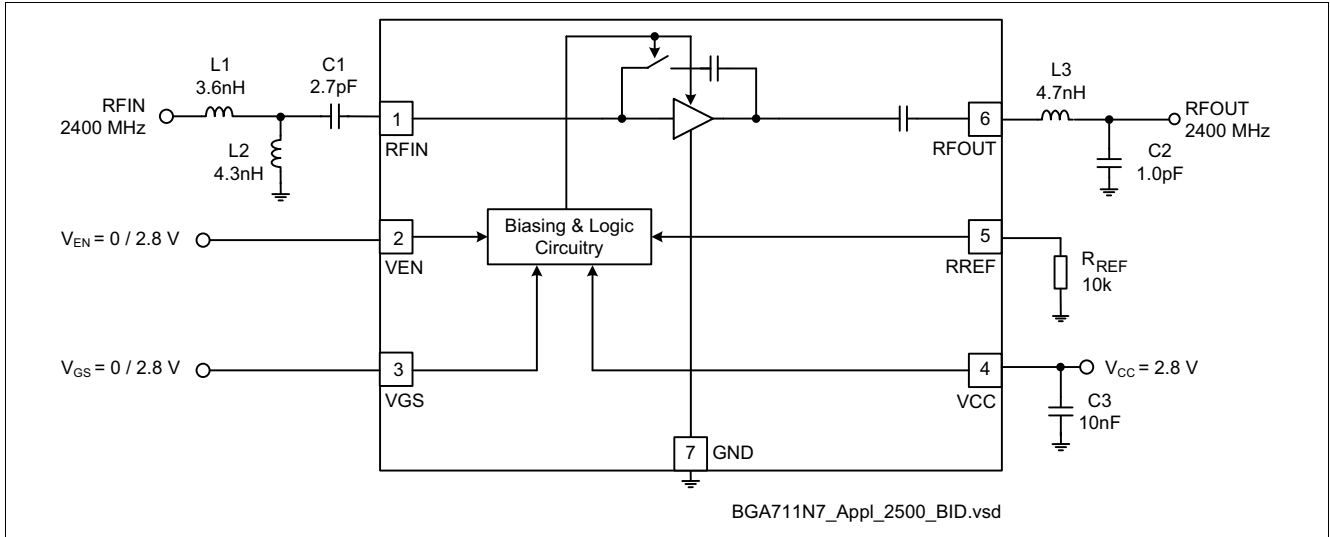
**Figure 5 Application Circuit with Chip Outline (Top View)**

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

**Table 17 Bill of Materials**

Part Number	Part Type	Manufacturer	Size	Comment
L1 ... L2	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C3	Chip capacitor	Various	0402	
R <sub>REF</sub>	Chip resistor	Various	0402	

### 3.5 2400/2500 MHz Band Application Circuit Schematic



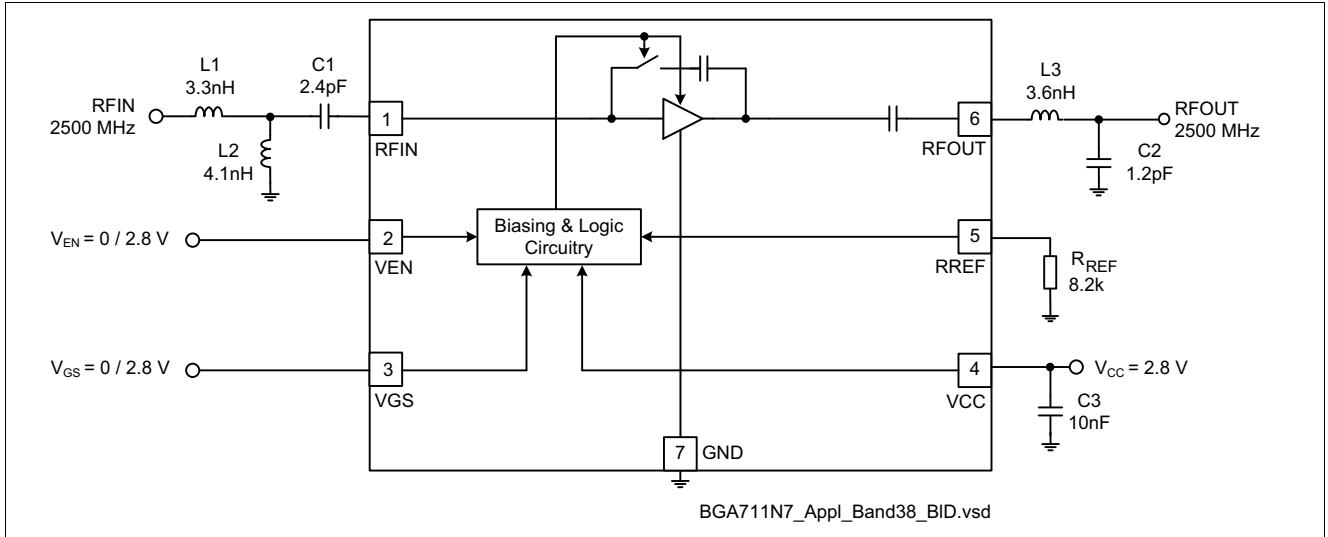
**Figure 6 Application Circuit with Chip Outline (Top View)**

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

**Table 18 Bill of Materials**

Part Number	Part Type	Manufacturer	Size	Comment
L1 ... L3	Chip inductor	Various	0402	Wirewound, $Q \approx 50$
C1 ... C3	Chip capacitor	Various	0402	
R <sub>REF</sub>	Chip resistor	Various	0402	

### 3.6 2600 MHz Band Application Circuit Schematic



**Figure 7 Application Circuit with Chip Outline (Top View)**

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

**Table 19 Bill of Materials**

Part Number	Part Type	Manufacturer	Size	Comment
L1 ... L3	Chip inductor	Various	0402	Wirewound, $Q \approx 50$
C1 ... C3	Chip capacitor	Various	0402	
R <sub>REF</sub>	Chip resistor	Various	0402	

### 3.7 2650 MHz Band Application Circuit Schematic

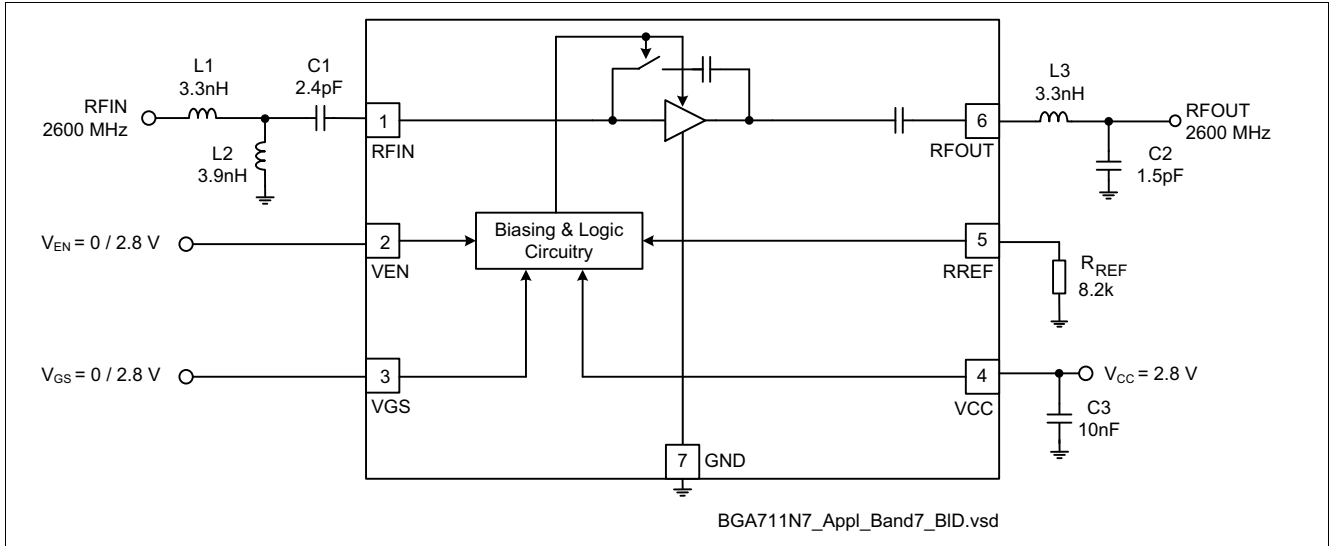


Figure 8 Application Circuit with Chip Outline (Top View)

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

Table 20 Bill of Materials

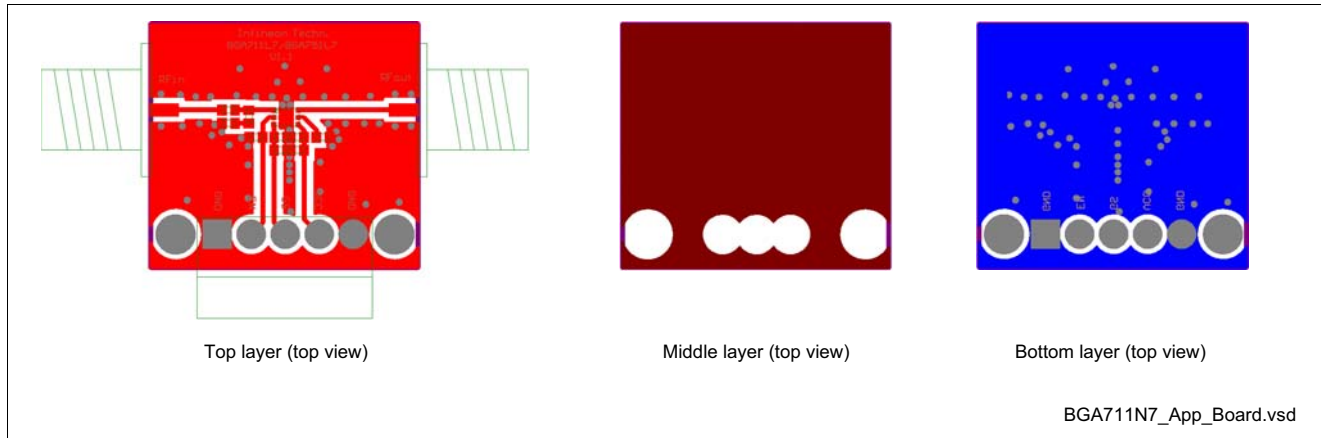
Part Number	Part Type	Manufacturer	Size	Comment
L1 ... L3	Chip inductor	Various	0402	Wirewound, $Q \approx 50$
C1 ... C3	Chip capacitor	Various	0402	
$R_{REF}$	Chip resistor	Various	0402	

### 3.8 Pin Definition

Table 21 Pin Definition and Function

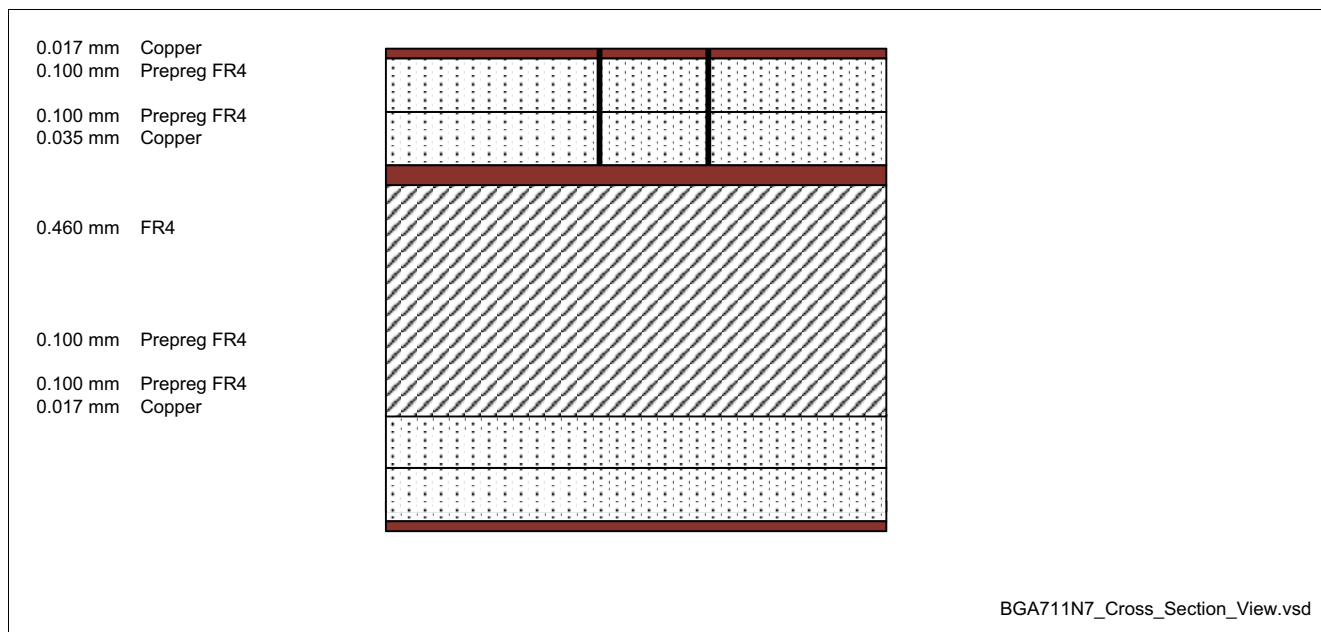
Pin Number	Symbol	Function
1	RFIN	LNA input
2	VEN	Band select control
3	VGS	Gain step control
4	VCC	Supply voltage
5	RREF	Bias current reference resistor (high gain mode)
6	RFOUT	LNA output
7	GND	Package paddle; ground connection for LNA and control circuitry

### 3.9 Application Board

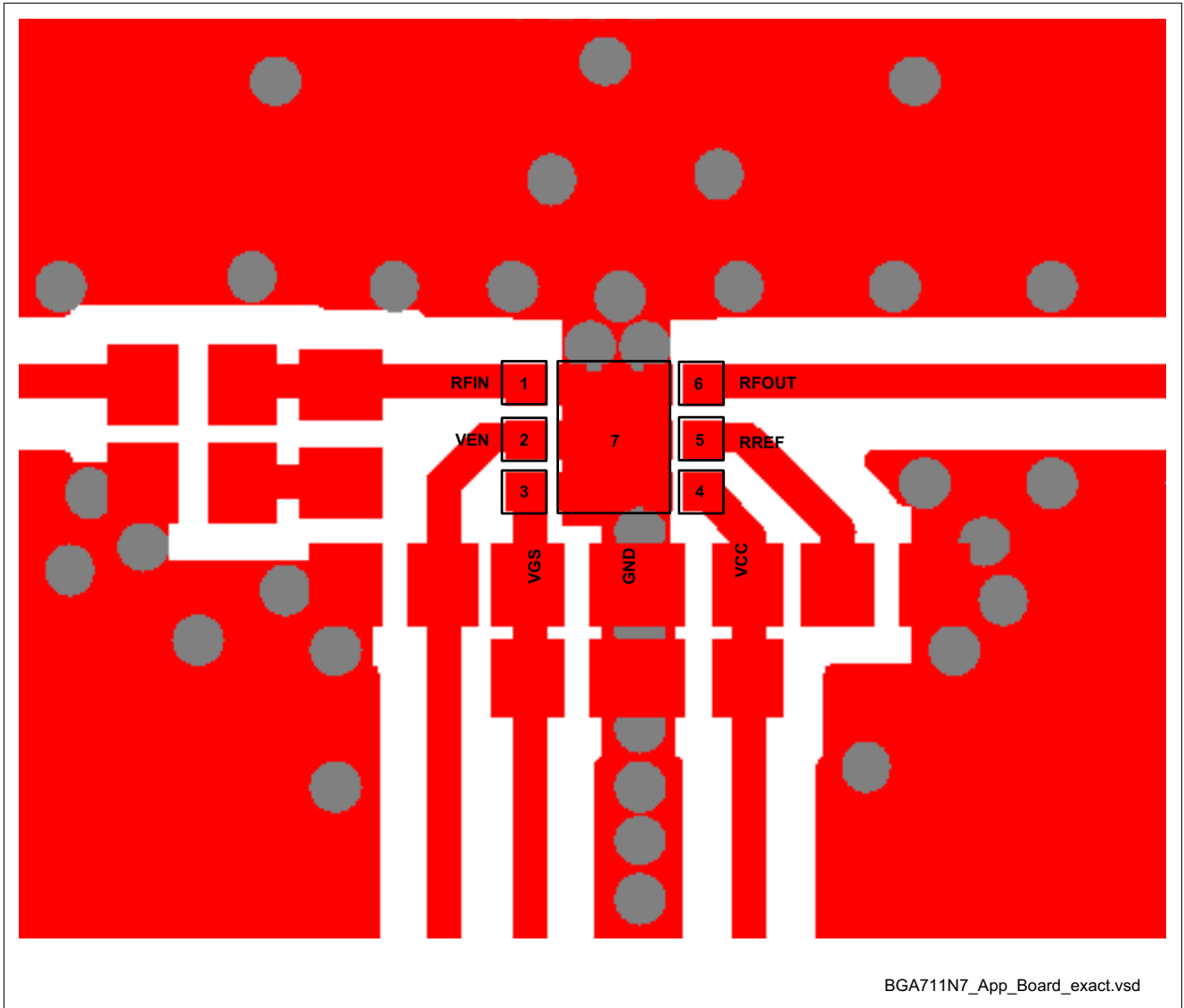


**Figure 9 Application Board Layout on 3-layer FR4**

Note: Top layer thickness: 0.2 mm, bottom layer thickness: 0.8 mm, 17 mm Cu metallization, gold plated. Board size: 21 x 19mm.



**Figure 10 Cross-Section View of Application Board**



**Figure 11 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

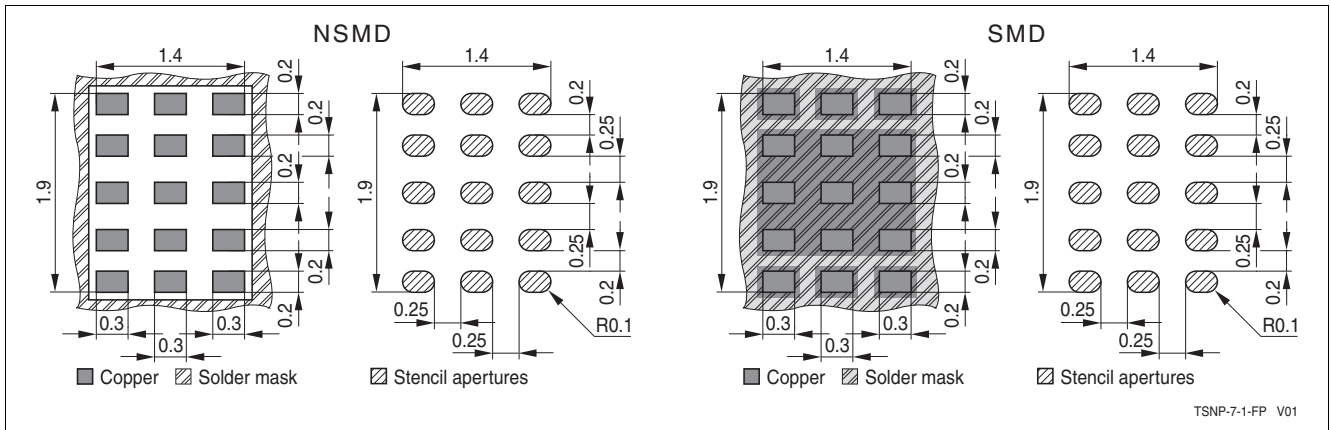


Figure 12 Footprint Recommendation 1 for the TSNP-7-1 Package

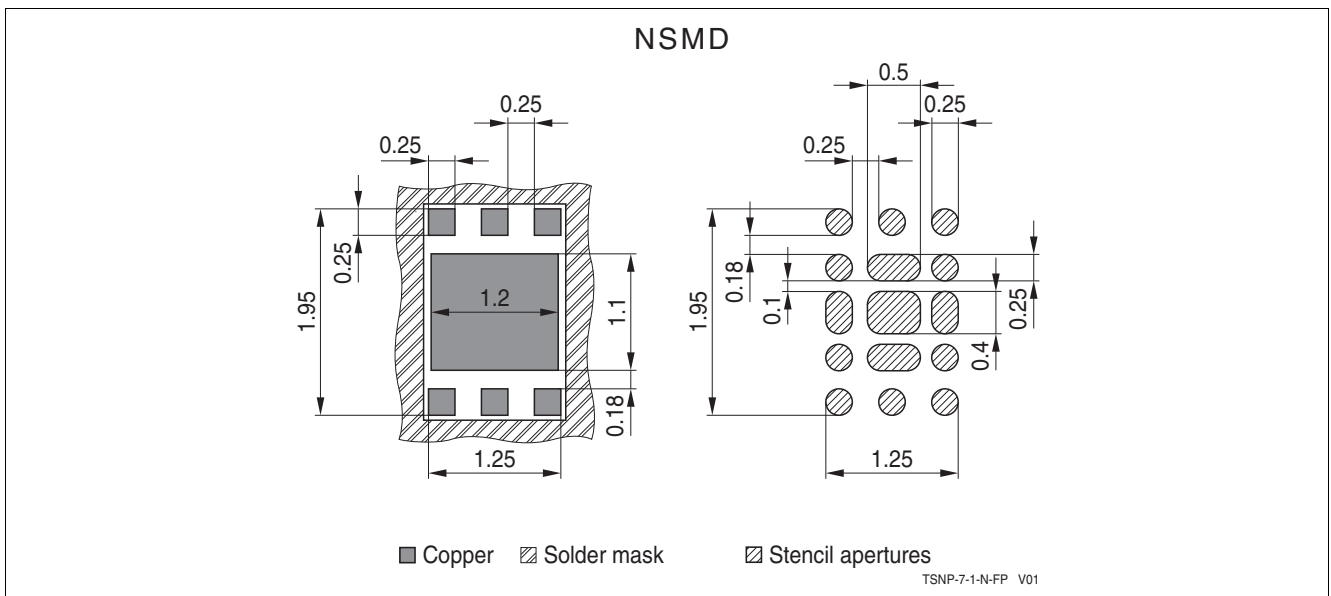


Figure 13 Footprint Recommendation 2 for the TSNP-7-1 Package

## 4.2 Package Dimensions

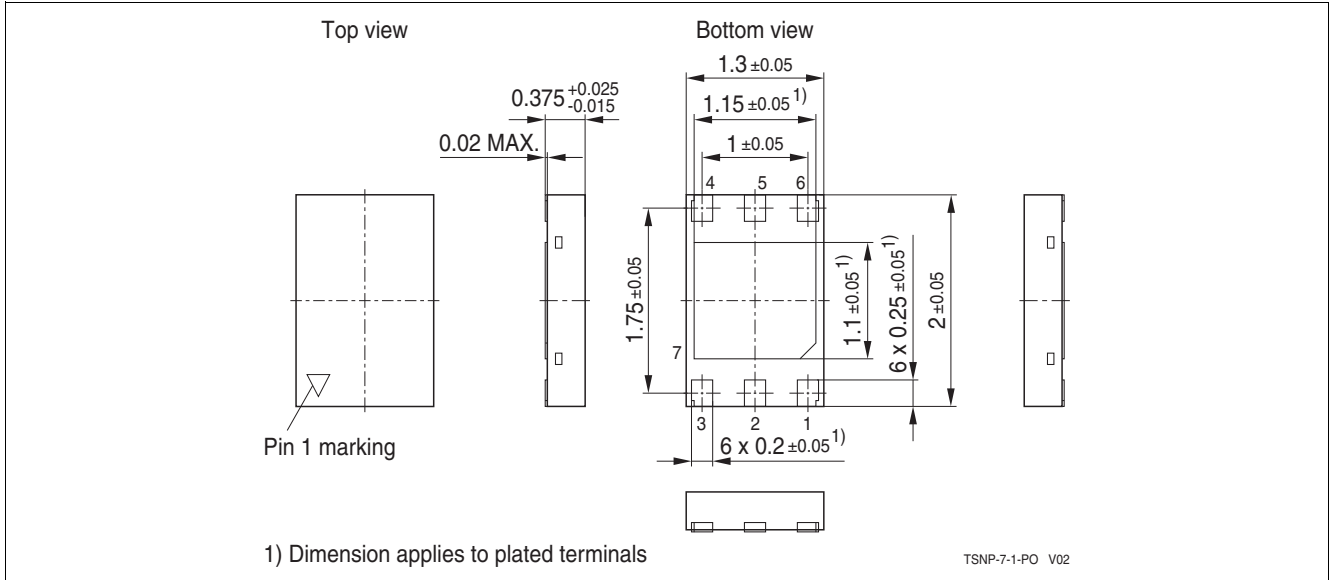


Figure 14 Package Outline (top, side and bottom view)

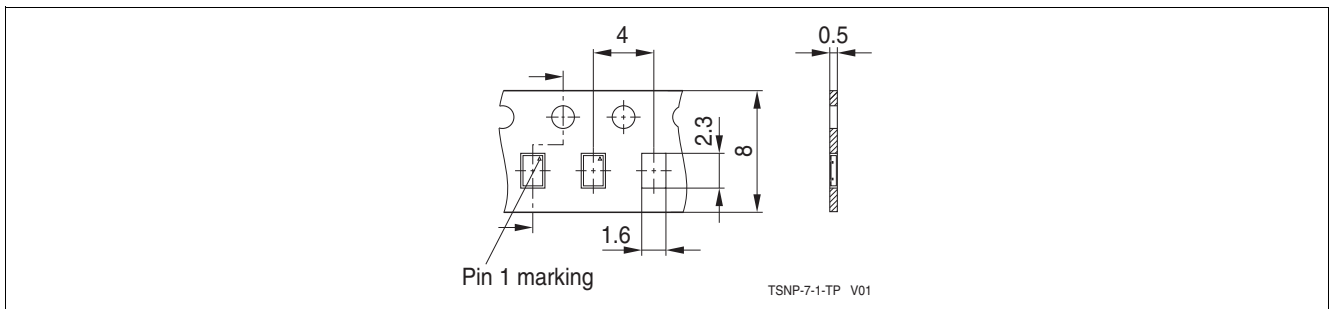


Figure 15 Tape & Reel Dimensions

## 4.3 Product Marking Pattern

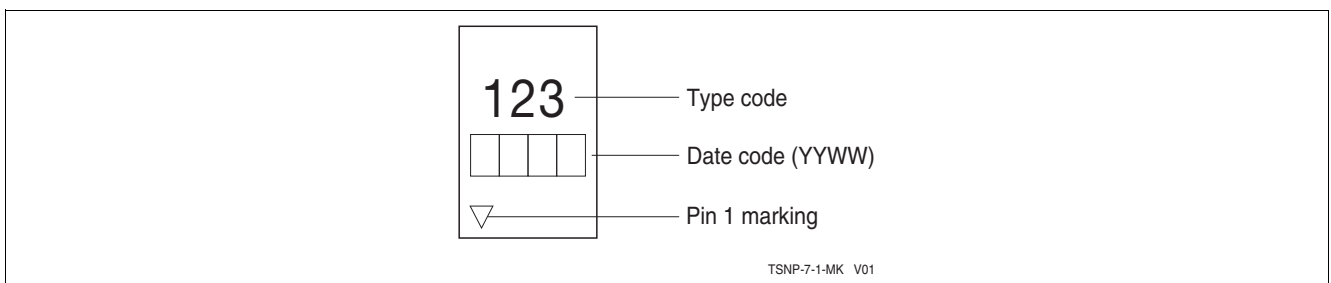


Figure 16 Marking Pattern (top view)

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