BGA771N16

High Linearity Dual-Band UMTS LNA
(1900/1800/2100, 800/900MHz)

Data Sheet

Revision 3.1, 2010-03-16
Final

RF & Protection Devices

Edition 2010-03-16

Published by
Infineon Technologies AG
81726 Munich, Germany

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BGA771N16
Revision History: 2010-03-16, V3.1

Previous Version: 2008-08-26, V3.0

Page	Subjects (major changes since last revision)
all	Updated package

Table of Contents

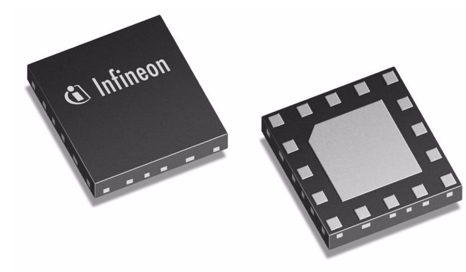
1 Description

The BGA771N16 is a highly flexible, high linearity dual-band (1900/1800/2100, 800/900 MHz) low noise amplifier MMIC for worldwide use. Based on Infineon's proprietary and cost-effective SiGe:C technology, the BGA771N16 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. For example, the 1900 MHz path can be converted into a 1800 MHz or a 2100 MHz path by optimizing the input and output matching network.

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

Features

- Gain: 16 / -7.5 dB in high / low gain mode (all bands)
- Noise figure: 1.1 / 1.1 dB in high gain mode (800 MHz / 1900 MHz)
- Supply current: 3.4 / 0.65 mA in high / low gain mode (all bands)
- Standby mode (< 2 µA typ.)
- Output internally matched to 50 Ω
- Inputs pre-matched to 50 Ω
- 2kV HBM ESD protection
- Low external component count
- Small leadless PG-TSNP-16-1 package (2.3 x 2.3 x 0.39 mm)
- Pb-free (RoHS compliant) package



PG-TSNP-16-1 package

RoHS

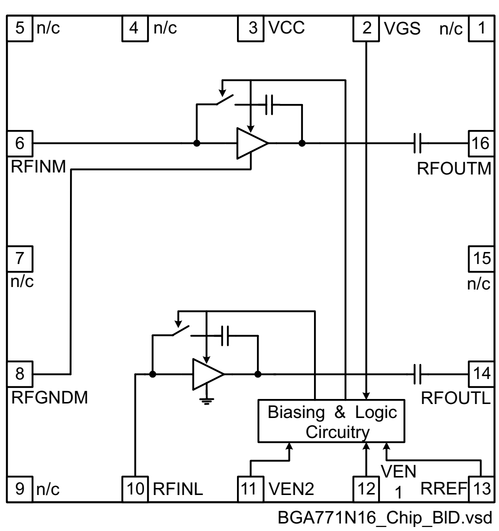


Figure 1 Block diagram of dual-band LNA

Type	Package	Marking	Chip
BGA771N16	PG-TSNP-16-1	BGA771	T1530

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 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	

2.2 Thermal Resistance

Table 2 Thermal Resistance

Parameter	Symbol	Value	Unit	Note / Test Conditions
Thermal resistance junction to soldering point	R_{thJS}	$\leq$ 37	K/W	

2.3 ESD Integrity

Table 3 ESD Integrity

Parameter	Symbol	Value (typ.)	Unit	Note / Test Conditions
ESD hardness HBM[1)]	$V_{ESD-HBM}$	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}	2.7	2.8	3.0	V	
Supply current high gain mode	I_{CCHG}		3.4		mA	All bands
Supply current low gain mode	I_{CCLG}		650		µA	All bands
Supply current standby mode	I_{CCOFF}		0.1	2	µA	
Logic level high	V_{HI}	1.5	2.8		V	VEN1, VEN2 and VGS
Logic level low	V_{LO}		0.0	0.5	V	
Logic currents VEN	I_{ENL}		0.2		µA	VEN1 and VEN2
	I_{ENH}		10.0		µA	
Logic currents VGS	I_{GSL}		0.1		µA	VGS
	I_{GSH}		5.0		µA	

2.5 Band Select / Gain Control Truth Table

Table 5 Band Select Truth Table, V_{CC} = 2.8 V

	Mid band	Low band	Power Down
VEN1	H	L	L
VEN2	L	H	L

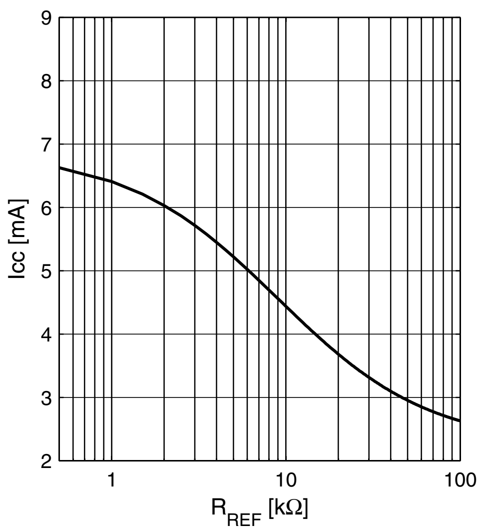
Table 6 Gain Control Truth Table, V_{CC} = 2.8 V

	High Gain	Low Gain
VGS	H	L

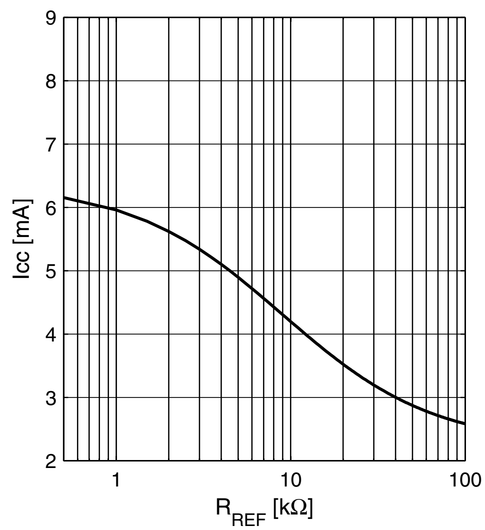
2.6 Supply current characteristics; T_A = 25 °C

Supply current high / mid gain mode versus reference resistor R_{REF} (see **Figure 2 on page 25** for reference resistor; low gain mode supply current is independent of reference resistor).

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



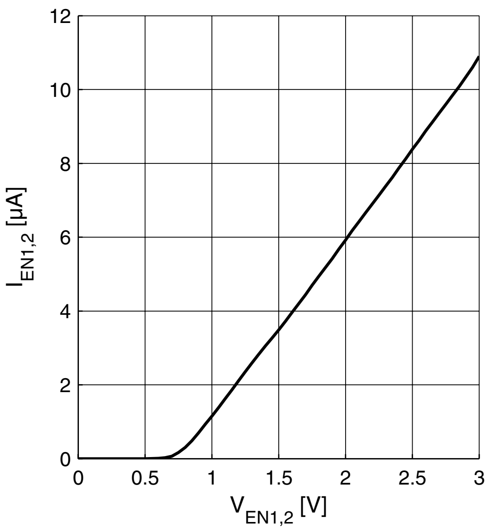
Supply Current Lowband I_{CC} = f (R_{REF})
V_{CC} = 2.8 V



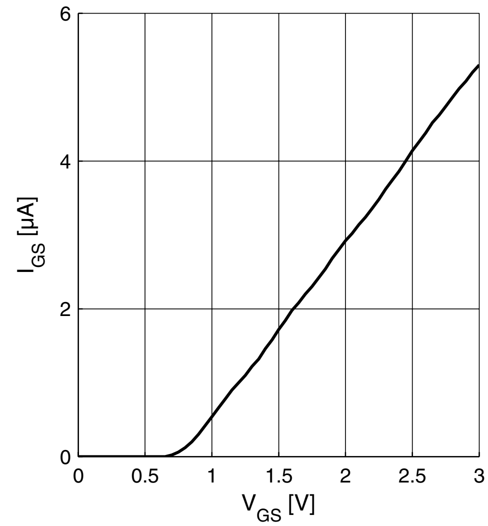
2.7 Logic Signal Characteristics; T_A = 25 °C

Current consumption of logic inputs VEN1, VEN2, VGS

Logic currents $I_{EN1,2} = f(V_{EN1,2})$
V_{CC} = 2.8 V



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



2.8 Switching Times

Table 7 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 all bands
Settling time bandselect	t_{BS}		1		µs	Switching from any band to a different band

2.9 Measured RF Characteristics Low Band

2.9.1 Measured RF Characteristics UMTS Bands V / VI

Table 8 Typical Characteristics 800 MHz Band, T_A = 25 °C, V_{CC} = 2.8 V

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range band V		869		894	MHz	
Pass band range band VI		875		885	MHz	
Current consumption	I_{CCHG}		3.4		mA	High gain mode
	I_{CCLG}		0.65		mA	Low gain mode
Gain	S_{21HG}		16.1		dB	High gain mode
	S_{21LG}		-7.5		dB	Low gain mode
Reverse Isolation[1)]	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}		7.5		dB	Low gain mode
Input return loss[1)]	S_{11HG}		-17		dB	50 Ω, high gain mode
	S_{11LG}		-17		dB	50 Ω, low gain mode
Output return loss[1)]	S_{22HG}		-17		dB	50 Ω, high gain mode
	S_{22LG}		-13		dB	50 Ω, low gain mode
Stability factor[2)]	k		>2.3			DC to 10 GHz; all gain modes
Input compression point[1)]	IP_{1dBHG}		-6		dBm	High gain mode
	IP_{1dBLG}		-8		dBm	Low gain mode
Inband IIP3[1)] 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) Verified by random sampling; not 100% RF tested

2) Not tested in production; guaranteed by device design

2.9.2 Measured RF Characteristics UMTS Band VIII

Table 9 Typical Characteristics 900 MHz Band, T_A = 25 °C, V_{CC} = 2.8 V

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		925		960	MHz	
Current consumption	I_{CCHG}		3.4		mA	High gain mode
	I_{CCLG}		0.65		mA	Low gain mode
Gain	S_{21HG}		16.1		dB	High gain mode
	S_{21LG}		-7.1		dB	Low gain mode
Reverse Isolation[1]	S_{12HG}		-36		dB	High gain mode
	S_{12LG}		-7		dB	Low gain mode
Noise figure	NF_{HG}		1.1		dB	High gain mode
	NF_{LG}		7.1		dB	Low gain mode
Input return loss[1]	S_{11HG}		-16		dB	50 Ω, high gain mode
	S_{11LG}		-15		dB	50 Ω, low gain mode
Output return loss[1]	S_{22HG}		-15		dB	50 Ω, high gain mode
	S_{22LG}		-16		dB	50 Ω, low gain mode
Stability factor[2]	k		>2.3			DC to 10 GHz; all gain modes
Input compression point[1]	IP_{1dBHG}		-5		dBm	High gain mode
	IP_{1dBLG}		-8		dBm	Low gain mode
Inband IIP3[1] $f_1 - f_2$ = 1 MHz $P_{f1} = P_{f2}$ = -37 dBm	$IIP3_{HG}$ $IIP3_{LG}$		-6 2		dBm	High gain mode Low gain mode

1) Verified by random sampling; not 100% RF tested
2) Not tested in production; guaranteed by device design

2.10 Measured RF Characteristics Mid Band

2.10.1 Measured RF Characteristics UMTS Band II

Table 10 Typical Characteristics 1900 MHz Band, T_A = 25 °C, V_{CC} = 2.8 V

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		1930		1990	MHz	
Current consumption	I_{CCHG}		3.4		mA	High gain mode
	I_{CCLG}		0.65		mA	Low gain mode
Gain	S_{21HG}		16.0		dB	High gain mode
	S_{21LG}		-7.8		dB	Low gain mode
Reverse Isolation[1]	S_{12HG}		-35		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[1]	S_{11HG}		-19		dB	50 Ω, high gain mode
	S_{11LG}		-18		dB	50 Ω, low gain mode
Output return loss[1]	S_{22HG}		-20		dB	50 Ω, high gain mode
	S_{22LG}		-15		dB	50 Ω, low gain mode
Stability factor[2]	k		>2.4			DC to 10 GHz; all gain modes
Input compression point[1]	IP_{1dBHG}		-7		dBm	High gain mode
	IP_{1dBLG}		-7		dBm	Low gain mode
Inband IIP3[1] $f_1 - f_2$ = 1 MHz $P_{f1} = P_{f2}$ = -37 dBm	$IIP3_{HG}$ $IIP3_{LG}$		-6 3		dBm	High gain mode Low gain mode

1) Verified by random sampling; not 100% RF tested
2) Not tested in production; guaranteed by device design

2.10.2 Measured RF Characteristics UMTS Bands III / IX

Table 11 Typical Characteristics 1800 MHz Band, T_A = 25 °C, V_{CC} = 2.8 V

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range band III		1805		1880	MHz	
Pass band range band IX		1844.9		1879.9	MHz	
Current consumption	I_{CCHG}		3.4		mA	High gain mode
	I_{CCLG}		0.65		mA	Low gain mode
Gain	S_{21HG}		16.2		dB	High gain mode
	S_{21LG}		-8.7		dB	Low gain mode
Reverse Isolation[1)]	S_{12HG}		-36		dB	High gain mode
	S_{12LG}		-9		dB	Low gain mode
Noise figure	NF_{HG}		1.0		dB	High gain mode
	NF_{LG}		8.7		dB	Low gain mode
Input return loss[1)]	S_{11HG}		-13		dB	50 Ω, high gain mode
	S_{11LG}		-14		dB	50 Ω, low gain mode
Output return loss[1)]	S_{22HG}		-19		dB	50 Ω, high gain mode
	S_{22LG}		-15		dB	50 Ω, low gain mode
Stability factor[2)]	k		>2.5			DC to 10 GHz; all gain modes
Input compression point[1)]	IP_{1dBHG}		-7		dBm	High gain mode
	IP_{1dBLG}		-6		dBm	Low gain mode
Inband IIP3[1)] $f_1 - f_2$ = 1 MHz $P_{f1} = P_{f2}$ = -37 dBm	$IIP3_{HG}$ $IIP3_{LG}$		-5 3		dBm	High gain mode Low gain mode

1) Verified by random sampling; not 100% RF tested
2) Not tested in production; guaranteed by device design

2.10.3 Measured RF Characteristics UMTS Band IV

Table 12 Typical Characteristics 2100 MHz Band, T_A = 25 °C, V_{CC} = 2.8 V

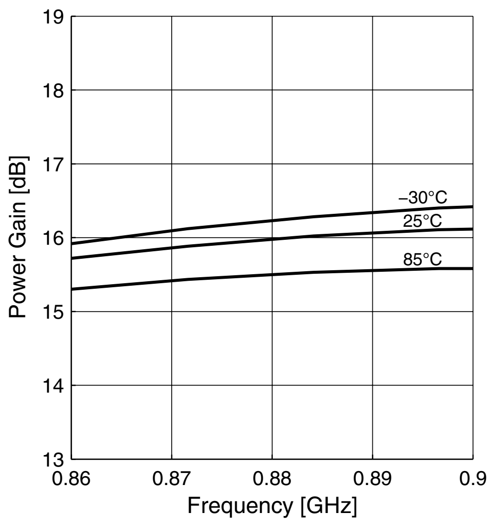
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		2110		2155	MHz	
Current consumption	I_{CCHG}		3.4		mA	High gain mode
	I_{CCLG}		0.65		mA	Low gain mode
Gain	S_{21HG}		15.8		dB	High gain mode
	S_{21LG}		-7.0		dB	Low gain mode
Reverse Isolation[1)]	S_{12HG}		-34		dB	High gain mode
	S_{12LG}		-7		dB	Low gain mode
Noise figure	NF_{HG}		1.1		dB	High gain mode
	NF_{LG}		7		dB	Low gain mode
Input return loss[1)]	S_{11HG}		-19		dB	50 Ω, high gain mode
	S_{11LG}		-14		dB	50 Ω, low gain mode
Output return loss[1)]	S_{22HG}		-19		dB	50 Ω, high gain mode
	S_{22LG}		-15		dB	50 Ω, low gain mode
Stability factor[2)]	k		>2.3			DC to 10 GHz; all gain modes
Input compression point[1)]	IP_{1dBHG}		-7		dBm	High gain mode
	IP_{1dBLG}		-4		dBm	Low gain mode
Inband IIP3[1)] $f_1 - f_2$ = 1 MHz $P_{f1} = P_{f2}$ = -37 dBm	$IIP3_{HG}$ $IIP3_{LG}$		-4 6		dBm	High gain mode Low gain mode

1) Verified by random sampling; not 100% RF tested
2) Not tested in production; guaranteed by device design

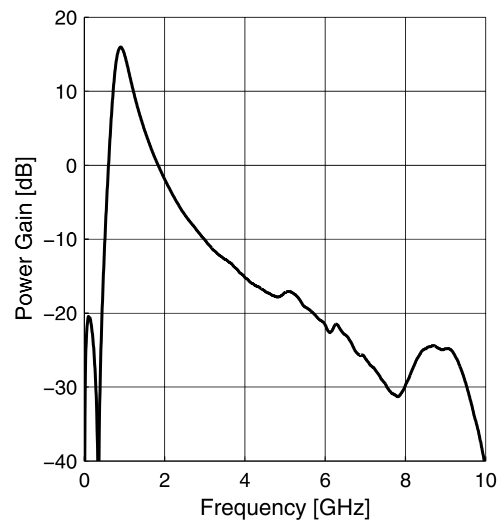
2.11 Measured Performance Low Band (Band V) High Gain Mode vs. Frequency

T_A= 25 °C, V_{CC} = 2.8 V, V_{GS} = 2.8 V, V_{EN1} = 0 V, V_{EN2} = 2.8 V

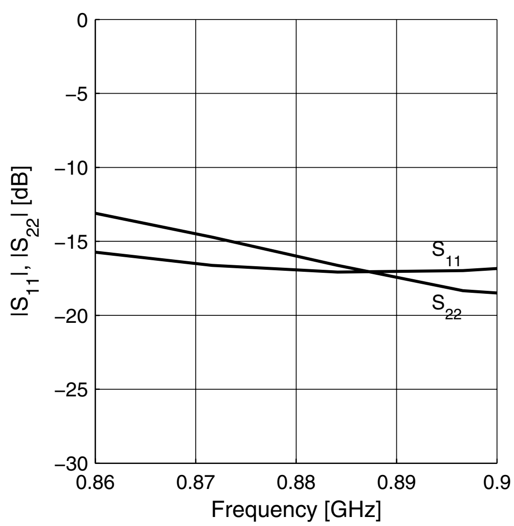
Power Gain $|S_{21}|$ = f (f)



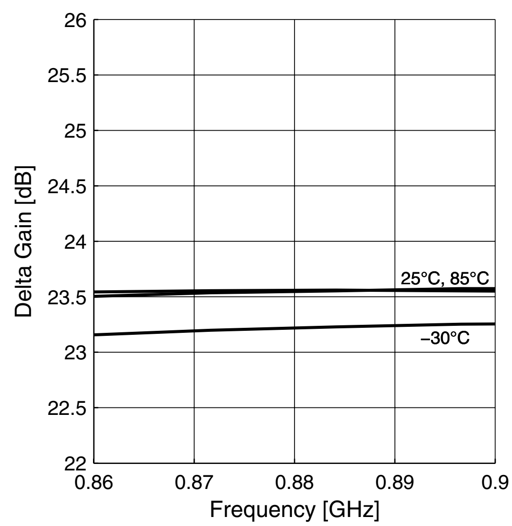
Power Gain wideband $|S_{21}|$ = f (f)



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

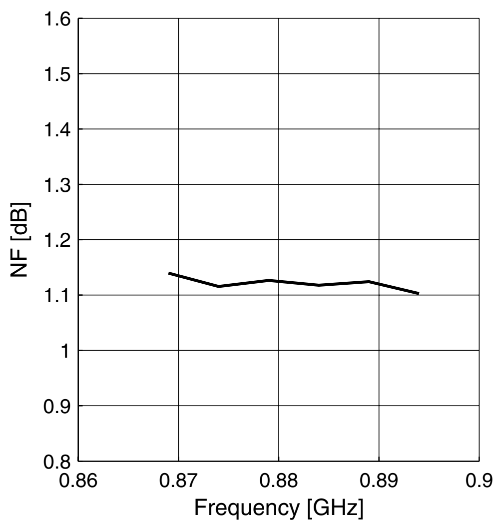


Gainstep HG-LG $|\Delta S_{21}|$ = f (f)

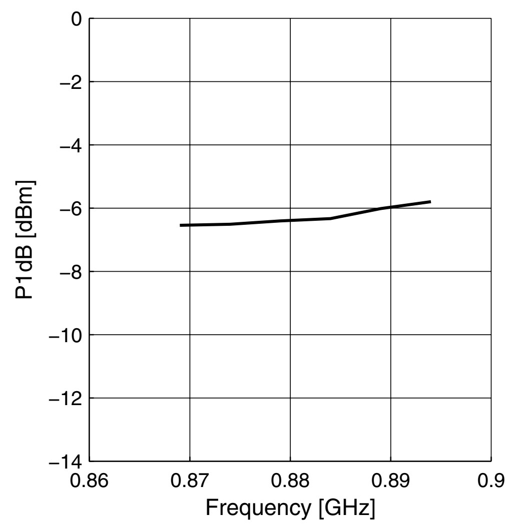


Measured Performance Low Band (Band V) High Gain Mode vs. Temperature

Noise Figure $NF = f(f)$



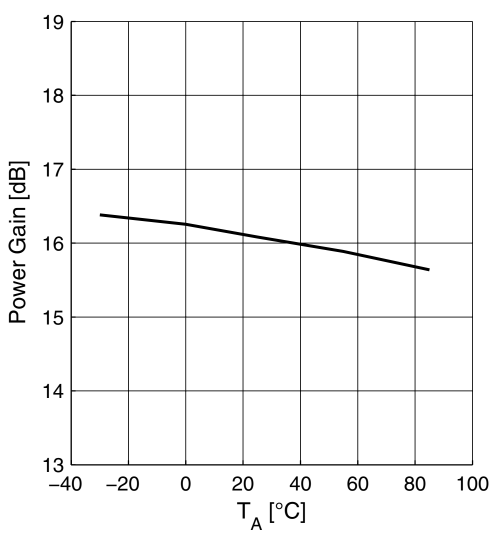
Input Compression $P1dB = f(f)$



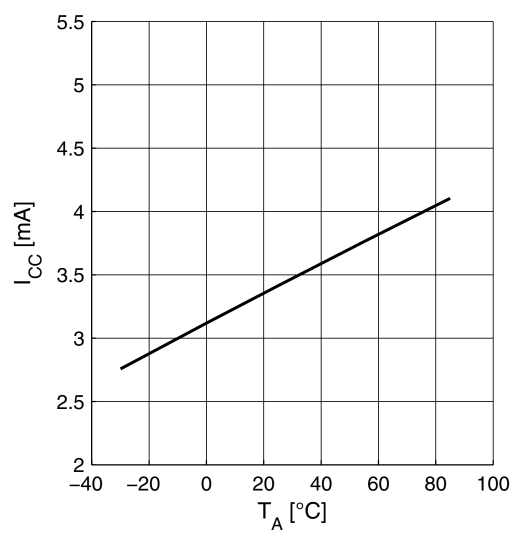
2.12 Measured Performance Low Band (Band V) High Gain Mode vs. Temperature

V_{CC} = 2.8 V, V_{GS} = 2.8 V, V_{EN1} = 0 V, V_{EN2} = 2.8 V, f = 880 MHz

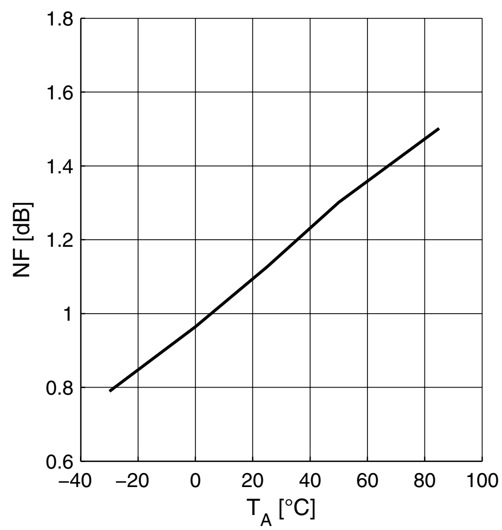
Power Gain $|S_{21}| = f(T_A)$



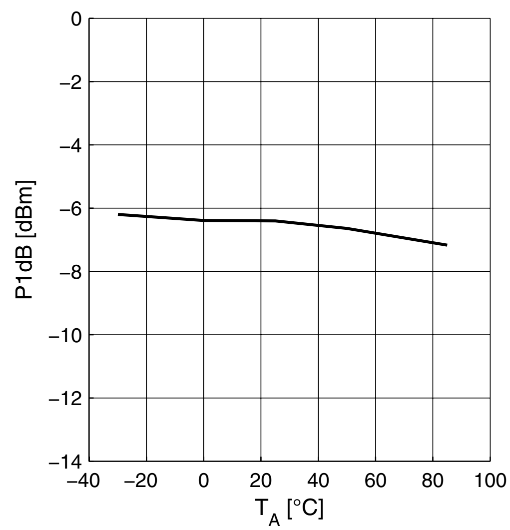
Supply Current $I_{CC} = f(T_A)$



Noise Figure NF = f (T_A)



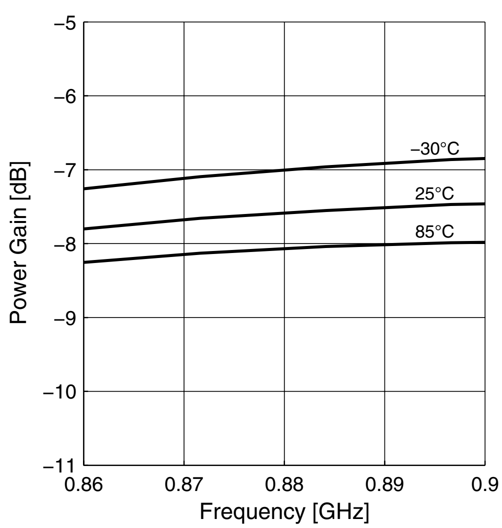
Input Compression $P1dB$ = f (T_A)



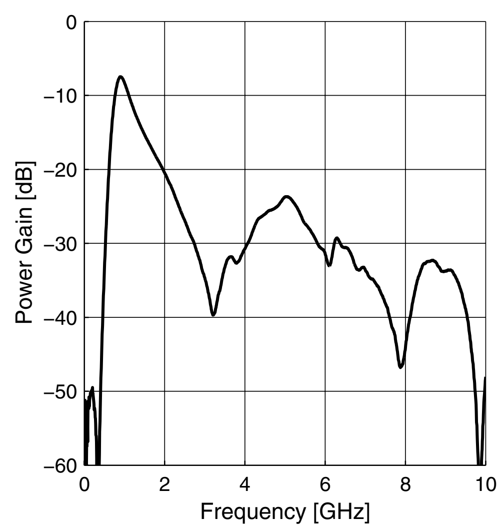
2.13 Measured Performance Low Band (Band V) Low Gain Mode vs. Frequency

T_A = 25 °C, V_{CC} = 2.8 V, V_{GS} = 0 V, V_{EN1} = 0 V, V_{EN2} = 2.8 V

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

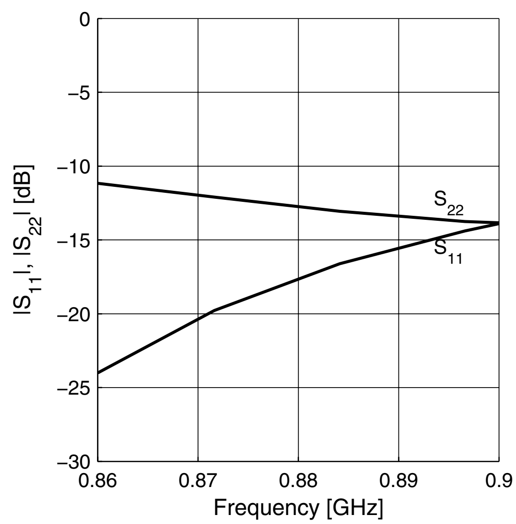


Power Gain wideband $|S_{21}|$ = f (f)

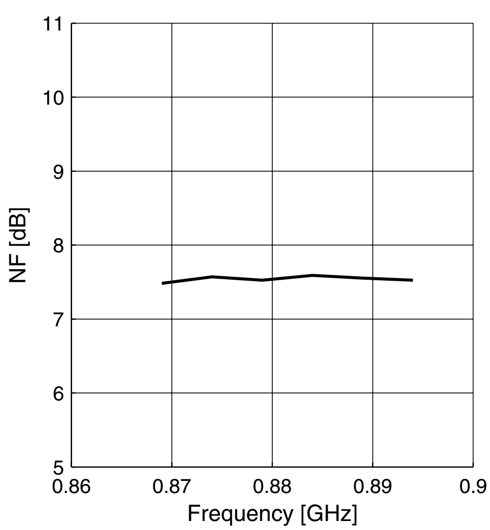


Measured Performance Low Band (Band V) Low Gain Mode vs. Frequency

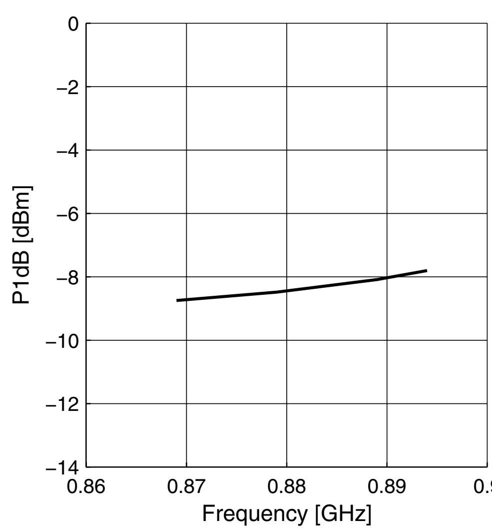
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



Noise Figure $NF = f(f)$



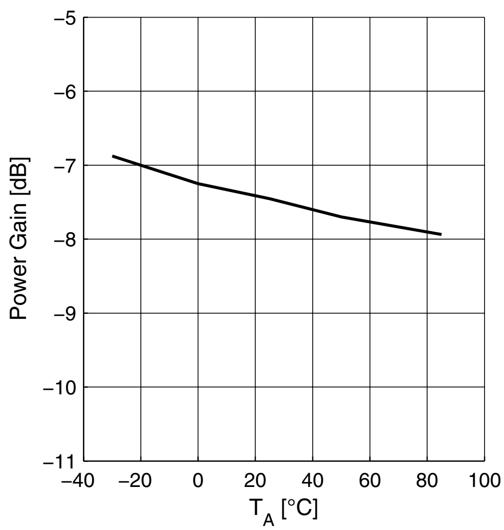
Input Compression $P1dB = f(f)$



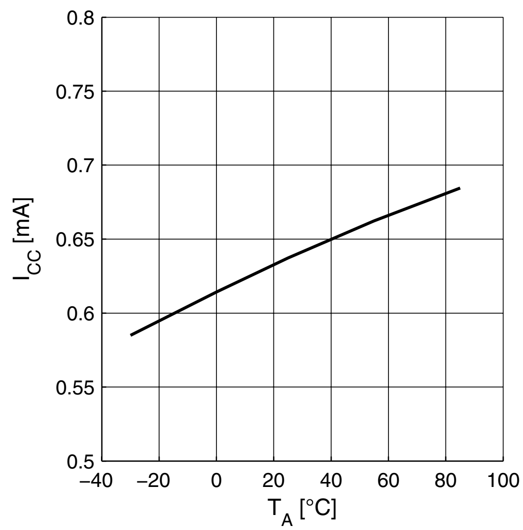
2.14 Measured Performance Low Band (Band V) Low Gain Mode vs. Temperature

V_{CC} = 2.8 V, V_{GS} = 0 V, V_{EN1} = 0 V, V_{EN2} = 2.8 V, f = 880 MHz

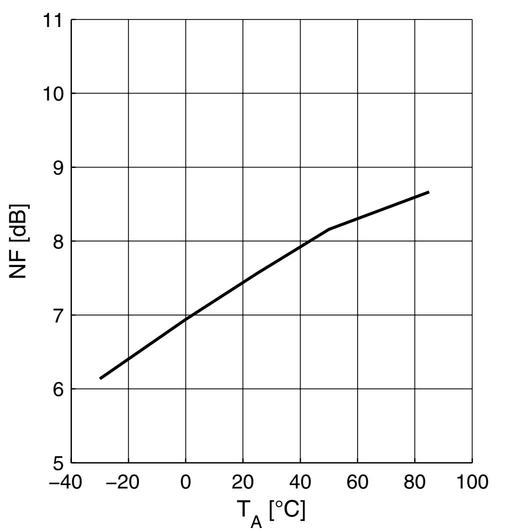
Power Gain $|S_{21}|$ = f (T_A)



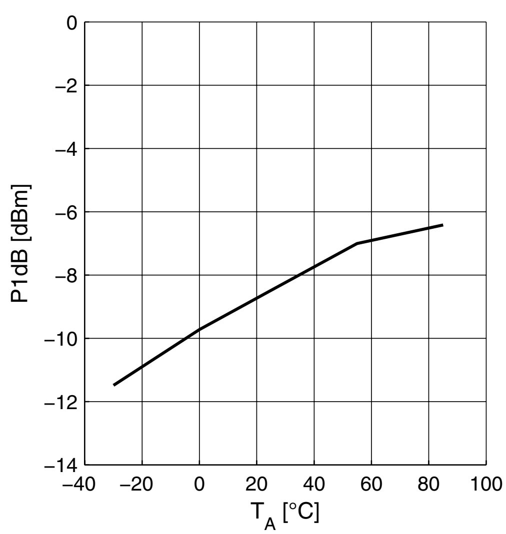
Supply Current I_{CC} = f (T_A)



Noise Figure NF = f (T_A)



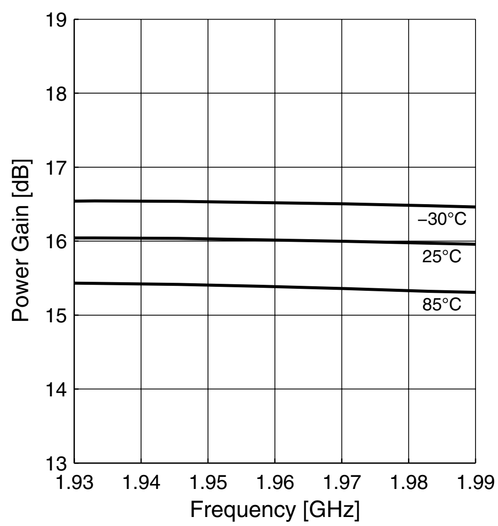
Input Compression $P1dB$ = f (T_A)



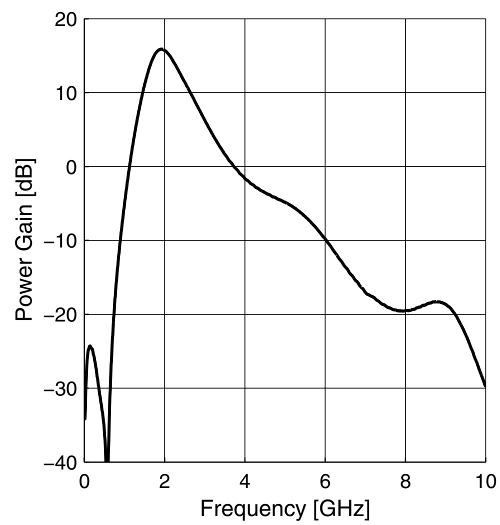
2.15 Measured Performance Mid Band (Band II) High Gain Mode vs. Frequency

T_A = 25 °C, V_{CC} = 2.8 V, V_{GS} = 2.8 V, V_{EN1} = 2.8 V, V_{EN2} = 0 V

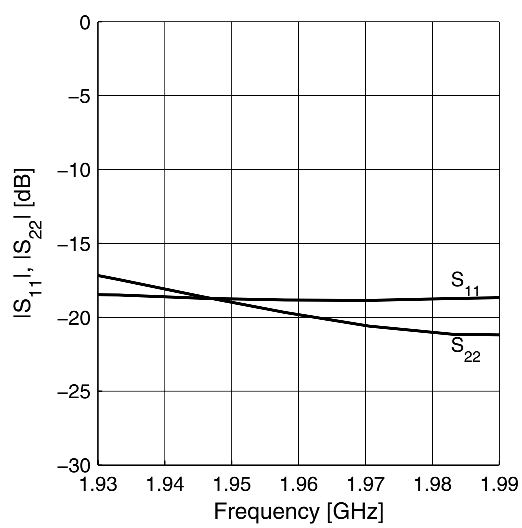
Power Gain $|S_{21}| = f(f)$



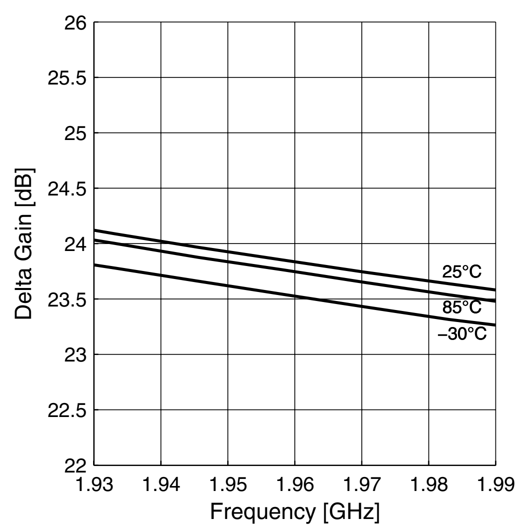
Power Gain wideband $|S_{21}| = f(f)$



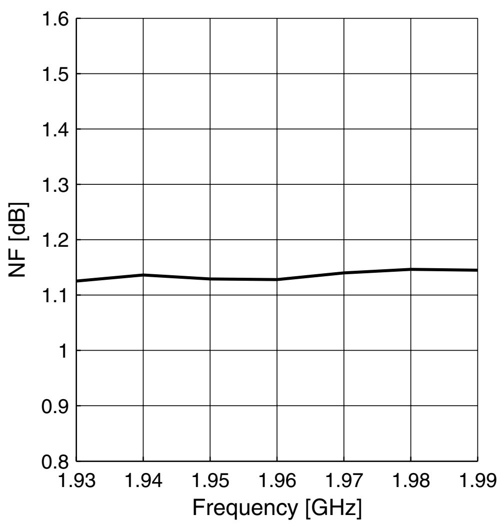
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



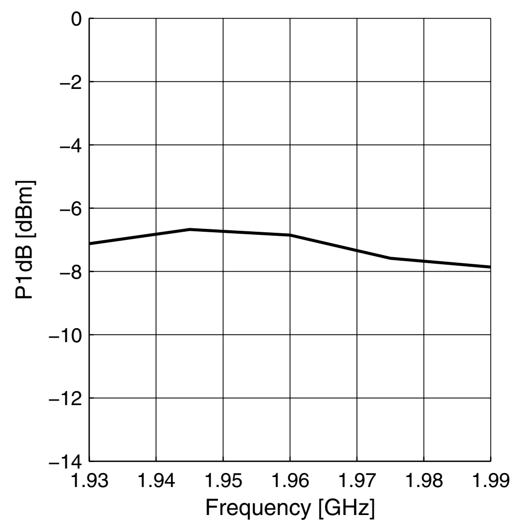
Gainstep HG-LG $|\Delta S_{21}| = f(f)$



Noise Figure NF = f (f)



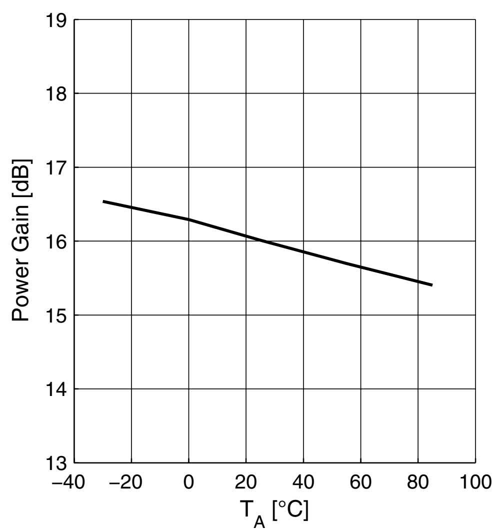
Input Compression $P1dB$ = f (f)



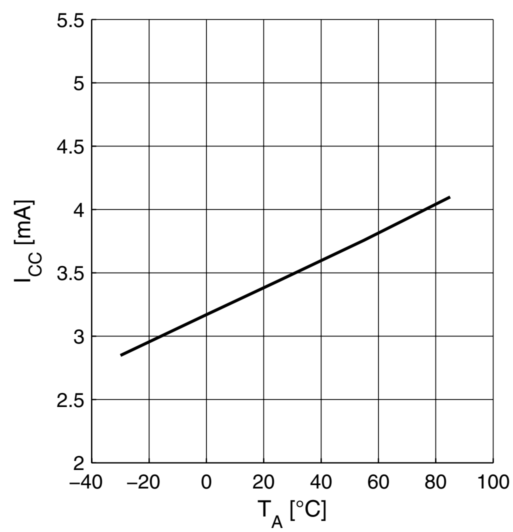
2.16 Measured Performance Mid Band (Band II) High Gain Mode vs. Temperature

V_{CC} = 2.8 V, V_{GS} = 2.8 V, V_{EN1} = 2.8 V, V_{EN2} = 0 V, f = 1960 MHz

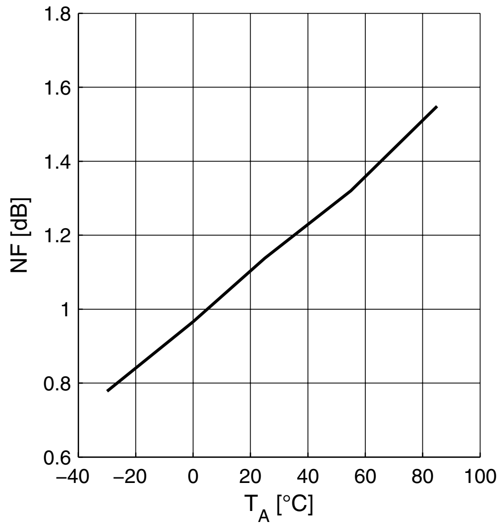
Power Gain $|S_{21}|$ = f (T_A)



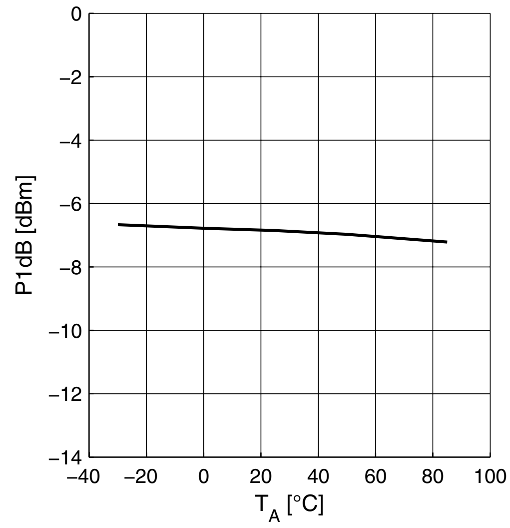
Supply Current I_{CC} = f (T_A)



Noise Figure NF = f (T_A)



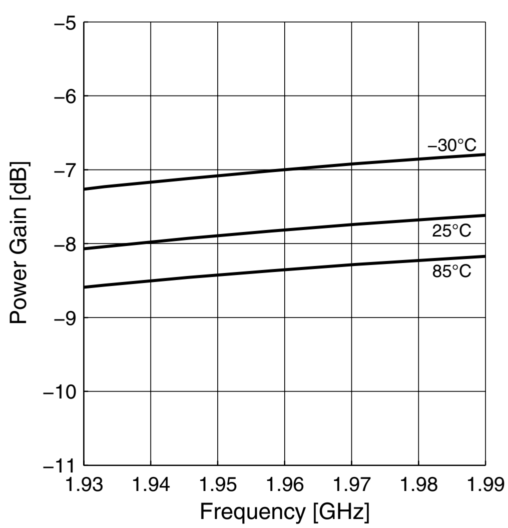
Input Compression $P1dB$ = f (T_A)



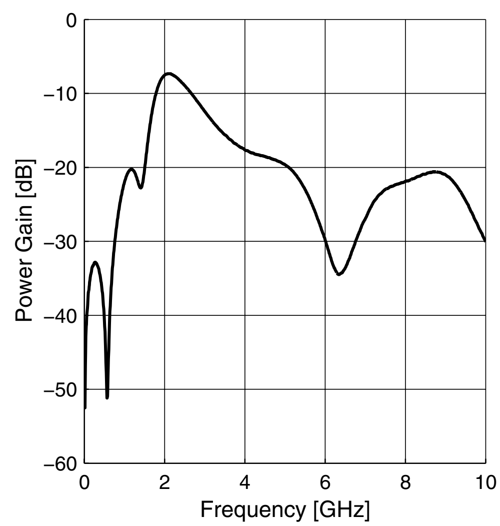
2.17 Measured Performance Mid Band (Band II) Low Gain Mode vs. Frequency

T_A = 25 °C, V_{CC} = 2.8 V, V_{GS} = 0 V, V_{EN1} = 2.8 V, V_{EN2} = 0 V

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

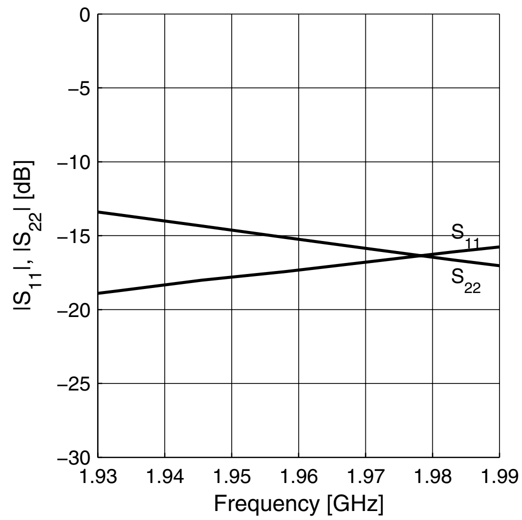


Power Gain wideband $|S_{21}|$ = f (f)

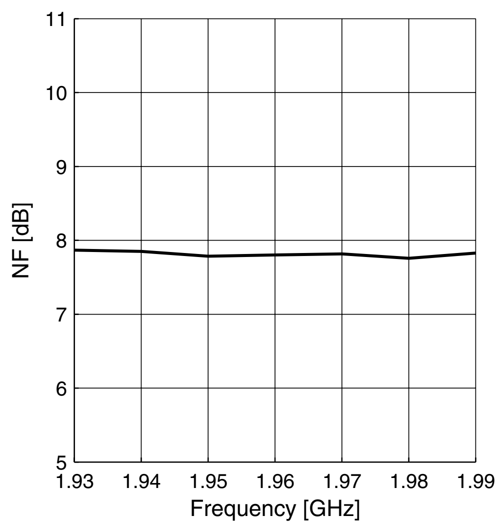


Measured Performance Mid Band (Band II) Low Gain Mode vs. Frequency

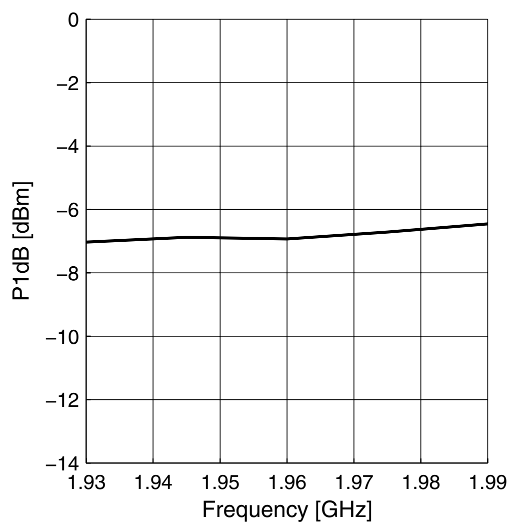
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



Noise Figure $NF = f(f)$



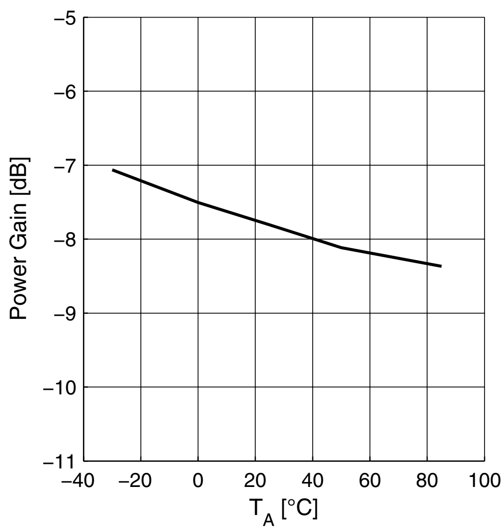
Input Compression $P1dB = f(f)$



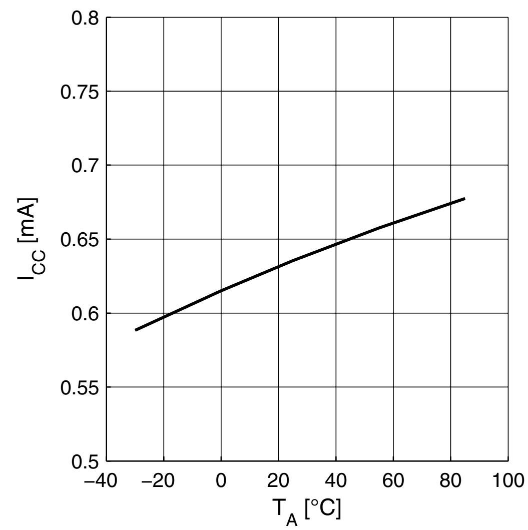
2.18 Measured Performance Mid Band (Band II) Low Gain Mode vs. Temperature

V_{CC} = 2.8 V, V_{GS} = 0 V, V_{EN1} = 2.8 V, V_{EN2} = 0 V, f = 1960 MHz

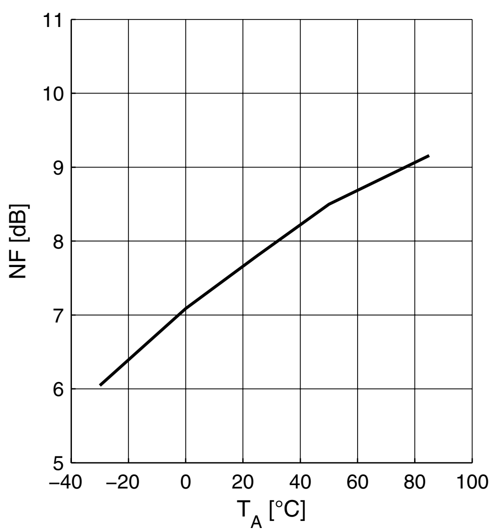
Power Gain $|S_{21}|$ = f (T_A)



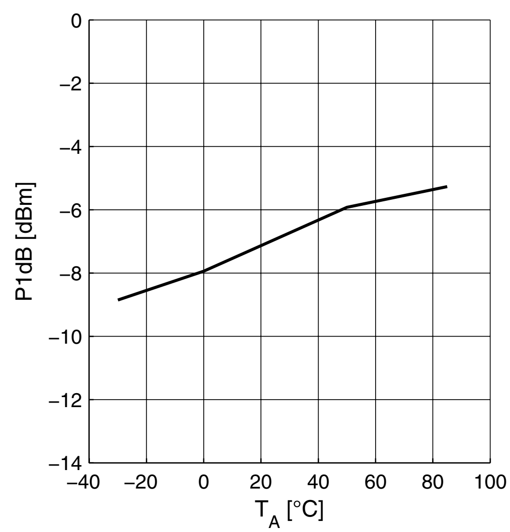
Supply Current I_{CC} = f (T_A)



Noise Figure NF = f (T_A)



Input Compression $P1dB$ = f (T_A)



3 Application Circuit and Block Diagram

3.1 UMTS bands II and V Application Circuit Schematic

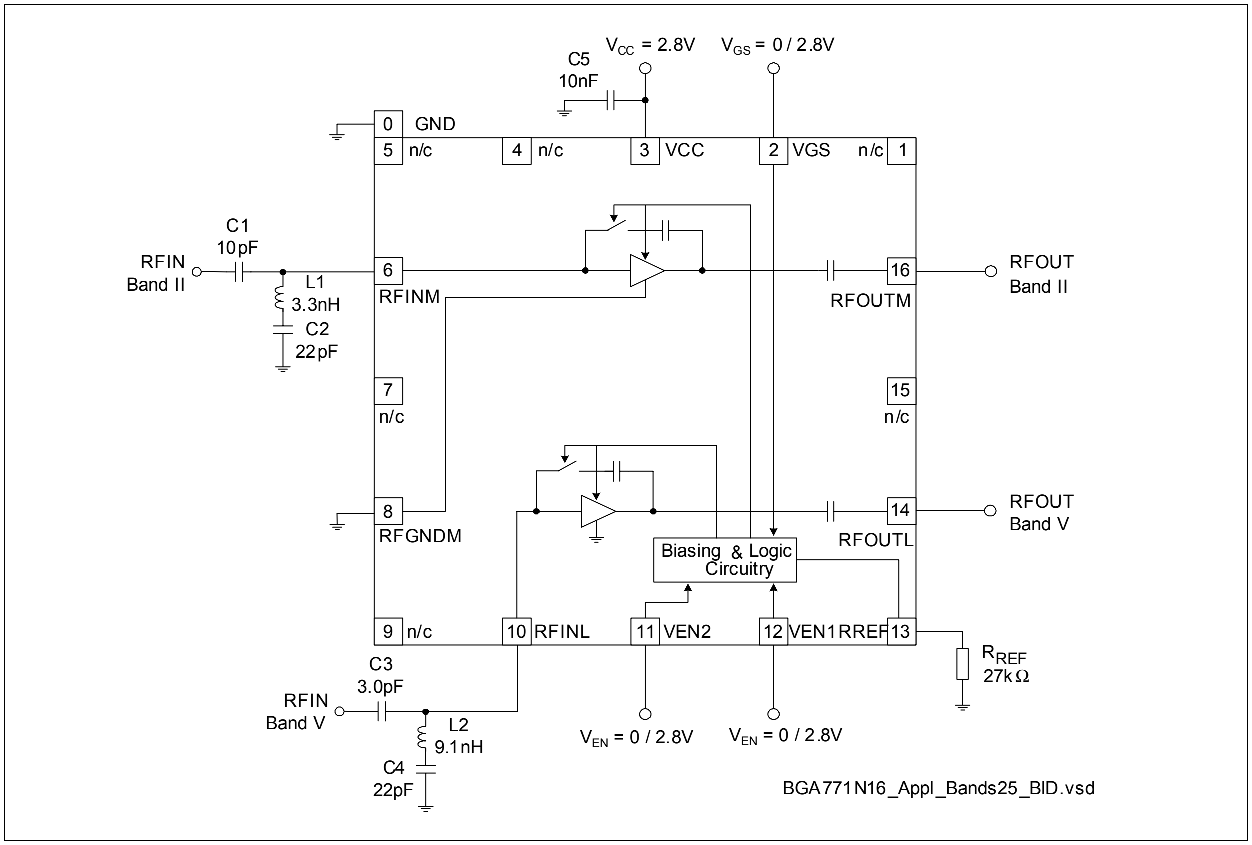


Figure 2 Application circuit with chip outline (top view)

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

Table 13 Parts List

Part Number	Part Type	Manufacturer	Size	Comment
L1 ... L2	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C5	Chip capacitor	Various	0402	
RREF	Chip resistor	Various	0402	

3.2 UMTS bands III and VIII Application Circuit Schematic

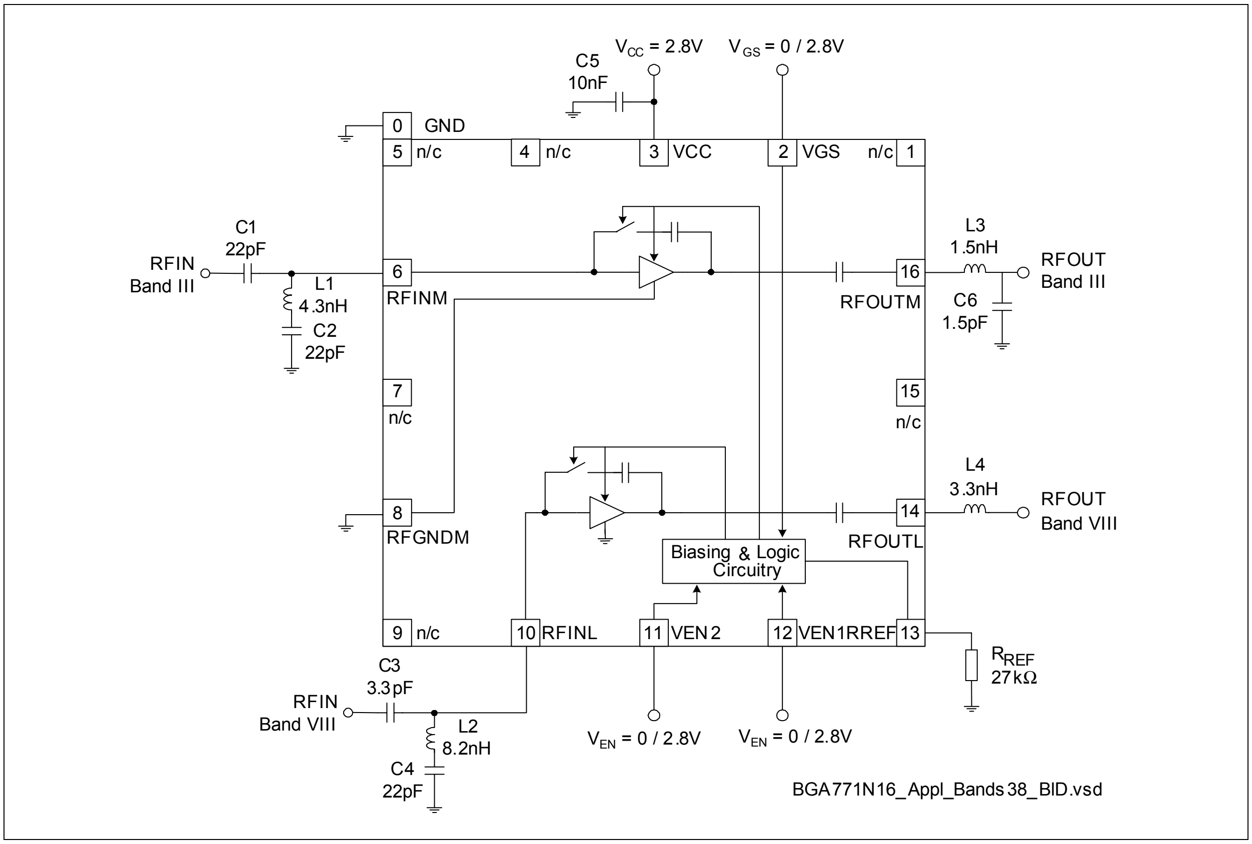


Figure 3 Application circuit with chip outline (top view)

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

Table 14 Parts List

Part Number	Part Type	Manufacturer	Size	Comment
L1 ... L4	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C6	Chip capacitor	Various	0402	
RREF	Chip resistor	Various	0402	

3.3 UMTS bands IV and VIII Application Circuit Schematic

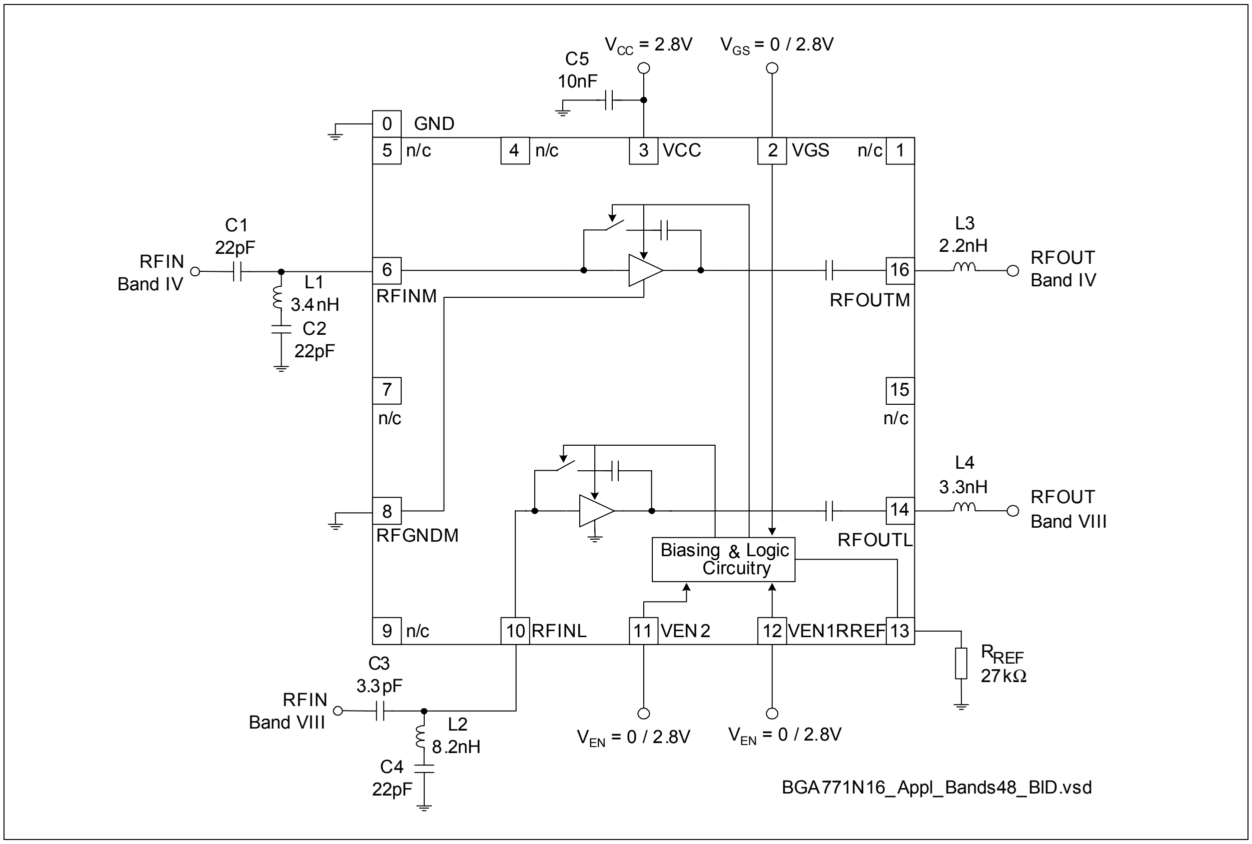


Figure 4 Application circuit with chip outline (top view)

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

Table 15 Parts List

Part Number	Part Type	Manufacturer	Size	Comment
L1 ... L4	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C5	Chip capacitor	Various	0402	
RREF	Chip resistor	Various	0402	

3.4 Pin Definition

Table 16 Pin Definition and Function

Pin Number	Symbol	Function
0	GND	Package paddle; ground connection for low band LNA and control circuity
1	n/c	Not connected
2	VGS	Gain step control
3	VCC	Supply voltage
4	n/c	Not connected
5	n/c	Not connected
6	RFINM	Mid band (1900/1800/2100 MHz) LNA input
7	n/c	Not connected
8	RFGNDM	Mid band LNA emitter ground
9	n/c	Not connected
10	RFINL	Low band (800/900 MHz) LNA input
11	VEN2	Band select control
12	VEN1	Band select control
13	RREF	Bias current reference resistor (high gain mode)
14	RFOUTL	Low band (800/900 MHz) LNA output
15	n/c	Not connected
16	RFOUTM	Mid band (1900/1800/2100 MHz) LNA output

3.5 Application Board

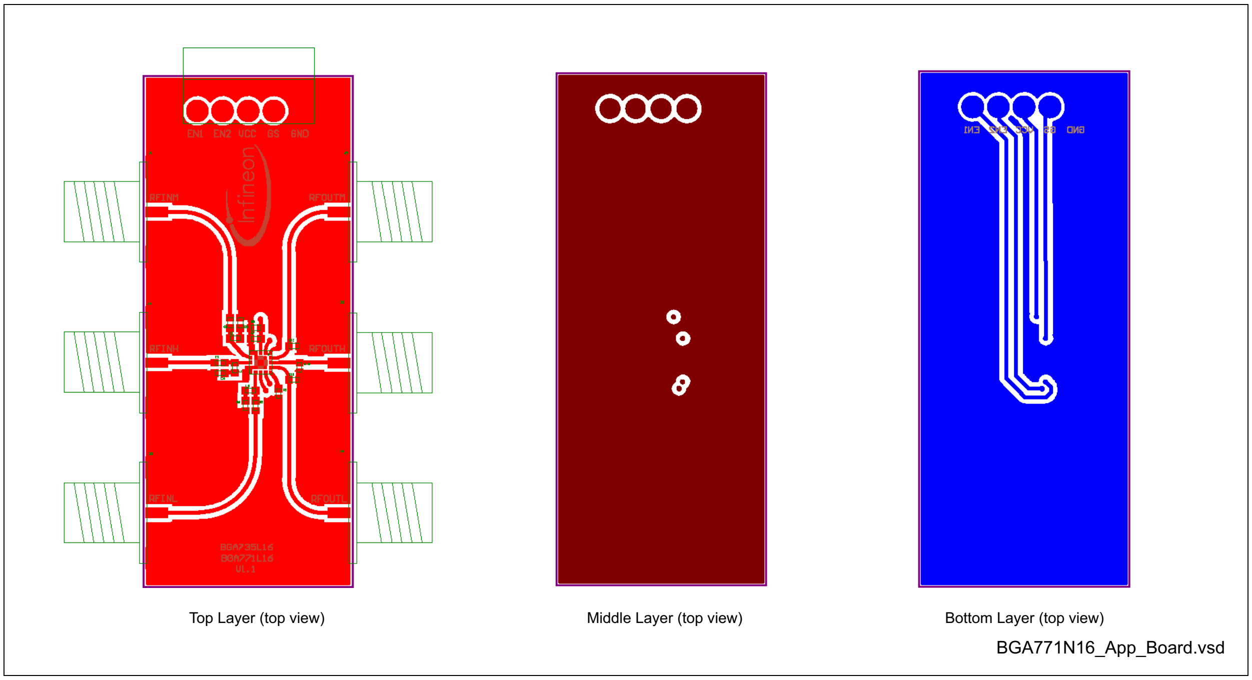


Figure 5 Application board layout on 3-layer FR4. Top layer thickness: 0.2 mm, bottom layer thickness: 0.8 mm, 17 µm Cu metallization, gold plated. Board size: 21 x 50 mm

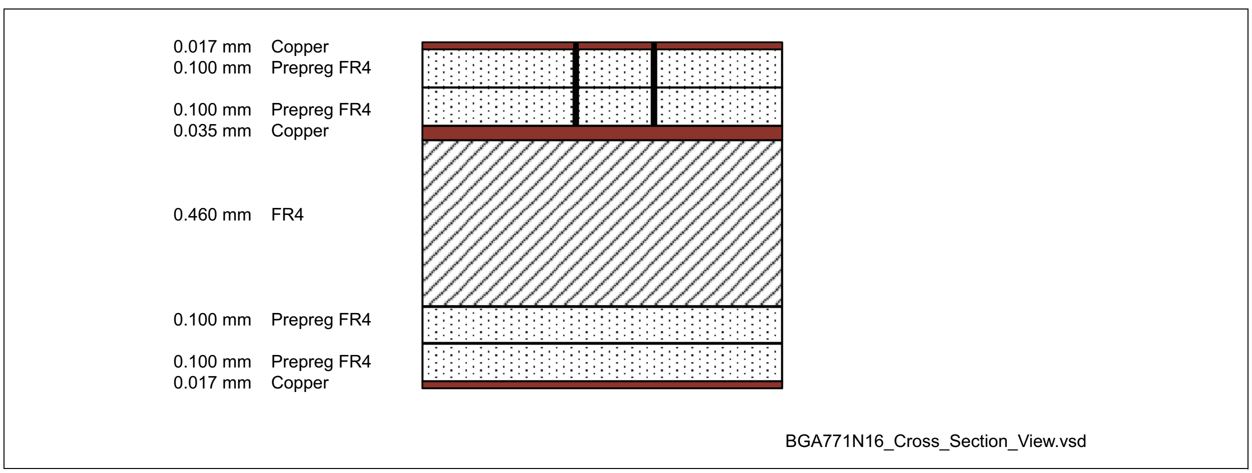


Figure 6 Cross-section view of application board

Application Board

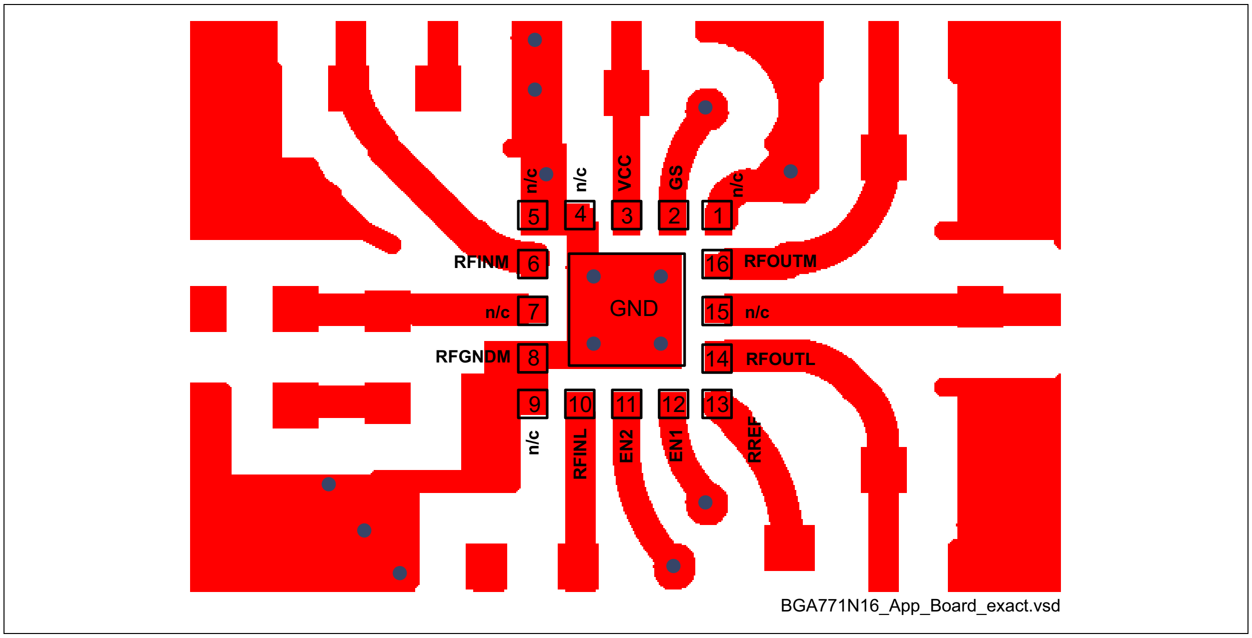


Figure 7 Detail of application board layout

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

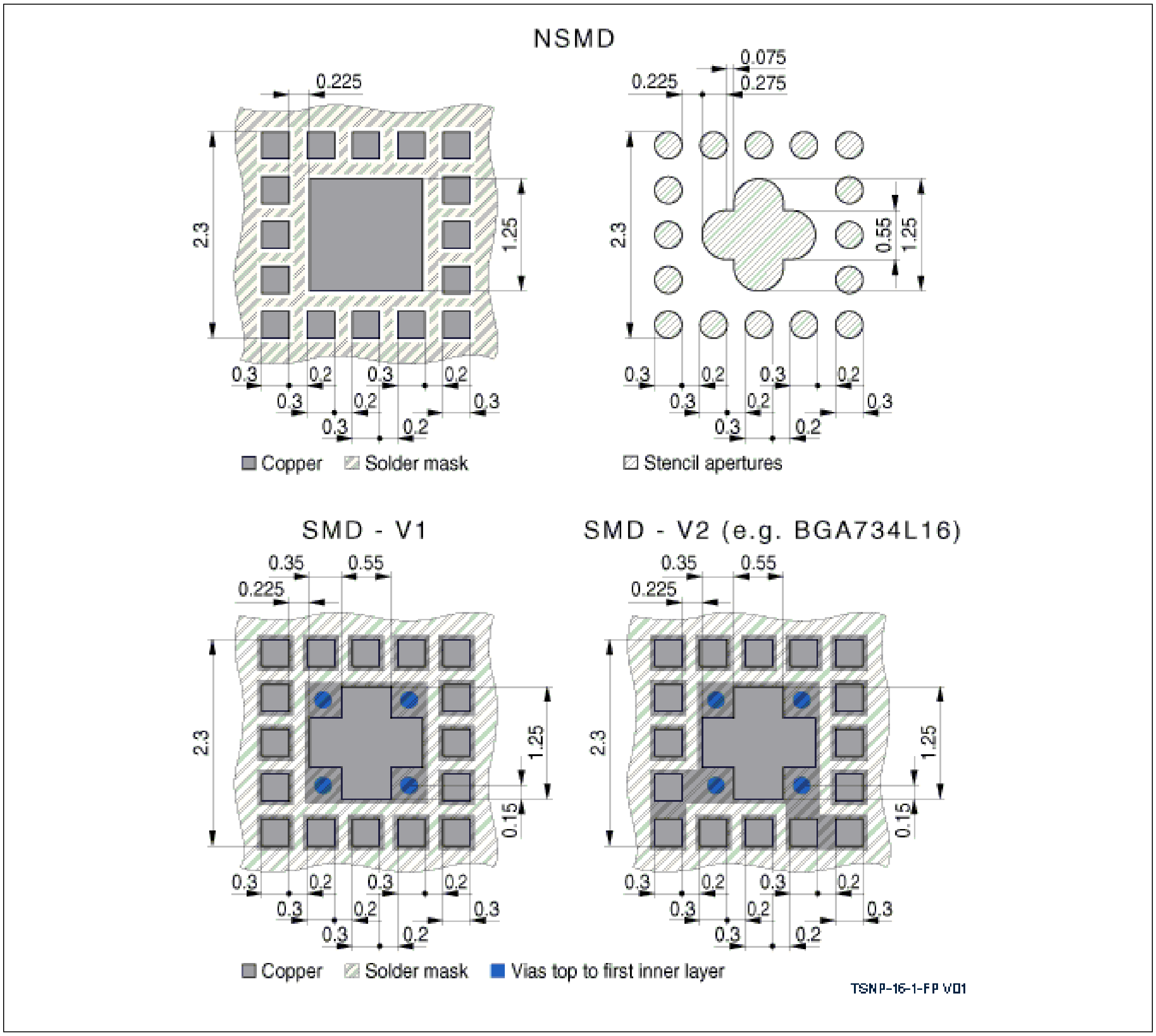


Figure 8 Recommended footprint and stencil layout for the TSNP-16-1 package

4.2 Package Dimensions

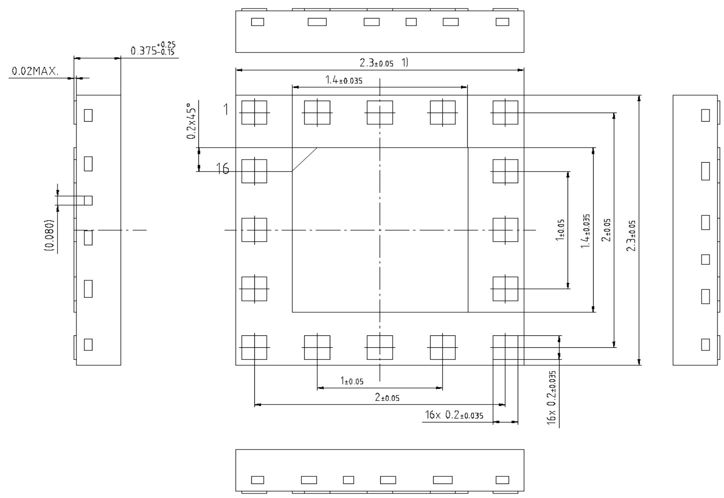


Figure 9 Package outline (top, side and bottom view)

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