BGA734L16

Low Power Tri-Band UMTS LNA (2100, 1900, 800 MHz)

Data Sheet

Revision 1.1, 2011-03-16

RF & Protection Devices

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BGA734L16 Low Power Tri-Band UMTS LNA (2100, 1900, 800 MHz)

Revision History: 2011-03-16, Revision 1.1

Previous Revision: 2008-01-25, Revision 1.0	
Page	**Subjects (major changes since last revision)**
10	Updated Logic Level Limit

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Last Trademarks Update 2010-10-26

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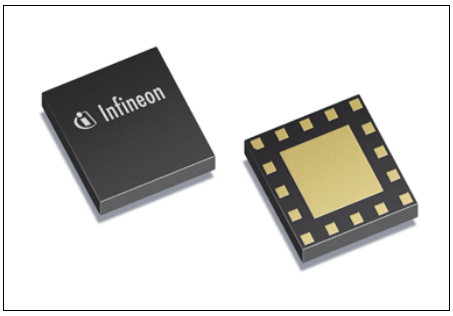

Main features:

- Gain: 15 / -8 dB in high / low gain
- Noise figure: 1.2 dB in high gain mode
- Low Band (5, 6, 8, FOMA800)
- Mid Band (2, 3, 9, FOMA1700)
- High Band (1, 4, 10)
- High and low gain modes support
- Supply current: 3.5 / 0.65 mA in high / low gain modes
- Standby mode (<10 μA typ)
- 1 kV HBM ESD protection
- Small leadless TSLP-16-1 package (2.3 x 2.3 x 0.39 mm)
- Pb-free (RoHS compliant) package

RoHS

Description

The BGA734L16 is a highly flexible tri-band (2100, 1900, 850/800 MHz) low noise amplifier MMIC for worldwide use. Based on Infineon's proprietary and cost-effective SiGe:C technology, the BGA734L16 features dynamic gain control, temperature stabilization, standby mode, and 1 kV ESD protection on-chip and matching off chip. Because the matching is off chip, the 1900 MHz path can be converted into a 2100 MHz path and vice versa by optimizing the input and output matching network. This document specifies device performance for the most common band combination - UMTS bands I, II, and V.

Product Name	Package	Chip	Marking
BGA734L16	TSLP-16-1	T1520	BGA734

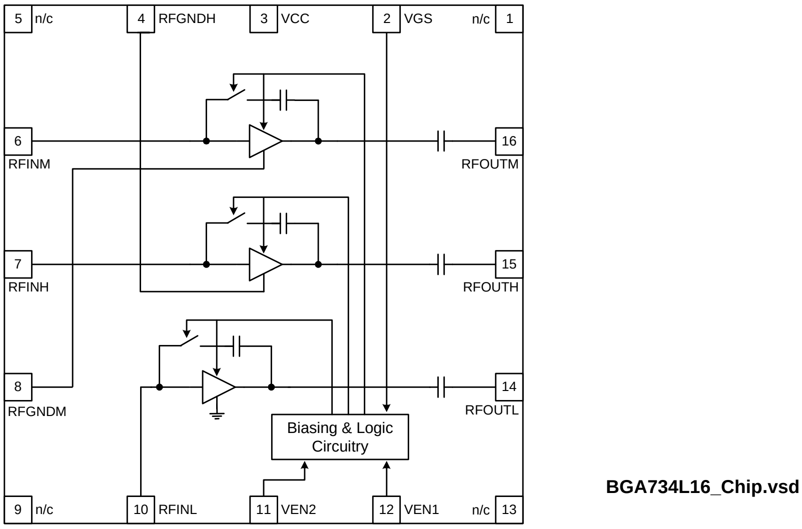

Figure 1 Block Diagram of Triple-Band LNA

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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}		–	5	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	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance junction to soldering point	R_{thJS}	–	–	≤ 110	K/W	–

2.3 ESD Integrity

Table 3 ESD Integrity

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
ESD hardness HBM[1)]	$V_{ESD-HBM}$	–	1000	–	V	All pins

1) According to JESD22-A114

2.4 DC Characteristics

Table 4 DC Characteristics, T_A = -30 ... 85 °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}	–	3.5	–	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}	1.4	2.8	–	V	VEN1 and VEN2
Logic level low	V_{LOW}	–	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

	Band I	Band II	Band V	Power Down
VCC	H	H	H	H
VEN1	H	H	L	L
VEN2	H	L	H	L

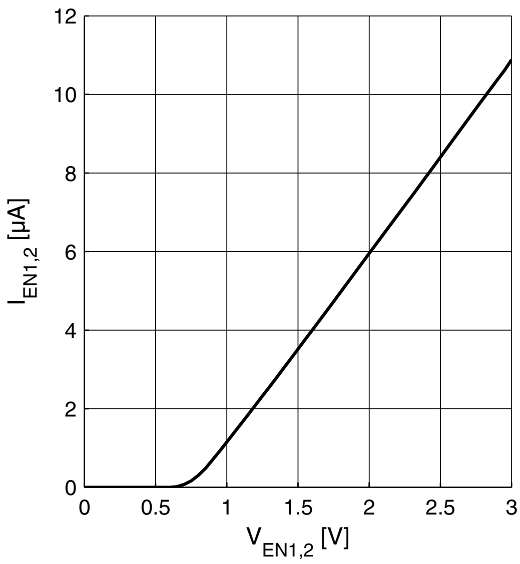
Table 6 Gain Control Truth Table, V_{CC} = 2.8 V

	High Gain	Low Gain
VGS	H	L

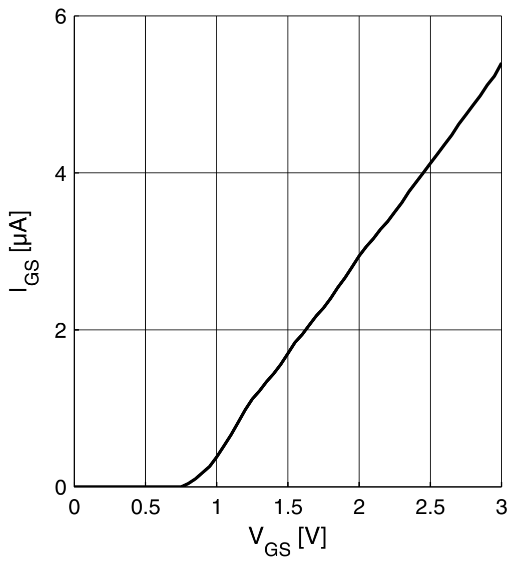
2.6 Logic Signal Characteristics; T_A = 25 °C

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



2.7 Switching Times

Table 7 Typical Switching Times; T_A = -30 ... 85 °C

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gainstep settling time	t_{GS}	–	1.2	–	µs	Switching LG ↔ HG all bands
Bandselect settling time	t_{BS}	–	1.2	–	µs	Switching from any band to a different band

2.8 Measured RF Characteristics UMTS Band 5

Table 8 Typical Characteristics 800 MHz Band, T_A = 25 °C, VCC = 2.8 V [1]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		869		894	MHz	
Input power range		-100		0	dBm	
Current consumption	I_{CCHG}	–	3.5	–	mA	High gain mode
	I_{CCLG}	–	0.65	–	mA	Low gain mode
Gain	S_{21HG}	–	15.2	–	dB	High gain mode
	S_{21LG}	–	-6.8	–	dB	Low gain mode
Reverse Isolation[2]	S_{12HG}	–	-34	–	dB	High gain mode
	S_{12LG}	–	-6.8	–	dB	Low gain mode
Noise figure	NF_{HG}	–	1.2	–	dB	High gain mode
	NF_{LG}	–	6.9	–	dB	Low gain mode
Input return loss[2]	S_{11HG}	–	-13	–	dB	50 Ω, high gain mode
	S_{11LG}	–	-18	–	dB	50 Ω, low gain mode
Output return loss[2]	S_{22HG}	–	-24	–	dB	50 Ω, high gain mode
	S_{22LG}	–	-11	–	dB	50 Ω, low gain mode
Stability factor[3]	k	–	>2.1	–	–	DC to 10 GHz; all gain modes
Input compression point[2]	IP_{1dBHG}	–	-12	–	dBm	High gain mode
	IP_{1dBLG}	–	-6	–	dBm	Low gain mode
Inband IIP3[2] f_1 - f_2 = 1 MHz P_{f1} = P_{f2} = -25 dBm	$IIP3_{HG}$ $IIP3_{LG}$	–	-6 5	–	dBm	High gain mode Low gain mode

1) Performance based on application circuit in Figure 2 on Page 33
2) Verification based on AQL; random production test.
3) Guaranteed by device design; not tested in production.

2.9 Measured RF Characteristics UMTS Band 2

Table 9 Typical Characteristics 1900 MHz Band, T_A = 25 °C, VCC = 2.8 V [1)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		1930		1990	MHz	
Input power range		-100		0	dBm	
Current consumption	I_{CCHG}	–	3.4	–	mA	High gain mode
	I_{CCLG}	–	0.65	–	mA	Low gain mode
Gain	S_{21HG}	–	16.5	–	dB	High gain mode
	S_{21LG}	–	-6.9	–	dB	Low gain mode
Reverse Isolation[2)]	S_{12HG}	–	-35	–	dB	High gain mode
	S_{12LG}	–	-7	–	dB	Low gain mode
Noise figure	NF_{HG}	–	1.0	–	dB	High gain mode
	NF_{LG}	–	6.8	–	dB	Low gain mode
Input return loss[2)]	S_{11HG}	–	-13	–	dB	50 Ω, high gain mode
	S_{11LG}	–	-12	–	dB	50 Ω, low gain mode
Output return loss[2)]	S_{22HG}	–	-20	–	dB	50 Ω, high gain mode
	S_{22LG}	–	-17	–	dB	50 Ω, low gain mode
Stability factor[3)]	k	–	>2.0	–	–	DC to 10 GHz; all gain modes
Input compression point[2)]	IP_{1dBHG}	–	-10	–	dBm	High gain mode
	IP_{1dBLG}	–	-4	–	dBm	Low gain mode
Inband IIP3[2)] $f_1 - f_2$ = 1 MHz $P_{f1} = P_{f2}$ = -26 dBm	$IIP3_{HG}$ $IIP3_{LG}$	–	-5 6	–	dBm	High gain mode Low gain mode

1) Performance based on application circuit in Figure 2 on Page 33
2) Verification based on AQL; random production test.
3) Guaranteed by device design; not tested in production.

2.10 Measured RF Characteristics UMTS Band 1

Table 10 Typical Characteristics 2100 MHz Band, T_A = 25 °C, VCC = 2.8 V [1]

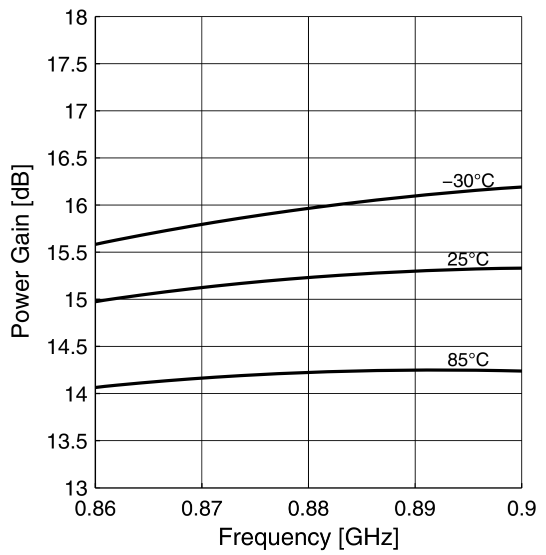
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		2110		2170	MHz	
Input power range		-100		0	dBm	
Current consumption	I_{CCHG}	–	3.5	–	mA	High gain mode
	I_{CCLG}	–	0.65	–	mA	Low gain mode
Gain	S_{21HG}	–	16.5	–	dB	High gain mode
	S_{21LG}	–	-7.7	–	dB	Low gain mode
Reverse Isolation[2]	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}	–	7.4	–	dB	Low gain mode
Input return loss[2]	S_{11HG}	–	-13	–	dB	50 Ω, high gain mode
	S_{11LG}	–	-27	–	dB	50 Ω, low gain mode
Output return loss[2]	S_{22HG}	–	-18	–	dB	50 Ω, high gain mode
	S_{22LG}	–	-9	–	dB	50 Ω, low gain mode
Stability factor[3]	k	–	>1.8	–	–	DC to 10 GHz; all gain modes
Input compression point[2]	IP_{1dBHG}	–	-11	–	dBm	High gain mode
	IP_{1dBLG}	–	-4	–	dBm	Low gain mode
Inband IIP3[2] $f_1 - f_2$ = 1 MHz $P_{f1} = P_{f2}$ = -26 dBm	$IIP3_{HG}$ $IIP3_{LG}$	–	-6 7	–	dBm	High gain mode Low gain mode

1) Performance based on application circuit in Figure 2 on Page 33
2) Verification based on AQL; random production test.
3) Guaranteed by device design; not tested in production.

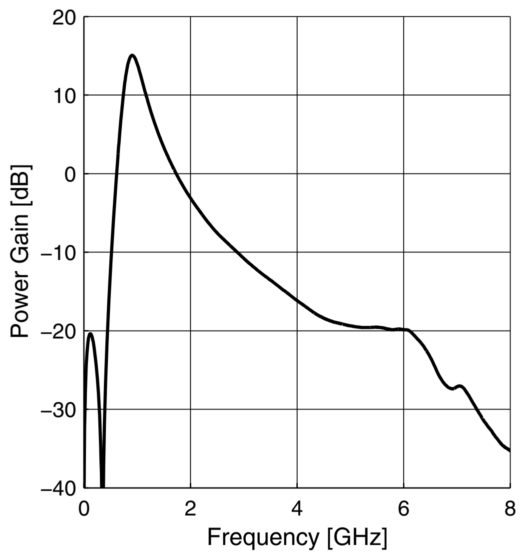
2.11 Measured Performance Low Band High Gain Mode vs. Frequency

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

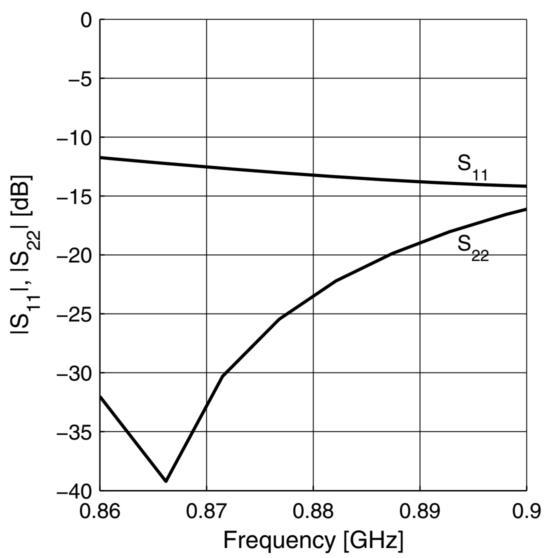
Power Gain $|S_{21}|$ = f (f)



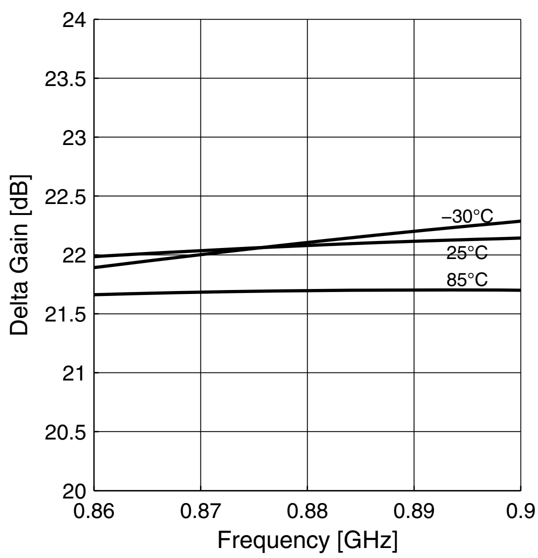
Power Gain Wideband $|S_{21}|$ = f (f)



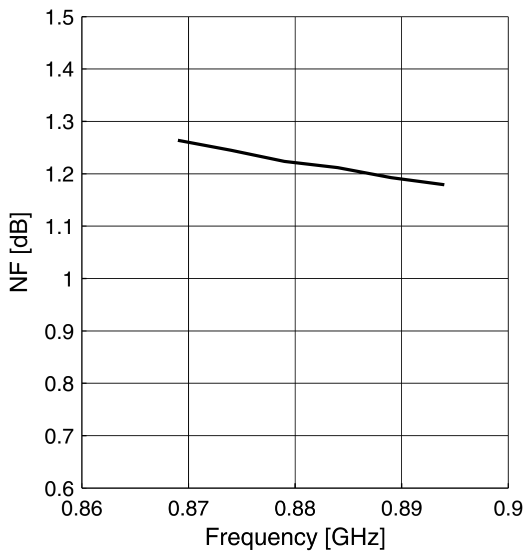
Matching $|S_{11}|$ = f (f), $|S_{22}|$ = f (f)



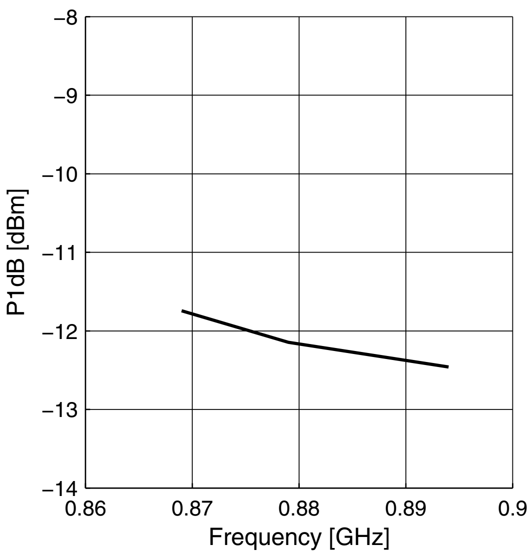
Gainstep HG - LG $|\Delta S_{21}|$ = f (f)



Noise Figure NF = f (f)



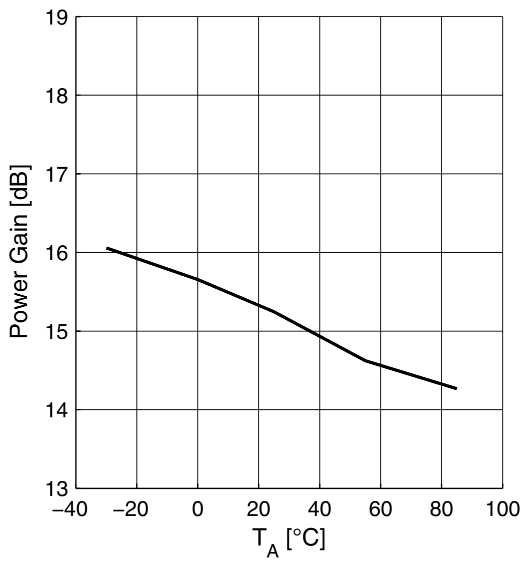
Input Compression P_{1dB} = f (f)



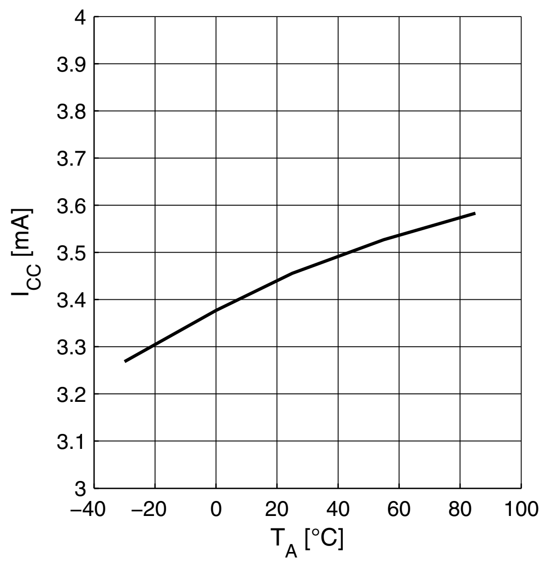
2.12 Measured Performance Low Band High Gain Mode vs. Temperature

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

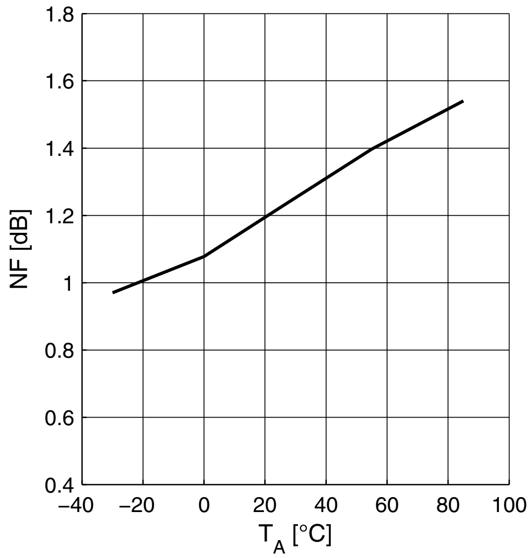
Power Gain $|S_{21}|$ = f (T_A)



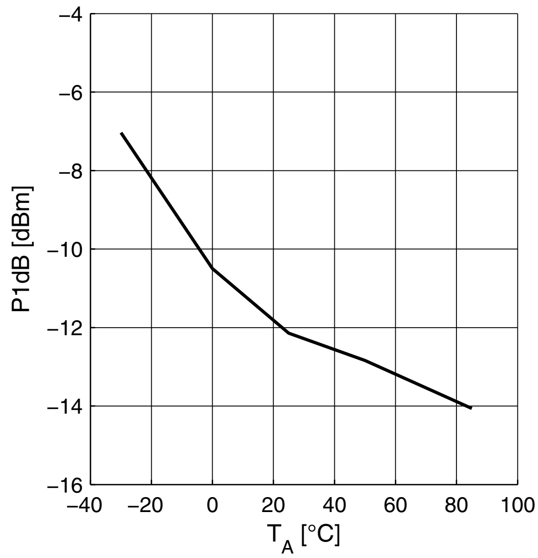
Supply Current I_{CC} = f (T_A)



Noise Figure NF = f (T_A)



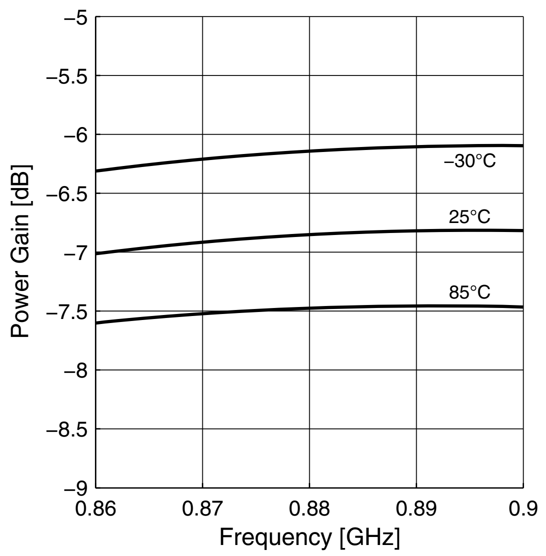
Input Compression P_{1dB} = f (T_A)



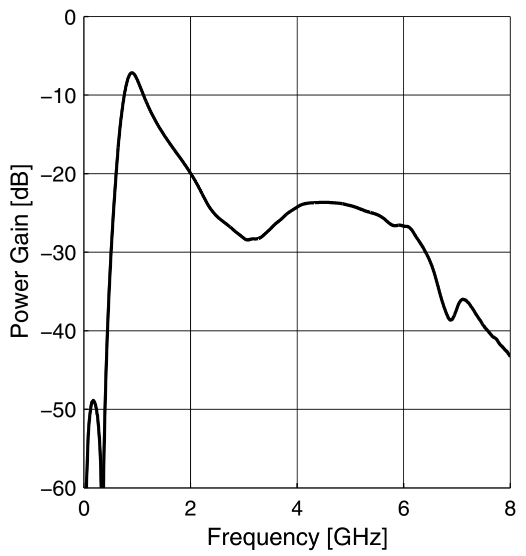
2.13 Measured Performance Low Band Low Gain Mode vs. Frequency

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

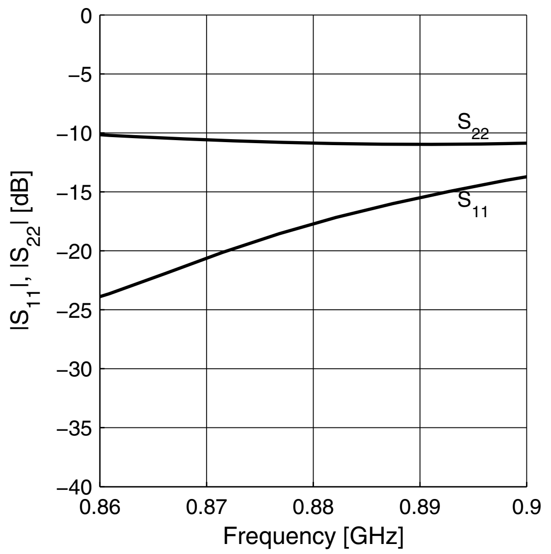
Power Gain $|S_{21}|$ = f (f)



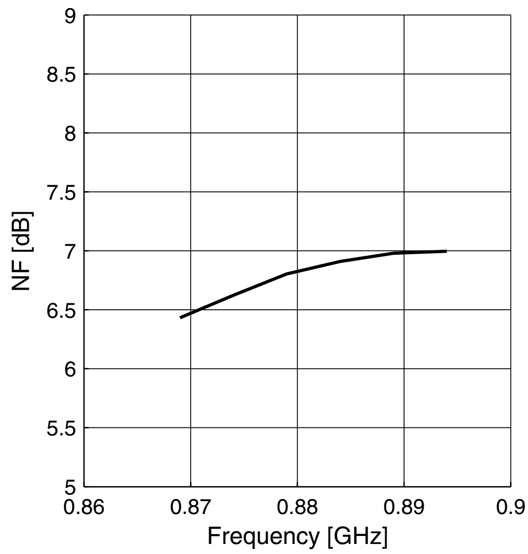
Power Gain Wideband $|S_{21}|$ = f (f)



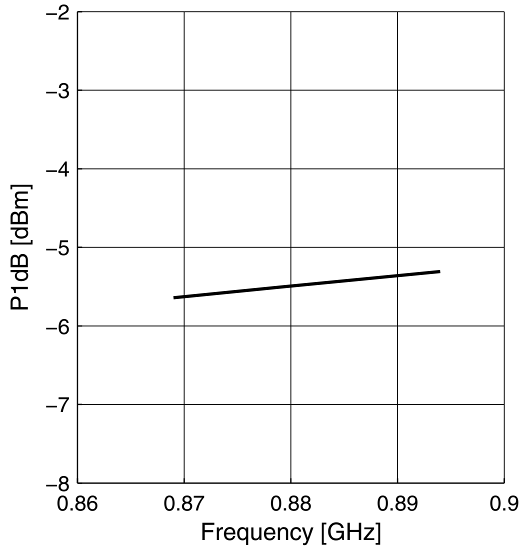
Matching $|S_{11}|$ = f (f), $|S_{22}|$ = f (f)



Noise Figure NF = f (f)



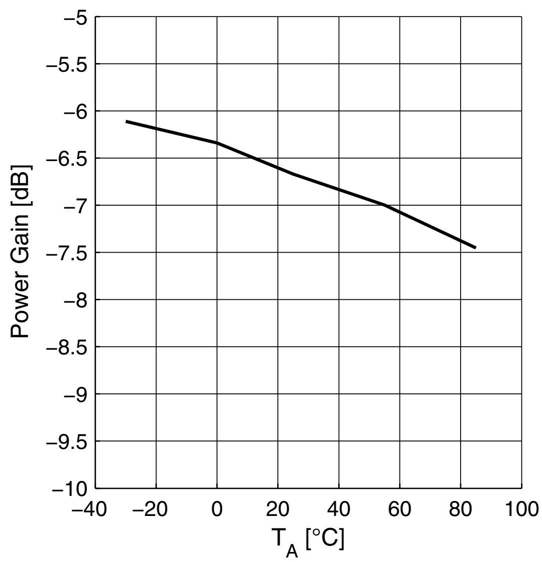
Input Compression P_{1dB} = f (f)



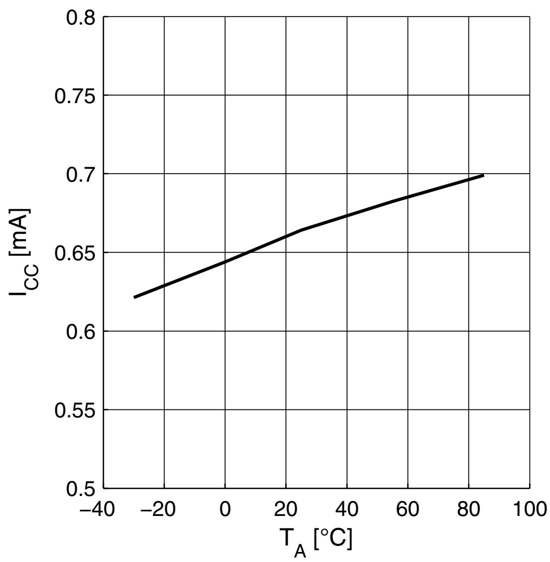
2.14 Measured Performance Low Band Low Gain Mode vs. Temperature

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

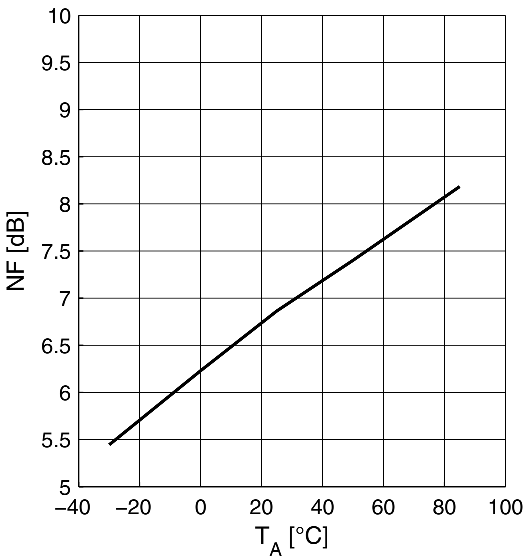
Power Gain $|S_{21}|$ = f (T_A)



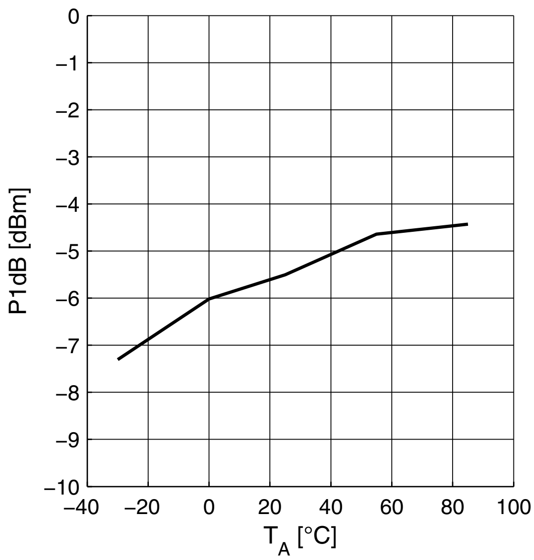
Supply Current I_{CC} = f (T_A)



Noise Figure NF = f (T_A)



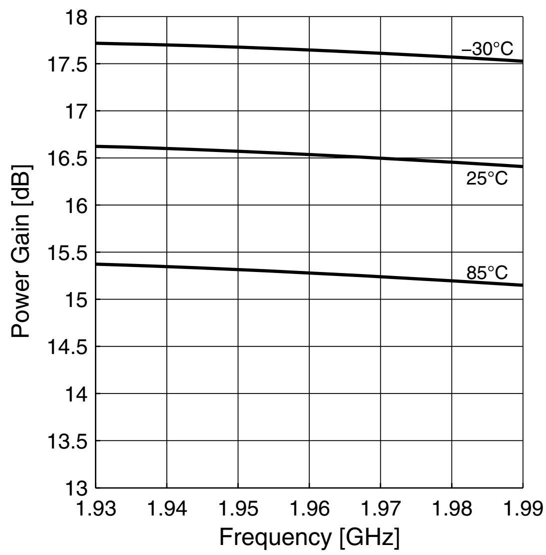
Input Compression P_{1dB} = f (T_A)



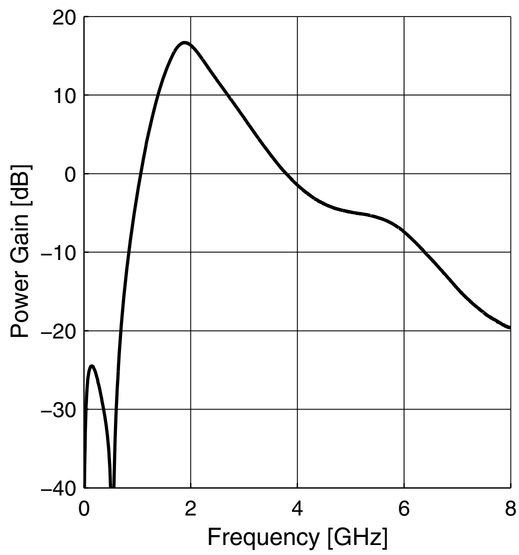
2.15 Measured Performance Mid Band High Gain Mode vs. Frequency

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

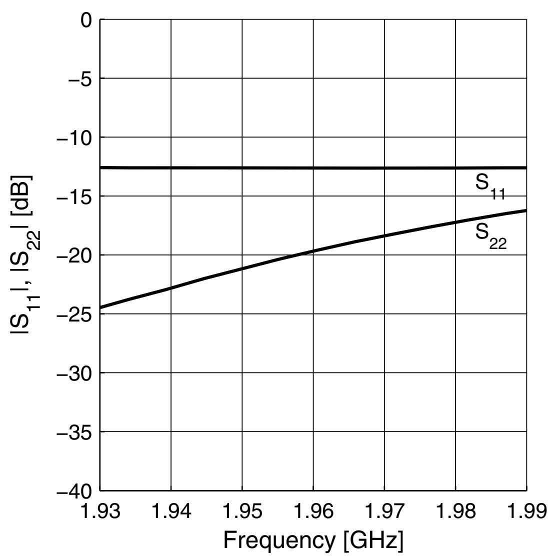
Power Gain $|S_{21}|$ = f (f)



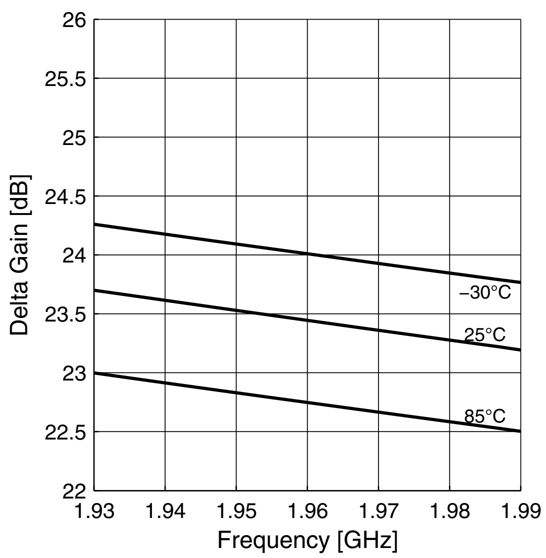
Power Gain Wideband $|S_{21}|$ = f (f)



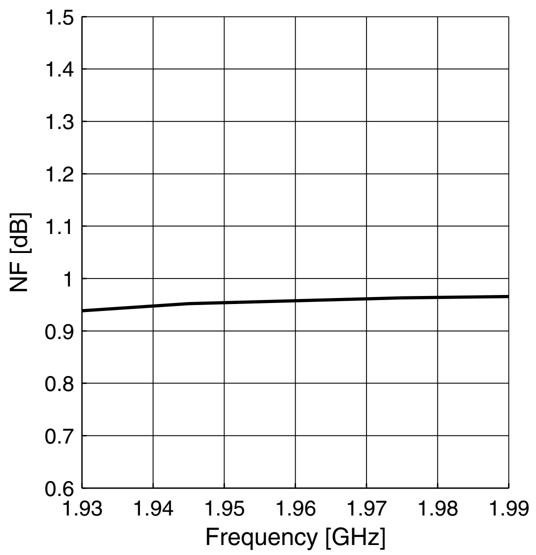
Matching $|S_{11}|$ = f (f), $|S_{22}|$ = f (f)



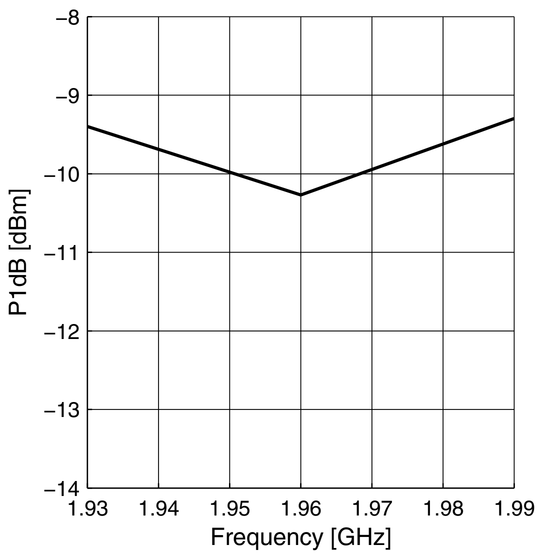
Gainstep HG - LG $|\Delta S_{21}|$ = f (f)



Noise Figure $NF = f(f)$



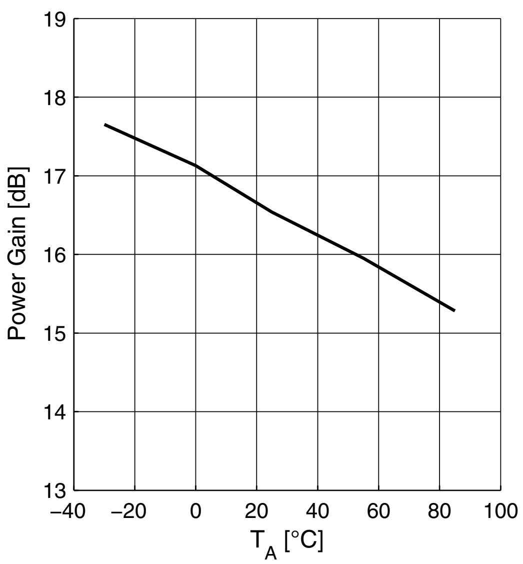
Input Compression $P_{1dB} = f(f)$



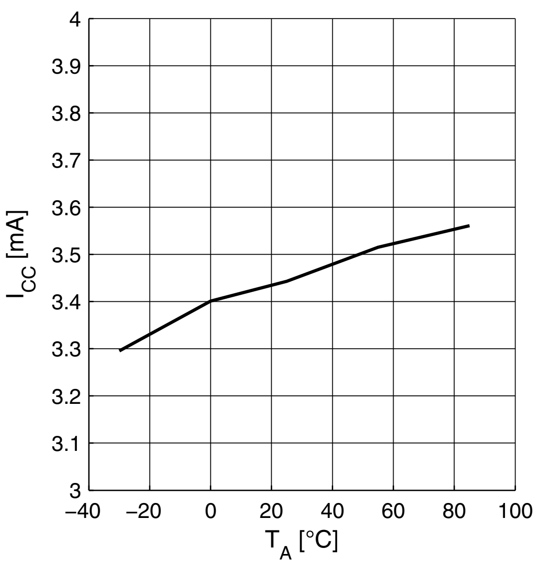
2.16 Measured Performance Mid Band High Gain Mode vs. Temperature

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

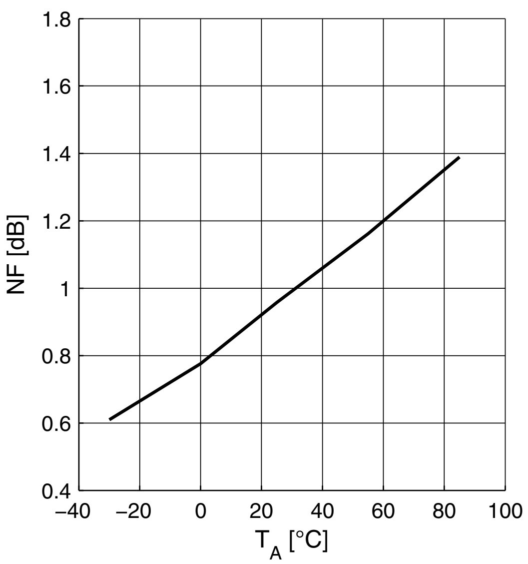
Power Gain $|S_{21}|$ = f (T_A)



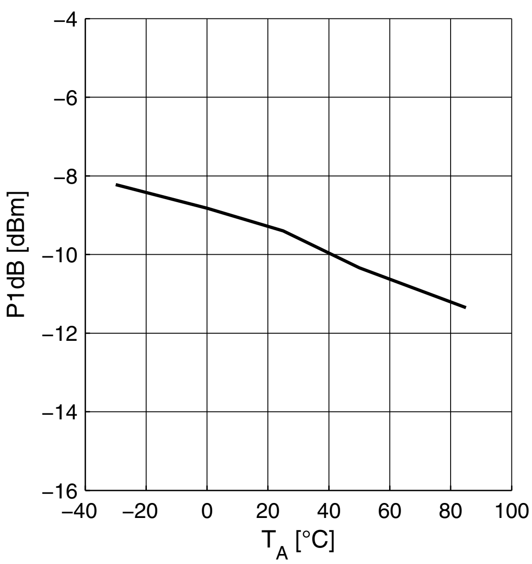
Supply Current I_{CC} = f (T_A)



Noise Figure NF = f (T_A)



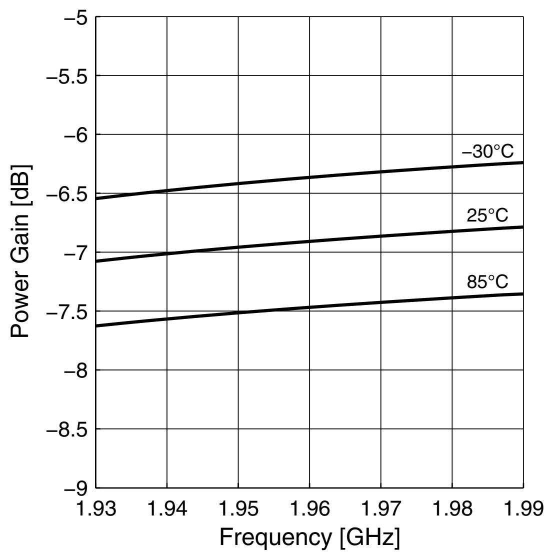
Input Compression P_{1dB} = f (T_A)



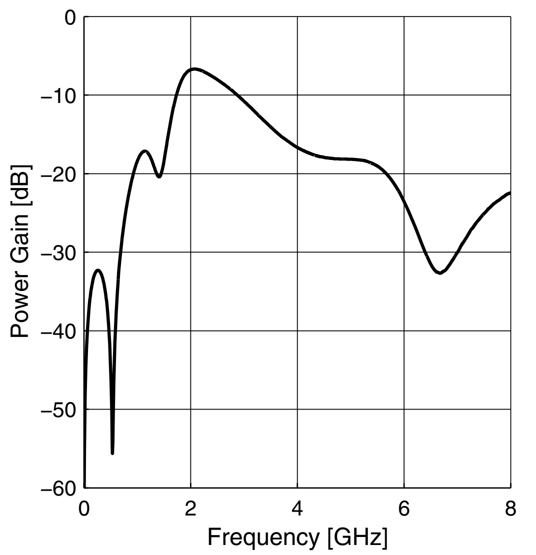
2.17 Measured Performance Mid Band Low Gain Mode vs. Frequency

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

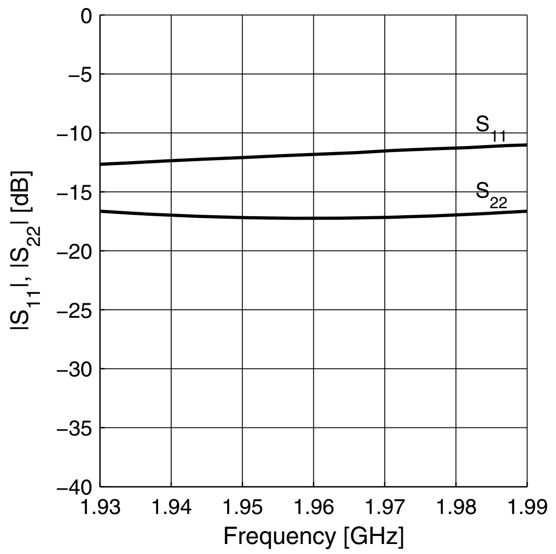
Power Gain $|S_{21}|$ = f (f)



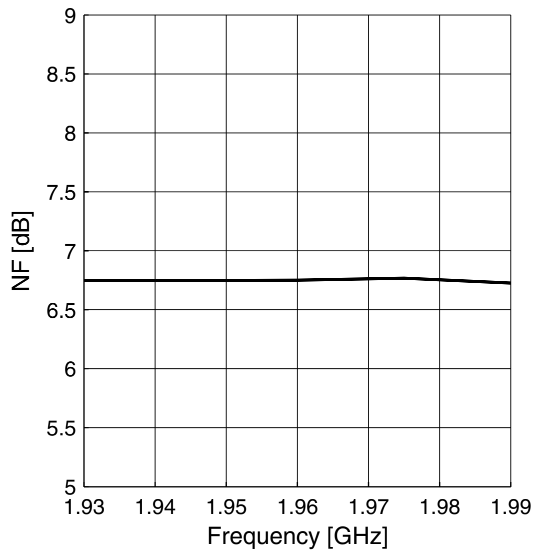
Power Gain Wideband $|S_{21}|$ = f (f)



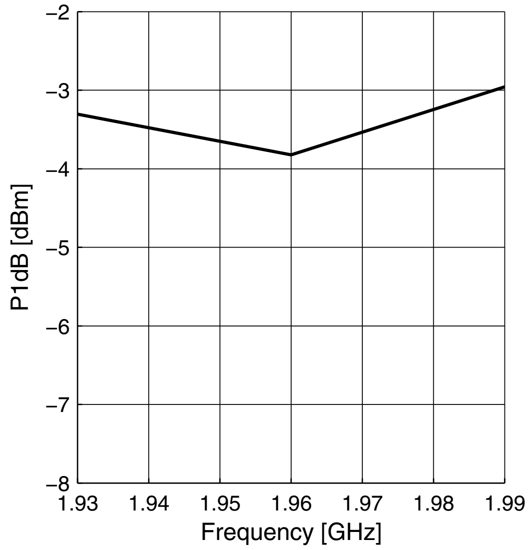
Matching $|S_{11}|$ = f (f), $|S_{22}|$ = f (f)



Noise Figure NF = f (f)



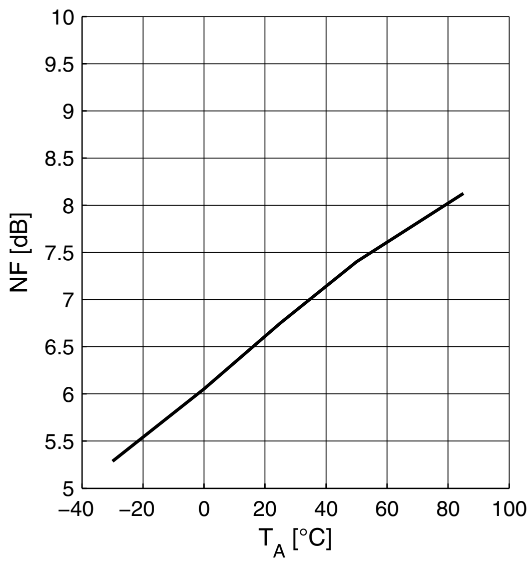
Input Compression $P_{1dB} = f(f)$



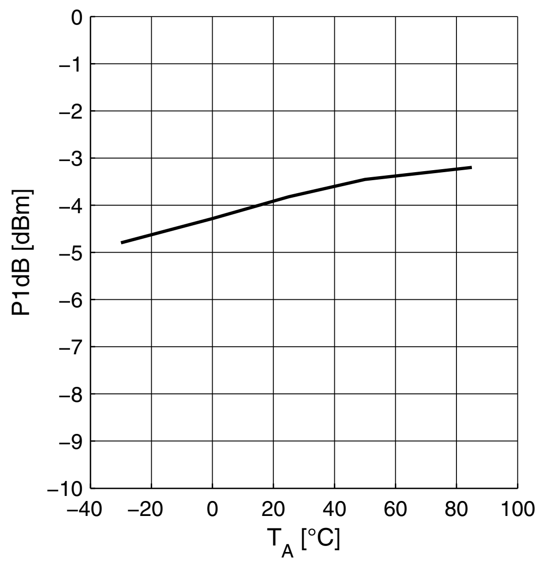
2.18 Measured Performance Mid Band Low Gain Mode vs. Temperature

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

Noise Figure NF = f (T_A)



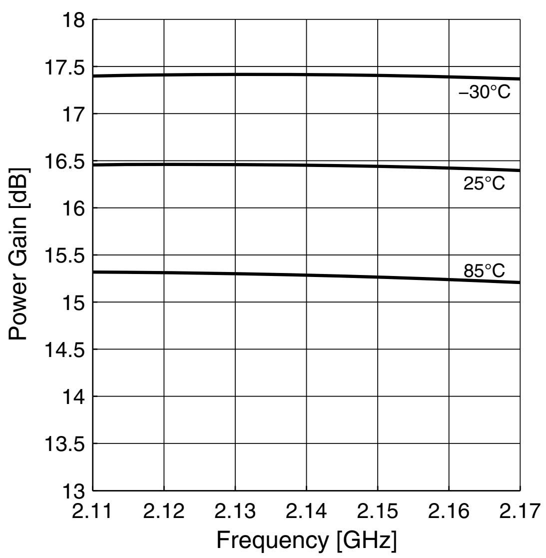
Input Compression P_{1dB} = f (T_A)



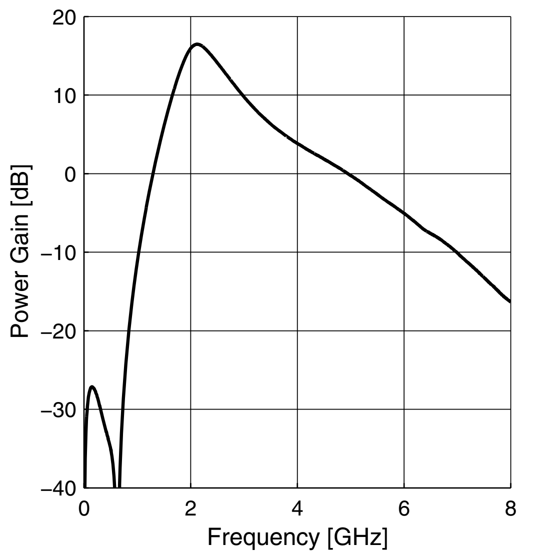
2.19 Measured Performance High Band High Gain Mode vs. Frequency

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

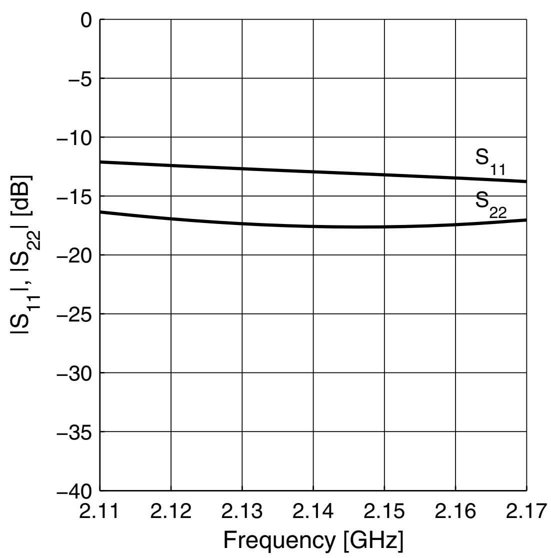
Power Gain $|S_{21}|$ = f (f)



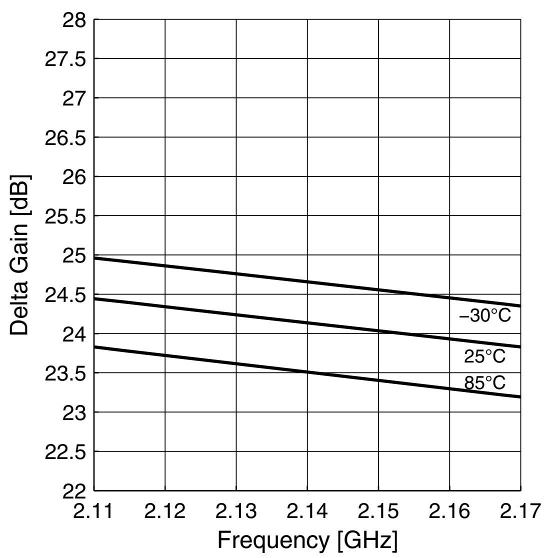
Power Gain Wideband $|S_{21}|$ = f (f)



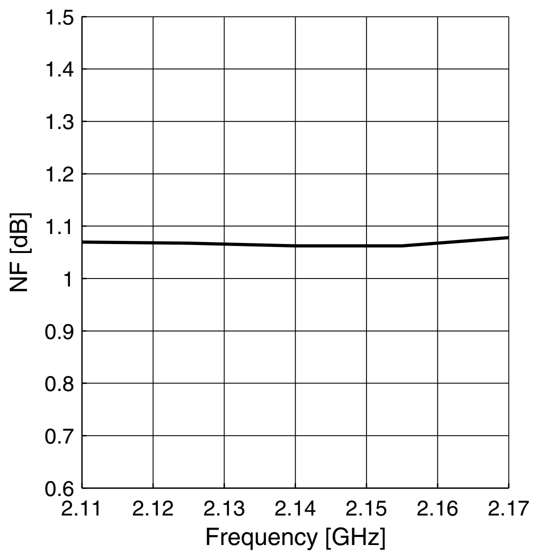
Matching $|S_{11}|$ = f (f), $|S_{22}|$ = f (f)



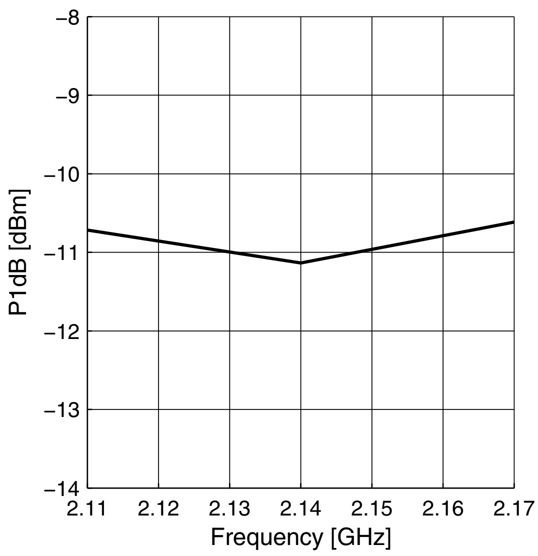
Gainstep HG - LG $|\Delta S_{21}|$ = f (f)



Noise Figure NF = f (f)



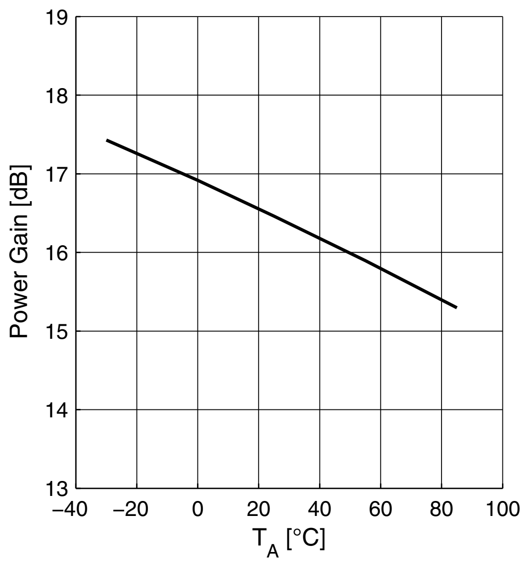
Input Compression P_{1dB} = f (f)



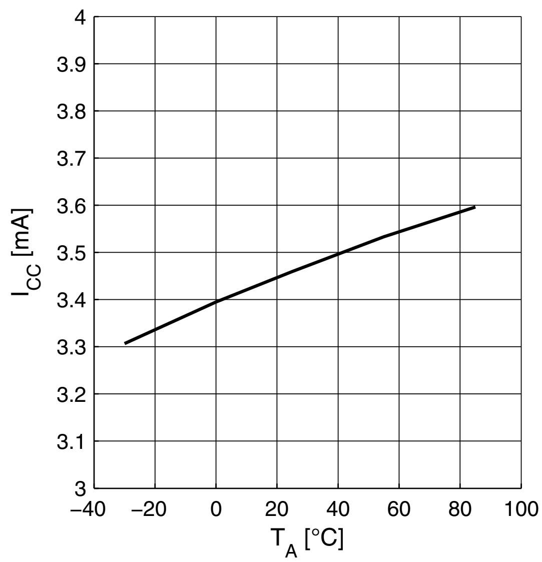
2.20 Measured Performance High Band High Gain Mode vs. Temperature

V_{CC} = 2.8 V, V_{GS} = 2.8 V, V_{EN1} = 2.8 V, V_{EN2} = 2.8 V

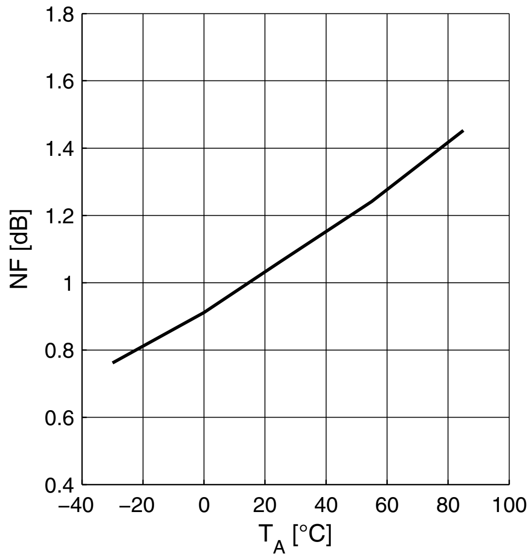
Power Gain $|S_{21}|$ = f (T_A)



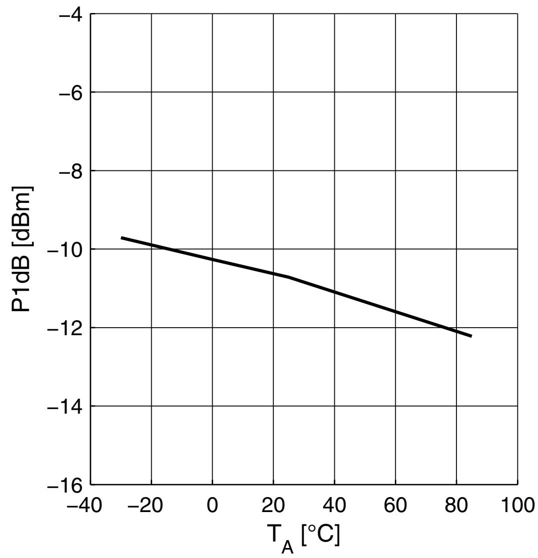
Supply Current I_{CC} = f (T_A)



Noise Figure NF = f (T_A)



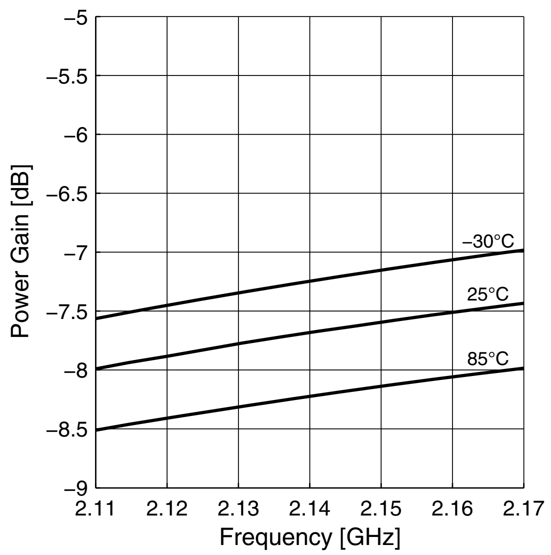
Input Compression P_{1dB} = f (T_A)



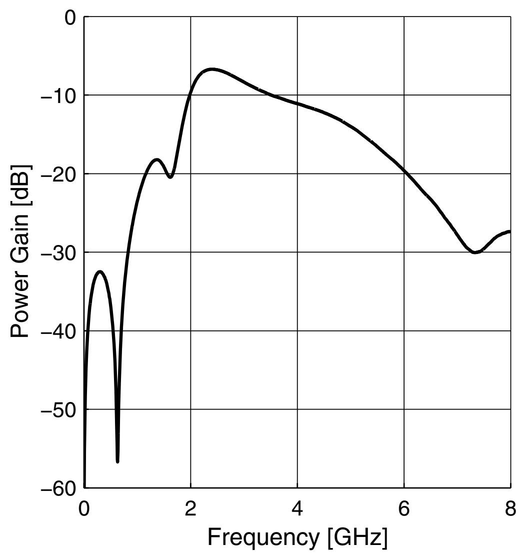
2.21 Measured Performance High Band Low Gain Mode vs. Frequency

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

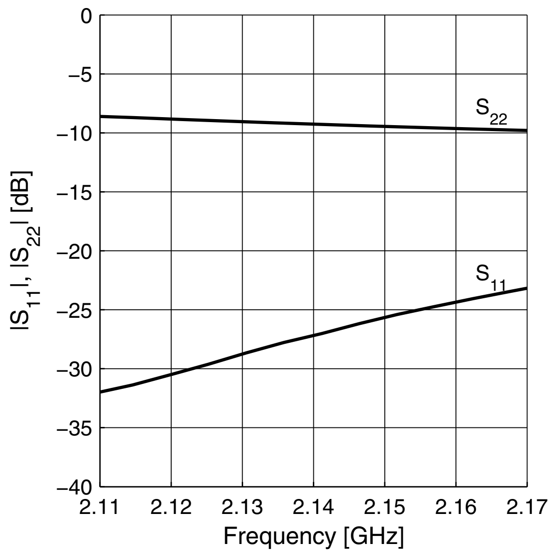
Power Gain $|S_{21}|$ = f (f)



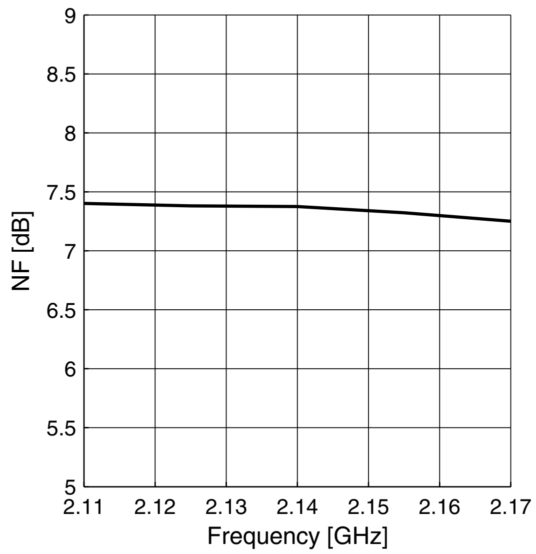
Power Gain Wideband $|S_{21}|$ = f (f)



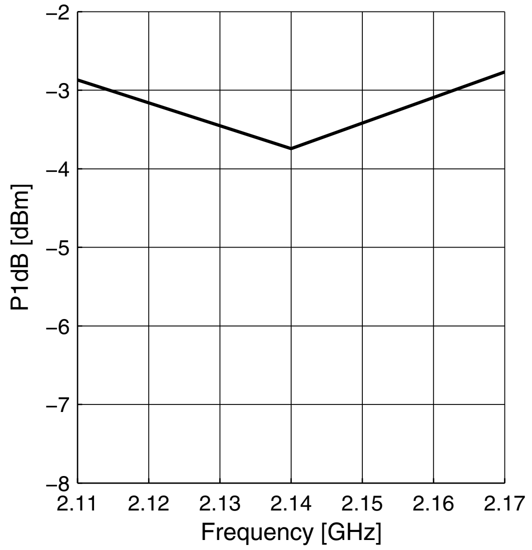
Matching $|S_{11}|$ = f (f), $|S_{22}|$ = f (f)



Noise Figure NF = f (f)



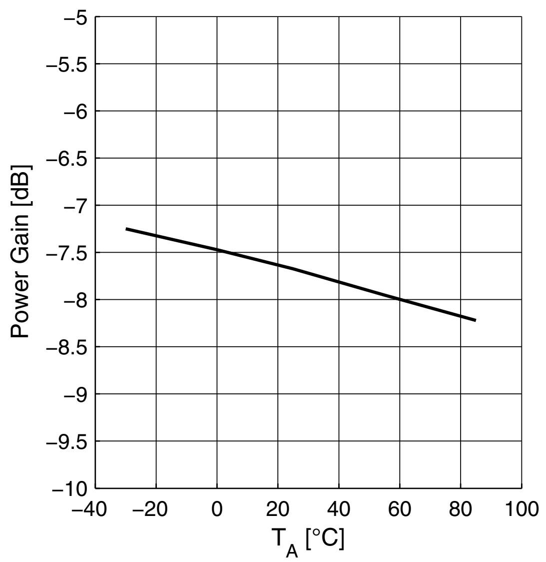
Input Compression P_{1dB} = f (f)



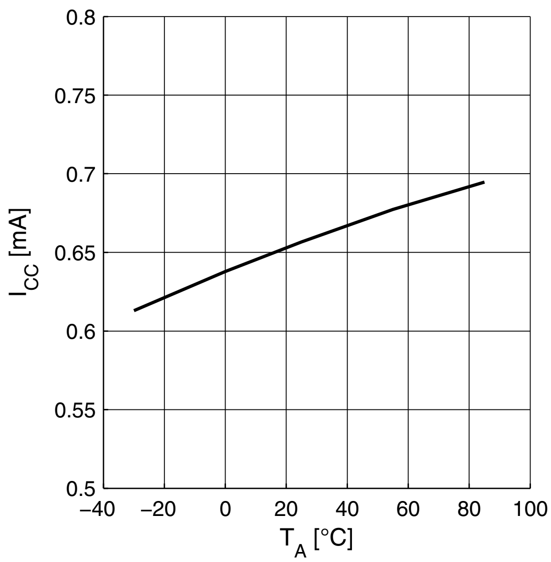
2.22 Measured Performance High Band Low Gain Mode vs. Temperature

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

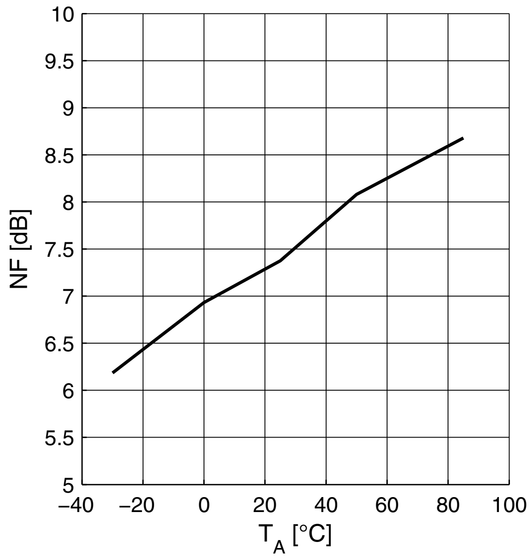
Power Gain $|S_{21}|$ = f (T_A)



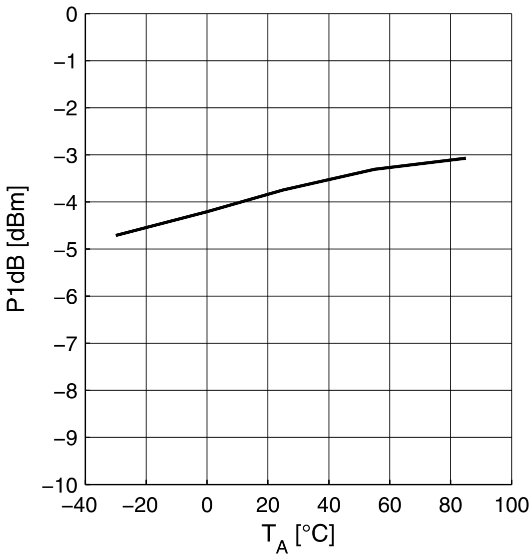
Supply Current I_{CC} = f (T_A)



Noise Figure NF = f (T_A)



Input Compression P_{1dB} = f (T_A)



3 Application Circuit and Block Diagram

3.1 UMTS Bands 1, 2 and 5 Application Circuit Schematic

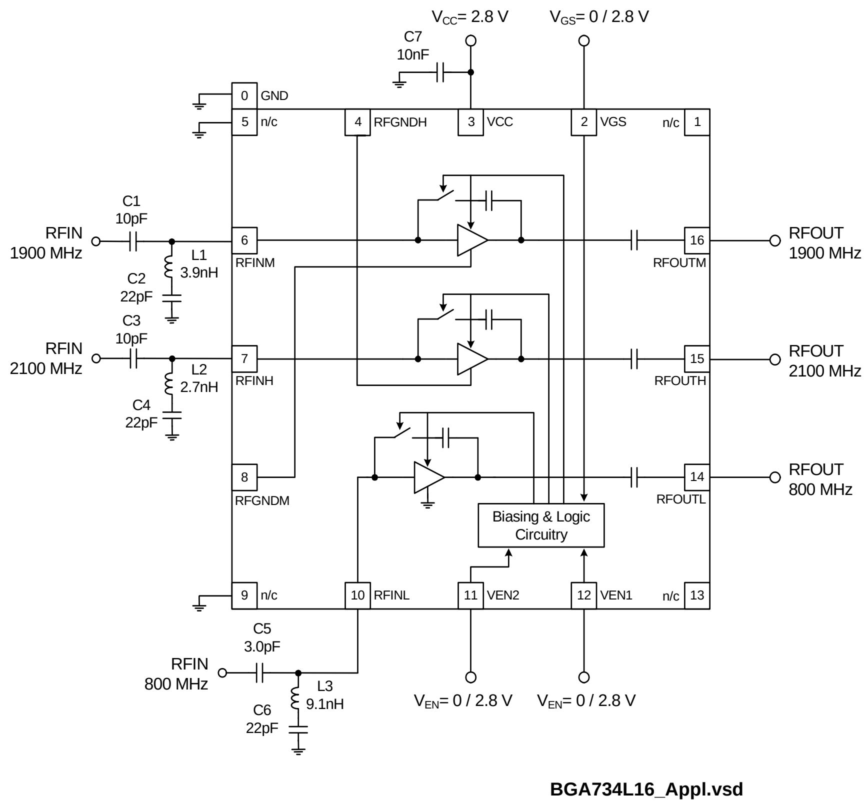


Figure 2 Application Circuit with Chip Outline (Top View)

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

Table 11 Bill of Materials

Part Number	Part Type	Manufacturer	Size	Comment
L1 ... L3	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C7	Chip capacitor	Various	0402	

3.2 Pin Description

Table 12 Pin Definition and Function

Pin No.	Name	Function
0	GND	Ground connection for low band (800 MHz) LNA and control circuity (package paddle)
1	n/c	Not connected
2	VGS	Gain step control
3	VCC	Supply voltage
4	RFGNDH	High band (2100 MHz) LNA emitter ground
5	n/c	Not connected
6	RFINM	Mid band (1900 MHz) LNA input
7	RFINH	High band (2100 MHz) LNA input
8	RFGNDM	Mid band (1900 MHz) LNA emitter ground
9	n/c	Not connected
10	RFINL	Low band (800 MHz) LNA input
11	VEN2	Band select control
12	VEN1	Band select control
13	n/c	Not connected
14	RFOUTL	Low band (800 MHz) LNA output
15	RFOUTH	High band (2100 MHz) LNA output
16	RFOUTM	Mid band (1900 MHz) LNA output

3.3 Application Board

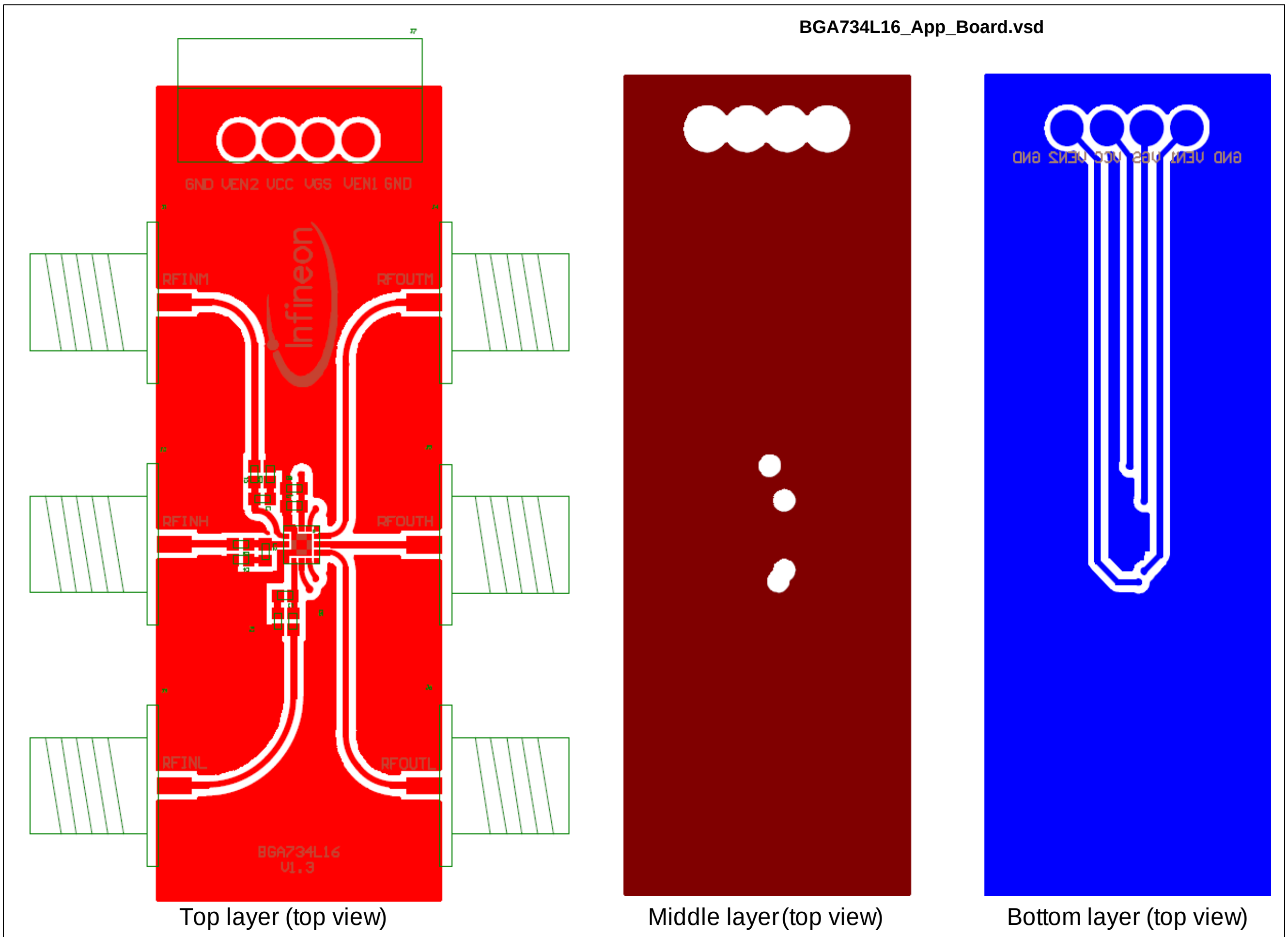


Figure 3 Application Board Layout on 3-layer FR4.

Note: Top layer thickness: 0.2 mm, bottom layer thickness: 0.8 mm, 17 µm Cu metallization, gold plated. Board size: 21 x 50 mm

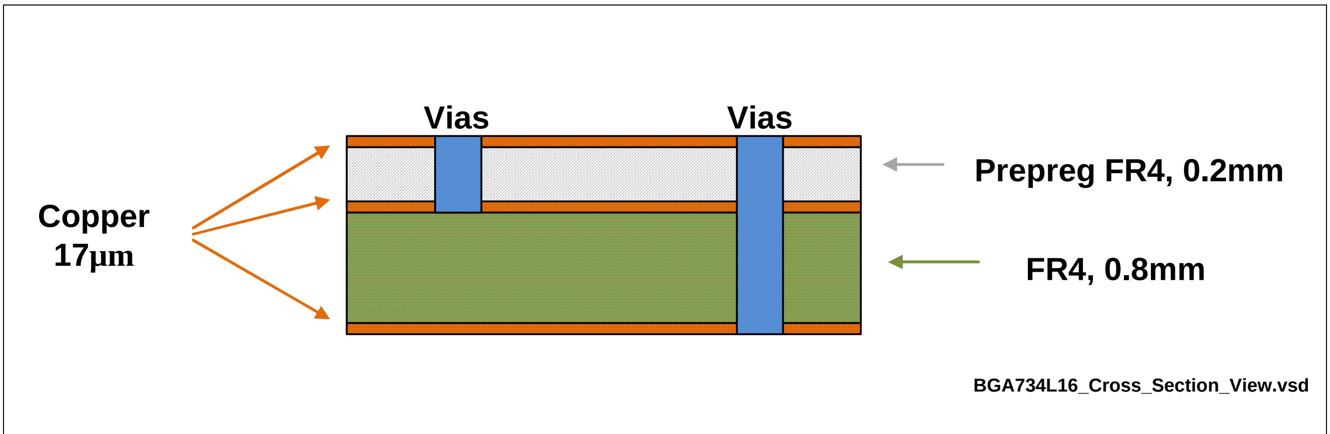


Figure 4 Cross-Section View of Application Board

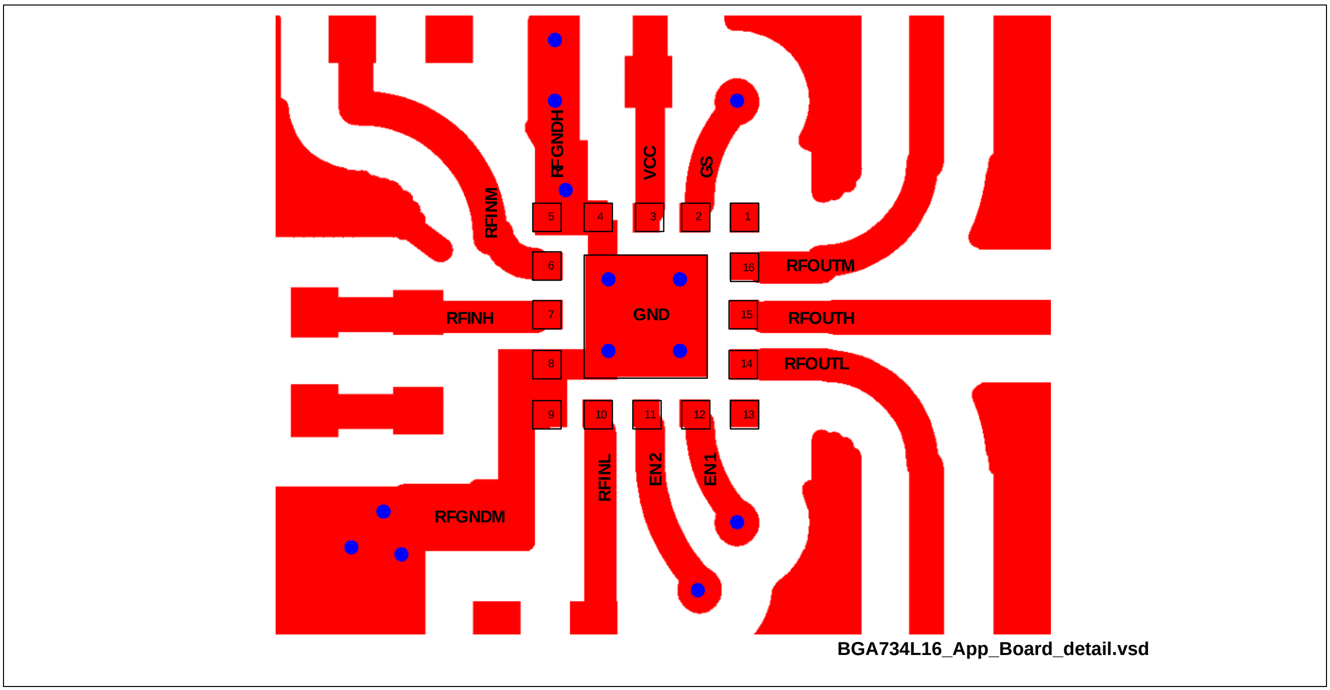


Figure 5 Detail of Application Board Layout

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

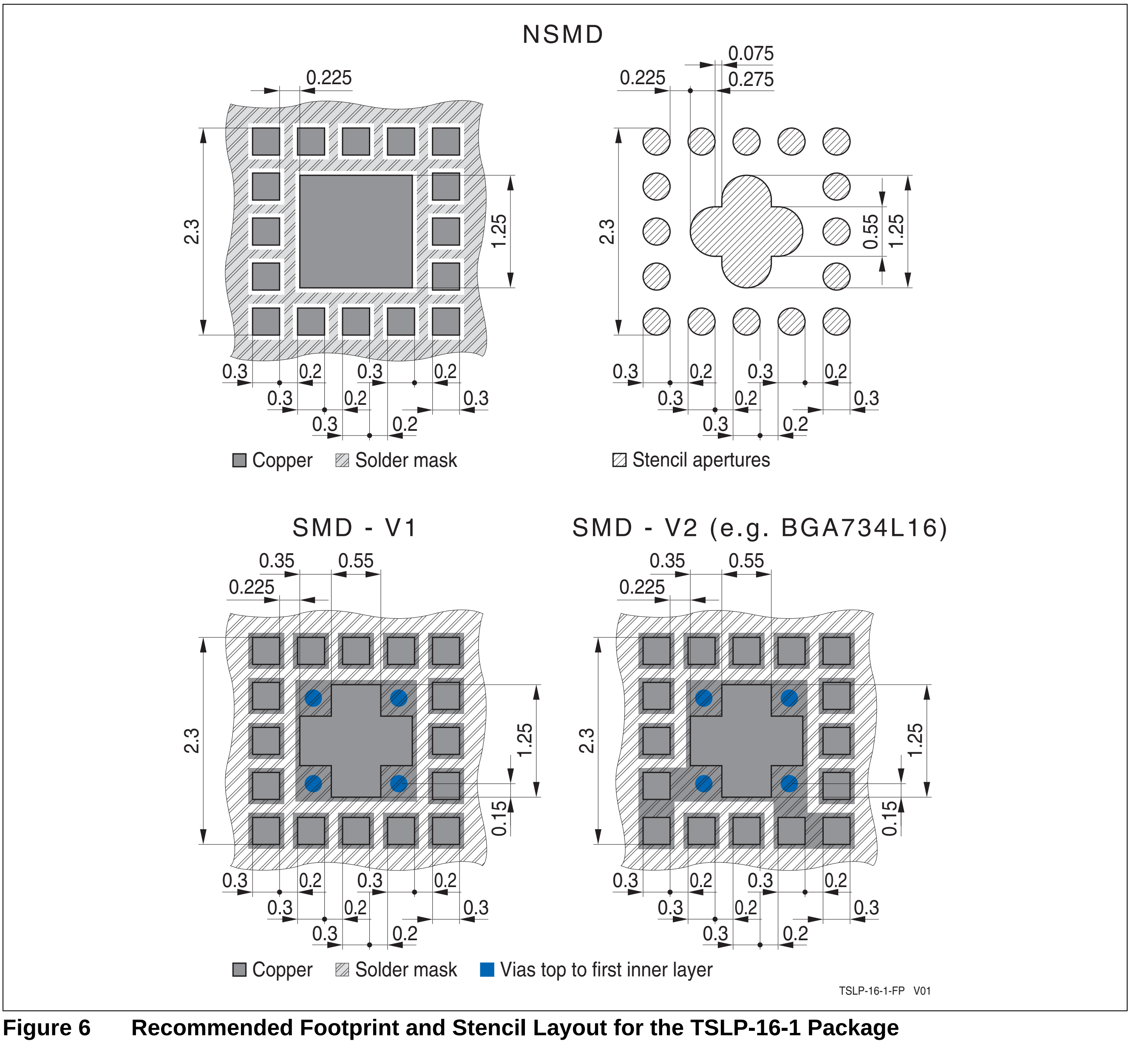


Figure 6 Recommended Footprint and Stencil Layout for the TSLP-16-1 Package

4.2 Package Dimensions

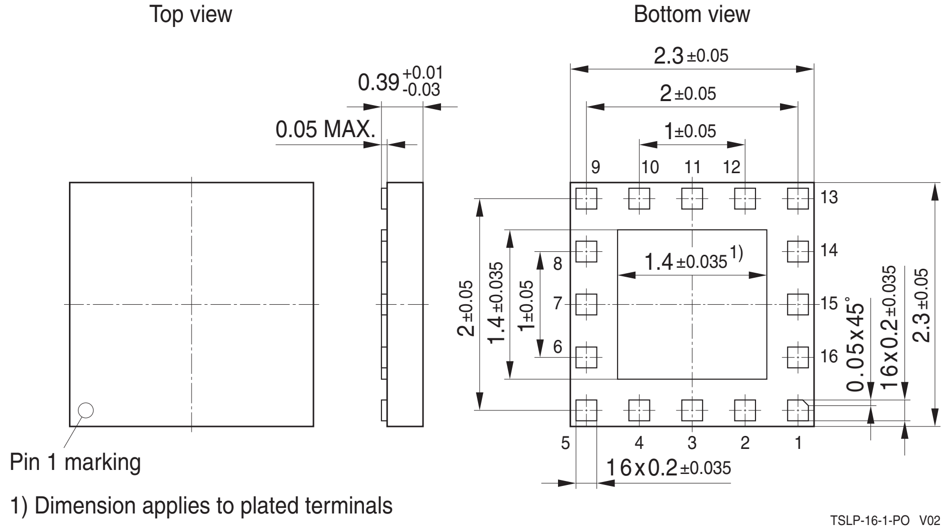


Figure 7 Package Outline (Top, Side and Bottom View)

w w w . i n f i n e o n . c o m

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