Data Sheet, V2.0, January 2008

BGA734L16

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

Small Signal Discretes

Never stop thinking

Edition 2008-01-25

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BGA734L16
Revision History: 2008-01-25, V2.0

Previous Version: V1.2, 2007-07-18

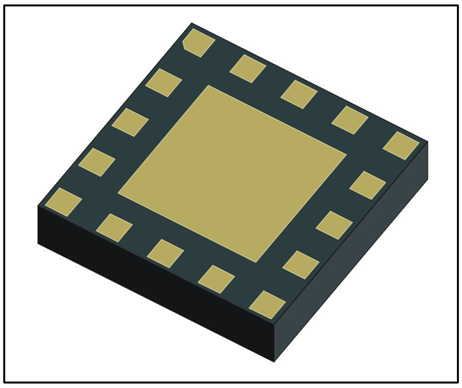
Page	**Subjects (major changes since last revision)**
8-10	Improved low gain mode IIP_3
8-10	Improved low gain mode P_{1dB}

1 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.

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



TSLP-16-1 package

RoHS

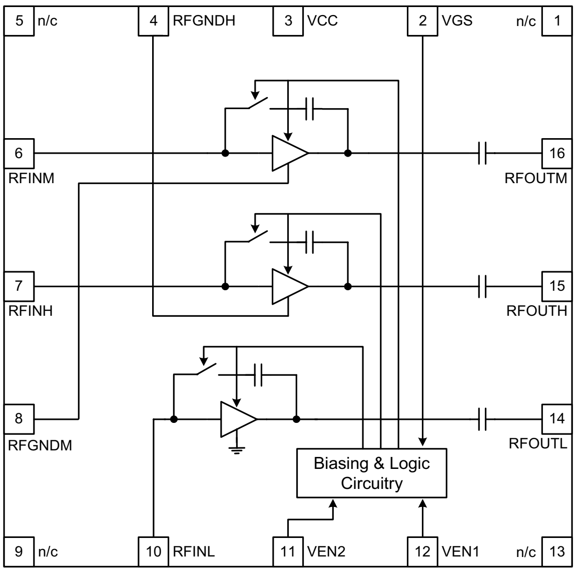


Figure 1 Block diagram of triple-band LNA

Type	Package	Marking	Chip
BGA734L16	TSLP-16-1	BGA734	T1520

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}		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	Value	Unit	Note / Test Conditions
Thermal resistance junction to soldering point	R_{thJS}	$\leq$ 110	K/W	

2.3 ESD Integrity

Table 3 ESD Integrity

Parameter	Symbol	Value	Unit	Note / Test Conditions
		Typ.		
ESD hardness HBM[1)]	$V_{ESD\text{-}HBM}$	1000	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}		3.5		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}	1.5	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

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

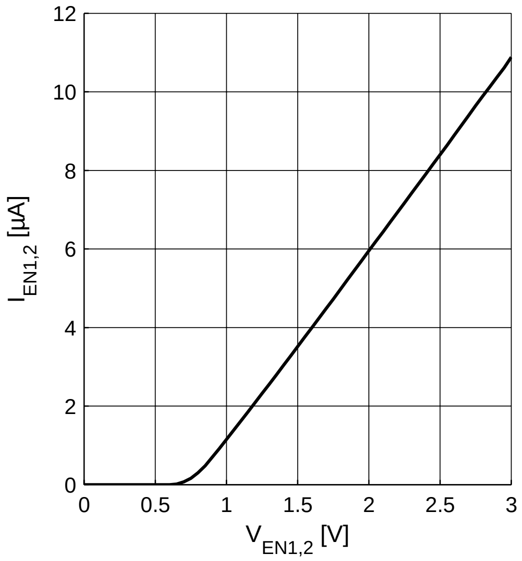
Table 6 Gain Control Truth Table

	High Gain	Low Gain
VGS	H	L

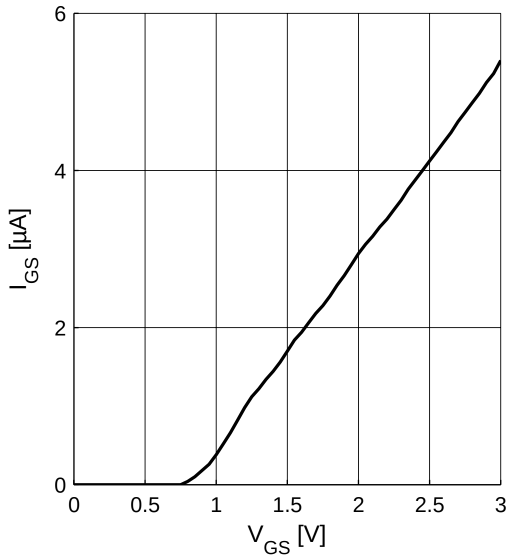
2.6 Logic Signal Characteristics; T_A = 25 °C

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.		
Settling time gainstep	t_{GS}		1.2		µs	Switching LG ↔ HG all bands
Settling time bandselect	t_{BS}		1.2		µs	Switching from any band to a different band

2.8 Measured RF Characteristics Low Band (UMTS Band V)

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

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[1)]	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[1)]	S_{11HG}		-13		dB	50 Ω, high gain mode
	S_{11LG}		-18		dB	50 Ω, low gain mode
Output return loss[1)]	S_{22HG}		-24		dB	50 Ω, high gain mode
	S_{22LG}		-11		dB	50 Ω, low gain mode
Stability factor[2)]	k		>2.1			DC to 10 GHz; all gain modes
Input compression point[1)]	IP_{1dBHG}		-12		dBm	High gain mode
	IP_{1dBLG}		-6		dBm	Low gain mode
Inband IIP3[1)] $f_1 - f_2$ = 1 MHz $P_{f1} = P_{f2}$ = -25 dBm	$IIP3_{HG}$ $IIP3_{LG}$		-6 5		dBm	High gain mode Low gain mode

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

2.9 Measured RF Characteristics Mid Band (UMTS Band II)

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

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[1)]	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[1)]	S_{11HG}		-13		dB	50 Ω, high gain mode
	S_{11LG}		-12		dB	50 Ω, low gain mode
Output return loss[1)]	S_{22HG}		-20		dB	50 Ω, high gain mode
	S_{22LG}		-17		dB	50 Ω, low gain mode
Stability factor[2)]	k		>2.0			DC to 10 GHz; all gain modes
Input compression point[1)]	IP_{1dBHG}		-10		dBm	High gain mode
	IP_{1dBLG}		-4		dBm	Low gain mode
Inband IIP3[1)] 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) Verified by random sampling; not 100% RF tested
2) Not tested in production; guaranteed by device design

2.10 Measured RF Characteristics High Band (UMTS Band I)

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

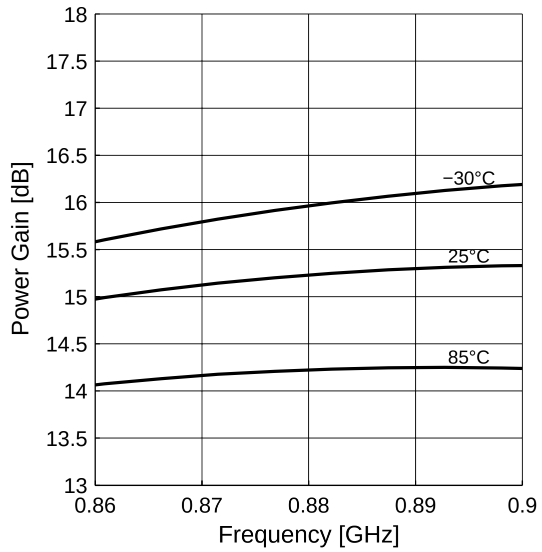
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		2110		2170	MHz	
Input power range		-100		0	dBm	
Current consumption	I_{CCHG}		3.5		mA	High gain mode
	I_{CCLG}		0.65		mA	Low gain mode
Gain	S_{21HG}		16.5		dB	High gain mode
	S_{21LG}		-7.7		dB	Low gain mode
Reverse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

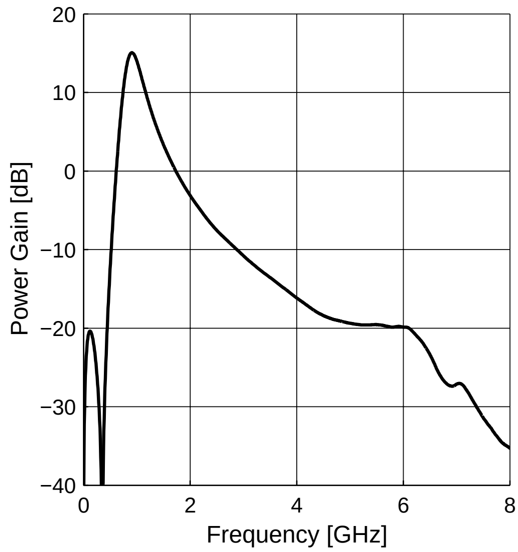
2.11 Measured Performance Low Band High Gain Mode vs. Frequency

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

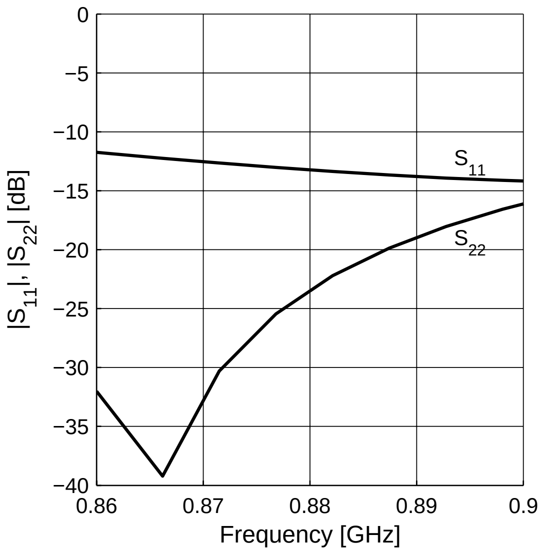
Power Gain $|S_{21}|$ = f (f)



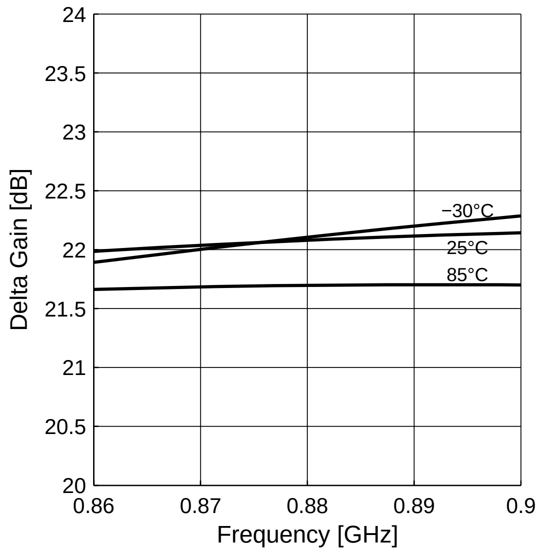
Power Gain Wideband $|S_{21}|$ = f (f)



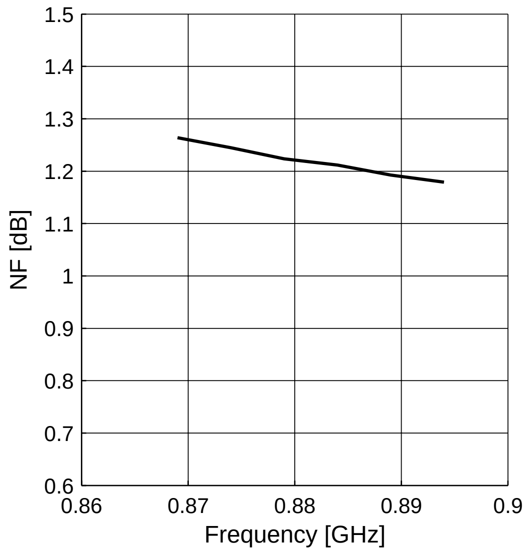
Matching $|S_{11}|$ = f (f), $|S_{22}|$ = f (f)



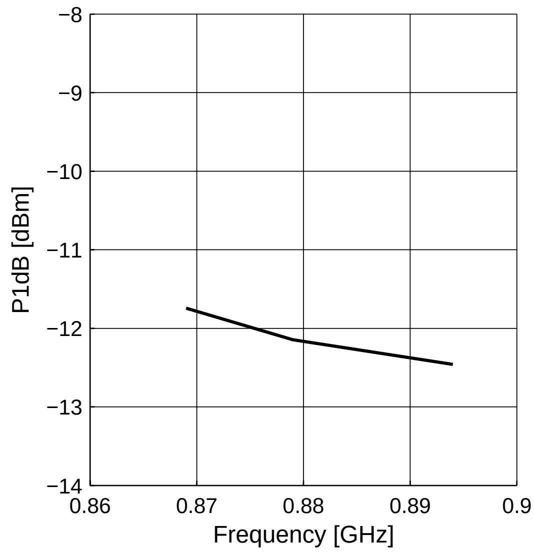
Gainstep HG - LG $|\Delta S_{21}|$ = f (f)



Noise Figure NF = f (f)



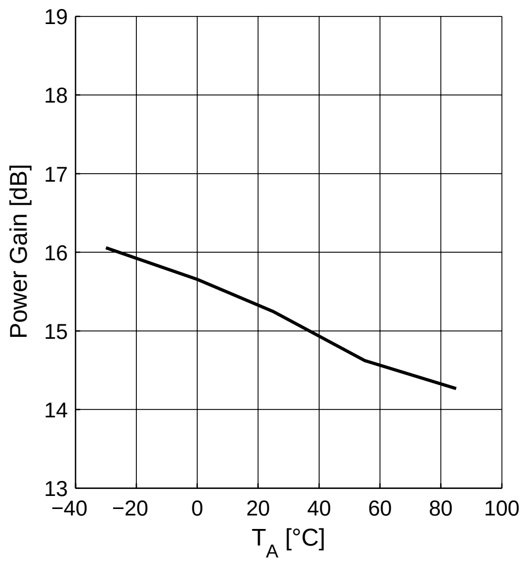
Input Compression P_{1dB} = f (f)



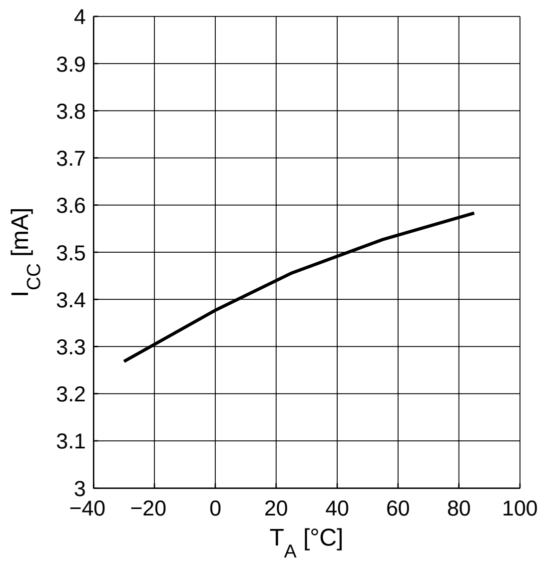
2.12 Measured Performance Low Band High Gain Mode vs. Temperature

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

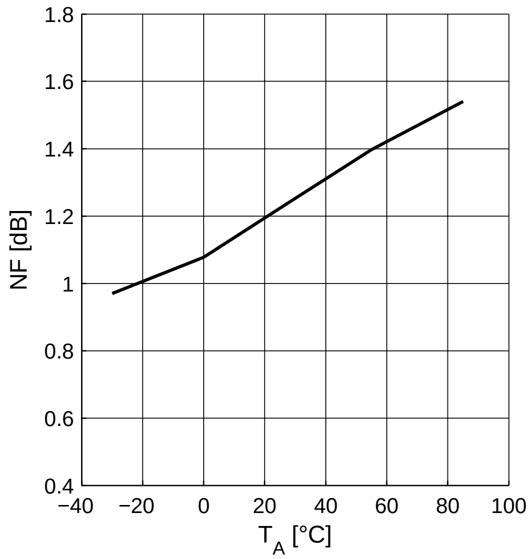
Power Gain $|S_{21}|$ = f (T_A)



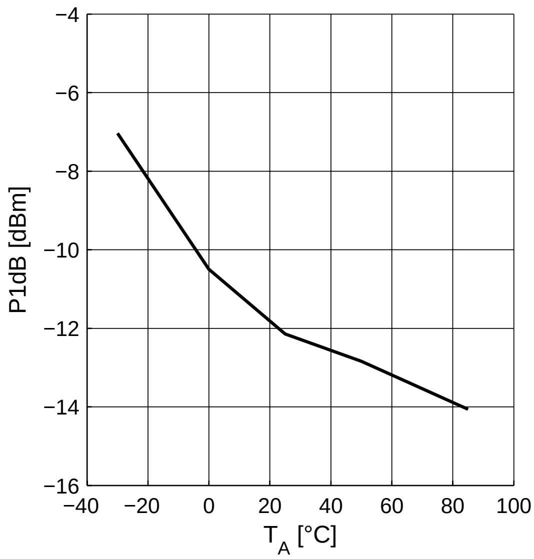
Supply Current I_{CC} = f (T_A)



Noise Figure NF = f (T_A)



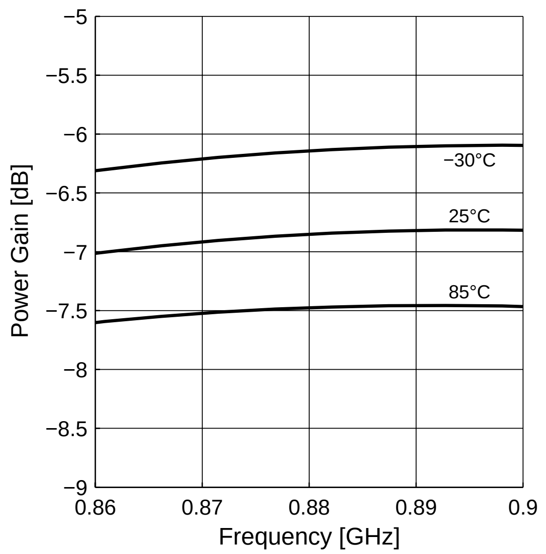
Input Compression P_{1dB} = f (T_A)



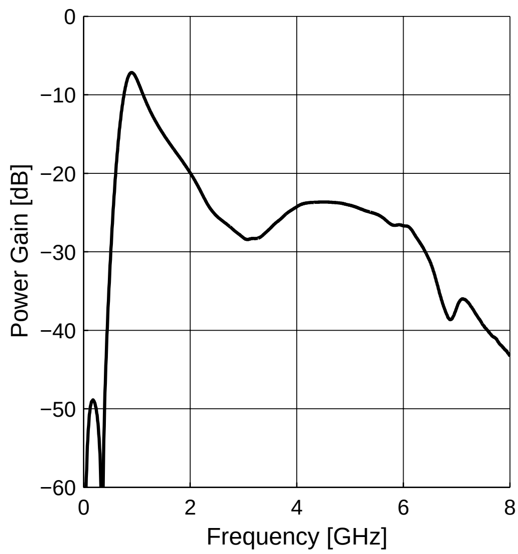
2.13 Measured Performance Low Band Low Gain Mode vs. Frequency

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)

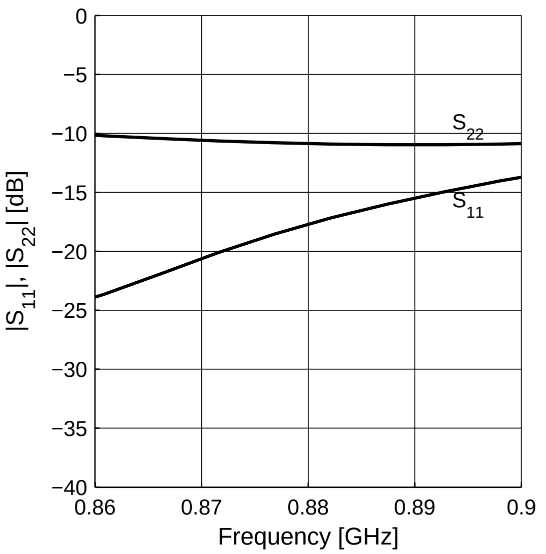


Power Gain Wideband $|S_{21}|$ = f (f)

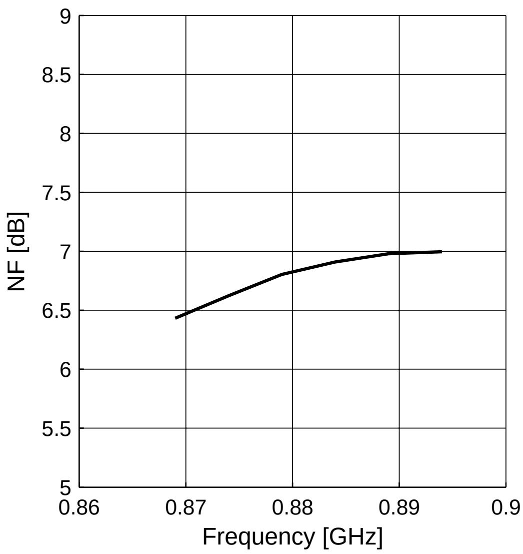


Measured Performance Low Band Low Gain Mode vs. Frequency

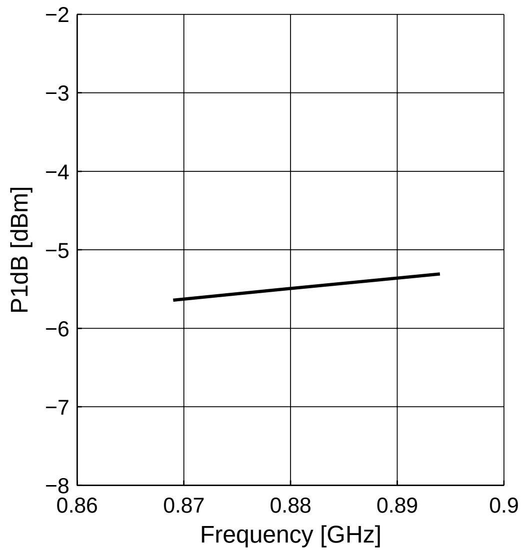
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



Noise Figure $NF = f(f)$



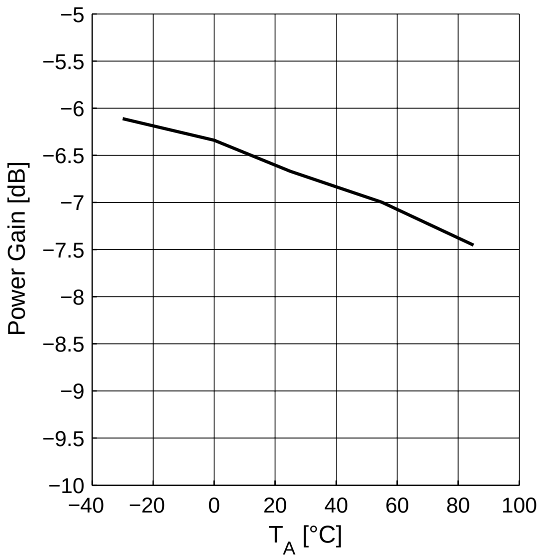
Input Compression $P_{1dB} = f(f)$



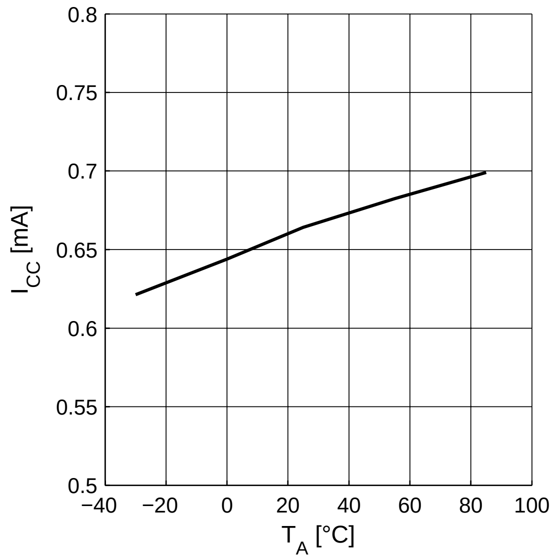
2.14 Measured Performance Low Band Low Gain Mode vs. Temperature

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

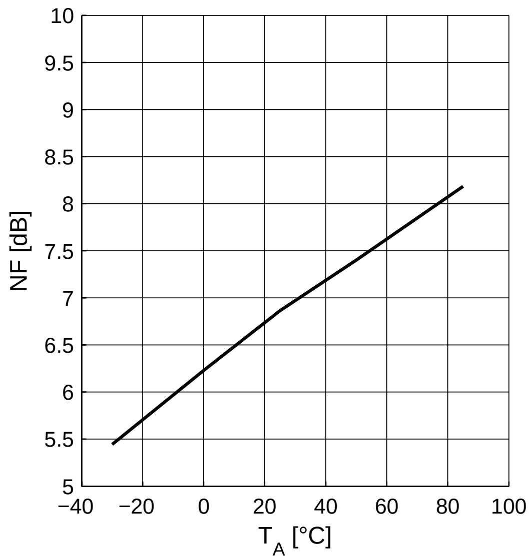
Power Gain $|S_{21}|$ = f (T_A)



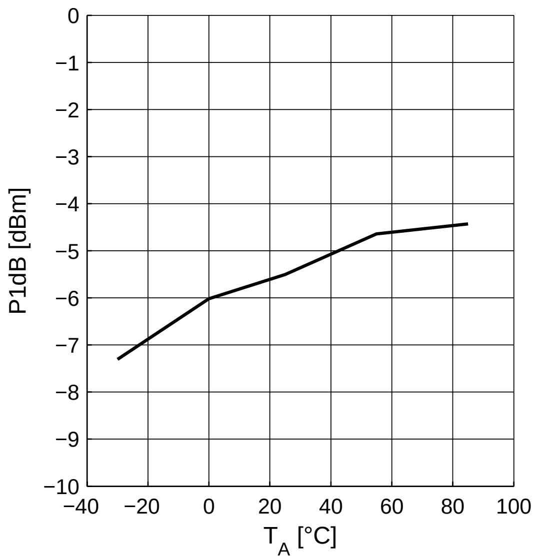
Supply Current I_{CC} = f (T_A)



Noise Figure NF = f (T_A)



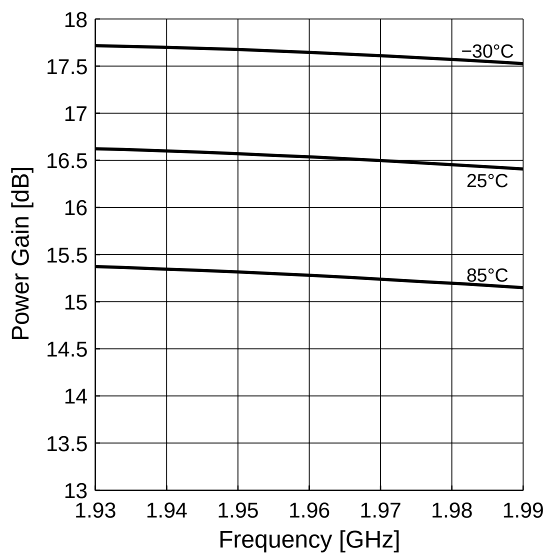
Input Compression P_{1dB} = f (T_A)



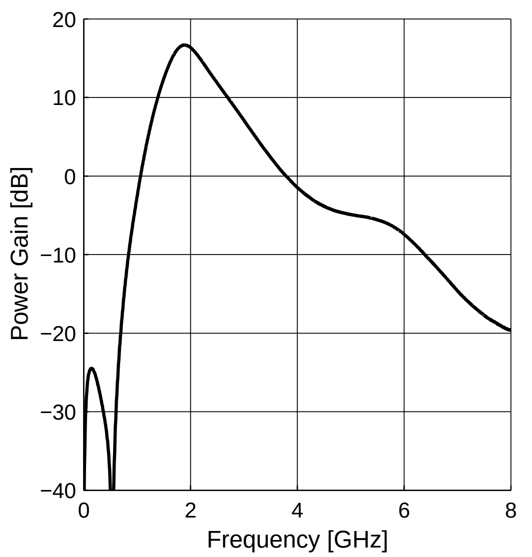
2.15 Measured Performance Mid Band High Gain Mode vs. Frequency

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

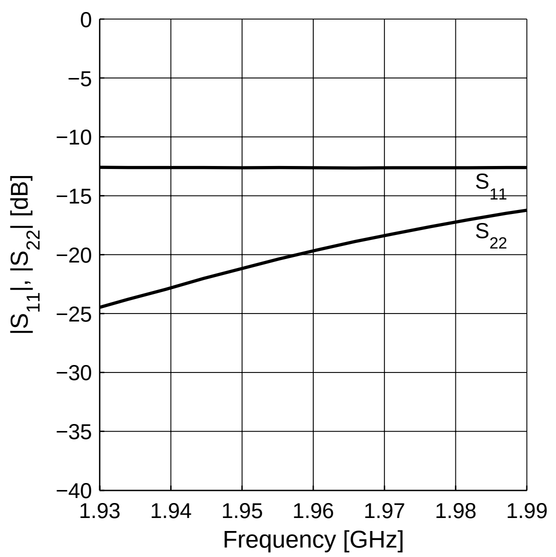
Power Gain $|S_{21}|$ = f (f)



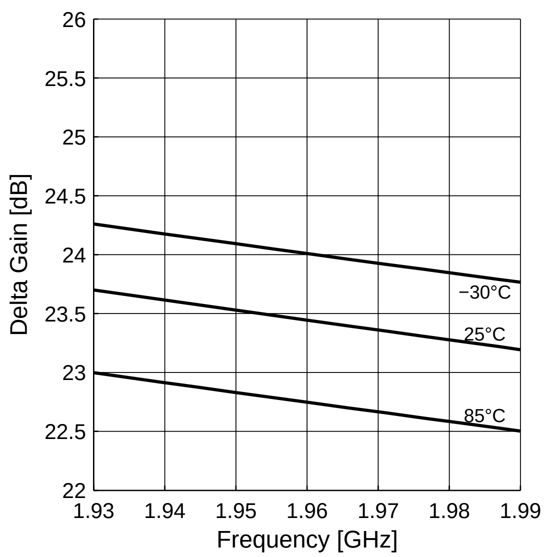
Power Gain Wideband $|S_{21}|$ = f (f)



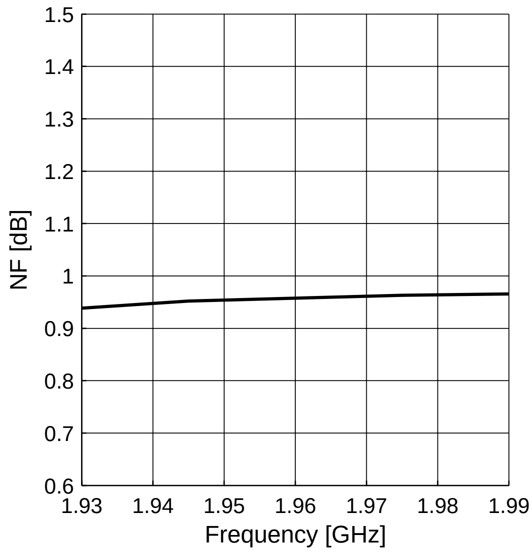
Matching $|S_{11}|$ = f (f), $|S_{22}|$ = f (f)



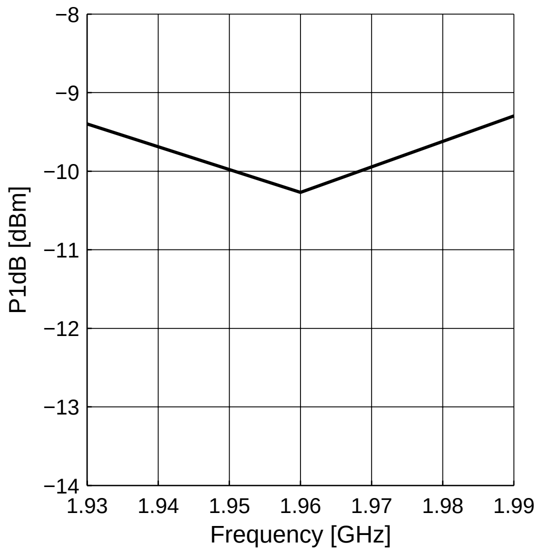
Gainstep HG - LG $|\Delta S_{21}|$ = f (f)



Noise Figure NF = f (f)



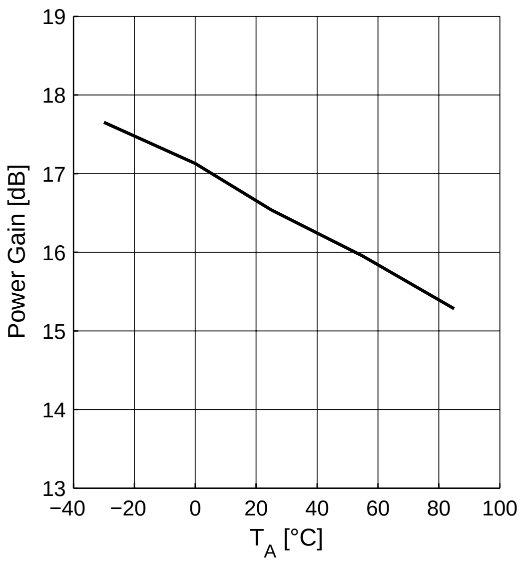
Input Compression P_{1dB} = f (f)



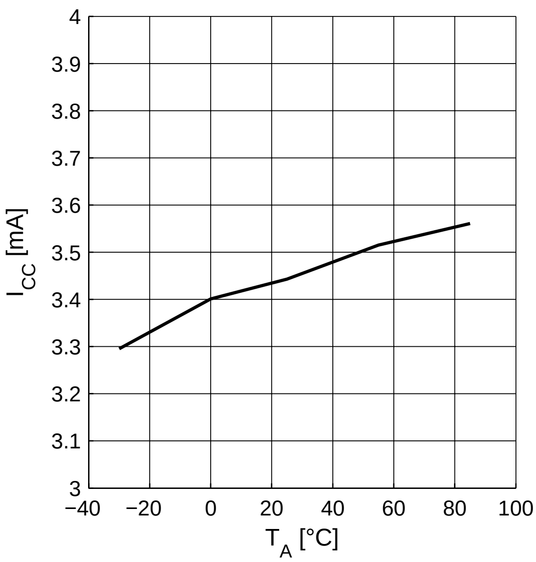
2.16 Measured Performance Mid Band High Gain Mode vs. Temperature

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

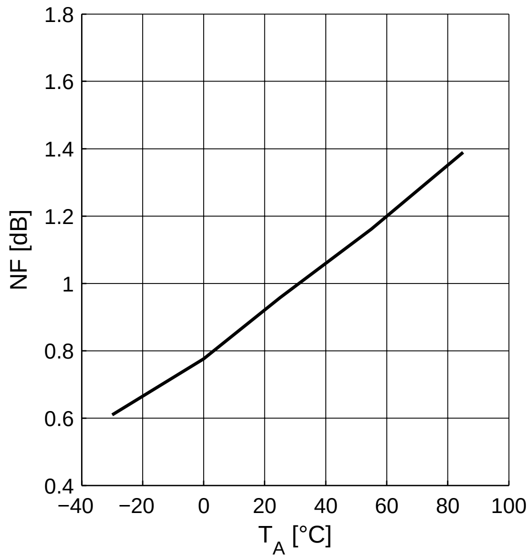
Power Gain $|S_{21}|$ = f (T_A)



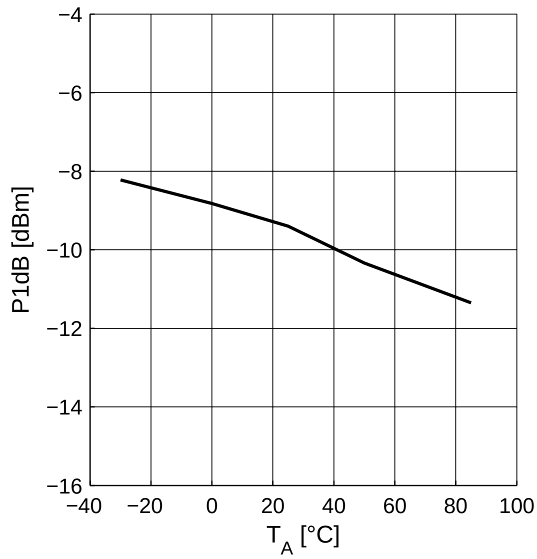
Supply Current I_{CC} = f (T_A)



Noise Figure NF = f (T_A)



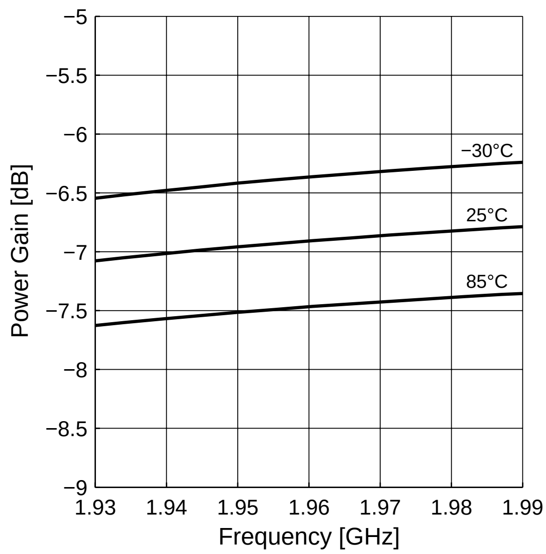
Input Compression P_{1dB} = f (T_A)



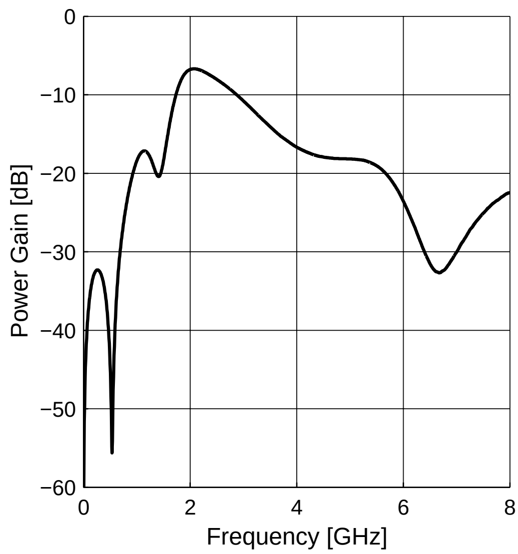
2.17 Measured Performance Mid Band Low Gain Mode vs. Frequency

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)

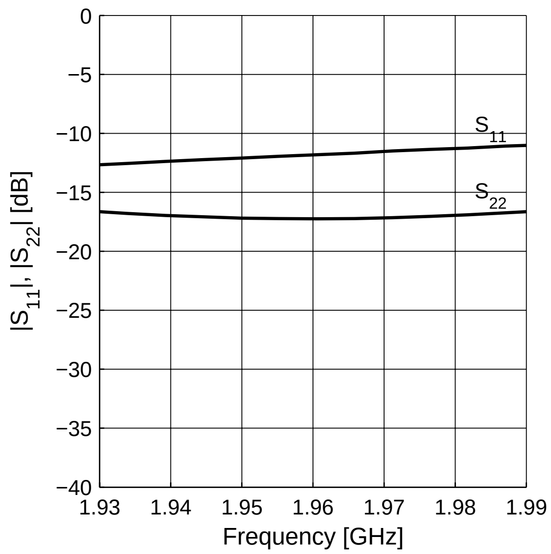


Power Gain Wideband $|S_{21}|$ = f (f)

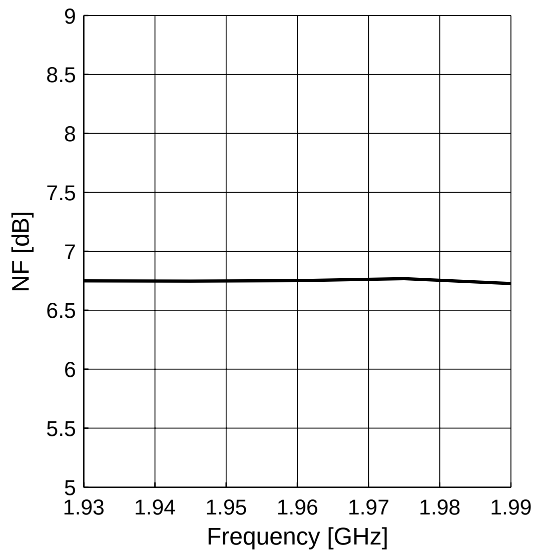


Measured Performance Mid Band Low Gain Mode vs. Frequency

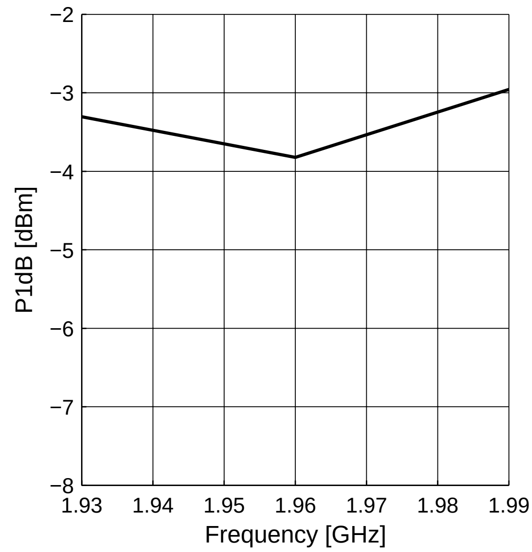
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



Noise Figure $NF = f(f)$



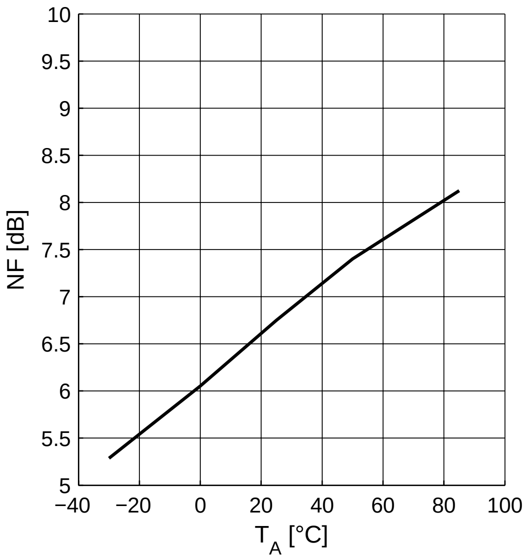
Input Compression $P_{1dB} = f(f)$



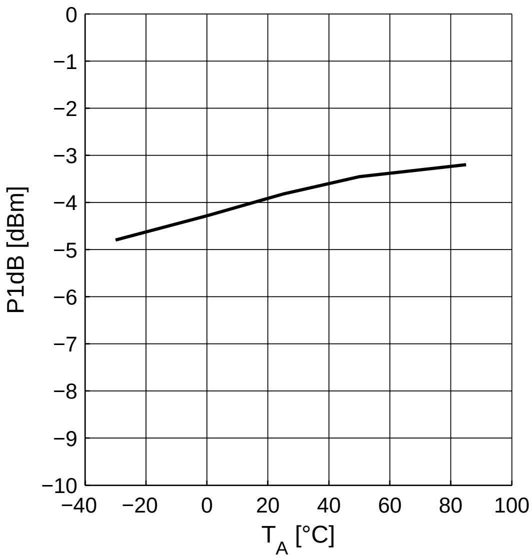
2.18 Measured Performance Mid Band Low Gain Mode vs. Temperature

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

Noise Figure NF = f (T_A)



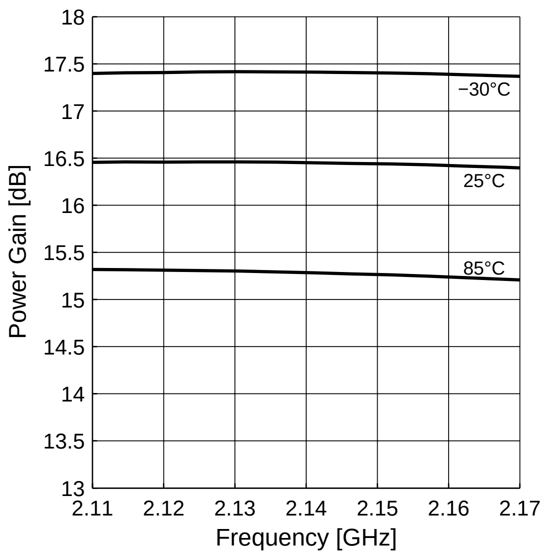
Input Compression P_{1dB} = f (T_A)



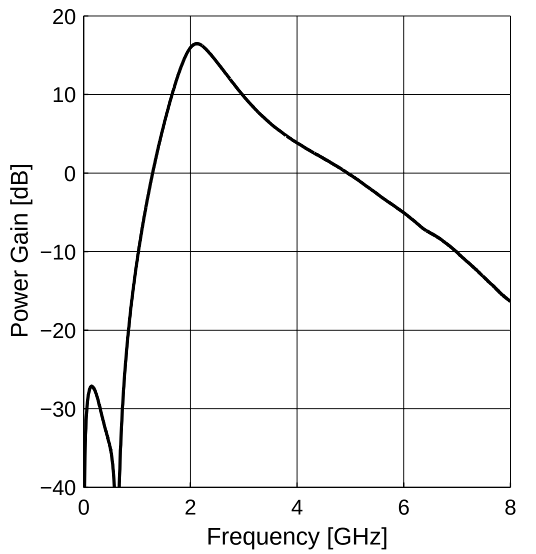
2.19 Measured Performance High Band High Gain Mode vs. Frequency

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

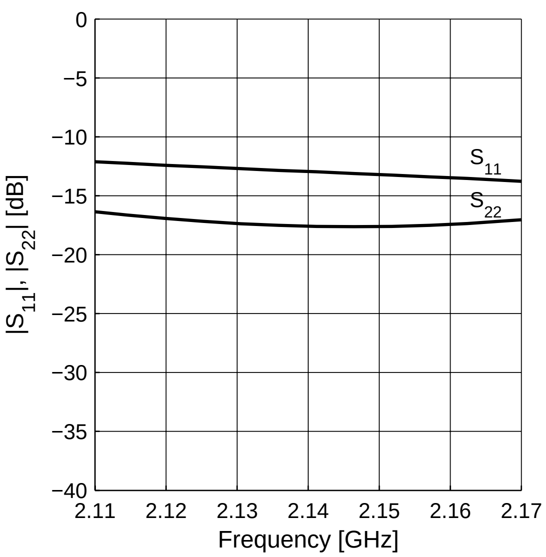
Power Gain $|S_{21}|$ = f (f)



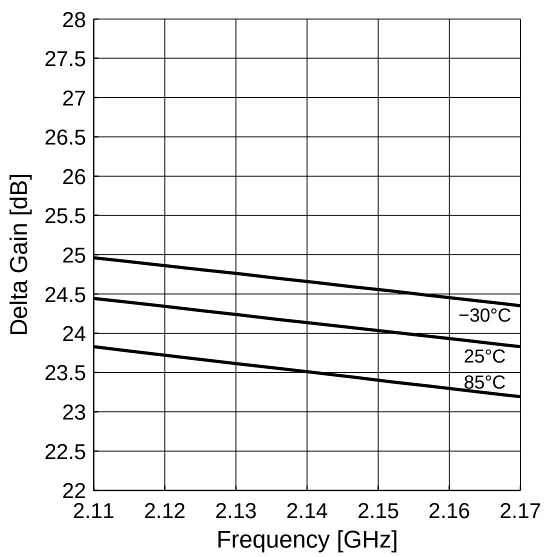
Power Gain Wideband $|S_{21}|$ = f (f)



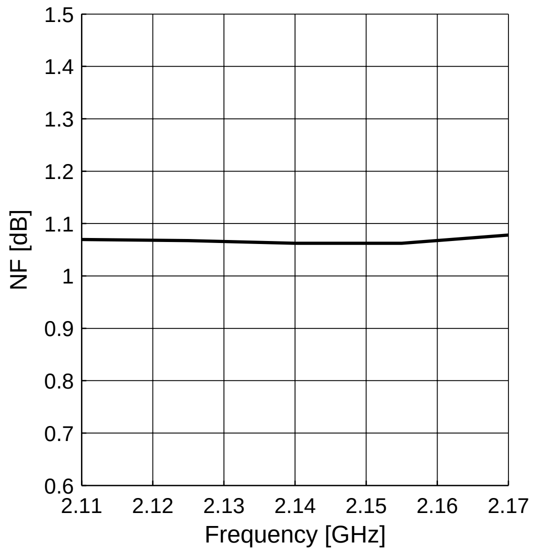
Matching $|S_{11}|$ = f (f), $|S_{22}|$ = f (f)



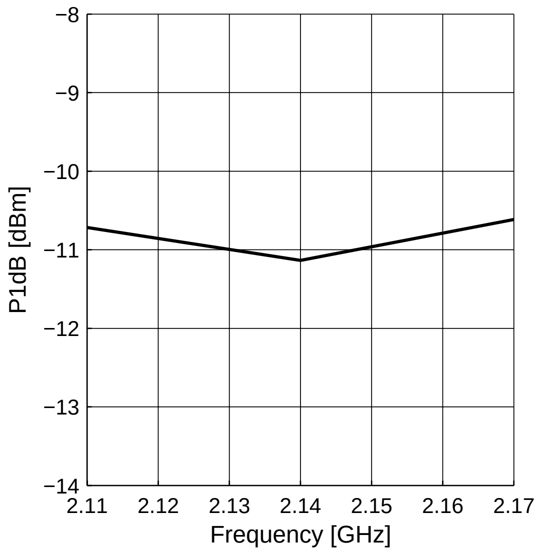
Gainstep HG - LG $|\Delta S_{21}|$ = f (f)



Noise Figure NF = f (f)



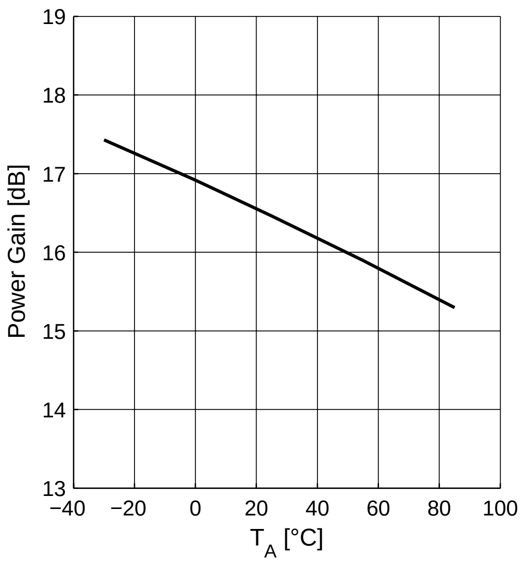
Input Compression P_{1dB} = f (f)



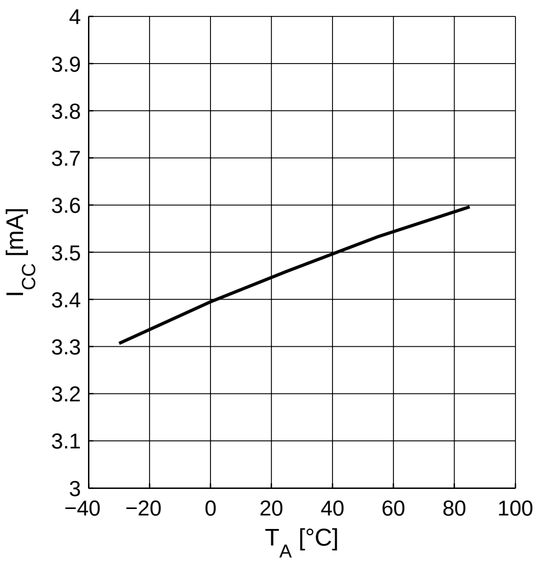
2.20 Measured Performance High Band High Gain Mode vs. Temperature

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

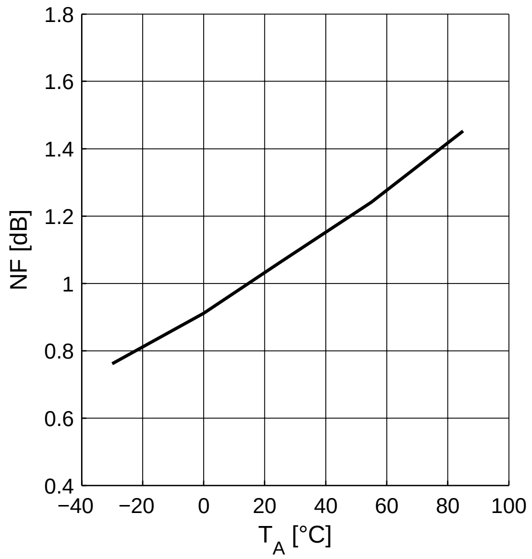
Power Gain $|S_{21}|$ = f (T_A)



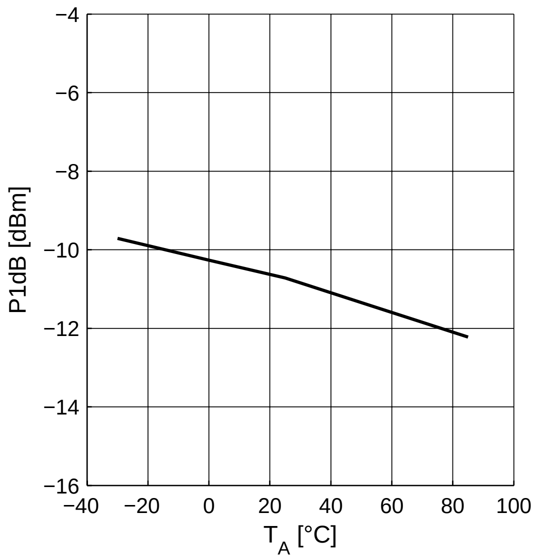
Supply Current I_{CC} = f (T_A)



Noise Figure $NF = \mathrm{f}(T_A)$



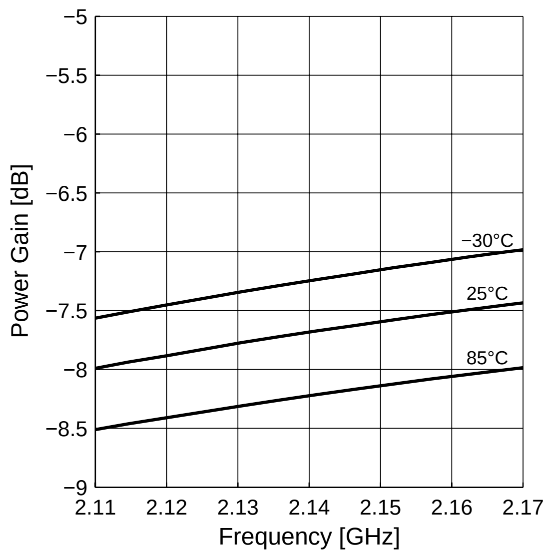
Input Compression $P_{1dB} = \mathrm{f}(T_A)$



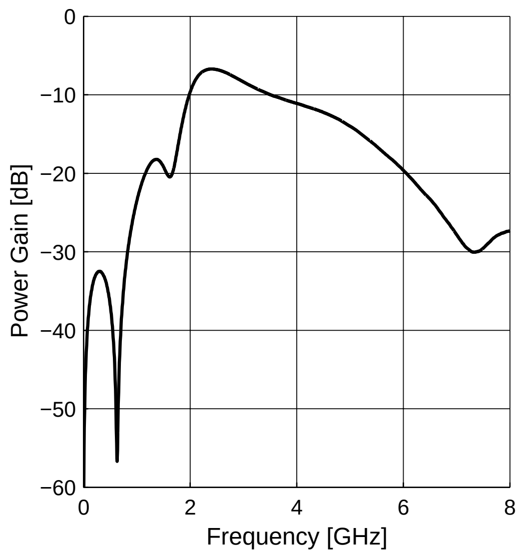
2.21 Measured Performance High Band Low Gain Mode vs. Frequency

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 $|S_{21}| = \mathrm{f}(f)$

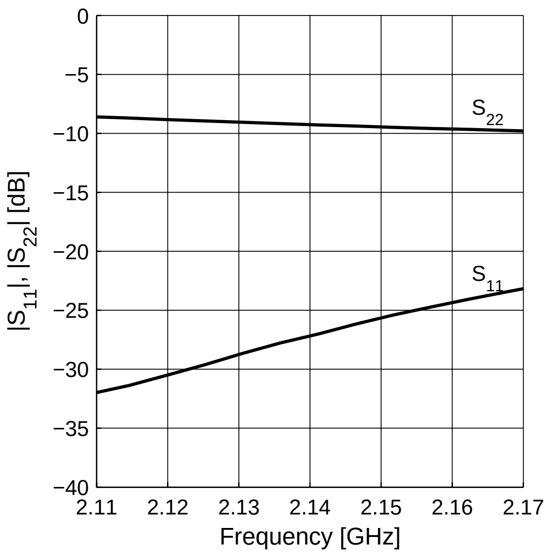


Power Gain Wideband $|S_{21}| = \mathrm{f}(f)$

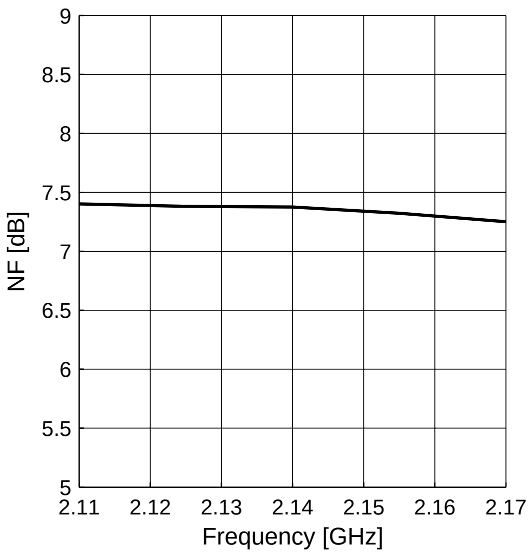


Measured Performance High Band Low Gain Mode vs. Frequency

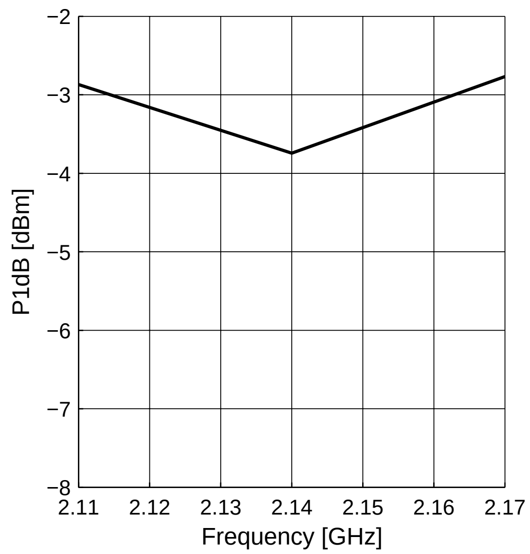
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



Noise Figure $NF = f(f)$



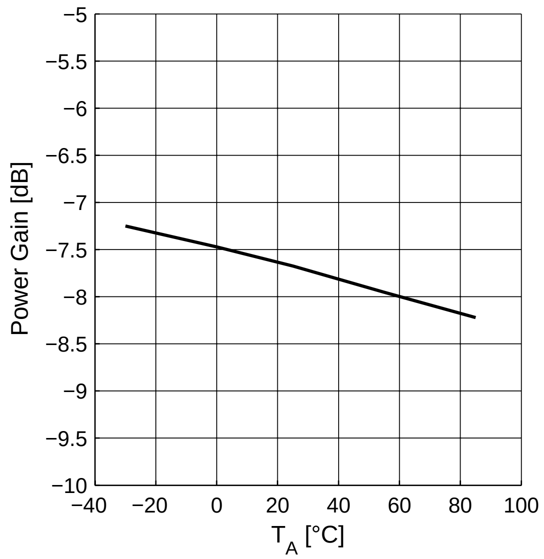
Input Compression $P_{1dB} = f(f)$



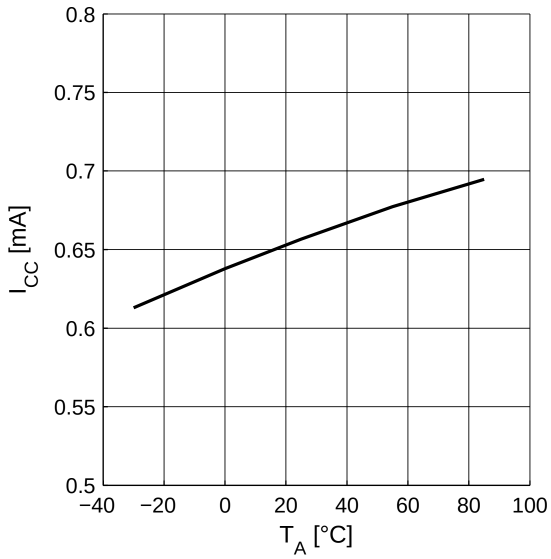
2.22 Measured Performance High Band Low Gain Mode vs. Temperature

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

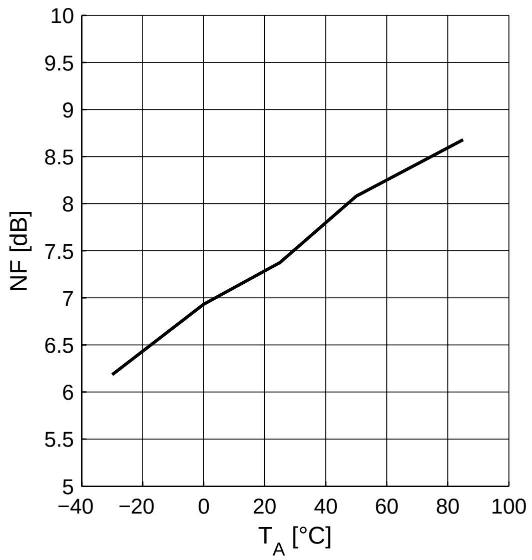
Power Gain $|S_{21}|$ = f (T_A)



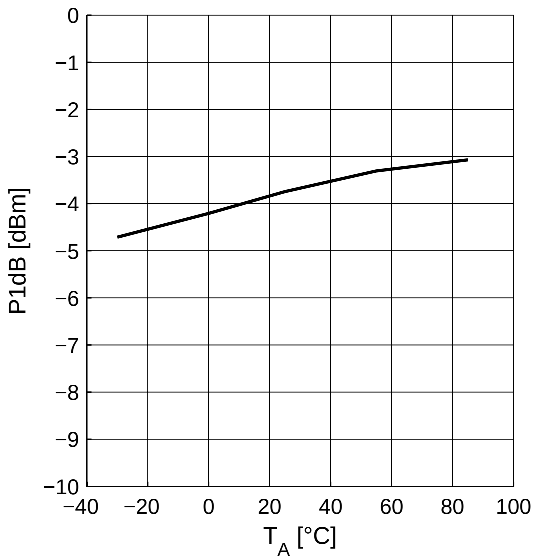
Supply Current I_{CC} = f (T_A)



Noise Figure NF = f (T_A)



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



3 Application Circuit and Block Diagram

3.1 UMTS bands I, II and V Application Circuit Schematic

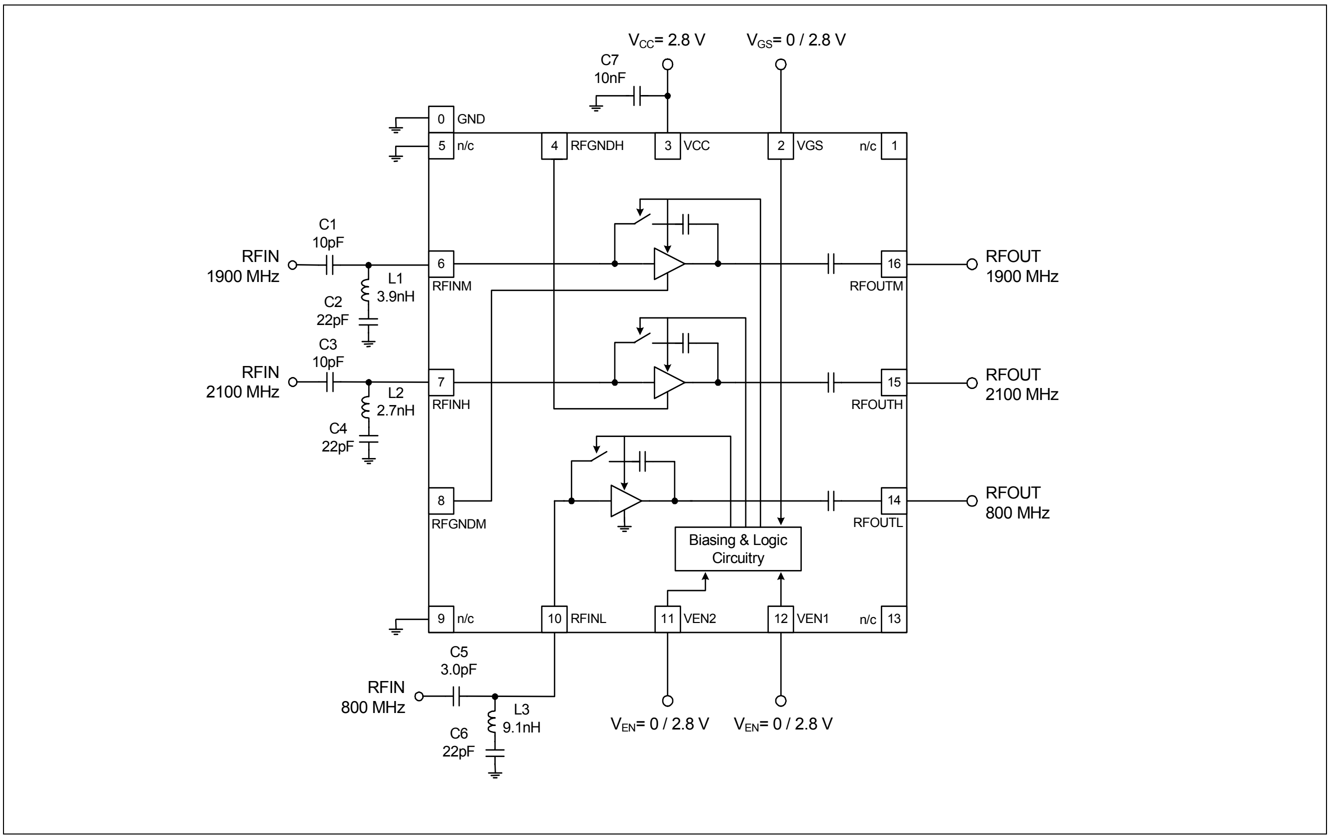


Figure 2 Application circuit with chip outline (top view)

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

Table 11 Parts List

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 Definition

Table 12 Pin Definition and Function

Pin Number	Symbol	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

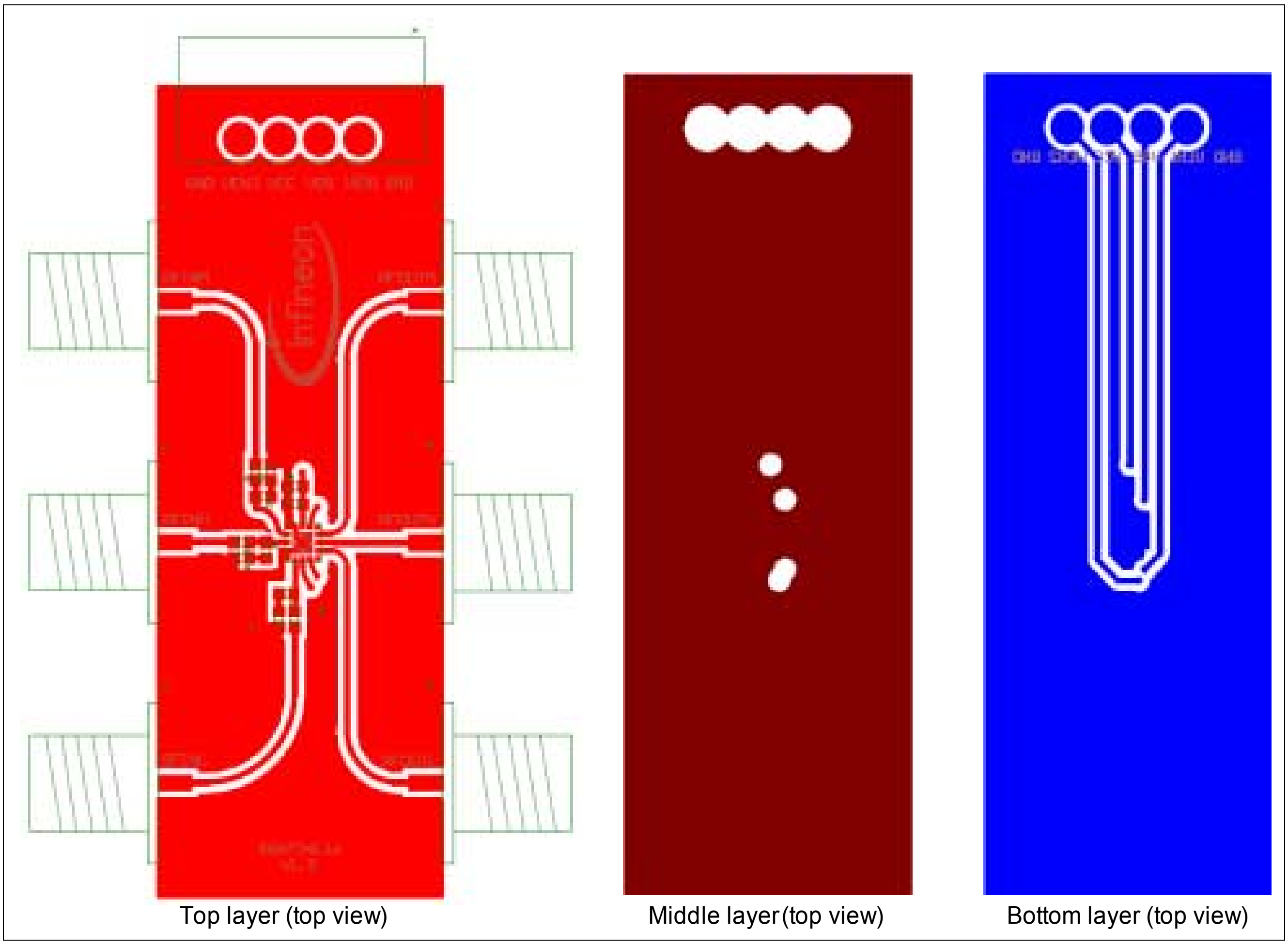


Figure 3 Application board layout on 3-layer FR4. Top layer thickness: 0.2 mm, bottom layer thickness: 0.8 mm, 35 µm Cu metallization, gold plated. Board size: 21 x 50 mm

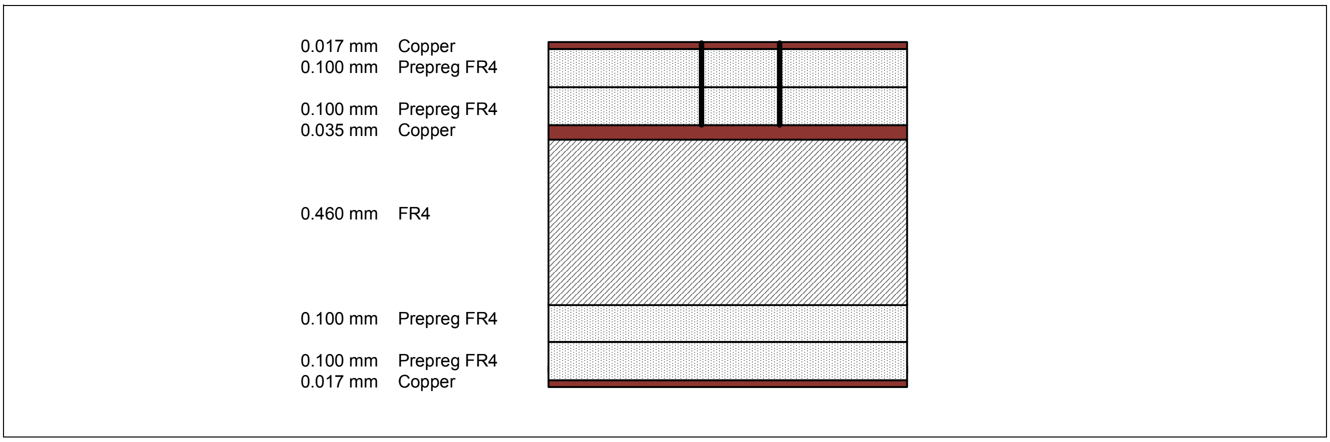


Figure 4 Cross-section view of application board

Application Board

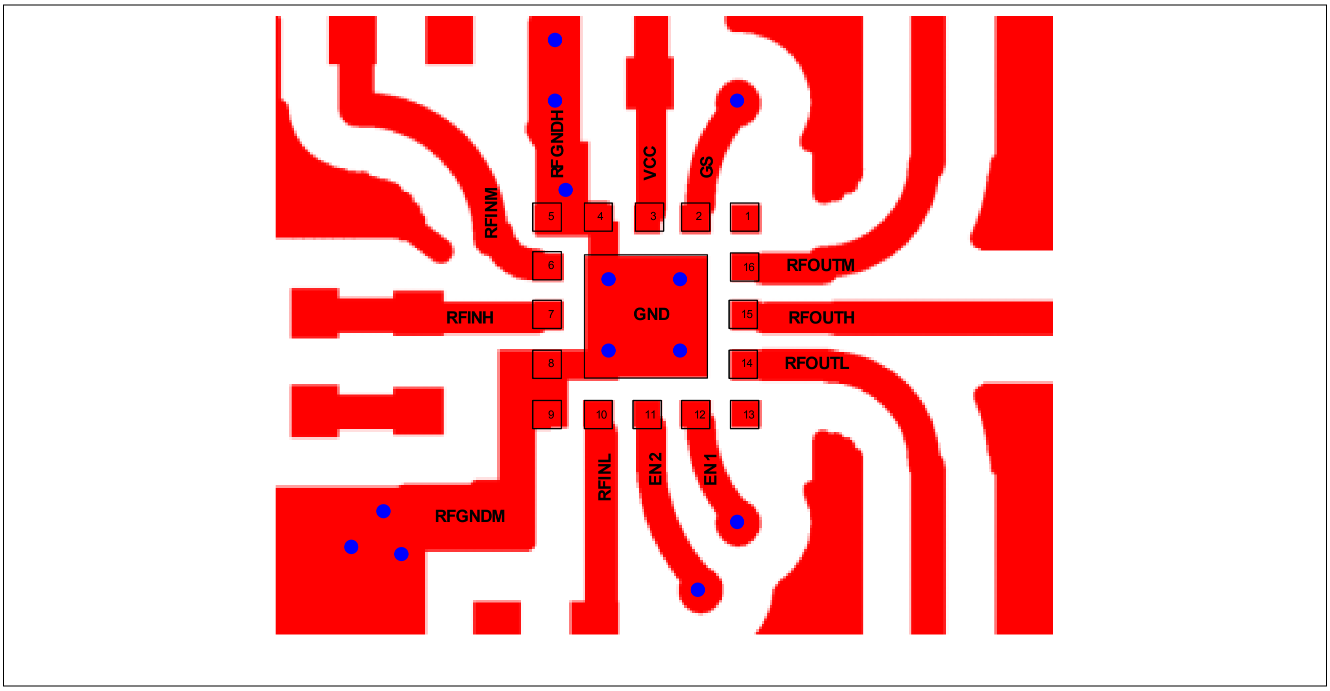


Figure 5 Detail of application board layout

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

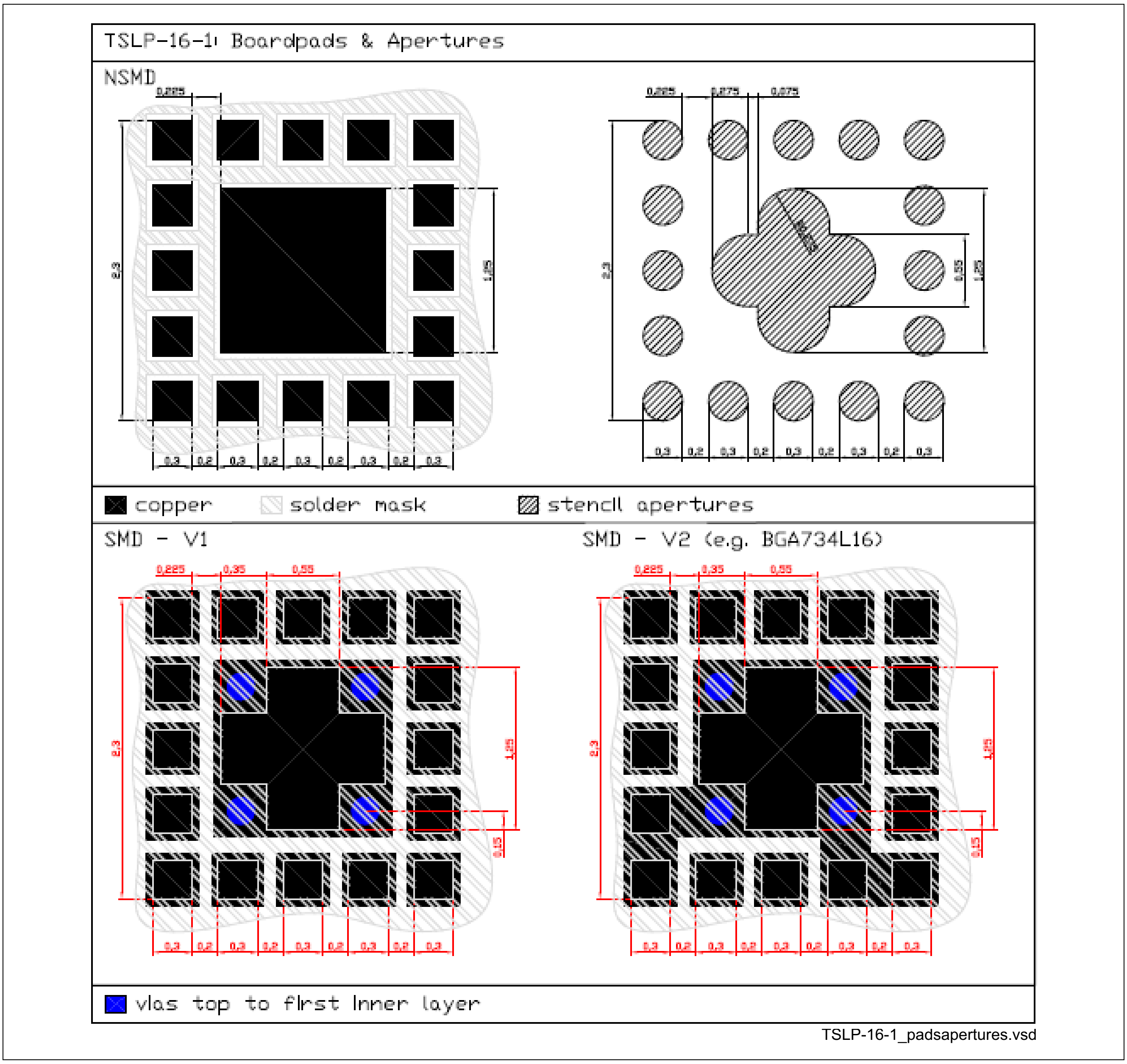


Figure 6 Recommended footprint and stencil layout for the TSLP-16-1 package

4.2 Package Dimensions

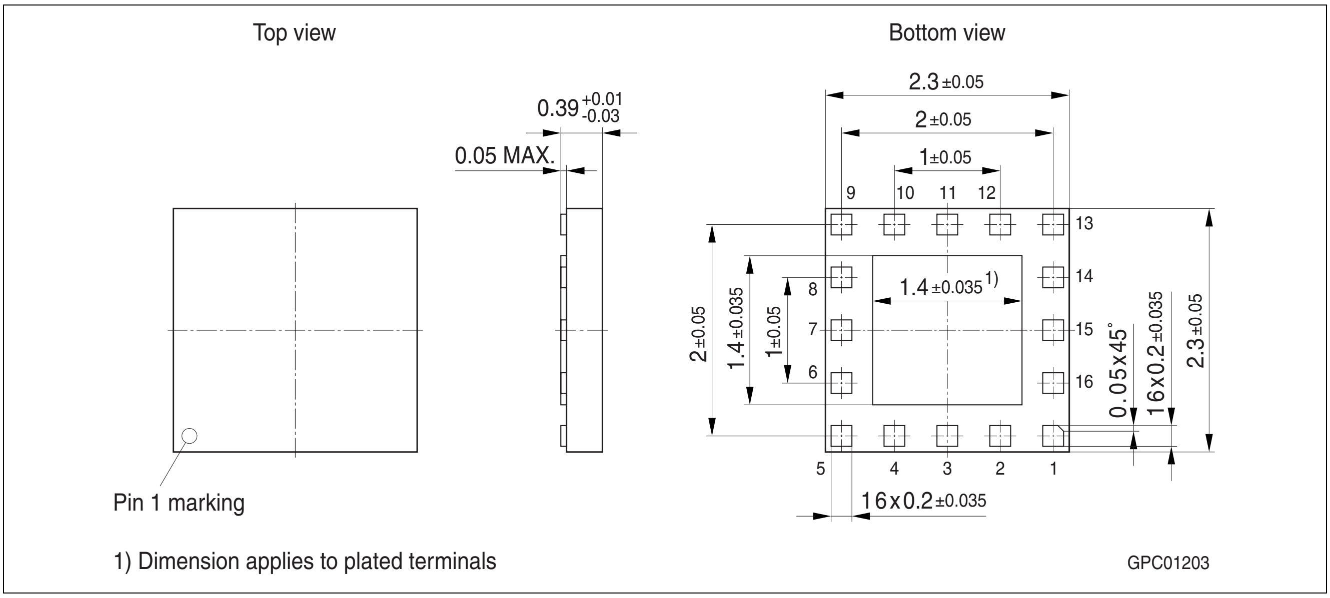


Figure 7 Package outline (top, side and bottom view)