

BGA734L16

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

RF & Protection Devices



Never stop thinking

Edition 2008-01-25

**Published by
Infineon Technologies AG
81726 München, Germany
© Infineon Technologies AG 2009.
All Rights Reserved.**

Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie"). With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

Information

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office (www.infineon.com).

Warnings

Due to technical requirements components may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies Office.

Infineon Technologies Components may only be used in life-support devices or systems with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

BGA734L16**Revision History: 2008-01-25, V1.0****Previous Version: V1.2, 2007-07-18**

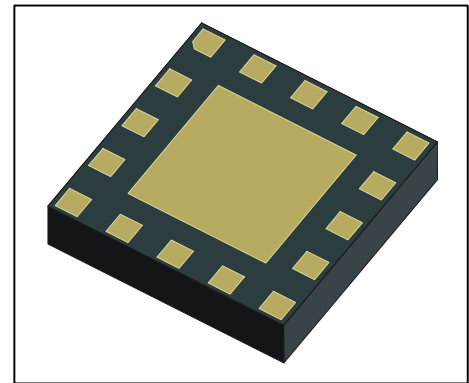
Page	Subjects (major changes since last revision)
8-10	Improved low gain mode IIP_3
8-10	Improved low gain mode P_{1dB}

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 μ A 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

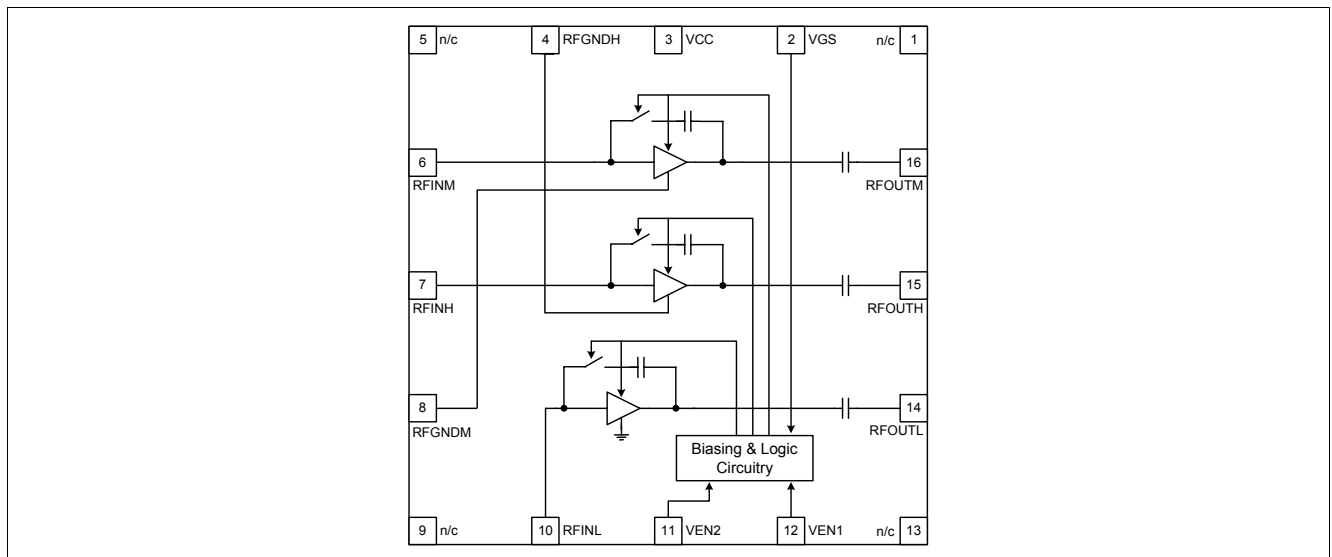


Figure 1 Block diagram of triple-band LNA

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}	≤ 110	K/W	

2.3 ESD Integrity

Table 3 ESD Integrity

Parameter	Symbol	Value	Unit	Note / Test Conditions
		Typ.		
ESD hardness HBM ¹⁾	$V_{ESD-HBM}$	1000	V	All pins

1) According to JESD22-A114

2.4 DC Characteristics

Table 4 DC Characteristics, $T_A = 25\text{ }^{\circ}\text{C}$

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

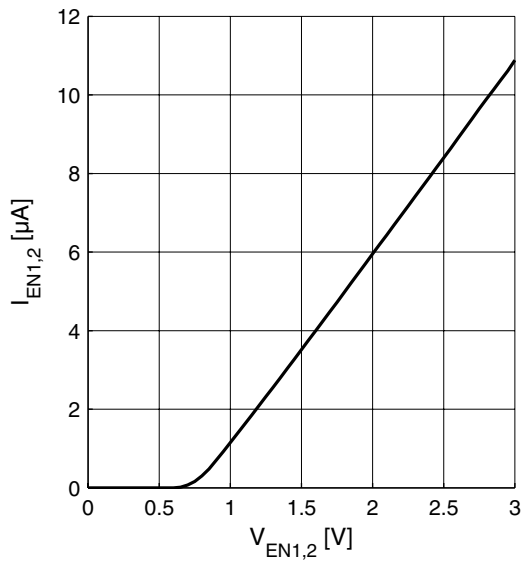
Table 6 Gain Control Truth Table

	High Gain	Low Gain
VGS	H	L

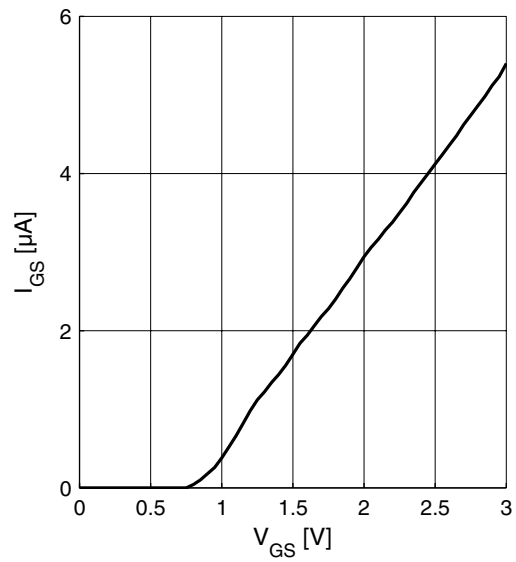
2.6 Logic Signal Characteristics; $T_A = 25\text{ °C}$

Current consumption of logic inputs VEN1, VEN2, VGS

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



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



2.7 Switching Times

Table 7 Typical switching times; $T_A = -30... 85\text{ °C}$

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

Measured RF Characteristics Low Band (UMTS Band V)

2.8 Measured RF Characteristics Low Band (UMTS Band V)

Table 8 Typical Characteristics 800 MHz Band, $T_A = 25\text{ }^{\circ}\text{C}$, $V_{CC} = 2.8\text{ V}$

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
	$IP_{1dB LG}$		-6		dBm	Low gain mode
Inband IIP3 ¹⁾ $f_1 - f_2 = 1\text{ MHz}$ $P_{f1} = P_{f2} = -25\text{ dBm}$	$IIP3_{HG}$		-6		dBm	High gain mode
	$IIP3_{LG}$		5			Low gain mode

1) Verified by random sampling; not 100% RF tested

2) Not tested in production; guaranteed by device design

Measured RF Characteristics Mid Band (UMTS Band II)

2.9 Measured RF Characteristics Mid Band (UMTS Band II)

Table 9 Typical Characteristics 1900 MHz Band, $T_A = 25\text{ }^{\circ}\text{C}$, $V_{CC} = 2.8\text{ V}$

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
	$IP_{1dB LG}$		-4		dBm	Low gain mode
Inband IIP3 ¹⁾ $f_1 - f_2 = 1\text{ MHz}$ $P_{f1} = P_{f2} = -26\text{ dBm}$	$IIP3_{HG}$		-5		dBm	High gain mode
	$IIP3_{LG}$		6			Low gain mode

1) Verified by random sampling; not 100% RF tested

2) Not tested in production; guaranteed by device design

Measured RF Characteristics High Band (UMTS Band I)

2.10 Measured RF Characteristics High Band (UMTS Band I)

Table 10 Typical Characteristics 2100 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}$

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
	$IP_{1dB LG}$		-4		dBm	Low gain mode
Inband IIP3 ¹⁾ $f_1 - f_2 = 1\text{ MHz}$ $P_{f1} = P_{f2} = -27\text{ dBm}$	$IIP3_{HG}$		-6		dBm	High gain mode
	$IIP3_{LG}$		7			Low gain mode

1) Verified by random sampling; not 100% RF tested

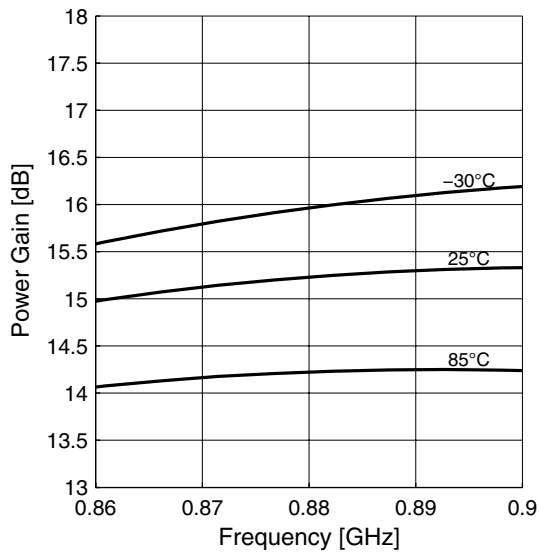
2) Not tested in production; guaranteed by device design

Measured Performance Low Band High Gain Mode vs. Frequency

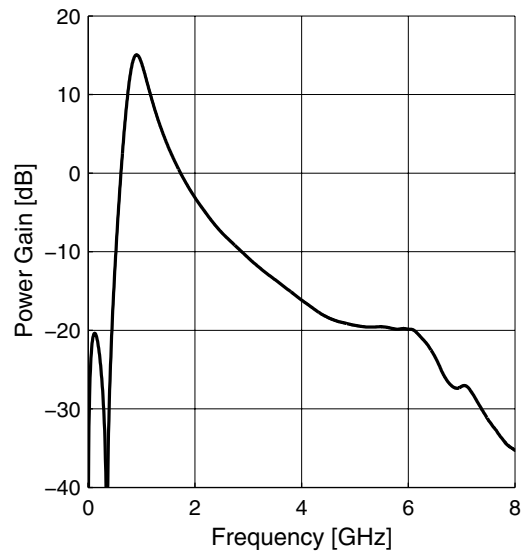
2.11 Measured Performance Low Band High Gain Mode vs. Frequency

$T_A = 25^\circ\text{C}$, $V_{CC} = 2.8\text{ V}$, $V_{GS} = 2.8\text{ V}$, $V_{EN1} = 0\text{ V}$, $V_{EN2} = 2.8\text{ V}$

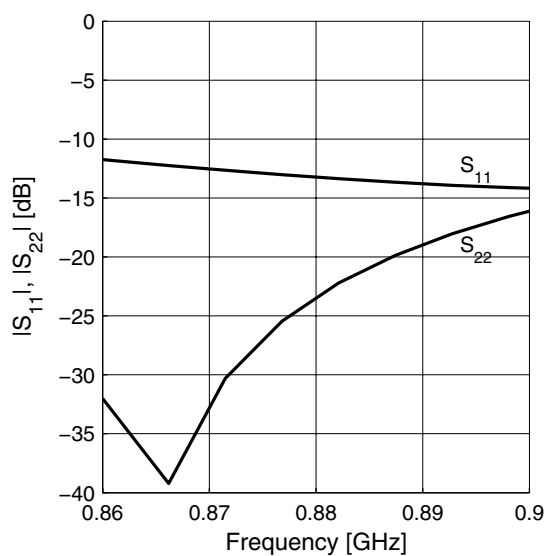
Power Gain $|S_{21}| = f(f)$



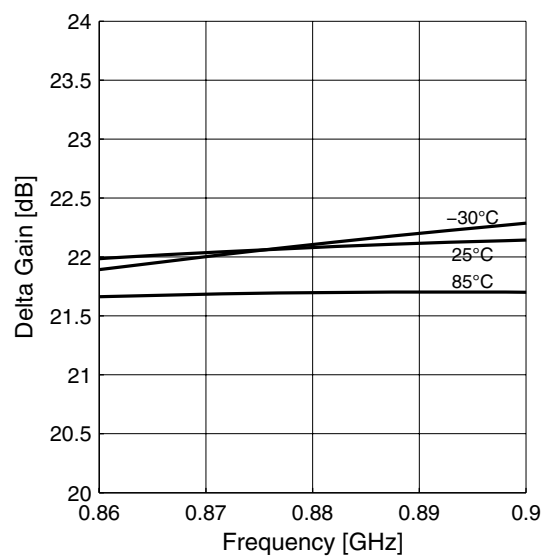
Power Gain Wideband $|S_{21}| = f(f)$



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

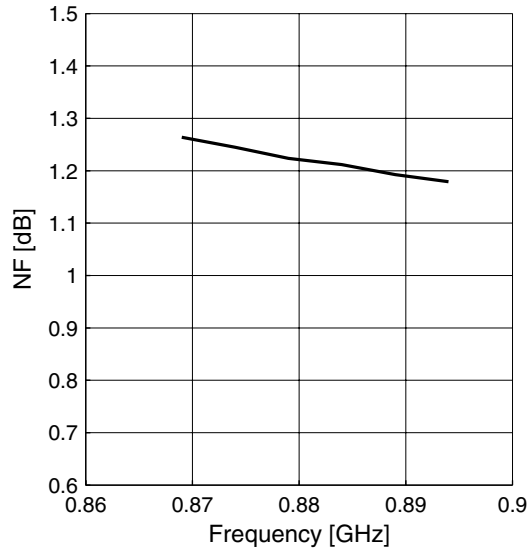


Gainstep HG - LG $|\Delta S_{21}| = f(f)$

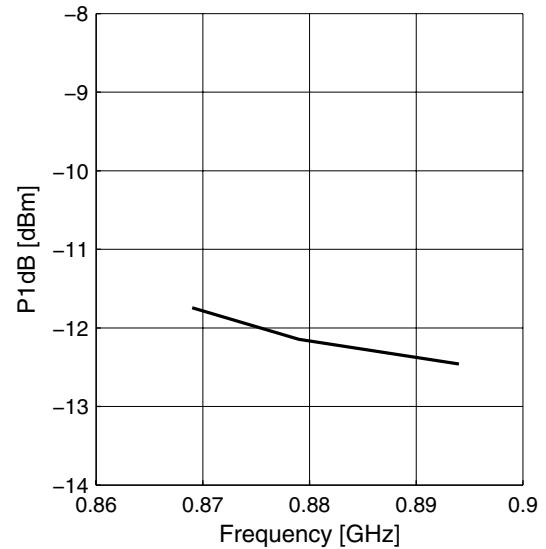


Measured Performance Low Band High Gain Mode vs. Temperature

Noise Figure $NF = f(f)$



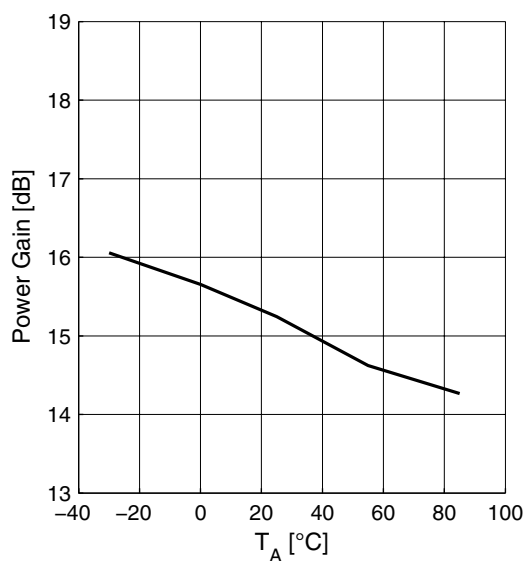
Input Compression $P_{1dB} = f(f)$



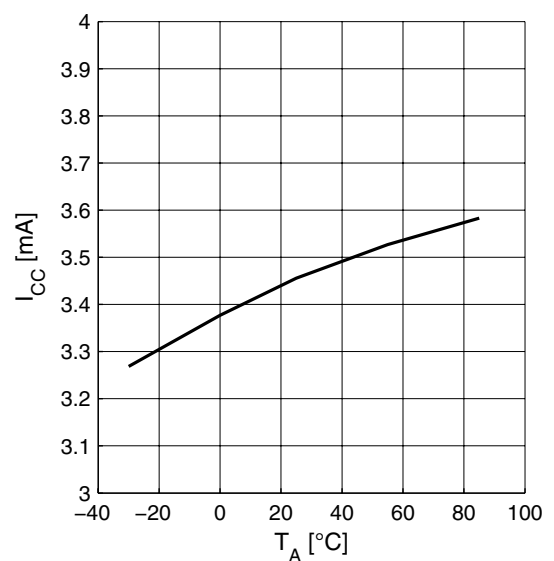
2.12 Measured Performance Low Band High Gain Mode vs. Temperature

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

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

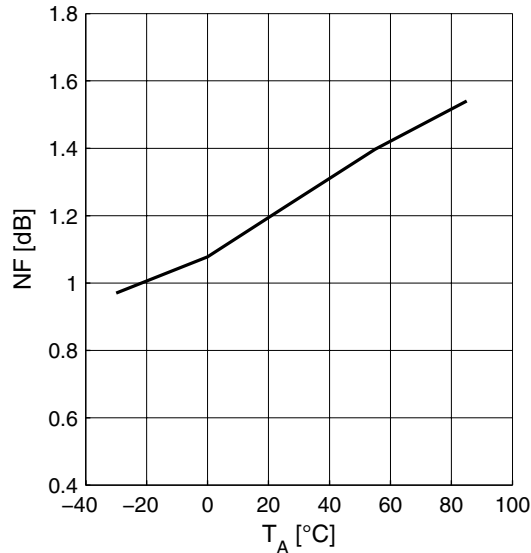


Supply Current $I_{CC} = f(T_A)$

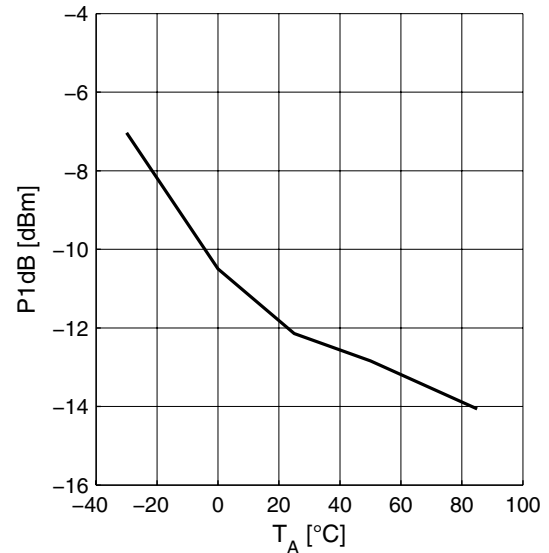


Measured Performance Low Band Low Gain Mode vs. Frequency

Noise Figure $NF = f(T_A)$



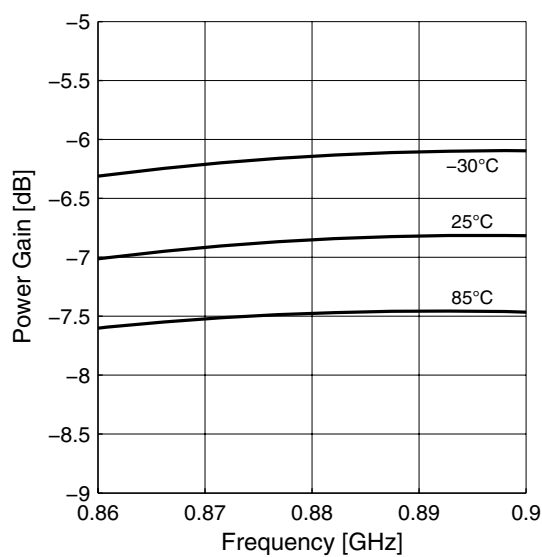
Input Compression $P_{1dB} = f(T_A)$



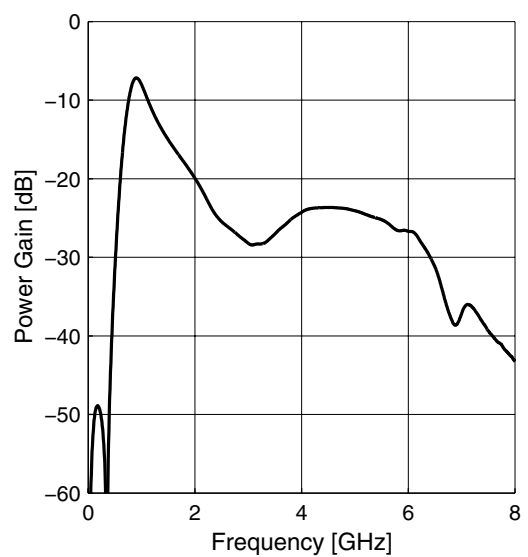
2.13 Measured Performance Low Band Low Gain Mode vs. Frequency

$T_A = 25^\circ\text{C}$, $V_{CC} = 2.8\text{ V}$, $V_{GS} = 0\text{ V}$, $V_{EN1} = 0\text{ V}$, $V_{EN2} = 2.8\text{ V}$

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

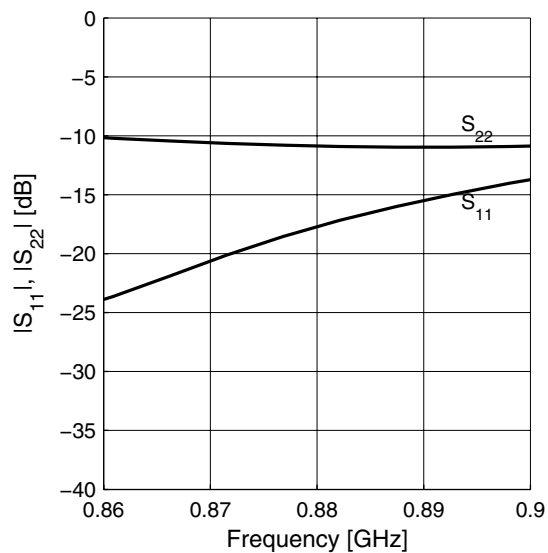


Power Gain Wideband $|S_{21}| = f(f)$

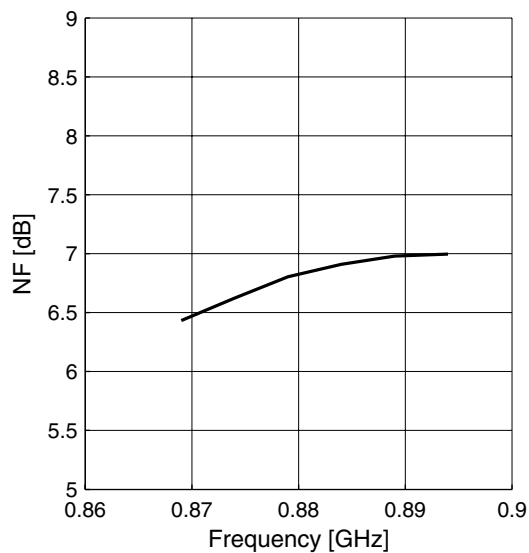


Measured Performance Low Band Low Gain Mode vs. Frequency

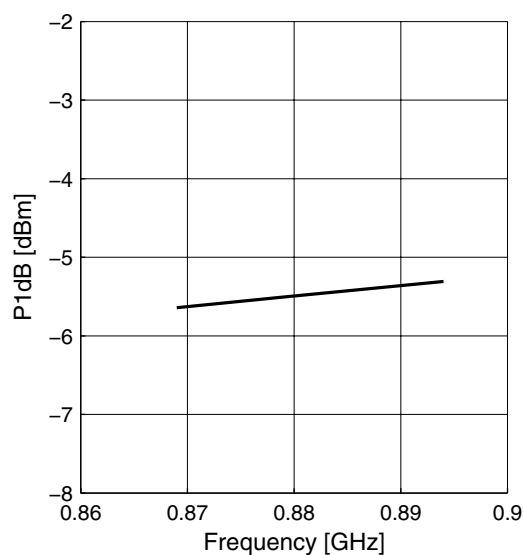
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



Noise Figure $NF = f(f)$



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

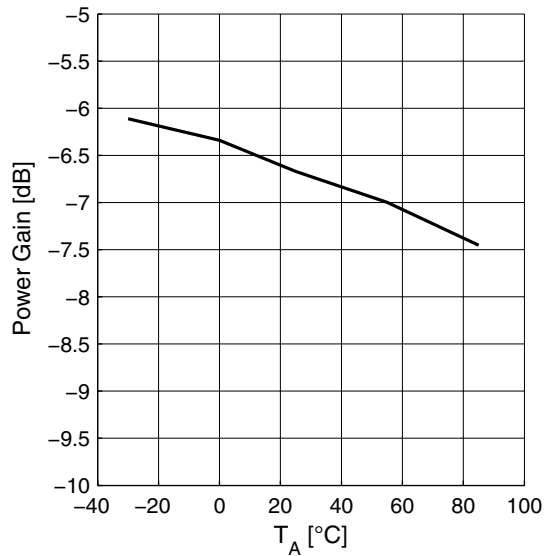


Measured Performance Low Band Low Gain Mode vs. Temperature

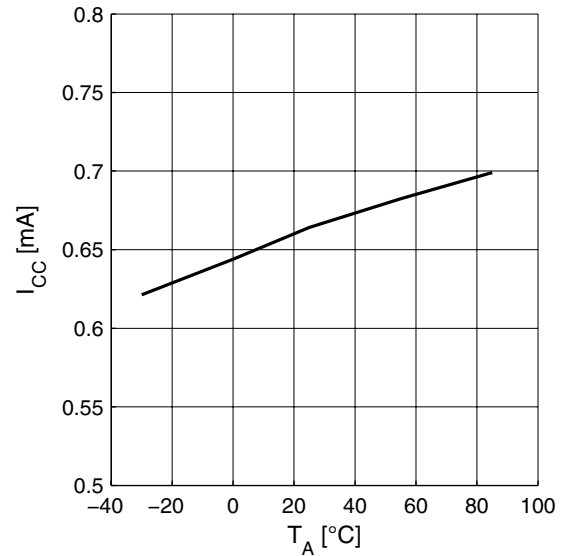
2.14 Measured Performance Low Band Low Gain Mode vs. Temperature

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

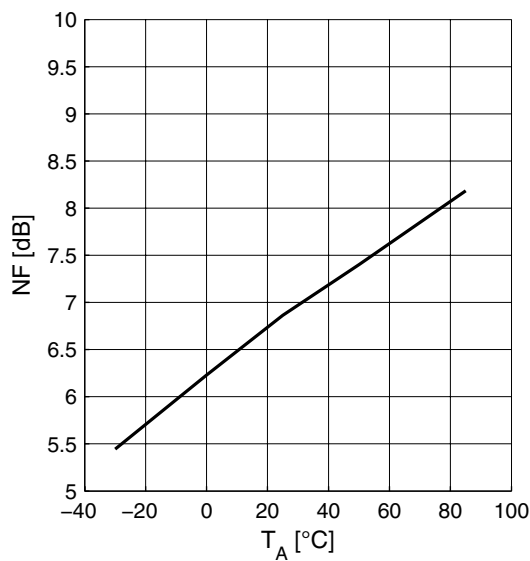
Power Gain $|S_{21}| = f(T_A)$



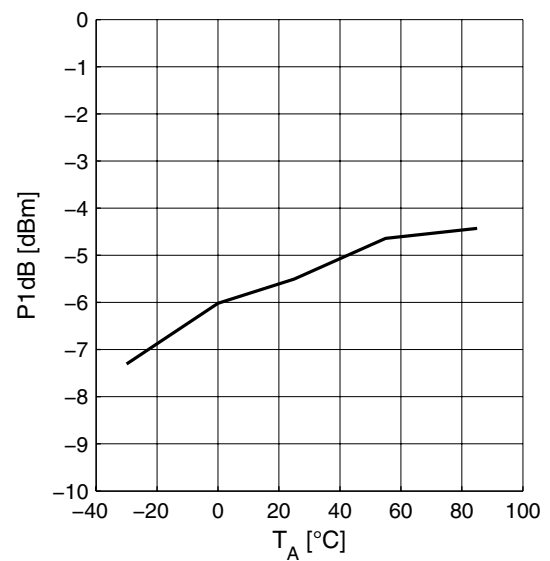
Supply Current $I_{CC} = f(T_A)$



Noise Figure $NF = f(T_A)$



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

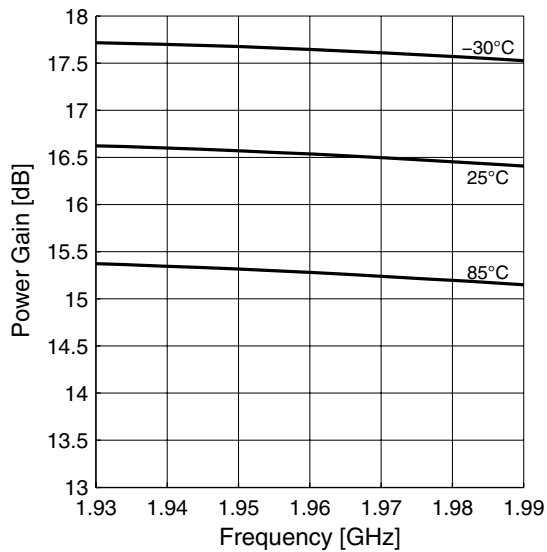


Measured Performance Mid Band High Gain Mode vs. Frequency

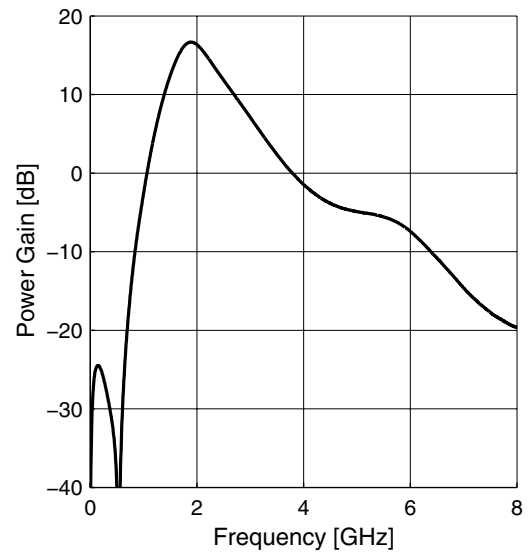
2.15 Measured Performance Mid Band High Gain Mode vs. Frequency

$T_A = 25^\circ\text{C}$, $V_{CC} = 2.8\text{ V}$, $V_{GS} = 2.8\text{ V}$, $V_{EN1} = 2.8\text{ V}$, $V_{EN2} = 0\text{ V}$

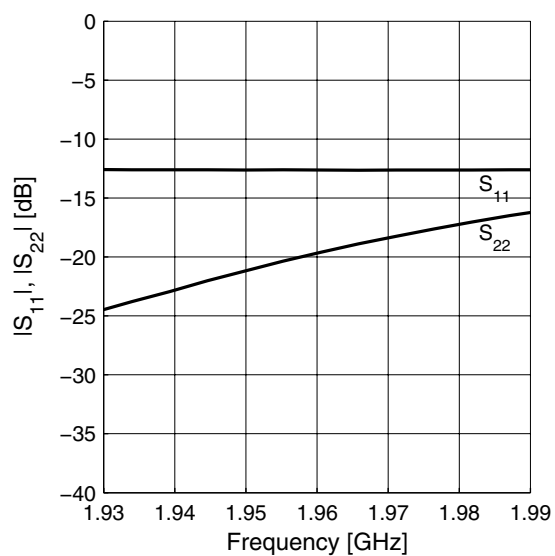
Power Gain $|S_{21}| = f(f)$



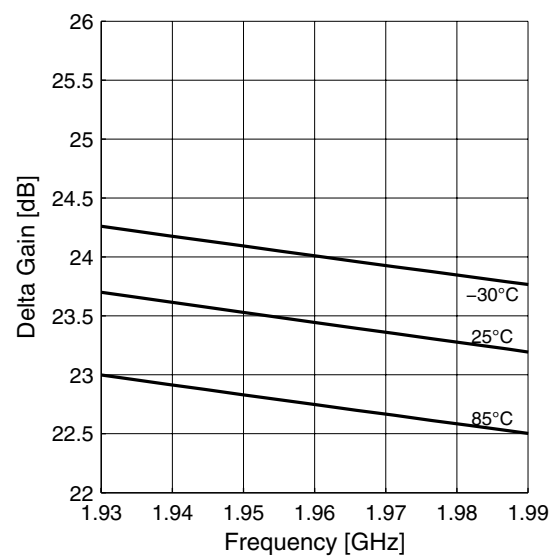
Power Gain Wideband $|S_{21}| = f(f)$



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

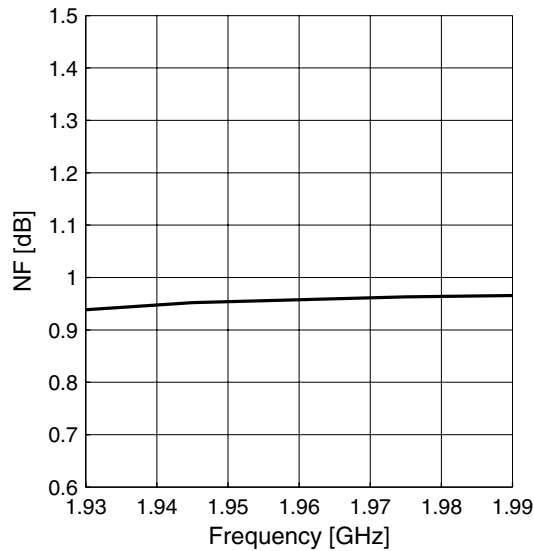


Gainstep HG - LG $|\Delta S_{21}| = f(f)$

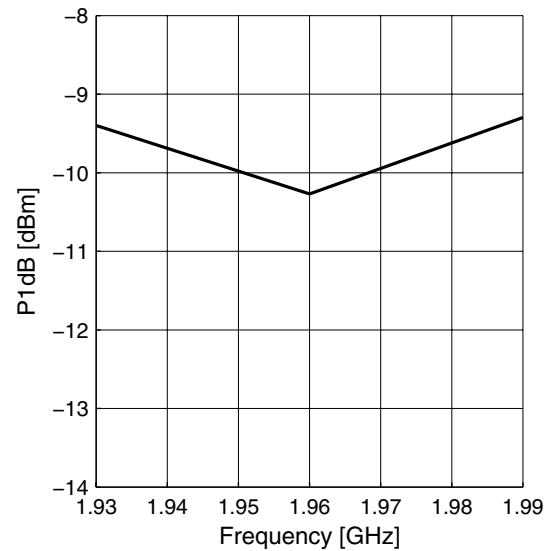


Measured Performance Mid Band High Gain Mode vs. Temperature

Noise Figure $NF = f(f)$



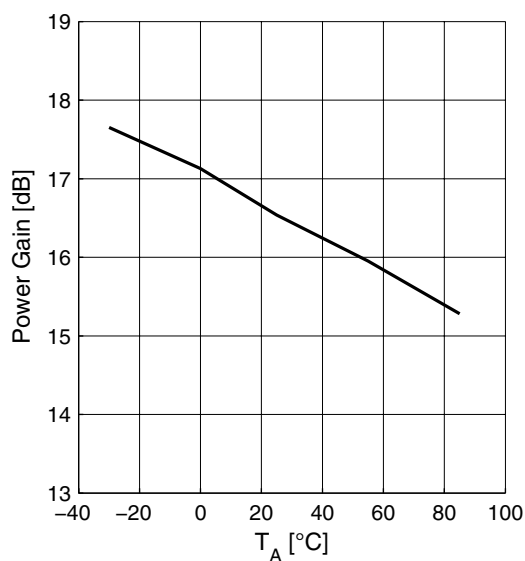
Input Compression $P_{1dB} = f(f)$



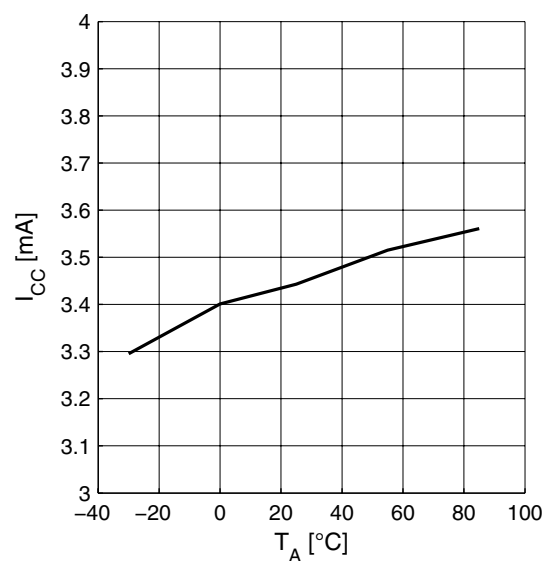
2.16 Measured Performance Mid Band High Gain Mode vs. Temperature

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

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

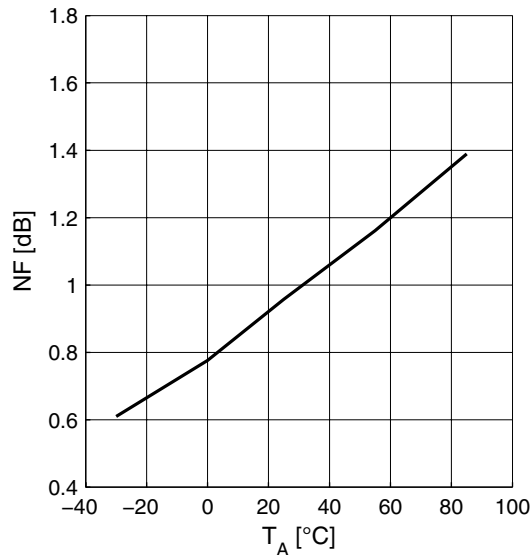


Supply Current $I_{CC} = f(T_A)$

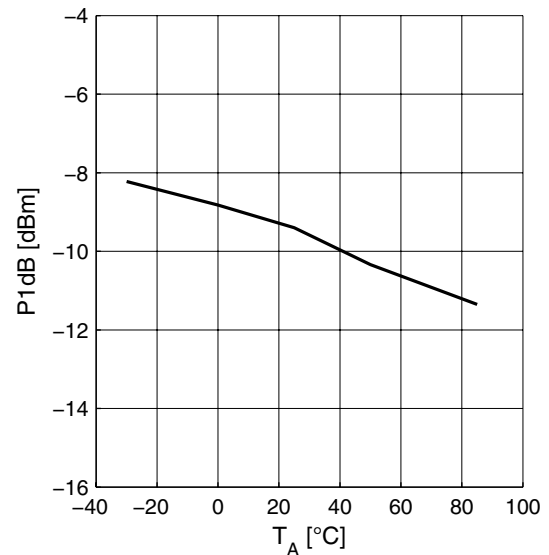


Measured Performance Mid Band Low Gain Mode vs. Frequency

Noise Figure $NF = f(T_A)$



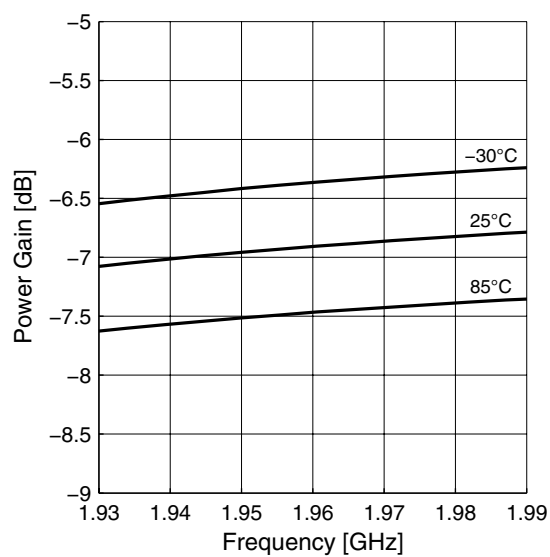
Input Compression $P_{1dB} = f(T_A)$



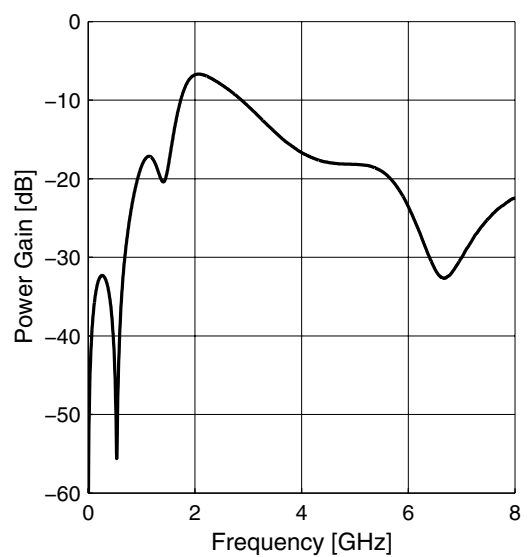
2.17 Measured Performance Mid Band Low Gain Mode vs. Frequency

$T_A = 25^\circ\text{C}$, $V_{CC} = 2.8\text{ V}$, $V_{GS} = 0\text{ V}$, $V_{EN1} = 2.8\text{ V}$, $V_{EN2} = 0\text{ V}$

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

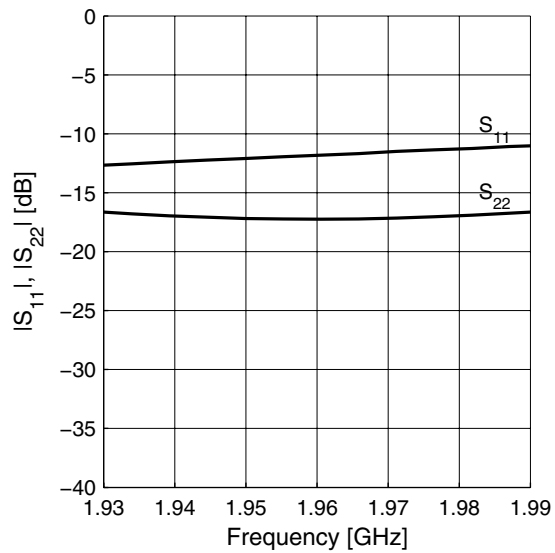


Power Gain Wideband $|S_{21}| = f(f)$

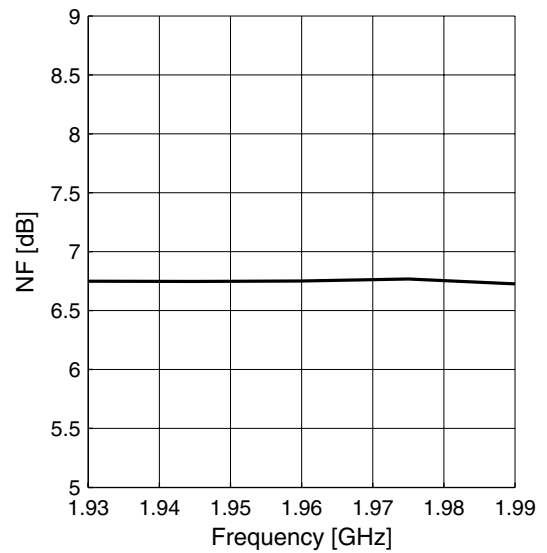


Measured Performance Mid Band Low Gain Mode vs. Frequency

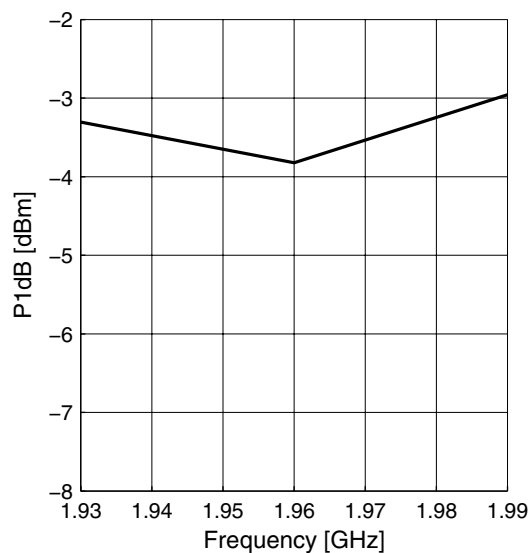
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



Noise Figure $NF = f(f)$



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

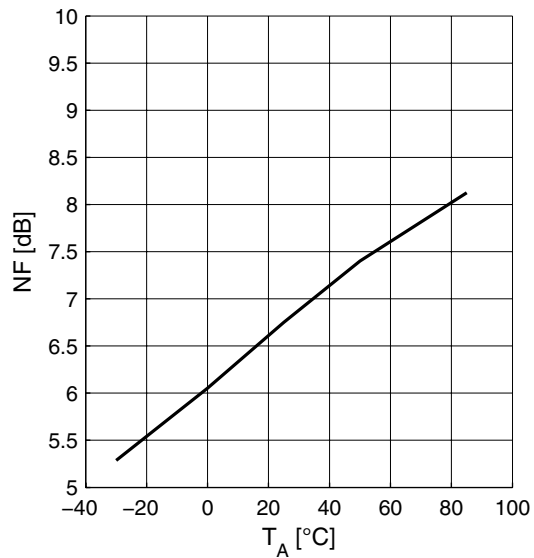


Measured Performance Mid Band Low Gain Mode vs. Temperature

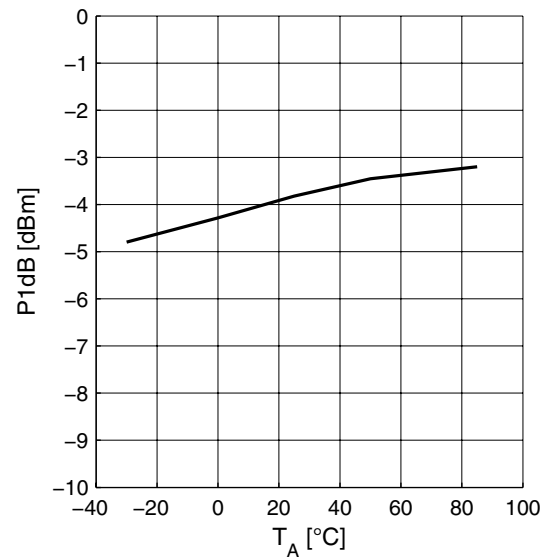
2.18 Measured Performance Mid Band Low Gain Mode vs. Temperature

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

Noise Figure $NF = f(T_A)$



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

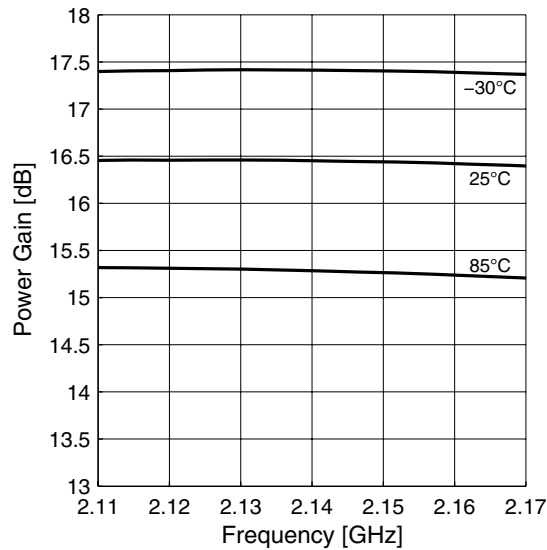


Measured Performance High Band High Gain Mode vs. Frequency

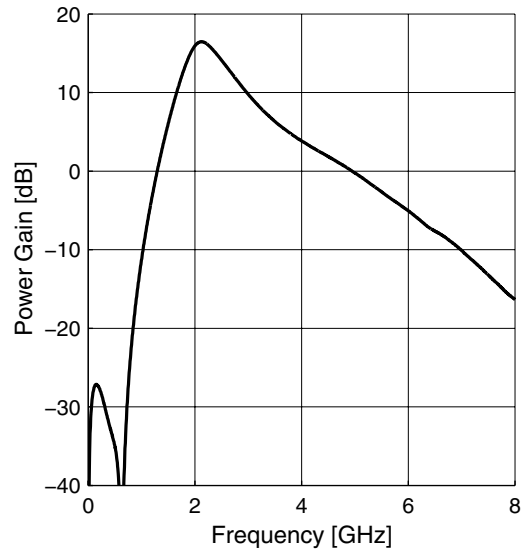
2.19 Measured Performance High Band High Gain Mode vs. Frequency

$T_A = 25^\circ\text{C}$, $V_{CC} = 2.8\text{ V}$, $V_{GS} = 2.8\text{ V}$, $V_{EN1} = 2.8\text{ V}$, $V_{EN2} = 2.8\text{ V}$

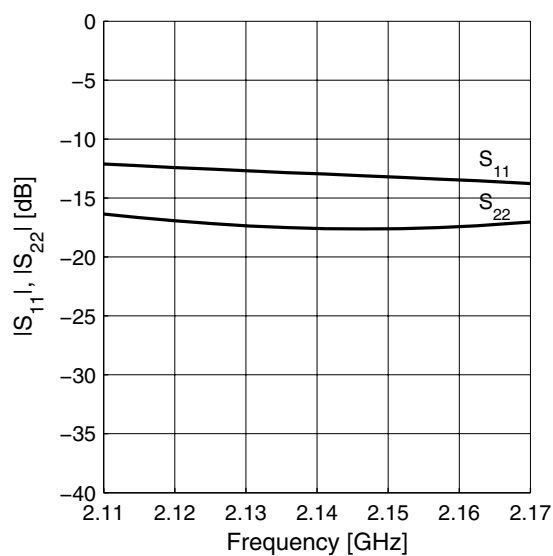
Power Gain $|S_{21}| = f(f)$



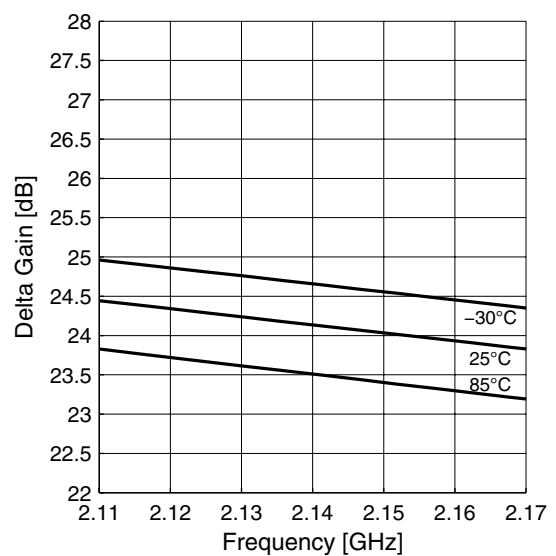
Power Gain Wideband $|S_{21}| = f(f)$



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

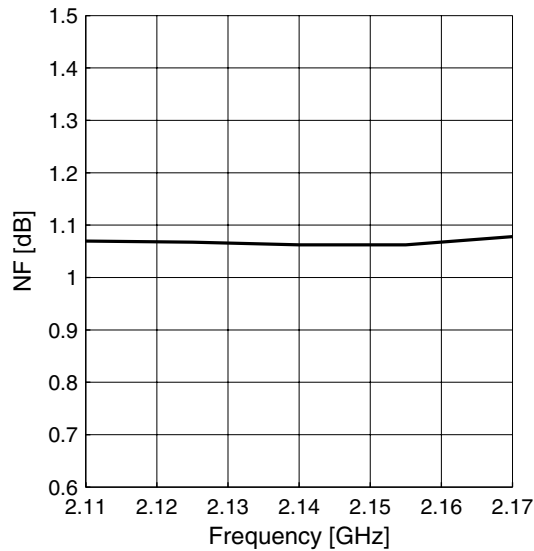


Gainstep HG - LG $|\Delta S_{21}| = f(f)$

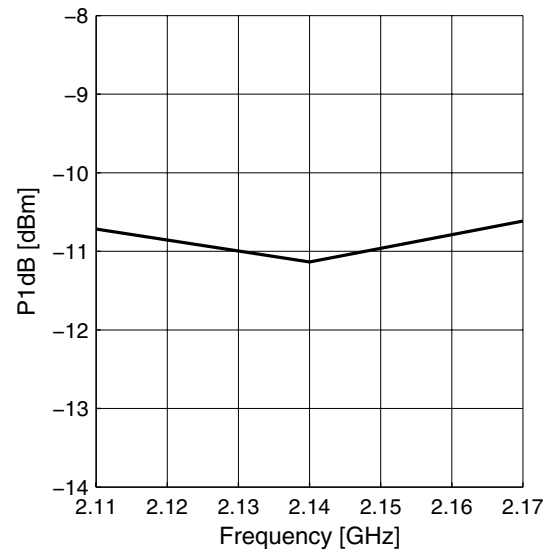


Measured Performance High Band High Gain Mode vs. Temperature

Noise Figure $NF = f(f)$



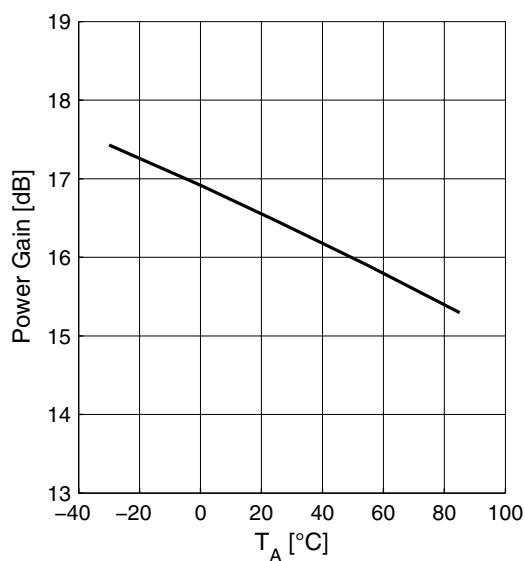
Input Compression $P_{1dB} = f(f)$



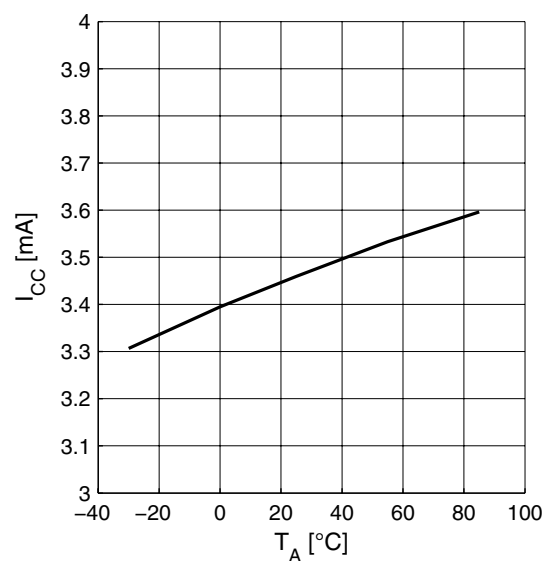
2.20 Measured Performance High Band High Gain Mode vs. Temperature

$V_{CC} = 2.8 \text{ V}$, $V_{GS} = 2.8 \text{ V}$, $V_{EN1} = 2.8 \text{ V}$, $V_{EN2} = 2.8 \text{ V}$

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

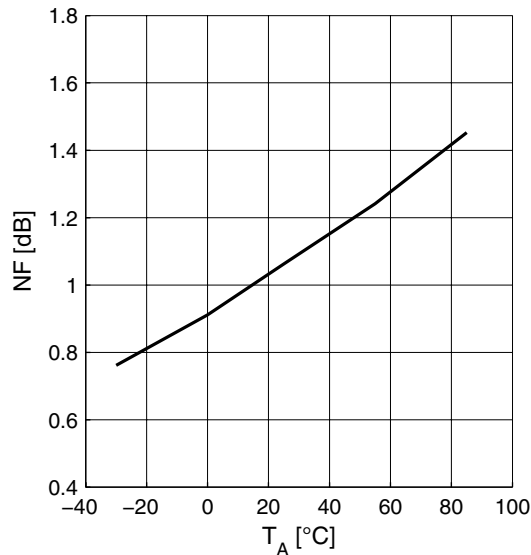


Supply Current $I_{CC} = f(T_A)$

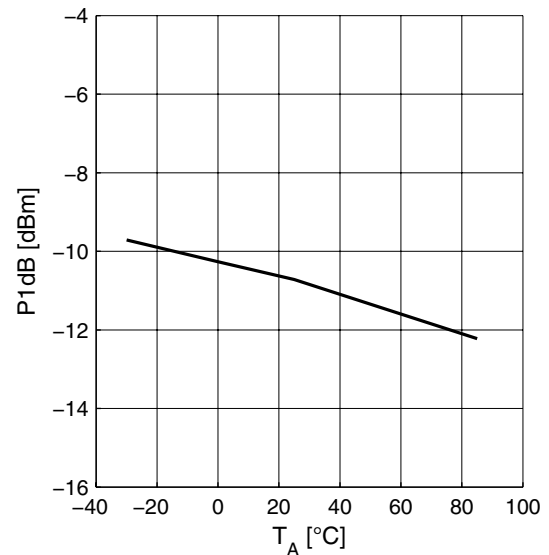


Measured Performance High Band Low Gain Mode vs. Frequency

Noise Figure $NF = f(T_A)$



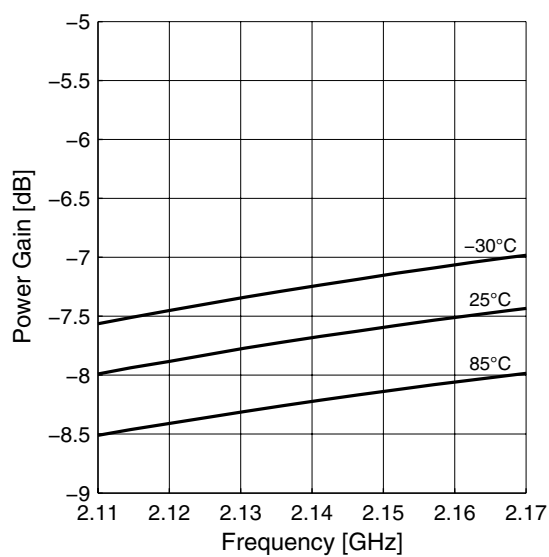
Input Compression $P_{1dB} = f(T_A)$



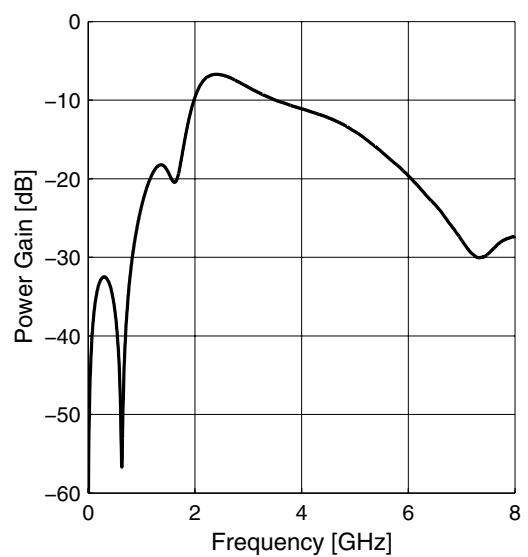
2.21 Measured Performance High Band Low Gain Mode vs. Frequency

$T_A = 25^\circ\text{C}$, $V_{CC} = 2.8\text{ V}$, $V_{GS} = 0\text{ V}$, $V_{EN1} = 2.8\text{ V}$, $V_{EN2} = 2.8\text{ V}$

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

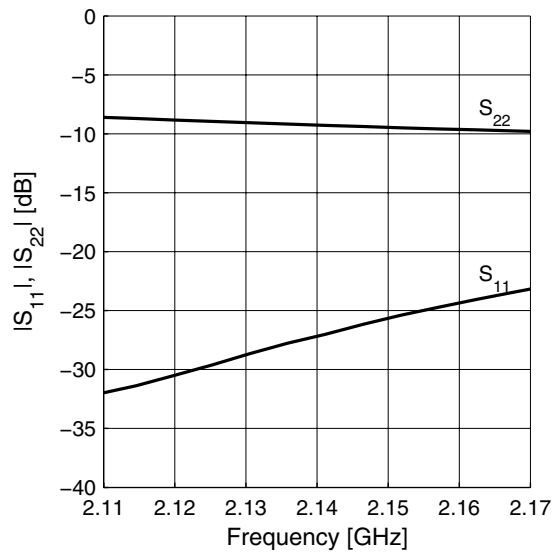


Power Gain Wideband $|S_{21}| = f(f)$

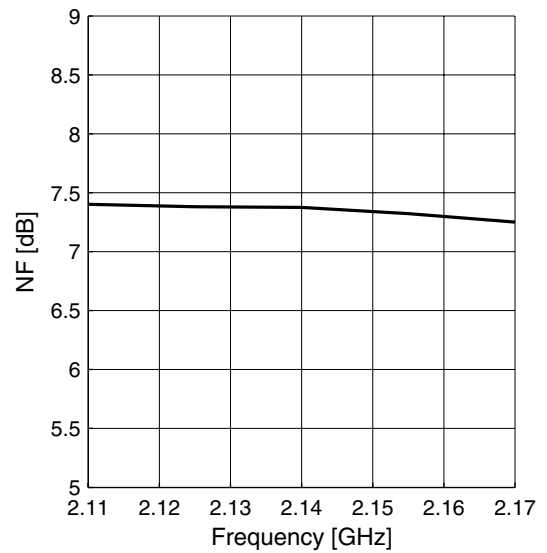


Measured Performance High Band Low Gain Mode vs. Frequency

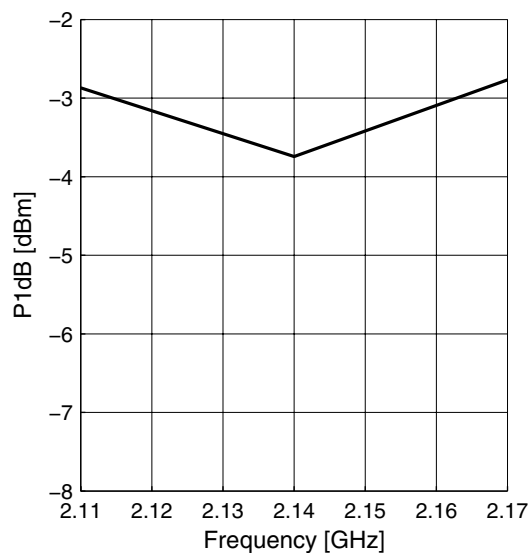
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



Noise Figure $NF = f(f)$



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

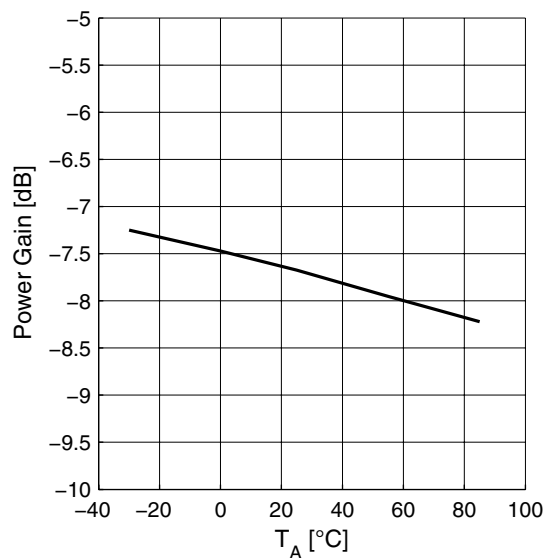


Measured Performance High Band Low Gain Mode vs. Temperature

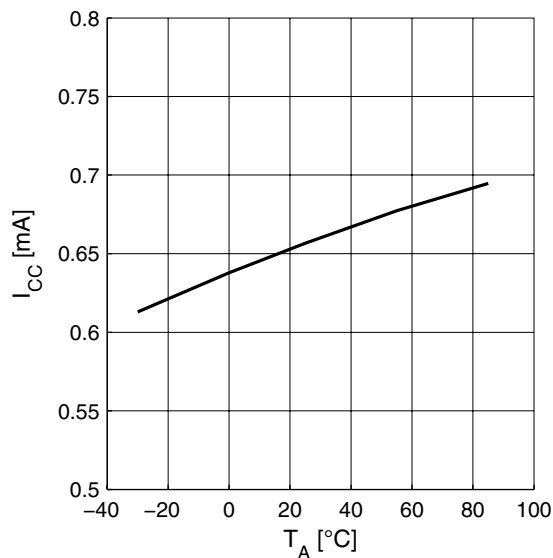
2.22 Measured Performance High Band Low Gain Mode vs. Temperature

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

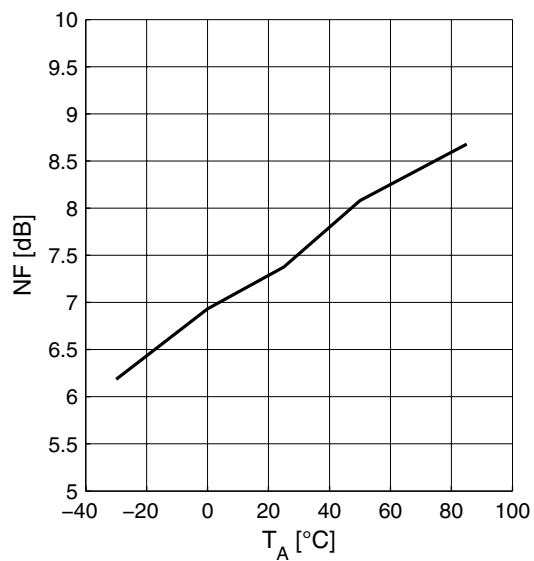
Power Gain $|S_{21}| = f(T_A)$



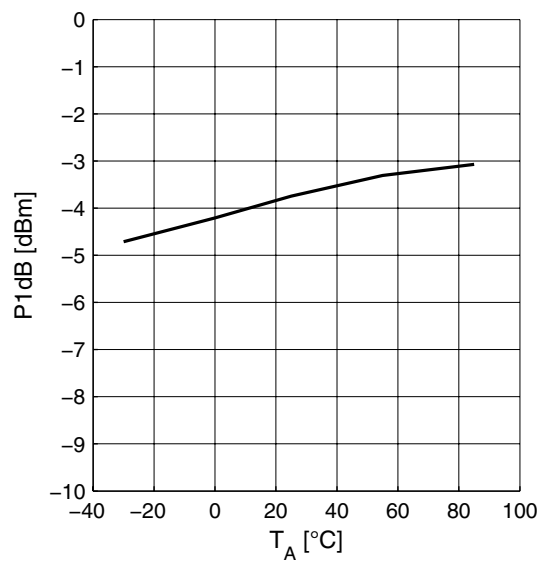
Supply Current $I_{CC} = f(T_A)$



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

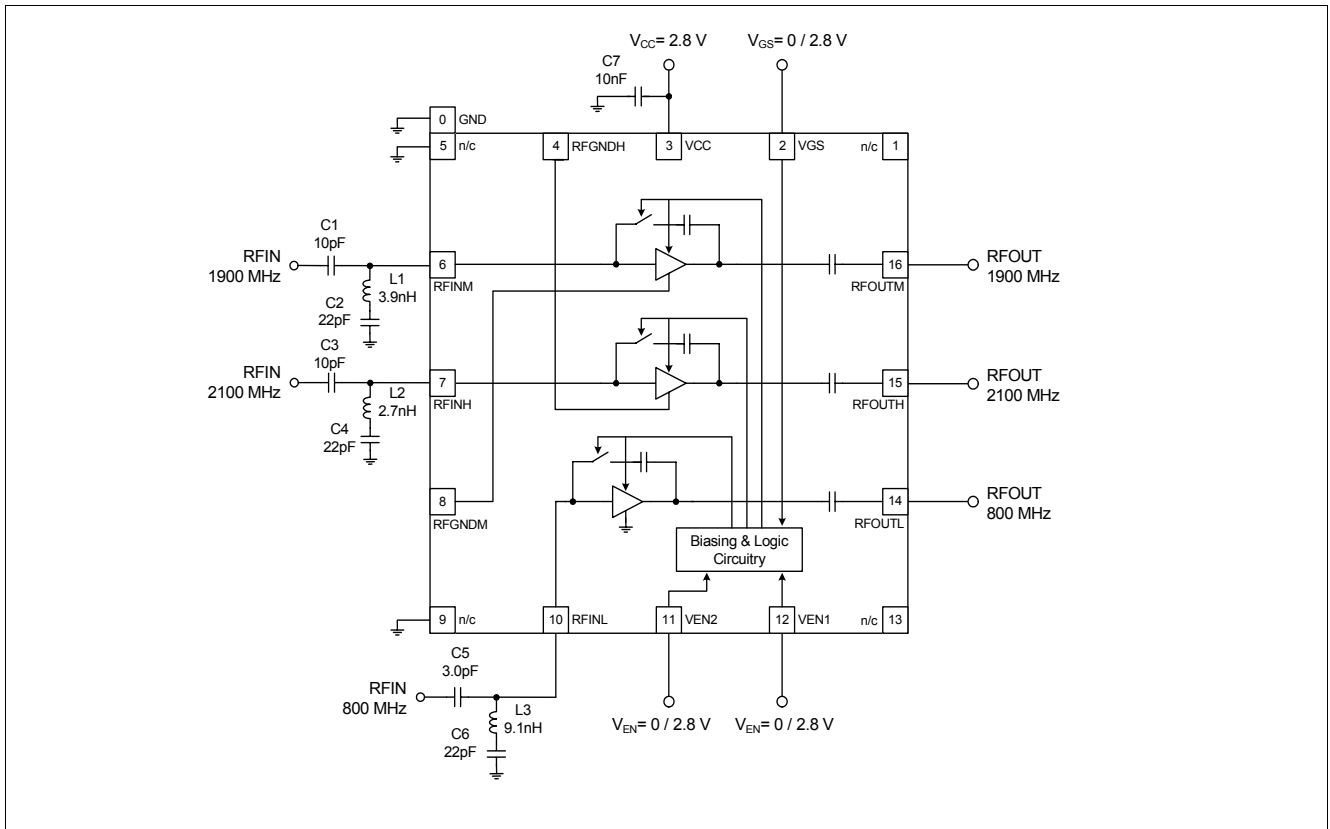


Figure 2 Application circuit with chip outline (top view)

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 circuitry (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

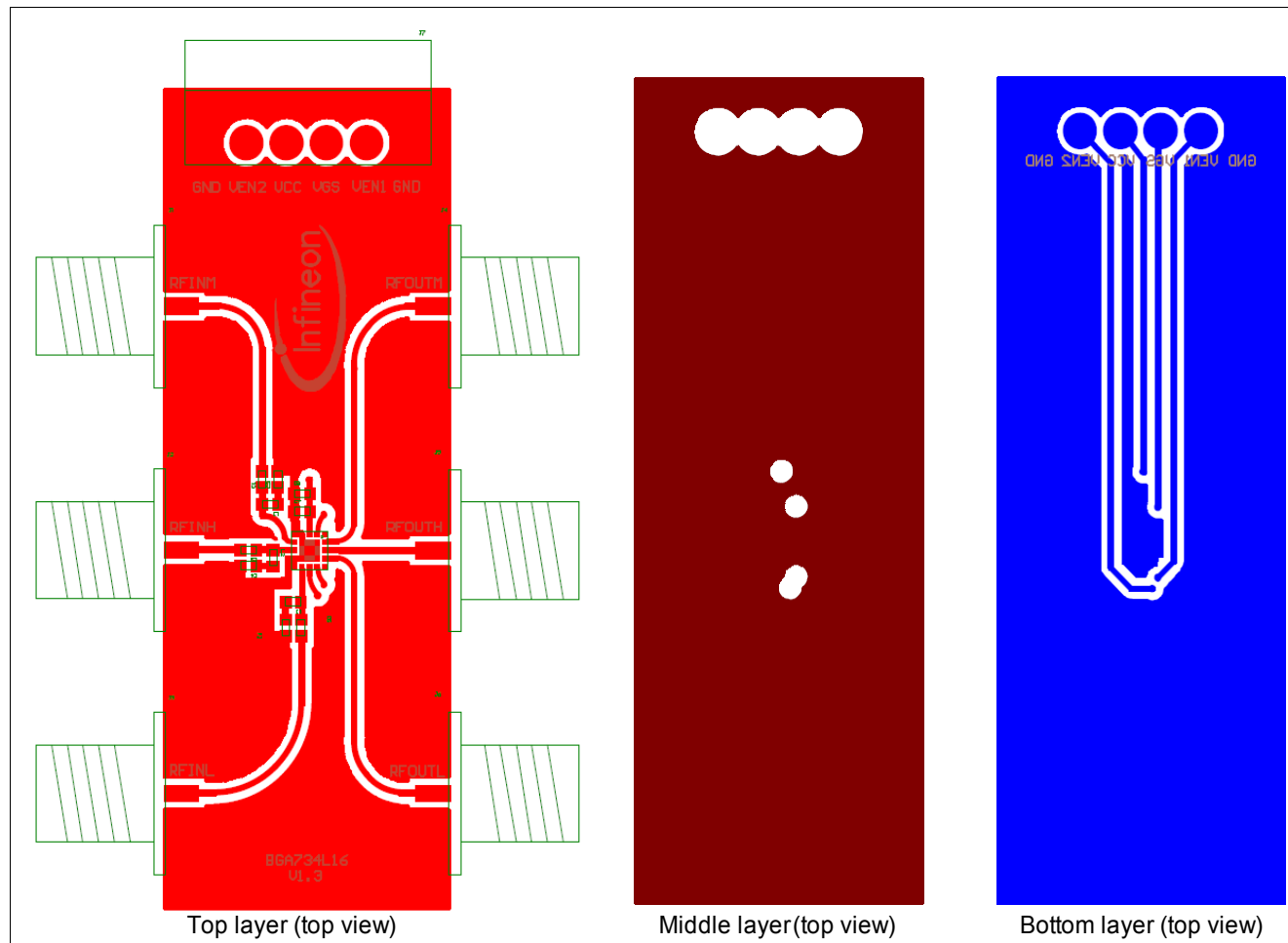


Figure 3 Application board layout on 3-layer FR4. Top layer thickness: 0.2 mm, bottom layer thickness: 0.8 mm, 35 μ m Cu metallization, gold plated. Board size: 21 x 50 mm

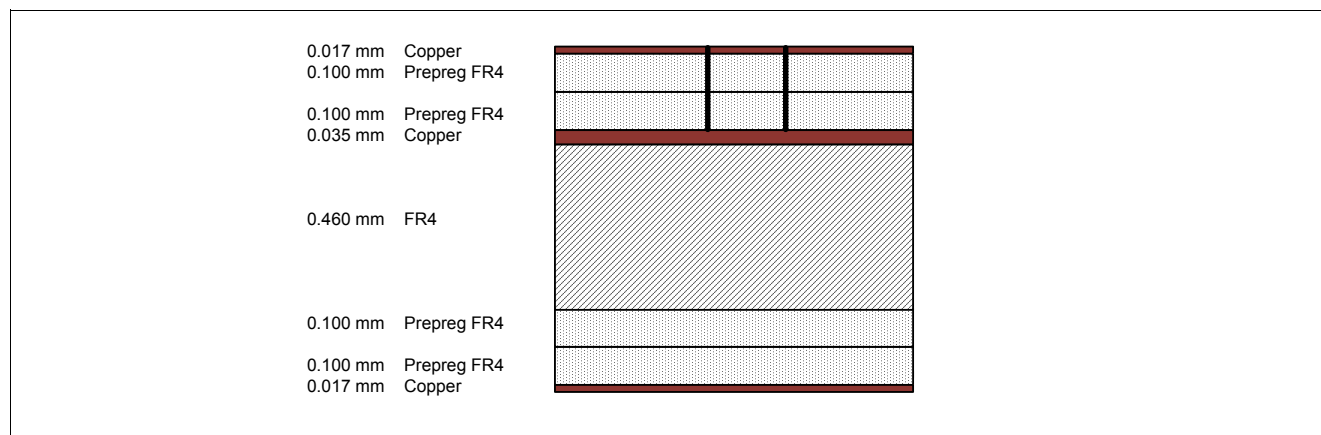


Figure 4 Cross-section view of application board

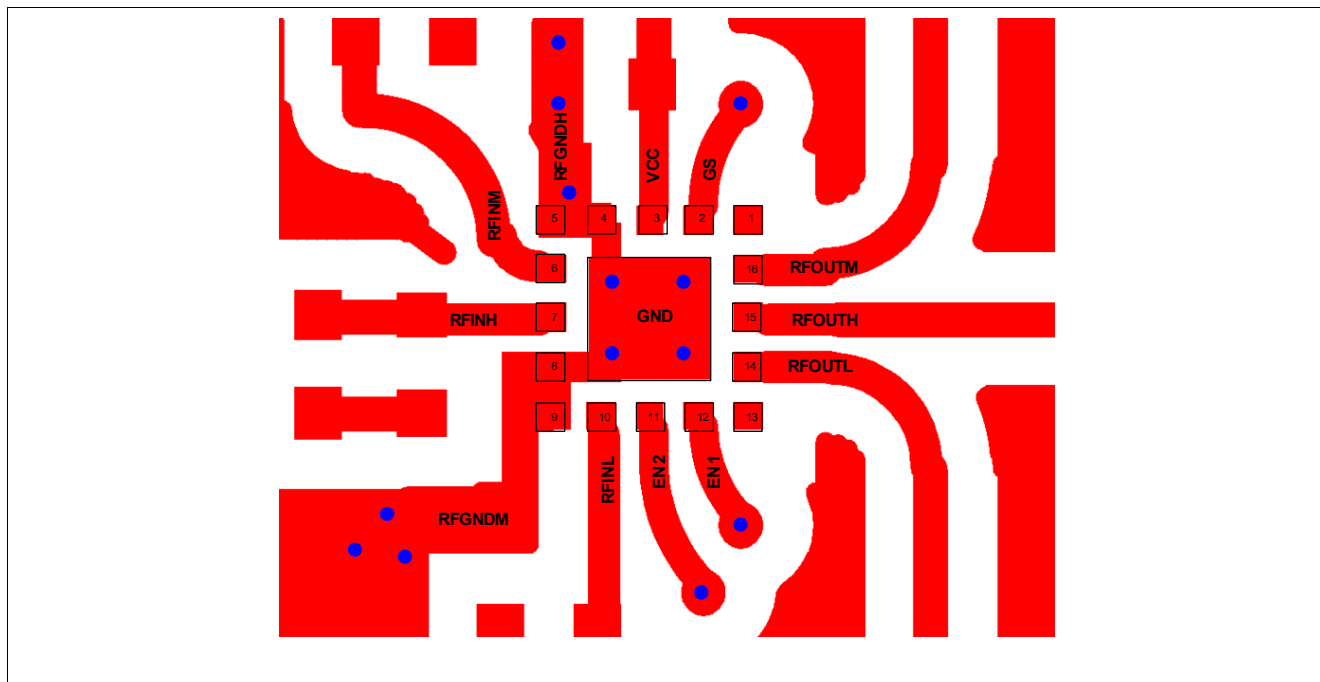


Figure 5 Detail of application board layout

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

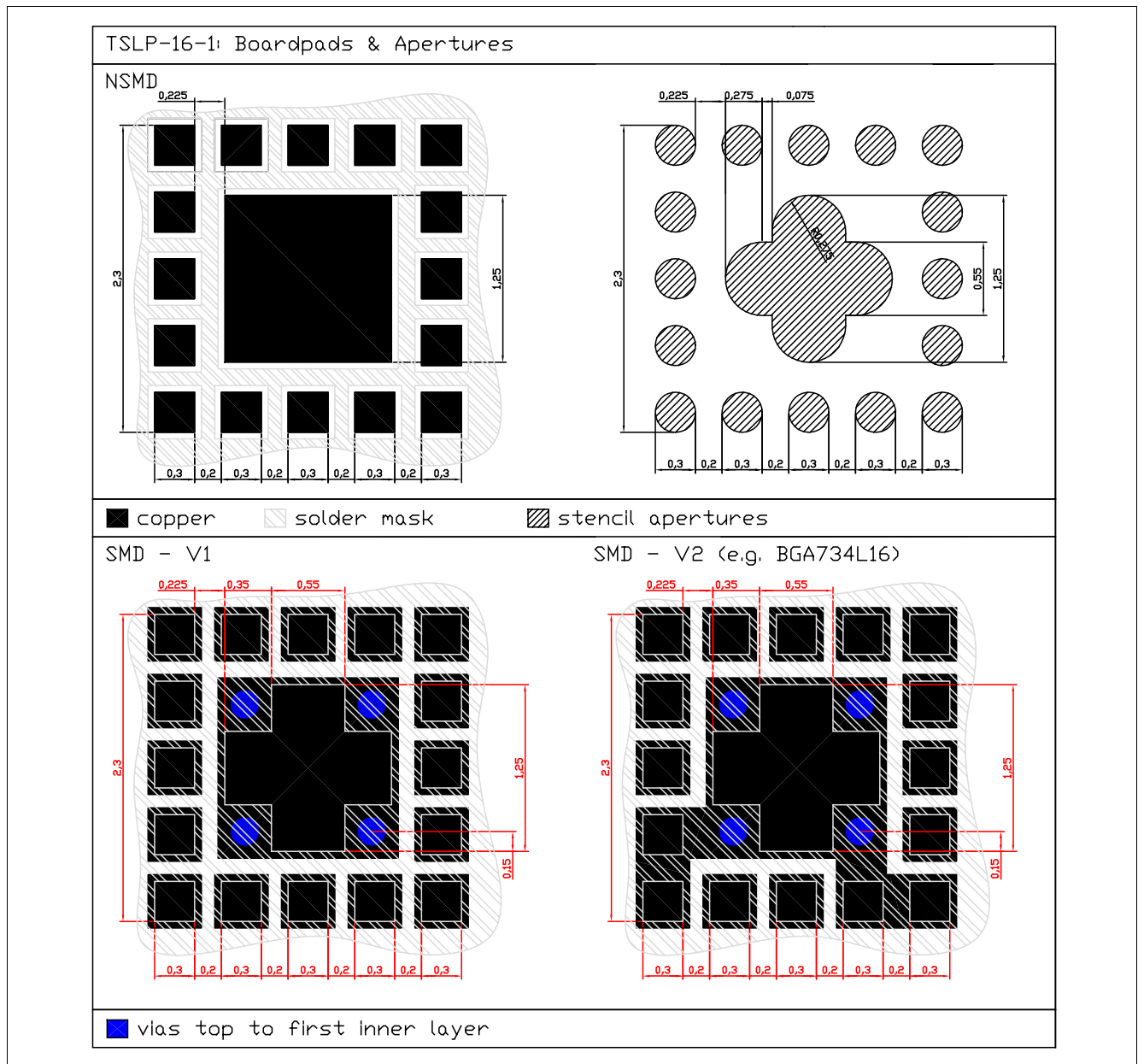


Figure 6 Recommended footprint and stencil layout for the TSLP-16-1 package.

4.2 Package Dimensions

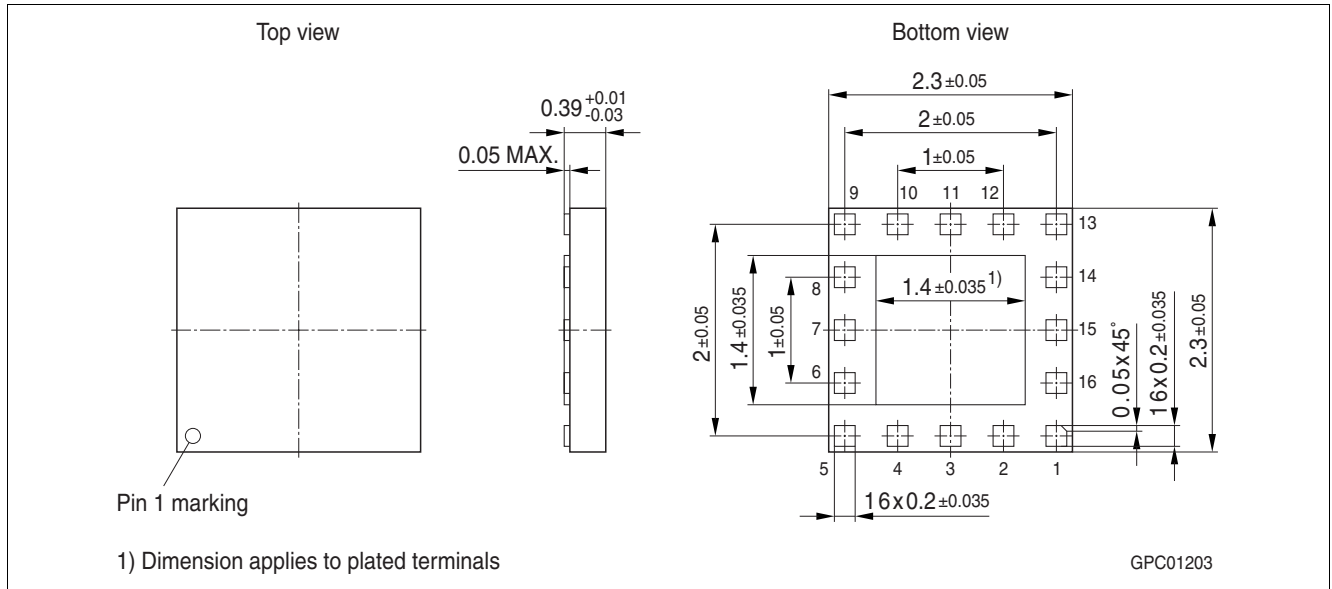


Figure 7 Package outline (top, side and bottom view)