

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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Previous Revision: 2008-01-25, Revision 1.0

Page	Subjects (major changes since last revision)
10	Updated Logic Level Limit

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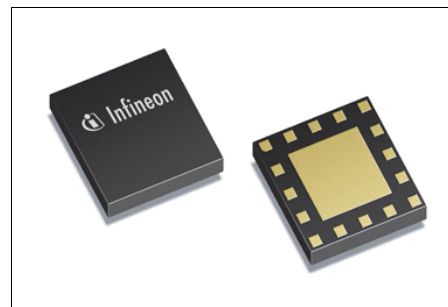
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1 Features

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 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



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

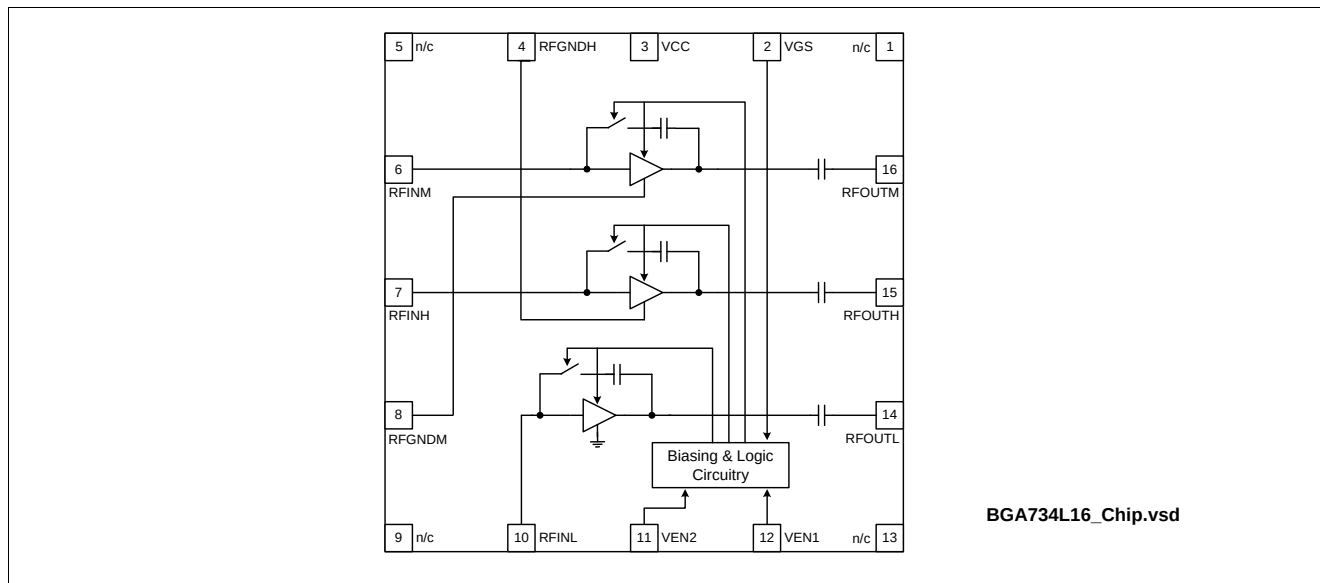


Figure 1 Block Diagram of Triple-Band LNA

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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, $T_A = -30 \dots 85 \text{ }^\circ\text{C}$

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}	1.4	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, $V_{CC} = 2.8 \text{ V}$

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

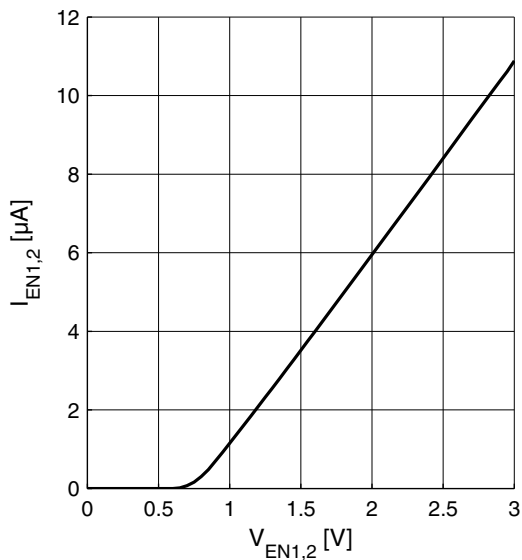
Table 6 Gain Control Truth Table, $V_{CC} = 2.8 \text{ V}$

	High Gain	Low Gain
VGS	H	L

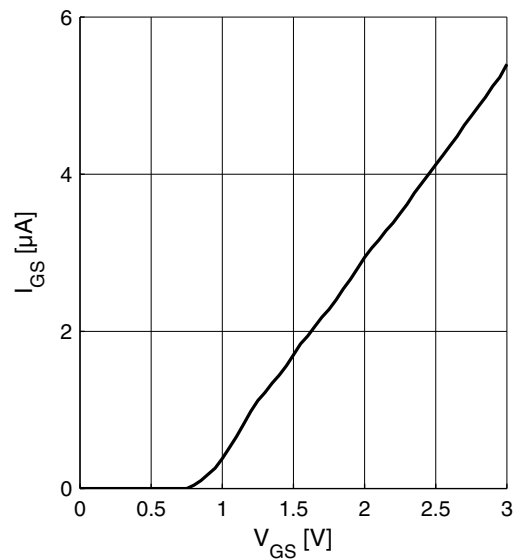
2.6 Logic Signal Characteristics; $T_A = 25\text{ }^{\circ}\text{C}$

Current consumption of logic inputs VEN1, VEN2, VGS

Logic currents $I_{\text{EN}1,2} = f(V_{\text{EN}1,2})$
 $V_{\text{CC}} = 2.8\text{ V}$



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



2.7 Switching Times

Table 7 Typical Switching Times; $T_A = -30 \dots 85\text{ }^{\circ}\text{C}$

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, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}$ 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⁾ $f_1 - f_2 = 1\text{ MHz}$ $P_{f1} = P_{f2} = -25\text{ dBm}$	$IIP3_{HG}$	—	-6	—	dBm	High gain mode
	$IIP3_{LG}$	—	5	—	dBm	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, $T_A = 25\text{ }^{\circ}\text{C}$, $V_{CC} = 2.8\text{ V}$ 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⁾ $f_1 - f_2 = 1\text{ MHz}$ $P_{f1} = P_{f2} = -26\text{ dBm}$	$IIP3_{HG}$	–	-5	–	dBm	High gain mode
	$IIP3_{LG}$	–	6	–	dBm	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, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}$ 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⁾ $f_1 - f_2 = 1\text{ MHz}$ $P_{f1} = P_{f2} = -26\text{ dBm}$	$IIP3_{HG}$	–	-6	–	dBm	High gain mode
	$IIP3_{LG}$	–	7	–	dBm	Low gain mode

1) Performance based on application circuit in Figure 2 on Page 33

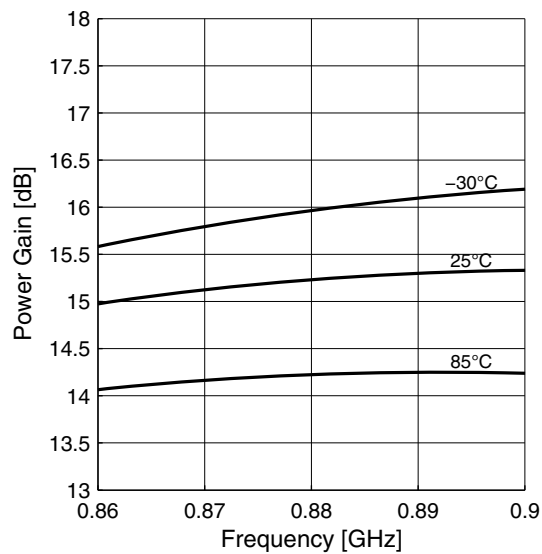
2) Verification based on AQL; random production test.

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

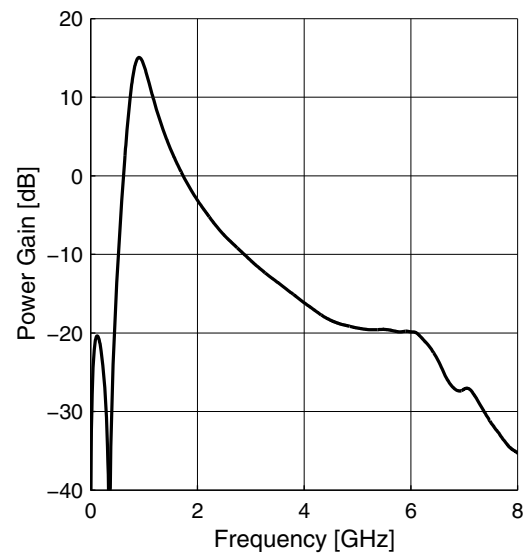
2.11 Measured Performance Low Band High Gain Mode vs. Frequency

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

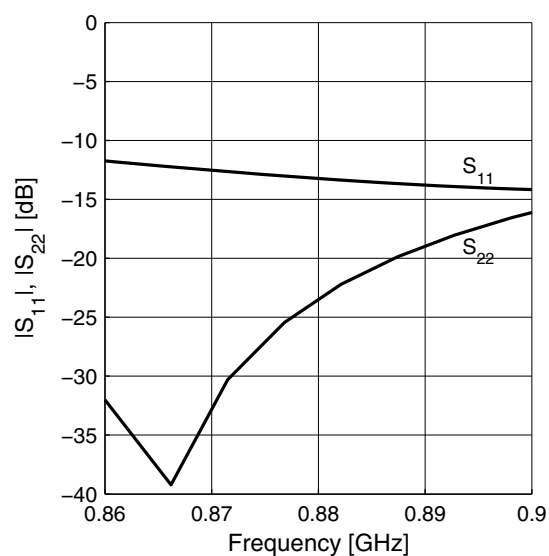
Power Gain $|S_{21}| = f(f)$



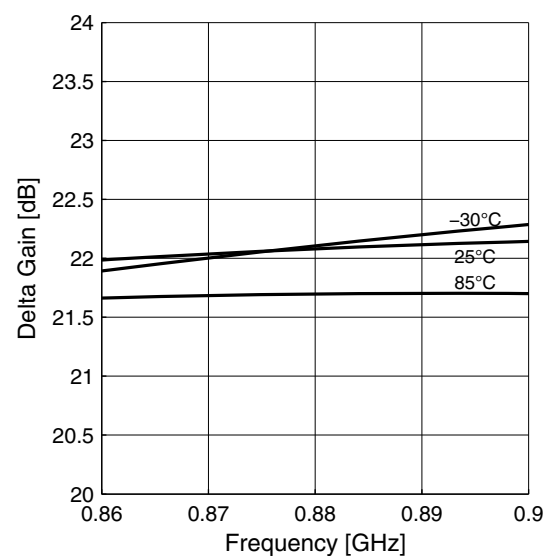
Power Gain Wideband $|S_{21}| = f(f)$



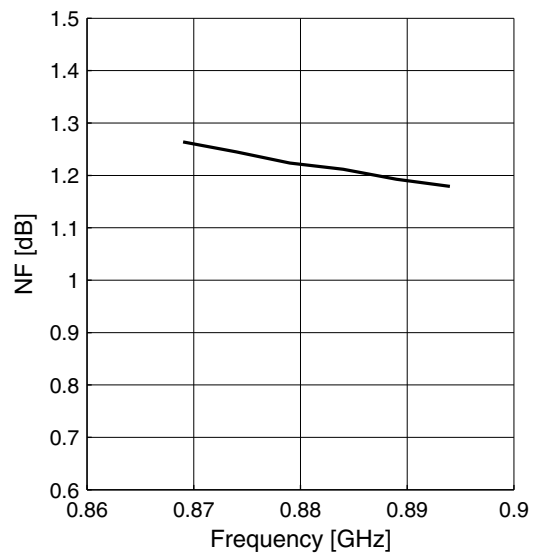
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



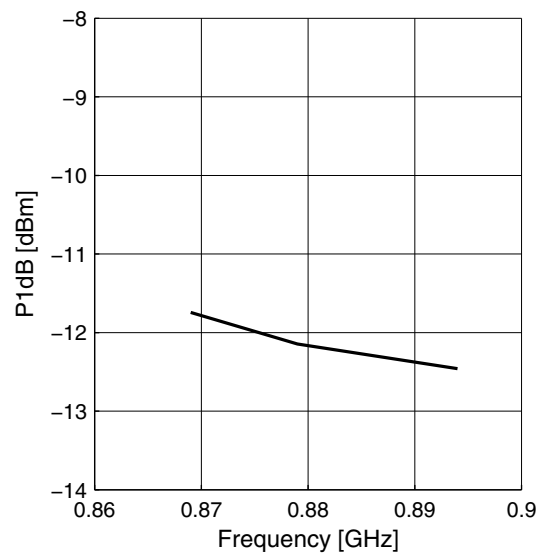
Gainstep HG - LG $|\Delta S_{21}| = f(f)$



Noise Figure $NF = f(f)$



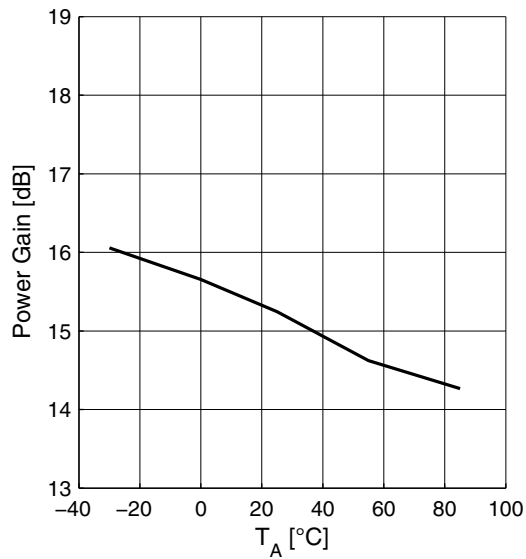
Input Compression $P_{1dB} = f(f)$



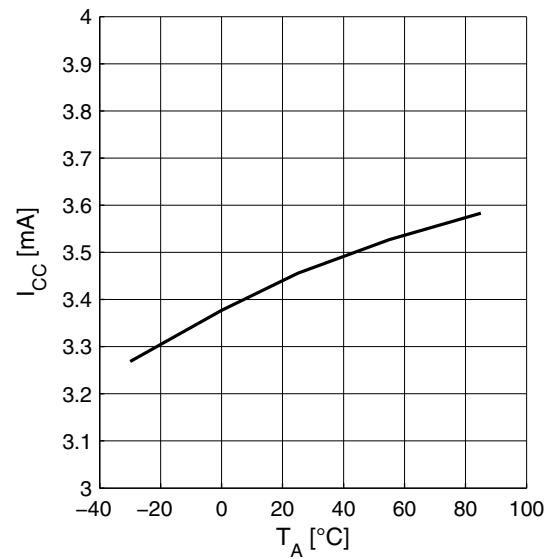
2.12 Measured Performance Low Band High Gain Mode vs. Temperature

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

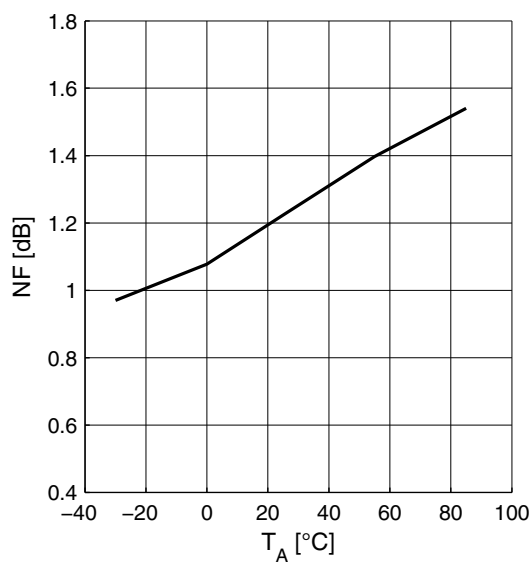
Power Gain $|S_{21}| = f(T_A)$



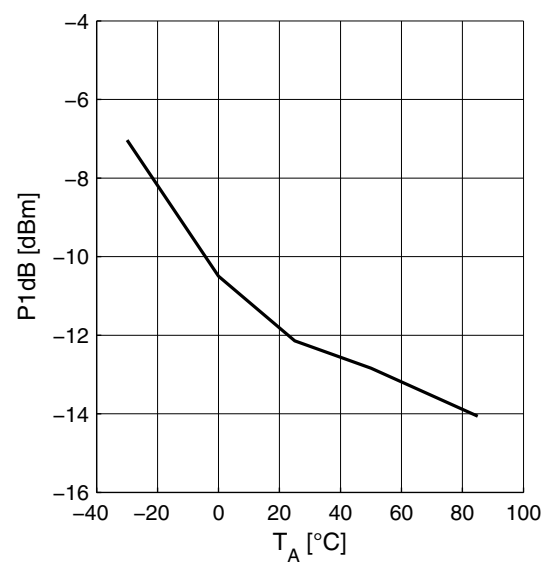
Supply Current $I_{CC} = f(T_A)$



Noise Figure $NF = f(T_A)$



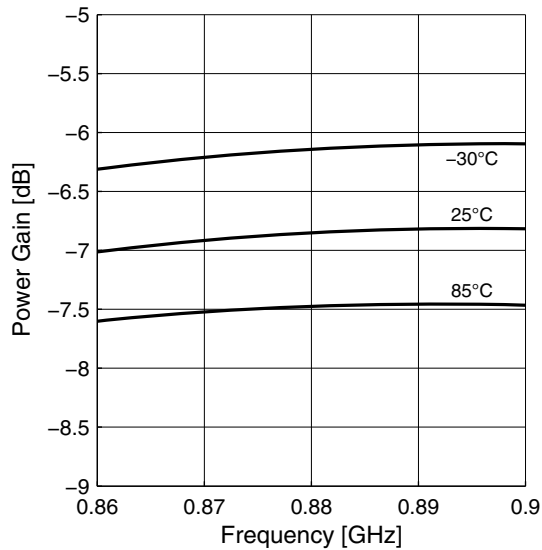
Input Compression $P_{1dB} = f(T_A)$



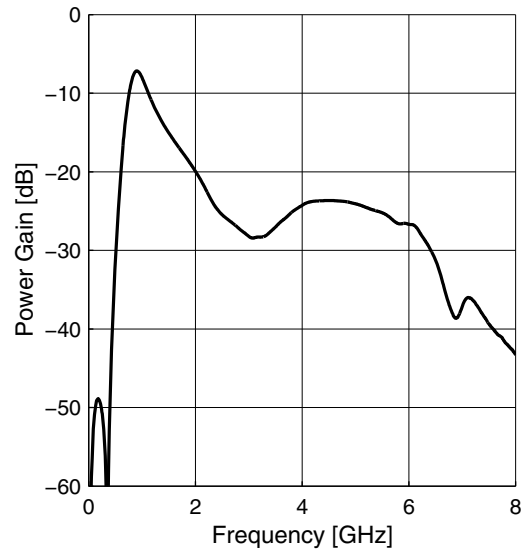
2.13 Measured Performance Low Band Low Gain Mode vs. Frequency

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

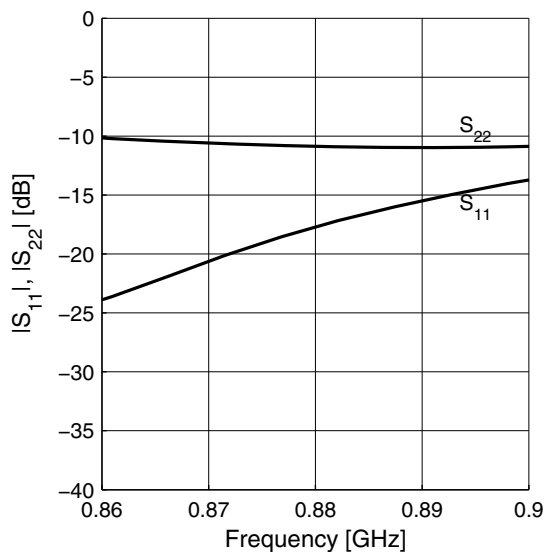
Power Gain $|S_{21}| = f(f)$



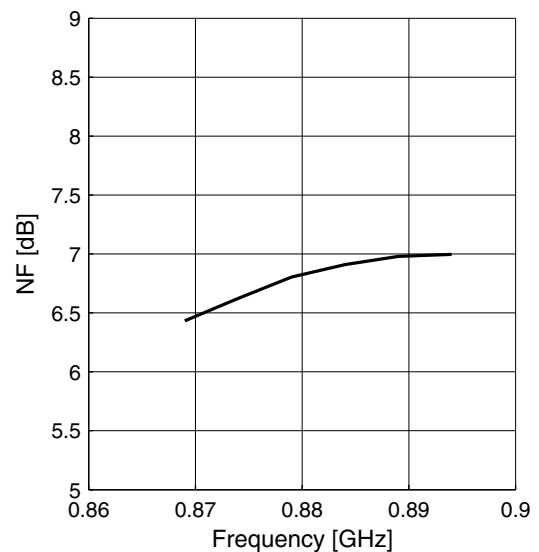
Power Gain Wideband $|S_{21}| = f(f)$



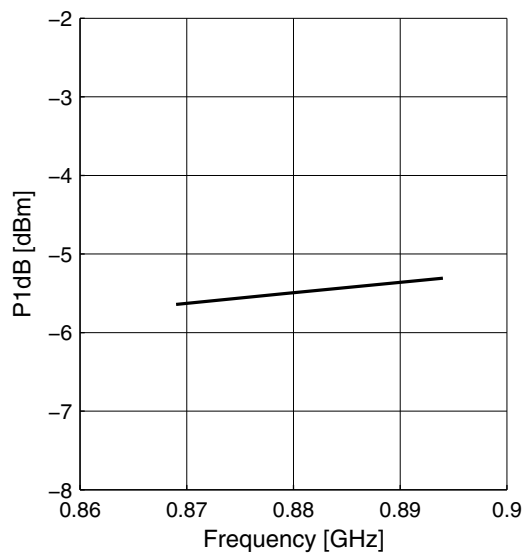
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



Noise Figure $NF = f(f)$



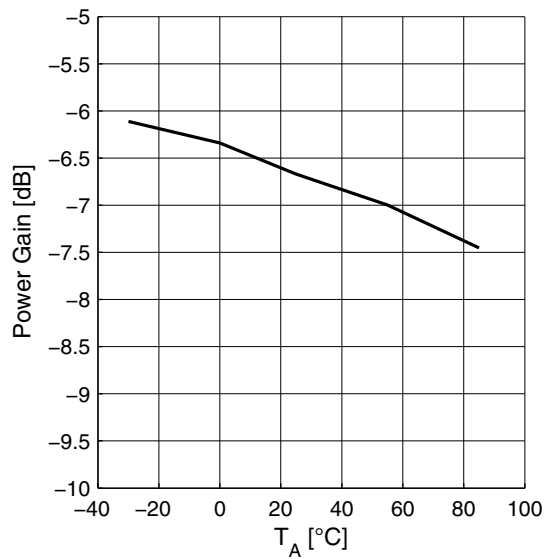
Input Compression $P_{1dB} = f(f)$



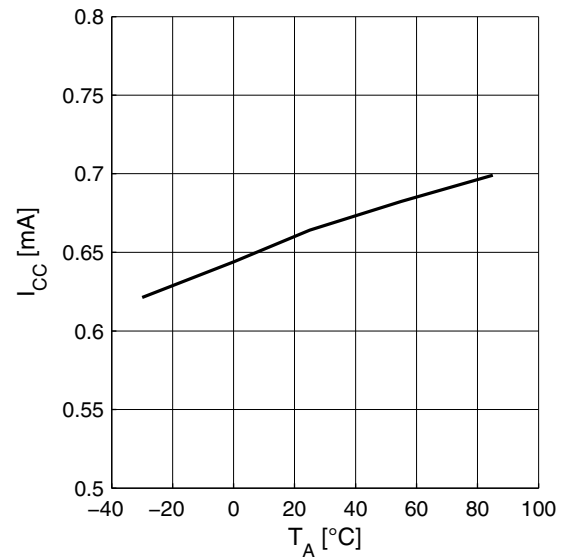
2.14 Measured Performance Low Band Low Gain Mode vs. Temperature

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

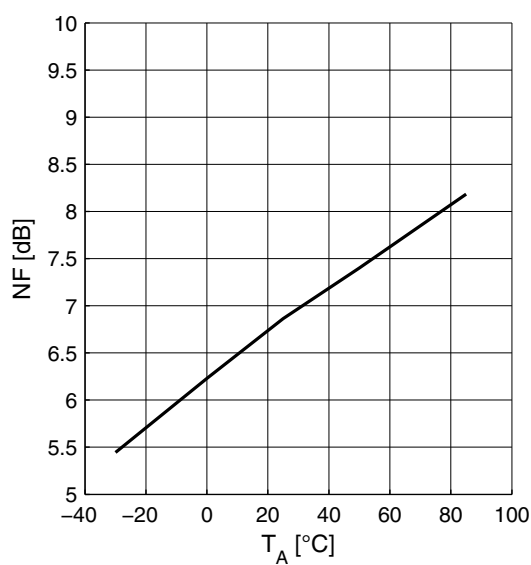
Power Gain $|S_{21}| = f(T_A)$



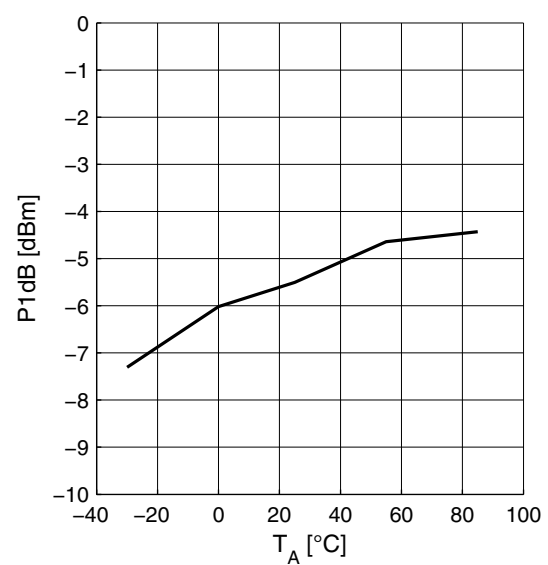
Supply Current $I_{CC} = f(T_A)$



Noise Figure $NF = f(T_A)$



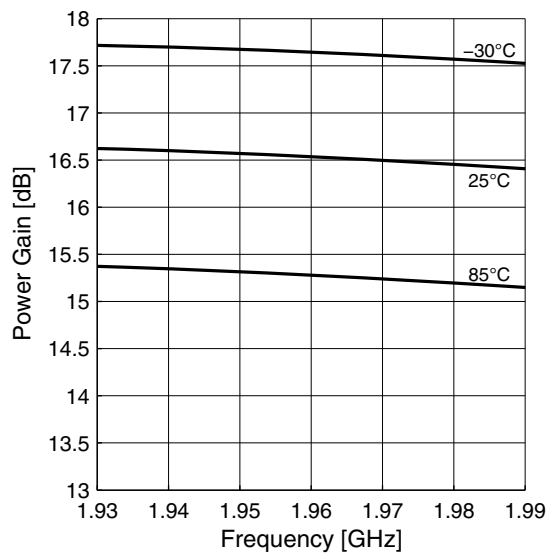
Input Compression $P_{1dB} = f(T_A)$



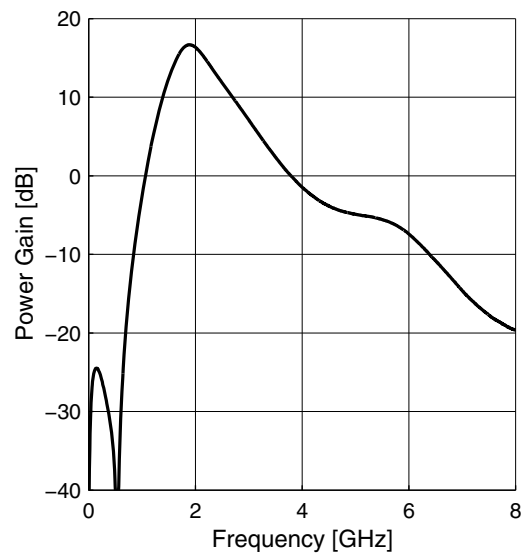
2.15 Measured Performance Mid Band High Gain Mode vs. Frequency

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

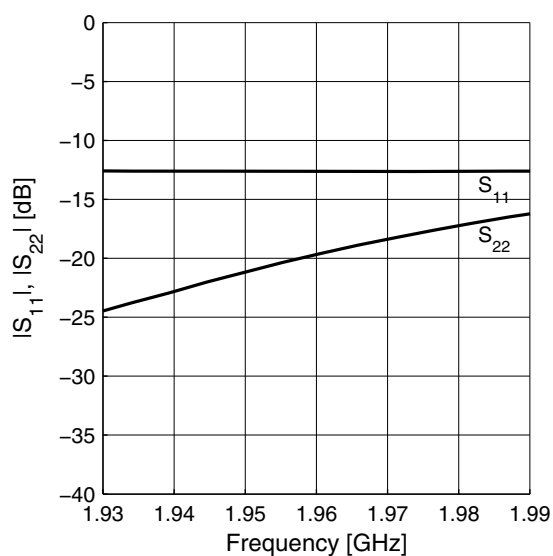
Power Gain $|S_{21}| = f(f)$



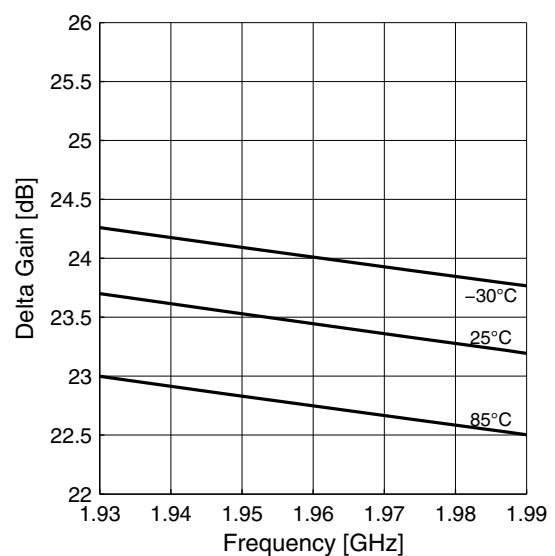
Power Gain Wideband $|S_{21}| = f(f)$



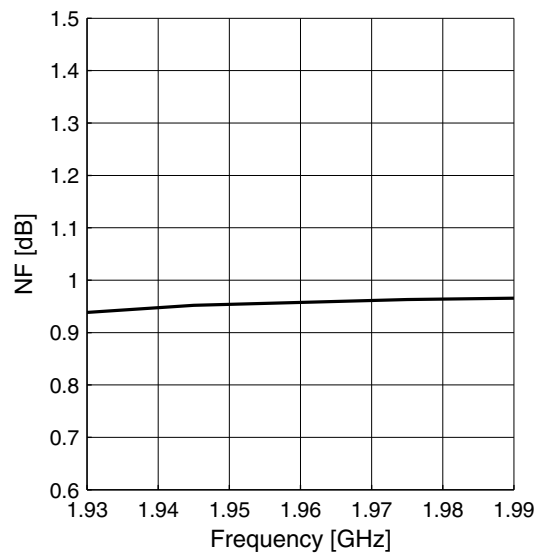
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



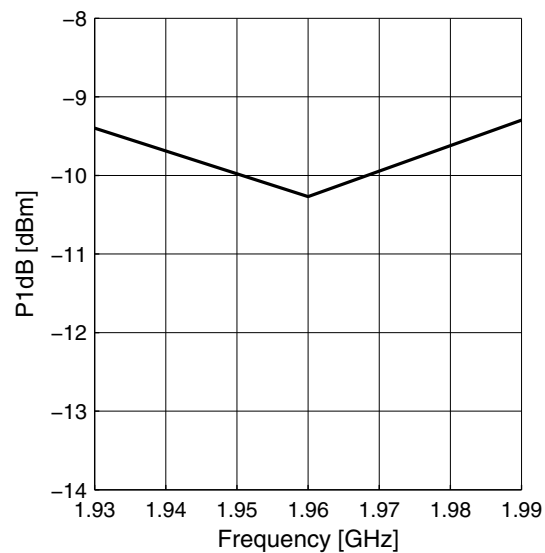
Gainstep HG - LG $|\Delta S_{21}| = f(f)$



Noise Figure $NF = f(f)$



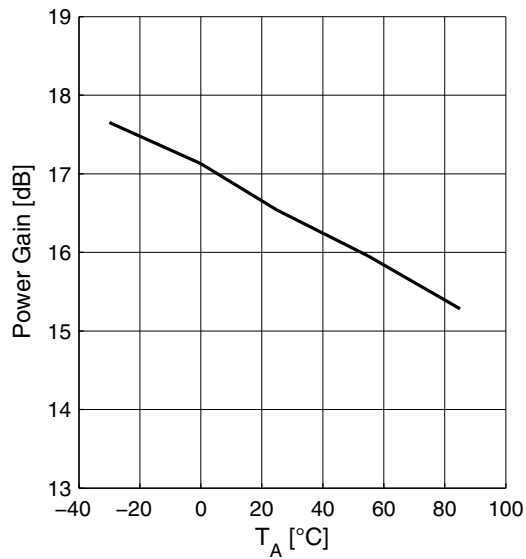
Input Compression $P_{1dB} = f(f)$



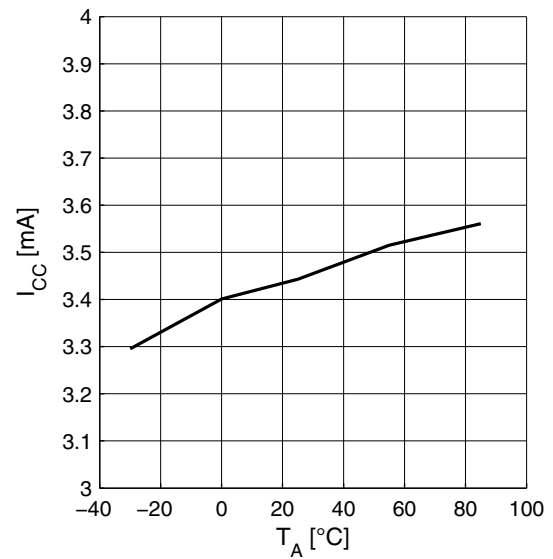
2.16 Measured Performance Mid Band High Gain Mode vs. Temperature

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

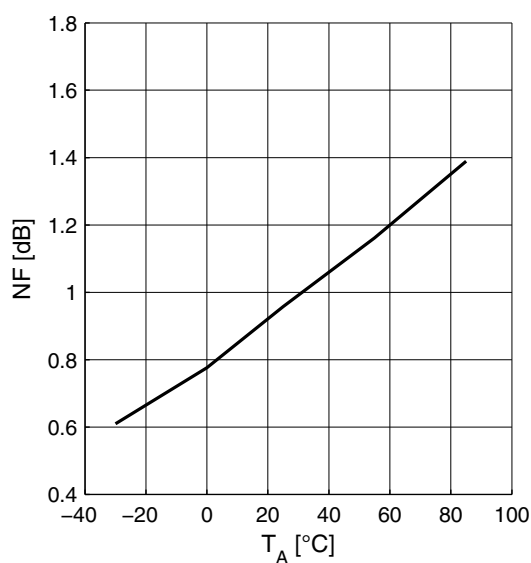
Power Gain $|S_{21}| = f(T_A)$



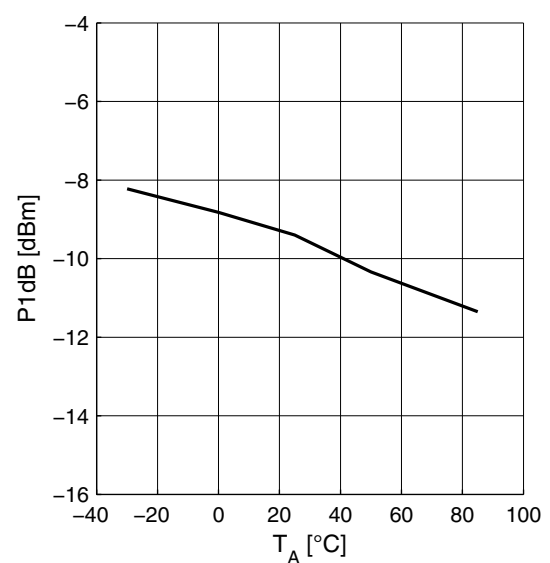
Supply Current $I_{CC} = f(T_A)$



Noise Figure $NF = f(T_A)$



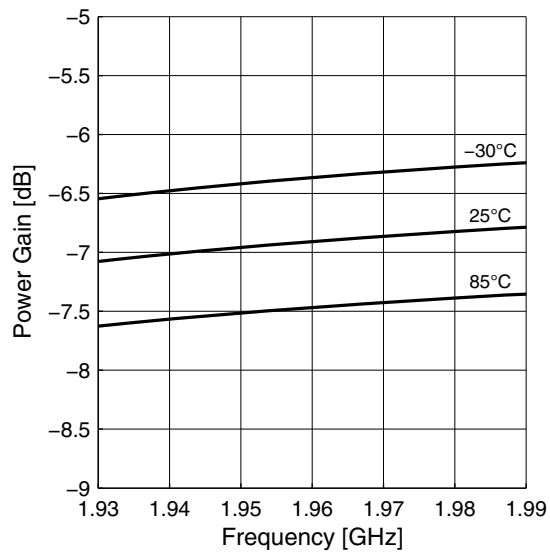
Input Compression $P_{1dB} = f(T_A)$



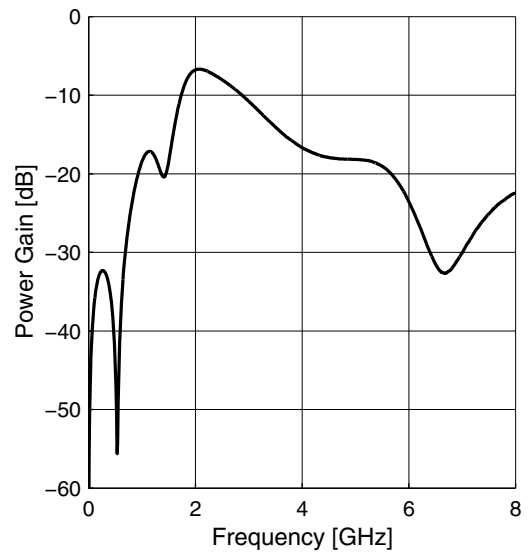
2.17 Measured Performance Mid Band Low Gain Mode vs. Frequency

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

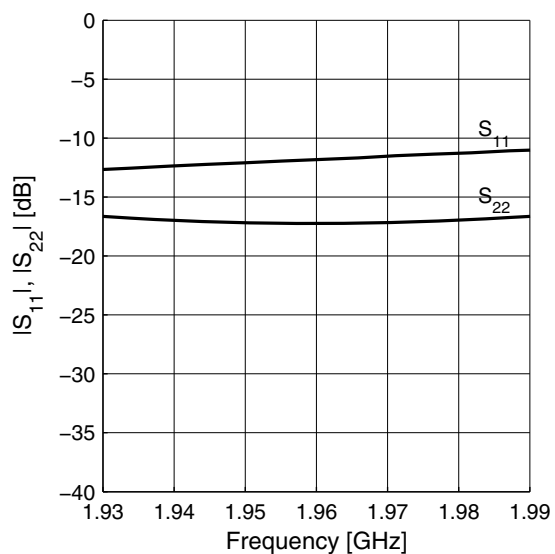
Power Gain $|S_{21}| = f(f)$



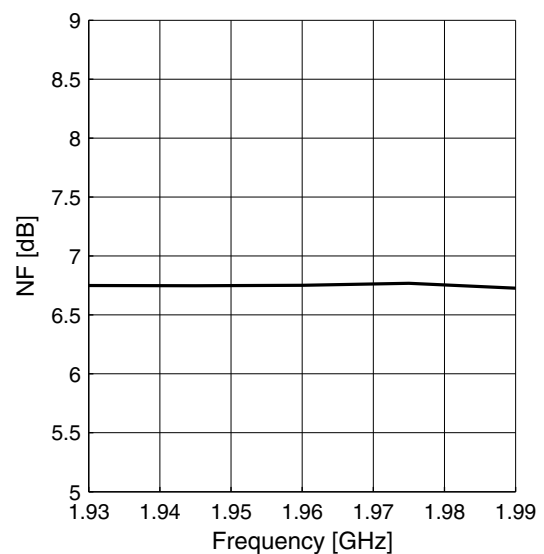
Power Gain Wideband $|S_{21}| = f(f)$



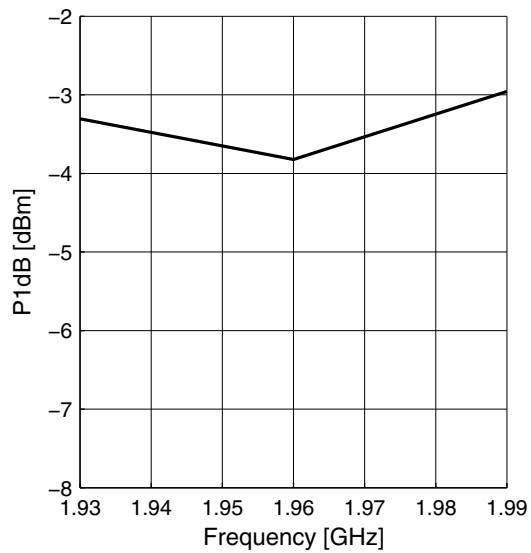
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



Noise Figure $NF = f(f)$



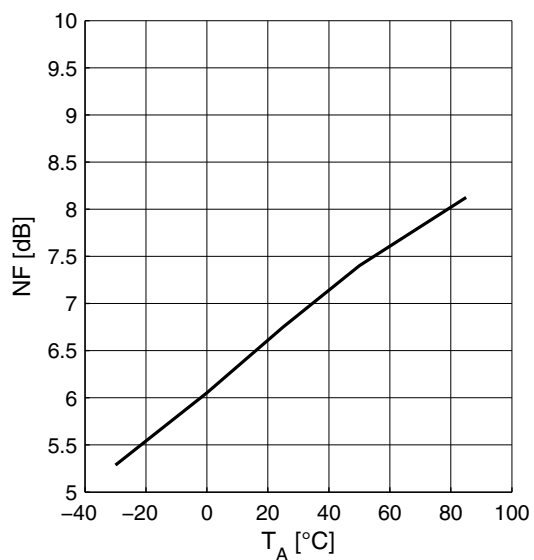
Input Compression $P_{1dB} = f(f)$



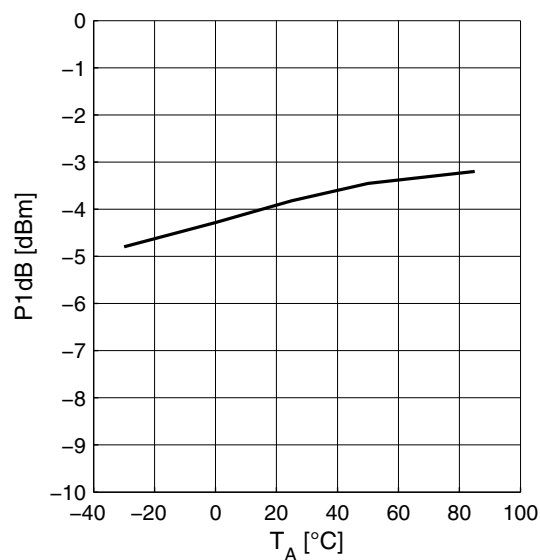
2.18 Measured Performance Mid Band Low Gain Mode vs. Temperature

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

Noise Figure $NF = f(T_A)$



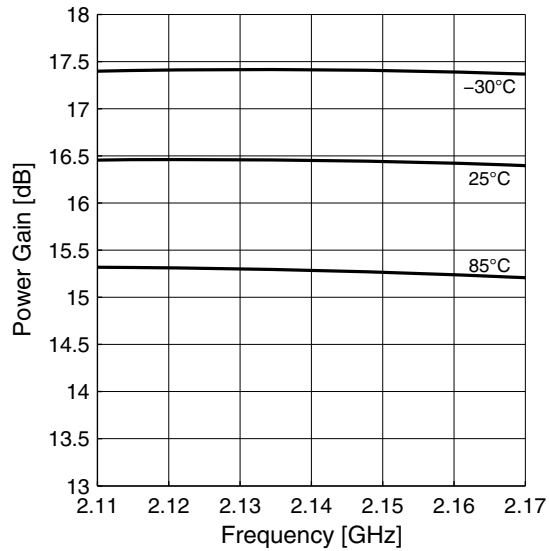
Input Compression $P_{1dB} = f(T_A)$



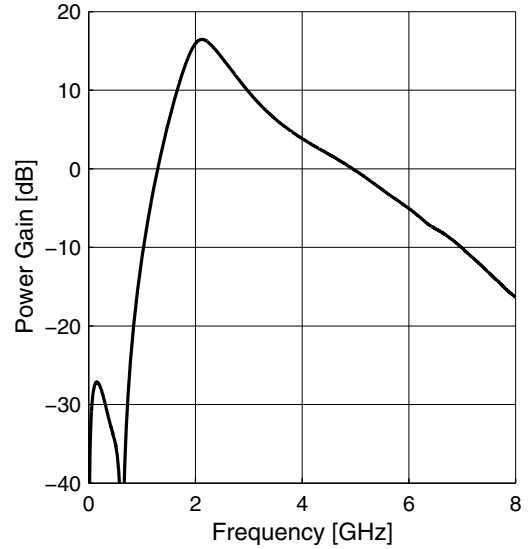
2.19 Measured Performance High Band High Gain Mode vs. Frequency

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

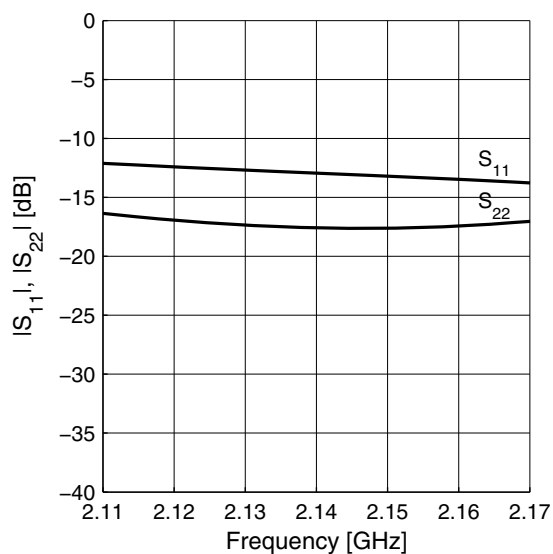
Power Gain $|S_{21}| = f(f)$



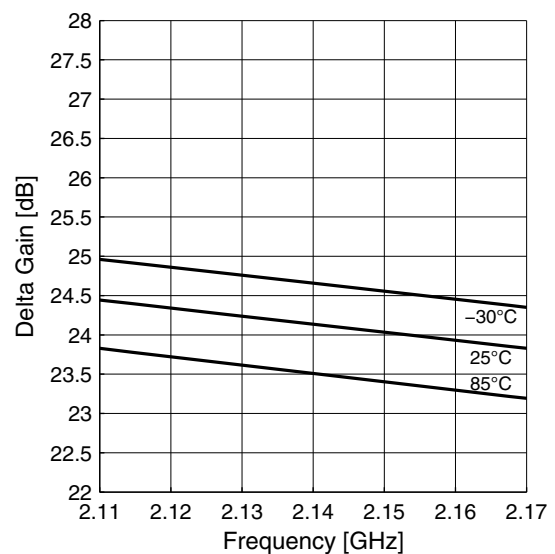
Power Gain Wideband $|S_{21}| = f(f)$



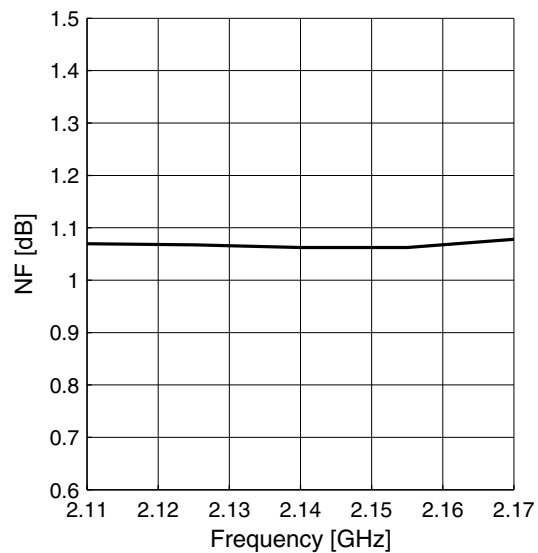
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



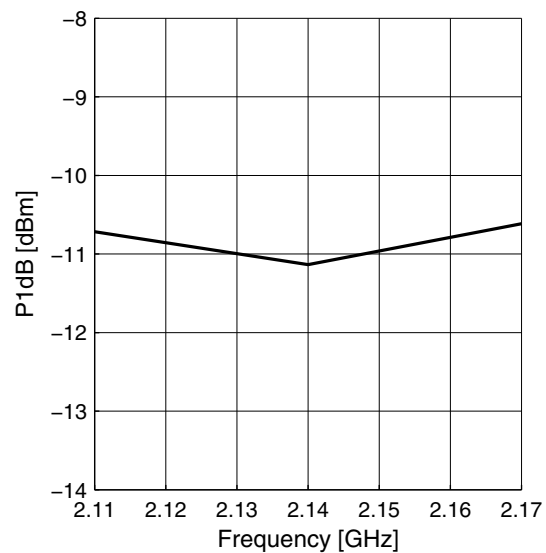
Gainstep HG - LG $|\Delta S_{21}| = f(f)$



Noise Figure $NF = f(f)$



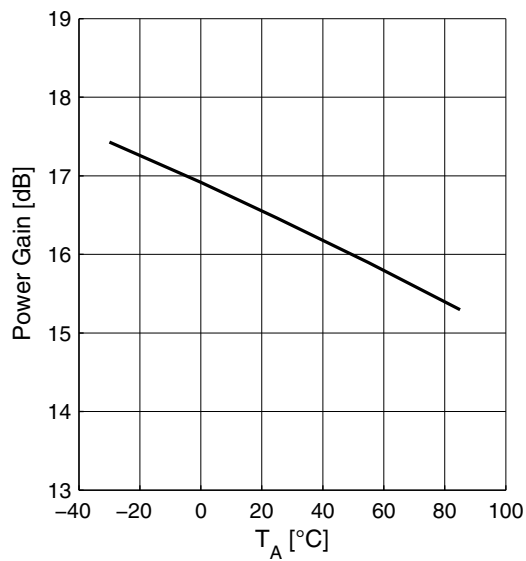
Input Compression $P_{1dB} = f(f)$



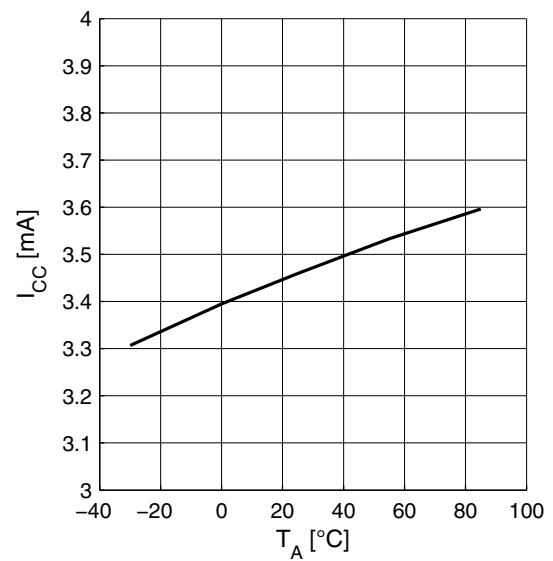
2.20 Measured Performance High Band High Gain Mode vs. Temperature

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

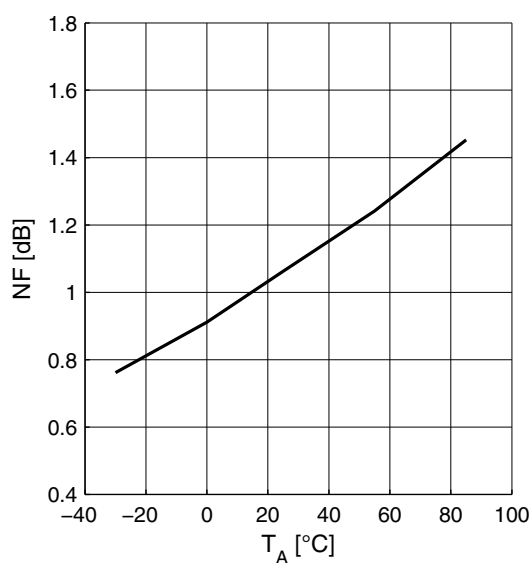
Power Gain $|S_{21}| = f(T_A)$



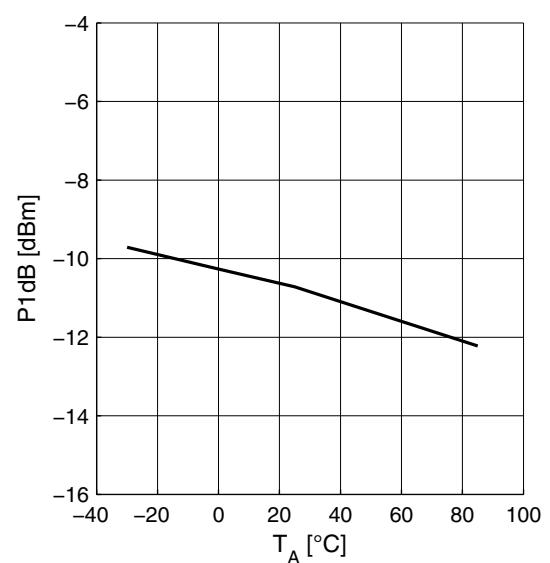
Supply Current $I_{CC} = f(T_A)$



Noise Figure $NF = f(T_A)$



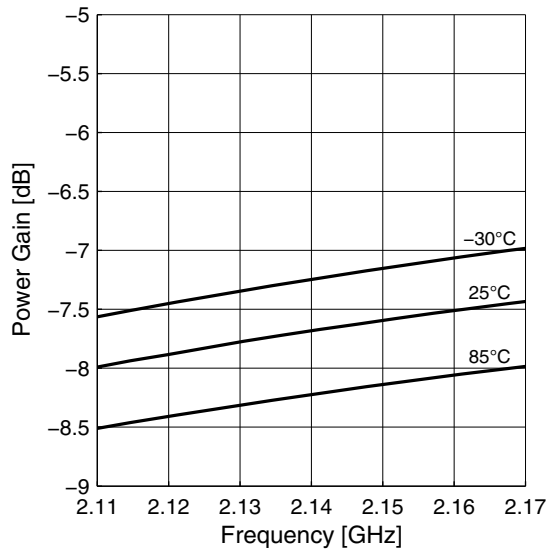
Input Compression $P_{1dB} = f(T_A)$



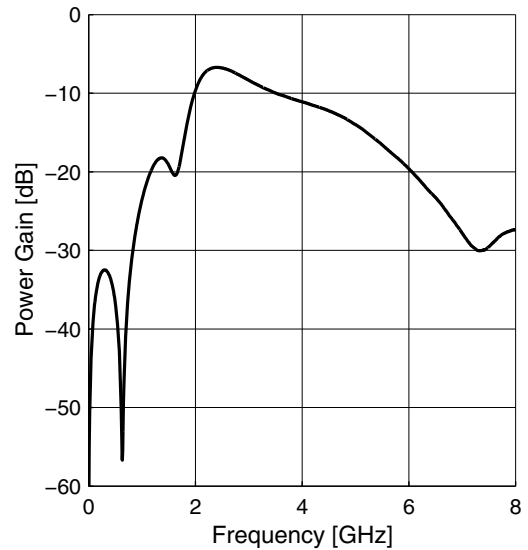
2.21 Measured Performance High Band Low Gain Mode vs. Frequency

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

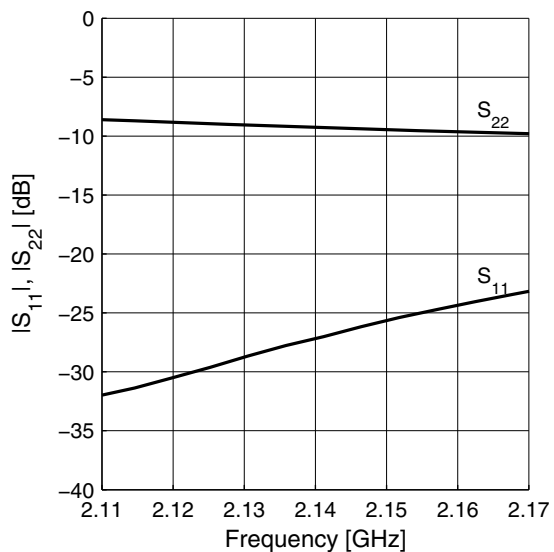
Power Gain $|S_{21}| = f(f)$



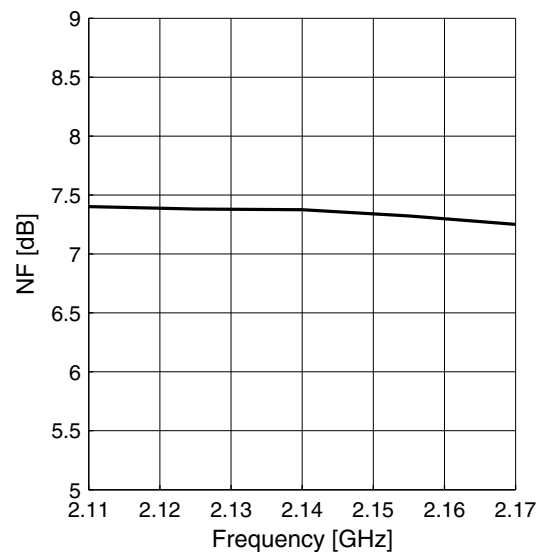
Power Gain Wideband $|S_{21}| = f(f)$



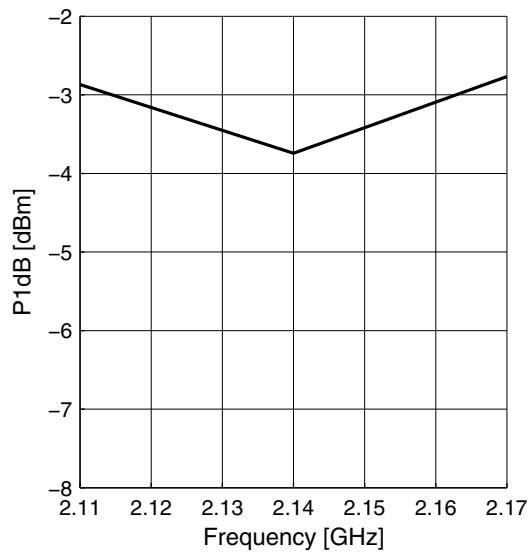
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



Noise Figure $NF = f(f)$



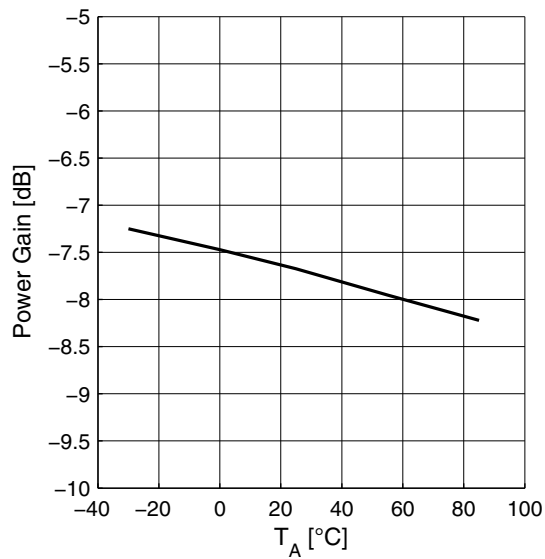
Input Compression $P_{1dB} = f(f)$



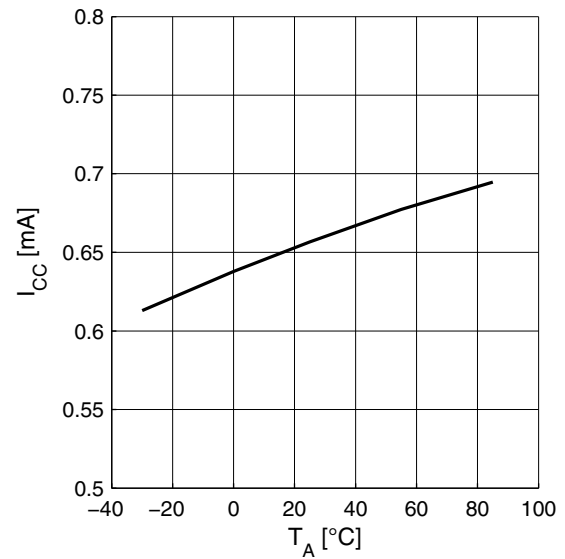
2.22 Measured Performance High Band Low Gain Mode vs. Temperature

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

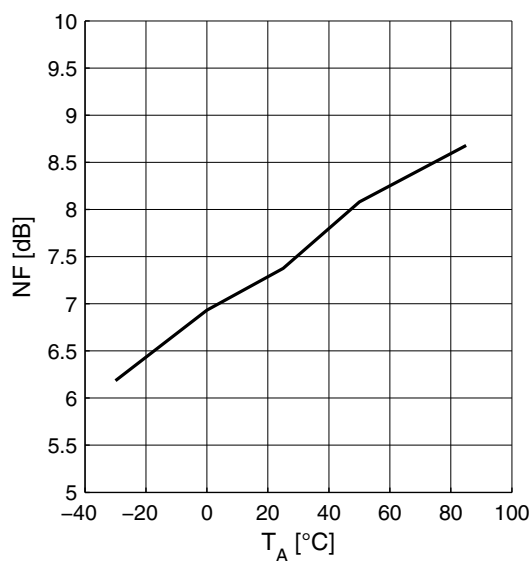
Power Gain $|S_{21}| = f(T_A)$



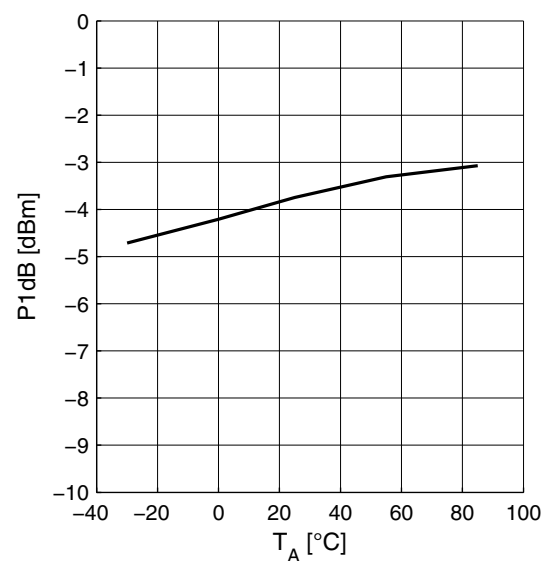
Supply Current $I_{CC} = f(T_A)$



Noise Figure $NF = f(T_A)$



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



3 Application Circuit and Block Diagram

3.1 UMTS Bands 1, 2 and 5 Application Circuit Schematic

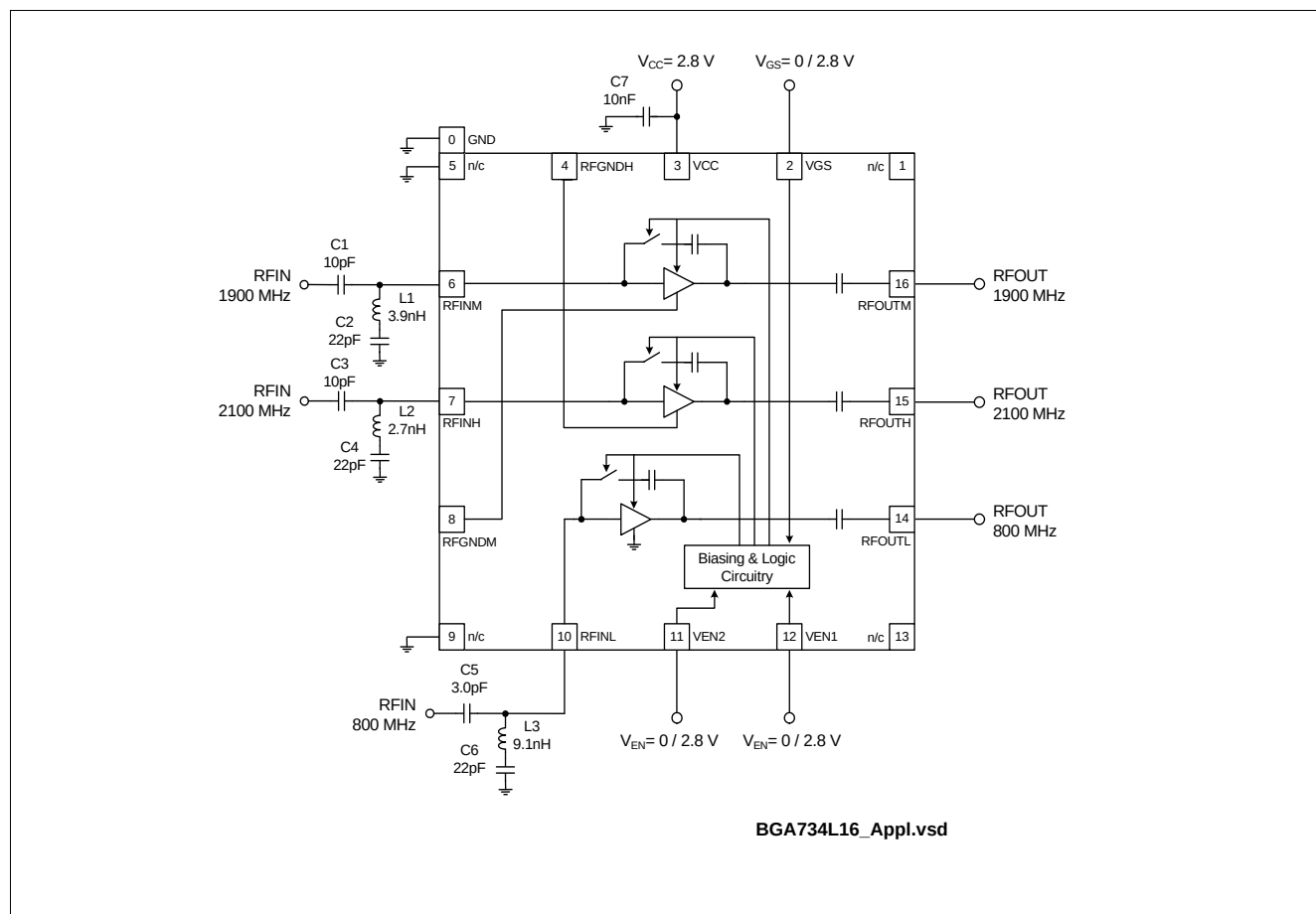


Figure 2 Application Circuit with Chip Outline (Top View)

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, $Q \approx 50$
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 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

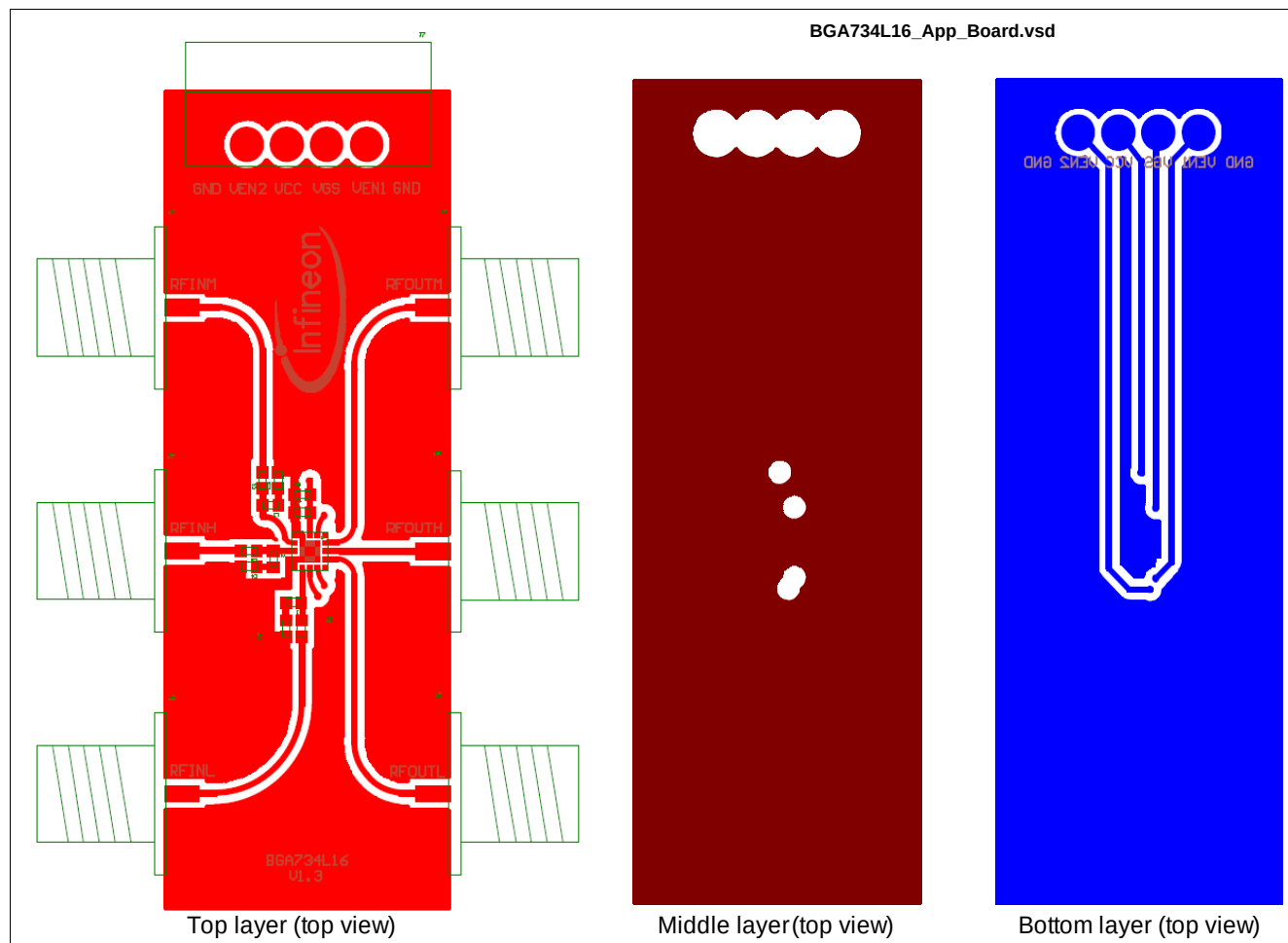


Figure 3 Application Board Layout on 3-layer FR4.

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

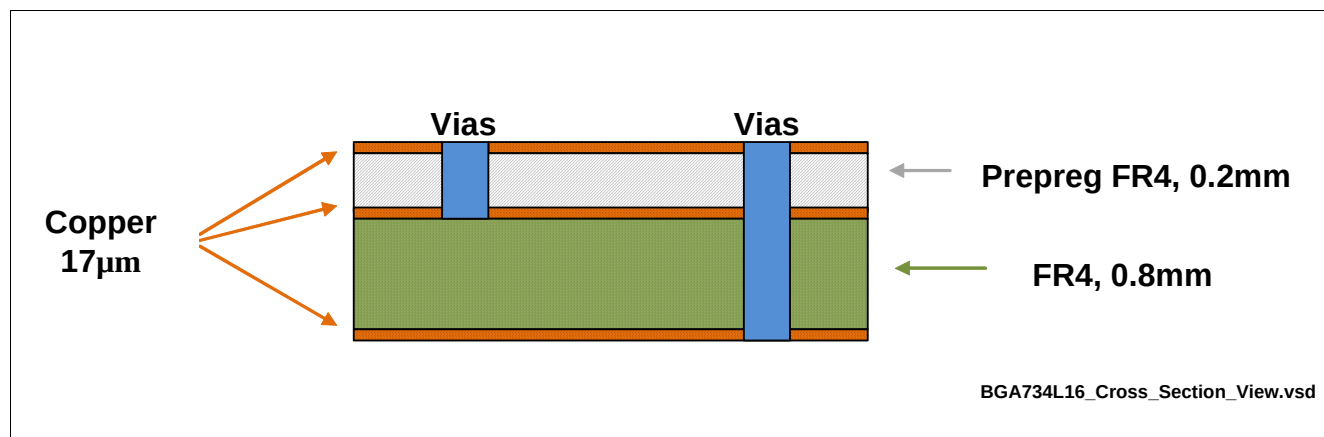


Figure 4 Cross-Section View of Application Board

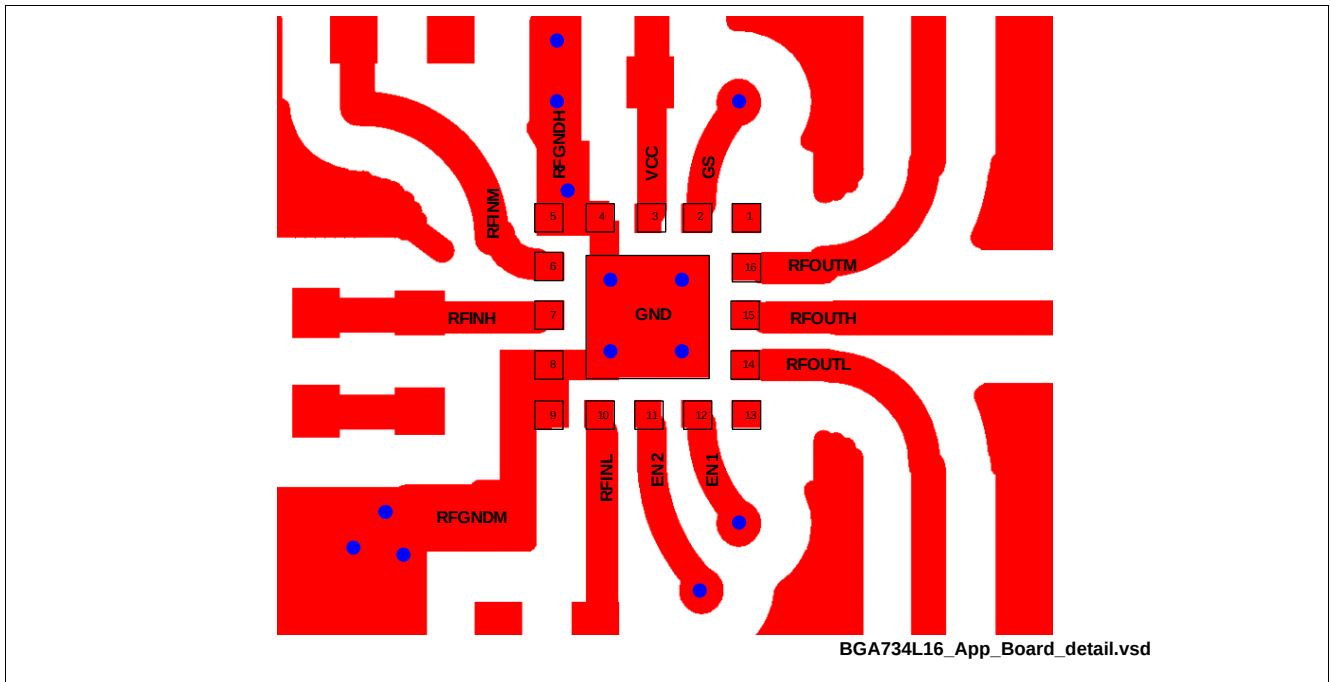


Figure 5 Detail of Application Board Layout

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

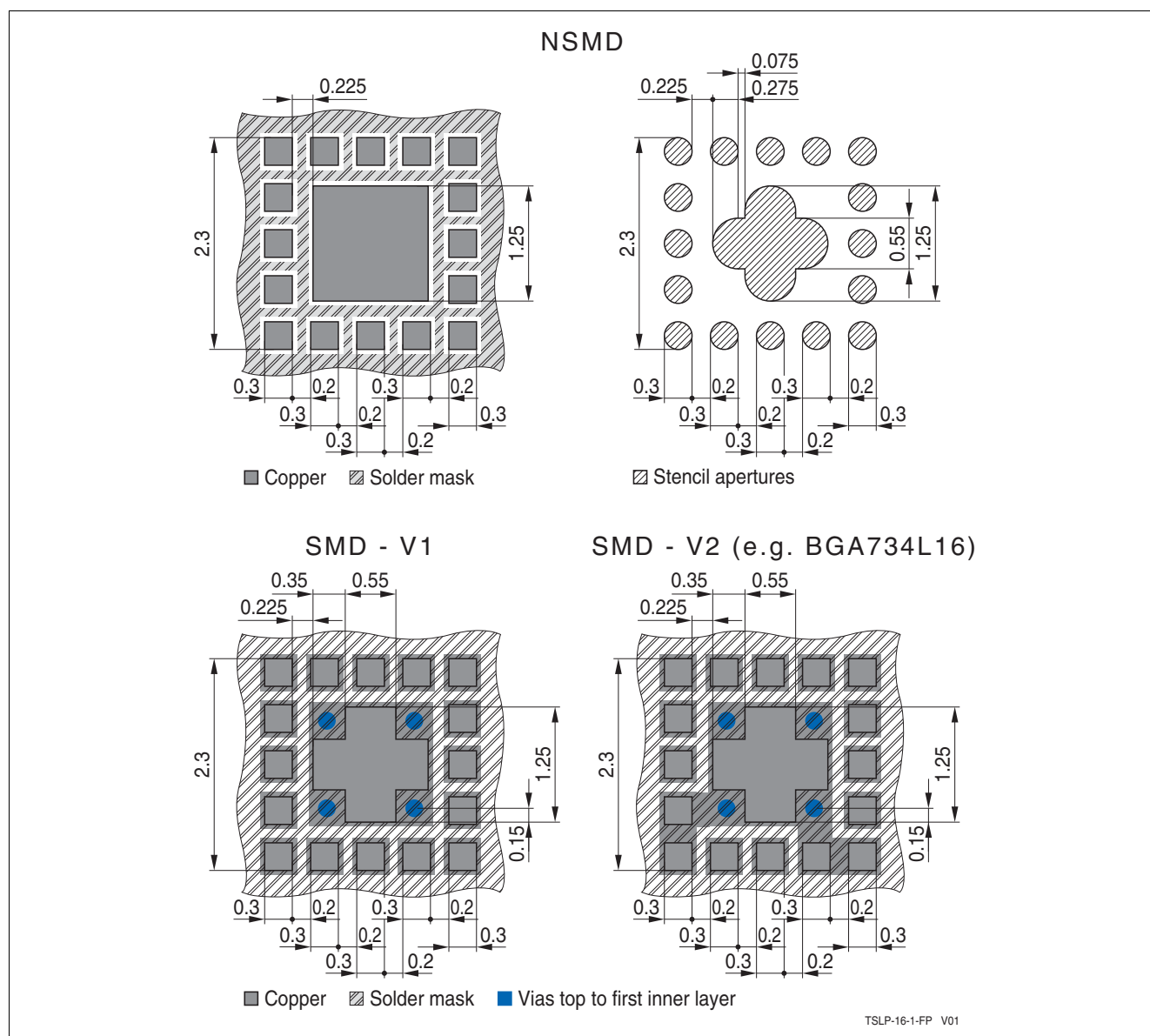


Figure 6 Recommended Footprint and Stencil Layout for the TSLP-16-1 Package

4.2 Package Dimensions

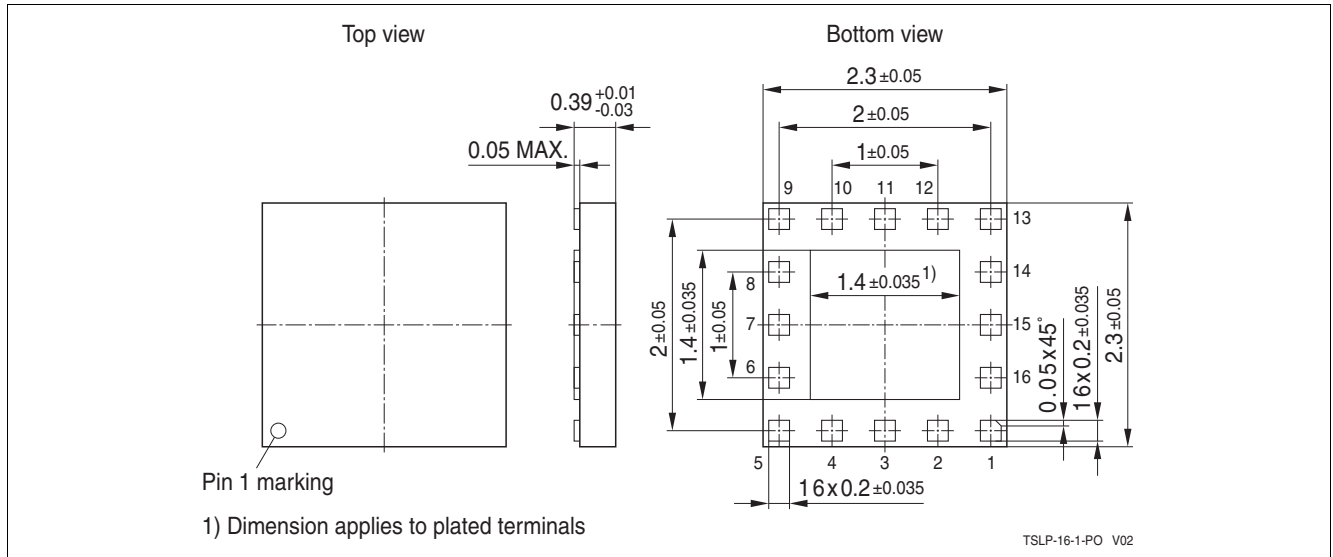


Figure 7 **Package Outline (Top, Side and Bottom View)**

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