

# BGA735L16

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

Small Signal Discretes



Never stop thinking

**Edition 2008-08-26**

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**BGA735L16**

**Revision History: 2008-08-26, V3.0**

**Previous Version: 2008-07-08, V2.1 preliminary**

<b>Page</b>	<b>Subjects (major changes since last revision)</b>
6	Updated value for thermal resistance
8	Added supply current characteristics

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## 1 Description

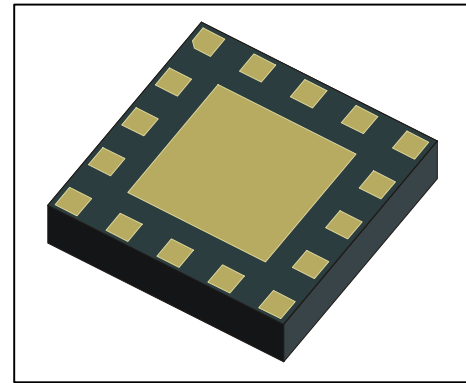
The BGA735L16 is a highly flexible, high linearity tri-band (2100, 1900/1800/2100, 800/900 MHz) low noise amplifier MMIC for worldwide use. Based on Infineon's proprietary and cost-effective SiGe:C technology, the BGA735L16 uses an advanced biasing concept in order to achieve high linearity.

The device features dynamic gain control, temperature stabilization, standby mode, and 2 kV ESD protection on-chip as well as matching off chip. Because the matching is off chip, different UMTS bands can be easily applied. For example, the 1900 MHz path can be converted into a 2100 MHz path and vice versa by optimizing the input and output matching network.

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

### Features

- Gain: 16 (17) / -7.5 dB in high / low gain mode (all bands)
- Noise figure: 1.1 / 1.1 / 1.1 dB in high gain mode (800 MHz / 1900 MHz / 2100 MHz)
- Supply current: 3.4 (4.0) / 0.65 mA in high / low gain mode (all bands)
- Standby mode (< 2  $\mu$ A typ.)
- Output internally matched to 50  $\Omega$
- Inputs pre-matched to 50  $\Omega$
- 2kV HBM ESD protection
- Low external component count
- Small leadless TSLP-16-1 package (2.3 x 2.3 x 0.39 mm)
- Pb-free (RoHS compliant) package



TSLP-16-1 package

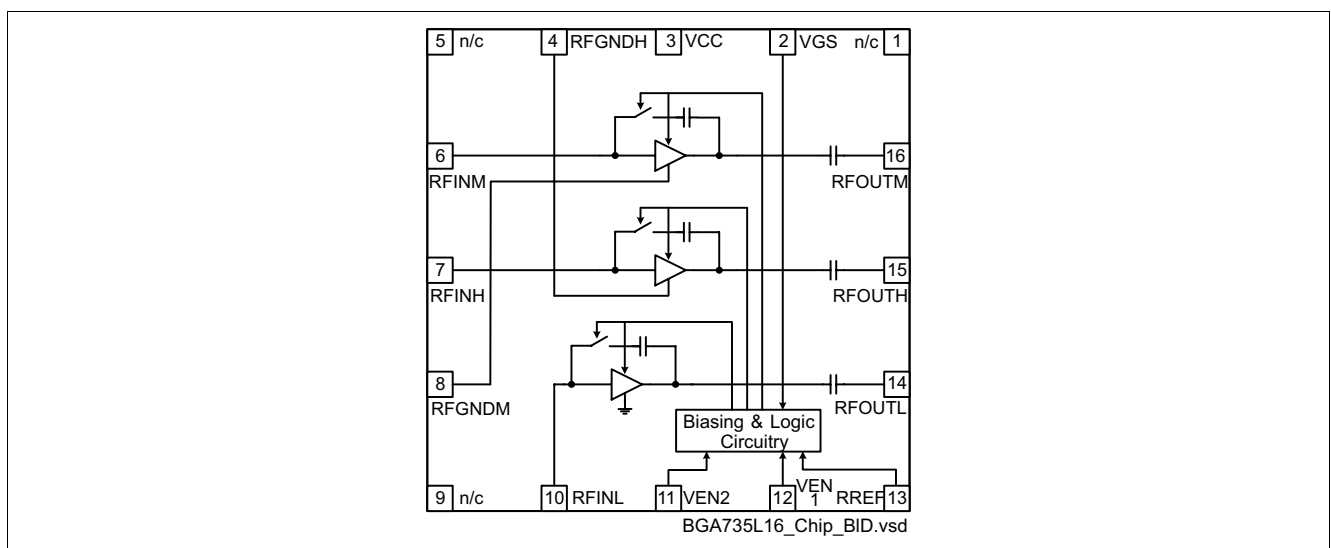


Figure 1 Block diagram of triple-band LNA

Type	Package	Marking	Chip
BGA735L16	TSLP-16-1	BGA735	T1530

## 2 Electrical Characteristics

### 2.1 Absolute Maximum Ratings

Table 1 Absolute Maximum Ratings

Parameter	Symbol	Values		Unit	Note / Test Condition
		Min.	Max.		
Supply voltage	$V_{CC}$	-0.3	3.6	V	
Supply current	$I_{CC}$		10	mA	
Pin voltage	$V_{PIN}$	-0.3	$V_{CC}+0.3$	V	All pins except RF input pins
Pin voltage RF Input Pins	$V_{RFIN}$	-0.3	0.9	V	
RF input power	$P_{RFIN}$		4	dBm	
Junction temperature	$T_j$		150	°C	
Ambient temperature range	$T_A$	-30	85	°C	
Storage temperature range	$T_{stg}$	-65	150	°C	

### 2.2 Thermal Resistance

Table 2 Thermal Resistance

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

### 2.3 ESD Integrity

Table 3 ESD Integrity

Parameter	Symbol	Value (typ.)	Unit	Note / Test Conditions
ESD hardness HBM <sup>1)</sup>	$V_{ESD-HBM}$	2000	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	$I_{CCHG}$		4.0 3.4		mA	High band Mid and low band
Supply current low gain mode	$I_{CCLG}$		650		$\mu\text{A}$	All bands
Supply current standby mode	$I_{CCOFF}$		0.1	2	$\mu\text{A}$	
Logic level high	$V_{HI}$	1.5	2.8		V	VEN1, VEN2 and VGS
Logic level low	$V_{LO}$		0.0	0.5	V	
Logic currents VEN	$I_{ENL}$		0.2		$\mu\text{A}$	VEN1 and VEN2
	$I_{ENH}$		10.0		$\mu\text{A}$	
Logic currents VGS	$I_{GSL}$		0.1		$\mu\text{A}$	VGS
	$I_{GSH}$		5.0		$\mu\text{A}$	

## 2.5 Band Select / Gain Control Truth Table

**Table 5 Band Select Truth Table,  $V_{CC} = 2.8\text{ V}$**

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

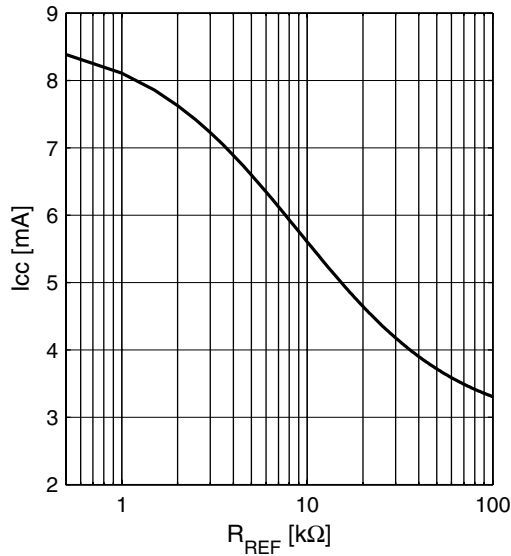
**Table 6 Gain Control Truth Table,  $V_{CC} = 2.8\text{ V}$**

	High Gain	Low Gain
VGS	H	L

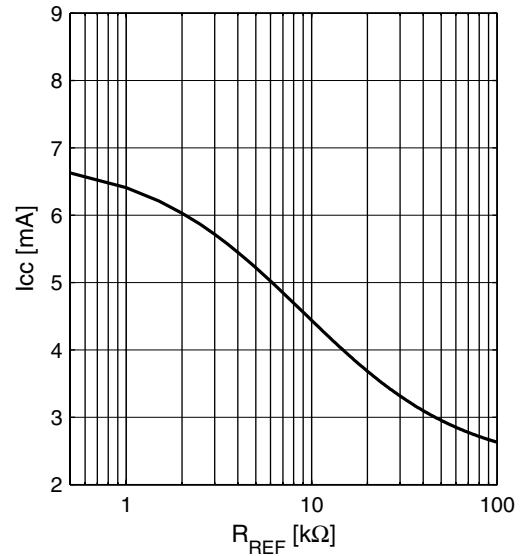
## 2.6 Supply current characteristics; $T_A = 25\text{ }^\circ\text{C}$

Supply current high / mid gain mode versus reference resistor  $R_{REF}$  (see [Figure 2 on page 31](#) for reference resistor; low gain mode supply current is independent of reference resistor).

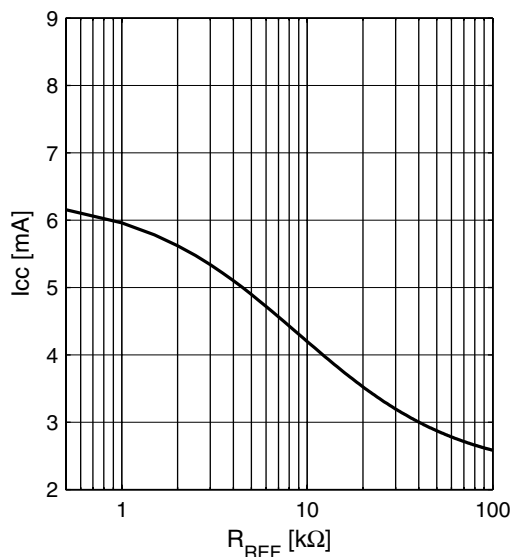
**Supply Current Highband**  $I_{CC} = f(R_{REF})$   
 $V_{CC} = 2.8\text{ V}$



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



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

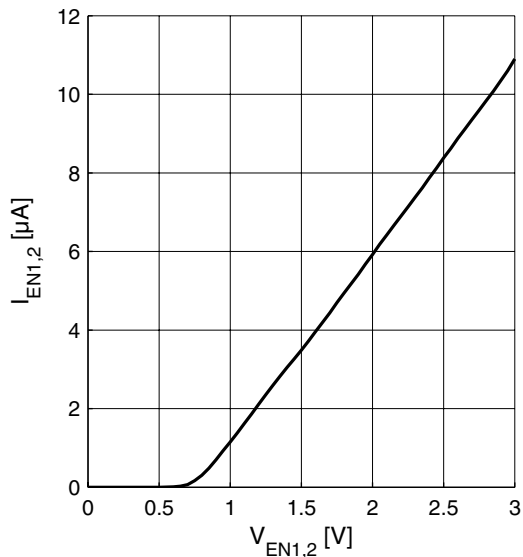




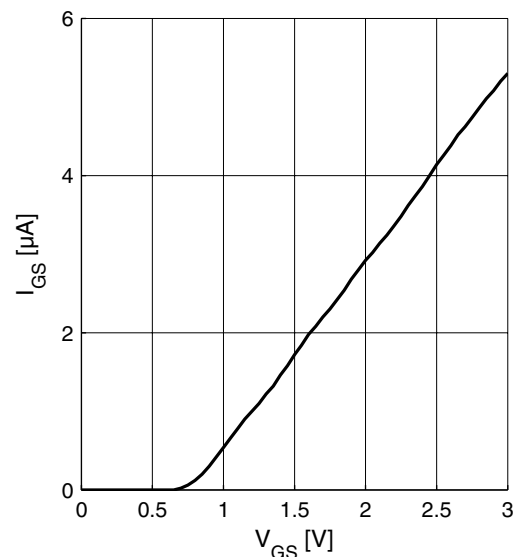
## 2.7 Logic Signal Characteristics; $T_A = 25\text{ °C}$

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



## 2.8 Switching Times

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

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Settling time gainstep	$t_{GS}$		1		µs	Switching LG ↔ HG all bands
Settling time bandselect	$t_{BS}$		1		µs	Switching from any band to a different band

## 2.9 Measured RF Characteristics Low Band

### 2.9.1 Measured RF Characteristics UMTS Bands V / VI

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

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range band V		869		894	MHz	
Pass band range band VI		875		885	MHz	
Current consumption	$I_{CCHG}$		3.4		mA	High gain mode
	$I_{CCLG}$		0.65		mA	Low gain mode
Gain	$S_{21HG}$		16.1		dB	High gain mode
	$S_{21LG}$		-7.5		dB	Low gain mode
Reverse Isolation <sup>1)</sup>	$S_{12HG}$		-36		dB	High gain mode
	$S_{12LG}$		-8		dB	Low gain mode
Noise figure	$NF_{HG}$		1.1		dB	High gain mode
	$NF_{LG}$		7.5		dB	Low gain mode
Input return loss <sup>1)</sup>	$S_{11HG}$		-17		dB	50 $\Omega$ , high gain mode
	$S_{11LG}$		-17		dB	50 $\Omega$ , low gain mode
Output return loss <sup>1)</sup>	$S_{22HG}$		-17		dB	50 $\Omega$ , high gain mode
	$S_{22LG}$		-13		dB	50 $\Omega$ , low gain mode
Stability factor <sup>2)</sup>	$k$		>2.3			DC to 10 GHz; all gain modes
Input compression point <sup>1)</sup>	$IP_{1dBHG}$		-6		dBm	High gain mode
	$IP_{1dB LG}$		-8		dBm	Low gain mode
Inband IIP3 <sup>1)</sup> $f_1 - f_2 = 1\text{ MHz}$ $P_{f1} = P_{f2} = -37\text{ dBm}$	$IIP3_{HG}$		-7		dBm	High gain mode
	$IIP3_{LG}$		2			Low gain mode

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

2) Not tested in production; guaranteed by device design

## 2.9.2 Measured RF Characteristics UMTS Band VIII

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

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

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

2) Not tested in production; guaranteed by device design

## 2.10 Measured RF Characteristics Mid Band

### 2.10.1 Measured RF Characteristics UMTS Band II

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

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		1930		1990	MHz	
Current consumption	$I_{CCHG}$		3.4		mA	High gain mode
	$I_{CCLG}$		0.65		mA	Low gain mode
Gain	$S_{21HG}$		16.0		dB	High gain mode
	$S_{21LG}$		-7.8		dB	Low gain mode
Reverse Isolation <sup>1)</sup>	$S_{12HG}$		-35		dB	High gain mode
	$S_{12LG}$		-8		dB	Low gain mode
Noise figure	$NF_{HG}$		1.1		dB	High gain mode
	$NF_{LG}$		7.8		dB	Low gain mode
Input return loss <sup>1)</sup>	$S_{11HG}$		-19		dB	50 $\Omega$ , high gain mode
	$S_{11LG}$		-18		dB	50 $\Omega$ , low gain mode
Output return loss <sup>1)</sup>	$S_{22HG}$		-20		dB	50 $\Omega$ , high gain mode
	$S_{22LG}$		-15		dB	50 $\Omega$ , low gain mode
Stability factor <sup>2)</sup>	$k$		>2.4			DC to 10 GHz; all gain modes
Input compression point <sup>1)</sup>	$IP_{1dBHG}$		-7		dBm	High gain mode
	$IP_{1dB LG}$		-7		dBm	Low gain mode
Inband IIP3 <sup>1)</sup> $f_1 - f_2 = 1\text{ MHz}$ $P_{f1} = P_{f2} = -37\text{ dBm}$	$IIP3_{HG}$		-6		dBm	High gain mode
	$IIP3_{LG}$		3			Low gain mode

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

2) Not tested in production; guaranteed by device design

### 2.10.2 Measured RF Characteristics UMTS Bands III / IX

**Table 11 Typical Characteristics 1800 MHz Band,  $T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$**

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

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

2) Not tested in production; guaranteed by device design

### 2.10.3 Measured RF Characteristics UMTS Band IV

**Table 12 Typical Characteristics 2100 MHz Band,  $T_A = 25\text{ }^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$**

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

## 2.11 Measured RF Characteristics High Band

### 2.11.1 Measured RF Characteristics UMTS Bands I / X

**Table 13 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 band I		2110		2170	MHz	
Pass band range band X		2110		2170	MHz	
Current consumption	$I_{CCHG}$		4.0		mA	High gain mode
	$I_{CCLG}$		0.65		mA	Low gain mode
Gain	$S_{21HG}$		17.2		dB	High gain mode
	$S_{21LG}$		-7.8		dB	Low gain mode
Reverse Isolation <sup>1)</sup>	$S_{12HG}$		-35		dB	High gain mode
	$S_{12LG}$		-8		dB	Low gain mode
Noise Figure	$NF_{HG}$		1.1		dB	High gain mode
	$NF_{LG}$		7.8		dB	Low gain mode
Input return loss <sup>1)</sup>	$S_{11HG}$		-16		dB	50 $\Omega$ , high gain mode
	$S_{11LG}$		-17		dB	50 $\Omega$ , low gain mode
Output return loss <sup>1)</sup>	$S_{22HG}$		-23		dB	50 $\Omega$ , high gain mode
	$S_{22LG}$		-12		dB	50 $\Omega$ , low gain mode
Stability factor <sup>2)</sup>	$k$		>2.3			DC to 10 GHz; all gain modes
Input compression point <sup>1)</sup>	$IP_{1dBHG}$		-10		dBm	High gain mode
	$IP_{1dB LG}$		-6		dBm	Low gain mode
Inband IIP3 <sup>1)</sup> $f_1 - f_2 = 1\text{ MHz}$ $P_{f1} = P_{f2} = -37\text{ dBm}$	$IIP3_{HG}$		-3		dBm	High gain mode
	$IIP3_{LG}$		3			Low gain mode

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

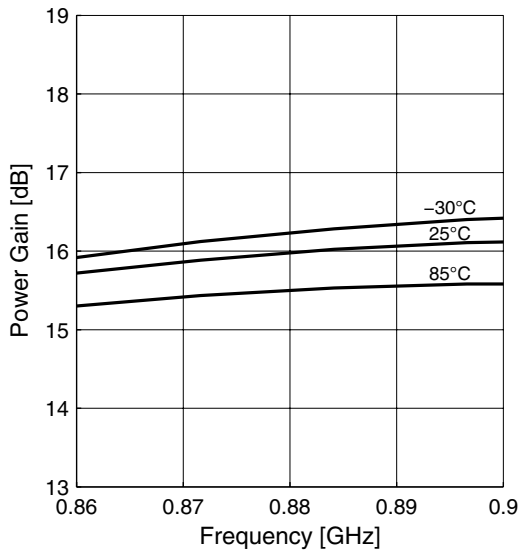
2) Not tested in production; guaranteed by device design

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

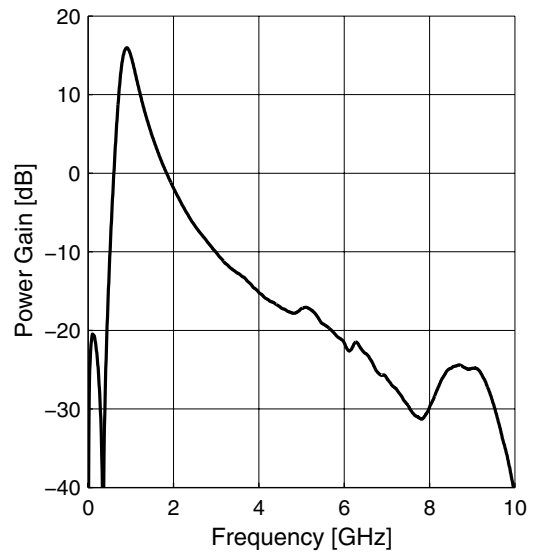
2.12 Measured Performance Low Band (Band V) High Gain Mode vs. Frequency

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

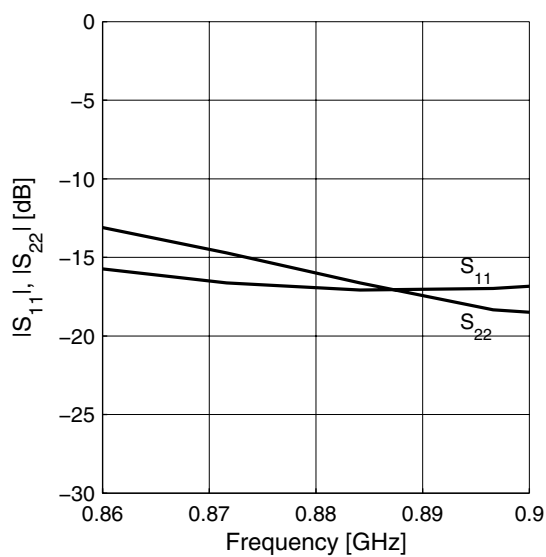
Power Gain  $|S_{21}| = f(f)$



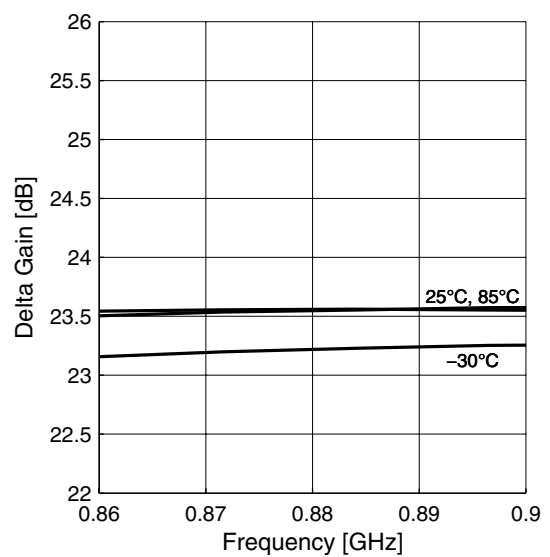
Power Gain wideband  $|S_{21}| = f(f)$



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



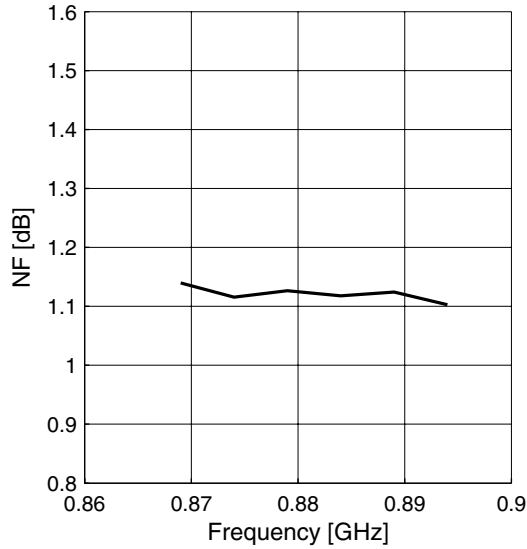
Gainstep HG-LG  $|\Delta S_{21}| = f(f)$



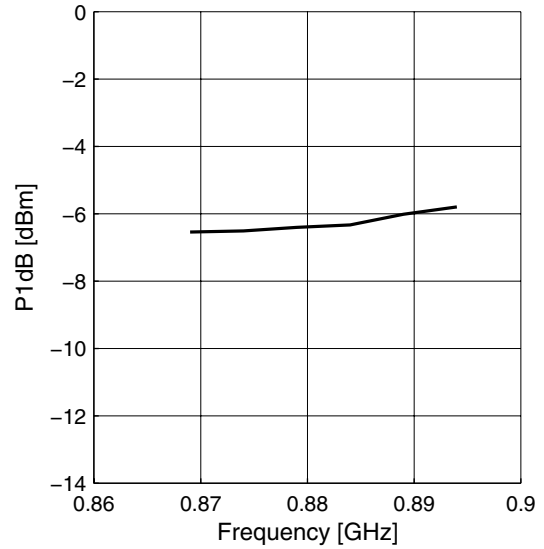


**Measured Performance Low Band (Band V) High Gain Mode vs. Temperature**

**Noise Figure  $NF = f(f)$**



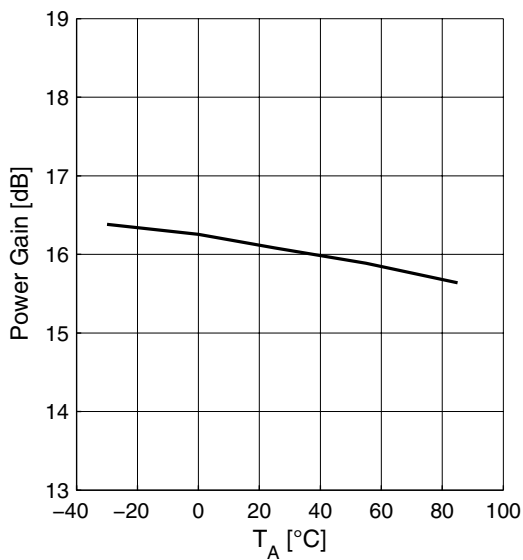
**Input Compression  $P1dB = f(f)$**



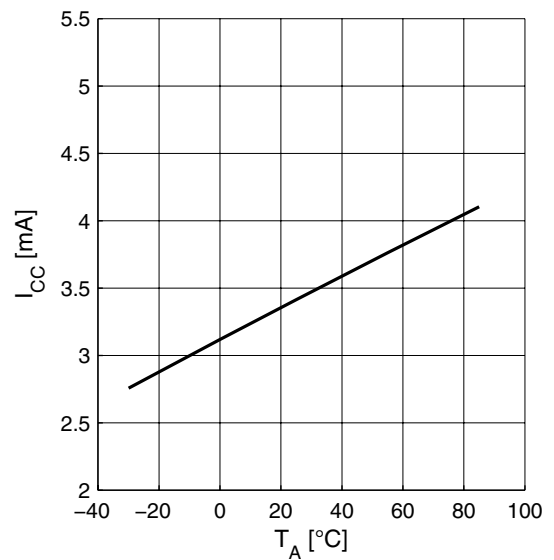
**2.13 Measured Performance Low Band (Band V) High Gain Mode vs. Temperature**

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

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

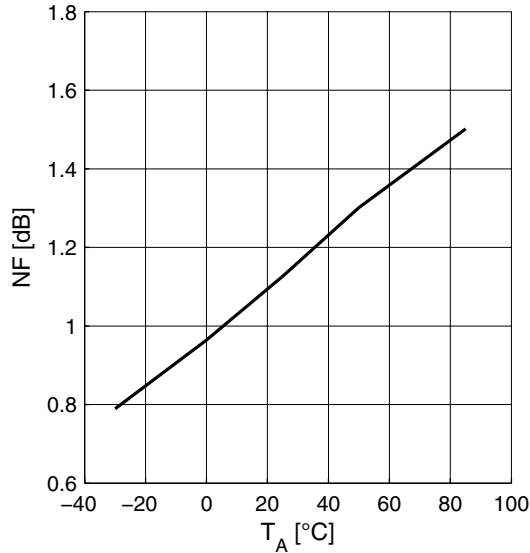


**Supply Current  $I_{CC} = f(T_A)$**

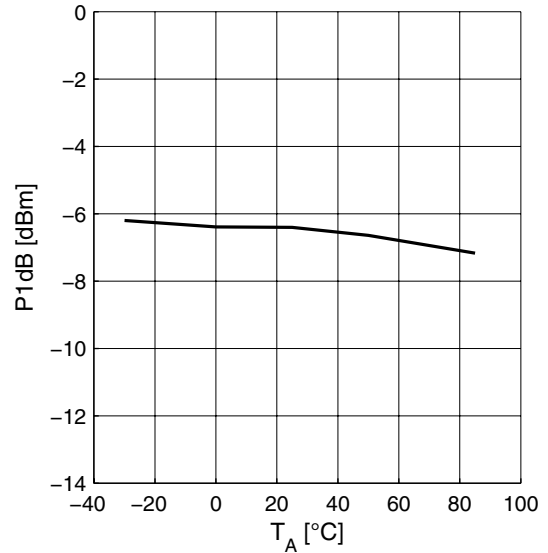


**Measured Performance Low Band (Band V) Low Gain Mode vs. Frequency**

**Noise Figure  $NF = f(T_A)$**



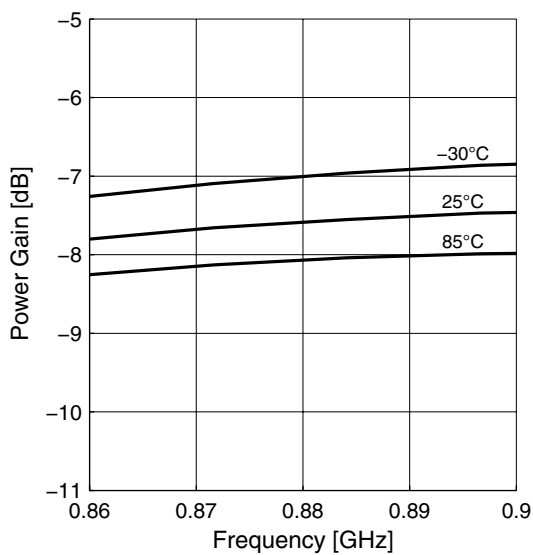
**Input Compression  $P1dB = f(T_A)$**



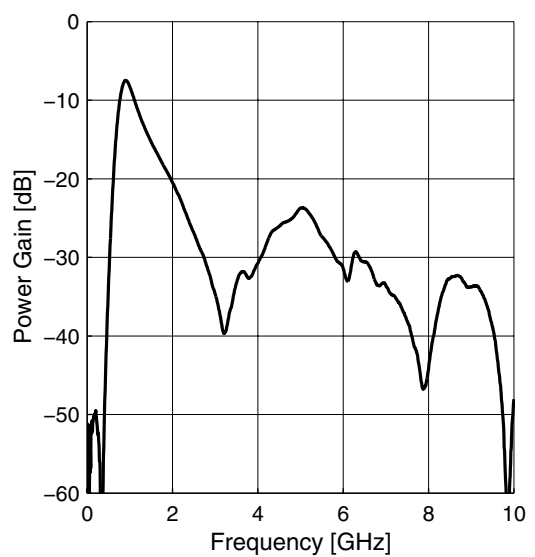
**2.14 Measured Performance Low Band (Band V) Low Gain Mode vs. Frequency**

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

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

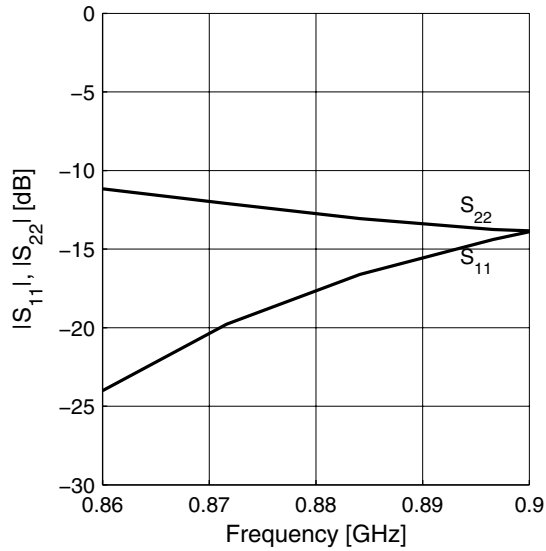


**Power Gain wideband  $|S_{21}| = f(f)$**

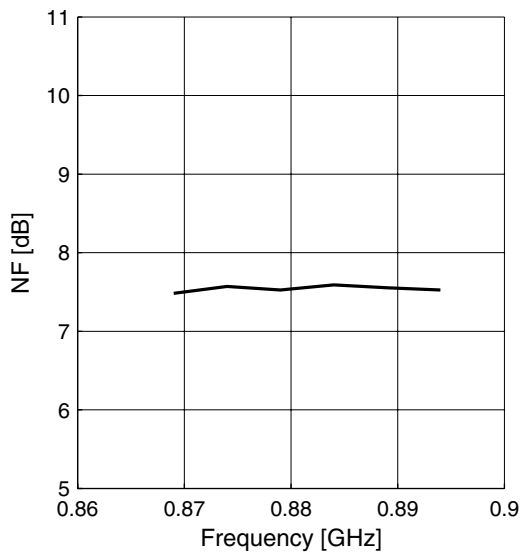


Measured Performance Low Band (Band V) Low Gain Mode vs. Frequency

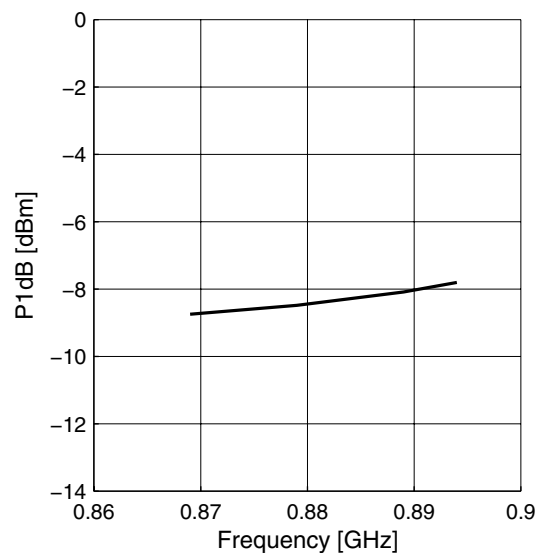
Matching  $|S_{11}| = f(f)$ ,  $|S_{22}| = f(f)$



Noise Figure  $NF = f(f)$



Input Compression  $P1dB = f(f)$

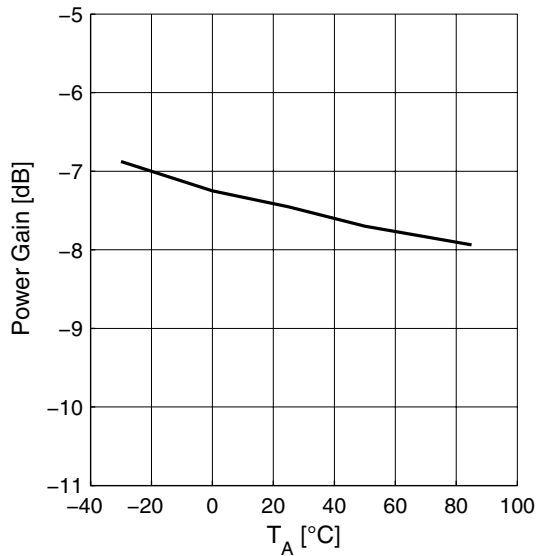


Measured Performance Low Band (Band V) Low Gain Mode vs. Temperature

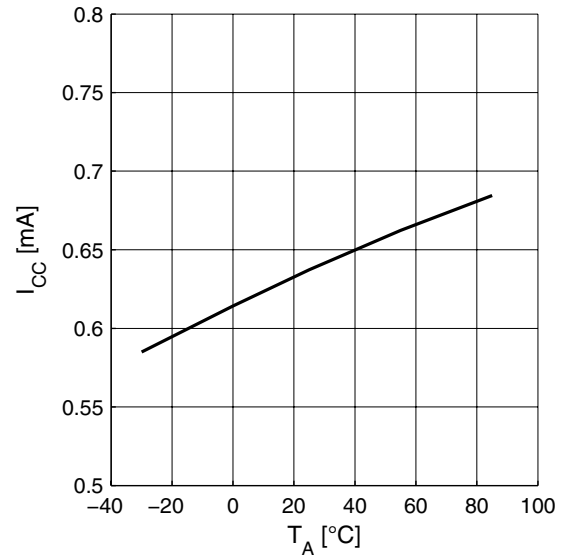
2.15 Measured Performance Low Band (Band V) Low Gain Mode vs. Temperature

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

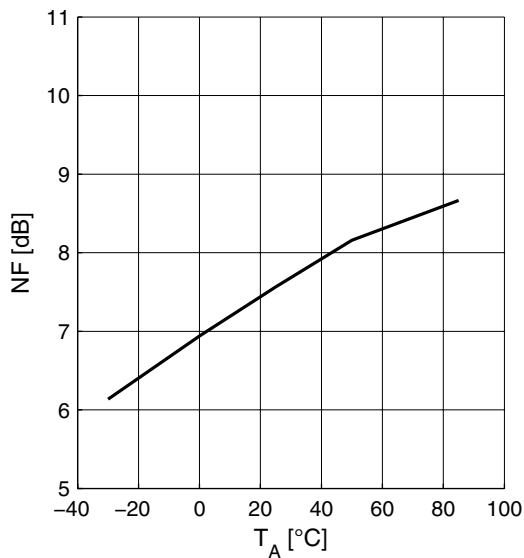
Power Gain  $|S_{21}| = f(T_A)$



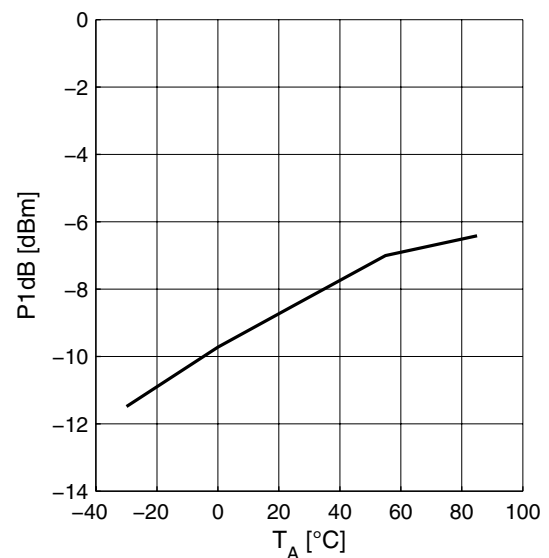
Supply Current  $I_{CC} = f(T_A)$



Noise Figure  $NF = f(T_A)$



Input Compression  $P1dB = f(T_A)$

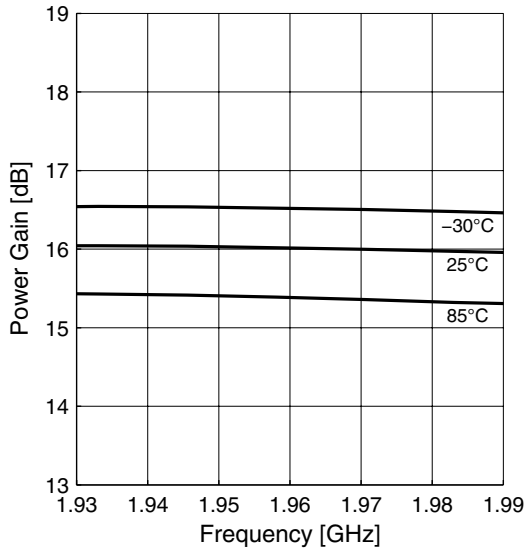


Measured Performance Mid Band (Band II) High Gain Mode vs. Frequency

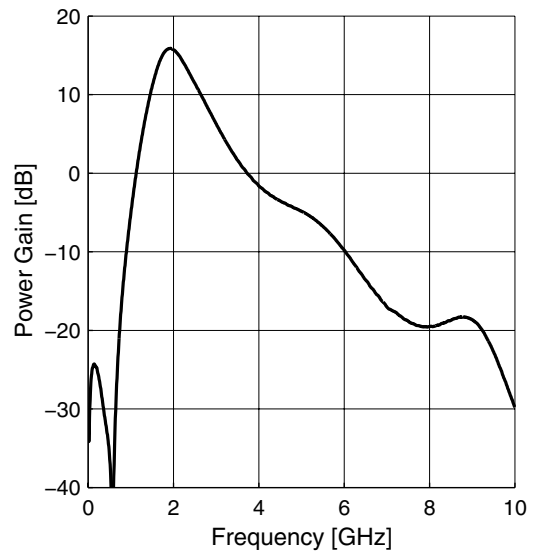
2.16 Measured Performance Mid Band (Band II) High Gain Mode vs. Frequency

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

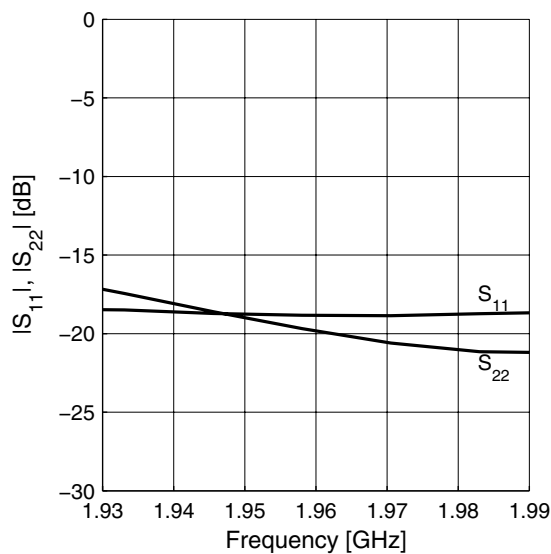
Power Gain  $|S_{21}| = f(f)$



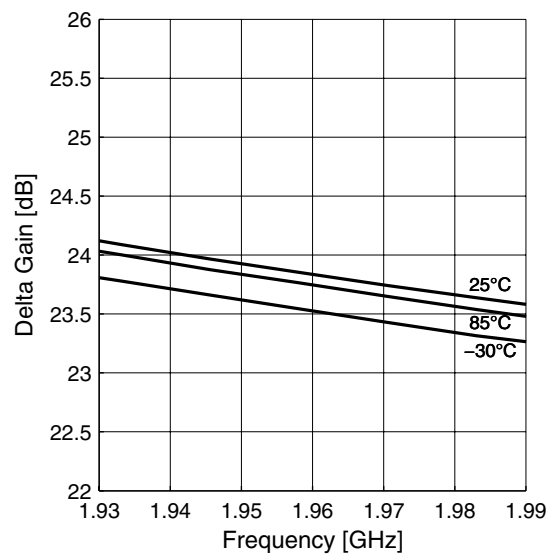
Power Gain wideband  $|S_{21}| = f(f)$



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

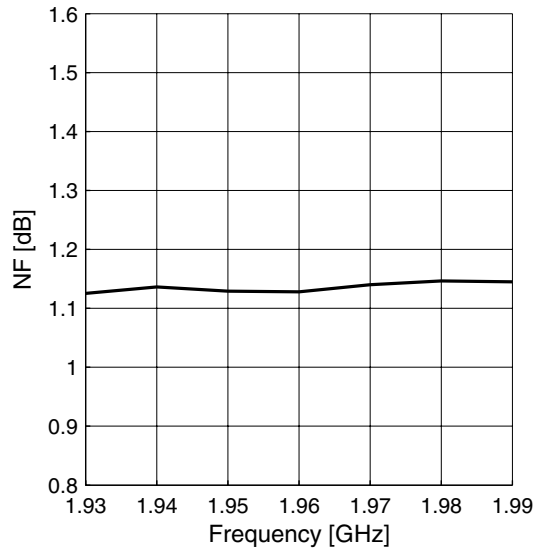


Gainstep HG-LG  $|\Delta S_{21}| = f(f)$

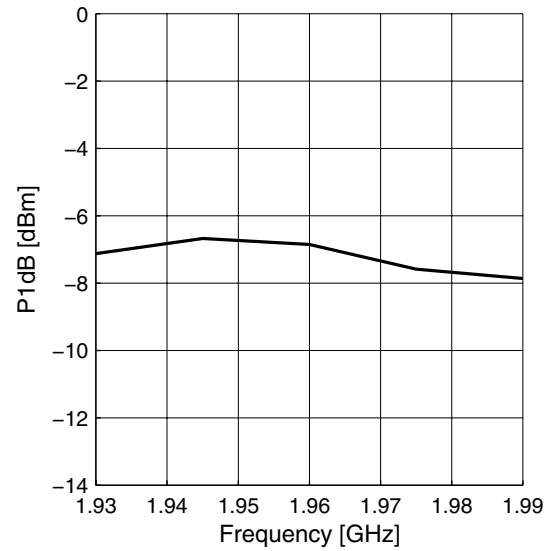


Measured Performance Mid Band (Band II) High Gain Mode vs. Temperature

Noise Figure  $NF = f(f)$



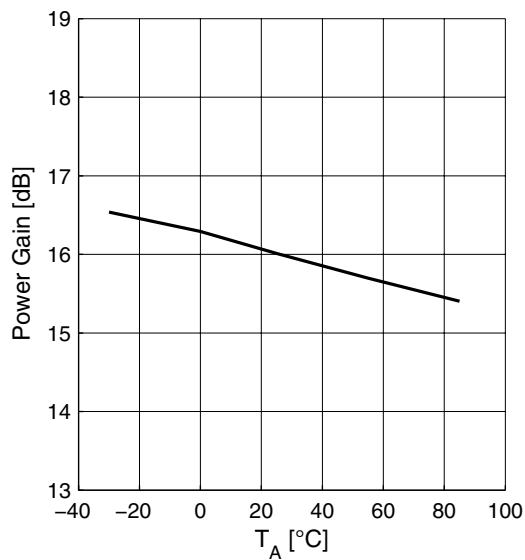
Input Compression  $P1dB = f(f)$



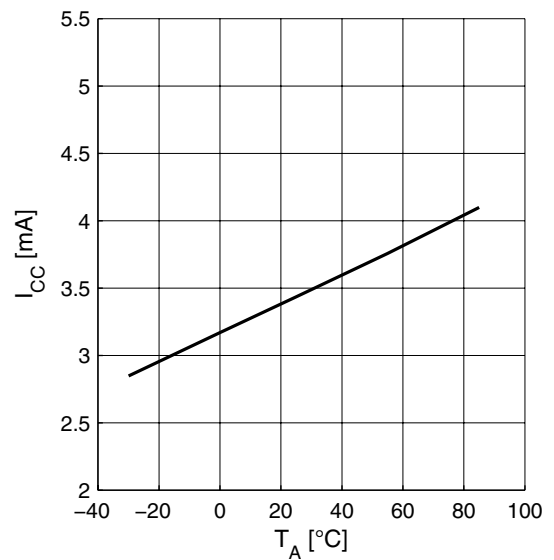
2.17 Measured Performance Mid Band (Band II) High Gain Mode vs. Temperature

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

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

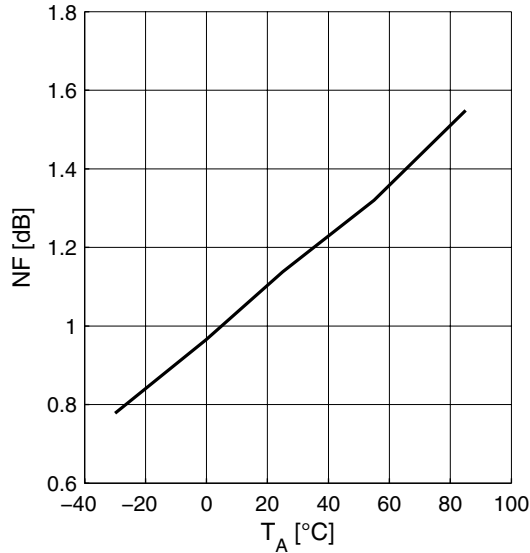


Supply Current  $I_{CC} = f(T_A)$

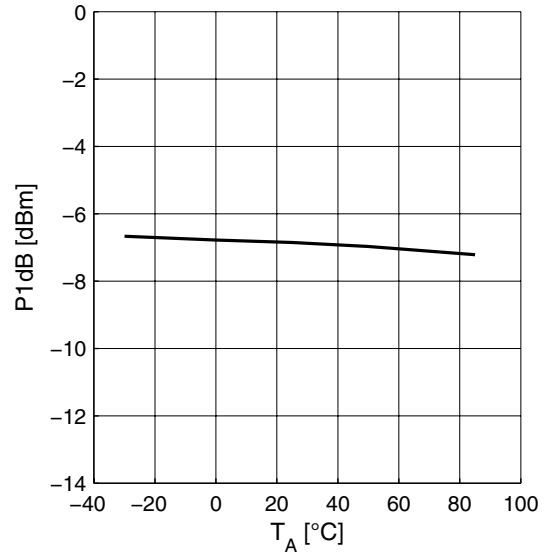


**Measured Performance Mid Band (Band II) Low Gain Mode vs. Frequency**

**Noise Figure  $NF = f(T_A)$**



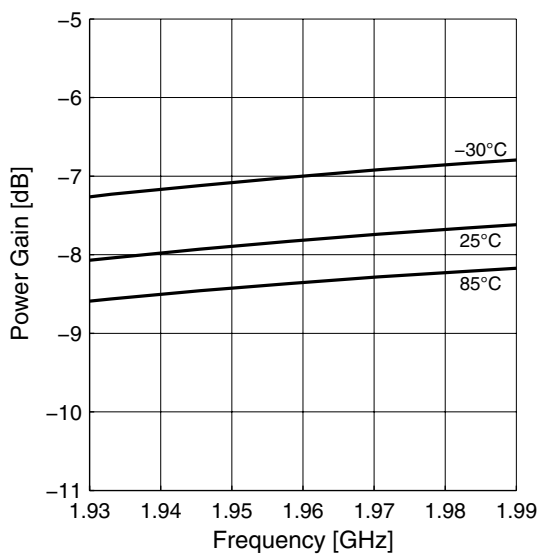
**Input Compression  $P1dB = f(T_A)$**



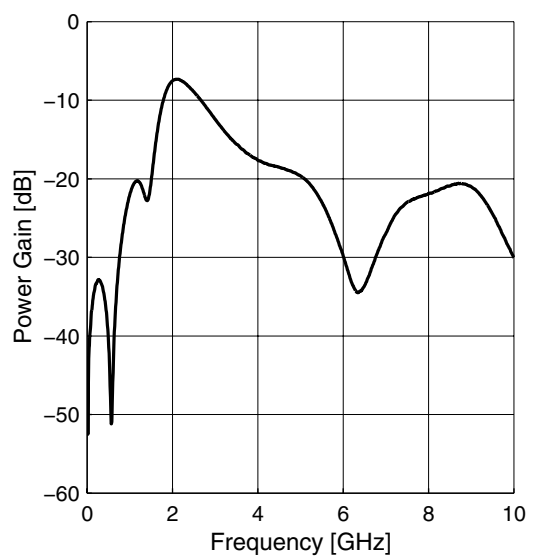
**2.18 Measured Performance Mid Band (Band II) Low Gain Mode vs. Frequency**

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

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

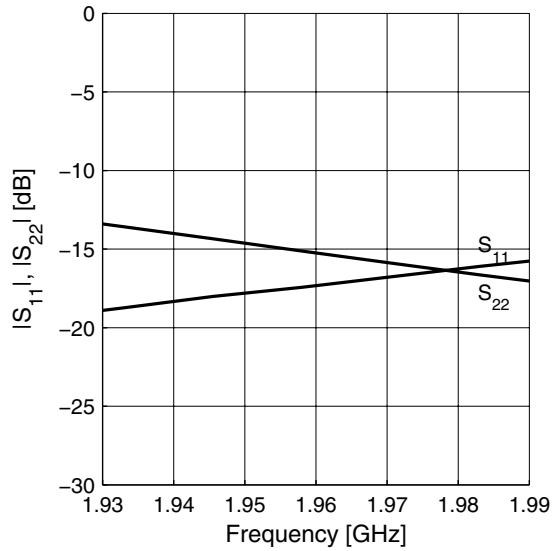


**Power Gain wideband  $|S_{21}| = f(f)$**

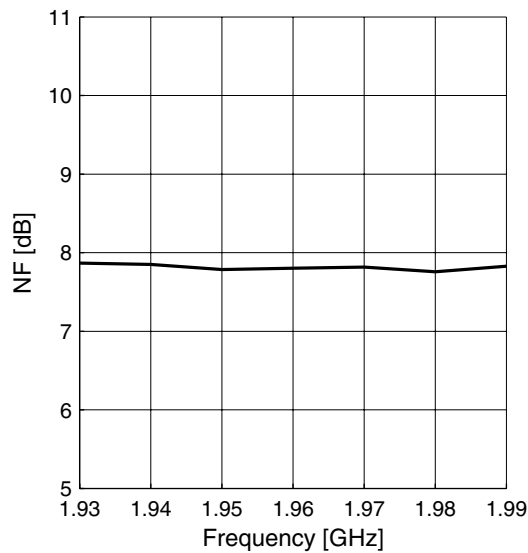


Measured Performance Mid Band (Band II) Low Gain Mode vs. Frequency

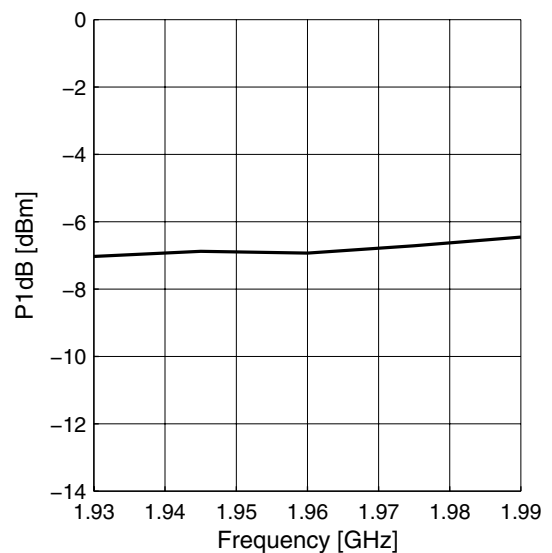
Matching  $|S_{11}| = f(f)$ ,  $|S_{22}| = f(f)$



Noise Figure  $NF = f(f)$



Input Compression  $P1dB = f(f)$



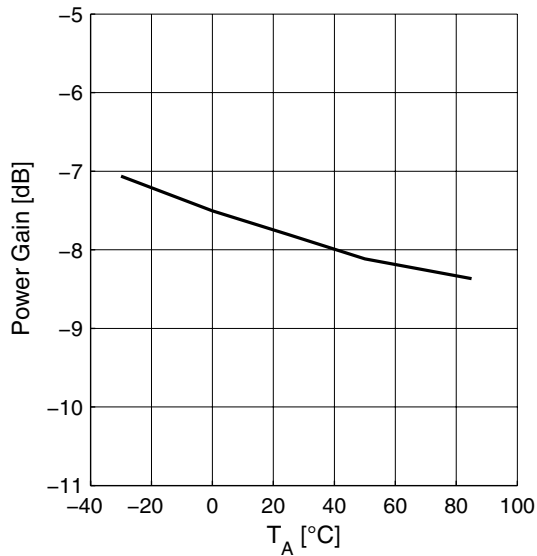


Measured Performance Mid Band (Band II) Low Gain Mode vs. Temperature

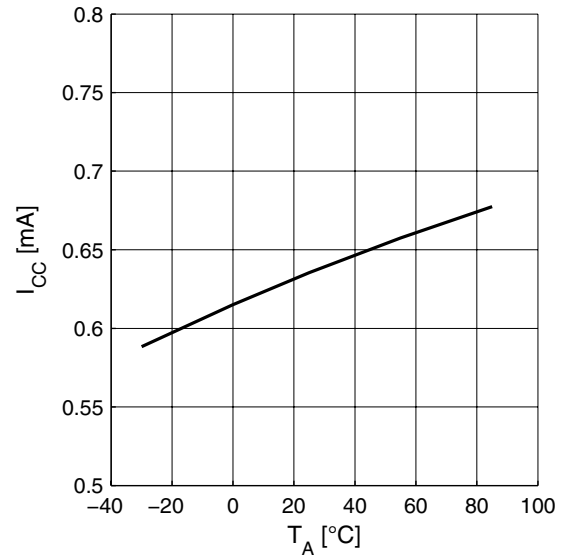
2.19 Measured Performance Mid Band (Band II) Low Gain Mode vs. Temperature

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

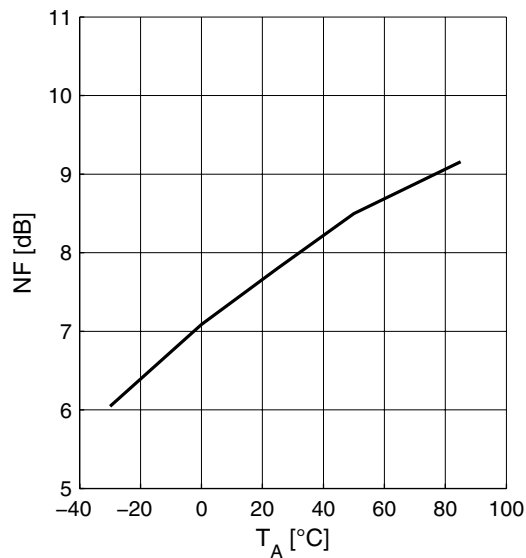
Power Gain  $|S_{21}| = f(T_A)$



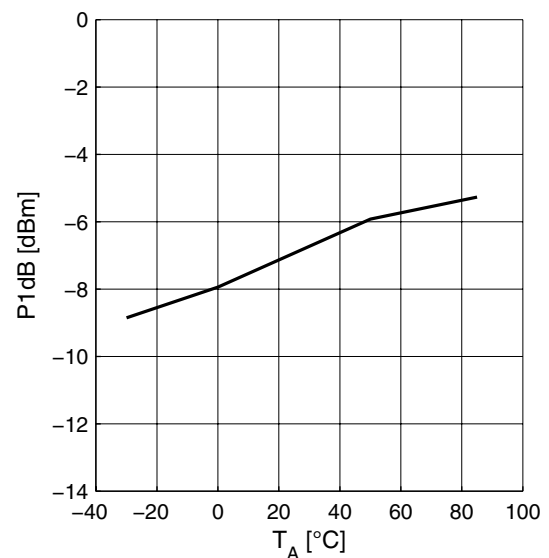
Supply Current  $I_{CC} = f(T_A)$



Noise Figure  $NF = f(T_A)$



Input Compression  $P1dB = f(T_A)$

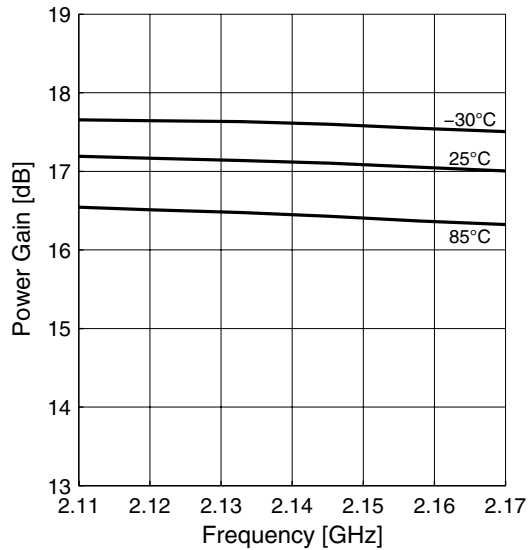


Measured Performance High Band (Band I) High Gain Mode vs. Frequency

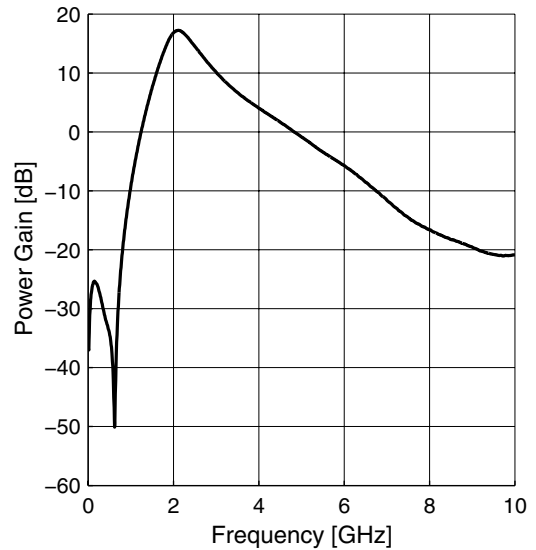
2.20 Measured Performance High Band (Band I) High Gain Mode vs. Frequency

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

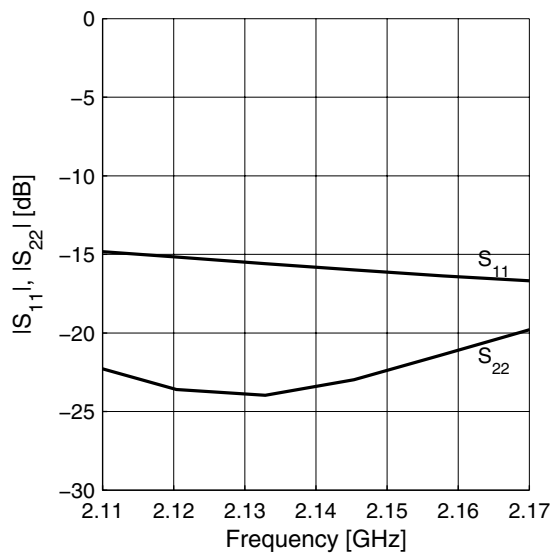
Power Gain  $|S_{21}| = f(f)$



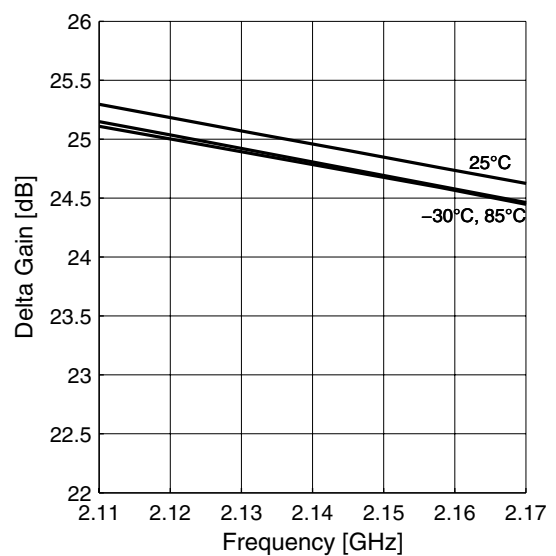
Power Gain wideband  $|S_{21}| = f(f)$



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

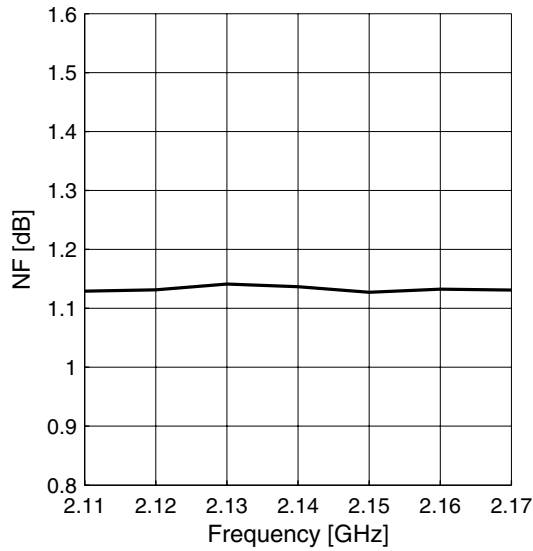


Gainstep HG-LG  $|\Delta S_{21}| = f(f)$

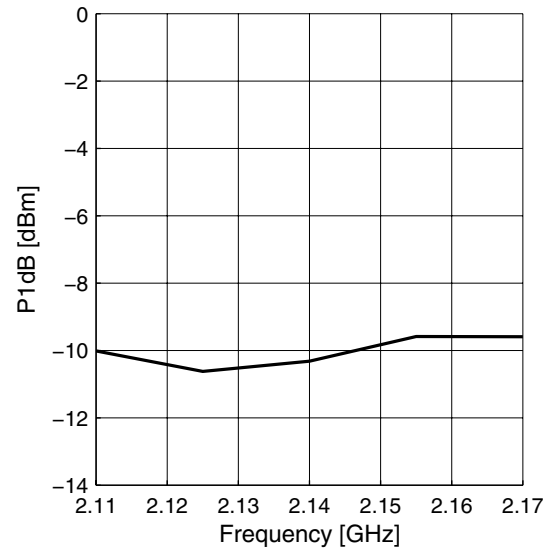


**Measured Performance High Band (Band I) High Gain Mode vs. Temperature**

**Noise Figure  $NF = f(f)$**



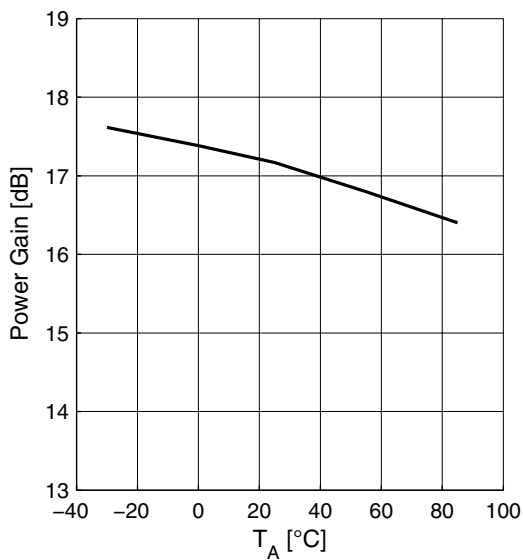
**Input Compression  $P1dB = f(f)$**



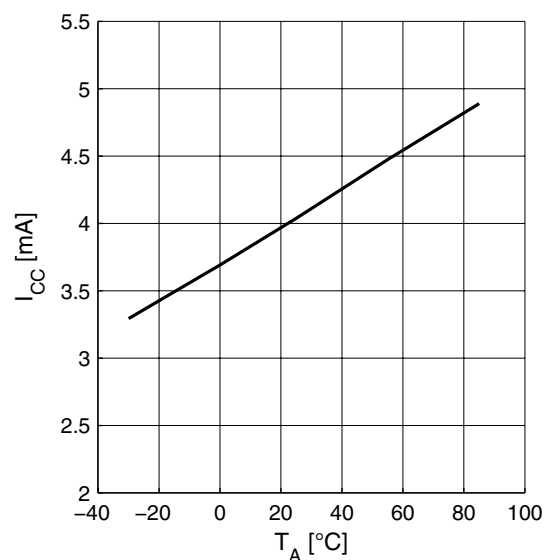
**2.21 Measured Performance High Band (Band I) High Gain Mode vs. Temperature**

$V_{CC} = 2.8\text{ V}$ ,  $V_{GS} = 2.8\text{ V}$ ,  $V_{EN1} = 2.8\text{ V}$ ,  $V_{EN2} = 2.8\text{ V}$ ,  $f = 2140\text{ MHz}$

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

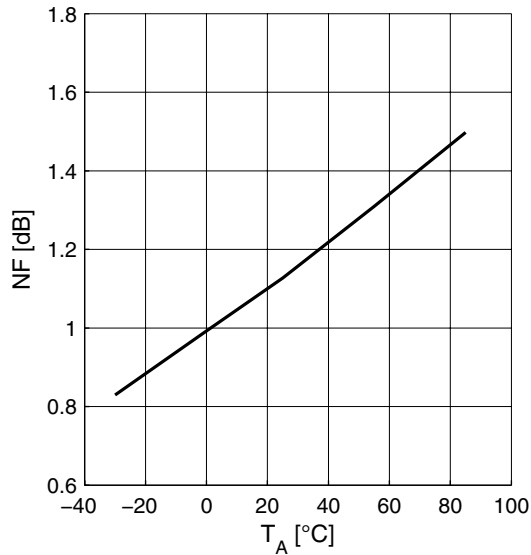


**Supply Current  $I_{CC} = f(T_A)$**

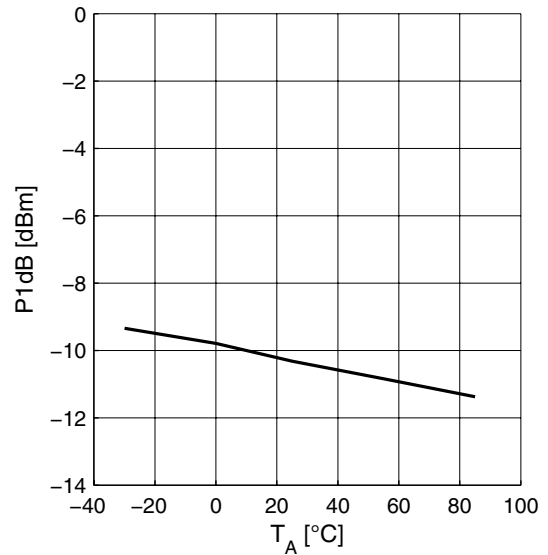


**Measured Performance High Band (Band I) Low Gain Mode vs. Frequency**

**Noise Figure  $NF = f(T_A)$**



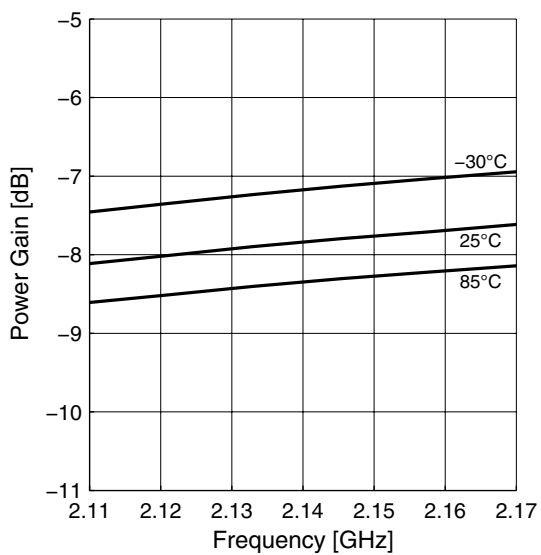
**Input Compression  $P1dB = f(T_A)$**



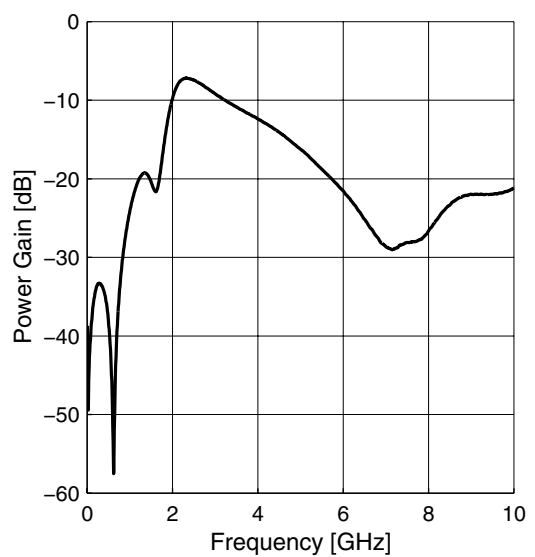
**2.22 Measured Performance High Band (Band I) Low Gain Mode vs. Frequency**

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

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

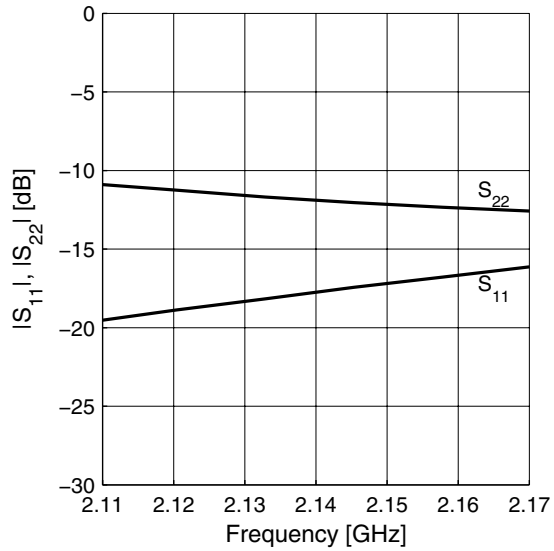


**Power Gain wideband  $|S_{21}| = f(f)$**

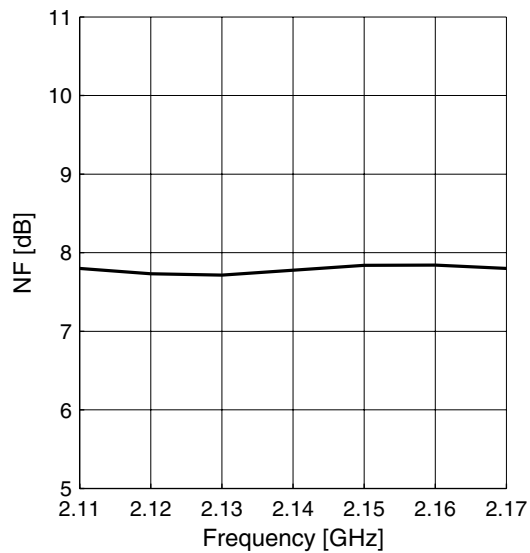


Measured Performance High Band (Band I) Low Gain Mode vs. Frequency

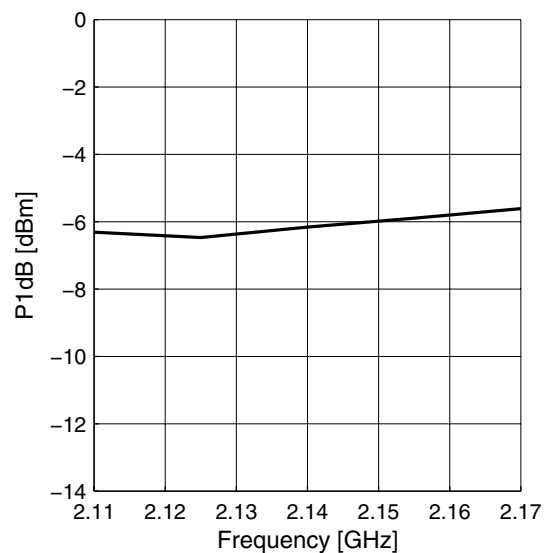
Matching  $|S_{11}| = f(f)$ ,  $|S_{22}| = f(f)$



Noise Figure  $NF = f(f)$



Input Compression  $P1dB = f(f)$

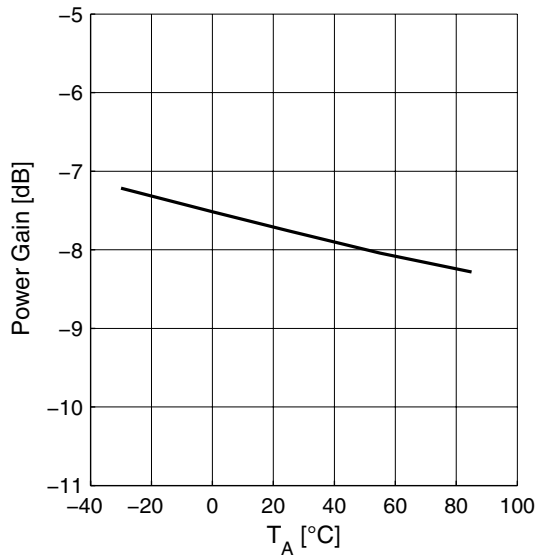


Measured Performance High Band (Band I) Low Gain Mode vs. Temperature

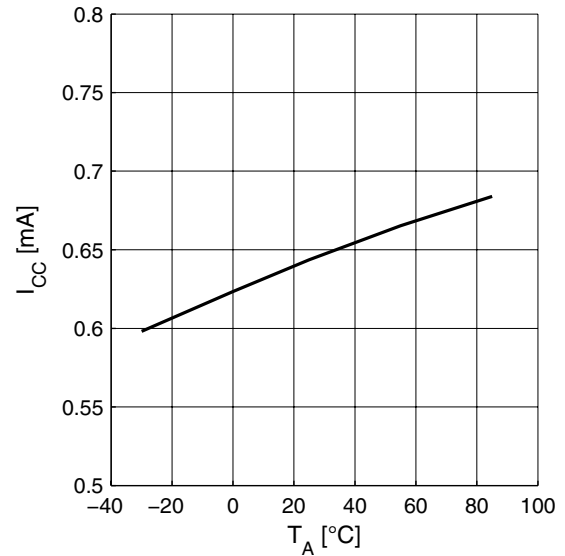
2.23 Measured Performance High Band (Band I) Low Gain Mode vs. Temperature

$V_{CC} = 2.8\text{ V}$ ,  $V_{GS} = 0\text{ V}$ ,  $V_{EN1} = 2.8\text{ V}$ ,  $V_{EN2} = 2.8\text{ V}$ ,  $f = 2140\text{ MHz}$

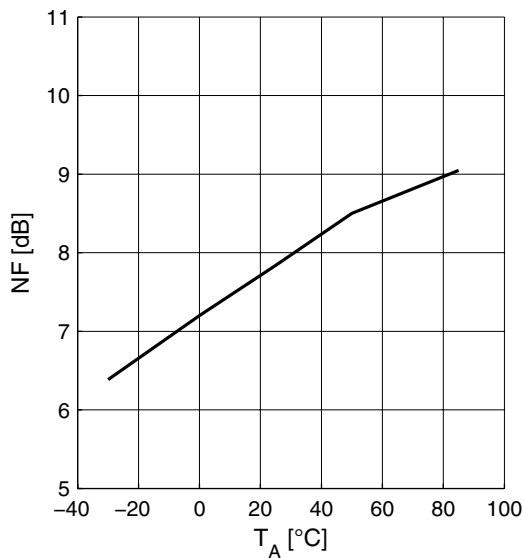
Power Gain  $|S_{21}| = f(T_A)$



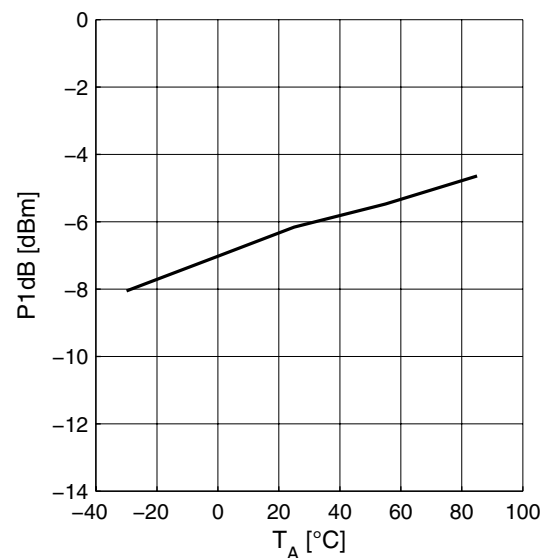
Supply Current  $I_{CC} = f(T_A)$



Noise Figure  $NF = f(T_A)$

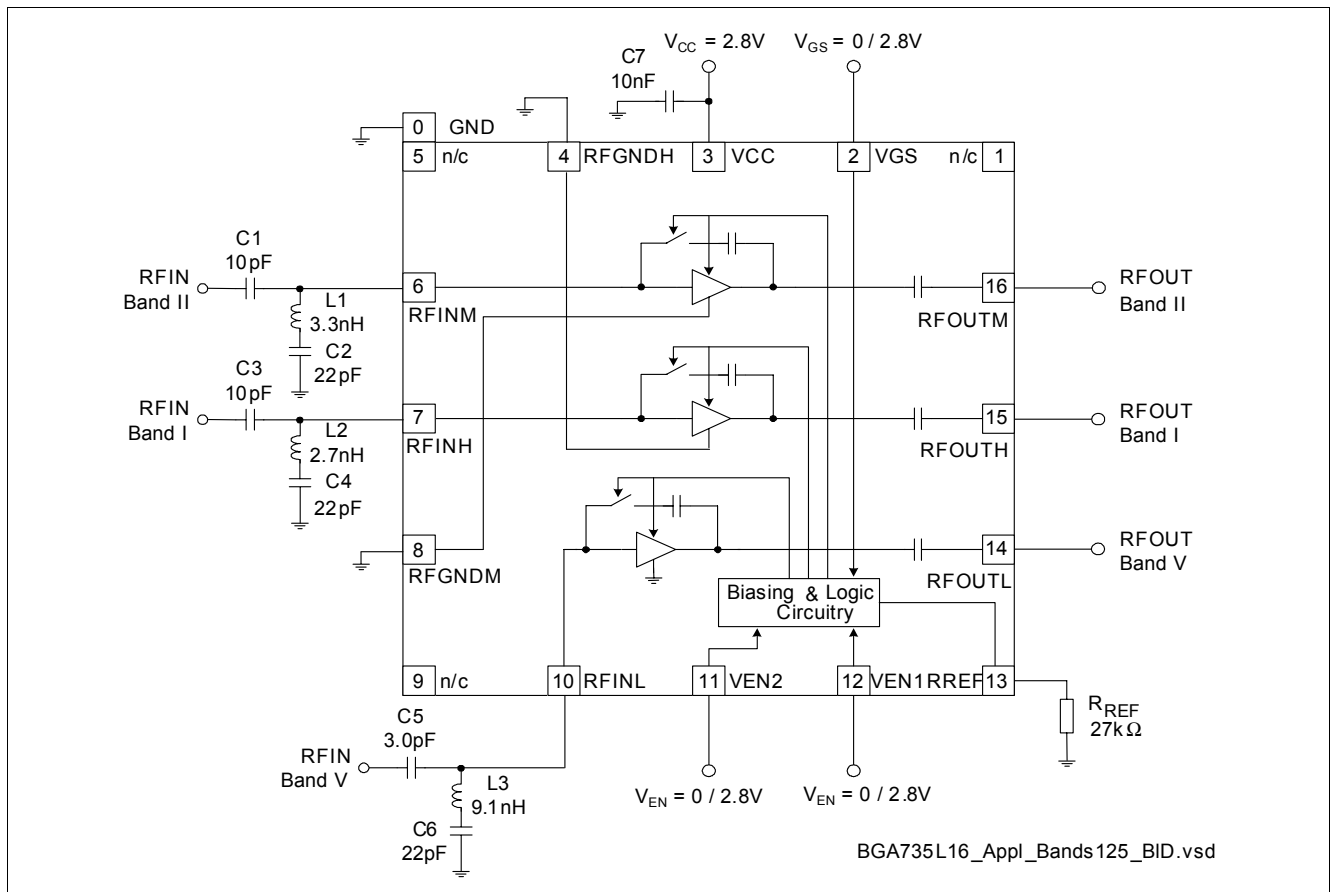


Input Compression  $P1dB = f(T_A)$



### 3 Application Circuit and Block Diagram

#### 3.1 UMTS bands I, II and V Application Circuit Schematic



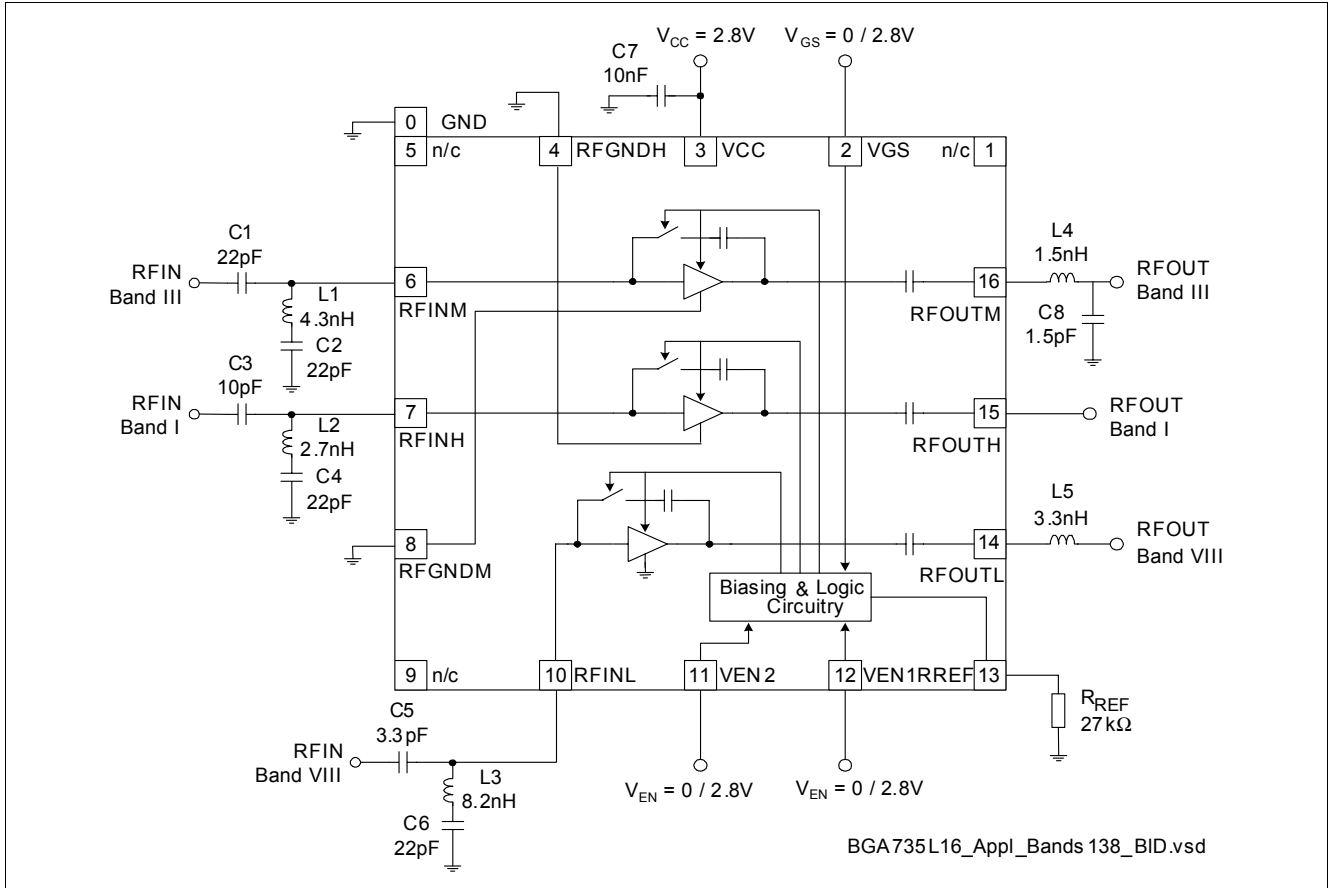
**Figure 2 Application circuit with chip outline (top view)**

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

**Table 14 Parts List**

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

**3.2 UMTS bands I, III and VIII Application Circuit Schematic**



**Figure 3 Application circuit with chip outline (top view)**

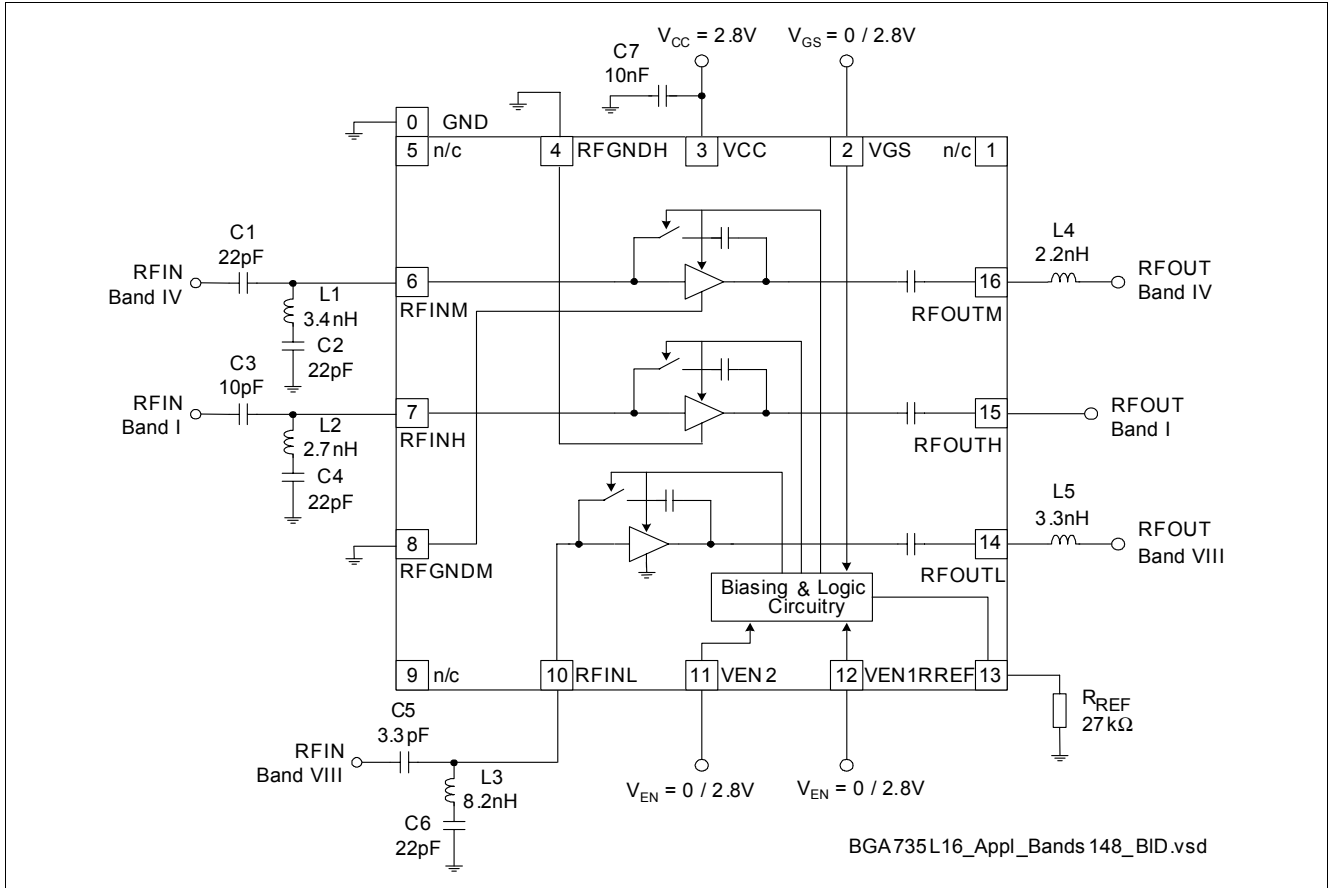
*Note: Package paddle (Pin 0) has to be RF grounded.*

**Table 15 Parts List**

Part Number	Part Type	Manufacturer	Size	Comment
L1 ... L5	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C8	Chip capacitor	Various	0402	
RREF	Chip resistor	Various	0402	



### 3.3 UMTS bands I, IV and VIII Application Circuit Schematic



**Figure 4 Application circuit with chip outline (top view)**

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

**Table 16 Parts List**

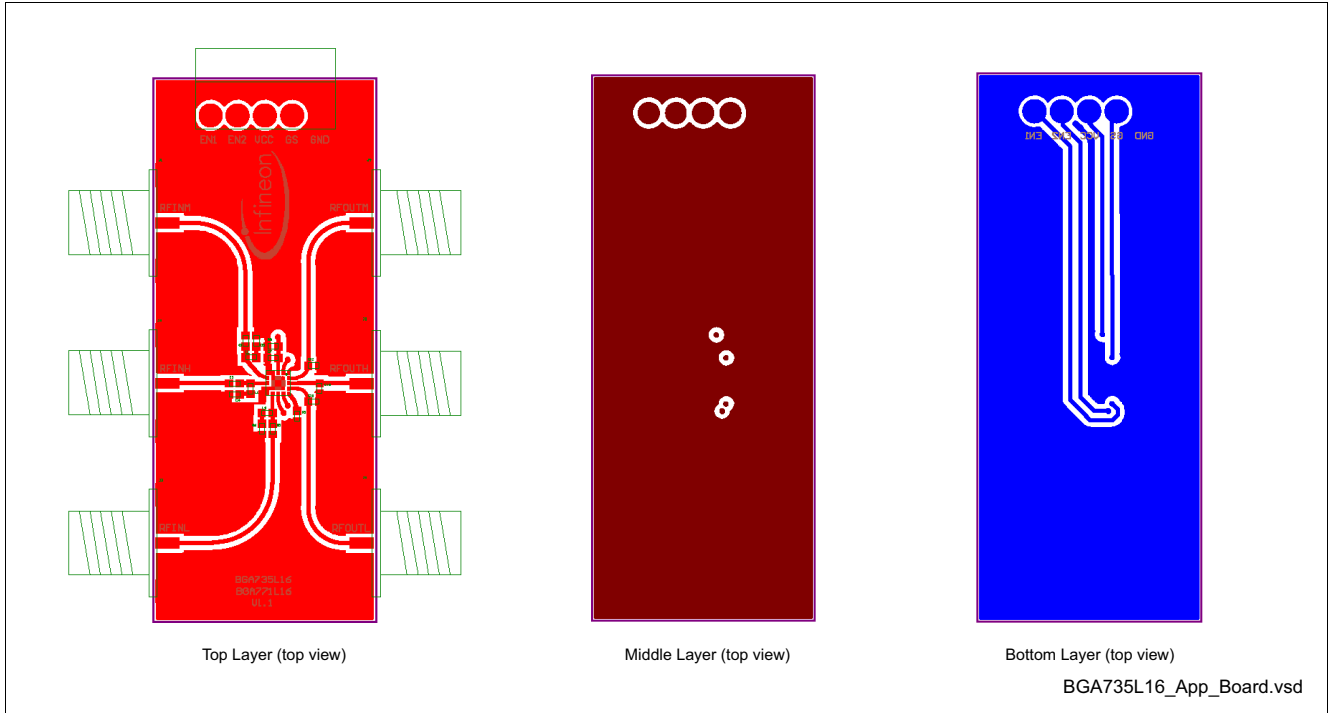
Part Number	Part Type	Manufacturer	Size	Comment
L1 ... L5	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C7	Chip capacitor	Various	0402	
RREF	Chip resistor	Various	0402	

### 3.4 Pin Definition

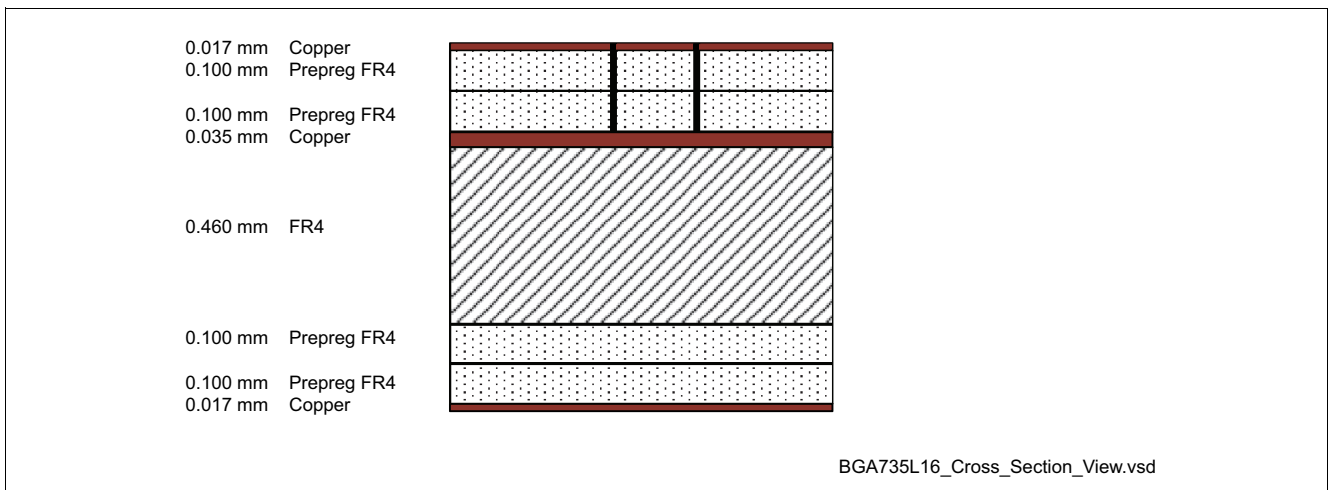
**Table 17 Pin Definition and Function**

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

**3.5 Application Board**



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



**Figure 6 Cross-section view of application board**

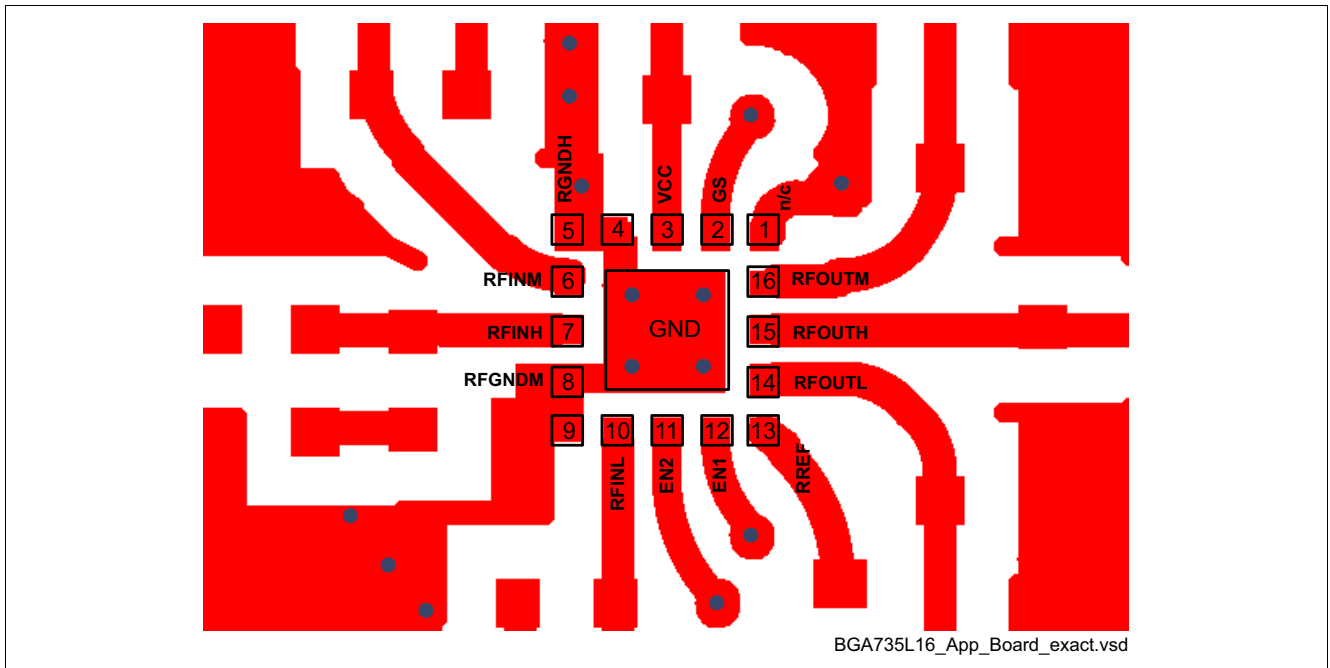


Figure 7 Detail of application board layout

Note: In order to achieve the same performance as given in this datasheet please follow the suggested PCB-layout as closely as possible. The position of the GND vias is critical for RF performance.

## 4 Physical Characteristics

### 4.1 Package Footprint

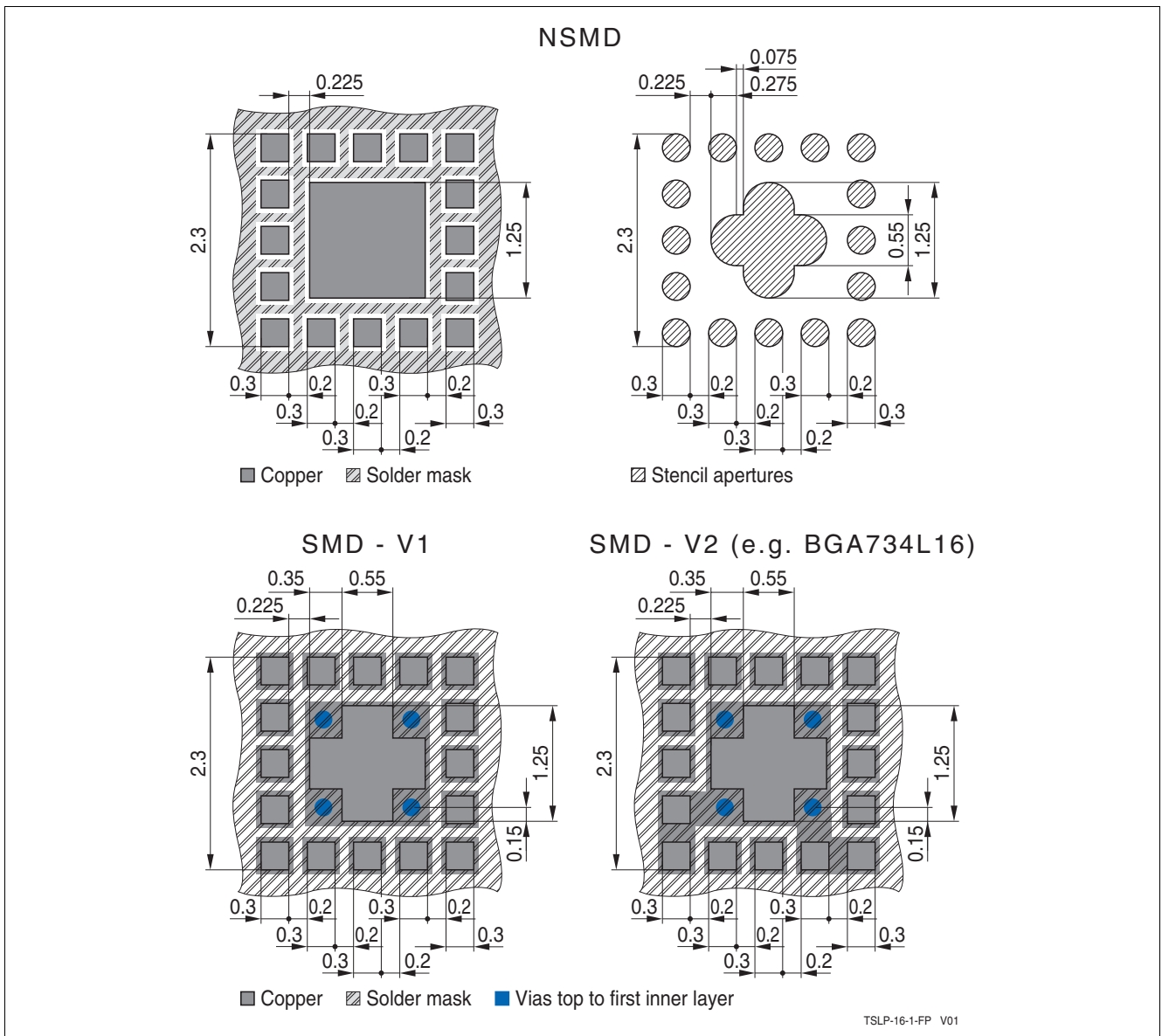


Figure 8 Recommended footprint and stencil layout for the TSLP-16-1 package

4.2 Package Dimensions

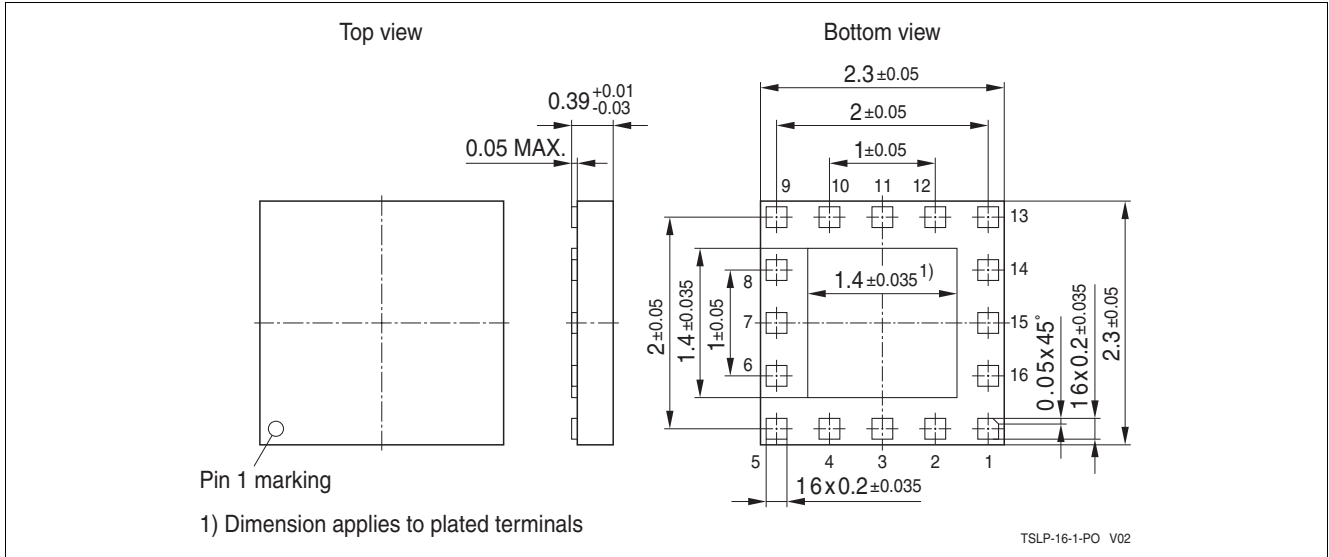


Figure 9 Package outline (top, side and bottom view)

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