Application Note No. 070

High Reverse Isolation Amplifiers at 900 MHz and 1800 MHz using BGA416

RF & Protection Devices

Never stop thinking

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Application Note No. 070

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Previous Version: 2000-02-03

Page	Subjects (major changes since last revision)
All	Document layout change

Trademarks

SIEGET® is a registered trademark of Infineon Technologies AG.

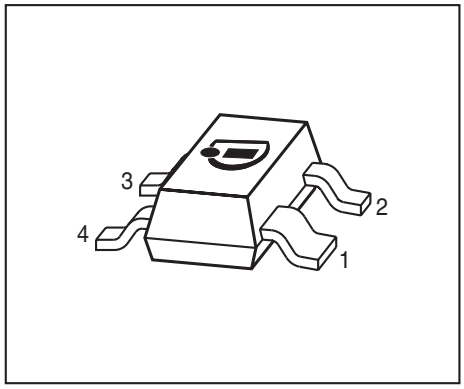
1 High Reverse Isolation Amplifiers at 900 MHz and 1800 MHz using BGA416

Features

- High Maximum Available Gain of 23 dB at 900 MHz
- Ultra high reverse isolation of 62 dB at 900 MHz
- Integrated on-chip biasing circuit
- Low Noise Figure of 1.3 dB at 900 MHz

Applications

- High Reverse Isolation buffer amplifier for oscillator applications
- Low Noise Amplifier for 800 / 900 MHz, GMS900, 900 MHz ISM, DCS1800, GPS, 1900 MHz PCS, WLAN, UMTS
- Active element in oscillator circuits



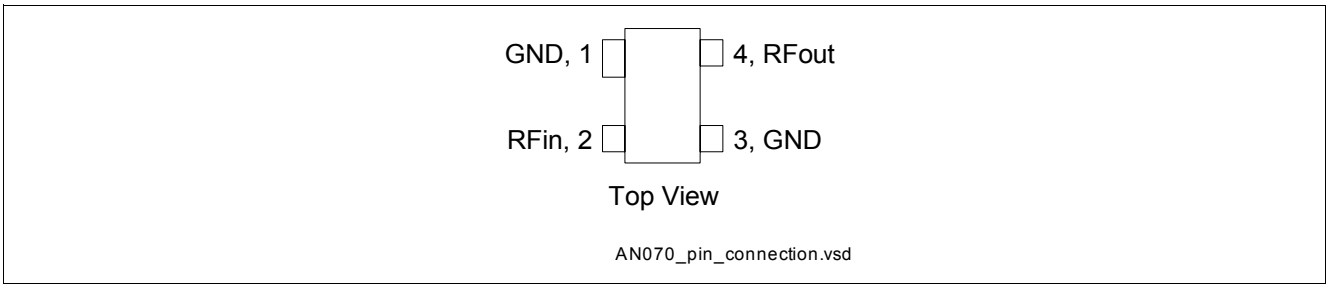


Figure 1 PIN configuration

1.1 Introduction

The BGA416 is a monolithic cascode amplifier realized in Infineon Technologies' SIEGET®25 bipolar process.

The cascode amplifier is a popular transistor configuration used in many RF functional blocks such as low noise amplifiers, voltage controlled oscillators, buffer amplifiers and others for a wide variety of RF and Wireless end products.

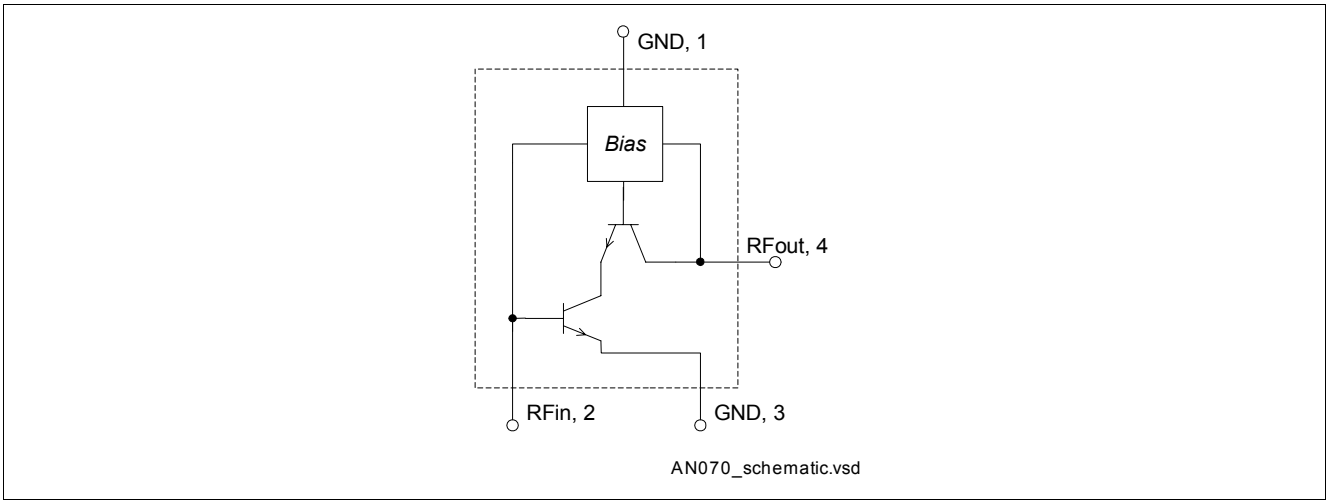


Figure 2 Schematic Diagram BGA416

The BGA416 features an integrated, on-chip bias circuit that sets the device's bias point resulting in a low total parts-count and reduction in required printed circuit board area. RF impedance matching is done off-chip to allow maximum flexibility, enabling the BGA416 to be used in a wide variety of applications.

2 The BGA416 in a 900 MHz Amplifier Application

900 MHz circuit

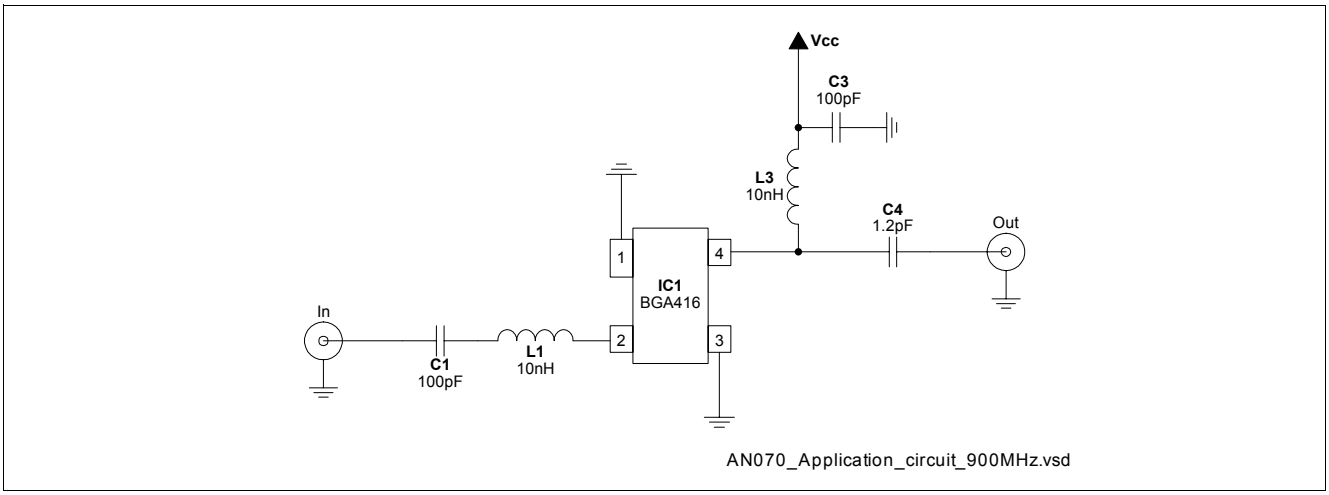


Figure 3 900 MHz Application Circuit Diagram

Table 1 Bill of Material of 900 MHz Circuit

Name	Value	Unit	Package	Manufacturer	Function
C1	100	pF	0402	Various	DC block
C2	1.2	pF	0402	Various	Output matching, DC block
C3	100	pF	0402	Various	RF bypass
IC1	BGA416		SOT143	Infineon Technologies	Si MMIC
L1	10	nH	0402	Toko LL1005-FH	Input matching
L2	10	nH	0402	Toko LL1005-FH	Output matching, RF choke

2.1 Performance Overview

The following table shows the measured performance of the application circuit in **Figure 3**. All measurement values presented in this application note include losses of both PCB and connectors - in other words, the reference planes used for measurements are the PCB's RF SMA connectors. Noise figure and gain results shown do not have any PCB loss extracted from them.

Table 2 Measured Performance Data at 900 MHz and V_{CC} = 3 V

Parameter	Symbol	Value	Unit
Supply current	I_{CC}	5.4	mA
Insertion power gain	$\|S_{21}\|^2$	20.6	dB
Noise figure	NF	1.7	dB
Input return loss	$\|S_{11}\|^2$	13.9	dB
Output return loss	$\|S_{22}\|^2$	11.6	dB
Reverse isolation	$\|S_{12}\|^2$	62	dB

Table 2 Measured Performance Data at 900 MHz and V_{cc} = 3 V (cont'd)

Parameter	Symbol	Value	Unit
Input 1 dB-compression point	IP_{1dB}	-17.5	dBm
Input third order intercept point[1)]	IIP_3	-8.8	dBm

1) Δf = 1 MHz; P_{in} = -35 dBm

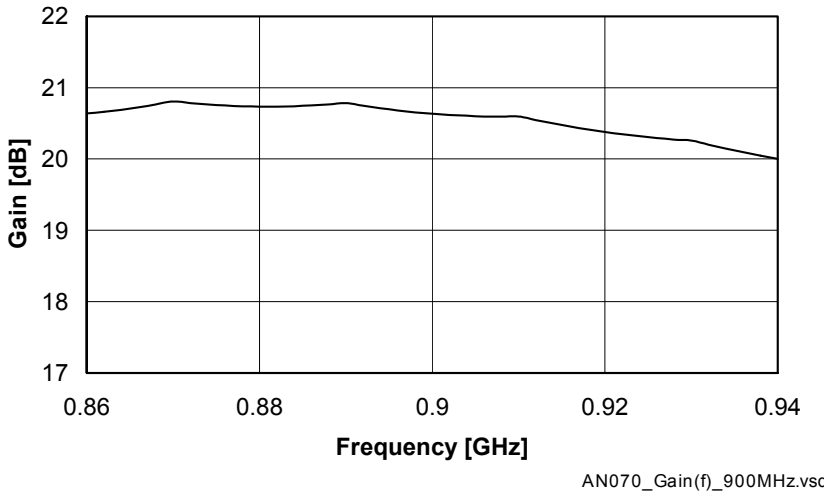


Figure 4 Insertion Power Gain

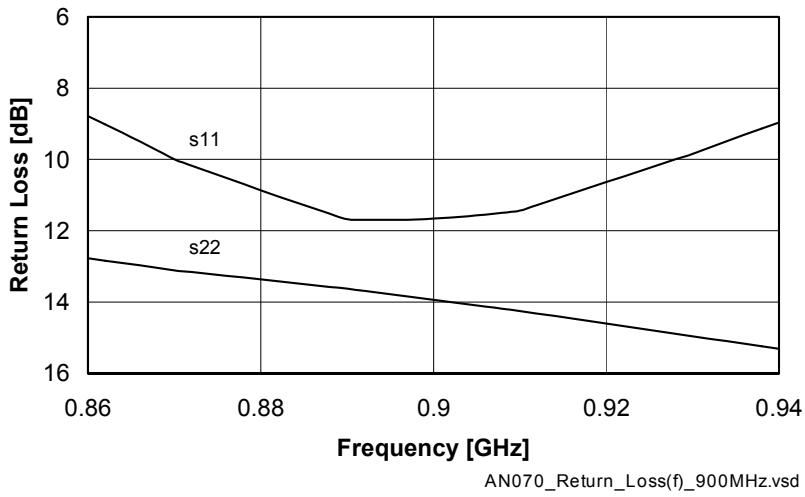


Figure 5 Return Loss

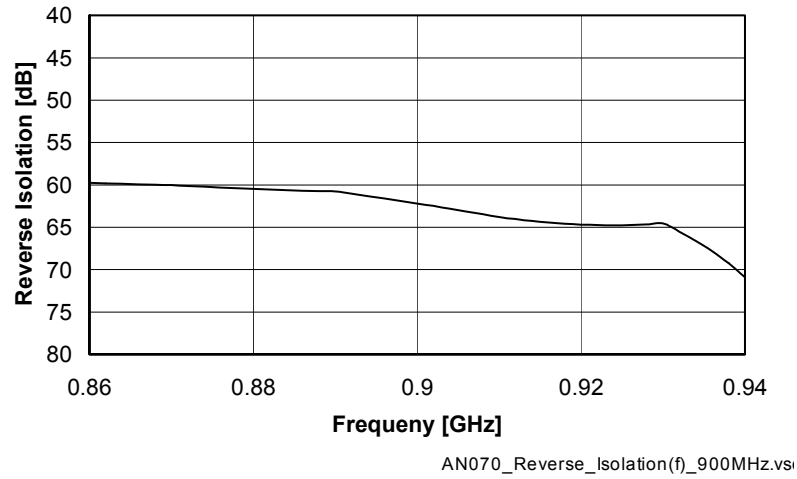


Figure 6 Reverse Isolation

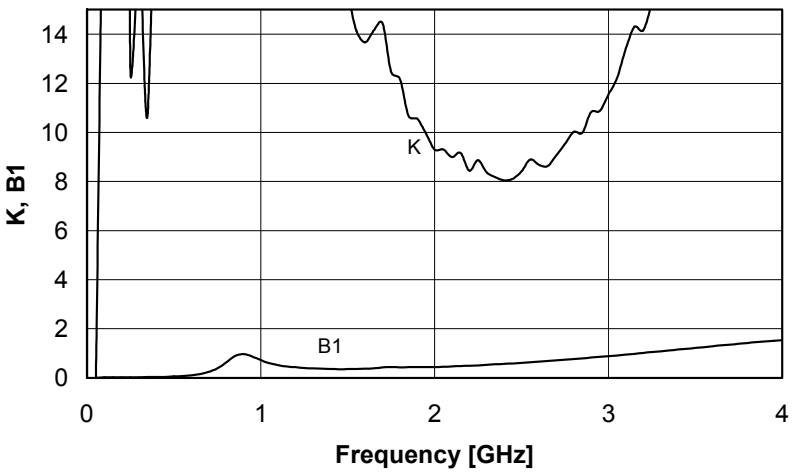


Figure 7 Stability

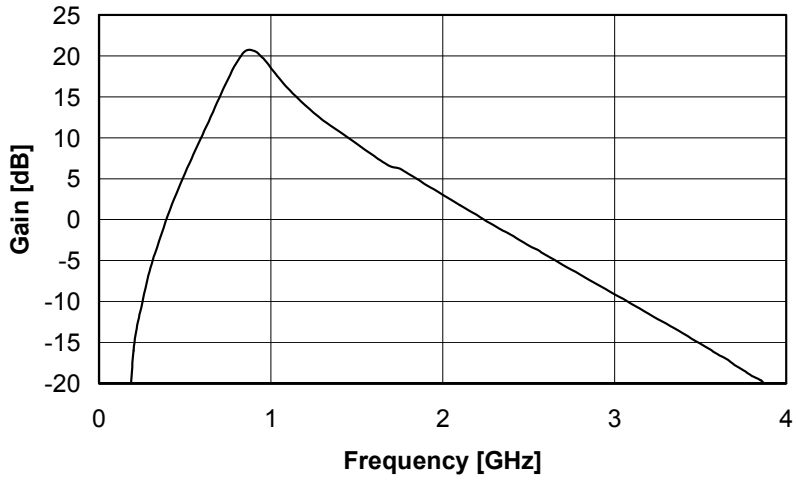


Figure 8 Wide Span Gain

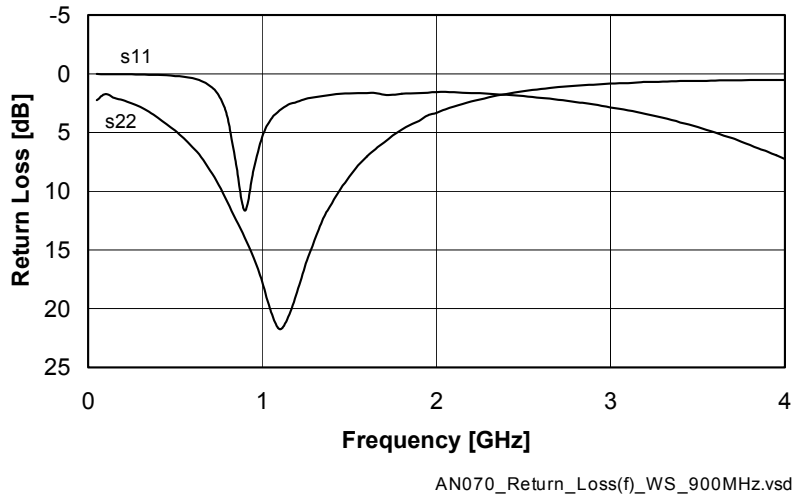


Figure 9 Wide Span Return Loss

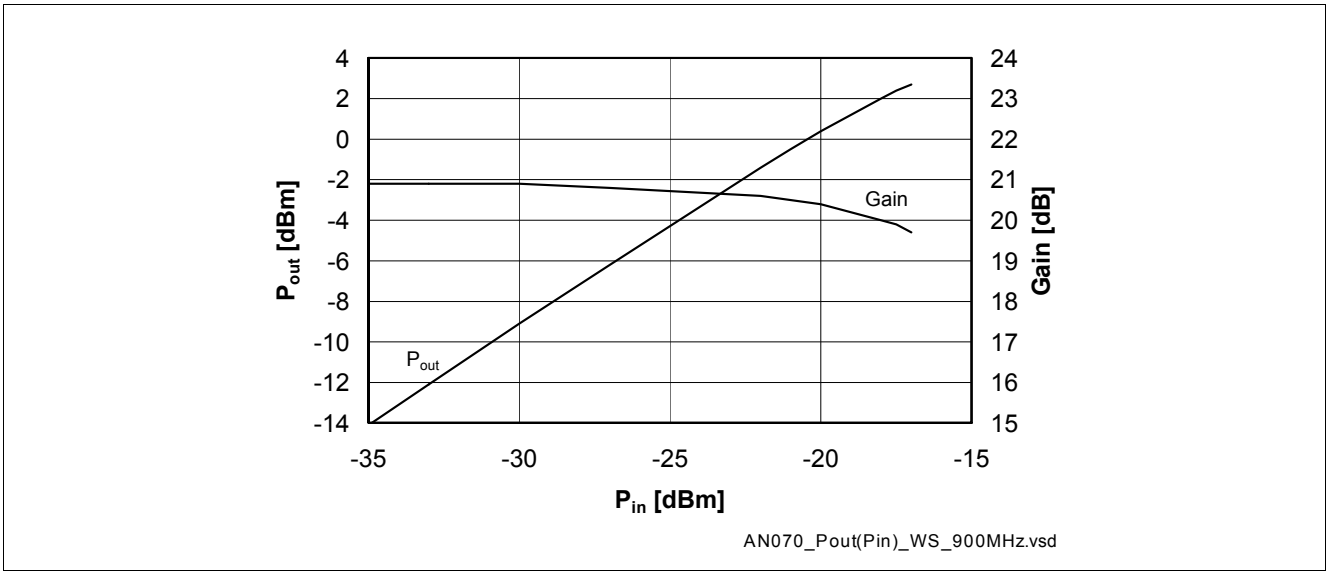


Figure 10 Gain Compression

3 The BGA416 in a 1800 MHz Amplifier Application

1800 MHz Circuit

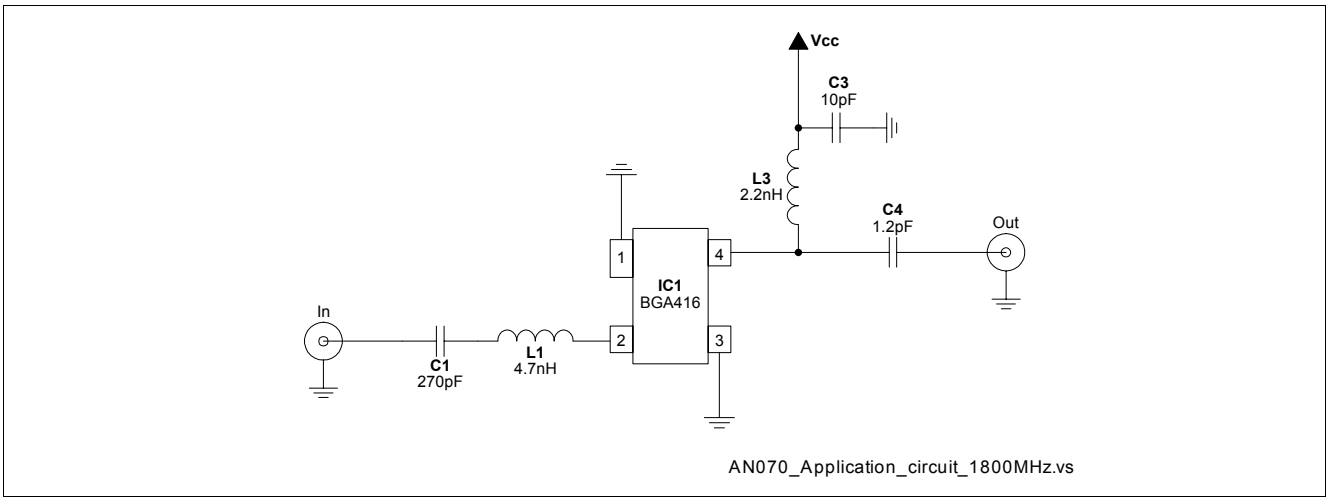


Figure 11 1800 MHz Application Circuit Diagram

Table 3 Bill of Material of 1800 MHz Circuit

Name	Value	Unit	Package	Manufacturer	Function
C1	270	pF	0402	Various	DC block
C2	1.2	pF	0402	Various	Output matching, DC block
C3	10	pF	0402	Various	RF bypass
IC1	BGA416		SOT143	Infineon Technologies	Si MMIC
L1	4.7	nH	0402	Toko LL1005-FH	Input matching
L2	2.2	nH	0402	Toko LL1005-FH	Output matching RF choke

3.1 Performance Overview

The following table shows the measured performance of the application circuit in **Figure 11**. As mentioned before all these values were measured at the SMA connectors of the application PCB.

Table 4 Measured Performance Data at 1800 MHz and V_{CC} = 3 V

Parameter	Symbol	Value	Unit
Supply current	I_{CC}	5.4	mA
Insertion power gain	$\|S_{21}\|^2$	12.9	dB
Noise figure	NF	2.1	dB
Input return loss	$\|S_{11}\|^2$	19.4	dB
Output return loss	$\|S_{22}\|^2$	23.9	dB
Reverse isolation	$\|S_{12}\|^2$	38	dB
Input 1 dB-compression point	IP_{1dB}	-13.5	dBm
Input third order intercept point[1)]	IIP_3	-3	dBm

1) Δf = 1 MHz; P_{in} = -35 dBm

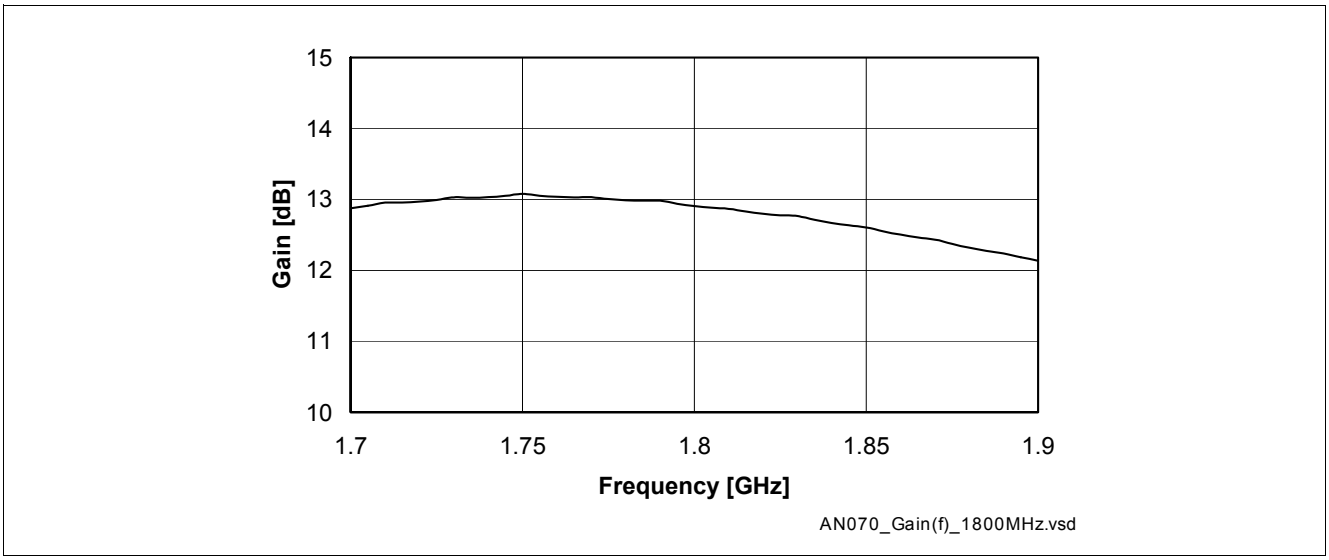


Figure 12 Insertion Power Gain

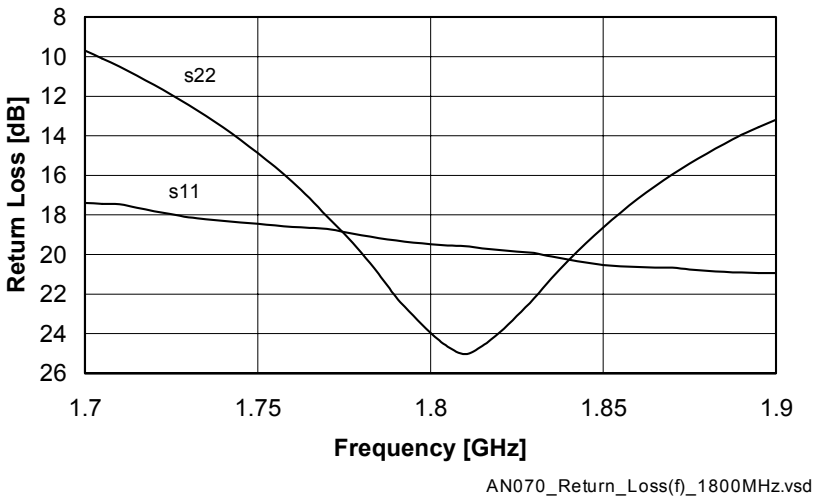


Figure 13 Return Loss

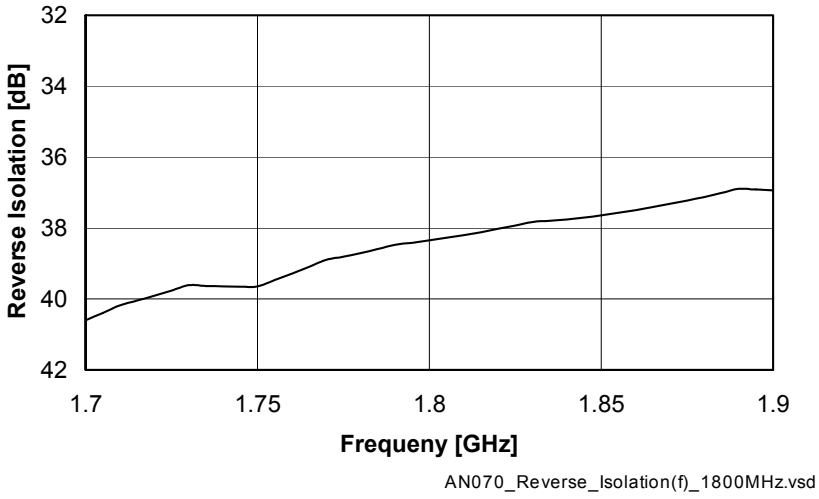


Figure 14 Reverse Isolation

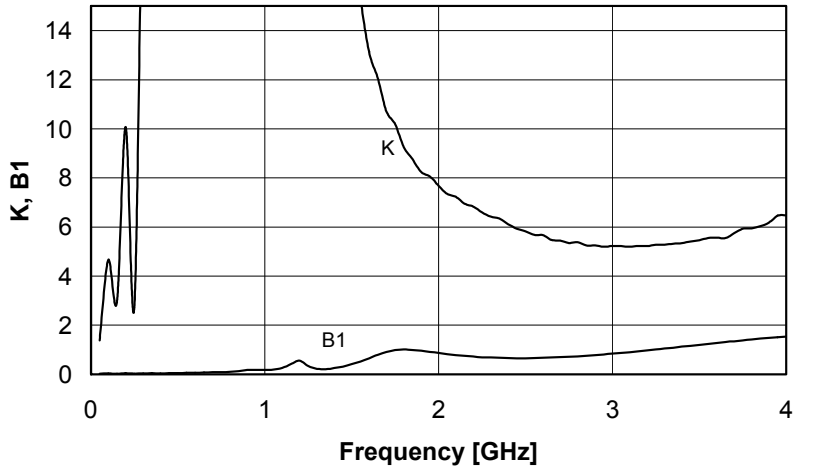


Figure 15 Stability

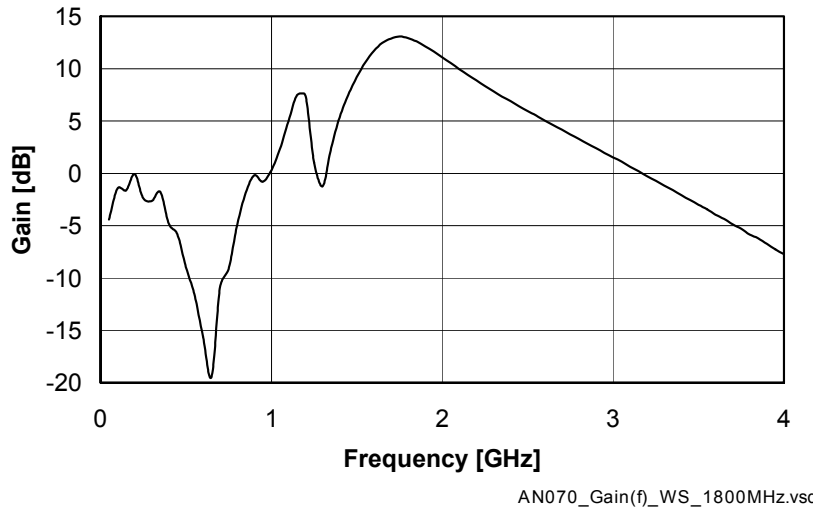


Figure 16 Wide Span Gain

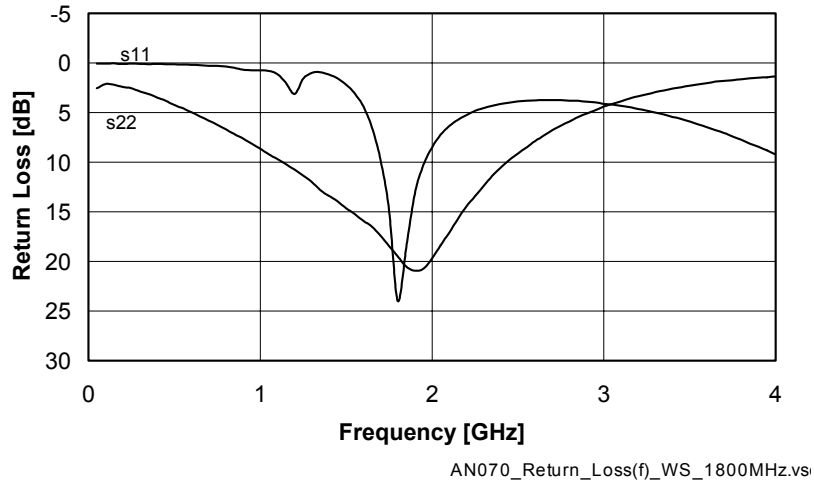


Figure 17 Wide Span Return Loss

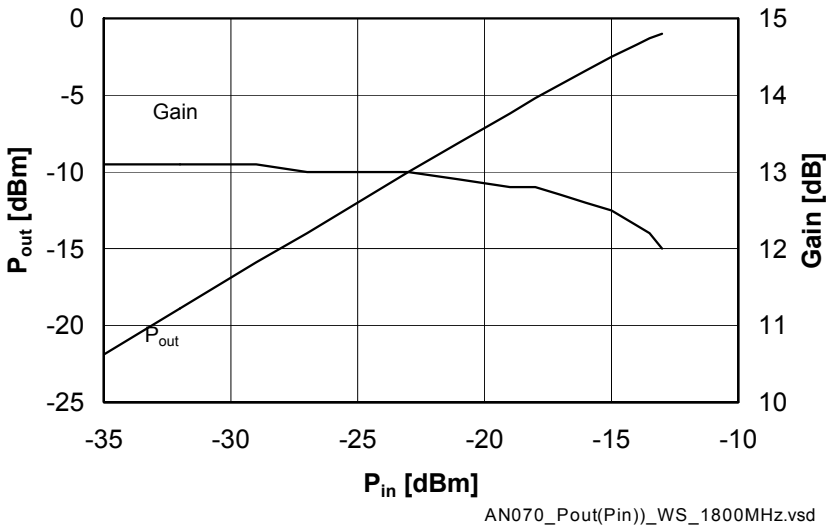


Figure 18 Gain Compression

4 Application Board and Component Placement

Figure 19 shows the placement of the particular components on the application board. The element labeled “NA” is not used in the designs described in this application note.

Figure 20 displays the cross section of the application PCB. The layer which is actually used for electrical / RF purposes is the layer with the 0.2 mm FR dielectric thickness. The 0.8 mm RF layer is used solely to provide mechanical rigidity and to allow for the use of edge-mount SMA RF connectors.

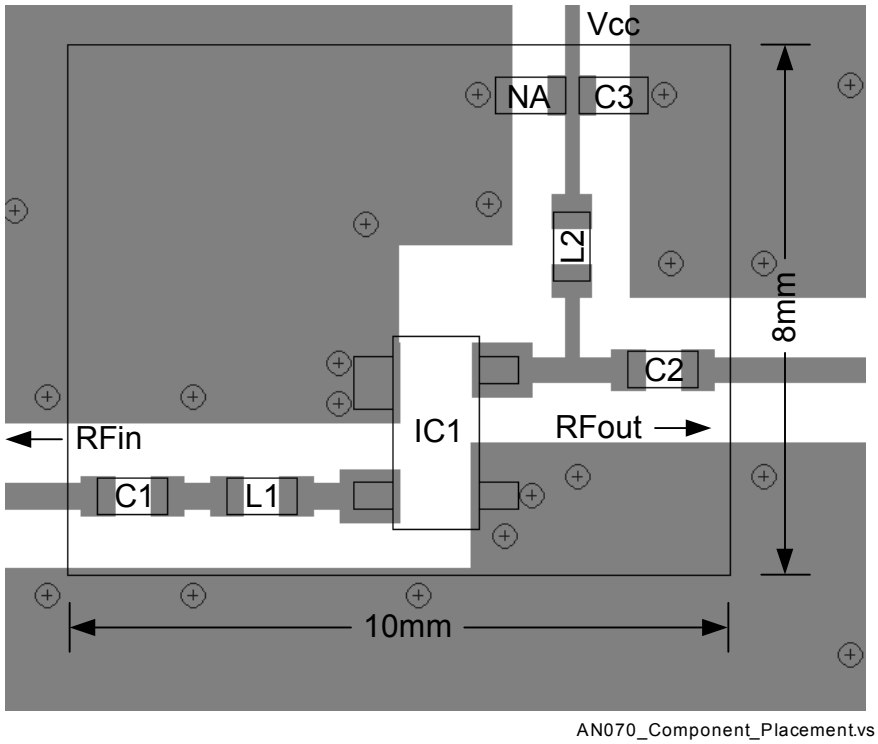


Figure 19 Component Placement on the Application PCB

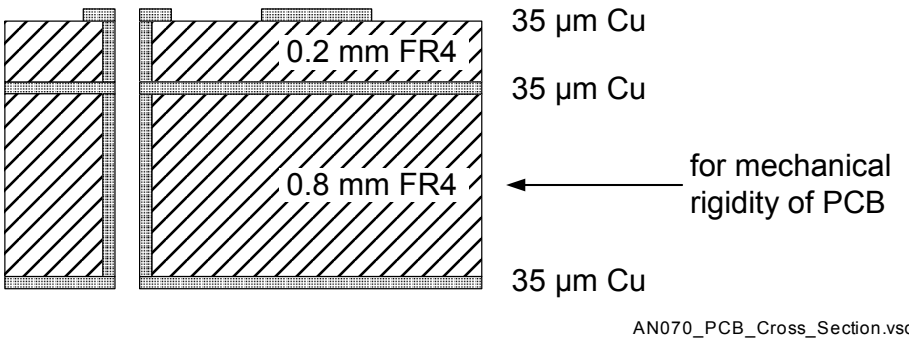


Figure 20 PCB Cross Section

Evaluation boards for the amplifier applications described in this application note are available form Infineon Technologies.