BGB719N7ESD

Miniature ESD robust Low Noise Amplifier for embedded FM Radio Antennas in Handsets

Application Note AN255

Revision: 1.1
2012-01-18

RF and Protection Devices

Edition 2012-01-18

Published by
Infineon Technologies AG
81726 Munich, Germany

Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. 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 the 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 the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only 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.

Application Note AN255

Revision History: 2012-01-18

Previous Revision: 1.0

Page	Subjects (major changes since last revision)
	Package change TSLP 7-8 >> TSNP 7-6

Table of Content

1 Introduction 5
1.1 Applications 5
2 Performance Overview 6
3 Application Information 7
4 Measured Graphs 8
5 Layout 11
Authors 12

List of Figures

Figure 1 BGB719N7ESD in TSNP-7-6 Package 5
Figure 2 FM Radio application schematic 6
Figure 3 Schematics of the BGB719N7ESD application circuit 7
Figure 4 Insertion Power Gain InBand 8
Figure 5 Input Matching 9
Figure 6 Output Matching 9
Figure 7 Z Parameters Input output matching 10
Figure 8 Reverse Isolation 10
Figure 9 BGB719N7ESD evaluation board layout 11

List of Tables

Table 1 Electrical Characteristics (at room temperature) 7
Table 2 Bill-of-Materials 8

1 Introduction

Features

- High performance FM Radio LNA with integrated biasing
- Frequency range: 10 MHz to 1 GHz
- Low external parts count
- Super miniature low profile leadless package TSNP-7-6, 1.26 x 1.4 x 0.37 mm
- High gain at only 2.8 mA current consumption
- Integrated active biasing circuit enables stable operation point against temperature-, supply voltage- and processing-variations
- Integrated ESD protection for all pins (1.5 kV, HBM)
- High input compression point
- High input impedance
- Excellent noise figure from latest SiGe:C technology
- Operation voltage: 1.5 V to 4.0 V
- Power-off function
- Pb-free (RoHS compliant) and halogen-free (WEEE compliant) product

Applications

- Low noise amplifier and active matching for FM reception with small antennas in all kinds of mobile devices such as cell phones, PDAs, portable FM Radio, MP3 players

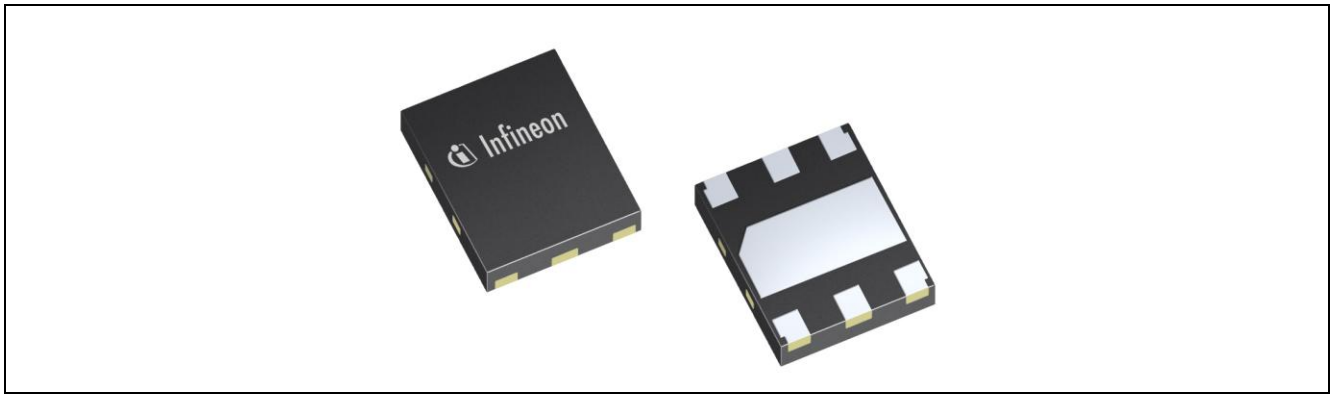

Figure 1 BGB719N7ESD in TSNP-7-6 Package

1.1 Applications

FM Radio has a long history to its credit starting from its development in 1933. Today, FM radio is an integral part of almost all mobile phones. In a common mobile phone, the headset cable serves as antenna for FM reception, wherein the antenna size (~75 cm) is a bit relaxed.
There is a clear market trend to be able to use FM radio also without the headset cable. The antenna needs then to be integrated inside the phone. But in this case, the space constraint poses a challenge on the antenna

design. Shrinking the size of the antenna introduces a high loss in the system which deteriorates the receiver performance, namely the receiver sensitivity.

Infineon's latest generation low noise amplifier (LNA) BGB719N7ESD is able to solve this problem by enhancing the receiver sensitivity. Using it in a hand held device also demands low current consumption, power-off function and high linearity due to the co-existence of cellular bands.The LNA is designed for worldwide FM band (76-108 MHz) and high ESD robustness at the RF-in port, which supports outstanding ESD robustness on system level. Infineon offers its LNA solution BGB719N7ESD, which fulfills all these performance criteria in a very small and leadless package TSNP-7-6 (1.26 x 1.4 x 0.375 mm). A further highlight of the BGB719N7ESD is an integrated active biasing which enables consistent operation with varying temperature and process variations. It finds its application in all kinds of mobile devices like mobile phones, PDAs, portable FM radio, MP3 players etc. Putting Infineon's ESD protection diode ESD0P8RFL in front of the LNA improves the system's ESD performance up to 8 kV contact discharge (IEC61000-4-2) at RF input. The diode is mounted in the small leadless TSLP-4-7 package (1.2 x 0.8 x 0.39 mm) and has a parasitic capacitance of only 0.8 pF.

With this application proposal Infineon offers a perfect solution for an ESD robust LNA for embedded FM radio antennas in handsets. The design is suited for miniature and slim handset design due to the small form factor of the TSNP packages. The LNA fits easily into a 8mm x 8mm sized area when using 0402 capacitors.

2 Performance Overview

Table 1 gives a quick overview on the performance of the FM Antenna LNA described in this application note. All measurements were performed in a 50Ohm environment.

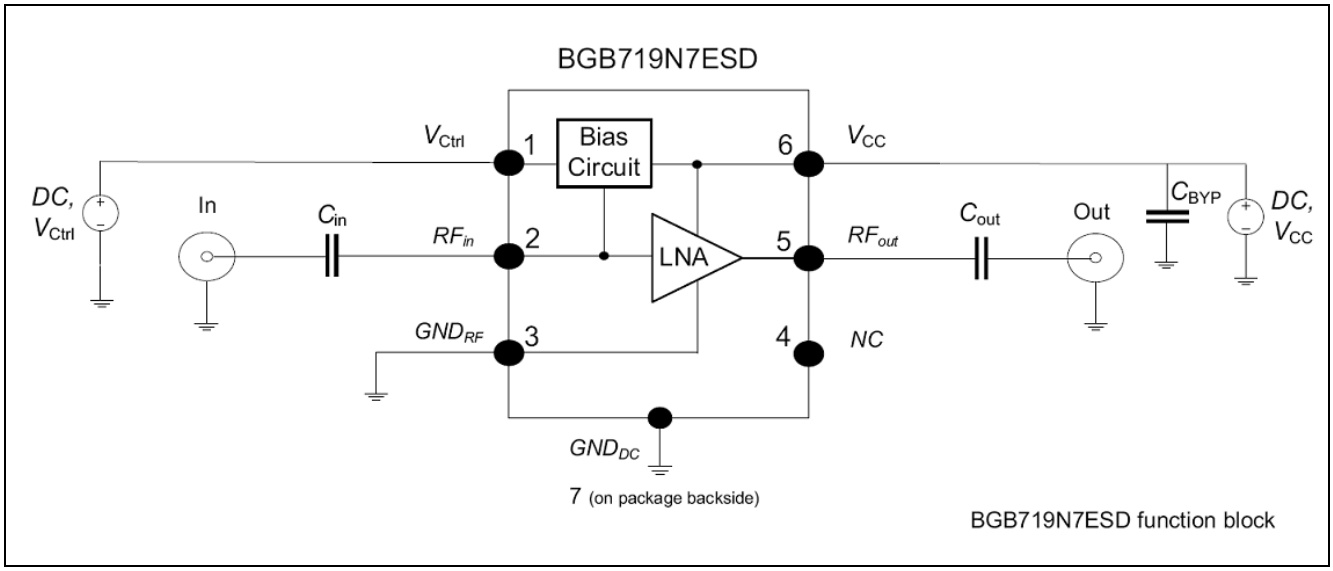

Figure 2 FM Radio application schematic

Table 1 Electrical Characteristics (at room temperature)

T_A = 25°C, V_{CC} = 3.0V, V_{PD} = 3.0 V, ICC_q = 3.0 mA, f = 100MHz

Parameter	Symbol	Value	Unit	Comment/Test Condition
Frequency Range	Freq	100	MHz	
DC Voltage	Vcc	3	V	
DC Current	Icc	2.8	mA	
Gain	G	13.5	dB	
Noise Figure	NF	1.2	dB	
Input Return Loss	RLin	0.5	dB	
Output Return Loss	RLout	11	dB	
Reverse Isolation	IRev	53	dB	
Input P1dB	IP1dB	-6	dBm	
Input IP3	IIP3	-14	dBm	
Stability	k	>1	--	Unconditionally stable up to 10 GHz

3 Application Information

In this section, the application circuit for the BGB719N7ESD is described. The circuit requires minimal usage of external SMD components due to the integration of the biasing circuit which saves PCB space and therefore cost.

The BGB719N7ESD can be easily matched to electrically short half-loop antennas and monopol antennas. Therefore a single passive element needs to be placed at the input of the LNA. In case of a half-loop antenna a shunt capacitance in the range of 35 pF is needed. If the application uses a monopol antenna, a shunt inductance in the range of 375 nH is required.

The application schematic is shown in **Figure 3** and the function of each component is explained in **Table 2**.

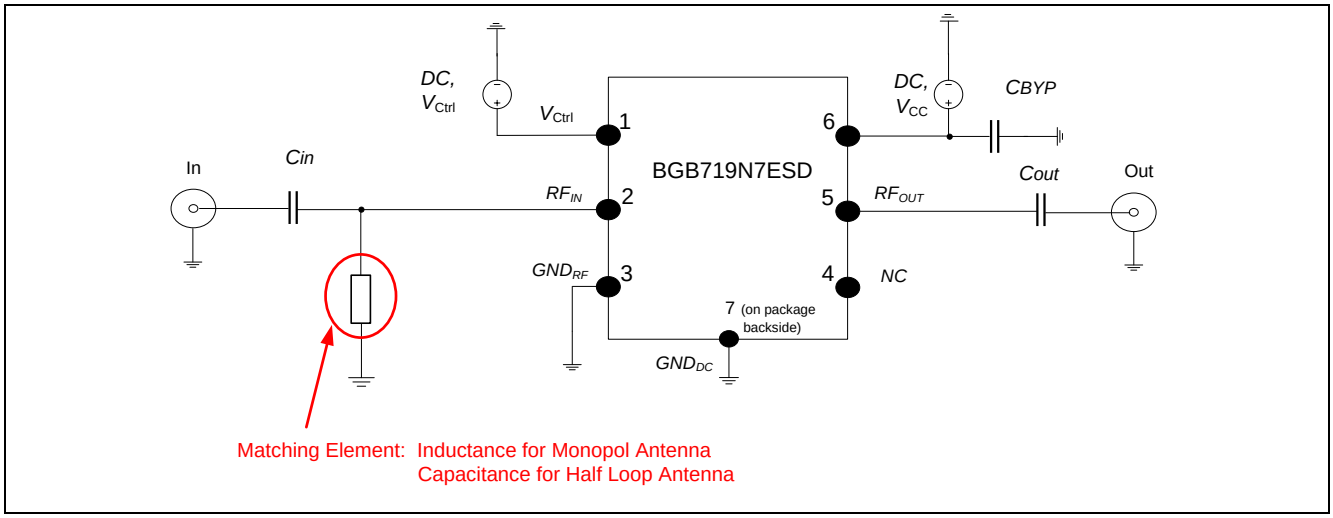

Figure 3 Schematics of the BGB719N7ESD application circuit

Table 2 Bill-of-Materials

Symbol	Value	Unit	Size	Manufacturer	Comment
Matching Element				Various/0402	Shunt C or L depending on the used FM antenna concept
CIN	330	pF		Various/0402	DC Blocking
COUT	330	pF		Various/0402	DC Blocking
CBYP	47	nF		Various/0402	Bypass Capacitor

4 Measured Graphs

Note: All measurements were performed in a 50Ohm environment.

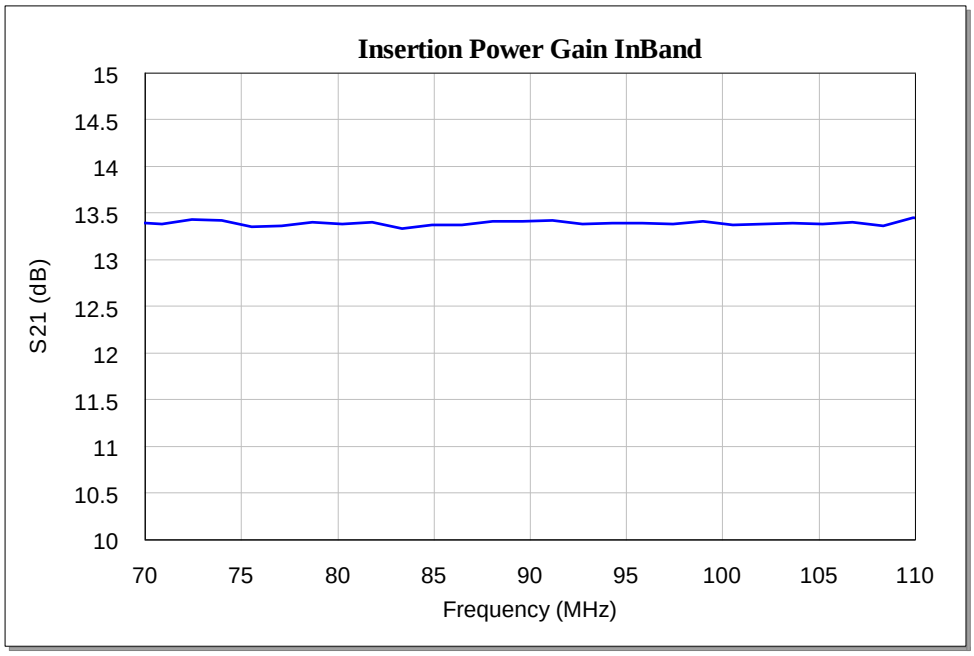

Figure 4 Insertion Power Gain InBand

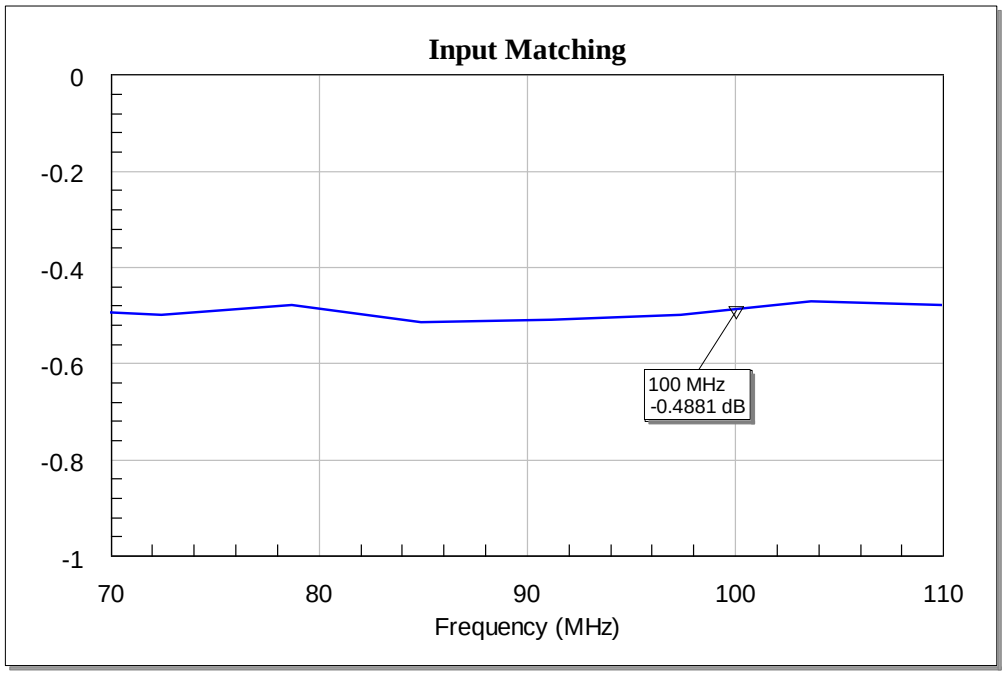

Figure 5 Input Matching

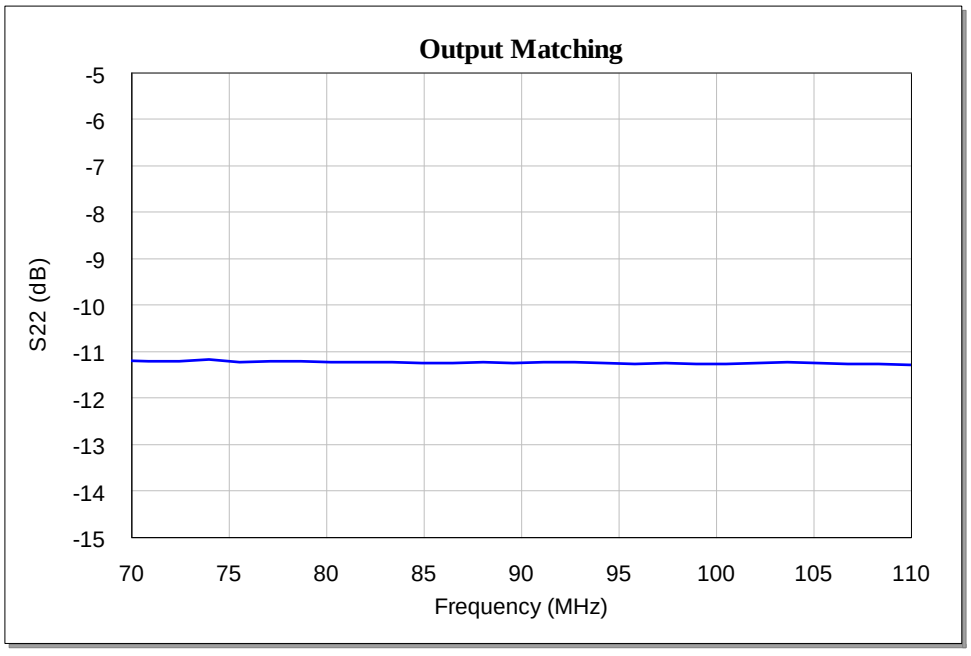

Figure 6 Output Matching

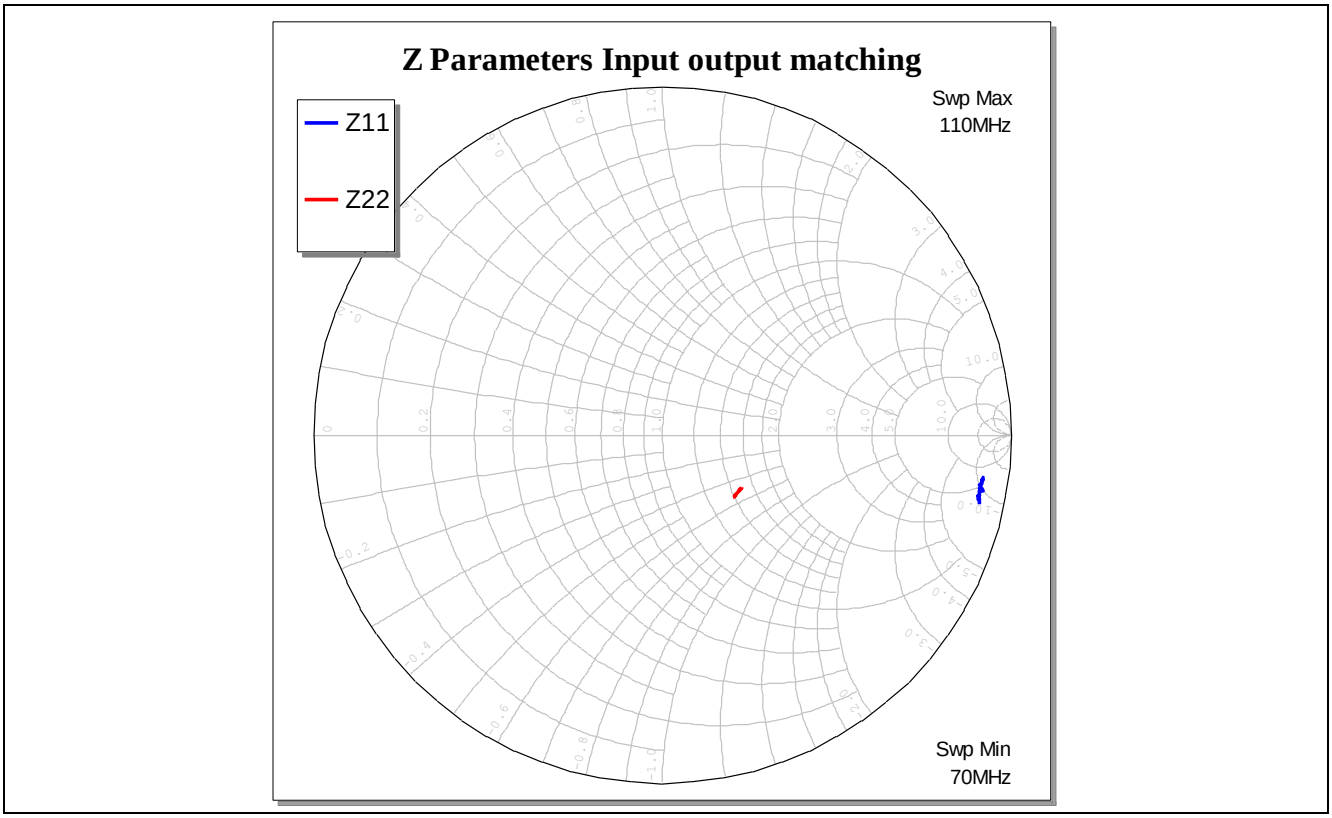

Figure 7 Z Parameters Input output matching

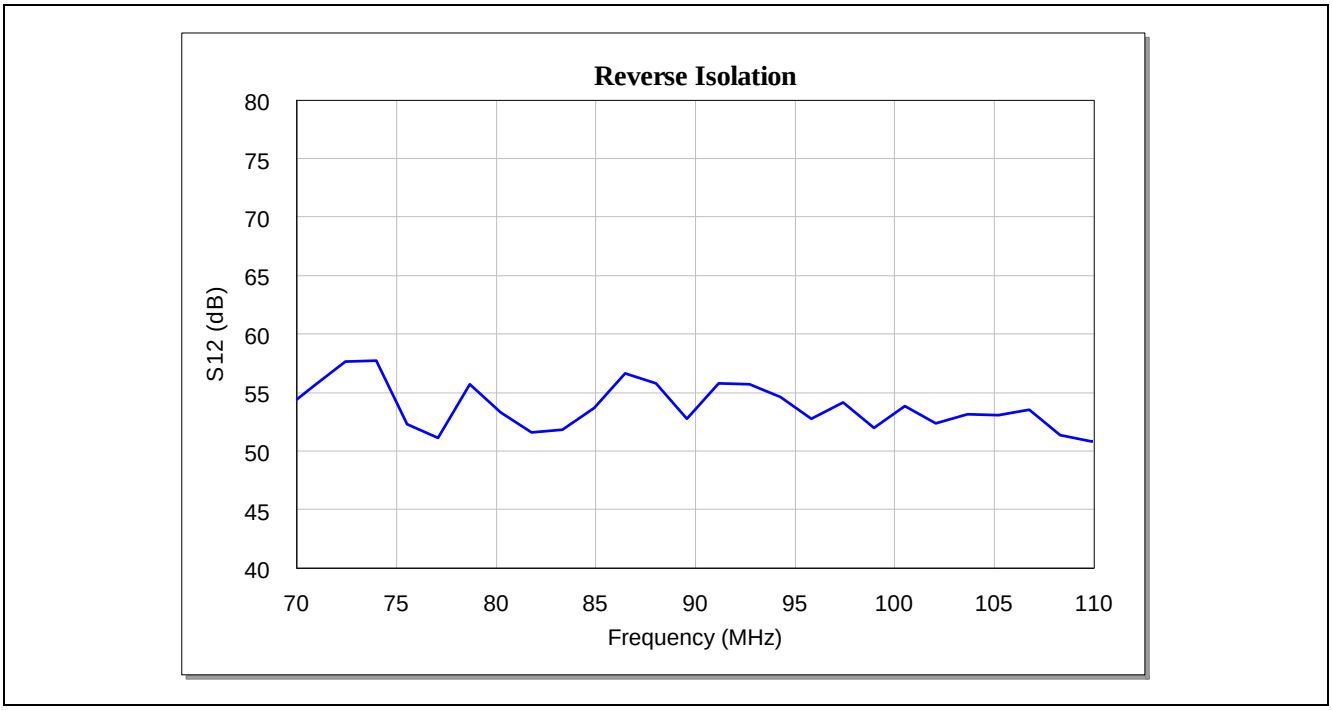

Figure 8 Reverse Isolation

5 Layout

Figure 9 shows the layout and the component placement of the printed circuit board used to assemble and test the LNA.

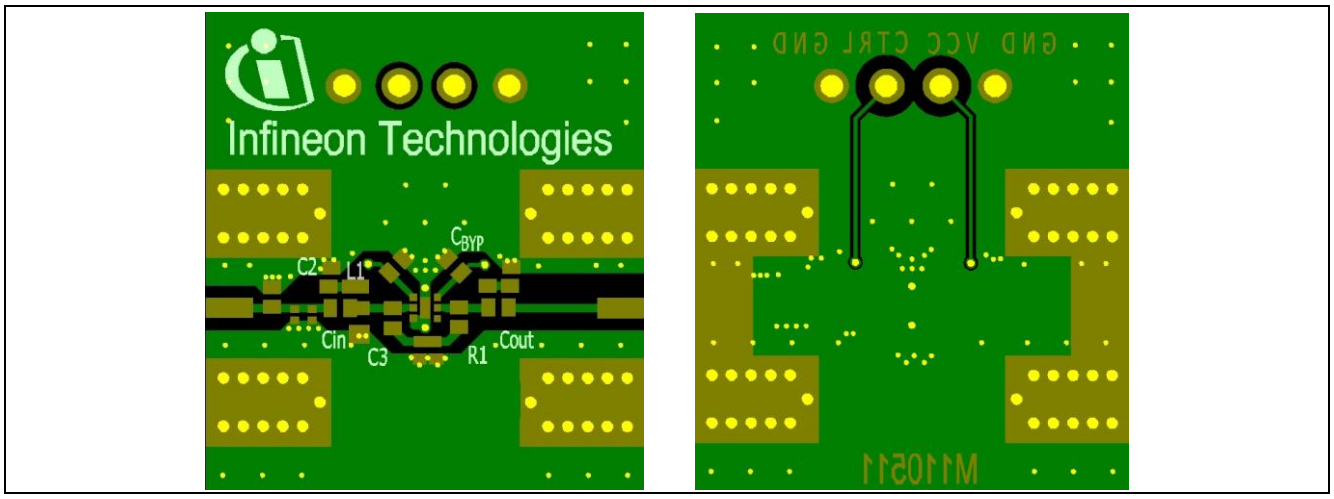

Figure 9 BGB719N7ESD evaluation board layout

Authors

Thomas Schwingshackl, Application Engineer of Business Unit “RF and Protection Devices”

Ralph Kuhn, Senior Staff Application Engineer of Business Unit “RF and Protection Devices”

---

w w w . i n f i n e o n . c o m

Published by Infineon Technologies AG AN255