BFP740FESD

Dual Band LNA for WiMAX/WLAN 2.3-2.7GHz and 5-6GHz applications

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Application Note AN189
Revision History: 2010-10-15

Previous Revision: no previous revision

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1 Introduction

1.1 Features

• Robust high performance low noise amplifier based on Infineon´s reliable, high volume SiGe:C wafer technology

•2 kV ESD robustness (HBM) due to integrated protection circuits

•Thin, small, flat, Pb- and halogen free (RoHS compliant) package with visible leads

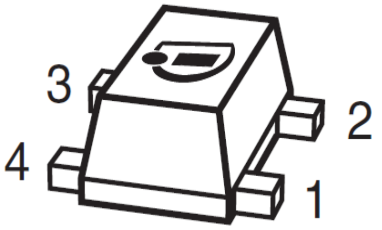

Figure 1 BFP740FESD in TSFP-4 Package

1.2 Applications

The BFP740FESD from Infineon Technologies is a SiGe:C Heterojunction bipolar transistor dedicated for low noise amplificators applications. Packaged into a TSFP-4 package, this transistor is easy-to-use for the designs. The pin configuration is shown in **Table 1**.

Table 1 Pin definition

Pin	Pin name	Comments
1	B	Base of the BFP740FESD transistor
2	E	Emitter of the BFP740FESD transistor
3	C	Collector of the BFP740FESD transistor
4	E	Emitter of the BFP740FESD transistor

This component is also suitable for WiMAX middle band (from 3.3 to 3.7GHz) and is therefore interesting for all the WiMAX/WLAN applications. However, this device fits for all GPS LNAs (1575MHz) and also for cordless phones systems (5.8GHz).

2 Using BFP740FESD for WiMAX/WLAN 2.3-2.7GHz and 5-6GHz Applications

Since the last 50 years, we saw a constant evolution on the field of wireless communications. Humans always try to communicate even longer and with the biggest amount of information to share. As the technology is getting more and more portative, the need to transfer datas and networks without any cable became important.

Nowadays, with the progress of technology regarding cell phones and others communication supports like computers and internet, the information traffic is getting heavier and heavier. Therefore, the telecommunications authorities which regulate and allocate frequency bands to users (military or public applications) have adopted the WLAN standards IEEE 802.11 a, b, and g… with different frequency bands especially dedicated for local area networks (LAN) in order to link computers to the web internet.

But, where the link to internet is difficult to provide or the infrastructures are getting too much expensive for places like villages or small towns, a new solution called WiMAX appeared. This standard that internet providers are now more and more developing, is created to link towns to the Wide Area Network (WAN) using wireless connections. Thus, users are able to use WiMAX from office to home with a wireless link.

This application note describes the BFP740FESD performances for WiMAX and WLAN high/Low bands.

The **Figure 2** presents the transmission reception Tx/Rx at each user side. In order to receive and treat the signal information received at the antenna, the weak signal needs to be amplified. Therefore, the use of an LNA is essential to amplify the signal generating a really low noise and thus, preserve the signal integrity. The use of BFP740FESD is interesting for this application, since, it is amplifying both high and also low band signals regarding WLAN and WiMAX.

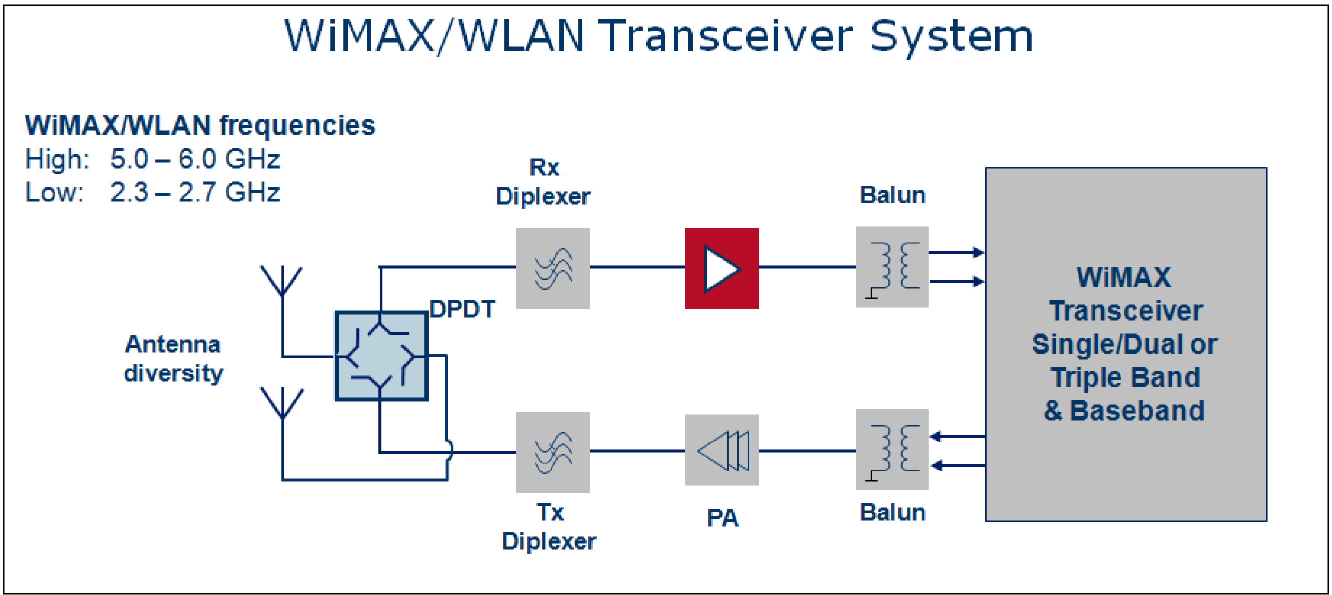

Figure 2 **WiMAX/WLAN Transceiver system**

The BFP740FESD is here presented in LNA configuration (please see the **Figure 3** for the circuit schematic and **Table 2** for the Bill-of-Materials). The summary of measurement results is located on **Table 3** and **Table 4**

The LNA provides a gain of about 14.0 dB in low band and 12.0 dB in high band of the WiMAX/WLAN standard. This LNA brings for both bands a maximum noise figure of 1.4 dB. The input and output are matched to 50 Ω with at least 9 dB matching.

The input 1dB compression point is reaching -15.5 dBm (low band) and -5.5 dBm (high band). The input 3rd Order intercept point is located at -6.0 dBm (low band) and 6.0 dBm (high band).

3 Application Information

3.1 Schematic diagram

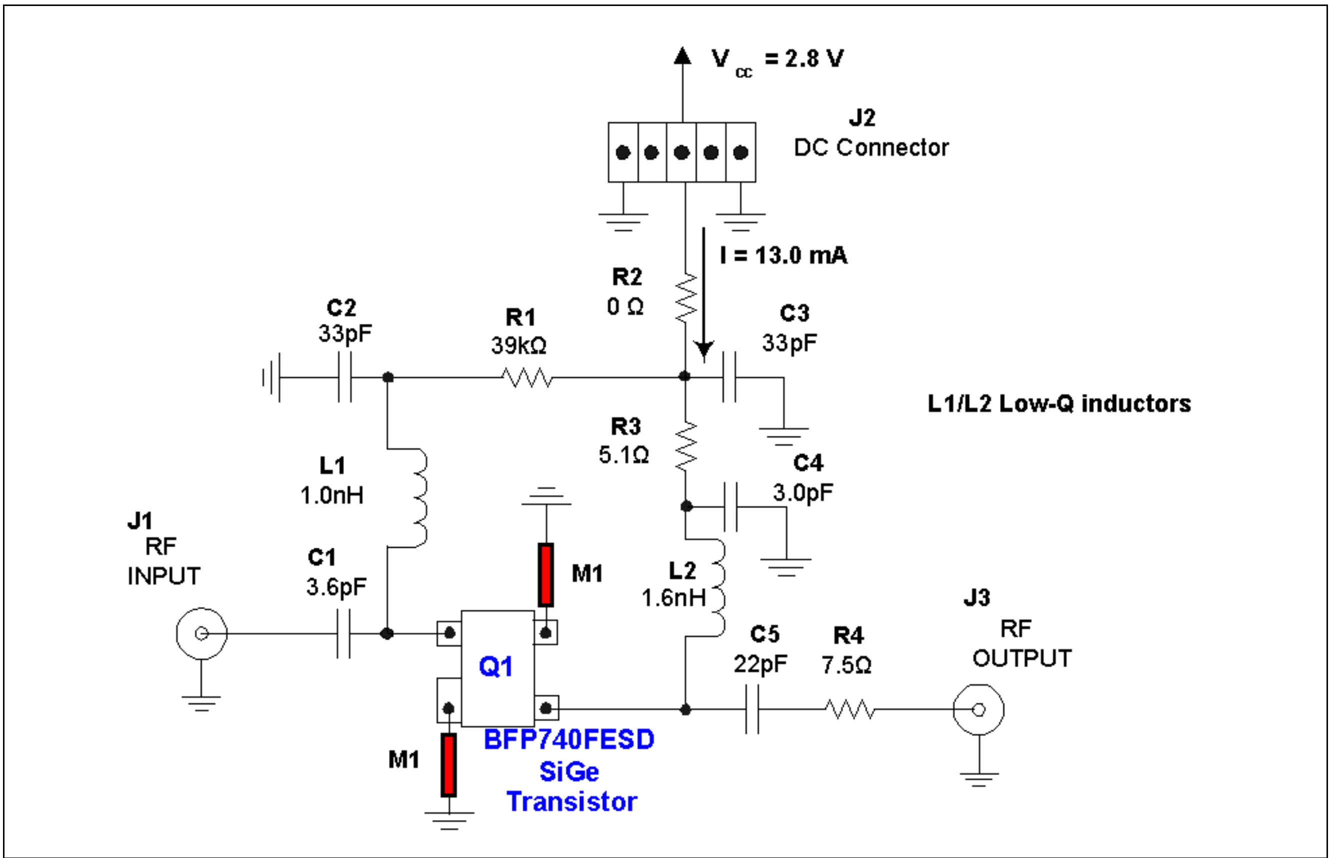

Figure 3 Schematic diagram of the application circuit

Table 2 Bill-of-Materials

Symbol	Value	Unit	Size	Manufacturer	Comment
C1	3.6	pF	0402	Various	Input Matching/DC Block
C2	33	pF	0402	Various	RF signal to ground
C3	33	pF	0402	Various	RF signal to ground
C4	3.0	pF	0402	Various	Stability/Gain reduction@2.4GHz
C5	22	pF	0402	Various	Output Matching/DC Block
L1	1.0	nH	0402	Murata LQG series	Input Matching/DC Block
L2	1.6	nH	0402	Murata LQG series	Output Matching/DC Block
R1	39	kΩ	0402	Various	Base current settings
R2	0	Ω	0402	Various	Jumper
R3	5.1	Ω	0402	Various	Collector current settings
R4	7.5	Ω	0402	Various	Output Matching/ Stability improvement
M1			0.2x0.6mm		Emitter degeneration FR4 substrate
Q	BFP740FESD		TSFP-4	Infineon Technologies	SiGe C: bipolar transistor

4 Typical Measurement Results

Table 3 Summary of Measurement results for WiMAX/WLAN 2.3-2.7GHz (at room temperature)

Vcc=2.8V, Ic=13mA, freq=2300…2700MHz

Parameter	Symbol	Value	Unit	Comment/Test Condition
Frequency Range	Freq	2300…2700	MHz	
DC Voltage	Vcc	2.8	V	
DC Current	Icc	13.0	mA	
Gain	G	14.0	dB	
Noise Figure	NF	1.2	dB	
Input Return Loss	RLin	9.0	dB	Input power Pin=-30 dBm
Output Return Loss	RLout	9.0	dB	
Reverse Isolation	IRev	29.0	dB	
Input P1dB	IP1dB	-15.5	dBm	Pin=-30..0dBm. measured @2.4GHz
Output P1dB	OP1dB	-3.0	dBm	
Input IP3	IIP3	-9.0	dBm	
Output IP3	OIP3	5.0	dBm	Pin=-40 dBm, f1=2400 MHz, f2=2401 MHz
Switching Time	TsMax	540	ns	Maximum time between rise and fall time
Stability	k	>1	--	Unconditionnally stable from 0 to 10 GHz

Table 4 Summary of Measurement results for WiMAX/WLAN 5-6GHz (at room temperature)

Vcc=2.8V, Ic=13mA, freq=5000…6000MHz

Parameter	Symbol	Value	Unit	Comment/Test Condition
Frequency Range	Freq	5000…6000	MHz	
DC Voltage	Vcc	2.8	V	
DC Current	Icc	13.0	mA	
Gain	G	12.0	dB	
Noise Figure	NF	1.4	dB	
Input Return Loss	RLin	9.0	dB	Input power Pin=-30 dBm
Output Return Loss	RLout	9.0	dB	
Reverse Isolation	IRev	22.0	dB	
Input P1dB	IP1dB	-5.5	dBm	Pin=-30…0 dBm. measured @5.5GHz
Output P1dB	OP1dB	-6.5	dBm	
Input IP3	IIP3	6.0	dBm	
Output IP3	OIP3	18.0	dBm	Pin=-30 dBm, f1=5500 MHz, f2=5501 MHz
Switching time	TsMax	540	ns	Maximum time between rise and fall time
Stability	k	>1	--	Unconditionnally stable from 0 to 10 GHz

Note: the measurements showed in Table 3 and Table 4 are excluding the PCB and SMA losses of 0.20dB.

5 Measured graphs from 2.3 to 2.7GHz

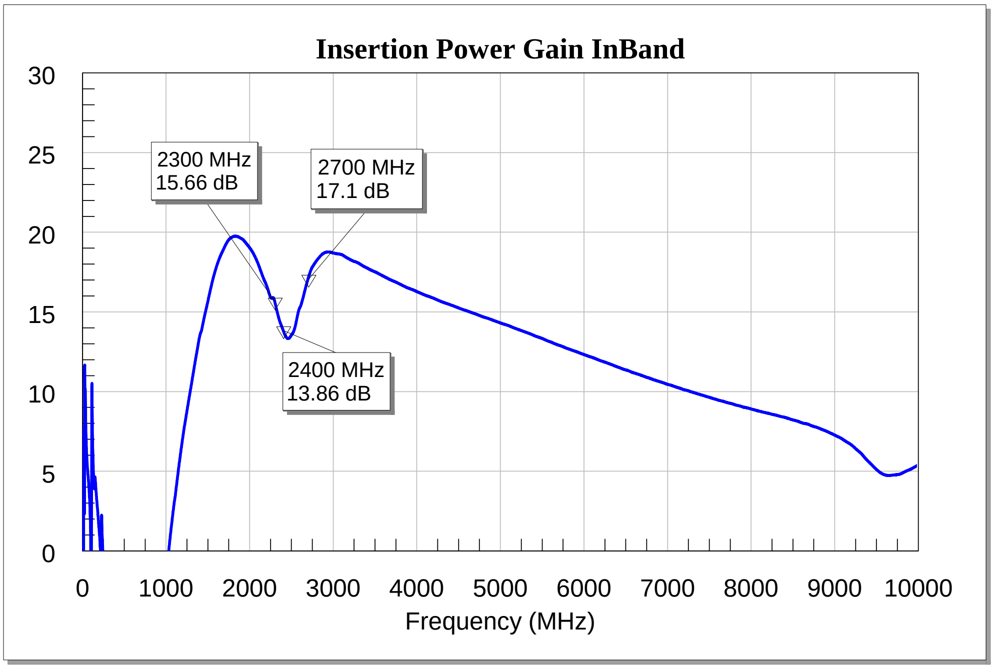

Figure 4 Insertion power gain of the BFP740FESD for WLAN/Wimax at 2.3-2.7GHz

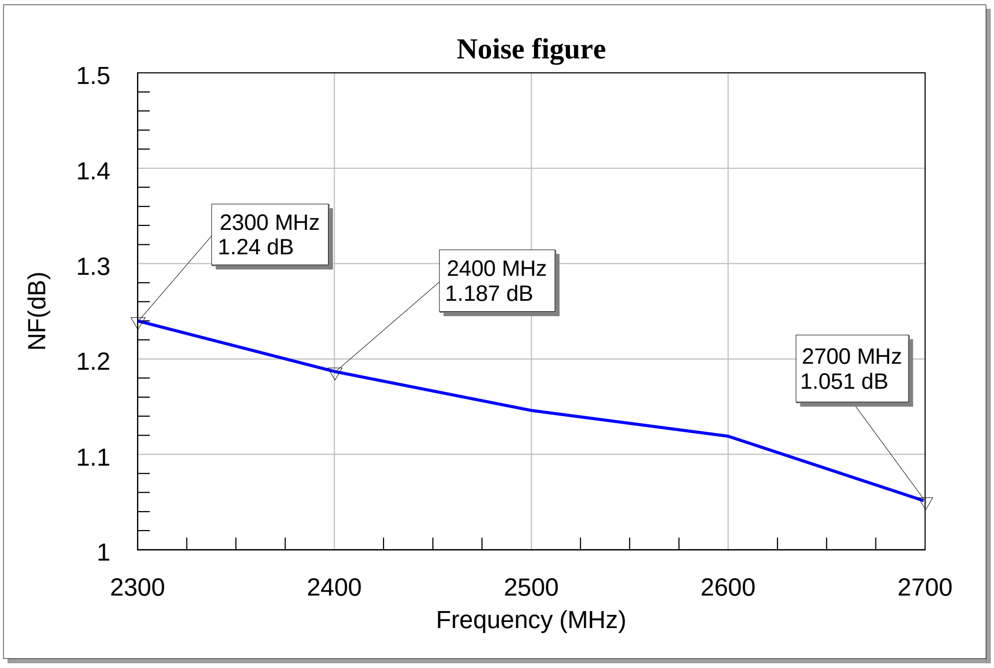

Figure 5 Noise figure of the BFP740FESD for WLAN/Wimax at 2.3-2.7GHz

Measured graphs from 2.3 to 2.7GHz

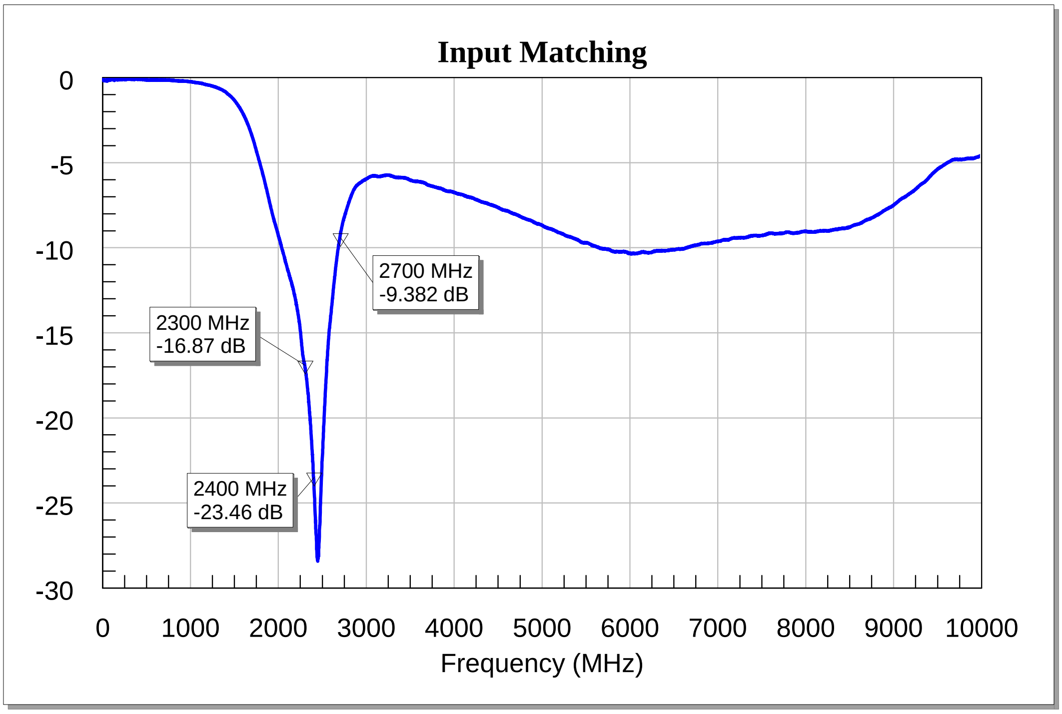

Figure 6 Input matching of the BFP740FESD for WLAN/Wimax at 2.3-2.7GHz

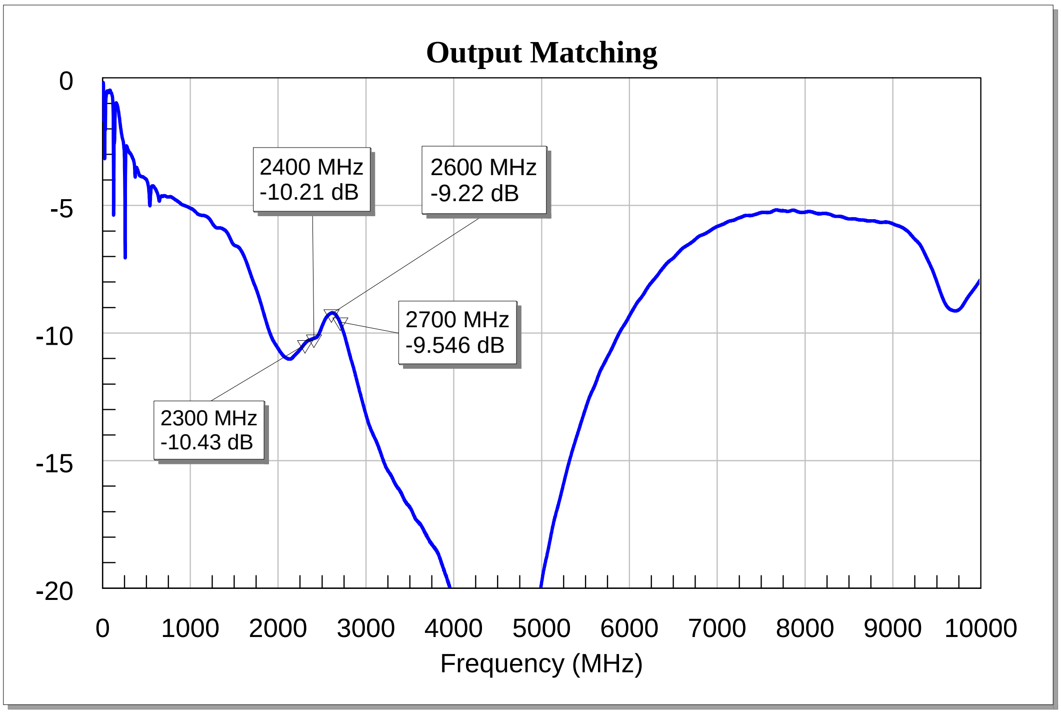

Figure 7 Output matching of the BFP740FESD for WLAN/Wimax at 2.3-2.7GHz

Measured graphs from 2.3 to 2.7GHz

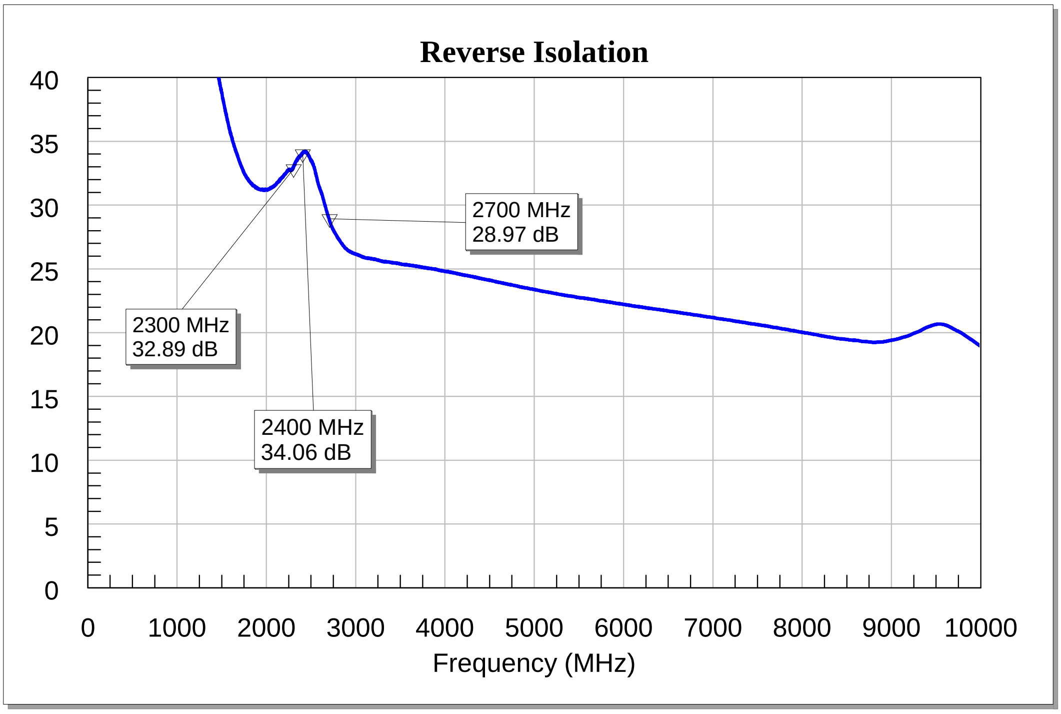

Figure 8 Reverse Isolation of the BFP740FESD for WLAN/Wimax at 2.3-2.7GHz

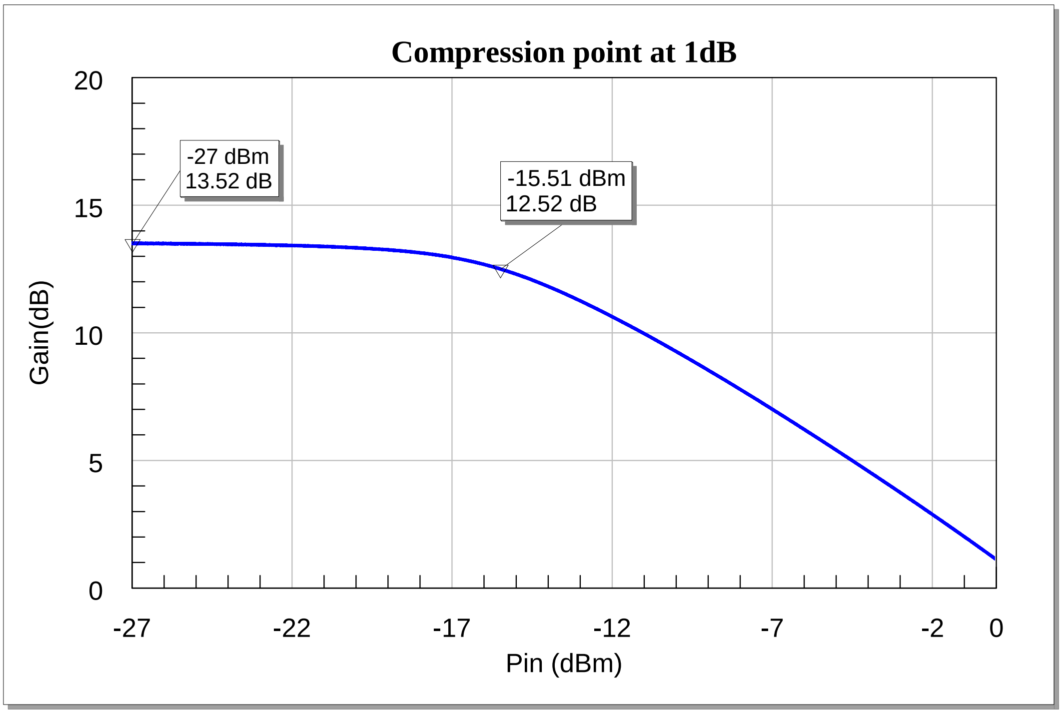

Figure 9 Input 1dB compression point of the BFP740FESD for WLAN/Wimax at 2.3-2.7GHz

Measured graphs from 2.3 to 2.7GHz

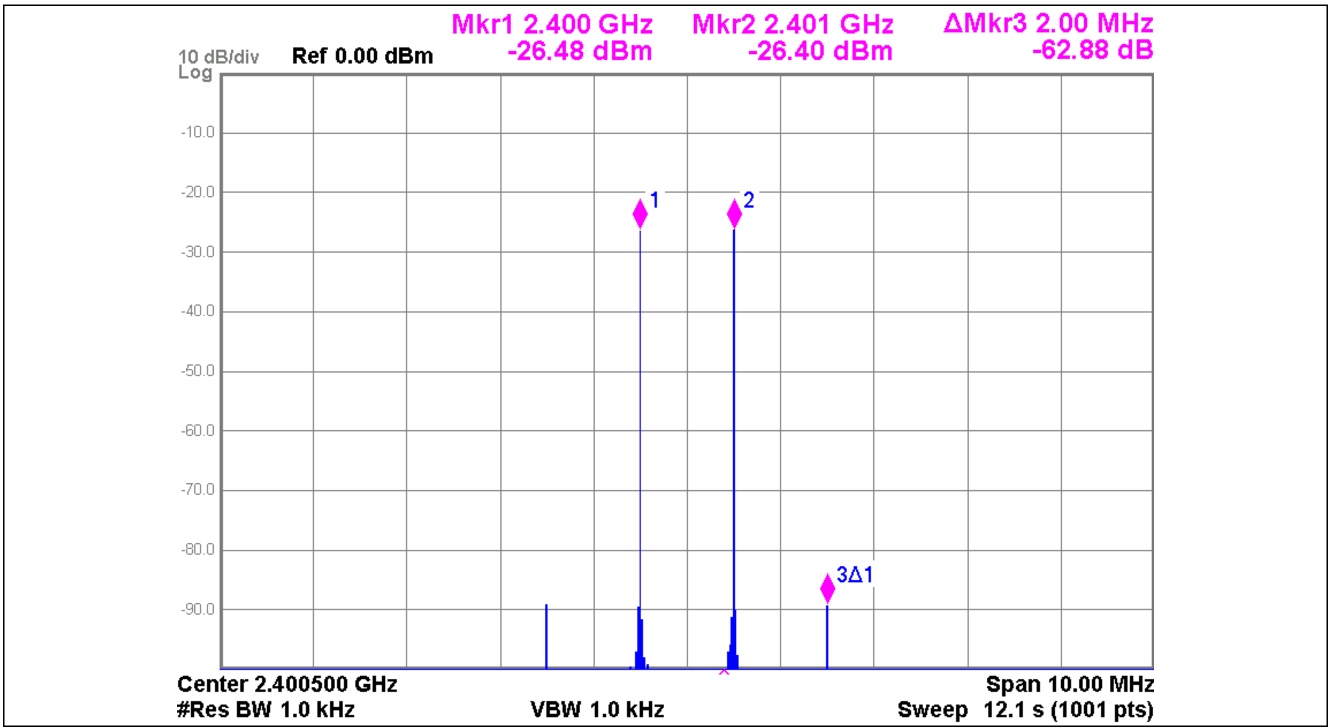

Figure 10 Output 3rd order Intercept point of the BFP740FESD for WLAN/Wimax at 2.3-2.7GHz

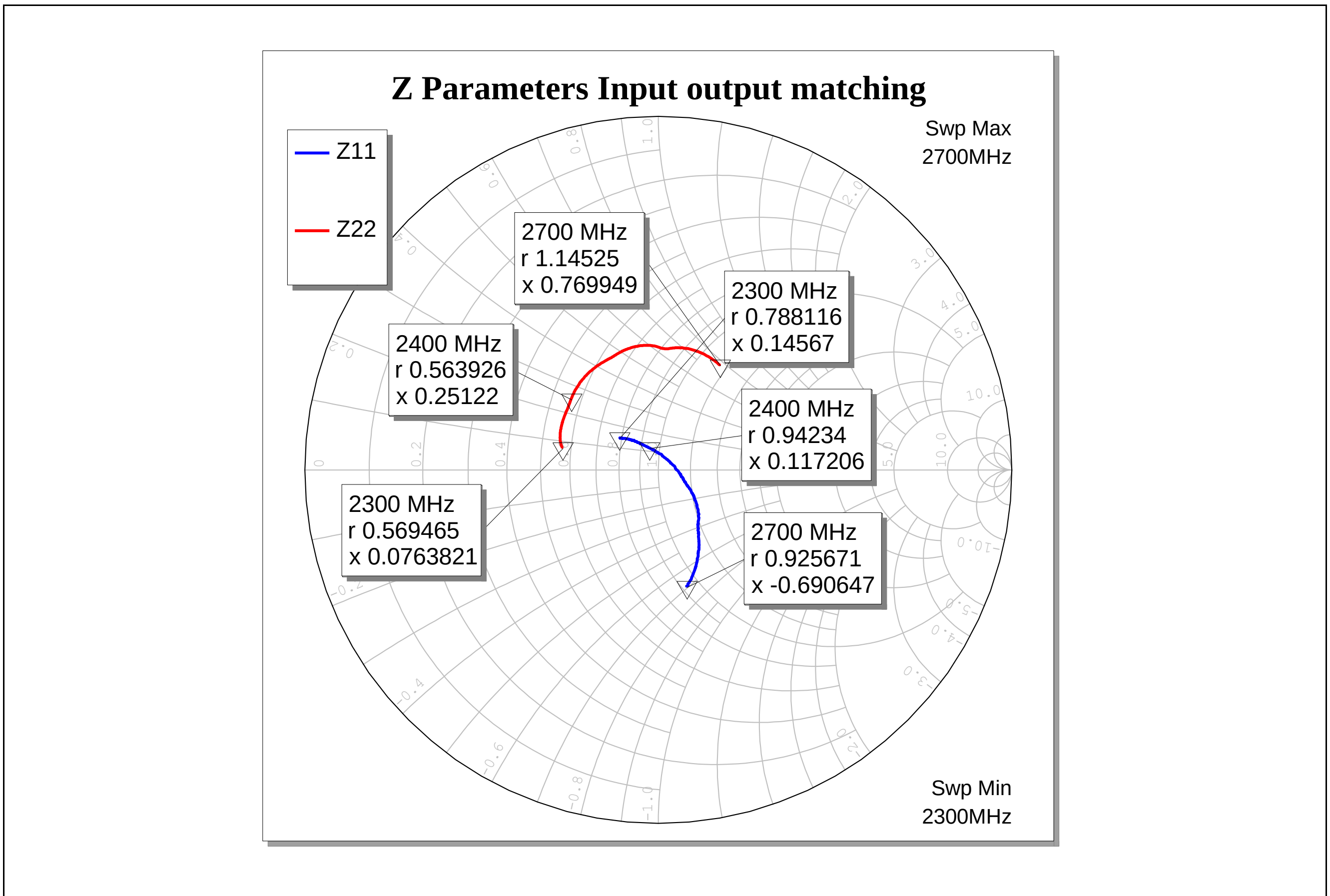

Figure 11 Input and Output impedance of the BFP740FESD for WLAN/Wimax at 2.3-2.7GHz

6 Measured graphs from 5.0 to 6.0GHz

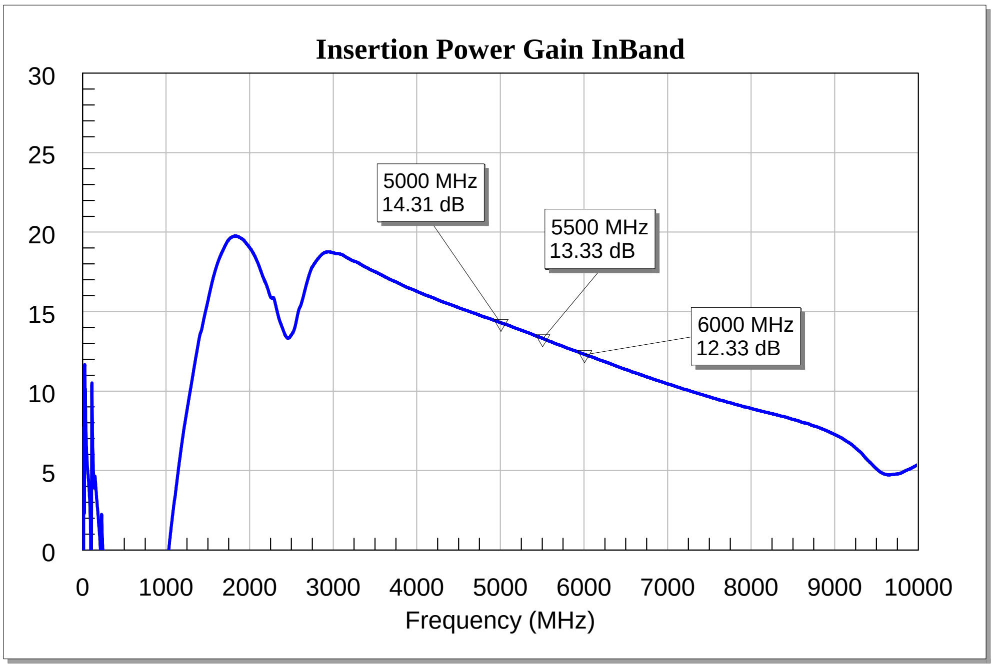

Figure 12 Insertion power gain of the BFP740FESD for WLAN/Wimax at 5-6GHz

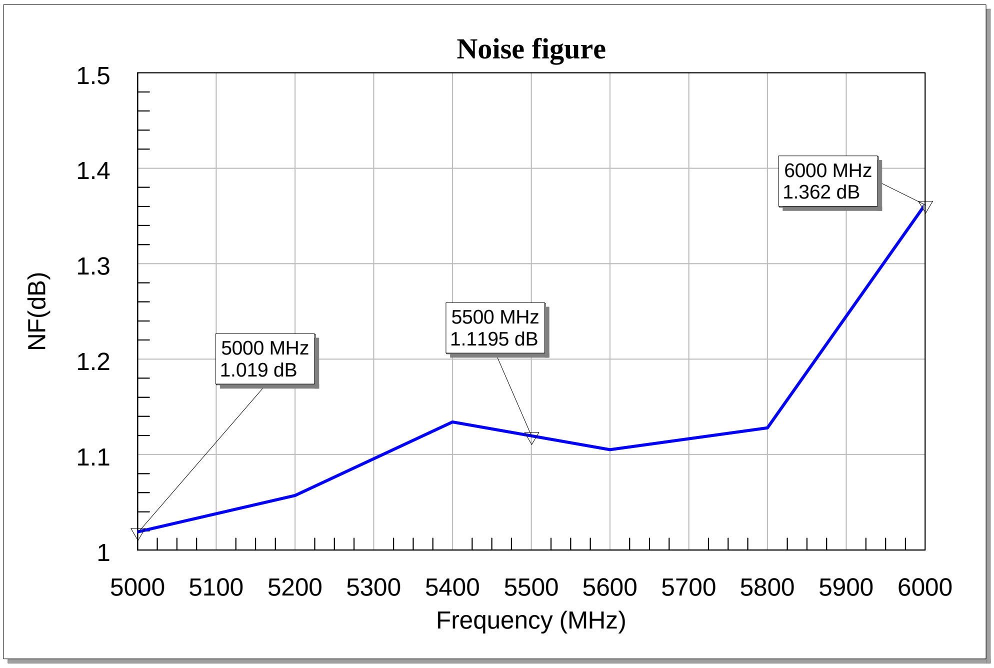

Figure 13 Noise figure of the BFP740FESD for WLAN/Wimax at 5-6GHz

Measured graphs from 5.0 to 6.0GHz

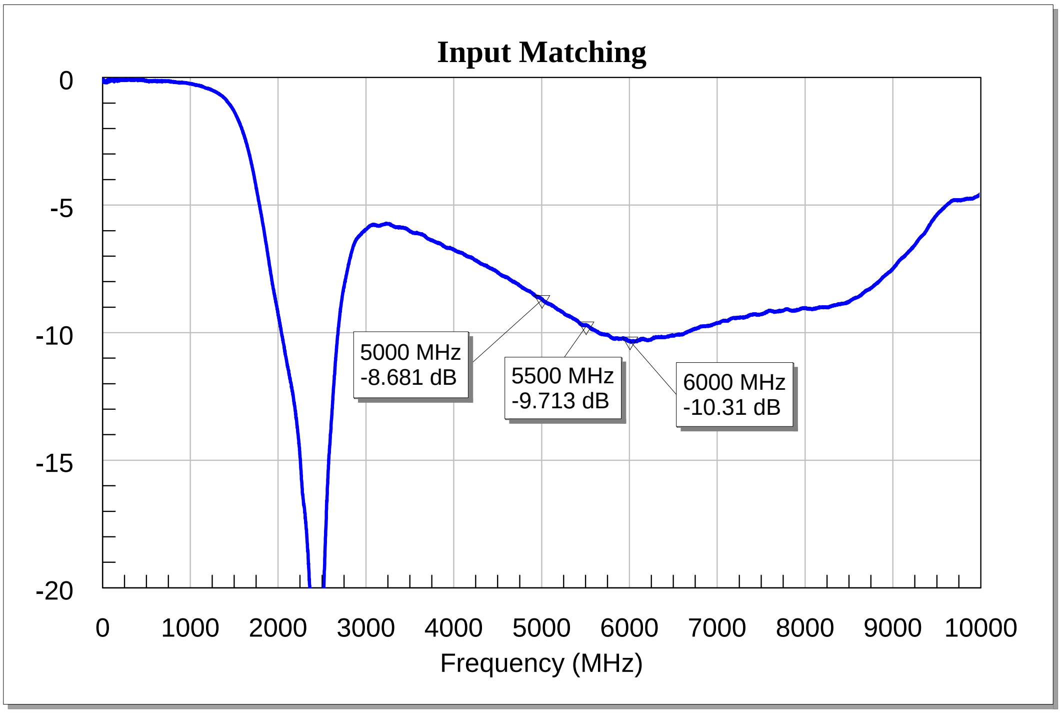

Figure 14 Input matching of the BFP740FESD for WLAN/Wimax at 5-6GHz

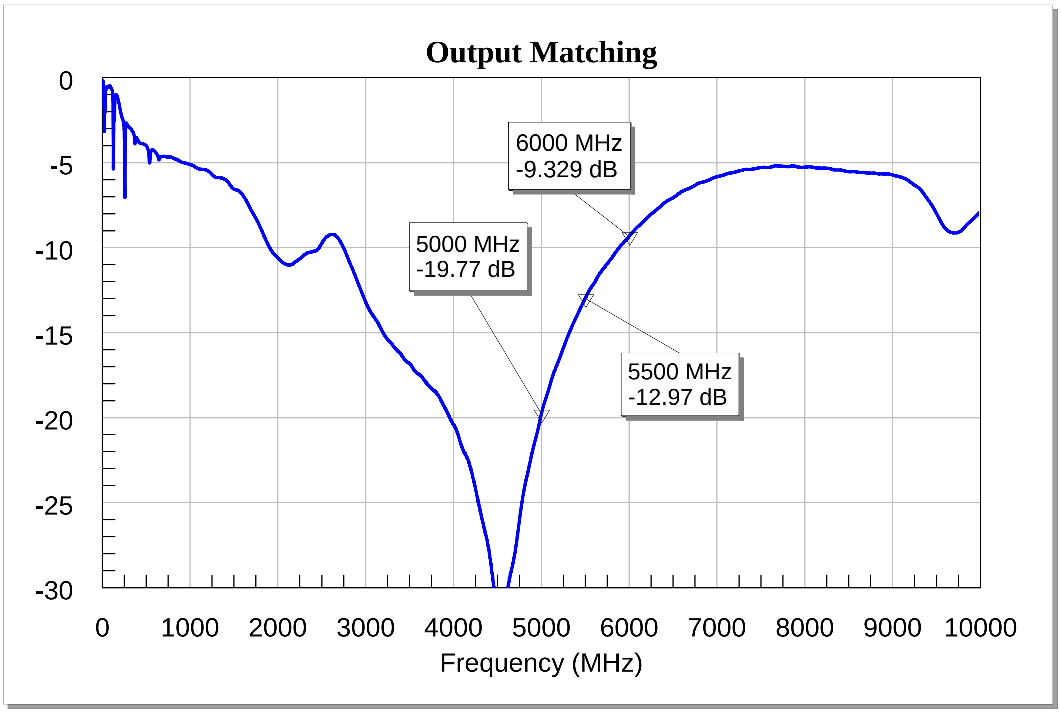

Figure 15 Output matching of the BFP740FESD for WLAN/Wimax at 5-6GHz

Measured graphs from 5.0 to 6.0GHz

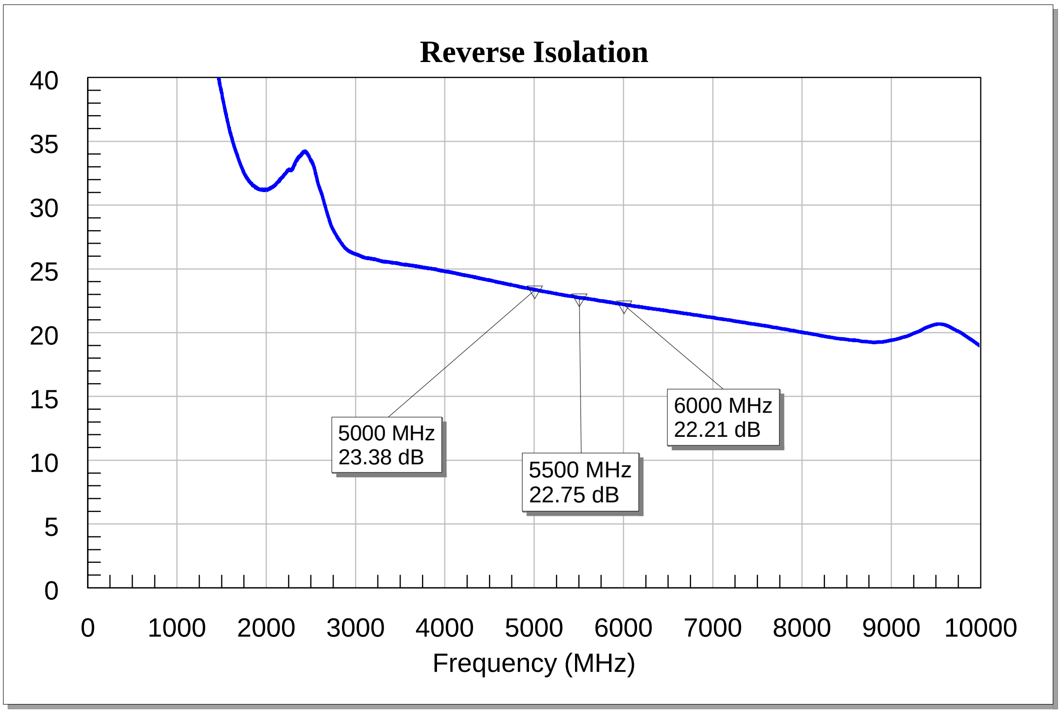

Figure 16 Reverse isolation of the BFP740FESD for WLAN/Wimax at 5-6GHz

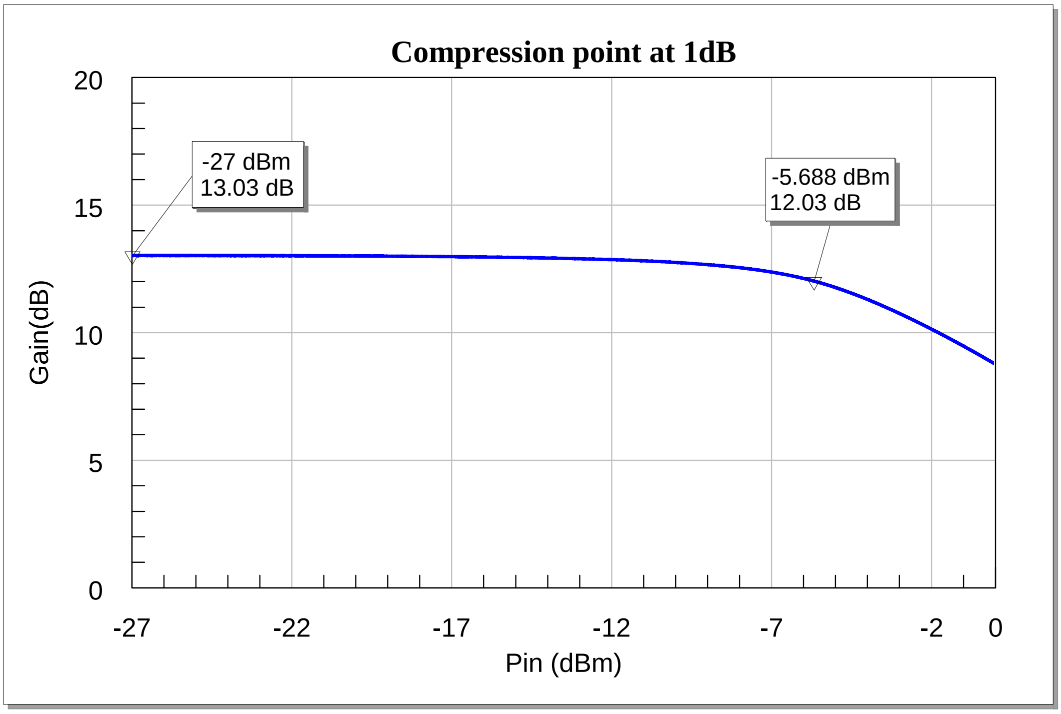

Figure 17 Input 1dB compression point of the BFP740FESD for WLAN/Wimax at 5-6GHz

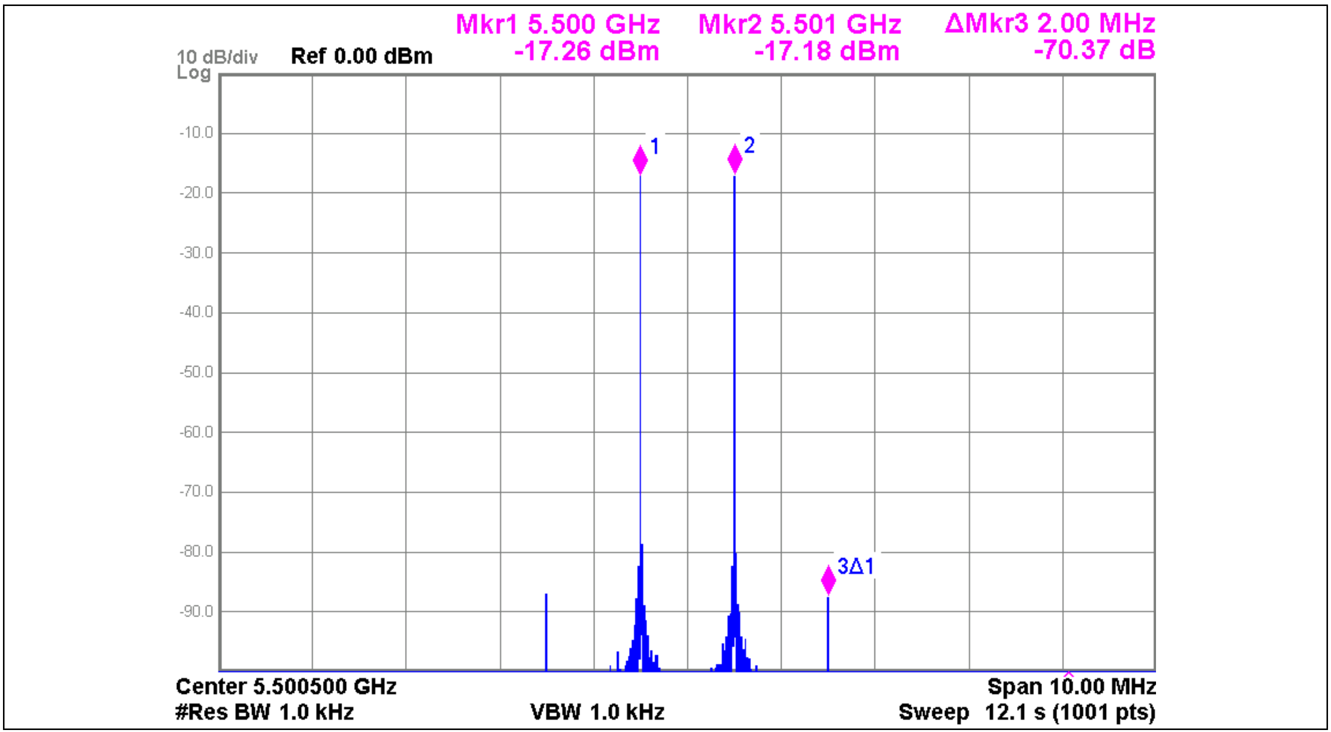

Figure 18 Output 3rd order intercept point of the BFP740FESD for WLAN/Wimax at 5-6GHz

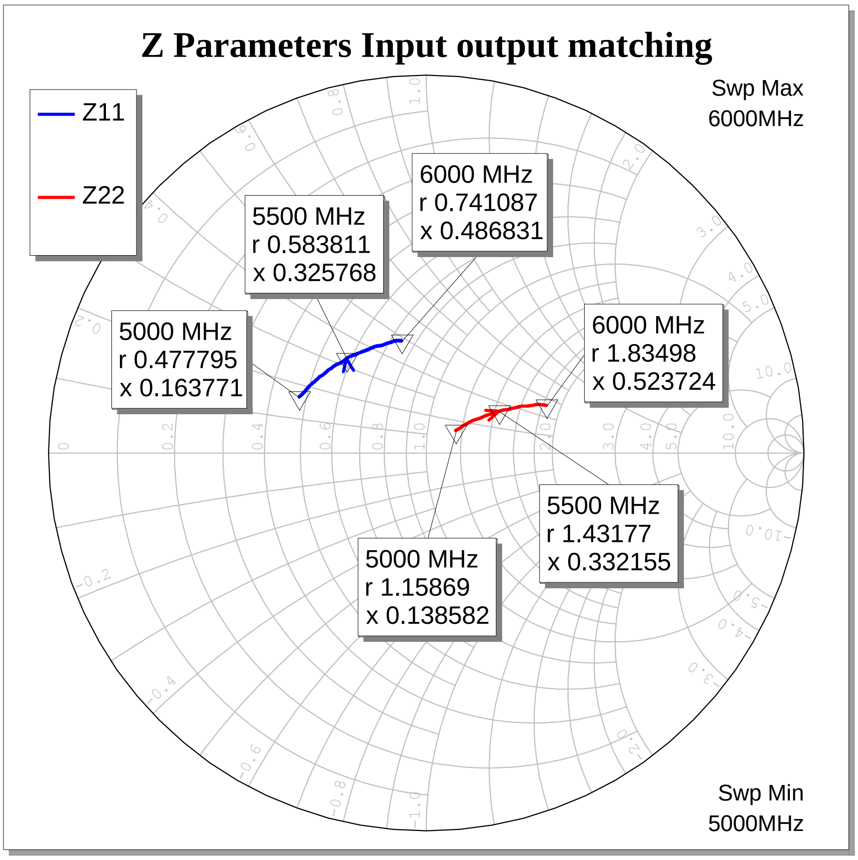

Figure 19 Input and Output impedance of the BFP740FESD for WLAN/Wimax at 5-6GHz

Measured graphs from 5.0 to 6.0GHz

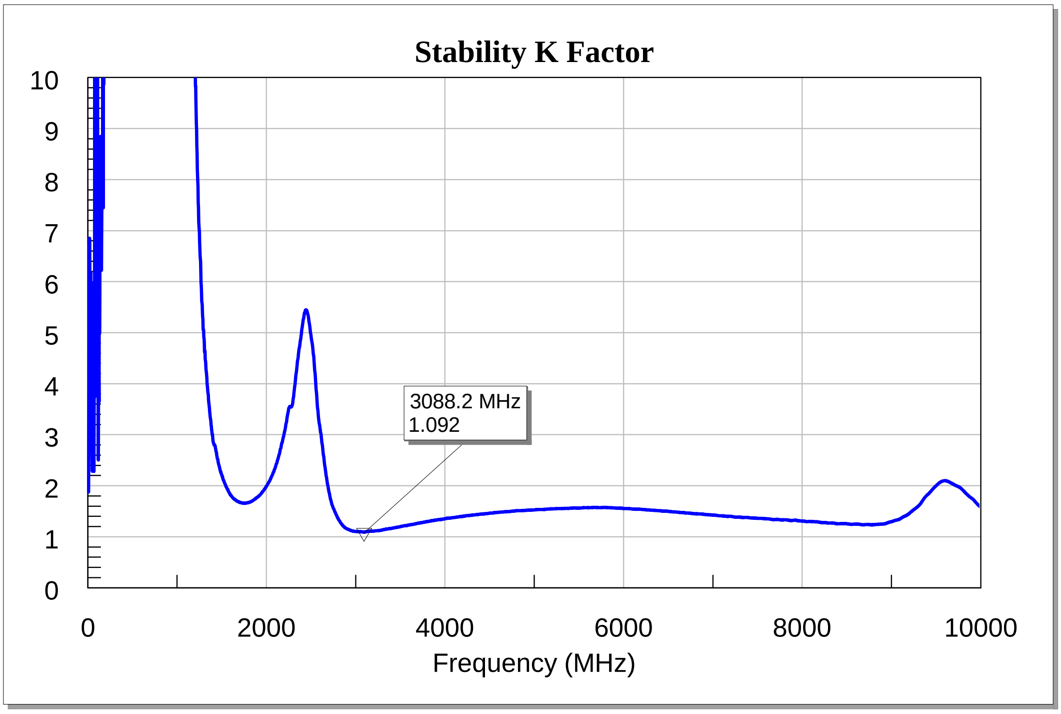

Figure 20 K-factor stability of the BFP740FESD for WLAN/Wimax 2.3-2.7&5-6GHz applications

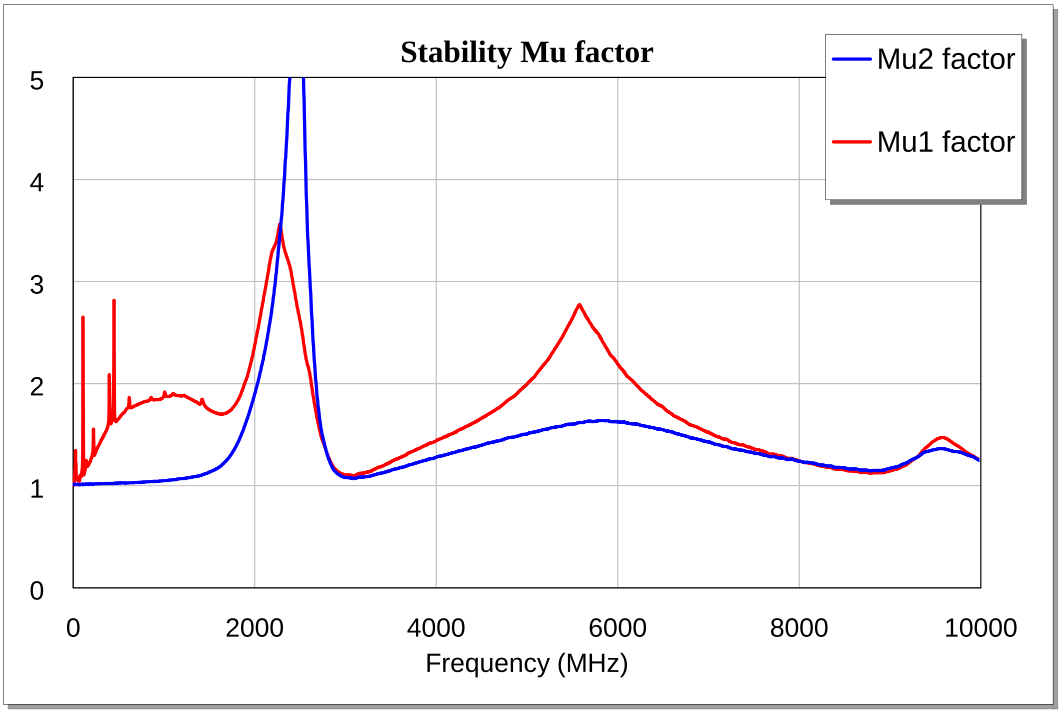

Figure 21 μ-factor stability of the BFP740FESD for WLAN/Wimax 2.3-2.7&5-6GHz applications

Measured graphs from 5.0 to 6.0GHz

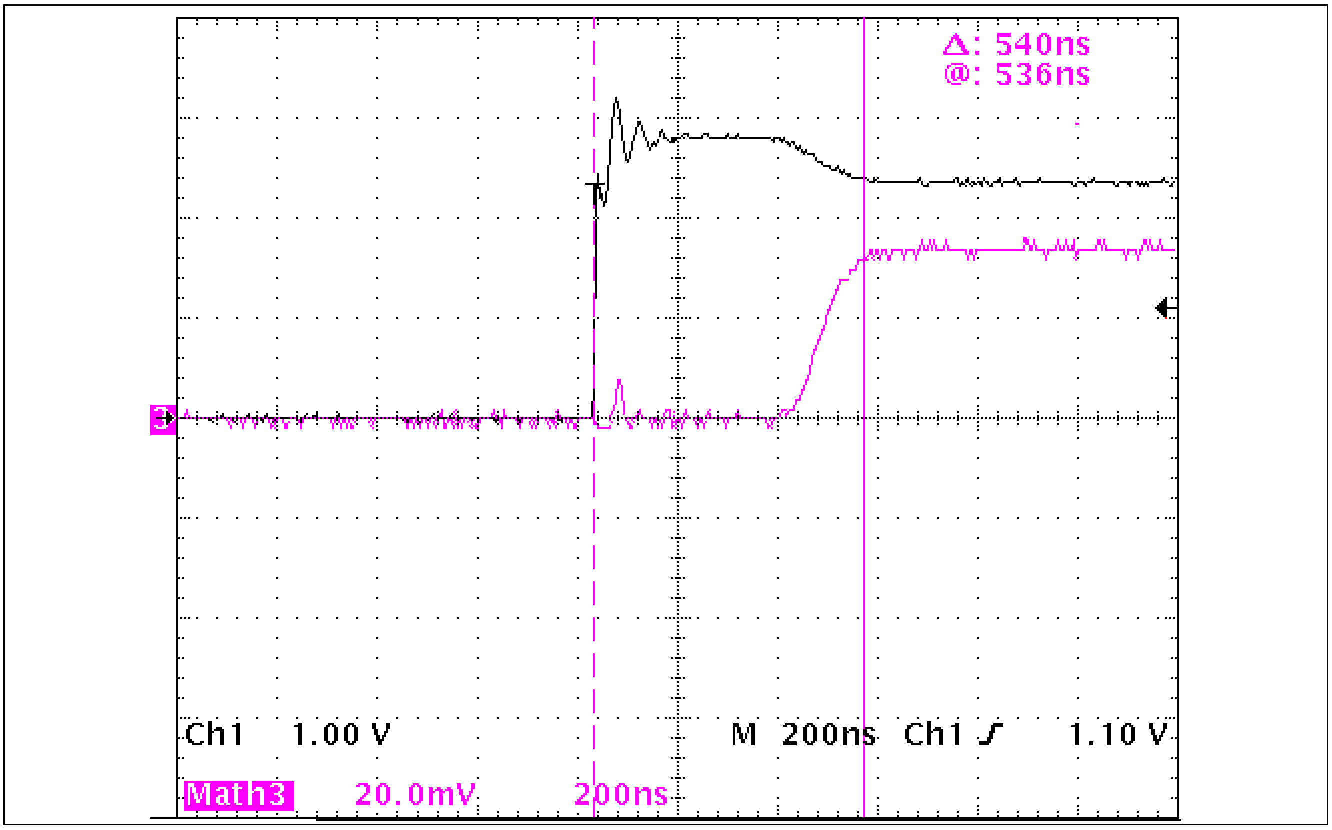

Figure 22 Rise switching time of the BFP740FESD for WLAN/Wimax 2.3-2.7&5-6GHz applications

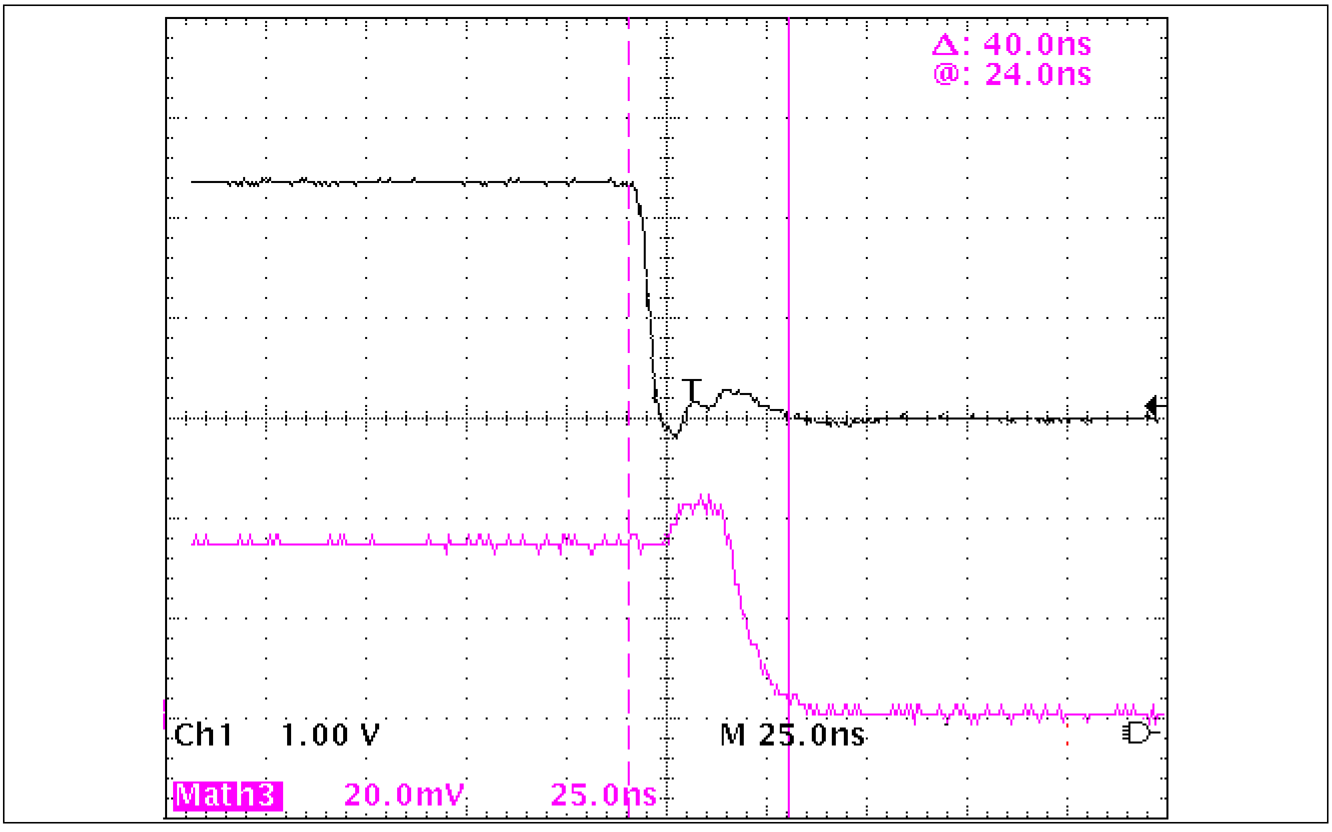

Figure 23 Fall switching time of the BFP740FESD for WLAN/Wimax 2.3-2.7&5-6GHz applications

7 Evaluation Board and layout Information

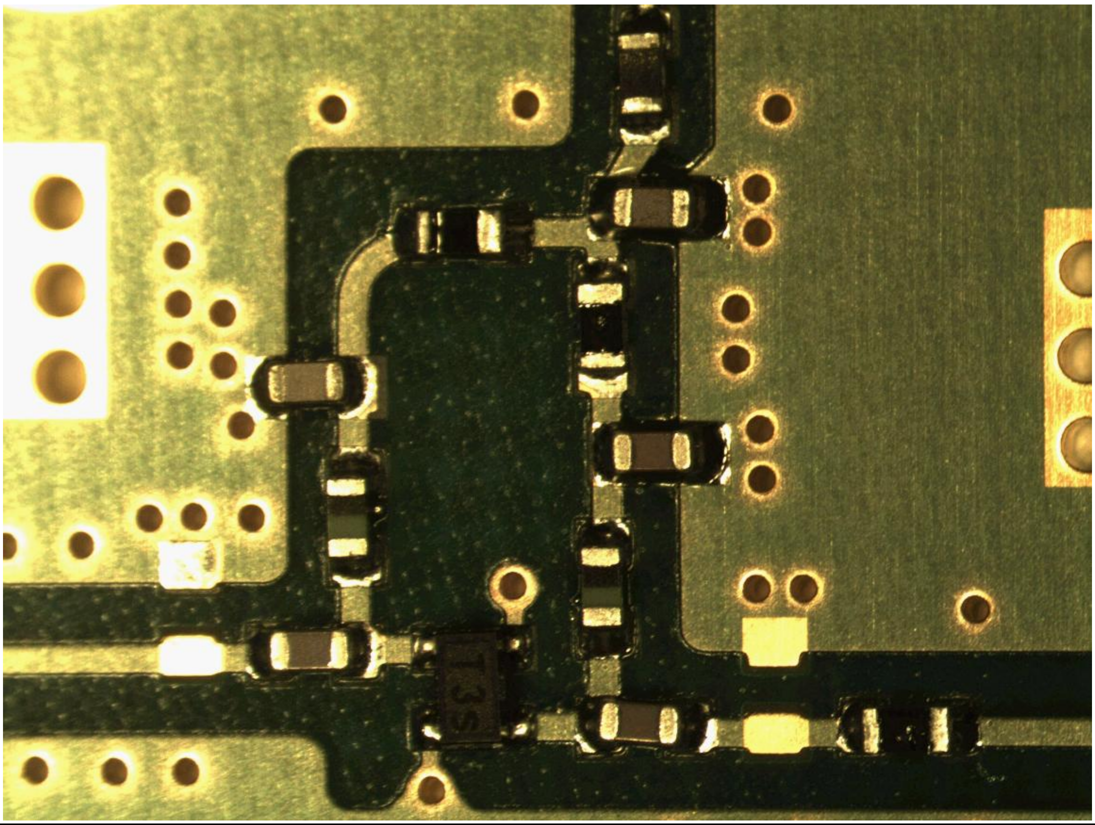

Figure 24 PCB Picture of Evaluation Board

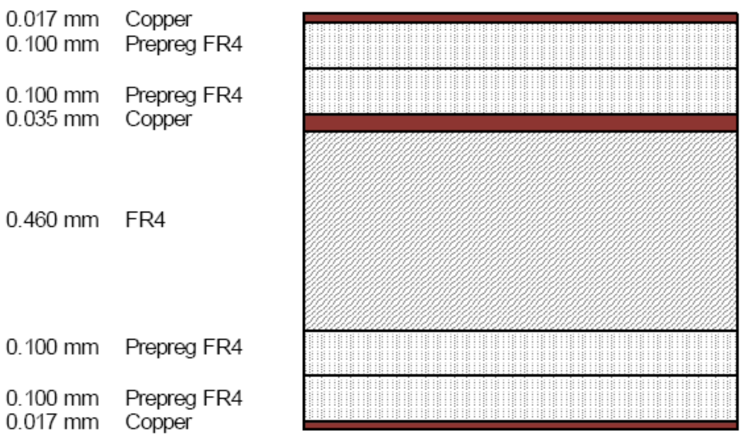

Figure 25 PCB Layer Information

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