



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



AN11293

BGA3012 - 5 MHz to 300 MHz 12 dB reverse amplifier application

Rev. 1 — 14 February 2013

Application note

Document information

Info	Content
Keywords	BGA3012, Evaluation board, CATV, Drop amplifier
Abstract	This application note describes the schematic and layout requirements for using the BGA3012 as a CATV reverse amplifier.



Revision history

Rev	Date	Description
1	20130214	First publication

Contact information

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: salesaddresses@nxp.com

1. Introduction

The BGA3012 customer evaluation board enables the user to evaluate the performance of the wideband CATV MMIC amplifier BGA3012.

The BGA3012 performance information is available in the BGA3012 datasheet.

This application note describes the evaluation board schematic and layout requirements for using the BGA3012 as a CATV reverse amplifier between 5 MHz and 300 MHz. The BGA3012 is fabricated in the BiCMOS process and packaged in a lead-free 3-pin SOT89 package. The BGA3012 is surface-mounted on an evaluation board with element matching and DC decoupling circuitry. The amplifier MMIC comprises a two stage amplifier with internal bias network and operates over a frequency range of 5 MHz to 1006 MHz with a supply voltage between 5 V and 8 V.

2. System features

- 12 dB gain
- Internally biased
- Flat gain between 5 MHz and 300 MHz
- Noise figure of 3.3 dB
- High linearity with an $IP3_o$ of 40 dBm and $IP2_o$ of 60 dBm
- 75 Ω input and output impedance
- Unconditionally stable
- Excellent input and output return loss

3. Customer evaluation kit contents

The evaluation kit contains the following items:

- ESD safe casing
- BGA3012 evaluation board
- BGA3012 SOT89 samples

4. Application Information

For evaluation purposes an evaluation board is available. The evaluation circuit can be seen in figure 1 and the corresponding PCB is shown in figure 2. Table 1 shows the bill of materials.

4.1 Evaluation board circuit

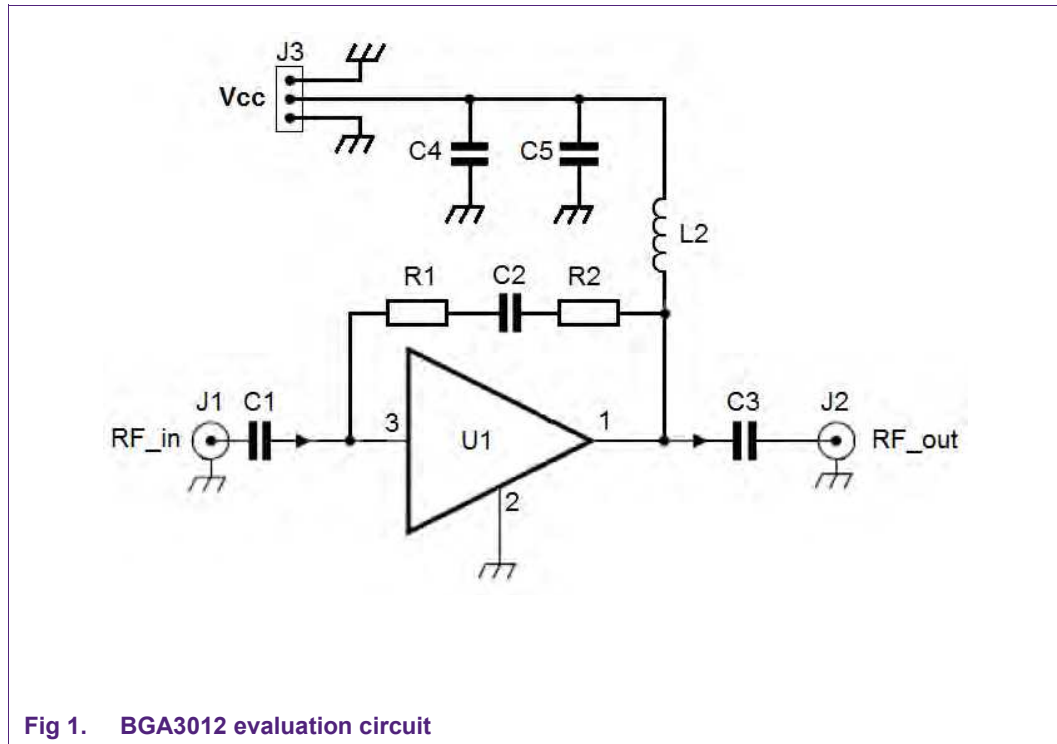
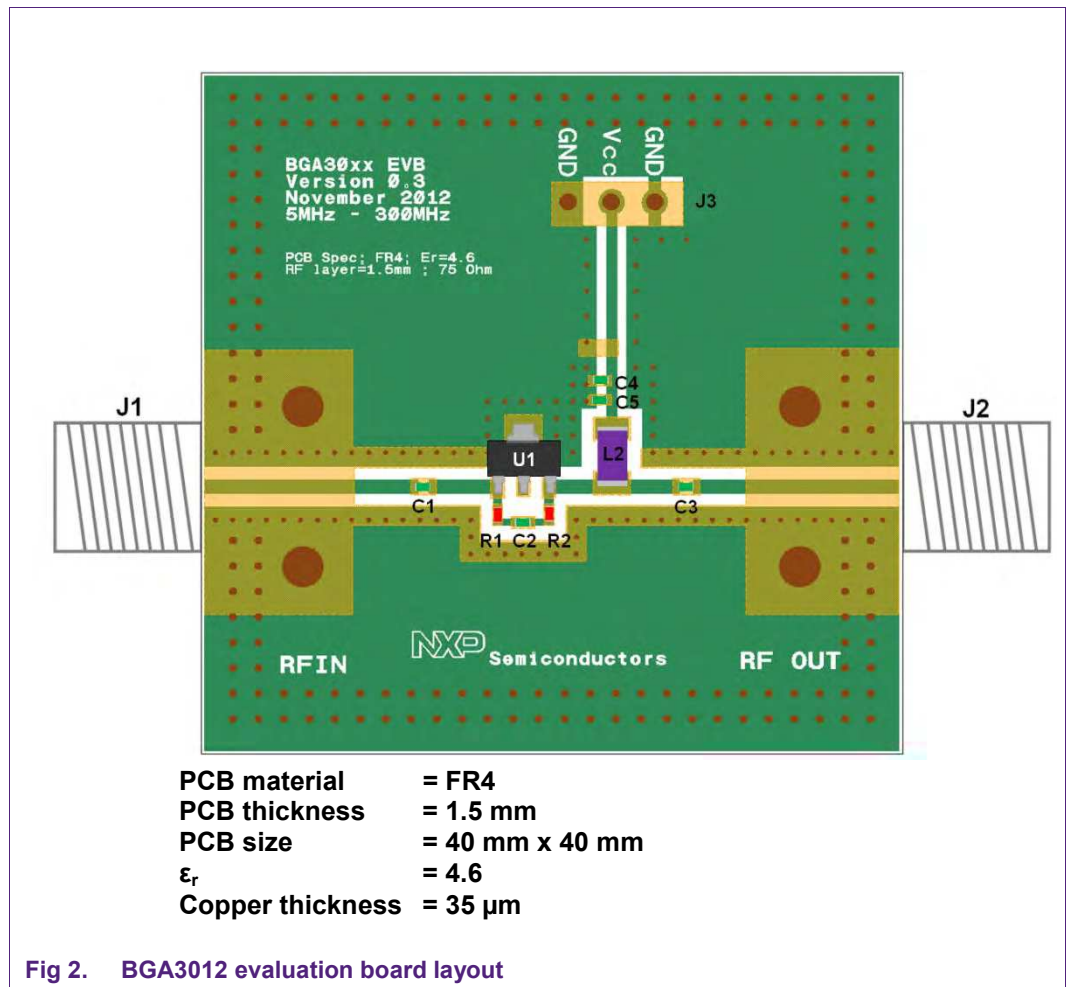


Fig 1. BGA3012 evaluation circuit

The power supply is applied on the center pin of connector J3 and is applied to the MMIC via choke L2 which provides RF blocking to the supply line. Capacitors C4 and C5 are supply decoupling capacitors.

At the F-connector J1 the RF input signal is applied where capacitor C1 provides DC-blocking. Resistors R1 and R2 are used as feedback resistors to set the gain and slope. Two resistors are used to lower the influence of the parasitic capacitance from the circuit board. Capacitor C2 provides DC-blocking between the input and output of the MMIC. Capacitor C3 provides DC-blocking before the RF signal is available at F-connector J2.

4.2 Evaluation board layout



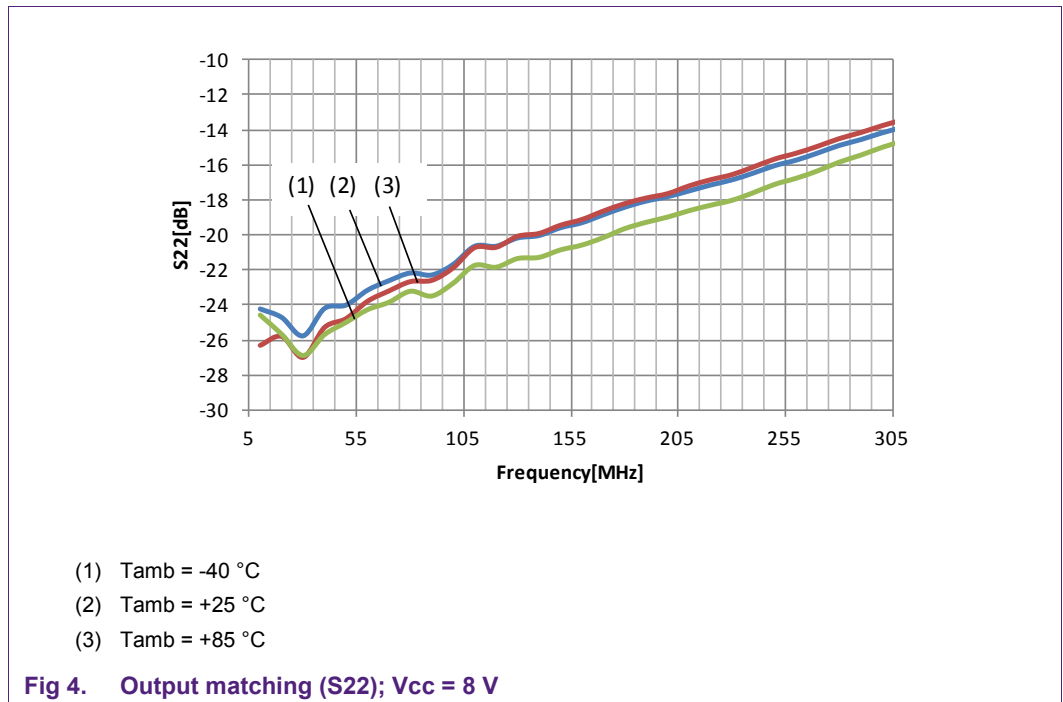
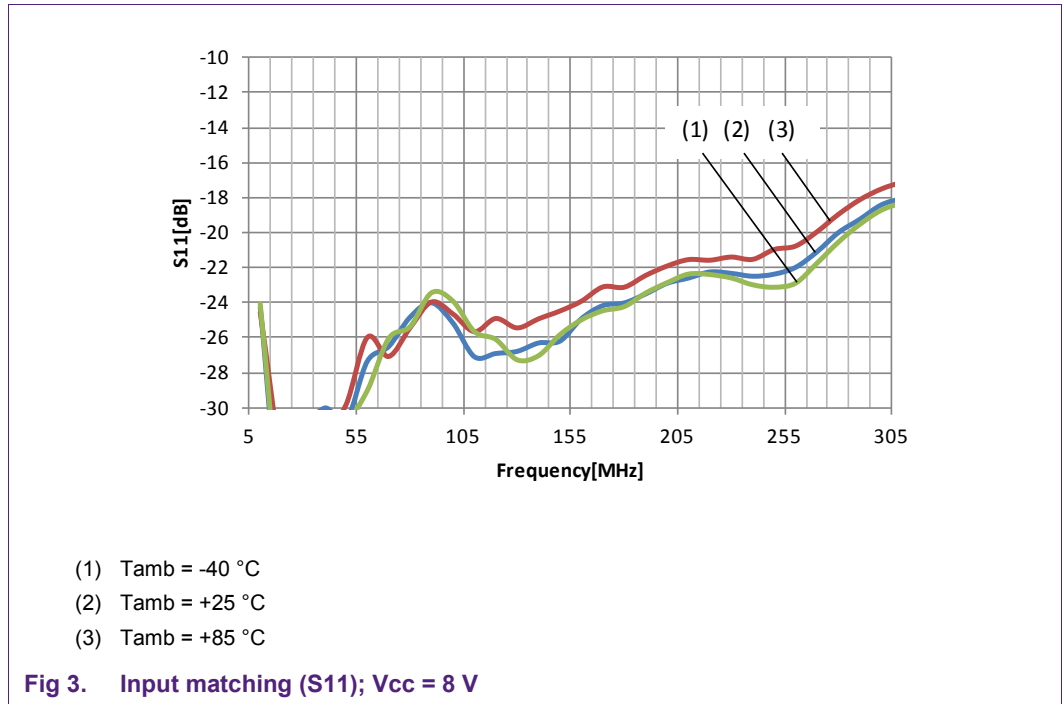
For optimum distortion performance it is important to have enough ground vias underneath and around the MMICs ground pins. This lowers the inductance to the ground plane. The evaluation board is made with two layer FR4 material.

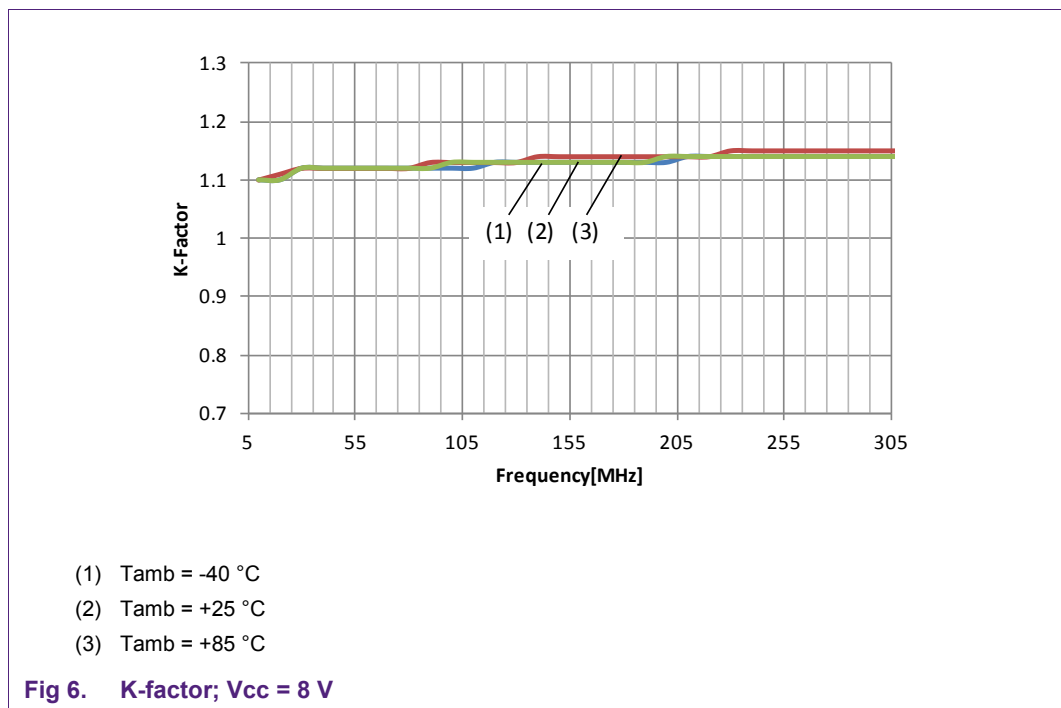
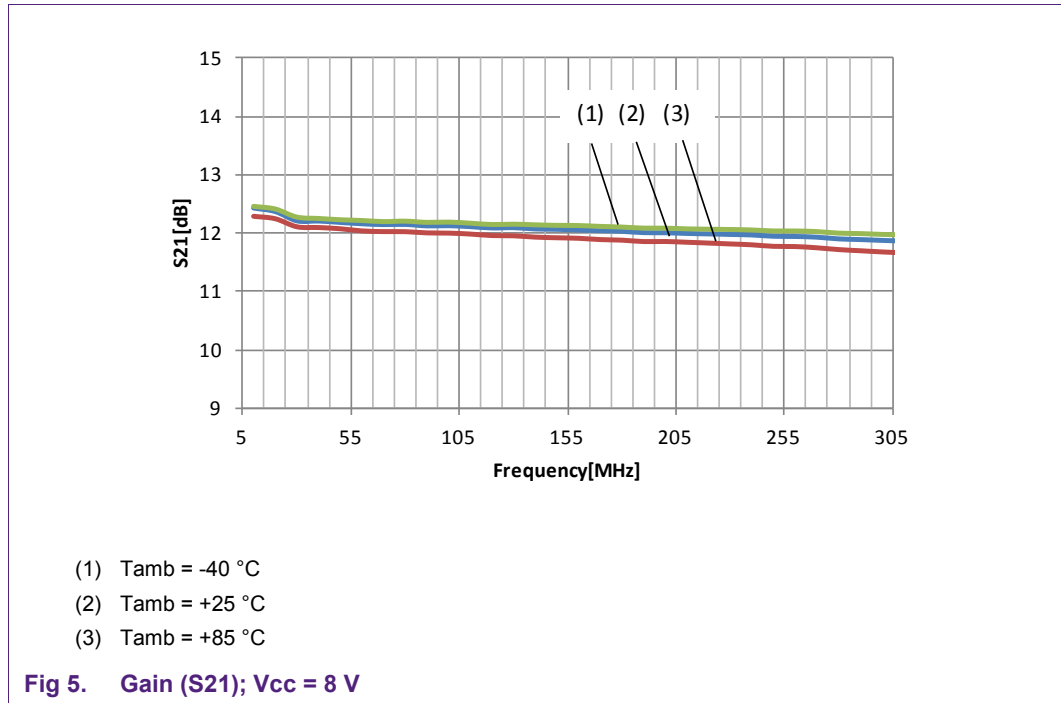
4.3 Bill of materials

Table 1. Evaluation board BoM

Circuit Reference	Description	Qty	Mfr	Manufacturer number	Supplier	Supplier part number
U1	BGA3012	1	NXP	BGA3012	NXP	BGA3012
C1, C2, C3, C4	10 nF	4	Murata	GRM155R71E103KA01D	Digikey	490-1312-1-ND
C5	100 pF	1	Murata	GRM1555C1H101JZ01D	Digikey	490-3458-1-ND
L2	22uH	1	Murata	LQH31CN220K03L	Digikey	LQH31CN220K03L-ND
R1	300 Ω	1	Yageo	RC0402FR-07300RL	Digikey	311-300LRCT-ND
R2	100 Ω	1	Yageo	RC0402FR-07100RL	Digikey	311-100LRCT-ND
J1, J2	75 Ω F-connector	2	Bomar	861V509ER6	Mouser	678-861V509ER6
J3	Header 3	1	Molex	90121-0763	Digikey	WM8109-ND

5. Measurement results at Vcc = 8 V





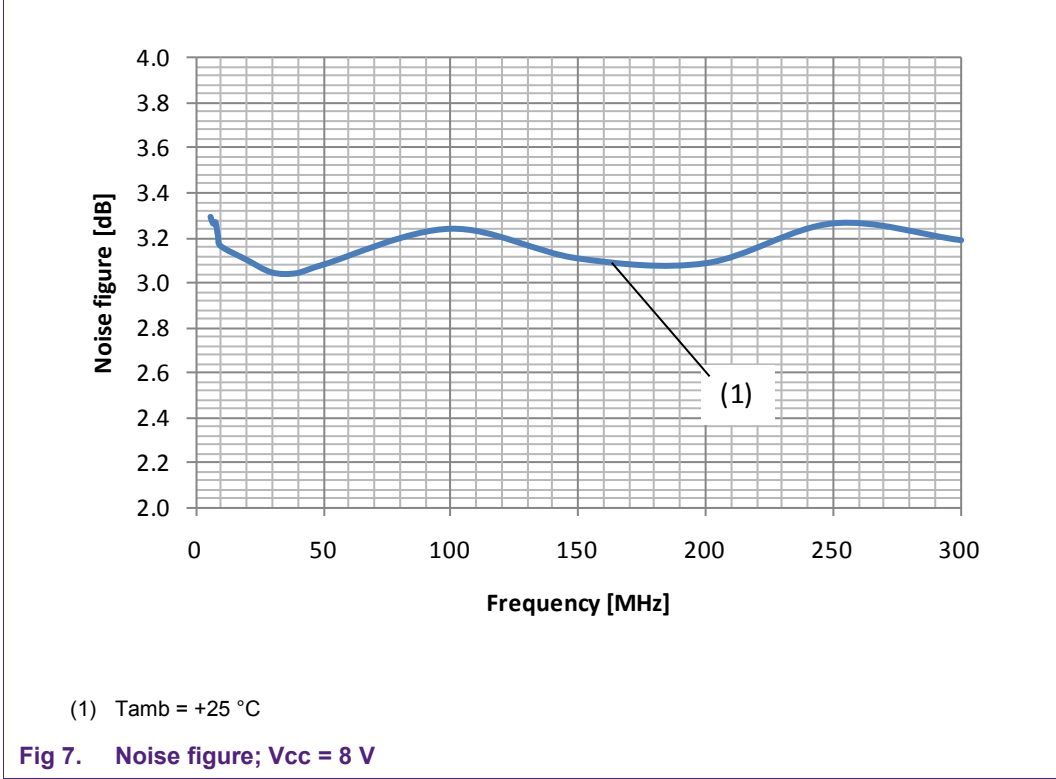


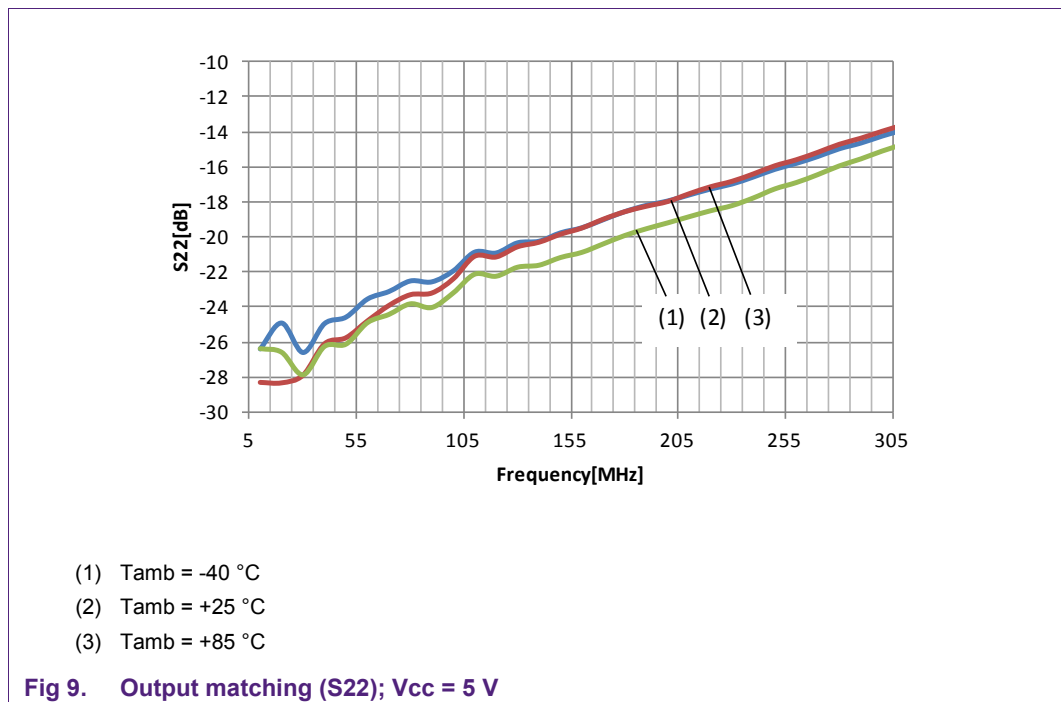
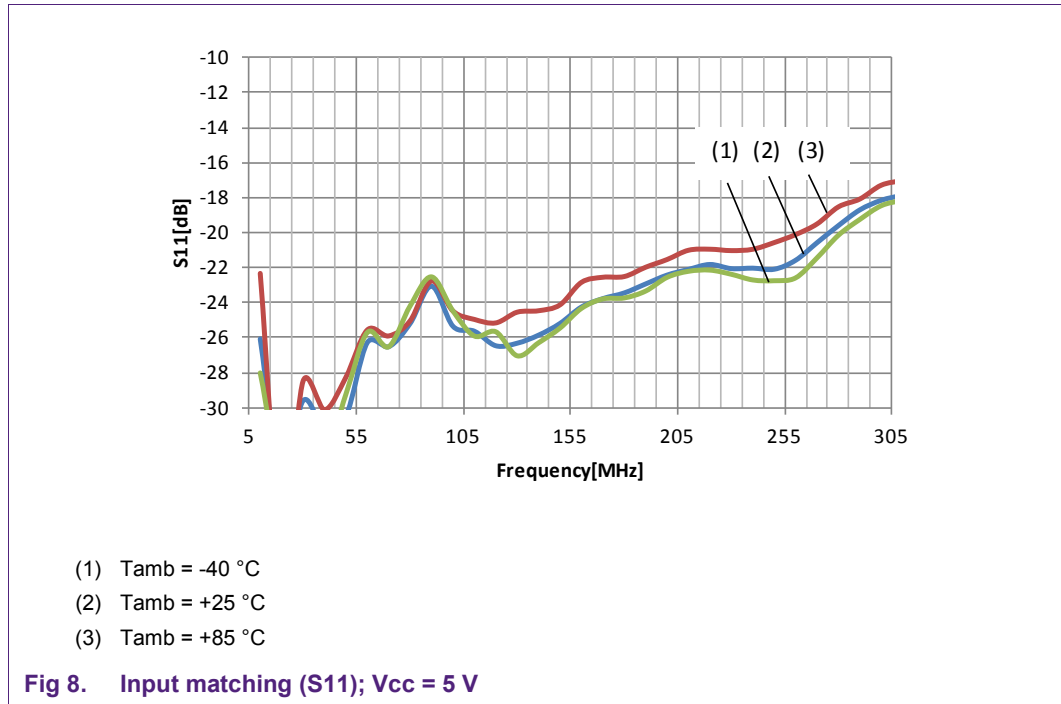
Table 2. Measurement results at Vcc = 8 V

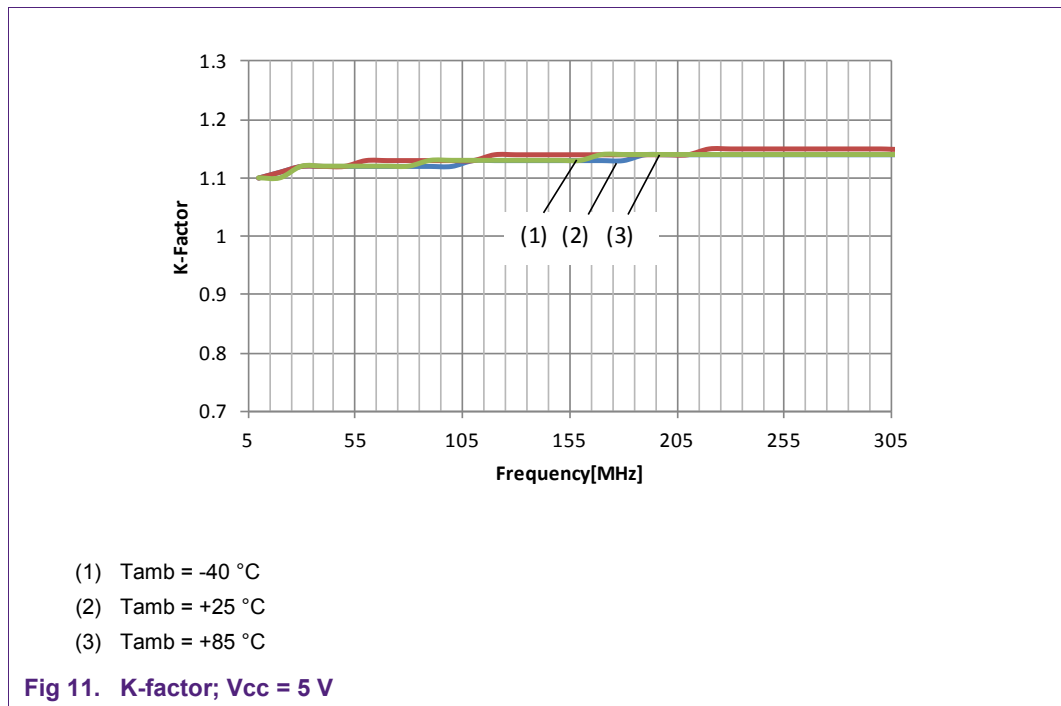
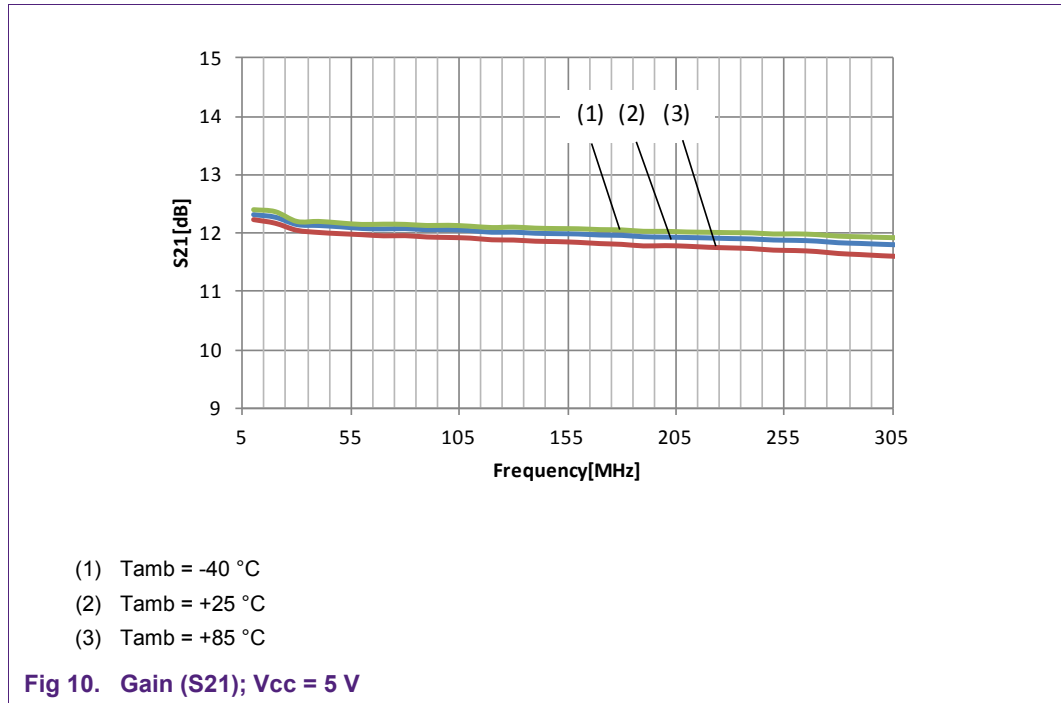
Symbol	Conditions	-40 °C	+25 °C	+85 °C	Unit	
NF	At 10 MHz	2.8	3.1	3.1	dB	
	At 300 MHz	3.0	3.2	3.4	dB	
P _{L(1dB)}	At 40 MHz	22.5	22.5	22.5	dBm	
IP _{3o}	At 34 MHz	[1]	44.5	44.0	42.5	dBc
	At 74 MHz	[1]	42.0	42.0	41.5	dBc
	At 114 MHz	[1]	42.5	42.0	41.5	dBc
	At 154 MHz	[1]	44.0	43.0	41.5	dBc
	At 194 MHz	[1]	45.0	43.5	42.0	dBc
	At 234 MHz	[1]	46.5	44.5	42.5	dBc
	At 274 MHz	[1]	48.0	45.0	42.5	dBc
IP _{2o}	At 86 MHz	[2]	63.0	61.0	60.0	dBc
	At 166 MHz	[2]	65.5	64.0	62.0	dBc
	At 246 MHz	[2]	62.5	61.0	60.0	dBc

[1] The fundamental frequencies (f_1) and (f_2) lay between 40 MHz and 300 MHz. The intermodulation product (IM3) is $2 \times f_2 - f_1$, where $f_2 = f_1 \pm 6$ MHz. Input power $P_i = -20$ dBm.

[2] The fundamental frequencies (f_1) and (f_2) lay between 40 MHz and 300 MHz. The intermodulation product (IM20 is $|f_2 - f_1|$, with $40 \text{ MHz} < |f_1 - f_2| < 300 \text{ MHz}$. Input power $P_i = -20$ dBm.

6. Measurement results at Vcc = 5 V





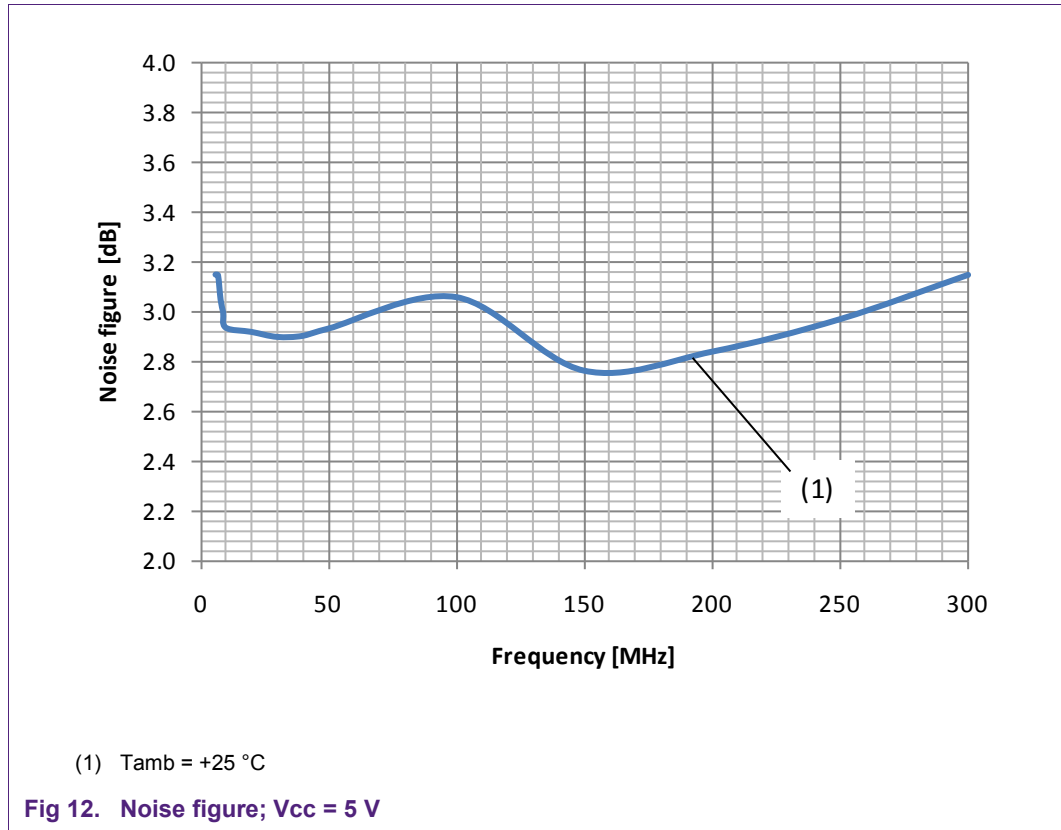


Table 3. Measurement results at Vcc = 5 V

Symbol	Conditions	-40 °C	+25 °C	+85 °C	Unit	
NF	At 10 MHz	2.7	2.9	2.9	dB	
	At 300 MHz	2.8	3.1	3.1	dB	
P _{L(1dB)}	At 40 MHz	17.5	17.5	17.5	dBm	
IP _{3o}	At 34 MHz	[1]	42.0	40.5	39.5	dBc
	At 74 MHz	[1]	40.5	38.5	38.0	dBc
	At 114 MHz	[1]	40.0	39.0	38.5	dBc
	At 154 MHz	[1]	40.5	39.5	38.5	dBc
	At 194 MHz	[1]	41.0	39.0	38.0	dBc
	At 234 MHz	[1]	41.0	39.5	38.0	dBc
	At 274 MHz	[1]	40.5	39.0	37.5	dBc
	At 246 MHz	[2]	58.5	56.5	55.0	dBc
IP _{2o}	At 166 MHz	[2]	59.5	57.0	56.0	dBc
	At 246 MHz	[2]	58.0	56.0	54.5	dBc

[1] The fundamental frequencies (f_1) and (f_2) lay between 40 MHz and 300 MHz. The intermodulation product (IM3) is $2 \times f_2 - f_1$, where $f_2 = f_1 \pm 6$ MHz. Input power $P_i = -20$ dBm.

[2] The fundamental frequencies (f_1) and (f_2) lay between 40 MHz and 300 MHz. The intermodulation product (IM20 is $|f_2 - f_1|$, with $40 \text{ MHz} < |f_1 - f_2| < 300 \text{ MHz}$. Input power $P_i = -20$ dBm.

7. Abbreviations

Table 2. Abbreviations

Acronym	Description
AC	Alternating Current
CATV	Community Antenna TeleVision
DC	Direct Current
ESD	Electro Static Discharge
MMIC	Monolithic Microwave Integrated Circuit
NTSC	National Television Standards Committee
PCB	Printed Circuit Board
RF	Radio Frequency
SMD	Surface Mounted Device

8. Legal information

8.1 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

8.2 Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors.

In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors and its suppliers accept no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP

Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from national authorities.

Evaluation products — This product is provided on an "as is" and "with all faults" basis for evaluation purposes only. NXP Semiconductors, its affiliates and their suppliers expressly disclaim all warranties, whether express, implied or statutory, including but not limited to the implied warranties of non-infringement, merchantability and fitness for a particular purpose. The entire risk as to the quality, or arising out of the use or performance, of this product remains with customer.

In no event shall NXP Semiconductors, its affiliates or their suppliers be liable to customer for any special, indirect, consequential, punitive or incidental damages (including without limitation damages for loss of business, business interruption, loss of use, loss of data or information, and the like) arising out the use of or inability to use the product, whether or not based on tort (including negligence), strict liability, breach of contract, breach of warranty or any other theory, even if advised of the possibility of such damages.

Notwithstanding any damages that customer might incur for any reason whatsoever (including without limitation, all damages referenced above and all direct or general damages), the entire liability of NXP Semiconductors, its affiliates and their suppliers and customer's exclusive remedy for all of the foregoing shall be limited to actual damages incurred by customer based on reasonable reliance up to the greater of the amount actually paid by customer for the product or five dollars (US\$5.00). The foregoing limitations, exclusions and disclaimers shall apply to the maximum extent permitted by applicable law, even if any remedy fails of its essential purpose.

8.3 Trademarks

Notice: All referenced brands, product names, service names and trademarks are property of their respective owners.

9. List of figures

Fig 1.	BGA3012 evaluation circuit.....	4
Fig 2.	BGA3012 evaluation board layout	5
Fig 3.	Input matching (S11); Vcc = 8 V	7
Fig 4.	Output matching (S22); Vcc = 8 V	7
Fig 5.	Gain (S21); Vcc = 8 V	8
Fig 6.	K-factor; Vcc = 8 V	8
Fig 7.	Noise figure; Vcc = 8 V	9
Fig 8.	Input matching (S11); Vcc = 5 V	11
Fig 9.	Output matching (S22); Vcc = 5 V	11
Fig 10.	Gain (S21); Vcc = 5 V	12
Fig 11.	K-factor; Vcc = 5 V	12
Fig 12.	Noise figure; Vcc = 5 V	13

10. List of tables

Table 1. Evaluation board BoM.....6
Table 2. Measurement results at Vcc = 8 V 10
Table 3. Measurement results at Vcc = 5 V 14

11. Contents

1.	Introduction	3
2.	System features.....	3
3.	Customer evaluation kit contents.....	3
4.	Application Information	4
4.1	Evaluation board circuit	4
4.2	Evaluation board layout.....	5
4.3	Bill of materials	6
5.	Measurement results at Vcc = 8 V.....	7
6.	Measurement results at Vcc = 5 V.....	11
7.	Abbreviations	15
8.	Legal information	16
8.1	Definitions	16
8.2	Disclaimers.....	16
8.3	Trademarks	16
9.	List of figures.....	17
10.	List of tables	18
11.	Contents.....	19

Please be aware that important notices concerning this document and the product(s) described herein, have been included in the section 'Legal information'.

© NXP B.V. 2013.

All rights reserved.

For more information, visit: <http://www.nxp.com>

For sales office addresses, please send an email to: salesaddresses@nxp.com

Date of release: 14 February 2013

Document identifier: AN11293