

# BGA3015

1 GHz 15 dB gain wideband amplifier MMIC

Rev. 3 — 25 September 2013

Product data sheet

## 1. Product profile

### 1.1 General description

The BGA3015 MMIC is a wideband amplifier with internal biasing. It is designed specifically for high linearity CATV line extenders and drop amplifiers over a frequency range of 5 MHz to 1006 MHz. The LNA is housed in a lead free 3-pin SOT89 package.

### 1.2 Features and benefits

- Internally biased
- Flat gain
- High linearity with an IP3<sub>O</sub> of 40 dBm and an IP2<sub>O</sub> of 60 dBm
- Noise figure of 2.5 dB
- 75  $\Omega$  input and output impedance
- Operating from 5 V to 8 V supply

### 1.3 Applications

- General wideband amplifiers.
- CATV return amplifier; frequency ranges of 5 MHz to 300 MHz.
- CATV infrastructure network driver in optical nodes (FTTx), distribution amplifiers, trunk amplifiers and line extenders in the frequency range from 40 MHz to 1006 MHz.
- The product is ideally suited for applications as drop amplifiers in CATV distribution systems such as FTTH

### 1.4 Quick reference data

**Table 1. Quick reference data**

Bandwidth 40 MHz to 1006 MHz;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ; typical values at  $V_{CC} = 8\text{ V}$ ;  $Z_S = Z_L = 75\text{ }\Omega$ ;  $R1 = R2 = 300\text{ }\Omega$ .

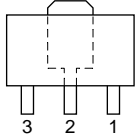
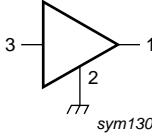
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	RF input AC coupled	7.6	8	8.4	V
$I_{CC(tot)}$	total supply current		-	110	125	mA
$T_{amb}$	ambient temperature		-40	-	+85	$^{\circ}\text{C}$
NF	noise figure	$f = 500\text{ MHz}$	-	2.5	3.0	dB
$P_{L(1dB)}$	output power at 1 dB gain compression		22.5	24	-	dBm
IP3 <sub>O</sub>	output third-order intercept point		[1] 36	40	-	dBm
IP2 <sub>O</sub>	output second-order intercept point		[2] -	60	-	dBm

- [1] The fundamental frequencies ( $f_1$ ) and ( $f_2$ ) lay between 40 MHz and 1006 MHz. The intermodulation product (IM3) is  $2 \times f_2 - f_1$ , where  $f_2 = f_1 \pm 6\text{ MHz}$ . Input power  $P_i = -20\text{ dBm}$ .
- [2] The fundamental frequencies ( $f_1$ ) and ( $f_2$ ) lay between 40 MHz and 1006 MHz. The intermodulation product (IM2) is  $|f_2 - f_1|$ , with  $40\text{ MHz} < |f_1 - f_2| < 1006\text{ MHz}$ . Input power  $P_i = -20\text{ dBm}$ .



## 2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	RF_OUT and biasing <a href="#">[1]</a>		
2	GND <a href="#">[2]</a>		
3	RF_IN <a href="#">[1]</a>		

[1] This pin is DC-coupled and requires an external DC-blocking capacitor.

[2] The center metal base of the SOT89 also functions as heatsink for the power amplifier.

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BGA3015	-	plastic surface-mounted package; exposed die pad for good heat transfer; 3 leads	SOT89
OM7859	EVB	1 GHz 15 dB gain wideband amplifier application	-
OM7863	EVB	5 MHz to 300 MHz 15 dB reverse amplifier application	-
OM7867	EVB	40 MHz to 1006 MHz push-pull amplifier application	-
OM7861	EVB	BGA301x wideband variable gain amplifier application	-

## 4. Marking

Table 4. Marking codes

Type number	Marking code	Description
BGA3015	*6X	* = W : made in China

## 5. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	supply voltage	RF input AC coupled	-0.6	+15	V
P <sub>i</sub>	input power	single tone	-	20	dBm
T <sub>stg</sub>	storage temperature		-65	+150	°C
T <sub>j</sub>	junction temperature		-	150	°C
T <sub>amb</sub>	ambient temperature		-40	+85	°C
V <sub>ESD</sub>	electrostatic discharge voltage	Human Body Model (HBM); According JEDEC standard 22-A114E	2	-	kV
		Charged Device Model (CDM); According JEDEC standard 22-C101B	2	-	kV

## 6. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point		40	K/W

## 7. Characteristics

### 7.1 Forward application

Table 7. Characteristics at  $V_{CC} = 8\text{ V}$

Bandwidth 40 MHz to 1006 MHz;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ; typical values at  $V_{CC} = 8\text{ V}$ ;  $Z_S = Z_L = 75\text{ }\Omega$ ;  $R1 = R2 = 300\text{ }\Omega$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	RF input AC coupled	7.6	8	8.4	V
$I_{CC(tot)}$	total supply current		-	110	125	mA
$ S_{21} ^2$	insertion power gain		14	15	16	dB
$SL_{sl}$	slope straight line		-	0.5	-	dB
FL	flatness of frequency response		-	0.5	-	dB
NF	noise figure	$f = 50\text{ MHz}$	-	2.3	2.8	dB
		$f = 500\text{ MHz}$	-	2.5	3.0	dB
		$f = 1000\text{ MHz}$	-	2.8	3.3	dB
$RL_{in}$	input return loss	$f = 50\text{ MHz}$	-	17	-	dB
		$f = 500\text{ MHz}$	-	18	-	dB
		$f = 1000\text{ MHz}$	-	28	-	dB
$RL_{out}$	output return loss	$f = 50\text{ MHz}$	-	24	-	dB
		$f = 500\text{ MHz}$	-	26	-	dB
		$f = 1000\text{ MHz}$	-	15	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression		22.5	24	-	dBm
$IP3_O$	output third-order intercept point	[1]	36	40	-	dBm
$IP2_O$	output second-order intercept point	[2]	-	60	-	dBm
CTB	composite triple beat	[3]	-	-75	-	dBc
CSO	composite second-order distortion	[3]	-	-60	-	dBc

[1] The fundamental frequencies ( $f_1$ ) and ( $f_2$ ) lay between 40 MHz and 1006 MHz. The intermodulation product (IM3) is  $2 \times f_2 - f_1$ , where  $f_2 = f_1 \pm 6\text{ MHz}$ . Input power  $P_i = -20\text{ dBm}$ .

[2] The fundamental frequencies ( $f_1$ ) and ( $f_2$ ) lay between 40 MHz and 1006 MHz. The intermodulation product (IM2) is  $|f_2 - f_1|$ , with  $40\text{ MHz} < |f_1 - f_2| < 1006\text{ MHz}$ . Input power  $P_i = -20\text{ dBm}$ .

[3] Measured with 132 NTSC channels  $V_O = 30\text{ dBmV}$ .

**Table 8. Characteristics at  $V_{CC} = 5\text{ V}$** 

Bandwidth 40 MHz to 1006 MHz;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ; typical values at  $V_{CC} = 5\text{ V}$ ;  $Z_S = Z_L = 75\text{ }\Omega$ ;  
 $R1 = R2 = 300\text{ }\Omega$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	RF input AC coupled	4.75	5	5.25	V
$I_{CC(tot)}$	total supply current		-	70	85	mA
$ S_{21} ^2$	insertion power gain		-	15	-	dB
$SL_{sl}$	slope straight line		-	0.5	-	dB
FL	flatness of frequency response		-	0.5	-	dB
NF	noise figure	$f = 50\text{ MHz}$	-	2.3	-	dB
		$f = 500\text{ MHz}$	-	2.3	-	dB
		$f = 1000\text{ MHz}$	-	2.6	-	dB
$RL_{in}$	input return loss	$f = 50\text{ MHz}$	-	18	-	dB
		$f = 500\text{ MHz}$	-	18	-	dB
		$f = 1000\text{ MHz}$	-	28	-	dB
$RL_{out}$	output return loss	$f = 50\text{ MHz}$	-	25	-	dB
		$f = 500\text{ MHz}$	-	26	-	dB
		$f = 1000\text{ MHz}$	-	15	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression		-	18	-	dBm
$IP3_O$	output third-order intercept point	[1]	-	36	-	dBm
$IP2_O$	output second-order intercept point	[2]	-	55	-	dBm
CTB	composite triple beat	[3]	-	-70	-	dBc
CSO	composite second-order distortion	[3]	-	-55	-	dBc

[1] The fundamental frequencies ( $f_1$ ) and ( $f_2$ ) lay between 40 MHz and 1006 MHz. The intermodulation product (IM3) is  $2 \times f_2 - f_1$ , where  $f_2 = f_1 \pm 6\text{ MHz}$ . Input power  $P_i = -20\text{ dBm}$ .

[2] The fundamental frequencies ( $f_1$ ) and ( $f_2$ ) lay between 40 MHz and 1006 MHz. The intermodulation product (IM2) is  $|f_2 - f_1|$ , with  $40\text{ MHz} < |f_1 - f_2| < 1006\text{ MHz}$ . Input power  $P_i = -20\text{ dBm}$ .

[3] Measured with 132 NTSC channels  $V_O = 30\text{ dBmV}$ .

## 7.2 Return application

**Table 9. Characteristics at  $V_{CC} = 8\text{ V}$**

Bandwidth 5 MHz to 300 MHz;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ; typical values at  $V_{CC} = 8\text{ V}$ ;  $Z_S = Z_L = 75\text{ }\Omega$ ;  $R1 = R2 = 300\text{ }\Omega$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	RF input AC coupled	7.6	8	8.4	V
$I_{CC(tot)}$	total supply current		-	110	125	mA
$ S_{21} ^2$	insertion power gain		-	15	-	dB
$SL_{sl}$	slope straight line		-	0.5	-	dB
FL	flatness of frequency response		-	0.5	-	dB
NF	noise figure	$f = 50\text{ MHz}$	-	2.3	-	dB
$RL_{in}$	input return loss	$f = 5\text{ MHz}$	-	18.5	-	dB
		$f = 100\text{ MHz}$	-	18.5	-	dB
		$f = 200\text{ MHz}$	-	18.5	-	dB
		$f = 300\text{ MHz}$	-	18.5	-	dB
$RL_{out}$	output return loss	$f = 5\text{ MHz}$	-	18.5	-	dB
		$f = 100\text{ MHz}$	-	18.5	-	dB
		$f = 200\text{ MHz}$	-	18.5	-	dB
		$f = 300\text{ MHz}$	-	18.5	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression		-	24	-	dBm
$IP3_O$	output third-order intercept point	[1]	-	40	-	dBm
$IP2_O$	output second-order intercept point	[2]	-	60	-	dBm

[1] The fundamental frequencies ( $f_1$ ) and ( $f_2$ ) lay between 5 MHz and 300 MHz. The intermodulation product (IM3) is  $2 \times f_2 - f_1$ , where  $f_2 = f_1 \pm 6\text{ MHz}$ . Input power  $P_i = -20\text{ dBm}$ .

[2] The fundamental frequencies ( $f_1$ ) and ( $f_2$ ) lay between 5 MHz and 300 MHz. The intermodulation product (IM2) is  $|f_2 - f_1|$ , with  $40\text{ MHz} < |f_1 - f_2| < 300\text{ MHz}$ . Input power  $P_i = -20\text{ dBm}$ .

**Table 10. Characteristics at  $V_{CC} = 5\text{ V}$** 

Bandwidth 5 MHz to 300 MHz;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ; typical values at  $V_{CC} = 5\text{ V}$ ;  $Z_S = Z_L = 75\text{ }\Omega$ ;  
 $R1 = R2 = 300\text{ }\Omega$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	RF input AC coupled	4.75	5	5.25	V
$I_{CC(tot)}$	total supply current		-	70	85	mA
$ S_{21} ^2$	insertion power gain		-	15	-	dB
$SL_{sl}$	slope straight line		-	0.5	-	dB
FL	flatness of frequency response		-	0.5	-	dB
NF	noise figure	$f = 50\text{ MHz}$	-	2.3	-	dB
$RL_{in}$	input return loss	$f = 5\text{ MHz}$	-	18.5	-	dB
		$f = 100\text{ MHz}$	-	18.5	-	dB
		$f = 200\text{ MHz}$	-	18.5	-	dB
		$f = 300\text{ MHz}$	-	18.5	-	dB
$RL_{out}$	output return loss	$f = 5\text{ MHz}$	-	18.5	-	dB
		$f = 100\text{ MHz}$	-	18.5	-	dB
		$f = 200\text{ MHz}$	-	18.5	-	dB
		$f = 300\text{ MHz}$	-	18.5	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression		-	18	-	dBm
$IP3_O$	output third-order intercept point	[1]	-	40	-	dBm
$IP2_O$	output second-order intercept point	[2]	-	55	-	dBm

[1] The fundamental frequencies ( $f_1$ ) and ( $f_2$ ) lay between 5 MHz and 300 MHz. The intermodulation product (IM3) is  $2 \times f_2 - f_1$ , where  $f_2 = f_1 \pm 6\text{ MHz}$ . Input power  $P_i = -20\text{ dBm}$ .

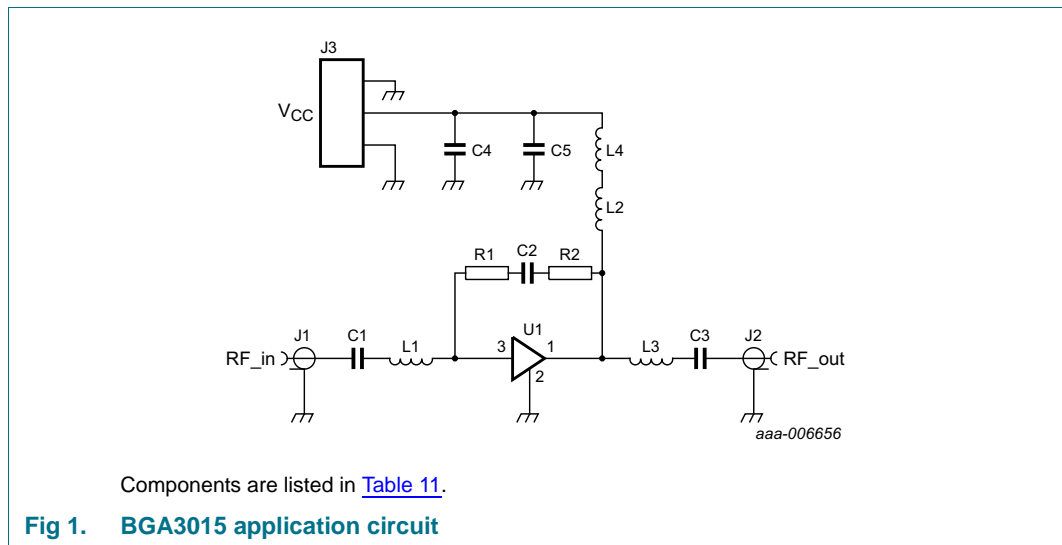
[2] The fundamental frequencies ( $f_1$ ) and ( $f_2$ ) lay between 5 MHz and 300 MHz. The intermodulation product (IM2) is  $|f_2 - f_1|$ , with  $40\text{ MHz} < |f_1 - f_2| < 300\text{ MHz}$ . Input power  $P_i = -20\text{ dBm}$ .

## 8. Application information

### 8.1 Forward application 40 MHz to 1006 MHz

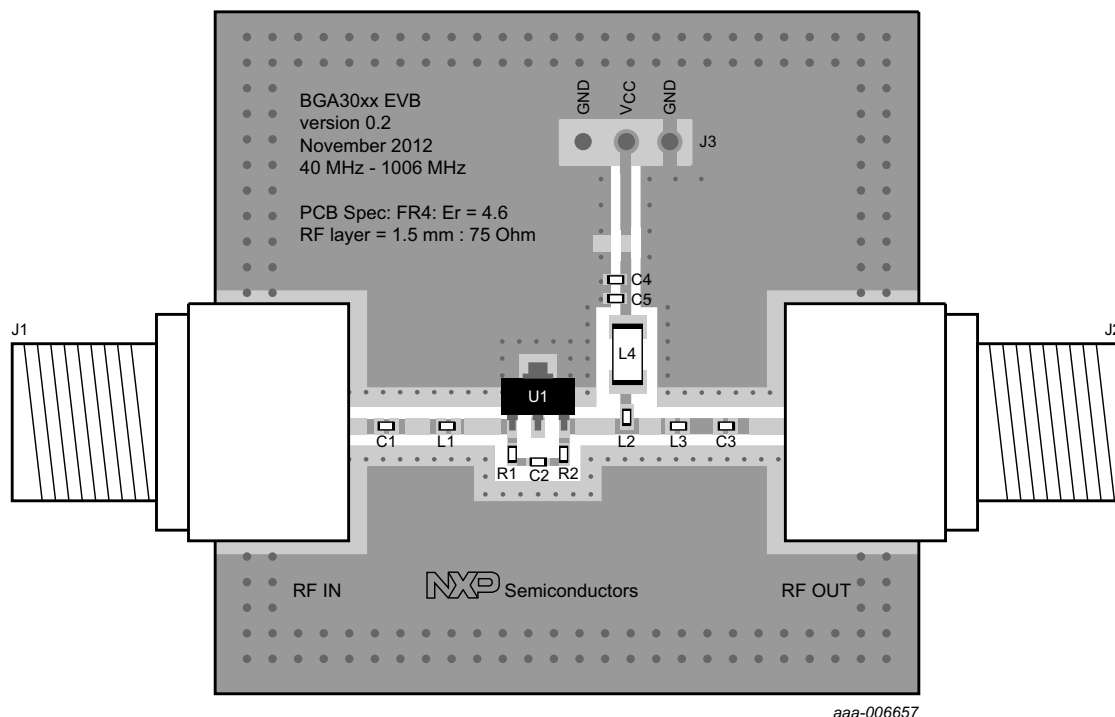
The BGA3015 can be used in other applications. Please contact your local sales representative for more information. Application notes are available on the NXP website.

#### 8.1.1 Forward application circuit



All control and supply lines must be decoupled properly. The decoupling capacitors must be placed as close to the device as possible.

## 8.1.2 Forward application circuit board layout



PCB (Printed-Circuit Board) material = FR4; thickness = 1.5 mm; size = 40 mm × 40 mm;  $\epsilon_r = 4.6$ ; thickness of copper layer = 35  $\mu\text{m}$ ;

Components are listed in [Table 11](#).

**Fig 2. BGA3015 application circuit board layout**

**Table 11. List of components**

See [Figure 1](#) and [Figure 2](#).

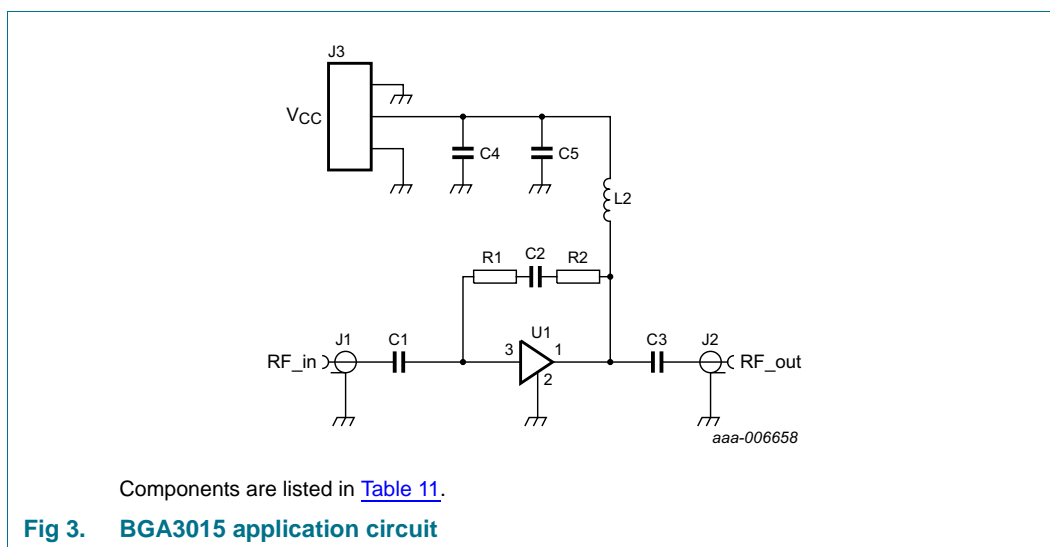
Component	Description	Value	Size	Remarks
C1, C2, C3, C4	capacitor	10 nF	SMD 0402	Murata GRM155R71E103KA01D or capacitor of same quality
C5	capacitor	100 pF	SMD 0402	Murata GRM1555C1H101JZ01D or capacitor of same quality
J1, J2	F-connector	75 $\Omega$	-	Bomar 861V509ER6 or F-connector of same quality
J3	header 3-way	-	-	Molex 90121-0763 or header of the same quality
L1, L3	inductor	3.9 nH	SMD 0402	Murata LQG15HS3N9S02D or inductor of same quality
L2	choke	-	SMD 0603	Murata BLM18HD182SN1D or choke of same quality
L4	inductor	880 nH	SMD 1206	Murata LQH31HNR88K03L or inductor of same quality
R1, R2	resistor	300 $\Omega$	SMD 0402	Yageo RC0402FR-07300RL or resistor of same quality
U1	BGA3015	-	-	NXP



## 8.2 Return application 5 MHz to 300 MHz

The BGA3015 can be used in other applications. Please contact your local sales representative for more information. Application notes are available on the NXP website.

### 8.2.1 Return application circuit



All control and supply lines must be decoupled properly. The decoupling capacitors must be placed as close to the device as possible.

8.2.2 Return application circuit board layout

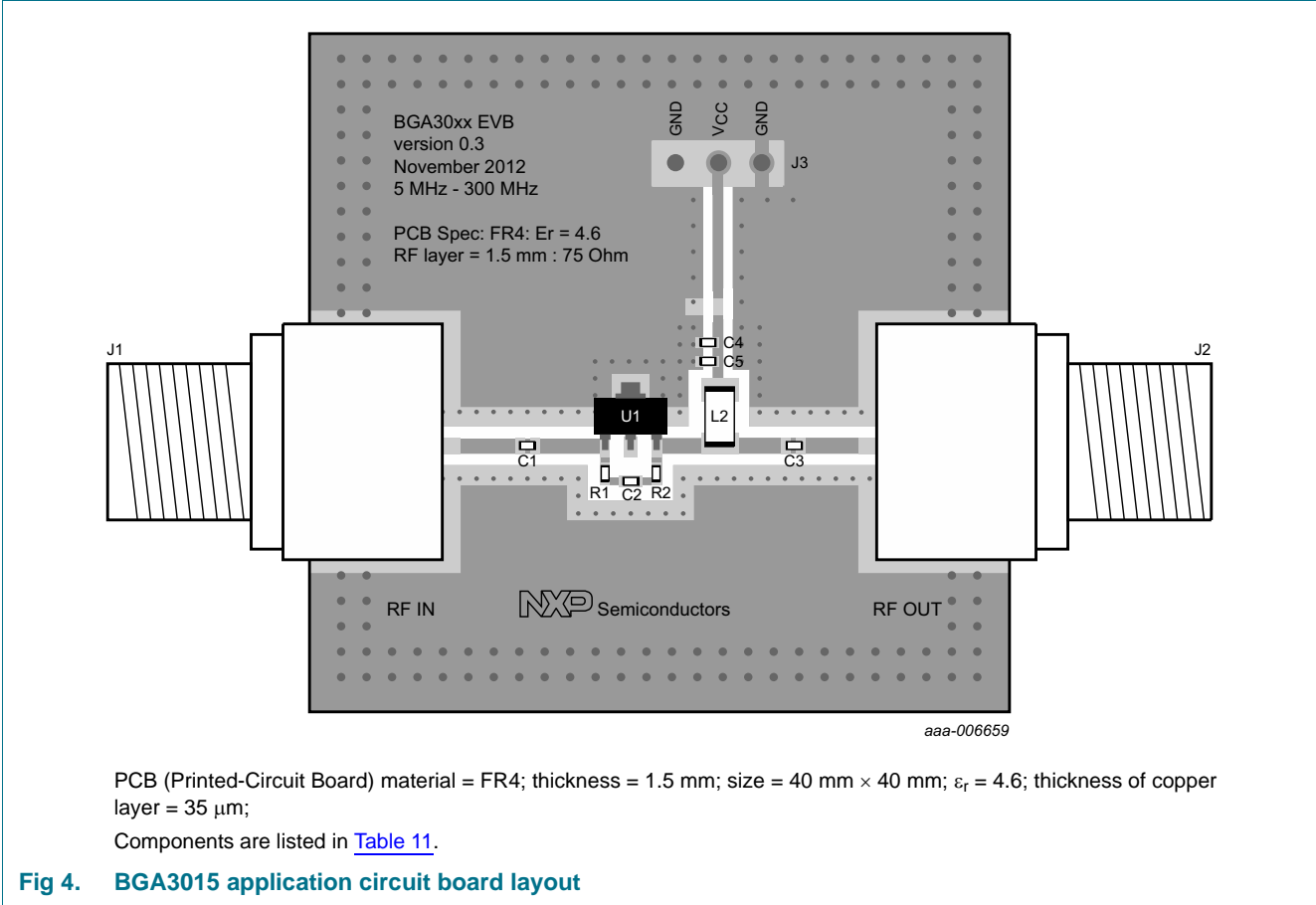


Table 12. List of components

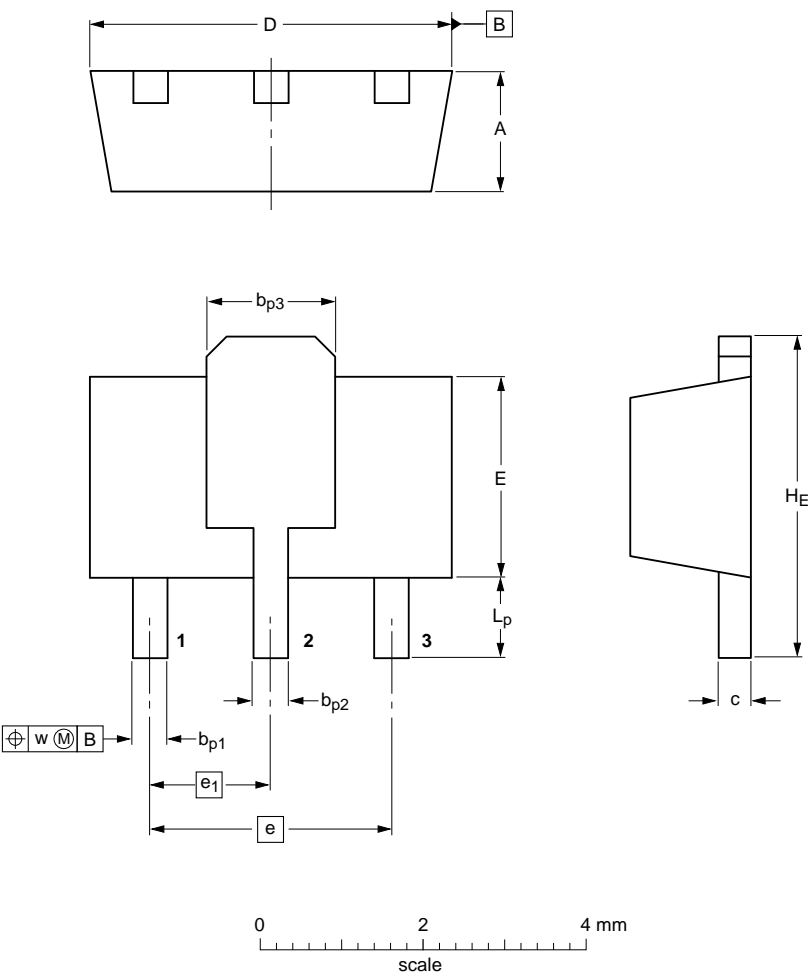
See [Figure 1](#) and [Figure 2](#).

Component	Description	Value	Size	Remarks
C1, C2, C3, C4	capacitor	10 nF	SMD 0402	Murata GRM155R71E103KA01D or capacitor of same quality
C5	capacitor	100 pF	SMD 0402	Murata GRM1555C1H101JZ01D or capacitor of same quality
J1, J2	F-connector	75 $\Omega$	-	Bomar 861V509ER6 or F-connector of same quality
J3	header 3-way	-	-	Molex 90121-0763 or header of the same quality
L2	inductor	22 $\mu\text{H}$	SMD 1206	Murata LQH31CN220K03L or inductor of same quality
R1, R2	resistor	300 $\Omega$	SMD 0402	Yageo RC0402FR-07300RL or resistor of same quality
U1	BGA3015	-	-	NXP

9. Package outline

Plastic surface-mounted package; exposed die pad for good heat transfer; 3 leads

SOT89



DIMENSIONS (mm are the original dimensions)

UNIT	A	b <sub>p1</sub>	b <sub>p2</sub>	b <sub>p3</sub>	c	D	E	e	e <sub>1</sub>	H <sub>E</sub>	L <sub>p</sub>	w
mm	1.6 1.4	0.48 0.35	0.53 0.40	1.8 1.4	0.44 0.23	4.6 4.4	2.6 2.4	3.0	1.5	4.25 3.75	1.2 0.8	0.13

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT89		TO-243	SC-62			06-03-16 06-08-29

Fig 5. Package outline SOT89 (SC-62)

## 10. Abbreviations

Table 13. Abbreviations

Acronym	Description
CATV	Community Antenna TeleVision
FTTH	Fiber To The Home
FTTx	Fiber To The "x"
LNA	Low-Noise Amplifier
MMIC	Monolithic Microwave Integrated Circuit

## 11. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BGA3015 v.3	20130925	Product data sheet	-	BGA3015 v.2
Modifications:	• <a href="#">Table 3 on page 2</a> : Evaluation boards have been added.			
BGA3015 v.2	20130415	Product data sheet	-	BGA3015 v.1
BGA3015 v.1	20130319	Preliminary data sheet	-	-

## 12. Legal information

### 12.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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