

BGA3012

1 GHz 12 dB gain wideband amplifier MMIC

Rev. 3 — 26 September 2013 Product data sheet

1. Product profile

1.1 General description

The BGA3012 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 $IP3_O$ of 40 dBm and an $IP2_O$ of 60 dBm
- Noise figure of 3.1 dB
- 75 Ω 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 °C; typical values at V_{CC} = 8 V; Z_S = Z_L = 75 Ω; R1 = 100 Ω; R2 = 300 Ω.

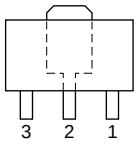
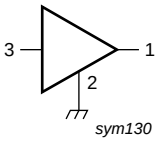
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{CC}	supply voltage	RF input AC coupled		7.6	8	8.4	V
$I_{CC(tot)}$	total supply current			-	110	125	mA
T_{amb}	ambient temperature			−40	-	+85	°C
NF	noise figure	f = 500 MHz		-	3.1	3.6	dB
$P_{L(1dB)}$	output power at 1 dB gain compression			21.5	23	-	dBm
$IP3_O$	output third-order intercept point		[1]	36	40	-	dBm
$IP2_O$	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 $f_2 = f_1 \pm 6$ MHz. Input power P_i = −20 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 MHz < $|f_1 - f_2|$ < 1006 MHz. Input power P_i = −20 dBm.

2. Pinning information

Table 2. Pinning

Pin	Description		Simplified outline	Graphic symbol
1	RF_OUT and biasing	[1]		
2	GND	[2]		
3	RF_IN	[1]		

[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
BGA3012	-	plastic surface-mounted package; exposed die pad for good heat transfer; 3 leads	SOT89
OM7858	EVB	1 GHz 12 dB gain wideband amplifier application	-
OM7862	EVB	5 MHz to 300 MHz 12 dB reverse amplifier application	-
OM7866	EVB	40 MHz to 1006 MHz push-pull amplifier application	-

4. Marking

Table 4. Marking codes

Type number	Marking code	Description
BGA3012	*6W	* = 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_{CC}	supply voltage	RF input AC coupled	–0.6	+15	V
P_i	input power	single tone	-	20	dBm
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		-	150	°C
T_{amb}	ambient temperature		–40	+85	°C
V_{ESD}	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

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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 V

Bandwidth 40 MHz to 1006 MHz; T_{amb} = 25 °C; typical values at V_{CC} = 8 V; $Z_S = Z_L$ = 75 Ω; R1 = 100 Ω; R2 = 300 Ω.

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		11	12	13	dB
SL_{sl}	slope straight line		-	0.5	-	dB
FL	flatness of frequency response		-	0.5	-	dB
NF	noise figure	f = 50 MHz	-	3.0	3.5	dB
		f = 500 MHz	-	3.1	3.6	dB
		f = 1000 MHz	-	3.4	3.9	dB
RL_{in}	input return loss	f = 50 MHz	-	22	-	dB
		f = 500 MHz	-	27	-	dB
		f = 1000 MHz	-	29	-	dB
RL_{out}	output return loss	f = 50 MHz	-	21	-	dB
		f = 500 MHz	-	22	-	dB
		f = 1000 MHz	-	15	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression		21.5	23	-	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 $f_2 = f_1 \pm 6$ MHz. Input power P_i = −20 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 MHz < $|f_1 - f_2|$ < 1006 MHz. Input power P_i = −20 dBm.

[3] Measured with 132 NTSC channels V_O = 30 dBmV.

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Table 8. Characteristics at V_{CC} = 5 V

Bandwidth 40 MHz to 1006 MHz; T_{amb} = 25 °C; typical values at V_{CC} = 5 V; $Z_S = Z_L$ = 75 Ω; R1 = 100 Ω; R2 = 300 Ω.

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			-	12	-	dB
SL_{sl}	slope straight line			-	0.5	-	dB
FL	flatness of frequency response			-	0.5	-	dB
NF	noise figure	f = 50 MHz		-	2.9	-	dB
		f = 500 MHz		-	2.9	-	dB
		f = 1000 MHz		-	3.2	-	dB
RL_{in}	input return loss	f = 50 MHz		-	22	-	dB
		f = 500 MHz		-	25	-	dB
		f = 1000 MHz		-	25	-	dB
RL_{out}	output return loss	f = 50 MHz		-	22	-	dB
		f = 500 MHz		-	22	-	dB
		f = 1000 MHz		-	12	-	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]	-	54	-	dBm
CTB	composite triple beat		[3]	-	–70	-	dBc
CSO	composite second-order distortion		[3]	-	–54	-	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 $f_2 = f_1 \pm 6$ MHz. Input power P_i = –20 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 MHz < $|f_1 - f_2|$ < 1006 MHz. Input power P_i = –20 dBm.

[3] Measured with 132 NTSC channels V_O = 30 dBmV.

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7.2 Return application

Table 9. Characteristics at V_{CC} = 8 V

Bandwidth 5 MHz to 300 MHz; T_{amb} = 25 °C; typical values at V_{CC} = 8 V; $Z_S = Z_L$ = 75 Ω; R1 = 100 Ω; R2 = 300 Ω.

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		-	12	-	dB
SL_{sl}	slope straight line		-	0.5	-	dB
FL	flatness of frequency response		-	0.5	-	dB
NF	noise figure	f = 50 MHz	-	3.0	-	dB
RL_{in}	input return loss	f = 5 MHz	-	18.5	-	dB
		f = 100 MHz	-	18.5	-	dB
		f = 200 MHz	-	18.5	-	dB
		f = 300 MHz	-	18.5	-	dB
RL_{out}	output return loss	f = 5 MHz	-	18.5	-	dB
		f = 100 MHz	-	18.5	-	dB
		f = 200 MHz	-	18.5	-	dB
		f = 300 MHz	-	18.5	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression		-	23	-	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 $f_2 = f_1 \pm 6$ MHz. Input power $P_i = -20$ 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 MHz < $|f_1 - f_2|$ < 300 MHz. Input power $P_i = -20$ dBm.

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Table 10. Characteristics at V_{CC} = 5 V

Bandwidth 5 MHz to 300 MHz; T_{amb} = 25 °C; typical values at V_{CC} = 5 V; Z_S = Z_L = 75 Ω; R1 = 100 Ω; R2 = 300 Ω.

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		-	12	-	dB
SL_{sl}	slope straight line		-	0.5	-	dB
FL	flatness of frequency response		-	0.5	-	dB
NF	noise figure	f = 50 MHz	-	2.9	-	dB
RL_{in}	input return loss	f = 5 MHz	-	18.5	-	dB
		f = 100 MHz	-	18.5	-	dB
		f = 200 MHz	-	18.5	-	dB
		f = 300 MHz	-	18.5	-	dB
RL_{out}	output return loss	f = 5 MHz	-	18.5	-	dB
		f = 100 MHz	-	18.5	-	dB
		f = 200 MHz	-	18.5	-	dB
		f = 300 MHz	-	18.5	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression		-	17	-	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 $f_2 = f_1 \pm 6$ MHz. Input power P_i = –20 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 MHz < $|f_1 - f_2|$ < 300 MHz. Input power P_i = –20 dBm.

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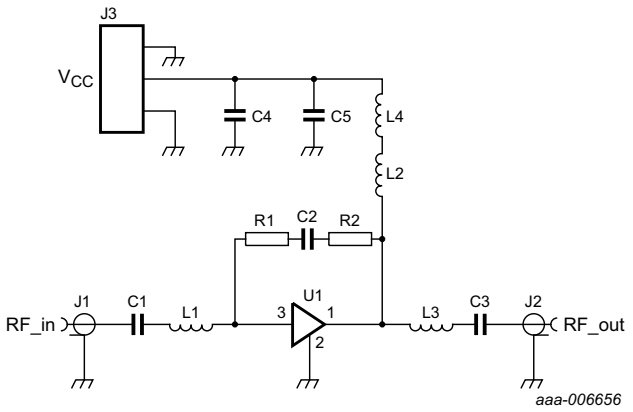
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8. Application information

8.1 Forward application 40 MHz to 1006 MHz

The BGA3012 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



Components are listed in Table 11.

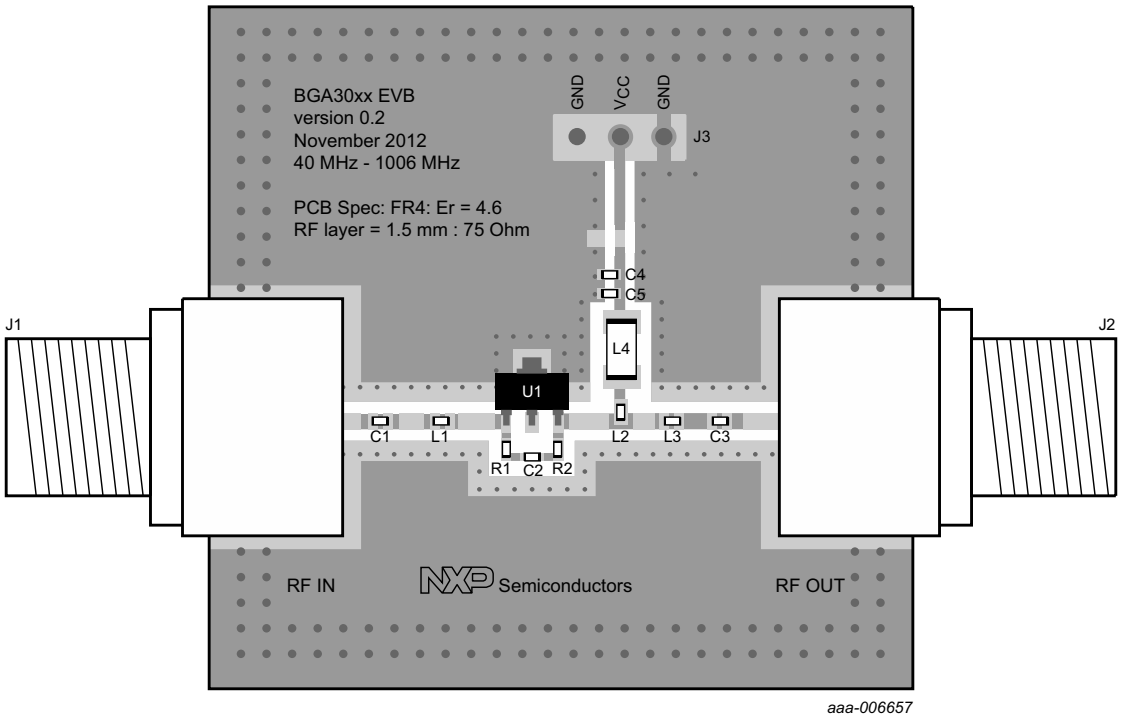
Fig 1. BGA3012 application circuit

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

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8.1.2 Forward application circuit board layout



PCB (Printed-Circuit Board) material = FR4; thickness = 1.5 mm; size = 40 mm × 40 mm; ε_r = 4.6; thickness of copper layer = 35 μm;

Components are listed in Table 11.

Fig 2. BGA3012 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 Ω	-	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	resistor	100 Ω	SMD 0402	Yageo RC0402FR-07100RL or resistor of same quality
R2	resistor	300 Ω	SMD 0402	Yageo RC0402FR-07300RL or resistor of same quality
U1	BGA3012	-	-	NXP

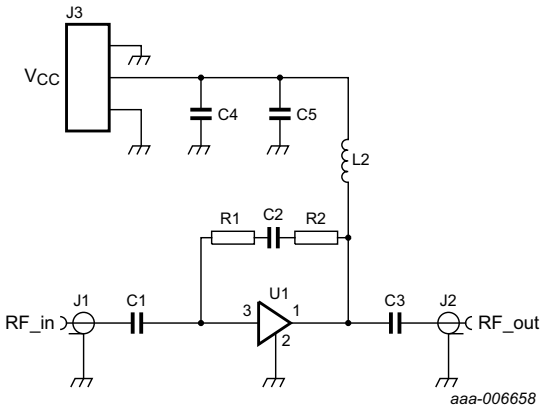
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8.2 Return application 5 MHz to 300 MHz

The BGA3012 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



Components are listed in Table 11.

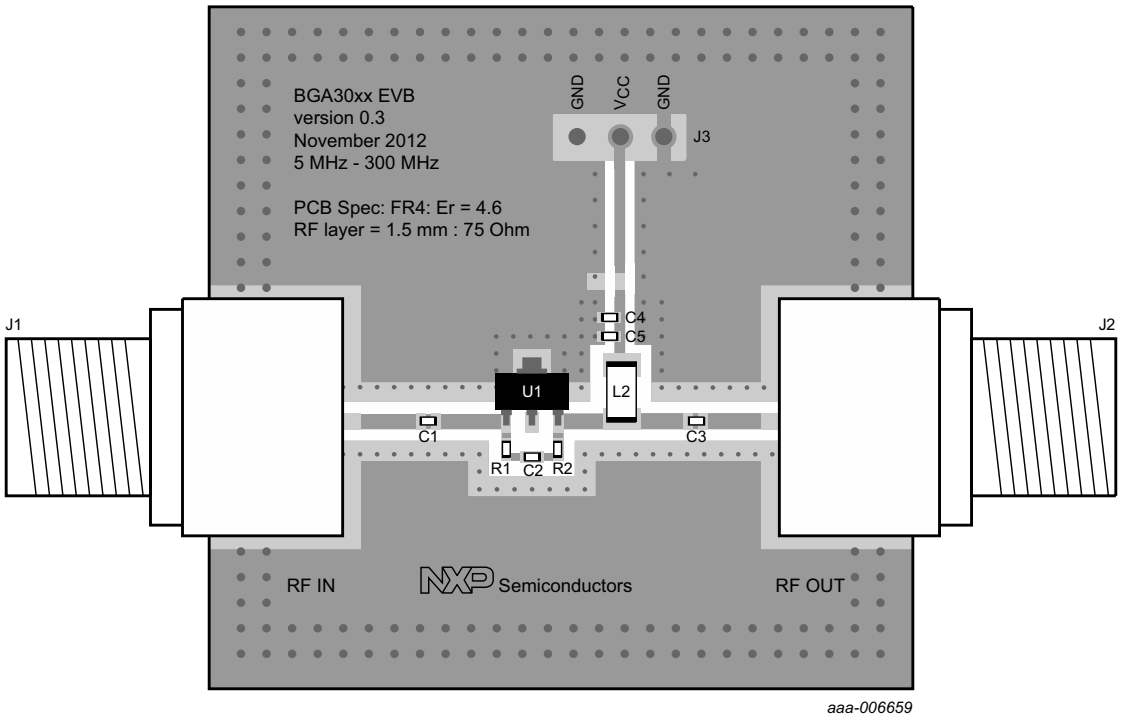
Fig 3. BGA3012 application circuit

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

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8.2.2 Return application circuit board layout



PCB (Printed-Circuit Board) material = FR4; thickness = 1.5 mm; size = 40 mm × 40 mm; ε_r = 4.6; thickness of copper layer = 35 μm;

Components are listed in Table 11.

Fig 4. BGA3012 application circuit board layout

Table 12. List of components

See Figure 1 and Figure 2.

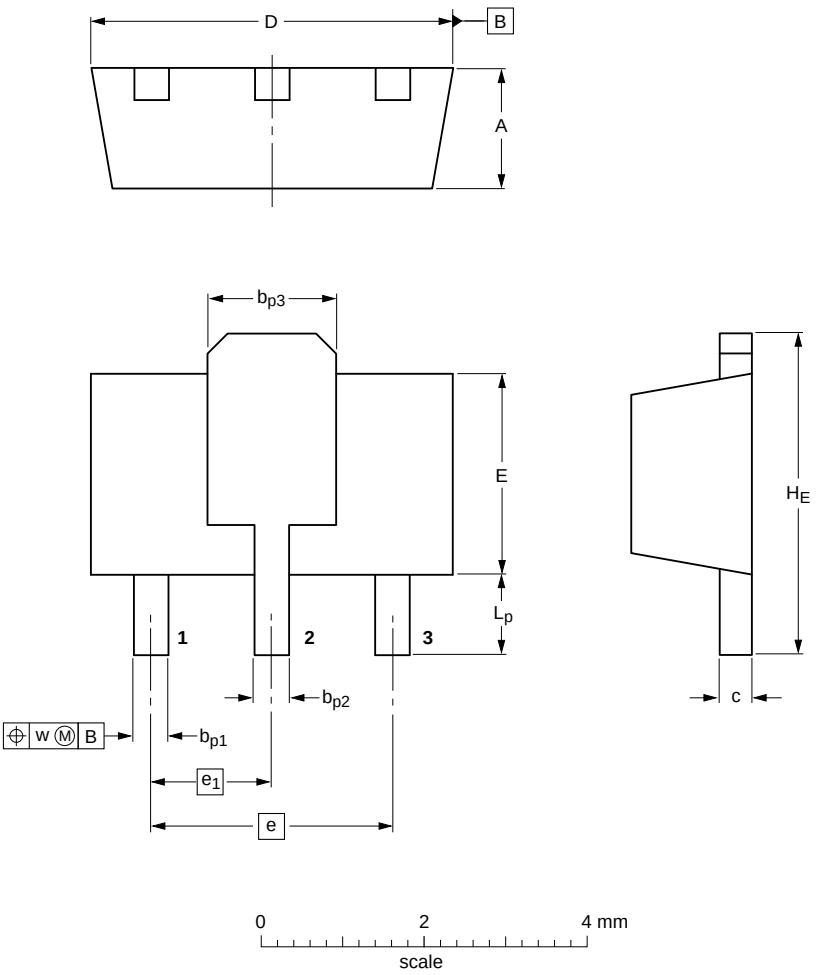
Component	Description	Value	Size	Remarks
C1, C2, C3, C4	capacitor	10 nF	SMD 0402	Murata GRM155R71E103KA01D or capacitor of same quality
C5	capacitor	100 pF	SMD 0402	Murata GRM1555C1H101JZ01D or capacitor of same quality
J1, J2	F-connector	75 Ω	-	Bomar 861V509ER6 or F-connector of same quality
J3	header 3-way	-	-	Molex 90121-0763 or header of the same quality
L2	inductor	22 μH	SMD 1206	Murata LQH31CN220K03L or inductor of same quality
R1	resistor	100 Ω	SMD 0402	Yageo RC0402FR-07100RL or resistor of same quality
R2	resistor	300 Ω	SMD 0402	Yageo RC0402FR-07300RL or resistor of same quality
U1	BGA3012	-	-	NXP

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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_{p1}	b_{p2}	b_{p3}	c	D	E	e	e_1	H_E	L_p	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)

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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
BGA3012 v.3	20130926	Product data sheet	-	BGA3012 v.2
Modifications:	• Table 3 on page 2: Evaluation boards have been added.			
BGA3012 v.2	20130415	Product data sheet	-	BGA3012 v.1
BGA3012 v.1	20130319	Preliminary data sheet	-	-

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12. Legal information

12.1 Data sheet status

Document status[1][2]	Product status[3]	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".

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