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

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





# BGA3021

1.2 GHz 16 dB gain CATV amplifier

Rev. 2 — 25 February 2015

Product data sheet

## 1. Product profile

### 1.1 General description

The BGA3021 MMIC is a dual wideband amplifier with internal biasing. It is a Medium Power Amplifier (MPA), specifically designed as an output stage for high linearity CATV optical mini- and mid-nodes, operating over a frequency range of 40 MHz to 1200 MHz.

The MPA is housed in a lead free 8-pin HSO8 package.

### 1.2 Features and benefits

- Internally biased
- High gain output 1dB compression point of 30 dBm
- Frequency range of 40 MHz to 1200 MHz
- 75  $\Omega$  input and output impedance
- High linearity with an IP3<sub>O</sub> of 47 dBm and an IP2<sub>O</sub> of 85 dBm
- I<sub>CC(tot)</sub> can be controlled between 175 mA and 350 mA
- Operating from 5 V to 8 V supply
- Integrated feedback

### 1.3 Applications

- CATV infrastructure network medium power output stage in optical nodes (FTTx), distribution amplifiers, trunk amplifiers and line extenders

### 1.4 Quick reference data

**Table 1. Quick reference data**

$T_{amb} = 25\text{ }^{\circ}\text{C}$ ; typical values at  $V_{CC} = 8\text{ V}$ ;  $Z_S = Z_L = 75\ \Omega$ ; input and output connected with 1:1 balun,  $V_{I(CTRL)} = 3.3\text{ V}$  or open (maximum total supply current);  $40\text{ MHz} \leq f_1 \leq 1200\text{ MHz}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	RF input AC coupled	7.6	8.0	8.4	V
$I_{CC(tot)}$	total supply current		175	350	-	mA
$T_{amb}$	ambient temperature		-40	-	+85	$^{\circ}\text{C}$
$P_{L(1dB)}$	output power at 1 dB gain compression		-	30	-	dBm
IP3 <sub>O</sub>	output third-order intercept point		[1]	47	-	dBm
IP2 <sub>O</sub>	output second-order intercept point		[2]	85	-	dBm

[1] Fundamental frequency  $f_1 = 500\text{ MHz}$ , fundamental frequency  $f_2 = 501\text{ MHz}$ . The intermodulation product (IM3) is measured at  $2 \times f_1 - f_2 = 499\text{ MHz}$ . The output power of the fundamental frequencies is 10 dBm per frequency.

[2] Fundamental frequency  $f_1 = 240\text{ MHz}$ , fundamental frequency  $f_2 = 260\text{ MHz}$ . The intermodulation product (IM2) is measured at  $f_1 + f_2 = 500\text{ MHz}$ . The output power of the fundamental frequencies is 10 dBm per frequency.



## 2. Pinning information

### 2.1 Pinning

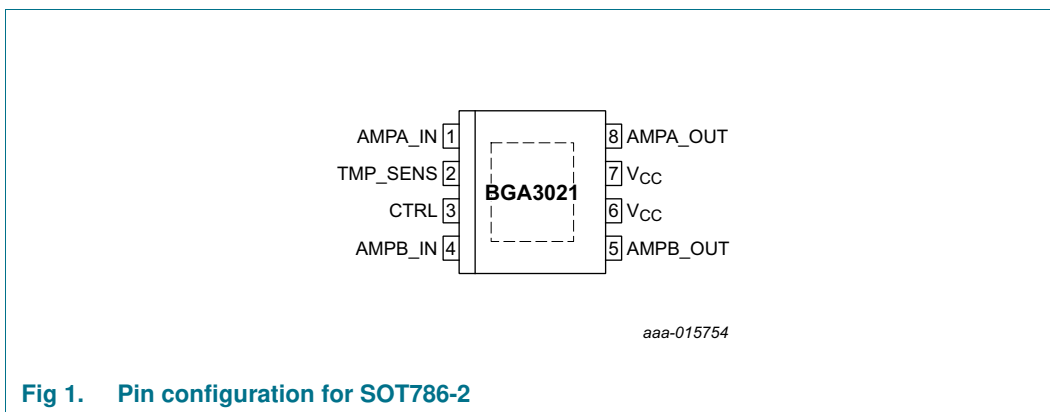


Fig 1. Pin configuration for SOT786-2

### 2.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
AMPA_IN	1	input amplifier A
TMP_SENS	2	temperature sense
CTRL	3	total supply current control
AMPB_IN	4	input amplifier B
AMPB_OUT	5	output amplifier B <a href="#">[1]</a>
V <sub>CC</sub>	6	supply <a href="#">[1]</a>
V <sub>CC</sub>	7	supply <a href="#">[1]</a>
AMPA_OUT	8	output amplifier A <a href="#">[1]</a>
GND	exposed die pad <a href="#">[2]</a>	ground

[1] See [Figure 2](#) for correct connection.

[2] The center metal base of the HSO8 also functions as heatsink for the power amplifier.

## 3. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
BGA3021	HSO8	plastic thermal enhanced small outline package; 8 leads; body width 3.9 mm; exposed die pad	SOT786-2

## 4. Limiting values

**Table 4. 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	+12	V
$V_{I(CTRL)}$	input voltage on pin CTRL		-0.6	+8	V
$V_{I(TMP\_SENS)}$	input voltage on pin TMP_SENS		-0.6	+8	V
$P_i$	input power	single tone; on balun <a href="#">[1]</a>	-	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	500	-	V

[1]  $P_i = 17$  dBm on AMPA\_IN (pin 1) and AMPB\_IN (pin 4).

## 5. Thermal characteristics

**Table 5. Thermal characteristics**

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	<a href="#">[1]</a> <a href="#">[2]</a>	15	K/W

[1] Case is ground solder pad.

[2] Thermal resistance measured using infrared measurement technique, device mounted on application board and placed in still air.

## 6. Characteristics

**Table 6. Characteristics at  $V_{CC} = 8\text{ V}$ ;  $I_{CC} = 350\text{ mA}$**

$T_{amb} = 25\text{ }^\circ\text{C}$ ; typical values at  $V_{CC} = 8\text{ V}$ ;  $Z_S = Z_L = 75\ \Omega$ ; input and output connected with 1:1 balun,  $V_{I(CTRL)} = 3.3\text{ V}$  or open (maximum total supply current);  $40\text{ MHz} \leq f_1 \leq 1200\text{ MHz}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	RF input AC coupled	7.6	8.0	8.4	V
$I_{CC(tot)}$	total supply current		-	350	-	mA
$ S_{21} ^2$	insertion power gain	$f = 40\text{ MHz}$	-	16.4	-	dB
$SL_{sl}$	slope straight line		-	-1.7	-	dB
FL	flatness of frequency response	[1]	-	0.15	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression		-	29	-	dBm
$IP3_O$	output third-order intercept point	[2]	-	47	-	dBm
$IP2_O$	output second-order intercept point	[3]	-	85	-	dBm
CTB	composite triple beat	$V_O = 43\text{ dBmV}$	[4]	-	-65	dBc
CSO	composite second-order distortion	$V_O = 43\text{ dBmV}$	[4]	-	-75	dBc
NF	noise figure	$f = 500\text{ MHz}$	-	5.5	-	dB
$RL_{in}$	input return loss	$f = 40\text{ MHz to }80\text{ MHz}$	-	-17	-	dB
		$f = 80\text{ MHz to }160\text{ MHz}$	-	-20	-	dB
		$f = 160\text{ MHz to }320\text{ MHz}$	-	-20	-	dB
		$f = 320\text{ MHz to }640\text{ MHz}$	-	-20	-	dB
		$f = 640\text{ MHz to }1000\text{ MHz}$	-	-20	-	dB
		$f = 1000\text{ MHz to }1200\text{ MHz}$	-	-16	-	dB
$RL_{out}$	output return loss	$f = 40\text{ MHz to }80\text{ MHz}$	-	-20	-	dB
		$f = 80\text{ MHz to }160\text{ MHz}$	-	-20	-	dB
		$f = 160\text{ MHz to }320\text{ MHz}$	-	-18	-	dB
		$f = 320\text{ MHz to }640\text{ MHz}$	-	-18	-	dB
		$f = 640\text{ MHz to }1000\text{ MHz}$	-	-18	-	dB
		$f = 1000\text{ MHz to }1200\text{ MHz}$	-	-15	-	dB

- [1] Flatness is defined as peak deviation to straight line.
- [2] Fundamental frequency  $f_1 = 500\text{ MHz}$ , fundamental frequency  $f_2 = 501\text{ MHz}$ . The intermodulation product (IM3) is measured at  $2 \times f_1 - f_2 = 499\text{ MHz}$ . The output power of the fundamental frequencies is 10 dBm per frequency.
- [3] Fundamental frequency  $f_1 = 240\text{ MHz}$ , fundamental frequency  $f_2 = 260\text{ MHz}$ . The intermodulation product (IM2) is measured at  $f_1 + f_2 = 500\text{ MHz}$ . The output power of the fundamental frequencies is 10 dBm per frequency.
- [4] Measured with 79 NTSC channels.

**Table 7. Characteristics at  $V_{CC} = 8\text{ V}$ ;  $I_{CC} = 175\text{ mA}$** 

$T_{amb} = 25\text{ }^{\circ}\text{C}$ ; typical values at  $V_{CC} = 8\text{ V}$ ;  $Z_S = Z_L = 75\ \Omega$ ; input and output connected with 1:1 balun,  $V_{I(CTRL)} = 0\text{ V}$  (minimum total supply current);  $40\text{ MHz} \leq f_1 \leq 1200\text{ MHz}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	RF input AC coupled	7.6	8.0	8.4	V
$I_{CC(tot)}$	total supply current		-	175	-	mA
$ S_{21} ^2$	insertion power gain	$f = 40\text{ MHz}$	-	16.2	-	dB
$SL_{sl}$	slope straight line		-	-1.9	-	dB
FL	flatness of frequency response		[1]	0.25	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression		-	26	-	dBm
$IP_{3O}$	output third-order intercept point		[2]	38	-	dBm
$IP_{2O}$	output second-order intercept point		[3]	68	-	dBm
CTB	composite triple beat	$V_O = 35\text{ dBmV}$	[4]	-66	-	dBc
CSO	composite second-order distortion	$V_O = 35\text{ dBmV}$	[4]	-75	-	dBc
NF	noise figure	$f = 500\text{ MHz}$	-	4.1	-	dB
$RL_{in}$	input return loss	$f = 40\text{ MHz to }80\text{ MHz}$	-	-19	-	dB
		$f = 80\text{ MHz to }160\text{ MHz}$	-	-21	-	dB
		$f = 160\text{ MHz to }320\text{ MHz}$	-	-20	-	dB
		$f = 320\text{ MHz to }640\text{ MHz}$	-	-20	-	dB
		$f = 640\text{ MHz to }1000\text{ MHz}$	-	-20	-	dB
		$f = 1000\text{ MHz to }1200\text{ MHz}$	-	-13	-	dB
$RL_{out}$	output return loss	$f = 40\text{ MHz to }80\text{ MHz}$	-	-23	-	dB
		$f = 80\text{ MHz to }160\text{ MHz}$	-	-22	-	dB
		$f = 160\text{ MHz to }320\text{ MHz}$	-	-18	-	dB
		$f = 320\text{ MHz to }640\text{ MHz}$	-	-18	-	dB
		$f = 640\text{ MHz to }1000\text{ MHz}$	-	-18	-	dB
		$f = 1000\text{ MHz to }1200\text{ MHz}$	-	-14	-	dB

[1] Flatness is defined as peak deviation to straight line.

[2] Fundamental frequency  $f_1 = 500\text{ MHz}$ , fundamental frequency  $f_2 = 501\text{ MHz}$ . The intermodulation product (IM3) is measured at  $2 \times f_1 - f_2 = 499\text{ MHz}$ . The output power of the fundamental frequencies is 10 dBm per frequency.

[3] Fundamental frequency  $f_1 = 240\text{ MHz}$ , fundamental frequency  $f_2 = 260\text{ MHz}$ . The intermodulation product (IM2) is measured at  $f_1 + f_2 = 500\text{ MHz}$ . The output power of the fundamental frequencies is 10 dBm per frequency.

[4] Measured with 79 NTSC channels.

**Table 8. Characteristics at  $V_{CC} = 5\text{ V}$ ;  $I_{CC} = 165\text{ mA}$**

$T_{amb} = 25\text{ }^\circ\text{C}$ ; typical values at  $V_{CC} = 5\text{ V}$ ;  $Z_S = Z_L = 75\text{ }\Omega$ ; input and output connected with 1:1 balun,  $V_{I(CTRL)} = 0\text{ V}$  (minimum total supply current);  $40\text{ MHz} \leq f_1 \leq 1200\text{ MHz}$  unless otherwise specified.

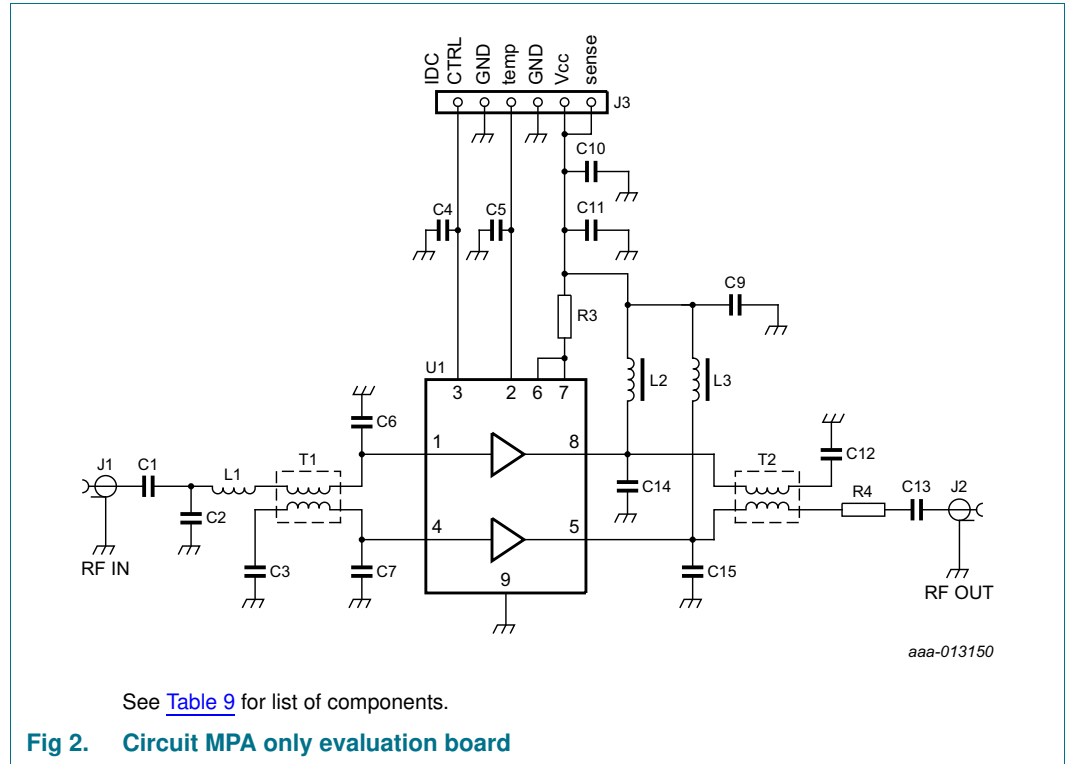
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	RF input AC coupled	4.75	5.00	5.25	V
$I_{CC(tot)}$	total supply current		-	165	-	mA
$ S_{21} ^2$	insertion power gain	$f = 40\text{ MHz}$	-	16.3	-	dB
$SL_{sl}$	slope straight line		-	-1.9	-	dB
FL	flatness of frequency response		[1]	0.2	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression		-	23	-	dBm
$IP3_O$	output third-order intercept point		[2]	38	-	dBm
$IP2_O$	output second-order intercept point		[3]	69	-	dBm
CTB	composite triple beat	$V_O = 35\text{ dBmV}$	[4]	-66	-	dBc
CSO	composite second-order distortion	$V_O = 35\text{ dBmV}$	[4]	-75	-	dBc
NF	noise figure	$f = 500\text{ MHz}$	-	4.1	-	dB
$RL_{in}$	input return loss	$f = 40\text{ MHz to }80\text{ MHz}$	-	-19	-	dB
		$f = 80\text{ MHz to }160\text{ MHz}$	-	-21	-	dB
		$f = 160\text{ MHz to }320\text{ MHz}$	-	-20	-	dB
		$f = 320\text{ MHz to }640\text{ MHz}$	-	-20	-	dB
		$f = 640\text{ MHz to }1000\text{ MHz}$	-	-20	-	dB
		$f = 1000\text{ MHz to }1200\text{ MHz}$	-	-14	-	dB
$RL_{out}$	output return loss	$f = 40\text{ MHz to }80\text{ MHz}$	-	-22	-	dB
		$f = 80\text{ MHz to }160\text{ MHz}$	-	-21	-	dB
		$f = 160\text{ MHz to }320\text{ MHz}$	-	-18	-	dB
		$f = 320\text{ MHz to }640\text{ MHz}$	-	-18	-	dB
		$f = 640\text{ MHz to }1000\text{ MHz}$	-	-18	-	dB
		$f = 1000\text{ MHz to }1200\text{ MHz}$	-	-15	-	dB

- [1] Flatness is defined as peak deviation to straight line.
- [2] Fundamental frequency  $f_1 = 500\text{ MHz}$ , fundamental frequency  $f_2 = 501\text{ MHz}$ . The intermodulation product (IM3) is measured at  $2 \times f_1 - f_2 = 499\text{ MHz}$ . The output power of the fundamental frequencies is 10 dBm per frequency.
- [3] Fundamental frequency  $f_1 = 240\text{ MHz}$ , fundamental frequency  $f_2 = 260\text{ MHz}$ . The intermodulation product (IM2) is measured at  $f_1 + f_2 = 500\text{ MHz}$ . The output power of the fundamental frequencies is 10 dBm per frequency.
- [4] Measured with 79 NTSC channels.

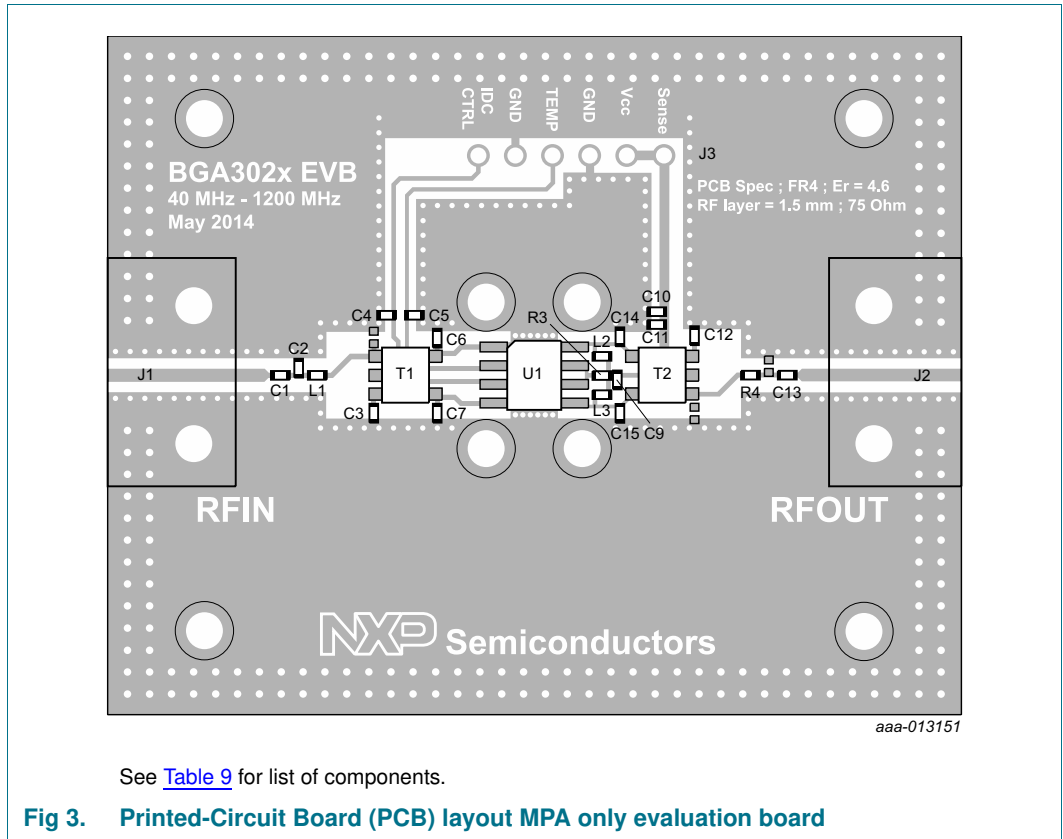
## 7. Application information

The BGA3021 can be used in other applications. Please contact your local sales representative for more information. Application notes are available on the NXP website.

### 7.1 Application board







See [Table 9](#) for list of components.

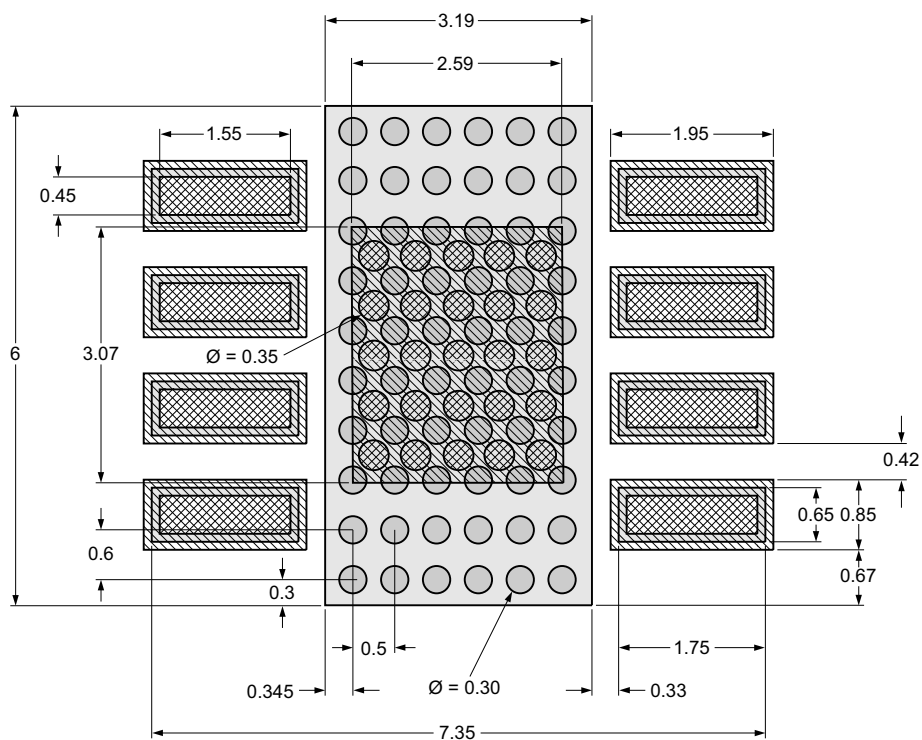
**Fig 3. Printed-Circuit Board (PCB) layout MPA only evaluation board**





**Table 9. List of components**

See [Figure 2](#) for schematics and [Figure 3](#) for Printed-Circuit Board (PCB).

Component	Description	Value	Remarks
C1, C3, C4, C5, C9, C11, C12, C13	capacitor	10 nF	Murata GRM155R71E103KA01D
C2	capacitor	0.47 pF	Phycomp 2238 869 14477
C10	capacitor	100 nF	Murata GRM155R61A104KA01D
C6, C7, C14, C15	capacitor	1 pF	Murata GRM1555C1H1R0CA01D
J1, J2	F-connector	75 Ω	Bomar 861V509ER6
J3	header 6-pin	-	Molex 22-29-2061
L1	SMD inductor	1.0 nH	Murata LQG15HS1N0S02D
L2, L3	choke	-	Murata BLM15HD182SN1D
R3	chip resistor	15 Ω	Yageo RC0402FR-0715RL
R4	chip resistor	0 Ω	Murata RC0402JR-070RL
T1	balun transformer	-	MACOM MABA-007159-000000
T2	balun transformer	-	MACOM MABA-010245-CT1160
U1	BGA3021	-	NXP

SOT768-2



-  solder mask top hole
-  solder paste
-  top metal
-  via hole

Dimensions in mm

aaa-013149

Fig 4. Recommended Printed-Circuit Board (PCB) footprint

8. Package outline

HSO8: plastic thermal enhanced small outline package;  
8 leads; body width 3.9 mm; exposed die pad

SOT786-2

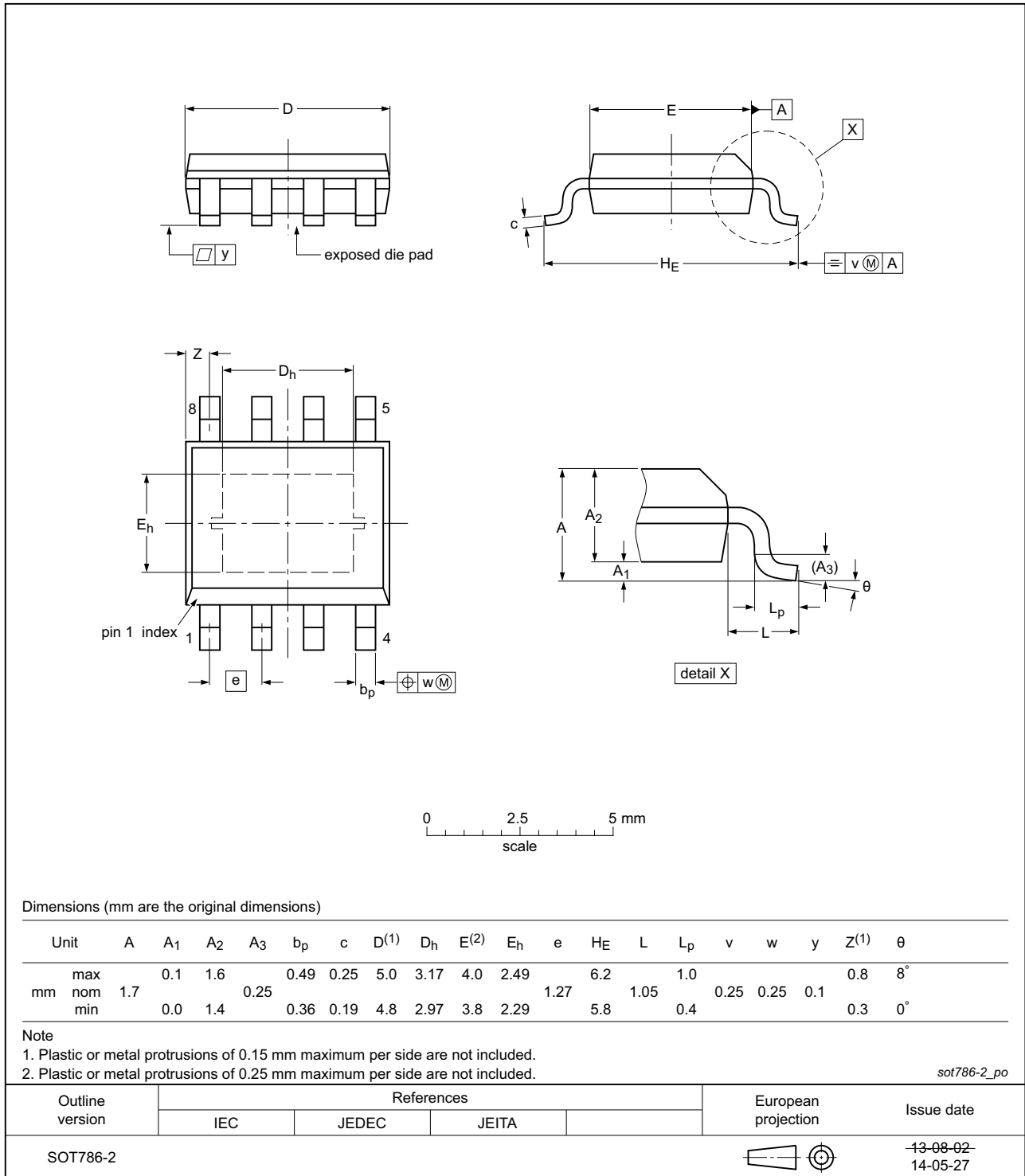


Fig 5. Package outline SOT786-2 (HSO8)

## 9. Abbreviations

Table 10. Abbreviations

Acronym	Description
CATV	Community Antenna TeleVision
FTTx	Fiber To The "x"
MMIC	Monolithic Microwave Integrated Circuit
MPA	Medium Power Amplifier
SMD	Surface Mounted Device

## 10. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BGA3021 v.2	20150225	Product data sheet	-	BGA3021 v.1
BGA3021 v.1	20141128	Preliminary data sheet	-	-

## 11. Legal information

### 11.1 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".

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For sales office addresses, please send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

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**Date of release: 25 February 2015**  
**Document identifier: BGA3021**