



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 Ω input and output impedance
- High linearity with an IP3_O of 47 dBm and an IP2_O of 85 dBm
- I_{CC(tot)} 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 _O | output third-order intercept point | | [1] | 47 | - | dBm |
| IP2 _O | 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

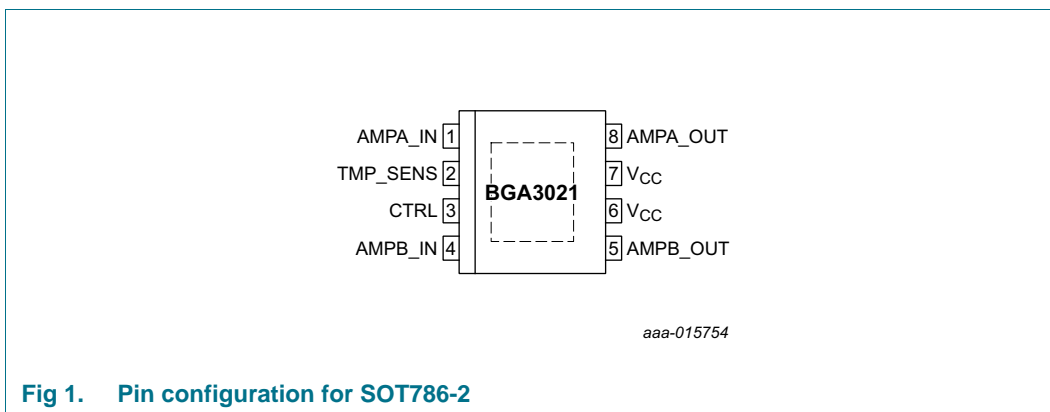


Fig 1. Pin configuration for SOT786-2

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 [1] |
| V _{CC} | 6 | supply [1] |
| V _{CC} | 7 | supply [1] |
| AMPA_OUT | 8 | output amplifier A [1] |
| GND | exposed die pad [2] | 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 [1] | - | 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 | [1] [2] | 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 $V_{CC} = 8\text{ V}$; $I_{CC} = 175\text{ mA}$

$T_{amb} = 25\text{ °C}$; typical values at $V_{CC} = 8\text{ V}$; $Z_S = Z_L = 75\text{ }\Omega$; 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 | 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 |
| IP_{3O} | output third-order intercept point | | [2] | 38 | - | dBm |
| IP_{2O} | 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.

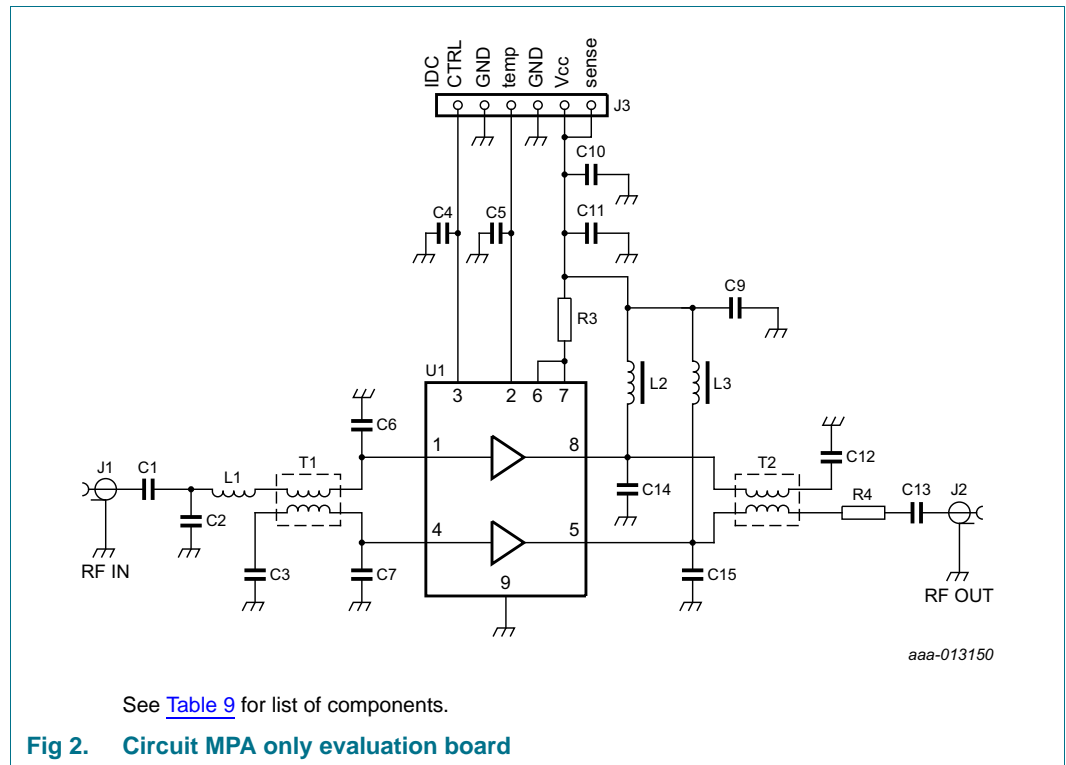
[3] Fundamental frequency $f_1 = 240\text{ MHz}$, fundamental frequency $f_2 = 260\text{ MHz}$. The intermodulation product (IM2) is measured at $f_1 + f_2 = 500\text{ MHz}$. The output power of the fundamental frequencies is 10 dBm per frequency.

[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



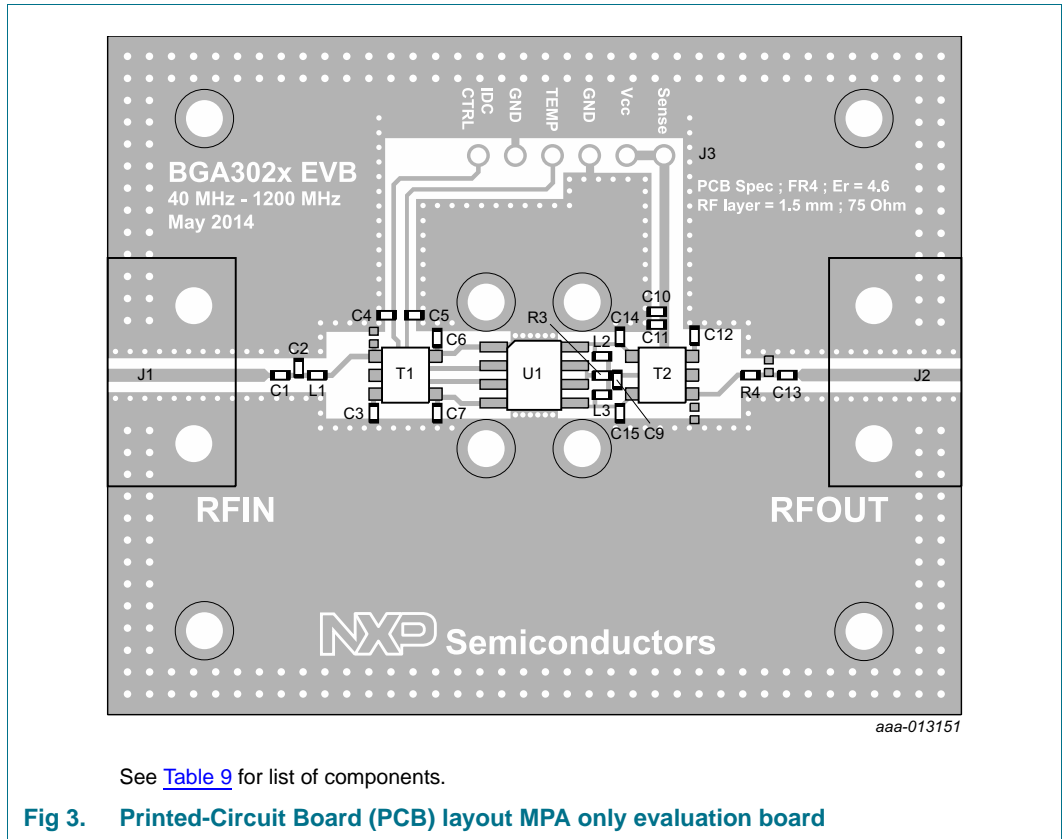
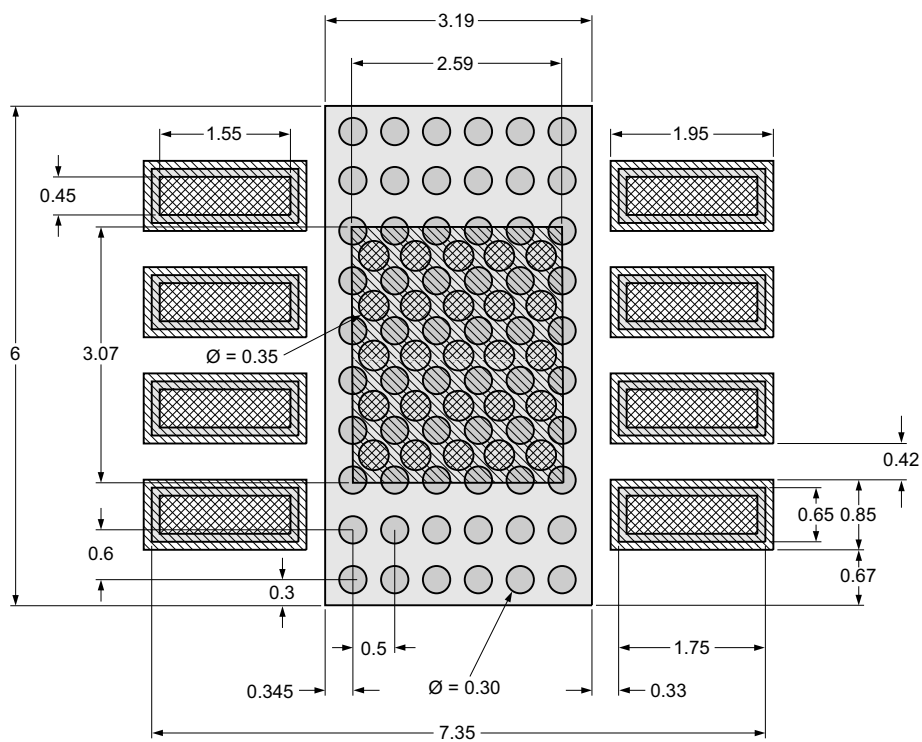


Table 9. List of components

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

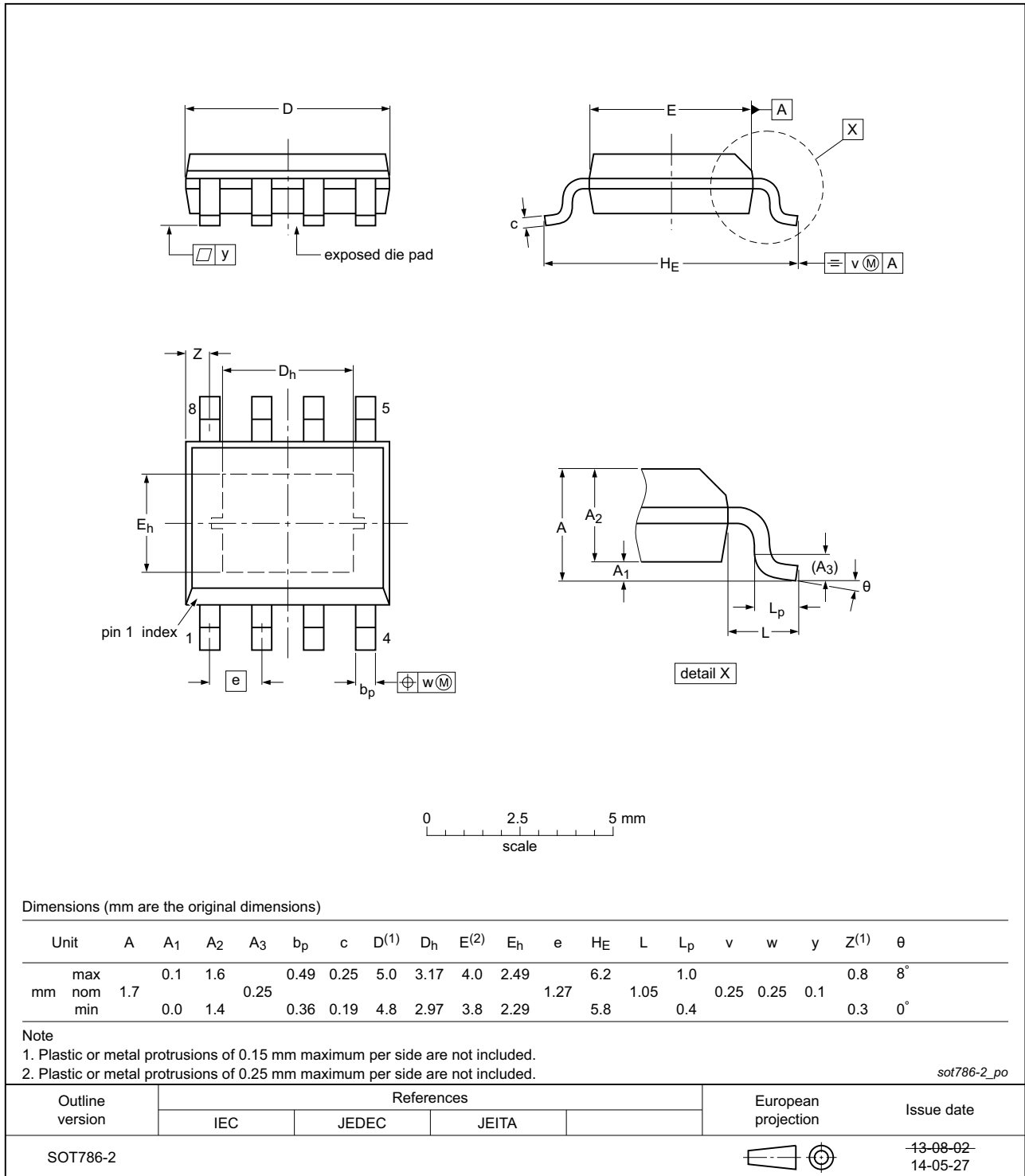


Fig 5. Package outline SOT786-2 (HSO8)

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

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