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BGA2817

MMIC wideband amplifier

Rev. 7 — 30 March 2017

Product data sheet

1. Product profile

1.1 General description

Silicon Monolithic Microwave Integrated Circuit (MMIC) wideband amplifier with internal matching circuit in a 6-pin SOT363 plastic SMD package.

1.2 Features and benefits

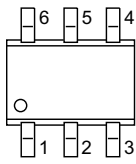
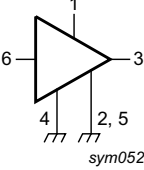
- Internally matched to $50\ \Omega$
- A gain of 24.4 dB at 2150 MHz
- Output power at 1 dB gain compression = 5 dBm at 2150 MHz
- Supply current = 20.0 mA at a supply voltage of 3.3 V
- Reverse isolation > 39 dB up to 2150 MHz
- Good linearity with low second order and third order products
- Noise figure = 3.9 dB at 950 MHz
- Unconditionally stable ($K > 1$)
- No output inductor required

1.3 Applications

- LNB IF amplifiers
- General purpose low noise wideband amplifier for frequencies between DC and 2.2 GHz

2. Pinning information

Table 1. Pinning

| Pin | Description | Simplified outline | Graphic symbol |
|------|-----------------|---|---|
| 1 | V _{CC} |  |  sym052 |
| 2, 5 | GND2 | | |
| 3 | RF_OUT | | |
| 4 | GND1 | | |
| 6 | RF_IN | | |

3. Ordering information

Table 2. Ordering information

| Type number | Package | | |
|-------------|---------|--|---------|
| | Name | Description | Version |
| BGA2817 | - | plastic surface-mounted package; 6 leads | SOT363 |

4. Marking

Table 3. Marking

| Type number | Marking code | Description |
|-------------|--------------|---------------------------|
| BGA2817 | LS* | * = - : made in Hong Kong |
| | | * = p : made in Hong Kong |
| | | * = W : made in China |
| | | * = t : made in Malaysia |

5. 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 | -0.5 | +5.0 | V |
| I_{CC} | supply current | | - | 55 | mA |
| P_{tot} | total power dissipation | $T_{sp} = 90\text{ °C}$ | - | 200 | mW |
| T_{stg} | storage temperature | | -40 | +125 | °C |
| T_j | junction temperature | | - | 125 | °C |
| P_{drive} | drive power | | - | 10 | dBm |

6. Thermal characteristics

Table 5. Thermal characteristics

| Symbol | Parameter | Conditions | Typ | Unit |
|----------------|--|---|-----|------|
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | $P_{tot} = 200\text{ mW}$; $T_{sp} = 90\text{ °C}$ | 300 | K/W |

7. Characteristics

Table 6. Characteristics

$V_{CC} = 3.3\text{ V}$; $Z_S = Z_L = 50\ \Omega$; $P_i = -40\text{ dBm}$; $T_{amb} = 25\text{ °C}$; measured on demo board; unless otherwise specified.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|----------|----------------|------------|------|------|------|------|
| V_{CC} | supply voltage | | 3.0 | 3.3 | 3.6 | V |
| I_{CC} | supply current | | 17.6 | 20.0 | 22.2 | mA |

Table 6. Characteristics ...continued

$V_{CC} = 3.3\text{ V}$; $Z_S = Z_L = 50\ \Omega$; $P_i = -40\text{ dBm}$; $T_{amb} = 25\text{ }^\circ\text{C}$; measured on demo board; unless otherwise specified.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------|---------------------------------------|---|------|------|------|------|
| G _p | power gain | f = 250 MHz | 23.6 | 24.2 | 24.8 | dB |
| | | f = 950 MHz | 23.5 | 24.3 | 25 | dB |
| | | f = 2150 MHz | 23 | 24.4 | 25.9 | dB |
| RL _{in} | input return loss | f = 250 MHz | 13 | 15 | - | dB |
| | | f = 950 MHz | 16 | 18 | - | dB |
| | | f = 2150 MHz | 13 | 20 | - | dB |
| RL _{out} | output return loss | f = 250 MHz | 12 | 17 | - | dB |
| | | f = 950 MHz | 16 | 17 | - | dB |
| | | f = 2150 MHz | 17 | 20 | - | dB |
| ISL | isolation | f = 250 MHz | 36 | 57 | - | dB |
| | | f = 950 MHz | 47 | 49 | - | dB |
| | | f = 2150 MHz | 37 | 39 | - | dB |
| NF | noise figure | f = 250 MHz | - | 3.9 | 4.4 | dB |
| | | f = 950 MHz | - | 3.9 | 4.3 | dB |
| | | f = 2150 MHz | - | 3.8 | 4.2 | dB |
| B _{-3dB} | -3 dB bandwidth | 3 dB below gain at 1 GHz | 3.3 | 3.5 | 3.7 | GHz |
| K | Rollett stability factor | f = 250 MHz | 10 | 21 | - | |
| | | f = 950 MHz | 7 | 9 | - | |
| | | f = 2150 MHz | 1.5 | 2.7 | - | |
| P _{L(sat)} | saturated output power | f = 250 MHz | 8 | 8 | - | dBm |
| | | f = 950 MHz | 5 | 7 | - | dBm |
| | | f = 2150 MHz | 5 | 6 | - | dBm |
| P _{L(1dB)} | output power at 1 dB gain compression | f = 250 MHz | 6 | 6 | - | dBm |
| | | f = 950 MHz | 5 | 6 | - | dBm |
| | | f = 2150 MHz | 4 | 5 | - | dBm |
| IP _{3I} | input third-order intercept point | P _{drive} = -40 dBm (for each tone) | | | | |
| | | f ₁ = 250 MHz; f ₂ = 251 MHz | -9 | -7 | - | dBm |
| | | f ₁ = 950 MHz; f ₂ = 951 MHz | -9 | -7 | - | dBm |
| | | f ₁ = 2150 MHz; f ₂ = 2151 MHz | -13 | -10 | - | dBm |
| IP _{3O} | output third-order intercept point | P _{drive} = -40 dBm (for each tone) | | | | |
| | | f ₁ = 250 MHz; f ₂ = 251 MHz | 16 | 18 | - | dBm |
| | | f ₁ = 950 MHz; f ₂ = 951 MHz | 16 | 18 | - | dBm |
| | | f ₁ = 2150 MHz; f ₂ = 2151 MHz | 12.5 | 15.5 | - | dBm |
| P _{L(2H)} | second harmonic output power | P _{drive} = -28 dBm | | | | |
| | | f _{1H} = 250 MHz; f _{2H} = 500 MHz | - | -53 | -51 | dBm |
| | | f _{1H} = 950 MHz; f _{2H} = 1900 MHz | - | -45 | -41 | dBm |
| ΔIM ₂ | second-order intermodulation distance | P _{drive} = -31 dBm (for each tone) | | | | |
| | | f ₁ = 250 MHz; f ₂ = 251 MHz | 34 | 36 | - | dBc |
| | | f ₁ = 950 MHz; f ₂ = 951 MHz | 33 | 39 | - | dBc |

8. Application information

Figure 1 shows a typical application circuit for the BGA2817 MMIC. The device is internally matched to 50 Ω, and therefore does not need any external matching. The value of the input and output DC blocking capacitors C2 and C3 should not be more than 100 pF for applications above 100 MHz. However, when the device is operated below 100 MHz, the capacitor value should be increased.

The location of the 470 pF supply decoupling capacitor (C_{dec}) can be precisely chosen for optimum performance.

The PCB top ground plane, connected to pins 2, 4 and 5 must be as close as possible to the MMIC, preferably also below the MMIC. When using via holes, use multiple via holes as close as possible to the MMIC.

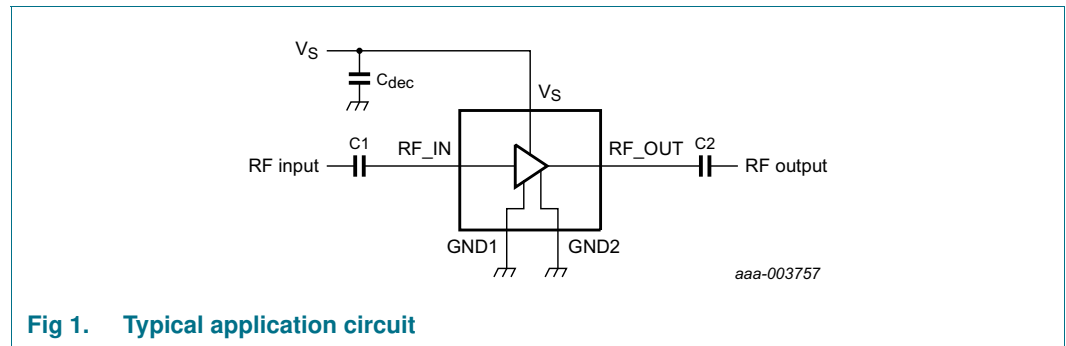


Fig 1. Typical application circuit

8.1 Application examples

The MMIC is very suitable as IF amplifier in e.g. LNB's. The excellent wideband characteristics make it an easy building block.

As second amplifier after an LNA, the MMIC offers an easy matching, low noise solution.

8.2 Tables

Table 7. Supply current over temperature and supply voltages
Typical values.

| Symbol | Parameter | Conditions | T _{amb} (°C) | | | Unit |
|-----------------|----------------|-------------------------|-----------------------|------|------|------|
| | | | -40 | +25 | +85 | |
| I _{CC} | supply current | V _{CC} = 3.0 V | 18.0 | 17.6 | 17.3 | mA |
| | | V _{CC} = 3.3 V | 20.4 | 20.0 | 19.6 | mA |
| | | V _{CC} = 3.6 V | 22.7 | 22.2 | 21.7 | mA |

Table 8. Second harmonic output power over temperature and supply voltages
Typical values.

| Symbol | Parameter | Conditions | T _{amb} (°C) | | | Unit |
|--------------------|------------------------------|---|-----------------------|-----|-----|------|
| | | | -40 | +25 | +85 | |
| P _{L(2H)} | second harmonic output power | f = 250 MHz; P _{drive} = -28 dBm | | | | |
| | | V _{CC} = 3.0 V | -38 | -44 | -52 | dBm |
| | | V _{CC} = 3.3 V | -45 | -53 | -60 | dBm |
| | | V _{CC} = 3.6 V | -56 | -59 | -53 | dBm |
| | | f = 950 MHz; P _{drive} = -28 dBm | | | | |
| | | V _{CC} = 3.0 V | -43 | -53 | -45 | dBm |
| | | V _{CC} = 3.3 V | -51 | -45 | -41 | dBm |
| | | V _{CC} = 3.6 V | -44 | -41 | -39 | dBm |

Table 9. Input power at 1 dB gain compression over temperature and supply voltages
Typical values.

| Symbol | Parameter | Conditions | T _{amb} (°C) | | | Unit |
|---------------------|--------------------------------------|-------------------------|-----------------------|-----|-----|------|
| | | | -40 | +25 | +85 | |
| P _{i(1dB)} | input power at 1 dB gain compression | f = 250 MHz | | | | |
| | | V _{CC} = 3.0 V | -19 | -18 | -18 | dBm |
| | | V _{CC} = 3.3 V | -17 | -17 | -17 | dBm |
| | | V _{CC} = 3.6 V | -16 | -16 | -16 | dBm |
| | | f = 950 MHz | | | | |
| | | V _{CC} = 3.0 V | -19 | -18 | -18 | dBm |
| | | V _{CC} = 3.3 V | -18 | -17 | -17 | dBm |
| | | V _{CC} = 3.6 V | -17 | -17 | -17 | dBm |
| | | f = 2150 MHz | | | | |
| | | V _{CC} = 3.0 V | -20 | -20 | -20 | dBm |
| | | V _{CC} = 3.3 V | -19 | -19 | -20 | dBm |
| | | V _{CC} = 3.6 V | -18 | -19 | -20 | dBm |

Table 10. Output power at 1 dB gain compression over temperature and supply voltages
Typical values.

| Symbol | Parameter | Conditions | T _{amb} (°C) | | | Unit |
|---------------------|---------------------------------------|-------------------------|-----------------------|-----|-----|------|
| | | | -40 | +25 | +85 | |
| P _{L(1dB)} | output power at 1 dB gain compression | f = 250 MHz | | | | |
| | | V _{CC} = 3.0 V | 4 | 5 | 5 | dBm |
| | | V _{CC} = 3.3 V | 6 | 6 | 6 | dBm |
| | | V _{CC} = 3.6 V | 8 | 8 | 7 | dBm |
| | | f = 950 MHz | | | | |
| | | V _{CC} = 3.0 V | 4 | 4 | 4 | dBm |
| | | V _{CC} = 3.3 V | 6 | 6 | 6 | dBm |
| | | V _{CC} = 3.6 V | 7 | 7 | 7 | dBm |
| | | f = 2150 MHz | | | | |
| | | V _{CC} = 3.0 V | 4 | 4 | 3 | dBm |
| | | V _{CC} = 3.3 V | 6 | 5 | 4 | dBm |
| | | V _{CC} = 3.6 V | 7 | 6 | 5 | dBm |

Table 11. Saturated output power over temperature and supply voltages
Typical values.

| Symbol | Parameter | Conditions | T _{amb} (°C) | | | Unit |
|---------------------|------------------------|-------------------------|-----------------------|-----|-----|------|
| | | | -40 | +25 | +85 | |
| P _{L(sat)} | saturated output power | f = 250 MHz | | | | |
| | | V _{CC} = 3.0 V | 6 | 6 | 7 | dBm |
| | | V _{CC} = 3.3 V | 8 | 8 | 8 | dBm |
| | | V _{CC} = 3.6 V | 9 | 9 | 9 | dBm |
| | | f = 950 MHz | | | | |
| | | V _{CC} = 3.0 V | 6 | 6 | 6 | dBm |
| | | V _{CC} = 3.3 V | 7 | 7 | 7 | dBm |
| | | V _{CC} = 3.6 V | 7 | 8 | 8 | dBm |
| | | f = 2150 MHz | | | | |
| | | V _{CC} = 3.0 V | 5 | 5 | 4 | dBm |
| | | V _{CC} = 3.3 V | 7 | 6 | 5 | dBm |
| | | V _{CC} = 3.6 V | 8 | 7 | 6 | dBm |

Table 12. Second-order intermodulation distance over temperature and supply voltages
Typical values.

| Symbol | Parameter | Conditions | T _{amb} (°C) | | | Unit | |
|--------|---------------------------------------|--|-------------------------|-----|-----|------|-----|
| | | | -40 | +25 | +85 | | |
| ΔIM2 | second-order intermodulation distance | f ₁ = 250 MHz; f ₂ = 251 MHz; P _{drive} = -31 dBm | | | | | |
| | | | V _{CC} = 3.0 V | 28 | 32 | 36 | dBc |
| | | | V _{CC} = 3.3 V | 33 | 36 | 40 | dBc |
| | | V _{CC} = 3.6 V | 38 | 40 | 44 | dBc | |
| | | f ₁ = 950 MHz; f ₂ = 951 MHz; P _{drive} = -31 dBm | | | | | |
| | | | V _{CC} = 3.0 V | 29 | 34 | 40 | dBc |
| | | | V _{CC} = 3.3 V | 35 | 39 | 43 | dBc |
| | | V _{CC} = 3.6 V | 40 | 44 | 42 | dBc | |

Table 13. Output third-order intercept point over temperature and supply voltages
Typical values.

| Symbol | Parameter | Conditions | T _{amb} (°C) | | | Unit | |
|------------------|------------------------------------|--|-------------------------|------|------|------|-----|
| | | | -40 | +25 | +85 | | |
| IP3 _O | output third-order intercept point | f ₁ = 250 MHz; f ₂ = 251 MHz; P _{drive} = -40 dBm | | | | | |
| | | | V _{CC} = 3.0 V | 14 | 15 | 16 | dBm |
| | | | V _{CC} = 3.3 V | 18 | 18 | 17 | dBm |
| | | V _{CC} = 3.6 V | 19 | 19 | 19 | dBm | |
| | | f ₁ = 950 MHz; f ₂ = 951 MHz; P _{drive} = -40 dBm | | | | | |
| | | | V _{CC} = 3.0 V | 15 | 16 | 15 | dBm |
| | | | V _{CC} = 3.3 V | 18 | 18 | 17 | dBm |
| | | V _{CC} = 3.6 V | 20 | 20 | 18 | dBm | |
| | | f ₁ = 2150 MHz; f ₂ = 2151 MHz; P _{drive} = -40 dBm | | | | | |
| | | | V _{CC} = 3.0 V | 15.5 | 14.5 | 12.5 | dBm |
| | | | V _{CC} = 3.3 V | 17.5 | 15.5 | 13.5 | dBm |
| | | V _{CC} = 3.6 V | 18.5 | 16.5 | 13.5 | dBm | |

Table 14. -3 dB bandwidth over temperature and supply voltages
Typical values.

| Symbol | Parameter | Conditions | T _{amb} (°C) | | | Unit |
|-------------------|-----------------|-------------------------|-----------------------|------|------|------|
| | | | -40 | +25 | +85 | |
| B _{-3dB} | -3 dB bandwidth | V _{CC} = 3.0 V | 3.6 | 3.49 | 3.34 | GHz |
| | | V _{CC} = 3.3 V | 3.59 | 3.47 | 3.32 | GHz |
| | | V _{CC} = 3.6 V | 3.58 | 3.46 | 3.31 | GHz |

9. Test information

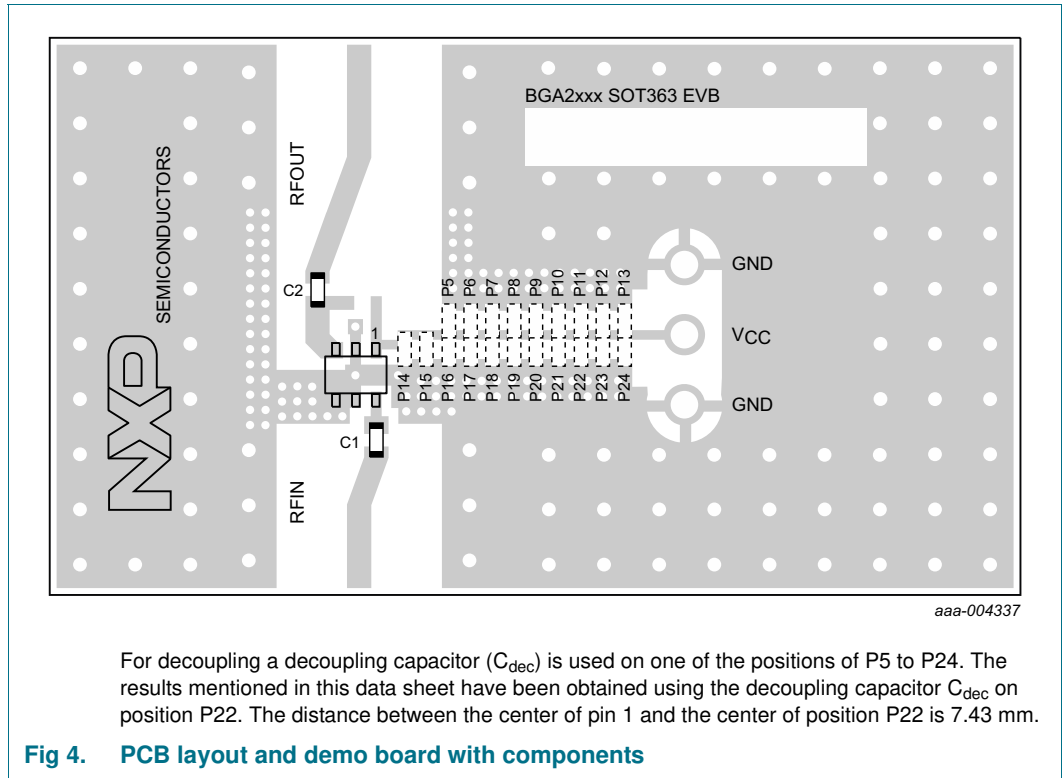


Table 15. List of components used for the typical application

| Component | Description | Value | Dimensions | Remarks |
|--------------------------|--|--------|------------|-----------------------------|
| C1, C2 | multilayer ceramic chip capacitor | 470 pF | 0603 | X7R RF coupling capacitor |
| P5 to P24 ^[1] | position for multilayer ceramic chip capacitor C_{dec} | 470 pF | 0603 | X7R RF decoupling capacitor |
| IC1 | BGA2817 MMIC | - | SOT363 | |

[1] For decoupling a decoupling capacitor (C_{dec}) is used on one of the positions of P5 to P24. The results mentioned in this data sheet have been obtained using the decoupling capacitor C_{dec} on position P22.

10. Package outline

Plastic surface-mounted package; 6 leads

SOT363

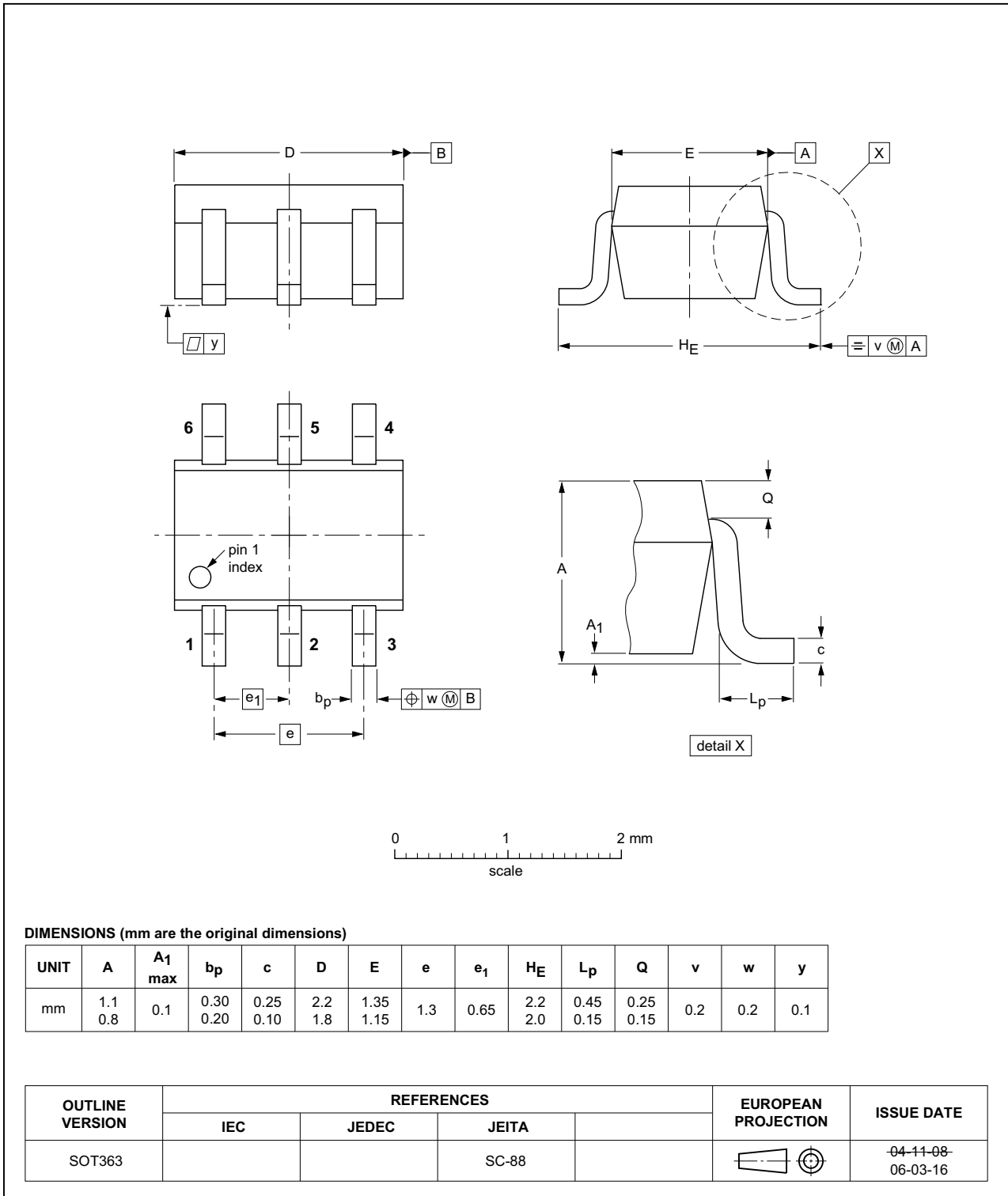


Fig 5. Package outline SOT363

11. Abbreviations

Table 16. Abbreviations

| Acronym | Description |
|---------|---------------------------|
| IF | Intermediate Frequency |
| LNA | Low-Noise Amplifier |
| LNB | Low-Noise Block converter |
| PCB | Printed-Circuit Board |
| SMD | Surface Mounted Device |

12. Revision history

Table 17. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|---|--------------------|---------------|-------------|
| BGA2817 v.7 | 20170330 | Product data sheet | - | BGA2817 v.6 |
| Modifications: | <ul style="list-style-type: none"> Table 6 on page 2: the maximum value for $f_{1H} = 950$ MHz; $f_{2H} = 1900$ MHz has been changed to -41 dBm Table 6 on page 2: the minimum value for $\Delta IM2$ ($f_1 = 950$ MHz; $f_2 = 951$ MHz) has been changed to 33 dBc Table 6 on page 2: the maximum value removed from RL_{in}, RL_{out}, ISL, K, $P_{L(sat)}$, $P_{L(1dB)}$, $IP3_I$, $IP3_O$, $\Delta IM2$ Table 6 on page 2: the minimum value removed from NF, $P_{L(2H)}$ | | | |
| BGA2817 v.6 | 20161003 | Product data sheet | - | BGA2817 v.5 |
| Modifications: | <ul style="list-style-type: none"> Table 6 on page 2: the min/max value for $P_{L(2H)}$ ($f_{1H} = 950$ MHz; $f_{2H} = 1900$ MHz) removed Table 6 on page 2: the min/max value for $\Delta IM2$ ($f_1 = 950$ MHz; $f_2 = 951$ MHz) removed | | | |
| BGA2817 v.5 | 20150330 | Product data sheet | - | BGA2817 v.4 |
| Modifications: | <ul style="list-style-type: none"> Table 4 on page 2: the maximum value for P_{drive} has been changed to 10 dBm | | | |
| BGA2817 v.4 | 20141203 | Product data sheet | - | BGA2817 v.3 |
| BGA2817 v.3 | 20130826 | Product data sheet | - | BGA2817 v.2 |
| BGA2817 v.2 | 20120419 | Product data sheet | - | BGA2817 v.1 |
| BGA2817 v.1 | 20111117 | Product data sheet | - | - |

13. Legal information

13.1 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.

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

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14. Contact information

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Date of release: 30 March 2017

Document identifier: BGA2817