

# BGU7003W

## Wideband silicon germanium low-noise amplifier MMIC

Rev. 2 — 11 April 2013

Product data sheet

## 1. Product profile

### 1.1 General description

The BGU7003W MMIC is a wideband amplifier in SiGe:C technology for high speed, low-noise applications in a plastic, leadless 6 pin, extremely thin small outline SOT886 package.

**Table 1. Application information**

$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $V_{CC} = 2.85\text{ V}$ ;  $I_{CC(tot)} = 3.2\text{ mA}$  [1];  $V_{ENABLE} \geq 0.7\text{ V}$ ;  $f = 100\text{ MHz}$ ;  $Z_S = Z_L = 50\text{ }\Omega$  unless otherwise specified. All measurements are done with the SMA-connectors as reference plane.

| Application       | NF<br>(dB) | $ S_{21} ^2$<br>(dB) | RL <sub>in</sub><br>(dB) | RL <sub>out</sub><br>(dB) | P <sub>i(1dB)</sub><br>(dBm) | P <sub>L(1dB)</sub><br>(dBm) | IP3 <sub>i</sub><br>(dBm) | IP3 <sub>o</sub><br>(dBm) |
|-------------------|------------|----------------------|--------------------------|---------------------------|------------------------------|------------------------------|---------------------------|---------------------------|
| high-ohmic FM LNA | 1.2        | 13                   | 0.5                      | 16.5                      | -23                          | -11                          | -15 [2]                   | -2 [2]                    |

[1]  $I_{CC(tot)} = I_{CC} + I_{RF\_OUT} + I_{R\_BIAS}$ .

[2] The third order intercept point is measured at -30 dBm per tone at RF\_IN ( $f_1 = 100\text{ MHz}$ ;  $f_2 = 100.2\text{ MHz}$ )

### 1.2 Features and benefits

- Low noise high gain microwave MMIC
- Applicable between 40 MHz and 6 GHz
- Integrated temperature stabilized bias for easy design
- Bias current configurable with external resistor
- 110 GHz transit frequency - SiGe:C technology
- Power-down mode current consumption < 1  $\mu\text{A}$
- ESD protection > 1 kV Human Body Model (HBM) on all pins

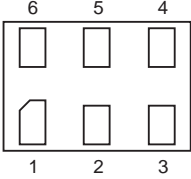
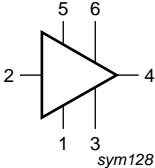
### 1.3 Applications

- GPS
- FM LNA
- Low-noise amplifiers for microwave communications systems
- WLAN and CDMA applications
- Analog / digital cordless applications



## 2. Pinning information

Table 2. Pinning

| Pin | Description     | Simplified outline  | Graphic symbol  |
|-----|-----------------|---|---|
| 1   | R_BIAS          |  |  |
| 2   | RF_IN           |   |   |
| 3   | GND             |   |   |
| 4   | RF_OUT          |   |   |
| 5   | ENABLE          |   |   |
| 6   | V <sub>CC</sub> |   |   |

## 3. Ordering information

Table 3. Ordering information

| Type number | Package |   |         |
|-------------|---------|---|---------|
|             | Name    | Description   | Version |
| BGU7003W    | XSON6   | plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm | SOT886  |

## 4. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| BGU7003W    | UW           |

## 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                 | -   | 3.0  | V    |
| I <sub>CC(tot)</sub> | total supply current    | configurable with external resistor | -   | 25   | mA   |
| P <sub>tot</sub>     | total power dissipation | T <sub>sp</sub> ≤ 103 °C            | [1] | 70   | mW   |
| T <sub>stg</sub>     | storage temperature     |                                     | -65 | +150 | °C   |
| T <sub>j</sub>       | junction temperature    |                                     | -   | 150  | °C   |

[1] T<sub>sp</sub> is the temperature at the solder point of the ground lead.

## 6. Thermal characteristics

Table 6. Thermal characteristics

| Symbol                | Parameter  | Conditions | Typ | Unit |
|-----------------------|--|------------|-----|------|
| R <sub>th(j-sp)</sub> | thermal resistance from junction to solder point |            | 235 | K/W  |

## 7. Characteristics

**Table 7. Characteristics**

$T_{amb} = 25\text{ °C}$ ;  $V_{CC} = 2.5\text{ V}$ ;  $I_{CC(tot)} = 5.0\text{ mA}$ ;  $V_{ENABLE} \geq 0.7\text{ V}$  unless otherwise specified. All measurements done on characterization board without matching, de-embedded up to the pins.

| Symbol        | Parameter              | Conditions                                      | Min                  | Typ  | Max   | Unit |    |
|---------------|------------------------|---|----------------------|------|-------|------|----|
| $V_{CC}$      | supply voltage         | RF input AC coupled                             | 2.2                  | -    | 2.85  | V    |    |
| $I_{CC(tot)}$ | total supply current   | configurable with external resistor             | [1] 3                | -    | 15    | mA   |    |
|               |                        | $V_{ENABLE} \leq 0.4\text{ V}$                  | [1] -                | -    | 0.001 | mA   |    |
| $T_{amb}$     | ambient temperature    |   | -40                  | +25  | +85   | °C   |    |
| $ S_{21} ^2$  | insertion power gain   | $T_{amb} = 25\text{ °C}$                        |                      |      |       |      |    |
|               |                        | $f = 100\text{ MHz}$                            | [2] 21.0             | 22.5 | -     | dB   |    |
|               |                        | $f = 900\text{ MHz}$                            | [2] 18.5             | 20.0 | -     | dB   |    |
|               |                        | $f = 1.575\text{ GHz}$                          | 16.0                 | 17.5 | -     | dB   |    |
|               |                        | $f = 2.4\text{ GHz}$                            | [2] 14.0             | 15.2 | -     | dB   |    |
|               |                        | $f = 5.8\text{ GHz}$                            | [2] 10.0             | 11.4 | -     | dB   |    |
|               |                        | $-40\text{ °C} \leq T_{amb} \leq +85\text{ °C}$ |                      |      |       |      |    |
|               |                        | $f = 100\text{ MHz}$                            | [2] 20.0             | 22.5 | -     | dB   |    |
|               |                        | $f = 900\text{ MHz}$                            | [2] 17.5             | 20.0 | -     | dB   |    |
|               |                        | $f = 1.575\text{ GHz}$                          | [2] 15.0             | 17.5 | -     | dB   |    |
|               |                        | $f = 2.4\text{ GHz}$                            | [2] 13.0             | 15.2 | -     | dB   |    |
|               |                        | $f = 5.8\text{ GHz}$                            | [2] 9.0              | 11.4 | -     | dB   |    |
| MSG           |                        | maximum stable gain                             | $f = 100\text{ MHz}$ | -    | 33.8  | -    | dB |
|               |                        |   | $f = 900\text{ MHz}$ | -    | 23.8  | -    | dB |
|               | $f = 1.575\text{ GHz}$ |   | -                    | 20.5 | -     | dB   |    |
|               | $f = 2.4\text{ GHz}$   |   | -                    | 17.8 | -     | dB   |    |
|               | $f = 5.8\text{ GHz}$   |   | -                    | 15.4 | -     | dB   |    |
| $NF_{min}$    | minimum noise figure   | $f = 100\text{ MHz}$                            | -                    | 0.6  | -     | dB   |    |
|               |                        | $f = 900\text{ MHz}$                            | -                    | 0.6  | -     | dB   |    |
|               |                        | $f = 1.575\text{ GHz}$                          | -                    | 0.7  | -     | dB   |    |
|               |                        | $f = 2.4\text{ GHz}$                            | -                    | 0.8  | -     | dB   |    |
|               |                        | $f = 5.8\text{ GHz}$                            | -                    | 1.5  | -     | dB   |    |

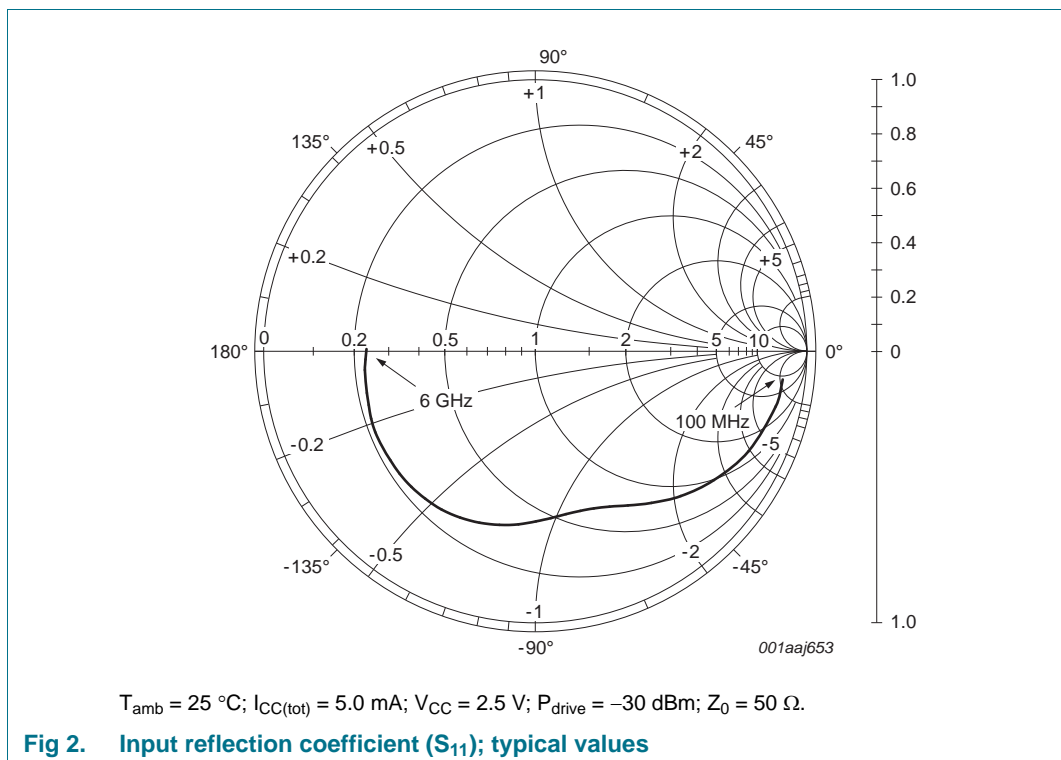
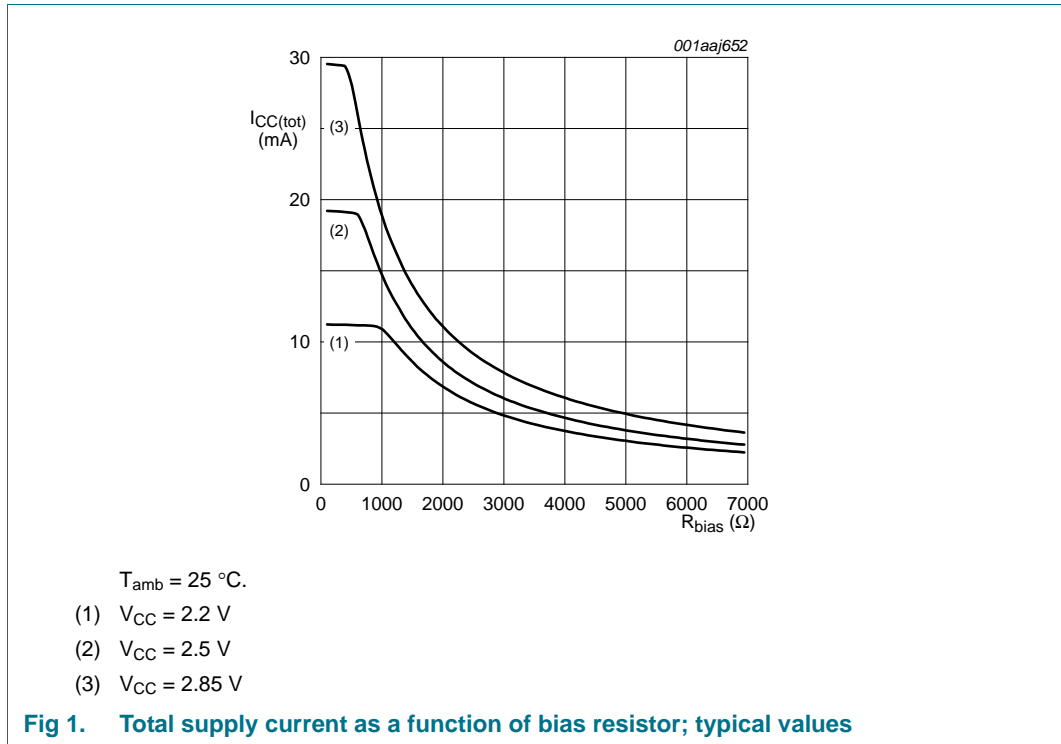
[1]  $I_{CC(tot)} = I_{CC} + I_{RF\_OUT} + I_{R\_BIAS}$

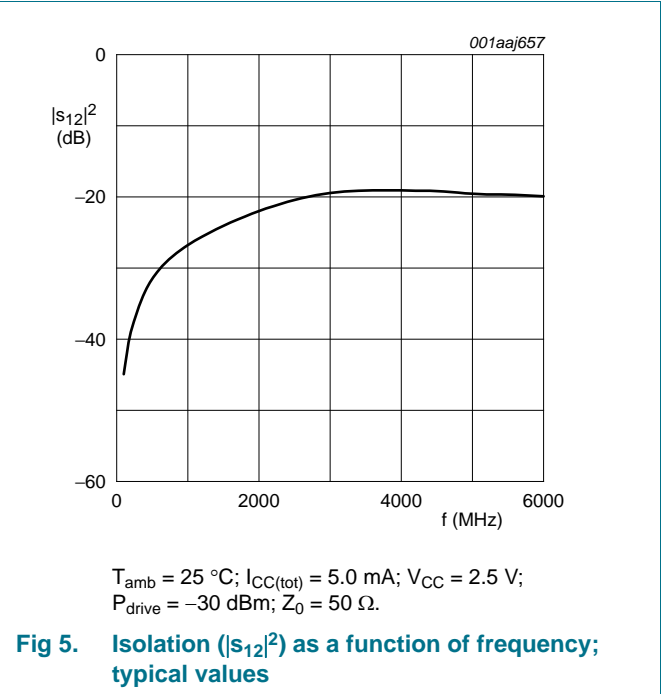
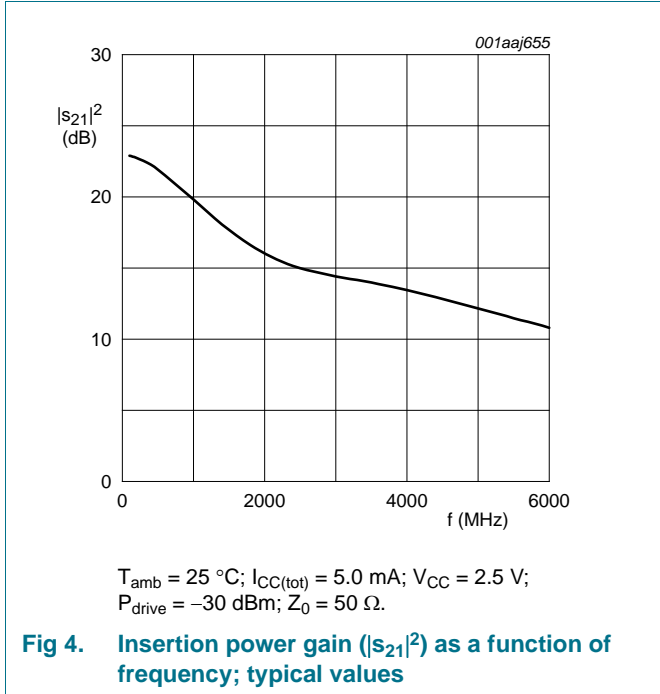
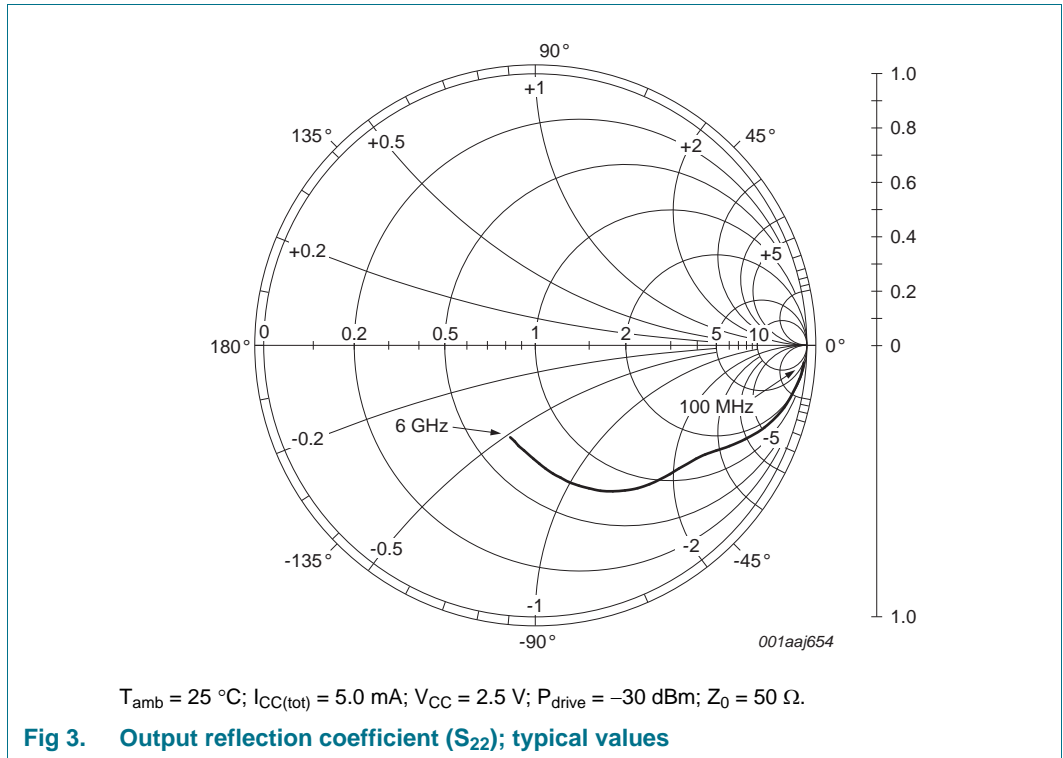
[2] Guaranteed by design and characterization.

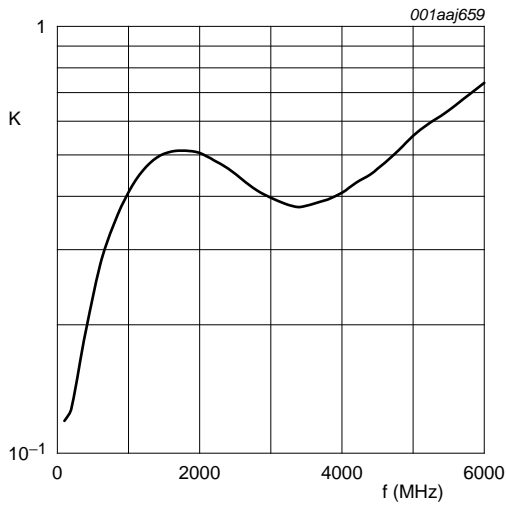
**Table 8. ENABLE (pin 5)**

$-40\text{ °C} \leq T_{amb} \leq +85\text{ °C}$

| $V_{ENABLE}\text{ (V)}$ | State |
|-------------------------|-------|
| $\leq 0.4$              | OFF   |
| $\geq 0.7$              | ON    |

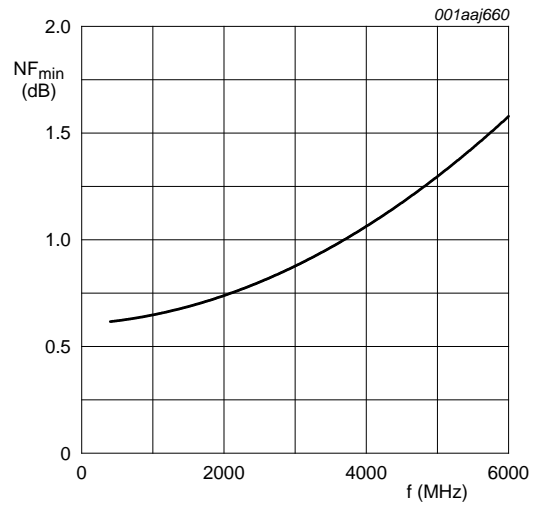






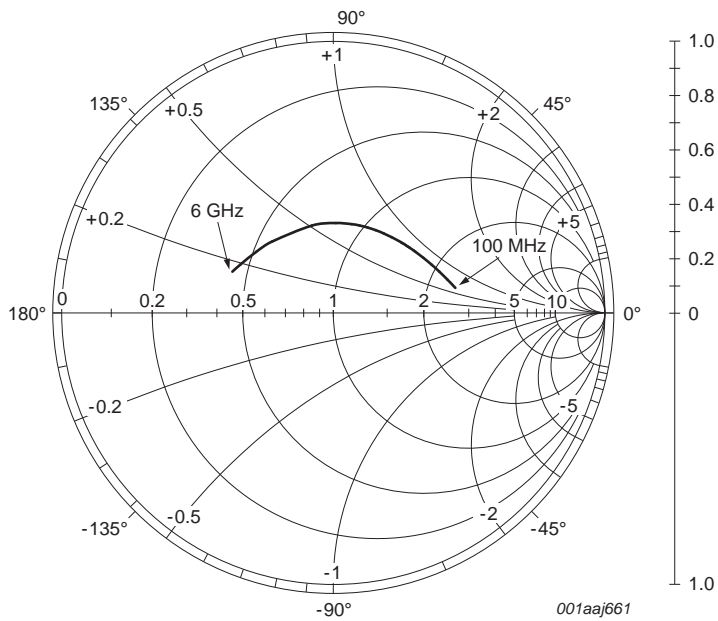
$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $I_{CC(tot)} = 5.0\text{ mA}$ ;  $V_{CC} = 2.5\text{ V}$ ;  
 $P_{drive} = -30\text{ dBm}$ ;  $Z_0 = 50\text{ }\Omega$ .

**Fig 6. Rollet's stability factor as a function of frequency; typical values**



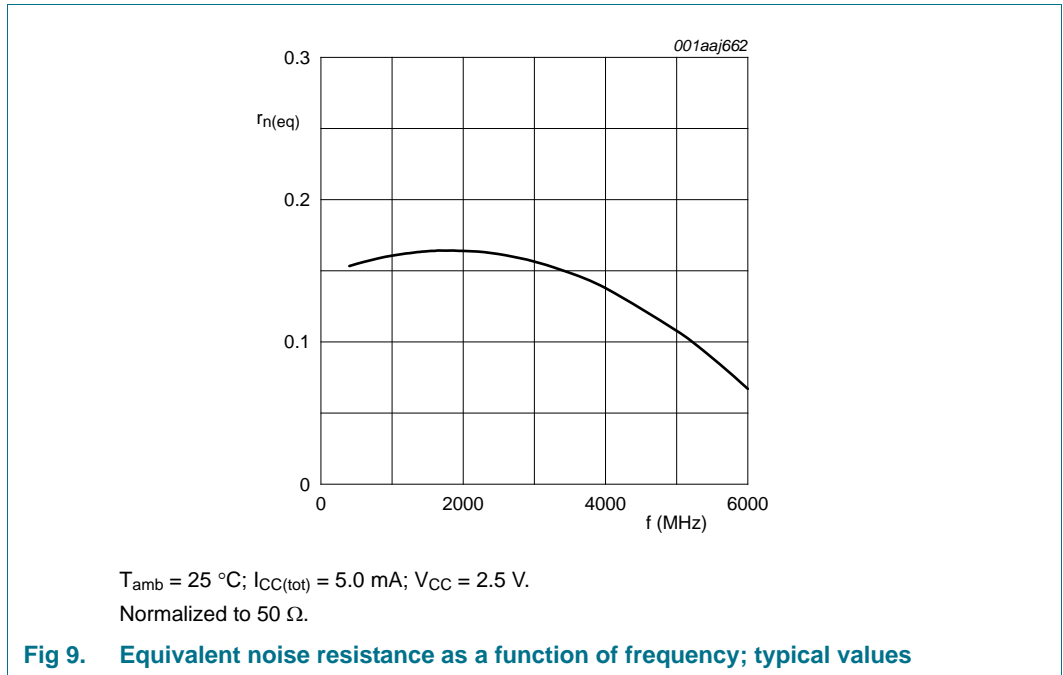
$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $I_{CC(tot)} = 5.0\text{ mA}$ ;  $V_{CC} = 2.5\text{ V}$ ;  
 $P_{drive} = -30\text{ dBm}$ ;  $Z_0 = 50\text{ }\Omega$ .

**Fig 7. Minimum noise figure as a function of frequency; typical values**



$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $I_{CC(tot)} = 5.0\text{ mA}$ ;  $V_{CC} = 2.5\text{ V}$ .

**Fig 8. Optimum source reflection coefficient for minimum noise figure; typical values**



## 8. Application information

### 8.1 High-ohmic FM LNA

**Table 9. Characteristics** [1]

$T_{amb} = 25\text{ }^{\circ}\text{C}; V_{CC} = 2.85\text{ V}; I_{CC(tot)} = 3.2\text{ mA}$  [2];  $V_{ENABLE} \geq 0.7\text{ V}; f = 100\text{ MHz}; Z_S = Z_L = 50\text{ }\Omega$  unless otherwise specified. All measurements are done with the SMA-connectors as reference plane.

| Symbol       | Parameter                             | Conditions | Min | Typ  | Max | Unit |
|--------------|---------------------------------------|------------|-----|------|-----|------|
| NF           | noise figure                          |            | -   | 1.2  | -   | dB   |
| $ S_{21} ^2$ | Insertion power gain                  |            | -   | 13   | -   | dB   |
| $RL_{in}$    | input return loss                     |            | -   | 0.5  | -   | dB   |
| $RL_{out}$   | output return loss                    |            | -   | 16.5 | -   | dB   |
| $P_{i(1dB)}$ | input power at 1 dB gain compression  |            | -   | -23  | -   | dBm  |
| $P_{L(1dB)}$ | output power at 1 dB gain compression |            | -   | -11  | -   | dBm  |
| $IP3_I$      | input third-order intercept point     |            | [3] | -15  | -   | dBm  |
| $IP3_O$      | output third-order intercept point    |            | [3] | -2   | -   | dBm  |

[1] See application note: AN11034 for details.

[2]  $I_{CC(tot)} = I_{CC} + I_{RF\_OUT} + I_{R\_BIAS}$ .

[3] The third order intercept point is measured at -30 dBm per tone at RF\_IN ( $f_1 = 100\text{ MHz}; f_2 = 100.2\text{ MHz}$ )

## 8.2 50 ohm FM LNA

**Table 10. Characteristics**<sup>[1]</sup>

$T_{amb} = 25\text{ °C}$ ;  $V_{CC} = 2.8\text{ V}$ ;  $I_{CC(tot)} = 4.3\text{ mA}$  <sup>[2]</sup>;  $V_{ENABLE} \geq 0.7\text{ V}$ ;  $f = 100\text{ MHz}$ ;  $Z_S = Z_L = 50\ \Omega$  (input and output matched to  $50\ \Omega$ ) unless otherwise specified. All measurements are done with the SMA-connectors as reference plane.

| Symbol       | Parameter                             | Conditions | Min              | Typ   | Max | Unit |
|--------------|---------------------------------------|------------|------------------|-------|-----|------|
| NF           | noise figure                          |            | -                | 1.5   | -   | dB   |
| $ S_{21} ^2$ | Insertion power gain                  |            | -                | 15    | -   | dB   |
| $RL_{in}$    | input return loss                     |            | -                | 9     | -   | dB   |
| $RL_{out}$   | output return loss                    |            | -                | 14    | -   | dB   |
| $P_{i(1dB)}$ | input power at 1 dB gain compression  |            | -                | -20   | -   | dBm  |
| $P_{L(1dB)}$ | output power at 1 dB gain compression |            | -                | -6    | -   | dBm  |
| $IP3_i$      | input third-order intercept point     |            | <sup>[3]</sup> - | -12.5 | -   | dBm  |
| $IP3_o$      | output third-order intercept point    |            | <sup>[3]</sup> - | 2.5   | -   | dBm  |

[1] See application note AN11035 for details.

[2]  $I_{CC(tot)} = I_{CC} + I_{RF\_OUT} + I_{R\_BIAS}$ .

[3] The third order intercept point is measured at -30 dBm per tone at RF\_IN ( $f_1 = 100\text{ MHz}$ ;  $f_2 = 100.2\text{ MHz}$ )



9. Package outline

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm

SOT886

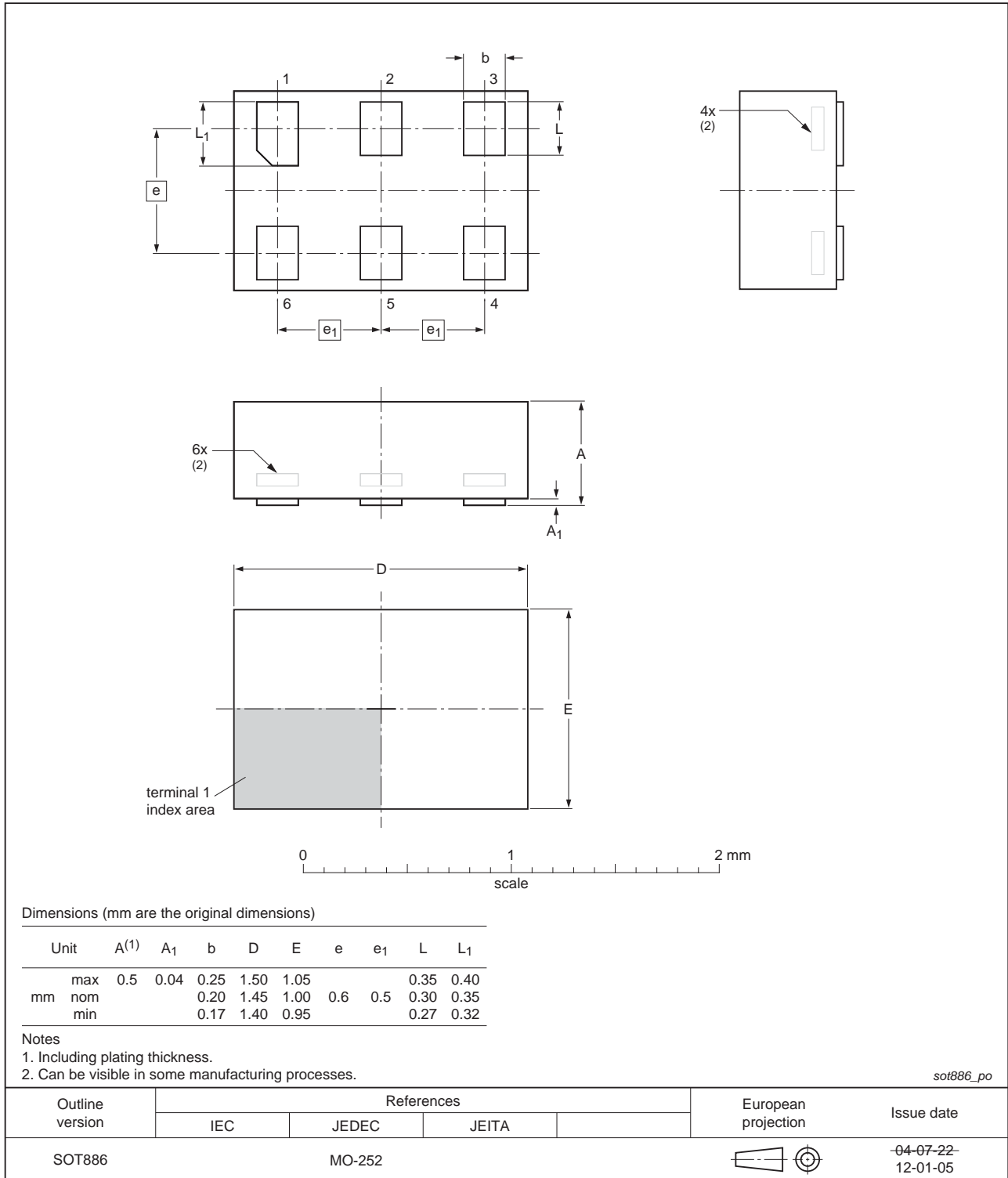


Fig 10. Package outline SOT886 (XSON6)

## 10. Handling information

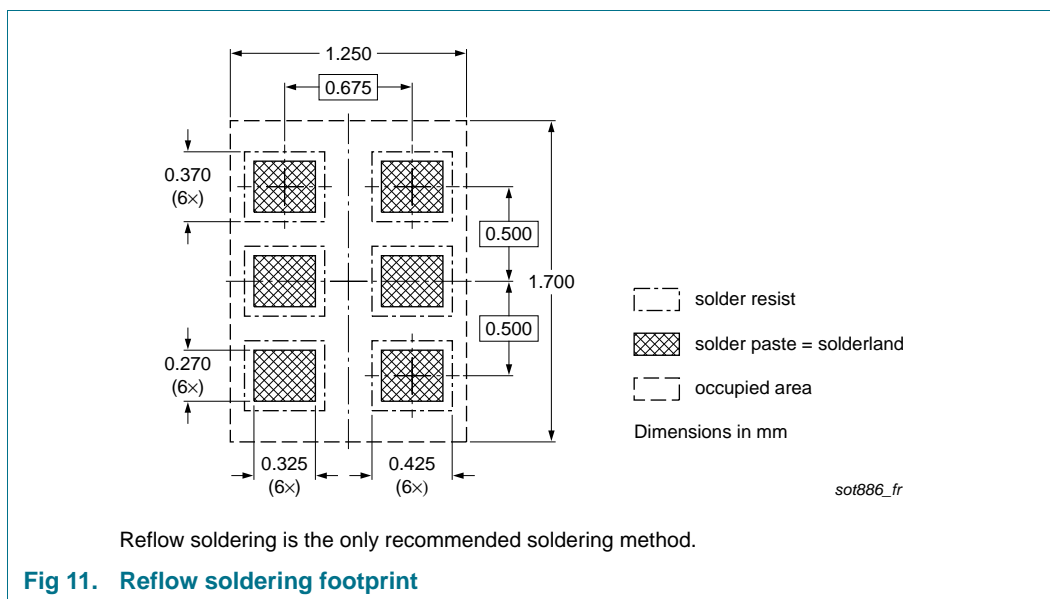
### CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.

Such precautions are described in the *ANSI/ESD S20.20*, *IEC/ST 61340-5*, *JESD625-A* or equivalent standards.

## 11. Soldering



## 12. Abbreviations

**Table 11. Abbreviations**

| Acronym | Description                             |
|---------|---|
| AC      | Alternating Current                     |
| CDMA    | Code Division Multiple Access           |
| DC      | Direct Current                          |
| FM      | Frequency Modulation                    |
| FR4     | Flame Retardant 4                       |
| GPS     | Global Positioning System               |
| LNA     | Low-Noise Amplifier                     |
| MMIC    | Monolithic Microwave Integrated Circuit |
| RF      | Radio Frequency                         |
| SiGe:C  | Silicon Germanium Carbon                |
| SMA     | SubMiniature version A                  |
| WLAN    | Wireless Local Area Network             |

## 13. Revision history

Table 12. Revision history

| Document ID    | Release date   | Data sheet status  | Change notice | Supersedes   |
|----------------|--|--------------------|---------------|--------------|
| BGU7003W v.2   | 20130411   | Product data sheet | -             | BGU7003W v.1 |
| Modifications: | • <a href="#">Figure 10 on page 9</a> : figure has been updated. |                    |               |              |
| BGU7003W v.1   | 20110830   | Product data sheet | -             | -            |

## 14. Legal information

### 14.1 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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