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

| Application | NF (dB) | $\|s_{21}\|^2$ (dB) | $RL_{in}$ (dB) | $RL_{out}$ (dB) | $P_{i(1dB)}$ (dBm) | $P_{L(1dB)}$ (dBm) | $IP3_I$ (dBm) | $IP3_O$ (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 MHz; $f_2$ = 100.2 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 μA
- ESD protection > 1 kV Human Body Model (HBM) on all pins

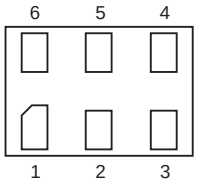
### 1.3 Applications

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

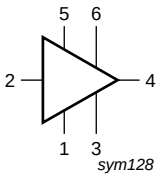
## 2. Pinning information

**Table 2. Pinning**

| Pin | Description | Simplified outline | Graphic symbol |
|---|---|---|---|
| 1 | R_BIAS | | |
| 2 | RF_IN | | |
| 3 | GND | | |
| 4 | RF_OUT | | |
| 5 | ENABLE | | |
| 6 | $V_{CC}$ | | |




Transparent top view




## 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 |
|---|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | RF input AC coupled | | - | 3.0 | V |
| $I_{CC(tot)}$ | total supply current | configurable with external resistor | | - | 25 | mA |
| $P_{tot}$ | total power dissipation | $T_{sp} \leq 103$ °C | [1] | - | 70 | mW |
| $T_{stg}$ | storage temperature | | | −65 | +150 | °C |
| $T_j$ | junction temperature | | | - | 150 | °C |

[1] $T_{sp}$ is the temperature at the solder point of the ground lead.

## 6. Thermal characteristics

**Table 6. Thermal characteristics**

| Symbol | Parameter | Conditions | Typ | Unit |
|---|---|---|---|---|
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | 235 | K/W |

# 7. Characteristics

**Table 7. Characteristics**

*$T_{amb}$ = 25 °C; $V_{CC}$ = 2.5 V; $I_{CC(tot)}$ = 5.0 mA; $V_{ENABLE} \geq 0.7$ 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 |
| | | $V_{ENABLE} \leq 0.4$ V | [1] | - | - | 0.001 | mA |
| $T_{amb}$ | ambient temperature | | | −40 | +25 | +85 | °C |
| $\|s_{21}\|^2$ | insertion power gain | $T_{amb}$ = 25 °C | | | | | |
| | | f = 100 MHz | [2] | 21.0 | 22.5 | - | dB |
| | | f = 900 MHz | [2] | 18.5 | 20.0 | - | dB |
| | | f = 1.575 GHz | | 16.0 | 17.5 | - | dB |
| | | f = 2.4 GHz | [2] | 14.0 | 15.2 | - | dB |
| | | f = 5.8 GHz | [2] | 10.0 | 11.4 | - | dB |
| | | −40 °C ≤ $T_{amb}$ ≤ +85 °C | | | | | |
| | | f = 100 MHz | [2] | 20.0 | 22.5 | - | dB |
| | | f = 900 MHz | [2] | 17.5 | 20.0 | - | dB |
| | | f = 1.575 GHz | [2] | 15.0 | 17.5 | - | dB |
| | | f = 2.4 GHz | [2] | 13.0 | 15.2 | - | dB |
| | | f = 5.8 GHz | [2] | 9.0 | 11.4 | - | dB |
| MSG | maximum stable gain | f = 100 MHz | | - | 33.8 | - | dB |
| | | f = 900 MHz | | - | 23.8 | - | dB |
| | | f = 1.575 GHz | | - | 20.5 | - | dB |
| | | f = 2.4 GHz | | - | 17.8 | - | dB |
| | | f = 5.8 GHz | | - | 15.4 | - | dB |
| $NF_{min}$ | minimum noise figure | f = 100 MHz | | - | 0.6 | - | dB |
| | | f = 900 MHz | | - | 0.6 | - | dB |
| | | f = 1.575 GHz | | - | 0.7 | - | dB |
| | | f = 2.4 GHz | | - | 0.8 | - | dB |
| | | f = 5.8 GHz | | - | 1.5 | - | dB |

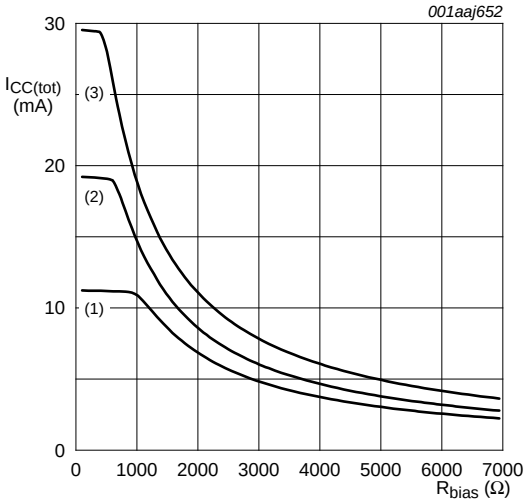
[1] $I_{CC(tot)} = I_{CC} + I_{RF\_OUT} + I_{R\_BIAS}$.

[2] Guaranteed by design and characterization.

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

*−40 °C ≤ $T_{amb}$ ≤ +85 °C*

| $V_{ENABLE}$ (V) | State |
|---|---|
| ≤ 0.4 | OFF |
| ≥ 0.7 | ON |



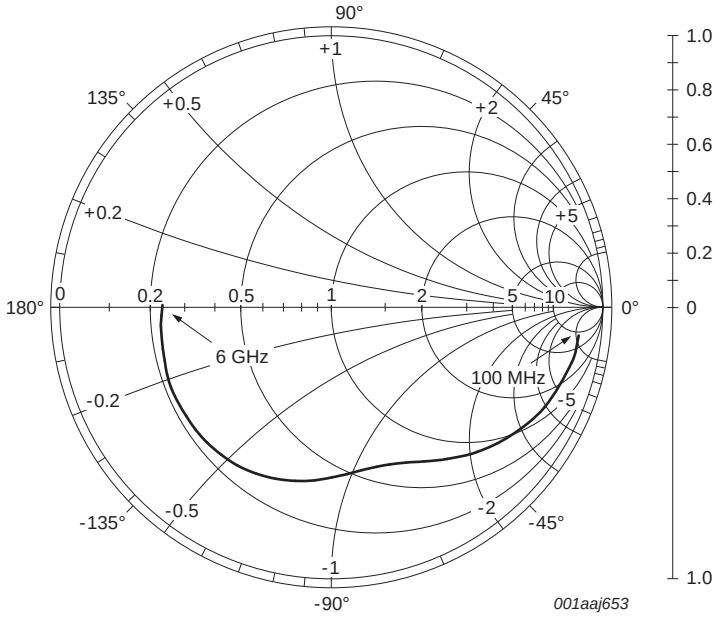

$T_{amb}$ = 25 °C.

(1) $V_{CC}$ = 2.2 V

(2) $V_{CC}$ = 2.5 V

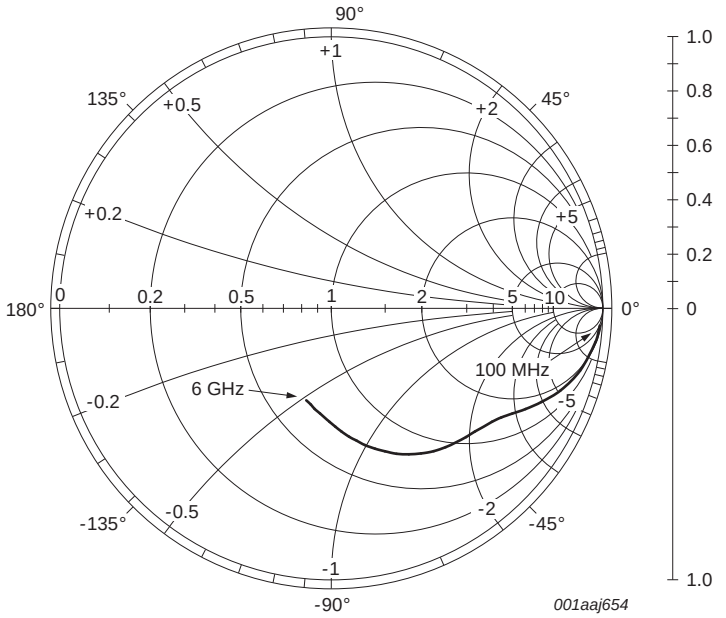
(3) $V_{CC}$ = 2.85 V

**Fig 1. Total supply current as a function of bias resistor; typical values**



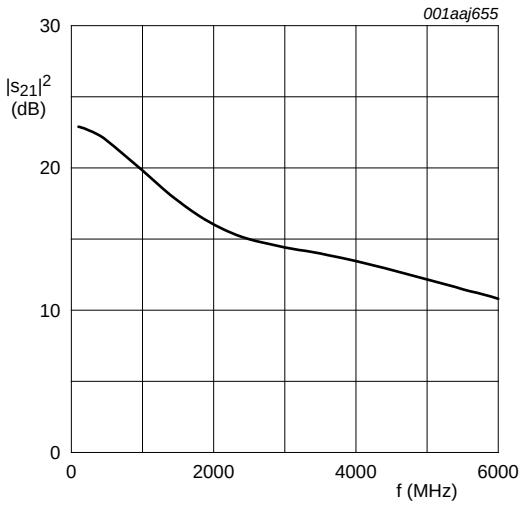

$T_{amb}$ = 25 °C; $I_{CC(tot)}$ = 5.0 mA; $V_{CC}$ = 2.5 V; $P_{drive}$ = −30 dBm; $Z_0$ = 50 Ω.

**Fig 2. Input reflection coefficient ($S_{11}$); typical values**



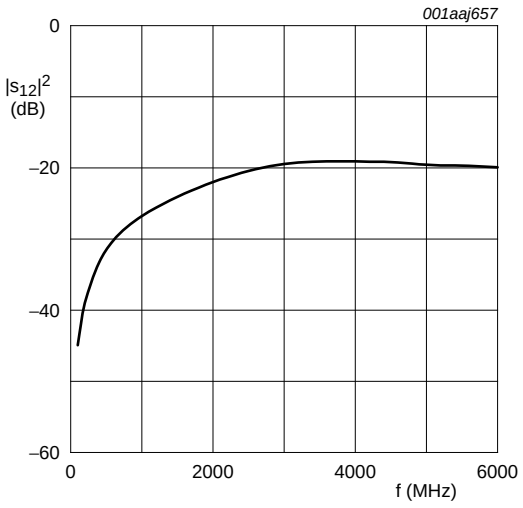

$T_{amb}$ = 25 °C; $I_{CC(tot)}$ = 5.0 mA; $V_{CC}$ = 2.5 V; $P_{drive}$ = −30 dBm; $Z_0$ = 50 Ω.

**Fig 3. Output reflection coefficient ($S_{22}$); typical values**



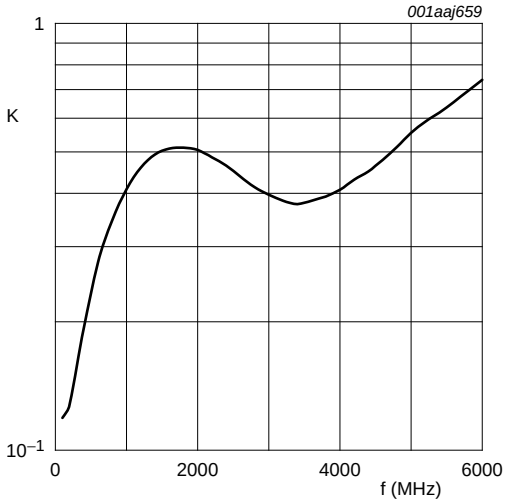

$T_{amb}$ = 25 °C; $I_{CC(tot)}$ = 5.0 mA; $V_{CC}$ = 2.5 V;
$P_{drive}$ = −30 dBm; $Z_0$ = 50 Ω.

**Fig 4. Insertion power gain ($|s_{21}|^2$) as a function of frequency; typical values**



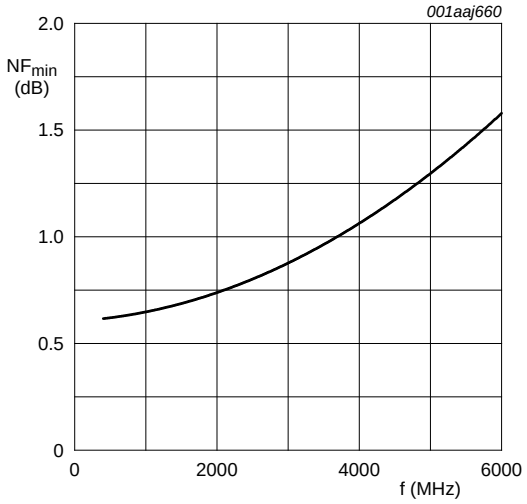

$T_{amb}$ = 25 °C; $I_{CC(tot)}$ = 5.0 mA; $V_{CC}$ = 2.5 V;
$P_{drive}$ = −30 dBm; $Z_0$ = 50 Ω.

**Fig 5. Isolation ($|s_{12}|^2$) as a function of frequency; typical values**



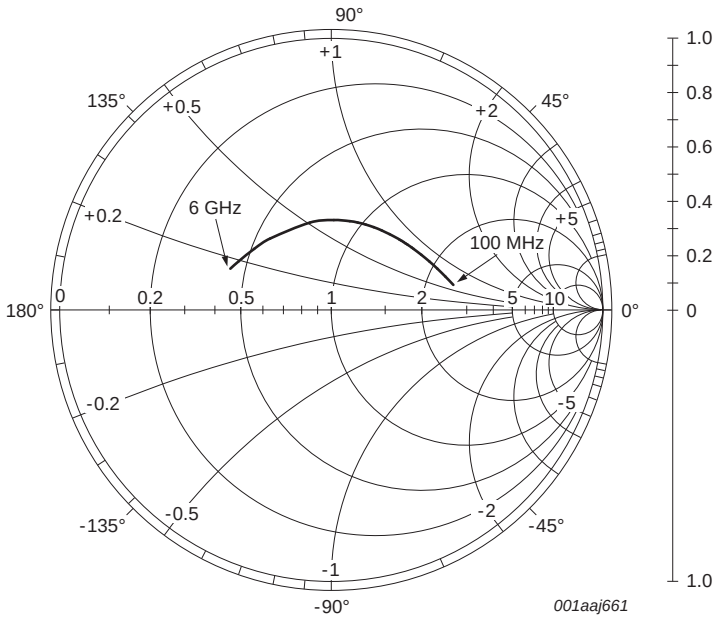

$T_{amb}$ = 25 °C; $I_{CC(tot)}$ = 5.0 mA; $V_{CC}$ = 2.5 V; $P_{drive}$ = −30 dBm; $Z_0$ = 50 Ω.

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



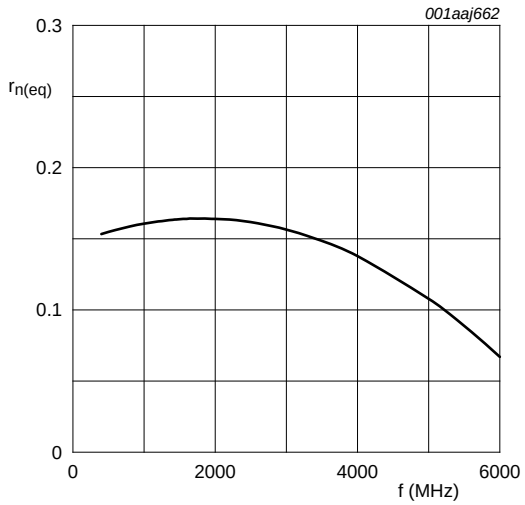

$T_{amb}$ = 25 °C; $I_{CC(tot)}$ = 5.0 mA; $V_{CC}$ = 2.5 V; $P_{drive}$ = −30 dBm; $Z_0$ = 50 Ω.

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




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

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




$T_{amb}$ = 25 °C; $I_{CC(tot)}$ = 5.0 mA; $V_{CC}$ = 2.5 V.
Normalized to 50 Ω.

**Fig 9. Equivalent noise resistance as a function of frequency; typical values**

# 8. Application information

## 8.1 High-ohmic FM LNA

**Table 9. Characteristics [1]**

*$T_{amb}$ = 25 °C; $V_{CC}$ = 2.85 V; $I_{CC(tot)}$ = 3.2 mA [2]; $V_{ENABLE} \geq 0.7$ V; f = 100 MHz; $Z_S = Z_L$ = 50 Ω 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 MHz; $f_2$ = 100.2 MHz)

## 8.2 50 ohm FM LNA

**Table 10. Characteristics[1]**

*$T_{amb}$ = 25 °C; $V_{CC}$ = 2.8 V; $I_{CC(tot)}$ = 4.3 mA [2]; $V_{ENABLE} \geq 0.7$ V; f = 100 MHz; $Z_S = Z_L$ = 50 Ω (input and output matched to 50 Ω) 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 | [3] | - | −12.5 | - | dBm |
| $IP3_O$ | output third-order intercept point | [3] | - | 2.5 | - | dBm |

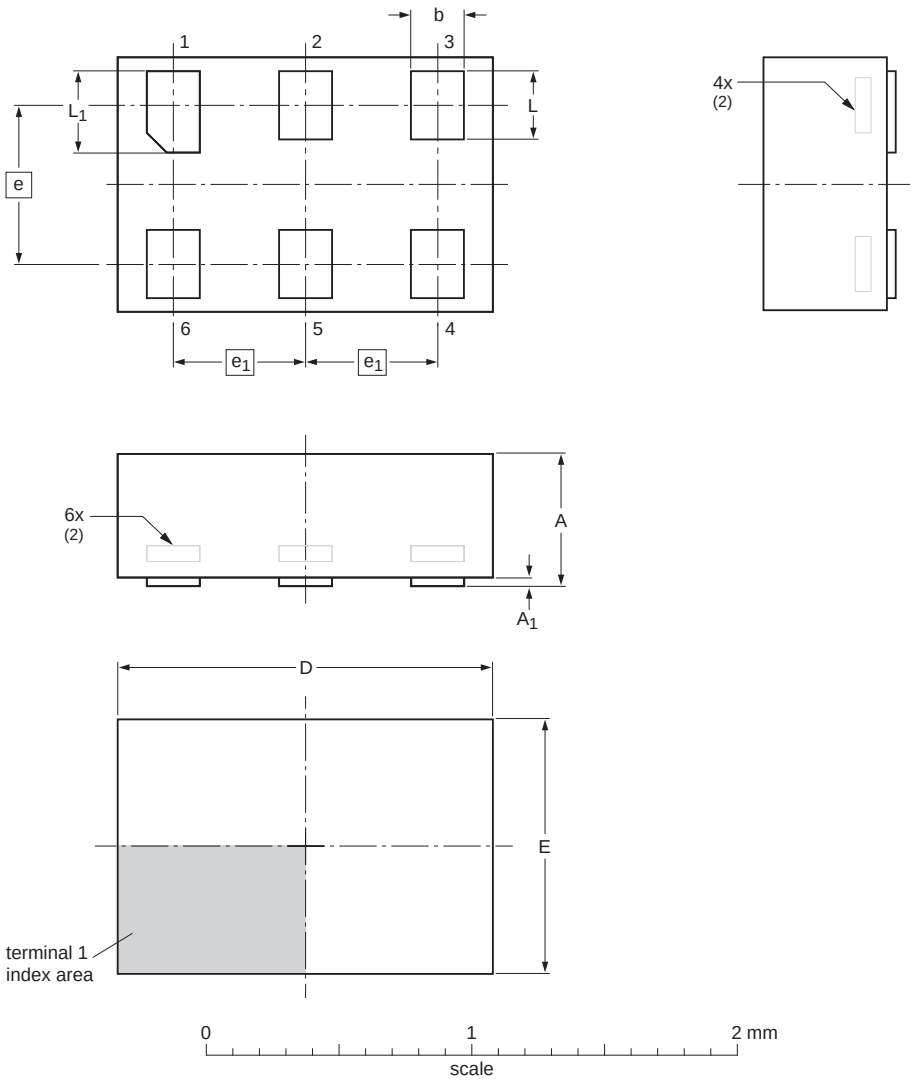
[1] See application note AN11035 for details.

[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 MHz; $f_2$ = 100.2 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




Dimensions (mm are the original dimensions)

| Unit | | A(1) | $A_1$ | b | D | E | e | $e_1$ | L | $L_1$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | max | 0.5 | 0.04 | 0.25 | 1.50 | 1.05 | | | 0.35 | 0.40 |
| mm | nom | | | 0.20 | 1.45 | 1.00 | 0.6 | 0.5 | 0.30 | 0.35 |
| | min | | | 0.17 | 1.40 | 0.95 | | | 0.27 | 0.32 |

Notes
1. Including plating thickness.
2. Can be visible in some manufacturing processes.

sot886_po

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT886 | | MO-252 | | | | ~~04-07-22~~ 12-01-05 |

**Fig 10. Package outline SOT886 (XSON6)**

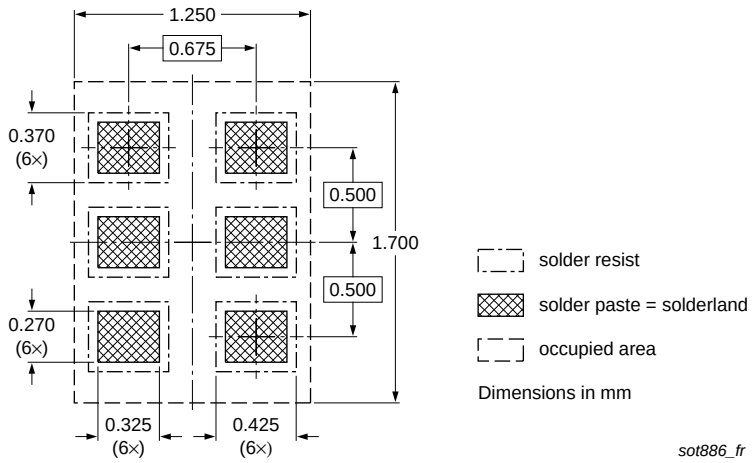
## 10. Handling information

**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




Reflow soldering is the only recommended soldering method.

**Fig 11. Reflow soldering footprint**

## 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: | • Figure 10 on page 9: figure has been updated. | | | |
| BGU7003W v.1 | 20110830 | Product data sheet | - | - |

# 14. Legal information

## 14.1 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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## 16. Contents





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**Document identifier: BGU7003W**

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