



# BFU730LX

NPN wideband silicon germanium RF transistor

Rev. 1 — 8 May 2013

Product data sheet

## 1. Product profile

### 1.1 General description

NPN silicon germanium microwave transistor for high speed, low noise applications in a SOT883C leadless ultra small plastic SMD package.

#### 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.

### 1.2 Features and benefits

- Leadless ultra small plastic SMD package 1.0 mm × 0.6 mm × 0.34 mm
- Low noise high gain microwave transistor
- Noise figure (NF) = 0.75 dB at 6 GHz
- High maximum power gain ( $G_{p(max)}$ ) of 15.8 dB at 6 GHz
- Excellent linearity in WiFi LNA from 5 GHz to 5.9 GHz:
  - ◆ input third-order intercept point ( $IP3_i$ ) = 15 dBm
  - ◆ input power at 1 dB gain compression ( $P_{i(1dB)}$ ) = 0 dBmSee application note *AN11224: Low Noise Fast Turn ON/OFF 5-5.9GHz WiFi LNA with BFU730LX*.
- 110 GHz  $f_T$  silicon germanium technology

### 1.3 Applications

- Wi-Fi / WLAN
  - See application notes:
    - ◆ *AN11223: Low Noise Fast Turn ON/OFF 2.4-2.5GHz WiFi LNA with BFU730LX*
    - ◆ *AN11224: Low Noise Fast Turn ON/OFF 5-5.9GHz WiFi LNA with BFU730LX*
- WiMAX
- LNA for GPS, GLONASS, Galileo and Compass (BeiDou)
- DBS (2nd LNA stage, mixer stage, DRO), SDARS
- RKE, AMR / Zigbee
- LNA for microwave communications systems
- Low current battery equipped applications
- Microwave driver / buffer applications



## 1.4 Quick reference data

**Table 1. Quick reference data**

$T_j = 25\text{ °C}$  unless otherwise specified.

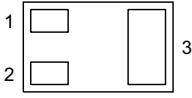
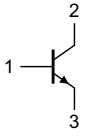
| Symbol       | Parameter                             | Conditions                                                                                                                            | Min | Typ  | Max  | Unit |
|--------------|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-----|------|------|------|
| $V_{CB}$     | collector-base voltage                | open emitter                                                                                                                          | -   | -    | 10.0 | V    |
| $V_{CE}$     | collector-emitter voltage             | open base                                                                                                                             | -   | -    | 3.0  | V    |
|              |                                       | shorted base                                                                                                                          | -   | -    | 10.0 | V    |
| $V_{EB}$     | emitter-base voltage                  | open collector                                                                                                                        | -   | -    | 1.3  | V    |
| $I_C$        | collector current                     |                                                                                                                                       | -   | 5    | 30   | mA   |
| $P_{tot}$    | total power dissipation               | $T_{sp} \leq 110\text{ °C}$                                                                                                           | [1] | -    | 160  | mW   |
| $h_{FE}$     | DC current gain                       | $I_C = 2\text{ mA}$ ; $V_{CE} = 2\text{ V}$ ;<br>$T_j = 25\text{ °C}$                                                                 | 205 | 380  | 555  |      |
| $f_T$        | transition frequency                  | $I_C = 25\text{ mA}$ ; $V_{CE} = 3\text{ V}$ ;<br>$f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$                                       | -   | 53   | -    | GHz  |
| $G_{p(max)}$ | maximum power gain                    | $I_C = 25\text{ mA}$ ; $V_{CE} = 3\text{ V}$ ;<br>$f = 6\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$                                       | [2] | 15.8 | -    | dB   |
| NF           | noise figure                          | $I_C = 5\text{ mA}$ ; $V_{CE} = 3\text{ V}$ ; $f = 6\text{ GHz}$ ;<br>$\Gamma_S = \Gamma_{opt}$                                       | -   | 0.75 | -    | dB   |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | $I_C = 25\text{ mA}$ ; $V_{CE} = 3\text{ V}$ ;<br>$Z_S = Z_L = 50\text{ }\Omega$ ;<br>$f = 1.8\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$ | -   | 11.7 | -    | dBm  |

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

[2]  $G_{p(max)}$  is the maximum power gain, if  $K > 1$ . If  $K < 1$  then  $G_{p(max)}$  = Maximum Stable Gain (MSG).

## 2. Pinning information

**Table 2. Discrete pinning**

| Pin | Description | Simplified outline                                                                                                | Graphic symbol                                                                                          |
|-----|-------------|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| 1   | base        |  <p>Transparent top view</p> |  <p>aaa-006018</p> |
| 2   | collector   |                                                                                                                   |                                                                                                         |
| 3   | emitter     |                                                                                                                   |                                                                                                         |

## 3. Ordering information

**Table 3. Ordering information**

| Type number | Package |                                                                                                 |         |
|-------------|---------|-------------------------------------------------------------------------------------------------|---------|
|             | Name    | Description                                                                                     | Version |
| BFU730LX    | -       | leadless ultra small plastic package; 3 terminals;<br>body $1 \times 0.6 \times 0.34\text{ mm}$ | SOT883C |

## 4. Marking

Table 4. Marking

| Type number | Marking |
|-------------|---------|
| BFU730LX    | ZD      |

## 5. Design support

Table 5. Available design support

Download from the BFU730LX product page on <http://www.nxp.com>.

| Support item                                                          | Available | Remarks                                           |
|-----------------------------------------------------------------------|-----------|---------------------------------------------------|
| Device models for Agilent EEsof EDA ADS                               | yes       | <a href="#">[1]</a> Based on Mextram device model |
| Device models for Agilent EEsof EDA Genesys                           | yes       | Based on Mextram device model                     |
| Device models for AWR Microwave Office                                | planned   | Based on Mextram device model                     |
| Device models for ANSYS Ansoft designer                               | planned   | Based on Mextram device model                     |
| SPICE model                                                           | planned   | Based on Gummel-Poon device model                 |
| S-parameters                                                          | yes       |                                                   |
| Noise parameters                                                      | yes       |                                                   |
| Customer evaluation kit                                               | yes       |                                                   |
| Gerber files evaluation board                                         | yes       |                                                   |
| Reflow soldering footprint                                            | yes       |                                                   |
| AN11223: Low Noise Fast Turn ON/OFF 2.4-2.5GHz WiFi LNA with BFU730LX | yes       | Application note                                  |
| AN11224: Low Noise Fast Turn ON/OFF 5-5.9GHz WiFi LNA with BFU730LX   | yes       | Application note                                  |

[1] See <http://www.nxp.com/models.html>.

## 6. Limiting values

Table 6. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol    | Parameter                 | Conditions                  | Min                   | Max  | Unit |
|-----------|---------------------------|-----------------------------|-----------------------|------|------|
| $V_{CB}$  | collector-base voltage    | open emitter                | -                     | 10.0 | V    |
| $V_{CE}$  | collector-emitter voltage | open base                   | -                     | 3.0  | V    |
|           |                           | shorted base                | -                     | 10.0 | V    |
| $V_{EB}$  | emitter-base voltage      | open collector              | -                     | 1.3  | V    |
| $P_{tot}$ | total power dissipation   | $T_{sp} \leq 110\text{ °C}$ | <a href="#">[1]</a> - | 160  | 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 emitter lead.

## 7. Recommended operating conditions

Table 7. Recommended operating conditions

| Symbol | Parameter            | Conditions | Min | Typ | Max  | Unit |
|--------|----------------------|------------|-----|-----|------|------|
| $T_j$  | junction temperature |            | -40 | -   | +125 | °C   |
| $I_C$  | collector current    |            | -   | -   | 30   | mA   |

## 8. Thermal characteristics

Table 8. Thermal characteristics

| Symbol         | Parameter                                        | Conditions | Typ | Unit |
|----------------|--------------------------------------------------|------------|-----|------|
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |            | 250 | K/W  |

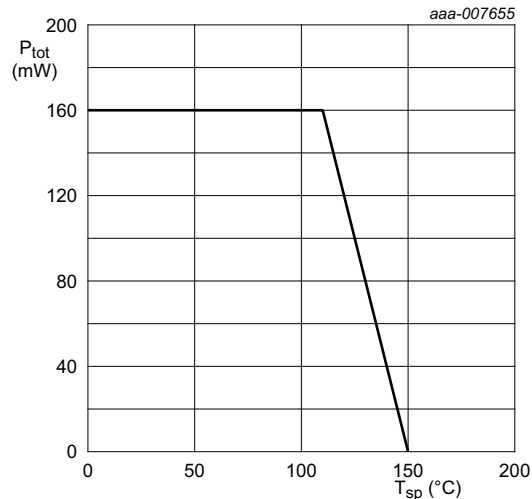


Fig 1. Total supply current as a function of solder point temperature

## 9. Characteristics

Table 9. Characteristics

$T_j = 25\text{ °C}$  unless otherwise specified; measurements done on characterization boards.

| Symbol        | Parameter                           | Conditions                                                                                   | Min | Typ | Max | Unit |
|---------------|-------------------------------------|----------------------------------------------------------------------------------------------|-----|-----|-----|------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = 2.5\text{ }\mu\text{A}$ ; $I_E = 0\text{ mA}$                                         | 10  | -   | -   | V    |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | $I_C = 1\text{ mA}$ ; $I_B = 0\text{ mA}$                                                    | 3.0 | -   | -   | V    |
| $I_C$         | collector current                   |                                                                                              | -   | 5   | 30  | mA   |
| $I_{CBO}$     | collector-base cut-off current      | $I_E = 0\text{ mA}$ ; $V_{CB} = 4.5\text{ V}$                                                | -   | -   | 100 | nA   |
| $h_{FE}$      | DC current gain                     | $I_C = 2\text{ mA}$ ; $V_{CE} = 2\text{ V}$                                                  | 205 | 380 | 555 |      |
| $C_{CE}$      | collector-emitter capacitance       | $V_{CE} = 2\text{ V}$ ; $f = 1\text{ MHz}$                                                   | -   | 145 | -   | fF   |
| $C_{EB}$      | emitter-base capacitance            | $V_{EB} = 0.5\text{ V}$ ; $f = 1\text{ MHz}$                                                 | -   | 310 | -   | fF   |
| $C_{CB}$      | collector-base capacitance          | $V_{CB} = 2\text{ V}$ ; $f = 1\text{ MHz}$                                                   | -   | 84  | -   | fF   |
| $f_T$         | transition frequency                | $I_C = 25\text{ mA}$ ; $V_{CE} = 3\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$ | -   | 53  | -   | GHz  |

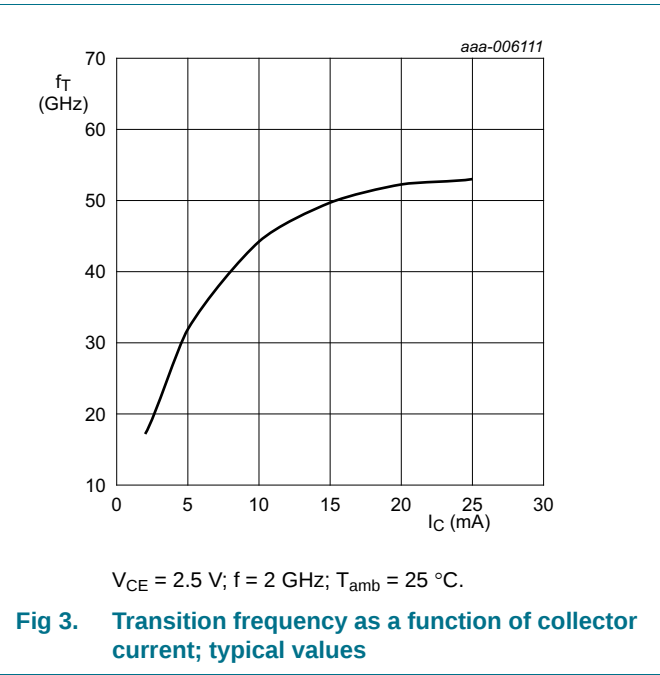
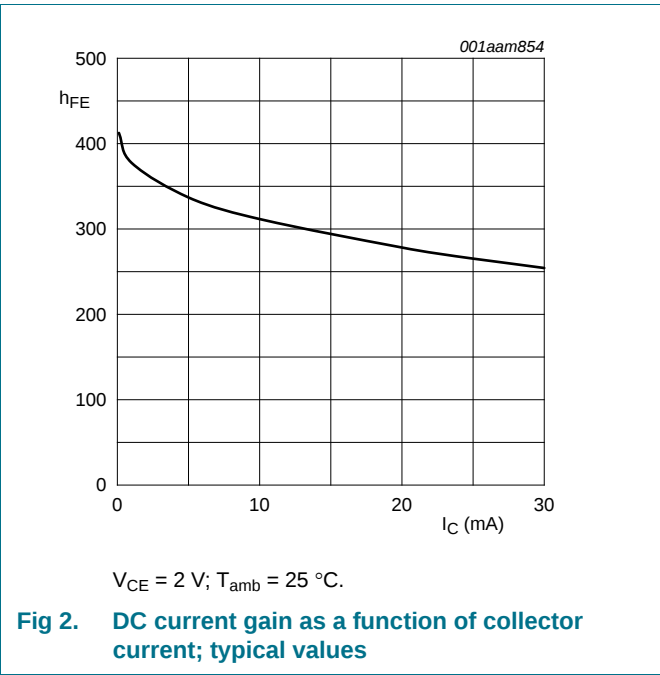
**Table 9.** Characteristics ...continued $T_j = 25\text{ °C}$  unless otherwise specified; measurements done on characterization boards.

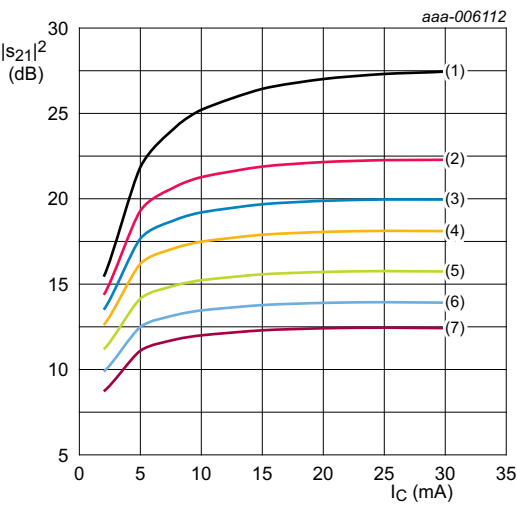
| Symbol       | Parameter                             | Conditions                                                                                      | Min | Typ  | Max | Unit |
|--------------|---------------------------------------|-------------------------------------------------------------------------------------------------|-----|------|-----|------|
| $G_{p(max)}$ | maximum power gain                    | $I_C = 5\text{ mA}; V_{CE} = 3\text{ V}; T_{amb} = 25\text{ °C}$ <a href="#">[1]</a>            |     |      |     |      |
|              |                                       | $f = 1.8\text{ GHz}$                                                                            | -   | 22.0 | -   | dB   |
|              |                                       | $f = 6\text{ GHz}$                                                                              | -   | 15.0 | -   | dB   |
|              |                                       | $I_C = 10\text{ mA}; V_{CE} = 3\text{ V}; T_{amb} = 25\text{ °C}$ <a href="#">[1]</a>           |     |      |     |      |
|              |                                       | $f = 1.8\text{ GHz}$                                                                            | -   | 23.6 | -   | dB   |
|              |                                       | $f = 6\text{ GHz}$                                                                              | -   | 15.7 | -   | dB   |
|              |                                       | $I_C = 25\text{ mA}; V_{CE} = 3\text{ V}; T_{amb} = 25\text{ °C}$ <a href="#">[1]</a>           |     |      |     |      |
|              |                                       | $f = 1.8\text{ GHz}$                                                                            | -   | 24.5 | -   | dB   |
|              |                                       | $f = 6\text{ GHz}$                                                                              | -   | 15.8 | -   | dB   |
| $ s_{21} ^2$ | insertion power gain                  | $I_C = 5\text{ mA}; V_{CE} = 3\text{ V}; T_{amb} = 25\text{ °C}$                                |     |      |     |      |
|              |                                       | $f = 1.8\text{ GHz}$                                                                            | -   | 19.3 | -   | dB   |
|              |                                       | $f = 6\text{ GHz}$                                                                              | -   | 11.1 | -   | dB   |
|              |                                       | $I_C = 10\text{ mA}; V_{CE} = 3\text{ V}; T_{amb} = 25\text{ °C}$                               |     |      |     |      |
|              |                                       | $f = 1.8\text{ GHz}$                                                                            | -   | 21.3 | -   | dB   |
|              |                                       | $f = 6\text{ GHz}$                                                                              | -   | 12.0 | -   | dB   |
|              |                                       | $I_C = 25\text{ mA}; V_{CE} = 3\text{ V}; T_{amb} = 25\text{ °C}$                               |     |      |     |      |
|              |                                       | $f = 1.8\text{ GHz}$                                                                            | -   | 22.3 | -   | dB   |
|              |                                       | $f = 6\text{ GHz}$                                                                              | -   | 12.5 | -   | dB   |
| $NF_{min}$   | minimum noise figure                  | $I_C = 5\text{ mA}; V_{CE} = 3\text{ V}; \Gamma_S = \Gamma_{opt}; T_{amb} = 25\text{ °C}$       |     |      |     |      |
|              |                                       | $f = 1.8\text{ GHz}$                                                                            | -   | 0.55 | -   | dB   |
|              |                                       | $f = 6\text{ GHz}$                                                                              | -   | 0.75 | -   | dB   |
|              |                                       | $I_C = 10\text{ mA}; V_{CE} = 3\text{ V}; \Gamma_S = \Gamma_{opt}; T_{amb} = 25\text{ °C}$      |     |      |     |      |
|              |                                       | $f = 1.8\text{ GHz}$                                                                            | -   | 0.7  | -   | dB   |
|              |                                       | $f = 6\text{ GHz}$                                                                              | -   | 0.9  | -   | dB   |
|              |                                       | $I_C = 25\text{ mA}; V_{CE} = 3\text{ V}; \Gamma_S = \Gamma_{opt}; T_{amb} = 25\text{ °C}$      |     |      |     |      |
|              |                                       | $f = 1.8\text{ GHz}$                                                                            | -   | 1.1  | -   | dB   |
|              |                                       | $f = 6\text{ GHz}$                                                                              | -   | 1.2  | -   | dB   |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | $I_C = 5\text{ mA}; V_{CE} = 3\text{ V}; Z_S = Z_L = 50\text{ }\Omega; T_{amb} = 25\text{ °C}$  |     |      |     |      |
|              |                                       | $f = 1.8\text{ GHz}$                                                                            | -   | -3.7 | -   | dBm  |
|              |                                       | $f = 6\text{ GHz}$                                                                              | -   | -1.6 | -   | dBm  |
|              |                                       | $I_C = 10\text{ mA}; V_{CE} = 3\text{ V}; Z_S = Z_L = 50\text{ }\Omega; T_{amb} = 25\text{ °C}$ |     |      |     |      |
|              |                                       | $f = 1.8\text{ GHz}$                                                                            | -   | 3.5  | -   | dBm  |
|              |                                       | $f = 6\text{ GHz}$                                                                              | -   | 5.4  | -   | dBm  |
|              |                                       | $I_C = 25\text{ mA}; V_{CE} = 3\text{ V}; Z_S = Z_L = 50\text{ }\Omega; T_{amb} = 25\text{ °C}$ |     |      |     |      |
|              |                                       | $f = 1.8\text{ GHz}$                                                                            | -   | 11.7 | -   | dBm  |
|              |                                       | $f = 6\text{ GHz}$                                                                              | -   | 12.7 | -   | dBm  |

Table 9. Characteristics ...continued  
*T<sub>j</sub> = 25 °C unless otherwise specified; measurements done on characterization boards.*

| Symbol           | Parameter                          | Conditions                                                                                                         | Min | Typ  | Max | Unit |
|------------------|------------------------------------|--------------------------------------------------------------------------------------------------------------------|-----|------|-----|------|
| IP3 <sub>o</sub> | output third-order intercept point | I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 3 V; Z <sub>S</sub> = Z <sub>L</sub> = 50 Ω;<br>T <sub>amb</sub> = 25 °C  |     |      |     |      |
|                  |                                    | f = 1.8 GHz                                                                                                        | -   | 14.7 | -   | dBm  |
|                  |                                    | f = 6 GHz                                                                                                          | -   | 19.0 | -   | dBm  |
|                  |                                    | I <sub>C</sub> = 10 mA; V <sub>CE</sub> = 3 V; Z <sub>S</sub> = Z <sub>L</sub> = 50 Ω;<br>T <sub>amb</sub> = 25 °C |     |      |     |      |
|                  |                                    | f = 1.8 GHz                                                                                                        | -   | 23.8 | -   | dBm  |
|                  |                                    | f = 6 GHz                                                                                                          | -   | 25.3 | -   | dBm  |
|                  |                                    | I <sub>C</sub> = 25 mA; V <sub>CE</sub> = 3 V; Z <sub>S</sub> = Z <sub>L</sub> = 50 Ω;<br>T <sub>amb</sub> = 25 °C |     |      |     |      |
|                  |                                    | f = 1.8 GHz                                                                                                        | -   | 25.5 | -   | dBm  |
|                  |                                    | f = 6 GHz                                                                                                          | -   | 26.9 | -   | dBm  |

[1] G<sub>p(max)</sub> is the maximum power gain, if K > 1. If K < 1 then G<sub>p(max)</sub> = MSG.

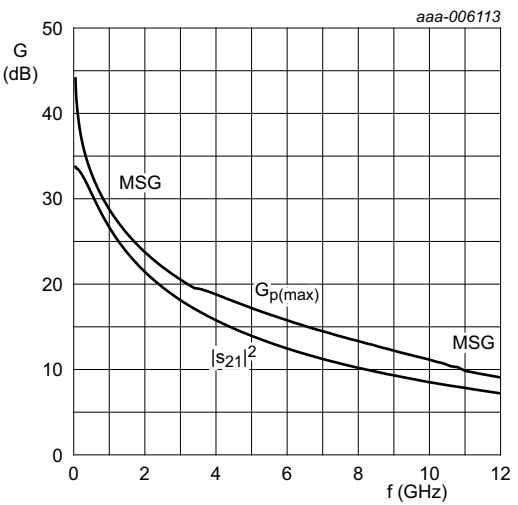




$V_{CE} = 3\text{ V}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

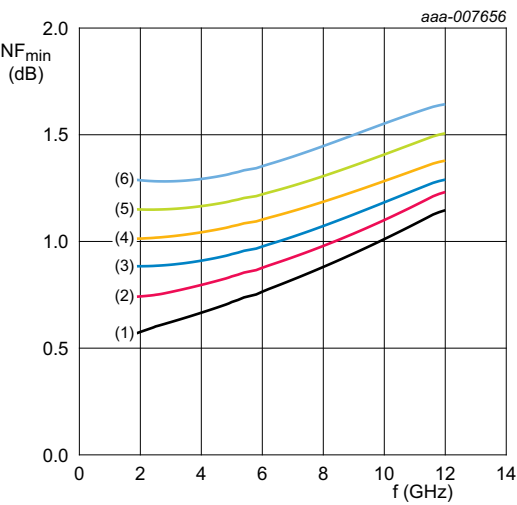
- (1)  $f = 0.9\text{ GHz}$
- (2)  $f = 1.8\text{ GHz}$
- (3)  $f = 2.4\text{ GHz}$
- (4)  $f = 3.0\text{ GHz}$
- (5)  $f = 4.0\text{ GHz}$
- (6)  $f = 5.0\text{ GHz}$
- (7)  $f = 6.0\text{ GHz}$

Fig 4. Insertion power gain as a function of collector current; typical value



$I_C = 25\text{ mA}$ ;  $V_{CE} = 3\text{ V}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

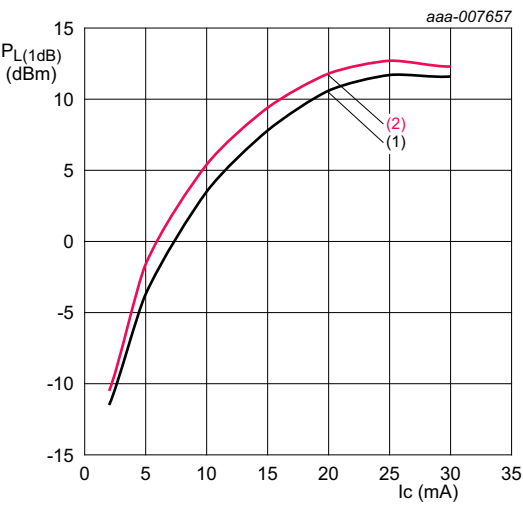
Fig 5. Gain as a function of frequency; typical values



$V_{CE} = 3$  V;  $T_{amb} = 25$  °C.

- (1)  $I_C = 5$  mA
- (2)  $I_C = 10$  mA
- (3)  $I_C = 15$  mA
- (4)  $I_C = 20$  mA
- (5)  $I_C = 25$  mA
- (6)  $I_C = 30$  mA

Fig 6. Minimum noise figure as a function of frequency; typical values



$V_{CE} = 3$  V;  $T_{amb} = 25$  °C.

- (1)  $f = 1.8$  GHz
- (2)  $f = 6$  GHz

Fig 7. Output power at 1 dB gain compression as a function of collector current; typical values

10. Package outline

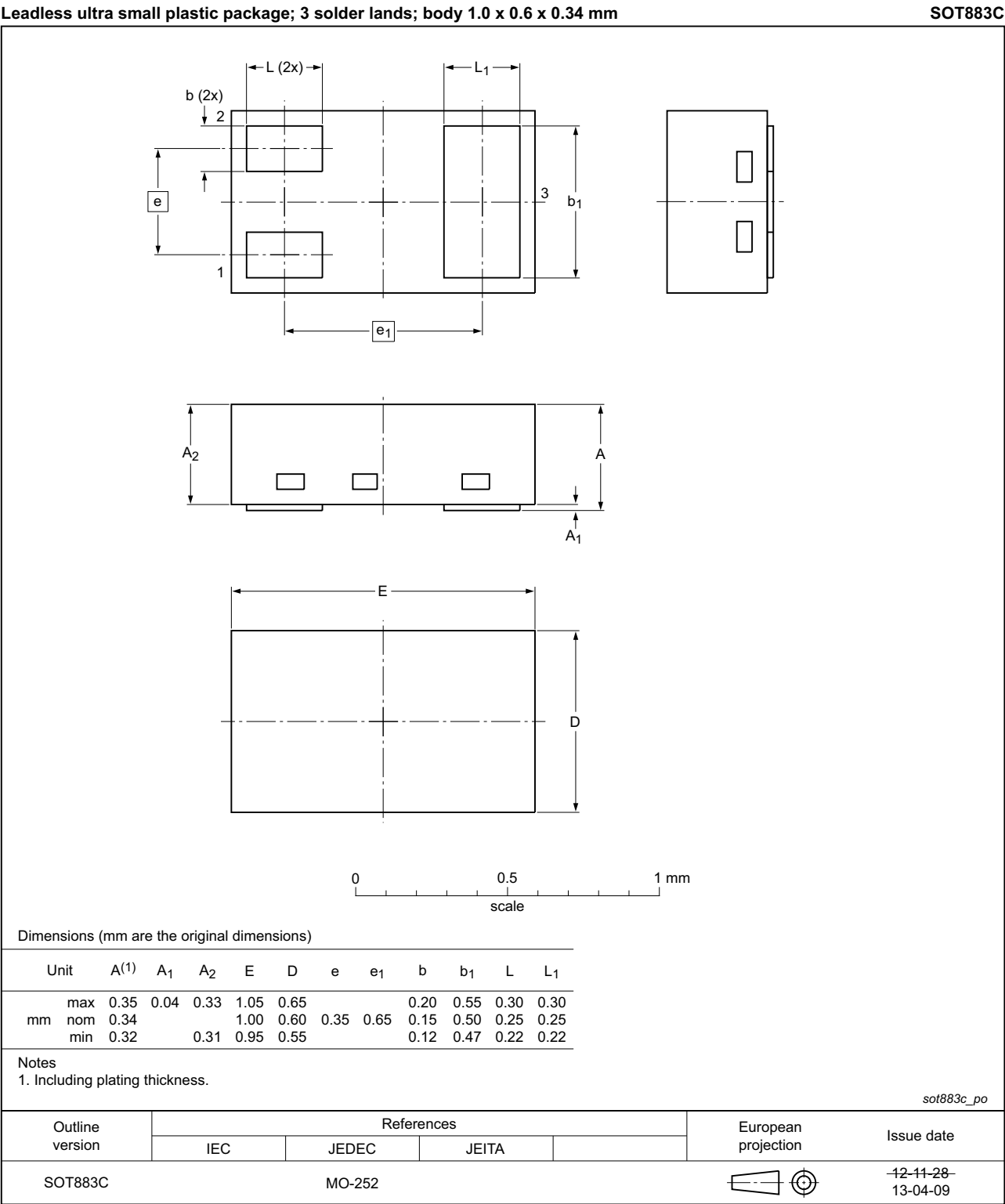


Fig 8. Package outline SOT883C

## 11. Abbreviations

Table 10. Abbreviations

| Acronym | Description                                     |
|---------|-------------------------------------------------|
| AMR     | Automatic Meter Reading                         |
| DBS     | Direct Broadcast Satellite                      |
| DRO     | Dielectric Resonator Oscillator                 |
| GLONASS | GLObal NAVigation Satellite System              |
| GPS     | Global Positioning System                       |
| LNA     | Low Noise Amplifier                             |
| LNB     | Low Noise Block                                 |
| NPN     | Negative-Positive-Negative                      |
| RKE     | Remote Keyless Entry                            |
| SDARS   | Satellite Digital Audio Radio Service           |
| SMD     | Surface-Mounted Device                          |
| WiMAX   | Worldwide Interoperability for Microwave Access |
| WLAN    | Wireless Local Area Network                     |

## 12. Revision history

Table 11. Revision history

| Document ID  | Release date | Data sheet status  | Change notice | Supersedes |
|--------------|--------------|--------------------|---------------|------------|
| BFU730LX v.1 | 20130508     | Product data sheet | -             | -          |

## 13. Legal information

### 13.1 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".

[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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