# BLF647PS

**Broadband power LDMOS transistor**

**Rev. 3 — 1 September 2015**

AMPLEON

**Product data sheet**

## 1. Product profile

### 1.1 General description

A 200 W LDMOS RF power transistor for broadcast transmitter and industrial applications. The transistor is suitable for the frequency range HF to 1500 MHz. The excellent ruggedness and broadband performance of this device makes it ideal for digital applications.

**Table 1. Application information**

*RF performance at $T_h$ = 25 °C in a common source test circuit.*

| Test signal | f | $V_{DS}$ | $I_{Dq}$ | $P_{L(AV)}$ | $P_{L(M)}$ | $G_p$ | $\eta_D$ | IMD3 |
|---|---|---|---|---|---|---|---|---|
| | (MHz) | (V) | (A) | (W) | (W) | (dB) | (%) | (dBc) |
| Pulsed, class-B | 1300 | 32 | 0.1 | - | 200 | 17.5 | 70 | - |
| CW, class-B | 1300 | 32 | 0.1 | 200 | - | 17.5 | 70 | - |
| 2-tone, class-AB | $f_1$ = 1299.95; $f_2$ = 1300.05 | 32 | 0.7 | 75 | - | 19 | 48 | –33 |

### 1.2 Features and benefits

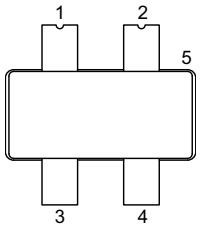
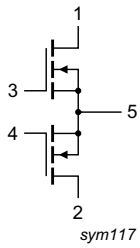
- Integrated ESD protection
- Excellent ruggedness
- High power gain
- High efficiency
- Excellent reliability
- Easy power control
- Compliant to Directive 2002/95/EC, regarding Restriction of Hazardous Substances (RoHS)

### 1.3 Applications

- Communication transmitter applications in the HF to 1500 MHz frequency range
- Industrial applications in the HF to 1500 MHz frequency range

## 2. Pinning information

**Table 2. Pinning**

| Pin | Description | Simplified outline | Graphic symbol |
|---|---|---|---|
| 1 | drain1 |  |  |
| 2 | drain2 | | |
| 3 | gate1 | | |
| 4 | gate2 | | |
| 5 | source [1] | | |





[1] Connected to flange

## 3. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| BLF647PS | - | earless flanged ceramic package; 4 leads | SOT1121B |

## 4. Limiting values

**Table 4. Limiting values**

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | | - | 65 | V |
| $V_{GS}$ | gate-source voltage | | −0.5 | +11 | V |
| $T_{stg}$ | storage temperature | | −65 | +150 | °C |
| $T_j$ | junction temperature | [1] | - | 225 | °C |

[1] Continuous use at maximum temperature will affect the reliability. For details refer to the on-line MTF calculator.

## 5. Thermal characteristics

**Table 5. Thermal characteristics**

| Symbol | Parameter | Conditions | | Typ | Unit |
|---|---|---|---|---|---|
| $R_{th(j-c)}$ | thermal resistance from junction to case | $T_{case}$ = 80 °C; $P_L$ = 200 W | [1] | 0.34 | K/W |

[1] $R_{th(j-c)}$ is measured under RF conditions.

# 6. Characteristics

**Table 6. DC characteristics**

*$T_j$ = 25 °C; per section unless otherwise specified.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $V_{GS}$ = 0 V; $I_D$ = 1.1 mA | 65 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $V_{DS}$ = 28 V; $I_D$ = 110 mA | 1.55 | 1.8 | 2.25 | V |
| $I_{DSS}$ | drain leakage current | $V_{GS}$ = 0 V; $V_{DS}$ = 28 V | - | - | 1.4 | μA |
| $I_{DSX}$ | drain cut-off current | $V_{GS}$ = $V_{GS(th)}$ + 3.75 V; $V_{DS}$ = 20 V | 18.1 | 20 | - | A |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 11 V; $V_{DS}$ = 0 V | - | - | 140 | nA |
| $g_{fs}$ | forward transconductance | $V_{DS}$ = 20 V; $I_D$ = 5500 mA | - | 7.6 | - | S |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS}$ = $V_{GS(th)}$ + 3.75 V; $I_D$ = 3.85 A | - | 140 | - | mΩ |

**Table 7. AC characteristics**

*$T_j$ = 25 °C; per section unless otherwise specified.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | input capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 32 V; f = 1 MHz | - | 78 | - | pF |
| $C_{oss}$ | output capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 32 V; f = 1 MHz | - | 30 | - | pF |
| $C_{rs}$ | feedback capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 32 V; f = 1 MHz | - | 1.3 | - | pF |

**Table 8. RF characteristics**

*Test signal: CW; f = 1300 MHz; RF performance at $V_{DS}$ = 32 V; $I_{Dq}$ = 100 mA; $T_{case}$ = 25 °C; unless otherwise specified; in a class-AB production test circuit.*

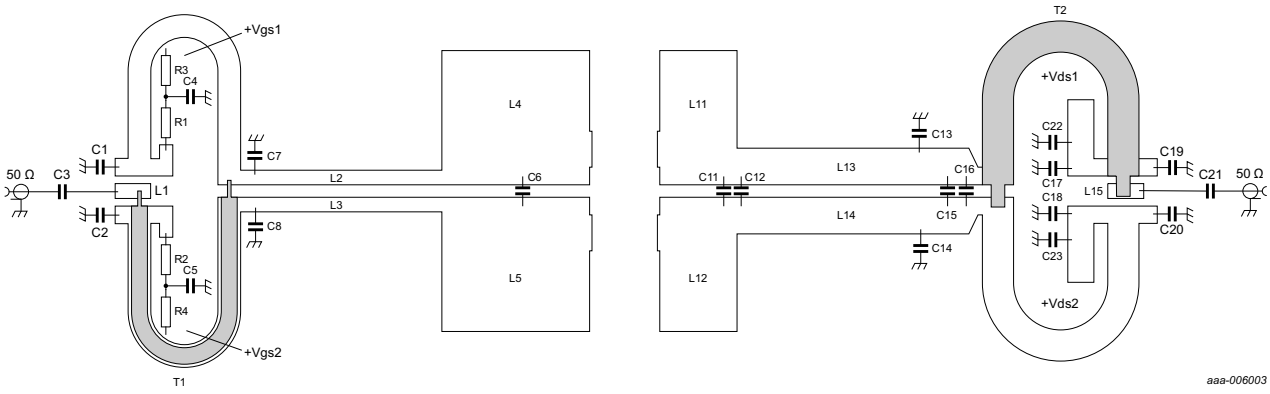
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $G_p$ | power gain | $P_L$ = 200 W | 16.5 | 17.5 | - | dB |
| $\eta_D$ | drain efficiency | $P_L$ = 200 W | 66 | 70 | - | % |

# 7. Test information

## 7.1 Ruggedness in class-AB operation

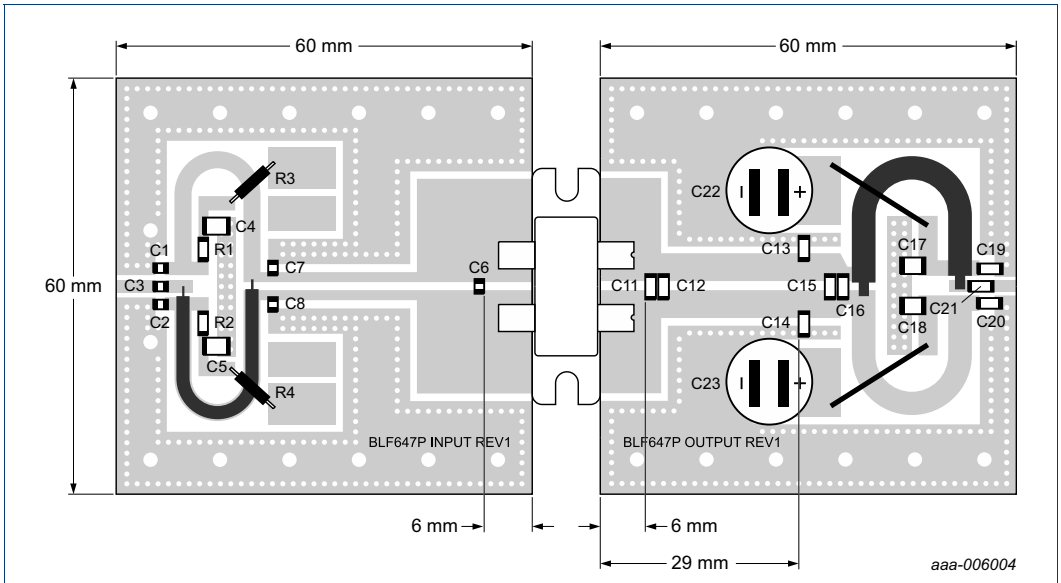
The BLF647PS is capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions: $V_{DS}$ = 32 V; f = 1300 MHz at rated load power.

## 7.2 Test circuit information




See Table 9 for a list of components.

**Fig 1. Schematic for class-AB production test circuit**




See Table 9 for a list of components.

**Fig 2. Component layout for class-AB production test circuit**

**Table 9. List of components**

*Printed-Circuit Board (PCB): RF 35; $\varepsilon_r$ = 3.5 F/m; thickness = 0.765 mm; thickness copper plating = 35 μm. See Figure 1 and Figure 2.*

| Component | Description | Value | | Remarks |
|---|---|---|---|---|
| C1, C2, C3 | multilayer ceramic chip capacitor | 68 pF | [1] | |
| C4, C5 | multilayer ceramic chip capacitor | 4.7 μF, 50 V | | |
| C6 | multilayer ceramic chip capacitor | 2.4 pF | [2] | |
| C7, C8 | multilayer ceramic chip capacitor | 4.7 pF | [1] | |
| C11 | multilayer ceramic chip capacitor | 3.3 pF | [3] | |
| C12 | multilayer ceramic chip capacitor | 2.4 pF | [3] | |
| C13, C14 | multilayer ceramic chip capacitor | 3.3 pF | [3] | |
| C15, C16 | multilayer ceramic chip capacitor | 1.2 pF | [3] | |
| C17, C18 | multilayer ceramic chip capacitor | 4.7 μF, 50 V | | |
| C19, C20, C21 | multilayer ceramic chip capacitor | 220 pF | [3] | |
| C22, C23 | electrolytic capacitor | 470 μF, 63 V | | |
| L1 | microstrip | | | (L × W) 4 mm × 1.7 mm |
| L2, L3 | microstrip | | | (L × W) 22.5 mm × 1.6 mm |
| L4, L5 | microstrip | | | (L × W) 16.5 mm × 15 mm |
| L11, L12 | microstrip | | | (L × W) 8.5 mm × 15 mm |
| L13, L14 | microstrip | | | (L × W) 26 mm × 4.2 mm |
| L15 | microstrip | | | (L × W) 4 mm × 1.7 mm |
| R1, R2 | SMD resistor | 5.6 Ω | | SMD1206 |
| R3, R4 | wire resistor | 100 Ω | | |
| T1 | semi rigid coax | 25 Ω, 40 mm | | Micro-Coax UT-090C-25 |
| T2 | semi rigid coax | 25 Ω, 40 mm | | Micro-Coax UT-141C-25 |

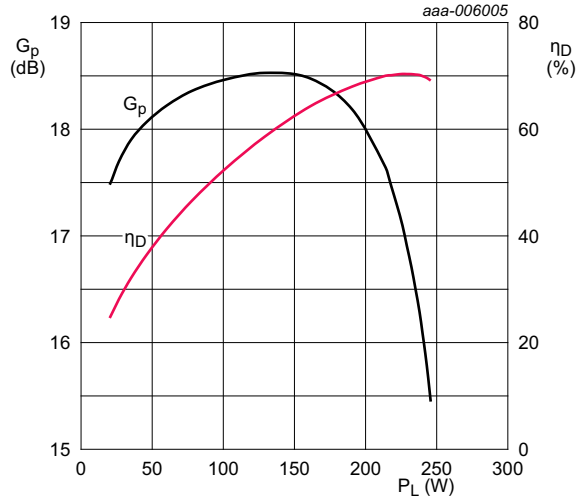
[1] American Technical Ceramics type 800A or capacitor of same quality.

[2] American Technical Ceramics type 100A or capacitor of same quality.

[3] American Technical Ceramics type 800B or capacitor of same quality.

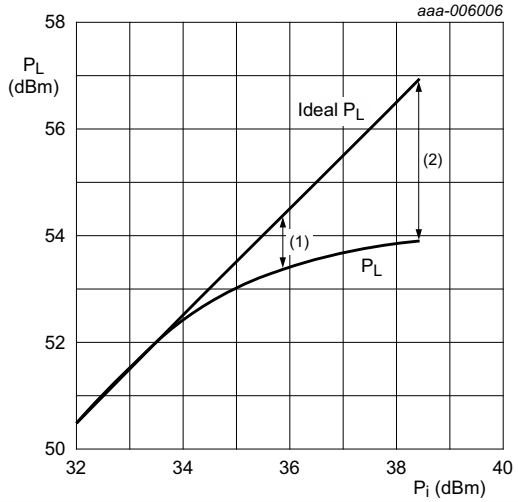
## 7.3 Graphical data

### 7.3.1 1-Tone CW




$V_{DS}$ = 32 V; $I_{Dq}$ = 100 mA; f = 1300 MHz.

**Fig 3. Power gain and drain efficiency as function of output power; typical values**

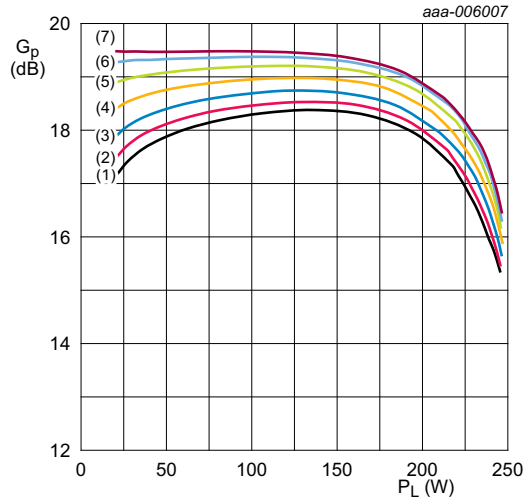



$V_{DS}$ = 32 V; $I_{Dq}$ = 100 mA; f = 1300 MHz.

(1) $P_{L(1dB)}$ = 53.4 dBm (217 W)

(2) $P_{L(3dB)}$ = 53.9 dBm (245 W)

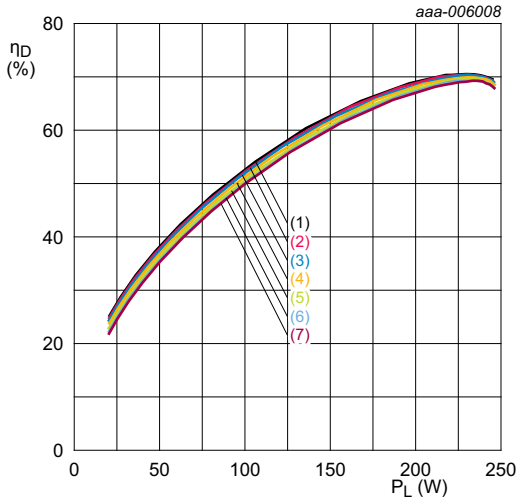
**Fig 4. Output power as a function of input power; typical values**




$V_{DS}$ = 32 V; f = 1300 MHz.

(1) $I_{Dq}$ = 50 mA
(2) $I_{Dq}$ = 100 mA
(3) $I_{Dq}$ = 200 mA
(4) $I_{Dq}$ = 300 mA
(5) $I_{Dq}$ = 700 mA
(6) $I_{Dq}$ = 1000 mA
(7) $I_{Dq}$ = 1200 mA

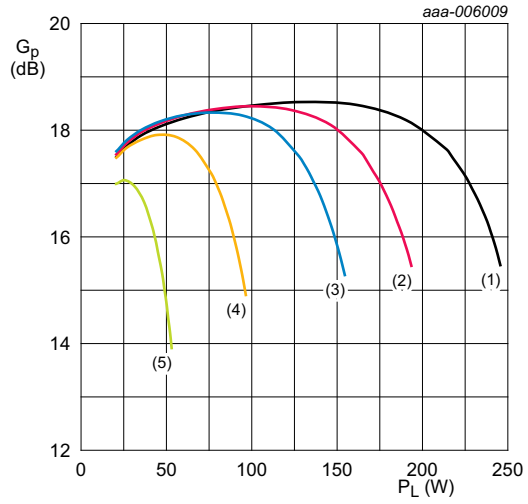
**Fig 5. Power gain as a function of output power; typical values**




$V_{DS}$ = 32 V; f = 1300 MHz.

(1) $I_{Dq}$ = 50 mA
(2) $I_{Dq}$ = 100 mA
(3) $I_{Dq}$ = 200 mA
(4) $I_{Dq}$ = 300 mA
(5) $I_{Dq}$ = 700 mA
(6) $I_{Dq}$ = 1000 mA
(7) $I_{Dq}$ = 1200 mA

**Fig 6. Drain efficiency as a function of output power; typical values**




$I_{Dq}$ = 100 mA; f = 1300 MHz.

(1) $V_{DS}$ = 32 V

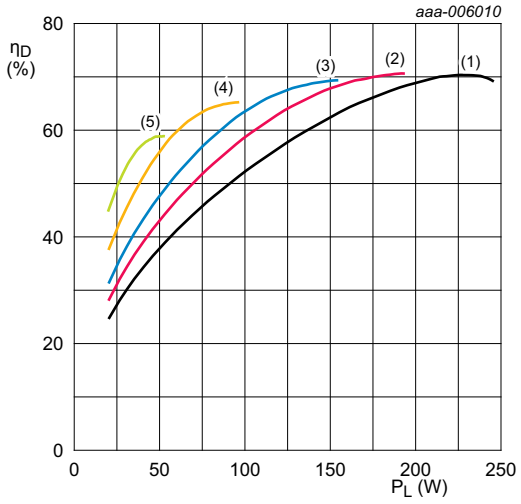
(2) $V_{DS}$ = 28 V

(3) $V_{DS}$ = 25 V

(4) $V_{DS}$ = 20 V

(5) $V_{DS}$ = 15 V

**Fig 7. Power gain as a function of output power; typical values**




$I_{Dq}$ = 100 mA; f = 1300 MHz.

(1) $V_{DS}$ = 32 V

(2) $V_{DS}$ = 28 V

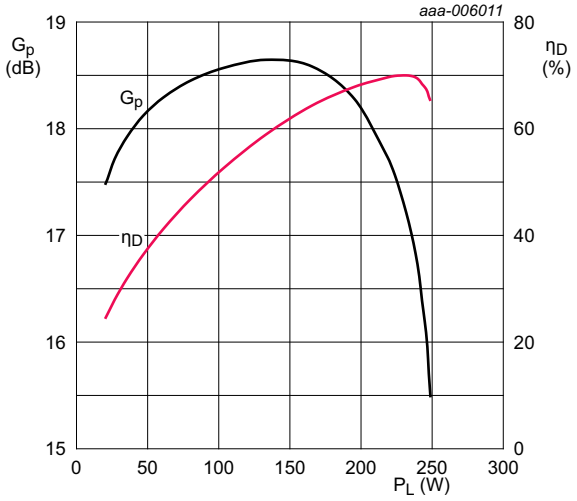
(3) $V_{DS}$ = 25 V

(4) $V_{DS}$ = 20 V

(5) $V_{DS}$ = 15 V

**Fig 8. Drain efficiency as a function of output power; typical values**

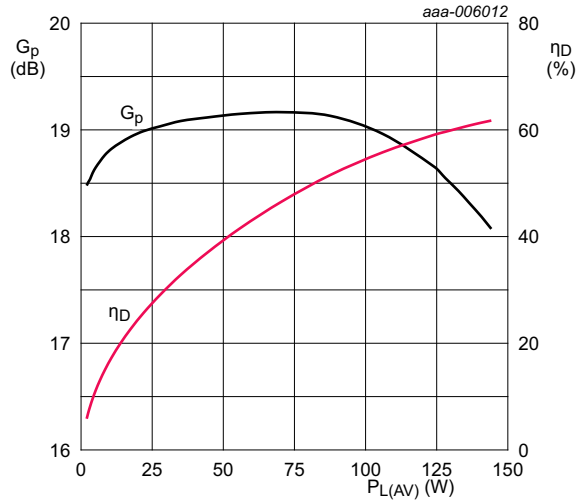
### 7.3.2 1-Tone pulsed




$V_{DS}$ = 32 V; $I_{Dq}$ = 100 mA; f = 1300 MHz; $t_p$ = 100 μs; δ = 20 %.

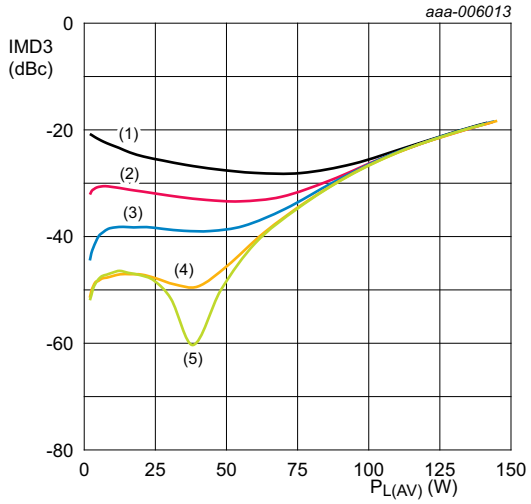
**Fig 9. Power gain and drain efficiency as function of output power; typical values**

### 7.3.3 2-Tone CW




$V_{DS}$ = 50 V; $I_{Dq}$ = 700 mA; $f_1$ = 1299.95 MHz; $f_2$ = 1300.05 MHz.

**Fig 10. Power gain and drain efficiency as function of average output power; typical values**



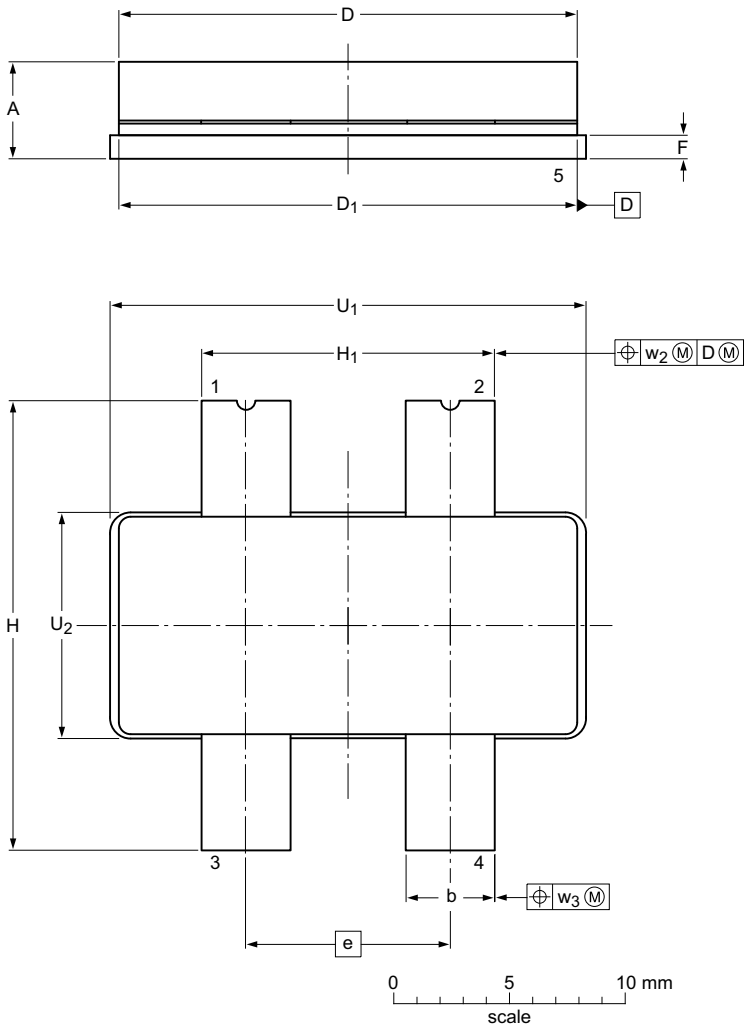

$V_{DS}$ = 32 V; $f_1$ = 1299.95 MHz; $f_2$ = 1300.05 MHz.

(1) $I_{Dq}$ = 100 mA
(2) $I_{Dq}$ = 400 mA
(3) $I_{Dq}$ = 700 mA
(4) $I_{Dq}$ = 1000 mA
(5) $I_{Dq}$ = 1200 mA

**Fig 11. Third order intermodulation distortion as a function of average output power; typical values**

# 8. Package outline

**Earless flanged ceramic package; 4 leads** **SOT1121B**




Dimensions

| Unit[1] | | A | b | c | D | $D_1$ | e | E | $E_1$ | F | H | $H_1$ | Q | $U_1$ | $U_2$ | $w_2$ | $w_3$ | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 4.75 | 3.94 | 0.18 | 20.02 | 19.96 | | 9.53 | 9.53 | 1.14 | 19.94 | 12.83 | 1.70 | 20.70 | 9.91 | 0.51 | 0.25 | 0.25 |
| | nom | | | | | | 8.89 | | | | | | | | | | | |
| | min | 3.45 | 3.68 | 0.08 | 19.61 | 19.66 | | 9.27 | 9.27 | 0.89 | 18.92 | 12.57 | 1.45 | 20.45 | 9.65 | | | |
| inches | max | 0.187 | 0.155 | 0.007 | 0.788 | 0.786 | | 0.375 | 0.375 | 0.045 | 0.785 | 0.505 | 0.067 | 0.815 | 0.39 | 0.02 | 0.01 | 0.01 |
| | nom | | | | | | 0.35 | | | | | | | | | | | |
| | min | 0.136 | 0.145 | 0.003 | 0.772 | 0.774 | | 0.365 | 0.365 | 0.035 | 0.745 | 0.495 | 0.057 | 0.805 | 0.38 | | | |

Note
1. millimeter dimensions are derived from the original inch dimensions.
2. dimension is measured 0.030 inch (0.76 mm) from the body.

*sot1121b_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT1121B | | | | | | ~~09-12-14~~ 12-06-07 |

**Fig 12. Package outline SOT1121B**

## 9. Handling information

| CAUTION | |
|---|---|
|  | This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.<br>Such precautions are described in the *ANSI/ESD S20.20*, *IEC/ST 61340-5*, *JESD625-A* or equivalent standards. |

## 10. Abbreviations

**Table 10. Abbreviations**

| Acronym | Description |
|---|---|
| CW | Continuous Wave |
| ESD | ElectroStatic Discharge |
| HF | High Frequency |
| LDMOS | Laterally Diffused Metal Oxide Semiconductor |
| SMD | Surface Mounted Device |
| VSWR | Voltage Standing-Wave Ratio |

## 11. Revision history

**Table 11. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BLF647PS#3 | 20150901 | Product data sheet | - | BLF647P_BLF647PS v.2 |
| Modifications: | • The format of this document has been redesigned to comply with the new identity guidelines of Ampleon.<br>• Legal texts have been adapted to the new company name where appropriate. | | | |
| BLF647PS v.2 | 20131118 | Product data sheet | - | BLF647P_BLF647PS v.1 |
| BLF647P_BLF647PS v.1 | 20120803 | Objective data sheet | - | - |

# 12. Legal information

## 12.1 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.ampleon.com.

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## 14. Contents





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**Date of release: 1 September 2015**
**Document identifier: BLF647PS#3**