# BLF984P; BLF984PS

**Power LDMOS transistor**

AMPLEON

**Rev. 3 — 14 August 2024** **Product data sheet**

## 1. Product profile

### 1.1 General description

A 450 W LDMOS RF power transistor for broadcast Doherty, class-AB transmitter and industrial applications. The excellent ruggedness of this device makes it ideal for digital and analog transmitter applications in the frequency range from 30 MHz to 860 MHz.

**Table 1. Typical information**

*RF performance at $T_{case}$ = 25 °C; $I_{Dq}$ = 2 × 325 mA; in a class-AB test circuit, unless otherwise specified, typical values.*

| Test signal | f | $V_{DS}$ | $P_L$ | $G_p$ | $\eta_D$ | $IMD_{shldr}$ | PAR |
|---|---|---|---|---|---|---|---|
| | (MHz) | (V) | (W) | (dB) | (%) | (dBc) | (dB) |
| DVB-T (8k OFDM) | 700 | 50 | 80 (AV) | 22.5 | 34 | −30 [1] | 8 [2] |
| pulsed CW [3] | 700 | 50 | 450 (peak) | 22 | 67.5 | - | - |
| CW [4] | 30 to 520 | 28 | 80 | 19.2 | 50.5 | - | - |

[1] Measured [dBc] with delta marker at 4.3 MHz from center frequency.

[2] PAR (of output signal) at 0.01 % probability on CCDF; PAR of input signal = 9.5 dB at 0.01 % probability on CCDF.

[3] $t_p$ = 100 μs; δ = 10 %.

[4] Center band performance numbers across the indicated frequency range measured with total $I_{Dq}$ of 300 mA.

### 1.2 Features and benefits

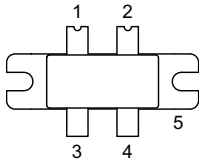
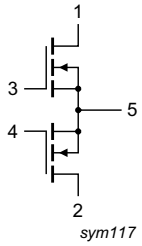
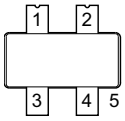
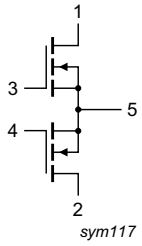
- Designed for broadband and Doherty operation
- High efficiency
- Integrated double sided ESD protection
- Excellent ruggedness
- High power gain
- Excellent reliability
- Easy power control
- Excellent stability
- For RoHS compliance see the product details on the Ampleon website

### 1.3 Applications

- Broadcast transmitter applications in the UHF band
- Digital and analog broadcasting
- Industrial, scientific and medical applications
- Applicable at frequencies from 30 MHz to 860 MHz

## 2. Pinning information

**Table 2. Pinning**

| Pin | Description | Simplified outline | Graphic symbol |
|---|---|---|---|
| **BLF984P (SOT1121A)** | | | |
| 1 | drain1 |  |  |
| 2 | drain2 | | |
| 3 | gate1 | | |
| 4 | gate2 | | |
| 5 | source [1] | | |
| **BLF984PS (SOT1121B)** | | | |
| 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 |
| BLF984P | - | flanged LDMOST ceramic package; 2 mounting holes; 4 leads | SOT1121A |
| BLF984PS | - | 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 | | - | 108 | V |
| $V_{GS}$ | gate-source voltage | | –6 | +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 online MTF calculator.

# 5. Thermal characteristics

**Table 5. Thermal characteristics**

| Symbol | Parameter | Conditions | Typ | Unit |
|---|---|---|---|---|
| $R_{th(j-c)}$ | thermal resistance from junction to case | $T_{case}$ = 85 °C; $P_{L(AV)}$ = 80 W [1] | 0.23 | K/W |

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

# 6. Characteristics

**Table 6. DC characteristics**

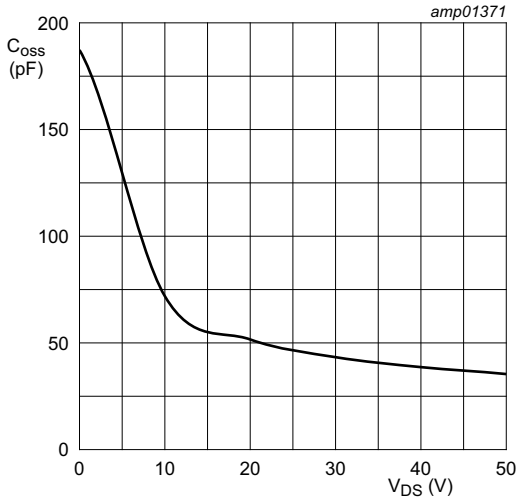
*$T_j$ = 25 °C; per section unless otherwise specified.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $V_{GS}$ = 0 V; $I_D$ = 1.2 mA | 108 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $V_{DS}$ = 10 V; $I_D$ = 120 mA | 1.5 | 2.0 | 2.5 | V |
| $I_{DSS}$ | drain leakage current | $V_{GS}$ = 0 V; $V_{DS}$ = 50 V | - | - | 1.4 | µA |
| $I_{DSX}$ | drain cut-off current | $V_{GS}$ = $V_{GS(th)}$ + 3.75 V; $V_{DS}$ = 10 V | - | 22 | - | A |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 10 V; $V_{DS}$ = 0 V | - | - | 140 | nA |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS}$ = $V_{GS(th)}$ + 3.75 V; $I_D$ = 4.2 A | - | 180 | - | mΩ |

**Table 7. AC characteristics**

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $C_{rs}$ | feedback capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 50 V; f = 1 MHz | - | 0.42 | - | pF |
| $C_{iss}$ | input capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 50 V; f = 1 MHz | - | 176 | - | pF |
| $C_{oss}$ | output capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 50 V; f = 1 MHz | - | 35 | - | pF |




$V_{GS}$ = 0 V; f = 1 MHz.

**Fig 1. Output capacitance as a function of drain-source voltage; typical values per section**

**Table 8. RF characteristics**

*RF characteristics in Ampleon production test circuit, $T_{case}$ = 25 °C; unless otherwise specified.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **DVB-T (8k OFDM), class-AB operation** | | | | | | |
| $V_{DS}$ | drain-source voltage | | - | 50 | - | V |
| $I_{Dq}$ | quiescent drain current | per section | - | 325 | - | mA |
| $P_{L(AV)}$ | average output power | f = 700 MHz | 78.4 | 80 | 81.6 | W |
| $G_p$ | power gain | f = 700 MHz | 21.8 | 22.5 | - | dB |
| $\eta_D$ | drain efficiency | f = 700 MHz | 31 | 34 | - | % |
| ACPR | adjacent channel power ratio | f = 700 MHz | - | −30 | −27 | dBc |
| PAR | peak-to-average ratio | f = 700 MHz | 7.2 | 8 | 8.4 | dB |

# 7. Test information

## 7.1 Ruggedness in class-AB operation

The BLF984P and BLF984PS are capable of withstanding a load mismatch corresponding to VSWR ≥ 40 : 1 through all phases under the following conditions: $V_{DS}$ = 60 V; f = 700 MHz; $P_{L(AV)}$ = 80 W; DVB-T; PAR = 8 dB.

## 7.2 Impedance information

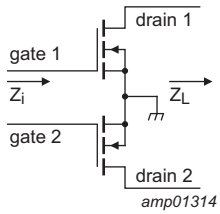


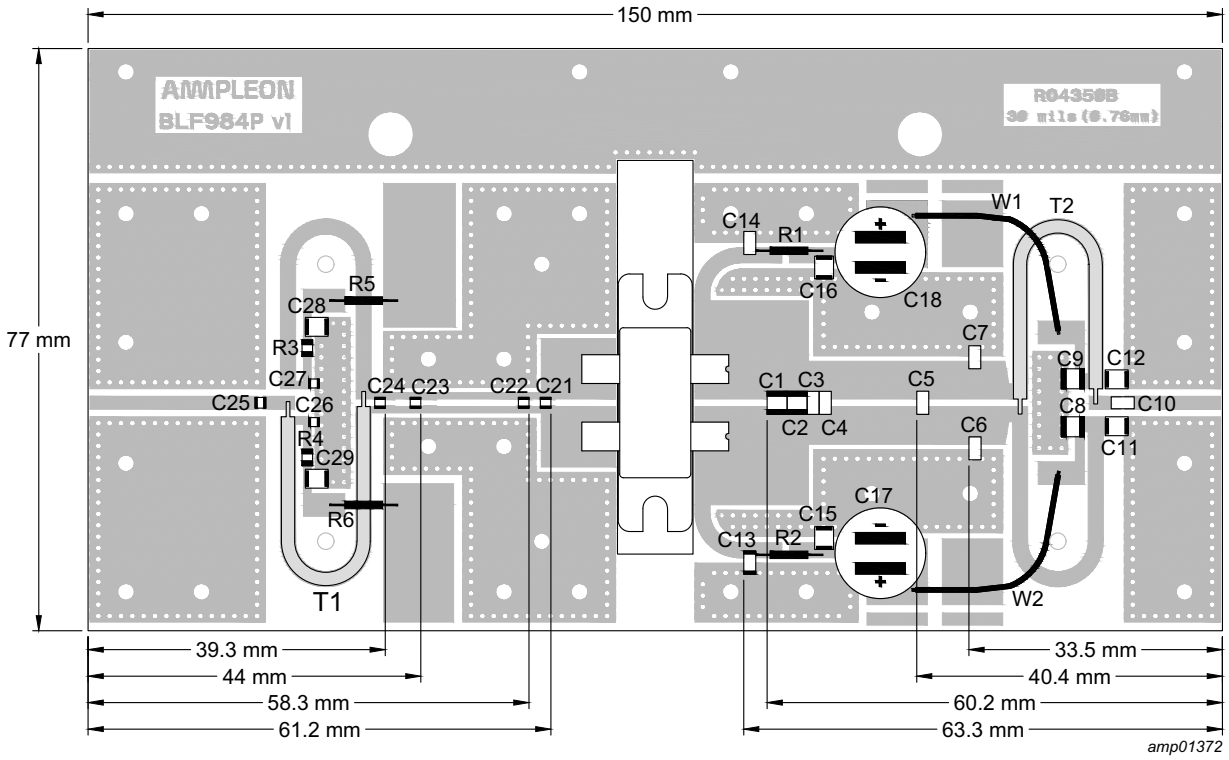

**Fig 2. Definition of transistor impedance**

**Table 9. Typical push-pull impedance**

*Simulated $Z_i$ and $Z_L$ device impedance; impedance info at $V_{DS}$ = 50 V and $P_{L(AV)}$ = 80 W (DVB-T).*

| f | $Z_i$ | $Z_L$ |
|---|---|---|
| (MHz) | (Ω) | (Ω) |
| 300 | 1.039 – j5.449 | 7.509 + j0.721 |
| 325 | 0.996 – j4.490 | 7.461 + j0.770 |
| 350 | 0.972 – j3.609 | 7.409 + j0.817 |
| 375 | 0.962 – j2.786 | 7.355 + j0.861 |
| 400 | 0.967 – j2.003 | 7.298 + j0.902 |
| 425 | 0.985 – j1.248 | 7.239 + j0.941 |
| 450 | 1.016 – j0.508 | 7.176 + j0.977 |
| 475 | 1.062 + j0.229 | 7.112 + j1.009 |
| 500 | 1.124 + j0.973 | 7.046 + j1.039 |
| 525 | 1.206 + j1.739 | 6.977 + j1.066 |
| 550 | 1.311 + j2.538 | 6.907 + j1.090 |
| 575 | 1.448 + j3.387 | 6.835 + j1.110 |
| 600 | 1.625 + j4.307 | 6.762 + j1.128 |
| 625 | 1.858 + j5.323 | 6.688 + j1.142 |
| 650 | 2.170 + j6.470 | 6.612 + j1.153 |
| 675 | 2.598 + j7.796 | 6.535 + j1.161 |
| 700 | 3.206 + j9.372 | 6.458 + j1.166 |
| 725 | 4.106 + j11.298 | 6.380 + j1.167 |
| 750 | 5.516 + j13.726 | 6.301 + j1.166 |
| 775 | 7.890 + j16.867 | 6.222 + j1.161 |
| 800 | 12.268 + j20.922 | 6.142 + j1.154 |
| 825 | 21.207 + j25.389 | 6.063 + j1.144 |
| 850 | 39.606 + j24.564 | 5.983 + j1.130 |
| 875 | 57.589 – j1.016 | 5.904 + j1.114 |
| 900 | 39.887 – j28.218 | 5.824 + j1.095 |
| 925 | 20.026 – j28.829 | 5.745 + j1.074 |
| 950 | 10.693 – j23.560 | 5.666 + j1.049 |
| 975 | 6.354 – j18.981 | 5.588 + j1.022 |
| 1000 | 4.114 – j15.546 | 5.510 + j0.993 |

## 7.3 Test circuit




Printed-Circuit Board (PCB): Rogers RO4350B; $\varepsilon_r$ = 3.48 F/m; height = 0.762 mm; Cu (top/bottom metallization); thickness copper plating = 35 μm.

See Table 10 for a list of components.

**Fig 3. Component layout**

**Table 10. List of components**

*For test circuit see Figure 3.*

| Component | Description | Value | Remarks |
|---|---|---|---|
| C1, C2 | multilayer ceramic chip capacitor | 5.1 pF | ATC800B5R1BT500XT |
| C3, C4 | multilayer ceramic chip capacitor | 6.8 pF | ATC800B6R8BT500XT |
| C5 | multilayer ceramic chip capacitor | 8.2 pF | ATC800B8R2BT500XT |
| C6, C7 | multilayer ceramic chip capacitor | 10 pF | ATC800B100FT500XT |
| C8, C9, C10, C13, C14 | multilayer ceramic chip capacitor | 100 pF | ATC800B101JT500XT |
| C11, C12, C28, C29 | multilayer ceramic chip capacitor | 4.7 μF, 100 V | Murata: GMR31CC72A475KE11L, SMD 1210 |
| C15, C16 | multilayer ceramic chip capacitor | 10 μF, 100 V | SMD 1210 |
| C17, C18 | electrolytic capacitor | 470 μF, 63 V | axial |
| C21 | multilayer ceramic chip capacitor | 11 pF | ATC800A110GT250XT |
| C22 | multilayer ceramic chip capacitor | 4.7 pF | ATC800A4R7BT250XT |
| C23 | multilayer ceramic chip capacitor | 22 pF | ATC800A220JT250XT |
| C24 | multilayer ceramic chip capacitor | 18 pF | ATC800A180JT250XT |
| C25, C26, C27 | multilayer ceramic chip capacitor | 100 pF | ATC800A101JT250XT |
| R1, R2 | wire resistor | 10 Ω, 0.6 W | |

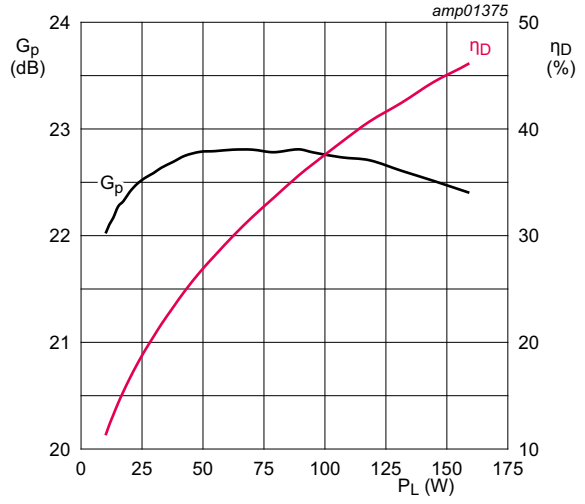
**Table 10. List of components** *…continued*
*For test circuit see Figure 3.*

| Component | Description | Value | Remarks |
|---|---|---|---|
| R3, R4 | resistor | 5.6 Ω | SMD 0805 |
| R5, R6 | wire resistor | 100 Ω, 0.6 W | |
| T1 | semi rigid coax | 25 Ω, 50 mm | EZ90-25 |
| T2 | semi rigid coax | 25 Ω, 50 mm | EZ90-25 |
| W1, W2 | wire | | 0.75 $mm^2$ conductor cross section |

## 7.4 Graphical data

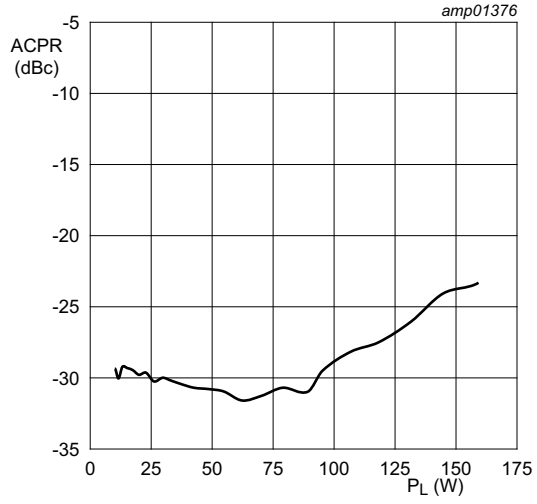
### 7.4.1 DVB-T

Measured in a narrowband RF production test circuit



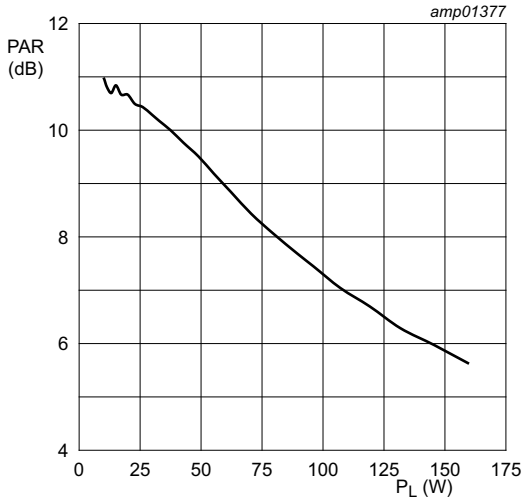

f = 700 MHz; $V_{DS}$ = 50 V; $I_{Dq}$ = 2 × 325 mA.

**Fig 4. Power gain and drain efficiency as function of output power; typical values**




f = 700 MHz; $V_{DS}$ = 50 V; $I_{Dq}$ = 2 × 325 mA.

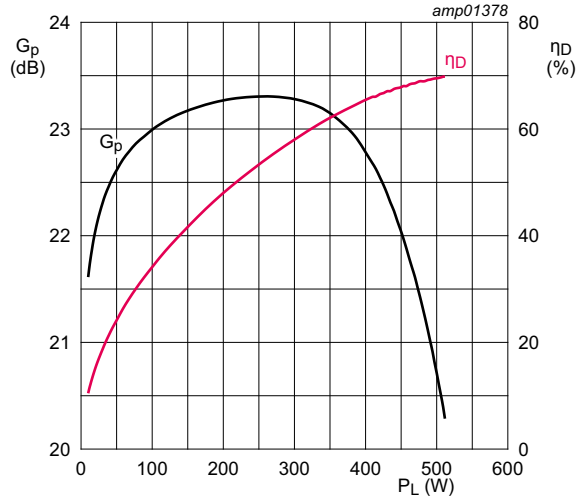
**Fig 5. Adjacent channel power ratio as a function of output power; typical values**




f = 700 MHz; $V_{DS}$ = 50 V; $I_{Dq}$ = 2 × 325 mA.

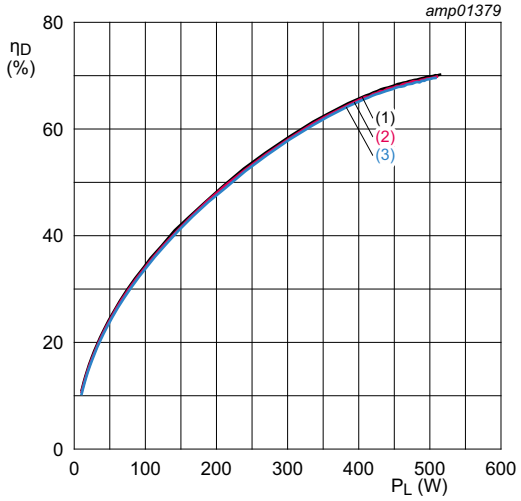
**Fig 6. Peak-to-average power ratio as a function of output power; typical values**

### 7.4.2 Pulsed CW




$V_{DS}$ = 50 V; f = 700 MHz; $I_{Dq}$ = 2 × 325 mA; $t_p$ = 100 μs; δ = 10 %.

**Fig 7. Power gain and drain efficiency as function of output power; typical values**



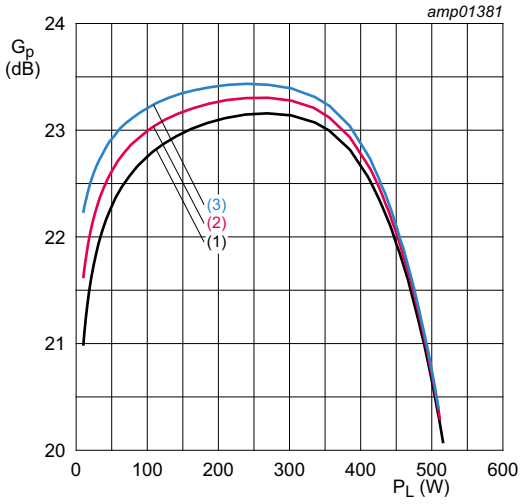

$V_{DS}$ = 50 V; f = 700 MHz; $t_p$ = 100 μs; δ = 10 %.

(1) $I_{Dq}$ = 225 mA

(2) $I_{Dq}$ = 325 mA

(3) $I_{Dq}$ = 425 mA

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




$V_{DS}$ = 50 V; f = 700 MHz; $t_p$ = 100 μs; δ = 10 %.

(1) $I_{Dq}$ = 225 mA

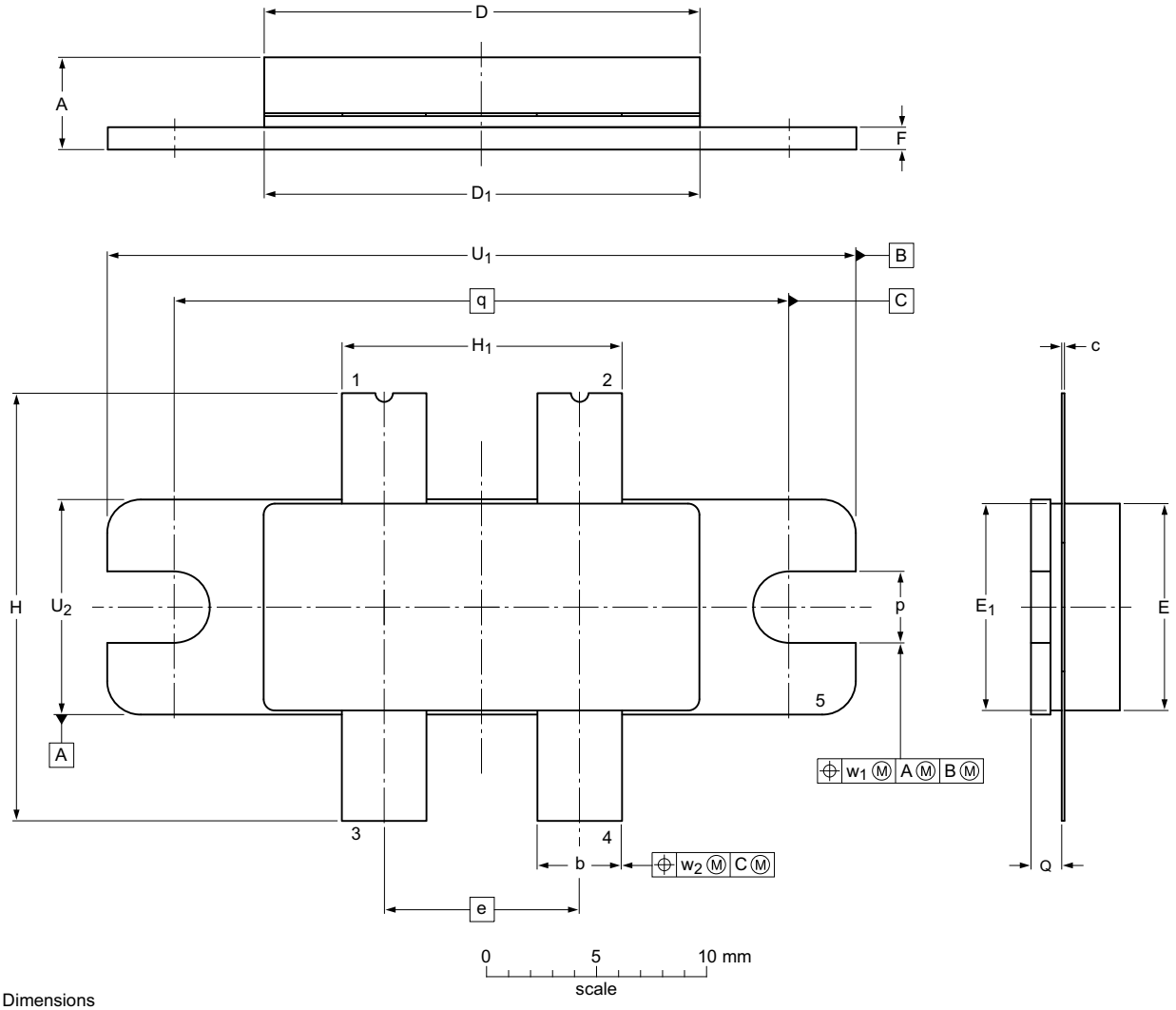
(2) $I_{Dq}$ = 325 mA

(3) $I_{Dq}$ = 425 mA

**Fig 9. Power gain as a function of output power; typical values**

## 8. Package outline

**Flanged LDMOST ceramic package; 2 mounting holes; 4 leads** **SOT1121A**




Dimensions

| Unit[1] | | A | b | c | D | D1 | e | E | E1 | F | H | H1 | p | Q[2] | q | U1 | U2 | w1 | w2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 4.75 | 3.94 | 0.18 | 20.02 | 19.96 | | 9.53 | 9.53 | 1.14 | 19.94 | 12.83 | 3.38 | 1.70 | | 34.16 | 9.91 | | |
| | nom | | | | | | 8.89 | | | | | | | | 27.94 | | | 0.25 | 0.51 |
| | min | 3.45 | 3.68 | 0.10 | 19.61 | 19.66 | | 9.27 | 9.27 | 0.89 | 18.92 | 12.57 | 3.12 | 1.45 | | 33.91 | 9.65 | | |
| inches | max | 0.187 | 0.155 | 0.007 | 0.788 | 0.786 | | 0.375 | 0.375 | 0.045 | 0.785 | 0.505 | 0.133 | 0.067 | | 1.345 | 0.39 | | |
| | nom | | | | | | 0.35 | | | | | | | | 1.1 | | | 0.01 | 0.02 |
| | min | 0.136 | 0.145 | 0.004 | 0.772 | 0.774 | | 0.365 | 0.365 | 0.035 | 0.745 | 0.495 | 0.123 | 0.057 | | 1.335 | 0.38 | | |

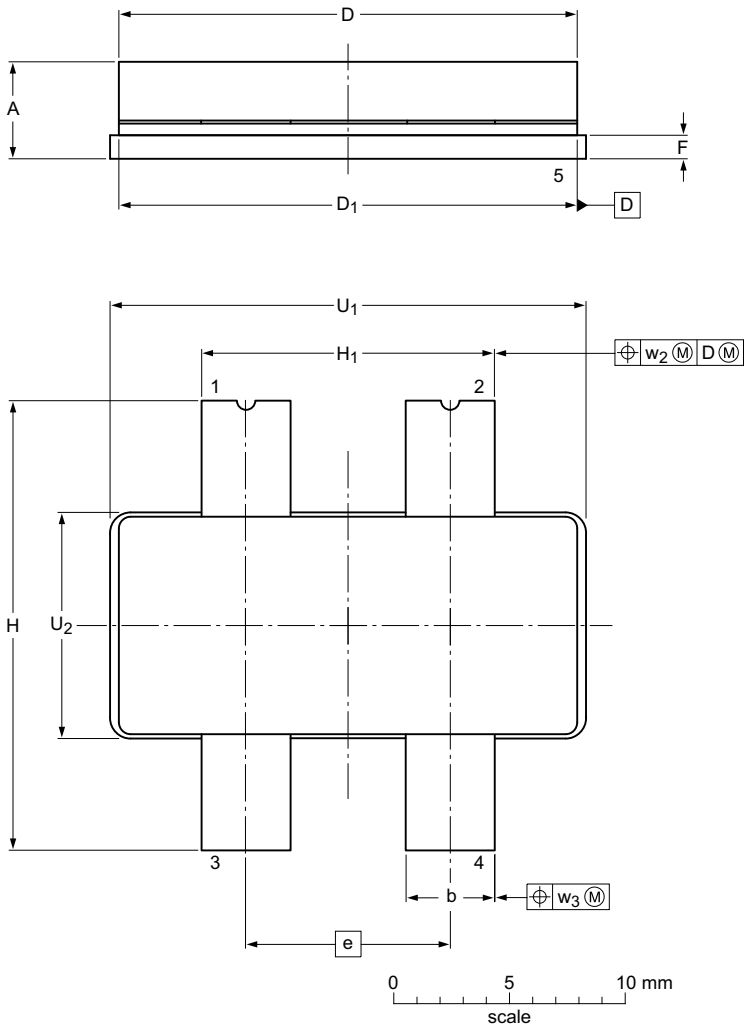
Note
1. millimeter dimensions are derived from the original inch dimensions.
2. dimension is measured 0.030 inch (0.76 mm) from the body.

*sot1121a_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT1121A | | | | | | ~~09-10-12~~ 10-02-02 |

**Fig 10. Package outline SOT1121A**

**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 | 0.10 |
| | 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 | 0.004 |
| | 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 | | | | | | ~~12-06-07~~ 15-07-21 |

**Fig 11. Package outline SOT1121B**

## 9. 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.

**Table 11. ESD sensitivity**

| ESD model | Class |
|---|---|
| Charged Device Model (CDM); According to ANSI/ESDA/JEDEC standard JS-002 | C2A |
| Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001 | 2 |

## 10. Abbreviations

**Table 12. Abbreviations**

| Acronym | Description |
|---|---|
| CCDF | Complementary Cumulative Distribution Function |
| DVB-T | Digital Video Broadcast - Terrestrial |
| ESD | ElectroStatic Discharge |
| LDMOS | Laterally Diffused Metal-Oxide Semiconductor |
| LDMOST | Laterally Diffused Metal-Oxide Semiconductor Transistor |
| MTF | Median Time to Failure |
| OFDM | Orthogonal Frequency Division Multiplexing |
| PAR | Peak-to-Average Ratio |
| RoHS | Restriction of Hazardous Substances |
| SMD | Surface Mounted Device |
| UHF | Ultra High Frequency |
| VSWR | Voltage Standing Wave Ratio |

## 11. Revision history

**Table 13. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BLF984P_BLF984PS v.3 | 20240814 | Product data sheet | - | BLF984P_BLF984PS v.2 |
| Modifications: | • Section 1.1 on page 1: changed in first paragraph 400 MHz to 30 MHz<br>• Table 1 on page 1: updated<br>• Section 1.3 on page 1: changed 400 MHz to 30 MHz<br>• Section 7.2 on page 5: section added | | | |
| BLF984P_BLF984PS v.2 | 20200729 | Product data sheet | - | BLF984P_BLF984PS v.1 |
| BLF984P_BLF984PS v.1 | 20200430 | Product 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.

## 12.2 Definitions

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