# BLF989; BLF989S

## UHF power LDMOS transistor

Rev. 3 — 24 May 2019

AMPLEON

Product data sheet

# 1. Product profile

## 1.1 General description

A 900 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 400 MHz to 860 MHz.

**Table 1. Application information**

*RF performance at $V_{DS}$ = 50 V in a class-AB broadband application demo, unless otherwise specified.*

| Test signal | f | $V_{DS}$ | $P_{L(AV)}$ | $G_p$ | $\eta_D$ | $IMD_{shldr}$ | PAR |
|---|---|---|---|---|---|---|---|
| | (MHz) | (V) | (W) | (dB) | (%) | (dBc) | (dB) |
| class-AB broadband/DVB-T (8k OFDM) | 470 to 710 | 50 | 150 | 20 | 34 | −30 | 8.2 [1] |
| symmetric Doherty/DVB-T (8k OFDM) [2][3] | 470 to 500 | 50 | 300 | 19 | 50 | −37 | - |
| symmetric Doherty/DVB-T (8k OFDM) [4][5] | 474 to 490 | 50 | 200 | 19 | 53 | −41 | - |

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

[2] ProTelevision 3000 Exciter corrected DVB-T.

[3] Narrowband classical Doherty application using two transistors.

[4] Anywave CTTB exciter XS.

[5] Narrowband Doherty using one transistor.

## 1.2 Features and benefits

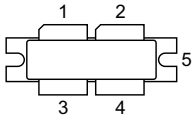
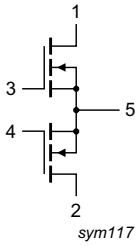
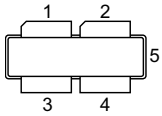
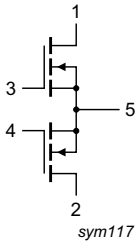
- Designed for broadband and Doherty operation
- High efficiency
- Integrated dual sided ESD protection
- Excellent ruggedness
- High power gain
- Excellent reliability
- Easy power control
- Excellent stability
- For RoHS compliance see the product details on the Ampleon website

## 1.3 Applications

- Broadcast transmitter applications in the UHF band
- Digital and analog broadcasting
- Industrial, scientific and medical applications
- Applicable at frequencies from 400 MHz to 860 MHz

## 2. Pinning information

**Table 2. Pinning**

| Pin | Description | Simplified outline | Graphic symbol |
|---|---|---|---|
| **BLF989 (SOT539A)** | | | |
| 1 | drain1 |  |  |
| 2 | drain2 | | |
| 3 | gate1 | | |
| 4 | gate2 | | |
| 5 | source [1] | | |
| **BLF989S (SOT539B)** | | | |
| 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 |
| BLF989 | - | flanged balanced ceramic package; 2 mounting holes; 4 leads | SOT539A |
| BLF989S | - | earless flanged balanced ceramic package; 4 leads | SOT539B |

## 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 | $T_{case}$ = 90 °C; $V_{DS}$ = 50 V; $P_L$ = 135 W; PAR = 8 dB [1] | 0.13 | K/W |

[1] Measured in a broadband application circuit, using DVB-T (8k OFDM) signal; PAR (of output signal) at 0.01 % probability on CCDF; PAR of input signal = 9.5 dB at 0.01 % probability on CCDF.

# 6. Characteristics

**Table 6. DC characteristics**

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $V_{GS}$ = 0 V; $I_D$ = 2.4 mA | 108 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $V_{DS}$ = 10 V; $I_D$ = 240 mA | 1.5 | 2.2 | 2.5 | V |
| $I_{DSS}$ | drain leakage current | $V_{GS}$ = 0 V; $V_{DS}$ = 50 V | - | - | 2.8 | μA |
| $I_{DSX}$ | drain cut-off current | $V_{GS}$ = $V_{GS(th)}$ + 3.75 V; $V_{DS}$ = 10 V | - | 41 | - | A |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 10 V; $V_{DS}$ = 0 V | - | - | 280 | nA |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS}$ = $V_{GS(th)}$ + 3.75 V; $I_D$ = 8.5 A | - | 90 | - | mΩ |

**Table 7. AC characteristics**

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | input capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 50 V; f = 1 MHz | - | 368 | - | pF |
| $C_{oss}$ | output capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 50 V; f = 1 MHz | - | 69 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 50 V; f = 1 MHz | - | 0.86 | - | pF |

**Table 8. RF characteristics**

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

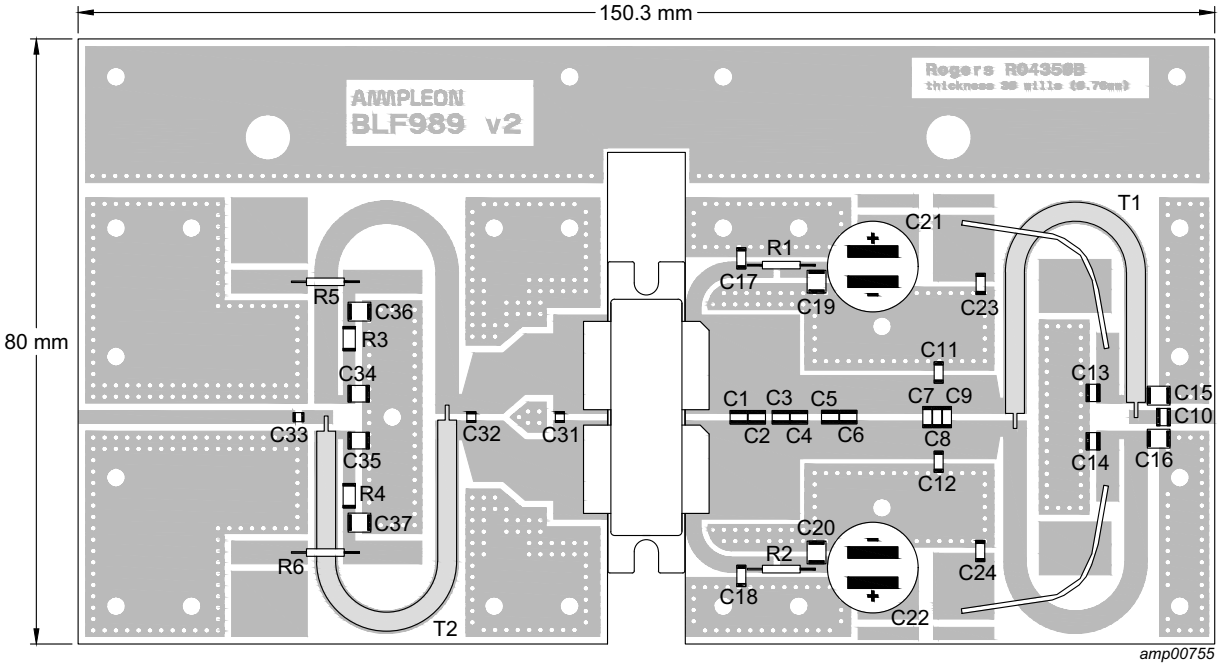
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **DVB-T (8k OFDM), class-AB operation** | | | | | | |
| $V_{DS}$ | drain-source voltage | | - | 50 | - | V |
| $I_{Dq}$ | quiescent drain current | per section | - | 650 | - | mA |
| $P_{L(AV)}$ | average output power | f = 700 MHz | 135 | - | - | W |
| $G_p$ | power gain | f = 700 MHz | 21.5 | 22.5 | - | dB |
| $\eta_D$ | drain efficiency | f = 700 MHz | 32 | 35 | - | % |
| ACPR | adjacent channel power ratio | f = 700 MHz | - | −30 | −27 | dBc |
| PAR | peak-to-average ratio | f = 700 MHz | - | 8 | - | dB |

# 7. Test information

## 7.1 Ruggedness in class-AB operation

The BLF989 and BLF989S 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; $P_L$ = 135 W: DVB-T; PAR = 8 dB.

## 7.2 Test circuit




Printed-Circuit Board (PCB): RO4350B: $\varepsilon_r$ = 3.48 F/m; height = 0.762 mm; Cu (top/bottom metallization); thickness copper plating = 35 μm. See Table 9 for a list of components.

**Fig 1. PCB and component layout of production RF test circuit**

**Table 9. List of components**

*See Figure 1 for component layout.*

| Component | Description | Value | Remarks |
|---|---|---|---|
| C1 | multilayer ceramic chip capacitor | 12 pF | ATC800R |
| C2, C3,C4,C5,C6 | multilayer ceramic chip capacitor | 8.2 pF | ATC800R |
| C7 | multilayer ceramic chip capacitor | 6.8 pF | ATC800B |
| C8 | multilayer ceramic chip capacitor | 2.7 pF | ATC800B |
| C9 | multilayer ceramic chip capacitor | 22 pF | ATC800B |
| C10, C13, C14 | multilayer ceramic chip capacitor | 100 pF | ATC180R |
| C11, C12 | multilayer ceramic chip capacitor | 10 pF | ATC800B |
| C15, C16 | multilayer ceramic chip capacitor | 4.7 μF, 50 V | Kemet: C1210X475K5RAC-TU or similar |
| C17, C18, C23, C24 | multilayer ceramic chip capacitor | 100 pF | ATC800B |
| C19, C20 | multilayer ceramic chip capacitor | 10 μF, 50 V | TDK: C570X7R1H106KT000N or similar |

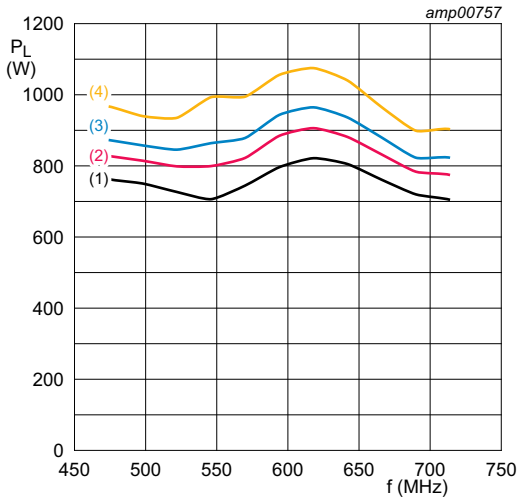
**Table 9. List of components** *…continued*

*See Figure 1 for component layout.*

| Component | Description | Value | Remarks |
|---|---|---|---|
| C21, C22 | electrolytic capacitor | 470 μF, 63 V | |
| C31 | multilayer ceramic chip capacitor | 18 pF | ATC800A |
| C32 | multilayer ceramic chip capacitor | 13 pF | ATC800A |
| C33, C34, C35 | multilayer ceramic chip capacitor | 100 pF | ATC100A |
| C36, C37 | multilayer ceramic chip capacitor | 4.7 μF, 50 V | TDK: C4532X7R1E475MT020U or similar |
| R1, R2 | wire resistor | 10 Ω | |
| R3, R4 | SMD resistor | 5.6 Ω | |
| R5, R6 | wire resistor | 100 Ω | |
| T1, T2 | semi rigid coax | 25 Ω, 60 mm | EZ90-25 |

## 7.3 Graphical data

### 7.3.1 Pulsed CW performance measured in class-AB broadband application




$V_{DS}$ = 50 V; $I_{Dq}$ = 2 × 650 mA; $t_p$ = 100 μs; δ = 10 %.

(1) $P_{L(1dB)}$

(2) $P_{L(2dB)}$

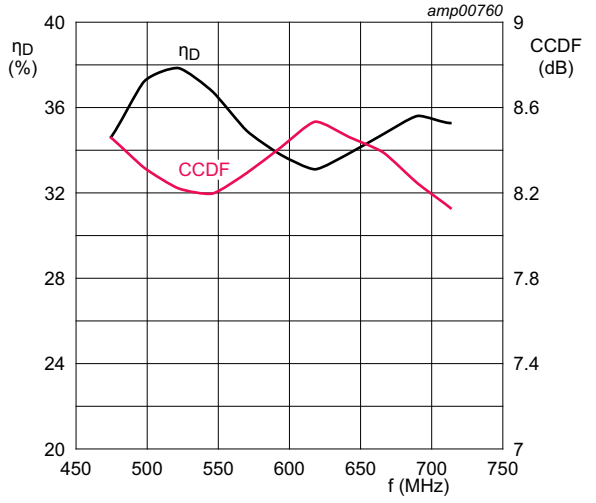
(3) $P_{L(3dB)}$

(4) $P_{L(6dB)}$

**Fig 2. Output power at gain compression as a function of frequency; typical values**

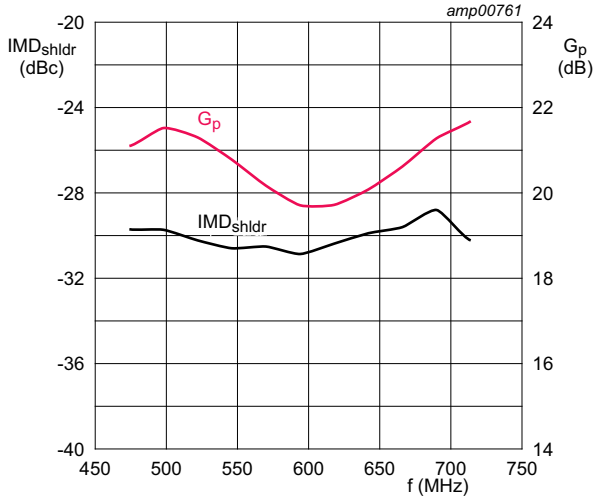
### 7.3.2 DVB-T performance measured in class-AB broadband application

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




$P_{L(AV)}$ = 150 W; $V_{DS}$ = 50 V; $I_{Dq}$ = 2 × 650 mA.

**Fig 3. Drain efficiency and CCDF as function of frequency; typical values**

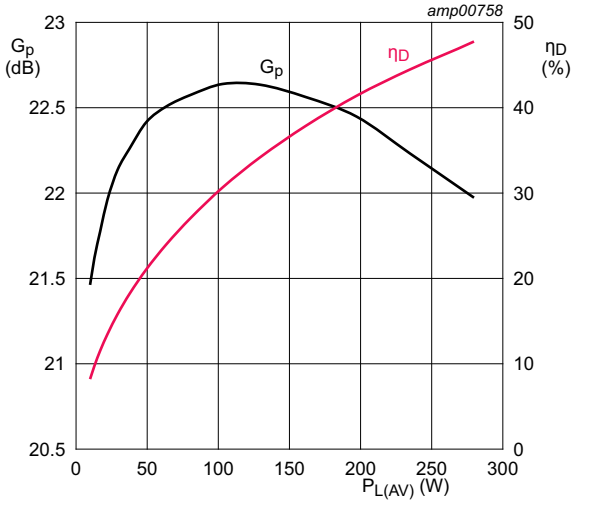



$P_{L(AV)}$ = 150 W; $V_{DS}$ = 50 V; $I_{Dq}$ = 2 × 650 mA.

**Fig 4. Intermodulation distortion shoulder and power gain as function of frequency; typical values**

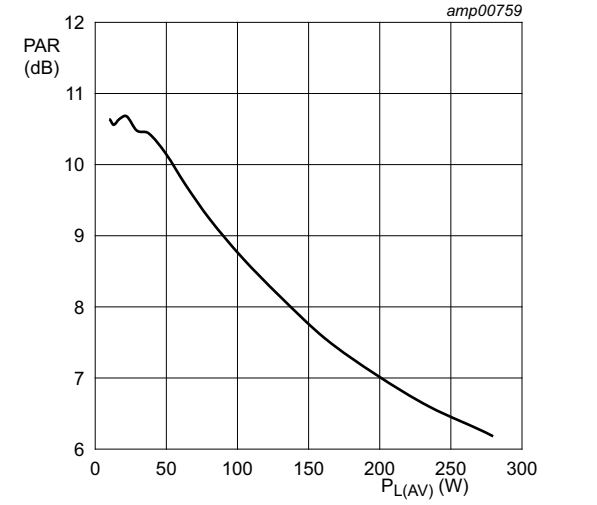
### 7.3.3 DVB-T performance measured in production RF test circuit

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




$V_{DS}$ = 50 V; $I_{Dq}$ = 2 × 650 mA; f = 700 MHz.

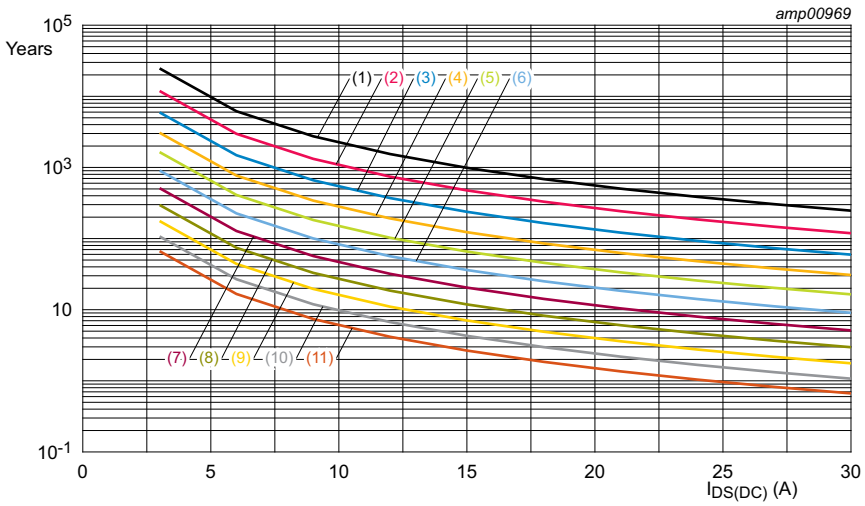
**Fig 5. Power gain and drain efficiency as function of average output power; typical values**




$V_{DS}$ = 50 V; $I_{Dq}$ = 2 × 650 mA; f = 700 MHz.

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

### 7.3.4 Reliability



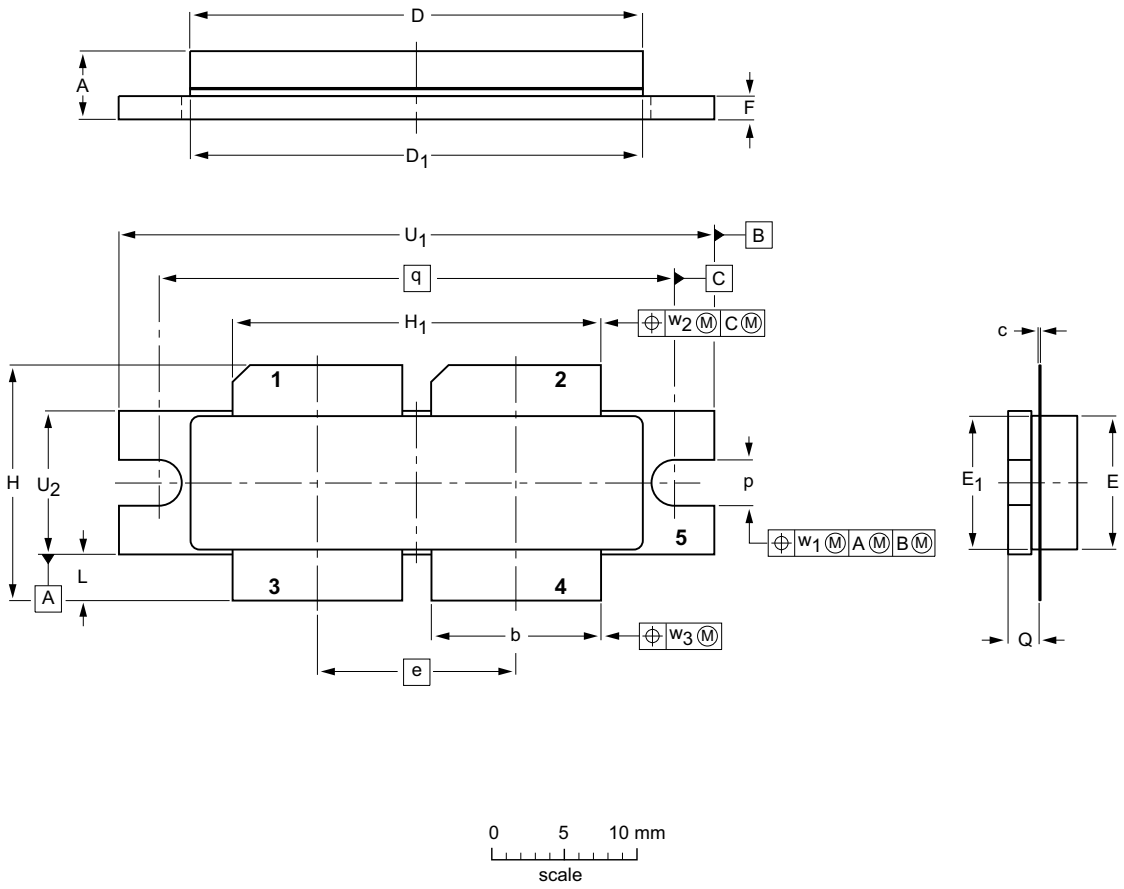

TTF (0.1 % failure fraction).
The reliability at pulsed conditions can be calculated as follows: TTF (0.1 %) × 1 / δ.

(1) $T_j$ = 100 °C
(2) $T_j$ = 110 °C
(3) $T_j$ = 120 °C
(4) $T_j$ = 130 °C
(5) $T_j$ = 140 °C
(6) $T_j$ = 150 °C
(7) $T_j$ = 160 °C
(8) $T_j$ = 170 °C
(9) $T_j$ = 180 °C
(10) $T_j$ = 190 °C
(11) $T_j$ = 200 °C

**Fig 7. BLF989: BLF989S electromigration ($I_{DS(DC)}$, total device)**

# 8. Package outline

**Flanged balanced ceramic package; 2 mounting holes; 4 leads** **SOT539A**




**DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)**

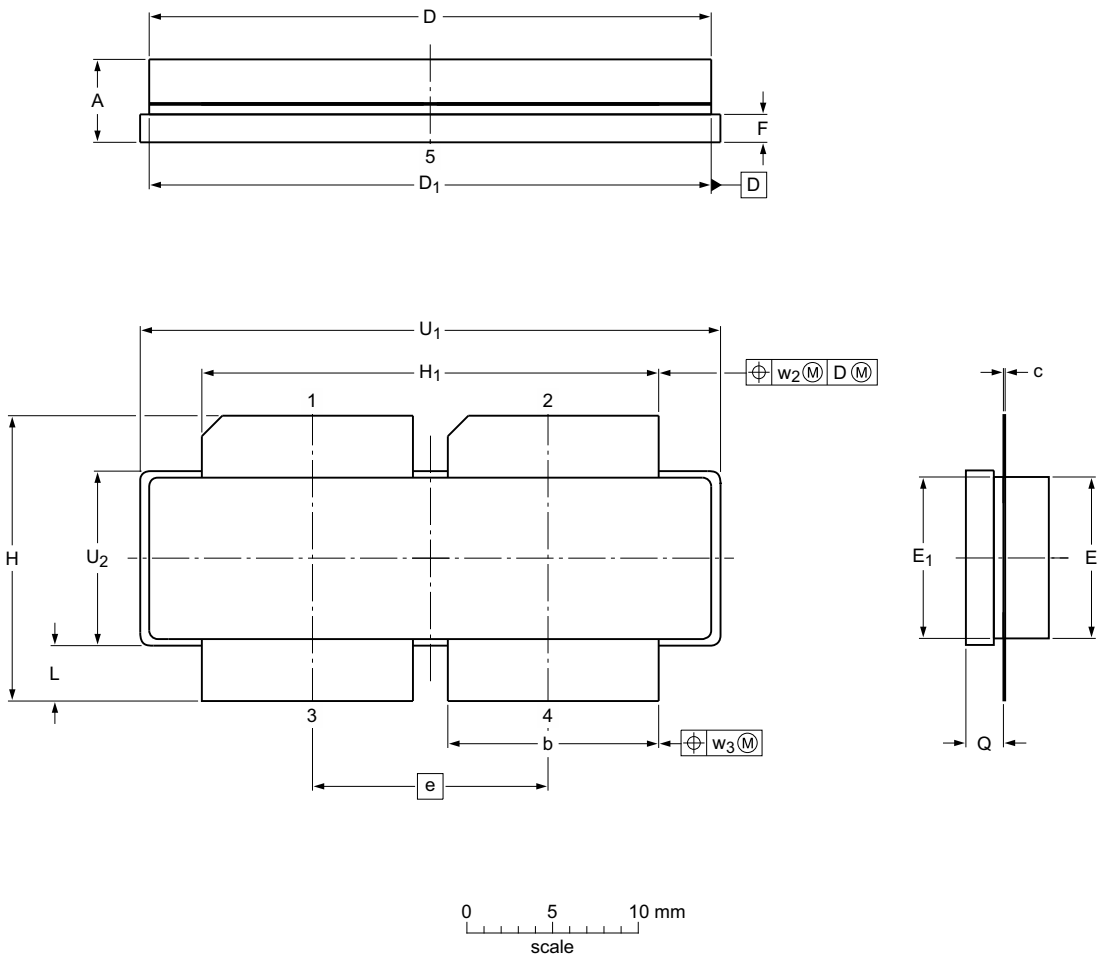
| UNIT | A | b | c | D | $D_1$ | e | E | $E_1$ | F | H | $H_1$ | L | p | Q | q | $U_1$ | $U_2$ | $w_1$ | $w_2$ | $w_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.7<br>4.2 | 11.81<br>11.56 | 0.18<br>0.10 | 31.55<br>30.94 | 31.52<br>30.96 | 13.72 | 9.50<br>9.30 | 9.53<br>9.27 | 1.75<br>1.50 | 17.12<br>16.10 | 25.53<br>25.27 | 3.48<br>2.97 | 3.30<br>3.05 | 2.26<br>2.01 | 35.56 | 41.28<br>41.02 | 10.29<br>10.03 | 0.25 | 0.51 | 0.25 |
| inches | 0.185<br>0.165 | 0.465<br>0.455 | 0.007<br>0.004 | 1.242<br>1.218 | 1.241<br>1.219 | 0.540 | 0.374<br>0.366 | 0.375<br>0.365 | 0.069<br>0.059 | 0.674<br>0.634 | 1.005<br>0.995 | 0.137<br>0.117 | 0.130<br>0.120 | 0.089<br>0.079 | 1.400 | 1.625<br>1.615 | 0.405<br>0.395 | 0.010 | 0.020 | 0.010 |

Note
1. millimeter dimensions are derived from the original inch dimensions.
2. recommended screw pitch dimension of 1.52 inch (38.6 mm) based on M3 screw.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT539A | | | | | | ~~10-02-02~~<br>12-05-02 |

**Fig 8. Package outline SOT539A**

**Earless flanged balanced ceramic package; 4 leads** **SOT539B**




Dimensions

| Unit[1] | | A | b | c | D | $D_1$ | E | $E_1$ | e | F | H | $H_1$ | L | Q | $U_1$ | $U_2$ | $w_2$ | $w_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 4.7 | 11.81 | 0.18 | 31.55 | 31.52 | 9.5 | 9.53 | 13.72 | 1.75 | 17.12 | 25.53 | 3.48 | 2.26 | 32.39 | 10.29 | 0.25 | 0.25 |
| | nom | | | | | | | | | | | | | | | | | |
| | min | 4.2 | 11.56 | 0.10 | 30.94 | 30.96 | 9.3 | 9.27 | | 1.50 | 16.10 | 25.27 | 2.97 | 2.01 | 32.13 | 10.03 | | |
| inches | max | 0.185 | 0.465 | 0.007 | 1.242 | 1.241 | 0.374 | 0.375 | 0.54 | 0.069 | 0.674 | 1.005 | 0.137 | 0.089 | 1.275 | 0.405 | 0.01 | 0.01 |
| | nom | | | | | | | | | | | | | | | | | |
| | min | 0.165 | 0.455 | 0.004 | 1.218 | 1.219 | 0.366 | 0.365 | | 0.059 | 0.634 | 0.995 | 0.117 | 0.079 | 1.265 | 0.395 | | |

Note

1. millimeter dimensions are derived from the original inch dimensions.

*sot539b_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT539B | | | | | | ~~12-05-02~~ 13-05-24 |

**Fig 9. Package outline SOT539B**

## 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 10. ESD sensitivity**

| ESD model | Class |
|---|---|
| Charged Device Model (CDM); According to ANSI/ESDA/JEDEC standard JS-002 | C2A [1] |
| Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001 | 2 [2] |

[1] CDM classification C2A is granted to any part that passes after exposure to an ESD pulse of 500 V.

[2] HBM classification 2 is granted to any part that passes after exposure to an ESD pulse of 2000 V.

## 10. Abbreviations

**Table 11. Abbreviations**

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

## 11. Revision history

**Table 12. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BLF989_BLF989S v.3 | 20190524 | Product data sheet | - | BLF989_BLF989S v.2 |
| Modifications | • Table 1 on page 1: third row added<br>• Section 7.3.4 on page 7: section added | | | |
| BLF989_BLF989S v.2 | 20190122 | Product data sheet | - | BLF989_BLF989S v.1 |
| BLF989_BLF989S v.1 | 20180907 | 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.

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# 13. Contact information

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## 14. Contents





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