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	η_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

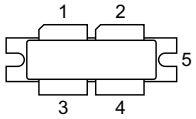
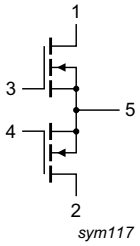
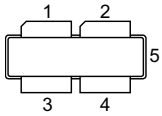
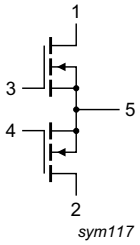
- Designed for broadband and Doherty operation
- High efficiency
- Integrated dual sided ESD protection
- Excellent ruggedness
- High power gain
- Excellent reliability
- Easy power control
- Excellent stability
- For RoHS compliance see the product details on the Ampleon website

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.

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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
η_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

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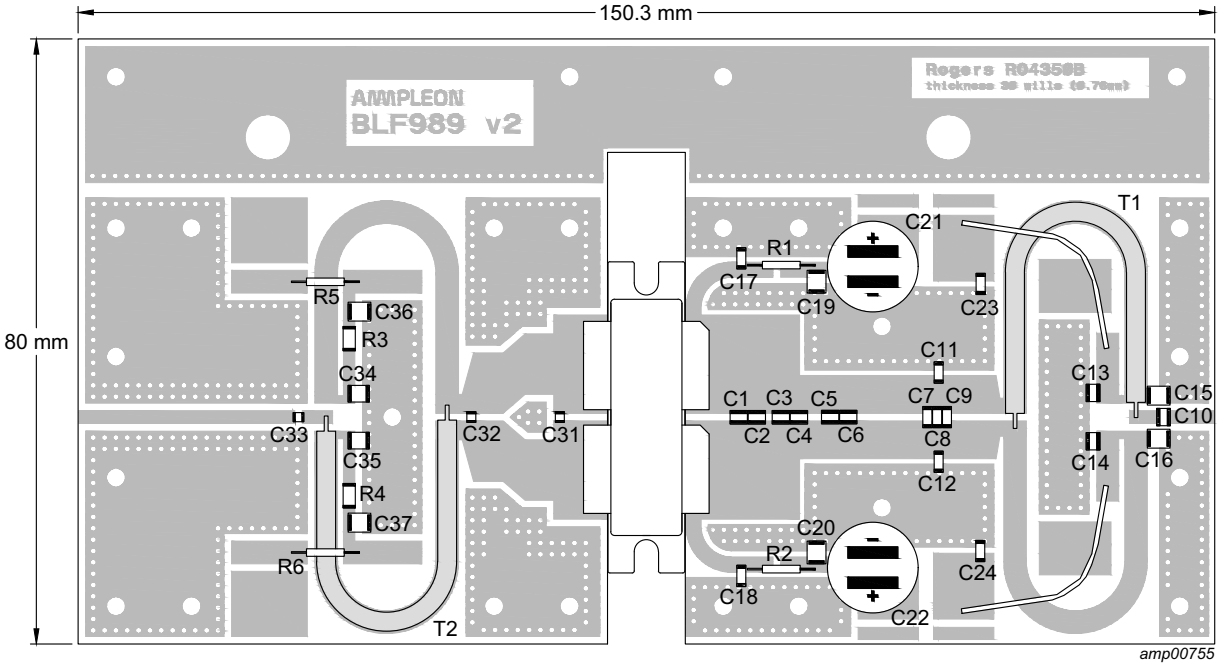
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7. Test information

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: ε_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

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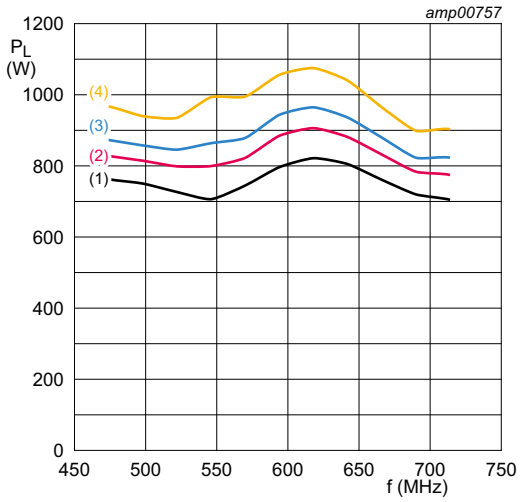
Table 9. List of components *…continued*

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) $P_{L(6dB)}$

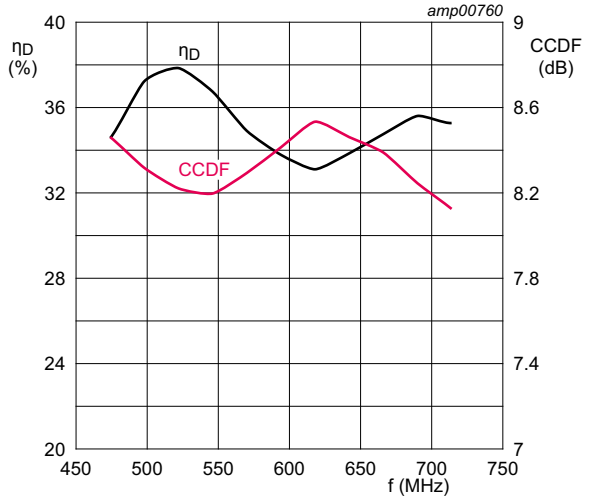
Fig 2. Output power at gain compression as a function of frequency; typical values

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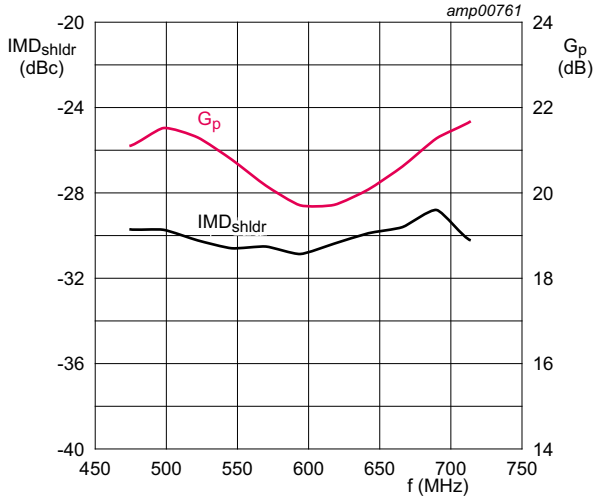
7.3.2 DVB-T performance measured in class-AB broadband application

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

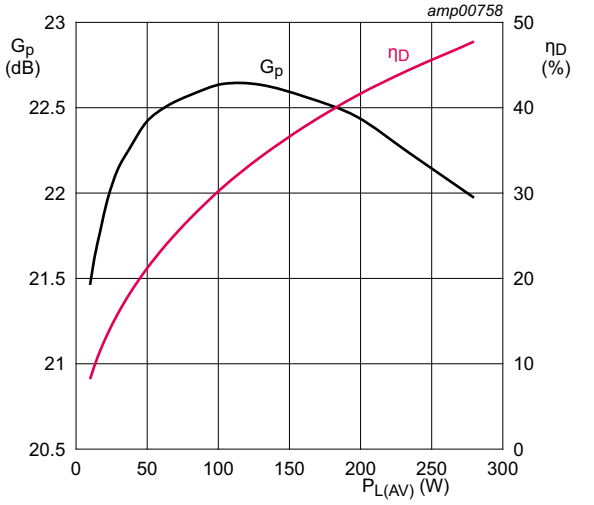


$P_{L(AV)}$ = 150 W; V_{DS} = 50 V; I_{Dq} = 2 × 650 mA.

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

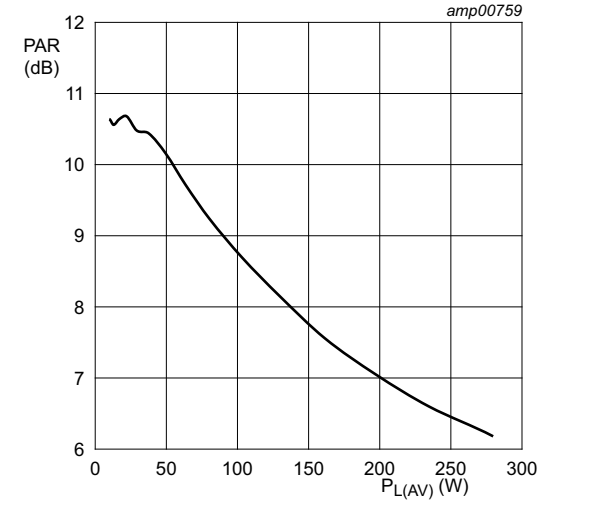
7.3.3 DVB-T performance measured in production RF test circuit

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

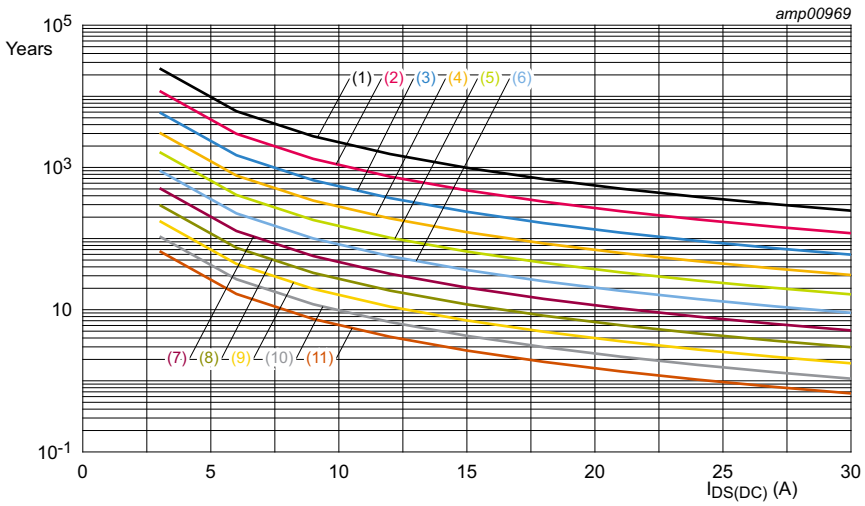


V_{DS} = 50 V; I_{Dq} = 2 × 650 mA; f = 700 MHz.

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

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7.3.4 Reliability



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

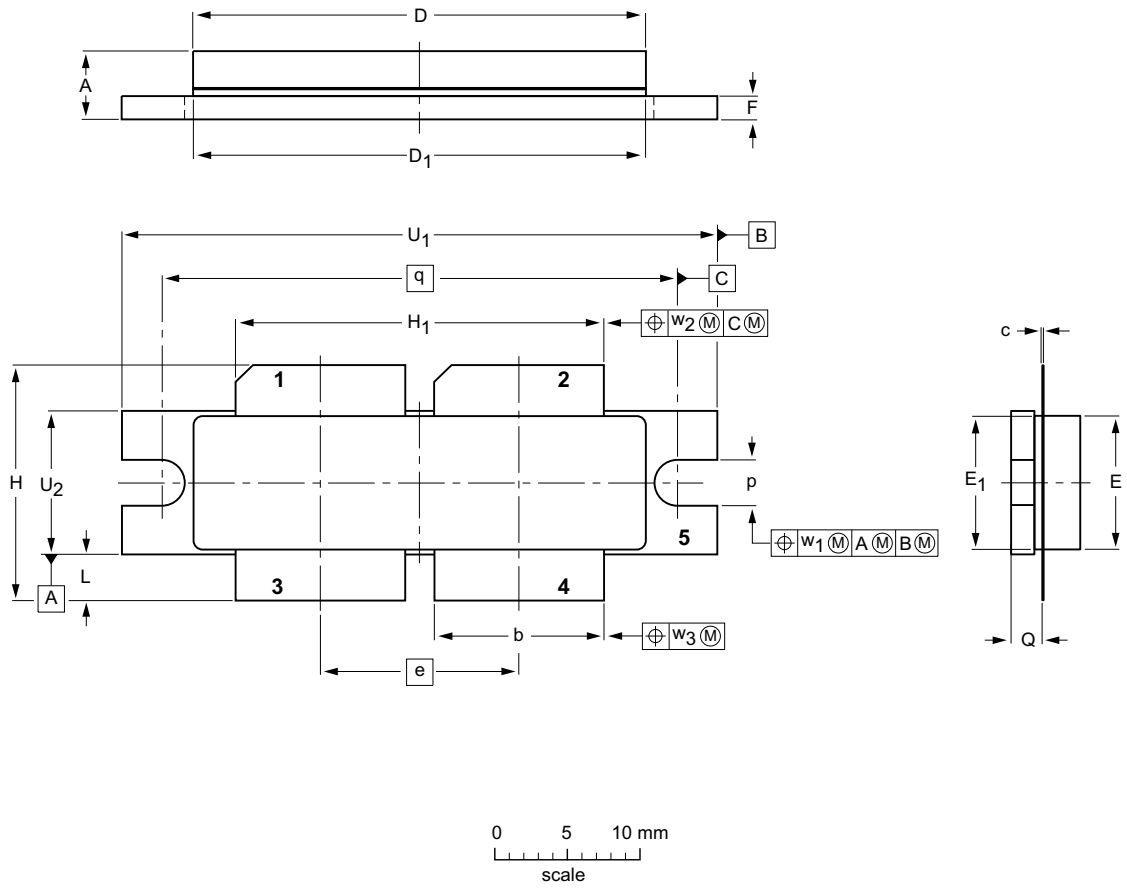
(1) T_j = 100 °C
(2) T_j = 110 °C
(3) T_j = 120 °C
(4) T_j = 130 °C
(5) T_j = 140 °C
(6) T_j = 150 °C
(7) T_j = 160 °C
(8) T_j = 170 °C
(9) T_j = 180 °C
(10) T_j = 190 °C
(11) T_j = 200 °C

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

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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 4.2	11.81 11.56	0.18 0.10	31.55 30.94	31.52 30.96	13.72	9.50 9.30	9.53 9.27	1.75 1.50	17.12 16.10	25.53 25.27	3.48 2.97	3.30 3.05	2.26 2.01	35.56	41.28 41.02	10.29 10.03	0.25	0.51	0.25
inches	0.185 0.165	0.465 0.455	0.007 0.004	1.242 1.218	1.241 1.219	0.540	0.374 0.366	0.375 0.365	0.069 0.059	0.674 0.634	1.005 0.995	0.137 0.117	0.130 0.120	0.089 0.079	1.400	1.625 1.615	0.405 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.

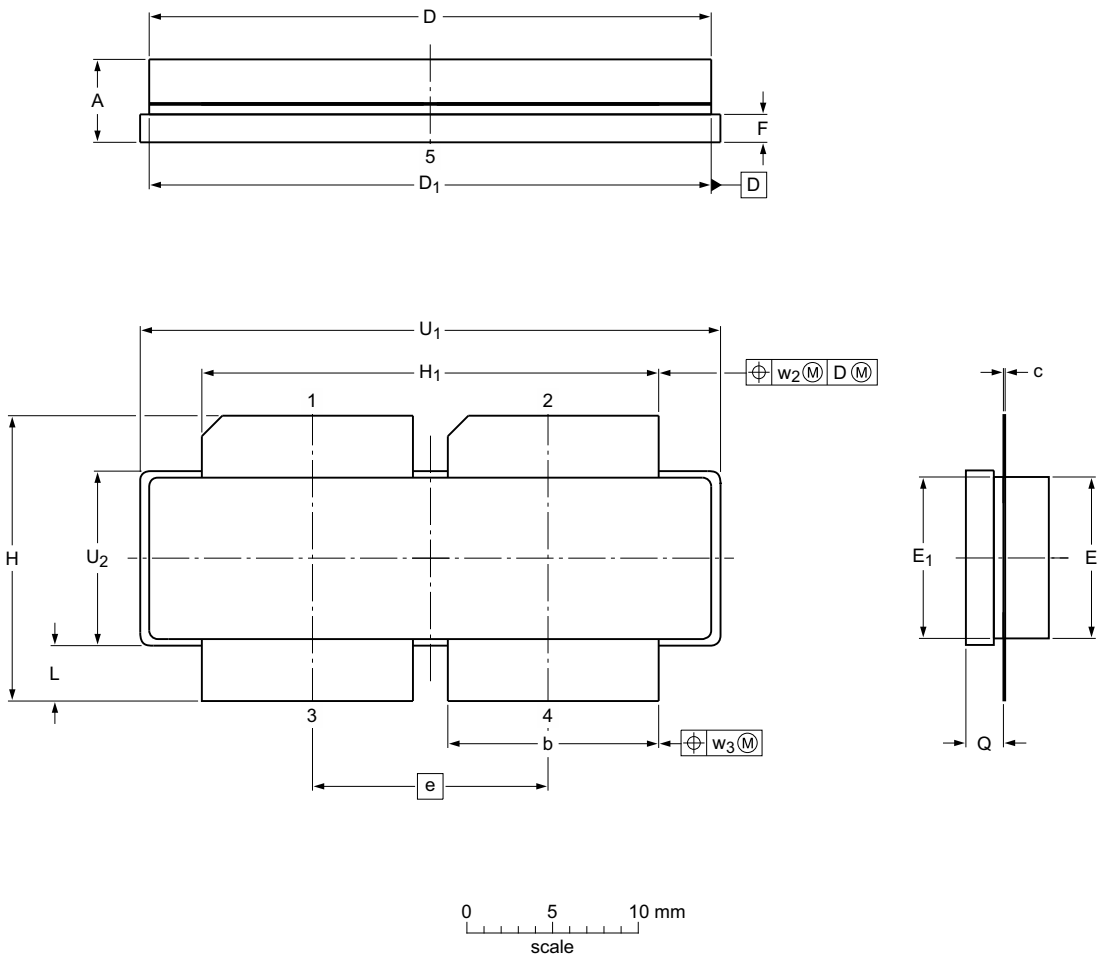
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT539A						~~10-02-02~~ 12-05-02

Fig 8. Package outline SOT539A

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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

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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 • 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	-	-

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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".

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Date of release: 24 May 2019
Document identifier: BLF989_BLF989S

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