# BLF888A; BLF888AS UHF power LDMOS transistor Rev. 5 — 4 November 2013

**Product data sheet** 

# 1. Product profile

### 1.1 General description

A 600 W LDMOS RF power transistor for broadcast transmitter applications and industrial applications. The excellent ruggedness of this device makes it ideal for digital and analog transmitter applications.

**Application information** Table 1.

RF performance at  $V_{DS} = 50 \text{ V}$  unless otherwise specified.

Mode of operation	f	P <sub>L(AV)</sub>	$P_{L(M)}$	Gp	η <sub>D</sub>	IMD3	IMD <sub>shldr</sub>	PAR
	(MHz)	(W)	(W)	(dB)	(%)	(dBc)	(dBc)	(dB)
RF performance in a cor	mmon source narrowband	d test circi	uit					
CW	650	-	600	20	67	-	-	-
CW (42 V)	650	-	500	20	69	-	-	-
2-tone, class-AB	$f_1 = 860$ ; $f_2 = 860.1$	250	-	21	46	-32	-	-
pulsed, class-AB [1]	860	-	600	20	58	-	-	-
DVB-T (8k OFDM)	858	110	-	21	31	-	-32 <sup>[2]</sup>	8.2 [3]
	858	125	-	21	32.5	-	-30 [2]	8.0 [3]
RF performance in a common source 470 MHz to 860 MHz broadband test circuit								
DVB-T (8k OFDM)	858	110	-	20	30	-	-32 [2]	8.0 [3]
	858	120	-	20	31	-	-31 <sup>[2]</sup>	7.8 [3]

<sup>[1]</sup> Measured at  $\delta$  = 10 %;  $t_p$  = 100  $\mu$ s.

### 1.2 Features and benefits

- Excellent ruggedness (VSWR ≥ 40 : 1 through all phases)
- Optimum thermal behavior and reliability, R<sub>th(i-c)</sub> = 0.15 K/W
- Suitable for CW UHF and ISM applications
- High power gain
- High efficiency
- Designed for broadband operation (470 MHz to 860 MHz)
- Internal input matching for high gain and optimum broadband operation
- Excellent reliability
- Easy power control
- Compliant to Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC



<sup>[2]</sup> Measured [dBc] with delta marker at 4.3 MHz from center frequency.

<sup>[3]</sup> PAR (of output signal) at 0.01 % probability on CCDF; PAR of input signal = 9.5 dB at 0.01 % probability on CCDF.

# 1.3 Applications

- Communication transmitter applications in the UHF band
- Industrial applications in the UHF band

# 2. Pinning information

Table 2. Pinning

	9			
Pin	Description		Simplified outline	Graphic symbol
BLF888A	(SOT539A)			
1	drain1			
2	drain2		1 2	
3	gate1		5	
4	gate2		3 4	3 - 5
5	source	<u>[1]</u>		4
				' <u> </u>
				2 sym117

BLF888	AS (SOT539B)			
1	drain1			
2	drain2		1 2	1
3	gate1		5	, <b> </b> +
4	gate2		3 4	3 - 5
5	source	<u>[1]</u>		4
				' <b>⊢</b> ¬
				2 sym117

<sup>[1]</sup> Connected to flange.

# 3. Ordering information

Table 3. Ordering information

Type number	Package					
	Name	Description	Version			
BLF888A	-	flanged balanced ceramic package; 2 mounting holes; 4 leads	SOT539A			
BLF888AS	-	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			-	110	V
$V_{GS}$	gate-source voltage			-0.5	+11	V
T <sub>stg</sub>	storage temperature			-65	+150	°C
Tj	junction temperature		[1]	-	225	°C

<sup>[1]</sup> 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	Тур	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	$T_{case}$ = 80 °C; $P_{L(AV)}$ = 125 W	0.15	K/W

<sup>[1]</sup> R<sub>th(i-c)</sub> is measured under RF conditions.

# 6. Characteristics

Table 6. DC characteristics

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

Symbol	Parameter	Conditions		Min	Тур	Max	Unit
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0 \text{ V}; I_D = 2.4 \text{ mA}$	[1]	110	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 10 \text{ V}; I_{D} = 240 \text{ mA}$	[1]	1.4	1.9	2.4	V
$I_{DSS}$	drain leakage current	$V_{GS} = 0 \text{ V}; V_{DS} = 50 \text{ V}$		-	-	2.8	μΑ
I <sub>DSX</sub>	drain cut-off current	$V_{GS} = V_{GS(th)} + 3.75 \text{ V};$ $V_{DS} = 10 \text{ V}$		-	36	-	Α
$I_{GSS}$	gate leakage current	$V_{GS} = 10 \text{ V}; V_{DS} = 0 \text{ V}$		-	-	280	nΑ
R <sub>DS(on)</sub>	drain-source on-state resistance	$V_{GS} = V_{GS(th)} + 3.75 \text{ V};$ $I_D = 8.5 \text{ A}$	[1]	-	143	-	mΩ
C <sub>iss</sub>	input capacitance	$V_{GS} = 0 \text{ V}; V_{DS} = 50 \text{ V};$ f = 1 MHz	[2]	-	220	-	pF
C <sub>oss</sub>	output capacitance	$V_{GS} = 0 \text{ V}; V_{DS} = 50 \text{ V};$ f = 1 MHz		-	74	-	pF
$C_{rss}$	reverse transfer capacitance	$V_{GS} = 0 \text{ V}; V_{DS} = 50 \text{ V};$ f = 1 MHz		-	1.2	-	pF

<sup>[1]</sup>  $I_D$  is the drain current.

<sup>[2]</sup> Capacitance values without internal matching.

Table 7. RF characteristics

RF characteristics in NXP production narrowband test circuit;  $T_{\rm case}$  = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions		Min	Тур	Max	Unit
2-Tone, c	lass-AB						
$V_{DS}$	drain-source voltage			-	50	-	V
$I_{Dq}$	quiescent drain current		[1]	-	1.3	-	Α
$P_{L(AV)}$	average output power	$f_1 = 860 \text{ MHz};$ $f_2 = 860.1 \text{ MHz}$		250	-	-	W
G <sub>p</sub>	power gain	$f_1 = 860 \text{ MHz};$ $f_2 = 860.1 \text{ MHz}$		20	21	-	dB
$\eta_{D}$	drain efficiency	$f_1 = 860 \text{ MHz};$ $f_2 = 860.1 \text{ MHz}$		42	46	-	%
IMD3	third-order intermodulation distortion	$f_1 = 860 \text{ MHz};$ $f_2 = 860.1 \text{ MHz}$		-	-32	-28	dBc
DVB-T (8	k OFDM), class-AB						
$V_{DS}$	drain-source voltage			-	50	-	V
$I_{Dq}$	quiescent drain current		<u>[1]</u>	-	1.3	-	Α
$P_{L(AV)}$	average output power	f = 858 MHz		110	-	-	W
G <sub>p</sub>	power gain	f = 858 MHz		20	21	-	dB
$\eta_{D}$	drain efficiency	f = 858 MHz		28	31	-	%
$IMD_{shldr}$	intermodulation distortion shoulder	f = 858 MHz	[2]	-	-32	-28	dBc
PAR	peak-to-average ratio	f = 858 MHz	[3]	-	8.2	-	dB

<sup>[1]</sup> I<sub>Dq</sub> for total device.

<sup>[3]</sup> PAR (of output signal) at 0.01 % probability on CCDF; PAR of input signal = 9.5 dB at 0.01 % probability on CCDF.

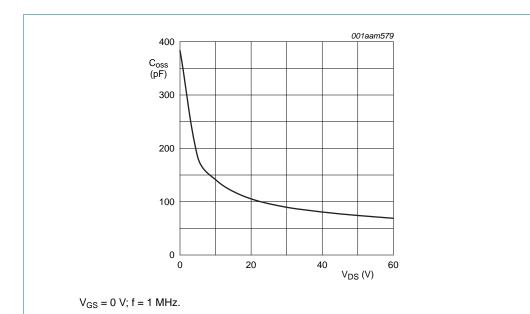


Fig 1. Output capacitance as a function of drain-source voltage; typical values per section

<sup>[2]</sup> Measured [dBc] with delta marker at 4.3 MHz from center frequency.

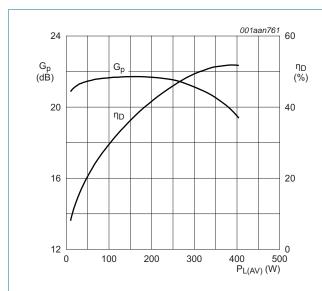
## 6.1 Ruggedness in class-AB operation

The BLF888A and BLF888AS are capable of withstanding a load mismatch corresponding to VSWR  $\geq$  40 : 1 through all phases under the following conditions:  $V_{DS}$  = 50 V; f = 860 MHz at rated power.

# 7. Application information

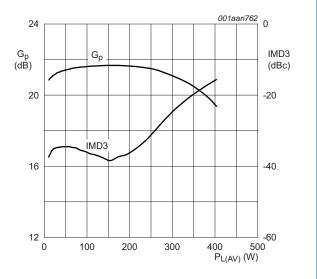
## 7.1 Narrowband RF figures

### 7.1.1 2-Tone



 $V_{DS} = 50 \ V; \ I_{Dq} = 1.3 \ A;$  measured in a common source narrowband 860 MHz test circuit.

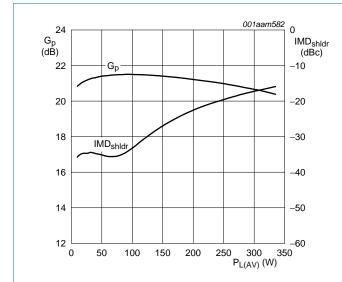
Fig 2. 2-Tone power gain and drain efficiency as function of load power; typical values



 $V_{DS} = 50 \ V; \ I_{Dq} = 1.3 \ A;$  measured in a common source narrowband 860 MHz test circuit.

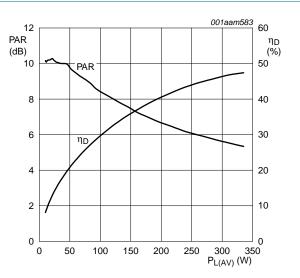
Fig 3. 2-Tone power gain and third order intermodulation distortion as load power; typical values

### 7.1.2 DVB-T



 $V_{DS} = 50 \ V; \ I_{Dq} = 1.3 \ A;$  measured in a common source narrowband 860 MHz test circuit.

Fig 4. DVB-T power gain and intermodulation distortion shoulder as function of load power; typical values

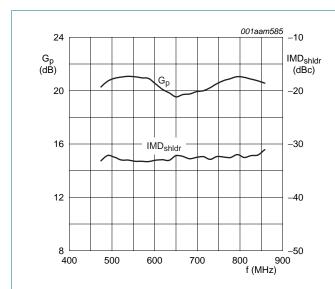


 $V_{DS}$  = 50 V;  $I_{Dq}$  = 1.3 A; measured in a common source narrowband 860 MHz test circuit.

Fig 5. DVB-T peak-to-average ratio and drain efficiency as function of load power; typical values

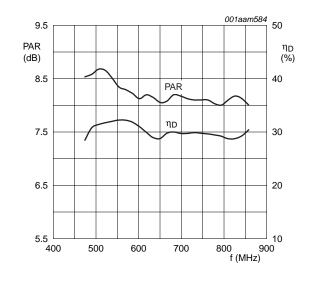
# 7.2 Broadband RF figures

### 7.2.1 DVB-T



 $P_{L(AV)}=110$  W;  $V_{DS}=50$  V;  $I_{Dq}=1.3$  A; measured in a common source broadband test circuit as described in Section 8.

Fig 6. DVB-T power gain and intermodulation distortion shoulder as a function of frequency; typical values



 $P_{L(AV)}=110$  W;  $V_{DS}=50$  V;  $I_{Dq}=1.3$  A; measured in a common source broadband test circuit as described in Section 8.

Fig 7. DVB-T peak-to-average ratio and drain efficiency as function of frequency; typical values

# 7.3 Impedance information

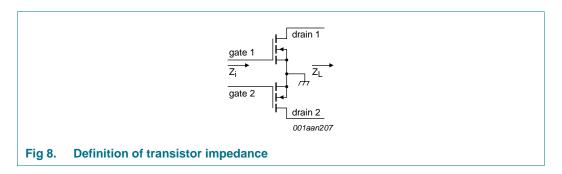
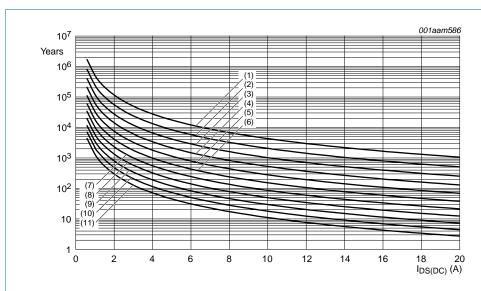


Table 8. Typical push-pull impedance

Simulated  $Z_i$  and  $Z_L$  device impedance; impedance info at  $V_{DS} = 50 \text{ V}$  and  $P_{L(AV)} = 110 \text{ W}$  (DVB-T).

f	Z <sub>i</sub>	Z <sub>L</sub>
MHz	Ω	Ω
300	0.617 – j1.715	4.989 + j1.365
325	0.635 - j1.355	4.867 + j1.424
350	0.655 – j1.026	4.741 + j1.472
375	0.677 – j0.721	4.614 + j1.511
400	0.702 - j0.435	4.486 + j1.540
425	0.731 – j0.164	4.357 + j1.559
450	0.762 + j0.096	4.228 + j1.570
475	0.798 + j0.347	4.100 + j1.573
500	0.839 + j0.592	4.974 + j1.567
525	0.884 + j0.833	3.850 + j1.554
550	0.936 + j1.072	3.728 + j1.534
575	0.995 + j1.310	3.608 + j1.508
600	1.063 + j1.549	3.492 + j1.475
625	1.141 + j1.791	3.378 + j1.437
650	1.230 + j2.037	3.268 + j1.394
675	1.334 + j2.289	3.161 + j1.347
700	1.456 + j2.548	3.057 + j1.295
725	1.599 + j2.814	2.957 + j1.239
750	1.768 + j3.090	2.860 + j1.180
775	1.971 + j3.376	2.676 + j1.118
800	2.214 + j3.671	2.677 + j1.053
825	2.510 + j3.975	2.591 + j0.985
850	2.873 + j4.282	2.508 + j0.915
875	3.320 + j4.584	2.428 + j0.843
900	3.875 + j4.865	2.351 + j0.770
925	4.562 + j5.095	2.277 + j0.695
950	5.409 + j5.223	2.206 + j0.618
975	6.426 + j5.166	2.138 + j0.540
1000	7.587 + j4.807	2.073 + j0.461

# 7.4 Reliability



TTF (0.1 % failure fraction).

The reliability at pulsed conditions can be calculated as follows: TTF (0.1 %)  $\times$  1 /  $\delta$ .

- (1)  $T_i = 100 \, ^{\circ}C$
- (2)  $T_i = 110 \, ^{\circ}C$
- (3)  $T_i = 120 \, ^{\circ}C$
- (4)  $T_i = 130 \,{}^{\circ}\text{C}$
- (5)  $T_i = 140 \,^{\circ}C$
- (6)  $T_j = 150 \,^{\circ}\text{C}$
- (7)  $T_i = 160 \, ^{\circ}C$ (8)  $T_j = 170 \, ^{\circ}C$
- (9)  $T_j = 180 \,{}^{\circ}\text{C}$ (10)  $T_i = 190 \,^{\circ}C$
- (11)  $T_j = 200 \, ^{\circ}C$

BLF888A; BLF888AS electromigration (I<sub>DS(DC)</sub>, total device)

# 8. Test information

Table 9. List of components

For test circuit, see Figure 10, Figure 11 and Figure 12.

Component	Description	Value		Remarks
B1, B2	semi rigid coax	25 $\Omega$ ; 49.5 mm		UT-090C-25 (EZ 90-25)
C1	multilayer ceramic chip capacitor	12 pF	[1]	
C2, C3, C4, C5, C6	multilayer ceramic chip capacitor	8.2 pF	[1]	
C7	multilayer ceramic chip capacitor	6.8 pF	[2]	
C8	multilayer ceramic chip capacitor	2.7 pF	[2]	
C9	multilayer ceramic chip capacitor	2.2 pF	[2]	
C10, C13, C14	multilayer ceramic chip capacitor	100 pF	[3]	
C11, C12	multilayer ceramic chip capacitor	10 pF	[2]	
C15, C16	multilayer ceramic chip capacitor	4.7 μF, 50 V		Kemet C1210X475K5RAC-TU or capacitor of same quality.
C17, C18, C23, C24	multilayer ceramic chip capacitor	100 pF	[2]	
C19, C20	multilayer ceramic chip capacitor	10 μF, 50 V		TDK C570X7R1H106KT000N or capacitor of same quality.
C21, C22	electrolytic capacitor	470 μF; 63 V		
C30	multilayer ceramic chip capacitor	10 pF	<u>[4]</u>	
C31	multilayer ceramic chip capacitor	9.1 pF	<u>[4]</u>	
C32	multilayer ceramic chip capacitor	3.9 pF	<u>[4]</u>	
C33, C34, C35	multilayer ceramic chip capacitor	100 pF	<u>[4]</u>	
C36, C37	multilayer ceramic chip capacitor	4.7 μF, 50 V		TDK C4532X7R1E475MT020U or capacitor of same quality.
L1	microstrip	-	<u>[5]</u>	(W $\times$ L) 15 mm $\times$ 13 mm
L2	microstrip	-	<u>[5]</u>	(W $\times$ L) 5 mm $\times$ 26 mm
L3, L32	microstrip	-	<u>[5]</u>	(W $\times$ L) 2 mm $\times$ 49.5 mm
L4	microstrip	-	<u>[5]</u>	(W $\times$ L) 1.7 mm 3.5 mm
L5	microstrip	-	<u>[5]</u>	(W $\times$ L) 2 mm $\times$ 9.5 mm
L30	microstrip	-	<u>[5]</u>	(W $\times$ L) 5 mm $\times$ 13 mm
L31	microstrip	-	<u>[5]</u>	(W $\times$ L) 2 mm $\times$ 11 mm
L33	microstrip	-	<u>[5]</u>	(W $\times$ L) 2 mm $\times$ 3 mm
R1, R2	wire resistor	10 Ω		
R3, R4	SMD resistor	5.6 Ω		0805
R5, R6	wire resistor	100 Ω		
R7, R8	potentiometer	10 kΩ		

<sup>[1]</sup> American technical ceramics type 800R or capacitor of same quality.

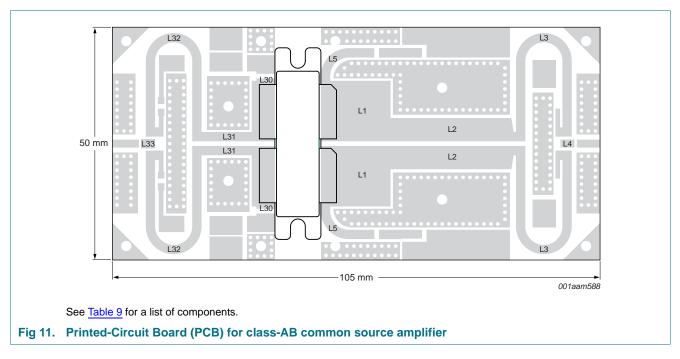
<sup>[2]</sup> American technical ceramics type 800B or capacitor of same quality.

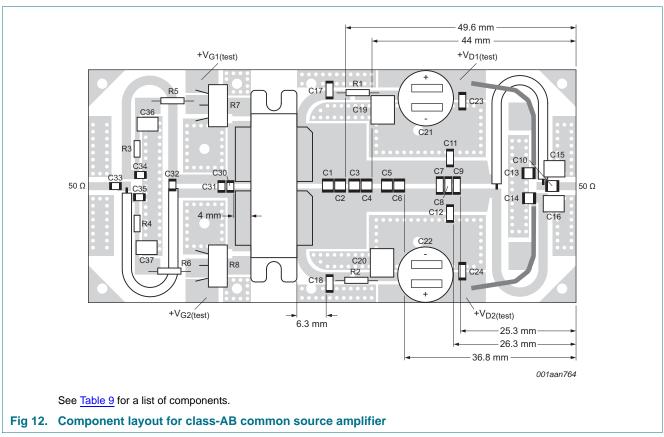
<sup>[3]</sup> American technical ceramics type 180R or capacitor of same quality.

<sup>[4]</sup> American technical ceramics type 100A or capacitor of same quality.

<sup>[5]</sup> Printed-Circuit Board (PCB): Taconic RF35;  $\epsilon_r$  = 3.5 F/m; height = 0.762 mm; Cu (top/bottom metallization); thickness copper plating = 35  $\mu$ m.

Product data sheet +V<sub>G1(test)</sub> C17 = -+V<sub>D1(test)</sub> All information provided in this document is subject to legal disclaimers. Rev. 5 — 4 November 2013 **C**11 L30 L32 L3 L31 L2 50 Ω ) C31 C30 C33 C10 L33 L4 C9 2 C4 C6 C7 В2 В1 C2 C14 = **‡** C16 # C35 R4 **‡** C12 C20 +V<sub>G2(test)</sub> 001aan763 © NXP B.V. 2013. All rights reserved 10 of 17 See Table 9 for a list of components. Fig 10. Class-AB common source broadband amplifier;  $V_{D1(test)}$ ,  $V_{D2(test)}$ ,  $V_{G1(test)}$  and  $V_{G2(test)}$  are drain and gate test voltages





# 9. Package outline

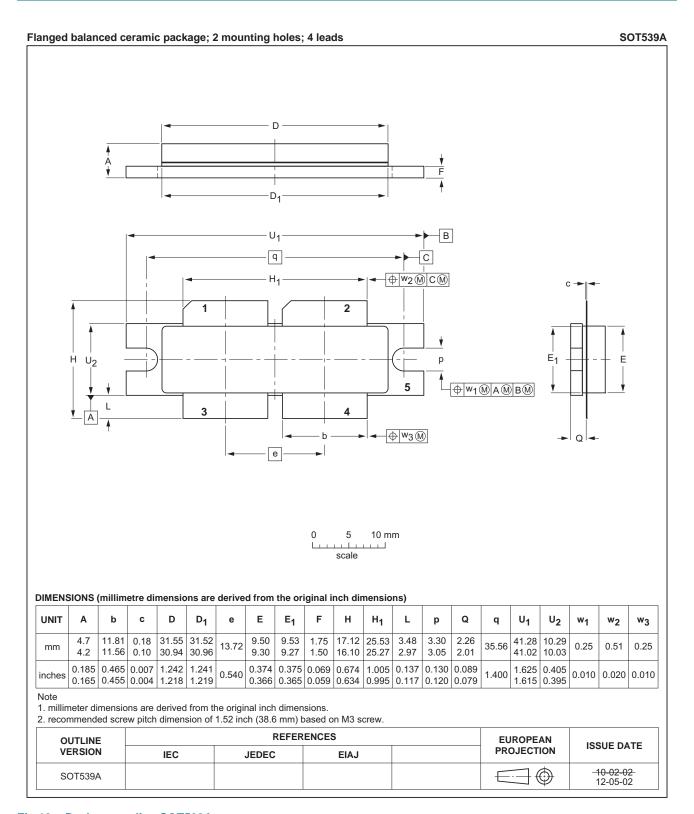


Fig 13. Package outline SOT539A

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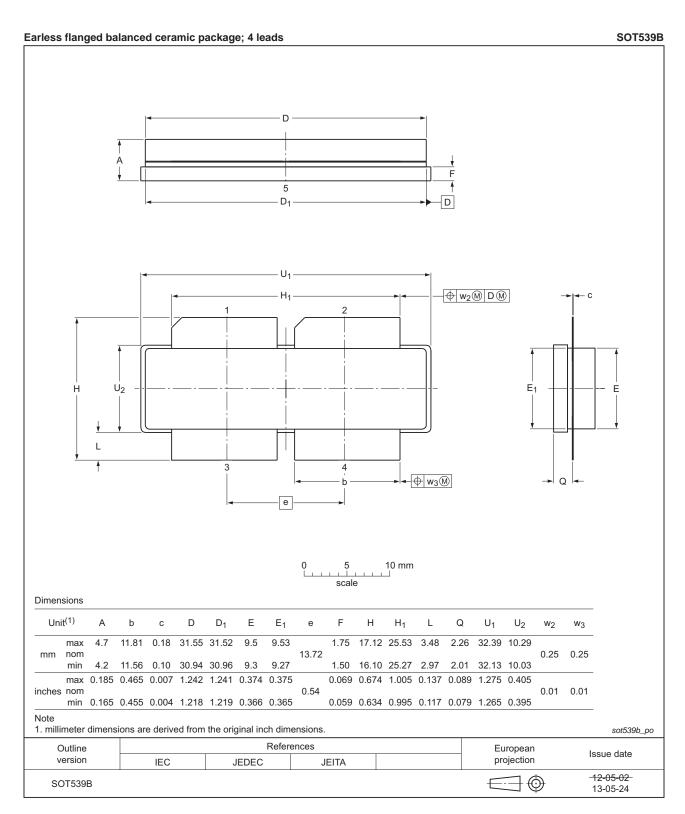


Fig 14. Package outline SOT539B

# 10. 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.

# 11. Abbreviations

Table 10. Abbreviations

Description
Complementary Cumulative Distribution Function
Continuous Wave
Digital Video Broadcast
Digital Video Broadcast - Terrestrial
Industrial, Scientific and Medical
Laterally Diffused Metal-Oxide Semiconductor
Median Time to Failure
Orthogonal Frequency Division Multiplexing
Peak-to-Average power Ratio
Surface Mounted Device
Ultra High Frequency
Voltage Standing-Wave Ratio

# 12. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes			
BLF888A_BLF888AS v.5	20131104	Product data sheet	-	BLF888A_BLF888AS v.4			
Modifications:	• <u>Table 1 on page 1</u> : table updated.						
	<ul> <li>Section 1.2</li> </ul>	2 on page 1: list item 'Suitabl	e for CW UHF and	ISM applications' added.			
	Section 4 of	on page 3: table updated.					
BLF888A_BLF888AS v.4	20130712	Product data sheet	-	BLF888A_BLF888AS v.3			
BLF888A_BLF888AS v.3	20110830	Product data sheet	-	BLF888A_BLF888AS v.2			
BLF888A_BLF888AS v.2	20110301	Preliminary data sheet	-	BLF888A_BLF888AS v.1			
BLF888A_BLF888AS v.1	20100921	Objective data sheet	-	-			

# 13. Legal information

### 13.1 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 <a href="http://www.nxp.com">http://www.nxp.com</a>.

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### **UHF power LDMOS transistor**

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