

# BLF178XR; BLF178XRS

Power LDMOS transistor

Rev. 4 — 12 July 2013

Product data sheet

## 1. Product profile

### 1.1 General description

A 1400 W extremely rugged LDMOS power transistor for broadcast and industrial applications in the HF to 128 MHz band.

Table 1. Application information

Test signal	f (MHz)	V <sub>DS</sub> (V)	P <sub>L</sub> (W)	G <sub>p</sub> (dB)	$\eta_D$ (%)
CW	108	50	1200	23	80
pulsed RF	108	50	1400	28	72

### 1.2 Features and benefits

- Typical pulsed performance at frequency of 108 MHz, a supply voltage of 50 V and an I<sub>DQ</sub> of 40 mA, a t<sub>p</sub> of 100  $\mu$ s with  $\delta$  of 20 %:
  - ◆ Output power = 1400 W
  - ◆ Power gain = 28 dB
  - ◆ Efficiency = 72 %
- Easy power control
- Integrated ESD protection
- Excellent ruggedness
- High efficiency
- Excellent thermal stability
- Designed for broadband operation (HF to 128 MHz)
- Compliant to Directive 2002/95/EC, regarding Restriction of Hazardous Substances (RoHS)

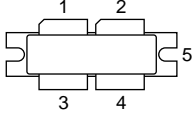
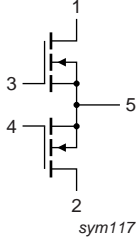
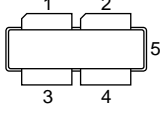
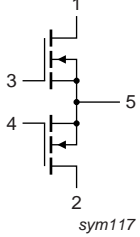
### 1.3 Applications

- Industrial, scientific and medical applications
- Broadcast transmitter applications



## 2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
<b>BLF178XR (SOT539A)</b>			
1	drain1		
2	drain2		
3	gate1		
4	gate2		
5	source		
<b>BLF178XRS (SOT539B)</b>			
1	drain1		
2	drain2		
3	gate1		
4	gate2		
5	source		

[1] Connected to flange.

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BLF178XR	-	flanged balanced LDMOST ceramic package; 2 mounting holes; 4 leads	SOT539A
BLF178XRS	-	earless flanged balanced LDMOST ceramic package; 4 leads	SOT539B

## 4. Limiting values

Table 4. Limiting values

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

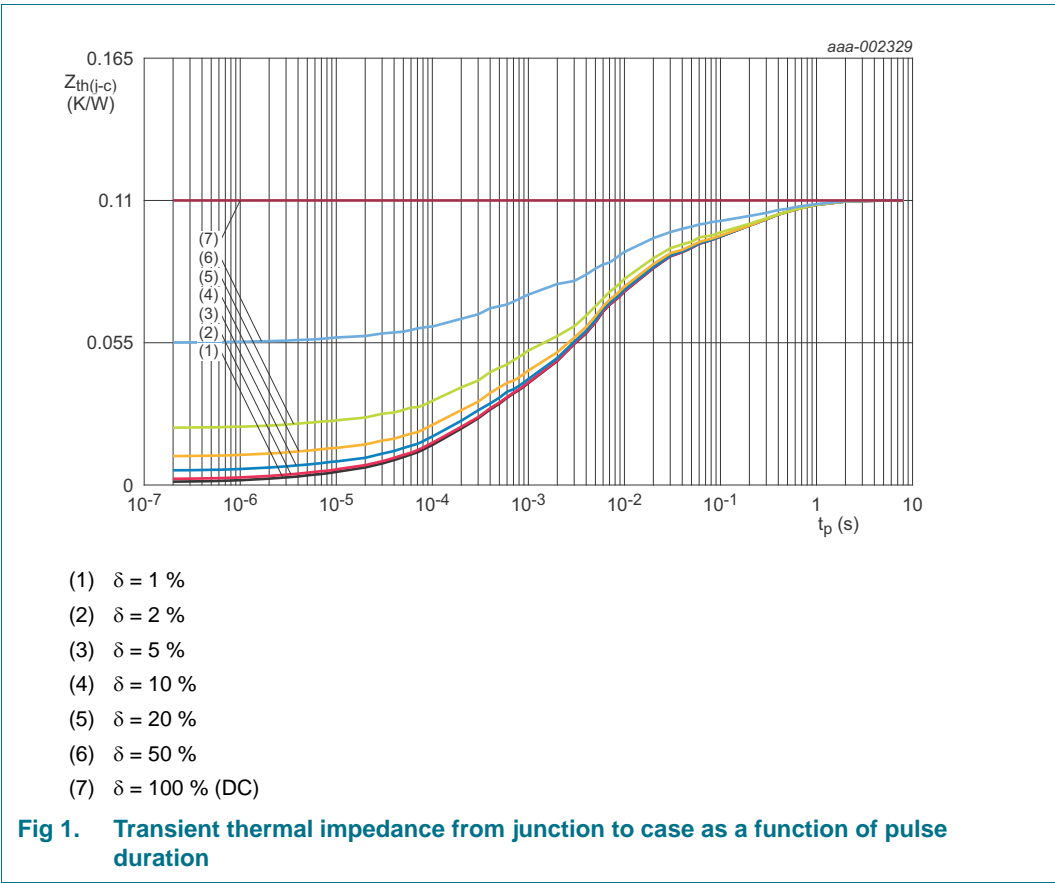
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage		-	110	V
$V_{GS}$	gate-source voltage		-6	+11	V
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature		-	200	°C

5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	$T_j = 150\text{ }^{\circ}\text{C}$	[1][2] 0.11	K/W
$Z_{th(j-c)}$	transient thermal impedance from junction to case	$T_j = 150\text{ }^{\circ}\text{C}$ ; $t_p = 100\text{ }\mu\text{s}$ ; $\delta = 20\text{ }\%$	[3] 0.033	K/W

- [1]  $T_j$  is the junction temperature.  
[2]  $R_{th(j-c)}$  is measured under RF conditions.  
[3] See [Figure 1](#).



## 6. Characteristics

**Table 6. DC characteristics**

$T_j = 25\text{ }^{\circ}\text{C}$ ; per section unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ ; $I_D = 5.5\text{ mA}$	110	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 10\text{ V}$ ; $I_D = 550\text{ mA}$	1.25	1.7	2.25	V
$V_{GSq}$	gate-source quiescent voltage	$V_{DS} = 50\text{ V}$ ; $I_D = 20\text{ mA}$	0.8	1.3	1.8	V
$I_{DSS}$	drain leakage current	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 50\text{ V}$	-	-	2.8	$\mu\text{A}$
$I_{DSX}$	drain cut-off current	$V_{GS} = V_{GS(th)} + 3.75\text{ V}$ ; $V_{DS} = 10\text{ V}$	-	77	-	A
$I_{GSS}$	gate leakage current	$V_{GS} = 11\text{ V}$ ; $V_{DS} = 0\text{ V}$	-	-	280	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = V_{GS(th)} + 3.75\text{ V}$ ; $I_D = 19.25\text{ A}$	-	0.07	-	$\Omega$

**Table 7. AC characteristics**

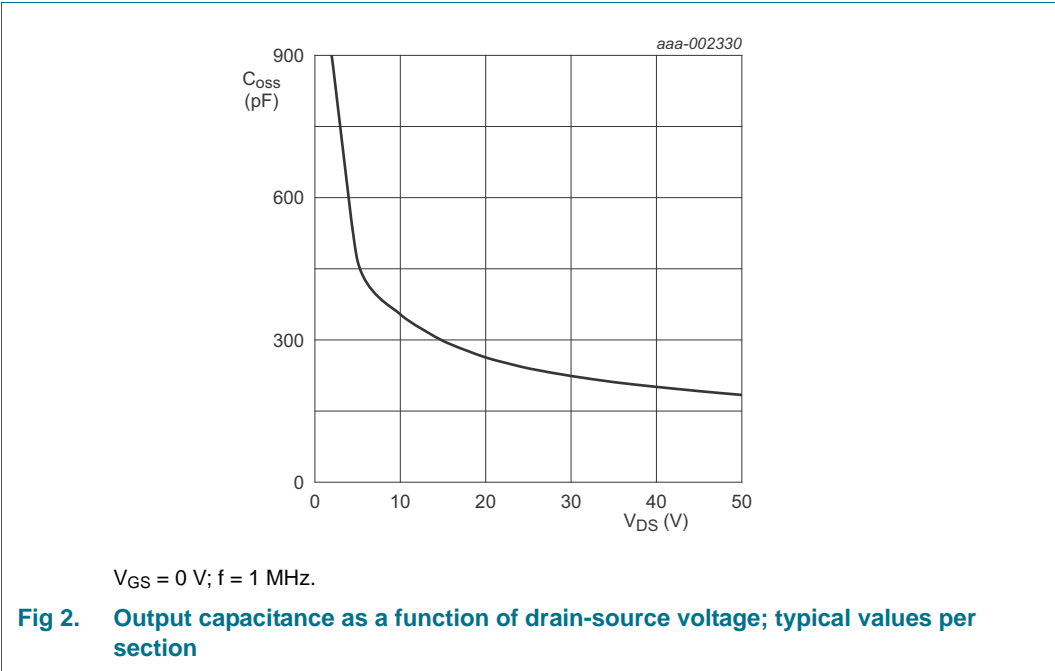
$T_j = 25\text{ }^{\circ}\text{C}$ ; per section unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{rs}$	feedback capacitance	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 50\text{ V}$ ; $f = 1\text{ MHz}$	-	5.5	-	pF
$C_{iss}$	input capacitance	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 50\text{ V}$ ; $f = 1\text{ MHz}$	-	414	-	pF
$C_{oss}$	output capacitance	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 50\text{ V}$ ; $f = 1\text{ MHz}$	-	184	-	pF

**Table 8. RF characteristics**

Test signal: pulsed RF;  $t_p = 100\text{ }\mu\text{s}$ ;  $\delta = 20\%$ ;  $f = 108\text{ MHz}$ ; RF performance at  $V_{DS} = 50\text{ V}$ ;  $I_{DQ} = 40\text{ mA}$ ;  $T_{case} = 25\text{ }^{\circ}\text{C}$ ; unless otherwise specified; in a class-AB production test circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$G_p$	power gain	$P_L = 1400\text{ W}$	27	28	-	dB
$RL_{in}$	input return loss	$P_L = 1400\text{ W}$	-	-15	-11	dB
$\eta_D$	drain efficiency	$P_L = 1400\text{ W}$	68	72	-	%

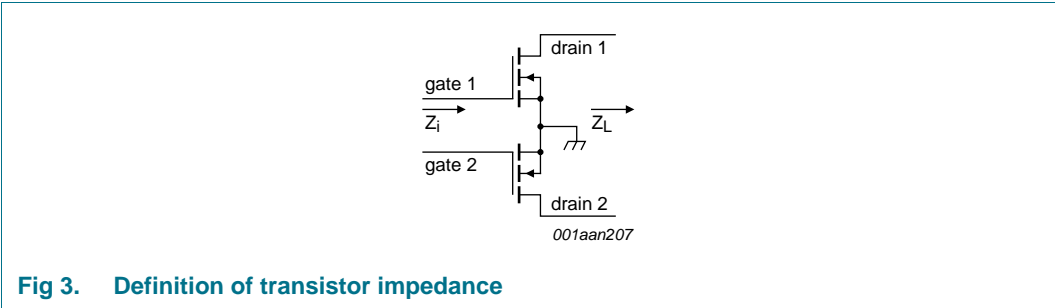


7. Test information

7.1 Ruggedness in class-AB operation

The BLF178XR and BLF178XRS are capable of withstanding a load mismatch corresponding to VSWR > 65 : 1 through all phases under the following conditions:  $V_{DS} = 50\text{ V}$ ;  $I_{Dq} = 40\text{ mA}$ ;  $P_L = 1400\text{ W}$  pulsed;  $f = 108\text{ MHz}$ .

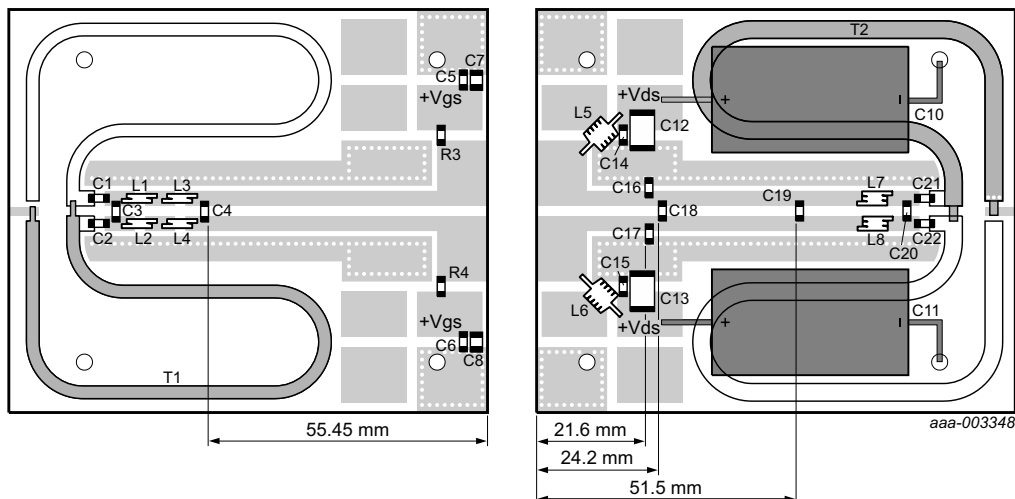
7.2 Impedance information



**Table 9. Typical push-pull impedance**  
*Simulated  $Z_i$  and  $Z_L$  device impedance; impedance info at  $V_{DS} = 50\text{ V}$  and  $P_L = 1400\text{ W}$ .*

f (MHz)	$Z_i$ ( $\Omega$ )	$Z_L$ ( $\Omega$ )
108	$2.35 - j6.06$	$2.78 + j0.48$

### 7.3 Test circuit



Printed-Circuit Board (PCB): RF 35;  $\epsilon_r = 3.5$ ; thickness = 0.765 mm; thickness copper plating = 35  $\mu\text{m}$ .

See [Table 10](#) for a list of components.

**Fig 4.** Component layout for class-AB production test circuit

**Table 10.** List of components

For test circuit see [Figure 4](#).

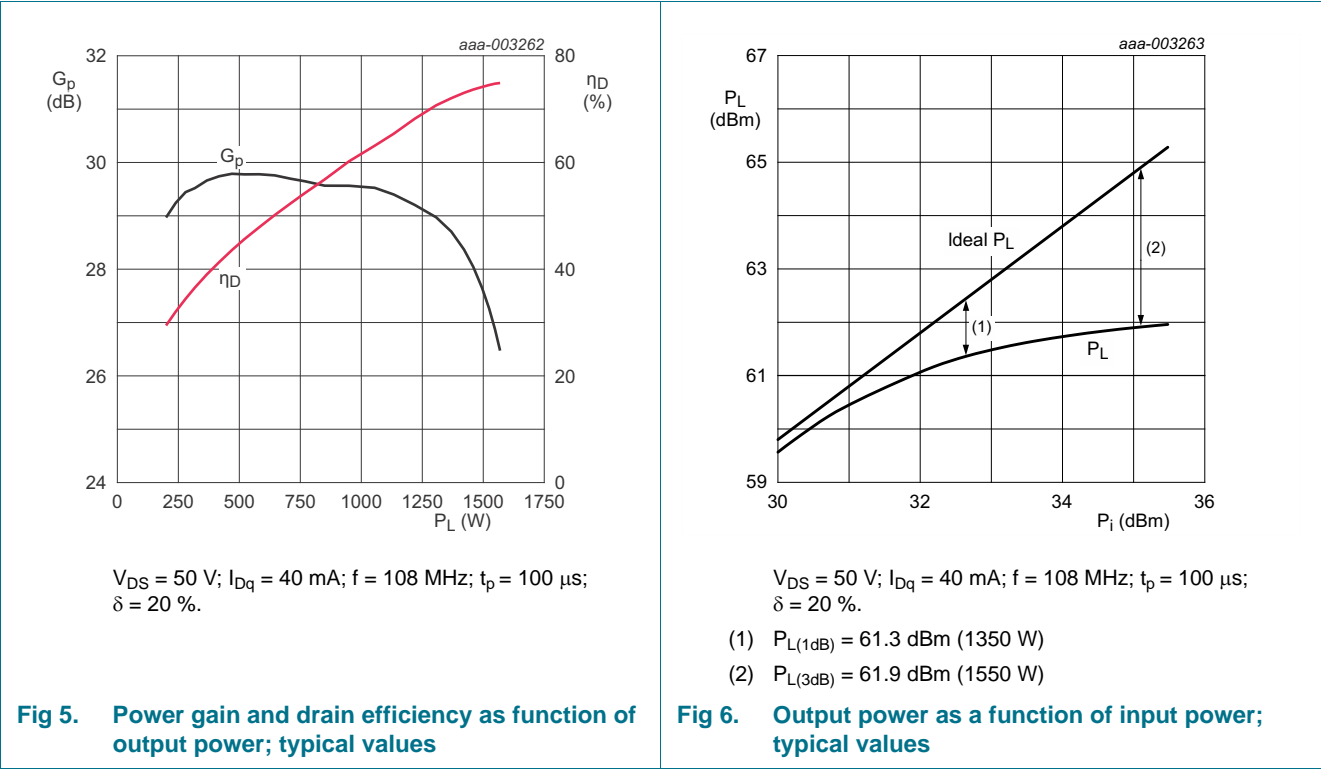
Component	Description	Value	Remarks
C1, C2, C5, C6, C14, C15, C21, C22	multilayer ceramic chip capacitor	1 nF	[1]
C3	multilayer ceramic chip capacitor	82 pF	[1]
C4	multilayer ceramic chip capacitor	240 pF	[1]
C7, C8	multilayer ceramic chip capacitor	4.7 $\mu\text{F}$ ; 50 V	
C10, C11	electrolytic capacitor	2200 $\mu\text{F}$ ; 63 V	
C12, C13	multilayer ceramic chip capacitor	4.7 $\mu\text{F}$ ; 100 V	
C16, C17	multilayer ceramic chip capacitor	120 pF	[1]
C18	multilayer ceramic chip capacitor	82 pF	[1]
C19	multilayer ceramic chip capacitor	110 pF	[1]
C20	multilayer ceramic chip capacitor	56 pF	[1]
L1, L2, L3, L4	1.5 turn 0.8 mm copper wire	D = 3 mm; length = 2 mm	
L5, L6	5 turn 0.8 mm copper wire	D = 3 mm; length = 4.5 mm	
L7, L8	2.5 turn 0.8 mm copper wire	D = 3 mm; length = 3 mm	
R3, R4	SMD resistor	9.1 $\Omega$	1206
T1	semi rigid coax	25 $\Omega$ ; 160 mm	UT-090C-25
T2	semi rigid coax	25 $\Omega$ ; 160 mm	UT-141C-25

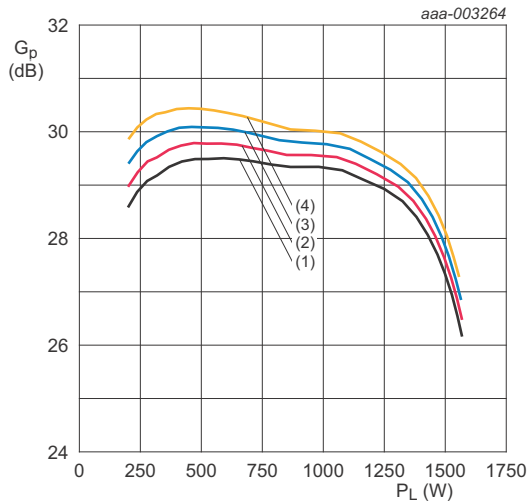
[1] American Technical Ceramics type 800B or capacitor of same quality.

7.4 Graphical data

The following figures are measured in a class-AB production test circuit.

7.4.1 1-Tone CW pulsed

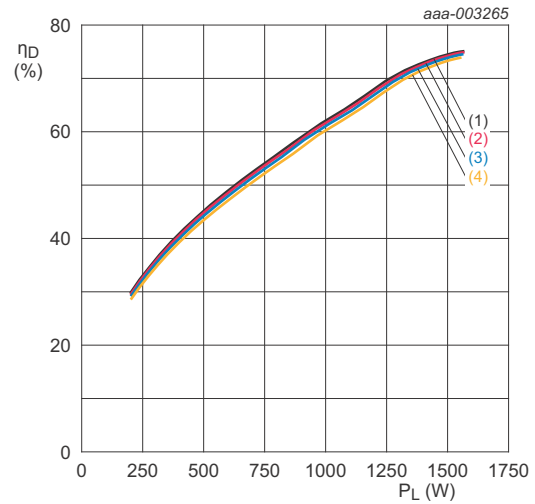




$V_{DS} = 50 \text{ V}$ ;  $f = 108 \text{ MHz}$ ;  $t_p = 100 \text{ } \mu\text{s}$ ;  $\delta = 20 \text{ } \%$ .

- (1)  $I_{Dq} = 20 \text{ mA}$
- (2)  $I_{Dq} = 40 \text{ mA}$
- (3)  $I_{Dq} = 80 \text{ mA}$
- (4)  $I_{Dq} = 160 \text{ mA}$

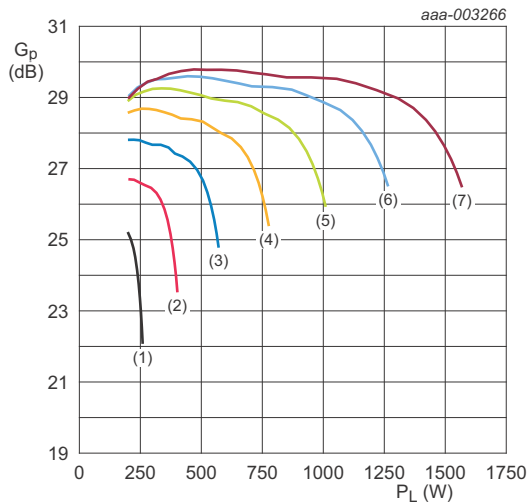
**Fig 7. Power gain as a function of output power; typical values**



$V_{DS} = 50 \text{ V}$ ;  $f = 108 \text{ MHz}$ ;  $t_p = 100 \text{ } \mu\text{s}$ ;  $\delta = 20 \text{ } \%$ .

- (1)  $I_{Dq} = 20 \text{ mA}$
- (2)  $I_{Dq} = 40 \text{ mA}$
- (3)  $I_{Dq} = 80 \text{ mA}$
- (4)  $I_{Dq} = 160 \text{ mA}$

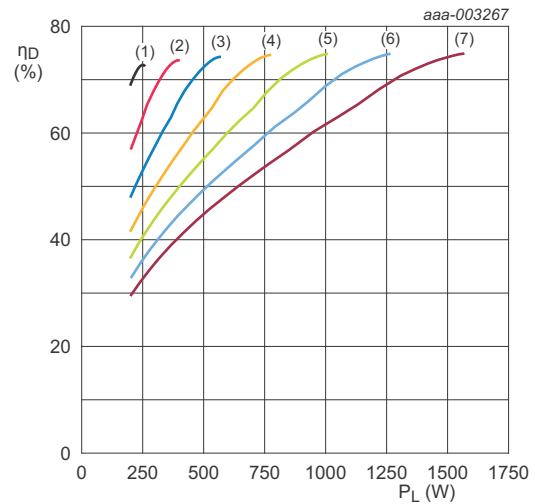
**Fig 8. Drain efficiency as a function of output power; typical values**



$I_{Dq} = 40 \text{ mA}$ ;  $f = 108 \text{ MHz}$ ;  $t_p = 100 \text{ } \mu\text{s}$ ;  $\delta = 20 \text{ } \%$ .

- (1)  $V_{DS} = 20 \text{ V}$
- (2)  $V_{DS} = 25 \text{ V}$
- (3)  $V_{DS} = 30 \text{ V}$
- (4)  $V_{DS} = 35 \text{ V}$
- (5)  $V_{DS} = 40 \text{ V}$
- (6)  $V_{DS} = 45 \text{ V}$
- (7)  $V_{DS} = 50 \text{ V}$

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



$I_{Dq} = 40 \text{ mA}$ ;  $f = 108 \text{ MHz}$ ;  $t_p = 100 \text{ } \mu\text{s}$ ;  $\delta = 20 \text{ } \%$ .

- (1)  $V_{DS} = 20 \text{ V}$
- (2)  $V_{DS} = 25 \text{ V}$
- (3)  $V_{DS} = 30 \text{ V}$
- (4)  $V_{DS} = 35 \text{ V}$
- (5)  $V_{DS} = 40 \text{ V}$
- (6)  $V_{DS} = 45 \text{ V}$
- (7)  $V_{DS} = 50 \text{ V}$

**Fig 10. Drain efficiency as a function of output power; typical values**



8. Package outline

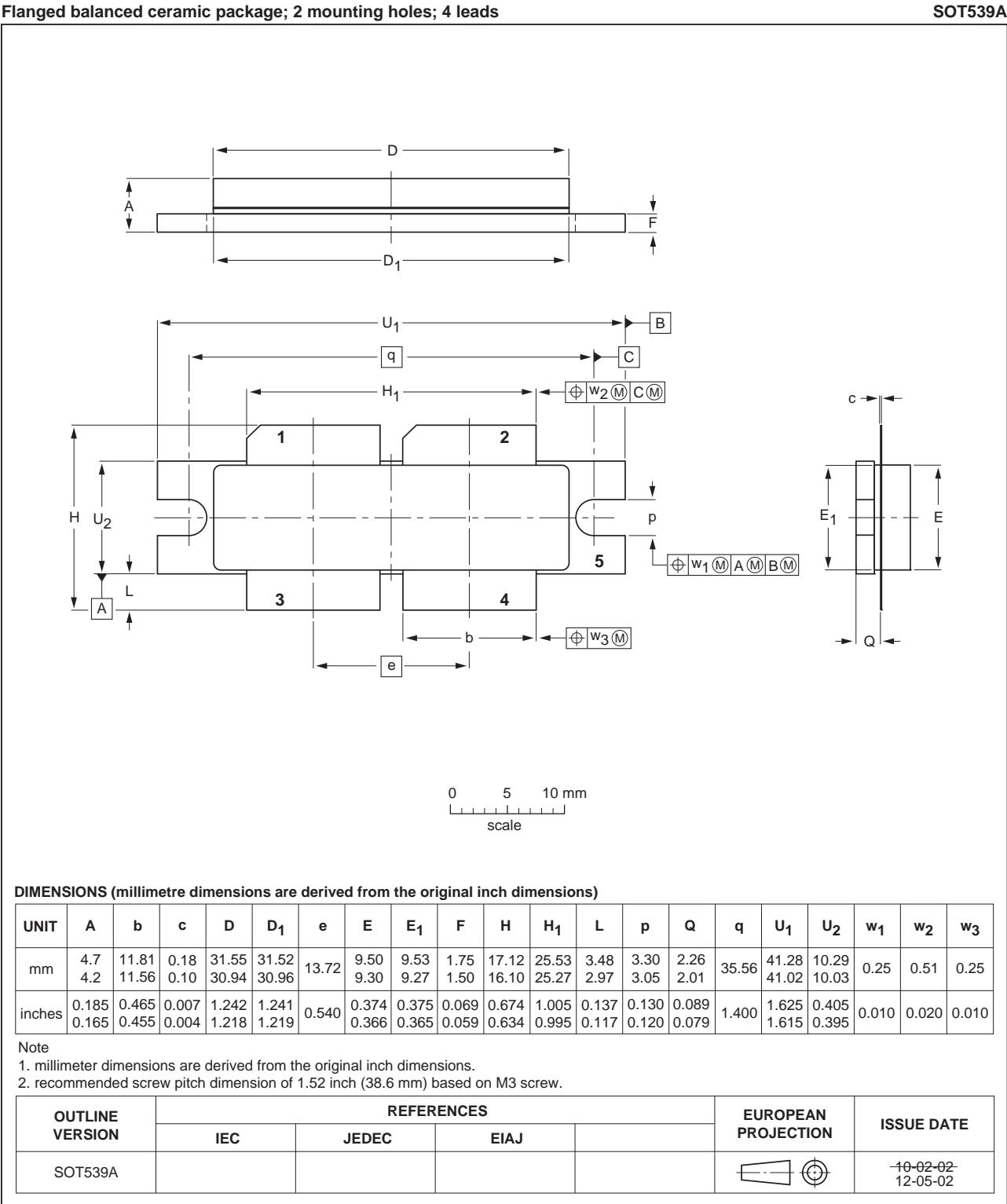
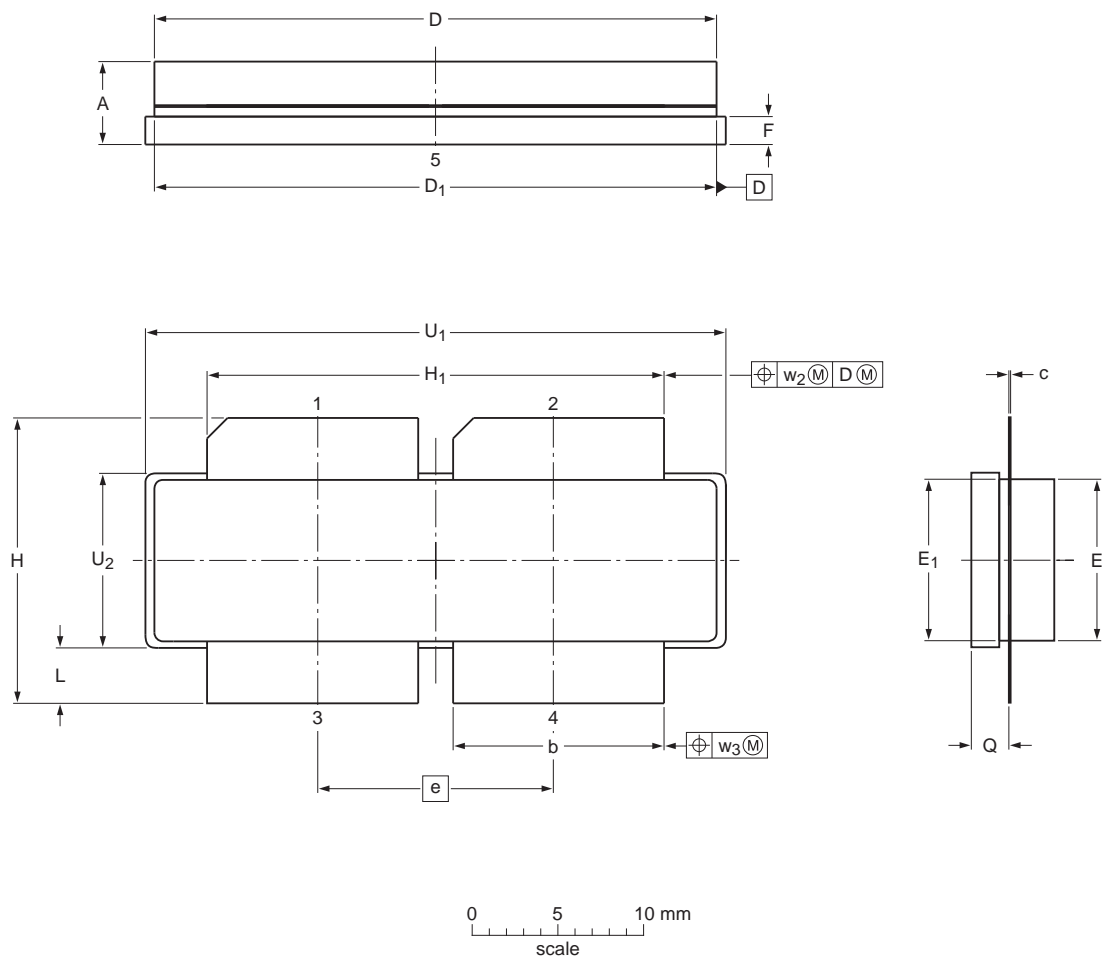


Fig 11. Package outline SOT539A

Earless flanged balanced ceramic package; 4 leads

SOT539B



Dimensions																	
Unit <sup>(1)</sup>	A	b	c	D	D <sub>1</sub>	E	E <sub>1</sub>	e	F	H	H <sub>1</sub>	L	Q	U <sub>1</sub>	U <sub>2</sub>	w <sub>2</sub>	w <sub>3</sub>
mm	max	4.7	11.81	0.18	31.55	31.52	9.5	9.53	1.75	17.12	25.53	3.48	2.26	32.39	10.29	0.25	0.25
	nom							13.72									
	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	0.069	0.674	1.005	0.137	0.089	1.275	0.405	0.01	0.01
	nom							0.54									
	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

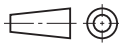
Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT539B						12-05-02 13-05-24

Fig 12. 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.

## 10. Abbreviations

Table 11. Abbreviations

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

## 11. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLF178XR_BLF178XRS v.4	20130712	Product data sheet	-	BLF178XR_BLF178XRS v.3
Modifications:	• The package outline <a href="#">Figure 12</a> is updated.			
BLF178XR_BLF178XRS v.3	20120625	Product data sheet	-	BLF178XR_BLF178XRS v.2
Modifications:	• The status of this document has been changed to Product data sheet.			
BLF178XR_BLF178XRS v.2	20120515	Preliminary data sheet	-	BLF178XR_BLF178XRS v.1
BLF178XR_BLF178XRS v.1	20120130	Objective data sheet	-	-

## 12. Legal information

### 12.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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.

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