

# BLF578XR; BLF578XRS

Power LDMOS transistor

Rev. 5 — 1 September 2015

AMPLEON

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 500 MHz band. This product is an enhanced version of the BLF578 using Ampleon's XR process to provide maximum ruggedness capability in the most severe applications without compromising the RF performance.

Table 1. Application information

Test signal	f (MHz)	V <sub>DS</sub> (V)	P <sub>L</sub> (W)	G <sub>p</sub> (dB)	$\eta_D$ (%)
pulsed RF	225	50	1400	23.5	69

### 1.2 Features and benefits

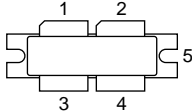
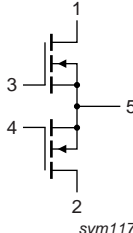
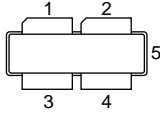
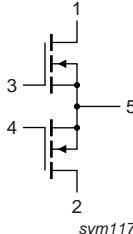
- Typical pulsed performance at frequency of 225 MHz, a supply voltage of 50 V and an I<sub>DQ</sub> of 40 mA, a t<sub>p</sub> of 100  $\mu$ s with  $\delta$  of 20 %:
  - ◆ Output power = 1400 W
  - ◆ Power gain = 23.5 dB
  - ◆ Efficiency = 69 %
- Easy power control
- Integrated ESD protection
- Excellent ruggedness
- High efficiency
- Excellent thermal stability
- Designed for broadband operation (HF to 500 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>BLF578XR (SOT539A)</b>			
1	drain1		 sym117
2	drain2		
3	gate1		
4	gate2		
5	source		
<b>BLF578XRS (SOT539B)</b>			
1	drain1		 sym117
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
BLF578XR	-	flanged balanced LDMOST ceramic package; 2 mounting holes; 4 leads	SOT539A
BLF578XRS	-	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).

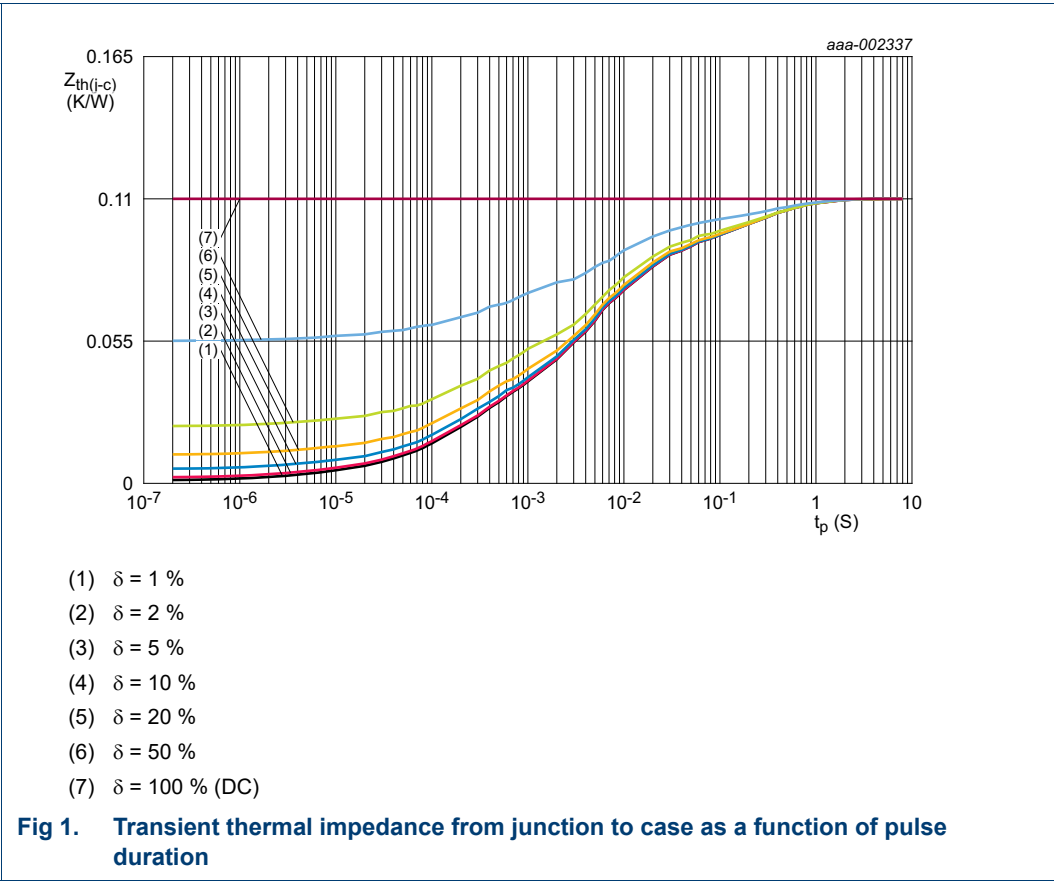
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage		-	110	V
$V_{GS}$	gate-source voltage		-6	+11	V
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature		-	200	°C

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**

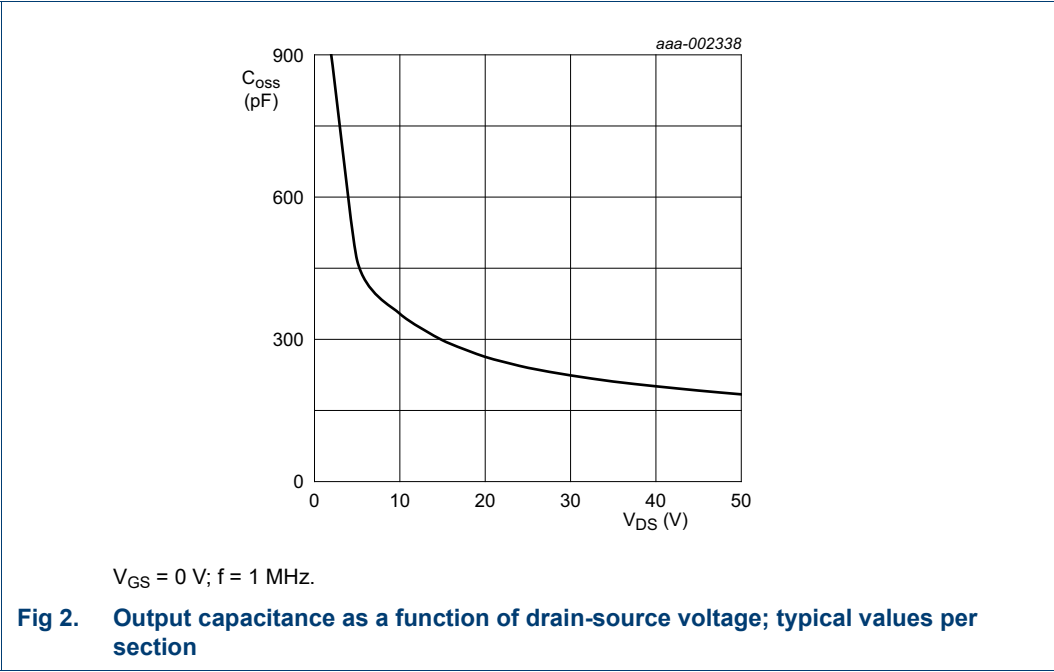
$T_j = 25\text{ }^{\circ}\text{C}$ ; per section unless otherwise specified.

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;  $t_p = 100\text{ }\mu\text{s}$ ;  $\delta = 20\%$ ;  $f = 225\text{ MHz}$ ; 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	$P_L = 1400\text{ W}$	22	23.5	-	dB
$RL_{in}$	input return loss	$P_L = 1400\text{ W}$	-	-17	-13	dB
$\eta_D$	drain efficiency	$P_L = 1400\text{ W}$	65	69	-	%

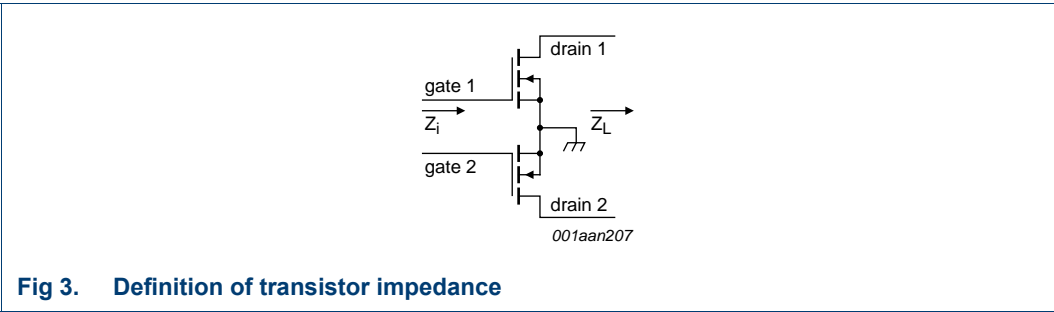


7. Test information

7.1 Ruggedness in class-AB operation

The BLF578XR and BLF578XRS are capable of withstanding a load mismatch corresponding to  $V_{SWR} > 65 : 1$  through all phases under the following conditions:  $V_{DS} = 50\text{ V}; I_{Dq} = 40\text{ mA}; P_L = 1400\text{ W}$  pulsed;  $f = 225\text{ MHz}.$

7.2 Impedance information

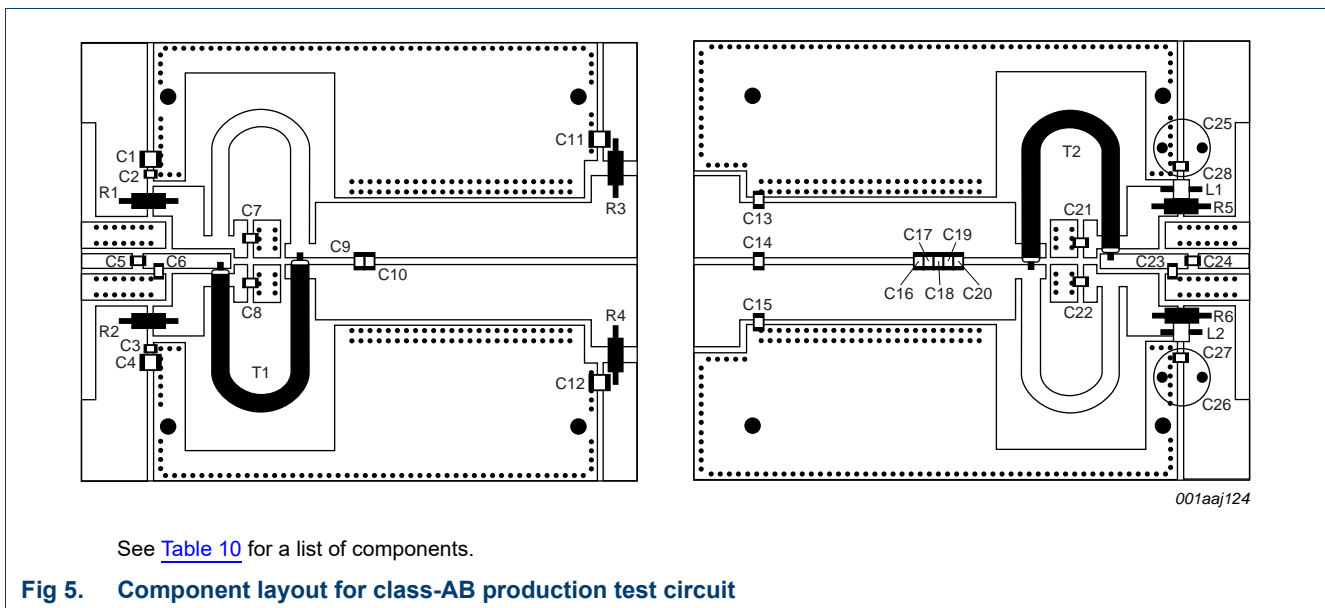
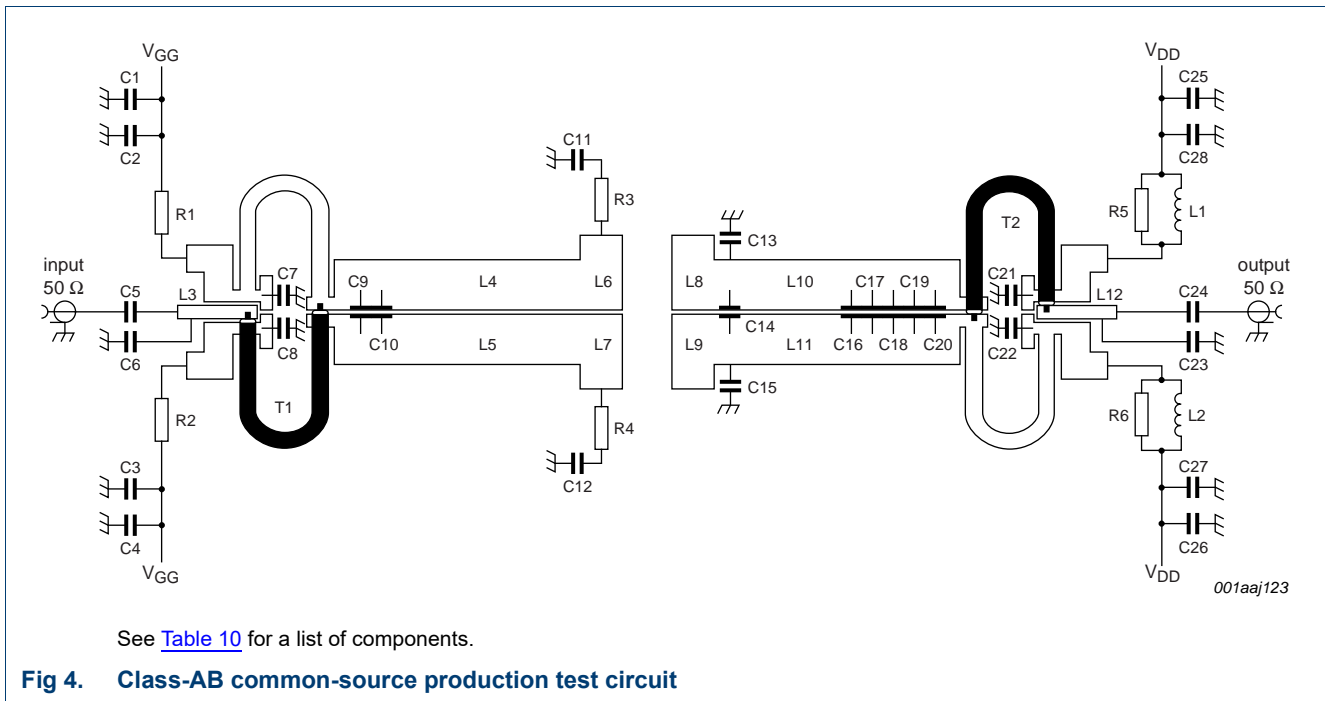


**Table 9. Typical push-pull impedance**

Simulated  $Z_i$  and  $Z_L$  device impedance; impedance info at  $V_{DS} = 50\text{ V}$  and  $P_L = 1400\text{ W}.$

f (MHz)	$Z_i$ ( $\Omega$ )	$Z_L$ ( $\Omega$ )
225	$2.36 - j2.78$	$2.45 + j0.86$

### 7.3 Test circuit



**Table 10. List of components**

For production test circuit, see [Figure 4](#) and [Figure 5](#).

Printed-Circuit Board (PCB): Rogers 5880;  $\epsilon_r = 2.2$  F/m; height = 0.79 mm; Cu (top/bottom metallization); thickness copper plating = 35  $\mu\text{m}$ .

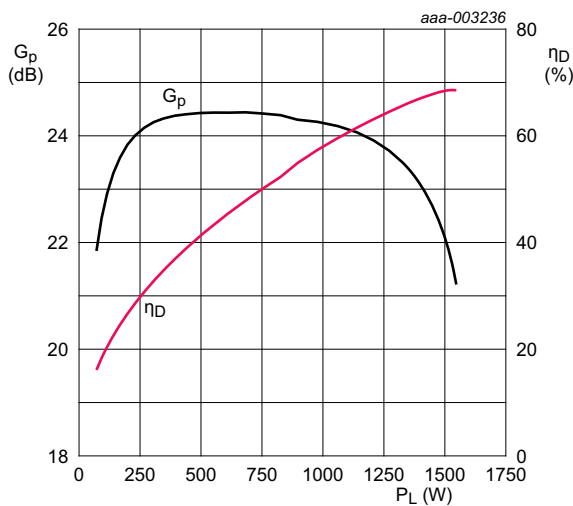
Component	Description	Value	Remarks
C1, C2, C11, C12	multilayer ceramic chip capacitor	4.7 $\mu\text{F}$	TDK4532X7R1E475Mt020U
C2, C3, C27, C28	multilayer ceramic chip capacitor	100 nF	Murata X7R 250 V
C5, C7, C8, C21, C22	multilayer ceramic chip capacitor	1 nF	<a href="#">[1]</a>
C6	multilayer ceramic chip capacitor	30 pF	<a href="#">[1]</a>
C9, C13, C15	multilayer ceramic chip capacitor	62 pF	<a href="#">[1]</a>
C10	multilayer ceramic chip capacitor	51 pF	<a href="#">[1]</a>
C14	multilayer ceramic chip capacitor	36 pF	<a href="#">[1]</a>
C16, C17	multilayer ceramic chip capacitor	24 pF	<a href="#">[1]</a>
C18	multilayer ceramic chip capacitor	30 pF	<a href="#">[1]</a>
C19	multilayer ceramic chip capacitor	27 pF	<a href="#">[1]</a>
C20	multilayer ceramic chip capacitor	9.1 pF	<a href="#">[1]</a>
C23	multilayer ceramic chip capacitor	13 pF	<a href="#">[1]</a>
C24	multilayer ceramic chip capacitor	16 pF	<a href="#">[1]</a>
C25, C26	electrolytic capacitor	220 $\mu\text{F}$ ; 63 V	
L1, L2	3 turns 1 mm copper wire	D = 2 mm; length = 3 mm	
L3, L12	stripline	-	(L $\times$ W) 15 mm $\times$ 2.4 mm
L4, L5, L10, L11	stripline	-	(L $\times$ W) 47 mm $\times$ 10 mm
L6, L7, L8, L9	stripline	-	(L $\times$ W) 8 mm $\times$ 15 mm
R1, R2	metal film resistor	2 $\Omega$ ; 0.6 W	
R3, R4	metal film resistor	20 $\Omega$ ; 0.6 W	
R5, R6	metal film resistor	1 $\Omega$ ; 0.6 W	
T1, T2	semi rigid coax	50 $\Omega$ ; 58 mm	EZ-141-AL-TP-M17

[1] American Technical Ceramics type 100B or capacitor of same quality.

7.4 Graphical data

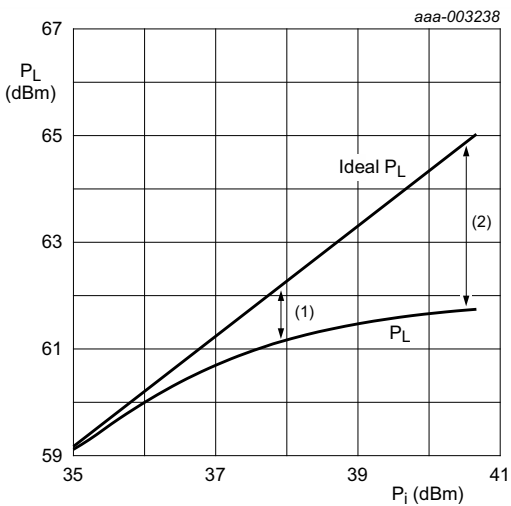
The following figures are measured in a class-AB production test circuit.

7.4.1 1-Tone CW pulsed



$V_{DS} = 50\text{ V}$ ;  $I_{Dq} = 40\text{ mA}$ ;  $f = 225\text{ MHz}$ ;  $t_p = 100\text{ }\mu\text{s}$ ;  
 $\delta = 20\text{ }\%$ .

Fig 6. Power gain and drain efficiency as function of output power; typical values

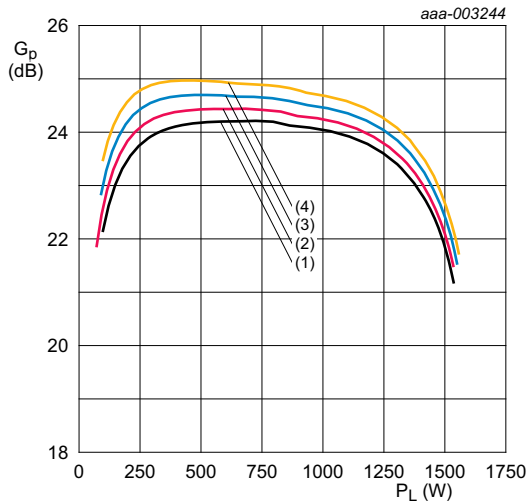


$V_{DS} = 50\text{ V}$ ;  $I_{Dq} = 40\text{ mA}$ ;  $f = 225\text{ MHz}$ ;  $t_p = 100\text{ }\mu\text{s}$ ;  
 $\delta = 20\text{ }\%$ .

- (1)  $P_{L(1dB)} = 61.3\text{ dBm}$  (1350 W)
- (2)  $P_{L(3dB)} = 61.9\text{ dBm}$  (1550 W)

Fig 7. Output power as a function of input power; typical values

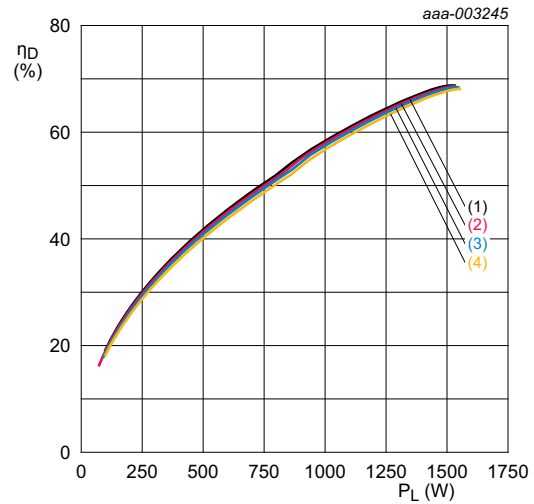




$V_{DS} = 50 \text{ V}$ ;  $f = 225 \text{ MHz}$ ;  $t_p = 100 \text{ } \mu\text{s}$ ;  $\delta = 20 \text{ } \%$ .

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

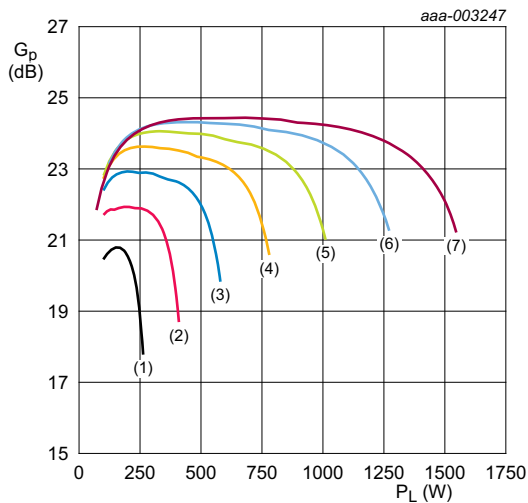
**Fig 8. Power gain as a function of output power; typical values**



$V_{DS} = 50 \text{ V}$ ;  $f = 225 \text{ MHz}$ ;  $t_p = 100 \text{ } \mu\text{s}$ ;  $\delta = 20 \text{ } \%$ .

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

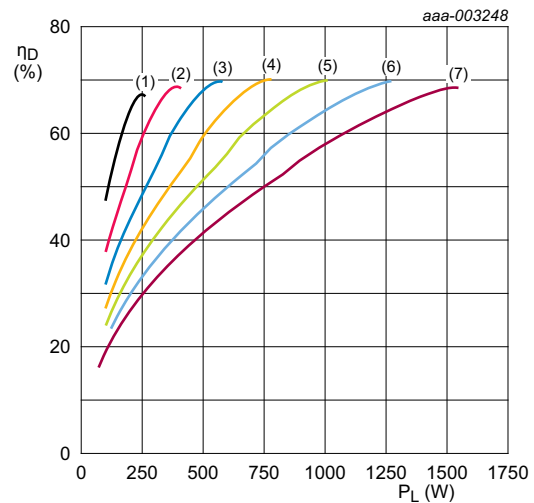
**Fig 9. Drain efficiency as a function of output power; typical values**



$I_{Dq} = 40 \text{ mA}$ ;  $f = 225 \text{ MHz}$ ;  $t_p = 100 \text{ } \mu\text{s}$ ;  $\delta = 20 \text{ } \%$ .

- (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. Power gain as a function of output power; typical values**



$I_{Dq} = 40 \text{ mA}$ ;  $f = 225 \text{ MHz}$ ;  $t_p = 100 \text{ } \mu\text{s}$ ;  $\delta = 20 \text{ } \%$ .

- (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 11. Drain efficiency as a function of output power; typical values**

8. Package outline

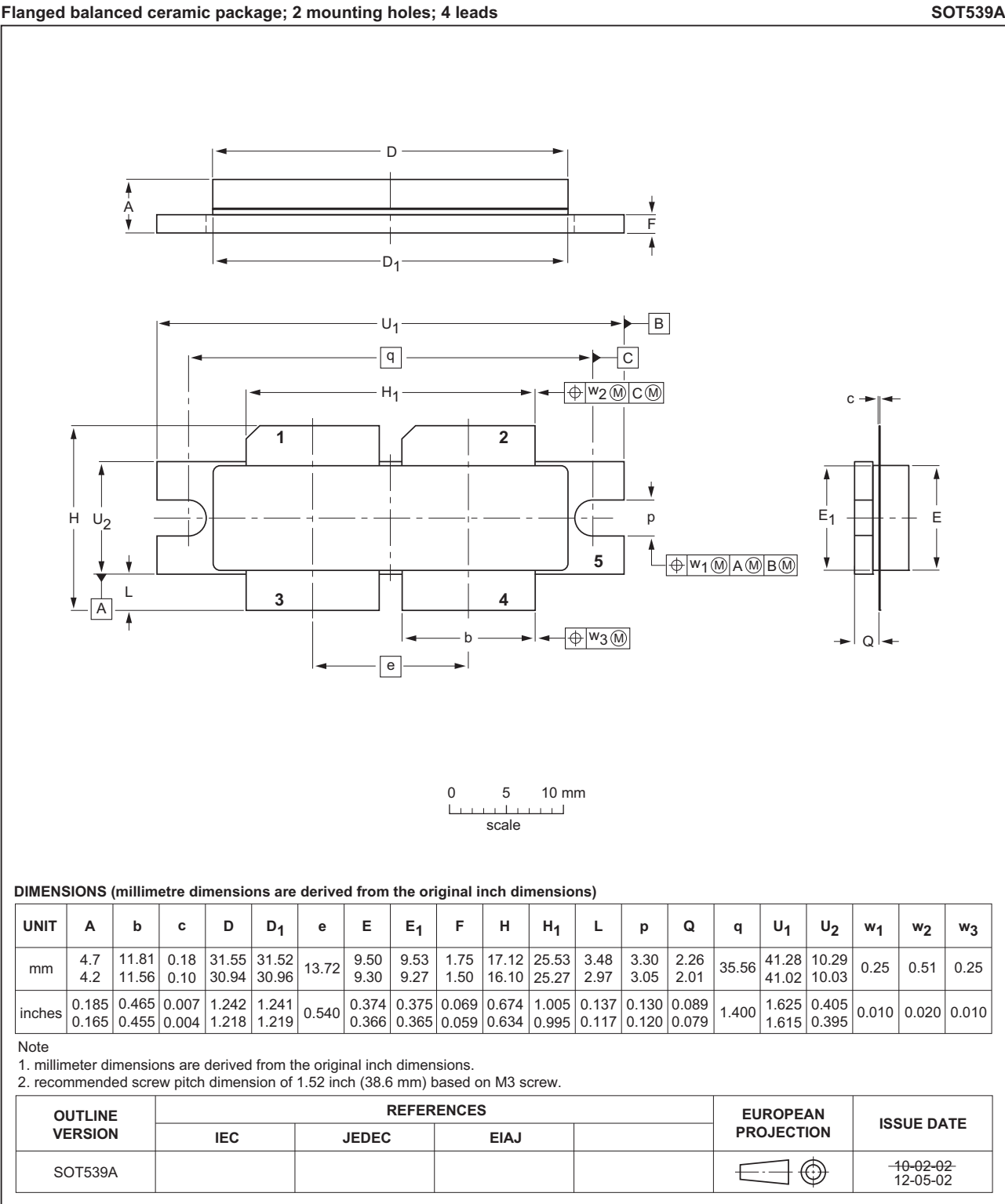
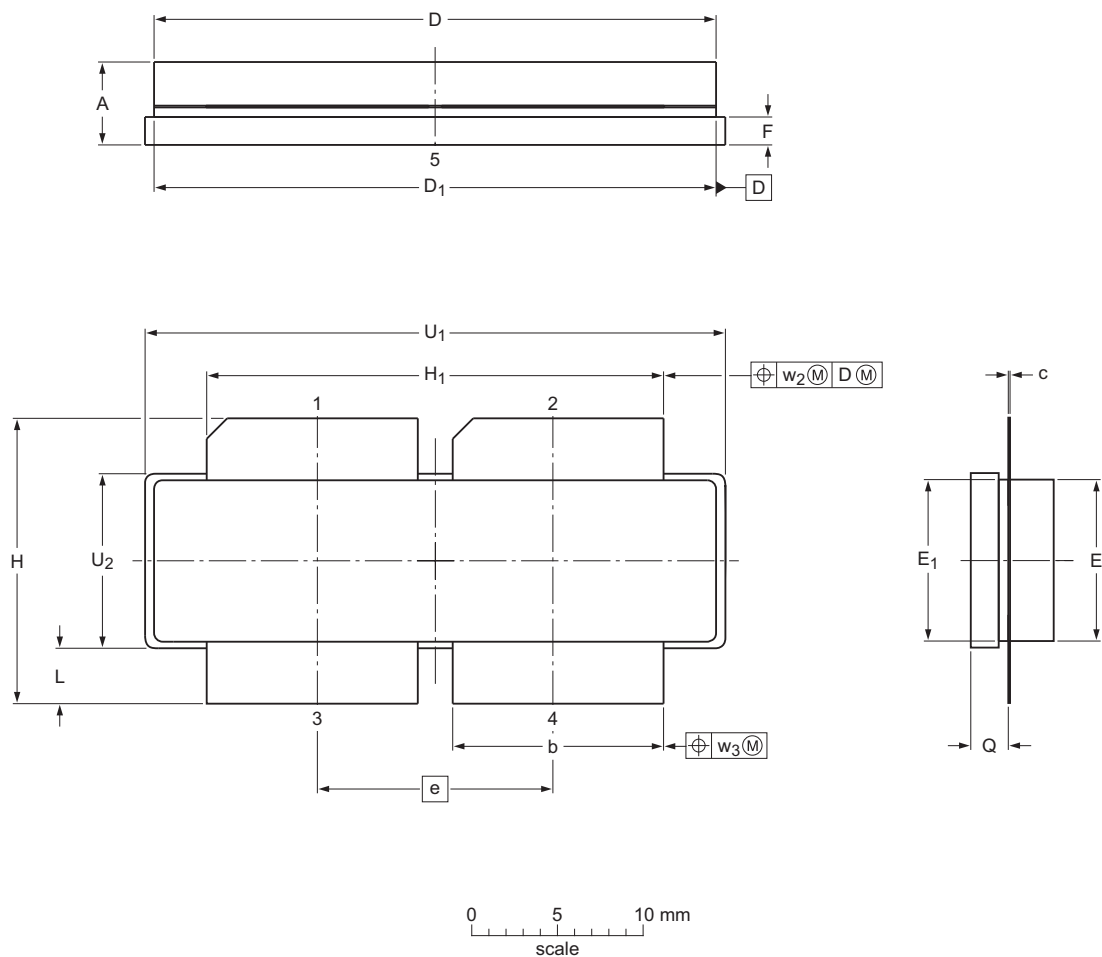


Fig 12. Package outline SOT539A

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		
	nom							13.72								0.25	0.25
	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		
	nom							0.54								0.01	0.01
	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 13. 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
VSWR	Voltage Standing-Wave Ratio
XR	eXtremely Rugged

## 11. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLF578XR_BLF578XRS#5	20150901	Product data sheet	-	BLF578XR_BLF578XRS v.4
Modifications:	<ul style="list-style-type: none"> <li>The format of this document has been redesigned to comply with the new identity guidelines of Ampleon.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>			
BLF578XR_BLF578XRS v.4	20130712	Product data sheet	-	BLF578XR_BLF578XRS v.3
BLF578XR_BLF578XRS v.3	20120625	Product data sheet	-	BLF578XR_BLF578XRS v.2
BLF578XR_BLF578XRS v.2	20120514	Preliminary data sheet	-	BLF578XR_BLF578XRS v.1
BLF578XR_BLF578XRS 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.

[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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## 14. Contents

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