

# BLF578

## Power LDMOS transistor

Rev. 02 — 4 February 2010

Product data sheet

## 1. Product profile

### 1.1 General description

A 1200 W LDMOS power transistor for broadcast applications and industrial applications in the HF to 500 MHz band.

Table 1. Application information

Mode of operation	f (MHz)	V <sub>DS</sub> (V)	P <sub>L</sub> (W)	G <sub>p</sub> (dB)	$\eta_D$ (%)
CW	108	50	1000	26	75
pulsed RF	225	50	1200	24	71

#### CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Therefore care should be taken during transport and handling.

### 1.2 Features

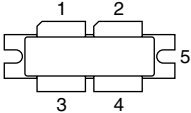
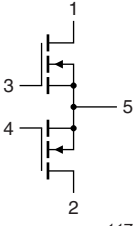
- Typical pulsed performance at frequency of 225 MHz, a supply voltage of 50 V and an I<sub>DQ</sub> of 40 mA, a t<sub>p</sub> of 100  $\mu$ s with  $\delta$  of 20 %:
  - ◆ Output power = 1200 W
  - ◆ Power gain = 24 dB
  - ◆ Efficiency = 71 %
- Easy power control
- Integrated ESD protection
- Excellent ruggedness
- High efficiency
- Excellent thermal stability
- Designed for broadband operation (10 MHz 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
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
BLF578	-	flanged balanced LDMOST ceramic package; 2 mounting holes; 4 leads	SOT539A

## 4. Limiting values

Table 4. Limiting values

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

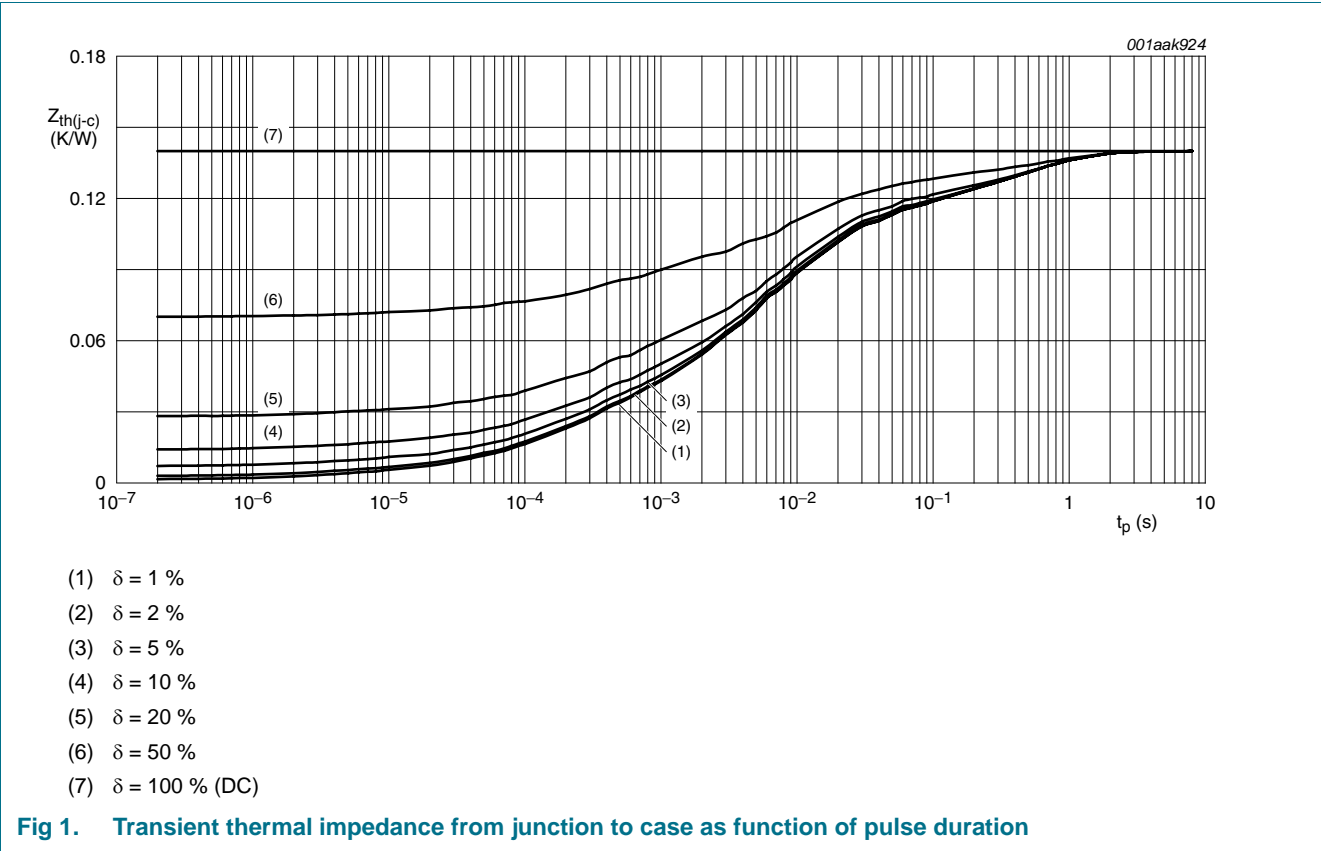
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage		-	110	V
$V_{GS}$	gate-source voltage		-0.5	+11	V
$I_D$	drain current		-	88	A
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature		-	225	°C

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] 0.14	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] 0.04	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.

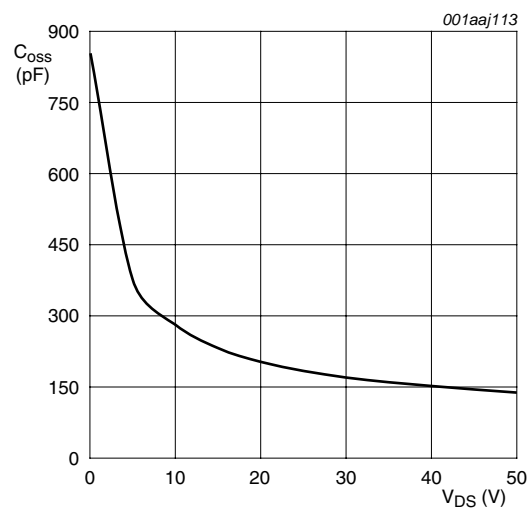
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ ; $I_D = 2.5\text{ mA}$	110	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 10\text{ V}$ ; $I_D = 500\text{ mA}$	1.25	1.7	2.25	V
$V_{GSq}$	gate-source quiescent voltage	$V_{DS} = 50\text{ V}$ ; $I_D = 20\text{ mA}$	0.8	1.3	1.8	V
$I_{DSS}$	drain leakage current	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 50\text{ V}$	-	-	2.8	$\mu\text{A}$

**Table 6. DC characteristics ...continued** $T_j = 25\text{ }^{\circ}\text{C}$ ; per section unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{DSX}$	drain cut-off current	$V_{GS} = V_{GS(th)} + 3.75\text{ V}$ ; $V_{DS} = 10\text{ V}$	58	70	-	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	$V_{GS} = V_{GS(th)} + 3.75\text{ V}$ ; $I_D = 16.66\text{ A}$	-	0.07	-	$\Omega$
$C_{rs}$	feedback capacitance	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 50\text{ V}$ ; $f = 1\text{ MHz}$	-	3	-	pF
$C_{iss}$	input capacitance	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 50\text{ V}$ ; $f = 1\text{ MHz}$	-	403	-	pF
$C_{oss}$	output capacitance	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 50\text{ V}$ ; $f = 1\text{ MHz}$	-	138	-	pF

**Table 7. RF characteristics**Mode of operation: pulsed RF;  $t_p = 100\text{ }\mu\text{s}$ ;  $\delta = 20\text{ }\%$ ;  $f = 225\text{ MHz}$ ; 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	$P_L = 1200\text{ W}$	23	24	25.4	dB
$RL_{in}$	input return loss	$P_L = 1200\text{ W}$	14	17.5	-	dB
$\eta_D$	drain efficiency	$P_L = 1200\text{ W}$	68	71	-	%

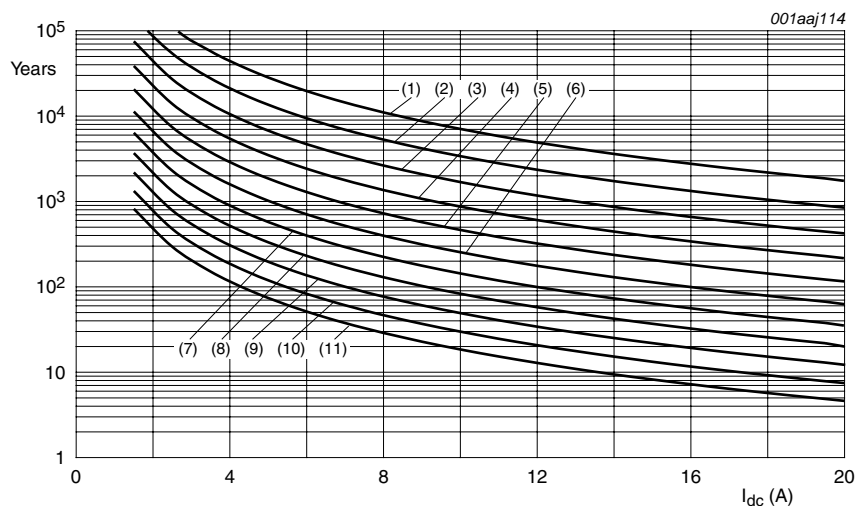
 $V_{GS} = 0\text{ V}$ ;  $f = 1\text{ MHz}$ .**Fig 2. Output capacitance as a function of drain-source voltage; typical values per section**

## 6.1 Ruggedness in class-AB operation

The BLF578 is capable of withstanding a load mismatch corresponding to  $VSWR = 13 : 1$  through all phases under the following conditions:  $V_{DS} = 50\text{ V}$ ;  $I_{DQ} = 40\text{ mA}$ ;  $P_L = 1200\text{ W}$  pulsed;  $f = 225\text{ MHz}$ .

## 7. Application information

### 7.1 Reliability



TTF (0.1 % failure fraction).

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

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

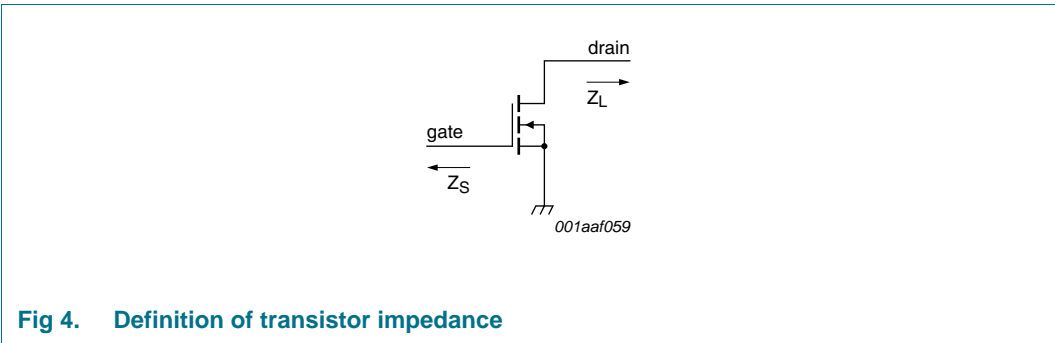
**Fig 3. BLF578 electromigration ( $I_D$ , total device)**

8. Test information

8.1 Impedance information

Table 8. Typical impedance  
Simulated  $Z_S$  and  $Z_L$  test circuit impedances.

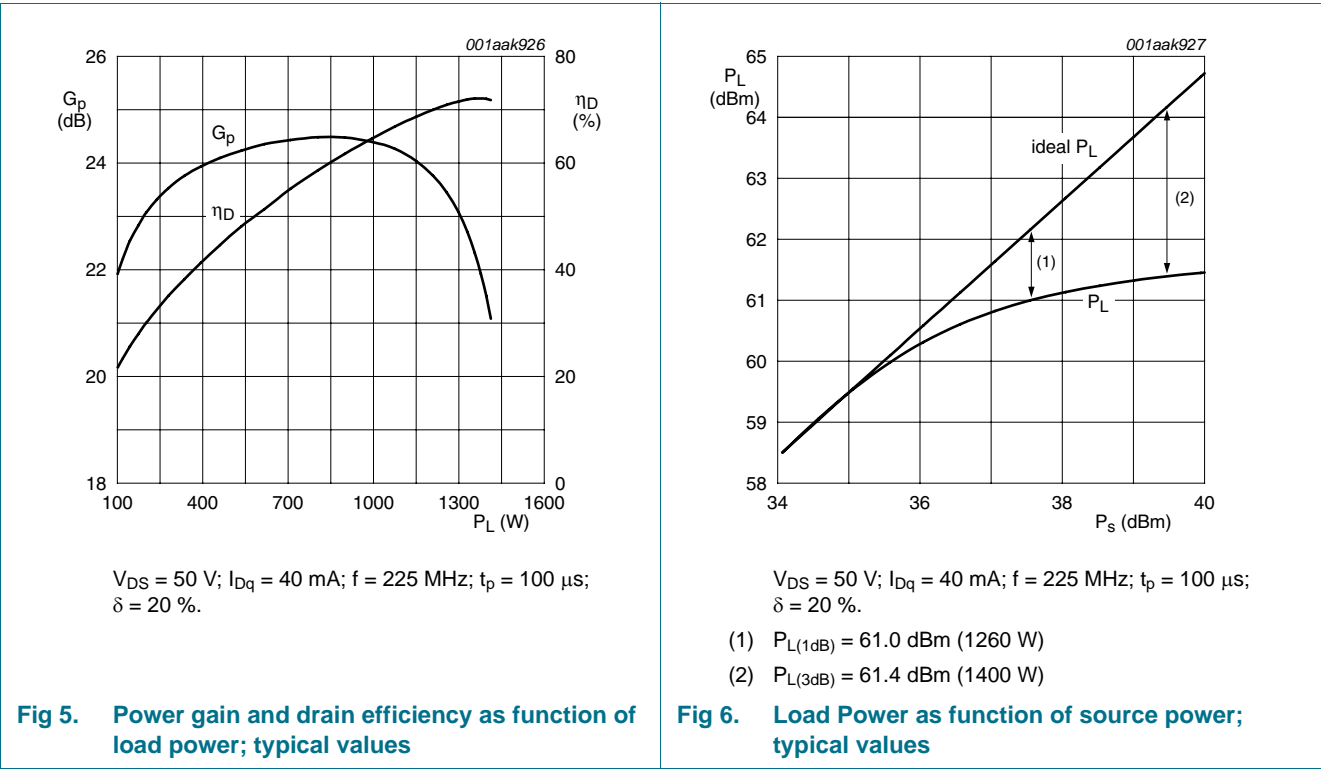
f	$Z_S$	$Z_L$
MHz	$\Omega$	$\Omega$
225	$3.2 + j2.6$	$3.7 - j0.2$

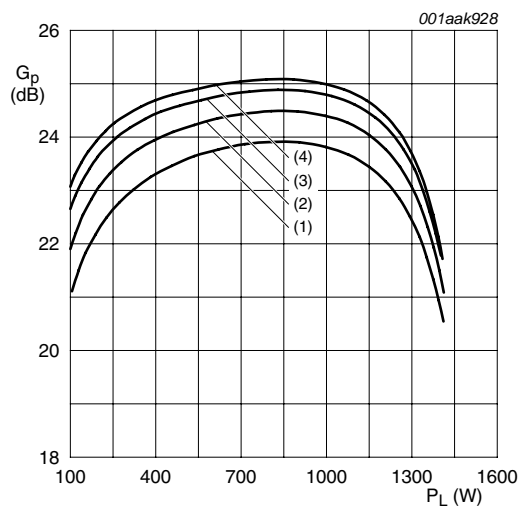


8.2 RF performance

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

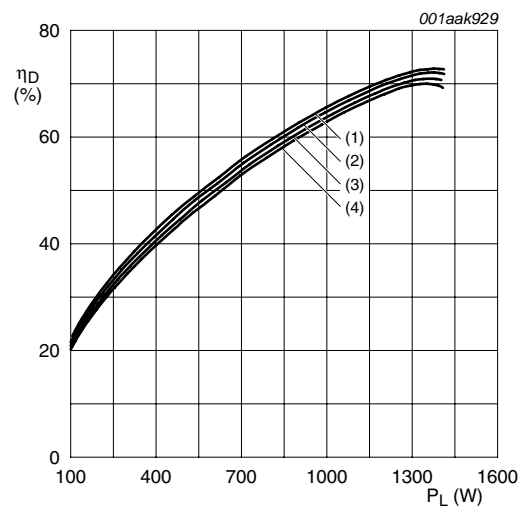
8.2.1 1-Tone CW pulsed





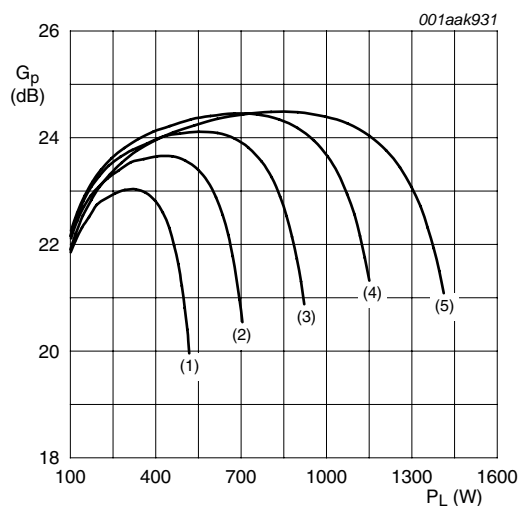
- $V_{DS} = 50\text{ V}$ ;  $f = 225\text{ MHz}$ ;  $t_p = 100\text{ }\mu\text{s}$ ;  $\delta = 20\text{ }\%$ .
- (1)  $I_{DQ} = 0\text{ mA}$
  - (2)  $I_{DQ} = 40\text{ mA}$
  - (3)  $I_{DQ} = 80\text{ mA}$
  - (4)  $I_{DQ} = 160\text{ mA}$

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



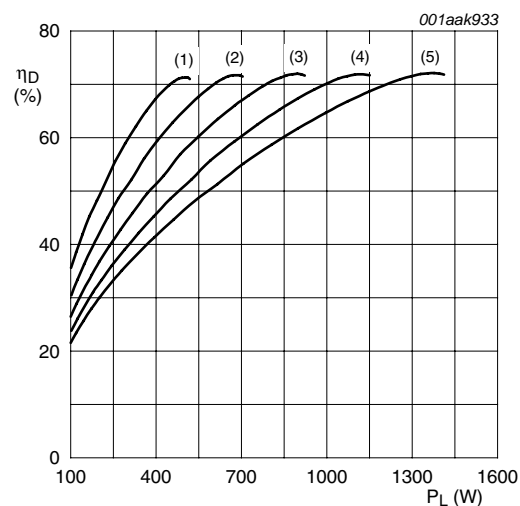
- $V_{DS} = 50\text{ V}$ ;  $f = 225\text{ MHz}$ ;  $t_p = 100\text{ }\mu\text{s}$ ;  $\delta = 20\text{ }\%$ .
- (1)  $I_{DQ} = 0\text{ mA}$
  - (2)  $I_{DQ} = 40\text{ mA}$
  - (3)  $I_{DQ} = 80\text{ mA}$
  - (4)  $I_{DQ} = 160\text{ mA}$

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



- $I_{DQ} = 40\text{ mA}$ ;  $f = 225\text{ MHz}$ ;  $t_p = 100\text{ }\mu\text{s}$ ;  $\delta = 20\text{ }\%$ .
- (1)  $V_{DS} = 30\text{ V}$
  - (2)  $V_{DS} = 35\text{ V}$
  - (3)  $V_{DS} = 40\text{ V}$
  - (4)  $V_{DS} = 45\text{ V}$
  - (5)  $V_{DS} = 50\text{ V}$

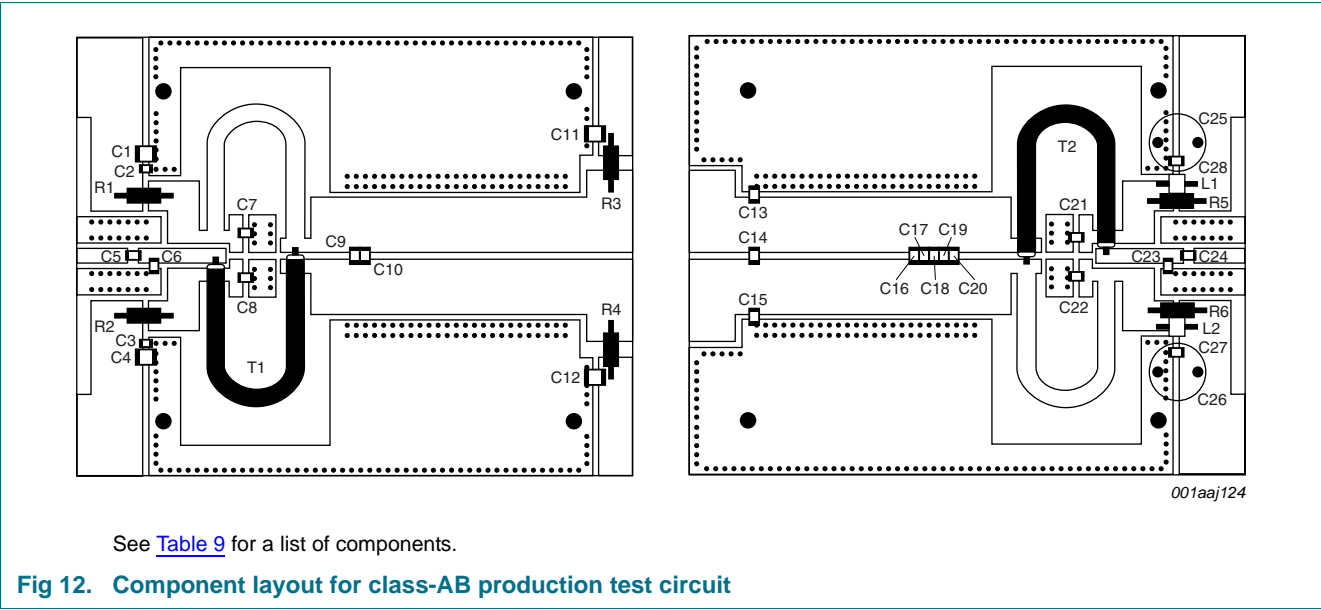
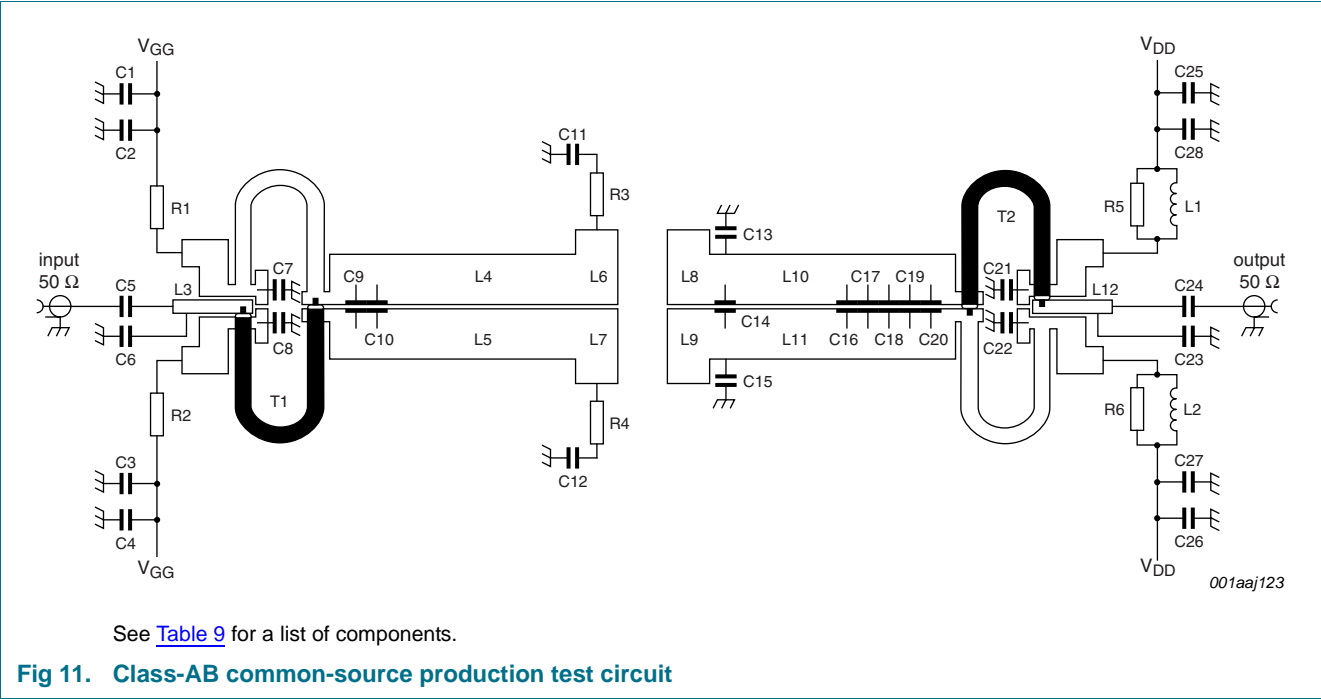
Fig 9. Power gain as a function of load power; typical values



- $I_{DQ} = 40\text{ mA}$ ;  $f = 225\text{ MHz}$ ;  $t_p = 100\text{ }\mu\text{s}$ ;  $\delta = 20\text{ }\%$ .
- (1)  $V_{DS} = 30\text{ V}$
  - (2)  $V_{DS} = 35\text{ V}$
  - (3)  $V_{DS} = 40\text{ V}$
  - (4)  $V_{DS} = 45\text{ V}$
  - (5)  $V_{DS} = 50\text{ V}$

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

8.3 Test circuit





**Table 9. List of components**

For production test circuit, see [Figure 11](#) and [Figure 12](#).

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	[1]
C6	multilayer ceramic chip capacitor	30 pF	[1]
C9, C10, C13, C15	multilayer ceramic chip capacitor	62 pF	[1]
C14	multilayer ceramic chip capacitor	36 pF	[1]
C16, C17	multilayer ceramic chip capacitor	24 pF	[1]
C18	multilayer ceramic chip capacitor	30 pF	[1]
C19	multilayer ceramic chip capacitor	27 pF	[1]
C20	multilayer ceramic chip capacitor	9.1 pF	[1]
C23	multilayer ceramic chip capacitor	13 pF	[1]
C24	multilayer ceramic chip capacitor	16 pF	[1]
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.

9. Package outline

Flanged balanced LDMOST ceramic package; 2 mounting holes; 4 leads

SOT539A

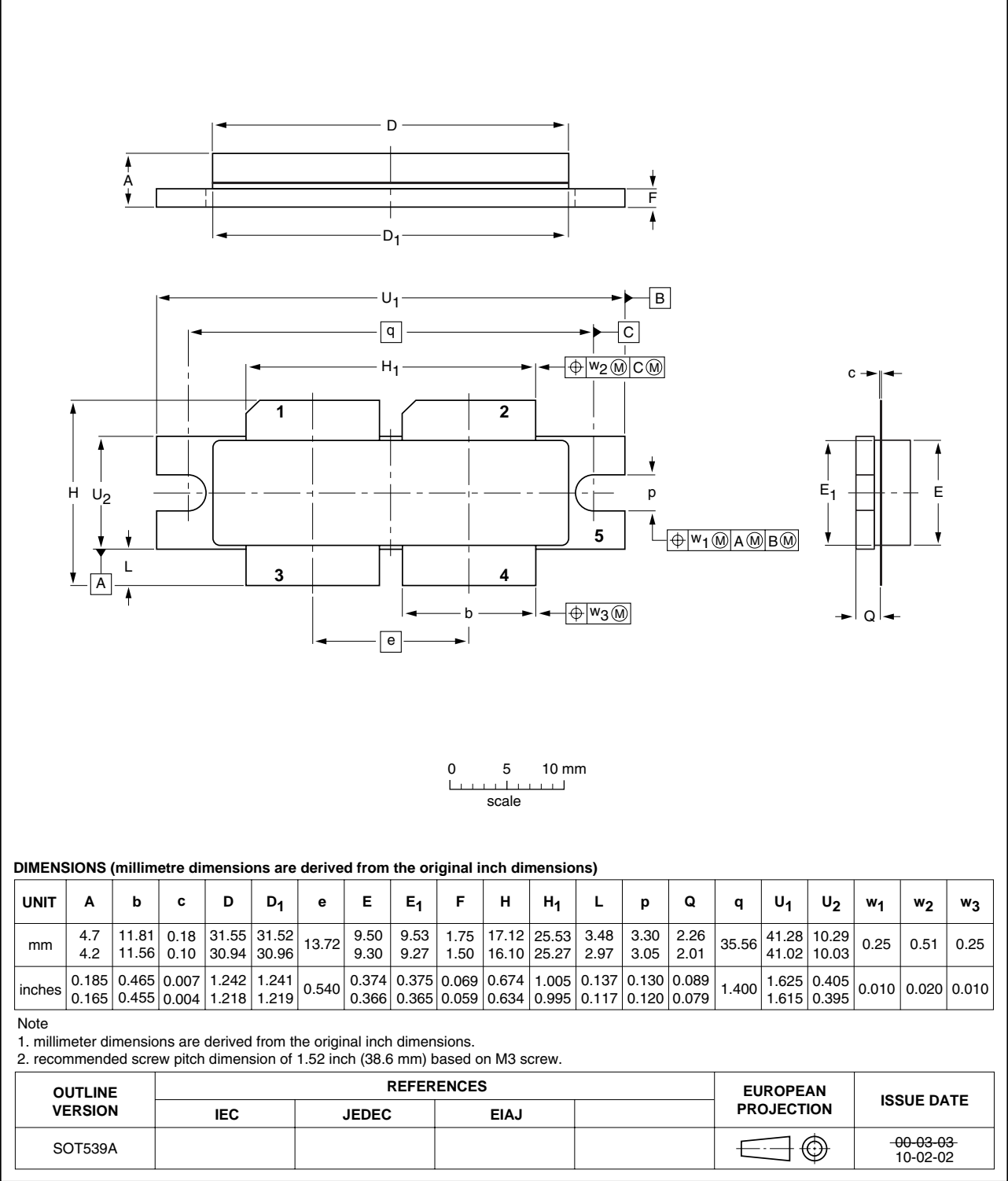


Fig 13. Package outline SOT539A

## 10. Abbreviations

Table 10. Abbreviations

Acronym	Description
CW	Continuous Wave
EDGE	Enhanced Data rates for GSM Evolution
GSM	Global System for Mobile communications
HF	High Frequency
LDMOS	Laterally Diffused Metal-Oxide Semiconductor
LDMOST	Laterally Diffused Metal-Oxide Semiconductor Transistor
RF	Radio Frequency
TTF	Time To Failure
VSWR	Voltage Standing-Wave Ratio

## 11. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLF578_2	20100204	Product data sheet	-	BLF578_1
Modifications:	<ul style="list-style-type: none"><li>• <a href="#">Table 1 on page 1</a>: added information for CW performance.</li><li>• <a href="#">Section 1 on page 1</a>: changed typical value of <math>\eta_D</math>.</li><li>• <a href="#">Table 4 on page 2</a>: changed maximum value of <math>I_D</math>.</li><li>• <a href="#">Table 5 on page 3</a>: changed value of <math>R_{th(j-c)}</math>.</li><li>• <a href="#">Table 5 on page 3</a>: added information about <math>Z_{th(j-c)}</math>.</li><li>• <a href="#">Figure 1 on page 3</a>: added figure.</li><li>• <a href="#">Table 6 on page 3</a>: added values vor <math>V_{GSq}</math>.</li><li>• <a href="#">Table 6 on page 3</a>: changed typical value of <math>I_{DSX}</math>.</li><li>• <a href="#">Table 7 on page 4</a>: changed some values.</li><li>• <a href="#">Section 8.2.1 on page 6</a>: changed some graphs.</li></ul>			
BLF578_1	20081211	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".

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