

# BLF978P

HF / VHF power LDMOS transistor

Rev. 2 — 13 June 2022

AMPLEON

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 700 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)	η <sub>D</sub> (%)
CW pulsed [1]	225	50	1200	25.5	80.0
CW pulsed [2]	352	50	1150	25.0	79.6
CW [2]	352	50	1150	23.6	76.7
CW [3]	500	45	800	22.3	71.6
CW [4]	650	50	1000	20.0	66.2

[1] On production test circuit  $t_p = 100 \mu\text{s}$ ;  $\delta = 10 \%$ .

[2] AR191160.

[3] AR191195.

[4] AR201049.

### 1.2 Features and benefits

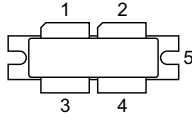
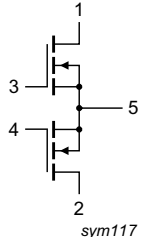
- Easy power control
- Integrated ESD protection
- Excellent ruggedness
- High efficiency
- Excellent thermal stability
- Designed for broadband operation (10 MHz to 700 MHz)
- For RoHS compliance see the product details on the Ampleon website

### 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		 sym117
2	drain2		
3	gate1		
4	gate2		
5	source <sup>[1]</sup>		

[1] Connected to flange.

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BLF978P	-	flanged balanced 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		-	108	V
$V_{GS}$	gate-source voltage		-6	+11	V
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature <sup>[1]</sup>		-	225	°C

[1] Continuous use at maximum temperature will affect the reliability, for details refer to the online MTF calculator.

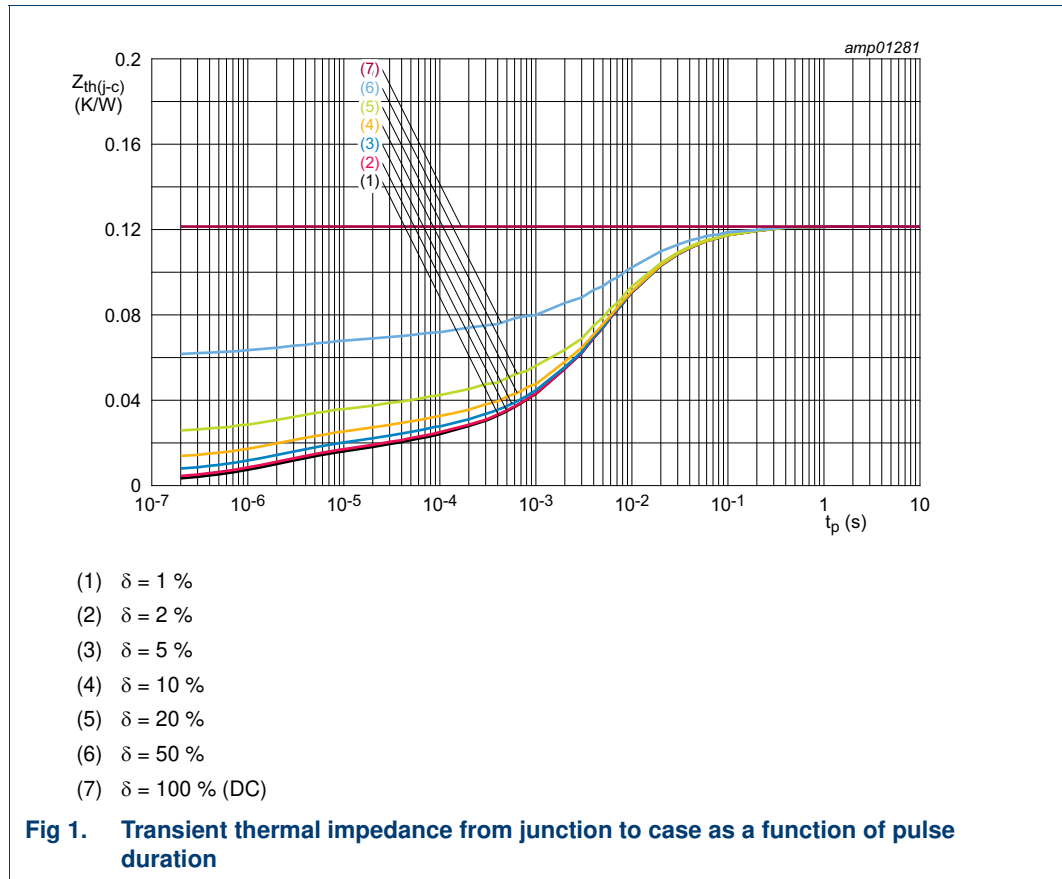
## 5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	$T_{case} = 90\text{ °C}$	<sup>[1]</sup> 0.121	K/W
$Z_{th(j-c)}$	transient thermal impedance from junction to case	$T_{case} = 90\text{ °C}$ ; $t_p = 100\text{ }\mu\text{s}$ ; $\delta = 10\%$	<sup>[2]</sup> 0.033	K/W

[1]  $R_{th(j-c)}$  is measured under RF conditions.

[2] See [Figure 1](#).



## 6. Characteristics

**Table 6. DC characteristics**

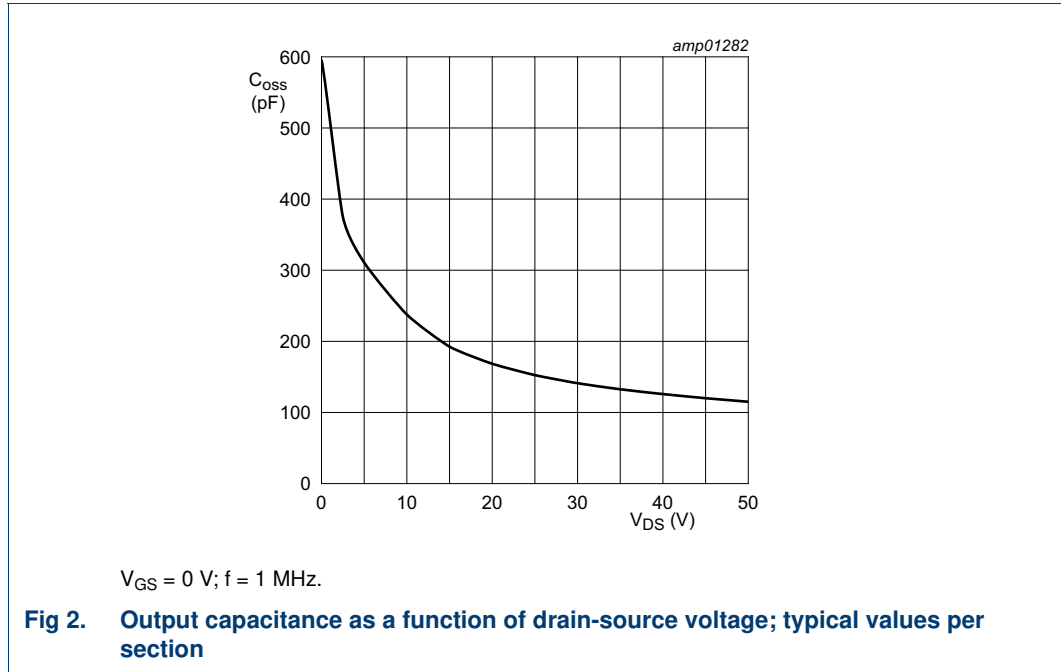
$T_j = 25\text{ }^\circ\text{C}$ ; per section unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}; I_D = 3.94\text{ mA}$	108	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 10\text{ V}; I_D = 394\text{ mA}$	1.5	2.0	2.5	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	$V_{GS} = V_{GS(th)} + 3.75\text{ V}; V_{DS} = 10\text{ V}$	54	71.7	-	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	$V_{GS} = V_{GS(th)} + 3.75\text{ V}; I_D = 13.79\text{ A}$	-	54	-	m $\Omega$

**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	$V_{GS} = 0\text{ V}; V_{DS} = 50\text{ V}; f = 1\text{ MHz}$	-	1.45	-	pF
$C_{iss}$	input capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 50\text{ V}; f = 1\text{ MHz}$	-	392	-	pF
$C_{oss}$	output capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 50\text{ V}; f = 1\text{ MHz}$	-	115	-	pF

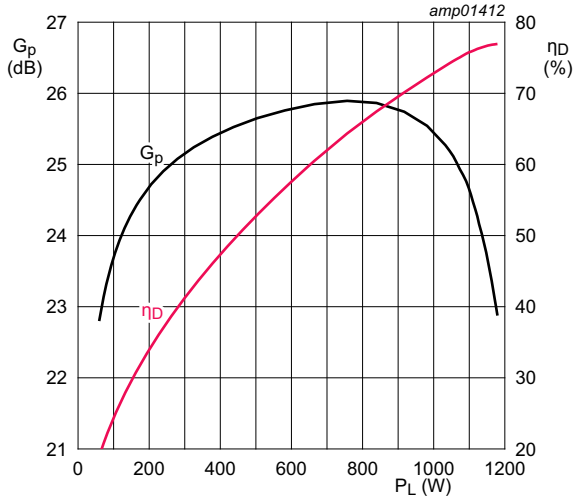


**Table 8. RF characteristics**

Test signal: CW pulsed;  $t_p = 100 \mu s$ ;  $\delta = 10 \%$ ;  $f = 225 \text{ MHz}$ ; RF performance at  $V_{DS} = 50 \text{ V}$ ;  $I_{Dq} = 50 \text{ mA}$  per section;  $T_{case} = 25 \text{ }^\circ\text{C}$ ; unless otherwise specified; in a class-AB production test circuit.

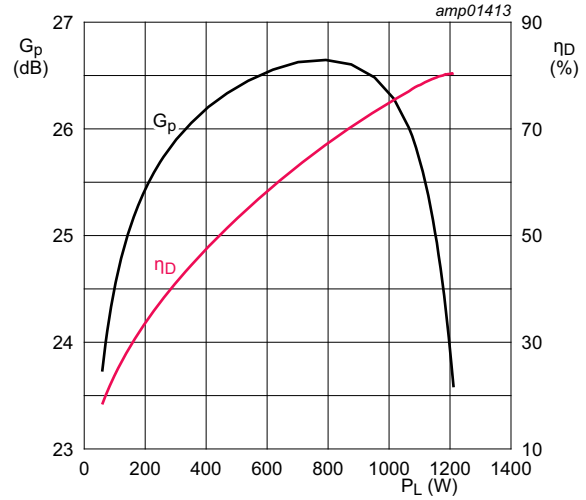
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
G <sub>p</sub>	power gain	P <sub>L</sub> = 1200 W	23	24.5	-	dB
RL <sub>in</sub>	input return loss	P <sub>L</sub> = 1200 W	-	-20	-12	dB
η <sub>D</sub>	drain efficiency	P <sub>L</sub> = 1200 W	78	80.6	-	%

7. Application information



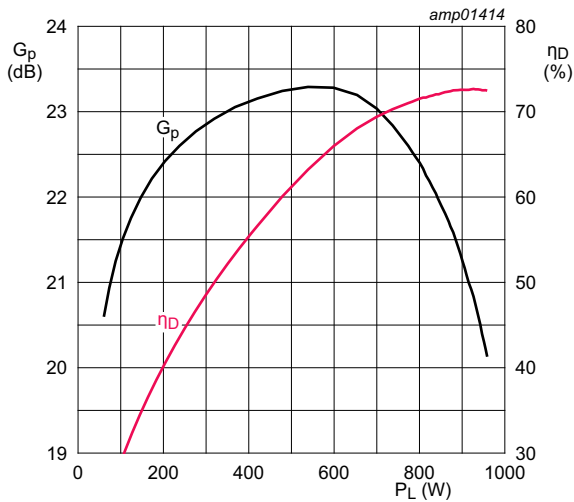
$V_{DS} = 50\text{ V}; I_{Dq} = 2 \times 5\text{ mA}; f = 352\text{ MHz}; \text{CW}$ .

Fig 3. Power gain and drain efficiency on AR191160 as function of output power; typical values



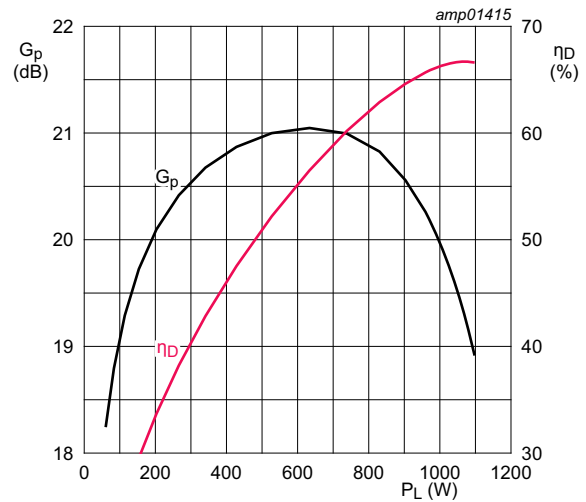
$V_{DS} = 50\text{ V}; I_{Dq} = 2 \times 50\text{ mA}; f = 352\text{ MHz}; \text{CW pulsed}$   
 $(t_p = 100\text{ }\mu\text{s}; \delta = 10\text{ \%})$ .

Fig 4. Power gain and drain efficiency on AR191160 as function of output power; typical values



$V_{DS} = 45\text{ V}; I_{Dq} = 2 \times 10\text{ mA}; f = 500\text{ MHz}; \text{CW}$ .

Fig 5. Power gain and drain efficiency on AR191195 as function of output power; typical values



$V_{DS} = 50\text{ V}; I_{Dq} = 2 \times 10\text{ mA}; f = 650\text{ MHz}; \text{CW}$ .

Fig 6. Power gain and drain efficiency on AR201049 as function of output power; typical values

## 8. Test information

### 8.1 Ruggedness in class-AB operation

The BLF978P is capable of withstanding a load mismatch corresponding to  $V_{SWR} = 40 : 1$  through all phases under the following conditions:  $V_{DS} = 50 \text{ V}$ ;  $I_{Dq} = 50 \text{ mA}$  per section;  $P_L = 1200 \text{ W}$ ;  $f = 225 \text{ MHz}$ ; CW pulsed ( $t_p = 100 \mu\text{s}$ ;  $\delta = 10 \%$ ).

### 8.2 Impedance information

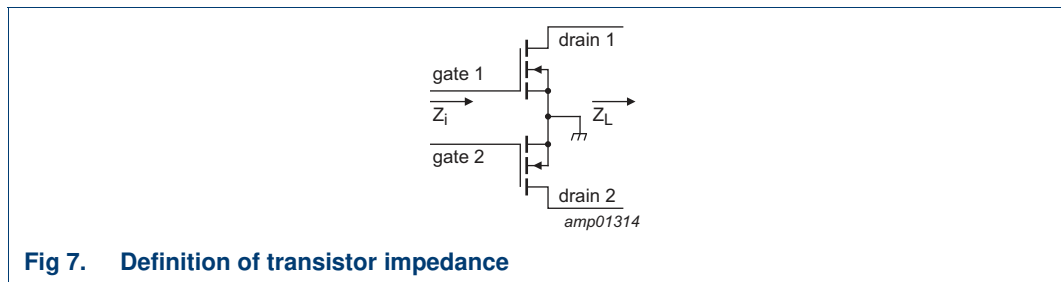


Fig 7. Definition of transistor impedance

Table 9. Typical push-pull impedance

Simulated  $Z_i$  and  $Z_L$  device impedance; impedance info at  $V_{DS} = 50 \text{ V}$  and  $P_L = 1200 \text{ W}$ .

f (MHz)	$Z_i$ ( $\Omega$ )	$Z_L$ ( $\Omega$ )
225	$1.1 - j4.4$	$3.7 + j1.1$

8.3 Test circuit

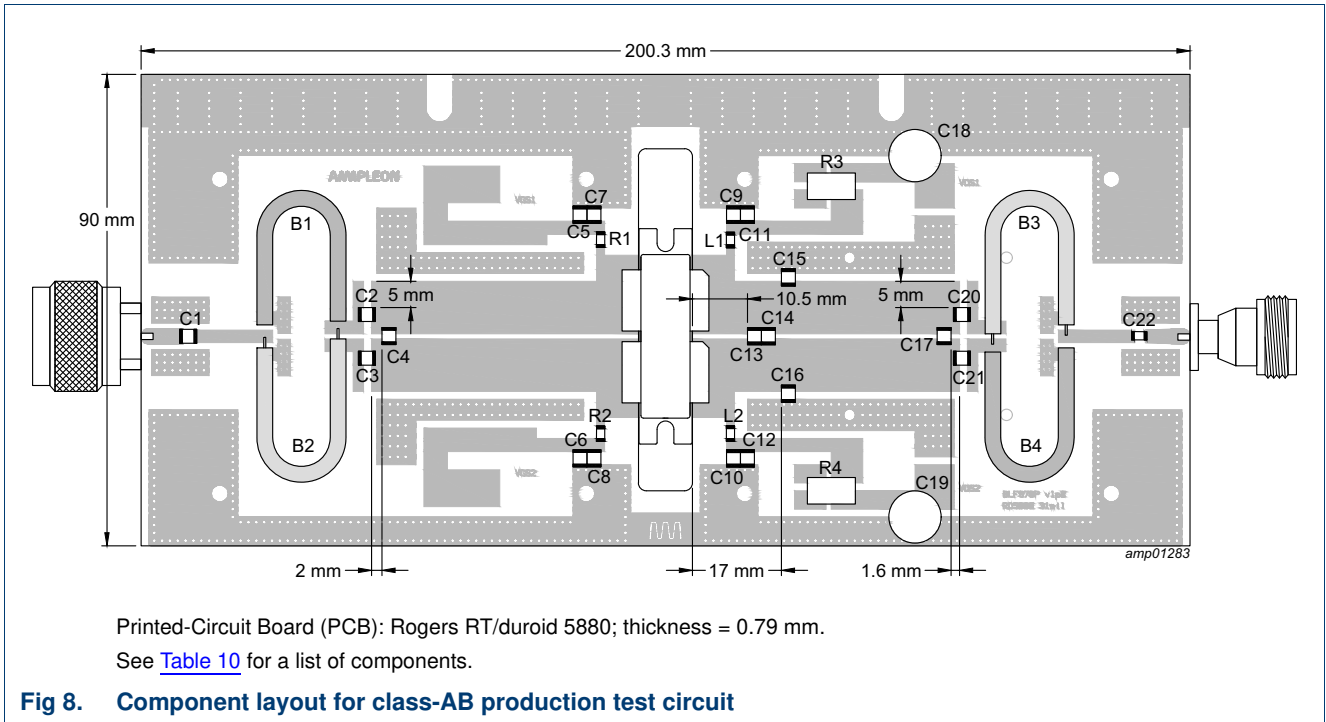


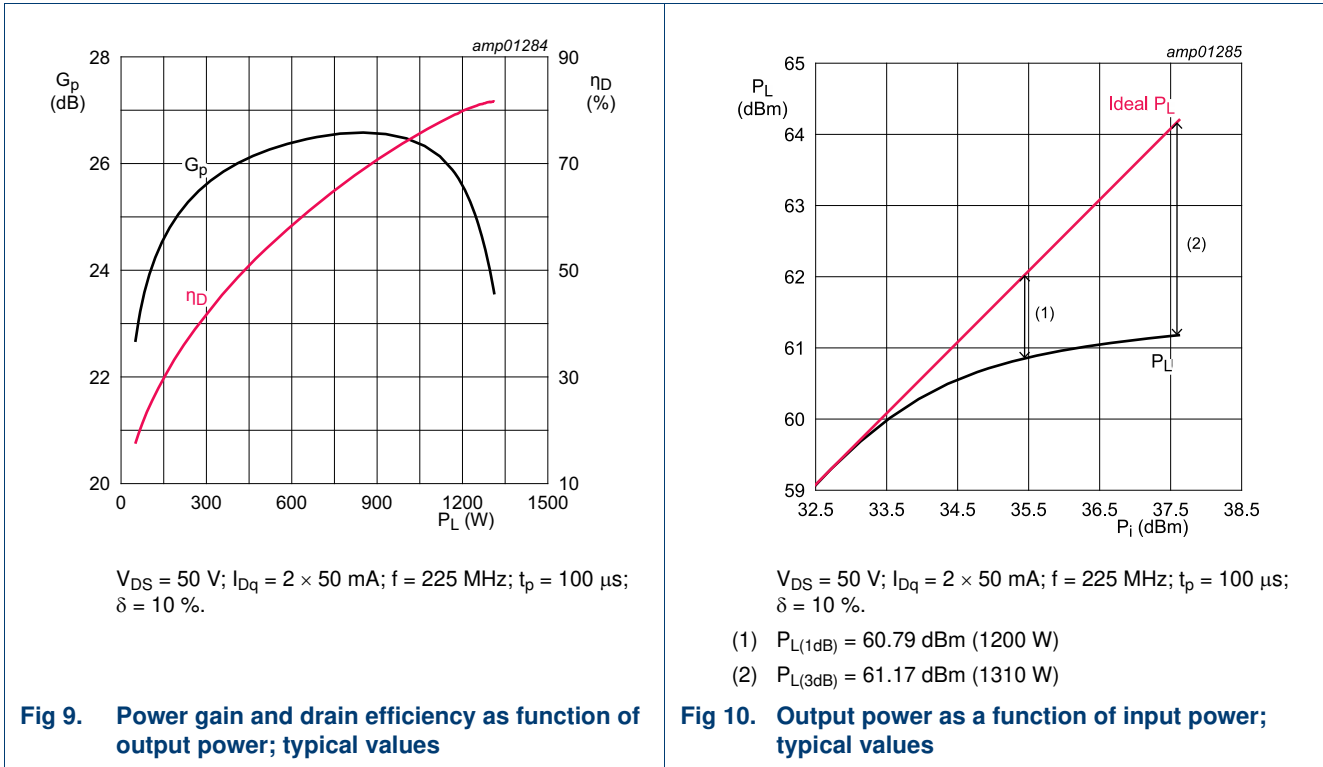
Table 10. List of components

For test circuit see [Figure 8](#).

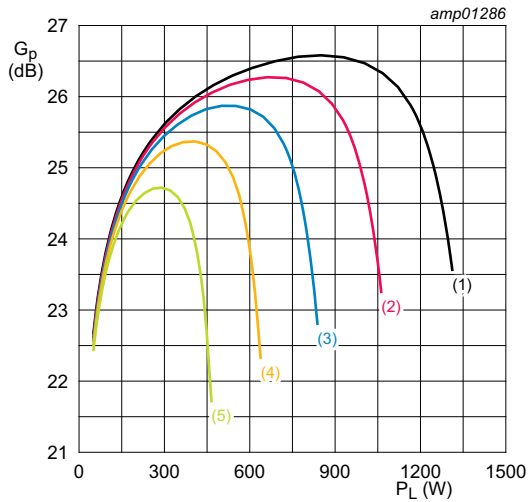
Component	Description	Value	Remarks
C1, C7, C8, C9, C10, C22	multilayer ceramic chip capacitor	1 nF	ATC 100B
C2, C3	multilayer ceramic chip capacitor	62 pF	ATC 100B
C4	multilayer ceramic chip capacitor	111 pF	ATC 100B
C5, C6, C11, C12	multilayer ceramic chip capacitor	4.7 $\mu$ F, 100 V	C3225X7S2A475K200AE
C13, C14, C20, C21	multilayer ceramic chip capacitor	47 pF	ATC 100B
C15, C16	multilayer ceramic chip capacitor	43 pF	ATC 100B
C17	multilayer ceramic chip capacitor	51 pF	ATC 100B
C18, C19	electrolytic capacitor	1500 $\mu$ F, 80 V	
L1, L2	air core inductor	17.5 nH	B06TJLB
R1, R2	SMD resistor	5.1 $\Omega$	SMD 1206
R3, R4	shunt resistor	0.01 $\Omega$	Ohmite: FC4L110R010FER
B1, B2, B3, B4	coaxial line	50 $\Omega$ , 58 mm	HUBER+SUHNER: EZ-141-AL-TP-M17

8.4 Graphical data

8.4.1 1-Tone CW pulsed



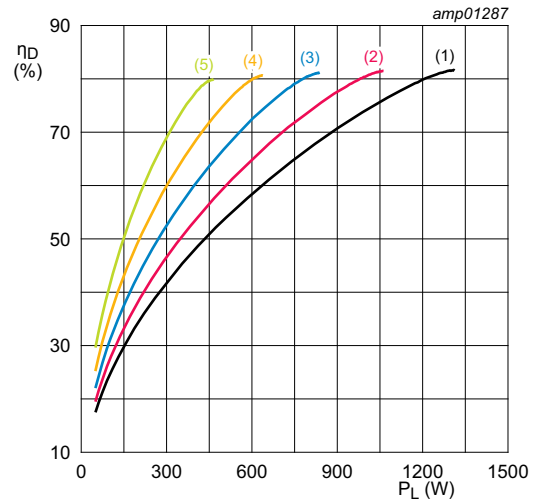




$I_{Dq} = 2 \times 50 \text{ mA}$ ;  $f = 225 \text{ MHz}$ ;  $t_p = 100 \text{ }\mu\text{s}$ ;  $\delta = 10 \text{ \%}$ .

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

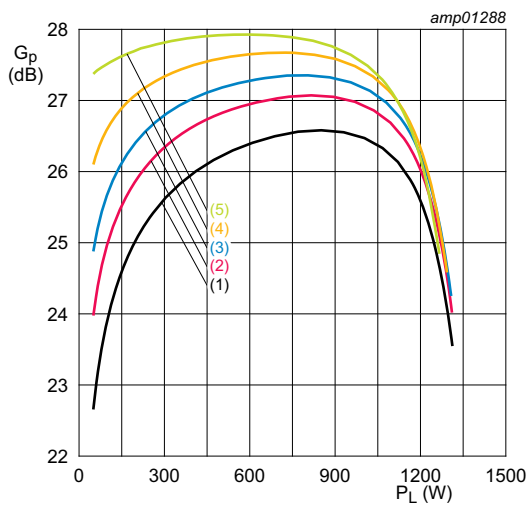
**Fig 11. Power gain as a function of output power; typical values**



$I_{Dq} = 2 \times 50 \text{ mA}$ ;  $f = 225 \text{ MHz}$ ;  $t_p = 100 \text{ }\mu\text{s}$ ;  $\delta = 10 \text{ \%}$ .

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

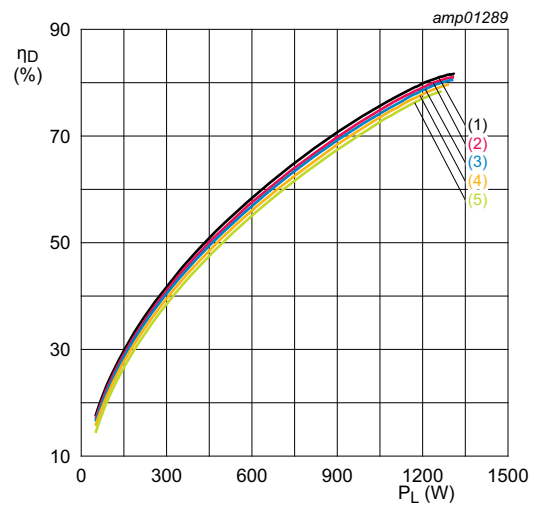
**Fig 12. Drain efficiency as a function of output power; typical values**



$V_{DS} = 50 \text{ V}$ ;  $f = 225 \text{ MHz}$ ;  $t_p = 100 \text{ }\mu\text{s}$ ;  $\delta = 10 \text{ \%}$ .

- (1)  $I_{Dq} = 2 \times 50 \text{ mA}$
- (2)  $I_{Dq} = 2 \times 200 \text{ mA}$
- (3)  $I_{Dq} = 2 \times 400 \text{ mA}$
- (4)  $I_{Dq} = 2 \times 800 \text{ mA}$
- (5)  $I_{Dq} = 2 \times 1400 \text{ mA}$

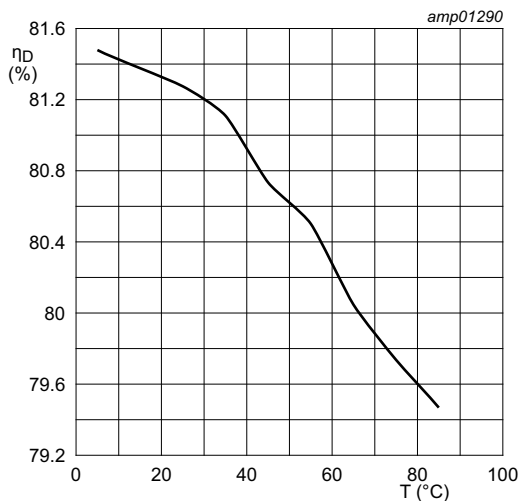
**Fig 13. Power gain as a function of output power; typical values**



$V_{DS} = 50 \text{ V}$ ;  $f = 225 \text{ MHz}$ ;  $t_p = 100 \text{ }\mu\text{s}$ ;  $\delta = 10 \text{ \%}$ .

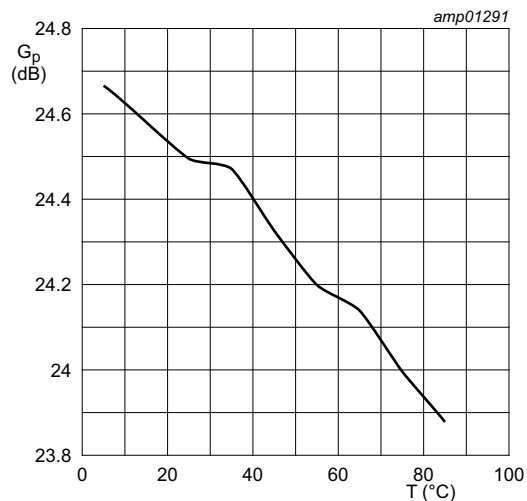
- (1)  $I_{Dq} = 2 \times 50 \text{ mA}$
- (2)  $I_{Dq} = 2 \times 200 \text{ mA}$
- (3)  $I_{Dq} = 2 \times 400 \text{ mA}$
- (4)  $I_{Dq} = 2 \times 800 \text{ mA}$
- (5)  $I_{Dq} = 2 \times 1400 \text{ mA}$

**Fig 14. Drain efficiency as a function of output power; typical values**



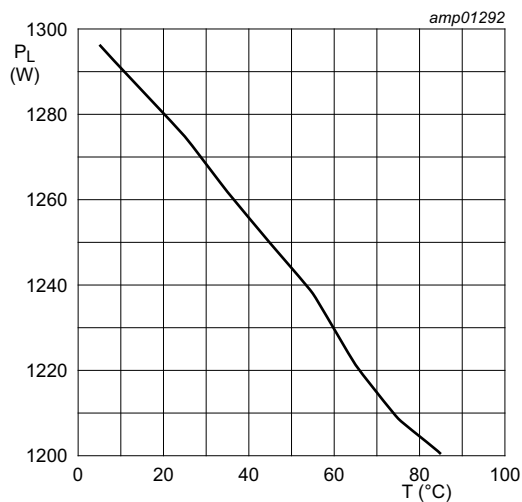
$V_{DS} = 50\text{ V}$ ;  $I_{Dq} = 2 \times 50\text{ mA}$ ;  $f = 225\text{ MHz}$ ; at  $P_{L(2dB)}$ .

**Fig 15. Drain efficiency as a function of temperature; typical values**



$V_{DS} = 50\text{ V}$ ;  $I_{Dq} = 2 \times 50\text{ mA}$ ;  $f = 225\text{ MHz}$ ; at  $P_{L(2dB)}$ .

**Fig 16. Power gain as a function of temperature; typical values**



$V_{DS} = 50\text{ V}$ ;  $I_{Dq} = 2 \times 50\text{ mA}$ ;  $f = 225\text{ MHz}$ ; at  $P_{L(2dB)}$ .

**Fig 17. Output power as a function of temperature; typical values**

9. Package outline

Flanged balanced ceramic package; 2 mounting holes; 4 leads

SOT539A

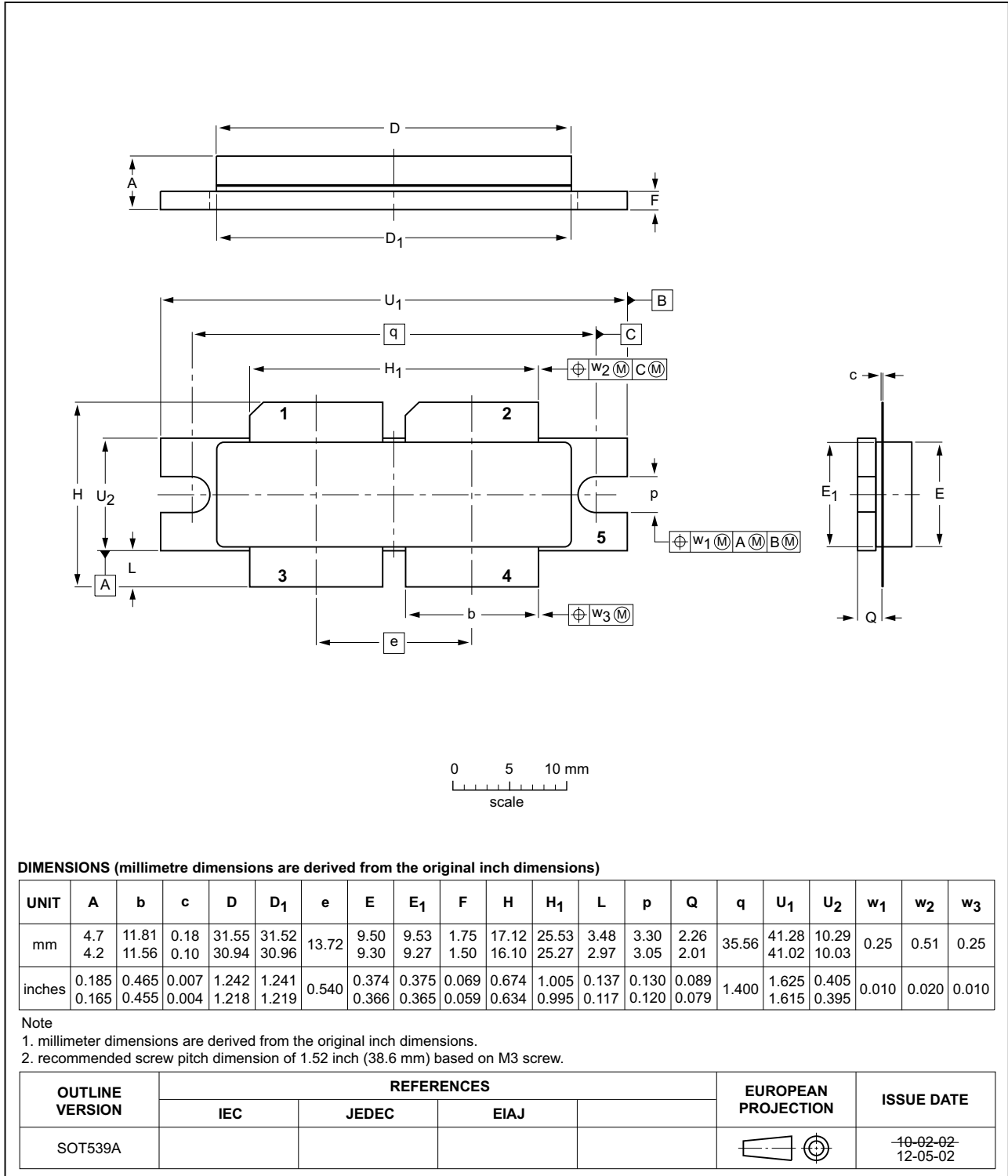


Fig 18. Package outline SOT539A

## 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.

**Table 11. ESD sensitivity**

ESD model	Class
Charged Device Model (CDM); According to ANSI/ESDA/JEDEC standard JS-002	C2A <a href="#">[1]</a>
Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001	2 <a href="#">[2]</a>

[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.

## 11. Abbreviations

**Table 12. Abbreviations**

Acronym	Description
CW	Continuous Wave
HF	High Frequency
LDMOS	Laterally Diffused Metal-Oxide Semiconductor
MTF	Median Time to Failure
RoHS	Restriction of Hazardous Substances
SMD	Surface Mounted Device
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio

## 12. Revision history

**Table 13. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLF978P v.2	20220613	Product data sheet	-	BLF978P v.1
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Section 8.1 on page 6</a>: changed value of VSWR from 13 : 1 to 40 : 1</li> <li><a href="#">Section 13.2 on page 13</a>: updated section</li> <li><a href="#">Section 13.3 on page 13</a>: updated section</li> </ul>			
BLF978P v.1	20200403	Product data sheet	-	-

## 13. Legal information

### 13.1 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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For sales office addresses, please visit: <http://www.ampleon.com/sales>

## 15. Contents

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<b>1</b>	<b>Product profile</b> . . . . .	<b>1</b>
1.1	General description . . . . .	1
1.2	Features and benefits . . . . .	1
1.3	Applications . . . . .	1
<b>2</b>	<b>Pinning information</b> . . . . .	<b>2</b>
<b>3</b>	<b>Ordering information</b> . . . . .	<b>2</b>
<b>4</b>	<b>Limiting values</b> . . . . .	<b>2</b>
<b>5</b>	<b>Thermal characteristics</b> . . . . .	<b>2</b>
<b>6</b>	<b>Characteristics</b> . . . . .	<b>3</b>
<b>7</b>	<b>Application information</b> . . . . .	<b>5</b>
<b>8</b>	<b>Test information</b> . . . . .	<b>6</b>
8.1	Ruggedness in class-AB operation . . . . .	6
8.2	Impedance information . . . . .	6
8.3	Test circuit . . . . .	7
8.4	Graphical data . . . . .	8
8.4.1	1-Tone CW pulsed . . . . .	8
<b>9</b>	<b>Package outline</b> . . . . .	<b>11</b>
<b>10</b>	<b>Handling information</b> . . . . .	<b>12</b>
<b>11</b>	<b>Abbreviations</b> . . . . .	<b>12</b>
<b>12</b>	<b>Revision history</b> . . . . .	<b>12</b>
<b>13</b>	<b>Legal information</b> . . . . .	<b>13</b>
13.1	Data sheet status . . . . .	13
13.2	Definitions . . . . .	13
13.3	Disclaimers . . . . .	13
13.4	Trademarks . . . . .	14
<b>14</b>	<b>Contact information</b> . . . . .	<b>14</b>
<b>15</b>	<b>Contents</b> . . . . .	<b>15</b>

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Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

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