

BLS2933-100

Microwave power LDMOS transistor

Rev. 01 — 1 August 2006

Product data sheet

1. Product profile

1.1 General description

100 W LDMOS power transistor (at a supply voltage of 32 V) for S-band radar applications in the 2.9 GHz to 3.3 GHz frequency range.

Table 1: Typical performance

$t_p = 200 \mu\text{s}$; $\delta = 12 \%$; $T_{case} = 25 \text{ }^\circ\text{C}$; in a class-AB production test circuit.

Mode of operation	f (GHz)	V _{DS} (V)	P _L (W)	G _p (dB)	η_D (%)	I _{Dq} (mA)
class AB	2.9 to 3.3	32	100	8	40	20

CAUTION



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

1.2 Features

- Easy power control
- Integrated ESD protection
- Excellent ruggedness
- Excellent thermal stability
- Designed for broadband operation (2.9 GHz to 3.3 GHz)
- Internally matched for ease of use

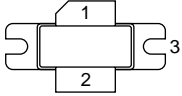
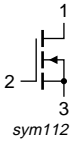
1.3 Applications

- S-band radar applications

PHILIPS

2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Symbol
1	drain		 sym112
2	gate		
3	source		

[1] connected to flange

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BLS2933-100	-	flanged LDMOST ceramic package; 2 mounting holes; 2 leads	SOT502A

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		-	65	V
V_{GS}	gate-source voltage		-	15	V
I_D	drain current		-	12	A
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
$Z_{th(j-h)}$	transient thermal impedance from junction to heatsink	$T_h = 25\text{ °C}$; $t_p = 200\text{ }\mu\text{s}$; $\delta = 12\text{ %}$	0.4	K/W

6. Characteristics

Table 6. Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}; I_D = 2.1\text{ mA}$	65	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 10\text{ V}; I_D = 180\text{ mA}$	2.5	3.1	3.5	V
V_{GSq}	gate-source quiescent voltage	$V_{DS} = 28\text{ V}; I_{DS} = 900\text{ mA}$	-	3.3	4.5	V
I_{DSS}	drain leakage current	$V_{GS} = 0\text{ V}; V_{DS} = 28\text{ V}$	-	-	2	μA
I_{DSX}	drain cut-off current	$V_{GS} = V_{GS(th)} + 9\text{ V}; V_{DS} = 10\text{ V}$	27	30	-	A
I_{GSS}	gate leakage current	$V_{GS} = 15\text{ V}; V_{DS} = 0\text{ V}$	-	-	200	nA
g_{fs}	forward transconductance	$V_{DS} = 10\text{ V}; I_D = 10\text{ A}$	-	9.0	-	S
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = V_{GS(th)} + 6\text{ V}; I_D = 6\text{ A}$	-	0.09	-	Ω
C_{rs}	feedback capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 28\text{ V}; f = 1\text{ MHz}$	-	2.5	-	pF

7. Application information

Table 7. Application information

RF performance in common source class-AB circuit; $T_h = 25\text{ }^\circ\text{C}; t_p = 200\text{ }\mu\text{s}; \delta = 12\text{ }%$;

$Z_{th(mb-h)} = 0.15\text{ K/W}$; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{oper}	operating frequency		2.9	-	3.3	GHz
V_{CC}	supply voltage		-	-	32	V
t_p	pulse duration		-	200	-	μs
δ	duty cycle		-	12	-	%
P_L	output power		100	-	-	W
$P_{L(1dB)}$	output power at 1 dB gain compression		-	120	-	W
G_p	power gain		6	8	-	dB
η_D	drain efficiency		33	40	-	%
$P_{droop(pulse)}$	pulse droop power		-	0.1	0.5	dB
t_r	rise time		-	20	50	ns
t_f	fall time		-	6	50	ns
$VSWR_{load}$	load voltage standing wave ratio		10 : 1	-	-	
IRL	input return loss		-	-10	-	dB

Table 8. Typical impedance

f GHz	Z_S Ω	Z_L Ω
2.9	3.3 – j5.6	3.5 – j3.3
3.0	3.7 – j5.3	3.1 – j3.6
3.1	5.9 – j5.8	3.3 – j3.3
3.2	6.8 – j3.4	3.2 – j3.5
3.3	6.6 – j2.7	3.1 – j3.6

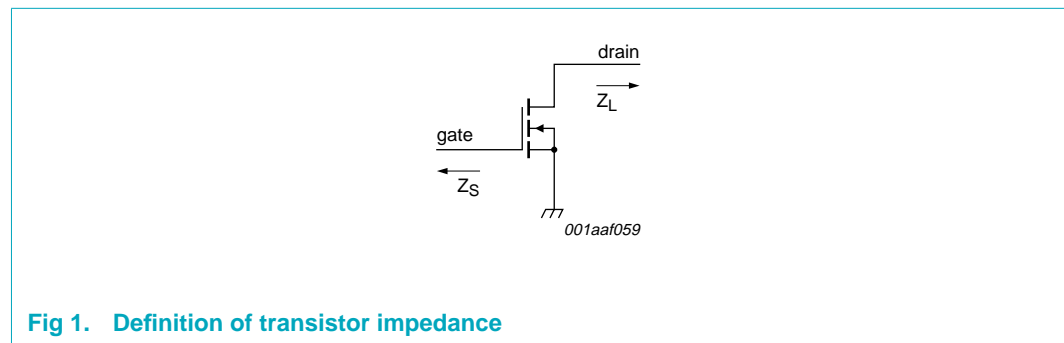
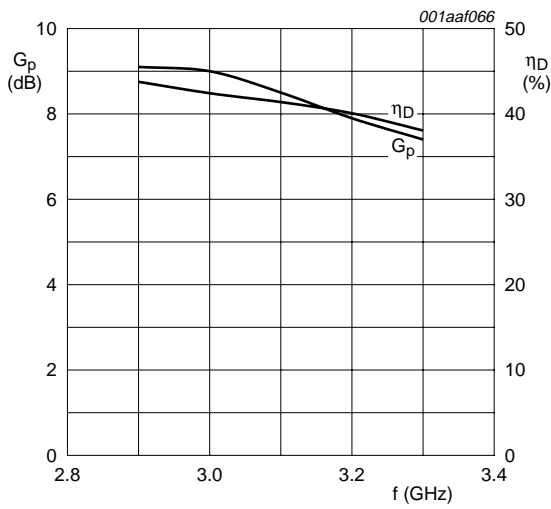


Fig 1. Definition of transistor impedance

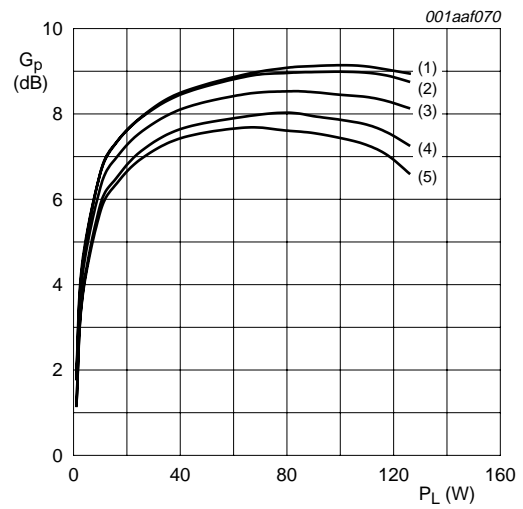
7.1 Ruggedness in class-AB operation

The BLS2933-100 is capable of withstanding a load mismatch corresponding to $V_{SWR} > 10 : 1$ through all phases under the following conditions: $V_{DS} = 32 \text{ V}$; $I_{DQ} = 20 \text{ mA}$; $P_L = 100 \text{ W}$ pulsed, $t_p = 200 \mu\text{s}$; $\delta = 12 \%$.



$V_{DS} = 32$ V; $I_{Dq} = 20$ mA; $t_p = 200$ μ s; $\delta = 12$ %; $P_L = 100$ W.

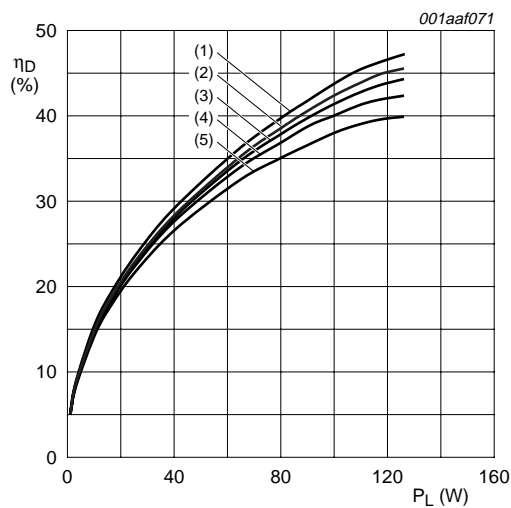
Fig 2. Power gain and drain efficiency as functions of frequency; typical values



- (1) $f = 2.9$ MHz.
- (2) $f = 3.0$ MHz.
- (3) $f = 3.1$ MHz.
- (4) $f = 3.2$ MHz.
- (5) $f = 3.3$ MHz.

$V_{DS} = 32$ V; $I_{Dq} = 20$ mA; $t_p = 200$ μ s; $\delta = 12$ %.

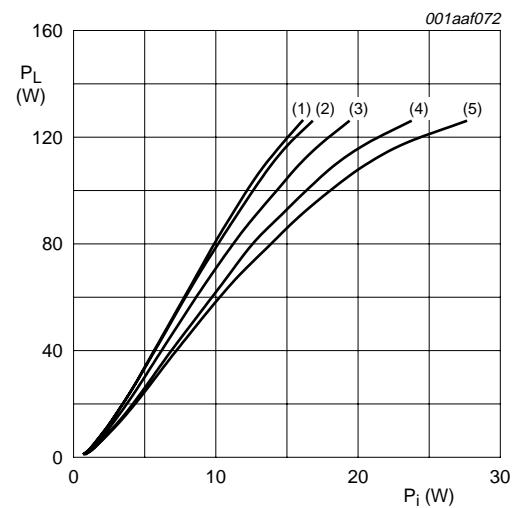
Fig 3. Power gain as a function of load power; typical values



- (1) $f = 2.9$ MHz.
- (2) $f = 3.0$ MHz.
- (3) $f = 3.1$ MHz.
- (4) $f = 3.2$ MHz.
- (5) $f = 3.3$ MHz.

$V_{DS} = 32$ V; $I_{Dq} = 20$ mA; $t_p = 200$ μ s; $\delta = 12$ %.

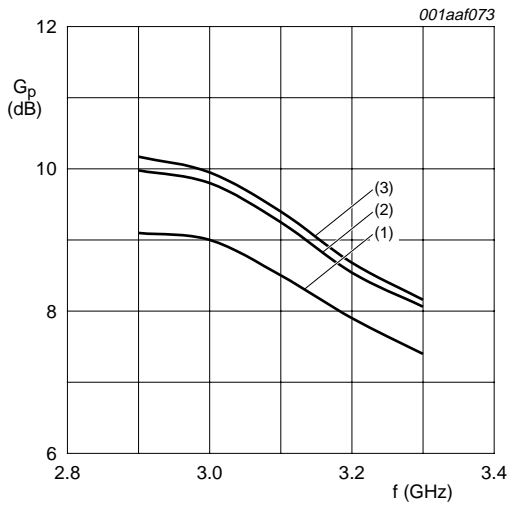
Fig 4. Efficiency as a function of power load; typical values



- (1) $f = 2.9$ MHz.
- (2) $f = 3.0$ MHz.
- (3) $f = 3.1$ MHz.
- (4) $f = 3.2$ MHz.
- (5) $f = 3.3$ MHz.

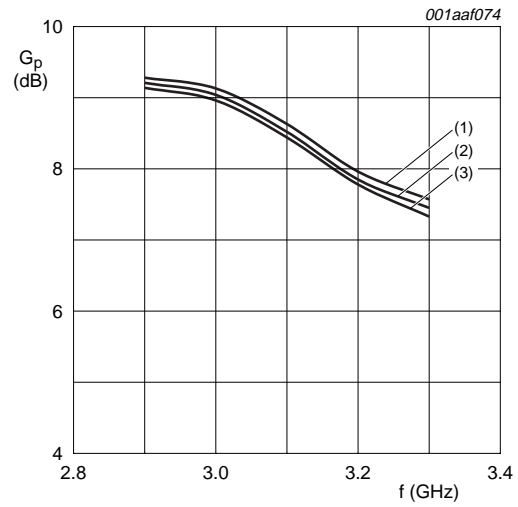
$V_{DS} = 32$ V; $I_{Dq} = 20$ mA; $t_p = 200$ μ s; $\delta = 12$ %.

Fig 5. Load power as a function of input power; typical values



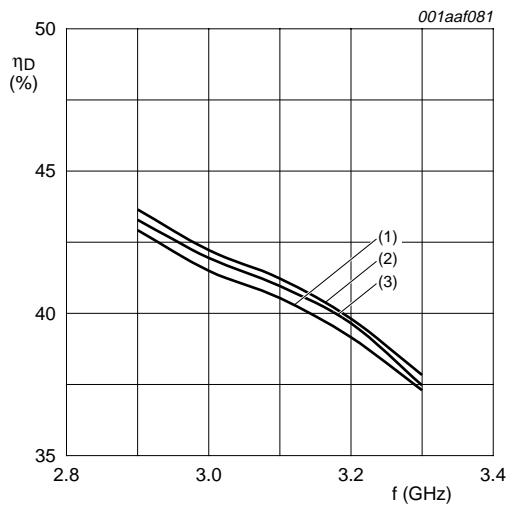
(1) $I_{Dq} = 20 \text{ mA}$.
 (2) $I_{Dq} = 150 \text{ mA}$.
 (3) $I_{Dq} = 500 \text{ mA}$.
 $V_{DS} = 32 \text{ V}$; $I_{Dq} = 20 \text{ mA}$; $t_p = 200 \mu\text{s}$; $\delta = 12 \%$;
 $P_L = 100 \text{ W}$.

Fig 6. Power gain as a function of frequency and I_{Dq} ; typical values



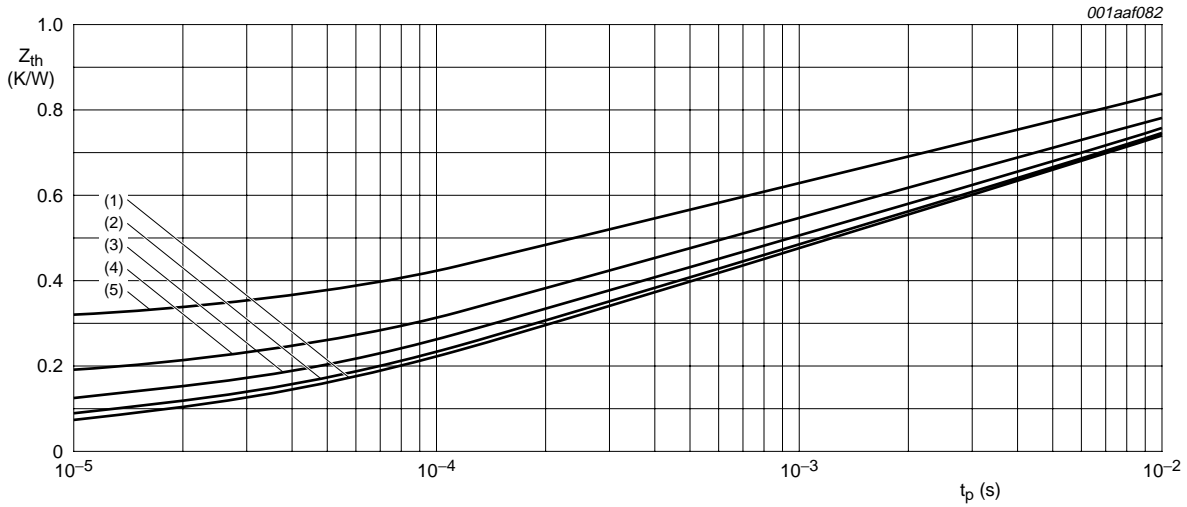
(1) $t_p = 100 \mu\text{s}$.
 (2) $t_p = 300 \mu\text{s}$.
 (3) $t_p = 500 \mu\text{s}$.
 $V_{DS} = 32 \text{ V}$; $I_{Dq} = 20 \text{ mA}$; $t_p = 100 \mu\text{s}$, $200 \mu\text{s}$ and $500 \mu\text{s}$; $\delta = 10 \%$; $P_L = 100 \text{ W}$.

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



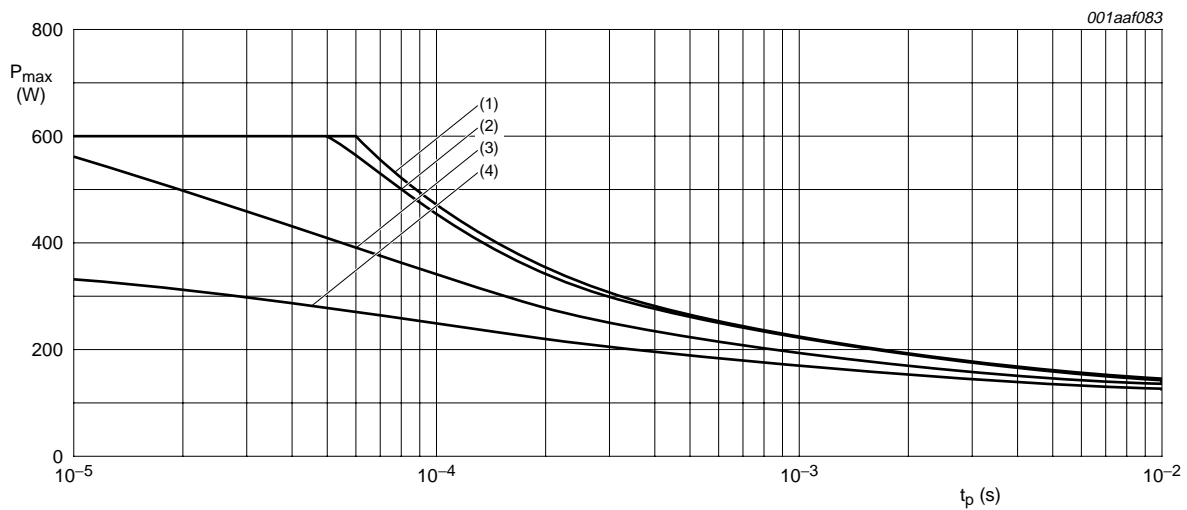
(1) $t_p = 100 \mu\text{s}$.
 (2) $t_p = 300 \mu\text{s}$.
 (3) $t_p = 500 \mu\text{s}$.
 $V_{DS} = 32 \text{ V}$; $I_{Dq} = 20 \text{ mA}$; $\delta = 10 \%$; $P_L = 100 \text{ W}$.

Fig 8. Efficiency as a function of frequency; typical values



- (1) 1 % duty cycle
- (2) 2 % duty cycle
- (3) 5 % duty cycle
- (4) 10 % duty cycle
- (5) 20 % duty cycle

Fig 9. Thermal resistance as function of pulse duration and duty cycle; typical values



$T_h = 70\text{ }^\circ\text{C}$

- (1) 1 % duty cycle
- (2) 2 % duty cycle
- (3) 10 % duty cycle
- (4) 20 % duty cycle

Fig 10. Maximum allowable dissipated power as function of pulse duration and duty cycle for reaching 200 °C junction temperature

8. Test information

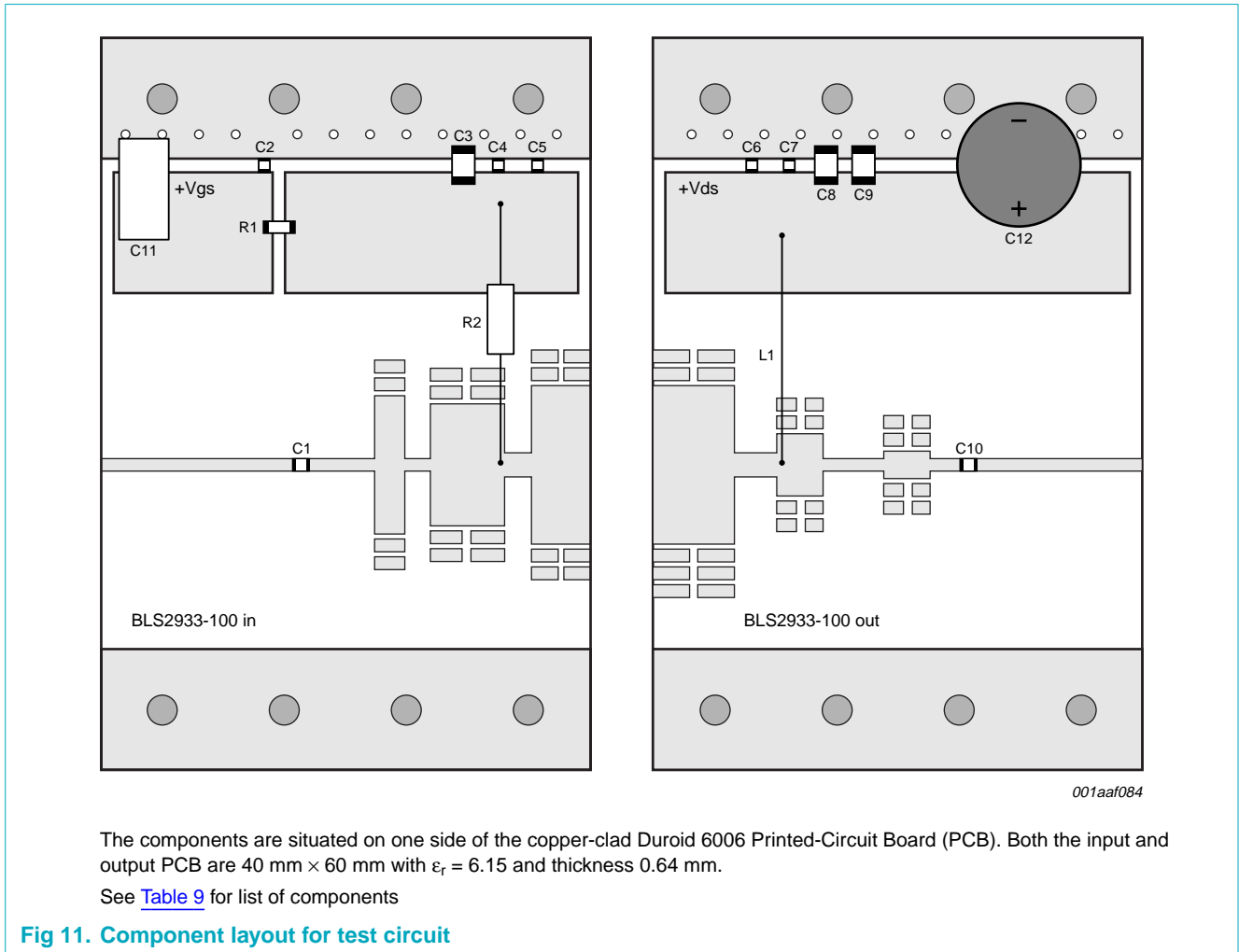


Table 9. List of components (see Figure 11)

Component	Description	Value	Dimensions	Catalogue number
C1, C2, C4, C5, C6, C7, C10	multilayer ceramic chip capacitor [1]	22 pF		
C3, C8, C9	multilayer ceramic chip capacitor [2]	470 pF		
C11	tantalum capacitor	4.7 μF; 50 V		Kemet T491D475K050AS
C12	electrolytic capacitor	220 μF; 63 V		
R1	resistor	560 Ω	SMD 0805	
R2	metafilm resistor	49.9 Ω; 0.6 W		
L1	copper wire 1 mm diameter		length of loop = 20 mm; height of loop = 10 mm	
N1	N-connector male			Suhner 13N-50-057/1
N2	N-connector female			Suhner 23N-50-057/1

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

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

9. Package outline

Flanged LDMOST ceramic package; 2 mounting holes; 2 leads

SOT502A

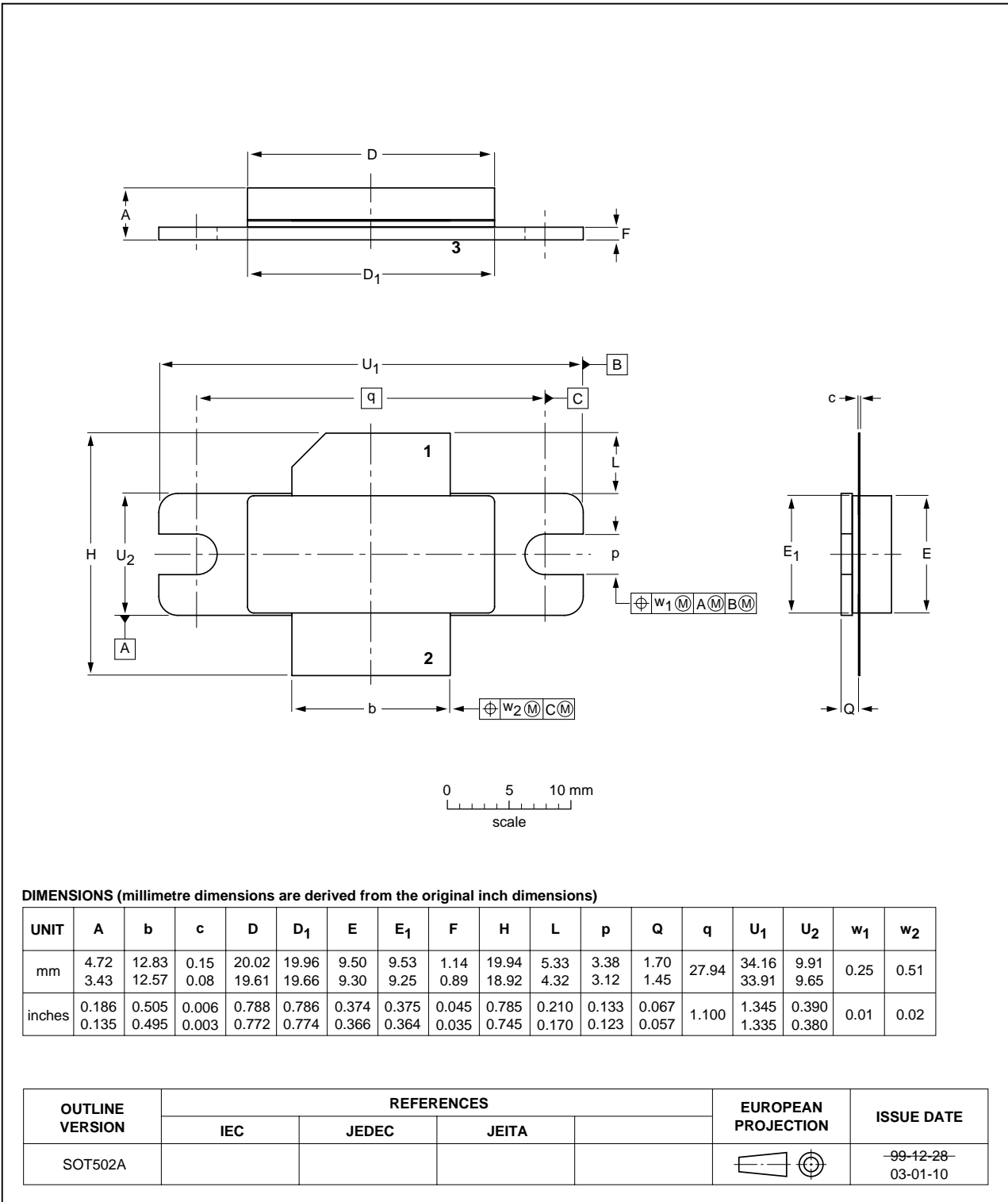


Fig 12. Package outline SOT502A

10. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLS2933-100_1	20060801	Product data sheet	-	-

11. Legal information

11.1 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".

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