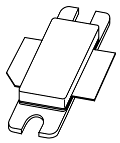


BLS2933-100

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 μs; δ = 12 %; T_{case} = 25 °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

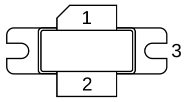
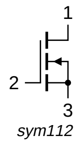
1.3 Applications

- S-band radar applications

PHILIPS

2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Symbol
1	drain		
2	gate		
3	source [1]		

[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 °C; t_p = 200 μs; δ = 12 %	0.4	K/W

6. Characteristics

Table 6. Characteristics

T_j = 25 °C unless otherwise specified.

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

7. Application information

Table 7. Application information

RF performance in common source class-AB circuit; T_h = 25 °C; t_p = 200 μs; δ = 12 %; $Z_{th(mb-h)}$ = 0.15 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	Z_S	Z_L
GHz	Ω	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

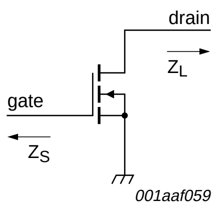
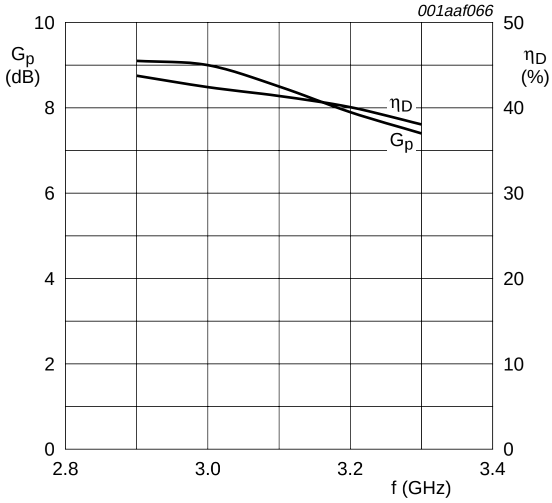


Fig 1. Definition of transistor impedance

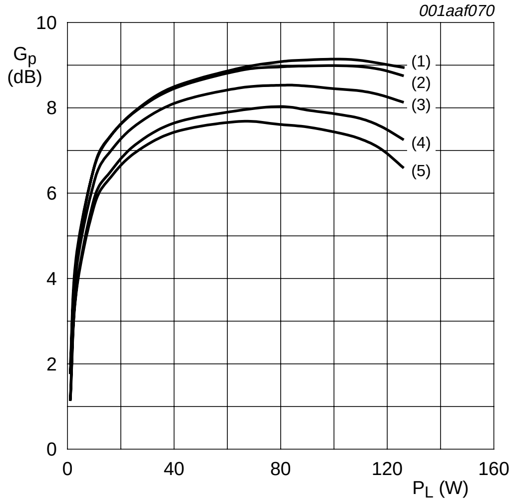
7.1 Ruggedness in class-AB operation

The BLS2933-100 is capable of withstanding a load mismatch corresponding to VSWR > 10 : 1 through all phases under the following conditions: V_{DS} = 32 V; I_{Dq} = 20 mA; P_L = 100 W pulsed, t_p = 200 μs; δ = 12 %.



V_{DS} = 32 V; I_{Dq} = 20 mA; t_p = 200 µs; δ = 12 %; P_L = 100 W.

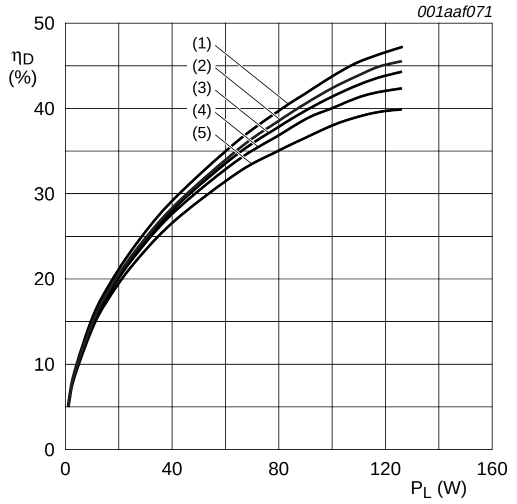
Fig 2. Power gain and drain efficiency as functions of frequency; typical values



(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 µs; δ = 12 %.

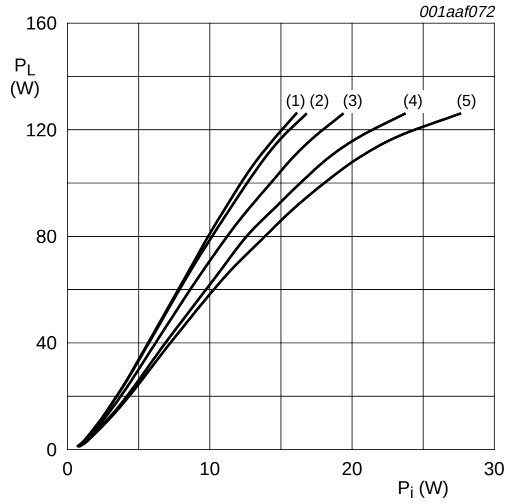
Fig 3. Power gain as a function of load power; typical values



(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 µs; δ = 12 %.

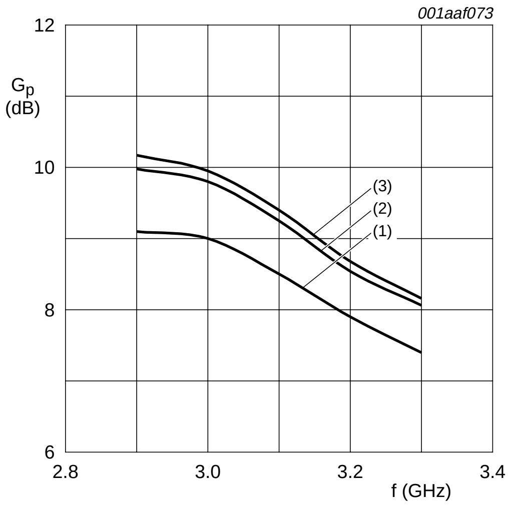
Fig 4. Efficiency as a function of power load; typical values



(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 µs; δ = 12 %.

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



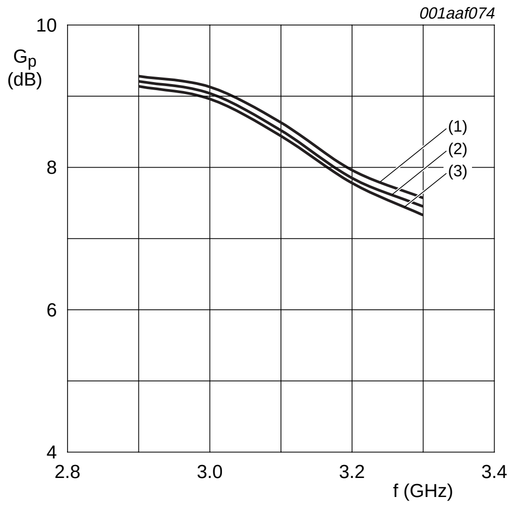
(1) I_{Dq} = 20 mA.

(2) I_{Dq} = 150 mA.

(3) I_{Dq} = 500 mA.

V_{DS} = 32 V; I_{Dq} = 20 mA; t_p = 200 µs; δ = 12 %; P_L = 100 W.

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



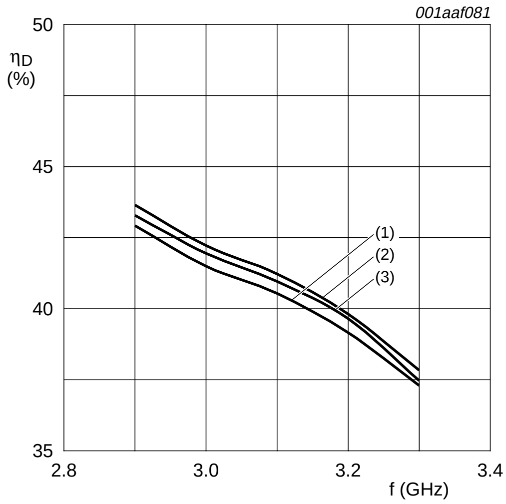
(1) t_p = 100 µs.

(2) t_p = 300 µs.

(3) t_p = 500 µs.

V_{DS} = 32 V; I_{Dq} = 20 mA; t_p = 100 µs, 200 µs and 500 µs; δ = 10 %; P_L = 100 W.

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



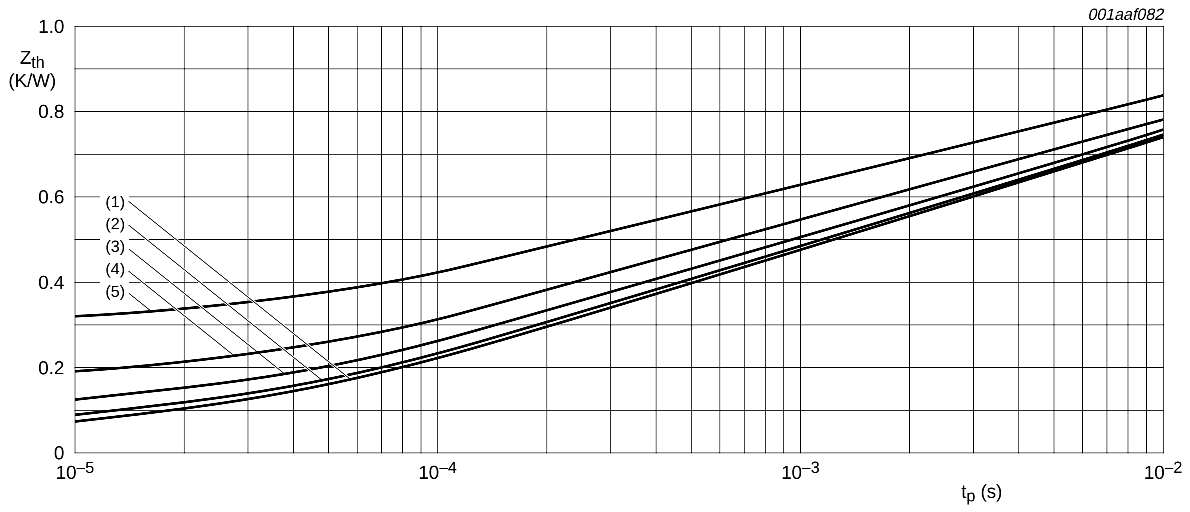
(1) t_p = 100 µs.

(2) t_p = 300 µs.

(3) t_p = 500 µs.

V_{DS} = 32 V; I_{Dq} = 20 mA; δ = 10 %; P_L = 100 W.

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



(1) 1 % duty cycle

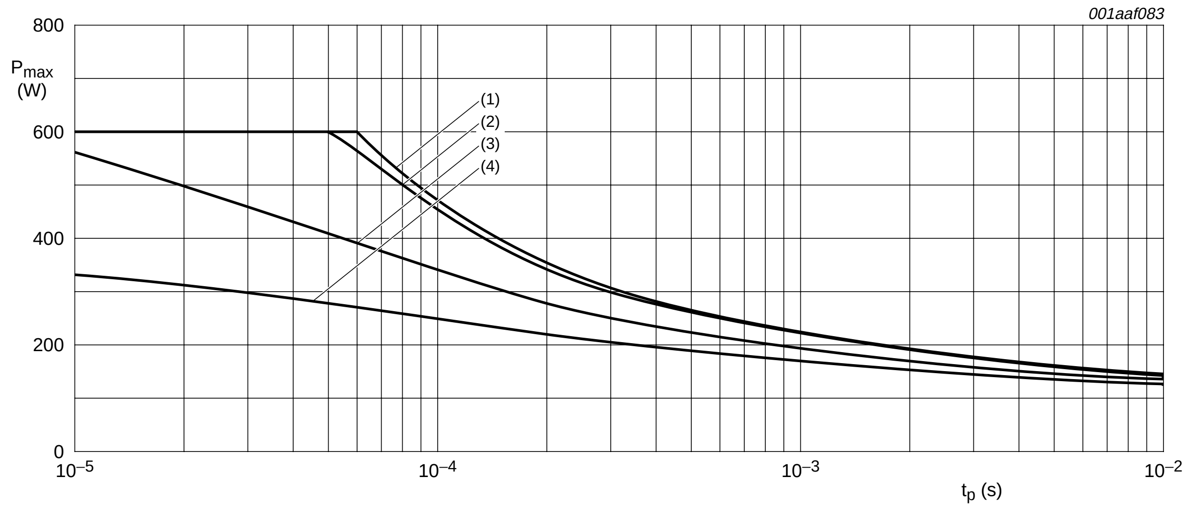
(2) 2 % duty cycle

(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 °C

(1) 1 % duty cycle

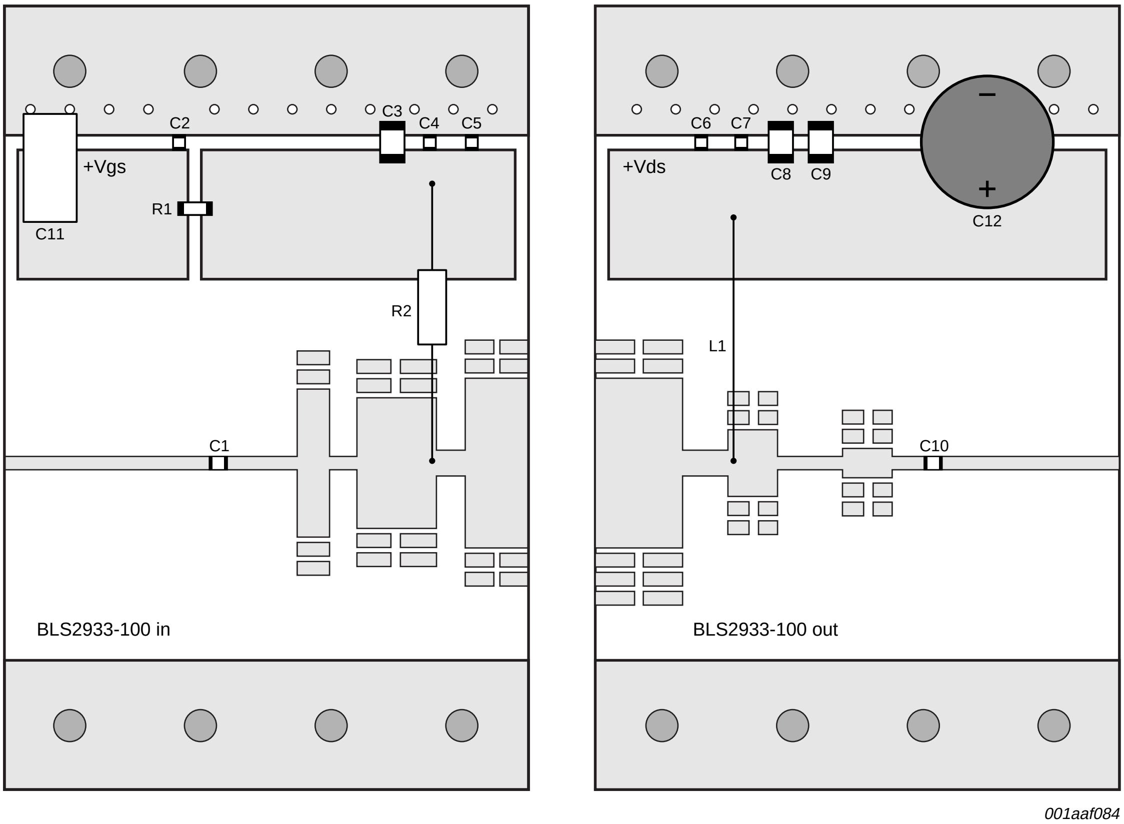
(2) 2 % duty cycle

(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



The components are situated on one side of the copper-clad Duroid 6006 Printed-Circuit Board (PCB). Both the input and output PCB are 40 mm × 60 mm with ε_r = 6.15 and thickness 0.64 mm.

See Table 9 for list of components

Fig 11. Component layout for test circuit

Table 9. List of components (see Figure 11)

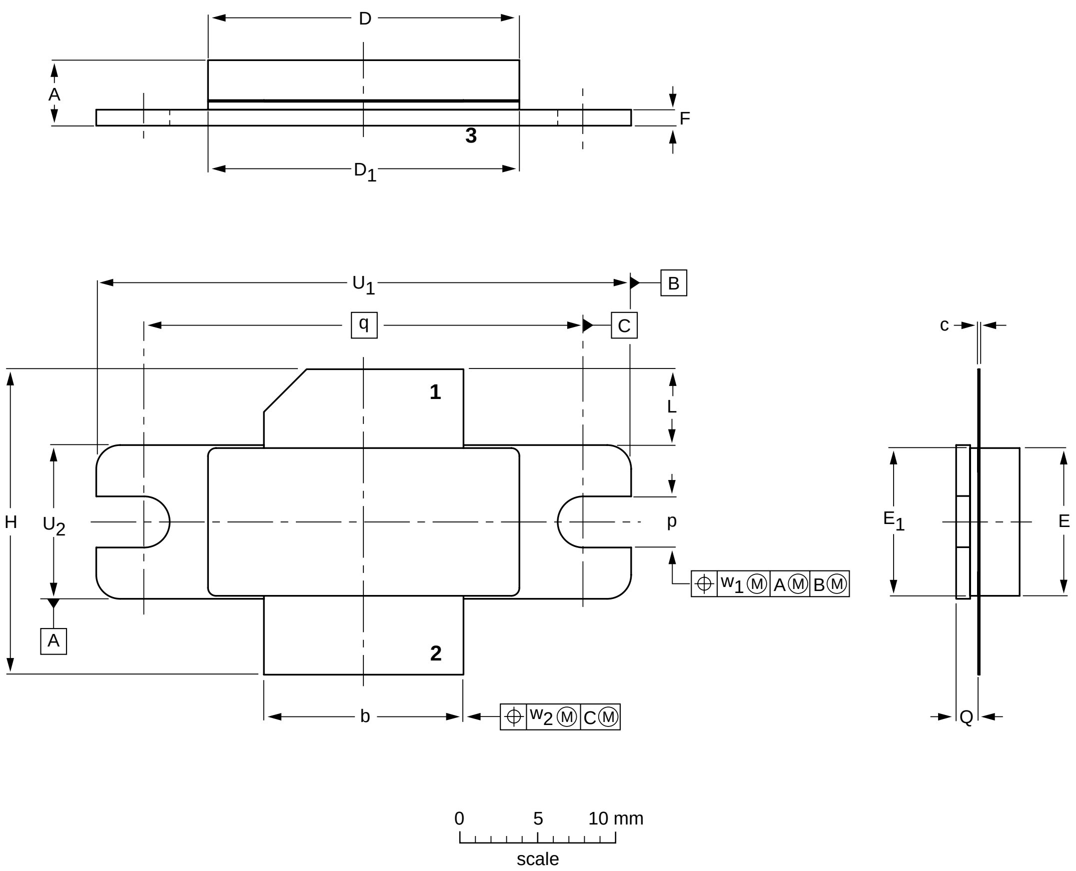
Component	Description	Value	Dimensions	Catalogue number
C1, C2, C4, C5, C6, C7, C10	multilayer ceramic chip capacitor [1]	22 pF		
C3, C8, C9	multilayer ceramic chip capacitor [2]	470 pF		
C11	tantalum capacitor	4.7 μF; 50 V		Kemet T491D475K050AS
C12	electrolytic capacitor	220 μF; 63 V		
R1	resistor	560 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**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	b	c	D	D_1	E	E_1	F	H	L	p	Q	q	U_1	U_2	w_1	w_2
mm	4.72 3.43	12.83 12.57	0.15 0.08	20.02 19.61	19.96 19.66	9.50 9.30	9.53 9.25	1.14 0.89	19.94 18.92	5.33 4.32	3.38 3.12	1.70 1.45	27.94	34.16 33.91	9.91 9.65	0.25	0.51
inches	0.186 0.135	0.505 0.495	0.006 0.003	0.788 0.772	0.786 0.774	0.374 0.366	0.375 0.364	0.045 0.035	0.785 0.745	0.210 0.170	0.133 0.123	0.067 0.057	1.100	1.345 1.335	0.390 0.380	0.01	0.02

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT502A						~~99-12-28~~ 03-01-10

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".

[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.semiconductors.philips.com.

11.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Philips Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Philips Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

11.3 Disclaimers

General — Information in this document is believed to be accurate and reliable. However, Philips Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

Right to make changes — Philips Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — Philips Semiconductors products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of a Philips Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Philips Semiconductors accepts no liability for inclusion and/or use of Philips Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

Terms and conditions of sale — Philips Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at http://www.semiconductors.philips.com/profile/terms, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by Philips Semiconductors. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

11.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

12. Contact information

For additional information, please visit: **http://www.semiconductors.philips.com**

For sales office addresses, send an email to: **sales.addresses@www.semiconductors.philips.com**

13. Contents

Date of release: 1 August 2006

Document identifier: BLS2933-100_1