

DISCRETE SEMICONDUCTORS

DATA SHEET

BLU99 **BLU99/SL** UHF power transistor

Product specification

March 1993

UHF power transistor

BLU99
BLU99/SL

DESCRIPTION

N-P-N silicon planar epitaxial transistor primarily intended for use in mobile radio transmitters in the u.h.f. band. The transistor is also very suitable for application in the 900 MHz mobile radio band.

FEATURES

- multi-base structure and diffused emitter-ballasting resistors for an optimum temperature profile;
- gold metallization ensures excellent reliability.

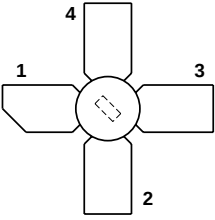
The BLU99 has a 4-lead stud envelope with a ceramic cap (SOT122A). All leads are isolated from the stud. The BLU99/SL is a studless version (SOT122D).

QUICK REFERENCE DATA

R.F. performance at $T_h = 25\text{ }^{\circ}\text{C}$ in a common-emitter class-B circuit.

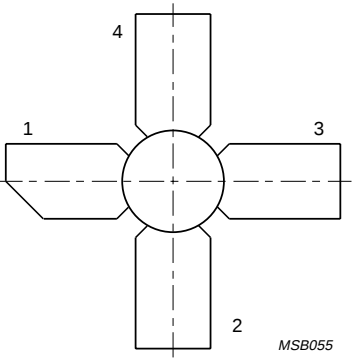
MODE OF OPERATION	V_{CE} V	f MHz	P_L W	G_p dB	η_c %
narrow band; c.w.	12,5	470	5	> 10,5	> 60
	12,5	900	4	typ. 7,0	typ. 60

PIN CONFIGURATION



Top view MBK187

Fig.1 Simplified outline.
SOT122A
(BLU99).



MSB055

Fig.2 Simplified outline.
SOT122D
(BLU99/SL).

PINNING - SOT122A; SOT122D

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter

PRODUCT SAFETY This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.

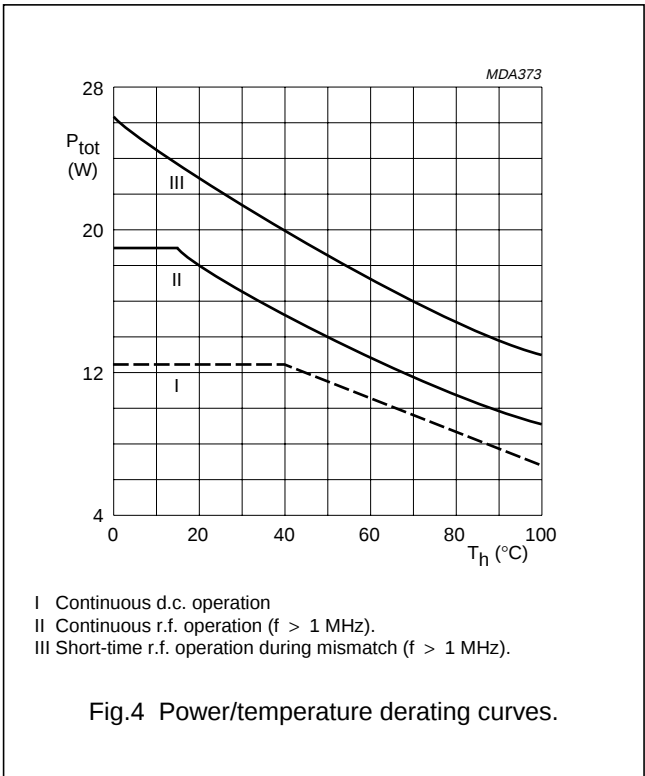
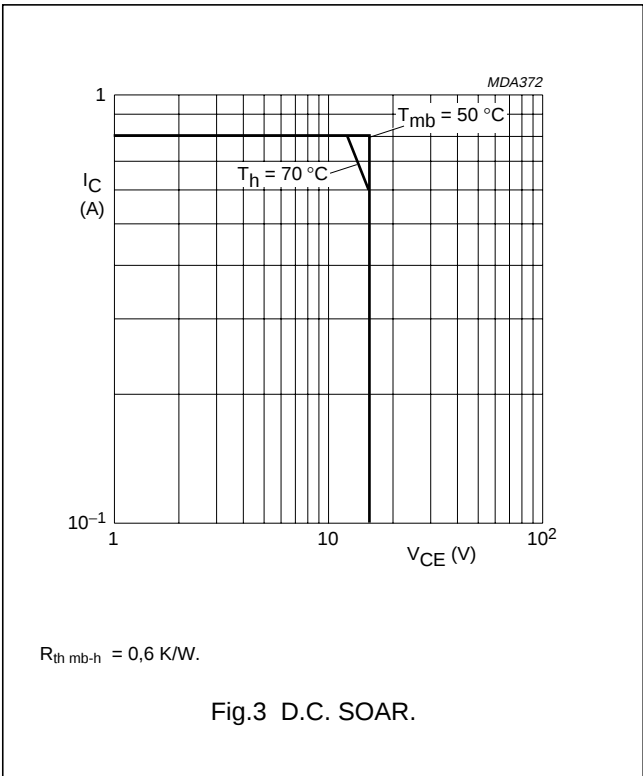
UHF power transistor

BLU99
BLU99/SL

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	36 V
Collector-emitter voltage (open base)	V_{CEO}	max.	16 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3 V
Collector current			
d.c. or average	$I_C; I_{C(AV)}$	max.	0,8 A
peak value; $f > 1$ MHz	I_{CM}	max.	2,5 A
D.C. power dissipation up to $T_{mb} = 50\text{ °C}$	$P_{tot (d.c.)}$	max.	12,5 W
R.F. power dissipation			
$f > 1$ MHz; $T_{mb} = 25\text{ °C}$	$P_{tot (r.f.)}$	max.	19 W
Storage temperature	T_{stg}		-65 to + 150 °C
Operating junction temperature	T_j	max.	200 °C



THERMAL RESISTANCE

(dissipation = 9 W; $T_{mb} = 25\text{ °C}$)

From junction to mounting base

(d.c. dissipation)

$$R_{th\ j-mb(dc)} = 10\text{ K/W}$$

From junction to mounting base

(r.f. dissipation)

$$R_{th\ j-mb(rf)} = 7,5\text{ K/W}$$

From mounting base to heatsink

$$R_{th\ mb-h} = 0,6\text{ K/W}$$

UHF power transistor

BLU99
BLU99/SL

CHARACTERISTICS

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

Collector-base breakdown voltage

open emitter; $I_C = 10\text{ mA}$

$V_{(BR)CBO} > 36\text{ V}$

Collector-emitter breakdown voltage

open base; $I_C = 20\text{ mA}$

$V_{(BR)CEO} > 16\text{ V}$

Emitter-base breakdown voltage

open collector; $I_E = 1\text{ mA}$

$V_{(BR)EBO} > 3\text{ V}$

Collector cut-off current

$V_{BE} = 0$; $V_{CE} = 16\text{ V}$

$I_{CES} < 5\text{ mA}$

Second breakdown energy; $L = 25\text{ mH}$; $f = 50\text{ Hz}$

$R_{BE} = 10\text{ }\Omega$

$E_{SBR} > 1\text{ mJ}$

D.C. current gain⁽²⁾

$I_C = 0,6\text{ A}$; $V_{CE} = 10\text{ V}$

$h_{FE} > 25$
typ. 100

Transition frequency at $f = 500\text{ MHz}$ ⁽¹⁾

$I_C = 0,6\text{ A}$; $V_{CE} = 12,5\text{ V}$

f_T typ. 4,0 GHz

Collector capacitance at $f = 1\text{ MHz}$

$I_E = I_e = 0$; $V_{CB} = 12,5\text{ V}$

C_c typ. 7,5 pF

Feedback capacitance at $f = 1\text{ MHz}$

$I_C = 0$; $V_{CE} = 12,5\text{ V}$

C_{re} typ. 5 pF

Collector-stud capacitance

C_{cs} typ. 1,2 pF

Notes

1. Measured under pulse conditions: $t_p = 50\text{ }\mu\text{s}$; $\delta < 0,01$.
2. Measured under pulse conditions: $t_p = 300\text{ }\mu\text{s}$; $\delta < 0,01$.

UHF power transistor

BLU99
BLU99/SL

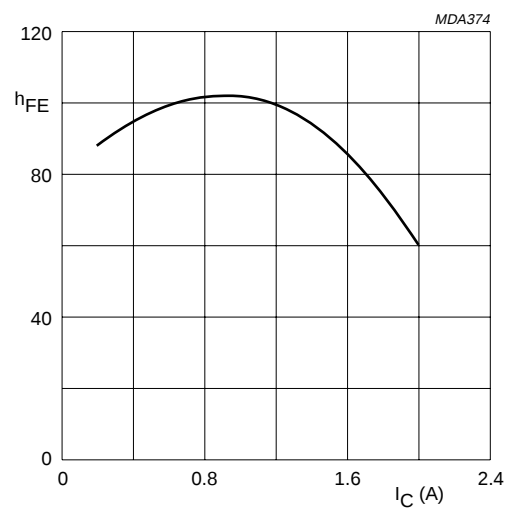


Fig.5 $V_{CE} = 10$ V; $T_j = 25$ °C; typ. values.

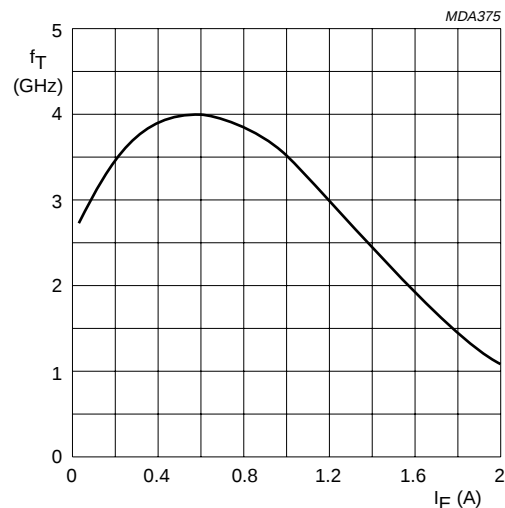


Fig.6 $V_{CB} = 12.5$ V; $f = 500$ MHz; $T_j = 25$ °C; typ. values.

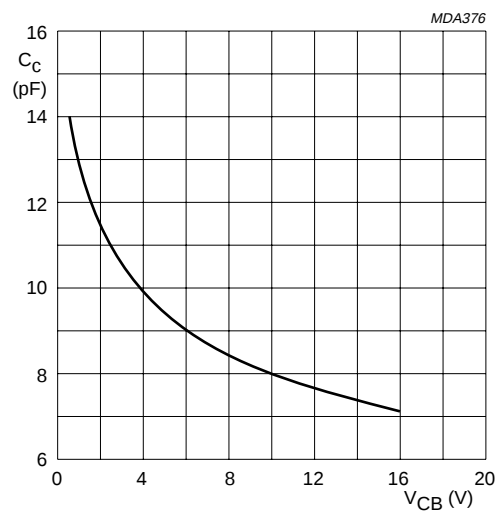


Fig.7 $I_E = i_e = 0$; $f = 1$ MHz; typ. values.

UHF power transistor

BLU99
BLU99/SL

APPLICATION INFORMATION (part I)

R.F. performance in c.w. operation (common-emitter class-B circuit) at $f = 470$ MHz; $T_h = 25$ °C.

MODE OF OPERATION	V_{CE} V	P_L W	P_S W	G_p dB	I_C A	η_C %
narrow band; c.w.	12,5	5	< 0,45 typ. 0,32	> 10,5 typ. 12	< 0,665 typ. 0,60	> 60 typ. 66

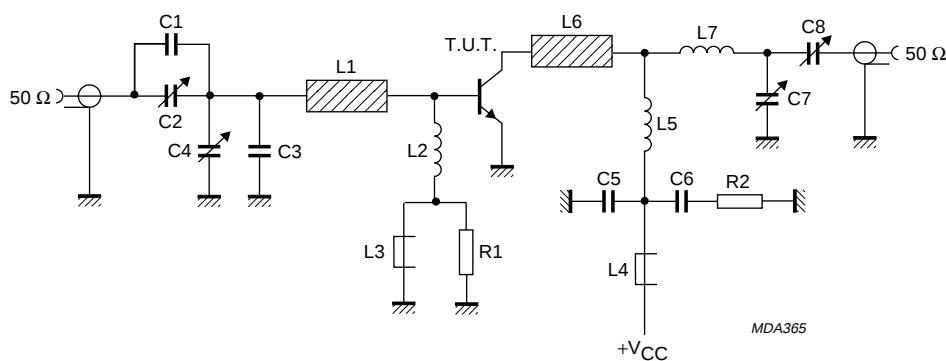


Fig.8 Class-B test circuit at $f = 470$ MHz.

List of components:

- C1 = 2,7 pF multilayer ceramic chip capacitor⁽¹⁾
- C2 = C7 = C8 = 1,4-5,5 pF film dielectric trimmer (cat.no. 2222 809 09001)
- C3 = 7,5 pF multilayer ceramic chip capacitor⁽¹⁾
- C4 = 2-9 pF film dielectric trimmer (cat.no. 2222 809 09002)
- C5 = 100 pF multilayer ceramic chip capacitor (cat. no. 2222 852 13101)
- C6 = 100 nF metallized film capacitor (cat. no. 2222 352 45104)
- L1 = stripline, 22,5 mm $\times$ 6,0 mm
- L2 = 1 turn Cu-wire (1,0 mm), int. dia. 5,5 mm, leads 2 $\times$ 5 mm
- L3 = L4 = Ferroxcube wideband h.f. choke, grade 3B (cat. no. 4312 020 36642)
- L5 = 4 turns enamelled Cu-wire (1,0 mm), int. dia. 6 mm, length 7,5 mm, leads 2 $\times$ 5 mm
- L6 = stripline, 10,0 mm $\times$ 6,0 mm
- L7 = 1 turn Cu-wire (1,0 mm), int. dia. 5 mm, leads 2 $\times$ 5 mm
- R1 = R2 = 10 Ω metal film resistor, 0,25 W

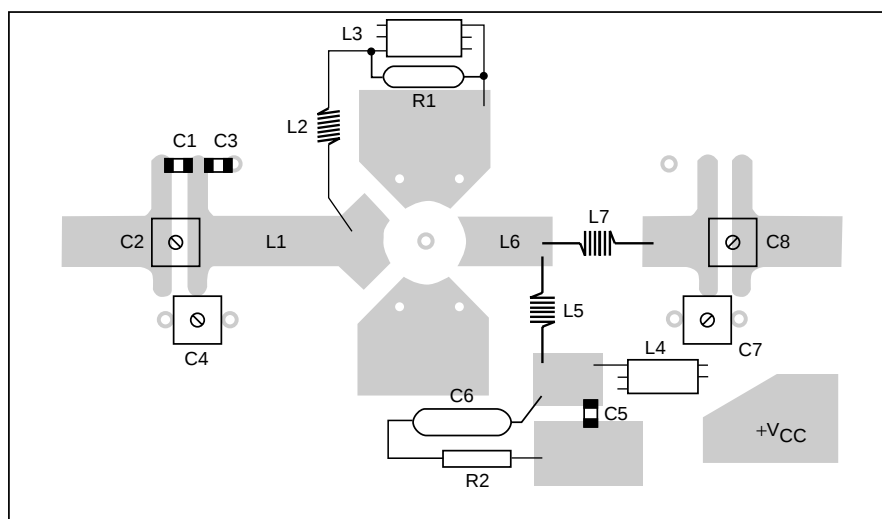
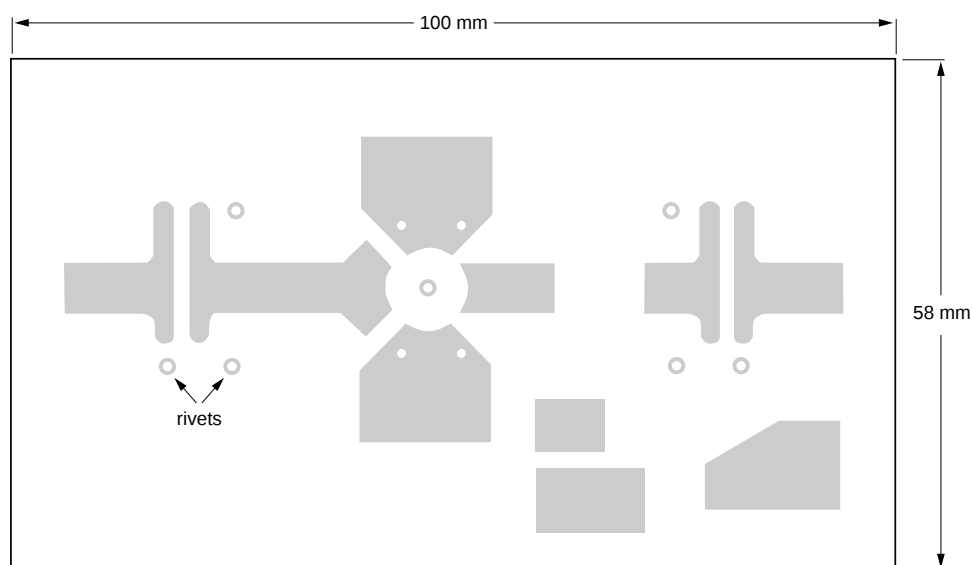
L1 and L6 are striplines on a double Cu-clad printed circuit board with P.T.F.E. fibre-glass dielectric ($\epsilon_r = 2,74$) and a thickness of $\frac{1}{16}$ inch.

Note

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

UHF power transistor

BLU99
BLU99/SL



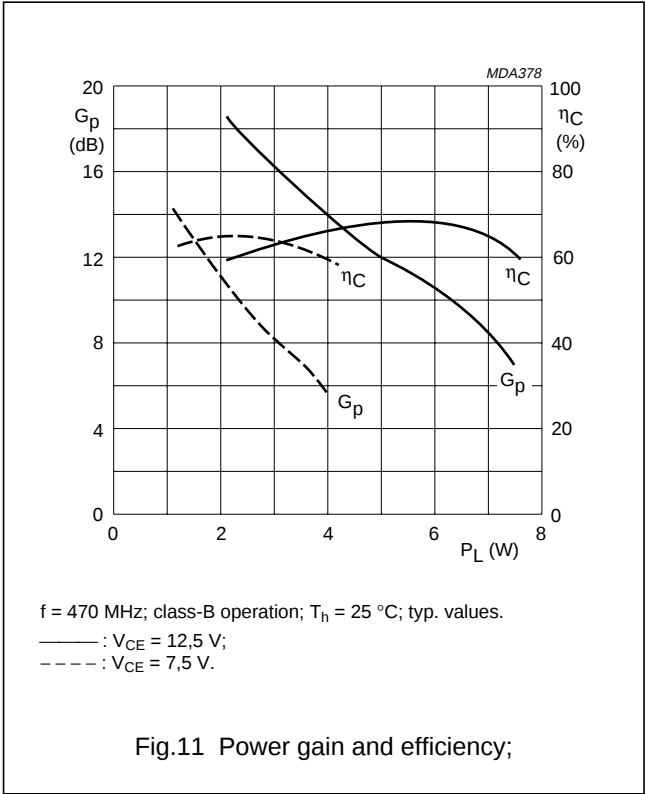
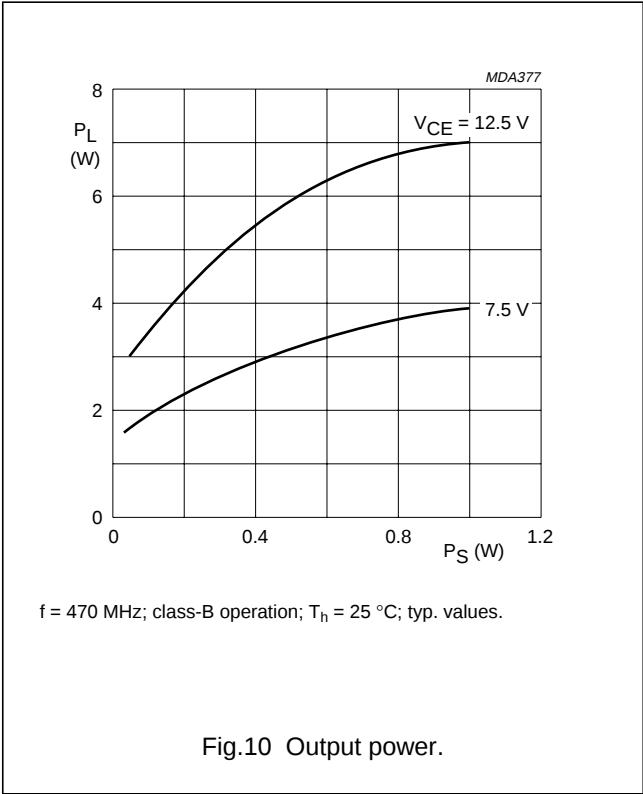
MDA366

The circuits and the components are on one side of the P.T.F.E. fibre-glass board; the other side is unetched copper to serve as ground plane. Earth connections are made by hollow rivets.

Fig.9 Printed circuit board and component layout for 470 MHz.

UHF power transistor

BLU99
BLU99/SL

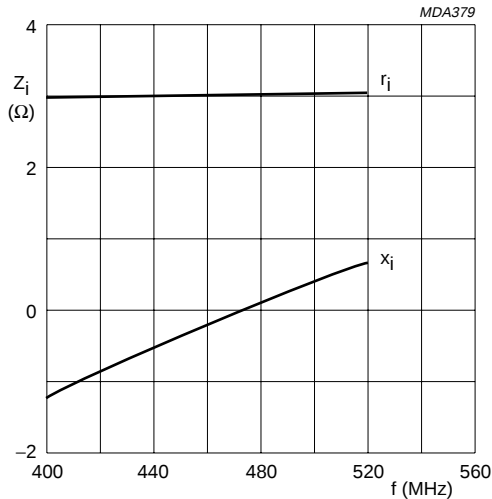


RUGGEDNESS:

The device is capable of withstanding a load mismatch with VSWR = 50 (all phases) up to a supply voltage of 15,5 V at rated load power.

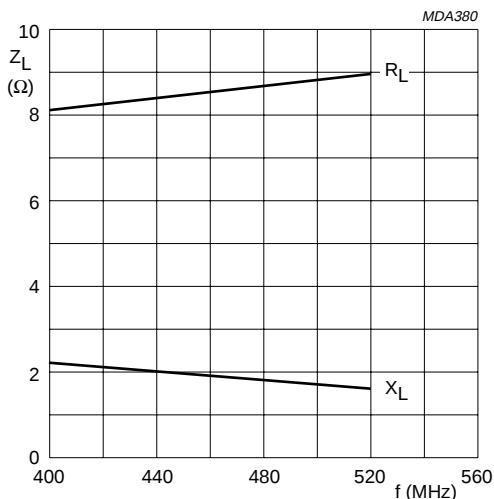
UHF power transistor

BLU99
BLU99/SL



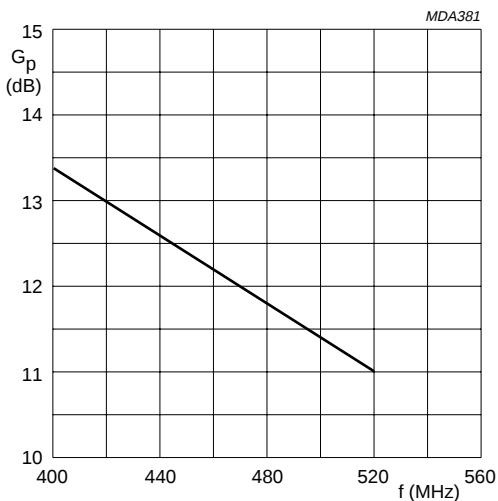
$V_{CE} = 12.5\text{ V}$; $P_L = 5\text{ W}$; $T_h = 25\text{ }^\circ\text{C}$;
 $f = 400\text{--}520\text{ MHz}$; typical values.

Fig.12 Input impedance (series components).



$V_{CE} = 12.5\text{ V}$; $P_L = 5\text{ W}$; $T_h = 25\text{ }^\circ\text{C}$;
 $f = 400\text{--}520\text{ MHz}$; typical values.

Fig.13 Load impedance (series components).



$V_{CE} = 12.5\text{ V}$; $P_L = 5\text{ W}$; $T_h = 25\text{ }^\circ\text{C}$;
 $f = 400\text{--}520\text{ MHz}$; typical values.

Fig.14 Power gain.

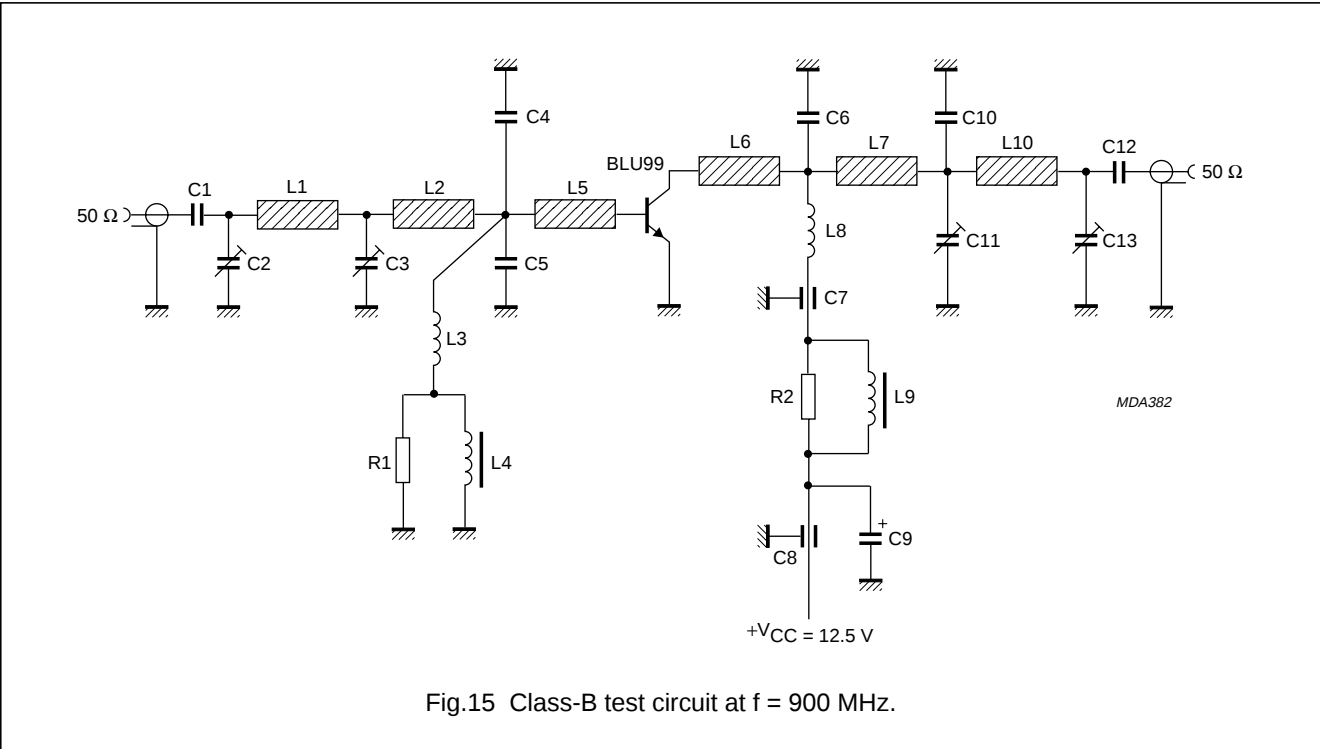
UHF power transistor

BLU99
BLU99/SL

APPLICATION INFORMATION (part II)

R.F. performance in c.w. operation (common-emitter class-B circuit) at f = 900 MHz; T_h = 25 °C

MODE OF OPERATION	V _{CE} V	P _L W	P _S W	G _P dB	I _C A	η _C %
narrow band; c.w.	12,5	4	typ. 0,8	typ. 7,0	typ. 0,54	typ. 60



UHF power transistor

BLU99
BLU99/SL

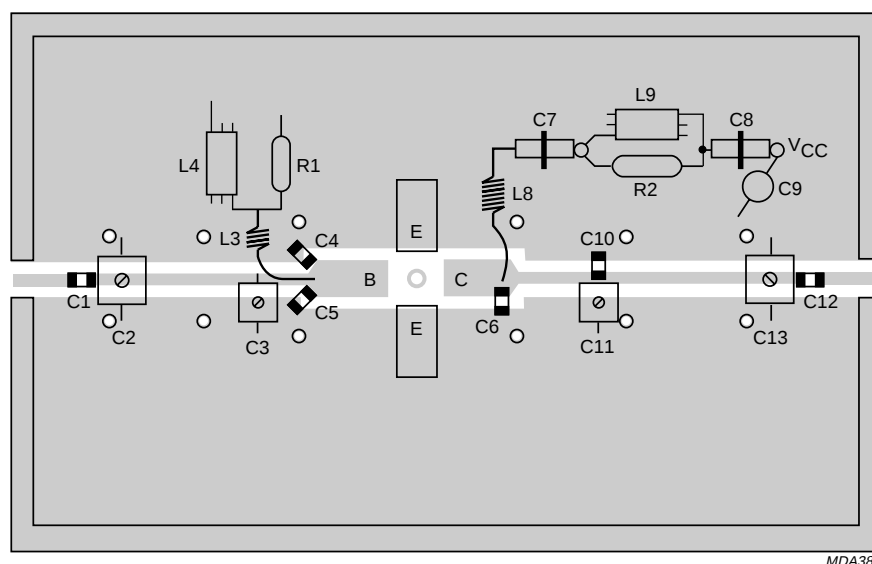
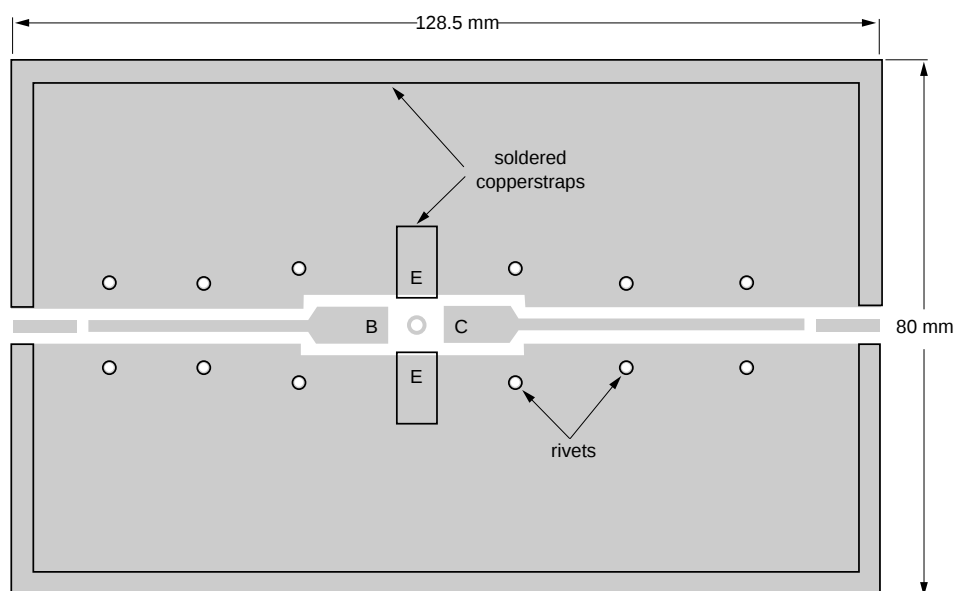
List of components:

- C1 = C12 = 33 pF multilayer ceramic chip capacitor⁽¹⁾
 - C2 = C13 = 1,4-5,5 pF film dielectric trimmer (cat. no. 2222 809 09001)
 - C3 = C11 = 1,2-3,5 pF film dielectric trimmer (cat. no. 2222 809 05001)
 - C4 = C5 = C10 = 6,2 pF multilayer ceramic chip capacitor⁽¹⁾
 - C6 = 1 pF multilayer ceramic chip capacitor⁽¹⁾
 - C7 = 10 pF ceramic feed-through capacitor
 - C8 = 330 pF ceramic feed-through capacitor
 - C9 = 2,2 μ F tantalum electrolytic capacitor
 - L1 = stripline, 21,0 mm $\times$ 1,85 mm
 - L2 = stripline, 5,0 mm $\times$ 1,85 mm
 - L3 = 60 nH, 4 turns enamelled Cu-wire (0,4 mm), close wound, int. dia. 3 mm
 - L4 = L9 = Ferroxcube wideband h.f. choke, grade 3B (cat. no 4312 020 36642)
 - L5 = stripline, 11,3 mm $\times$ 6,0 mm
 - L6 = stripline, 10,0 mm $\times$ 6,0 mm
 - L7 = stripline, 15,9 mm $\times$ 1,85 mm
 - L8 = 280 nH, 15 turns enamelled Cu-wire (0,4 mm), close wound, int. dia. 3 mm
 - L10 = stripline, 28,0 mm $\times$ 1,85 mm
 - R1 = R2 = 10 Ω metal film resistor, 0,25 W
- L1, L2, L5, L6, L7 and L10 are striplines on a double Cu-clad printed circuit board with P.T.F.E. fibre-glass dielectric ($\epsilon_r = 2,74$) and thickness of $\frac{1}{32}$ inch.

Note

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

UHF power transistor

BLU99
BLU99/SL

The circuit and the components are on one side of the P.T.F.E. fibre-glass board; the other side is unetched copper to serve as a ground plane. Earth connections are made by hollow rivets and also by fixing screws and copper straps around the board and under the emitters to provide a direct contact between the copper on the component side and the ground plane.

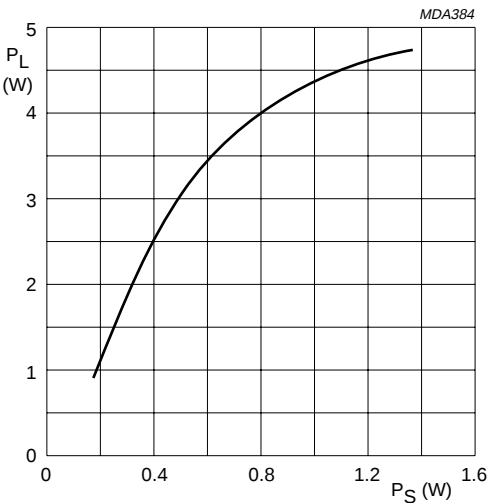
Fig.16 Printed circuit board and component layout for a 900 MHz test circuit.

RUGGEDNESS

The device is capable of withstanding a load mismatch with VSWR = 50 (all phases) up to a supply voltage of 15,5 V at rated load power.

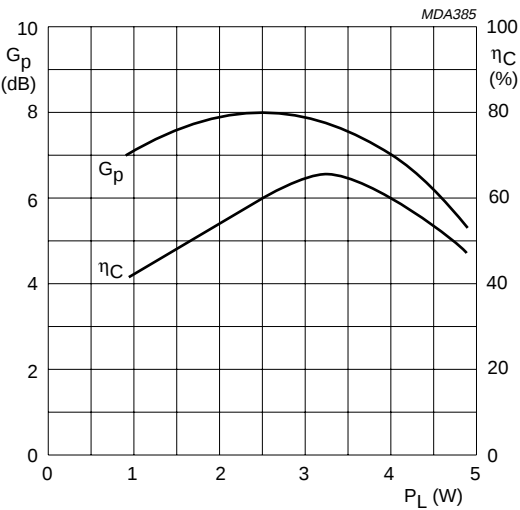
UHF power transistor

BLU99
BLU99/SL



$f = 900\text{ MHz}$; $V_{CE} = 12,5\text{ V}$; class-B operation;
 $T_h = 25\text{ }^{\circ}\text{C}$; typ. values.

Fig.17 Output power.

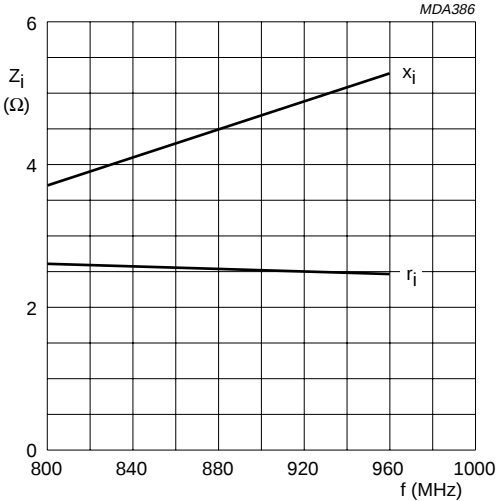


$f = 900\text{ MHz}$; $V_{CE} = 12,5\text{ V}$; class-B operation;
 $T_h = 25\text{ }^{\circ}\text{C}$; typ. values.

Fig.18 Power gain and efficiency.

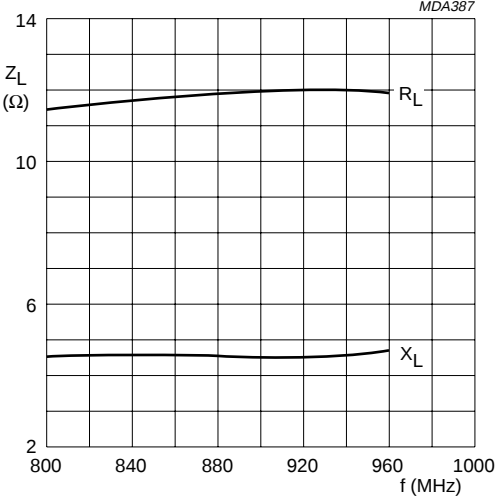
UHF power transistor

BLU99
BLU99/SL



f = 800-960 MHz; $V_{CE} = 12,5$ V; $P_L = 4$ W;
 $T_h = 25$ °C; typ. values.

Fig.19 Input impedance (series components).



f = 800-960 MHz; $V_{CE} = 12,5$ V; $P_L = 4$ W;
 $T_h = 25$ °C; typ. values.

Fig.20 Load impedance (series components).

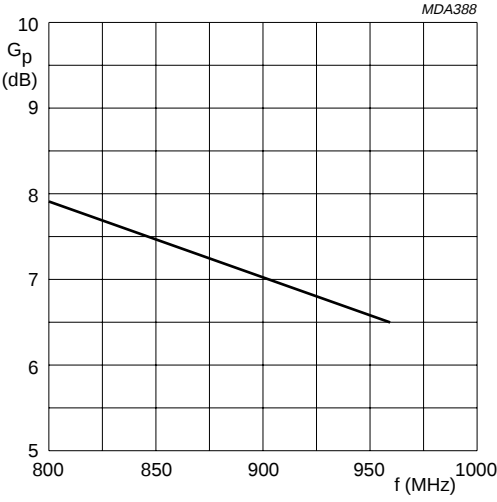


Fig.21 Power gain.

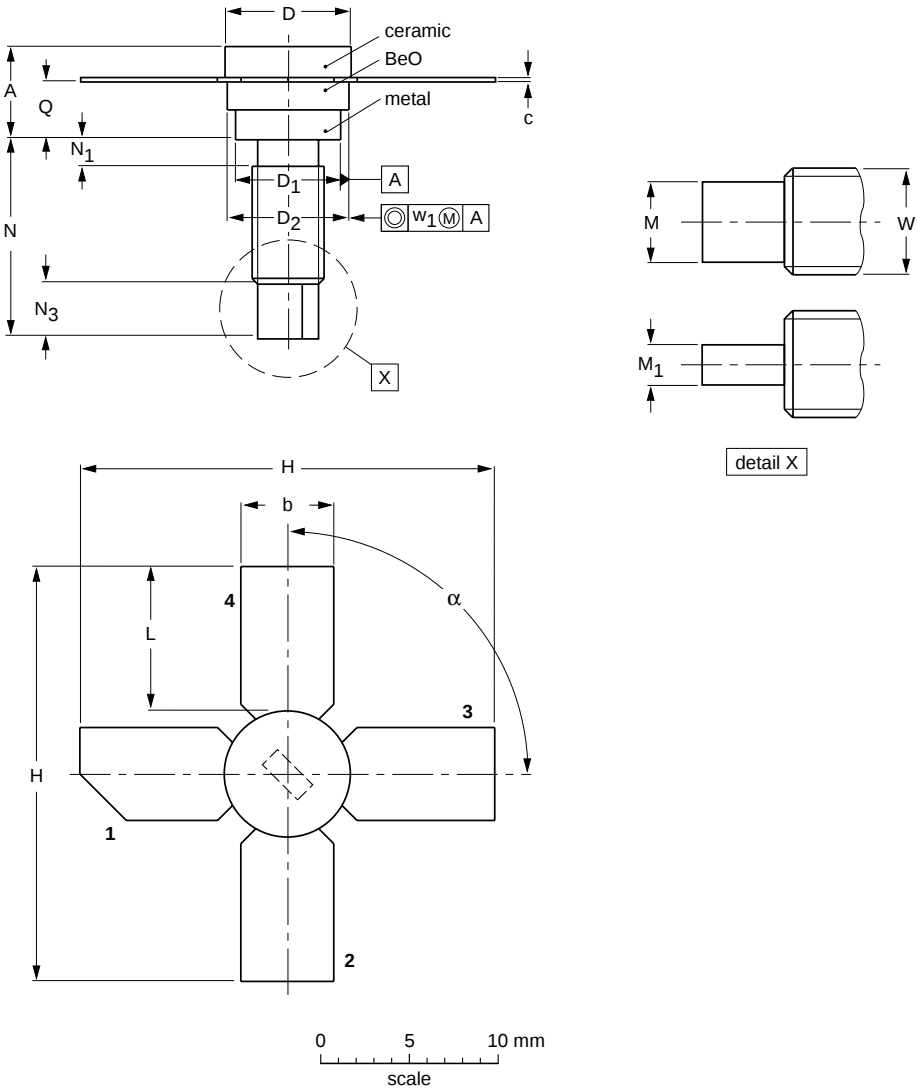
UHF power transistor

BLU99
BLU99/SL

PACKAGE OUTLINES

Studded ceramic package; 4 leads

SOT122A



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

UNIT	A	b	c	D	D ₁	D ₂	H	L	M ₁	M	N	N ₁ max.	N ₃	Q	W	w ₁	α
mm	5.97 4.74	5.85 5.58	0.18 0.14	7.50 7.23	6.48 6.22	7.24 6.93	27.56 25.78	9.91 9.14	3.18 2.66	1.66 1.39	11.82 11.04	1.02	3.86 2.92	3.38 2.74	8-32 UNC	0.381	90°

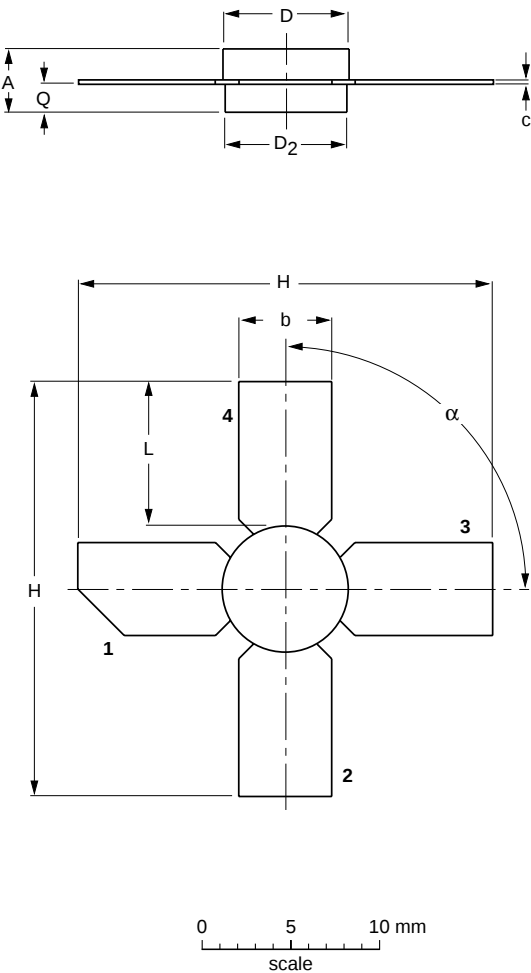
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT122A						97-04-18

UHF power transistor

BLU99
BLU99/SL

Studless ceramic package; 4 leads

SOT122D



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

UNIT	A	b	c	D	D ₂	H	L	Q	α
mm	4.17 3.27	5.85 5.58	0.18 0.14	7.50 7.23	7.24 6.98	27.56 25.78	9.91 9.14	1.58 1.27	90°

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT122D						97-04-18

UHF power transistor

BLU99
BLU99/SL**DEFINITIONS**

Data Sheet Status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.