DATA SHEET

BLW85
HF/VHF power transistor

Product specification

March 1993

Philips
Semiconductors

PHILIPS

HF/VHF power transistor BLW85

DESCRIPTION

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated mobile h.f. and v.h.f. transmitters with a nominal supply voltage of 12,5 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16,5 V.

Matched h_{FE} groups are available on request.

It has a 3/8" flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

R.F. performance up to T_h = 25 °C

MODE OF OPERATION	V_{CE} V	f MHz	P_L W	G_p dB	η %	$\overline{z_i}$ Ω	$\overline{Z_L}$ Ω	d_3 dB
c.w. (class-B)	**12,5**	**175**	**45**	> **4,5**	> **75**	**1,4 + j1,5**	**2,7–j1,3**	–
s.s.b. (class-AB)	12,5	1,6–28	3–30 (P.E.P.)	typ. 19,5	typ. 35	–	–	typ. –33

PIN CONFIGURATION

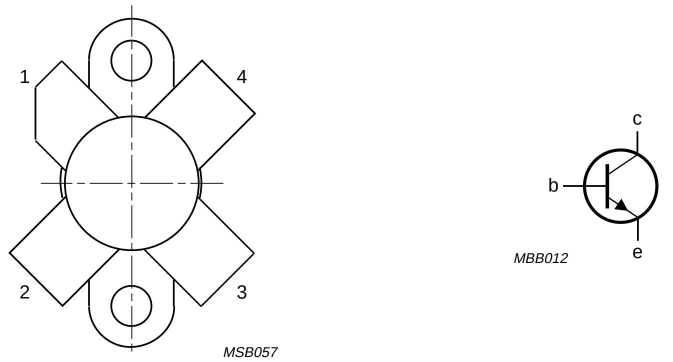


Fig.1 Simplified outline and symbol.

PINNING - SOT123

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.

RATINGS

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

Collector-emitter voltage (V_{BE} = 0)				
peak value	V_{CESM}	max.	36	V
Collector-emitter voltage (open base)	V_{CEO}	max.	16	V
Emitter-base voltage (open-collector)	V_{EBO}	max.	4	V
Collector current (average)	$I_{C(AV)}$	max.	9	A
Collector current (peak value); f > 1 MHz	I_{CM}	max.	22	A
R.F. power dissipation up to (f > 1 MHz); T_{mb} = 25 °C	P_{rf}	max.	105	W
Storage temperature	T_{stg}		–65 to + 150	°C
Operating junction temperature	T_j	max.	200	°C

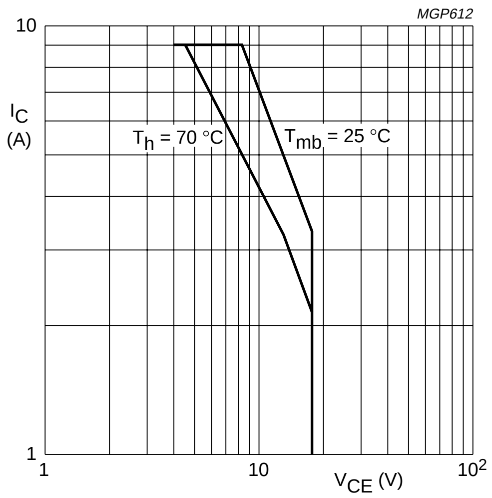


Fig.2 D.C. SOAR.

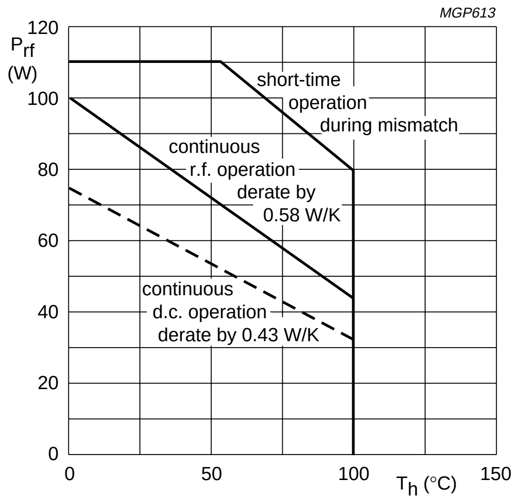


Fig.3 R.F. power dissipation; $V_{CE} \leq 16{,}5$ V; f ≥ 1 MHz.

THERMAL RESISTANCE

(dissipation = 30 W; T_{mb} = 79 °C, i.e. T_h = 70 °C)

From junction to mounting base (d.c. dissipation)	$R_{th\ j\text{-}mb(dc)}$	=	2,5	K/W
From junction to mounting base (r.f. dissipation)	$R_{th\ j\text{-}mb(rf)}$	=	1,8	K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,3	K/W

CHARACTERISTICS

$T_j = 25\ °C$

Collector-emitter breakdown voltage				
$V_{BE} = 0$; $I_C = 50$ mA	$V_{(BR)\,CES}$	>	36	V
Collector-emitter breakdown voltage				
open base; $I_C = 100$ mA	$V_{(BR)\,CEO}$	>	16	V
Emitter-base breakdown voltage				
open collector; $I_E = 25$ mA	$V_{(BR)EBO}$	>	4	V
Collector cut-off current				
$V_{BE} = 0$; $V_{CE} = 18$ V	I_{CES}	<	25	mA
Second breakdown energy; L = 25 mH; f = 50 Hz				
open base	E_{SBO}	>	8	mJ
$R_{BE} = 10\ \Omega$	E_{SBR}	>	8	mJ
D.C. current gain(1)		typ.	50	
$I_C = 4$ A; $V_{CE} = 5$ V	h_{FE}		10 to 80	
D.C. current gain ratio of matched devices(1)				
$I_C = 4$ A; $V_{CE} = 5$ V	h_{FE1}/h_{FE2}	<	1,2	
Collector-emitter saturation voltage(1)				
$I_C = 12,5$ A; $I_B = 2,5$ A	V_{CEsat}	typ.	1,5	V
Transition frequency at f = 100 MHz(1)				
$-I_E = 4$ A; $V_{CB} = 12,5$ V	f_T	typ.	650	MHz
$-I_E = 12,5$ A; $V_{CB} = 12,5$ V	f_T	typ.	600	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 15$ V	C_c	typ.	120	pF
Feedback capacitance at f = 1 MHz				
$I_C = 200$ mA; $V_{CE} = 15$ V	C_{re}	typ.	82	pF
Collector-flange capacitance	C_{cf}	typ.	2	pF

Note

1. Measured under pulse conditions: $t_p \le 200\ \mu s$; $\delta \le 0,02$.

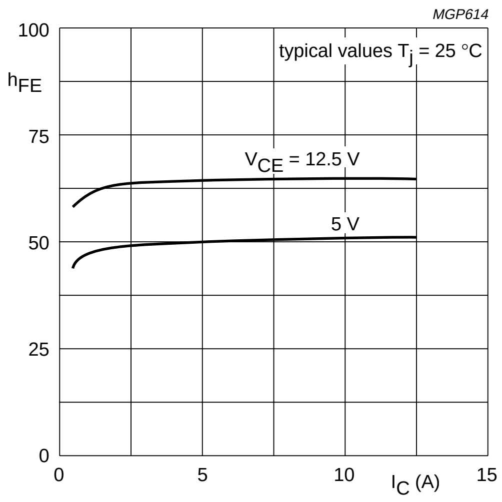


Fig.4

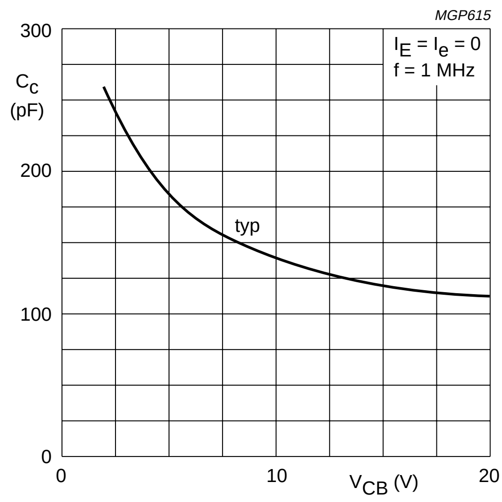


Fig.5 T_j = 25 °C.

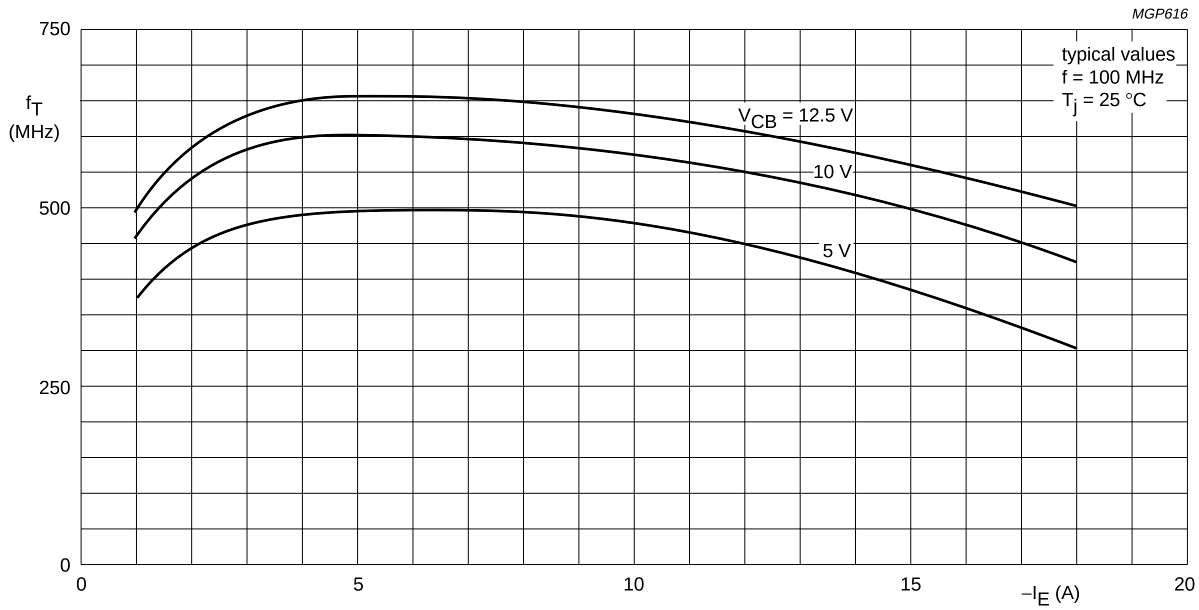


Fig.6

APPLICATION INFORMATION

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

f (MHz)	V_{CE} (V)	P_L (W)	P_S (W)	G_p (dB)	I_C (A)	η (%)	$\bar{z}_i$ (Ω)	$\bar{Z}_L$ (Ω)
175	**12,5**	**45**	**< 16**	**> 4,5**	**< 4,8**	**> 75**	**1,4 + j1,5**	**2,7 − j1,3**
175	13,5	45	–	typ. 6,0	–	typ. 75	–	–

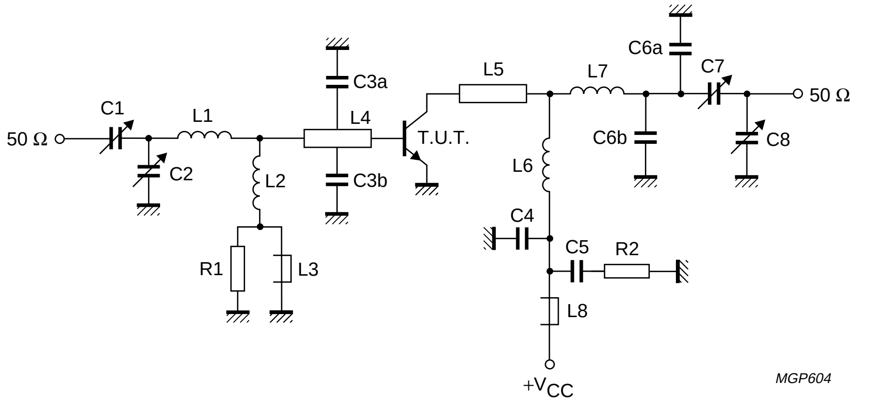


Fig.7 Test circuit; c.w. class-B.

List of components:

C1 = 2,5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
C2 = C8 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
C3a = C3b = 47 pF ceramic capacitor (500 V)
C4 = 120 pF ceramic capacitor (500 V)
C5 = 100 nF polyester capacitor
C6a = C6b = 8,2 pF ceramic capacitor (500 V)
C7 = 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
L1 = 1 turn Cu wire (1,6 mm); int. dia. 9,0 mm; leads 2 × 5 mm
L2 = 100 nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm; leads 2 × 5 mm
L3 = L8 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L4 = L5 = strip (12 mm × 6 mm); taps for C3a and C3b at 5 mm from transistor
L6 = 2 turns enamelled Cu wire (1,6 mm); int. dia. 5,0 mm; length 6,0 mm; leads 2 × 5 mm
L7 = 2 turns enamelled Cu wire (1,6 mm); int. dia. 4,5 mm; length 6,0 mm; leads 2 × 5 mm

L4 and L5 are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16".

R1 = 10 Ω (±10%) carbon resistor (0,25 W)
R2 = 4,7 Ω (±5%) carbon resistor (0,25 W)

Component layout and printed-circuit board for 175 MHz test circuit are shown in Fig.8.

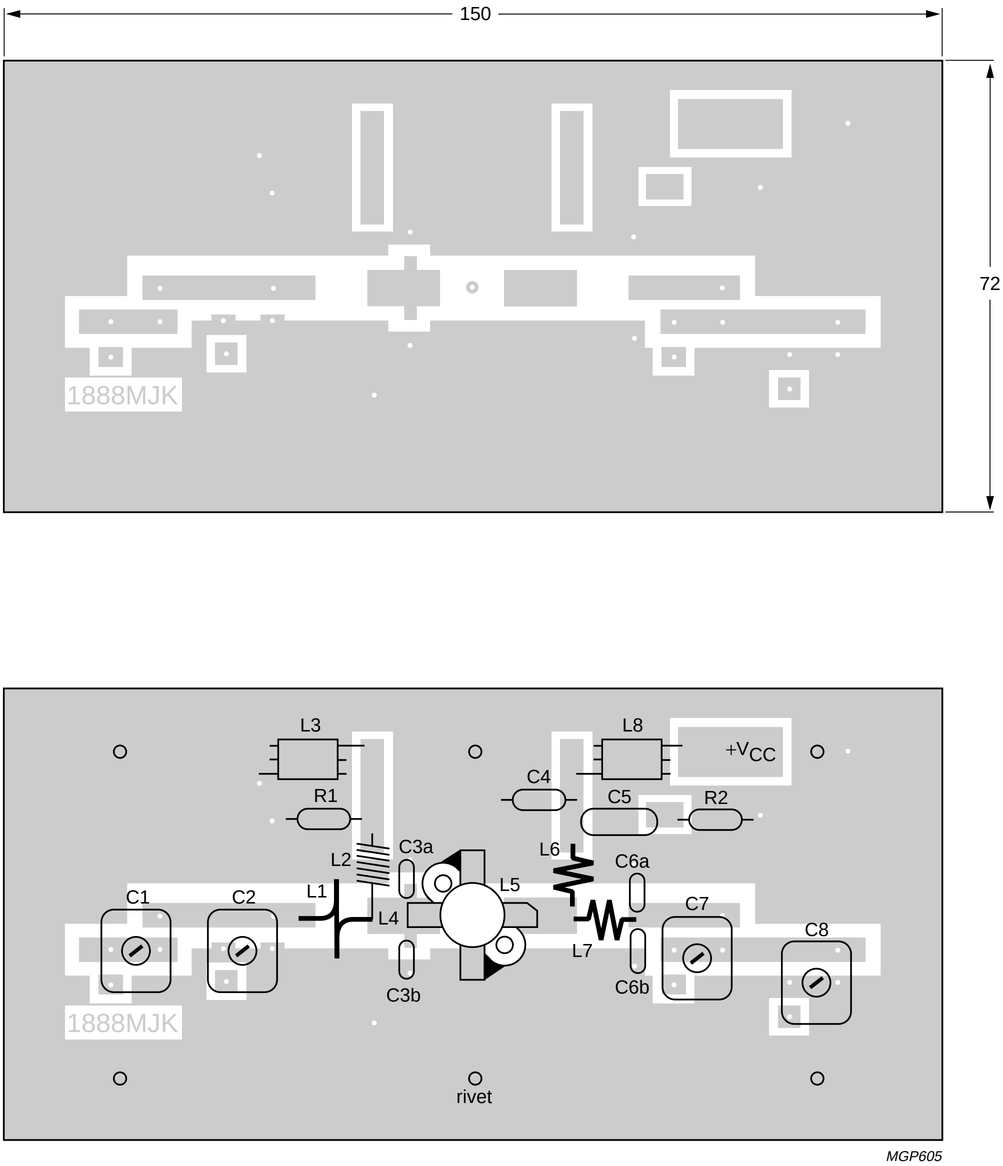


Fig.8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.

To minimize the dielectric losses, the ground plane under the interconnection of L7 and C7 has been removed.

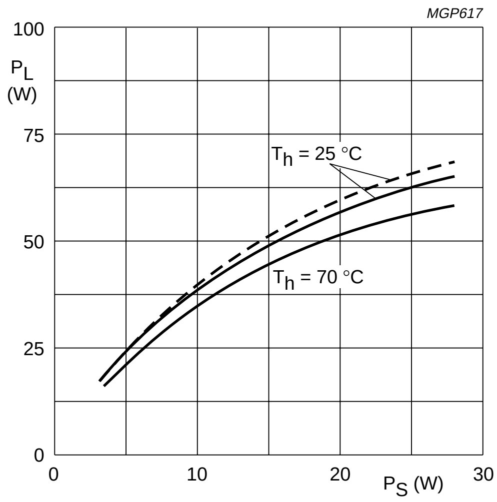


Fig.9 Typical values; f = 175 MHz;
— V_{CE} = 12,5 V; - - - V_{CE} = 13,5 V.

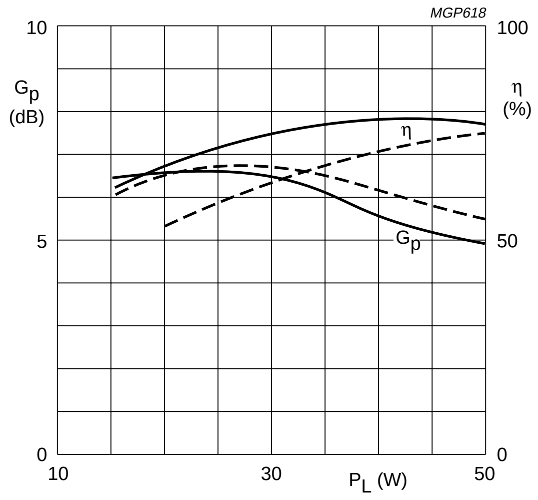


Fig.10 Typical values; f = 175 MHz ;T_h = 25 °C;
— V_{CE} = 12,5 V; - - - V_{CE} = 13,5 V.

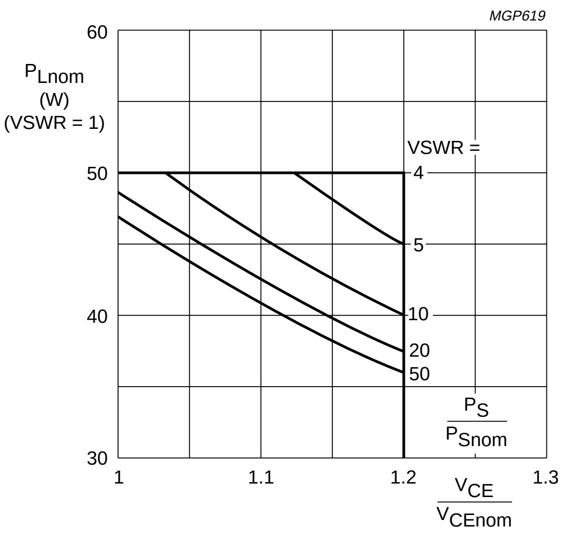
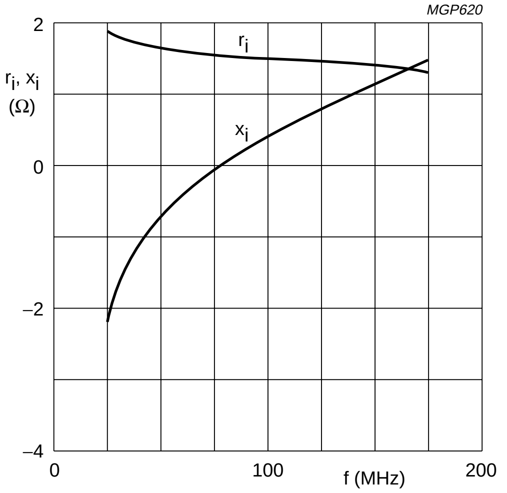


Fig.11 R.F. SOAR; (short-time operation during mismatch); f = 175 MHz; T_h = 70 °C;
$R_{th\ mb-h}$ = 0,3 K/W ;
V_{CEnom} = 12,5 V or 13,5 V; P_S = P_{Snom} at V_{CEnom} and VSWR =1 measured in the circuit of Fig.7.

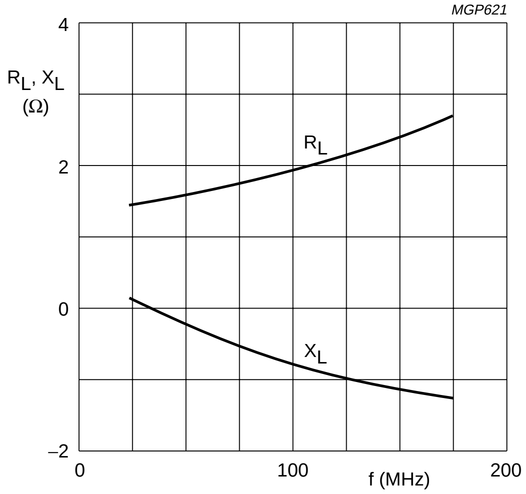
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio with VSWR as parameter.

The graph applies to the situation in which the drive (P_S/P_{Snom}) increases linearly with supply over-voltage ratio.



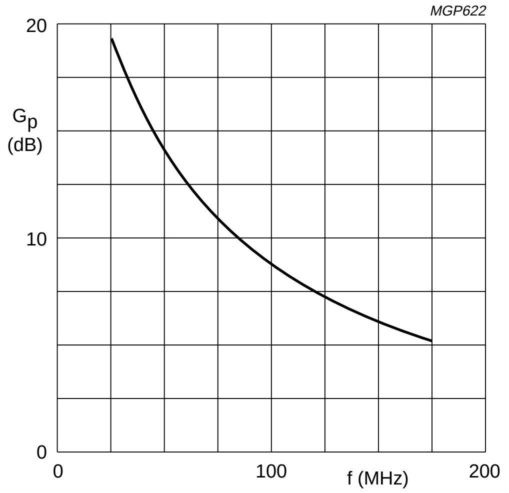
Typical values; V_{CE} = 12,5 V; P_L = 45 W;
class-B operation; T_h = 25 °C

Fig.12 Input impedance (series components).



Typical values; V_{CE} = 12,5 V; P_L = 45 W;
class-B operation; T_h = 25 °C

Fig.13 Load impedance (series components).



Typical values; V_{CE} = 12,5 V; P_L = 45 W;
class-B operation; T_h = 25 °C

Fig.14

R.F. performance in s.s.b. class-AB operation

V_{CE} = 12,5 V; T_h up to 25 °C; $R_{th\ mb\text{-}h} \leq$ 0,3 K/W

f_1 = 28,000 MHz; f_2 = 28,001 Mhz

OUTPUT POWER W	G_p **dB**	η_{dt} **%**	d_3 **dB**(1)	d_5 **dB**(1)	$I_{C(ZS)}$ **mA**
3 to 30 (P.E.P.)	typ. 19,5	typ. 35	typ. –33	typ. –36	25

Note

1. Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.

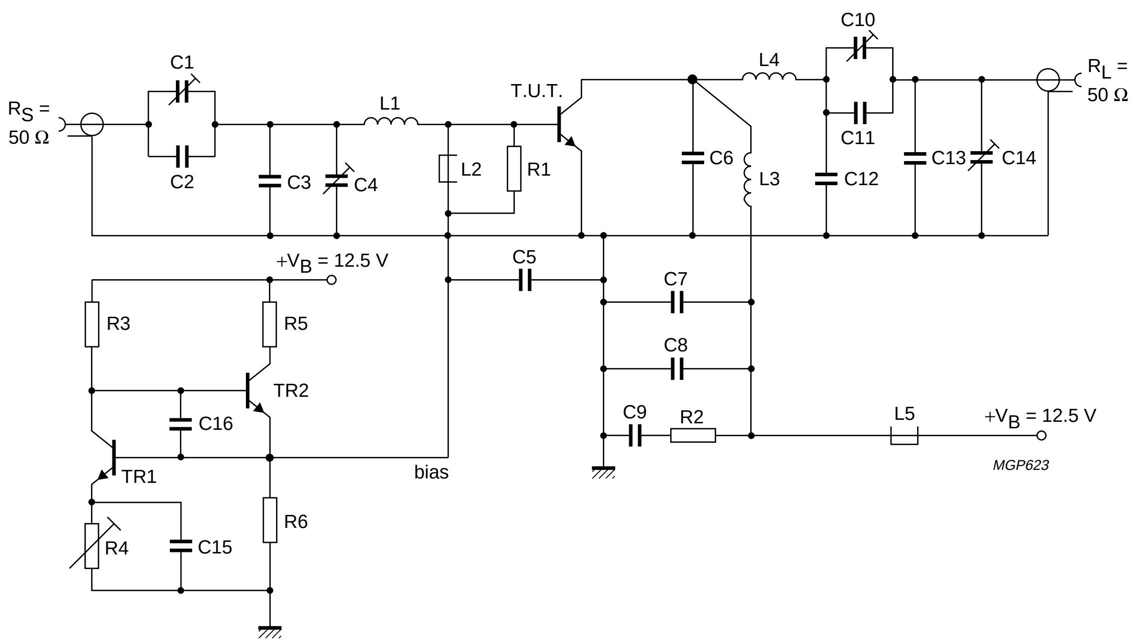
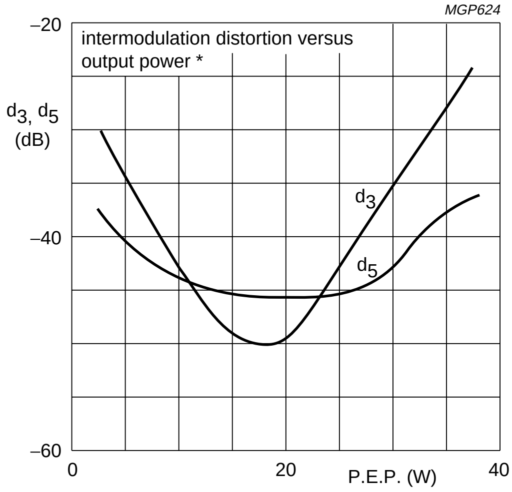


Fig.15 Test circuit; s.s.b. class-AB.

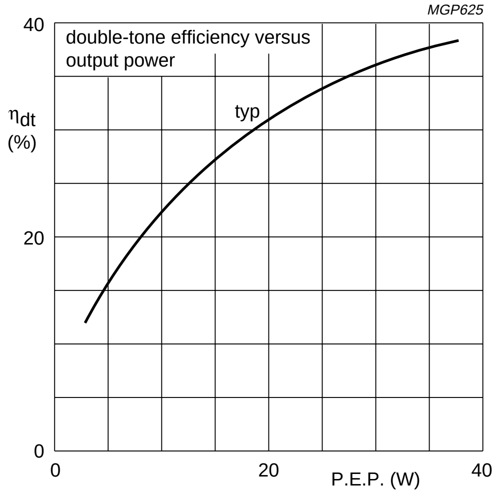
List of components:

TR1	=	TR2 = BD137
C1	=	100 pF air dielectric trimmer (single insulated rotor type)
C2	=	27 pF ceramic capacitor (500 V)
C3	=	180 pF polystyrene capacitor
C4	=	100 pF air dielectric trimmer (single non-insulated rotor type)
C5	=	C7 = 3,9 nF polyester capacitor
C6	=	2 × 270 pF polystyrene capacitors in parallel
C8	=	C15 = C16 = 100 nF polyester capacitor
C9	=	2,2 μF moulded metallized polyester capacitor
C10	=	2 × 385 pF (sections in parallel) film dielectric trimmer
C11	=	68 pF ceramic capacitor (500 V)
C12	=	2 × 82 pF ceramic capacitors in parallel (500 V)
C13	=	47 pF ceramic capacitor (500 V)
C14	=	385 pF film dielectric trimmer
L1	=	88 nH; 3 turns Cu wire (1,0 mm); int. dia. 9 mm; length 6,1 mm; leads 2 × 5 mm
L2	=	L5 = Ferroxcube choke coil (cat. no. 4312 020 36640)
L3	=	68 nH; 3 turns enamelled Cu wire (1,6 mm); int. dia. 8 mm; length 8,3 mm; leads 2 × 5 mm
L4	=	96 nH; 3 turns enamelled Cu wire (1,6 mm); int. dia. 10 mm; length 7,6 mm; leads 2 × 5 mm
R1	=	27 Ω (±5%) carbon resistor (0,5 W)
R2	=	4,7 Ω (±5%) carbon resistor (0,25 W)
R3	=	1,5 kΩ (±5%) carbon resistor (0,5 W)
R4	=	10 Ω wirewound potentiometer (3 W)
R5	=	47 Ω wirewound resistor (5,5 W)
R6	=	150 Ω (±5%) carbon resistor (0,25 W)



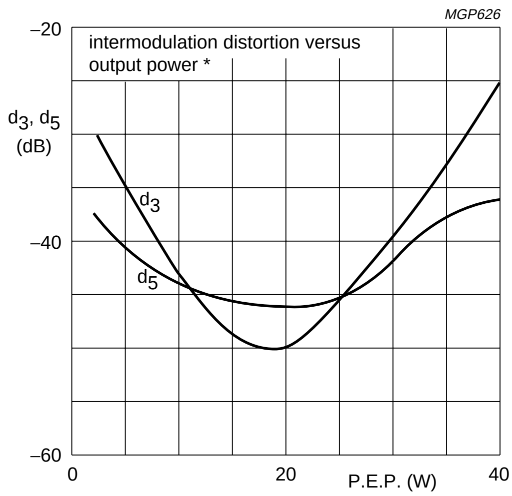
V_{CE} = 12,5 V; f_1 = 28,000 Mhz; f_2 = 28,001 MHz; T_h = 25 °C; $R_{th\ mb\text{-}h}$ ≤ 0,3 °K/W; $I_{C(ZS)}$ = 25 mA; typical values.

Fig.16



V_{CE} = 12,5 V; f_1 = 28,000 Mhz; f_2 = 28,001 MHz; T_h = 25 °C; $R_{th\ mb\text{-}h}$ ≤ 0,3 °K/W; $I_{C(ZS)}$ = 25 mA; typical values.

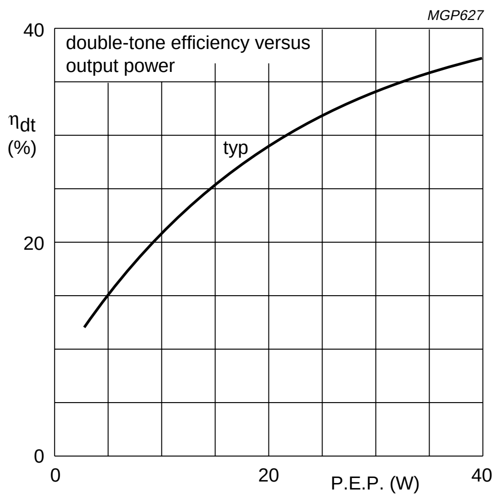
Fig.17



V_{CE} = 13,5 V; f_1 = 28,000 MHz; f_2 = 28,001 MHz; T_h = 25 °C; $R_{th\ mb\text{-}h}$ ≤ 0,3 K/W ; $I_{C(ZS)}$ = 25 mA; typical values.

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.

Fig.18



V_{CE} = 13,5 V; f_1 = 28,000 MHz; f_2 = 28,001 MHz; T_h = 25 °C; $R_{th\ mb\text{-}h}$ ≤ 0,3 K/W ; $I_{C(ZS)}$ = 25 mA; typical values.

Fig.19

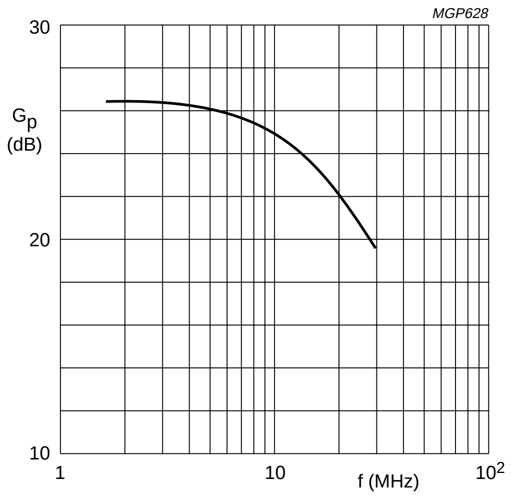


Fig.20 Power gain as a function of frequency.

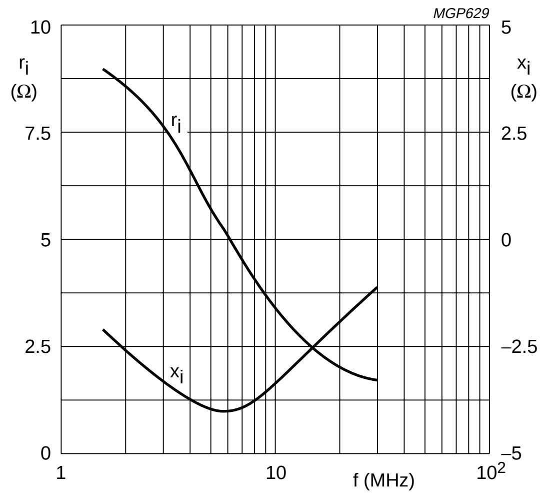


Fig.21 Input impedance (series components) as a function of frequency.

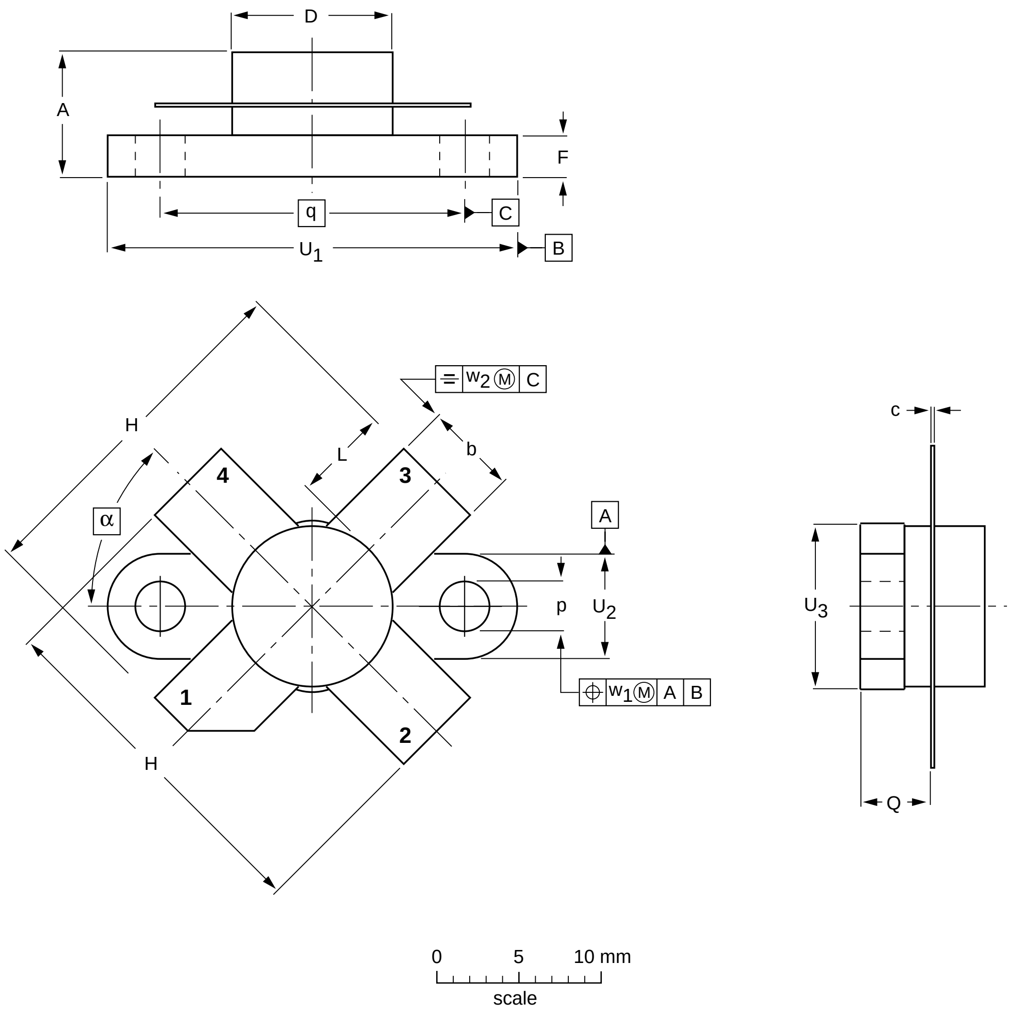
Fig. 20 and 21 are typical curves and hold for an unneutralized amplifier in s.s.b. class-AB operation.

Conditions:

V_{CE} = 12, 5 V	V_{CE} = 13, 5 V
P_L = 30 W (P.E.P.)	P_L = 35 W (P.E.P.)
T_h = 25 °C	T_h = 25 °C
$R_{th\ mb\text{-}h}$ ≤ 0,3 K/W	$R_{th\ mb\text{-}h}$ ≤ 0,3 K/W
$I_{C(ZS)}$ = 25 mA	$I_{C(ZS)}$ = 25 mA
Z_L = 1,8 Ω	Z_L = 1,8 Ω

PACKAGE OUTLINE

Flanged ceramic package; 2 mounting holes; 4 leads **SOT123A**



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

UNIT	A	b	c	D	D_1	F	H	L	p	Q	q	U_1	U_2	U_3	w_1	w_2	α
mm	7.47 6.37	5.82 5.56	0.18 0.10	9.73 9.47	9.63 9.42	2.72 2.31	20.71 19.93	5.61 5.16	3.33 3.04	4.63 4.11	18.42	25.15 24.38	6.61 6.09	9.78 9.39	0.51	1.02	45°
inches	0.294 0.251	0.229 0.219	0.007 0.004	0.383 0.373	0.397 0.371	0.107 0.091	0.815 0.785	0.221 0.203	0.131 0.120	0.182 0.162	0.725	0.99 0.96	0.26 0.24	0.385 0.370	0.02	0.04	

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT123A						97-06-28

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

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