DATA SHEET

BLW96
HF/VHF power transistor

Product specification

August 1986

Philips
Semiconductors

HF/VHF power transistor BLW96

DESCRIPTION

N-P-N silicon planar epitaxial transistor intended for use in class-A, AB and B operated high power industrial and military transmitting equipment in the h.f. and v.h.f. band. The transistor presents excellent performance as a linear amplifier in s.s.b. applications. It is resistance stabilized and is guaranteed to withstand severe load mismatch conditions. Transistors are supplied in matched h_{FE} groups.

The transistor has a ½" 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 %	d_3 dB	d_5 dB	$I_{C(ZS)}$ (I_C) A
s.s.b. (class-AB)	**50**	**1,6 – 28**	**25 – 200 (P.E.P.)**	> 13,5	> **40**(1)	< **–30**	< **–30**	**0,1**
c.w. (class-B)	50	108	200	typ. 6,5	typ. 67	–	–	(6)
s.s.b. (class-A)	40	28	50 (P.E.P.)	typ. 19	–	typ. –40	< –40	(4)

Note

1. η_{dt} at 200 W P.E.P.

PIN CONFIGURATION

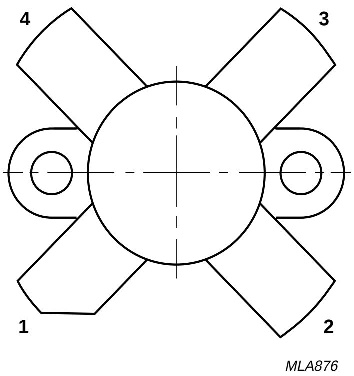


Fig.1 Simplified outline. SOT121B.

PINNING - SOT121B.

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.	110	V
Collector-emitter voltage (open base)	V_{CEO}	max.	55	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4	V
Collector current (average)	$I_{C(AV)}$	max.	12	A
Collector current (peak value); f > 1 MHz	I_{CM}	max.	40	A
R.F. power dissipation (f > 1 MHz); T_{mb} = 45 °C	P_{rf}	max.	340	W
Storage temperature	T_{stg}	–65 to + 150		°C
Operating junction temperature	T_j	max.	200	°C

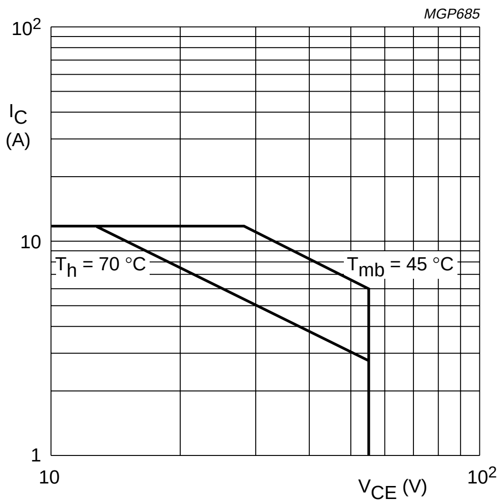
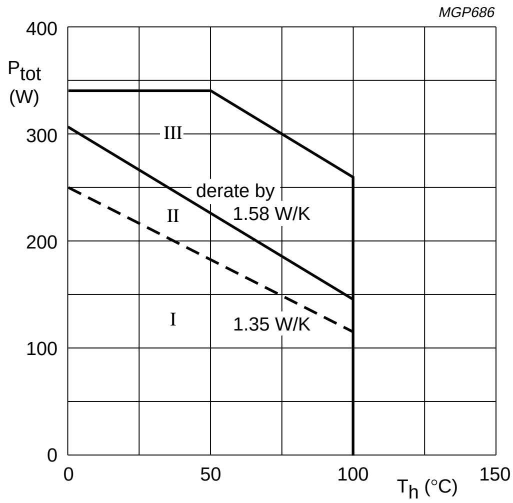


Fig.2 D.C. SOAR.



I Continuous d.c. operation
II Continuous r.f. operation; f > 1 MHz
III Short-time operation during mismatch; f > 1 MHz

Fig.3 Power/temperature derating curves.

THERMAL RESISTANCE

(dissipation = 150 W; T_{mb} = 100 °C, i.e. T_h = 70 °C)

From junction to mounting base (d.c. dissipation)	$R_{th\ j\text{-}mb(dc)}$	=	0,63	K/W
From junction to mounting base (r.f. dissipation)	$R_{th\ j\text{-}mb(rf)}$	=	0,45	K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,2	K/W

CHARACTERISTICS

T_j = 25 °C

Collector-emitter breakdown voltage				
V_{BE} = 0; I_C = 50 mA	$V_{(BR)CES}$	>	110	V
Collector-emitter breakdown voltage				
open base; I_C = 200 mA	$V_{(BR)CEO}$	>	55	V
Emitter-base breakdown voltage				
open collector; I_E = 20 mA	$V_{(BR)EBO}$	>	4	V
Collector cut-off current				
V_{BE} = 0; V_{CE} = 55 V	I_{CES}	<	10	mA
Second breakdown energy; L = 25 mH; f = 50 Hz				
open base	E_{SBO}	>	20	mJ
R_{BE} = 10 Ω	E_{SBR}	>	20	mJ
D.C. current gain[1]				
I_C = 7 A; V_{CE} = 5 V	h_{FE}	typ. 15 to	30 50	
D.C. current gain ratio of matched devices[1]				
I_C = 7 A; V_{CE} = 5 V	h_{FE1}/h_{FE2}	≤	1,2	
Collector-emitter saturation voltage[1]				
I_C = 20 A; I_B = 4 A	V_{CEsat}	typ.	1,9	V
Transition frequency at f = 100 MHz[2]				
$-I_E$ = 7 A; V_{CB} = 45 V	f_T	typ.	235	MHz
$-I_E$ = 20 A; V_{CB} = 45 V	f_T	typ.	245	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e$ = 0; V_{CB} = 50 V				
Feedback capacitance at f = 1 MHz	C_c	typ.	280	pF
I_C = 150 mA; V_{CE} = 50 V	C_{re}	typ.	170	pF
Collecting-flange capacitance	C_{cf}	typ.	4,4	pF

Notes

1. Measured under pulse conditions: $t_p \leq 300$ µs; $\delta \leq 0{,}02$.
2. Measured under pulse conditions: $t_p \leq 50$ µs; $\delta \leq 0{,}01$.

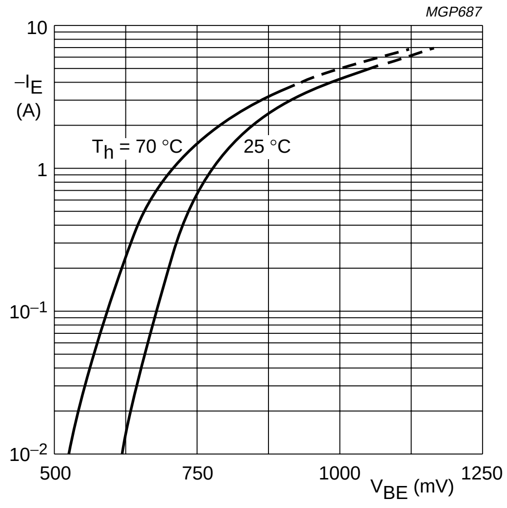


Fig.4 Typical values; V_{CE} = 40 V.

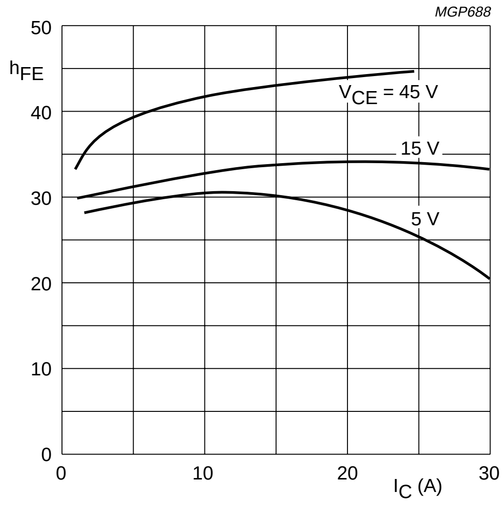


Fig.5 Typical values; T_j = 25 °C.

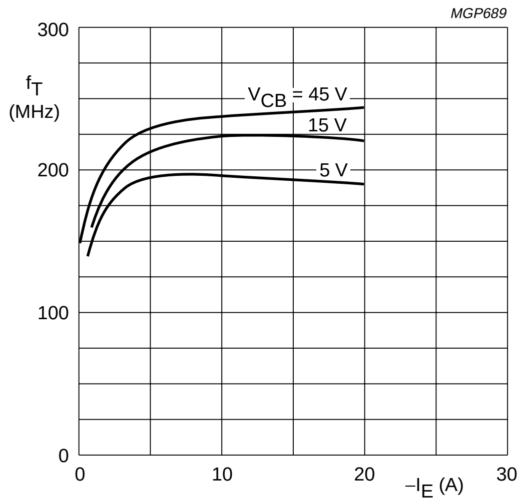


Fig.6 Typical values; f = 100 MHz; T_j = 25 °C.

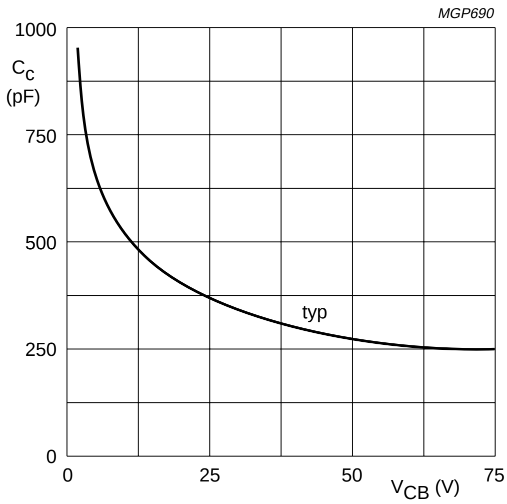


Fig.7 $I_E = I_e = 0$; f = 1 MHz; T_j = 25 °C.

APPLICATION INFORMATION

R.F. performance in s.s.b. class-AB operation (linear power amplifier)

V_{CE} = 50 V; T_h = 25 °C; f_1 = 28,000 MHz; f_2 = 28,001 MHz

OUTPUT POWER W	G_p dB	η_{dt} (%) at 200 W (P.E.P.)	I_C (A) at 200 W (P.E.P.)	d_3 (1) dB	d_5 (1) dB	$I_{C(ZS)}$ A
25 to 200 (P.E.P.)	**> 13,5**	**> 40**	**< 5,0**	< –30	< **–30**	**0,1**

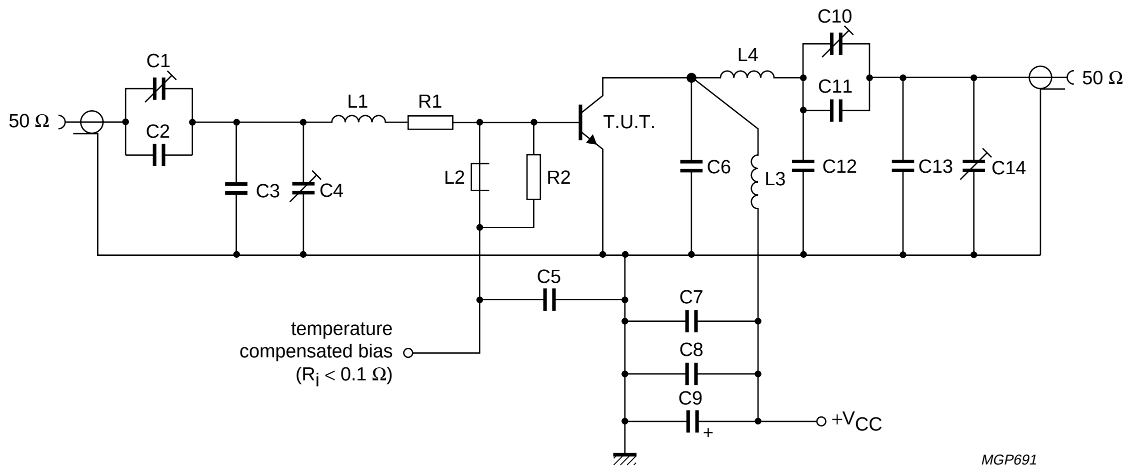


Fig.8 Test circuit; s.s.b. class-AB.

List of components:

C1 = C4 = C10 = C14 = 100 pF film dielectric trimmer

C2 = 27 pF ceramic capacitor (500 V)

C3 = 270 pF polysterene capacitor (630 V)

C5 = C7 = C8 = 220 nF multilayer ceramic chip capacitor

C6 = 27 pF multilayer ceramic chip capacitor (500 V; ATC[2])

C9 = 47 µF/63 V electrolytic capacitor

C11 = 2 × 36 pF multilayer ceramic chip capacitors (500 V; ATC[2]) in parallel

C12 = 2 × 43 pF multilayer ceramic chip capacitors (500 V; ATC[2]) in parallel

C13 = 43 pF multilayer ceramic chip capacitor (500 V; ATC[2])

L1 = 88 nH; 3 turns Cu wire (1,0 mm); int. dia. 9,0 mm; length 6,1 mm; leads 2 × 5 mm

L2 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)

L3 = 150 nH; 5 turns Cu wire (2,0 mm); int. dia. 10,0 mm; length 18,7 mm; leads 2 × 5 mm

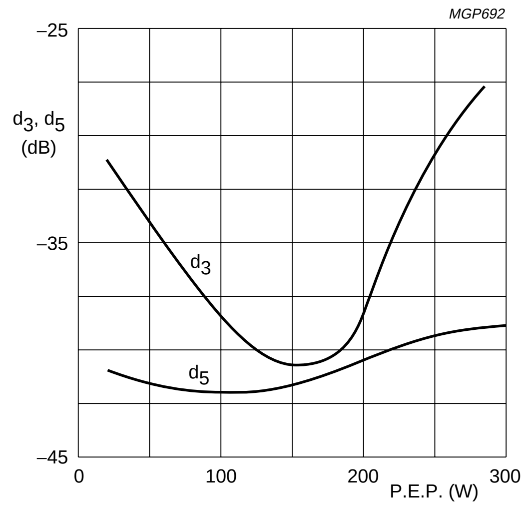
L4 = 197 nH; 5 turns Cu wire (2,0 mm); int. dia. 12,0 mm; length 18,6 mm; leads 2 × 5 mm

R1 = 0,66 Ω; parallel connection of 5 × 3,3 Ω metal film resistors (PR37; ± 5%; 1,6 W each)

R2 = 27 Ω carbon resistor (± 5%; 0,5 W)

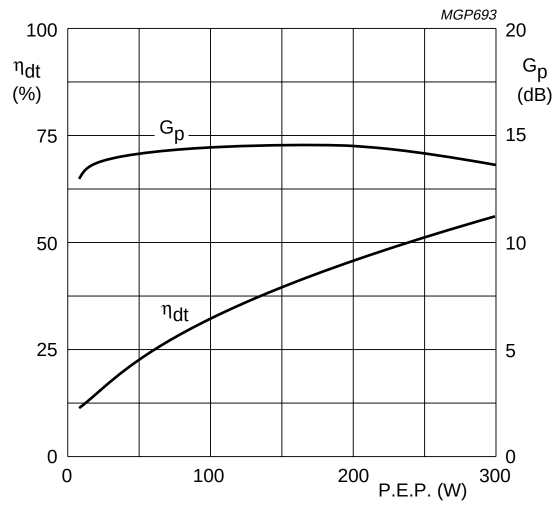
Notes

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.
2. ATC means American Technical Ceramics.



V_{CE} = 50 V; $I_{C(ZS)}$ = 0,1 A; f_1 = 28,000 MHz;
f_2 = 28,001 MHz; T_h = 25 °C; typical values.

Fig.9 Intermodulation distortion as a function of output power.(1)



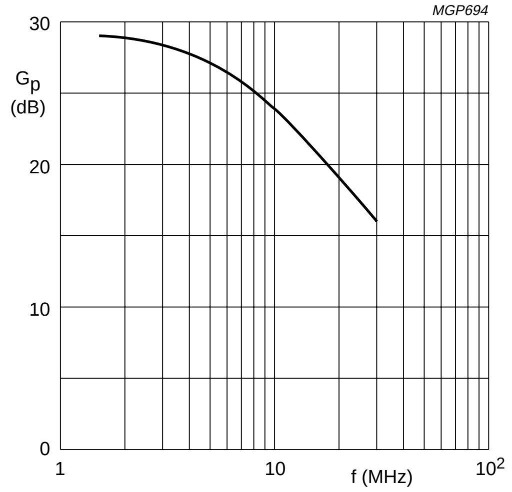
V_{CE} = 50 V; $I_{C(ZS)}$ = 0,1 A; f_1 = 28,000 MHz;
f_2 = 28,001 MHz; T_h = 25 °C; typical values.

Fig.10 Double-tone efficiency and power gain as a function of output power.

Ruggedness

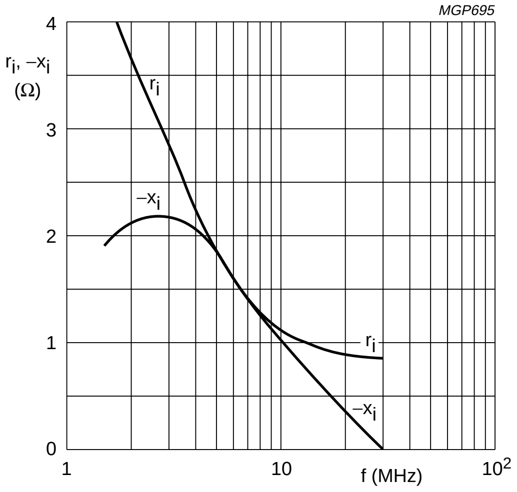
The BLW96 is capable of withstanding full load mismatch (VSWR = 50 through all phases) up to 150 W (P.E.P.) or a load mismatch (VSWR = 5 through all phases) up to 200 W (P.E.P.) under the following conditions:

V_{CE} = 45 V; f = 28 MHz; T_h = 70 °C; $R_{th\ mb-h}$ = 0,2 K/W.



V_{CE} = 50 V; $I_{C(ZS)}$ = 0,1 A; P_L = 200 W (P.E.P.);
T_h = 25 °C; Z_L = 5 Ω; neutralizing capacitor: 47 pF

Fig.11 Power gain as a function of frequency.



V_{CE} = 50 V; $I_{C(ZS)}$ = 0,1 A; P_L = 200 W (P.E.P.);
T_h = 25 °C; Z_L = 5 Ω; neutralizing capacitor: 47 pF

Fig.12 Input impedance (series components) as a function of frequency.

Figs 11 and 12 are typical curves and hold for one transistor of a push-pull amplifier with cross-neutralization in s.s.b. class-AB operation.

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 (%)
108	50	200	typ. 45	typ. 6,5	typ. 6	typ. 67

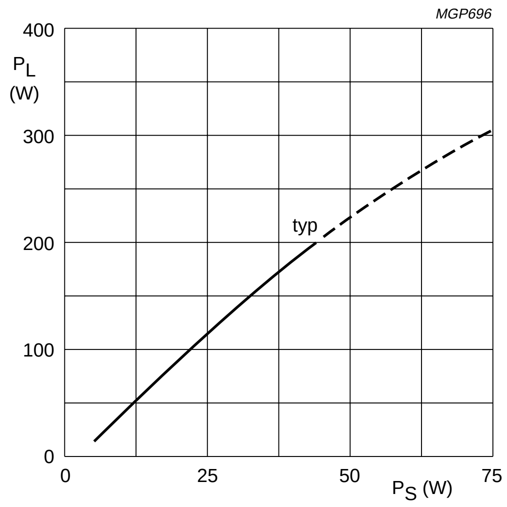


Fig.13 V_{CE} = 50 V; f = 108 MHz; T_h = 25 °C.

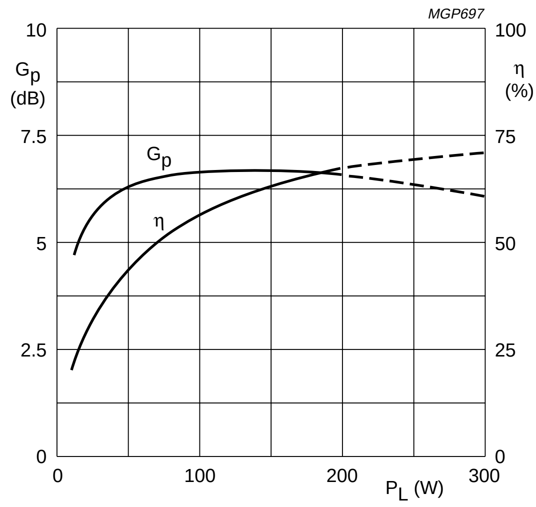
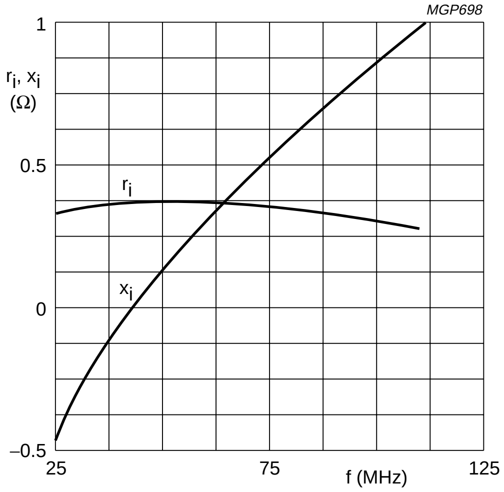
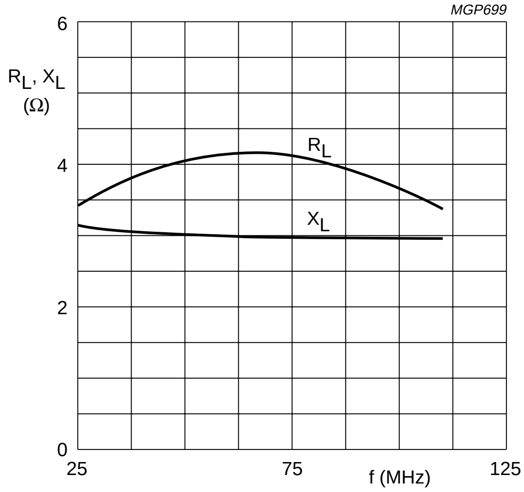


Fig.14 V_{CE} = 50 V; f = 108 MHz; T_h = 25 °C; typical values.



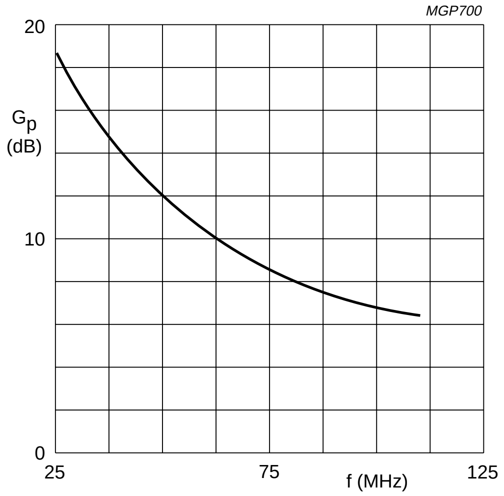
Typical values; V_{CE} = 50 V; P_L = 200 W; T_h = 25 °C; class-B operation

Fig.15 Input impedance (series components).



Typical values; V_{CE} = 50 V; P_L = 200 W; T_h = 25 °C; class-B operation

Fig.16 Load impedance (series components).



Typical values; V_{CE} = 50 V; P_L = 200 W; T_h = 25 °C; class-B operation

Fig.17

R.F. performance in s.s.b. class-A operation (linear power amplifier)

V_{CE} = 40 V; T_h = 25 °C; f_1 = 28,000 MHz; f_2 = 28,001 MHz

OUTPUT POWER W	G_p dB	I_C A	d_3 (1) dB	d_5 (1) dB
typ. 50 (P.E.P.)	typ. 19	4	typ. –40	< –40

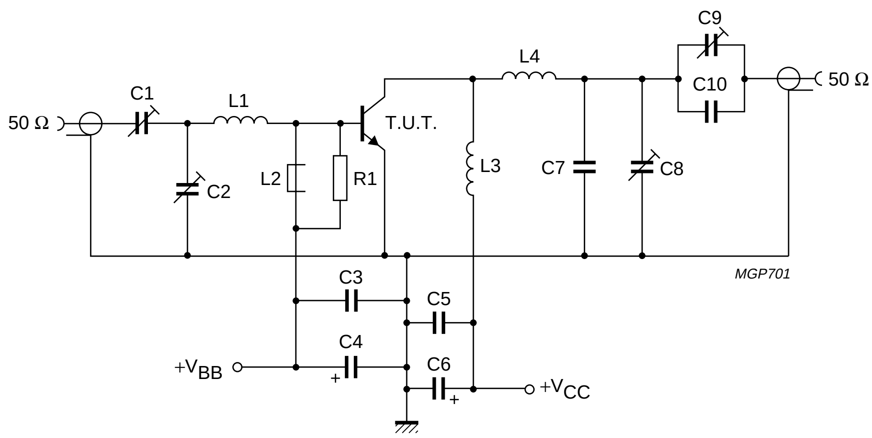


Fig.18 Test circuit; s.s.b. class-A.

List of components:

C1 = C2 = 10 to 780 pF film dielectric trimmer

C3 = 220 nF polyester capacitor (100 V)

C4 = 100 µF/4 V electrolytic capacitor

C5 = 2 × 330 nF polyester capacitors (100 V) in parallel

C6 = 47 µF/63 V electrolytic capacitor

C7 = C10 = 2 × 82 pF ceramic capacitors (500 V) in parallel

C8 = C9 = 10 to 150 pF air dielectric trimmer

L1 = 45 nH; 2 turns enamelled Cu wire (1,6 mm); int. dia. 8,0 mm; length 4,0 mm; leads 2 × 3 mm

L2 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)

L3 = 110 nH; 4 turns enamelled Cu wire (2,0 mm); int. dia. 10,0 mm; length 8,0 mm; leads 2 × 2 mm

L4 = 210 nH; 5 turns enamelled Cu wire (2,0 mm); int. dia. 12,0 mm; length 10,0 mm; leads 2 × 2 mm

R1 = 27 Ω carbon resistor (± 5%; 0,5 W)

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.

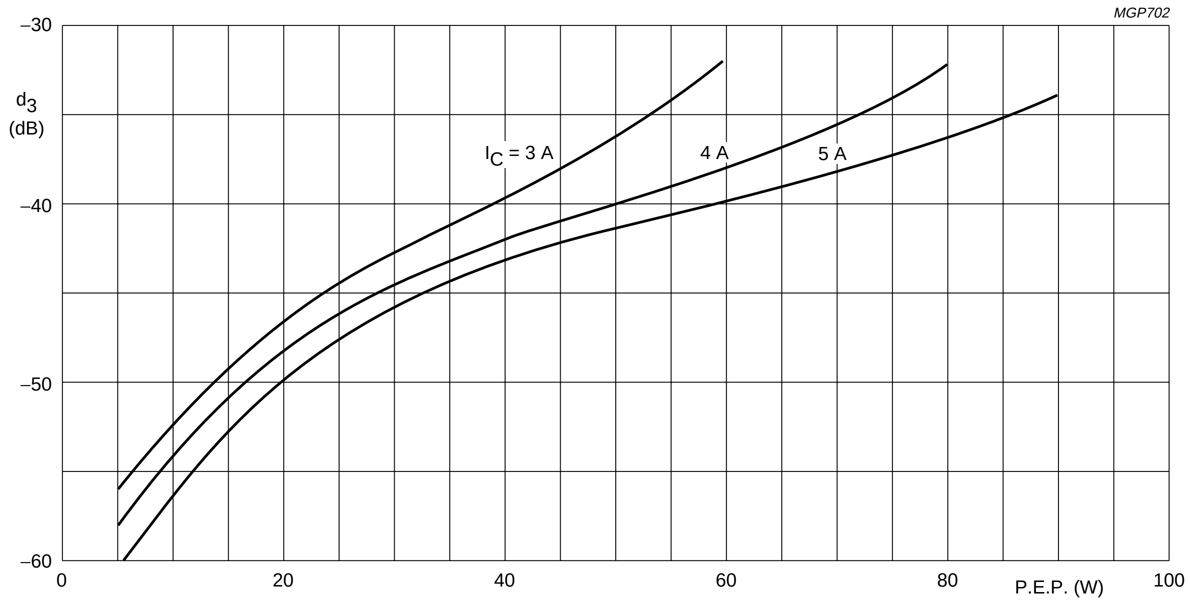
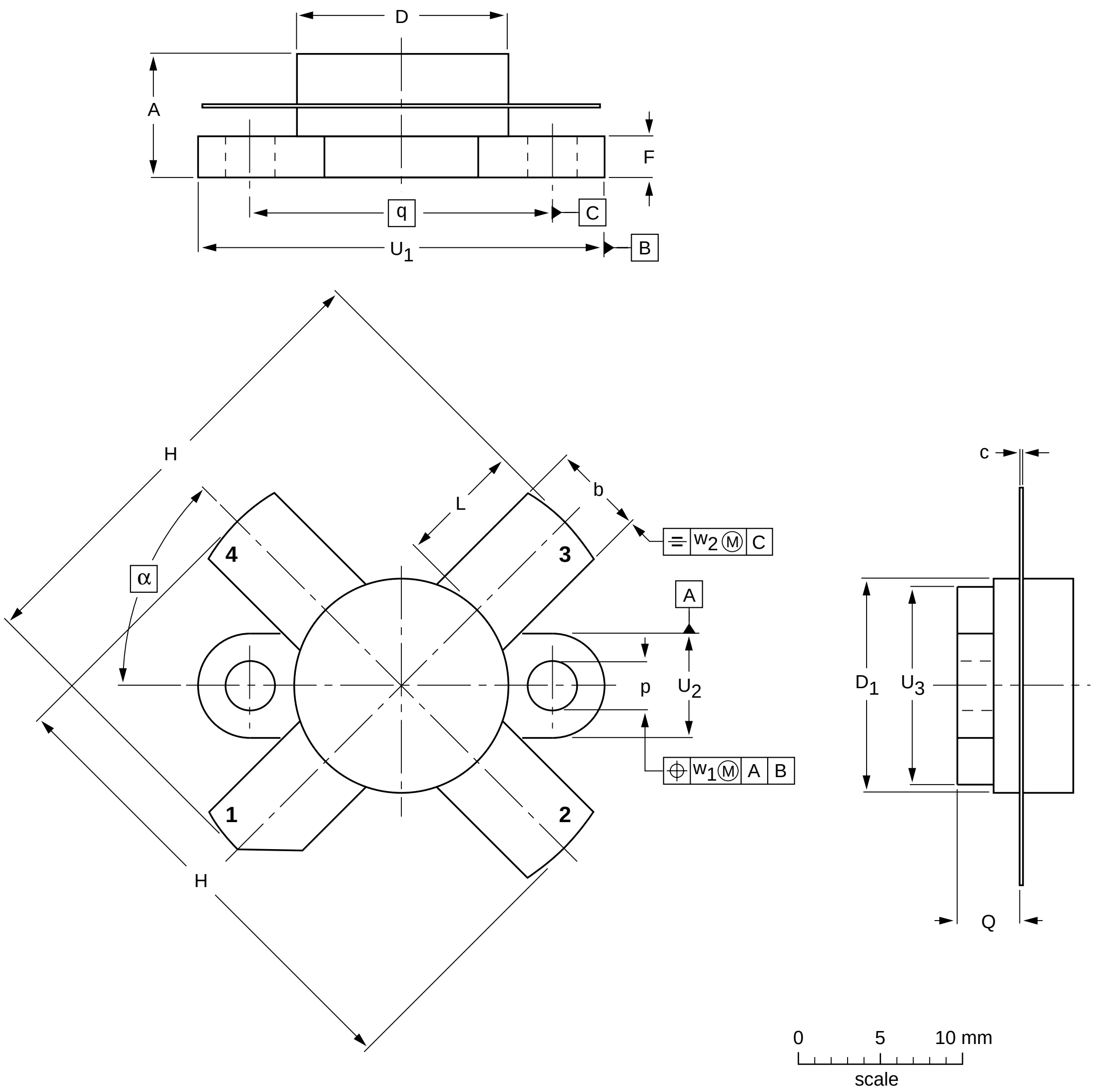


Fig.19 Third order intermodulation distortion as a function of output power.(1) Typical values; V_{CE} = 40 V; T_h = 25 °C; f_1 = 28,000 MHz; f_2 = 28,001 MHz.

PACKAGE OUTLINE

Flanged ceramic package; 2 mounting holes; 4 leads **SOT121B**



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	7.27 6.17	5.82 5.56	0.16 0.10	12.86 12.59	12.83 12.57	2.67 2.41	28.45 25.52	7.93 6.32	3.30 3.05	4.45 3.91	18.42	24.90 24.63	6.48 6.22	12.32 12.06	0.51	1.02	45°
inches	0.286 0.243	0.229 0.219	0.006 0.004	0.506 0.496	0.505 0.495	0.105 0.095	1.120 1.005	0.312 0.249	0.130 0.120	0.175 0.154	0.725	0.98 0.97	0.255 0.245	0.485 0.475	0.02	0.04	

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT121B						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

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.