

Amplificatore a larga banda per ripetitori TV, bande IV/V, impiegante due BLW 98 in parallelo

Viene descritto un amplificatore a larga banda (470 ÷ 860 MHz) destinato a sostituire i convenzionali amplificatori accordati su singoli canali U.H.F. Il transistor impiegato è il BLW 98; l'amplificatore lavora in classe A. Per ottenere la potenza di uscita di 3,8 W, vengono impiegati due amplificatori (2 × BLW 98) identici accoppiati in ingresso e uscita mediante convenzionali accoppiatori ibridi coassiali. Questo progetto è destinato a semplificare l'installazione e il servizio degli amplificatori impiegati nei ripetitori operanti nelle bande IV e V U.H.F.

1 - Introduzione

Fino a poco tempo fa gli amplificatori per i ripetitori TV venivano realizzati in forma di *amplificatori accordati* su un determinato canale; ciò per poter avere un guadagno di potenza molto elevato. Attualmente ci si sta invece orientando su *amplificatori a larga banda*, e ciò in quanto, essendo questi amplificatori in genere, installati in luoghi poco accessibili, in caso di un eventuale guasto, l'esecuzione a larga banda permetterebbe una loro più rapida sostituzione.

Il **BLW 98** consente appunto di realizzare amplificatori UHF a larga banda ultralinearari. L'amplificatore descritto copre le bande UHF TV IV e V complete. In questo amplificatore, il BLW 98 lavora in classe A.

Questo transistor deve considerarsi il successore del BLX 98 dal quale si differenzia per avere un guadagno in potenza più elevato (6,9 dB) e una potenza di uscita di circa 3,8 W (picco-sincronismo) ad un livello di intermodulazione di -60 dB (misurato con il sistema delle tre frequenze).

Le condizioni di lavoro in classe A del BLW 98 sono le seguenti:

$$V_{CE} = 25 \text{ V}$$
$$I_C = 850 \text{ mA}$$

Nelle figure 1, 2 e 3 è riportato, in funzione della potenza, l'andamento:

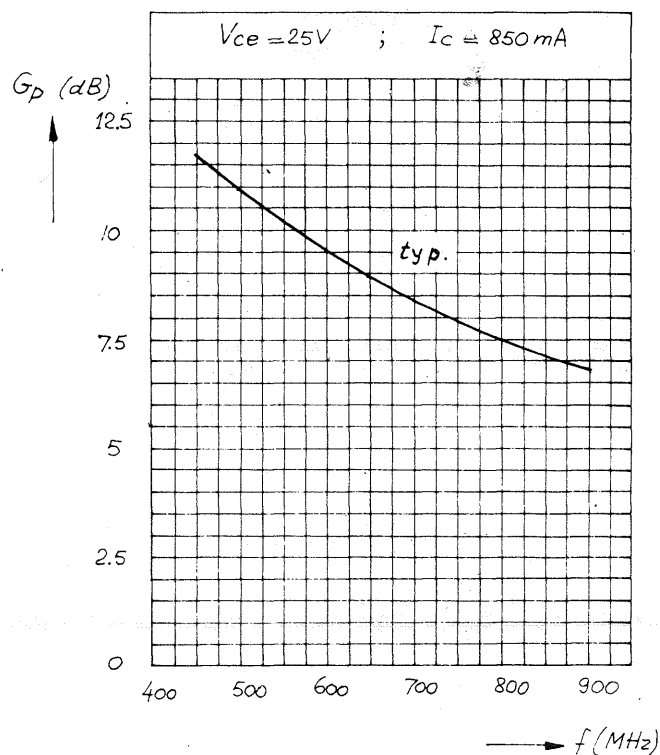


Fig. 1 - Guadagno di potenza in funzione della frequenza.

typical values
 $V_{ce} = 25V$; $I_c = 850 mA$

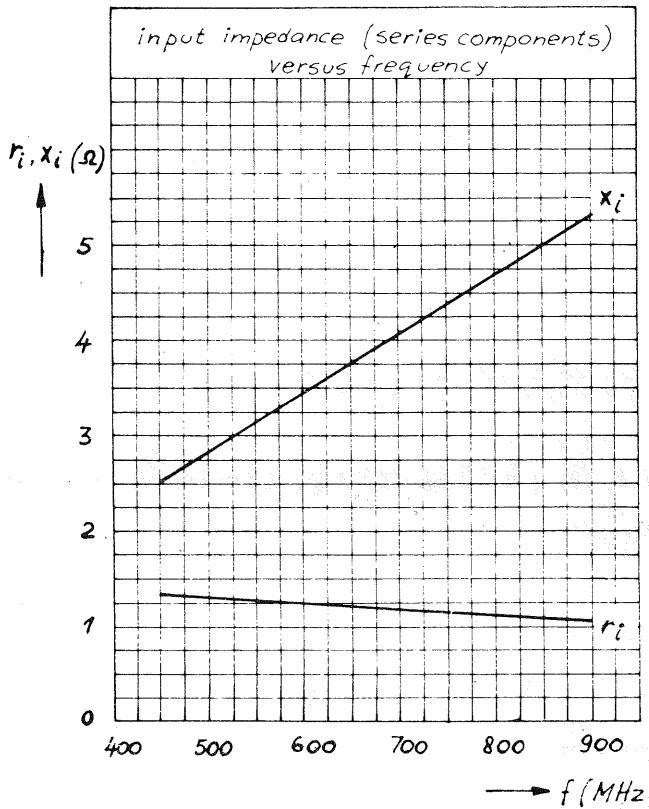


Fig. 2 - Impedenza d'ingresso (componenti in serie) in funzione della frequenza. ($V_{ce} = 25V$, $I_c = 850 mA$).

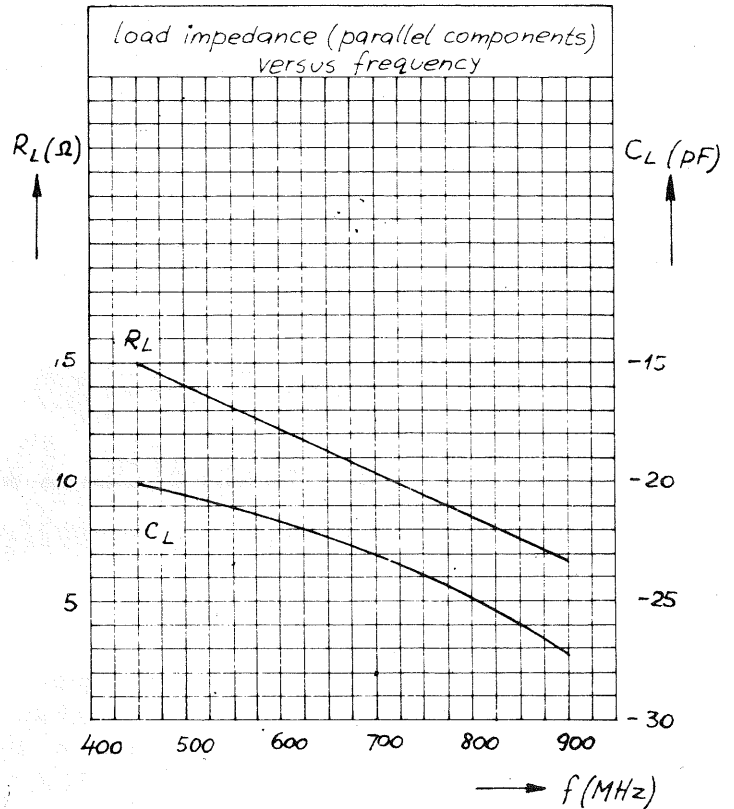


Fig. 3 - Impedenza di carico (componenti in parallelo) in funzione della frequenza. ($V_{ce} = 25V$, $I_c = 850 mA$).

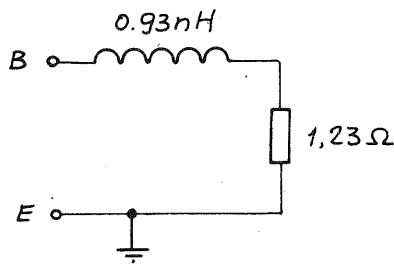


Fig. 4 - Circuito equivalente dell'impedenza d'ingresso del transistor.

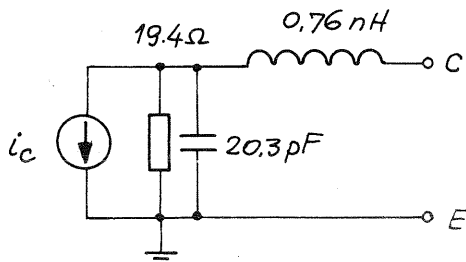


Fig. 5 - Circuito equivalente dell'impedenza di uscita del transistor.

- 1) del guadagno in potenza
- 2) dell'impedenza d'ingresso (componenti in serie)
- 3) dell'impedenza di carico (componenti in parallelo).

2 - Le reti di uscita e di ingresso

La rete di uscita, di cui in fig. 5 è riportato un circuito equivalente, deve essere realizzata con il rame della piastra del circuito stampato; (fibra di vetro PTFE; valore del dielettrico (ϵ_e) = 2,74; spessore = 1/16").

Per evitare di dover tagliare i terminali di base e di collettore del transistor, le reti rispettivamente di ingresso e di uscita « iniziano » con una strip-line (striscetta ricavata dal rame del circuito stampato) larga 6 mm lunga 10 mm.

La resistenza caratteristica di queste strip-line è dell'ordine dei 40 Ω.

Per ottenere il migliore adattamento, la capacità di uscita del transistor unitamente all'induttanza costituita dalla bobina di arresto RF (choke) di collettore viene fatta risonare sulla frequenza centrale della banda passante (470 ÷ 860 MHz).

La bobina di arresto è stata realizzata sotto forma di « strip-line », larga 2 mm; per motivi pratici è stata collegata alla linea di trasmissione principale alla distanza di 3 mm dallo spigolo del transistor.

Per ciò che riguarda la rete d'ingresso, di cui in fig. 4 è riportato un circuito equivalente si deve tener presente che nella banda di frequenze compresa tra

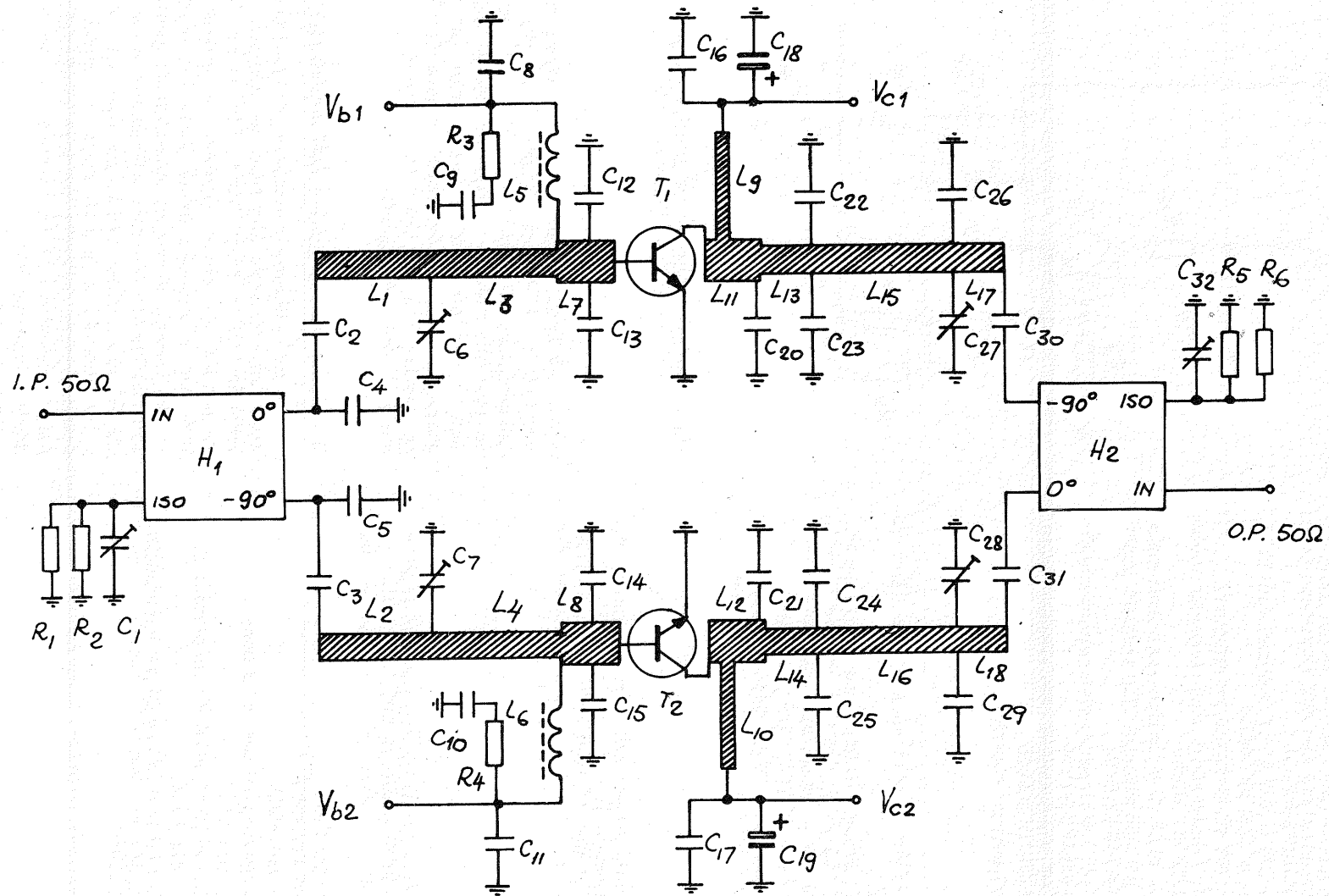


Fig. 6 - Schema elettrico completo dell'amplificatore lineare di potenza a larga banda equipaggiato con due transistori BLW 98. Banda amplificata 470 ÷ 860 MHz.

COMPONENTI

Condensatori

C1 = C32 = 1...3,5 pF, trimmer con dielettrico a film (n. codice 2222 809 05001).

C2 = C3 = C8 = C11 = C16 = C17 = C30 = C31 = 100 pF, condensatori chip ceramici multistrato (n. codice n. 2222 852 13101).

C4 = C5 = C12 = C15 = C20 = C21 = 1,8 pF, condensatori chip ceramici multistrato, tipo ATC (American Technical Ceramics) 100A-1R8-B-Px-50.

C6 = C7 = C27 = C28 = 1,4...5,5 pF, trimmer con dielettrico a film (codice n. 2222 809 09001).

C9 = C10 = C35 = 100 nF, condensatori poliestere

C13 = C14 = 10 pF, condensatori chip ceramici multistrato (codice n. 2222 851 13109).

C18 = C19 = C33 = 10 μ F, 63 V, condensatori elettrolitici.

C22 = C25 = 5,6 pF, condensatori chip ceramici multistrato, tipo ATC 100A-5R6-B-Px-50.

C23 = C24 = 6,8 pF, condensatori chip ceramici multistrato, tipo ATC 100A-6R8-B-Px-50.

C26 = C29 = 1,5 pF, condensatori chip ceramici multistrato, tipo ATC 100A-1R5-B-Px-50.

C34 = 470 nF, condensatore poliestere.

Induttori

L1, L3 = L2, L4 = striscetta di rame strip-line ($Z_c = 50 \Omega$), $34,0 \times 4,3 \text{ mm}^2$.*

L5 = L6 = 5,6 μ H; 29 spire di filo di rame smaltato avvolte strettamente (0,2 mm); diametro interno 3,0 mm.

L7 = L8 = strip-line ($Z_c = 40 \Omega$), $10,0 \times 6,0 \text{ mm}^2$.*

L9 = L10 = strip-line ($Z_c = 77 \Omega$), $12,5 \times 2,0 \text{ mm}^2$.*

L11 = L12 = strip-line ($Z_c = 40 \Omega$), $10,0 \times 6,0 \text{ mm}^2$.*

L13, L15, L17 = L14, L16, L18 = strip-line ($Z_c = 50 \Omega$) $46,3 \times 4,3 \text{ mm}^2$.*

* Queste strip-line sono ricavate dallo strato superiore del rame del circuito stampato; lo strato di rame opposto serve da massa; materiale in fibra di vetro PTFE, costante dielettrica ($\epsilon_r = 2,74$); spessore $1/16''$. La posizione esatta dei chip e dei condensatori variabili è indicata in fig. 10.

Resistori

R1 = R2 = R5 = R6 = 100 Ω ($\pm 5\%$) resistori di potenza, metal film, tipo PR37 (codice n. 2322 191 31001).

R3 = R4 = R14 = 10 Ω ($\pm 5\%$), resistori a carbone tipo CR25.

R7 = 1 k Ω ($\pm 5\%$) tipo CR25.

R8 = 1,8 k Ω ($\pm 5\%$) tipo CR25.

R9 = 150 Ω ($\pm 5\%$) tipo CR25.

R10 = 220 Ω , potenziometro-trimmer a carbone.

R11 = 33 Ω ($\pm 5\%$), tipo CR25.

R12 = 220 Ω ($\pm 5\%$) resistore metal film di potenza tipo PR52 (codice n. 2322 192 32201).

R13 = 5,6 Ω ($\pm 5\%$) e 6,8 Ω ($\pm 5\%$) collegati in parallelo; resistori smaltati a filo tipo WR 0617E (codice n. 2322 330 22568 e 2322 330 22688).

Semiconduttori

D = BY 206.

T1 = T2 = BLW 98.

T3 = BD 136.

H1 = H2 = accoppiatore ultraminiatura 3 dB — 90° modello n. 10264-3, larghezza di banda 0,5 — 1,0 GHz. Prodotto dalla Anaren Microwave Inc.

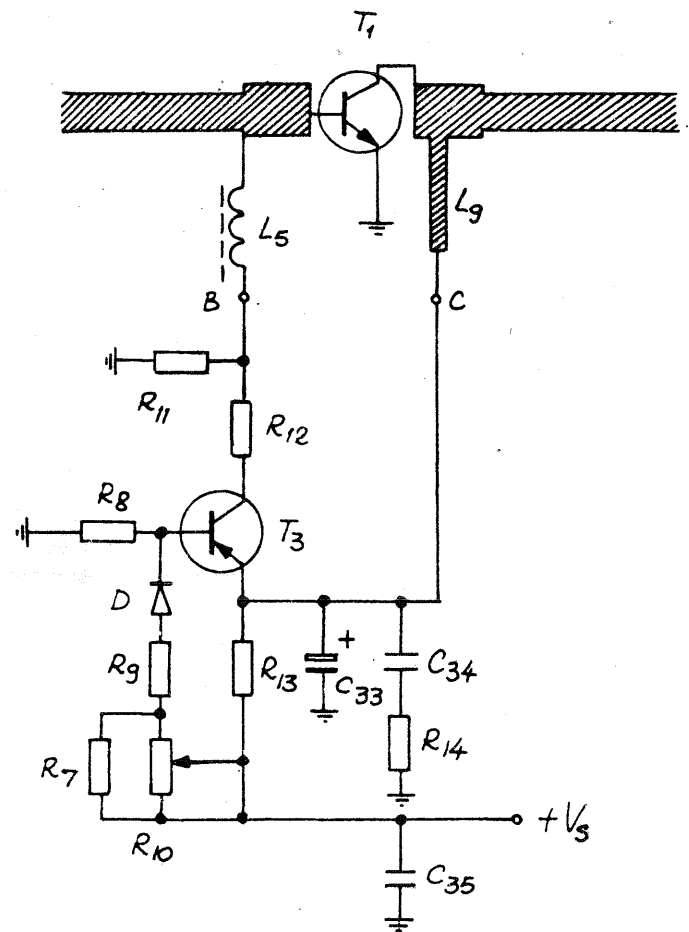


Fig. 7 - Schema elettrico del circuito per la polarizzazione di una sezione dell'amplificatore a larga banda.

470 e 860 MHz, il guadagno in potenza del BLW 98 decresce nella misura di circa 5 dB per ottava. Dimensionando opportunamente la rete d'ingresso è però possibile ridurre considerevolmente questa variazione e mantenere nello stesso tempo un ragionevole guadagno intorno a 860 MHz. Questo sistema di compensazione si trova descritto ampiamente nel riferimento 2 della bibliografia.

3 - Realizzazione pratica dell'amplificatore

Fin qui abbiamo presentato sommariamente i dati essenziali che sono alla base del progetto di un solo amplificatore a larga banda impiegante il BLW 98. In pratica, ciò che è richiesto da questo amplificatore non è solo una banda larga ma anche una discreta potenza di uscita; quest'ultima potrà però essere facilmente ottenuta collegando in parallelo due amplificatori come quello già descritto; ovviamente, i due ingressi e le due uscite di queste unità dovranno essere collegate tra loro mediante convenzionali accoppiatori ibridi coassiali, a larga banda (3 dB/90°, ingresso 50 Ω).

Questa configurazione consentirà di avere una potenza di uscita doppia e, nello stesso tempo, un VSWR aggirantesi intorno a 1,2. La potenza riflessa viene infatti assorbita dal resistore di adattamento dell'ibrido (50 Ω), formato in pratica da due resistori

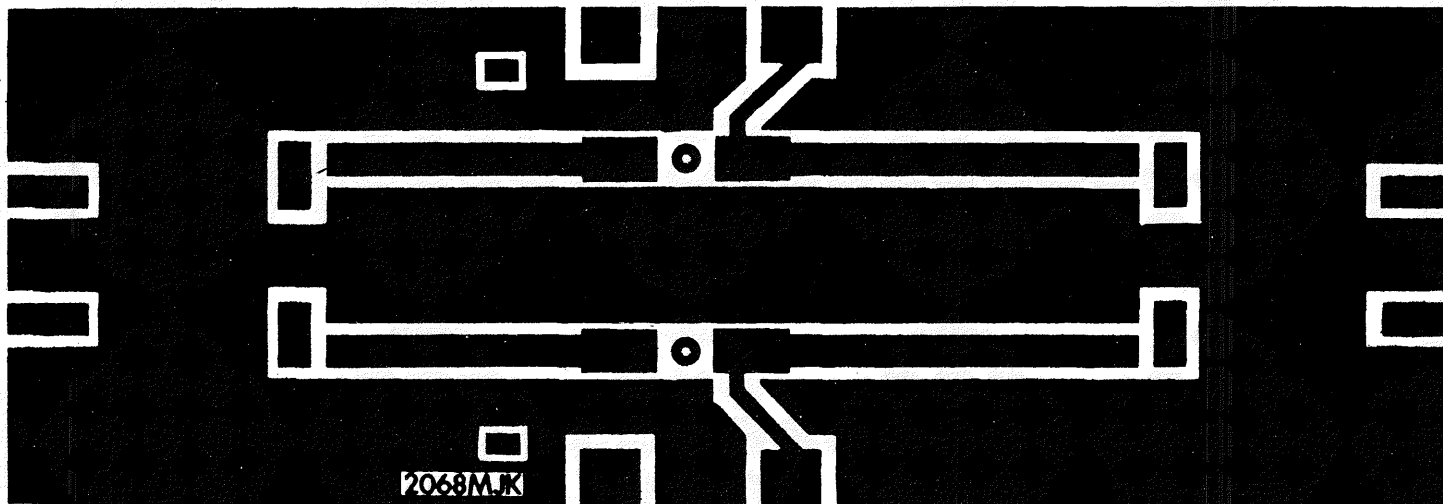


Fig. 8 - Configurazione del rame del circuito stampato dell'amplificatore visto dalla parte dove verranno montati i componenti (scala 1:1).

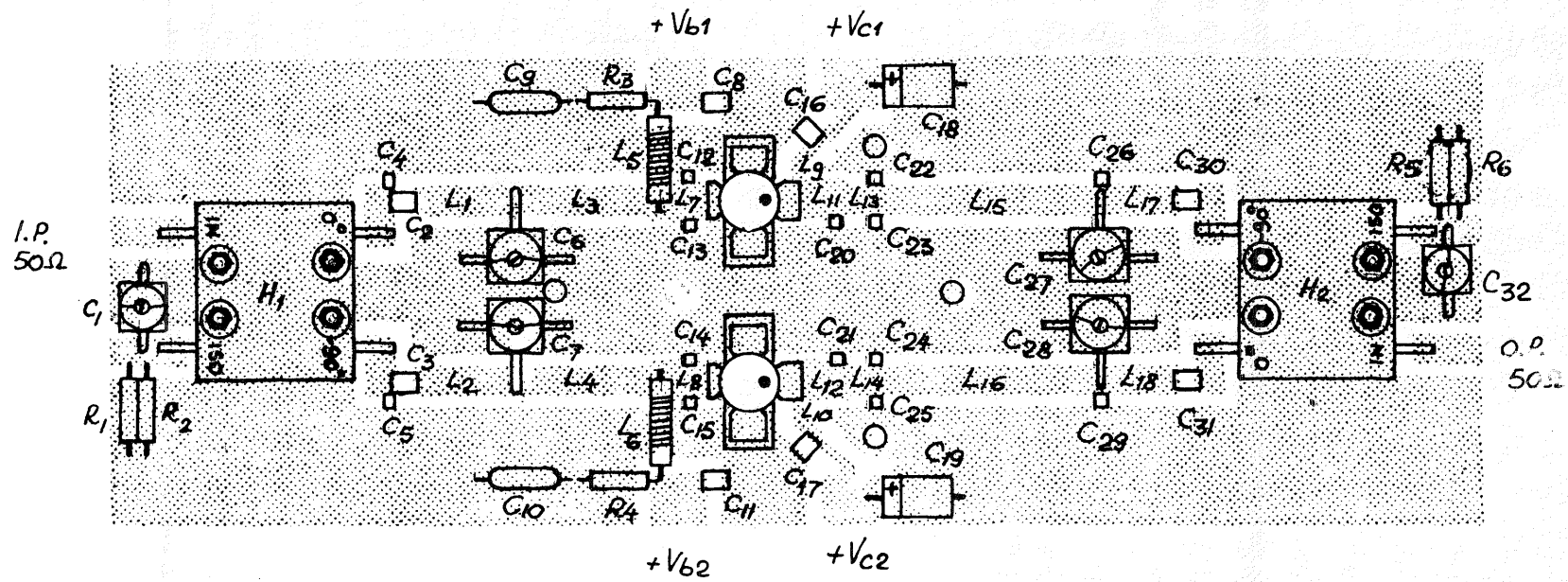


Fig. 9 - Circuito stampato dell'amplificatore UHF a larga banda con i componenti montati.

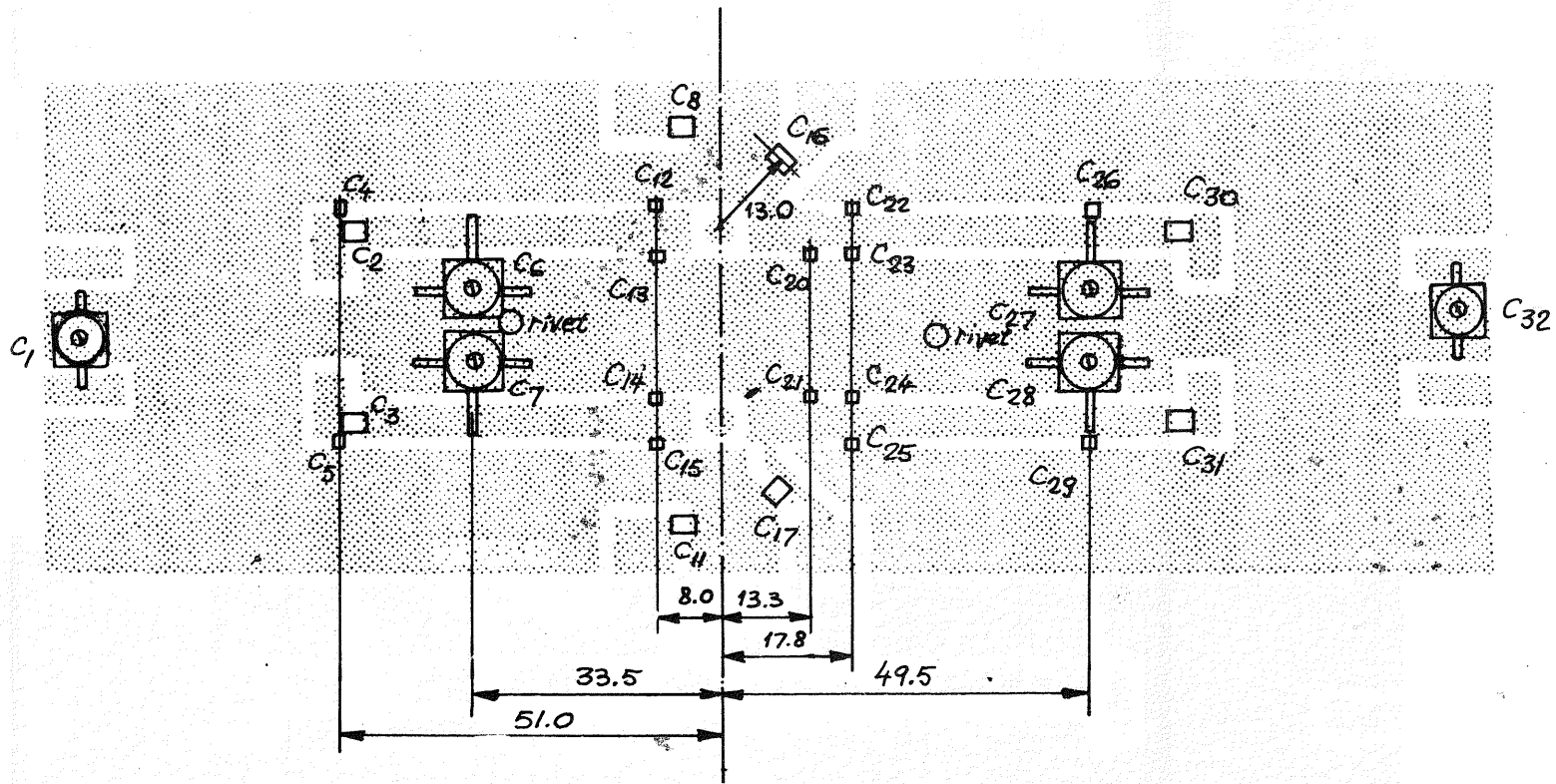


Fig. 10 - Circuito stampato dell'amplificatore visto dalla parte dove sono montati i componenti. Serve per mettere in evidenza la posizione dei condensatori «chip» ceramici e dei condensatori variabili con dielettrico a film.

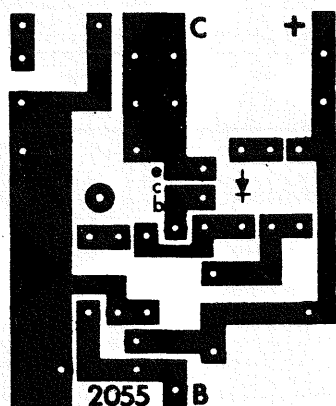


Fig. 11 - Circuito stampato dei circuiti di polarizzazione di base e di collettore visto dalla parte del rame

(metal film) di potenza, da 100Ω , collegati in parallelo. La stessa cosa dovrà essere fatta all'uscita delle due unità.

In fig. 6 è riportato lo schema elettrico dell'amplificatore di potenza a larga banda completo. Il circuito di polarizzazione rispettivamente di base e di collettore di ciascuna unità amplificatrice è riportato in figura 7; il positivo del circuito stampato che consentirà la realizzazione pratica dell'amplificatore completo è riportato in fig. 8; la fig. 9 indica invece lo stesso circuito con i componenti montati. La fig. 10 dà invece un'idea dell'esatta posizione dei condensatori « chip » multistrato, e dei condensatori di accordo (trimmer) con dielettrico a film.

Le figure 11 e 12 indicano rispettivamente lo stampato del circuito di polarizzazione visto dalla parte del rame (fig. 11) e visto dalla parte dei componenti (figura 12). Evidentemente, per l'unità completa, occorreranno due di questi circuiti di polarizzazione, uno per ciascun transistor BLW 98.

Anche il circuito stampato dove viene montato il circuito di polarizzazione è in resina epossidica con spessore di $1/16''$. Il circuito stampato sul quale viene realizzata l'unità completa è, come abbiamo visto, in resina epossidica PTFE con costante dielettrica $\epsilon_r = 2,74$, spessore = $1/16''$.

Siccome le linee di trasmissione (strip-line) devono essere realizzate con il rame del circuito stampato, quest'ultimo dovrà essere del tipo a doppio rivestimento; il foglio di rame sottostante servirà, in questo caso, da piano di massa.

Tutti i componenti dell'unità si trovano sulla parte anteriore del circuito stampato come indicato in fig. 9. I collegamenti a massa devono essere fatti mediante rivetti che verranno saldati in una fase successiva. I collegamenti a massa dell'emettitore devono essere più corti possibili, ed è per questo motivo che vengono

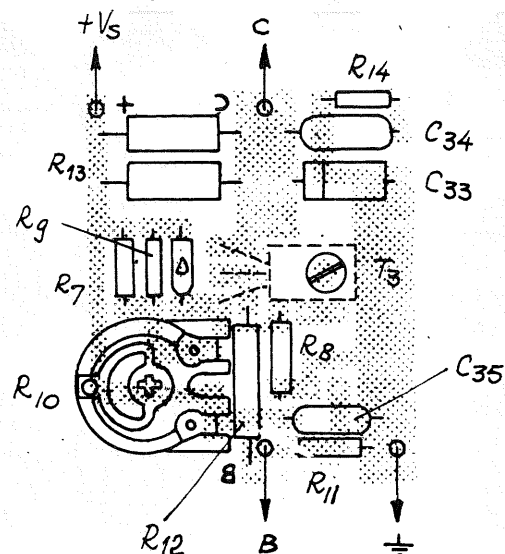


Fig. 12 - Circuito di polarizzazione visto dalla parte dei componenti.

impiegati entrambi i terminali di emettitore del transistor.

I fori che servono per il fissaggio dei transistori al circuito stampato sono quadrati anziché rotondi; il che consentirà di saldare le striscette di rame che si trovano sotto i terminali dei due emettitori.

Non ci stancheremo mai di far presente che i collegamenti a massa dovranno essere più corti possibile.

Inoltre, bisognerà fare in modo che la disposizione dei componenti dei due amplificatori sia più simmetrica possibile.

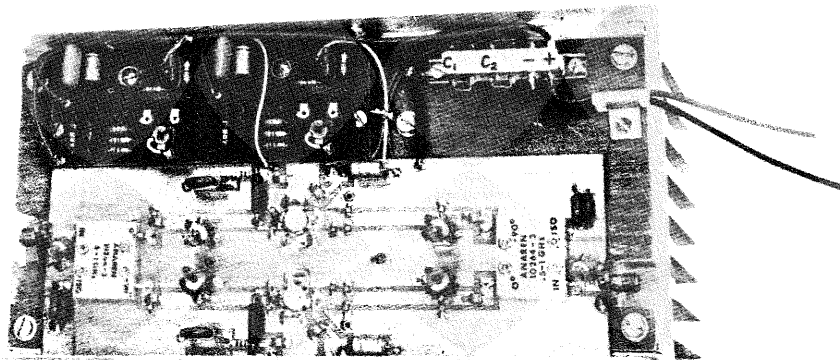
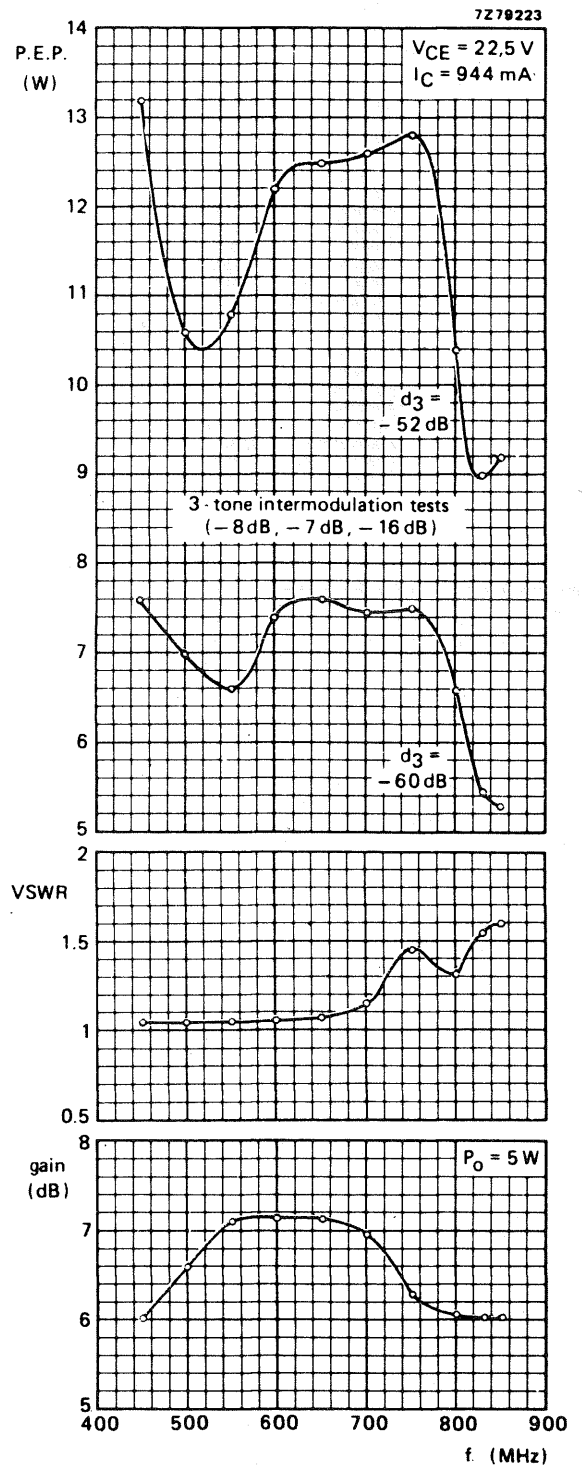
La ditta Anarem, fornitrice degli ibridi coassiali, raccomanda che i fori di montaggio dei medesimi siano ben collegati a massa. La qual cosa viene fatta saldando le viti di montaggio dei due ibridi coassiali allo strato superiore e inferiore del rame del circuito stampato. I due transistori dovranno essere avvitati su una piastra di rame (dissipatore di calore) raffreddata ad acqua. Ciò consentirà di mantenere la temperatura del dissipatore, durante le misure, intorno ai 20°C . Si consiglia di collegare a massa anche il dissipatore di calore.

I connettori coassiali impiegati sono del tipo SMA 50Ω .

Bibliografia

- Rif. 1: G. L. Matthaei - *Tables of Chebyshev impedance transforming networks of low-pass filter form*. Proc. of the IEEE, August 1964.
- Rif. 2: O. Pitzalis, Jr. and R. A. Gilson - *Tables of Impedance Matching Networks Which Approximate Prescribed Attenuation Versus Frequency Slopes*. IEEE Transactions on Microwave Theory and Techniques, Vol. MTT-19, No. 4, April 1971, pp. 381-386.
- Rif. 3: M. J. Köppen - *The BLX 98 as a linear amplifier at 1 GHz*. C.A.B. report ECO 7601.

Fig 13- Curve di risposta tipiche relative all'amplificatore descritto.



Prototipo di laboratorio dell'amplificatore UHF a larga banda di figura 6. Si notino i due accoppiatori ibridi 3 dB - 90° (ANAREN) che consentono il funzionamento in parallelo dei due BLW 98.

Appendice 1 — DATI TECNICI COMPLETI DEL TRANSISTORE DI POTENZA PHILIPS/ELCOMA BLW 98 DA IMPIEGARE NEI RIPETITORI OPERANTI NELLE BANDE IV / V UHF

U.H.F. POWER TRANSISTOR

BLW98

N-P-N silicon planar epitaxial transistor intended for use in u.h.f. power amplifiers, where optimum linearity is required. The transistor is specially suited for all transistorized television transmitters and transmitters in band IV and V, as well as for driver stages in tube systems. The combination of excellent d.c. dissipation properties, which have been obtained by means of diffused emitter-ballasting resistors and the application of a Ti-Pt-Au sandwich metallization, gives an optimum reliability. The transistor has a 1/4" capstan envelope with ceramic cap.

QUICK REFERENCE DATA

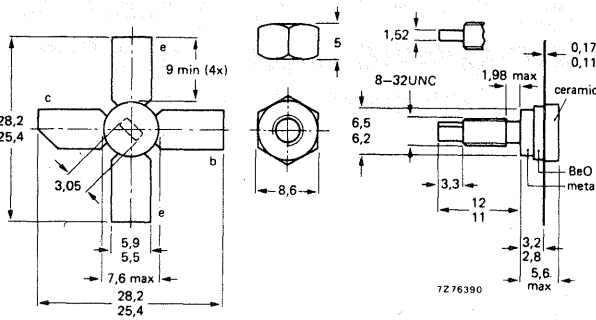
R.F. performance							
mode of operation	f_{vision} MHz	V_{CE} V	I_{C} mA	T_{h} °C	d_{im}^* dB	$P_{\text{o sync}}^*$ W	G_{p} dB
class-A; linear amplifier	860	25	850	70	-60	> 3,5	> 6,5
	860	25	850	25	-60	typ. 4,4	typ. 7

* Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-122.



Torque on nut: min. 0,75 Nm (7,5 kg cm)
max. 0,85 Nm (8,5 kg cm)

Diameter of clearance hole in heatsink: max. 4,2 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION 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-base voltage (open emitter; peak value)	V_{CBOM}	max.	50 V
Collector-emitter voltage (open base)	V_{CEO}	max.	27 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3,5 V
Collector current (d.c.)	I_{C}	max.	2 A
Collector current (peak value) $f > 1$ MHz	I_{CM}	max.	4 A
Total power dissipation at $T_{\text{h}} = 70$ °C	P_{tot}	max.	21,5 W
Storage temperature	T_{stg}		-65 to +150 °C
Operating junction temperature	T_{j}	max.	200 °C

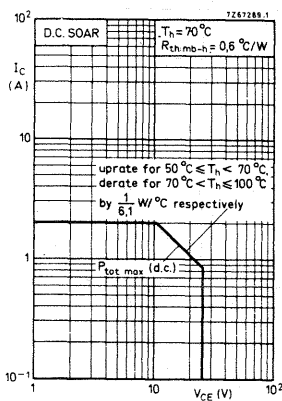


Fig. 2 D.C. SOAR.

THERMAL RESISTANCE

From junction to mounting base
From mounting base to heatsink

$R_{\text{th j-mb}}$	=	5,5 °C/W
$R_{\text{th mb-h}}$	=	0,6 °C/W

CHARACTERISTICS

$T_{\text{j}} = 25$ °C

Collector-base breakdown voltage

open emitter; $I_{\text{C}} = 10$ mA

Collector-emitter breakdown voltage

open base; $I_{\text{C}} = 25$ mA

Emitter-base breakdown voltage

open collector; $I_{\text{E}} = 5$ mA

D.C. current gain*

$I_{\text{C}} = 0,85$ A; $V_{\text{CE}} = 25$ V

Collector-emitter saturation voltage*

$I_{\text{C}} = 500$ mA; $I_{\text{B}} = 100$ mA

Transition frequency at $f = 500$ MHz*

$-I_{\text{E}} = 0,85$ A; $V_{\text{CB}} = 25$ V

Collector capacitance at $f = 1$ MHz

$I_{\text{E}} = I_{\text{C}} = 0$; $V_{\text{CE}} = 25$ V

Feedback capacitance at $f = 1$ MHz

$I_{\text{C}} = 50$ mA; $V_{\text{CE}} = 25$ V; $T_{\text{mb}} = 25$ °C

Collector-stud capacitance

$V_{\text{(BR)CBO}} > 50$ V

$V_{\text{(BR)CEO}} > 27$ V

$V_{\text{(BR)EBO}} > 3,5$ V

$h_{\text{FE}} > 15$

typ. 40*

V_{CEsat} typ. 0,25 V

f_{T} typ. 2,5 GHz ←

C_{c} typ. 24 pF

< 30 pF

C_{re} typ. 15 pF

C_{cs} typ. 2 pF

* Measured under pulse conditions: $t_{\text{p}} \leq 200$ μ s; $\delta \leq 0,02$.

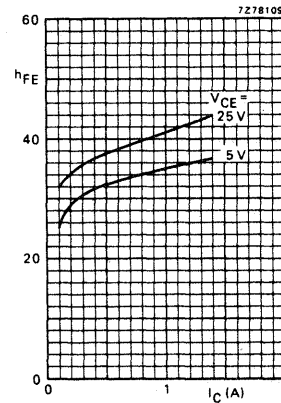


Fig. 3 Typical values; $T_{\text{j}} = 25$ °C.

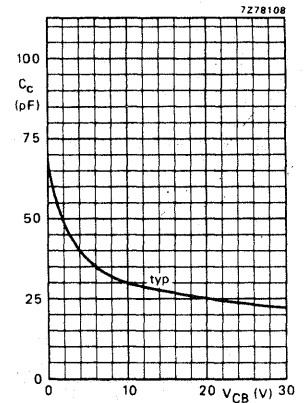


Fig. 4 $I_{\text{E}} = I_{\text{C}} = 0$; $f = 1$ MHz; $T_{\text{j}} = 25$ °C.

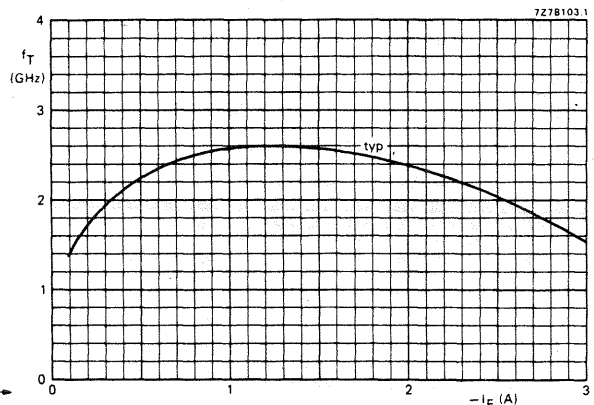


Fig. 5 $V_{\text{CB}} = 25$ V; $f = 500$ MHz; $T_{\text{j}} = 25$ °C.

APPLICATION INFORMATION

f_{vision} (MHz)	V_{CE} (V)	I_{C} (mA)	T_{h} (°C)	d_{im} (dB)*	$P_{\text{o sync}}$ (W)*	G_{p} (dB)
860	25	850	70	-60	>3,5	>6,5
860	25	850	70	-60	typ. 3,8	typ. 7
860	25	850	25	-60	typ. 4,4	typ. 7

* Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

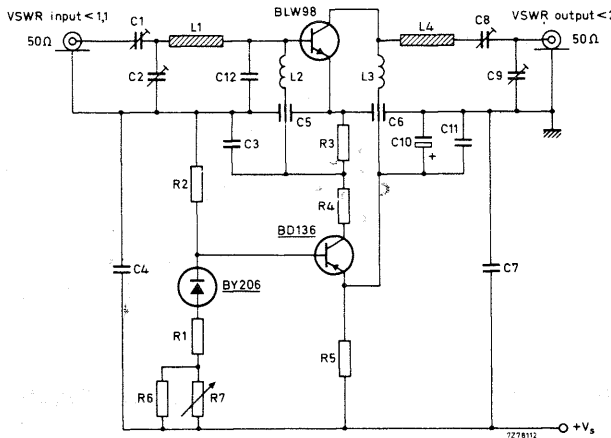


Fig. 6 Test circuit at $f_{\text{vision}} = 860$ MHz.

List of components (see also page 6):

- C1 = C2 = 1,4 to 5,5 pF film dielectric trimmers (cat. no. 2222 809 09001)
- C3 = C4 = 100 nF polyester capacitors
- C5 = C6 = 1 nF feed-through capacitors
- C7 = 5,6 pF ceramic capacitor
- C8 = 2 to 18 pF film dielectric trimmer (cat. no. 2222 809 09003)
- C9 = 2 to 9 pF film dielectric trimmer (cat. no. 2222 809 09002)
- C10 = 10 $\mu\text{F}/40$ V solid aluminium electrolytic capacitor
- C11 = 470 nF polyester capacitor
- C12 = 2 x 3,3 pF chip capacitors (in parallel)

APPLICATION INFORMATION (continued)

List of components (continued)

- R1 = 150 Ω carbon resistor (0,25 W)
- R2 = 1,8 k Ω carbon resistor (0,5 W)
- R3 = 33 Ω carbon resistor (0,5 W)
- R4 = 220 Ω carbon resistor (1 W)
- R5 = 4 x 12 Ω carbon resistors in parallel (1 W each)
- R6 = 1 k Ω carbon resistor (0,25 W)
- R7 = 220 Ω carbon potentiometer (0,25 W)
- L1 = stripline (13,6 mm x 6,9 mm)
- L2 = microchoke 0,47 μH (cat. no. 4322 057 04770)
- L3 = 1 turn Cu wire (1 mm); internal diameter 5,5 mm; leads 2 x 5 mm
- L4 = stripline (40,8 mm x 6,9 mm)
- L1 and L4 are striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric ($\epsilon_r = 2,74$); thickness 1,5 mm.

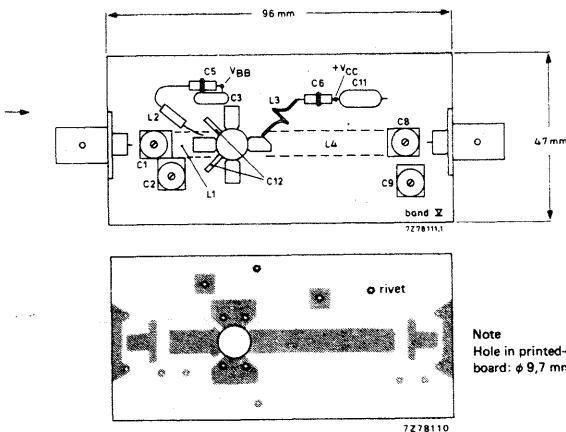
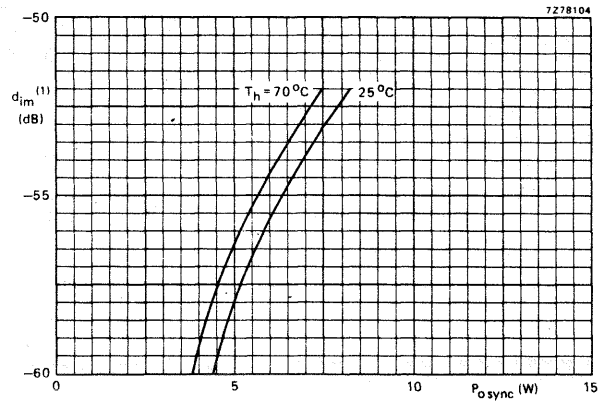


Fig. 7 Component layout and printed-circuit board for 860 MHz test circuit.

The circuit and the components are situated on one side of the PTFE fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.



(1) Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level. Intermodulation distortion of input signal ≤ -75 dB.

Fig. 8 Intermodulation distortion as a function of output power. Typical values; $V_{\text{CE}} = 25$ V; $I_{\text{C}} = 850$ mA; $f_{\text{vision}} = 860$ MHz.

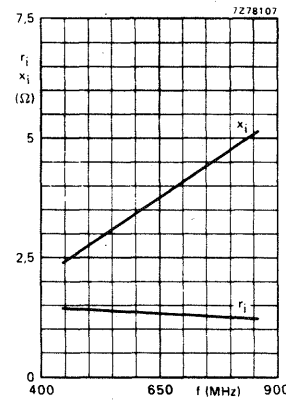


Fig. 9 Input impedance (series components) as a function of frequency.

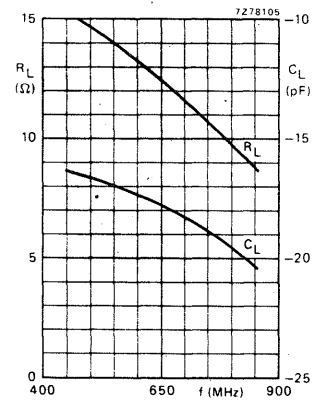


Fig. 10 Load impedance (parallel components) as a function of frequency.

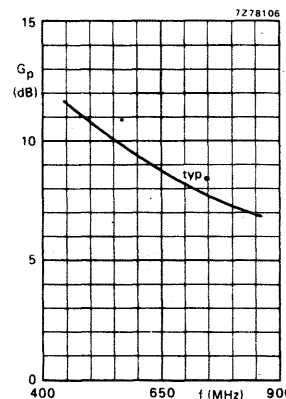


Fig. 11 Power gain as a function of frequency.

Conditions for Figs 9, 10 and 11
 $V_{\text{CE}} = 25$ V; $I_{\text{C}} = 850$ mA; typical values.

Appendice 2 — DATI TECNICI COMPLETI DEI TRANSISTORI PHILIPS/ELCOMA BFQ 34, BLW 32, BLW 34

SILICON-PLANAR EPITAXIAL TRANSISTOR

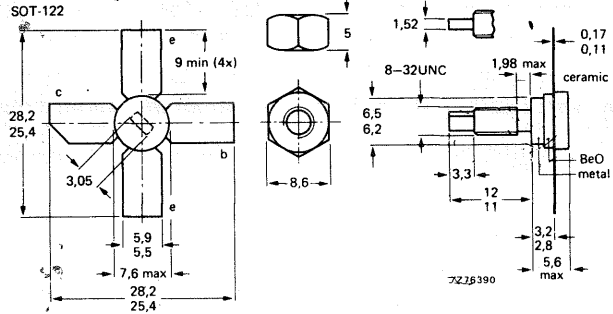
BFQ34

N-P-N transistor in a 1/4" capstan envelope with a ceramic cap primarily intended for MATV purposes.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max	25 V
Collector-emitter voltage (open base)	V_{CEO}	max	18 V
Collector current (d.c.)	I_C	max	150 mA*
Total power dissipation (d.c.) up to $T_{mb} = 125^\circ\text{C}$	P_{tot}	max	2,25 W
Operating junction temperature	T_j	max	200 °C
Transition frequency	f_T	>	3,5 GHz
$I_C = 150\text{ mA}; V_{CE} = 15\text{ V}; T_j = 25^\circ\text{C}$			
Intermodulation distortion at $T_{amb} = 25^\circ\text{C}$	d_{im}	typ	-60 dB
$I_C = 120\text{ mA}; V_{CE} = 15\text{ V}; R_L = 75\ \Omega; V_o = 1,2\text{ V}$			
$f_{(p+q-r)} = 793,25\text{ MHz}$ (see page 3)			

MECHANICAL DATA



Dimensions in mm

Torque on nut: min 0,75 Nm (7,5 kg cm) max 0,85 Nm (8,5 kg cm)

Diameter of clearance hole in heatsink: max 4,2 mm. Mounting hole to have no burrs at either end. De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

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

Intermodulation distortion (see Fig. 1)

$I_C = 120\text{ mA}; V_{CE} = 15\text{ V}; R_L = 75\ \Omega; T_{amb} = 25^\circ\text{C}$

$V_p = V_o = 1,2\text{ V}$ at $f_p = 795,25\text{ MHz}$

$V_q = V_o - 6\text{ dB}$ at $f_q = 803,25\text{ MHz}$

$V_r = V_o - 6\text{ dB}$ at $f_r = 805,25\text{ MHz}$

Measured at $f_{(p+q-r)} = 793,25\text{ MHz}$

d_{im} typ -60 dB

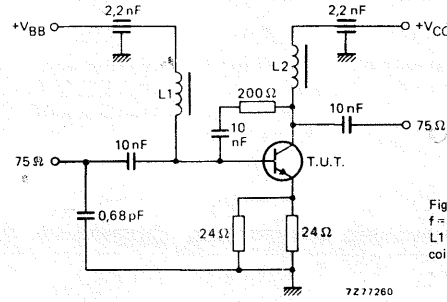


Fig. 1 MATV test circuit
 $f = 40\text{ MHz}$ to 860 MHz .
 $L_1 = L_2 = 5\ \mu\text{H}$ Ferroxcube coil (cat. no. 3122 108 20153).

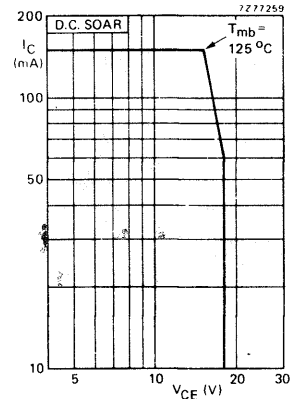


Fig. 2.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max	25 V
Collector-emitter voltage (open base) (see Fig. 2)	V_{CEO}	max	18 V
Emitter-base voltage (open collector)	V_{EB0}	max	2 V
Collector current (d.c.)	I_C	max	150 mA
Total power dissipation (d.c.) up to $T_{mb} = 125^\circ\text{C}$ (see Fig. 2)	P_{tot}	max	2,25 W
Storage temperature	T_{stg}		-65 to +150 °C
Operating junction temperature	T_j	max	200 °C

THERMAL RESISTANCE

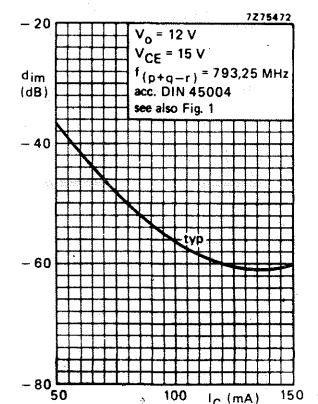
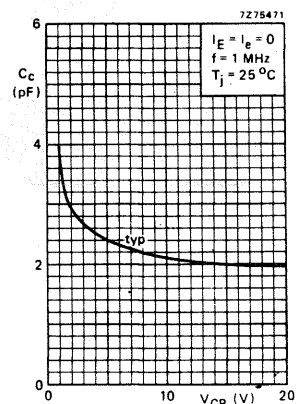
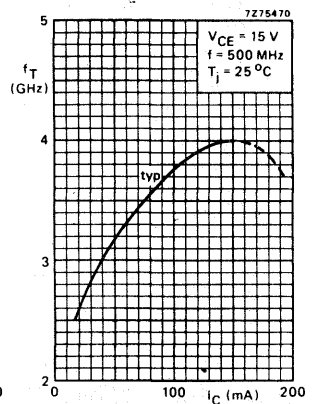
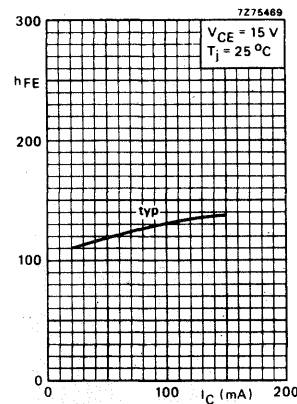
From junction to mounting base	$R_{th\ j-mb}$	=	15,0 °C/W
From mounting base to heatsink	$R_{th\ mb-h}$	=	0,6 °C/W

CHARACTERISTICS

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

Collector cut-off current $I_E = 0; V_{CB} = 15\text{ V}$	I_{CBO}	<	100 μA
D.C. current gain * $I_C = 75\text{ mA}; V_{CE} = 15\text{ V}$	h_{FE}	>	25
$I_C = 150\text{ mA}; V_{CE} = 15\text{ V}$	h_{FE}	>	25
Transition frequency * $I_C = 75\text{ mA}; V_{CE} = 15\text{ V}$	f_T	>	3,0 GHz
	f_T	typ	3,5 GHz
	f_T	>	3,5 GHz
	f_T	typ	4,0 GHz
Collector capacitance at $f = 1\text{ MHz}$ $I_E = I_C = 0; V_{CB} = 15\text{ V}$	C_c	typ	2,0 pF
	C_c	<	2,75 pF
Emitter capacitance at $f = 1\text{ MHz}$ $I_C = 0; V_{EB} = 0,5\text{ V}$	C_e	typ	11 pF
Feedback capacitance at $f = 1\text{ MHz}$ $I_C = 10\text{ mA}; V_{CE} = 15\text{ V}$	C_{re}	typ	1,0 pF
	C_{re}	<	1,35 pF
Collector-stud capacitance	C_{cs}	typ	2 pF
Noise figure measured in MATV test circuit (see Fig. 1) $I_C = 120\text{ mA}; V_{CE} = 15\text{ V}; f = 500\text{ MHz}$	F	typ	8 dB
Maximum unilateral power gain (s_{re} assumed to be zero) G_{UM} (in dB) = $10 \log \frac{ s_{fe} ^2}{(1 - s_{fe} ^2)(1 - s_{oe} ^2)}$ $I_C = 120\text{ mA}; V_{CE} = 15\text{ V}; f = 500\text{ MHz}$	G_{UM}	typ	16 dB

* Measured under pulse conditions.



DEVELOPMENT SAMPLE DATA

This information is derived from development samples made available for evaluation. It does not form part of our data handbook system and does not necessarily imply that the device will go into production.

731BLY/A (BLW32)

N-P-N silicon planar epitaxial transistor primarily intended for use in linear u.h.f. amplifiers for television transmitters and transposers. The excellent d.c. dissipation properties for class-A operation are obtained by means of diffused emitter ballasting resistors and a multi-base structure, providing an optimum temperature profile on the crystal area. The combination of optimum thermal design and the application of gold sandwich metallization realizes excellent reliability properties.

The transistor has a 1/4" capstan envelope with ceramic cap.

QUICK REFERENCE DATA

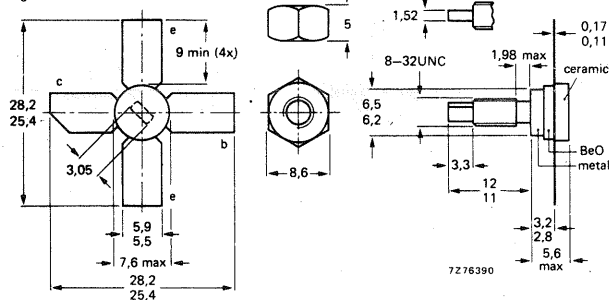
R.F. performance

mode of operation	f_{vision} MHz	V_{CE} V	I_{C} mA	T_{h} °C	d_{im} dB	$P_{\text{o sync}}$ W	G_{p} dB
class-A; linear amplifier	860 860	25 25	150 150	70 25	-60 -60	> 0,5 typ. 0,63	> 11 typ. 12,2

* Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

MECHANICAL DATA

Fig. 1 SOT-122.



Torque on nut: min. 0,75 Nm
(7,5 kg cm).
max. 0,85 Nm
(8,5 kg cm)

Diameter of clearance hole in heatsink: max. 4,2 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

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

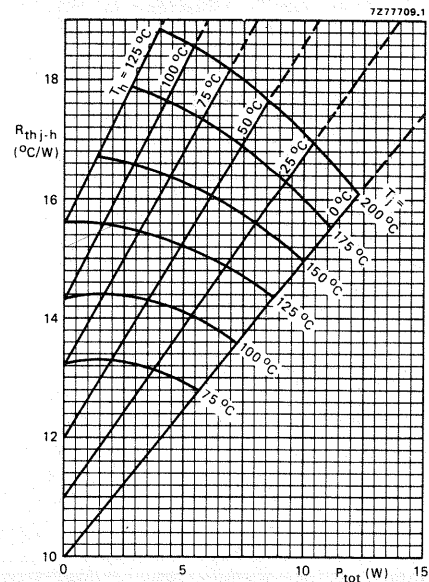


Fig. 4 Maximum thermal resistance from junction to heatsink as a function of power dissipation, with heatsink and junction temperature as parameters. ($R_{\text{th mb-h}} = 0,6 \text{ } ^\circ\text{C/W}$).

Example

Nominal class-A operation: $V_{\text{CE}} = 25 \text{ V}$; $I_{\text{C}} = 150 \text{ mA}$; $T_{\text{h}} = 70 \text{ } ^\circ\text{C}$.

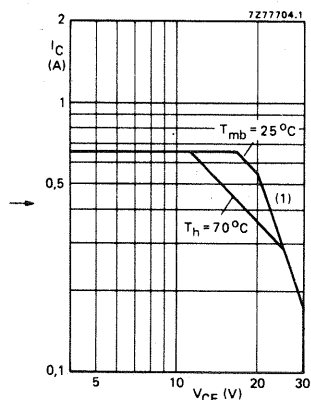
Fig. 4 shows: $R_{\text{th j-h}}$ max. $15,6 \text{ } ^\circ\text{C/W}$
 T_{j} max. $130 \text{ } ^\circ\text{C}$

Typical device: $R_{\text{th j-h}}$ typ. $13,5 \text{ } ^\circ\text{C/W}$
 T_{j} typ. $120 \text{ } ^\circ\text{C}$

RATINGS

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

Collector-emitter voltage (peak value); $V_{\text{RE}} = 0$ open base	V_{CESM} max.	50 V
Emitter-base voltage (open collector)	V_{CEO} max.	30 V
Collector current d.c. or average (peak value); $f > 1 \text{ MHz}$	V_{EBO} max.	4 V
Total power dissipation up to $T_{\text{mb}} = 25 \text{ } ^\circ\text{C}$	I_{C} max.	650 mA
	I_{CM} max.	1000 mA
	P_{tot} max.	10,8 W
	T_{stg}	-65 to +150 °C
Storage temperature	T_{j} max.	200 °C
Operating junction temperature		



(1) Second breakdown limit (independent of temperature).

Fig. 2 D.C. SOAR.

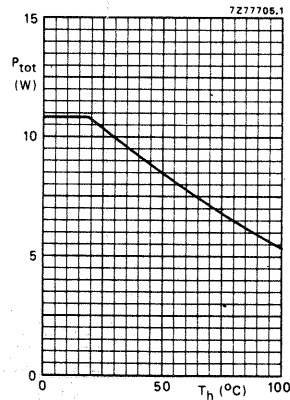


Fig. 3 Power derating curve vs. temperature.

THERMAL RESISTANCE (see Fig. 4)

From junction to mounting base
(dissipation = 3,75 W; $T_{\text{mb}} = 72,3 \text{ } ^\circ\text{C}$; i.e. $T_{\text{h}} = 70 \text{ } ^\circ\text{C}$)

From mounting base to heatsink

$$R_{\text{th j-mb}} = 15,0 \text{ } ^\circ\text{C/W}$$

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

CHARACTERISTICS

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

Collector-emitter breakdown voltage

$V_{\text{BE}} = 0$; $I_{\text{C}} = 2 \text{ mA}$

open base; $I_{\text{C}} = 15 \text{ mA}$

Emitter-base breakdown voltage

open collector; $I_{\text{E}} = 1 \text{ mA}$

Collector cut-off current

$V_{\text{BE}} = 0$; $V_{\text{CE}} = 30 \text{ V}$

$V_{\text{BE}} = 0$; $V_{\text{CE}} = 30 \text{ V}$; $T_{\text{j}} = 175 \text{ } ^\circ\text{C}$

D.C. current gain *

$I_{\text{C}} = 150 \text{ mA}$; $V_{\text{CE}} = 25 \text{ V}$

$I_{\text{C}} = 150 \text{ mA}$; $V_{\text{CE}} = 25 \text{ V}$; $T_{\text{j}} = 175 \text{ } ^\circ\text{C}$

Collector-emitter saturation voltage *

$I_{\text{C}} = 300 \text{ mA}$; $I_{\text{B}} = 30 \text{ mA}$

Transition frequency at $f = 500 \text{ MHz}$ **

$-I_{\text{E}} = 150 \text{ mA}$; $V_{\text{CB}} = 25 \text{ V}$

$-I_{\text{E}} = 300 \text{ mA}$; $V_{\text{CB}} = 25 \text{ V}$

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

$I_{\text{E}} = I_{\text{e}} = 0$; $V_{\text{CB}} = 25 \text{ V}$

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

$I_{\text{C}} = 10 \text{ mA}$; $V_{\text{CE}} = 25 \text{ V}$

Collector-stud capacitance

$V_{\text{(BR)CES}}$	>	50 V
$V_{\text{(BR)CEO}}$	>	30 V
$V_{\text{(BR)EBO}}$	>	4 V
I_{CES}	<	0,5 mA
I_{CES}	<	1,2 mA
h_{FE}	>	20
h_{FE}	typ.	40
h_{FE}	<	120
V_{CEsat}	typ.	500 mV
f_{T}	typ.	3,5 GHz
f_{T}	typ.	3,4 GHz
C_{c}	typ.	3,7 pF
C_{re}	typ.	1,9 pF
C_{cs}	typ.	2 pF

* Measured under pulse conditions: $t_{\text{p}} \leq 300 \text{ } \mu\text{s}$; $\delta \leq 0,02$.

** Measured under pulse conditions: $t_{\text{p}} \leq 50 \text{ } \mu\text{s}$; $\delta \leq 0,01$.

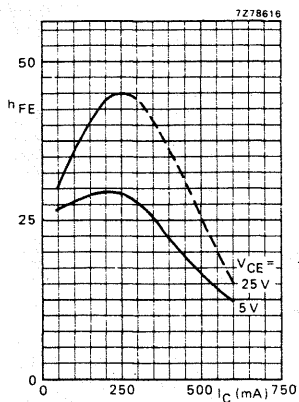


Fig. 5 Typical values; $T_j = 25^\circ\text{C}$.

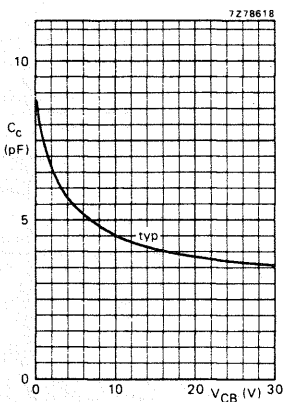


Fig. 6 $I_E = I_C = 0$; $f = 1\text{ MHz}$; $T_j = 25^\circ\text{C}$.

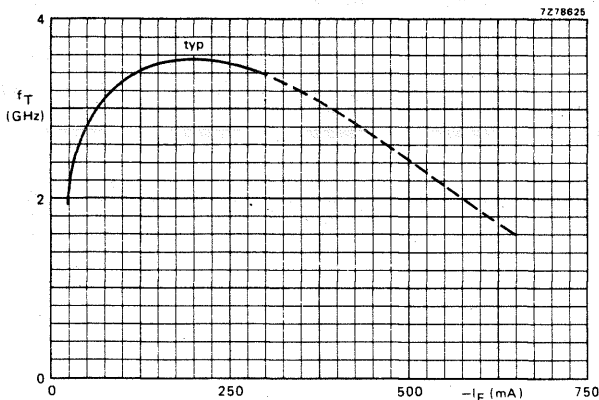
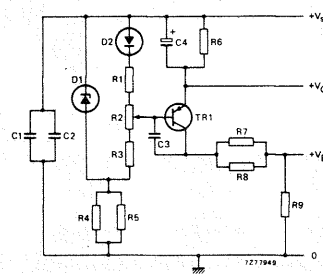
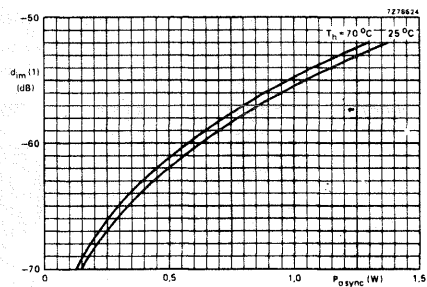


Fig. 7 $V_{CB} = 25\text{ V}$; $f = 500\text{ MHz}$; $T_j = 25^\circ\text{C}$.



- List of components:
 C1 = C2 = C3 = 100 nF polyester capacitor
 C4 = 10 $\mu\text{F}/25\text{ V}$ solid aluminium electrolytic capacitor
 R1 = 150 Ω carbon resistor (0,25 W)
 R2 = 100 Ω carbon resistor (0,25 W)
 R3 = 82 Ω carbon resistor (0,25 W)
 R4 = R5 = 2,2 k Ω carbon resistor (0,25 W)
 R6 = 12 Ω carbon resistor (0,5 W)
 R7 = R8 = 820 Ω carbon resistor (0,5 W)
 R9 = 33 Ω carbon resistor (0,25 W)
 D1 = BZY88-C3V3
 D2 = BY206
 TR1 = BD136

Fig. 9 Bias circuit for class-A linear amplifier at $f_{\text{vision}} = 860\text{ MHz}$.



(1) Three-tone test method (vision carrier -8 dB , sound carrier -7 dB , sideband signal -16 dB), zero dB corresponds to peak sync level. Intermodulation distortion of input signal $\leq -75\text{ dB}$.

Fig. 10 Intermodulation distortion as a function of output power. Typical values; $V_{CE} = 25\text{ V}$; $I_C = 150\text{ mA}$; $f_{\text{vision}} = 860\text{ MHz}$.

APPLICATION INFORMATION

f_{vision} (MHz)	V_{CE} (V)	I_C (mA)	T_h ($^\circ\text{C}$)	d_{im} (dB) *	$P_{0\text{sync}}$ (W) *	G_p (dB)
860	25	150	70	-60	> 0,5	> 11
860	25	150	70	-60	typ. 0,58	typ. 12,2
860	25	150	25	-60	typ. 0,63	typ. 12,2

Three-tone test method (vision carrier -8 dB , sound carrier -7 dB , sideband signal -16 dB), zero dB corresponds to peak sync level.

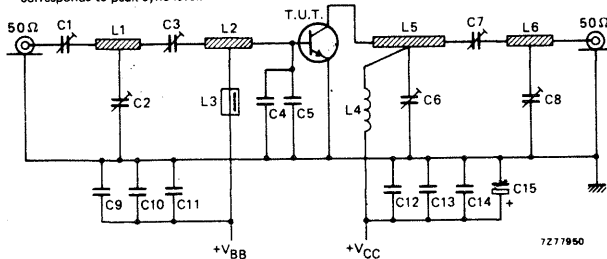


Fig. 8 Test circuit at $f_{\text{vision}} = 860\text{ MHz}$.

List of components:

- C1 = C3 = 2 to 9 pF film dielectric trimmer (cat. no. 2222 809 09002)
- C2 = C6 = C8 = 1 to 3,5 pF film dielectric trimmer (cat. no. 2222 809 05001)
- C4 = C5 = 3 pF chip capacitor
- C7 = 2 to 18 pF film dielectric trimmer (cat. no. 2222 809 09003)
- C9 = C12 = 1 nF chip capacitor
- C10 = 100 nF polyester capacitor
- C11 = C13 = 470 nF polyester capacitor
- C14 = 10 nF polyester capacitor
- C15 = 3,3 $\mu\text{F}/40\text{ V}$ solid aluminium electrolytic capacitor

- L1 = stripline (13,2 mm x 4,3 mm)
- L2 = stripline (15,2 mm x 4,3 mm)
- L3 = micro choke 0,47 μH (4322 057 04770)
- L4 = 4 turns closely wound enamelled Cu wire (1,0 mm); int. dia. 5,5 mm; leads 2 x 5 mm
- L5 = stripline (37,0 mm x 4,3 mm)
- L6 = stripline (13,5 mm x 4,3 mm)

L1; L2; L5 and L6 are striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric ($\epsilon_r = 2,74$); thickness 1,5 mm.

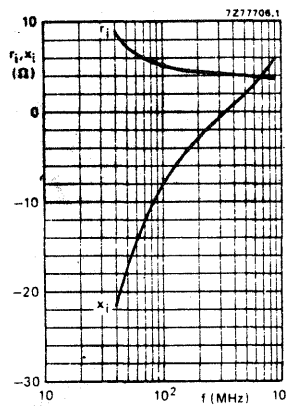


Fig. 11 Input impedance (series components).

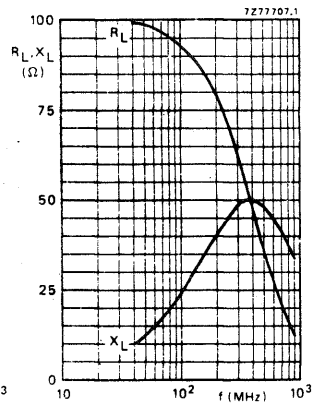


Fig. 12 Load impedance (series components).

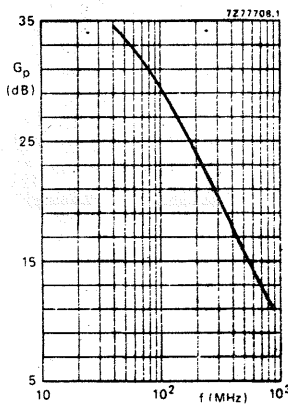


Fig. 13.

Conditions for Figs 11, 12 and 13:

Typical values; $V_{CE} = 25\text{ V}$; $I_C = 150\text{ mA}$; $T_h = 70^\circ\text{C}$.

Ruggedness

The BLW32 is capable of withstanding a load mismatch ($V_{\text{SWR}} = 50$) under the following conditions:
 $f = 860\text{ MHz}$; $V_{CE} = 25\text{ V}$; $I_C = 150\text{ mA}$;
 $T_h = 70^\circ\text{C}$ and $P_{L(AV)} = 1\text{ W}$.
 This holds for single-tone as well as for two-tone operation (vision and sound).

DEVELOPMENT SAMPLE DATA

This information is derived from development samples made available for evaluation. It does not form part of our data handbook system and does not necessarily imply that the device will go into production.

733BLY/A
(BLW34)

U.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor primarily intended for use in linear u.h.f. amplifiers for television transmitters and transposers. The excellent d.c. dissipation properties for class-A operation are obtained by means of diffused emitter ballasting resistors and a multi-base structure, providing an optimum temperature profile on the crystal area. The combination of optimum thermal design and the application of gold sandwich metallization realizes excellent reliability properties. The transistor has a 1/4" capstan envelope with ceramic cap.

QUICK REFERENCE DATA

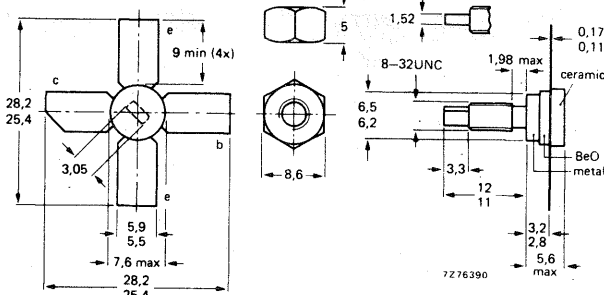
R.F. performance

mode of operation	f_{vision} MHz	V_{CE} V	I_C mA	T_h °C	d_{im} dB	$P_{O \text{ sync}}$ W	G_p dB
class A; linear amplifier	860	25	600	70	-60	> 1,8	> 9
	860	25	600	25	-60	typ. 2,15	typ. 10,2

Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

MECHANICAL DATA

Fig. 1 SOT-122.



Torque on nut: min. 0,75 Nm
(7,5 kg cm)
max. 0,85 Nm
(8,5 kg cm)

Diameter of clearance hole in heatsink: max. 4,2 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

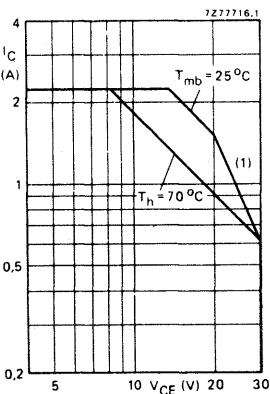
When locking is required an adhesive is preferred instead of a lock washer.

CAUTION 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 (peak value); $V_{BE} = 0$ open base	V_{CESM}	max.	50 V
Emitter-base voltage (open collector)	V_{CEO}	max.	30 V
Collector current d.c. or average (peak value); $f > 1$ MHz	V_{EBO}	max.	4 V
Total power dissipation at $T_{mb} = 25$ °C	I_C	max.	2,25 A
	I_{CM}	max.	3,5 A
Storage temperature	P_{tot}	max.	31 W
Operating junction temperature	T_{stg}		-65 to +150 °C
	T_j	max.	200 °C



(1) Second breakdown limit (independent of temperature).

Fig. 2 D.C. SOAR.

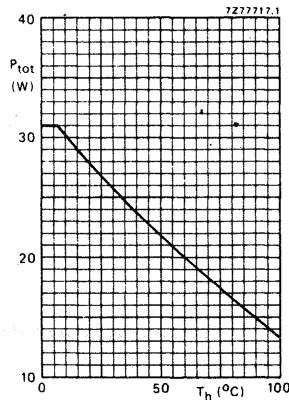


Fig. 3 Power derating curve vs. temperature.

THERMAL RESISTANCE (see Fig. 4)

From junction to mounting base
(dissipation = 15 W; $T_{mb} = 79$ °C; i.e. $T_h = 70$ °C)

$$R_{th \text{ j-mb}} = 6,2 \text{ } ^\circ\text{C/W}$$

From mounting base to heatsink

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

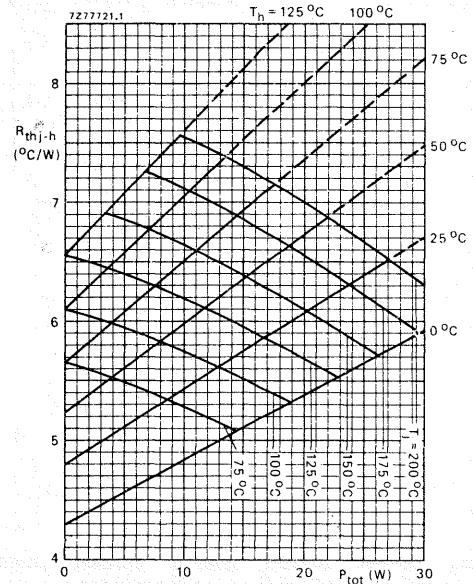


Fig. 4 Maximum thermal resistance from junction to heatsink as a function of power dissipation, with heatsink and junction temperature as parameters. ($R_{th \text{ mb-h}} = 0,6$ °C/W).

Example

Nominal class-A operation: $V_{CE} = 25$ V; $I_C = 600$ mA; $T_h = 70$ °C.

Fig. 4 shows: $R_{th \text{ j-h}}$ max. 6,75 °C/W
 T_j max. 170 °C

Typical device: $R_{th \text{ j-h}}$ typ. 5,45 °C/W
 T_j typ. 152 °C

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified

Collector-emitter breakdown voltage

$V_{BE} = 0$; $I_C = 8$ mA

open base; $I_C = 60$ mA

Emitter-base breakdown voltage

open collector; $I_E = 4$ mA

Collector cut-off current

$V_{BE} = 0$; $V_{CE} = 30$ V

$V_{BE} = 0$; $V_{CE} = 30$ V; $T_j = 175$ °C

D.C. current gain

$I_C = 600$ mA; $V_{CE} = 25$ V

$I_C = 600$ mA; $V_{CE} = 25$ V; $T_j = 175$ °C

Collector-emitter saturation voltage *

$I_C = 1,2$ A; $I_B = 0,12$ A

Transition frequency at $f = 500$ MHz **

$-I_E = 0,6$ A; $V_{CB} = 25$ V

$-I_E = 1,2$ A; $V_{CB} = 25$ V

Collector capacitance at $f = 1$ MHz

$I_E = I_C = 0$; $V_{CB} = 25$ V

Feedback capacitance at $f = 1$ MHz

$I_C = 40$ mA; $V_{CE} = 25$ V

Collector-stud capacitance

$V_{(BR)CES} > 50$ V

$V_{(BR)CEO} > 30$ V

$V_{(BR)EBO} > 4$ V

$I_{CES} < 2,0$ mA

$I_{CES} < 5,0$ mA

$h_{FE} > 20$

h_{FE} typ. 40

$h_{FE} < 120$

V_{CEsat} typ. 450 mV

f_T typ. 3,3 GHz

f_{TB} typ. 3,0 GHz

C_C typ. 13,5 pF

C_{re} typ. 8,4 pF

C_{cs} typ. 2 pF

* Measured under pulse conditions: $t_p \leq 300$ μ s; $\delta \leq 0,02$.

** Measured under pulse conditions: $t_p \leq 50$ μ s; $\delta \leq 0,01$.

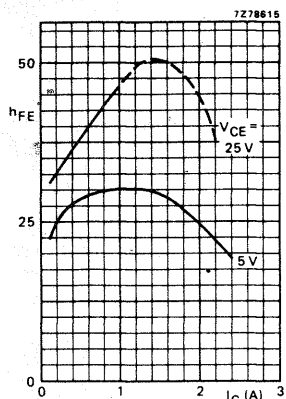


Fig. 5 Typical values; $T_j = 25\text{ }^\circ\text{C}$.

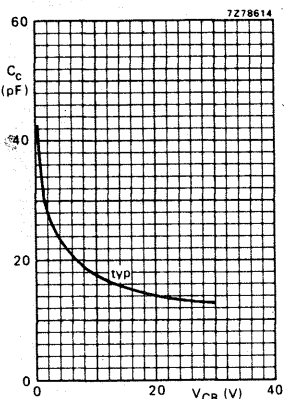


Fig. 6 $I_E = I_B = 0$; $f = 1\text{ MHz}$; $T_j = 25\text{ }^\circ\text{C}$.

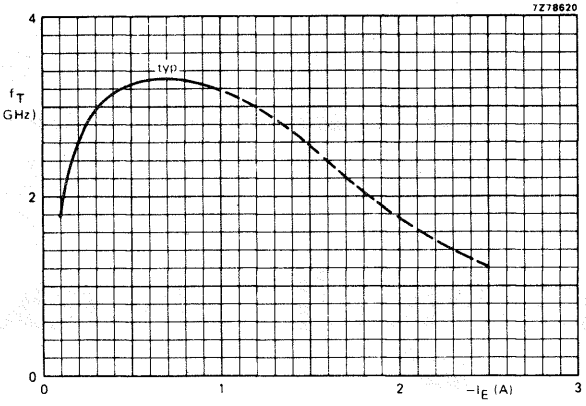
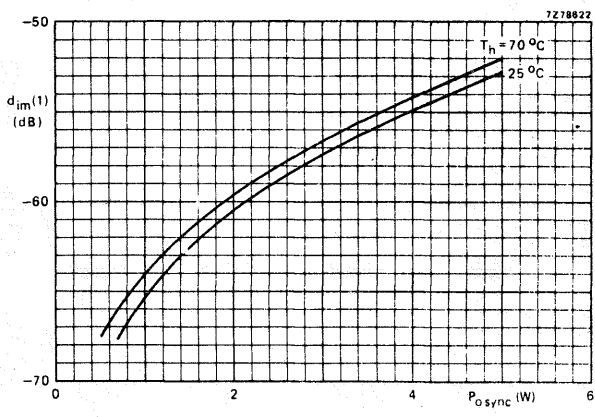


Fig. 7 $V_{CB} = 25\text{ V}$; $f = 500\text{ MHz}$; $T_j = 25\text{ }^\circ\text{C}$.

List of components (continued):

- R1 = 1,8 k Ω carbon resistor (0,5 W)
- R2 = 150 Ω carbon resistor (0,25 W)
- R3 = 100 Ω wirewound potentiometer (3 W)
- R4 = 33 Ω carbon resistor (0,5 W)
- R5 = 220 Ω carbon resistor (1 W)
- R6 = 3 Ω ; parallel connectign of 4 x 12 Ω carbon resistors (1 W each)

- L1 = stripline (13,6 mm x 6,9 mm)
- L2 = microchoke 0,47 μH (cat. no. 4322 057 04770)
- L3 = 1 turn Cu wire (1 mm); internal diameter 5,5 mm; leads 2 x 5 mm
- L4 = stripline (40,8 mm x 6,9 mm)
- L1 and L4 are striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric ($\epsilon_r = 2,74$); thickness 1,5 mm.



(1) Three-tone test method (vision carrier -8 dB , sound carrier -7 dB , sideband signal -16 dB), zero dB corresponds to peak sync level. Intermodulation distortion of input signal $\leq -75\text{ dB}$.

Fig. 9 Intermodulation distortion as a function of output power. Typical values: $V_{CE} = 25\text{ V}$; $I_C = 600\text{ mA}$; $f_{\text{vision}} = 860\text{ MHz}$.

APPLICATION INFORMATION

f_{vision} (MHz)	V_{CE} (V)	I_C (mA)	T_h ($^\circ\text{C}$)	d_{im} (dB) *	$P_{O\text{sync}}$ (W) *	G_p (dB)
860	25	600	70	-60	$> 1,8$	> 9
860	25	600	70	typ. -60	typ. 1,9	typ. 10,2
860	25	600	25	-60	typ. 2,15	typ. 10,2

* Three-tone test method (vision carrier -8 dB , sound carrier -7 dB , sideband signal -16 dB), zero dB corresponds to peak sync level.

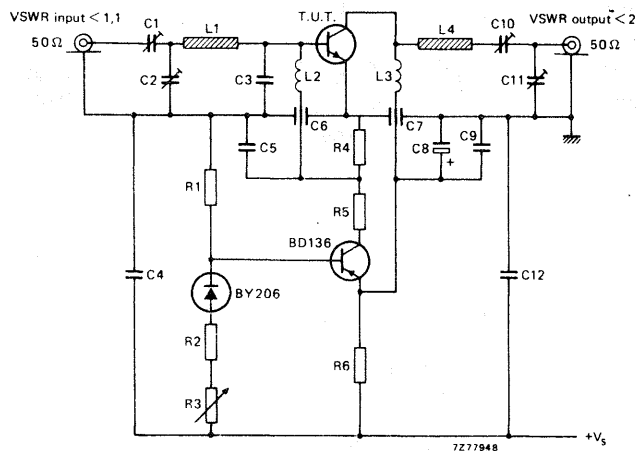


Fig. 8 Test circuit at $f_{\text{vision}} = 860\text{ MHz}$.

List of components:

- C1 = C2 = 1,4 pF to 5,5 pF film dielectric trimmer (cat. no. 2222 809 09001)
- C3 = 2 x 5,6 pF chip capacitors (in parallel)
- C4 = C5 = 100 nF polyester capacitor
- C6 = C7 = 1 nF feed-through capacitor
- C8 = 10 $\mu\text{F}/40\text{ V}$ solid aluminium electrolytic capacitor
- C9 = 470 nF polyester capacitor
- C10 = 2 to 18 pF film dielectric trimmer (cat. no. 2222 809 09003)
- C11 = 2 to 9 pF film dielectric trimmer (cat. no. 2222 809 09002)
- C12 = 5,6 pF ceramic capacitor

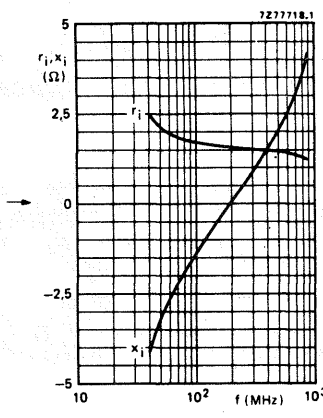


Fig. 10 Input impedance (series components).

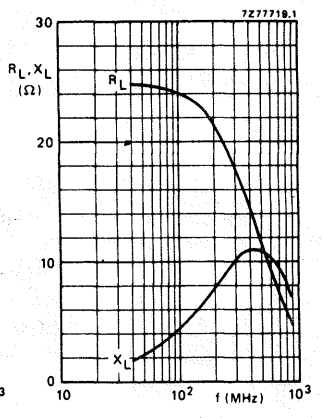


Fig. 11 Load impedance (series components).

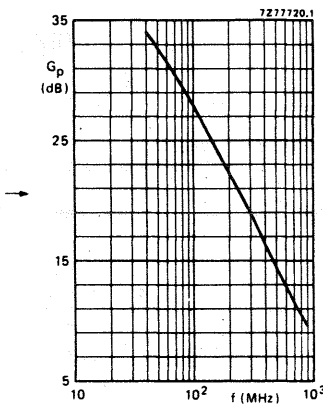


Fig. 12.

Conditions for Figs 10, 11 and 12:
Typical values: $V_{CE} = 25\text{ V}$; $I_C = 600\text{ mA}$; $T_h = 70\text{ }^\circ\text{C}$.

Ruggedness

The BLW34 is capable of withstanding a load mismatch ($V_{\text{SWR}} = 50$) under the following conditions:
 $f = 860\text{ MHz}$; $V_{CE} = 25\text{ V}$; $I_C = 600\text{ mA}$; $T_h = 70\text{ }^\circ\text{C}$ and $P_{L(AV)} = 4\text{ W}$.
This holds for single-tone as well as for two-tone operation (vision and sound).