U.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for transmitting applications in class-A, B or C in the u.h.f. frequency range for supply voltages up to 28 V. The transistor is resistance stabilized and is tested under severe load mismatch conditions. Due to a gold metallization excellent reliability properties have been obtained. The transistor is housed in a capstan envelope with a moulded cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

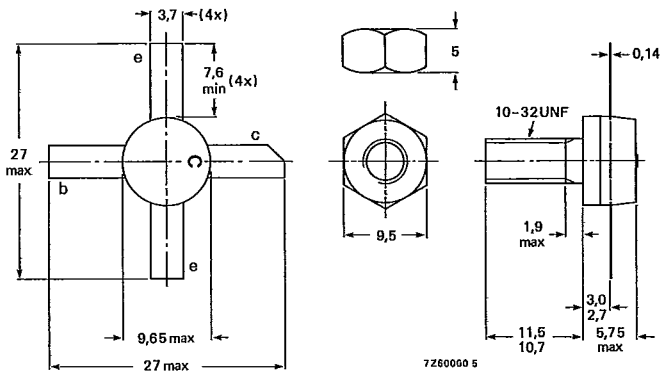
R.F. performance up to T_h = 25 °C in an unneutralized common-emitter class-B circuit

mode of operation	V_{CE} V	f MHz	P_S W	P_L W	I_C A	G_p dB	η %
c.w.	28	470	< 14,2	40	< 2,4	> 4,5	> 60
c.w.	28	175	typ. 3,2	40	typ. 1,9	typ. 11	typ. 75

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-56.



Torque on nut: min. 1,5 Nm (15 kg cm)
max. 1,7 Nm (17 kg cm)

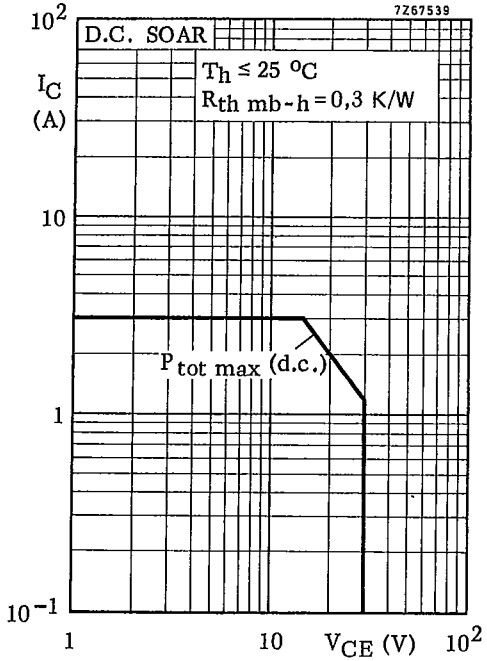
Diameter of clearance hole in heatsink: max. 4,9 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

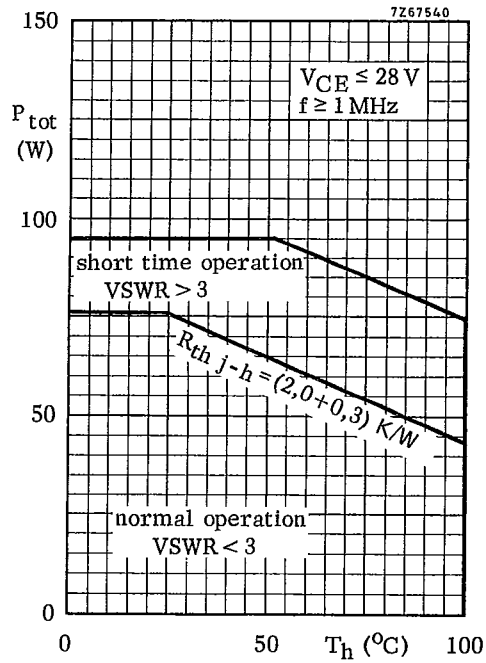
When locking is required an adhesive is preferred instead of a lock washer.

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 (IEC134)

Collector-base voltage (open emitter) peak value	V_{CBOM}	max.	65	V
Collector-emitter voltage ($R_{BE} = 10\,\Omega$) peak value	V_{CERM}	max.	65	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4	V
Collector current (average)	$I_{C(AV)}$	max.	3,0	A
Collector current (peak value) f > 1 MHz	I_{CM}	max.	10,0	A





Storage temperature	T_{stg}	−65 to +200	°C
Junction temperature	T_j	max. 200	°C

THERMAL RESISTANCE

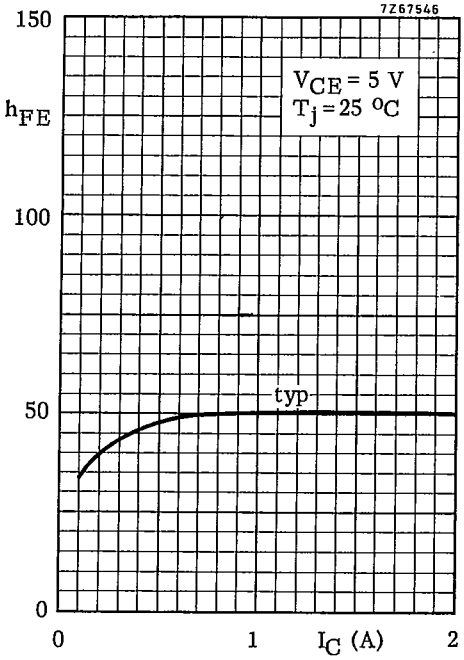
From junction to mounting base	$R_{th\ j\text{-}mb}$	= 2,0	K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	= 0,3	K/W

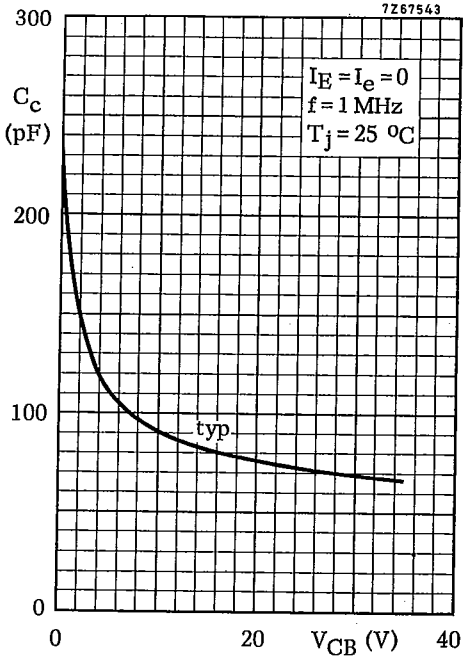
CHARACTERISTICS

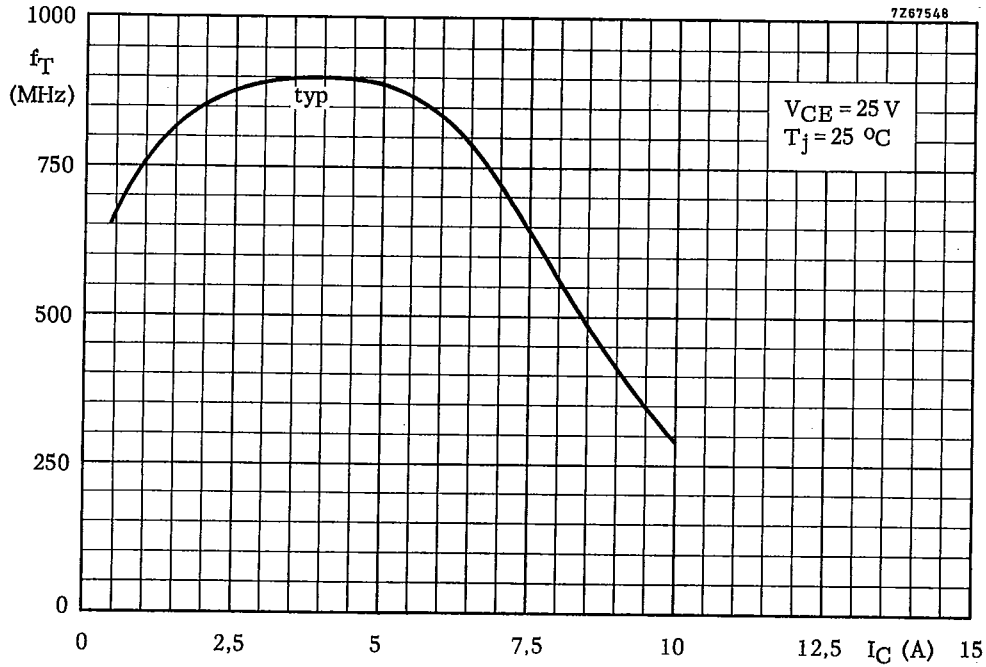
T_j = 25 °C unless otherwise specified

Breakdown voltages

Collector-base voltage open emitter, I_C = 50 mA	$V_{(BR)CBO}$	>	65	V
Collector-emitter voltage R_{BE} = 10 Ω, I_C = 50 mA	$V_{(BR)CER}$	>	65	V
Collector-emitter voltage open base, I_C = 50 mA	$V_{(BR)CEO}$	>	30	V
Emitter-base voltage open collector, I_E = 10 mA	$V_{(BR)EBO}$	>	4	V
Transient energy				
L = 25 mH; f = 50 Hz				
open base	E	>	4,5	mS
$-V_{BE}$ = 1,5 V; R_{BE} = 33 Ω	E	>	4,5	mS
D.C. current gain				
I_C = 1,0 A; V_{CE} = 5 V	h_{FE}	25 to 100		
Transition frequency				
I_C = 4 A; V_{CE} = 25 V	f_T	typ.	900	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e$ = 0; V_{CB} = 30 V	C_c	typ. <	68 80	pF pF
Feedback capacitance at f = 1 MHz				
I_C = 200 mA; V_{CE} = 30 V	C_{re}	typ.	39	pF
Collector-stud capacitance	C_{cs}	typ.	2	pF


7Z67546
150
h_{FE}
100
50
0
V_{CE} = 5 V
T_j = 25 °C
typ
0
1
I_C (A)
2


7Z67543
300
C_c
(pF)
200
100
0
$I_E = I_e = 0$
f = 1 MHz
T_j = 25 °C
typ
0
20
V_{CB} (V)
40


7Z67548
1000
f_T
(MHz)
750
500
250
0
typ
V_{CE} = 25 V
T_j = 25 °C
0
2,5
5
7,5
10
12,5
I_C (A)
15

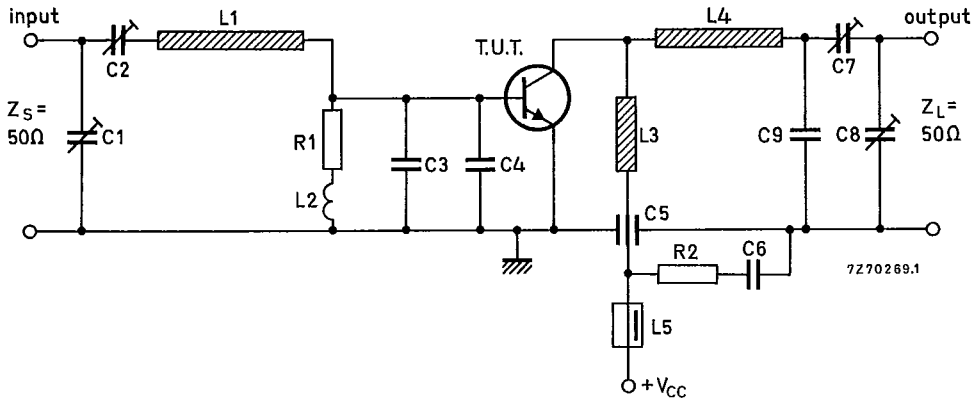
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

V_{CE} = 28 V; T_h up to 25 °C

f (MHz)	P_S (W)	P_L (W)	I_C (A)	G_p (dB)	η (%)
470	< 14,2	40	< 2,4	> 4,5	> 60
175	typ. 3,2	40	typ. 1,9	typ. 11	typ. 75

Test circuit: 470 MHz; c.w. class-B.



List of components:

C1 = C7 = C8 = 2 to 18 pF film dielectric trimmer (cat. no. 2222 809 09003)
C2 = 1,8 to 9 pF film dielectric trimmer (cat. no. 2222 809 09002)
C3 = C4 = 18 pF chip capacitor
C5 = 100 pF feed-through capacitor
C6 = 33 nF polyester capacitor
C9 = 2 x 3,3 pF miniature ceramic plate capacitors (in parallel)

R1 = 1 Ω carbon resistor (0,25 W)
R2 = 10 Ω carbon resistor (0,25 W)

L1 = stripline (21,4 mm x 5,3 mm)
L2 = 13 turns closely wound enamelled Cu wire (0,5 mm); internal diameter 4,0 mm
L3 = stripline (43,8 mm x 3,0 mm)
L4 = stripline (45,5 mm x 5,3 mm)
L5 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)

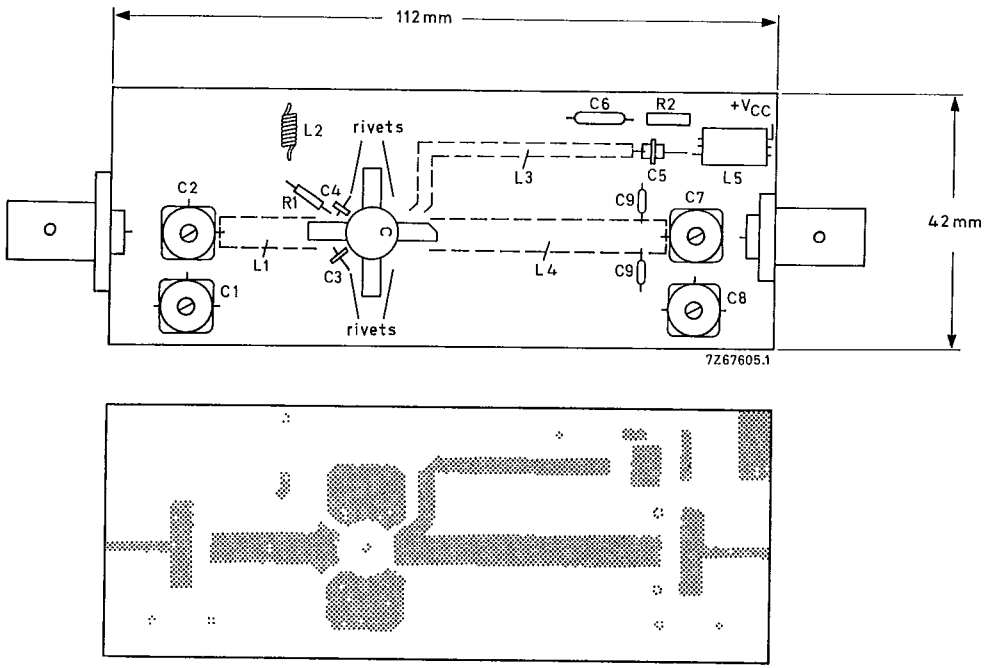
L1; L3; L4 are striplines on a double Cu-clad print plate with PTFE fibre-glass dielectric. (ϵ_r = 2,74); thickness 1/32".

At P_L = 40 W and V_{CE} = 28 V, the output power at heatsink temperatures between 25 °C and 70 °C relative to that at 25 °C is diminished by typ. 50 mW/K.

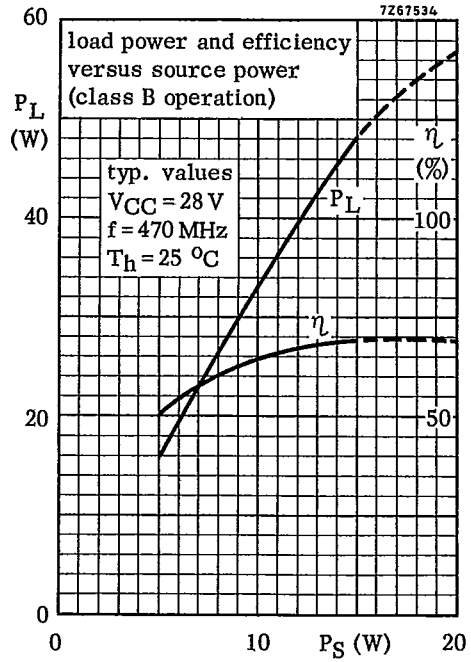
The transistor is designed to withstand full load mismatch in the test circuit under the following conditions: V_{CE} = 28 V; f = 470 MHz; T_h = 70 °C.
VSWR = 50 through all phases; P_L = 36 W.

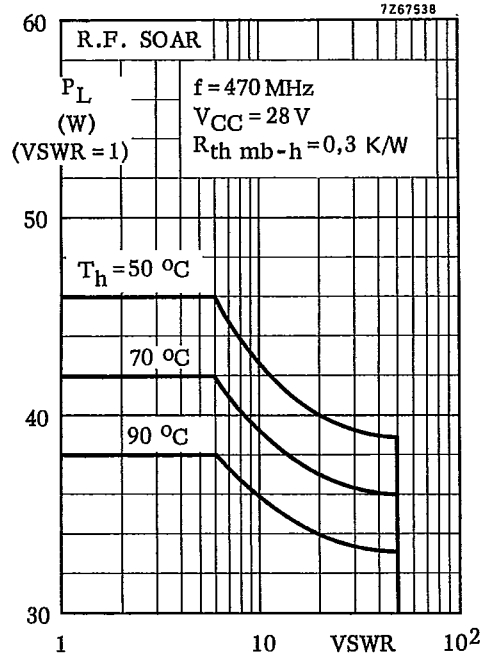
APPLICATION INFORMATION (continued)

Component layout and printed-circuit board for 470 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.



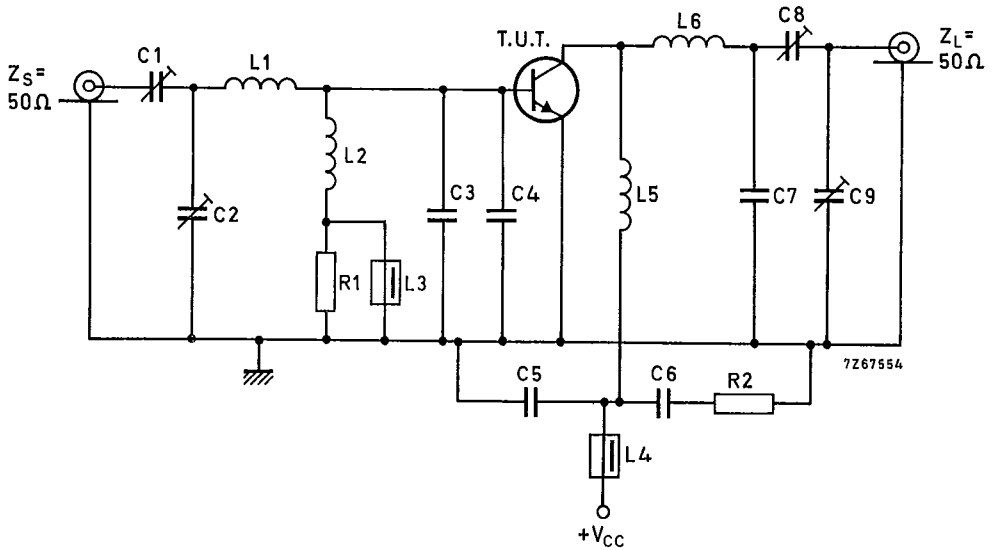


Indicated load power as a function of overload.

The graph has been derived from an evaluation of the performance of transistors matched up to 46W load power in the test amplifier and subsequently subjected to various mismatch conditions at 28 V with VSWR up to 50 and elevated heatsink temperatures.
This indicates a restriction to the load power matched under nominal conditions in the recommended test configuration.

APPLICATION INFORMATION (continued)

Test circuit for 175 MHz:



List of components:

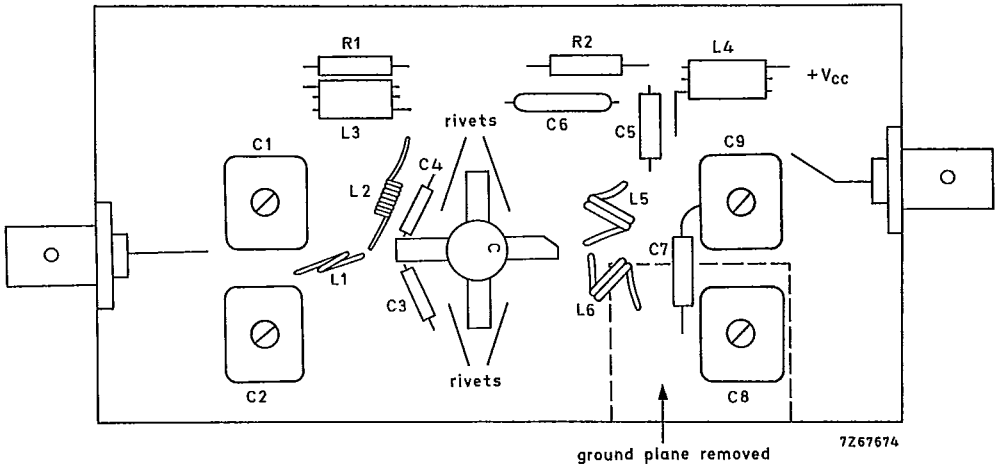
C1 = 2,5 to 20 pF film dielectric trimmer (code number 2222 809 07004)
C2 = 4 to 40 pF film dielectric trimmer (code number 2222 809 07008)
C3 = C4 = 47 pF ceramic capacitor
C5 = 100 pF ceramic capacitor
C6 = 100 nF polyester capacitor
C7 = 6,8 pF ceramic capacitor
C8 = 4 to 60 pF film dielectric trimmer (code number 2222 809 07011)
C9 = 4 to 100 pF film dielectric trimmer (code number 2222 809 07015)

L1 = 0,5 turn enamelled Cu wire (1,5 mm); int. diam. 6 mm; lead length 2 x 6 mm
L2 = 100 nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. diam. 3 mm; lead length 2 x 5 mm
L3 = L4 = ferroxcube choke coil (code number 4312 020 36640)
L5 = 53 nH; 2 turns enamelled Cu wire (1,5 mm); int. diam. 10 mm; coil length 5,2 mm; lead length 2 x 5 mm
L6 = 46 nH; 2 turns enamelled Cu wire (1,5 mm); int. diam. 9 mm; coil length 5,4 mm; lead length 2 x 5 mm

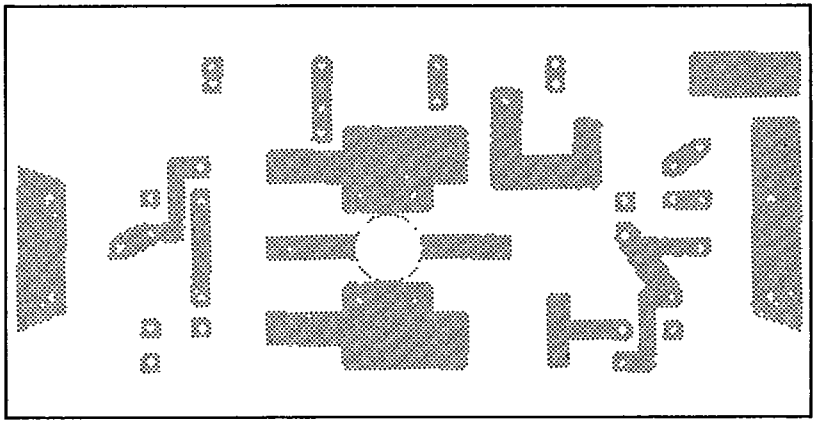
R1 = R2 = 10 Ω carbon resistor (0,25 W)

APPLICATION INFORMATION (continued)

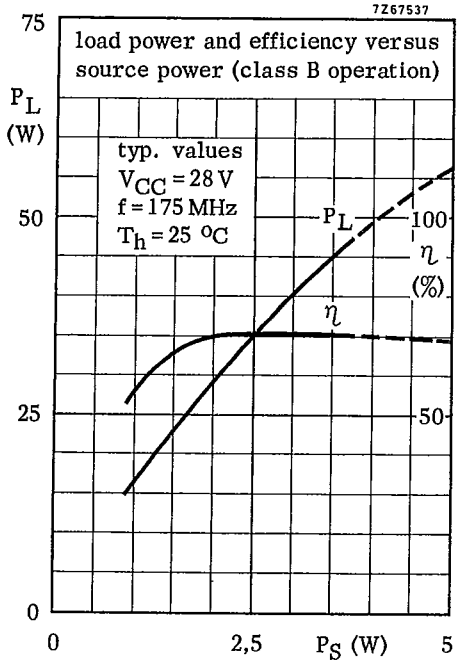
Component lay-out and printed circuit board for 175 MHz test circuit.

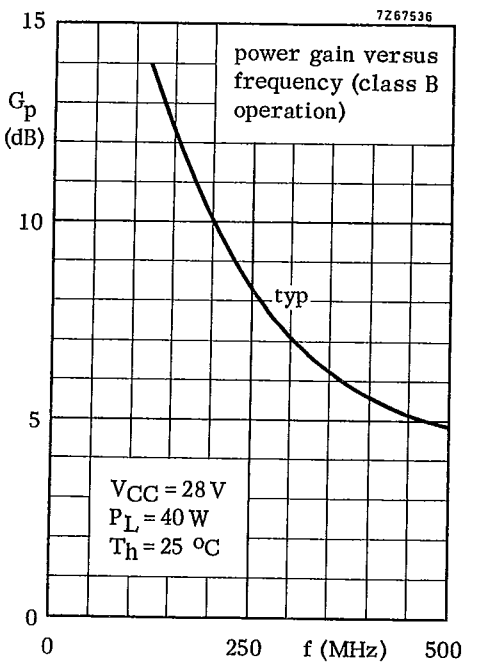


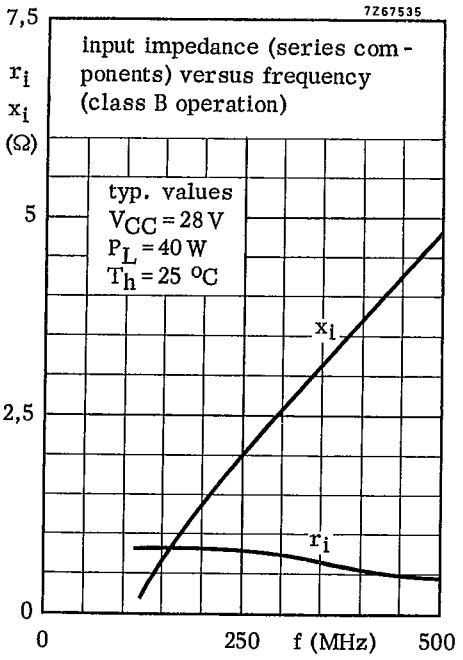
Dimensions of printed circuit board 123 mm x 55 mm.

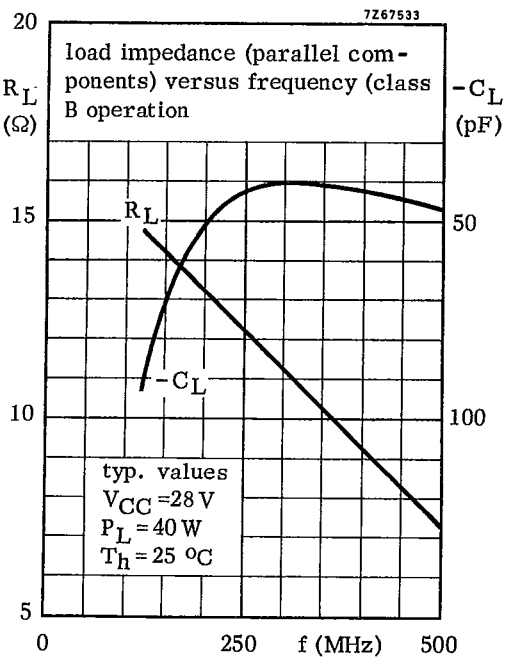


The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.


7Z67537
load power and efficiency versus source power (class B operation)
typ. values
V_{CC} = 28 V
f = 175 MHz
T_h = 25 °C
P_L
η
P_L (W)
η (%)
75
50
25
0
100
50
0
2,5
P_S (W)
5


7Z67536
power gain versus frequency (class B operation)
typ
V_{CC} = 28 V
P_L = 40 W
T_h = 25 °C
G_p (dB)
15
10
5
0
0
250
f (MHz)
500


7Z67535
input impedance (series components) versus frequency (class B operation)
typ. values
V_{CC} = 28 V
P_L = 40 W
T_h = 25 °C
x_i
r_i
r_i
x_i (Ω)
7,5
5
2,5
0
0
250
f (MHz)
500


7Z67533
load impedance (parallel components) versus frequency (class B operation
R_L
$-C_L$
typ. values
V_{CC} = 28 V
P_L = 40 W
T_h = 25 °C
R_L (Ω)
$-C_L$ (pF)
20
15
10
5
50
100
0
250
f (MHz)
500