Issue 1
24.2.70

DESIGNS DEPARTMENT SPECIFICATION

NO.5.175(70)

U.H.F. Power Amplifier AM14/525

.....
G.G. Johnstone
for Head of Designs Department

Written by : B.C. Taylor

BBC

DS/SPA4

JLW

D.D.Spec.No.5.175(70)
Title Sheet

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C O N T E N T S

D R A W I N G S

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U.H.F. Power Amplifier AM14/525

INTRODUCTION

This amplifier is intended for the output stage of Band IV/V TV Translators and Active Deflectors and can provide up to about 1.5W of power (vision carrier peak sync), when handling a normal composite vision and sound U.H.F. signal.

TECHNIQUE

This amplifier uses four U.H.F. power transistors (type 2N4430) which are combined in pairs at input and output using 3dB quadrature couplers and the pairs are then themselves combined using further couplers. This is a logical extension of the method used in the AM14/516. Because of the extra coupler, the input match to the amplifier can be very good over a wide bandwidth, but it will still depend on the degree to which the transistor input impedances are balanced, and also on the loading of the amplifier. The absolute mismatch at the transistor inputs reflects power into the input coupler terminations. Failure of one transistor will reduce both gain and power handling by about 4 - 5dB.

The transistor circuitry is similar to that in the AM14/516, employing Class A operation in common emitter mode. However the one version tunes over the whole of Bands IV and V.

MECHANICAL CONSTRUCTION

The amplifiers are constructed in a wider box to the AM14/516 ($4\frac{1}{4}$" x $3\frac{3}{4}$" x 4") though it will still fit into the mounting framework FW1/8. The three input couplers are printed on the same board assembly, and again external terminations are used, similarly with the three output couplers.

GENERAL SPECIFICATION

Note: Where a frequency or channel is specified in the following it is assumed that the amplifier has first been tuned to that frequency.

Gain

Maximum at 470MHz	8.5dB ± 0.5dB
Minimum at 850MHz	6.0dB ± 0.5dB
Typical figure at 600MHz	7.0 - 7.5dB

Maximum Output Power

Minimum power (peak vision power in presence of sound carrier) at which the intermodulation product in a standard 3-tone test is at -52dB.

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Normal working level	
Power level (defined as above) at which the 3-tone I.P. is not more than -58dB	900mW
Input and output impedances	50Ω
Input return loss) Recommended load return loss)	Better than 20dB over any 8MHz channel from 470 to 850MHz.
Frequency response	
Variation of gain over any 8MHz channel from 470 to 850MHz	± 0.2dB
-1dB bandwidth (varies with centre frequency)	20 - 50MHz
Saturated output power with C.W. signal	About 5W
Power requirements	
(a) +ve earthed supply	12V ± 0.25V 800mA
-ve to C15	
and (b) variable constant current supply	800mA ± 100
+ve to C15	(about 2V)
-ve to C20	
Input and output sockets	Sealectro Conhex miniature 50Ω, screw-on (Pattern 17) (MIL-C-22557).

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PRODUCTION TEST SCHEDULE

Equipment Required

a) Wideband sweeping equipment for displaying frequency response with provision also for measuring gain and return loss. Preferably, calibrated swept measurements of both are desirable but spot measurements with the sweeper stopped will also be acceptable though more tedious. It is preferable too, to sample input and output using dual directional couplers connected by short leads or adaptors to the amplifier. Some alternative items of gear are listed below.

Texscan sweeper VS80

Texscan LN40 log. amp.)
) OR Texscan calibrated display unit
C.R.O. display unit)

Hewlett Packard dual directional couplers type 775D (one on input - one on output)

Hewlett Packard Vector Voltmeter type 8405A OR Rohde & Schwarz U.H.F. receiver type USVD

OR Rohde & Schwarz Selektomat type USWV

Alternative Equipment

Rohde & Schwarz	Polyskop II	type SWOB
"	Reflectometer	type ZAP
"	Selektomat	type USWV

b) Suitably terminated leads or adaptors for Conhex 50Ω screw-on jacks.

c) Care should be taken to ensure that the amplifier is correctly terminated (VSWR $\leqslant$ 1.10) and hence a 10dB buffer pad or 50Ω termination may be needed in addition to the above.

d) AVO model 8.

e) Power supplies 12V (+ve earthed) -ve to C15) 800mA
0 - 3V variable, +ve to C15, -ve to C20)

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improve the gain by detuning to one side with one input trimmer (e.g. C18, C19) and correcting with the other (C5, C6). The bandwidth will in general take care of itself, but in some cases, especially towards the top of Band V, some settings of the input trimmers will give too sharp a response. Having obtained a satisfactory response, check the return loss at PL.A over the channel, it should be at least 20dB. If it is not, small adjustments of the input trimmers on one or both transistors should bring it in without having much effect on the frequency response.

Now replace the trimmations on PL.A and PL.E and connect the input and output leads to PL.D and PL.G leaving PL.B and PL.H terminated. Carry out the tuning of TR3 and TR4 in a precisely similar way to that for TR1, TR2 described above, for capacitors C18, C19, C27, C28, C5, C6 described above, read C21, C22, C29, C30, C7, C8. When the performance of this half of the amplifier is also satisfactory replace the terminations on PL.D and PL.G and connect input and output leads to their normal positions, PL.B and PL.H.

Examine the frequency response and return loss of the whole amplifier using a narrow band sweep and increase the current, until the gain just begins to fall off, probably at about 760mA. If necessary make small adjustments of the trimmers, remembering to move the trimmers in pairs as much as possible, but large trimmer movements should not be necessary now.

Measure the gain and bandwidth and check against the figures given in the general specification.

With experience it will not be necessary to tune the two halves of the amplifier separately and considerable rough tuning can be done by inspecting the positions of the trimmers, and looking at the overall frequency response.

5. In the event of poor performance a clue as the cause may be obtained by measuring the power lost in the various coupler terminations (by transferring the lead normally on the output socket to the appropriate termination socket, and the 50Ω termination to the output socket). The powers should not be significantly higher than the following levels over the channel to which the amplifier is tuned.

Terminations	A and D	-10dB	relative to input level
"	C	-20dB	" " " "
"	E " G	-13dB	" " output "
"	F	-10dB	" " " "

Another point to check, though this may have more relevance to the power output test to be described in the next paragraph, is the d.c. balance between the stages. Measure the voltages across the emitter resistors R9, R10, R11, R12. Assuming the values of these are the same, any differences will be due to transistor parameter spreads and it is hoped that these will be small.

6. If desired at this stage a 3-tone linearity test can be carried out, though this can be deferred until tests on the complete active deflector or translator equipment are being done.

improve the gain by detuning to one side with one input trimmer (e.g. C18, C19) and correcting with the other (C5, C6). The bandwidth will in general take care of itself, but in some cases, especially towards the top of Band V, some settings of the input trimmers will give too sharp a response. Having obtained a satisfactory response, check the return loss at PL.A over the channel, it should be at least 20dB. If it is not, small adjustments of the input trimmers on one or both transistors should bring it in without having much effect on the frequency response.

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Measure the gain and bandwidth and check against the figures given in the general specification.

With experience it will not be necessary to tune the two halves of the amplifier separately and considerable rough tuning can be done by inspecting the positions of the trimmers, and looking at the overall frequency response.

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6. If desired at this stage a 3-tone linearity test can be carried out, though this can be deferred until tests on the complete active deflector or translator equipment are being done.

The test is carried out using normal practice and the results should be checked against the figures in the general specification.

Some points to note are : -

i) The ingoing 3-tone signal should be 'clean', i.e. have no I.P.'s present, and the relative levels should be correct at the output of the amplifier.

ii) The amplifier is conveniently terminated by the power meter and attenuator and the spectrum analyser can be fed from a directional coupler placed in the amplifier output. The P.E.P. (peak envelope power) will be the power meter reading +4.2dB.

iii) Some improvement in the I.P. figure from the amplifier may be obtained by slightly increasing the bias current at the expense of a small decrease in gain (< 0.5dB) though this should be finally set up in the actual translator or active deflector equipment using the control on the UN3/25 bias unit.

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AM14/525, AMPLIFIER, U.H.F. POWER. PARTS LIST

ISS.	CHANGE	
1	6/1/70	ITEM 17 WAS 60-001-0501 ITEM 18 WAS 50-045-0000 C.J.A R.B.A. 28-4-72
2		

ITEM No.	No. OFF	SEE NOTE	DESCRIPTION	C'C'T REF.	BBC REF. OR DRG. No.
			DRAWING NUMBERS		
			Circuit D24214 A2		
			Parts List D24215 A4		
			Assembly & Wiring D24216 A1		
			Order of Assembly D24218 A4		
			Details 1-4 D24217 A1		
			P.B. Assembly D24221 A3		
			P.B. Wiring (Board "A") D24222 A2		
			P.B. Drilling (Board "A") D24223 A4		
			P.B. Wiring (Board "B") D24224 A2		
			P.B. Wiring (Board "C") D24226 A2		
			P.B. Drilling (Board "C") D24227 A4		
			FURTHER INFORMATION REQUIRED FOR MANUFACTURE		
			Unit Assembly Information EA10484		
			Inductors L/1183		FOR BBC REF. ONLY
			SPEC. ED/AM14/525		
1	2		Printed board assy (Boards A & B)		D24221 A3
			EACH INCLUDING:-		
		*	2 - Tucker eyelets type L1 Silver plated		
		*	Printed board wiring (Board "A")		D24222 A2, D24223 A4
		*	" " " (Board "B")		D24224 A2
2	2	*	Printed board wiring (Board "C")		D24226 A2, D24227 A4
3	1		Frame		D24217 A1 Det. 1
4	1		Cover plate		D24217 A1 Det. 2
5	2		Clamping plate		D24217 A1 Det. 3
6	2		Packing P.T.F.E. 0.010" thick		D24217 A1 Det. 4
7					
8	1	*	Inductor L/1183	L1	
9	1	*	" "	L4	
10	1	*	" "	L5	
11	1	*	" "	L8	
12	1	*	330µH type C12 Painton 58/10/0020/10	L2	
13	1	*	330µH " " " "	L3	
14	1	*	330µH " " " "	L6	
15	1	*	330µH " " " "	L7	
16					
17	6	*	Resistive terminations	SKA	
			61-001-0501 Sealectro	SKC-SKG	
18	8	*	Bulkhead receptacle	PLA-PLH	
			51-045-0000 Sealectro		
19					
20					
21					

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AM14/525

Amplifier, U.H.F. POWER. PARTS LIST.

DRN.	GWW
TPD.	LJ
CKD.	
APPD	CRC

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AM14/525 - Parts List

ISS.	CHANGE	
1	6/1/70	
2	12/8/71	ITEMS 23-26 WERE UNITED AIRCRAFT TYPE 2N4430. C.J.A 28-4-72 R.B.A. (2N1010G)
3		

ITEM No.	No. OFF	SEE NOTE	DESCRIPTION	C'C'T REF.	BBC REF. OR DRG. No.
22					
			TRANSISTOR		
23	1	*	BLX 92 MULLARD (OR 2N4430 UNITED AIRCRAFT AS ALTERNATIVE)	TR1	
24	1	*	" " " " " " " "	TR2	
25	1	*	" " " " " " " "	TR3	
26	1	*	" " " " " " " "	TR4	
27					
28					
			CAPACITORS VARIABLE		
29	1	*	1-14pF Airtronic Type AT4480	C5	
30	1	*	" " " "	C6	
31	1	*	" " " "	C7	
32	1	*	" " " "	C8	
33	1	*	" " " "	C18	
34	1	*	" " " "	C19	
35	1	*	" " " "	C21	
36	1	*	" " " "	C22	
37	1	*	" " " "	C27	
38	1	*	" " " "	C28	
39	1	*	" " " "	C29	
40	1	*	" " " "	C30	
41					
			CAPACITORS LEAD-THRO		
42	1	*	.002µF 1KV Erie type 1202-005	C15	
43	1	*	.002µF 1KV " " " "	C20	
44					
45					
			CAPACITORS TRANSCAP DISC		
46	1	*	0.1µF 30V D.C. Erie 811/T/30V	C9	
47	1	*	0.1µF 30V D.C. " "	C10	
48	1	*	0.1µF 30V D.C. " "	C11	
49	1	*	0.1µF 30V D.C. " "	C12	
50					
			CAPACITOR CERAMIC DISC		
51	1	*	10pF 250V D.C. Erie N330 LD19-20	C1	
52	1	*	10pF " " " " "	C2	
53	1	*	10pF " " " " "	C3	
54	1	*	10pF " " " " "	C4	
55	1	*	0.001µF " " " K350081 LD25-20	C13	
56	1	*	0.001µF " " " " "	C14	
57	1	*	0.001µF " " " " "	C16	
58	1	*	0.001µF " " " " "	C17	
59	1	*	0.001µF " " " " "	C23	
60	1	*	0.001µF " " " " "	C24	
61	1	*	0.001µF " " " " "	C25	
62	1	*	0.001µF " " " " "	C26	
63	1	*	0.001µF " " " " "	C31	
64	1	*	0.001µF " " " " "	C32	
65	1	*	0.001µF " " " " "	C33	
66	1	*	0.001µF " " " " "	C34	
67					
68					

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AM14/525
Parts List

DRN.	GWW
TPD.	LJ
CKD.	
APPD.	CRC

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AM14/525 - Parts Lists

ISS.	CHANGE	
1	6/1/70	LENGTHS ADDED TO ITEMS 89-92 ITEM 103 ADDED. C.J.A. R.B.A. 28—4—72
2		

ITEM No.	No. OFF	SEE NOTE	DESCRIPTION	C'C'T REF.:	BBC REF. OR DRG. No.
69					
			RESISTORS WIREWOUND		
70	1	*	4.7Ω ± 5% Painton MV1A	R9	
71	1	*	4.7Ω ± 5% " "	R10	
72	1	*	4.7Ω ± 5% " "	R11	
73	1	*	4.7Ω ± 5% " "	R12	
74					
			RESISTORS CARBON		
75	1	*	100Ω ± 2% MULLARD type MR25	R5	
76	1	*	100Ω ± " " " "	R6	
77	1	*	100Ω ± " " " "	R7	
78	1	*	100Ω ± " " " "	R8	
79	1	*	2.7KΩ ± " " " " A.O.T.	R1	
80	1	*	2.7KΩ ± " " " "	R2	
81	1	*	2.7KΩ ± " " " "	R3	
82	1	*	2.7KΩ ± " " " "	R4	
83					
84					
85					
86	A/R		16 S.W.G. (.064" dia) silver plated copper wire		
87	A/R		Copper Foil sheet 0.001" thick		
88	~~A/R~~		~~Sumel sleeving 1/2 mm 1/4 dia (white)~~		
89	6"	*	Wire PUF 1/6M Orange		SPEC. ED112/PUF1/6M
90	6"	*	" " Blue		" " "
91	6"	*	" " Green		" " "
92	6"	*	" " Yellow		" " "
93					
94					
95					
96					
			SCREWS — FOR FIXING ITEMS		
97	8		6BA x 5/16 CH.HD.St.Zn.P. — 2		
98	12		6BA x 3/8" CSK HD St.Zn.P. — 1, 5, 6		
99					
100					
			NUTS		
101	8		6BA Hex. Full, St.Zn.P. — 2		
102					
103	1		CARTON CARDBOARD		SPEC. ED/AM14/525.

NOTE

* DENOTES ITEMS SUPPLIED ON EMBODIMENT LOAN TO THE CONTRACTOR BY THE BBC FREE OF CHARGE.

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AM14/525
Parts List

DRN.	GWW
TPD.	LJ
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APPD.	CRC

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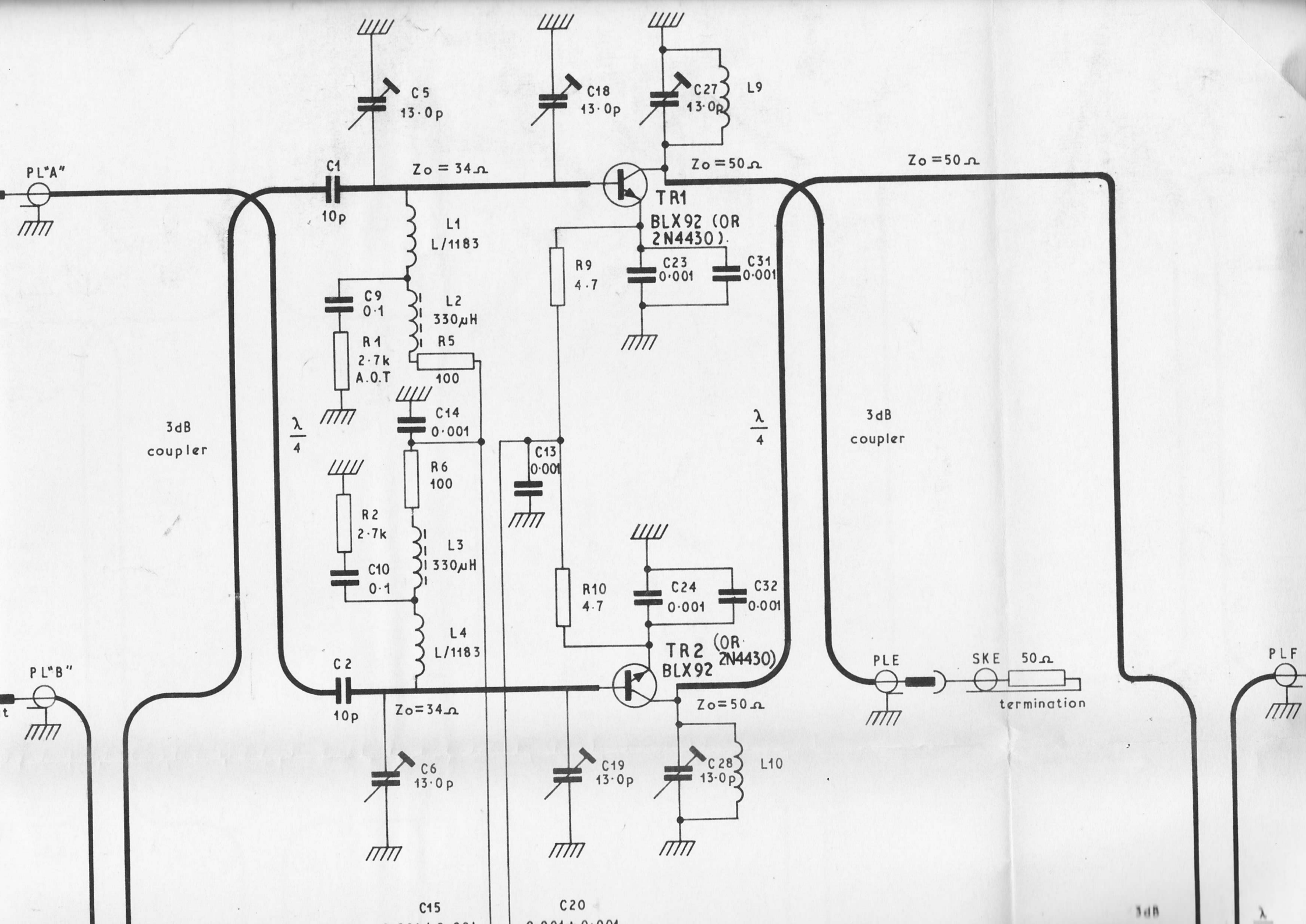
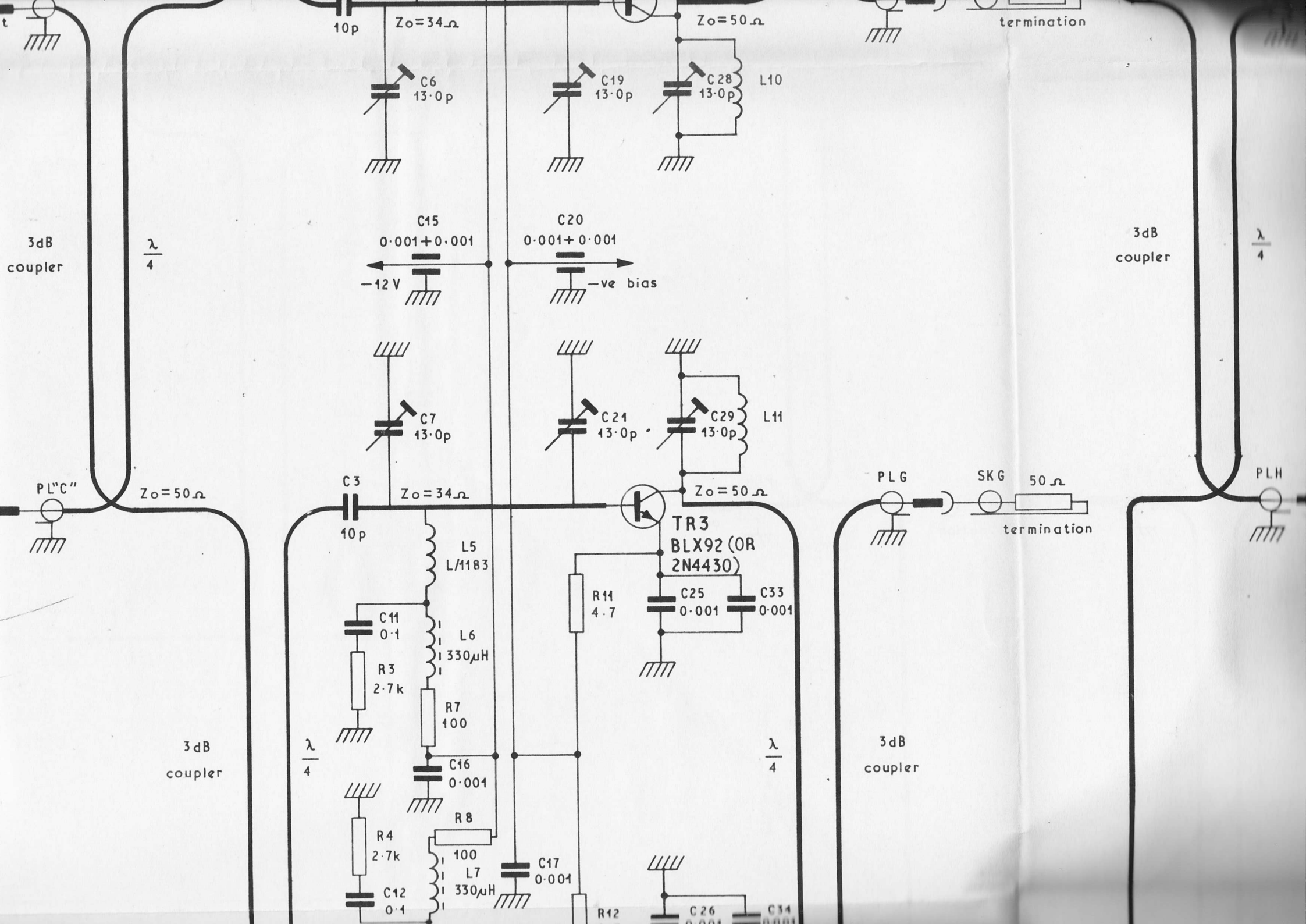
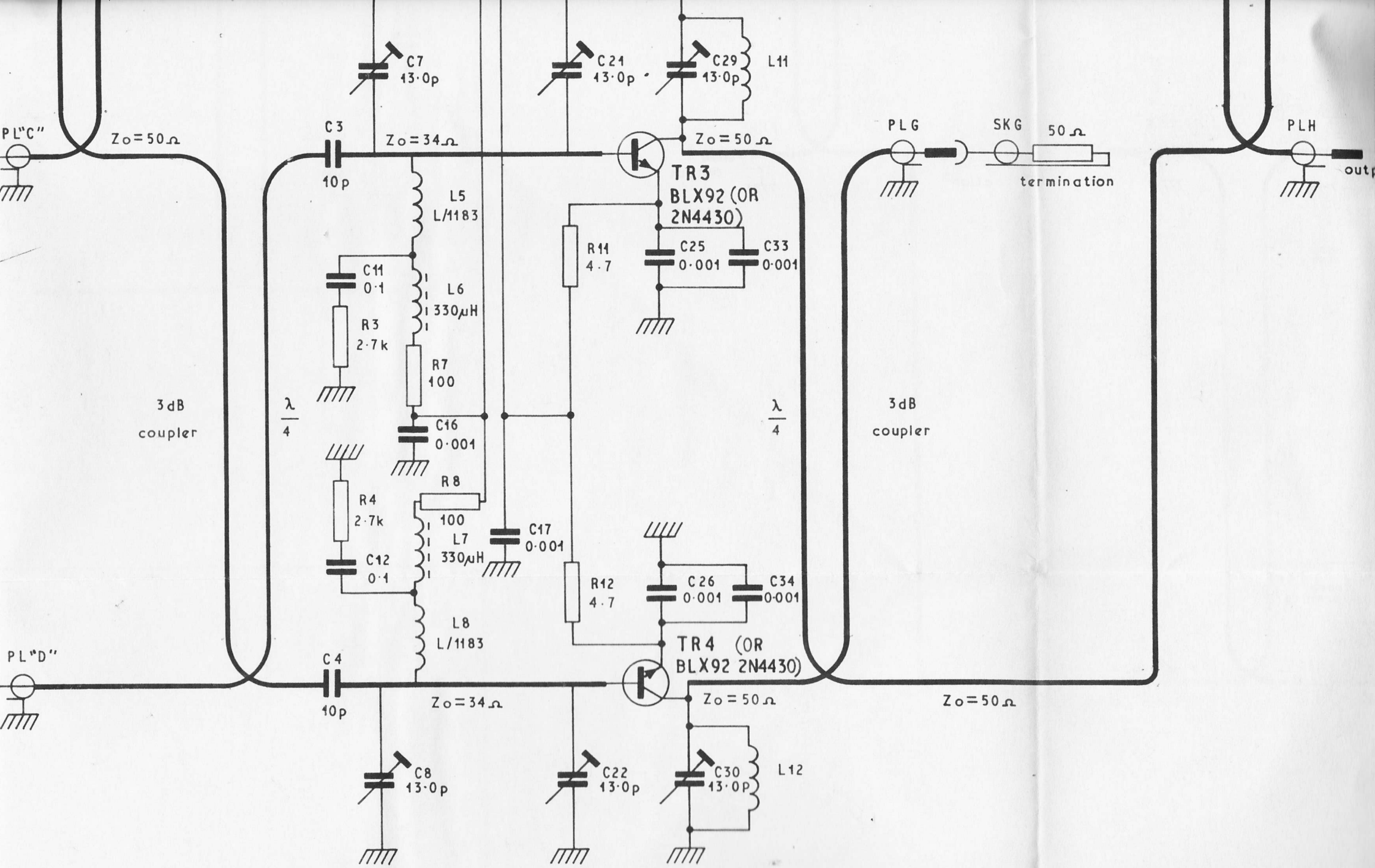

C5
13·0p
C18
13·0p
C27
13·0p
L9
PL"A"
C1
10p
Zo = 34Ω
Zo = 50Ω
Zo = 50Ω
TR1
BLX92 (OR
2N4430).
L1
L/1183
R9
4·7
C23
0·001
C31
0·001
C9
0·1
L2
330µH
R1
2·7k
A.O.T
R5
100
C14
0·001
3dB
coupler
λ/4
C13
0·001
λ/4
3dB
coupler
R6
100
R2
2·7k
C10
0·1
L3
330µH
R10
4·7
C24
0·001
C32
0·001
L4
L/1183
TR2 (OR
2N4430)
BLX92
PL"B"
C2
10p
Zo=34Ω
Zo=50Ω
PLE
SKE
50Ω
termination
PLF
C6
13·0p
C19
13·0p
C28
13·0p
L10
C15
C20
3dB
λ


3dB coupler
λ/4
PL"C"
Zo=50Ω
10p
Zo=34Ω
C6 13·0p
C19 13·0p
C28 13·0p
L10
Zo=50Ω
termination
C15 0·001+0·001
−12 V
C20 0·001+0·001
−ve bias
C7 13·0p
C21 13·0p
C29 13·0p
L11
C3
10p
Zo=34Ω
Zo=50Ω
TR3
BLX92 (OR 2N4430)
L5 L/1183
C11 0·1
L6 330µH
R3 2·7k
R7 100
C16 0·001
R8 100
R4 2·7k
C12 0·1
L7 330µH
C17 0·001
R11 4·7
C25 0·001
C33 0·001
R12
C26
C34
PLG
SKG
50Ω
termination
PLH



w on leads
tor terminations

b