Issue 1
24.1.73

DESIGNS DEPARTMENT

MANUFACTURING INFORMATION NO. 5.209(71)

General Purpose Wideband UHF Amplifiers

AM14/540 and AM14/537

.....
(G.H. JOHNSTONE)
for Head of Designs Department

Written by: C.R. Caine
M.T. Ellen

BBC

DS/SPA4

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D.D.M.I. No. 5.209(71)
Title Sheet

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C O N T E N T S

D R A W I N G S

AM14/540

Circuit	D 29480 A2
Parts List	D 29481 A4
Assembly	D 29482 A2
Order of Assembly	D 29483 A4
Detail 1	D 29484 A3
Printed Board Drilling	D 29486 A4
Detail 2	D 29521 A4

AM14/537

Block Diagram	D 29125 A4
Parts List	D 29126 A4
Assembly and Wiring	D 29127 A2
Details 1-5	D 29128 A2
Detail 7	D 29130 A4

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DESIGNS DEPARTMENT MANUFACTURING INFORMATION NO. 5.209(71)

General Purpose Wideband UHF Amplifiers AM14/540 and AM14/537

Introduction

These amplifiers are general purpose wideband amplifiers for use in bands IV and V. The AM14/540 was designed for the low power stages of the EP7/513 and EP7/514 translators and active deflectors. The AM14/537 is the same module mounted in a chassis CH1/12A with or without a filter.

The AM14/540 supersedes AM14/521 and the AM14/537 now supersedes early units of the same code which incorporated the AM14/521.

Electrical Technique

The amplifier module uses the Englebrecht configuration. The input signal is split by a 3dB coupler and drives two identical amplifier chains of three BFW92 transistors each. The outputs of these are combined in an identical 3dB coupler. Using this configuration, input and output return losses are only governed by the similarity of the two amplifier chains, not their independent return losses, and can be made good over a wide bandwidth. The absolute mismatch at the amplifier inputs reflects power into the termination on the coupler's fourth port, not out of the input socket. Failure of one half reduces both gain and power handling by 6dB.

Mechanical Construction

The module AM14/540 consists of a single printed circuit carrying the six stripline transistors and other components in two "mirror image" amplifiers. The 3dB couplers are a coaxial "Wireline" cable cut to length and connected to the edge of the printed circuit card. The whole is mounted in a cast chassis type CH1/57B, and is fitted with Sealectro "Snap-on" conhex chassis plugs.

When fitted in a CH1/12A the whole becomes an AM14/537. The chassis carries two series 'N' panel jacks on the escutcheon plate with leads to the amplifiers own connectors. Connections to the 15 way plug on the back permit connection of -12 volts, or -18V or -30V to maintain compatability with earlier models.

General Specification

Gain and Frequency Response:- 21dB ± 3dB
Between 470MHz and 860MHz, the slope should not be greater than .2dB over any 8MHz. But see section 2 of the production test schedule.

Output Level:-

⩾+3dBm (2mW) of 3 tone test with +1.57MHz intermodulation product -60dB
1dB compression point +10dBm (10mW)

Impedance and Return Loss:-

Input 50 ohms, 20dB return loss
Output 50 ohms, 14dB return loss

Recomended Load Return Loss:-

> 14dB

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Noise figure:-

Maximum 8dB
Typical 7dB

Connectors:-

AM14/540 Sealectro "Snap-on" conhex SMB miniature 50 ohms
AM14/537 Female series 'N'

Power Supply

AM14/540 -12V ± 1V @ 80mA ± 5mA

AM14/537 -12V ± 1V)
-18V ± 1V) @ 80mA ± 5mA
-30V ± 1V)
depending on pin connections.

DESIGNS DEPARTMENT MANUFACTURING INFORMATION NO. 5.209(71)

General Purpose Wideband UHF Amplifiers AM14/540 and AM14/537

PRODUCTION TEST SCHEDULE

Measurements Required

Gain
Frequency Response
Return losses
Output Power
Noise Figure

Equipment

	Example
Power Meter	HP432A
Sweep Generator OdBm out, 400-900MHz	Texcan VS80, Polskop etc.
Switched attenuators 1dB step & 10dB steps, unless incorporated with generator.	
Coupler 20dB	HP 775D Narda Microline 3020A
Detector & display of good sensitivity	Log amplifier, Texscan LN40A. XY display, Texscan DU88. UHF amplifiers 2X AM14/540. or Selektomat and Polyskop
Three CW Generators, OdBm output tunable 470-850MHz	
Two combiners e.g. 3dB couplers	
Spectrum Analyser	HP 8552/4
Noise Generator	Rohde and Schwarz SKTU
Stabilised Bench PSU 12V 500mA	

A number of 50 ohms leads, adaptors, fixed coaxial attenuators (e.g. 3, 6, 10dB), variable attenuators (1dB and 10dB step) and terminations will be necessary.

Test Procedure

1. The amplifiers will be supplied in the first instance bolted down inside the chassis CH1/57B, but without connectors.

(a) Inspect the printed board carefully, noting that each leadless disc capacitor is not cracked, or has lost any of the silver surface area during soldering. If necessary remove the board from the chassis to inspect the copper tape patches on the earth plane side.

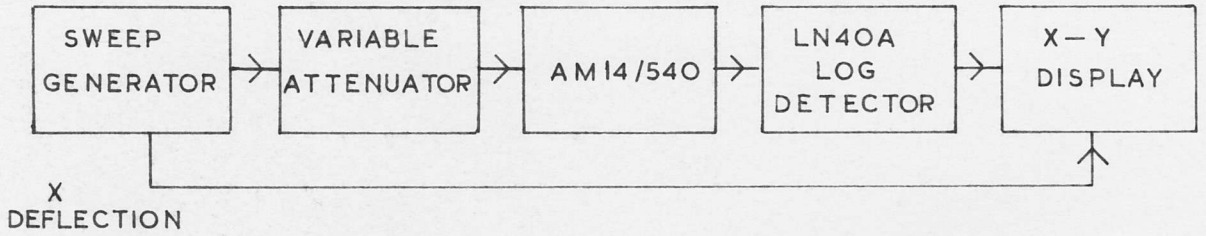
(b) Inspect the Sage "Wireline" 3dB couplers on the input and output. Check that the lengths of exposed inner conductors are as per Order of Assembly instructions D 29483 A4 and that the yellow and clean leads are correctly connected.

(c) Connect -12Volts to amplifier H.T., 0 volts to earth and measure H.T. current (80mA ± 5mA). If in doubt measure voltage across emitter resistors. The two halves of the amplifier are "Mirror Images" facilitating comparison of one side against the other. Probable causes of any fault are broken leadless disc capacitors or transistors upside down, i.e. base and collector connections reversed.

(d) Return Amplifiers for completion of assembly.

2. Ensure that terminations are attached to PLA and PLD and repeat each test with them changed to PLB and PLC.

(a) Gain and Frequency Response.

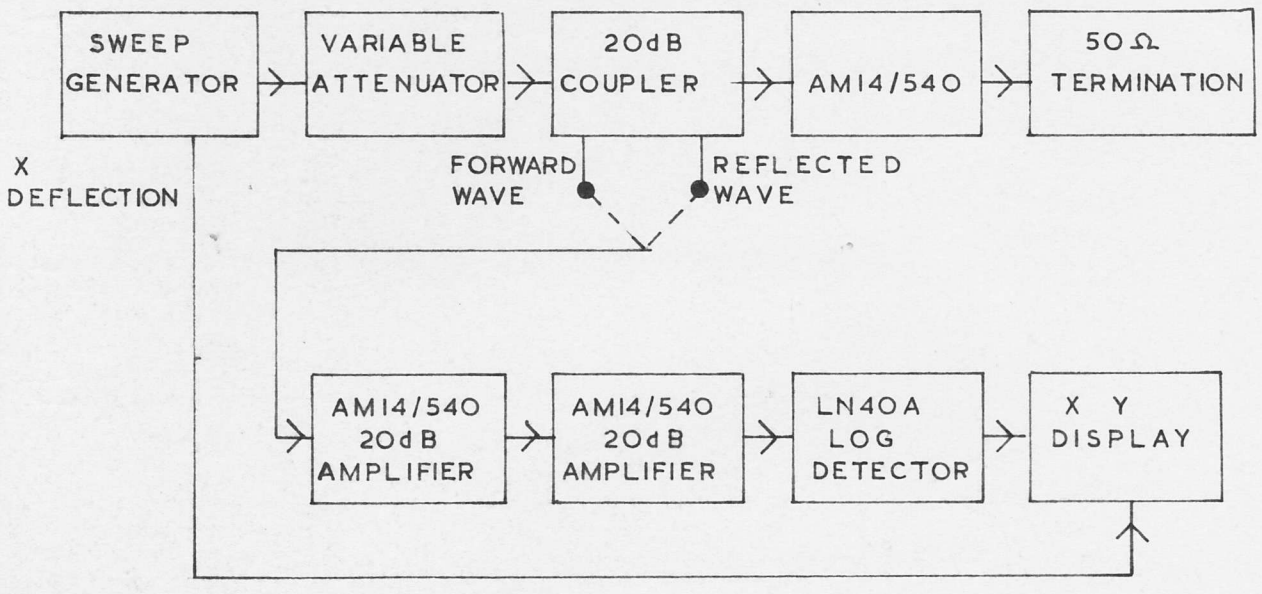


FREQUENCY RESPONCE MEASUREMENT

With approximately 0dBm output from the sweep generator, fed straight into the LN40A, set up a convenient trace on the X-Y display. Insert switched attenuators and amplifier and adjust attenuators to measure gain, which must be 21dB ± 3dB.

Inspect the whole range (470-860MHz) and expand any part of the trace with a rapid change of gain. The EP7/513 and EP7/514 translators and active deflectors must have an overall gain variation of less than ± 0.5dB relative to vision carrier over the range fv - 0.75MHz to fv + 6.25MHz. Therefore the AM14/540 amplifiers should not have a gain variation of more than 0.2dB over any 8MHz channel, when used in the translators or active deflectors. It is difficult to measure 0.2dB accurately at UHF therefore it is sufficient to ensure that the gain varies by less than 1dB over 40MHz and that there are no kinks in the response.

(b) Return losses

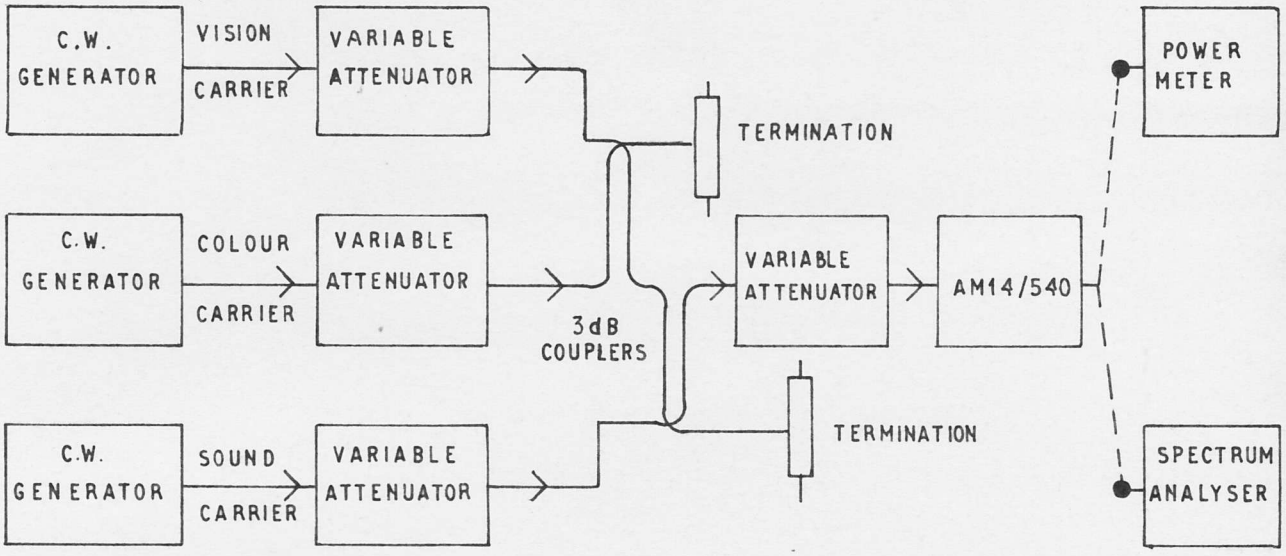


RETURN LOSS MEASUREMENT

The lead from the coupler to the amplifier under test must be less than three inches long. With approximately -40dBm from the generator, connect the detector amplifiers' input to the forward wave port on the input coupler, and set up a convenient trace on the X-Y display. Increase the generator output by 20dB and transfer the detector amplifiers input to the reflected wave port. This should be below the forward wave trace over the range 470-860MHz. Adjust the attenuator to measure return loss to the nearest dB. Reverse the positions of the terminations and repeat. Then reverse the amplifier and measure the output return loss by the same method, except that the generator output should only be increased by 14dB, the output return loss requirement. Again reverse the terminations and repeat. Choose the arrangement giving the best input return loss and affix input and output labels to correspond. The amplifier need only pass the specification on this arrangement. If fixed frequency measurements are more convenient, intervals of 50MHz will be an adequate check.

Failure in the return loss specification will almost certainly be due to poor termination of the coupler ends, but could be due to disconnection of one half of the amplifier.

(c) Power handling



OUTPUT POWER MEASUREMENT

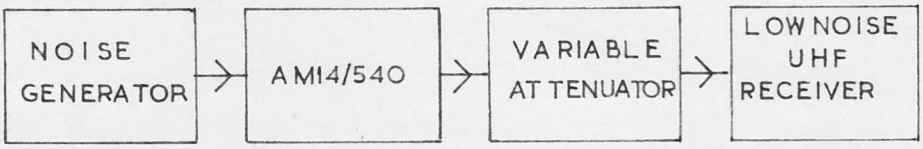
Connect three generators as shown. The couplers need not be 3dB. Output levels will be of the order of -20dBm to -30dBm, and it is better to isolate the generators with large attenuators to prevent intermodulation between generators, than to reduce e.m.f. If large pads are used, combiners can be 50 ohms STAR or DELTA pads.

Connect the output of the amplifier to the spectrum analyser, tune it to the required channel and adjust the controls to give a reference line level of 0dBm, 10dB/cm, 1MHz/cm. Adjust the frequencies of the generators to be the vision carrier (V) of the channel in which the amplifier is to be tested, the sound carrier (V + 6MHz = S) and the colour carrier (V + 4.43MHz = C). Adjust the levels of the generators by the attenuators so that the spectrum analyser shows V at -8dB, S at -7dB and C at -17dB relative to the top line of the graticule.

Connect the output of the amplifier to a power meter via the shortest lead possible and adjust the attenuator connected to the input of the amplifier so that the power meter reads -1.2dBm, that is 4.2dB below +3dBm (2mW). By adding 4.2dB to the power meter reading the peak envelope power is obtained (the power meter reads the mean power). Connect the output of the amplifier back to the spectrum analyser and adjust its sensitivity to show V at -8dB, S at -7dB and C at -17dB relative to the top line of the graticule. Now measure the level of the intermodulation product (IP) at V + 1.57MHz, it should be better than -60dB relative to the top line of the graticule.

This test should be carried out on the channel at which the amplifier is to be used in service, if this is not known it should be done at channel 21 and channel 66.

(e) Noise Figure



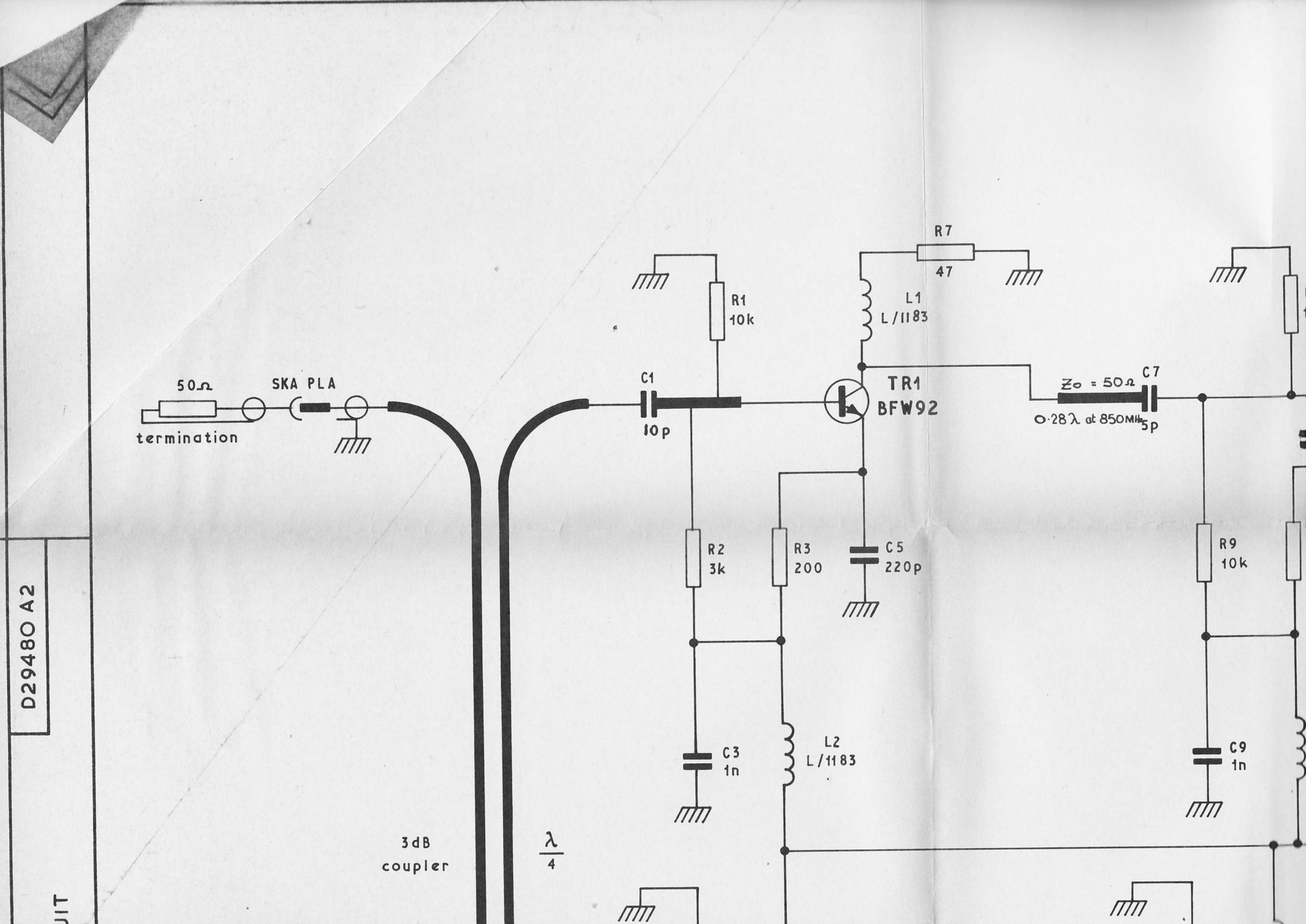
NOISE FIGURE MEASUREMENT

With the noise generator set to zero output adjust the attenuator to zero and note the receiver output level.

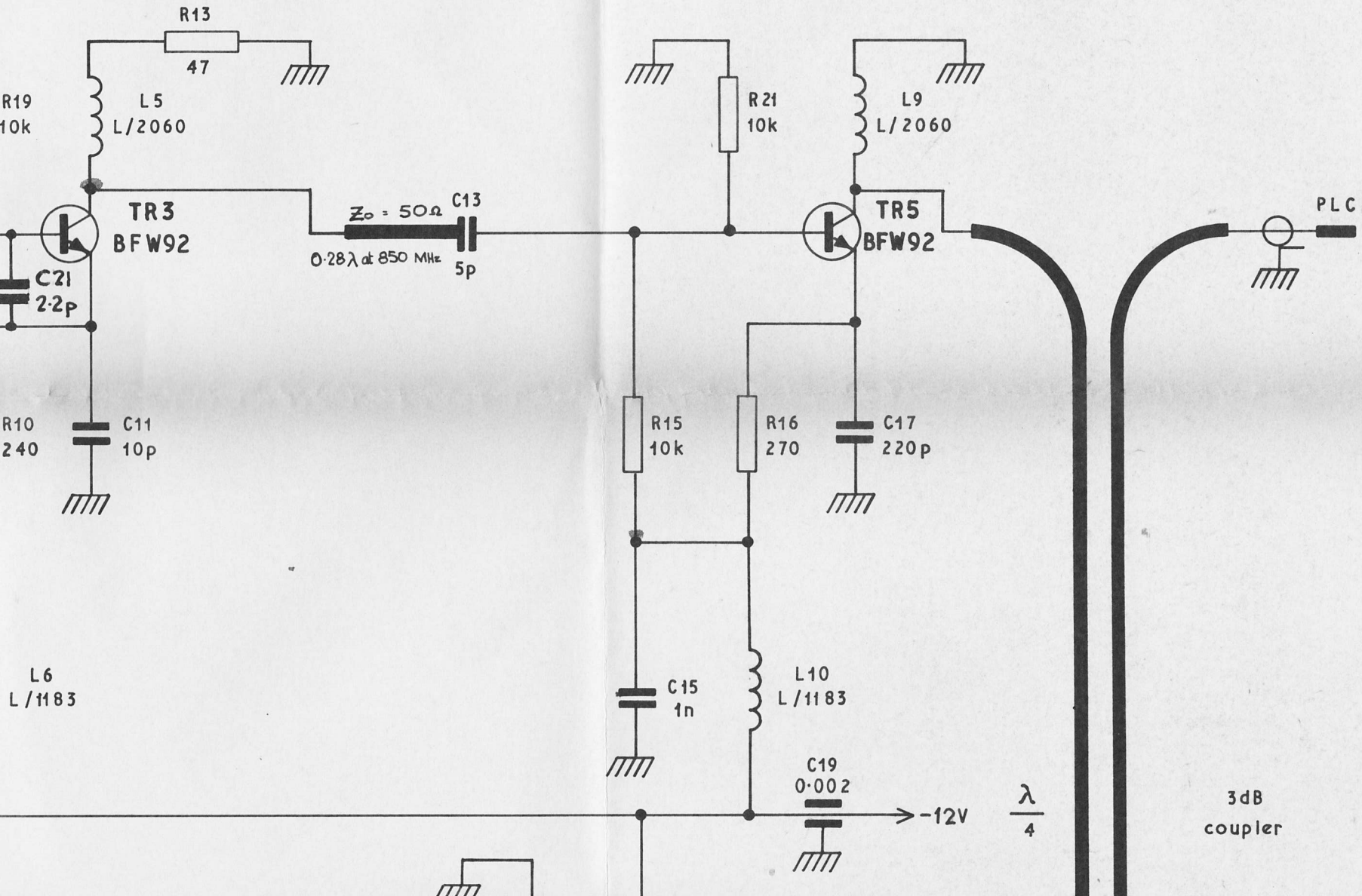
Set the attenuator to 3dB and adjust the output of the noise generator to give an identical reading. The noise meter gives a direct reading in dB, which must be 8dB or less.

Packing

Before despatching amplifiers individually, i.e. not fixed into a chassis or framework, remove the two terminations and pack separately, or tape onto top of amplifier to prevent damage.


D29480 A2
50Ω
termination
SKA PLA
3dB
coupler
λ/4
C1
10p
R1
10k
R7
47
L1
L/1183
TR1
BFW92
Zo = 50Ω
0·28λ at 850MHz
C7
5p
R2
3k
R3
200
C5
220p
C3
1n
L2
L/1183
R9
10k
C9
1n

CHANGE	ISS
24 - 11 - 71	1
L1&L4 WERE L/2060. C.J.A R.B.A. 27 4 72	2
C21, C20 ADDED. C1.C2 WERE 220pF. CF1116I(2) Jer. 3.11.72	3



D29481 A4

sheet 1 of 3 sheets.

ISS.	CHANGE	
1	24 - 11 - 71	
2	'*' ADDED. ITEM 1 REVISED. C.J.A. R.B.A. 27-4-72	
3	ITEM 13, 23, 24 ADDED JCR. 6.11.72. CF111175(4)	3A
	ITEMS 9-12 TYPE NOS REVISED JRS	

ITEM No.	No. OFF	SEE NOTE	DESCRIPTION	C'C'T REF.	BBC REF. OR DRG. No.
			DRAWING NUMBERS.		
			Circuit D29480A2		
			Parts List D29481A4		
			Assembly & WIRING D29482A2		
			Order of Assembly D29483A4		
			Detail 1 D29484A3		
			P.B. Wiring D29485A2		
			P.B. Drilling D29486A4		
			Detail 2 D29521A4		
			FURTHER INFORMATION REQUIRED FOR MANUFACTURE		
			Unit Assembly Information EA10484		
			SPEC. ED/AM14/540		
1	1	*	Chassis CH1/57B. MODIFIED BY CONTRACTOR :- Frame DRILLED to:-		SPEC. ED/CH1/57 D29484A3, Det.1
2					
3	1	*	Unit Label		D29521A4, Det.2 & ESK2571 A3.
4					
5	1	*	Resistive Terminations Sealectro Type 61-001-0501	SK.A	
6	1	*	" " " " "	SK.D	
7					
8					
9	1	*	Bulkhead receptacle Sealectro Type 51.045.9009	PL.A	1-24682-503
10	1	*	" " " " "	PL.B	" "
11	1	*	" " " " "	PL.C	" "
12	1	*	" " " " "	PL.D	" "
13	1	*	PRINTED BD. ASSY. COMPRISING ITEMS;- 15, 23-42 44-55, 57-78, 81-86, 100		SPEC. ED/DO/1.
15	1	+	Printed Board		D29485A2, D29486A4
16					
17	1		6B.A. Solder Tag D/E		
18					
19					
20	A/R		Copper Foil Strip, .001" Thick		
			CAPACITORS FEED THROUGH		
21	1	*	0.002μF 1kV	C19	1-20638-286
22					
23	1	+	CAPACITOR, CERAMIC TUB. 2·2pF	C20	1-20671-018
24	1	+	" " " "	C21	" "

AM14/540. AMP. U.H.F. LOW POWER - PARTS LIST

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AM14/540
AMPLIFIER, U.H.F. LOW POWER.
PARTS LIST

DRN.	T.C.H.
TPD.	
CKD.	
APPD.	

DESIGNS DEPARTMENT

D29481 A4

sheet 1 of 3 sheets.

D29481 A4.
sheet 2 of 3 sheets.

ISS.	CHANGE
1	24 - 11 - 71 ITEMS 30 & 31 WERE L/2060 R.J.A.
2	27—4—72 ITEMS 31 & 32 WERE CF1116I(2) 220 PF. JCR.
3	6.11.72 ITEMS 25-28 STOCK Nos ADDED JRS
3A	

ITEM No.	No. OFF	SEE NOTE	DESCRIPTION	C'C'T REF.	BBC REF. OR DRG. No.
			CAPACITORS LEADLESS ± 20%		
25	1	+	5pF 250V Erie type LD 19.30 N 330	C7	1-20612-034
26	1	+	5pF " " " " "	C8	" "
27	1	+	5pF " " " " "	C13	" "
28	1	+	5pF " " " " "	C14	" "
29	1	+	10pF	C11	1-20612-046
30	1	+	10pF	C12	" " SEE NOTE
31	1	+	10pF	C1	" " △
32	1	+	10pF	C2	" "
33	1	+	220pF	C5	" 198
34	1	+	220pF	C6	" "
35	1	+	220pF	C17	" "
36	1	+	220pF	C18	" "
37	1	+	1000pF	C3	" 276
38	1	+	1000pF	C4	" "
39	1	+	1000pF	C9	" "
40	1	+	1000pF	C10	" "
41	1	+	1000pF	C15	" "
42	1	+	1000pF	C16	" "
43					
			INDUCTORS.		
44	1	+	Ferrite Bead	L2	L/1183
45	1	+	" "	L3	"
46	1	+	" "	L6	"
47	1	+	" "	L7	"
48	1	+	" "	L10	"
49	1	+	" "	L11	"
50	1	+	" "	L1	"
51	1	+	" "	L4	"
52	1	+	AIR CORE	L5	L/2060
53	1	+	" "	L8	"
54	1	+	" "	L9	"
55	1	+	" "	L12	"
56					
			RESISTORS METAL FILM 0.4W ± 2%		
57	1	+	47Ω	R7	1-26877-192
58	1	+	47Ω	R8	" "
59	1	+	47Ω	R13	" "
60	1	+	47Ω	R14	" "
61	1	+	200Ω	R3	" 318
62	1	+	200Ω	R5	" "
63	1	+	240Ω	R10	" 322
64	1	+	240Ω	R12	" "
65	1	+	270Ω	R16	" 325
66	1	+	270Ω	R18	" "
67	1	+	3kΩ	R2	" 428
68	1	+	3kΩ	R4	" "
69	1	+	10kΩ	R1	" 498
70	1	+	10kΩ	R6	" "

AM14/540 - PARTS LIST

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AM14/540 - PARTS LIST

DRN.	T. C. H.
TPD.	
CKD.	
APPD.	

DESIGNS DEPARTMENT
D 29481 A4
sheet 2 of 3 sheets.

D29481A4.

sheet 3 of 3 sheets.

ISS.	1	2	3	4	
CHANGE	24-11-71	ITEM 101 ADDED. C.J.A. R.B.A. 27—4—72	ITEM 96 WAS S.M.M TYPE CERAMIC No 1. JCR. 31.7.72.	ITEMS 93, 97-99 & + NOTE ADDED. ITEM 100 REVISED CF 7808 (3) JCR. 6.11.72.	ITEMS 73,74,77 & 78 WERE 10kΩ JKS 4A CF7886(6)

AM14/540 - PARTS LIST

ITEM No.	No. OFF	SEE NOTE	DESCRIPTION	C'C'T REF.	BBC REF. OR DRG. No.
			RESISTORS METAL FILM 0.4W ± 2%		
71	1	+	10kΩ	R9	1-26877-498
72	1	+	10kΩ	R11	" "
73	1	+	4·7kΩ	R15	" 445
74	1	+	4·7kΩ	R17	" "
75	1	+	10kΩ	R19	" 498
76	1	+	10kΩ	R20	" "
77	1	+	4·7kΩ	R21	" 445
78	1	+	4·7kΩ	R22	" "
79					
80					
			TRANSISTORS.		
81	1	+	BFW 92	TR1	
82	1	+	BFW92	TR2	
83	1	+	BFW92	TR3	
84	1	+	BFW92	TR4	
85	1	+	BFW92	TR5	
86	1	+	BFW92	TR6	
87					
88					
89					
			SCREWS For Fixing Items		
90	4		6BA x 5/16" LG.CH.HD.MS.Zn.P 15		
91					
92	1		6BA x 3/16" " " " " 17		
93	4		6BA x 5/16" CH.HD. ST. Zn.P. 13		
			WIRE.		
94	2"	*	PUN1/1M BLUE		SPEC. ED112/PUN1/1M
95					
96	A/R		SOLDER, MULTICORE LMP. COLOUR, R/B		
97	1		WASHER, S/P. 6BA. ST. Zn.P. 17		
98	4	*	WASHER, 8BA INSULATING N.S.F. 220011		
99	1	*	LABEL, SELF-ADHESIVE, GREEN, BLICK No 8		
100	2	+	3dB coupler, Sage Wirelm H0000		
			TO DRG. D29483 A4. SHT. 3. (MADE BY SPECIALIST FIRM)		
101	1		CARTON CARDBOARD		SPEC. ED/AM14/540

NOTE

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

Δ IT IS IMPERATIVE THAT DIFFERENT VALUES OF LEADLESS CAPACITORS ITEMS 25-36 ARE SUPPLIED & KEPT IN SEPERATE BAGS, CLEARLY MARKED WITH VALUE PRIOR TO ASSEMBLY.

\+ DENOTES ITEMS SUPPLIED AS PART OF ITEM 13 THESE ITEMS WILL BE SUPPLIED ON EMBODIMENT LOAN TO THE CONTRACTOR ASSEMBLING ITEM 13 BY THE BBC FREE OF CHARGE.

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DS/PLA4

AM14/540

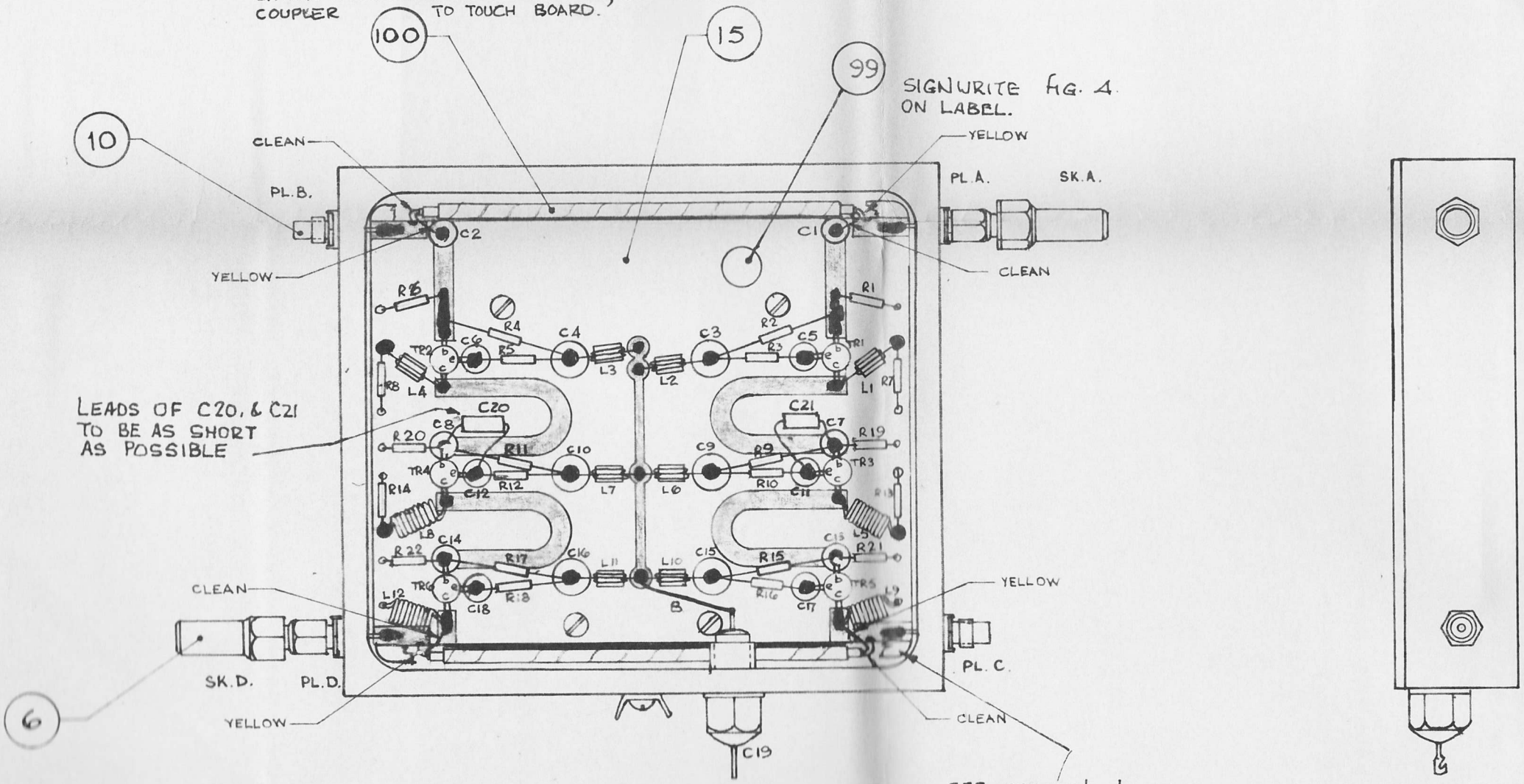
PARTS LIST

DRN.	T.C.H. DESIGNS DEPARTMENT
TPD.	
CKD.	
APPD.	GRC

D29481 A4

sheet 3 of 3 sheets.

N.B. 2 INNER CONDUCTORS OF SAGE WIRELINE COUPLER ARE CLEAN & YELLOW WRAPED RESPECTIVELY; ENSURE CONNECTIONS ARE AS SHOWN, BUT LENGTHS AS IN SCRAP DIAGRAM.



VIEW WITH LID REMOVED FOR CLARITY

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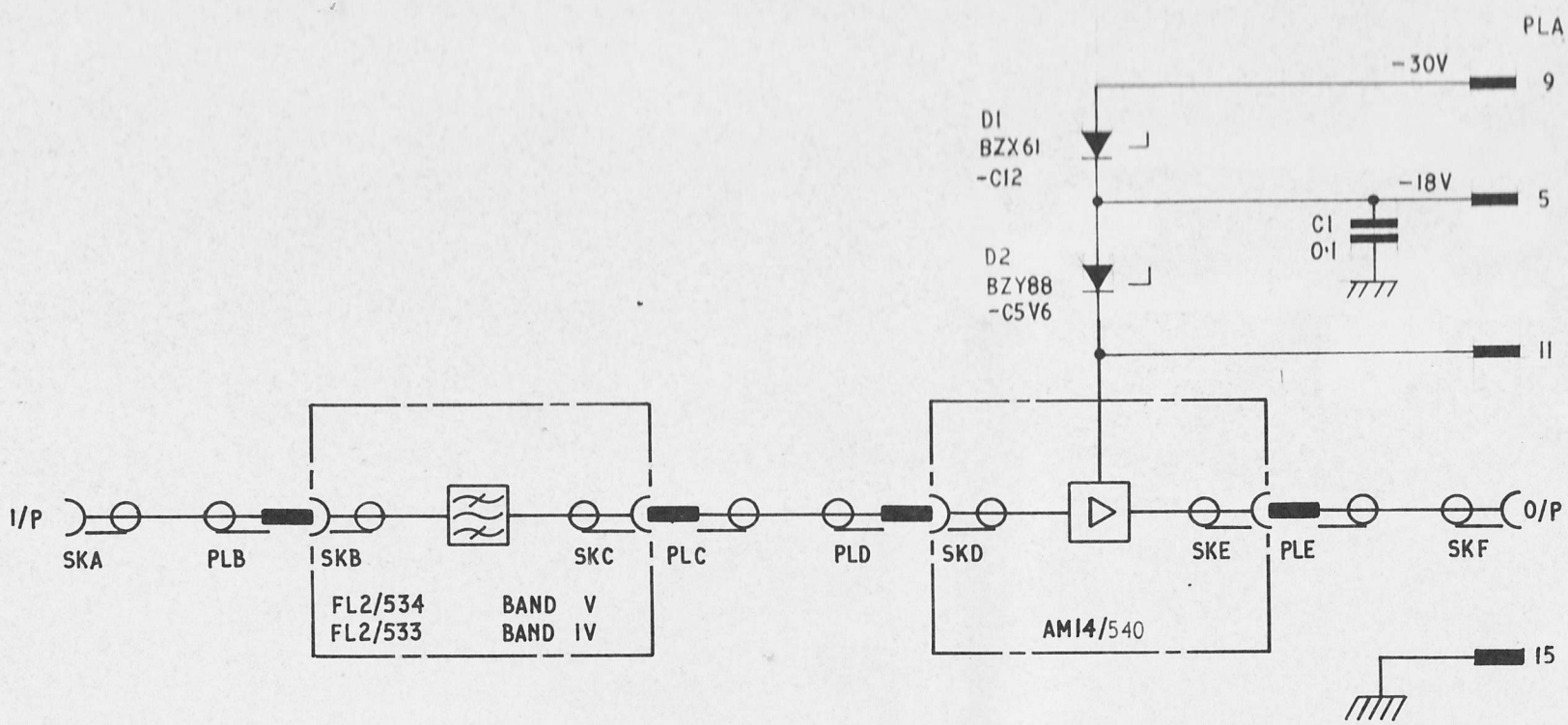
DS/A4

AM14/537 BLOCK DIAGRAM

D29125A4

CHANGE	ISS
9/3/71	1
AM14/540 WAS AM14/521 D2 & PLA 11 ADDED. D1 WAS BZY94 CF 11106(1) JRS 6-9-72	2



DRN

TCD DEK

CKD

APPD CRC

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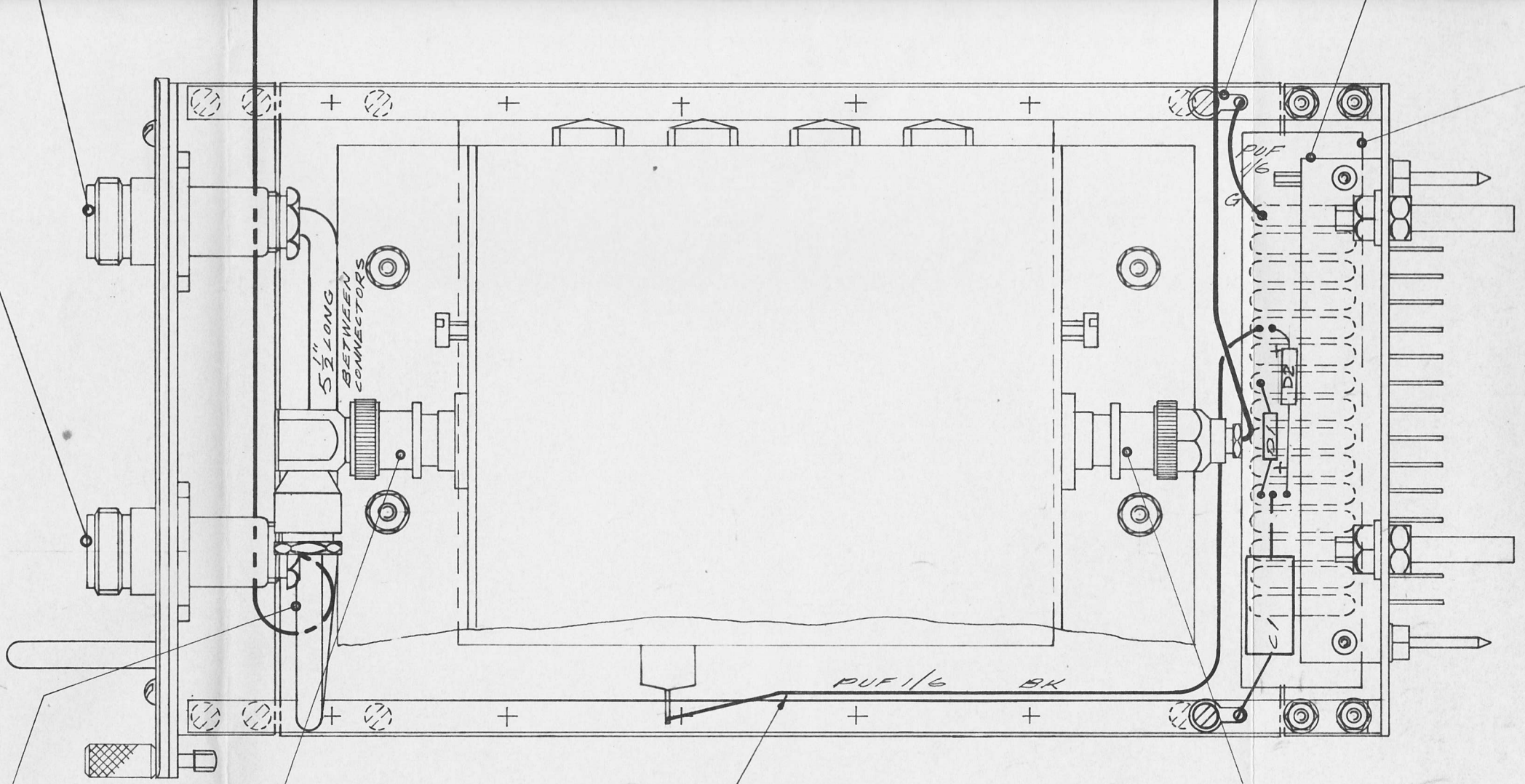
D29125A4

AM14/537 BLOCK DIAGRAM



6" LEAD TO BE LEFT UN-CONNECTED AT THIS END, BY CONTRACTOR. SUBSEQUENT CONNECTION TO BE MADE BY B.B.C. ON TEST.

AM14/537 ASSEMBLY & WIRING.