

DESIGNS DEPARTMENT

MANUFACTURING INFORMATION NO. 5.211(71)

UHF Drive Amplifiers AM14/539 and AM14/542

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

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

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DS/SPA4

DESIGNS DEPARTMENT MANUFACTURING INFORMATION NO. 5.211(71)

UHF Drive Amplifiers AM14/539 and AM14/542

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AM14/542

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AM14/539

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DESIGNS DEPARTMENT MANUFACTURING INFORMATION NO. 5.211(71)

UHF Drive Amplifier AM14/539 and AM14/542

1. Introduction

The AM14/542 was designed for the output stages of the EP7/513 and EP7/514 translators and active deflectors. The module is tunable to any channel in bands IV and V and supersedes all versions of the AM14/516 series. It operates comfortably at a level of  $\frac{1}{2}$  watt peak-sync-power plus sound.

The AM14/539 comprises the module mounted on a CH1/12A. Early units of this code used the AM14/516 module.

2. Electrical Technique

The amplifier uses the Englebrecht configuration. The input signal is split by a 3dB coupler and drives two identical amplifier circuits comprising an input matching circuit, stripline power transistor BLX92 and output tuned circuit. The two outputs are combined in an identical 3dB coupler. Using this configuration, input and output return losses are only governed by the similarity of the two amplifiers, not their independent return losses. The absolute mismatch at the amplifier inputs reflects power into the termination on the coupler's fourth port, not out of the input socket.

The gain of the module is the gain of the individual transistor stages which work in class A, common emitter mode. Failure of either half reduces both gain and power handling by 6dB.

3. Mechanical Construction

The amplifier consists of a single printed board carrying the two transistors and other components in two "mirror image" amplifiers. The 3dB couplers are coaxial "Wireline" cable cut to length and connected to the edge of the printed board. The whole is mounted in a cast box type CH1/57A and the transistors are bolted through the casting for heat dissipation. The connectors are sealectro "Snap-on" conhex, and the module can be mounted with a number of other CH1/57 type modules in the framework FW1/9.

The module can also be mounted conveniently elsewhere, e.g. on a CH1/12A in which case the unit bears the code AM14/539.

4. General Specification

The figures apply to the channel to which the amplifier has been aligned.

Gain	7dB to 9dB Band IV 6dB to 8dB Band V
Bandwidth	Greater than 12MHz at 1dB Greater than 30MHz at 1dB.
Impedance	50 ohms
Return losses: Input	> 20dB
Output	> 14dB

Recommended Load Return loss 20dB

Output power For 3 tone i.p. of 60dB:  $-\frac{1}{2}$  watt P.E.P.  
1dB compression: 2 watts

Normal operating output level  $\frac{1}{2}$  watt peak-sync-power plus sound carrier

Power Requirement: AM14/542 -20V  $\pm$  1V base supply and 300mA constant current emitter supply.

AM14/539 24 volts +1 volt -0 volts at 350mA

Connectors AM14/542 Seaelectro "Snap-on" conhex  
AM14/539 type 'N' Female

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UHF Drive Amplifiers AM14/539 and AM14/542

PRODUCTION TEST SCHEDULE

Measurements Required

Gain  
Frequency Response  
Return losses  
Power handling

} with tuning procedure

Equipment

Example

Sweep Generator, 0dBm out, 400-900MHz

Texscan VS60  
VS80  
Polyskop II

Switched attenuators 1dB and 10dB steps  
(unless incorporated in generator)

Coupler, 20dB

Hewlett Packard 7775D  
Narda Microline

Detector and Display of good sensitivity

Log amplifier, Texscan type 1  
LN40A. X-Y display, Texscan  
type DU88. UHF amplifier AM14/540  
or Selektomat and Polyskop.

High power three tone generating  
equipment, see section 2(c)

Power meter, Hewlett Packard  
type HP432A. Spectrum analyser,  
Hewlett Packard type 141T, 8554L  
and 8552B. 3 off, UHF oscillator  
General Radio type 1362. 2 off  
3dB UHF couplers, UHF amps. type  
AM14/541 and AM14/542.

Double Bench power supply 0 to 20 volts  
500mA

A number of 50 ohm leads, adaptors, coaxial attenuators (e.g. 3, 6 and 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 CH1/57A, 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. See that dust caps have been removed from all trimmers. If necessary, remove the board from the chassis to inspect the copper tape patches on the earth-plane side. Remove the nuts on the transistor studs carefully, take care to retain and replace any washers placed between the transistors and the chassis and replace the nuts on reassembly using a torque wrench ( oz/inches). These transistors cost about £8 each.

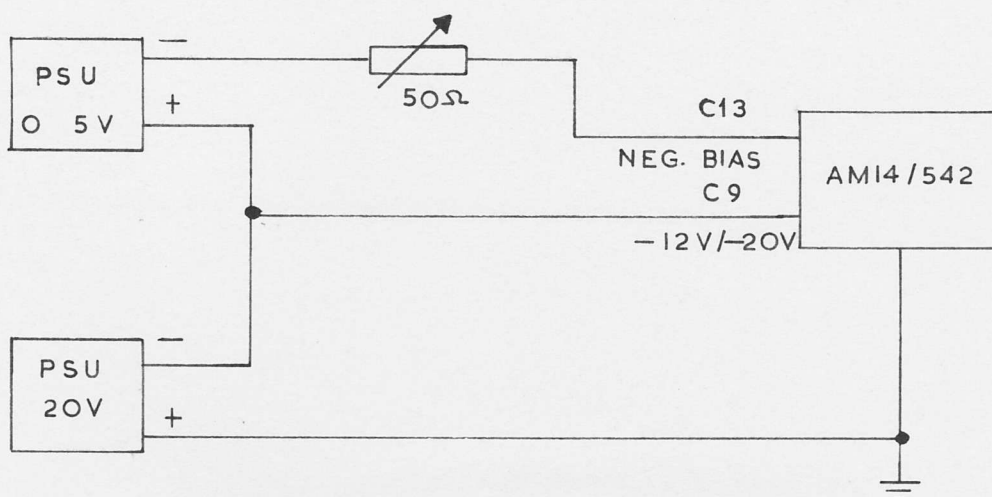
(b) Inspect the Sage "Wireline" 3dB couplers on the input and output. Check that lengths of exposed inner conductors are as per Order of Assembly instructions D 2934 A4 and that yellow and clean leads are correctly connected.

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(c) Connect power supply as shown:



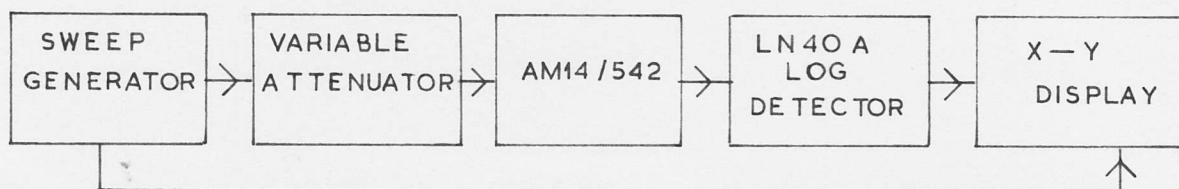
POWER SUPPLY CONNECTIONS

Adjust the upper power supply, or rheostat, till the current is 300mA. See that the base supply (-20 volts) takes the same current to within 5%. Measure the voltage drop across the emitter resistors R4 and R5, these should be within 5% of each other. Probable causes of any fault are broken leadless disc capacitors or wrongly orientated transistors.

(d) Return the amplifiers for completion of assembly.

2. Ensure that terminations are attached to PLA and PLD. These tests must be carried out on the channel at which each individual amplifier will be used, if the channel is not known the tests should be carried out on channels 21 and 66.

(a) Tuning and Gain/Frequency Responses.



FREQUENCY RESPONSE MEASUREMENT

Fig. 2.1

With approximately 0dBm output from the sweep generator into the LN40A, set up a convenient trace on the X-Y display. Insert the amplifier and attenuators and tune the amplifier to the required channel.

The generator must be centred on the channel, and it is convenient to start with a sweep greater than  $\pm 100\text{MHz}$  narrowing this to  $\pm 20\text{MHz}$  later.

Adjust all the trimmers for maximum output at the channel centre frequency (vision carrier  $+2.75\text{MHz}$ ) as shown on the X-Y display. Then measure the gain of the amplifier by noting the attenuation which has to be removed in order to maintain the same maximum overall gain when the amplifier is replaced by a through connection. Replace the amplifier in the test set up and reduce the attenuation by  $1\text{dB}$  in order to measure the  $1\text{dB}$  bandwidth. Ensure that gain and bandwidth are within the specification.

(b) Return loss

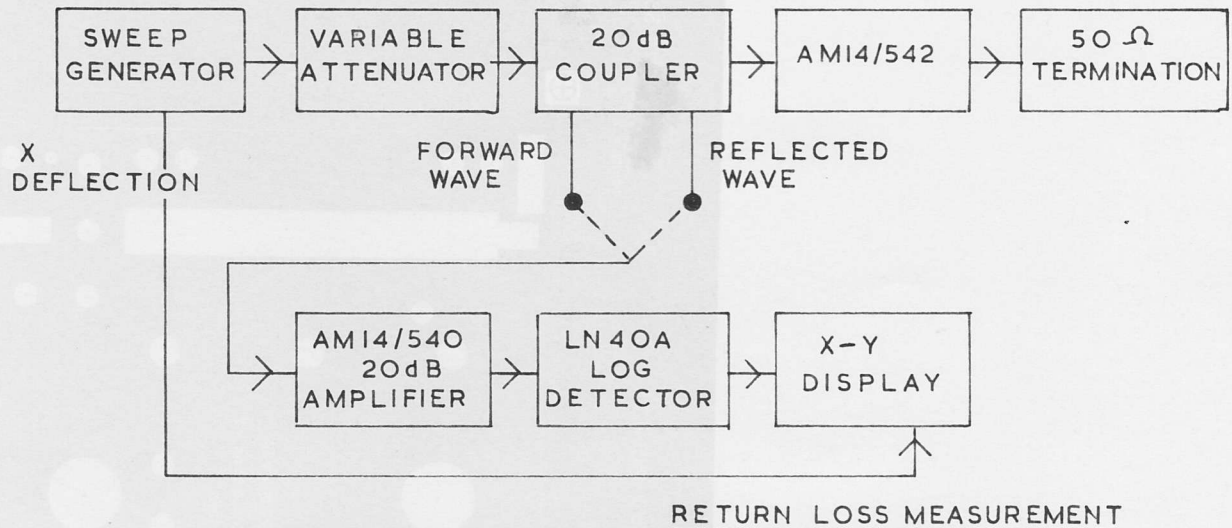


Fig. 2.2

The lead from the coupler to the amplifier under test must be less than three inches long. With approximately  $-20\text{dBm}$  from the generator, connect the detector amplifier's 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  $20\text{dB}$  and transfer the detector amplifier's input to the reflected wave port on the coupler. The return wave should be below the forward wave trace over the channel. Adjust the attenuator to measure return loss to the nearest dB. Slight adjustment of one of the input trimmers will usually bring the return loss well into specification. Otherwise change the positions of the terminations from PL A & FLD or PL B and PLC and measure return loss on the other input port. Failure on this test is usually due to a badly fitted wireline coupler. When satisfactory, affix input and output labels to the appropriate, chosen sockets. It is necessary to check the gain/response test if the input is changed over, or any serious adjustment or repair is made.

Reverse the amplifier and measure the output return loss. This must be  $14\text{dB}$  over the channel. Again, a slight adjustment of an output trimmer will correct small errors.

(c) Power Handling

(c) Power Handling

Set up the three tone generator as shown in the diagram below. An alternative arrangement may be used provided it can produce a signal with a peak envelope power of 150mW and intermodulation products > 70dB below PEP.

Connect the output of the amplifier to the spectrum analyser (via a 26dB pad), 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 to which the amplifier is tuned, 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.

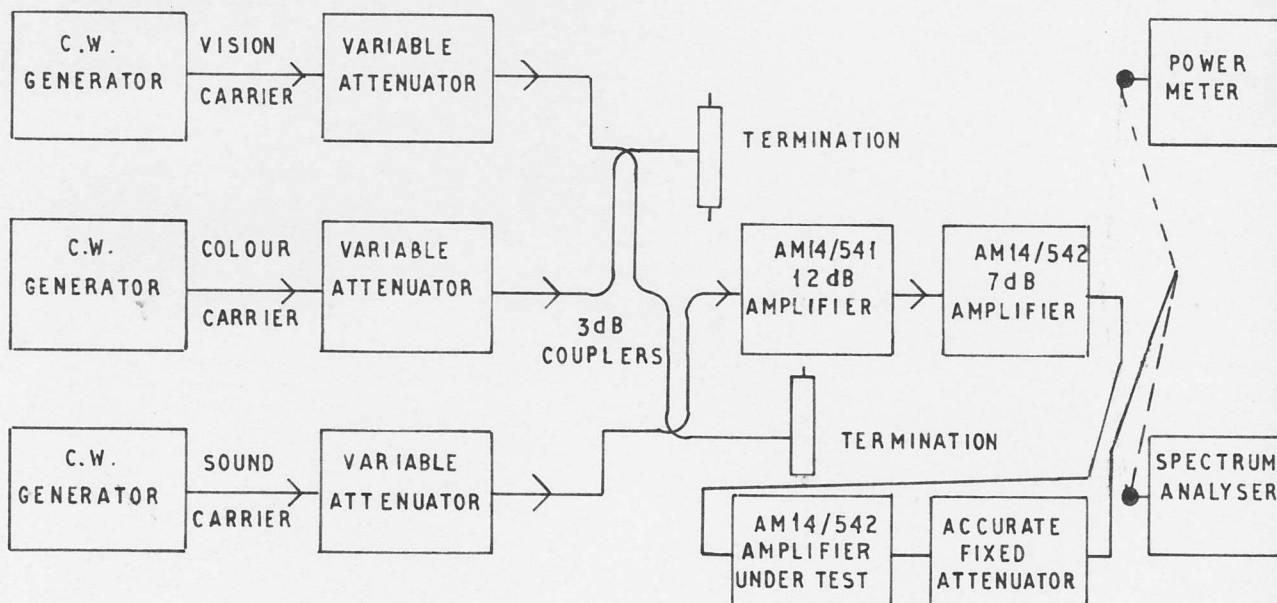
Connect the output of the amplifier to a power meter via the shortest possible lead and an accurate 30dB attenuator then adjust the attenuator connected to the input of the amplifier so that the power meter reads -7.2dBm, that is 34.2dB below 500mW. By adding 4.2dB to the power meter reading the peak envelope power is obtained (the power meter reads the mean power). Connect the output of the amplifier back to the spectrum analyser (via a suitable pad) 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 (1P) at V + 1.57MHz, it should be better than -60dB relative to the top line of the graticule.

(d) Labelling

Fix a label to the side of the cast box showing the channel number to which the amplifier has been tuned.

(e) Packing

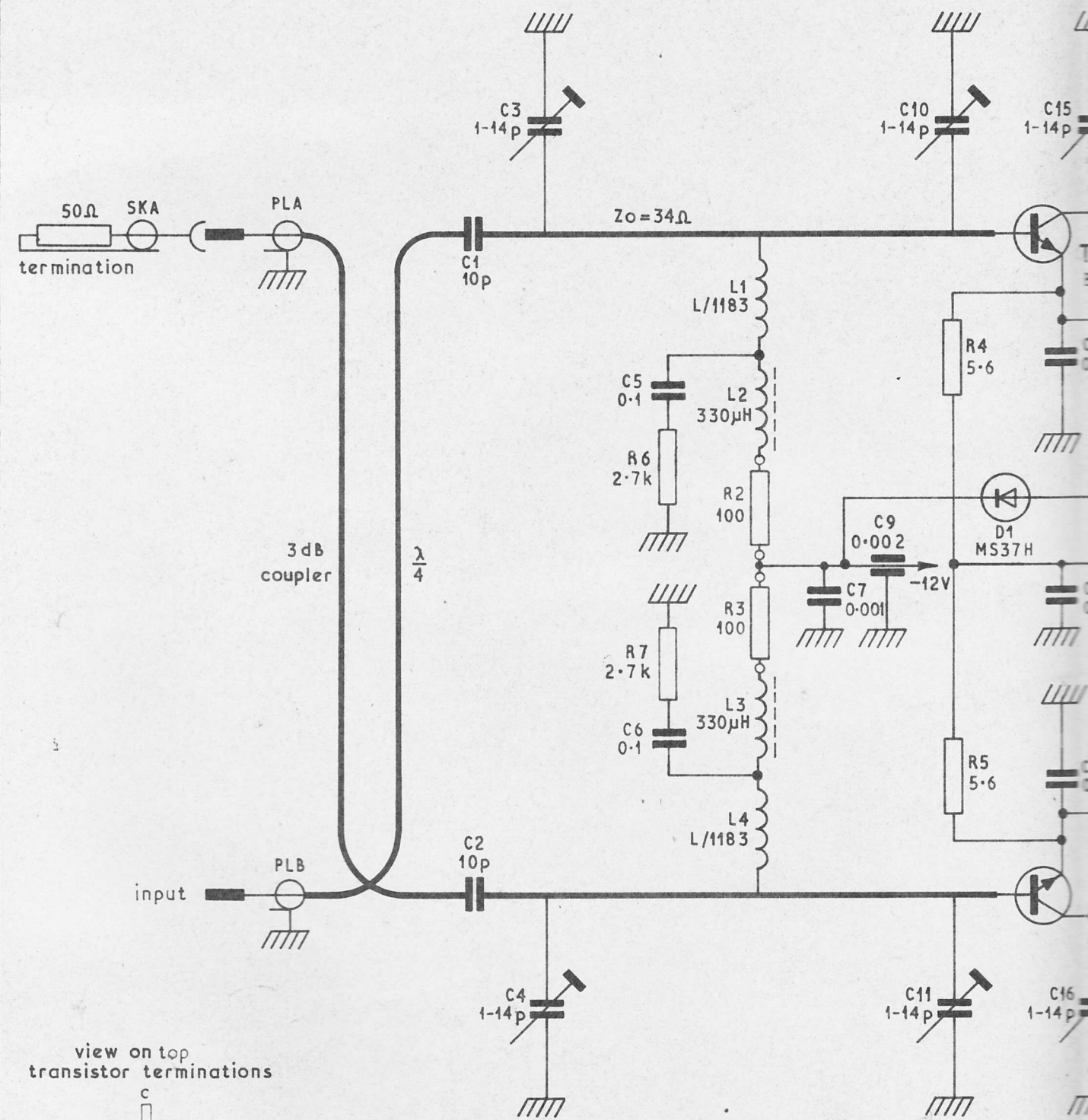
Before despatching amplifiers individually, i.e. not fixed into a chassis or framework, remove the two terminations and pack separately, or tape them onto the top of the amplifier to prevent damage.



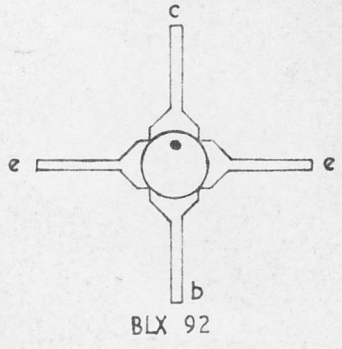
OUTPUT POWER MEASUREMENT



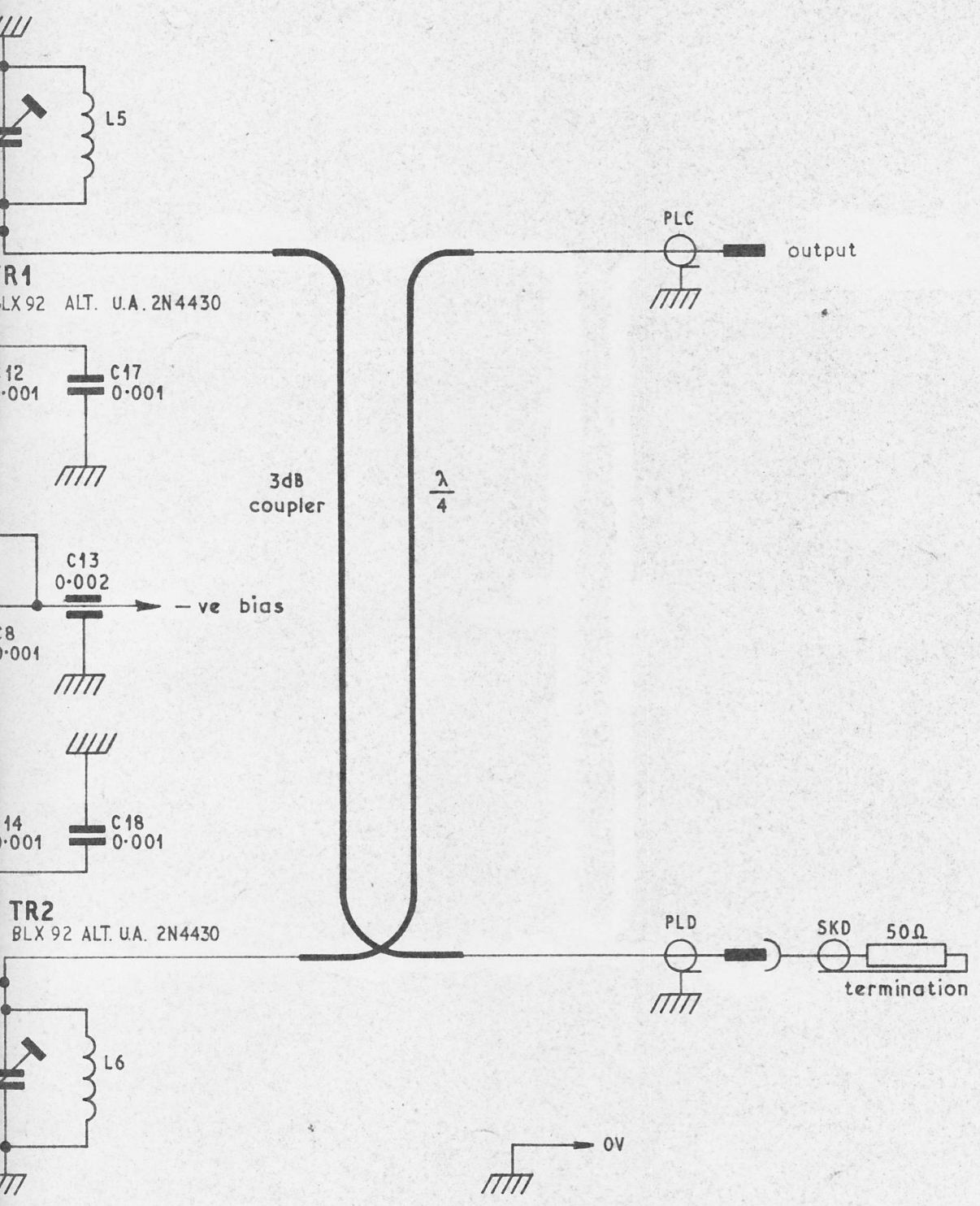
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view on top  
transistor terminations



CHANGE	ISS
17 / 11 / 71	1
TRANS. TYPE REVISED.	2
J.H. C.F. 11011(1)	
R.B.A. 20-4-72	



parts list : D29415 A4

ER CIRCUIT

DRN	T.C.H.	DESIGNS DEPARTMENT
TCD		
CKD	<i>[Signature]</i>	
APPD		
		D29414 A3

D29415 A4.

sheet 1 of 3 sheets.

AM14/542 - AMPLIFIER U.H.F. DRIVE PARTS LIST

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ISS.	CHANGE	ITEM No.	No. OFF	SEE NOTES	DESCRIPTION	CCT REF.	BBC REF. OR DRG. No.
1	17. 11. 71						
2	ITEM 1 REVISED. ITEMS 16-21 WERE AIRTRONIC TYPE. J.H. R.B.A 20-4-72						
3	ITEMS 4-5-7-10 C.S. NO. ADDED. ITEM 11 ADDED. ITEMS 12, 16-21 + WPS NO. ITEMS 16-21 GUEST NO. AT 3901 DELETED. GNG 7-11-72						
<u>DRAWING NUMBERS.</u>							
					Circuit	D29414A3	
					Parts List	D29415A4	
					Assembly & WIRING	D29416A2	
					Order of Assembly	D29434A4	
					Details 1&2	D29417A3	
					P.B. Wiring	D29418A2	
					P.B. Drilling	D29419A4	
					Detail 3	D29420A4	
<u>FURTHER INFORMATION REQUIRED FOR MANUFACTURE</u>							
					Unit assembly information	EA10484	
					UNIT WIRING INFORMATION	EA10140	
					SPEC. ED/AM14/542		
1	1	*			Chassis CH1/57A modified BY CONTRACTOR AS FOLLOWS:- Frame DRILLED TO:-		SPEC. ED/CHI/57 D29417A3, Det.1
2	1				LABEL, SELF ADHESIVE, BLICK REF 8 GREEN		
3							
4	1	*			Resistive Terminations	SK. A	1-27422-515
5	1	*			" "	SK. D	" "
6	1	*			Unit Label		D29420A4, Det.3 & ESK 2571 A3
7	1	*			Bulkhead receptacle	PL. A	1-24682-500
8	1	*			" "	PL. B	" "
9	1	*			" "	PL. C	" "
10	1	*			" "	PL. D	" "
11	1	*			P.B. ASSEMBLY COMPRISING ITEMS 12,16-21,27,28,30,31,33-38,44-49,51,52 55-58,60,61,72.		SPEC ED/DO/3
12	1	+			PRINTED BOARD		D29418A2, D29419A4
13	1				6 B.A. Solder Tag. D/E		
14							
15	A/R				Copper Foil Strip, 0.001" Thick VARIABLE CAPACITORS.		
16	1	+			1-14pF	C3	1-21213-007
17	1	+			1-14pF	C4	" "
18	1	+			1-14pF	C10	" "
19	1	+			1-14pF	C11	" "
20	1	+			1-14pF	C15	" "
21	1	+			1-14pF	C16	" "
22							

BBC  
DS/PLA4

AM14/542  
AMPLIFIER U.H.F. DRIVE  
PARTS LIST

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CKD.  
APPD

DESIGNS DEPARTMENT  
**D29415 A4**  
sheet 1 of 3 sheets.

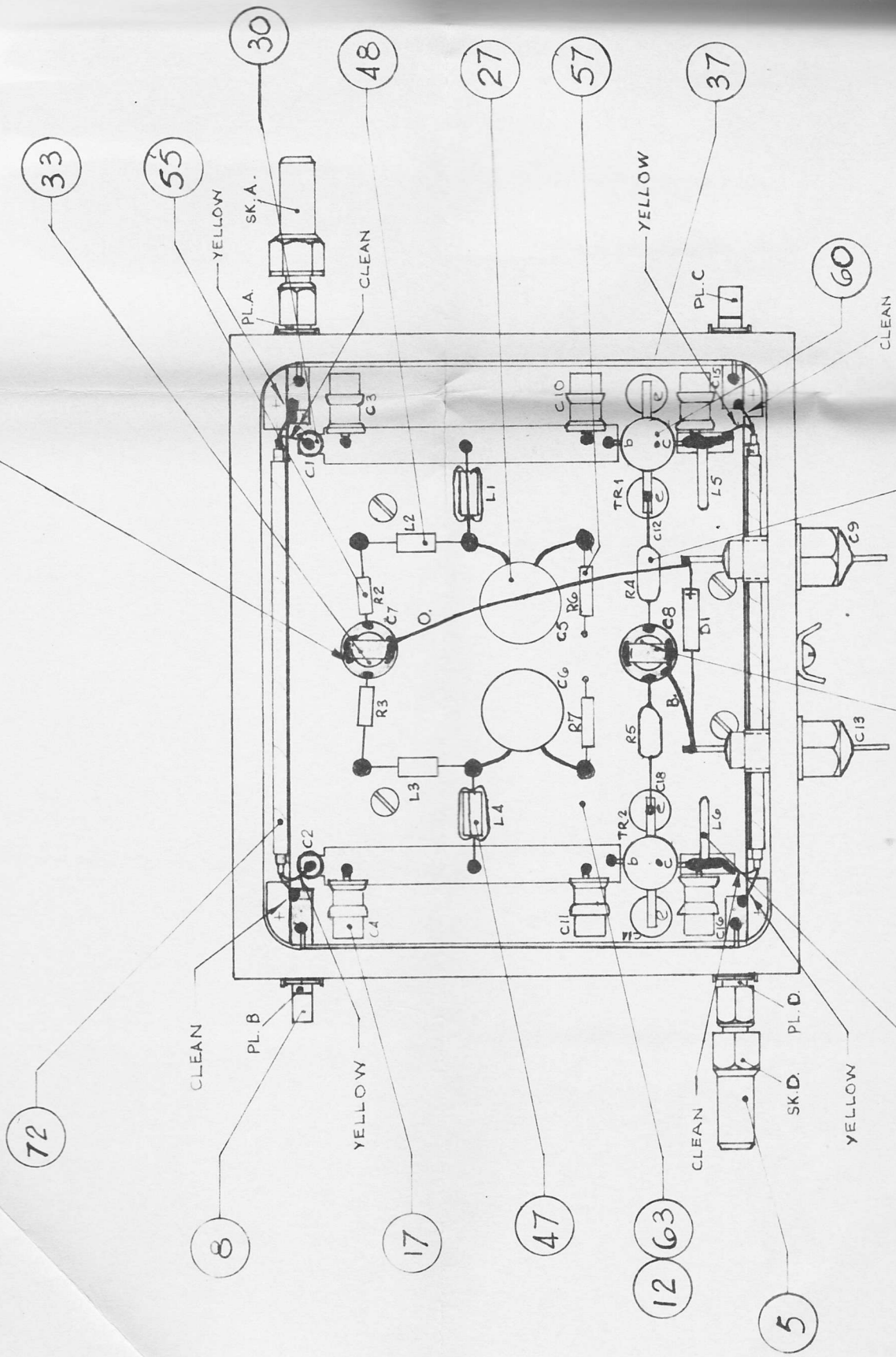
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CHANGE	ISS.
17. 11. 71.	1
ITEMS 60 & 61 MULLARD BLX92 ADDED. C.F. 11011(1)	2
S.M. R.B.A. 20-4-72 ITEMS 2128, 3031, 33-38, 46- 49, 51, 52, 55-58, 60, 61 + WAS * ITEMS 30, 31, 33-38, 48, 49. MANUF. TYPE N° DELETED. GNG T-11-72	3

ITEM No.	No. OFF.	SEE NOTES	DESCRIPTION	CCT REF.	BBC REF. OR DRG. No.
<u>CAPACITORS FEED-THROUGH</u>					
23	1	*	.002LF 1KV	C9	1-20638-286
24	1	*	.002LF 1KV	C13	" "
25					
26					
<u>CAPACITORS CERAMIC DISC.</u>					
27	1	+	0.1LF -25% + 50%	C5	1-20614-406
28	1	+	0.1LF -25% + 50%	C6	" "
29					
30	1	+	10pF 250V D.C. LEADLESS	C1	1-20612-046
31	1	+	10pF 250V " " "	C2	" "
32					
33	1	+	0.001LF 250V D.C. LEADLESS	C7	1-20612-276
34	1	+	0.001LF " " "	C8	" "
35	1	+	0.001LF " " "	C12	" "
36	1	+	0.001LF " " "	C14	" "
37	1	+	0.001LF " " "	C17	" "
38	1	+	0.001LF " " "	C18	" "
39					
40					
<u>DIODES.</u>					
41	1	*	MS-37H A.E.1	D1	
42					
43					
<u>INDUCTORS.</u>					
44	1		Silvered Copper	L5	D29417A3, Det.2
45	1		" "	L6	" "
46	1	+	Ferrite Bead	L1	L/1183
47	1	+	" "	L4	"
48	1	+	330uH ± 10% 0.2W	L2	1-21471-631
49	1	+	330uH ± 10% "	L3	" "
50					
<u>RESISTORS WIREWOUND 2 1/2W.</u>					
51	1	+	5.6Ω ± 5%	R4	1-27051-074
52	1	+	5.6Ω ± 5%	R5	" "
53					
54					
<u>RESISTORS METAL FILM 0.4W</u>					
55	1	+	100Ω ± 2%	R2	1-26877-298
56	1	+	100Ω "	R3	" "
57	1	+	2.7kΩ "	R6	" 425
58	1	+	2.7kΩ "	R7	" "
59					
<u>TRANSISTORS.</u>					
60	1	+	BLX92 MULLARD	TR1	IF NOT AVAILABLE ALT. UNITED AIRCRAFT 2N4430
61	1	+	" " "	TR2	
62					
<u>SCREWS</u> For Fixing Items					
63	4		6BA x 5/16" Lg. CH. HD. M.S. Zn. P		12
64	1		6BA x 3/16 " RD " " " " "		13
65	4		8BA x 3/16" " CH HD " " " "		12
66					



N.B. 2 INNER CONDUCTORS OF SAGE WIRELINE COUPLER ARE CLEAN AND YELLOW WRAPPED RESPECTIVELY, SOLDERED, IN POSITIONS SHOWN, TO C7 ENSURE CONNECTIONS ARE AS SHOWN, COUPLERS TO TOUCH BOARD. AND C8 AND SURROUNDING PADS



D 29416 A2

& WIRING

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ISS	CHANGE
1	17. 11. 71.
2	PARAGRAPH 4 REVISED TO 11030(2) PARA. 7 REVISED J.H. R.B.A. 20-4-72
3	SOLDER REVISED. PARA 4-B RENUMBERED & REVISED. GNG 14-11-72

IMPORTANT

Solder used for assembling capacitors on board must be "MULTICORE" L.M.P. COLOUR CODE RED/BLUE (2% SILVER) or equivalent, used with a 500°F soldering iron.

PART 1

All free components must be mounted touching the board. & WIRES AS SHORT AS POSSIBLE.

1. Take printed board, ready drilled and soft solder squares of copper foil in positions shown on D 29416A3 to underside.
2. Fit C7, C8, C12, C14, C17 and C18 (.001uF) to printed board by tinning one side of the capacitor and dropping it into the hole in the board on top of the foil. Applying the soldering iron to the pad on the bottom side of the board is easier and less likely to crack the capacitors for the absolute minimum time possible, and in any case less than five seconds.
3. Solder C1 and C2 (10pF) in position on top of the board, taking equal care.
4. FIT PRINTED BOARD TO THE ASSEMBLY JIG ESK2676A2 USING THE 4 THUMBNUTS & CHECK BOARD IS CORRECTLY SEATED.
5. Solder trimming capacitors C3, C4, C10, C11, C15 and C16 AS CLOSE AS POSSIBLE TO THE P.C. BOARD IN THE POSITIONS SHOWN, BUT KEEPING THE AXIS OF EACH TRIMMER PARALLEL TO THE P.C. BOARD SURFACE.
6. Solder L1, L2, L3, L4, L5 and L6 in position taking care that L5 and L6 are parallel to the top edge of the board.
7. Solder C5, C6, R2, R3, R6 and R7 to printed board in position shown. Do not fit R4, R5.
8. SOLDER THE EARTHING FOIL OF THE "SAGE" WIRE COUPLERS (ITEM 72 ON PARTS LIST D 29415A4) to underside of printed board with couplers in positions shown, then connect to topside of C1 and C2 and to adjacent pads, taking care to connect 'clear' and yellow wrapped wires as shown. All inner conductors must be kept as short as is possible. COUPLERS TO BE TOUCHING BOARD.
9. Tin upper surfaces of C12, C14, C17 and C18.
10. Identify collector leads on TR1 and TR2 and mark on transistor case using a dab of paint.

SPEC. ED/AM14/542

DRN.	T.C.H.	DESIGNS DEPARTMENT
TCD.		
CKD.		
APPD.		

D 29434 A4

Sheet 2 of 3 Sheets

AM14/542 ORDER OF ASSEMBLY

ISS	1
CHANGE	17. 11. 71
	PARA. 12 & 16 REVISED. PARA 17 ADDED. PARA 18-21 RENUMBER GNG 14-11-72
	2

11. Cut base and collector leads of TR1 and TR2 to approx 1/8" long and tin all four leads on both sides.

12. POSITION TRANSISTOR ON P.B. PASSING STUDS THRU' BOARD & JIG. HOLD IN POSITION USING THUMB NUT. (CARE TO BE TAKEN NOT TO OVERTIGHTEN) & SOLDER LEADS TO PRINTED BOARD.

14. Fit R4 and R5 making the connection to the transistor emitter quickly allowing the solder flow between emitter lead and C12 and C18. Solder down opposite emitter leads quickly.

15. Solder 1/8" wide strip of copper foil across capacitors C7, C8 and down to the board on each side.

16. REMOVE UNIT FROM JIG & RETURN UNIT TO B.B.C. TEST LABORATORY FOR INSPECTION & D.C. TEST ACCORDING TO PRODUCTION TEST SCHEDULE.

PART 2.

17. FIT AL. ALLOY WASHERS (ITEM 70) SMEARED WITH HEATSINK COMPOUND (ITEM 71) TO TR1 & 2 AND POSITION ASSEMBLED P.B. IN CHASSIS. SCREW DOWN P.B. & TIGHTEN TRANSISTOR NUTS TO A TORQUE OF 7.5 - 8.5 KG-CM.

18. Fit PL.A, PL.B, PL.C and PL.D to frame as shown, using shake proof washer provided, and discard nut. Solder inner to copper area on corner of printed board.

19. Fit C9 and C13 and earth tag to frame using shake-proof washers supplied, and solder blue and orange wires in position.

20. Solder D1 across C9 and C13, with positive (Cathode ringed) towards C9.

21. Fit terminations SK.A and SK.D to PL.A and PL.D and screw of lid.

SPEC. ED/AM14/542

BBC

AM14/542 ORDER OF ASSEMBLY

DRN. T.C.H. DESIGNS DEPARTMENT

TCD.

CKD.

APPD

D 29434 A4

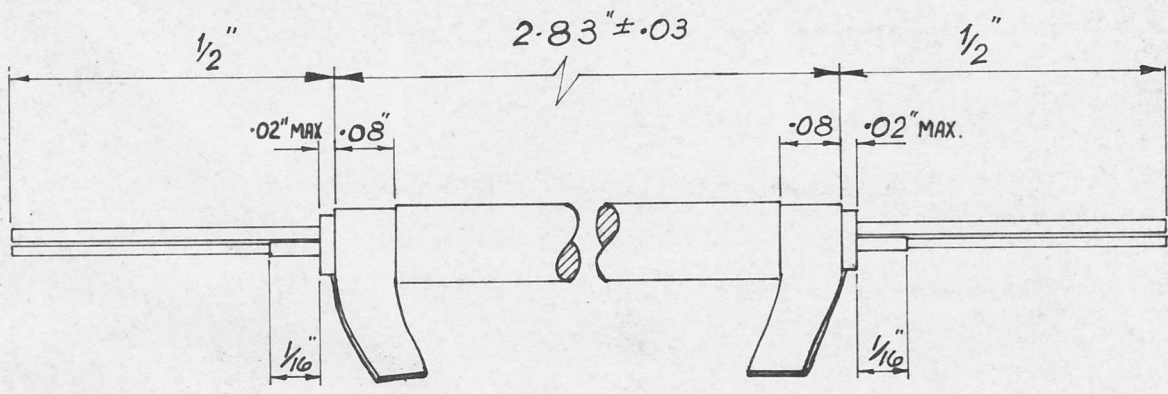
Sheet 2 of 3 Sheets

DS/A 4

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ISS	1
CHANGE	17. 11. 71
	2.83" REFERRED TO JACKET LENGTH, NOTES REVISED. GING 14-11-72.
	2



SCALE 4:1

STRIPPING OF WIRELINE HYBRIDS

- STEP 1. USING THERMAL STRIPPER REMOVE OUTER COVER FOR  $0.5 \pm 0.020$ " AT EACH END, DOUBLE WRAP FOIL WILL BE EXPOSED.
- STEP 2. UNWIND BOTH FOIL WRAPS TO OUTER JACKET, SO THAT TOTAL FOIL LENGTH IS  $2.83 \pm 0.03$ ", TIN THE INSIDE OF BOTH STRIPS & SOLDER TOGETHER KEEPING THEM AS TIGHT AND AS SQUARE AS POSSIBLE AGAINST THE SHOULDER OF THE OUTER JACKET. CUT TO APPROX:  $1/4$ " LONG.
- STEP 3. HEAT STRIP AND THEN TRIM THE TEFLON JACKET (THE LAYER UNDER THE FOIL) FROM THE TWO CONDUCTORS SO THAT NO MORE THAN 0.02" IS VISIBLE PAST THE FOIL WRAP. TAKE CARE WHILST TRIMMING NOT TO DAMAGE THE YELLOW FILM ON ONE CONDUCTOR WITHIN  $1/16$ " OF THE TEFLON COATING.
- STEP 4. STRIP THE YELLOW H-FILM BACK, TO WITHIN  $1/16$ " OF THE TEFLON COATING.

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SPEC. ED/AM14/542

BBC

AM14/542  
ORDER OF ASSEMBLY

DRN.		DESIGNS DEPARTMENT
TCD.		D 29434 A 4
CKD.		
APPD.		
		SHEET 3 OF 3 SHEETS

DS/A.4

D29417 A3

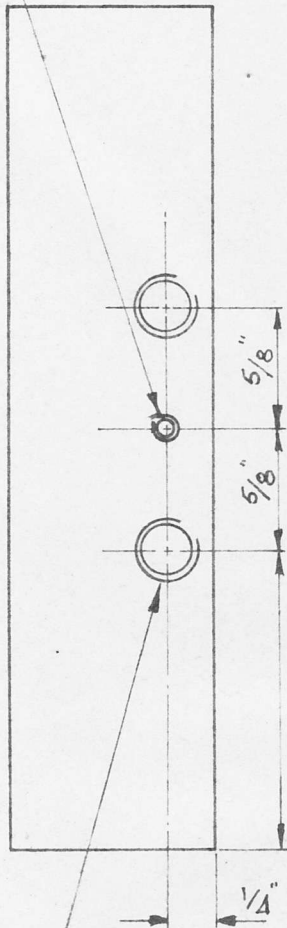
AM14/542 DETAILS 1&2

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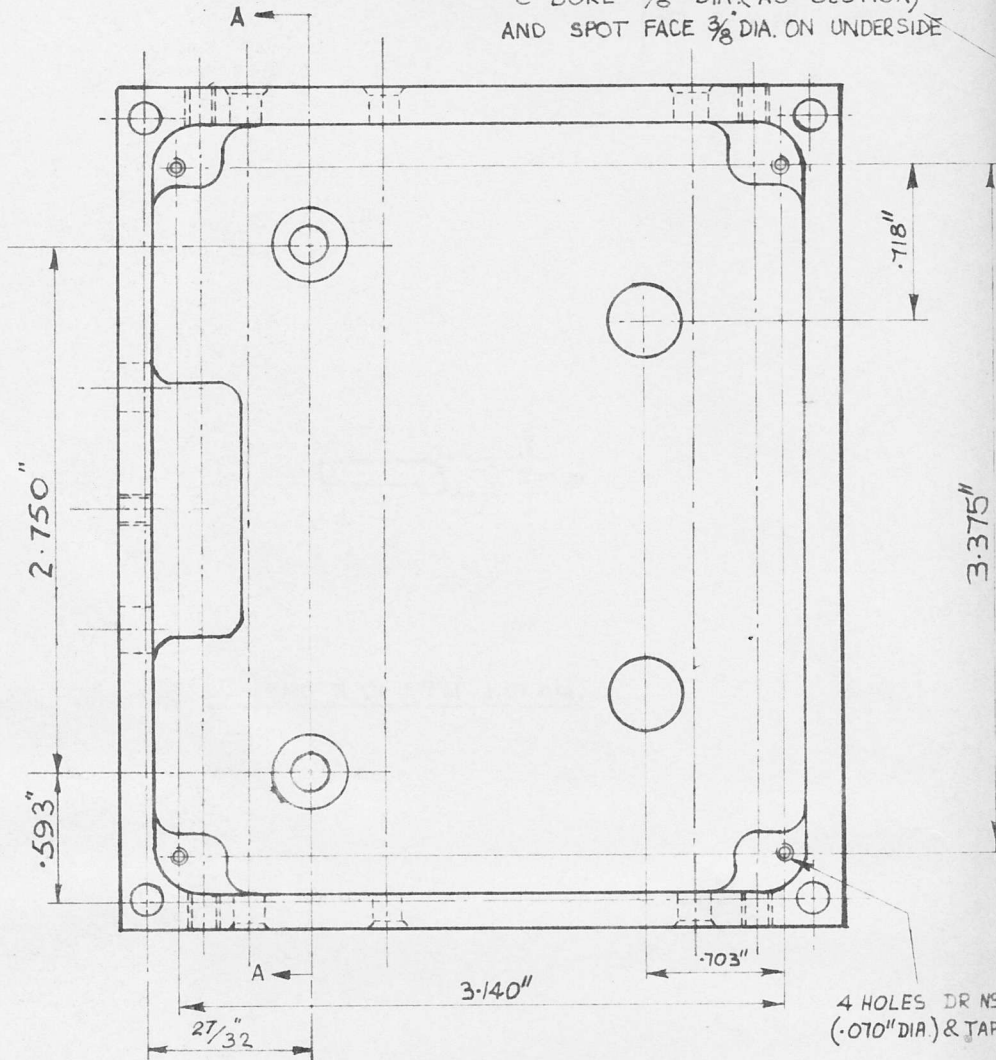
DS/A3

1 HOLE DRILL  $42 (.093")$  DIA.  
TAP 6 B.A.

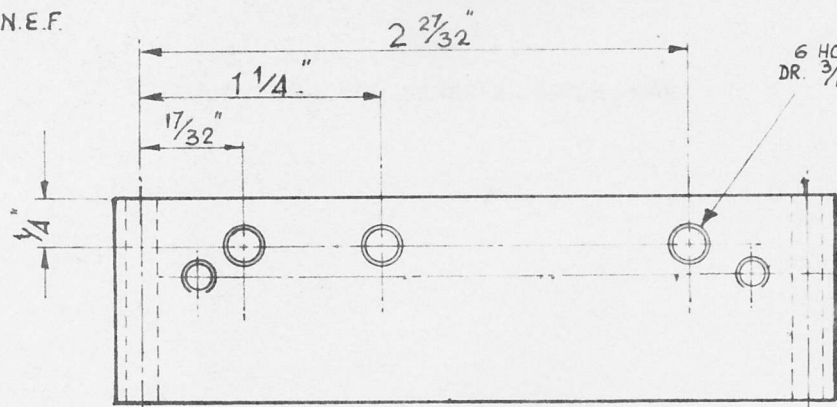


2 HOLES TAP  $5/16 - 32$  U.N.E.F.

2 HOLES DRILL  $3/16$  DIA AND  
C'BORE  $3/8$  DIA. (AS SECTION)  
AND SPOT FACE  $3/8$  DIA. ON UNDERSIDE



4 HOLES DR  $3/16$  DIA. & TAP



6 HOLES (3 EACH SIDE)  
DR.  $3/16$  DIA. & C'S'K 7/16

DETAIL 1: FRAME  
MATERIAL: CHI/57A FRAME  
FINISH: CLEAN

SCALE

AM14/542

DETA