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DESIGNS DEPARTMENT MANUFACTURING

INFORMATION No. 5.241(73)

UHF ACTIVE DEFLECTOR EQUIPMENT

EP7/514 A & B

.....
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for Head of Designs Department

Written by M.T. Ellen

JW

BBC

DS/SPA4

DESIGNS DEPARTMENT MANUFACTURING INFORMATION No. 5.241(73)

UHF Active Deflector Equipment EP7/514 A & B

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UHF Active Deflector Equipment EP7/514 A & B

1. INTRODUCTION

1.1 An Active Deflector is a low-power relay equipment which re-radiates a television signal on the same channel as its parent station. In order to prevent instability due to feedback from output to input, the isolation between the receive and transmit aerials is maintained at 30 dB greater than the maximum gain of the active deflector amplifier.

1.2 All the active RF units are made in cast metal boxes (CH1/57A and B) which are clamped firmly together in a framework (FW1/9). Power is supplied to each RF unit via "Filtercons" on the tops of the boxes and RF connections are made via SMB snap-on coaxial connectors on the sides of the boxes. Semi-rigid coaxial cable is used between each of the units in order to reduce power losses to the lowest possible amount.

1.3 The framework (FW1/9) is mounted on top of a panel (PN1/20) together with all the filters. The panel PN1/20) is mounted on top of another panel (PN3/23) which holds four plug-in chassis (bias unit and power supplies).

1.4 All the active RF Units can be removed by simply unplugging the SMB Connectors, unsoldering the power supply connections and unscrewing the clamp in the framework (FW1/9).

1.5 All the active RF Units have a nominal input and output impedance of 50 ohms and spare units can be fitted with minimal re-alignment. However, the high power amplifier (AM14/452) must be tuned to the required channel, and the AGC units may need adjustment to compensate for changes in gain.

1.6 For more detailed information see the handbook for the EP7/514 A & B (No.5.80 (73)).

2. GENERAL SPECIFICATION

Operating frequencies:

EP7/514A	channels 21 to 34 (Band IV) (tuned to required channel)
EP7/514B	channels 39 to 68 (Band V) (tuned to required channel)
Bandwidth	$\pm$ 0.5 dB from fv - 1.25 MHz to fv +6.25MHz (fv = vision carrier frequency.)
Frequency Response	At least -40 dB relative to gain at fv, at fv -18 MHz and fv + 22 MHz.
Output Power	500 mW (+27 dBm) peak evelope power (PEP) for 3 tone intermodulation product of -52 dB relative to PEP.

Nominal maximum sensitivity	0.5 mV (-53 dBm)
Nominal minimum sensitivity	6.3 mV (-31 dBm) A pad should be connected to the input for higher input levels.
AGC range	Median 1/P level +6 dB, -10 dB for output power variation of < ± 0.5 dB Median 1/P level + 6 dB, - 16 dB for output power variation of + 0.5 dB, -1 dB.
Nominal input and output impedance	50 ohms
Input return loss	>20 dB from fv -1.25 MHz to fv +6.25 MHz
Output return loss	>14 dB from fv -1.25 MHz to fv +6.25 MHz (not normally measured)
Recommended load return loss	>14 dB (no damage will result if the output of the EP7/514A or B is open or short circuited).
Output monitor coupling factor	20 dB to 25 dB dependent on the output channel.
Intercarrier detector sensitivity	Relay contacts closed when output power >-3 dB relative to nominal output power.
Spurious outputs	
fv -6 MHz	-53 dB relative to peak sync power.
fv +12 MHz	-53 dB relative to peak sync power.
Cross-modulation (vision on sound)	<4%
Noise figure	
sensitivity 1 mV	<9.5 dB
sensitivity 10 mV	<17 dB
Periodic signal/noise	>50 dB
Input socket	Type N
Output socket	Type N
UHF Monitor socket	Type TNC
Intercarrier detector output socket	PLH, 7 pin BBC Ref No. 11-24983-007 (pins 1 and 2)
Mains input socket	Cannon type XLR LNE 32

Mains input	195 volts to 265 volts, 50 Hz
Power consumption	160 watts (approx.)
Voltages and current drawn by each sub unit.	
AM14/540	-12V 80 mA
AM14/541	-24V 220 mA
AM14/542	-20V 300 mA (separate constant current supply)
UN3/541	+6V 8 mA to 30 mA
	-6V 12 mA
UN3/547	+6V 3.5 mA to 23 mA
	-6V 3.5 mA
MN2/522	+6V 28 mA
	-6V 26 mA
UN3/540	
Input	-12V
Output	-20V
not normally used	300 mA constant current supply CC1
	300 mA " " " CC2
	300 mA " " " CC3
	600 mA " " " CC4
PS2/121V	(+) 6 V 750 mA
	(-) 6 V 750 mA
PS2/74B	12V 3 A
PS2/74B	12V 3 A

UHF Active Deflector Equipment EP7/514 A & B

PRODUCTION TEST SCHEDULE

3.1 Equipment Required

	Example
Multimeter	AVO 8
Frequency Counter	Hewlett Packard Type 5245L with plug-in type 5253B
Power Meter	Hewlett Packard Type HP432A
Sweep Generator	Texscan VS60 or Polyskop II
20dB Coupler	Narda Microline
Detector and display of good sensitivity	
Log amplifier	Texscan Type LN40A
X-Y display	Texscan Type DU88
UHF amplifiers	2 x AM14/540
or	Selektomat and Polyskop
Three-tone generating equipment	
UHF Oscillators	3 x General Radio Type 1362
3dB couplers	FL1/27A
UHF amplifiers	AM14/540
Spectrum Analyser	Hewlett Packard Type 8554L and 8552B
Voltmeter detector tee	General Radio Type 874 - VQ
General purpose oscilloscope	Telequipment D67
Noise generator	Rohde and Schwarz SKTU
UHF receiver	Rohde and Schwarz USVD

3.2 All the measurements made during production testing must be recorded on the sheets provided (TCPD Acceptance Test Record, drawing number VMA4/987 to VMA4/996).

A set of Acceptance Test Record sheets has been included with this specification these sheets are for information only and they should be completed.

Final Assembly and Mechanical Inspection

3.3 By referring to test laboratory records check that the filters and AM14/542 amplifiers have been tuned to the required channels. Refer to the TCPD requisition for the relevant channel numbers.

3.4 Inspect the PN3/23 and check that all its plug-in units fit correctly without straining the framework or back wiring printed circuit board. Ensure that the framework (FW1/9) and all the passive sub-units are fitted securely to the PN1/20, and check that the PN1/20 is fixed to the PN3/23 (four knurled nuts at the corners of the horizontal panel).

3.5 Unscrew the clamping capstan and the two knurled bolts on the FW1/9, raise the top of the framework and check that the cast boxes (CH1/57A and B) can be removed without tilting. Ensure that aluminium covered rubber pads have been inserted between the boxes and at the rear end of the framework. With reference to the assembly and wiring drawing, check that the active sub-units have been fitted in the correct positions, then close the framework and tighten the capstan.

3.6 Referring to the assembly and wiring drawing shape and fit the semi rigid coaxial leads after checking that their connectors have been fitted satisfactorily. Also connect the flexible coaxial lead from the coupler unit to the output filter.

3.7 Check that all the switches, plugs and sockets have been fitted correctly and wired neatly (the tests described in sections 4.1 and 4.2 check if they have been wired correctly). Ensure that all the power supplies have been fitted with the correct fuses.

3.8 Check that the perspex label on the front panel shows the name of the relay station, BBC1 or BBC2, and the channel number, together with the relevant offset .

3.9 Inspect the runners on the sides of the active deflector and check that four metal spacers have been supplied to mount the equipment on a 19 inch bay.

3.10 Strip the end of all the wires routed along the top of the framework FW1/9 and bend the wires up so that they do not touch the amplifiers or each other. Connect PL'J' to SK'J' and connect a mains lead to SK'G' but do not switch on. Plug in the two PS2/74B power supplies, the PS2/121V power supply and the UN3/540 bias unit.

4. TEST PROCEDURE

D.C. Tests

4.1 Switch on the power to the active deflector, check that the red and green lamps on the PS2/74B power supplies are on and also check that the red lamps on the PS2/121V are on. If a fault condition is indicated unplug PL'J' to see if the fault is in the PN3/23 or the PN1/20 wiring.

4.2 Referring to the wiring diagram (D 31407 A1) use an Avo 8 to check the voltage on all the wires along the framework FW1/9 except the constant current sources and the AGC meter wire (NB the framework is the reference, 0 volts). Set the AVO 8 to its 1 amp FSD range and connect it between a -20 volt output (+ve lead) and each of the constant current outputs in turn, and check that the currents can be adjusted to their nominal values using the potentiometers on the front of the UN3/540. Also check the calibration of the left hand meter on the front panel against the readings on the Avo 8, the discrepancy should be less than 5%.

4.3 Switch the active deflector and solder the wires on the top of the FW1/9 to the units in the framework. Take care to connect the two wires to each AM14/542 correctly, and insulate the end of any unused wires.

4.4 Switch the active deflector on and check all the power supply voltages using the left hand meter and the meter switch. Also set the current fed to the AM14/542 amplifiers to 300 mA.

4.5 Leave the translator switched on for thirty minutes before carrying out the following RF tests (this time could be used to prepare the test equipment).

RF Tests

4.6 In order to isolate faults in the RF part of the active deflector, the sub-unit interconnections may be broken at any convenient point in the chain provided the impedance of the test equipment is 50 ohms.

However, it should be noted that the AGC unit will settle at minimum attenuation when the signal path is broken, and if a higher insertion loss is required S1 on the UN3/541 should be set to "MAN" and the "MAN" control should be adjusted to obtain the required loss.

4.7 Output Power, Sensivity and Stability

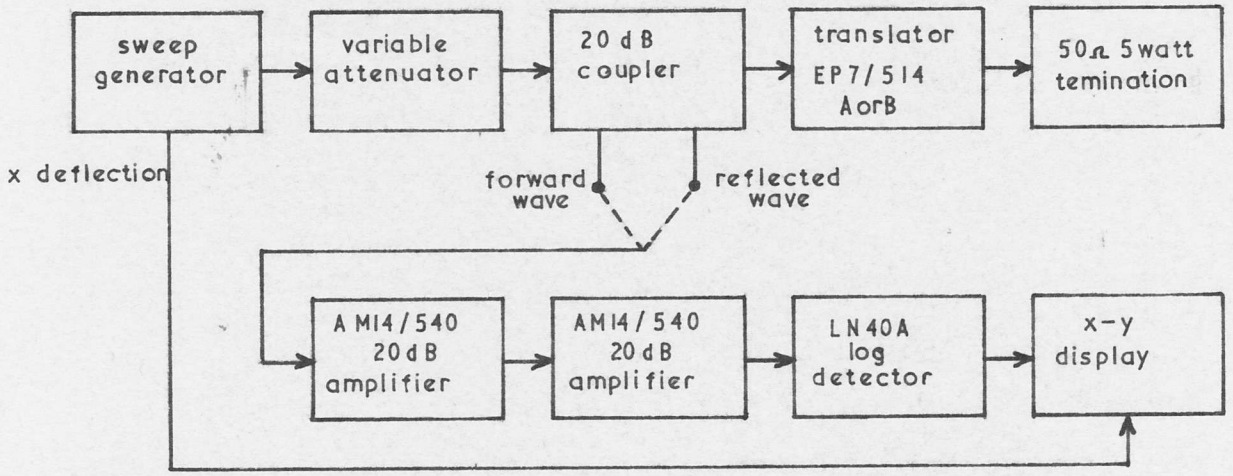
Connect a power meter to the output socket via a 30 dB attenuator. Set a UHF generator, tuned to the input channel, to 16 dB below the median input level and connect it to the input of the active deflector via a variable attenuator. With S1 on the UN3/541 set to "MAN" adjust R12 "MAN" to give minimum insertion loss for this unit, i.e. so that the front panel AGC meter reads "0". Adjust the variable attenuator to obtain the nominal output power and replace it with a fixed pad of the same value, this pad should now be regarded as the input of the active deflector. Increase the input level by 16 dB (to the median level) and adjust R12 "MAN" on the UN3/541 to give nominal output. Set S1 on the UN3/541 to "AGC" and adjust R10 "AGC" on the UN3/541 so that the active deflector gives its nominal output again. Measure and record the output level when the input is at the median level and repeat this measurement after about three hours. Now measure the output level when the input is adjusted to the median level (b) +6 dB, b -10 dB and b -16 dB, and record these levels in dB's relative to the output power when the input is at the median level.

4.8 UHF Output Monitor

With the active deflector set to its rated output power exactly, terminate the output and connect a power meter to the monitor socket SK'U' via a 10 dB pad. Measure the power out of themonitor socket and record it, also record the coupling factor in dB's (difference between the power at SK'G' and SK'U').

4.9 Input Return Loss

Set the equipment as shown in Fig.1.



RETURN LOSS MEASUREMENT.

FIG.1

Set the sweep generator to cover fv -4 MHz to fv + 10 MHz approximately. The lead from the coupler to the active deflector must be as short as possible. Set the generator to 14 dB below the median level of the active deflector (refer to TCPD requisition for the median level), connect the detector amplifier input to the forward wave port on the 20 dB coupler and set up a convenient trace on the X-Y display. Increase the generator output by 20 dB and transfer the detector amplifier input to the reflected wave port. The trace should be below the forward wave trace over the range fv -1.25 MHz to fv +6.75 MHz. Adjust the attenuator to measure the worst return loss over the channel and record its value and frequency.

4.10 Frequency Response

Set up the equipment as shown in Fig.2

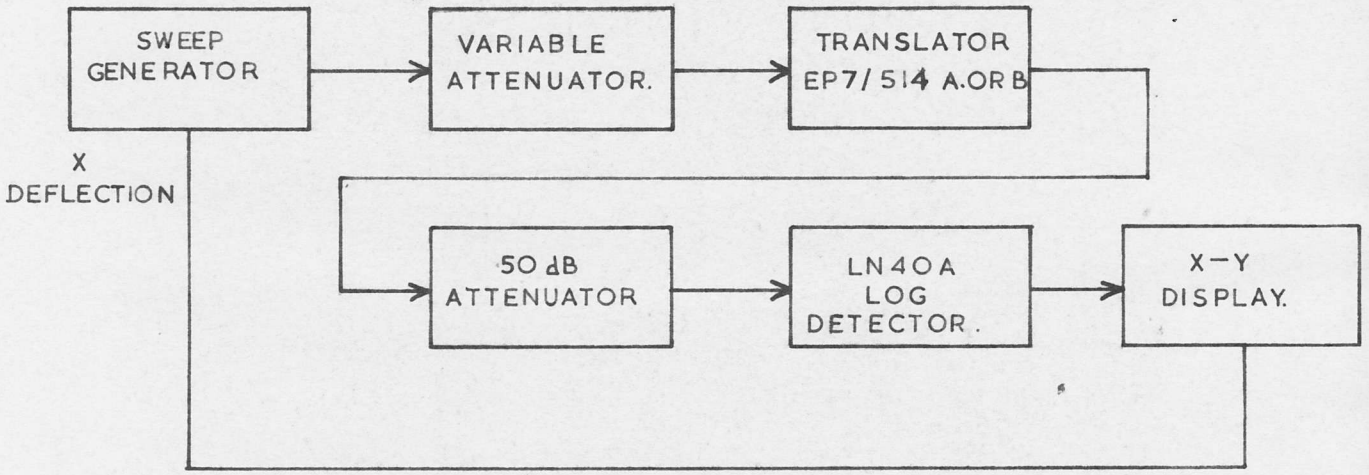


FIG 2 FREQUENCY RESPONSE MEASUREMENT

Set the sweep generator to cover fv -4 MHz to fv +10 MHz approximately and set its output level to the median input level of the active deflector. Switch S1 on the UN3/541 to "MAN". Adjust the gain control on the display to set the vision carrier frequency (fv) to a reference line, then using an accurate 1 dB stepped attenuator and interpolating between steps, make the following measurements:-

1. Highest gain in dB relative to gain at fv between fv -1.25 MHz and fv +6.75 MHz.

2. Frequency relative to fv of measurement (1).

3. Lowest gain in dB relative to gain at fv between fv -1.25 MHz and fv +6.75 MHz.

4. Frequency relative to fv of measurement (3).

5. Gain in dB\$ relative to gain at fv, at fv -2 MHz.

6. Gain in dB\$ relative to gain at fv, at fv +8 MHz.

If the results of these measurements do not conform with the specification the frequency response of the active deflector should be checked in two halves as follows:-

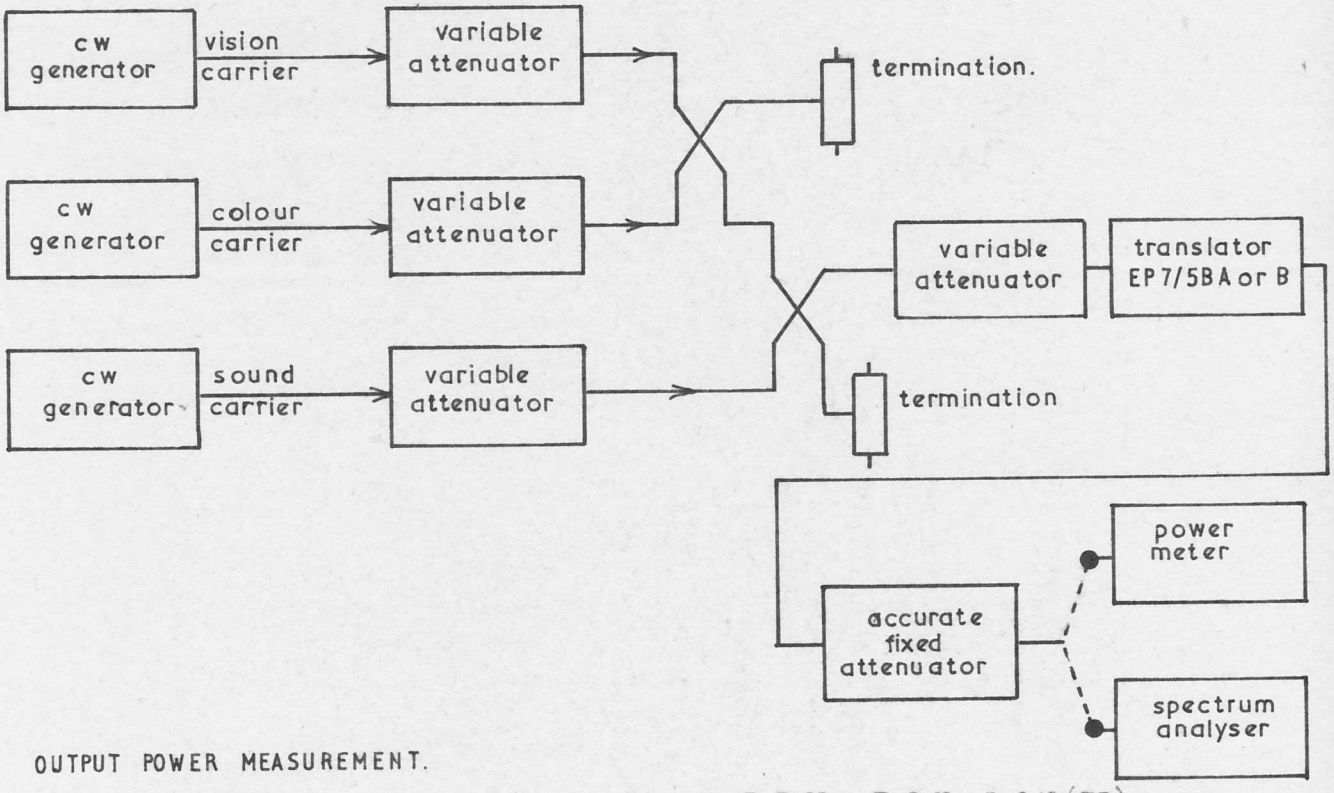
a) Disconnect the output of the second filter and connect it via a 10 dB pad to the logarithmic detector. Check that the gain from fv -1.25 MHz to fv +6.75 MHz is ±0.25 dB from the gain at fv, if it is not, check the response of each filter in turn (see filter production test schedules).

b) Connect the sweep generator via a 10 dB pad to the input of the last AM14/540 in the chain, and connect the output of the active deflector via a 50 dB pad to the logarithmic detector. Check that the gain from fv -1.25 MHz to fv +6.75 MHz is ±0.25 dB from the gain at fv, if it is not check the response of the output filter and AM14/542 amplifiers separately (see individual production test schedules).

Reconnect the second filter and set up the equipment as shown in Fig.2. If the response still doesn't conform with the specification the fault is probably due to a bad filter/amplifier impedance match. In order to connect for the mismatch, adjust the output coupling and output resonator of the second filter in the chain whilst observing the frequency response of the whole active deflector. Only a small adjustment (less than one turn) should be required, if the response cannot be varied sufficiently by this method there is a fault elsewhere in the active deflector.

4.11 Intermodulation Products

Set up the equipment as shown in Fig. 3



OUTPUT POWER MEASUREMENT.

Set S1 on the UN3/541 to "MAN". Connect the output of the active deflector to the spectrum analyser (via a 30 dB pad), tune it to the relevant channel and adjust the controls to give a reference line of -6 dBm, 10 dB/cm 1 MHz/cm. Adjust the frequencies of the generators to be the input vision carrier (fv), the sound carrier fv +6 MHz = f_s and the colour carrier fv +4.43 MHz = fc. Adjust the levels of the generators so that the spectrum analyser shows fv at -8 dB, fs at -7 dB and fc at -17 dB relative to the reference line of the graticule. Connect the output of the active deflector to the power meter via the shortest possible lead and an accurate 30 dB attenuator, then adjust R12 "MAN" on the UN3/541 so that the power meter reads -7.2 dBm, that is 34.2 dB below 500 mW (only a small adjustment should be necessary). By adding 4.2 dB to the power meter reading the peak envelope power is obtained (the power meter indicates mean power). Connect the output of the active deflector back to the spectrum analyser (via a 30 dB pad) and adjust its sensitivity to show fv at -8 dB, fs at -7 dB and fc at -17 dB relative to the top line of the graticule. Measure and record the level of the intermodulation product (IP) at fv +1.57 MHz and fv -1.57 MHz relative to the top line of the graticule under the following conditions:-

1. Median input level (as set up in above paragraph).
2. Median input level + 1 dB
3. Median input level +2 dB.
4. Median input level -1 dB.
5. Median input level -2 dB.

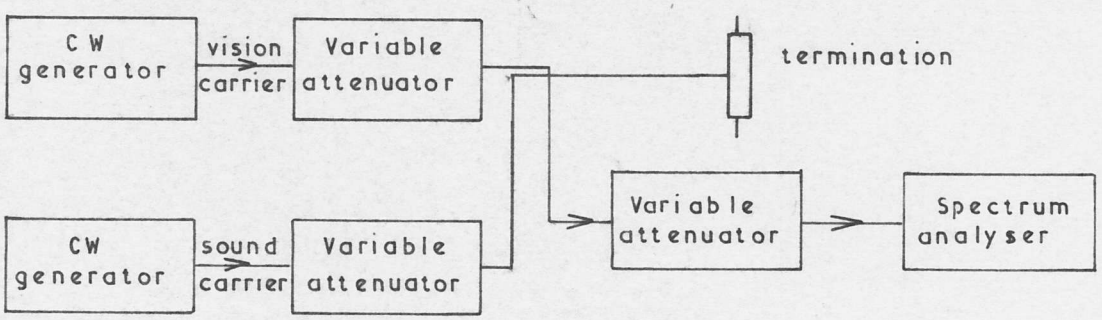
Before making each measurement, adjust the sensitivity of the spectrum analyser to show fv at -8 dB relative to the top line of the graticule.

Now set the input back to the median level then measure and record the best and worst IP levels as the fc oscillator is tuned between fv +2.8 MHz and fv +5.5 MHz.

Set the fc oscillator back to fv +4.43 MHz, switch S1 on the UN3/541 to "AGC", connect the output of the deflector to the power meter via an accurate 30 dB attenuator and adjust R10 "AGC" on the UN3/541 so that the power meter reads -7.2 dBm. Connect the output of the translator back to the spectrum analyser (via a 30 dB pad) and measure the inter-modulation products at fv +1.57 MHz and fv -1.57 MHz when the input level is a) increased by 6 dB and b) decreased by 10 dB. Record the results.

4.12 Spurious Emissions

Set up the equipment as shown in Fig.4.



Set the vision carrier to the median input level for the active deflector and set the sound carrier 7 dB below the vision carrier level. Set up the equipment as shown in Fig.5.

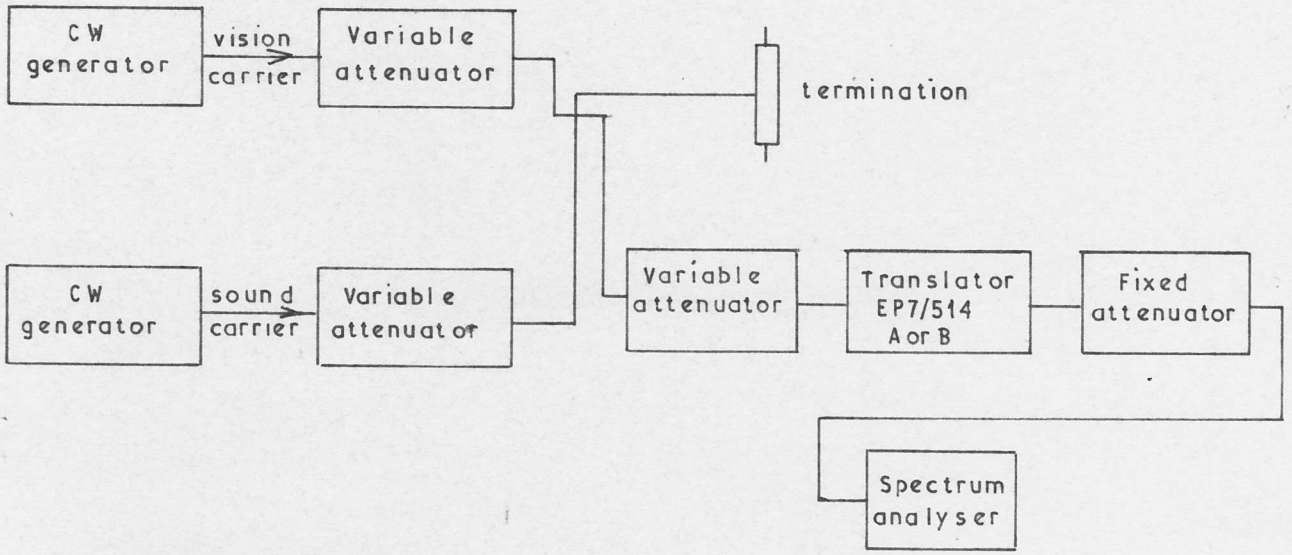


FIG. 5 SPURIOUS EMISSIONS MEASUREMENT

For this test S1 on the UN3/541 should be in the "MAN" position. Measure and record the level of the signals appearing at fv -6 MHz and fv +12 MHz relative to the level of fv. Increase the input level by 6 dB and repeat the above measurement.

4.13 Cross Modulation of Sound Carrier

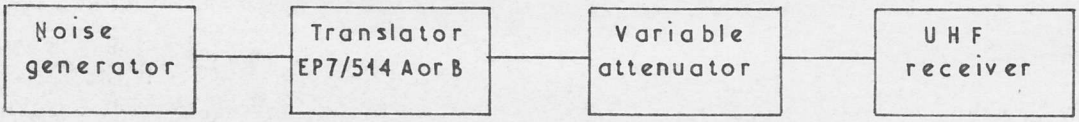
Set up the equipment as shown in Fig.4, set the vision carrier to the median input level for the active deflector and set the sound carrier 7 dB below the vision carrier level. Set up the equipment as shown in Fig.5 with S1 in the UN3/541 on "AGC". Tune the spectrum analyser to the sound carrier, switch off the sweep and set the scale to linear. Measure and record the sound carrier amplitude (S) in mV then remove the vision carrier and re-measure the sound carrier amplitude (W) in mV. The cross modulation is given by

$$\frac{W - S}{W} \times 100\%$$

Record the cross modulation percentage and ensure that it conforms with the specification.

4.14 Noise Figure

Set a UHF generator, tuned to the vision carrier frequency, to 1 mV output and connect it to the input of the active deflector. Set S1 on the UN3/541 to "MAN" and adjust R12 "MAN" to give the rated output power. Disconnect the UHF generator and set up the equipment as shown in Fig.6.



NOISE FIGURE MEASUREMENT

Fig. 6

With the noise generator set to zero output adjust the variable attenuator to zero and note the noise output level. Set the attenuator to 3dB and adjust the output of the noise generator to give an identical noise output level. The meter on the noise generator gives a direct reading of the translator noise figure, ensure that it conforms with the specification and record the result.

Repeat the above procedure with the UHF generator set to 5mV, but set the variable attenuator to 2dB instead of 3dB and add 2.2dB to the noise figure reading obtained on the noise generator. This procedure extends the effective range of the noise generator (type SKTU) to 17.2dB. Ensure that the noise figure conforms with the specification and record the result.

Reset the sensitivity of the active deflector as shown in section 4.7.

4.15 Periodic Noise (Hum)

Set S1 on the UN3/541 to "AGC" and connect a UHF generator, tuned to the input vision carrier frequency and set to the median input signal level, to the input of the active deflector. Connect the output of the active deflector to a voltmeter detector tee and thence to a 30 dB pad and a power meter. Measure the d.c. voltage (V1) at the detector output with and oscilloscope (check that the output power is set to its nominal value). Remove the UHF input signal and measure the new voltage (V2).

Reconnect the UHF input signal and measure the peak to peak hum (V3) at the output of the detector.

$$\frac{\text{peak to peak hum amplitude (mv)}}{\text{peak to peak amplitude of the picture luminance signal (mv)}}$$

$$= 20 \log \frac{V_3}{(V_1-V_2)\ 0.56} \text{ dB}$$

Substitute the measurements in the above equation, ensure that the resulting figure conforms with the specification and record the result.

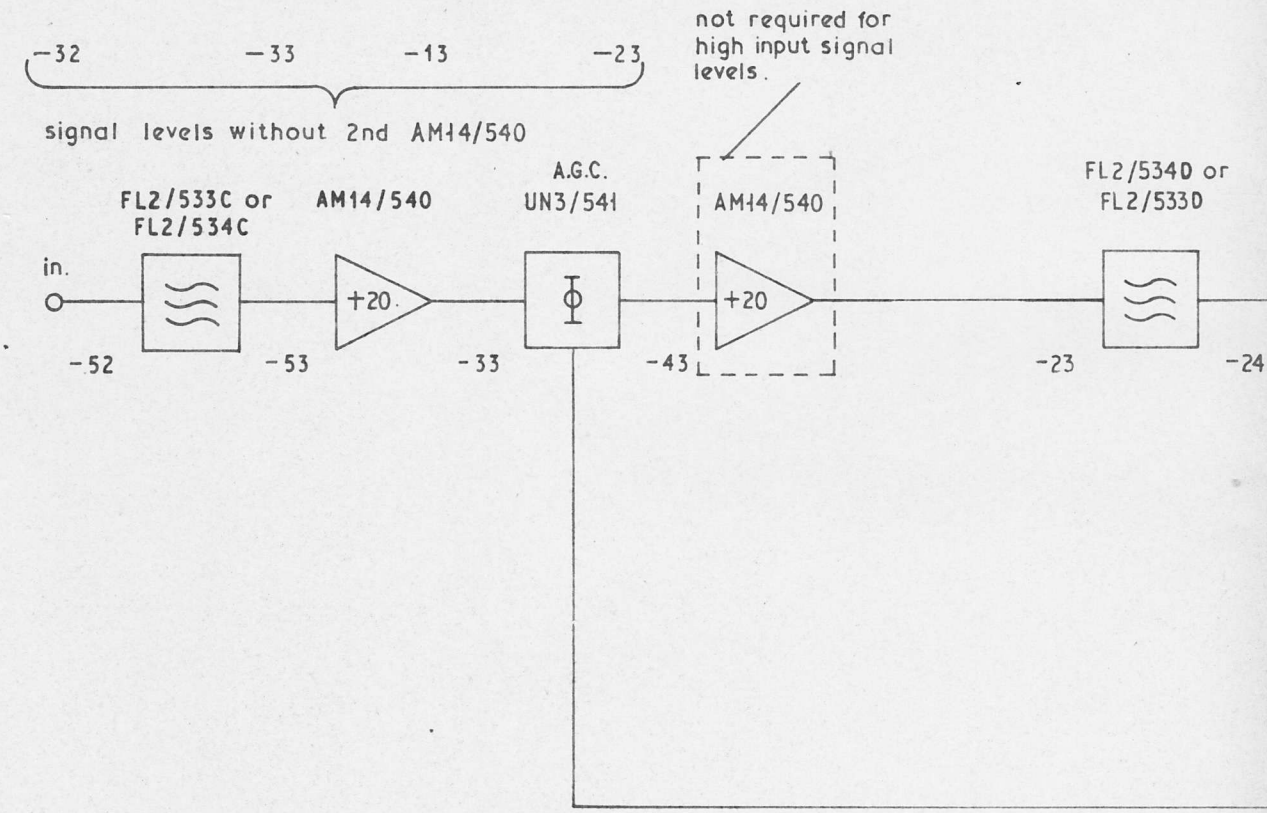
4.16 Intercarrier Detector Sensitivity

Set up the equipment as shown in Fig.4 and switch S1 on the UN3/541 to "AGC". Connect an AVO 8 set to its ohms range between pins 1 and 2 of PL'H' and reduce the input level of the active deflector until the output level drops by 3 dB. Adjust R12 on the MN2/522 until pins 1 and 2 are open circuit, then re-adjust R12 until pins 1 and 2 are closed circuit. Reduce the output level by a further 3 dB and check that pins 1 and 2 become open circuit. If pins 1 and 2 do not become open circuit when the output level is 6 dB below nominal, the sensitivity of the MN2/522 should be reduced by adjusting R12 when the output level is 1 or 2 dBs below nominal.

Pins 1 and 2 of PL'H' should be closed circuit when the output is greater than 3 dB below nominal output power, and they should be open circuit when the output is less than 5 dB below nominal output power.

D314O6A3.

EP7/514A&B. R.F. BLOCK DIAGRAM.



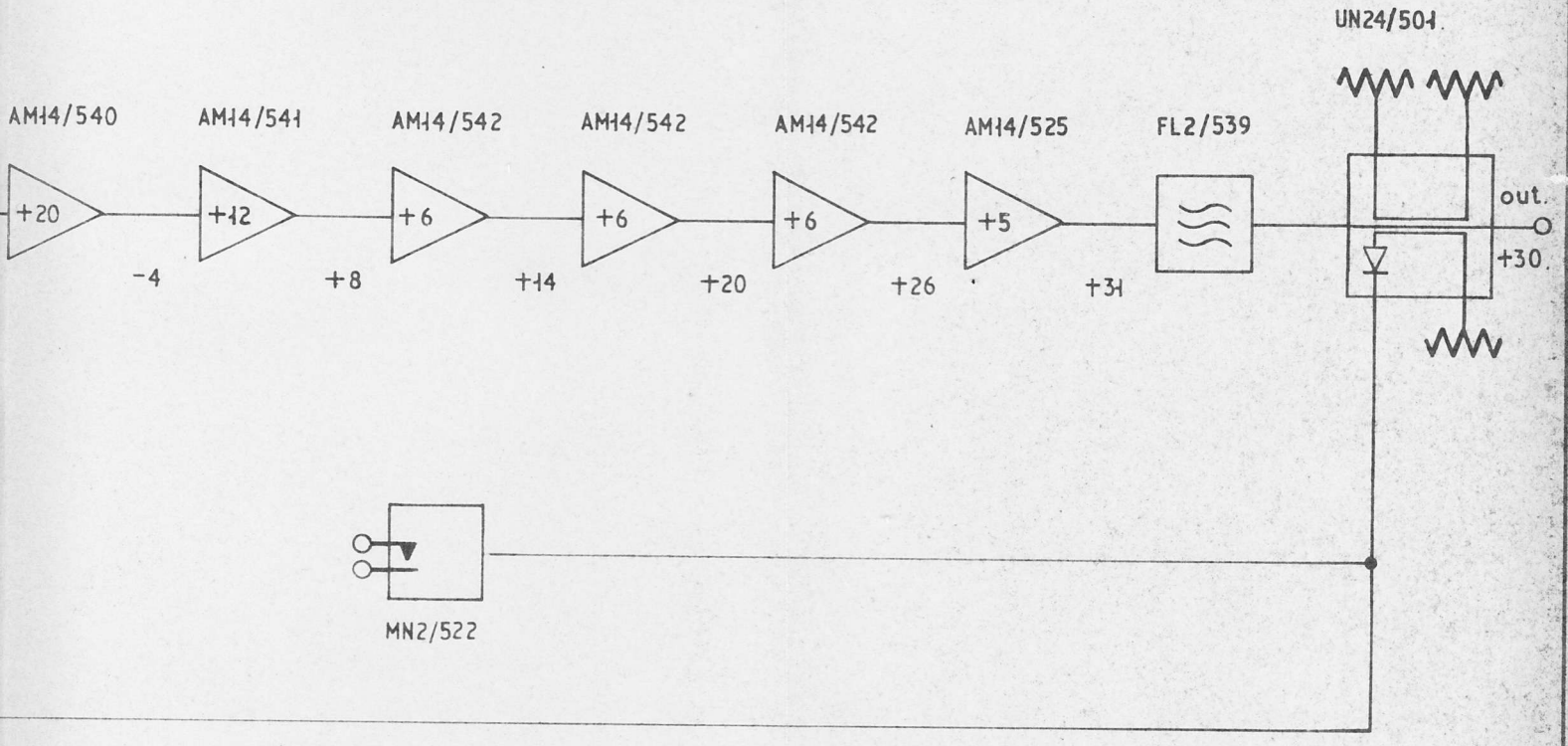
Note. All levels in Dbm

BBC

DS/A3

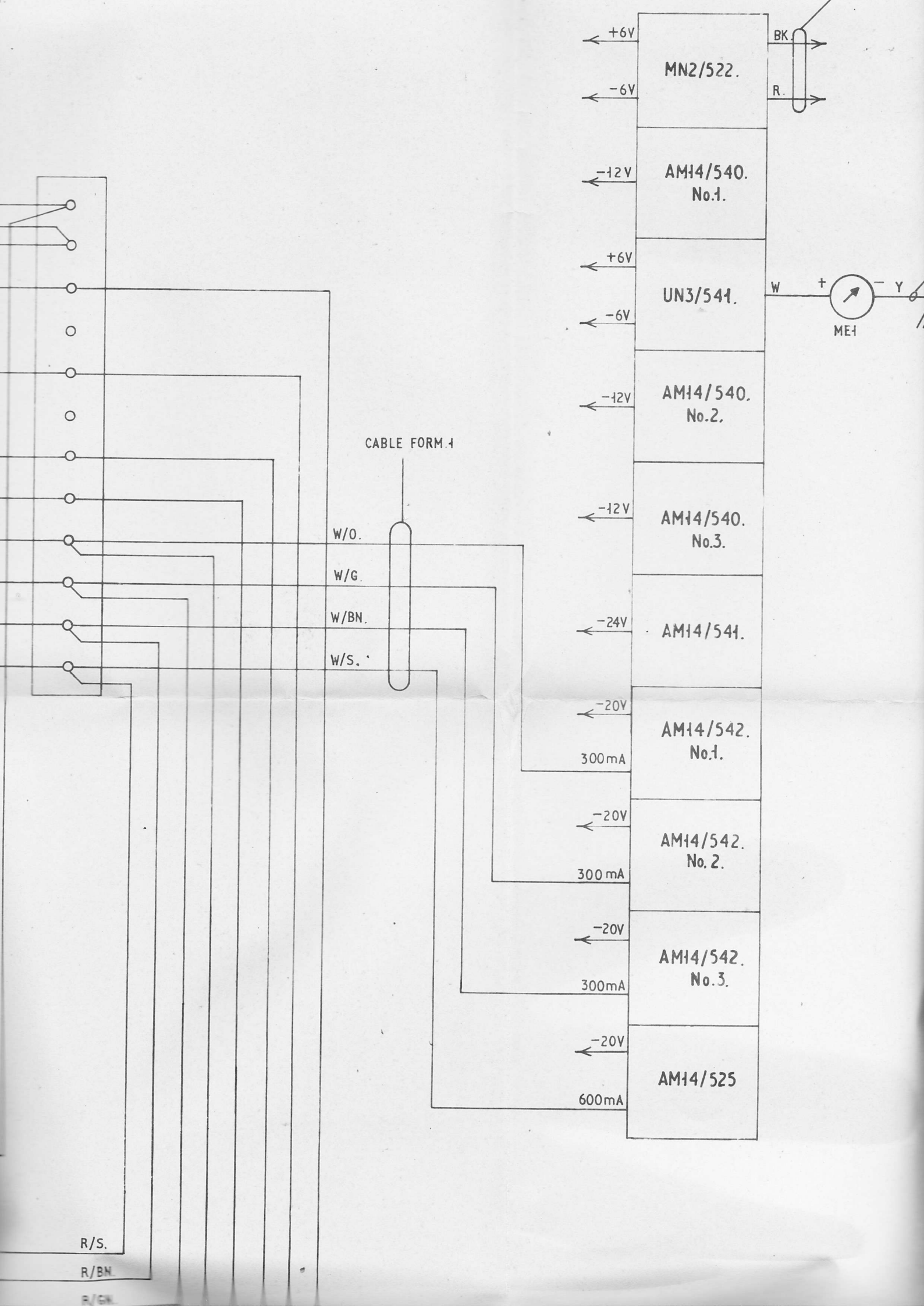
EP7/514A&B. R.F. BLOCK DIAG

CHANGE	
2/3/72	1



RAM

DRN		DESIGNS DEPARTMENT.
TCD	D.C.	D31406A3.
CKD		
APPD	C R C	


+6V
-6V
MN2/522.
BK.
R.
-12V
AM14/540.
No.1.
+6V
-6V
UN3/541.
W
+
-
Y
ME1
-12V
AM14/540.
No.2.
-12V
AM14/540.
No.3.
-24V
AM14/541.
-20V
300mA
AM14/542.
No.1.
-20V
300 mA
AM14/542.
No. 2.
-20V
300mA
AM14/542.
No.3.
-20V
600mA
AM14/525
CABLE FORM.1
W/O.
W/G.
W/BN.
W/S.
R/S.
R/BN.
R/GN.

D31408A4

sheet 1 of 6 sheets.

EP7/514A & B – EQUIPMENT U.H.F. ACTIVE DEFLECTOR PARTS LIST

CHANGE	ISS.
2/12/42	1
13/12/42	2

ITEM No.	No. OFF	DESCRIPTION	C'C'T REF.	BBC REF. OR DRG. No.
		DRAWING NUMBERS		
		D31406A3 R.F. Block Diagram		
		D31407A1 D.C. Wiring		
		D31408A4 Parts List		
		D31409A1 Assembly		
		D31410A2 Details 1-3		
		D31411A3 " 4		
		D31412A4 " 5		
		D31413A4 " 6		
		D31414A3 " 8-21		
		D31415A2 P.W. Wiring		
		D31416A2 P.B. Drilling		
		FURTHER INFORMATION REQUIRED FOR MANUFACTURE.		
		Unit Assembly Information EA10434		
		Unit Wiring Information EA10137, EA10138		
		Connector Assembly Information D26814A4		
		D26844A4, D26843A4, D26844A4, D26853A4-CP		
		Switch D27219A4. LABEL D31477A4-CP		
1	3	AM14/540 AMPLIFIER, U.H.F.		
2	1	AM14/541 AMPLIFIER, U.H.F.		
3	3	AM14/542 AMPLIFIER, U.H.F.		
4	1	AM14/525 AMPLIFIER, U.H.F.		
5	1	FW1/9 Framework, Amplifier U.H.F.		
6	1	MN2/522 INTER-CARRIER, DETECTOR UNIT.		
7	1			
8	1	UN9/531 UNIT SWITCH MANUAL		
9	1	PN1/6A DUMMY PANEL		
10	1	PN1/20A PANEL HOLDING		
11	2	PS2/74B POWER SUPPLIER.		

BBC

DS/PLA4

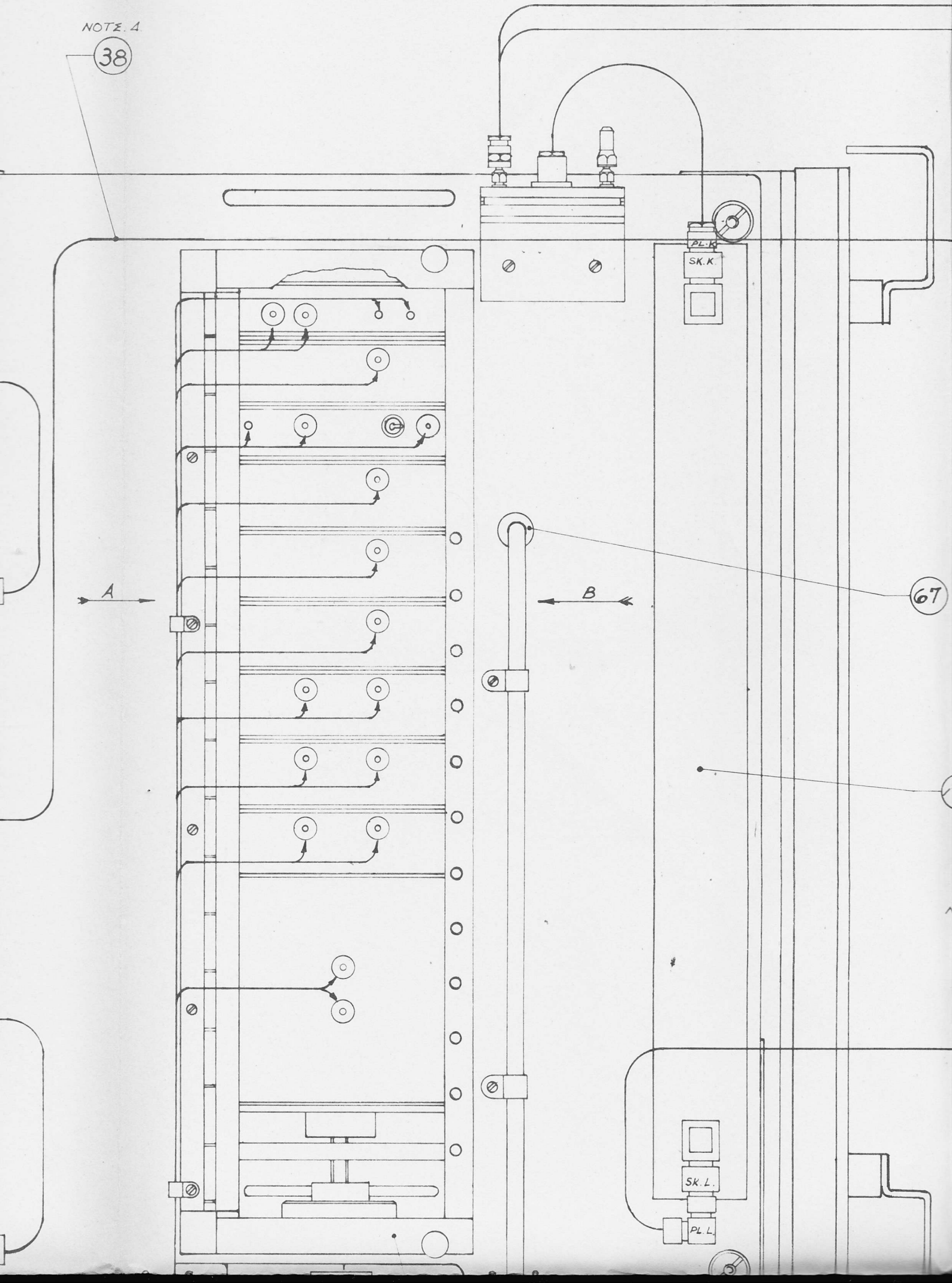
EP7/514A & B.
EQUIPMENT U.H.F. ACTIVE DEFLECTOR
PARTS LIST

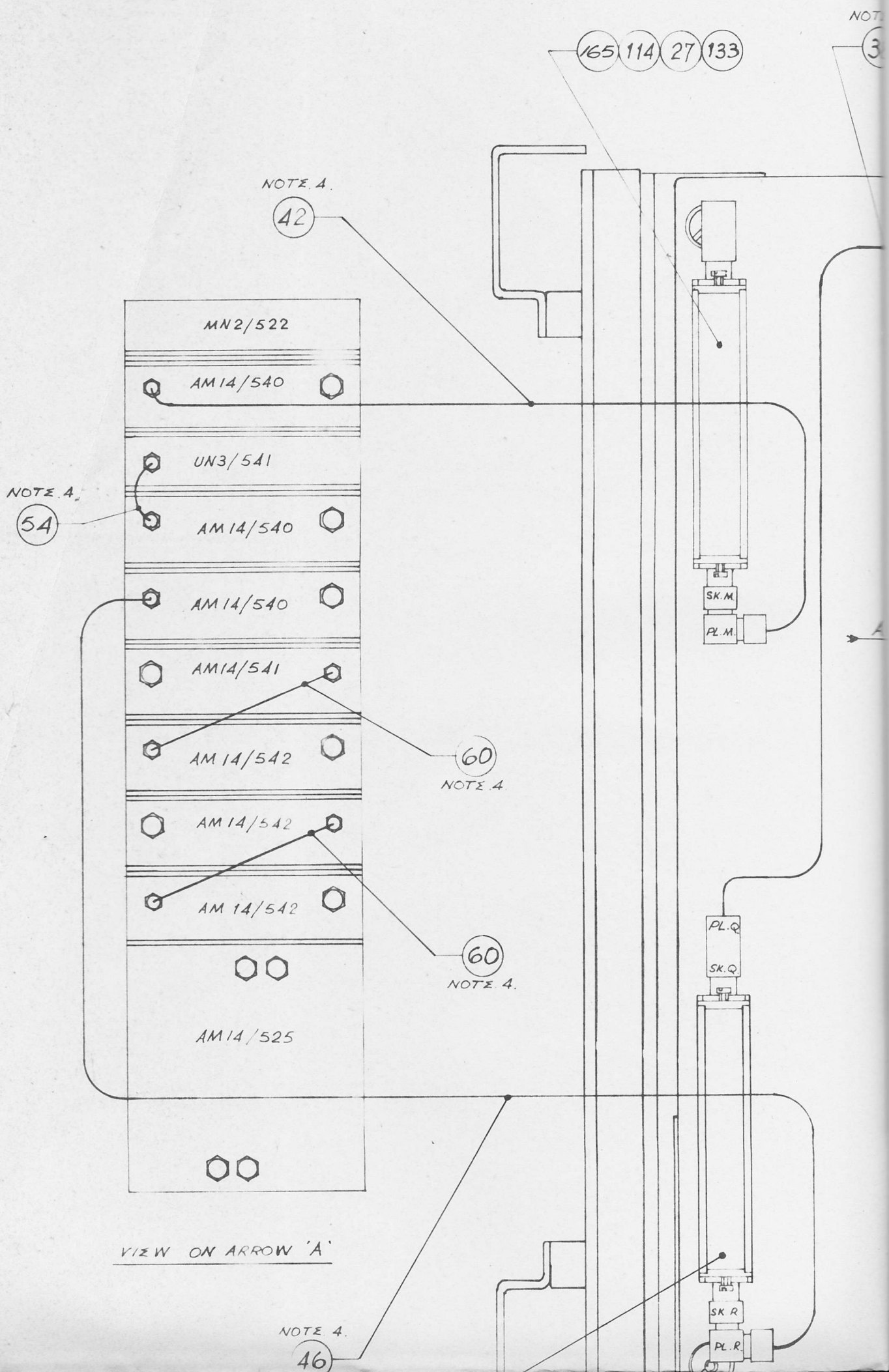
DRN.	G.W.W.
TPD.	
CKD.	
APPD	C.R.C.

DESIGNS DEPARTMENT

D31408 A4.

sheet 1 of 6 sheets.


NOTE. 4
38
PL. K
SK. K
A
B
67
SK. L.
PL. L.


NOTE 4.
42
165
114
27
133
MN2/522
AM14/540
UN3/541
NOTE 4.
54
AM14/540
AM14/540
AM14/541
AM14/542
60
NOTE 4.
AM14/542
AM14/542
60
NOTE 4.
AM14/525
SK.M.
PL.M.
PL.Q
SK.Q
SK.R
PL.R
VIEW ON ARROW 'A'
NOTE 4.
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