TELEVISION U.H.F. RECEIVERS RC5M/501 and RC5M/501A

U.H.F. TRANSMITTER DEMODULATOR DM1M/501

Introduction

The RC5M/501 is a high quality re-broadcast vision and sound receiver for Bands IV and V; it can also be used for the remote monitoring of unattended transmitters.

The RC5M/501A is a 2 channel monitoring receiver, similar to the RC5M/501, but has no u.h.f. amplification; it is intended for use as a monitoring receiver in situations of high signal strength.

The DM1M/501 is used to check the performance of u.h.f. transmitters and is directly fed from a probe attached to the transmitter aerial feeder. It is basically similar to the RC5M/501 but has no u.h.f. amplification or a.g.c.

Each receiver consists of 2 tiers of CH1/12 and CH1/39 chassis which, for the RC5M/501 and DM1M/501, are mounted in cases type CS/12A. They are suitable for both portable and bay mounting uses. Front panels are available for the cases to complete the overall screening if this is necessary. The RC5M/501A is mounted in a light alloy case not suitable for bay mounting and not provided with a front panel.

The input and output connectors used are as follows:

R.F. input socket	50 ohm type C
Video outputs	2 musa 75 ohm P.O. No. 1
Sound output	XLR-5-32
Carrier sensing	XLR-5-32
Mains power input	XLR-LNE-32

The receivers consist of sub-units as listed in Table 1.

TABLE 1

Receiver Sub-unit	*Receiver Type*		
	RC5M/501	*RC5M/501A*	*DM1M/501*
Low Noise Head Amplifier	EP1/517	—	—
U.H.F. Bandpass Filter	FL2M/532	FL2M/532	FL2/533 or FL2/534
U.H.F. Converter	CO2M/516 or CO2/542	CO2/528	CO2/517
Local Oscillator	OS2/511	OS2/511	OS2/511
Shaping Filter	FL1/513	FL1/513	FL1/513
Vision I.F. Amplifier	AM1/543	AM1/543	AM1/545
Vision Demodulator	DM2/504	DM2/504	DM2/504
Video Equaliser	EQ5/516	EQ5/516	EQ5/516
Video Amplifier	AM1/555	AM1/555	AM1/555
Vision A.G.C. Unit	UN1/564	UN1/564	—
Sound I.F. Amplifier	AM1/556*	AM1/556*	—
Sound Frequency Converter	CO2/529*	CO2/529*	CO2/529
Sound Demodulator	DM3/501	DM3/501	DM3/501
Pulse Generator	—	—	GE2/546
Power Supplier	PS2/45	PS2/45	PS2/45

* either AM1/556 or CO2/529 as required.

General Specification

(for all receivers except as indicated)

General Data

Frequency Coverage (preset)

RC5M/501, DM1M/501	Any one channel in Bands IV or V
RC5M/501A	Any two channels in Bands IV or V

Input VSWR over 8 MHz Channel

RC5M/501, DM1M/501	less than 1·3
RC5M/501A	less than 1·5

Some of the early models of the RC5M/501 (serial Nos. 1-25) have units DM2/503, EQ5/512 and AM1/544 in place of the DM2/504, EQ5/516 and AM1/555 respectively.

Vision Carrier IF	37·5 MHz
Sound Carrier	
First IF	31·5 MHz
Second IF	6 MHz

Local Oscillator Frequency	37·5 MHz above vision carrier
Sensing Relay Contact Current	0·25 A max
Ambient Temperature Range	
RC5M/501, RC5M/501A	0°C to 45°C
DM1M/501	10°C to 45°C
Power Requirements	50 W at 240 V, 50 Hz
Weights	
RC5M/501, DM1M/501	60 lb.
RC5M/501A	68 lb.

Vision Data

U.H.F. Input (max)	
RC5M/501	10 mV r.m.s.
RC5M/501A	50 mV r.m.s.
DM1M/501	240 mV r.m.s.
U.H.F. Input (typical)	
RC5M/501	3 mV r.m.s.
RC5M/501A	30 mV r.m.s.
DM1M/501	200 mV r.m.s.
Video Output across 75 ohms (two)	1 volt p-p
Output Impedance	75 ohms nominal
A.G.C. (Variation in output level for variations in r.f. input)	
RC5M/501 100 μV to 10 mV r.m.s.	not greater than 0·5 dB
RC5M/501A 0·5 mV to 50 mV r.m.s.	not greater than 0·5 dB
Gain Control (manual)	
DM1M/501	12 dB variation
Waveform Performance	
50-Hz square wave	k not greater than 1%
25 μs bar	k not greater than 1%
2T pulse	k not greater than 2%
2T p/b ratio	k not greater than 1%
1T p/b ratio	84% ±2%
1T ring frequency	greater than 5·5 MHz
1T pulse first leading and trailing lobes	16% ±4%
Line Time Non-linearity	
RC5M/501 inputs up to 10 mV	not greater than 4%
RC5M/501A inputs up to 50 mV	not greater than 4%
DM1M/501	not greater than 4%
Differential Phase Distortion at 4·43 MHz	4° ±1°
Differential Gain Distortion at 4·43 MHz	4% ±1%
Gain Stability (change in gain per day after one hour warm up period)	
DM1M/501	not greater than 0·3 dB
Chrominance/Luminance	
Gain inequality	not greater than 5%
Delay inequality	15 ns leading, ±25 ns
Crosstalk[2]	−5% ±1%
Hum Level	−40 dB min (relative 0·7 V p-p)
Noise Figure	
RC5M/501	16 dB
With low noise head amplifier	7 dB

Signal/Noise Ratio at Typical Input Level

	unweighted	*weighted monochrome*	*weighted colour*
RC5M/501	45 dB	54 dB	51 dB
RC5M/501A	54 dB	60 dB	57 dB
DM1M/501	50 dB	59 dB	56 dB

Sound Data

Sound Output into 600 ohms with 50 kHz Deviation at 400 Hz	+14 dB max (w.r.t. 1 mW)
D.C. on Output when Correctly Terminated	not greater than 50 mV line/line or line/earth

Output Impedance line/ line Balanced	600 ohms ±12%
Output Impedance line/ earth	300 ohms ±12%
Sound Regulation for Variation of Carrier over Full Range of Input Levels	output constant to within ±0·2 dB
Frequency Response 30 Hz to 15 kHz	flat to within ±0·2 dB
Signal/Noise Ratio relative to 1 mW	
RC5M/501 (input above 50 μV)	50 dB
RC5M/501A (input above 250 μV)	50 dB
DM1M/501	55 dB
Harmonic Distortion at 50 kHz deviation, 100 Hz and 1 kHz modulation, outputs up to +14 dB	−50 dB
Hum Relative to Zero Level	−50 dB

Description

Block diagrams of the receivers are given in Fig. 1, Fig. 2 and Fig. 3 on pages 5, 7 and 9 respectively.

The receivers operate in preselected channels and have stable and accurately defined vestigial characteristics. The shaping filter, FL1/513, is the main factor in determining the overall characteristic, the u.h.f. and i.f. circuits being relatively wide band. The video frequency characteristic is flat to 5 MHz and the overall gain is very stable. Advantage of this is taken in the DM1M/501 and a.g.c. is not provided.

The sound discriminator is of the pulse counting type and is fed with a 6 MHz signal produced either by the intercarrier method or by normal frequency changing. Alternative sound converters are available for the RC5M/501 and RC5M/501A, the choice depending on whether or not the intercarrier facility is required.

The RC5M/501 is primarily intended as a rebroadcast receiver for satellite stations, but it can also be used for remote monitoring of unattended stations. It is provided with carrier-sensing facilities which may be used to initiate executive action in the event of carrier failure. A low-noise head amplifier, EP1/517, is available for use with this receiver. This is constructed in a weatherproof box and is intended to be mounted as close to the aerial array as possible. It is powered via the feeder which connects the head amplifier to the receiver.

The RC5M/501A is a two-channel local-station monitor. It has two local oscillators and a broadband mixer, channels being changed by means of short U-links of cable at the front of the receiver. A double-pole switch mounted at the rear of the receiver, provides access to the monitoring outputs of both oscillators.

The DM1M/501 is used for checking the performance of u.h.f. transmitters. It employs a wide-band crystal mixer which feeds the sound and vision sections of the receiver. A peak detector circuit is provided for indicating the video output level and there are facilities for switching off the vision i.f. amplifier for about 5μs in each line thus providing a reference level from which the depth of modulation of the transmitted signal may be found.

Maintenance

Routine maintenance is not required but gain and response can be checked if the performance of the receiver becomes suspect.

No adjustment should be made to the Equaliser EQ5/516 without reference to the full Production Test Schedule[1]. A Test Equipment RC1A/510 is required.

For the gain tests, the various signal levels through the receivers are shown in Figs. 4 and 5. A Tektronix oscilloscope type 585A or equivalent is suitable for making the measurements at i.f., but at u.h.f. different arrangements are necessary.

The input level to the receiver may be measured using a u.h.f. millivoltmeter and either a u.h.f. signal generator or a U.H.F. Test Equipment RC1A/510 with a known output level (see below). The procedure is as follows.

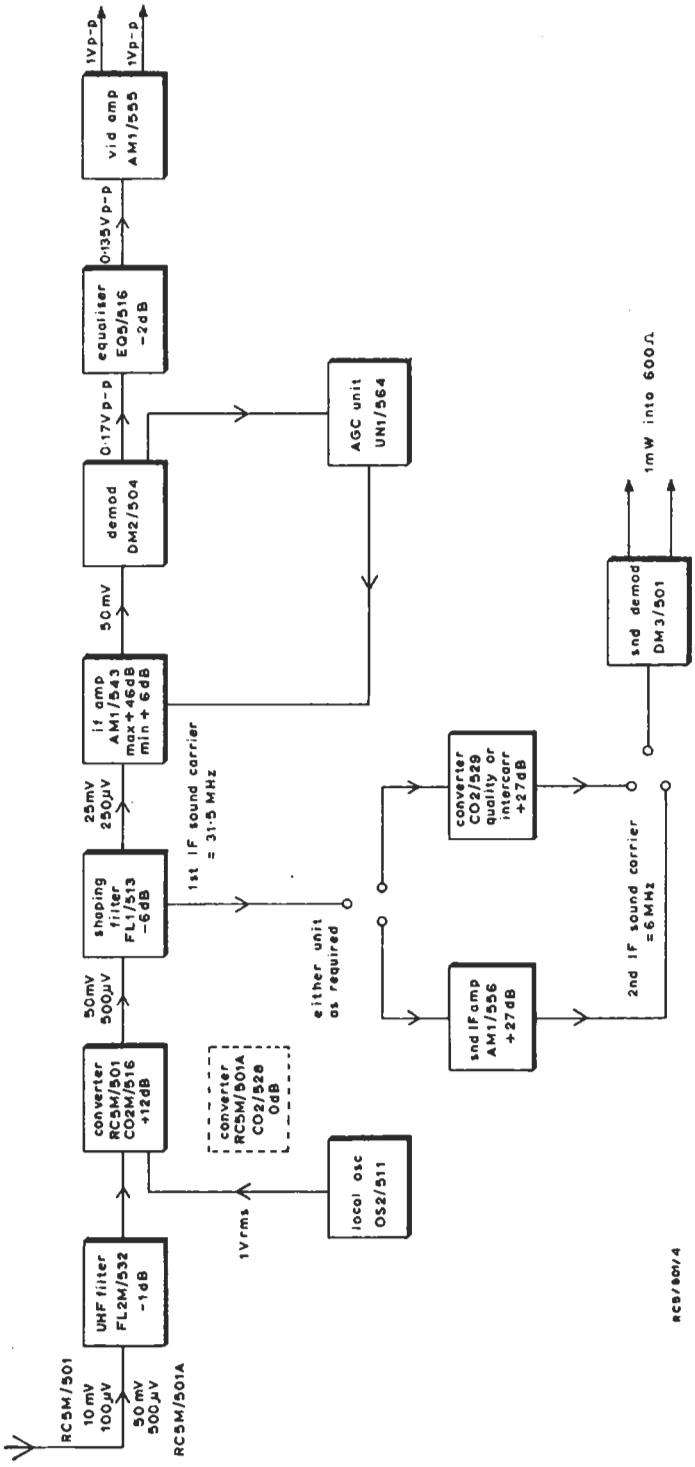


Fig. 4 Signal Levels in the RC5M/501 and RC5M/501A

RC5/501
DM1/501

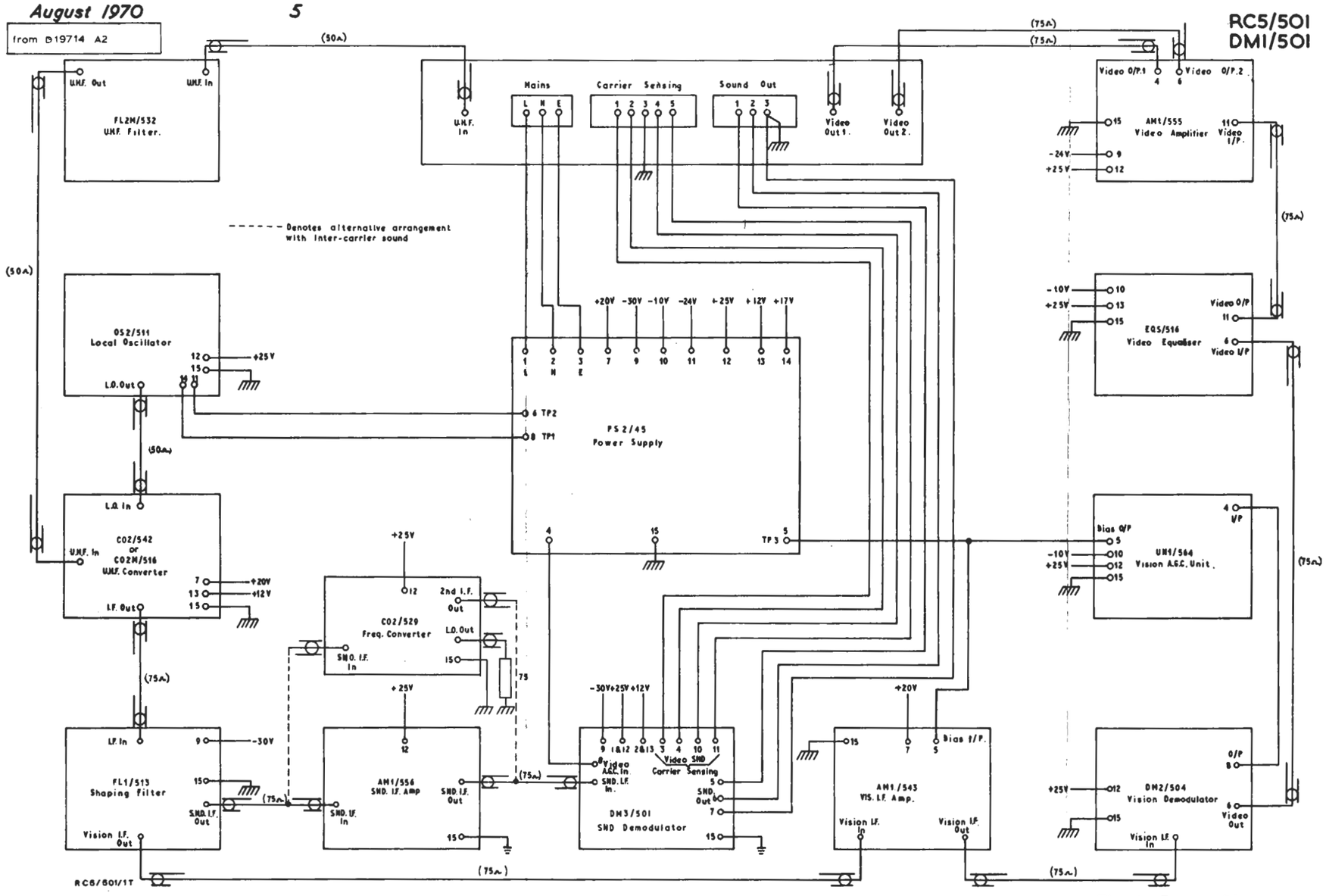
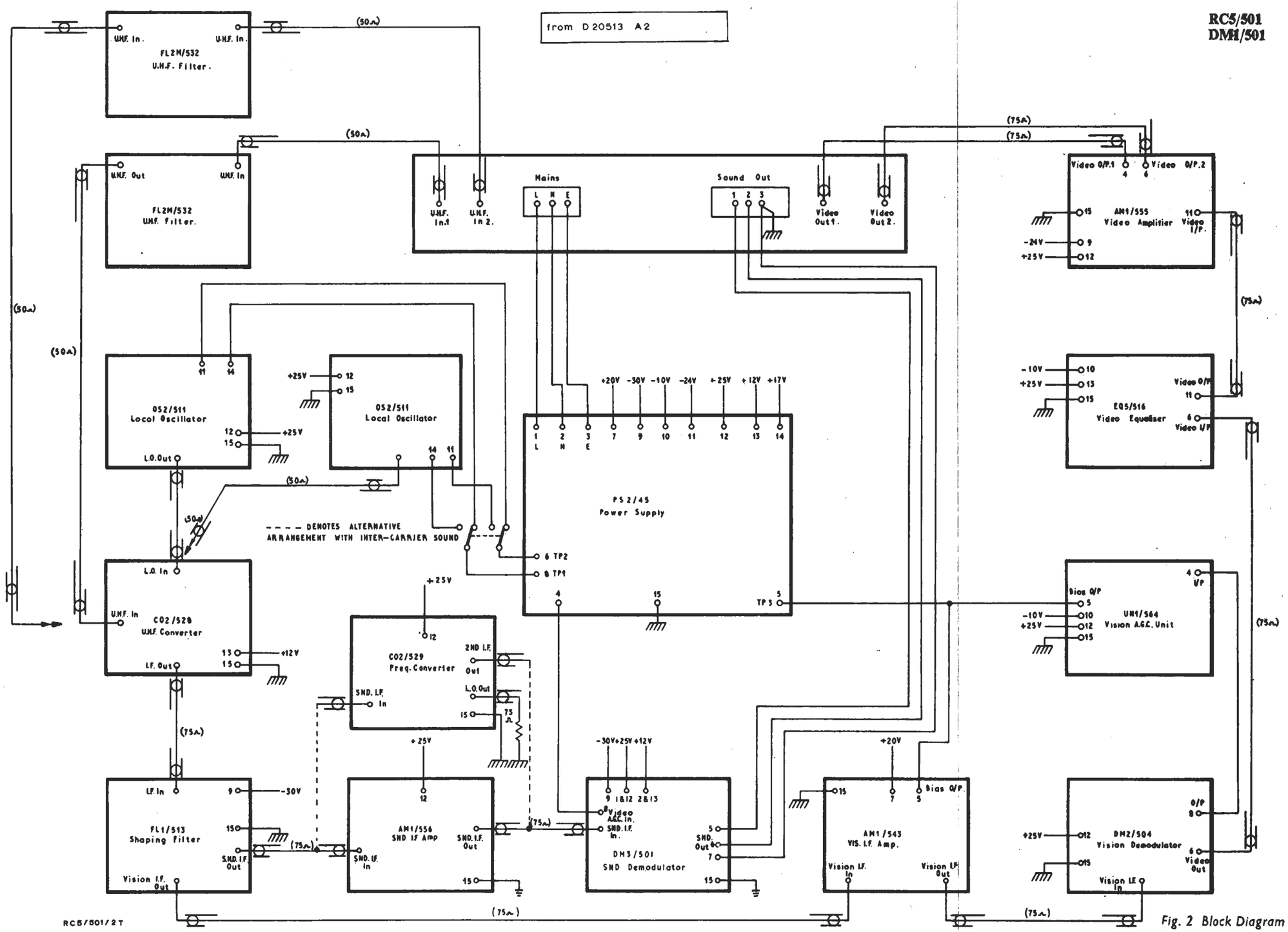


Fig. 1. Block Diagram of the RC5M/501



RC5/501, DM1/501 7

RC5/501/2T

Fig. 2 Block Diagram of the RC5M/501A

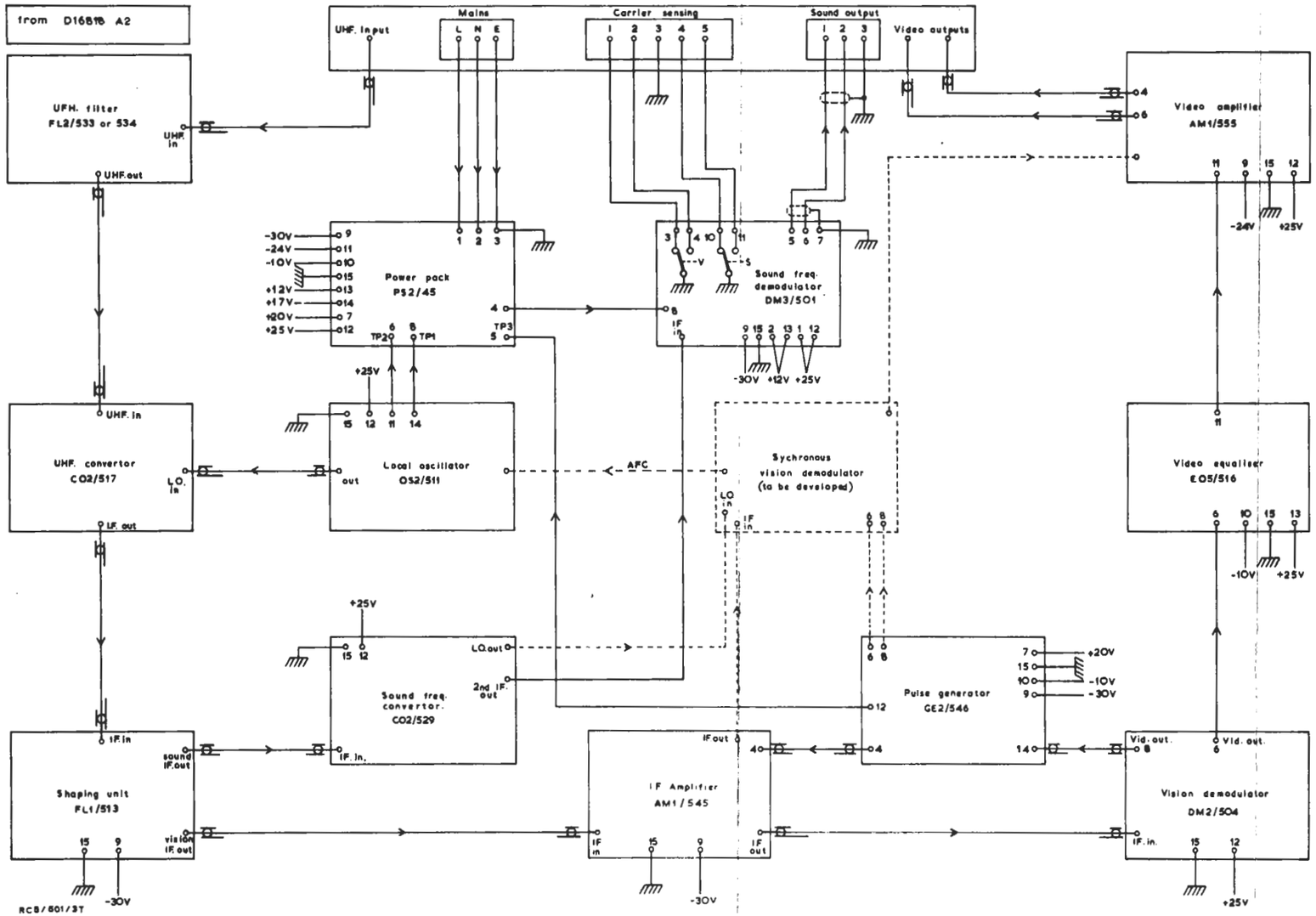


Fig. 3 Block Diagram of the DM1M/501

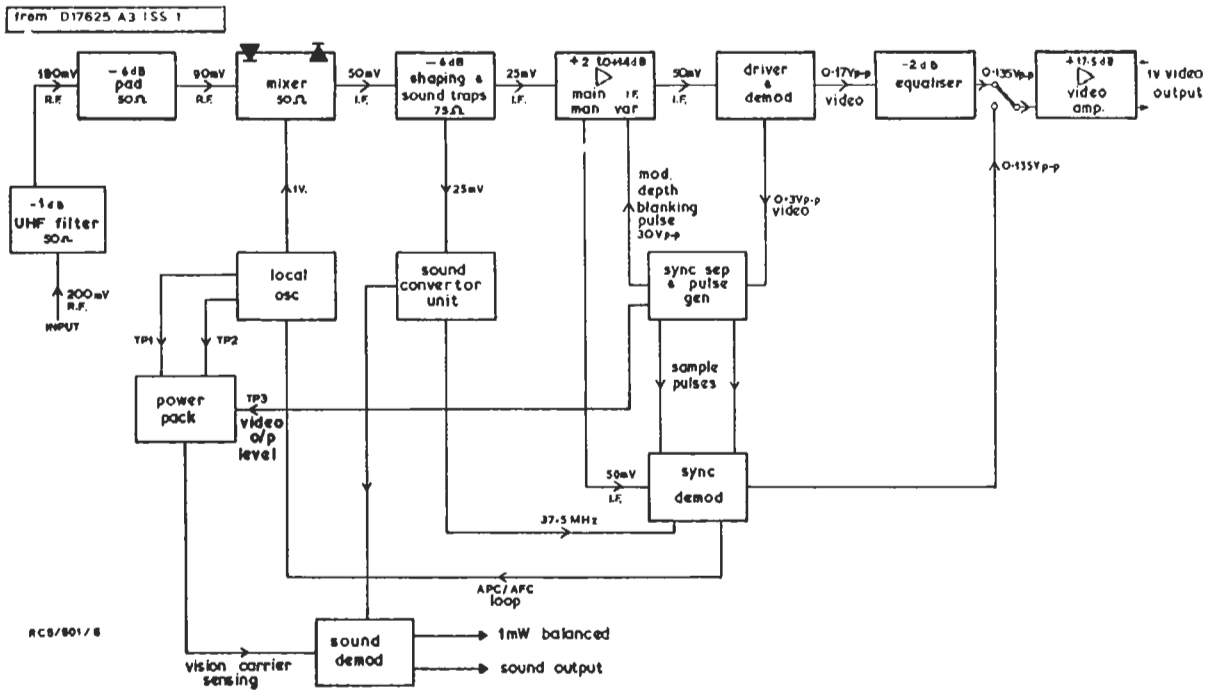


Fig. 5 Signal Levels in the DM1M/501

U.H.F. Signal Generator

1. Connect a modulated u.h.f. signal to the input of the receiver (pulse and bar modulation is suitable).
2. Connect the output from the i.f. amplifier AM1/543 or AM1/545 to the oscilloscope terminated with 75 ohms.
3. Switch the receiver to manual gain and adjust the control for a convenient display on the oscilloscope. (Commonly the gains of the receiver and oscilloscope are adjusted to obtain a p-p deflection on sync tips of 4 cm with an oscilloscope input up to 150 mV p-p.)
4. If a signal generator is available, set this to give an output at vision carrier frequency; the frequency must be checked with a counter or other accurate means.
5. Connect the generator to the receiver input in place of the modulated signal input and adjust the level to obtain a CW display of the same p-p amplitude as before (4 cm.). Alternatively, connect the u.h.f. test equipment output to the receiver input via a variable 50-ohm attenuator and adjust the latter until the same p-p deflection is obtained.
6. Measure the output of the signal generator with the u.h.f. millivoltmeter, terminated in 50 ohms, or by other suitable means. Alternatively, obtain the input level to the receiver from the known output of the test equipment and the attenuator setting.

RC1A/510

To find the output signal level from the u.h.f. test equipment proceed as follows:

1. Set the Test Equipment on to the correct channel.
2. Connect a pulse and bar video signal to the input of the test equipment and ensure that it is producing a properly modulated u.h.f. signal with the correct depth of modulation, i.e., 20% residual carrier.
3. Connect the oscilloscope to *IF*1 on the test equipment.
4. Adjust oscilloscope gain to give a convenient display, e.g., 4 cm.
5. Remove the U-link marked *6MHz* (to remove the sound carrier).
6. Remove the U-links marked *77MHz* and *IF*1 *amp* and connect a variable 75-ohm attenuator (0-60 dB in 1 dB steps) between the left-hand musa sockets of the two U-link positions.
7. Adjust the attenuator to give the same amplitude of CW (as displayed on the oscilloscope)

as was previously obtained at the sync pulse tips.

8. Disconnect the oscilloscope from *IF*1 and replace the U-link.
9. Measure the output from *UHF out* on the test equipment on a convenient instrument, e.g., a u.h.f. millivoltmeter. This measurement must be made at the output of the receiver comb-line filter, FL2M/532, to remove the unwanted sideband from the test equipment output. The signal level indicated is the r.m.s. of the peak sync pulse carrier less the loss in the filter, nominally 1 dB.

The response tests require sweep-frequency equipment, e.g., a Polyskop SWOB or a sweep generator with a marker pip generator and a double beam oscilloscope. The results at u.h.f. and i.f. should be as shown in Fig. 6.

For the i.f. tests the procedure is as follows:

1. Connect the input signal, sweeping between about 30 MHz and 40 MHz, to the input of the shaping filter, FL1/513.
2. Set the a.g.c./manual switch to *Manual* (RC5M/501 and RC5M/501A).
3. Adjust the gain control to give 1·2V p-p at the receiver output.
4. The response at 37·5 MHz, the vision i.f. carrier frequency, relative to the peak of the swept wave (approximately at 35 MHz) should be −6 dB ±0·2 dB.
5. The response at 32·5 MHz with respect to the peak should be −1·5 dB ±0·5dB.

The measurements in 4 and 5 above can be made by using the second trace of the oscilloscope to mark, in turn, the 37·5 MHz and the 32·5 MHz levels and then, by means of an external variable attenuator, reducing the input to the oscilloscope until the peak of the displayed waveform corresponds with the marked levels.

The same procedure can be used at u.h.f. except that the input signal is fed to the receiver input terminal. The response at the u.h.f. vision carrier frequency should be −6 dB ±0·2 dB and at vision carrier frequency plus 4·75 MHz it should be −1·3 dB ±0·5 dB, both with respect to the peak of the swept waveform.

Note that the sweep tests only check the u.h.f. and i.f. response of the receivers up to the demodulator diodes. The swept signal is effectively a variable frequency carrier, amplitude modulated by a 50-Hz signal. Thus the video part of the receiver only carries the 50-Hz component and the video equaliser is ineffective. The expected result is a droop in the swept characteristic, as indicated in Fig. 6.

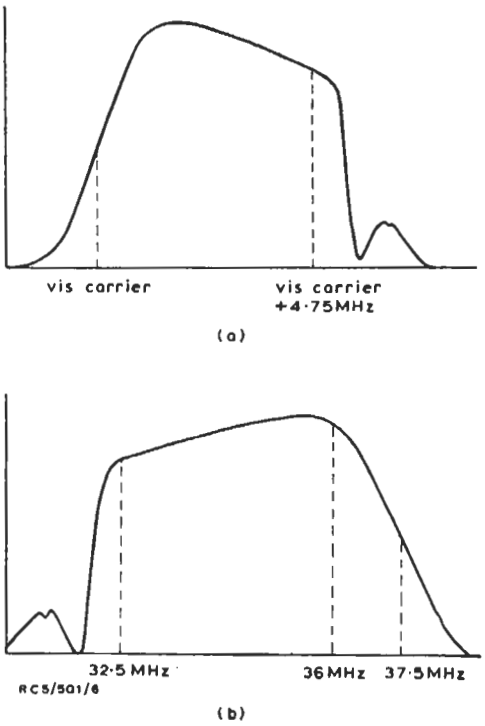


Fig. 6 Swept-frequency Response of the RC5M/501 (a) u.h.f. (b) i.f.

The waveform responses of the receivers is shown in Fig. 7.

Adjustment of the sound and vision carrier sensing circuits in the sound demodulator unit, DM3/501, may be necessary if any of the sub-units of the receivers are changed. The procedure is as follows, the receiver having been powered for at least one hour prior to the start of adjustment. It is necessary also to remove the escutcheon plate of the DM3/501.

Sound Carrier Sensing. Remove the signal input from the receiver and adjust the multi-turn potentiometer [redacted] (adjacent to the green lamp) in an anti-clockwise direction until the green lamp lights. Return the potentiometer control slowly in a clockwise direction until the lamp extinguishes and then add one half turn more (clockwise) to the setting. Connection and disconnection of the aerial should now cause the lamp to light and extinguish. Note that there will be a delay of up to 10 seconds between connection of the aerial and the lamp lighting.

Vision Carrier Sensing on RC5M/501 and RC5M/501A. Disconnect the aerial input and check that the meter on the power supplier PS2/45, reads zero at the TP3(AGC) position. If it does

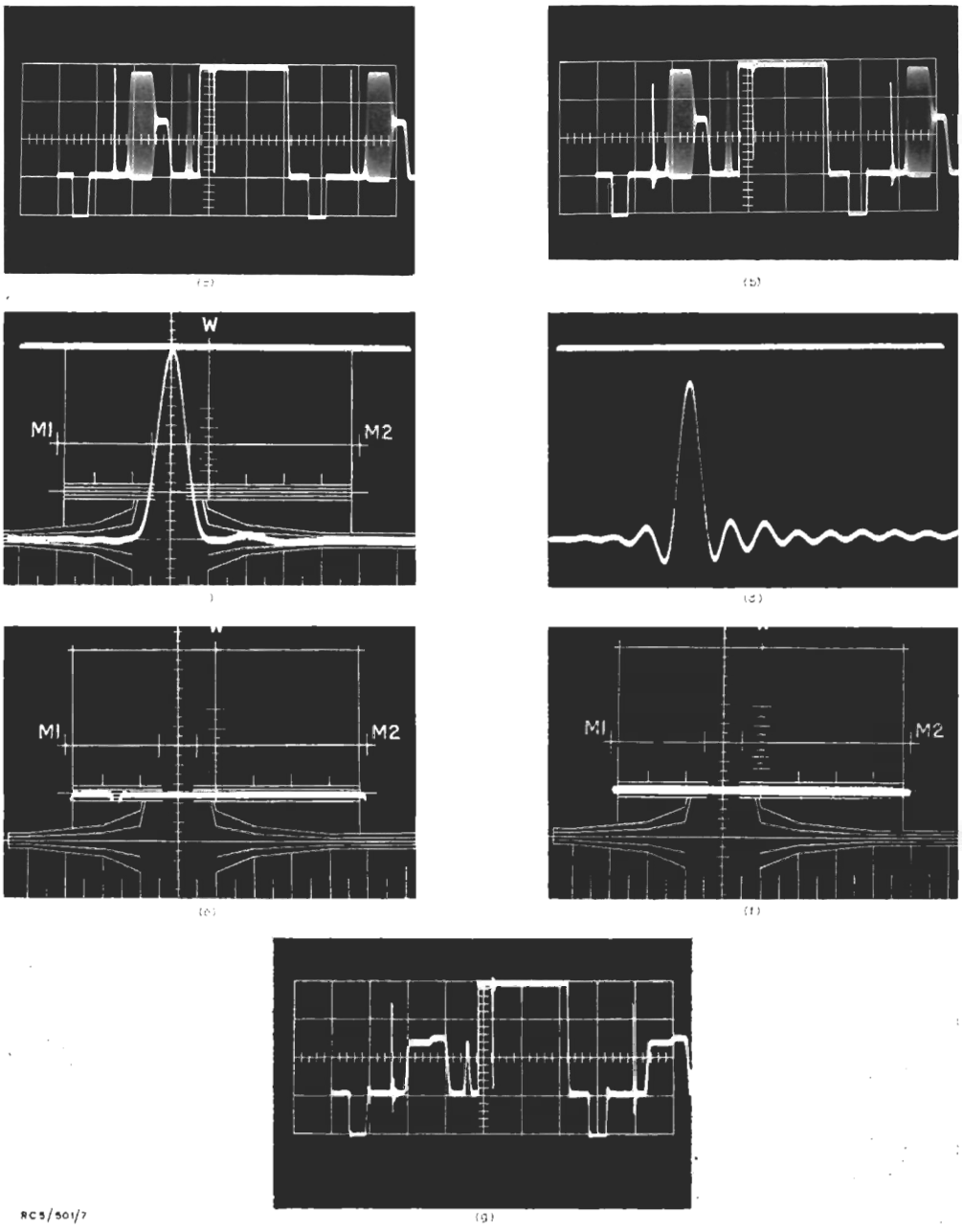


Fig. 7 Waveform Responses of the RC5M/501, A and DM1M/501

(*a*) *Chrominance-luminance 2T Pulse and Bar* (*b*) *Chrominance-luminance 1T Pulse and bar*
(*c*) *2T Pulse* (*d*) *1T Pulse*
(*e*) *25-μs Line Bar* (*f*) *50-Hz Squarewave*
(*g*) *Filtered chrominance-luminance Waveform (subcarrier removed for measurement of crosstalk)*

not, adjust potentiometer RV24 (*set TP*3 above the meter). Reconnect the aerial to the receiver via a 50-ohm u.h.f. attenuator. Attenuate the signal until the meter reads zero again and then reduce the attenuation until the meter just starts to move off the zero mark. From this point increase the signal level by 6 dB and adjust the multi-turn potentiometer R33 adjacent to the amber lamp, so that the lamp just lights. Reducing the signal level by 6 dB should now extinguish the lamp.

Vision Carrier Sensing on DM1M/501. Set the video output to 0·7 volts p-p using the i.f. gain control. Adjust potentiometer R33 adjacent to the amber lamp until the lamp extinguishes. Now increase the i.f. gain when the lamp should relight before the video output reaches 0·9 volts p-p.

Test point TP3 on the DM1M/501 is provided to allow the drive to the modulator to be checked. With the meter switch on the power supplier PS2/45 set to the TP3 position, the meter should give a scale reading of 25 when the video output level is 1 volt p-p from a correctly modulated input signal. Adjustment is provided by the *Set TP*3 control.

If the results of the above tests are not satisfactory, the receiver should be returned to Equipment Department for service.

Reference

1. Designs Department Specification No. 6.106(67).
AIB 10/68

Operational Notes

Considerable distortion of the output-signal picture/sync ratio and linearity occurs if the Demodulator DM1/501 is overloaded; particular care must be taken to ensure that the input signal does not exceed the specified maximum value of 240 mV r.m.s. at peak syncs. The normal working input signal level is 200 mV r.m.s. which leaves a small margin to cover measurement tolerances. If the figure of 200 mV (peak syncs) is likely to be exceeded, additional input attenuation must be used.

Adjustment of Demodulator Output Level

Set the switched attenuator in the input circuit of the AM1/545 to its *0 dB* gain position, i.e., to produce a loss of 6 dB.

Using the i.f. gain control on the AM1/545, set the output level to 1 volt p-p as indicated by the meter on the PS2/45. The meter must be calibrated as follows.

Calibration of meter on PS2/45

This calibration must be carried out whenever the *Set TP3* control is disturbed otherwise the meter does not give a reliable indication of demodulator output level.

Set the switched attenuator in the input circuit of the AM1/545 to its *0 dB* gain position.

Apply to the demodulator input a correctly modulated r.f. (vision only) signal obtained from the transmitter feeder probe.

Adjust the signal level to 200 mV r.m.s. (peak syncs).

Set the output-signal level from the demodulator to 1 volt p-p by means of the r.f. gain control and using a suitable oscilloscope as indicator.

Adjust the *Set TP3* control to give a scale reading of 25.

Lock the *Set TP3* control to prevent it being moved inadvertently.

With the control switch of the AM1/545 attenuator set to its *+6 dB* gain position (i.e. zero dB loss) an extra 6 dB i.f. gain is provided for convenience at transmitting stations where parallel transmitters are used. The r.f. signal level to the demodulator is adjusted to be 200 mV r.m.s. (peak syncs) with both transmitters powered and with the switch in the *0 dB* gain position. When one transmitter is switched off, the output from the demodulator may be restored approximately to normal by switching to the *+6 dB* gain position.