SYNC PULSE STABILISING AMPLIFIER AM18/503A

Introduction

The AM18/503A forms part of the MX1/501A video mixer. It accepts the following input signals:

(a) the Cut/Fade and Split Screen video outputs of the mixing circuits
(b) a syncs-and-colour-burst signal (colour syncs)
(c) outputs from the A and B banks of the mixer which provide sync-pulse and colour-burst signals when a non-sync source is being handled.

It provides a 1-volt peak-to-peak composite output signal which:

(a) is clamped at blanking level and clipped at white level
(b) has sync pulses of the correct shape and amplitude
(c) has colour bursts of the correct amplitude and phase.

The AM18/503A consists of the following units mounted in a CH1/13 portable box:

Stabilising Amplifier AM18/520
Burst Error Amplifier AM1/558
Error Signal Amplifier AM3/501
Auto Time Constant Controller UN3/503
Gating Pulse Generator GE2/503B
Sync Pulse Generator GE2/504A
Sync Pulse Separator UN1/510A
Sync Source Switch UN9/511A
Video Source Switch UN9/512A
Power Supplier PS2/57
Relay Network NE1/514

The title of the UN9/512A is misleading because, in this application, it is used solely as a delay network and video switching is carried out by a separate relay network (the NE1/514) which is mounted on the back of the main AM18/503A chassis.

General Specification

Gain	0 dB
Impedances	
Video input (Fade or Split Screen)	high w.r.t. 75 ohms
Video A and Video B	about 900 ohms
Black level (colour syncs)	about 900 ohms
Video output	75 ohms
Frequency Response	±0·2 dB from 10 kHz to 5·5 MHz
k rating (625-line)	better than 1%
Differential Gain	better than 3% on a ten-step 625-line signal
Differential Phase	less than 0·8° at 4·43 MHz (CCIR worst case)
Rise-time of Output Syncs	0·2 to 0·25 µs
Mains Input	200 to 240 V, 50 Hz
Weight	about 26 lbs

General Description

A block diagram which shows the interconnections between the units is given in Fig. 1.

The video input signal is obtained either from the *Cut/Fade* or from the Split Screen outputs of the mixer. The required signal is selected by means of the Relay Unit NE1/514 and is applied to the burst-stabilising section of the Stabilising Amplifier AM1/520. After passing through an input amplifier it is fed to the Burst Error Amplifier AM1/558 and it is fed also, via a delay line which compensates for the delay introduced by the AM1/558, to an adder stage. In the AM1/558 the burst component of the signal is subtracted from a reference-burst signal and the difference signal produced is fed back to the AM18/520 where it is added to the burst component of the original signal to maintain the burst amplitude at a constant level.

The burst-stabilised signal is fed, via the delay line in the Video Switch Unit UN9/512A, to the processing-amplifier section of the AM18/520. The delay line inserts about 0·6 µs of delay into the video path and thus allows the sync-gating stage in the AM18/520 to become low-impedance before the leading edges of the sync pulses contained in the video waveform reach it.

In the processing-amplifier section of the AM18/520 the signal is applied to a feedback clamp, formed by the Error Signal Amplifier AM3/501, which clamps the blanking level of the signal to earth potential. The signal is then clipped

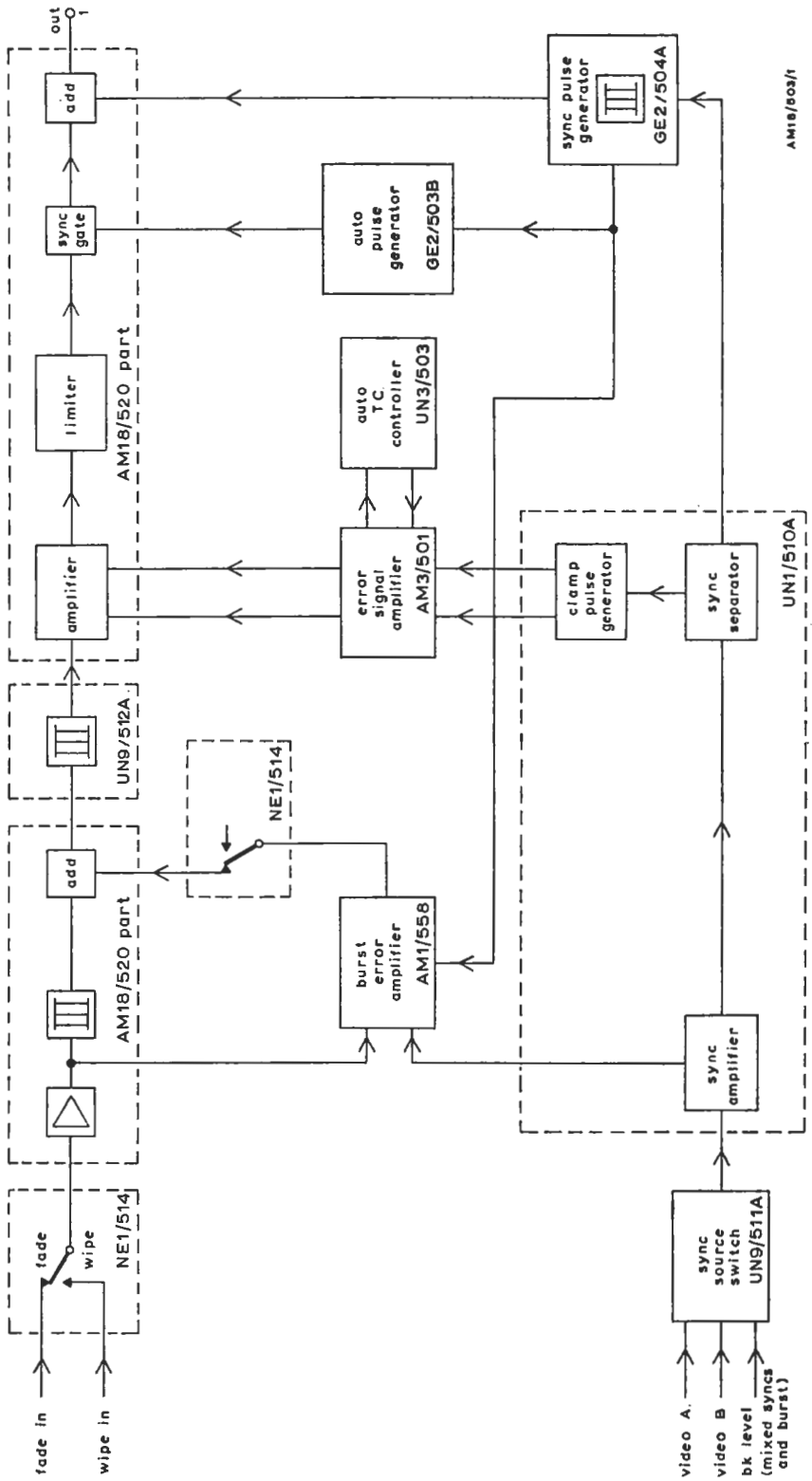

Fig. 1 Block Diagram of the Stabilising Amplifier AM18/503A

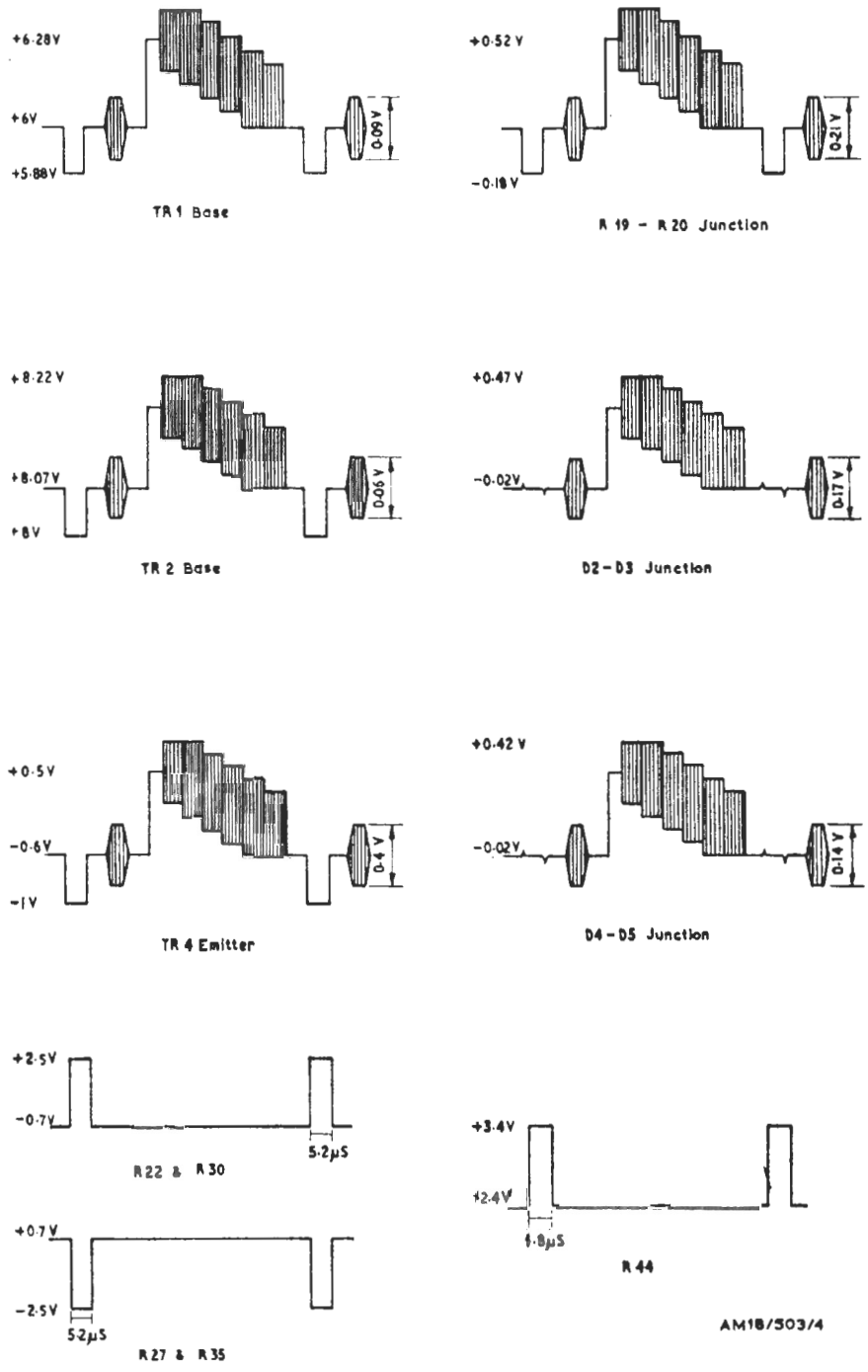

Fig. 2 Waveforms in the AM18/520 (1)

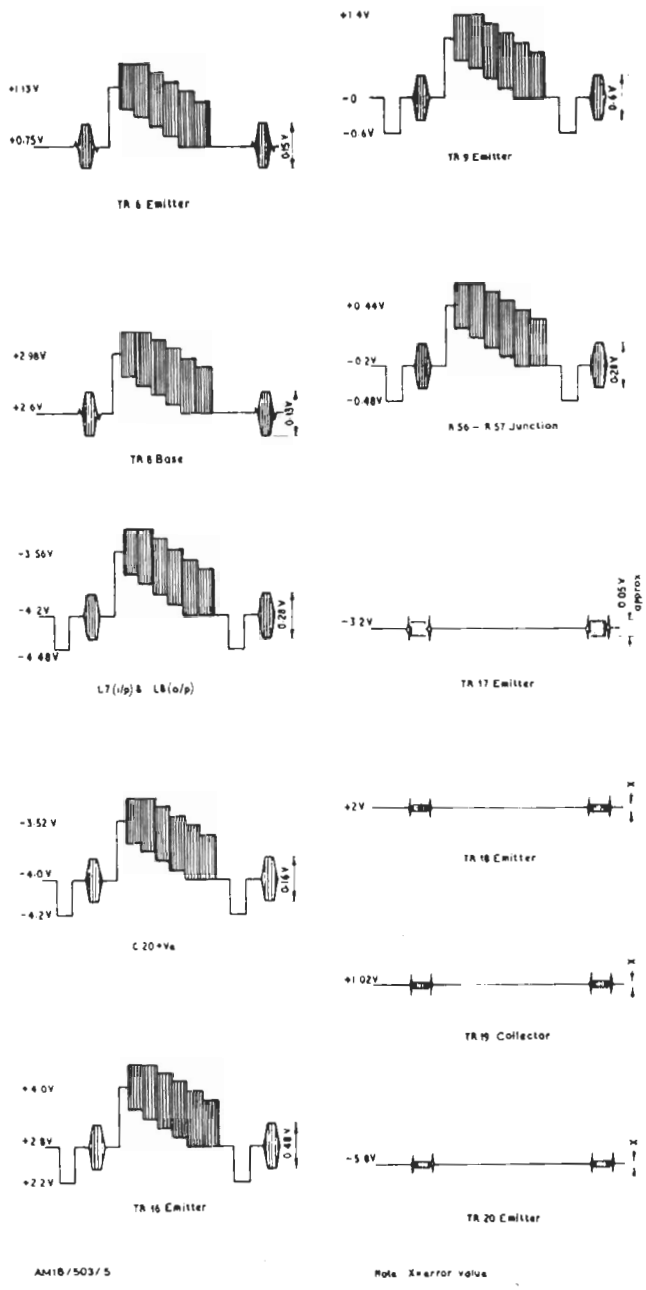

Fig. 3 Waveforms in the AM18/520 (2)

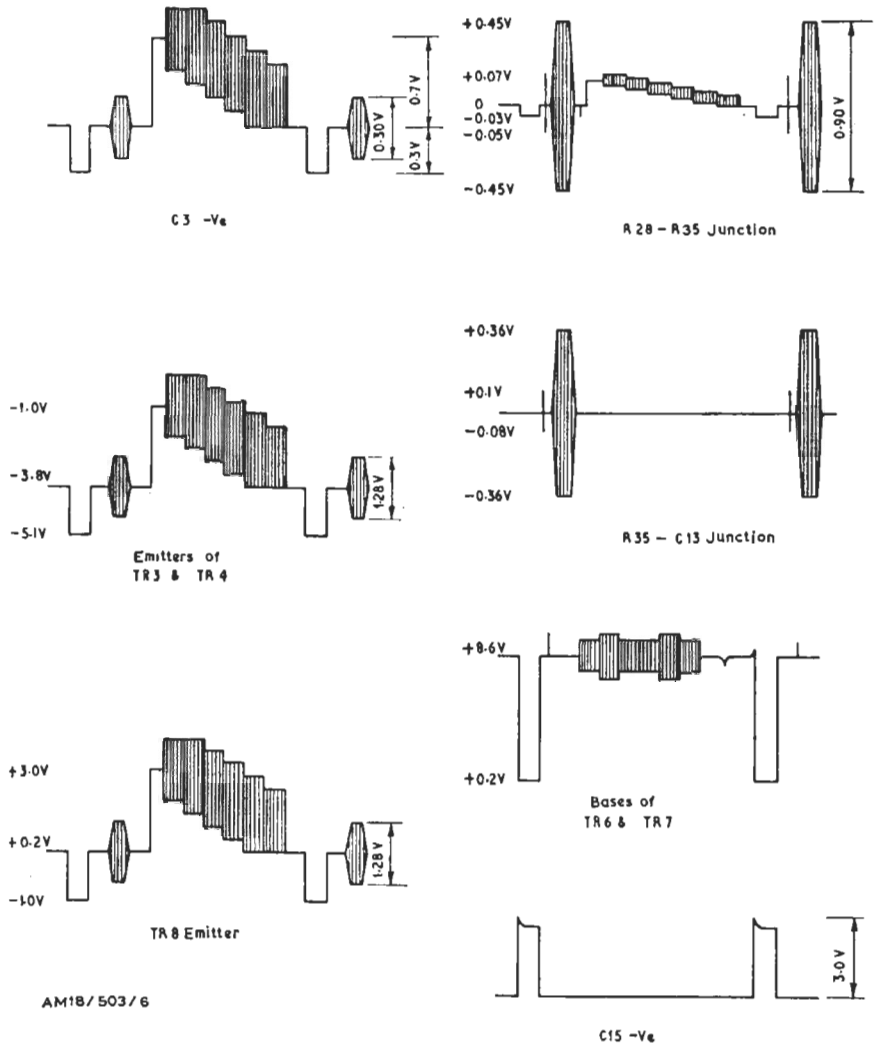

Fig. 4 Waveforms in the AM1/558 (1)

at white level and applied to two cascade-connected sync-gating stages where the original sync pulses are removed. From the second gating stage, the syncless signal is fed to the sync-mixer and output-amplifier stage where reconstituted sync pulses of the correct shape and amplitude are added.

Synchronising, clamping, gating and reference-burst signals are derived from the output of the Sync Source Switch UN9/511A which feeds the selected sync signal to the Sync Pulse Separator UN1/510A. A feed of the signal is taken prior to the sync-separator section of the unit and fed as a reference burst to the Burst Error Amplifier. The separated syncs are fed to the Sync Pulse Generator GE2/504A and are applied also to a clamp-pulse-generator circuit (within the UN1/510A) which provides sampling pulses for use in the Error Signal Amplifier.

In the GE2/504A the sync pulses are passed through a delay network to ensure that syncs and video will have the correct time relationship when the two signals are finally combined. The sync pulses are then passed through a shaping network, which gives the pulse edges a sine-squared shape, before they are added to the video signal in the output stage of the processing amplifier. Pulses

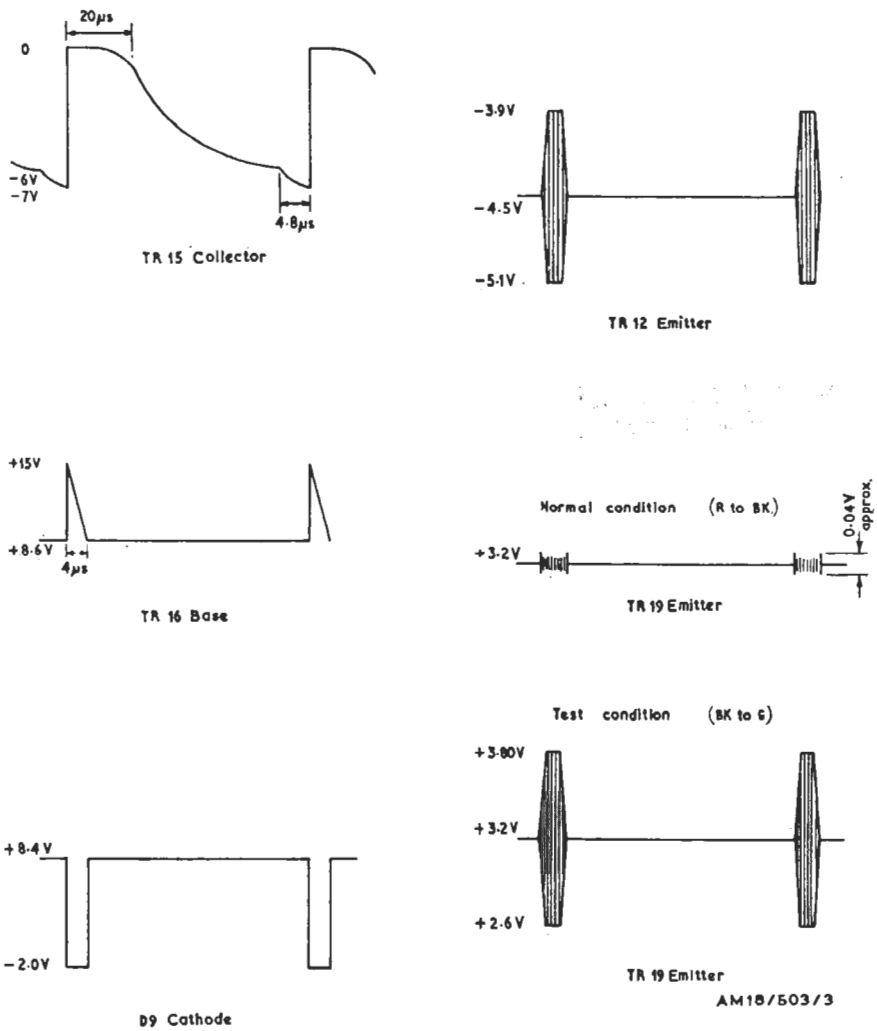

Fig. 5 Waveforms in the AM1/558 (2)

from the input stage of the GE2/504A are fed also to the Gating Pulse Generator GE2/503B. This unit provides push-pull gating pulses for the operation of the sync-gating stages in the processing amplifier.

Alignment

The units comprising an AM18/503A must be aligned as an integral assembly. Unless otherwise stated, all adjustments are carried out with the appropriate unit mounted on a chassis extender. In some instances the presence of the extender affects the adjustment; when this happens a further small adjustment may be required when the unit has been replaced in the main assembly and the effect of the initial adjustment noted.

The waveforms present at various points in the AM18/520 and AM1/558 units are shown (for a colour-bar input signal) in Figs. 2 to 5, the waveforms present in the other units are shown in the appropriate circuit diagrams.

The alignment procedure is given in tabular form. This allows any step in the alignment to be readily identified if a partial line-up is all that is needed.

Initial Checks

Subject	*Unit*	*Control Adjusted or Point Monitored*	*Check or Adjustment*
Power Supplies	PS2/57	R8, pin 5 R21, pin 7 R27, pin 9 R17, pin 13 R33, pin 11	Adjust for +12 V Adjust for +9 V Adjust for +4 V Adjust for −14 V Adjust for −4 V The ripple voltage on all outputs should be less than 1 mV p-p.
Main Unit Inputs	AM18/503A	Signal inputs	Set the mixer to *Fade* and select a suitable colour test signal. Check that this signal is present at the *Fade* input of the AM18/503A. Check also that colour syncs are present at the *Black Level* input.
Sync Gating	AM18/520	Monitor junctions of: R22 and pin 3, R30 and pin 2 R22, R30	Using a high-impedance probe, monitor at each of these points in turn and check that positive-going gating pulses (as shown in Fig. 2) are present. If gating pulses are not present, check the GE2/503B unit.
		Monitor junctions of: R27 and pin 4, R35 and pin 1	Using a high-impedance probe, monitor at each of these points in turn and check that negative-going gating pulses (as shown in Fig. 2) are present. If gating pulses are not present, check the GE2/503B unit.
Sync re-insertion	AM18/520	R44	Using a high-impedance probe, check that inverted sync pulses are present at this point. If they are not check the GE2/504A unit.
Video clamping	AM3/501	Pins 12 and 13	Check that wide sampling pulses are present at pin 12 and narrow sampling pulses at pin 13. If they are not check the UN1/510A unit.

Subject	*Unit*	*Control Adjusted or Point Monitored*	*Check or Adjustment*
Burst Stabilising			
(1) Input signals	AM1/558	*Video* input *Ref.* input *Sync* input	Select a synchronous colour signal on either bank of the mixer. Check that a 0·93 V p-p composite signal is present at the *Video* input, a colour-syncs signal is present at the *Ref.* input and a 3 V p-p inverted-sync signal is present at the *Sync* input.
(2) Burst Gating	AM1/558	D9 cathode	Check that the clamp pulses at this point are as shown in Fig. 5. If they are not, check the waveforms at the base of TR16 and the collector of TR15 against those shown in Fig. 5.
		R22, monitor at emitter of TR12	Use a high-impedance probe and adjust R22 for zero gating step (see Fig. 5).
		R87, monitor at emitter of TR32	Use a high-impedance probe and adjust R87 for zero gating step.
		C34, C37 C42, C45 Monitor at *Burst Error* monitor point on AM18/520	Adjust these components in turn for minimum amplitude of gating spike before and after the residual burst. The best compromise is to obtain zero spike after the burst and less than 50 mV of spike before the burst, because the pre-burst spike is removed in a later gating stage.
		R87, monitor at *Burst Error* monitor point	Re-adjust R87 for zero step if necessary.
(3) Burst Removal	AM1/558	C10, monitor at AM18/503A output	Set the movable link at the reference input to *Test* (green to black). Adjust C10 for a burst amplitude of less than 10 mV. If this is not possible, set C10 to about one third of its capacitance and adjust R88 and C39 on the AM18/520 unit for minimum burst. If a gross misalignment is suspected, check step (5).

Subject	*Unit*	*Control Adjusted or Point Monitored*	*Check or Adjustment*
(4) Burst re-insertion	AM1/558	R110, C28, monitor at *Burst Error* monitor point on AM18/520	Set the movable link at the reference input to *Normal* (red to black). Feed the AM18/503A with a non-sync colour signal via the A-bank of the mixer. Adjust R110 and C28 for a burst amplitude of less than 40 mV. If this is not obtainable, RV5 and C7 on the UN9/511A unit must be adjusted. Feed a non-sync colour signal through the B-bank of the mixer and check that the amplitude of the residual burst does not change. If it does change, adjust RV6 and C8 on the UN9/511A unit.
	UN9/511A	RV5, C7, monitor at *Burst Error* monitor point	Select a non-sync colour signal on the A-bank of the mixer. Adjust RV5 and C7 on the UN9/511A for minimum burst (less than 40 mV).
		RV6, C8, monitor at *Burst Error* monitor point	Select a non-sync colour signal on the B-bank of the mixer. Adjust RV6 and C8 for minimum burst (less than 40 mV).
		RV4, C6, monitor at *Burst Error* monitor point	Select a synchronous colour signal. Adjust RV4 and C6 for minimum burst (less than 40 mV).
(5) Chrominance/luminance gain of burst-delay section	AM18/520	Monitor at junction of R56/R57	Use a high-impedance probe and check that the burst amplitude is 270 mV.
		L7, L8, monitor at junction of R101/R61 and at junction of R62/R104	Check that the burst amplitude at each point is 285 mV $\pm 5\%$. If it is not then, initially, L7 and L8 must be adjusted to give equal amplitudes at these points. Further adjustment of L7 from this equality setting is necessary to give a constant burst phase when fading from 0 dB to 20 dB. Following any adjustment of L7, R110 and C28 must be re-adjusted (see step 4).

Subject	*Unit*	*Control Adjusted or Point Monitored*	*Check or Adjustment*
Sync Gating: Picture and Sync Amplitudes			
(6) Input Signals	UN9/512A	RV1, monitor at M3	Adjust RV1 for a signal amplitude of 0·37 V p-p.
(7) Sync Gate Steps	AM18/520	R24, R32, monitor at output of AM18/503A	Check that the AM18/503A is terminated in 75 ohms and monitor at the output. Press the *Sync Pulse Removal* switch on the GE2/504A unit and adjust R24 and R32 to remove any steps that may be present during the line-blanking period.
(8) Sync Gate Transients	AM18/520	C12	Keep the *Sync Pulse Removal* switch pressed and adjust C12 for minimum-amplitude gating spikes. If, after adjustment, the spike amplitude is greater than 20 mV p-p, alter the values of capacitors C11 and C13. Note that the presence of the chassis extender seriously affects this adjustment. Release the *Sync Pulse Removal* switch.
(9) Output d.c.	AM18/520	R49	Adjust to bring the blanking level of the output signal to zero volts.
(10) Picture Gain	AM18/520	R37	Adjust to make the picture component of the output signal 0·7 V p-p.
(11) Sync Gain	GE2/504A	*Sync Gain*	Adjust the *Sync Gain* control which is mounted on the front panel of the GE2/504A to make the sync component of the output signal 0·3 V p-p.

Subject	*Unit*	*Control Adjusted or Point Monitored*	*Check or Adjustment*
White-level Clipper			
(12) White-level clipper	AM18/520	R17, monitor at output of AM18/503A	Apply a composite sawtooth signal with an amplitude of 1·5 V p-p to the input of the AM18/503A. Adjust **R17** to limit the picture component of the output signal to 0·8 V p-p.
Frequency Response and Differential Phase Distortion			
(13) Frequency Response	AM18/520	C8, monitor at output of AM18/503A	Apply the output from an augmented pulse-and-bar generator such as the GE2/543 or the GE2/559 to the AM18/503A. Use an oscilloscope terminated in 75 ohms. Check that the pulse-to-bar ratio of both the 2T pulse and the 10T chrominance/luminance pulse is better than 1%. If it is not, adjust C8. The 1T pulse should be within 2% of the 2T pulse-to-bar ratio. Attenuate the pulse-and-bar input signal in 1-dB steps until it is 20 dB down on a 1 V signal. Observe the sub-carrier burst. Throughout the attenuation process the burst amplitude should not vary by more than ±2% and the burst phase should not vary by more than ±1°.
(14) Differential Phase Distortion	AM18/520	L6	Use a Remote Signal Analyser EP1M/508 and a Non-linearity Distortion Test Signal Generator GE2M/520 (or GE4/505A with GE4/514) to check the differential phase distortion. (See Fig. 6 and the Instruction on the EP1M/508.) The distortion should be less than 0·6°. If it is not adjust L6.

Subject	*Unit*	*Control Adjusted or Point Monitored*	*Check or Adjustment*
Clamp Circuit			
(15) Subcarrier Rejection	AM3/501	L1, monitor at junction of R4/C1	Remove the unit from the assembly and apply a 4·43 MHz subcarrier signal at 1 V p-p to monitor point MP1. Use a high-impedance probe and adjust the core of L1 for minimum signal. Replace the unit in the main assembly.
(16) Feedback Clamp Adjustments	AM3/501	RV2, C18	Remove the input signal from the AM18/520 unit, but check that the other units of the AM18/503A are still being fed with pulses via the UN9/511A unit.
		Monitor at MP2	Set S1 on the AM3/501 to the *0 V* position. Adjust RV2 to remove any step that may be present and then adjust C18 to minimise transients.
		S1	Set S1 to the *−10 mV* position. A pulse of about 0·7 V p-p should be present at MP2. A low-amplitude pulse indicates low gain in the amplifier circuits. Reset S1 to *0 V*.
		RV3, monitor at emitter of TR5 in AM18/520	Use a high-impedance probe and adjust RV3 to make the potential at this point zero volts.
(17) Feedback Clamp: Operation Checks	AM3/501	RV1	Set S1 to *Normal* and restore the video input to the AM18/520. Check that a correctly-clamped video signal appears at the emitter of TR5 on the AM18/520 unit. Set the display to show the field-blanking period and adjust RV1 for minimum distortion. Check RV2 and re-adjust if necessary.

Subject	*Unit*	*Control Adjusted or Point Monitored*	*Check or Adjustment*
(18) Manual Time-constant	AM3/501	S2, monitor at output of AM18/503A with 75-ohm termination	Set the mixer to the non-sync condition and apply an 0·7 V p-p 50-Hz sine-waveform to the *Fade* input of the AM18/503A. Set S2 on the AM3/501 unit to *Medium*. Check that the output signal amplitude is −25 dB (+2 dB) with respect to the input signal. Set S2 to *Long*. The output should now be −19 dB with respect to the input. Set S2 to *Short*. The output should now be −31 dB with respect to the input. Set S2 to *Auto* and align the UN3/503.
(19) Automatic Time-constant	UN3/503	RV2, monitor at output of AM18/503A	Set S1 on the UN3/503 to *Normal*. Adjust RV2 to obtain the same degree of 50-Hz attenuation as was obtained with S2 on the AM3/501 set to *Short*.
		RV1, monitor at output of AM18/503A	Set S1 to *Test*. Adjust RV1 to obtain the same degree of 50-Hz attenuation as was obtained with S2 on the AM3/501 set to *Long*. Note that about 30 seconds must be allowed between each adjustment of the controls on the UN3/503 because of the thermal delay caused by the thermistor on the AM3/501. When the adjustments on the UN3/503 are completed, reset S1 to *Normal* and set S2 on the AM3/501 to the required position. Remove the 50-Hz input to the AM18/503A and restore the video input signal.

Subject	Unit	Control Adjusted or Point Monitored	Check or Adjustment
Setting Sync-switching Levels			
(20) To minimise sync-switch bumps	UN9/511A	RV1, RV2, RV3, monitor at output	Remove all three input signals to the UN1/511A and set RV1, RV2 and RV3 fully clockwise. Use an oscilloscope set to a sweep speed of 0·1 cm/sec. Cut between a sync and a non-sync channel on the A-side of the mixer and adjust RV2 for minimum step at the output. Cut between a sync and a non-sync channel on the B-side of the mixer and adjust RV3 for minimum step at the output. If, after these adjustments have been made, a step of more than 150 mV is still present at the output of the unit when switching between sync and non-sync sources, turn RV1 slightly anti-clockwise and re-adjust RV2 and RV3.

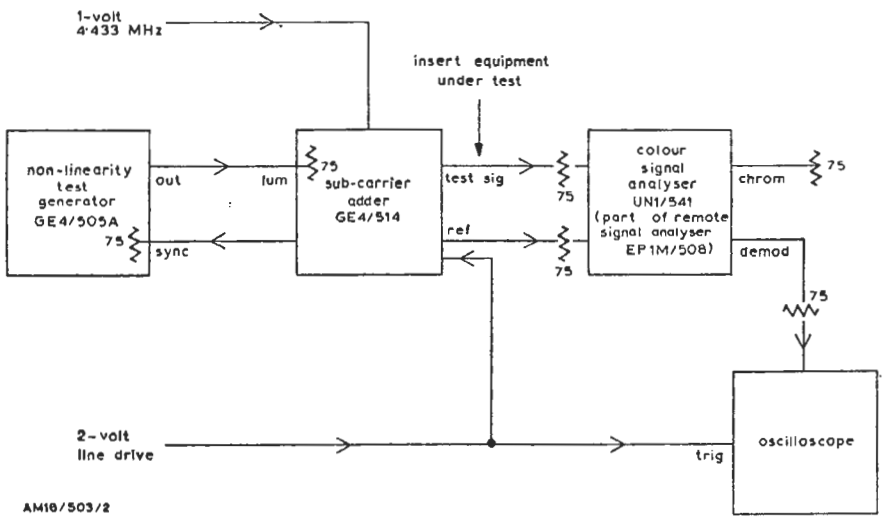

Fig. 6 Differential-phase Distortion Test Arrangement for the AM18/520