CUT/FADE AMPLIFIER AM1/504

General Description

The AM1/504 unit accepts up to ten video signals, of which any one can be selected by the application of switching pulses to an appropriate diode-switch circuit. The selected signal is used to provide two outputs from the unit, one directly (the *unfaded* signal) and the other via a remotely-controlled fader (the *faded* signal). A block diagram of the unit is given in Fig. 1.2.

The unit consists of a chassis type CH1/13D (index-stud hole positions 1 and 3) containing the following sub-units:

Three of the Three-channel Switch Unit UN9/510 (index-stud positions 2 and 6).
Single-channel Switch Unit UN9/509 (index-stud positions 3 and 10).

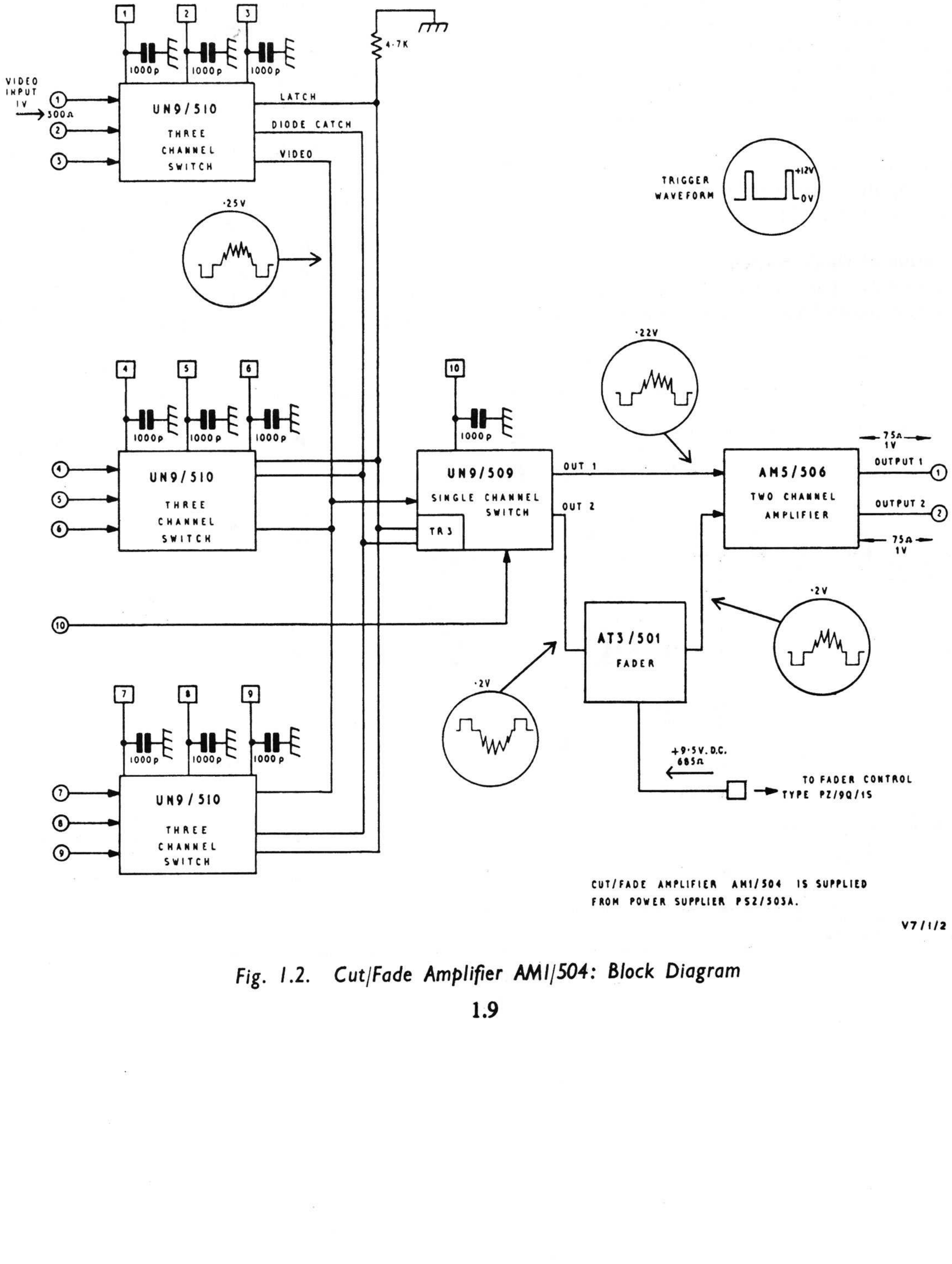


Fig. 1.2. Cut/Fade Amplifier AM1/504: Block Diagram

Remotely-controlled Fader AT3/501
(index-stud positions 3 and 10).
Two-channel G.P. Amplifier AM5/506
(index-stud positions 3 and 6).
Stabilised Power Supplier PS2/503A
(index-stud positions 1 and 6).

The power supplier is described in Instruction G.2. The remaining sub-units, all assembled on a chassis type CH1/12A, are described here. A circuit diagram of the chassis wiring is given in Fig. 16.

Three of the ten possible video inputs are applied to each of the three-channel switch units; the remaining signal being applied to the single-channel switch unit. The outputs of the three-channel switch units are paralleled to a common load in the single-channel switch unit. From the selected signal developed across this load two outputs are obtained and fed to the two-channel G.P. amplifier, one directly and the other via the remotely-controlled fader.

Operation of Diode Switch

An essential part of both the three-channel and the single-channel switch units is the diode switch, which is a self-contained component-assembly on a printed-wiring board. The typical circuit in Fig. 1.3 has generalised component references for explanatory purposes only; the differing specific codes for individual cards are tabled subsequently.

The signal path through the switch is between tags 2 and 9 of the card, and consists of MR1 and MR8 connected in opposing senses. Where there is a potential between the junction of the diodes, and the input and output tags of the card of such polarity that the diodes are conducting, the switch is closed. When the polarity is reversed so that the diodes are non-conducting, the switch is open.

In the single- and three-channel switch units, tags 2 and 9 of the card are connected via resistive loads to the negative (earthy) side of the d.c. supply. The junction of MR1 and MR8 is connected through R8 and via tag 5 to parallel-connected fixed and pre-set resistors. Thus a potential is applied to the diodes in their conducting sense, causing a current to flow in R8, in the diodes and in the loads of the switch; this is the *closed* condition of the switch.

The junction of the diodes is also connected to the negative side of the supply via MR4 and R1.

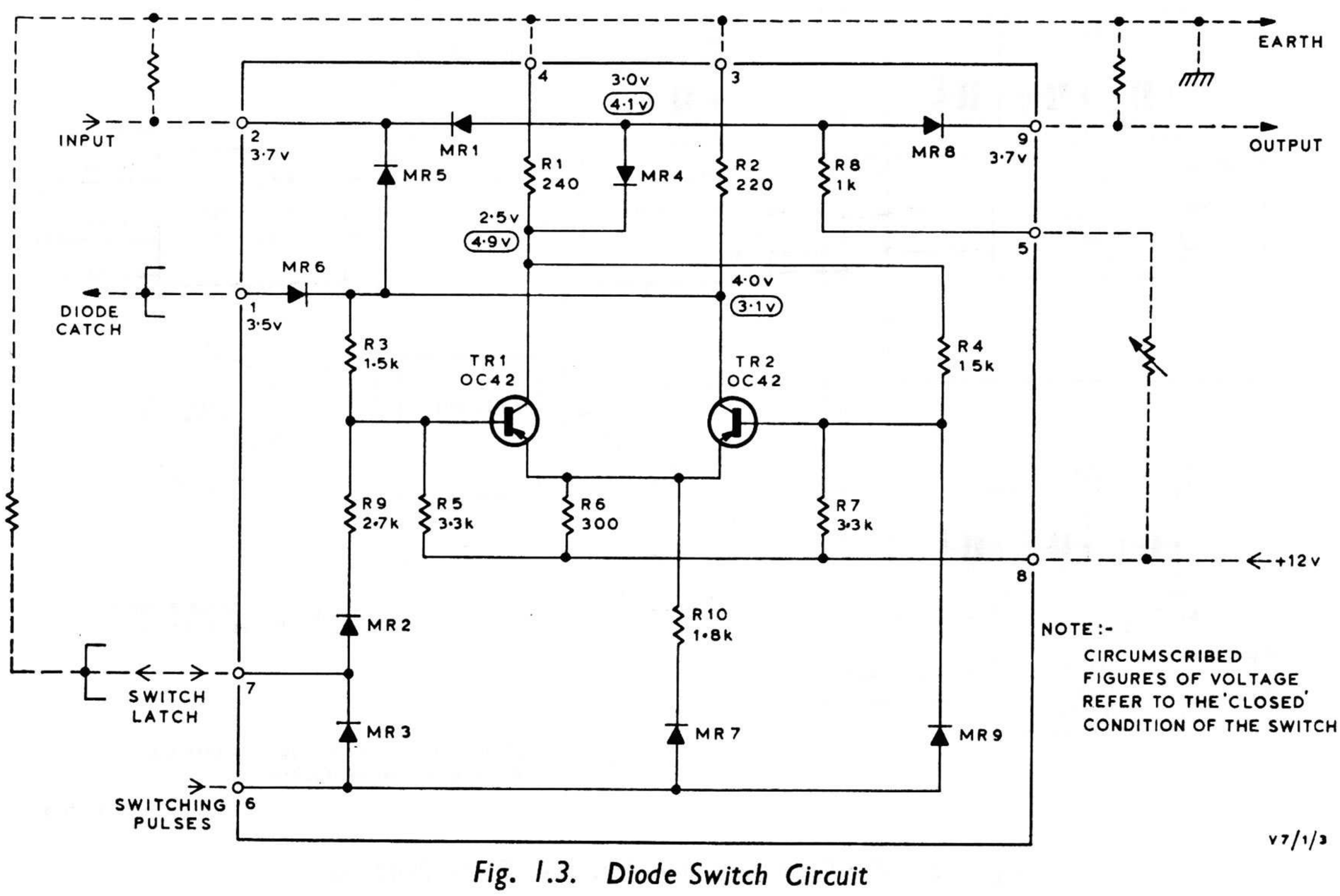


Fig. 1.3. Diode Switch Circuit

R1 is the collector load of TR1, which is one of a pair of transistors (TR1, TR2) in a bistable multivibrator circuit. The above-mentioned closed condition of the diode switch is produced by one condition of the multivibrator, in which TR1 conducts heavily and TR2 is cut off. The TR1 collector current is sufficient to bring the potential at the positive end of R1 above that at the junction of MR1 and MR8. The potential difference across MR4 is then in the non-conducting sense of the diode.

In the other condition of the multivibrator, TR1 is non-conducting and no collector current flows in R1. The potential at the positive end of R1 is lower than that at the junction of MR1 and MR8, causing MR4 to conduct. R1, MR4 and R8 form a voltage-divider across the d.c. supply, placing on the junction of MR1 and MR8 a positive potential lower than that at tags 2 and 9 of the card; thus MR1 and MR8 combination is non-conducting, and the switch is open. The positive potential at tag 9 is maintained by its common connection with the corresponding tag on all other switches, one of which is normally closed and so passing a current through the common output load. The positive potential at tag 2 is due to conduction by MR5, this connecting the tag to the TR2 collector and thus to R2, which serves as a dummy load on the source in place of the circuit on the output side of the switch. When the switch is open, TR2 is heavily conducting and its collector potential is therefore high. (When the switch is closed, TR2 is non-conducting and its collector potential is lower than that developed at tag 2 as described above; MR5 is therefore non-conducting).

The multivibrator comprises TR1, TR2 and R1–R7. It changes state on receiving a positive-going switching pulse at the base of either TR2 or TR1. A pulse applied to TR2 base causes the diode switch to close; a pulse applied to TR1 base causes it to open. If a succession of pulses is applied to the same point, the first has the effect described and the remainder have no effect.

When the diode switch is open, the leading edge of a switching pulse applied via tag 6 of the card causes MR9 to conduct and drives the base of TR2 positive, cutting off the collector current and causing TR1 to conduct heavily; this closes the switch, as already described. The same pulse also reaches the base of TR1 via MR3, MR2 and R9, and the emitters of both transistors via MR7 and R10, but at these points it is attenuated by R9 and R5 and by R10 and the common emitter-impedance of the transistor circuit respectively. The effects of the pulse at the base and emitter of TR1 balance one another, because the pulse is attenuated at both points. The pulse is not attenuated at the base of TR2 and therefore is only partly offset by the input at the emitter, so the circuit changes state as described.

The junction of MR2 and MR3 is connected via tag 7 of the card to the corresponding tag on all the other cards in the sub-units; because none of these cards is receiving a switching pulse at tag 6, the rise in potential at the bases of all TR1 transistors causes any closed diode switches to open, as previously described. Thus the closing of one diode switch ensures that all others in the same cut/fade amplifier are open. The connection linking tag 7 of all the cards is termed the *switch-latch* connection.

The *diode-catch* connection, from the TR2 collector via MR6 and tag 1, is taken to a precautionary circuit described as part of the single-channel switch unit.

The component numbering of the individual diode-switch cards in the three- and single-channel switch units is given in the table.

Ref. Fig. 1.3	*UN9/510*			*UN9/509*
	Card 1	*Card 2*	*Card 3*	
R1	R15	R25	R38	R9
R2	R20	R30	R43	R14
R3	R17	R27	R40	R12
R4	R16	R26	R39	R11
R5	R14	R24	R37	R7
R6	R18	R28	R41	R10
R7	R21	R31	R44	R16
R8	R12	R22	R35	R8
R9	R13	R23	R36	R6
R10	R19	R29	R42	R13
MR1	MR6	MR15	MR25	MR1
MR2	MR2	MR11	MR21	MR2
MR3	MR3	MR12	MR22	MR3
MR4	MR5	MR14	MR24	MR4
MR5	MR7	MR16	MR26	MR5
MR6	MR4	MR13	MR23	MR6
MR7	MR8	MR17	MR27	MR7
MR8	MR1	MR10	MR20	MR8
MR9	MR9	MR18	MR28	MR9
TR1	TR1	TR3	TR5	TR1
TR2	TR2	TR4	TR6	TR2

Three-channel Switch Unit UN9/510 (Fig. 17)

This sub-unit consists of three diode-switch cards with their input, output and supply circuits. The three inputs are designated A, B and C, and are applied to cards 1, 2 and 3 respectively. The connections to the sub-unit are via two connectors PLA and PLB (Fig. 17).

The circuits relating to card 1 are now described; those relating to the other two cards are similar, and their component and connector-pin numbering can be seen in Fig. 17.

Card 1

The video input signal is applied to tag 2 via pin 15 of connector PLB, C2 and the slider of RV1; the last-mentioned is used with R9 and R8 to form the input load of the diode switch and to serve as a pre-set level control. The shunt resistor R6 provides d.c. connection to the negative (earthy) side of the 12-volt supply and ensures correct polarisation of C2.

The switching-pulse input is applied directly to tag 6 via pin 5 of connector PLA. In the wiring of the cut/fade amplifier chassis (see Fig. 16) a 0·001-μF capacitor is connected across the switching-pulse input to reduce the possibility of false operation of the diode switch by spurious signals.

Tag 9 (the diode-switch output) is connected in common with the same tags of the other two cards to pin 1 of connector PLB. The cut/fade amplifier chassis is wired to common this output with those of the other two three-channel switches, as a combined connection for the single-channel switch. Signal amplitude in this part of the circuit is approximately -12 dB with respect to 1 volt.

Tag 5 (the switch-diode junction) is connected to the 12-volt supply via R32 and RV3 in parallel. RV3, in conjunction with the corresponding controls RV4 and RV5 for the other cards, enables the potentials of the junctions to be adjusted relative to one another.

Tag 7 (the switch-latch circuit) is connected (a) to tags 7 of the other two cards, (b) via pin 4 of PLA to tags 7 of the cards in the other switch units, and (c) to earth via MR19 and R34. The live end of R34 is coupled to the positive side of the supply by C5. This connection to the switch-latch circuit is to ensure that sudden application of the 12-volt supply (as, for example, when the sub-unit is inserted into equipment which is already switched on) shall automatically set all the diode switches to their open condition. When the supply is connected, C5 charges through R34 and the charging current produces a positive-going pulse at the live end of the resistor. This pulse is applied via the switch-latch circuit to tags 7 of all the diode-switch cards.

Tag 1 (the diode-catch circuit) is connected, together with the corresponding tags of the other two cards, via pin 15 of connector PLA to the remainder of the circuit in the other switch units.

The 12-volt d.c. supply enters the sub-unit via pin 1 of PLA and is decoupled by L1, C1 and C4.

Single-channel Switch Unit UN9/509 (Fig. 18)

This sub-unit consists of (a) one diode-switch card with its input and supply circuits, (b) the common output load of all diode-switch cards in the cut/fade amplifier, (c) the operative part of the diode-catch circuit, and (d) two separate output stages. Connections to the sub-unit are via a single connector PLA (Fig. 18).

The diode-switch card and its input and supply circuits are similar to those already described for the three-channel switch. R19 is the common output load of the diode switches; it is connected to tag 9 of the card and via pin 15 of the connector to tags 9 of the cards in the three three-channel switches.

The purpose of the diode-catch circuit is to guard against failure of a diode switch to open as another is closed. This may occur if, for example, imperfect closure of relay contacts reduces the amplitude of the switching pulses applied to tag 6 of a diode-switch card. The chosen switch may then close, but the pulse as applied via the switch-latch circuit to all other switches is additionally attenuated at the bases of their TR1 transistors (Fig. 1.3) and the amplitude may be insufficient to open any switch that is already closed. The result is that two diode switches tend to be closed simultaneously, and hence the conduction currents of two diodes (MR8) flow in the d.c. load R19 (Fig. 18) instead of the normal current due to one diode. This would continue until the switching pulses became normal, meanwhile causing (in addition to an unwanted mixture of signals) the appearance across R19 of a large-amplitude positive-going pulse which would pass as a spurious video signal to the remainder of the chain.

The diode-catch circuit has connections from tag 1 of all the diode-switch cards in the three-channel and single-channel switch units. The circuit enters the single-channel switch unit via

pin 13 of the sub-unit connector, and is tied to the positive side of the 12-volt supply by R17. This resistor forms the emitter circuit of a common-base amplifying stage utilising a pnp transistor TR6. The collector load of TR6 consists of R33, R18 and the input impedance of TR3. R31 and R32 are a voltage-divider which maintains the base of TR6 at a potential of 3·6 volts, slightly higher than the normal potential (3·5 volts) of the diode-catch circuit. Thus the base-emitter junction of TR6 is normally reverse-biased, no collector current flows, and there are no base or collector currents in TR3. TR3 is a common-emitter stage utilising an npn transistor, the collector of which is connected to the switch-latch circuit via diode MR10.

The potential of the diode-catch circuit is determined by a flow of current through R17 and the equivalents of MR6 and R2 (Fig. 1.3) in the circuit of any diode switch which is closed. Normally, when only one switch in the system is closed, the collector potential of TR2 is 3·1 volts, and the potential of the diode-catch circuit is 3·5 volts. No current flows in the equivalent of the MR6-and-R2 branch (Fig. 1.3) of diode switches which are open, because the TR2 collector potential in such switches is 4 volts and so MR6 is reverse-biased. In the event of the condition described earlier, two such currents flow simultaneously in R17 (Fig. 18) causing an increased potential difference across the resistor. Thus the diode-catch-circuit potential falls, and the negative-going change of potential at the emitter of TR6 forward-biases the base-emitter junction of the transistor. Collector current flows, applying to the TR3 base an amplified negative-going pulse. This appears at the collector of TR3 (in the switch-latch circuit) as a positive-going pulse which reinforces the faulty switching pulse and thus ends the undesirable condition within the duration of a single pulse.

Diode MR10 is provided in the collector lead of TR3 to minimise the ill-effects of a failure of the 12-volt supply to the unit. That failure could cause the potential of TR3 emitter to fall to zero volts; during the incidence of a switching pulse a positive potential of 12 volts is applied to pin 7 of the sub-unit and so via tag 6, MR3 (or equivalent) and tag 7 of the diode- switch card (Fig. 1.3) to the collector of TR3. If the emitter potential were zero, and MR10 absent, there would thus be a potential of 12 volts applied to the transistor in the forward sense of the collector-to-base junction, causing heavy conduction which would load the switching-pulse source heavily and so reduce the amplitude of the switching pulses. The result could be unreliable operation of diode switches in other units.

The two output stages are TR5 (output No. 1) and TR4 (output No. 2). They are fed via separate pre-set gain controls RV3 and RV4, respectively, which are shunted by the fixed resistor R20 and coupled to R19 by C5. The low-signal-potential ends of the gain controls are connected to the junction of R21, R23 which form a voltage-divider across the 12-volt supply to obtain a suitable potential on the bases of the transistors. R21 and R23 in parallel also form, with the gain controls, an a.c. load on the diode switches. The pre-set inductor L2, in series with R23, provides adjustable compensation for high-frequency losses in the switches.

TR5 is an emitter-follower, the output of which is fed via pin 9 of the connector and the cut/fade amplifier chassis-wiring to provide the unfaded input to the two-channel G.P. amplifier. TR4 is a conventional common-emitter stage, the output of which is fed via the coupling network C7, R26, R29, pin 11 of the connector and the unit chassis-wiring to the remotely-controlled fader. The input impedance of the last-mentioned forms the a.c. load of TR4.

The signal amplitudes across R19 and at the outputs of the sub-unit are approximately −12 dB with respect to 1 volt.

The 12-volt d.c. supply enters the sub-unit via pin 1 of the connector and is decoupled by L1, C2 and C3.

Remotely-controlled Fader AT3/501 (Fig. 19)

This sub-unit consists of a bridge circuit, amplifying stage and emitter-follower forming the signal path, and a control circuit, utilising three transistors. The control circuit enables the condition of the bridge to be varied by means of an extended circuit carrying only d.c. and having a fader control as its variable element. When the bridge is balanced, no signal is applied to the amplifier; thus this condition corresponds to the *out* setting of the fader control, and the condition of increasing unbalance occurs as the fader control is moved towards its *up* setting. The connections to the sub-unit are via a single connector PLA (Fig. 19).

Signal Path: TR4, TR5 (Fig. 19)

The incoming signal enters the sub-unit via pin 13 of the connector and is applied directly to the

bridge; the a.c. path to earth is completed by C4.

The output signal from the bridge is applied between the base and emitter of TR4. R23 and the input impedance of the transistor load the bridge, and R24 provides a d.c. path for the supply to the emitter. R24 is of sufficiently high resistance to have negligible shunting effect on the arm b-c of the bridge.

TR4 and TR5 are connected in conventional amplifying and emitter-follower stages respectively. L1 is provided to correct for losses at high frequencies, and there is negative feedback due to R23. The output signal of the sub-unit is taken from the emitter of TR5.

The signal amplitudes at the input to the sub-unit, and at the output when the fader control is disconnected or set to its fully-up condition, are approximately −12 dB with respect to 1 volt.

Bridge (*Fig. 19*)

The arms of the bridge are as follows:

a–b: R7, shunted by C1 and RV1;

b–c: R4, R6, R16, R17 in series-parallel, shunted by MR1, MR3, MR4, MR2 respectively. If the bridge is considered as an a.c. circuit, R5 and R15 are in parallel with R4 and R17 respectively.

c–d: R18, RV3, R19, R4 in series-parallel.

d–a: R11.

The video signal is applied between points a and c, and the bridge is therefore balanced when: (a–b)/(b–c) = (d–a)/(c–d). This condition is obtained by adjustment of RV3 and RV4 when the external fader control is set to its fully-out condition: RV3 and RV4 serve as coarse and fine controls, respectively. Any residual unbalance at high frequencies, due to stray capacitance in the circuit, can be minimised by the adjustment of C1 and RV1.

The state of balance of the bridge is varied by differential adjustment of the potentials applied to points x and y in the circuit of the arm b–c. The diodes MR1, MR2, MR3 and MR4 are utilised as non-linear resistors; they are operated with applied potentials within a fraction of a volt of zero, and their current/voltage characteristic is sharply curved in this region. When x is positive with respect to y, the diodes are biased to a conducting condition and their resistances are low; the resistance to a.c. of the bridge arm b–c is then approximately 25 ohms. When y is positive with respect to x, a small bias in the non-conducting sense is applied to the diodes, so that their resistances are high; the resistance to a.c. of the bridge arm b–c is then due mainly to the combination of R4–R6 and R15–R17 and is approximately 220 ohms.

The shape of the characteristic curve of the diodes, in conjunction with the law of the fader control, provides a smooth transition between the minimum and maximum values of resistance of the bridge arm b–c as the magnitude and polarity of the potential difference between x and y are varied. The maximum value corresponds to the balanced condition of the bridge, obtained at the *out* setting of the fader control.

Control Circuit: TR1, TR2, TR3 (*Fig. 19*)

The potentials applied to points x and y are developed across R5 and R15 by the collector currents of TR1 and TR3 respectively. The TR3 base is connected to the tapping point of a potential divider consisting of R21, in parallel with the fader control and R29, and R20. When the fader control is operated, the base potential of TR3 and hence the collector current are varied. The collector current flows in an emitter load consisting of R13 and TR2; the base of TR2 is held at constant potential by connection to the potential divider R2, R3 and decoupled by C2. This emitter load is shared with TR1, and the change of current in it develops a signal potential which is applied to the TR1 emitter. The TR1 base is held at constant potential, by connection to the voltage-dividing chain R8, R9, R10 and RV2, and decoupled by C3.

TR1 behaves as a common-base stage driven by TR3. The changes of collector current in TR1 are approximately equal and opposite to those of TR3. In theory, they cannot be exactly equal, because they would then cancel one another and there would be no input signal to TR1. Clearly, the higher the impedance of the shared emitter load, the smaller the unbalance necessary to provide the required input to the transistor. The dynamic impedance of the circuit of TR2, at the collector, is sufficiently high for the unbalance to be negligibly small for practical purposes.

The *out* condition of the fader control places a minimum resistance in parallel with R21, causing maximum collector current in TR3, minimum current in TR1, point y to be positive with respect to point x, and the resistances of the diodes MR1 to MR4 to be high. Thus the bridge is balanced.

The capacitor C6 is provided to prevent conditions in the circuit from being disturbed by impulses accidentally induced into the lead to the fader control (the equivalent of 'clicks' in an audio circuit).

In the setting-up of the fader, RV2 is adjusted so that the video signal is attenuated by 21·5 dB when the fader-control lever is moved from the fully-up setting (open circuit) to a setting giving a resistance of 750 ohms. A 750-ohm resistor is provided in series with the *Control* test-socket, rather than a 1-kilohm resistor as in other test positions, so that the fader-control adjustment can conveniently be simulated by temporarily earthing that socket. The setting-up of the unit is detailed subsequently.

Supplementary Notes

The video output signal from the emitter of TR5 is fed from the sub-unit via pin 9 of the connector and via the cut/fade amplifier chassis-wiring (Fig. 16) to input 2 of the two-channel G.P. Amplifier (tag 5, SKT 12).

The fader control is connected between tag 7 of the mating connector of PLA and earth, via the unit chassis-wiring and pin 5 of connector PL2.

The 12-volt d.c. supply enters the sub-unit via pin 1 of PLA and is decoupled by L2 and C8.

The balance of the circuit of this sub-unit is particularly susceptible to disturbance by any variation of stray circuit capacitance; to maintain these constant and to screen the input circuits from the output circuits a screen is fitted to enclose most of the components forming circuits prior to the collector load of TR4.

Two-channel G.P. Amplifier AM5/506 (Fig. 20)

This sub-unit consists of two separate four-stage circuits assembled on a common printed-wiring board. They accept video signals from output No. 1 of the single-channel switch unit and from the remotely-controlled fader (the unfaded and faded signals, respectively) and amplify them to provide standard 1-volt signals into 75 ohms. Connections to the sub-unit are via a single connector PLA (Fig. 20).

Channel 1: TR1 to TR4 (Fig. 20)

This is the circuit carrying the unfaded signal, which enters via pin 13 of the sub-unit connector. R2 and R3 form a potential-divider which places on the connector pin a standing potential equal to that at the output of the preceding sub-unit. Thus no d.c. flows in the signal connection, and circuit disturbance due to the removal or insertion of that sub-unit while the equipment is working is minimised. The input connection is coupled by C1 to the TR1 base, the potential on which is stabilised by R4 and R5. TR1 is an emitter-follower, giving the sub-unit a high input impedance and matching the low impedance at the base of TR2, to which TR1 is coupled by C2.

TR2 functions as a grounded-base amplifier of the forward signal; negative feedback is applied to the base. An emitter-follower TR3 presents a high impedance to the collector of TR2, enabling maximum gain to be obtained from the combination of TR1 and TR2. The emitter load of TR3 includes a voltage-divider R12, R13, R14. The fraction of the signal developed across R14 is applied via R10 and R9 to the base of TR2 as the negative feedback signal mentioned above; R9, R10 and R14 also form a voltage-divider placing the correct d.c. potential on the base of TR2. R9 is shunted by C3 and C4, which reduce the negative feedback applied to TR2 at high frequencies, thereby increasing the gain of the amplifier to compensate for some of the losses at these frequencies in the input video switches. The fraction of the output signal from TR3 developed across R12 is applied between base and emitter of TR4, an emitter-follower which presents a low impedance at the output connection of the sub-unit.

Channel 2: TR5 to TR8 (Fig. 20)

This is the circuit carrying the faded signal, which enters via pin 5 of the sub-unit connector. The circuit configuration is similar to that of Channel 1, but three components, R19, R20 and R31, differ in value from the corresponding components R2, R3 and R14. R19 and R20 form a voltage-divider to match the output conditions of the preceding sub-unit, R31 has a slightly lower resistance than R14 so as to give less negative feedback from TR8 to TR6, and hence a gain of 14 dB instead of 13 dB.

Supplementary Notes

The output signals from channels 1 and 2 leave the sub-unit via pins 11 and 3 of the connector and are fed via the unit chassis-wiring to pins 3 and 1 respectively of connector PL2 of the cut/fade amplifier (Fig. 16).

The d.c. supply to the sub-unit enters via pin 1 of the connector and is decoupled by L1 and C5 to supply channel 1 and by L2 and C11 to supply channel 2.

1.7 Maintenance

Test Facilities

Chassis extenders are provided to facilitate maintenance on the unit. These are small chassis of similar length to the CH1/12A, fitted with 15-way male and female connectors at their opposite ends. Corresponding tags on the connectors are joined by a set of parallel conductive strips on a printed-wiring board.

The chassis extender is interposed between a sub-unit and its mating connector on a unit chassis, so that the sub-unit is supported clear of surrounding apparatus with its components readily accessible. The arrangement is illustrated in Fig. 1.4.

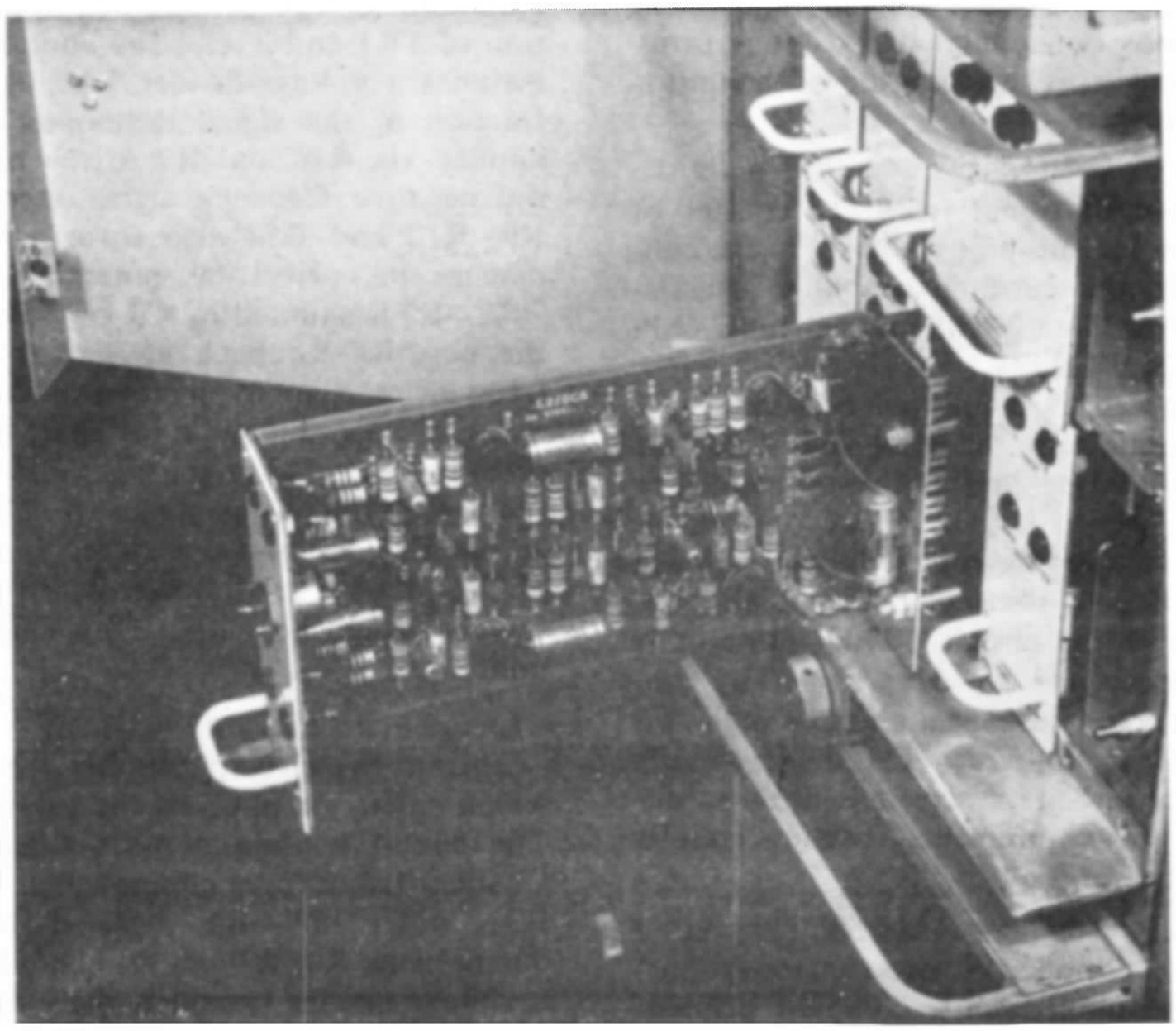


Fig. 1.4. Use of Chassis Extender

Right-hand and left-hand versions of the extender are provided; one of each is shown in Fig. 1.5. Both must be used when the sub-unit under test is fitted with two connectors, as are the three-channel switch units in the cut/fade amplifier. Sub-units having one connector require only the left-hand extender.

The left-hand extender carries a microswitch to ensure that operating-supply connection is deferred until the connectors of extender and sub-unit are correctly mated. If the sub-unit is one to which an a.c. mains connection is made, incorrect mating in the absence of this precautionary arrangement (for example, the inadvertent insertion of the indexing stud of a sub-unit into the mains-carrying socket of the chassis-extender connector) could cause the chassis of the sub-unit to become live, with consequent risk of shock to personnel. The switch, under a paxolin cover (1 in Fig. 1.5), is between female-connector tag 1 and the printed conductor from male-connector pin 1; it is normal for this conductor to carry the supply or, if the sub-unit is mains-operated, the live side of the circuit. As a sub-unit is being engaged, one of its locating pins enters the socket (4 in Fig. 1.5) and passes into a housing (3) where it forces a plunger against an operating lever (2) to close the switch.

The extenders are suited to use with any sub-unit by the absence of index pegs. Consequently

care must be taken to see that sub-units are plugged through extenders to the appropriate connectors of the unit chassis. This is particularly important to avoid damaging an operational sub-unit by its inadvertent engagement with a position carrying the mains feed for a power supplier.

When a power supplier or other mains-carrying sub-unit is to be connected via a chassis extender, the extender should always be plugged to the equipment first, and the sub-unit then plugged to the extender, because the reverse order of procedure would vitiate the action of the microswitch mentioned above.

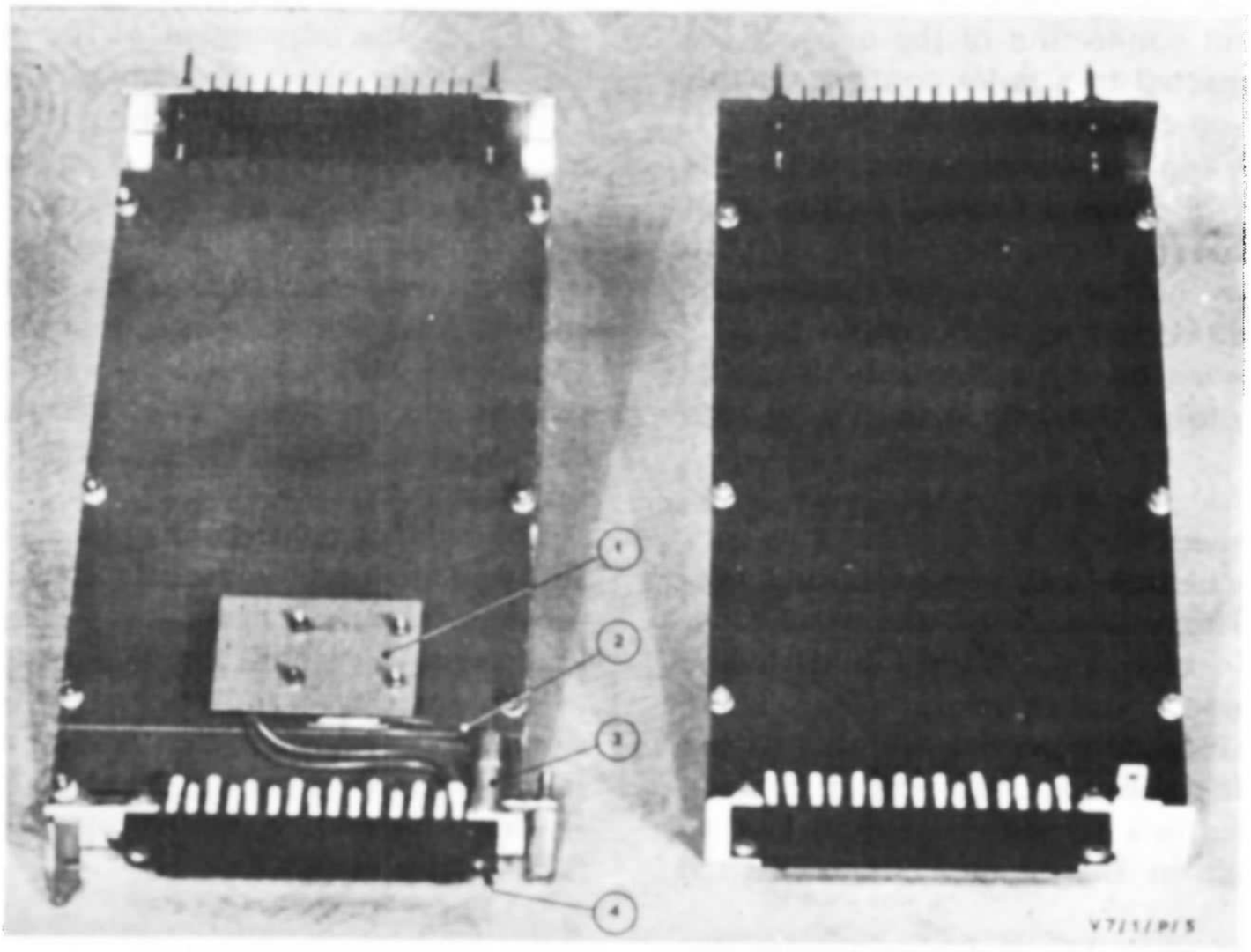


Fig. 1.5. Chassis Extender

The reactances of chassis-extender conductors are not negligible at the higher video frequencies. Consequently optimum adjustments obtainable with extenders in use are not necessarily absolutely correct when sub-units are returned to their service positions. With experience it is possible to allow for such changes by mis-setting the controls affected, to an extent giving substantially the required optima after removal of extenders.

Monitoring points are provided on the sub-units. Only high-impedance devices should be used to examine the signals at these points, both to avoid placing abnormal loads on the circuits and because the points are connected via series resistors and so constitute high-impedance sources.

Each input circuit has an impedance of 300 ohms, and must be shunted by a 100-ohm resistor if the unit is tested separately from the equipment of which it forms a part. The two output circuits also must be loaded, each with 75 ohms.

Gain Adjustments

Each of the three-channel switch units has three pre-set gain controls RV1, RV2 and RV6 (Fig. 17) in the A, B and C input circuits, respectively. These controls are on the printed-wiring boards, inside the sub-units. The single-channel switch unit (Fig. 18) has a similar gain control, RV1, in the input circuit to its diode switch.

These controls must be set to obtain equal gains from all the ten input circuits: the procedure is as follows:

1. Set the preset control labelled *Gain 1* on the front panel of the single-channel switch unit to mid-position.
2. Connect a sawtooth-waveform signal generator to input 1 of the unit, and a high-grade oscilloscope, via a coaxial lead terminated

at the instrument with a 75-ohm load, to output 1 (the unfaded-output connection of the unit).

3. Select the applied signal by operating the controls of the equipment in which the AM1/504 unit is installed.
4. Adjust RV1 in the appropriate three-channel switch unit to obtain an output signal amplitude within ±0·1 dB of that of the input signal.
5. Repeat the procedure to set the gain of each of the remaining nine input circuits.
6. Connect the input signal to input 1 of the unit, and the oscilloscope to output 2 (the faded-output connection of the unit). If the unit is connected to a fader control, set this to its fully-up condition.
7. Select the applied signal, and adjust the preset control labelled *Gain 2*, on the front panel of the single-channel switch unit, to obtain from output 2 a signal having the same amplitude as that from output 1.

The gain between all input connections of the unit and each output connection should be zero ±0·1 dB.

Balance Adjustments

In each three-channel switch unit are three pre-set variable resistors RV3, RV4 and RV5 (Fig. 17), connected in 12-volt d.c. supply leads to the A, B and C diode switches, respectively. These controls are mounted on the printed-wiring boards, inside the sub-units. A similar control, RV2, is connected in a 12-volt d.c. supply lead to the diode switch in the Single-channel Switch Unit (Fig. 18).

These controls must be set for minimum disturbance of the output-signal waveform when a change of selection is made between any two input signals. This adjustment is usually occasioned by component change in one of the diode switches; the following simple procedure is normally adequate.

1. Connect a high-grade oscilloscope, via a coaxial lead terminated at the instrument with a 75-ohm load, to output 1 of the AM1/504 unit, and set the controls of the instrument to obtain a time base of 0·1 sec/cm.
2. Connect dummy source impedances of 75 ohms to all the input connections of the equipment in which the unit is installed, and operate the controls of the equipment to make changes of selection between the ten input circuits at the rate of approximately one change per second. Note that a differentiated potential-change appears on the oscilloscope each time a change is made.
3. Unless the component change has been in the single-channel switch unit, select input circuit 10, then that in which the component change was made. Alternate these two selections repeatedly while adjusting the relevant pre-set control (RV3, RV4 or RV5) until the potential-changes referred to in 2 above are reduced to a minimum amplitude, which should not exceed 150 ~~μV~~ mV.
4. Check the adjustment of the other input circuits by selecting each of them alternately with circuit 10, disturbing the corresponding pre-set controls only if necessary; RV2 in the single-channel switch unit should not be touched.

If the component change has been in the single-channel switch unit, select input circuits 1 and 10 alternately, adjusting RV2 in the single-channel switch unit in the manner described above. In this instance, RV3 in input circuit 1 should not be touched.

The balance controls may be so severely out of adjustment that a satisfactory alignment is prevented by their limited ranges of variation. In that event procedure detailed under heading 3.1 of Designs Department Specification No. 8.61(62) should be followed, but using, instead of the test connector panel and control box referred to in that information, the equipment in which the AM1/504 is installed.

Adjustments to Remotely-controlled Fader AT3/501 (Fig. 19)

The balance of the circuit of this sub-unit is particularly susceptible to disturbance by any variation of stray circuit capacitances; to maintain these constant and to shield the input circuits from the output circuits an electrostatic screen is fitted around most of the components forming circuits prior to the collector load of TR4. This screen should not be removed during the adjustments described below; access to the enclosed pre-set controls is provided by holes in the screen.

(a) *Adjustment of Fader Law*

1. Set the fader control to which the sub-unit is connected to its fully-up condition.
2. Apply a 1-volt p-p signal of sawtooth waveform to an input connection of the equip-

ment in which the unit is installed, and operate the controls of the equipment to select this signal.

3. Connect a high-grade oscilloscope, via a coaxial lead terminated in 75 ohms at the instrument, to output 2 of the unit, and note the amplitude of the output signal.
4. Short-circuit the monitoring point labelled *Control* to the chassis of the sub-unit, and note the new amplitude of the output signal.
5. If necessary, adjust RV2 to obtain a new output-signal amplitude 21·5 dB below that first noted. (RV2 is a preset resistor mounted inside the sub-unit, on the printed-wiring board).
6. Remove the short-circuit from the *Control* monitoring point.

(*b*) *Adjustment of Fader Isolation*

1. Connect a dummy source-impedance of 75 ohms to each of the input circuits 2 to 10 of the unit.
2. Apply to input-circuit 1 a sinusoidal signal having a frequency of 100 kc/s and an amplitude of 1 volt p–p. Select this input by operating the controls of the equipment in which the unit is installed.
3. Operate the fader control to which the sub-unit is connected, and check that this action controls the amplitude of the fader output signal from the unit. Leave the fader control set fully-out.
4. Connect the faded output circuit of the unit via a 75-ohm precision variable attenuator to a radio receiver having a 75-ohm input impedance, an S-meter and switchable a.v.c. (the Marconi Type CR100 receiver is suitable). The a.v.c. must be switched off, and the receiver controls set for the reception of a c.w. signal.
5. Set the attenuator to 0 dB. Tune the receiver to 100 kc/s and adjust the sensitivity to obtain a convenient indication on the S-meter.
6. Break the connection between the unit and the attenuator to check that the S-meter indication falls to zero, thereby proving that the reading was due to a residual output from the fader. Re-make the connection.
7. Adjust RV4 and, if necessary, RV3 to obtain a minimum indication on the S-meter. (RV3 is the coarse control; before adjusting it, set RV4 to mid-range.)

If adjustment of RV3 is necessary, follow it by tapping the control lightly with the trimming tool. This is done to release parts of the control from small flexures caused by the adjustment, so reducing the possibility of an eventual spontaneous release which might alter the control setting. Any change resulting from the tapping can be offset by a final adjustment of RV4.

8. Re-tune the signal source and the radio receiver to 3 Mc/s, and adjust C1 to obtain a minimum residual output from the fader at this frequency.
9. Re-tune the signal source and the radio receiver to 5 Mc/s, and adjust RV1 to obtain a minimum residual output from the fader at this frequency. (RV4, RV3, C1 and RV1 are all pre-set controls mounted inside the sub-unit, on the printed-wiring board.)

Because RV4, RV3, C1 and RV1 all interact to some extent, repeat the foregoing cycle of operations until stable settings are found.

10. Re-tune the signal source and radio receiver to 100 kc/s and note the indication on the S-meter of the receiver.
11. Set the attenuator to 70 dB and the fader control fully-up, then adjust the attenuator setting to obtain the same S-meter reading as before. Note the attenuator setting so determined; this is the figure for fader isolation at 100 kc/s, and should be greater than 70 dB.

Similarly determine the figures for fader isolation at 3 Mc/s and 5 Mc/s; these should be greater than 50 dB and 45 dB, respectively.

Frequency Response of Cut/Fade Amplifier

1. Apply a 1-volt, 625-line, 1-T pulse-and-bar test signal to input 10 of the unit. (The principles of pulse-and-bar testing methods and the meaning of the term 1-T are explained in Section 9 of Instruction V.5).
2. Connect a high-grade oscilloscope, via a coaxial lead terminated at the instrument with a 75-ohm load, to output 1 of the unit.
3. Adjust L2 in the single-channel switch unit (Fig. 18) to obtain an amplitude ratio of unity between the pulse and bar elements of the displayed waveform.
4. Transfer the oscilloscope connection to output 2 of the unit, and adjust L1 in the remotely-controlled fader (Fig. 19) to obtain an amplitude ratio of unity between the pulse and bar elements of the waveform, as before.

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C4 and C10 in the two-channel G.P. amplifier (Fig. 20) normally require adjustment only if component changes have been made in the sub-unit. They govern the higher-frequency responses in the unfaded and faded channels respectively, and are usually set an approximate half-turn from the setting at which the capacitor plates begin to mesh.

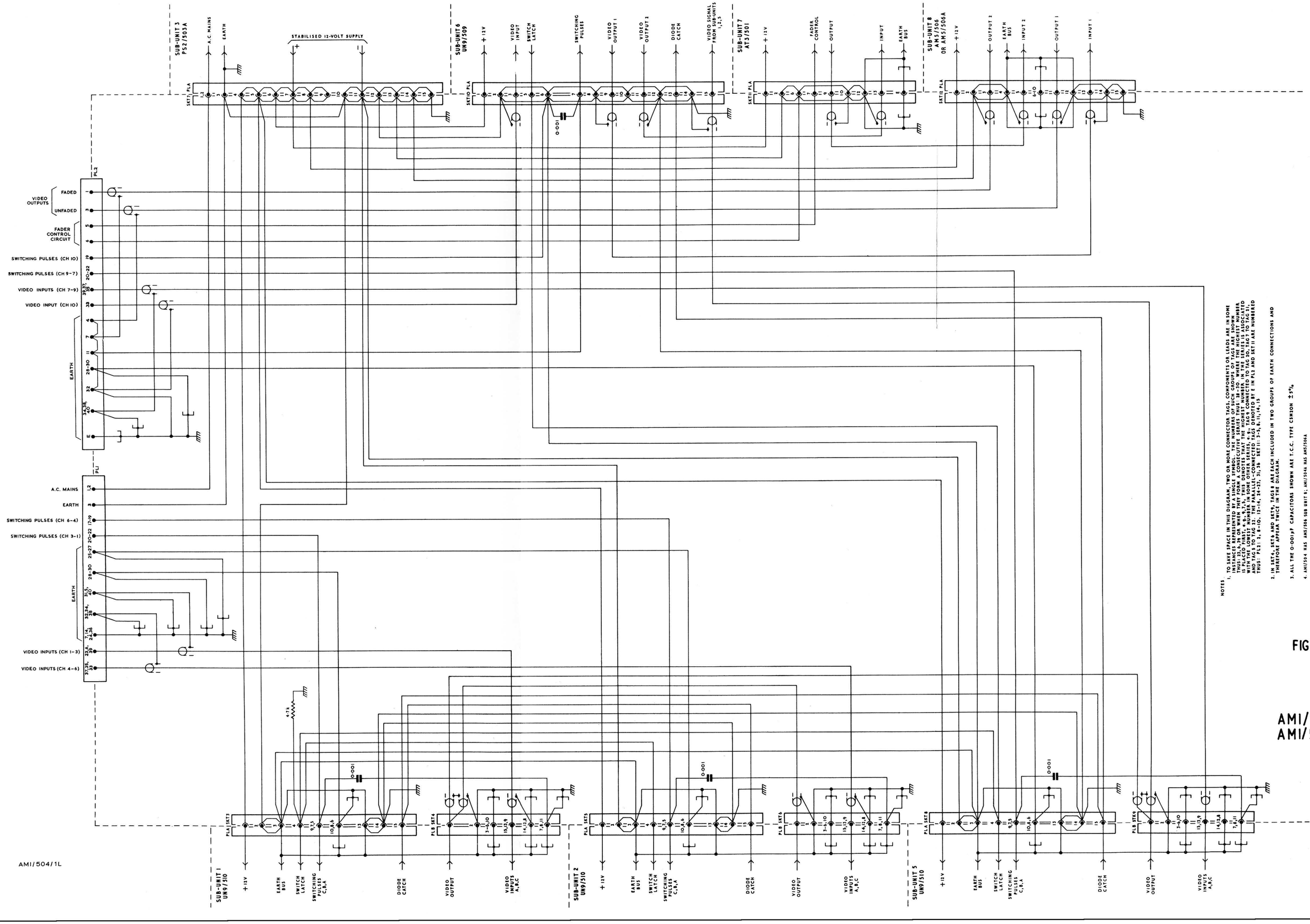
Production Test Schedule

The test procedures given above are likely to satisfy routine requirements. If more thorough test procedures are required, refer to the production test schedule given in Designs Department Specification No. 8.61(62).

Cut/Fade Amplifier AM1/504A

This is a version of the amplifier Type AM1/504, intended for use in colour television equipment. It contains a Two-channel G.P. Amplifier AM5/506A in place of the amplifier Type AM5/506.

DEH/0965



NOTES

1. TO SAVE SPACE IN THIS DIAGRAM, TWO OR MORE CONNECTOR TAGS, COMPONENTS OR LEADS ARE IN SOME INSTANCES REPRESENTED BY SINGLE SYMBOLS. CONNECTOR TAGS ARE NUMBERED IN GROUPS OF FIVE OR MORE CONSECUTIVE SERIES THUS: 28–30. WHERE THE HIGHEST NUMBER IS PLACED FIRST, e.g. 9,7,5, THIS DENOTES THAT THE SERIES IS ASSOCIATED WITH THE EVEN NUMBERED TAGS ONLY. COMPONENTS OR LEADS ARE NUMBERED AND TAGS TO TAG 22. THE PARALLEL-CONNECTED TAGS DENOTED BY E IN PL2 AND SKT 11 ARE NUMBERED THUS: PL2: 2, 8–10, 12–14, 24–27, 31, 36 SKT 11: 3–5, 8, 11, 14, 15
2. IN SKT4, SKT6 AND SKT9, TAGS 8 ARE EACH INCLUDED IN TWO GROUPS OF EARTH CONNECTIONS AND THEREFORE APPEAR TWICE IN THE DIAGRAM.
3. ALL THE 0·001μF CAPACITORS SHOWN ARE T.C.C. TYPE CSM10N ±5%
4. AMI/504 HAS AMI/506 SUB UNIT 5; AMI/504A HAS AM5/506A

FIG 16

AMI/504
AMI/504A