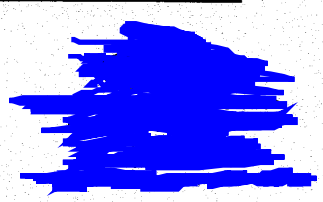
Handbook of The EMI TG12345 Recording Console

(Mark 2 Version.)



1 Introduction.

The mixer has been designed to meet the following requirements.

1.1 To be suitable for fixed or mobile use.

1.2 To be light, easily dismantled and transported.

1.3 To comprise cassettes, which can be assembled in different combinations, to form mixers with up to 24 inputs for up to 8-track recording.

1.4 When a multi-track recording is being made, to provide for simultaneously feeding a 2-track stereo tape machine.

1.5 To be complete with all foreseeable facilities required for both classical and pop recording.

1.6 To have a very high degree of reliability.

1.7 Any faults which may occur to be easily located.

1.8 Spare cassettes to be easily inserted to remove faults.

2. General

2.1 Terminology

2.1.1 Drawing numbers

Throughout this handbook when a reference is made to a Drawing Number, it assumed to be preceded by TG12345 unless otherwise stated.

2.1.2 Signal levels

Signal voltage levels are expressed in dBv, this being the voltage level in decibels with respect to 0.447v (this being the r.m.s. voltage across a 200Ω resistor when dissipating one milliwatt). The figures quoted are not all strictly accurate as they do not, in general, take into account the loading effect of a high impedance load across a 200Ω or lower impedance source.

In the manufacturing test specifications which require more precision, sending levels are expressed in dBi, this being the indicated sending level of a 200Ω Gain Set. At an indicated level setting of 0 dBi, the gain set would deliver a zero level signal, 0 dBm, i.e. 1 milliwatt, into a 200Ω load. Thus at the output of the Gain Set when loaded with 200Ω, dBm, dBv and dBi are numerically equal. If the output is completely unloaded then dBV=dBi + 6.02

2.4 Electrical Components and Features

2.4.1 Active Units

Each cassette contains a multiplicity of active units, each of which is designed to perform a specific function. This enables the internal signal level in the Mixer to be kept substantially constant, thereby making possible an extremely good signal to noise ratio and very low power consumption. Many of the active units are used in more than one type of cassette thereby simplifying manufacture and the maintenance of a stock of spare components.

These active units are described in Section 12.

2.4.2 Mixing

Although a mixer has to perform many functions other than that of mixing, nevertheless, this function is of predominant importance on account of the multiplicity of input and output channels which may be involved.

In the present Mixer facilities are provided for mixing the signals from microphone channels and applying them to group channels, for mixing signals from microphone and/or group channels, for mixing signals from main channels and applying them to the inputs of auxiliary stereo main channels and for mixing auxiliary signals from various channels to send to echo or cue circuits.

In order to provide for this, each output which may require to be mixed with signal from another channel is provided with an amplifier B which operates as a voltage to current converter and each input into which signals are to be mixed is provided with and amplifier C which has a virtual earth input. The circuit values are chosen so that when an amplifier C2 follows an amplifier B, the overall gain is unity. The output impedance of the voltage to current converter is of the order of 20kΩ and the virtual earth input impedance is of the order of 20Ω. Thus each extra channel which is connected to the mixing point only changes the impedance at that point by 0.1% and therefore changes the gain of existing channels by about 0.01dB. Thus, the connection of 20 extra channels changes the gain by 0.2dB, which is negligible.

2.4.3 Power Supply

Since a mixer for recording purposes will always be used with one or more mains powered tape machines, there is no need to provide for battery operation of the mixer. It is therefore designed to operate from 200/250 V, 50 to 60 Hz mains. If it were essential to be able to operate from a battery or other d.c. supply, a d.c. to a.c converter could be used.

Each cassette has a Power Unit attached to its underside, which provides positive and negative 20 V supplies from series stabilisers. The low output impedance and the very low ripple level enable supply decoupling circuits to be cut to a minimum. Most of the amplifiers have no decoupling.

It is advantageous for equipment to work over a considerable range of mains voltages without any tap changing or other adjustment being necessary. If the series stabilisers had been designed to cope with this, there would have been greater heat dissipation in the series transistors. Although most components will operate satisfactorily over a considerable range of temperatures, it is in general advantageous to keep temperature rise to a minimum. A d.c. stabiliser, which gives an output of 240 V ± 1% for a range of input voltage from 204 to 252, is therefore included in the Main Power Unit. This is followed by a step-down transformer, which gives an output at 50 V with a centre tap, which is earthed. This balanced 50 V supply is fed to the power transformers of all the cassette power units through a screened twisted pair cable. The cassette power transformer only has to handle about 5 watts and is therefore quite small. It is enclosed in a magnetic screening can to minimise the risk of mains hum injection into the audio channels of the mixer.

With this method of supply, the Mixer desk is classed as an "extra low voltage" piece of equipment and it is therefore not legally necessary to bond its metalwork to the mains earth, but this is normally done.

2.4.4 RF Rejection and Earthing

Any long lead connected to the mixer is liable to act as an aerial and feed RF into the mixer where, if the level is sufficiently high, it may be rectified and result in audible interference on the programme material.

This is counteracted by providing every input and output with a screened transformer. These are placed as close as possible to the respective input and output sockets and screened leads are used to connect the sockets to the transformers.

The inter-winding screen of each transformer is connected to the chassis of the cassette. The chassis of a cassette may become electrically connected to the mixer frame by the fixing screws, but as the top panel of the cassette is painted, and the fixing screws chrome plated, this cannot be relied upon. Interconnection of the chassis is effected through a lead in the main cableform and four ways of each of the multi-way plugs and sockets used for signal interconnections. As an added precaution each cassette is provided with a screw terminal and a heavy gauge lead with spade terminals, provides a very low resistance linkage.

Since all signal interconnections between cassettes are unbalanced, it is most important that the common earthy return line should be of low resistance or cross talk may be introduced.

The common signal point in each cassette, which is also the common point of the positive and negative 20 V lines, is insulated from the chassis, thereby facilitating the tracing of earth faults in components or wiring. This is also connected to the corresponding point of each of the other cassettes through four ways in parallel of the multi-way plug and the main cableform. These interconnecting leads in the main cableform, and the spade terminal interconnecting lead, each have a spur near the centre provided with a spade tag. These are connected together and to the main frame of the mixer at a terminal on the frame, at which point the whole system may be connected to any suitable earth. In some circumstances it may be

impossible to obtain an earth, but even under these conditions the system gives satisfactory results.

2.4.5 Metering

A VU meter is provided for each Main Cassette output, these being the outputs which feed signal to the tape machines. The meters are mounted in a meter box, which is part of the mixer frame. Since each Main Cassette contains two main channels, two meters per cassette are required and these are mounted one above the other, the upper meter being connected to the left channel and the lower being connected to the right channel. The frame has a flying lead terminating in a 7-pin plug for each pair of meters. Each main cassette has a corresponding 7-pin socket carrying the VU meter signals. Since the mixer operating level is lower than normal VU meter level, the meters are fed through amplifiers. These derive their input signals prior to the output amplifiers and under normal conditions they give an indication of 0 VU when the open circuit output voltage is 0.447 V rms. Under these conditions the input voltage to the meter amplifier is 10 dB less than this.

Since a VU meter is a linear and not a logarithmic meter, the scale becomes very cramped at the lower end of the scale. The range of indication is extended by providing each Main Cassette with two locking push buttons. One of these increases the gain of both VU meter amplifiers by 10 dB, and the other increases the gain by 20 dB.

The inputs of the VU meter amplifiers are connected to a selector switch whereby they may be connected to the follow/replay key for measuring record and replay levels, to the inputs to the particular Main Cassette, to the selector switches in the Group, Control Room Monitor or Studio Playback Cassettes for measurement of levels in these cassettes, to an external socket for measurement of levels in other equipment, or to the –10 dBV oscillator line. If a mixer has more than one Main Cassette, the cableform is wired so that only the first Main Cassette (i.e. Tracks 1 & 2) can be used for measurements in the Control Room Monitor and Studio Playback cassettes and this Main Cassette is also connected for measurements in the left hand Group Cassette. The second Main Cassette is used for measurements in the second Group Cassette. All VU meters can be switched simultaneously if desired, to the test oscillator so that their sensitivities and frequency response may be checked.

There are also meters associated with the Compressor/Limiters and the correlator, the indications of which will be dealt with later.

2.4.6 Switching

Stud or keyswitches are used for signal switching where these can be used without excessive complication of the switch or wiring.

Where multiple and/or remote switching is required, then it is effected by using transistors as switches. In this way the use of electro-mechanical relays, which tend to be large, heavy and power consuming, has been avoided in the signal circuits.

Transistor switching is used in the following circuits:

The solo facility described in 3.6, whereby the signal in any one microphone channel may be heard on the left hand control room monitor loudspeaker, the right hand speaker being simultaneously muted, without interfering with the recording.

The track announce circuitry described in 5.2.7 and 5.2.8, which provides a separate button for each track and a further button for announcements on all tracks simultaneously.

The operator and artist manager talkback circuitry described in 8.3

2.4.7 Frequency response

In previous generations of mixers, each channel has included several transformers which have provided appreciable attenuation at frequencies above and below the audio band. This is advantageous since it is undesirable that unwanted frequencies should be indicated on the programme meters, or recorded on the master tape. As the present mixer only has two transformers per channel and as these have wide pass bands, particularly in the bass, each channel in each cassette is provided with a Band Pass Filter, which is described in 12.7

Since each channel contains several separate active units, d.c. blocking capacitors are required at the interconnections. Many of these feed into resistive potentiometer controls, the impedance of which has been limited to a maximum of about 6kΩ in order to avoid excessive impedance at the slider. In order to avoid clicks when the control is operated, it is necessary to use capacitors with very low leakage currents. Hence, polyester and polycarbonate types have been selected. Very large and bulky components would be required if the total bass loss of a cassette were to be kept less than 0.1 dB at 30 Hz. Smaller capacitors are therefore used and an adjust on test (AOT) resistor in the Band Pass Filter on each channel is selected on test so that the bass rise of the filter before it begins to attenuate, just balances the attenuation of the couplings.

In this way the response is kept substantially flat down to 30 Hz. Below this the Band Pass Filter cuts at 12 dB per octave and the coupling capacitors increase this rate. The Band Pass Filter has a further A.O.T. resistor for trimming the overall high frequency (20 kHz) gain of each channel of each cassette.

2.4.8 Gain

In general, the gain of an active unit is determined by the ratio of two feedback resistors, the forward gain being so high that it has a negligible effect. The resistors employed are of the high stability type and their values are specified to ± 1%. The errors in the overall gain due to deviation of resistor values can be cumulative and the unbalance of a pair of channels could be considerable of errors were of opposite sign. This is overcome without the use of very close tolerance resistors by providing one active unit in each channel of each cassette with an A.O.T. resistor for setting the gain of that channel to the nominal value. This also covers variations in the ratios of transformers, which are also specified to ± 1%.

The amplifiers in which the gain is trimmed are Amplifiers E, G and K. Some channels have two separate amplifiers B. As it would not be economical to adjust the gain of these, the gain determining resistors of these are specified to ± 0.5% to ensure a balance of gain within 0.1 dB between the channels.

When measuring gain of mixer channels, all inputs should be fed from a 200Ω source. All outputs have an impedance of about 200Ω and are designed to feed a load of 2 kΩ or greater. Thus a gain set with a 200Ω sending unit and a bridging receive unit is required. For fault finding or for checking purposes it may be necessary to measure the gain of an individual cassette. A cassette output, which feeds a bus line, is intended to work into an amplifier C, which has a virtual earth input. A test rig intended for this measurement is therefore provided with an amplifier C3, which is similar to an amplifier C2, but with a feedback resistor with a closer tolerance.

For testing a cassette having an Amplifier C at its input, a resistor of 6k8 ±0.5% is used to build out the Gain Set sending impedance to provide a current source.

2.4.9 Echo Cassettes

Each microphone channel has an echo send level control and a switch whereby a signal, which is tapped off after the fader, can be routed to any of four echo lines

Solely for convenience, and not because there is any association, the echo output circuits are located in the Group Cassettes, two output circuits being included in each Group Cassette. Thus if three or four echo output circuits are required, the mixer must have two Group Cassettes. Switching is provided whereby the echo output level may be observed on the VU meters.

A normal microphone channel is used for each echo return and the signal, suitably controlled, can be fed to any track or pair of tracks. If it is required to record without echo but to listen with echo on the monitor speakers, signal from the channels in the Track Monitor Cassette can be fed to the echo bus lines and the output of any microphone channel used as an echo return can be switched so that it is injected into the required channel. A total of eight inject lines is available. If the mixer provides for eight track recording plus auxiliary stereo, six of the inject lines connect to the monitor channels associated with the first six of the eight tracks, and the remaining two, Nos. 4A and 4B connect to the auxiliary stereo monitor channels 5A and 5B.

2.4.10 Cue Circuits

Two cue circuits are provided. Signal from any microphone channel is tapped off prior to the fader and fed through a level control to a switch whereby it can be fed to either of the two cue bus lines, or both of them simultaneously without introducing cross talk. Signal from each main channel circuit can also be fed to either or both of the cue bus lines, in this case separate level controls being provided.

Main cue level controls and line output amplifiers are provided in the Control Room Monitor Cassette, switching being provided whereby the output level may be

observed on the VU meters. This cassette also contains level controls whereby two synchronous replay signals, designated left and right, which are routed through the Studio Playback Cassette, can be fed to the cue circuits, left to cue 1 and right to cue 2. The synchronous replay signals and the cue bus signals are available on the input selector switches of the Control Room Monitor and Studio Playback Cassette so that any of these signals can be fed to the control room or studio loudspeakers.

The zero level cue signals from the Control Room Monitor Cassette are fed to small power amplifiers located in the main power unit. These will provide a very loud signal for up to six pairs of 50Ω headphones in parallel or will operate a small 8Ω loudspeaker. A selector switch and two level controls are provided to enable the artist manager to communicate through the cue circuits. The operator has a key switch, which connects the output from his microphone through separate pre-set level controls to both cue circuits.

3. MICROPHONE CASSETTE

3.1 Channels

Each Microphone Cassette contains two identical channels, which can be used either for two mono microphones or for a stereo pair.

3.2 Input Socket

A 5-pin Tuchel socket is used for the two inputs. Each input is provided with a screened input transformer having a step-up ratio of 1: 3.16 the primary winding of which is intended to operate from a 200Ω source.

3.3 Condenser Microphone Powering

Provision is made for 50 V phantom powering of condenser microphones. A pair of 6.8 kΩ resistors the values of which are balanced to within 0.5% is connected in series across each input circuit. The common points of these two pairs are connected to the sliders of a 2-pole 4-way switch whereby neither, either or both can be connected to the positive side of a 50 V supply. The unit providing this supply is located in the main power unit. Its output is brought in a pair with the 50 V a.c. supply to the Control Room Monitor Cassette. It is then distributed to the Microphone Cassettes through the main cableform. The negative side of this supply is connected to the 0 V line in the Control Room Monitor Cassette.

3.4 Input Circuit

3.4.1 Coarse Input Level Control

The Coarse input level control provides 12 steps of attenuation of 5dB each. In order to maintain a high input impedance, and to ensure that the noise of the channel is less at all intermediate settings of the input level control than at the zero loss setting, the first three 5 dB steps are obtained from tappings on the input transformer secondary winding. The remaining steps are obtained by means of a resistive potentiometer of 8.33 kΩ total resistance.

3.4.2 Input amplifier and Fine Gain Control

This is an Amplifier D described in 12.27. Its nominal voltage gain is 25 dB. Used as it is in conjunction with the fine input gain control, which has a range of ±5 dB in 0.5 dB steps, an effective voltage gain from 20 to 30 dB can be obtained. The fine gain control operates in the feedback circuit of the Amplifier D.

3.4.3 Range of Input Levels

For the standard level of –10 dBV at the output of the Amplifier D, the level at the input of the Amplifier D can be between –30 and –40 dBV. The level at the secondary of the transformer can therefore be between +30 and –40 dBV so that the corresponding range of input voltage is from +20 to –50 dBV.

3.4.4 Re-Record Inputs

Each coarse input level control has a further five positions in which it can select signals for re-recording via the microphone input bus lines. There are ten of these lines numbered 1A to 5A and 1B to 5B. The A series being available on the left hand channel of each Microphone Cassette and the B series being available on the right hand channel of each Microphone Cassette. These bus lines are fed at a level of –10 dBV from the outputs of Amplifiers A1 in the Track Monitor Cassettes, line 1A, 1B, 2A and 2B coming from the extreme left Track Monitor Cassette, lines 3A, 3B, 4A and 4B coming from the next cassette and lines 5A and 5B coming from the extreme right hand Track Monitor Cassette this being the one for use with the Auxiliary Stereo tape machines.

Between each bus line and the corresponding stud on the input selector control a 25 dB resistive loss pad is inserted to reduce the level from –10 to –35 dBV. The fine gain control is available to give ± 5 dB of fine adjustment of the level.

3.4.5 Test Input

The extreme anticlockwise position of each coarse input level control makes connection with an oscillator bus line. The Oscillator is located in the Studio Playback Cassette and, when the Oscillator level control is at 0, the level on this bus line is –35 dBV, this being the standard level at the point of injection.

3.5 Signal Path

3.5.1 Band Pass Filter

The output of each Amplifier D is connected to the input of a Band Pass Filter, the circuit of which is described in 12.7. These contain adjust on test resistors whereby the overall frequency response of the channel is trimmed.

The output of the Band Pass Filter is at about –6 V and is directly connected to the input of the Compressor/Limiter. In order not to apply potential to the inject socket an a.c. coupling consisting of a 6.8 μF capacitor and 33 kΩ resistor is inserted.

3.5.2 Compressor/Limiter

This is described in 12.22. A 3-position locking key is provided in each channel, the positions being marked "Out", "Compress" and "Limit". In the Out position, the Compressor/Limiter is removed from the forward path but its input is left connected so that its meter indicates the signal level.

A Third locking key is provided which is marked Gang. When this is set to the forward position the two compressor/limiters are controlled by which ever of the two control voltages is instantaneously the greater. When this is used the two other keys should both be set to Compress or Limit. The hold and recovery controls are coaxial. The recovery control is the lower of the two and is a stud switch with six positions numbered 1 to 6. The recovery times corresponding to these positions are approximately 0.1, 0.25, 0.5, 1, 2 and 5 seconds respectively. An approximate calibration of the hold control which is a logarithmic 10kΩ carbon potentiometer is marked on the panel. Normally the hold control will be adjusted prior to a take and the setting is then most easily made by observing the relevant limiter meter and setting the hold control so that the meter reads the desired number of decibels of compression or limiting. If it is found necessary to alter the hold control during a take, the calibration on the panel will be found useful but it is not as precise as the meter reading. When the compressor/limiters are ganged only the left hand hold control functions.

Connection is made to both the meters through a 7-way chassis mounting socket on the rear of the cassette and a mating plug on a flying lead from the meter box of the console. The socket has the +20 V, 0 V and –20 V lines connected to socket pins 3, 4 and 5 respectively for test purposes.

3.5.3 Inject

Although the mixer is intended to be completely self-contained with all normal facilities, occasions may arise when, to produce some unusual effect, it is necessary to introduce some other device. For this purpose an inject socket for each channel is provided on the underside of the chassis. For normal operation this must be provided with a plug with pins 1 and 2 shorted together. The external device must be connected through an injection unit which complies with the specification given in 12.30. This requires the provision of input and output transformers to maintain r.f. rejection and to remove the possibility of earth loops.

3.5.4 Presence Controls

The circuit of these is described in 12.1. Each channel has two controls. One of these is marked dB Presence and provides 0, 2, 4, 6, 8 or 10 dB boost or cut at the frequency selected by the other which is marked kHz Presence. The frequencies available are 0.5, 0.8, 1.2, 1.8, 2.8, 4.2, 6.5 and 10kHz. The curves obtained in the ± 10dB conditions are shown on Drawing No. 376.

3.5.5 Bass Control

This provides a flat position and five steps of 2 dB lift or cut. Although it is called a bass control, the frequency of half lift or cut is actually 500 Hz. The frequency response obtained at the various settings is shown in Drawing No. 375.

The circuit is described in 12.2. Since the circuit has no output capacitor, a 6.8 μF capacitor is provided externally with 150kΩ to the 0 V line to prevent a large plop when the fader is inserted.

3.5.6 Fader

This follows the bass control and is a quadrant type instrument, in which the control enters through a bearing near the bottom thereby minimising the entry of dust. It has two chains of resistors connected in parallel. The sliders are staggered half a stud and the resistors are such that the instrument provides 30 steps of 0.5 dB followed by a graded law of 26 steps to –64 dB and off. The input resistance is 3.19kΩ and, when fed from a low impedance, it gives its indicated voltage loss into 50kΩ. Since the fader is designed to feed a 50kΩ load, a buffer amplifier is necessary between it and the following pan pot and echo level controls in parallel.

Since the setting of the fader for standard level through the channel is at 5 dB loss, it is desirable that this amplifier should have 5 dB of voltage gain. The Amplifier E serves this purpose. Its input impedance is 50kΩ and its output is designed to feed a pan pot and echo level control in parallel. Its circuit is described in 12.6

3.5.7 Pan-pot

This consists of two reverse connected potentiometers each having a total resistance of 11kΩ with the inputs in parallel. If the outputs from the sliders are fed to a stereo channel, the control may be used to pan the signal full left, full right or to any of 19 intermediate positions. The extreme positions provide the means of switching the signal to either of two output channels that are not a stereo pair.

3.5.8 Output Circuits

Each pan-pot slider is connected to the input of an Amplifier B which acts as a voltage to current converter. This amplifier is described in 12.4.

The outputs of the two Amplifiers B in one channel are connected to the sliders of the output selector, a 2-pole, 11-way stud switch. The extreme anticlockwise position is and "off". For a current source, the normal connection for "off" is a short circuit. If however this stud were connected to the 0 V line, since the switch is of the shorting type, the transition from the first to second stud would put a short circuit on the input of the amplifier connected to the second stud. As this is a virtual earth input amplifier, it generates a click under these conditions. This is avoided by using a 3.3kΩ resistor on the first stud and this provides a reasonably low load for the Amplifier B in the off position.

The remaining ten positions of the channel selectors are connected to bus lines. In each case the channel to which signal is fed when the pan pot is in its anticlockwise position is connected to an A bus line and the other channel (clockwise pan pot) to a B bus line. The A and B bus lines feed to the left and right channels of the subsequent cassette. Provision is made for two Group Cassettes (G1A, G1B, G2A and G2B), for four Main Cassettes (Main 1A, 1B to 4A, 4B) and for eight channels (Monitor 1A to 4B) to Track Monitor Cassettes. If a mixer has less

than the maximum numbers of Group, Main and Track Monitor cassettes, some of these bus lines will not be used.

The purpose of the monitor bus lines is to allow a recording to be made without added echo but to be able to listen to it on the monitor speakers with added echo. In this case, the cassette selector of the microphone channel used for echo return is switched to the desired monitor channel where it is added to the direct signal. (See 6.5.2)

Although with 8-track and simultaneous auxiliary stereo working there are 10 monitor channels in use, it is thought that the 8 monitor inject channels provided are quite adequate. In this set up lines 1A, 1B, 2A and 2B, are routed to the extreme left hand Track Monitor Cassette lines 3A and 3B to the upper channels of the second Track Monitor Cassette and lines 4A and 4B to the upper channels of the Track Monitor Cassette at the right hand end of the Mixer, this being the one used for the auxiliary stereo channels.

3.6 Solo Facility

3.6.1

This facility allows signal from any microphone channel to be fed to the left-hand monitor loudspeaker in the control room without interfering in any way with any recording which is in progress, the right hand loudspeaker being simultaneously muted.

3.6.2

To allow the signal or noise on a channel to be heard when the fader is closed, the tapping is taken from the input to the fader, and, in order to provide isolation, is fed to the input of an Amplifier G. This amplifier, which is described in 12.8, has a voltage gain of unity and a low output impedance.

3.6.3

Each channel is provided with a push button located near the upper end of the fader. Operation of this button connects the output of the Amplifier G through a 16kΩ resistor to the solo bus line and also operates the solo active relay in the Control Room Monitor Cassette. This relay removes existing signals from the loudspeakers and feeds signal from the bus line to the left-hand speaker.

3.7 Cue Channels

3.7.1 Cue Level Control

In order that a signal from a channel may be available for cueing purposes when the fader is closed, the cue tapping must be taken from the input side of the fader. This is the same point as is used for the solo facility so the output of the Amplifier G is also fed to the cue level control, a logarithmic 5kΩ carbon potentiometer.

3.7.2 Cue Line Selector

The slider of the cue level control potentiometer is connected to the cue channel selector whereby the inputs of two Amplifiers B may neither, either or both be connected thereto. In positions where an amplifier input is not connected to the signal line, it is connected to the 0 V line.

3.7.3 Cue Bus Lines

The outputs of the two Amplifiers B in each microphone channel are connected to the Cue 1 and Cue 2 bus lines which are connected to the cue line output circuits in the Control Room Monitor Cassette.

3.8 Echo Circuits

3.8.1 Echo Level Control

The Echo Level Control is connected in parallel with the pan-pot. It is a miniature stud switch potentiometer of about 6.8kΩ total resistance. It provides 20 steps of 2 dB of attenuation and has an "off" position. This control is used in several places in the Mixer and is referred to as the general-purpose attenuator. In this particular case it is scaled from –40 dB in the penultimate anticlockwise position to 0 dB in the fully clockwise position.

3.8.2 Echo Selector

The output of the level control is fed to an Amplifier B and thence to the echo selector whereby it may be connected to any of four echo bus lines. There is also an "off" position in which the amplifier output is connected to the 0 V line through a 3.3kΩ resistor for the reason given in 3.5.8. The Amplifier B shares a board with the Amplifier G in the cue circuit.

3.8.3 Echo Bus Lines

Echo bus lines Nos. 1 and 2 connect to echo line output circuits in the left hand Group Cassette and lines Nos. 3 and 4 connect to similar circuits in the right hand Group Cassette. (See 2.4.9) If there is only one Group Cassette then only Nos. 1 and 2 echo send circuits are available.

3.9 Power Supply

A cassette power unit, the circuit of which is described in 12.21 is mounted on the underside of the cassette. It receives its input at 50 V with an earthed centre tap, 50 or 60 Hz on a 6-pin plug. This is of the same type as the 7-pin plug used elsewhere but pin 2 is removed and socket 2 is plugged so that they are not interchangeable. Soldered connections are made between the +20, 0 and –20 V outputs of the power unit and the corresponding rails of the cassette. The +20, 0 and –20 V outputs also appear on pins 3, 4 and 5 respectively of the input plug for test purposes.

The maximum rating of the power supply unit is 75 mA at +20 V and 120 mA at –20 V. The microphone cassette actually uses 58 mA at +20 V and 82 mA at –20V.

4. GROUP CASSETTE

4.1 Contents

Each Group Cassette contains two identical and independent group channels and two identical and independent echo line output circuits.

4.2 Group Channel

4.2.1 Input Gain Control

The input to each group channel is a group bus line and therefore requires to feed into an Amplifier C the circuit of which is described in 12.5. At this point, it is desirable to have some degree of gain control. Firstly, the level at the input will increase with increasing number of input channels. Doubling the number of channels will result in a 3 dB increase if the signals are not related or a 6 dB increase of the signals are identical. Secondly, if the signal has been limited in the Microphone Cassette and if the fader is set to 0, the output of the Microphone Cassette will be a standard level signal as measured by the limiter meter which is a peak reading meter. Depending on the signal waveform this may be substantially less than a standard level signal as measured on a V.U. meter where it will be fed to the tape machine. In the first case, it is desirable to have less gain available and in the second case more gain is required. The standard Amplifier C2 has a feedback resistor of such value that an Amplifier B plus an Amplifier C2 has unity overall gain. In this case an Amplifier C1 is employed. This has a feedback resistor of greater value than the C2 and this, when shunted by the input gain control provides a range of ±10 dB in 2 dB stops.

4.2.2 Compressor/Limiter

This is identical in every respect with that in the Microphone Cassette (see section 3.5.2). The controls and meters are identical and are similarly positioned. The a.c. coupling consisting of 6.8 μF and 33kΩ between the C1 Amplifier output and the Out-Compress-Limit key would at first sight appear to be superfluous since the Amplifier C1, itself has an output coupling capacitor. The Compressor/Limiter introduces a small amount of bass loss when feeding into the fader. This bass loss is counteracted by trimming the band pass filter. The a.c. coupling introduces a bass loss equal to that of the compressor limiter and maintains a similar frequency characteristic whether or not the Compressor/Limiter is in circuit.

4.2.3 Inject

This is identical with the facility provided in the microphone channels (see 3.5.3).

4.2.4 Fader

The fader used is electrically identical with that in the microphone channels. In this case, the left-hand fader is provided with an optional ganging device. If the two faders are set to the same reading and the projection on the right hand side of the left-hand control knob is pressed home, the two faders can be operated as a ganged pair. The two controls can easily be separated by lifting the ganging member.

4.2.5 Poling

As some channels may be routed directly from Microphone to Main Cassettes and other channels may be routed through a Group Cassette, it is essential that a Group Cassette should not introduce a reversal of polarity. As the circuit of this cassette is one side earthy throughout, each channel must contain an even number of active elements, which produce a reversal of polarity. The Amplifier C, Amplifier B and Band Pass Filter all reverse so it is necessary to add a fourth. Therefore, instead of using an Amplifier E to counteract the 5 dB loss of the fader at its normal operating point as in a microphone channel, an Amplifier K, which gives a phase reversal, is used for this purpose. The circuit of the Amplifier K is describer in 12.12.

4.2.6 Presence Controls

These are identical with those used in the Microphone Cassette and are similarly positioned.

4.2.7 Band Pass Filter

This is similar to that in the Microphone Cassette but two of the components in the part of the circuit which is used for trimming the high frequency response of the cassette have slightly different values.

4.2.8 Output

The Band Pass Filter feeds an Amplifier B the output of which is connected to the output selector whereby it may be routed to any of eight main channel input bus lines. An "off" position is also provided. The Amplifier B is one of two on a B + B board, the other one being unused. In the event of a fault the unused one could be brought into use by suitable wire links.

4.3 Echo Output Circuit

4.3.1 Main Level Control

Each echo bus line feeds an Amplifier C2 (fixed gain) the output of which is connected to a general-purpose attenuator. This is the main control of the level sent to the particular echo device (chamber, plate, etc.) and it is calibrated from 0 to –40 dB and "off".

4.3.2 Output Amplifier

This is an Amplifier R and is described in 12.17. Together with the output transformer, it provides 10 dB of voltage gain to give an output of 0 dBV into open circuit. The output impedance is approximately 200Ω and it is intended to work into an impedance of 2kΩ or greater. Under these conditions it will handle a level of +20 dBV without clipping. The two echo outputs from a cassette are available on a 5-pin Tuchel socket.

4.4 Metering

The V.U. meter switch in the corresponding Main Cassette when turned to "Check Group" connects the relevant V.U. Meter Amplifiers to the sliders of the check switch in the Group Cassette. This is a 3-position switch of which the centre is an off position in which terminating resistors to the 0 V line are provided. The other positions allow the V.U. Meters to measure the levels either at the outputs of the main channel Amplifiers C, this being the nearest point to the cassette input at which a measurement can be made, or at the echo outputs. Since the V.U. Meter Amplifiers require an input level of –10 dB and the output transformers have a step-up ratio of 1:1.77 (5 dB) the metering point is taken from a 5 dB resistive potentiometer across the Amplifier R output. Thus 0 on the V.U. meter corresponds to an open circuit output voltage of 0.447 V.

4.5 Power Supply

The Power Unit is identical with that used on the Microphone Cassette. The Group Cassette uses about 57 mA at +20 V and 93 mA at –20 V.

5. MAIN CASSETTE

5.1 Contents

Each Main cassette contains two identical main channels, the signal in each of which can also be fed, if desired, to an auxiliary stereo channel and to the two cue channels.

5.2 Main Channel

5.1.1 Input Gain Control

Each input is a main channel bus line. As in the case of a Group Cassette input, it is desirable to have a gain control. An input circuit consisting of an amplifier C1 with a feedback control giving a range of ±10 dB in 2 dB steps is therefore provided.

5.2.2. Inject

This facility is identical with that provided in the Microphone and Group cassettes (See 3.5.3).

5.2.3. Fader

Faders with optional ganging are provided as in the Group Cassettes (See 4.2.4).

5.2.4 Poling

In order to maintain correct overall polarity a phase reversal is required so, as in the Group Cassettes, an Amplifier K is used to provide this and the 5 dB gain necessary to counteract the 5 dB loss of the fader at its normal working position.

5.2.5 Presence Controls

These are identical with those used in the Microphone and Group Cassette.

5.2.6 Band Pass Filter

This again is similar to that used in the Microphone Cassette. Since in this case it is followed by a switch, an output a.c. coupling C2, R1 (C4, R2 in the right channel) is provided.

5.2.7 Track Announce – Individual

For announcement on an individual track, each channel has a push button with change-over contacts which transfer the input of the subsequent amplifier from the output of the Band Pass Filter to the track announce signal bus line, and make contacts which connect together the track announce control bus lines. These lines are linked to the studio playback cassette where their connection operates an active control relay RL1, which in turn quiets the control room loudspeakers. The track announce signal bus line also originates in the Studio Playback Cassette and, when the oscillator key is in its central position, receives the amplified output from the operators microphone through a pre-set level control.

5.2.8 Track Announce – Multi

When the multi-track announce button in the Studio Playback Cassette is operated, it operates RL1 to quiet the control room loudspeakers and applies a voltage to pin3 of the track announce relay RL5 in each main cassette. Each relay RL5 provides two control signals to each of the switching control amplifiers N, the circuit of which is described in 12.14

The application of these control signals causes the switching amplifier to perform the same function as the changeover contacts on the individual track announce push-button. The amplifier N has unity voltage gain.

5.2.9 Output Amplifiers

The output amplifiers and output transformer are identical with those used in the Group cassette for the echo outputs (see 4.3.2). Since it is common practice to run two tape machines in parallel, two 5-pin Tuchel output sockets wired in parallel are provided.

5.3 Cue Circuits

In order to allow signal from any Main Channel to fed to the cue circuits, a connection is taken from the output of the Amplifier N and fed through an isolating Amplifier G to a cue selector switch, as used in the Microphone Cassettes. Instead of the common level control used in the Microphone Cassette, the Main Cassette provides a separate level control for each cue channel. These feed through Amplifiers B to the cue bus lines.

5.4 Auxiliary Stereo

When a multi-track master is being made, it may be desired also to have a twin track stereo tape which can be replayed on a normal type machine, without the mixing facilities required for the multi-track version.

5.4.1 Auxiliary Stereo Channel

A tapping is taken from the output of the input Amplifier C1 in each channel to feed the following chain.

a. Band Pass Filter (B14 or B28).
b. Coupling Capacitor (C1 or C3).
c. Level Control (General-purpose attenuator).
d. Amplifier G (Unity gain).
e. Pan Pot.
f. Pair of Amplifiers B.
g. Auxiliary Stereo bus lines, left and right.

5.4.2 Auxiliary Stereo Bus Lines

If auxiliary stereo working is provided for, the left and right auxiliary stereo bus lines which are fed from each channel of each of the multi-track Main Cassettes are connected to the left and right inputs of an extra Main Cassette. The main outputs of this feed the auxiliary stereo tape machine(s). The auxiliary stereo channels of the extra Main Cassette are not connected to anything, and the auxiliary stereo channels of this cassette are completely unused (the level controls should be left at OFF) but they are fitted so that all Main Cassettes are interchangeable.

5.5 Metering

5.5.1 Meter Connections

The two VU Meters associated with a Main Cassette have a 7-pin plug on a flying lead, which is inserted into socket SK3 of the cassette. On this socket the +20 and –20 V supplies are available for test purposes.

5.5.2 Meter Amplifier

Each VU Meter is driven by an amplifier U, the circuit of which is described in 12.19. The amplifier has an output impedance of 3.9 kΩ so no build-out resistor is required. When the standard internal signal level of –10 dBV is applied to the

amplifier U, the corresponding VU meter will give a reading of 0 VU. Push buttons PB1 and PB2 modify the feedback of both amplifiers to boost the gains by 10 dB and 20 dB respectively.

5.5.3 Meter Selector

The inputs of amplifiers U are connected to the slider of the meter selector switch, which has the following positions:

1. Off
2. Record/Replay
3. Input to Main
4. Check Group
5. Check CRM
6. Check SP
7. External
8. Oscillator

The switch employed is of the shorting type. In order to prevent two measuring points being shorted together when the switch is being operated, alternate studs are provided with 2kΩ series resistors which are mounted inside the switch. This is low, compared with the input impedance, and therefore introduces negligible error.

In the "off" position the studs are directly connected to the 0 V line. In the "record/replay" position connection is actually made to the moving contacts of the follow/replay key which is in the Control Room Monitor Cassette. With this key and the record/replay key suitably set the V.U. meters can measure either record or replay level. The record signal is supplied to the keys from the output of the Amplifier G in the cue channel associated with the main channel under consideration, this being a point, isolated from the main channel, which has the correct signal level at a low source impedance (see 5.3).

The "input to main" position derives its signal from the output of the Amplifier C1 at the input to the Main Cassette and therefore measures the signal level after the input gain control.

In the "Check Group", "Check CRM" and "Check SP" positions the "check" switched in these cassettes are brought into circuit for making measurements. The "Check CRM" and "Check SP" positions only apply in the extreme left hand Main Cassette. In the case of "Check Group", groups 1A, 1B are available in the extreme left hand Main Cassette and groups 2A, 2B are available in the adjacent Main Cassette.

In the "external" position connection is made to SK6, a 5-pin Tuchel socket. This facility can be of use in tracing faults in the Mixer and also for measuring levels from other pieces of equipment. For example if SK8 is connected to SK4 or 5 by a suitable jumper, the actual output level can be measured. If this is other than 10 dB above the level indicated when switched to "Record", then there is probably a fault in the relevant Amplifier G or R or output transformer or the wiring thereto.

In the "Oscillator" position connection is made to the –10 dBV oscillator bus line. Under these conditions, with the oscillator attenuator at 0 the V.U. meter should also read 0. The frequency characteristics of the Amplifier U plus V.U. Meter can be checked by varying the oscillator frequency and observing the meter reading. The 10 dB and 20 dB boost can be checked by setting the oscillator attenuator to –10 dB and –20 dB and pressing the corresponding boost button when the meters should again read 0.

5.6 The power supply is identical with that used in the Microphone Cassette. The Main Cassette uses about 42 mA at +20 V and 78 mA at –20 V.

6. TRACK MONITOR CASSETTE

6.1 Function

This cassette has eight inputs which can accept the replay outputs of up to two 4-track tape machines. It provides facilities for routing these to microphone channels for re-recording and also to the control room monitor and studio playback channels.

6.2 Inputs

Four 5-pin Tuchel input sockets are provided each of which carries two channels. The upper pair is designated Machine No. 1 and the lower pair Machine No. 2. As seen from the back of the Mixer, the right hand pair carried channels 1 and 2 and the left hand pair channels 3 and 4. For 8-track working the second Track Monitor Cassette will carry tracks 5 to 8 on the inputs marked 1 to 4 respectively. These inputs feed eight screened input transformers the primary windings of which are floating. Since these are intended to accept nominally zero level signals and since the normal internal working level of –10 dB is required within the Mixer, these transformers have a step down ratio of 3.16 : 1.

6.3 Re-Record

Two re-record selector switches are provided. The left hand one, S1, selects tracks 1 and 2 (or 5 and 6) from Machine 1 (or from Machine 2). The right hand one, S12, selects tracks 3 and 4 (or 7 and 8) from Machine 1 (or Machine 2). Both these switches have central "off" positions. The outputs of these selector switches feed general purpose attenuators which are calibrated from +10 to –30 dB and "off". At this point, the terminology changes from that of track numbers to that of the re-record input bus lines in the Microphone Cassettes.

The re-record selector No. 1 has this number on its knob and it feeds microphone input bus lines 1A and 1B through level controls with knobs bearing these inscriptions. Similarly for re-record selector No. 2, and for Nos. 3 and 4 if the mixer has provision for 8-track working.

If the mixer has provision for auxiliary stereo working, another Track Monitor Cassette is required of which only half is employed. By using a standard cassette it acts as a spare for the multi-track positions.

In the auxiliary stereo Track Monitor Cassette the record selector knobs are engraved 5 and -, the upper level controls are engraved 5A and 5B and the lower level controls are unmarked. If, due to a fault, it is necessary to interchange cassettes the knobs can easily be interchanged also.

6.4 Monitor Channels

Each Track Monitor Cassette contains four monitor channels.

6.4.1 Tape Machine Selection

Each Track Monitor Cassette is provided with a 4-pole change over key which performs a function similar to the two re-record selectors. Since this key is used in conjunction with the record/replay key to perform A/B checks on both tape machines, it is located in the Control Room Monitor Cassette near to the record/replay key but, to facilitate the understanding of its operation, it is shown on the block schematic diagram of the Track Monitor Cassette, those leads thereto which are external to this cassette being shown in broken lines.

6.4.2 Amplifier

The impedance of the secondary winding of the input transformer is about 200Ω. The tape machine selector switch which is followed by the record/replay key (see 7.3.2) is followed by a nominally unity gain Amplifier G in which the overall gain of the channel is trimmed.

Each monitor channel then consists of:

(a) An Amplifier G to provide for trimming the gain of the channel.
(b) A BandPass Filter
(c) A coupling capacitor
(d) A Monitor track Level Control (general purpose attenuator) calibrated 0 to –40 dB and off
(e) An Amplifier B.
(f) An Amplifier C2.
(g) A Pan Pot.
(h) Two Amplifiers B feeding output bus lines. These lines are paralleled in pairs within the cassette and the pairs are paralleled in the track monitor cassette socket of the main cableform.

6.5 Echo Channels

6.5.1 Echo Send

In order to be able to add to a monitor channel echo which is not recorded, a tapping is taken from the output of the monitor track level control and fed through the following:

(a) An Amplifier G
(b) An echo level control (general purpose attenuator) calibrated 0 to –40 dB and "off".
(c) An Amplifier B.

(d) An echo channel selector as used in the Microphone cassette which can select any of the four echo bus lines.

6.5.2 Echo Return

A Microphone channel is used for echo return and, as described in 3.58 this can be switched to certain monitor channels. The point of return is the virtual earth input of the Amplifier C2. Connection is made to this point through a 47Ω resistor which prevents parasitic oscillation.

6.6 Power Supply

The power supply is identical with that used in the microphone cassette (see 3.9). A Track Monitor Cassette uses about 36 mA at +20V and 59 mA at –20 V

7. CONTROL ROOM MONITOR CASSETTE

7.1 Function

This cassette contains the record/replay switching and provides the controls for the control room monitor loudspeakers including signal selection, level, poling, muting and quieting. It also contains the correlator switching and circuitry, the provision for sending synchronous replay to cue, the cue line output circuitry and the buzzer and red light buttons.

7.2 Loudspeaker Channel

7.2.1 Input Key

A single key K2 is used for both channels to select either the multi-track bus bars or the auxiliary stereo bus bars.

7.2.2 Input Amplifiers

The bus bars selected by K2 are connected to the inputs of fixed gain Amplifiers C2.

7.2.3 Monitor Selectors

These are two five position switches, one for each channel. Each has an "off" position, a normal position, position for Cue 1 and Cue 2 and a synchronous replay position.

In the normal position signals are taken from the outputs of the Amplifiers C2.

The cue signals are derived from the cue output circuits, which are located in this cassette and are described in 7.6.

The synchronous replay signals are available on lines from the Studio Playback Cassette (see 8.1.1) and the signals on the left and right had can only be switched to the left and right channels respectively.

7.2.4 Level Control

The selected signals pass through Band Pass Filters and coupling capacitors to the Control Room Monitor Level control. This is a ganged control with 20 steps of 2 dB calibrated from +20 to –20. There is no "off" position. Each of the potentiometers has a total resistance of 3.2kΩ. The output level with the control at zero is –30 dBV.

7.2.5 Pole

A spring return push button is provided which when pressed reverses the polarity of the signal in the right hand channel. The polarity change is effected by using an Amplifier P, the circuit of which is described in 12.28. In each channel the Amplifier P carries two separate amplifiers connected in series, both of which introduce phase reversals. The first amplifier has a voltage gain of 16 dB and the second amplifier has unity voltage gain. Each amplifier output is built out with a 5.1kΩ resistor and, when actually used as an output, is terminated externally in 5.1kΩ, thereby introducing a voltage loss of 6 dB. The overall voltage gain is therefore 10 dB and, since the input level is –30 dBV, the output level is –20 dBV.

In the left hand channel, the output of the second amplifier only is used, this being in phase with the input. In the right hand channel the in phase second amplifier output is the one normally used, but pressing the Pole Button changes over to the phase reversed output of the first amplifier.

7.2.6 Solo

The solo bus line is connected to the terminal B of the Amplifier P in the left hand channel. This terminal is coupled to the virtual earth input of the second amplifier. Since the solo signal from a microphone channel is 10 dBV signal fed through 16kΩ and since the feedback resistor of the amplifier is 20kΩ there is a gain of about 2 dB giving an open circuit output voltage of –8 dBV for solo and –14 dBV for main channel signals.

The coupling between the output of each first amplifier (Terminal A), and the input of the corresponding second amplifier (Terminal B) is made through a chain of three resistors in series on the Solo Relay board. The total value of these is about 20kΩ which is equal to the value of the feedback resistor in the second amplifier thereby producing unity gain. The Solo Relay board is described in 12.24.

Pressing a solo button not only injects signal from that microphone channel into the left loudspeaker channel as described above but also short circuits the solo control bus bars. This causes four transistors to be switched on to provide low impedance connections to the 0 V line from the resistor junctions in the two coupling chains of three resistors. This effectively switches off the normal monitor signal in both channels and leaves only the solo signal in the left hand loudspeaker channel.

7.2.7 Control Room Loudspeaker Switch

This provides for the following:

(a) Off.
(b) Left (both channels on left loudspeaker).
(c) Right (both channels on right loudspeaker).
(d) Stereo (each channel or corresponding loudspeaker).
(e) Parallel (both channels on both loudspeakers).

In positions (b), (c) and (e) above the signals from the two channels are mixed by connecting together the amplifier P outputs which are built out with 5.1kΩ resistors. Thus each provides a termination for the other. In position (d) each channel requires a 5.1kΩ termination and these are provided on the switch.

7.2.8 Loudspeaker Quiet – Remote Control

An amplifier J described in 12.11 follows the loudspeaker switch in each channel. This serves two purposes, firstly it raises the level from –20 to –10 dBV. Secondly it contains three transistors each of which, when it is turned on, quiets the loudspeaker. One of these is turned on when a track announce button is operated and this reduces the loudspeaker level about 23 dB. The second of these is turned on when the operator uses the talkback. The amount of quieting can be adjusted by a screwdriver operated preset control, which has a range of from 4 dB to 20 dB. The third is turned on when the artist manager uses the talkback. There is a preset control with a similar range. The two preset controls are ganged pairs operating on both channels and are located just above the control room monitor level control./ Another output is taken from the Amplifier J to the correlator switch. This is not affected by the quieting circuits but is provided with a series resistor to prevent low loading when the correlator switch is operated.

7.2.9 Loudspeaker Quiet – Direct

A key is provided just above the record/replay key for quieting the loudspeakers without use of the normal level control. This also has a pre-set control (labelled KEY) grouped with the OP and AM pre-sets and which has a range from about 3 dB to 23 dB. On each side of the loudspeaker quiet key is a spring return push button which mutes the corresponding channel.

7.2.10 Loudspeaker Line Output

Each channel has an Amplifier R and an output transformer as used for all other line outputs. A 5-pin Tuchel Socket is provided for connection of the loudspeaker amplifier leads.

7.3 Record/Replay Switching

7.3.1 Tape Replay Selection

Grouped with the input key are the tree tape machine selection keys referred to in 6.4.1.

7.3.2 Record/Replay

This is a 12-pole change over key of which only 10 poles are actually used, eight for 8-track working and two for auxiliary stereo for switching the monitor loud speakers. In the record position, signal is received from the outputs of Amplifiers G in the Main Cassettes (see section 5.5.3). In the replay position signal is received from the tape machine selection keys (see 7.3.1). The movers of this key are connected to the monitor channel inputs in the Track Monitor Cassettes (see6.4.2) and also to the follow contacts of the follow/replay key.

7.3.3 Follow/Replay

This also uses 10-poles of a 12-pole change over key. Its fixed contacts connect to the movers and replay contacts of the record/replay key and its movers connect to the record/replay contacts on the V.U. Meter selector switches in the Main Cassettes (see 5.3.3). It thus enables the V.U. Meters either to follow the changes of the record/replay key or to be left on replay.

7.4 Correlator

7.4.1 Correlator Switch

This is a 2-pole 8-positionswitch, the positions being marked Off, Mon., 1, 2, 3, 4, 5 & 6. The two poles handle the two inputs of the Correlator. In the "off" position these are connected to the 0 V line. In the Mon. position they derive signal from the special outputs of the Amplifier J (section 7.2.8). In positions 1 to 6 the switch is wired to the movers of the follow/replay key so that in positions 1 to 5 the correlator meter indicates the correlation between the signals on the two V.U. Meters associated with Main Cassettes Nos. 1 to 5 respectively. Since the signal is taken from the output side of the follow/replay key, the indication can be switched to record or replay by the record/replay key if the follow/replay key is set to follow. In order to prevent the shorting together of two channels when the switch is operated, series resistors are connected in series with alternate studs within the switch.

7.4.2 Correlator

The circuit of this is described in 12.18. It gives a positive indication on the meter if the signals at the two inputs are in phase and a negative indication if they are out of phase. If the two signals are completely uncorrelated the meter will remain on its centre zero. The circuitry is such that indication is inhibited if the signal levels in the two channels differ by more than about 20 dB.

7.4.3 Low Level Meters

The Correlator requires an amplifier in each channel which will be linear at low levels but which will limit at high signal levels. These amplifiers have been made to meet a double purpose by adding rectifiers and meters. The meters are the same size as the limiter/compressor meters, and are similarly mounted. They are calibrated from –60 to –40 dB these being levels with respect to a 0 dBV signal at an output. Since the normal internal signal level is –10 dBV, this range corresponds to –70 to –50 dBV at the input to the correlator. These meters are useful for giving an indication of the level of very low level signals or of excessively

high noise levels. Since the correlator inputs are taken from points in the monitor channels subsequent to the control room monitor level control, the low level meter readings are correct only when this control is on zero. By use of this control, the range of the meters can be extended 20 dB in either direction. Thus with a range extending to – 80 V.U. the noise of various parts of the mixer itself can be checked.

7.4.4 Meter Connections

An 11-pin socket is provided to receive the flying lead with a mating plug which connects to the Correlator and the two low level meters on the frame. The +20 V and –20 V are also available on this socket for test purposes.

7.5 Synchronous Replay

7.5.1 Input – Synchronous

Replay signals are available on the selector switches for the control room loudspeakers and also for the studio playback. The input socket and input transformers are located in the Studio Playback Cassette (see 8.1.1) and –10 dBV lines are brought through the main cableform to the Control Room Monitor Cassette where the left and right signals are available at the left and right monitor selector switched.

7.5.2 Synchronous Replay to Cue

The input lines are connected to the inputs of unity gain Amplifiers G the outputs of which feed 5kΩ carbon potentiometers which act as level controls. The sliders of these are connected to the inputs of Amplifier B the outputs of which feed the cue bus lines, left to cue 1 and right to cue 2.

7.6 Cue Output

The cue output circuits are identical with the echo output circuits in the Group Cassette which are described in 4.3

7.7 Cue to Loudspeakers

In order that the cue signals shall be available on the control room monitor and studio playback loudspeakers, the V.U. Meter outputs on the cue output Amplifiers R are both connected to both the input selector switches on both the Control Room Monitor Cassette and the Studio Playback Cassettes.

7.8 Metering

A 3-position, centre "off", switch similar to that in the Group Cassette allows the V.U. Meter tapping either in the loudspeaker output amplifiers or in the cue line output amplifiers to be routed to the "Check CRM" position on the meter switch on the left hand Main Cassette so that signals at these outputs can be measured on the V.U. Meters associated with No. 1 Main Cassette.

7.9 Signalling

Push buttons are provided at the front of this cassette for operating the buzzer and red light. The former is non-locking and the latter is optionally locking by turning when depressed.

The push buttons energise 24 V relays in the Main Power Unit whereby the mains supply is fed to the buzzer and red lights. The relay connections to the Main Power Unit are made through a 7-pin plug PL3 which plug also carries the 50 V supply for condenser microphone powering, this supply being fed to the Microphone Cassettes by way of the main cableform.

7.10 Power Supply

The cassette employs the standard power unit. It uses about 72 mA at +20 V and 111 mA at –20 V.

8. STUDIO PLAYBACK CASSETTE

8.1 Function

This provides for selection and control of signals sent to studio loudspeakers, and also includes synchronous replay input circuits, talkback circuitry, track announce switching and the test oscillator.

8.1.1 Synchronous Replay

A 5-pin Tuchel socket is connected to two transformers of the type used at the Track Monitor Cassette inputs (ratio 3.16:1), to give signals at –10 dBV which are available on the input selectors of this and the Control Room Monitor Cassette.

2 Loudspeaker Channels

8.2.1 Input Selectors

Each channel has an input selector with positions identical with those of the monitor selectors in the Control Room Monitor Cassette (Section 7.2.3).

8.2.2 Level Controls

The outputs of the input selectors are passed through Ban Pass Filters and coupling capacitors to level controls. Since the two channels may be used to handle unrelated signals, independent controls are provided. Electrically these are similar to the twin control used in the Control Room Monitor Cassette but they are calibrated from +10 dB to –30 dB.

8.2.3 Pole

The facility of reversing the polarity of the right hand channel by means of a spring return push button is provided as in the Control Room Monitor Cassette. As the facilities for the solo feature are not required in the studio playback circuits, the

Amplifier H is used which is a simplified form of Amplifier P. Amplifier H is described in 12.10.

8.2.4 Loudspeaker Switch

This is identical with that used in the Control Room Monitor Cassette (section 7.2.7).

8.2.5 Studio Talkback

In order to provide for the replacement of normal signal by talkback, a switching Amplifier N is included in each channel, this being the amplifier used in the Main Cassettes for switching track announce. The control signals for switching the Amplifiers N are supplied by active relay RL4, the operation of which is described in 8.3.

8.2.6 Output

The output circuits consist of Amplifiers R and output transformers with a 5-pin Tuchel output socket as used for echo outputs in the Group Cassette (section 4.3.2).

8.3 Talkback

8.3.1 Operator's Microphone

The Studio Playback Cassette has no meter associated with it so its meter space in the frame is used for the microphone for the operator. It is a 200Ω moving coil type and it is provided with a 6-pin miniature Tuchel plug on a flying lead, a mating socket SK7 being provided on the cassette.

8.3.2 Gain

The microphone signals are amplified by an Amplifier A4 with 40 dB of gain followed by an Amplifier A3 with 20 dB of gain.

8.3.3 Studio Talkback, Normal

The Studio Talkback Normal button PB1 when operated connects the output of the Amplifier A3 (B9) through a 10kΩ mixing resistor R102 to VR9 and R107 in series. Normally signal is taken from the common point of these amplifier by another 20 dB Amplifier A3 (B21) to K3 which, in its central position marked Studio LS, passes the signal to the Studio Talkback Normal level control VR4 the slider of which feeds the A inputs of the Amplifiers N in the Studio loudspeaker chain.

A further make contact on PB1 operates active relay RL2 to quiet the control room loudspeakers and also operates active relay RL4 to switch the Amplifier N from their normal inputs to their A inputs.

8.3.4 Studio Talkback, 'Loud'

Pressing this button transfers the input of Amplifier A3 (B21) from the lower end of VR9 to the slider thereof. According to the setting of this control up to 10 dB more gain will be introduced when the loud button is pressed. VR4 (Normal) and VR9 (Loud) are screwdriver adjustable controls located just in front of the respective buttons. *In order to obtain the loud condition the normal and loud buttons must both be pressed.*

8.3.5 Artist Manager's Microphone

This is a hand microphone of 25Ω impedance and is provided with a "press to speak" switch. When pressed this switch removes a short circuit from the output and closes an independent pair of contacts. A screened quad lead is provided with a miniature Tuchel 6-pin plug for insertion into SK8 on the rear of the cassette.

8.3.6 A.M. Gain

The microphone output is adjusted by a level control VR5 which has a screwdriver slot and has a range of about 20 dB. This is followed by a 40 dB Amplifier A4. As this microphone is normally held close to the mouth its output is much greater than that of the operator's microphone so less gain is provided.

8.3.7 A.M. Mixing

With the Artist Manager selector switch at Talkback, signal is mixed with that from the operator's circuit through another 10kΩ resistor R101. R103 and R104 are included at the input ends of the mixing resistors to reduce the change of gain through one channel which is caused by switching on the other channel. To minimise this effect these resistors should be equal to the output impedance of an Amplifier A but this would low-load the amplifier output. The value chosen is a compromise. From this point at which the signals are mixed the operator and the artist manager have the same facilities. The independent pair of contacts in the Artists Manager's microphone is used to operate active relay RL3 to quiet the control room monitor loudspeakers and to operate active relay Rl4 to switch the Amplifiers N from normal signal to talkback.

8.3.8 R.F. Suppression

The microphone connections constitute leads entering the Mixer at low level with no input transformers and no Band Pass Filters. In order to minimise the risk of these leads introducing r.f. interference, these inputs are shunted by capacitors, 0.1 μF in the case of the 25Ω microphone ando.022 μF in the case of the 200Ω microphone.

8.4 Alternative Talkback

At the right hand side of the panel beyond the Studio Talkback Loud button is a 3-position key. In its central position marked Studio LS the talkback system operates as described above. In both the other positions the signal from the Amplifier A3 (B21) is disconnected from the Studio Talkback Normal level control and connected to VR 8 marked ALT T/B Level on the block schematic diagram.

This is a screwdriver operated control located just in front of the key which brings it into circuit. This control feeds a normal line output circuit consisting of an Amplifier R and output transformer the output of which is available on pins 4 and 5 of 5-pin Tuchel socket SK2 for feeding to a power amplifier and loudspeaker.

In the forward position marked ALT a pair of contacts on the key is used to break the energising supply to RL4 thereby preventing it from being energised so that the signal to the studio loudspeakers is unchanged.

The backward position is marked ALT (M), the (M) indicating that the studio speakers are muted. This is realised by allowing RL4 to operate thereby feeding the studio loudspeakers from the talkback line, but as the signal has been removed from this line, the loudspeakers are muted.

8.5 Intercom

This allows the operator to talk to another location, possibly a remote machine room.

Signal from the output of the Amplifier A3 (B9) can also be switched by a key located to the left of the alternative talkback key, through a preset level control in front of the key to another Amplifier R and output transformer. The output is available at line level on pins 1 and 2 of SK2.

8.6 Cueing

8.6.1 Operator to Cue

By operating the intercom key in the reverse direction which is marked OP to Cue, signal is applied to two level controls with "off" positions. These controls are marked CUE 1 and CUE 2 and they allow signal to be routed through Amplifier B to the cue bus lines.

8.6.2 Artist Manager to Cue

By operating the selector switch in the box marked Artist Manager the output from this microphone can be diverted from the talkback circuit to either Cue 1 or Cue 2. The box contains separate level controls for the two circuits and these controls feed to cue bus lines through Amplifiers B.

8.7 Track Announce

8.7.1 Signals

Signal from the output of the operator's Amplifier A3 (B9) is fed to a preset level control at the bottom right and corner of the panel. This is padded out with resistors at both ends so that it has a range of about 5 to 25 dB of loss. With the oscillator key K2 in its normal central position, signal from the level control is connected to the input of an Amplifier M (see 12.13). Output 2 of this amplifier is connected to the track announce inputs of the Main Cassettes.

8.7.2 Switching – Separate Tracks

Operating a track announce button on a Main Cassette connects the signal line of 8.7.1 with that channel in place of the existing signal and also short circuits pins 25 and 35 of PL1 on the Studio Playback Cassette to operate active relay RL1, thereby quieting the control room monitor loudspeakers.

8.7.3 Switching – Multi-Track

Operating the multi-track announce button which is at the bottom left hand corner of the cassette operates active relay RL1 to quiet the control room monitor loudspeakers and through a lead on pin 21 of PL1 operates the active relays RL5 in all the Main Cassettes, thereby providing control signals to switch the Amplifiers N to the track announce signal line.

8.8 Oscillator

The circuit is described in 12.20.

8.8.1 Frequencies

The oscillator frequency switch selects any of the following frequencies 0.03, 0.06, 0.1, 0.5, 1, 3, 5,8, 10, 12 and 15 kHz.

8.8.2 Level

The output level from the oscillator is +10 dBV at all frequencies. The output feeds a general purpose attenuator calibrated from +10 dB to –30 dB and "off" so that the level at the slider is that indicated by the calibration.

8.8.3 Distribution

When the oscillator key is in the mid position, the oscillator is disconnected from the attenuator. In both other positions the output of the oscillator control is connected to the input of the Amplifier M in place of the track announce signal. The Amplifie4r M has three outputs. With the oscillator level control set to zero the outputs are as follows:-

No. 1 is at a level of –35 dBV which, when the oscillator key is in the "on" position, is connected to the oscillator position on the input selectors on the Microphone Cassettes, this being the level required for standard level in a microphone channel. In other positions of the oscillator key this output line is connected the 0 V rail.

Output No. 2 is at a level of –10 dBV and, in addition to feeding the track announce inputs on the Main Cassettes, also supplies level for checking the V.U. Meters through the oscillator positions of the meter selector switches.

Output No. 3 is a zero level output which is available on both channels of Sk4, a 5-pin Tuchel socket. It is a low impedance output which must not be loaded with less than 2kΩ.

8.8.4 Tape Machine Test

For sending tone to tape machines the oscillator key is set to the up position marked "To Tracks". The oscillator is fed to the track announce line as in the "on" position but in addition RL5 is energised to operate the change-overs in the Amplifiers N to accept the oscillator from the track announce line. In addition RL1 is operated to quiet the control room monitor loudspeakers.

8.9 Metering

As in the Control Room Monitor Cassette a 3-position, centre "off", switch is provided. This enables the levels either at the two studio playback line outputs or at the alternative talkback and intercom line outputs to be observed on the V.U. meters associated with the left hand Main Cassette when the meter switch in that cassette is suitably set.

There is no meter socket on the cassette but the +20 V and –20 V are available on SK6 for test purposes.

A spare socket SK5 is also provided.

8.10 Power Supply

The cassette employs the standard power unit. It uses about 49 mA at +20 V and 91 mA at –20 V.

8. FRAME

9.1 Capacity

Two frames are available one of which will accommodate up to 12 cassettes and the other will accommodate up to 24 cassettes. A smaller number can always be used.

Blank panels are available to fill vacant spaces. These have plugs on which the sockets of the cableforms can be parked.

9.2 Cassette Requirements

These are as follows:

1 Microphone Cassette for every 2 microphone channels and every two echo return channels, up to a maximum of 12 cassettes frames should be made to accommodate more if necessary.

1 Group Cassette for every 2 group channels with a maximum of 2 cassettes. Each Group Cassette also provides 2 echo output channels so that it is possible that the number of Group Cassettes is determined by the number of echo outputs required.

1 Main Cassette for every 2 main outputs up to 4 for 8-track working. An extra cassette must be added to provide for auxiliary stereo working if this is required.

1 Track Monitor Cassette for every 4 main tracks. An extra cassette is required for auxiliary stereo.

1 Control Room Monitor Cassette.

1 Studio Playback Cassette.

9.3 Construction

Lateral rigidity is provided by the use of steel angle, welded to form a rectangular member extending laterally substantially the full length of the frame and vertically from the top of the visible part of the legs up to the meter box.

The forward portion which houses the cassettes is made of sheet aluminium assembled with bolts so that it can be dismantled and packed substantially flat. The frame for 24 cassettes consists of two sections each similar to that used in the frame for 12 cassettes.

The legs are also made of sheet aluminium and can readily be unbolted for transit. They are identical for the two sized of frame. The hand rest which extends the full length is Formica faced wood supported on easily detachable brackets. The end trim is also wood.

9.4 Cable Forms

Only two cable forms are used and these are completely separate from the frame. There is no permanent wiring on the frame except the leads from the microphones and meters which terminate on plugs for insertion into the relevant cassettes.

9.4.1 Main Cableform

This has a multi-pin socket for each cassette and provides all the inter-cassette signal connections. It has two spade terminals on flying leads for connecting the circuit earth chassis to a terminal on the frame.

9.4.2 Power Cableform

This has a 6-pin socket of which only two pins are used for supplying 50 V a.c. to the cassette Power Units, the centre tap of this supply being earthed at the Main Power Unit. The plugs on the cassette Power Units to which these sockets are applied have +20, 0 and –20 V on pins 3, 4 and 5 respectively for test purposes.

In order to minimise the risk of hum injection into the signal cableform from the power cableform, the latter employs twisted screened cable, the screen of which is also earthed at the Main Power Unit. A power supply cable extension lead using an

11-pin plug and socket is used to connect the power cableform to the Main Power Unit.

10. MAIN POWER UNIT

10.1 Function

This accepts mains supplies 204 V to 252 V, 45 to 65 Hz. It contains an a.c. stabiliser and a step-down transformer to provide the 50 V, centre tap earthed supply for the Cassette Power Units. It also contains cue Output Amplifiers and their Power Units, condenser microphone power units, relays to operate the buzzer and red light, relay power supply and metering.

10.2 A.C. Constant Voltage Regulator

This uses a solid state control circuit. It is set for 240 V out and for an input range of –15%, +5%, i.e. from 204 V to 252 V. If desired this can be altered to ±10%, i.e. from 216 V to 264 V. The ranges are selectable by changing the connections to both the input range terminals. The following are its other main features.

Output current	1.5 amps max
Output accuracy	±0.3% r.m.s., zero to full load
Time constant	0.1 sec.
Frequency range	45 to 65 Hz.
Distortion	Total harmonics less than 3.5% at unity power factor. Slightly greater at other power factors.
Environment	Rated for use up to 45°C Ambient temperature.
Temperature Coefficient	Within 0.02% per °C.
Maintenance	No routine maintenance is required or recommended. In case of failure, a replacement control amplifier should be ordered.

10.3 50 V A.C. Supply

This is provided by a step-down transformer T1, the primary of which is fed from the a.c. stabiliser. The centre tap of the secondary winding is linked to the chassis which is also connected to the earth pin of the mains input plug.

The 50 V supply is fed through Sk1 and an extension lead to the Mixer power cableform and through Sk2 to the cue Power Units and any other units which may be mounted in the rack which houses the cue units.

10.4 Relay Power Supply

D1 and D2 provide bi-phase rectification from the 50 V a.c. supply and together with R6 for peak current limiting and C6 for smoothing constitute the relay power supply.

10.5 Buzzer Operation

Pressing the buzzer button on the Control Room Monitor Cassette connects together sockets 1 and 2 of Sk6 thereby operating RL1 which applies mains supply to Sk3 for operating a mains buzzer plugged therein.

10.6 Red Light Operation

Pressing the red light button on the Control Room Monitor Cassette connects together; sockets 2 and 3 of Sk6 thereby operating RL2 and RL3, RL2 applies mains to SK4 for operating a mains red light circuit. RL3 short circuits the contacts of SK5 which can be used to operate a separate relay operated, or other self powered, system. C1 to C5 and R1 to R5 provide interference suppression.

10.7 Microphone Powering

Provision is made for powering Neumann Transistor Condenser Microphones series f.e.t. 80 or microphones requiring a similar supply. The supply is adequate for up to 24 of these microphones. T.2 is a transformer of the type used in the Cassette Power Units. Here it is used to provide an earth-free 50 V supply for half wave rectification in the Microphone Power unit the circuit of which is described in 12.29. The output of this power unit is routed through SK6 and the corresponding connecting lead to the Control Room Monitor Cassette from which it passes through the main cableform to all the Microphone Cassettes.

10.8 Metering

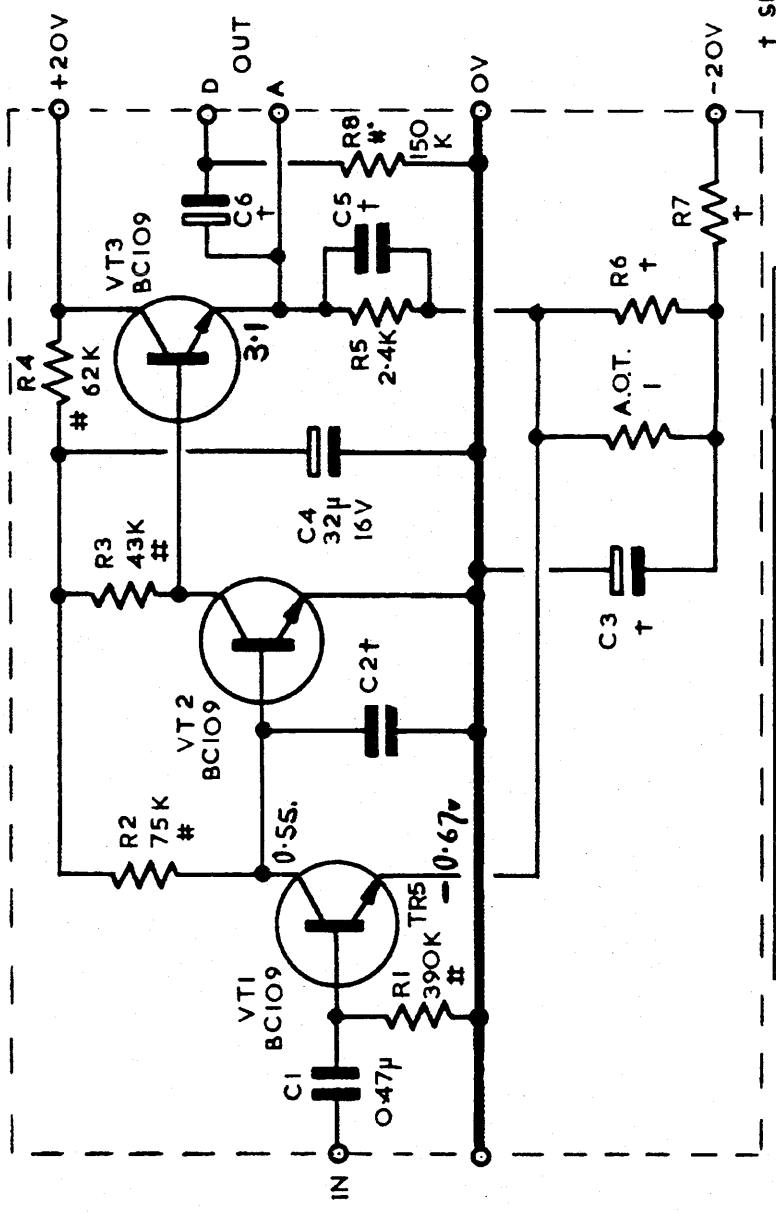
Three meters are provided. A 300 V moving iron meter is connected to a switch whereby it can be connected either to the mains input or to the output of the a.c. stabiliser. The scale has a mark at 240 V and a black band extending from 210 V to 250 V (On early model 195 V to 255 V).

A 60 V moving iron meter is permanently connected across the 50 V a.c. output. This has a mark at 50 V and a black band extending from 48.5 V to 53.3 V.

An hours meter is permanently connected across the output of the a.c. stabiliser to indicate the total use of the unit.

DRAWING NUMBER

TG12345/AE203



TYPE	A1	A3	A4	A5	
GAIN	10dB	20dB	40dB	46dB	
C2	8200p	8200p	0·033µ	0.033µ	
C3	320µ/4V	320µ/4V	80µ/6·4V	320µ/4V	
C5	150p	150p	560p	560p	
C6	25µ/4V	1µ	1µ	1µ	
R6	1·2K	270	24	24	
R7	10K	11K	11K	11K	
A.O.T.I.	SELECT	OMIT	OMIT	24	
		Suitable for Mk 1			

Amplifier 'A'

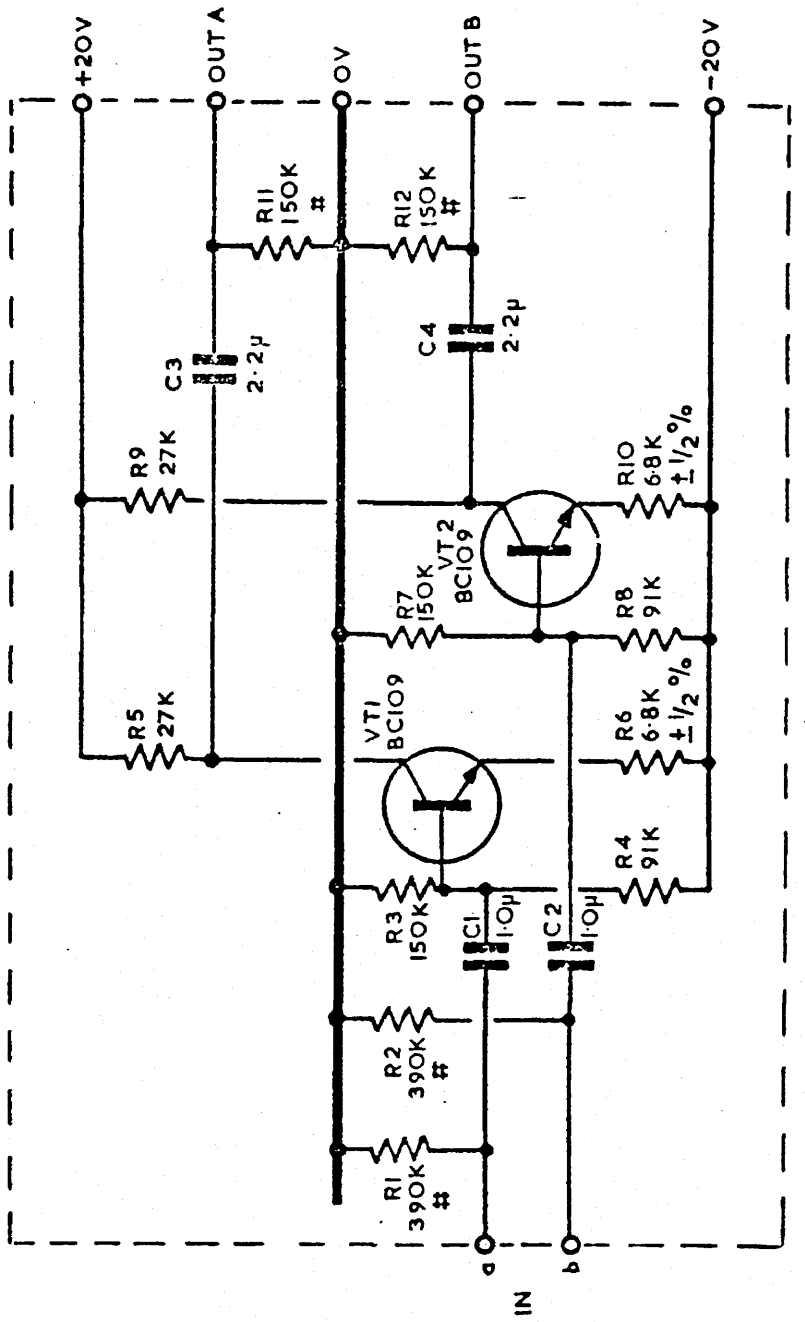
					RESISTORS * = ± 2%
					RESISTORS # = ± 5%
6	21-1-70	TG			UNMARKED = ± 1%
ISSUE	DATE	MOD.No.	ISSUE	DATE	

E.M.I. RESEARCH LABORATORIES HAYES MIDDX.

DRAWING NUMBER

TG 12345/AE204

R



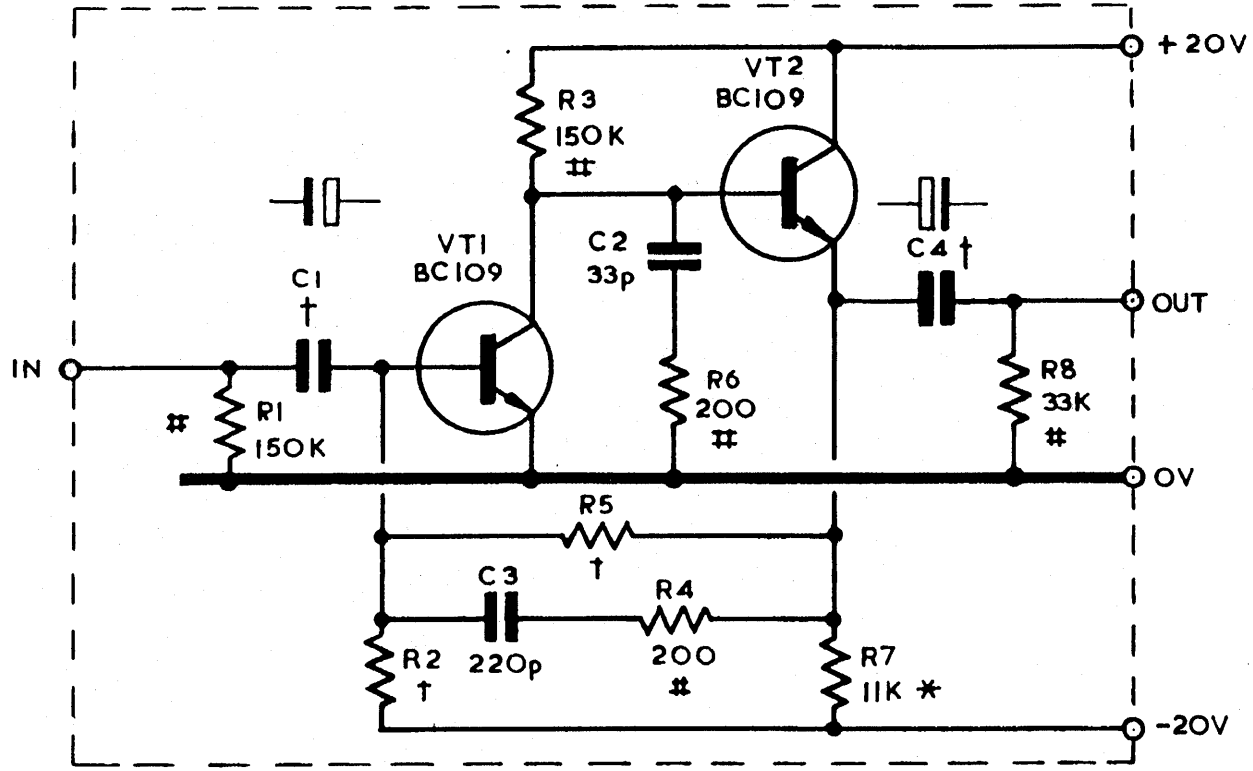
BOARD TG. 12345/B52/2

					TG	RESISTORS * = ± 2%
						RESISTORS # = ± 5%
J3	3	21-1-70				UNMARKED = ± 1%
MOD.No	ISSUE	DATE	MOD.No.	ISSUE	DATE	

USED ON	E.M.I. RESEARCH LABORATORIES HAYES MIDDX.	
TRACED H.J.S.LTD.	SUB TITLE AMPLIFIER B + B	
DRAWN C.S.D.	TITLE MULTI-WAY MIXER	DRAWING NUMBER TG 12345/AE 204

DRAWING NUMBER
TG12345/AE205

Drg. No. AE205 Amplifiers C1-C7



† SEE TABLE

USE BOARD TG12345/B65/1

RESISTORS * = ± 2%
RESISTORS # = ± 5%
UNMARKED = ± 1%

Mark 1 Uses C1

TYPE	R2	R5	C1	C4	ASSY
C1	390K	47K	4·7µ	4·7µ	B205A/C1
C2	56K	6·8K	4·7µ	4·7µ	B205A/C2
C3	390K	47K	4·7µ	200µ10V	B205A/C3
C4	56K	6·8K ± 1%	4·7µ	4·7µ	B205A/C4
C5	56K	6·8K	4·7µ	200µ10V	B205A/C5

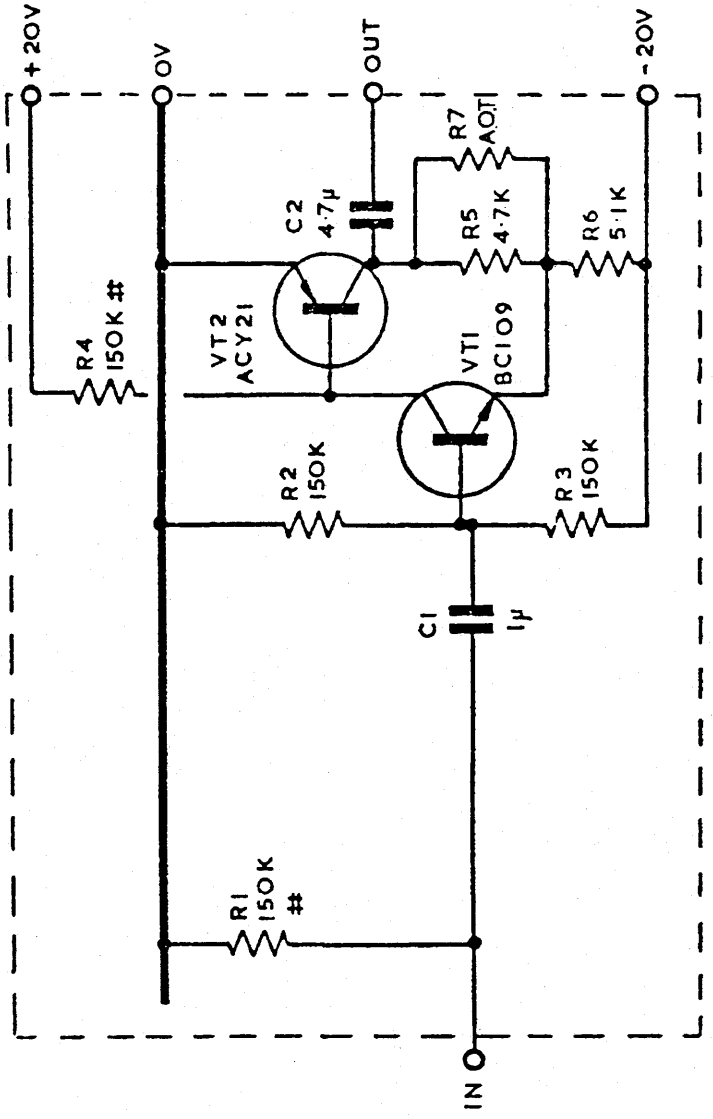
TYPE	R2	R5	C1	C4	ASSY
C6	56K	6·8K	25µ 4V	4·7µ	B205A/C6
C7	56K	6·8K	25µ 4V	200µ 10V	B205A/C7

DRAWING NUMBER

TG 12345/AE207

R

BOARD TG.12345/853/1

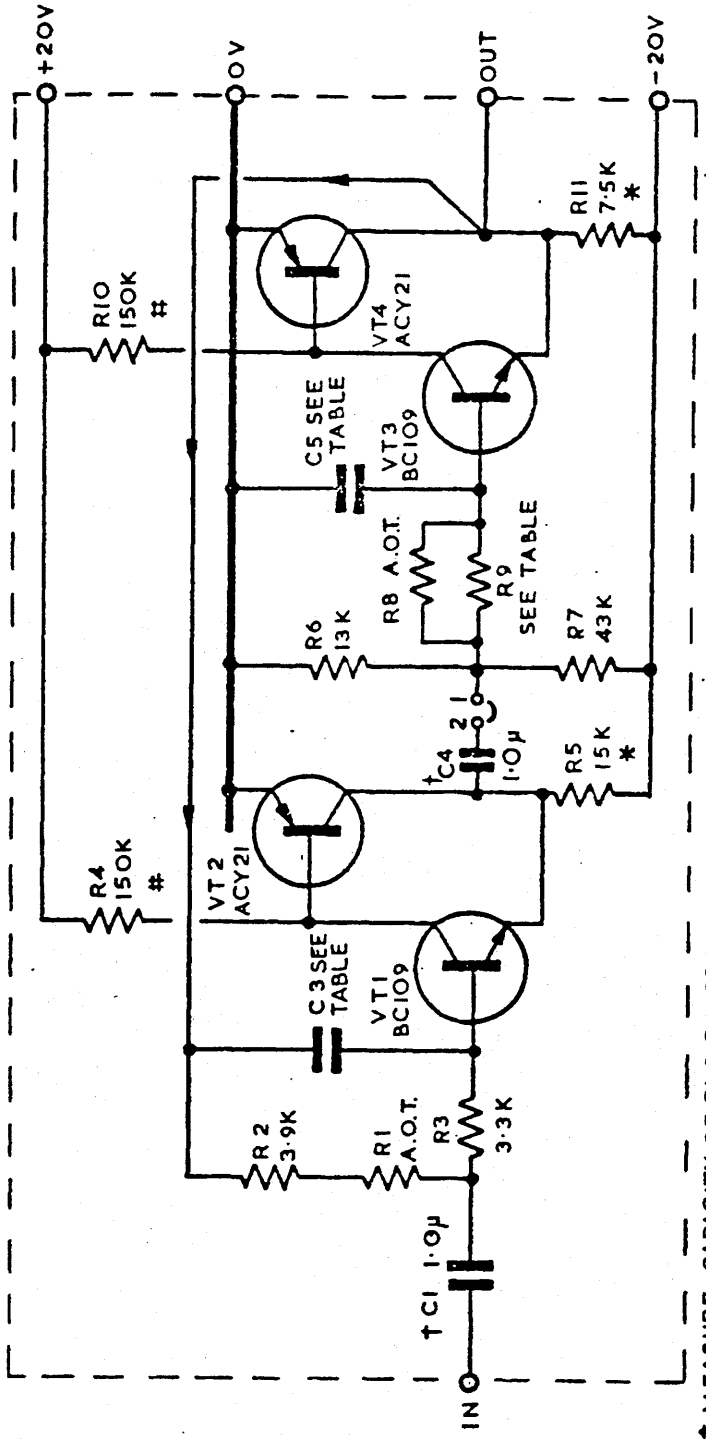


						RESISTORS * = ± 2%
						RESISTORS # = ± 5%
J3	4	21-1-70				UNMARKED = ± 1%
MOD.No	ISSUE	DATE	MOD. No.	ISSUE	DATE	

USED ON	E.M.I. RESEARCH LABORATORIES HAYES MIDDX.	
TRACED H.J.S. LTD.	SUB TITLE AMPLIFIER 'E'	
DRAWN C.S.D.	TITLE MULTI-WAY MIXER	DRAWING NUMBER TG12345/AE207

DRAWING NUMBER

TG12345 / AE 208



† MEASURE CAPACITY OF C1 & C4 BEFORE FITTING THEN SELECT SO THAT C1 = C4 ± 5%

BOARD TG.12345/B54/3

TYPE	F1	F2	F3	F4	F5
C3	1000p	1000p	1000p	1000p	100p
C5	2000p	1500p	1200p	1800p	180p
R9	3.9K	3.3K	3.3K	3.3K	3·3K
ASSY. No.	/B208A/F1	/B208A/F2	/B208A/F3	/B 208A/F4	/B208A/F5

						RESISTORS * = ± 2%
						RESISTORS # = ± 5%
J19	5	11.2.70				UNMARKED = ± 1%
MOD.No.	ISSUE	DATE	MOD.No.	ISSUE	DATE	

USED ON

E.M.I. RESEARCH LABORATORIES HAYES MIDDX

TRACED H.J.S. LTD

SUB TITLE

BAND PASS FILTER F1 F2 F3 F4 & F5

DRAWN C.S.D.

TITLE

MULTI-WAY MIXER

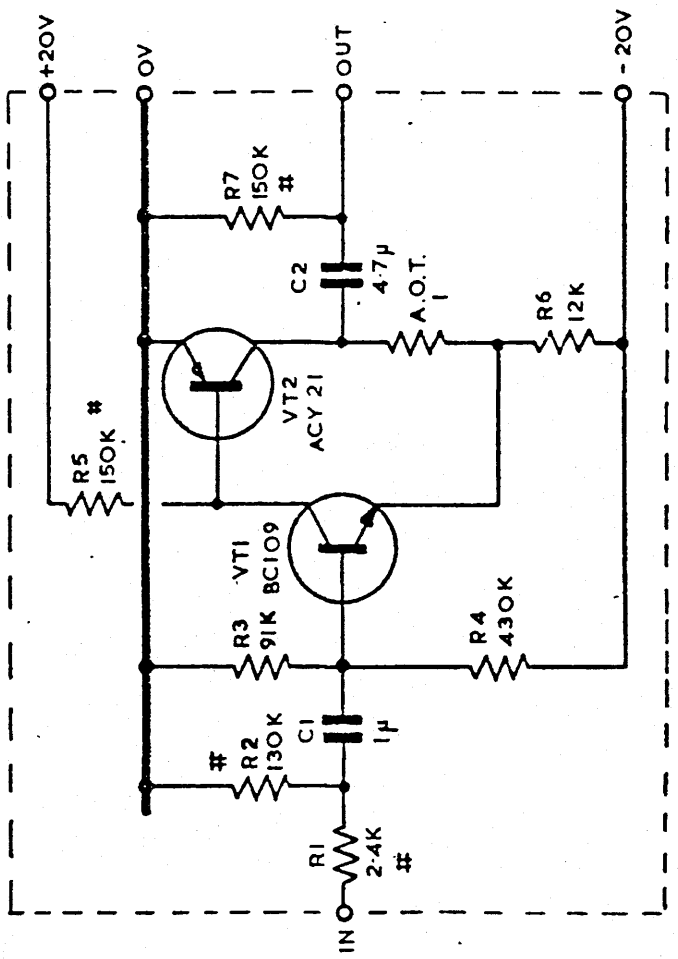
DRAWING NUMBER

TG12345/AE208

DRAWING NUMBER
TG 12345/AE209

R

BOARD TG.12345/B66/1

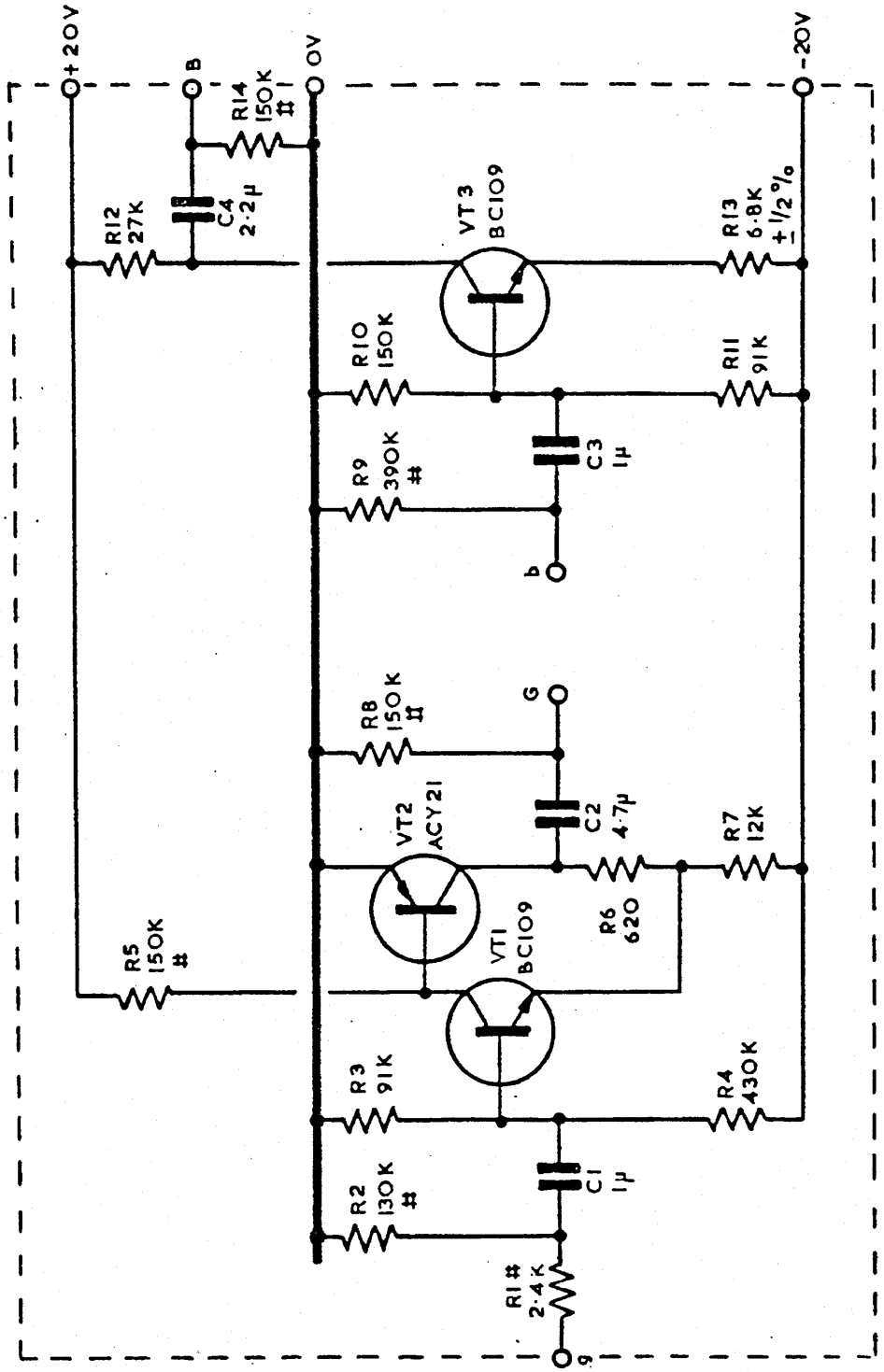


						RESISTORS * = ± 2%
						RESISTORS # = ± 5%
J3	8	21-1-70				UNMARKED = ± 1%
MOD. No.	ISSUE	DATE	MOD. No.	ISSUE	DATE	

USED ON	E.M.I. RESEARCH LABORATORIES HAYES MIDDX.	
TRACED H.J.S. LTD.	SUB TITLE AMPLIFIER 'G'	
DRAWN C.S.D	TITLE MULTI-WAY MIXER	DRAWING NUMBER TG12345/AE209

DRAWING NUMBER
TG12345/AE210

R



BOARD TG.12345/B58/2

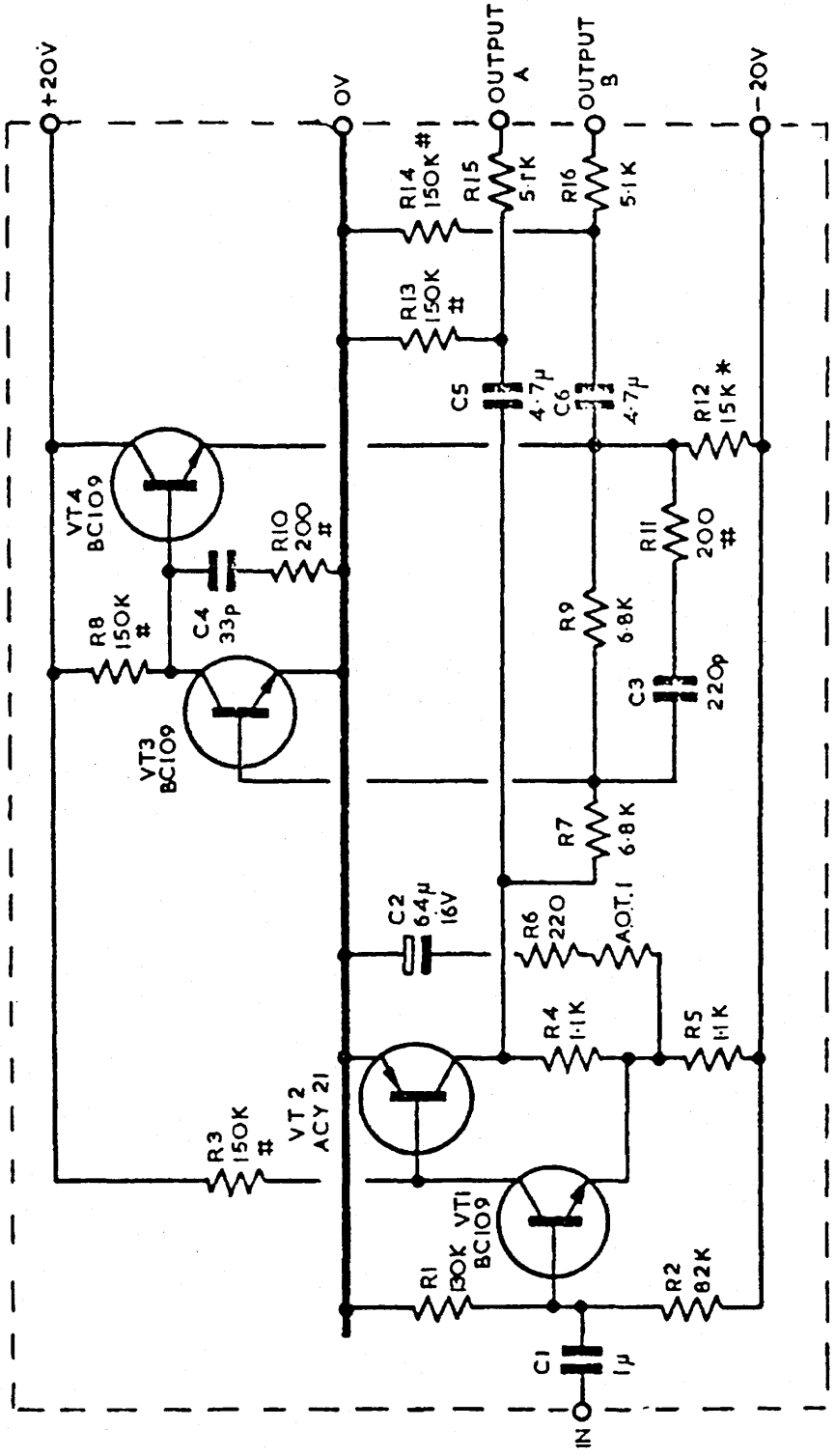
						RESISTORS * = ± 2%
						RESISTORS # = ± 5%
J3	4	21-1-70				UNMARKED = ± 1%
MOD.No	ISSUE	DATE	MOD.No.	ISSUE	DATE	

USED ON	E.M.I. RESEARCH LABORATORIES HAYES MIDDX.	
TRACED H.J.S. LTD.	SUB TITLE AMPLIFIER 'G' & 'B'	
DRAWN P.T.G.	TITLE MULTI-WAY MIXER	DRAWING NUMBER TG12345/AE210

DRAWING NUMBER

TG 12345 / AE211

R



BOARD TG 12345/B67/1

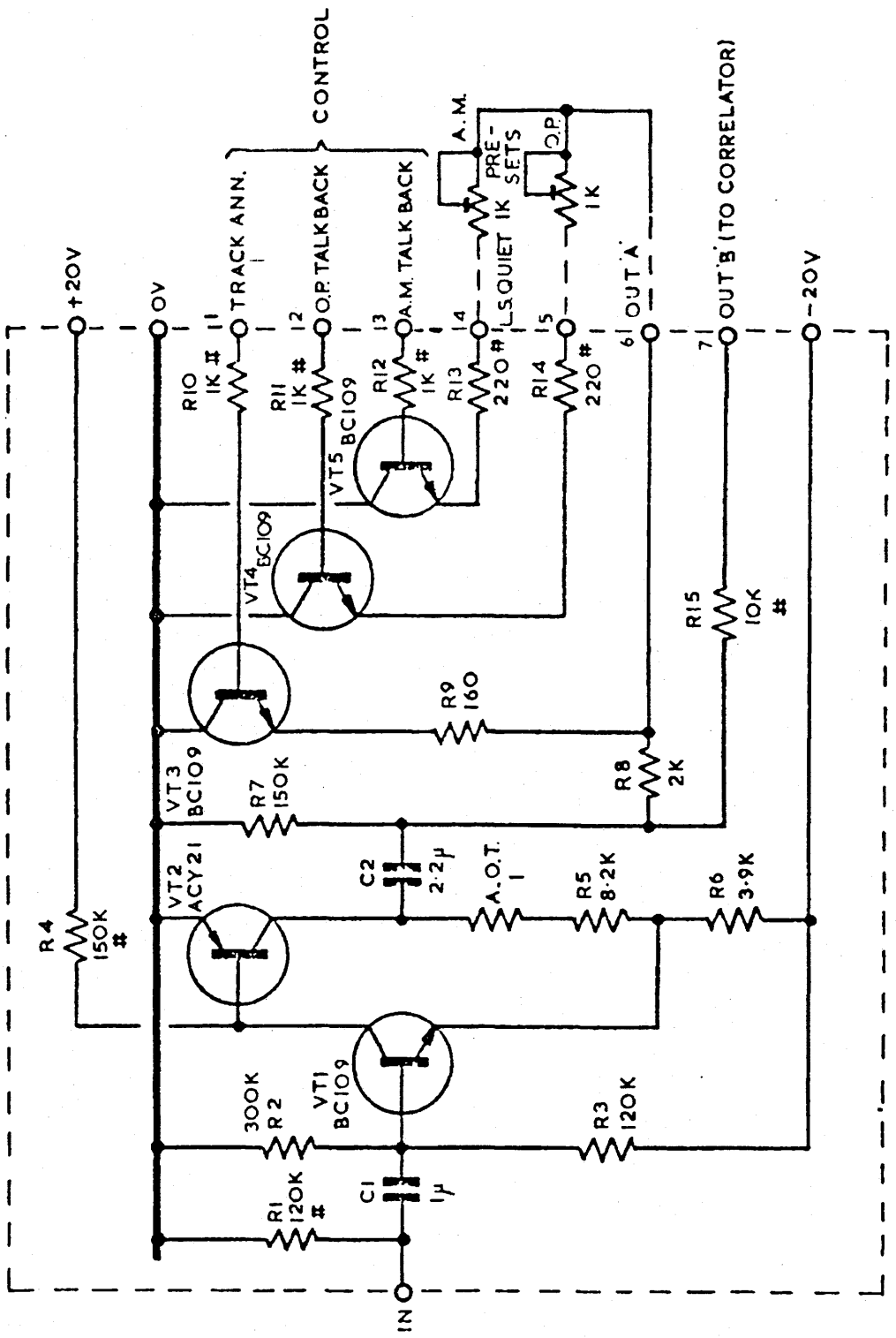
						RESISTORS * = ± 2%
						RESISTORS # = ± 5%
J3	5	21-1-70				UNMARKED = ± 1%
MOD.No	ISSUE	DATE	MOD. No.	ISSUE	DATE	

USED ON	E.M.I. RESEARCH LABORATORIES HAYES MIDDX.	
TRACED TG	SUB TITLE AMPLIFIER 'H'	
DRAWN	TITLE MULTI-WAY MIXER	DRAWING NUMBER TG 12345/AE 211

DRAWING NUMBER

TG 12345/AE 212

R



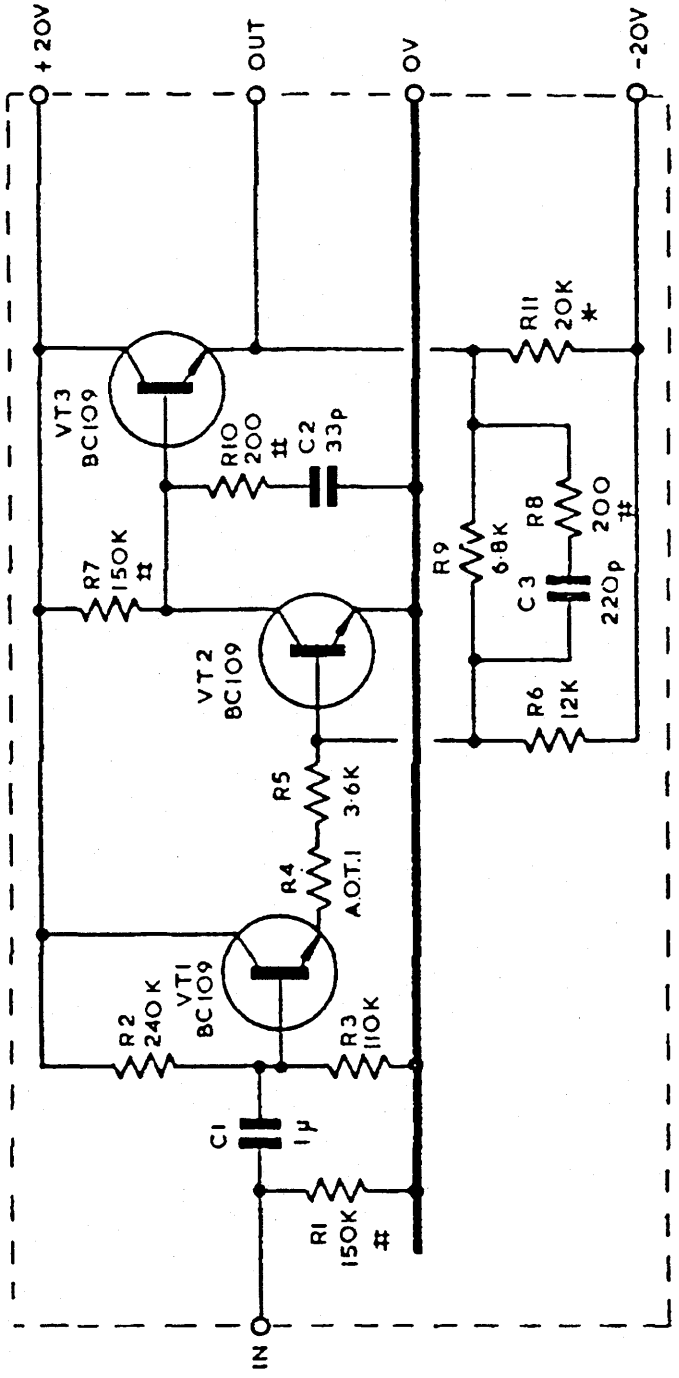
						RESISTORS * = ± 2%
						RESISTORS # = ± 5%
J3	4	21-1-70				UNMARKED = ± 1%
MOD.No	ISSUE	DATE	MOD.No.	ISSUE	DATE	

USED ON	E.M.I. RESEARCH LABORATORIES HAYES MIDDX.	
TRACED TG	SUBTITLE AMPLIFIER 'J'	
DRAWN	TITLE MULTI-WAY MIXER	DRAWING NUMBER TG12345/AE 212

DRAWING NUMBER

TG12345/AE213

R



BOARD TG.12345/B64/1

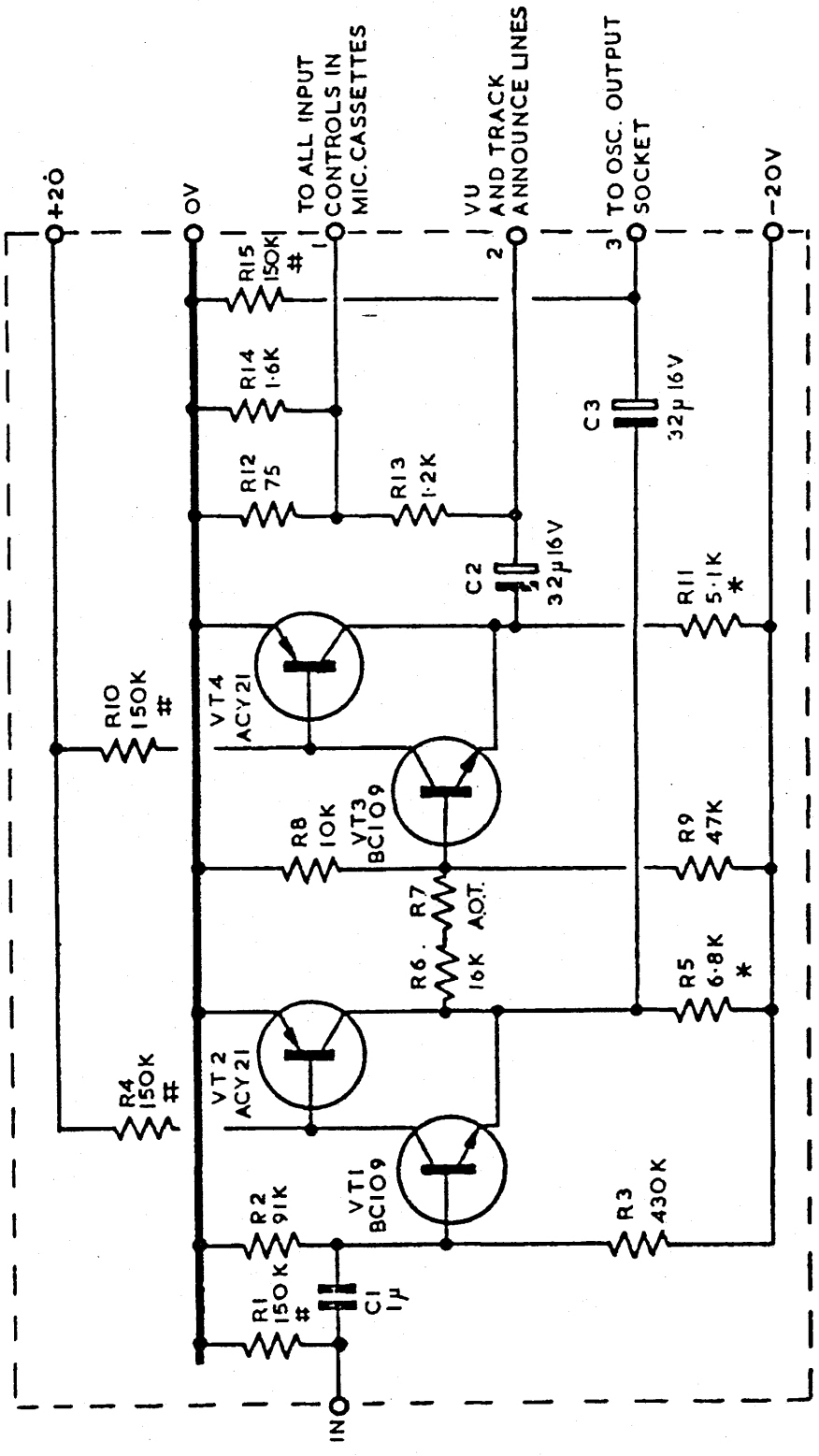
						RESISTORS * = ± 2%
						RESISTORS ‡ = ± 5%
J3	5	21-1-70				UNMARKED = ± 1%
MOD.No	ISSUE	DATE	MOD.No	ISSUE	DATE	

USED ON	E.M.I. RESEARCH LABORATORIES HAYES MIDDX.	
TRACED TG	SUB TITLE AMPLIFIER 'K'	
DRAWN C S.D.	TITLE MULTI-WAY MIXER	DRAWING NUMBER TG12345/AE 213

DRAWING NUMBER

TG 12345 / AE 215

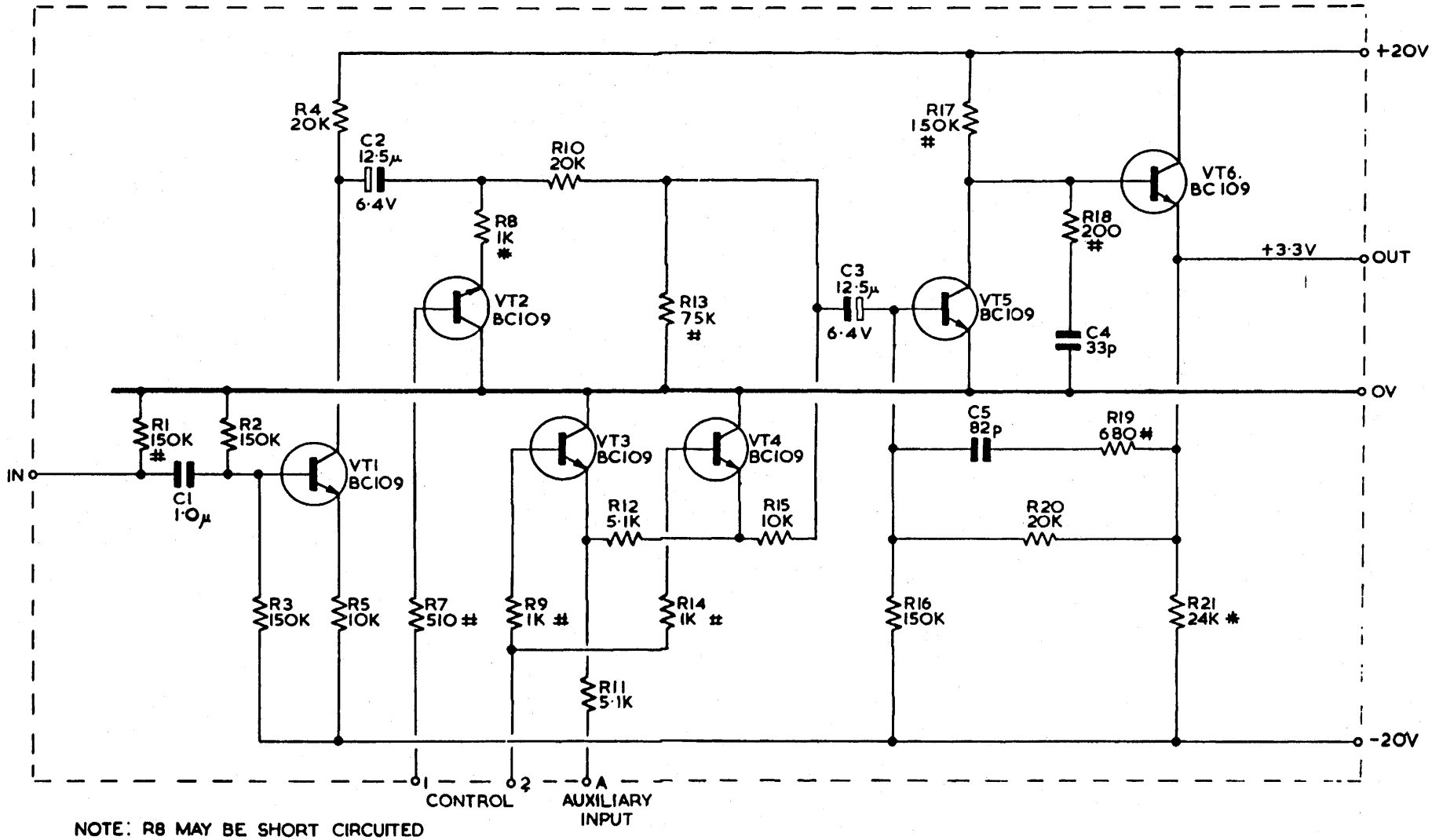
R



BOARD TG. 12345/B69/1

						RESISTORS * = ± 2 %
						RESISTORS # = ± 5 %
J3	S	21-1-70				UNMARKED = ± 1 %
MOD. No.	ISSUE	DATE	MOD. No.	ISSUE	DATD	

USED ON	E.M.I. RESEARCH LABORATORIES HAYES MIDDX.	
TRACED TG	SUB TITLE AMPLIFIER 'M'	
DRAWN C.S.D.	TITLE MULTI-WAY MIXER	DRAWING NUMBER TG12345/AE 215



NOTE: R8 MAY BE SHORT CIRCUITED IF MUTING OF SIGNAL IS REQUIRED.

BOARD TG. 12345/B70/2

RESISTORS * = ± 2%
UNMARKED # = ± 5%
= ± 1%

ISS.	DATE	CH.NT.No	DRAWN	APPD.
5	20·1·70	J3	D.R.W.	

TITLE

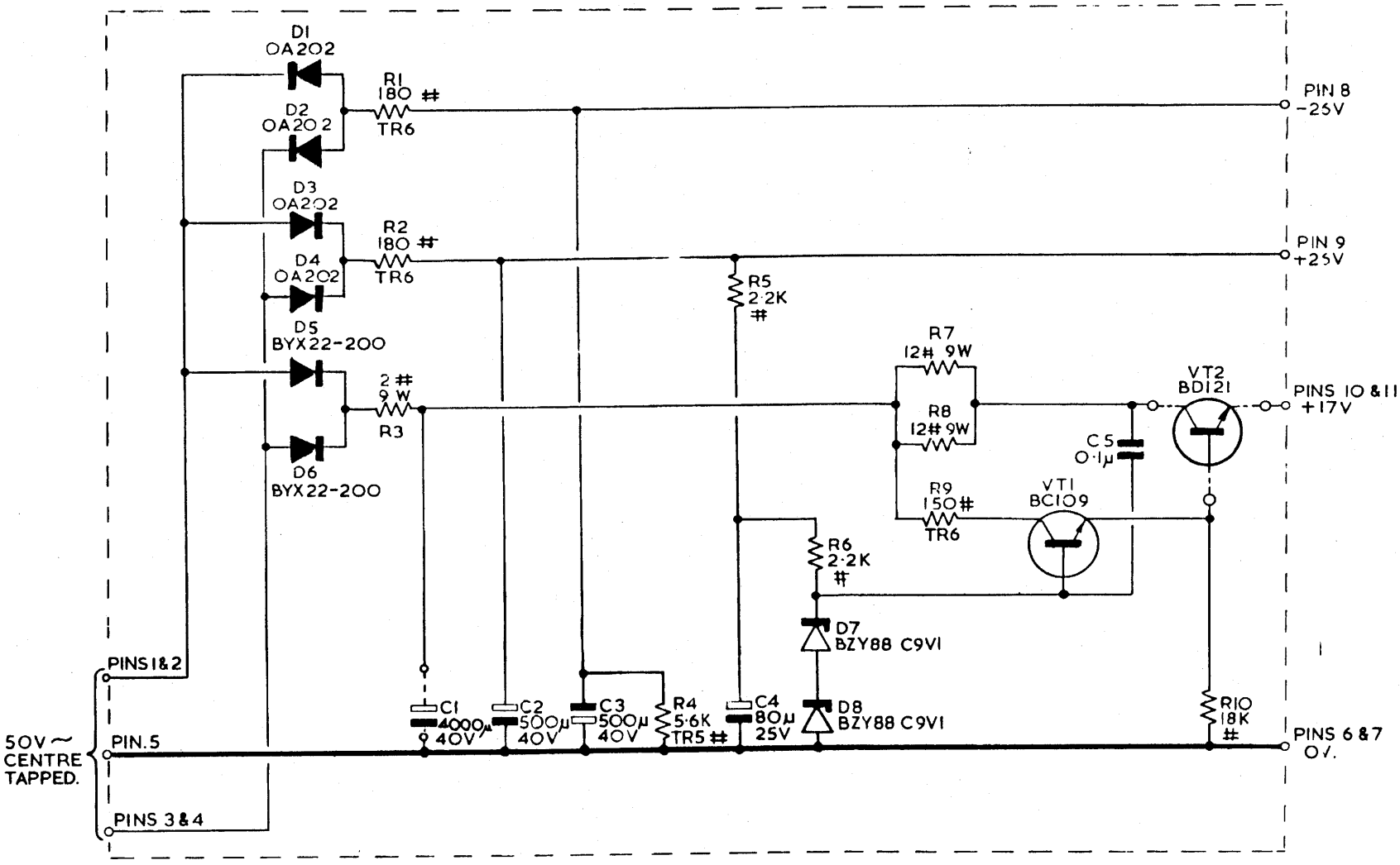
MULTI-WAY MIXER

E.M.I. RESEARCH LABORATORIES HAYES, MIDDX.

SUB TITLE
AMPLIFIER 'N' MK. II

DRG. TG 12345

BE 216
SHEET



BOARD TG.12345/C77/1

ISS	DATE	CH.NT NO	DRAWN	APPD
4	20·1·70	J3	D.R.W.	

RESISTORS * = ± 2%
# = ± 5%
UNMARKED = ± 1%

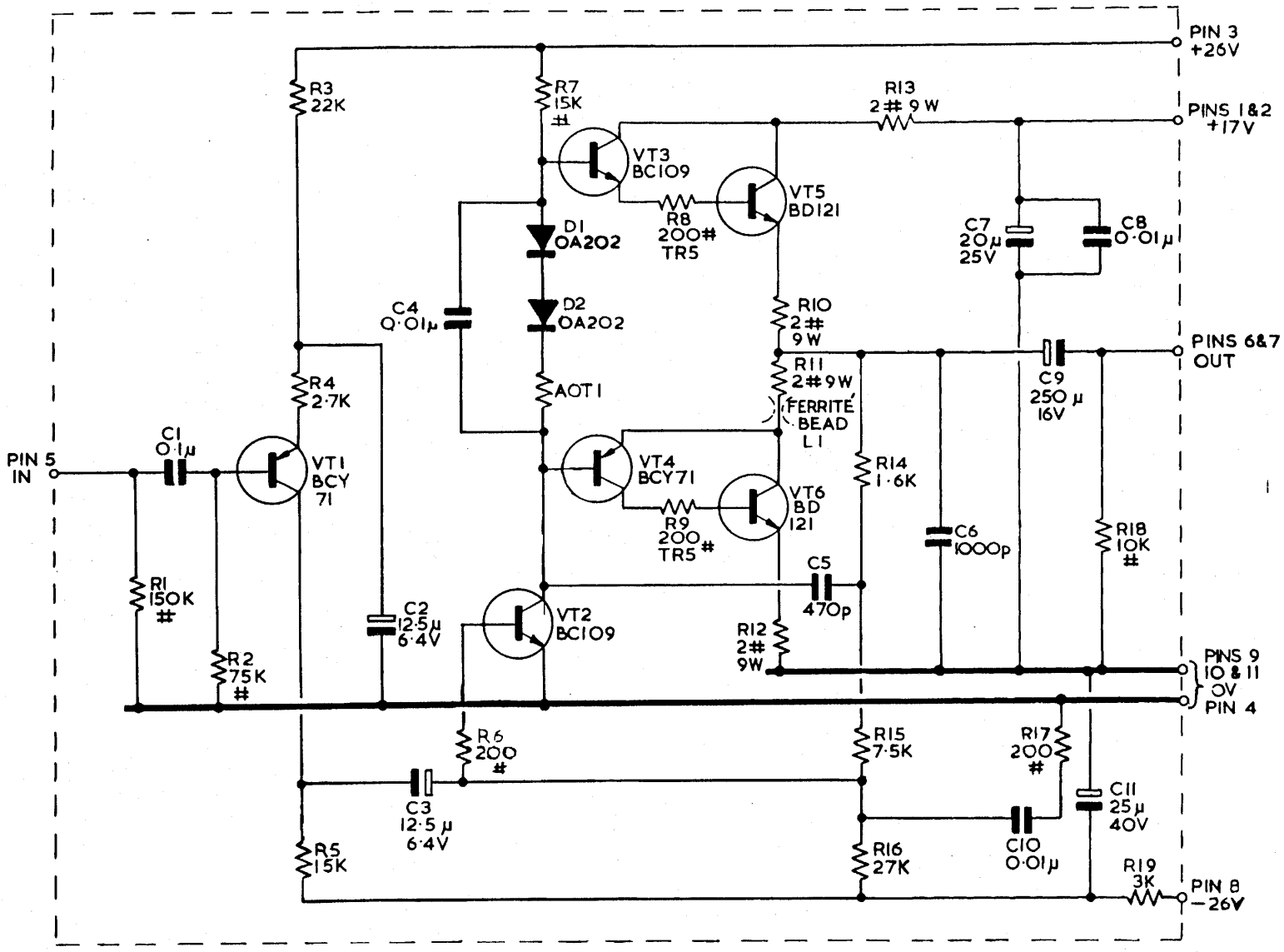
TITLE

MULTI -WAY MIXER

E.M.I. RESEARCH LABORATORIES HAYES. MIDDX.

SUB TITLE
POWER UNIT FOR
2 AMPLIFIERS 'Q'

DRG. TG 12345 BE 217
SHEET



RESISTORS * = ± 2%
# = ± 5%
UNMARKED = ± 1%

ISS.	DATE	CH.NT.No	DRAWN	APPD.
5	20·1·70	J3	D.R.W.	

BOARD TG.12345/C7 1/2

TITLE

MULTI-WAY MIXER

E.M.I. RESEARCH LABORATORIES HAYES, MIDDX.

SUB TITLE

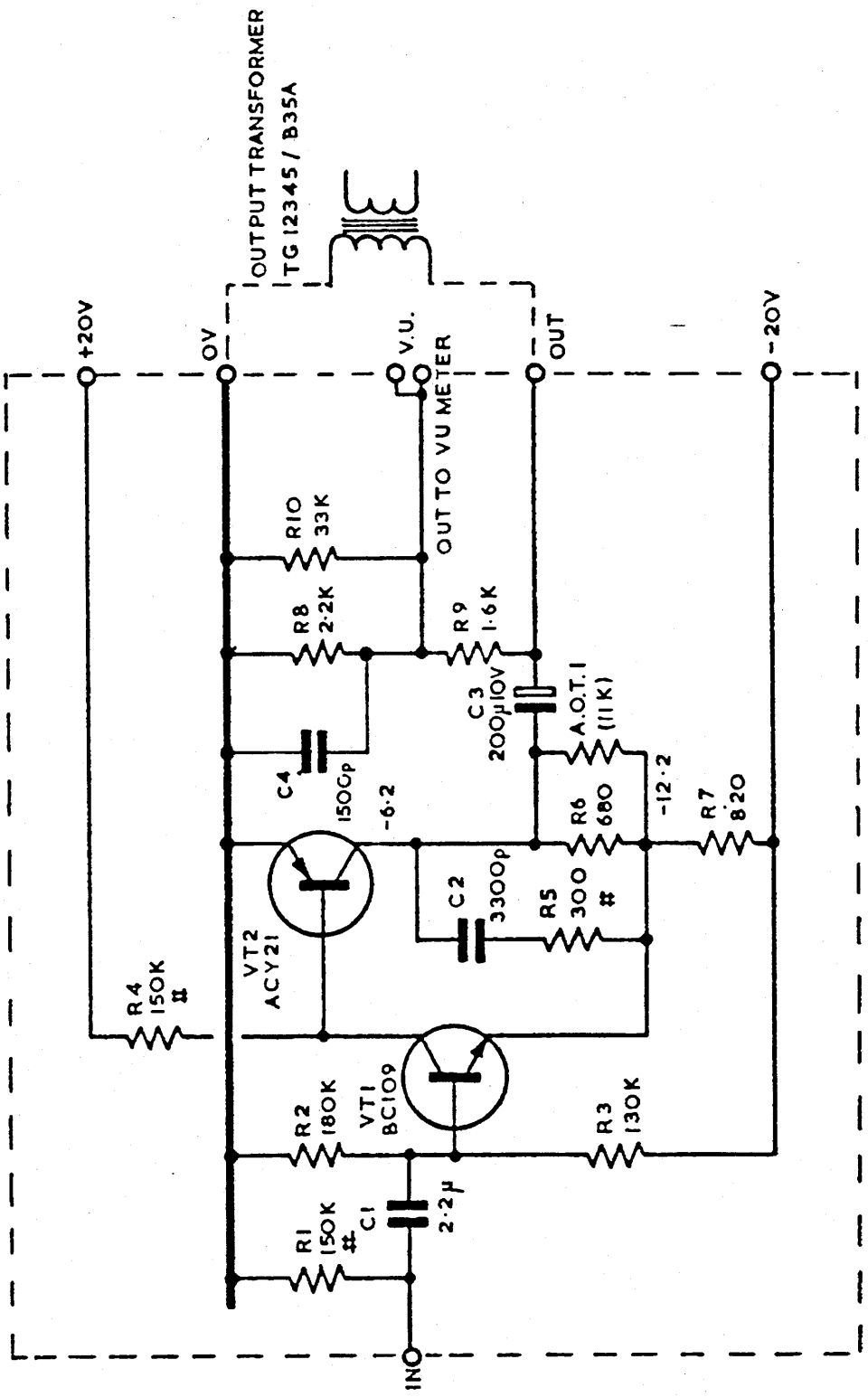
AMPLIFIER 'Q'

DRG. TG 12345 BE 218

SHEET

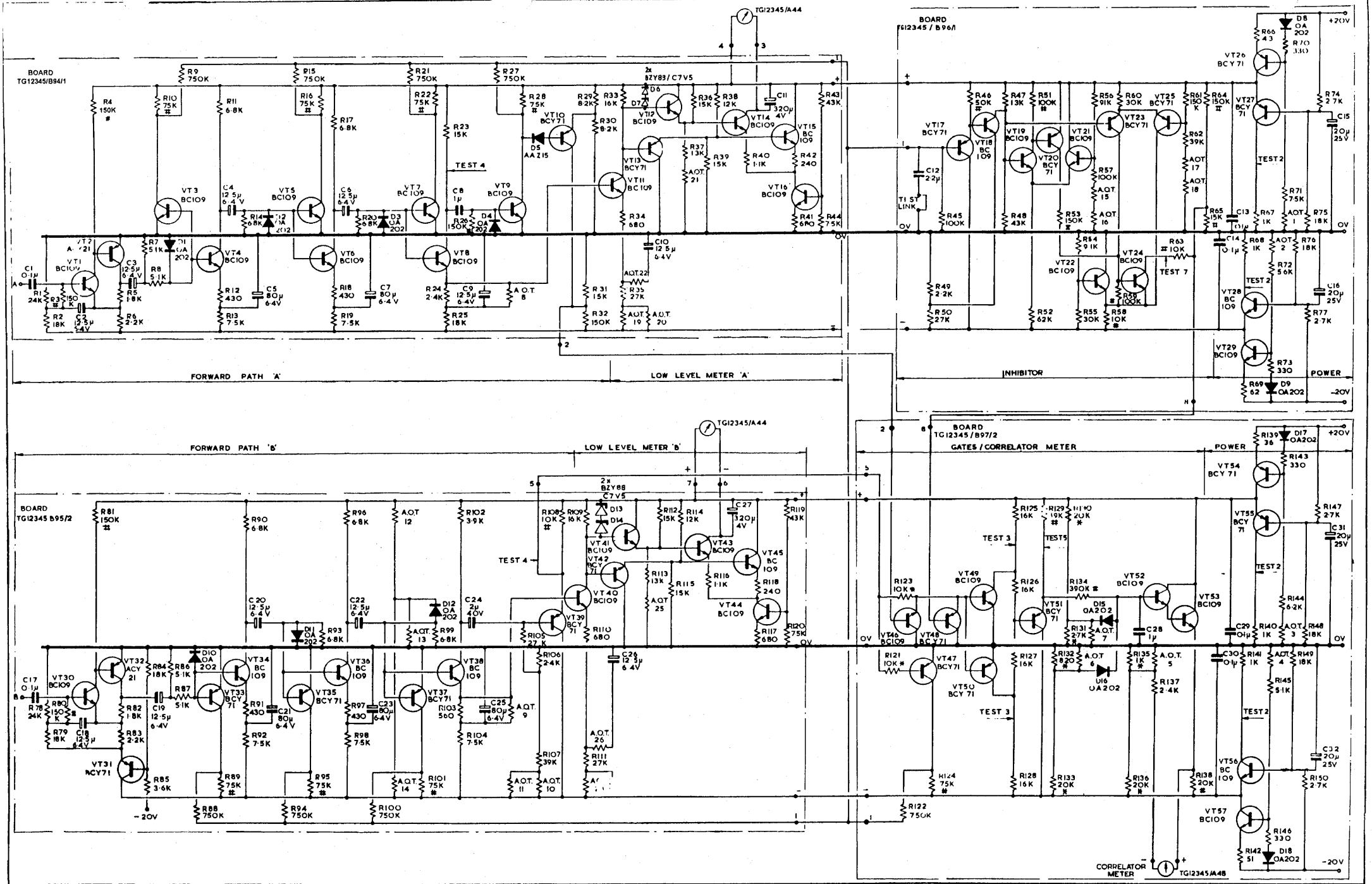
DRAWING NUMBER
TG12345/AE219

R



						RESISTORS * = ±2%
						RESISTORS # = ±5%
J3	4	21-1-70				UNMARKED = ±1%
MOD.No.	ISSUE	DATE	MOD.No.	ISSUE	DATE	

USED ON	E.M.I. RESEARCH LABORATORIES HAYES MIDDX.	
TRACED TG	SUB TITLE OUTPUT AMPLIFIER 'R'	
DRAWN C.S.D.	TITLE MULTI-WAY MIXER	DRAWING NUMBER TG12345/AE219



MULTI — WAY MIXER

E.M.I. RESEARCH LABORATORIES HAYES, MIDDX.

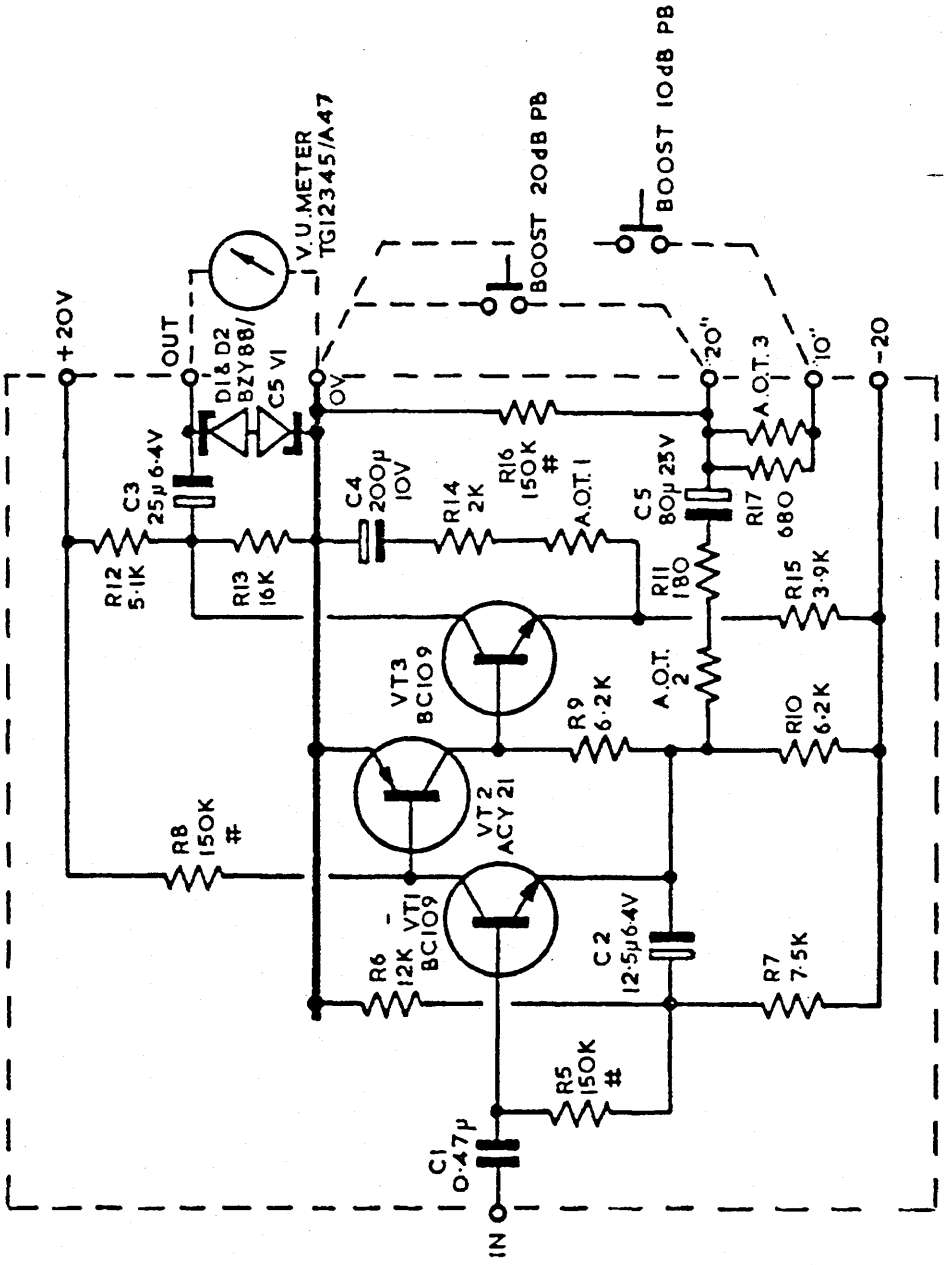
SUB-TITLE. CORRELATOR.

Dᵂᵍ TG12345 DE221 SHEET

RESISTORS ± 2%
RESISTORS ± 5%
UNMARKED ± 10%

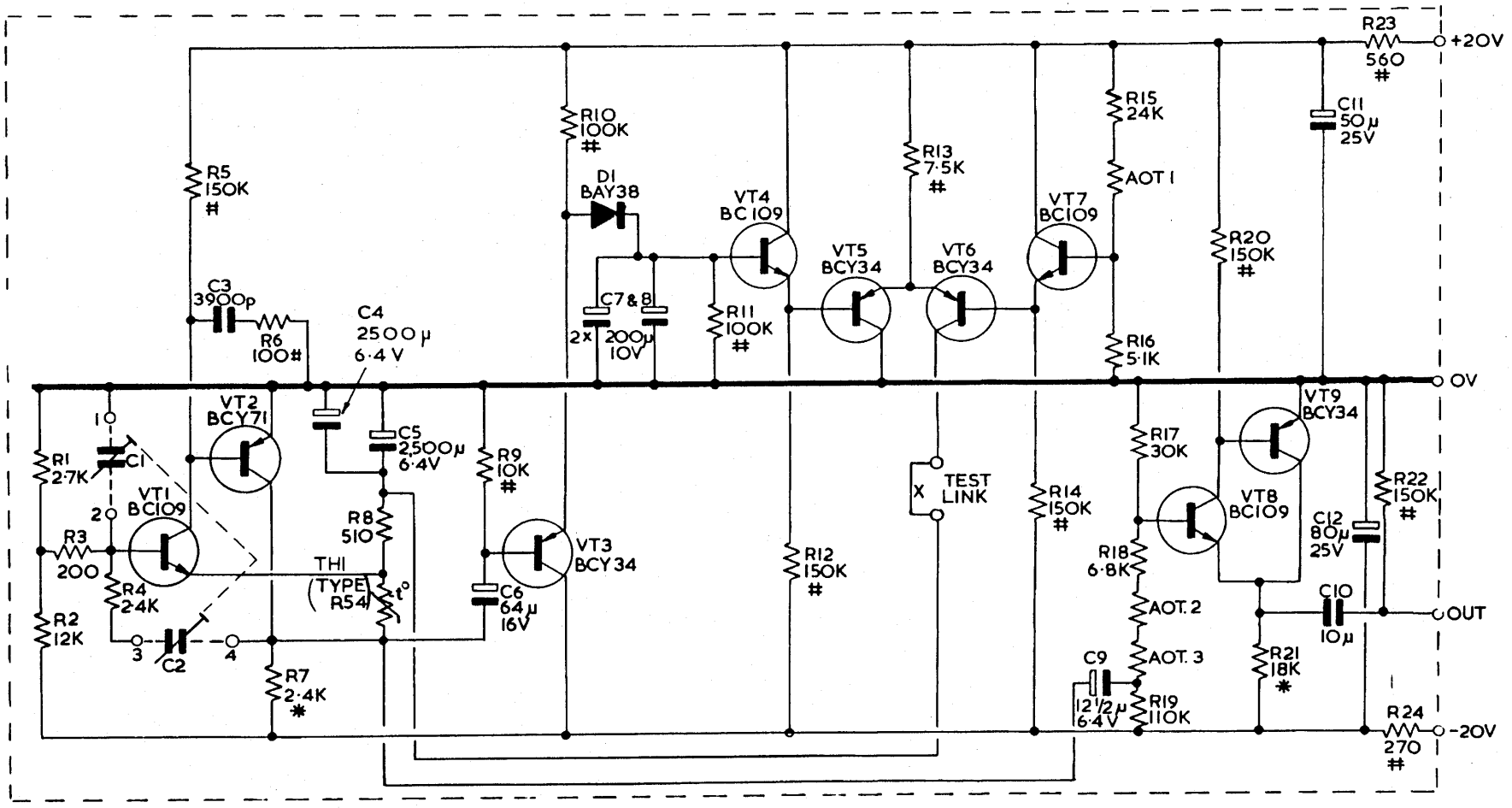
DRAWING NUMBER
TG12345/AE222

R



						RESISTORS * = ± 2%
						RESISTORS ¤ = ± 5%
J3	6	21-1-70				UNMARKED = ± 1%
MOD.No	ISSUE	DATE	MOD.No	ISSUE	DATE	

USED ON	E.M.I. RESEARCH LABORATORIES HAYES MIDDX.	
TRACED TG	SUB TITLE V.U. METER AMPLIFIER 'U'	
DRAWN C.S.D.	TITLE MULTI-WAY MIXER	DRAWING NUMBER TG12345/AE 222



CAPACITORS C1 (A to L) ARE MOUNTED ON ONE BOARD
CAPACITORS C2 (A to L) ARE MOUNTED ON MATCHED BOARD. } TG12345/B228A
VALUES OF C1 & C2 ARE GIVEN ON I/L TG 12345/B228A SEE NOTE †

USE BOARD TG.12345/B75/3

NOTE †

C1 = C2 ± 1%	NOMINAL VALUE ± 3%	OSC. f
A	2·2μ	30 Hz.
B	1·1	60
C	0·66	100
D	0·132	500
E	0·066	1kHz
F	0·022	3
G	0·0132	5
H	0·00825	8
J	0·0066	10
K	0·0055	12
L	0·0044	15

RESISTORS * = ± 2%
# = ± 5%
UNMARKED = ± 1%

ISS.	DATE	CH.NT.Nº	DRAWN	APPD
6	21-1-70	J3	D.R.W.	TG

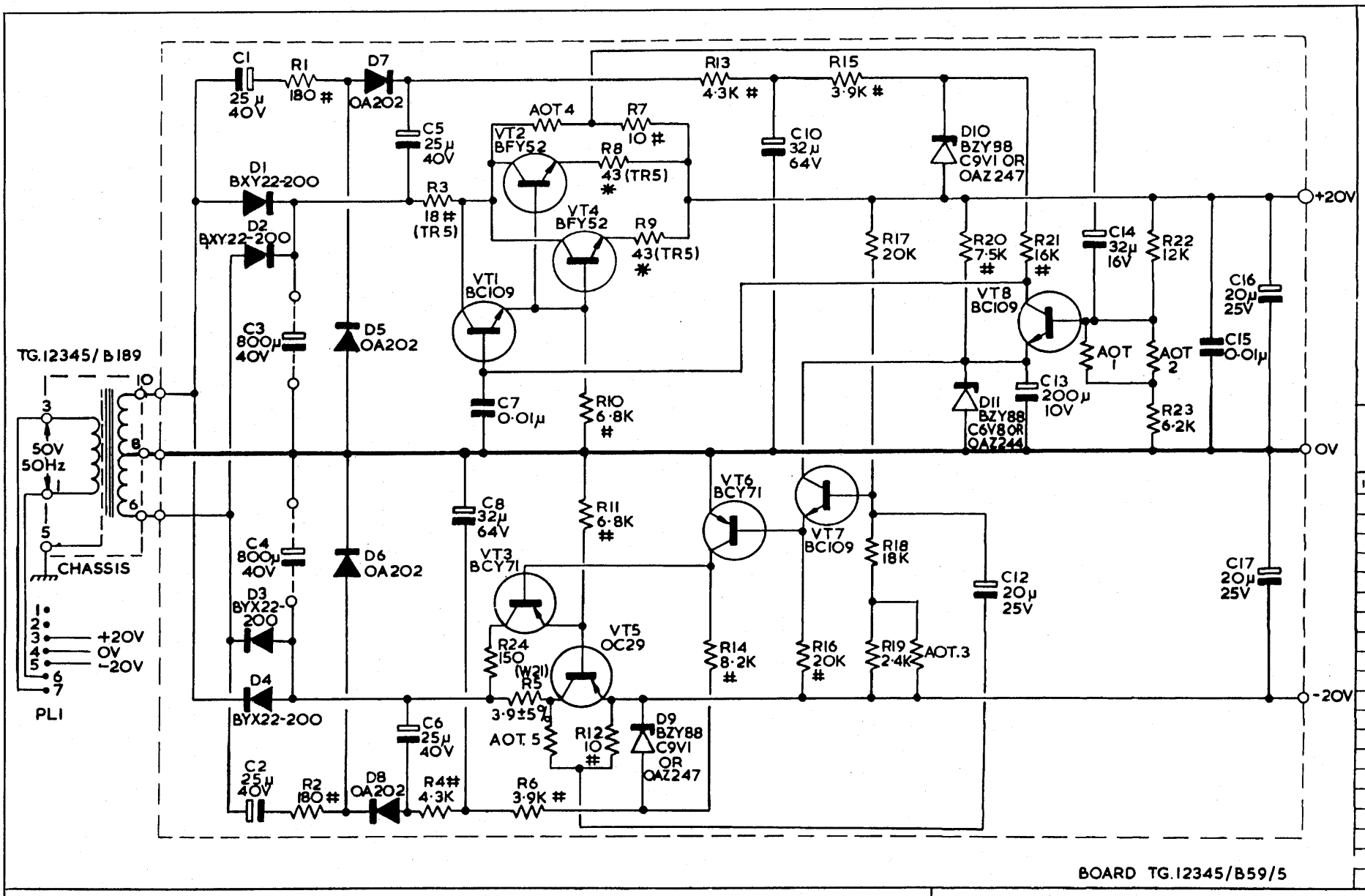
TITLE

MULTI-WAY MIXER

E.M.I. RESEARCH LABORATORIES HAYES, MIDDX.

SUB-TITLE
MK II OSCILLATOR 'W'

DRG. TG 12345 BE 224
SHEET



RESISTORS * = ± 2%
# = ± 5%
UNMARKED. = ± 1%

ISS.	DATE	CH.NT.Nº	DRAWN	APPD.
7	20-1-70	J3	DRW.	TG

BOARD TG.12345/B59/5

TITLE

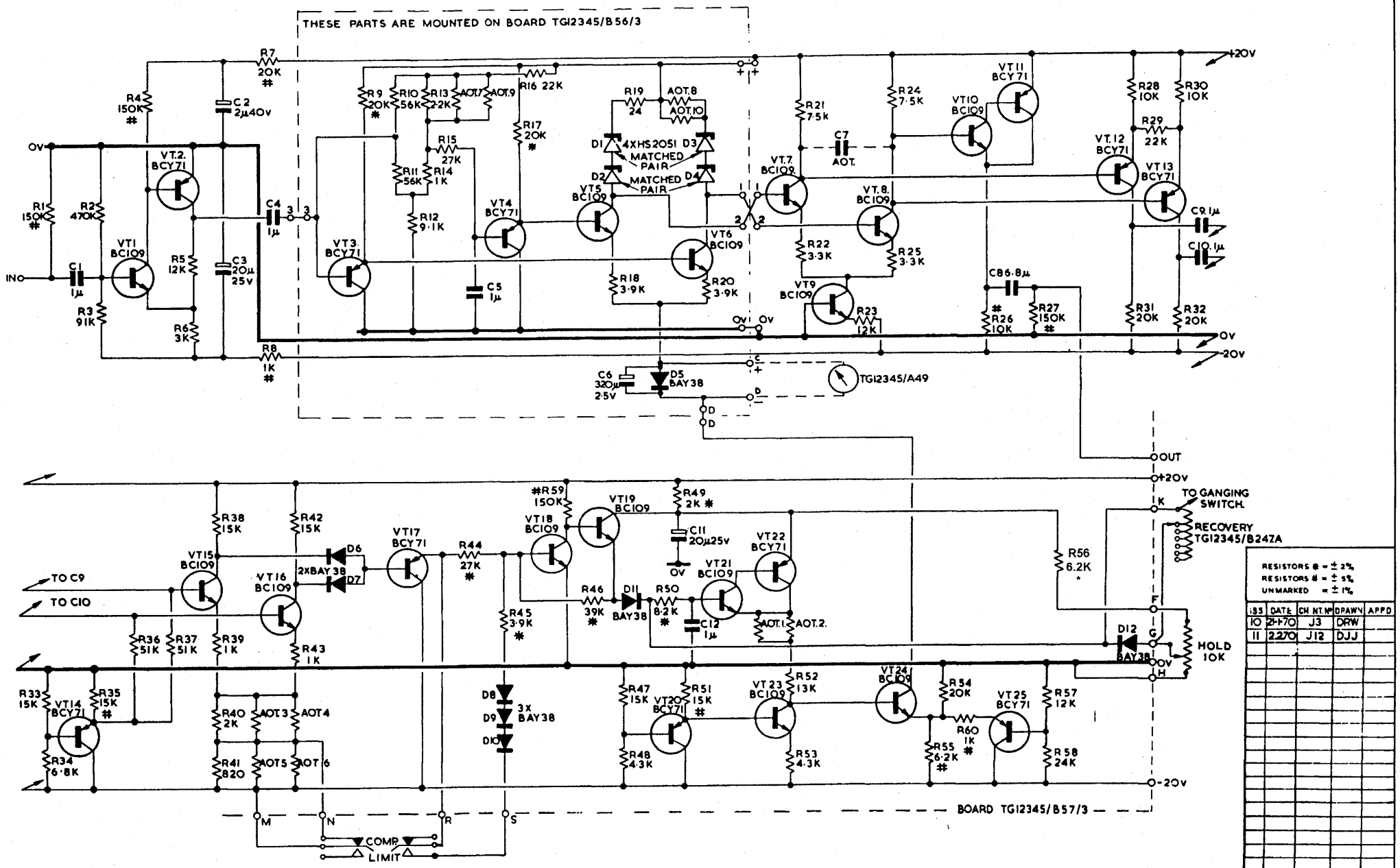
MULTI-WAY MIXER

E.M.I. RESEARCH LABORATORIES HAYES, MIDDX.

SUB TITLE
CASSETTE POWER UNIT MK. II

DRG. TG 12345 BE 225

SHEET



TITLE

MULTI - WAY MIXER.

E.M.I. RESEARCH LABORATORIES HAYES, MIDDX.

SUB-TITLE

MK II ZENER LIMITER.

Dᴿᴳ. TG12345 CE226

SHEET

Drg. No. CE227 Active Relays Mark 2

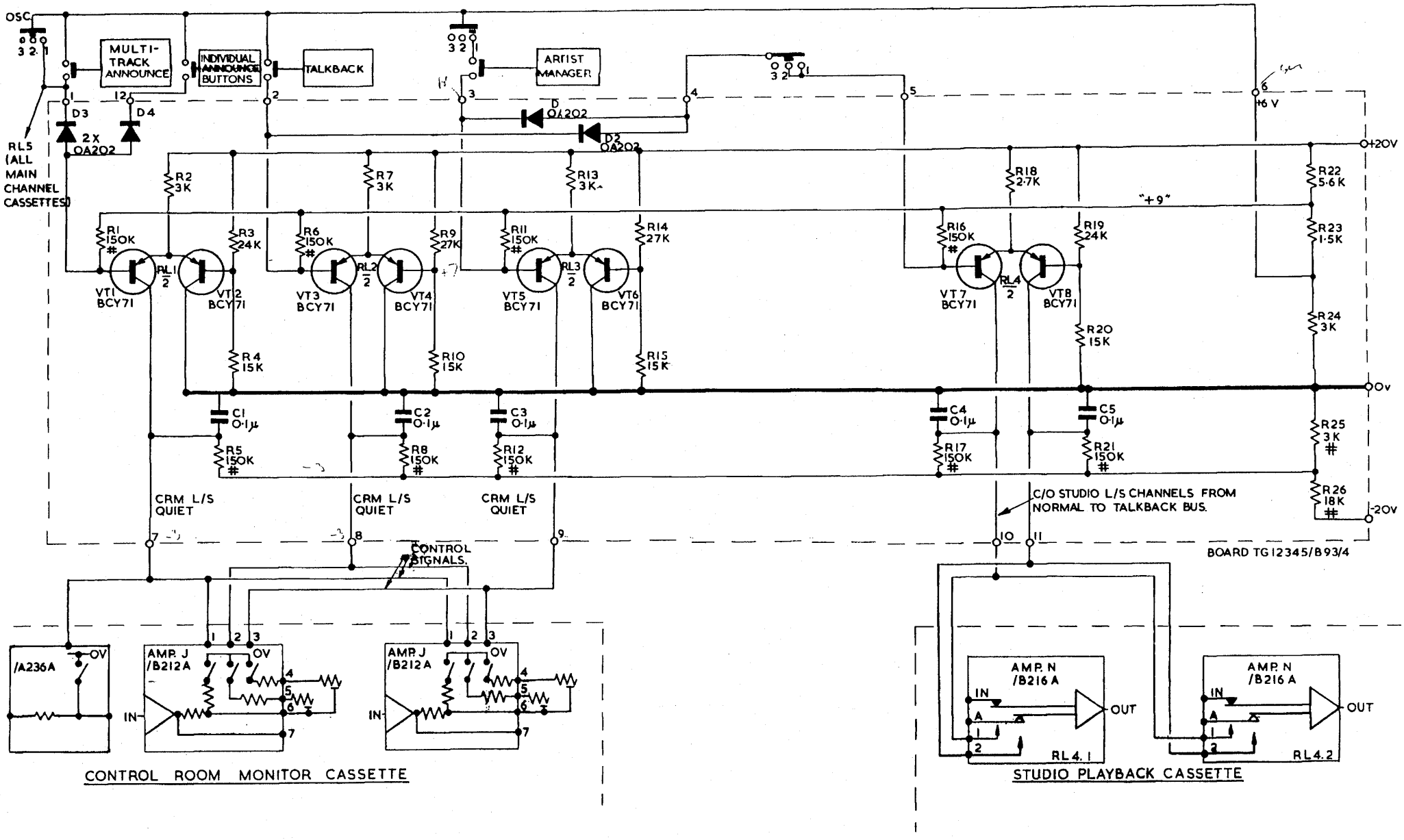
RELAY FUNCTIONS	
RL1	(TRACK ANNOUNCE)
RL2	(TALKBACK)
RL3	(ARTIST MANAGER)
RL4	SWITCHES STUDIO LOUDSPEAKERS FROM NORMAL TO TALKBACK BUS.

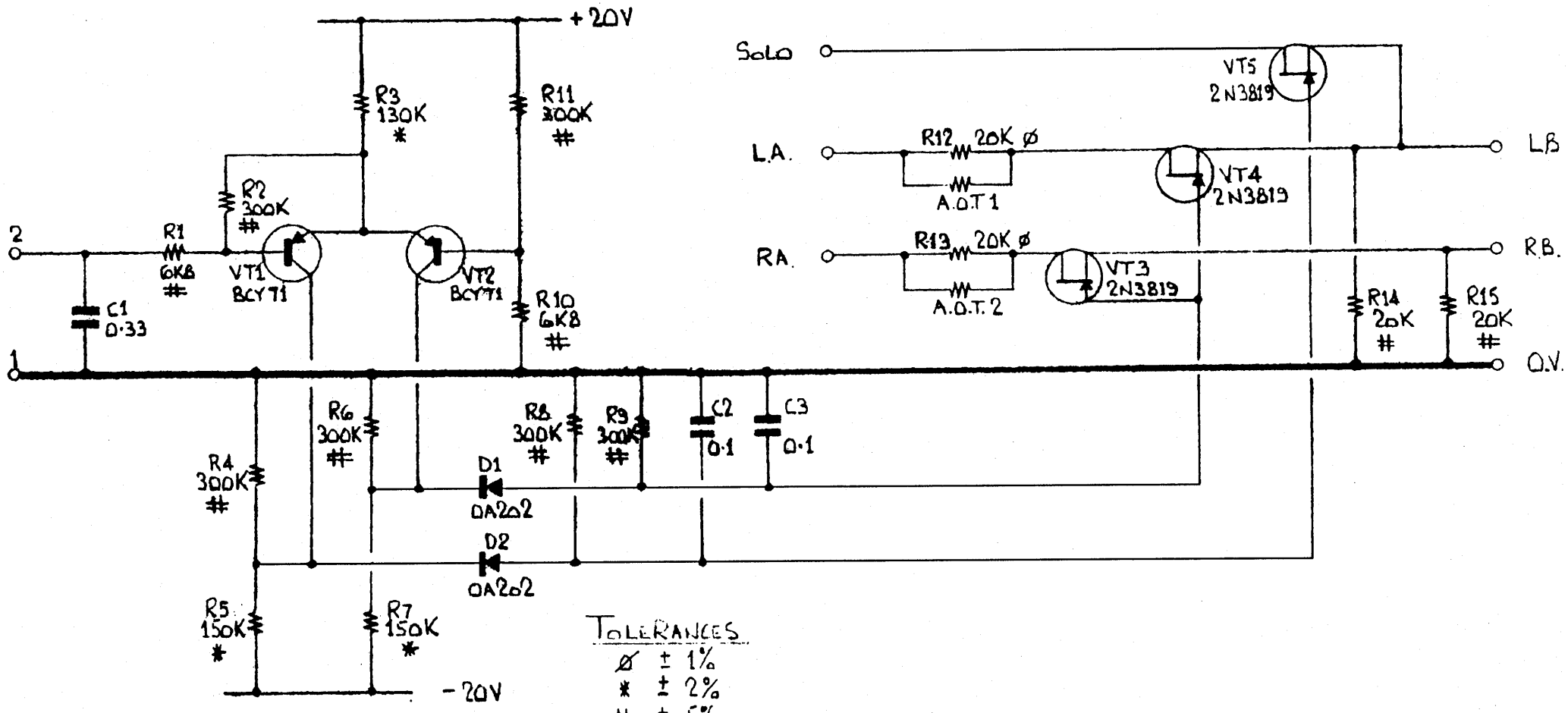
QUIET L & R CONTROL ROOM MONITOR LOUDSPEAKERS.

OSCILLATOR KEY	
1	TO TRACKS
2	OFF
3	ON

ARTIST MANAGER SWITCH	
1	TALKBACK
2	CUE 1
3	CUE 2

ALT. TALK BACK KEY	
1	TO ALT. T.B (STUDIO L.S. MUTE)
2	TO STUDIO L.S.
3	TO ALT. T.B (STUDIO L.S. NORMAL)





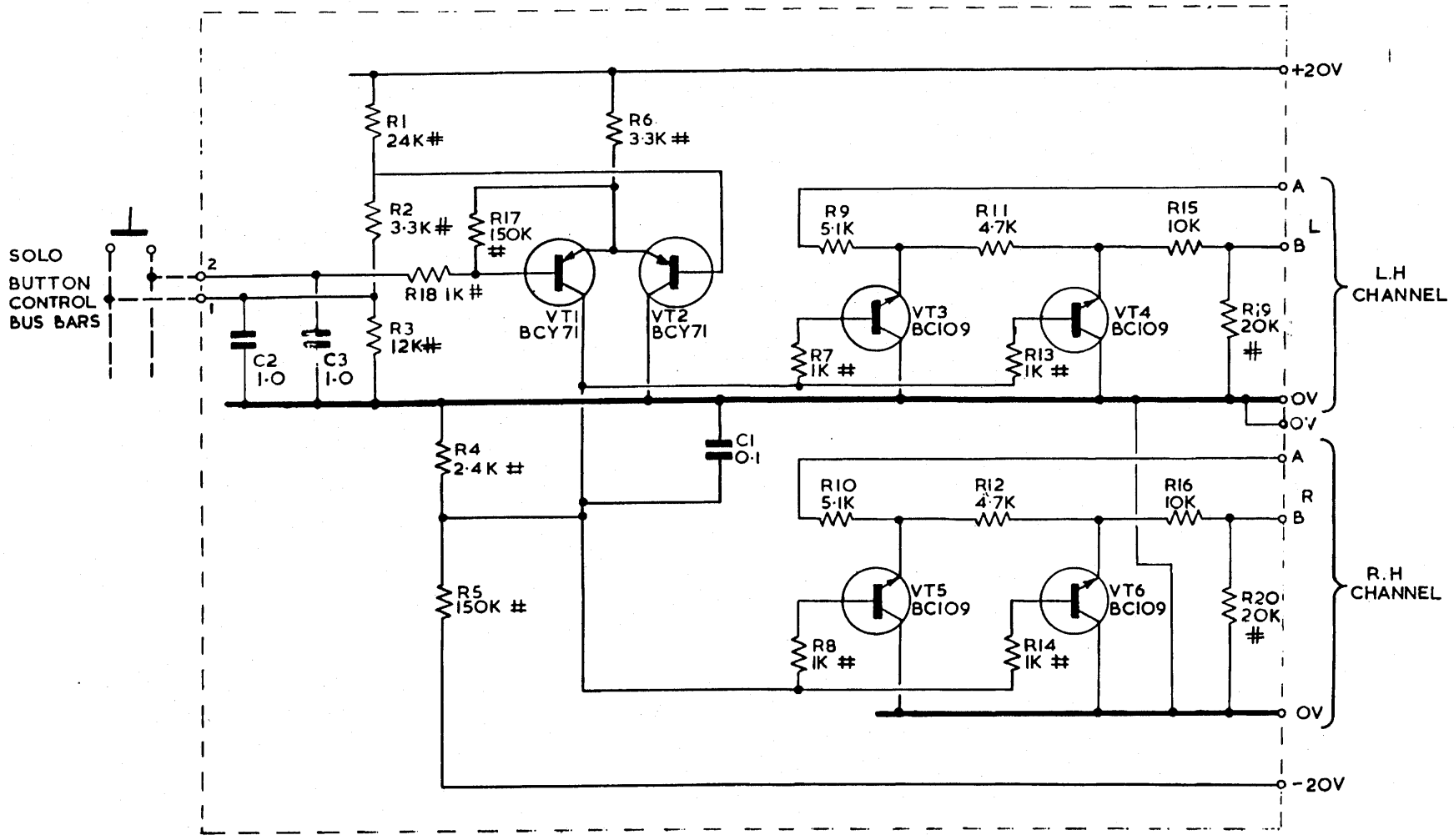
TOLERANCES

ø ± 1%
* ± 2%
# ± 5%
⊙ ± 10%

NO INDICATION ±20% OR MORE

PRINTED BOARD TG12345B98/4

TG **Drg. No. BE229 Solo Active Relay**



RESISTORS * = ± 2%
# = ± 5%
UNMARKED = ± 1%

ISS.	DATE	CH.NT.NO	DRAWN	APPD.
5	22-1-70	J3	D.R.W.	
6	2-4-70	J34	R.L.C.	

PRINTED BOARD TG. 12345/B98/3

TITLE

MULTI-WAY MIXER

E.M.I. RESEARCH LABORATORIES HAYES, MIDDX.

SUB TITLE

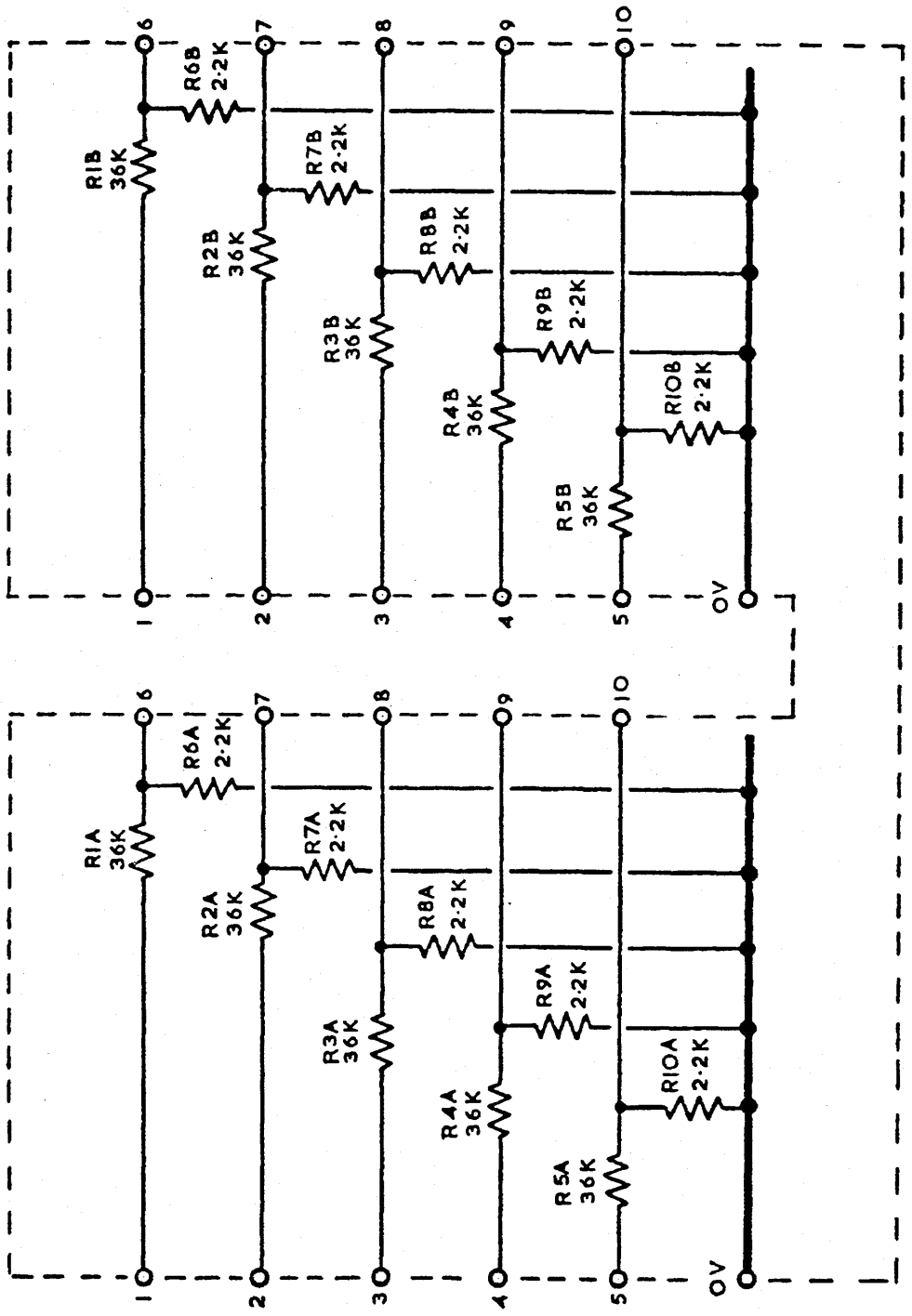
SOLO RELAY

DRG. TG12345 BE229

SHEET

DRAWING NUMBER
TG 12345 / AE230

R



						RESISTORS *=± 2%
						RESISTORS #=± 5%
J3	3	21-1-70				UNMARKED =± 1%
MOD. No	ISSUE	DATE	MOD.No.	ISSUE	DATE	

USED ON

E.M.I. RESEARCH LABORATORIES HAYES MIDDX.

TRACED

SUB-TITLE
RE-RECORD ATTENUATORS

DRAWN

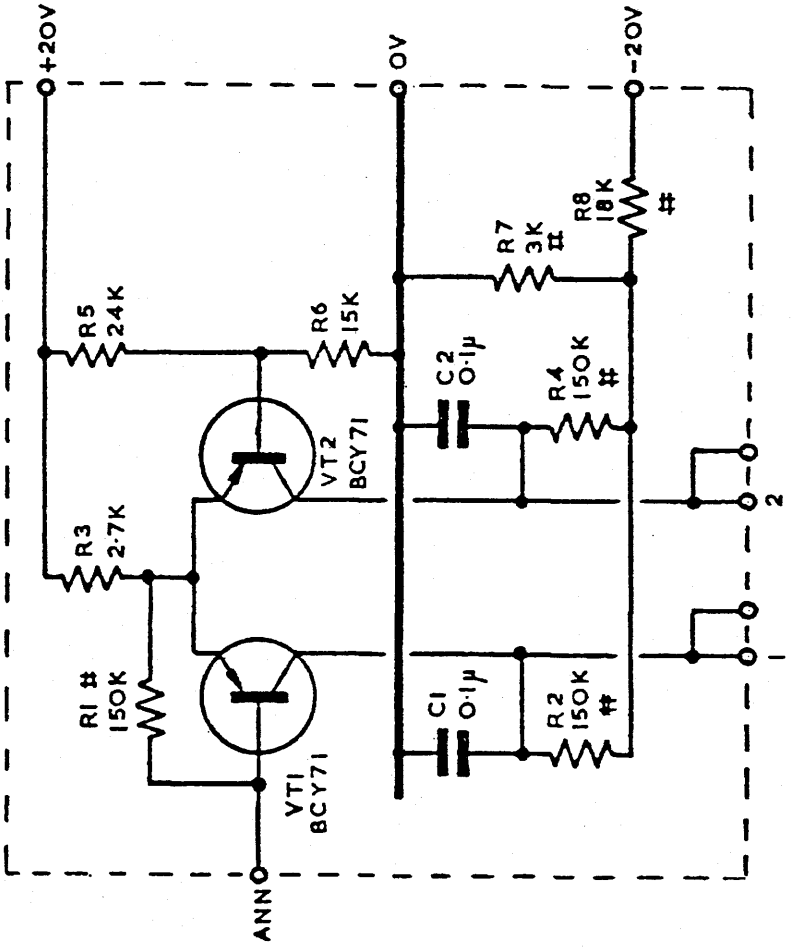
TITLE
MULTI-WAY MIXER

DRAWING NUMBER
TG 12345 / AE230

DRAWING NUMBER
TG 12345/ AE 231

R

BOARD TG 12345/B92/1



						RESISTORS * = ± 2%
						RESISTORS # = ± 5%
J3	4	21-1-70				UNMARKED = ± 1%
MOD.No.	ISSUE	DATE	MOD. No	ISSUE	DATE	

USED ON

E.M.I. RESEARCH LABORATORIES HAYES MIDDX.

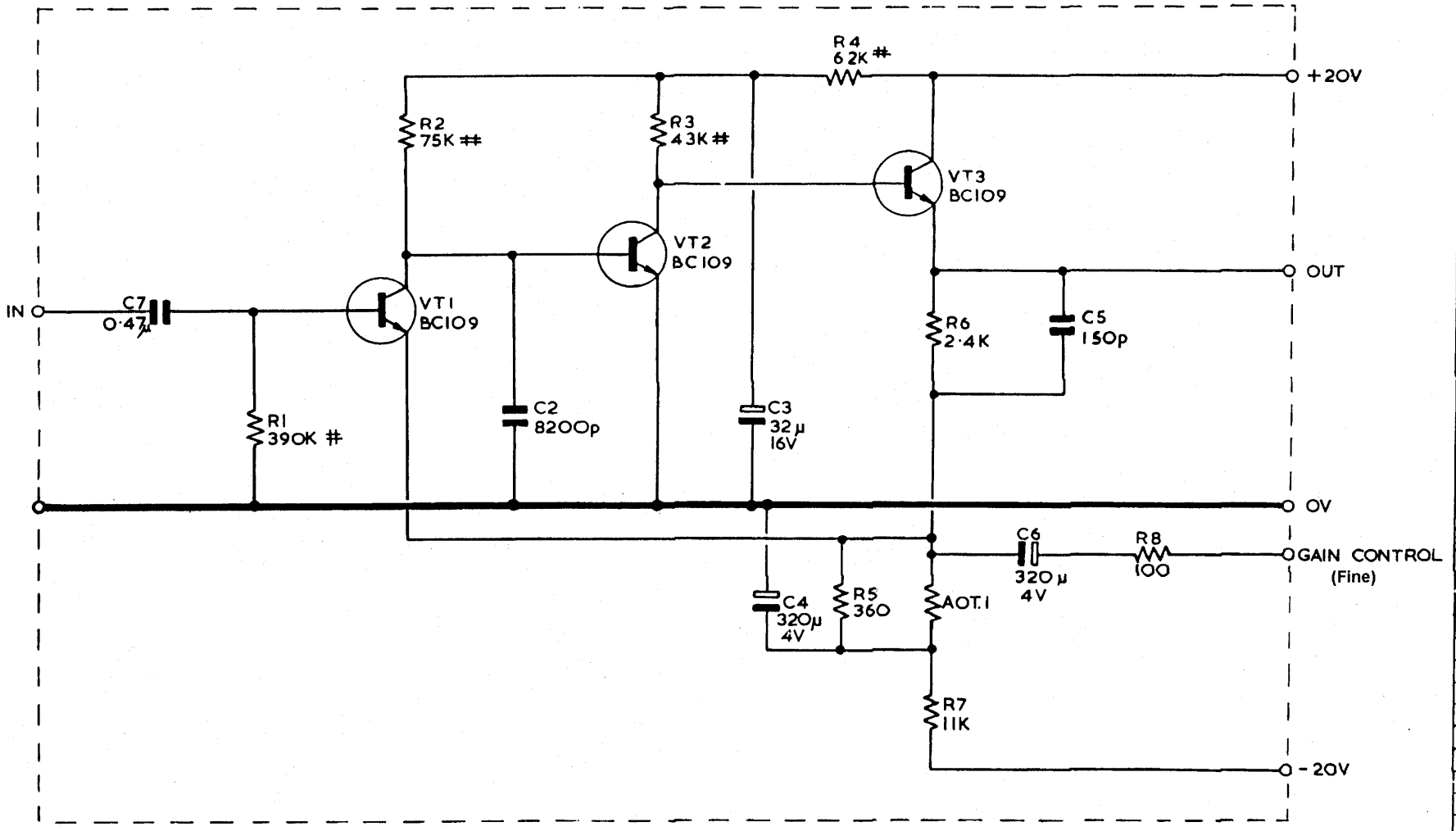
TRACED TG

SUB TITLE
TRACK ANNOUNCE RELAY

DRAWN

TITLE
MULTI-WAY MIXER

DRAWING NUMBER
TG 12345/ AE 231



PRINTED BOARD TG12345/B257/1

RESISTORS ## = ± 2%
# = ± 5%
UNMARKED. = ± 1%

ISS.	DATE	CH.NT.NO	DRAWN	APPD.
2	20·1·70	J3	D.R.W.	

TITLE

MULTI – WAY MIXER

E.M.I. RESEARCH LABORATORIES HAYES, MIDDX.

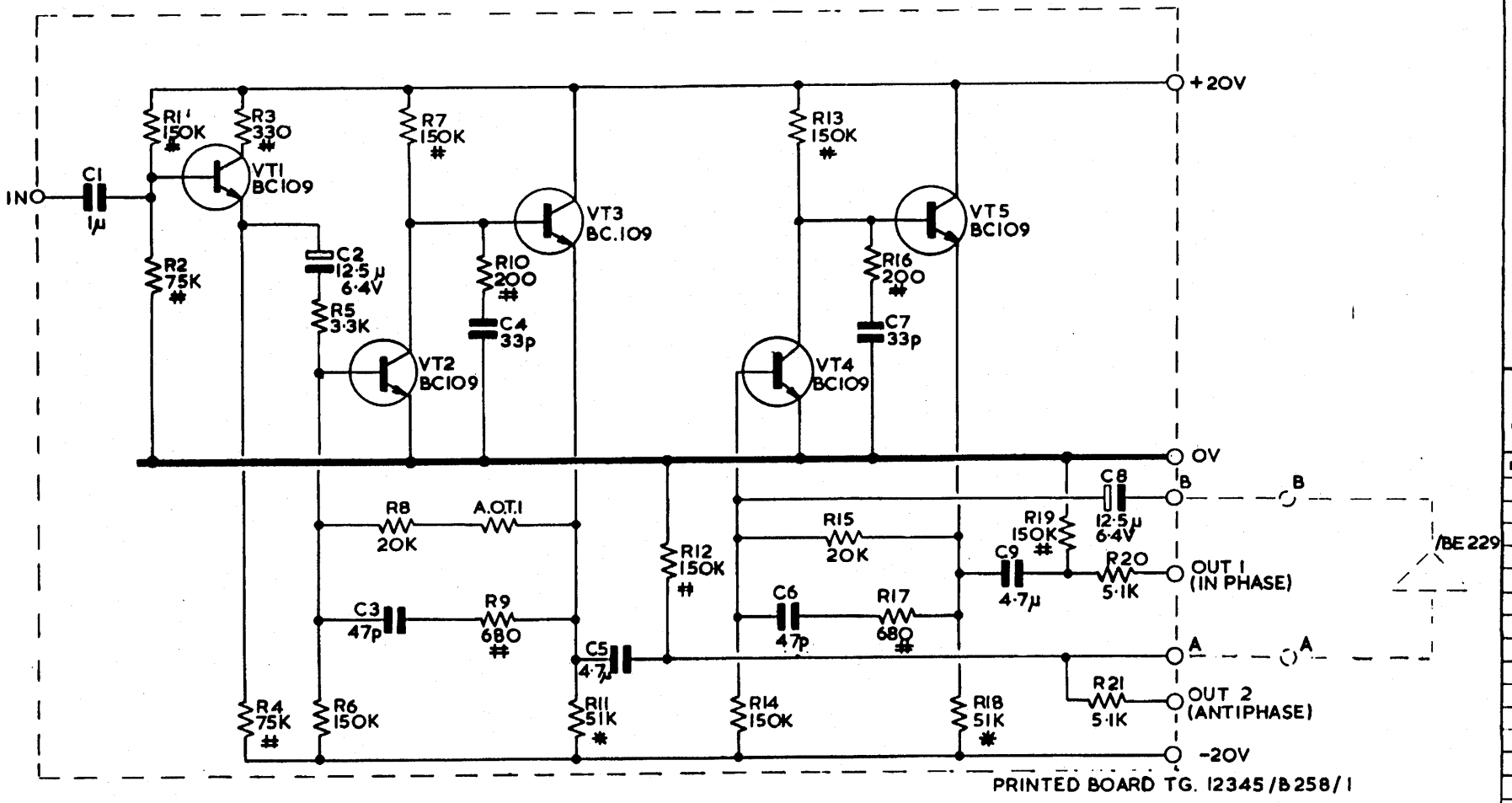
SUB TITLE

INPUT AMPLIFIER 'D'

DRG. TG12345 BE232

SHEET

OZALID



RESISTORS * = ± 2%
# = ± 5%
UNMARKED. = ± 1%

ISS.	DATE	CH.NT.Nº	DRAWN	APPD.
4	21·1·70	J3	D.R.W.	

TITLE

MULTI-WAY MIXER

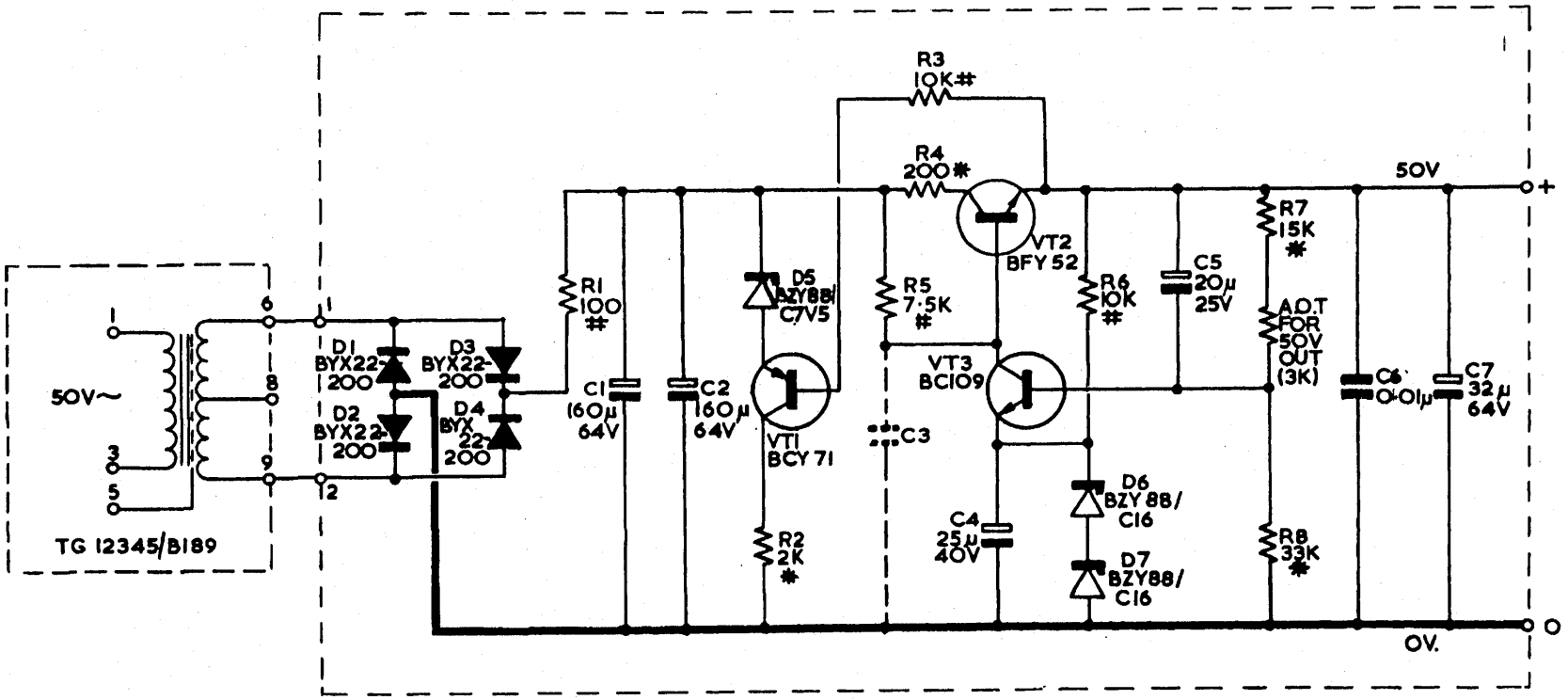
E.M.I. RESEARCH LABORATORIES HAYES, MIDDX.

SUB TITLE

AMPLIFIER 'P'

DRG. TG12345 BE233
SHEET

GTALRB



BOARD TG.12345 / B237/1

THESE WERE ONLY CAPABLE OF SUPPLYING ABOUT 20mA
AND WERE USUALLY REPLACED OR UPRATED.

RESISTORS * = ± 2%
# = ± 5%
UNMARKED = ± 1%

ISS.	DATE	CH.NT.Nº	DRAWN	APP'D.
3	20-1-70	J3	D.R.W.	

TITLE

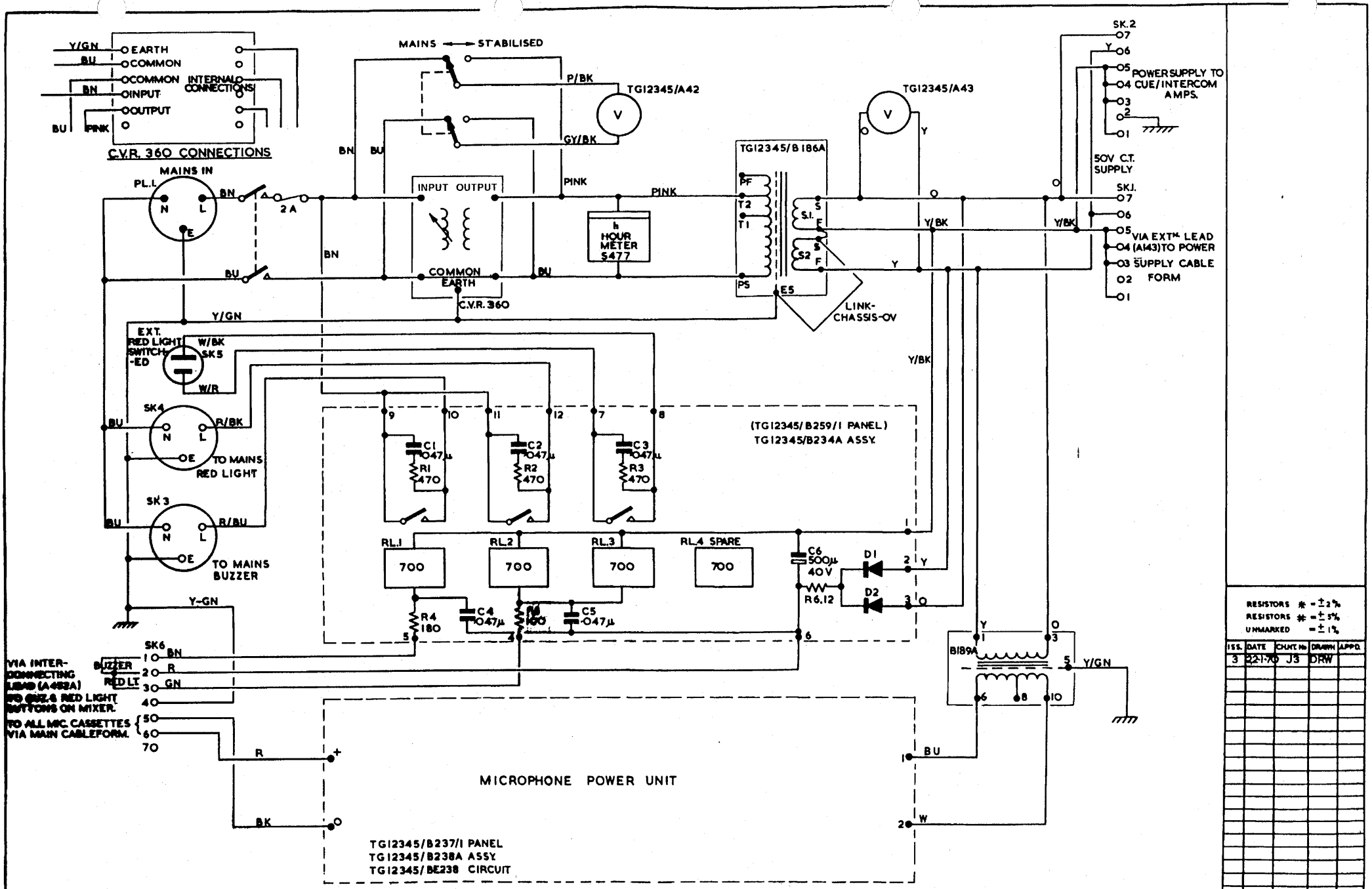
MULTI-WAY MIXER

E.M.I. RESEARCH LABORATORIES HAYES, MIDDX.

SUB TITLE
MICROPHONE
POWER UNIT

DRG. TG12345 BE238
SHEET

OPALIS



RESISTORS * = ±2%
RESISTORS * = ±5%
UNMARKED = ±1%

ISS.	DATE	CHGT. No	DRAWN	APPD.
3	22-1-70	J3	DRW	

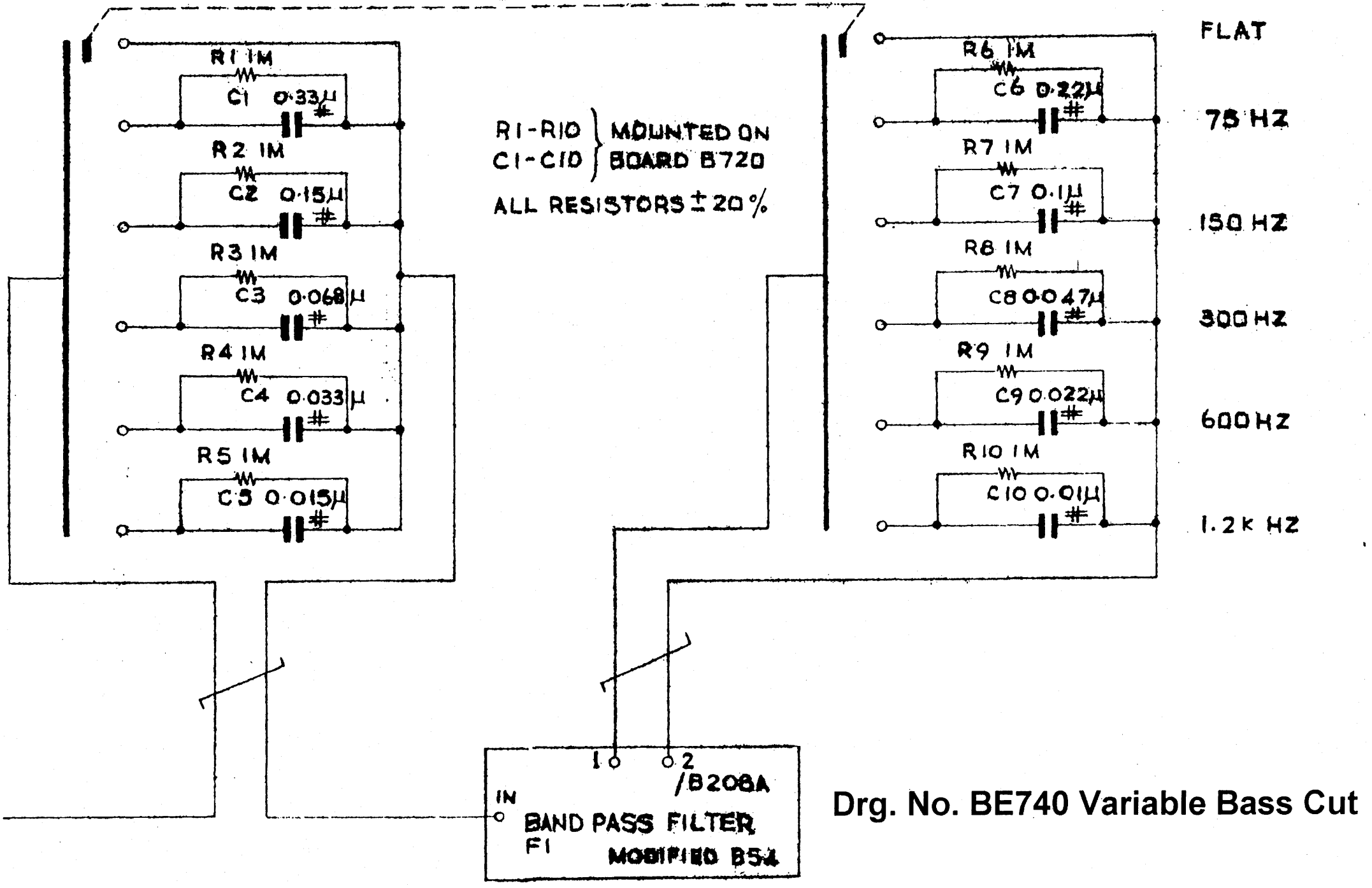
TITLE

MULTI-WAY MIXER

E.M.I. RESEARCH LABORATORIES HAYES, MIDDX.

SUB TITLE
MAIN POWER UNIT CIRCUIT

DRG. TG12345 CE 8
SHEET



Drg. No. BE740 Variable Bass Cut

EMI Mixing Console TG12345

General Test Procedures

For all tests, unless otherwise stated, set controls as follows:

All Microphone Cassettes
Henceforth written as [MIC]

Output Selector	OFF
Fine Gain	0
Input Level	~
Cue 1 Level	Off
Cue 2 Level	Off
Limiters	OUT
Hold	20
Recovery	3
Bass	0
Presence Freq.	0.5kHz
Presence dB	0
Echo Channel	OFF
Echo Level	OFF
Pan LH	ODD
Pan RH	EVEN
Faders	OFF

All Main Cassettes
Henceforth written as [MAIN]

Input Gains	0
Cue 1 Levels	OFF
Cue 2 Levels	OFF
VU Meters	Input to Main
VU Meter Boost	Nil
Pan LH	Left
Pan RH	Right
Replay Levels	OFF
Echo Channels	OFF
Echo Levels	OFF
Faders	OFF

All Echo Cassettes
Henceforth written as [ECHO]

Check switch	OFF
Boost	Nil
Output Selectors	OFF
Pan LH	ODD
Pan RH	EVEN
Cue 1 Levels	OFF
Cue 2 Levels	OFF
Bass	0
Presence Feq.	0.5kHz
Presence dB	0
Bass Cut	Flat
Presence Freq.(Send)	0.5kHz
Presence (Send)	0
Send Level	OFF
Faders	OFF

Control Room Monitor Cassette
Henceforth written as [CRM]

Check Switch	CRM Input
Boost	Nil
LS Switch	STEREO
Monitor Selector	NORMAL
Sync to Cue Level	OFF
Main Cue Levels	OFF
Correlator	MON
Replay to Cue	OFF
L/S Quiet pre-sets	Approx. Centre
Monitor Level	0
Monitor Tracks	OFF
Monitor Extras	OFF
LS Quiet	Nil
Record/Replay key	RECORD
VU Meter Key	FOLLOW

Studio Playback Cassette
Henceforth written as [SP]

Check switch	OFF
Studio LS	STEREO
Playback Selectors	NORMAL
Artist Manager Switch	TALKBACK
Artist Manager pre-set	Full ANTI-CLOCK
Cue Levels	OFF
Oscillator Level	0
Oscillator Key	ON
Oscillator kHz	1
Oscillator Pre-Set	IGNORE
Studio Playback Level	0
Operator to Cue Levels	OFF
Studio L/S - ALT. Key	Studio LS
5 pre-set controls	Full ANTI-CLOCK

Group Cassettes (Where fitted)
Henceforth written as [GROUP]

Output Selector	OFF
Check Switch	OFF
Input Switches	0
Limiters	OUT
Limiter Hold	20
Limiter Recovery	3
Presence Freq.	0.5kHz
Presence dB	0
Main Echo Level	OFF
Pan LH	ODD
Pan RH	EVEN
Faders	OFF

After each test return all controls except those marked * to the settings listed above.
Controls marked * will be specified in the next test.

1. Check of VU meters

Set [SP] Oscillator Level * to ' 0 '
Set [MAIN] VU meters to "Oscillator"
Set [CRM] Check switch to "Oscillator"

All [MAIN] VU meters and the pair of [CRM] VU meters should indicate 0 VU. Adjust the Oscillator Level pre-set control so that the average VU meter indication is 0 VU. Leave the pre-set control alone for the remainder of the tests.

2. Check of [MIC] to [MAIN] and [CRM] routing (Main buss lines)

Set [SP] Oscillator level * to ' -4'
Set all [MIC] faders * to ' max'
Set [CRM] 'Monitor Extras' to "MIC"
Set each [MIC] Output Selector to P1, P3, P5...P15, CRM in turn
The corresponding [MAIN] or [CRM] VU meter (1,3 ,5...15 CRM LH for LH Output Selectors or 2, 4, 6..16 CRM RH for RH Output Selectors) should each indicate + 1 VU in turn.

3. Check of [MIC] to [GROUP] routing (Group buss lines)

Leave [SP] Oscillator level at '–4'
Leave all [MIC] faders at ' max'
Set [GROUP] check switches to "Check Group"
Set each [MIC] Output selector to "G1" in turn
The corresponding [CRM] VU meter (LH / RH meter for LH / RH Output selector) should indicate +1 VU

Set [CRM] Check switch to "Check Group 2"
Set each [MIC] Output selector to "G2" in turn
The corresponding [CRM] VU meter should indicate +1 VU

4. Check of [GROUP] to [MAIN] routing (Main buss lines)

Set [SP] Oscillator level * to '-10'
Leave all [MIC] faders at ' max'
Set [MIC] 1 Output selectors to "G1"
Set [MIC] 2 Output selectors to "G3"
Set all [GROUP] faders at ' max'
Set each [GROUP] Output selector to P1,P3,P5...P15 in turn
The corresponding [MAIN] VU meter (1,3,5...15 for LH output selectors, or 2,4,6...16 for RH output selectors) should indicate 0 VU

5. Check of Echo Send Routing (Echo Buss lines)

5.1 From [MIC] to [ECHO]
Set [SP] oscillator level * to ' -4'
Leave all [MIC] faders at ' max'
Set [ECHO] Check Switches * to "Echo Send"
Set [ECHO] Echo Send level controls * to ' 0'
Set all [MIC] Echo level controls to ' 0'
Set each [MIC] Echo channel selector to 1,2,3...6 in turn
The corresponding [ECHO] VU meter (1,2,3...6) should indicate +1 VU

5.2 From [MAIN] to [ECHO]
Set [SP] Oscillator Level * to ' 0' (+4)**
Leave [ECHO] Check switches at "Echo Send"

Leave [ECHO] Echo Send level controls at ' 0'**
Set all [MAIN] Echo level controls to ' 0'
Set all [MAIN] Replay level controls to ' 0'
Set [CRM] Record/Replay key to Replay
Connect a 5-pin Tuchel jumper lead from [SP] Oscillator socket to a replay socket of [MAIN] 1,2,3...8 in turn
Set appropriate [MAIN] Echo Channel selector to 1,2,3...6 in turn
The corresponding [ECHO] VU meter (1,2,3 etc.) should indicate 0 VU (- 0.8 VU)**

6. Check of Echo Return Routing

6.1 (Main Buss Lines)
Set [SP] Oscillator level * to ' –4' (0)**
Set all [ECHO] Faders to max
Set [CRM] Monitor Extras to "Echo"
Connect a 5-pin Tuchel jumper lead from [SP] Oscillator socket to the "Return" socket of [ECHO] 1 then [ECHO] 2 in turn
Set each of the appropriate [ECHO] Output Selectors to P1,P3...P15, CRM in turn
The corresponding [MAIN] VU meter or [CRM] VU meter (1,3,5...15, CRM LH for LH Output Selectors, 2,4,6...16, CRM RH for RH Output Selectors) should indicate + 1 VU (+ 0.2 VU)**

6.2 (Group Buss Lines)
Leave [SP] Oscillator Level at ' –4' (0)**
Leave all [ECHO] faders at ' max'
Set [CRM] Check switch to "Check Group 1" and "Check Group 2" in turn
Set both [GROUP] Check switches to "Input to Group"
Connect a 5-pin Tuchel jumper lead from [SP] Oscillator socket to the "Return" socket of [ECHO] 1 then [ECHO] 2 in turn
Set each of the appropriate [ECHO] Output Selector to G1 and G3 in turn
The corresponding [CRM] VU meter should indicate + 1 VU (+ 0.2 VU)**

7 Check of Cue Routing

7.1 From [MIC] + [CRM]
Set [SP] Oscillator Level * to ' 0'
Set [CRM] Check Switch * to "Cue Line Out"
Set [CRM] Main Cue Level controls * to ' 0'
Set each [MIC] LH Cue Level control to max. in turn
The corresponding [CRM] VU meter (LH / RH meter for Cue1 / Cue2 Level control) should indicate ' 0' VU

7.2 From [MAIN] to [CRM}
Set [SP] Oscillator level * to ' 0'
Leave [CRM] Check switch * at "Cue Line Out"
Leave [CRM] Main Cue Level controls * at ' 0'
Set [SP] oscillator key to "To Tracks"
Set each [MAIN] LH Cue Level control to max. in turn
The corresponding [CRM] VU meter (LH / RH meter for Cue1 / Cue2 Level control) should indicate ' 0' VU

**7.3 From [ECHO] to [CRM]
Set [SP] Oscillator level * to ' 0' (+4)**
Leave [CRM] Check switch * at "Cue Line Out"
Leave [CRM] Main Cue Level controls * at ' 0'
Connect a 5-pin Tuchel jumper cable from [SP] Oscillator socket to the "Return" socket of each [ECHO] in turn
Set each of the appropriate [ECHO] LH Cue level controls to max. in turn

---

** If equipment is set up to 0.775v standard
** If equipment is set up to 0.775v standard

The corresponding [CRM] VU meter (LH / RH meter for Cue1 / Cue2 Level control) should indicate ' 0' VU (-0.8VU**)

7.4 From Sync Replay to [CRM]
Leave [SP] Oscillator level * to ' 0' (+4)**
Leave [CRM] Main Cue Level controls * at ' 0'
Connect a 5-pin Tuchel jumper cable from [SP] Oscillator socket to the [SP] Sync socket
Set each of the [CRM] Sync Replay Level to Cue controls to max. in turn
The corresponding [CRM] VU meter (LH / RH meter for Cue1 / Cue2 Level control) should indicate ' 0' VU (-0.8VU**)

7.5 From Artist manager Microphone to [CRM]
Leave [SP] Oscillator level * to ' 0' (+4)** (for convenience)
Leave [CRM] Check switch * at "Cue Line Out"
Leave [CRM] Main Cue Level controls * at ' 0'
Leave the 5-pin Tuchel jumper cable from [SP] Oscillator socket to the [SP] Sync socket (for convenience)
Set both [SP] Artist Manager selector switch to "To Cue1" and "To Cue 2" in turn
Speak into the Artist Manager microphone whilst pressing its "operate" button
The corresponding [CRM] VU meter (LH / RH meter for Cue1 / Cue2 respectively) should be deflected

8 Check of [CRM] loudspeaker quieting
Leave [SP] Oscillator level * to ' 0' (+4)**
Set [CRM] Check Switch to "Output to LS"
Set [CRM] Monitor Selector to "Sync L" and "Sync R"
Leave the 5-pin Tuchel jumper cable from [SP] Oscillator socket to the [SP] Sync socket
Both [CRM] VU meters should indicate ' 0' VU

(a) Press the Artist Manager microphone operate button
Both [CRM] VU meter readings should then fall considerably

(b) Press the [SP] Studio Talkback Normal button
Both [CRM] VU meter readings should then fall considerably

(c) Press the [SP} Multi-track announce button
Both [CRM] VU meter readings should then fall considerably

(d) Press each of the [MAIN] LH Track announce buttons in turn
Both [CRM] VU meter readings should then fall considerably each time

9 Check of Multi-Track announce
Set [SP] Oscillator Level * to ' 0'
Set all [MAIN] VU Meter selector switches to "Record/Replay"
Press [SP] Multi-Track announce button
All the [MAIN] VU Meters should read ' 0' VU

10 Check of [CRM] Multi-Track Buss lines
Leave [SP] Oscillator Level * at ' 0'
Set [SP] Oscillator Key * to "Tracks"
Set each [MAIN} Replay Level control to ' 0' in turn
Set [CRM] monitor Track Key to "1-8" whilst checking [MAIN] 1 to 4 and to "9-16" whilst checking [MAIN] 5 to 8
The corresponding [CRM] VU meter (LH/RH meter for LH/RH Replay Controls) should indicate ' 0' VU**

11 Check of [CRM] and [SP] links

11.1 (Normal Links)
Leave [SP] Oscillator Level at ' 0'

** If equipment is set up for 0.775v standard

Leave [SP] Oscillator key * at "To Tracks"
Set [CRM] Monitor track key to "1-8"
Set [CRM] Check switch * to "Check SP"
Set [SP] Check switch * to "Output to LS"
Set each of the two [MAIN] 1 Replay Level controls to ' 0' in turn
The corresponding [CRM] VU meter (LH/RH meter for LH/RH Level Controls) should indicate ' 0' VU

11.2 (Cue Links)
Leave [SP] Oscillator Level * at '0'
Leave [SP] Oscillator Key at 'To Tracks'
Leave [SP] Check switch to 'Output to LS'
Leave [CRM] Check switch to 'Check SP'
Set [CRM] Main Cue Levels to '0'
Set [SP] Playback Selector L to 'Cue 1'
Set [SP] Playback Selector R to 'Cue 2'
Set [MAIN] 1 LH Cue 1 and Cue 2 Level controls to max. in turn.
The corresponding [CRM] VU meter (LH/RH meter for Cue 1/Cue 2 Level controls) should indicate '0VU'

12 Check of Solo routes
Set [SP] Oscillator Level * to '-4'
Set both [MIC] 1 faders to '+3' (approx.)
Set both [MIC] 1 Output Selector to 'CRM'
Set [CRM] Monitor Extras switch to 'MIC'
Set [CRM] Check switch to 'Output to LS'
Both [CRM] VU meters should now indicate '-1 VU' (approx.)
Connect a 5 pin Tuchel jumper from [SP] Oscillator socket to the 'Return' socket of [ECHO] 1 then [ECHO] 2 whilst checking the [ECHO] solo buttons as described below.
Press each [MIC] and [ECHO] Solo button in turn. This should cause the LH VU meter to indicate '+ 1 VU' (or –3.8 VU for [ECHO] solo buttons) ** and the RH VU meter to indicate nil.

13. Check of Correlator Bus Lines
Set [SP] Oscillator Level * '-30'
Set [SP] Oscillator Key to 'To Tracks'
Set [CRM] Correlator switch to 'Main'
Press each [MAIN] Correlator button in turn.
The corresponding [CRM] Low level meter (LH/RH meter for L/R Correlator buttons respectively) should indicate 'f.s.d.'

14. Check of Record/Replay Key control lines.
Set [SP] Oscillator level * to '0' (+4) **
Set Record/Replay Key to 'Replay'
Set all [MAIN] VU meters switches to 'Record/Replay'
All [MAIN] VU meters should indicate 'nil'
Connect a 5 pin Tuchel jumper from the [SP] Oscillator socket to the 'Replay' socket of [MAIN] 1, 2, 3 ... 8 in turn.
The corresponding pair of [MAIN] VU meters (1 + 2, 3 + 4 ... 15 + 16) in turn should indicate 'OVU (-0.8) **

15. Check of VU Key control lines.
Leave all [MAIN] VU meters switches to 'Record/Replay'
Leave [SP] Oscillator Level at '0' (+4) **
Set VU Key to 'Replay'
All [MAIN] VU meters should indicate 'nil'
Connect a 5 pin Tuchel jumper from the [SP] Oscillator socket to the 'Replay' socket of [MAIN] 1, 2, 3 ... 8 in turn.
The corresponding pair of [MAIN] VU meters (1 + 2, 3 + 4 ... 15 + 16 in turn) should Indicate 'OVU' (-0.8) **

TG12345 Mixing Console
Common Tests Schedule

1.Equipment Required.

1.1 Power unit assembly TG12345/C117A supplied with 50V, +3/-1V, 50 or 60Hz centre tap earthed. If a centre tap earthed supply is not available a supply to the alternative given on TG12345/AE350 sheet 1 is adequate.

1.2 Voltmeter, with an accuracy of ±2%

1.3 An AC millivoltmeter of ±3% accuracy, calibrated to read the rms value of a sine wave.

1.4 Bridging Gain Set capable of receiving at –10dBV (-10dB with respect to 0.447V). Bridging gain being defined as "The ratio expressed in dB of the output voltage from the amplifier under test into its rated load to the voltage which the source would deliver into a matching load.

1.4.1 For testing limiters the gain set must be capable of receiving at levels between –30 and –6dBV.

1.4.2 For testing presence units the gain set oscillator must either be continuously variable or be capable of variation in steps of less than 3%.

1.5 An Oscilloscope.

1.6 A noise meter with a range from –50 to –110 dBV, which can measure either "Flat" or to "A Weighted" and with a pass band from 20Hz to 20 KHz.

2. Procedure

No soldered joint or clip connection should be made to any part of the circuit with the power on.

The power may be switched either at mains voltage at the primary of the step-down transformer, or at 50V at the secondary of the step-down transformer.

3. Tests

The following general requirements are to be read in conjunction with the relevant test schedule of the board in question. This states which tests are to be performed, special requirements for any of the tests, and acceptance limits.

TEST 1 **INSPECTION**

Before making any connections to a board, visually inspect it, paying particular attention to the following:

Correctness of components
Correct polarity of diodes and electrolytic capacitors
Absence of dry solder joints
Absence of solder splashes
Absence of short circuits

For the following tests connect earth free positive and negative 20V supplies as required from Power Unit assembly TG12345/C117A, fed as in 1.1 above.

TEST 2 **Gain Measurement in absence of feedback**

Temporarily remove feedback by method indicated in relevant test schedule. Connect bridging gain set as shown in Fig.1 with values of R and R_L as called for in the relevant test schedule, C being circuited (or omitted) if specified.

Measure bridging gain to nearest 0.5dB at the frequencies specified.

Restore Feedback.

TEST 3 **Bridging gain measurement**

Set-up as for Test 2.

Measure the bridging gain at 20 Hz, 1 KHz and 20 KHz.

TEST 4 **Overload level**

Set-up as Fig.2.

Test frequency 1 KHz.

Increase sending level until peak clipping is just visible on the 'scope.

Observe the ac mV meter reading.

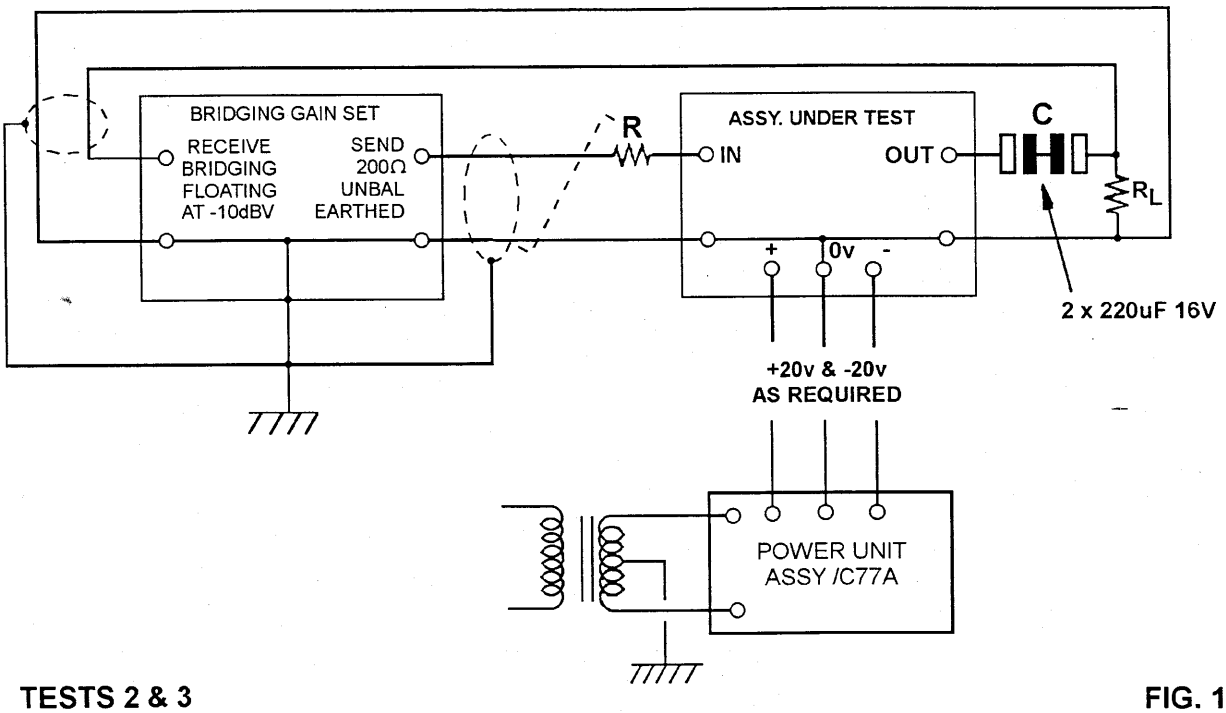
TEST 5 **Noise Measurement**

Set-up as Fig. 3.

Measure noise 1, Flat
2, A weighted

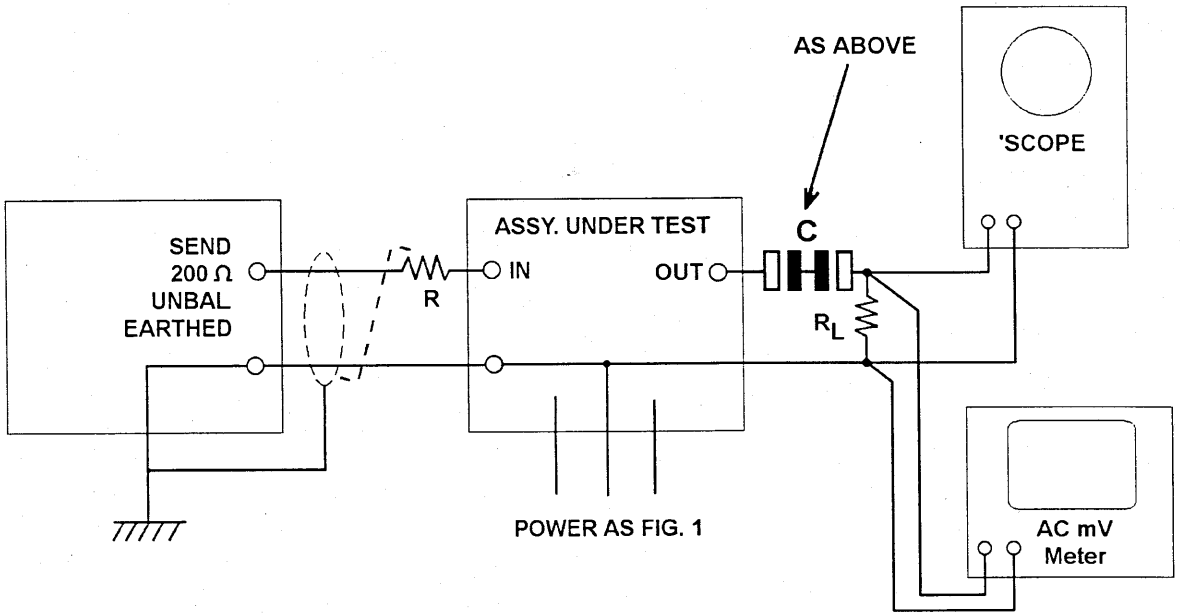
TEST SETUPS FOR SUB-ASSEMBLIES

REFER TO TEST SCHEDULE FOR DETAILS



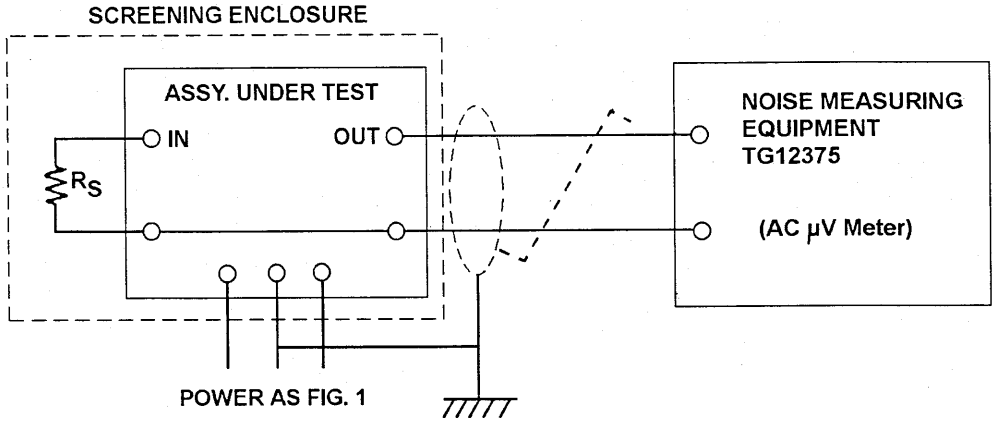
TESTS 2 & 3

FIG. 1



TEST 4

FIG. 2



TEST 5

FIG. 3

TEST SCHEDULE FOR MARK II LIMITER ASSEMBLY /C226A

See Drawings TG12345/CE226 and /CE226A and /AE299.

Test to which may be applied to separate Board Assemblies /B56 are described on Sheets 4 and 5.

TEST 1
Visually inspect both Board Assemblies (/B56 and /B57) as descried in the Common Tests Schedule /AE299.

TEST 2 **DC Voltages**
Connect without shortening, the end wires a resistor of 100 Ω ± 1% as AOT 2. Also connect a decade resistance box set initially to 1.8 K Ω as AOT 9 and another resistance box set initially to 24 Ω as AOT 10. For maintenance checks on a limiter which has been in service leave all AOT resistors as found. In both cases make further connections as follows: -

Connect a resistor of 270 k Ω = 10% from point "K" to point "G" and connect point "M" to point "N". Connect a limiter meter ("G12345/A49) as shown on drawing /AE226 between point "C" and point "D". Connect a 10 K HOLD control to points "F", "G" and "H" as shown on Drawing /CE226. Set the HOLD control fully anticlockwise. Connect the power supplies and using a sub-standard meter check that both supply potentials are 20.0 V. Then using a Model 9, Mk II AVO meter, on the lowest possible range note the direct potentials, referred to the OV rail, of the points stated below. Results should lie within the limits shown.

E = Emitter C = Collector B = Base

VT 2C	-8.1V ± 0.4V	VT15E	-13.8V ± 0.3V
R7/C2	+17.0V ±0.3V	VT16E	-13.8V ± 0.3V
R8/C3	-19.0V ± 0.2V	VT15C	+1.1V ±1.0V
VT5E	+6.2V ±0.2V	VT16C	+VT15C ±0.7V
VT6E	+6.2V ± 0.2V	VT19E	+0.6V ±0.1V
VT7E	+11.3V ± 1.4V	VT19C	+15.8V ± 0.2V
VT8E	+VT7E ±0.3V	VT21E	-0.3V ±0.1V
VT10E	+13.5V ±0.5V	VT23E	-15.5V ±0.4V
VT12E	+14.6V ±0.6V	VT24E	-14.5V ±0.4V
VT13E	+14.6V ±0.6V	VT24C	+5.8V ±0.2V
VT12C	-8.2V ±1.4V	VT25B	+6.4V ±0.2V
VT13C	-8.2V ± 1.4V		

If the collector potentials of transistors VR12 and VT13 are outside the quoted limits connect the AVO meter (on its 3 V d.c. range) between the emitters of transistors VT5 and VT6. Adjust the resistance box (AOT 9) for zero AB meter indication and fit, without shortening the end wires, a resistor of preferred value nearest to the setting of the resistance box. Repeat the direct potential measurements from VT5E onwards. The results should now fall within the quoted limits.

On a limiter which has been adjusted in accordance with the remaining tests detailed in this schedule certain of the direct potentials listed above should have changed to the values given below: -

VT5E = VT6E ± 0.1V
VT8E = VT7E ± 0.2V
If VT16C > VT15C then VT15C = +0.2V ±0.2V, but if
VT15C > VT16C then VT16C = +0.2V ±0.2V

Continued/...

TEST 3 **Preliminary Noise Check**

Connect point "IN" to the OV rail. Use the set up shown for TEST 5 on the Common Tests Schedule /AE299. Measure and record the noise level from the Limiter output with the HOLD control adjusted first to make the meter read "0", and then to make the meter read "20". Accept noise levels less than –92 dBv FLAT and –84 dBv FLAT respectively.

TEST 4 **Quiescent Gain (AOT 1 & 2)**

Use the set up shown for TEST 3 on the Common Tests Schedule /AE299 with resistor R = 0, R_L = 3K and using the limiter output direct (without C). Receive at a level of –30 dBv. Connect point "K" to the OV rail, and disconnect point "M" from "N". Replace the temporary AOT2 with a decade resistance box set to 100 Ω. Send an indicated send level of –61 dBi at 1 kHz and adjust the resistance box to give a receive level of –30 dBv. Fit a resistor as AOT1 of the nearest preferred value above the setting of the resistance box. Allow to cool for not less than five minutes, then re-adjust the resistance box to give a receive level of –30 dBv. Remove the resistance box and fit a resistor as AOT2 of the nearest preferred value to the setting of the resistance box. Allow to cool and check that the receive level is –30.0 = 0.2 dBv.

Note this receive level and the values of the resistors AOT1 and AOT2.

Disconnect point "K" from the OV line. Check that with the HOLD control fully anticlockwise an indicated send level of –57 dBi results in a receive level between –30 and –26 dBv. Note this receive level.

TEST 5 **Compressor Characteristic (AOT 3 & 4)**

Connect point "M" to point "N" and connect the decade resistance box set initially to 30k as AOT4. Set the HOLD control fully anticlockwise. Send an indicated send level of –54 dBi at 1 kHz and adjust the resistance box to give a receive level of –29 dBv. Fit a resistor as AOT 3 of the nearest preferred value above the setting of the resistance box.

Allow to cool for not less than five minutes then re-adjust the resistance box for a receive level of –29 dBv. Remove the resistance box and fit a resistor as AOT 4 of the nearest preferred value to the setting of the resistance box. Allow to cool for not less than five minutes then check that the receive level is –29.0 ±0.1 dBv (indicated send level –54 dBi). Note this receive level and also the receive levels obtained when the indicated send level is –36 dBi and –16 dBi. These should be –20 ± 0.5 dBv and –10.7 ±0.8 dBv.

TEST 6 **Limiter characteristic (AOT 5 & 6)**

Disconnect point "M" from point "N" and connect point "R" to point "S". Connect the decade resistance box set initially to 10 k Ω as AOT 6. Send 1 kHz at an indicated send level of –16.0 dBi and adjust the resistance box for a receive level of –10.0 dBv. Fit a resistor as AOT 5 of the nearest preferred value above the setting of the resistance box. Allow to cool for not less than five minutes, then re-adjust the resistance box for a receive level of –10.0 dBv. Remove the resistance box and fit a resistor as AOT 6 of the nearest preferred value to the setting of the resistance box. Allow to cool for not less than five minutes then check that the receive level is –10.0 ±0.1 dBv. Note this receive level and also the receive levels obtained when the indicated send level is –16.0 dBi and –36 dBi. These should be –11.0 ±0.3 dBv and –12.6 ±0.3 dBv respectively.

TEST 7 **Control Overload**

Increase the input in steps of 1 dB, starting at –16.0 dBi, and note the send level at which the limiter output starts to rise in steps of approximately 1 dB. Note this level which should not be less than –8 dBi. Disconnect the gain set.

Continued/...

TEST 8 **Balance (AOT 7, 8, 9 & 10)**

Connect the Control Current Sweep Generator TG12345/AE399 to the same positive and negative 20V supplies as are used for the Limiter and connect the generator output to point "C". Connect point "IN" to the OV rail. Connect a mV meter to the output of the limiter. With the generator switched off check that the noise output indicated by the mV meter is less than 50 μV. Switch the generator on. For maintenance purposes on a limiter which has been in service, check that the output indicated by the mV meter is less than 1.5 mV. If it is not or if the Board/B56 is a new one, proceed as follows. Adjust alternately the two decade resistance boxes AOT 9 & 10 so as to minimise the signal out of the limiter.

Having found "a balance" the AOT 10 resistance should be increased by about 2 Ω and a "new balance" found by adjusting the AOT 9 resistance box. The corresponding "new out of balance signal" should be greater than the old. Similarly if the AOT 10 resistance is decreased by 2 ohm and a "new balance" found the "new balance" signal should also be greater than the old. If both these conditions are fulfilled the "old balance" is the best obtainable balance. If either one of these conditions is not fulfilled, then the decade box settings giving the lower "new out of balance signal" are nearest to the best obtainable balance. The procedure stated in this paragraph should then be repeated. The final "out of balance" signal should be less than 1½ mV.

Then fit resistors as AOT 7 and AOT 8 of the nearest preferred values above the setting of the resistance boxes AOT 9 and AOT 10 respectively. Allow not less than five minutes to cool then adjust the resistance boxes for minimum limiter output signal. Remove the resistance boxes and fit resistors as AOT 9 and AOT 10 of the nearest preferred value to the settings of the resistance boxes. Allow not less than ten minutes to cool then check that the "out of balance" signal is less than 1½ mV. Note the values of resistors AOT 7, 8, 9 and 10, and the "out of balance" signal. Disconnect the Control Current Sweep Generator and mV meter.

TEST 9 **Quiescent Frequency Response**

Use the set up shown for TEST 3 on the Common Tests Schedule /AE299 with resistors R = 0 and R_L = 3 k Ω ±1% and using the limiter output direct (without C) but receive at a nominal level of –20 dBv. Set the HOLD control to give a receive level of –20.0 dBv when sending an indicated send level of –46 dBi. Note the receive level at the frequencies shown below and check that it is within the limits shown.

20 Hz	-21.5 ±0.3 dBv
40 Hz	-20.4 ±0.2 dBv
100 Hz	-20.1 ±0.2 dBv
1 kHz	-20.0 dBv set by "HOLD"
10 kHz	-20.0 ±0.1 dBv
20 kHz	-20.2 ±0.2 dBv

TEST 10 **Frequency Response when Limiting**

Use the same set up as for TEST 9. Set the HOLD control fully anticlockwise then send an indicated send level of =16.0 dBi and note the receive level at the following frequencies. Check that the output is within the following limits: -

20 Hz	-10.2 dBv ±0.7 dB
1 kHz	-10.0 dBv ±0.1 dB
20 kHz	-10.2 dBv ±0.3 dB

Continued/...

TEST 11 **Overload**

Use the same set up as for TEST 9 but set the HOLD control fully anticlockwise. Connect an oscilloscope across the output of the limiter and note the indicated send level at 1 kHz at which the limiter output first starts to clip. This should not be less than –5 dBi.

Disconnect the oscilloscope and gain set.

TEST 12 **Control Attack Time**

Send to pin "IN" and the OV rail from a tone burst generator long bursts of 1 kHz at a level of –10 dBv so as to cause the limiter meter to indicate "0 dB". Then reduce the burst duration to about ¼ sec. set the burst rise time to 1 ms or less and set the burst repetition rate to about once every 3 sec. Set the HOLD control fully anticlockwise. Check the "zero" of an oscilloscope set to measure direct potentials, and connect it across the reservoir capacitor C12. Note the maximum value of the control voltage developed across the capacitor, and the time taken to reach 90% of that value. The voltage should be 7.5 ±1V and the time taken should be 8.5 ms ± 1.5 ms.

Disconnect the oscilloscope and tone burst generator.

TEST 13 **Noise**

Connect point "IN" to the OV rail. Use the set up shown for TEST 5 on the Common Tests Schedule /AE299. Note the noise level out of the limiter with the "HOLD" control adjusted to make the limiter meter indicate "20 dB", "10 dB" and "0 dB". Check that the noise level is not greater than the levels below.

HOLD

20 < - 84 dBv FLAT
< - 87 dBv "A"

10 < -91 dBv Flat
< -94 dBv "A"

0 < -92 dBv Flat
< -95 dBv "A"

TEST ON BOARD ASSEMBLY TG12345/B56

To ease maintenance it may be desirable to hold a stock of tested Board Assemblies /B56. These may be tested as follows.

TEST 14

Visually inspect the board as described in the Common Tests Schedule.

TEST 15 **Direct potentials**

Remove Board /B56 from a fully tested Limiter Assembly /C226A and replace it using wires of about three inches length by the untested Board /56. Connect pin R to pin S. Connect a decade resistance box set initially to 1.8 k Ωas AOT 9 and another decade resistance box set initially to 24 Ωas AOT 10. Connect a resistor of 270 k Ω±10% from pin K to pin C and a 10 k ohm "HOLD" potentiometer to pins F, G and H as shown on Drawing /CE226. Set the "HOLD control fully anticlockwise. Connect a Limiter Meter (Drawing .A49) as shown on Drawing /CE226 between pin C and pin D.

Connect the power supplies and using a sub-standard meter check that both supply potentials are 20.0V. Then using a model 9 Mk II AVO meter on the lowest possible range note the direct potentials referred to the OV rail. Of the points stated below. Results should lie within the limits shown.

VT5E +6.2 V ± 0.2 V
VT6E +6.2 V ±0.2 V
VT7E +11.3 V ±1.4 V
VT8E = VT7E ± 0.3 V

TEST 16	As TEST 3	**Preliminary Noise Check**
TEST 17	As TEST 8	**Balance**
TEST 18	As TEST 9	**Quiescent Frequency Response**
TEST 19	As TEST 11	**Overload**
TEST 20	As TEST 13	**Noise**

When a Board /B56 tested as above is fitted as a replacement on a Limiter Assembly it will be necessary to check all tests from 2 to 14 inclusive and probably it will be necessary to readjust AOT1 and 2.

Zener Diode Selection For Limiter

1. Noise test of HS2051 Zener diodes for use in limiter type TG12345/CE226

1.1 Connect each diode in series with a 47KΩ histab low noise resistor across one of the 20V supplies of a unit type TG12345/C117A. Connect the junctions of the diodes and resistors to selector switches so that the noise voltage across each diode in turn may be measured by a noise measuring unit TG12375 set to "flat" frequency response.

1.2 Measure the noise voltage across each diode and reject or replace any having a noise level greater than -100dBV (ref 0.447 V)

1.3 Leave the diodes passing current (about 300mA) for at least 75 hours then measure their noise level again. Accept only those having a noise equal to or less than -100 dBV

1.4 A record of the percentage yield of each batch should be kept.

2. Selection of Matched Pairs

2.1 Interconnect a balance test set type TG12345/BE400, a current sweep generator Type TG12345/AE399, two decade resistance boxes, a mV meter and a +20/0/-20V power supply type TG12345/C117A as shown below.

2.2 Identify every diode which has passed the noise test described in section 1 by a numbered adhesive label.

2.3 Secure the first diode in the "reference" spring clips and the second diode in the "test" spring clips of the Balance test set. Handle the diodes by their adhesive labels rather than their bodies, to a void heating them. Close the hinged lid so shield them from draughts, direct sunlight and electrical interference.

2.4 Switch on the power supply and with the sweep generator switched off check that the mV meter indicates less than 50mV of hum and noise. Switch the sweep generator on.

2.5 Minimise the mV meter indication by alternately adjusting the two resistance boxes. This balance will not necessarily be the best that can be obtained. Hence increase the setting of box A about 5% and readjust box B. If the new balance is better than the original repeat the procedure, but if it is worse, decrease the setting of box A about 5% of its original setting and readjust box B. Note the final settings of both resistance boxes. Switch the power supplies off.

2.6 Replace the "test" diode by another diode, switch on the power supplies and repeat the procedure of para 2.5

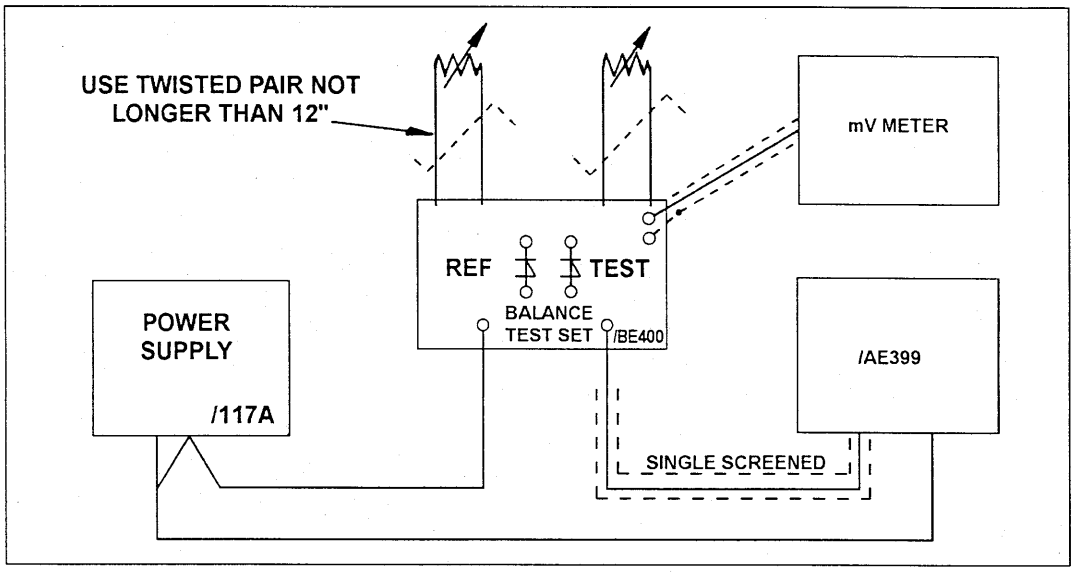
2.7 Repeat the procedure until all the diodes have been tested and a table of resistance box settings completed. Remove the reference diode.

2.8 Examine the table and pick out pairs of diodes having resistance box settings as nearly the same as possible. Diodes having box A settings within 5% of one another and box B settings within 1% (preferably 0.5%) of each other will usually be a matched pair.

2.9 Secure each pair in turn to the balance test set, switch on and use the procedure of para. 2.5 except that the mV meter indication should be noted instead of the resistance box settings. Accept only those diode pairs giving a mV meter reading at balance of 300mV or less.

2.10 Repeat the procedures of paras. 2.5 to 2.9 on all those diodes which have not yet been selected as matched pairs, but use a new reference diode which may be any one except the one used originally.

2.11 Repeat the procedure of para. 2.10 as necessary to get an acceptable yield of matched pairs.



ZENER DIODE SELECTION SET-UP

The EMI TG 12345 Multi-Track Mixing Console

The EMI TG12345 Mixing console was produced by EMI Research Laboratories, Hayes, to a design brief submitted by Abbey Road Studios. The design was for a Transistorised ("Solid State") multi-channel mixing console to replace the 10in/4out valve (vacuum tube) mixers, which had been in use at the studios since the 1950's.

Part of the original design brief was for the desk to be "transportable," (as opposed to portable), so that it could be used for location recording, and also the ability to make a simultaneous stereo recording at the same time as a multi-track session.

A specification for the console was drafted in December 1967

Since at this time EMI manufactured its own recording equipment there would be a limited production run of these consoles to equip its various studios in Europe, Africa and the far east.

The main points which differ on the TG consoles compared to some other designs are outlined as follows:

1. Operating Line level is 0dBm = 0.447 volts.
   This is a legacy of EMI's earlier consoles, which worked at an operating impedance of 200 ohms, as opposed to the US operating impedance of 600 ohms. 0dB Line level in a 600 ohm system is 0.775 volts (1 milliwatt dissipated in a 600ohm load) with the usual operating level being +4 dBm which is 1.228 volts.
   The TG operating level is 0 dBm into 200 ohms (1milliwatt dissipated in a 200ohm load), which is 0.447 volts. This is 8.8 dB lower than +4 dBm (usually rounded up to a nominal 9 dB)
   [N.B. The internal busses of the console work a further 10 dB lower than the external levels. This is not uncommon in professional recording consoles].

2. All inputs and outputs are balanced using transformers.

3.a There is no integral patchbay and no internal insertion or patching points.

3.b There was an intended provision for insertion into the channel path via an "Inject Point" which bypassed the built in limiter. The intention of this was to allow an external limiter to be connected. The wiring to do this was brought out to a socket on the bottom of the channel which was fitted with a plug with a wire link when the inject facility was not being used. Because the internal signal bus operates 10 dB below the operating line level, to use the inject facility correctly an external buffer amplifier and balancing transformer was required on both the send and return signal paths.

4. Almost every rotary control is a stud switch, with precise calibration for repeatability and matching.

5. Each modular section ("Cassette") was dual channel containing identical left and right signal paths.

6. Each Cassette contained its own local DC power supply, with its own rectification, regulation and decoupling.
   The mixer "Power Unit" was simply a constant voltage transformer, which supplied 50 volts ac to a wiring loom, which fed all the power supplies on the individual cassettes.
   Keeping the power regulation local to the channel meant that much smaller decoupling capacitors could be used rather than the massive decoupling necessary on a remote DC power feed.
   A heavy gauge earth loom was supplied to link all the individual cassettes and the frame together, and provide a low impedance ground return path.

Item 1 above makes it slightly awkward to use these consoles with modern recording equipment operating at +4 dBm line levels. Although most tape machines have sufficient gain in hand to allow for adjustment, other equipment sometimes needs a +9 dB buffer amp on the send and a simple resistive attenuator on the return.

Regarding 3.b, although in theory it was a simple task to provide the appropriate amplification and transformers the inject facility was never used for its intended purpose on any of the consoles installed at Abbey Road.

EVOLUTION and DEVELOPMENT

The TG series of mixing consoles evolved through several different versions.

Mk I

This was the original spec. (prototype) version as supplied to Abbey Road. It was only produced as a 24 mic. 8 track (group output) + Aux stereo configuration. Basic EQ.(Bass & Treble on Mic channels). It also featured a stereo "spreader" (width control) which could be switched in on the Mic. channels. Finished in light grey paint on panels with a dark grey hammer finish frame.

Mk II

This was also produced in a 24/8 format but with modified EQ. The HF equaliser on the Mic. channels was thought to be too limited in its operation. Abbey Road engineers requested a presence control as fitted to the Group channel be fitted to the Mic. Channels in place of the HF Equaliser. Various minor refinements such as multi-track announce instead of the individual track buttons of the Mk I.
Abbey Road examples had dark grey front panels and the dark grey hammer finish console frame was dressed up with wooden end cheeks.

—> Mk III

Final production version of the TG console as supplied to overseas studios, but never used at Abbey Road.
This was a 16 track version of the desk. In order to minimise the frame size, the Group channels and the track monitor ("TMC") cassettes were eliminated. The monitor controls were moved to the area of the main cassettes previously occupied by the Aux Stereo controls.

Mark 4/ "Mark Q" (Unofficial designations)

Only two consoles of this specification were produced both of which were installed at Abbey Road (originally in Studios 2 & 3, later the desk from 3 was transferred to Studio 1).
The Mark Q designation came from the provision to monitor "Quadraphonic" 4 channel surround sound, with the addition of front/back pan controls on the monitor channels and the incorporation of encoder/decoder switching on the Control Room Monitor cassette, allowing the effects of the "SQ"[*1] processing system to be monitored.
The Main and Group channels were eliminated completely and Mic. cassettes from the Mk III were used throughout the desk, supplemented by specially made "auxiliary" Mic. and Main cassettes. The

[1] "SQ" is a trademark of CBS, now SONY Music, covering a method of encoding a 4-channel surround sound signal into a stereo compatible 2-channel format.

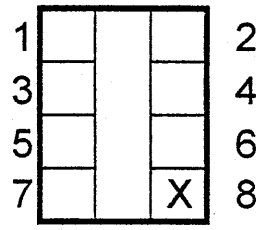
frame also housed a simple 16 channel "sync mixer" to mix the sync playback signals from the tape machine and feed them to the cue (foldback) circuits.
Although the basic configuration of the console was 24/16, the possibility of using Mics on the main channel inputs meant it was theoretically possible to have up to 40 mics with 16 group outputs. The flexibility of the configuration also meant that some channels could be used as monitors for tape returns allowing for 24 track operation, and still have up to 16 microphone inputs available. It was this flexibility which allowed the desk to be used well into the 24 track era before it was finally replaced in Studio 2, by an SSL 4000E series console in 1983.

The "Mark 4" mixer was housed in a wooden console housing which had a semi-wrap around layout, with the outer wings of the frame angled back towards the operator for easier access. The whole console was a much sturdier construction and was much better suited to a fixed studio environment.

The earlier mark I and mark II desks became used exclusively as mobile desks at Abbey Road.
Since their mechanical construction was too flimsy to withstand continual mobile use, the cableforms were split and fitted with mating connectors whilst the frames were rebuilt in sections constructed of tubular steel which were much stronger than the originals. These were fitted with lockable castors, which made transporting them much easier. Once on location the sections of the frame could be wheeled together and secured, then the cableforms would be plugged together and the desk would be ready for use. These modifications were all carried out by Abbey Road engineers
There was even a 16 track version built from two 8 track frames, although the desk featured two Control Room Monitor cassettes and it was necessary to operate two line in/line out keys simultaneously when switching from record to replay.

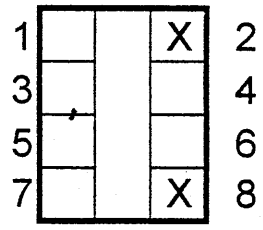
EMI Wire information

DC Bus, used on main CRM cassette and Sync rep level to Cue :



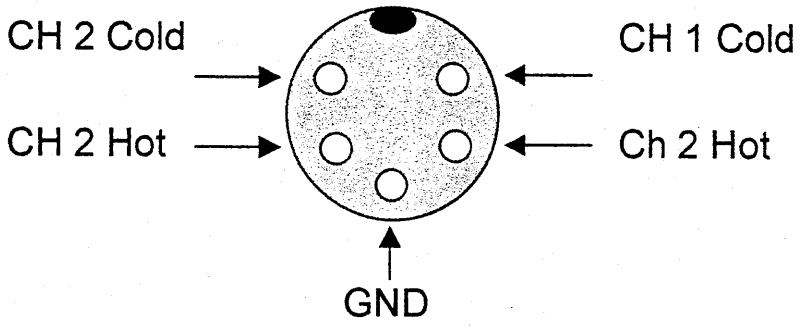
4 : GND
3 : +20Volts
5 : -20 Volts

AC Bus, used on all Mic, Monitor, Echo and aux Main cassette :

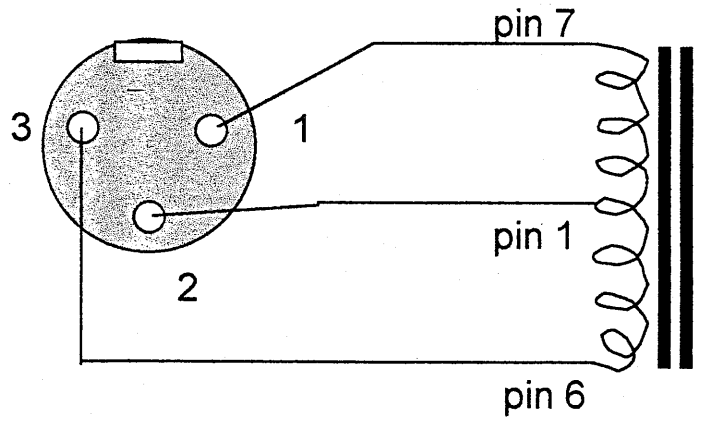


1 : GND (center tap)
6 : 25 Volts AC
7 : 25 Volt AC
} 50V AC across pin 6-7

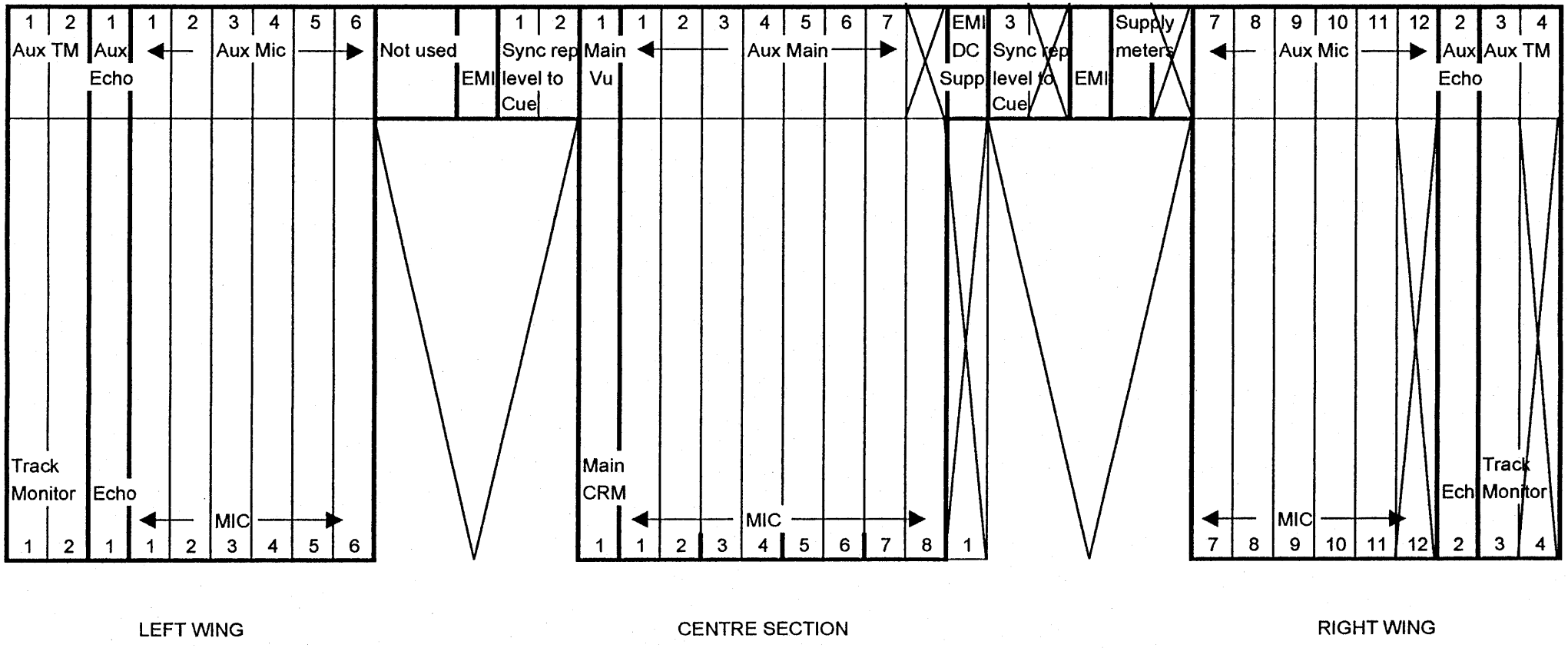
Microphone, Monitor and Echo Cassette :



Internal connections in power supply, secondary winding (AC BUS):



EMI console layout



EMI -TG12345- Microphone cassette

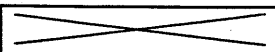
60	~~X~~	59	B5 bus	58	A5 bus	57	Oscillator bus
56	B4 bus	55	A4 bus	54	Solo switch	53	Solo signal
52	B3 bus	51	A3 bus	50	Solo switch	49	48 V bus
48	B2 bus	47	A2 bus	46	N.C	45	Cue 2 bus
44	B1 bus	43	A1 bus	42	N.C	41	Cue 1 bus
40	P16 bus	39	P14 bus	38	CRM R bus	37	N.C
36	P12 bus	35	P10 bus	34	0 V	33	Gnd
32	P8 bus	31	P6 bus	30	0 V	29	Gnd
28	P4 bus	27	P2 bus	26	0 V	25	Gnd
24	G4 bus	23	G2 bus	22	0 V	21	Gnd
20	P15 bus	19	P13 bus	18	CRM L bus	17	Echo 4 bus
16	P11 bus	15	P9 bus	14	Echo 6 bus	13	Echo 3 bus
12	P7 bus	11	P5 bus	10	Echo 5 bus	9	Echo 2 bus
8	P3 bus	7	P1 bus	6	N.C	5	Echo 1 bus
4	G3 bus	3	G1 bus	2	N.C	1	N.C

36	~~S16 bus~~	35		34		33	
32		31		30		29	
28		27		26		25	
24	S16 bus	23	S14 bus	22	S12 bus	21	S10 bus
20	S8 bus	19	S6 bus	18	S4 bus	17	S2 bus
16		15		14		13	
12		11		10		9	
8	S15 bus	7	S13 bus	6	S11 bus	5	S9 bus
4	S7 bus	3	S5 bus	2	S3 bus	1	S1 bus

EMI -TG12345- Studio Playback cassette

36		35	N.C	34	0 V	33	**Oscillator o/p** bus
32	**Vu Check R** signal	31	**Vu Check L** signal	30	0 V	29	**Track Annonce bus to Vus**
28	**Artist manager** Quieting of CRM	27	**Operator CRM** Quieting of CRM	26	0 V	25	N.C
24	N.C	23		22	0 V	21	**CRM L/S quiet**
20	N.C	19	GND	18	GND	17	
16	N.C	15	GND	14	GND	13	**Track Annonce bus to Vus**
12	**Sync Replay (R)** signal	11	**Sync Replay (L)** signal	10	**Main Cue 2** signal	9	**Main Cue 1** signal
8		7		6	**Playback R** From main monitor	5	**Playback L** From main monitor
4	**Cue 2** bus	3	**Cue 1** bus	2	N.C	1	N.C

EMI -TG12345- Track Monitor cassette

48		47	N.C	46	N.C	45	N.C
44	N.C	43	N.C	42	N.C	41	N.C
40	**Re-Record 1**	39	**Re-Record 2**	38	**Re-Record 3**	37	**Re-Record 4**
36	N.C	35	N.C	34	0 V	33	GND
32	**MTK 4 - M/C 2**	31	**MTK 2 - M/C 2**	30	0 V	29	GND
28	**MTK 3 - M/C 2**	27	**MTK 1 - M/C 2**	26	0 V	25	GND
24	**Replay 2B (4)**	23	**Replay 1B (3)**	22	0 V	21	GND
20	**Replay 2A (2)**	19	**Replay 1A (1)**	18	**ECHO 4** bus For TRK 3&4	17	**ECHO 4** bus For TRK 1&2
16	**MTK 4 - M/C 1**	15	**MTK 2 - M/C 1**	14	**ECHO 3** bus For TRK 3&4	13	**ECHO 3** bus For TRK 1&2
12	**MTK 3 - M/C 1**	11	**MTK 1 - M/C 1**	10	**ECHO 2** bus For TRK 3&4	9	**ECHO 2** bus For TRK 1&2
8	**Right Back** bus	7	**Right Front** bus	6	**ECHO 1** bus For TRK 3&4	5	**ECHO 1** bus For TRK 1&2
4	**Left Back** bus	3	**Left Front** bus	2	N.C	1	N.C

EMI -TG12345- CRM cassette

60	~~X~~	59	GND	58	N.C	57	GND
56	GND	55	N.C	54	N.C	53	N.C
52	**Correlate R** Bus	51	**Correlate L** Bus	50	N.C	49	GND
48	N.C	47 orange	**Rec** (Rec/Fol/Rep) CMD signal (0V)	46 bleu	**Rep** (Rec/Fol/Rep) CMD signal (0V)	45 Blanc	**Fol** (Rec/Fol/Rep) CMD signal (0V)
44	**Echo R** Echo cass. Bus	43	**Echo L** Echo cass. Bus	42	**CRM R** bus	41	**CRM L** bus
40	GND	39	**Monitor R 9-16** bus	38	**Monitor L 9-16** bus	37	**Monitor R 1-8** bus
36	**Monitor L 1-8** bus	35	**Artist Manager** CMD signal	34	0 V	33	**Operator Talkbk** CMD signal
32	**Solo signal**	31	**48 V** bus	30	0 V	29	**Track Annonce** CMD signal
28	**Main Cue 2** Signal	27	**Main Cue 1** Signal	26	0 V	25	N.C
24 Vert/Jaune	**Main Rec status** CMD signal (0V)	23 Gris	**Main Rep status** CMD signal (0V)	22	0 V	21	**Track Annonce** Bus to Vus
20	GND	19	GND	18	**Monitor R to S.P** Signal	17	**Monitor L to S.P** Signal
16	GND	15	GND	14	**Solo** CMD signal	13	N.C
12	**Sync Replay (R)** Signal	11	**Sync Replay (L)** Signal	10	GND (solo)	9	N.C
8	**Check S.P (R)** position 7	7	**Check S.P (L)** position 7	6	N.C	5	N.C
4	**Cue 2** bus	3	**Cue 1** bus	2	N.C	1	N.C

Follow mode means :	45	**0V**	46	N.C	47	N.C
Repro mode means :	45	N.C	46	**0V**	47	N.C
Record mode means :	45	N.C	46	N.C	47	**0V**

Sync replay is an external stereo macine

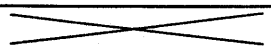
EMI -TG12345- Aux CRM cassette

36	~~X~~	**35**	**Repro** CMD signal	**34**	**Follow** CMD signal	**33**	**Record** CMD signal
32	**Rep** (Rec/Fol/Rep) CMD signal	**31**	GND	**30**	**Main Repro** CMD signal	**29**	**Main Rec** CMD signal
28	**Fol** (Rec/Fol/Rep) CMD signal (1v)	**27**	GND	**26**	**Machine 2** CMD signal (1v)	**25**	**Machine 1** CMD signal (1v)
24	**Rep** (Rec/Rep) CMD signal	**23**	GND	**22**	**Rec/Fol/Rep** CMD signal	**21**	**Rec / Rep main** CMD signal
20	GND	**19**	GND	**18**	GND	**17**	GND
16	GND	**15**		**14**	GND	**13**	
12	GND	**11**		**10**	GND	**9**	
8	GND	**7**	GND	**6**	GND	**5**	GND
4		**3**		**2**		**1**	

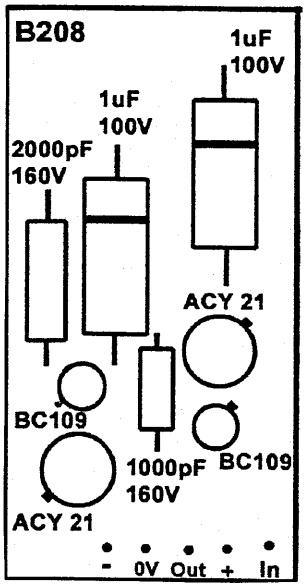
EMI -TG12345- Aux Main cassette

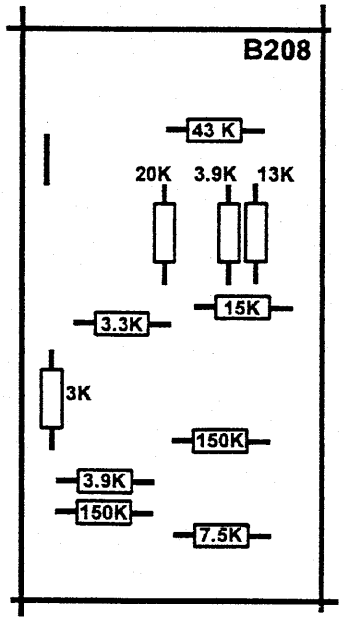
36		**35**	**Track Annonce** CMD signal	**34**	GND (TRK Ann.)	**33**	**Correlete R** bus
32	**Rec/Fol/Rep** CMD signal	**31**	**Rec / Rep main** CMD signal	**30**	GND (Rec/Rep)	**29**	**Correlete L** bus
28	**Rec/Fol/Rep** Bus (even)	**27**	**Rec/Fol/Rep** Bus (odd)	**26**	0 V	**25**	N.C
24	N.C	**23**	N.C	**22**	**Rec/Rep even** bus	**21**	**Rec/Rep odd** bus
20	GND	**19**	GND	**18**	GND	**17**	GND
16	**P even R** bus	**15**	**P odd L** bus	**14**	0 V	**13**	N.C
12	**Osc. & TRK Ann.** bus	**11**	0 V	**10**	**S even R** bus	**9**	**S odd L** bus
8	0 V	**7**	0 V	**6**	0 V	**5**	0 V
4		**3**	**Main R i/p**	**2**	0 V	**1**	**Main L i/p**

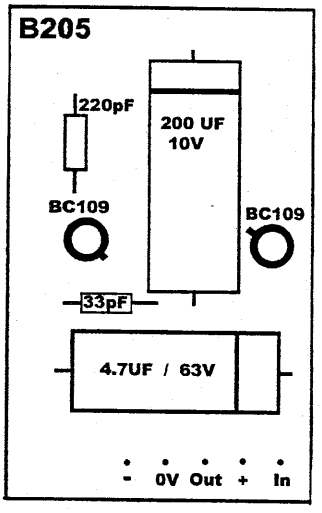
EMI -TG12345- Aux T.M cassette

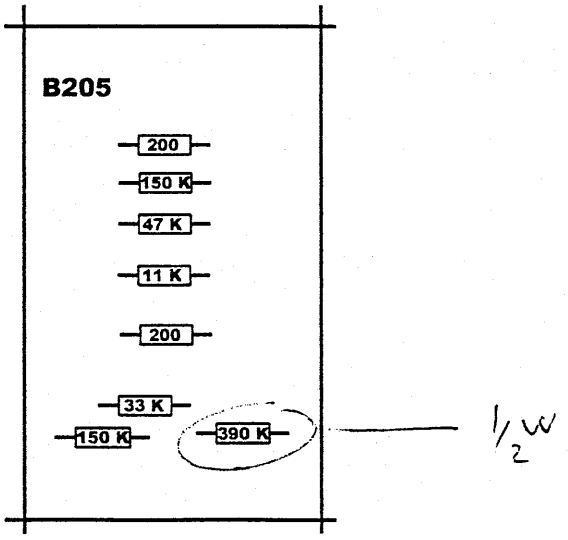
48		**47**	**Rep** (Rec/Rep) CMD signal	**46**	**Machine 2** CMD signal (1v)	**45**	**Solo control**
44	**Rep** (Rec/Fol/Rep) CMD signal	**43**	**Fol** (Rec/Fol/Rep) CMD signal	**42**	**Machine 1** CMD signal (1v)	**41**	**Solo control**
40	N.C	**39**	(Gnd)	**38**	(Gnd)	**37**	(Gnd)
36	GND	**35**	**MTK 4 - M/C 2**	**34**	GND	**33**	**MTK 3 - M/C 2**
32	**MTK 2 - M/C 2**	**31**	GND	**30**	**MTK 1 - M/C 2**	**29**	GND
28	0 V	**27**	**MTK 4 - M/C 1**	**26**	0 V	**25**	**MTK 3 - M/C 1**
24	**MTK 2 - M/C 1**	**23**	0 V	**22**	**MTK 1 - M/C 1**	**21**	0 V
20	GND (solo)	**19**	0 V	**18**	0 V	**17**	N.C
16	**Solo signal**	**15**	0 V	**14**	(Gnd)	**13**	0 V
12	**Rec/Rep** bus 4	**11**	**Rec/Rep** bus 3	**10**	**Rec/Rep** bus 2	**9**	**Rec/Rep** bus 1
8	**Rec/Fol/Rep** bus 4	**7**	**Rec/Fol/Rep** bus 3	**6**	**Rec/Fol/Rep** bus 2	**5**	**Rec/Fol/Rep** bus 1
4	**Replay 2B (4)** Signal	**3**	**Replay 2A (2)** Signal	**2**	**Replay 1B (3)** Signal	**1**	**Replay 1A (1)** Signal

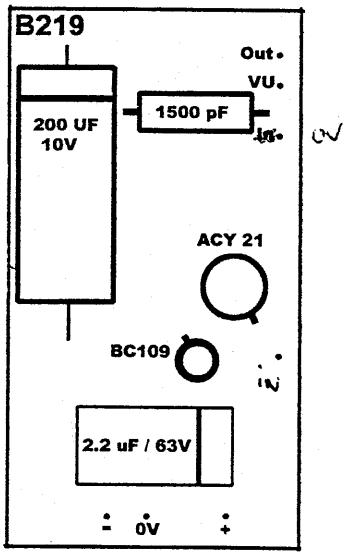
(These are Post Replay/Record mode TMC input link)

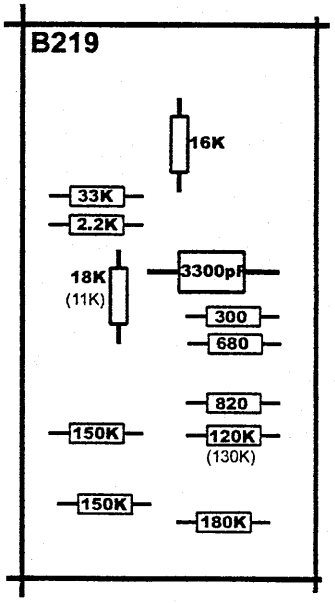

B208
1uF
100V
1uF
100V
2000pF
160V
ACY 21
BC109
1000pF
160V
BC109
ACY 21
-
0V
Out
+
In

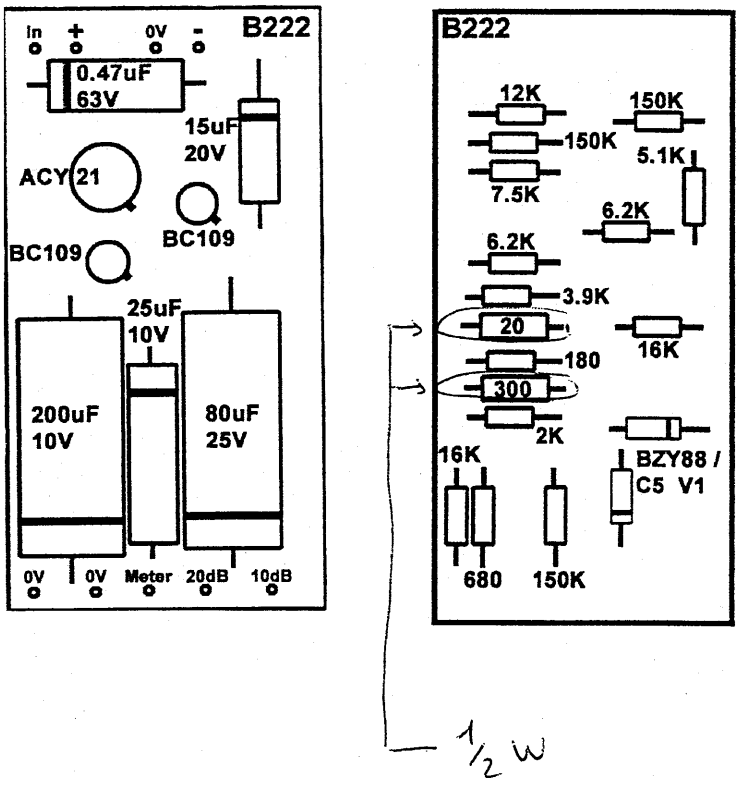

B208
43 K
20K
3.9K
13K
15K
3.3K
3K
150K
3.9K
150K
7.5K


B205
220pF
200 UF
10V
BC109
BC109
33pF
4.7UF / 63V
- 0V Out + In


B205
200
150 K
47 K
11 K
200
33 K
150 K
390 K
1/2 W


B219
Out
VU
200 UF
10V
1500 pF
ACY 21
BC109
2.2 uF / 63V
0V


B219
16K
33K
2.2K
18K
(11K)
3300pF
300
680
820
150K
120K
(130K)
150K
180K


B222
In
+
0V
-
0.47uF
63V
15uF
20V
ACY21
BC109
BC109
25uF
10V
200uF
10V
80uF
25V
0V
0V
Meter
20dB
10dB
B222
12K
150K
150K
5.1K
7.5K
6.2K
6.2K
3.9K
20
16K
180
300
2K
16K
BZY88 /
C5 V1
680
150K
1/2 W