DOLBY LABORATORIES

INSTRUCTION MANUAL

Audio Noise Reduction System

A301

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Contents

Figures

Introduction

The A301 Audio Noise Reduction System has been designed to reduce noises commonly encountered in audio signal recording and transmission systems. These noises may take the form of rumble, hum, crosstalk, clicks, pops, buzzing, and hiss, as well as discrete frequency interference such as television synchronising pulse crosstalk. All of these noises are reduced by the A301 without affecting the overall frequency response or dynamics of the signal itself.

In the particular field of magnetic tape recording, the system will reduce tape hiss and also alleviate other problems such as print-through and high-frequency modulation noise. The print-through reduction is of special significance, as it allows the long-term storage of high quality master tapes with minimal degradation.

The system is suitable for use in any situation in which the signal is available for processing at both ends of the recording or transmission chain. The processing operations can be separated by any distance or any time duration, since once correctly adjusted, the A301 parameters are extremely accurate and stable. Furthermore, the system is tolerant of gain-errors in the recording or transmission channel. An incorrect level to the playback unit of $\pm$ 3 dB does not result in any perceptible alteration of the restored signal.

It should be appreciated that when recording or transmission noise is reduced, other noises masked by it naturally become more apparent. Full use of the increased dynamic range provided by the noise reduction system may therefore sometimes require a tightening of standards in the rest of the chain - i.e. in connection with noise from microphone amplifiers, mixers, and monitor amplifiers, as well as noise from wholly acoustic sources such as buzzing fluorescent lights, creaking chairs, and the movement of persons in the studio. (On the other hand, it can be argued that acoustic noises, having purely natural origins, contribute to a feeling of realism and immediacy.)

The A301 unit is fully self-contained and is normally supplied for mounting in a 19" rack.

Specifications

Layout:	Two independent signal processors per A301 unit; each may be switched into either record mode or playback mode.
Signal connections:	One XLR input and output for each processor (Tuchel connectors optional).
Inputs:	10k ohm balanced bridging transformers, accepting all normal line levels. Provision made for addition of termination resistors, if required, to match line impedance.
Outputs:	Balanced - levels and impedances to order. Normal options are: 0 VU (+4dBm), 600 ohms (U.S. standard). 1.55v (+6dB), 30 ohms (Continental standard). +8dBm peak, 600 ohms (U.K. broadcasting standard). Output termination switches provided on 600 ohm units.
Overall (record-playback) frequency response:	Better than $\pm$ 1dB, 20Hz to 20kHz.
Overall total harmonic distortion:	At + 8dBm (600 ohms), less than 0.1% at 1kHz; less than 0.2% from 40Hz to 20kHz.
Output clipping point:	Better than + 18dBm (600 ohms); better than + 16dB (30 ohms).
Noise reduction:	10dB from 20Hz to 5kHz, rising to 15dB at 15kHz; with noise reduction switched off, system becomes unity-gain line amplifier.
Overall noise level:	Better than 80dB (unweighted) below + 8dBm (600 ohms) or +6dB (30 ohms).
Crosstalk:	Better than 80dB, processor to processor, 20Hz to 20kHz.

Matching between units:	Better than 1dB at any level and any frequency.
Stability:	System is highly stable - does not require routine alignment.
Operating temperature:	Up to 45° C.
Operating controls:	None.
Panel meters:	NAB and DIN level setting meters for recorder gain calibration.
Construction:	Modular, eight plug-in circuit modules together with plug-in chassis module for power supply and audio transformers. Fibreglass printed circuits, solid state devices throughout (103 silicon transistors including stabilized power supply).
Finish:	Anodized aluminum case, front panels dark grey with white characters.
Size:	8 3/4"x 19" rack mounting, 10 5/8" deep (225 x 483 x 270 mm).
Weight:	28 lbs. (13 kgs).
Power requirements:	100-125 v and 200-250 v, voltage selector, 50-60 Hz single phase, 18 VA.

Principles of Operation

In sound recording or transmission systems the high and low audio frequencies are often pre-emphasised during recording and de-emphasised during reproduction in order to improve the signal to noise ratio. However, the equalisation characteristic must be chosen such that even in the worst cases there are no detrimental effects; organ pedal notes or cymbal crashes must not cause distortion. Therefore the allowable boost with fixed equalisation is not as great as it might be for optimum utilisation of the recording medium. For example, recording an instrument such as a piano or violin does not usefully load the channel over the whole audio spectrum, and thus low and high frequency noises are particularly noticeable during reproduction.

It is clear that the situation could be improved with a more flexible equalisation method. The A301 system provides a characteristic, controlled by the incoming signal, which achieves optimum loading of the recording medium under all signal conditions. During playback a complementary characteristic is applied which restores all frequency components to their correct amplitudes and in the process attenuates any noise introduced during recording.

The necessary characteristics are obtained by splitting the spectrum into four bands (see block diagram, page 29). The record signal is produced by adding together the outputs of four independent filter and compressor bands and combining the result with the incoming signal. While each compressor has a compression characteristic which by itself is more like that of a limiter, the overall law produced at the output can be described as compression.

After being recorded or transmitted, the compressed signal is processed in a complementary way. The filter networks and compressors are identical to those used in the recording processor, but they are connected in the feedback loop of an amplifier. This arrangement produces an inverse characteristic to that used in recording; every change in the signal during recording is matched by an equal and opposite change in playback. In this way the signal leaving the A301 is identical in all respects to that entering.

Noise produced by the tape or transmission channel is added to the signal while it is in the compressed condition, in which all low-level signal components have higher than normal amplitudes. On playback the low-level components are attenuated, thereby restoring the signal to its original condition; the noise contribution is therefore attenuated by the same amount.

Circuit Description

Power Supply Module

The power supply module contains the power supply itself, the XLR input and output connectors, the input and output transformers, and the level standardization meters and associated amplifiers. The relevant schematic diagrams are given on pages 32 - 33.1.

Power Supply

The power supply sub-assembly is manufactured to Dolby Laboratories specifications by Coutant Electronics Ltd. The unit delivers an output of +18 V at 370 mA with about 100 µV p-p ripple and noise. The schematic of the unit is given on page 32.

Single phase ac power is supplied via a slow-blow fuse to the primary of the transformer, which produces a main feed of 21V and two subsidiary isolated 14 V feeds. The latter are rectified by MR10 to MR17 and stabilized by MR4 and MR5 to give two rails of 5 V and 9 V respectively. R23 is added to ensure that the positive supply decays before the negative supply at switch-off, which prevents voltage overshoots at the output.

The voltage from the main winding is rectified by MR6 - MR9 and smoothed by C9. The resulting dc is controlled by the compound emitter follower VT6 and VT7 and error-sensing amplifier VT1 - VT4. The base of VT2 is held at a constant potential relative to the positive output terminal by zener diode MR3. The base of VT1 is maintained at a pre-set fraction of the output voltage by a resistor chain which incorporates the voltage control RV1. Diode MR1 is included for temperature stabilization.

The two transistors VT1 and VT2 are connected in the long-tailed pair configuration, acting as a difference amplifier, such that signals proportional to the differences in the two base voltages appear at the two collectors; VT3 and VT4 are connected in a similar manner and provide further amplification. The output of VT4 is connected via R27 to the base of the output pair, thus completing the feedback loop.

When the demand for current from the unit increases, the voltage at the base of VT1 tends to fall, but not as far as the voltage on the base of VT2, which falls by the full amount of the supply change. Thus VT1 draws more current, and VT4 draws less; more current is thereby diverted to the base of VT6 to compensate for the increased demand.

The loop gain of the amplifier is increased at hum and ripple frequencies by the addition of C2 and R5 across R1. Components C3 and R12 tailor the high frequency response of the amplifier. MR2 is added to prevent lock-out on initial switch-on.

Overload protection is provided by VT5, which is normally held in the non-conducting state by the chain R13 and R3. The output current flowing under normal conditions causes very little voltage drop across R17. However, as the load current increases, the drop across R17 eventually causes VT5 to conduct, diverting current from the base of VT6 and thereby limiting the load current to a safe value.

Transformers

The input and output circuitry of the system is given on pages 33 and 33.1. Inputs are fed through XLR or Tuchel connectors JF 405 and JF 406 to the input transformers T403 and T404; the primary windings are left floating. Without the terminating resistors R403 and R404 the unit presents an impedance of more than 10K and is thus suitable for line bridging. Terminals are provided under the chassis to terminate the inputs if required. As with the input transformer primaries, the secondaries of the output transformers T401 and T402 are left floating. The secondaries are fed directly to XLR or Tuchel output connectors JM403 and JM404; output termination switches are provided on 200 ohm and 600 ohm output impedance units.

Meters and Meter Amplifier

The schematic of the meter amplifier is given on page 32.1. The printed circuit board is mounted above the output transformers, and the two amplifier outputs are connected directly to meters on the front panel.

To facilitate the international exchange of tapes, the operating level within the A301 is standardized relative to the magnetic flux level recorded on the tape. This point is covered more fully in the section on Standardization and Alignment (page 14). The internal operating level is monitored at the output of the filter driver amplifier in the amplifier module; a voltage of 500 mV at this point corresponds to a recorded flux of 32 mM/mm. In test tape terms, this level corresponds to the level setting section of European DIN reference tapes (4 dB higher than Ampex Operating Level).

The metering signals from processors A and B are taken via the rack wiring into the power supply module and to the printed circuit card, which comprises two identical amplifiers. Q401 and Q402 form a two-stage dc-coupled amplifier with an operating point stabilized by dc feedback from the emitter of Q402 to the base of Q401, via R415. AC feedback is taken from the collector of Q402 to the emitter of Q401 in a path which includes D401, D402, and a 500 uA meter. In this way, the diode characteristics are modified into a substantially linear relationship of forward current to forward voltage drop; that is, the meter current becomes directly proportional to the input voltage to the amplifier.

The sensitivity of the amplifier is set by the input resistance chain; R410 is adjusted on test to allow for component tolerances in the remainder of the circuit. The meter is calibrated at the DIN mark, since this level is used during system alignment; the accuracy at the NAB mark is satisfactory for normal operating conditions. When either a DIN or NAB standard tape is played back into the A301, the meter will indicate the correct level if the recorder and A301 have been correctly adjusted. For highest accuracy, the A301 noise reduction on-off switch should be in the "off" position during this measurement.

When the A301 is used in the record mode, the meters should indicate the correct level when a tape is being recorded to the same flux level as that of a standard tape.

Amplifier Module

The schematic of the amplifier module is given on pages 34 and 34.1. The input signal is fed to the input level potentiometer RV101, which is adjusted to give standard operating conditions within the system.

After passing through the 30 kHz filter, which removes any tape recorder bias or other high frequency signals in the input, the signal is fed to the filter driver amplifier Q103 and Q104. The low impedance output of the amplifier is passed to the filters in the control module and also to the output amplifier (Q107 - Q110) through R116. The output level of the unit is set by RV104, which controls the negative voltage feedback in the output amplifier.

In the 200 and 600 ohm model (page 34), the output impedance is determined by negative current feedback from R139. The output impedance of the amplifier itself is 200 ohms; other impedances, such as 600 ohms, are obtained by choice of transformer ratios. Low output impedance (30 ohms) is obtained by eliminating the negative current feedback (page 34.1).

The noise reduction signal returning from the control module is amplified by the noise reduction amplifier Q105 and Q106. The output is fed to the edge connector of the module; switches on the back of the unit determine whether the processor operates in the record or the playback mode (see schematic on page 38). For recording, the noise reduction signal joins the main signal at Q107 through R127 and RV103; in playback the signal is passed to Q103 through R117 and RV102, forming a negative feedback loop.

The output of the noise reduction amplifier is also taken to Pin 24 via C122; earthing this point (noise reduction on-off switch) cancels the noise reduction action, and the A301 then effectively becomes a line amplifier with a gain of unity.

Compressor Module

The schematic of the compressor module is given on page 35, and the compression characteristic produced is shown on page 29. It should be noted that each module contains two independent compressor circuits and that all compressor modules are identical and interchangeable.

The input signal to each compressor (the output from one of the filters in the control module) is fed to the emitter follower Q202, which in turn feeds the balanced diode compressor circuit D201, 202, 204, and 205. The outputs of the two halves of the compressors are added and then amplified by Q205 and Q206. The signal is passed through a limiting circuit D206 and D207 and returned to the control module, where the outputs of all compressors are combined. The output is also amplified further by Q208 and passed to a

phase splitter and rectifier circuit Q209, D213, and D214, and from there to the integrators in the control module.

The resulting dc signal, with defined rise and fall times, returns to the compressor module at the base of Q203, which controls the current flowing in the diode compressor network. Control current will start to flow only when the input voltage is more positive than the voltage on the base of Q204 (neglecting emitter-base voltage drops of Q203 and Q204), so that RV201 acts as a compressor threshold control. The diodes form part of an attenuator (which includes R214 and R215), such that the audio signal output at the base of Q205 varies in amplitude with the control signal; dc shift is eliminated by the balanced configuration. D203, R216, and R217 determine the attenuation law. Distortion produced by the compressor diodes is extremely low because of the low signal amplitudes handled.

The down-turning compression curve shown on page 29 (Differential Network curve) is achieved by feeding part of the input signal around the compressor network via R210 into the control amplifier circuit. At low-levels this feed-forward signal has no effect on the attenuator characteristic, but at higher inputs it causes the output of the attenuator to decrease with increasing input.

Control Module

The control module schematic is given on page 36. This module coordinates and controls the operation of the four compressors. The signal from the driver amplifier enters the control module at JM301, Pin 1, is passed to all the filters, and from the outputs of these to the appropriate compressors. The signal is rectified in the compressor module and then passed back to the control module for integration.

The integrators are specially designed to give a dynamically optimum smoothing action; the schematic on page 37 gives a simplified layout. The rectifier circuit first charges a pre-integrator capacitor. The dc output is then passed through the emitter follower Q201 to a second integrator capacitor via a diode non-linear network arranged such that fast large changes in signal amplitude are passed quickly, while small changes are transferred slowly. In this way both fast recovery and low signal distortion are achieved; in conventional time-constant circuits these two requirements are mutually exclusive. The recovery time-constant is governed by R250, together with the pre-integrator capacitor. A special version of the control module which is designed for half-speed tape to disc transfers is described on page 27.1 (Cat. No. 3-50).

Installation and Operation

The A301 noise reduction system is designed for mounting in a standard 19" rack. However, it is not critical in position and can be operated in any plane. When first installing the system, the mains voltage tap in the power supply module should be checked for correct connection.

Cannon XLR connectors are provided at the rear for the input and output signals; a three pin plug is also supplied for single phase mains power.

In installing and operating the A301, the following general principles should be borne in mind (see block diagram, page 28).

1. One recording processor and one playback processor are required for each audio channel. In a mono system, therefore, only one A301 unit is required; one processor is switched to record and the other to playback. In a stereo system a similar arrangement can be used, with one A301 unit for each channel; for stereo playback only, both processors are switched to the playback mode. The Remote Changeover Unit, which takes advantage of the switchable mode facility for both recording and playback, is discussed on p. 27.2.

2. The recorder with which the A301 is used should have flat frequency response and a fixed overall gain.

3. The noise reduction system should be considered to be part of the recorder and not a studio tool such as an equaliser, filter, mixer, or compressor. The use of these latter facilities should, in general, be confined to before and after the recorder and the noise reduction system - that is, before point I and after point IV on page 28. If they are introduced between the A301 and the recorder (points II and III) the overall characteristics of the system will be altered, and normally such operation is not recommended.

4. Level adjustments to compensate for variations in tape and recorder characteristics should be made between points II and III - i.e. in the recorder itself. Initial level adjustments should follow the procedure given in the Standarization and Alignment section. The Simplified Operating Instructions at the end of the manual should be used for routine operation.

5. Programme level monitoring can be accomplished at any point (I, II, III, IV); amplitude errors at points II and III are negligible under signal conditions.

6. The A301 noise reduction circuitry can be de-activated by means of the noise reduction on-off switch at the back of the unit. With the noise reduction switched off, both processors effectively become unity-gain line amplifiers.

7. When safety copies are being made during recording, it is unnecessary to provide a separate A301 unit for each recorder. More than one recorder can be bridged across each A301 output.

8. It is unnecessary to use an A301 unit when making copies of noise reduction recordings; copies can be made with two ordinary recorders. The noise reduction characteristic on the recording is carried straight through the copying process, and only the final playback must be made through an A301 unit.

9. For level standardization in the international exchange of tapes, a 700 Hz tone should be recorded at the beginning of the tape at Ampex Operating Level (NAB mark on A301 meters).

Standardization and Alignment

Basic standardization requirements

Correct operation of the A301 Audio Noise Reduction System is dependent on only one basic requirement - that the signal voltage fed into the playback processor should be the same (with 2dB) as that which leaves the recording processor. In other words, the recording system should have an overall record-playback gain of unity. However, the question of tape interchangeability imposes a further requirement - that the signal levels in the noise reduction system should be related to the levels on internationally recognised test tapes (Ampex-NAB or DIN).

Because of these requirements, it is necessary to give some thought to the matter of the levels, impedances, and terminations used in the studio in which the noise reduction system is installed. Once these factors have been established, it is a straightforward matter to adjust the input and output level controls on the A301 appropriately. It should be noted that, apart from terminations, only the input and output level controls are used in matching the A301 to studio conditions; all other controls in the system (Rec Cal, PB Cal, compressor Gain, compressor Law) have adjustments which are independent of the particular signal standard used.

Meters are provided on all units above serial no. 180 to assist in setting levels. As described previously, the meters measure the output of the filter driver amplifier, thereby giving a direct indication of the level being fed to the compressor circuitry. When the level conditions are correct in a complete chain (A301 record processor, recording or transmission channel, A301 playback processor) the record and playback A301 meters should give identical indications. Overall level adjustment is therefore easily accomplished with reference either to the NAB mark or the DIN mark.

If the A301 system is used on a transmission channel (landline, microwave link) the following standarized operating conditions are recommended:

1. With fast risetime peak programme meters, the nominal 100% or peak operating level should correspond to the DIN mark on the A301 meters (using tone).

2. With VU meters, O VU should correspond to the NAB mark on the A301 meters (using tone).

Regardless of the method of monitoring the programme level, it is necessary only to ensure that the two A301 meters on the input and output of the channel yield the same readings.

For tape recording, the considerations above are similarly applicable. However, because of the requirement for international tape interchangeability, it is also necessary that the operating level within the A301 system should be related to an absolute flux level on the tape. As mentioned previously, standardization is accomplished by use of the two main 15 ips alignment tapes in use, Ampex-NAB and DIN. These tapes employ different reference levels - the DIN level being approximately 4dB higher - which has been allowed for on the scales of the A301 level setting meters.

For standardization purposes the A301 compressor alignment is tied to the signal level produced by the DIN alignment tape (that is, from a recorded flux of 32 mM/mm at 1 kHz). Once the internal alignment has been carried out, routine level setting and operation should follow the Simplified Operating Instructions on the last page of the manual.

Alignment - Preliminary

Because of the stability of its circuitry, the A301 system does not require routine alignment. Nevertheless, some thought must be given to the matter of standardization and alignment at the time of installation. The alignment procedure breaks down into two main parts:

a. Adjustment of the input and output level controls to suit the signal standard used.

b. Adjustment of the noise reduction circuitry.

Studio level check:

For the purpose of adjusting the input and output level controls, the following studio level check should be made.

a. Transmission applications (landlines, etc.).

Using an AC millivoltmeter, measure (in volts) the signal level used in the studio or network under the following conditions: O VU (using VU meters) or peak operating level (using peak programme meters). The A301 level controls will be adjusted such that this voltage corresponds to either the NAB or DIN mark, respectively, on the front panel meters.

b. Tape recording applications.

Use one of the following test tapes:

Ampex 01-31311-01 Reproduce Alignment Tape-15 ips NAB	(NAB mark)
Ampex 01-31315-01 Level Set Tape-15 ips	(NAB mark)
Agfa DIN-Bezugsband 38, according to DIN 45513	(DIN mark)

Reproduce the tape under normal level conditions, measuring (in volts) the signal produced by the level setting section of the tape. The A301 level controls will be adjusted such that this voltage corresponds to the NAB or DIN mark, as appropriate.

Processor Alignment

After the studio level check has been made, the two signal processors are adjusted accordingly, following a standard procedure which ensures that all modules of a given type are fully interchangeable. The same procedure is used for processors switched to the record mode as for those switched to the playback mode. Except for 30 ohm output impedance units, the outputs should be terminated correctly during alignment.

The following instruments are required:

1. Alignment Extender, catalogue no. 6-B
2. DC voltmeter
3. Audio signal generator
4. AC millivoltmeter with voltage and dB scales; minimum input impedance 100 K ohms.

The following procedure is used for complete alignment of the A301 system:

A. DC voltage adjustment

1. Remove one amplifier module, plug in Alignment Extender (switched to "Direct"), and insert amplifier module into connector on extender; use clip on extender to secure amplifier module.
2. Check supply voltage (+18V, $\pm$ 0.5 V) at TP102. If necessary, remove power supply module and adjust output voltage control (RV1).

B. Adjustment of input and output level controls

1. Unplug one amplifier module. Insert Alignment Extender and plug amplifier module into extender.
2. Set extender switch to "Input-Output Level".
3. Feed 1 kHz signal into input XLR connector at voltage previously determined in "studio level check".
4. Adjust Input Level control (RV101) for reading of "NAB" or "DIN", as appropriate.
5. Connect AC millivoltmeter to output. Adjust Output Level control (RV104) for overall gain of unity, as measured from input XLR connector to output XLR connector.
6. Repeat steps 1 to 5 for second amplifier module.

NOTE: No meters were used on units below serial No. 180. The non-metered alignment procedure calls for an input signal at the DIN level (4 dB above NAB), the Input Level control then being adjusted for a reading of 100 mV at TP101. Therefore, on metered units the instruction on the amplifier panel to "Adjust for 100 mV at TP101" should be ignored in NAB installations, except for the compressor adjustments described below. The old non-metered procedure and the new metered procedure are fully compatible and produce identical results.

C. Adjustment of noise reduction circuitry

Amplifiers:

1. Ensure that noise reduction on-off switch is in "on" position.
2. Unplug one amplifier module. Insert Alignment Extender and plug amplifier module into extender.
3. Feed in 1 kHz at normal studio level, as in step B-3.
4. Connect AC millivoltmeter to output XLR connector.
5. Move extender switch from "In-Out Level" to "Rec Cal" position. Adjust Rec Cal control (RV103) such that output level drops exactly 10 dB. For greatest accuracy, use 10 dB range switch on meter rather than dB calibration on meter scale.

6. Move extender switch from "In-Out Level" to PB Cal" position. Adjust PB Cal control (RV102) such that output level rises exactly 10dB.

7. Repeat steps 1 to 6 for second amplifier module.

Compressors:

8. Feed 1kHz into input XLR connector, adjusting oscillator level for reading of "DIN" on A301 meter (which is equivalent to obtaining 100 mV at TP101).

9. Unplug one compressor module. Insert Alignment Extender and plug compressor module into extender.

10. Set extender switch to "Gain".

11. Adjust Gain control (RV202) of top compressor for reading of 10 mV at TP201, using AC millivoltmeter.

12. Move extender switch to "Law" position and adjust Law control (RV201) for reading of 50 mV.

13. Repeat steps 10 to 12 for bottom compressor.

14. Repeat steps 8 to 12 for three remaining compressor modules.

Control Modules:

The control modules do not require adjustment.

Overall Alignment Check

After each processor has been aligned, the following checks should be made:

1. With the processors switched to the record mode, feed a level of about 50dB below the DIN level into the inputs of the unit. When the noise reduction on-off switch is in the "on" position, the outputs should be boosted by 10dB ($\pm$0.5dB) uniformly up to 5kHz. The outputs should be 15dB higher at 15kHz.

2. With the processors switched to the playback mode, feed a level of about 40dB below the DIN level into the inputs of the unit. When the noise reduction on-off switch is in the "on" position, the outputs should be attenuated by 10dB ($\pm$0.5dB) uniformly up to 5kHz. The outputs should be 15dB lower at 15kHz.

3. Processor A should then be switched to the record mode and processor B to the playback mode. A signal should be fed through the two processors in series. At all levels the output overall should be flat, $\pm$ 1dB, from 20 Hz to 20 kHz.

Servicing

Overall Check

As a quick check for satisfactory operation of the A301 system, the following test is recommended.

1. Switch processor A to record mode and processor B to playback mode.
2. Connect output of processor A directly to input of processor B. Ensure that termination conditions are correct.
3. Ensure that noise reduction switch is in "on" position.
4. Feed 250 Hz signal at normal operating level into processor A.
5. Check that both meters indicate correctly (NAB or DIN).
6. Check that levels are correct at processor A and B outputs.
7. If level check is satisfactory, make frequency sweep over whole audio band (30 Hz to 20 kHz) at 30 dB below DIN level or about 26 dB below NAB level, measuring output of playback processor. Output level should be same as input level, and frequency response should be flat within ± 1 dB if system is operating normally.

Identification of Faulty Modules

The first diagnostic step (after making certain that the noise reduction system is at fault) is to determine which of the two processor units is operating incorrectly. Measurement or monitoring of the input and output levels on an A - B comparison basis is the best method of determining this. In a stereo system a reversal of channels is often helpful.

When the ailing processor has been identified, the next step is to determine which of the four modules is at fault. Since only three types of modules are used (Amplifier, Control, and Compressor) substitution checking of modules is a straightforward matter. The power supply can also be checked by substitution, although a fault here, except with transformers and connectors, will affect both processors and can be recognized by this symptom. In a large installation, spare modules should be available for emergency replacement, but modules can always be switched about within a given unit or borrowed from one which is known to be working properly.

In the diagnostic process, first unplug the control module. The positions of the modules are given on page 31 and also on the side of the Alignment Extender. With the control module withdrawn, only the amplifier module is in the circuit - both compressor modules are inactivated. The amplifier module has unity gain and does not alter the signal in any way; any departure from the ideal state is thus easily recognized. Successful passing of this test is a necessary - and nearly sufficient - proof that the amplifier is working properly, the only reservation being the possibility of a fault in the noise reduction amplifier section, Q105 and Q106.

Following this test, replace the control module and make substitution tests on the compressor modules. If the trouble persists, change the control module and finally the amplifier module. The power supply module, which includes the input and output transformers, should not be overlooked; substitution tests can be made in the same way as with the other modules. The A301 does not have to be switched off when the modules are unplugged or plugged in. However, as the power supply module is withdrawn from the chassis, the power cord and the audio cables will be pulled out with it. To remove the power supply, these connections have to be unplugged, but provided a suitable length of free cable is left during installation this can be achieved from the front.

If the unit is still faulty, the wiring and connectors at the rear of the main chassis should be examined.

Module Servicing

For module servicing, remove the cover plates and use the Alignment Extender. The Alignment Extender should be switched to 'Direct', except when its special test facilities are required.

A quick method of troubleshooting is to compare the faulty module with one known to be good. In general, if there are any errors in the ac performance, a complete dc voltage check should be made before progressing any further. In the following section, tables of normal ac and dc voltages are given for each module. For most tests an ac millivoltmeter

(input impedance at least 100K), a dc meter (minimum sensitivity 20,000 ohms per volt), and an audio oscillator are required.

Malfunctions can usually be traced to faulty electrolytic capacitors, connectors, potentiometers, and, from time to time, to the transistors themselves.

Voltages - Amplifier Module

Test Notes:

The amplifier under test should be plugged into the Alignment Extender, switched to 'Direct'. The AC voltages in the amplifier module depend to some extent on the particular signal standards used. However, the 'DIN' level always corresponds to 0.5 V at the emitter of Q104 and to 100 mV at TP101.

Normal current consumption: 52 mA

DC Voltages	Emitter	Base	Collector
Q101	11	12	18
Q102	10	11	18
Q103	1.5	2	10
Q104	9	10	16
Q105	1	2	10
Q106	9	10	18
Q107	2	3	10
Q108	9	10	18
Q109	8	9	18
Q110	7	6	0

Voltages - Compressor Module

Test Notes:

The compressor under test should be plugged into the Alignment Extender switched to either the 'Gain'or 'Law' position. The audio input to the A301 unit should be 1000 Hz at 'DIN' Level.

Normal current consumption: 39 mA

DC Voltages		Emitter	Base	Collector
Q201	Gain	4.8	5.1	18
	Law	5.4	5.8	18
Q202		8	9	18
Q203	Gain	4.7*	4.9*	17.8*
	Law	5.0*	5.4*	17.6*
Q204	Gain	4.4*	4.2	0.2*
	Law	4.6*	4.2	0.4*
Q205		8	9*	18
Q206		7	8	12
Q207		12	13	17
Q208		2	3*	8
Q209		5	6*	12

Starred voltages should be measured with a very high input impedance meter, such as a VTVM, to avoid errors in measurement.

Compressor module voltages, continued:

AC voltages		emitter	collector
Q202	Gain	1.5 mV	
	Law	15	
Q205	Gain	1.3	
	Law	6.4	
Q206	Gain		10
	Law		51
Q207	Gain	10	
	Law	50	
Q208	Gain		140
	Law		760
Q209	Gain	140	120
	Law	760	650
TP201	Gain	10	
	Law	50	

Voltages - Control Module

Test Notes: The control module normally draws a current of 4.1 mA. There are no active elements or potentiometers on this module, so that, apart from possible failure of the two electrolytic capacitors, C313 and C314, faults are extremely unlikely.

DC voltages C313: 9.6V

C314: 9.6V

Voltages - Meter Amplifier

Test Notes:

The power supply module should be withdrawn from the A301 chassis and a suitable power cord connected; the DC voltages on the amplifier card can then be measured. Almost all faults will be found by such measurements, and in most cases it will be unnecessary to investigate the AC characteristics. However, signals can be injected into pins 2 and 3 of the power supply edge connector, corresponding to channels A and B, for AC checking. Since the input at these pins is normally at a DC potential of about 9 volts (from the filter driver amplifier in the Amplifier Module), a similar voltage should be applied during AC tests to polarise the input capacitors correctly. An input of 500 mV should give a reading at the DIN mark, with 316 mV for the NAB mark.

DC Voltages	Collector
Q401	12
Q402	7

Transistor Types

General Data

Silicon transistors are used throughout. The voltage rating is 25 V, except for certain types in the stabilized power supply module. Most of the audio signal transistors are high gain types, some of which are chosen for their low noise properties. All have a minimum f_t of 50 MHz. The table below lists the transistors, together with their important parameters for each particular position. All the current gain measurements (h_{fe}) are made at a collector current of 2 mA, except where stated otherwise. General purpose transistors are labelled 'gp', and low noise versions 'ln'.

Detailed Data

Circuit No.	Description	h_{fe} min	Typical types
Amplifier Module			
Q101	npn, gp	100	BC108, 2N2924
Q102	npn, gp	100	BC108, 2N2924
Q103	npn, ln	200	BC109, 2N2484, 2N3391A
Q104	npn, gp	100	BC108, 2N2924
Q105	npn, ln	200	BC109, 2N930, 2N2484, 2N3391
Q106	npn, gp	100	BC108, 2N2924
Q107	npn, ln	200	BC109, 2N930 2N2484, 2N3391
Q108	npn, gp	100	BC108, 2N2924
Q109	npn, gp	100	BC108, 2N2924
Q110	pnp, gp	100	2N3702

Circuit Number	Description	h_{fe} min	Typical Types
Compressor Module			
Q201	npn, high gain	100 at 100 µA	BC108B
Q202	npn, gp	100	BC108, 2N2924
Q203	npn, high gain	50 at 10 µA	BC109C, 2N930, 2N2484
Q204	pnp, high gain	50 at 10 µA	Selected 2N4058
Q205	npn, ln high gain	100 at 100µA	BC109C, 2N930. 2N2484
Q206	npn, ln	100	BC109, 2N929, 2N2484, 2N3391
Q207	npn, gp	100	BC108, 2N2924
Q208	npn, gp	100	BC108, 2N2924
Q209	npn, gp	100	BC108, 2N2924
Power Supply Module			
VT1-4	npn, Coutant SM4976		2N3709
VT5	npn, Coutant SM4977		2N697
VT6	npn, Motorola 2N3053		2N697, 2N3418
VT7	npn, Motorola MJ2801		2S033, 2S034
MR3	Motorola zener, ¼M/4.3/Z5		OAZ200, OAZ240
MR4	Motorola zener, ¼M/5.1/Z5		OAZ201, OAZ241
MR5	Motorola zener, ¼M/9/Z5		OAZ207, OAZ247
MR6-9	Motorola IN4003		1S2069
MR10-17	Hughes HS3131		OA202, MS2H
MR1-2	Hughes HS3131		OA202, MS2H
Q401	npn, gp		BC108, 2N2924
Q402	pnp, gp		2N3702

Alignment Extender (Cat. No. 6-B)

The Alignment Extender is designed for servicing and adjustment of the A301 modules. For troubleshooting purposes the switch on the extender should be in the 'Direct' position, which connects the pins on the rear of the extender directly to the corresponding sockets on the front; see schematic on page 39.

The remaining positions of the switch effect various alignment interconnections, enabling system alignment to be carried out rapidly with minimum adjustment of the external measuring equipment. Three of the switch positions are for use with the amplifier module, the other two for the compressor module.

With an amplifier module on the extender, the switch is set first to 'Input-Output Level'. In this position the noise reduction amplifier is inoperative (S60lb), which enables both the input and output levels to be adjusted without interactions from the compressors.

The switch is then moved to the 'Record' position, which connects the unit in the record mode by S601d and S601f. The output of the filter driver amplifier is connected to the input of the noise reduction amplifier via the precision resistor R601 and S601b. In this way a known current is injected into the amplifier, enabling the 'Rec Cal' control RV103 to be adjusted.

In the 'Playback' position the same signal (from R601) is injected into the noise reduction amplifier, but S601d and S601f connect the unit in the playback mode, allowing the 'PB Cal' control RV102 to be adjusted.

In both the Rec Cal and PB Cal positions, the limiting diodes in the noise reduction amplifier circuit (D104, D105) are disconnected by S601e in order to prevent their operation during the calibration procedure. These diodes are normally brought into use by a link on the rear wiring of the chassis, connecting them to earth; with the extender in use, this link is replaced by S601e, which connects pin 21 to earth in the 'Direct' position.

The remaining two positions are used for alignment of the compressor module. In the 'Gain' position, the filter driver output is picked up from pin 1 via wiring on the rear of the chassis and is fed to the precision attenuator R60 and R605 through S601a. When the 'DIN' level is fed into

the system, the attenuator produces an accurate signal of 50dB below 500 mV. This calibration signal, enabling the low-level compressor gains to be set (RV202), is fed by C601, R608 and S601c to the input of the upper compressor and by R609 and S601d to the input of the lower compressor. DC bias for the compressor input stage, which is normally derived in the control module, is provided by R606 and R607.

With the Alignment Extender switch in the 'Law' position, the input to the compressors is raised by 20dB (S601a), and the law controls RV201 are adjusted.

Half-Speed Control Module

Cat. No. 3-50

The Half-Speed Control Module, identified by a white insert in the handle, is used in place of the normal control module during half-speed tape to disc transfers. Refer to page 31 for the control module positions in the A301 unit. Unplug the normal control modules and insert the half-speed modules; the system is ready to use without any further alterations or adjustments.

In the half-speed module the integrator time-constants are doubled and the filter frequencies are halved. Correct half-speed playback processing of noise reduction tapes will thus be obtained. The tape recorder playback level and equalization should be adjusted or modified such that half-speed playback of a normal speed alignment tape yields the usual operating level and flat frequency response. Any special frequency compensation used to optimize half-speed cutting should be introduced after the A301 unit, not before it.

The schematic of the half-speed module is the same as that of the normal control module on page 36. However, the component values in the integrator and filter circuits are as follows:

C301	2.0 uF 2%	L301	63.8 mH, 1%
C303	0.2 uF, 2%	L302	2.39 H, 3%
C304	4.0 uF, 2%	L303	21.2 mH, 1%
C306	0.4 uF, 2%	L304	2.39 H, 3%
C307	2.0 uF, 2%	L305	63.8 mH, 1%
C309	0.2 uF, 2%	R318	800 ohms, 1%
C310	4.0 uF, 2%	R320	750 ohms, 1%
C312	0.4 uF, 2%	R321	820 ohms, 1%
C315	0.177 uF, 1%	R322	750 ohms, 1%
C316	6.64 uF, 1%	R323	800 ohms, 1%
C317	0.0592 uF, 1%		
C318	6.64 uF, 1%		
C319	0.177 uF, 1%		

REMOTE CHANGEOVER UNIT

Cat. No. 7

Instructions

Contents

A. List of Figures

B. Introduction

The Remote Changeover Unit basically enables one A301 unit to do the work of two. For applications in which playback during recording is unnecessary, the changeover unit automatically transfers the noise reduction system back and forth between the record and playback modes as required. A single A301 unit can thus be used for stereo recording or playback; for four or eight-track operation the changeover feature can be a significant economic factor.

The changeover unit, which can be added at any time, replaces the normal A301 back panel. Record and playback input and output connectors are provided for two recorder channels. Controlled by relays, the following functions are provided independently for each processor: transfer of input and output connections to record or playback side of recorder, together with selection of record-playback operating mode to suit; noise reduction on-off (A301 in or out of circuit); remote mode signalling.

Powered by an internal 24 volt power supply, the changeover unit may be controlled by remote switches or relay contacts, the operating mode being indicated by remote lamps if desired; when connected to the record circuit of the tape recorder, the changeover unit is completely automatic. Override facilities are also provided, enabling the unit to be controlled manually when required.

The signal connections are arranged such that during playback, Line-Out is the tape replayed through the noise reduction system; during recording, Line-Out is the unrestored noise-reduction tape signal.

In addition to the normal signal connections, a switched monitor output is provided, enabling the signals at Line-In, To Recorder, From Recorder, and Line-out to be measured or checked conveniently.

C. Use of A301 and Remote Changeover Unit in audio chain

Refer to Fig. 1.

1. Connections for one track shown; complete A301 unit (two processors) serves two tracks.

2. Changeover operation comprises:

   a. Changeover of A301 signal connections from record to playback side of recorder.

   b. Change of operating mode of A301 to suit.

c. Power to remote indicator lights as appropriate.

3. Signal goes through processor on one side, straight-through on the other side.

4. In bypass mode, signal goes straight-through on both sides.

D. Installation

1. Mounting of changeover unit on A301. Refer to Fig. 2 and Fig. 7 (Pages 39.2 and 39.7).

a. Check that changeover unit is wired for correct power line voltage. To change voltage, refer to Fig. 7.

b. Remove back panel of A301.

c. Unplug mode switch connectors and discard back panel assembly.

d. For units above Ser. No. 630, plug leads from changeover unit as shown in Fig. 2. For units prior to Ser. No. 630, remove links or switch wires from pins 29-32 of JF504 and JF508 (amplifier connectors). Then remove connector on changeover leads and solder leads to above pins (29, blue; 30, green; 31, yellow; 32, red).

e. Install unit on rear of A301 using two short and four long screws provided.

f. Plug XLR cables and power cable from changeover unit into A301.

2. Terminations:

It is recommended that the whole recording setup should be operated such that all termination resistors are connected on the sending end and that all inputs are bridging. The A301 outputs should thus be terminated internally, together with the mixer outputs and tape recorder outputs. Check that the recorder inputs, A301 inputs, and monitor inputs (from A301 playback) are all bridging.

An alternative method of terminating is to leave all outputs unterminated and to terminate all inputs. This method is, however, not too practical in most recording situations because of the frequent necessity of bridging more than one recorder across the mixer outputs (or, with noise reduction, more than one recorder across the A301 outputs). The first method of terminating will therefore usually prove to be the most convenient.

3. Remote Control Interconnections:

Refer to Fig. 3.

a. For ganged remote control of all processors, connect control circuit and gang cables as shown.

b. For individual remote control of each processor, use separate remote control circuits (no gang cables).

c. For automatic record-playback changeover, use spare contact on record relay of tape recorder for control of each track. If no spare contact is available, connect extra relay (single pole, normally open) in parallel with record relay of recorder. For on-bypass function, switches installed in mixing console may be used.

4. Indicator Lamps:

If use of the remote mode indicator lamp facilities is desired, a dummy plug wired according to Fig. 3 or Fig. 6 must be used. For separate control of each processor, a dummy plug should be inserted in each Remote-Out socket, while for ganged control the dummy plug should be inserted at the end of the line as shown in Fig. 3.

The purpose of the dummy plug arrangement is to provide for fail-safe operation of the mode indicator lamps. The lamps are energized only if all of the processors in the chain are in the same mode, which takes account of improper remote control interconnections, the A301 Mode switches being incorrectly set, or power failure to (or in) any of the changeover units. The fail-safe facility is obtained by looping the lamp connections through all of the changeover units; the lamp current must thus not only pass through all of the interconnecting cables and contacts but through contacts on the A301 Mode switch S701C and through contacts on relay RL702, which is energized by a simple logic circuit comprising diodes D704, D705, and D706.

It should be noted that the fail-safe facility will not detect that the power cable joining the A301 to the changeover unit may be disconnected, that the noise reduction switch on the A301 may be in the off position, or that the signal connections themselves may be incorrect.

The remote indicator lamps themselves may be any convenient 24 volt incandescent lamps, drawing a maximum of about 100 mA each (2-3 watts).

E. Operation

1. Manual Operation:

For manual control of the changeover unit (i.e. by means of the A301 Mode switches on the back of the unit), no control cables are necessary. Simply switch the unit to the operating mode required.

2. Remote Operation:

Ideally, the changeover circuits relating to a particular track should be controlled automatically by the appropriate record button circuit of the tape recorder. For manual remote control, each processor may be controlled independently by the use of a separate remote control cable and switch assembly. Whether by automatic or manual remote mode control, separate control of each processor is necessary for multiple-track work in which sel-syncing and ping-ponging may be involved.

Alternatively, ganged control of all processors may be employed, a practical operating method for two, three, and four-track classical music. The manual override facility, using the A301 Mode switches, may nevertheless be used on any track without disturbing the remote control of the other tracks.

3. Indicator lamps:

The indicator lamps are designed to provide a visual reminder that the noise reduction system is switched to the required operating mode. If separate remote control and indicator lamp facilities are provided for each track, the lamps indicate the true state of the system, regardless of whether the control may have been accomplished remotely or by means of the A301 Mode switches on the back of the changeover unit.

If ganged remote control and mode indication are used, the fail-safe feature ensures that the lamps operate only when all of the changeover units are in the same mode, the purpose of this arrangement being to avoid confusion. For instance, operating situations may arise in which it is desired to have one track in a different mode from that of the other tracks (e.g. three tracks recording, one playing). In such cases, a combination of remote control and manual control may be used, but, as all of the tracks are not in the same mode, the indicator lamps will be inoperative.

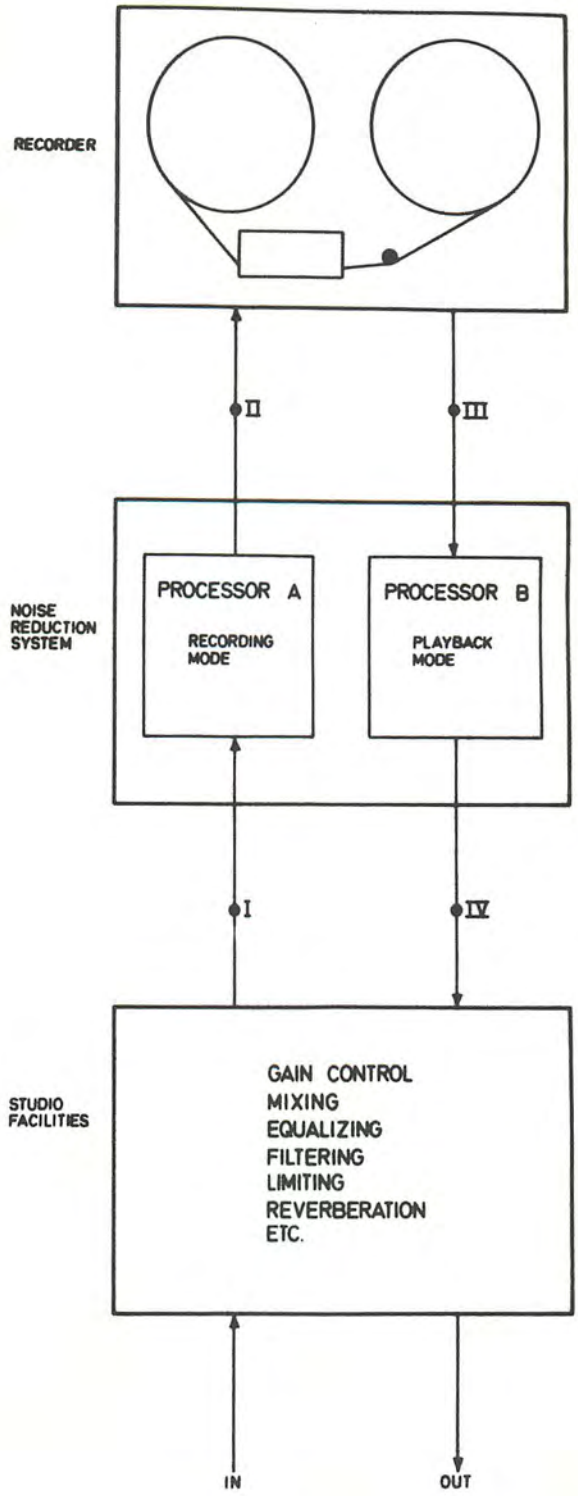
4. Monitor facility (signal test point):

A monitor switch, together with a monitor output socket, is provided for each processor, whereby Line-In, To Recorder, From Recorder, and Line-Out may be checked. In order to avoid disturbing the levels in the system, the monitor load should be 10K greater.

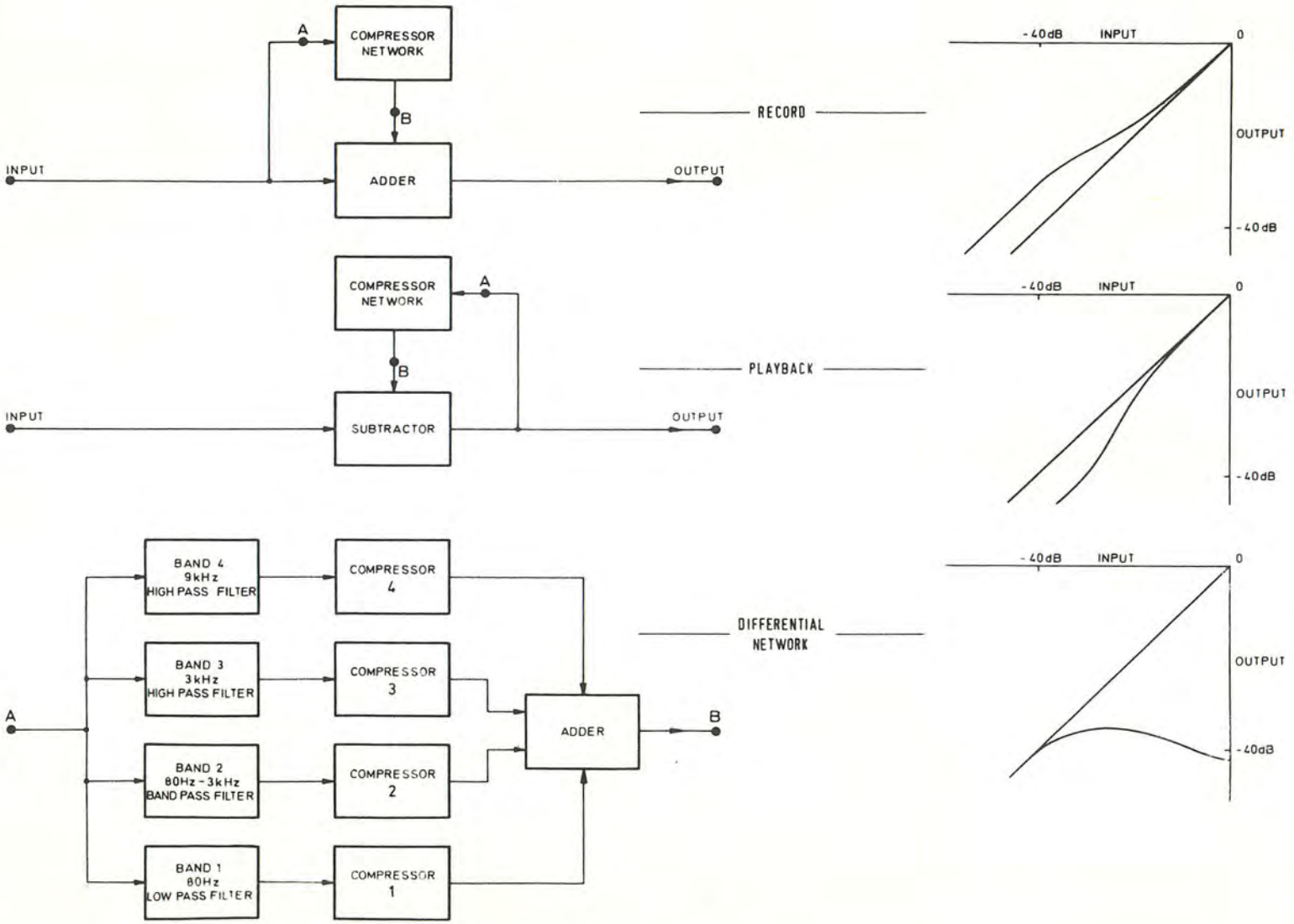
In the initial set-up of the system, a VTVM may be connected to the monitor output for convenient measurement of levels. With the switch set to the To Recorder position, the monitor output may also be used to feed a second recorder.

F. Schematics

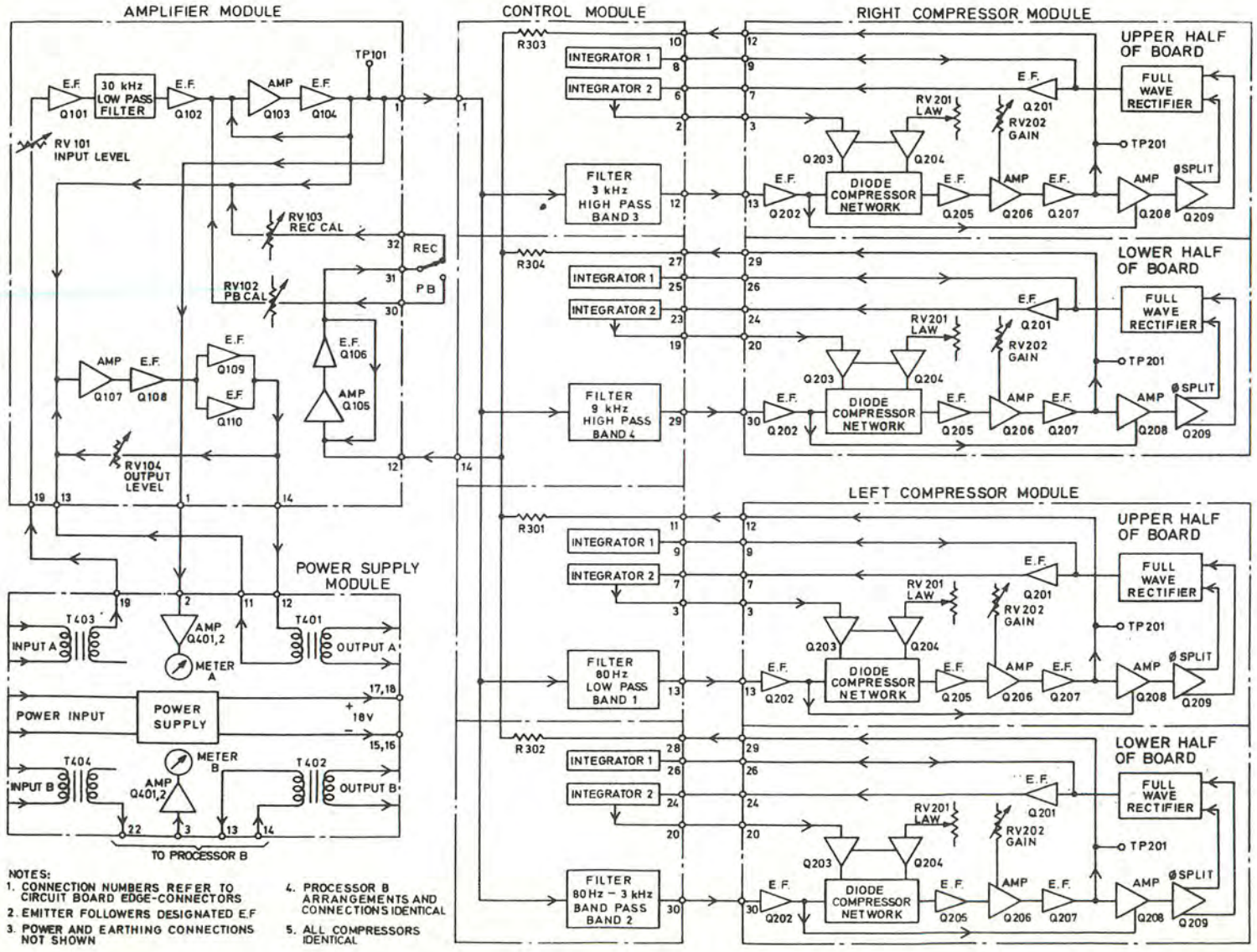
Fig. 5 shows the signal connections relating to one processor, Fig. 4 being a simplified version of the same. The control circuitry for Fig. 5 is given in Fig. 6, and the common 24 volt power supply is shown in Fig. 7. One Remote Changeover Unit thus comprises one power supply (Fig. 7), two signal circuits (Fig. 5), and two control circuits (Fig. 6).



USE OF NOISE REDUCTION SYSTEM
IN AUDIO CHAIN (ONE CHANNEL)

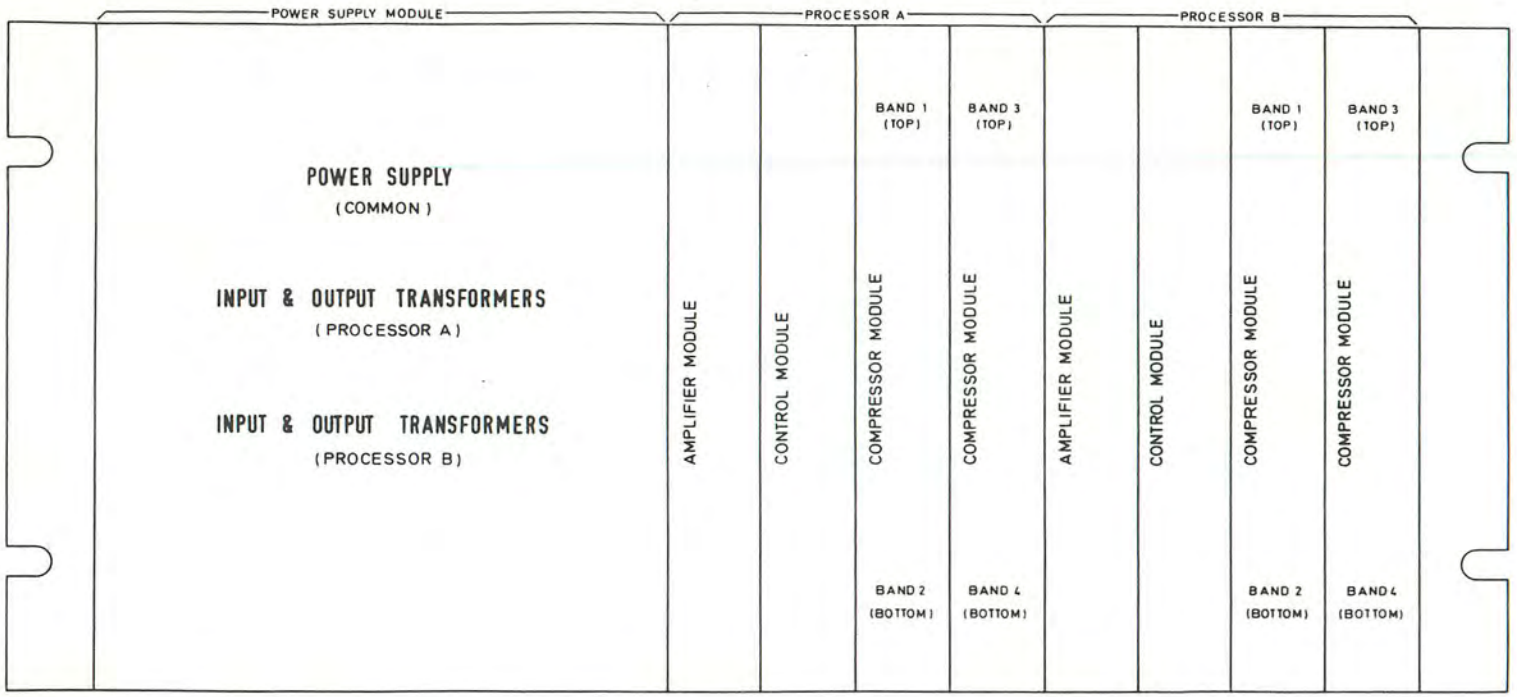


A301 BLOCK DIAGRAM



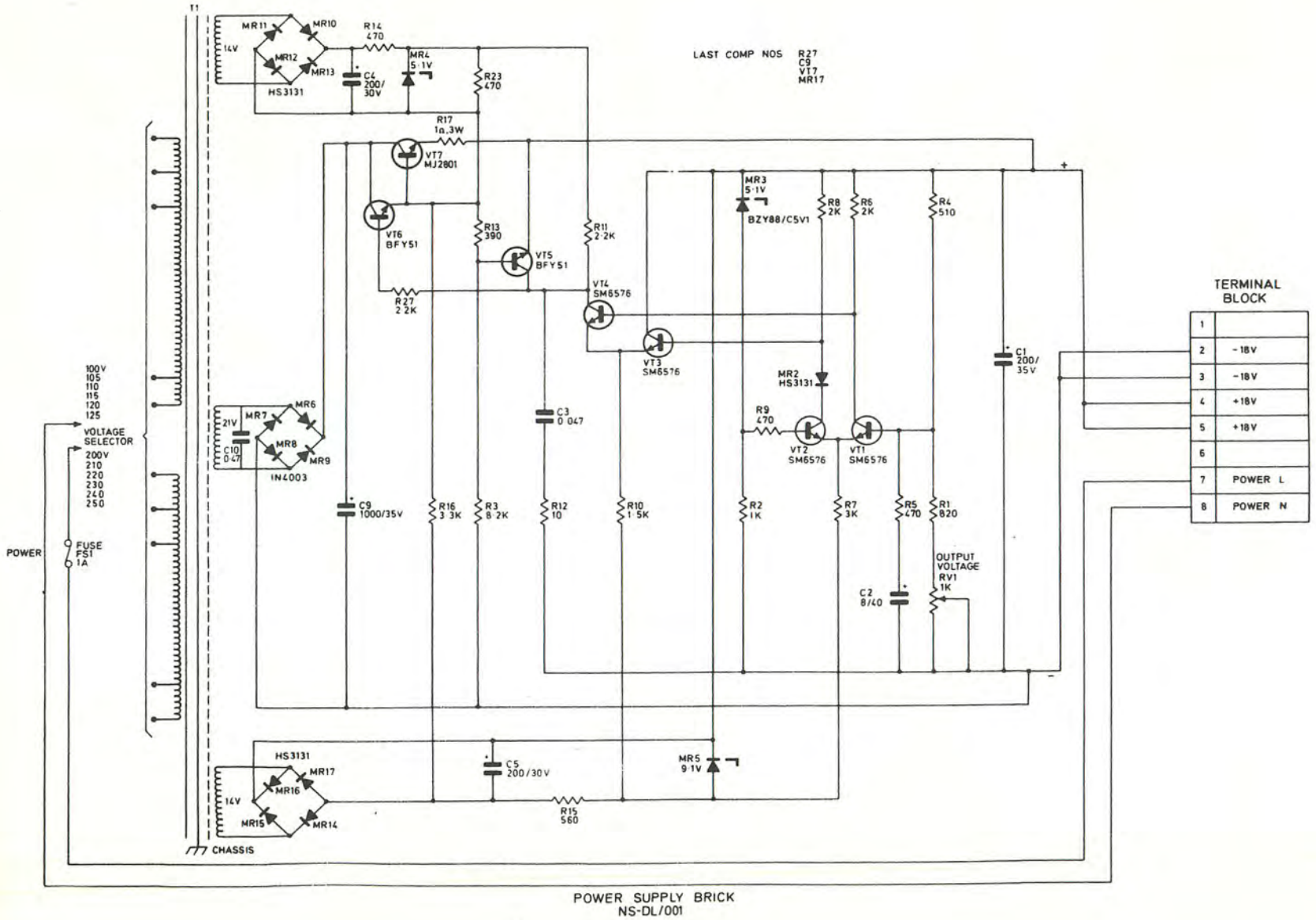
NOTES:
1. CONNECTION NUMBERS REFER TO CIRCUIT BOARD EDGE-CONNECTORS
2. EMITTER FOLLOWERS DESIGNATED E.F
3. POWER AND EARTHING CONNECTIONS NOT SHOWN
4. PROCESSOR B ARRANGEMENTS AND CONNECTIONS IDENTICAL
5. ALL COMPRESSORS IDENTICAL

A301 BLOCK DIAGRAM (PROCESSOR A)

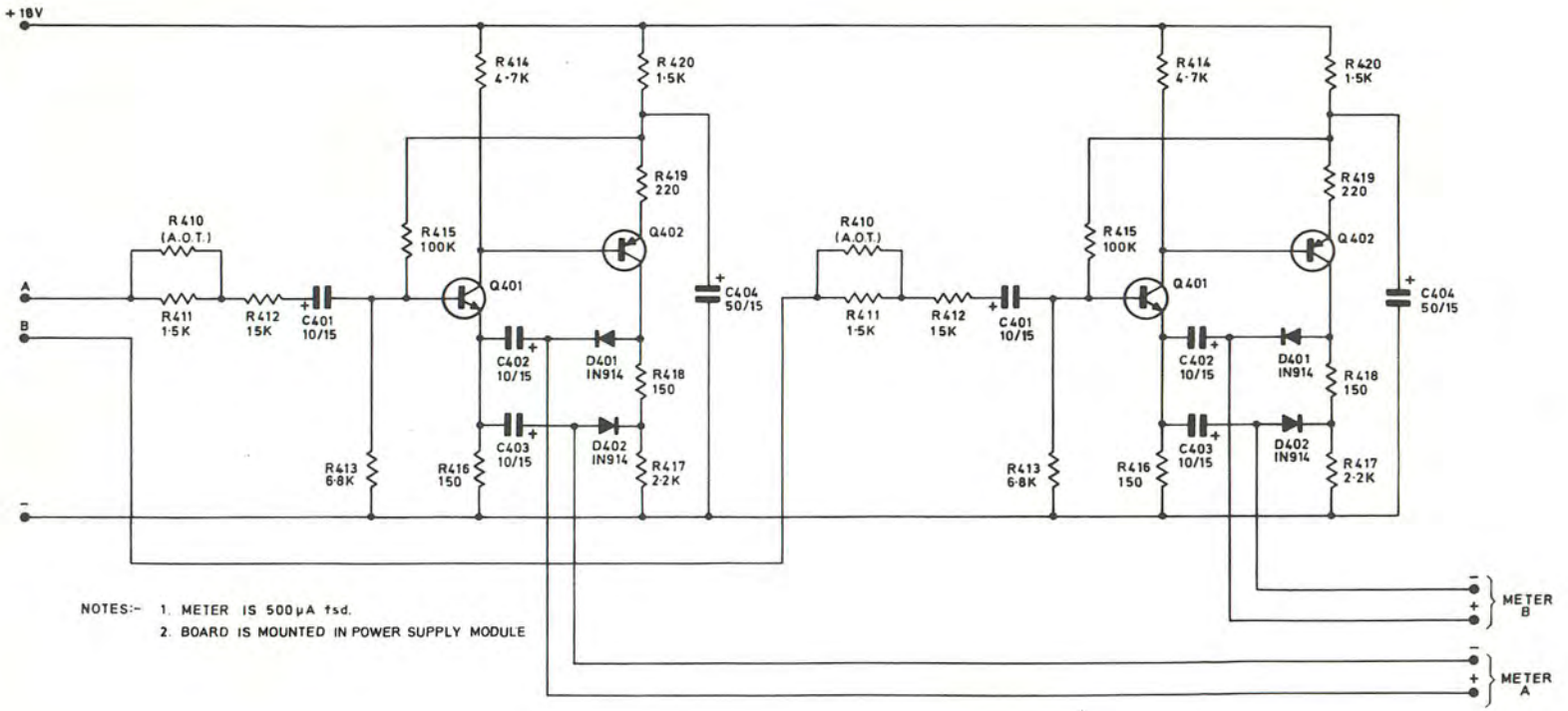


FRONT VIEW

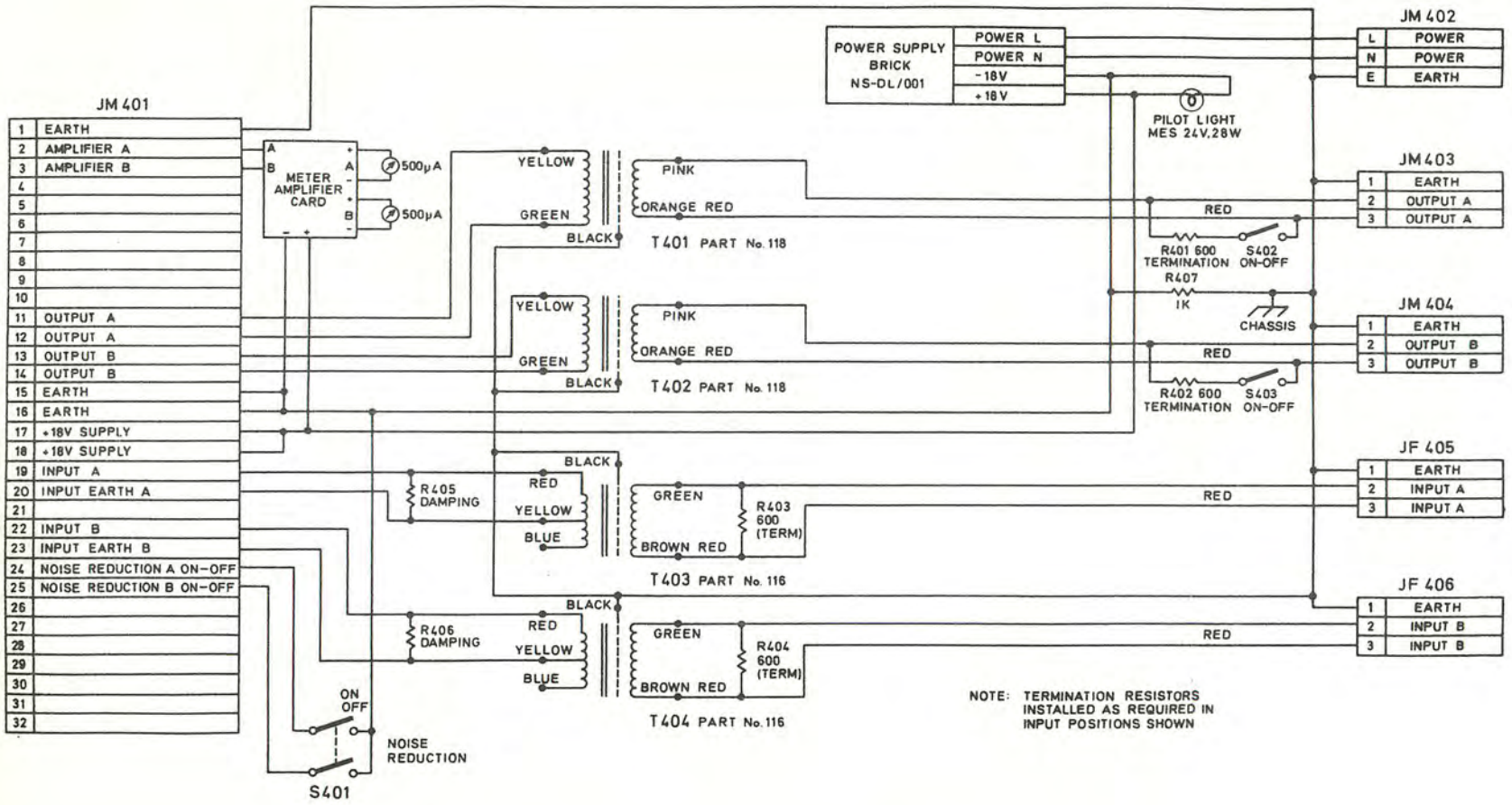
CHASSIS LAYOUT



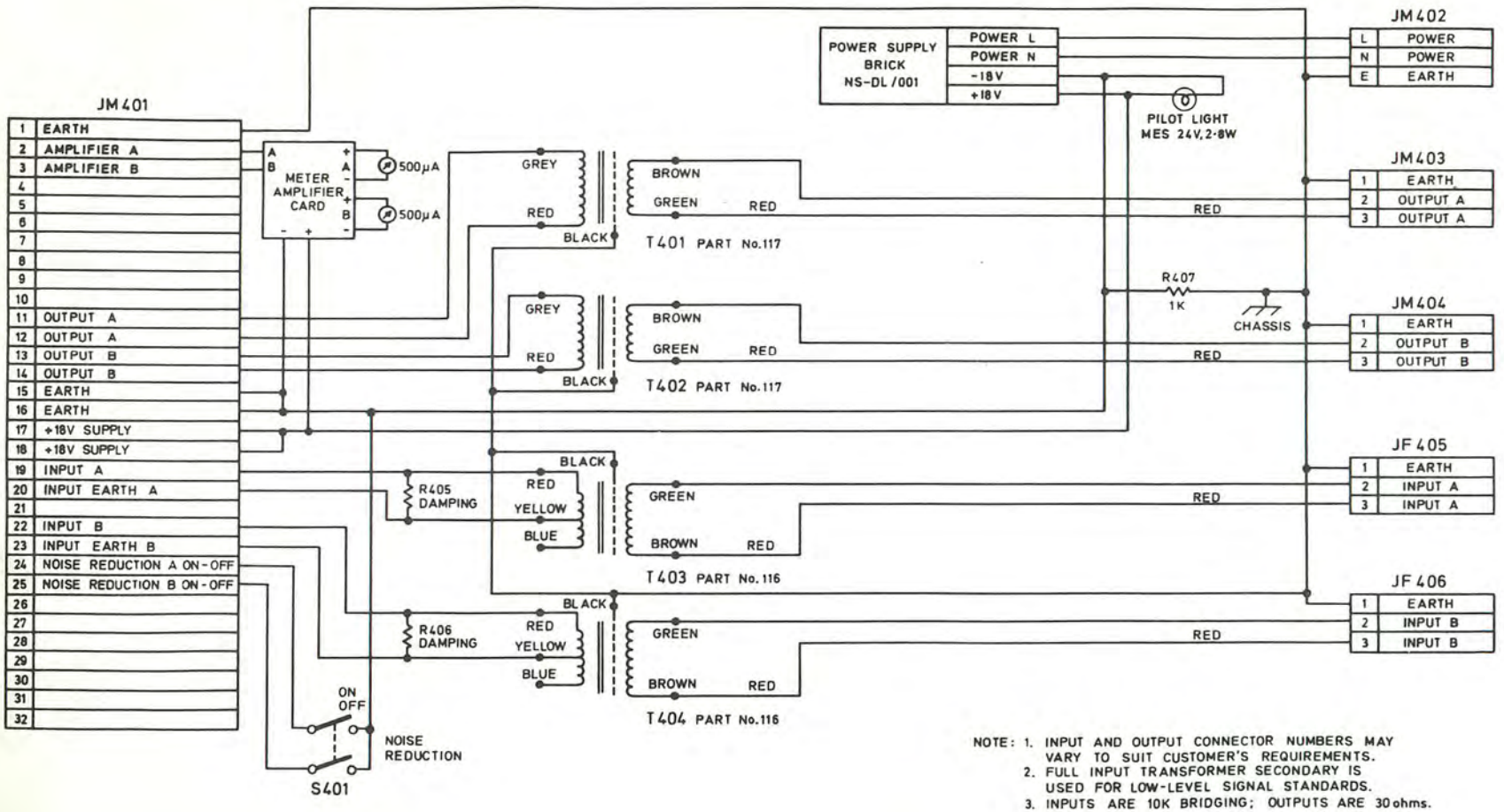
POWER SUPPLY BRICK
NS-DL/001



METER AMPLIFIER CIRCUIT

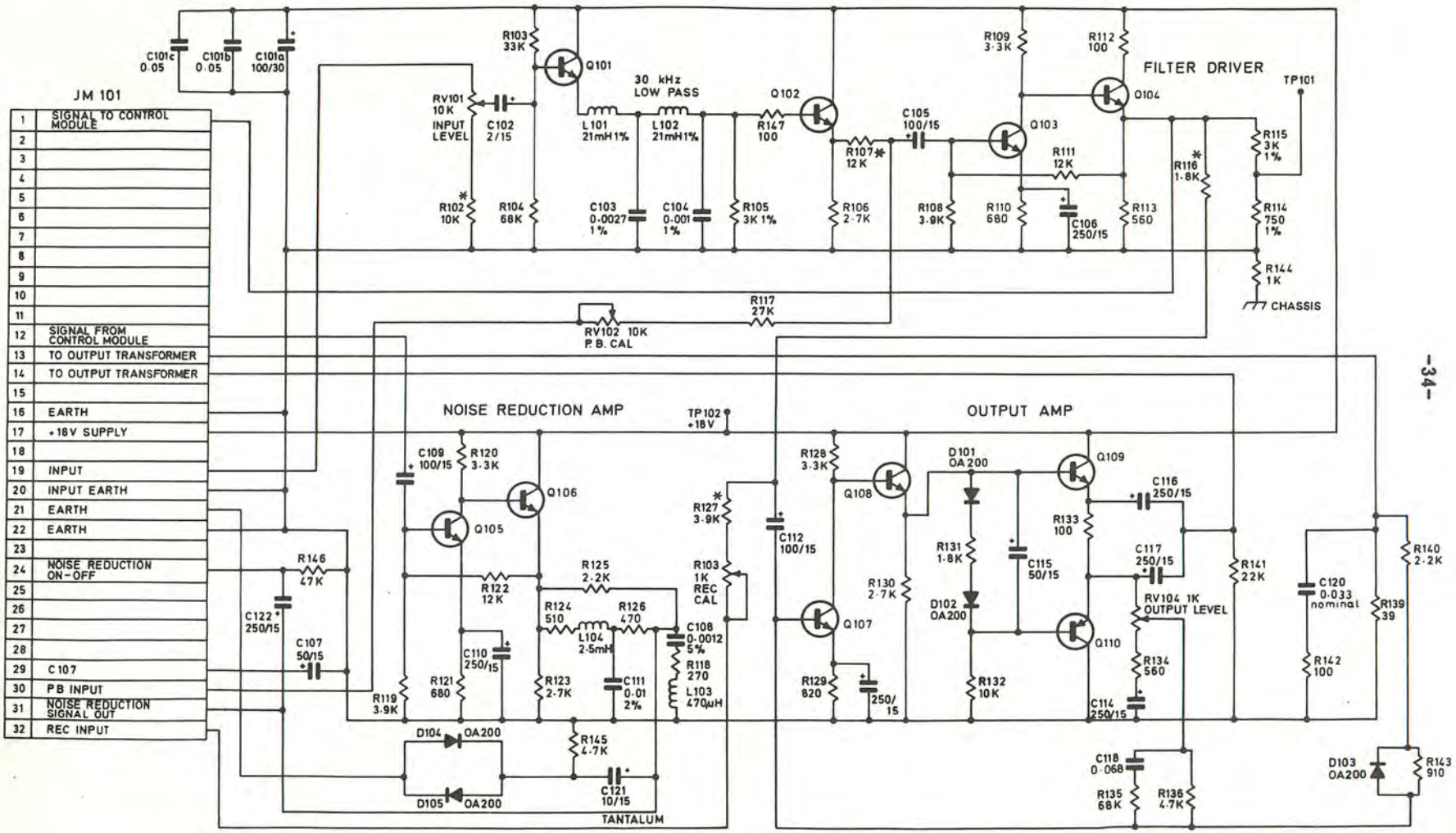


POWER SUPPLY MODULE (600ohm VERSION)



NOTE: 1. INPUT AND OUTPUT CONNECTOR NUMBERS MAY VARY TO SUIT CUSTOMER'S REQUIREMENTS.
2. FULL INPUT TRANSFORMER SECONDARY IS USED FOR LOW-LEVEL SIGNAL STANDARDS.
3. INPUTS ARE 10K BRIDGING; OUTPUTS ARE 30 ohms.

POWER SUPPLY MODULE (30 ohm VERSION)

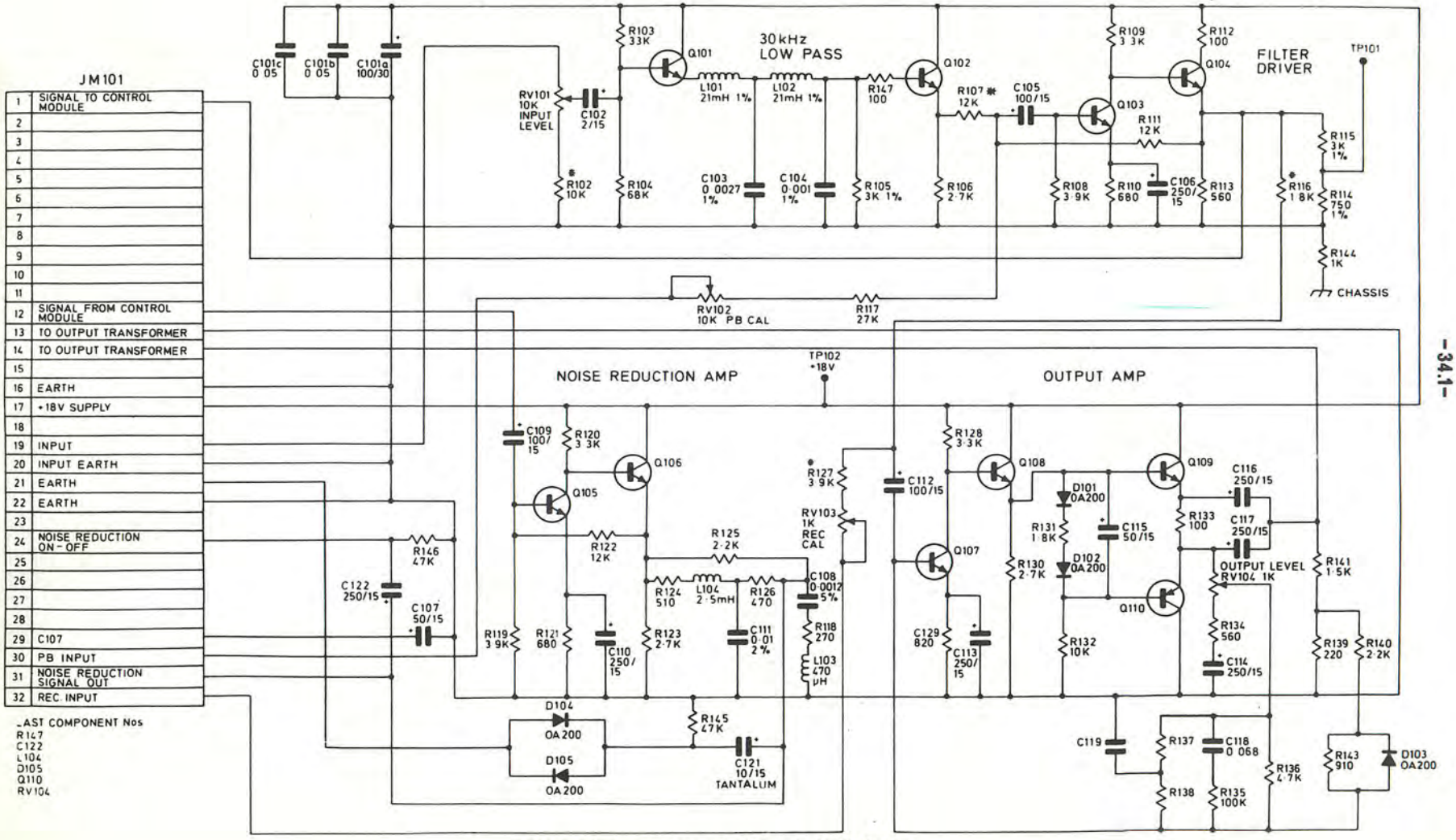


LAST COMPONENT Nos.
R147
C122
L104
D105
Q110
RV104

NOTES: OUTPUT TRANSFORMER FREQUENCY COMPENSATION
(a) L.F. C118 AND R135
(b) H.F. C120 AND R142

COMPONENTS MARKED THUS (*) CHANGE DEPENDING ON INPUT AND OUTPUT LEVEL STANDARDS

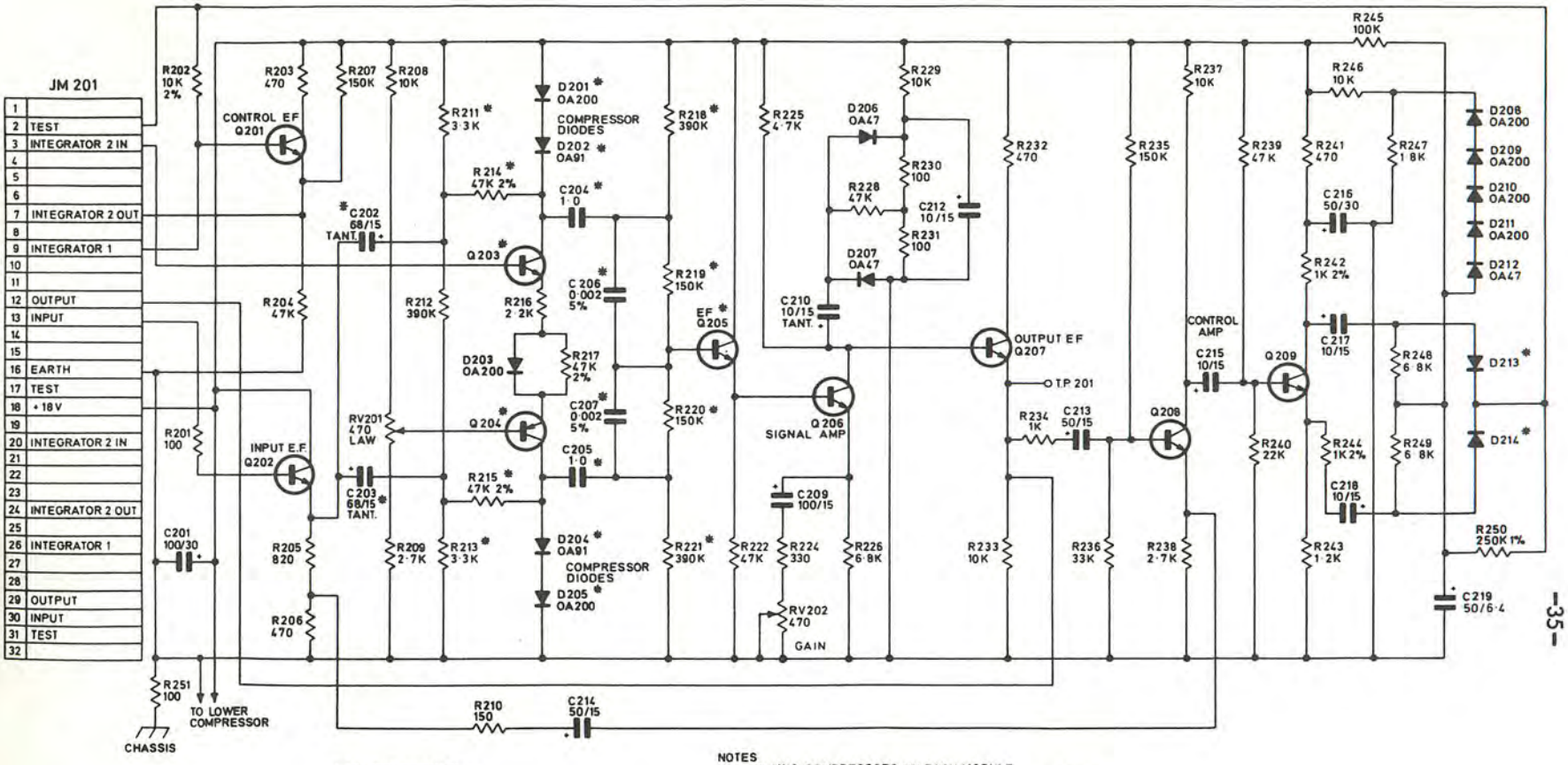
AMPLIFIER MODULE (200 AND 600ohm VERSIONS)



NOTE :- 1 OUTPUT TRANSFORMER FREQUENCY COMPENSATION
(a) L F C118 AND R135
(b) H F C119 R137 AND R138, IF REQUIRED

2 COMPONENTS MARKED THUS (*) CHANGE DEPENDING ON INPUT AND OUTPUT LEVEL STANDARDS

AMPLIFIER MODULE (30 ohm version)



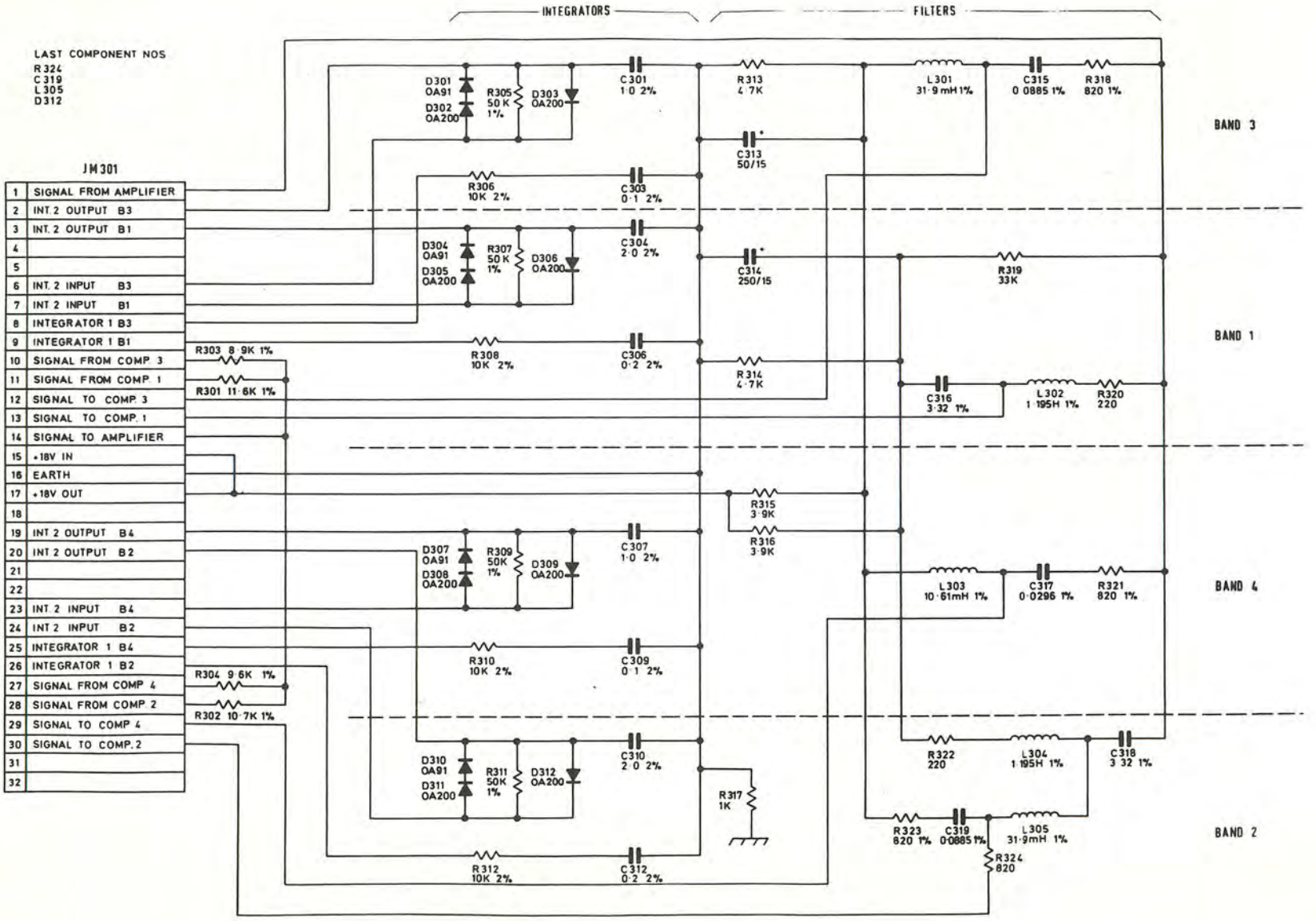
LAST COMPONENT Nos

R 251
C 219
D 214
Q 209
RV202

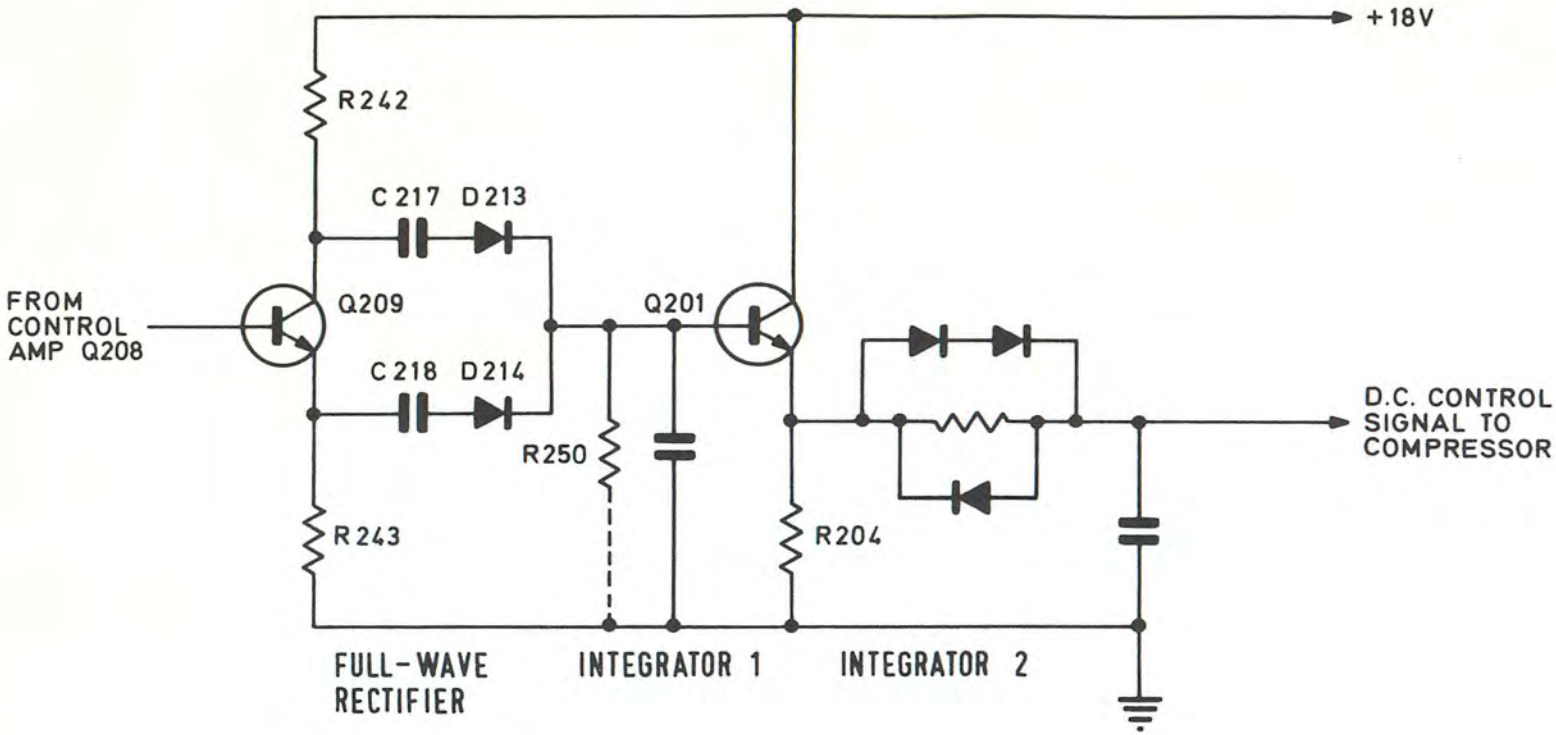
NOTES

1. TWO COMPRESSORS ON EACH MODULE.
   UPPER COMPRESSOR (BAND 1 OR 3) IS SHOWN ABOVE.
   LOWER COMPRESSOR (BAND 2 OR 4) IS IDENTICAL
   AND USES LOWER HALF OF EDGE CONNECTOR.
2. RESISTORS ARE 5% HIGH STABILITY UNLESS OTHERWISE NOTED.
3. SPECIALLY SELECTED OR MATCHED COMPONENTS ARE INDICATED BY *

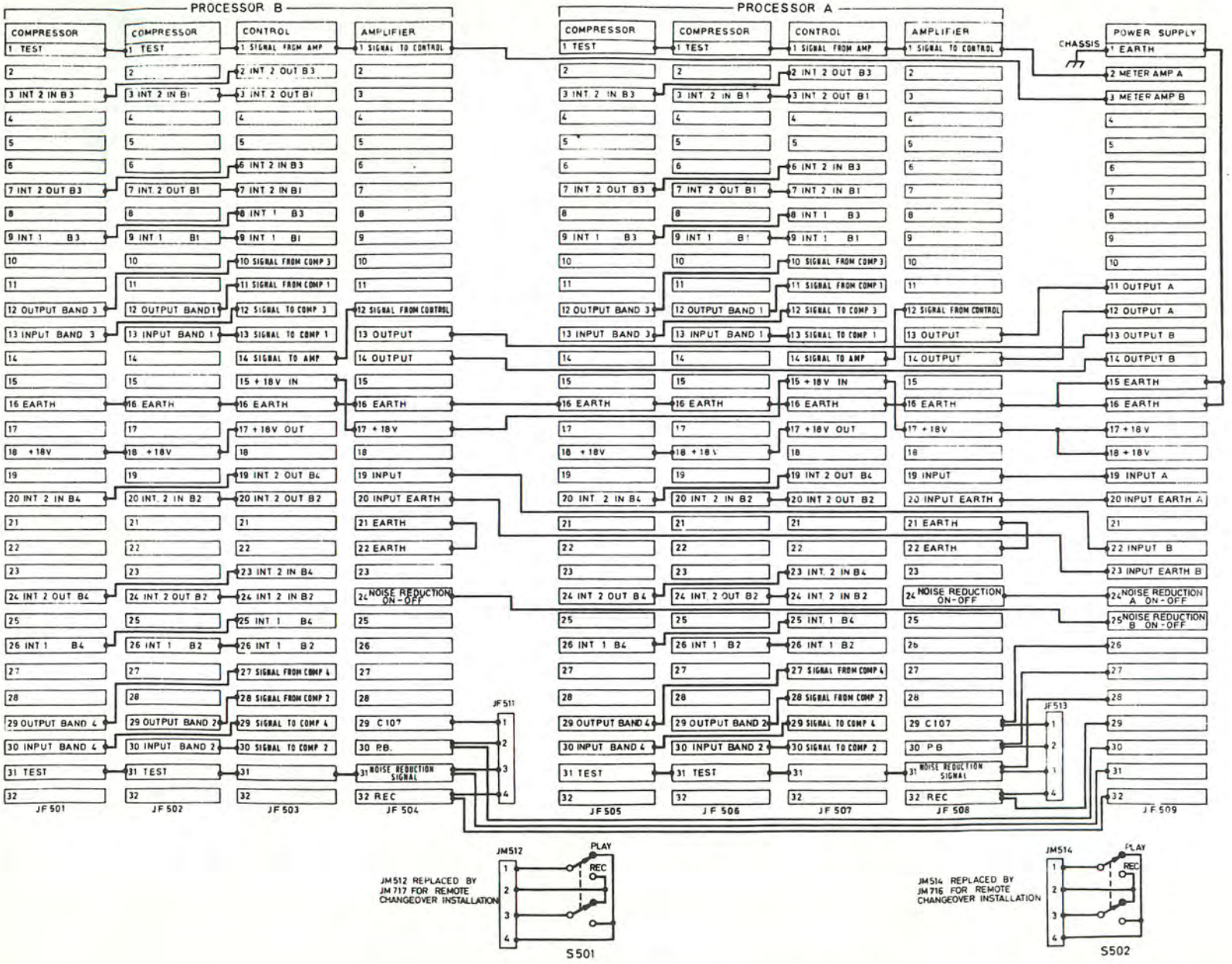
COMPRESSOR MODULE



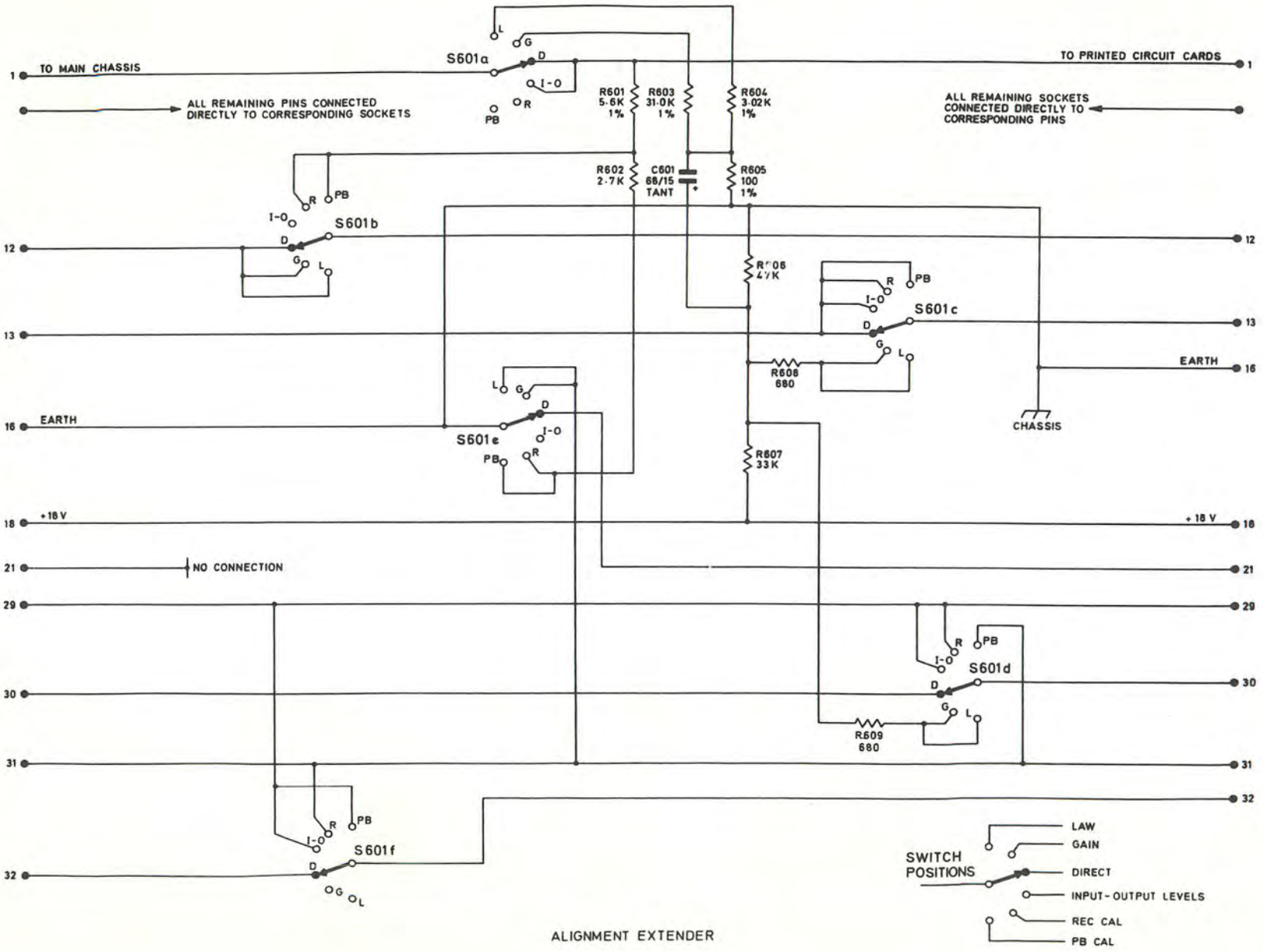
CONTROL MODULE



SIMPLIFIED INTEGRATOR CIRCUIT



CHASSIS INTERCONNECTIONS



ALIGNMENT EXTENDER

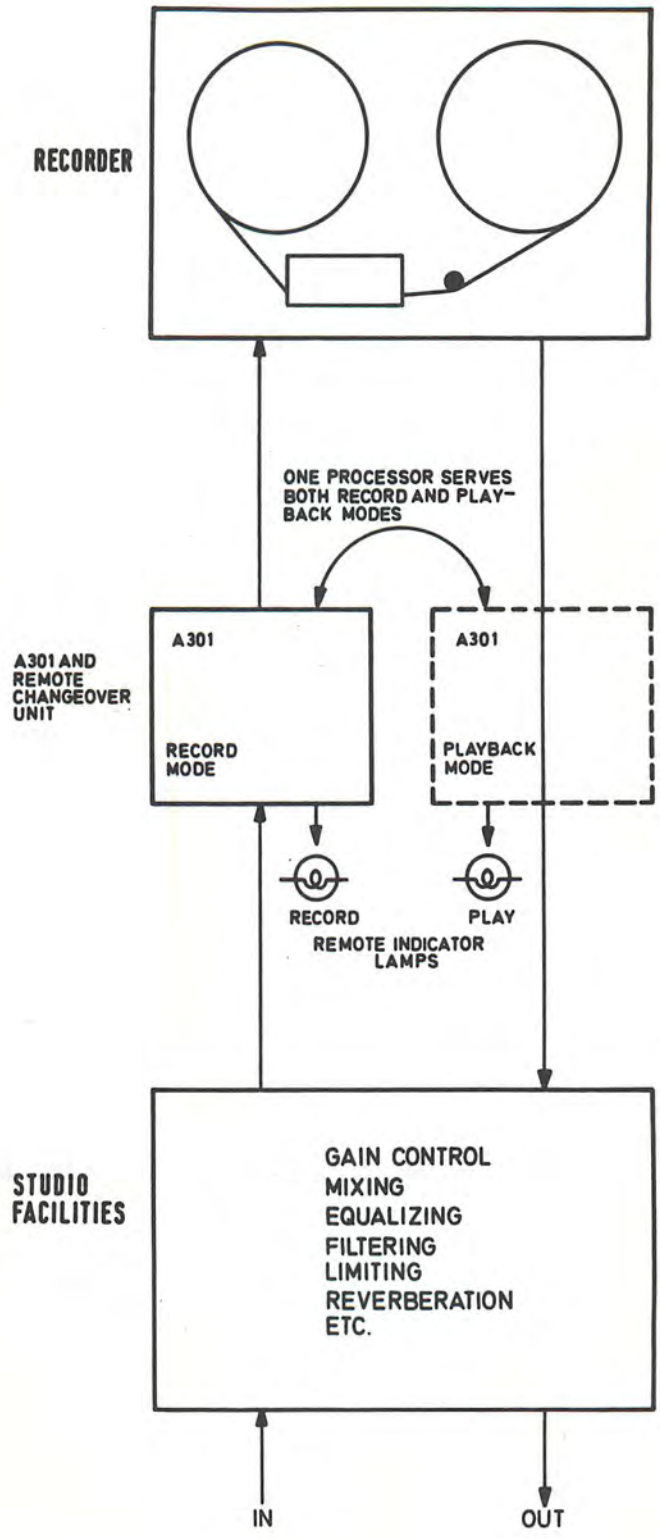


FIG.1 USE OF A301 AND REMOTE CHANGEOVER UNIT IN AUDIO CHAIN
(one channel only)

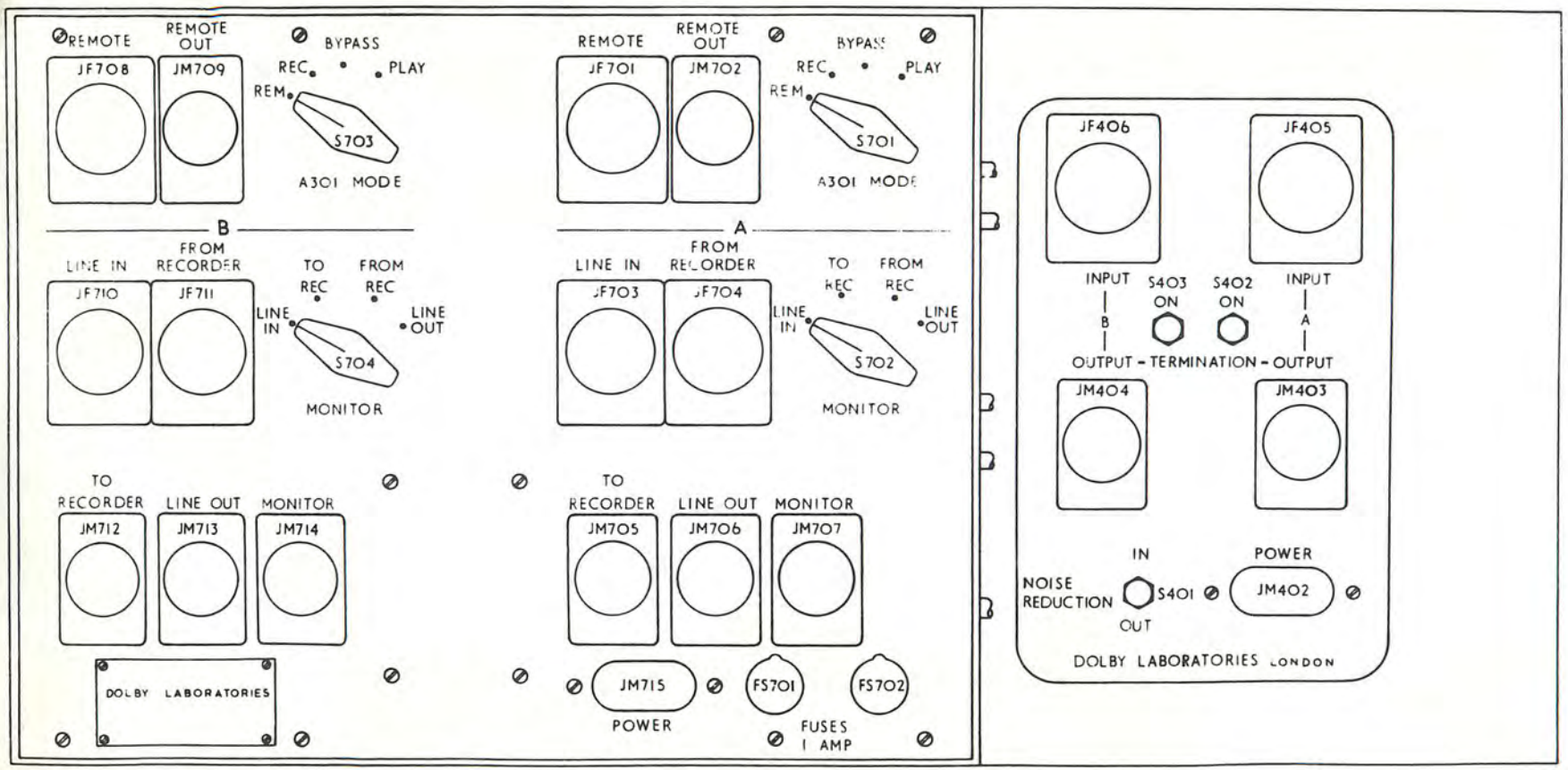


FIG. 1.1 REAR VIEW OF REMOTE CHANGEOVER UNIT

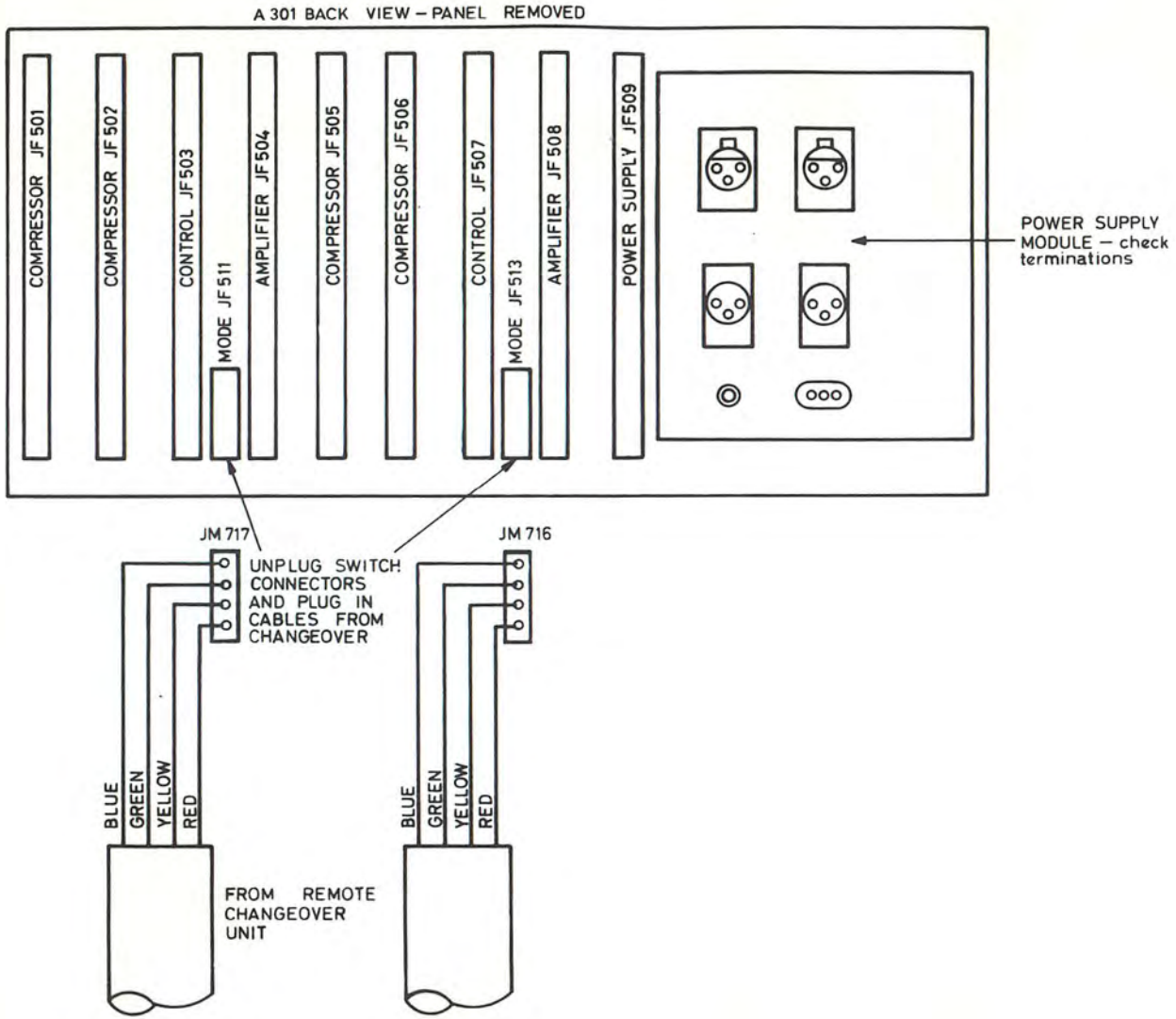


FIG. 2. INSTALLATION OF REMOTE CHANGEOVER UNIT

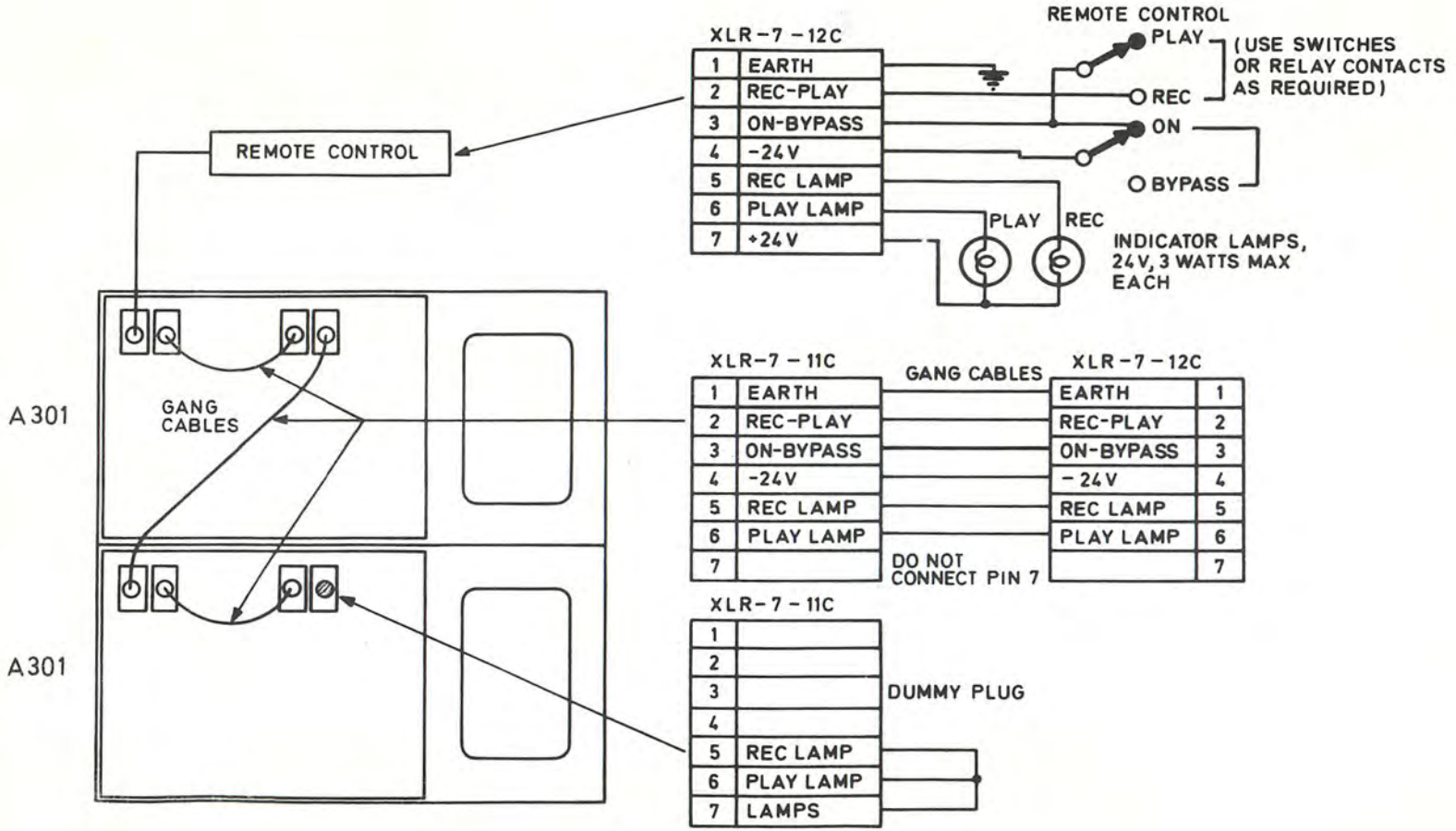


FIG. 3 REMOTE CONTROL INTERCONNECTIONS

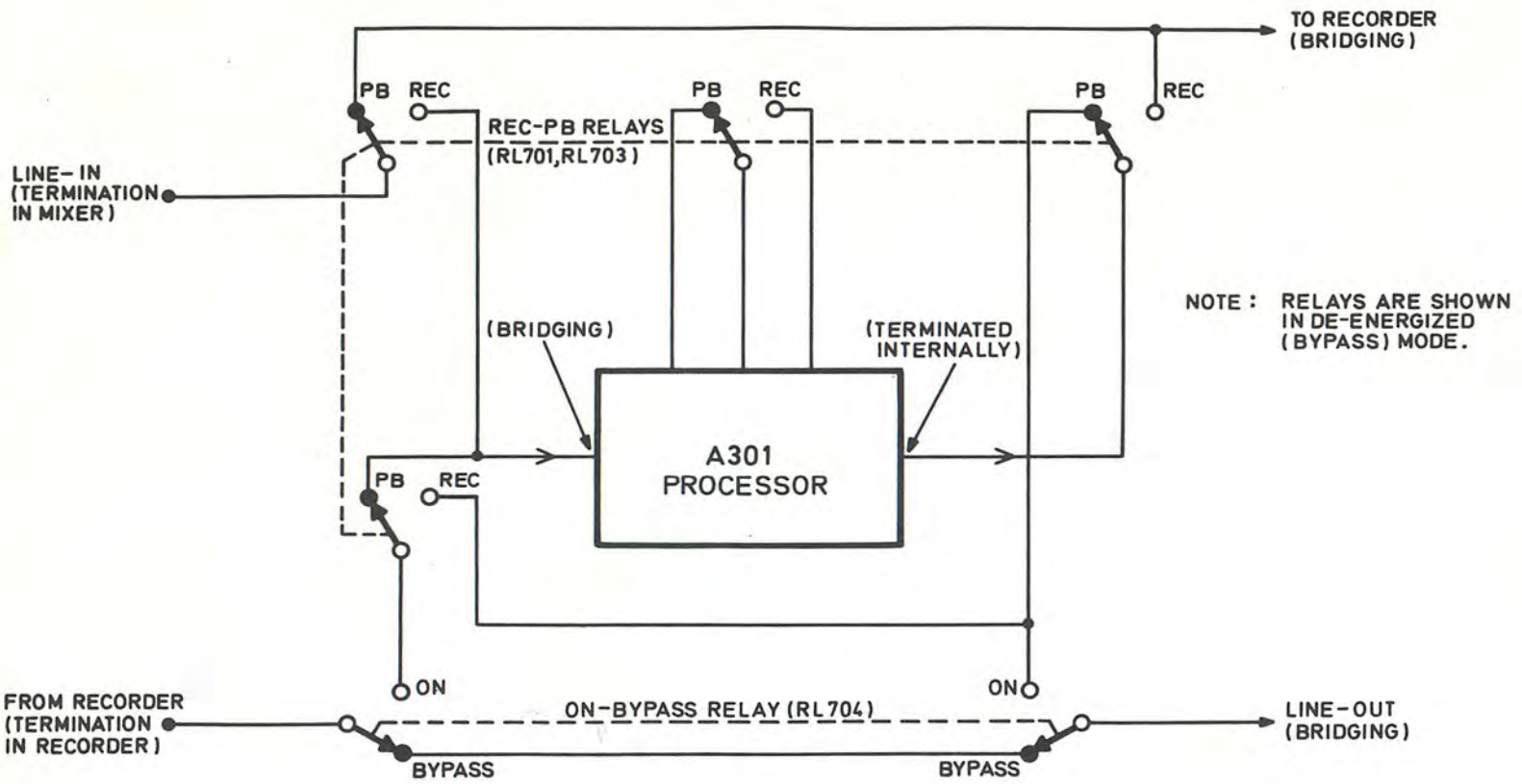
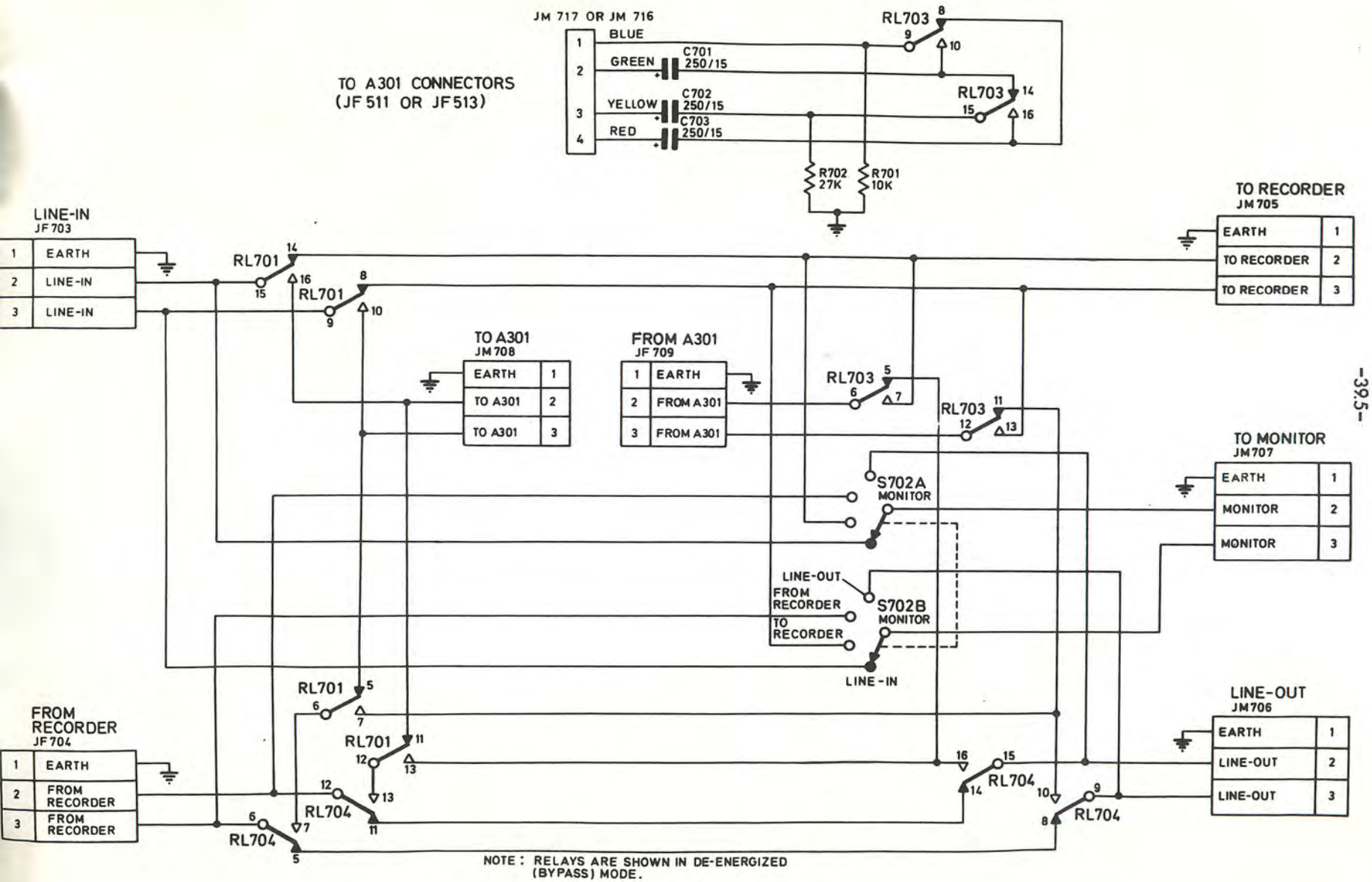


FIG. 4 SIMPLIFIED SIGNAL CONNECTIONS
(one channel only)



NOTE : RELAYS ARE SHOWN IN DE-ENERGIZED (BYPASS) MODE.

FIG.5 SIGNAL CONNECTIONS SCHEMATIC
(one channel only)

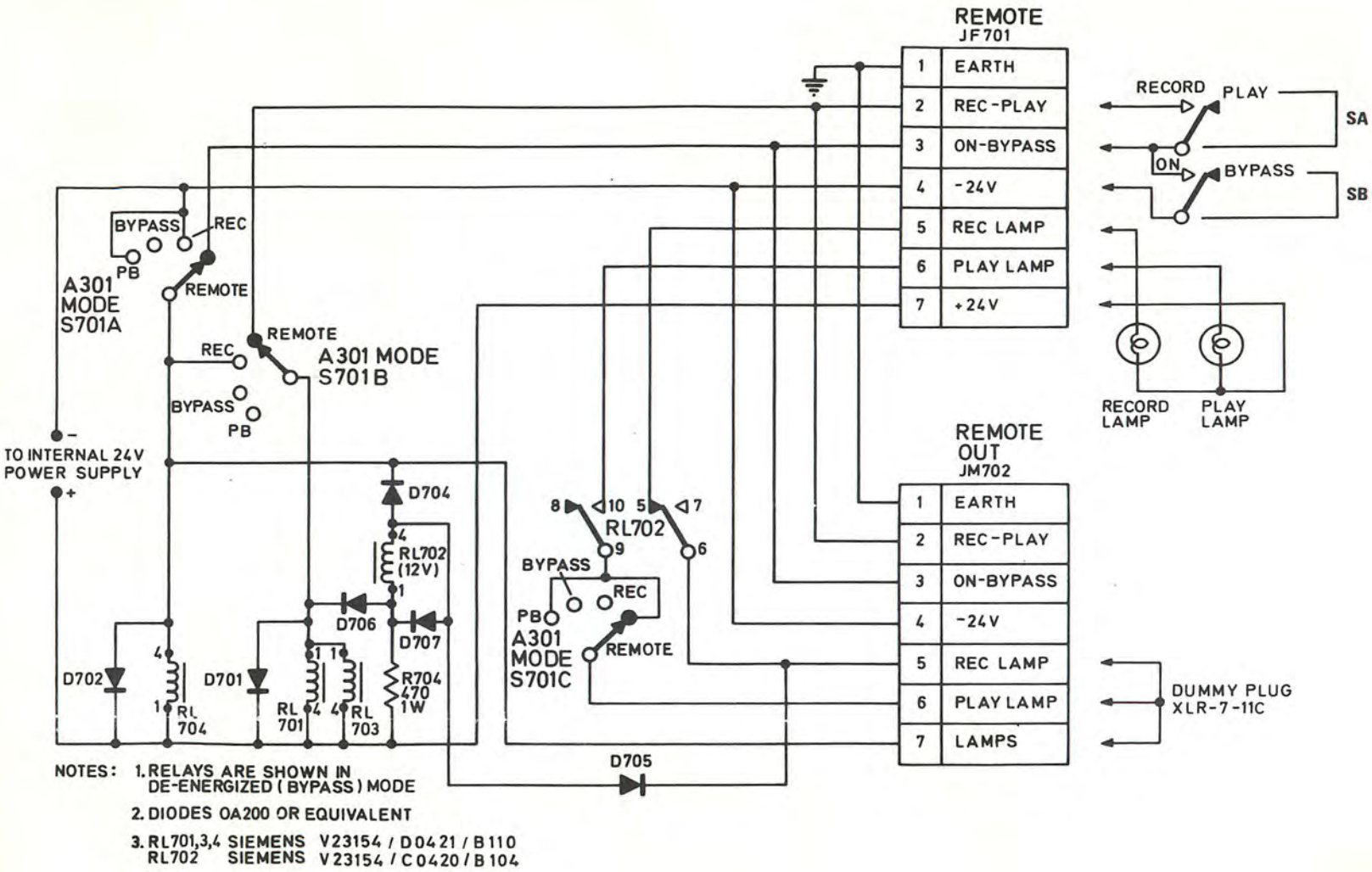


FIG. 6 CONTROL CIRCUIT SCHEMATIC
(one channel only)

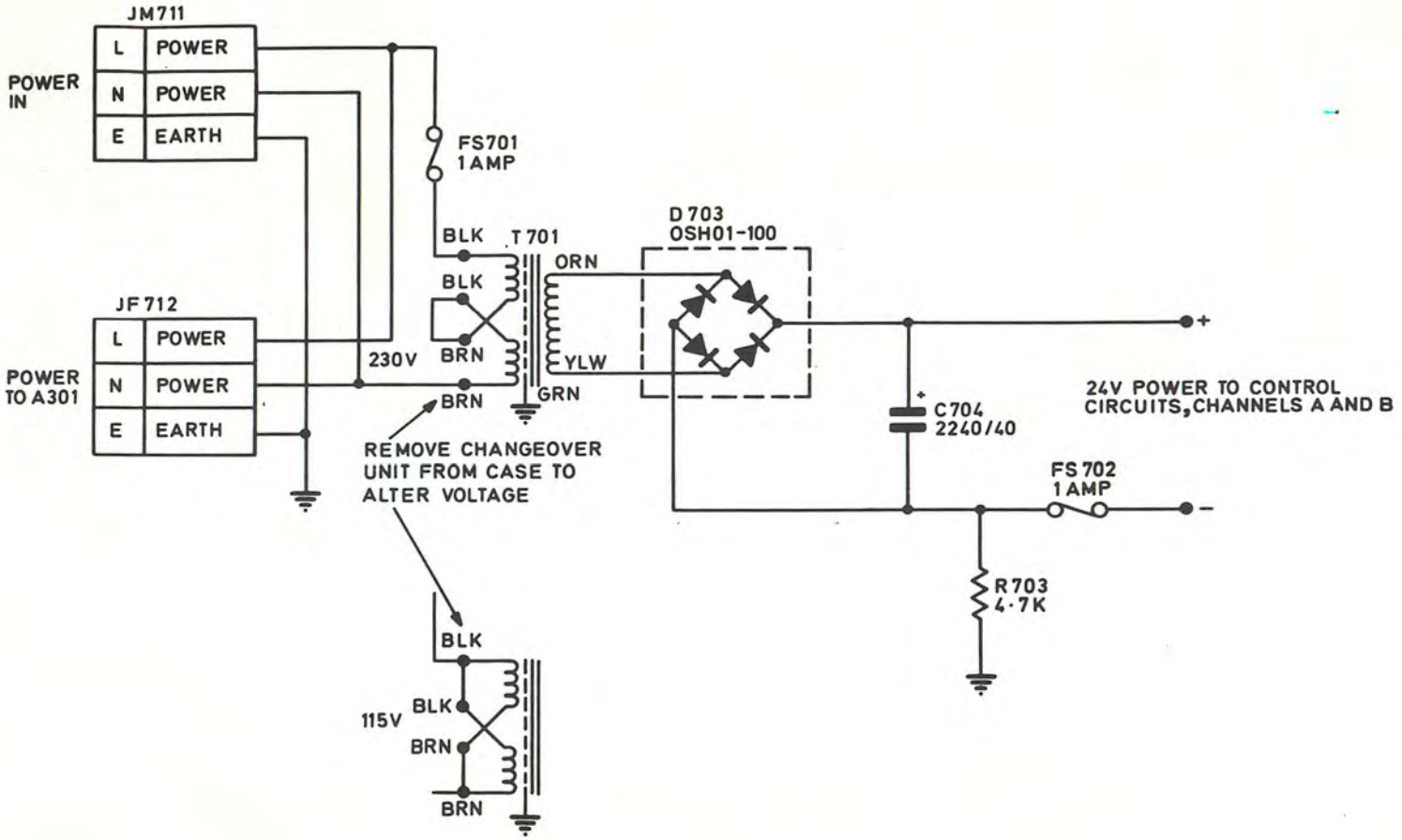


FIG.7 REMOTE CHANGEOVER POWER SUPPLY

DOLBY LABORATORIES

AUDIO NOISE REDUCTION SYSTEM A301
SIMPLIFIED OPERATING INSTRUCTIONS

A. Playback

1. Feed each tape channel output directly into corresponding A301 channel input.
2. Use NAB or DIN standard alignment tape. Adjust playback gain of each tape channel such that A301 meters read either "NAB" or "DIN"; during adjustment, disregard readings on all other meters. Recommended test tapes are:

   Ampex 01-31311-01 Reproduce Alignment Tape-15 ips NAB
   Ampex 01-31315-01 Level Set Tape-15 ips
   Agfa DIN-Bezugsband 38, according to DIN 45513

3. Feed A301 outputs to monitor facilities.

B. Record

1. Ensure that playback level controls on recorder have been adjusted according to above procedure.
2. Feed each A301 channel output directly into corresponding recorder channel input.
3. Feed 1 kHz tone into each record A301 input, adjusting oscillator level such that A301 meter reading of "NAB" or "DIN", as appropriate, is obtained.
4. Record on blank tape. Adjust each record gain control on recorder such that a level equal to standard alignment tape level is recorded. Verify that correct level has been recorded by noting playback A301 meter reading obtained.
5. Feed each program source into corresponding record A301 input. Do not compensate for different types of program material (e.g. piano) or different types of tape (e.g. high-output) by altering previously adjusted record and playback gain controls on recorder; set level actually recorded on tape by adjusting level of program source (mixer output). These precautions are necessary for international tape interchangeability.

Notes

1. Ensure that A301 mode switches (record - playback) are correctly set.
2. Ensure that termination conditions are correct. Except for 30 ohm version, A301 outputs should be terminated either externally or by termination switches on rear. Inputs are 10K ohm bridging unless terminated in power supply module. Both inputs and outputs are balanced-floating.
3. Noise reduction circuits can be de-activated by on-off switch. For greatest accuracy during playback and record level adjustments above, switch should be off.

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