DOLBY LABORATORIES

INSTRUCTION MANUAL

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WARRANTY INFORMATION: Equipment manufactured by Dolby Laboratories is warranted against defects in materials and workmanship for one year from the date of purchase. There are no other express or implied warranties and no warranty of merchantability or fitness for a particular purpose.

During the warranty period Dolby Laboratories will repair or, at its option, replace components which prove to be defective, provided the unit is returned, shipped prepaid, to the manufacturer direct or via an authorized distributor. Defects caused by modifications, misuse or accidents, and any further damage caused by inadequate packing for service return, are not covered by this warranty.

Dolby Laboratories' obligation is restricted to the repair or replacement of defective parts and under no circumstances shall Dolby Laboratories be liable for any other damage, either direct or consequential.

All requests for repairs or information should include the unit serial number to ensure rapid service.

S80/677/2789

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SECTION 1

MODEL 360 NOISE REDUCTION SYSTEM - INTRODUCTION

(495)

Model 360 - Introduction

The Dolby A-Type 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 synchronizing pulse crosstalk. All of these noises are reduced by the system 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 system 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 ±2 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 Dolby 360 Series units are compact second generation Dolby A-Type (professional) noise reduction units which are fully compatible with the A301. Designed with space and weight in mind, the units are especially useful for multi-track and portable work. The Model 360 is a single-channel noise reduction processor unit. The unit can be used for either recording or playback (encoding or decoding), the operating mode being pre-set by pushbutton switches on the front panel. This model is designed for monitoring, editing, and disc cutting, as well as for applications in which simultaneous record-playback monitoring facilities are required (one unit in record, one in playback).

The circuits used are highly stable and do not require any adjustments, apart from input and output levels, which are set during installation. The noise reduction circuitry is factory-set to precise limits and contains no adjustable controls. All components are mounted in a single module which can be purchased separately. Should failure ever occur, plug-in substitution will rapidly restore operation of the system with no adjustments necessary. A removable front panel allows the input and output controls to be adjusted from the front to match the unit to any of the normal studio signal levels; the panel also provides front access to the noise reduction module.

An internal Dolby Tone oscillator is provided for establishing correct operating levels. The characteristic modulation of this tone also serves as identification for Dolby-processed tapes. All oscillators in a multichannel installation can be controlled by a single switch.

SECTION 2

CONTROLS AND CONNECTORS

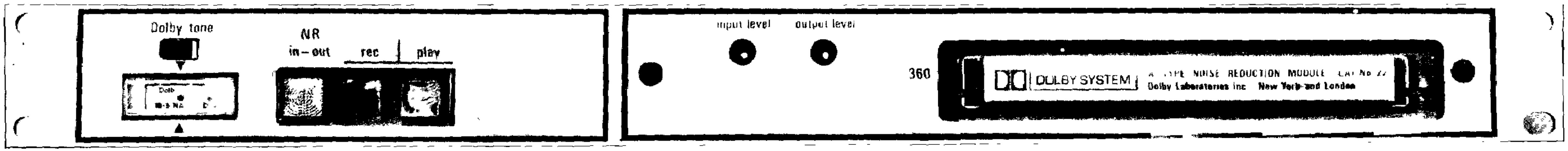
DOLBY TONE BUTTON FOR OPERATION OF INTERNAL OSCILLATOR. PROVIDES DOLBY LEVEL SIGNAL FOR IDENTIFICATION AND CALIBRATION PURPOSES — S8

INTERNALLY ILLUMINATED NR IN–OUT BUTTON CONTROLS NOISE REDUCTION ACTION. — S2

MULTI–TURN POTENTIOMETER ADJUSTS INPUT SENSITIVITY TO SUIT STUDIO LINE LEVEL ADJUST USING STANDARD TEST TAPE AND METER ON UNIT. — RV1

MULTI–TURN POTENTIOMETER ADJUSTS OUTPUT LEVEL TO SUIT STUDIO LINE LEVEL WHEN PLAYING STANDARD TEST TAPE — RV2

PLUG–IN CAT No 22 NOISE REDUCTION MODULE CONTAINS ALL CIRCUITRY FOR NOISE REDUCTION FUNCTIONS



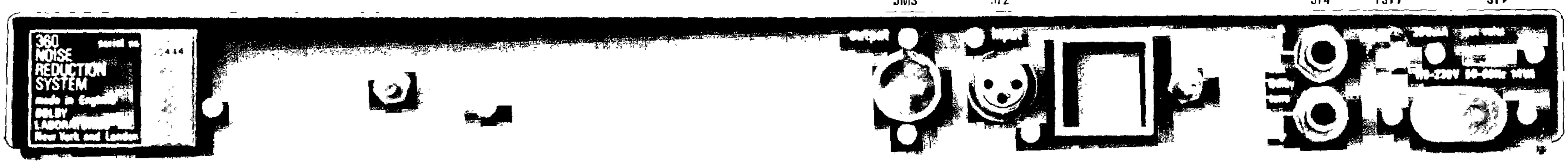
M1 — METER TO ASSIST IN CALIBRATION OF RECORDER GAIN CONTROLS. CALIBRATED FOR DOLBY LEVEL AND EUROPEAN AND U.S TEST TAPES.

S3, S4 — INTERLOCKED ILLUMINATED BUTTONS TO CONTROL MODE OF UNIT

100mA FUSE (SLOW BLOW) — FS1

VOLTAGE ADJUST (SLIDE SWITCH) — S1

JM3 JF2 JF4



JF5 — JACKS LINKING DOLBY TONE FUNCTION ON SEVERAL UNITS ALSO FOR REMOTE OPERATION OF DOLBY TONE

JM1 — POWER CONNECTOR. CENTRAL PIN IS CONNECTED TO CHASSIS.

FOR DETAILED DESCRIPTION SEE SECTION 5

MODEL 360 CONTROLS AND CONNECTORS

Drg No. AOD 694

SECTION 3
SPECIFICATIONS

Specifications - Model 360

Layout:	One signal processor, which can be set for either record mode or play mode. Control by illuminated push-button switches on front panel.
Signal Connections:	XLR input and output (cable connectors provided with unit).
Operating controls:	Illuminated push-button switches for REC/PLAY mode and noise reduction IN/OUT. Push-button switch for DOLBY TONE calibration oscillator.
Panel meter:	Level setting meter for recorder gain calibration. Calibration marks for Dolby Level (185 nWb/m, Ampex-NAB level) and DIN level (320 nWb/m).
Dolby Tone oscillator:	Internal oscillator provided for establishing correct operating levels on an international basis. Push-button Dolby Tone is recorded at Dolby Level (185 nWb/m) and is modulated in a characteristic way for identification. Provision for linking together Dolby Tone oscillators in multi-track installations (cable connectors provided with unit).
Input circuit:	Bridging transformer, 10 K balanced floating.
Output circuit:	Transformer, 20 ohm output impedance, balanced floating; will drive any load impedance from 200 ohms upwards.
Signal levels:	Input and output levels adjusted by multi-turn potentiometers accessible from front of unit. Minimum input 350 mV for Dolby Level, 600 mV for DIN level. Maximum output level +22 dB into bridging load; +21 dBm into 600 ohms; +20 dBm into 200 ohms.
Overall frequency response:	$\pm$1 dB from 30 Hz to 20 kHz.
Overall total harmonic distortion:	At +8 dBm, less than 0.1% at 1 kHz; less than 0.2% from 40 Hz to 20 kHz.
Noise reduction:	Dolby A-Type professional characteristic, providing 10 dB of noise reduction from 30 Hz to 5 kHz, rising to 15 dB at 15 kHz. With noise reduction action switched off, unit becomes unity-gain line amplifier.

Overall noise level:	Record-playback, 80 dB (unweighted, 30 Hz to 20 kHz bandwidth) below Dolby Level.
Matching between units:	±1 dB at any level and any frequency, 30 Hz to 20 kHz.
Signal delay:	Constant with frequency, 24 μsec per channel. Overall encode-decode process, 48 μsec.
Phase error:	Less than 5°, 20-20 kHz overall encode-decode.
Stability:	System is highly stable - does not require routine alignment.
Operating temperature:	Up to 45°C.
Construction:	Plug-in Noise Reduction Module (Cat. No. 22) accessible through front panel. Fibreglass printed circuits, solid state devices throughout.
Finish:	Steel case, grey stoved plastic textured finish; front panel clear anodized with black characters.
Size:	44 x 483 mm rack mounting ($1\frac{3}{4}$" x 19"). Maximum projection behind mounting surface - 228 mm ($8^{15}/_{16}$"). Maximum projection in front of mounting surface - 22 mm ($^{7}/_{8}$").
Weight:	5 kgs (11 lbs).
Power requirements:	Units are designed for operation from centrally switched power source. Power cables provided. 100-130 V and 200-260 V, 50-60 Hz single phase, 14 VA.

SECTION 4

GENERAL PRINCIPLES

General principles

In sound recording or transmission systems the high and low audio frequencies are often pre-emphasized during recording and de-emphasized during reproduction in order to improve the signal-to-noise ratio. However, the equalization 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 equalization is not as great as it might be for optimum utilization 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 equalization method. The Dolby A-type 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 phases and in the process attenuates any noise introduced during recording.

Systems which improve signal-to-noise ratios by compression in the encoding mode, followed by expansion in subsequent decoding, are known generally as compandors. Such devices have a long history, and it is therefore important to discuss these conventional techniques to appreciate the significant differences between them and the Dolby system.

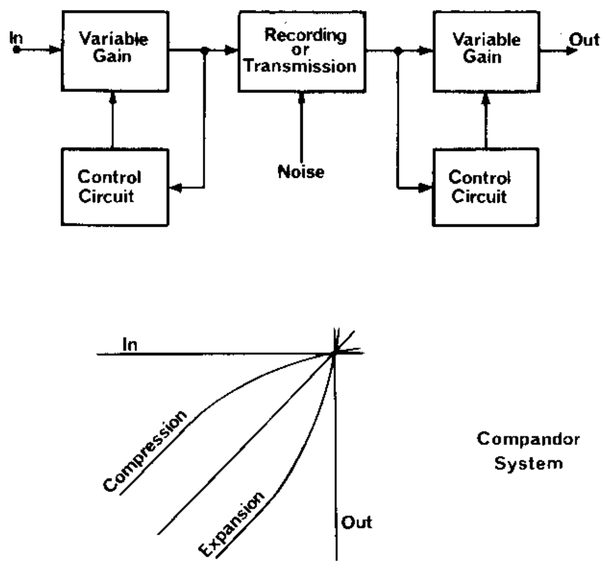
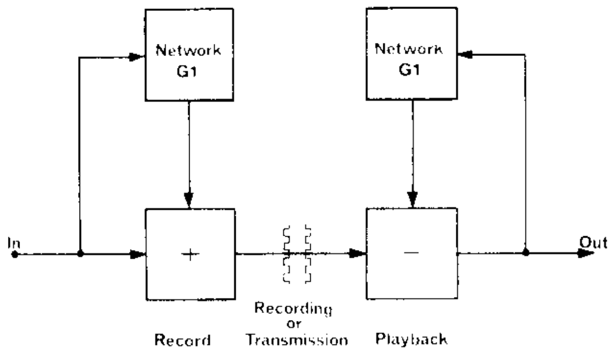


Fig. 4 1

Fig. 4.1 is a block diagram of a conventional compandor, together with its transfer characteristics. Well-known compandor difficulties - which by now are regarded as classical - include poor tracking between recording and reproducing, both statically and dynamically; high sensitivity to gain errors in recording or transmission; inadequate dynamic range (high noise level vs. high distortion); production of overshoots with transient inputs; audible modulation-product generation under dynamic conditions; distortion of low frequencies by control-signal ripple modulation; and generation of noticeable signal-modulated noise effects.

A comparison of conventional compandor performance as outlined above with the requirements for studio and broadcast applications shows that the normal compression and expansion approach is inadequate. Prior to the introduction of the Dolby type of compandor in 1966, compandors were generally found to be usable without qualification only in relatively low-grade, narrow-band applications such as telephone circuits.

In normal compression or limiting, a primary object is to modify high-level signal dynamics; it is thus unfortunately necessary to subject the signal as a whole to the hazards of passage through a variable-gain system. In applying compression techniques to the noise reduction problem, in which the objective does not include modification of signal dynamics, it is unnecessary and undesirable to operate upon high-level signal components; noise amplitude in a high-quality channel is only of the order of 0.1% of maximum signal amplitude. It is clearly preferable to generate a small correction or differential component which can be appropriately subtracted from the signal, thereby cancelling or reducing noise while leaving the larger aspects of the signal untouched.



Noise Reduction System — Basic Layout

Fig. 4.2

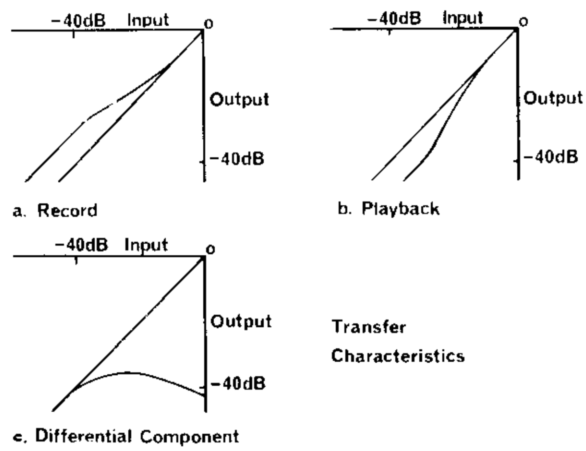
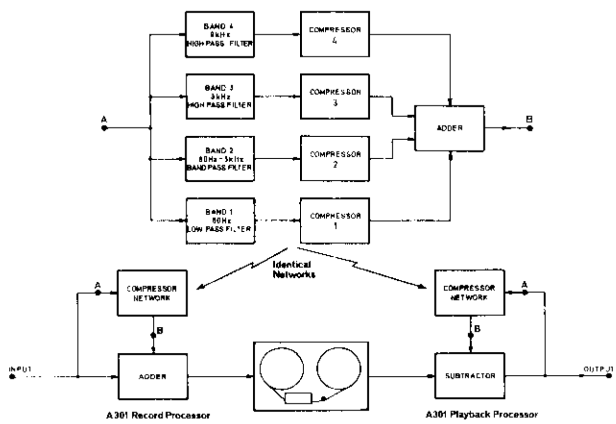


Fig. 4.3



Noise Reduction System—Basic Block Diagram

Fig. 4.4

The differential treatment of the signal in the Dolby noise reduction system is illustrated in Fig. 4.2. Incoming signals to the record unit are split into two paths. The main path treats the signal linearly. The signal in the secondary path passes through a variable attenuation network G1, the output of which is combined additively with the main signal. In playback the situation is similar, but the variable attenuation network G1 is connected in a feedback loop and its output is combined subtractively with the main signal. The basic input/output characteristic of the attenuators is given in Fig. 4.3, which also shows the encoding and decoding characteristics obtained by addition and subtraction. It is evident that the signal is modified only at low levels; by analogy with calculus, the correction signal is known as the differential component of the signal.

In practical embodiments, the Dolby method satisfies all the requirements for high-quality transmission. Overshoots are minimal (less than $1\frac{1}{2}$ dB), since the contribution of the side chain is always low even under dynamic conditions. Mis-tracking between units is a function of the attenuators, which can be designed and built to follow a standard curve to within 0.5 dB. Signal level errors between the encoding and decoding units appear at the output only as linear level changes at high and low levels, since the input/output characteristics of the playback unit are linear in these regions. Even at the level of maximum compression slope (2:1), at around -30 dB, moderate errors (about 2 dB) in recording or transmission channel gain are not noticeable on programme material.

With moderate signal level changes, the differential approach allows relatively long time constants to be used for control signal attack and decay times, and therefore modulation products are minimal. For larger signal level changes, the attack time is decreased; this is achieved by non-linear control signal smoothing circuits which also keep low-frequency distortion to a figure of less than 0.2% at 40 Hz and peak level.

In order to obtain effective noise reduction under all signal conditions, the Dolby system utilizes the psychoacoustic phenomenon of masking, which is a kind of naturally occurring noise reduction. This is combined with electronic noise reduction (compression/expansion) to provide complete overall coverage. The masking effect, extending on both sides of the signal frequency, is dependent on both the absolute and relative amplitudes of the signal and noise. Taking these facts into account, the network G1 (Fig. 4.2) is in fact four band-splitting filters, followed by four limiter circuits. In this scheme the masking effect is combined with compression and expansion in such a way that there are no audible noise modulation effects. The frequency bands are chosen with regard to the probable frequency distribution of a high-quality signal and to the types of noises likely to be encountered (Fig. 4.4).

The differential approach, together with the band-splitting technique, results in a noise reduction system which is suitable for high-quality sound transmission with excellent static and dynamic noise reduction and signal handling characteristics.

SECTION 5

LEVEL STANDARDIZATION

5.1 Basic Standardization Requirements

Correct operation of the Dolby A-type Noise Reduction System is dependent on only one basic requirement - that the signal voltage in the playback processor should be the same (within 2 dB) as that in the recording processor. In other words, the recording system should have an effective overall record-playback gain of unity. However, the requirement for signal interchangeability imposes a further requirement - that the signal levels in the noise reduction system should be related to the levels of internationally recognized standards, such as magnetic test tapes (of which the most widely used are the Ampex NAB and DIN tapes).

In order to correlate the various voltage levels and flux levels used in the complete recording or transmission chain, the concept of "Dolby Level" is employed. Dolby Level bears a fixed amplitude relationship to the noise reduction compression and expansion parameters. In 360 Series units, this level correlation is achieved in practice by a meter with a Dolby Level mark and by a special built-in Dolby Tone oscillator which generates a signal at Dolby Level. For maximum effectiveness, the Dolby Tone has been designed to be easily recognizable in order to avoid possible confusion with the multiplicity of tone signals at present in use for equalization or testing purposes. Its level has been chosen to be readily measurable on normal programme level meters in studios or broadcast stations, as well as on the meters of 360 Series units (on A301 units Dolby Level corresponds to the NAB meter mark). Since Dolby Level bears a fixed relationship to the noise reduction transfer curves. it can be further linked to the recording or transmission system parameters - i.e. line levels, flux levels, etc.

The Dolby Tone is generated by a constant-amplitude oscillator which is periodically frequency-modulated upwards with a 10% frequency change. The modulation occurs for a period in the low tens of milliseconds, which the ear interprets not as frequency modulation but more as amplitude modulation. However, since the amplitude is in fact constant, level setting meters maintain constant indications (regardless of their time constants). The A-type oscillator runs at 850 Hz and is modulated to approximately 930 Hz for 30 milliseconds every 750 milliseconds. The resulting periodic chirp-like sound is highly characteristic.

5.2 Magnetic Tape Recording

Dolby Level is linked to the flux on the tape, and is defined as 185 nWb/m. This corresponds to Ampex Operating Level (which is approximately 4.8 dB below the DIN reference level of 320 nWb/m). This flux level is used for all magnetic recording formats, e.g. magnetic film, audio tracks on video tape recorders, or magnetic sprocketed film.

5.3 Transmission Applications

Dolby Level is linked to the transmission level by the following relationships:

1. If VU meters are used, Dolby Level corresponds to 0 VU on a steady-state basis.

2. If fast risetime peak programme meters are used, Dolby Level corresponds to a level of 4 dB below the nominal 100% or peak operating level on a steady-state basis (i.e. PPM 5 for UK peak meters, +4 on the EBU meter scale, or -4 on light-beam instruments).

5.4 Optical Sound Tracks

Dolby Level is defined as 6 dB below clash (clipping) level, or 50% of full track width modulation.

5.5 Other Systems

Dolby Level can be defined by reference to the overload properties of the transmission system following the guidelines provided by the above definitions.

5.6 Adjustment of Input and Output Levels

The adjustment of signal levels is covered in detail in Section 8, Operation. A generalized description is given here to illustrate the part played by the Dolby Level calibration.

Decode or playback units are calibrated first. A tone, from a test tape or oscillator, at either 0 VU (or Ampex Operating Level - Dolby Level) or DIN (peak) level, is fed into the unit and the input level potentiometer is adjusted to give an appropriate reading on the front-panel meter on the unit (i.e. Dolby Level or DIN). The output level potentiometer is then adjusted to give unity gain through the 360 Series unit.

Following correct calibration of the decoder unit, the encoder or record unit is set up. The record gain controls on the recorder or the line sending controls on the line amplifier are adjusted to suit the usual line levels. The Dolby Tone button is pressed, and the output level control on the 360 Series unit is adjusted such that the recorded or received tone, as indicated by the previously calibrated decoder unit, is at the Dolby Level mark. The input potentiometer of the encoder unit is then adjusted to suit the incoming signal level.

After this calibration is completed, the A-type encoder and decoder units, together with the recorder or transmission line coupling them, should be treated as a fixed, unity-gain system. The decoded output is at studio or line level; for encoding, studio or line level should be fed in.

In operation, do not compensate for different types of programme material (e.g. piano) or different types of tape (e.g. high-output) by altering any of the previously adjusted record and playback gain controls in the chain; set the level actually recorded on the tape or sent to the line by adjusting the level of the programme source (mixer output). The calibration procedure ensures that the internal characteristics of the A-type units are directly related to the transmission or recording parameters (e.g. tape flux density), and altering the gain settings to suit programme material would destroy this relationship. These precautions are essential for tape and transmission standardization. To assist in maintaining standardization in tape exchanges and inter-studio transmissions, always record or send a section of Dolby Tone at the beginning of each programme using the internal Dolby Tone oscillator.

It should be emphasized that the requirement for level standardization in using the Dolby system in no sense puts a constraint on the actual programme levels used. The programme levels themselves should be the same as those used in the absence of the Dolby system. However, with the system it may be found advantageous to devote some of the 10 dB increase in usable dynamic range to a reduction of distortion produced by the recording or transmission channel; a reduction of programme level would then be called for.

SECTION 6
APPLICATIONS

6.1 Applicability of Dolby system

Dolby A-type audio noise reduction units can be applied to any noise-introducing recording or transmission channel in which the signal is available before and after the noisy channel and in which the gain and frequency response characteristics of the channel are fixed and known. These basic considerations are discussed in Sections 1 and 4. In addition to the handling of normal music and other audio signals, the Dolby system can in principle be used for the recording or transmission of any type of analogue signal in which the ultimate method of presentation of the information is aural.

6.2 Magnetic Sound Recording

6.2.1. Mono and Stereo Tape Recording. The A-system has applications in mono or stereo recording at all tape speeds. The system will reduce tape noise, modulation noise, and crosstalk; it also reduces amplifier noise such as hum, hiss or flicker noise. Multi-generation copying is an application in which these noise reductions are particularly valuable.

6.2.2. Multi-track Tape Recording. Multi-track tapes (usually 16 and 24 tracks on 2 inch tape, 8 tracks on 1 inch) are considerably improved by the Dolby system. The mixing of tracks during reduction to a two or four track master inevitably results in an accumulation of noise on the master, following basic physical laws. For example, if ten tracks are mixed at equal level to form one new track, the signal-to-noise ratio is degraded by 10 dB. The A-system reduces the noise level of the ten-track mix to that of a single track recorded without noise reduction; an improvement of this magnitude could otherwise be achieved only by running the tape at ten times the speed or by increasing the track widths by a factor of ten (for example, resulting in a tape width of 20 inches).

6.2.3. Disc Cutting. To take full advantage of the noise reduction used in the production of the master tape, Dolby-encoded tapes should be sent for disc mastering. Each channel in the disc cutter is then decoded via Dolby A-type noise reduction units. Similarly, where copies of master tapes are sent abroad for processing by licensees, A-type encoding should preferably be used in order to maintain optimum quality (see Dolby international user list).

6.2.4. Tape Duplication. The benefits of noise reduction can be applied to all stages of a duplicating chain. With Dolby B-type (consumer) encoding on open reel, cassette, or cartridge, the noise from a single non-encoded master tape generation is audible on the resultant duplicate. It is therefore preferable that all tapes used in the duplicating process should be noise-reduced.

6.2.5. Archive Recording. Storage of magnetic tapes for archival purposes often results in magnetic printing from layer to layer in the reel, producing pre- and post-echoes. If the original tape has been encoded by Dolby A-type noise reduction units a long term 10 dB reduction in print-through is achieved. While a reduction of print-through cannot be obtained on existing conventionally recorded tapes, further print can effectively be arrested by re-recording of the material through A-type units.

6.2.6. Sprocketed Magnetic Film. The Dolby system can be of significant assistance in the motion picture and television industries for sound recording on 35 mm or 16 mm sprocketed magnetic film. The use of noise reduction is especially valuable wherever the final sound track may be built up from several synchronized recordings or where multiple generation dubbing techniques may be used.

6.2.7. Video Tape Recorders. The quality of the audio track on both quadruplex and helical scan video tape recorders is usually inferior to that of professional audio recorders. The poor quality is due to a combination of narrow tracks, thin oxides, a disadvantageous magnetic orientation of oxide particles (which for quadruplex recorders are aligned in the direction of the transverse video tracks rather than that of the audio tracks), and various crosstalk and spurious signal problems, such as from the control track, video tracks, and capstan drive motor. The A-system can improve the main audio track nearly to studio quality; this provides not only recording of superior sound quality but in addition the capability of utilizing electronic editing and transfer or dubbing techniques without excessive noise build-up.

The quality of the cue tracks (in particular on quadruplex machines) is significantly inferior to the main audio track, since the track is even narrower. In the case of quadruplex machines, break-through of control track pulses and tone occurs. There are occasions when it is desirable to raise the quality of the cue track to allow a second audio channel to be recorded - for example in countries where two languages exist. The Dolby A-system is capable of upgrading the cue track to a satisfactory standard for full broadcast use.

6.3 Transmission Applications

6.3.1. Landlines. Lines between studios and transmitters, or between distribution centres, are still often coaxial or twisted pairs. Such lines are subject to a variety of interferences ranging from cross-talk and telephone dialling pulses to low frequency noise which can be either hum or noises introduced by earth or sea movements. Adjacent circuits carrying video signals may contribute television line-frequency interference. Landlines often suffer from considerable high frequency attenuation, and the degree of high frequency equalization which then has to be applied may result in unacceptable high frequency noise. The Dolby system is of great value in alleviating these line noise proplems.

6.3.2. Microwave Links. Broadcast signals are often sent from station to station through some form of microwave system. This may take the form of a number of probably adjacent 3 kHz bandwidth channels multiplexed onto a carrier. At the receiving end of the chain the 3 kHz channels are demodulated and re-assembled. Any over-modulation of the channels can cause distortion products to be generated in adjacent channels; hence signal overshoots must be minimal. The Dolby A-type noise reduction technique avoids overshoot problems and allows transmission of all types of programme. The noise reduction action also removes low-level carrier interference signals which may occur in this type of transmission.

6.3.3. Other Transmission Methods. The A-type system is generally suitable for use with any communication link with fixed gain and frequency response characteristics. However, for correct operation the signal entering the decode processor should be identical (within normal operating tolerances) to that leaving the encode processor. The signals should also be in unequalized (flat) form.

6.4 Motion Picture Industry

6.4.1. Location Recording. Since Dolby A-type noise reduction units have application throughout the motion picture industry, from the location recording to the final print in the cinema, it is preferable if a sound recording is A-type encoded from the beginning. On location, camera noise and other naturally occurring sounds will often dominate the tape noise. But there are many instances when this is not so, and the use of noise reduction at this early stage increases the flexibility in subsequent signal processing without the hazard of noise build-up.

6.4.2. Transfer and Dubbing. The motion picture industry has traditionally used the technique of multiple dubbing to assemble the final master (full-coat, triple or M.E.D.) recording from a variety of sources (dubbing units), rather than the music recording industry's method of parallel recording on multi-track machines. Clearly noise build-up is a problem which can be alleviated by use of the Dolby technique.

6.4.3. Release Prints. Historically, the sound quality of the cinema itself - the final link in the chain - has lagged behind the rest of the audio entertainment industry. Early methods of recording and reproduction were limited, and cinemas were designed to use a high frequency roll-off, known as the Academy roll-off, to reduce the effects of wideband and impulsive noise. The loss is severe - about 15 dB at 8 kHz which, when added to the high frequency attenuation in the speaker-screen combination, causes dialogue and music to be dull and indistinct. To improve intelligibility it has become common studio practice to boost middle and high frequencies during dubbing, causing further distortion due to the limited modulation capabilities of the film. The Dolby A-type system provides the way out of the dilemma, making it possible to produce wide-range optical sound, since the system reduces background noise without impairing high frequency response. Special A-type units are available for installation in cinemas, enabling the new Dolby encoded optical or magnetic tracks to be replayed, yet retaining the switched option of standard Academy responses for non-encoded material. The units can be used with combined or separate optical or magnetic tracks.

6.5 Sound Delay and Echo Systems

6.5.1. Tape Delay. Popular tape delays use either an endless tape loop or a magnetic disc; both systems use a master recording head and several playback heads. Delay units are used to increase intelligibility in large reverberant buildings, to equalize time-differences between vision channels transmitted via satellite and their associated audio channels transmitted via cable, or to create special sound effects. Since magnetic tape is usually the recording medium, noise is a problem which can be alleviated through the use of the A-type noise reduction system.

6.5.2. Electronic Delay. Various methods are being used to produce electronic delays, including shift registers and sample, storage and read circuits. For economic reasons the noise performance is often inadequate for the most demanding applications, and in general the noise spectra is obtrusive since it is not white. In such instances the signal can be noise reduction encoded prior to the delay unit and decoded at the output, yielding a significant improvement in signal-to-noise ratio.

6.5.3. Reverberation systems. Echo chambers or reverberant plates are often noise limited. Dolby A-type noise reduction units can be placed around the echo chain, resulting in a significant improvement in signal-to-noise ratio. Unfortunately, such applications are not as straightforward as they might appear, since due to dispersion the signal at the decoder is not identical to that leaving the encoder. Thus a comparison of the signal with and without noise reduction will reveal differences. The apparent reverberation time will be decreased, but this can be compensated by readjustment of the plate time or room damping materials.

6.6 Digital Applications

Digital techniques are becoming more common as the size and cost of complex semiconductor logic arrays are reduced. Digital techniques for delay purposes have already been discussed (Subsection 6.5.2.). Another digital application is the use of pulse code modulation (PCM) for signal transmission. To describe an audio signal in digital form needs a given number of bits (level samples) occurring at a given sampling rate, producing a serial data rate in the order of 500 kilobits per second. To transmit this information requires a wide bandwidth; or in recording terms either a multiplicity of tracks or a high head-to-tape speed. The data rate can be reduced if one of the required performance parameters is relaxed, such as signal to noise ratio; incorporation of the analogue A-type noise reduction system into existing or new digital designs can save two bits to give a useful reduction in bit rate for a given ratio. The economic saving of two bits can sometimes be greater than the cost of the A-type processors. The processors should be used before the input to the digital encoder and after the output of the digital decoder.

6.7 Electronic Music

It is not necessary that the programme being encoded consist of naturally occurring sounds. The A-system is equally effective when processing the signals which are often found in electronic music composition. Furthermore, because of the specialized techniques (such as multiple dubbing and the mixing of many pre-recorded sources) employed in these compositions, noise reduction is of particular value in preventing excessive noise build-up.

SECTION 7

INSTALLATION

DOLBY LABORATORIES INC

A-TYPE NOISE REDUCTION SYSTEM

INSTALLATION INSTRUCTIONS

MODEL 360
One channel record or playback (no automatic changeover)

NOTE: CHECK VOLTAGE SELECTOR BEFORE APPLYING POWER

1. Unpack Model 360 units and check for damage. Remove top covers of units and check interiors.

2. Mount units in rack.

3. Set voltage selector switches (115-230v) appropriately.

4. Connect power cables. If power plugs on cables are changed for another type, the following wiring convention should be observed (for cables supplied with units).

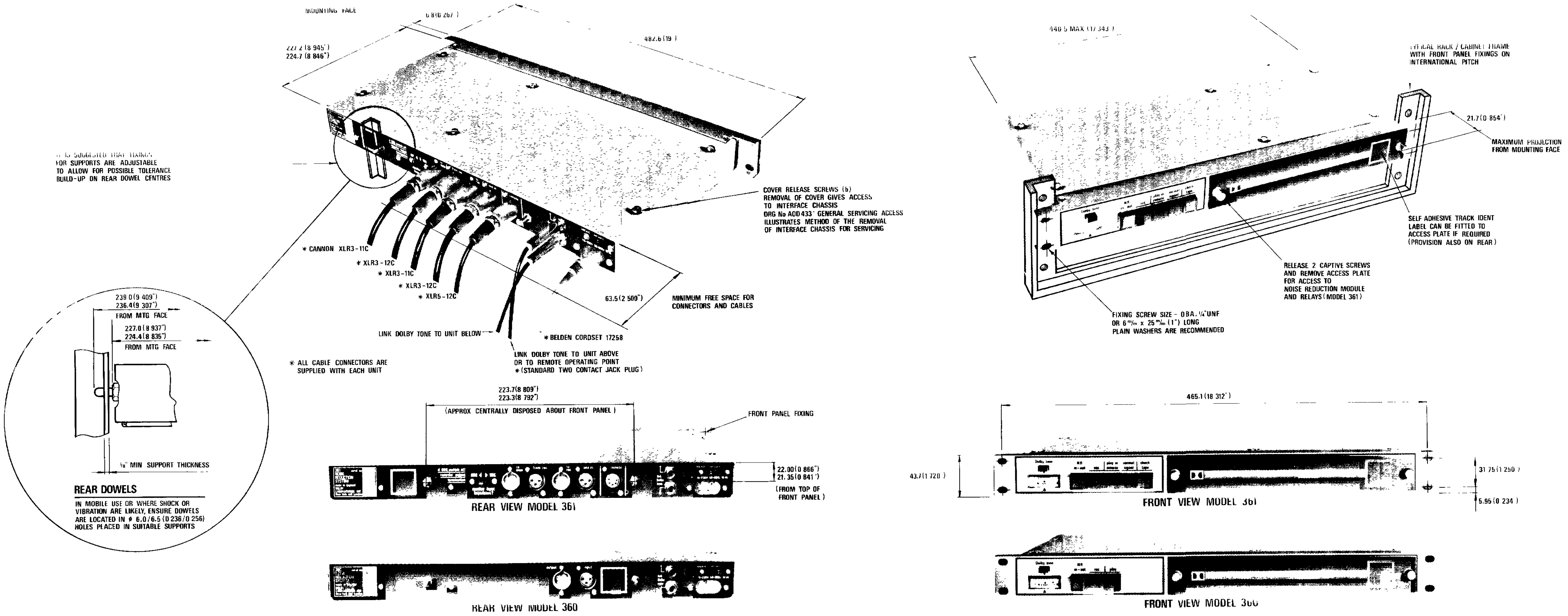
U.S. style	Power: L, black; N, white	Earth: green
Continental style	Power: L, brown; N, blue	Earth: yellow/green

5. Connect signal cables to Model 360 units using three-pin XLR cable connectors. For use in recording, prepare cables from mixing console and cables to recorder. For use in playback, prepare cables from recorder and cables to monitor facilities. In all of the three-pin XLR signal connectors, pin 1 is earth and pins 2 and 3 are the balanced-floating winding of the input or output transformer, with pin 2 as the "low" side and pin 3 as the "high" side for standardized phasing. For unbalanced operation, pin 2 should be connected to earth; pin 3 is signal.

6. Input impedance of Model 360 is 10k; output impedance is 20 ohms. Unit will drive any load impedance from 200 ohms upwards; therefore it is unnecessary to provide an output termination resistor when feeding a bridging load. However, if tape recorder has output termination switch, switch should be "on" when driving Model 360 (playback mode).

7. Link together Dolby Tone circuits of all Model 360 units (both record and playback) using two-conductor cables and jack plugs provided. The Dolby Tone oscillator and calibration circuitry in the Model 360 are activated by connecting the centre pin of the jack plug to earth. Pressing the Dolby Tone button on any linked Model 360 unit connects this pin to earth. The Dolby Tone functions may be activated remotely (at the mixing console, for example) simply by extending the jack plug links; connect a single pole normally-open push button to the end of the remote link.

8. Refer to Model 360 Operating Instructions for calibration and operating procedures.



INSTALLATION INFORMATION — 330 and 360 Series

All dimensions in millimetres auxiliary dimensions in inches Drg No. AOD 495

SECTION 8

OPERATION

DOLBY LABORATORIES INC

A-TYPE NOISE REDUCTION SYSTEM

OPERATING INSTRUCTIONS

MODEL 360
One channel record or playback (no automatic changeover)

> NOTE: CALIBRATION TRIMPOTS ON UNITS ARE TURNED DOWN BEFORE SHIPMENT. CALIBRATION PROCEDURE BELOW MUST BE CARRIED OUT BEFORE UNITS ARE USED.

A. For playback use

1. Ensure that installation has been carried out according to "Model 360 Installation Instructions."

2. Press PLAY buttons and NR-IN buttons on all Model 360 units.

3. If recorder electronics have line-in/line-out monitor switches (i.e. source/tape or rec/play), set switches to line-out (tape) position.

   Play NAB or DIN level set tape. Recommended test tapes are:

   Ampex:
   $\frac{1}{4}$" 31311-01 Reproduce Alignment Tape - 15 ips NAB (185 nWb/m)
   $\frac{1}{4}$" 31315-01 Level Set Tape " " "
   $\frac{1}{2}$" 31311-05 Reproduce Alignment Tape " " "
   1" 4690005-01 " " " " " "
   2" 4690024 " " " " " "
   2" 4690018 " " " " " "

   BASF:
   $\frac{1}{4}$" Bezugsband 38, according to DIN 45513 (320 nWb/m)
   $\frac{1}{2}$" " " " " " " "
   1" " " " " " " "
   2" " " " " " " "

   Agfa:
   $\frac{1}{4}$" Bezugsband 38, according to DIN 45513 (320 nWb/m)

5. Adjust playback gain controls on recorder to give normal studio line level out of recorder.

6. Adjust input level controls on Model 360 playback units (remove front cover plates) to give readings of "NAB" or "DIN", as appropriate, on meters. Press any Dolby Tone button while making readings; in playback mode, button de-activates noise reduction circuits of all Model 360 units with linked Dolby Tone.

7. Adjust output level controls on Model 360 playback units to give normal studio line level to monitor facilities.

346 Clapham Road
London SW9
Telephone 01-720 1111
Telex 919109

B. For use in recording

1. Ensure that installation and playback adjustment procedures above have been carried out.

2. Press RECORD buttons and NR-IN buttons on all Model 360 record units.

3. Adjust record gain controls on recorder to suit normal studio line level.

4. Press Dolby Tone button on any Model 360 unit with linked Dolby Tone and record on blank tape. Adjust output level controls on Model 360 record units (remove front cover plates) such that tone is recorded at Dolby Level (18.5 mM/mm - Ampex-NAB level) on all channels (not DIN level). Verify that correct levels are being recorded by noting playback Model 360 meter readings obtained.

5. Adjust input controls on Model 360 record units to suit line level in.

6. After above calibration has been carried out, Model 360 record units, recorder, and Model 360 playback units should be treated as a fixed, unity-gain recording system. Playback output is at studio level; for recording, studio level should be fed in.

Notes

a. 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 program level actually recorded on tape by adjusting level of program source (e.g. mixer outputs). Optionally, input controls on record Model 360 units (together with output controls on playback Model 360 units) can be used. This standardized recording practice is necessary for international tape interchangeability. As an added precaution to ensure correct playback of tapes, always record Dolby Tone at beginning.

b. Procedures 2 to 6 in playback section above will normally give correct playback level conditions for tapes received without Dolby Tone at beginning. If a tape is received with Dolby Tone but Model 360 playback unit meter does not register Dolby Level (NAB mark), an incorrect record level calibration used in recording the tape and/or a track width discrepancy is indicated. In such cases readjust playback gain controls on recorder to give Dolby Level readings (press any Dolby Tone button while making readings); recalibrate (procedures 4-6 in playback section above) after replaying tape.

c. To record or replay tapes without Dolby noise reduction characteristic, press NR IN-OUT buttons appropriately.

SECTION 9

MODEL 360 INTERFACE - CIRCUIT DESCRIPTION

9.1 Interface Chassis

The interface assembly provides for all interface requirements between the Cat. No. 22 noise reduction module (NRM) and the recorder or other equipment with which the noise reduction system is used. As well as providing a housing for the module, the interface includes a power supply, a meter and associated circuitry, input and output potentiometers, and pushbuttons to control the functions of the module. Most of the components are mounted on a single printed circuit board, the physical layout of which can be seen on the drawings at the end of Section 11, Servicing. The interface circuit drawing (A0C367) is at the rear of this section, and may be folded out clear of the text for reference.

9.2 Power Supply

AC power is fed to a double primary transformer (T1) which can be set for 115 V or 230 V operation by means of a screwdriver-slot slide switch (S1) mounted on the rear of the unit. In the 230 V position the unit will operate on any power line voltage from 200 to 250 V, and over an equivalent range when the 115 V position is selected.

The ac output of the transformer secondary, nominally 19 V, is fed to the bridge rectifier (D1) mounted on the printed circuit board. The resultant dc voltage is smoothed by capacitor C1, which is fixed by clips in the channel immediately behind the printed circuit. This raw dc supply is fed to the NRM by two routes; directly for power, and also via the Record switch S3b as a record interlock signal for the Dolby Tone logic circuits in the module.

The 19 V ac signal is also used to power the indicator lamps via appropriate contacts on the Record switch S3c and Noise Reduction In-Out switch S2a.

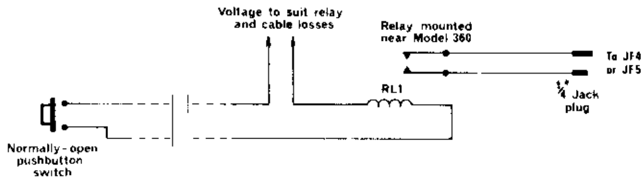
9.3 Mode Switching

The noise reduction signal from the NRM is fed back to the correct input via the mode switches S3 and S4. The record mode is selected by depressing the Record button, which is then illuminated in red. Pressing the Play button releases the Record button and puts the unit in Play mode; the green lamp in the Play button is then illuminated.

The noise reduction signal can also be shorted to earth via S2b, turning off the noise reduction action and converting the Model 360 unit into a fixed gain amplifier. This facility is used when making or playing back non-Dolby recordings, removing the necessity for patching the unit out of the circuit. The pushbutton is illuminated in the NR In mode.

9.4 Dolby Tone Operation

The Dolby Tone oscillator in the NRM (see Sections 5, 8, and 10) may be operated by the front panel biased pushbutton S5. This normally-open switch earths pin 3 of the module, switching on the oscillator. Capacitors C5 and C6 provide a small delay in the turn-off time of the oscillator and logic circuits; two capacitors are used in series to reduce the possibility of leakage currents.



REMOTE OPERATION OF DOLBY TONE (over 100m, 300 ft)

Fig. 9.1

The Dolby Tone on-off operating line is also brought out to two parallel-connected phone jacks (JF4, JF5) on the rear of the unit, allowing units to be linked together so that any front panel pushbutton operates all oscillators. The oscillator can also be operated remotely through these sockets; for distances up to 100 m (300 feet), two conductor cables and a normally-open pushbutton switch can be used. The total cable resistance should not exceed about 100 ohms. For longer distances, external relay control should be used; a suitable method is described in Section 7, Installation.

9.5 Signal Paths

Audio input signals are routed from the input connector JF2 to a tagstrip near the input transformer; if required, a line input termination resistor can be soldered across the appropriate terminals at this point (transformer primary leads are grey and white). The secondary of the transformer is routed to the printed circuit board. The high-frequency resonance of the transformer is damped by resistor R1 mounted on the top surface of the printed circuit board. (Below serial number 360-00450, R1 was mounted on the transformer tagstrip.) Trimpot RV1 (Input Level) attenuates the studio line level to suit the input requirements of the module; the trimpot is a screw-driver-adjust control which is accessible when the front panel cover plate is removed. The sensitivity of the unit is such that a minimum input of about 350 mV is required at Dolby Level (185 nWb/m tape flux). Higher sensitivities can be provided with a special input transformer T2 or by the use of an additional amplifier between the output of RV1 and the input to the NRM; these special requirements should be specified at the time of ordering.

The output level control RV2 is the NRM line amplifier gain control, enabling the output signal to be set at levels up to +16 dB for Dolby Level. With the front cover plate removed, the control is accessible through a front panel hole next to the input level control.

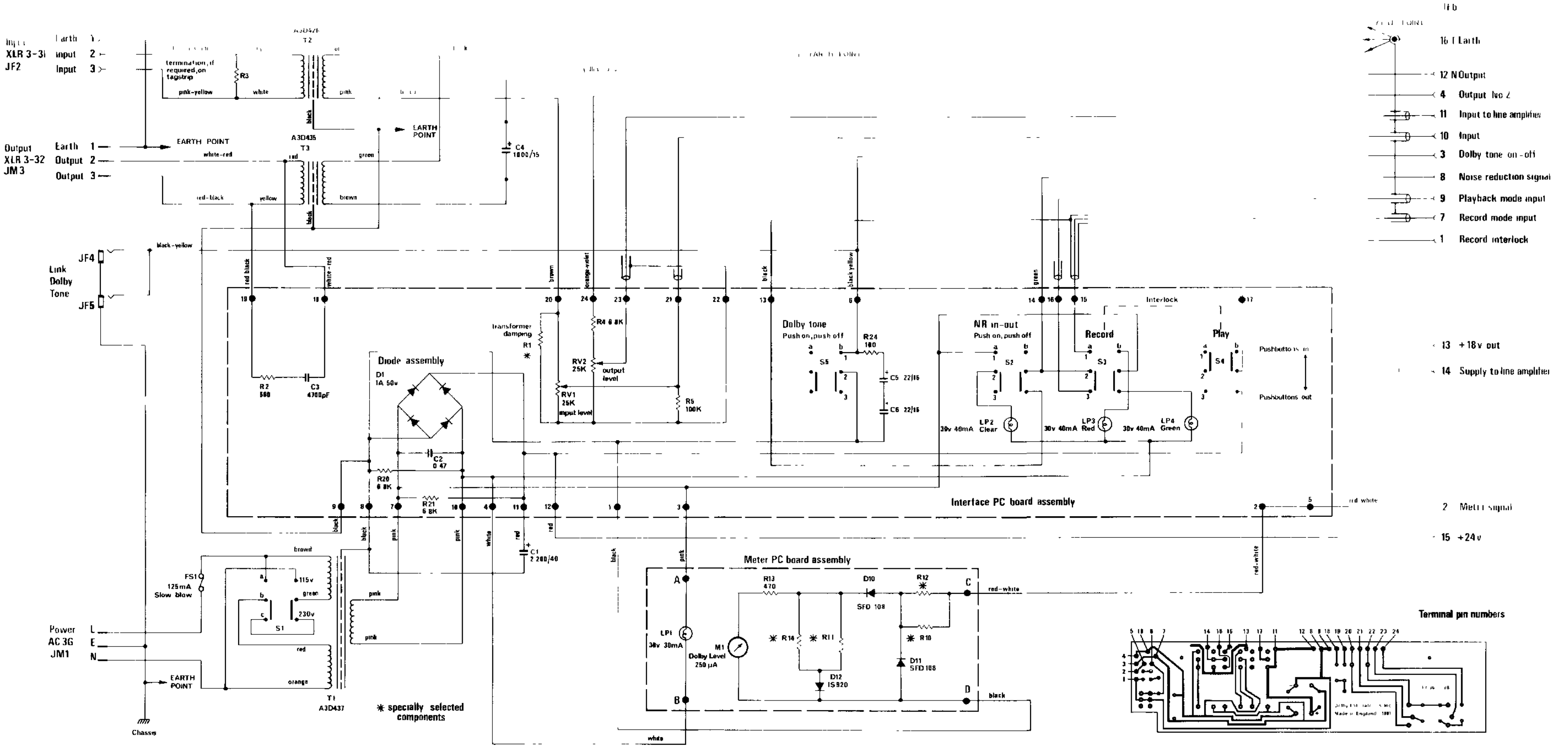
The unbalanced output of the NRM is routed to the output transformer T3 through capacitor C4 (mounted under the transformer tagstrip), isolating the dc voltage component present at the module output. The transformer has a 1:2 step-up, providing a maximum output signal in excess of +21 dBm into 600 ohms. Resistor R2 and capacitor C3 form a high-frequency damping network, which damps the 500 kHz resonance of the transformer. This high resonant frequency is a consequence of the extremely low leakage reactance of the transformer, which is necessary to maintain a low output impedance (approx. 20 ohms) throughout the audio passband. The transformer secondary is connected to the output connector JM3, and is free from any earth connection.

9.6 Meter Circuit

The noise reduction module contains a meter amplifier which provides an ac output signal related to the operating parameters of the noise reduction system (see Sections 4 and 5), which in turn are related to the flux on the tape. A tape flux of 185 nWb/m (Ampex NAB level) is designated Dolby Level and corresponds to a meter signal from the module of 1.85 V. The DIN flux level of 320 nWb/m (32 mMx/mm) corresponds to 3.2 volts, and similarly for any other flux level. The meter circuit in the 360 interface is driven by these signals and displays them on a calibrated scale.

Referring to the Model 360 interface circuit, the meter signal is rectified by the voltage doubler D10 and D11 acting with the meter amplifier output capacitor in the NRM. The resulting dc is fed to the meter via a non-linear network R14 and D12, which linearizes the meter characteristics. With an input of 1.85 V, the input attenuator (R10) is factory-adjusted to give half-scale deflection, corresponding to the NAB mark. Under these conditions the voltage developed across the meter is less than 0.6 V, so that D12 does not conduct. As the input level is raised, this diode conducts, progressively shunting current from the meter. At an input of 3.2 V, R11 is factory-adjusted such that the meter reads DIN. DIN readings should be taken from a point directly in front of the meter (not on the axis of the needle).

All the meter components are mounted on a printed circuit sub-assembly which is in turn fixed to the meter casing. The meter is internally illuminated by a miniature lamp, LP1, which can be replaced through a hole in the side of the chassis. The meter sub-assembly must be exchanged intact if meter replacement is ever required.

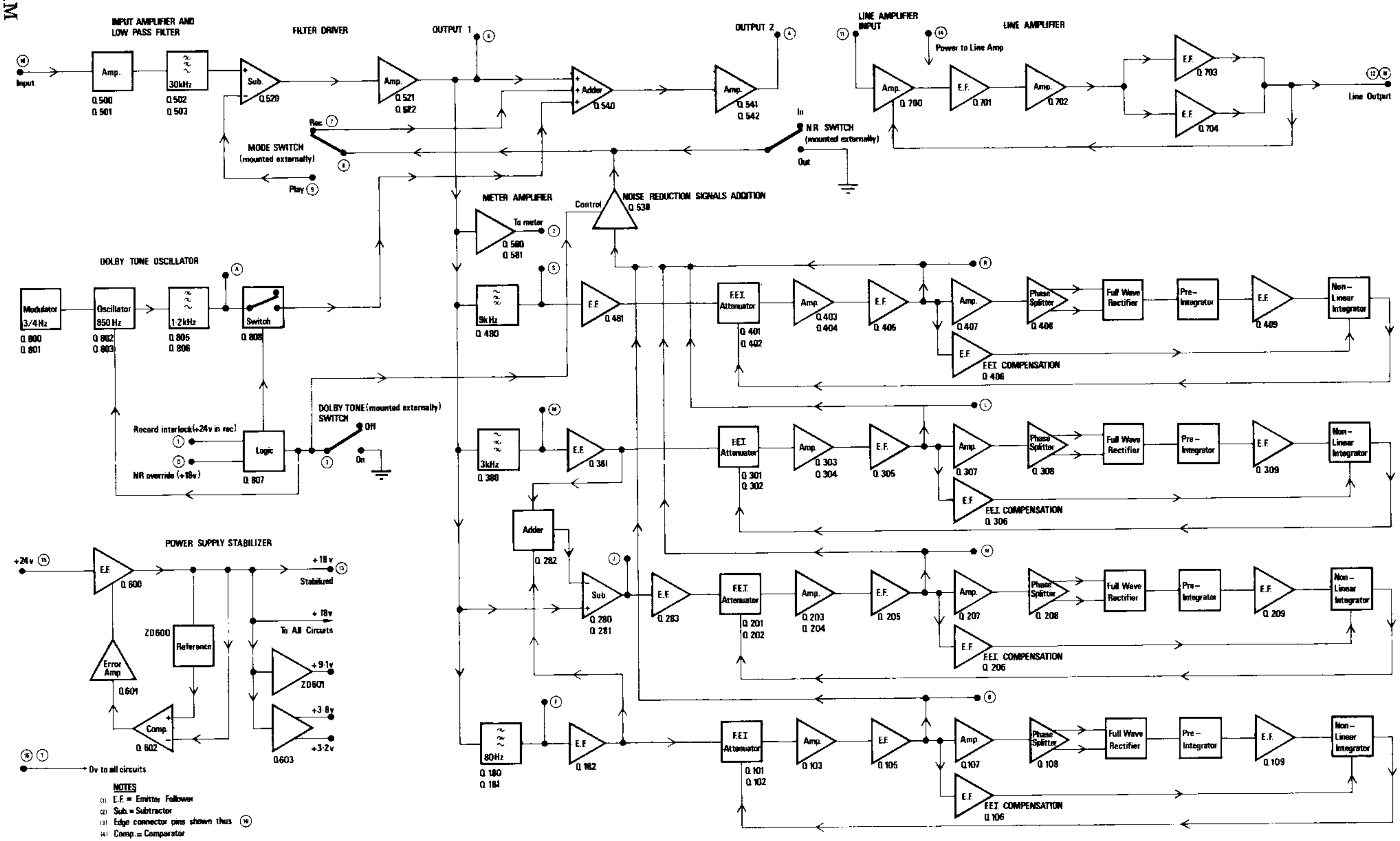


NOTE –
Unit shown in Play mode and NR out

Drawing no AOC 367
(Serial nos 360-1 03829 and following) MODEL 360 INTERFACE CIRCUIT

SECTION 10

CAT. NO. 22 NOISE REDUCTION MODULE - CIRCUIT DESCRIPTION



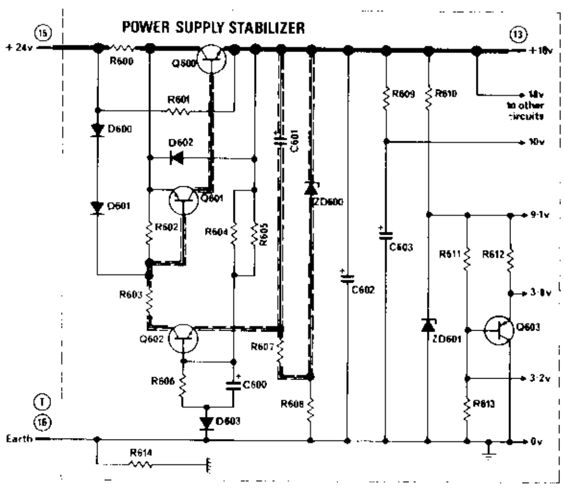
© Dolby Laboratories Inc 1977 Drawing No. A08 441 CAT. 22 NOISE REDUCTION MODULE BLOCK DIAGRAM

10.1 Introduction

The block diagram on the opposite page outlines the electronic sections of the noise reduction module. The main signal path is shown along the top, from the Input Amplifier through Filter Driver, Output 2 Amplifier, and finally Line Amplifier sections. The side chain signals pass through the filters and compressors, are combined, and then combined additively or subtractively with the main signal.

Each section will be described in turn, and will be preceded in the text by its circuit diagram. In these, the convention is adopted of main signal paths being shown by a heavy solid line, feedback paths by a light outlining of the signal line, and noise reduction signal paths by a solid dotted line. The complete circuit diagram is given at the end of the Cat. 22 section of this manual.

10.2 Power Supply



The Power Supply Stabilizer receives a roughly smoothed dc voltage (+24 V nominal, but with a minimum value of +19.5 V, including negative ripple excursions) and stabilizes this to 18.0 V $\pm$ 0.3 V. The current supplied by the stabilizer is 105 mA, with a further 10 mA for the Line Amplifier. At high output levels, the Line Amplifier requirements reach a peak of 100 mA.

Transistor Q602 functions as a comparator, responding to the voltage difference between base and emitter. The zener action of ZD600 ensures that the emitter is always a constant 6.8V below the output voltage; the base is held at a slightly higher voltage by the divider R605 and R606.

The operation of the circuit is best explained by considering the results of a change in output. If more current is demanded, the output voltage will tend to fall. Transistor Q602 emitter falls by the full amount of the change (since the voltage across ZD600 is always constant), but the base is held at a constant voltage by C600 for rapid changes;

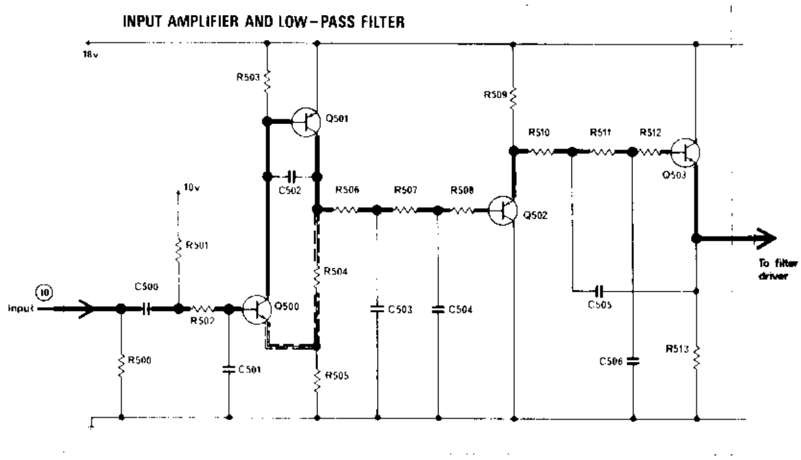
for slower changes the base falls to a lesser degree owing to the potential divider action of R605 and R606. Transistor Q602 thus passes more current, and the resulting fall in collector voltage is amplified and inverted by Q601. The output voltage rises, counteracting the initial output voltage drop; the reverse action occurs if the output voltage rises. The series regulator transistor Q600 is bolted to a small heatsink which dissipates about 850 mW with a rough supply of 24 V.

In addition to voltage stabilization, the circuit also provides for foldback current limiting. If an increased current is demanded from the stabilizer, the voltage drop across R600 increases; Q601 then passes more current. When the voltage drop across R600 is greater than 0. 7 V, diodes D600 and D601 conduct and clamp the base potential of Q601. Thus no more current will flow, and the output is current-limited. If the load is increased, the constant current mode progressively collapses into a foldback characteristic. Under short circuit conditions, the current flowing is typically 15 mA.

The module also produces a secondary supply of 10 V, a zener diode 9.1 V supply, and two voltages (3.2 V and 3.8 V) that are related by the base-emitter voltage of Q603. The difference in these two is therefore temperature-related, and this thermal dependence is used to compensate for variations which occur in the limiter circuits.

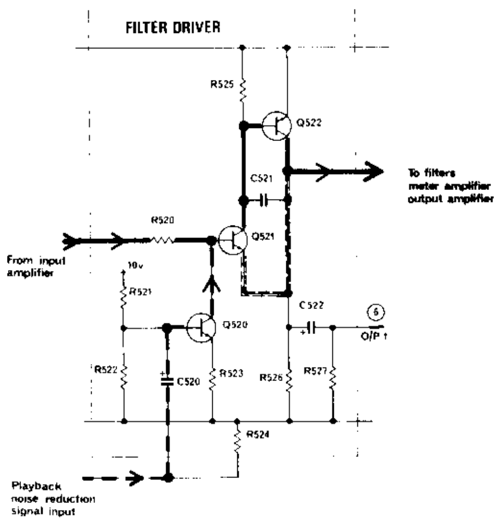
It is also possible to operate the processor module from batteries or other external supplies. A ripple-free voltage of about + 18 V can be applied to pin 13; all parts of the circuit which are significantly voltage-sensitive are supplied from the 9.1 V supply, which is fully stabilized by the action of zener diode ZD 601. Diode D602 prevents transistor Q600 from becoming reverse-biased. The module operates correctly at lower supply voltages down to about +16 V, but with reduced output capability. The current requirement is dependent on the supply voltage used, 115 mA being drawn at +18 V. The maximum voltage which can be applied to pin 13 is 28 V; higher external voltages or supplies with ripple present should be applied to pin 15 with series resistors if necessary to limit the voltage at pin 15 to 30 V.

10.3 Input Amplifiers



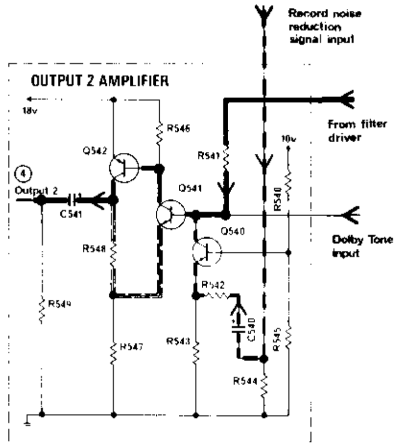
Input signals are applied to the input stage via an RF filter (R502 and C501). Transistors Q500 and Q501 function as a high input impedance unity-gain amplifier. The maximum sensitivity of the module is 300 mV for Dolby Level (corresponding to a magnetic tape flux level of 185 nWb/m, Ampex Operating Level). Transistors Q502 and Q503 form a two-stage active 34 kHz low pass filter, which prevents tape recorder bias or high frequency interference from entering the module and affecting the noise reduction circuitry.

10.4 Filter Driver



Transistors Q521 and Q522 act as a high input impedance, low output impedance unity-gain amplifier, which is designed to feed the filter amplifiers. The noise reduction signal (which will be described in detail in Sections 10.9, 10.10, and 10.11) is routed in the playback mode to Q520, via pin 9. At pin 9 it is in phase with the signal at Q503 emitter; the inverting action of Q520 causes the noise reduction signal voltage developed across R520 to subtract from the main signal path voltages. A reduction in gain at low playback signals is thus achieved (see Section 4).

10.5 Output 2 Amplifier

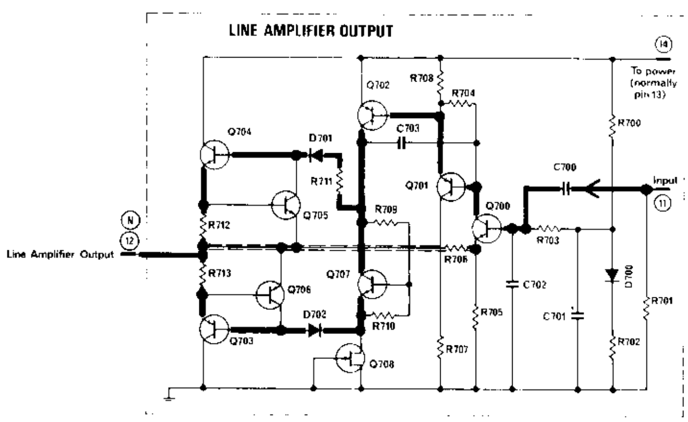


The main path continues to Output 2 Amplifier; Q541 and Q542 are arranged in a feedback amplifier configuration to raise the 300 mV signal to 500 mV. The output signal (pin 4) can be used independently; for example, in situations where the module is an integral part of a tape recorder, this signal would go via a preset calibration control to the record amplifier input.

In the case of the Model 360, 361 and 364 Noise Reduction Units it passes via a potentiometer (Output Level) to the input of the Line Amplifier.

The noise reduction signal is applied in the record mode to Q540 emitter; being in phase with the signal at Q522 collector, the noise reduction signal adds to the main signal in R541 to provide the desired record characteristics (see Section 4).

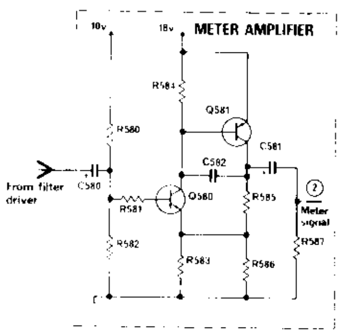
10.6 Line Amplifier



The module contains an independent line amplifier, with an input on pin 11 and an output on pins 12 and N. The amplifier can be fed from any signal — for example from Output 1 or Output 2 via appropriate attenuators. The amplifier is designed to feed a 1:2 transformer to provide balanced or floating outputs. The normal input level is 90 mV for a 600 mV output (e.g. 1.23 V, +4 dBm with the transformer). Via the transformer, the clipping level is +16 dB (relative to 0 dB = 0.775 V) into 200 ohms or +21 dBm into 600 ohms when powered from the internal 18 V supply (pin 14 strapped to pin 13). Higher outputs, at slightly higher hum levels, can be obtained by connecting the positive voltage rail (pin 14) directly to the +24 V rough supply (pin 15). Still higher output levels can be obtained by using an external higher voltage connected directly to pin 14. This external voltage should not exceed 40 V, and should have a maximum ripple content of less than 1V peak to peak.

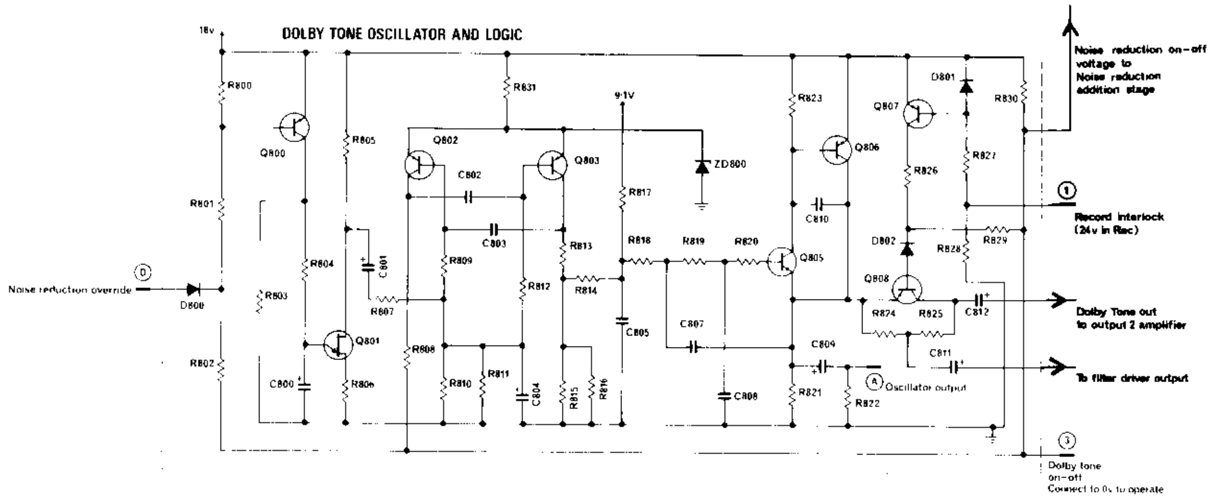
Transistors Q700 and Q702 form a voltage amplifier, with Q701 isolating the two gain stages. Transistors Q703 and Q704 are complementary-symmetry emitter followers, whose quiescent current is determined by the amplified diode arrangement Q707, R709, and R710. Negative feedback is taken from the output to the emitter of Q700 via R706 to determine the gain and raise the input impedance. Transistors Q705 and Q706 act as current limiters; if, for example, high positive-going currents are demanded from the output stage, the voltage across R712 must rise and hence the base voltage of Q705 rises. Eventually Q705 conducts and limits the base voltage on Q704, thereby limiting the output current. Similarly on opposite half cycles, transistor Q706 operates. Thermal protection is provided by mounting transistors Q707 and Q704 in a single copper clip; any rise in the output stage temperature is transferred to transistor Q707, reducing the collector-emitter voltage and hence reducing the output stage current. Thermal runaway is thus prevented.

10.7 Meter Amplifier



The meter amplifier comprises transistors Q580 and Q581, which function as an amplifier with low output impedance for driving a suitable meter incorporating rectifier diodes. The amplifier is driven from the filter driver output (Output 1), which is called the reference point. All compressor characteristics are related in a fixed manner to the voltage at this point. Level calibration of the unit is thus achieved when the input voltage (from the tape recorder, for example) is adjusted to read the correct level at this point. A reference level, called Dolby Level, can be related to the operating standards of the medium with which the noise reduction system is used. In professional tape recording, Dolby Level corresponds to a tape flux of 185 nWb/m (Ampex Operating Level), which should be replayed to give 300 mV at the reference point; the meter amplifier then produces 1.85 V at pin 2. Similarly, if a reference tape flux of 320 nWb/m is the standard in use (European practice), the meter amplifier produces 3.2 V at pin 2. The amplifier gain is precisely set during manufacture by selection of R583. Pin 2 can be connected to any suitable meter via an appropriate attenuator.

10.8 Dolby Tone Oscillator



To assist in recorder gain calibration and level setting, each module includes a built-in oscillator. The output of the oscillator is injected into the signal circuit at a level corresponding to Dolby Level.

Transistors Q802 and Q803 form a 850 Hz multivibrator, which oscillates when pin 3 is earthed (by operation of an external push-to-make Dolby Tone switch). In multichannel installations, the Dolby Tone on-off line (pin 3) of all channels may be commoned, so that a single switch operates all modules. The square wave output from the oscillator passes to a three-stage active filter. The output from Q805 and Q806 is a sine wave of approximately 2% total harmonic distortion. For use with the NRM Tester (Cat. No. 35) this output is available on pin A.

Transistor Q808 is an electronic switch; in one condition it presents a high impedance, in the other a low impedance. With the switch in the low impedance mode, the oscillator output is routed to the input of the Output 2 amplifier. Since the output impedance of Q805 and Q806 is low, any signals from the filter driver will be almost completely attenuated by the action of R541 (10 k) working into this low impedance. However, any such signals will nevertheless register on any meter connected to the meter amplifier. This facility can be used during record gain calibration, when pressing the Dolby Tone switch can be arranged to feed Dolby Tone to the record amplifier in a tape recorder, while leaving the input amplifier of the noise reduction module connected to the playback side. The meter will then read the Dolby Tone signal actually played back from the tape, allowing the record level controls on the recorder to be set precisely.

The electronic switch itself is programmed to operate only in the record mode of the tape recorder. Under record mode conditions, a +24 V record interlock signal is applied to pin 1, turning transistor Q807 off. If pin 3 is earthed, the base of Q808 is made more negative than the emitter, which is held at about +3.5 volts by Q805 and Q806. Transistor Q808 therefore conducts. If pin 3 is not earthed, the voltage rises to about +15 volts, which turns Q808 off.

If the 24 volt record interlock signal is not present on pin 1, then Q807 will conduct. The base of Q808 is thus held more positive than the emitter, which prevents the electronic switch from conducting, whether or not pin 3 is earthed. Note that earthing pin 3 will still turn the oscillator on, providing an output at pin A for use with the NRM Tester. However, under these conditions the output will not be injected into the signal circuitry via Q808.

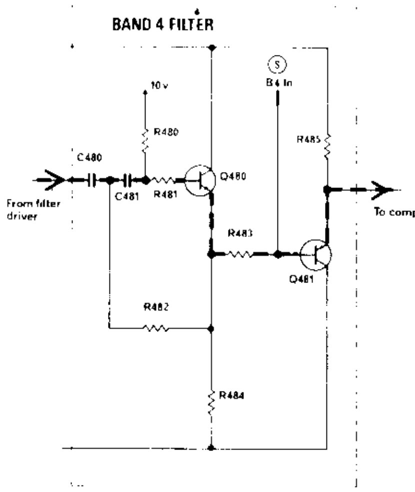
To equalize the dc voltage component across the transistor switch Q808, a resistor must be added from emitter to collector; if the switch is to have a high on-off resistance ratio, the value of this resistor must be large. To avoid the use of high value resistors, two resistors of comparatively low value (R824 and R825) are used with their centre point bootstrapped via C811 to a low impedance point carrying the same signal as is present on Q808 collector.

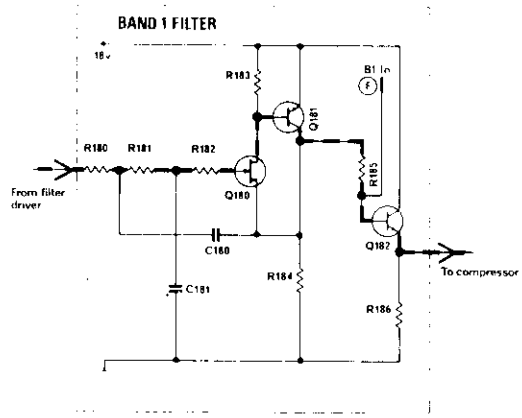
The Dolby Tone on-off line (pin 3) is also connected to the noise reduction signals addition stage, described in Section 10.11. When pin 3 is earthed, the noise reduction action is electronically removed. Note that this action occurs in both the record and playback modes. Since the on-off line may be paralleled for simultaneous operation of all channels in a multichannel installation, this allows a single switch both to turn on all oscillators for record calibration and to remove the noise reduction action during playback calibration.

To make the Dolby Tone distinctive, it is frequency-modulated. Transistor Q801 is a unijunction device, functioning as a relaxation oscillator. When pin 3 is earthed, a current is fed from Q800 into C800, which slowly charges up towards +18 V. When the peak point emitter voltage of the unijunction is reached, the base emitter junction becomes low impedance, discharging C800. The interbase resistance is low, and the resulting current flow produces a negative-going pulse in R805. Transistor Q801 then reverts to its off state, and C800 recommences its charging cycle. The time constants are arranged to produce a 30 msec pulse with a period of 750 msec. The pulse is applied to the multivibrator timing resistors R809 and R812, raising the frequency by approximately 10% for the pulse duration.

To avoid confusion when the oscillator is used with the NRM Tester, the frequency modulation is removed. In these circumstances pin D is taken to a voltage of +18 V or higher, so that Q800 becomes non-conducting. Capacitor C800 cannot charge, and hence Q801 will not oscillate.

10.9 Filters

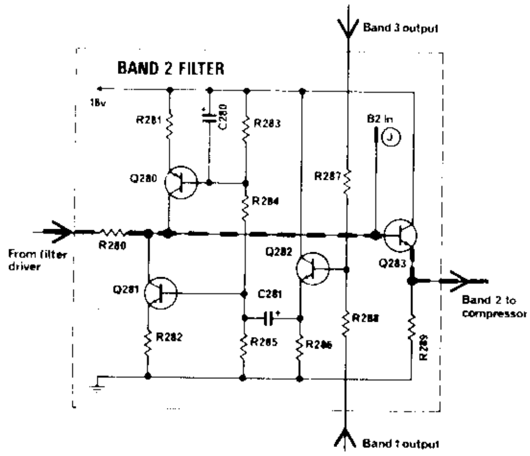




The side chain or differential path commences at the output of the filter driver Q521 and Q522. This stage drives the four filters, which split the audio signal into four frequency bands. The output from each of these bands passes through an independent low-level compressor before being combined to form the noise reduction signal which is then re-introduced to the main signal path. Bands 3 and 4 are both high-pass filters of identical circuit configuration with changed component values; only Band 4 is shown above.

Transistor Q480 is an active high pass filter, with the components C480 and C481, together with R480 and R482, chosen for a cutoff frequency of 9 kHz. Transistor Q581 is an emitter follower. Similarly, Q380 forms a 3 kHz high-pass filter. A rearrangement of capacitors and resistors in a similar circuit around Q180 forms an 80 Hz low-pass filter. In this filter a field effect transistor is used to raise the input impedance (allowing small value capacitors to be used) and the transistor amplifier Q181 is used to provide a low output impedance.

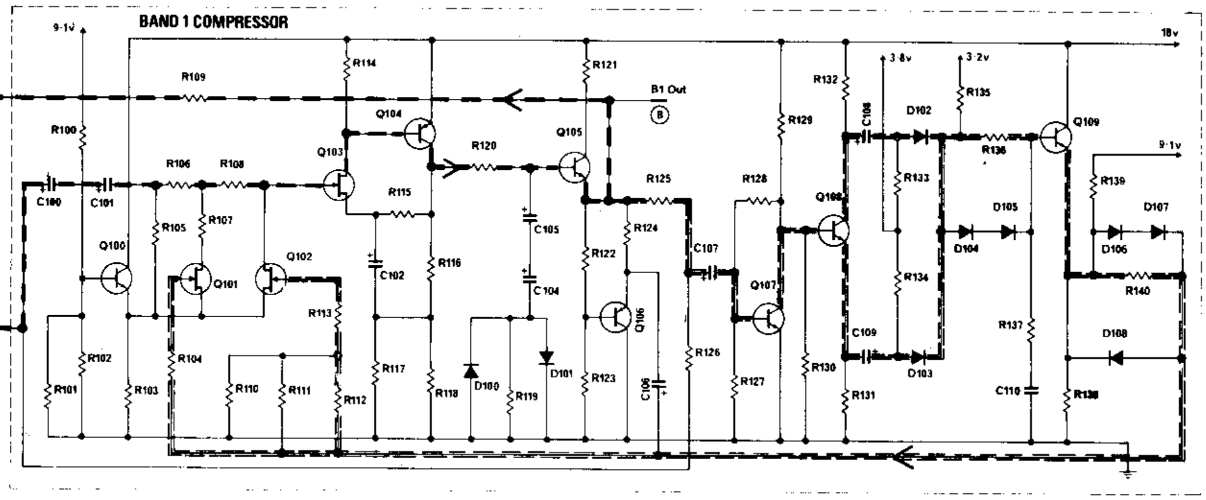
The band 2 filter provides for a band-pass characteristic from 80 Hz to 3 kHz, with an amplitude and phase response which is complementary to that of bands 1 and 3. This is achieved by subtracting the outputs from band 1 (80 Hz, low pass) and band 3 (3 kHz, high pass) from the wideband input signal.



The outputs of bands 1 and 3 are added at the base of Q282 by R287 and R288. and then inverted by Q281. The collector current is thus proportional to the outputs of bands 1 and 3, but is out of phase. This difference signal is combined with the wide-band signal by R280, providing the required signal in the band 80 Hz to 3 kHz, and passes to the Band 2 compressor via emitter follower Q283.

To avoid a dc voltage drop in R280 which would reduce the dynamic range of stage Q281, Q280 provides a constant dc current which is equal to the average current of Q281; hence, no significant dc current flows in R280.

10.10 The Compressors



The compressors in all four bands are substantially identical, and thus only that of band 1 need be described. The signal from each filter enters the compressor and under low level signal conditions is passed unattenuated to Q103 and Q104, an amplifier with a very high input impedance produced by the field effect transistor Q103. Transistor Q105 is an emitter follower; the output is taken via R109 to the noise reduction signals addition stage. The overall signal gain of the compressor is precisely set during manufacture by selecting R117.

The control signal amplifier comprises the amplifier Q107 and phase splitter Q108. The audio signal is rectified by D102 and D103. and the resulting dc is smoothed in the pre-integrator R136 and R137 together with C110. The pre-integrator output passes via C109 to the final integrator R140 and C106. The time constants of the integrators in bands 1 and 2 are twice those in the higher frequency bands.

Both pre- and final integrators have non-linear characteristics produced by the diodes D104 - D108. Fast, large changes in signal amplitude are passed quickly, whereas small changes are transferred slowly. This dynamic smoothing action produces optimum results with respect to modulation effects, low frequency distortion, and distortion components generated by the control signal. The circuit achieves both fast recovery and low signal distortion; in conventional arrangements these two criteria are mutually exclusive.

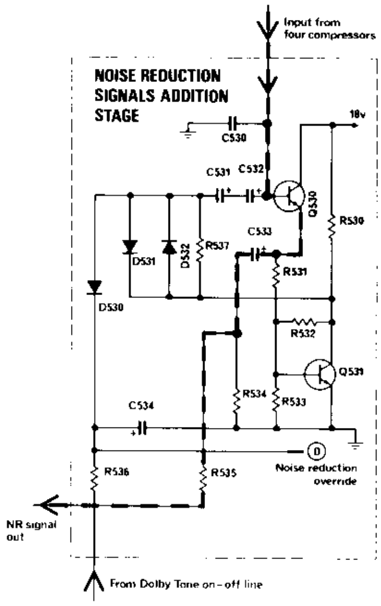
The resulting dc control signal is fed to the gates of the field effect transistors Q101 and Q102, which act as variable resistances in two series L-attenuators. The control voltage applied to Q102 is a dc offset and slightly attenuated version of that to Q101. Both FETs are factory-selected for similar pinch-off voltages, so that as the control voltage rises, first Q101 and then Q102 conducts. The attenuation produced by Q101 is limited by R107 working against R106 and the source-drain resistance of Q101. Therefore the rate of change of attenuation is gentle. As the signal level increases, the rising control voltage causes Q102 to conduct, and the rate of attenuation increases. The source voltage is factory-adjusted by R101 and R102 to compensate for differing pinch-off voltages of the FET pair. Similarly, R111 and R112 are adjusted to match the required precise compressor curve. R105 maintains dc conditions across the FET pair.

At high signal level inputs, it is desirable to reduce the compressor output still further, so that the noise reduction signal represents a negligible proportion of the main signal. To achieve this, some of the input signal to the compressor is fed forward around the attenuator section through R126. Under low-level signal conditions, when Q101 and Q102 produce no attenuation, the output from the amplifier (passing through R125) is considerably greater than the feed-forward signal. As the attenuator operates, the proportion of feed-forward to normal signal entering the control signal path increases, until eventually primary control is produced by the feed-forward component. This in turn produces the down-turning curve of the compressor input-output characteristic.

FET compressors produce even-order distortion components unless correction techniques are used. While this distortion can be reduced by operating the FET in a push-pull configuration, it can be shown that this is equivalent to adding half the ac drain signal to the gate terminal. In the Cat. No. 22 compressor circuit this is achieved by taking the correct proportion of the FET output signal and adding this in series with the dc gate control voltage. Transistor Q106 adds this signal, at the same time providing the low impedance necessary for smoothing the dc control signal by C106. Resistors R122 and R123 form an attenuator to compensate for the gain of Q103 and Q104, reducing the ac signal on the emitter of Q106 to half that on the base of Q103.

Diodes D100 and D101 form a non-linear limiter circuit to prevent transient overshoots of the noise reduction signal during the compressor attack period. Under normal signal conditions the diodes are non-conducting, but under extreme transient conditions the diodes limit the noise reduction signal to a level which results in an overall output overshoot of less than 2 dB. The limited overshoot condition applies for about 1 msec only and is inaudible; when added to the high-level main signal, the noise reduction signal represents a very small proportion of the total signal. Two series capacitors C105 and C104 are used to prevent leakage currents forward-biasing the diodes.

10.11 Noise Reduction Signals Addition Stage



The outputs from the four compressors are fed to the addition stage via mixing resistors R109, R209, R309, and R409. Transistor Q530 is an emitter follower providing a low output impedance noise reduction signal.

If the limiting diodes D100 and D101 are operative in two or more bands, the transient signals from the compressors will combine additively. Under these conditions diodes D531 and D532 conduct, reducing the amplitude of the combined transient without any further limiting of the noise reduction signal itself. Amplifier Q531 provides an out-of-phase signal to the lower end of the diodes, to provide correct threshold conditions for the diodes and the signal levels present at this point.

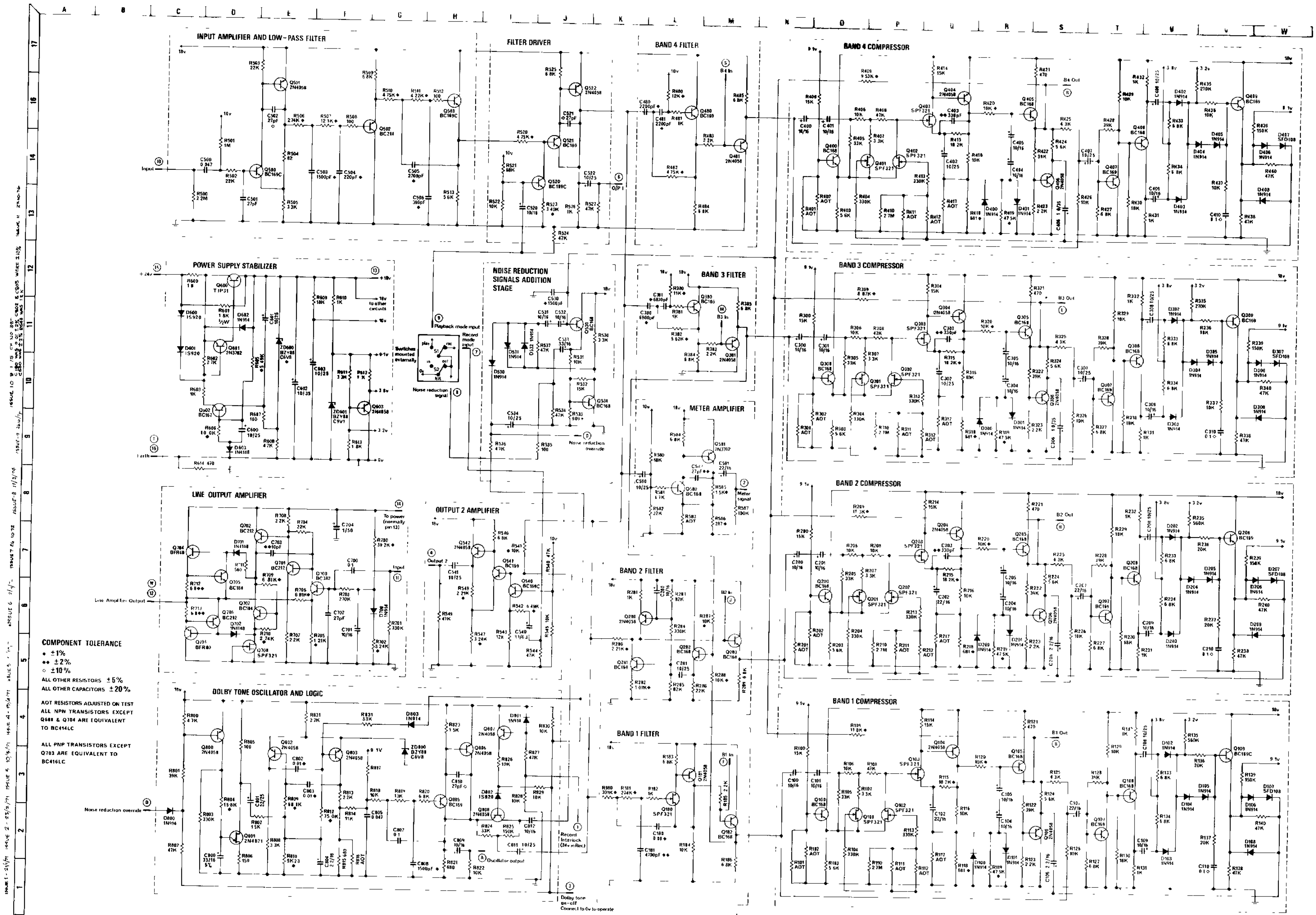
The noise reduction signal appears on pin 8 and is connected to the record mode input (pin 7) or playback mode input (pin 9) by a suitable external single pole changeover switch. By earthing pin 7 the noise reduction signal is cancelled; the module then becomes a linear amplifier.

The noise reduction action is also removed by operation of the Dolby Tone oscillator. Under normal conditions D530 is reverse-biased by the positive voltage difference between the collector of Q531 (+6 V) and the Dolby Tone on-off line (+15 V on pin 3, to which D530 is connected via R536). However, when the Dolby Tone oscillator is operated by earthing pin 3, D530 conducts and short-circuits the noise reduction signal. This facility is useful during the playback calibration procedure, especially in multichannel installations where the Dolby Tone on-off lines may be connected together.

Certain modes of the NRM Tester require that the oscillator should work and also that the noise reduction signal should be available. The NRM Tester therefore feeds +18 V into pin D in these modes, so that D530 is maintained in the non-conducting state even when pin 3 is earthed.

10.12 General Notes

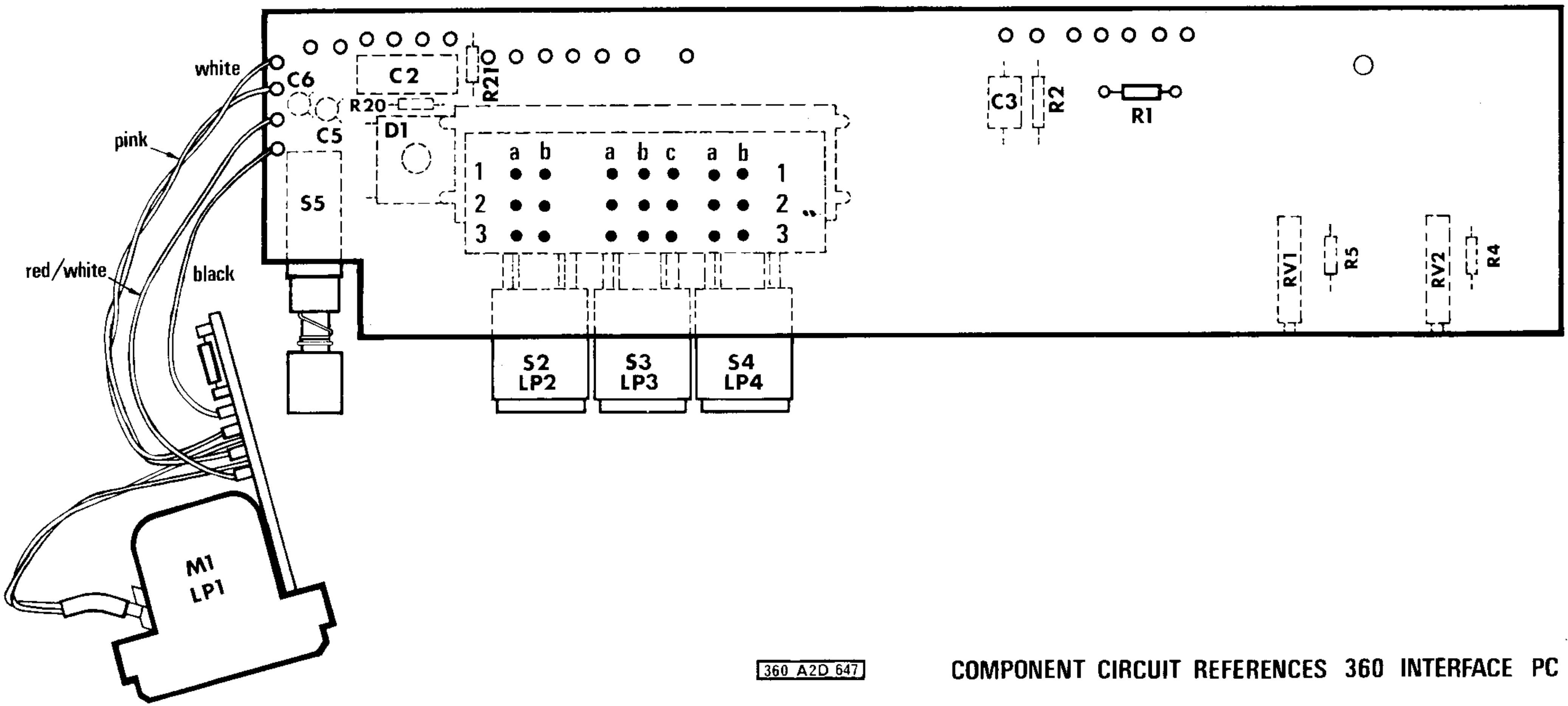
To facilitate incorporation of the NRM into tape recorders and mixers, all inputs and outputs are in phase. Furthermore, all outputs are at low impedance and are thus tolerant of the effects of wiring lengths. Cables of up to 30 m (100 feet) may be attached to any of the module outputs.



© Dolby Laboratories Inc 1971 Drawing no AOC 441 – Cat 22 NOISE REDUCTION MODULE CIRCUIT
SERIAL No 15000 UPWARDS

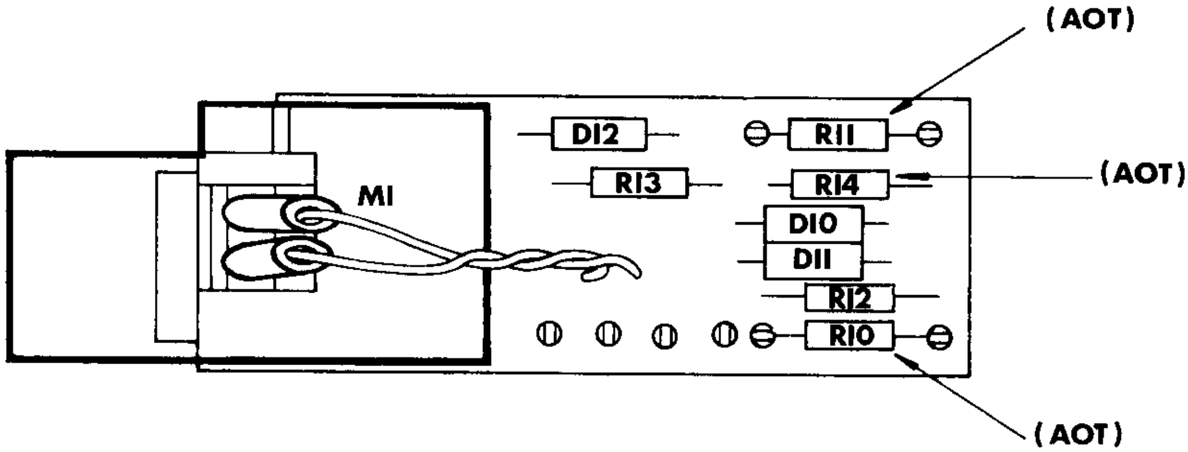
SECTION 11

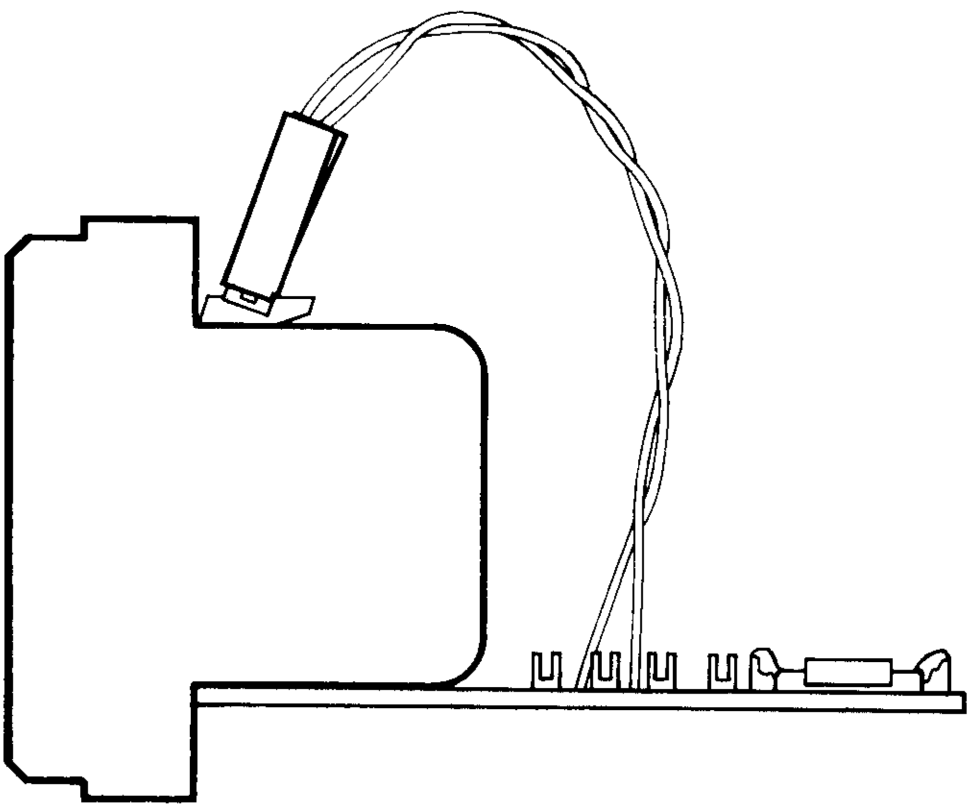
INTERFACE SERVICING



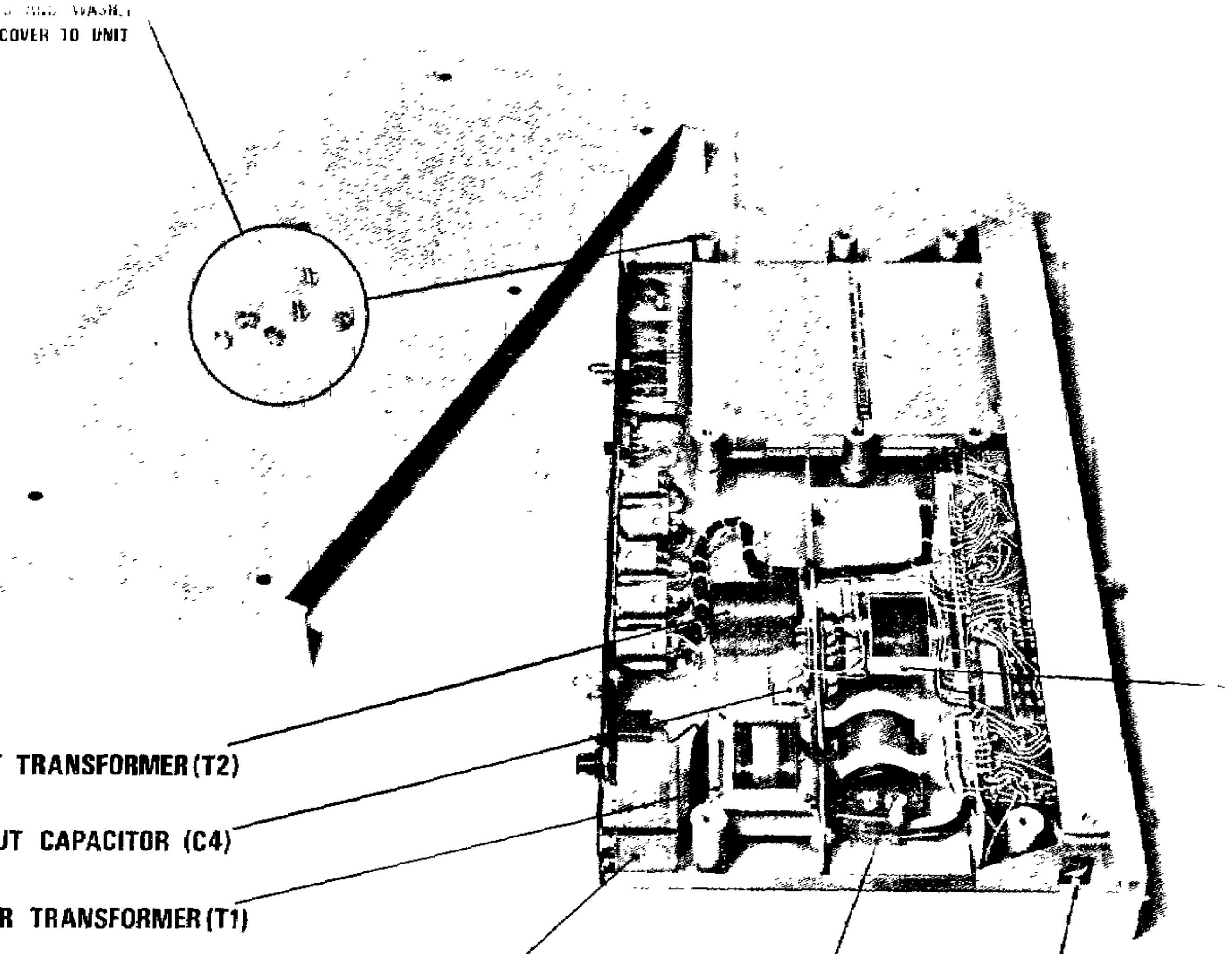
360 A2D 647

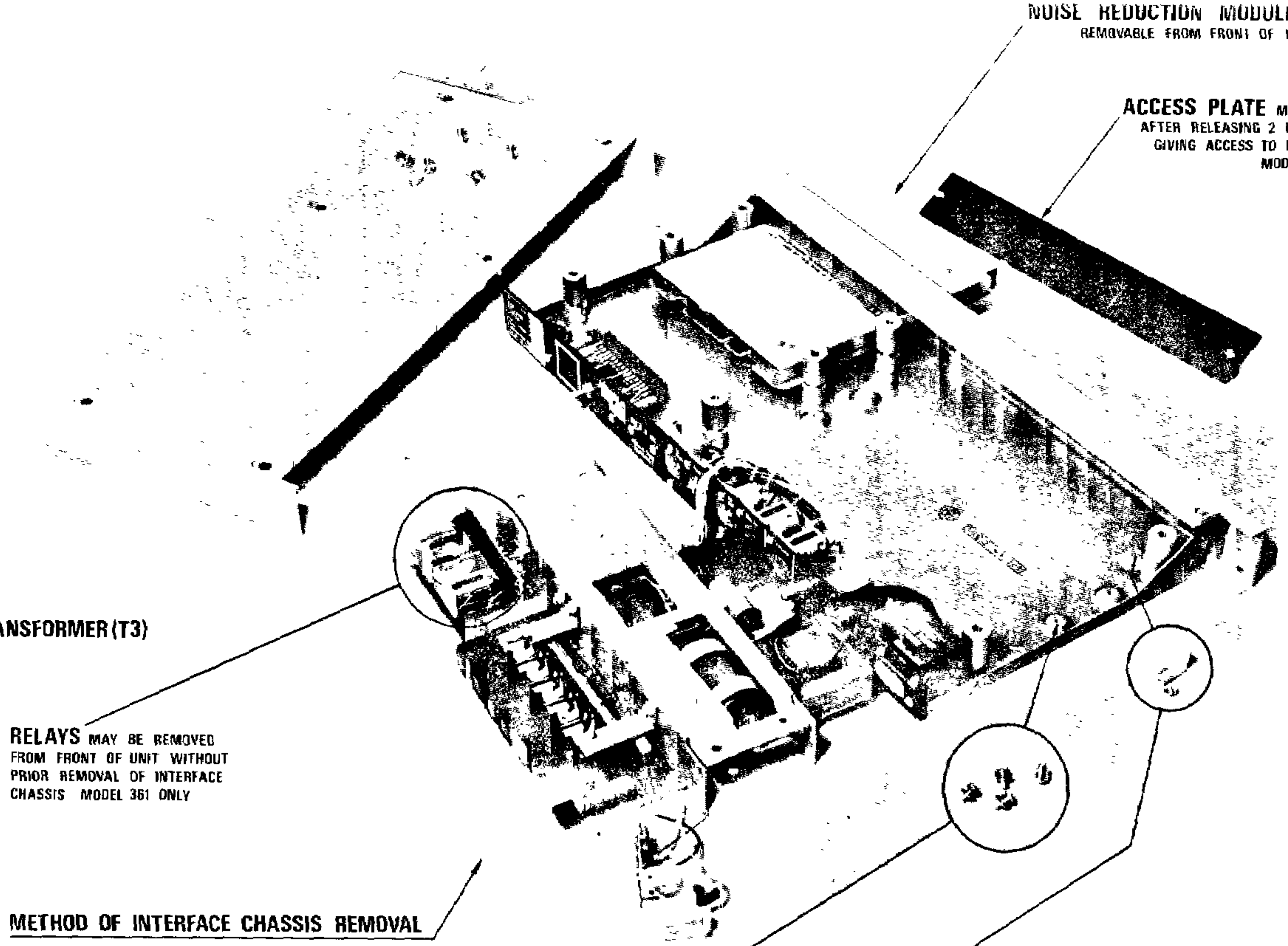
COMPONENT CIRCUIT REFERENCES 360 INTERFACE PC





A2D 660/1 **COMPONENT CIRCUIT REFERENCES — METER PC**





METHOD OF INTERFACE CHASSIS REMOVAL

THE INTERFACE CHASSIS AND METER ASSEMBLY CAN BE SWUNG OVER AND BACKWARDS TO L CLEAR OF UNIT AS SHOWN BY USING THE FOLLOWING PROCEDURE.

1. REMOVE 4 FIXING SCREWS AND WASHERS FROM INTERFACE CHASSIS
2. SLIDE INTERFACE CHASSIS TOWARDS REAR OF UNIT TO EXPOSE **METER RETAINER** AND TO ALLOW PUSHBUTTON SWITCHES TO CLEAR THE FRONT PANEL AFTER REMOVAL OF METER RETAINER, WITH SCREW AND WASHER, THE INTERFACE CHASSIS AND METER ASSEMBLY ARE BOTH FREE

(880)

GENERAL SERVICING ACCESS — 330 and 360 Series
Drg.No. AOD 433

SECTION 12

SERVICING

CAT. NO. 22 NOISE REDUCTION MODULE

12.1 Introduction

Module exchange is the easiest and most reliable method of repair of the Cat. No. 22 Noise Reduction Module (NRM). However, for situations in which this is not practical, this section provides some basic guidance in user-servicing.

The NRM has been designed for accuracy, reliability, and long life. The individual circuits operate well below their dissipation limits, and close tolerance high stability components ensure repeatability and accuracy of system parameters. There is no need for adjustment of the printed circuit card; the critical parts of the circuit are pre-adjusted during manufacture with fixed-value selected components, using custom-designed test equipment and procedures.

Routine maintenance is confined to verification of the system performance. Repair is usually and most practically achieved by module interchange; faulty modules are then exchanged by local distributors or Dolby Laboratories offices. All modules are guaranteed by Dolby Laboratories for a period of one year from receipt by the customer, the guarantee including freight charges. Subject to the particular customs formalities of the customer's country, the repair will usually be effected on a replacement-basis, with a new or factory-tested module, ensuring that studio inconvenience is kept to a minimum.

12.2 Cat. 35 NRM Test Set

The Cat. No. 35 Test Set (Section 13) is designed for the rapid testing and verification of NRM performance. Needing no external test equipment, the Test Set checks all major functions of the NRM in less than a minute using an internal GO/NO GO meter. More sophisticated tests can also be carried out by the use of external test sources and measuring requirement. Terminals are provided which allow the use of an oscilloscope and ac and dc meters to check points monitored by the tester. This feature allows the circuit area of many faults to be identified quickly. While most troubleshooting and repair work can be achieved by the use of the internal oscillator of the Cat. No. 22, the Test Set also provides terminals and a switch for the use of an external oscillator when necessary.

12.3 Fault Repair

Faults can be categorized into three types. The first type is that of complete failure, which will usually involve a single component in a particular section of the circuit. Such faults are readily traceable, and in general repairs can be made by substitution of a new component.

The second type of fault is a partial, rather than complete, failure. While this may be more difficult to diagnose than the first type, the failure, as before, will usually concern only a single component.

The third and most difficult fault is the intermittent one. It may be difficult to provoke the fault on the test bench, but it will usually yield to one or more of the following factors: heat, cold, humidity, jolts, vibration, or time. Usually only a single component will be involved.

On modules above serial number 2400, an epoxy covering is provided on the top printed circuit tracks; this greatly diminishes the possibility of shorts between the tracks and resistors crossing the tracks. Therefore, even though the resistor bodies are themselves well insulated, the probability of top track shorts is greater on the non-covered boards prior to serial number 2400. This fact should be borne in mind during troubleshooting.

DC voltages are perhaps the best clue to malfunctions, and at the end of this section there is a table showing the principle voltages in the module. The circuit diagram (rear of Section 10) indicates the component tolerances which must be used in all cases of component replacement.

Any fault which involves replacing a selected component, such as the adjus-on-test (AOT) resistors, a component in the +9 volt regulator, or any of the compressor field effect transistors, is not repairable by the user. These components are in general those which determine the Dolby A-type noise reduction characteristic, and are set up to a high degree of accuracy at the factory using specialized test techniques and apparatus. An attempted user repair may compromise the performance of the unit, and all such failures should be returned to Dolby Laboratories or one of its distributors for exchange.

12.4 NRM Test Set Voltage Measurements

It is possible to identify the defective circuit fairly readily by the use of the NRM Test Set even before the module covers are removed. The main ac characteristics can be checked by the use of the internal oscillator and meter, as well as by the test points on the rear of the NRM Tester. Similarly, a number of significant dc measurements can be made using the NRM test points.

For the tests, the Cat. No. 22 module should be plugged into the NRM Tester. The Test Extender should be plugged into the 360 Series or other unit supplying power, and the cable connector should be plugged into the NRM Tester. In the tests, the pin connections and ac and dc voltages brought out from the Cat. No. 22 module to the test point on the rear of the NRM Tester are given in parentheses.

1. In the 24 V position of S1, the ripple on the incoming rough dc supply is checked (pin 15, 600 mV ac maximum, 20-28 V dc).

2. In the 18 V position of S1, the ripple and noise on the output of the module voltage regulator are checked (pin 13, 400 uV ac maximum, 100 kHz bandwidth, 17.5 - 18.5 V dc).

3. In the OSC position of S1, the output of the module oscillator is checked (pin A, 290 - 310 mV ac, 0 V dc). In this position the signal from pin A is also amplified in the NRM Tester to 1.85 V ac, 0 V dc, at connector JF1 and is used to check the calibration of level setting meters (Dolby Level, 185 nWb/m). When the DIN CHECK button is pressed, the signal from pin A is amplified to 3.2 V at JF1 (corresponding to 320 nWb/m).

4. In the OUT 1 position of S1, the signal from the module oscillator (pin A) is fed into the module input (pin 10), and the main-path signal circuit is checked at Output 1 (pin 6, 290 - 310 mV ac, 0 V dc), which follows the playback noise reduction signal combination point.

5. In the METER AMP position of S1, the signal from the module oscillator (pin A) is fed into the module input (pin 10), and the output of the meter amplifier is checked (pin 2, 1.8 - 1.9 V ac, 0 V dc).

6. In the OUT 2 position of S1, the signal from the module oscillator (pin A) is fed into the module input (pin 10), and the main-path signal circuit is checked at Output 2 (pin 4, 480 - 520 mV ac, 0 V dc), which follows the record noise reduction signal combination point.

7. In the DOLBY TONE position of S1, the module oscillator is FM modulated to produce the Dolby Tone, the electronic switch Q808 is energized, and the signal at Output 2 is checked (pin 4, 480 - 520 mV ac, 0 V dc).

8. In the LINE AMP position of S1, the signal from the module oscillator (pin A) is fed into the line amplifier input (pin 11) and the output of the line amplifier is checked (pins 12, N; 1.9 - 2.1 V ac, 8 - 10 V dc).

9. For the compressor tests, switch S1 is set at COMPRESSORS. In this position, the signal from the module oscillator (pin A) is attenuated to 2 mV, 10 mV, and 50 mV for the GAIN, LAW 1, and LAW 2 tests, respectively (S2). The attenuated signal is fed into the input of the compressor selected by S2 (pins, F, J, M, and S for bands 1 - 4, respectively). The outputs of the compressors are checked as follows (pins B, H, L, and R for bands 1 - 4, respectively):

A. GAIN, 16 - 18 mV ac, 6 - 8 V dc.
B. LAW 1, 55 - 65 mV ac, 6 - 8 V dc.
C. LAW 2, 67 - 77 mV ac, 6 - 8 V dc.

10. In the RECORD position of S1, the module is connected in the record mode (pin 8 connected to pin 7), and a signal from the module oscillator (pin A) is attenuated to 3 mV and fed into the module input (pin 10). The output of the module is checked at Output 2 (pin 4, 15 - 17 mV ac, 0 V dc).

11. In the NR OUT position of S1, the noise reduction signal is disabled and a signal from the module oscillator (pin A) is attenuated to 3 mV and fed into the module input (pin 10). The output of the module is checked at Output 2 (pin 4, 4.8 - 5.2 mV, 0 V dc: i.e. 9.5 - 10.5 dB lower than in test 10 above).

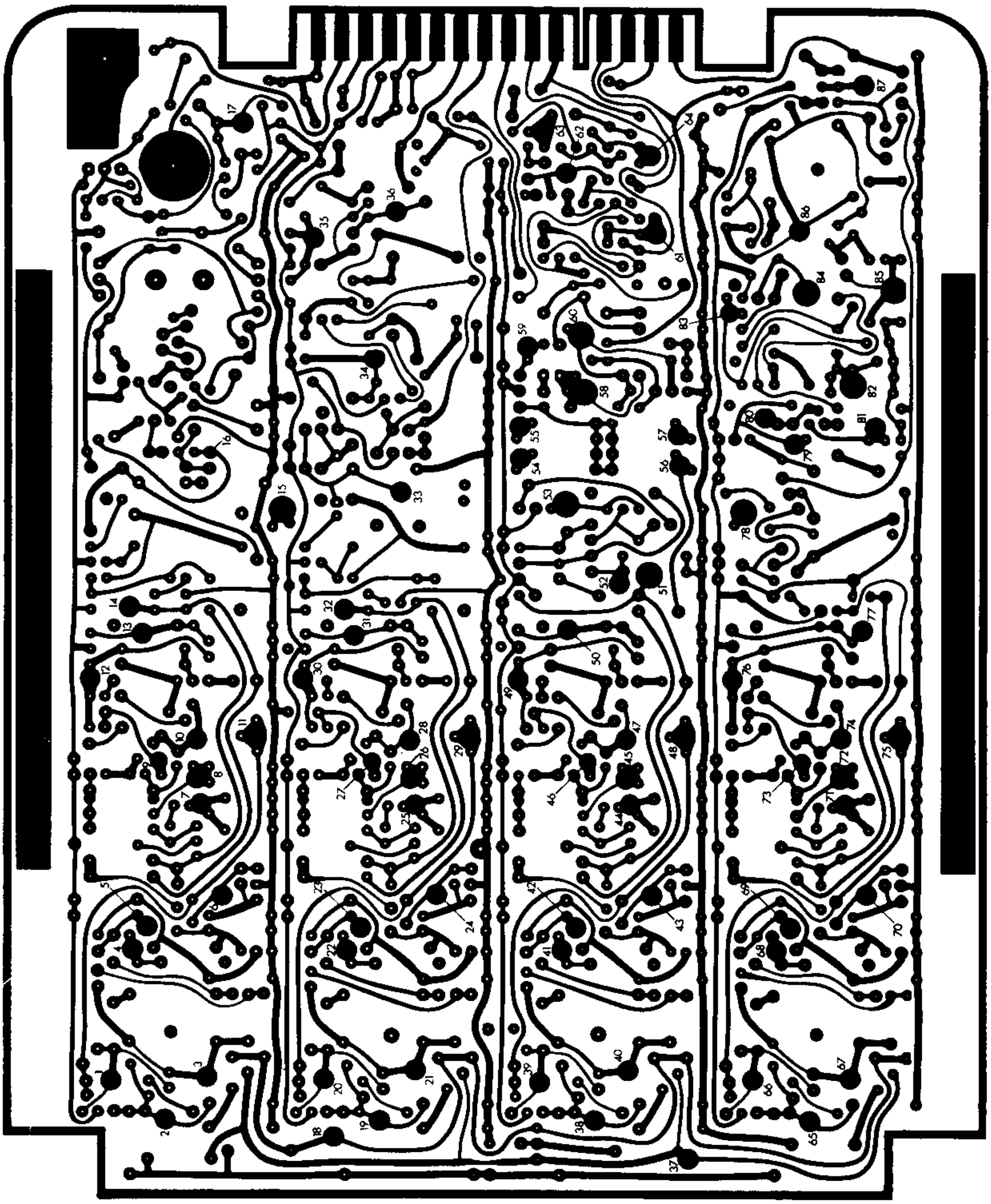
12. In the PLAY position of S1, the module is connected in the playback mode (pin 8 connected to pin 9) and a signal from the module oscillator (pin A) is attenuated to 3 mV and fed into the module input (pin 10). The output of the module is checked at Output 2 (pin 4, 1.5 - 1.7 mV ac, 0 V dc; i.e. 9.5. - 10.5 dB lower than in test 11 above).

12.5 Comprehensive dc Voltage Measurements

Once the general circuit area of the fault if given by the tests in Section 12.4 above, the module covers should be removed for further investigations.

Detailed circuit tests can be made of the suspected area by referring to the voltage tables given on pages 12.7 to 12.9, the test point location drawing on page 12.6, and the component location drawing on page 12.10.

The NRM Tester can be used on its side for this application, allowing access to both top and bottom of the NRM.



Test Points			
1–17	18–36	37–64	65–87

CAT No. 22 TEST POINT LOCATIONS

Drg. No. A1PM 747

Voltage Tables

1. Power Supply Voltages

   Note: 1. Pin number are circled.
   2. dc voltage tolerance ±0.5 V except where stated.

Measuring point	Testpad/Pin No.	dc voltage	max ac (rms)
Incoming rough supply	(15)	24 (±4)	600 mV
+18 v line	(13)	18	400 uV
+10 v line	15	10.2	-
+9.1 v line	84	9.1	-
+3.2 v line	37	3.2	-
+3.8 v line	18	3.8	-

2. Main signal path

   Note: Collector designated c, emitter designated e.

Measuring point	Testpad/Pin No.	dc voltage	ac voltage with Cat. No. 35
Q503 e	34	9.6	Out 1 290-310 mV
Q522 c	33	8.1	Out 1 290-310 mV
Q542	62	10.0	Out 1 480-520 mV
Q581 c	63	10.5	Out 1 1.8-1.9 v
Q700 e	16	1.4	Line Amp 290-310 mV
Line Amp Output	(12) or (N)	9.0	Line Amp 1.9-2.1 v

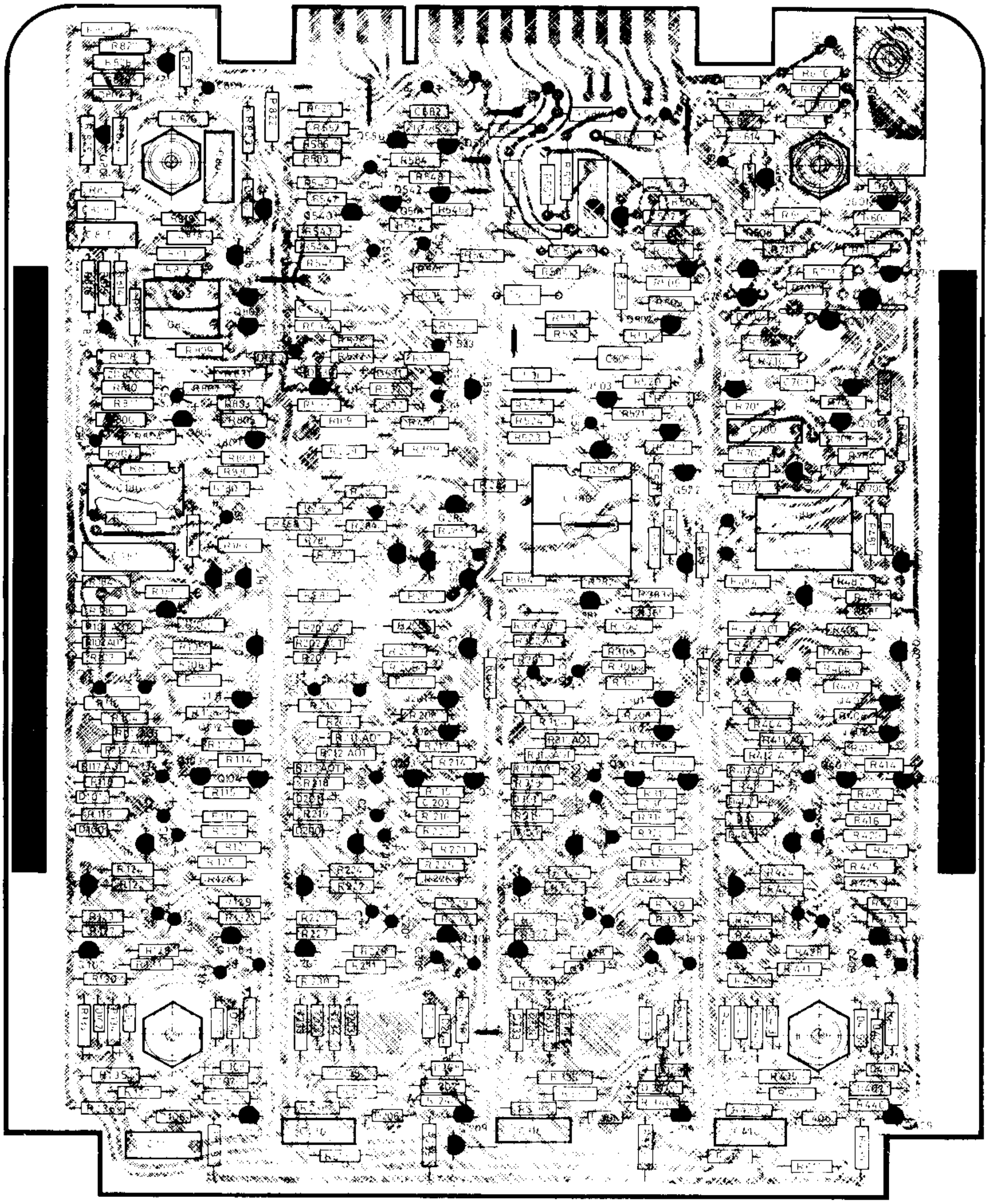
3. Noise Reduction Path

Measuring point	Testpad/Pin No.	dc voltage	ac voltage with Cat. No. 35
Q182 c	78	10.5	
Q283 e	51	6.8	
Q282 c	52	10.0	
Q381 e	32	10.2	
Q481 e	14	10.2	
Q100 c	76	5.9 (1)	
Q200 e	49	5.9 (1)	
Q300 e	30	5.9 (1)	
Q400 e	12	5.9 (1)	
Q105 e	Ⓑ	6.8	Gain 16-18 mV
Q205 e	Ⓗ	6.8	Law 1 55-65 mV
Q305 e	Ⓛ	6.8	Law 2 67-77 mV
Q405 e	Ⓡ	6.8	
Q108 c	69	14.3	
Q208 c	42	14.3	
Q308 c	23	14.3	
Q408 c	5	14.3	
Q109 e	65	3.2 (2)	
Q209 e	38	3.2 (2)	
Q309 e	19	3.2 (2)	
Q409 e	2	3.2 (2)	
Q106 e	70	1.0	
Q206 e	43	1.0	
Q306 e	24	1.0	
Q406 e	6	1.0	
C106/R140 Gain	75	3.1	
Law 1	75	3.5	
Law 2	75	3.7	
C206/R240 Gain	48	3.1	
Law 1	48	3.5	
Law 2	48	3.7	
C305/R340 Gain	29	3.1	
Law 1	29	3.5	
Law 2	29	3.7	
C406/R440 Gain	11	3.1	
Law 1	11	3.5	
Law 2	11	3.7	
Q530 e	59	6.6	
Q531 c	60	3.0	

Note: (1) Prior to Serial No. 1500, tolerance is ±2 v
(2) High input impedance voltmeter must be used

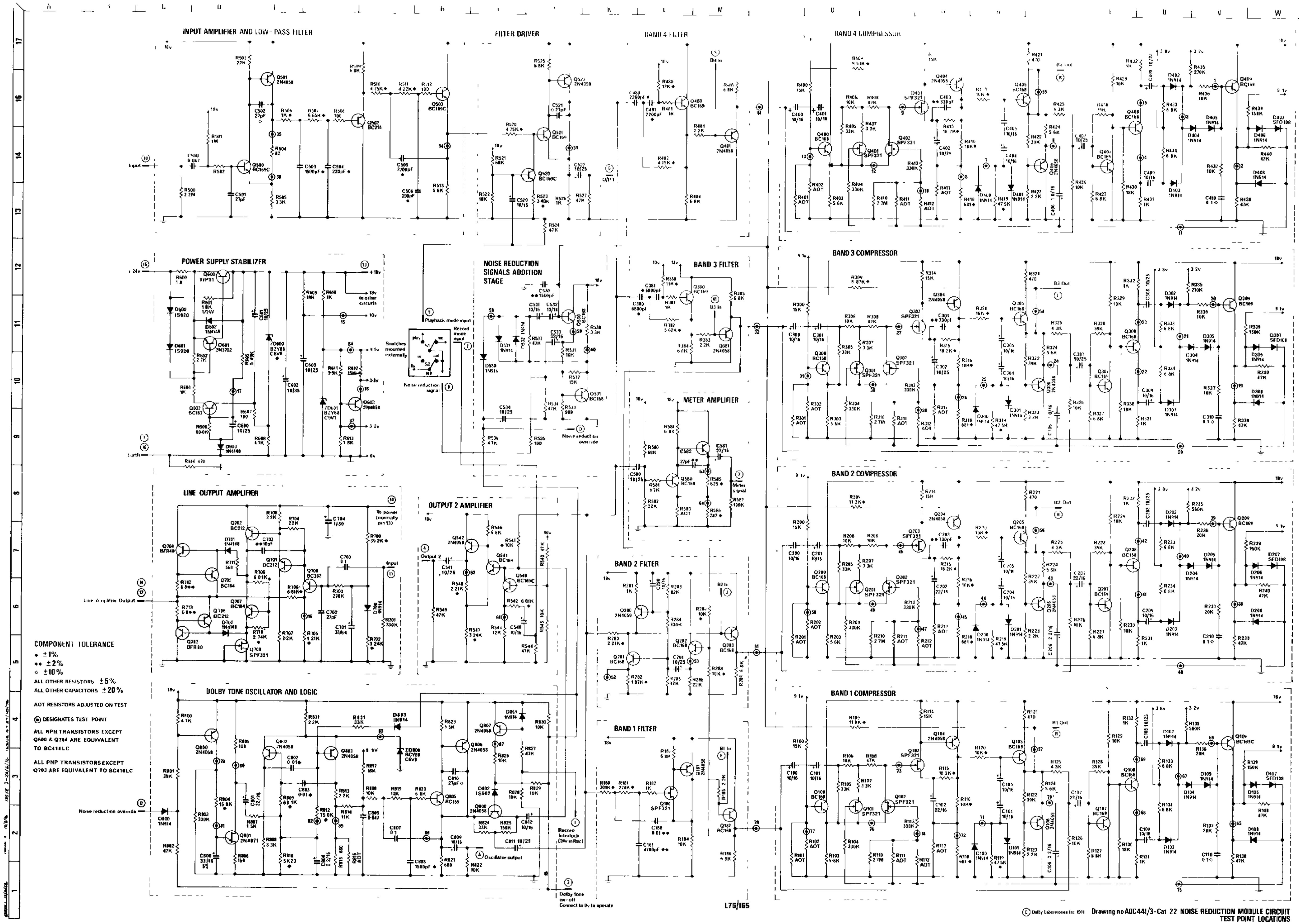
4. Oscillator and Logic

Measuring point	Testpad/Pin No.	dc voltage	Notes
Q803 e	83	6.8	
Q805 e	86	3.6	Normal operation in installation, or Cat. 35 'Noise' modes.
Q805 e	86	3.0	D.T. button pressed, or all Cat. 35 modes except 'Noise'.
D.T. line	(3)	13.5 ±2	Normal operation in installation.
D.T. line	(3)	0	D.T. button pressed, or all Cat. 35 modes except 'Noise'.
Q807 c	87	17.9	Installation Play mode or all Cat. 35 modes except 'Dolby Tone'.
Q807 c	87	1.7	Cat. 35 'Dolby Tone' mode. Installation Record Mode or Cat. 35 'Dolby Tone' mode.
NR override	(D)	13.5 ±2	In installation, and Cat. 35 'Dolby Tone' mode.
NR override	(D)	18	In Cat. 35, except 'Dolby Tone' mode.



Issue 6-1

Cat No 22 COMPONENT LOCATION


INPUT AMPLIFIER AND LOW-PASS FILTER
FILTER DRIVER
BAND 4 FILTER
BAND 4 COMPRESSOR
POWER SUPPLY STABILIZER
NOISE REDUCTION SIGNALS ADDITION STAGE
BAND 3 FILTER
BAND 3 COMPRESSOR
METER AMPLIFIER
LINE OUTPUT AMPLIFIER
OUTPUT 2 AMPLIFIER
BAND 2 FILTER
BAND 2 COMPRESSOR
BAND 1 FILTER
BAND 1 COMPRESSOR
DOLBY TONE OSCILLATOR AND LOGIC
COMPONENT TOLERANCE
• ±1%
•• ±2%
○ ±10%
ALL OTHER RESISTORS ±5%
ALL OTHER CAPACITORS ±20%
AOT RESISTORS ADJUSTED ON TEST
⊙ DESIGNATES TEST POINT
ALL NPN TRANSISTORS EXCEPT Q600 & Q704 ARE EQUIVALENT TO BC414LC
ALL PNP TRANSISTORS EXCEPT Q703 ARE EQUIVALENT TO BC416LC
Switches mounted externally
Noise reduction signal
Playback mode input
Record mode input
Line Amplifier Output
Noise reduction override
Record interlock (24v = Rec)
Oscillator output
Dolby tone on-off Connect to 0v to operate
L76/165
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Drawing no A0C441/3-Cat 22 NOISE REDUCTION MODULE CIRCUIT TEST POINT LOCATIONS

SECTION 13

CAT. NO. 35 NRM TEST SET

DOLBY LABORATORIES INC

A-TYPE NOISE REDUCTION SYSTEM

OPERATING INSTRUCTIONS

NRM Test Set, Cat. No. 35

NRM Tester, Cat. No. 35A

Test Extender, Cat. No. 35B

The NRM Test Set comprises the Noise Reduction Module Tester (Cat. No. 35A) and the Test Extender (Cat. No. 35B). The Test Set is designed to test all major functions of the Noise Reduction Module (Cat. No. 22), to check the ripple level of the rough d. c. supply which powers the module, and to verify the accuracy of level setting meters used in the equipment in which the module is installed.

Testing of Noise Reduction Modules

1. Brief operating instructions are given on the front of the Test Extender. More detailed instructions and explanations are provided below.

2. Remove the Cat. No. 22 Noise Reduction Module to be tested. In 360 Series units, access to the module is provided by removal of the front cover plate.

3. Plug the module into the connector on the NRM Tester.

4. Plug the Test Extender into the connector from which the module was removed.

5. Plug the cable connector from the Test Extender into connector JF1 on the NRM Tester. This provides power to the NRM Tester and the module under test. The cable also provides a return signal from the NRM Tester for meter calibration purposes.

6. For completely self-contained operation of the NRM Tester, set the oscillator switch on the rear of the tester to the internal position. In this mode the signal used in the various tests is provided by the internal Dolby Tone oscillator in the module.

7. To test the various circuit functions of the module, rotate the switch S1 progressively clockwise, beginning at 24V NOISE. Stop at COMPRESSOR, and rotate switch S2 through all of its positions, beginning at GAIN, BAND 1. Following the compressor tests,

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San Francisco CA 94111
Telephone (415) 392-0300
Telex 34409

346 Clapham Road
London SW9 9AP
Telephone 01-720 1111
Telex 919109

proceed with switching S1 clockwise. The meter should read TEST (or the green LED should be on) in all positions except NOISE. The two noise positions should provide meter readings in the band marked NOISE (in this case, the green LED also should be on).

NOTE: Latest models of the Cat. No. 35 use an LED display in place of the meter, providing greater reliability and improved accuracy. All tests are satisfactory if the green LED is on; the red LED indicates a fault condition. The yellow LED shows a condition analogous to the meter pointer being exactly on the tolerance limits, and shows that the module almost certainly can be used with satisfactory results, but should be returned for overhaul as soon as practical. Note that if the amber LED is on for all tests (equivalent to all test results being marginal), this probably signifies a low or high Dolby test tone oscillator and no malfunction in the Dolby circuit itself. The green LED covers a range ±0.5 dB about the desired value, and the yellow LED covers a further ±0.5 dB. The black area on the meter version also indicated a ±0.5 dB range about nominal value.

Testing of Meters

1. To check the calibration of level setting meters, set switch S1 to OSC position. 360 Series meters or other meters associated with the module should read 185 nWb/m (Dolby Level).

2. On 360 Series units the calibration of the DIN-mark on the meter can be checked by pressing the DIN CHECK button (OSC position of S1) on the NRM Tester. The 360 Series meter should be read from directly in front; parallax should not be corrected for when making DIN readings.

Details of Tests

In the tests, the pin connections and a.c. and d.c. voltages brought out from the Cat. No. 22 module to the test point on the rear of the NRM Tester are given in parentheses.

1. In the 24V position of S1, the ripple on the income rough d.c. supply is checked (pin 15, 600 mV a.c. maximum, 20-28V d.c.).

2. In the 18V position of S1, the ripple and noise on the output of the module voltage regulator are checked (pin 13, 400 uV a.c. maximum, 17.7-18.5V d.c.).

3. In the OSC position of S1, the output of the module oscillator is checked (pin A, 290-310 mV a.c., 0V d.c.). In this position the

signal from pin A is also amplified in the NRM Tester to 1. 85V a. c. 0V d. c., at connector JF1 and is used to check the calibration of level setting meters (Dolby Level, 185 nWb/m). When the DIN CHECK button is pressed, the signal from pin A is amplified to 3. 2V at JF1 (corresponding to 320nWb/m). (The LED display is switched off for this test).

4. In the OUT 1 position of S1, the signal from the module oscillator (pin A) is fed into the module input (pin 10), and the main-path signal circuit is checked at Output 1 (pin 6, 290-310 mV a. c., 0V d. c.), which follows the playback noise reduction signal combination point.

5. In the METER AMP position of S1, the signal from the module oscillator (pin A) is fed into the module input (pin 10), and the output of the meter amplifier is checked (pin 2, 1. 8-1. 9V a. c., 0V d. c.).

6. In the OUT 2 position of S1, the signal from the module oscillator (pin A) is fed into the module input (pin 10), and the main-path signal circuit is checked at Output 2 (pin 4, 480-520 mV a. c., 0V d. c.), which follows the record noise reduction signal combination point.

7. In the DOLBY TONE position of S1, the module oscillator is FM modulated to produce the Dolby Tone, the electronic switch Q808 is energized, and the signal at Output 2 is checked (pin 4, 480-520 mV a. c., 0V d. c.).

8. In the LINE AMP position of S1, the signal from the module oscillator (pin A) is fed into the line amplifier input (pin 11), and the output of the line amplifier is checked (pins 12, N; 1. 9-2. 1V a. c., 8-10 d. c.).

9. For the compressor tests, switch S1 is set at COMPRESSORS. In this position, the signal from the module oscillator (pin A) is attenuated to 2 mV, 10 mV and 40 mV for the GAIN, LAW 1, and LAW 2 tests, respectively (S2). The attenuated signal is fed into the input of the compressor selected by S2 (pins F, J, M and S for bands 1-4, respectively). The outputs of the compressors are checked as follows (pins B, H, L and R for bands 1-4, respectively):

   A. GAIN, 16 - 18 mV a. c., 6 - 8V d. c.

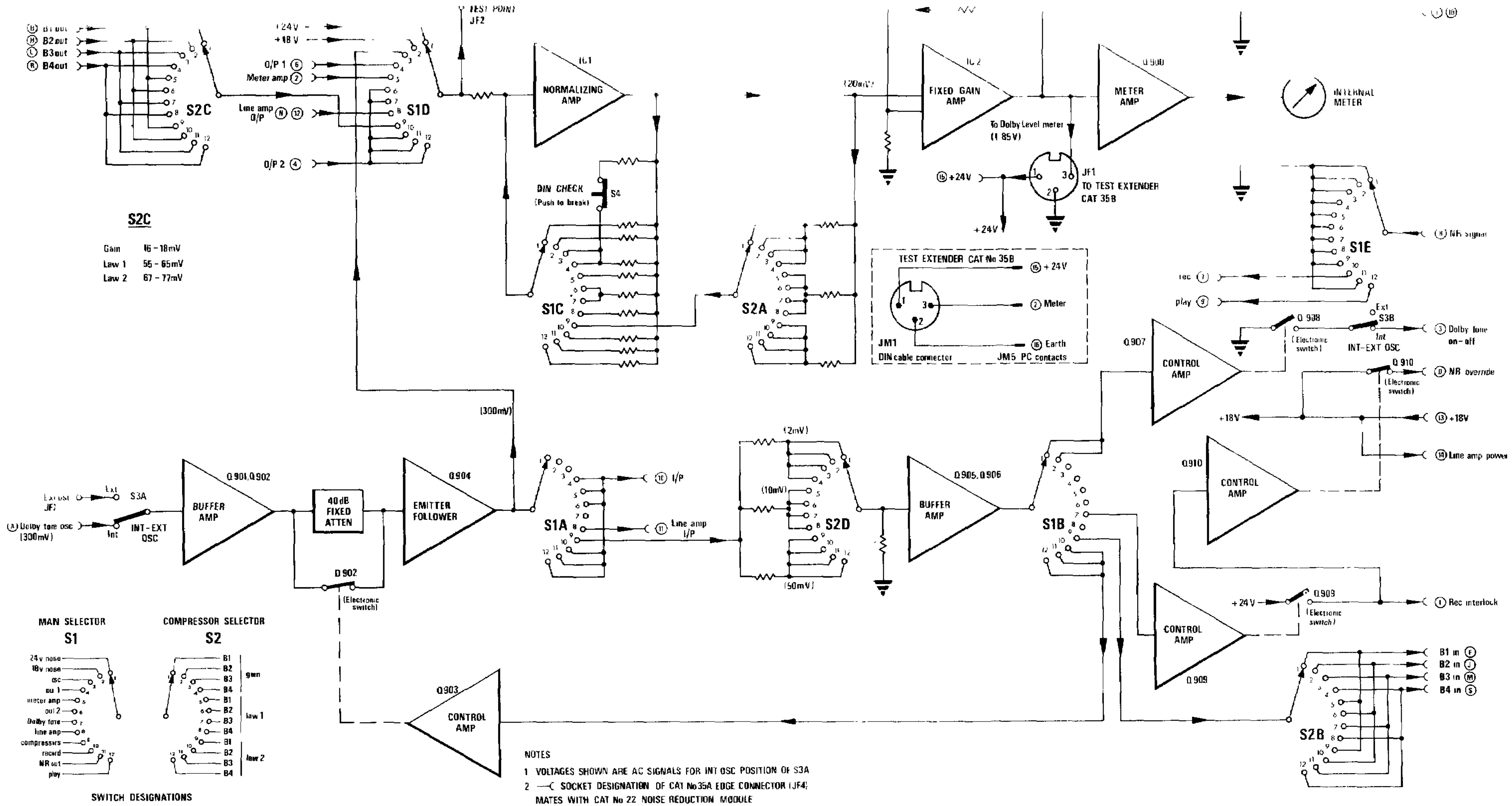
   B. LAW 1, 55 - 63 mV a. c., 6 - 8V d. c.

   C. LAW 2, 67 - 77 mV a. c., 6 - 8V d. c.

10. In the RECORD position of S1, the module is connected in the record mode (pin 8 connected to pin 7), and a signal from the module oscillator (pin A) is attenuated to 3 mV and fed into the module input (pin 10). The output of the module is checked at Output 2 (pin 4, 15-17 mV a.c., 0V d.c.).

11. In the NR OUT position of S1, the noise reduction signal is disabled and a signal from the module oscillator (pin A) is attenuated to 3 mV and fed into the module input (pin 10). The output of the module is checked at Output 2 (pin 4, 4.8-5.2 mV a.c., 0V d.c.; i.e. 9.5-10.5 dB lower than in test 10 above).

12. In the PLAY position of S1, the module is connected in the playback mode (pin 8 connected to pin 9) and a signal from the module oscillator (pin A) is attenuated to 3 mV and fed into the module input (pin 10). The output of the module is checked at Output 2 (pin 4, 1.5-1.7 mV a.c., 0V d.c.; i.e. 9.5-10.5 dB lower than in test 11 above).

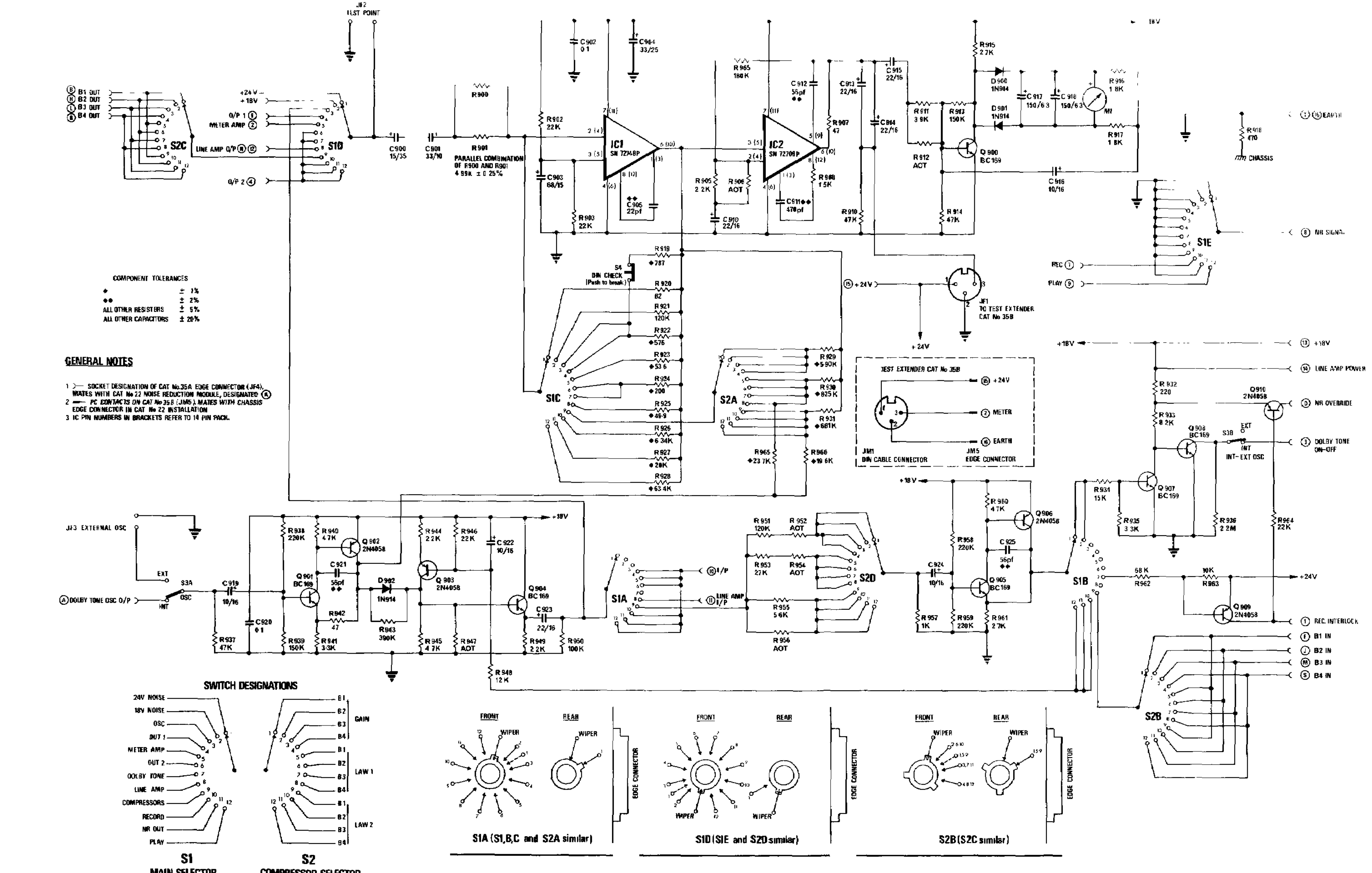


NOTES

1 VOLTAGES SHOWN ARE AC SIGNALS FOR INT OSC POSITION OF S3A
2 —⊂ SOCKET DESIGNATION OF CAT No 35A EDGE CONNECTOR (JF4) MATES WITH CAT No 22 NOISE REDUCTION MODULE
3 —▬ PC CONTACTS ON CAT No 35B (JM5) MATES WITH CHASSIS EDGE CONNECTOR IN CAT No 22 INSTALLATION

NRM TEST SET CAT No. 35 BLOCK DIAGRAM

 Drg. No A1B 716

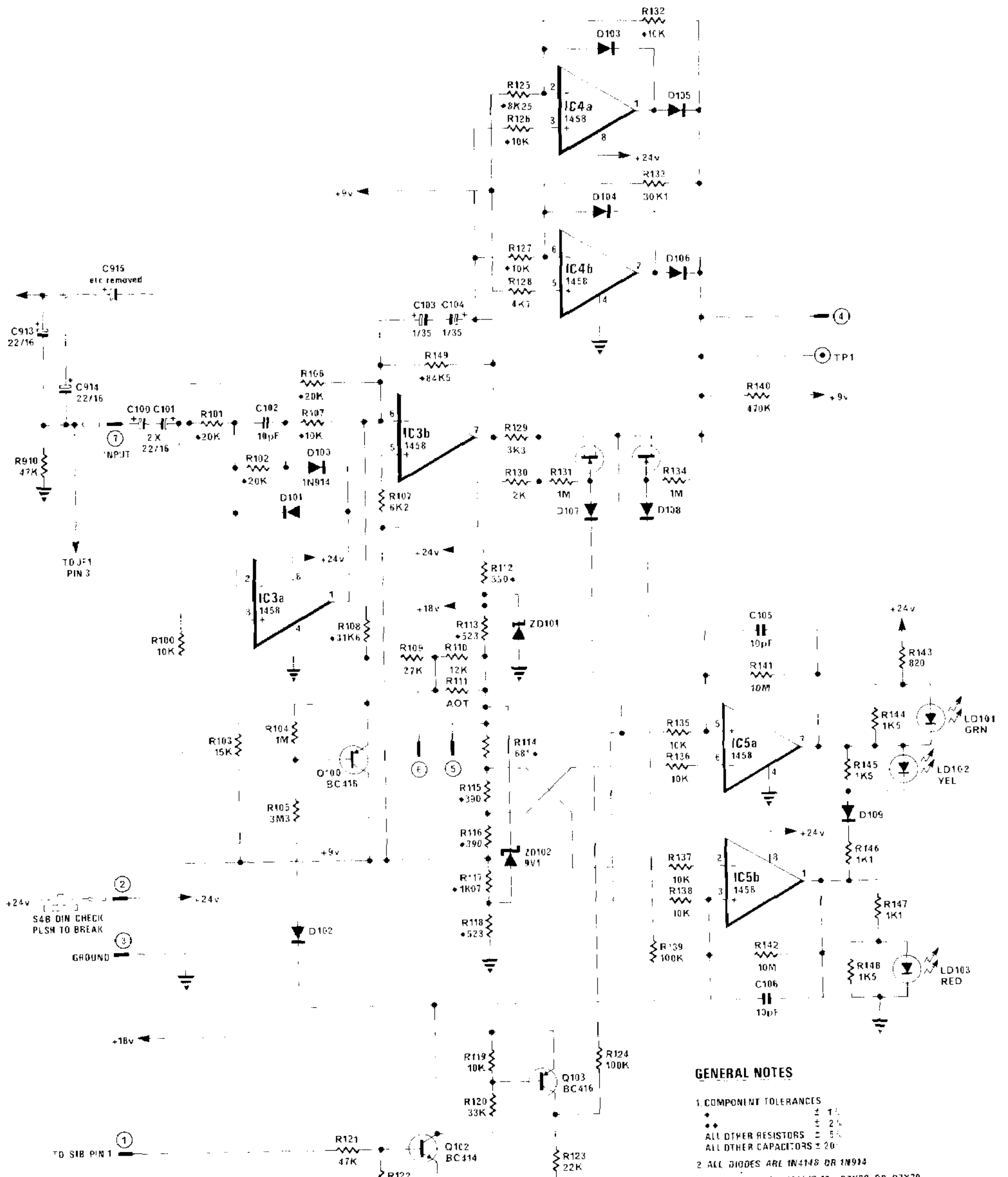


SWITCH NOTES

1 ALL WAFERS ARE VIEWED FROM THE KNOB END.
2 WAFERS ARE SHOWN RELATIVE TO EDGE CONNECTORS.
3 WAFERS S1B & D HAVE NON-SHORTING BLADES. ALL OTHER WAFERS HAVE SHORTING BLADES.
4 WAFERS ARE LETTERED IN ALPHABETICAL ORDER FROM THE KNOB END.

NRM TEST SET CAT No.35 CIRCUIT DIAGRAM

 Drg No AOC 613



GENERAL NOTES

1. COMPONENT TOLERANCES

•	± 1%
••	± 2%
ALL OTHER RESISTORS	± 5%
ALL OTHER CAPACITORS	± 20

2. ALL DIODES ARE 1N4148 OR 1N914

3. ZENER DIODE (ZD101) IS 18v. BZY88 OR BZX70.

A1C1627

LED METERING CIRCUIT – replaces Q900 and associated components.

LED Metering Circuit

L78/46