DOLBY LABORATORIES
INSTRUCTION MANUAL

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SECTION 1
MODEL 362 NOISE REDUCTION SYSTEM – INTRODUCTION

Model 362 – 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 Model 362 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 preset 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 channel in record, the other in play).

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.

An internal Dolby Tone oscillator is provided for each channel to establish 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.

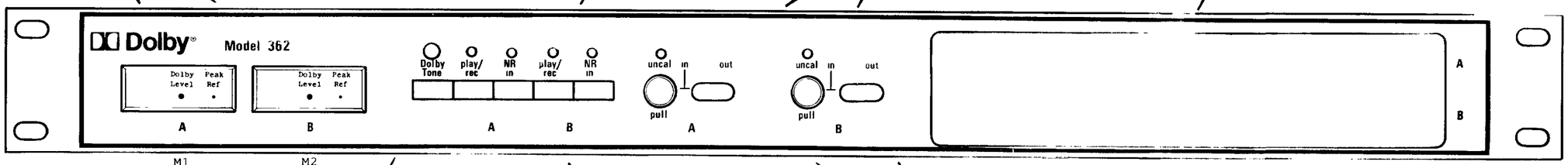
SECTION 2
CONTROLS AND CONNECTORS

METERS TO ASSIST IN CALIBRATION OF RECORDER GAIN CONTROLS CALIBRATED FOR DOLBY LEVEL (SEE SECTION 8)

LED DISPLAY INDICATING SELECTED FUNCTIONS.

PULL TO OPERATE SINGLE TURN 'UNCAL' POTENTIOMETERS TO ALLOW QUICK ALIGNMENT OF INPUT LEVELS IF DEVIATION FROM STANDARD LINE LEVELS IS REQUIRED.

TWO PLUG-IN CAT No 22 NOISE REDUCTION MODULES



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

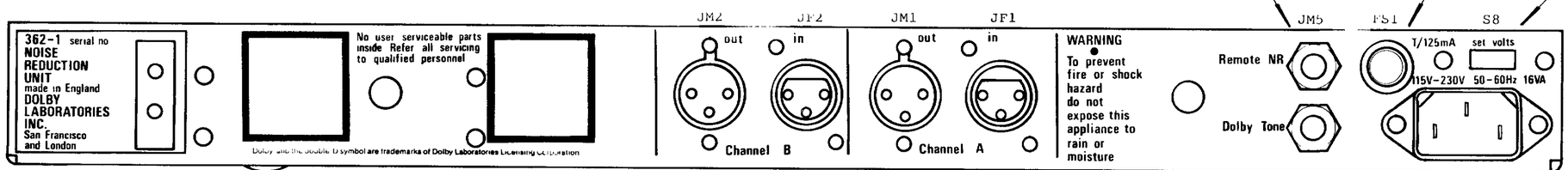
PUSH BUTTON SELECTION OF CHANNEL FUNCTIONS

MULTI-TURN CALIBRATION POTENTIOMETERS TO ADJUST INPUT AND OUTPUT LEVELS TO SUIT STUDIO LINE LEVELS

JACK LINKING AND/OR REMOTE CONTROLLING 'NR' FUNCTIONS (STEREO JACK PLUG REQUIRED) (SEE SECTION 8)

125mA FUSE (SLOW BLOW)

VOLTAGE ADJUST (SLIDE SWITCH)



JACK LINKING AND/OR REMOTE CONTROLLING DOLBY TONE FUNCTIONS (MONO JACK PLUG REQUIRED)

POWER CONNECTOR, CENTRAL PIN IS CONNECTED TO CHASSIS

L85/60

MODEL 362 CONTROLS AND CONNECTORS
Drawing No. A1D 6551 Issue 1

SECTION 3
SPECIFICATIONS

Specifications – Model 362–1

Layout:	Two independent signal processors per unit.
Signal Connections:	XLR inputs and outputs.
Input Circuit:	Bridging transformer, 10k Ohm balanced and floating.
Output Circuit:	Transformer, 20 Ohms output impedance, balanced and floating. Will drive any load impedance from 200 Ohms upwards.
Signal Levels:	Input levels adjusted either by single turn " Uncal " or multi-turn " Cal " potentiometers. Output levels adjusted by multi-turn potentiometers accessible from front of unit. Minimum input of 350 mV for Dolby Level on both calibrated and uncalibrated inputs. Maximum output level of +22 dBm into bridging load; +21 dBm into 600 Ohms; +20 dBm into 200 Ohms.
Meters:	Level setting meter for recorder gain calibration. Calibration marks for Dolby Level and Peak Reference Level.
Panel Controls:	Pushbutton for selection of:– a. Record/Play b. NR in/out or remote c. Dolby Tone and a pull to operate uncalibrated input option.
Remote Control:	Mono jack socket for linking and/or remoting Dolby Tone. Stereo jack socket for independent NR remote operation. Control is effected by grounding the terminals for NR in and Dolby Tone on. Maximum grounding resistance 25 Ohm.
Overall Frequency Response:	±1 dB from 30 Hz to 20 kHz (encode–decode).
Total Harmonic Distortion:	At +4 dBm, less than 0.1% at 1 kHz: less than 0.2% from 40 Hz to 20 kHz.
Encoding Characteristics:	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, the unit becomes a fixed, unity gain line amplifier.
Overall Noise Level:	Record-playback (NR off), 80 dB below Dolby Level over a 20 Hz to 20 kHz bandwidth.
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 encodedecode process 48 μsec.
Phase Error:	Less than 5°, 20 Hz to 20 kHz overall encodedecode.
Crosstalk:	Better than 70 dB over 20 Hz to 20 kHz.

Stability:	The system is highly stable and does not need routine alignment.
Operating Temperature:	Up to 45°C.
Construction:	Plug-in noise reduction modules (Cat. 22). Level setting potentiometers immediately accessible through front panel. Fibre-glass printed circuit board and solid-state devices throughout.
Finish:	Steel case, zinc passivated finish; front panel clear anodised with black characters.
Size:	1 ¾" x 19" rack mounting (44 x 483 mm). Maximum projection behind mounting surface: 8 15/16" (228 mm). Maximum projection in front of mounting surface 7/8" (22 mm).
Weight:	12 lbs (5.5 Kg).
Power Requirements:	Units are designed for operation from a centrally switched power source. Power cables provided. 104–130 V and 208–260 V, single phase, 16 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 charactertistic 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.

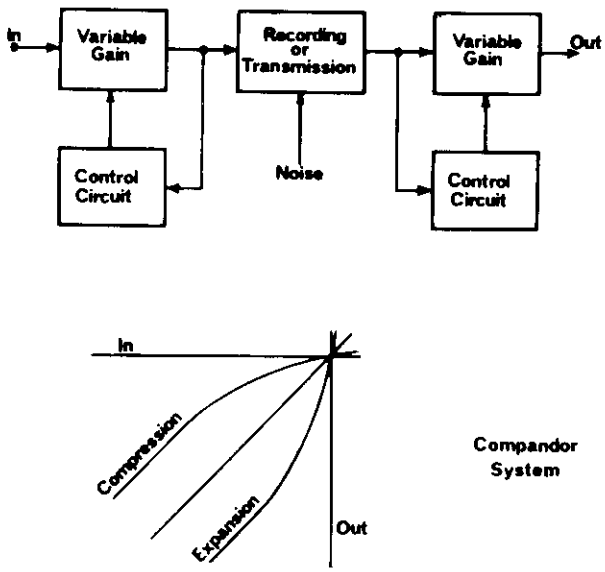
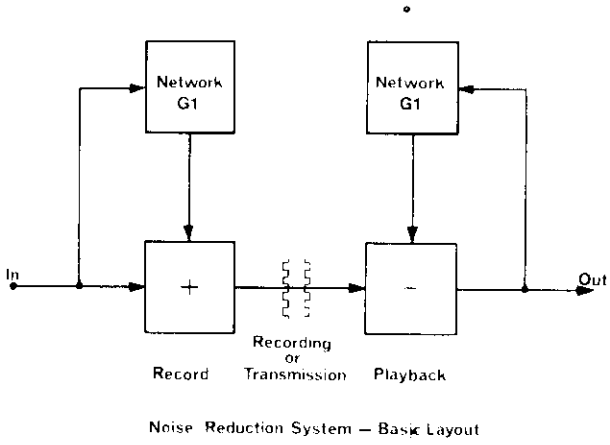


Fig. 4.1

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 tansient 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 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

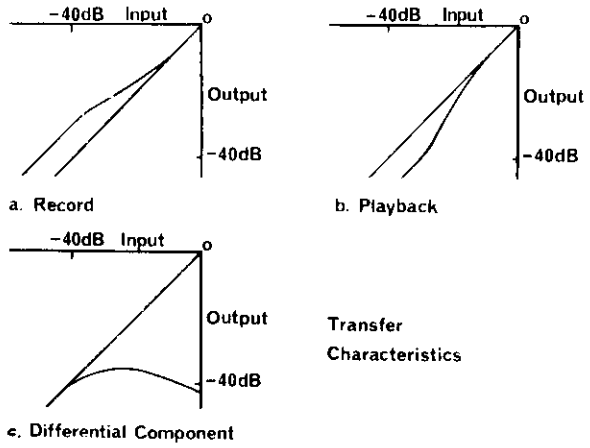
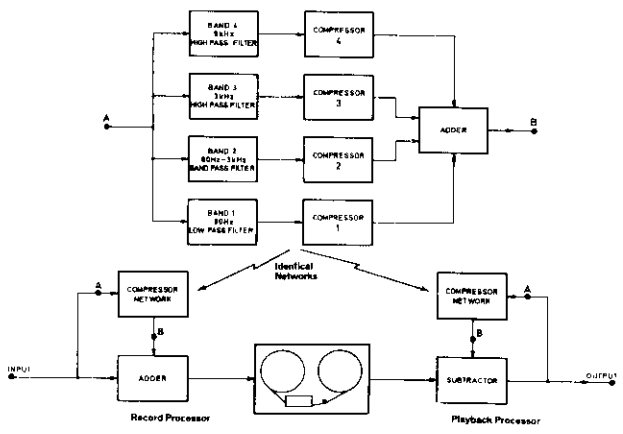


Fig. 4.3



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 1½ dB), since the contribution of the side chain is always low even under dynamic conditions. Miss-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 magnetic flux level on the tape and was originally defined as 185nWb/m (this corresponds to Ampex operating level which is approximately 4.8dB below the I.E.C. reference level of 320nWb/m). As tape types have improved operational levels have increased and 185nWb/m may not be appropriate. If you use VU meters then use a Dolby Level equal to the flux level which corresponds to 0 VU. If you use peak reading meters then use a Dolby Level equal to the flux level corresponding to 5dB below your 100% level. For other types of magnetic media Dolby Level is defined as follows:

Magnetic film; 185nWb/m
Video tape (B and C format); 100nWb/m (EBU/SMPTE reference level).

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 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 PEAK REF). The output level potentiometer is then adjusted to give unity gain through the 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 recorder 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 standarization 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-type system has applications in mono or stereo recording at all tape speeds. The system will reduce tape noise, modulation noise, and crosstalk. 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 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-type 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 of 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 master tapes used in the duplicating process should use A-type noise reduction.

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 sychronized recordings or where multiple generation dubbing techniques may be used.

6.2.7. Videotape Recorders. Audio on videotape has long suffered from the problems associated with trying to record sound on magnetic tape designed for recording video signals. On quadruplex machines the effects of the basic oxide formulation were compounded by the fact that the magnetic particles needed to be aligned perpendicularly to the direction of tape travel in order to make the recording of the video signal easier. This resulted in a fairly high basic noise level. The addition of Dolby A-type noise reduction to this format greatly assisted in improving the audio performance of the system.

The more recent 1 inch formats have in themselves offered significant audio improvements over quadruplex machines and with the addition of Dolby A-type noise reduction can now give results much closer to the performance people have come to expect from standard audio recorders.

Because of the need for easy tape interchange between national and international broadcast organizations, Dolby Level has been rigidly defined for 1" broadcast applications. Again, in order to make things simpler and avoid using a variety of different levels, Dolby Level has been defined for C–format tapes as being the same as EBU/SMPTE reference level, that is Dolby level = 100nWb/m flux level on tape.

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 problems.

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 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 entertainment industry. To reduce the audibility of wideband and impulse noise a high frequency filter, known as the Academy roll-off, is used in traditional mono optical reproduction systems.

Dolby A-type noise reduction, incorporated into the Dolby Stereo System, is now widely used in cinemas as a means of improving not only the dynamic range but – more importantly – the overall bandwidth of the reproduction system.

This improvement in cinema sound quality has made the use of noise reduction even more important in the early stages of a production if they are not to limit the final product.

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 semi-conductor 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 700 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

Installation Instructions

MODEL 362

Two channel record or playback (no automatic changeover)

NOTE: CHECK VOLTAGE SELECTOR BEFORE APPLYING POWER

1. Unpack Model 362 unit and check for damage.

2. Set voltage selector switches (115–230V) appropriately.

3. Mount unit in rack.

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 362 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 362 is 10k Ohms; output impedance is 20 Ohms. The 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 the tape-recorder has an output termination switch, the switch should be "on" when driving Model 362 (playback mode).

7. Dolby Tone may be linked to other units and/or remotely controlled via a mono jack plug inserted into the appropriate socket on the rear of the unit.

   The Dolby Tone oscillators within a single Model 362 have common control via this socket and are activated by connecting the centre pin of the jack plug to earth.

   Pressing the Dolby Tone button on any linked units 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 switch to the end of the remote link.

   NR may also be linked and/or remotely controlled in a similar way to Dolby Tone, the significant difference being that a stereo jack plug is required.

   The tip controls channel A and the ring controls channel B.

8. Refer to Model 362 Operating Instructions for calibration and operating procedures.

SECTION 8
OPERATION

Operating Instructions

MODEL 362

Dual 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 362 Installation Instructions".

2. Select Play and NR–IN mode in all required channels.

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

4. Adjust input level controls on Model 362 playback channels to give readings of 'Dolby Level' on meters. Press Dolby Tone button while making readings; in playback mode, button de-activates noise reduction circuits of all Model 362 units with linked Dolby Tone.

5. Adjust output level controls on Model 362 playback units to give normal studio line level to monitor facilities.

6. Release Dolby Tone.

B. For use in recordings

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

2. Select RECORD and NR-IN mode on all required channels.

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

4. Press Dolby Tone button on any Model 362 unit with linked Dolby Tone and record on blank tape. Adjust output level controls on Model 362 record channels such that tone is recorded at Dolby Level (not DIN reference), on all channels. Verify that correct levels are being recorded by noting playback Model 362 meter readings obtained.

5. Adjust input controls on Model 362 record channels to suit line level in.

6. After above calibration has been carried out, Model 362 record channels, recorder, and Model 362 playback channels should be treated as a fixed, unity gain recording system operating at your normal line levels.

Use of Uncal

Model 362 input levels can be adjusted via the pull to operate 'uncal knob' should playback of a tape recorded at a non-standard level be necessary.

When the uncal knob is returned to the 'cal' position, the system returns to standard levels.

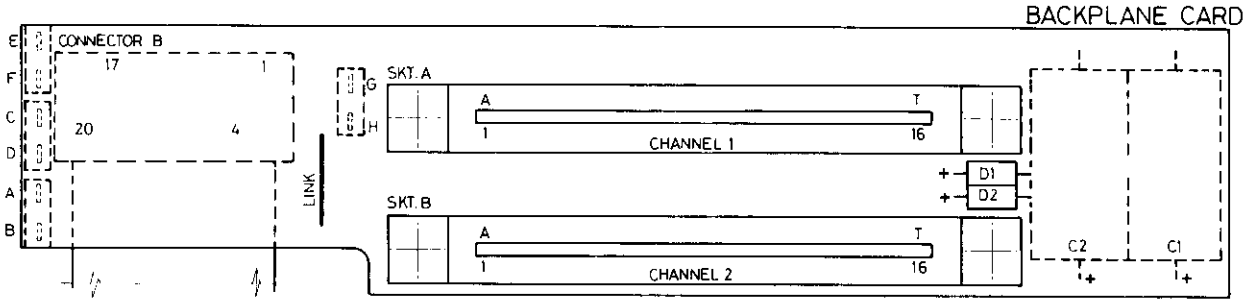
Notes:

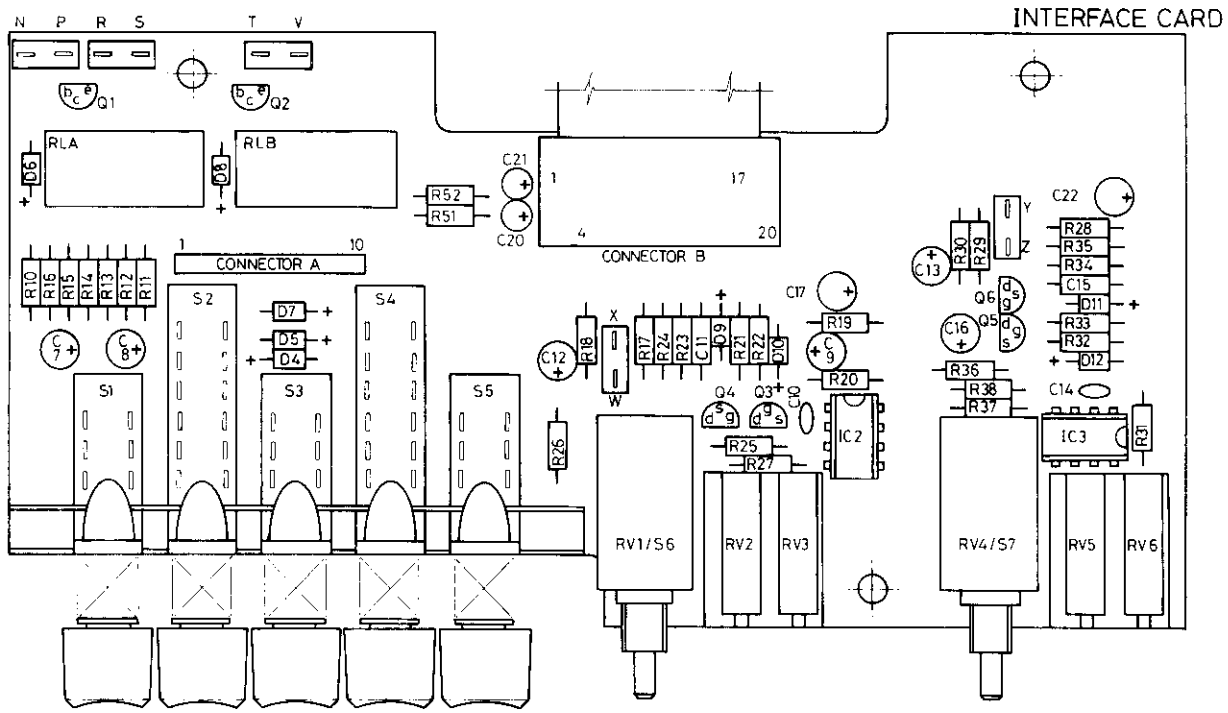
a. Do not compensate for different types of program material (e.g. piano) or different types of tape (e.g. high-output) by altering previously adjusted record and playback gain controls on recorder. Set program level actually recorded on tape by adjusting level or program source (e.g. mixer outputs). Optionally, 'uncal' controls on record Model 362 units (together with output controls on playback Model 362 units) can be used. This standarized recording practice is necessary for international tape interchangeability. As an added precaution to ensure correct playback of tapes, always record Dolby Tone at beginning.

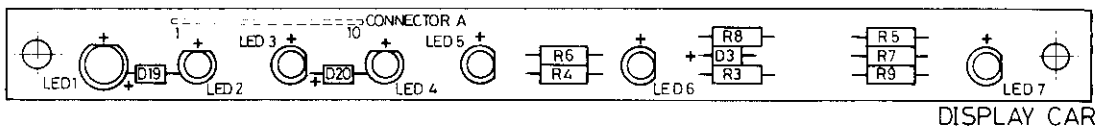
b. Procedures 2 to 6 in playback section above will normally give correct playback level conditions for tapes received without Dolby Tone at beginning. If a tape is received with Dolby Tone but Model 362 playback unit meter does not register Dolby Level an incorrect record level calibration used in recording the tape and/or a track width discrepancy is indicated. In such cases adjust the uncal control to give Dolby Level readings (press any Dolby Tone button while making readings); press the uncal control to return to normal levels after replaying tape.

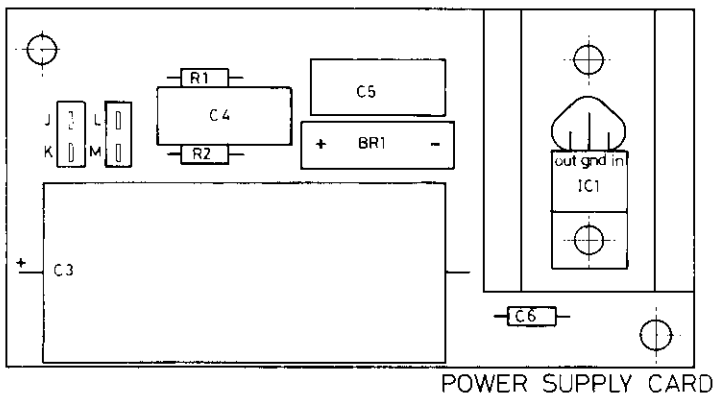
c. To record or replay tapes without Dolby noise reduction characteristic, press NR IN–OUT buttons appropriately.

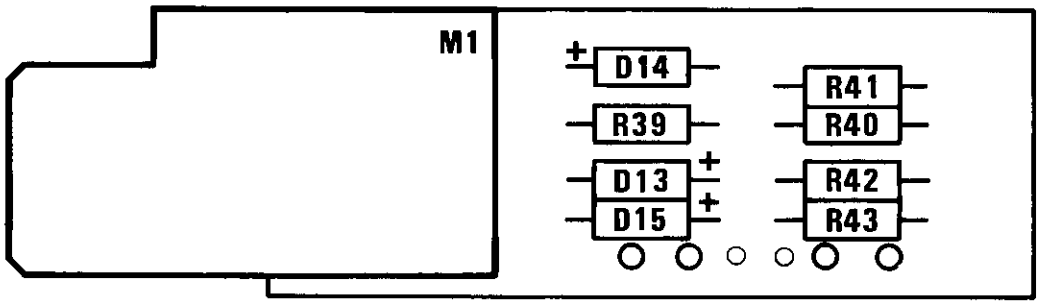
SECTION 9
INTERFACE SERVICING


BACKPLANE CARD
CONNECTOR B
17
1
20
4
E
F
C
D
A
B
LINK
G
H
SKT. A
A
T
1
16
CHANNEL 1
SKT. B
CHANNEL 2
D1
D2
C2
C1

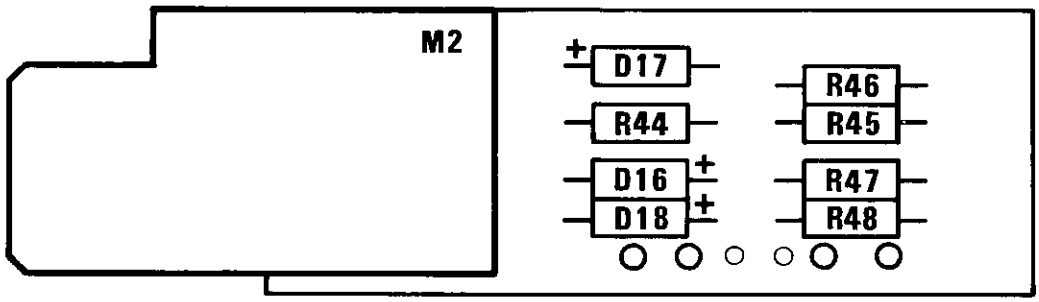

INTERFACE CARD
N P R S T V
Q1
Q2
RLA
RLB
D6
D8
R52
R51
C21
C20
1
17
4
20
CONNECTOR B
CONNECTOR A
1
10
R10
R16
R15
R14
R13
R12
R11
C7
C8
S1
S2
S3
S4
S5
D7
D5
D4
C12
R18
X
W
R17
R24
R23
C11
D9
R21
R22
D10
C17
R19
C9
R20
Q4
Q3
C10
IC2
R25
R27
R26
RV1/S6
RV2
RV3
RV4/S7
RV5
RV6
C22
R28
R35
R34
C15
D11
R33
R32
D12
C13
R30
R29
Y
Z
Q6
Q5
C16
R36
R38
R37
C14
IC3
R31


CONNECTOR A
1
10
LED1
D19
LED2
LED 3
D20
LED 4
LED 5
R6
R4
LED 6
R8
D3
R3
R5
R7
R9
LED 7
DISPLAY CARD

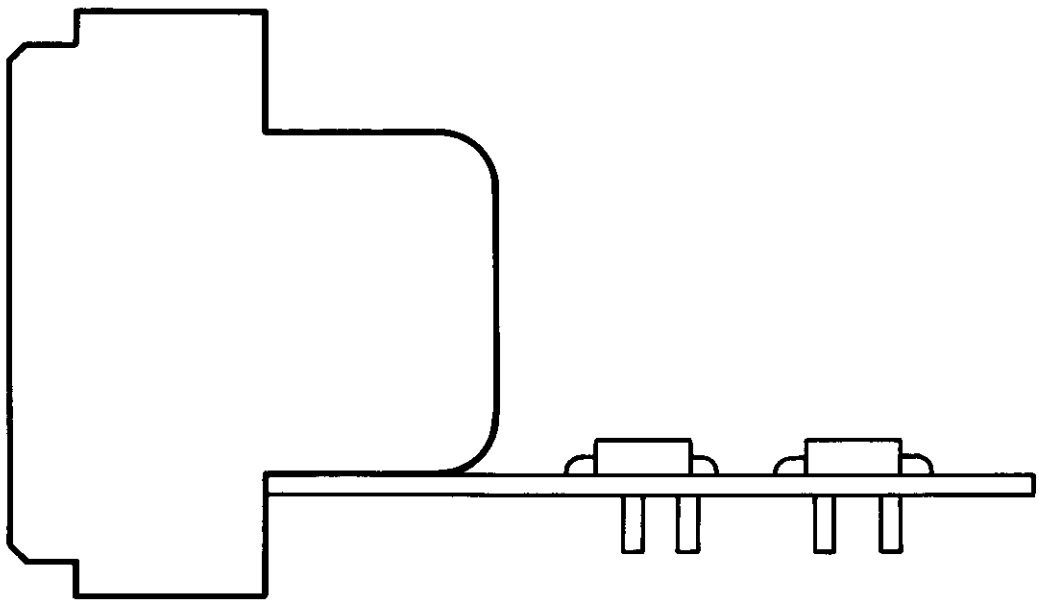

R1
C4
R2
C5
BR1
J
K
L
M
C3
out gnd in
IC1
C6
POWER SUPPLY CARD

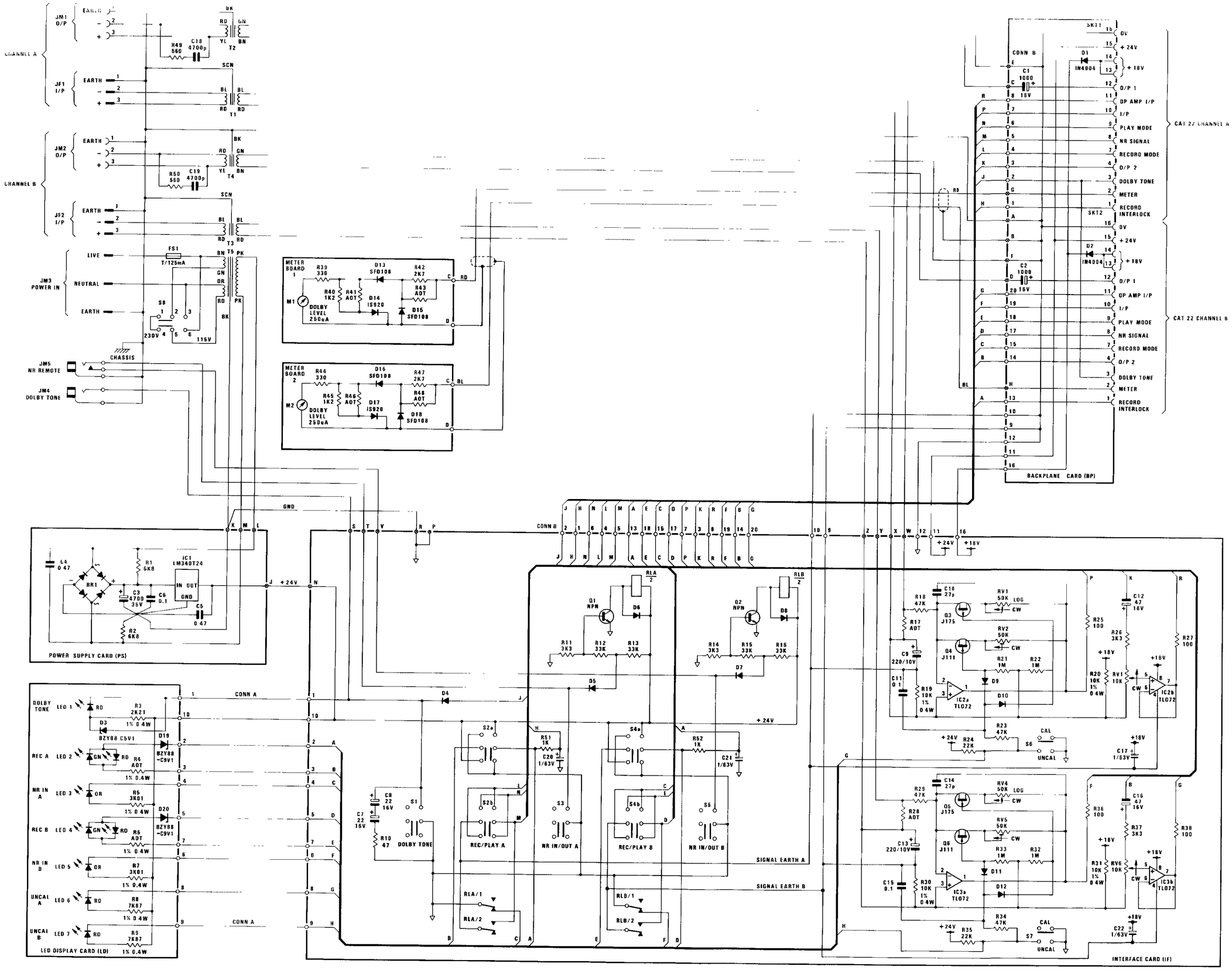


CHANNEL A



CHANNEL B





NOTES

a. ⊗ = PCB PIN

UNLESS OTHERWISE STATED
b. ALL RESISTORS ARE 0 25W 5%
c. ALL CAPACITOR VALUES ARE IN uF
d. POTENTIOMETERS ARE LINEAR
e. ALL DIODES ARE IN 4148

362-1 CIRCUIT DIAGRAM
AOC 6351 ISSUE 04

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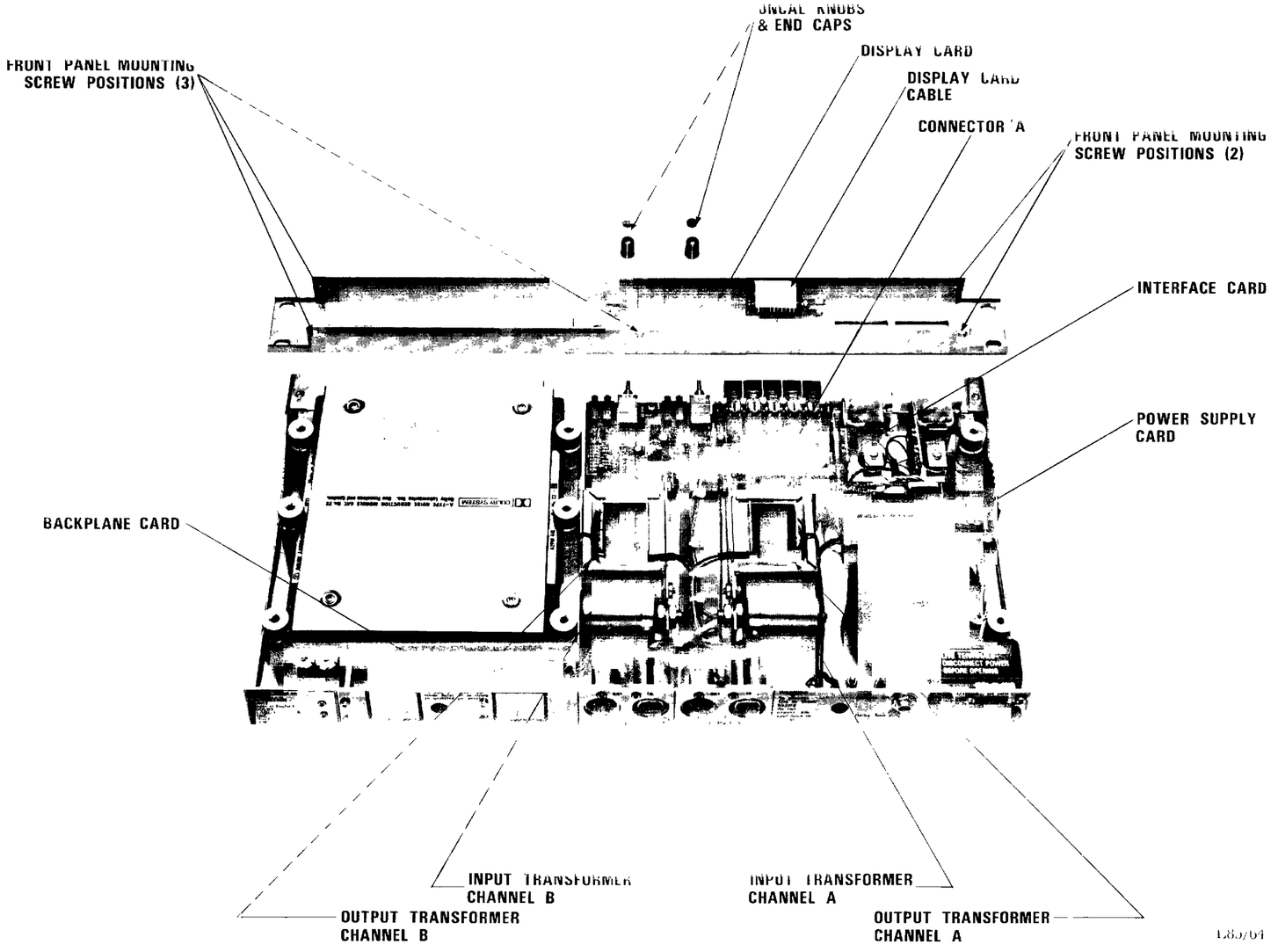
GENERAL SERVICING ACCESS MODEL 362

1. Remove top cover (6 screws)
2. Remove the end caps of the two "uncal" knobs, release the screw by 1 turn and slide the knobs of the shaft. When refitting the white line on the knob should be at 7 o'clock when it is turned counter clockwise
3. Unplug display card cable; Introduce the shaft of a screwdriver behind the flexible flat cable and disengage from connector A on the interface card. The unplugged end of the cable is terminated in delicate wires and extreme care should be taken when replugging.
4. Remove 5 front panel mounting screws. (2 top and 3 bottom).
5. Slide front panel of the tray.



L83/64

SECTION 10
CAT. NO. 35 NRM TEST SET

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, 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 of 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 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 amplifer 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.

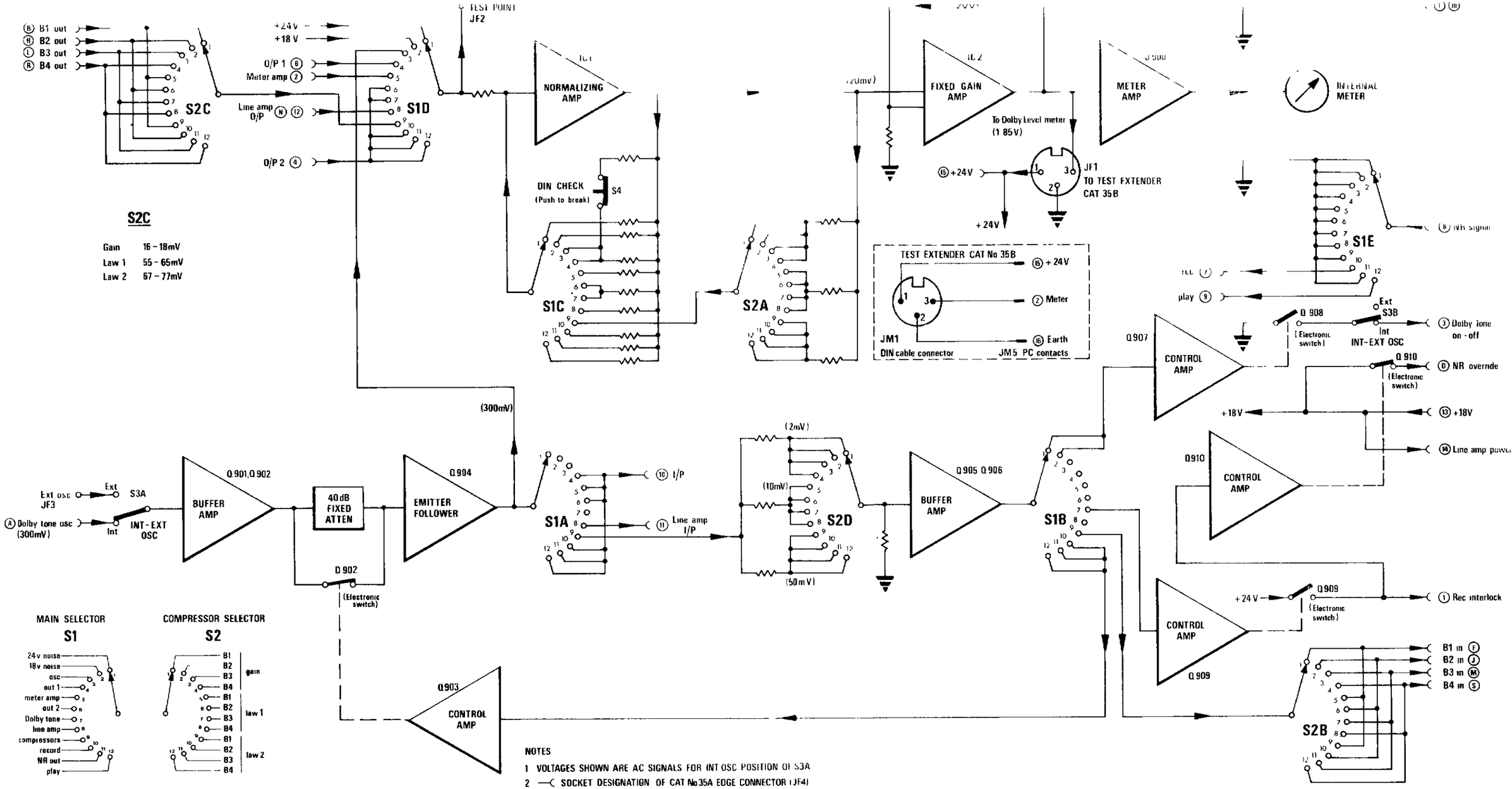
   B. LAW 1, 55 – 63 mV a.c., 6 – 8V d.c.

   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 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

JF2 TEST POINT

U B1 OUT
N B2 OUT
L B3 OUT
R B4 OUT

S2C

+24 V
+18V
O/P 1 (6) METER AMP
(2) LINE AMP O/P (N) (12)
O/P 2 (4)

S1D

C900 15/35

C901 33/10

R900

R901 PARALLEL COMBINATION OF R900 AND R901 4 99K ± 0 25%

C902 0 1

C904 33/25

R902 22 K

C903 68/15

R903 22 K

IC1 SN 72748P

C905 22pf

R905 2 2K

R906 AOT

C910 22/16

IC2 SN 72709P

C912 56pf

C911 470pf

R907 47

R908 1 5K

C913 22/16

C914 22/16

R910 47K

R914 47K

C915 22/16

R915 2 7K

R911 3 9K

R912 AOT

R913 150K

D900 1N914

D901 1N914

C917 150/6 3

C918 150/6 3

R916 1 8K

M1

R917 1 8K

Q900 BC169

C916 10/16

R918 470

CHASSIS

(1) (16) EARTH

S1E

REC (7)
PLAY (9)

(8) NR SIGNAL

COMPONENT TOLERANCES

◆	± 1%
◆◆	± 2%
ALL OTHER RESISTERS	± 5%
ALL OTHER CAPACITORS	± 20%

GENERAL NOTES

1 ⟩— SOCKET DESIGNATION OF CAT No.35A EDGE CONNECTOR (JF4), MATES WITH CAT No 22 NOISE REDUCTION MODULE, DESIGNATED (A)
2 —— PC CONTACTS ON CAT No 35 B (JM5), MATES WITH CHASSIS EDGE CONNECTOR IN CAT No 22 INSTALLATION.
3. IC PIN NUMBERS IN BRACKETS REFER TO 14 PIN PACK.

R919 ◆787

S4 DIN CHECK (Push to break)

R920 82

R921 120K

R922 ◆576

R923 ◆53·6

R924 ◆200

R925 ◆49·9

R926 ◆6 34K

R927 ◆20K

R928 ◆63 4K

S1C

(15) +24V

JF1 TO TEST EXTENDER CAT No 35B

+24V

R929 ◆5·90K

R930 ◆825 K

R931 ◆681K

S2A

R965 ◆23 7K

R966 ◆19 6K

TEST EXTENDER CAT No 35B

(15) +24V
(2) METER
(16) EARTH

JM1 DIN CABLE CONNECTOR

JM5 EDGE CONNECTOR

+18V

(13) +18V
(14) LINE AMP POWER

R932 220

R933 8 2K

Q910 2N4058

(D) NR OVERRIDE

Q908 BC169

S3B EXT INT

INT- EXT OSC

(J) DOLBY TONE ON-OFF

Q907 BC169

R934 15K

R935 3 3K

R936 2 2M

R964 22K

JF3 EXTERNAL OSC

EXT

S3A

INT OSC

(A) DOLBY TONE OSC O/P

C919 10/16

C920 0 1

R937 47K

Q901 BC169

R938 220K

R939 150K

R940 4 7K

Q902 2N4058

C921 56pf

R941 3 3K

R942 47

D902 1N914

R943 390K

R944 2 2K

Q903 2N4058

R945 4 7K

R946 22K

R947 AOT

C922 10/16

Q904 BC169

C923 22/16

R949 2 2K

R950 100K

R948 12K

+18V

S1A

(10) I/P

(11) LINE AMP I/P

R951 120K

R952 AOT

R953 27K

R954 AOT

R955 5 6K

R956 AOT

S2D

C924 10/16

R957 1K

R958 220K

R959 220K

Q905 BC169

C925 56pf

R960 4 7K

Q906 2N4058

R961 2 7K

S1B

68 K R962

10K R963

Q909 2N4058

+24V

(1) REC. INTERLOCK

(F) B1 IN
(J) B2 IN
(M) B3 IN
(S) B4 IN

S2B

SWITCH DESIGNATIONS

S1 MAIN SELECTOR

24V NOISE
18V NOISE
OSC
OUT 1
METER AMP
OUT 2
DOLBY TONE
LINE AMP
COMPRESSORS
RECORD
NR OUT
PLAY

S2 COMPRESSOR SELECTOR

GAIN: B1 B2 B3 B4
LAW 1: B1 B2 B3 B4
LAW 2: B1 B2 B3 B4

S1A (S1,B,C and S2A similar)

FRONT WIPER
REAR WIPER
EDGE CONNECTOR

S1D (S1E and S2D similar)

FRONT WIPER
REAR WIPER
EDGE CONNECTOR

S2B (S2C similar)

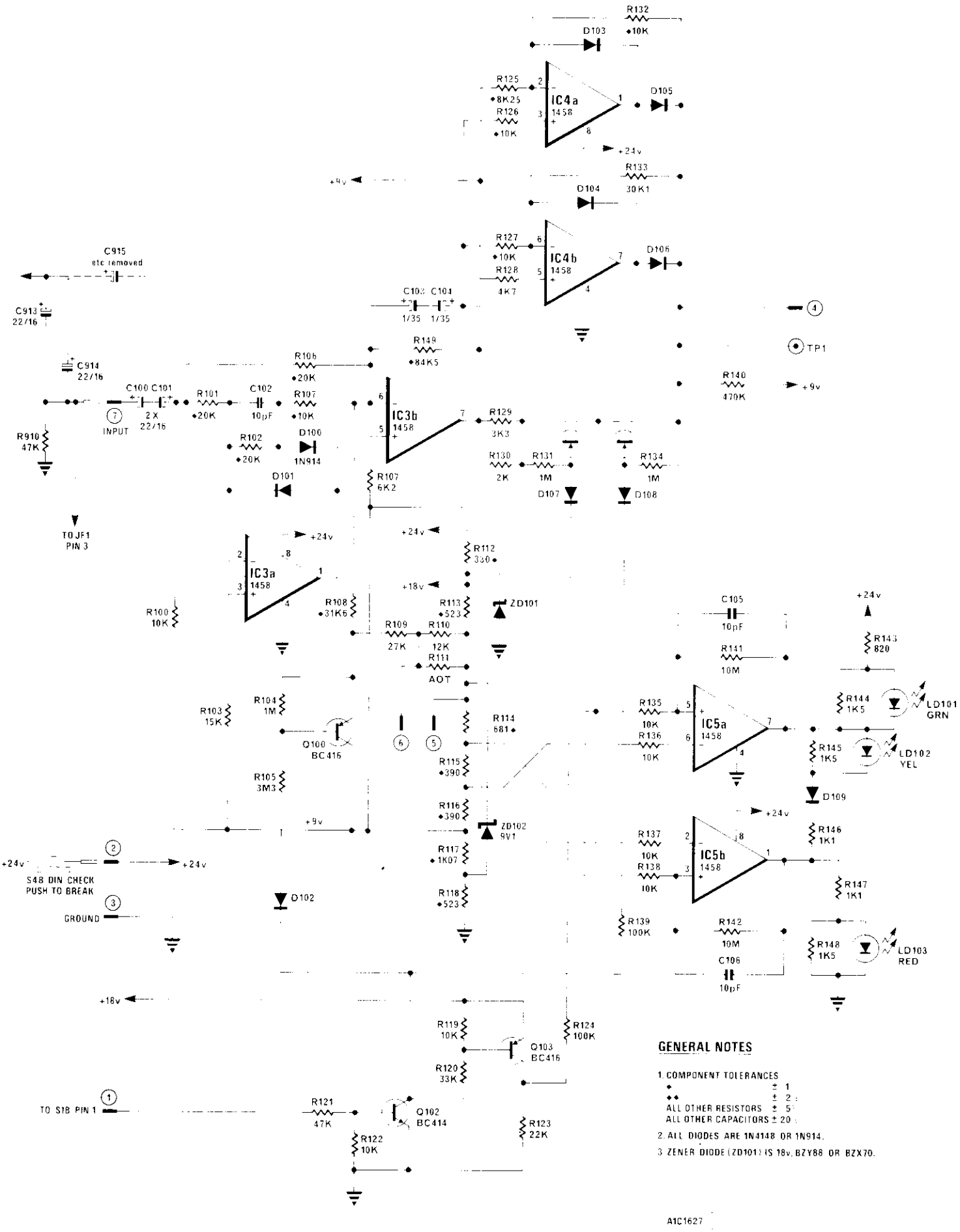
FRONT WIPER
REAR WIPER
EDGE CONNECTOR

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 A0C 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.

LED METERING CIRCUIT - replaces Q900 and associated components.

LED Metering Circuit