DOLBY LABORATORIES

INSTRUCTION MANUAL

MODEL 330 TAPE DUPLICATION UNIT

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S82/2789/4086

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SECTION 1

MODEL 330

TAPE DUPLICATION UNIT

INTRODUCTION

1.1 Introduction

The Model 330 Tape Duplication Unit is a professional encoder/decoder having consumer noise reduction characteristics. The unit is designed for use in the production of pre-recorded tapes, either audio tapes or the audio portions of video pre-recorded tapes.

The Model 330 enables manufacturers of pre-recorded tapes to prepare masters for duplication with Dolby noise reduction characteristics. Plug-in modules provide either Dolby B-type or C-type noise reduction characteristics. Tapes made by means of the Model 330 and played back through consumer replay units which incorporate Dolby noise reduction circuitry will benefit from a 10 dB reduction in high-frequency noise (B-type noise reduction) or a 20 dB reduction in middle- and high-frequency noise (C-type noise reduction) without alteration of the signal itself.

For recording, the Model 330 is inserted between the mixing console and the inputs to the recorder on which the duplicating master is made. The result is a master with either B-type or C-type characteristics which can be copied or duplicated conventionally. The duplicated tapes will thus carry the noise reduction characteristics. The unit is suitable for open-reel and cassette formats.

The noise reduction modules used in the Model 330 contain built-in calibration oscillators to ensure the international standardization of all pre-recorded tapes using the Dolby system. The parameters of the system are extremely stable; once installed, the Model 330 requires no day-to-day maintenance.

The unit is normally used in the encoding mode. However, for quality monitoring the Model 330 may be switched manually to the decoding mode.

The unit is self-contained and is normally supplied for mounting in a 19" (483 mm) rack.

SECTION 2

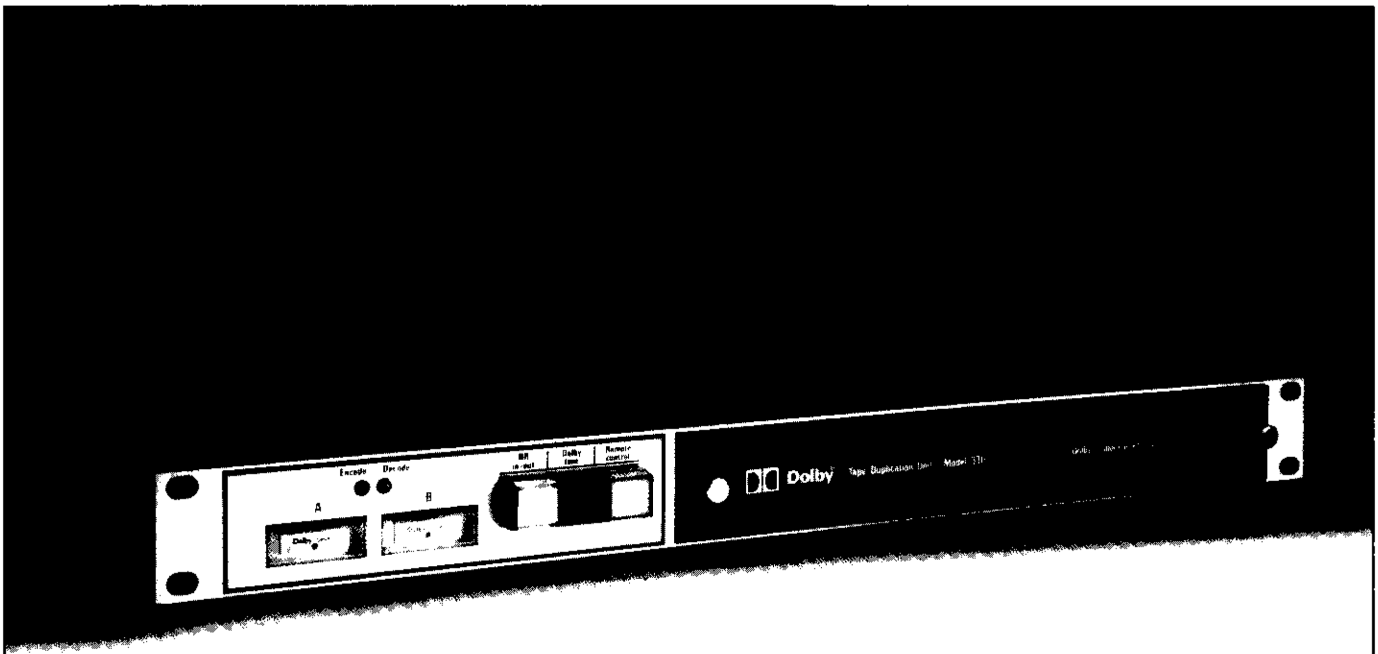
SPECIFICATIONS

2.1 Specifications

Layout	Two independent signal processors per unit.
Signal connections	One XLR input and output for each processor.
Input circuit	Bridging transformer, 10 k ohm balanced floating.
Output circuit	Transformer, 10 ohms 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. Maximum output level +22 dB into bridging load; +21 dB into 600 ohms; +20 dB into 200 ohms (0 dB = 775 mV rms).
Meters	Front panel meters for level calibration. Dolby Level mark corresponds to 185 nWb/m (Ampex operating level) on open-reel duplicates and to 200 nWb/m on cassettes.
Panel controls	Pushbutton for selection of: a) NR in-out b) Dolby Tone c) Remote/local operation Toggle switch mode selector behind front cover plate for selecting encode or decode (quality monitoring) mode.
Remote control	Five-pin XLR connector for remote control of NR in-out and Dolby Tone oscillator. Control effected by earthing terminals for NR out, oscillator on. Maximum resistance in earthing lines, 1 k ohm.
Overall frequency response	(encode-decode) 30 Hz - 15 kHz, ± 1 dB.
Total overall harmonic distortion	At +4 dB (1.23 V) into 600 ohms, less than 0.1% at 1 kHz.
Low pass filter	Built-in 16 kHz low pass filter giving 45 dB attenuation at 100 kHz. Filter response below 15 kHz, ± 0.5 dB.
Overall noise level	Better than 80 dB (unweighted or according to CCIR/ARM) below Dolby Level of +4 dB.
Crosstalk	Better than -60 dB between channels at 1 kHz, and -40 dB at 10 kHz and above.
Signal delay	27 μsec.
Phase	Difference between channels less than 5°, 20 Hz to 12 kHz, overall encode-decode.
Matching between units	Better than 1 dB at any level and any frequency.

Encoding characteristics	a) With Cat. No. 66 module Dolby B-type noise reduction characteristics +3 dB at 500 Hz +6 dB at 1000 Hz +10 dB from 4 kHz upwards b) With Cat. No. 219 module Dolby C-type noise reduction characteristics +3 dB at 100 Hz +6 dB at 150 Hz +20 dB at 1.5 kHz up to 5 kHz, reducing above 5 kHz in controlled manner With noise reduction switched out, system becomes a line amplifier.
Stability	System is highly stable - does not require routine alignment.
Operating temperature	Up to 45°C.
Construction	Main frame plug-in accepts B-type (Cat. No. 66) or C-type (Cat. No. 219) noise reduction modules. Level-setting potentiometers and mode changeover switch accessible through front panel. Fibre-glass printed circuit, 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 (1-3/4" x 19"). Maximum projection behind mounting surface: 228 mm (8-15/16"). Maximum projection in front of mounting surface: 22 mm (7/8").
Weight	5.5 kg (12 lbs).
Power requirements	Unit is designed for operation from centrally-switched power source. Power cable provided. 100-130 V and 200-260 V, 50-60 Hz single phase, 13 VA.

Dolby 330 Tape Duplication Unit



The Dolby 330 is designed for use in the preparation of master tapes for high speed duplication on to cassettes, cartridges, and open-reel tapes to be played back on home equipment incorporating Dolby B-type and/or C-type noise reduction circuitry.

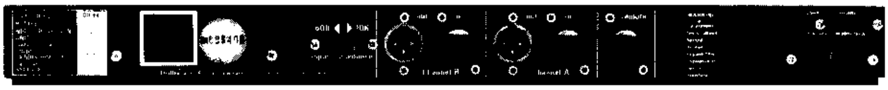
The Model 330 can accommodate either the Cat. No. 66 B-type module or the Cat. No. 219B C-type module. The Cat. No. 66 comes standard with the 330 and the Cat. No. 219B is available as an option. User may specify the inclusion of either module upon ordering the unit.

The Dolby 330 is inserted between the mixing console and the inputs to the recorder on which the duplicating master is to be made. The resulting tape will have either Dolby B-type or C-type characteristics, and can be duplicated as any conventional duplicating master, with noise reduction encoding automatically carried over to the duplicated tape.

For monitoring of the master or the final product, the 330 can be operated in the playback mode by activating a switch under the removable access plate on the front panel.

Reprints of a paper describing the production of Dolby B type cassettes (by D P Robinson, **J. Audio Eng. Soc.**, vol 20, pp 835-841, December 1972) are available upon request from Dolby Laboratories.

Dolby Model 330
Specifications



Layout:
Two independent signal processors per unit.

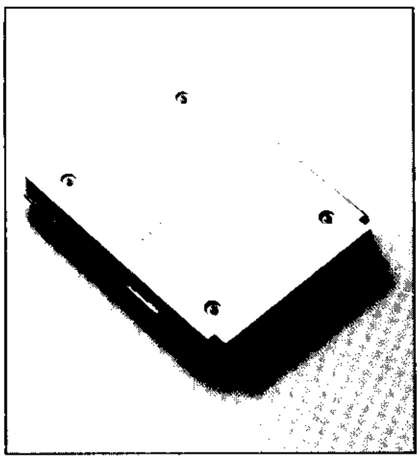
Signal Connections:
Three-pin XLR input and output connectors for each processor.

Input Circuit:
Balanced floating transformer. Input impedance: 10 k ohm or 600 ohm, selected by rear-mounted switch.

Output Circuit:
Transformer, 20 ohms 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. Maximum output level +22 dB into bridging load; +21 dBm into 600 ohms; +20 dBm into 200 ohms (0 dB = 0.775 rms).

Meters:
Front panel meters for level calibration. Dolby level mark corresponds to 185 nWb/m (Ampex operating level) on open reel and cartridge duplicates, and to 200 nWb/m on cassettes.



Panel Controls:
Push-buttons for selection of:
- a. NR in/out
- b. Dolby tone
- c. Remote/local operation

Toggle switch mode selector behind access plate for selecting encode or decode (quality monitoring) mode.

Remote Control:
Five-pin XLR connector for remote control of NR in/out and Dolby tone oscillator is provided. Control effected by grounding terminals for NR out, oscillator on. Maximum resistance in grounding line, 1 k ohm.

Overall Frequency Response:
(encode-decode)
30 Hz-15 kHz, ±1 dB.

Total Harmonic Distortion:
At +4 dB, less than 0.1% at 1 kHz; less than 0.2% from 40 Hz to 20 kHz.

Encoding Characteristics:
Dolby B-type characteristics:
(−40 dB below Dolby level)
+3 dB at 500 Hz; +6 dB at 1000 Hz;
+10 dB from 4 kHz upwards.

Dolby C-type characteristics:
(−60 dB below Dolby level)
+8 dB at 200 Hz; +16 dB at 500 Hz;
+20 dB from 2 kHz to 7 kHz.

With noise reduction switched out, system becomes line amplifier.

Low-Pass Filter:
Built-in 16 kHz low-pass filter giving 45 dB attenuation at 80 kHz. Filter response below 15 kHz, ±0.5 dB.

Overall Noise Level:
Better than 80 dB (unweighted or according to CCIR/ARM), below Dolby level.

Crosstalk:
Better than 50 dB between channels, 20 Hz to 20 kHz.

Signal Delay:
20 μsec.

Phase Difference Between Channels:
Less than 5° 20 Hz to 12 kHz, overall encode-decode.

Matching Between Units:
Better than 1 dB at any level and any frequency.

Stability:
System is highly stable — does not require routine alignment.

Operating Temperature:
Up to 45° C.

Construction:
Plug-in B-type (Cat. No. 66) or C-type (Cat. No. 219B) noise reduction module, level setting potentiometers and mode changeover switch accessible under front panel. Fiberglass printed circuits, solid state devices throughout.

Finish:
Steel case, grey stoved plastic textured finish; front panel clear anodized with black characters.

Size:
1¾"x19" rack mounting (44 mm x 483 mm).
Maximum projection behind mounting surface: 8-5/16" (228 mm).
Maximum projection in front of mounting surface: 7/8" (22 mm).

Weight:
12 lbs. (5.5 kg).

Power Requirements:
Unit is designed for operation from centrally-switched power source.
Power cable provided. 100-130 V and 200-260 V, 50-60 Hz single phase, 13 VA.

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SECTION 3

PRINCIPLES OF OPERATION

3.1 B-type Noise Reduction System

In sound recording or transmission systems, the high 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 with high-level high-frequency signals, there are no detrimental effects. 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 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 B-type noise reduction system provides a characteristic, controlled by the incoming signal, which achieves optimum loading of the recording or transmission channel under all signal conditions. During reproduction, a complementary characteristic is applied which restores all frequency components to their correct amplitudes and, in the process, attenuates noise.

In consumer tape and broadcast applications, the main noise problem, hiss, can be handled inexpensively but adequately by a single high-frequency noise reduction band. The necessary characteristics are obtained by splitting the input signal into two paths, one direct path and one passing only high frequencies through a low-level compressor circuit. The encoded signal is produced by adding together the output of the compressor to the direct path output (fig. 3.1).

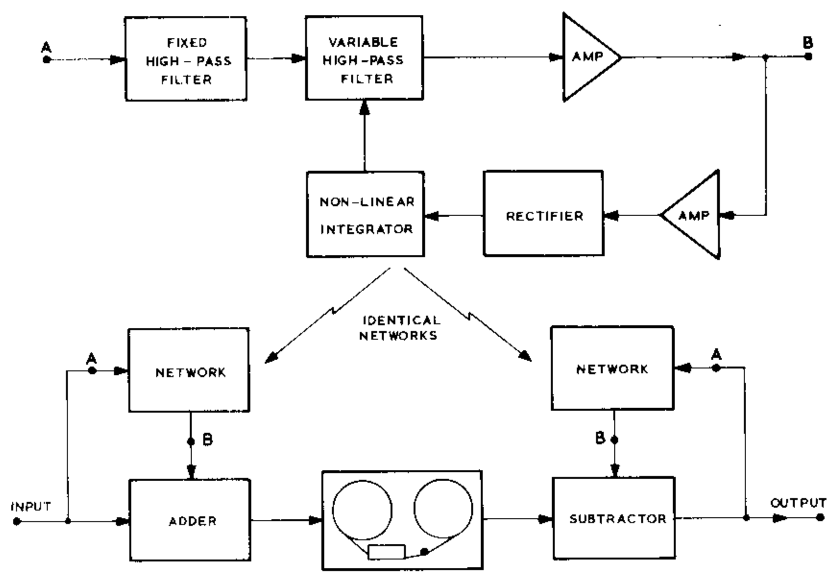


Fig. 3.1 Block diagram of B-type noise reduction system

While the compressor has a compression characteristic which by itself is more like that of a limiter, the overall law produced at the output can be described as compression (figs. 3.2, 3.3).

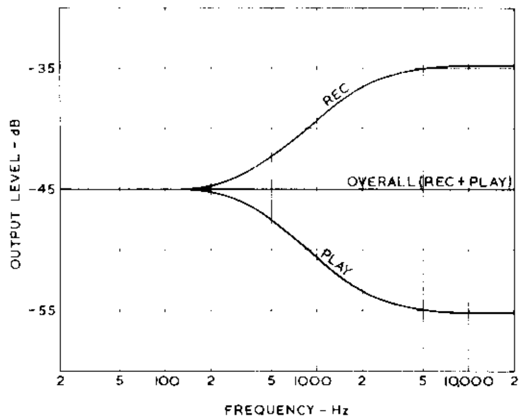


Fig. 3.2 Low-level frequency response characteristics of record and play processors

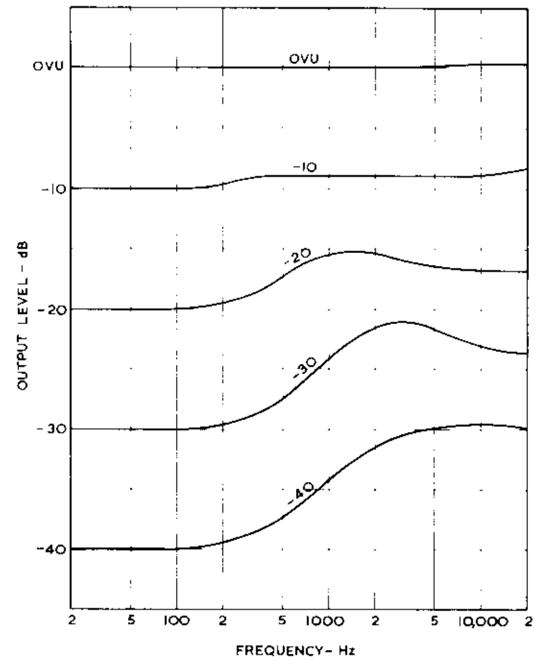


Fig. 3.3 Encode processor characteristics

During playback or reception, the encoded signal is processed in a complementary way. The decoding compressor is identical to that used in the encoding process, but the side chain is connected such that its output is subtracted from the input to the processor. The decode processor thus acts as an expander, and its characteristic is such as to mirror the characteristics of the encode processor precisely; every change in the signal during encoding is matched by an equal and opposite change in decoding. In this way, the signal leaving the B-type unit in the decode mode is identical in all respects to that entering prior to encoding.

Noise produced by the tape or broadcasting and reception channel is added to the signal while it is in the B-encoded condition, in which all low-level components have higher than normal amplitudes. During decoding, the low-level components are attenuated, thereby restoring the signal to its original condition; the noise contribution is therefore attenuated by the same amount.

The complementary properties of the Dolby system are of special significance where matrix encoded signals are to be handled, whether in the form of recordings or FM transmissions. It should be noted that in the Dolby encoding-decoding process there are no overall changes in signal dynamics, frequency response, phase response, or transient response. While there are changes in all of these parameters in the encoded signal, the decoding process compensates precisely for the changes introduced. The phase errors introduced in encoding-decoding are typically less than five degrees at all frequencies and levels, which results in minimal interference with the matrix encoding-decoding process.

It should be noted that, in common with all electronic circuits, the input filter in the Model 330 produces a signal delay, 27 μsec in this case, which is constant with frequency. Phase measurements made between input and output of the Model 330 are therefore invalid unless this delay is taken into account.

3.2 C-type Noise Reduction System

The Dolby B-type noise reduction system is well established in consumer audio products, providing 10 dB of noise reduction (CCIR/ARM weighted). In most applications, and under most listening conditions, this amount is sufficient to reduce the noise level from magnetic tape to an unobtrusive level, or at least to a level comparable with that of most sources available to the average consumer. However, under some circumstances it is advantageous to be able to provide more noise reduction, and this consideration has led to the development of the Dolby C-type system, which is offered to licensees as an addition to the B-type system.

Similar principles to those of the B-type system can be applied to produce a system giving substantially more noise reduction (about 20 dB), without the side effects produced by conventional systems (such as constant slope companders). The system operates by boosting low-level signals in two mid- and high-frequency stages in the encode mode, and attenuating the same signals in a complementary manner in the decode mode. During the latter process, noise in the treated frequency range is also attenuated. There is a useful reduction in power-line frequency harmonics. (However, this should not be depended upon in tape recorder design; low-frequency noise should not be a problem in well-designed recorders.) In addition, other parts of the circuit have been designed to alleviate the high-level high-frequency deficiencies of slow-speed magnetic tape.

A necessary feature of the C-type system is that it must be switchable to provide a B-type circuit, so that the consumer can record and play standard B-type recordings. This is essential on at least three grounds. Firstly, most users of the C-type system will be B-type users already, and therefore will possess libraries of B-type recordings. Secondly, for a long time to come the great majority of products with noise reduction will be recorders with B-type circuits only; most of the marketplace will continue as at present, but with the top-end high-quality units incorporating C-type. Thirdly, for the foreseeable future, the majority of pre-recorded tapes from the major manufacturers will be encoded with B-type noise reduction. Thus, the C-type circuit provides a standard B-type system when switched to that mode.

In addition, a design feature of the C-type system is that there is a useful degree of compatibility between C-type and B-type systems; that is, a pre-recorded tape encoded with the C-type system will play back with tolerable results on a machine equipped only with the B-type system, especially if a graphic equalizer or tone control is used to optimize tonal balance. With the large amounts of noise reduction being used, the compatibility when a C-type recording is played back with no noise reduction at all is obviously not so good, but nevertheless is such that many listeners would accept the quality as satisfactory when playing on inexpensive portable units and the like.

C-type encoding modifies the high-frequency characteristics of highs in a manner to improve the high-frequency MOL of pre-recorded tapes. This allows duplicators to overcome the common problems of high-frequency saturation and produce pre-recorded tapes whose technical performance surpasses that of conventional discs.

The operation of the noise reduction system will be described with reference to block diagrams figs. 3.4 and 3.5 of an encoder and decoder respectively. Both the encoder and decoder comprise two active stages, called the high-level stage and the low-level stage.

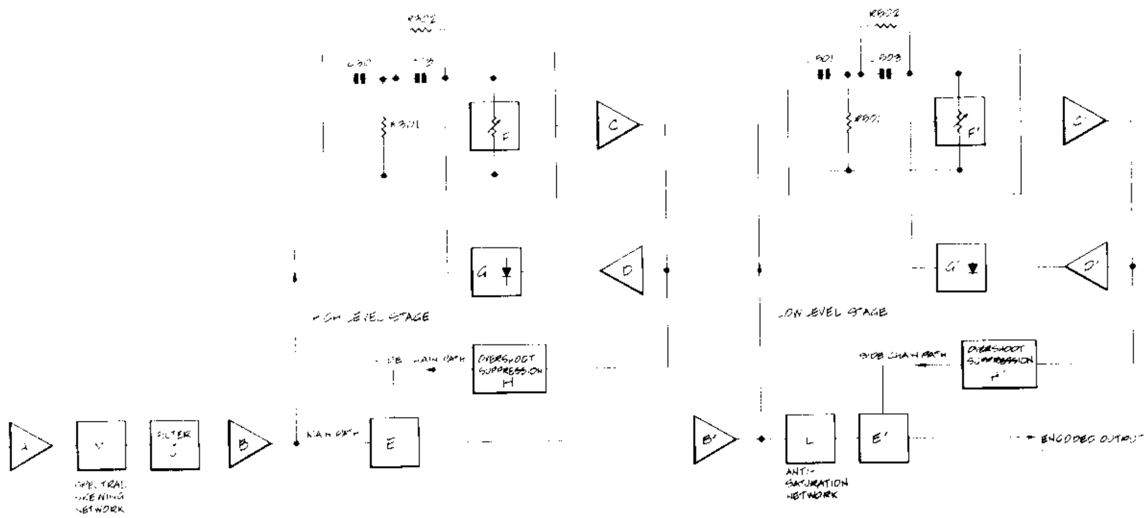


Fig 3.4 Dolby C-type system encoder block diagram

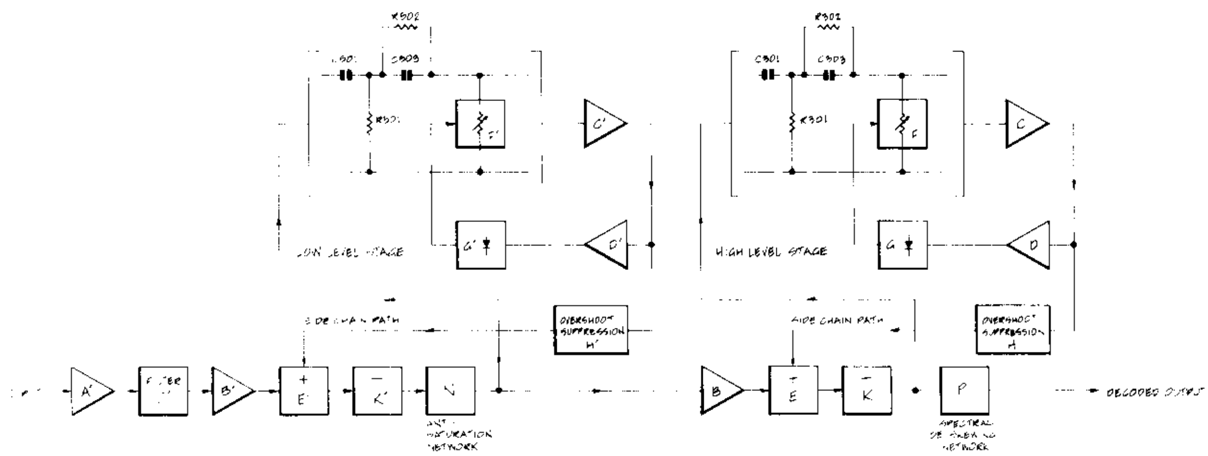


Fig 3.5 Dolby C-type system decoder block diagram

Referring to fig. 3.4, signals enter the encoder via amplifier A and pass through a spectral skewing network M and low-pass filter J. The spectral skewing network reduces the level of extreme high-frequency signals passing to the rest of the processor. This desensitizes the decode processor to any high-frequency response errors in the tape recorder, therefore reducing any potential decoding errors of low- and mid-frequency program if extremely high frequency signals are also present. There is also an effective improvement in the extremely high frequency saturation characteristics of the recorder and a corresponding reduction in intermodulation distortion. The noise reduction action is essentially unimpaired because of the relative insensitivity of the human ear to noise above 10 kHz when the noise level is extremely low, as it is when the C-type system is used.

The low-pass filter attenuates all unwanted signals such as tape recorder bias, FM stereo, or television sound multiplex signals to a level such that they are below the thresholds of the compressors to avoid incorrect decoding.

The signal at the output of amplifier B enters the high-level stage and is split into two paths; one, the main path, provides an unaltered signal component directly to the output via adder E, while the other, known as the noise reduction side chain, controls the dynamic characteristics of the processor.

The side chain contains a dynamic high-pass filter comprising capacitors C301 and C303 and resistors R301, R302 and the controlled resistance F. Under low-level signal conditions, F has a high value, and the first part of the filter (i.e. C301 and R301) then controls the response of the side chain.

The output of the filter is amplified by amplifier C, and the resulting noise reduction signal is added to the main signal in adder E. The low-level gain of the side chain is such that the overall output is increased by 10 dB at about 1.5 kHz when the noise reduction signal is added. Thus the action of the high-level stage of the encoder is similar to that of the B-type system, except that the turn-over frequency of the side-chain filter has been moved down by two octaves.

The side-chain output is amplified further by D and then rectified and smoothed by a non-linear integrator (block G). The resulting DC control signal is fed back to vary resistance F. When this control voltage exceeds a threshold value, the resistance of F falls, causing the turnover frequency of the second part of the filter (R302, C303 and F) to increase, thereby attenuating low- and medium-frequency signals in the side chain. With increasing input levels, the side-chain signal becomes a decreasing proportion of the main signal.

The output of the encoder is passed to a second, low-level stage of encoding which is similar (components B', C', etc.). The turn-over frequency of the second side-chain filter (C501, R501, etc.) is the same as that of the high-level stage. Thus the noise reduction action is built up to 20 dB in two successive actions, which avoids the serious problems inherent in attempting to achieve such figures in a single-stage circuit.

The control circuits of the low-level stage are set to provide a lower threshold than that of the high-level stage. Moreover, since the first part of the encoder raises the signal to the second part, the second receives a higher signal level than the first, which contributes to the fact that the low-level stage starts compressing first. Thus the second part is called the "low level stage" and the first part is called the "high level stage".

A further difference between the stages is the introduction of an anti-saturation network L in the low-level section. Together with the spectral skewing network M, this ensures that the saturation level of the tape is always better with C-type noise reduction than without any noise reduction; the improvement in saturation level depends somewhat on the tape and recording bias, but is of the order of 4 dB at 10 kHz and 8 dB at 15 kHz.

The combined characteristics are shown in fig. 3.6, which shows the low level characteristics of the C-type system encoder, and fig. 3.7, which is the encode processor characteristics for a wide range of input signals.

The control circuits in the detectors G and G' use a non-linear smoothing scheme to avoid the generation of modulation products, while providing fast response under transient conditions. To reduce overshoots in the output during this interval, the side chains include overshoot suppressors H and H', which operate only under extreme transient conditions during which the side chain is re-establishing its steady-state operating point. Thus, for a very short period, the encoded output consists of a large, pure signal (via the direct path) and a small clipped component (via the side chain). Under steady-state conditions, the overshoot suppressors H and H' are inoperative.

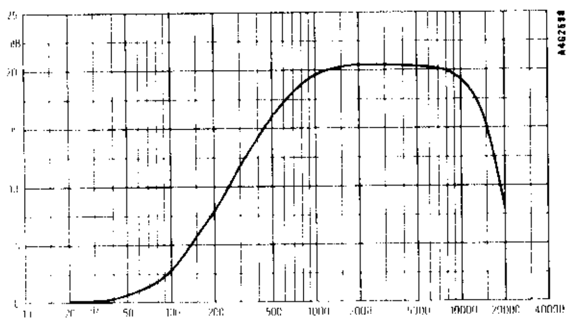


Fig. 3.6 Low level C-type characteristics

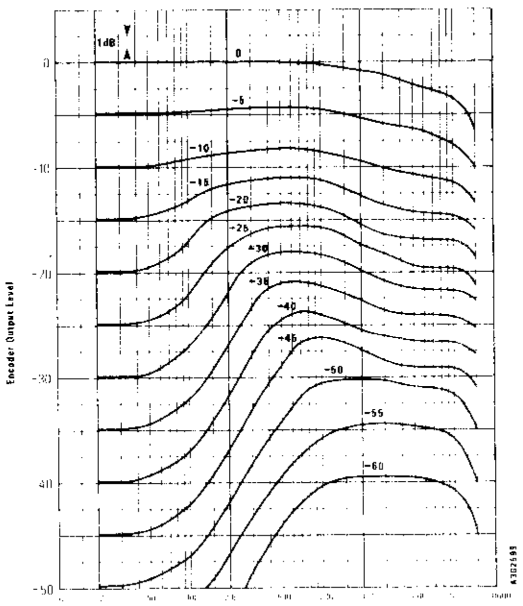


Fig. 3.7 C-type encode characteristics

For decoding (fig. 3.5), essentially the same circuitry is used, but in this case the side chain forms part of a double-negative-feedback loop in which the noise reduction signal is subtracted from (instead of added to) the main path signal. The decoder characteristics are therefore complementary to the encoder characteristics. Referring to fig. 3.5, which shows the decoder, the inverters K and K' invert the phase of the signal feeding the side chain relative to that in the encoder. Networks N and P provide the inverse functions to the encoder networks L and M (respectively anti-saturation and spectral skewing). A flat frequency response is thereby maintained at all levels in the full encode-decode process.

In the decode mode the small clipped side-chain component referred to above is now subtracted from the main signal, thus fully compensating for the small brief distortion in the encoded signal. Thus the overall signal has very low dynamic distortion.

3.3 Consumer Tape Application

In professional tape recording, noise problems are distributed fairly evenly throughout the audio spectrum. These not only include high-frequency hiss, but wide-band noise at lower frequencies, print-through, crosstalk, modulation noise, and DC noise; hum may sometimes be a problem in malfunction situations. Because of the very low noise levels which are now expected in professional tape recording, together with the wide-band nature of the noise reduction protection which must be provided, the Dolby A-type wide-band noise reduction system is in universal use in the professional environment.

In consumer tape applications, the requirement for tape economy has resulted in tape speeds and equalization characteristics which concentrate the main noise problem overwhelmingly at the high-frequency end of the audio spectrum. This imbalance in the noise spectrum is corrected adequately by the simple and economical Dolby B system, which is, in practice, primarily a hiss reduction system. In addition to reducing hiss, however, the B system usefully reduces high-frequency modulation noise, which results in cleaner-sounding recordings.

The Dolby B-type noise reduction system enables cassettes, when produced with care, to rival the overall quality of the best conventional discs. Open-reel 7.5 ips mass-duplicated recordings have such low noise levels when using the B system that it will usually be found that the noise level and overall quality will be determined by the master recording. An important objective of the recording engineer--that the master recording should be transferred to the consumer medium with minimal degradation--therefore becomes achievable in practice.

The Dolby C-type noise reduction system provides 20 dB of noise reduction and a significantly improved capability of recording very high frequencies onto slow-speed tape, such as cassette. Such cassettes can produce superior sound quality to even direct-cut and digitally-mastered discs, and rival digital systems in dynamic range.

SECTION 4

INSTALLATION

CONTROLS AND CONNECTORS

4.1 Planning the installation

The Model 330 is designed for the encoding of duplicating master tapes with either B-type or C-type noise reduction characteristics and for quality monitoring of these tapes or subsequent duplicates. The Model 330 unit should be considered as part of the recorder and not a studio tool such as an equalizer, filter, mixer or compressor.

The block diagram at the end of this section shows how the noise reduction system fits into a duplicating chain. Each Model 330 contains two independent processor channels with common function switching. For tape duplication, the Model 330 is normally used to provide two noise reduction encoded outputs for building up two tracks at a time on the duplicating master. The remaining tracks are built up by repeated passes. If simultaneous playback monitoring of this master is required, then a second Model 330 must be used, connected in the decode mode. If simultaneous monitoring is not required, the tape may be subsequently checked by switching the unit previously used for encoding to the decode mode and suitably re-connecting the input and output leads. The program level can be monitored at any point in the chain (normal signal or encoded).

4.2 Installation

The Model 330 is designed for mounting in a standard 19" rack. However, its position is not critical, and it can be operated in any plane.

NOTE: CHECK VOLTAGE SELECTOR BEFORE APPLYING POWER

a) Unpack Model 330 unit and check for damage. Remove top cover of unit and check interior.

b) Mount unit in rack.

c) Set voltage selector switch (115-230 V) appropriately.

d) Connect power cable. If power plug on cable is changed for another type, the following wiring convention should be observed (for cable supplied with unit).

U.S. style	Power: L - black; N - white; earth - green
I.E.C style	Power: L - brown; N - blue; earth - yellow/green

e) Connect signal cables to Model 330 unit using three-pin XLR cable connectors provided. 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.

f) Check position of mode toggle switch under front cover plate (encode for use in recording, decode in playback).

g) Check position of rear-mounted input termination switch (fitted after Ser. No. 35). Normal position is 10 k bridging input impedance; in the rare case of a true 600 ohm system, move switch to left.

h) Carry out the level adjustment procedure given in Section 5, Level Standardization and Initial Calibration.

4.3 Remote Operation

Remote facilities are provided for the operation of Dolby Tone and switching of noise reduction. To utilize the remote facilities, the front panel push button must be depressed.

a) Dolby Tone

The Dolby Tone oscillator may be activated by connecting pin 2 of the five-pin XLR connector to earth by means, for example, of a normally open push button at the end of the remote cable. The cable can be extended for long distances, subject to the requirement that the total resistance in the cable is less than 1 k ohm; standard two-conductor cable is suitable. An earth connection is available on pin 1 of the five-pin XLR and should be used; do not use an earth at the remote position.

The Dolby Tone oscillator is part of the plug-in noise reduction module; different oscillators are used to identify B-type or C-type noise reduction tapes; see section 6.4 for details.

b) Noise Reduction In-Out

Similarly, earthing pin 5 of the five-pin XLR connector removes the noise reduction action; the unit then is a line amplifier and has a flat frequency response. Two-conductor cable may be used, provided the total resistance in the cable is less than 1 k ohm. An earth connection is available on pin 1 of the five-pin XLR; do not use an earth at the remote position.

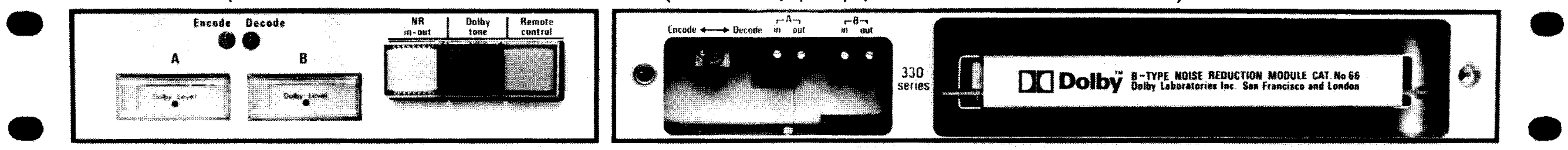
Indicators showing mode of operation

Internally illuminated NR in-out switch controls noise reduction action

Toggle switch selects encode or decode mode

Multi-turn potentiometers adjust input sensitivities and output levels

Plug-in CAT. NO. 66 (B-type) or CAT. NO. 219 (C-type) noise reduction module contains all circuitry for noise reduction functions of two channels



M1 M2

Meters provide indication of proper replay level of Dolby tone in decode mode

Dolby tone button for operation of internal oscillator provides Dolby level signal for identification and calibration purposes

Switch permits remote control of NR in-out and Dolby tone

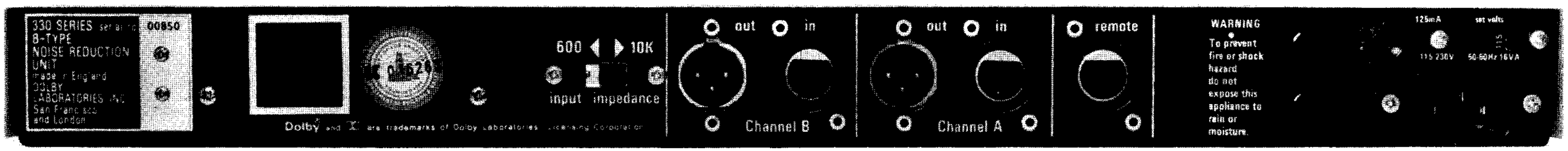
Input termination switch

Remote connector for NR in-out and Dolby tone

125 mA fuse (slow blow)

Power line voltage select (slide switch)

JM5 JF4 JM3 JF2 JF6 FS1 S1

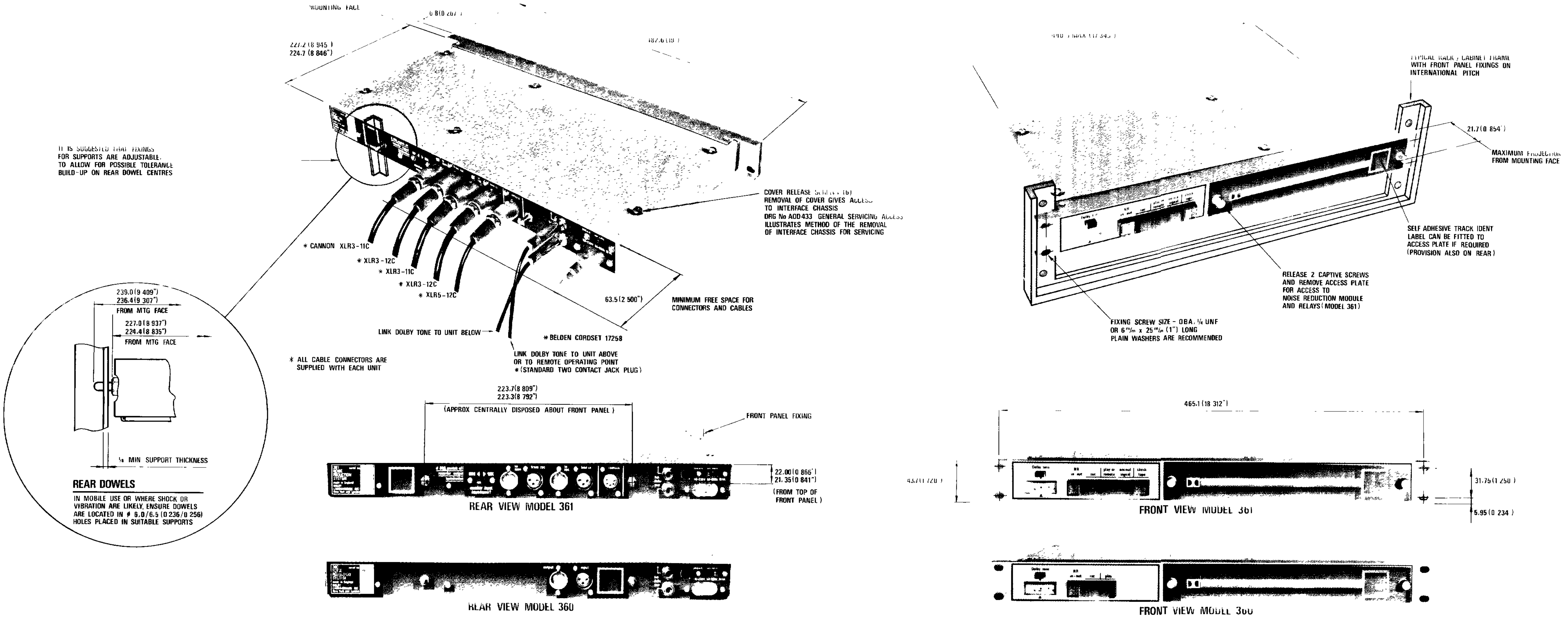


JM1

Space for channel/program identification label

Channel B audio connectors

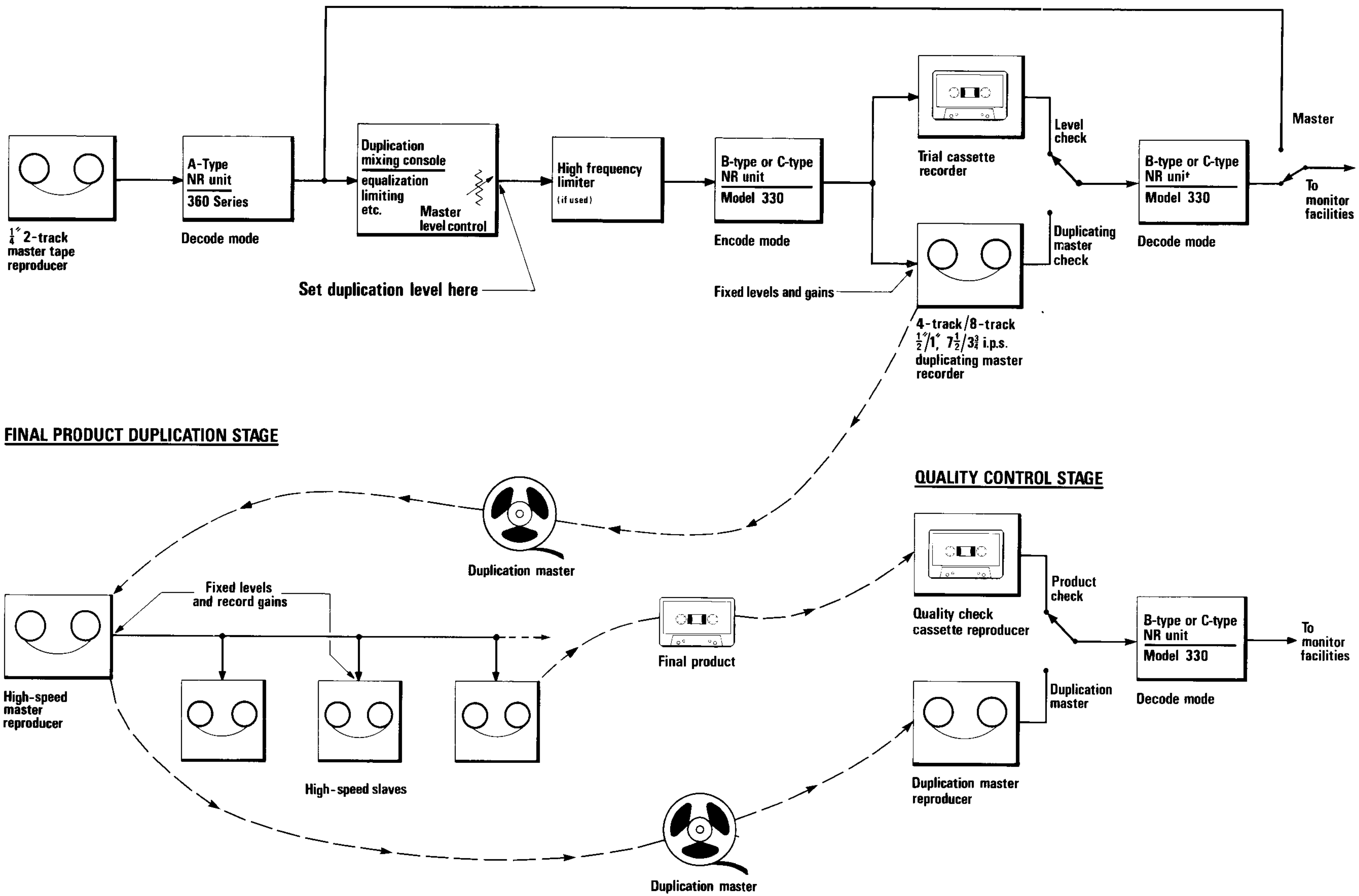
Channel A audio connectors



INSTALLATION INFORMATION - 330 and 360 Series

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

DUPLICATING MASTER PREPARATION STAGE



SECTION 5

LEVEL STANDARDIZATION AND INITIAL CALIBRATION

5.1 Standardization

Correct operation of any Dolby noise reduction sytem is dependent on only one basic requirement - that the signal voltage in any playback processor should be the same (within 2 dB) as that in the recording processor. However, the requirement for interchangeability of tapes and decoders imposes a further restriction - that the signal levels in the noise reduction system should be related to absolute flux levels on the duplicate.

In order to correlate the various voltage levels and flux levels used in the duplicating chain, from master through to finished product, the concept of "Dolby Level" is employed. Dolby Level bears a fixed amplitude relationship to the noise reduction compression and expansion parameters. In the B-type and C-type noise reduction systems, Dolby Level is defined at 400 Hz.

Consumer tape decks for replay of pre-recorded tapes using the Dolby system are factory calibrated for correct replay level. Add-on noise reduction units are equipped with a meter which is calibrated for Dolby Level, either at the 0 VU point or by means of a separate Dolby Level mark.

5.2 Copy Dolby Level

Dolby Level on the duplicated copy is fixed with respect to flux levels as follows:

i. For open-reel duplicates, Dolby Level is defined as a flux level of 185 nWb/m (corresponding to Ampex operating Level).

ii. For cassette duplicates, Dolby Level is defined as a flux level of 200 nWb/m.

The Model 330 Tape Duplication Unit incorporates a precision Dolby Level oscillator which should be used in the initial and subsequent calibration of the duplicating chain. The complete duplicating line must be adjusted so that this tone, when duplicated onto the final tape format, is at the correct flux level as defined above. **Regular maintenance procedures should include tests to insure that this condition is met.**

5.3 Master Dolby Level

In the past, Dolby Laboratories recommended that the flux level corresponding to Dolby Level on the duplicating master tape should be 185 nWb/m. However, by about 1973, experience had shown that using this figure for cassette duplication did not result in an optimum signal-to-noise ratio, particularly when using chromium dioxide tape for the duplicate. The reason is that the thin oxide used on cassettes requires that the peak program level must be accurately measured and controlled to prevent unacceptable distortion. The tied Dolby Level flux relationship between the duplicate and the duplicating master thus resulted in an under-recorded duplicating master and a noise contribution at least comparable with that from the final cassette. In order to take advantage of the headroom on modern master tapes, which is considerably in excess of 185 nWb/m, we now recommend that a higher level (320 nWb/m for example) should be used for Master Dolby Level (i.e., on the duplicating master) for cassette duplication (but not for open-reel duplication).

It is particularly important to use peak reading meters to set the program level, and to establish the correct program level (which is independent of the Dolby calibration level). If VU meters are used and Dolby level set equal to 0 VU, it is almost inevitable that peak distortions will occur; the overload properties of the thin oxide tape are such that these distortions are very obtrusive. Note that though the setting of program level and Dolby calibration level are independent, once the master tape has been made, they are tied together throughout the subsequent duplicating process.

From the preceding it is clear that Master Dolby Level for cassette duplication should be 4 to 5 dB higher than the usual 185 nWb/m, making Dolby Level equal to 320 nWb/m. This flux level recognizes the relative levels of noise, overload, and distortion between master and cassette duplicate. It also has the merit that it is easily measured in terms of commonly-available test tapes (i.e., the level setting portions of DIN 38 and 19S test tapes). A possible exception to this level is duplication at 64 times speed, where the master tape is recorded at the slow speed of 9.5 cm/sec (3 3/4 ips) when high-frequency saturation can occur with modern program material. In this case a more conservative Master Dolby Level/peak program level should be used. The anti-saturation networks in C-type encoding are a benefit here, effectively raising the high-frequency saturation of the tape. In addition, new formulations for mastering tape promise improvements.

The situation is different for duplication of open-reel tapes, where the overload capabilities, noise levels and headroom are similar between master and duplicate. The program level is therefore higher on such duplicating masters, and there is no advantage to be gained by changing the Dolby Level reference flux. Hence, in this application the flux corresponding to Dolby Level should remain at 185 nWb/m (or be raised slightly only if the output capability of the duplicating master is markedly higher than that of the tape used for the duplicate).

In all instances, it is recommended that a short section of Dolby Tone be recorded on the beginning of the duplicating master tape so that initial levels in the duplicating line can be quickly checked out.

5.4 Calibration Tapes

For level standardization, the following test tapes should be used, as appropriate. Refer to the drawing at the end of Section 4 (Use of Model 330 in Duplicating Chain). The test tapes below contain sections of reference tone recorded to the known flux level as listed. Correlation of these flux levels with that required on the duplicating master tape (see Section 5.3) will enable Dolby Level to be calibrated correctly.

a) For calibration of duplicating master recorder, use one of the following:

For open-reel tape duplication

Ampex 0.5" 31321-05 Reproduce Alignment Tape 7.5 ips NAB 185 nWb/m
Ampex 0.5" 31311-05 Reproduce Alignment Tape 3.75 ips NAB 185 nWb/m
Ampex 1.0" 4690005-01 Reproduce Alignment Tape 15 ips NAB 185 nWb/m

For cassette duplication

BASF 0.5" Bezugsband 38, according to DIN 45513, 320 nWb/m
BASF 1.0" Bezugsband 38, according to DIN 45513, 320 nWb/m

NOTE: If a DIN tape is not available, an Ampex tape can be used, together with a 4.5 dB level correction.

b) For calibration of open-reel level check recorder, use one of the following:

Ampex 0.25" 31321-01 Reproduce Alignment Tape 7.5 ips NAB 185 nWb/m
Ampex 0.25" 31331-01 Reproduce Alignment Tape 3.75 ips NAB 185 nWb/m
Ampex 0.25" 31315-01 Level Set Tape 15 ips NAB 185 nWb/m

c) For calibration of cassette level check recorder, use one of the following:

Dolby 0.15" Cat. 31 Dolby Level Tape (pancake) 1.875 ips (4.75 cm/sec) 200 nWb/m
Dolby 0.15" Cat. 32 Dolby Level Tape (cassette) 1.875 ips (4.75 cm/sec) 200 nWb/m

5.5 Play Calibration

a) Ensure that the Model 330 unit is connected correctly according to Section 4, Installation. Remove the front cover plate and check that the mode switch is in the decode position.

b) Select and play the level setting portion of the appropriate test tape listed in Section 5.4.

c) Adjust the playback output controls on the recorder until the desired line levels out of the recorder are obtained. If the Model 330 unit is switched between a duplicating master recorder and the level check recorder, then the same line level must be used for Dolby Level on the two recorders.

d) Check that the Dolby Tone button on the Model 330 unit is not depressed. Adjust the input level controls on the 330 unit until Dolby Level is indicated by both meters.

e) Adjust the output level controls on the 330 unit until the desired output level is obtained.

f) Replace the front cover plate. The 330 unit is now ready to use. Refer to the operating notes in Section 6.

5.6 Record Calibration

a) Ensure that the Model 330 is connected correctly according to Section 4, Installation. Remove the front cover plate and check that the mode switch is in the encode position.

b) Press the Dolby Tone button. This switches on the internal frequency modulated 400 Hz Dolby Tone oscillator at Dolby Level. Adjust the output level controls on the 330 unit until the desired line level is obtained from the 330 outputs.

c) Adjust the record calibration controls on the duplicating master recorder until a flux level of 320 nWb/m is recorded on the duplicating master for cassette duplication. Similarly, adjust the record calibration controls on the consumer check recorder such that a flux level of 200 nWb/m is recorded for cassettes or a flux level of 185 nWb/m is recorded for open-reel. Verify that the correct levels are being recorded by comparison with the test tapes listed in Section 5.4.

d) Release the Dolby Tone button. Feed signal from the duplication mixing console and adjust the input level controls on the 330 unit until the desired program level is recorded onto the consumer check recorder and duplicating master recorder.

e) Replace the front cover plate. The 330 unit is now ready to use. Refer to the operating notes in Section 6.

SECTION 6

OPERATING NOTES

6.1 Preparation of Duplicating Master

The principal concern in the preparation of the duplicating master should be that the final cassette product is the closest possible match with the original stereo master.

The step-by-step basic operational procedure for tape duplication is at the end of this manual for quick reference. Initial level adjustments should follow the procedure given in Section 5, Level Standardization. Following these initial procedures, the following operational points can be made. Refer to the general layout at the end of Section 4.

The master tape (usually 1/4", 15 ips, 2-track) is replayed on a normal studio recorder. If the tape has been recorded with the Dolby A-type professional noise reduction system, it is first replayed through an A-type playback unit before it is fed into the duplicating mixing console for appropriate modification (equalization, limiting, reverberation, etc.). The duplication mixing console serves also as the master level control for the whole system; the level as established at this point will determine the level which finally appears on the pre-recorded duplicate.

Before preparing the duplicating master tape for cassette production it is good practice to make a trial cassette recording in real time using the same tape formulation as that used for the final tape product, at the same level and with the same signal processing as will be used for the production of the duplicating master tape. In this way, many of the problems that would otherwise call for re-mastering can be recognized and attended to at the dubbing studio stage.

After the correct level has been determined, the signal is fed into the duplicating master recorder and the master is recorded. After initial calibration of the system, level adjustments to compensate for variations in tape and recorder characteristics should not be made in the Model 330; they should be made in the duplicating master recorder. A short section of Dolby Tone should be recorded on the duplicating master for level standardization purposes. The resultant duplicating master can be quality checked by replaying through a Model 330 unit.

In the recording of the duplicating master tape, the signal should always be fed through the Model 330 in the forward direction. Because of the time constants of the integrator circuits used in the Model 330, it is incorrect to process time-reversed signals (e.g., with two tracks being processed in the forward direction and the other two simultaneously in the reverse direction). Of course, time-constant errors do not occur in high-speed duplicating itself (or in making copies of noise reduction duplication masters), even though half of the program is time-reversed, since no processing is involved.

If a high-frequency limiter is employed in the preparation of the duplicating master, it should be situated before the Model 330 (between mixing console and Model 330). Ideally, however, duplicating tape should be used which does not require the use of a high-frequency limiter. In general, the high-frequency overload characteristics of thin oxide tapes are better than those having thick oxides. In addition, the antisaturation characteristics of the C-type encoding process effectively increase the high-frequency overload characteristics, but in specific cases, some judicious high-frequency limiting may be beneficial.

Do <u>not</u> compensate for different types of program 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 (both duplicating master and resultant duplicate) only by adjusting the level of the program source (mixer output) or by adjusting the 330 input level controls. The calibration procedure ensures that the internal characteristics of the Model 330 are directly referred to tape flux density, and altering the gain settings to suit program material would destroy this relationship. These precautions are essential for international pre-recorded tape standardization and for inter-plant interchangeability of duplicating masters. To assist in duplicating master tape interchanges, record a section of Dolby Tone at the beginning of each tape using the internal Dolby Tone oscillator.

These procedures should be strictly adhered to in the production of B-type tapes in order to ensure correct frequency response during final playback. However, this will not usually prove to be a great inconvenience, since many duplicating organizations already find that such procedures avoid problems in normal duplication as well. The recording engineers preparing the duplicating masters determine the levels to be recorded on the duplicates by careful metering techniques together with experimental verification by means of test duplicates which are made in real time. The optimum level is then recorded on the duplication master and fixed gain conditions are used in the duplication plant itself (i.e., at the outputs of the high-speed master reproducer and the inputs of the high-speed slave recorders). This standardized practice avoids confusion and errors by production personnel. Thus, the procedures to be adopted in the B-type or C-type duplicating situation are merely extensions of normal good duplicating practice.

If two or more duplicating masters are recorded simultaneously, it is unnecessary to provide a separate Model 330 unit for each recorder. More than one recorder can be bridged across each Model 330 output.

It is unnecessary to use a Model 330 unit when making copies of noise reduction encoded duplicating masters; copies can be made with two ordinary recorders. The noise reduction characteristic on the recording is carried straight through the copying process. Care must be taken to ensure one-to-one level conditions and a flat frequency response. Of course, there is no reason why the signals should not be decoded and re-encoded via two Model 330 units if the arrangement of the dubbing room is such that this is easier. If any level changing or processing is to be carried out when copying, then the signal must be decoded prior to such treatment and then re-encoded on the copy.

In the preparation of four-channel duplicating masters on which four discrete tape channels are employed for each program, two Model 330 units should be used normally (one processor per channel). For matrix-type encoding systems, only a single Model 330 is used, as in normal two-channel stereo. In preparing the duplicating masters, the encoder should always precede the Model 330 unit. During reproduction, the decoder should follow the noise reduction playback unit. Other than ensuring that the encoding and decoding are accomplished in the correct order, there are no special problems in the use of noise reduction systems with any of the four-channel systems known at the moment; the noise reduction system and the system operate independently.

The Model 330 noise reduction circuitry can be switched out by the push button on the front of the unit. With this switch in the 'out' position, the processors effectively become line amplifiers. It is not necessary to patch the unit out if a tape without Dolby noise reduction is to be made.

6.2 Duplication

The duplicating master is reproduced at high speed and the signal is fed into the slave recorders, with standardized levels and gain conditions being observed in the process. After duplication, a section of the duplicated Dolby Tone should be replayed on the level check recorder. If the duplicating chain is set up correctly, the meters on the replay Model 330 should indicate Dolby Level.

The Dolby Level calibration procedures described previously are idealized, and during practical duplication it may be advantageous to alter the output from the master reproducer, even though this is theoretically incorrect. Fortunately, Dolby noise reduction systems are sufficiently tolerant of gain errors to permit gain adjustments of ±2 dB without affecting the resultant frequency response following de-processing. Changes in overall frequency response will begin to be observed with 3 or 4 dB of gain error. The first duplicates should be made at the nominally correct level. They should then be checked for noise and distortion. If any distortion is observed, the master reproducer output level can be reduced 2 dB; if no distortion is observed, a trial run can be made with the gain increased by 2 dB. However, such changes cannot be recommended, and it is much preferable to produce a correct master. It is thus important in the preparation of the master to use peak meters and as well to make trial recordings on the consumer check recorder to identify possible problem sections of the program, and to make any necessary corrections to the master recording.

In the duplication of cassettes, the choice of the type of cassette tape used is of the utmost importance. Without noise reduction, cassettes have an unacceptable noise level for quality music purposes; with the B-type system, cassette noise levels become marginally acceptable for critical consumer use; with the C-type system, tape noise is inaudible in even the best listening environment. It is therefore essential to select the highest quality duplication tape obtainable. There are as yet significant differences in the quality of available tapes with regard to hiss level, DC noise, modulation noise, dropouts, maximum output at long wavelengths, and maximum output at short wavelengths.

It is important to obtain, by experiment, data of such parameters as maximum output level at various frequencies and harmonic distortion versus level so that the maximum signal loading characteristics of the tape to be used is well known. This information, together with the known spread of adjustment of the duplication equipment can be used to provide guidelines to the master dubbing studio in terms of allowable frequency response, spectral distribution and dynamic range. It is clearly unwise to prepare a duplicating master that, although a good copy of the original master, would produce poor cassettes because of excessive high-frequency content or unreasonable dynamic range.

6.3 Remote Operation

A front panel button is provided for selection of remote operation. With this button depressed, the Dolby B-type mode may be selected and the Dolby Tone oscillator turned on. These remote operations are effected by grounding or open circuiting the appropriate pins on the rear-mounting five-pin XLR connector (see Section 4).

6.4 Dolby Tone Oscillators

Both the Cat. No. 66 B-type module and the Cat. No. 219 C-type module carry Dolby Tone oscillators to aid the initial level calibration. In addition, the characteristic "warble" tone acts as identification that the master tape has been recorded with noise reduction.

The B-type oscillator is a 400 Hz tone, modulated by 10% upwards in frequency for 30 msec every 500 msec.

The C-type oscillator is the same 400 Hz tone, but with a double modulation; two pulses of 10% upwards modulation occur every 500 msec for 30 msec each and separated by 70 msec.

MODEL 330 NOISE REDUCTION PROCESSOR FOR TAPE DUPLICATION

SIMPLIFIED OPERATING INSTRUCTIONS

A. Setup

1. For playback, switch channel mode switch under front cover plate to decode mode. Feed each tape channel output directly into corresponding Model 330 input. Feed outputs to monitor facilities.

2. For recording, switch channel mode switches under front cover plate to encode mode. Feed Model 330 outputs to recorder channel inputs. Feed signals to be recorded into Model 330 inputs.

B. Dolby Level Definition

As a result of the different tape thicknesses and formulations used in the common recording formats, the relative recording level on the various tapes used must be considered. For example, the recording level on thin-oxide cassette tape must be lower than on a master tape. To achieve optimum signal-to-noise ratio on the final copies, "Master Dolby Level" has been defined and used for optimizing the level on the duplicate itself (see sub-section 5.2). In the case of the cassette, Master Dolby Level is defined as 320 nWb/m; Copy Dolby Level on the cassette is 200 nWb/m. For open reel duplicates, Master Dolby Level coincides with Copy Dolby Level at 185 nWb/m. These points must be borne in mind during the following Model 330 playback or record calibration.

C. Play Calibration

1. Playback of encoded duplicated copies.

   Play level setting portions of appropriate test tape below and adjust playback gains until meters of Model 330 indicate Dolby Level.

   a) For replay of open-reel pre-recorded encoded tapes, use:

      Ampex 0.25" 31311-01 Reproduce Alignment Tape 15 ips NAB 185 nWb/m
      Ampex 0.25" 31321-01 Reproduce Alignment Tape 7.5 ips NAB 185 nWb/m
      Ampex 0.25" 31331-01 Reproduce Alignment Tape 3.75 ips NAB 185 nWb/m
      Ampex 0.25" 31315-01 Level Set Tape 15 ips NAB 185 nWb/m

   b) For replay of encoded pre-recorded cassettes, use:

      Dolby 0.15" Cat. No. 31 Dolby Level Tape (pancake) 1.875 ips 200 nWb/m
      Dolby 0.15" Cat. No. 32 Dolby Level Tape (cassette) 1.875 ips 200 nWb/m

2. Playback of duplicating masters for open-reel copies

   Play level setting portion of 185 nWb/m test tape and adjust playback gain until meters of Model 330 indicate Dolby Level. Master Dolby Level coincides with Copy Dolby Level, allowing the following standard tapes to be used:

      Ampex 0.5" 31311-05 Reproduce Alignment Tape 15 ips NAB 185 nWb/m
      Ampex 1.0" 4690005 Reproduce Alignment Tape 15 ips NAB 185 nWb/m

3. Playback gain calibration of duplicating master recorder

Calibrate playback gain of duplicating master recorder by replaying level setting section of 320 nWb/m test tape (BASF or Agfa Bezugsband 38 or 19S to DIN 45513), adjusting playback gain controls until Dolby Level is indicated on Model 330 meters. If a 320 nWb/m tape is not available, the level can be set by measuring the voltage at the master recorder output from a tape of known flux, and suitably calibrating the playback controls so that a 320 nWb/m tape would produce the correct Master Dolby Level indication. Typical test tapes and the difference from the desired Master Dolby Level are:

640 nWb/m, which should read 6 dB above Master Dolby Level
510 nWb/m, which should read 4 dB above Master Dolby Level
320 nWb/m, which should read 0 dB above Master Dolby Level
250 nWb/m, which should read 2.2 dB below Master Dolby Level
200 nWb/m, which should read 4 dB below Master Dolby Level
185 nWb/m, which should read 4.8 dB below Master Dolby Level
160 nWb/m, which should read 6 dB below Master Dolby Level

D. Record Calibration

1. Recording of duplicating masters for open-reel copies

a) Switch on Dolby Tone oscillator (push button). Record onto blank tape, adjusting recorder gain control such that a level of 185 nWb/m (Master Dolby Level) is recorded on duplicating master. Check by comparison with standard test tape used previously in Section C2 above.

b) Transfer duplicating master to high-speed master reproducer. Adjust master reproducer level normally and set slave recording level so that Dolby Tone is recorded at 185 nWb/m on open-reel copies. Verify by playing copies on machine previously calibrated, as in Section C1 above.

2. Recording of duplicating masters for cassettes

a) Switch on Dolby Tone oscillator. Record onto blank tape, adjusting recorder gain control such that a level of 320 nWb/m (Master Dolby Level) is recorded on duplicating master. Check by comparison with standard test tape used previously in Section C3 above.

b) Transfer duplicating master tape to high-speed master reproducer. Adjust master reproducer normally and set slave recording level so that Dolby Tone is recorded at 200 nWb/m. Verify by playing copies on machine previously calibrated, as in Section C1 above.

E. Notes

1. When the complete chain (Model 330 to final duplicate) has been calibrated by the above procedure, any level changes (e.g., to accommodate various types of program content) greater than ±2 dB must be made before the Model 330 recording processor and not at any of the subsequent stages.

2. If encoded duplicating masters are to be interchanged with other duplicating organizations, it is strongly recommended that Dolby Tone is recorded at the beginning or end of the duplicating master. Playback gain of the final high-speed master reproducer will then be adjusted so that Dolby Tone will be at Copy Dolby Level after duplication. It is also desirable to include an azimuth tone and a frequency response run to ensure correct duplication conditions.

SECTION 7

INTERFACE CIRCUIT DESCRIPTION

7.1 Interface Chassis

The interface assembly provides for all interface requirements between the Cat. No. 66 B-type or Cat. No. 219 C-type noise reduction module (NRM) and the tape recorder, FM transmitter, 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, two meters and associated circuitry, input and output potentiometers, and push buttons and logic circuits to control and indicate 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 in Section 8, Interface Servicing. The interface circuit drawing (AOC 1299) is at the rear of this section and may be folded out clear of the text for reference.

7.2 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 190 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. Capacitor C2 and resistors R20 and R21 reduce power line related interference effects. Light-emitting diodes D2 and D3 provide an indication of the mode of the unit and also that it is switched on.

7.3 Signal Paths

The two channels are identical; thus only one need be described. The circuit reference numbers of the second channel are in parentheses.

Audio input signals are routed from the input connector JF2 (JF4) to a tagstrip near the input transformer T2 (T4). Switch S6 connects a 620 ohm resistor across the input to provide a 600 ohm termination when required. Normally the input is bridging high impedance (10 k ohm). The secondary of the transformer is routed to the printed circuit board. The high-frequency resonance of the transformer is damped by resistor R1 (R3) mounted on the top surface of the printed circuit board. Trimpot RV1 (RV3), labelled IN A, attenuates the input line level to suit the requirements of the module; the trimpot is a screwdriver-adjust control which is accessible when the front cover plate is removed. The sensitivity of the unit is such that a minimum input of about 350 mV is required for Dolby Level.

The output level control RV2 (RV4), OUT A, is the NRM line amplifier gain control, enabling the output signal to be set at levels up to +8 dB for Dolby Level. This control is accessible when the front cover plate is removed.

The unbalanced output of the NRM is routed to the output transformer T3 (T5) through capacitor C5 (C6), mounted under the transformer tagstrip, isolating the DC voltage component present at the module output. The transformer has a 1:2 step-up ratio, providing a maximum output signal in excess of +21 dBm into 600 ohms. Resistor R5 and capacitor C3 (R6, C4) 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 pass band. The transformer secondary is connected to the output connector JM3 (JM5), and is free from any earth connection.

7.4 Meter Circuit

The noise reduction module contains meter amplifiers which provide AC output signals related to the operating parameters of the noise reduction system (see Section 5); these in turn are related to the flux on the tape or deviation in FM transmission systems. In order to correlate the various voltage levels or FM deviations used in the audio chain, the concept of Dolby Level is employed. Dolby Level signals are generated in the 330 series unit and can be used to calibrate the complete chain. Dolby Level corresponds to meter signals of 1.85 V from the module. The meter circuits in the 330 series interface are driven by these signals and display them on calibrated scales.

Referring to the 330 series interface circuit, each meter signal is rectified by the appropriate 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 is used in some applications to linearize the meter and in others to protect the meter from overload. With an input of 1.85 V, the input attenuator (R10) is factory adjusted to give half-scale deflection corresponding to the Dolby Level 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. Full scale deflection corresponds to about 5 dB above the Dolby Level mark.

All the meter components are mounted on a printed circuit sub-assembly which is in turn fixed to the meter casing. The complete meter sub-assembly must be exchanged if meter replacement is ever required, since the meter calibration procedure involves the characteristics of the individual meter.

7.5 Functions of 330 Series Unit

The 330 series units can be used either for the production of Dolby B-type or C-type encoded pre-recorded tapes (Model 330) or for encoding FM broadcasts (Model 334). Linking the appropriate terminals on the interface printed circuit board (under top cover of unit) provides the Cat. No. 66 B-type noise reduction module with function information (Tape Duplication or FM Broadcasting) which is used together with the mode information (encode or decode) to provide the necessary circuit configuration. These links have no effect on the Cat. No. 219 C-type noise reduction module.

In the case of the Model 330 Tape Duplication Unit, link LK1 (Duplicator) is connected so that terminal B3 on the Cat. No. 66 module is grounded. The position of the duplicator link is marked on the upper surface of the board. In the Model 334 FM Broadcast Unit, link LK1 is in the 'Broadcast' position, which leaves terminal B3 on the Cat. No. 66 module unconnected. When used in North America, where the FM pre- and de-emphasis time constant is 75 μsec for conventional broadcasts, link LK2 is in the '75 μsec' position, which leaves terminal B2 on the Cat. No. 66 module unconnected. In most of the rest of the world, the time constant is 50 μsec; link LK2 (in '50 μsec' position) grounds terminal B2 in this case. In case of doubt on the correct time constant, check with the local broadcast authority.

7.6 Mode Switching

The mode (encode, decode) of the Dolby Cat. No. 66 B-type or Cat. No. 219 C-type noise reduction module is electronically controlled by transistor switches within the module. Both channels operate in the encode mode when a positive potential is applied via S5 to terminals B4 and B22 of the module (S5 is located behind the front panel access plate).

The noise reduction action may be controlled by the front panel push button switch S2. With S2 in the out position and local operation selected (see subsection 7.8), a ground connection is applied to terminal A2 of the module, removing the noise reduction action (and, in the case of the Model 334, causing the time constant to revert from 25 to 75 or 50 µsec). Removing the ground restores the noise reduction action; the potential on terminal A2 rises to several volts, causing the transistor pair Q3 and Q4 to switch on. Indicator lamp LP2, inside S2, is therefore illuminated.

7.7 Dolby Tone Operation

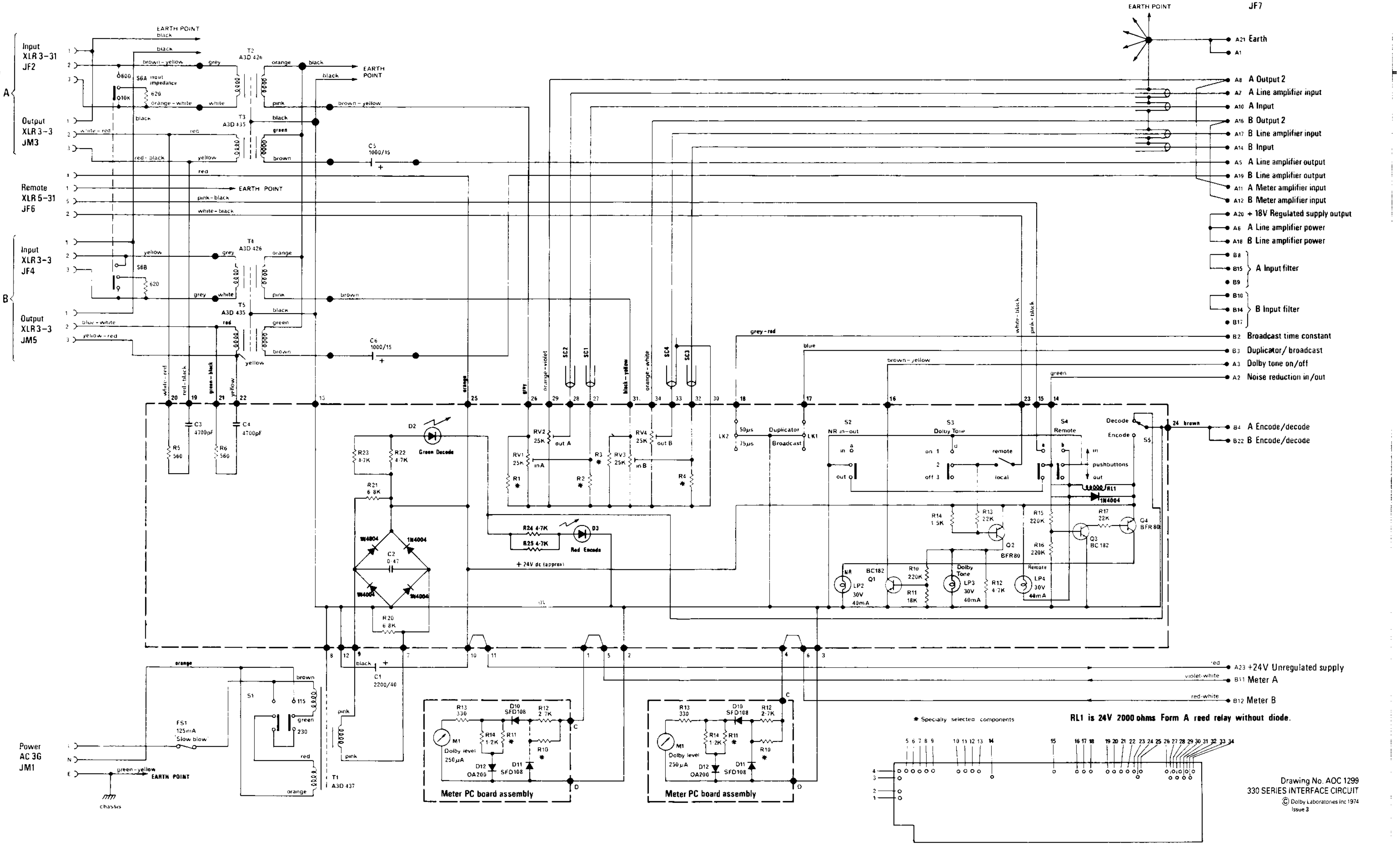
Push button switch S3 controls the Dolby Tone oscillator within the Cat. No. 66 or Cat. No. 219 noise reduction module. Pushing S3 switches on transistor switch Q2, illuminating indicator lamp LP3 inside S3, also causing Q1 to switch on. A ground connection is therefore applied to terminal A3 of the noise reduction module, which starts the internal oscillator.

7.8 Remote Operation

Operation of the remote switch S4 transfers complete control of the NR in-out function to a remote location, such as the studio, and parallels the Dolby Tone operation to this remote location. With S4 depressed, grounding pin 5 of the rear-mounted socket JF6 turns off the noise reduction action, and ground pin 2 turns on the Dolby Tone oscillator. The local Dolby Tone switch on the unit is still in circuit, but the local NR in-out is isolated. In local or remote operation, the NR in-out indicator lamp LP2 shows the correct status of the unit.

The Dolby Tone indicator lamp LP3 is, however, illuminated whenever the Dolby Tone switch is pressed.

The total resistance in either remote operation line should be less than 1 k ohm. A ground connection can be obtained from pin 1 of JF6; if possible, a remote ground should not be used.



Drawing No. AOC 1299
330 SERIES INTERFACE CIRCUIT
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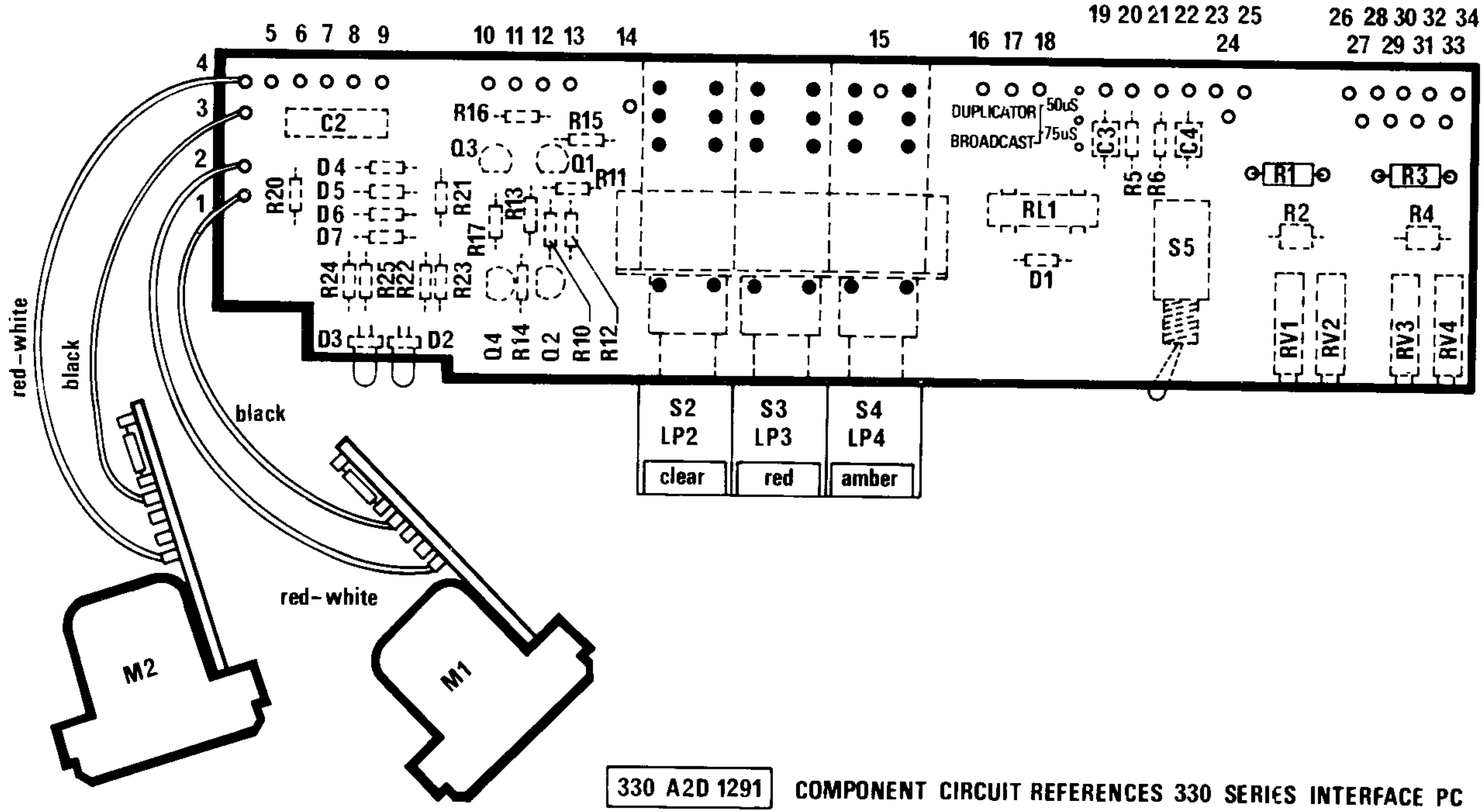
Issue 3

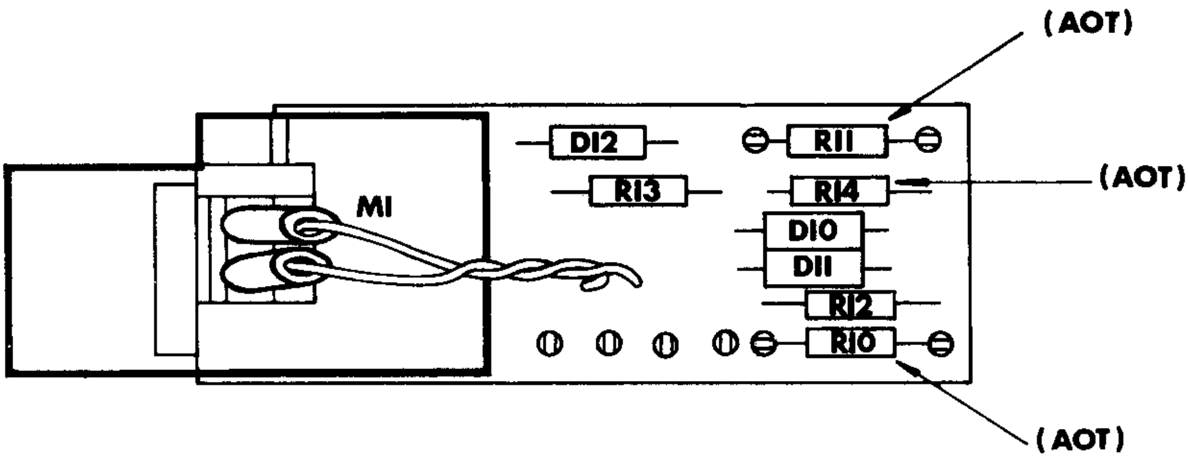
SECTION 8

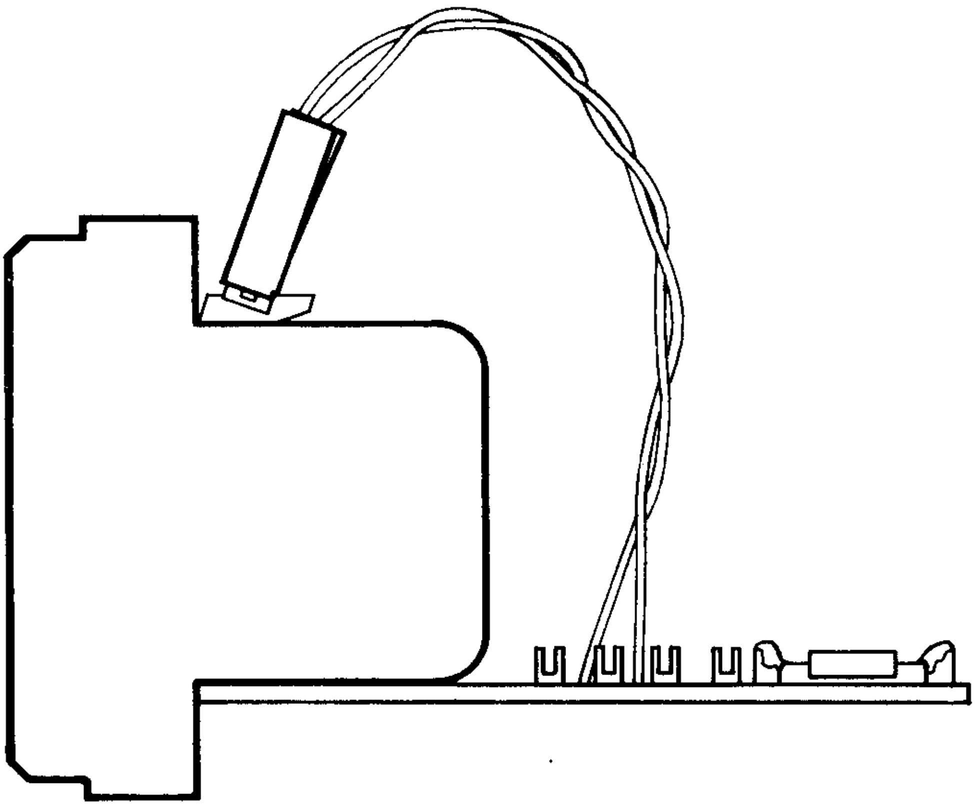
INTERFACE SERVICING



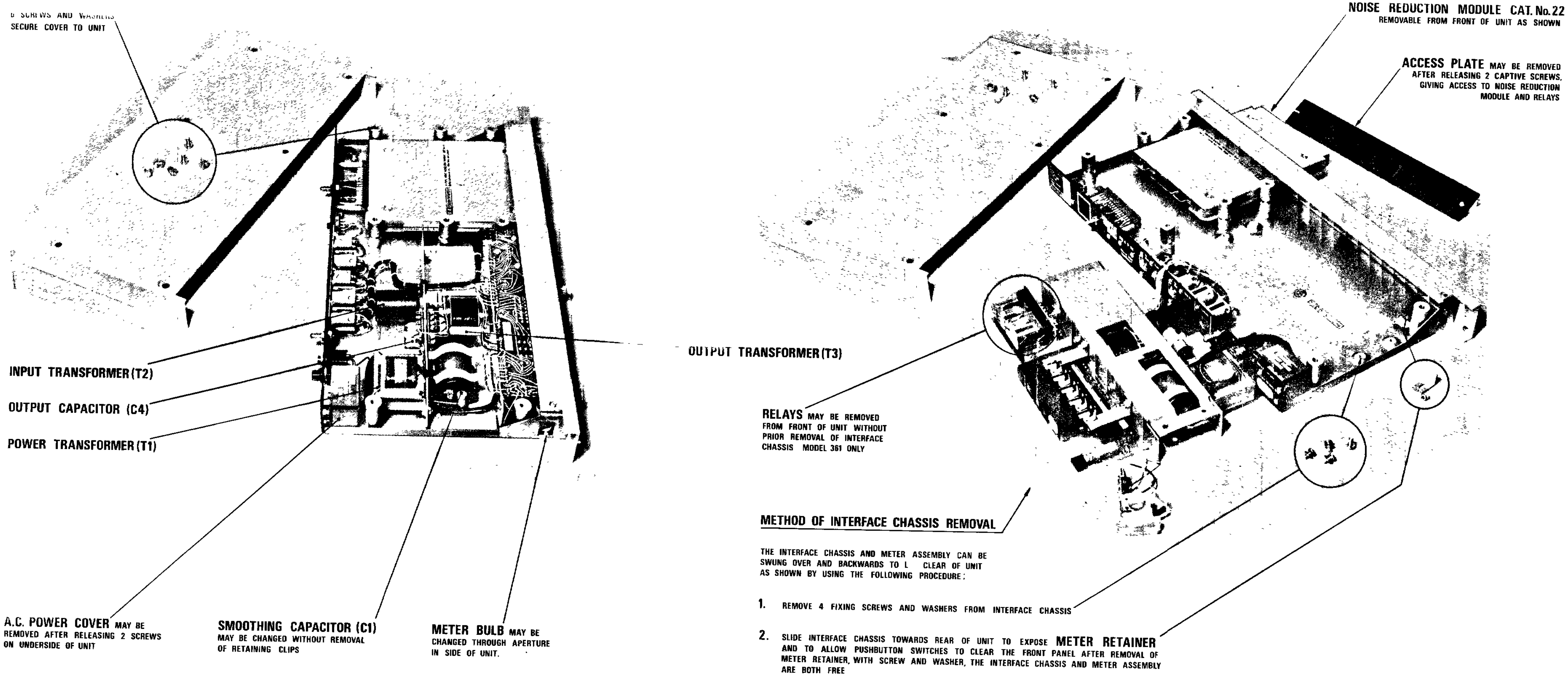
330 A2D 1291 COMPONENT CIRCUIT REFERENCES 330 SERIES INTERFACE PC

Issue 2





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



GENERAL SERVICING ACCESS — 330 and 360 Series

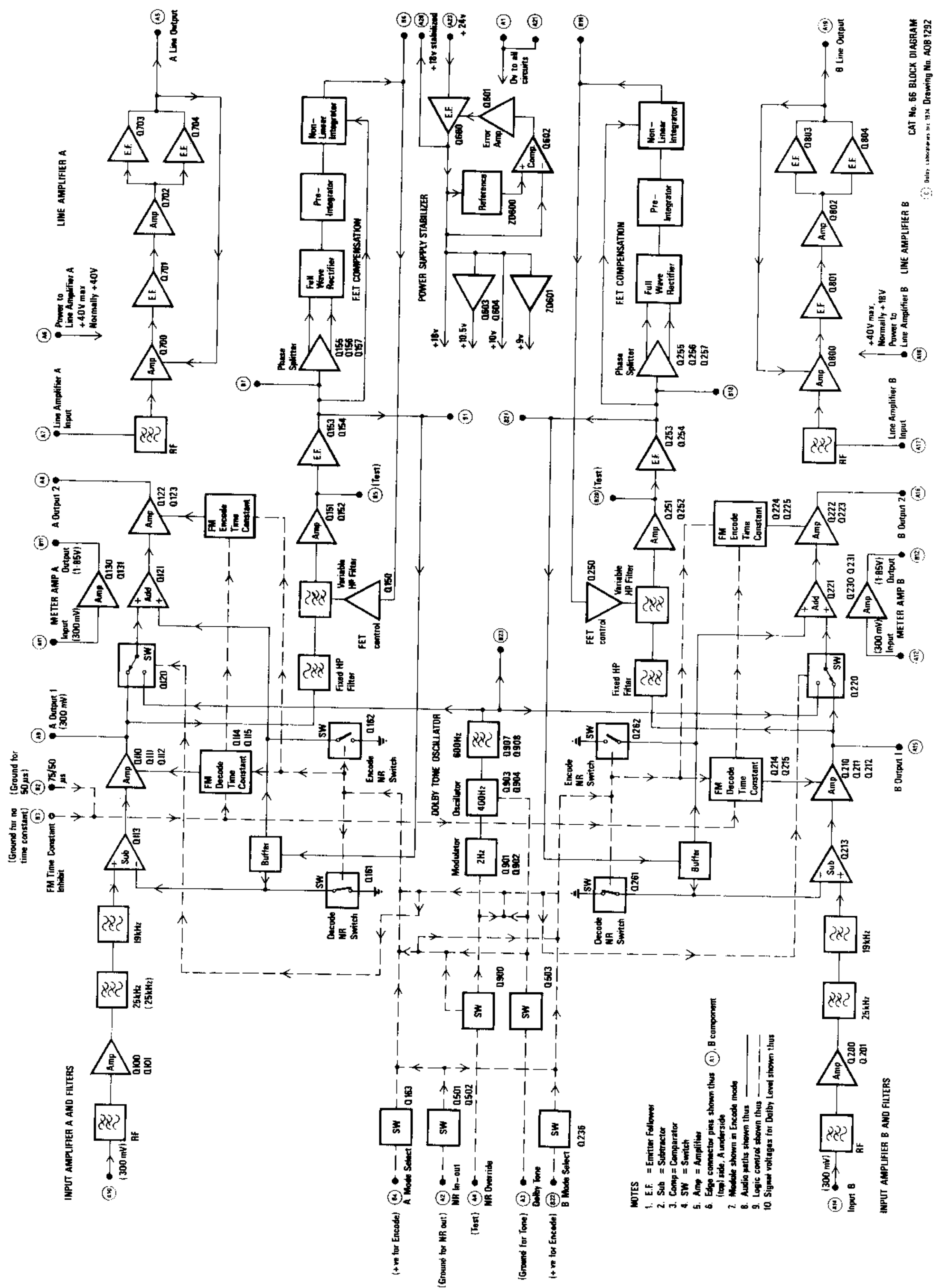
Drg.No. AOD 433

(880)

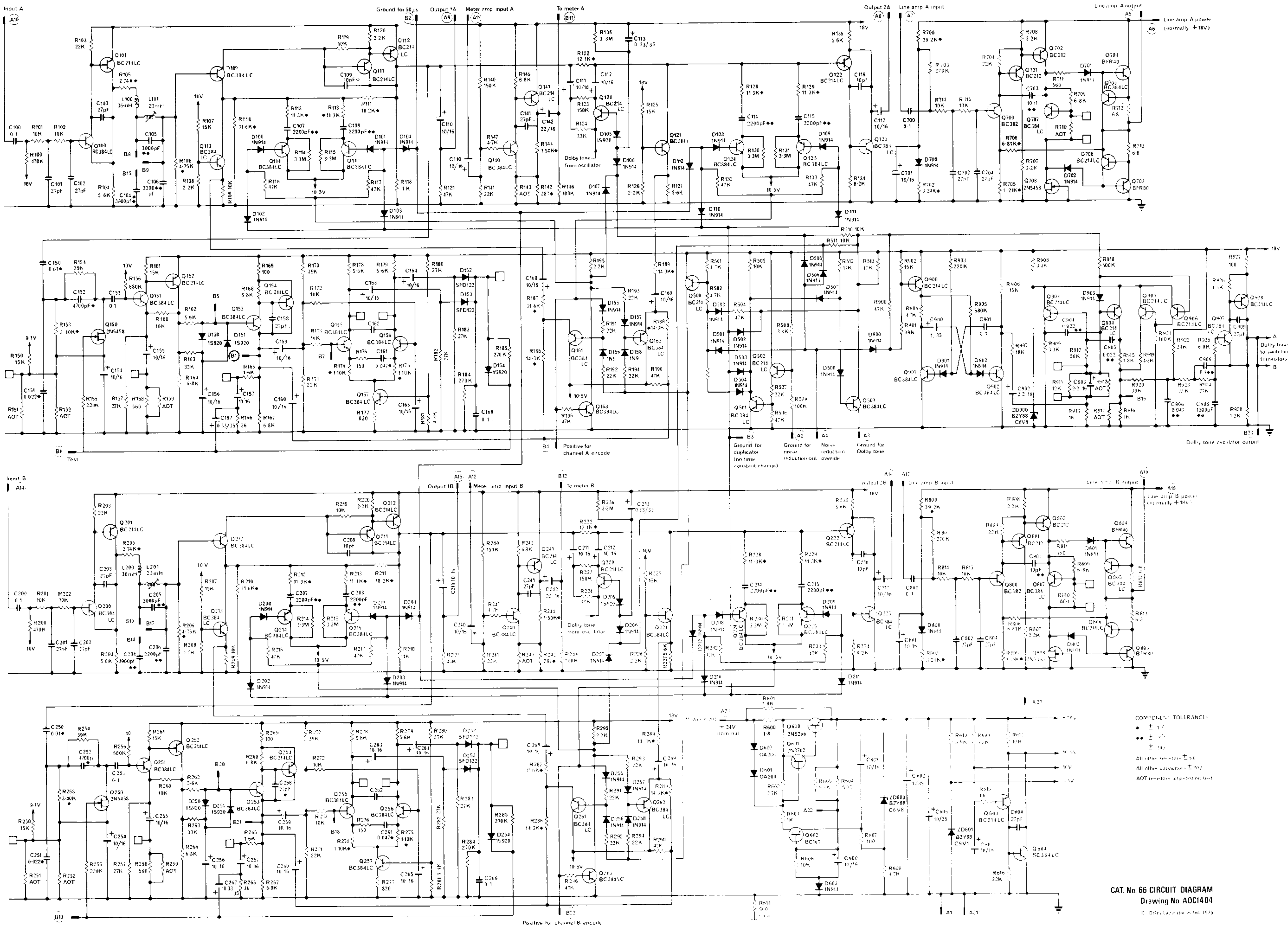
SECTION 9

CAT. NO. 66 AND CAT. NO. 219 NOISE REDUCTION MODULES

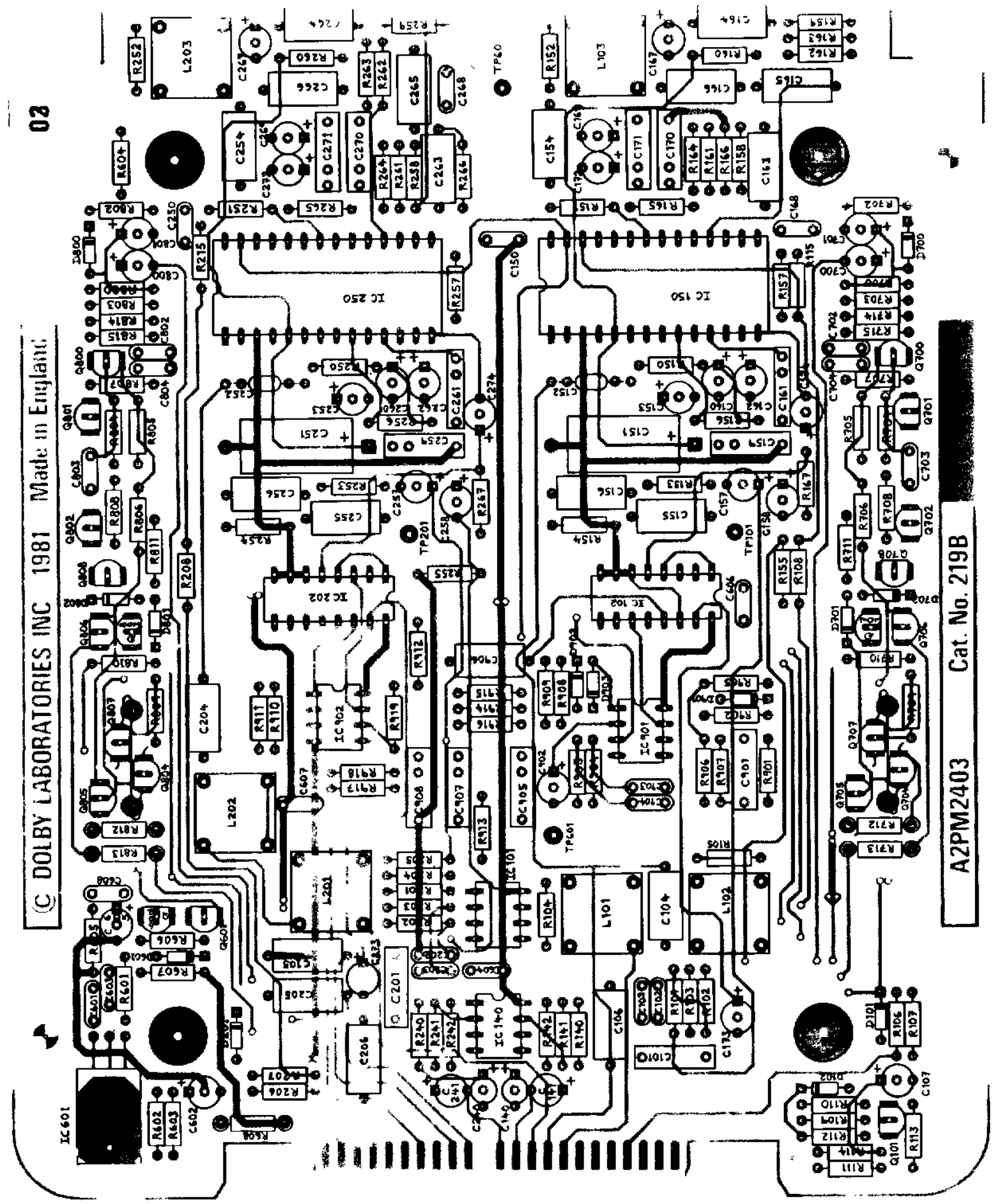
CIRCUIT INFORMATION

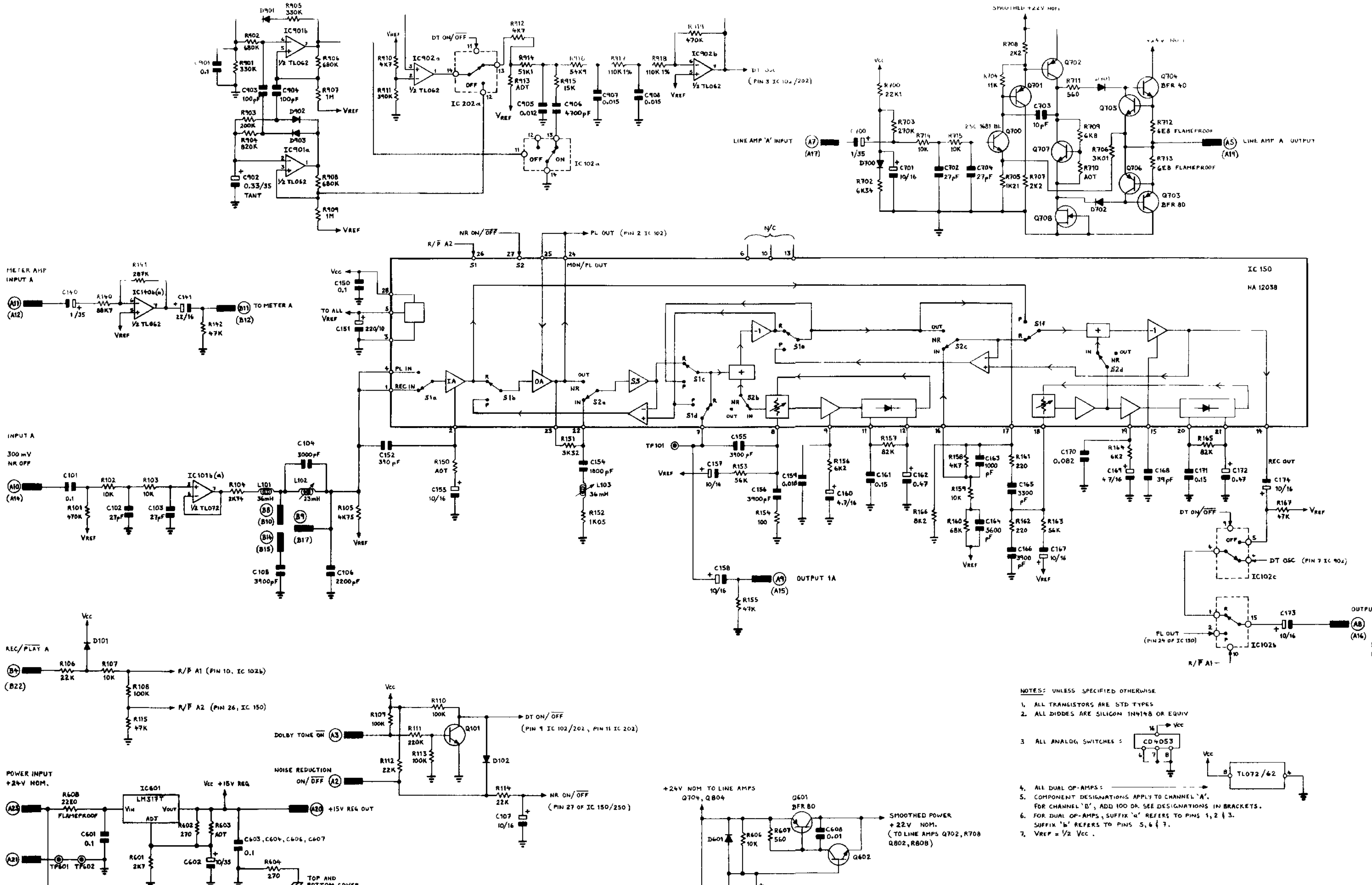


Cat. No. 66 B-type module block diagram



CAT. No. 66 CIRCUIT DIAGRAM
Drawing No. AOC1404





Cat. No. 219B Circuit Diagram
Drawing No. A1C2403 iss. 6

SECTION 10

CAT. NO. 66 OR CAT. NO. 219 NOISE REDUCTION MODULES

SERVICING

10.1 Introduction

Module exchange is the easiest and most reliable method of repair of either the Cat. No. 66 or Cat. No. 219 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 inconvenience is kept to a minimum.

10.2 Fault Repair

Most failures are catastrophic, usually involving a single component in a particular section of the circuit. Such failures are readily traceable and, in general, repairs can be made by substitution of a new component. Most parts are general purpose devices; however, the field effect transistors in the Cat. No. 66 module (Q150 and Q250) and the integrated circuits in the Cat. No. 219 (IC 150 and IC 250) are specially selected and only available from Dolby Laboratories; in the event of failure of these parts, the module must be returned to the nearest distributor for exchange. Similarly, if any of the reference voltages fail, replacement of the devices alone will probably not be satisfactory, since several adjust-on-test (AOT) components depend critically on the exact value of the reference voltage. Here too, the module must be returned for exchange and recalibration.