Dolby®

XP & SRP SERIES MULTI-TRACK UNITS

Users' Manual

XP & SRP SERIES
MULTI-TRACK UNITS

INSTALLATION AND
ALIGNMENT INSTRUCTIONS

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1.1 General Information

The Dolby XP and SRP Series are multi-channel interface frames intended for use with multi-channel tape recorders. The XP is supplied with up to 24 channels of Dolby A-type noise reduction (Cat. No. 331 modules) or Dolby SR (spectral recording, Cat. No. 431 modules). The SRP is supplied with up to 24 channels of Dolby SR (Cat. No. 531 modules). All modules are interchangeable between XP and SRP frames (but Cat. Nos. 331 and 531 may not be used in Dolby Laboratories' earlier SP-series frames).

Each module provides individual channel control of level settings, a led array to display levels, remote control of record/playback switching, and a bypass switch. The Cat. No. 331 and 431 modules also have individual processing in/out switches and uncal controls permitting quick realignment for tapes with different reference levels.

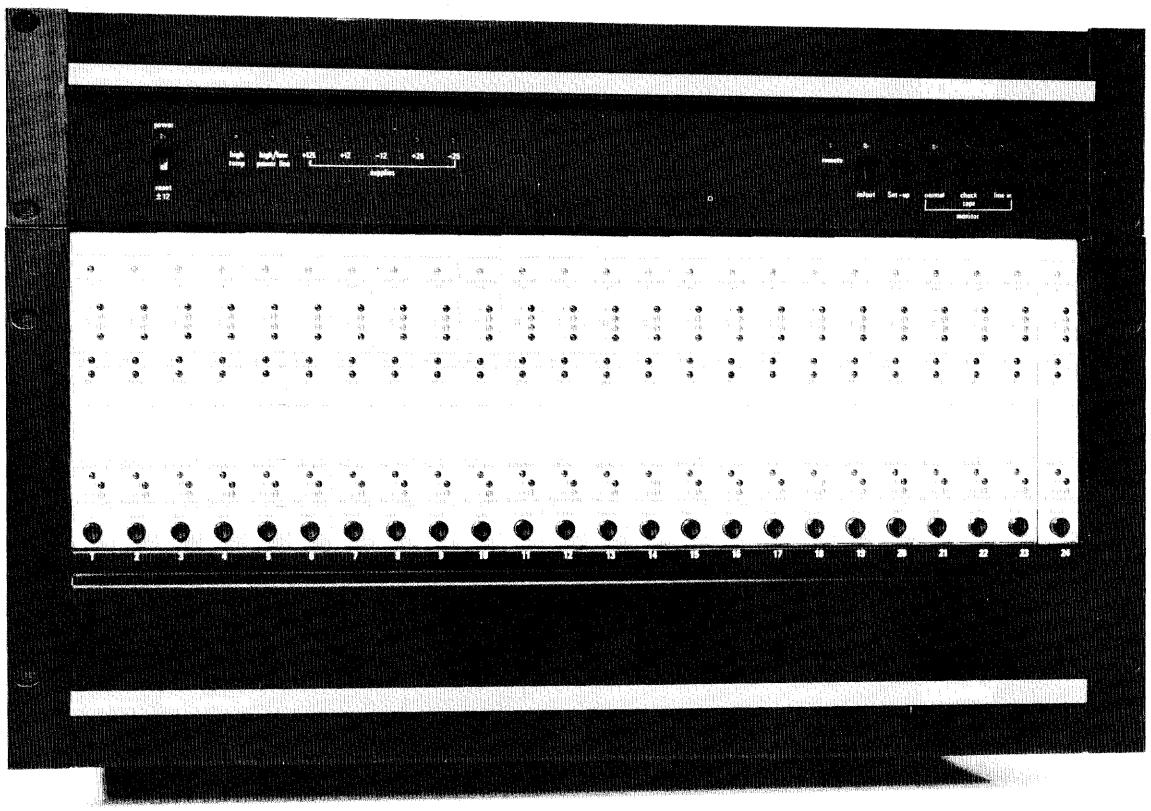
The PS3, a separate fan-cooled power supply, is supplied with each XP or SRP frame and provides electronically regulated and protected power. The PS3 also contains the common functions for the main frame: master control of processing in/out, calibration signals and monitoring. A switch on the backplane of the mainframe selects "hard-wired" or electronic bypass of the processing.

The XP and SRP Series units are designed for continuous operation.

Circuit schematics and block diagrams are provided in section 10, reference drawings.

The Dolby® SRP Series Multi-track Unit

DD Dolby® SR



The Dolby SRP Series for multi-track recorders contains up to 24 channels of Dolby SR signal processing, in only 12-1/4" of rack space, including power supply. Dolby Spectral Recording is a process that yields recordings of exceptional clarity and dynamic range. Dolby SR audibly eliminates tape hiss, crosstalk, print-through, drastically reduces tape modulation noise and distortion, while giving substantial improvements in headroom and high level transient performance—and all with a minimum of signal processing. Dolby SR offers excellent sound quality and convenient tape interchange, at a substantially lower cost than the digital alternatives.

Each channel consists of a plug-in Cat. No. 531 module which contains Dolby SR signal processing circuitry, precision input and output amplifiers, input and output level controls, and an accurate LED calibration display. If Dolby A-type noise reduction is required, Cat. No. 331 A–type modules can be interchanged with the Cat. No. 531 SR modules supplied. Cat. No. 431 SR modules from an XP or SP-series unit will also work in the SRP frame.

The separate PS3 power supply, designed for rack mounting directly above the main chassis, contains fan cooling and electronically controlled output protection.

Each SRP channel contains an Auto Compare circuit that allows quick and accurate verification of tape recorder alignment. The user can select the option of "hard-wired" or electronically-buffered bypass on individual channels or all channels simultaneously. The unit employs FET switching for reliable, noise-free routing of audio signals.

Dolby SR has become the standard for professional multi-track recording throughout the world in music, broadcast, film, television and videotape studios.

The Dolby® SRP Series Multi-track Unit

Note: All specifications apply with input and output controls set for Dolby level equal to +4 dBr (1.23V rms). (0 dBr=0.775V)

Signal Connections:
Custom input/output connectors on backplane, with provisions for locking to main chassis.

Individual Track Controls (Cat. No. 531 module):
BYPASS: provides relay-controlled "hard" bypass of all circuitry.

LED mode indicators for SR IN, and RECORD.

Calibration Display:
Four-LED display for each track permits accurate calibration of Dolby level by matching intensity of LED pairs.

Auto Compare Display:
Two LEDs (red/Reference, green/Tape) indicate the Auto Compare function status. With Dolby noise enabled, the Auto Compare function allows an immediate audible comparison between Dolby noise from tape and internal reference pink noise.

Signal Levels:
The minimum input is –5 dBr for Dolby level, all inputs.

The maximum output is +24 dBr into 600 ohms and above.

Switching Circuits:
Noise-free electronic switching for all internal functions; relay switching for "hard" bypass.

Remote Mode Changeover:
Record/play changeover designed for remote control by recorder. Opto-isolator on logic input requires +4 to +25 V DC voltage differential to activate changeover logic (the current requirement is approximately 5 mA, any voltage).

Input Circuitry:
Link-selectable for floating balanced differential or unbalanced bridging—impedance approximately 10k ohms.

Input Common-mode Rejection:
45 dB at 100 Hz (balanced condition).

Output Circuitry:
Hum-cancelling, single-ended outputs drive any load impedance from a minimum of 200 ohms. Each output is link-selectable for operation with balanced or unbalanced loads.

Output Ground-Noise Rejection:
40 dB (driving single-ended load, output adjusted for +4 dBr at Dolby level, 100 Hz).

Overall Frequency Response:
20 Hz-20 kHz, ±1 dB, encode/decode.

Bandwidth Limitation:
Internal filters: 10 Hz-50 kHz.

Overall Harmonic Distortion:
Second and third harmonic each 0.3% at 3 dB below peak level, 20 Hz-20 kHz. Negligible higher order distortion components at any level.

Overall Dynamic Range of SR System (typical):[1]
105 dB—clipping level to CCIR/ARM noise level.

93 dB—clipping level to CCIR Rec. 468-2 weighted noise level.

105 dB—clipping level to NAB A-weighted noise level.[2]

95 dB—clipping level to unweighted noise level, 30 Hz-20 kHz.[3]

Typical Obtainable Dynamic Range, 15 ips:
90-95 dB.

Matching Between Units:
±1 dB at any level and any frequency, 20 Hz-20 kHz.

Signal Delay:
20 µsec overall, encode/decode.

Stability:
System is highly stable—does not require routine alignment (no adjustable internal user controls).

Operating Temperature:
Up to 40°C.

Construction:
Each channel of processing is contained on separate plug-in fiberglass printed circuit card with clear anodized cover, injection-molded front panel and gold-plated edge connectors.

The separate PS3 power supply provides fan cooling for the processing modules and must be mounted directly above the main chassis.

Common Facilities Controls (on PS3 Power Supply):
IN/OUT: User-selectable choice of electronic (soft) bypass or hardwired (hard) bypass of all tracks simultaneously by means of switch on backplane of SRP series frame.

SET-UP: Activates internal master Dolby noise generator.

MONITOR: Selects the output to be monitored by NORMAL (automatic switching between line-in during recording and decoded tape during playback), CHECK TAPE (in recording mode monitors encoded signal directly from tape without decoding), or LINE IN switches.

RESET ±12V: Restores power after overload has occurred.

LED mode indicators for power ON, IN/OUT, the selected monitor output mode, and SET-UP; LEDs for status of power supply (HIGH TEMP and HIGH/LOW POWER LINE) and for each of the five power supply rails.

Remote Control:
Remote control of common facilities can be selected by positioning a link on the rear of the PS3; a front panel LED indicates REMOTE mode when selected.

Dimensions:
Mainframe: 222 x 483 mm rack mounting (8-3/4" x 19"). 460 mm (18-1/8") maximum projection behind mounting surface. 13 mm (1/2") maximum projection in front of mounting surface.

PS3: 89 x 483 mm rack mounting (3-1/2" x 19"). 476 mm (18-3/4") maximum projection behind mounting surface. 13 mm (1/2") in front of mounting surface.

Weight:
Mainframe (number in model designation indicates number of tracks supplied):

SRP8	12.5 kg	(28 lbs.)
SRP16	17.9 kg	(39 lbs.)
SRP24	23.1 kg	(51 lbs.)
PS3:	13.6 kg	(30 lbs.)

Power Requirements:
Mainframe operates from PS3 Power Supply; power and interconnecting cables are provided. User-selectable voltage ranges (50-60 Hz, single-phase): 85-115V; 102-132 V; 187-242 V; 204-264V. Consumption with Cat. No. 531 cards: SRP8, 90VA; SRP16, 150VA; SRP24, 200VA.

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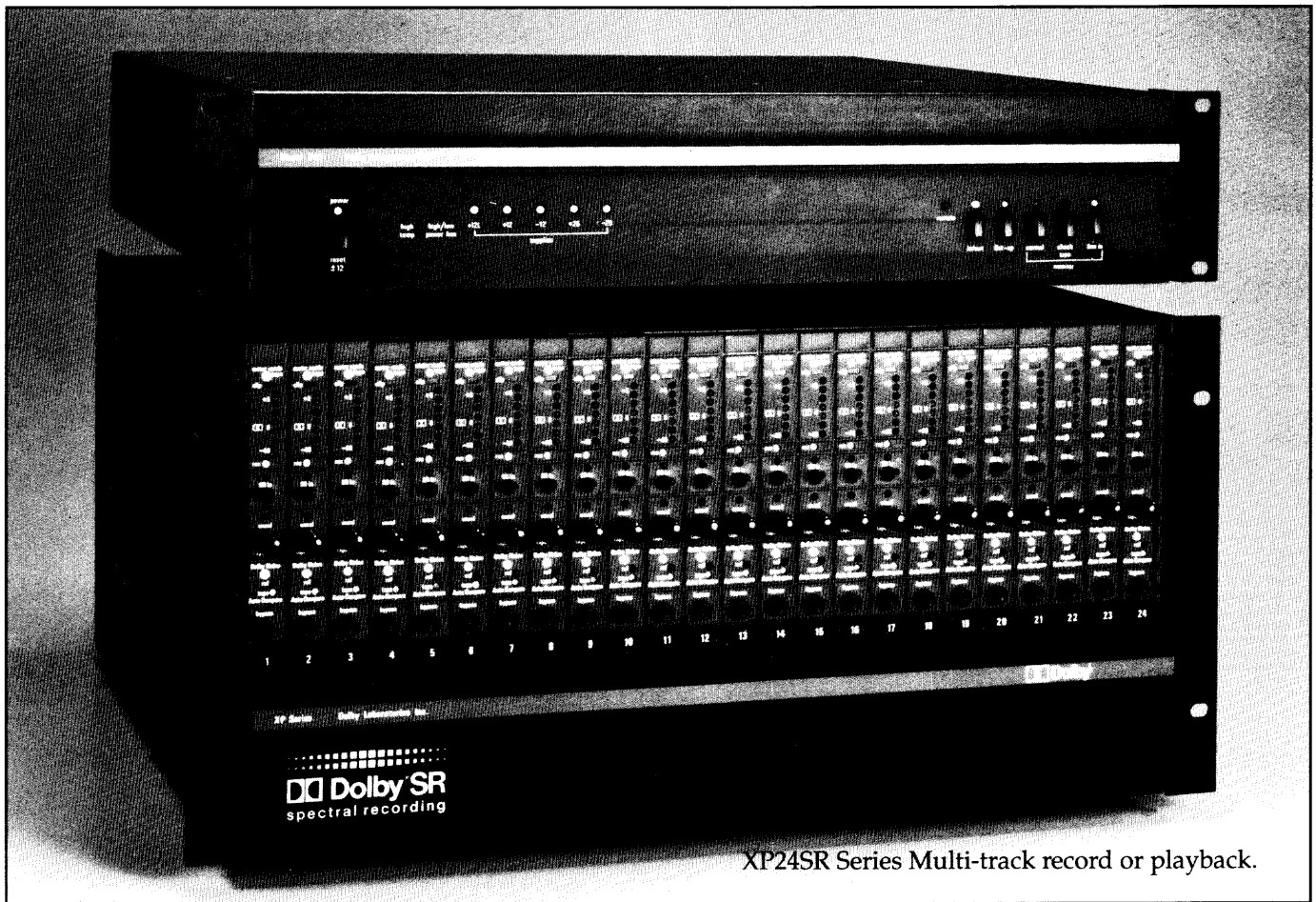
1. Processor alone; in interfaces, may depend on line levels used.
2. Weighting filter supplemented by 25 kHz 4-pole low-pass filter to ensure that only audible noise is measured.
3. Rms or average responding meter, 4-pole filters.

L92/023

The Dolby® XPSR Series Multi-track Unit

Dolby® SR



XP24SR Series Multi-track record or playback.

The Dolby XPSR Series for multi-track recorders contains up to 24 channels of Dolby SR signal processing, in only 12 1/4" of rack space, including power supply. Dolby Spectral Recording is a process that yields recordings of exceptional clarity and dynamic range. Dolby SR audibly eliminates tape hiss, crosstalk, print-through, drastically reduces tape modulation noise and distortion, while giving substantial improvements in headroom and high level transient performance — and all with a minimum of signal processing. Dolby SR offers excellent sound quality and convenient tape interchange, at a substantially lower cost than the digital alternatives.

Each XP channel consists of a plug-in Cat. No. 431 module which contains Dolby SR signal processing circuitry, precision input and output amplifiers, input and output level controls, and an accurate LED calibration display. When Dolby A-type noise reduction is required, Cat. No. 331 A-type NR modules can be readily interchanged on any or all channels of the XPSR with the Cat. No. 431 SR modules supplied.

The separate PS3 power supply, designed for rack mounting directly above the main chassis, contains fan cooling and electronically controlled output protection.

The XPSR Series includes "uncal" controls, permitting convenient resetting of Dolby level for playback and punch-in on tapes from studios with different Dolby level standards. Each XPSR channel contains an Auto Compare circuit that allows quick and accurate verification of tape recorder alignment. The user can select the option of "hard-wired" or electronically-buffered bypass on individual channels or all channels simultaneously. The XPSR Series offers FET switching for reliable, noise-free routing of audio signals.

The Dolby XPSR is quickly becoming the standard for professional multi-track recording throughout the world in music, broadcast, film, television and videotape studios.

Dolby® XPSR Series Specifications

Note: All specifications apply with input and output controls set for Dolby level equal to +4 dBr (1.23V rms). (0 dBr=0.775V)

Signal Connections:

Custom input/output connectors on backplane, with provisions for locking to main chassis.

Individual Track Controls (Cat. No. 431 module):

SR IN: electronically switches spectral recording characteristic in and out.

BYPASS: provides relay-controlled "hard" bypass of all circuitry.

UNCAL: permits temporary recalibration of Dolby system (±6 dB) for playback of and punch-in on non-standard-level tapes without disturbing the preset studio Dolby level (pull to activate recalibration, push to restore preset level). In the UNCAL mode, record calibration automatically matches the modified playback calibration.

LED mode indicators for SR IN, UNCAL, and RECORD.

Calibration Display:

Eight-LED display for each track permits accurate calibration of Dolby level by matching intensity of LED pairs, indicates the presence of signals and clipping, and assists in alignment with high-level reference tapes.

Auto Compare Display:

Two LEDs (red/Reference, green/Tape) indicate the Auto Compare function status. With Dolby noise enabled, the Auto Compare function allows an immediate audible comparison between Dolby noise from tape and internal reference pink noise.

Signal Levels:

The minimum input is -5 dBr for Dolby level, all inputs.

The maximum output is +24 dBr in XP interfaces (PS3 power supply) into 600 ohms and above.

Switching Circuits:

Noise-free electronic switching for all internal functions; relay switching for "hard" bypass.

Remote Mode Changeover:

Record/play changeover designed for remote control by recorder. Opto-isolator on logic input requires +4 to +25 V DC voltage differential to activate changeover logic (the current requirement is approximately 5 mA, any voltage).

Input Circuitry:

Link-selectable for floating balanced differential or unbalanced bridging — impedance approximately 10k ohms.

Input Common-mode Rejection:

45 dB at 100 Hz (balanced condition).

Output Circuitry:

Hum-cancelling, single-ended outputs drive any load impedance from a minimum of 200 ohms. Each output is link-selectable for operation with balanced or unbalanced loads.

Output Ground-Noise Rejection:

40 dB (driving single-ended load, output adjusted for +4 dBr at Dolby level, 100 Hz).

Overall Frequency Response:

20 Hz-20 kHz, ±1 dB, encode/decode.

Bandwidth Limitation:

Internal filters: 10 Hz-50 kHz.

Overall Harmonic Distortion:

Second and third harmonic each 0.3% at 3 dB below peak level, 20 Hz-20 kHz. Negligible higher order distortion components at any level.

Overall Dynamic Range of SR System (typical):[1]

105 dB — clipping level to CCIR/ARM noise level.

93 dB — clipping level to CCIR Rec. 468-2 weighted noise level.

105 dB — clipping level to NAB A-weighted noise level.[2]

95 dB — clipping level to unweighted noise level, 20 Hz-20 kHz.[3]

Typical Obtainable Dynamic Range, 15 ips:

90-95 dB.

Matching Between Units:

±1 dB at any level and any frequency, 20 Hz-20 kHz.

Signal Delay:

20 µsec overall, encode/decode.

Stability:

System is highly stable — does not require routine alignment (no adjustable internal user controls).

Operating Temperature:

Up to 40° C.

Construction:

Each channel of processing is contained on separate plug-in fibreglass printed circuit card with clear anodized cover, injection-molded front panel and gold-plated edge connectors.

The separate PS3 power supply with black anodized finish and white characters provides fan cooling for the processing modules and must be mounted directly above the main chassis.

Common Facilities Controls (on PS3 Power Supply):

IN/OUT: User-selectable choice of electronic (soft) bypass or hardwired (hard) bypass of all tracks simultaneously by means of switch on backplane of XP series frame.

SET-UP: Activates internal master Dolby noise generator.

MONITOR: Selects the output to be monitored by NORMAL (automatic switching between line-in during recording and decoded tape during playback), CHECK TAPE (in recording mode monitors encoded signal directly from tape without decoding), or LINE IN switches.

RESET ±12V: Restores power after overload has occurred.

LED mode indicators for power ON, IN/OUT, the selected monitor output mode, and SET-UP; LEDs for status of power supply (HIGH TEMP and HIGH/LOW POWER LINE) and for each of the five power supply rails.

Remote Control:

Remote control of common facilities can be selected by positioning a link on the rear of the PS3; a front panel LED indicates REMOTE mode when selected.

Dimensions:

Mainframe: 222 x 483 mm rack mounting (8 3/4" x 19"). 460 mm (18 1/8") maximum projection behind mounting surface. 13 mm (1/2") maximum projection in front of mounting surface.

PS3: 89 x 483 mm rack mounting (3 1/2" x 19"). 476 mm (18 3/4") maximum projection behind mounting surface. 13 mm (1/2") in front of mounting surface.

Weight:

Mainframe (number in model designation indicates number of tracks supplied):

XP 8	12.7 kg	(28 lb.)
XP16	18.2 kg	(40 lb.)
XP24	23.6 kg	(52 lb.)
PS3:	13.6 kg	(30 lb.)

Power Requirements:

Mainframe operates from PS3 Power Supply; power and interconnecting cables are provided. User-selectable voltage ranges (50-60 Hz, single-phase): 85-115V; 102-132 V; 187-242 V; 204-264 V. Consumption with Cat. No. 431 cards: XP8, 90VA; XP16, 150VA; XP24, 200VA.

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1. Processor alone; in interfaces, may depend on line levels used.
2. Weighting filter supplemented by 25 kHz 4-pole low-pass filter to ensure that only audible noise is measured.
3. Rms or average responding meter, 4-pole filters.

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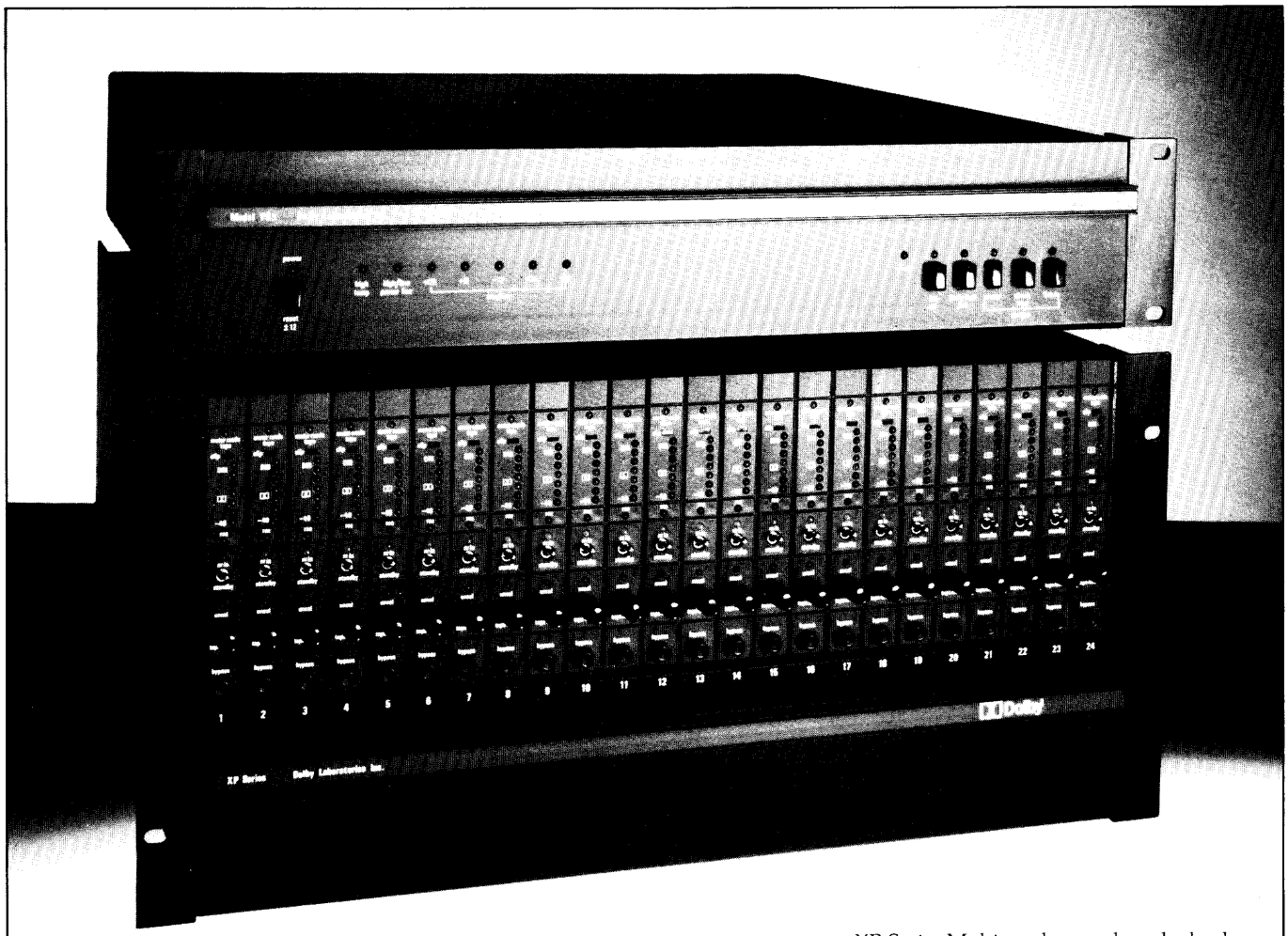
The Dolby® XP Series Multi-track Noise Reduction Unit

This product sheet describes the performance of the Dolby XP Series interface with Dolby A-type noise reduction. The XP Series may also be purchased with Dolby spectral recording modules. Performance specifications for Dolby SR are given on the product sheet for the Cat. No. 431 spectral recording module.



XP Series Multi-track record or playback.

The Dolby XP Series contains up to 24 channels of Dolby A-type noise reduction in 12¼" of rack space, including power supply. The XP Series utilizes an on-board, integrated noise reduction circuit instead of the interchangeable Cat. No. 22 modules used in the SP Series, thus providing the same A-type noise reduction at a lower price.

Each XP noise reduction channel consists of a plug-in Cat. No. 331 module which contains the integrated Dolby A-type noise reduction circuitry, precision input and output amplifiers with low distortion, controls, and an accurate LED calibration display. The separate, regulated PS3 power supply, designed for rack mounting directly above the noise reduction unit chassis, contains fan cooling and electronically-controlled output protection.

The XP Series includes "uncal" controls, permitting convenient resetting of Dolby level for playback of and punch-in on tapes from studios with different Dolby level standards. The user can select the option of "hard-wired" or electronically-buffered bypass of individual channels or all channels simultaneously. The XP offers discrete FET switching for reliable, noise-free routing of audio signals.

Dolby noise reduction is a mainstay of professional multi-track recording in studios throughout the world for music, film, broadcast, television, and videotape production. The benefits of Dolby A-type — improved signal-to-noise ratio, lower distortion, and reduced cross-talk and print-through — are achieved with a minimum of signal processing and with resultant high signal integrity.

Dolby XP Series Specifications

Note: All specifications apply with input and output controls set for Dolby Level equal to +4 dBr (1.23V rms). (0 dBr = 0.775V)

Signal Connections:

Custom input/output connectors on backplane, with provisions for locking to main chassis.

Individual Track Controls (Cat. No. 331 module):

NR IN/STANDBY: electronically switches noise reduction characteristic in and out.

BYPASS: provides relay-controlled "hard" bypass of all circuitry.

UNCAL: permits temporary recalibration of Dolby system (± 6 dB) for playback of and punch-in on non-standard-level tapes without disturbing the preset studio Dolby Level (pull to activate recalibration, push to restore preset level). In the UNCAL mode, record calibration automatically matches the modified playback calibration.

LED mode indicators for NR IN, UNCAL, and RECORD.

Common Facilities Controls (on PS3 Power Supply):

IN/OUT (push for out): User-selectable choice of electronic (soft) bypass or hard-wired (hard) bypass of all tracks simultaneously by means of switch on backplane of main XP series mainframe.

SET-UP: Activates internal master Dolby Tone oscillator.

MONITOR: Selects the output to be monitored by NORMAL (automatic switching between line-in during recording and decoded tape during playback), CHECK TAPE (in recording mode monitors encoded signal directly from tape without decoding), or LINE IN switches.

RESET ± 12V: Restores power after overload has occurred.

LED mode indicators for power ON, IN/OUT, the selected monitor output mode, and SET-UP; LEDs for status of power supply (HIGH TEMP and HIGH/LOW POWER LINE) and for each of the five power supply rails.

Remote Control:

Remote control of common facilities can be selected by positioning a link on the rear of the PS3; a front panel LED indicates REMOTE mode when selected.

Calibration Display:

Eight-LED display for each track permits accurate calibration of Dolby Level (within ± 0.1 dB if desired) by matching intensity of LED pairs, indicates the presence of signals and clipping, and assists in alignment with high-level reference tapes.

Signal Levels:

Multi-turn potentiometers for each track (located behind door) adjust levels to and from the console and to and from the recorder. The minimum input is −5 dBr for Dolby Level, all inputs. The maximum output is 12V rms (+24 dBr) into 600 ohms and above (0 dBr = 0.775V).

Switching Circuits:

Noise-free discrete FET switching for all internal functions; relay switching for "hard" bypass.

Remote Mode Changeover:

Record/play changeover designed for remote control by recorder. Opto-isolator on logic input requires +4 to +25V DC voltage differential to activate changeover logic (the current requirement is approximately 5 mA, any voltage).

Record-Play Changeover Time:

3 ms maximum.

Input Circuitry:

Switch-selectable for floating balanced differential or unbalanced bridging impedance (approximately 10k ohms).

Input Common-Mode Rejection:

45 dB at 100 Hz (balanced condition).

Output Circuitry:

Hum-cancelling, single-ended outputs drive any load impedance from a minimum of 200 ohms. Each output is switch-selectable for operation with balanced or unbalanced loads.

Output Ground-Noise Rejection:

40 dB (driving single-ended load, output adjusted for +4 dBr at Dolby Level, 100 Hz).

Total Harmonic Distortion:

Less than 0.1%, 20 Hz-20 kHz,
Less than 0.04% at 1 kHz.

Overall Noise Level Record-playback:

>80 dB below Dolby Level (A-weighted, un-weighted 20 Hz to 20 kHz, or CCIR/ARM); >70 dB below Dolby Level (CCIR 468.2 weighting).

Noise Reduction:

Standard Dolby A-type characteristic, providing 10 dB of noise reduction from 30 Hz to 5 kHz, rising to 15 dB at 15 kHz.

Overall Frequency Response:

20 Hz to 20 kHz ± 1 dB, encode-decode, at any level.

Matching Between Units:

±1 dB at any level and frequency, 30 Hz to 20 kHz, between any Dolby A-type units.

Signal Delay:

13.5 μsec per channel; overall encode-decode process, 27 μsec.

Phase Error:

+ 26° at 20 Hz; −7.5° at 20 kHz; less than ±5° from 50 Hz to 15 kHz (overall, NR in).

Stability:

Unit is highly stable and does not require internal alignment.

Ambient Operating Temperature:

Up to 40° C.

Construction:

Plug-in Cat. No. 331 card for each track contains interface circuitry and controls, noise reduction circuit, and LED calibration display. Fiberglass printed circuits, solid-state devices throughout. Cat. No. 231 bypass card provided for use should the module require servicing. Separate PS3 power supply with cooling fan is rack mounted directly above noise reduction unit chassis and provides cooling for the noise reduction modules. Black anodized finish with dark trim and white characters.

Dimensions:

Mainframe: 222 x 483 mm rack mounting (8¾" x 19"). 460 mm (18⅛") maximum projection behind mounting surface. 13 mm (½") maximum projection in front of mounting surface.

PS3: 89 x 483 mm rack mounting (3½" x 19"). 476 mm (18¾") maximum projection behind mounting surface. 13 mm (½") in front of mounting surface.

Weight:

Mainframe (number in model designation indicates number of tracks supplied):

XP 8	9.4 kg	(21 lb.)
XP16	12.8 kg	(29 lb.)
XP24	16.3 kg	(36 lb.)
PS3:	13.6 kg	(30 lb.)

Power Requirements:

Mainframe operates from PS3 Power Supply; power and interconnecting cables are provided. User-selectable voltage ranges (50-60 Hz, single-phase): 85-115V; 102-132V; 187-242V; 204-264V. Consumption with Cat. No. 331 card: XP8, 90VA; XP16, 150VA; XP24, 200VA.

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S86/6522/7420

SECTION 2
INTRODUCTION

2.1 Dolby Audio Processing Systems

The two Dolby professional signal processing systems, Dolby A-type noise reduction and Dolby spectral recording (SR), are designed to use the recording medium with optimum efficiency using complementary, or two-part, processes. The sound signal is processed before it is recorded onto the tape; after playback it is again processed but in an equal-and-opposite way, restoring the original sound and reducing any audible effects from the intermediate recording process, such as noise and distortion.

Dolby A-type noise reduction (introduced in 1966) has been established over many years as the most widely used noise reduction system for professional music recording and broadcast video tape. Operating independently in four frequency bands it provides an improvement in audio noise performance of 10 dB at all frequencies up to 3 kHz, rising to 15 dB at 15 kHz.

Dolby SR, introduced in 1986, is a high-performance system that operates flexibly to discriminate accurately between the signal and unwanted noise and distortion. In addition, it uses anti-saturation techniques to improve the recording headroom and restore accurate transient performance. In overall performance, the system reduces noise selectively to match the sensitivity of the ear, giving a weighted noise improvement of 24 dB, as well as increasing the tape headroom by up to 10 dB at extreme high and low audio frequencies.

These systems operate selectively within the audio dynamic range, treating low level and high level signals independently to achieve best results with the minimum of signal processing. This requires that the levels in the playback (decode) processor should be the same as in the record (encode) processor, within normal operational tolerances. This relationship is calibrated during the installation procedure and is confirmed by routine operational checks. Special reference signals are provided to help this calibration. (See Section 2.3 Calibration Signals.)

2.2 Interchanging processing modules between SP, XP and SRP frames

As supplied by Dolby Laboratories, XP frames may contain Cat. No. 331 A-type or Cat. No. 431 SR modules. SRP frames are supplied with Cat. No. 531 SR modules. However, 331, 431 and 531 modules will all work correctly in both XP and SRP frames.

Cat. No. 431 SR modules may also be used in Dolby Laboratories' earlier SP frames (with the addition of a Cat. No. 342 Dolby noise generator). However 331s and 531s will not work in SP frames, and the Cat. No. 230/Cat. No. 22 combinations supplied with the SP frames will not work in XP and SRP frames.

Recordings made with any module can be decoded accurately using any other module containing the same processing system.

2.3 Calibration Signals—Dolby Tone and Dolby Noise

Both Dolby A-type noise reduction and Dolby SR require the signal to return to the playback processor at the same level as it left the record processor; in other words the record/play path should be unity gain. To help with this calibration, special alignment signals are provided: Dolby tone for A-type noise reduction and Dolby noise for Dolby SR. A calibrated LED display is also provided on each processing module to check the level of these signals.

Dolby tone is an audibly modulated 850 Hz tone at Dolby level. A short section of Dolby tone should be recorded at the beginning of each new A-type encoded tape; when replayed it should read at Dolby level on the LED displays to confirm correct calibration.

Dolby SR uses Dolby noise for similar purposes. It is a pink noise signal that is interrupted briefly at 2-second intervals. It is used for various functions:

a. The interruptions, or 'nicks', provide an audible identification for the SR recording.

b. The level of the signal, while not at Dolby level, is fixed in relation to Dolby level and is used for calibration checks. In 'Set-up' mode, replayed Dolby noise will read at Dolby level on the indicators.

c. The Dolby noise may be displayed using a real-time analyzer to show any variation of the overall frequency response.

d. Selecting 'Set-up' mode on the PS3, the power supply and control unit, enables a special 'Auto Compare' function. This alternates 4 seconds of Dolby noise from the tape with 4 seconds of noise directly from the generator. Variations in recorder level and response can be heard as differences between the two noise sources. (See Section 4.7.)

SECTION 3
INSTALLATION

CAUTION

Check the voltage selector and fuse before applying power to the unit.

3.1 Installation

STEP 1 Unpack the XP Series and PS3 units and check for damage. Check the packing material for the power cable and accessories.

STEP 2 Mount the units appropriately in a rack or in a tape recorder. The PS3 Power Supply should be located directly above the XP Series frame. Check that the air flow at the bottom of the main frame and at the rear of PS3 is not blocked and that the incoming air is not heated by other equipment situated below it.

STEP 3 Check the selected AC mains voltage at the rear panel of the PS3. If necessary, lever open the voltage selector/fuse compartment door in the power supply input connector. Rotate the voltage selectyor drum until it reads the correct voltage for the installation. (The drum may also be removed and replaced with the correct voltage displayed; it will only fit one way around.)

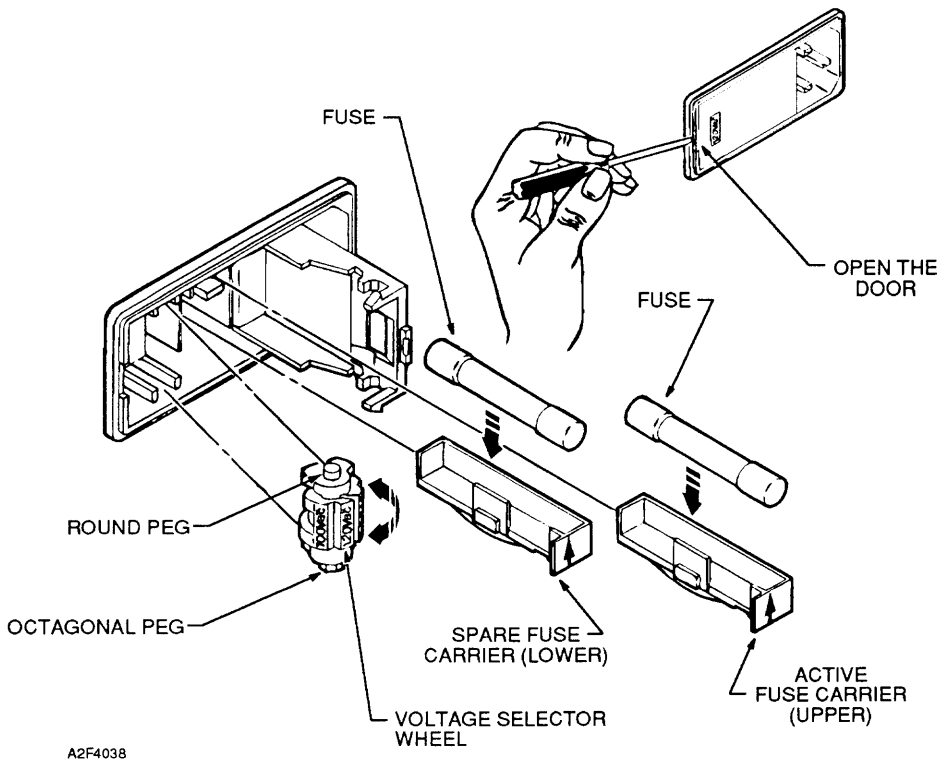


Figure 3-1 Fuse Location and Selection of Operating Voltage

STEP 4

WARNING: Check that the correct fuses are installed. To reduce the risk of fire, replace the fuses only with the same type and rating.

For 100/120 Vac, use 5A/250 V—1/4" x 1-1/4" slow-blow fuses in all positions.
For 220/240 Vac, use T5A/250 V—5 x 20mm time-lag fuses in all positions.

The power supply input connector has positions for two fuses (F1) and will accept carriers for either 20 mm or 1.25" fuses; only the upper fuse position is electrically connected. Select the appropriate fuse and carrier, and insert the assembly into the upper position with the arrow on the carrier in the same direction (upwards) as the arrows inside the compartment door (**Note:** a spare fuse of the same rating and type can be put in the lower position). When closing compartment door, make sure that it clicks firmly into place.

The DC output (secondary) fuse holders (F2, F3, F4) next to the AC mains input connector will accept carriers for either 20mm or 1-1/4" fuses. Use the same rating as listed above.

ADDITIONAL INFORMATION FOR THE SAFE OPERATION OF THE UNIT

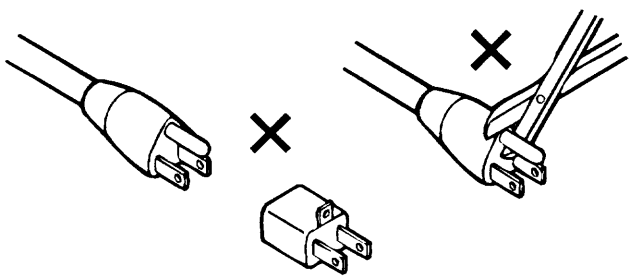
To ensure proper operation and guard against potential shock hazard, the unit must be connected only to a properly wired, grounded (earthed) power outlet. If you are uncertain about the wiring of your outlet **do not use it. Consult a qualified electrician**. The power cable is furnished either with a standard U.S.A. three-prong plug or with unterminated leads for use in other countries. The wires are colored as follows.

	International	U.S.
live or hot	**brown**	**black**
neutral	**blue**	**white**
earth	**green/yellow**	**green or green/yellow**

Before the power cable is connected to the unit, ensure that a qualified electrician has wired it as above.

U.S. Style Plugs

The ground terminal of the plug is connected directly to the chassis of the unit. For continued protection against electric shock, a three-pin power receptacle MUST be used, and the ground wire MUST always be connected. DO NOT use a ground-lifting adaptor and NEVER cut the ground pin on a three-prong plug.



Connections for United Kingdom

WARNING: THIS APPARATUS MUST BE EARTHED.

As the colours of the cores in the mains lead may not correspond with the coloured markings identifying the terminals in your plug, proceed as follows:

- the core which is coloured green and yellow must be connected to the terminal in the plug which is marked with the letter E or by the earth symbol ⏚, or coloured green or green and yellow.
- the core which is coloured blue must be connected to the terminal which is marked with the letter N or coloured black.
- the core which is coloured brown must be connected to the terminal which is marked with the letter L or coloured red.

Safety Notices

IMPORTANT SAFETY NOTICE

This unit complies with the safety standard EN60065. The unit shall not be exposed to dripping or splashing and no objects filled with liquids, such as coffee cups, shall be placed on the equipment. To ensure safe operation and to guard against potential shock hazard or risk of fire, the following **must** be observed:

GB

- Ensure that your mains supply is in the correct range for the input power requirement of the unit.
- Ensure **fuses** fitted are the **correct rating and type** as marked on the unit.
- The unit **must be earthed** by connecting to a correctly wired and **earthed** power outlet.
- The **power cord** supplied with this unit must be wired as follows:

Live—Brown Neutral—Blue Earth—Green/Yellow

IMPORTANT – NOTE DE SECURITE

Ce materiel est conforme à la norme EN60065. Ne pas exposer cet appareil aux éclaboussures ou aux gouttes de liquide. Ne pas poser d'objets remplis de liquide, tels que des tasses de café, sur l'appareil. Pour vous assurer d'un fonctionnement sans danger et de prévenir tout choc électrique ou tout risque d'incendie, veillez à observer les recommandations suivantes.

F

- Le selecteur de tension doit être placé sur la valeur correspondante à votre alimentation réseau.
- Les fusibles doivent correspondre à la valeur indiquée sur le materiel.
- Le materiel doit être correctement relié à la terre.
- Le cordon secteur livré avec le materiel doit être cablé de la manière suivante:

Phase—Brun Neutre—Bleu Terre—Vert/Jaune

WICHTIGER SICHERHEITSHINWEIS

Dieses Gerät entspricht der Sicherheitsnorm EN60065. Das Gerät darf nicht mit Füssigkeiten (Spritzwasser usw.) in Berührung kommen; stellen Sie keine Gefäße, z.B. Kaffeetassen, auf das Gerät. Für das sichere Funktionieren des Gerätes und zur Unfallverhütung (elektrischer Schlag, Feuer) sind die folgenden Regeln unbedingt einzuhalten:

D

- Der Spannungswähler muß auf Ihre Netzspannung eingestellt sein.
- Die Sicherungen müssen in Typ und Stromwert mit den Angaben auf dem Gerät übereinstimmen.
- Die Erdung des Gerätes muß über eine geerdete Steckdose gewährleistet sein.
- Das mitgelieferte Netzkabel muß wie folgt verdrahtet werden:

Phase—braun Nulleiter—blau Erde—grün/gelb

NORME DI SICUREZZA – IMPORTANTE

Questa apparecchiatura è stata costruita in accordo alle norme di sicurezza EN60065. Il prodotto non deve essere sottoposto a schizzi, spruzzi e gocciolamenti, e nessun tipo di oggetto riempito con liquidi, come ad esempio tazze di caffè, deve essere appoggiato sul dispositivo. Per una perfetta sicurezza ed al fine di evitare eventuali rischi di scossa êlettrica o d'incendio vanno osservate le seguenti misure di sicurezza:

I

- Assicurarsi che il selettore di cambio tensione sia posizionato sul valore corretto.
- Assicurarsi che la portata ed il tipo di fusibili siano quelli prescritti dalla casa costruttrice.
- L'apparecchiatura deve avere un collegamento di messa a terra ben eseguito; anche la connessione rete deve avere un collegamento a terra.
- Il cavo di alimentazione a corredo dell'apparecchiatura deve essere collegato come segue:

Filo tensione—Marrone Neutro—Blu Massa—Verde/Giallo

AVISO IMPORTANTE DE SEGURIDAD

Esta unidad cumple con la norma de seguridad EN60065. La unidad no debe ser expuesta a goteos o salpicaduras y no deben colocarse sobre el equipo recipientes con liquidos, como tazas de cafe. Para asegurarse un funcionamiento seguro y prevenir cualquier posible peligro de descarga o riesgo de incendio, se han de observar las siguientes precauciones:

E

- Asegúrese que el selector de tensión esté ajustado a la tensión correcta para su alimentación.
- Asegúrese que los fusibles colocados son del tipo y valor correctos, tal como se marca en la unidad.
- La unidad debe ser puesta a tierra, conectándola a un conector de red correctamente cableado y puesto a tierra.
- El cable de red suministrado con esta unidad, debe ser cableado como sigue:

Vivo—Marrón Neutro—Azul Tierra—Verde/Amarillo

VIKTIGA SÄKERHETSÅTGÄRDER!

Denna enhet uppfyller säkerhetsstandard EN60065. Enheten får ej utsättas för yttre åverkan samt föremål innehållande vätska, såsom kaffemuggar, får ej placeras på utrustningen." För att garantera säkerheten och gardera mot eventuell elchock eller brandrisk, måste följande observeras:

S

- Kontrollera att spänningsväljaren är inställd på korrekt nätspänning.
- Konrollera att säkringarna är av rätt typ och för rätt strömstyrka så som anvisningarna på enheten föreskriver.
- Enheten måste vara jordad genom anslutning till ett korrekt kopplat och jordat el-uttag.
- El-sladden som medföljer denna enhet måste kopplas enligt foljande:

Fas—Brun Neutral—Blå Jord—Grön/Gul

BELANGRIJK VEILIGHEIDS-VOORSCHRIFT:

Deze unit voldoet aan de EN60065 veiligheids-standaards. Dit apparaat mag niet worden blootgesteld aan vocht. Vanwege het risico dat er druppels in het apparaat vallen, dient u er geen vloeistoffen in bekers op te plaatsen. Voor een veilig gebruik en om het gevaar van electrische schokken en het risico van brand te vermijden, dienen de volgende regels in acht te worden genomen:

NL

- Controleer of de spanningscaroussel op het juiste Voltage staat.
- Gebruik alleen zekeringen van de aangegeven typen en waarden.
- Aansluiting van de unit alleen aan een geaarde wandcontactdoos.
- De netkabel die met de unit wordt geleverd, moet als volgt worden aangesloten:

Fase—Bruin Nul—Blauw Aarde—Groen/Geel

3.2 Connections

STEP 1 Connect the DC power cable between J2 on the PS3 power supply and JM2 on the main frame.

STEP 2 Connect the control functions ribbon cable provided between J1 on the PS3 power supply and JM1 on the main frame.

STEP 3 Examine Figure 3-2 which shows the method of making input and output connections.

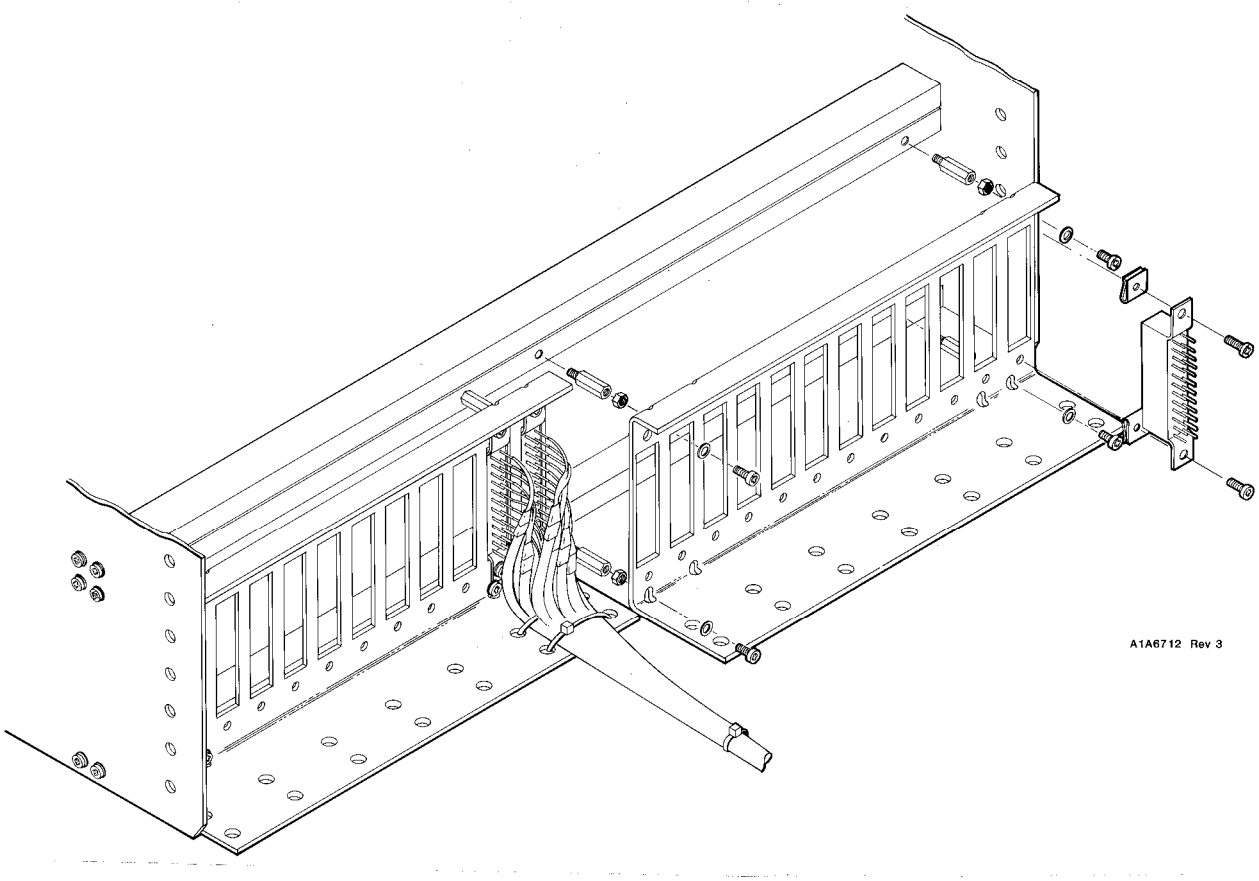


Figure 3-2 Rear Connector Plate, Mounting Details

The connector plate is fully assembled at the factory with all connectors in place. The plate can be removed for ease of making connections by loosening the four captive screws used to mount the plate in place. Note that the connectors in the plate have been so assembled that there is approximately 1.5mm of play in the vertical axis. This float assists in correct seating of the module edge-connectors.

STEP 4 Connect the record logic remote control circuit of each module to the recorder electronics. See the application notes in Section 3.3.

- A voltage difference of 4V to 25V between pins B10(+) and B11(–) of the input/output connector for each channel (see Figure 3-3) will operate the floating switch and change the mode from playback to record. The current drain is approximately 5 mA (independent of voltage).

- Connect pins B10 (+) and B11(–) of the input/output connector for each channel via two-conductor cables to the record relay coil of the corresponding channel of the tape recorder. Observe the polarity, because it is important.

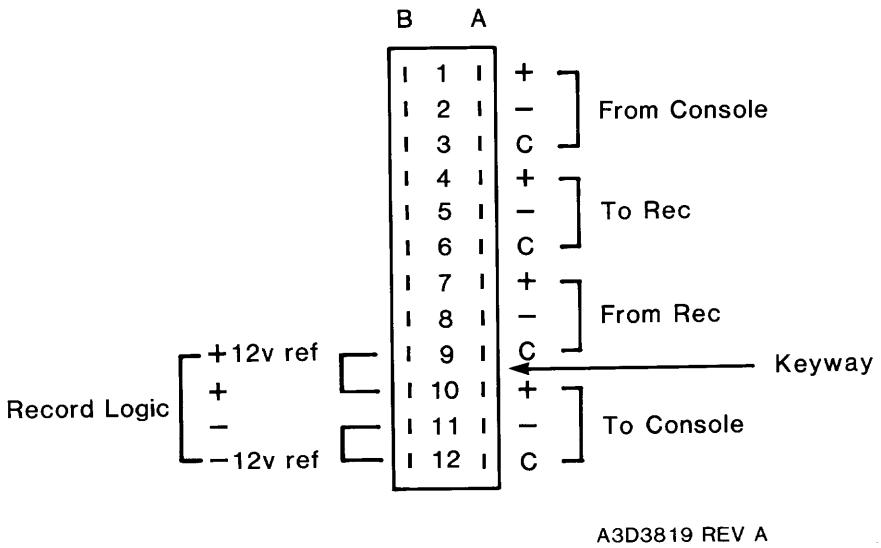


Figure 3-3 I/O Connector Wiring (rear view, as seen at cable entry)

- Alternatively, make connections to a suitable record-only voltage that is often supplied for this purpose with newer multi-track tape recorders or is available at the remote operation connector of a recorder (the application notes at the end of this section describe the remote control arrangements of many popular multi-track recorders).

- Reference voltages on pins B9 (+12V) and B12 (–12V) of the I/O connector are provided to simplify the interface (when needed). In order to avoid possible problems with ground returns, it is recommended that both terminals of the floating switch be powered only from the recorder. If either of the reference voltages is used and there is not a spare set of record relay contacts, a common ground must be provided between the XP/SRP Series unit and the tape recorder chassis.

STEP 5 Connect signal cables to the XP/SRP Series I/O connectors using appropriate two-conductor shielded cable. The best practice is to connect the shield (screen) at only one end of the cable. The convention in this manual is that the shield is to be connected to the ground of the sending unit only. The opposite convention may be used as well, but be sure to follow a consistent rule in all of your signal connections.

BALANCED CIRCUITS:

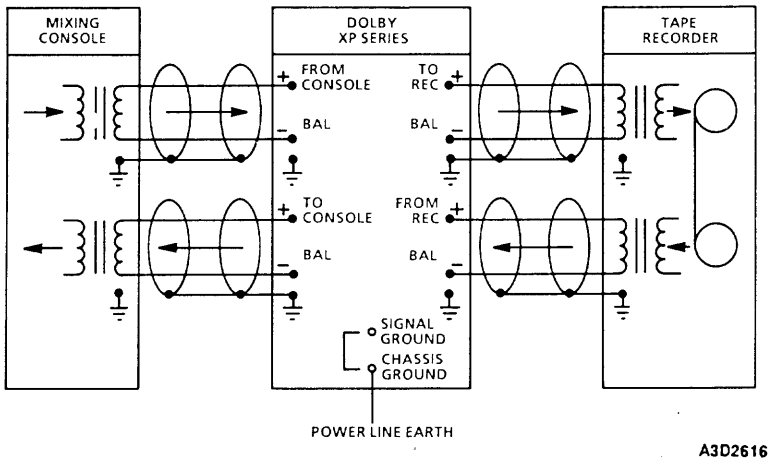


Figure 3-4a Wiring of XP/SRP Series Unit To/From Balanced Circuits

Inputs Driven from Balanced Source: Connect the signal **high** side to '**+**' and the **low** side to '**–**'. Do not connect the shield at this end.

Outputs Driving Balanced Inputs: Connect the signal **high** side to '**+**'. Connect the **low** side to '**–**' and the shield to '**C**'.

UNBALANCED CIRCUITS:

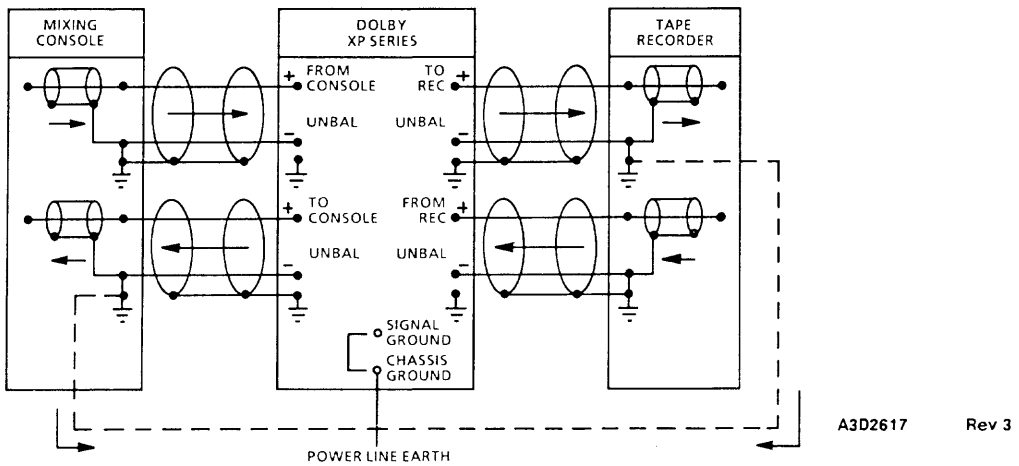


Figure 3-4b Wiring of XP/SRP Series Unit To/From Unbalanced Circuits

Inputs Driven from Unbalanced Source: Connect the signal to '**+**' and the ground of the sending unit to '**–**'. Do not connect the shield at this end.

Outputs Driving Unbalanced Inputs: Connect the signal **high** side to '**+**', the **low** side **(–)** to the ground of the receiving unit, and the shield to '**C**'.

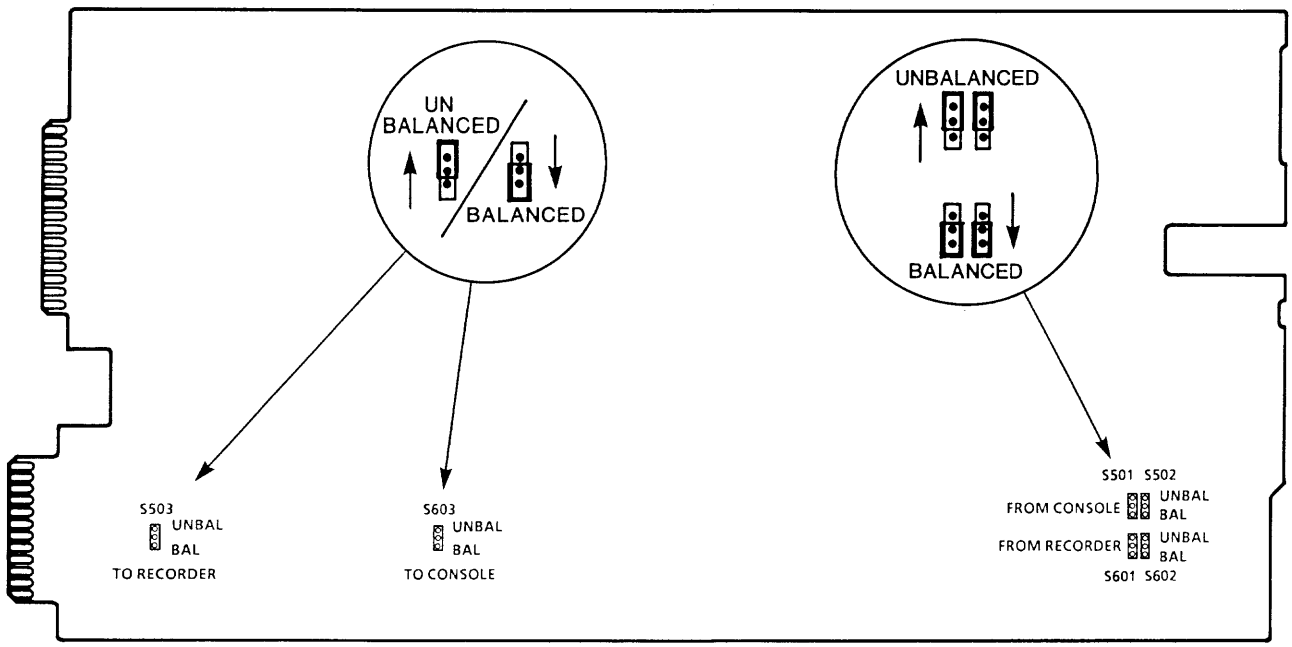


Figure 3-5 Cat. No. 331 Configuration Links

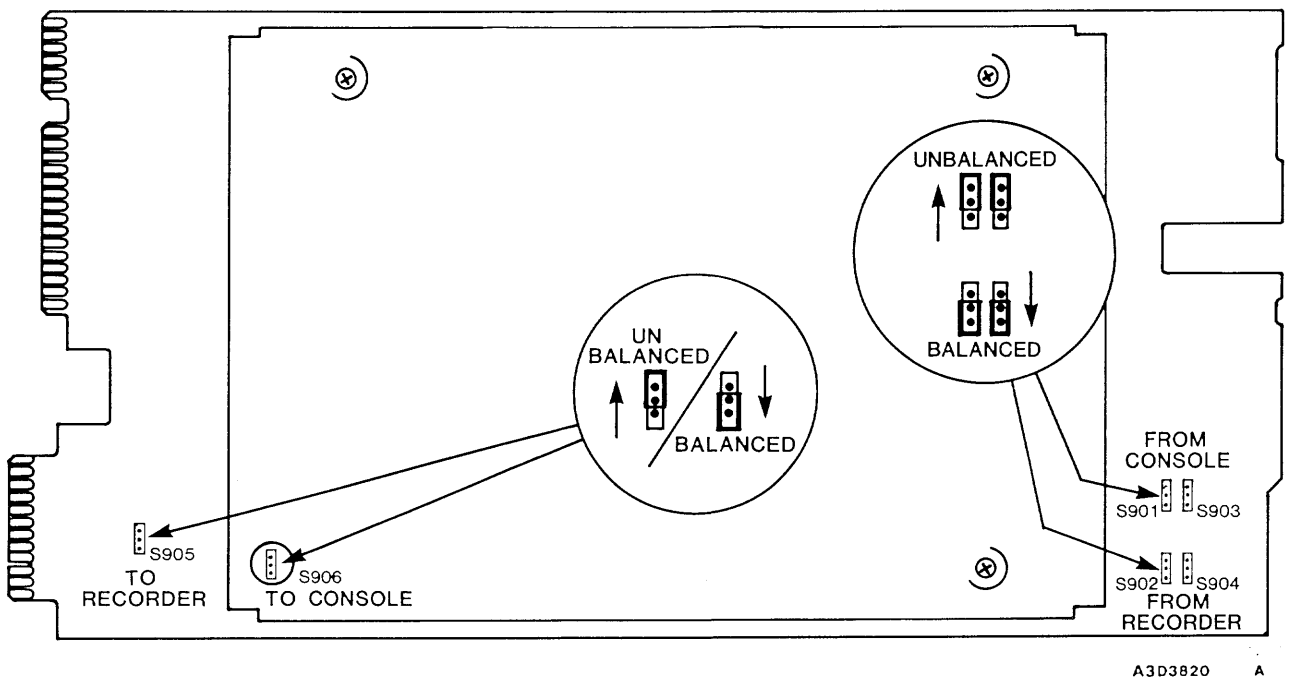


Figure 3-6 Cat. No. 431/531 Configuration Links

NOTE

In the unbalanced cases, shields and **low** sides must **NOT** be commoned but must be connected individually as shown in Figure 3-4b. If the shield connection at the mixing console or tape recorder is via a plug and socket, make certain that the appropriate pins really are connected to ground inside the console. **Connect a single signal ground wire between units making one connection on each unit.**

It is usually unnecessary to terminate the **FROM CONSOLE** and **FROM REC** inputs to the XP/SRP Series unit. It is also unnecessary to terminate the **TO CONSOLE** or **TO REC** outputs. They will drive any load above 200 ohms.

STEP 6 Set the configuration links on each module for the proper interface with balanced or unbalanced inputs and outputs. See Figures 3-5 and 3-6 for the jumper locations.

STEP 7 In order to reinstall the connector plates to the frame, perform the following steps:

STEP 7A Slide all of the modules away from the backplane an inch or two.

STEP 7B Refasten the connector plates to the frame.

STEP 7C Plug in the rightmost and leftmost modules of each connector plate (channels 1 and 12, 13 and 24) and check the alignment of the plates. If necessary, loosen the mounting screws and adjust the plates.

STEP 8 Make certain that you have installed strain relief for each of the signal cables as shown in Figure 3-2.

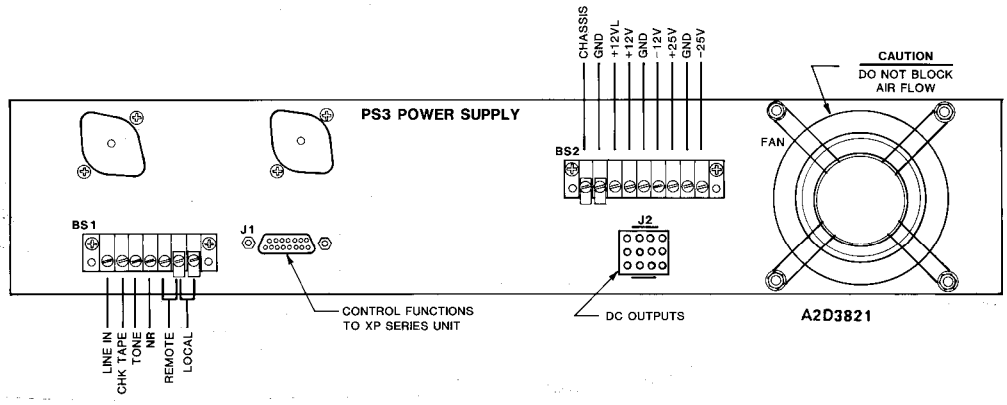


Figure 3-7 Location of Terminal Blocks on Rear of PS3 Power Supply

STEP 9 The PS3 master control functions can be operated remotely by means of terminal block BS1 **(REMOTE CONTROL)** on the rear of the PS3 and a suitable mechanical switch circuit built by the user (see Figure 3-8). Connections to BS1 are made via a seven-terminal fanning strip that is packed with the unit. To permit remote switching, remove the link that connects terminals 6 and 7 **(LOCAL)** and connect it instead between terminals 5 and 6 **(REMOTE)**; an orange LED on the front of the PS3 lights to indicate that the unit is under remote control.

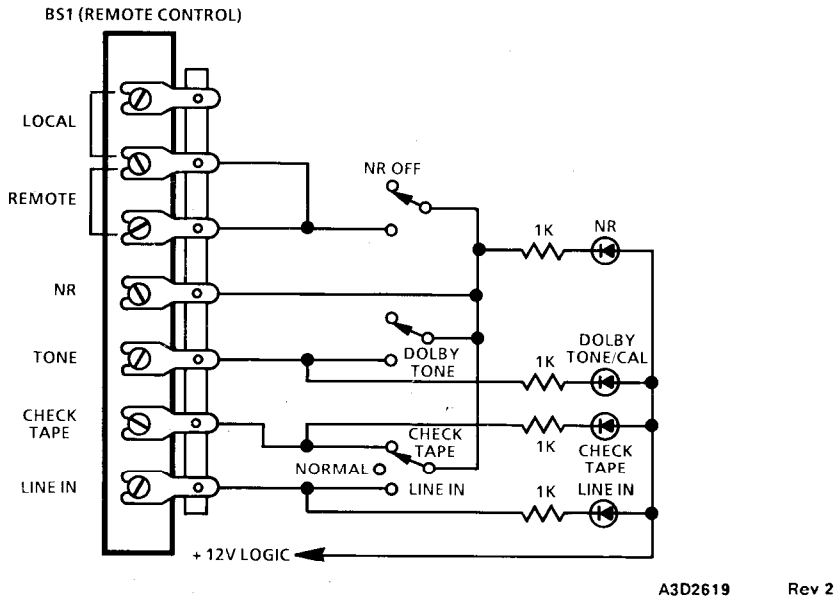


Figure 3-8 Remote Control Circuitry

STEP 10 Fittings on the PS3 permit the unit to be supported from the rear in the rack. It is recommended that a rear support be installed in mobile installations or in other installations where the unit may be subjected to mechanical vibration.

STEP 11 Read the safety information in Section 1.3. When you are confident that you have observed its provisions, connect the power cable between the PS3 power supply and a power outlet.

STEP 12 Signal ground can be isolated from the chassis by removing an externally accessible link located on terminal block BS2 on the rear panel of the PS3 (see Figure 3-7 below). The chassis is always connected to ground via the power cable; for safety reasons this ground should never be disconnected.

3.3 Record/Play Switching — Application Notes

The XP and SRP Series have been designed for record-play changeover operation of each channel. Solid-state switches place the Dolby processing electronics in either the input (Record) signal paths or the output (Play) signal paths. The circuits are typically switched under control from the recorder. Each channel can be switched from playback mode to record mode by applying a voltage in the range 4-25 Vdc between pins B10 and B11 of each channel. Many tape recorders have suitable switching voltages available. The switching input uses an opto-isolator to provide a floating input. The input current is roughly 5mA, essentially independent of voltage up to 25V. Switching voltages higher than 25 V can be accommodated by adding an appropriate external resistor. The following notes show the interconnections between the record/play logic and popular tape recorders. Figure 3-9 shows the general case; the remaining Figures apply to specific models of recording equipment.

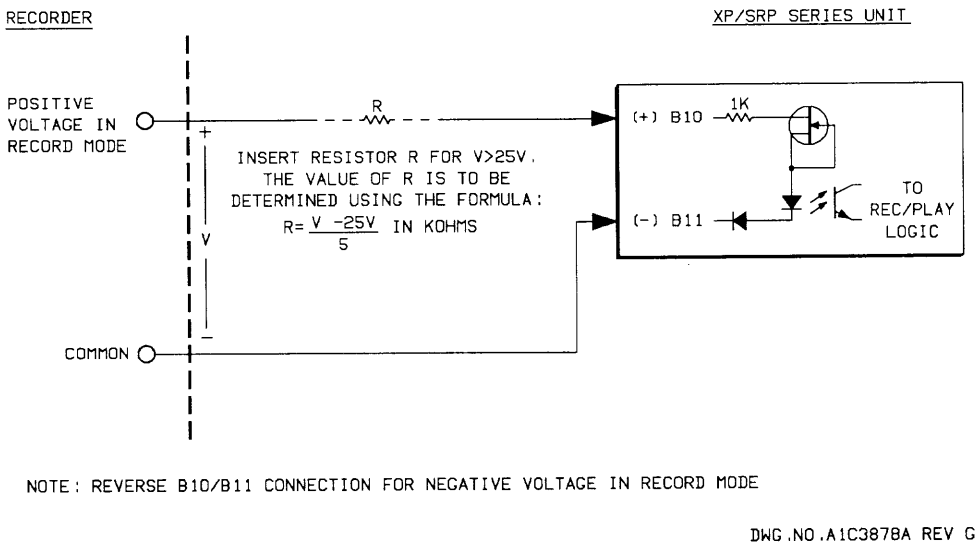


Figure 3-9 Remote Connection of XP/SRP Series Unit Record/Play Logic to Tape Recorder (General Case)

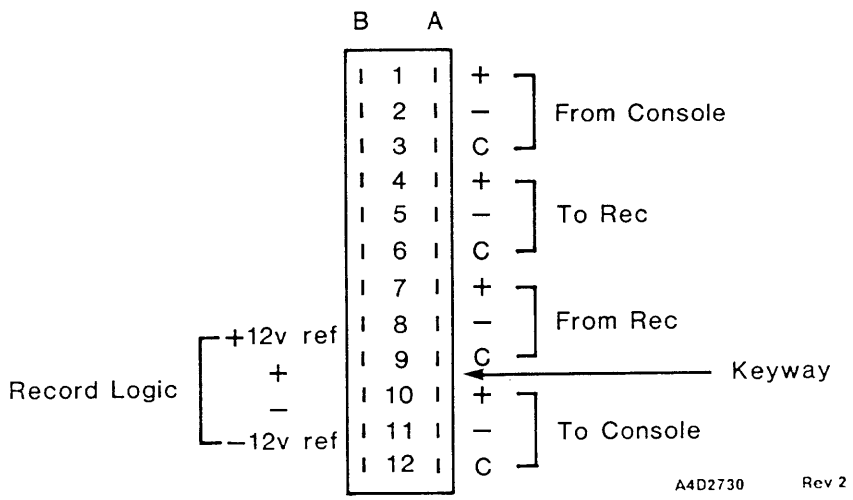


Figure 3-10 I/O Connector Wiring (rear view, as seen at cable entry)

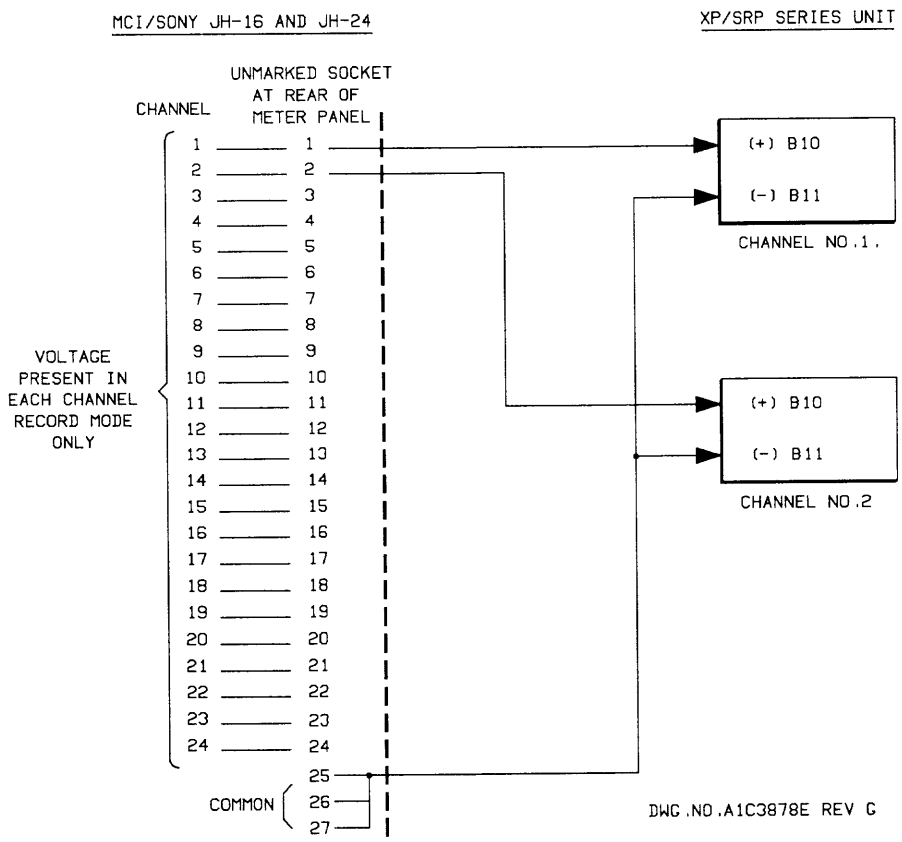
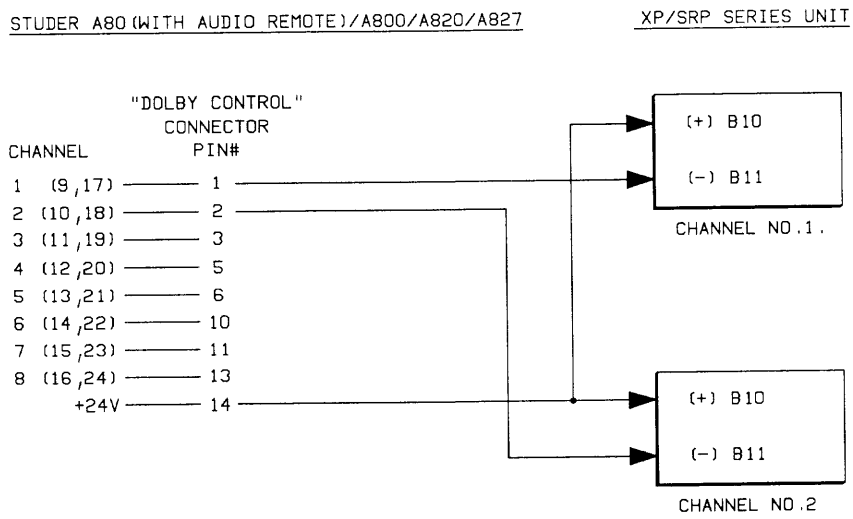


Figure 3-11 Remote Connection of XP/SRP Series Unit to MCI/Sony JH-16 and JH-24 Recorders

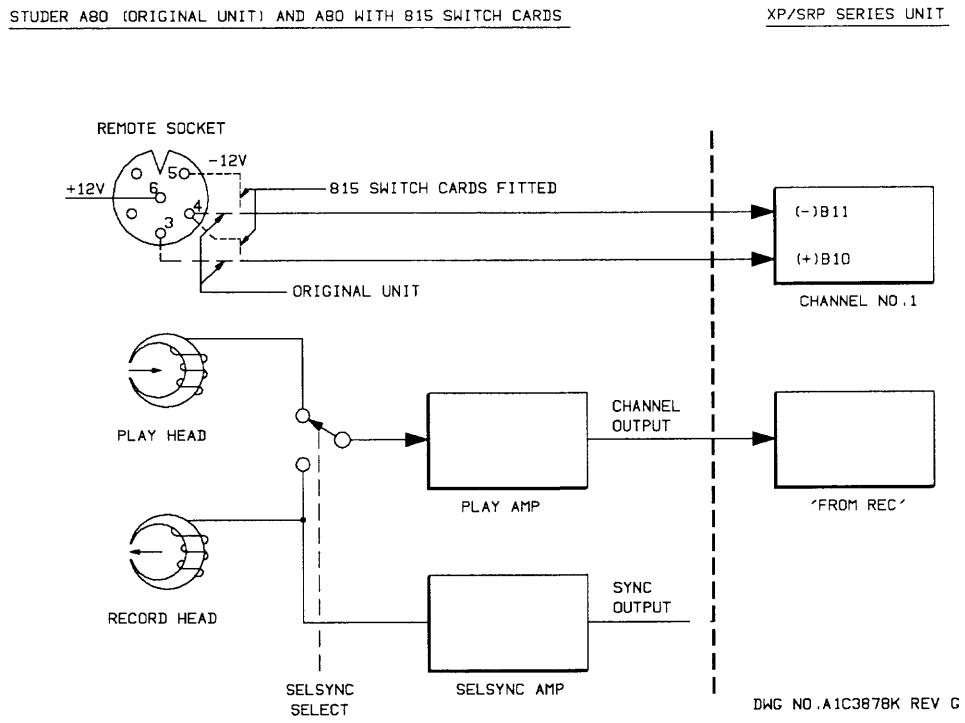


NOTES

1. MODEL A820 MUST BE FITTED WITH EXTERNAL NR CONTROLLER BOARD-STUDER PART NO.1.820.816.00
2. "DOLBY CONTROL" CONNECTORS ARE EL02 (04,06) ON MODEL A80 AND EL05 ON MODELS A800/A820

DWG.NO.A1C3878D REV C

Figure 3-12 Remote Connection of XP/SRP Series Unit to Studer A800, A820, A827 and A80 fitted with Studer remote interface



NOTES:

1. SELSYNC OUTPUT APPEARS AUTOMATICALLY ON CHANNEL OUTPUT WHEN SELSYNC IS SELECTED.
2. USE IDENTICAL CONNECTIONS FOR ALL CHANNELS.
3. REMOTE SOCKET PINS MUST NOT BE COMMONED IN ANY CIRCUMSTANCES.

Figure 3-13 Remote Connection of XP/SRP Series Unit to Studer A80 (Original Unit) and A80 with 815 Switching Cards

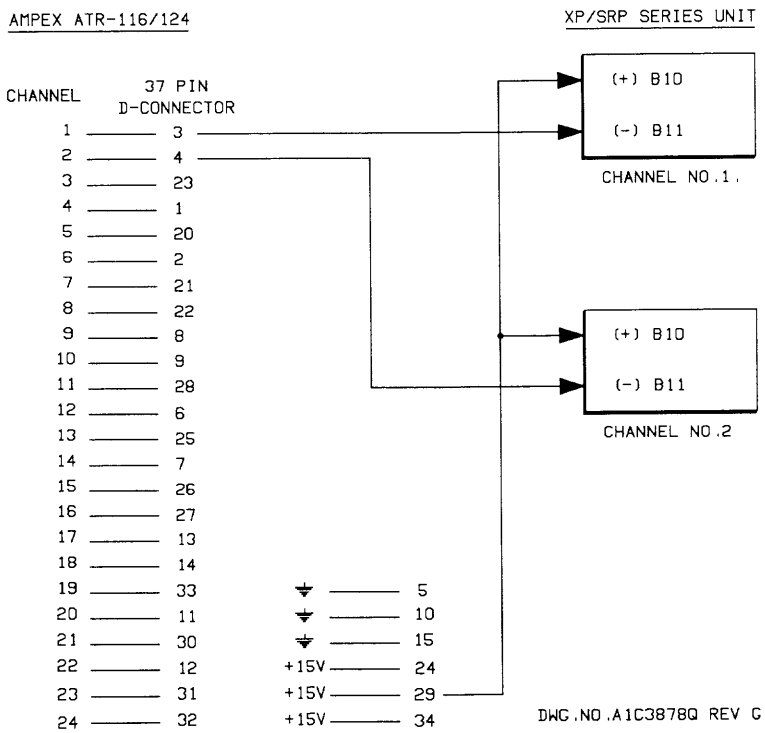


Figure 3-14 Remote Connection of XP/SRP Series Unit to Ampex ATR-116/124 Recorders

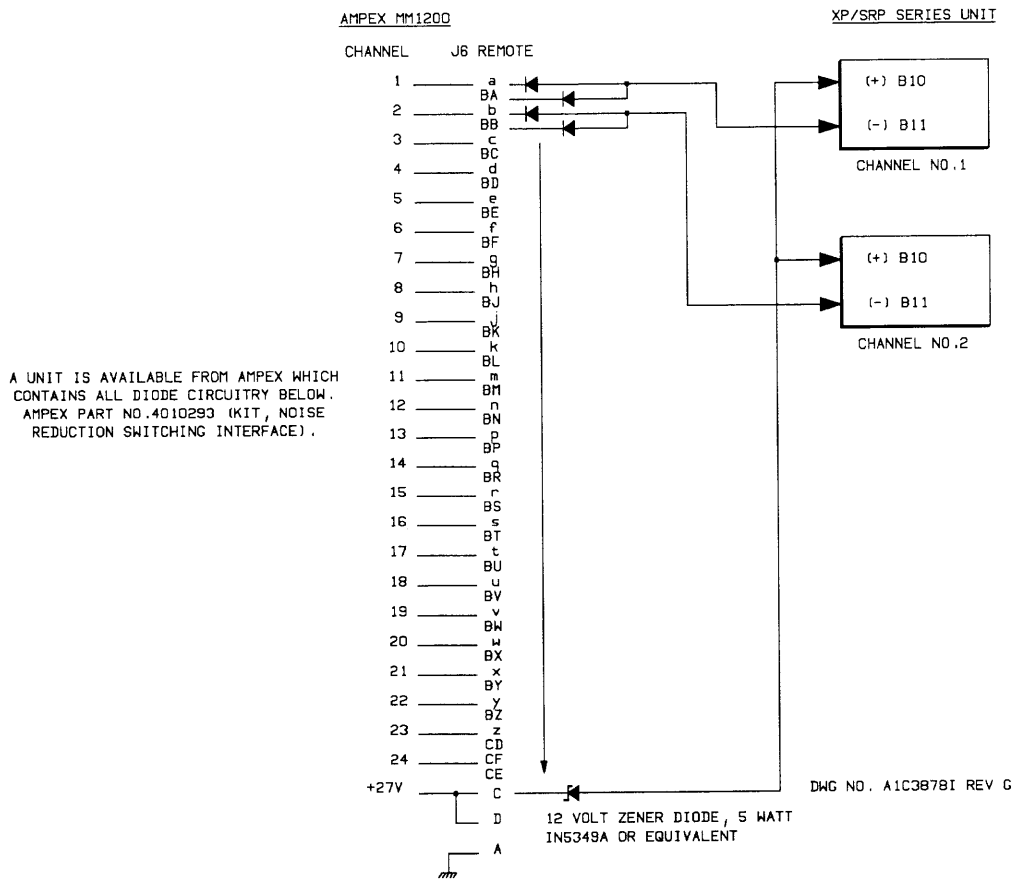


Figure 3-15 Remote Connection of XP/SRP Series Unit to Ampex MM1200 Recorder

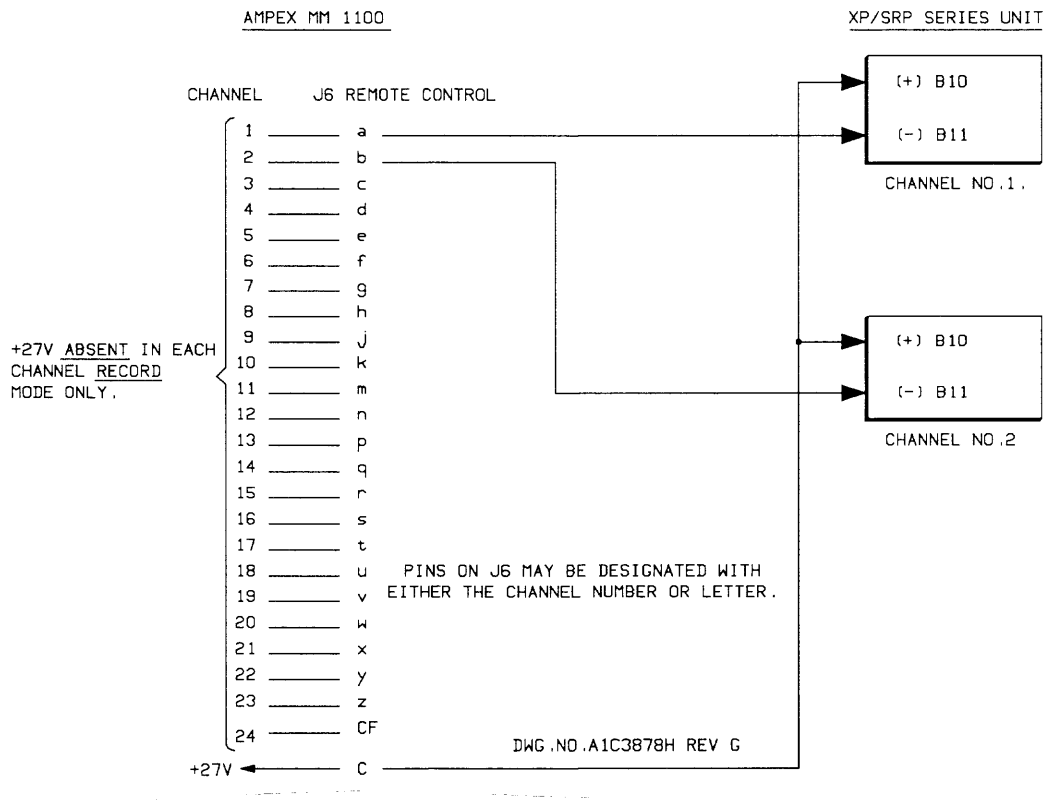


Figure 3-16 Remote Connection of XP/SRP Series Unit to Ampex MM1100 Recorder

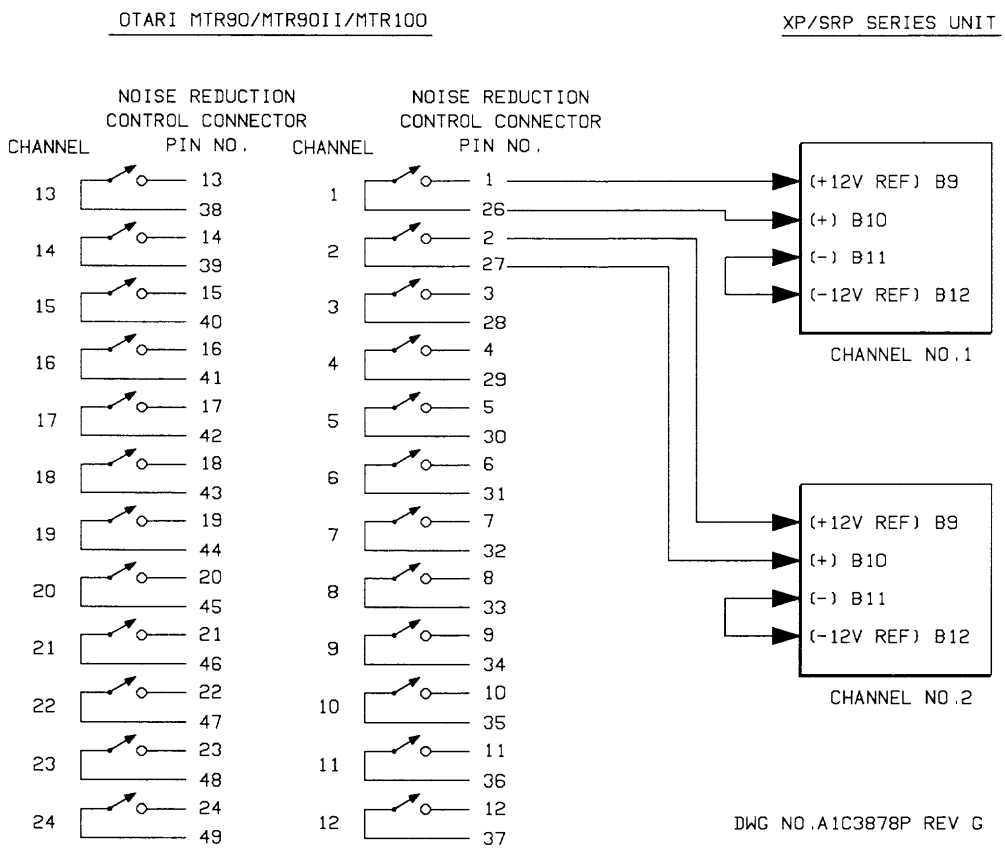


Figure 3-17 Remote Connection of XP/SRP Series Unit to Otari MTR-90 / MTR-9011 / MTR-100 Recorders

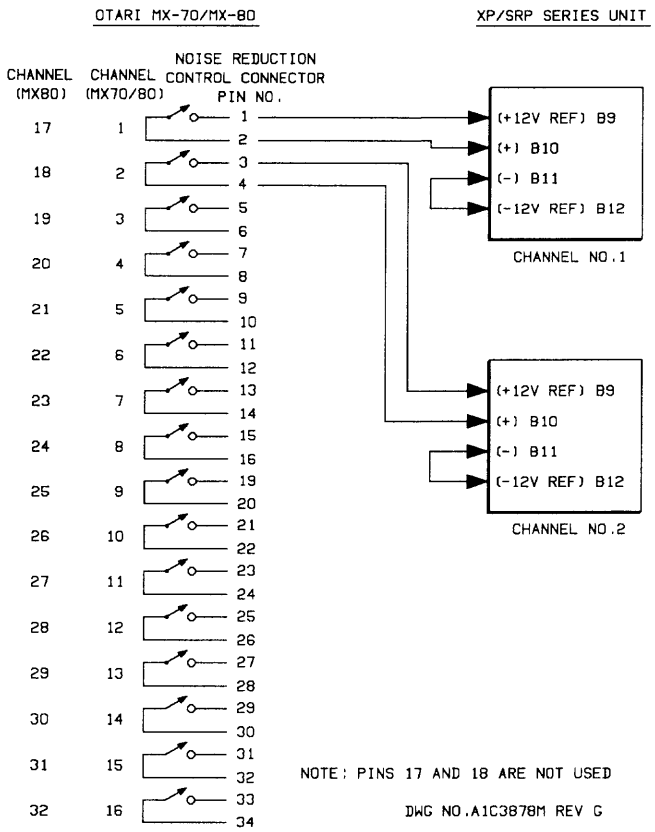


Figure 3-18 Remote Connection of XP/SRP Series Unit to Otari MX 70/80 Recorder

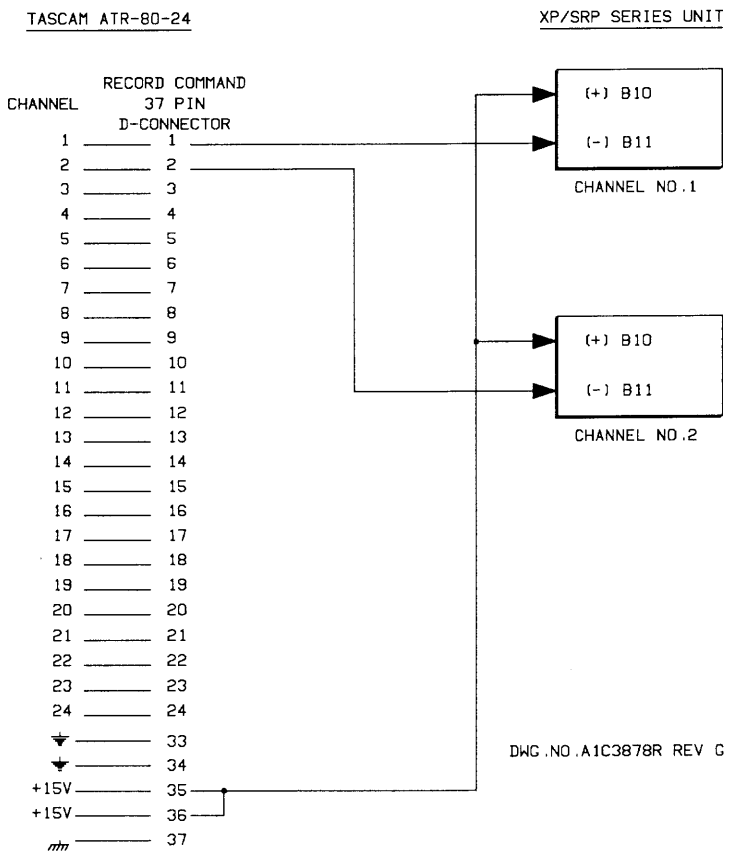


Figure 3-19 Remote Connection of XP/SRP Series Unit to Tascam ATR-80-24 Recorder

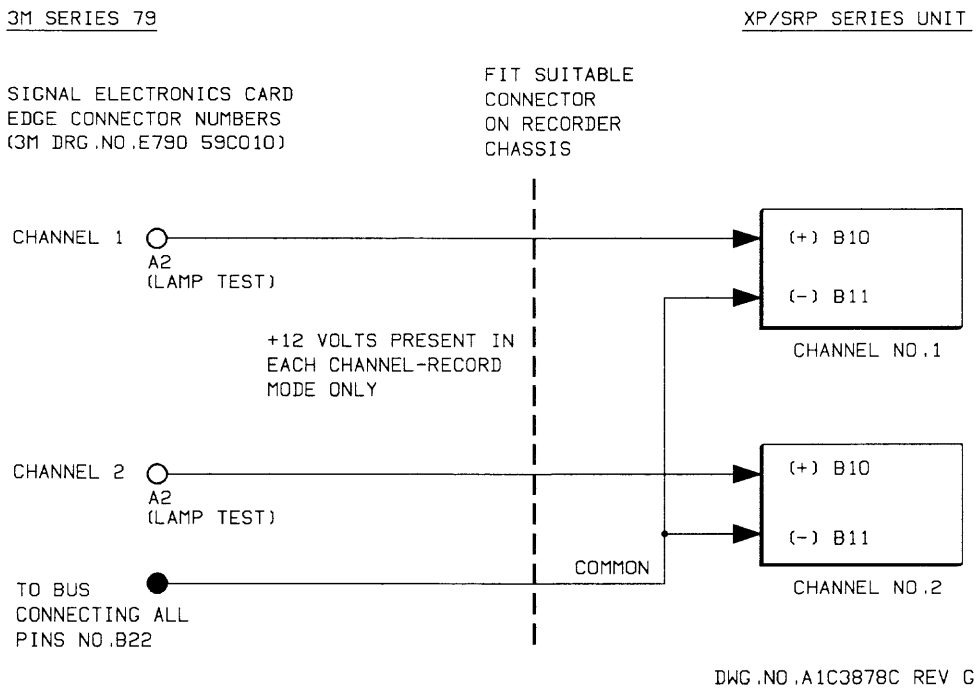


Figure 3-20 Remote Connection of XP/SRP Series to 3M Series 79 Recorders

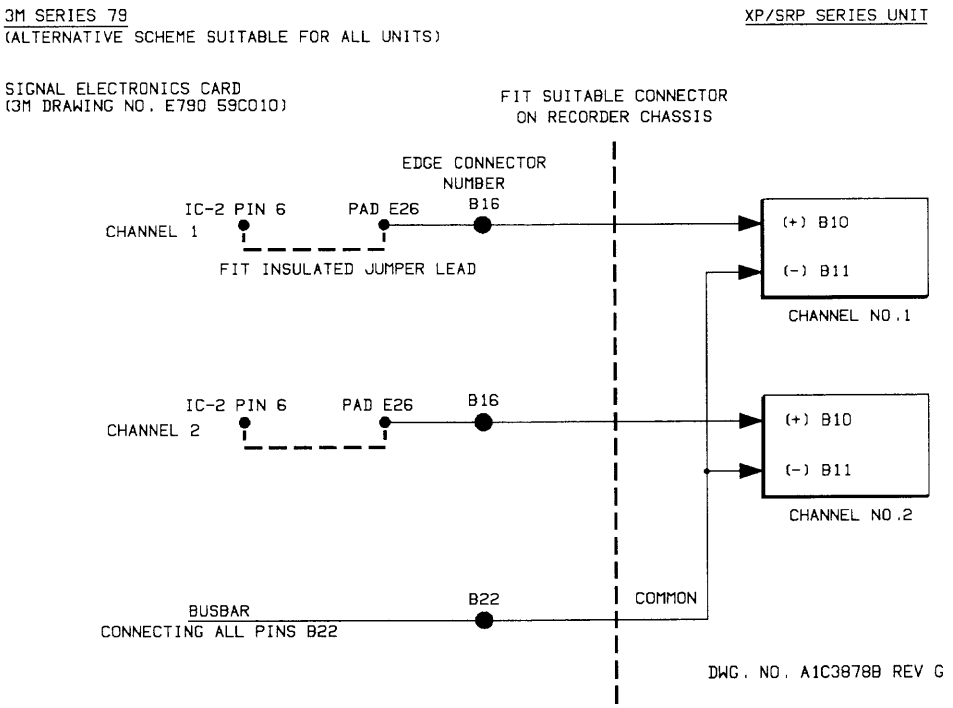


Figure 3-21 Remote Connection of XP/SRP Series to 3M Series 79 Recorders (Alternative Scheme)

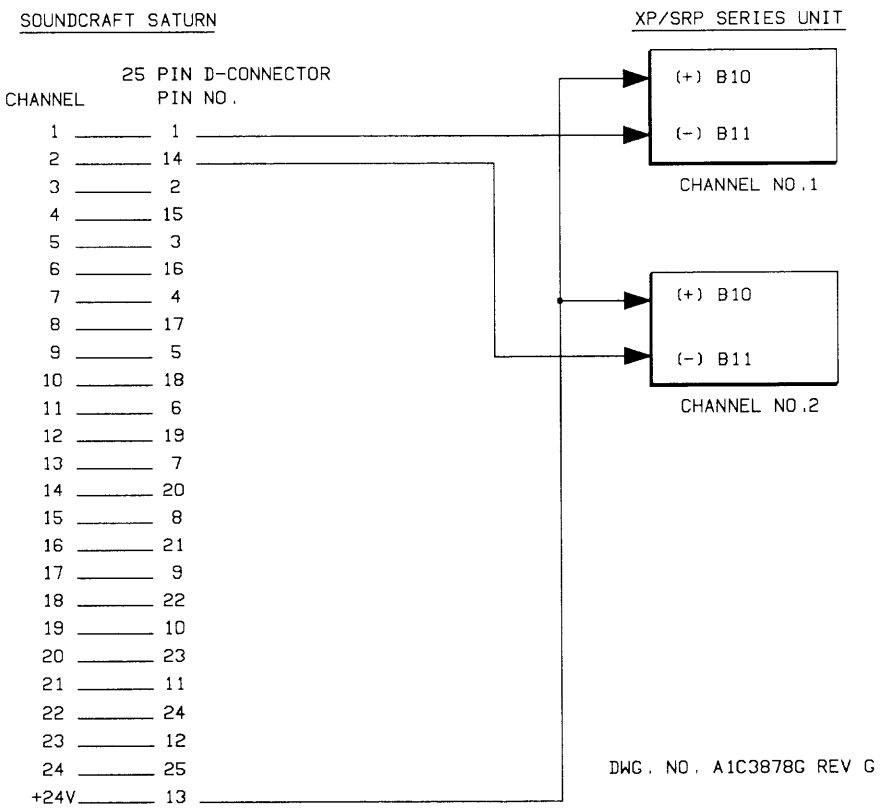


Figure 3-22 Remote Connection of XP/SRP Series to Soundcraft Saturn

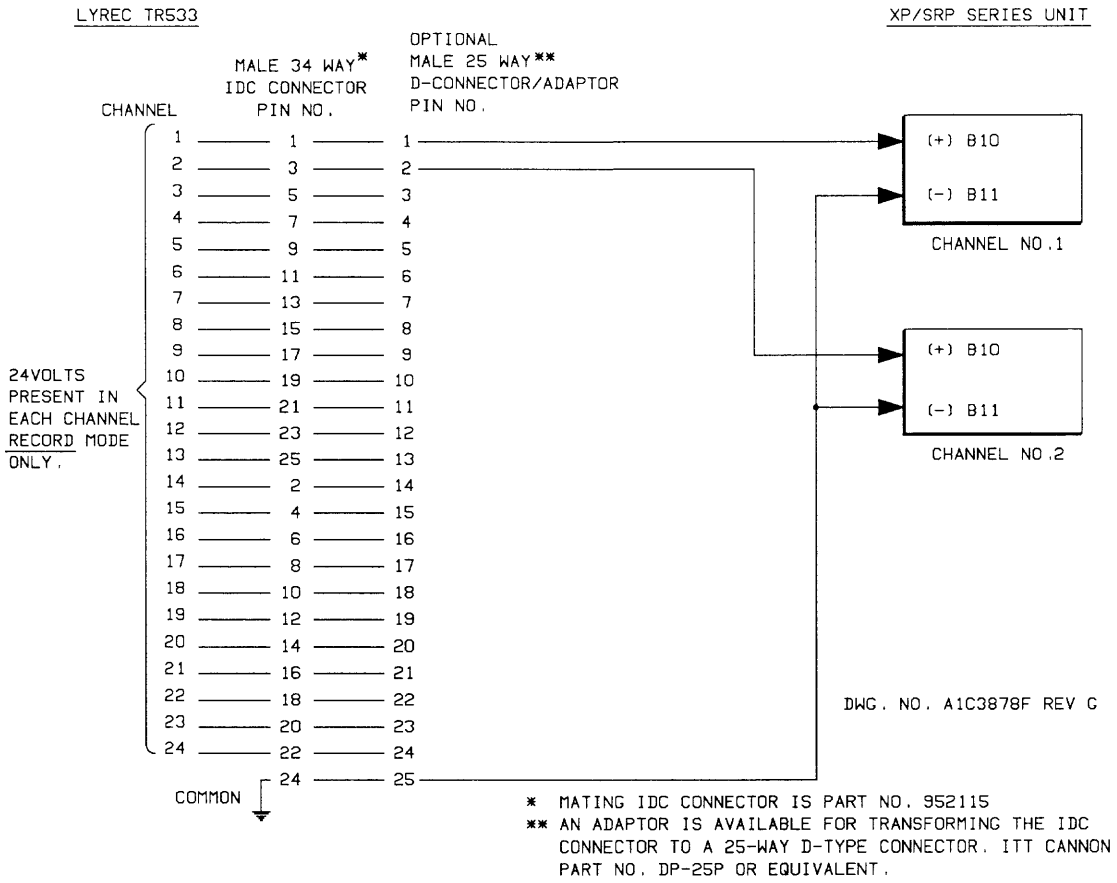


Figure 3-23 Remote Connection of XP/SRP Series to Lyrec TR533 Recorder

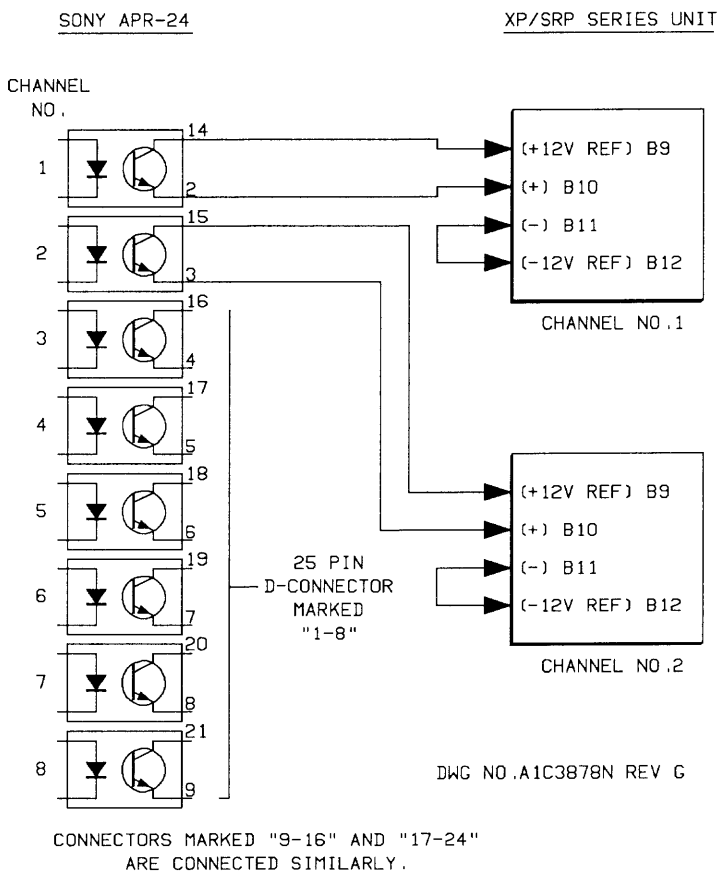


Figure 3-24 Remote Connection of XP/SRP Series to Sony APR-24 Recorder

3.4 Dedicated Encode or Decode Operation

It is possible to use XP or SRP Series channels for dedicated encode or decode only operation.

On the channels dedicated to encode, the console should be connected through to the tape recorder using the '**FROM CONSOLE**' and '**TO REC**' connections on the record channels and the record logic switching linked so that the channel is locked into encode (record) operation (see Figure 3-25). The From Console and the To Rec potentiometers are used to set record path input and output levels.

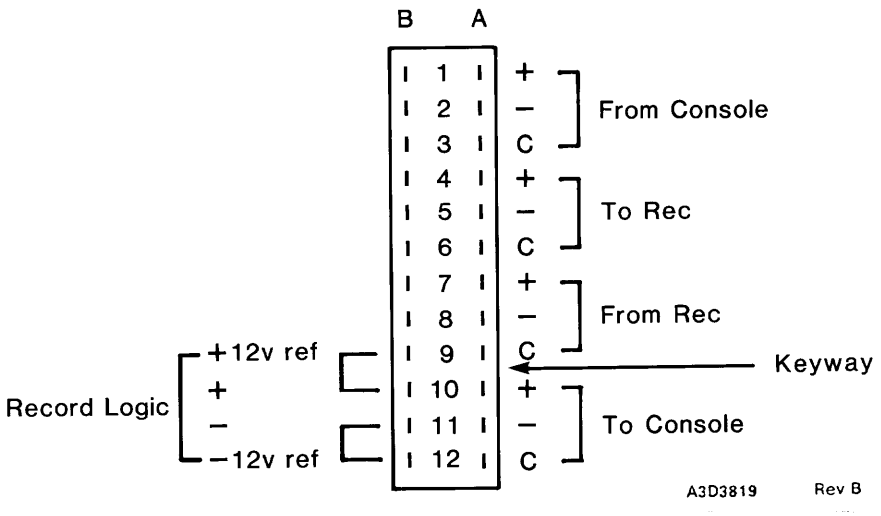


Figure 3-25 Cat. No. 331/431 Input Output Connector Wired for Record (Encode) Only Operation

On the channels dedicated to decode, the playback machine is connected through the '**FROM RECORDER**' and '**TO CONSOLE**' connections. Links are not necessary. The **FROM RECORDER** and **TO CONSOLE** potentiometers (See Figures 4-1, 4-2, 4-3) are used to set playback path input and output levels.

SECTION 4
CONTROLS AND FUNCTIONS

4.1 PS3 Monitor Controls

When the **normal** monitor push button is pressed, the monitor output of the XP/SRP Series (the **TO CONSOLE** output) is: (1) the signal from the output of the console during the record mode and (2) the decoded tape signal during the play mode. A normal (non-encoded) signal is thus heard at all times.

To monitor the console output while the recorder is in either the rest or play modes, press the **line in** monitor push button on the PS3 or use the line in monitor switch on the recorder if equipped.

It is sometimes useful to monitor the signal from the tape during recording rather than the console output as discussed above. Press the **check tape** monitor push button on the PS3. The signal heard will be in the encoded form. This function is intended to be used as a quick means to verify that the signal is being recorded. When using Cat. No. 431 or 531 SR modules, do not press **check tape** if any channel is in the playback mode during a recording session (ping-pong or sync operations). Incorrect operation of the decoding process will result. When using Cat. No. 331 A-type modules the check tape switching is internally blocked on any channel which is in playback mode.

4.2 Set-up Push Button (Dolby Tone/Cal On Early Units)

Pressing the **Set-up** push button (with the recorder in the record mode) at the start of each reel of tape automatically records the appropriate calibration signal—Dolby noise for tracks with SR selected, Dolby tone for tracks with A-type selected. The use of Dolby tone/noise provides a simple accurate alignment check for correct decoding, overdubbing and "punch-in" on existing tracks for any studio at any time. It will also identify those tracks with Dolby processing. The appropriate calibration signal should always be recorded even if other normal studio tones are recorded as well.

When the **Set-up** push button is pressed the Dolby calibration signal is sent to the recorder on all channels with Dolby NR or SR switched IN, and the XP/SRP Series displays are automatically switched to read the playback signal from the recorder. The complete recorder and XP/SRP Series combination is thus easily checked both for signal continuity and for level calibration.

With Cat. No. 431 or 531 Dolby SR modules installed, verification of the complete recording system is carried further to include the frequency response of each recording channel using the Auto Compare facility. (See Sections 4.7 and 4.7.1.) Pressing the **Set-up** push button initiates the Auto Compare facility and alters the LED display calibration to enable a Dolby noise signal to indicate Dolby level on all channels with SR selected.

When the calibration is correct, the XP/SRP Series indicators should always indicate equal brightness of the green display LEDs in the '**Set-up**' mode, independent of the alignment procedure used.

Note that pressing the **Set-up** push button inhibits the Dolby processing on all channels in both play and record modes; this fact is indicated by the off status of the **SR** or **NR** LED on each channel. Keep in mind, however, that the Dolby tone or noise is recorded only on channels on which processing is active (master switch on PS3 **IN** and, for Cat. Nos. 331 and 431 only, individual processing toggle switches up).

4.3 The PS3 IN/OUT Switch (NR OFF Switch On Early Units)

The user has the option of selecting the function of the PS3 **in/out** (or nr off) push button by the use of switch SW1 on the rear of main frame (see Figure 5-2). In the "NR out" position, the PS3 **in/out** push button disables the noise reduction/spectral recording function (standby/out mode) leaving the input and output line amps still in circuit, whereas in the "bypass" position the PS3 **in/out** push button places the XP/SRP Series in hard-wired bypass.

4.4 Cat. No. 331, 431 and 531 Front Panel Controls

The front panel controls of the Cat. No. 331 A-type and the Cat. No. 431 and 531 SR modules are very similar.

Each module has a calibration display for accurate measurement of Dolby tone or Dolby noise, LEDs to indicate processing on, record mode and "meter reads tape", an individual bypass switch, and multi-turn potentiometers for the input and output levels.

SR modules (Cat. Nos. 431 and 531) have three additional LEDs associated with the AutoCompare function. All three are off if Auto Compare is not activated. See paragraph 4.7 below.

Cat. Nos. 331 (A-type) and 431 (SR) have more elaborate level displays. In addition to the basic 4-LED display for Dolby level (red-green-green-red), they have an orange presence-of-signal indicator, a pair of orange LEDs which glow equally brightly when a tone is present at +4.7 dB relative to Dolby level ("DIN level"), and a red LED indicating overload ("clip").

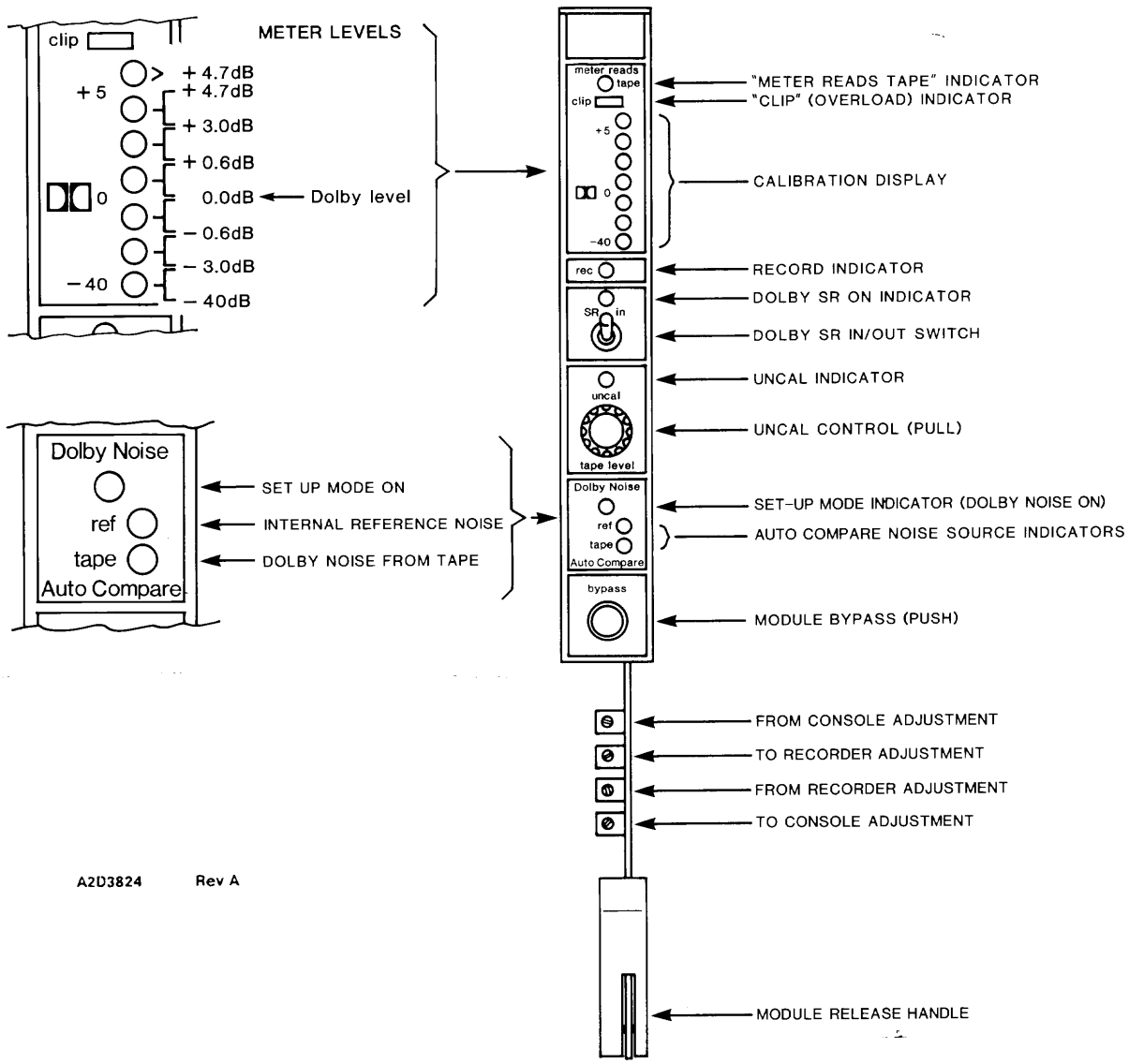


Figure 4-1 Cat. No. 431 Front Panel Controls

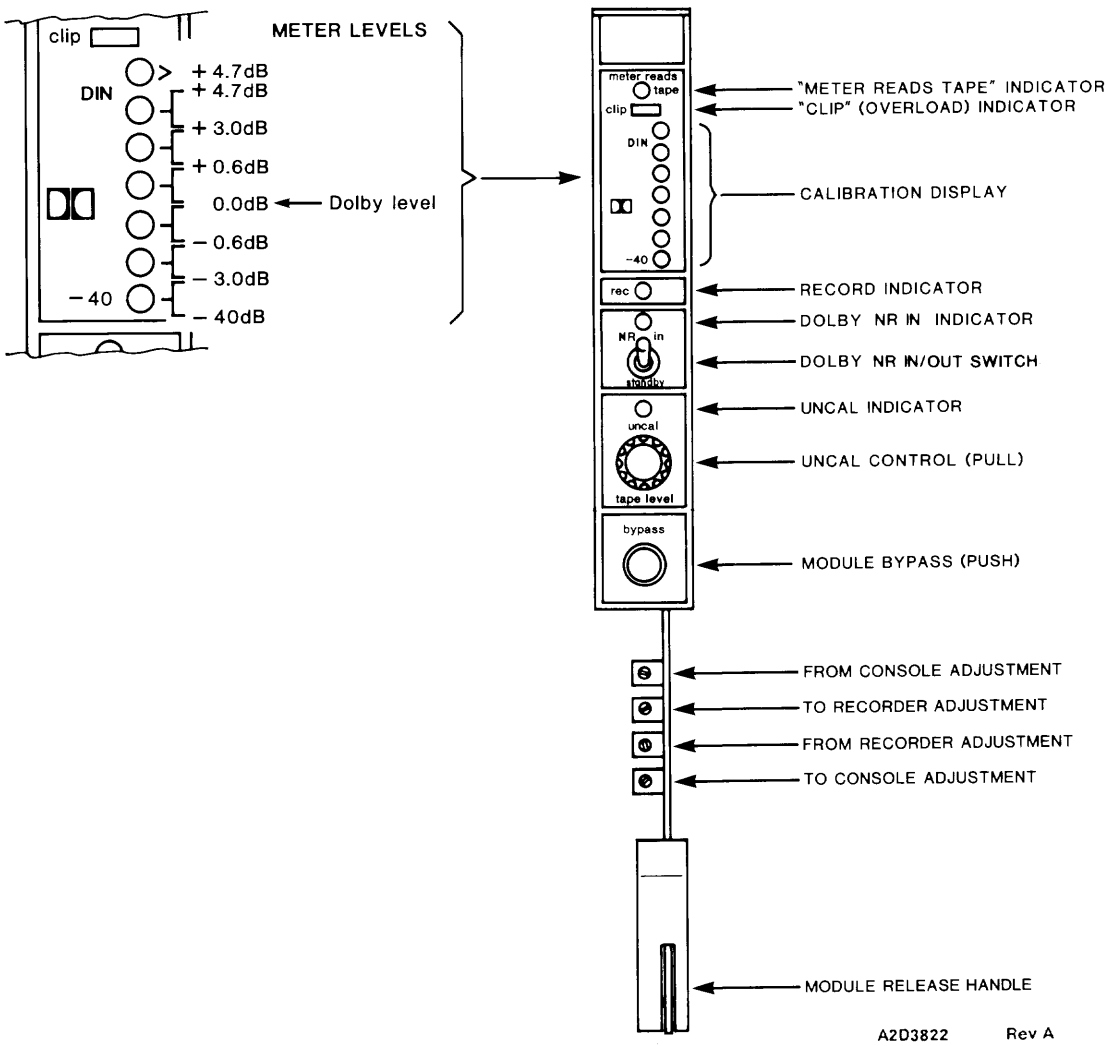


Figure 4-2 Cat. No. 331 Front Panel Controls

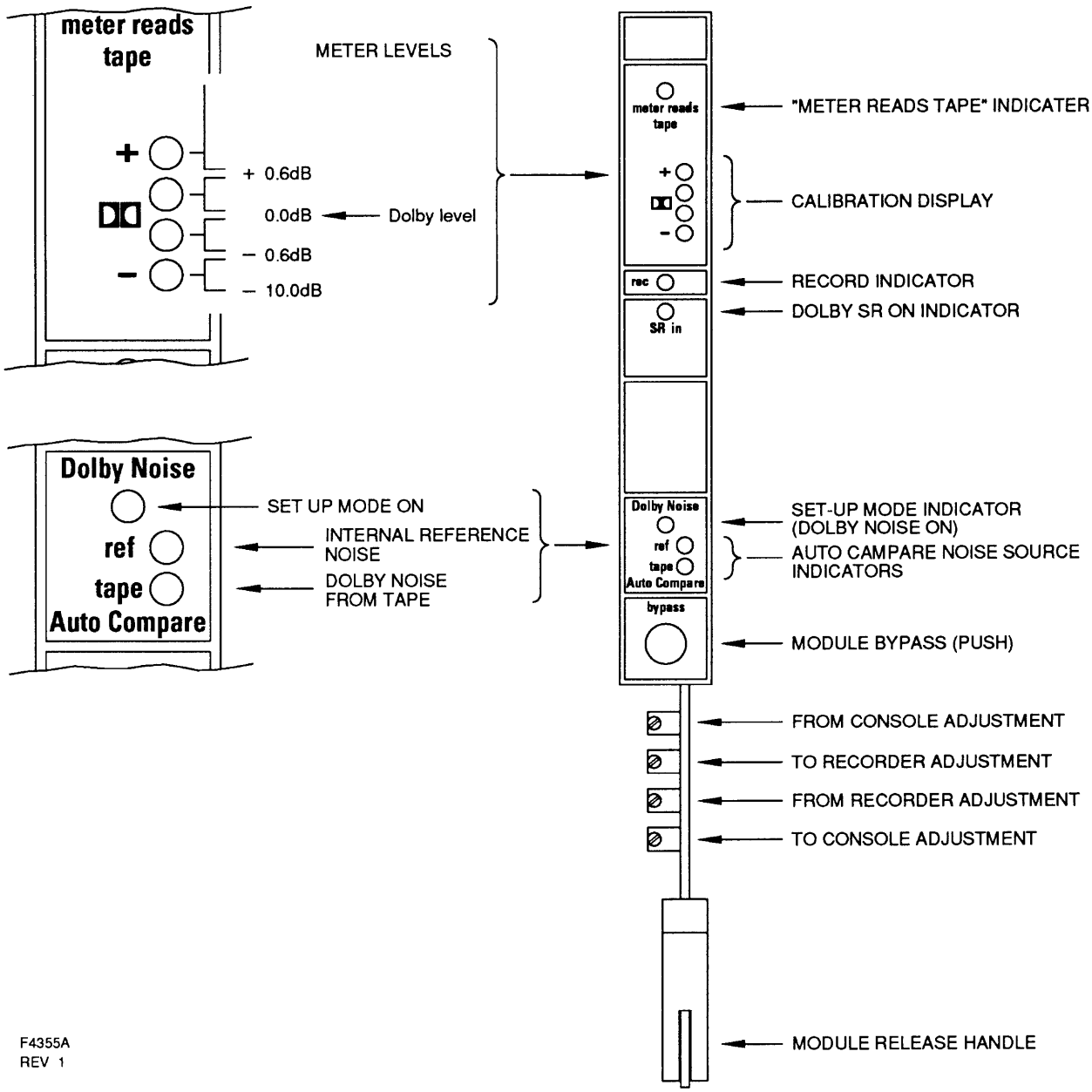


Figure 4-3 Cat. No. 531 Front Panel Controls

4.5 Calibration with the LED Display

Accurate indication of Dolby level (repeatable within ±0.1dB) is obtained by matching the intensity of the two green LEDs. Dolby tone, or Dolby noise as appropriate, must always be aligned to Dolby level in the 'Set-up' mode.

The **DIN** or +5 mark on the LED displays of the Cat. Nos. 331 and 431 should never be used for Dolby tone. It was originally intended for studios using a 320 nWb/m DIN level set tape as a peak flux reference. When this peak reference was adjusted to light the two orange LEDs, Dolby level would then be at 185 nWb/m ANSI (4.7 dB lower).

When recorded Dolby tone or Dolby noise is played back in the '**Set-up**' mode, the lighting of one or both of the green LEDs indicates that the unit is satisfactorily aligned. The lighting of only a red LED indicates that audible effects caused by misalignment may be occurring; the unit should be recalibrated to the tape being played (see Section 4.3). When both the red and green LEDs are lit, the calibration is not exact but audible effects are unlikely to occur.

4.6 **Uncal** (Cat. Nos. 331 and 431 only)

A simple and fast way to align a unit with tapes from other studios is to use the **uncal** feature. Pull the **uncal** knobs and play the recorded Dolby tone/noise section on the tape. Press the PS3 **Set-up** push button. While the recorded Dolby tone/noise on the tape is playing, adjust the **uncal** knobs for equal brightness of the green display LEDs. This adjustment trims the **FROM REC** calibration and simultaneously trims the **TO REC** calibration for proper over-dub and punch-in levels. To disable the uncal feature, merely push the **uncal** knobs "in" to return to your pre-set calibration.

4.7 **Auto Compare** (Cat. No. 431 and 531 Modules)

"Auto Compare" is an exclusive function of Dolby SR. When the **Set-up** button on the PS3 is pressed, Cat. No. 431 and 531 SR modules initiate Auto Compare. Auto Compare provides a simple and convenient way of quickly verifying the performance of the recording channel. During the Auto Compare mode, the internal reference pink noise and the recorded Dolby noise are alternately switched to the monitor output at four-second intervals. The Dolby noise recorded on the tape has interruptions every two seconds. The internal reference noise, on the other hand, is continuous and does not have the interruptions. This leads to an easily identifiable pattern of four seconds of continuous reference noise followed by four seconds of the interrupted or "nicked" Dolby noise. By listening to this continuous A/B comparison, quick identification of errors in level and frequency response may be carried out by ear if you listen to one track at a time.

The orange LED on the front of the Cat. No. 431 and 531 indicates when the unit is ready to perform Auto Compare. When Dolby noise is received from the tape, the red and green LEDs on the front of the module indicate whether the monitor is receiving the internal reference noise (red) or the Dolby noise from the tape recorder (green).

4.7.1 Auto Compare Control and Metering

Auto Compare is controlled by the **Set-up** button on the power supply and by the status of the tape recorder. An Auto Compare sequence will automatically begin IF the tape recorder is playing Dolby noise AND **Set-up** is pressed.

The Auto Compare circuitry may deliver spurious and unexpected noises if it receives signals other than Dolby noise (including silence); this is normal and harmless. To avoid such anomalies it is good operating practice when playing Dolby noise to find the appropriate point on the tape before you press the **Set-up** button, and to release the button as soon as you have finished with the Auto Compare sequence.

The Dolby noise signal is sent to the tape recorder at 15 dB below the established Dolby level. This level is compensated for by gain in the calibration display whenever the **Set-up** button is pressed. Therefore, the Dolby noise should read Dolby level (equal greens) when, and only when, the **Set-up** button is pressed.

In order for Dolby noise to produce an accurate and reliable display reading, the Dolby noise signal returning from the tape is band-limited. The signal is then amplified so that Dolby noise reads Dolby level—the center green LEDs—on the calibration display. The calibration display will always indicate the Dolby noise signal from the tape and not the alternating Tape/Reference sequence sent to the monitor. When the **Set-up** button is not pressed, the band limiting and amplification and not in circuit, and the display functions normally.

SECTION 5
SYSTEM ALIGNMENT

5.1 Alignment—General Rules

There is one very simple rule in aligning Dolby equipment:

Dolby tone or noise from the record processor should always indicate Dolby level on the calibration display on playback (with the **set-up** button depressed when using Dolby SR).

This means that whenever a recording is made, a short section of Dolby tone or noise should be recorded on the tape as a Dolby level reference. When this is played back, whether immediately or in another studio some time later, the Dolby unit should be adjusted so that the two green LEDs on the LED display glow with equal brightness. Alignment will then be correct: any other alignment will be for level interfacing which, while operationally convenient, will not affect the Dolby processing.

When carrying out regular in-house alignment, it is simplest to send a tone at Dolby level (e.g., 0 VU) from the console and align for the same unity gain structure as there is when the unit is bypassed. When aligning to a tape from another studio, it may be necessary to take the Dolby level recorded on the tape as the starting point and set up the unity gain structure from there. For this reason there are two alignment procedures set out here:

"Dolby level Taken from the Console" uses a 1 kHz console tone to indicate Dolby level. This is the simplest way of calibrating or checking regular in-house alignment.

"Dolby level Taken from Tape" takes Dolby level from the Dolby tone or noise recorded on tape. Typically this will have been recorded in another studio.

Many parts of the audio industry have standardized their Dolby level to ease interchange of material. The list below gives some examples:

Application	Dolby level	
	Meter Reading	Level
Recording studio, Europe	0 VU	320 nWb/m
Recording studio, USA	0 VU	250 nWb/m
C-format 1" video	- -	100 nWb/m
35mm Magnetic film	- -	185 nWb/m
35mm Optical film	- -	50%

If there is no standard for a particular application, the user should choose a level that is easy to read on the meters normally used, or check with other users in this same field to make interchange convenient.

5.2 Dolby level Taken From The Console Routine "In-House" Alignment

RECORDER ALIGNMENT

The recorder must be aligned before calibrating the XP/SRP Series unit.

STEP 1 Switch the unit to hard **bypass**.

The **in/out** (nr off in earlier units) push button on the PS3 may be programmed via switch SW1 on the rear of the main frame to select either "hard-wired bypass" or "NR/SR out-soft bypass" (which means the signal is still routed through the input and output circuitry). To switch the unit to hard bypass:

SW1 Switch Position	Hard Bypass Method
"Hard bypass"	Operate the PS3 front panel **in/out** (or nr off) push button. All channels will switch to hard bypass.
"Soft bypass"	Operate the individual channel **bypass** push buttons.

See also: 5.7b "Using the XP/SRP Series units as a gain stage between recorder and console"

STEP 2 Adjust both the play and record aspects of the recorder, including the line level interfacing with the console. Adjust sync level controls (if available) to match the play level.

The recorder and console meters should match or have a known relationship during record and play. Correct the meter calibrations if necessary.

XP/SRP SERIES ALIGNMENT

The following alignment steps involve sending a 1 kHz tone from the console at Dolby level. In many studios this will be the normal studio line level, e.g., 0 VU. Further information on Dolby level can be found in Sections 5.5 and 5.6. See Figures 4-1, 4-2 and 4-3 for locating the front panel controls.

STEP 3 Restore the unit to normal operation by operating the **in/out** (or nr off) push button on the PS3 or releasing the individual **bypass** push buttons.

STEP 4 Check that all **uncal** knobs are pushed in fully and the **uncal** LEDs are off (Cat. Nos. 331 and 431 only).

STEP 5 Press the **line in** push button on the PS3. If you have Cat. Nos. 331 or 431, set the individual processing switches **OUT** (down position).

RECORD SIDE

STEP 6 Send a 1 kHz test tone at Dolby level (e.g., 0 VU) from the console to the XP/SRP Series unit.

STEP 7 Adjust the FROM CONSOLE control on the processing modules for Dolby level, equal brightness of the green LEDs.

STEP 8 Place the recorder in line-in, EE or record using blank tape. Adjust the TO RECORDER control on the processing module for unity gain by observing each recorder meter while depressing and releasing **bypass** on each channel. The recorder indications should be identical with individual **bypass** switches in and out.

PLAYBACK SIDE

STEP 9 Switch console meters to read from tape.

STEP 10 Adjust the **TO CONSOLE** controls on the processing modules for Dolby level (e.g., 0 VU) on the console meters.

STEP 11 Press the **normal** button on the PS3.

STEP 12 If you have Cat. Nos. 331 or 431, set the individual NR/SR switches **IN** (up position).

STEP 13 Press the **Set-up** push button on the PS3.

STEP 14 Adjust **FROM REC** on the processing modules for Dolby level, (equal brightness of the green LEDs).

STEP 15 Release the **Set-up** push button on the PS3.

Alignment is now complete.

Record a section of Dolby tone or noise on fresh tape as a reference for new recordings by pressing **Set-up** on the PS3. (Note that Dolby noise is recorded on tape 15 dB below Dolby level. This level difference is automatically compensated in the LED display when **Set-up** is selected.) Under these conditions, when using Dolby SR, the module will go into the **Auto Compare** mode. **Auto Compare provides the user with an accurate audible verification that both the tape recorder frequency response and the calibration levels are set properly regardless of the indications shown on the tape recorder meters and Dolby calibration displays.** Listen for level differences between the pink noise signal coming from the output of the tape and internal Dolby noise generator in the **Auto Compare** mode. The two LEDs on the front of the modules indicate whether the monitors are receiving the internal reference signal (red LED) or the Dolby noise from the tape recorder (green LED). The alignment procedure is correct when the levels between the tape and reference levels audibly match.

Note: Dolby level on tape will now have a fixed flux level that may be referred to in relation to the magnetic reference tape used in recorder alignment, e.g., "Dolby level is +4 dB above 185 nWb/m."

It may be useful to write the alignment details in the space provided on the insert card in the unit door.

5.3 Dolby level Taken from Tape
Aligning to Dolby Tone/Noise on a Previously Recorded Tape

RECORDER ALIGNMENT

The recorder must be aligned before calibrating the XP/SRP Series unit.

STEP 1 Switch the unit to hard **bypass**.

The **in/out** (nr off in earlier units) push button on the PS3 may be programmed via the switch SW1 on the rear of the main frame to select either "hard-wired bypass" or "NR/SR out-soft bypass" (which means the signal is still routed through the input and output circuitry). To switch the XP/SRP Series to hard bypass:

SW1 Switch Position	Hard Bypass Method
"Hard bypass"	Operate the PS3 front panel **in/out** (or nr off) push button. All channels will switch to hard bypass.
"Soft bypass"	Operate the individual channel **bypass** push buttons.

See also: 5.7b "Using the XP/SRP Series unit as a gain stage between recorder and console"

STEP 2 Align the recorder using the tones on the incoming tape as playback reference, and check that recorder and console meters agree, or bear a known fixed relationship.

XP/SRP SERIES ALIGNMENT

STEP 3 Restore the unit to normal operation by operating the **in/out** (or nr off) push button on the PS3 or releasing the individual **bypass** push buttons.

STEP 4 Check that all **uncal** knobs are pushed in fully and the **uncal** LEDs are off (Cat. Nos. 331 and 431 only).

STEP 5 Press the **normal** push button on the PS3. If you have Cat. Nos. 331 or 431, set the individual processing switches to **IN** (up position).

DOLBY LEVEL MATCHING

STEP 6 Replay the Dolby tone or noise from tape and then press **Set-up** on the PS3. When using Dolby SR, Cat. No. 431 or 531 modules will go into the **Auto Compare** mode. **Auto Compare provides the user with an accurate audible verification that both the tape recorder frequency response and the calibration levels are set properly regardless of the indications shown on the tape recorder meters and Dolby calibration displays.** Listen for level differences between the pink noise signal coming from the tape and the internal Dolby noise generator in the **Auto Compare** mode. The two LEDs on the front of the Cat. No. 431/531 module indicate whether the monitors are receiving the internal reference signal (red LED) or the Dolby noise from the tape recorder (green LED).

STEP 7 Adjust the **FROM RECORDER** control on each channel until the tape and reference levels audibly match in the **Auto Compare** mode or for equal brightness of the green LEDs.

STEP 8 Place the recorder in Line In, EE, or record using blank tape.

STEP 9 Adjust the **TO RECORDER** control on the processing modules for Dolby level (equal brightness of the green LEDs).

CONSOLE LEVEL MATCHING

STEP 10 Release the **Set-up** button. If you have Cat. Nos. 331 or 431, select **STANDBY** or **OUT** (down position) on the individual processing switches.

STEP 11 Send a 1 kHz test tone at a convenient level (e.g., 0 VU) from the console to the unit.

STEP 12 Observe the recorder meters with the **bypass** buttons depressed on the processing modules.

STEP 13 Release the **bypass** buttons and adjust the **FROM CONSOLE** controls for identical recorder indications with individual channel **bypass** buttons in and out.

STEP 14 Switch the console meters to read from Tape.

STEP 15 Adjust the **TO CONSOLE** controls to return the tone to the console meters at the same level (e.g., 0 VU).

STEP 16 If you have Cat. Nos. 331 or 431, set the individual Cat. No. 331/431 NR/SR switches **IN** (up position).

Alignment is now complete.

Dolby level is now adjusted to match the Dolby level on the incoming tape; the normal console/recorder level relationship remains the same. (Note that Dolby noise is recorded on tape 15 dB below Dolby level. This level difference is automatically compensated in the LED display when **Set-up** is selected).

5.4 Further Information on Alignment

For correct operation of all Dolby processing the signal level in the playback (decode) processor should be the same as in the record (encode) processor. Dolby units therefore require level calibration—lining up.

To make this calibration simple, all Dolby units provide a reference tone at a level fixed in relation to the internal processing, together with a display on which this level can be checked. This reference level is known as "Dolby level." With Dolby A-type noise reduction, Dolby level is indicated by Dolby tone, a tone with momentary modulations in pitch. With Dolby SR spectral recording, Dolby level is indicated by Dolby noise, a pink noise signal with a periodic nick every 2 seconds. These reference signals are intentionally different both from each other and from other alignment signals to distinguish between A-type, SR and other recordings, in addition to indicating Dolby level.

Dolby level is a high level reference: it is helpful to relate it directly to existing studio reference levels and metering principles: e.g., "0 VU", "ppm 5", "–6 dB". Dolby level may also be defined in terms of magnetic flux on tape since there is a fixed correlation between magnetic flux and console or recorder meter readings in any given studio. For further information on Dolby level for specific applications, please see Section 5.1.

For operational convenience the Dolby unit should be aligned to match the existing studio gain structure, in other words the combination of the recorder and Dolby unit are aligned for unity gain. When carrying out regular in-house alignment, it is simplest to send a tone at Dolby level from the console and align for the same unity gain structure as there is when the unit is bypassed. When aligning to a tape from another studio, it may be necessary to take the Dolby level recorded on the tape as the starting point, and set up the unity gain structure from there. For this reason there are two alignment procedures set out here; the first (Section 5.2) sets Dolby level to a tone from the console (Console Level Reference), the second (Section 5.3) to a different Dolby level recorded on a tape from another studio (Tape Level Reference).

5.5 Dolby level with Dolby A-type Noise Reduction

Historically, the existence of two different metering practices has led to two distinct approaches to equipment alignment. These in turn affect the approach to the alignment of Dolby noise reduction. To simplify A-type alignment, reference to the more common operating level standards of 'NAB' and 'DIN' was made in earlier A-type calibration procedures.

'NAB' and 'DIN' date back to when the NAB reference of 185 nWb/m (Ampex operating level) was always read on a VU meter as 0 VU, and the DIN (German) standard of 320 nWb/m (a peak reference level) was read as 100% modulation, ppm 6, or 0 dB on a peak reading meter. The actual difference between the two is between 4 and 5 dB.

The introduction of high output tapes led to actual flux levels on tape being elevated above these standard references, and to the use of higher level reference tapes, e.g., 250 nWb/m. At the time some studios elevated Dolby level along with the reference level while others kept Dolby level at 185 nWb/m. This situation became further complicated by some studios assuming all other studios to be using the same operating procedures and failing to record a section of Dolby tone with the flux level reference tones. Confusion and incorrect operating procedures sometimes resulted.

Dolby tone is also a positive indication of tape recorder tracks that have been Dolby A-type encoded.

Today most music studios using VU meters conveniently use a Dolby level equal to the flux level that corresponds to 0 VU.

Broadcasting studios and others using peak reading meters with a Peak Level reference often use a Dolby level equal to the flux level corresponding to 4.7 dB below 100% level.

Film studios will use a 320 nWb/m reference for 0 VU but Dolby level will always be at 185 nWb/m.

Video facilities use a Dolby level reference of 100 nWb/m.

Whichever test tape is used, and whether the level is elevated above that reference or not, a short recording of Dolby tone will always permit correct decoding or overdubbing at any time by any studio, regardless of the flux level used for Dolby level. Dolby tone, easily recognized by its characteristic warble, must always be aligned to the two green LEDs.

5.6 Dolby level with Dolby SR

In general, the principles governing Dolby A-type alignment and Dolby level can be applied directly to Dolby SR alignment. In certain cases, however, a direct application of A-type alignment principles could compromise the dynamic range obtainable with Dolby SR on magnetic tape.

To get the most from Dolby SR, Dolby level should be optimized so that the noise floor of the SR system electronics is below that of the recording medium with SR processing. In this way headroom of the SR circuitry is not wasted. With magnetic tape, this means that Dolby level will lie between 100 nWb/m and 320 nWb/m.

For example:

In VU meter studios, using a flux level for 0 VU at 320 nWb/m or less, Dolby level on steady state tone (e.g., 1 kHz) can conveniently correspond to 0 VU.

(If the magnetic flux level for 0 VU is greater than 320, e.g., 400 nWb/m, Dolby level should be set to a convenient point on the meter 4 to 6 dB below 0 VU. See 5.6.1, Dynamic Range with Dolby SR.)

In peak meter studios, optimal Dolby level on steady state tone (e.g., 1 kHz) will be 8 to 12 dB below the actual program peaks as read on the meter. Consequently, Dolby level should be set at a convenient point on the meter to 8 to 12 dB below the maximum signal peak reading.

(If for example your "0" dB peak corresponds to 514 nWb/m magnetic flux and program peaks reach "+3 dB," set Dolby level to ?6 dB on steady state tone.)

It may be useful to record a section of 1 kHz tone at Dolby level for use as an "in-house" reference tape.

Dolby level is indicated by equal brightness in the two green LEDs on the Cat. No. 431/531 SR modules. Dolby noise should read Dolby level when, and only when, the **Set-up** button is pressed.

5.6.1 Dynamic Range with Dolby SR

Strictly speaking, when studios use 320 nWb/m for "0" VU the dynamic range may be a 1 or 2 dB greater with Dolby level set to 200 nWb/m ("–4" VU) rather than "0" VU.

A consideration of the relationship between "operating level" (e.g., 0 VU) and Dolby level shows why setting Dolby level at 185/200 nWb/m offers slightly greater dynamic range than at 320 or 400. To obtain the greatest improvement from SR, the electronic noise of the SR processor should be substantially lower than the tape noise, that is, when the two are added together the tape noise should be dominant.

Figure 5-1 shows that the tape noise is dominant if Dolby level is set at 185/200 nWb/m. However if Dolby level is at 320 nWb/m the noise of the electronics and the tape noise are comparable, and therefore the total noise is 2 to 3 dB higher than it would have been if the contribution of the electronics had been negligible.

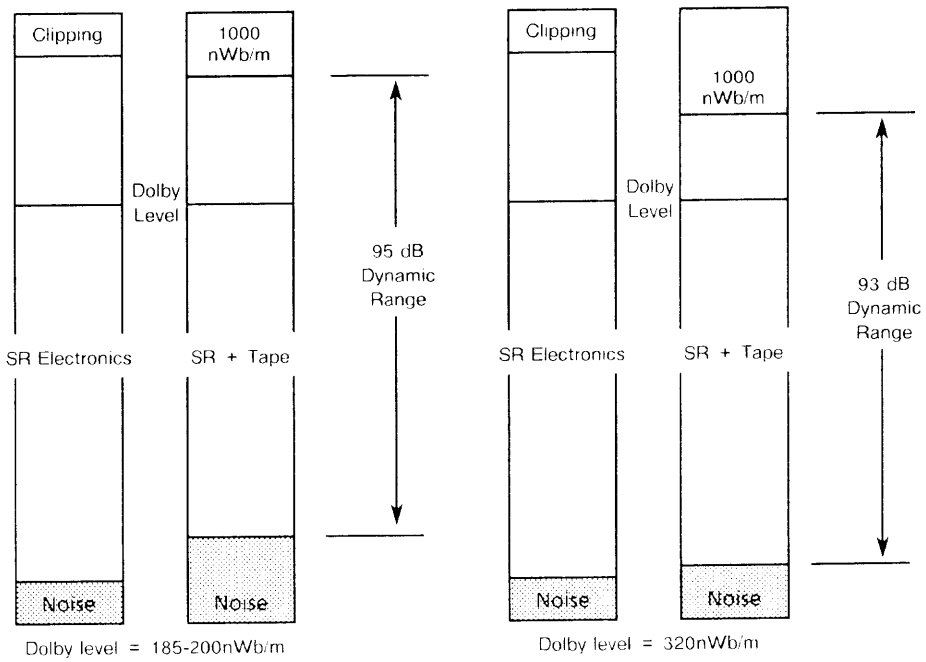


Figure 5-1 Typical Noise and Overload Levels

With a recorder running at 15 ips (38 cm/s) typical results are as follows (all noise levels CCIR/ARM weighted):

Relative to Dolby level at 185 nWb/m

tape noise plus electronics	–80 dB
audible tape distortion	+15 dB
effective dynamic range	95 dB

Relative to Dolby level at 320 nWb/m

tape noise plus electronics	–83 dB
audible tape distortion	+10 dB
effective dynamic range	93 dB

Changing Dolby level from 320 to 185 nWb/m increases the dynamic range by about 2 dB. This order of improvement would be measured rather than heard. In most real recording situations with Dolby SR, the overall performance of the recording system is limited by noise from microphone pre-amplifiers, other electronic processing equipment such as delay lines, or frequently the ambient noise level at the recording location.

5.7 Level and Impedance Matching with the XP/SRP Series

If your console and recorder output impedances are low (<50 ohm) and input impedances are high impedance bridging (>10k ohm), as will be the majority of studio installations, you should not experience any level mismatch.

a. Output trimming due to impedance mismatch.

Recorder output levels should not be affected when switching the unit from bypass to in-circuit. Trimming may be required with low-impedance (600 ohms) inputs. The unit has high impedance bridging inputs, but when it is bypassed the output of the recorder is loaded directly by the tape return input impedance of the console. If this impedance is low the output level of the recorder may fall slightly. Correct setting of the termination switches on the recorder is usually sufficient to eliminate discrepancies in level so that minimal trimming of the recorder output level is required.

b. Using the XP/SRP Series unit as a gain stage between recorder and console.

Bypassing the unit may be impractical in installations where it doubles as a gain stage between the recorder and the console, or where the signal level changes when bypass is selected because of the input and output impedances of the console and the recorder. For this reason, the user has the option of selecting the function of the PS3 **in/out** (or nr off) push button by the use of switch SW1 on the rear of the main frame. In the "NR out" position, the PS3 **in/out** push button disables the noise reduction/spectral recording function (standby/out mode) leaving the input and output line amps still in circuit, whereas in the "bypass" position the PS3 **in/out** push button places the unit in hard-wired bypass.

If the installation requires use of the unit for signal gain, a meter must be used to set the proper levels at the inputs and outputs during initial calibration.

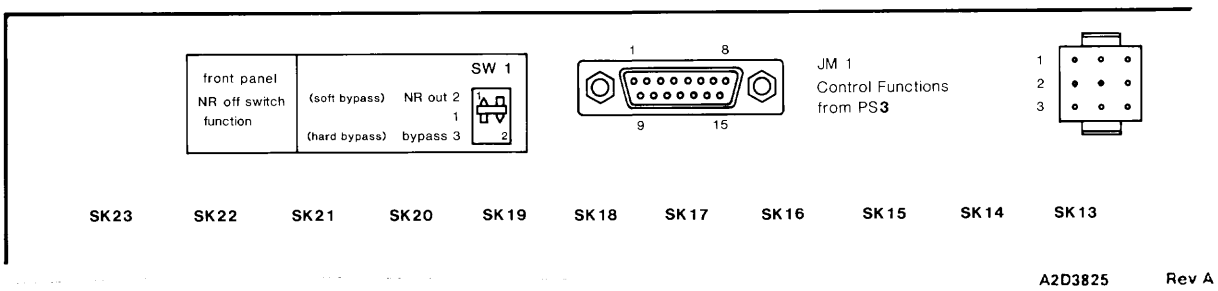


Figure 5-2 Switch on the Rear of the XP/SRP Series Frame

5.8 Maximum Output Level and Dolby Level

The maximum output level of the Cat. No. 331, 431 and 531 modules is +24 dBr into an impedance greater than 600 ohm giving 20 dB of headroom above Dolby level where Dolby level is set to +4 dBr, or 16 dB of headroom if Dolby level is set to +8 dBr. Note that the clip point of the processing circuit itself is approximately 21 dB above Dolby level.

The Cat. No. 331 and Cat. No. 431 modules have a **clip** indicator that warns that the peak level of the input signal has exceeded the output capability of the module. Should this LED occasionally flash, the peak program level through the module is too high. In a properly calibrated recording system, the maximum peak level of the program material will be determined by the tape overload characteristics and the interface electronics should never clip the audio. If, however, the reference flux level established for Dolby level is either too low or the output level of the interface is set too high, the peak level can exceed the established Dolby level enough to clip the internal electronics and the warning indicator will flash.

(0 dBr = 0.775 V)

SECTION 6
OPERATION

The following instructions apply for normal operation of XP or SRP Series units, regardless of the conditions of operation or method of initial calibration (see Sections 4.2 and 4.3).

REMEMBER

For correct decoding: Whenever a recorded Dolby noise signal or Dolby tone on your own tape or on a tape from another studio is played back with the **Set-up** button depressed, the green calibration display LEDs should glow with equal brightness.

6.1 Initial Check

STEP 1 Make certain the individual channel **bypass** push buttons on the processing modules are released.

Step 2 Cat. Nos. 331 and 431:
Set all NR/SR switches on the modules to the **IN** position (up), unless Dolby processing is not required on a particular channel.

Cat. No. 531:
Skip this step. It is not possible to turn off the processing of individual channels (except by means of the **bypass** push button).

Step 3 Cat. Nos. 331 and 431:
Check if the **uncal** adjustments are in use by observing the **uncal** lights. If the normal calibration is to be used, push the **uncal** knobs in so that the **uncal** lights are off (see 6.3 below for use of the **uncal** adjustment).

Cat. No. 531:
Skip this step. There are no **uncal** controls.

STEP 4 Push in the **in/out** push button (or release the **NR off** button on early PS3's) and press the **NORMAL** monitor push button on the PS3. Check that the **Set-up** push button is released.

If remote operation of the PS3 common facilities functions is in use, only the **Set-up** push button will continue to function locally.

The unit is now ready for use. The tape recorder is used normally. The output of the recorder should be set to monitor off tape.

6.2 Tape Variations

The XP/SRP Series electronics are extremely stable. After the unit has been calibrated, any discrepancies in level are usually caused by variations in tape or possibly by changes in the characteristics of the recorder.

A convenient way to compensate for a small discrepancy in the recording level caused by a change in tape sensitivity is simply to record Dolby tone or noise on the blank tape and to adjust the input or record level controls on the recorder until the discrepancy is eliminated.

In any event, do not start adjusting the XP/SRP Series unit until after the recorder and tape have been checked thoroughly. During any tape recorder alignment, operate the PS3 **in/out** push button (if switch SW1 on the rear of the main frame is in **bypass**) or press the individual channel bypass buttons.

6.3 Tapes from Other Studios

If you receive a tape from another studio, the level of the Dolby tone/noise recorded on it must be matched to the Dolby level in your XP/SRP Series unit. For this purpose, disregard the levels of any tones on the tape other than the Dolby tone/noise. Note that a discrepancy in Dolby level does not necessarily mean that the other studio has aligned its recorder and/or Dolby units carelessly; there may be a difference in track width between your recorder and theirs (or, if the difference is as much as 2 or 3 dB, they are using a Dolby level standard that differs from yours).

If you have Cat. Nos. 331 or 431, a simple and fast way to align the unit for tapes from other studios is to use the "**uncal**" feature. Pull the **uncal** knobs and press the PS3 **Set-up** push button. While the recorded Dolby tone/noise on the tape is playing, adjust the **uncal** knobs for equal brightness of the green display LEDs. This adjustment trims the **FROM REC** calibration and simultaneously trims the **TO REC** calibration for proper over-dub and punch-in levels. To disable the **uncal** feature, merely push the **uncal** knobs "in" which returns to your pre-set calibration. The Cat. No. 531 SR processing module does not have this facility.

6.4 Good Operating Practice

The following notes cover routine day-to-day alignment information and hints on good practice when using Dolby SR or A-type signal processing.

1. **Recording Dolby tone or Dolby noise**: At the start of each new tape, always record a section of Dolby tone (A-type NR), or Dolby noise (SR) (the type of calibration signal automatically follows the choice of SR or A-type signal processing). This will be important later for other operators to identify the tape processing used, and for them to calibrate to their own operation.

2. **Playback and check**: If you are playing a tape that uses A-type or SR, play back the Dolby tone or Dolby noise section. Select 'Set-up' mode and check that the LED display reads Dolby level (equal brightness of the green LEDs). Remember to release the **Set-up** button when you have finished.

3. **Auto Compare**: While playing Dolby noise in the 'Set-up' mode, you are able to listen to the 'Auto Compare' feature. The monitor output will switch between Dolby noise from tape, and pink noise direct from the reference generator. Any substantial audible variation between the two will indicate a difference between the performance of the recorder and the player. Make sure only one track at a time is feeding the loudspeakers. The LED calibration display, however, will continuously read from tape.

4. **Monitoring off-tape**: Normal monitoring will provide a 'Line-In' signal during the record process, or a decoded playback signal in all other modes. In some recorders, a 'check' or 'confidence' tape replay is provided while recording. Pressing the Check Tape button allows the operator to hear the tape signal in this situation, although it will be in the encoded form. The encoded sound is not intended for quality monitoring, but will be adequate to confirm that the recording is taking place, the presence of tape drop-outs, and the accuracy of edits. If full quality monitoring is needed while recording, a second set of Dolby processors can be connected to the recorder output for decoding.

5. **Tape copying**: In normal operations, all audio signals will be encoded before the recording, and decoded on playback. This keeps the processing as a part of the machine's recording characteristic and is an automatic process. If tapes need to be copied, and processing equipment is not available, this can be done simply by making a direct copy of the encoded tape, taking care to keep levels and frequency response constant. The encoding characteristic will be transferred accurately. Make sure you also transfer the original calibration tones, including Dolby tone or Dolby noise.

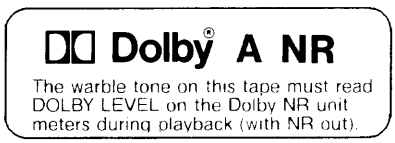
   NOTE: When the signal is in an encoded form, dynamic and equalization changes to the signal will result in incorrect decoding. These changes, which include fades or mixes, equalization or limiting/compression, should be made on the decoded signal before re-encoding and re-recording the signal.

6. **Editing**: When editing a Dolby SR encoded tape, it may prove advantageous to monitor the encoded signal with decoding switched OUT. This will give less of a low frequency bias to the sound when rolling the tape slowly over the heads to finalize the edit point.

7. **Box labelling**: It is good practice to mark clearly on the tape box and/or recording report information describing the recording. In addition to the normal information, this should clearly indicate details of:

   Processing system (A-type or SR)
   Recording reference level
   Dolby level
   Details of the calibration signals recorded on tape

8. **Reel Labelling**: Use "Dolby A" stickers (Cat. No. 100) on your tapes to identify Dolby A-type encoded recordings or "Dolby SR" stickers (Cat. No. 400) on your tapes to identify Dolby SR encoded recordings.



Cat. No. 100

Cat. No. 400

9. **Remember**—to ensure correct calibration:

   a. Always record Dolby noise or Dolby tone at the head of each track.

   b. Always align Dolby noise and Dolby tone on playback in the 'Set-up' mode for Dolby level.

SECTION 7
PRINCIPLES OF NOISE REDUCTION AND SPECTRAL RECORDING

7.1 Introduction

The XP/SRP Series may contain Dolby A-type noise reduction (using Cat. No. 331 modules) or Dolby spectral recording (using Cat. No. 431 or 531 modules). There are two other analog Dolby systems, B-type and C-type. All employ some principles in common: for completeness, the following contains brief descriptions of all. More detailed descriptions of A-type and SR can be found in the appendices.

7.2 General

In sound recording or transmission the higher audio frequencies are often pre-emphasized to improve the signal-to-noise ratio (see Figure 7-1). However the equalization characteristic must be chosen so that even in the worst cases there are no detrimental effects: material rich in high frequencies must not cause distortion. Therefore the allowable boost with fixed equalization is limited and the degree of noise reduction is modest.

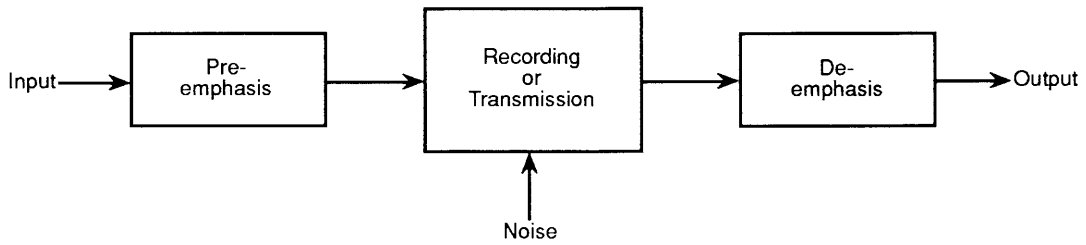


Figure 7-1 Fixed pre- and de-emphasis

Systems which improve the signal-to-noise ratio by compression in the encoding mode followed by expansion in subsequent decoding are known generally as compandors. Figure 7-2 shows the block diagram of a typical system.

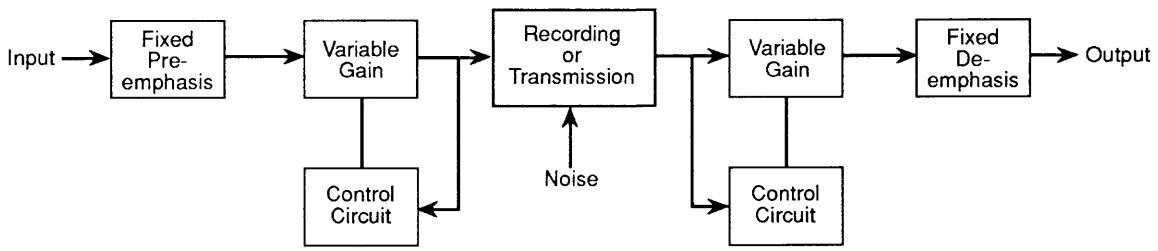


Figure 7-2 Typical compandor

The variable gain blocks change gain under the control of the signal level, most commonly with a straight-line relationship when the compressor output is plotted against its input using decibel scales; such a system is known as a constant slope compandor. The noise level at the output of the expander rises as the signal level rises. A loud signal in one area of the spectrum will mask noise in that same area, but the variation in noise in other areas may be audible. Compandors of this type are inherently susceptible to this audible variation in noise level, called noise modulation.

Noise modulation can only be eliminated by ensuring that the gains of the encoder and decoder in any particular part of the spectrum are fixed except when signals are present in that part of the spectrum at levels above a defined threshold. The output noise will then be constant in all parts of the spectrum except those where signals are present to mask the changes in noise.

A system with this property must be capable of changing gain in any one area of the spectrum without changing at others. Clearly in a conventional compandor (such as in Figure 7-2), any change in gain occurs at all frequencies equally, so that a signal at any one frequency must inevitably alter the noise level at other (unmasked) frequencies.

Constant slope compandors have no upper or lower thresholds, and hence possess the virtue that there is no need to ensure that the absolute signal levels in the compressor and expander are equal. A superficially attractive idea is to use several constant slope compressors each fed by a separate band-splitting filter. Unfortunately because of the practical limits on filter slopes and the absence of compressor thresholds, each band compressor receives signals (albeit attenuated) from the other bands and responds with gain changes. It can be shown that a change in input signal at any particular frequency that causes x dB gain change in one band causes exactly x dB change in all the other bands. Thus, constant slope split band compandors also inevitably lead to audible noise modulation.

The solution is to employ a defined low-level input threshold below which the frequency dependent gain or loss of the processor is constant. Together with appropriate frequency response adaptation it is then possible for the processor to keep its sub-threshold gain or loss except in those areas of the spectrum where high level signals mask the noise. If the gain or loss in unmasked regions of the spectrum is constant, then there can be no noise modulation. Such a response adaptation and low-level threshold are features of all the Dolby systems.

If the level of an input signal at a particular frequency increases abruptly, an encoder must reduce its gain in response to that new level. This gain reduction occurs over a finite time during which the encoder output level will be excessive: this excess level is known as overshoot. In general the magnitude of an overshoot corresponds to the degree of gain reduction and its duration to the response ("attack") time. Provided the overshoot does not lead to overloading of the recording or transmission system, it is harmless. However for high level signals overshoot can cause transient distortion and non-complementary behavior in the decoder. (Note in passing that it is possible to use instantaneous or near-instantaneous attack to eliminate overshoot, but such an approach can be disastrous subjectively because of wide-band modulation products.)

The Dolby systems use a dual-path configuration in which the input signal passes directly from input to output; the processing consists of the addition or subtraction of a further signal whose maximum amplitude is small compared with the maximum amplitude of the input. This method imposes an upper threshold above which gain reduction ceases (see Figures 7-3 and 7-4); note the fixed gains at low and high levels. This shape of characteristic permits overshoot suppression within the further path. The result is that overshoots resulting from high level signals are much smaller than the degree of gain reduction, and there is little danger of transient overload of the recording or transmission system.

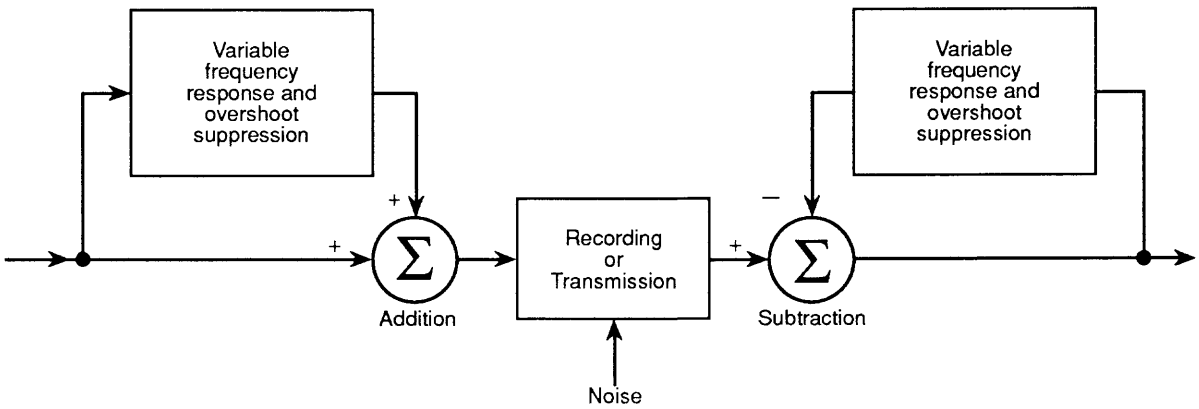


Figure 7-3 Dual-path configuration of all Dolby systems

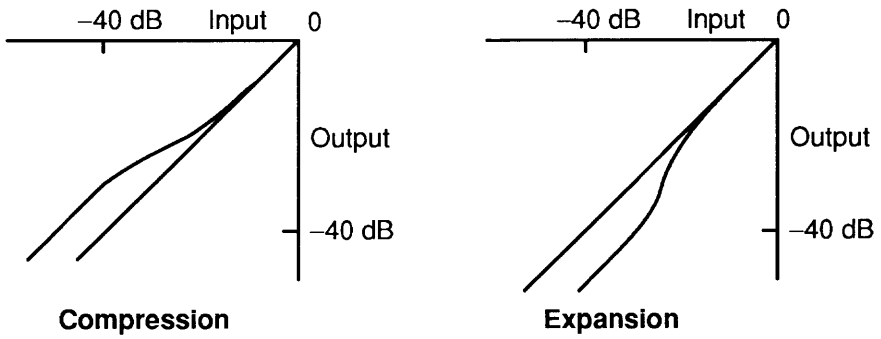


Figure 7-4 General form of compression and expansion characteristic of all Dolby systems

7.3 Dolby A-type Noise Reduction

A-type noise reduction (nr) is a professional system introduced in 1966, and manufactured only by Dolby Laboratories. It provides 10 dB of nr over most of the audio spectrum rising to 15 dB at very high frequencies. The requirement for variable frequency response is met by dividing the frequency range into four bands, each with its individual compressor (see Figure 7-5). A high-level signal in one band does not affect the other bands, where noise may not be masked, and hence in general the system does not give audible noise modulation.

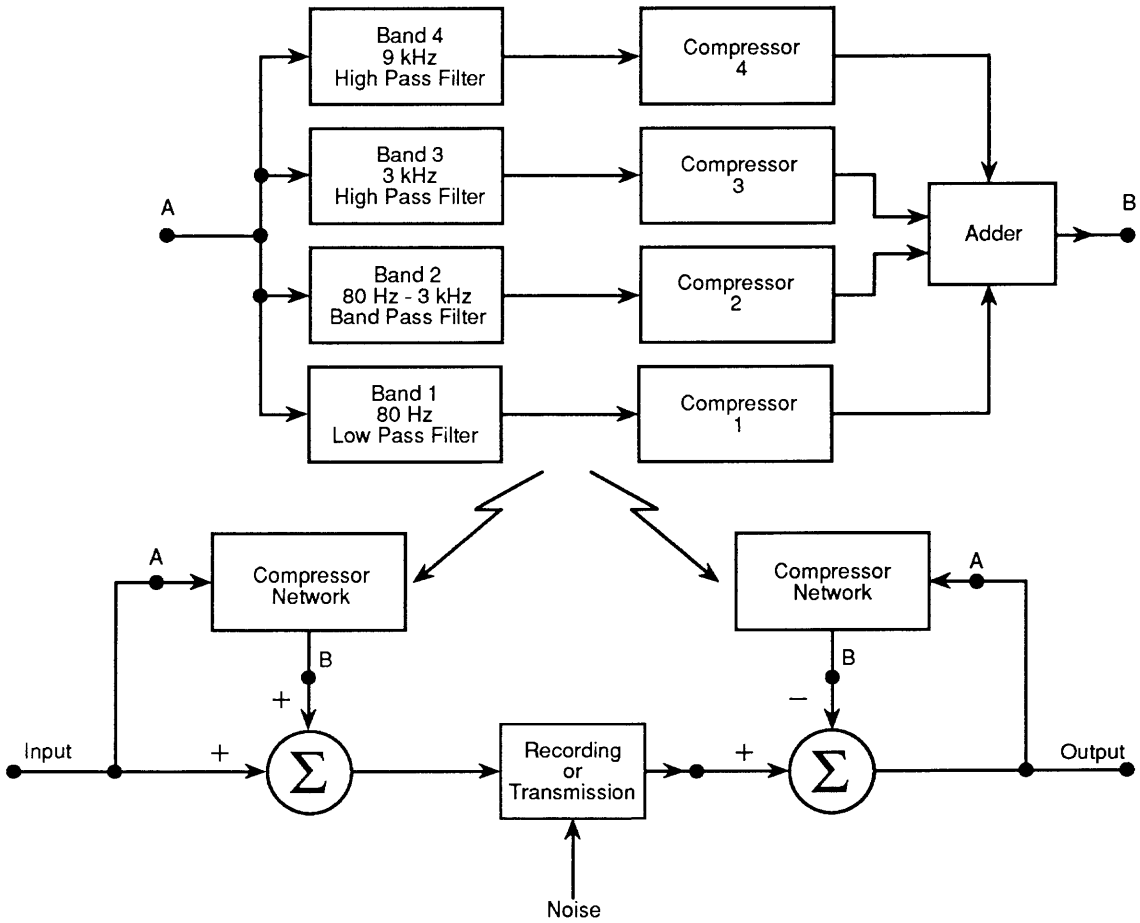


Figure 7-5 Block diagram of A-type noise reduction

A-type nr is in widespread use throughout the recording, broadcast and film industries. It is an essential ingredient in the film release format known as Dolby Stereo.

7.4 Dolby B-type Noise Reduction

B-type nr is a consumer system intended primarily for use with low-speed tape, especially the Philips compact cassette. It was first introduced in 1969. It reduces tape hiss by 10 dB. Unlike A-type nr, it uses only one frequency band: instead of providing variable gain within a fixed range of frequencies it provides fixed gain (or cut in the decoder) within a band of variable width. It can be considered as a high frequency emphasis of fixed magnitude whose start and stop frequencies slide upwards along the frequency axis so as not to boost the dominant, high level spectral components of the input while providing a fixed 10 dB of nr at frequencies above those dominant components (see Figures 7-6 and 7-7). At any one frequency the output/input characteristic of the encoder displays gentle compression, permitting complementary expansion in the decoder. The fixed magnitude ensures that noise not masked by the input signal has a fixed level, and therefore no noise modulation is perceived.

The vast majority of B-type circuits are built under license from Dolby Laboratories Licensing Corporation by over 200 world-wide licensees who include all the major manufacturers of consumer tape recorders. Dolby Laboratories manufactures small numbers of professional B-type processors for use in the preparation of pre-recorded tapes (audio cassettes and VHS video cassettes).

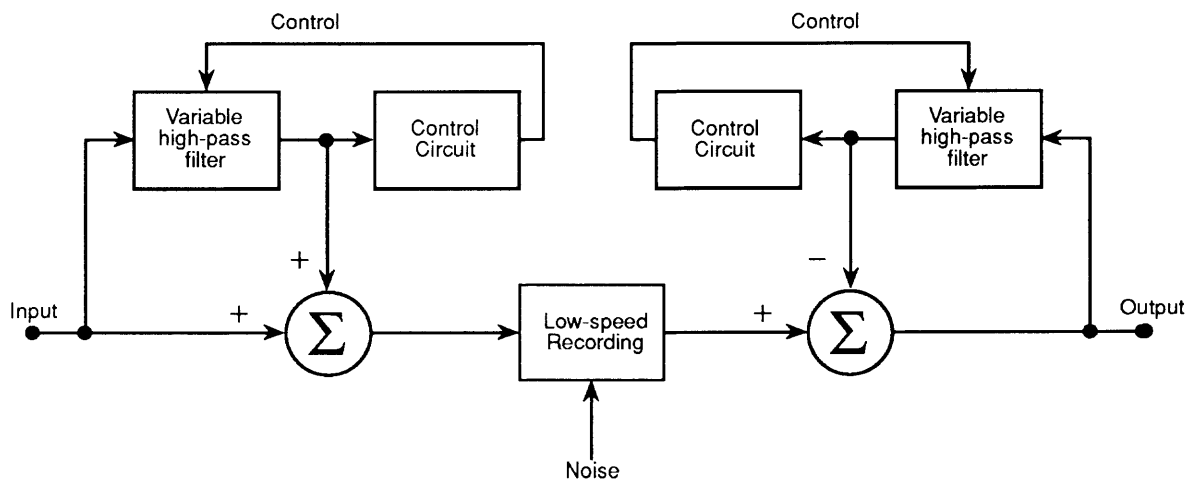


Figure 7-6 Block diagram of B-type noise reduction

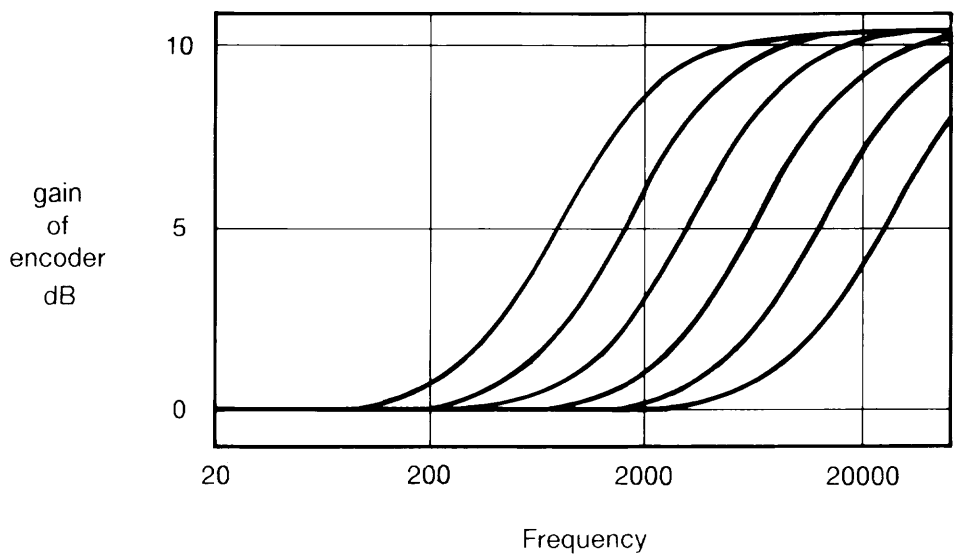


Figure 7-7 Family of response curves for B-type noise reduction

7.5 Dolby C-type Noise Reduction

C-type nr was introduced in 1980 and is used in consumer audio cassette recorders and in the audio channels of professional Betacam*, MII*, and U-matic SP* video recorders. It operates in a manner similar to B-type, but offers 20 dB of nr. It achieves the steeper filter slopes required to give adequate nr at high frequencies in the presence lower frequency dominant signals by employing two overlapping processor stages in tandem, operating with offset ("staggered") thresholds and with an action extending two octaves lower than B-type (see Figures 7-8 and 7-9).

Frequency shaping ("spectral skewing") at the input of the encoder desensitizes the processor to the effects of high frequency response errors. Additional shaping in the main path ("anti-saturation") lowers the amplitude of high frequency high level signals before they are applied to the tape, reducing high frequency distortion and self-erasure.

The decoder contains complementary circuits to restore the frequency response: the amount of nr at the highest frequencies is decreased, but this is where the ear is least sensitive to noise.

Virtually all C-type circuits are built under license.

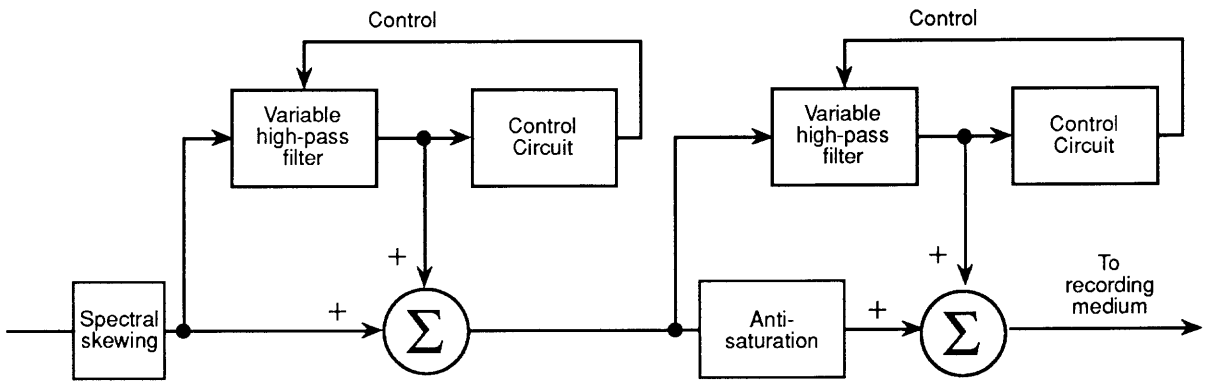


Figure 7-8 Block diagram of C-type encoder

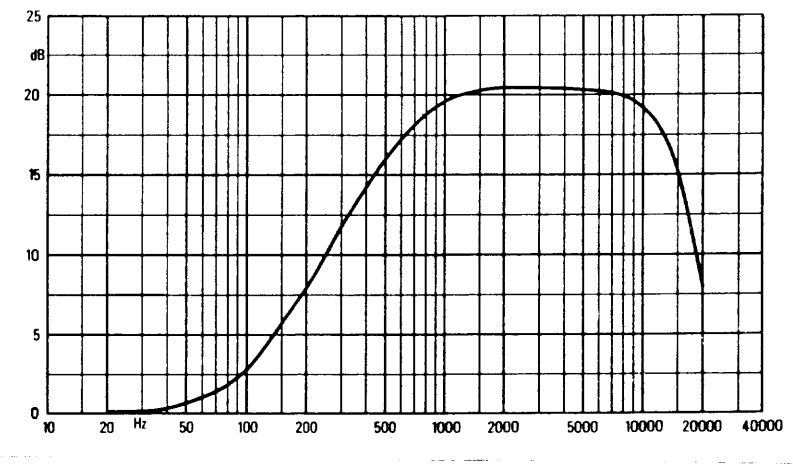


Figure 7-9 Low-level C-type encoder response

*Betacam and U-matic are trademarks of Sony Corporation, and MII is a trademark of Matsushita Electric Industrial Co. Ltd.

7.6 Dolby Spectral Recording

Introduced in 1986, Dolby spectral recording (SR) is a professional system which combines all the advantages of fixed bands (as in A-type) with the spectral adaptation of sliding bands (as in B-type and C-type). It also employs spectral skewing and anti-saturation, but applied at low frequencies as well as high.

SR uses three high frequency and two low frequency stages in tandem, with a crossover at 800 Hz (see Figure 7-10). Together they result in a reduction in audible noise of 24 dB (see Figure 7-11), taking into account the frequency dependent sensitivity of the ear.

The SR processor response adapts to the input spectrum to obtain full unchanged boost except in the immediate neighborhood of dominant frequencies. In this way, the system reduces not only noise but other unwanted signals such as tape modulation noise and distortion products introduced between the encoder and decoder.

The spectral skewing and multi-stage processing give greater tolerance to level and frequency response errors compared with A-type nr.

Dolby SR circuits are built exclusively by Dolby Laboratories.

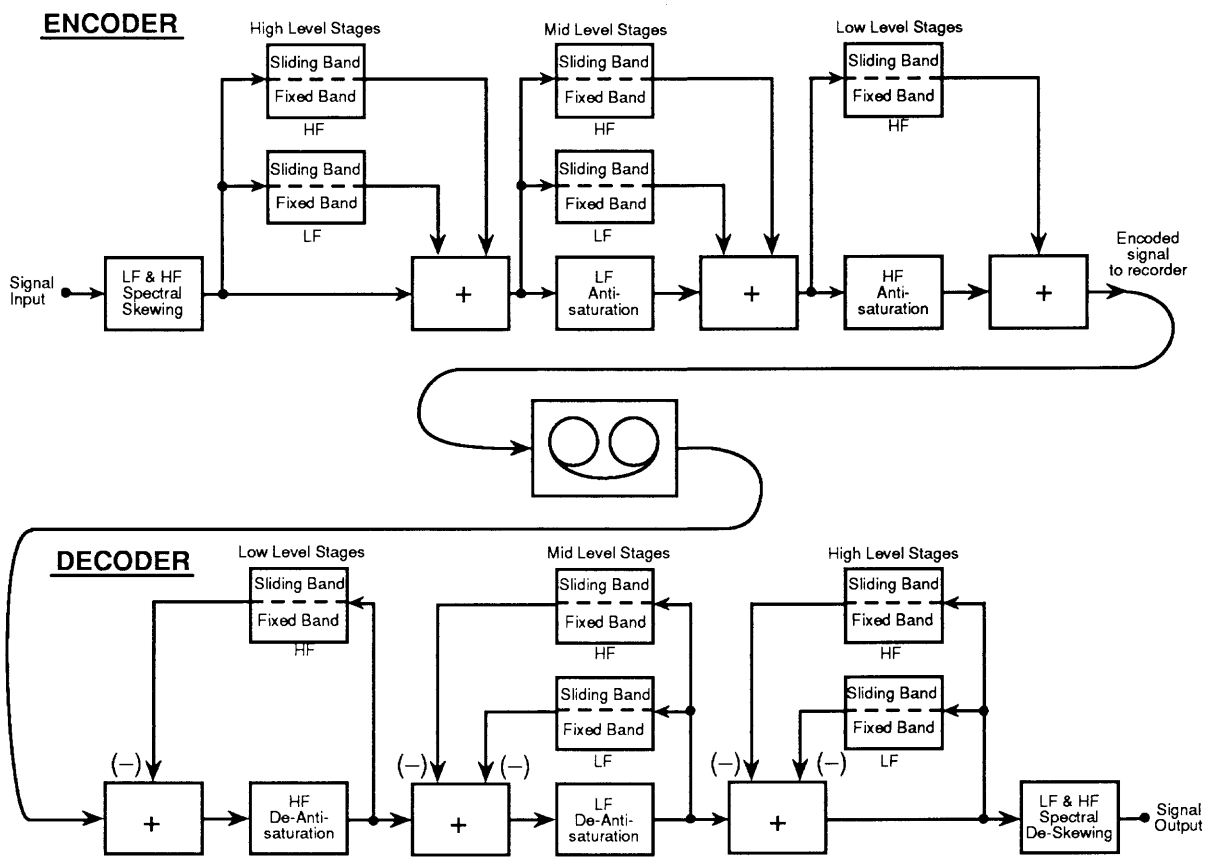


Figure 7-10 Block Diagram of Dolby SR

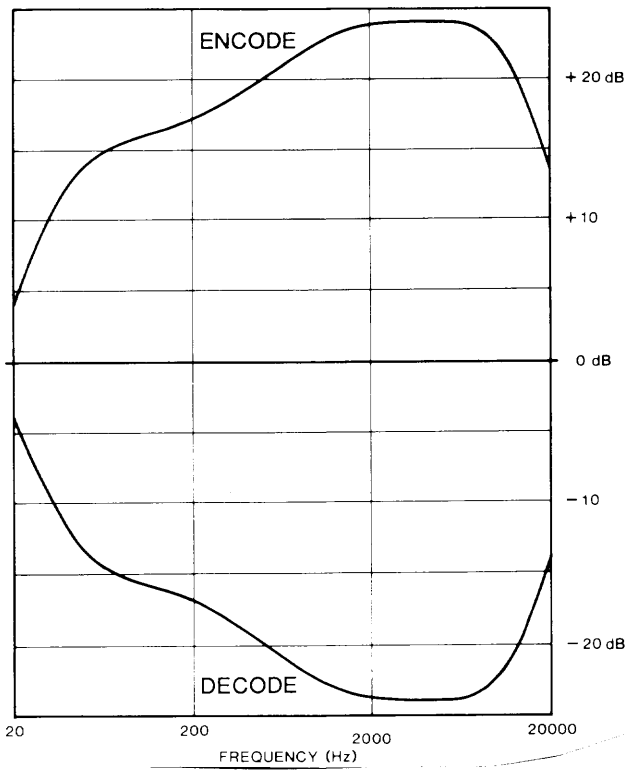


Figure 7-11 Low level response of Dolby SR processor

SECTION 8
CIRCUIT DESCRIPTIONS

8.1 Cat. No. 331

The Cat. No. 331 circuit module provides input and output interfacing for the A-type noise reduction (NR) circuit, the noise reduction circuit itself, metering of Dolby level, and bypass capability for the channel. In the record mode, the signal passes via the **FROM CONSOLE** input and the NR circuit to the **TO REC** output. The unencoded signal is sent to the **TO CONSOLE** output for monitoring. In the play mode, the signal passes through the **FROM REC** input and into the NR circuit where it is decoded and passed on to the **TO CONSOLE** output.

Each section of circuitry is described separately. The schematic diagram and the block diagram are located in Section 10.

8.1.1 Input Stages

Nearly identical op amp stages are used for the **FROM CONSOLE** and **FROM REC** inputs. These stages are balanced and virtually floating (750 k ohm impedance from either input to ground), using an instrumentation-style input made up of two operational amplifiers—op. amps (IC501, IC601). Gain is controlled by a variable attenuating pad in the input network to the op. amps. Jumpers S501/S502 and S601/S602 are provided to unbalance the input pad for single-ended inputs, thus preventing common-mode overload of the stage.

An NE5532 (IC501) dual op. amp is used for the **line In** input to provide a low-noise stage. A low-pass network of capacitors and coupled inductors roll off frequencies above 250 kHz to minimize AM detection at the bipolar op amp inputs. A TL072 op amp (IC601) is used for the **FROM REC** input; noise is not of critical concern here because this stage is within the NR loop. Again, a low-pass network is used at the head of this stage, but without the coupled inductors; AM detection is not as serious a problem with FET input amplifiers as with bipolar input amplifiers.

The outputs of each of the input stages pass to filter stages made up of IC502a, IC502b, and associated components that include C508 and C608. These filters (34 kHz low-pass and 4 Hz high-pass) prevent out-of-band signals from entering the noise reduction circuitry in both the encode and the playback modes.

8.1.2 Output Stages

Two identical output stages (for both the **TO REC** and **TO CONSOLE** signals) drive either single-ended or balanced inputs with a maximum +24 dB signal into 600 ohms or higher (relative to 0.775V rms). When it is driving a balanced load, the amplifier operates as a simple single-ended output amplifier, using the common-mode rejection (CMR) of the following balanced input for noise rejection. When it is driving a single-ended load, the amplifier operates with a reference input to sense the "ground" of the load, and thus provides the noise rejection itself. Single-ended or balanced mode operation can be selected via jumpers S503 and S603.

Each output amplifier consists of a transconductance stage that drives a discrete op. amp. This topology allows gain to be controlled with a single variable resistor in the negative feedback loop of the discrete op. amp stage (giving a constant signal-to-noise ratio independent of gain setting), while permitting the non-inverting input of the stage to be used directly as the sense input.

The transconductance stage consists of a TL072 op. amp (IC505) with a combination of negative and positive feedback. A selected resistor in the positive loop (R537, R637) balances the gains of both negative and positive feedback loops and provides a nearly infinite output impedance for the stage. Note that there is a phase inversion in IC505a with respect to IC505b to compensate for the extra inversion in the **CAL/ UNCAL** circuit (IC504a).

The discrete output stage utilizes a standard op. amp topology. A differential PNP input stage (transistors Q508/Q509, Q608/Q609) with an active load (Q510/Q610) drives a single-ended gain stage (Q512/Q612). An emitter follower (Q515, Q615) drives the output devices (Q517/Q518, Q617/Q618) which are biased in class AB mode. Short-circuit protection is provided by sensing the voltage drop across the emitter resistors of the output transistors (R555/R556, R655/R656) with devices Q516/D507 and Q616/D607. An inductor in the output path is coupled to an inductor in the negative feedback path (L502, L602) to ensure stability with large capacitive loads. Pole-zero compensation (capacitor/resistor C512/R545, C612/R645) provides stable operation. The output signal is AC coupled through capacitors C517 and C617 to the input/output connector. The output offset of the amplifier is purposely set at about +200 mV DC by resistors R535 and R635 to ensure a small bias on the output coupling capacitors C517 and C617.

8.1.3 Calibration Display

The display accurately monitors Dolby level signals over a practical range as well as signals at the upper and lower ends of the signal range. Dolby level is indicated when two green LEDs (DS726 and DS727) glow with equal brightness. These Dolby level indicators are placed between two red LEDs (DS725 and DS728) which indicate signal levels ±3 dB around Dolby level. DIN level (approximately 4.7 dB above Dolby level) is indicated by equal brightness of two orange LEDs (DS723 and DS724). "Presence of signal" (approximately 40 dB below Dolby level) is indicated by orange LED DS729. "Clip" is indicated by the red rectangular LED DS722.

The circuit can be divided into three sections; the "main array," the "presence of signal" indicator, and the "clip" indicator. The main array and the presence of signal indicators take their input from the amplifier output (IC709b) which amplifies the audio signal present at the input of the NR side chain. The clip indicator monitors the outputs of the **TO REC** and **MON** line amplifiers and the internal level of the NR circuit.

The rectifier for the main array display is diode D711, followed by inverting buffer Q708. Transistor Q707 in the collector of Q708 provides a temperature compensated voltage drop that balances the DC offset of the rectifier and buffer. Capacitor C711 (4.7 µF) smoothes the rectified signal. The output of the buffer is compared via comparators IC705a/b/c/d and IC706c/d with appropriate reference voltages derived from the series combination of diode D712 and zener DZ713. The LEDs are driven by the comparators in a manner that permits only one LED to be fully on at one time. To obtain the LED cross fade for Dolby and DIN levels, the weighted audio signal at the input of the rectifier is mixed with the output of the buffer at the inputs of comparators IC706a/d, thus switching the cross-fading LEDs back and forth in proportion to the offset between the rectified signal and the reference voltage.

A similar arrangement (with a different amount of addition of the weighted audio signal) is used to cross-fade the transition between the two green Dolby level LEDs and the adjacent red LED. In operation, whenever recorded Dolby tone causes either of the green LEDs to be lit, decoding will be excellent. Decoding is most accurate when the LEDs are equally bright. If only a red LED lights, the calibration should be checked.

Figure 8-1 shows the range and effects of the cross fades produced in the calibration display.

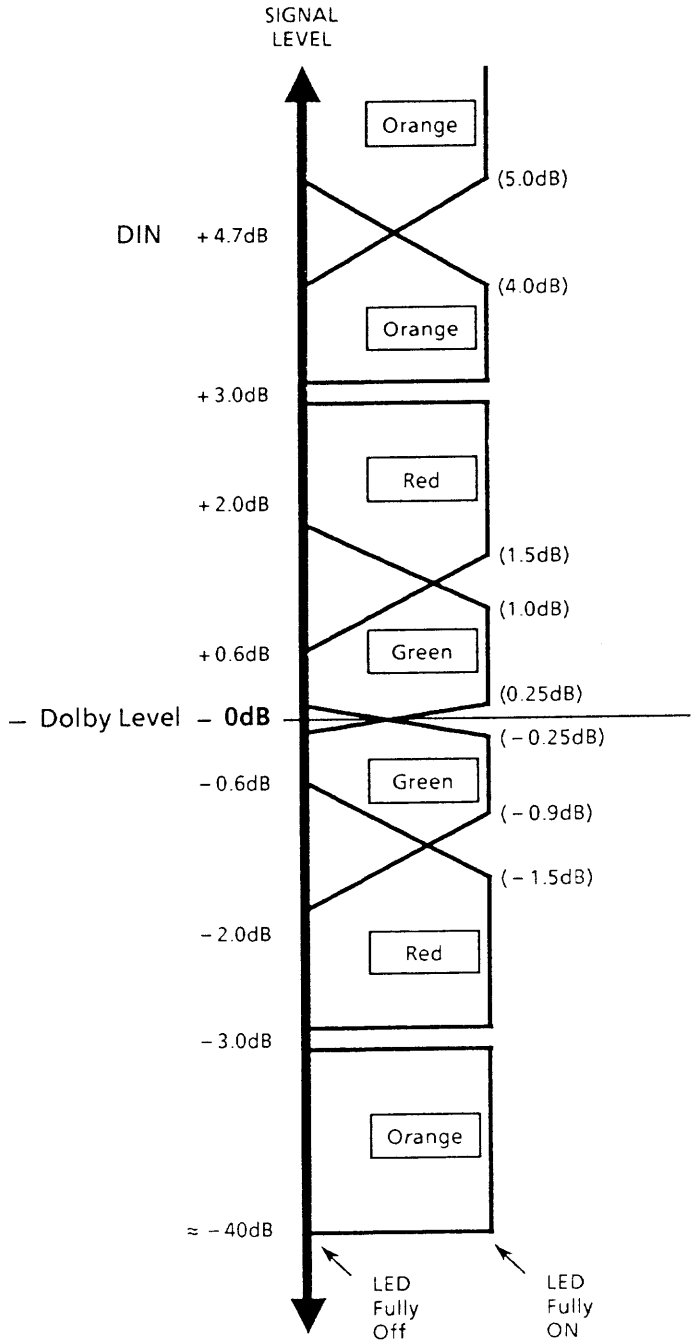


Figure 8-1 Range and Effects of Cross Fades Produced in LED Calibration Display

The presence of signal indicator is obtained by adding 40 dB of gain via amplifier IC706a, rectifying it with diodes D714 and D715, and comparing it via comparator IC706b to the reference voltage. Capacitor C715 (1 µF) smoothes the rectified signal.

The clip indicator compares the peak levels of three signal levels to fixed DC references; the outputs of the three comparators (IC704a/b/c) are combined and then drive the clip indicator through IC704c. Capacitor C709 (2.2 µF) provides a holding time constant.

8.1.4 Switching and Logic

Logic circuitry looks at the combination of signals from the Common Facilities switches in Power Supply PS3 and the individual channel front panel switches on the Cat. No. 331 modules to determine the state of the switching FETs, the bypass relay, and the front panel LED indicators.

Signals from the Common Facilities switches are either 0 V or +12 V; these signals are converted into signals of either −12 V or +12 V (necessary to control the FETs) in the comparators IC702 and IC703. These comparators also perform simple logic between the inputs. The outputs of the comparators are then sent to each FET via diode logic circuits that perform additional logic functions.

The operation of the logic is best understood by a study of the schematic diagram which also includes drawings of the logic levels. Signals from the PS3 Common Facilities are described as follows:

NO	Normal	These three functions are produced
CT	Check tape	by interlocking push buttons; only
LI	**line In**	one may be selected at a time.
NR	Noise reduction	(controlled by the **in/out** switch on the PS3)
DT	Dolby tone	(controlled by the **Set-up** switch on the PS3)
MS	User-defined signal for hard-wired bypass of electronics or NR off (soft bypass)	

In addition, control signals are generated in the Cat. No. 331 module:

REC	Controls the routing of the record signal and the encoding functions
PLA	Controls the routing of the playback signal and the decoding functions.

FETs are used throughout to switch signals. For example, Q605 and Q606 determine the signal at the **TO CONSOLE** output of the unit. The FETs are ON (short circuit from source to drain) if the gate is held positive; a negative signal turns the FET OFF (open circuit). The logic is so organized that a negative control signal on an FET gate takes precedence over a positive control signal.

For example, consider the actions when Dolby tone is recorded on the tape. FET Q503 permits the Dolby tone calibration and identification signal to enter the recording channel (to be recorded on the tape).

- In order for Q503 to conduct, three conditions that are provided by the diodes D508, D509, and D510 must be met. (1) noise reduction must be selected by pressing **in/out** in, (2) Dolby tone must be switched on by pressing **Set-up**, and (3) the unit must be switched into the record mode. The gate of the FET is positive only if all of these signals are present, thus permitting the FET to conduct.

- At the same time as the above, Q504 is also ON and short-circuits any normal recording signal from the console.

- Noise reduction is turned OFF. (Q505 and Q506 are turned OFF by **DT** ON; in the playback mode, Q607 is similarly turned OFF.)

- The meter circuit—which in the RECORD mode reads the **line In** signal from the console—is switched to read the signal from the tape (Q604 is on) in order to permit rapid calibration of the recording level. Q704 is turned OFF and the "meter reads tape" LED is permitted to light.

Inspection of the circuit diagrams and the logic waveforms will enable the other functions to be understood.

The hard-wired bypass function is controlled by transistor Q702 and relay RL701. During the first two seconds after the initial power switch-on, NR and MS signals are at +12V; transistor Q702 cannot switch ON and relay RL701 is not energized. The XP/SRP Series unit is in the hard-wired bypass mode and no LEDs light in the individual channel modules (Q715 is OFF). This initial delay prevents thumps (produced by the stabilization of the PS3 power supply) from being transmitted to the console or recorder connected to the unit.

After about two seconds, the **MS** lines drop to 0V and (with **NR** IN) the **NR** line also drops to 0V; then relay RL701 is permitted to be energized. (With the **in/out** switch on the PS3 pressed in, the relay is, in fact, always energized.) The user has the option of two states in the **NR** OUT mode. A switch mounted on the rear of the main frame enables the user to select either (1) a hard-wired bypass or (2) a "soft" bypass that permits the signals to pass through the amplifiers in the unit— thus preserving the signal levels and impedances in the audio chain to and from the console, the XP/SRP Series unit, and the recorder while the noise reduction action is turned OFF electronically. This switch is shown on the circuit diagram for the Cat. No. 331.

In actual use, momentary feedback can occur if the tape recorder output is set to monitor the incoming signal and the XP/SRP Series unit is switched between record and play. In order to prevent such feedback, the network R721 and C707 controls the switching behavior of one of the control lines, permitting only the presence of a **line In** audio signal at the **TO REC** output. This switching time is typically on the order of 3 msec, long enough to prevent feedback but short enough to prevent interference in the worst case.

The current for the indicating LEDs is provided by constant-current source Q715 and is controlled by transistor Q702 (as is the bypass relay). Switching of the LEDs is accomplished by current-steering about the LEDs with transistors Q704, Q705, Q706, and Q703 for the **meter reads tape, rec, uncal,** and **nr** LEDs, respectively.

8.2 Cat. Nos. 431 and 531

The Cat. No. 431/531 circuit modules provide input and output interfacing for the spectral recording (SR) circuit, the SR circuit itself, metering of Dolby level, and bypass capability for the channel. In the record mode, the signal passes via the **FROM CONSOLE** input and the SR circuit to the **TO REC** output. The unencoded signal is sent to the **TO CONSOLE** output for monitoring. In the play mode, the signal passes through the **FROM REC** input into the SR circuit where it is decoded and passed on to the **TO CONSOLE** output.

Each section of circuitry is described separately. Where no distinction is drawn between the Cat.No.431 and 531, the two are identical. The schematic and block diagrams are in Section 10.

8.2.1 Input Stages

Nearly identical op amp stages are used for the **FROM CONSOLE** and **FROM REC** inputs. These stages are balanced and virtually floating (750 k ohm impedance from either input to ground), using an instrumentation-style input made up of two operational amplifiers: op. amps (IC901, IC902). Gain is controlled by a variable attenuating pad in the input network to the op. amps. Jumpers S901/903 and S902/904 are provided to unbalance the input pad for single-ended inputs, thus preventing common-mode overload of the stage.

An NE5532 (IC901) dual op. amp is used for the **line in** input to provide a low-noise stage. A low-pass network of capacitors and coupled inductors roll off frequencies above 250 kHz to minimize AM detection at the bipolar op amp inputs. A TL072 op amp (IC902) is used for the **FROM REC** input; noise is not of critical concern here because this stage is within the NR loop. Again, a low-pass network is used at the head of this stage, but without the coupled inductors; AM detection is not as serious a problem with FET input amplifiers as with bipolar input amplifiers.

CMOS analog gate IC810a selects the output of one of the input stages and feeds it to the input bandpass filter, IC701a, IC703a and associated components. This filter (50 kHz low-pass and 10 Hz high-pass) prevents out-of-band signals from entering the processing circuitry.

8.2.2 Output Stages

Two identical output stages (for both the **TO REC** and **TO CONSOLE** signals) drive either single-ended or balanced inputs with a maximum +24 dB signal into 600 ohms or higher (relative to 0.775V rms). When it is driving a balanced load, the amplifier operates as a simple single-ended output amplifier, using the common-mode rejection (CMR) of the following balanced input for noise rejection. When it is driving a single-ended load, the amplifier operates with a reference input to sense the "ground" of the load, and thus provides the noise rejection itself. Single-ended or balanced mode operation can be selected via jumpers S905 and S906.

Each output amplifier consists of a transconductance stage that drives a discrete op. amp. This topology allows gain to be controlled with a single variable resistor in the negative feedback loop of the discrete op. amp stage (giving a constant signal-to-noise ratio independent of gain setting), while permitting the non-inverting input of the stage to be used directly as the sense input.

The transconductance stage consists of a TL072 op. amp (IC905) with a combination of negative and positive feedback. A selected resistor in the positive loop (R943, R944) balances the gains of both negative and positive feedback loops that provides a nearly infinite output impedance for the stage.

The discrete output stage utilizes a standard op. amp topology. A differential PNP input stage (transistors Q907/909, Q908/910) with an active load (Q911/912) drives a single-ended gain stage (Q915/916). An emitter follower (Q921/922) drives the output devices (Q925/927, Q926/928) which are biased in class AB mode. Short-circuit protection is provided by sensing the voltage drop across the emitter resistors of the output transistors (R981/983, R982/984) with devices Q923/D913 and Q924/D914. An inductor in the output path is coupled to an inductor in the negative feedback path (L903/L902) to ensure stability with large capacitive loads. Pole-zero compensation (capacitor/resistor C911,R961, C912/R962) provides stable operation. The output signal is AC coupled through capacitors C921 and C922 to the input/output connector. The output offset of the amplifier is purposely set at about +200 mV DC by resistors R941 and R942 to ensure a small bias on the output coupling capacitors.

8.2.3a Calibration Display of Cat. No.431

The display accurately monitors Dolby level signals over a practical range as well as signals at the upper and lower ends of the signal range. Dolby level is indicated when two green LEDs (DS826 and DS827) glow with equal brightness. These Dolby level indicators are placed between two red LEDs (DS825 and DS828) which indicate signal levels ±3 dB around Dolby level. DIN level (approximately 4.7 dB above Dolby level) is indicated by equal brightness of two orange LEDs (DS823 and DS824). "Presence of signal" (approximately 40 dB below Dolby level) is indicated by orange LED DS829. "Clip" is indicated by the red rectangular LED DS822.

The circuit can be divided into three sections; the "main array," the "presence of signal" indicator, and the "clip" indicator. The main array and the presence of signal indicators take their input from the output (IC705b) which amplifies the audio signal present at the input of the NR side chain. The clip indicator monitors the outputs of the **TO REC** and **MON** line amplifiers and the internal level of the NR circuit.

The rectifier for the main array display is IC809 and associated parts. Capacitors C810 and C815 smooth the rectified signal. The output of the rectifier is compared via comparators IC805 and IC806c/d with appropriate reference voltages derived from the series combination of diode D812 and zener DZ813. The LEDs are driven by the comparators in a manner that permits only one LED to be fully on at one time. To obtain a cross-fade for Dolby and DIN levels, the audio input to the rectifier is also fed to IC806a. For inputs in the region of Dolby level this amplifier delivers a hard clipped signal which is suitably filtered (R857, C819) and added to the rectifier output via R849 and R850.

In operation, whenever recorded Dolby noise causes either of the green LEDs to be lit, decoding will be excellent. Decoding is most accurate when the LEDs are equally bright. If only one red LED lights, the calibration should be checked.

Figure 8-2a shows the range and effects of the cross fades produced in the calibration display.

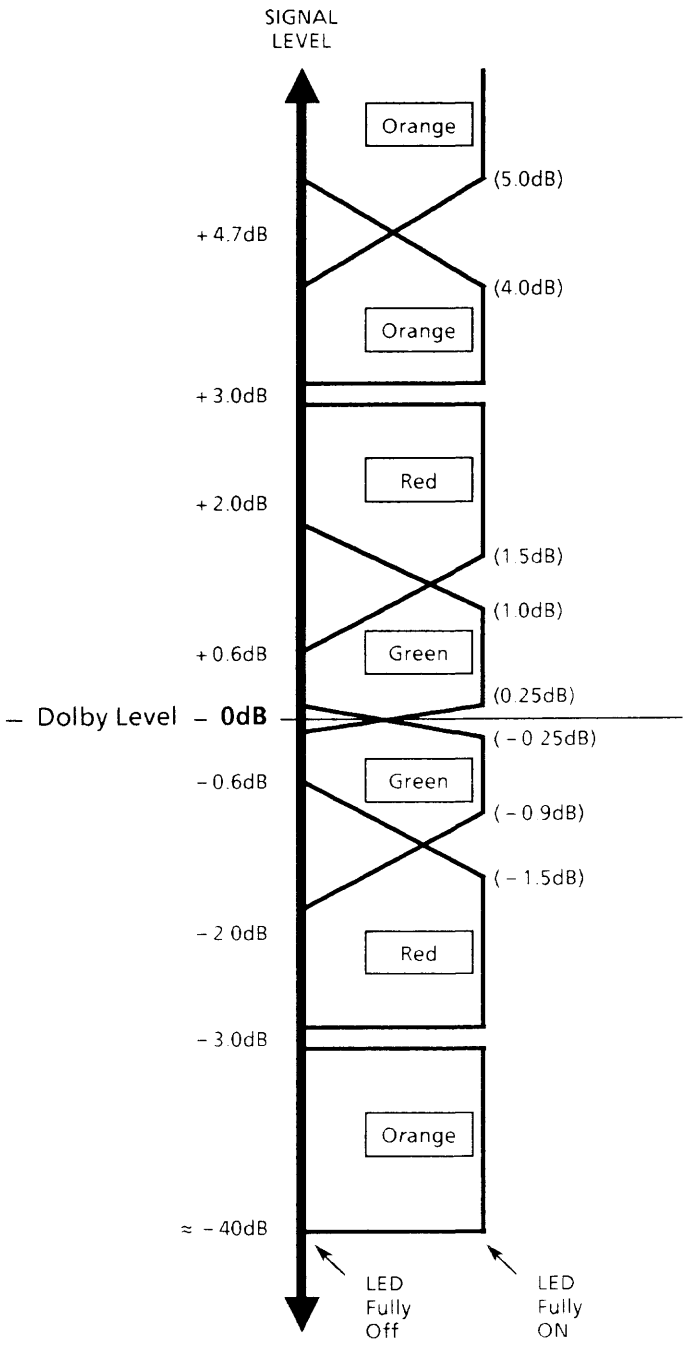


Figure 8-2a Range and Effects of Cross Fades Produced in LED Calibration Display

The presence of signal indication is obtained by rectifying the output of IC806a by means of D815, and comparing the result in IC806b with a reference voltage generated by R896/R856.

The clip indicator compares the peak levels in the two line output amplifiers and in the SR processing with appropriate reference voltages; the outputs of the three comparators (IC804a/b/c) are combined and then drive the clip indicator through IC804. Capacitor C809 (2.2 nF) provides a holding time constant.

8.2.3b Calibration Display of Cat. No. 531

The display consists of a block of four leds DS825-828. Dolby level is indicated when the two middle (green) LEDs glow with equal brightness. The upper (red) LED shows that the level is too high and the lower that the level is low but within about 10 dB of Dolby level.

The rectifier for the main array display is IC809 and associated parts. Capacitors C810 and C814 smooth the rectified signal. The output of the rectifier is compared via comparators IC805 a/b/d and IC806c with appropriate reference voltages derived from the series combination of diode D812 and zener DZ813. The LEDs are driven by the comparators in a manner that permits only one LED to be fully on at one time. To obtain a cross-fade for Dolby level, the audio input to the rectifier is also fed to IC806a. For inputs in the region of Dolby level this amplifier delivers a hard clipped signal which is suitably filtered (R857, C819) and added to the comparator reference.

In operation, whenever recorded Dolby noise causes either of the green LEDs to be lit, decoding will be excellent. Decoding is most accurate when the LEDs are equally bright. If only one red LED lights, the calibration should be checked.

Figure 8-2b shows the range and effects of the cross fades produced in the calibration display.

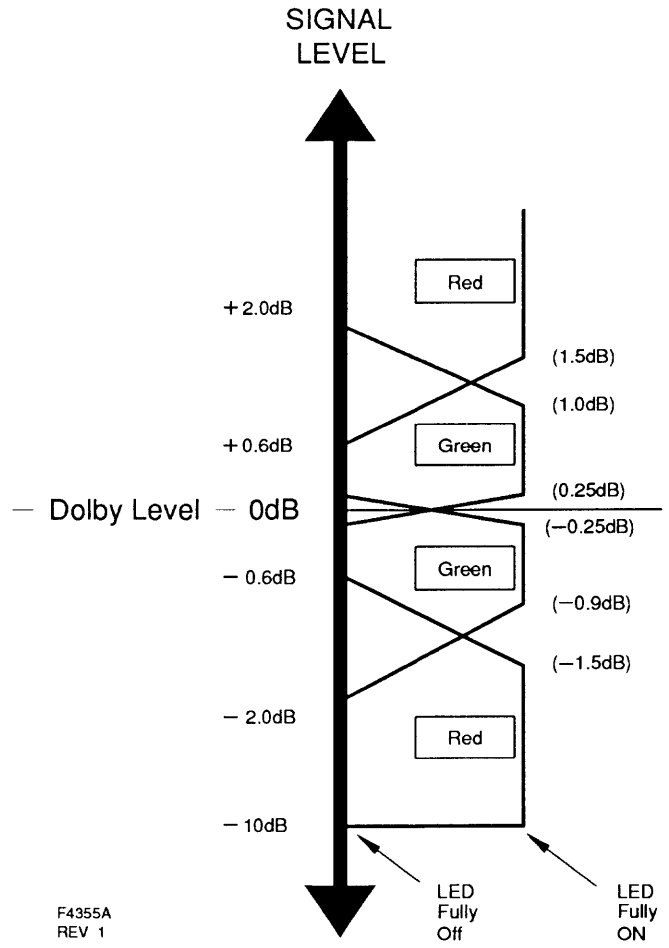


Figure 8-2b Range and Effects of Cross Fades Produced in LED Calibration Display of the Cat. No. 531

8.2.4 Switching and Logic

Logic circuitry receives signals from the common facilities switches on the power supply PS3 and from the individual channel switches on the Cat. No. 431/531 module and derives control signals for the electronic switches, the bypass relay and the front panel LEDs.

Signals from the PS3 are either 0V or +12V; these are converted to ±9V by comparators IC802 and 803, which also perform simple logic functions.

The operation of the logic is best understood by a study of the block and schematic diagrams. CMOS analog gates perform most of the switching of audio signals. In most places they are used as voltage switches to minimize switching clicks. On the block diagram they are shown in the appropriate positions for recording. On the schematic they are all shown in the position adopted when their control terminals are at the low level (–9V).

In the bypass condition, the bypass relay RL801 is de-energized and all LEDs are turned off. This condition also exists for about two seconds after power is applied to the PS3, preventing switch-on thumps.

A switch mounted on the rear of the main frame determines the function of the **in/out** switch of the PS3. In one position ("hard") the OUT position de-energizes the bypass relays of all the processing modules; in the other ("soft") the OUT position disables the SR processing but leaves the input and output amplifiers in circuit, ensuring that there are no differences in gains and termination impedances between the in and out conditions.

The appropriate positions of the CMOS switches for the record, playback and check tape modes can be read directly from the labelling on the block diagram, and the corresponding logic levels deduced easily. CMOS switches operate so rapidly that there is no need to delay the operation of some switches relative to others to avoid momentary feedback during record/playback transitions. The line-in monitoring condition which can be selected on the PS3 forces all Cat. No. 431/531s into the record mode.

However, the requirements for the 'Set-up' condition are not so straightforward. If SR is out, the **Set-up** button does nothing. If SR is in and **Set-up** is selected, the switches move to the positions shown as follows (observe the labels on the block diagram; on the schematic Set-up is designated DN for Dolby noise):

Q701	IN	Removes mute on Dolby noise entering at pin N.
IC811c	**Set-up**	Passes Dolby noise to the **TO RECORDER** output.
IC810a and IC811a	PLAY	Feeds the **FROM RECORDER** signal to the SR circuitry, irrespective of the state of the remote record logic.
IC811b	**Set-up**	Disables the SR decoding.
IC810c	**Set-up**	Alternates between **TAPE** and **REF** pink noise (pin R) to deliver an Auto Compare sequence to the **TO CONSOLE** output.
IC812c	**Set-up**	Introduces the filter and amplification so that the calibration display reads correctly on Dolby noise.
IC810b	NORM	Doesn't move!

The Auto Compare indicator LEDs (DS831/832) follow the Auto Compare sequence, provided there is an input signal as shown by a "low" output from comparator IC806c; if there is no input signal on which to perform Auto Compare, neither LED is lit.

The current for the indicating LEDs is provided by constant current source Q815, and switching of each LED is performed by the appropriate shunt transistor (Q804, etc.).

8.3 Description of PS3 Circuit

The PS3 is a stand-alone unit that provides regulated power supply voltages, common facilities signals, and a cooling fan for the XP/SRP Series noise reduction unit. The PS3 is designed for high reliability and ease of service.

The schematic diagrams are in Section 10, Circuit Diagrams.

8.3.1 Primary Circuits

The primary circuits of the PS3 include the AC input module, the thermal protection switches, and the power transformer.

AC Input Module

The AC power line voltage is applied to the AC input module. This module permits the user to switch the two tapped primary windings of the power transformer for different AC power line voltages. A 5-Amp slow-blow fuse is also contained in the module to protect against shorts in the primary circuit; a line filter rejects RF noise.

Transient and Thermal Sensing

Protection against power line transients is provided by a varistor with 150 VAC breakdown across each primary winding.

Thermally controlled switches S1 and S2 in series with the primary of the transformer also control AC power to the unit. Switch S1 is located on the regulator heat sink and opens when the temperature of the heat sink reaches 99°C. "Hi temp" condition (S1 open) is indicated on the front panel of the PS3 by LED DS401. (Note that the opening of a thermal switch may indicate failure or blockage of a fan). Switch S2 is located between the 25 Volt regulators that are mounted on the rear wall; it opens when the temperature of the wall exceeds 60°C. DS401 also indicates if S2 opens.

Power Transformer

The power transformer is a shielded toroidal type to minimize radiated magnetic fields. The cooling fan is powered from the 100V taps on the transformer primary. Three separate secondary windings supply the correct voltages to the regulator inputs.

8.3.2 Secondary Circuits

The secondary circuits of the PS3 include the +25V and –25V regulators, the +12V and –12V regulators, the +12V logic regulator, and the power line monitor circuit. The DC inputs to the regulators are full-wave rectified and filtered. All of the regulators are integrated circuit regulators; separate regulators are used for the +25V and –25V outputs, and a dual regulator (with external current amplifiers) is used for the +12V and –12V supply. All regulators are protected fully against short circuits.

Inherently, the dual regulator will not start when it is switched on into a full load. In order to permit correct start-up, the current limit is increased for a short period by relay RL1 which closes momentarily at start-up. The relay also performs a reset function (via the front panel **reset** push button) if the current protection circuit is triggered during normal operation.

8.3.3 Common Facilities

The common facilities circuit provides the user with master control functions for the NR unit. These functions are **in/out**, **Set-up**, and special monitor controls **normal**, **line In,** and **check tape**. The operation of these features are described in Section 6, Operation.

Simple switching and diode logic accomplish the control functions of the common facilities circuit. Front panel LEDs mounted above the switches indicate operation of their respective functions. All control lines are active "low;" i.e., they sink current when "on." A timer circuit (Q102/Q103/Q104) lifts the switch ground for approximately two seconds when the PS3 is first powered "on," and thus holds the NR unit in hard-wired bypass during this time period, preventing audible turn-on transients from appearing at the outputs.

All common facilities functions can be controlled remotely; suggested user-built remote facilities are shown in Figure 3-8. Note that only one set of control switches (i.e., front panel or the remote panel) can be active at any one time, with the exception of the **Set-up** control which functions both locally and remotely.

8.3.4 Dolby Tone Generator

The Dolby tone generator is on the common facilities card in the PS3 power supply unit (see Figure 10-7).

Q301 (TL430) gives an accurate and stable 4.0 V reference, adjusted by selected resistor R317. When the Dolby tone generator is enabled, this reference is applied via Q204 to IC201a and b which deliver symmetrical positive and negative supplies to switching transistors Q201 and Q202.

An 850 Hz sinewave is generated by a phase-shift oscillator consisting of a phase-shift network (R220, C204, R222, C203, R223, C202), a buffer amplifier (IC201c), a comparator (IC202a) and the pair of switching transistors (Q201, Q202). The output amplitude is adjusted to 300 mV rms by selected resistors R225/226.

An astable multivibrator (IC201d etc.) delivers pulses which frequency modulate the sinewave via Q203, giving the characteristic warble to the A-type Dolby tone.

8.3.5 Dolby Noise Generator

The Dolby noise generator is carried on a small printed circuit board, Cat. No. 342, which plugs on to the common facilities card in the PS3 power supply unit (or in XP or SP units which have been upgraded from A-type to SR, on the back of the main frame).

Regulator IC6, diode D3 and amplifier IC4a deliver temperature dependent ±5.7 V supplies to the rest of the circuitry. The temperature dependence compensates for the variation in output level of IC3.

Pseudo-random sequence generator IC3 and the "pinking" filter (C10-13, R21 and R27-30) together with high-pass and low-pass filters (C7/R20 and IC4b etc.) deliver band-limited pink noise to pins P3-31 and P8-8 and to "notching" switch IC5c. These outputs are enabled by switch IC5b which is turned on when pin P8-5 goes to 4 V. Resistor R31 is selected so that the output level at pin P8-8 is –3.3 dBr (0 dBr=775 mV) when measured on an average-responding meter via a bandpass filter (2-pole or more) passing 1 kHz to 20 kHz.

With switch IC5a in the position shown, IC2a and b form a free-running pulse generator to provide the required 20 ms notches at 2 s intervals in the Dolby noise at pins P8-1 and P3-20. When IC5a is in the other position, IC2 puts out a pulse only when triggered by the negative edge of a pulse on the sync bus, pins P8-9 and P3-10.

If the sync bus is high (no pulses are present) at the time the circuit is enabled (i.e., when pin P8-5 moves to +4 V), transistor Q2 is off and capacitor C4 moves towards +2.8 V. After 2 to 3 s pin 8 of IC1c goes low, IC5 runs free and the circuit delivers asynchronous Dolby noise. If however negative-going pulses are present on the sync bus, capacitor C4 never charges enough to switch IC1c, whose output remains high, so the notches are synchronous with the pulses on the bus.

If pulses are subsequently lost, C4 charges towards 2.8 V and after 2 to 3 s IC1c reverts to the non-sync (free-run) state. If pulses resume, hysteresis round IC1c via R11 prevents the circuit from returning to the synchronous state unless the Set-up switch is released and pressed again.

Transistor Q1 and the associated parts are used when the Cat. No. 342 is used in an SP-series frame.

SECTION 9
IN CASE OF DIFFICULTY

CAUTION

Remove AC power from the PS3 before you replace components in the primary circuit. These instructions are for use by qualified personnel only. To avoid electric shock do not perform any servicing unless you are qualified to do so. Refer all servicing to qualified service personnel.

9.1 Introduction

Problems in the XP/SRP Series noise reduction unit and the accompanying PS3 power supply can be easily localized.

The Cat. No. 331 A-type and Cat. No. 431/531 SR circuits themselves are not considered to be field repairable. Proper matching of encode/decode characteristics requires selected components and specialized procedures.

Defective modules should be returned to the factory for repair. Dolby Laboratories maintains a liberal warranty policy and will usually make an immediate exchange of a defective module.

The following guide is designed to aid the technician in troubleshooting the unit.

9.2 Routine Checks

a. Confirm that the power on and power rail indicators on the front of the PS3 are all lit. Press the **reset** switch if necessary.

b. The common facility LEDs on the PS3 should light when the corresponding switch is pressed. A failure of the LED to light means there is a problem in the PS3 common facilities module or a misconnected remote control link on the rear panel of the PS3.

c. The rear DC power and control cables should be installed properly.

9.3 General

a. **BAL/UNBAL** (balanced/unbalanced) jumpers located on each channel module should be set as described in Step 7 of Section 3, Installation. Improper setting of these switches can cause distortion.

b. Interchange the processing module with one from a known good channel. (Printed circuit board mounted jumpers must be set to the same position as on the original module). If the exchanged module has been preset to the same operating levels as the module in question, no adjustment may be necessary; otherwise the module should be properly aligned using manual Section 5, Alignment. Replace the original module if it is found to be at fault or return the module for repair.

c. If a spare module is not available, press the **bypass** push button on the module in question to bypass that channel.

d. If a module is removed for repair, replace it with a spare module. If a spare is not available, replace the defective channel with a Cat. No. 231 bypass module (stored at the far right of each main frame).

e. When you send a faulty module back to your Dolby distributor for repair or replacement, be sure to pack the module carefully. Include a note describing the fault that was observed.

9.4 Automatic Tester for the Cat. No. 431/531

Dolby Laboratories produces a tester for use in large installations. Cat. No. 356 automatically performs a comprehensive series of tests on the SR module by simply pushing a start switch and monitoring test status LEDs.

9.5 Quick Check for Dolby A-type NR and SR Processing

A quick test of the Dolby processing may be carried out in the field to check the outline characteristics of both the record (encode) and play (decode) modes. Tones at various levels and frequencies are sent to the XP/SRP Series and the outputs at the **TO RECORDER** and **TO CONSOLE** are measured. Alternatively, if (as is usually the case) two channels are available simple back-to-back checks can be made by putting one channel into the record mode and the other in the play mode. Test signals at various levels and frequencies and program material can be sent through the two channels in series, and a comparison of input to final output will very soon show up any problems.

In the field, it is sometimes difficult to measure levels precisely due to the lack of accurate instruments. This procedure, therefore, has been chosen to allow a quick operational "rule-of-thumb" check to be made. Accurate tests on the modules must be made using specialized test instruments and are of necessity too time-consuming for an operational procedure.

Measurements given and their expected ranges assume that the input signal level is only accurate to within ±0.5 dB. Thus the range of values given does not represent the tolerance of the Dolby system; with a defined input, the accuracy is much better.

Tests are made by first switching out the signal processing, and selecting the record mode. Next send a tone into the **FROM CONSOLE** input at Dolby level (so that the two green LEDs on the calibration display are equally illuminated). Measure the output at the **TO RECORDER** output, which in most installations should be at the same level as the input. Reduce the level from the console by 24 dB; note the reading at the output, and select either A-type or SR. The measured signal should increase as listed in the table below.

To check the play mode, transfer the input test signal to the **FROM RECORDER** input and the meter to the **TO CONSOLE** output. Repeat the test above, making sure to switch to **PLAY** and to check the calibration display has equally illuminated green LEDs (with processing switched out) before reducing the input by 24 dB.

FREQUENCY	SR		A-TYPE	
	ENCODE (±0.3dB)	DECODE (±0.9dB)	ENCODE (±0.3dB)	DECODE (±0.9dB)
80 Hz	+5.0	–9.9	5.2	–8.6
800 Hz	+9.1	–17.1	+5.0	–8.9
8 kHz	+5.5	–10.1	+6.9	–11.3

Figure 9-1 Approximate encode/decode level changes at 24 dB below Dolby level

9.6 Servicing the PS3 Power Supply

CAUTION

These instructions are for use by qualified personnel only. To avoid electric shock do not perform any servicing unless you are qualified to do so. Refer all servicing to qualified service personnel.

Condition 1: **high/low** Power Line Indicator is on.

a. Check that the AC input module is configured for the correct AC power line voltage. See Figure 3.1.

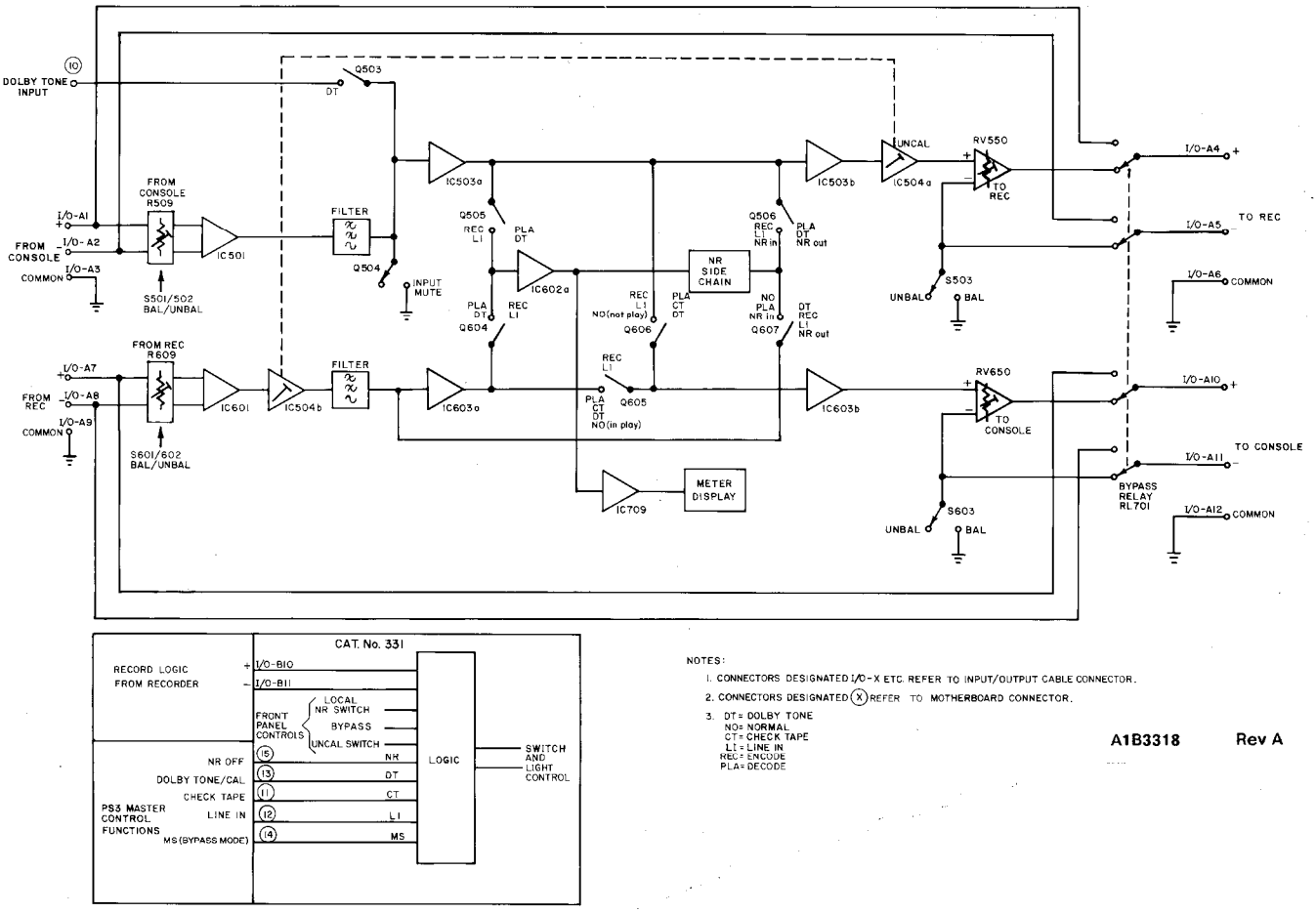
b. Check that the AC power line voltage is within the limits of +10% and –15% of the nominal voltage setting on the AC input module. Note that the high/low power line indicator lights when the AC power line voltage exceeds the limits of approximately +6% and –12% of nominal line voltage. The PS3 is designed to be operated within the specified limits of +10% and –15% to accommodate variances in the AC line voltage; continuous operation at these limits can cause the unit to turn itself off.

Condition 2: **high/temp** Indicator is on.

a. Check that the fan is operating correctly. Remove anything that blocks the flow of air or replace the fan, as required.

b. Thermal switch S2 opens when the temperature of the regulator heat sink is between 97°C to 100°C. Thermal switch S1 monitors the temperature of the two power regulators mounted on the rear of the chassis and opens when the temperature is in the range 58°C to 61°C. Replace the switches if they open at temperatures outside their correct range.

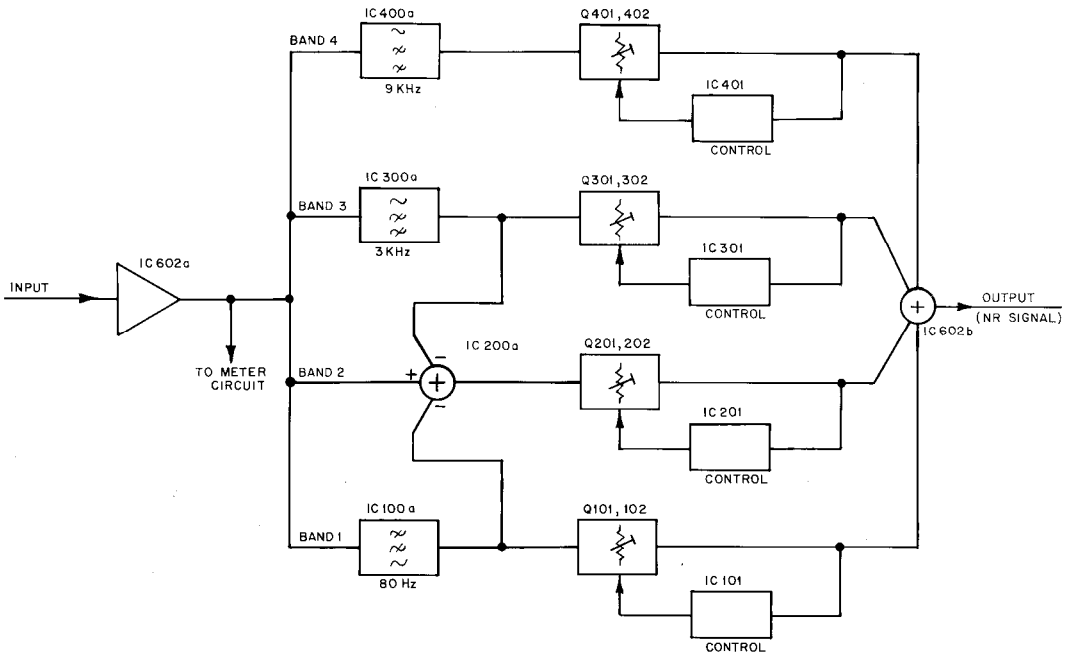
SECTION 10
REFERENCE DRAWINGS



NOTES:

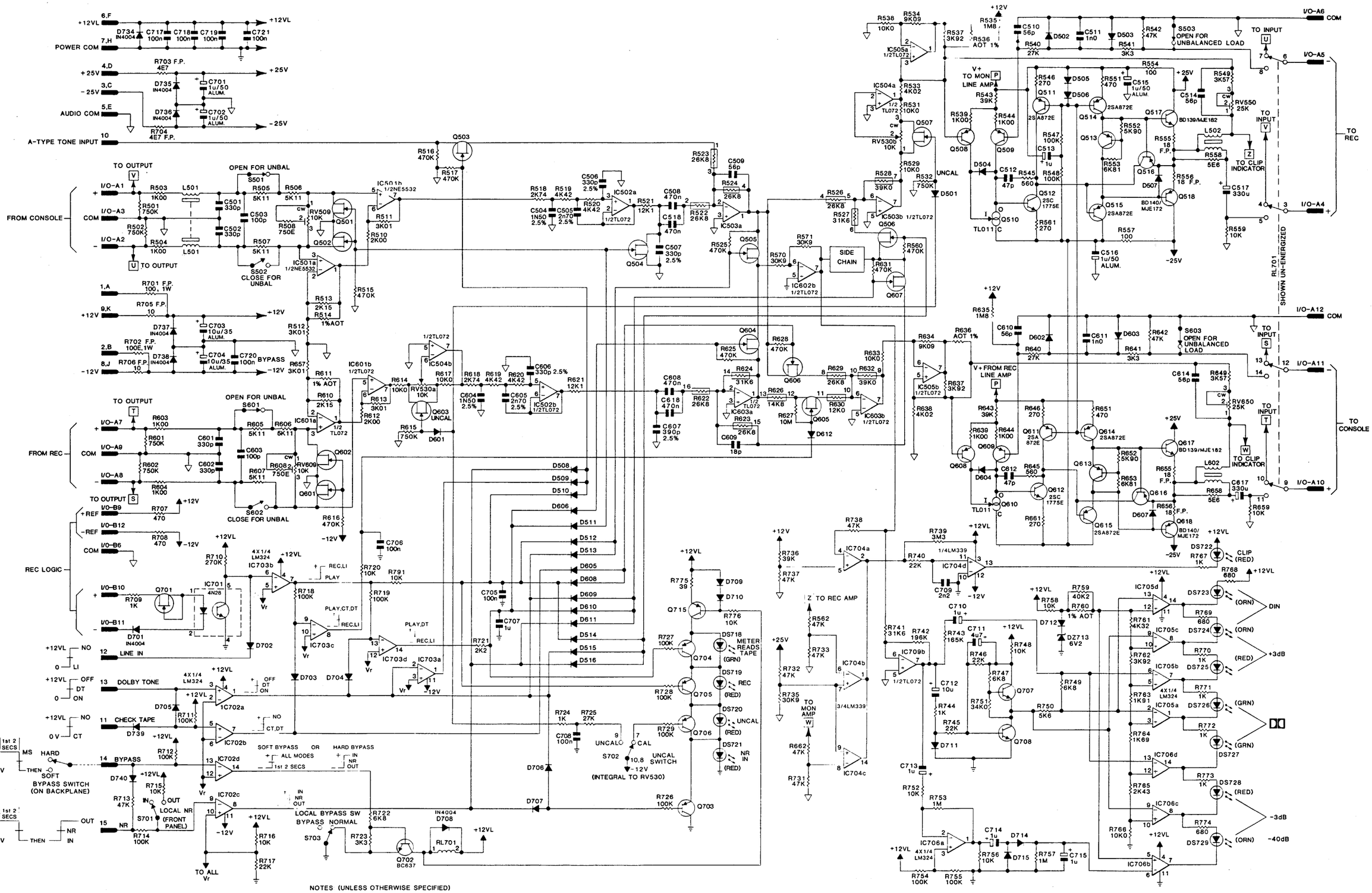
1. CONNECTORS DESIGNATED I/O-X ETC. REFER TO INPUT/OUTPUT CABLE CONNECTOR.
2. CONNECTORS DESIGNATED (X) REFER TO MOTHERBOARD CONNECTOR.
3. DT = DOLBY TONE
   NO = NORMAL
   CT = CHECK TAPE
   LI = LINE IN
   REC = ENCODE
   PLA = DECODE

A1B3318 Rev A



SIDE CHAIN BLOCK DIAGRAM A1B3318 Rev A

Figure 10-1 Cat. No. 331 Module, Block Diagram

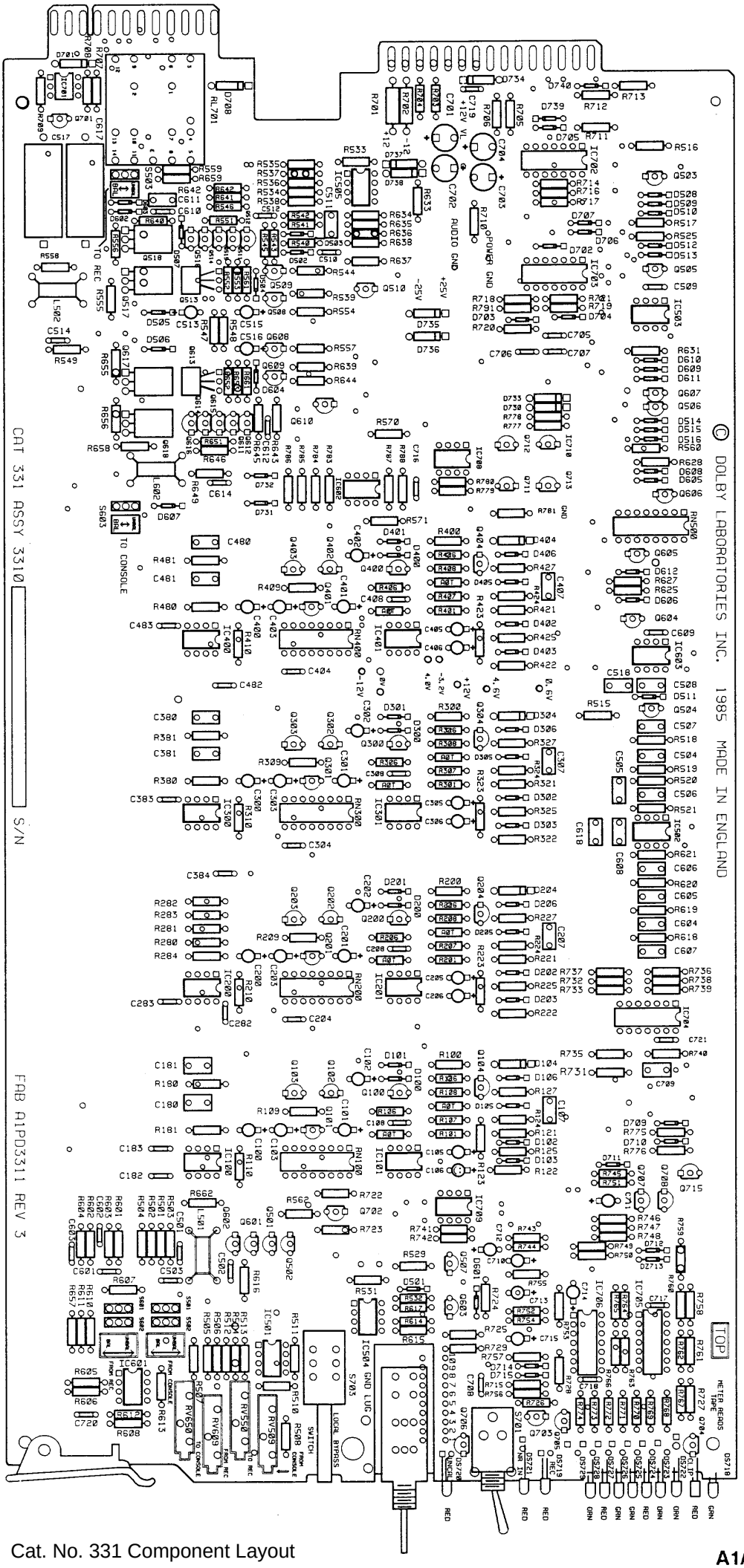


NOTES (UNLESS OTHERWISE SPECIFIED)

1. LOGIC NOTATION.
   NO = NORMAL
   LI = LINE IN
   CT = CHECK TAPE
   NR = NOISE REDUCTION
   DT = DOLBY TONE AND CAL
   MS = USER DEFINED MODE
2. F.P. = FLAMEPROOF.
3. RESISTOR VALUES ARE IN OHMS.
4. CAPACITOR VALUES ARE IN FARADS.
5. DIODES ARE IN4148.
6. FETS ARE J112 EXCEPT FET Q701 WHICH IS 2N5458 OR SIMILAR.
7. DUAL OPAMPS (TL062, TL072, 5532)
   +12V TO PIN 8
   -12V TO PIN 4
8. ⟋⟋ PART OF RESISTOR PACK CDD1016 (RN500).
9. BIPOLAR TRANSISTORS ARE DOLBY STANDARD DEVICES
   NPN - BC414, 2SC732 OR SIMILAR
   PNP - BC416, 2SA970 OR SIMILAR.

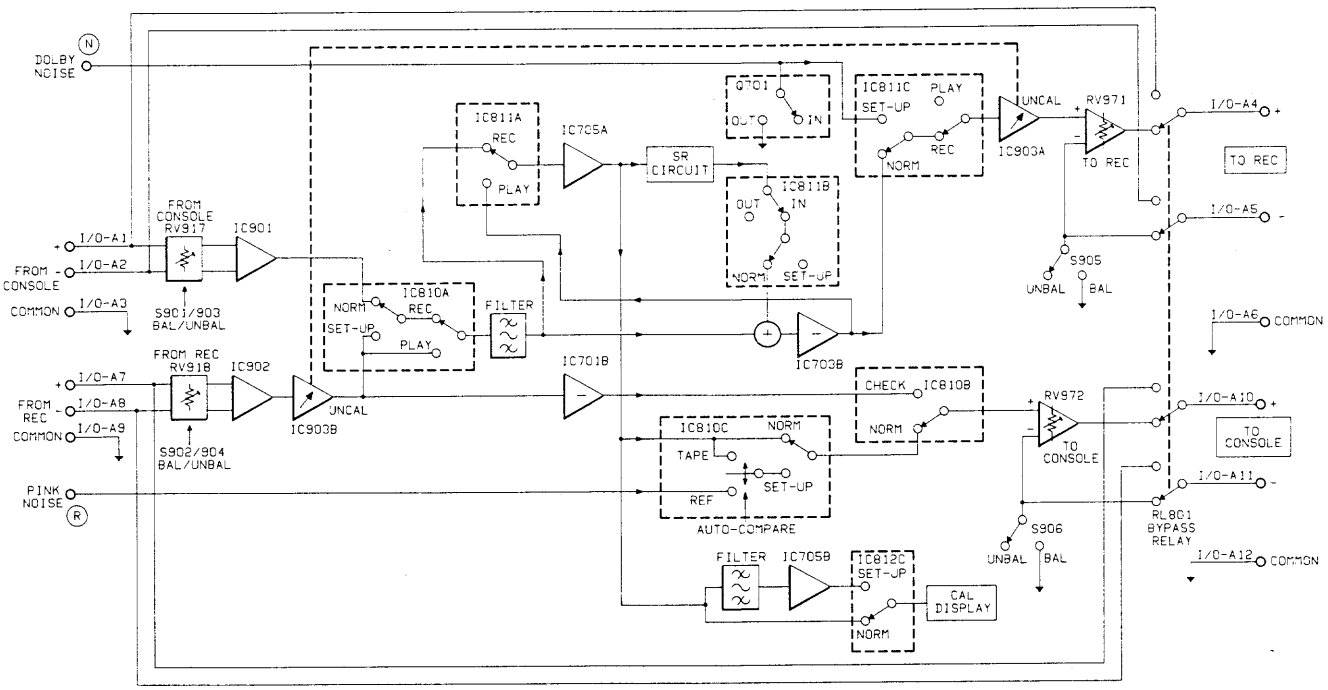
A0C3310 Rev 5

Figure 10-2 Cat. No. 331 Module, Component Layout and Schematic Diagram

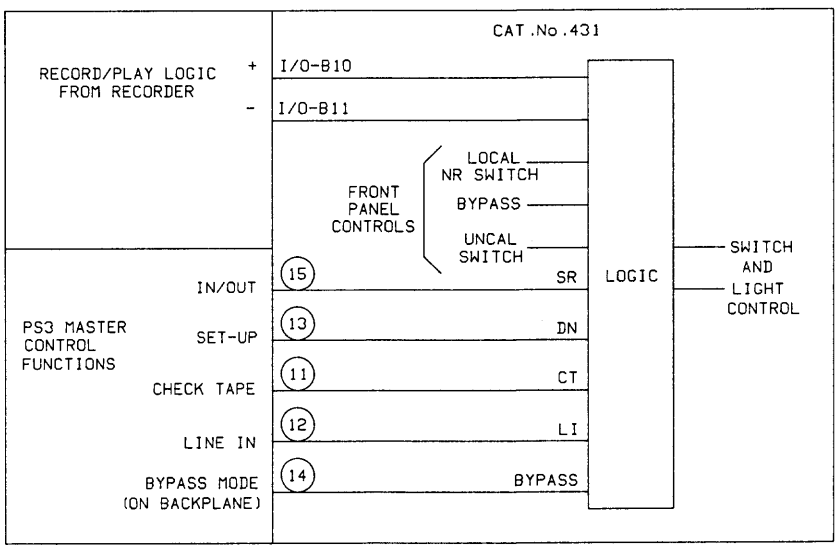


Cat. No. 331 Component Layout

A1A3879 **Rev A**



A1B3648 **Rev B**



1. CONNECTOR PINS DESIGNATED I/O-XXX REFER TO INPUT/OUTPUT CABLE CONNECTOR.
2. CONNECTOR PINS DESIGNATED (X) REFER TO MOTHERBOARD CONNECTOR.

A2B3648 **Rev A**

Figure 10-3 Cat. No. 431 Module, Block Diagram

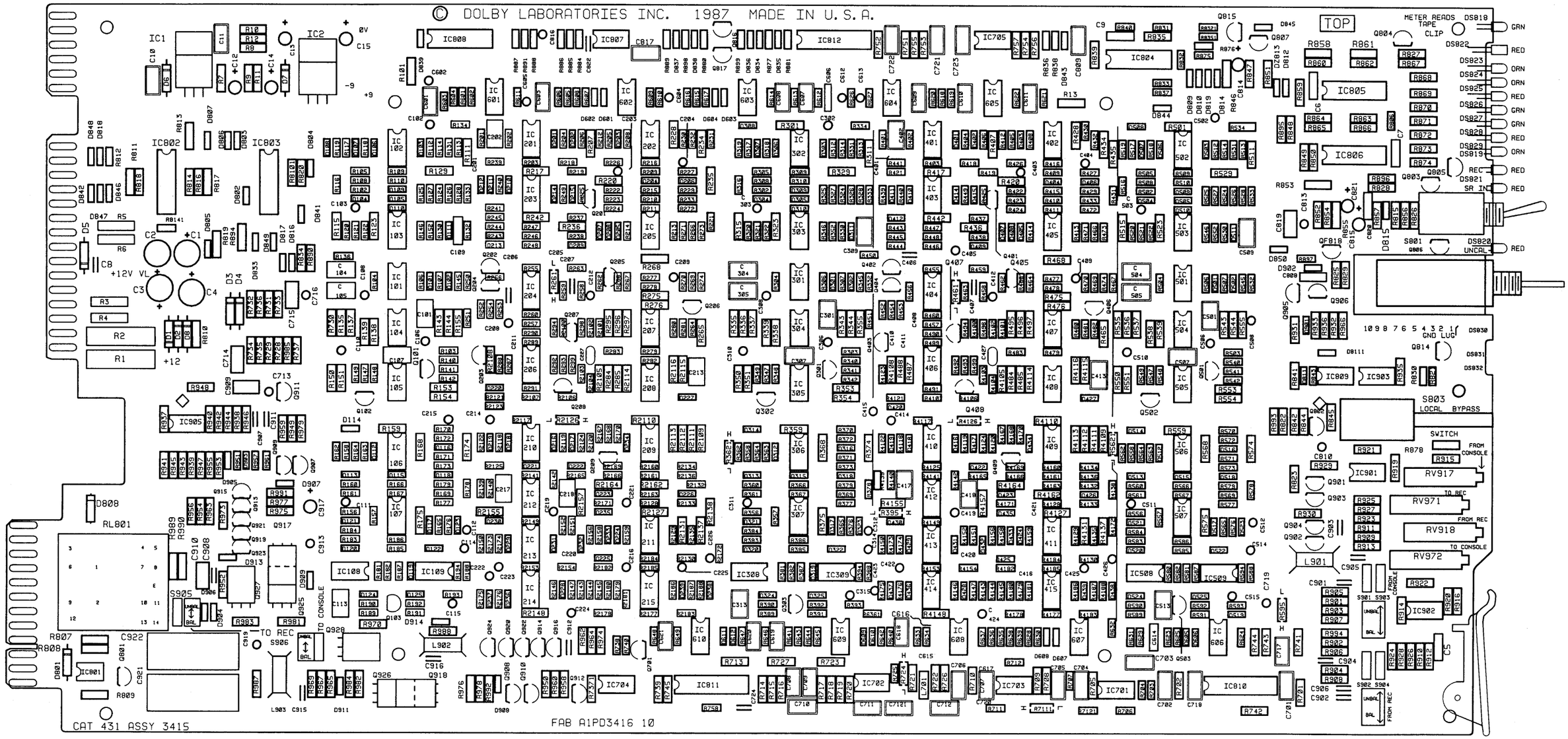
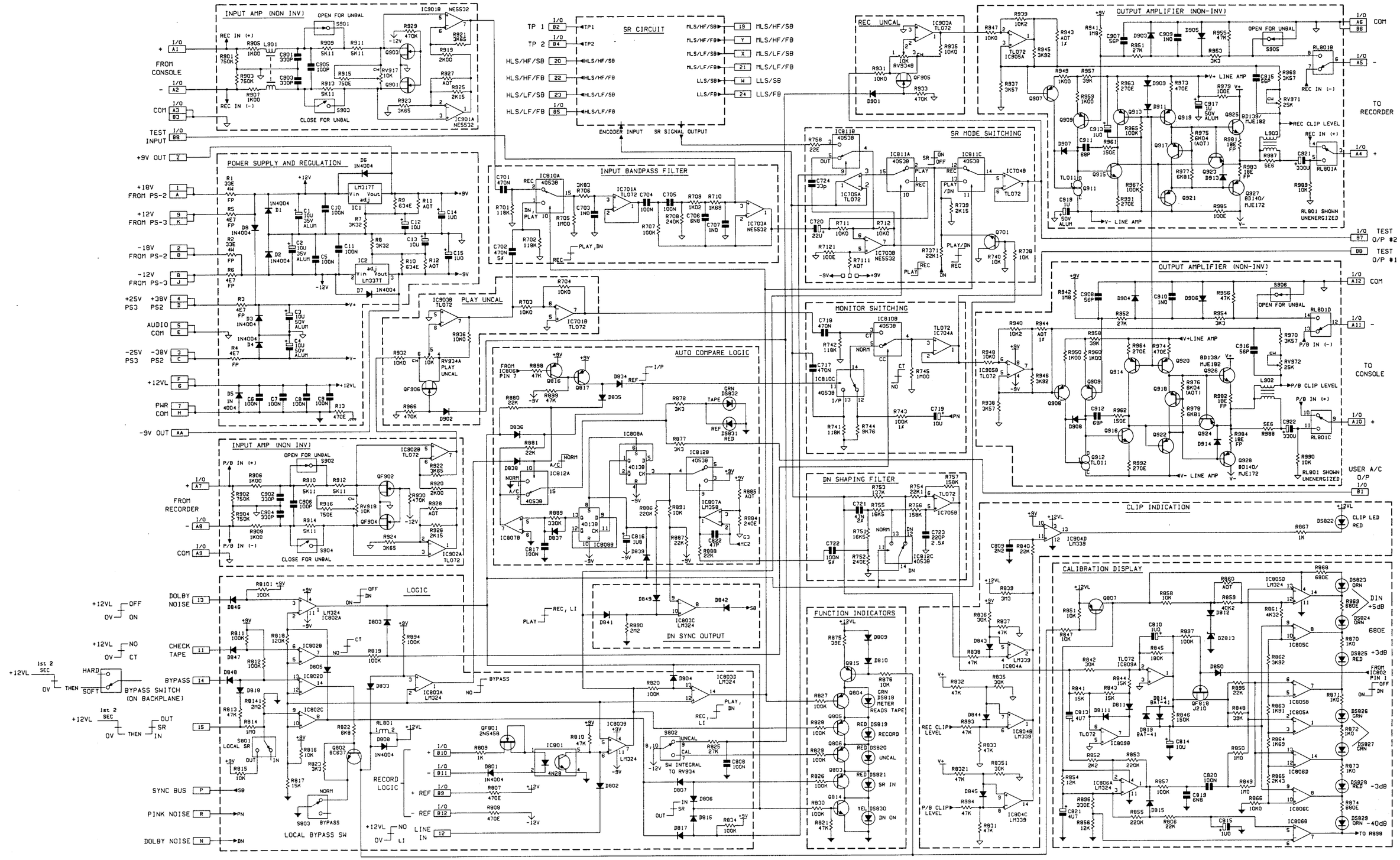


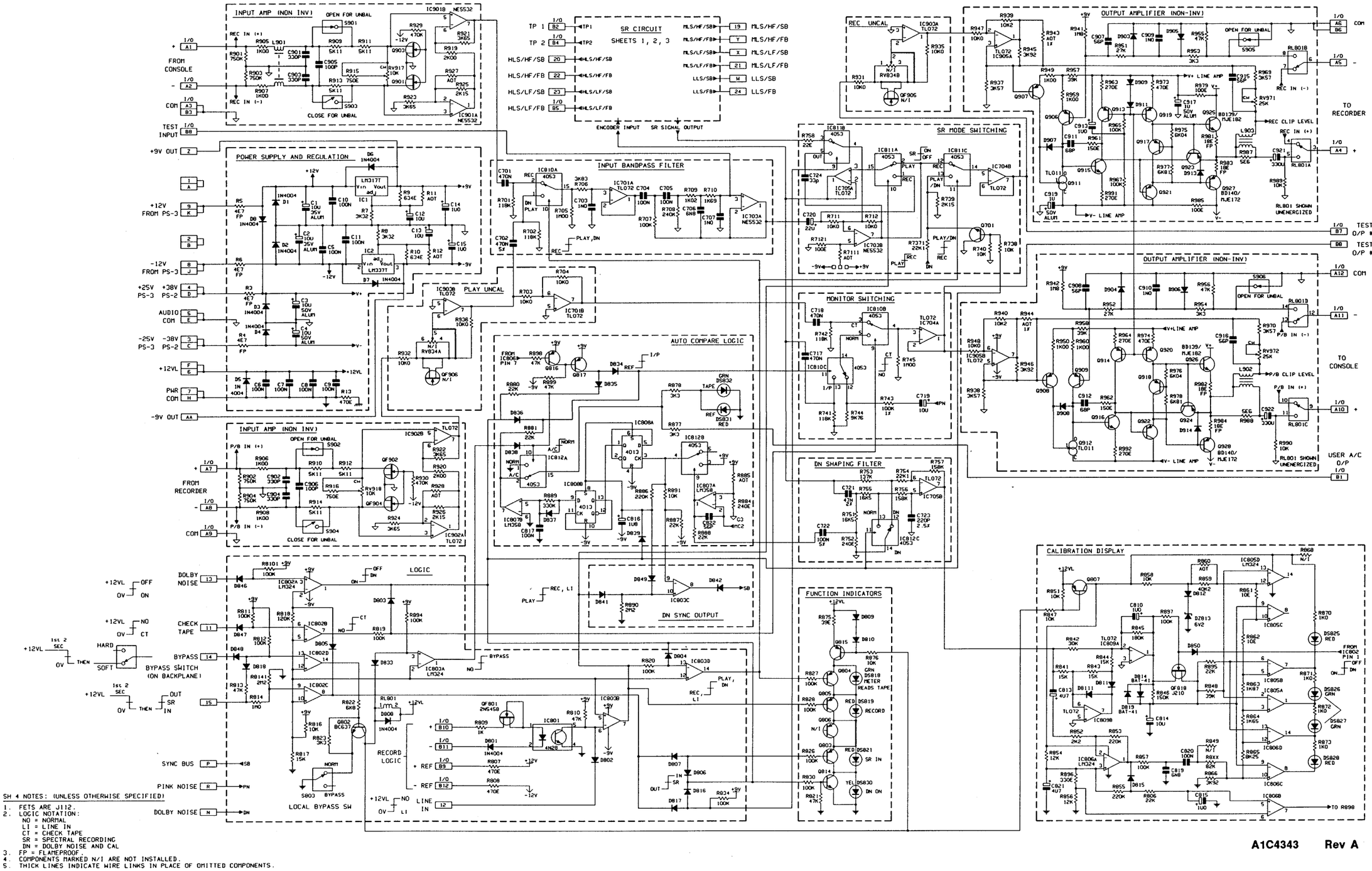
Figure 10-4 Cat. No. 431 Module, Component Layout



1) RESISTOR VALUES IN OHMS
2) CAPACITOR VALUES ARE IN FARADS
3) DIODES ARE 1N4148
4) FETS ARE J112
5) TRANSISTORS ARE DOLBY STANDARD:
   NPN=BC414, 2SC2240 OR EQUIV
   PNP=BC416, 2SA970 OR EQUIV
6) DUAL OP AMPS LM358, TL062, TL072, 5532:
   +9V TO PIN 8, -9V TO PIN 4
7) LOGIC NOTATION:
   NO = NORMAL
   LI = LINE IN
   CT = CHECK TAPE
   SR = SPECTRAL RECORDING
   DN = DOLBY NOISE AND CAL
8) FP = FLAMEPROOF

A1C3415
Rev 20

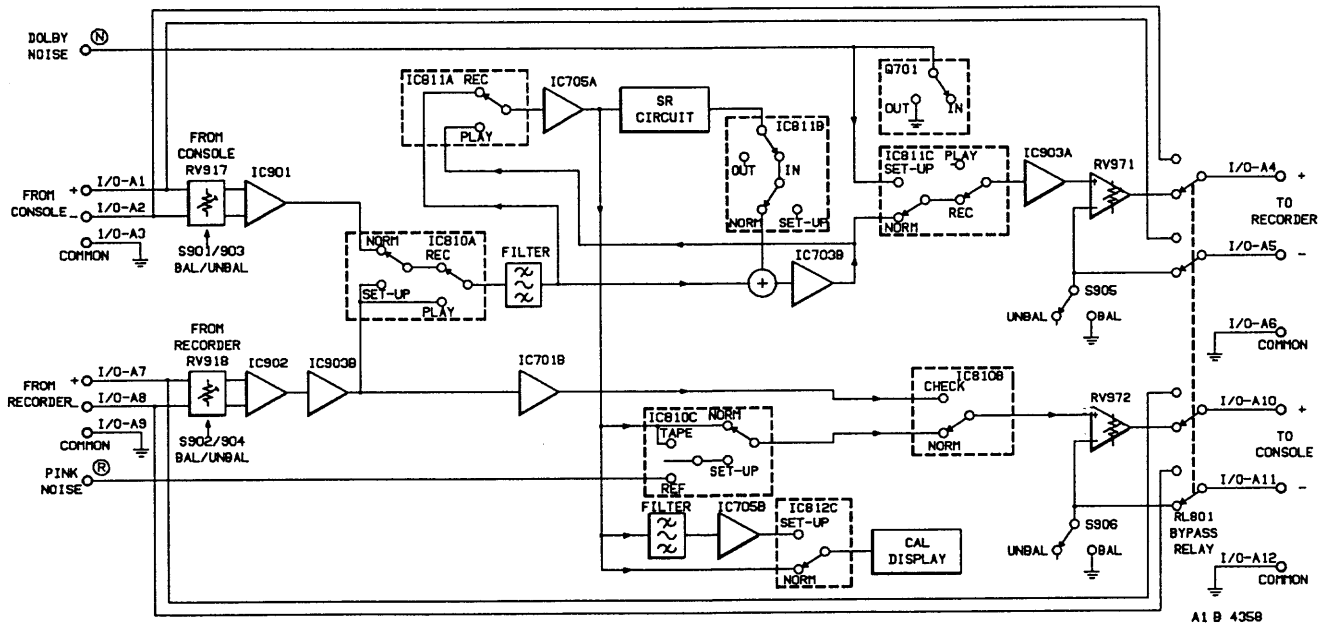
Figure 10-5 Cat. No. 431 Module Schematic Diagram

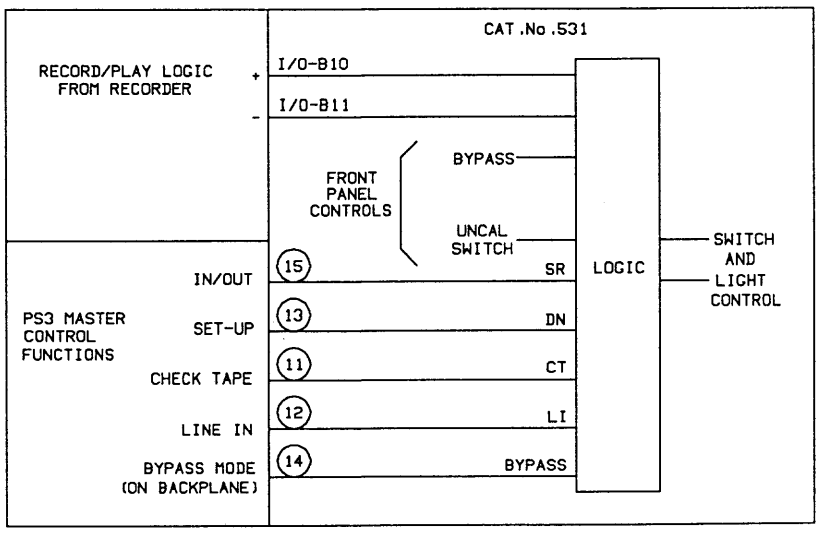


SH 4 NOTES: (UNLESS OTHERWISE SPECIFIED)

1. FETS ARE J112.
2. LOGIC NOTATION:
   NO = NORMAL
   LI = LINE IN
   CT = CHECK TAPE
   SR = SPECTRAL RECORDING
   DN = DOLBY NOISE AND CAL
3. FP = FLAMEPROOF.
4. COMPONENTS MARKED N/I ARE NOT INSTALLED.
5. THICK LINES INDICATE WIRE LINKS IN PLACE OF OMITTED COMPONENTS.

Figure 10-6 Cat. No. 531 Module, Schematic Diagram

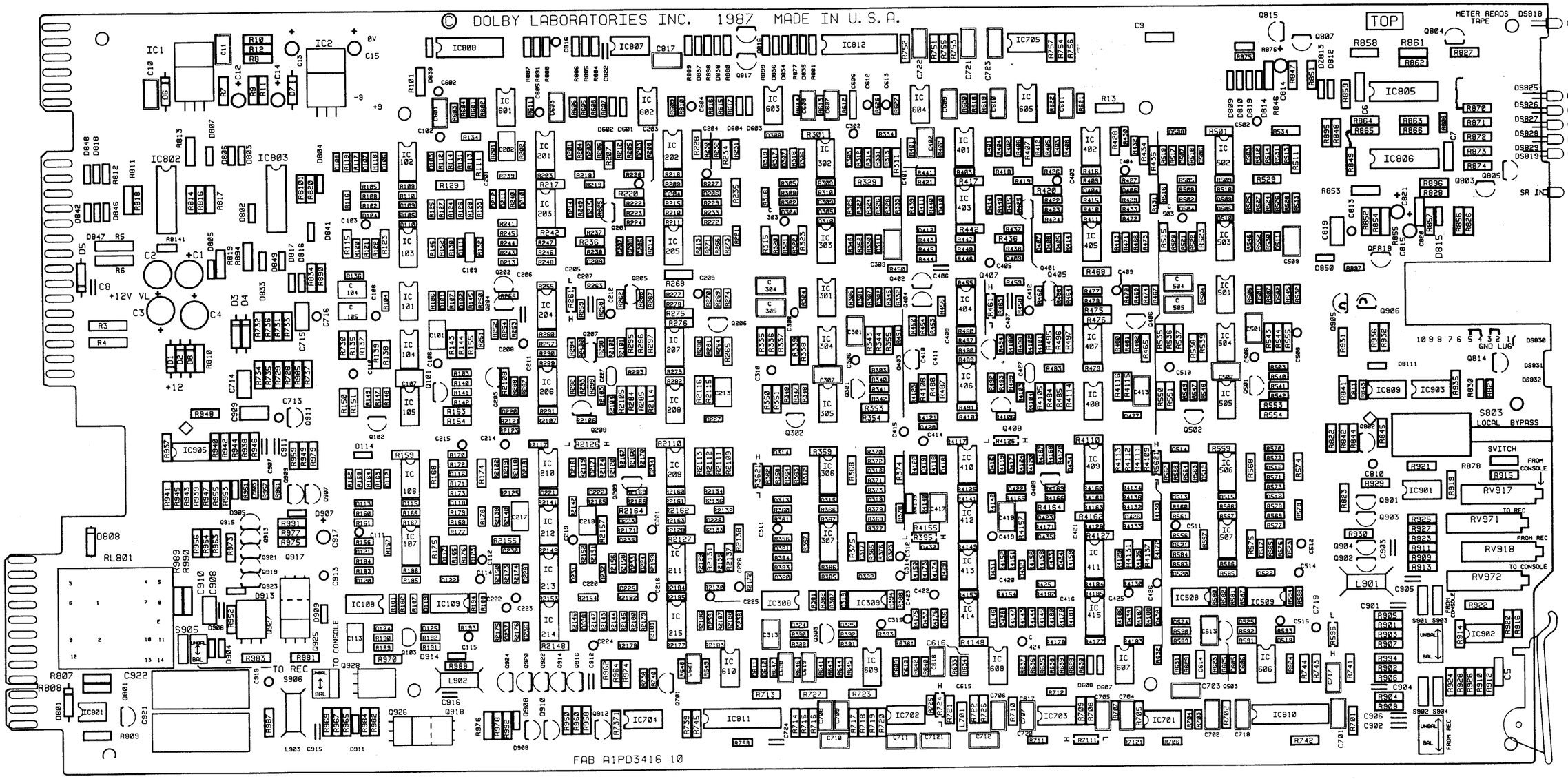




A2B4358 REV.1

1. CONNECTOR PINS DESIGNATED I/O-XXX REFER TO INPUT/OUTPUT CABLE CONNECTOR.
2. CONNECTOR PINS DESIGNATED (X) REFER TO MOTHERBOARD CONNECTOR.

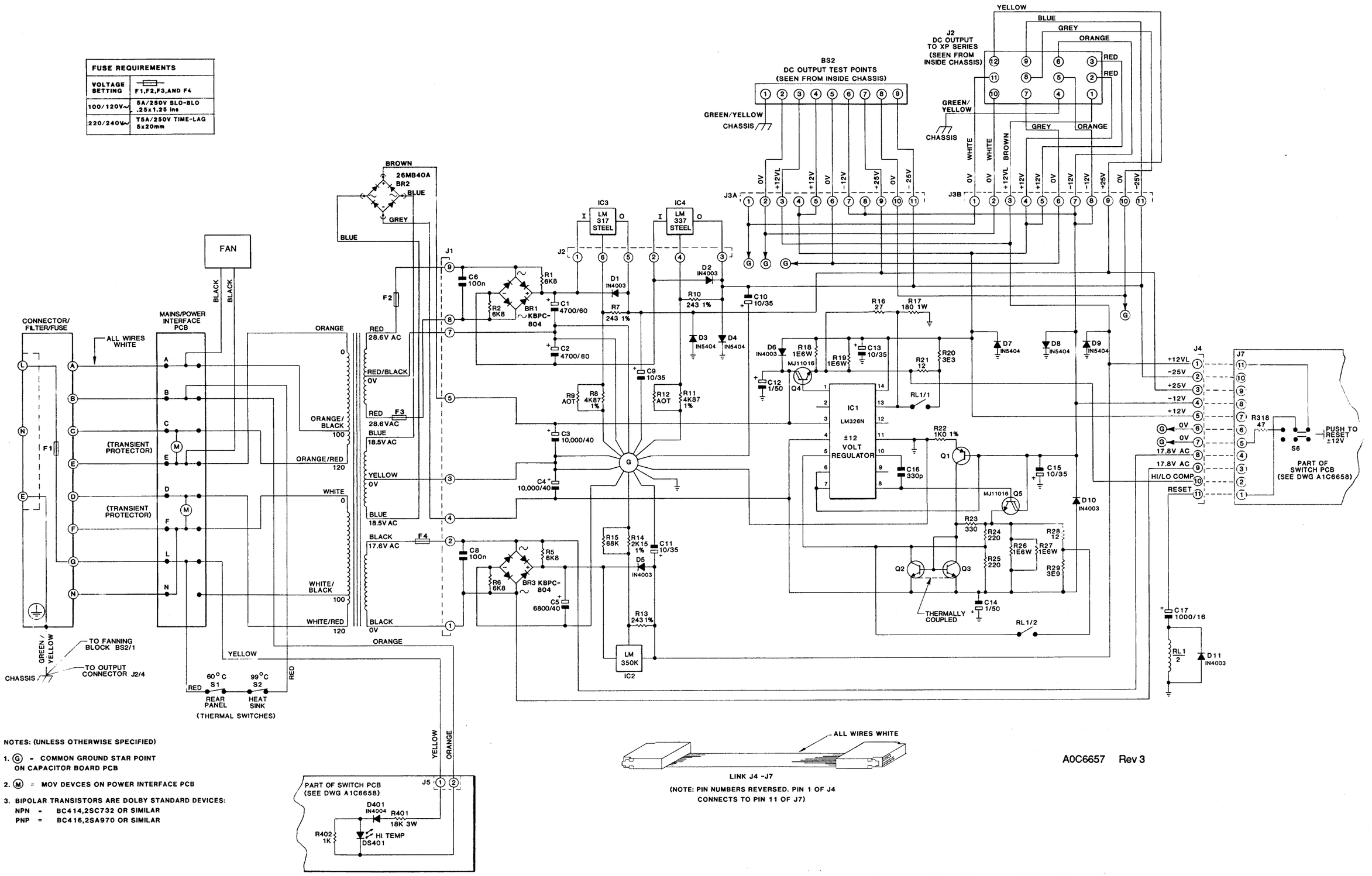
Figure 10-8 Cat. No. 531 Module, Block Diagram



NOTE: The actual printed circuit board shows positions for components which are not installed in the Cat. No. 531 and which are not shown above.

Figure 10-7 Cat. No. 531 Module, Component Layout

FUSE REQUIREMENTS	
VOLTAGE SETTING	F1,F2,F3,AND F4
100/120V~	5A/250V SLO-BLO .25x1.25 ins
220/240V~	T5A/250V TIME-LAG 5x20mm

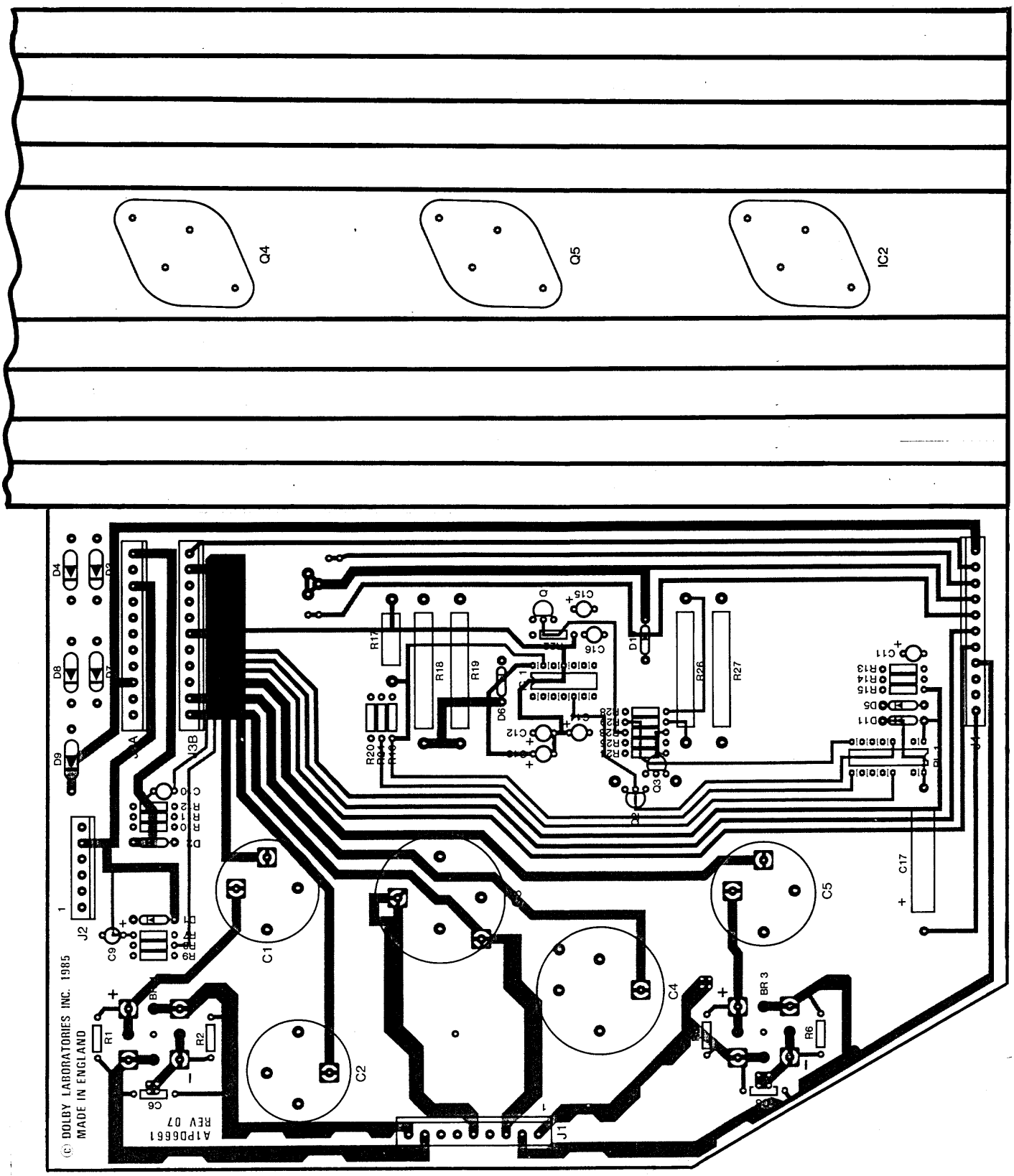


NOTES: (UNLESS OTHERWISE SPECIFIED)

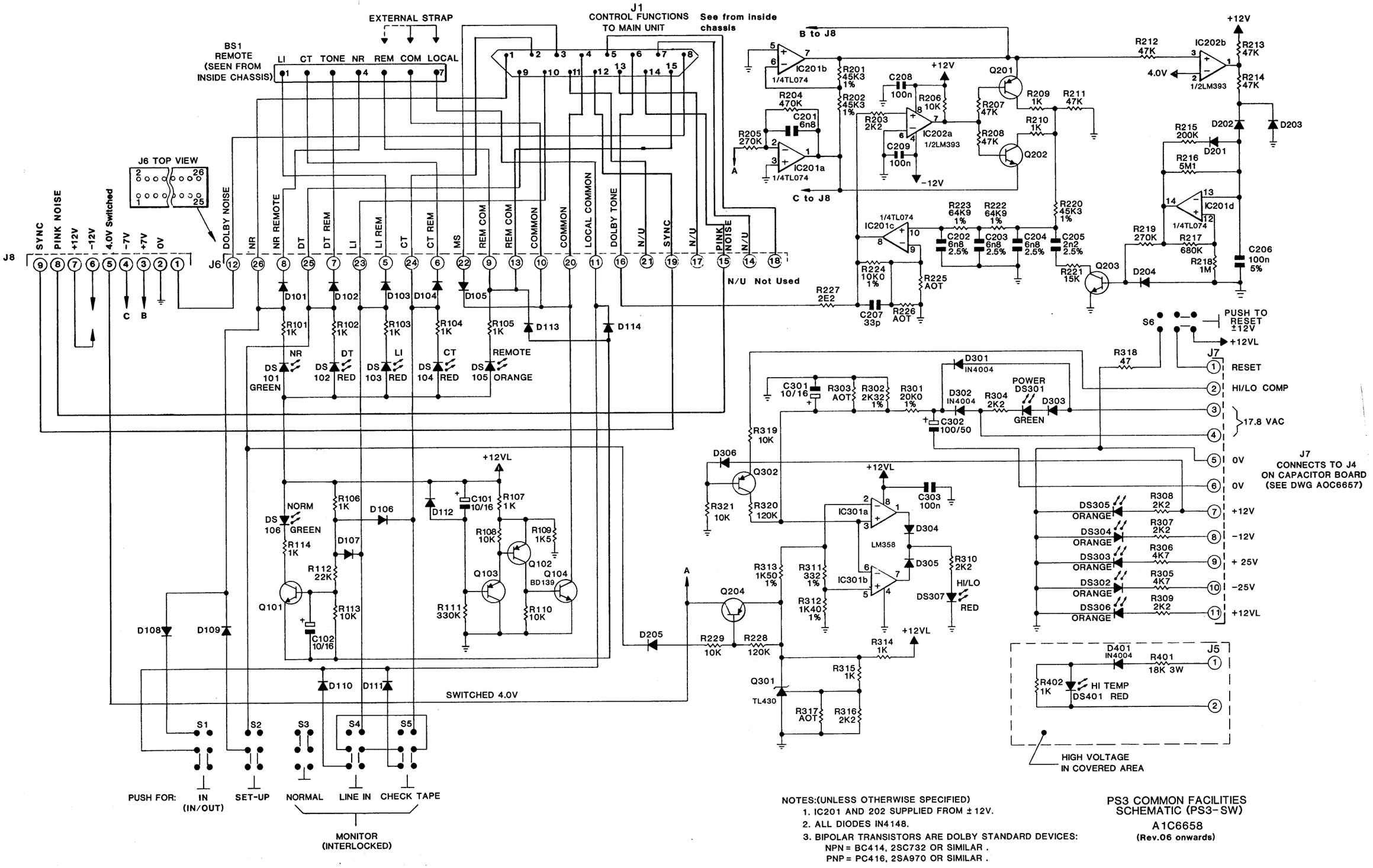
1. (G) = COMMON GROUND STAR POINT ON CAPACITOR BOARD PCB
2. (M) = MOV DEVCES ON POWER INTERFACE PCB
3. BIPOLAR TRANSISTORS ARE DOLBY STANDARD DEVICES:
   NPN = BC414,2SC732 OR SIMILAR
   PNP = BC416,2SA970 OR SIMILAR

A0C6657 Rev 3

Figure 10-9 PS3 Power Supply AC Wiring and Regulators, Component Layout and Schematic Diagram



PS3 Main PCB Layout **A1PD6661 Rev 7**

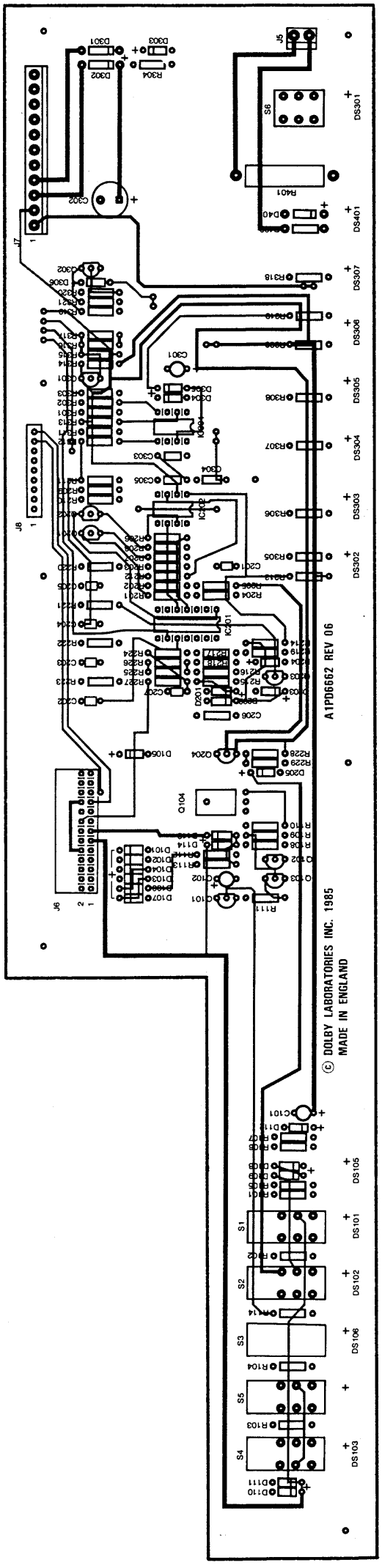


NOTES:(UNLESS OTHERWISE SPECIFIED)

1. IC201 AND 202 SUPPLIED FROM ± 12V.
2. ALL DIODES IN4148.
3. BIPOLAR TRANSISTORS ARE DOLBY STANDARD DEVICES:
   NPN = BC414, 2SC732 OR SIMILAR .
   PNP = PC416, 2SA970 OR SIMILAR .

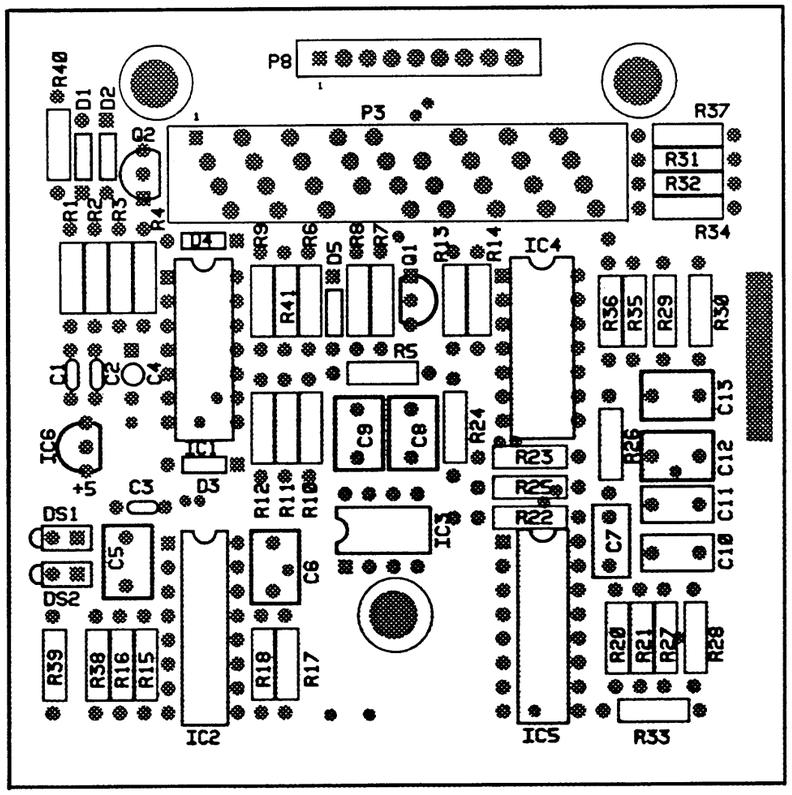
PS3 COMMON FACILITIES
SCHEMATIC (PS3-SW)
A1C6658
(Rev.06 onwards)

Figure 10-10 PS3 Common Facilities (NR Control and Dolby Tone Oscillator and Control), Component Layout and Schematic Diagram



PS3 Common Facilities PCB Layout

A1PD6662 Rev 6



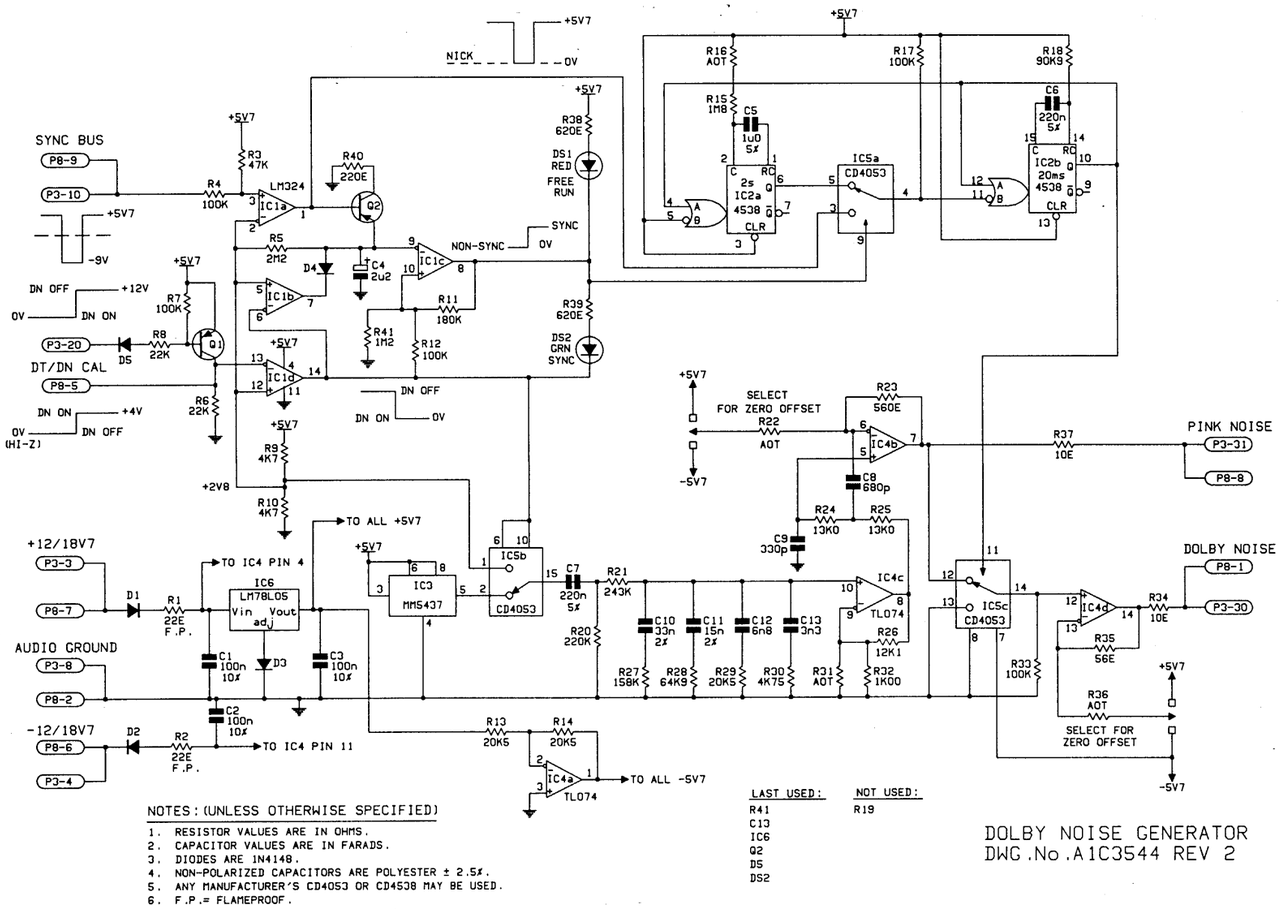
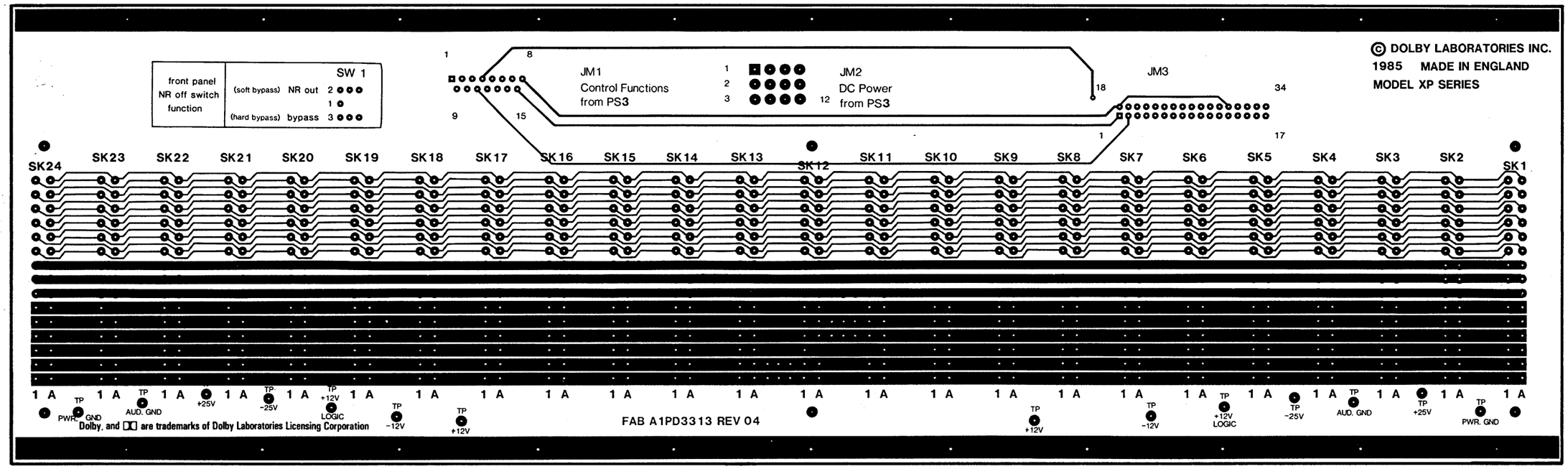


Figure 10-11 PS3 Cat. No. 342, Dolby Noise Generator Board



A1PD3313 Rev 4

Figure 10-12 Backplane Layout

APPENDICES

Section A-4 is a reprint of a semi-technical description of Dolby SR, which forms a good introduction to the concepts before reading the following two papers.

The papers in parts 5 and 6 were written and presented by Ray M. Dolby; the first, on Dolby SR, was given at the 81st Convention of the Audio Engineering Society, Los Angeles, November 1986. The second, on Dolby A-type noise reduction, was given at the 32nd Convention in Los Angeles, in April 1967. Both papers are reprinted from the Journal of the Society.

A-1 Multi-track Use of Auto Compare

In multi-track recording, it is desirable to have synchronization of the Auto Compare sequence between channels. Synchronous switching allows the operator to switch freely the individual channel output signals to the monitor speakers without an apparent interruption in the audible tape/reference switching pattern. In order to accomplish this, the Dolby noise recordings on the recorded tracks must themselves be synchronized, that is, all the recorded Dolby noise "nicks" occurring at the same time.

Dolby noise, generated in the XP/SRP Series, is derived from the single Dolby noise generator, mounted either in the power supply or on the backplane in the case of early units. Tracks where Dolby noise is recorded at the same time will, therefore, be automatically synchronized. In situations where there is previously recorded Dolby noise on the tape, it is necessary to synchronize the internal generator with the existing Dolby noise recorded on the tape. This is done by playing the existing Dolby noise using the "sync" playback mode on the tape recorder and then pressing the **Set-up** ("Dolby tone/Cal") button after the Dolby noise on the tape has begun to play.

In cases where there is previously recorded Dolby noise on a number of tracks and they are not synchronized (i.e., recorded at different times without re-syncing), the internal Dolby noise generator must be forced to ignore out-of-sequence Dolby noise signals. On Cat. No. 431s this is done by switching the SR process OFF on those tracks that are unsynchronized ("SR **in/out**" switch DOWN on the Cat. No. 431 panel). On Cat. No. 531s it is done by muting the Dolby noise outputs from unsynchronized tracks (e.g. by switching from playback to source at the recorder). It is important to remember to listen to only one channel at a time for valid Auto Compare information.

When the **Set-up** (Dolby tone/Cal) button is pressed, the internal Dolby noise generator looks for about three seconds for an external synchronization signal from any channel that is in PLAY - unless Dolby SR is switched OUT (down) on that channel. If, after three seconds, it sees no external synchronization signal, it will begin to free-run from its internal clock. In practice, this means that when Dolby noise is initially recorded on the tape, it should be recorded over blank or erased tape; otherwise the internal sync pulse generator may try to synchronize on the previously recorded program material. This will lead to erratic sync pulses being inserted into the new Dolby noise being recorded.

When a new Dolby noise recording is being synchronized with previously recorded Dolby noise, occasionally the synchronization pattern may be reversed. That is, the tape/reference pattern may be backwards when compared with the previously recorded Dolby noise track. In record, this has no real

consequence and can be ignored. In playback, however, it can cause confusion if the user is switching different channels to the monitor loudspeaker quickly. To remedy this, release the **Set-up** button briefly and then press it again; all of the auto compare circuits will be reset to monitor off tape.

A-2 Measurement of Noise and Noise Reduction Effect of Dolby SR

A. Measurement of Noise

Human hearing is not uniformly sensitive with frequency. At low levels, those in which unwanted background noises exist, it is most sensitive over a middle range of frequencies, and progressively less so at frequencies further from the middle. Beyond about 20 Hz and 20 kHz it is "infinitely insensitive," that is, these frequencies cannot be heard irrespective of level by the large majority of people. However, the spectrum of noise delivered by most audio systems is roughly uniform with frequency ("white"), containing significant noise contributions at the extremes of the audio spectrum and usually well beyond those extremes.

Dolby SR has been designed to reduce noise in accordance with its audibility. Operating on signals at the extremes of the audio spectrum or beyond, where noise is not a problem, is counter-productive; it increases the possibility of audible side-effects and obviously has no audible benefit in reducing noise. SR therefore reduces noise most over the middle of the spectrum, has only a modest effect at the extremes, and indeed slightly degrades noise at infrasonic frequencies (less than 20 Hz). The design of SR in accordance with the audibility of noise means that, for sensible results, noise measurements must also take into account the audibility of noise. A simple wide-band (unweighted) noise measurement will yield a disappointing result which does not agree with the listening experience. Most of the noise being measured will be at and beyond the extremes of the audible range; this can be confirmed by examination of the noise on a spectrum analyzer. On an oscilloscope the unreduced very low frequency noise will yield an unsteady base-line, which has in the past mistakenly been interpreted as low frequency instability; it actually is the original noise waveform with the audible frequencies removed, leaving the inaudible very low frequencies.

Weighted noise measurements yield answers which correlate more closely with audibility. However, depending on the amount of ultrasonic noise, the A-weighting curve may provide inadequate attenuation of noise above 20 kHz, and therefore must be supplemented by an audio bandpass filter (say 20 kHz, preferably using a 4-pole design) to eliminate inaudible frequencies. CCIR 468 and CCIR/ARM give results which agree with listening provided the test equipment works properly. Unfortunately, many integrated instruments (meters containing switchable weighting filters) have inadequate headroom in their amplifiers and/or high frequency crosstalk across their switches, and as a result give grossly inaccurate results. Such problems can be identified while measuring noise reduced by SR by switching the meter from wide-band (not audio band, but 100 kHz or more) to weighted measurement. If it is necessary to increase the meter gain by 20 dB or more to restore the deflection of the meter, the meter amplifier is probably overloading, and a quiet audio low- or bandpass filter should be connected ahead of the meter. In many cases a passive single-pole low-pass at 20 kHz will be adequate.

Assuming that noise sources ahead of the SR encoder and after the SR decoder are negligible, Dolby SR will give an audible and a weighted measured noise reduction in the range 20 to 24 dB. If less noise reduction is observed, it is likely that the measurement is at fault, as described above.

B. Measurement of Noise Reduction Effect

In many installations the extended dynamic range offered by Dolby SR means that noise sources which can normally be neglected (such as input and output amplifiers) may become significant. Any measurement of the effectiveness of the noise reduction action must also measure the contribution of noise from these sources. Simply replaying a biased (no signal) tape and turning the noise reduction system on and off will not give a figure for the practical efficiency of the system; it will only measure the playback effect.

Unfortunately, this playback-only technique does not always give results which relate well to the effect produced in the full record/replay process. The Dolby system is a complementary system; recordings to be played with noise reduction switched on are not made with noise reduction switched off. Therefore it is not sufficient to use a piece of blank tape for the tape noise source. The tape to be played back with noise reduction switched on must be recorded with noise reduction switched on. Similarly, the tape to be played

back with noise reduction switched off must be recorded with noise reduction switched off. Only by doing this can the effect of extraneous noise sources on the total noise be properly assessed.

The correct test procedure is as follows:

a. Feed a signal at normal reference level from the console, record a test length, play back the tape, and confirm the output level is also at reference.

b. Remove the source signal (if the test oscillator is merely turned down, ensure there is really no signal at its output—a small leakage of tone would invalidate the noise reduction measurement).

c. Record a length of tape with the noise reduction system off, and at a convenient timing point turn the system on.

d. Rewind the tape, and play back the section recorded without noise reduction with the noise reduction switched off, and measure the output noise.

e. At the point at which the system was switched on in the recording, switch on the system and measure the reduced output noise.

f. The noise reduction effect is the difference between the measurements in d. and e. above. The exact figure will depend on the weighting method used, but should be over 10 dB for Dolby A-type noise reduction and over 20 dB for Dolby SR.

A-3 Spurious Input Signals

While the module has a low-pass filter at the input, care should be taken to prevent spurious signals from entering the module. Dolby signal processing, both A-type and SR, has characteristics which are based on human hearing. Therefore it may be disturbed by the presence of signals at or beyond the limit of inaudibility, and in particular by unwanted crosstalk of signals at recording bias or television horizontal frequencies.

To prevent the possibility of disturbance, spurious signals at the top of the audio band must be at least 60 dB below Dolby level at the input of the Cat. No. 431/531. Typical bias frequencies, for example 100 kHz and above, must be at least 40 dB below Dolby level.