Model EX-EU4/EX-DU4
Surround Encoder/Decoder
User's Manual

Issue 1 Part No. 91759

MAIN

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WARNING: Troubleshooting must be performed by trained technicians. Do not attempt to service this equipment unless you are qualified to do so. Check that the correct fuses have been installed. To reduce the risk of fire, replace the fuses only with the same type and rating. See Section 1.3.

Issue 1
S01/13818
Part No. 91759

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Regulatory Notices

FCC

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his or her own expense.

Canada

This Class A digital apparatus complies with Canadian ICES-003.

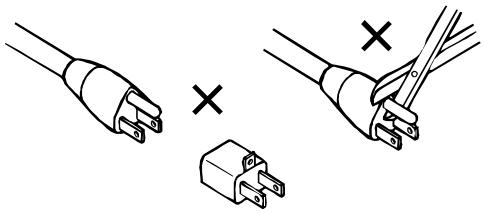
UL

WARNING: Troubleshooting must be performed by a trained technician. Do not attempt to service this equipment unless you are qualified to do so.

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

Exposed portions of the power supply assembly are electrically "hot". In order to reduce the risk of electrical shock, the power cord MUST be disconnected when the power supply assembly is removed.

The ground terminal of the power plug is connected directly to the chassis of the unit. For continued protection against electric shock, a correctly wired and grounded (earthed) three-pin power outlet must be used. Do not use a ground-lifting adapter and never cut the ground pin on the three-prong plug.



UK

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

- The core, colored green and yellow, must be connected to the terminal in the plug that is marked with the letter **E** or by the ground symbol ⏚ or colored green or green and yellow.
- The core, colored blue, must be connected to the terminal that is marked with the letter **N** or colored black.
- The core, colored brown, must be connected to the terminal that is marked with the letter **L** or colored red.

EU

This equipment complies with the EMC requirements of EN55103-1 and EN55103-2 when operated in an E2 environment in accordance with this manual.

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

Chapter 1 Introduction

1.1 Product Overview

The Dolby EX-EU4 and EX-DU4 are for use in recording, mixing, postproduction, and DVD authoring facilities to create and monitor the surround channels of a production encoded in Dolby Digital Surround EX. The EX-EU4 is usually used during the mixing process together with an EX-DU4 for monitoring purposes. Subsequently, the EX-DU4 will be used in other postproduction stages, such as audio encoding, to monitor the Dolby Digital Surround EX soundtrack.

At the heart of the EX-EU4 is a precision matrix encoder that combines discrete left, back, and right surround inputs into a signal pair, known as left surround total (Lst) and right surround total (Rst). This can be integrated seamlessly into the two surround channels (left surround and right surround) within Dolby Digital, to create Dolby Digital Surround EX material for distribution via DTV or DVD. The resulting output can be heard in full six-channel surround in home systems equipped with Dolby Digital Surround EX decoding, and is compatible with 5.1-channel reproduction, as well.

The EX-EU4 features adjustable trim controls and electronic balanced inputs and outputs, as well as LED meters for calibration purposes.

The corresponding EX-DU4 is a reference Dolby Digital Surround EX matrix decoder. The decoder derives separate left surround, back surround, and right surround output signals from the left surround total/right surround total channels of a Dolby Digital Surround EX signal. (The Lst and Rst signals would be taken from a Dolby Digital decoder such as a Dolby DP562.) The three surround channel signals are then sent via an internal router to four individual outputs: Left Surround (Ls), Back Surround Left (Bsl), Back Surround Right (Bsr), and Right Surround (Rs). This arrangement allows for the appropriate switching of the back surround speakers between conventional 5.1 Dolby Digital and Dolby Digital Surround EX operation. The EX-DU4 can also be configured to provide a mono surround channel to monitor Dolby Surround Pro Logic material.

The EX-DU4 features front-panel mode selection (Dolby Surround EX, 5.1, and Dolby Surround Pro Logic), balanced floating transformerless inputs and outputs, pink noise generator for calibration purposes, and a rear-panel D-connector providing remote control and fixed-level signal monitoring points.

1.2 Specifications

EX-EU4 Signal Connections (rear panel)

Left Surround, Back Surround, and Right Surround XLR inputs. Left Surround Total and Right Surround Total XLR outputs.

EX-DU4 Signal Connections (rear panel)

Lst (Left Surround Total) and Rst (Right Surround Total) XLR inputs for two-channel encoded signal; Left Surround, Back Surround Left, Back Surround Right and Right Surround XLR outputs.

EX-EU4 Front-Panel Controls and Indicators

Five screwdriver-adjustable trim controls: Left Surround, Back Surround, and Right Surround input. Lst and Rst outputs. Four-segment LED meters for each input.

EX-DU4 Front-Panel Controls and Indicators

One toggle switch and three push-button switches control system operating modes and internal test signals. Screwdriver adjustable controls recessed behind panel for adjustment of input and output levels. LED meters indicate Lst and Rst input level. Signal-presence LED's indicate Left Surround, Back Surround Left, Back Surround Right, and Right Surround decoder outputs.

Operating Modes EX-DU4

Dolby Surround EX, conventional **Stereo**, and **Mono** modes, selected by front-panel button or remote control.

Pink Noise Calibration Function

Pink noise from the EX-DU4's internal generator can be sent to the outputs. Noise can be automatically cycled between Left Surround, Back Surround, Right Surround, remaining for three seconds at each output; or to any desired channel under manual control.

Input Circuit (0 dBr=0.775 Vrms)

Balanced floating transformerless inputs. Input gain adjustment will accommodate a range of 300 mV (–8.2 dBr) to 2 Vrms (+8.2 dBr). Input impedance is greater than 10 kΩ. Maximum common mode voltage 4 Vrms, 5.8 V peak.

Output Circuit

Balanced floating transformerless outputs. Output gain adjustment will accommodate a range of 250 mV (–9.8 dBr) to 2.5 V (+10.2 dBr). Output impedance 25 Ω.

Maximum output voltage +26 dBr into balanced 600 Ω load, less into lower impedances. Maximum output +20 dBr into unbalanced 600 Ω load.

Overall Frequency Response

20Hz–20 kHz (± l dB).

S/N Ratio (referenced to Dolby level)

Greater than 80 dB (Left, Center, Right), CCIR/ARM weighted.

Distortion

Total harmonic distortion (THD) at the main balanced outputs will not exceed 0.25% into balanced loads 600 Ω or greater at any output level up to 12.5 Vrms. THD at Dolby level at 1 kHz with input and output adjusted for +4 dBr, 0.1% typical.

Ambient Operating Temperature

Up to 40 degrees C.

Size

1-U rack-mount; 43 mm (1.75") high, 260 mm (10.25") deep behind mounting surface; maximum projection in front of mounting surface 22 mm (0.875").

Weight

5 kg (11 lb).

Power Requirements

The EX-EU4 and EX-DU4 each consume about 20 W and are designed for operation from a centrally switched power source. 230 V version: 198–264 VAC, 50/60 Hz, uses one 20 mm T250 mA fuse. Multivoltage version: 85–132 VAC, 50/60 Hz, uses one 1.25" 500 mA slow-blow fuse; or 187–264 VAC, 50/60 Hz, uses one 20 mm T250 mA fuse.

1.3 Mains Fuse and Voltage Selection

1.3.1 230 V-Only Unit

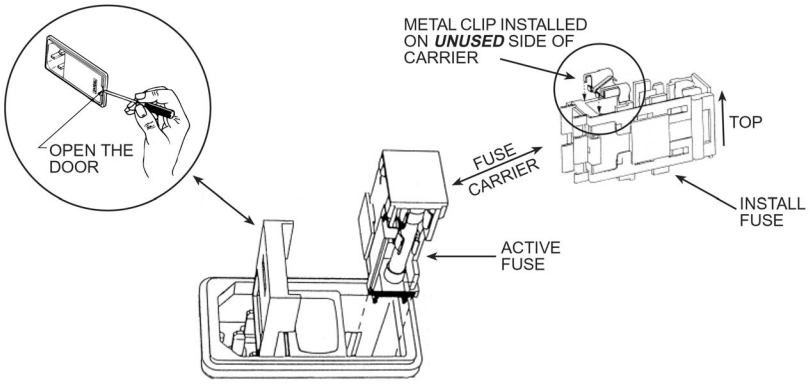


Figure 1-1 Fuse Compartment, 230 V Unit

Open the fuse compartment door in the AC mains input connector with a small flat-blade screwdriver (see Figure 1-1), and check that the fuse has the correct rating (T250 mA 20 mm time-lag).

Caution: *The fuse carrier must be inserted into the compartment with the orientation as shown. Do not force the carrier into the compartment; damage will result.*

1.3.2 Multivoltage Unit

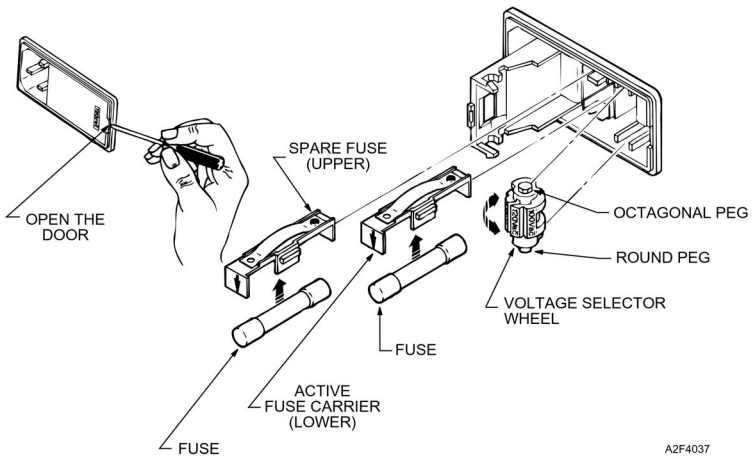


Figure 1-2 Fuse Compartment, Multivoltage Unit

Open the fuse compartment door in the AC mains input connector with a small flat-blade screwdriver (see Figure 1-2), and check that the fuse has the correct rating. If necessary, rotate the selector drum until it displays the correct voltage for the installation. (The drum may also be removed and replaced in the desired position. It will only fit one way around.) Snap the fuse compartment door closed .

For 85 to 132 VAC, use a 500 mA, 1.25", slow-blow fuse.

For 187 to 264 VAC, use a T250 mA, 20 mm, time-lag fuse.

1.4 Audio Connections

The EX-EU4 and EX-DU4 have been designed to interface with professional audio equipment at common operating levels. Connections to and from the unit are made using standard 3-pin XLR-type connectors. Both the input and output stages are electronically balanced, with pin 2 being positive and pin 3 negative. For optimum immunity to radio-frequency interference, cable shields should be connected to the shells of the XLR connectors, not to pin 1.

Chapter 2
Installation

The two main applications for the EX-EU4 and EX-DU4 are:

- Mixing a Surround EX program and producing a 5.1-channel master tape
- Dolby Digital encoding of a Surround EX program for DVD authoring

In this chapter we will give examples of possible equipment installations and discuss the major issues for each these applications.

2.1 Mixing a Surround EX program

It is important when mixing a Surround EX program, that the mixing engineer is able to monitor the effects of the Surround EX encoding and decoding throughout the entire mixing process. In this way the mixing engineer can be sure how the final mix will sound when played-back on both Surround EX and non-Surround EX capable systems.

Two example installations for a mixing studio are shown on the next page. For encoding, both utilize the EX-EU4, Dolby Surround EX encoder, connected between the mixing console and multitrack recorder. To provide suitable monitoring, the simplest method is to add the EX-DU4 Surround EX decoder within the monitoring path as shown in Figure 2-1. An alternative is to use the DP570 Multichannel Audio Tool as it contains a Surround EX decoder, see Figure 2-2. One advantage of the DP570 is that it can also emulate the effects of metadata (as used within Dolby Digital). This is especially useful if the program is to be encoded as a Dolby Digital soundtrack for DVD or DTV release, as the operator will also be able to check for mono, stereo, Dolby Surround Pro Logic, 5.1-channel and Surround EX compatibility.

The standard delivery format for Surround EX programs is as either a discrete multi-track tape or as Dolby E. In either case it is usual to supply 6 channels of audio comprising of the left, right, center, Low Frequency Effects (LFE), left surround total and right surround total channels. Note that the encoded left, right and back surround channel signals are contained within the left surround total and right surround total channel pair.

It is of course important to mark the tape box clearly to show that this is a Surround EX program.

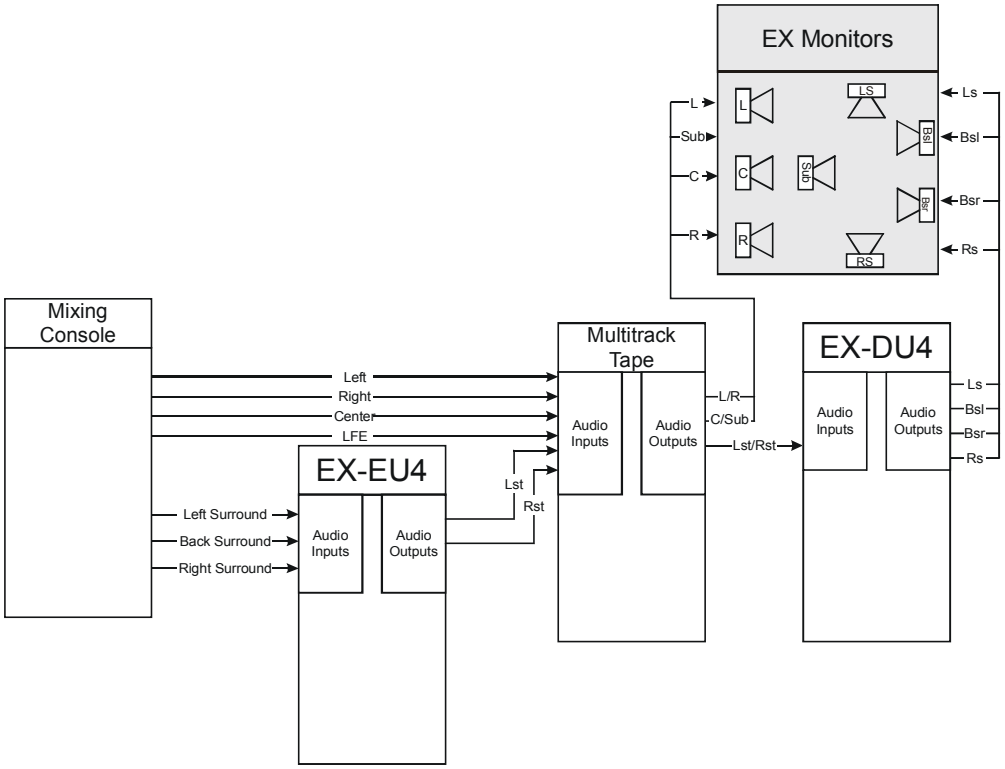


Figure 2-1 Mixing and Monitoring Installation Example

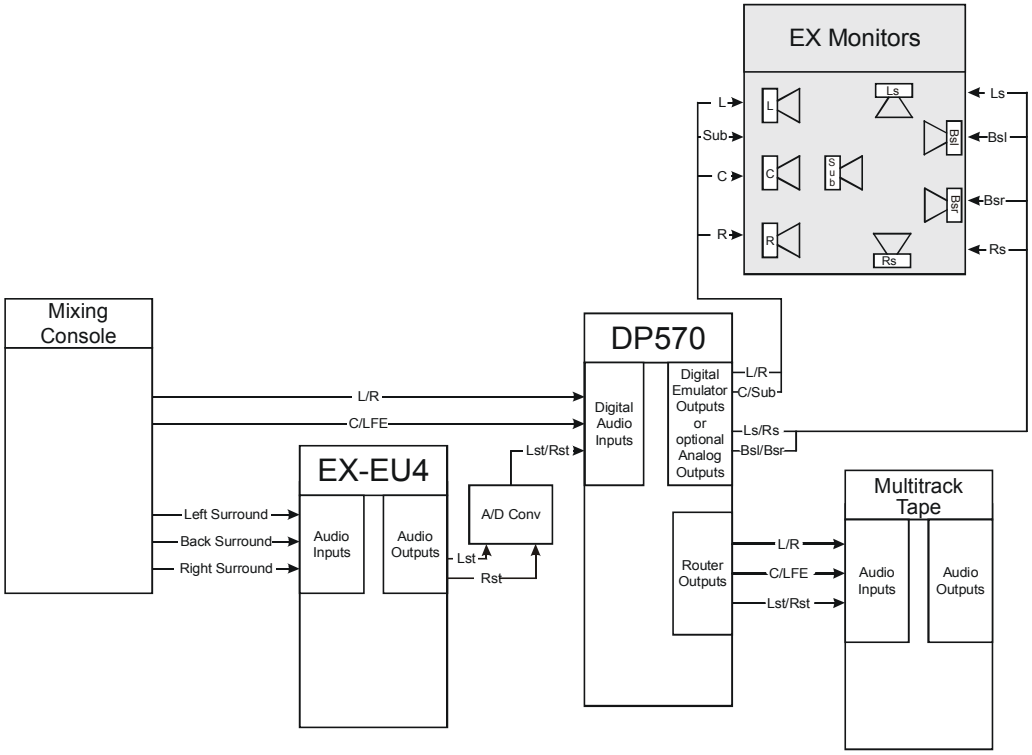


Figure 2-2 Mixing and Monitoring Using DP570 Installation Example

2.2 Dolby Digital Encoding of a Surround EX Program

In the main, Dolby Digital encoding of a Surround EX program is identical to encoding a regular 5.1-channel program. As the master audio tape will already contain encoded left, right and back surround signals within the normal stereo surround channels, the encoding facility should not notice any major differences in their pre-processing and audio conforming stages.

The encoding process is also very similar, the only change being to set the Dolby Surround EX flag in the Dolby Digital bitstream, (version 2.0 or higher is required in the DP569).

The major difference is that the monitoring system must be capable of decoding and reproducing Surround EX programs. The easiest way to do this is to add the EX-DU4 Surround EX decoder after the DP562 Dolby Digital decoder as shown in Figure 2-3.

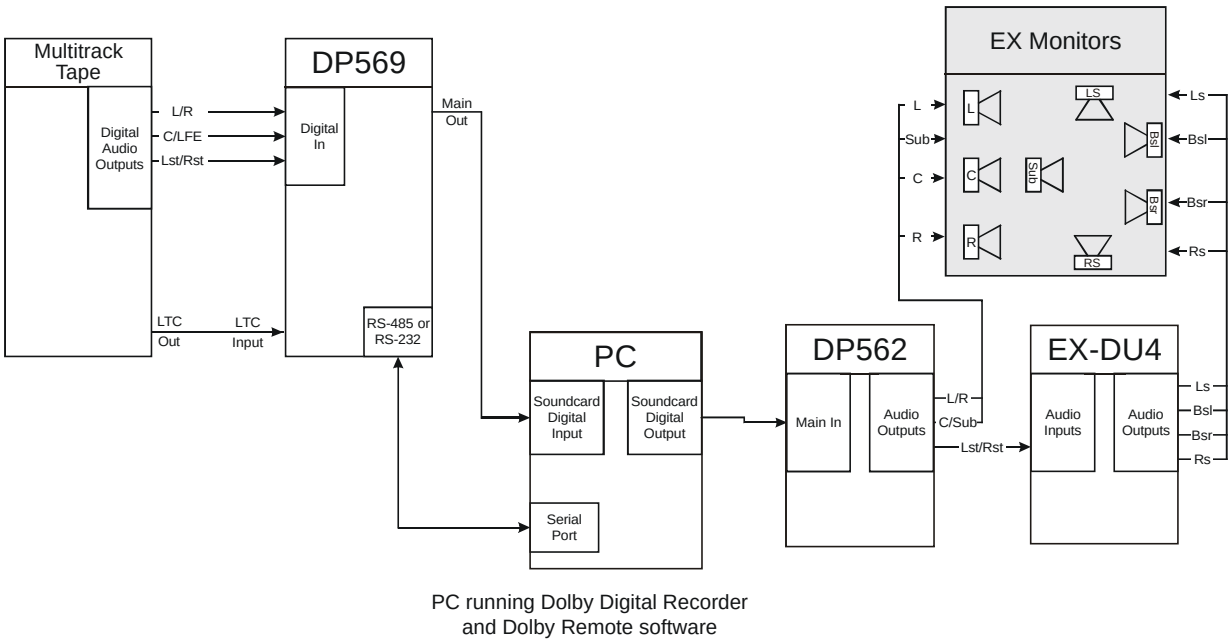


Figure 2-3 Dolby Digital Encoding Surround EX Programs Installation Example

Chapter 3
EX-EU4

3.1 Calibration

The EX-EU4 (and EX-DU4) are easily calibrated using an external 1 kHz test tone, but consideration must be given to the level this tone has in relation to the levels in the remainder of the recording system. The tone should be set to the studio's standard level, (for example, +4 dBr). The EX-EU4 can be calibrated for input levels ranging between –8 and +8 dBr. The level used should have a known and constant relationship to the recording level and monitor level in use. Any level can be used for reference level, provided the recording system and monitor system are related to this level.

Recording Level

Dolby Digital Surround EX program material often has a wide volume range. Deciding on optimum reference levels is a complex subject involving knowledge of the available headroom of the whole system down to the release format. You can consult with Dolby staff for advice regarding your particular application.

Monitor Level

The external calibration test tone should be related to the monitoring level. Monitor level is usually established and verified using pink noise. Procedures for setting monitor level are covered in Chapter 4 of this manual. It is important to remember that the calibration tone is referenced to a specific level of pink noise, which in turn should produce a known sound pressure level in the listening environment.

Items Needed for Calibration

- External 1 kHz tone at standard level
- An AC voltmeter with an XLR-type connector

3.2 Alignment Instructions

1. Connect an external tone (1 kHz at studio reference level) to the Ls (left surround) input XLR on the rear. Adjust the left surround input potentiometer at the front panel until the two green LED's on the left surround channel level indicator are on.

2. Repeat the above procedure for the back surround and right surround inputs.

3. Apply the tone to the left input only. Connect a voltmeter to the Lt (left total) output and adjust the Lt output control to obtain studio reference level.

4. Repeat step 3 for the right channel by connecting the signal source to the right input only and adjusting the Rt output control for reference level at the Rt output.

Chapter 4
EX-DU4

4.1 External Facilities Connector (J503)

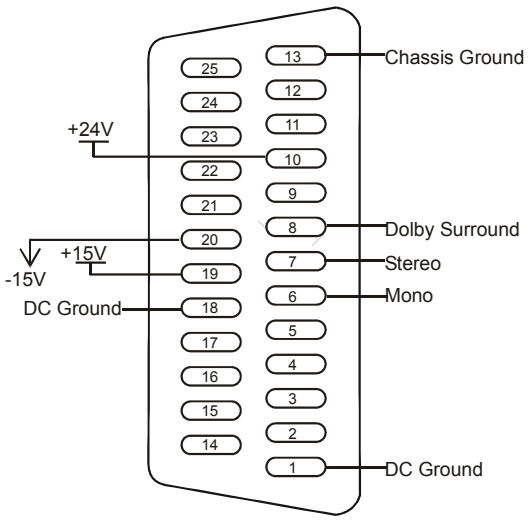


Figure 4-1 J503 Connections

Connector J503 (25-pin female D-connector) provides various remote control functions; see Figure 4-1. For optimum immunity to radio-frequency interference all cables connecting to J503 should be shielded with the shields connected to the metal cover of the D-connector, not to pin 13 or 1.

4.2 Internal Switch Settings

For reference, the correct switch positions on the Cat. No. 844 card are shown below. Do not change these settings.

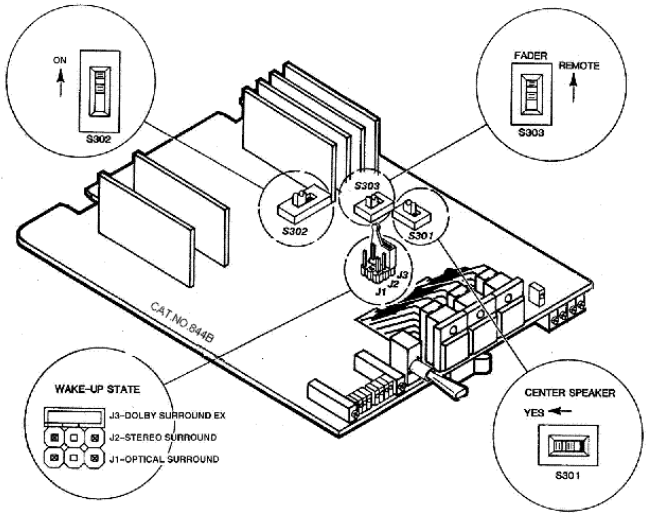


Figure 4-2 Cat. No. 844B

4.3 Calibration

4.3.1 Input Level Setting

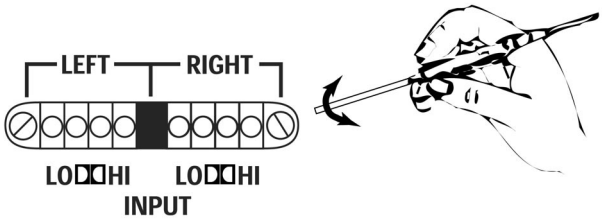


Figure 4-3 LED Calibration Meter and Input Adjustments

The EX-DU4 contains two four-element LED calibration indicators for setting the input level.

The two input level potentiometers are set so that reference tone from the signal source, representing the studio's operating level, is equal to the EX-DU4's internal operating level.

Any level between –8 and +8 dBr (0 dBr = 0.775 Vrms) can be set to correspond with the internal operating level. This is indicated by the two green LED's being equally illuminated.

4.3.2 Output Level Setting

The EX-DU4 contains an internal pink noise generator that allows easy setting of the output level controls and the verification of correct operation of the monitor system. (Always select Surround EX mode before using the pink noise generator. If you unintentionally operate the toggle switch in one of the other modes, return it to the OFF position and select Surround EX to reset the internal logic.)

The generator has two modes of operation—manual and automatic—as selected by the front-panel toggle switch. With the switch in the center, or OFF position, the EX-DU4 functions normally. In the down, or Manual, position, wideband pink noise can be manually stepped to each output channel using the "noise sequence" buttons. The manual position is typically used during initial setup, where correct monitor equalization is being set using a calibrated microphone and real-time analyzer. In the up, or Auto, position the pink noise is automatically sequenced through the output channels.

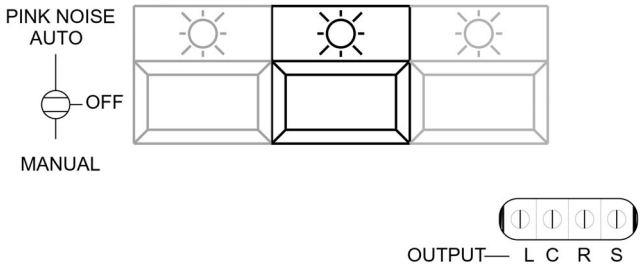


Figure 4-4 Pink Noise Calibration Functions

4.3.3 Output Level Adjustments

Output potentiometers are provided so that the decoder output level can be matched to the monitor system.

Typically, the EX-DU4 output level is set using the internal pink noise source. The EX-DU4 output trims, (or alternatively, the level controls on the power amplifiers) are set so that the sound pressure level in the primary listening area is adjusted to the recommended level with one channel at a time being driven with wideband pink noise.

In cases where the EX-DU4 outputs are routed though a switching system and the outputs from other devices are connected to the power amplifiers, set the EX-DU4 outputs to an established house reference level (+4 dBr, for instance) and make the final monitor level adjustments at the power amplifiers.

4.3.4 Alignment Instructions

The following steps assume a monitor sound pressure level of 85dBc as used in film mixing situations, however other reference levels such as 79dBc or 82dBc are often

used for TV or DVD work to be more representative of a home environment. Therefore, it may be necessary to substitute the numbers below with your chosen operating reference sound pressure level (SPL).

1. Send a 1 kHz tone at the studio's Dolby reference level (0 VU in North America) from the console to left surround total input. Adjust the left input trim on the front panel to obtain Dolby level (two green LED's lit) on the adjacent meter.

   An alternative if using the EX-DU4 within a Dolby Digital encoding system, is to use the test tone generator in the DP569. Set this to the house digital level. Set the DP562 to **None** and **Full** modes. It is recommended that the DP562 level trims are left at 0.00dB and that level adjustments are made to the EX-DU4.

2. Repeat this procedure for the right surround total input.

3. Select **Stereo** mode.

4. Set the overall monitor level control to its standard level, (often marked as ref on the control).

5. Using the internal generator send pink noise to the left surround speaker(s) only. Mute the back surround left speaker(s).

6. Adjust the Ls output level trim to 82 dBC SPL. (The reference SPL level – 3dB).

7. Leave the left surround speaker on and unmute the back surround left speaker(s).

8. Adjust the Bsl output trim to obtain 85 dBC SPL. (The reference SPL level).

9. Send pink noise to the right surround speaker only. Mute the back surround right speaker.

10. Adjust the Rs output level trim to 82 dBC SPL. (The reference SPL level – 3dB).

11. Leave the right surround speaker(s) on and unmute the back surround right speaker(s).

12. Adjust the Bsr output trim to obtain 85 dBC SPL. (The reference SPL level).

13. Select **Surround EX** mode.

14. Send pink noise to the back surround speakers only.

15. Adjust the level of the back surround speakers to produce 85 dBC SPL (the reference SPL level) using the Bs output level trim on the left of the unit.

4.4 Basic Operation

The unit has three modes of operation: stereo, Surround EX, and mono.

Stereo

This is effectively a bypass mode. With the unit switched to **Stereo** mode on the front panel, left surround passes to the left surround and back surround left outputs. Right surround passes to right surround and back surround right. There is no decoding action. This mode allows the EX-DU4 to be installed semi-permanently and monitor non-EX soundtracks. It also allows the operator to monitor Surround EX mixes, as they would be heard on a replay system without Surround EX decoding.

Surround EX

In the **Surround EX** mode, the unit decodes the Dolby Surround EX format. The back surround left and back surround right outputs are fed from the decoded back surround channel. The left surround and right surround outputs are decoded from their appropriate channels in the Lst/Rst pair.

Mono

All four outputs are a mono mix of Lst and Rst, attenuated to compensate for the addition of the signals. This option does not represent any particular consumer listening environment and so is rarely used.