

*CP-2
Digital
Audio
Surround
Processor*

*Owner's
Manual*


lexicon

Introduction

The Lexicon CP-2 Digital Audio Surround Processor uses proprietary all-digital signal processing to offer extremely accurate Dolby Pro Logic decoding for Dolby Surround encoded films, and Lexicon's own decoding circuitry for monaural film soundtracks.

For films encoded in Dolby Stereo, the CP-2 incorporates a completely digital Dolby Pro Logic Surround decoder, with Auto Azimuth™ – automatic correction of azimuth and channel-balance errors. The CP-2 also provides a program for playing music through a Surround speaker set-up (Music Logic), and a program for enhancing monaural film sound tracks (Mono Logic).

This manual describes the CP-2's controls and indicators, the programs and their adjustable parameters, and provides information on setting up the CP-2 for maximum effectiveness. At the end of this manual is a section on the theory behind surround sound for those who want to know more about the CP-2 design.

Auto Azimuth™ and the symbol

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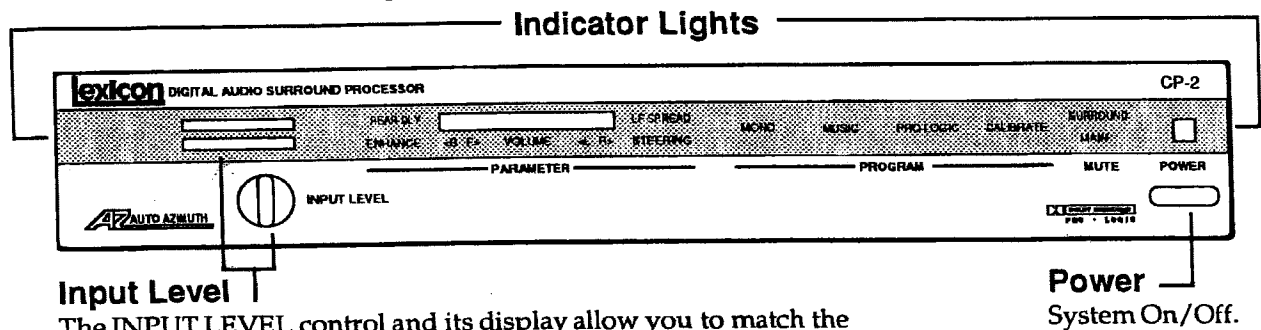
Installation

The CP-2 may be installed on a shelf or in a standard 19" equipment rack, using the optional rack-mounting hardware (Lexicon part #021-06639). Connect the power cord to a wall outlet or to an outlet on the back of your preamplifier. Observe the following precautions:

- Make sure the remote control receiver (located on the right side of the front panel) is unobstructed. The remote control must be in line of sight to this receiver for proper operation.
- Select a dry, well-ventilated location out of direct sunlight.
- Do not stack the CP-2 directly above heat-producing equipment such as power amplifiers.
- Avoid placing the CP-2 near unshielded TV or FM antennas; it may interfere with some FM tuners if it is placed immediately above or below them.
- Install two AAA batteries (supplied) in the CP-2 remote control.

CP-2 Panel Controls

The CP-2 display panel contains indicator lights to show the program in use, the parameters and level settings for each program, and the mutes when they are in effect.



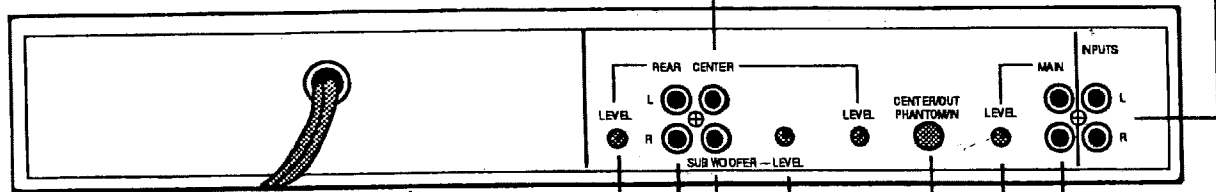
Input Level

The INPUT LEVEL control and its display allow you to match the level of the incoming signal to the CP-2 digital encoding circuits (two 16-bit analog-to-digital converters). When correctly set, loud passages will light the entire row of green LEDs without flashing the red ones.

Power
System On/Off.

Center channel output with level adjusting knob.

Center Output



Rear Output

Outputs with level adjusting knob for rear power amplifier(s).

Subwoofer Output

Output with level adjusting knob.
(100Hz/12dB per octave)

Main Outputs

Main outputs, with level adjusting knob.

Center/Out Phantom/In

Push the button IN if you have no center channel; leave it OUT if a center speaker is connected.

LEAVING THIS BUTTON OUT WITH NO CENTER CHANNEL WILL CAUSE THE PROGRAMS TO MALFUNCTION.

The Remote Control

Balance

BALANCE: F and B adjust the levels of the rear speaker(s) relative to the fronts.

FOR PROPER PERFORMANCE WHEN NO REAR SPEAKERS ARE USED, THIS CONTROL SHOULD BE SET ALL THE WAY TO THE FRONT.

BALANCE: L and R adjust the left/right balance of the front speakers. It assumes the function of the balance control on your preamp or receiver. This balance does not control the center and rear surround speakers.

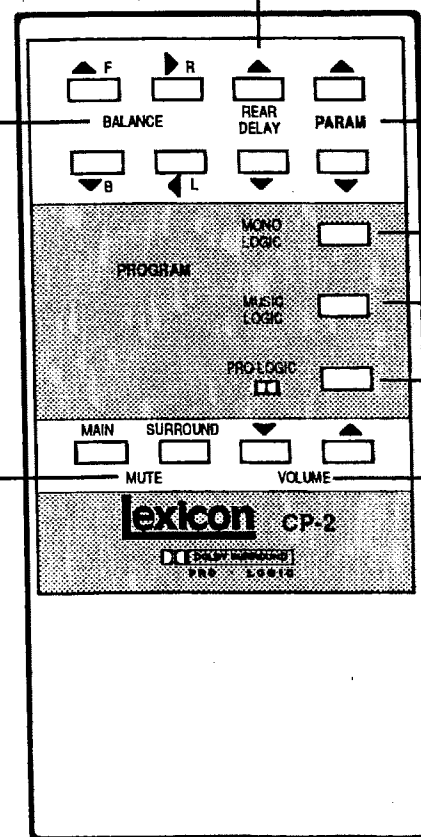
Mute

MAIN MUTE turns off all outputs and lights both the MAIN and SURROUND MUTE indicators. Pushing SURROUND MUTE while in Main Mute mode turns the Surround effects alone back on. The center speaker will remain muted until MAIN MUTE is pressed a second time.

SURROUND MUTE alternately turns off and on all signals added by the CP-2. Use it to compare the sound with and without CP-2 processing.

Controls the delay time for the rear channels. Variable from 16-32ms in Pro Logic, from 0-32ms in Music Logic (not available in Mono Logic).

Rear Delay



Parameter

PARAM UP and DOWN adjust the parameter of the program in use.

The Programs

MONOLOGIC expands the music and effects on monaural films into the additional channels while leaving the dialog in the front center.

MUSIC LOGIC enhances music with surround speakers as well as regular stereo TV broadcasts.

PROLOGIC decodes the matrixed surround tracks used on most feature films.

Volume

VOLUME: UP and DOWN adjust the level of all channels simultaneously. It assumes the function of the volume control on your preamp or receiver.

**Connections
to Other
Equipment**

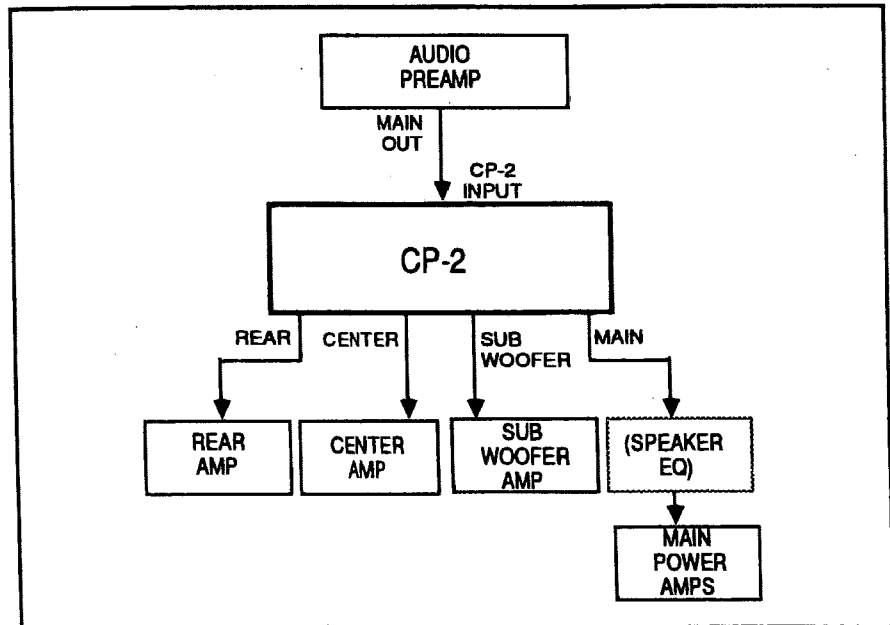


Figure 1

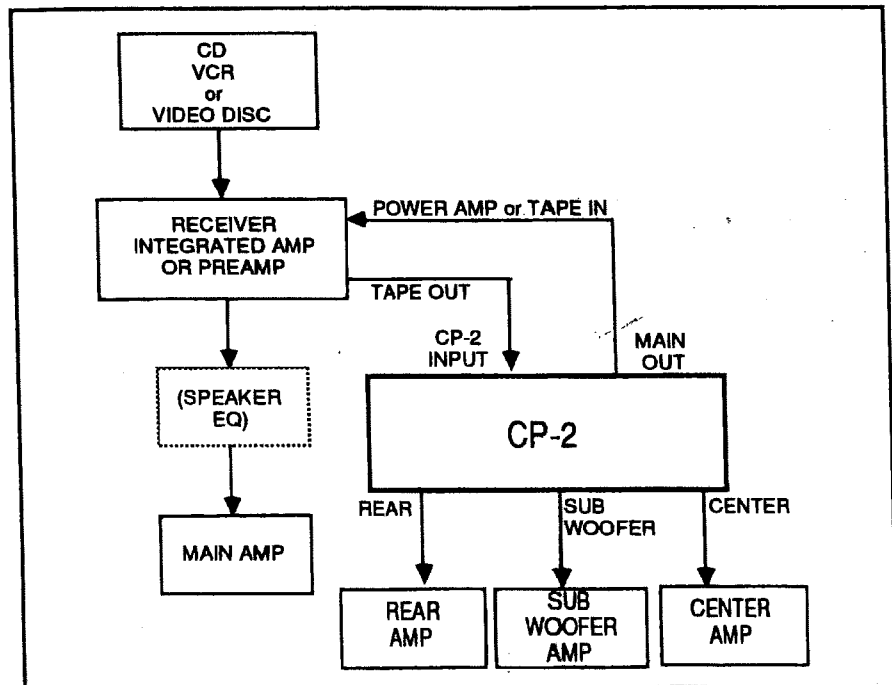


Figure 2

Turn off ALL audio and video components, including individual power amplifiers. (Unplug any power amps that don't have switches.) Locate the gain controls on the rear panel of the CP-2; these are knobs at the top of the panel, marked REAR, MAIN, CENTER and SUB. Turn each one all the way down (counterclockwise as viewed from the back).

Connect the main outputs of your source selector (video switcher, preamp, receiver, etc.) to the inputs on the CP-2. It is best to use a fixed, line level output like the tape output (Tape Rec) so that the input level to the CP-2 is not affected by the volume setting on your source. If a mono source is used in conjunction with the Mono Logic program, it must be fed to the Left Input of the CP-2.

If you are using a separate preamp and power amp there are two ways to connect the CP-2:

Connecting the CP-2's Main Outputs directly into the power amp inputs will functionally replace the volume control on your preamp and allow the CP-2 full control over the volume and balance of your system. (See Figure 1.)

Using the Tape Monitor input on the preamp gives you the full effect of the CP-2 and also allows you to bypass the CP-2 by disengaging Tape Monitor on the preamp. With this setup, however, the volume control on the preamp will affect the balance of the left and right speakers relative to the center and surround channels. (See Figure 2.)

If you are using a receiver or integrated amp, use its power amp inputs (if available). Otherwise, use the tape playback input (Tape Monitor). If you are using the Tape Monitor input you must engage the Tape Monitor on the receiver in order to hear the CP-2 on the Main channels. Remember that with this setup the volume control on the receiver will still control the volume of the front speakers. Set this volume control to about 11 or 12 o'clock.

Connect the CP-2 Center Output to your center channel amplifier input. If you are using the sound system in your TV, use the audio inputs associated with the video source you will be using. (For example, if your VCR is in Video input 1, use audio input 1 for the center channel.) With this setup the volume control on the TV will control the level of the center channel. (If you are using your TV sound system or a small speaker, consult the LFSREAD discussion on Page 10.)

Locate the button marked CENTER/OUT, PHANTOM/IN. If you have no center front speaker push this button in; if you have a center channel make sure this button is in the out position.

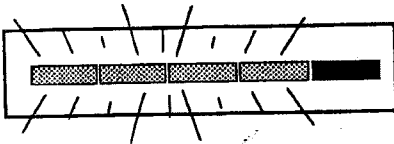
Turn the INPUT LEVEL knob all the way down (counterclockwise).

Audio Inputs

Audio Outputs

Setting the Main Input and Output Levels

Input Levels



Be sure the Input Level is as high as possible without flashing red.

If you are using the CP-2 volume and balance controls in place of the ones on your existing preamp or receiver, set the gains in your main stereo channels for optimum dynamic range as follows.

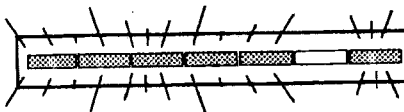
Make sure that all rear panel Output Level controls are set to their lowest level (fully counterclockwise) before proceeding. These Output Level controls provide 20 dB of adjustment range.

FOR BEST PERFORMANCE, THE CP-2 SHOULD ALWAYS BE DRIVEN TO ITS FULL INPUT LEVEL.

Turn on the CP-2 and allow it to run through its power up diagnostics and display check. Push SURROUND MUTE on the Remote. The SURROUND MUTE indicator on the CP-2 will light.

Turn on your preamp or receiver and your main amplifier. Choose a signal source and play some loud music from the source you will be using the most with the CP-2. Adjust the INPUT LEVEL on the CP-2 front panel until the level indicators on the display above this knob blink red occasionally, then reduce the INPUT LEVEL until only the green indicators are lit.

Output Levels

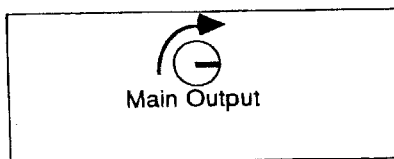


Set CP-2 remote control Volume so that all but one LED is lit.

Using the CP-2 remote control, increase the volume so that all but one of the green LEDs on the volume indicator are lit. (The green LED farthest to the right is always lit to indicate maximum range.)

Slowly advance the MAIN OUTPUT knob on the rear panel until the sound is as loud as you will want to play the system. **USE EXTREME CAUTION NOT TO OVERDRIVE THE AMPLIFIER OR SPEAKERS. IF YOU HEAR DISTORTION, TURN THE VOLUME DOWN IMMEDIATELY.**

If you are using the CP-2 with a receiver or integrated amp on the front channel remember that its volume control will also affect the level. **ONCE YOU HAVE SET THE MAXIMUM LEVEL, DO NOT CHANGE THIS SETTING. USE THE CP-2 REMOTE VOLUME CONTROL.**



Set Main Output so system is as loud as you are ever going to need it.

If you do not get any sound, first view the CP-2 input level indicators to make sure that signal is going into the CP-2. If you are using the tape loop configuration, check to see that the Tape Monitor on your receiver is engaged.

If there are audible differences between the levels of the source you used for this calibration procedure and other sources, you may have to readjust the INPUT LEVEL to accommodate them.

If you do not have rear speakers, set the remote control F/B BALANCE to full front position. This balance should remain panned to the front at all times or sounds which should emanate from the rear speakers will be lost. (With the balance all the way to the front, the CP-2 will mix these sounds into your front speakers, thereby restoring the complete performance.)

Use VOLUME DOWN to reduce CP-2 volume about halfway.

If the SURROUND MUTE indicator is on, push SURROUND MUTE to cancel it.

Press one of the three program buttons and hold it down until the CALIBRATE indicator lights, then release the button.

The sound you hear is a band of noise centered around 1 kHz, being sent in sequence to: all channels, left front, center, right front and rear channel(s). If you have a center speaker, the rear-panel CENTER/PHANTOM button should be OUT. Since all amplifiers are OFF, except for MAIN, you will hear only: both fronts, left only, silence, right only, silence. If you have no center speaker the rear-panel button should be IN. You will hear: both fronts, left-only, both fronts, right only, silence.

Turn on the remaining power amplifiers and turn up the CP-2 rear panel REAR and CENTER Output Level controls until all channels sound equally loud. When the front, center and rear channels are balanced, press any program key to turn off the calibration signal.

If you are using a separate low-frequency channel, use music or the test signal of your choice to adjust the SUB WOOFER gain until the low bass balances the rest of the spectrum.

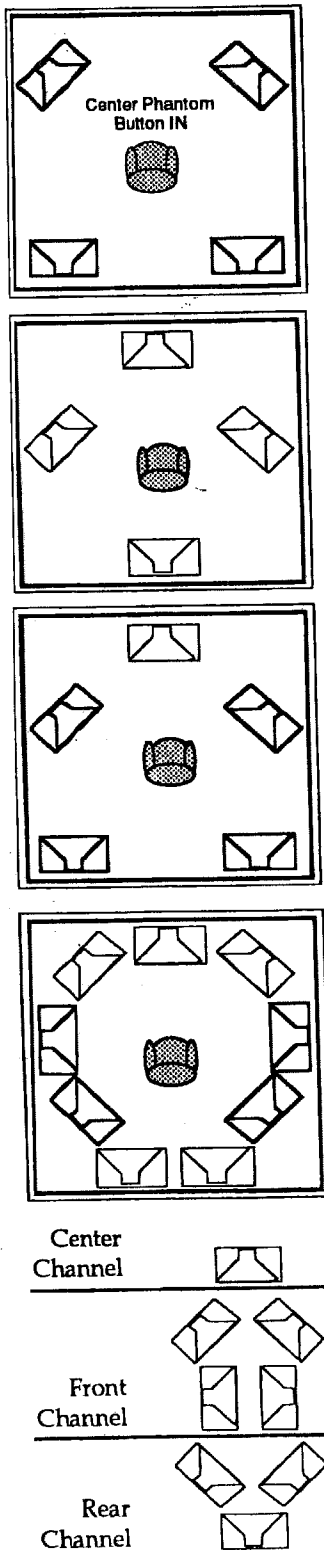
Connecting a subwoofer to the CP-2 adds bass energy without removing any from your main speakers. The built-in crossover in the CP-2 rolls off high frequencies above 100 Hz at a rate of 12dB per octave. Note, however that many of the subwoofers currently on the market have their own crossover built in, and in some cases it cannot be adjusted or defeated. (These are generally designed to generate the deep bass for your system in order to relieve your main speakers and amplifiers from having to produce these low frequencies.) If you wish to take advantage of this, the subwoofer crossover should be connected to the CP-2 Main Output. Connecting the subwoofer between your source selector and the CP-2 allows the subwoofer crossover to roll off the bass for all the speakers. With this setup, however, remember that the volume control on your subwoofer will affect the input level of the CP-2.

If you have connected the CP-2 in a tape monitor loop so that it can be bypassed, you will also be bypassing the subwoofer. With this setup, connect the subwoofer crossover to the main outputs of your preamp (as though the CP-2 were not in the system).

Balancing Additional Channels

Subwoofer Connections

Speaker Placement



Although the Dolby Surround system consists of only four channels (left, right, center and surround) there is no limit to the number of loudspeakers that can be employed. In a movie theater it is not unusual to see eight or more surround speakers, even though they are all reproducing the same signal. In a home installation, a single rear speaker is sufficient (since there is only one rear channel encoded in the film itself), but multiple speakers will help to give a more diffuse and "bigger" sound to the rear. Two speakers are typically used for the surround channel, and it may be desirable to add more. The low output impedance of the CP-2 (500 ohms) allows multiple amplifiers to be run off the rear channel output without degradation, as long as reasonably low-capacitance cables are used. (A single rear channel may be hooked up to either the left or right rear output.)

Placement of rear speakers is not critical because the variable time delay makes it easy to optimize the system. Ideally, rear speakers should be at or above ear level. If this is not possible, try placing the speakers on their backs, facing the ceiling.

Given a five-speaker system (main left and right, center, rear left and right), it is best to spread the speakers apart as much as possible.

The further the front left and right speakers are spread out to the sides, the greater the apparent stage in front of you. (In most films there are many more effects that are panned left and right than there are front to rear.) If your main speakers cannot be widely spread, it may be beneficial to have a second speaker pair spread widely apart and connected in parallel to the main front speakers.

The center speaker should be placed as close to the screen as possible. Experiment to see whether the speaker sounds better above or below the screen. Tilting the speaker up or down slightly is often effective. Ideally, dialog should appear to come right off the screen.

SPEAKER MAGNETS CAN DISTORT THE TV PICTURE. IF YOU SEE ANY DISCOLORATION OF THE PICTURE IN THE AREA CLOSEST TO THE SPEAKER, THE SPEAKER IS TOO CLOSE TO THE SCREEN.

If you are not using a center speaker make sure the rear panel Center Phantom button is pushed IN. In this mode the center *channel* is turned off and the center *signal* is mixed in with the two main outputs.

To Load and Modify Programs

The CP-2 contains three programs: Mono Logic, Music Logic and Pro Logic.

Mono Logic takes a monaural soundtrack and sends music and sound effects to the left, right and rear through a room simulator program, while keeping dialog in the center. It can create a surprisingly spacious sound from a monaural source.

Music Logic enhances music played through a system whose speakers are laid out primarily for films and non-Dolby-encoded stereo films and broadcasts.

Pro Logic is Lexicon's all-digital implementation of the Dolby Pro Logic Surround decoding process. It provides unequalled performance on Surround-encoded soundtracks.

Pushing one of the program buttons will load that program. Whenever the CP-2 is turned on, it will load the program that was running when it was turned off.

Within each program is an adjustable parameter to enhance its effectiveness. The range of each parameter can be viewed on the CP-2 display by pushing the PARAM UP or DOWN buttons on the remote control. The display will show the range of settings for the parameter available in the program that is currently running. (Holding either of these buttons down will cause the parameter's value to be changed continuously throughout its range.) Changes made to parameter settings will be retained, even after power is shut off.

The Mono Logic program contains a parameter called ENHANCE which adjusts the level of all channels *except* the center. With ENHANCE at its lowest setting *only* the center speaker will be heard. (If your system has no center speaker, the lowest setting of ENHANCE will cause this center signal to be split equally between the Main left and right speakers.

In the Music Logic program, dialog, music and sound effects are dynamically directed to the output channels. The STEERING parameter in Music Logic allows you to adjust the depth of this effect. With STEERING all the way down, the rear rolloff starts at 2.3 kHz. As STEERING is increased, the filter rolloff is increased to 4.2 kHz, then to 7kHz and, finally, opened up to the full bandwidth of the machine. With STEERING all the way up, Music Logic is very similar to Pro Logic except that the rear speakers are fed a wider bandwidth signal and Auto Azimuth™ is turned off.

The Programs

Loading a Program

Modifying a Program

Program Parameters

Program Parameters, cont'd.

The Pro Logic program allows adjustment of LF/SPREAD. Increasing LF/SPREAD takes the low bass from the center channel and distributes it instead to the left and right front-channel speakers. This is valuable because in many video installations the center speaker is smaller than the two main stereo speakers and, therefore, less capable of handling the lowest frequencies. **THIS BASS BLENDING WILL MAINTAIN ITS EFFECT IN THE MUSIC LOGIC PROGRAM.**

The Mute functions are always reset when the CP-2 is turned ON. Changes made to any other setting are automatically retained.

Both Music Logic and Pro Logic have adjustable PARAM and REAR DELAY levels. The settings for VOLUME, L/R BALANCE and F/B BALANCE are common to all programs in the CP-2.

AUTO AZIMUTH™ is automatically set ON in Pro Logic and OFF in Music Logic. When it is on, special digital circuits continually monitor the dialog and adjust both the relative level and time offset of the two channels to keep the dialog properly centered. Because of this automatic feature the CP-2 does not have, or need, an input balance control for Dolby Surround decoding.

Restoring Defaults

The CP-2 default settings can be restored to factory condition as follows:

1. Turn CP-2 power OFF.
2. Press and hold PARAM UP on the Remote while turning CP-2 power ON.
3. Continue to hold down PARAM UP until the Surround Mute indicator blinks repeatedly. At this point the unit is reset.
4. Release PARAM UP to resume normal operation.

Troubleshooting

Make sure **INPUT LEVEL** on the CP-2 front panel is turned up. Check the connections on the rear and make sure signal is going into the CP-2. Check that the cables feeding the input of the CP-2 are connected to the correct output of your preamp, receiver, or other source.

**Input Level Meters
Not Functioning, No Audio**

Check the batteries and make sure that they are inserted correctly. Make sure that the infrared receiver on the CP-1 front panel above the **POWER** switch is not obstructed. If the remote control unit is still not functioning, **RESTORE DEFAULTS** as described below.

**Remote Control
Not Working**

First verify that signal is coming into the CP-2 by observing the Input Level meters. Increase **VOLUME** using the Remote Control and check the **Front/Back** and **Left/Right** balances. Check all other equipment settings and connections and verify that the amplifier(s) being fed by the CP-2 are operational. If a mono source is being used, make sure that it is connected to the **Left Input** on the CP-2.

No Output

If severe power surges or sags cause problems with CP-2 memory storage, or you simply want to start with a clean slate in the parameter level settings, you can restore factory presets with the procedure described on Page 10.

Restoring Defaults

If you cannot solve functional problems through these procedures, consult your dealer or Lexicon/Customer Service Department. **DO NOT, UNDER ANY CIRCUMSTANCES, OPEN THE UNIT. DOING SO WILL VOID YOUR WARRANTY, AND MODIFICATIONS MAY RENDER THE UNIT UNSERVICEABLE.**

Theory and Design

Mono Logic

Mono Logic is a stereo conversion program for monaural film sound tracks. A quick look through any video rental selection will prove the usefulness of such a program; many classic titles are mono.

The problem of mono-to-stereo conversion is an old one. One time-honored solution is to break the incoming signal into frequency bands, sending some to one channel and the rest to the other. When the filters are complementary (the sum of the two output channels equals the original input channel) this solution can give stereo spread without ruining the tonal balance. When the filters are non-complementary, they can produce an unpleasant fake stereo effect.

Some effort has been made to design filter pairs for film sound which leave voice frequencies unchanged while spreading out the music. More recent designs have gone in another direction, using digital or analog delay lines to produce a comb filter effect. So far, these attempts have not been very successful.

The principal element of film sound is dialog and the principal rule in reproducing it is to assure that it appears exclusively in the center channel. Broadcasters, who have an interest in converting mixtures of dialog and music to synthesized stereo, have built circuits designed to turn off the stereo synthesizer when voice appears. Unfortunately, the switch from mono to stereo is often abrupt and the chances of dropping into mono by mistake during music are high. One basic problem with films, especially modern ones, is that music or background effects which should be spread out into the side and rear speakers frequently appear at a low level beneath the dialog.

The Mono Logic program electronically identifies certain properties of film speech and removes it from the stereo synthesis. This allows music and effects in the film to be spread out while leaving the dialog centered. The remaining music and effects are directed to the input of a room simulation program that creates a space the size of a large room or small theater. The room simulator has outputs for left, right and rear surround speakers.

The monaural input sound from the film is unchanged in the center speaker, so that all the dialog and music that the director expected to come from the screen still does. Partly because of the acoustical character of the room synthesizer, the result is often so successful that switching from a monaural input with Mono Logic to a stereo input with Pro Logic may make a surprisingly small difference.

The ENHANCE parameter in Mono Logic must be properly set for optimal performance. Ideally the film's music and effects should appear to come from the front but with the added sense of a large space surrounding you. The rear speaker(s) should not be individually audible.

Mono Logic works with the left input channel only. If it is used with a stereo input, material recorded exclusively in the right channel will be ignored.

Music Logic

The Music Logic program is primarily designed for the playback of music through film-sound systems. Its basic structure is similar to Pro Logic but its parameters are set for music.

Music does not necessarily contain a crucial, centrally located element analogous to the dialog in films. So Music Logic has no automatic adjustment for interchannel time delay and balance (that is, Auto Azimuth correction is off). The Steering parameter allows control of the steering of effects, music and ambient sounds. The rear channel delay can be adjusted in 2ms increments from 0-32ms and the bandwidth is more than double the 7kHz in Pro Logic.

The Music Logic Program can provide an unusual and revealing way to listen to music. With a multi-speaker surround system the program puts you in the middle of the music, so that interior elements formerly buried in the mix become audible. Try setting Steering all the way up, then mute the center channel by pushing Main Mute to turn main and effects signals off, then Surround Mute to turn everything but the center back on. This allows you to hear all of the mix (except for strongly centered material such as vocals) separated and spread throughout the room.

This method also provides an interesting look into the details of film sound mixes. You can check the quality of the balance and azimuth in a film by setting the Steering parameter all the way up and then comparing Music Logic to Pro Logic.

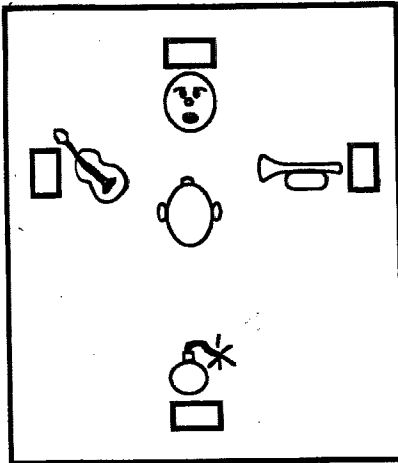
The CP-2 can also be used without any front-channel processing at all. If the main outputs are connected to the Tape Monitor inputs on your preamp or receiver, disengaging the Monitor mode on your preamp completely bypasses the CP-2 front channels. The rear channel in Music Logic is derived from the difference between the left and right channels (L-R). This signal usually contains ambient information which is masked in normal playback. The Music Logic program allows you to extract and manipulate this "hidden" information, greatly increasing the spaciousness and realism of many recordings. The level, delay, and high frequency content of this signal can all be controlled with the CP-2 remote control - experiment with Delay, Steering and F/B Balance.

Dolby Stereo

The CP-2 is one of the first consumer products to offer full Pro Logic Dolby Surround decoding and operation entirely in the digital domain. This has important advantages, but to understand them we must first take a brief look at how a film soundtrack is put together.

The term Dolby Stereo refers to both movies and equipment used exclusively for theatrical presentation. When one of these movies is transferred to commercial video media, the special audio encoding of the Dolby Motion Picture matrix is retained in the two-channel stereo soundtrack. The resulting video software and the hardware designed to reproduce it use the name Dolby Surround to distinguish it from the theatrical optical format.

Dolby Pro Logic Surround decoding is the licensed consumer version of the professional Dolby Stereo cinema processors, which allows the home viewer to obtain all the spatial effects of the soundtrack heard in a theatre over a wider range of seating positions than conventional Dolby Surround playback.



Films originally have four channels: one for dialog and three for music and effects. To make a Dolby Stereo film, these are combined to two.

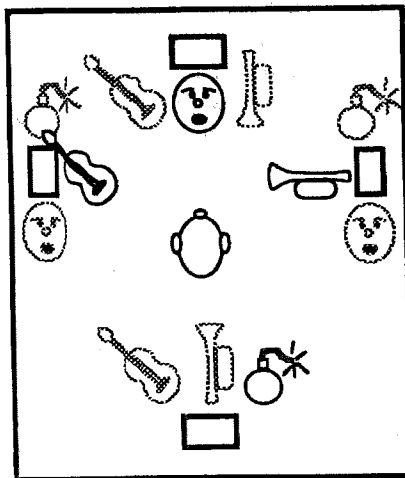
A Dolby Stereo film sound track has four basic components: Left and right channels, a center front channel and a surround channel. The first three are fed to speakers arrayed behind the movie screen, while the surround sound goes to speakers on the side and rear walls of the theater. The four channels are recorded on separate magnetic tracks and are combined by the Dolby Stereo matrix encoder into two stereo channels during the final mixing process. The original left and right channels go directly onto the left and right channels of the Dolby Stereo mix. The center channel is fed equally to both channels, in phase, and the surround track is fed equally to both channels, but 180 degrees out of phase.

The center channel carries the dialog; music is normally mixed so that it appears to come from the front, with reverberation or ambience coming from the surrounds. For special effects, music can be encoded to come from all around the listener or even from behind. In any case, with music and ambient effects there is always substantial spread across the front of the loudspeaker array.

Sound effects can come from any direction around the listener and it is the job of the decoder to duplicate as closely as possible the film mixer's placements.

Dolby Surround Decoding

When the movie is shown the two Dolby Stereo tracks must be decoded and separated into the original four. The Dolby Surround decoder does this in a rather rudimentary way: it supplies a signal to the center channel which is just the sum of the two input channels. This signal contains the dialog. However, the left and right signals still contain dialog too, so the dialog is spread out among the three front speakers. Similarly, the Dolby Surround decoder takes all out-of-phase signals and sends them to the surround speakers, while leaving the original out-of-phase components in the left and right front speakers.



With conventional surround any sound comes from at least three directions.

The basic Dolby Surround decoder has high channel separation between left and right decoded audio, and between center and surround. The separation between left or right and center, or between left or right and surround, however, is only a few dB. The simple Dolby Surround decoder does pretty well with music (although sometimes the center channel is too loud) but, because any sound will be reproduced in at least three loudspeakers, effects are smeared and often unconvincing.

Pro Logic Decoding

A Pro Logic decoder, like the professional Dolby Stereo cinema processor, both enhances the dialog in the center and removes it from the left and right, while maintaining as much stereo separation as possible. This is a form of directional steering. Properly done, steering prevents the dialog from appearing in the other channels and enhances its plausibility.

CP-2 Digital Audio Surround Processor

The situation is similar with music and sound effects. For example, if the sound was intended to be in the left, the decoder will remove it from the center and surround channels. If it was intended to be halfway between left and center, the Pro Logic decoder presents it equally to the left and center speakers and removes it from the right and surround channels.

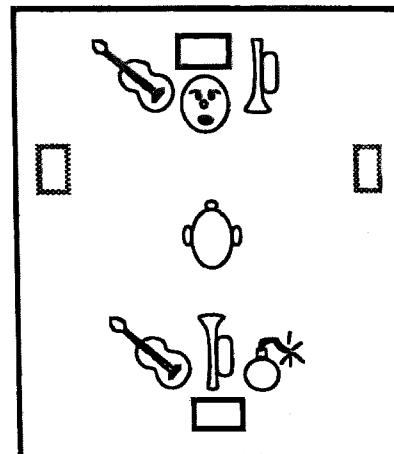
The Pro Logic decoder can give good stereo spread and precise control over front-to-back perspective. But the real strength of Pro Logic decoding emerges when music and dialog occur at the same time. When dialog is present, the center channel information must be removed from the left and right channels without reducing the spread or loudness of the music.

Pro Logic decoders sense both the direction of the loudest sound and the difference in level between it and any ambient information. They then use this information to direct the steering. The accuracy with which this is done is even more important in a home decoder than in a professional model, because the small size of the playback room makes decoding errors more audible than they are in a theater. The level detection must be very fast, and the matrix must adapt very quickly or there will be a time lag between the audibility of a sound and its correct steering. Since phase relationships determine how the sound is steered, Pro Logic decoding puts unusual demands on the accuracy of the phase and balance of the input channels. Other Pro-Logic decoders have a front panel control for adjusting input balance and for best results a user should carefully adjust this for each program. But what if the channel balance varies during playback?

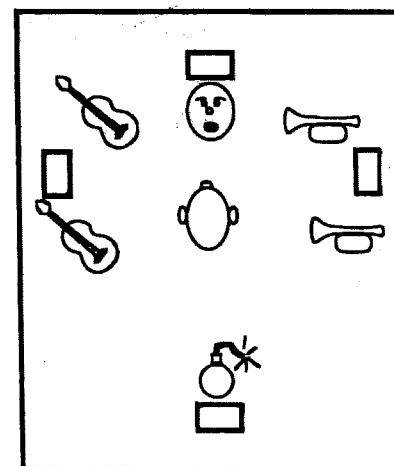
The manual balancing procedure does nothing to correct azimuth errors. During the preparation of the master for a video tape or disc, misalignment of the playback heads or skewing of the film produce small time differences between the two channels. Azimuth is poorly controlled in both professional video recorders and optical film chains. In the final product, which has been through many generations, it can easily be wrong by 50 microseconds or more, and may vary as the tape or disk is played. At middle and high frequencies it doesn't take much misalignment to generate large inter-channel differences in phase, which are just what the decoder uses to do its steering.

The CP-2 decoder is unusual in a number of ways. First of all, it is entirely digital. (Most surround decoders advertise that they are digital because there is a digital delay line for the surround channel but the matrix and the logic decoding are actually done in analog.)

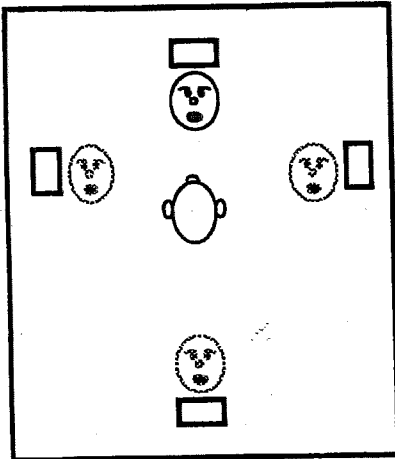
Because the CP-2 is all digital, we can use some of the digital memory to delay all the output channels by 20 milliseconds — about the same as the acoustic delay you get in the front row of a theater. (The surround channel is delayed by an additional 16 to 32 milliseconds.) This delay allows plenty of time for the CP-2 to determine the direction of sounds and adjust the matrix before the sounds are sent to the amplifiers. This substantially improves dialog and effects cancellation, as is immediately apparent from the spread of ambient material or music, even in the presence of dialog.



Simple logic decoders turn down the left and right speakers during dialog. This seriously affects music and effects.



Pro Logic decoders remove dialog from the left and right channels, while maintaining stereo as much as possible.



Pro Logic requires phase accuracy. Common azimuth errors cause ghost dialog in all channels unless the azimuth error is corrected.

The CP-2 can also sense and continuously correct both balance and azimuth errors in the incoming material. All the time the film is playing, the CP-2 is checking balance and azimuth, keeping the dialog perfectly centered. The result is superior steering. An added benefit is that the CP-2 needs no input balance control.

The quality of the azimuth and balance of a film can be checked by comparing the dialog placement and spatial location of sound effects with the Auto Azimuth™ and Auto Input Balance enabled and disabled. If you increase the Steering parameter to its maximum setting in Music Logic, the steering will be the same as in Pro Logic, without Auto Azimuth and input balance correction. Any difference you hear in the location of sounds (particularly dialog) indicates that there is some level and/or azimuth error in the soundtrack. When you switch back to Pro Logic, it will take several seconds for the error correction to take effect. During these few seconds, you may actually hear dialog being cancelled in the front and surround speakers and steered into the center channel. Notice how each sound has its own discrete position in the soundfield and how expansive the soundfield can be on a good film.

Dolby Stereo Theaters and Home Theaters

The requirements for film sound are quite different from those for the playback of music. The most important track in any film is the dialog. When the two stereo channels are played back through two speakers with no decoder, dialog will appear to come more or less from the center, but only for those listeners on the center line of the main stereo pair.

The most important job for a Pro Logic decoder is canceling the dialog from left and right loudspeakers. To be able to hear this you have to set up a center speaker. We strongly recommend that a center channel speaker be used with any surround decoder; the difference it can make to the subjective quality of a film is enormous.

Assuming some form of center speaker has been provided, the next most important point is providing increased lateral sound. The best way to do this is with loudspeakers at the sides of the listeners. We have found that when the Left and Right loudspeakers are spread wide enough to fall within 20 degrees of the listeners' sides, there is a tremendous change in the impact of the film. The sound stage becomes much wider than the screen - so wide in fact that the listener is literally drawn into the action. This effect should not be surprising - lateral sound is known to grab our attention in a way that front sound does not. Occasional extra wide sound effects can seem peculiar at first for being so much wider than the screen but when the mix is good the emotional impact of the wide sound can be very great. The disparity between the size of the video screen and the size of the sound is usually easy to accept, and the added impact is hard to give up once you have heard it.

CP-2 Digital Audio Surround Processor

A few theaters are beginning to wake up to the power of this effect. It is being used presently and has been used in the past. Some theaters, such as Imax and Omnimax, use it routinely with multi-track masters, and older techniques such as Todd-AO had wonderful multichannel soundsystems.

The major reason standard theaters do not use this is the poor accuracy of previous surround decoders when used with commercially available stereo prints. Azimuth errors on both optical and magnetic masters are common and in theaters there can often be considerable dialog leakage into the left and right channels. To increase the seating area with acceptable dialog, theaters place the left and right speakers within the confines of the screen.

The needed spatial impression is supplied by the acoustics of the theater itself, augmented by surround speakers placed all around the audience. The surround speakers are driven in parallel from the surround channel output of the decoder.

Auto Azimuth™, auto balance and digital steering make the CP-2 superior to any other surround decoder, including the professional decoder for theaters.

With a good home theater system, sound quality can easily surpass that of most theaters. The sophistication of the CP-2 allows you to relax and enjoy films and music without worrying about adjustments or calibration errors. Whatever the source, the CP-2 provides absolutely the best sound with an ease of operation unparalleled in consumer or professional electronics.

During the early days of film stereo, dialog was sometimes mixed (by "panning" the monaural dialog track) to come from the same part of the screen as the image of the actor. Subjective reactions to this technique were varied, and technical problems with some magnetic sound tracks helped to discourage the practice, so modern movies are seldom mixed with panned dialog. In a home system with a good Pro Logic decoder, however, the effect can work quite well; recent releases with panned dialog include "Yellow Submarine" and "Superman I". In most films, though, all dialog comes from the center channel.

CP-2 Specifications*

Frequency Response:	10 Hz - 16 kHz, +1, -3dB, Ref. 1 kHz
THD:	Less than .05%, 1 kHz, max level
Minimum Input Level:	100 mVRMS
Maximum Output Level:	4.5 VRMS
Input Impedance:	50 k ohms
Output Impedance:	500 ohms
Signal to Noise Ratio:	Better than 80dB, A-weighted, Ref. 1 kHz max level
Voltage:	120V/60 Hz 100V/50-60 Hz 220V/50 Hz 240V/50 Hz
Dimensions:	17"W x 12.5"D x 2.5"H
Weight:	11 lbs.
Optional Equipment:	Rack-mount adapter, Lexicon Part# 021-06639

*Measurements taken in Test Mode (cannot be user-accessed)