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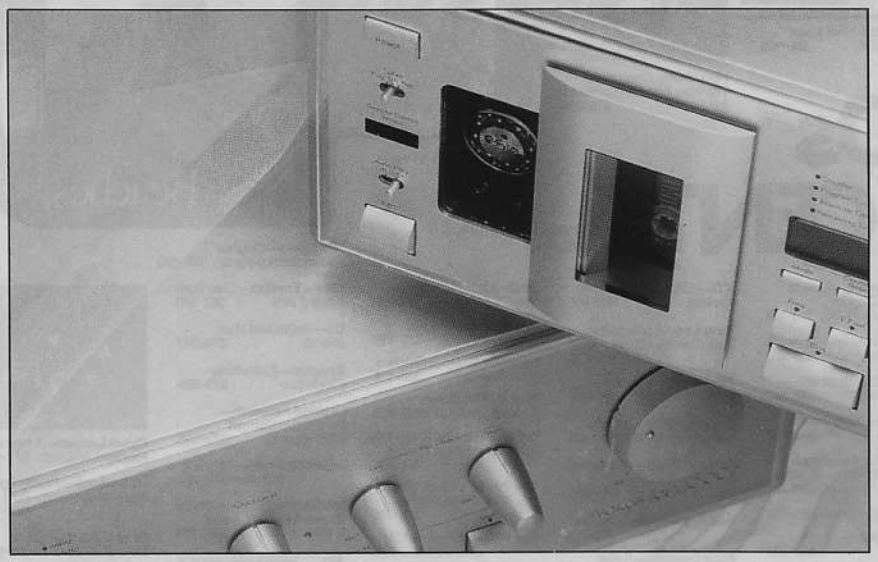

Nakamichi DAT Recording System, page 90

Blue Max, page 68

FEATURES

EQUIPMENT PROFILES

MUSIC REVIEWS

DEPARTMENTS

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Binaural Sound, page 74

Charlie Parker, page 86

2

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LEXICON CP-1 DIGITAL AUDIO ENVIRONMENT PROCESSOR

Manufacturer's Specifications
Frequency Response: Analog, 10 Hz to 100 kHz, +1, −3 dB; digital, 10 Hz to 16 kHz, +1, −3 dB.
THD: Less than 0.05% at maximum level, all channels.
Minimum Input Level: 300 mV rms.
Maximum Output Level: 3.5 V rms.
Input Impedance: 50 kilohms.
Output Impedance: 500 ohms.
S/N Ratio: 85 dBA, referred to maximum level at 1 kHz.
Power Requirements: 120 V a.c., 60 Hz.
Dimensions: 17 in. W × 2½ in. H × 12½ in. D (43.2 cm × 6.4 cm × 31.8 cm).
Weight: 11 lbs. (5 kg).
Price: $1,295.
Company Address: 100 Beaver St., Waltham, Mass. 02154.
For literature, circle No. 91

Lexicon is well known for its many recording-studio and professional sound-reinforcement products. The CP-1 surround processor is its first home high-fidelity product, however, and an interesting one it is. Sophisticated processors from other manufacturers have programs that are based on a series of acoustical measurements at specific performance sites. The CP-1, on the other hand, has programs that are based on fundamental characteristics of good performance halls in general. Lexicon reviewed the work of many people (Manfred Schroeder, A. H. Marshall, Michael Barron, and others) to aid in pinpointing the important factors that needed to be understood.

A rough summary of the conclusions from this analysis is that the best halls generate large differences in sound between the two ears of the concert-goer. Michael Barron found that this characteristic was created by lateral, sideways-moving reflected sound, and he defined it as "spatial impression" (SI). Only the reflections moving from side to side produce SI; those from other directions actually muddy the sound. The CP-1 is designed to increase SI from the original recording or to generate a new acoustic environment. (Some readers might like to refer to "Early Lateral Reflections in Some Modern Concert Halls," by Lothar Cremer, in the March 1989 issue of the *Journal of the Acoustical Society of America*.)

In the CP-1's "Panorama" programs, SI is extracted from the recording and processed to increase its effect; the choices are "Normal," "Wide," and "Binaural." "Binaural," a program unique to the CP-1, creates a realistic sound field from a source that was recorded for binaural headphone listening. When a listener is in the correct spot, these programs provide an almost ideal re-creation of the original recording space. Digital processing is used to cancel the crosstalk between the listener's ears from the different loudspeakers. The cancellation is high-order—much better than the first-order approach used by some processors and loudspeakers. With the CP-1's "Panorama" program, the sound is effectively spread from the two front loudspeakers in a wide arc in front of the listener. Adding speakers increases the realism of the illusion.

The Lexicon's "Ambience" and "Reverb" programs, three of each type, provide signals for driving widely spaced side and rear speakers, directly exciting sideways sound and heightening the impact over a large listening area. When there are no side speakers, these programs can be set to include a "Panorama" effect, to move the stereo image outward, past the main speakers. The "Ambience" and "Reverb" programs transform the listening room into a new acoustic space, providing six choices of environment to match the music and the listener's mood. Unlike some other hall simulators, the Lexicon provides full stereo processing.

The "Ambience" programs generate side and rear reflection patterns like those of idealized rooms and concert halls. The "Reverb" programs are similar, but they place more emphasis on rich, dense reverberant decay than on early reflections. Large, highly reverberant spaces are well simulated. Choices of "Small," "Medium," and "Large," for both "Ambience" and "Reverb," provide considerable flexibility in finding the desired hall depth, liveness, and realism to match classical, popular, jazz, or rock music.

The CP-1 incorporates the first completely digital Dolby Pro-Logic surround decoder. It is the only processor with automatic correction of azimuth and channel-balance errors, which are the most common problems in currently available films. Lexicon has also included a "Stereo" logic program for playing stereo music through a surround-sound speaker setup and "Mono" logic for expanding monaural film soundtracks.

All of the preset programs discussed above have parameters that can be modified for storage in any of 12 user program positions; the CP-1 has a front-panel LCD display for programs, parameters, and level changes. An input-level meter helps you set maximum levels which are high enough for good processing without causing distortion. The main, side, rear, center, and subwoofer outputs have level-set pots. The unit has a switch to get a phantom-center mode, in case a center speaker is not used. An unusual and valuable feature of this Lexicon processor is that it can be internally configured to match any of 12 speaker layouts in the listener's home.

Control Layout

The Lexicon CP-1 has a relatively simple front panel with easily read white designations. From the far left are three pairs of mechanically interlocked pushbuttons: "Source" ("I" and "II"), "Monitor" ("Source" and "Tape"), and "Tape" ("Pre" and "Post"). "Pre" means the tape deck gets the signal unaltered, or pre-processing; "Post" applies processing to the tape output from the CP-1, thereby including effects in what is being recorded. For such recording, the unit must be in its two-speaker configuration mode. (These

The "Binaural" program in the CP-1 creates realistic sound fields, via speakers, from recordings made for binaural headphone use.

modes will be discussed later.) Next on the right is the "Input Level" control, with a handy bar-type knob. Above is the very useful horizontal input-level meter, with 11 green LED segments and one red segment for each channel. Input meters are essential for units with digital circuitry, to ensure that the level is high enough for the best processing but not so high as to cause overload.

To the right of the meters is the two-line alphanumeric display. Each line can have up to 16 amber characters announcing programs, parameters, levels, and other useful information. When you turn on the CP-1, the software's version number and copyright date, and then the speaker configuration, are displayed for 2 S each. The last-used program is then shown until changes are made. (Details of what is displayed will be provided when the remote control is discussed.) Further to the right are three square LEDs. The first, which is green, goes on whenever a button is pushed on the remote control. The red "System Mute" LED is next, followed by the orange "Effect Mute" indicator. The "Power" on/off switch is at the lower right end of the panel.

From right to left, on the back panel, are gold-plated stereo pairs for "Inputs" ("I" and "II"), then the tape input and output jacks. Further to the left are the jacks and trim pots for the "Center," "Sub Woofer," "Main," "Side," and "Rear" outputs. The trim-pot knobs are very small, but their good knurling makes them easy to turn. Having convenient trims on all the channels makes matching levels much easier, and I'm glad Lexicon provided them. To the right of the subwoofer jack is a "Center/Out, Phantom/In" pushbutton. This switch ensures that centered information, such as dialog, is fed to the center output only if the channel is operating with a speaker.

I removed the top and side cover to get a look at the internal construction. What at first appeared to be one high-quality, chassis-size p.c. board was actually two boards. They are separated by a front-to-back stiffening rail which also provides mounting for the power transformer. This transformer was barely hot after hours of operation with the cover in place and the manual and some other papers on top. All of the parts and adjustments are identified. I could pick out elements of the circuitry which demonstrated the stereo processing capability. A Lexicon VLSI chip caught my attention, as did the Zilog Z80 CPU. The label on the socket-mounted Lexicon software chip showed that it was Version 1.04. This is a very interesting and potentially important feature: If there is an update in the programs to improve performance, a simple chip replacement is possible for all owners. As mentioned earlier, the user can check the software version of his unit just by watching the display when he turns the CP-1 on. A small touch, perhaps, but a good one.

A small board for the trim pots and associated circuitry is well supported at the back panel. I noted two fuses in clips near the transformer. The combination of the center rail and two side rails establishes good rigidity for the unit; it's even better with the cover in place. Rack adaptors are available for the CP-1. According to Lexicon, these are trays which go almost all the way back to the rear of the unit. That's an improvement on the usual mounting ears, which are only acceptable for use in systems that aren't moved around much. For use in a rack that's transported frequently (admittedly unlikely, for a home unit like this), I'd prefer to see the unit anchored at the back as well, to minimize front-panel stresses.

All program selections and parameter changes are made with the remote control unit. The Lexicon controller is smaller than those for some other surround units and is easily held and actuated. Its 26 buttons are positioned in a logical arrangement. From the emitting end are four columns of buttons, in six rows, and then a final two-button row.

The first four rows are for programs and parameters. The program buttons are in the first three columns, with "Panorama" in the first row, "Ambience" in the second, "Reverb" in the third, and "Surround" in the fourth. "Panorama" provides programs with enhanced lateral sound for either music or films. It is effective even when using just two front loudspeakers. The choices are, from the left: "Normal," "Wide," and "Binaural." "Binaural" is a program specifically designed for loudspeaker reproduction of recordings made with a dummy head. This program is unique, as far as I know, and would be very useful with such music.

The "Ambience" programs are "Small," "Medium," and "Large" and simulate concert halls of different sizes, generating reflections of appropriate directionality, delay, and spectral shape and sending them to side and rear speakers. "Ambience" has an adjustable liveness parameter, but "Reverb" is preferable when you want long reverberation times. "Reverb" has "Small," "Medium," and "Large" programs for simulating rooms of three sizes with the use of side and rear channels. The "Surround" programs are "Mono," "Stereo," and Dolby Pro-Logic, indicated by the standard double-D symbol. "Mono" logic expands the music and effects on monaural films while leaving the dialog in the front center. "Stereo" logic enhances music by bringing in the surround speakers, and it allows adjustment of parameters that are fixed in the Dolby Pro-Logic program, which provides the same decoding used in Dolby Stereo theater systems and uses up to eight speakers.

The fourth column of the remote's program section has a "Bank" button to switch between two program memory banks (for 12 factory-preset programs and 12 user-modified ones), a "Param" button to cycle through the adjustable parameters, and a pair of buttons to adjust each parameter up and down.

When "Bank" is pushed, it switches to the other set of memories without changing program number, rather than switching to whatever program was last used in that bank. Because I store my modified programs in the same memory positions as the preset programs I derived them from, I find that Lexicon's approach makes comparisons between preset and user versions easier.

Holding "Bank" in for a few seconds puts the CP-1 into configuration mode. "LCD Contrast Adj" appears in the display, and the parameter up/down buttons are used to set the contrast to personal preference. Pushing "Param" while the above words are still displayed will get the current speaker configuration.

There are 12 such configurations, and a change to any other one is a simple matter of pushing the up/down buttons. The choices are: Two main speakers; two main and one center speaker; two main and one rear speaker; two

main and two rear speakers; two main and two side speakers; two main, one center, and one rear speaker; two main, one center, and two side speakers; two main, one center, and two rear speakers; two main, two side, and two rear speakers; two main, one center, two side, and two rear speakers; two main, one center, two side, and one rear speaker, and two main, two side, and one rear speaker.

Whatever choice is made, the front-panel display shows what the combination is—i.e., "Configuration: 11, 2FR 1CT 2SI 1RE." The CP-1 automatically responds to whatever configuration you select by changing its internal connections and processing to get the best results with both the selected program and the actual speaker complement being used. It is very easy to make changes in the surround system, adding speakers or moving them and reconfiguring the system electronically by pushing buttons.

Modifiable parameters, primarily for the "Panorama," "Ambience," and "Reverb" programs, can be stored in the user program bank. (All of the programs also have "Set Program Name" and "Memorize Program" commands.) In the following discussion of parameters and their possible values, the factory-preset default values are shown in parentheses. In a "Panorama" program, the first push of "Param" gets "Input Balance," which has ±16 steps relative to center zero ("0"). Next are "Listener Position," with 254 steps ("127"), and then "Speaker Angle," with 12 values from 29° to 90° ("49"), which are set when calibrating the "Panorama" program. "LF Width," with unit steps from "−25" to "+25" ("0"), controls the ratio between the low-frequency information in the sum and difference channels; this varies the sense of warmth and spaciousness in the signal. "Rear Level" has unit steps from "0" to "32" ("16"). "Rear Rolloff" has 15 choices from 329 Hz to 14.1 kHz ("2.9 kHz"). "Rear Delay" has unit steps from 0 to 32 mS ("16"). Pushing "Param" until the display shows "Calibrate" puts the CP-1 into "Panorama" calibration mode. (I'll say more later about adjustments for best listening.)

The first "Ambience" parameter is "Room Shape," with "Rectangle" the default and "Fan" the other choice. "Liveness" has steps from "0" to "6" (default is "4"). "Rolloff" has 15 choices, from 329 Hz to 14.1 kHz, with 5.9, 3.6, and 2.9 kHz the defaults for "Small," "Medium," and "Large," respectively. "Panorama Eff," used for image expansion when side speakers are not used, has steps from "0" to "32" ("28"). Next are "Listener Pos," with 254 steps ("127"), and then "Speaker Angle," with 10 values from 33° to 91° ("51"). These two parameters are normally set to match the results obtained in the "Panorama" program calibration. Because of a difference in processing, the "Speaker Angle" values of "Ambience" are not exactly the same as those for "Panorama"—a minor discrepancy. The "Speech Detector" is normally on to detect monaural speech, which makes announcements with music programs sound much better; it can be switched off, if desired.

The first adjustable parameter for "Reverb" programs is "Mid RT," which stands for midrange (mid-frequency) reverberation time. Default values are 0.46, 0.92, and 2.16 S for "Small," "Medium," and "Large," respectively. Each range has 10 values, from 0.32 to 2.8, 0.64 to 5.6, and 1.28 to 11.2 S for "Small," "Medium," and "Large," respectively. "Bass RT" is the low-frequency reverberation time; its values are in terms of ratios to "Mid RT." The choices for all three room sizes are "0.7," "Equals," and "1.25." The default values are "Equals" for "Small" and "1.25" for the other two room sizes. "Treble" is the roll-off parameter, with a range of 329 Hz to 14.1 kHz; defaults are 5.9, 4.2, and 3.6 kHz for "Small," "Medium," and "Large," respectively. "Panorama Eff" has unit steps from "0" to "32"; default is "0" with side speakers and "28" without. "Listener Pos" and "Speaker Angle" are the same as for "Ambience" programs. "Predelay," with 8-mS steps from "0" to "120 mS" ("0 mS"), delays the start of reverberation, making the hall seem larger.

The only adjustable parameter for the "Surround" program's "Mono" setting is "Treble," which has a 2.3-kHz default and a range of 329 Hz to 14.1 kHz. The first two parameters for "Stereo" are "Front Effect" and "Rear Effect," which both have defaults of "8" and a range of "0" to "16." The settings determine the amount of signal steering, with higher values for more steering. "Rear Rolloff" has a default of 14.1 kHz and the standard range of 329 Hz to 14.1 kHz, plus an "Automatic" mode. In this mode, the rear channels are rolled off above 7 kHz, until the logic steers a sound effect to the rear channels, at which point the bandwidth opens up to beyond 15 kHz. "Bass Blend" takes low-bass energy from the center and shifts it to the main left and right speakers. The range is from "0" to "16" ("0").

The next "Stereo" parameter, "Auto Azimuth/Bal," is normally off, as it should be for music. When turned on for movies, it will automatically adjust the level and time offset of the two incoming channels, eliminating the need for an input-balance control for Dolby-encoded material. "Rear Delay" has a range of "0" to "32 mS" ("8 mS"), with 2-mS steps. "Rear Noise Chip" is normally off, which is best for music; it is turned on to get the special Dolby B NR used in Dolby Surround. "Calibrate" is used to check and adjust channel levels in multi-speaker systems and is *not* the same mode as "Calibrate" in the "Panorama" program. (The "Surround" program "Calibrate" will be discussed later.) The first Pro-Logic parameter is "Rear Delay," which has a range of "16" to "32 mS" ("20 mS"). Other parameters for Pro-Logic that are the same as "Stereo" are "Calibrate" and, except for defaults, "Auto Azimuth/Bal" ("On") and "Bass Blend" ("6").

Below the program and parameter sections on the remote control are the two rows of level controls. The far-left column has the "Effect" up and down buttons. Next are the "Balance" "F" (front) and "B" (back) buttons and the "R" (right) and "L" (left) buttons. The "Volume" up and down buttons are in the far-right column. A little arrow next to each level button minimizes confusion. The display of effects levels has figures from "1" to "63" for "Panorama" programs and "−64" to "−00 dB" for other programs. The horizontal bargraph-type display conveys the effective level immediately. Front/back and left/right balances are indicated with a left/right shifting bar. "Volume," which controls all channel levels simultaneously, goes from "−64" to "−00 dB." In the remote's last row are buttons to mute the entire system or the effects channels alone.

The front-panel LCD display always presents information in an easily understood form. The current program selection

Judging spatial effects is easiest from the listening position, so the CP-1's programs are selected and varied from its remote.

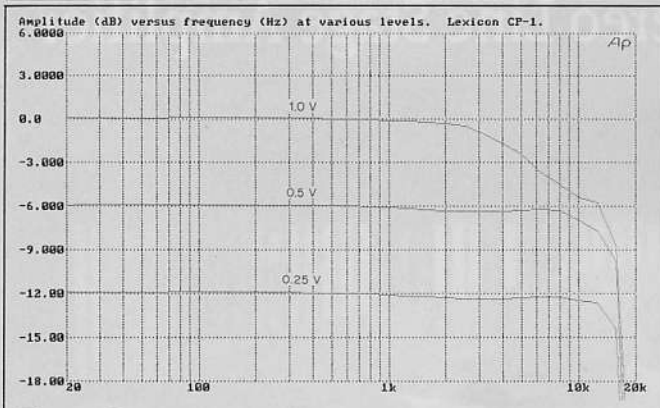

Fig. 1—Frequency response of side channel at several input levels; see text.

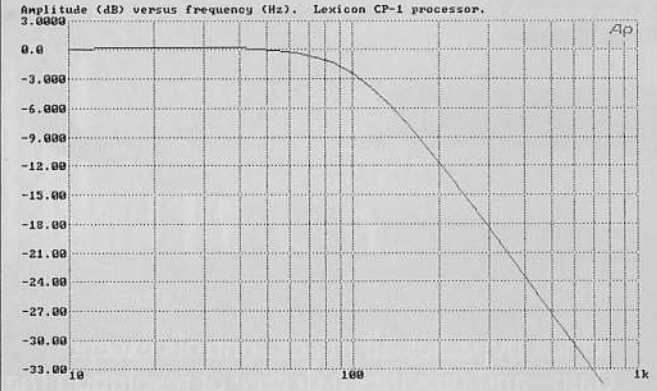

Fig. 2—Frequency response of subwoofer channel.

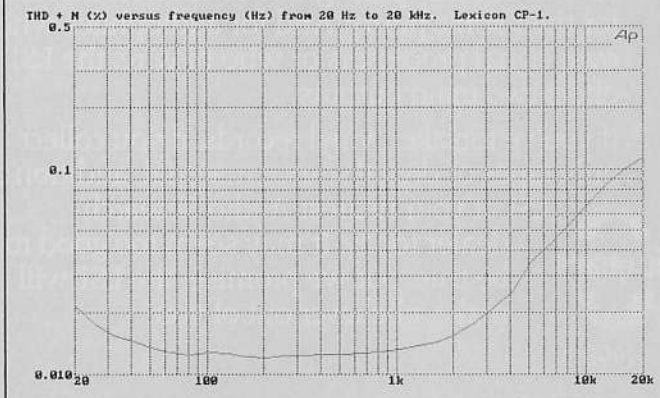

Fig. 3—THD + N at 3 V out; right main channel is shown.

is continuously shown, except when parameters and parameter values are being changed. Non-program information is normally displayed for 5 S after the last instruction.

I noted some items of good protocol while using the remote. Parameters with on/off functions are turned on with its "Param" up button and off with its down button. The last parameter checked or changed can be shifted immediately with a push of the up or down button, without pushing "Param" first. The white labels on the remote control are very easy to read against the black background.

Measurements

Let me first point out that all measurements were made after the listening and viewing. With the aid of the CP-1 service manual, I was able to defeat the normal processing so I could make instrument tests. The CP-1 was set, with the input pot, for close to maximum level (red LEDs just off) for an input of 316 mV. The main-channel response was down 0.09 dB at 20 Hz, 0.04 dB at 20 kHz, and 3 dB at 3.0 Hz and 140 kHz. The input voltage was increased to 1 V, and the pot was turned down until the red LEDs just turned off. The side-channel responses were then taken in "Surround" Pro-Logic, at input voltages of 1.0, 0.5, and 0.25 V. The reference level (0 dB) in Fig. 1 was the output voltage at 1 kHz with the 1 V input. The response at this maximum input level has a high-frequency roll-off which is less significant than it first appears. The test signal was a stepped sine wave, and the test-signal level above 2 kHz was much higher than spectral levels of music would be for the same frequencies at the same overall input level. The responses at lower, normal levels were close to 0 dB down at 20 Hz and less than 3 dB down at 16 kHz, showing agreement with specifications. The subwoofer-channel response curve is shown in Fig. 2. The roll-off above 100 Hz is at 12 dB per octave.

With the pot settings used for the listening tests, the S/N ratio was 100.5 dBA for the main channels, relative to 1 V in and out. The S/N ratios (re: 1 V in and out) for the side and rear channels, respectively, were 113.7 and 85.1 dBA for the "Panorama" program's "Wide" setting, 85.3 and 95.8 dBA for the "Ambience" program's "Medium" setting, 89.6 and 90.7 dBA for the "Reverb" program's "Medium" setting, and 82.2 and 80.6 dBA for the "Surround" program's "Stereo" setting. Overall, these figures are very good, to say the least; with the specified 3.5-V reference level, all of these figures would be 10.9 dBA higher. Figure 3 shows THD + N, across the band, for the right main channel at 3 V output. The results are typical for any of the channels, with very low distortion over most of the band.

The input sensitivity was 270 mV for maximum acceptable input level, with the input-level control at maximum, just below red-LED turn-on. The level for input clipping above the LED's turn-on varied with program selection. Waveform distortion seemed to appear with "Panorama" just about turn-on, but perhaps that was from level-sensitive processing. Input levels could be noticeably higher for other programs, but setting the control for prevention of red-LED turn-on makes sense for all programs. The maximum input level, with the control turned down, was greater than 31 V. With red-LED turn-on as the 0-dB reference, the green segments turned on at −50, −43, −37, −32, −28, −24, −19,

The processor is easily configured for optimum results with any of twelve common speaker setups.

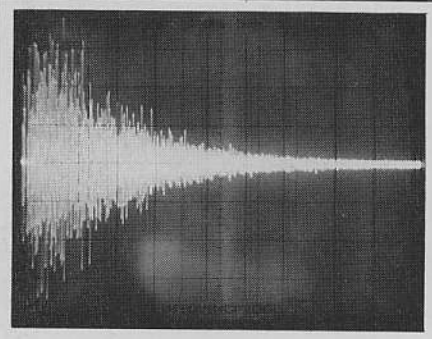

Fig. 4—Output from surround channel, in "Reverb" program's "Large" mode, for a 1-mS burst (one cycle) of a 1-kHz sine wave. Note the smooth decay; see text. (Horizontal scale: 0.2 S/div.)

−15.4, −11.2, −7.3, and −3.3 dB. The level range of the meter is certainly wide, which is good, but smaller steps at the top would be of some help. The red LED turned on with a 1-mS, 5-kHz tone burst at a continuous level 1 dB above indicator turn-on. The LED indicating −19 dB turned off 245 mS after the signal stopped—a shorter decay time than a peak-detecting meter should have. The Lexicon's meter will detect very short peaks, so the user should respond to any red flashing by reducing level. The output level for clipping was at least 4.7 V.

Figure 4 shows the output from a surround channel in the preset "Reverb" program's "Large" mode, with a single-cycle, 1-kHz burst. The smooth decay can be observed over the 2-S sweep of the oscilloscope, which is very close to the 2.16-S "Mid RT" default. The output polarity was the same as the input in the main channels. The main-channel output level was the same as the input level when the preset "Reverb" program was in "Medium," with the input level set for red-LED turn-on, the back-panel trim at maximum, and the main volume control at −11 dB. This relationship varied from program to program. The input impedance was 41 kilohms. The output impedance was 490 to 500 ohms for the various channels.

The two sections of the input-level pot tracked within 1 dB from wide open down to −47 dB. The master volume control's sections tracked within fractions of a dB for 55 dB. Each of the level steps were within ±0.03 dB of the indicated 1 dB. With a monaural input, left and right rear channels were down 25 and 27.5 dB, respectively, in the "Surround" program's "Stereo" mode and greater than 31 and 45 dB, respectively, in Pro-Logic mode. The delay adjustment range was from 0 to 32 mS. Each of the 2-mS steps was accurate within ±0.2 mS. The residue of the 33-kHz sampling frequency was down over 96 dB in the main outputs. The spectrum of the calibration noise used for channel balancing was centered at 800 Hz, with roll-offs at 400 Hz and 1.6 kHz.

Use and Listening Tests

The reference processor for the listening and viewing tests was the Yamaha DSP-1. A Yamaha AVC-50 amp was used for switching among the various sources: A Yamaha TX-900U AM/FM tuner, a Magnavox 1041 CD player, a Sanyo VCR-7200 Beta VCR, an Akai VS-555U VHS VCR, and a Yamaha LV-X1 videodisc player. For power amplification, I used the second section of the AVC-50 for the main stereo channels, a JBL/UREI 6210 for the center channel, and a Yamaha M-35 four-channel amp for the side and rear channels.

The speakers were two JBL 4301s (main stereo), a JBL 4408 (center), a self-powered Triad Design HSW-300 (subwoofer), and four Dynaco A-25s (surround). The Akai VS-555U VCR was used as the stereo TV decoder. I connected a two-channel oscilloscope across the left and right inputs and operated it in X/Y mode to show the existence or lack of stereo and surround information on the incoming signal. Figure 5 shows the arrangement of the system for evaluating the CP-1. The processor's subwoofer output was not used, as my subwoofer is designed to be connected across the main speakers. Two listener positions are shown because I moved back and forth, depending on the program selected and the speaker configuration used.

The owner's manual provides much useful information in a friendly page format with lucid text and well-done illustrations. Many pertinent comments throughout help the user to operate the unit and to understand what happens. The instructions on channel balancing and calibration of the "Panorama" program are well written. The sections on speaker setup and configuration and on programs and parameters are particularly good—the manuals for too many surround-sound units do not provide the detailed guidance needed. A 16-page section on theory and design is a good tutorial on certain aspects of concert halls, the design of the CP-1 programs, and how to get the most out of them. Lexicon also supplies a handy, single-sheet reference guide on stiff paper.

When setting up the CP-1, I first adjusted the contrast of its front-panel display for easiest viewing from my main listening position. Then, I moved around with the remote control to check its range. Up close, commands were received up to ±150° off axis horizontally and up to at least ±30° vertically. Control response was reliable out to ±45° at 25 feet and to greater than 30 feet on axis. I tried "Panorama" with just the center and front speakers (configuration 2) and was impressed by the spread possible in this mode. The calibration process worked well, and I found the specific parameters for my listening area quite speedily. I used the default "127" for the listener-position setting, but I preferred a speaker angle of 55° over the default "49." I did find that the best results in "Panorama" were secured with a listening position closer to the main speakers than for the other programs, particularly if the side speakers were off. The "sweet spot" did require sitting in the exact center: It was quite amazing to hear substantially nothing in the right ear with the "Calibrate Left Only" signal.

During the majority of the listening, I used two speaker configurations: Two front, two rear, and one center, and with two side speakers added. I checked all of the speaker

Unlike many other units, the CP-1 can provide very satisfying sound fields with only two speakers.

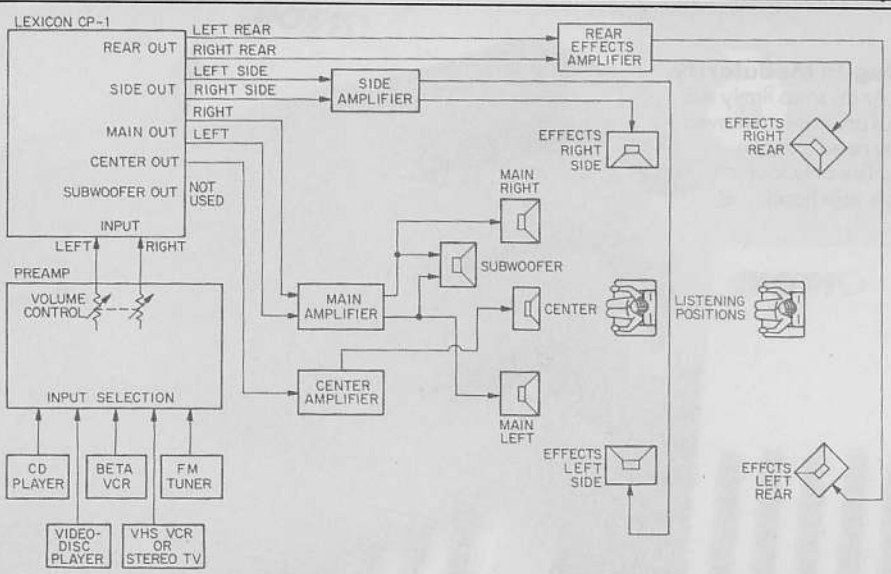

Fig. 5—Listening setup used in evaluating the Lexicon CP-1. Two listener positions were used; see text.

levels by using the calibration mode of "Surround" Pro-Logic. It was very easy to trim the levels with the back-panel trim pots as the shaped-noise signal stepped from speaker to speaker. Then I ran through all of the programs to review the effects of varying the parameters. I changed a number of values and stored all of the modified programs in the user memories.

Television

The first source I tried was television, with *Tour of Duty*, the CBS series, received in mono on the channel I used. "Surround" in "Mono" was the only acceptable program, made better with some reduction in effects level. Dialog centering was good, without any of the spread or diffusion that occurs with systems lacking center speakers. The results were similar on *Dance with a Stranger*, a movie on the Arts & Entertainment channel featuring Miranda Richardson and Rupert Everett. In both of these cases, effects were well handled, and I found some benefit in adding some voice-presence EQ.

Fine Romance (ABC), *48 Hours* (CBS), and *Different World* (NBC) all showed stereo on applause and effects but with all the dialog monaural and right in the center. I preferred "Panorama" in "Normal" and "Wide" when I was in the close listening position and "Surround" in "Stereo" and Dolby Pro-Logic when sitting in the regular position. The oscilloscope monitor showed that some television programs which turned on the stereo TV's detector had no stereo information, real or synthesized.

Videocassettes and Videodiscs

The videocassette of *Bull Durham*, the Orion film with Kevin Costner and Susan Sarandon, had a more pointed dialog sound with "Stereo," but Pro-Logic delivered a better voice quality and a superior sound quality overall. The steering of off-screen sound was very good, and the importance of the center speaker for dialog was demonstrated again and again. The videodisc of MCA Home Video's **batteries not included*, with Hume Cronyn and Jessica Tandy, was very satisfying with Dolby Pro-Logic. This program was definitely the best, with a combination of stable dialog centering and good spread of the effects, particularly when the little spaceships were zipping around. This movie had good changes in voice presence to go with the action in each scene.

Runaway Train, an MGM/UA Home Video videodisc with Jon Voight, Eric Roberts, and Rebecca DeMornay, was very good with both speaker configurations mentioned above. Many effects were very well positioned: The crowd during the boxing match, the panning of the sound of the passing train, the fast change in scene and sound localization when the runaway train hits the caboose, and the creative positioning of music. Yelling, off screen and to the left at the start of the movie, was well localized. Occasional effects actually seemed too far right or left with either speaker setup. The distraction was very minor and very much outweighed by all the evidence of good steering. Pro-Logic was the preferred program, but "Stereo" was more exciting with some scenes, including a few with the runaway locomotive. The subwoofer helped to give a solid bottom to the sound.

Star Trek IV, a Paramount Pictures videodisc with William Shatner, Leonard Nimoy, and DeForest Kelley, also benefited from the subwoofer. The whale rescue had good surround, as did a number of other scenes. "Stereo" was the better mode for this movie; Pro-Logic seemed to be more echoey. More and more, I came to the conclusion that the excessive liveness was a property of the soundtrack on the disc. Then I tried a Pioneer laser videodisc of Carole King, *One to One*. The amount of good surround information varied from track to track. The user versions of "Ambience" in "Small" and of "Surround" in "Stereo" gave the best

The CP-1 is the first unit I've reviewed that creates both good hall illusions for music and well-steered movie surround and dialog.

results overall, but for some of the tracks, I liked the preset "Panorama" in "Wide" better.

Compact Discs

The first CD I tried was Mozart's *Sinfonia Concertante, K. 364*, with Iona Brown and the Academy of St. Martin-in-the-Fields (Argo 411613-2-ZH). The user "Ambience" in "Small" or "Medium" gave me the best illusion of the hall sound I wanted. "Ambience" in "Large" was not good, but "Reverb" in "Small" and "Panorama" in "Normal" were possibilities that others might prefer. High-level trumpet notes showed some obvious modulation distortion in *The Extraordinary Roger Voisin: The Baroque Trumpet*, with the Kapp Sinfonietta (MCA Classics MCAD2-9807). The improvement over regular stereo was still very obvious with the preset "Panorama" in "Normal" and "Ambience" in "Medium." "Ambience" in "Small" was the best of my user-modified programs.

Debussy's *La Mer*, with Slatkin and the St. Louis Symphony Orchestra (Telarc CD-80071), was particularly appealing during the early, quiet parts with "Panorama" in "Normal." In later parts, I favored the illusion generated with "Ambience" in "Large" or with "Reverb" in "Medium." For Tchaikovsky's *Capriccio Italien*, performed by Kunzel and the Cincinnati Symphony Orchestra (Telarc CD-80041), it was a toss-up between "Panorama" in "Normal" and "Ambience" in "Large." "Reverb" in "Medium" provided a fairly good illusion, but "Reverb" in "Large" was unacceptable—more so in the user version. *The Music of Waldteufel*, with Kunzel and the Cincinnati Pops Orchestra (MMG MCD-10025), was much the best with "Panorama" in "Normal." A few spots with the bass drum were particularly realistic with this program. "Ambience" in "Small" was good for its tone color, and the other "Ambience" programs were also satisfactory choices.

The Fauré *Requiem*, with Shaw and the Atlanta Symphony Orchestra and Chorus (Telarc CD-80135), had a lovely, detailed sound quality with "Panorama" in "Normal," but I preferred the more large-church sound of "Ambience" in "Medium" and all the "Reverb" programs. In the "Sanctus" and "Agnus Dei" sections in particular, I felt "Reverb" in "Large" was best of all, with "Medium" my second choice. "Reverb" in "Small" was rated just below "Ambience" in "Medium." Mozart's *Opera Arias*, with Te Kanawa, Davis, and the London Symphony Orchestra (Philips 411148-2PH), sounded better with the preset programs than it did with my versions. "Ambience" in "Small" and "Panorama" in "Normal" were the best, according to my ears, and "Ambience" in "Medium" and "Panorama" in "Wide" were the only others I liked for some pieces. I found it interesting that I also preferred the same basic programs for much of Puccini's *Tosca*, with Milanov, Bjoerling, Warren, Leinsdorf, and the Rome Opera House Orchestra and Chorus (RCA 4514-2-RG). With the opera, however, the user versions created better illusions for most of the scenes, and "Ambience" in "Small" was the best overall.

Beethoven's *Piano Trio No. 11*, with the Beaux Arts Trio (Philips 420231-2PH), immediately seemed to be a good match for "Ambience" in "Medium," with the preset program the better one. This was very satisfying listening, and as I have heard the Beaux Arts Trio almost every year over a period of 30 years, I have very definite ideas on what they and the hall should sound like. For a different piano style, to say the least, I listened to *The Joint Is Jumpin'*, with Fats Waller (Bluebird 6288-2-RB). Preset "Panorama" in "Normal" and "Ambience" in "Small" were pretty good, but user "Surround" in "Stereo" was the best for this CD, which had very little stereo information on any track. I was surprised by the amount of the improvement, considering the age of the original source material.

Air Supply's *Love & Other Bruises* (Columbia CK-35047) was a good match for "Panorama" in "Wide," both the preset and user programs. Infrequently, the spread was almost too wide with these programs. "Surround" in "Stereo" and Dolby Pro-Logic weren't as good as the "Panorama" programs overall, but they had a larger good-listening area. Preset "Panorama" in "Normal" and "Wide" were both good choices for the "Italian Concerto Presto" track of Don Dorsey's *Bachbusters* (Telarc CD-80123). They weren't pleasurable earlier, however, and overall, I liked user "Ambience" in "Small" for most of the tracks. The Police's *Synchronicity* (A&M CD-3735) was very good with both preset and user "Panorama" in "Normal" and "Wide," as long as I stayed right in the center. "Ambience" in "Small" was the best choice for a larger listening area.

Conclusion

A great deal of pleasurable listening was obtained with the smooth surround sound from the Lexicon CP-1. I did not detect any limitations I would ascribe to the 33-kHz sampling rate or the related 16-kHz roll-off in the surround channels. The "Panorama" programs are different from those available from stored-measurement-type processors such as my Yamaha DSP-1 reference unit. The "Panorama" programs can provide a class of very satisfying sound fields—even with just two speakers—that are not even possible with other processors. The ease with which the internal operation of the CP-1 can be changed to match any of 12 speaker configurations is unique and could be a very important feature for some users. The CP-1 is the first unit I have reviewed that provides good performance-hall illusions with music and also delivers well-steered surround sound and properly localized dialog with movies. (I should note that I did not evaluate the Yamaha DSP-1 or DSP-3000 with the DSR-100 Pro decoder for Dolby Pro-Logic.)

The CP-1 almost always delivered a nice-sounding illusion, even if it wasn't exactly what I envisioned before selection. From one choice to another, the sound character did not usually change as noticeably as it did with the DSP-1. However, other listeners, using different parameter settings, might not agree. Whatever high-performance surround processor is evaluated by the potential buyer, the demonstration arrangement should correlate to the particular design of the unit. The Lexicon CP-1 performs best with side loudspeakers, but it can be set up for operation in a home listening space that might not accept this configuration. Its limitations are minor, and its price is quite reasonable for its features and performance quality. For music *and* movies, the Lexicon CP-1 is worthy of comparison to any other units currently on the market. *Howard A. Roberson*