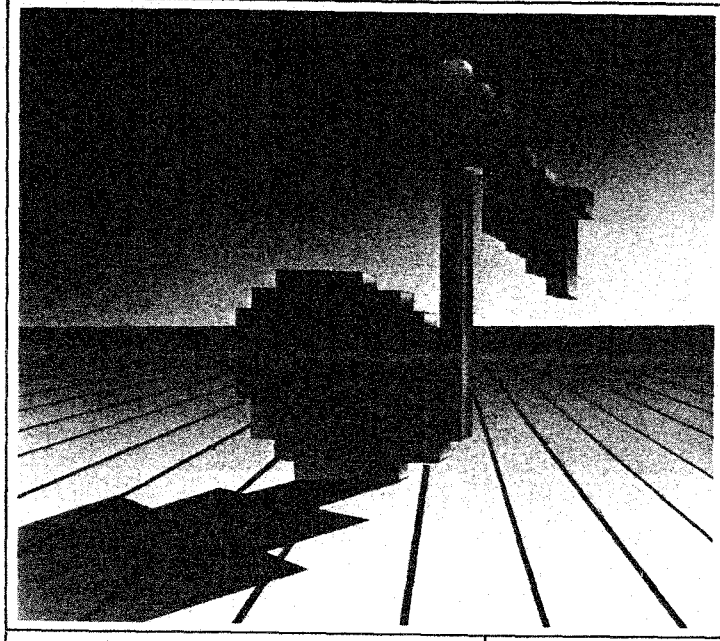
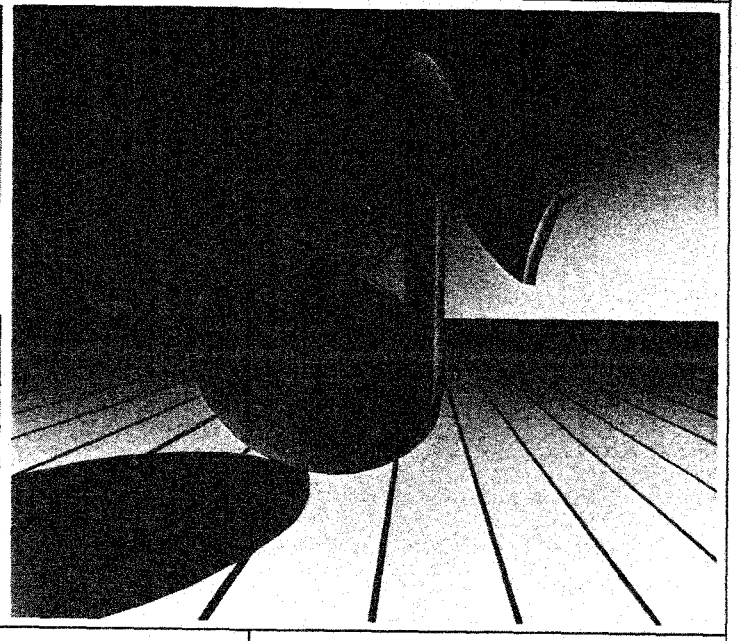
DIGITAL TIME LENS TECHNOLOGY AND COMPACT DISCS.





Compact Discs represent the first significant improvement in audio sound sources since the stereo phonograph record. You don't have to be a "golden ear audiophile" to instantly perceive the remarkable sonic improvement.

Still, one must view digital sound with the same historical perspective applied to such breakthroughs as stereo, transistor amplification and FM broadcasts. Each was demonstrably better than what preceeded it. And yet each had shortcomings which were improved later on, when the initial blush faded.

Just as Bob Carver has enhanced FM reception, power amplification and the effect of stereo, so he has taken digital Compact Disc sound to its next plateau with Digital Time Lens Technology.

While hundreds of articles and reviews have been written on the digital audio recording process, it is valuable to review just how the process works in theory to better appreciate the Digital Time Lens' further contribution.

Analog recording uses magnetic tape to record varying amounts of musical signal. The more musical impulses in a given passage of music, the more magnetism is imparted on that portion of tape passing the recording head.

While this recording method has given us thirty years of memorable recordings, it labors under at least five physical limitations which cause audible degradation of the signal. 1) Tape has finite limits as to the amount of energy it can record. Saturation and distortion occur when the limit is reached, yet musical dynamics extend far louder and softer than the medium can handle. 2) Magnetic tape, by its very composition, imparts some internal energy which we hear as hiss. Thus quiet parts of recordings can suffer from annoying background noise. 3) It is very hard for tape to deal with extremely high and extremely low frequencies, again due to physical realities of tape oxide composition, speed and head configuration. 4) Even if problems 1-3 are minimized, the result gets scratched into the surface of a piece of plastic and played back by letting a small diamond wiggle around in the groove. Not theoretically the best method by any stretch of the imagination. 5) Even if said grooved plastic disc is the best virgin vinyl and the wiggly diamond is a $1000 handmade cartridge on a $2000 turntable, the record can come to a bad end in seconds at the hands of a) a five-year-old with a peanut butter sandwich, b) an inquisitive pussycat, c) your best friend after half a bottle of Cabernet.

Digital recording gets around all of these problems. The musical signal is sampled and analyzed by a computer which, in effect, impartially measures the signal with a ruler. It is recording impartial digital comments such as, "This segment is VERY loud+98dB -and goes down to 20Hz." "This segment is extremely quiet and contains a flute solo with harmonics to 19,000Hz." "This segment increases in dynamics by 60dB in less than a hundredth of second, etc."

Instead of trying to make a physical model of these measurements the way analog tape does, digital recording simply "prepares a report," coded in 1's and 0's much the way a floppy disc can contain the text of a book encoded in binary language.

The Compact Disc playback unit "reads" the report and changes the sound back to analog musical impulses which are fed into your hi-fi just like a tuner, cassette deck or phonograph source. Except that the digital source will be free of background hiss, contain the full range of frequencies from deepest fundamentals to almost inaudible highs and provide dynamics ranging from gossamer-soft to thunderstorm loud.

Since it's not limited by actually trying to emulate the musical signal, more sheer excitement, sonic impact and definition of individual instruments reaches your preamplifier. Unquestionably digital has proved a quantum leap ahead of previous recording and playback methods. You might compare it to a good stereo disc versus an Edison wax cylinder. That's how much better a Compact Disc can be than the average vinyl recording. Still, this wonderful process has received some qualified criticism from experts who have extremely good ears. Many professional musicians, audiophiles and audio journalists, while praising the quietness and dynamic range of Compact Discs, have often expressed a lingering disappointment in the way music itself sounds on many commercial examples. This is particularly evident when the compact disc is compared with a well-executed analog counterpart. The complaint boils down to a lack of ambience and spatial detail, along with a midrange which often has been described as sounding bright, hot and harsh.

When Bob Carver received his first Compact Disc player, he too was not prepared for the compromises in sound he heard on some discs. The three-dimensional perspective which his analog system provided in lush abundancy on phono discs evaporated into a flat, brittle wasteland. The next day, he purchased no less than 23 Compact Discs and their analog, vinyl counterparts and set about quantifying the differences.

As expected, the CD discs were quieter, exhibiting better dynamic range and richer, tighter bass. But testing uncovered two inherent flaws: **1) Different spectral energy balance.** The overall frequency response was shifted on the CD towards more midrange above 400 Hz; **2) The amount of Left-minus-Right channel information versus the amount of Left-plus-Right differed by about 1.25dB between analog and digital.**

It is important to understand that the Left-minus-Right (L – R) component of stereo carries the three-dimensional part of sound field information, much as is done with FM stereo (refer to the section on Carver's tuner circuitry). A deficiency of 1.25dB doesn't sound like much. But since power goes up as the square of the voltage, it means that analog records carry a whopping thirty-three percent more ambience information than digital discs. That's a noticeable reduction in three-dimensionality, imaging and other psychoacoustic factors that put the realism into music.

How does the Digital Time Lens correct these problems? Bob Carver's circuitry adjusts

the ratio of L – R to L + R and restores the octave-to-octave balance originally intended by the musician and recording engineer as evidenced by the analog recording.

More specifically, Bob discovered that the L + R component of a digital disc had to be equalized somewhat differently than the L – R component of the digital disc so that it would match the analog disc (the analog version of the same musical recording). There were two equalization curves necessary to make the digital disc sound the same, exactly the same as its analog counterpart. In addition to equalizing the L + R band and the L – R band independently, it was necessary to increase the level of the L – R band so that it would match the L – R level that was on the analog disc.

Now, since the equalizations were different for the two bands, it was necessary to introduce a time correction in the L + R band because the equalization was steeper in the L – R and so the signal would go through the L – R with a greater group delay than it would go through the L + R signal chain and would arrive out of step, so a compensating delay, just micro-seconds, is employed in the L + R signal chain so that when the two signals arrive at the matrix to be turned back into left signal and right signal, they arrive without time domain errors.

The Digital Time Lens, Theory and Practice.

Bob Carver, along with many others, was displeased by the sound of the earliest CD's and decided to find out why some didn't sound the same as the LP versions of the same recordings. Unlike many who have complained about poor stereo imaging, lack of depth and strident, harsh treble – and who have blamed the CD digital system itself – Carver was enough of a mathematician and engineering theorist to know that the system itself was inherently blameless.

After extensive comparison tests between LP's and their CD versions, which included time-synched playings of both types of record while measurements and observations were made, Bob concluded that there were two major differences between certain CD's and their LP equivalents. The first had to do with stereo depth or separation. In any stereo program, the stereo effect is transmitted by the difference between left and right signals. Bob discovered that many CD's have less relative L – R information than do the LP's for the same programs at the same musical moment.

In order to see it, Bob devised a special test circuit that would amplify the difference. The figures show the Lissajous patterns obtained from the same instant of musical program in its LP (fig B2) and CD (fig B3) versions.

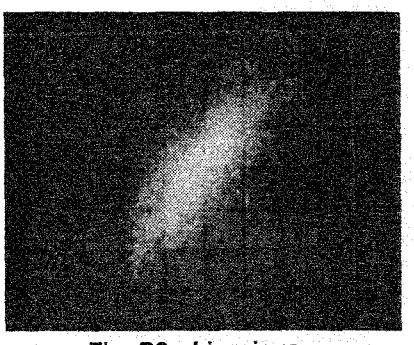


Fig. B2—Lissajous pattern showing (L – R)/ (L + R) ratio from an LP record.

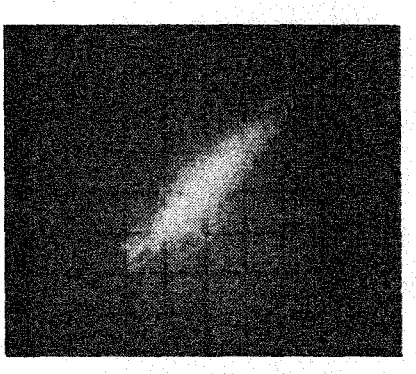


Fig. B3—The same instant of music as in Fig. B2 but taken from the CD version. Note the decreased difference (L – R) content, as shown by the narrowed trace.

In this type of display, a straight, thin diagonal line from the lower left to the upper right would represent a purely monophonic signal. The more stereo "difference" information there is, the more the line spreads out into an ellipse.

Notice that there is significantly more difference (L – R) signal in the LP version of the music!

The second major difference noted by Bob Carver between some CD's and their LP counterparts was a difference in equalization, or the overall frequency response. Using a fine moving-coil cartridge to play the LP versions of certain programs, Carver noted that there was a slight BOOST in the mid-bass region and a slight CUT in the mid-treble region compared with the response obtained when playing the CD version of the same program.

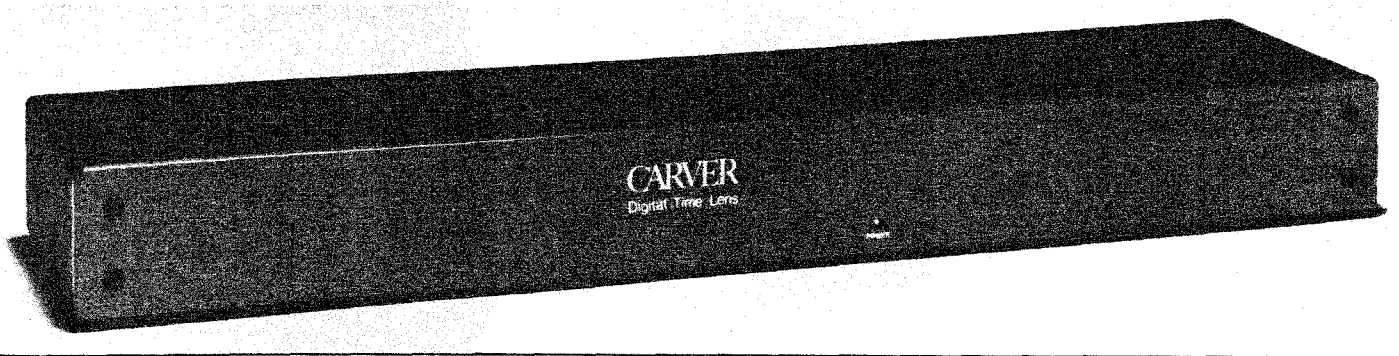
Bob's objective in designing the Digital Time Lens was to give the user the ability to introduce the converse of the two effects at will. That essentially is what he has done: If there is a deficiency of L-R signal in some CD's, the user can interpose a form of matrix-dematrix circuitry that will put back some of the extra L-R signal. If there is overly bright mid-treble and somewhat diminished mid-bass in a CD, the user can add a little mid-bass and attenuate some mid-treble frequencies by means of a switchable circuit. L.F.

If you have read the excerpt from Audio Magazine included on this page, you will note that the reviewer qualified his comments by noting that not all CD's need the beneficial effect of the Digital Time Lens.

We concur. Later on in the review, the same reviewer noted, "I suspect that many owners will ... put little marks on their CDs that indicate whether they should be played with the Time Lens or not. I find nothing wrong with such an arrangement."

Again, we concur. It took a lot of courage on Bob Carver's part to play the part of the truthful child confronted with the Emperors's new clothes, the part of the person with the courage to point out that digital could often sound better.

But unlike a mere critic, Bob Carver has done something about the shortcomings he perceived. He has given every music lover the final tool necessary to open up an exciting new world of sound.



CARVER DIGITAL TIME LENS

You can't buy a better CD Player than the Carver CD Player. Impartial magazine reviews prove it. Qualified listeners prove it. Your own ears will prove it in a demo at your Carver Dealer.

Unfortunately, some of you already own Compact Disc Players. There is a solution.

The outboard Digital Time Lens adds the finishing touches of sonic accuracy and realism to Compact Digital Audio Discs. It turns an innovation into near musical perfection.

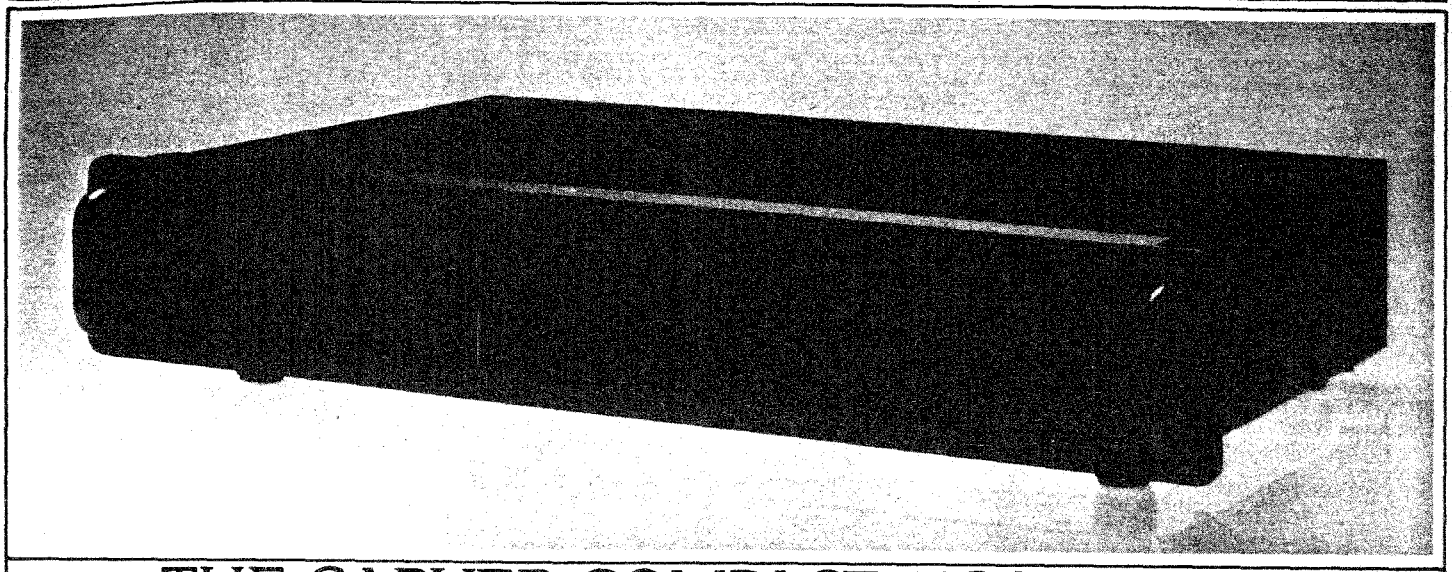
If you are willing to make a commitment to vastly improving your sound source with a Compact Digital Disc player, you should also go the short extra step that lets digital realize its true potential.

That step is a Carver Digital Time Lens, connected between your CD player and preamplifier.

Visit your nearest Carver dealer and ask for a demonstration of how we've "focused" digital playback into a crystal-clear image of the original performance.

Input: 2 v. 50k ohms
Impedance Output: 2 v.
Distortion: 0.005%.
Frequency Response: 20 Hz-20 kHz
Dimensions: 17¾" wide, 4" deep, 1⅓" high.
Line Voltage: 120 VAC 60 HZ Dither signal: OdB. – 70 dB adjustable.

ALL SPECIFICATIONS OR FUNCTIONS SUBJECT TO CHANGE WITHOUT NOTICE.



THE CARVER COMPACT DISC PLAYER

WITH DIGITAL TIME LENS

How logical it is for a company dedicated to delivering music with maximum dynamic impact to offer a state-of-the-art CD player. Anyone who ever wondered why Carver makes amplifiers capable of delivering hundreds of watts of power need wonder no longer after they have heard the Carver Compact Disc Player as a sound source.

There are dozens of brands of Compact Disc players available right now, many of them rushed to market as "me too" line extensions with little regard for the finer technical points of digital playback technology. Carver was in no hurry. They wanted to do digital right.

Because the state of the art has advanced considerably since the first players appeared several years ago. Unlike many of the "off-brand" models now available which employ less advanced technology, the Carver Compact Disc Player makes use of the latest triple laser beam pick-ups and sophisticated oversampling and digital filtering technology.

Except for features like display and programming, the real determining factor in CD player quality is its ability to reconstruct music from digital information bits. And that is not an easy job nor one that can be effectively achieved while skimping on circuitry.

The Carver Compact Disc Player reads discs with more precisely focused laser power than most other models, resulting in improved tracking and less chance of drop-outs when dust or smudges are encountered on a CD.

Along with a potentially audible signal ranging up to 20kHz, there are endless images of the signal at 40K, 80K, 160K etc. While they are above the range of human hearing, they must be removed from the signal to prevent harmonic problems which could turn into audible distortion. Earlier CD models placed an anti-imaging filter after the digital/analog converter stage. Carver uses DIGITAL filtering ahead of the D/A converter through a process called *double oversampling*. The signal is passed through a shift register which delays the samples, so that the weighted average of a large number of signals is generated. Through a complicated process, frequency bands are suppressed between 20kHz and 160kHz, eliminating harmonic distortion problems early on before the complicated D/A translation.

The same oversampling process also distributes the same amount of noise over twice as wide a frequency range, resulting in half as much noise in the final signal. Then after translation to analog, the signal is once again filtered for a gentle roll-off above 17kHz that imparts a more natural musical sound to the final output.

One of the important tests applied to determine the effectiveness of digital-to-analog translation circuitry is the reproduction of a square wave. When *Audio Magazine* applied this test to the Carver Compact Disc Player, their test equipment displayed the following:

One doesn't need an engineering degree to recognize the accuracy of the Carver Compact Disc Player's output. The reviewer observed that "*Reproduction of a 1-kHz digitally generated signal was as close to a true square wave as I have ever seen from a CD player that used digital filtering. (The Carver Digital Disc Player) shows a virtual absence of phase error.*"

On top of this unerring ability to produce warm, real-sounding music from the CD's digital bits, the Carver Compact Disc Player has the remarkable Digital Time Lens circuit which can further enhance your listening enjoyment.

When Bob Carver received his first Compact Disc player, he was surprised at the sound derived from some discs. The three-dimensional perspective which his analog system provided in lush abundancy on phono discs evaporated into a flat, brittle wasteland. After extensive testing, Bob had uncovered two inherent flaws in some but not all Compact Discs: 1) *Different spectral energy balance.* The overall frequency response was shifted on the CD towards more midrange above 400 Hz; 2) *The amount of Left-minus-Right channel information versus the amount of Left-plus-Right differed by about 1.25dB between analog and digital.*

Bob Carver's circuitry adjusts the ratio of L – R to L + R and restores the octave-to-octave balance originally intended by the musician and recording engineer as evidenced by the analog recording.

In addition, the L + R component of a digital discs is equalized by the Digital Time Lens differently than the L – R component and the level of the L – R band is increased slightly to enhance ambient effects found on corresponding analog discs.

The result is a warmer sound with more of the three-dimensional ambient information that places us in the same space with performers. You won't need the Digital Time Lens on all CD's. But it is there when you need it. And only on the Carver Compact Disc Player.

Ease of operation is a hallmark of Carver components and the Carver Compact Disc Player is no exception. A subtle but easy-to-read LCD display not only shows selection number, elapsed time and total time of the CD, but also "talks" to the user. Turn on the Carver Compact Disc Player and the display asks for a disc. When the disc tray is open, the display reminds you with an OPEN readout. When a CD has completed playing, the multi-function display reads END.

With the Carver Compact Disc Player's Programmable Random Access Playback System, track search and programming of up to nine different selections is a snap, as is automatic repeat of a previous selection or an entire CD. For classical music lovers, the Carver Compact Disc Player has complete indexing capabilties as well.

The large, easy-to-use feather-touch controls include pause, fast forward and reverse. You can even monitor music at high speed to find a certain portion of a selection.

If you really enjoy music, you owe it to yourself to begin your digital experience with the only full-feature CD player that has the Carver touch. The only CD player that can actually improve on what is already the best playback medium ever offered.

Audition the Carver Compact Disc Player with Digital Time Lens at your Carver dealer soon.

Specifications

Frequency response: 5Hz-20kHz
THD: 0.5%
Signal-to-noise ratio: 96dB
Output voltage: 1.9V
Channel Seperation: 86dB @ 1kHz
Dynamic Range: 96dB

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