4

PHILIPS CD960 COMPACT DISC PLAYER

Manufacturer's Specifications

Frequency Response: 2 Hz to 20 kHz.
Amplitude Linearity: 20 Hz to 20 kHz, ±0.01 dB.
Phase Linearity: ±0.2°, 20 Hz to 20 kHz.
Dynamic Range: 96 dB.
S/N: 101 dB.
Channel Separation: 100 dB, 20 Hz to 20 kHz.
THD: 0.0015%.
Audio Output Level: 2.0 V rms.
Headphone Load Impedance: 8 to 1,000 ohms.
Number of Programmable Selections: 20 (see text).
Power Requirements: 120 V, 60 Hz, 30 watts.
Dimensions: 16-17/32 in. W × 3⅞ in. H × 14⅞ in. D (42 cm × 9.8 cm × 37.8 cm).
Weight: 22 lbs. (10 kg).
Price: $949.
Company Address: Philips Consumer Electronics, P.O. Box 14810, Knoxville, Tenn. 37914.
For literature, circle No. 93

This report marks the first time I have tested a Compact Disc player that bears the Philips name. Philips, as many readers know, is the giant electronics firm based in the Netherlands which was a co-developer of the Compact Disc. Though highly respected in just about every country in the world, the Philips brand name has had a mixed history in the United States. For whatever reasons, earlier attempts to sell products under the Philips brand name have had irregular success here. As a result, North American Philips (NAP), a subsidiary of the Dutch parent, marketed audio and video products under the familiar brand names of Magnavox, Sylvania, and Philco. A few months ago, this changed. Philips has now introduced a high-quality line of audio components under its own name; the Model CD960 is an excellent Compact Disc player, one that should do the Philips parents proud.

Thanks to its "FTS" feature, the CD960 can play tracks which the user has previously selected from many discs and then programmed into memory.

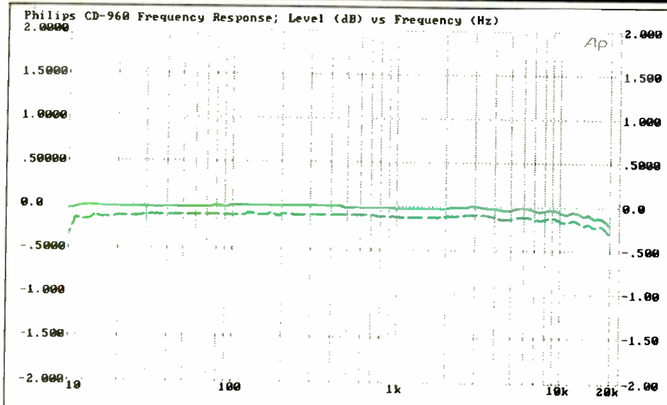

Fig. 1—Frequency response at 0-dB recorded level, using signal from CBS CD-1 test disc, for left channel (solid curve) and right channel (dashed curve).

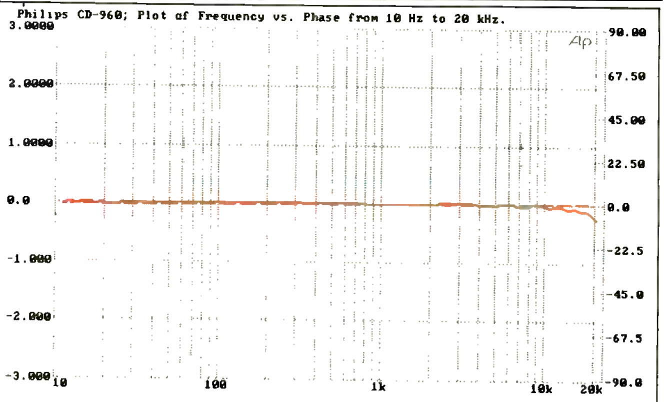

Fig. 2—Phase vs. frequency response indicates the use of dual D/A converters or accurate time compensation between multiplexed left and right channels.

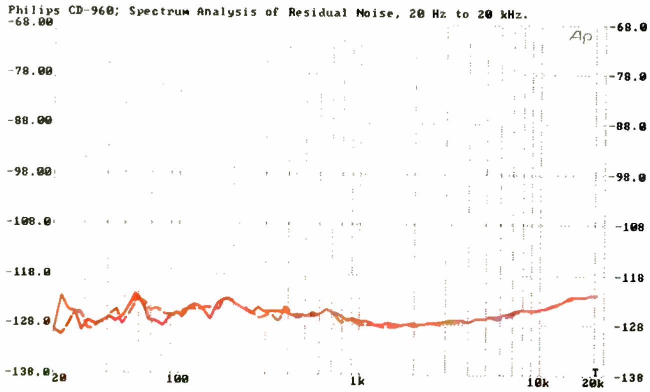

Fig. 3—Residual noise vs. frequency for left (solid curve) and right channels.

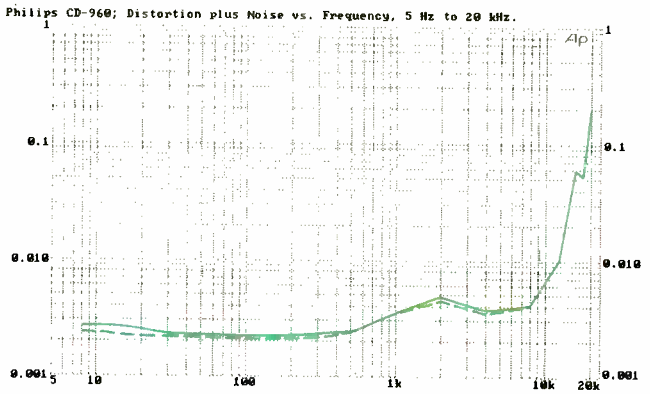

Fig. 4—THD + N vs. frequency for left (solid curve) and right channels.

Like a few of its Magnavox siblings, the Philips CD960 has Favorite Track Selection. This remarkably innovative feature allows you to store track numbers of many discs in a permanent memory. When you insert one of these discs and identify it by its FTS number, the CD960 will play only the tracks you previously selected for that particular disc. The player has enough memory for an absolute maximum of 226 discs, but the number of FTS programs that can be stored depends on the number of memory blocks being used. If you store five tracks per disc, for example, programs for 157 discs can be stored. The program for each disc—as well as any current, conventional programming for immediate play—may have a maximum of 20 memory blocks. Memorizing a track number uses one memory block, requesting an index point within a track uses two memory blocks, and requesting start of play at a given time (minutes and seconds into a track) uses five memory blocks. To simplify the task of cataloging discs that have been programmed using FTS, Philips provides a sheet of numbered labels which can be affixed to the label side of a disc or to its jewel-box case.

As is true of many top-quality CD players, you can advance to the beginning of any track, start play at any given particular index point, or start play at a specific time within a track. The unit allows repeat play of a disc or repeat of a continuous play loop (from one point on a disc to another). Forward or reverse searching is possible at three speeds, depending on how long the search buttons are pressed. Sound is audible during the two slower speeds. The scan feature allows listening to approximately the first 10 S of every track on a disc, in ascending order. During scan, you

The overall unweighted S/N measured about 110 dB for both channels. When I added a filter, results went to 114 dB.

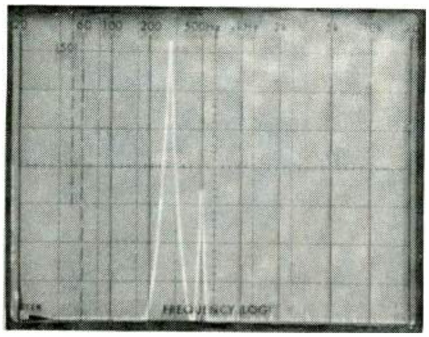

Fig. 5—Spectrum analysis of the CD960's output when reproducing 20-kHz test tone. Sweep is linear, from 0 Hz to 50 kHz.

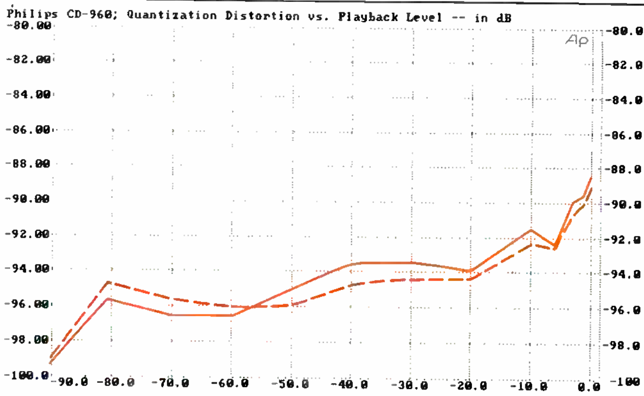

Fig. 6—Quantization distortion vs. frequency for left (solid curve) and right channels.

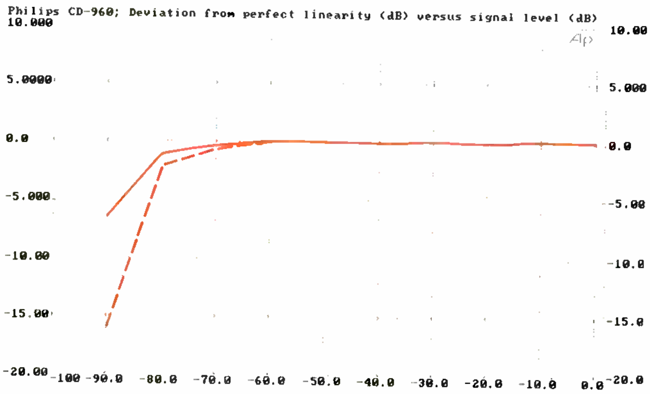

Fig. 7—Deviation from linearity as a function of recorded level for left (solid curve) and right channels, using undithered signal from CD-1 test disc. See text.

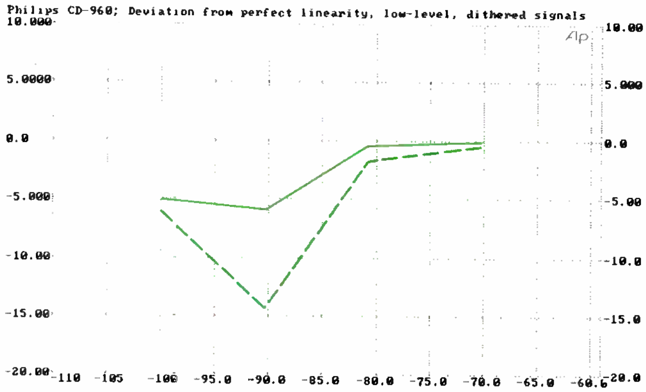

Fig. 8—Same as Fig. 7 but using dithered test signal.

can also program tracks you like for later play, but only if you want to listen to these tracks in the same order in which they appear on the disc.

Control Layout

The "On/Off" switch and stereo phone jack are at the left end of the front panel, adjacent to the disc tray. A slider control below the tray adjusts headphone volume. Major operating pushbuttons, including the fast-search keys, are at the right end of the front panel.

A display area is located directly to the right of the disc tray. A minutes and seconds readout shows total playing time of a disc, elapsed time for the track being played, remaining time of a disc or program, or a selected time position. Track numbers and index numbers are also displayed, as are a wide variety of word indications. The latter includes "Error" (if you have made a mistake during programming), "Disc" (after loading), "Program" (when a program is stored in memory), "A-B" (when playing a continuously repeating loop), "FTS" (when an FTS program is in operation), "Scan" (when the scanning function is in use), "Review" (when visually reviewing a previously assigned program), "Repeat," and "Pause."

Pushbuttons for programming or track and index selection are found on a lower section of the front panel. When this section is pressed, it moves forward, out of the front

Now that Philips is using true 16-bit D/A converters and four-times oversampling, players such as the CD960 offer even better sound.

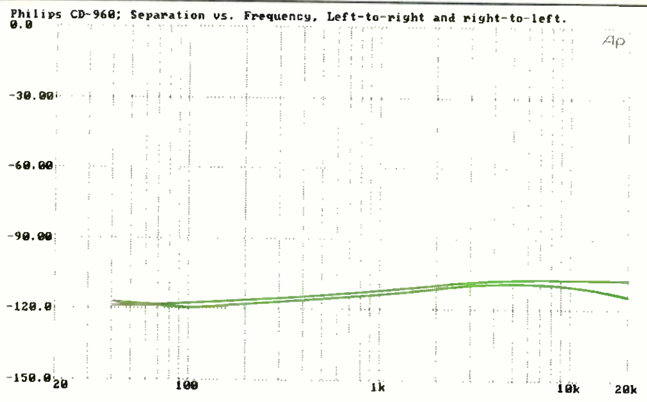

Fig. 9—Separation vs. frequency for left-to-right and right-to-left analysis.

panel, disclosing additional buttons for "Clear," "Store," "Review," "Scan," "Index," "Repeat," and "A-B." A mode switch selects "Normal Play," "Single Play," "Copy Pause," and "Auto Pause." The latter two settings are useful when tape recording CDs. They add either predetermined or automatic pause periods between tracks so that, if your cassette deck has track-seeking facilities, it will be able to find selections by these periods of silence between tracks.

In addition to the usual analog stereo output jacks, the rear panel is equipped with an optical output jack (for processing of the digital signal via a fiber-optical interface to a preamplifier or amplifier) and a digital output jack (for direct connection to a digital input on a preamplifier or separate D/A-converter unit). Remote-control jacks are for connection to either a remote-control sensor, which is available from Philips as the EM-2200, or to operate in a system configuration with other Philips components controlled by the RC-5 remote. A two-position switch selects between reception of signals from the remote-control transmitter or from an alternative remote receiver (used, for example, when the player is part of an audio system that has its own universal remote control).

Measurements

Figure 1 is a plot of frequency response from 10 Hz to 20 kHz. My new Audio Precision test setup is able to plot response of both channels simultaneously, using a glide sweep contained on the EIA-approved CBS CD-1 test disc. Output levels from the two channels were not exactly identical. The left channel measured 2.044 V (and was used to set up the 0-dB reference level), while the right measured 2.014 V. The difference between the two outputs, amounting to about 0.128 dB, shows up clearly in Fig. 1. Response for the left channel was flat down to 10 Hz and was off by no more than 0.23 dB at 20 kHz.

Figure 2 is a plot of frequency versus phase response between channels. Outputs from both channels were precisely in phase, with only a very slight phase displacement of a few degrees at 20 kHz.

Figure 3 is a spectrum analysis of residual noise versus frequency, referenced to maximum recorded output level. The overall unweighted S/N for this player was 109.9 dB from the left channel and 110.5 dB from the right. Adding an A-weighting filter in the signal path further improved the readings, to 114.5 dB from the left channel and 114.7 dB from the right.

Figure 4 is a plot of THD + N versus frequency for both channels. At 1 kHz, THD + N was no more than 0.0035%, decreasing to still lower values at lower frequencies. The moderate rise at high frequencies was not so much an increase in actual harmonic distortion as it was the appearance of out-of-band "beat" components beyond the audible range. In Fig. 5, a spectrum analysis of the CD960's reproduction of a steady-state 20-kHz signal, one of these beat components is easily seen at 24.1 kHz. It is important to note that no such nonharmonically related beats appear in the audible spectrum.

CCIF (twin-tone) IM was 0.00095% on the left channel and 0.00136% on the right channel. SMPTE-IM distortion at 0-dB level was a mere 0.00434% on the left channel and 0.00384% on the right. Dynamic range measured just over 104 dB.

Figure 6 is a plot of the Philips CD960's quantization distortion—expressed in dB rather than percent—as a function of playback level. Interestingly, the quantization distortion was actually lower at lower recorded levels than it was at higher levels (although quantization distortion figures of −90 dB or better are hardly worth quarrelling about at any playback level).

Figure 7 is a plot of linearity *deviation* versus recorded level. From maximum recorded level down to −70 dB, linearity was virtually perfect. However, between −70 and −80 dB, linearity errors were evident, about 1 dB for the left channel and nearly 2.5 dB for the right channel. Severe nonlinearity was present from −80 to −90 dB; the right channel's deviation was far worse than the left channel's—more than 15 dB of linearity error at −90 dB. I suspect that one of the two D/A converters in the sample that I tested was the culprit here. Even though these tests were conducted using undithered signals on the CD-1 disc, I would not normally expect such a high degree of nonlinearity, especially in the negative direction. Nonlinearities of this type are usually positive (what should be a −80 dB signal reads *less* than −80, for instance). Using dithered test tones ranging from −70 to −100 dB, it was possible to plot deviation from perfect linearity below the limits supposedly imposed by 16-bit systems (Fig. 8). Here, too, it became obvious that something was wrong with the low-level signal D/A-conversion process. The deviation from perfect linearity at −90 dB is almost identical to that shown in Fig. 7. (The deviation should have been less, all things being equal, due to the dithering of the signals used in this test.)

Separation between channels is plotted in Fig. 9. Even at 20 kHz, separation exceeded 100 dB. Using my new test system's capabilities for spectrum analysis, I analyzed the nature of the SMPTE-IM distortion components in the range from 20 Hz to 1 kHz; the results are shown in Fig. 10. There appears to be a major contribution of IM at 120 Hz (which I would expect, considering that it is the second harmonic of

Although the unit I tested exhibited some low-level nonlinearities, I detected no glitches at all during the listening sessions.

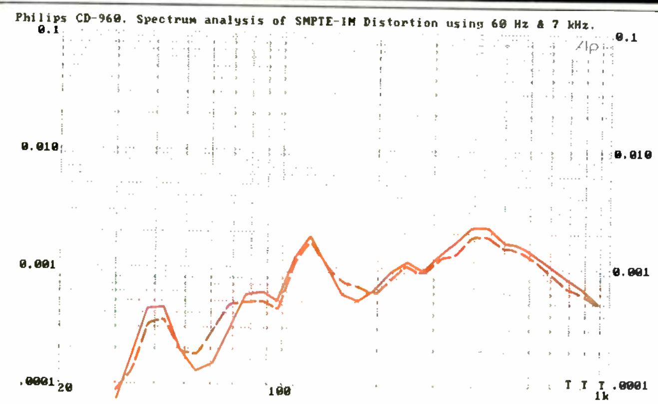

Fig. 10—Spectrum analysis of SMPTE-IM distortion for left (solid curve) and right channels.

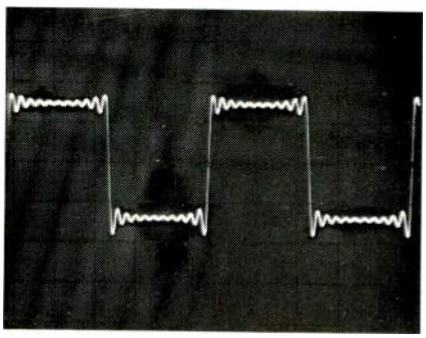

Fig. 11—Reproduction of 1-kHz square wave.

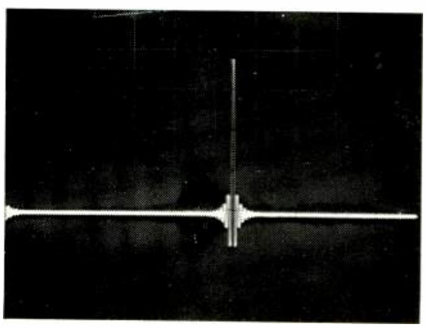

Fig. 12—Unit-pulse test.

one of the two frequencies involved in this test) and another "bump" at around 400 Hz.

Figure 11 shows how a 1-kHz square-wave signal was reproduced by the CD960, and Fig. 12 shows how it reproduced a unit pulse. The shape of the unit pulse in Fig. 12 shows that the analog audio stages of the CD960 do not invert polarity. The square wave in Fig. 11 is typical of those seen for CD players employing digital filtering and oversampling techniques.

Use and Listening Tests

Many of the earliest and best-sounding CD players were based on the early Magnavox (actually, Philips) players and mechanisms. There is a good reason for this: Philips technology is at the heart of all optically read media (such as CDs and videodiscs). Although these players did not employ true 16-bit D/A converters, they achieved the equivalent of 16-bit performance by using the innovative four-times oversampling technique, which has become almost standard in better units. Now that Philips has turned to true 16-bit D/A converters and maintained their four-times oversampling technique for reduced modulation noise beyond the audible spectrum, players such as the CD960 offer outstanding sound quality.

I listened to a wide variety of discs on this top-of-the-line machine, experimenting along the way with its FTS and other programming features. If you want to hear what a properly recorded disc can sound like on a well-designed player, listen to the CD960 reproduce Telarc's new release, *Hollywood's Greatest Hits, Volume I* (CD-80168). Try track 10, in particular, to hear how a good recording of a piano should sound. Several of this disc's other tracks will not only show you the kind of solid bass that can be reproduced digitally, but should put the rest of your system through its paces as well. Despite the low-level nonlinearities present in my sample (I suspect that this may not be the case in all production units), the CDs that I used for my listening tests sounded great. I did not detect the sort of glitches (akin to "crossover" distortion) that these nonlinearities might have been expected to produce.

Unlike units from Philips that bore the Magnavox label, the CD960's chassis construction is extremely rugged. Both the chassis and the laser assembly are of die-cast components and provide high resistance to external vibration and internal resonances. I couldn't resist opening up the unit to compare construction with earlier Magnavox models. The CD960 features four separate power supplies—arranged on separate modular p.c. boards—to drive the digital, servo, display, and analog circuits. Needless to say, not one of the defects on my Philips defects test disc was able to cause mistracking of the laser assembly. Access time from track to track was less than 1 S, while access from an inner track to the outermost track took about 3.5 S.

There are still CD players around that sell for considerably more than the CD960, but I haven't found one that sounds substantially better—or any that offers more convenience features. With personal CD collections in most audio-oriented households growing by leaps and bounds, the FTS feature, too, could not have come at a better time.

Leonard Feldman