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YAMAHA CD-X1 COMPACT DISC PLAYER

Manufacturer's Specifications
Frequency Response: 5 Hz to 20 kHz, ±0.5 dB.
S/N Ratio: Unweighted, 95 dB; A-weighted, 100 dB.
Dynamic Range: Greater than 95 dB.
Channel Separation: Greater than 90 dB at 1 kHz.
Noise Plus Harmonic Distortion: Less than 0.005% at 1 kHz, 0 dB.
Output Level: 2.0 V for 0 dB.
Number of Programmable Selections: 23.
Power Consumption: 20 watts.
Dimensions: 13⅜ in. (34 cm) W × 3⅝ in. (9.2 cm) H × 11⅜ in. (28.9 cm) D.
Weight: 7 lbs., 15 oz. (3.6 kg).
Price: $499.00.
Company Address: 6660 Orangethorpe Ave., Buena Park, Cal. 90620.
For literature, circle No. 92

Yamaha's second-generation CD player is a good example of what can be done to bring the miracle of laser-read digital sound to a broader audience, for its large-scale integrated (LSI) circuitry has had an impact on product cost. The CD-X1, with a suggested price less than half that of Yamaha's first CD model, is a feature-laden player whose sonic performance rivals or perhaps even exceeds that of the earlier, much bulkier unit. The CD-X1 is, in fact, the lightest (home) CD player I have encountered to date, tipping the scale at just under 8 pounds.

According to Yamaha, the substantial reduction in size and weight (not to mention price) was made possible by the development of two LSIs which are used for all of the necessary signal processing, servo-controlled tracking, and digital filtering. Yes, for those of you who feel that you can tell the difference, Yamaha has elected to go the digital filtering route in this player. They have doubled the effective sampling rate (from 44.1 to 88.2 kHz) and were therefore able to use a simpler low-pass filter to reduce phase distortion. According to the owner's manual, only a seventh-order LC filter is used in the post-D/A circuitry. The CD-X1 also uses a three-beam laser pickup for excellent tracking.

As for convenience features, they are remarkable, considering the price of the unit. Discs are loaded into a motorized tray, and the user can select auto play (which starts the disc playing as soon as the door is closed), timer-activated play, or a mode that permits playback of a single selection at a time—all in addition to the normal play mode. Up to 23 selections can be programmed to play in normal sequence, but the unit does not allow completely random-access programming. In other words, you can ask the CD-X1 to play tracks 1, 5, 9, 11 and 12 but you cannot request that the playing sequence be out of numerical order. Fast-forward and fast-reverse audible music search is possible, and while this feature is operating, audible output level is reduced by 20 dB. An A-to-B repeat function allows you to repeat-play an entire disc or certain phrases within a single selection.

Control Panel Layout

The power switch is located beneath the disc drawer at the left of the unit. Although there is a separate "Open/Close" button to the right of the drawer, I quickly discovered that a slight tap on the front of the opened drawer also causes it to close. The three-position "Play Mode" switch, with settings identified as "Auto," "Norm" and "Single," is below the drawer touch button. A multi-function display of playback information, to the right of these buttons, shows elapsed or remaining time, track number, and playback status (which illuminates during normal playback, flashes during pause, and is off in stop mode). Other playback display indicators are "Repeat" (which lights when any repeat mode has been selected), A-B repeat, and "Memory" (which lights during memory playback or when entering selections during programming of the unit). "Play/Pause" and "Stop" buttons are just to the right of the display.

Remaining touch buttons are located along the lower right section of the front panel. They include "Repeat On/Off," "Repeat A-B," and the "Store," "Cancel" and "Check/RT" buttons associated with memory programming. The final four buttons relate to the CD-X1's "Music Search" feature.

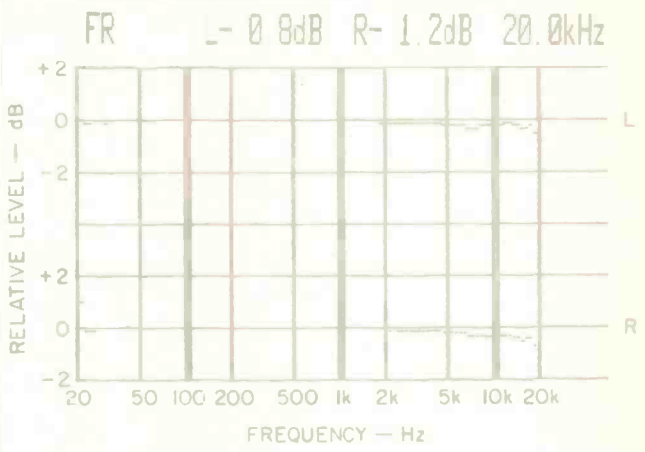

Fig. 1—Frequency response, left (top) and right channels.

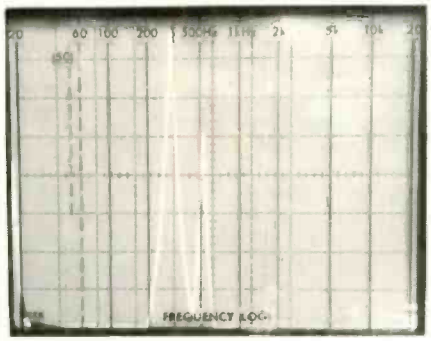

Fig. 2—Spectrum analysis, 0 Hz to 50 kHz, showing 20-kHz tone (tall spike) and spurious beat tone at 24.1 kHz (smaller spike), only 26 dB lower.

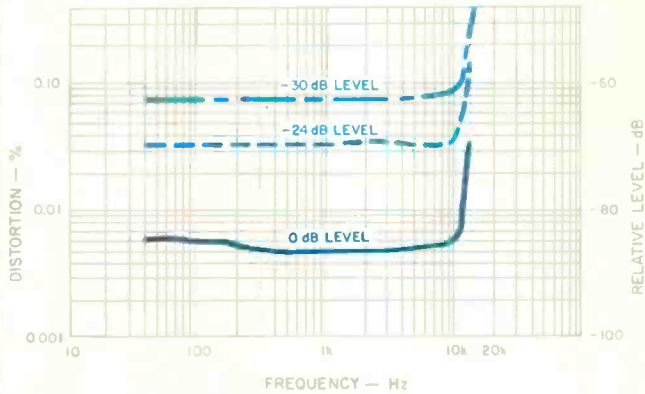

Fig. 3—THD vs. frequency at three recorded levels.

The performance of the feature-laden CD-X1 rivals or exceeds that of the previous Yamaha model, at less than half the price.

Two are used for fast-forward or fast-reverse searching. The audible search is fairly slow for the first 3 S, but it speeds up if you keep your finger on either button for a longer period of time. Depressing the remaining two buttons, labelled "+" and "−," will advance (or reverse) the pickup to the next (or previous) track. No provision is made for accessing music by index numbers, but in view of the fact that the player offers audible fast searching, I do not regard this as a major omission. I do rather wish that the unit had an output-level control (2.0 V for 0 dB is a bit much compared with such other typical program sources as tuners or tape decks), but since lower pricing was an important objective of Yamaha, I think, overall, the designers managed to incorporate the most essential and useful features, leaving out those which most of us can certainly live without.

Measurements

Figure 1 shows a plot of frequency response for both left and right channels of this CD player. As in previous reports, the vertical scale has been expanded to 2 dB per division. At 20 kHz, response was down by 0.8 dB for the left channel and 1.2 dB for the right.

Harmonic distortion at mid-frequencies, for maximum recorded level, measured only 0.0045%, rising to 0.006% at 10 kHz. Above that frequency, I encountered a by-now familiar sudden rise in apparent THD. Using a simple distortion analyzer, the readings jumped to a high 0.4% at 20 kHz. Investigating the phenomenon with my spectrum analyzer, I quickly discovered that the high reading was not actually harmonic distortion, but rather a "beat" frequency appearing at 24.1 kHz, outside the range of human hearing. In Fig. 2, a linear sweep from 0 Hz to 50 kHz was used (5 kHz per division). The tall spike is the desired 20-kHz output signal; just to its right, about 4 kHz higher in frequency, is the spurious beat component which was responsible for the higher distortion reading. Figure 3 presents plots of distortion versus frequency for 0-dB recorded level as well as for −24 and −30 dB levels. The expected relationships (higher distortion at lower output levels) hold true here, as in previously tested CD players.

Output linearity was accurate to within 0.2 dB from 0-dB output down to −60 dB, and within 0.6 dB from −60 to −80 dB. Stereo channel separation is plotted for left and right channels in the graph of Fig. 4. I measured separations of approximately 88 dB at mid-frequencies and between 82 and 84 dB at the high-frequency end of the spectrum.

SMPTE-IM distortion measured 0.0018% at 0-dB recording level, increasing to 0.012% at −20 dB. CCIF (twin-tone) IM, using 19- and 20-kHz signals of equal amplitude corresponding to a sum signal at 0-dB level, measured 0.002%, while the same signals, reproduced at a −10 dB equivalent level, produced a CCIF-IM figure of 0.0044%. Signal-to-noise analysis was conducted with and without an A-weighting network. Unweighted S/N measured 91.6 dB (as displayed in Fig. 5A), and weighted S/N was 99.4 dB (Fig. 5B).

Reproduction of a 1-kHz, digitally generated square-wave test signal, shown in Fig. 6, was typical of that encountered with CD players which utilize digital filtering plus gentler multi-pole, analog post-D/A filters. The same held true for reproduction of the digitally generated unit-pulse test signal,

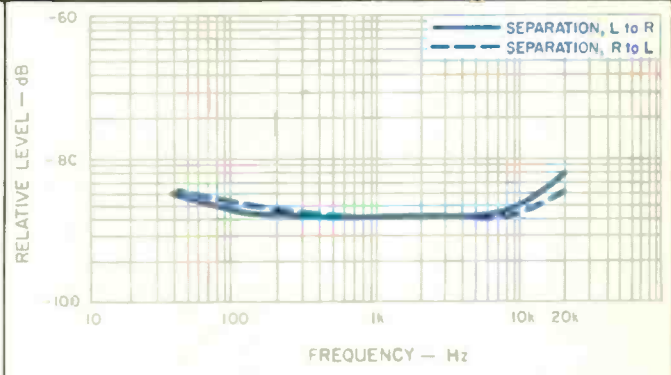

Fig. 4—Separation vs. frequency.

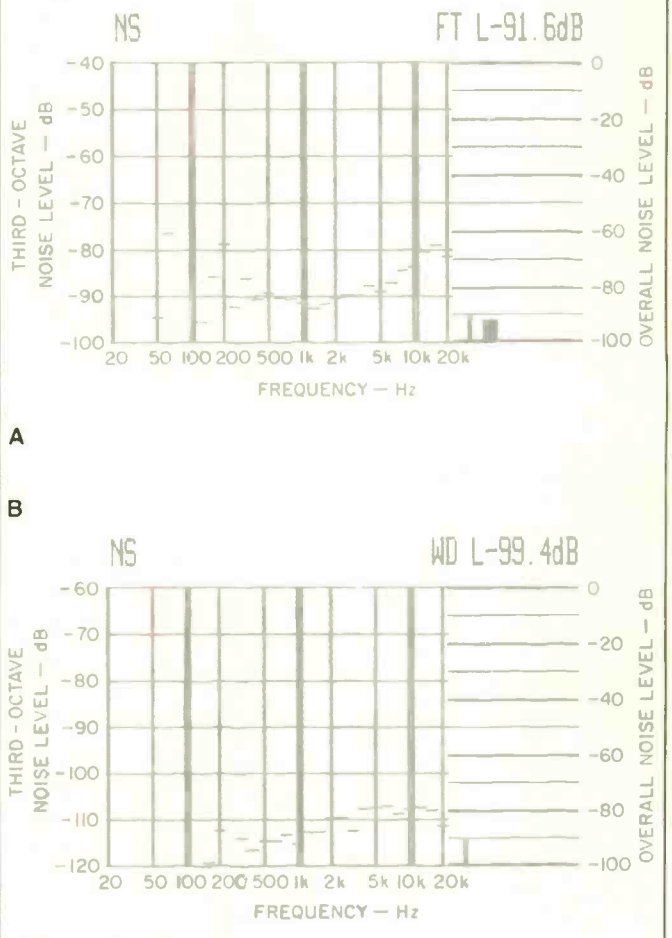

Fig. 5—S/N analysis, both unweighted (A) and A-weighted (B).

The CD-X1 is one of the few players I've tested that can track the test record's entire "obstacle course."

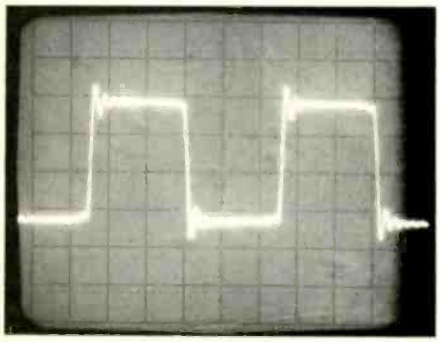

Fig. 6—Reproduction of 1-kHz square wave.

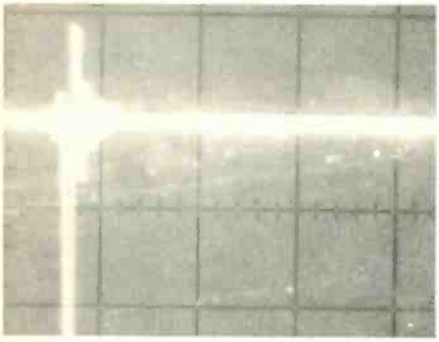

Fig. 7—Single-pulse test.

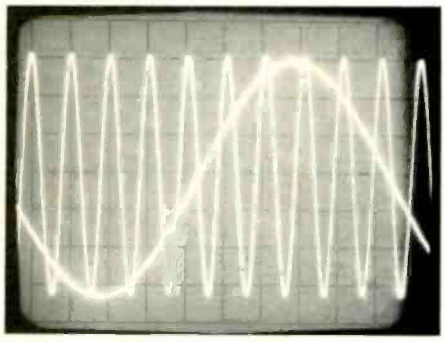

Fig. 8—Phase linearity test, 200-Hz and 2-kHz signals.

shown in the 'scope photo of Fig. 7. The usual slight phase displacement between a left-channel, 200-Hz test signal and a right-channel, 2-kHz test signal is evident in the 'scope photo of Fig. 8. Had phase linearity been perfect, positive crossing of the zero axis would have occurred at the same time for both signal frequencies.

I conducted my usual tracking and error-correction tests using the specially prepared Philips test disc, which contains a wedge of opaque material, several black dots of specified diameters and a semi-transparent simulated fingerprint smudge. The Yamaha CD-X1 was among the few CD players I have tested which successfully completed this "obstacle course" without ever muting or mistracking. This means its laser tracking system, in combination with the built-in error-correction circuitry, was able to "overlook" disc "scratches" having a linear thickness of 900 microns, "dust" particles of 800-micron diameter, and a rather nasty "smudge" occupying nearly an inch of linear distance near the outer diameter of the test disc. It took a rather heavy pounding of my fist to the top of the unit to make the laser pickup mistrack because of externally induced vibration, and I was also able to tap the sides of the CD-X1 reasonably hard without upsetting its tracking servo and laser pickup. Small and light though this CD player may be, it rivals the more ruggedly built, heavier units as far as stability of the tracking mechanism is concerned.

Use and Listening Tests

Testing this player gave me an opportunity to try out a couple of new Telarc CDs. One was the CD version of a digitally mastered LP, *Malcom Frager Plays Chopin* (on a Bösendorfer Imperial Concert Grand piano, Telarc CD-80040). I had been overwhelmed by the rich sound of that instrument when I first heard it more than a year ago on the LP. Now that I've heard the CD version, I can tell you that anyone who prefers the LP is, in my opinion, simply being an obstinate die-hard. With the surface noise gone, and the dynamic range even further expanded than it was in the admittedly excellent LP, that Bösendorfer was *in my listening room!* I like listening to good music with my eyes closed, but I literally had to open them every few minutes to remind myself that I was not in the same room with Frager and his magnificent instrument.

Does that mean this lightweight player from Yamaha is superior to my reference CD player? Not at all! I played the Frager disc, as well as a marvelous live recording of Lionel Hampton (part of a jazz sampler CD released for demonstration purposes by Sony), on my "older" CD player, and they sounded great. It's as I've been saying right along: Given good software, nearly all the CD players I've tested produce musically accurate sound, with little of the harshness or brightness which engendered complaints from listeners about earlier discs.

None of this is meant to detract from the many merits of the Yamaha CD-X1. That it produced such magnificent music—at the price it costs and with the features it has—makes it an outstanding CD player that will undoubtedly attract a large audience which has been waiting for a lower-priced unit that doesn't sacrifice performance, reliability and convenience features. *Leonard Feldman*