

# MusicBank™ System

## PRODUCT TEST REPORTS

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*CD Review, High Performance Review,*  
*Popular Electronics, and Stereo Review*

Nakamichi

# LUCKY 7

BY DANIEL KUMIN



NAKAMICHI CDPLAYER2 MULTIDISC PLAYER

While digital audio technology has continued to evolve since the CD's introduction almost a decade ago, with the exception of the rise of the popular carousel changer there's been little new in the way we play CDs. Changers in general have proved enormously successful; the carousel concept in particular continues to find strong demand because it brings multidisc capabilities without the hassle and comparatively slow disc access of magazine-type changers.

Nakamichi, a firm widely known as unafraid to innovate, has come up with the first significant new slant on multidisc workings since the carousel. In something the company dubs MusicBank, Nakamichi's CDPlayer2—our test subject here—effectively and truly melds changer and single-play machines.

The CDPlayer2 appears perfectly conventional. Its attractively sculpted face includes the usual slide-out single-disc drawer, basic transport keys (a 40-key wireless remote control is included), and a fairly standard yet complete fluorescent display. However, an internal "stocker" mechanism swallows up—via the ordinary-appearing disc tray—as many

as six CDs. These can be called up in any order or grouping, much as in a six-disc magazine changer. And in combination with a seventh disc loaded last in the tray they provide a theoretical total playing time of more than 8.5 hours—adequate for even the most marathon of frat parties.

Where most players have a single-drawer open/close button, the CDPlayer2 offers two: Load and Store. Load puts the CD in the tray into single-disc playback in the usual fashion. Store, however, whisks the CD inside the player where it quickly (5 to 7 seconds, depending on disc position) disappears into the stocker. Working fast, you can load six discs in sequence in about a half a minute. Unloading is equally rapid. Once they're loaded, CDs may be played singly, programmed, or randomized for shuffle play. The latter mode mixes up all stocked discs on a track-by-track basis, for true multidisc random sequencing.

Several worthwhile ergonomic factors are built into the CDPlayer2's on-board logic. A Delete feature lets you quickly program tracks to suit the way most people generally want to listen—by playing all of a disc (or discs) *except* a few excised selections that are disliked or

overplayed. As many as 50 tracks from one to seven discs can be entered, and a built-in lithium battery backs up the memory contents against power outages. A Time Data remote key loads each disc in sequence, memorizing track and time data to speed up programming operations for a stocker set. And an entire disc (all tracks) can be programmed or deleted with just a couple of keystrokes. There's also a fairly elaborate synchro-recording function. In concert with sibling Nakamichi cassette decks, this largely automates the chore of CD dubbing.

Nakamichi's MusicBank concept brings both advantages and liabilities. On the plus side, of course, the unit yields hands-off extended play—without loading fussy CD cartridges—from the internal six-disc magazine, combined with the convenience of a fully functional single-play machine that's always ready to play just one disc. The negative aspect is that loaded discs are entirely out of sight: You can't just lift the lid or pop out a magazine to refresh your memory as to what disc is in which slot. To address this problem Nakamichi provides Disc Scan. Press one remote control key and the CDPlayer2 automatically plays the first 10

TEST REPORT NAKAMICHI CDPLAYER2 MUSICBANK CD PLAYER ★★★★★

Frequency Response (dB 20 Hz to 20 kHz)	left	+0.01/-0.26
	right	+0.3/-0.20
S/N Ratio (dB A-weighted)	left	108.4
	right	107.6
Dynamic Range (dB)	left	98.6
	right	98.9
Max. Deemphasis Error (in dB at 16 kHz)	left	-0.2
	right	-0.1
SMPTE IM Distortion (percent)	left	0.004
	right	0.004
Max. L-R Phase Diff. (at 20 kHz)		0.1 deg.
Oversampling		8 times
No. of D/A Converters		4 18-bit
No. of Programmable Sel.		50
Max. Search Time		5 sec.; 13 sec. disc-to-disc
Audible Fast Search		Yes
Indexing		No
CD3		Yes
Digital Output		1 Coax.
Remote Control		Yes
Headphone Jack		Yes, variable
Power Consumption		27 watts
Dimensions		16.9 x 3.9 x 14.75 in.
Weight		17 lb. 10 oz.
Price		\$799
Address	Nakamichi America Corp. 19701 S. Vermont Ave. Torrance, CA 90502	

Manufacturer's Specifications

Frequency Response	5 Hz-20 kHz ± 0.5 dB
Dynamic Range	> 100 dB
S/N Ratio	> 105 dB
THD + Noise	0.0035% (@ 1 kHz)
Channel Separation	> 100 dB (@ N/A kHz)
Output Level:	2 v

The Nakamichi CDPlayer2's innovative MusicBank mechanicals are backed up by generally fine electronic performance. The slight response drop (about -0.2 dB) in the top octaves, and the rising high-frequency THD + Noise (to about 0.06% @ 19 kHz)—both essentially inconsequential audibly—probably result from its mild analog filtering; the THD + Noise dropped markedly with the introduction of a 22 kHz brickwall LP test filter. Distortion v. level was superb; still some 26 dB below a -70 dB input.

Channel separation was unusually good at lower frequencies, and remained below 80 dB right up to 16 kHz. D/A converter linearity in every measurement was superb (within 1 dB to -110 dB with dithered signals)—supporting Nakamichi's technical claims for their quad-DAC 20-bit Enhanced Linearity topology.

The CDPlayer2's impact immunity was a bit below average vertically, and a bit more so horizontally. However, it successfully tracked a 1.25 mm disc error—excellent trackability. —DK

seconds of each disc's initial track—including that (if any) in the single tray. The process takes about two minutes in the case of a full, seven-CD load.

Around back of the CDPlayer2 you'll find fixed and remote-controlled variable analog output pairs, a single coax digital output, and two mini-jacks for interconnecting the player with a Nakamichi deck for synchro recording. There's also a small bulge for the power supply's transformer; this increases the unit's effective shelf-depth to almost 16 inches.

The unit's interior is dominated by the unusual MusicBank disc drive and transport. Picture a hotel with bizarre elevators: The elevator

car (the disc drive) remains stationary, while the entire seven-story building (the CDPlayer2's stocker mechanism) rides up and down to match up the desired floor. This is how the stocker works. The drive is in front with the magazine behind; discs are slid rapidly between any magazine slot and the tray. The stocker's top, seventh slot remains empty unless a single-disc-position CD must be stored while playing one or more of the other six. The entire business just about fills the left side of the metal chassis.

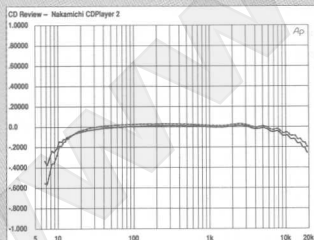
The right side is taken by a single main circuit board holding all of the player's electrical doings except for a small piggyback board

with the digital out and remote interconnect jacks. Construction and layout are clean, though with more than the usual amount of handwiring—understandably, as this is a complex design.

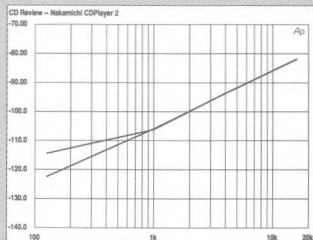
Two latest-generation Burr Brown PCM1700 dual 18-bit D/A converters are used. They are driven in a novel configuration in which each channel employs part of two DACs in a bit-switching system that distributes low-signal digital data to one converter, and higher-amplitude data to the other; Nakamichi claims 20-bit precision for the setup. Eight-times oversampling is used, and an analog output stage with mild, linear-phase third-order Bessel filtering is built almost entirely of discrete circuit components.

In operation, Nakamichi's hybrid performed smoothly, rapidly, and reliably. The MusicBank mechanism is an object lesson in electro-mechanical engineering. In the listening room, the CDPlayer2 disported itself elegantly. Sound was refined and smooth—even warm on some discs—but with no apparent compromise of detail or image quality. Silent backgrounds, excellent timbral definition, and generous hall-sound seemed notable features of the sonic landscape. Another item worthy of mention is the CDPlayer2's headphone amp. It provides unusually high gain for fine, plenty-loud-enough sound with virtually all headphones regardless of impedance—by no means the case from all CD players today.

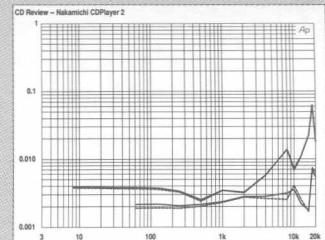
As Nakamichi's flagship in a new line of innovative, affordable MusicBank components, the CDPlayer2 deserves high marks. Yes, plenty of changers provide multidisc functionality at prices well below the CDPlayer2's \$799 tag. But none can claim the unique multiple personality of the new Nakamichi—especially in such a technically advanced, good-sounding package. ■



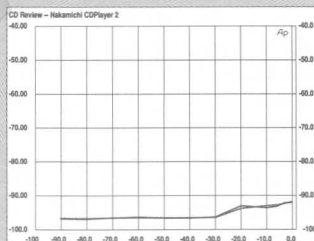
Swept frequency response; 10 Hz to 20 kHz at 0 dB.



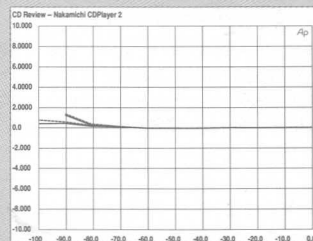
L-R and R-L channel separation from 125 Hz to 16 kHz; in dB relative to 0 dB.



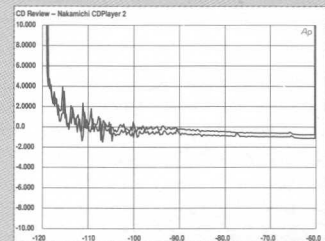
THD + Noise v. frequency at 0 dB; both full-band, and with a 22 kHz brickwall filter in the test circuit (lower trace set).



THD + Noise v. amplitude at 1 kHz; THD + N appears on the vertical axis, v. input-signal amplitude as shown on horizontal axis.



D/A linearity (1 kHz); to -90 dB, and from -70 dB to -100 dB with dithered signals.



D/A converter linearity, dual-channel fade-to-zero from -60 dB (dithered 500 Hz tone). Data have been averaged to clarify curve.



## TEST REPORTS



JOOK P. LEUNG

### NAKAMICHI CDPLAYER2 COMPACT DISC CHANGER

*Julian Hirsch, Hirsch-Houck Laboratories*

**T**HE Nakamichi CDPlayer2 appears to be a typical front-loading compact disc player, differing from most others principally by the relatively small number of its visible buttons and controls. Despite its basically conventional appearance, however, it is one of the few truly unique CD players to appear in some time.

Behind the seemingly ordinary disc drawer is a mechanism that can automatically play a sequence of as many as six discs in addition to providing single-play operation. The CDPlayer2 is functionally similar to a magazine-loading CD changer except that the magazine is fixed inside the player.

Instead of the cumbersome process of swinging out a hinged compartment from a conventional magazine, placing a disc in it, and swinging it back into the magazine, then repeating the process for each additional disc, you load the Nakamichi CDPlayer2 one disc at

a time through a normal disc drawer. The disc-drawer button is pivoted about its center, and pressing either end opens the drawer for loading a disc. If you then press the upper end (STORE), the mechanism automatically loads the disc into a slot of the internal magazine, and the drawer reopens to receive another disc. When the magazine is full, or no more discs are to be loaded, you press the other end of the button (LOAD/EJECT) to close the drawer, and the player is ready for use. To play a single disc, the LOAD/EJECT end of the button is used as in a conventional CD player. The six discs in the magazine, along with a seventh in the single-play slot, can be played in sequence, giving the changer an effective seven-disc capacity. It can also handle 3-inch discs, without adaptors, but only in its single-play mode.

The display window, to the right of the drawer, normally shows the numbers of the occupied magazine slots,

the total number of tracks on the current disc, the current track number, the elapsed time in the track, and the operating status of the machine.

In addition to the multifunction disc-drawer control, there are three similar flat, pivoted controls. The DISC(1-6)/DISC(SINGLE) button selects either single-play or multiple-play operation and provides access to any of the six slots in the storage magazine. The forward/reverse track-skip control and the play/pause/stop control are much the same as on other CD players.

The front-panel headphone jack has a volume control that affects the variable-level line output in the rear of the player. A second pair of rear jacks supplies a fixed-level output, and there is also a coaxial digital output jack.

In addition to the basic functions controlled from the front panel, the CDPlayer2 has a full complement of features operated from its infrared remote-control unit, which also duplicates all the front-panel operating controls except those involving loading or removing a disc. (A small motor operates the volume knob when it is adjusted from the remote control.)

A TIME button on the remote toggles the display through four modes: elapsed time in the current track (the



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default setting), elapsed time on the current disc, remaining time on the disc, and the total number of tracks and time on the disc. When a disc is loaded, the display initially shows all of its track numbers (to a maximum of twenty) and deletes the numbers as the tracks are played.

The repeat mode repeats all tracks on a disc indefinitely, and the random mode plays them in random order. These modes apply to both single- and multiple-disc operation. Although the front-panel track-skip button can be used to select any track, the remote control has a numerical keypad that gives convenient direct access to any numbered track.

The player can be programmed from the remote control to play as many as fifty tracks on any of the loaded discs in any order or to skip as many as fifty tracks and play the remaining ones in their normal order. A CALL button on the remote control can be used to check the status of the memorized sequence (including its total playing time) and to add, delete, or modify any entry in the memory. In multidisc op-

eration, the DISC SCAN button plays the first 10 seconds of each track on every disc in the magazine.

The CDPlayer2 also has a Memory Synchro Recording feature, usable with Nakamichi tape decks equipped with a remote terminal, that enables

*The Nakamichi CDPlayer2 is functionally similar to a magazine-loading changer except that the magazine is fixed inside the player.*

the player to control the tape deck so that any combination of tracks from any of the loaded discs can be recorded most efficiently in the available tape space. The CD player's remote control has a number of keys dedicated to this feature and to other functions associated with compatible Nakamichi components.

The CDPlayer2 uses two high-precision, glitch-free 18-bit digital-to-analog (D/A) converters in each channel,

operating over different level ranges to yield 20-bit resolution and good linearity down to the lowest signal levels. An eight-times-oversampling (352.8-kHz), 20-bit digital filter is also used to insure consistent performance over the full dynamic range. Other features include a magnetic mechanism to clamp the playing disc firmly as it rotates, minimizing the focusing errors that must be corrected by its servo circuits. Interference and noise are minimized by separate power-transformer windings and regulators for the analog and digital circuits and by isolated grounds that keep the two sections of the unit apart.

The Nakamichi CDPlayer2, finished in black, measures 17 inches wide, 14 $\frac{3}{4}$  inches deep, and 4 inches high. It weighs 17 pounds, 10 ounces. Price: \$799. Nakamichi, Dept. SR, 19701 S. Vermont Ave., Torrance, CA 90502.

### Lab Tests

The CDPlayer2's output level from a 0-dB (maximum-level) test track measured 2.08 volts at the fixed-level jacks and at the variable-level jacks set to their maximum output. Channel levels were matched within 0.01 dB. Frequency response was down 0.1 dB at 15 and 11,000 Hz and 0.25 dB at 20,000 Hz. De-emphasis error was a maximum of -0.17 dB at 16,000 Hz. Interchannel phase shift was a maximum of 0.25 degree at 20,000 Hz.

At a 0-dB recorded level, the total harmonic distortion plus noise (THD + N) was 0.003 to 0.004 percent from 20 to 2,000 Hz, increasing to 0.01 percent at 10,000 Hz and 0.056 percent at 20,000 Hz. At 1,000 Hz, the THD + N was 0.002 percent from -30 to -90 dB, rising to 0.004 percent at 0 dB. Low-level linearity was excellent, with amplitude errors of no more than +0.15 dB at -90 dB.

The noise spectrum from a zero-infinity (no-signal) track was -115 to -120 dB from 20,000 Hz down to 1,000 Hz, but the noise was overshadowed by power-line-hum harmonics at lower frequencies. Although the 60-Hz component was below the noise level, the 120-Hz harmonic was about -98 dB, and the 240-, 360-, and 480-Hz harmonics were each about -108 dB. The wide-band (A-weighted) noise level was -108.6 dB. Dynamic range (EIAJ) was 98.4 dB, and quantization noise was -88.1 dB. Channel separa-

### FEATURES

- Eight-times oversampling (at 352.8 kHz) and 20-bit digital filtering
- Quadruple 18-bit D/A converters for 20-bit resolution
- Loads and stores as many as six discs for automatic play from internal magazine plus conventional single-disc load/play
- Programmable to play (or skip) as many as fifty tracks from loaded discs
- Front-panel volume control for headphone jack and rear variable-level analog outputs; motor-operated for remote adjustment
- Fixed-level analog line outputs and coaxial digital output on rear
- Display of current disc and track numbers, elapsed time in track, elapsed and remaining time on disc, total tracks and time, operating status
- Infrared remote control for programming functions, volume adjustment, other operating features; keypad for direct access to numbered tracks
- Random-play and repeat modes
- Disc Scan to audition first 10 seconds of each track on all discs
- Interface with compatible Nakamichi cassette decks for automatic taping of selected tracks

### LABORATORY MEASUREMENTS

**Maximum output level:** 2.08 volts  
**Total harmonic distortion** at 1,000 Hz: 0.004% at 0 dB, 0.0023% at -20 dB, 0.002% at -60 dB  
**Signal-to-noise ratio** (A-weighted): 108.6 dB  
**Dynamic range:** 98.4 dB  
**Channel separation:** 110 dB at 100 Hz, 105 dB at 1,000 Hz, 80 dB at 20,000 Hz  
**Maximum interchannel phase shift:** -0.25 degree at 20,000 Hz

**Frequency response:** -0.25 dB at 11 and 20,000 Hz  
**Low-level linearity error:** -0.11 dB at -70 dB, +0.11 dB at -80 dB, +0.16 dB at -90 dB  
**Speed error:** -0.0035%  
**Slewing time:** 2.5 seconds; 7 seconds between discs  
**Impact resistance:** top, C; sides, B  
**Defect tracking:** tracked 1,500-micrometer defects on Pierre Verany #2 test disc

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tion was 110 dB at 100 Hz, 105 dB at 1,000 Hz, and 80 dB at 20,000 Hz. The frequency (speed) error was  $-0.0035$  percent.

The CDPlayer2 was quite sensitive to moderate finger tapping on its top cover, which caused mistracking and dropouts. It was able to track through 1,500-micrometer data interruptions, but 2,000-micrometer defects caused mistracking. The slewing time from Track 1 to Track 15 of the Philips TS4 test disc was 2.5 seconds, about average for a CD player. A disc change required about 7 seconds from the end of a track on one disc to the start of one on the next disc. Headphone volume was very good.

### Comments

The performance (and sound) of the

Nakamichi CDPlayer2 was first-rate. It is probably one of the easiest CD players or changers to use, with a nearly irreducible minimum of controls. Nevertheless, few other players can match its versatility.

The instruction manual leaves nothing to the imagination, providing step-by-step guidance through the changer's many operating capabilities. The unit's basic performance as a CD player, without regard for its special operating features, was as nearly ideal as you are likely to find. Nakamichi has certainly demonstrated that a well-designed multibit D/A converter is capable of all the performance refinement of the new 1-bit converters. Which approach is "better" (a term that is probably meaningless when you reach this level of performance) will

doubtless be argued for some time, but the CDPlayer2 is clearly representative of today's state of the art.

The ingenious multidisc system even gives you the opportunity to amaze your friends, as Nakamichi did at its press introduction, by playing a single disc, unloading it, then playing six more (preloaded) discs. The effect is startling, to say the least.

The CDPlayer2 is a bit more expensive than most other CD changers, but it is measurably (if not audibly) better also, and it has a special appeal of its own. It carries on the Nakamichi tradition of doing the best job the company knows how to do, even if it differs from competitors' approaches or costs more. A very fine player!



Nakamichi America Corporation 19701 South Vermont Avenue, Torrance, California 90502 (800) 421-2313 (800) 223-1521 (CA)  
Nakamichi Canada 276 South West Marine Drive, Vancouver, B.C. V5X 2R4 (604) 324-7535

# Nakamichi CDPlayer2 Compact Disc Player

By Martin Forrest

***There are carousels and there are magazine CD changers. And then there's the 1+6 MusicBank System***

**N**akamichi is, first and foremost, an innovative company. It was the famed Nakamichi 1000 three-head cassette recorder that set the standard for consumer cassette decks way back in the 1970s, and owners of that recorder still consider it to be one of the best home tape recorders ever built. In introducing its new series of CD players, Nakamichi has been no less resourceful once again.

The most innovative feature of this new CD player from Nakamichi is called the MusicBank System. Although this remarkable CD player looks for all the world like a conventional single-disc player, in fact, the CDPlayer2 needs to be classified as a multiple disc player. But it's like

no other CD changer currently available on the market, except, perhaps, for the Nakamichi CDPlayer3 which employs the same MusicBank system but has fewer of the other features of the CDPlayer2.

Playing a single CD with the CDPlayer2 is no different from playing a disc on an ordinary single-disc player. The difference involves an ingenious "1+6" stocking mechanism that lets you internally store up to six additional discs for fast, direct access at any time. You load, inspect, or retrieve and unload CDs using the same single-disc tray. And even if six discs have been loaded and stored internally, you can still play a seventh, single disc without having to juggle the other discs. Neither do you have to remove the single disc to play any of the stored

discs. We found the MusicBank system to be quieter and faster than conventional changer mechanisms.

Another important feature of the CDPlayer2 is its large-diameter disc stabilizer that is magnetically clamped into place on top of a compact disc before play begins. This stabilizer is said to suppress the effects of external vibrations and to dampen disc resonances.

The Nakamichi CDPlayer2 also features a newly developed servo system that insures excellent tracking. Tracking ability has been further improved by locating the RF amplifier right at the optical transport instead of on the main circuit board, thereby shortening the signal path between the optical pickup and the processing circuitry. The CDPlayer2 also features digital deemphasis. When deemphasis is required it is performed in the digital domain to avoid phase shifts and distortion. The Nakamichi CDPlayer2 employs 8-times oversampling digital filters, and the analog low-pass filters preceding the outputs are linear phase active 3rd order Bessel type circuits that ensure a high degree of phase accuracy. The CDPlayer2 uses dual D/A 20-bit converters.

Other features include a multi-regulated power supply, a full complement of disc and track search,



access and programming features, delete play, 3-way random play, 3-way repeat play, 50-program memory, synchro recording for automated CD dubbing with most Nakamichi cassette decks, 3-inch disc compatibility in the single-play mode, a digital output, remote controllable motor-driven variable output and headphone level and a full-function wireless remote control.

**First Listening Tests**

Phase coherency is especially important when decoding Dolby Surround musical program material. Until recently, Dolby Surround

Sound tracks were available only on Laser video discs. Recently, Inter-sound, Inc. issued several ProArte Audio+ discs containing a wide variety of program material encoded as Dolby Surround Sound. A sampler of these (Cat. CDX013) begins with Bach's well-known *Tocatta and Fugue in D Minor*. One of our listening rooms is set up for all types of surround sound and hall simulations, and it was in this room that we checked out the Nakamichi CDPlayer2 in our first listening tests. The thunderous sounds of the organ were enhanced, of course, by the Dolby surround process and

while sounds were certainly clean, with superb dynamic range reproduced with no audible distortion, this was hardly the sort of material that would serve to verify excellent phase coherency.

The disc continues with the now-accepted demos of some fly-bys by various aircraft. That's fine if you like to listen to jets flying overhead and, indeed, the illusion of such aircraft, first zooming in front of us, then to our rear and then diagonally across the listening space and beyond, was extremely good.

But it's music that we were interested in. Particularly noteworthy on

**Fig. 1: Frequency response measures flat from 20 Hz to 20 kHz**

**Fig. 2: Total harmonic distortion (THD) plus noise measures 0.004% or less through 1 kHz**

**Fig. 3: THD for a 1 kHz signal for left channel (solid line) and right channel (broken line) is more than 95 dB below maximum level**

**Fig. 4: Composite distortion is only 0.0022%**

**Fig. 5: A-weighted S/N ratio is 106.9 dB for left channel and 107.3 dB for right channel**

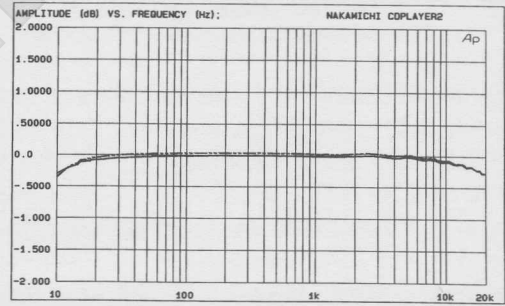
**Fig. 6: Stereo separation in either direction exceeds 100 dB at lower frequencies and 85 dB at 16 kHz**

**Fig. 7: Linearity error (deviation) with undithered signals measures no more than 0.5 dB**

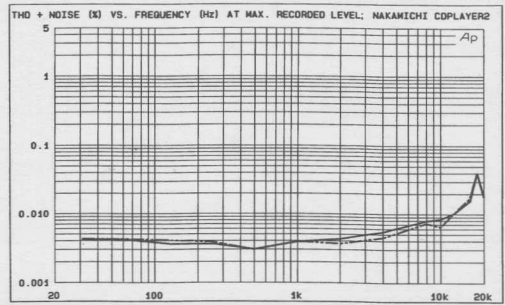
**Fig. 8: Deviation with dithered signals containing noise is less than 1 dB even at -100 dB**

**Fig. 9: Virtually no deviation from perfect linearity is shown with faded signal to below -100 dB**

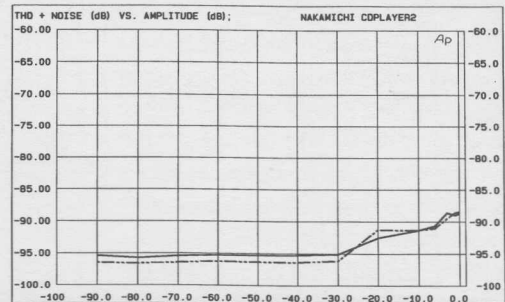
**Fig. 1**



**Fig. 2**



**Fig. 3**



this disc was a brief sample of the choral section of the last movement of Beethoven's *Ninth Symphony*. We felt as though we were actually in the midst of the chorus. Whether you agree that this is the way to listen to this classic or not, you are not likely to fault the player for any "misplacement" of this complex sound field.

### ProArte "Fireworks" for Orchestra (CDS 527)

This disc, too, was recorded with encoded Dolby Surround. Here, we were more able to judge musical accuracy with less emphasis on the

"surround sound" aspects of the sample selections. The full rendition of Dukas' *Sorcerer's Apprentice* (without being distracted by visual images of Mickey Mouse) offered clear evidence of the wide dynamic range capability of the player as well as its superb signal-to-noise ratio. The gradually increasing intensity of this music, culminating in that last, familiar crescendo is ideal material with which to judge overall linearity of a CD player, and in the case of the CDPlayer2, the softest tones were as "grit free" as the loudest passages of this music.

Now, back to the machine.

### Control Arrangement

Nakamichi has maintained an elegant, non-intimidating look to the front panel of the CDPlayer2 by employing several rocker-type, light-touch pushbutton switches. Touching the lower end of one of these switches initiates one function while touching the upper part activates a different, but generally related function. The power on/off switch is at the extreme left end of the panel, adjacent to the disc loading tray and drawer. To the right of the tray is the first of these dual function buttons. Touch the lower part of this control and the tray opens to accept a single

Fig. 4

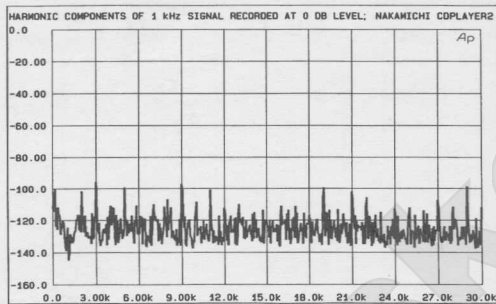


Fig. 7

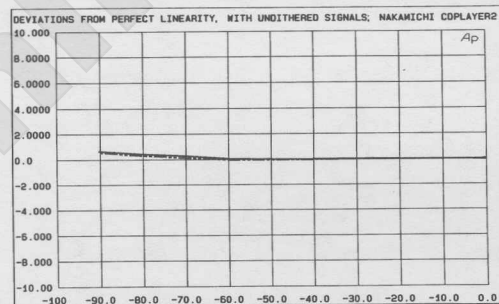


Fig. 5

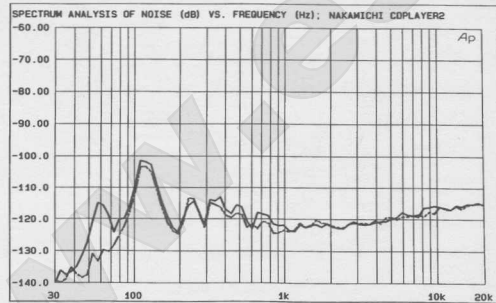


Fig. 8

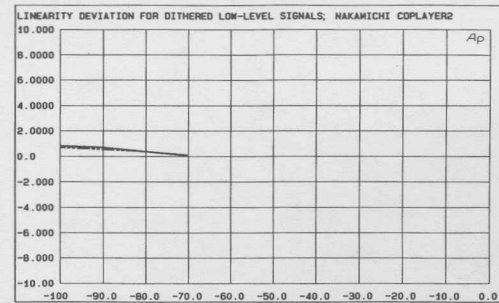


Fig. 6

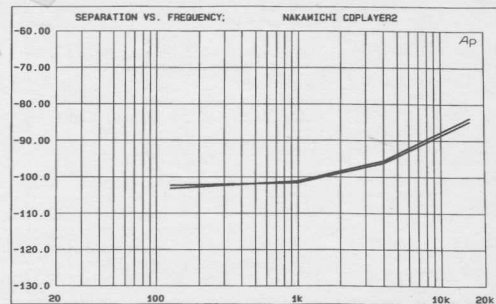
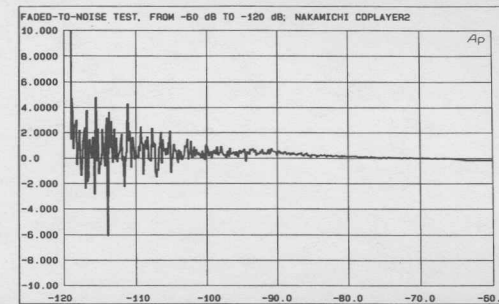


Fig. 9



## REVIEW

disc. Touch it again and the tray smoothly closes. If the upper part of the button is depressed, the tray opens once more, but this time, upon closing, it stores the disc in the internal stocking area of the player and reopens, ready to accept one or more additional discs. A display area to the right of the "load/store" button provides an assortment of useful status data, such as the number of discs stored, the number of the disc that's currently playing, indications for synchro-editing, memory programming, play, pause, time editing, time/track data and time counter mode. Of course, repeat play and random play are also displayed.

To the right of the display are three more dual-function pushbuttons. The first of these chooses discs 1 through 6 sequentially when the MusicBank storage feature is in use. Alternatively, it chooses single disc operation. The second button is used for forward or reverse track skipping. The third button is used for play/pause commands or for stopping the player. Beneath these three buttons, at the lower right of the panel are a stereo headphone jack and an output level control that varies both headphone and variable line output levels.



*The 1+6 stoker mechanism is located in the upper left corner; at lower left is the large, round disc stabilizer; at upper right, are the dual D/A converters; between the D/A converter and stoker mechanism are the isolated-ground power supplies*

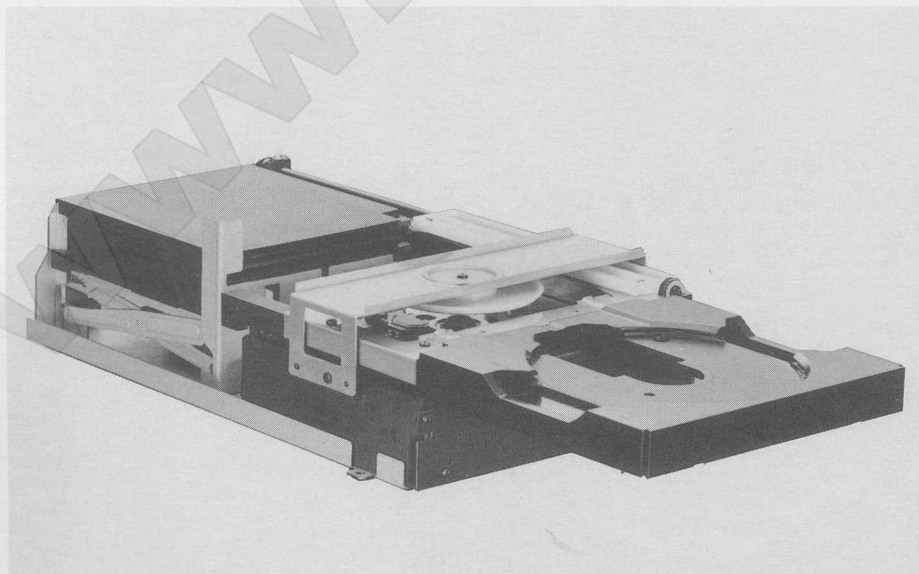
The supplied remote control has buttons that duplicate all of the front panel functions except power on/off. In addition, there are numeric buttons for programming, for disc selection. There are also buttons that take care of the special features of the player, such as track delete, program clear, time editing, synchro recording functions, disc scanning (for playing the the beginning of the first track of each disc

stored in the MusicBank system), random play and repeat play modes. The rear panel of the CDPlayer2 is equipped with pairs of fixed and variable stereo output jacks, a coaxial digital output jack, a switch for selecting analog or digital output and jacks for system remote control and synchro-editing, useful when certain other Nakamichi audio components or cassette decks are used in conjunction with this player.

### Test Results

Frequency response of the Nakamichi CDPlayer2, shown in Fig. 1, was essentially flat from 20 Hz to 20 kHz, with a roll-off of no more than 0.3 dB at 20 Hz and 0.25 dB at 20 kHz. Ripple was virtually nonexistent at the treble end of the spectrum, a good indication of the high quality and matching characteristics of the analog low-pass output filters. Output levels from both channels were virtually identical.

Figure 2 is a plot of distortion plus noise versus frequency. Throughout the low and mid-frequency region, and even for lower treble frequencies, harmonic distortion plus noise





was around 0.004% or less, rising to a maximum of 0.04% near the top of the audio spectrum. Even this slight rise was not attributable to actual distortion but resulted from minute "beats" that occur at such high frequencies, but that are generally inaudible at such low levels.

Figure 3 shows how THD for a 1 kHz signal varied with changes in recorded level. For all levels below -30 dB (referred to maximum recorded level), THD plus noise was more than 95 dB below maximum level for the left channel (solid line plot) and even a bit lower for the right channel.

Quoted in percentage terms that works out to be 0.002% or less. As maximum recorded levels are approached, the THD plus noise rises insignificantly to around -88.5 dB for both channels, corresponding closely with the 0.004% readings noted earlier in connection with the tests depicted in Fig. 2. In order to separate the actual distortion products from the small amount of accompanying noise, we ran a spectrum analysis of a full-level 1 kHz test signal, using the THD mode of our Audio Precision digital signal processing system.

In Fig. 4, the fundamental 1 kHz tone is suppressed (to around -142 dB) and only the harmonic components of that signal show up on the plotted graph.

Residual noise is "averaged out" by acquiring the signal and sampling it 16 successive times. Since the noise is random, it tends to be cancelled out by these successive readings, allowing us to zero in on the discrete, repeated harmonic components, which remain in the same place regardless of the number of sweeps. The tallest of these (at 2 kHz, 3 kHz, 5 kHz, 9 kHz, 11 kHz etc.) are all about 100 dB below maximum recorded level.

If we calculate the composite distortion represented by these "spikes"

we come up with an actual harmonic distortion figure (ignoring noise components) of only 0.0022%! This is considerably less than the 0.0035% figure claimed by Nakamichi in its published specifications for this particular model.

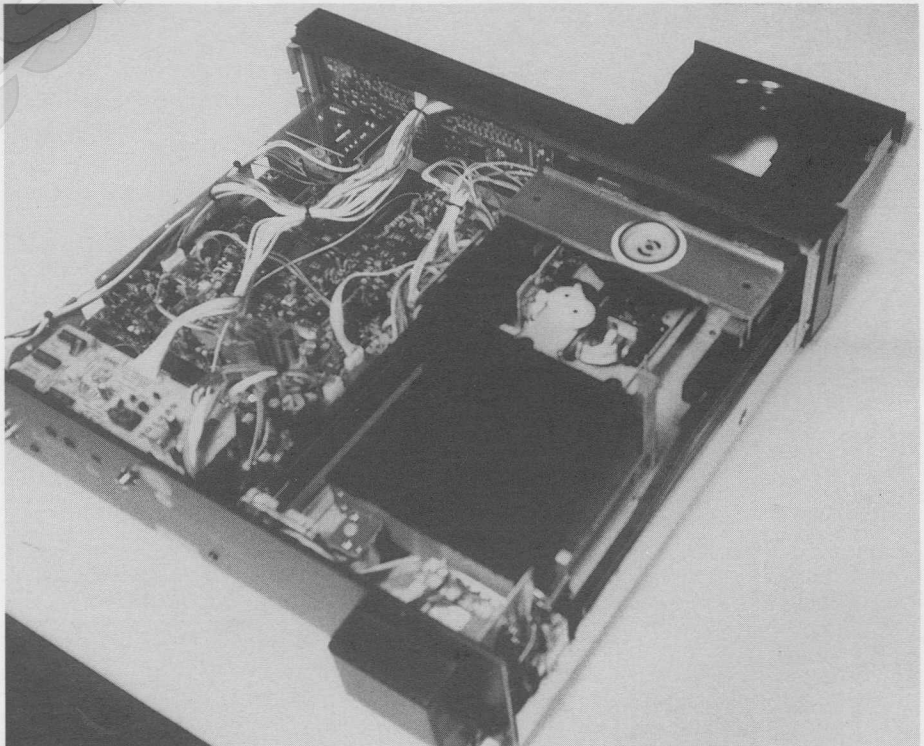
A-weighted signal-to-noise ratio of the CDPlayer2 measured 106.9 dB for the left channel and 107.3 dB for the right channel, again exceeding Nakamichi's claims by a small margin. A spectrum analysis of the residual noise of this player is shown in Fig. 5. Actual random noise is far lower than the overall S/N figure just quoted. The major contributions to the overall S/N readings are from the minute amounts of power-supply related components (at 60 Hz, 120 Hz, etc.), and even the greatest of these was well over 100 dB below maximum recorded level.

Figure 6 shows how stereo separation varied with frequency. At 1 kHz,

separation was better than 100 dB, just as claimed by Nakamichi. As usual, separation tended to decrease somewhat at higher frequencies, but it still measured around 85 dB at 16 kHz. What's more, separation was very nearly identical whether measured from left channel to right channel or in the opposite direction.

Figures 7, 8 and 9 show various measurements of deviation from perfect linearity at various recorded levels. In Fig. 7 we plotted linearity errors from maximum recorded level (0 dB) down to -90 dB, using undithered signals. At the lowest extreme of that plot, deviation from perfect linearity was no more than about +0.5 dB. That's about as good as we have ever measured for any CD player, regardless of price. For Fig. 8, we used dithered signals (signals containing deliberate noise that actually enables a CD player to extract lower level information than would be possible otherwise) in the

*The disc stabilizer has a magnetic chuck to reduce resonance. Immediately next to it is the RF amplifier which reduces pickup errors*





Discs are loaded in the conventional way into the drawer, but you can load up to seven of them. The three buttons on the right control (1) disc access, (2) skip forward/reverse and (3) play/pause

range from -70 dB to -100 dB below maximum recorded level. Even at -100 dB, deviation from perfect linearity was less than +1.0 dB!

Finally, using a test signal that gradually fades from -60 dB to -120 dB, we plotted deviation from perfect linearity again, as the signal fades into the residual noise level. Results of this test are shown in Fig. 9. Again, linearity was superb, hovering at or near the 0 dB deviation line to well below -100 dB. This test also enables us to determine the dynamic range capability of the player, which turned out to be approximately 107 dB. Frequency accuracy of the internal master digital clock was also measured and was accurate to within 0.0033%.

The Nakamichi CDPlayer2 was able to play through a disc even when rather severe vibrations and shocks were applied externally to its case. It

was also able to track our special defects disc at points in the disc where 1.5mm of missing data was deliberately "built into" the test disc. The MusicBank system handled discs extremely well, and with a speed that we have not seen in other CD changers that use separate cartridges for disc loading.

### More Listening

Having completed our lab bench tests, we decided to do some more listening, this time in our other listening room which is set up for ordinary two-channel stereo reproduction. A couple of favorite CDs were used for these tests.

#### **W. A. Mozart, Symphony No.36 in C Major and No. 38 in D Major (Denon 81757 4176 2)(DDD)**

This being the bicentennial anniversary of Mozart's death, we

chose a couple of discs representative of the composer's best works.

The so-called *Linz* symphony (No. 36), with its opening sonorous Adagio movement is a study in superb orchestration in which any muddying of reproduction caused by the generation of IM distortion products can easily destroy the subtleties and complexities of Mozart's genius. By contrast, the third and fourth movements, if properly reproduced by a good system, enable the listener to easily define the opening string sections and to verify the accuracy of the string sounds, whether they be from the violin section, the violas or the cello.

The result was not unexpected. Clarity of tone and instrumental definition are characteristics that immediately came to mind as we listened to this disc played on the Nakamichi CDPlayer2.



**W.A. Mozart Clarinet Quintet in A Major (Denon 28C37-40)(ADD)**

The gentle opening first movement of this delightful quintet, with the slowly ascending notes of the clarinet responding to the string instruments in turn, as reproduced in our listening room with the Nakamichi CDPlayer2, came about as close as possible to what the royal court in Vienna must have experienced over two centuries ago when the young Wolfgang was struggling to make it big as court composer. A clarinet produces fairly complex overtones which, if not reproduced in correct proportion and phase relationships, can easily destroy the beauty of the sounds that it produces. Suffice it to say that no such degradation was detected when listening to this disc. It was as if we could listen right through a relatively transparent system and focus in on the performance itself. That, after all, is what a properly designed audio system should be able to do. At \$799.00 suggested

***We obtained a  
harmonic distortion  
figure of 0.0022%,  
considerably less  
than the 0.0035%  
figure in the  
Nakamichi published  
specs***

list price, we can't imagine how those seeking a superbly designed multiple disc player that handles and sounds as good as the very best single-play CD units will be able to resist the CDPlayer2.

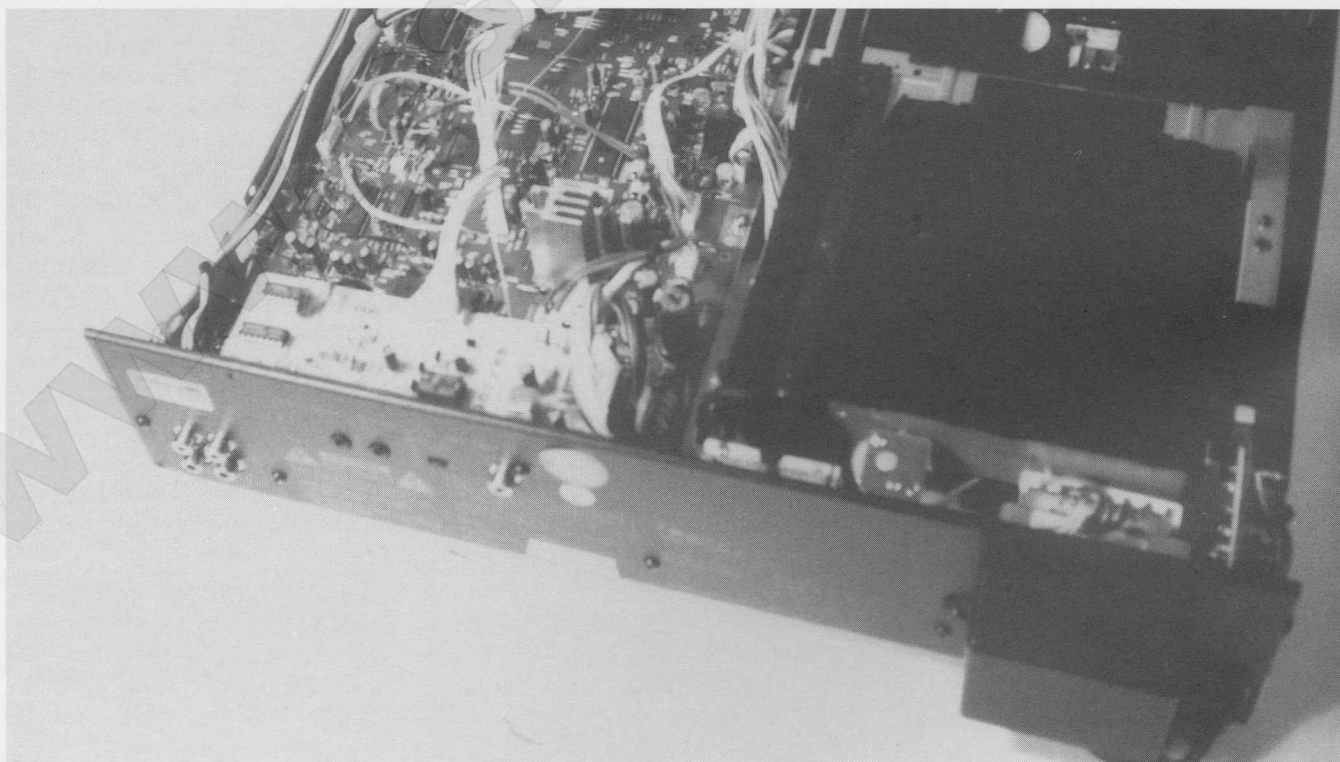
**Associated Equipment**

Sony TAE-1000ESD DSP Preamplifier (set to Dolby Surround decoding for first listening tests), Carver 1.5t Power Amplifier, KEF 105 Mark II Loudspeakers (front channels), DCM Time Frame TF-209 (rear channels), Monster Cable speaker cable (front channels only).

**Test Equipment**

Audio Precision: System One, Dual Domain (DSP) Test Set. Epson: Equity II Computer. Hewlett-Packard: HP-IIP Laser Printer. Pacific Data: Plotter-in-a-Cartridge. Hameg: HM-204-2 20 MHz Dual Trace Oscilloscope. CBS Records: CD-1 Test Disc. Pierre Vernay: Digital Test and Demonstration Discs. □

*The coaxial terminal toward the center connects to a D/A converter or amp with integrated DAC*





# PRODUCT TEST REPORTS

By Len Feldman

## Nakamichi CDPlayer2 CD Changer

**A**lthough this remarkable CD player looks to all the world like a conventional single-disc player, thanks to Nakamichi's innovative MusicBank system, the CDPlayer2 is in fact a CD changer. But, aside from its brother unit, the CDPlayer3, it's like no other CD changer currently available.

What makes the CDPlayer2 different is an ingenious "1 + 6" stocking mechanism that lets you internally store up to six discs for fast, direct access at any time. You load, inspect, or retrieve and unload CD's using the same

of the CDPlayer2 is its large diameter disc stabilizer that is magnetically clamped into place on top of a CD before play begins. That stabilizer is said to suppress the effects of external vibrations and dampens disc resonances.

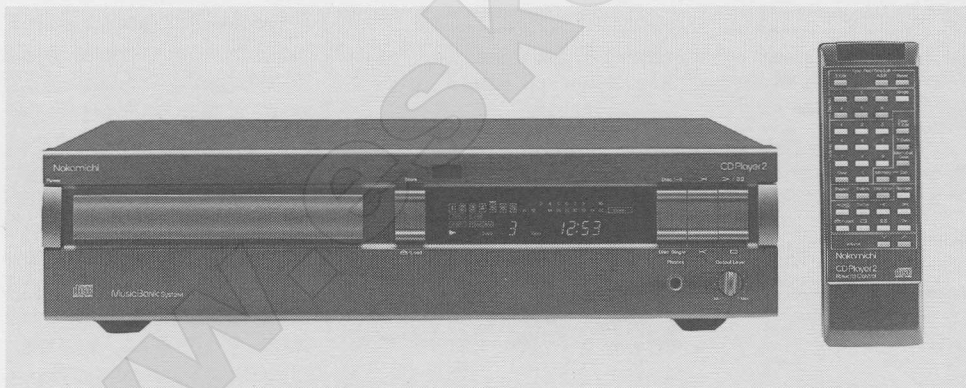
The Nakamichi CDPlayer2 also features a newly developed stereo system that insures excellent tracking. Tracking ability is also improved by locating the RF amplifier right at the optical transport instead of on the main circuit board, thereby shortening the signal path between the optical pickup and the processing circuitry.

Other features include a multi-regulated power supply; a full complement of disc and track search, access and programming features; delete play; 3-way random play; 3-way repeat play; 50-program memory; synchro recording for automated CD dubbing with most Nakamichi cassette decks; 3-inch disc compatibility in the single-play mode; a digital output; remote controllable, motor-driven variable output and headphone level; and a full-function wireless remote control.

### THE CONTROLS

Nakamichi has maintained an elegant, non-intimidating look to the front panel of the CDPlayer2 by using several rocker-type, light-touch pushbutton switches. Touch the lower end of one of these switches and one function is performed; touch the upper part and a different function is activated.

The power on/off switch is at the extreme left end of the panel, adjacent to the disc-loading tray and drawer. To the right of the tray is the first of the dual function buttons. Touch the lower part of that control and the tray opens to accept a single disc. Touch it again and the tray smoothly closes. If the upper part of the button is depressed, the tray opens once more; but this time, upon closing, it stores the disc in the internal stocking area of the player and reopens for the insertion of one or more additional discs. A display



The Nakamichi CDPlayer2 CD Changer

single-disc tray. And even if six discs have been loaded and stored internally, you can still play a seventh disc without having to juggle the others. Further, you do not have to remove the single disc to play any of the stored discs.

We found the MusicBank System to be quieter and faster than conventional changer mechanisms. It requires no external cartridge for multi-disc operation.

Another unusual feature

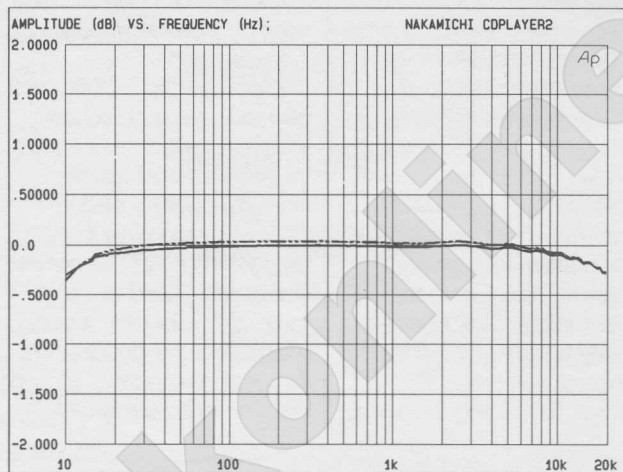
The player also features digital de-emphasis. When de-emphasis is required, it is performed in the digital domain to avoid phase shifts and distortion. The unit uses 8-times oversampling digital filters, and the analog low-pass filters preceding the outputs are linear-phase-active, 3rd-order Bessel-type circuits that ensure a high degree of phase accuracy. The CDPlayer2 uses dual D/A 20-bit converters.

area to the right of this "load/store" button provides an assortment of status information, such as the number of discs stored; the number of the disc that's currently playing; and synchro recording, memory-programming, play, pause, time-editing, time- and track-data, time-counter mode, repeat-play, and random-play indicators.

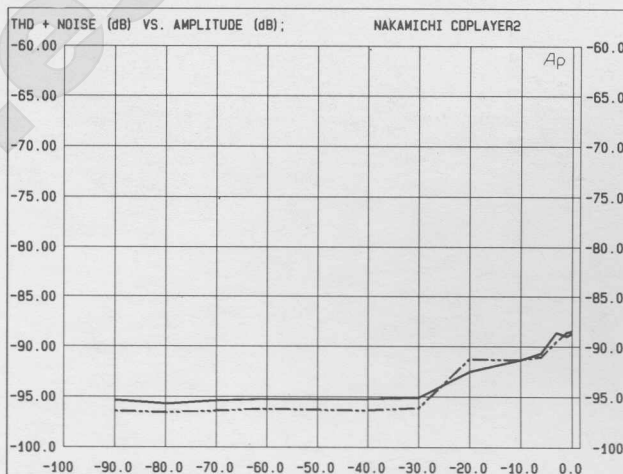
To the right of the display are three more dual-function, rocker-type pushbuttons. The first of these sequentially choose discs 1 through 6 when the MusicBank storage feature is in use. Alternatively, it chooses single-disc operation. The second button is used for forward or reverse track skipping. The third dual function button is used for play/pause commands or for stopping the player. Beneath those three buttons, at the lower right of the panel, are a stereo-headphone jack and an output-level control that sets both the headphone and the variable line-output levels.

The supplied remote control has buttons that duplicate all of the front-panel functions except power on/off. In addition, there are two sets of number buttons that are used for programming and for disc selection. There are also a variety of buttons to take care of the special features of the player such as track delete, program clear, time editing, synchro recording, disc scanning (for playing the beginning of the first track of each disc stored in the MusicBank System), random play, and repeat play. The rear panel of the CDPlayer2 is equipped with pairs of fixed and variable stereo-output jacks, a coaxial digital-output jack, a switch for selecting analog or digital output, and jacks for system remote control and synchro

Specification	Manufacturer's Claim	PE Measured
Frequency response	5-20,000 Hz, $\pm 0.5$ dB	Confirmed
Signal-to-noise ratio	105 dB	106.9 dB
Dynamic range	100 dB	108 dB
THD at 1 kHz	0.0035%	0.0022%
THD + noise	0.004%	0.004%
Channel separation	More than than 100 dB	101.5 dB
Output level		
Fixed	2.0 volts	2.06 volts
Variable (max.)	2.0 volts	2.06 volts
Headphones	60 mW (40 ohms)	62 mW (40 ohms)
Power requirement	120 V, 60 Hz, 27 watts	Confirmed
Dimensions (W x H x D, in.)	16 <sup>15</sup> / <sub>16</sub> x 3 <sup>15</sup> / <sub>16</sub> x 14 <sup>3</sup> / <sub>4</sub>	Confirmed
Weight	17 lbs. 10 oz.	Confirmed
Suggested Price:	\$799	



The frequency response of the Nakamichi CDPlayer2 from below 10 Hz to 20 kHz is shown here. The dashed line trace is the right-channel output; the solid line is the left channel.



This plot shows how THD varied with changes in the recorded level of a 1-kHz test signal. For all levels below -30 dB (referred to the maximum recorded level), THD plus noise was -95 dB or better. In percentage terms, that works out to a THD of 0.002% or better.

recording when certain other Nakamichi audio components are used with this player.

#### THE TEST RESULTS

Frequency response of the Nakamichi CDPlayer2 was essentially flat from 20

Hz to 20 kHz, with a roll-off of no more than 0.3 dB at 20 Hz and 0.25 dB at 20 kHz. Ripple was virtually non-existent at the treble end of the spectrum, a good indication of the high quality and matching characteristics of the analog low-pass output filters. Output levels from both channels were virtually identical.

Throughout the low and mid-frequency region, and even for lower treble frequencies, harmonic distortion plus noise was around 0.004% or less, rising to a maximum of 0.004% near the top of the audio spectrum. Even that slight rise was not attributable to actual distortion but resulted from minute "beats" that occur at such high frequencies, but which are generally inaudible at such low levels.

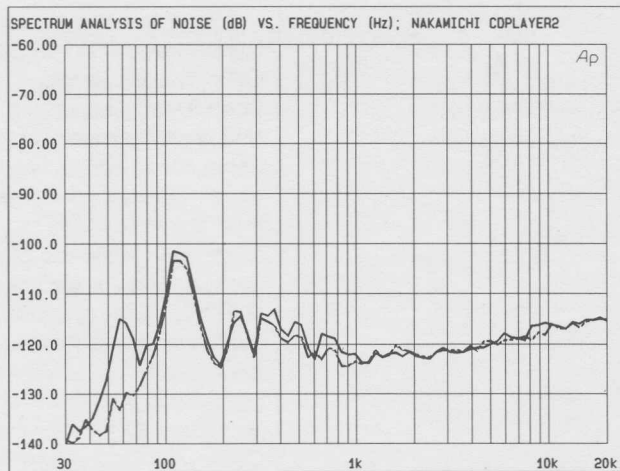
We next looked at how THD varied with changes in recorded level; we used a 1-kHz signal on our CBS CD-1 test disc for these tests. For all levels below -30 dB (referred to maximum recorded level), THD plus noise was more than 95 dB below the maximum level. Quoted in percentage terms, that works out to be 0.002%, or less. As the maximum recorded levels are approached, the THD plus noise rises insignificantly to around -88.5 dB for both channels, corresponding closely with the 0.004% readings that were noted earlier.

In order to separate the actual distortion products from the small amount of accompanying noise, we ran a spectrum analysis of a full-level 1-kHz test signal using the THD mode of our Audio Precision digital signal-processing system. In that test, the fundamental 1-kHz tone was suppressed (to around -142 dB) leaving only the harmonic components of that signal. Residual noise was then

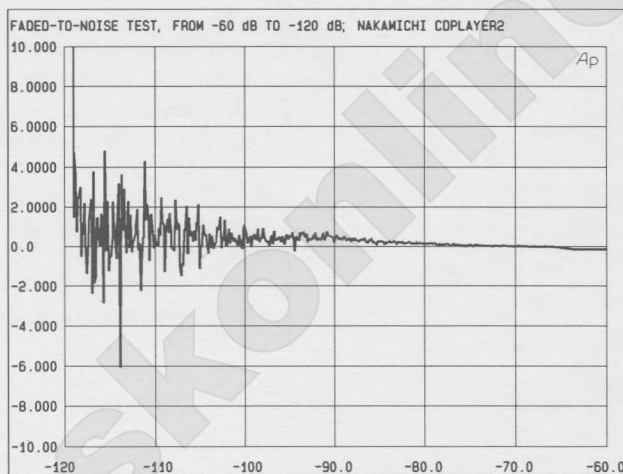
"averaged out" by acquiring the signal and analyzing it sixteen successive times. Since the noise is random, it tends to be canceled out by those successive readings, allowing us to zero in on the discrete, repeated harmonic components, which remain in the same place regardless of the number of sweeps. The tallest of those harmonic "spikes" were all about 100 dB below the maximum recorded level. If we calculate the composite distortion represented by those spikes we come up with an actual harmonic distortion figure (ignoring noise components) of only 0.0022%, or actually considerably less than the 0.0035% figure claimed by Nakamichi in their published specifications for this model. A measurement of SMPTE-IM distortion resulted in readings of only 0.0044%.

The A-weighted signal-to-noise ratio of the CDPlayer2 measured 106.9 dB for the left channel and 107.3 dB for the right channel, again exceeding Nakamichi's claims by a small margin. A spectrum analysis of the residual noise of this player revealed that the actual random noise is far lower than the overall S/N figure just quoted. The major contributions to the overall S/N readings are from the minute amounts of power-supply related components (at 60 Hz, 120 Hz, etc.), and even the greatest of those was well over 100 dB below maximum recorded level.

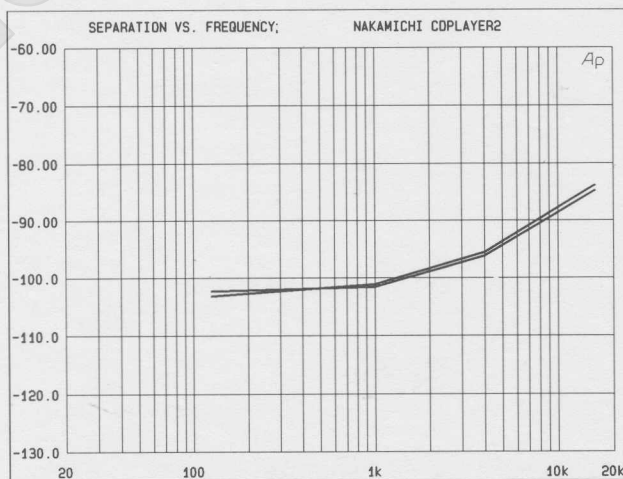
We next examined how stereo separation varied with frequency. At 1 kHz, separation was better than 100 dB, just as claimed by Nakamichi. As usual, separation tended to decrease somewhat at higher frequencies, but it still measured around 85 dB at 16 kHz. What's more, separation was very nearly



The A-weighted signal-to-noise ratio of the unit measured 106.9 dB for the left channel and 107.3 dB for the right. This spectrum analysis of the residual noise of this player shows that the actual random noise is far lower than that overall S/N figure.



The fade-to-noise test provided further indication of the superb linearity of this player, and also provided the data needed for determining the dynamic range, which measured over 107 dB.



This plot shows how stereo separation varied with frequency. As shown, the separation was virtually identical for both channels—hence the overlap of the two curves.

identical whether measured from left channel to right channel, or in the op-

posite direction.

We also looked at the player's deviation from per-

fect linearity at various recorded levels. In one test, we plotted linearity errors from maximum recorded level (0 dB) down to -90 dB using undithered signals. At the lowest extreme of that plot, deviation from perfect linearity was no more than about +0.5 dB. That's about as good as we have ever measured for any CD player, regardless of price.

For the next test, we used dithered signals (signals containing deliberate amounts of noise that actually enable a CD player to extract lower-level information than would be possible otherwise) in the range from -70 dB to -100 dB below maximum recorded level. Even at -100 dB, deviation from perfect linearity was less than +1.0 dB.

Finally, using a test signal that gradually fades from a -60-dB level to a -120-dB level, we plotted deviation from perfect linearity again, as the signal fades into the residual noise level. Again, linearity was superb, hovering at or near the 0-dB deviation line to well below -100 dB. This test also enabled us to determine the dynamic range capability of the player, which turned out to be approximately 107 dB. Frequency accuracy of the internal master digital clock was also measured and was accurate to within 0.0033%.

## HANDS-ON TESTS

The Nakamichi CDPlayer2 was able to play through a disc even when rather severe vibrations and shocks were applied externally to its case. It was also able to track our special "defects" disc at points where 1.5 millimeters of missing data was deliberately "built into" that test disc. The Music-Bank System handled discs extremely well, and with a speed that we have not



## PRODUCT REPORT

seen equalled by other CD changers, which use separate cartridges for disc loading. Perhaps more important than these physical qualities of the player is the quality of musical reproduction that the CDPlayer2 delivers. It is extremely clean and smooth, even during whisper-soft moments in a musical selection where some players tend to imbue sounds with a gritty or grainy characteristic.

About the only thing we would have liked to see on this model that was not present is the ability to access a given index point within a track, where such index points are included in a CD. Since it is possible to fast-search forward or backward, however, this is not a serious omission.

If you have been debating between a single-play CD player (for its supposedly superior sound) and a multiple disc machine (for its convenience) you need seek no further than the Nakamichi CDPlayer2. While this player's suggested retail price (\$799) is certainly justified, if that's a bit steep for your budget you might want to consider Nakamichi's other MusicBank CD Player, the CDPlayer3. That player has a suggested price of \$599.00, and the only difference between it and the more expensive model is the use of 18-bit D/A converters (as opposed to the 20-bit type used in the CDPlayer2) and the fact that it does not use the new high-stability servo system.

For more information on the CDPlayer2, contact Nakamichi (19701 S. Vermont Ave., Torrance, CA 90502) directly, or circle no. 120 on the Free Information Card. ■

www.eskonline.nl

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