

Reference Cassette Recorders

# CR-4/CR-3/CR-2/CR-1

Discrete Head Cassette Decks

2-Head Cassette Decks



# CR-4/CR-3 ■ Uncompromised performance with Nakamichi Discrete

The CR-4 and CR-3 Discrete Head Cassette Decks are designed for the true music enthusiast, the audiophile for whom nothing less than perfection is acceptable. These are the tangible results of more than 15 years' cassette recording research conducted by Nakamichi and available *only from Nakamichi*. The CR-4/CR-3 incorporate the three essentials of Nakamichi Cassette Technology: the Discrete Three-Head System which we created, our exclusive Asymmetrical Dual-Capstan Transport with Pressure-Pad Lifter, and our special electronics that perfectly match our recording and playback heads. The CR-4 differs from the CR-3 in that it features a Manual Calibration System to extract the last iota of performance from each tape, it uses a more exotic capstan motor to reduce wow and flutter to the vanishing point, and it is constructed on a copper-plated chassis which affords an extra measure of shielding against electromagnetic interference.

## Discrete 3-Head Technology

Ever since Nakamichi created the world's first three-head cassette deck — the legendary Model 1000 — many have tried to match it. None have succeeded. Although many 3-head decks are available, most offer little more than an ability to "monitor" the tape — *not* the primary advantage of a 3-head system! A 3-head deck should be able to record and reproduce tapes of exceptional quality because, with separate record and play heads, each can be optimized for one specific task.

In this, the average 3-head deck fails to meet expectations. Most use "sandwich" heads in which record and play sections are in a common housing. Once the head is made, there's no way to align the gaps and without perfect magnetic alignment, response is seriously impaired.

Furthermore, with both gaps in the same housing, record flux leaks into the play head where it affects playback quality and makes proper calibration impossible.

The CR-4 and CR-3 use physically discrete record and play heads that are aligned after installation to ensure flat response, maximum headroom, minimum noise and, in the case of the CR-4, accurate calibration. The heads are individually shielded to

prevent crossfeed and noise pickup and are wound with the finest oxygen-free-copper (OFC) wire to minimize loss. The laminated Crystalloy used in the R-3L and P2H-3L heads is the world's



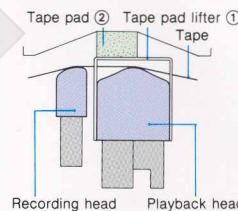
finest core material. Properly fabricated, it has extremely low core loss and exceptional flux-handling ability — which means low-noise playback and low-distortion recording. Our special record gap "focuses" magnetic energy to penetrate the full tape coating and achieve higher recording levels with less distortion. Our sub-micron play gap resolves

recordings to beyond 20 kHz while a special contour promotes long life and unusually smooth bass response.

## Asymmetrical Dual-Capstan Transport

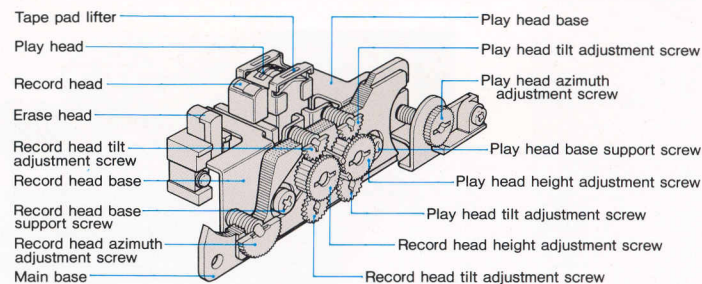
Nakamichi's Asymmetrical Dual-Capstan Transport is as different from ordinary dual-capstan drives as our Discrete 3-Head Recording System is from conventional 3-head designs. The capstans and flywheels used in the CR-4 and CR-3 are precision machined to different diameters, and the capstan surfaces are specially treated to improve their "grip" on the tape. The capstans rotate at different speeds in order to maintain proper tension in the tape as it contacts the heads. This "asymmetry" is not accidental. It is a purposeful part of the design in order to prevent common-mode resonance from being set up between the two capstans. Such resonances, when they occur, concentrate wow at specific frequencies and make it more audible than published specifications would suggest. The Nakamichi CR-4/CR-3 transport not only "measures" well, it *sounds* even better than it "measures!"

Our Asymmetrical Dual-Capstan Drive maintains such *uniform* tension in the tape as it passes the heads that *the pressure pad in the cassette isn't needed* to maintain tape-to-head contact. A unique "pressure-pad lifter" pushes it out of contact with the tape and eliminates the pad as a cause of speed instability. This dramatically reduces scrape flutter and modulation noise, two factors that do not appear in published specifications but have an extremely important effect on sound quality. In fact, the "thick" sound that characterizes many cassette recordings and differentiates them most obviously from CD reproduction is as much caused by scrape flutter and modulation noise as by any other factors. There is little doubt that the unusually clear transparent sound provided



During recording and playback the tape pad lifter ① pushes the tape pad ② away from the tape, to eliminate the contact action unnecessary with Nakamichi transports.

Operation of tape pad lifter



Nakamichi Head Alignment System

# CR-4

Discrete Head Cassette Deck



# 3-Head Technology

by the CR-4 and CR-3 is, to a large extent, a result of our unique transport design.

Although the CR-4 and CR-3 transports share the same basic design, they differ in detail. The CR-3 uses a belt-drive capstan system and is powered by a DC-servo motor. The more expensive CR-4 uses a FG (Frequency-Generator) servo motor that directly drives the takeup capstan (DD principle) to reduce wow and flutter even further.

## Tape Calibration

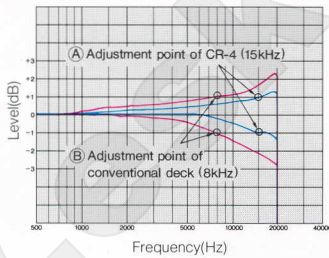
Experienced recordists know that no two tapes are precisely identical. Even tapes from the same manufacturer, carrying the same designation, differ from batch to batch and from year to year. Tapes from different manufacturers vary more widely. The CR-4 and CR-3 each provides a means to adjust bias to match different tapes. The CR-3 has a manual Bias Trim control which you adjust while monitoring playback for best sound. The CR-4 features a *full tape-calibration system with built-in test signals and precision metering* that permits bias adjustment and correction for differences in tape sensitivity. With Nakamichi calibration, you are assured of flat response — with or without Dolby noise reduction — on every tape you use.

Calibration involves recording and playing two test tones: a low-frequency tone used to adjust the gain of the recording amplifier to compensate for differences in tape sensitivity and ensure proper Dolby tracking, and a high-frequency tone used to adjust bias and produce flat response.

Ordinary calibration systems have several problems. With the "sandwich" head used in other decks, flux leaks from the recording gap into the playback core because the two "heads" are in the same housing and there's no room between them for adequate shielding. This leakage produces incorrect playback levels and erroneous calibration.

Furthermore, with a "sandwich" head there's no way to align the gaps after construction.

Azimuth misalignment causes a loss in treble response which, if "corrected" by reducing bias, increases distortion and reduces dynamic range. The tape is so *miscalibrated* it would have been better not to calibrate at all! To reduce misalignment error, most decks adjust bias using an 8- or 10-kHz test tone. This reduces the error but produces unpredictable response at higher frequencies. Thanks to Nakamichi "Discrete-Head Technology," the CR-4 can be *accurately* calibrated. Our independent record and play

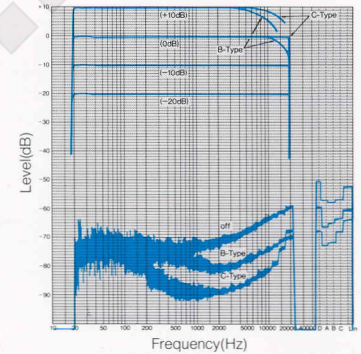


Even if adjustment is carried out to the same tolerance specification ( $\pm 1$  dB), the curves B measured with a deck which uses an adjustment point of 8 kHz show a much wider discrepancy in the high-frequency range than the curves A measured with the CR-4 which uses an adjustment point of 15 kHz.

heads are individually shielded to prevent leakage and they are aligned after the deck is built for perfect magnetic azimuth accuracy. This permits us to use a 15-kHz bias-calibration tone and achieve flat response to 21 kHz on quality tapes such as Nakamichi ZX, SX or EXII. Furthermore, unlike other decks that record test tones on *one* track and use the result to calibrate *both*, CR-4 test tones are recorded on *both* tracks and the *average* of the outputs is used to adjust the bias. This ensures much more similar response on the two channels than is usually achieved. Calibrating the CR-4 is easy. Press CALIBRATION and adjust the BIAS and LEVEL for "0" readings on the indicators. Release the button and the tape rewinds automatically.

## Nakamichi Electronics

Nakamichi's electronics' expertise is evident in the design of the CR-4 and CR-3. Newly developed Dolby circuitry and discrete playback preamps have reduced noise to the vanishing point while our special record amplifiers and custom-designed record head achieve recording levels of +10 dB on metal tape. Our balanced bias oscillator is inherently free of even-order distortion so "biased-tape noise" is almost as low as that of an unrecorded tape. The oscillator operates at 105 kHz, such a high frequency that intermodulation distortion is practically eliminated. With metal tape and Dolby-C NR, the dynamic range possible with these decks is truly spectacular!



CR-4 Frequency Response/Noise Analysis  
Deck: CR-4 / Tape: ZX (Type W) / PB Eq. 70<sub>1</sub>s / MPX FILTER OFF

## Superior Layout & Construction

The CR-4/CR-3's special layout and power supply are designed to reduce noise and enhance separation. Each circuit's ground lines are routed to one point to prevent "loops," and left- and right-channel grounds are separated to prevent coupling. The power supply uses the Nakamichi Multi-Regulation principle. Audio and logic circuits are fed from separate transformer windings to isolate them from each other, and the transformer is quadruple shielded to prevent hum. Local regulators isolate circuits *affected* by noise from those that *create* noise and from those that draw variable current. Only the finest quality components are used in the CR-4/CR-3 albeit the CR-4 goes one step further and features a copper-plated chassis for superior electromagnetic shielding, oxygen-free-copper PC board traces and OFC wiring. Both decks rest on four isolation pads that prevent vibration and acoustic feedback from affecting sound clarity.

# CR-3

Discrete Head Cassette Deck

# CR-2

2-Head Cassette Deck



# CR-2/CR-1 ■ 2-Head Decks That Rival Many 3-Head Designs

The Nakamichi CR-2 and CR-1 have gained a reputation as two of the "great buys" in consumer electronics. They were created to provide Nakamichi Reference-Quality Sound at an affordable price and the degree to which they have succeeded is quite remarkable. These 2-head decks actually rival the performance of most 3-head designs and beat many of them hands down. The secret of their remarkable reproduction is straightforward — concentration on the four essentials of recording technology: transport, heads, electronics and quality control.

## Microprocessor-Controlled Silent Mechanism

Although the CR-2/CR-1 transport is simpler than the tape drive used in the CR-4/CR-3, like every Nakamichi transport, it is based upon our Microprocessor-Controlled Silent-Mechanism design. In a Nakamichi transport, a motor-driven cam engages the head base, pinch roller and brakes more gently and more precisely than is possible with solenoid operation. Since the motor turns only when *changing* functions, there's no vibration during actual operation. Freedom from vibration is essential to reduce the modulation noise and high-frequency flutter that destroy musical clarity. The microprocessor supervises every change in function and automatically inserts the intermediate steps needed to protect the tape. Thus, you can switch between any two modes with complete safety. The CR-2/CR-1 capstan is powered by a servo-controlled DC motor to ensure speed accuracy. And, since single-capstan transports are particularly sensitive to reel-torque variation, the CR-2 and CR-1 use an *independent* high-performance motor just to drive the reels. Torque is transmitted to the reels by a precision gearing arrangement (rather than ordinary plastic wheels) to ensure smooth operation and low wow and flutter.

## 3-Head Performance in a 2-Head Deck

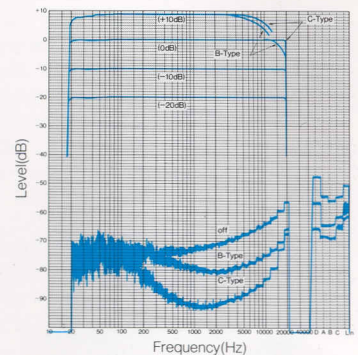
With over 30 years' of experience in magnetic design, Nakamichi is uniquely qualified to create a combination R/P head that rivals the performance of most 3-head systems in breadth of response and freedom from distortion. In fact, few 3-head decks can match the CR-2/CR-1's flat response from 20 Hz to 20 kHz — a smoothness that guarantees freedom from sonic coloration. The RP-2G's laminated-sandust core takes unusually full advantage of metal-tape's potential and actually achieves a midrange recording level of +7 dB. In playback, its 1.2-micron gap easily resolves 20-kHz recordings while its hyperbolic geometry minimizes the so-called



"contour effect" for smoother bass response. The E-2D Erase Head's dual-gap design and low-loss ferrite core ensure more complete erasure of metal tape than many competitive decks.

## Quality Electronics For Best Performance

Without quality electronics, it is impossible to attain the cassette's full potential so, even in the economical CR-2 and CR-1, no expense was spared here. The noise reduction systems use the latest Dolby ICs which provide significantly improved performance over previously available circuits. The recording amplifiers use specially selected high-output ICs and Nakamichi Double-NF equalization that eliminates the distortion caused by electrolytic capacitors. The playback amplifiers also use Double-NF topology but are discretely configured of low-noise transistors to match the play head and ensure maximum signal transfer. A bipolar supply powers the amplifier to eliminate the need for interstage coupling capacitors. Removing them eliminates the distortion they cause. The power transformer is doubly shielded to prevent hum radiation, and the amplifier and logic circuits are powered from separate windings to minimize noise. Independent local regulators are used extensively to prevent interstage coupling through the ground system. As in the CR-4 and CR-3, the bias supply features balanced operation at 105 kHz for the lowest possible intermodulation distortion. Operation at this frequency requires top quality recording and erase heads but it is essential to achieve Nakamichi Reference Sound clarity.



CR-2 Frequency Response/Noise Analysis  
Deck: CR-2 / Tape: ZX (Type IV) / PBEq 70µs / MPX FILTER OFF

## Custom Calibration

Many decks in this price range have just one internal adjustment for bias and another for recording level. Such decks can only be calibrated for one type of tape. The CR-2 and CR-1 have a *full complement of internal controls* that allows us to calibrate bias and level for *each track and each tape type*. Costly — but worth it to guarantee Nakamichi Sound. In addition, the CR-2 features a user-operated Bias Trim with which you can obtain best response with whatever tape you're using.



# CR-1

2-Head Cassette Deck



## The Nakamichi Reference Series A New Standard Of Excellence

In every endeavor,  
One individual or group is preeminent.  
In recording technology,  
That company is Nakamichi.  
Each product in our new  
Reference Cassette Series  
Establishes the standard of excellence  
Against which others will be compared.



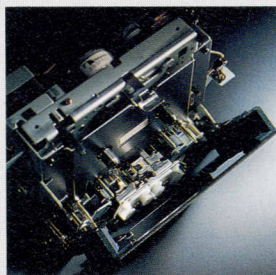
### Sound Research Center

Nowhere is Nakamichi's dedication to sonic excellence more clearly apparent than in our Sound Research Center — an acoustically perfect concert hall in which we compare Nakamichi Reference Cassette recordings with live performances.



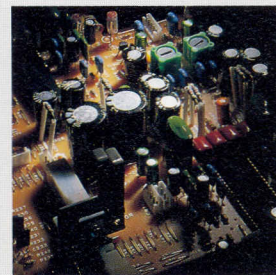
### Magnetic Head Technology

Nakamichi's magnetic-head technology is world renowned. Proprietary manufacturing techniques enable us to elicit remarkable performance from our Crystalloy material — arguably the most perfect material ever created for magnetic-head fabrication.



### Mechanism Design

Another area of recognized Nakamichi leadership. Our Asymmetrical Dual-Capstan Diffused-Resonance Transport is the only cassette deck in which tape motion is so well controlled that a pressure pad isn't needed to maintain tape-to-head contact.



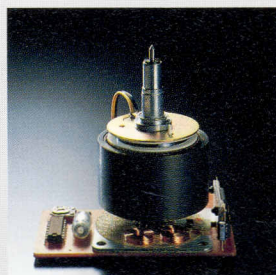
### Electronic Design

Nakamichi electronics are custom designed to match our recording and playback heads. Direct coupling ensures optimum dynamic range and extended bass response while an unusual power-supply topology prevents interstage noise and crosstalk.



### Acoustic Isolation

The compliant feet used on Nakamichi Reference Cassette Decks isolate the head and tape from external vibration and acoustic feedback. No matter how loudly a system is played, Nakamichi reference decks deliver extraordinarily transparent sound.



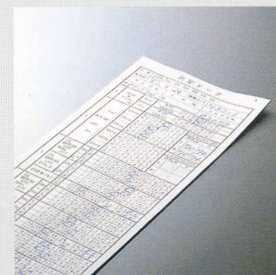
### Multiple Motors

Even the least expensive Nakamichi cassette deck employs 3 motors: a servo-controlled capstan motor for accurate tape speed, a high-quality DC motor to power the reels and a separate DC motor to activate the cam-controlled "Silent Mechanism."



### Chassis Construction

Nakamichi chassis are designed to absorb vibration, ensure high structural rigidity and isolate the transport and electronics from external influences. The CR-4 chassis is even copper plated to provide an extra measure of electromagnetic shielding.



### Custom Calibration

Every Nakamichi Reference Series Cassette Deck has 30 internal adjustments and undergoes a complete 56-step checkout and calibration with all three major tape types before it leaves the factory. Costly, but your assurance of Nakamichi quality.

FEATURE	CR-4	CR-3	CR-2	CR-1	FEATURE	CR-4	CR-3	CR-2	CR-1
<b>Nakamichi Discrete Three-Head Recording System</b> For maximum dynamic range (+10 dB on metal tape) & extended frequency response.	●	●			<b>One-Touch Record/Pause</b> Speeds up and simplifies recording.	●	●	●	●
<b>Precision Bias &amp; Level Calibration With Built-In Test Signals</b> Ensures optimum performance and accurate Dolby tracking with every tape.	●				<b>Record Mute</b> Mutes recording for as long as button is pressed.	●	●	●	
<b>Bias Fine-Tune Control</b> For improved performance with different tapes.		●	●		<b>Timer Rec/Play</b> For unattended recording and playback via accessory timer.	●	●	●	●
<b>Dolby B- &amp; C-Type Noise Reduction</b> Full compatibility with the most popular noise reduction systems.	●	●	●	●	<b>Memory Stop</b> Automatically stops at counter zero during rewind and (except CR-1) fastforward.	●	●	●	●
<b>Defeatable MPX Filter</b> For full-range response when taping sources other than FM broadcasts.	●	●	●	●	<b>Auto Repeat</b> Automatically reenters play mode after rewinding to counter zero.	●	●	●	●
<b>Multi-Regulated Power Supply</b> Eliminates circuit interaction for reduced noise and better performance.	●	●	●	●	<b>Copper-Plated Chassis</b> For improved shielding.	●			
<b>Fast-Response Discrete-Configuration Voltage Regulator</b> Maintains perfect regulation under severe dynamic conditions.	●	●			<b>Acoustic Isolating Feet</b> Reduce acoustic feedback for more transparent sound.	●	●	●	●
<b>Independent Tape &amp; EQ Selection</b> To reduce noise or increase high-frequency headroom under special recording conditions.	●	●	●	●	<b>Coaxial Record-Level/Balance Controls</b> For easy channel balance and record-level setting.	●	●	●	●
<b>Wide-Range Peak-Level Meters</b> Provide accurate indication of recording level and (on CR-4) precise calibration.	●	●	●	●	<b>Output Level Control</b> Adjusts line and headphone output level.	●	●	●	
<b>Reference-Quality DC-Coupled Amplifier</b> For extended frequency response and lowest distortion.	●	●	●	●	<b>Wired Remote-Control Input</b> Permits transport control via optional RM-5 Remote Control Unit.	●	●	●	
<b>Dual-Mono Amplifier Construction</b> For more precise stereo imaging.	●	●	●	●	<b>System Remote-Control Input</b> Permits system-wide control via CA-7 Control Amplifier or TA-4/TA-3/TA-2 Tuner/Amplifiers.	●	●	●	●
<b>Asymmetrical Dual-Capstan Transport With Tape-Pad Lifter</b> Reduces scrape flutter and modulation noise for more transparent sound.	●	●			<b>Oxygen-Free-Copper (OFC) PC-Board Traces</b> For improved conductivity.	●			
<b>FG-Servo Direct-Drive Capstan Motor</b> For minimum wow and flutter and precise speed control.	●				<b>Oxygen-Free-Copper Wiring</b>	●			
<b>Microprocessor-Controlled "Silent Mechanism"</b> Reduces harmful vibration and ensures proper head alignment.	●	●	●	●	<b>Gold-Plated Input/Output Jacks</b>	●	●	●	●
<b>Automatic Slack Tape Takeup</b> Minimizes probability of tape damage during startup.	●	●			<b>Gold-Plated Headphone Jack</b>	●	●	●	●
<b>4-Digit Electronic Tape Counter</b> Indicates relative position in tape pack.	●	●	●		<b>Interconnect Cable With Gold-Plated RCA Plugs</b>	●	●	●	●

## Specifications

	CR-4	CR-3	CR-2/CR-1
Track Configuration	4 tracks/2-channel stereo	4 tracks/2-channel stereo	4 tracks/2-channel stereo
Heads	3 (erase head x 1, record head x 1, playback head x 1)	3 (erase head x 1, record head x 1, playback head x 1)	2 (erase head x 1, record/playback head x 1)
Motors	Transport: Brushless, slotless, coreless Direct-Drive FG servo motor (Capstan Drive) x 1 DC motor (Reel Drive) x 1 DC motor (Cam Drive) x 1 Mechanism: DC motor (Cam Drive) x 1	DC servo motor (Capstan Drive) x 1 DC motor (Reel Drive) x 1 DC motor (Cam Drive) x 1	DC servo motor (Capstan Drive) x 1 DC motor (Reel Drive) x 1 DC motor (Cam Drive) x 1
Tape Speed	1-7/8 ips (4.8 cm/sec) ±0.5%	1-7/8 ips (4.8 cm/sec) ±0.5%	1-7/8 ips (4.8 cm/sec) ±0.5%
Wow and Flutter	Less than ±0.048% WTD Peak Less than 0.027% WTD RMS	Less than ±0.06% WTD Peak Less than 0.035% WTD RMS	Less than ±0.11% WTD Peak Less than 0.06% WTD RMS
Frequency Response (-20 recording level, ZX, SX, EXII tape)	20 Hz — 21,000 Hz ±3 dB	20 Hz — 20,000 Hz ±3 dB	20 Hz — 20,000 Hz ±3 dB
Signal-to-Noise Ratio (A-Wtd re 3% THD at 400 Hz, 70 μs/ZX tape)	Dolby-C NR: Better than 72 dB Dolby-B NR: Better than 66 dB	Dolby-C NR: Better than 72 dB Dolby-B NR: Better than 66 dB	Dolby-C NR: Better than 70 dB Dolby-B NR: Better than 64 dB
Total Harmonic Distortion (400 Hz, 0 dB)	Less than 0.8% (ZX tape) Less than 1.0% (SX, EXII tape)	Less than 0.9% (ZX tape) Less than 1.0% (SX, EXII tape)	Less than 1.0% (ZX, SX, EXII tape)
Erase (100 Hz, +10 dB)	Better than 60 dB	Better than 60 dB	Better than 60 dB
Separation (1 kHz, 0 dB)	Better than 37 dB	Better than 37 dB	Better than 36 dB
Crosstalk (1 kHz, 0 dB)	Better than 60 dB	Better than 60 dB	Better than 60 dB
Bias Frequency	105 kHz	105 kHz	105 kHz
Input	50 mV / 30k ohms	50 mV / 30k ohms	50 mV / 30k ohms
Output (400 Hz/0 dB/Output Control Max.)	Line: 0.5V / 2.2k ohms Headphone: 5 mW into 8 ohms	0.5V / 2.2k ohms 5 mW into 8 ohms	0.5V / 2.2k ohms CR-2: 2.2 mW into 8 ohms CR-1: 1.2 mW into 8 ohms
Fast-Wind Time (C-60 cassette)	Approx. 80 seconds	Approx. 80 seconds	Approx. 80 seconds
Power Source	120, 220, 240 or 110/127/220/240 V AC, 50/60 Hz (according to country of sale)	120, 220, 240 or 110/127/220/240 V AC, 50/60 Hz (according to country of sale)	120, 220, 240 or 110/127/220/240 V AC, 50/60 Hz (according to country of sale)
Power Consumption	38 W max.	35 W max.	CR-2: 30 W max. CR-1: 25 W max.
Dimensions	430(W) x 100(H) x 265(D) mm 16-15/16(W) x 3-15/16(H) x 10-7/16(D) inches	430(W) x 100(H) x 265(D) mm 16-15/16(W) x 3-15/16(H) x 10-7/16(D) inches	430(W) x 100(H) x 265(D) mm 16-15/16(W) x 3-15/16(H) x 10-7/16(D) inches
Approximate Weight	5.9 kg, 13 lb	5.8 kg, 12 lb 13 oz	5.4 kg, 11 lb 14 oz

•Specifications and appearance subject to change for further improvement without notice. •The word "DOLBY" and the Double-D Symbol are trademarks of Dolby Laboratories Licensing Corporation. •Noise Reduction System manufactured under license from Dolby Laboratories Licensing Corporation.

Nakamichi Corporation/Tokyo Office  
Nakamichi America Corporation  
Nakamichi Canada  
Nakamichi Australia  
Nakamichi GmbH  
Nakamichi B&W U.K. Ltd.

Shinjuku Daiichi Seimei Bldg., 2-7-1 Nishishinjuku, Shinjuku-ku, Tokyo 163 Phone: (03) 342-4461 Telex: 2324721 (NAKAM J)  
19701 South Vermont Ave., Torrance, CA 90502 Phone: (213) 538-8150  
276 South West, Marine Drive, Vancouver, B.C. V5X 2R4 Phone: (604) 324-7535  
Unit 10, 21-29 Chester Street, Camperdown, N.S.W. 2050 Phone: (02) 519-3977  
Praunheimer Landstraße 32 6000 Frankfurt Main 90 Phone: (069) 7682021-28  
Marlborough Road, Lancing, West Sussex, BN15 8TR Phone: (0903) 750750