



# Nakamichi

## RX-505/RX-303

Unidirectional Auto Reverse Cassette Decks



## UDAR—Unidirectional Performance With Auto-Reverse Convenience

### Bidirectional azimuth error

Conventional auto-reverse decks move tape from left to right on Side A and from right to left on Side B. Unfortunately cassette tolerances make it impossible to guarantee that the tape will track along the same path when moved in different directions. This skewing causes "bidirectional azimuth error" which leads to a loss of high frequencies.

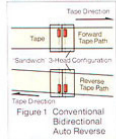


Figure 1 Conventional Bidirectional Auto Reverse

### Unidirectional Auto Reverse

The RX-505/RX-303's revolutionary Unidirectional Auto-Reverse (UDAR) mechanism provides auto-reverse convenience without

bidirectional azimuth error. UDAR automates the actions performed manually on a one-way deck. At the end of side, UDAR disengages the cassette, turns it, and reloads. Tape moves in the same direction for perfect performance and 20-Hz to 20-kHz response on both sides.

UDAR—no-compromise auto-reverse—from Nakamichi, of course!

UDAR Cassette-Reversal Process



### Microprocessor Control

The UDAR mechanism is totally independent of the transport so it cannot degrade performance in any way. It's microprocessor controlled and powered by a servo motor that reverses the cassette quickly and reliably. UDAR performs every normal auto-reverse operation: "one-way," "once-through," or "continuous" playback and "one-way" or "once-through" recording. Sides change automatically when the tape runs out or whenever you press REVERSE. UDAR's "intelligence" enables a number of unique features that make auto-reverse recording and playback more convenient and "continuous" than ever!

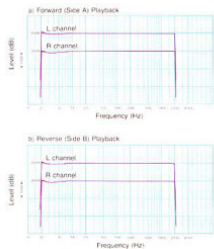


Figure 3 Frequency Response

Deck: RX-505 Level: 20dB PB Eq: 70µs NR: off Tape: ZX (Metal)

## Discrete Three-Head Perfect Response To

### UDAR...To make "Discrete 3-Head" auto-reverse recording possible

Until UDAR, it was impossible to have 3-head auto-reverse recording and playback without a mechanism to rotate the head. The "looseness" needed for rotation precludes accurate alignment, and, as the mechanism wears, matters go from bad to worse!

Every bidirectional 3-head auto-reverse recorder uses a "sandwich" head because there's no way to rotate physically independent record and play heads. The close proximity of the two sections within the sandwich head produces "crossfeed" which destroys monitoring performance.

"Sandwich" heads simply are not comparable to the Nakamichi "Discrete Three-Head System." Only physically independent heads can be truly optimized for perfect performance. Only physically independent heads can be individually adjusted for perfect magnetic azimuth and ideal tape contact. "Discrete Three-Head Technology" extracts total performance from every cassette, guarantees flat response to 20 kHz, and ensures maximum headroom and minimum noise at all frequencies.

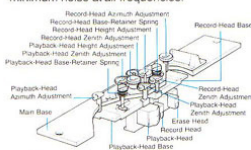


Figure 4 Discrete 3-Head Mounting Arrangement



Image reproduced from the  
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December 2002

# The Asymmetrical Resonance Transport

## Nakamichi—The acknowledged leader in magnetic research

For 30 years, Nakamichi has specialized in magnetic research. We are one of the very few cassette-deck manufacturers to produce its own heads. They're made by proprietary equipment most of which we created ourselves. Our unique production technology enhances the superb properties of our Crystalloy core material, and our special surfacing techniques yield a life expectancy in excess of 10,000 hours—that's 4 hours a day, 365 days a year, for almost 7 years!

Our recording and playback heads are separately shielded to eliminate crossfeed and noise pickup. They are individually adjustable in height, azimuth, and zenith to ensure *perfect* tracking, magnetic azimuth alignment, and tape contact. Our mounting arrangement (Figure 4) is the most sophisticated in the industry. Without such precision it is impossible to achieve truly superior performance. The results speak for themselves!

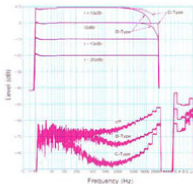


Figure 5 RX-505 Frequency Response/Noise Analysis  
Deck: RX-505; Tape: ZX (Metal) PB EQ; 70µs MPX Filter: off

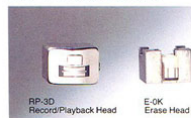
• **P-8L Playback Head:** With its 0.6-micron gap and low-loss laminated-Crystalloy core, the P-8L provides clean response to beyond 20 kHz. Its special hyperbolic geometry eliminates "contour effect" so response is incredibly *uniform* throughout the *entire* audio spectrum.

• **R-8L Recording Head:** The R-8L's 3.5-micron gap produces an extremely sharp critical zone for maximum high-frequency response and MOL. Its laminated-Crystalloy core easily handles the bias needed to record high-coercivity tape and ensures exceptional low-frequency headroom.

• **E-OK Erase Head:** The E-OK is used in both the RX-505 and RX-303. Its double-gap ferritecore produces more than sufficient flux for *complete* erasure of low-frequency information.



• **RP-3D Record/Playback Head (RX-303):** A high-saturation low-loss triple-laminated sendust core and precision gap permit reproduction to 20 kHz while providing sufficient flux to utilize metal tape with unusual effectiveness. Despite the compromises inherent in any combination head, the RX-303 actually *outperforms* many "3-head" configurations.



## All transports are not the same

The transport is the heart of a cassette deck. It determines sound quality to a far greater extent than many realize.

A closed-loop dual-capstan transport should have less wow and flutter than a single-capstan transport but many do not.

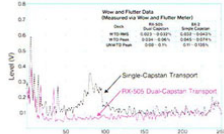
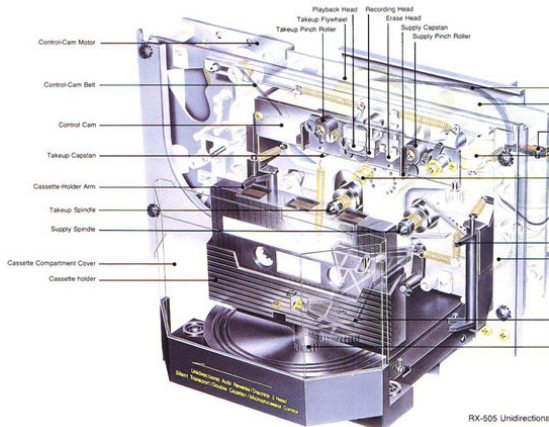


Figure 6 RX-505 Flyer Analysis

Frequency: 3kHz Test Tape  
Wow/Flutter Meter: Magma MC-6/S  
Spectrum Analyzer: HP-3582A

When both capstans have the same diameter and rotate at the same speed, they resonate and concentrate wow at specific frequencies. "Coherent" wow is much more audible than "random" wow, a fact ignored by a weighted-flyer specification. We have gone to extraordinary lengths to ensure optimum performance from the RX-505/RX-303's closed-loop transport.



# RX-505

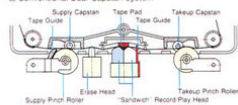
Unidirectional Auto Reverse  
Cassette Deck

RX-505 Unidirectional

## The quintessential transport

After years of research, Nakamichi created the "Asymmetrical Dual-Capstan Diffused-Resonance Transport"—the only mechanism that eliminates coherent wow and exercises such precise control over the tape that *neither pressure pad nor intercapstan guide are required*. Design 7 compares the RX-505/RX-303 transport with a conventional dual-capstan design.

a) Conventional Dual-Capstan System



b) Nakamichi Dual-Capstan System

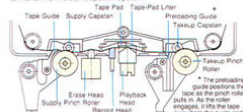


Figure 7 Tape Path In A Dual-Capstan System

Pressure pads are notoriously unreliable. They vary in size—which makes tape-to-head contact erratic—and, unless the pad is perfectly oriented in the cassette, it causes the tape to "skew" throwing off azimuth alignment.

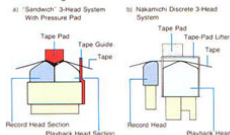


Figure 8 Closeup View Of Head Contact Area

The pressure pad and guide have *audible* effects too. As the tape scrapes by, it vibrates causing "scrape flutter" and "modulation noise"—two unspecified parameters that greatly affect sound clarity. Modulation noise varies with recording level so it's *not* suppressed by noise-reduction systems. In fact, the perceived quality of digital recording is *due as much to the absence of modulation noise as to its inherent dynamic range*. By removing both pressure pad and intercapstan guide, we've virtually eliminated scrape flutter and modulation noise and allowed the music to emerge with digital-like transparency.

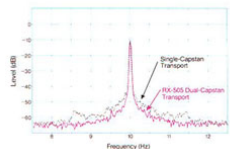


Figure 9 RX-505 Modulation-Noise Analysis  
Eq: 70µs/Freq; 10kHz/Tape: ZX (Metal)

Anything that causes tape vibration creates high-frequency flutter and modulation noise. The tape pad and guide are primary sources but there are others: motors, solenoids, even external sources of vibration. To prevent these from influencing sound quality, the RX-505/RX-303 chassis is fabricated from materials chosen and treated to absorb vibration *before* it can affect tape motion.

To prevent common-mode resonance and coherent wow, the RX-505/RX-303 are "asymmetrically" designed; supply and takeup capstans are of different diameter and rotate at different rates so they don't resonate and concentrate wow at specific frequencies.

## The Nakamichi "Silent Mechanism"

Our Motor-Driven-Cam "Silent Mechanism" is justly famous. A microprocessor-controlled motor replaces the solenoids used in conventional decks. It turns *only* when changing functions so there's no vibration. The microprocessor adds intermediate steps as needed to prevent tape damage so you can switch between modes in complete safety. Pinch rollers engage the instant tape-to-head contact is made for quick stable start-up, and the motor brings the heads up to the tape quickly, then slows down and eases them into place as no solenoid can do. Head alignment stays accurate after operation!

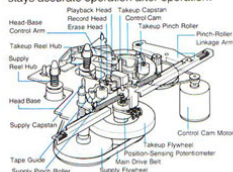


Figure 10 Control System Construction

## The PLL Differential-Speed System

The flywheels are driven by a precision flat belt that filters motor-torque variations. Speed is controlled by a phase-locked-loop (PLL) servo for exceptional accuracy. Flywheel diameters are calculated to produce an unloaded takeup-capstan speed 0.2% faster than the supply capstan. This differential—controlled to within 0.05%—establishes a specific tension in the tape and maintains perfect tape-to-head contact *without* a pressure pad.

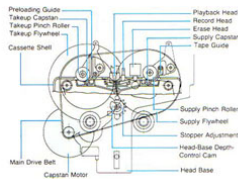


Figure 11 Top View Of Asymmetrical Dual-Capstan System

Unidirectional Auto Reverse  
Cassette Deck

# RX-303



## Perfectly Matched Electronics

We design and manufacture heads, transport, and electronics, so we're in an unusual position to optimize quality. Our recording and playback amplifiers match our heads perfectly. Direct coupling ensures maximum signal transfer and eliminates distortion-causing capacitors. Each stage is powered by a bipolar supply for DC stability, and distortion is below 0.005%—equal to the finest component amplifiers. We confirm each design not only by electrical tests but by extensive listening.

### • Non-Differential Playback Amplifier:

The differential amplifier used in many decks has 3 dB more noise than a well designed non-differential preamp. We've developed an elegantly simple non-differential circuit that provides high stability and extraordinarily low noise.

### • Dolby-B/C NR has excellent noise-reduction

properties and is free of "breathing," but, unless the deck is near perfect, Dolby NR's full potential won't be realized. Proper decoding requires high signal-to-noise, low distortion, and flat response to begin with. In a very real sense, it is the remarkable basic performance of the RX-505/RX-303 that allow them to work so well with Dolby NR.

## Useful Features Make Auto-Reverse Recording Unusually Convenient

### • Auto Fade

tions before the tape runs out. When AUTO FADE is on during auto-reverse recording, a 2-second fade automatically begins about 20 seconds before the end of Side A. The tape reverses, and an auto fade-in begins Side B. About 20 seconds before the end of Side B, the recording fades out. In playback, AUTO FADE reverses the tape at the same point it did when the recording was made for an exceptionally smooth transition.

• **Auto Rec Standby** makes set-up a one-touch operation. One press of AUTO REC STANDBY rewinds the tape to the beginning of the side, fast forwards through the leader, records a 6-second blank "header," resets the tape counter, and leaves the deck in the Rec-Standby mode. To start over, hit STOP and AUTO REC STANDBY, and the deck repeats the set-up procedure. If you're almost finished recording Side A and wish to begin the next selection on Side B, two taps on AUTO REC STANDBY fast forwards to the end of Side A, reverses the cassette, skips through the leader, records a blank, resets the counter, and leaves the deck in Rec Standby.

### • Auto Skip

the side and reverses when it finds a 40-second playback blank. After reversal, the transport skips over the leader, and resumes playback.

• **Dual-Speed Master Fader** creates professional fades at a touch. Press lightly on UP or DOWN for a 2-second fade; press and hold for a 1-second fade.

• **Auto Rec Pause** (RX-505) monitors recording and, after a 45-second blank, stops recording, rewinds to within 15 seconds of the last recorded segment, and leaves the deck in Rec Standby. Unattended disc recording has never been so convenient!

• **Program Seek** (RX-505) fast forwards to the beginning of the next program (or rewinds to the start of the current one) and reinitiates playback. A double press skips ahead (or back) two programs.

• **Dual-Speed Cueing** (RX-505) enables you to monitor the tape at 1/3 or 1/6 normal fast-wind speed and "rock" between FF and REW to find the exact point you want.

• **Punch-In Recording** (RX-505) allows you to switch instantly from PLAY to RECORD to facilitate tight editing.



## RX-505/RX-303 Feature Comparison Chart

FEATURE	RX-505	RX-303
<b>Unidirectional Auto Reverse (UDAR) Mechanism</b> Eliminates bidirectional azimuth error	•	•
<b>Discrete Three-Head System</b> Guarantees flat response to 20 kHz	•	•
<b>Asymmetrical Dual-Capstan Transport</b> Eliminates need for pressure pad and guide	•	•
<b>Low-Distortion DC Amplifiers</b> Matched to heads for optimum performance	•	•
<b>Auto Fade</b> Fades out recording 20 seconds before end	•	•
<b>Auto Rec Standby</b> Automates recording setup	•	•
<b>Auto Rec Pause</b> Stops recording at end of program	•	•
<b>Program Seek</b> Finds next program in either direction	•	•
<b>Dual-Speed Cueing</b> Facilitates tight editing	•	•
<b>Dual-Speed Master Fader</b> Creates 2- or 1-second fades at a touch	•	•
<b>Direct Operation</b> Loads tape and initiates desired function	•	•
<b>SKIP (Defeatable)</b> At end of program, fast winds and reverses	•	•
<b>Rec Mute</b> Creates interprogram blanks	•	•
<b>Punch-In Recording</b> Permits direct access from play to record	•	•
<b>Memory Stop/Play</b> Fast winds to counter zero and stops/plays	•	•
<b>Timer Record/Play</b> Unattended operation via accessory timer	•	•
<b>Dolby B/C Type NR</b> Noise-free recordings without side effects	•	•
<b>MPX Filter (Defeatable)</b> Removes 19-kHz FM-stereo pilot	•	•
<b>Subsonic Filter (Defeatable)</b> Prevents distortion from warped records	•	•
<b>Bias Tune</b> Adjusts bias to accommodate a variety of tape	•	•
<b>3-Position Tape Selector</b> Accommodates ferric, chrome, and metal tape	•	•
<b>2-Position Equalization Switch</b> Permits use of 120- and 70-μs equalization	•	•
<b>Independent L/R Record Level Controls</b> Set recording level and channel balance	•	•
<b>Output Level Control</b> Sets line and headphone level	•	•
<b>4-Digit LED Tape Counter</b> Reads from "999" to "9999"	•	•
<b>-40 ~ +10 dB LED Peak Level Meters</b> Accurately indicate recording level	•	•
<b>Optional Remote Control (RM-15)</b> Controls main transport functions remotely	•	•

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

## RX-505/RX-303 Specifications

Track Configuration	4 tracks 2-channel stereo (auto-reverse recording and playback)
Heads	RX-505: 3 (erase head × 1, record head × 1, playback head × 1) RX-303: 2 (erase head × 1, rip head × 1)
Motors	Transport: PLL servo motor (capstan drive) × 1, DC motor (reel drive) × 1 Mechanism: DC motor (cam operation) × 1 DC motor (cassette reversal) × 1
Power Source	100, 120, 120/220-240, 220 or 240V AC; 50/60 Hz (according to country of sale)
Power Consumption	33 W max.
Tape Speed	1-7/8 ips (4.8 cm/sec) ± 0.5%
Wow and Flutter	Less than ± 0.08% WTD Peak Less than 0.04% WTD RMS
Frequency Response	RX-505: 20 Hz–20,000 Hz ± 3 dB (-20 dB recording level) RX-303: 20 Hz–20,000 Hz
Signal-to-Noise	RX-505: Dolby-C NR: Better than 70 dB (A-WTD re 3% THD at 400Hz) RX-303: Dolby-C NR: Better than 68 dB (70 μs, ZX tape) Dolby-B NR: Better than 62 dB
Total Harmonic Distortion	RX-505: Less than 0.9% (ZX tape) Less than 1.0% (SX, EX II tape) RX-303: Less than 1.0% (ZX, EX II tape) Less than 1.2% (SX tape)
Erasure	Better than 60 dB (100 Hz, 0 dB)
Separation	Better than 36 dB (1 kHz, 0 dB)
Crosstalk	Better than 60 dB (1 kHz, 0 dB)
Bias Frequency	105 kHz
Fast-Wind Time	Approx. 60 seconds (C-60)
Input (Line)	50 mV, 70k ohms
Output (Line)	1.0 V (400 Hz, 0 dB, output control max.) 2 k ohms
(Headphone)	12 mV (400 Hz, 0 dB, output control max.) 8 ohms
Dimensions	450 (W) × 144 (H) × 300 (D) millimeters 17-3/4 (W) × 5-11/16 (H) × 11-13/16 (D) inches
Approximate Weight	10 kg, 22 lb 1 oz

<b>Tapes</b> ZX Metalloy Cassette Tape (70 μs, metal bias) ZX C-60 ZX C-90	SX Ferricobalt Cassette Tape (70 μs, CrO <sub>2</sub> bias) SX C-60 SX C-90	EX Ferricobalt Cassette Tape (120 μs, normal bias) EX C-60 EX C-90
SX II Super Ferricobalt Tape (70 μs, CrO <sub>2</sub> bias) SX II C-60 SX II C-90	EX II Ferricobalt Cassette Tape (120 μs, normal bias) EX II C-60 EX II C-90	



RM-15 Remote Control



DM-10 Head Demagnetizer



SP-7 Stereo Headphones

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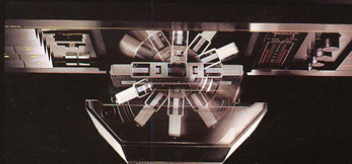
# Nakamichi Didn't Invent Auto

## RX-505 Unidirectional Auto Reverse Cassette Deck



### 1 Nakamichi Reference Technology Unidirectional Auto Reverse (UDAR)

No transport can ensure that tape follows the same path when pulled in opposite directions so we sidestep the problem with UDAR—a revolutionary mechanism that turns the cassette at the end of the side. Tape travels in the *same* direction so there's no "bidirectional azimuth error."

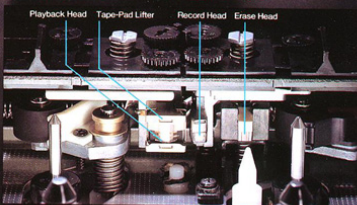


Unidirectional Auto Reverse Mechanism in Action

### 2 Nakamichi Reference Technology Discrete Three-Head System (RX-505)

To Nakamichi, "3-head" always means three *discrete* heads—physically independent record, playback, and erase heads that are perfectly optimized and critically aligned in magnetic azimuth to ensure flat response to beyond 20 kHz and optimum MOL.

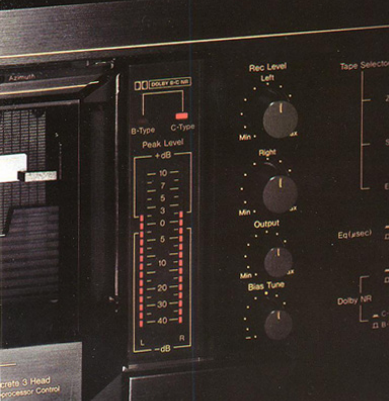
\*The RX-303's triple-laminated sendust record/play head rivals the performance of conventional "sandwich" 3-head designs.



Nakamichi Discrete Three-Head System



# Reverse...We Perfected It!



## Perfectionist Auto Reverse

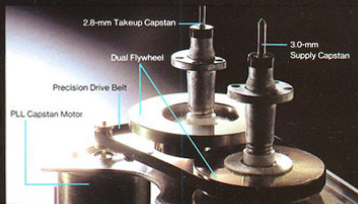
Nakamichi's reputation is founded upon our unique ability to develop cassette decks of unparalleled performance. We have never risked sound quality for useless features—or even for convenience features if they sacrifice performance. Our obsession with perfection leads us to view conventional auto-reverse cassette decks with suspicion.

When tape travels in opposite directions, tracking changes causing azimuth error and high-frequency loss. Conventional 3-head auto-reverse decks use "sandwich" heads that can't meet our standards and transports that simply cannot be compared with a Nakamichi *unidirectional* drive.

Now, four Nakamichi Reference Technologies combine to create the RX-505—the world's first Discrete Three-Head, Asymmetrical Dual-Capstan Cassette Deck with auto-reverse recording and playback. The RX-505 and 2-Head RX-303 bring Nakamichi perfection to auto-reverse recording and introduce truly useful features that make auto-reverse recording unusually convenient.

## 3 Nakamichi Reference Technology Asymmetrical Dual-Capstan Transport

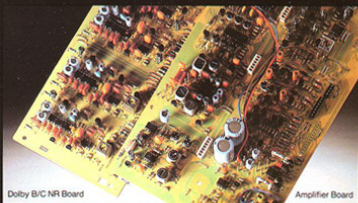
Only Nakamichi's Asymmetrical Dual-Capstan Diffused-Resonance Transport maintains such precise control over the tape that neither pressure pad nor intercapstan guide are needed. Removing them reduces scrape flutter and modulation noise and reveals hitherto unheard musical detail.



Asymmetrical Dual-Capstan Transport

## 4 Nakamichi Reference Technology High-Performance Direct-Coupled Electronics

RX-505/RX-303 heads are directly coupled to the electronics to minimize loss and ensure exceedingly accurate equalization. A novel "non-differential" playback preamp has 3 dB less noise than typical circuitry and incredibly low distortion to bring out the full potential of Dolby-B and -C NR.



High-Performance Direct-Coupled Electronic