

Nakamichi

MR-1 Discrete Head Professional Cassette Deck



The MR-1 Discrete Head Professional Cassette Deck—From Nakamichi—The Company Whose Profession Is Recording!

The MR-1 brings *Nakamichi* recording technology to the *professional* market—a unique Asymmetrical Dual-Capstan Diffused-Resonance Transport so accurate that no pressure pad is required to maintain tape-to-head contact, the Nakamichi Discrete 3-Head recording system to provide perfectly accurate azimuth alignment, extended bandwidth and exceptional dynamic range, and custom Nakamichi electronics which have established a world-wide reputation for ultra low-noise/high-headroom performance.

The MR-1 is specifically designed to meet the needs of the *professional* market. Front-panel ¼-inch balanced-line input jacks simplify temporary connection of signal sources with the MR-1 while balanced XLR input and output jacks on the rear provide permanent connection. An input selector chooses between front and rear inputs. Quarter-inch rear-panel jacks provide unbalanced connection to the MR-1 with the unbalanced inputs given priority over the XLR inputs when a jack is inserted.

The balanced inputs meet professional standards vis-à-vis input impedance (600 ohms) and rated input level (+4 dBm) with 16 dB headroom to the maximum input level (+20 dBm). Minimum input level is -6 dBm. The unbalanced inputs bridge virtually any source. A 100-kilohm input impedance ensures negligible loading, and high-gain circuitry produces nominal recording level with an input of -20 dBV (0.1 volt). Nominal input level is 10 dB higher (0.316 volt) with the input circuitry designed to be overload proof.

The balanced line outputs are designed for termination in a standard 600-ohm load and have a source impedance of 100 ohms (balanced). Nominal output level is identical with nominal input level (+4 dBm) with 16 dB headroom to saturation (+20 dBm). The unbalanced line outputs have a 2200-ohm source impedance and

are designed to work into a 25-kilohm load. Nominal output level matches nominal input level (0.316 volt) with an output saturation point 18 dB higher (2.51 volts). The headphone output drives 100 mW into a 4-ohm load and is provided with a volume control independent of the output-level control.

The MR-1 has self-contained Dolby-B and -C noise reduction and provisions for use with any NR system. The external NR loop is accessed via phono jacks that are jumpered when an outboard processor isn't used. The noise-reduction system is controlled by two pushbuttons Ext/Dolby and Dolby NR B/C. Choosing Ext with the rear jacks jumpered provides recording/playback without noise reduction. The internal choices are indicated by Dolby B/C lamps.

A Source/Tape switch selects the signals presented at the output terminals and displayed on the level meters. An LED lights to indicate the monitoring mode. Dual 16-segment peak-reading LED level meters with an attack time of 100 ms and a decay time of 2 seconds accurately indicate recording/playback level in 2-dB steps from -20 dB to +10 dB re nominal. Recording level is set via dual sliders.

The MR-1 accommodates the three major cassette formulations with independent control of bias and equalization. Bias is selected via three pushbuttons—Normal (I)/High (II)/Metal (IV)—while equalization is chosen via another button (120/70). This permits recording and reproducing Type-II

tapes with 120-microsecond EQ if desired.

A defeatable subsonic filter (12 dB/octave below 18 Hz) prevents modulation caused by turntable rumble, record warp, and other low-frequency resonances

when recording conventional discs. A 19-kHz multiplex filter can be activated by a rear-panel switch and provides well over 30 dB rejection of the FM-stereo pilot.

The Discrete Three-Head Perfect Magnetic Azimuth Ensures 20—20,000 Hz

For professional use, the 3-head format is an absolute requirement, for you must monitor while recording to ensure quality. Furthermore, only *separate* record and play gaps can be *individually* optimized for maximum MOL (requiring a wide record gap) and full frequency response (which requires a narrow play gap). But *all 3-head decks are not the same!*

Many 3-head decks use "sandwich" heads—record and play sections are in the same housing. Once the head is made, there's no way to align the gaps. Even if the gaps are mechanically parallel, the *magnetic* gaps may not be, and, without perfect *magnetic* alignment, high frequencies are lost. Furthermore, with closely spaced gaps, record flux may leak into the play head and upset Dolby *monitoring* when monitoring thus compromising the monitor's usefulness.

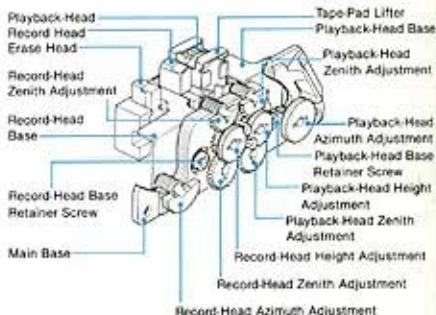


Figure 3 Discrete 3-Head Mounting Arrangement

The MR-1 employs Nakamichi *Discrete-Head Technology*—with *physically* independent heads that are perfectly optimized and magnetically aligned *after* installation to ensure flat response, maximum headroom and minimum noise at *all* frequencies.

The recording and playback heads are *individually* shielded to eliminate cross-feed and noise pickup. They are *individually* adjustable in height, azimuth, and zenith to ensure perfect tracking, magnetic alignment and tape contact. The mounting system (Figure 3) is unusually sophisticated and allows non-interacting adjustment of *each* parameter for *each* head *after* installation.

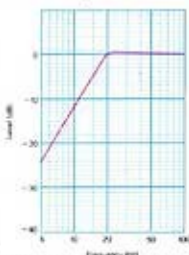


Figure 1 MR-1 Subsonic Filter Characteristics

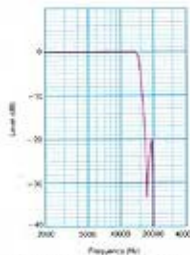


Figure 2 MR-1 MPX Filter Characteristics



ad System— with Alignment Response.

The results (Figure 4) speak for themselves!

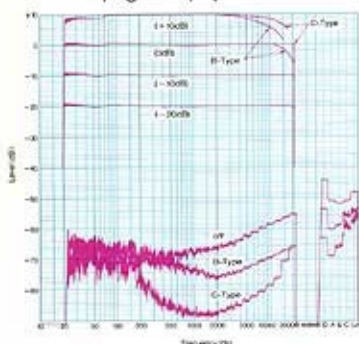


Figure 4 MR-1 Frequency Response/Noise Analysis
Deck: MR-1/ Tape: ZX (Metal) PB Eq: 70µs/ MPX Filter: off

The $\frac{1}{2}$ heads are the result of Nakamichi's 30+ years of experience in magnetic research. During that time, we discovered the best magnetic materials, created the unique designs that launched the cassette as a high fidelity medium, and developed proprietary processes that avoid internal stress in the core material and thereby preserve its magnetic properties to the fullest. Our special surface geometry ensures uniform wear and gives our heads a service life of over 10,000 hours!



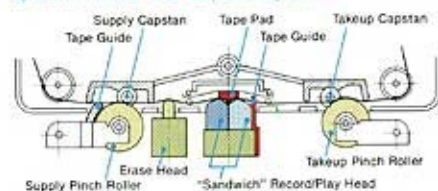
- P2H-3L Playback Head:** With a 0.8-micron gap and laminated-Crystalloy core, the P2H-3L provides smooth response to 20 kHz. Special geometry eliminates "head bumps" so response is flat to the lowest frequencies.
- R-3L Recording Head:** The R-3L's 3.5-micron gap creates an extremely sharp critical zone for maximum high frequency MOL while its laminated-Crystalloy core ensures exceptional dynamic range on metal tape.
- E-4F Erase Head:** Dual gaps, a low-loss ferrite core and sendust poletips ensure complete erasure for perfect clarity.

Asymmetrical Dual-Capstan Diffused-Resonance Transport Eliminates Scrape Flutter And Modulation Noise.

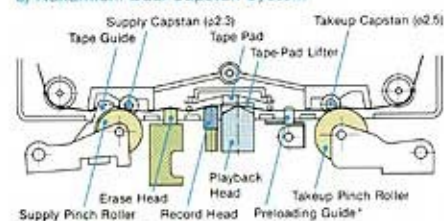
Just as a 3-head deck *should* be better than a 2-head deck (but many aren't!), a closed-loop dual-capstan transport *should* have less wow and flutter than a single-capstan transport. Many do not! *All dual-capstan transports are not the same!*

Many dual-capstan decks use identical capstans for supply and takeup. They rotate at the same rate and concentrate wow at specific frequencies making it much more audible. Tape tension within the "closed loop" isn't constant—the whole point of a closed-loop system—so a pressure pad is used to maintain tape-to-head contact. With a pressure pad, tape-to-head contact becomes erratic, and, unless the pad is perfectly oriented (a matter of luck), the tape skews causing mistracking and azimuth error. Thus an intracapstan guide is needed.

a) Conventional Dual-Capstan System



b) Nakamichi Dual-Capstan System



*The preloading guide positions the tape as the pinch roller pulls in. As the roller engages, it lifts the tape away from the guide and the dual-capstan system maintains tracking from then on.

Figure 5 Tape Path In A Dual-Capstan System

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 that *neither pressure pad nor intracapstan guide are required.*

The pad and guide have audible effects. As the tape passes them, it vibrates causing "scrape flutter" and "modulation noise" which destroy 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 largely due to the absence of modulation noise.* Removing the pad and guide virtually eliminates scrape flutter and modulation noise and allows music to emerge with digital-like transparency.

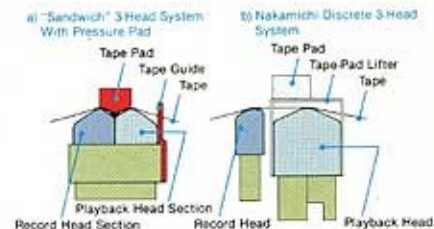


Figure 6 Closeup View Of Head Contact Area

Figures 5 and 6 compare the MR-1 transport with a conventional design. As you can see, in the MR-1, nothing contacts the tape except the heads themselves!

To eliminate coherent wow, the transport is "asymmetric"; capstans are of *different* diameter and rotate at different rates so they don't resonate and concentrate wow at specific frequencies. Again, the results—shown in Figure 7—speak for themselves!

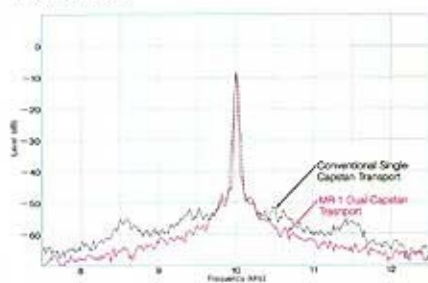


Figure 7 MR-1 Modulation Noise Analysis
Eq: 70µs/ Freq: 10kHz/ Tape: ZX (Metal)



High-Inertia Direct-Drive Capstan Motor And High-Precision Servo Ensure Ultra-Low Wow & Flutter

"Direct Drive" should be superior to belt drive because a belt can introduce speed variations if it doesn't run true. But, direct drive mercilessly reveals motor cogging because there's no compliant belt to filter it. Cogging causes high frequency flutter that is heard but ignored in specifications. All DD decks are not the same!

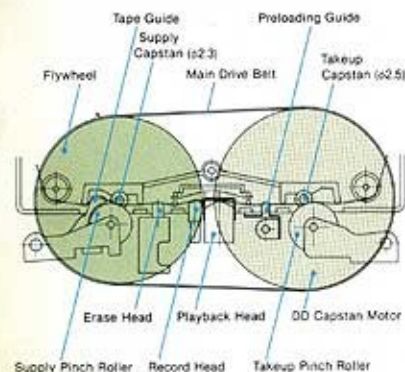


Figure 8 Top View Of Asymmetrical Dual-Capstan System

The MR-1 takeup capstan is directly driven by an outstanding new motor that is virtually cog-free thanks to its unusually high inertia. The motor has an exceptionally heavy rotor with the mass concentrated at the circumference to create a flywheel that ensures smooth rotation. It is brushless, slotless and coreless so torque fluctuations are inherently low.



Figure 9 shows the results—cog-free performance with under 0.027% wow and flutter!

The MR-1 features Nakamichi's "Silent Mechanism" in which a microprocessor-controlled Motor-Driven Cam replaces conventional solenoids. There's no mechanical shock to upset head alignment and each operation is performed swiftly and precisely.

The motor actuates three switch cams to inform the microprocessor of the current status. This "dialogue" between mechanism and microprocessor permits sophisticated precise control. For example, when PLAY is pressed, the heads approach the tape very rapidly but, just before contact, slow down and ease into place. Only after the tape has contacted the heads do the pressure rollers engage. This ensures stable accurate tape tension from the outset.

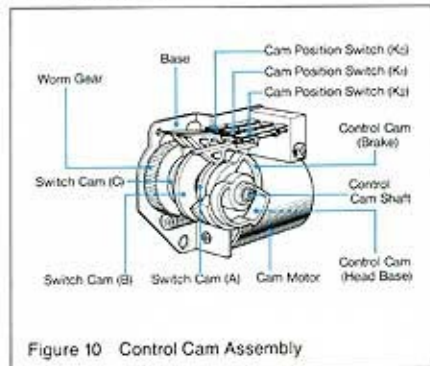


Figure 10 Control Cam Assembly

Professional Features For True Professional Performance

- Nakamichi Discrete 3-Head Technology
- Asymmetrical Dual-Capstan Diffused-Resonance Transport
- High-Inertia Direct-Drive Capstan Motor With Wide-Bandwidth FG Servo
- Low-Distortion Direct-Coupled Electronics
- Balanced Inputs: 1/4-Inch Front Panel XLR Rear Panel
- Unbalanced Inputs: 1/4-Inch Rear Panel
- Line Input Selector Switch
- Outputs: XLR Rear Panel (Balanced) 1/4-Inch Rear Panel (Unbalanced)
- Self-Contained Dolby-B and -C Noise Reduction
- Provision For External Noise-Reduction Systems
- 16-Segment Linear-Scale (2 dB steps) Peak-Responding Meters
- Independent L/R Record Level Controls
- 3-Position Tape Selector
- 2-Position Equalization Selector
- Defeatable MPX Filter
- Defeatable Subsonic Filter
- One-Touch Record Pause
- Record Mute
- Tape Monitor Indicator
- Line Output Level Control
- Headphone Jack With Independent Headphone Volume Control
- Playback Pitch Control ($\pm 6\%$)
- 4-Digit LED Tape Counter
- Memory Stop
- Timer Record/Play
- Automatic Slack-Tape Takeup
- Remote Control (via optional RM-200)
- EIA Rack-Mount Adapter With Carrying Handle

To further reduce flutter, we extended the servo bandwidth to correct torque variations up to 1 kHz—the key element being a 160-segment frequency generator that senses speed every 2 1/4 degrees of rotation! A careful choice of components ensures excellent stability over time and temperature.

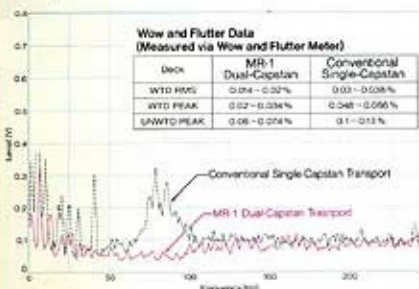
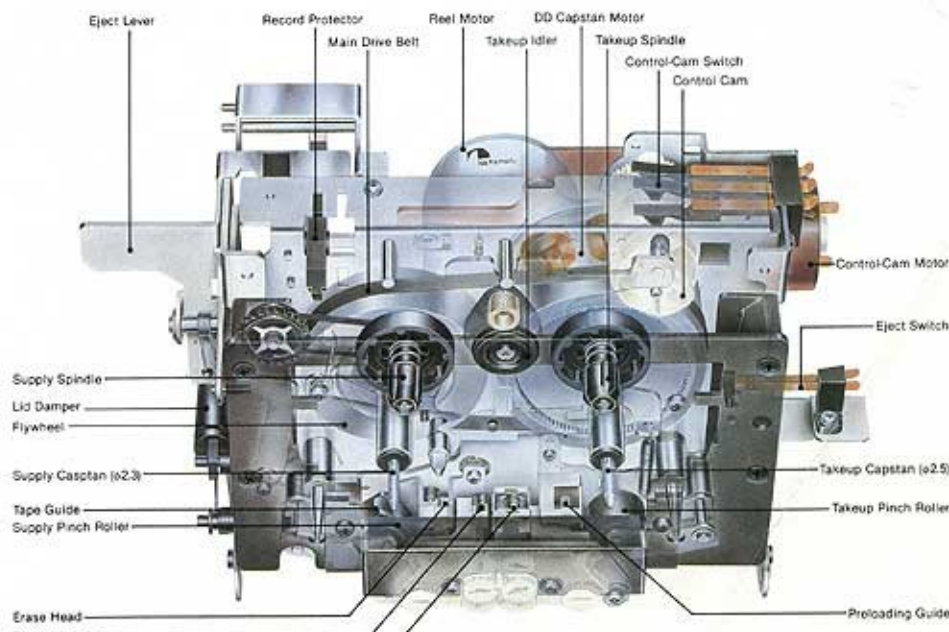


Figure 9 MR-1 Flutter Analysis

Frequency: 3kHz Test Tape/Wow and Flutter Meter: Meguro MK-615/Spectrum Analyzer: HP-3562A

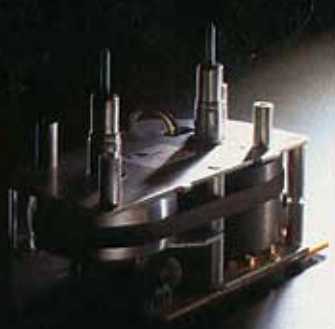


MR-1 Transport Mechanism



Discrete 3-Head System

The original Nakamichi technology that guarantees flat response from 20 to 20,000 Hz, perfect magnetic azimuth alignment and optimum MOL.



Asymmetrical Dual-Capstan Transport

Another Nakamichi innovation that dramatically reduces scrape flutter and modulation noise to reveal hitherto unheard detail.



Direct-Drive Capstan Motor

A newly developed high-performance direct-drive capstan motor virtually eliminates "conventional" wow and flutter for rock-stable performance.



Professional Electronics

MR-1 electronics are fully compatible with professional standards vis-à-vis input and output impedance, level and connectors. Distortion is virtually non-existent.

Professional Precision For The Professional Recordist The Nakamichi MR-1

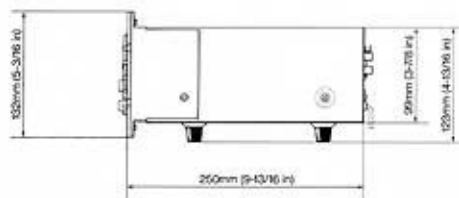
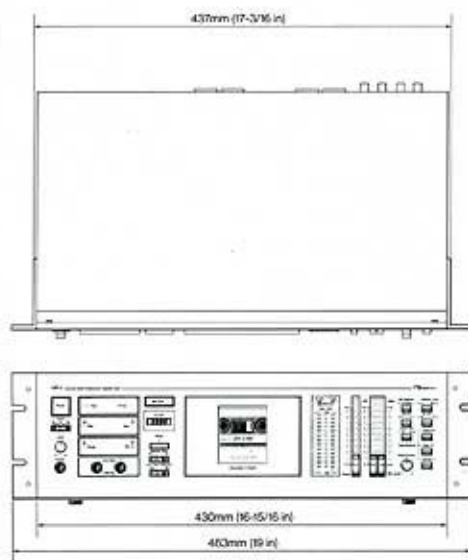


MR-1 Specifications

Track Configuration	4 tracks/2-channel stereo
Heads	3 (Erase Head × 1, Record Head × 1, Playback Head × 1)
Motors	Tape Transport: FG servo brushless, slotless, coreless DD motor (Capstan Drive) × 1 DC motor (Reel Drive) × 1 Mechanism: DC motor (Cam Drive) × 1
Power Source	100, 120, 120/220-240, 220 or 240 V AC, 50/60 Hz (According to country of sale)
Power Consumption	30 W max.
Tape Speed	1-7/8 ips (4.8 cm/sec) ± 0.5%
Wow and Flutter	Less than ± 0.048% Wtd. Peak Less than 0.027% WRMS
Frequency Response	20 Hz—20,000 Hz ± 3 dB (-20 dB level)
S/N Ratio (A-Wtd rms)	Dolby-C NR: Better than 70 dB (re 3% THD at 400 Hz, ZX tape) Dolby-B NR: Better than 64 dB (ZX tape)
Total Harmonic Distortion (400 Hz, 0 dB)	Less than 0.9% (ZX tape) Less than 1.0% (SX, EXII tape)
Erase	Better than 60 dB (100 Hz, +10 dB)
Separation	Better than 36 dB (1 kHz, 0 dB)
Crosstalk	Better than 60 dB (1 kHz, 0 dB)
Bias Frequency	105 kHz
Line Input (XLR 3-31)	
Input Impedance	600 ohms (Balanced)
Nominal Input Level	+4 dBm (1.228 V)
Minimum Input Level	-6 dBm (0.388 V)
Maximum Input Level	+20 dBm (7.75 V)
Line Input (1/4-inch Front-Panel)	
Input Impedance	600 ohms (Balanced)

Nominal Input Level	+4 dBm (1.228 V)
Minimum Input Level	-6 dBm (0.388 V)
Maximum Input Level	+20 dBm (7.75 V)
Line Input (1/4-inch Rear-Panel)	
Input Impedance	100k ohms (Unbalanced)
Nominal Input Level	-10 dBV (0.316 V)
Minimum Input Level	-20 dBV (0.1 V)
Line Output (XLR 3-32)	
Output Impedance	100 ohms (Balanced)
Nominal Load Impedance	600 ohms
Nominal Output Level	+4 dBm (1.228 V)
Output Saturation Level	+20 dBm (7.75 V)
Line Output (1/4-inch)	
Output Impedance	2.2k ohms (Unbalanced)
Nominal Load Impedance	25k ohms
Nominal Output Level	-10 dBV (0.316 V)
Output Saturation Level	+8 dBV (2.51 V)
Headphone Output	Max. 100 mW (with 4-ohm load)
Equalization (Switchable)	
Normal	.3180 microseconds + 120 microseconds
High, Metal	.3180 microseconds + 70 microseconds
Fast-Wind Time	Approx. 80 seconds (C-60 cassette)
Dimensions	483(W) × 132(H) × 250 (D) millimeters 19(W) × 5-3/16(H) × 9-13/16(D) inches
Approximate Weight	6.3 kg, 13 lb 14 oz

Dimensions



- In these specifications, 0 dBV is referenced to 1.0 volt. Actual voltage levels are given in parentheses. To calculate the 0 dB = 0.775 volt reference level (i.e. 0 dBm in a 600-ohm circuit), add 2.2 dB to the listed dB value, for example, -10 dBV = -7.8 dBm.
- 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.



Tapes
ZX Metalloy Cassette Tape
(70µs, metal bias)
ZX C-60 ZX C-90

SX Ferricobalt Cassette Tape
(70µs, CrO₂, bias)
SX C-60 SX C-90

SXII Super Ferricobalt Tape
(70µs, CrO₂, bias)
SXII C-60 SXII C-90

EXII Ferricrystal Cassette Tape
(120µs, normal bias)
EXII C-60 EXII C-90



DM-10 Head Demagnetizer



RM-200 Remote Control



SP-7 Stereo Headphones

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