



# Nakamichi

## 682ZX/681ZX

Discrete Head Cassette Decks



# Calibration/Operation

Azimuth And Recording Sensitivity Are Calibrated Automatically. A Simple Manual Bias-Adjustment Procedure Assures Accurate Tape Matching. A 9-Program RAMM Locates Any Desired Selection.

## Calibration

### Auto Calibration (Azimuth, Level)

To insure stable, extended high-frequency response and perfect Dolby-NR tracking, recording-head azimuth and record-amplifier sensitivity are calibrated automatically.

### Automatic Azimuth Alignment

For 22-kHz response, record and play head *magnetic* azimuths must be aligned with extraordinary precision. Even an error of 6 minutes of angle — 0.1 degree — causes unacceptable loss. Because of the tolerances of their housings, azimuth should be aligned for each cassette. This is possible only with mechanically independent ("discrete") record and playback heads. Nakamichi's unique Auto Azimuth Alignment system quickly and accurately performs this critical procedure.

From REC/PAUSE, pressing AUTO CAL and PLAY causes a 400-Hz tone to be recorded on the two tracks. As the tone is reproduced, any phase difference between left and right channels is detected, amplified, and used to drive a servo motor that is coupled to a lever via a belt-driven

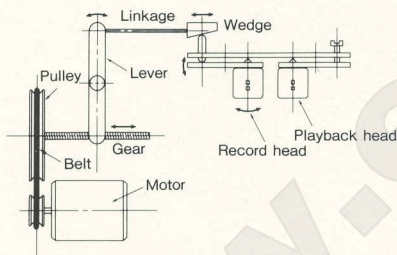


Figure 1 Auto Azimuth Alignment Control Mechanism

recording-head angle until the phase (azimuth) error disappears. Figure 1 shows the Auto Azimuth Alignment mechanism.

### Automatic Record-Level Calibration

Tapes differ in sensitivity — the magnetic flux recorded for a given recording current. Since Dolby NR senses recording level and adjusts response accordingly, it is necessary to match record current and playback level precisely for each tape.

During AUTO CAL, the playback level of the 400-Hz tone is measured and compared with a reference. The error is amplified and drives a servo motor that is belt coupled to a worm gear (cf Figure 2). A pinion engaging the worm controls a potentiometer that adjusts record-amplifier gain until the playback level matches the reference precisely — thus compensating for the tape's actual sensitivity. Since the potentiometer has *continuous* control of gain, the system is more precise than other methods that select among a few *discrete* gain settings.

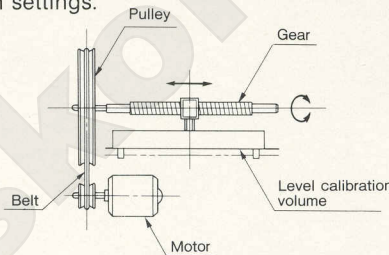


Figure 2 Auto Level Calibration Control Mechanism

Error is less than  $\pm 0.5$  dB over a control range of  $\pm 2.5$  dB — sufficient to accommodate normal tapes. Both Auto Azimuth Alignment and Auto Record-Level Calibration are accomplished within 6 seconds.

### Bias Calibration

Tapes differ in bias needs as well as in sensitivity, and calibration is required to achieve flat response and low distortion. Insufficient bias increases distortion and exaggerates treble response while excessive bias reduces highs and dulls the sound.

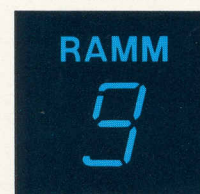
The 682ZX and 681ZX have separate bias controls for each channel and for each major tape type. Pressing 15-kHz TONE records this frequency at  $-20$  dB. The tone is reproduced and measured on the display whose sensitivity has been increased 20 dB to show the level more accurately. The bias adjustment range is  $\pm 4.5$  dB for EX (Type-I) tape,  $\pm 3$  dB for SX (Type-II) tape and,  $\pm 6$  dB for ZX (Type-IV) Tape.



## Operation

### RAMM

The 682ZX/681ZX feature the Nakamichi RAMM (Random Access Music Memory) which is programmed — locally or remotely via the RM-200 — by PAUSE, F. FWD., and



REW. From 1 to 9 selections can be skipped in either fast forward or rewind. An LED display indicates the number of programs to be skipped.

### Soft-Touch Controls

A light touch on PLAY, F. FWD., REW., or STOP activates sophisticated C-MOS IC logic that controls all functions via a unique motor-driven cam. Tape handling is exceptionally gentle even when switching directly from a fast-wind mode to playback.

- Easy Cueing — Press PAUSE while in either fast-wind mode, and transport speed is reduced to 1/3. The playback head approaches the tape so you can hear the recording. Pressing either fast-wind button drops tape speed to 1/5 to identify the precise start of a program.
- Rec. Mute — Once in the recording mode, the input signal is muted for as long as RECORD is depressed to create inter-program gaps or eliminate commercials.
- Remote Control — In addition to controlling every normal-mode function, the RM-200 option operates the Easy-Cue and Record Mute systems.



# Dolby C-Type Noise Reduction

Dolby C-Type NR Provides 20-dB Of Quieting In The Tape-Hiss Region (2kHz-8kHz) Without Audible Breathing Or Other Side Effects. B-Type NR Also Is Included For Total Compatibility.

Dolby B-Type noise reduction helped establish the cassette as a true high-fidelity recording medium. Prior to B-Type NR, dynamic range was limited. Low-level passages were submerged in hiss while loud ones were distorted. Not much can be done to increase the overload point which is limited by tape formulation, but noise can be reduced by compressing the signals's dynamic range prior to recording and expanding it upon playback.

While "compansion" is not new, most circuits suffer from audible side effects; transient response is poor, and noise level changes with program causing a pumping or breathing sound. The more noise reduction that is attempted, the more audible the side effects become. Dolby-B NR's success is directly attributable to its achieving useful noise reduction without side effects. This was done by limiting the noise reduction to 10 dB and concentrating it on the "hiss" region.

Since the development of B-Type processing, program sources have improved. Direct-to-disc and digital recordings have substantially greater dynamic range than their predecessors increasing the need for an NR system with greater capability. Unfortunately, simple "linear compansion" systems that could provide more noise reduction have unacceptable side effects while those semi-professional techniques that offer more noise reduction without side effects are expensive. In 1980, Dolby Laboratories solved this conundrum by developing a C-Type system that provides twice the noise reduction of B-Type processing without increased side effects. After careful research, Nakamichi adopted Dobby C-Type technology and incorporates it in the 682ZX/681ZX. The B-Type system also is included for compatibility with existing tape libraries.



## Dolby C-Type Processing

B-Type and C-Type processing share the same operating principle. At those frequencies where tape hiss is most annoying, low level signals are selectively boosted (compressed) prior to recording and expanded downward on playback thus

decreasing noise introduced by the tape. By dynamically adjusting the degree and frequency range of the compansion in accordance with the energy spectrum of the program ("sliding-band" technique), audible side effects are minimized.

To improve transient handling, compression and expansion are limited to 10 dB per stage. The B-Type system uses one stage and achieves 10 dB of noise reduction. The C-Type system utilizes two stages — a high-level one and a low-level one — to achieve a 20-dB reduction. In addition, the C-Type system incorporates spectral-skewing and anti-saturation networks that reduce high-frequency IM distortion and transient overload.

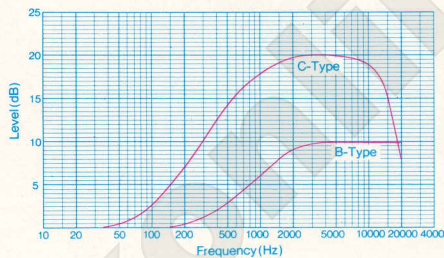


Figure 3 Low-Level Encoder Response (-60 dB)

Figure 3 compares the low-level (-60 dB) encoding of B and C-Type processing. Between 2 and 8 kHz, C-Type NR provides 20-dB quieting — twice that of the B-Type system. C-Type processing also is effective over a wider frequency range. Noise reduction starts two octaves lower to achieve a psychoacoustically uniform noise floor.

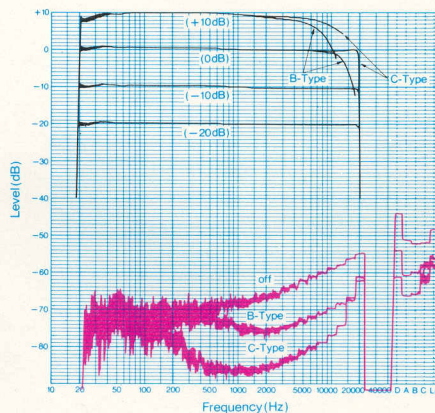


Figure 4 682ZX Frequency Response/Noise Analysis  
Tape Deck: Nakamichi 682ZX Tape: Nakamichi ZX(Metal) PB Eq: 70 $\mu$ s

C-Type NR requires exceptional performance from the recorder with which it is used. Figure 4 shows the response and noise analysis of the 682ZX with and without B and C-Type NR. With C-type processing, response is flat to beyond 20 kHz *even at 0 dB* thanks to the spectral-skewing circuitry, and noise is remarkably reduced. A-wtd S/N ratio is better than 72 dB (400 Hz, 3% THD).

# Mechanism

The Unique Construction Of The Diffused-Resonance, Double-Capstan Tape Stability, Extremely Low Fl

Nakamichi research has shed new light on tape-transport problems. While it is well known that double-capstan transports isolate the active portion of the tape from reel-hub perturbations, few have considered the mutual resonances involved. When two capstans rotate at the same rate, they are in resonance, and flutter components at the resonance frequencies are magnified causing peaks in the flutter spectrum that are much more audible than specifications would suggest. Thus Nakamichi transports are designed with "asymmetrical" capstans and flywheels that rotate at different rates to eliminate this common-mode resonance.

Another source of flutter and modulation noise — not included in standard specifications — comes from tape vibration as it passes the magnetic heads, partially, this originates with motor vibration so we construct our transports on an aluminum chassis that has been coated with vibration-

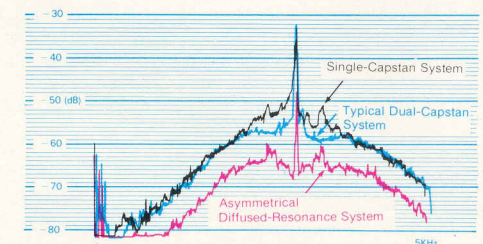
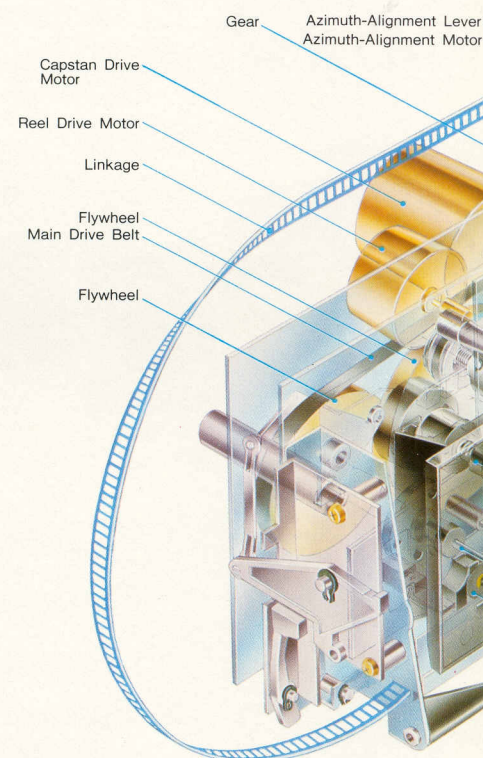


Figure 5 Modulation Noise Analysis



# Heads/Amplifiers/Indicators

Nakamichi Asymmetrical, Stan Transport Provides Absolute Control, And Operational Simplicity.

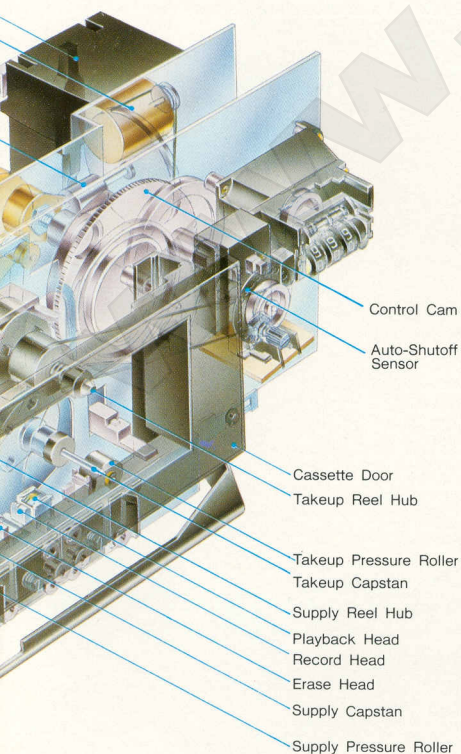
Exclusive Discrete 3-Head Technology, Low-Noise, Double-NF Amplifiers And FL Indicators Typify Nakamichi's Leadership In Cassette-Deck Componentry.

damping resin. Yet another source of tape-motion irregularity is tape contraction and expansion due to variations in holdback and takeup tension so we have paid particular attention to preventing these irregularities. In fact, tape tension is controlled so precisely that proper tape-to-head contact is maintained without a pressure pad. A unique tape-pad lifter forces it out of the way thus eliminating this very important source of scrape flutter and modulation noise. Furthermore, by holding the pad away from the tape, the effects of pad-spring vibration are totally eliminated.

## Silent Mechanism

Feather-touch keys activate C-MOS IC logic that interprets each command and inserts the logically correct intermediate steps to prevent tape damage. You may switch from either fast-wind mode to play in complete safety. The logic also accepts instructions from the RM-200 remote-control unit and permits several keys to be used for dual functions — Rec. Mute, and Easy Cue.

The logic controls a unique motor-driven cam that positions heads, engages brakes, and performs every function normally associated with solenoids but does so more quietly, more gently and precisely, and with less power consumption and heat buildup. The main capstan motor is a PLL servo type that immediately senses and corrects speed error.



## Head Technology

Nakamichi conceived and developed Discrete 3-Head cassette recording. Only mechanically as well as magnetically independent heads can realize the full potential of the cassette, for only such a system can assure accurate magnetic azimuth alignment. In the 682ZX and 681ZX, azimuth alignment is performed automatically on each cassette you record.

Figure 6 shows the head-block arrangement. All three heads are located between the two capstans to insure stable tape tension and uniform tape-to-head contact, while slot guides at each capstan position the tape more precisely than is possible with fork guides.

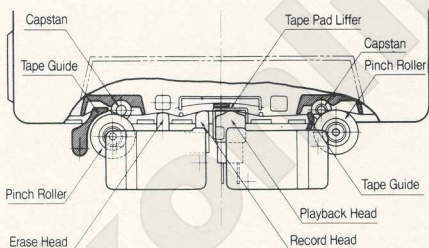
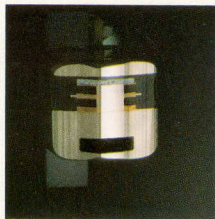


Figure 6 Discrete Head Configuration

## Playback Head

The P-8L play head has a high-permeability, low-coercivity Crystalloy core to maximize efficiency and thereby reduce noise. The extremely narrow 0.6-micron gap realizes a frequency response to 22 kHz while polepiece geometry has been carefully refined to eliminate contour effect and extend response smoothly to the ultra-low frequency region. A special shape prevents core wear on one side and extends service life to 10,000 hours.



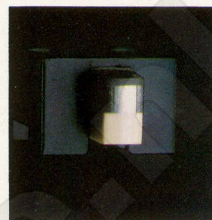
## Record Head

The R-8L record head also utilizes a laminated Crystalloy core to assure minimum high-frequency self demagnetization. A 3.5-micron gap with carefully defined critical recording zone enables complete penetration of the tape coating and exceptionally high maximum operating levels (MOL) with any type of tape. Like the playback head, a special contact shape extends service life to 10,000 hours.



## Erase Head

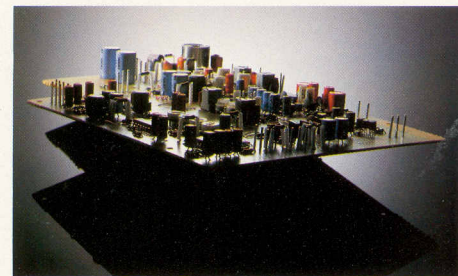
The E-8L erase head combines the excellent high-frequency properties of a ferrite core with the superior flux-handling ability of Sendust poletips. The double-gap design assures complete erasure of metal tape.



## Amplifiers

Nakamichi has always paid special attention to amplifier design. Dolby C-Type NR has made high-quality amplification more important than ever. Unless the circuitry surrounding the Dolby processors is extremely quiet, the full potential of this remarkable system will not be realized.

The recording, playback, and line-output amplifiers of the 682ZX/681ZX utilize double-NF circuitry with separate AC and DC feedback loops to insure high stability and low-noise operation. Record and playback heads are directly coupled to their respective amplifiers to reduce distortion and low frequency phase error and thus produce a cleaner, more transparent sound.



## Indicators

The 682ZX/681ZX employ peak-responding FL (fluorescent) metering. This advanced system covers a broad 50-dB range (-40 dB to +10 dB) in 24 segments. The display is entirely electronic and responds rapidly but without overshoot to any transient thus making it very easy to set recording level accurately.

During bias setup, the meter sensitivity is increased by 20 dB so that the 15-kHz tone is displayed in the high-resolution region about "0." Bias is then adjusted to achieve a "0" indication.



# 682ZX/681ZX Discrete-Head Cassette Decks

Automatic Azimuth Alignment And Record-Level Calibration Plus Manual Bias Adjustment Achieves Flat Response To 22 kHz While Dolby C-Type NR Eliminates Virtually All Tape Noise.

The Nakamichi 680ZX led the way. With its innovative Auto Azimuth Alignment system, it broke the 20-kHz response barrier at standard speed and achieved an unprecedented 15-kHz bandwidth at half normal speed. Once and for all, the importance of flat response to *beyond* 20 kHz was established for the 680ZX had a clarity of reproduction that was truly amazing. All harmonics — even the highest overtones — were reproduced in precise balance with the fundamental and lower partials.

The 682ZX and 681ZX share the 680ZX heritage. While both are single (standard) speed recorders, they utilize the same heads and transport — the same Auto Azimuth Alignment system — as the 680ZX,

and, with it, they share the distinction of 20 — 22,000 Hz  $\pm$ 3 dB response! Each features a 9-program RAMM that rapidly searches for any desired selection, 50-dB peak-responding fluorescent (FL) metering to monitor recording level, and a unique multi-speed cueing system.

682ZX/681ZX capabilities extend beyond those of the 680ZX. During Auto Azimuth Alignment, record level is automatically calibrated too via a unique motor-driven continuous linear potentiometer that is much more precise than conventional gain-control systems. Together with manual bias adjustments — for *each* track and tape type, the 682ZX and 681ZX adapt to almost *any* tape! In addition to standard Dolby-B NR, the 682ZX/681ZX offer the

newest in noise-reduction technology — Dolby C-Type processing that virtually eliminates tape noise in its entirety.

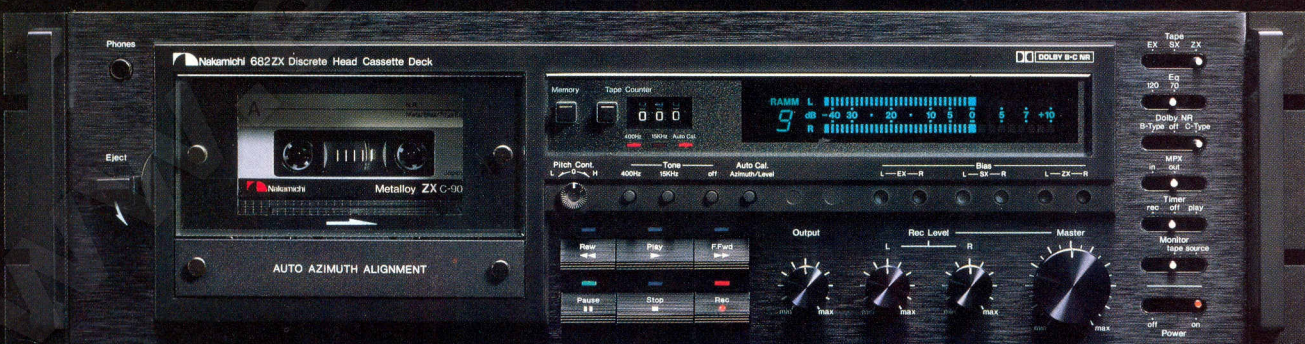
## 682ZX Discrete-Head Cassette Deck

The 682ZX takes full advantage of Nakamichi's Discrete 3-Head Technology. Independent Dolby processors in the recording and playback circuits permit the tape to be monitored as it is being recorded.

## 681ZX Discrete-Head Cassette Deck

In the more economical 681ZX, the same Dolby processor is shared by the recording and playback circuits. While off-tape monitoring is not possible, the 681ZX achieves the same level of performance as the 682ZX, and bias adjustments can be made directly without need to rewind the tape.

682ZX



681ZX



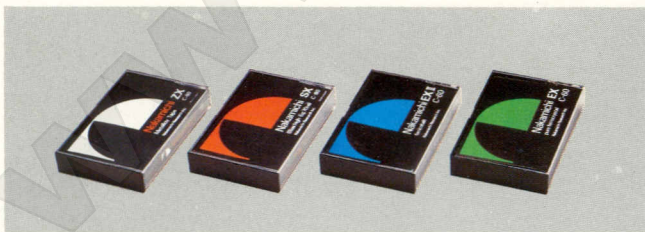
## Features

- Auto Azimuth And Rec. Level Calibration Plus Manual Bias Calibration
- 9-Program RAMM (Random Access Music Memory) Simplifies Program Selection
- 50-dB Peak-Responding FL (Fluorescent) Metering
- Dolby B And Dolby C Noise Reduction With Defeatable MPX Filter
- Metal-Tape Recording For Superior High-Frequency Headroom
- Discrete 3-Head Technology With 22-kHz Response
- Dual-Gap Erase Head For Low-Noise Erasure Of Metal Tape
- Separate Tape And Equalization Switches For ZX, SX, And EX II Tapes
- Asymmetrical, Dual-Capstan, Diffused-Resonance Transport With Motor-Driven Cam, Dual Slot Guides, And Tape-Pad Lifter
- Non-Resonant Chassis And Stable Flywheels
- IC Logic With Cue, High-Speed Shutoff, And Slack-Tape Takeup
- Pitch Control ( $\pm 6\%$ )
- Independent Left And Right Record-Level Controls With Master Fader
- High-Output Headphone Jack Plus Output-Level Control
- DC Output Jack For Powering Blackbox Series
- Tape-Start Memory And Unattended Operation (Via Any Timer)
- Total Remote Control Of All Functions And RAMM Programming Via RM-200 Option
- Removable Rack-Mount Assembly (EIA Standard)

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

## 681/682ZX Specifications:

|                                |  |
|--------------------------------|--|
| Power Source .....             | 100, 120, 120/220-240, 220 or 240V AC; 50/60Hz<br>(According to country of sale)   |
| Power Consumption .....        | 36W max.   |
| Tape Speed .....               | 1-7/8 ips (4.8cm/sec.) $\pm 0.5\%$   |
| Wow-and-Flutter .....          | Less than 0.08% Wtd peak<br>Less than 0.04% Wtd rms  |
| Frequency Response .....       | 20-22,000 Hz $\pm 3$ dB (recording level -20 dB, ZX tape)<br>20-20,000 Hz $\pm 3$ dB (recording level -20 dB, SX, EX II tape)  |
| Signal to Noise Ratio .....    | <b>Dolby C-Type NR on</b> (70 $\mu$ s, ZX tape)<br>Better than 72 dB (400 Hz, 3% THD, IHF A-Wtd rms)<br><b>Dolby B-Type NR on</b> (70 $\mu$ s, ZX tape)<br>Better than 66 dB (400 Hz, 3% THD, IHF A-Wtd rms) |
| Total Harmonic Distortion ...  | Less than 0.8% (400 Hz, 0 dB, ZX tape)<br>Less than 1.0% (400 Hz, 0 dB, SX, EX II tape)  |
| Erase .....                    | Better than 60 dB (100 Hz, 0dB)  |
| Separation .....               | Better than 37 dB (1 kHz, 0 dB)  |
| Crosstalk .....                | Better than 60 dB (1 kHz, 0 dB)  |
| Bias Frequency .....           | 105 kHz  |
| Input (Line) .....             | 50 mV, 50 k $\Omega$   |
| Output (Line) .....            | 1V (400 Hz, 0 dB, output level control at max.), 2.2 k $\Omega$  |
| (Headphones) .....             | 45 mW (400 Hz, 0 dB, output level control at max.), 8 $\Omega$ load  |
| Black Box Series DC Output ... | $\pm 10$ V, 125 mA max.  |
| Dimensions .....               | 482(W) x 143(H) x 340(D) millimeters<br>19(W) x 5-5/8(H) x 13-3/8(D) inches  |
| Approximate Weight .....       | 9 kg<br>19 lb. 13 oz   |



### Tapes

ZX Metalloy Cassette Tape  
(70  $\mu$ s, metal bias)  
ZX C-60 ZX C-90

SX Ferricobalt Cassette Tape  
(70  $\mu$ s, CrO<sub>2</sub> bias)  
SX C-60 SX C-90

EX II Ferricrystal Cassette Tape  
(120  $\mu$ s, normal bias)  
EX II C-60 EX II C-90

EX Ferrioxide Cassette Tape  
(120  $\mu$ s, normal bias)  
EX C-60 EX C-90



RM-200 Remote Control



DM-10 Head Demagnetizer

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