

Accuphase

# DP-70V

COMPACT DISC PLAYER

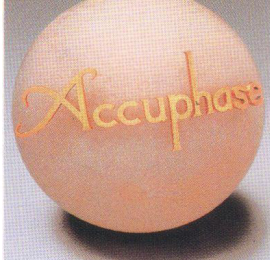
- 20-bit Discrete D/A Converter
- 8-Time Oversampling Digital Filter
- 3-Pole GIC Butterworth Lowpass Filter
- Digital Control Center Functions
- Digital and Analog Circuits Perfectly Separated by Ultra-high-speed Opto-couplers



Hersteller  
Michael Otto

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COMPACT  
disc  
DIGITAL AUDIO



# Equipped with the World-Proud, High-Precision 20-bit Discrete D/A Converter, 8-Time Oversampling Digital Filter, and Digital Control Center Functions Corresponding to Three Sampling Frequencies.

The DP-70V is an integrated type CD player created to meet the highest standards of sound reproduction by employing the technology developed for the separate type CD player model DP-80L/DC-81L. This Model offers a digital control center function to meet the requirements of the next generation of audio technology. This function allows DP-70V's the high-quality, precision D/A converter to demodulate and record digital signal inputs from multiple digital audio tape (DAT) recorders or BS (Satellite Broadcast) tuners.

The DP-70V was developed to meet the following basic objectives:

1. Application of discrete components for the genuine 20-bit converter at the heart of the unit to achieve the performance of the most precision and highest quality D/A conversion available.
2. Digital control center function to allow the high-performance converter to process signals from DAT recorders and BS tuners.
3. Comprehensive vibration countermeasures to ensure faithful signal reproduction.
4. Perfection of construction design, circuit topology and electrical as well as constructional isolation to cut off high-frequency noise.
5. Emphasis on ensuring good sound quality, while avoiding conscious efforts to artificially tailor sounds, in every part of the audio frequency spectrum from low level to high level signals as well as on faithful reproduction of airy atmosphere of concert halls.

We believe that the DP-70V meets these stringent objectives. The following is a brief description of the DP-70V.

The D/A converters employed are Accuphase's exclusive 20-bit discrete converter constructed with carefully selected superb discrete components. Each converter is carefully adjusted at the manufacturing stage to achieve exactly 16 times the conversion accuracy of a 16-bit D/A converter.

The noise shaper technique employed successfully reduces undesirable requantized noise to extremely low levels that the feeling of silence in the sound reproduction is sensational.

The digital filters employed are of the 8-times oversampling type with  $-110\text{dB}$  attenuation capability, thus successfully eliminating unwanted noise-band components over  $328\text{kHz}$ .

The 3-pole GIC audio filters have been employed to ensure optimum sound reproduction quality.

Digital input terminals and a switching function are specially provided to allow the processor section,

which includes the D/A converter, to be operated as an independent digital control center. Two pairs each of optical and coaxial inputs are provided, so that a total of 4 different DAT recorders or BS tuners can be connected. The sampling frequencies of  $48\text{kHz}$ ,  $44.1\text{kHz}$  and  $32\text{kHz}$  are automatically selected.

One pair each of optical and coaxial digital output terminals is provided, to enable digital recording to a DAT recorder.

The digital circuit section, which includes the CD transport, is constructually separated from the analog filter circuitry by means of a metal shield in order to eliminate inter-section interferences. In addition, these two sections are electrically isolated by extremely fast  $40\text{Mbit/sec.}$  opto-couplers to provide perfect isolation. Furthermore, a separate independent power transformer is provided for each of the digital and analog circuit sections in order to eliminate all types of noise interference.

The exquisitely smooth linear motor driven laser pickup, that Accuphase has been employing since the first CD player, is also used for the DP-70V. An *RF Amplifier* is newly built into the pickup unit, thus perfectly eliminating noise interference to the minute signal path.

The transport unit section is supported by a thick aluminum diecast frame, and further mounted firmly to the main chassis to eliminate resonance and vibration. This gives the DP-70V a total weight exceeding  $24\text{kg}$ , a weight unheard of for a CD player. All these additional constructual countermeasures make an enormous contribution to the excellent sound quality of the DP-70V.

All operational controls except a few essential functions are incorporated into Accuphase's traditional sub-panel to present an extremely simple and elegant overall appearance.

## DIGITAL PROCESSOR UNIT

### World's First 20-bit Discrete D/A Converter Achieves Theoretical Limit Performance

The 20-bit D/A converter at the heart of the digital processor unit was developed to achieve a theoretical limit of performance. The bit precision of  $1/2^{20}$  ( $=9.54 \times 10^{-7}$ ) is 16 times higher than the precision offered by a 16-bit D/A converter. The resulting measured distortion (distortion component excluding noise at  $1\text{kHz}$ ) of only  $0.0007\%$  equals the theoretical limit of CD player performance. Quantization noise, which is detrimental to high quality audio reproduction, has

been considerably reduced.

The D/A conversion method employed is a current-addition type, which features excellent linearity characteristics. The digital processor unit is constructed of carefully selected discrete components to ensure the maximum theoretical 20-bit performance. The construction is shown at the right of Fig. 1. The figure shows that the construction includes a current switch element and an extra high precision resistor for each bit of conversion. To ensure perfect operation, each individual unit of the converter is finely adjusted to give the ideal linearity throughout the entire output range from minute levels to high levels, to attain an ideal performance in elimination of zero-cross distortion and low-output distortion.

### Independent 20-Bit 8-Time Oversampling Digital Filters for Both Left and Right Channels

By increasing the sampling frequency in integer multiples of the fundamental frequency, it makes it possible for a digital filter to diminish the attenuation characteristics of the audio filters, which remove the undesirable noise components. However, it is insufficient for a digital filter to only offer a large number of multiples. The filter must also be able to suppress the unwanted components between the audio band and sample frequency.

The digital filters used for the DP-70V employ a sophisticated digital algorithm to suppress unwanted components in the range of  $24.1\text{kHz}$  to  $328.7\text{kHz}$  to the astonishing level of  $-110\text{dB}$ . Bandpass ripple, which can cause deterioration of the sound quality, is kept within  $\pm 0.00005\text{dB}$ , proving that these filters are of the highest quality currently available.

### 3-Pole Discrete GIC Butterworth Active Filter with Strictly Selected Components

Because the sampling frequency is increased eight times to  $352.8\text{kHz}$ , the signal output from the D/A converter contains high frequency components over  $332.8\text{kHz}$  ( $352.8-20$ ). Naturally, unwanted components also exist, even if the sampling frequency is increased 16 times or 24 times for example. Thanks to the high order of the oversampling, audio lowpass filters with moderate 3-pole ( $18\text{dB/oct.}$ ) characteristics are sufficient to eliminate these unwanted components and to contribute to the sound quality. The discrete 3-pole GIC Butterworth type active filter employed is constructed of strictly selected components to eliminate any possibility of sound deterioration.

### Digital and Analog Circuits are completely Isolated to Prevent Deterioration of Sound Quality by High Frequency Noise

Digital signals contain components of extremely high frequency, which may reduce the sound quality by interfering with the demodulated audio signals. This effect can be eliminated by completely isolating the digital circuits from the analog circuits electrically, static-electrically, and electro-magnetically.

In the DP-70V, all analog circuits following the D/A converter, including the CD transport section are electrically isolated from the digital circuits by means of opto-couplers. The four ultra high speed,  $40\text{Mbit/sec.}$  opto-couplers per channel provide excellent electrical insulation, while faithfully transmitting signals in the form of light.

High frequency noise can also be transmitted through the power supply circuitry, even if the digital and analog circuits are isolated. To cut off this noise, an independent power transformer is provided for each of the digital and analog circuits.

To further improve the audio characteristics, the power for the left and right channel is supplied from different windings of analog transformer.

High frequency noise can also be transmitted through air as static-electric or electro-magnetic interference. This interference is eliminated by shielding the digital and analog circuits from each other by means of a thick metal plate placed between the two circuit sections.

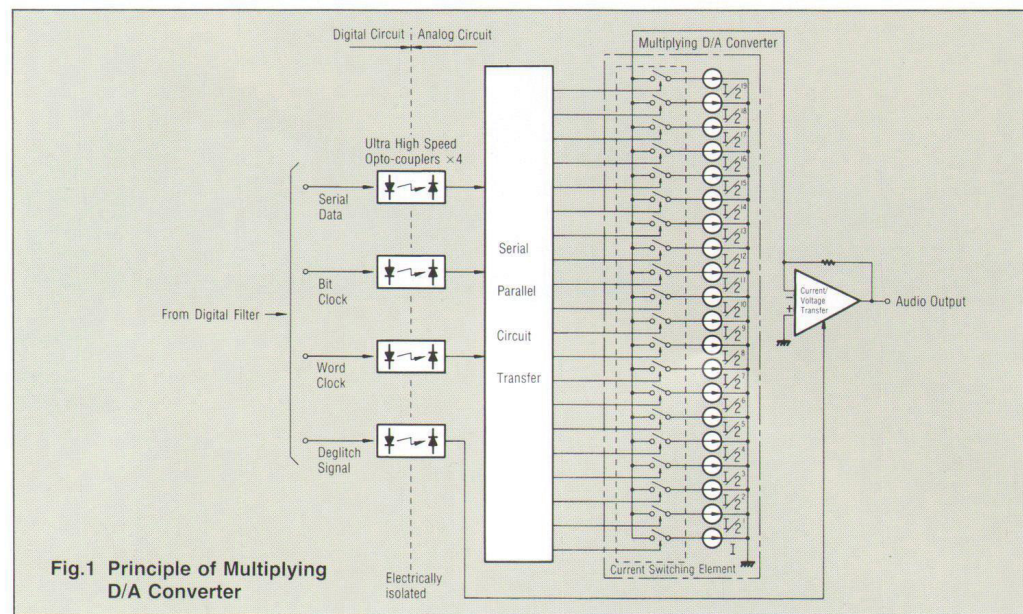
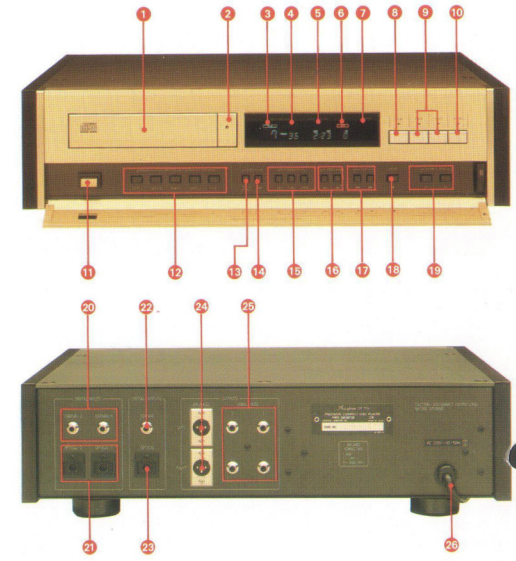
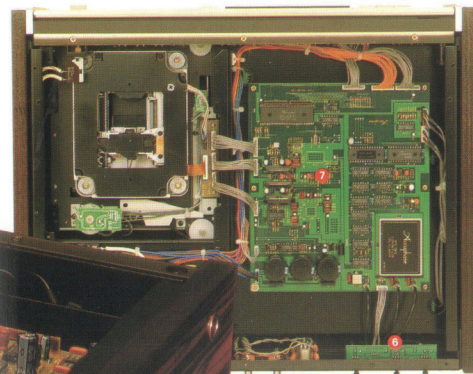
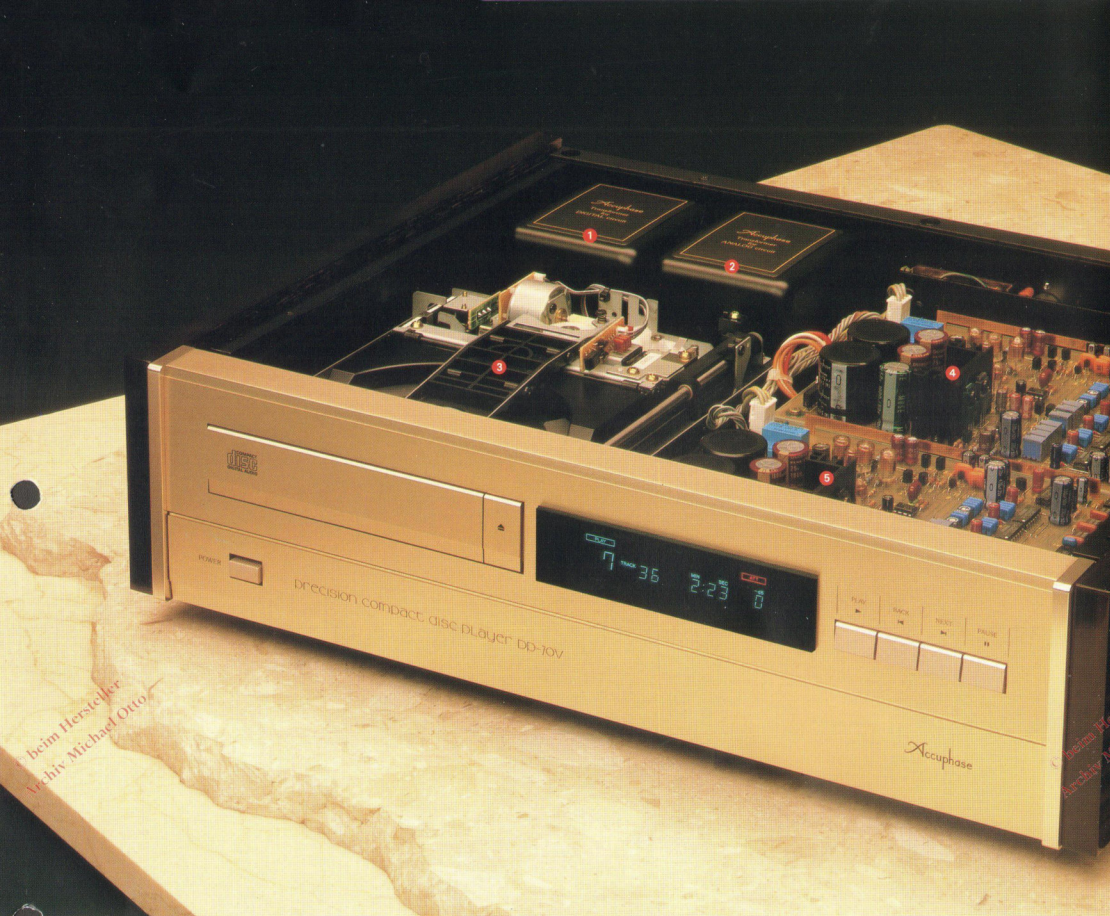


Fig.1 Principle of Multiplying D/A Converter



**Interior (upper side)**

- 1 Power transformer for digital circuit
- 2 Power transformer for analog circuit
- 3 CD mechanical deck
- 4 Right-channel analog circuit board
- 5 Left-channel analog circuit board

**Interior (bottom)**

- 1 Optical signal transmitter (for digital input and output)
- 2 Digital signal processing circuit board
- 3 Master microcomputer, servo circuits, digital filter, and PLL circuit are mounted.

**Front Panel**

- 1 Disc tray
- 2 Disc tray OPEN/CLOSE switch
- 3 Play track indicator
- 4 TRACK/INDEX indicator
- 5 Time indicator
- 6 Output level indicator
- 7 Remote sensor
- 8 Play key
- 9 Track search key
- 10 PAUSE key
- 11 Power switch
- 12 Input selector key
- 13 TRACK/INDEX selector
- 14 Time display selector
- 15 Repeat key

**Rear Panel**

- 1 Index search key
- 2 Disc reverse/fast forward key
- 3 STOP key
- 4 Output level adjuster
- 5 Digital input jack
- 6 Digital input optical fiber connector
- 7 Digital output jack
- 8 Digital output optical fiber connector
- 9 Balanced output connector (for audio output) Cannon made XLR-3-32 or equivalent
- 10 Unbalanced output jack (for audio output) 1: ground 2: inverted (-) 3: non-inverted (+)
- 11 AC power cord

**Digital Control Center Functions Compatible with 3-Sampling Frequencies: 32kHz, 44.1kHz, and 48kHz. 4 Digital Input Systems and 2 Digital Outputs Systems Permit Digital Copying**

DAT technology is now coming of age, and satellite broadcasting is becoming ever more popular. DAT recorders and BS tuners are providing direct digital outputs, thus offering an excellent opportunity of high grade, high quality sound reproduction through a high quality D/A converter. To provide compatibility with these new technologies, the DP-70V is equipped with digital input terminals, which assure excellent sound quality thanks to its high quality converter. The DP-70V digital control center functions allow the internal converter to reproduce these digital signals. The three pre-programmed sampling frequencies (32kHz, 44.1kHz, and 48kHz) are selected automatically to match the source frequency.

A lithium-tantalate monocrystal oscillator is used in the VCO, which generates the sampling frequencies. The lithium-tantalate monocrystal resonator restricts the side-spectrum to the level achieved by a crystal resonator, while offering a wide locking range of the sampling frequencies.

The four pairs of digital inputs (two optical and two coaxial) and two pairs of digital outputs (one optical and one coaxial) permit direct digital copying.

**Noise Shaper Reduces Quantization Noise**

The noise shaper reduces noise across the audio frequency band by feeding back the interpolation errors generated by the digital filter to the next data.

Coupled with the 20-bit conversion, the noise shaper

effectively reduces the requantized noise to extremely low levels. This considerably improves the sensation of silence in sound reproduction and the sound quality, while allowing full reproduction of delicate nuances.

**Digital Deemphasis Circuit Achieving the Ideal Characteristics of 0.001dB Deviation and a Phase Difference Within 1.5°**

To improve the S/N ratio, some CD's are produced using special recording methods, in which the high frequency area of the recording is emphasized. The emphasized high frequency band should be deemphasized during playback. These CD's include a special signal, which is detected by the player during reproduction to automatically deemphasize such emphasized high frequency characteristics.

Normally, these characteristics cause CR elements to change the frequency characteristics of the audio circuits, but the DP-70V employs a digital deemphasis circuit to change the characteristics already at the digital signal stage.

The deemphasis circuit achieves the ideal performance characteristics of deviation of +0.001dB and phase difference within 1.5° vis-a-vis the prescribed characteristics to prevent sound deterioration of such emphasized CD's.

**Digital Level Control**

The disc access can be controlled from the remote commander, but it is extremely inconvenient to have to rely on the setting of the amplifier function knobs to control the volume level.

In the DP-70V, the advantages of the 20-bit D/A

converter have been exploited to provide a digital volume control. The volume can be adjusted in 1dB steps from -40dB. Thanks to the extra four bits, ideal level control is achieved without deterioration of the sound quality even at low volume.

**Fully Balanced Output**

The DP-70V is equipped with two pairs of normal RCA phono jack terminals and one pair of XLR type balanced connectors, which Accuphase favors for their noise-free, high quality sound reproduction.

**PLAYER UNIT**

**The CD Transport Mechanism is Mounted on a Floating Aluminum Diecast Frame to Eliminate Vibrations and Resonance. Extra Heavy Chassis**

Since the spindle rotates at high speeds, between 200 to 500 r.p.m., measures are required to restrict vibration and resonance, which may cause internal parts to vibrate and thus impair sound quality. The DP-70V mechanism is mounted on an aluminum diecast frame to prevent resonance. This frame is floated above the chassis to cut off the transmission of vibrations. As a result, the entire disc tray is floating to minimize external vibrations on the mechanism.

Analysis of the vibration modes of the mechanical construction has revealed that by supporting the mechanism on a thick metal chassis, it is most effective in improvement of the resistance to secondary vibrations. The rigid frame construction makes the unit impervious to external vibrations, so that sound quality is unaffected by the location or by sound pressure from nearby speakers.

**Laser Pickup with Built-in RF Amplifier Offers Improved Noise Resistance Characteristics.**

In normal CD players, the output of the photodetector mounted to the laser pickup, which reads the signals, is conducted outside the CD transport unit, where it is then amplified by the RF amplifier. This system is susceptible to noise and code distortion due to the low photodetector output voltage.

This noise susceptibility has been overcome in the DP-70V by the development of an ultra compact RF amplifier, which is attached to the photodetector to increase the output signal voltage, thus ensuring an accurate digital signal.

**All Operations Controlled from a Single Master Clock to Eliminate Sound Deterioration by Beats**

It is a crystal resonator clock that creates the standard signal, which controls the operation of a CD player. Normally, two separate clocks are used to control the digital processor and the microprocessor. However, if the frequencies generated by these two clocks differ by even a small amount, the system can produce beats, which impair the sound quality.

In the DP-70V, a single crystal resonator is used to generate a standard clock signal, which controls all unit operations. The single clock signal eliminates the possibility of harmful beats, thus guaranteeing excellent interference-free sound quality.

**Linear Motor Pickup and 8-bit Microprocessor Achieve Access Time under 1 second**

Key selection of tracks in CD is one of the most attractive features of CD players. The DP-70V employs the

most advanced linear motor mechanism to drive the laser pickup. Controlled by the 8-bit microprocessor, which has been exclusively developed for Accuphase CD players, the pickup smoothly and quickly selects any track in approximately one second.

In addition, the rapid disc transport tray action imparts a smooth, soft feeling.

**Frame Reproduction Function Permits 1/75 sec. Access Time and Reproduction**

The CD digital signals are divided into 1/75 second units, known as frames. The DP-70V permits access and reproduction of each such frames; thus enabling the selection of explosive sounds from a cannon or quick, pulse type signals to be accurately output.

**Simple, Elegant Design Harmonizes with Other Accuphase Products**

The simple layout with the operational controls arranged in a separate sub-panel and an elegant champagne gold finish, makes the DP-70V harmonize perfectly with other Accuphase components.

The natural persimmon sideboard enhances the atmosphere of your listening room.

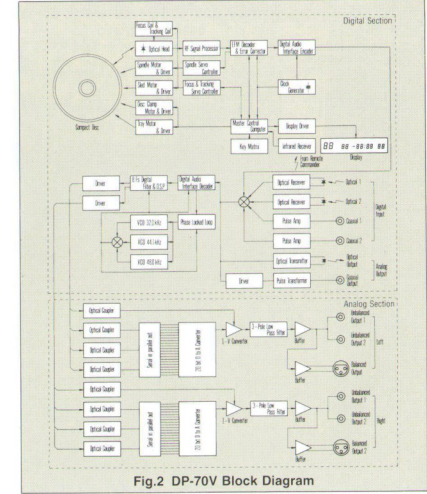
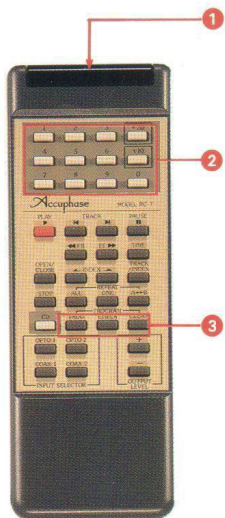


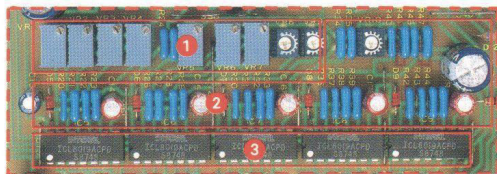
Fig.2 DP-70V Block Diagram



**Remote Commander RC-7**  
(Functions added separately from the main unit)

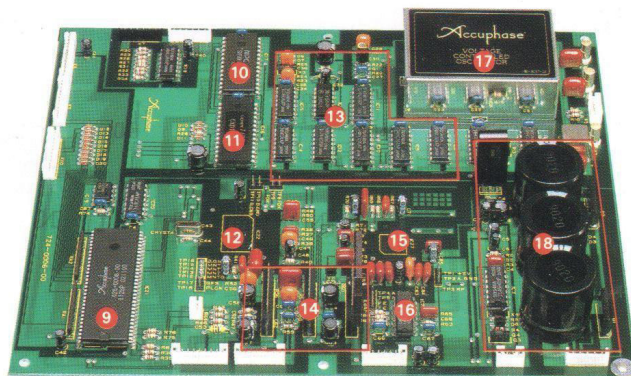
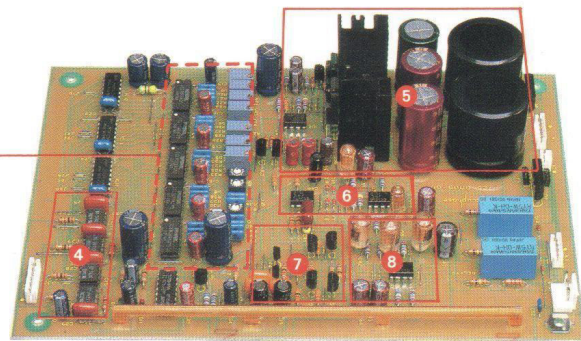
- 1 LED transmitting section
- 2 Direct selection key
- 3 Program key

Ultra high precision 20-bit discrete D/A converter



**Circuit Board**

- 1 Precision potentiometers
- 2 Ultra precision metal foiled resistors
- 3 4 bit × 5 current switches
- 4 Ultra high speed photo isolators
- 5 Regulated power supply for analog circuit
- 6 Output circuit
- 7 Current and voltage converter
- 8 3-pole GIC Butterworth lowpass filter
- 9 8-bit, 16kbyte original microcomputer
- 10 Digital signal processor
- 11 IC for DAI (Digital Analog Interface)
- 12 IC for digital signal processing circuit (on the back of the circuit board)
- 13 PLL (phase-locked loop) circuit
- 14 Laser pickup driver
- 15 IC for servo signal processing circuit (on the back of the circuit board)
- 16 Digital potentiometer
- 17 VCO for 32kHz, 44.1kHz, and 48kHz
- 18 Power supply for logical circuit



We have a philosophy of offering products that can satisfy music lovers who want high quality audio reproduction. We don't want to make just ordinary audio equipment, but rather equipment that will move one's heart or set it at rest with the sound of the music that the equipment can produce. This is the philosophy of Accuphase.



enrich life through technology

## QUARANTY SPECIFICATIONS

(Guarantee specifications are measured according to EIA-J standard CP-307.)

### Performance Guaranty:

All Accuphase product specifications are guaranteed as stated.

### TRANSPORT SECTION

#### ● Format:

CD standard format  
Error correction method: CIRC  
Number of channels: 2  
Spindle speed: 200 to 500 r.p.m. (CLV)  
Scan velocity: 1.2m/s to 1.4m/s

#### ● Data read method:

Non-contact optical pick-up (semiconductor laser pickup)

#### ● Laser:

GaAlAs (double hetrodyne diode)

#### ● Digital output format level (conforming to EIA standards):

Format: Digital audio interface  
Optical: Output: -21 to -15dBm (EIAJ)  
Wavelength: 660nm  
Coaxial: 0.5Vp-p at 75 ohms

### DIGITAL PROCESSOR SECTION

#### ● Format:

EIA standard format  
No. of quantizations: 16 bits linear  
Sampling frequency (timing accuracy: Level II)  
32.0kHz  $\pm 0.1\%$   
44.1kHz  $\pm 0.1\%$   
48.0kHz  $\pm 0.1\%$

#### ● Frequency response:

4.0 to 20,000Hz  $\pm 0.3$ dB

#### ● D/A converter:

20-bit, discrete type

#### ● Digital filter:

20-bit, 8-times oversampling  
Noise shaper function  
Digital deemphasis function  
Deviation:  $\pm 0.001$ dB

#### ● Total harmonic distortion & noise:

0.0016% (1,000Hz)  
0.002% (20 to 20,000Hz)

#### ● Signal-to-noise ratio (S/N):

119dB

#### ● Dynamic range:

98dB

#### ● Channel separation:

109dB

#### ● Rated output voltage and impedance:

Balanced: 2.5V at 50 ohms (25/25 ohms), balanced XLR type  
Unbalanced: 2.5V at 50 ohms, RCA phono jack type

#### ● Output level control:

0 to -40dB, 1dB steps (digital method)

#### ● Digital input format level (conforming to EIA standards):

Format: Digital audio interface  
Optical: Output: -15 to -27dBm  
Coaxial: 0.5Vp-p at 75 ohms

### OTHERS

#### ● Semiconductors complement:

32 transistors, 74 IC's, 66 diodes

#### ● Power requirements:

100V, 117V, 220V, 240V, 50/60Hz

#### ● Power consumption:

23W

#### ● Dimensions:

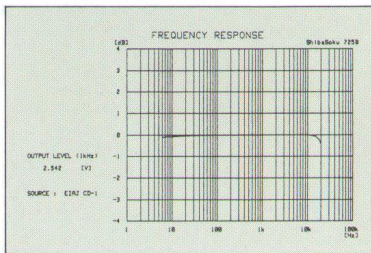
475mm (18-11/16") width, 35mm (5-5/16") height, 375mm (14-3/4") depth

#### ● Weight:

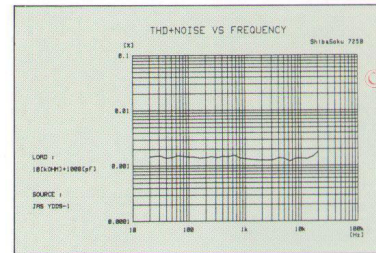
24.3kg (53.6 lbs.) net  
29.3kg (64.6 lbs.) in shipping carton

### Supplied Remote Commander RC-7

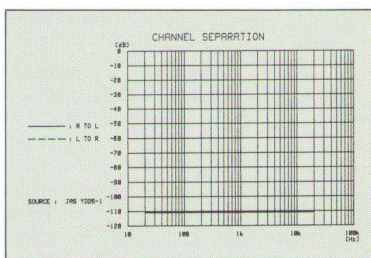
Remote control system: Infrared pulse  
Power requirements: 3V DC  
Batteries: 2 x IEC designation R6 (size AA)  
Dimensions: 64mm (2-1/2") width x 18mm (11/16") height x 176mm (6-15/16") depth  
Weight: 180g (6.3 oz) including batteries



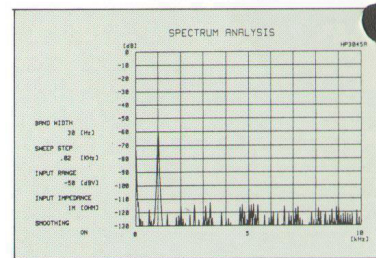
● Frequency characteristic



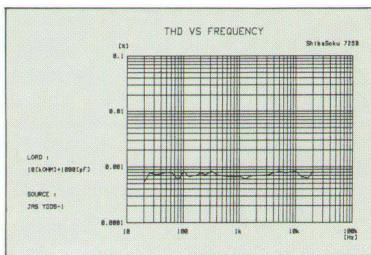
● THD + noise vs. frequency characteristic



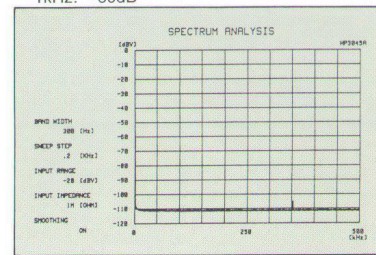
● Channel separation characteristic



● Spectrum analysis of reproducing signal at 1kHz: -60dB



● THD vs. frequency characteristic



● Spectrum analysis of non-signal reproduced noise vs. frequency characteristic (352.8kHz sampling frequency is attenuated to about 105dBV.)

Accuphase

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