

Accuphase

COMPACT DISC PLAYER

DP-60



COMPACT
disc
DIGITAL AUDIO

"8-time Oversampling Digital Filter", "18-bit D/A Converter" Precisely Adjusted One by One, and Complete Separation Between the Digital and Analog Sections via the "Very High Speed Optoisolators"



DP-60

COMPACT DISC PLAYER

Utilizing the technology developed for its predecessor, the top-rated DP-80L/DC-81L, Accuphase's new CD player, the DP-60, brings to the user an attractive world of music, unattainable with any other CD players of this class.

Inside the chassis of the DP-60, digital circuitry, such as the player, is electrically isolated from the analog circuitry by ultra high-speed, optoisolators with a transmission capacity of 40Mbits/second. In addition, special technology protects the internal circuitry from electromagnetic and static electricity interference, thus preventing the sound quality from being degraded by high-frequency noise.

Carefully selected, top-grade 18-bit ICs are adopted for the D/A converters, each of which is precisely adjusted on the production line to achieve upper-limit performance. A 20-bit eight-time oversampling filter, the most advanced digital filter, is provided for both the left and the right channels. These digital filters are independent of each other and achieve an unnecessary bandpass attenuation of -110dB and a bandpass ripple of $\pm 0.00005\text{dB}$.

The DP-60 can boast a lot more of Accuphase's state-of-the-art technology though, such as a noise shaper that reduces re-quantized noise to near the theoretical lower limit, a 3-pole GIC lowpass filter with excellent amplitude and phase characteristics, a high-precision digital deemphasis circuit with a deviation of $\pm 0.001\text{dB}$, and digital remote control that can adjust the gain up to -24dB in 1dB units.

Another feature of DP-60 is its rigid construction and high resistance to vibration and shock. The linear motor laser pickup is securely mounted on a diecast aluminum frame and the mechanism itself is fixed to a metal chassis of 1.6mm thick, so that the vibration generated by the motor is almost completely absorbed. This construction brings the total weight of DP-60 to 14.5kg , making it one of the heaviest CD players available.

The custom-built 8-bit microprocessor in the DP-60 gives remarkably short access time of 1 second or less.

The side panels of the DP-60 use natural persimmon board, following the design of the series of Accuphase models, with only the necessary switches on the front panel for ease of operation.

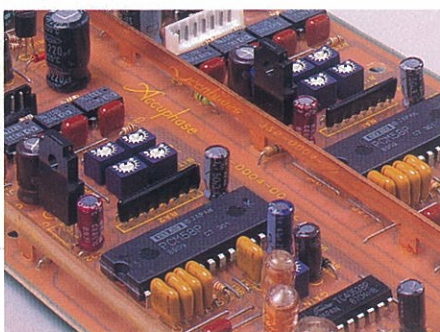
Despite this simplicity of appearance, the DP-60 has many convenient functions, such as "power-ON play" that automatically starts playback when the power is turned on, and a function to display and play back in units of one frame ($1/75$ second).

The DP-60 has opened a new era in the world of digital audio.

1 Individually Adjusted 18-bit D/A Converters

The D/A converter is the heart of digital audio equipment. The Accuphase DP-60 employs carefully selected 18-bit D/A converter ICs offering excellent characteristics. These D/A converters are designed specifically so that their bit precision can be individually adjusted during the production process to achieve upper-limit performance.

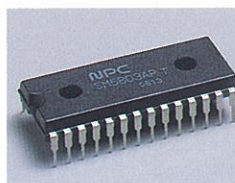
While the number of bits of a D/A converter can be increased by connecting an external circuit to the converter. The technique has no real effect on an IC with a precision as high as 18 bits. In producing the DP-60, therefore, the utmost emphasis is placed on perfecting the 18-bit precision of the ICs, and the long-term stability of the unit under a variety of environmental changes. All the D/A converters in the DP-60 have achieved the theoretical upper-limit characteristics.



2 Independent 20-bit Eight-Time Oversampling Filters for Both Left and Right Channels

A digital filter eliminates the causes of sound quality degradation by increasing the sampling frequency in multiples of fundamental frequency and by employing the noise-reducing audio filter with smooth cutoff characteristics. Therefore, a digital filter that can only deal in multiples is not enough for practical applications, and the capability to suppress the unwanted component in the audio band and between sampling frequencies is of the utmost importance.

The DP-60 employs eight-time oversampling digital filters that operate on a high-level digital algorithm and suppress un-



wanted components in the range of 24.1 to 328.7kHz to an astonishing level of -110dB . Bandpass ripple, which can cause degradation of sound quality, is reduced to $\pm 0.00005\text{dB}$, proving that these digital filters are the highest in quality currently available on the market.

3 3-Pole GIC Butterworth Active Filter Having Specially Selected Elements

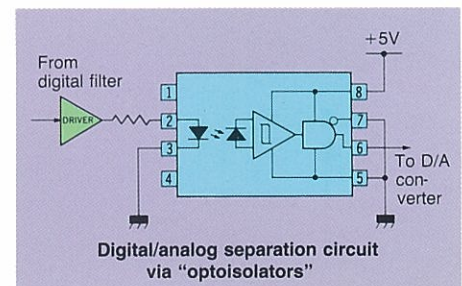
Since the sampling frequency is increased eight-fold to 352.8kHz , the signal output from the D/A converter contains high-frequency components of over 332.8kHz ($=352.8/20$). Of course, unwanted components also exist in sampling frequencies that are increased 16-fold, 24-fold, and so on. An audio lowpass filter that cuts off these unwanted high-frequency components should only have moderate, 3-pole (18dB/oct.) characteristics. The discrete 3-pole GIC Butterworth active filters employed in DP-60 are made up of specially selected elements to improve the sound quality.

4 Digital Circuitry and Analog Circuitry are Completely Isolated to Prevent Degradation of Sound Quality by High-Frequency Noise

Digital signals have components of very high frequency, which may mutually interfere with demodulated audio signals, degrading the sound quality. To prevent this, it is essential to completely isolate the digital circuitry from the analog circuitry to suppress the influence of static electricity and electromagnetism.

The digital circuitry, including the player, of the DP-60 is electrically isolated by optoisolators from the analog circuitry in the stage following the D/A converter. Four ultra high-speed, optoisolators with a transmission capacity of 40Mbits/second are provided for each channel, so that only high-fidelity signals are transmitted in the form of light.

But though the digital and analog circuitry are

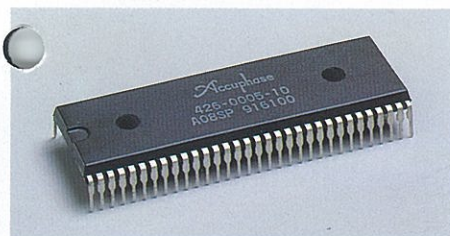


isolated, high-frequency noise may be transmitted along the power cable. Therefore, the digital and analog circuits have their own independent power transformers to maintain their isolation. In addition, the power to the left and right channels is supplied from different windings to improve audio characteristics.

High-frequency noise may also travel through air, causing static electricity and electromagnetic interference. Electrically isolating the digital and analog circuits is therefore not enough to protect them from the adverse influence of high-frequency noise. For this reason, both the analog and digital circuits of the DP-60 are completely shielded with a thick metal plate.

5 Selection Time of 1 Second or Less is Achieved by Employing a Linear Motor Laser Pickup and 8-bit Microprocessor

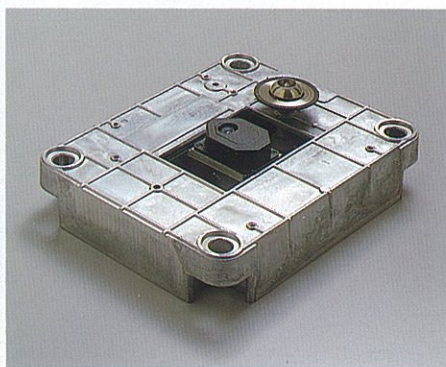
Direct key selection is an attractive feature of CD players. The DP-60 employs the most advanced linear motor mechanism for swift and smooth tracking of the laser pickup. With this mechanism and the 8-bit microprocessor developed for this CD player, selection time of 1 second or less is achieved. Additionally, the disc table is controlled by microprocessor, guaranteeing smooth operation.



6 The Mechanism is Mounted on a Diecast Aluminum Frame Floated from the Chassis so that the Effects of Vibration and Resonance on the Sound Quality are Virtually Eliminated.

Since the disc rotates at 200 to 500rpm, if measures to eliminate vibration and resonance are not taken, components inside the unit will vibrate and cause deterioration of sound quality. In the DP-60, the mechanism itself is mounted on a floating diecast aluminum frame so that vibration is almost totally eliminated. Similarly, the disc compartment is also floated from the chassis so that external shock to the mechanism is minimized.

The DP-60 weighs 14.5kg and is one of the heaviest of CD players. The thick, metal frame construction of the entire unit is effective against vibration and resonance, and the sound quality is not affected by sound pressure from the speakers or by location, guaranteeing stable operation.



7 Noise Shaper

A noise shaper reduces the noise in the audio frequency band by feeding back the rounding errors generated by each digital filter to the next data. This noise shaper reduces the requantized noise to the lower limits to improve sound quality and allow full reproduction of delicate nuances.

8 Digital Deemphasis Circuit with Ideal Characteristics of 0.001dB Deviation and 1.5 degree Phase

Emphasized CD software that raises the high-frequency band during recording and lowers it during reproduction to improve the signal-to-noise ratio is now available on the market.

These emphasized CDs have special signals which are detected by the player during reproduction so that the high-frequency characteristics are automatically selected. These characteristics cause CR elements to change the frequency characteristics of audio circuits. The DP-60 employs a digital deemphasis circuit that changes the frequency characteristics at the digital signal stage. This deemphasis circuit achieves an ideal deviation of $\pm 0.001\text{dB}$ and a phase of 1.5 degree maximum vis-a-vis given values, allowing the DP-60 to fully exploit emphasized CDs.

9 DC Directly Coupled Output Stage with a Buffer Amplifier with 0dB Gain

The quality of reproduced sound is ultimately determined by the performance of the audio stage. The DP-60 has converters with output that does not need to be amplified and a DC servo directly coupled amplifier with a buffer only. As a result, the upper limits of signal-to-noise ratio and distortion characteristics have been achieved.

10 Digital Level Control that Can be Adjusted by Remote Commander. Three Output Systems: Two Unbalanced and One Balanced.

The DP-60 is provided with a digital level control, making the best use of the 18-bit D/A converter. Thanks to the extra two bits, the sound quality is not degraded even when the volume is turned down, and the level can be controlled ideally in a range of 0 to -24dB by the remote commander.

Two pairs of ordinary RCA phono jacks and one pair of XLR type balanced output jacks are provided. The balanced output jacks are the result of

Accuphase's search for the overall balance of amplification systems in a product, and have made noise-free, high quality sound possible.



11 Wideband Optical Fiber and 75-ohm Coaxial Cables for Output

The digital signals are output from a standard 75-ohm coaxial cable connector and optical fiber connector, as originally proposed by Accuphase and regulated by EIA. The optical transmitter improves pulse width distortion and jitter, so that excellent, pure signals can be transmitted.

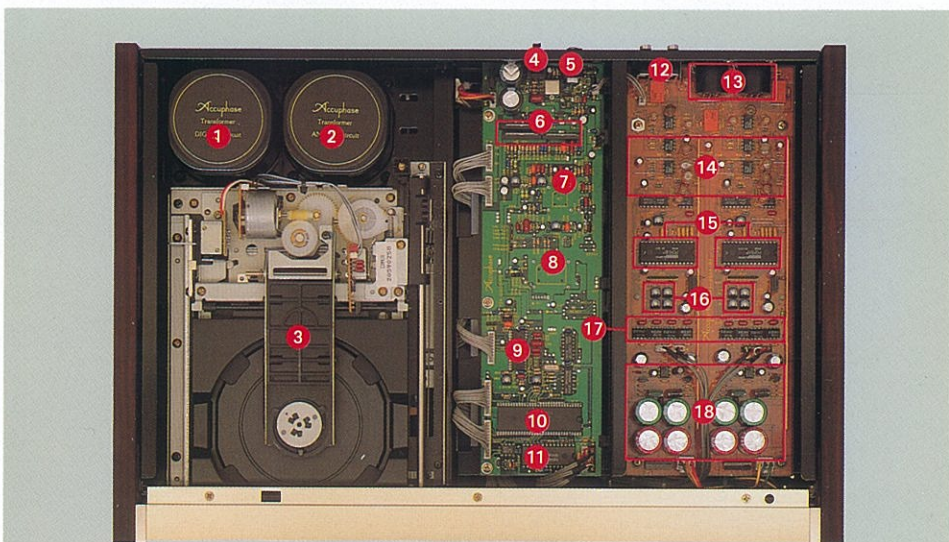


12 Power-ON Play Function that Starts Playback from Specified Music

The DP-60 has a power-ON play function that works with a timer to begin playback as soon as the power is applied. The starting track can also be freely selected.

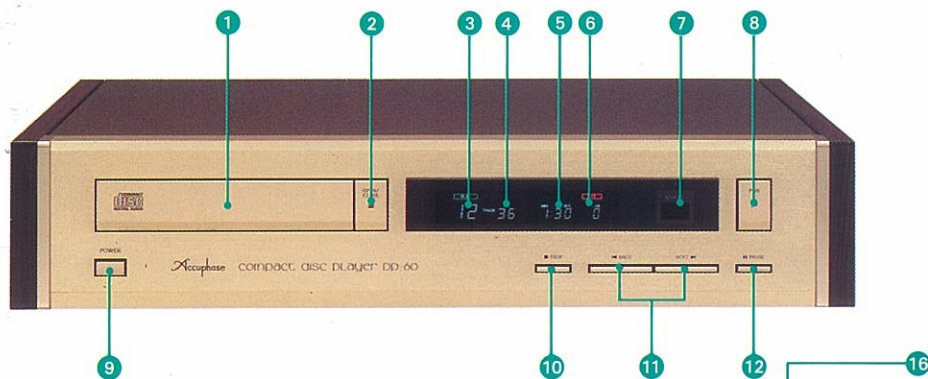
13 Simple, Yet Elegant Appearance, Creating a Refined Mood.

The DP-60 has a neat design with Accuphase's traditional champagne-gold finish front panel, with only the necessary switches. The side panels, made of persimmon board, create a refined look that adds elegance to its surroundings.



Internal layout

- | | |
|--|--|
| 1 Power supply transformer for digital circuit | 11 20-bit 8fs digital signal processor |
| 2 Power supply transformer for analog circuit | 12 Receptacle for unbalanced output |
| 3 CD mechanism deck | 13 Receptacle for balanced output |
| 4 Optical digital output receptacle | 14 3-pole GIC type tertiary Butterworth low-pass filter |
| 5 Coaxial digital output receptacle | 15 18-bit D/A converter |
| 6 Operating amplification IC group for mechanical drive | 16 Trimmer for adjusting the top 4-bit |
| 7 ICs for servo control (rear side) | 17 Very high speed optocoupler group for separation between digital and analog signals |
| 8 ICs for digital signal processing (rear side) | 18 Power supply circuit for rectifying and stabilizing the analog circuit |
| 9 RF amplification ICs for laser pickup | |
| 10 8-bit microprocessor (for mechanicals and main control) | |



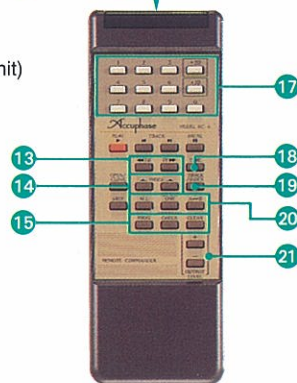
DP-60 front panel

- 1 Disc tray
- 2 Disc tray OPEN/CLOSE key
- 3 Play track indicator
- 4 TRACK/INDEX indicator
- 5 Time indicator
- 6 OUTPUT LEVEL indicator
- 7 Remote sensor
- 8 PLAY key
- 9 Power switch
- 10 STOP key
- 11 TRACK search key
- 12 PAUSE key

Remote commander RC-4

(Functions added separately from the main unit)

- 13 Fast rewind/fastforward keys
- 14 INDEX search key
- 15 PROGRAM key
- 16 LED transmitting section
- 17 Direct play key
- 18 Time display switching key
- 19 TRACK/INDEX display switching key
- 20 REPEAT key
- 21 OUTPUT LEVEL adjusting key

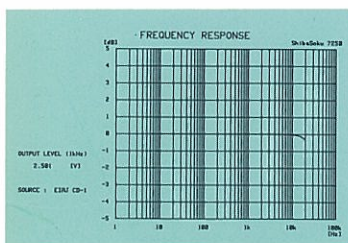


Remote Commander RC-6 (Optional)

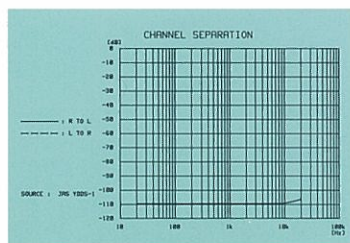


The RC-6 Remote Commander can be used control the E-405 Integrated Amplifier and the DP-60 CD Player, as well as the T-108 FM Tuner.

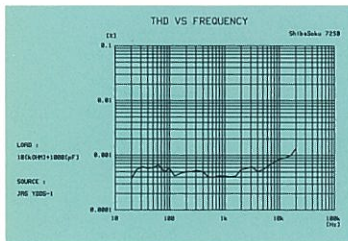
Remote control system: Infra-red pulse
Power supply: 3V DC (Two IEC R14 batteries)
Dimensions: 237mm (9-5/16") width, 39mm (1-1/2") height, 175mm (6-7/8") depth
Weight: 1.4kg (3.1 lbs) including batteries



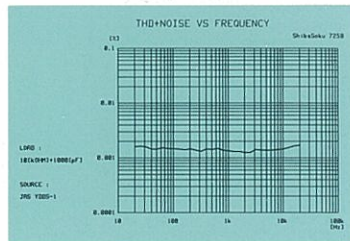
• Frequency characteristic



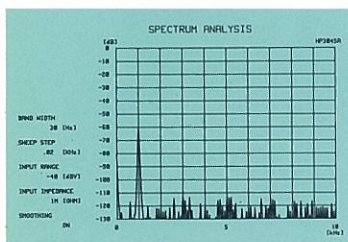
• Channel separation characteristic



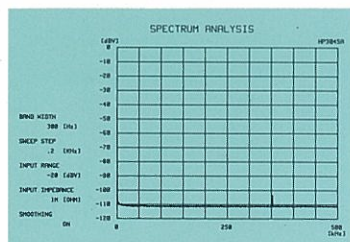
• THD vs. frequency characteristic



• THD + noise vs. frequency characteristic



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



• Spectrum analysis of non-signal reproduced noise vs. frequency characteristic (352.8kHz sampling frequency is attenuated to about 104dBV.)

GUARANTY SPECIFICATIONS

(Guaranty specifications are measured according to EIAJ standard CP-307.)

Performance Guaranty:

All Accuphase product specifications are guaranteed as stated.

- **Type:** CD digital signal player
- **Format:** Compact disc standard format
Number of quantizations: 16 bits
Sampling frequency: 44.1kHz
Error correction method: CIRC
Number of channels: 2
Spindle speed: 200 to 500rpm
Scan velocity: 1.2 to 1.4m/s
- **Data read:** Non-contact optical pickup (semiconductor laser pickup)
- **Laser:** GaAlAs (double heterodyne diode)
- **Frequency characteristics:** 4.0 to 20,000Hz ± 0.3 dB
- **D/A converter:** Ladder resistor type, 18 bits
- **Digital filter:** Eight-time oversampling
Noise shaper function
Digital deemphasis function
Deviation: ± 0.001 dB
- **Total harmonic distortion + noise:** 0.002% (20 to 20,000Hz)
- **Signal-to-noise ratio:** 114dB
- **Dynamic range:** 98dB

- **Channel separation:** 106dB
- **Output voltage and impedance:**
Balanced: 2.5V at 50 ohms (25 ohms/25 ohms), balanced XLR type
Unbalanced: 2.5V at 50 ohms, RCA phono jack
Digital level control: 0 to -24dB, 1dB steps
- **Digital output format level:**
Format: digital audio interface
Optical: output: -21 to -15dBm (EIAJ)
wavelength: 660nm
Coaxial: 0.5Vp-p at 75 ohms
- **Semiconductors used:** 15 transistors, 46 ICs, 26 diodes
- **Power requirements:** Voltage: 100V, 117V, 220V, 240V, 50/60Hz
- **Power consumption:** 20W
- **Dimensions:** 475mm (18-11/16") width, 115mm (4-1/2") height max., 325mm (12-13/16") depth
- **Weight:** 14.5kg (32.0 lbs.) net, 19.5kg (43.0 lbs.) in shipping carton
- **Supplied remote commander RC-4**
Remote control system: Infrared pulse
Power requirements: 3V DC with two batteries IEC designation R6 (size AA)
Dimensions: 64mm (3-1/2") width, 176mm (6-15/16") height, 18mm (11/16") depth
Weight: 180g (0.4 lbs) (including batteries)