

# DENON

INTEGRATED AMPLIFIER

## PMA-SA1

CD / SUPER AUDIO CD PLAYER

## DCD-SA1

## The last frontiers of audio await exploration.

The yearning to experience a performance of great music, again and again with refreshing depth, lies in the heart of every audiophile. Whether it be classical music, jazz, popular songs, rock and roll, or traditional folk music, DENON continues to find a way to reproduce high-quality digital sound sources so that lovers of any kind of music can quickly be transported to the real performance of their choice.

This aspiration for the ultimate audio experience permeates all of DENON's development efforts. It was true when DENON developed the S1 Series 10 years ago, and of course it is still true today with the new SA1 Series.

For a decade, the S1 Series provided the foundation from which DENON continued to nurture technologies and accumulate experience, giving birth to the SA1 Series today. In the SA1, DENON proudly brings you the last frontiers of audio for you to explore.



INTEGRATED AMPLIFIER  
**PMA-SA1**

Balancing dynamic power and delicate details in sound,  
 the fruit of many years of DENON audio technology and experience.

The "S1 Series" that appeared in 1993 was a reference-class audio series designed to please the most discerning of all audiophiles.

The primary objective of the S1 Series was to reproduce "reality"---- a deeper, more natural sound.

Continuing the same quest for high-quality sound reproduction that the S1 Series had been pursuing, the PMA-SA1 combines the latest audio technologies with the reliability that DENON's amplifiers have earned over the past 10 years. From the external design to the details on the inside, the PMA-SA1 has been developed as a member of the new SA Series embodying the essence of DENON's advanced audio technologies.

With new advances in audio formats and the ability now of many households to enjoy multi-channel sound in their own home theatres, "authentic sound" is in even greater demand. The SA Series represents DENON's latest offering of possibilities in pure 2-channel audio for today's most dedicated music lovers.

Main Features

**UHC-MOS, the ideal large-current amplifier**

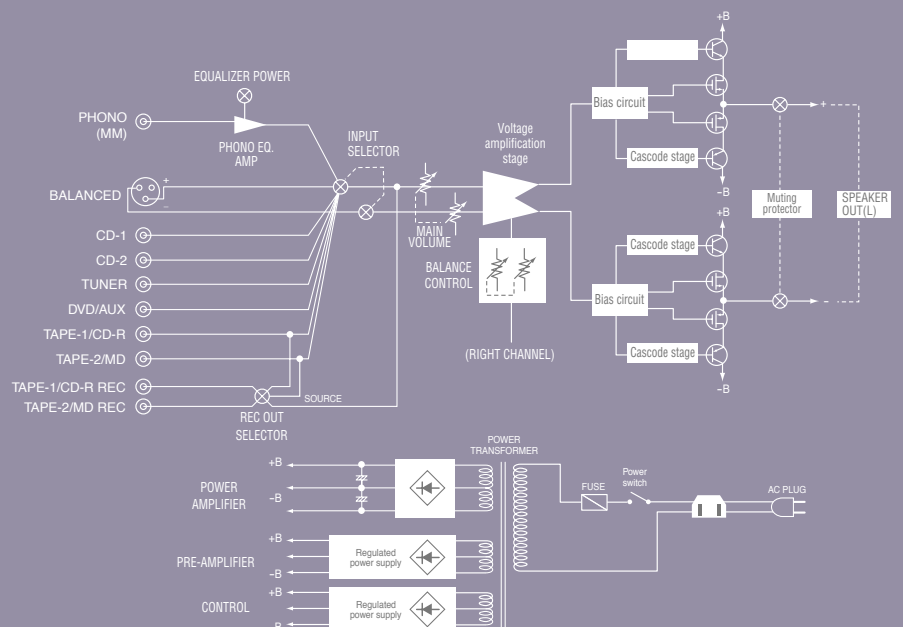
The ideal amplifier uses a minimum number of amplifier elements to control output current. Obtaining large output from simple circuitry, however, requires elements capable of handling incredibly large current. Since its development of the POA-S1, DENON has been employing the UHC-MOS large-current amplifier element in its amplifiers. DENON's UHC-MOS uses single push-pull technology to configure the ideal circuit for a large-output amplifier. The UHC-MOS has a gain that is even higher than that of bipolar transistors; with a single element, the UHC-MOS achieves the current linearity of 35 MOS-FETs and 3 bipolars. The UHC-MOS incorporates the capability of MOS-FETs to reproduce the delicate nuances of music and thus masterfully reproduces the full sonic range, from the sound of a violin solo that gradually tapers off into the acoustics of the hall, to the dramatic climax of a full orchestra that causes heaven and earth to tremble.



**Cascode Bootstrap Connection, to bring out the maximum potential of UHC-MOS**

This UHC-MOS that boasts large current and superior linearity on its own suffers from low withstand voltage and large junction capacity. Solving these shortcomings is the Cascode Bootstrap Connection, a technology that ensures

stable operation and brings out the UHC-MOS's outstanding conversion characteristics. The cascode bootstrap circuitry maintains voltage to the UHC-MOS at a constant level and solves the size of junction capacity. In addition, it vastly improves temperature stability to successfully stabilise and bring out the superior acoustic characteristics of the UHC-MOS.





### Simple amplifier stage configuration

The cascode bootstrap circuitry in the PMA-SA1 achieves ideal characteristics at the power amplification stage and ensures stable operation. This solution simplifies the configuration of the power amplification stage and allows the amplifier to reproduce music with total purity. The stable operation and drive capabilities of the UHC-MOS also help eliminate sources of resistance that degrade the quality of the musical signal. This produces a circuit configuration in which the output stage, equipped with powerful drive capabilities, is directly connected to the speakers.

### All-stage balanced amplifier configuration, to protect clarity of musical signals

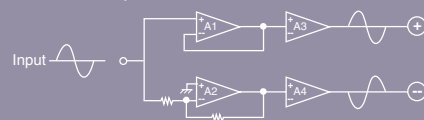
The PMA-SA1 has achieved a balance among all stages. Since a balanced configuration makes it possible to keep internal voltage at a low level, superior devices for low voltage can also be used. Furthermore, since noise and interference between circuits can be suppressed and output current to the speakers is completely separated from the ground circuit, the speakers are driven purely by the output stage, giving the PMA-SA1 superior drive capabilities. The resulting sound features a truly realistic spatial expression and the music is full of life.

### Inverted $\Sigma$ Balance Circuit, realising a balanced amplifier for high sound quality

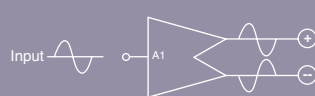
The PMA-SA1 is endowed with an Inverted  $\Sigma$  Balance Circuit that supports both balanced and unbalanced input. This design does not require separate conversion circuits in the preceding stage

but allows the signal to be input directly to the power stage in a balanced configuration. Along with the UHC-MOS of the output stage, this circuit adheres to the principle of "simple and straight" to ensure a beautiful, transparent sound.

Conventional System



New Inverted  $\Sigma$  Balance Circuit



### High-grade volume control

The PMA-SA1 has a 50mm-diameter volume control for ultimate audio performance. Low-distortion carbon ink and a multiple-contact, gold-plated wire brush have been used to ensure faithful music playback and enable highly precise volume control with maximum attenuation of -120 dB. Superior sound quality and channel separation are achieved through the use of a machined copper case that shuts out the unwanted influences of external vibration or noise.



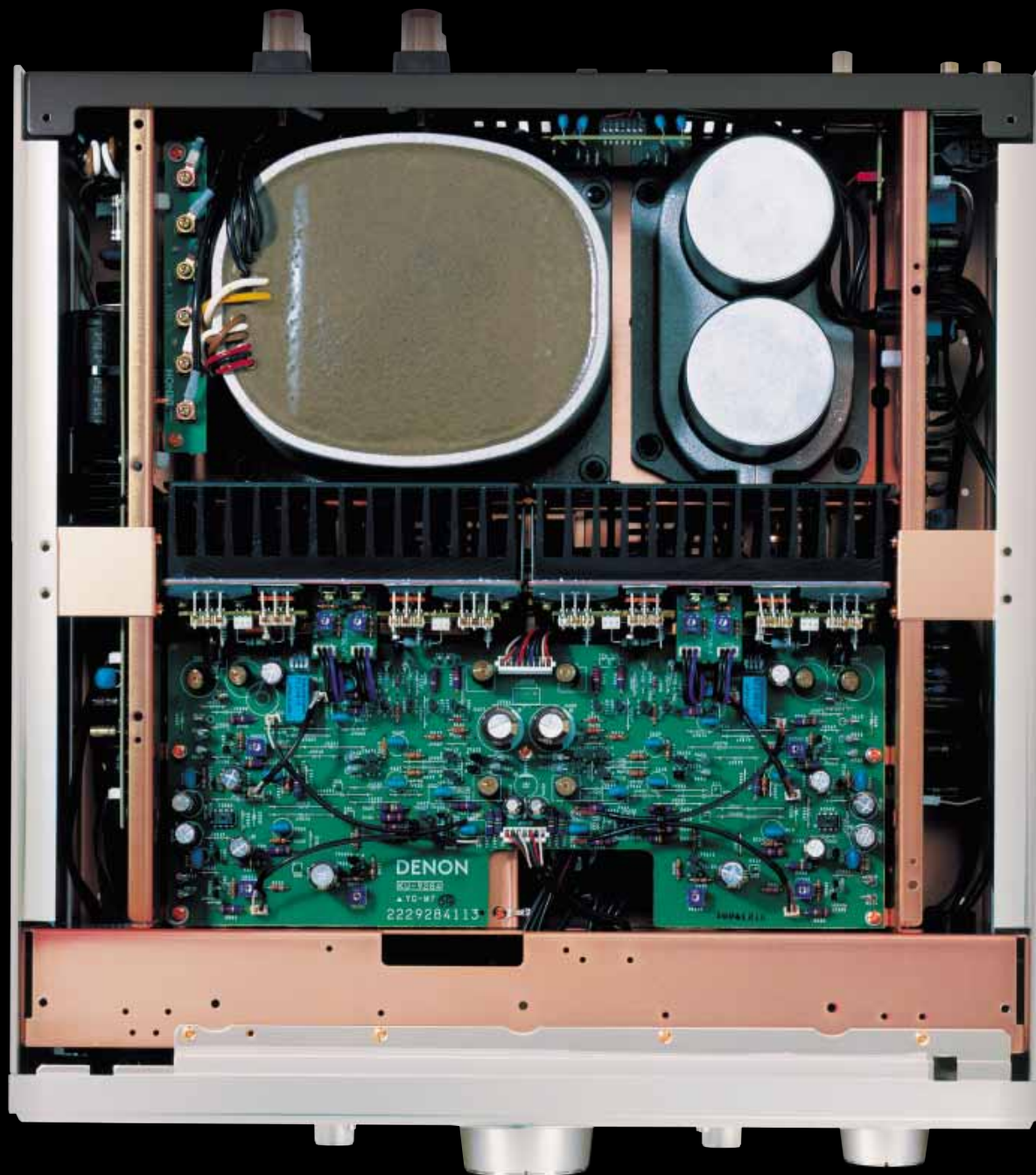
### Aluminum transformer case and capacitor holder

Since the transformer is the largest source of vibration inside an amplifier, the transformer has been placed into a highly vibration-resistant sand-cast case. Also, since the capacitors are particularly sensitive to the effects of vibration, they have been secured inside sand-cast holders. These efforts to totally protect the audio signal from the adverse effects of vibration ensure that the playback sound is perfectly clean.



### Robust power supply for each section

In the PMA-SA1's power unit, the output stage requiring large current and the voltage amplification stage requiring stability are completely isolated from the transformer coil stage. A large-capacity electrode capacitor utilising low-impedance electrode foil and high-quality-sound capacitors of different frequencies have been combined for use in rectification. In addition, low-loss, low-noise, high-speed Schottky barrier diodes have been used for the rectifier elements. These features ensure a sufficiently clean, powerful current supply. The control system including relays has also been isolated from the transformer coils to eliminate adverse influences on sound quality.



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POWER  
& TUNER  
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### **Precision Signal Ground Circuit, to preserve signal purity**

In the PMA-SA1, the adverse effects of noise from the constant current circuit and other sources onto the signal as it passes through the power amplifier stage are minimised by the careful placement of ground points for each circuit. The signal is thus amplified under ideal conditions to produce an eminently clean, transparent sound.

### **Fully independent phono equaliser amplifiers**

The phono equaliser circuit, equipped with its own dedicated stable power supply, uses a low-noise FET at the first stage, allowing the listener to enjoy recorded performances with superior sound quality and characteristics. Since the power supply is independent, the phono equaliser alone can be turned on and off. If the equaliser is not being used in CD playback or other situations, turning it off prevents adverse effects on line input.

### **"Simple & Straight" circuit design**

To ensure that music playback is pure and free of coloration, every effort has been made to keep the signal path simple and straight. The PMA-SA1 does not come with PRE OUT / MAIN IN or headphone terminals, or with tone, loudness, and muting controls.

### **Chassis construction with 6 independent blocks**

The PMA-SA1's chassis has been divided into six independent blocks for the equaliser/input section, volume control section, voltage amplification section, power amplification section, power

supply section, and the control section. The 1.6mm thick copper-plated steel plates used to construct the chassis protect the signal circuitry from external vibration and also eliminate adverse influences between the circuits.

### **Independent L/R Heat Sinks**

The PMA-SA1's heat sinks are equipped with stabilisers that sufficiently suppress resonance, and L/R separation is clearly improved by having independent heat sinks for the left and right channels.

### **Generous use of large gold-plated speaker terminals and other parts selected for high sound quality**

DENON has endowed the PMA-SA1 with a wealth of parts carefully selected for superior sound quality. These include machined gold-plated pin jacks, OFC for internal wiring, resistors, capacitors, cast insulators, and large gold-plated speaker terminals.



### **European Sound Tune**

In the selection of parts for the PMA-SA1, primary emphasis was placed on the texture and atmosphere created by the sound, since most Europeans come into contact with live performances in all genres of music on a daily basis and naturally expect this quality of sound from their

sound system at home. Amplifiers that handle delicate, low-level input signals are particularly subject to both internal and external vibrations that adversely affect the sound's transparency over the entire audible spectrum. To avoid these difficulties, DENON has devised their own unique method of combining a variety of vibration-resistant materials that ensure an ideal level of silence within the PMA-SA1. Together with its UHC-MOS single push-pull circuitry and robust power supply, the PMA-SA1 reproduces a remarkable musical balance, from the finest pianissimos to the most powerful fortissimos.



### **Improvements in Parts for High Sound Quality**

The PMA-SA1 uses parts, such as film capacitors, electrolytic capacitors, resistors, and inductors, that have been dramatically improved for sound quality over the past ten years since DENON released the PMA-S1. Each part has been carefully selected through stringent tests to ensure they perform at uniform standards and are appropriate for reproducing the original sound. In addition, OFC wire has been used for the power supply connector cable and the lead wires from the transformer. The overall aim of these parts is to produce a more natural and realistic sound.





Super radiation aluminum top cover

## Specifications

### Power Amplifier Section

Rated output..... 50 W + 50 W (8Ω, 20 Hz -20 kHz, THD 0.07%)  
 100 W + 100 W (4Ω, 1kHz, THD 0.7%)  
 Total Harmonic Distortion..... 0.007% (-3dB at rated output, 8Ω, 1 kHz)

### Preamplifier Section

Equaliser Amp Output..... 150mV  
 Input sensitivity/Impedance... PHONO MM: 2.5 mV/47kΩ  
 BALANCED: 105mV/100kΩ  
 LINE: 105mV/47kΩ  
 RIAA deviation ..... PHONO MM: 20Hz - 20kHz ±0.3dB

### General

Signal-to-noise ratio ..... PHONO MM:89dB  
 BALANCED: 105dB  
 LINE: 105dB  
 Power consumption ..... 230 W  
 Dimensions ..... W434 x H181 x D508 mm  
 Weight ..... 30kg

*Ultra High Current MOS*  
 SINGLE PUSH-PULL CIRCUIT



# DCD-SA1

Meticulously designed circuitry, drive mechanism, construction reflect the best of DENON's technology and experience.

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## Main Features

### 'Advanced AL24 Processing,' the latest technology for high sound quality



The DCD-SA1 employs Advanced AL24 Processing, the ultimate analog waveform reproduction technology developed by DENON, for use during PCM signal input (during stereo signal processing). In addition to the data expansion of existing AL24 Processing Plus technology, up-converted sampling is used to achieve natural interpolation without losing original data. Greater optimisation in digital processing algorithm has also been achieved for ringing-free pulse response and for pulsive music data and attack sounds. This enhances naturalness in the reproduction of spatial information such as the delicate nuances in the music, the locations of the performers, and the breadth, height, and depth of the concert hall.



### Original Drive Mechanism, the heart of DENON's digital disc playback technology

DENON has been developing original drive mechanisms for a large number of digital disc players from CD players to universal DVD players. In addition, the control firmware (for the signal processor and loader drive circuit) to operate these mechanisms was also developed by DENON. These technologies as well as DENON's track record of supplying mechanism engines to other manufacturers have earned high marks.

Since Super Audio CDs rotate at high speed during playback, the length of the motor shaft has been considerably shortened. A long-life brushless motor capable of withstanding vibration caused by high-speed rotation has also been used. In addition, thorough consideration has been given to mechanical deviations in the optical axis of the laser beam being irradiated by the pickup onto the disc, mechanical unevenness in the base of the pickup mechanism, and the mechanical inclination of the brushless motor shaft.

The DCD-SA1's mechanism uses a vibration-resistant coating that was used in the highly-acclaimed SVH loader. In addition to an optimum mechanism base floating design, the DCD-SA1 features a thorough hybrid vibration-resistant construction based on vibration analyses in order to sup-

press the resonance of components caused by disc rotation.



### High-accuracy master clock oscillator, to suppress jitter and noise

The importance of a master clock has been growing with the spread of high-grade, high-sampling audio sources such as Super Audio CD and DVD-Audio and advances in high sampling and signal processing during CD playback. The DCD-SA1 employs an oscillator with high accuracy and high stability. Extremely stable oscillation output has been achieved by modularising the oscillator's circuit blocks and suppressing influences such as load capacity from PC boards and other areas compared to general crystal oscillators. The pattern wiring on the clock PC board has been designed to ensure high signal transfer efficiency with negligible loss, and the clock accurately controls how signals are sent to each IC. In particular, the physical dis-



tance between the clock and the DAC has been shortened, resulting in a clock design that would not be possible without internal oscillation centred on the DAC. This design thoroughly minimises the adverse influences of jitter and noise. During Super Audio CD playback, the vital DSD clock is frequency divided from the high-accuracy master clock and supplied to the DSD decoder on the slave side. As for clock supply to the DAC, the master device, this is supplied after the DSD clock is timing adjusted again by the master clock. This process strictly adheres to oscillation accuracy.

### Fully balanced output using 4-DAC configuration

The DCD-SA1's D/A conversion circuitry, configuring a differential output circuit, uses 2 D/A converters for each stereo channel. Independent converters are used for each of the hot and cold terminals to realise a fully differential balanced circuit. This configuration is very different from a balanced output configuration that uses an operational amplifier to invert phase following conventional D/A converter output. Since delays between hot and cold terminals no longer occur and interference is avoided, it is an ideal high-quality sound output. The differential drive circuit configuration is also used for the unbalanced output circuit.

### Triple floating power supply

The elimination of the adverse effects of vibration from the power supply transformer not only suppresses resonance among all components and prevents noise from influencing the audio signal, it also ensures a clean, stable supply of power. The DCD-SA1 features a triple floating construction from the base of the power supply to the transformer.

(1) Vibration-resistant construction between the transformer and the case: A base filling material is first poured onto the bottom of the cast aluminum case, and the power supply transformer is placed into the case after it hardens. The filling material is then inserted again.

(2) Suppression of vibration onto the secured base: Shock absorbing material is inserted between the transformer case and the cast aluminum transformer base.

(3) Control of vibration transmitted to the chassis in all frequencies: Four types of shock absorbing materials of different resonance frequencies have been combined between the transformer base and the chassis.



### Thoroughly vibration-resistant construction

To prevent external vibration and minute internal vibration from adversely affecting sound quality, the DCD-SA1 has been engineered to be thoroughly vibration resistant.

#### - 4-layer bottom plate construction

Surface resonance of the chassis is suppressed and rigidity is enhanced by three flat plates that have been layered at the bottom of the chassis.

#### - Cast iron insulator

The cast iron has a carbon content specified by DENON following considerable sound quality tuning. In addition, a special absorbent material and high-quality habutae fabric have been added between the insulator and bottom plate layers to effectively suppress the adverse effects of vibration components over a wide frequency range.

#### - Hybrid construction for all panels

Comprehensive vibration analyses have been conducted for each of the side, top, and rear panels forming the cabinet, and a vibration-resistant construction combining hybrid materials has been

adopted to minimise the resonance frequencies of individual parts.

### - Vibration-resistant PC board design

Fluorocarbon resin has been applied between the chassis and the PC boards in order to "float" them and minimise their exposure to minute vibration from the chassis.



### Flexible input/output, also operates as high-grade D/A converter

Since the DCD-SA1 supports digital input signals of a sampling frequency up to 192 kHz, it can be connected to a variety of devices offering PCM digital signal output. The DCD-SA1 can also be connected as a high-grade D/A converter with Advanced AL24 Processing, allowing audiophiles to enjoy a variety of high-quality sound sources.

### Pure Direct mode

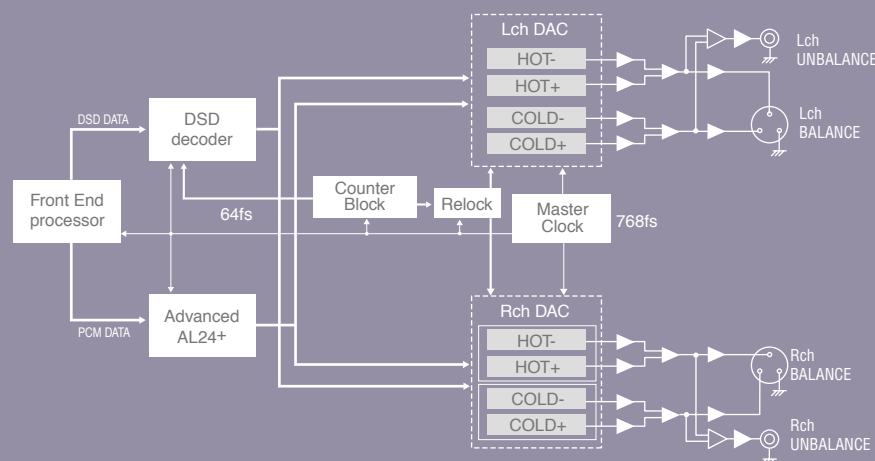
The Pure Direct mode turns off the display and digital signal output to create an environment for enjoying only the purity of music. When the high-pulse signals of the display drive circuit have been turned off, the audio circuitry is further protected from adverse influences, ensuring an even cleaner sound from music sources.

### European Sound Tune

With the advance of Super Audio CD and other new formats, fans of high-end audio are demanding refinements in the quality of sound from audio equipment. European audiophiles are particularly keen to reproduce the naturalness of live sound, including transparency, precise localisation, and a thoroughly realistic ambience.

The parts for the DCD-SA1 have been carefully selected for their ability to deliver superior sound quality. Since some of these parts are hand-made, they are difficult to procure and are currently used only by DENON. The DCD-SA1 has a large number of top-grade capacitors, for instance, that use a natural silk textile on the inside and high-purity copper wires.

DENON's technologies, design philosophy, and strictly selected parts together produce a sublime artistry that eminently befits a flagship audio component.





# The Development of "Advanced AL24 Processing": Taking On the Challenge to Reduce Digital Distortion

DENON led the world in developing a practical PCM recorder in 1972. The shift to digital technology solved numerous problems such as noise, wow, flutter, and frequency response. The delicate nuances of sound from CD up to the least significant bit (LSB) are lost, however, due to the 16-bit quantisation and band cutting at  $f_s/2$  (half the sampling frequency) during 44.1-kHz sampling. DENON was determined to tackle the problem of quantisation noise that remained in digital audio, and developed ALPHA (adaptive line pattern harmonised algorithm), a technology that reproduced 16-bit data with 20-bit quality and became a favourite with audiophiles around the world.

This development later progressed to 24-bit quality with the evolution of "AL24 Processing," and as support for higher resolutions and sampling continued to improve, DENON developed "AL24 Processing Plus" for the 192-kHz sampling of DVD-Audio.

DENON's most recent achievement is "Advanced AL24 Processing," a proprietary high-speed signal processing technology that expands the volume of data along the time axis.

## "AL24 Processing" for Bit Expansion, "Advanced" Circuitry for Greater Data Volume along the Time Axis

In AL24 Processing, the internal processing circuit generates 8 lower bits of data which are added to the original 16 higher bits for 24-bit quality output. The circuit then interpolates the digital data so that it as closely as possible reproduces the smoothness of an analog waveform and allows recordings on CD or other digital media to sound the way they should in the natural world.

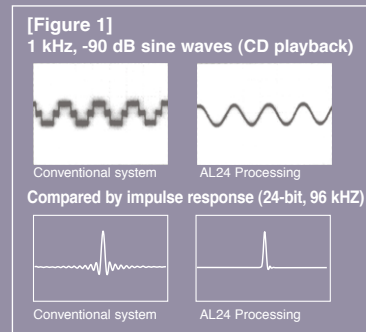
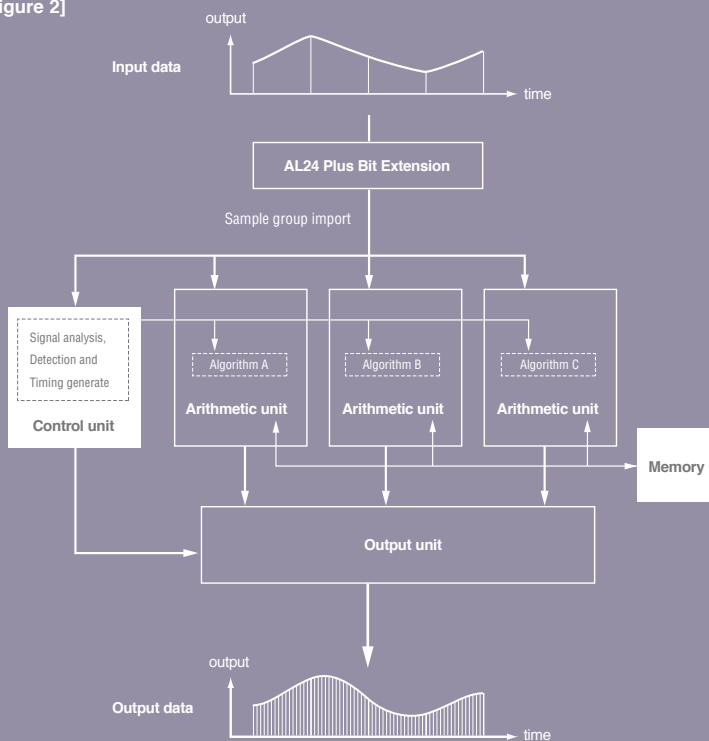


Figure 1 shows the playback sine wave of conventional 16-bit data and how an audio signal that is only output in steps of one LSB is smoothed as if it were 24-bit data. Of course, these differences are also clearly audible: distortion that causes discomfort is reduced and the sound enjoys a superior S/N, free of noise. In addition, Advanced AL24 Processing uses proprietary high-speed signal detection technology and high-speed processing technology to perform high-sampling up conversion on the time axis and produce a sine wave that is even closer to that of an analog signal. Besides expanding the conventional number of bits, Advanced AL24 Processing uses high-speed arithmetic processing algorithms developed by DENON to observe and analyse sample groups of the original data and make interpolations associated with up sampling and frequency range expansion. (Figure 2)

Figure 3 shows the features of arithmetic processing. If we observe the sine wave of a relatively large attack signal assuming an actual music signal, we can easily see how different it is from conventional processing. While considerable ringing occurs with general FIR filters both before and after the attack signal, there is little ringing with

[Figure 2]



Advanced AL24 Processing and we can see how well suited this technology is for the reproducibility of sine waves. Since greater efficiency in processing and higher processing capacity allow data samples to be processed in one stage across a wide range, signals can also be interpolated with greater accuracy compared to methods such as multi-stage configurations that use conventional digital filters. In addition, the oversampling rate has been boosted to 16fs from 8fs to facilitate the expansion of data volume that contains a more detailed, natural sound. The sonic result for the audiophile is the ability to enjoy musical recordings

with the full ambience of the concert hall replete with its spaciousness and the movements of musicians.

## Greater Resolution for the Adaptive Digital Filter

The adaptive digital filter is one more brain of ALPHA. In the conventional ALPHA, adaptive digital filters were used to prevent the occurrence of ringing by extending the pass band with respect to pulse data. For Advanced AL24 Processing, however, DENON developed more highly adaptive filter algorithms. Since this filter varies the inaudible frequency range using the most appropriate algorithm for the pulsive musical data or continuous high-frequency sound, adverse influences caused by repeated noise or reduced response in the high frequency range are avoided, enabling optimum sound reproduction.

