

Noise Canceling Headphones

Product Information _____

GB

产品信息 _____

CS

MDR-NC500D

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1. Introduction

MDR-NC500D is the Digital Noise Canceling Headphones, which Sony developed as the first of their kind in the world.

For this development, Sony put in all of its acoustical analysis technology, digital signal processing technology and transducer technology.

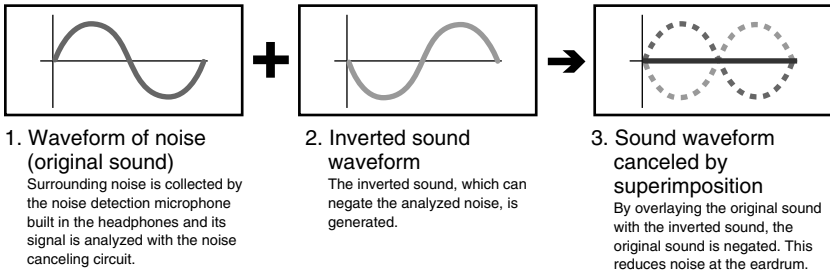
By digitizing the noise canceling function, we succeeded in improving the performance in the following points which, were difficult to be addressed with the conventional analog signal processing:

- High canceling performance
- AI (Artificial Intelligence) Noise Canceling function
- Excellent sound quality
- Higher Signal to Noise ratio

2. Principle of Operation of MDR-NC500D and Its Configuration

The noise canceling headphones make a canceling signal by analyzing with their noise canceling circuit the surrounding noise collected by the small noise detection microphone built in their main body.

With this canceling signal superimposed on the regenerative signal from the connected equipment, reproduction from the driver unit reduces surrounding noise and makes it possible to listen to music more clearly.



For the noise canceling, the following two methods are mainly used:

- Feedback type
- Feedforward type

Continued

2.1. Feedback Type and Feedforward Type

Feedback type

The noise canceling function of the “feedback type” is used in MDR-NC500D.

In the feedback type, the noise detection microphone is placed close to the ear.

By collecting noise in the position closer to the ear, a noise canceling effect with high accuracy can be obtained.

The audio signal of noise collected by the noise detection microphone is analyzed on real time with the noise canceling circuit (NC circuit), producing a canceling signal to always minimize the noise at the eardrum. The canceling signal is reproduced from the driver unit.

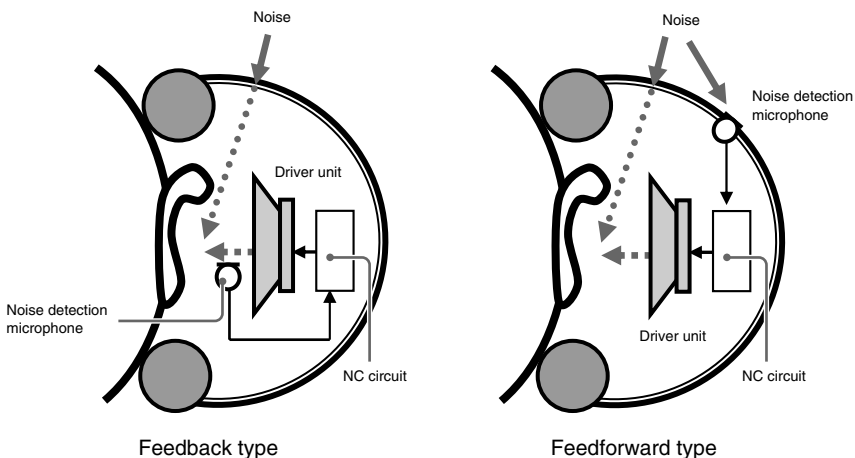
Using this method enables the cancellation effect to be increased with the changing environmental noise addressed.

Feedforward type

In the feedforward type, the noise detection microphone is attached outside the headphones.

The NC circuit analyzes the noise signal collected by the noise detection microphone to estimate what kind of sound the noise will become when it comes to the eardrum. And from this estimated result, a canceling signal to minimize the noise is made and it is reproduced from the driver unit.

This type enables miniaturization of the headphones since it is not necessary for the noise detection microphone to be located near the ear where space is limited.

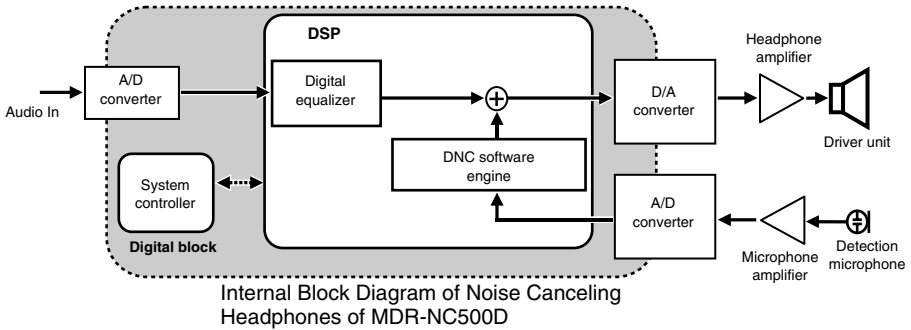


Comparison between Feedback Type and Feedforward Type

	Feedback type	Feedforward type
Noise canceling effect	Excellent	Good
Anti dependency of noise canceling effect against individual difference / fitting difference	Better	Average
Miniaturization	Less suitable	More suitable

2.2. System configuration of MDR-NC500D

The Internal Block Diagram of MDR-NC500D is shown below:



The noise detection microphone of MDR-NC500D collects noise around the ear.

The noise signal is digitized through the microphone amplifier and high-speed A/D converter and is inputted in Digital Signal Processor (DSP). Then the DNC software engine inside DSP generates the canceling signal, which is inverted to the original noise.

Meanwhile, the regenerative signal of a music source supplied from the audio input terminal is digitized by the high-speed A/D converter and is inputted in DSP. Then, its frequency characteristic is adjusted by the digital equalizer inside DSP. After the canceling signal is added, the regenerative signal is reproduced as a sound by way of the high-speed D/A converter, the headphone amplifier and the driver unit.

Mixing of the reproduced sound and the outside noise at the ear negates only environmental noise, making it possible to enjoy music etc. calmly.



High-speed A/D, D/A converter

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2.3. Advantages of Digitization

The performance of noise canceling headphones greatly depends on the efficiency of the filter circuit (NC filter) between the microphone to detect noise and the driver unit to reproduce the canceling signal.

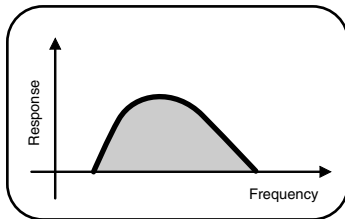
In MDR-NC500D, the filter circuit for noise canceling is realized on the DSP as the digital signal processing of the newly developed “DNC software engine.”

In addition to general advantages such as accurate computation results, no theatrical variation, and no electric noise, the digital signal processing has also the advantage of making it possible to create special filter shapes, which were not able to be realized with existing analog filters.

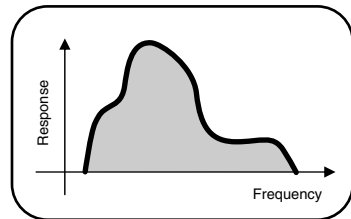
During the development of the DNC software engine, the architecture of internal filter computation was thoroughly examined in order to implement a more effective noise canceling.

The know-how of Sony’s digital sound treatment was used to construct a software engine specialized in the noise canceling treatment and the calculation accuracy was heightened. Noise canceling with less residual noise and higher Signal to Noise ratio was made possible.

Example of the characteristic of conventional NC filter



Example of the characteristic of digital NC filter



3.AI Noise Canceling Function

The characteristics of environmental noise vary with the scene to be used.

In an airplane, for example, low and midrange frequencies can have a large noise energy and other frequency ranges have a smaller noise energy.

On the other hand, in the environment such as an office, the noise energy is small but distributed over a wider range.

In MDR-NC500D, the filter circuit to control a noise canceling ratio was digitized and it is controlled by software.

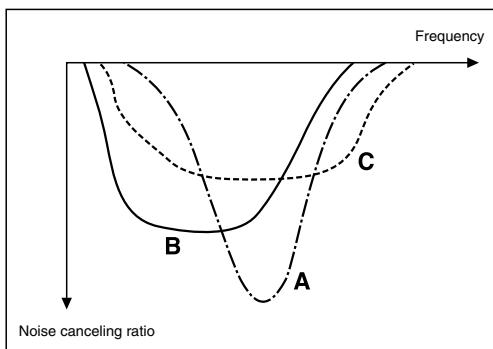
This enables the filter characteristic to be switched: AI Noise Canceling function with which MDR-NC500D selects automatically the filter characteristic (noise canceling mode) that is the most suitable for the user's environment.

AI Noise Canceling function

Digital technology allows selection from multiple noise canceling modes.

The headphones analyze the outside noise and automatically select the optimal canceling mode.

----- A ——— B ----- C



* Manual mode selection is also possible.

NC MODE A

Noise mainly in an airplane is effectively reduced.



NC MODE B

Noise mainly in a bus or a train is effectively reduced.



NC MODE C

Noise mainly found in an office environment (PC, copier, air ventilation, etc.) is effectively reduced.



Continued

3.1. Operation of AI Noise Canceling function

The operation of actual AI Noise Canceling function is as follows:

1. Press the AI NC MODE button to start the analysis program. *
2. Built-in DSP analyzes the sound information of noise from the noise detection microphone.

Its specific value is extracted from the signal and the most effective noise canceling mode is selected.

3. The noise canceling operation is started in the selected mode.

* During analysis, reproduction of music source and noise canceling function are temporarily stopped in order to gather exact noise information.

MDR-NC500D completes the above-mentioned processing in a short time of about 3 seconds.

The analysis algorithm of AI Noise Canceling (AINC) developed a proprietary calculation technique based on the Auditory psychology emphasizing the frequencies, which make noise more audible to the ear.

It is the very realization of “smart headphones” which can follow man's feeling.

With the AI Noise Canceling function only made possible by Digital, please enjoy its comfortable canceling effect.



DSP used in
MDR-NC500D

4. Specialized Driver Unit

In order that feedback type headphones obtain a wider canceling range, it is necessary to minimize the time delay between the output of the driver unit and the input to the noise detection microphone.

By integrating the noise detection microphone with the driver unit to minimize the time delay, MDR-NC500D achieved a stable and wider range canceling performance.

Moreover, the use of re-informed diaphragm significantly improved the canceling performance against environmental noise with a high sound pressure that is generated in a very low frequency.



Driver unit

5. High-Quality Sound Unique to Digital

MDR-NC500D digitized the NC circuit and used the digital equalizer in the playback system.

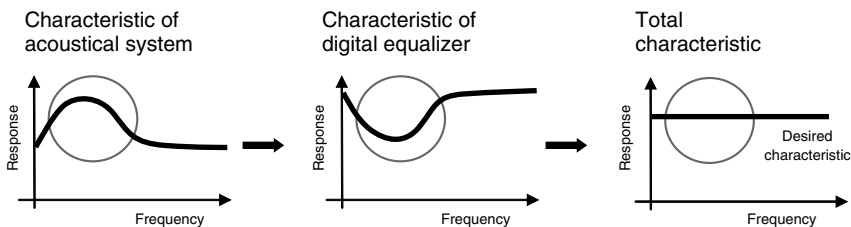
The acoustical system of noise canceling headphones is generally based on the design, which emphasizes low frequency in order to maximize the effect with limited electric power.

Moreover, in the case of the noise canceling headphones of feedback type, in principle their music signal is impacted by the canceling function, so that the quality of the reproduced sound is also impacted.

To solve these problems, an equalizer circuit is prepared in the audio input side.

The digital equalizer mounted in MDR-NC500D blocks the impact on the sound quality and also brings about high-quality sound to maximize the intrinsic performance of the driver unit.

By generously providing the digital equalizing technology accumulated with Sony's AV amplifiers and Hi-Fi audiovisual apparatus and using the newly developed computation method optimized to the system, it was made possible to reproduce a music source with a sense of realism from deep bass to silky highs.



6. Weight saving mechanism

Magnesium and 7075 aluminum are used as the material for the housing and the headband, respectively.

By using these unstintingly, the mass is reduced to as small as 195 g or more than 10 % weight reduction. *

* In comparison with MDR-NC60.

7. Other Features

7.1. Monitor function

MDR-NC500D is equipped with the monitor function to make the surrounding sound more audible by muting music etc. during reproduction when you are spoken to, for example.

While wearing the headphones, you can hear an announcement etc. in an airplane or in a train only by pressing the button.

During monitoring, disturbing noise can be reduced by the noise canceling function.

7.2. Swivel mechanism

A mechanism to reduce the storage thickness by rotation of the housing is used in order to enhance portability. (Swivel mechanism)

7.3. Detachable connecting cord

The main body side of the headphones connecting cord is detachable.

According to the equipment in combination, you can select the connecting cord of optimal length from accessories. When using the noise canceling function without any music playback, etc., disconnect the cord for comfortable use.

Moreover, the connecting cord with battery case also serves as power source.

MDR-NC500D can be used longer in combination with the built-in lithium ion rechargeable battery.

7.4. Power supply

MDR-NC500D supports three kinds of power supply methods: Built-in lithium-ion rechargeable battery, Alkaline LR03 (size AA) battery ^{*1} and AC power adaptor.

The AC power adaptor is of 100 V to 240 V multi-voltage type.

It can be used almost all over the world. ^{*2}

^{*1} When the connecting cord with battery case is used. Two Alkaline LR03 (size AA) batteries are used.

^{*2} Use with the outlet of a different shape needs an optional plug adapter.

7.5. High-quality sound BTL headphone amplifier

The headphone amplifier is of BTL (Bridged Transformer-Less) type.

You can enjoy a powerful sound with a wide dynamic range.

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1. 前言

MDR-NC500D 是由 Sony 研发的全球第一款数字降噪耳机。

对于此项研发，Sony 投入了其所有声学分析技术、数字信号处理技术和传感器技术。

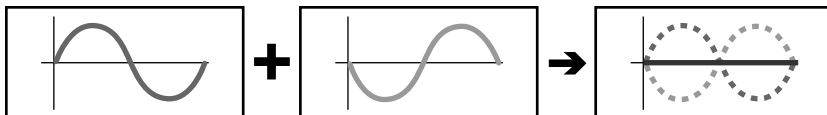
通过数字化降噪功能，我们成功改善了以下性能，这些性能很难用传统的模拟信号达到：

- 高降噪性能
- AI（人工智能）降噪功能
- 卓越的音质
- 更高信噪比

2. MDR-NC500D 工作原理及其配置

降噪耳机由耳机内置的微型噪音检测麦克风收集周围噪音，并通过降噪电路进行分析，从而生成降噪信号。

将此降噪信号叠加在所连接装置产生的信号上，从驱动单元再现的声音将降低周围的噪音，从而使听到的音乐更为清晰。



1. 噪音波形（原始声音）
由耳机内置的噪音检测麦克风收集周围噪音，并通过降噪电路对其信号进行分析。

2. 反向声波
产生能消除被分析噪音的反向声音。

3. 重叠降噪后的声波
通过用反向声音覆盖原始声音，原始声音即被消除。这样即降低了耳膜中的噪音。

对于降噪，主要使用了以下两种方法：

- 反馈型
- 前馈型

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2.1. 反馈型和前馈型

反馈型

MDR-NC500D 中采用“反馈型”降噪功能。

在反馈型中，噪音检测麦克风的位置靠近耳朵。

通过收集耳朵旁的噪音，即可获得高精度的降噪效果。

由噪音检测麦克风收集的噪音音频信号经降噪电路（NC 电路）实时分析，产生的消噪信号始终能减小耳膜中的噪音。消噪信号由驱动单元产生。

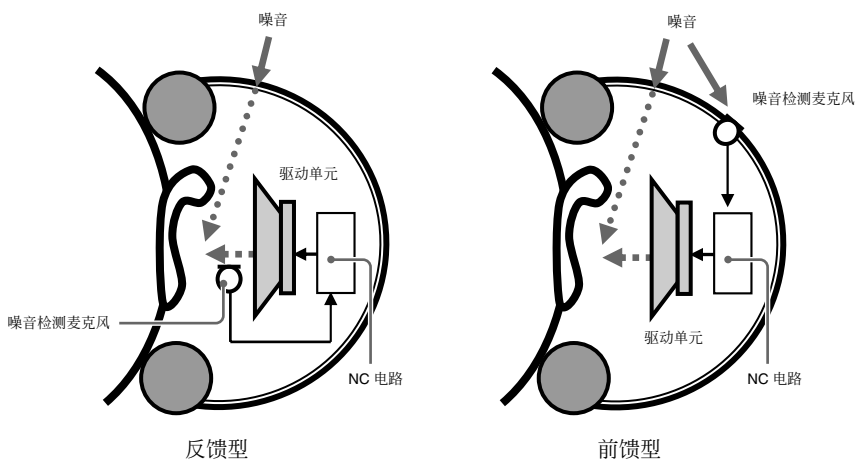
使用此方法可使消噪效果随环境噪音位置改变而增强。

前馈型

在前馈型中，噪音检测麦克风安装在耳机的外部。

NC 电路通过分析噪音检测麦克风收集的噪音信号，来推测噪音进入耳膜时将要变成的声音类型。根据推测出的结果生成减小噪音的降噪信号，此信号从驱动单元送出。

由于此类型不需要将噪音检测麦克风装在空间有限的耳朵旁，因此可以使耳机小型化。

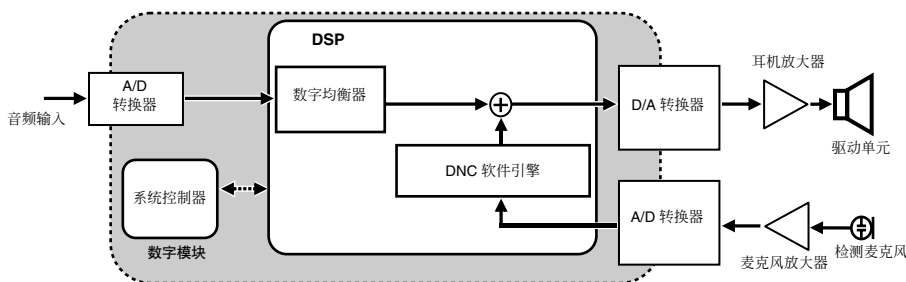


反馈型与前馈型对比

	反馈型	前馈型
降噪效果	极好	良好
降噪效果不受个人差异/佩戴差异的影响	更好	一般
小型化	稍不适	更适合

2.2. MDR-NC500D 系统配置

以下所示为 MDR-NC500D 的内部结构图：



MDR-NC500D 降噪耳机内部结构图

MDR-NC500D 噪音检测麦克风收集耳朵周围的噪音。

噪音信号通过麦克风放大器和高速 A/D 转换器被数字化，并输入数字信号处理器（DSP）。然后 DSP 内部的 DNC 软件引擎产生降噪信号，此信号转换为原始噪音。

同时，来自音频输入端子的音乐源再生信号通过高速 A/D 转换器被数字化，并输入 DSP。然后，由 DSP 内的数字均衡器调节其频率特性。添加降噪信号后，再生信号经由高速 D/A 转换器、耳机放大器和驱动单元重新生成声音。

重新生成的声音与耳朵处的外部噪音混合，仅仅消除了环境噪音，从而更静心欣赏音乐。



高速 A/D、D/A 转换器

2.3. 数字化的优点

降噪耳机的性能很大程度依赖于检测噪音的麦克风与重新生成降噪信号的驱动单元之间的滤波电路（NC 滤波器）的效能。

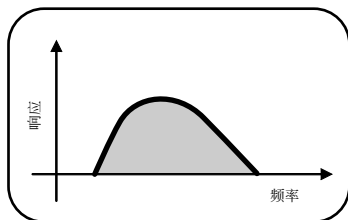
在 MDR-NC500D 中，降噪滤波器电路在 DSP 上完成最新开发的“DNC 软件引擎”的数字信号处理。

除计算结果精确、无夸张变化及电子干扰等一般优点以外，数字信号处理还具有创造特殊滤波器形状的优点，而这些都是现有模拟滤波器所无法做到的。

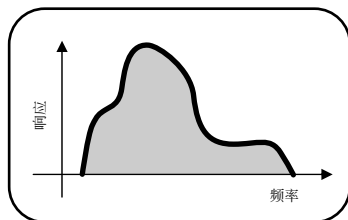
在 DNC 软件引擎开发过程中，为了实现更有效的降噪，我们对内部滤波器计算结构进行了彻底的研究。

Sony 数字声处理专业技术通常用于创建降噪处理专用软件引擎，以及提高计算精确性。降噪处理因而可能减少剩余噪音且提高信噪比。

传统 NC 滤波器特性示例



数字 NC 滤波器特性示例



3.AI 降噪功能

环境噪音的特性随所使用的场景而异。

例如在飞机上，低频和中频会具有很大的噪声能量，而其他频率范围具有较小的噪声能量。

另一方面，在办公室等环境中，噪声能量较小，但分布范围却更广。

在 MDR-NC500D 中，控制降噪率的滤波器电路被数字化，且由软件进行控制。

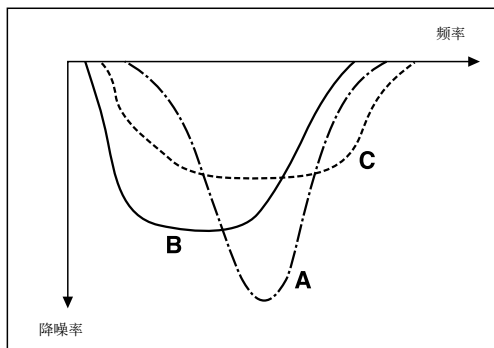
如此能对滤波器特性进行切换：具有 AI 降噪功能的 MDR-NC500D 自动选择滤波器特性（降噪模式），此模式最适合用户环境。

AI 降噪功能

数字技术允许选择多个降噪模式。

耳机分析外部噪音，并自动选择最佳降噪模式。

----- A —— B ----- C



* 也可以使用手动模式选择。

NC MODE A

主要对降低飞机上的噪音有效。



NC MODE B

主要对降低公共汽车或火车上的噪音有效。



NC MODE C

主要对降低办公室环境（电脑，复印机，空调等）中的噪音有效。



3.1. AI 降噪功能操作

实际 AI 降噪功能操作如下：

1. 按 AI NC MODE 按钮开始分析程序。*
2. 内置 DSP 开始分析噪音检测麦克风收集的噪音声音信息。
从此信号中提取特殊数值，并选择最有效的降噪模式。
3. 降噪操作以所选择的模式开始运行。

* 在分析过程中，为了更精确收集噪音信息，音乐源再现和降噪功能暂时停止。

MDR-NC500D 约 3 秒钟内很快完成上述处理。

AI 降噪（AINC）分析运算法则体现了以听觉心理为基础的人性化技术，使耳朵更能听见噪音。

此款绝对的“智能耳机”能跟随人的感觉。

AI 降噪功能只能通过数字化进行操作，尽情享受其舒适的降噪效果。



MDR-NC500D
中所使用的 DSP

4. 专用驱动单元

为了使反馈型耳机获得更宽的降噪范围，必须将驱动单元的输出与噪音检测麦克风输入之间的时间延迟减到最小。

通过将噪音检测麦克风与驱动单元结合，将时间延迟减到最小，MDR-NC500D 实现了稳定而又更广范围的降噪性能。

此外，采用再通知振动膜有效提高了对抗在非常低的频率中产生的高声压环境噪音的降噪性能。



驱动单元

5. 独特的数字化高品质声音

MDR-NC500D 对 NC 电路进行数字化，并在播放系统中使用了数字均衡器。

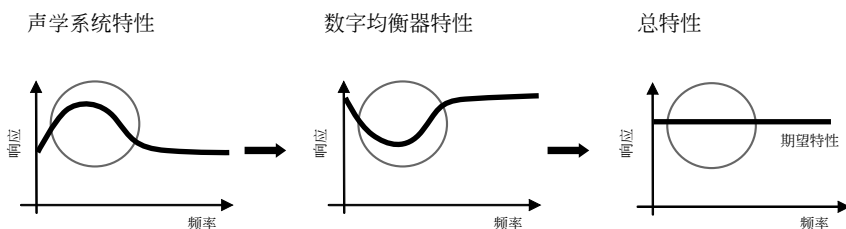
降噪耳机的声学系统通常基于设计，为了在有限的功率条件下获得最大效果而加强低频。

此外，在使用反馈型降噪耳机情况下，原则上音乐信号通过降噪功能而受到影响，因此再现声音的质量也受到影响。

为了解决这些问题，在音频输入端预备了均衡器电路。

MDR-NC500D 中安装的数字均衡器阻止对音质的影响，同时也产生了高品质声音，使驱动单元固有性能达到最佳。

通过提供 Sony AV 放大器和视听设备中所汇集的大量数字化均衡技术，并使用最新研发优化系统的计算方式，使具有现实场景的音乐从深沉低音达到更柔滑的高度。



6. 减重结构

使用镁和 7075 铝分别作为耳机罩和头箍的材质。

大量使用这些材质，使质量减小到 195 g 或重量减轻超过 10 %。*

* 与 MDR-NC60 对比。

7. 其它特点

7.1. 监听功能

MDR-NC500D 具有监听功能，例如在播放过程中您需要说话时，通过将音乐静音从而听见周围的声音。

在飞机或火车上戴着耳机，只要按一下按钮便能听到广播信息。
在监听过程中，通过降噪功能可以减小烦躁的噪音。

7.2. 旋转结构

本耳机采用了一种可以减小存放厚度的结构，通过转动耳机罩提高了便携性。（旋转结构）

7.3. 拆卸式连接线

耳机连接线的机身侧为可拆卸式。

根据所组合的装置，可以从附件中选择最佳长度的连接线。如果未播放音乐使用降噪功能，请断开连接线以便舒适使用。

此外，电池盒的连接线还可以节约电源。

与内置锂离子充电电池配合使用，MDR-NC500D 可以使用更长时间。

7.4. 电源

MDR-NC500D 支持三种用电方式：内置锂离子充电电池，LR03 碱性（尺寸 AA）电池 *¹ 和交流电源适配器。

交流电源适配器使用 100 V 至 240 V 各种电压类型。

几乎可以在全球使用。*²

*¹ 使用电池盒连接线时。使用两节 LR03 碱性（尺寸 AA）电池。

*² 使用不同形状的电源插座需要有选购插头转接器。

7.5. 高音质 **BTL** 耳机放大器

耳机放大器为 BTL（桥式推挽放大电路）型。

您可以欣赏到动态范围宽广的强劲音效。

