

**Technical Description of Apple AirPods 2nd generation: Features, Design, and
Functionality**

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ENGL 21007: Writing for Engineering

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April 3, 2023

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The history of headphones and AirPods

The concept of headphones can be dated back to the late 1800s with the invention of the telephone. Engineer Nathan Baldwin invented the first audio headphones in 1910 with the headphones being bulky and heavy but allowing better sound quality and improved communication. The first wireless headphones were developed for the military in the 1940s, leading to the first wireless headphones to be used for personal use by the 1960s. With the development of Bluetooth technology in 1994, the first Bluetooth enabled headphones were introduced in the 2000s. Apple, one of the largest and most successful technology companies in the world, developed their first-generation wireless Bluetooth earbuds, known as “AirPods,” in 2016. As their technology advanced, several updates were made to the AirPods, leading to the development of the second generation AirPods with a wireless charging case in 2019.

Technical Description

Wireless Charging Case

The AirPods second generation earphones are divided into two components. The first component is the wireless charging case. The case is separated into 2 parts and 7 subparts. The two parts consist of the lid and the body. On the lid, there is the hinge. The body consists of 6 subparts. These subparts include the lightning connector, LED charging indicator, pairing button, AirPods slots, charging contacts, and the battery.

Figure 1

Back view of the AirPods 2nd Generation wireless charging case

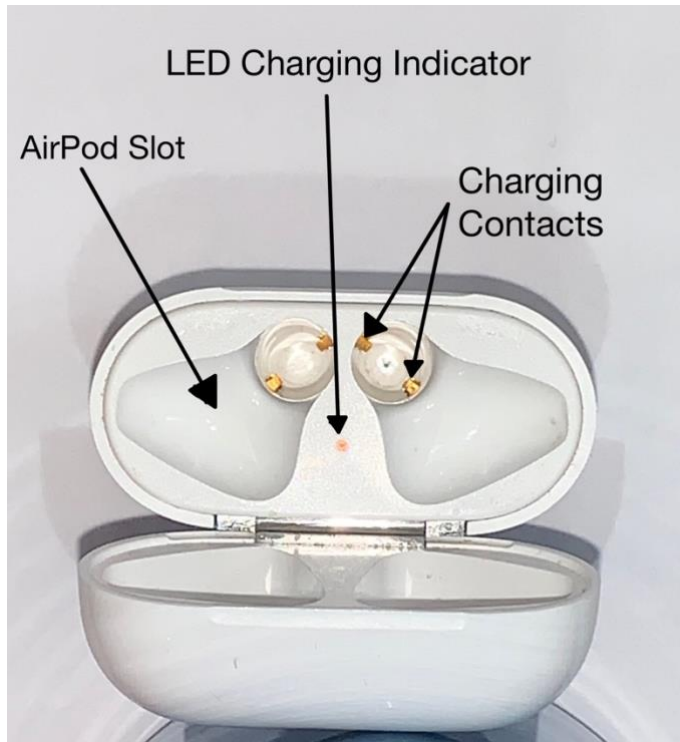
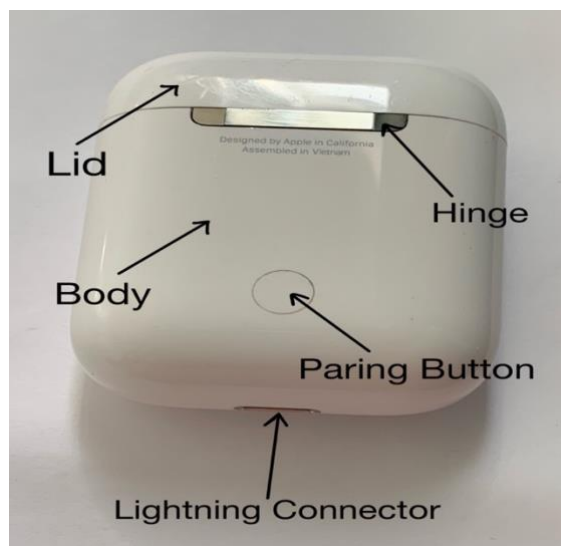


Figure 2

Inside view of the Airpods 2nd Generation wireless case



The Case Lid

The first part of the AirPods wireless charging case is the case lid. With a height of 0.5 inches, 1.74 inches wide, and 0.84 inches deep, lid of the case is designed to be lightweight and close the access to the earbuds. It is made of white polycarbonate plastic with a smooth, glossy finish (Mansour et al., 2021). The lid accurately aligns with the bottom half of the case, ensuring for the security and protection of the AirPods. Additionally, it features a magnetic closure that snaps the lid close. The lid protects the AirPods from damaging and accumulating dirt as well as allow for accessibility to the AirPods.

The Hinge

The only subpart of the wireless charging case lid is the hinge. The hinge connects the lid of the case to the body of the case. As shown in Figure 1, the first part shown on the very left side of the image displays the lid and hinge. The hinge is located on the back of the charging case, where the lid and bottom half of the case meet. It is designed for repeated use, as the user will constantly open and close the case for access to the AirPods. Measuring at $\frac{2}{16}$ inches wide and $\frac{13}{16}$ inches long, it is made of stainless steel that resists wear and tear due to its corrosion resistance.

The Body

The second part of the Apple AirPods 2nd generation charging case is the body with the design akin to a box. The lower body of the case, similarly to the lid, is made with a white polycarbonate plastic with a smooth, glossy finish. The design is slim and compact, allowing for ease of portability. With a height of 1.61 inches, 1.74 inches wide, and 0.84 inches deep, the body provides structural support for the AirPods, along with housing the inner subparts such as

the battery. With the hinge from the lid also being attached to the body, it allows the two parts to close when not in use.

Lightning Connector

With a height of 0.16 inches, a width of 0.31 inches, and a depth of 0.22 inches, it is an oval shaped hole located at the bottom of the case. This is used to charge the case's battery via a lightning cable. It is made of metal; specifically, copper and nickel. These combinations of metals are commonly used in electric connectors due to its durability and corrosion resistant properties, as well as its ability to conduct electricity well (Juneke, 2019).

LED Charging Indicator

The LED charging indicator is a small, circular light located on the top of the body of the case, measuring at approximately 1 mm in diameter. When the case is open, the LED light flashes, indicating the charging status. When the charging indicator lights up orange, it is indicating that the AirPods are charging or, that the case is low on battery. When the charging indicator lights up green, it is indicating that the AirPods are fully charged. Once the lid is closed, you can no longer see the charging indicator.

Pairing Button

The pairing button is a small circular button located on the back of the case. Measuring at approximately 4/16 of an inch, it is made of hard plastic that has a slightly raised texture compared to the smooth finish of the rest of the case. It is slightly elevated so that the user can press the button. This button allows users to manually enter pairing mode when they want to connect the AirPods to a new device. To use this button, the user needs to open the lid of the case, then press and hold the pairing button until the LED charging indicator flashes white. The

white light indicates that the AirPods are in pairing mode, allowing for the user to use the AirPods with their device.

AirPods Slots

The body of the case has two small slots on the inside of the case that hold the AirPods. Each slot is identically shaped as the AirPods and has a small magnet opening that allows each AirPod to snap securely in place. These plastic slots measure at approximately 30 mm in length, 15 mm in width, and 22 mm in height. They hold the AirPods securely in place when they are not in use and allow for them to charge.

Charging Contacts

On the bottom of each AirPod slot, there are two small squared shaped contacts measuring at approximately 1 mm in diameter and is made of corrosion-resistant metal. These contacts transfer power from the case to the AirPods for charging. When the AirPods are placed inside the case, the charging contacts make contact with the charging pins on the bottom of each AirPod, and transfer power to the AirPod's batteries.

Battery

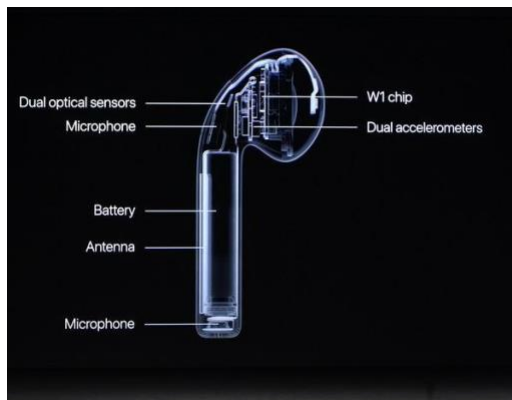
The case contains a built-in rechargeable battery that is responsible for charging the AirPods when they are placed inside the case. The battery is a black, rectangular shape, measuring approximately 44 mm in length, 21 mm in width, and 53mm in height. The lithium-ion battery has a capacity of 398mAh that provides the AirPods with multiple charges before needing to be recharged itself. The battery allows for a quick charge feature that provides up to 3 hours of listening time with 15 minutes of charging. With one full charge, up to 5 hours of listening time is available (Apple, 2023).

AirPod

The second component of the 2nd generation AirPods is the AirPod itself which has 2 parts and 7 subparts. The two parts consist of the earbud and the stem. The subparts located inside the earbud include the earbud housing, speaker, and accelerometer. The four subparts located within the stem of the Airpod include the microphone, touch controls, battery, antennae, and charging contacts.

Figure 3

An inside look of the AirPod



Note. Instead of the W1 chip, the Apple AirPods 2nd Generation has an H1 chip. There are also no dual optic sensors.

Earbud Housing

The earbud housing of the Airpod is the curved, elongated shaped part that sit inside the user's ear. As with the case, it is made of white, polycarbonate plastic with a smooth, glossy finish. It is approximately 9/16 inches in length, 10/16 inches in height, and 5/16 inches in depth. The function of the earbud housing is to not only go into the user's ear, but it also contains several subparts such as the speaker, and dual accelerometers.

Speaker

The small compact speaker is located on the top portion of the earbud housing. It is not visible from the outside and the dimensions are not publicly available. The speaker is responsible for producing the audio output that the user hears when listening to music, watching videos, or taking calls.

Accelerometer

The accelerometer is a small, rectangular shaped component that is located inside the earbud housing portion. It is a type of sensor that measures acceleration and movement, allowing for the AirPods to detect when it is being worn, and when it is removed from the user's ear. This detection performs specific actions such as pausing audio when it detects that the user has removed it from their ear. The audio will then continue to play when it detects that the earbud is inserted back into the user's ear.

Stem

The stem portion of the AirPods is the long, white cylindrical shape that houses the touch controls, charging contacts, battery, antenna, and microphone.

Touch controls

The touch controls on the stem of each AirPods allows the user to perform various functions that is normally manually done on their paired device. The user can manually choose what function they would like to perform using a double tap method on the setting app of their paired device. By double tapping on the left or right AirPods, the user can either play or pause an audio playback, skip to the next or go back to a previous track, or the user has the option to activate Siri, Apples virtual assistant.

Charging contacts

At the bottom of each AirPods, there is a silver metallic charging contact. This allows power from the charging case to charge the AirPods itself when placed inside. The oval shaped design is approximately 0.1 mm in diameter, with a hole in the center. This hole includes a dust-proof gate for the microphone that measures $2/16^{\text{th}}$ of an inch in diameter on the longer side and $1.5/16^{\text{th}}$ of an inch in diameter on the shorter side.

Microphone

The microphone captures the user's voice during voice calls, as well as enabling hand free Siri voice commands. It is a small black circular shaped object that is hidden within the bottom interior of the stem.

Antenna

The antenna is a small, rectangular strip that is built into the stem of each AirPods which provides a wireless connection between the AirPods and the user's paired device. It works in conjunction with the H1 chip to provide fast and seamless pairing. The H1 chip is responsible for providing a range of features and functions. These functions include providing faster and more reliable connectivity between the AirPods and user's device. This allows for clear audio quality and reduced delay during music playback and phone calls.

Battery

The small, black rectangular shaped battery in the stem of each AirPods provides power to the earbud for several hours of use. When the battery in the earbud runs low, it is placed into the charging case to recharge the earbuds. When the battery of an AirPods completely runs out, the user will hear a low-pitches sound that is played once.

Conclusion

In conclusion, the Apple AirPods 2nd generation provides a wireless audio experience for users. The case and earbuds are designed to hold separate functions, but is known as one, cohesive device. With the case, there is the case lid that holds the hinge, and the body which holds the lightning connector, LED charging indicator, pairing button, AirPods slots, charging contacts and the battery. The AirPods itself has the earbud housing which houses a speaker and an accelerometer. The stem portion of the AirPods holds the touch controls, charging contacts, microphone, antenna, and battery.

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