

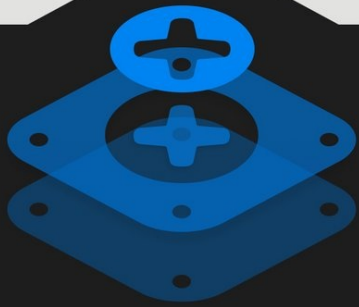


## Apple Watch Teardown

Time flies: it's been eight months since Apple...

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# Apple Watch



# TEARDOWN

# INTRODUCTION

Time flies: it's been eight months since Apple announced its (digital) crowning achievement, the Apple Watch. Join us as we make time stand still by tearing down the Apple Watch—and see what makes it tick.

**Update: We've got more Apple Watch teardown goodness! When you're done here, wind your way over to our [X-ray teardown](#).**

The good times never end at iFixit—and you can be a part of the fun by following us on [Instagram](#), [Twitter](#), and [Facebook](#)!

[video: <https://www.youtube.com/watch?v=rrDjP7iK7H8&feature=youtu.be>]

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## TOOLS:

[iOpener](#) (1)

[iFixit Tech Knife](#) (1)

[iFixit Opening Picks \(Set of 6\)](#) (1)

[Tweezers](#) (1)

[iFixit Opening Tool](#) (1)

[Tri-point Y000 Screwdriver](#) (1)

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## Step 1 — Apple Watch Teardown



- Ladies and gentlemen, the Apple Watch has arrived. But before we get down to the brass tacks, here's a quick overview of the tech specs:
  - Pressure-sensitive, flexible, touchscreen AMOLED Retina display
    - ① One model measuring 38 mm (vertically) with 272 x 340 pixels (290 ppi), the other model measuring 42 mm (vertically) with 312 x 390 pixels (302 ppi)
  - Custom-designed Apple S1 [SiP](#) (System in Package)
  - 8 GB onboard storage
  - NFC + Wi-Fi 802.11b/g/n + Bluetooth 4.0
  - Accelerometer + gyroscope + heart rate monitor + microphone + speaker
  - Watch OS

## Step 2



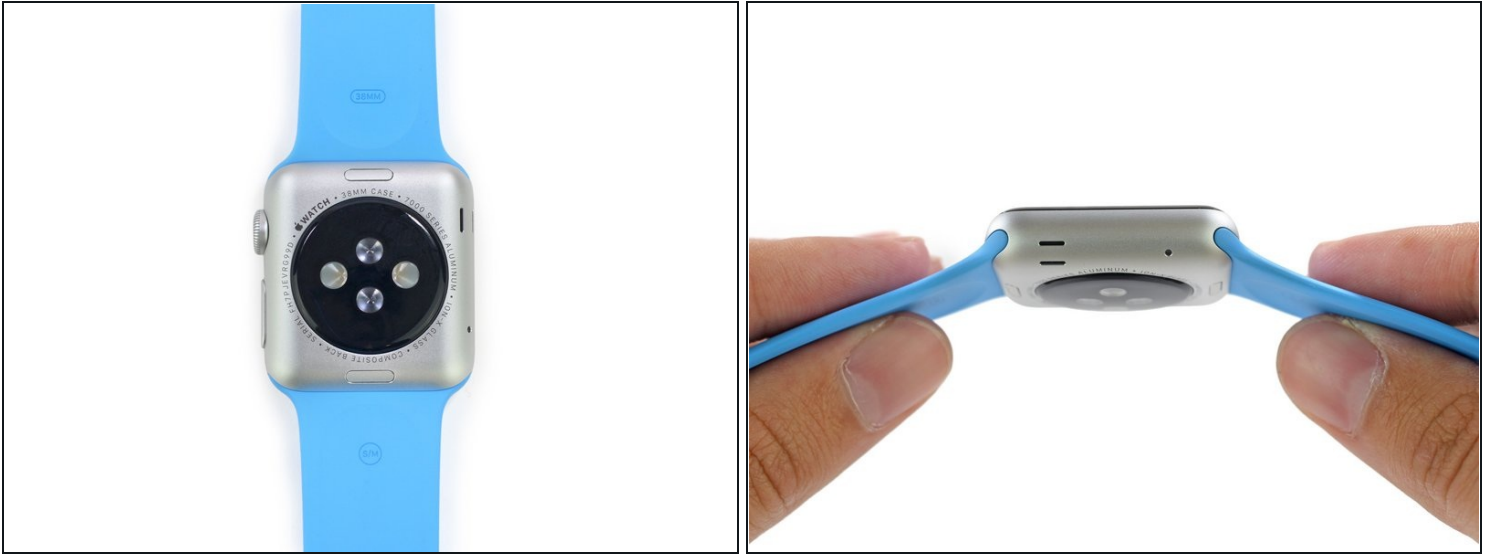
- So ends [the wait](#). The Apple Watch has arrived, and our first course of action is to unbox it.
- While we'd hoped to find a golden ticket inside, we'll settle for the next best thing: the Apple Watch Sport, complete with its Sport Band, charging cradle, and power adapter.
- ☑ A big thanks to [MacFixit Australia](#), who let us use their digs in Melbourne for this teardown-down-under. They stock Mac and iPhone upgrades/accessories, and also carry our iFixit toolkits.

### Step 3



- We were all set to disassemble the Apple Watch until we got distracted by a fancy graphic visualization. [\*Oooh\*](#), pretty colors.
- Not sure how to fasten that fancy Sport Band? Have no fear—Apple included instructions right on the back of the band!
- There's no need for pesky charging cables—the Apple Watch features MagSafe inductive charging technology, which allows it to magnetically attach to the charger. Apple also touts that it is a "...completely sealed system free of exposed contacts."

## Step 4



- We turn our attention to the back of the case, where we find a composite cover with hard-coated, optical polymer lenses protecting a set of LEDs and photodiodes.
- The specially designed heart rate sensor uses a combination of infrared and visible-light sensors to gauge your heart rate.
  - ✦ Unlike the Apple Watch Sport, the back cases of the Apple Watch and the Apple Watch Edition feature a [Zirconia ceramic](#) cover with sapphire lenses.
- Opposite the Digital Crown, we find the microphone and speaker ports.

## Step 5



- Before [laying it out on the chopping block](#), we'll try something non-destructive: removing the band.
- ① Pressing this button on the back case releases a spring-loaded metal peg in the band, allowing it to slide right out.
  - If you're looking forward to swapping out bands, there's not much to it, physically. However, Apple would prefer that you only use bands [from the same collection](#). No Link Bracelets on your Watch Sport, please.
- The Sport Band is all plastic—or, more accurately, [elastomer](#)—with no metal watch band pins.
- Assembled in China!

## Step 6



- Hidden inside the Sport Band slot, we spot a mysterious cover—a door of sorts.
- ① What is the door for? Where does it lead? We may never know...but it looks like the [reported diagnostic port](#).
- Taking a closer look at the side of the Apple Watch, we find the model number: A1553.
- ① The Apple Watch comes in [two different model numbers](#): A1553 for the 38 mm case, and A1554 for the 42 mm case.

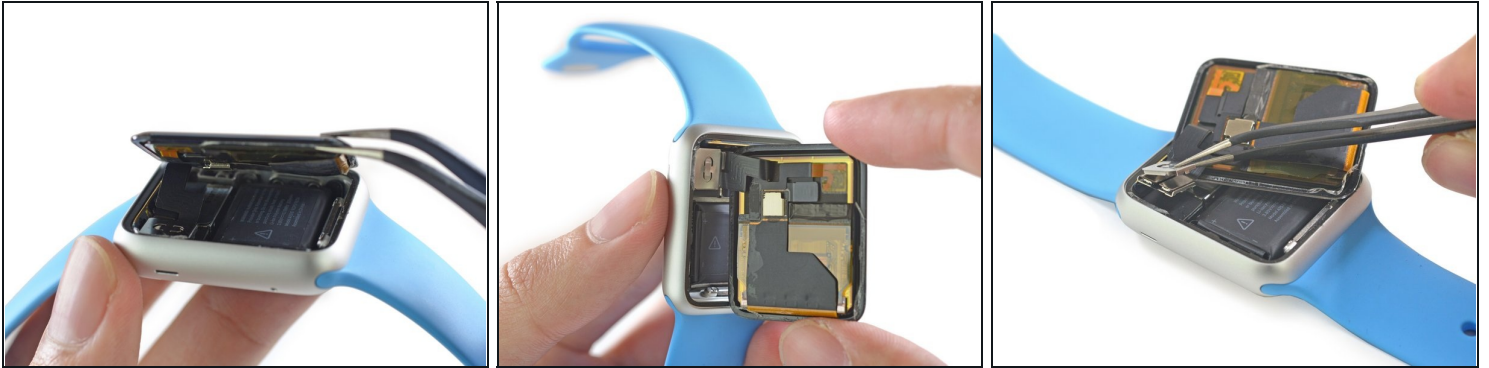
## Step 7



- Unfazed by the lack of external screws, we reattach the Sport Band for extra leverage and whip out an iOpener to negotiate our way into the belly of this beast.
- Forgoing our traditional opening tools, we give this display all the [force](#) our [Tech Knife](#) can muster.
- We move in with our opening pick to finish things off. Let's hope this doesn't get as [messy](#) as Apple's *other* flagship release.



## Step 8



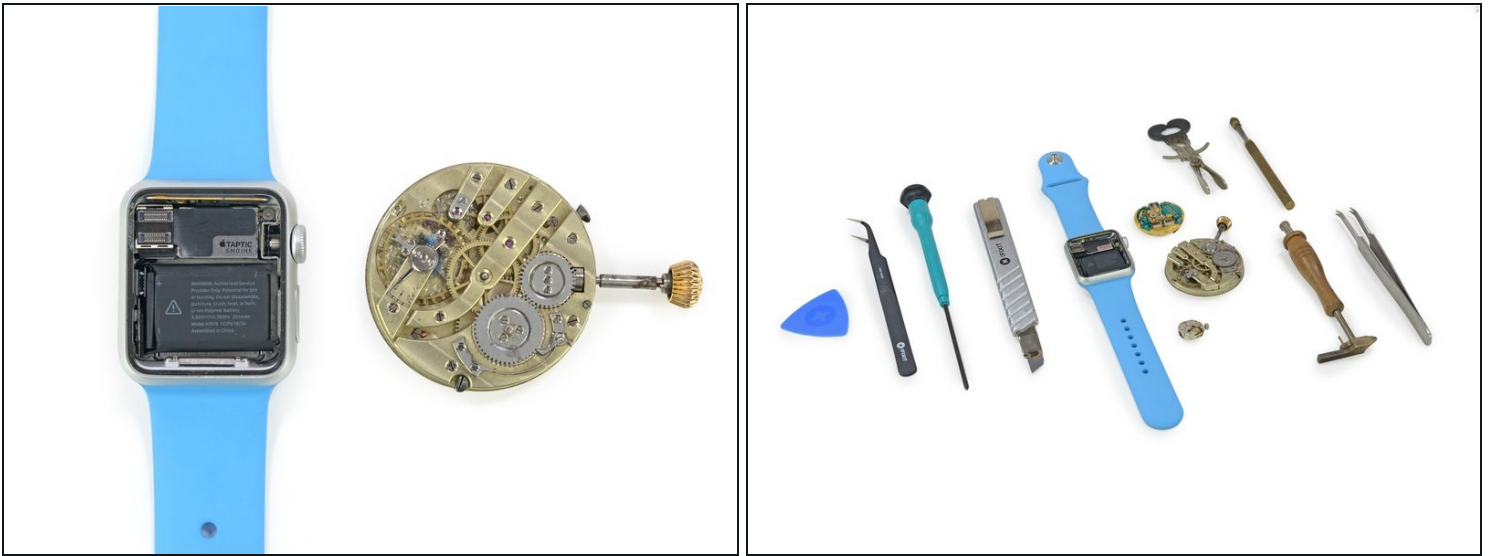
- We gingerly lift up the display, expecting a snaggle of cables—namely, the display and digitizer cables.
- Disconnecting the display isn't easy, as the display cables are trapped under a springy bracket (not unlike the [Touch ID cable cover](#) of the iPhone 5s).
- Our teardown engineers are watching out for such tricks... but [who watches the watchmen?](#)

## Step 9



- Houston, we have [separation](#). With the display panel removed, we quickly spy two highly-advertised Apple Watch features: the Taptic Engine and the Digital Crown.
- It looks like even the lowly Watch Sport gets a bit of glitzy gold. We expect that this is some kind of antenna, featuring Apple's [familiar gold treatment](#).

## Step 10



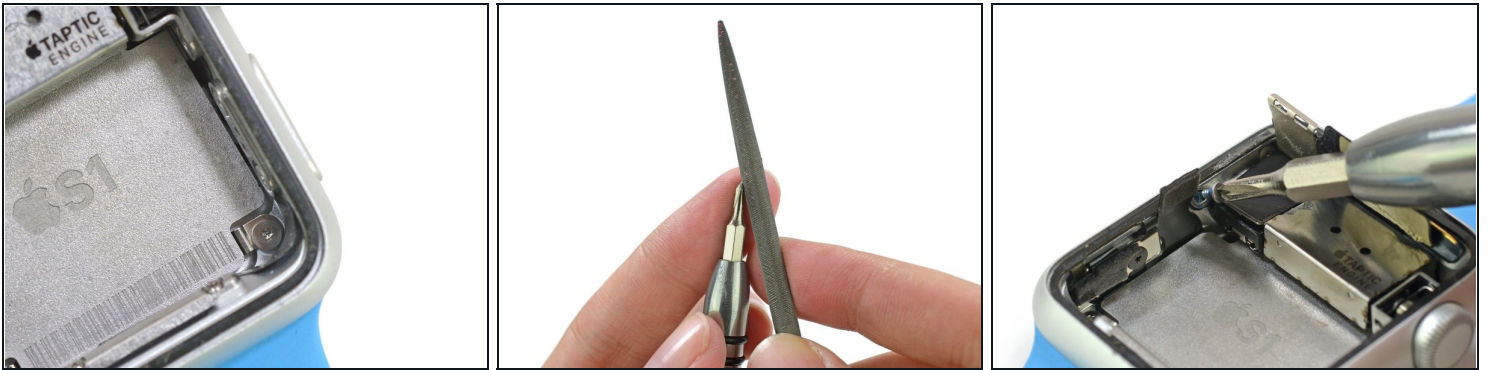
- With this first photo, we take a moment to compare the internals of the Apple Watch with that of a classic mechanical watch as old as time itself.
  - ① On the right, a pocket watch mechanism, circa 1890. (At 125 years old, it doesn't look a day over 39.) On the left, a smartwatch from 2015.
- Which of these will outlast the other?
- Although we're still dealing with a watch, this second photo makes it clear that the tools required for routine repairs have very much changed with the times.
  - You're already familiar with our friends on the left: opening pick, tweezers, driver, and tech knife.
  - On the right, the tool with the Mickey Mouse ears is none other than a pallet fork tool. To its immediate right, we've got a pin vise. Below that, a roller jewel shacking tool...
  - ...and to its right, [tweezers](#)! Some things really don't change. (Though our resident watchmaker informs us that it's perhaps more accurately called "the lazy man's screw holder.")

## Step 11



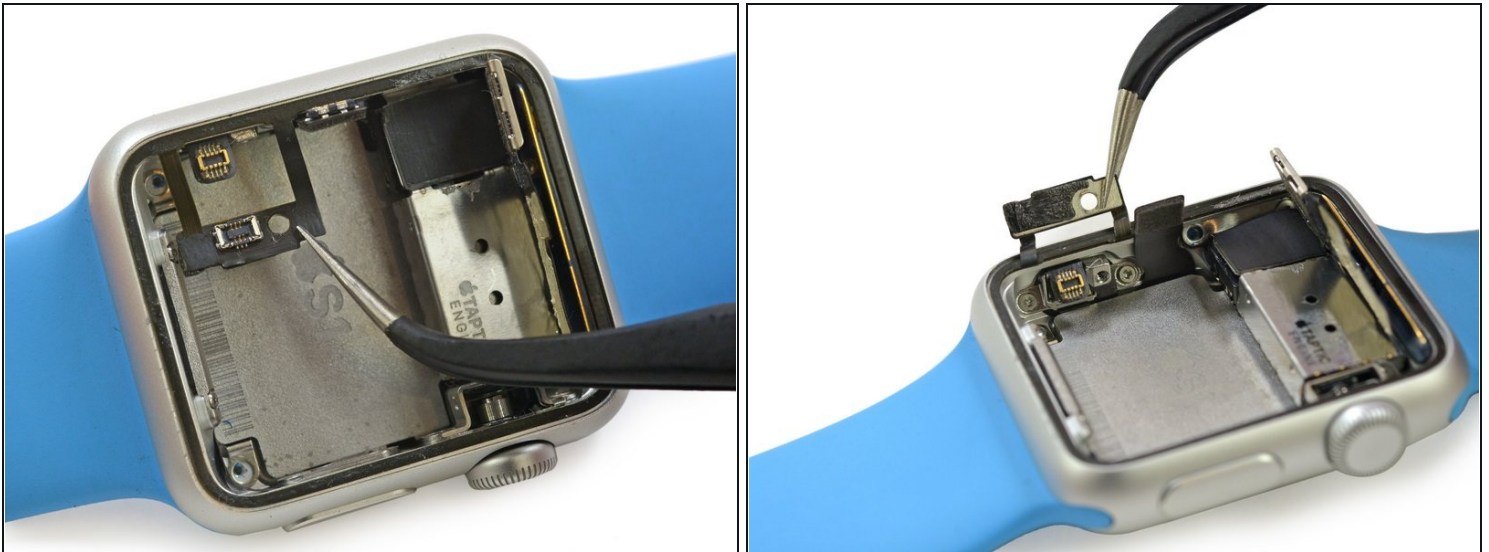
- A quick flick of a plastic opening tool is all it takes to dispatch the light adhesive securing the battery.
- This wee 3.8 V, 0.78 Wh lithium-ion battery is the power behind the 38 mm Apple Watch. No gears here! Apple claims the 205 mAh battery should provide up to 18 hours of use (which translates to 6.5 hours of audio playback, 3 hours of talk time, or 72 hours of Power Reserve mode.)
  - ✦ According to Apple, the "battery performance claims are based on test results from the 38 mm Apple Watch. A 42 mm Apple Watch typically experiences longer battery life."
- ① A 205 mAh battery seems miniscule in comparison to the 300 mAh batteries found in the [Moto 360](#) and [Samsung Gear Live](#). Hopefully, Apple's Watch OS will help the battery stand the test of time and avoid the problems that initially [plagued](#) the Moto 360.

## Step 12



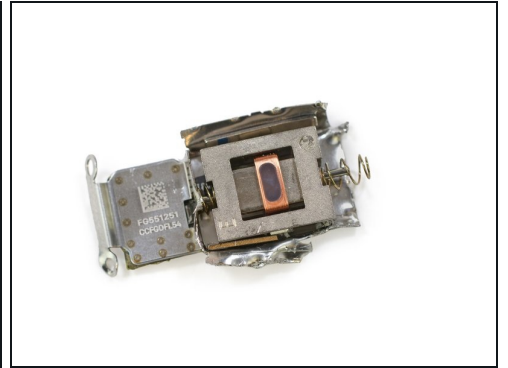
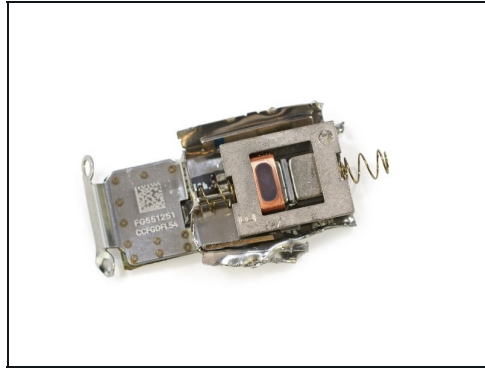
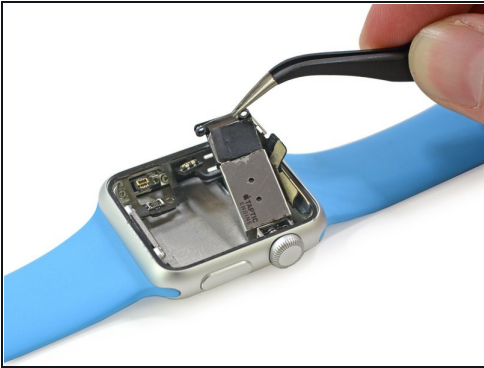
- As we work our way to the S1 SiP, we encounter the tiniest tri-point screws we've ever seen.
- No, [we don't think Apple had repairability in mind when they designed her, Fixers.](#)
- It's rare that we don't have the right tool for the job, but even our teensiest bit isn't up to snuff. We've never been thwarted before—so it's time for some [modifications](#).
- ① Achievement unlocked.

## Step 13



- Given the limited amount of [space](#) inside the Apple Watch, we find the microphone ribbon cable creatively ensnared between the inner and outer layers of the case.

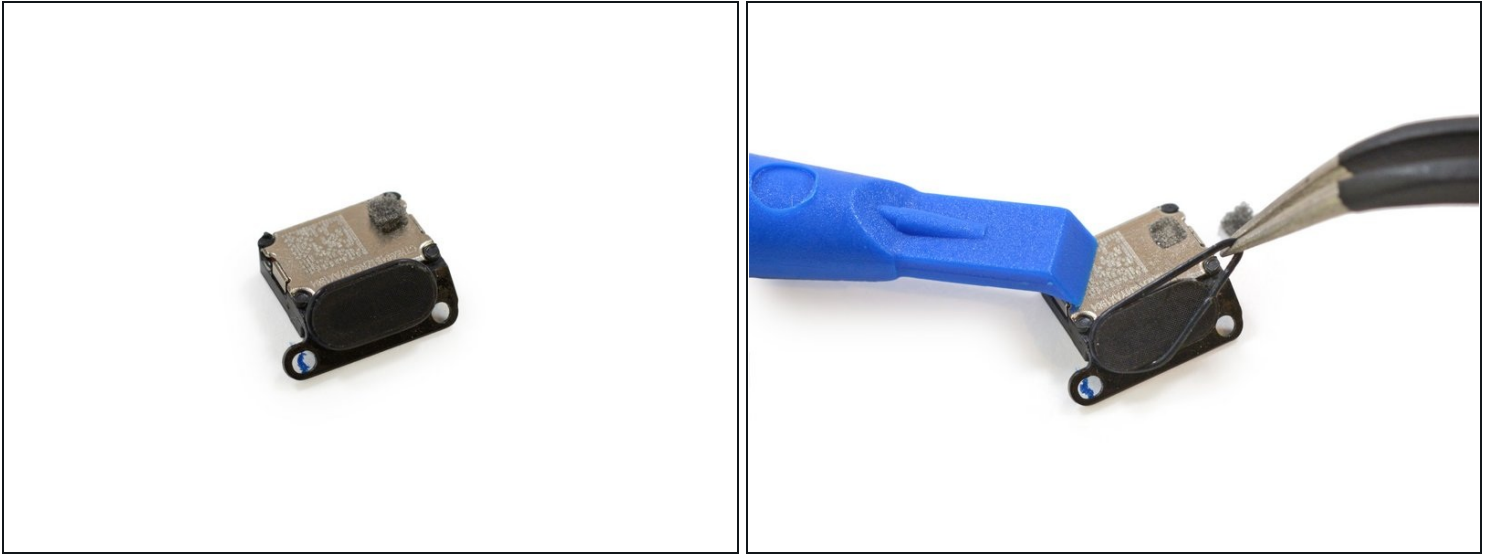
## Step 14



- It's time to remove the Taptic Engine, which is attached at the hip to the speaker.
- ① The Taptic Engine is Apple's take on the [linear actuator](#). It creates motion in a straight line (as opposed to the circular motion of an electric motor), which in turn provides [haptic feedback](#).
- It makes sense that the Taptic Engine is attached to the speaker. When combined with subtle audio cues from the specially engineered speaker driver, the Taptic Engine is designed to output a unique motion.



## Step 15



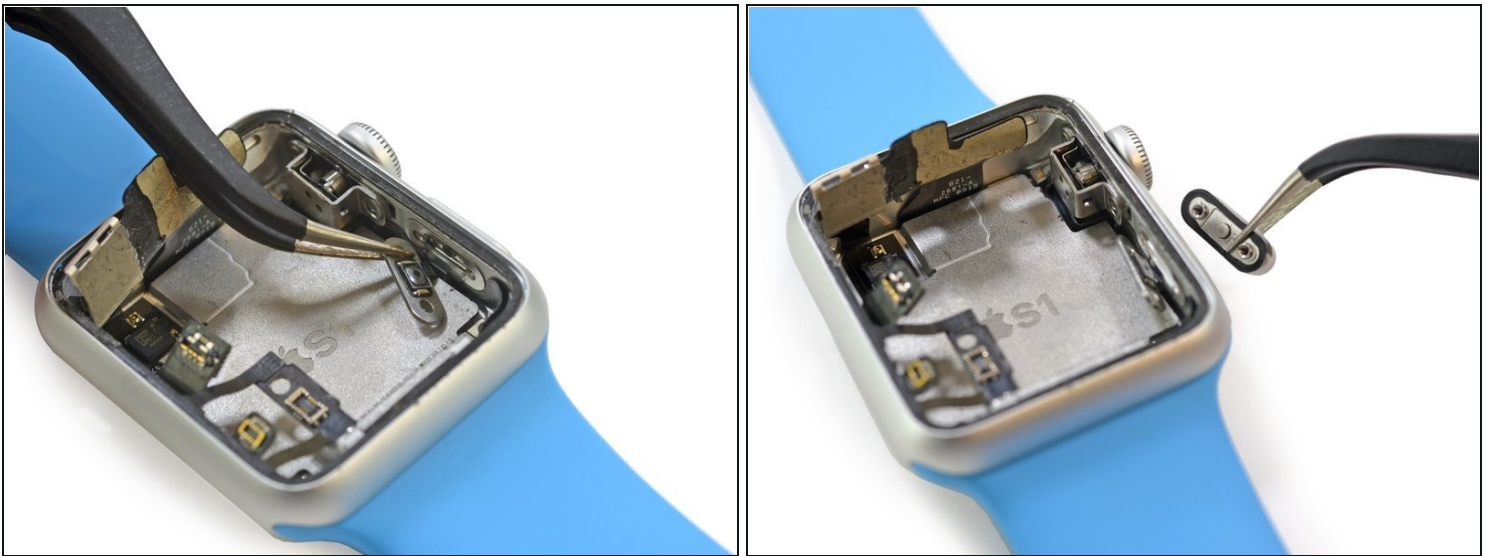
- The speaker comes equipped with an O-ring for water resistance. Like everything else in this device, [it's tiny](#).
- ① Apple's been touting Watch's [IPX7 water-resistance rating](#). These gaskets help, but rapid temperature changes will cause any metal to shrink or expand and can compromise the integrity of these seals.
- For the spec geeks out there, IPX7 means that the Apple Watch can withstand up to 30 minutes of full submersion in up to 1 meter of water.
- Apple doesn't recommend testing those limits, stating that you can "...wear and use Apple Watch during exercise, in the rain, and while washing your hands, but submerging Apple Watch is not recommended."

## Step 16



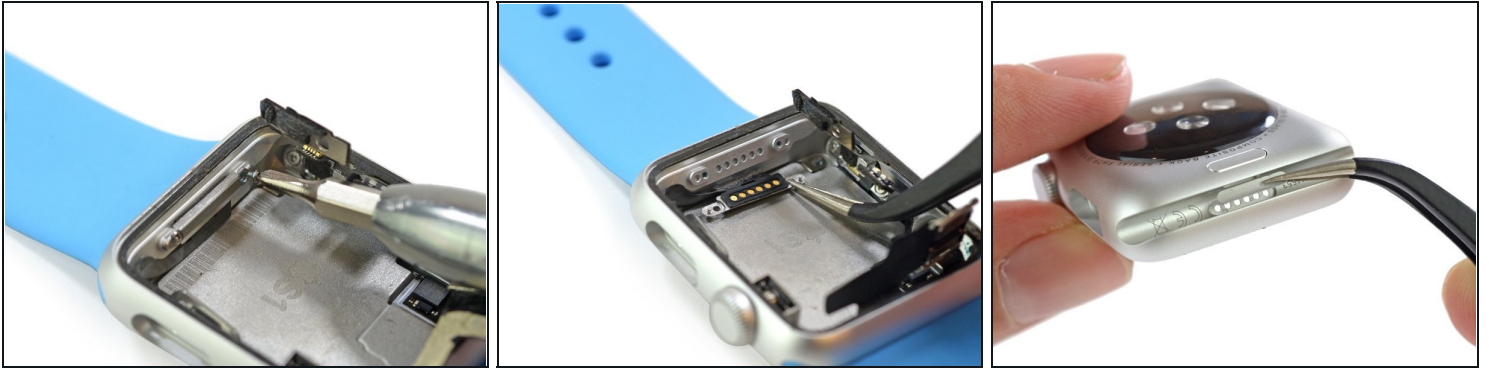
- We carefully remove the antenna assembly, which is discreetly tucked into the recesses of the case.
  - ① We're betting that this 'lil guy handles the Apple Watch's Wi-Fi and Bluetooth capabilities. Recent Apple patents suggest that part of the antenna assembly *may* be [integrated into the case](#).

## Step 17



- What is this? [A phone for ants](#)? Just like a miniature version of an iPhone, we find a button cable with a mechanical button.
  - The little button even comes with a little button cover and gasket.

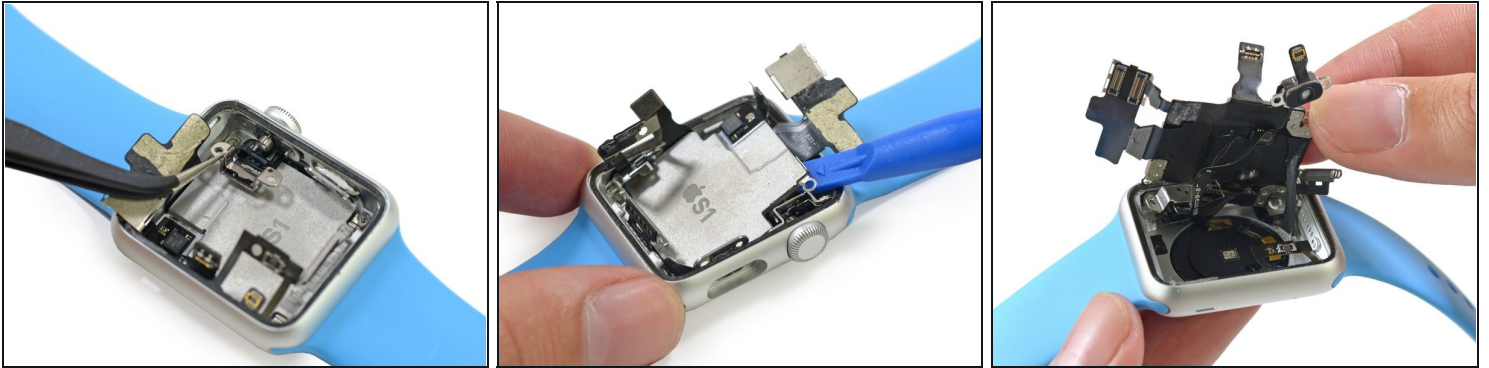
## Step 18



- We quickly dispatch two very small tri-point screws holding a tiny panel to the watch case.
- Behind the tiny panel we find a set of contacts that align perfectly with the location of the hidden diagnostic port.
- Not wanting to make [contact](#), we quickly dispatch this little connector.
- Still unable to remove the diagnostic port door, we resort to pushing it free through the little holes on the inside of the case.
- ① There's got to be an easier way to access the door than disassembling the whole watch—but we're not privy to Apple's secrets.



## Step 19



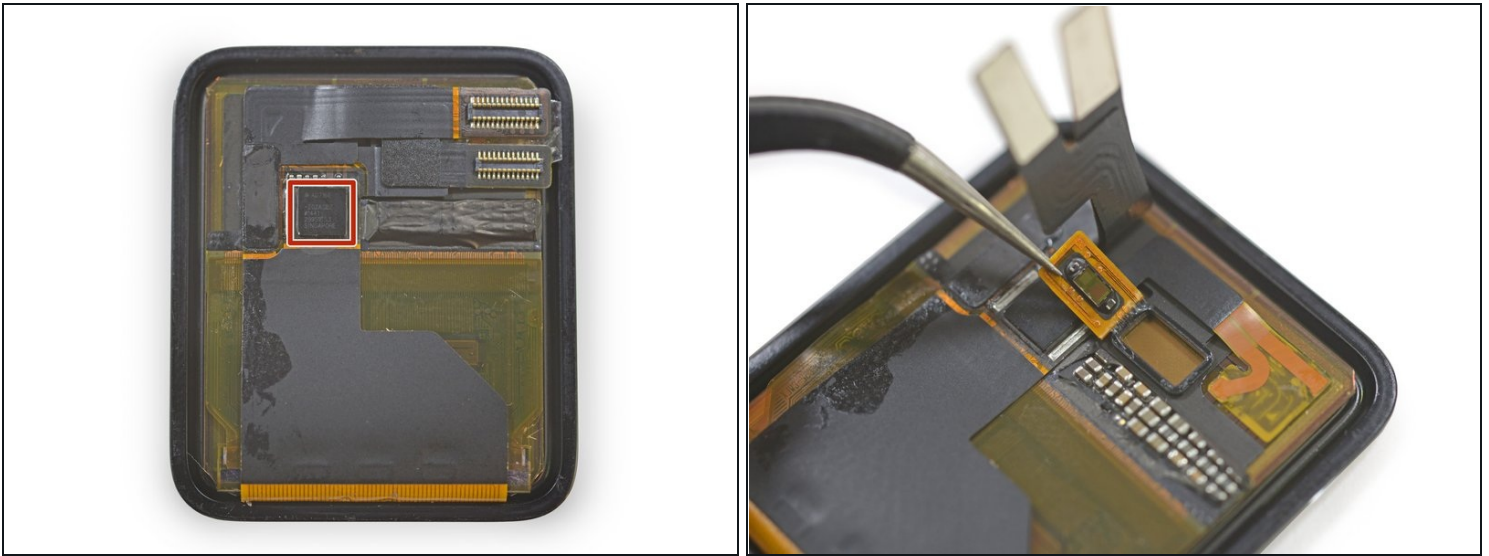
- We remove the Digital Crown bracket, the final obstacle keeping us from the S1 SiP.
  - Cue the [epic rising of the monolith](#).
- We can feel the power as we slowly peel the ~~future of humanity~~ S1 out of the case.
- The back of the S1 isn't as pretty as the front—with ribbon cables running to every peripheral and gobs of adhesive gripping it in place, the chip leaves a nasty mess in its wake.

## Step 20



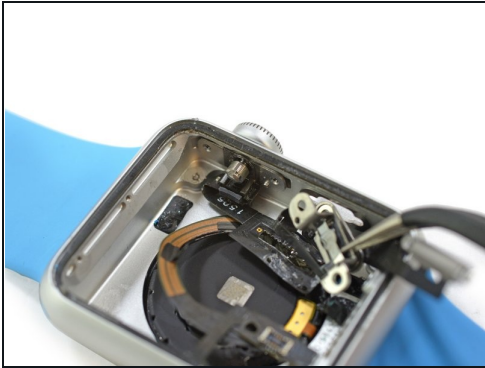
- Pulling this mess out is a destructive procedure, but after ripping out some soldered connectors we get our first real look at the S1.
- Despite [rumors](#) (and hopes) of an upgradable product, the difficulty of removing the S1 alone casts serious doubt on the idea of simply swapping out the internals.
- Unfortunately, our first look is obstructed—that S1-emblazoned silver cap isn't a cap at all. It's a solid block of plasticky resin, hiding treasures deep within.
- **Update:** [Chipworks](#) has identified this small IC as the STMicroelectronics C451 gyroscope + accelerometer.

## Step 21



- After removing the S1, we go [back to the future](#), and the display panel, to find a lonesome chip:
  - Analog Devices [AD7166](#) ARM Cortex M3-based Touchscreen Controller
- ① Analysts have [anticipated](#) that [LG would be the supplier](#) of the Apple Watch's Retina display, and our best guess is that Watch is sporting a [Plastic AMOLED](#) display made by LG.
- With some careful tweezing, we pull up what appears to be an ambient light sensor.
  - ① We're betting that this is one of Apple's new [solar cell ambient light sensors](#). This allows for the sensor to be *behind* the display panel, as opposed to the traditional surface-mounted design seen on most smartphones and tablets.

## Step 22



- The Digital Crown seems to have an encoder system, like the [Nest Thermostat](#), to read the spinning of the dial.
  - ① [Rotary encoders](#) work by translating the angular position of a shaft into analog or digital code that computers can understand.
- The encoder branches off of the button cable, along with the single push button and the diagnostic port contacts.
- ① All these peripherals leave us wondering whether Apple has any intention of offering an upgrade program for the Apple Watch. Stripping out the internals will be difficult and time-consuming—not the sort of thing your local Genius is equipped to handle, but we suppose Apple could provide a mail-order option.

## Step 23



- Scraping the bottom of the barrel watch case, we find the pulse-pounding sensor action. And lenses.
- Apple's heart rate monitor is actually a [plethysmograph](#)—it [looks and acts like a pulse oximeter](#), but Apple isn't claiming it can measure your blood oxygen level. Why? *Beats us.*
  - ① Our best guesses involve [FDA regulations](#).
- Nestled in the case we also find a magnet, to help seat the watch on its inductive charger. *Electrifying.*
- We find a [familiar looking](#) coil of wire resting in the composite cover. We're guessing this is the inductive charging coil.
- **Update:** [Chipworks](#) has identified the Texas Instruments OPA2376 Precision, low noise, low quiescent current Op Amp as part of the sensor package.

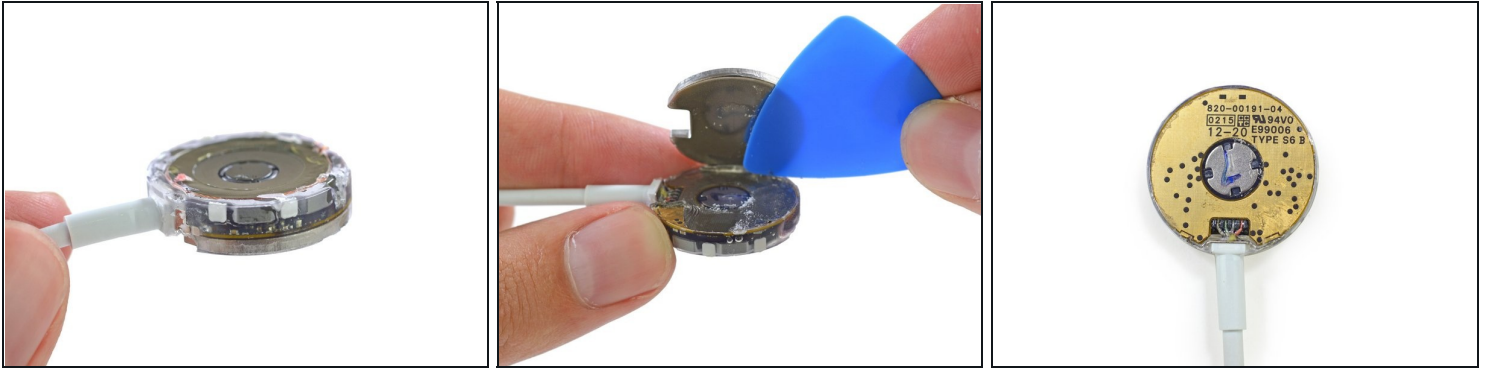
## Step 24



- Don't touch that dial! We're not done quite yet.
- Apple's inductive charger is a [pretty big deal](#), and we're always itching to open their newest adapters.
- Officially known as the [Apple Watch Magnetic Charging Cable](#), it features a 6.7 mm thick cradle with a diameter of 28 mm.
- After some heat, we try to pry, and end up ripping up the back case of the mag-safe-ish charger.
- To find it filled to the brim with glue!



## Step 25



- We cut away the housing to get at the little glue cake (complete with magnetic center).
  - After peeling away the weight, we find some markings, but that's about it.
- ① Apple has been notably absent from the ongoing fray over wireless charging standards. Some have speculated that Apple has been [devising their own](#) method for inductive charging. Recent Apple patents covering an [integrated NFC/inductive charging coil](#) support these hypotheses.

## Step 26



### REPAIRABILITY SCORE:



- Apple Watch Repairability Score: **5 out of 10** (10 is easiest to repair)
  - While not an industry standard, the watch band is easily removed and swapped out for a replacement.
  - Removing the screen is difficult, but not impossible—it's the first component out, simplifying replacement.
  - Once you're inside, the battery is quite easy to remove—only mild adhesive holds it in place.
  - While not proprietary, incredibly tiny tri-point screws are a repair hinderance—especially when Torx or Phillips could have been used.
  - Removing any other component is essentially impossible—all peripheral cables are soldered onto the back of the S1.
  - The fully encased S1 system makes board-level repairs impossible.

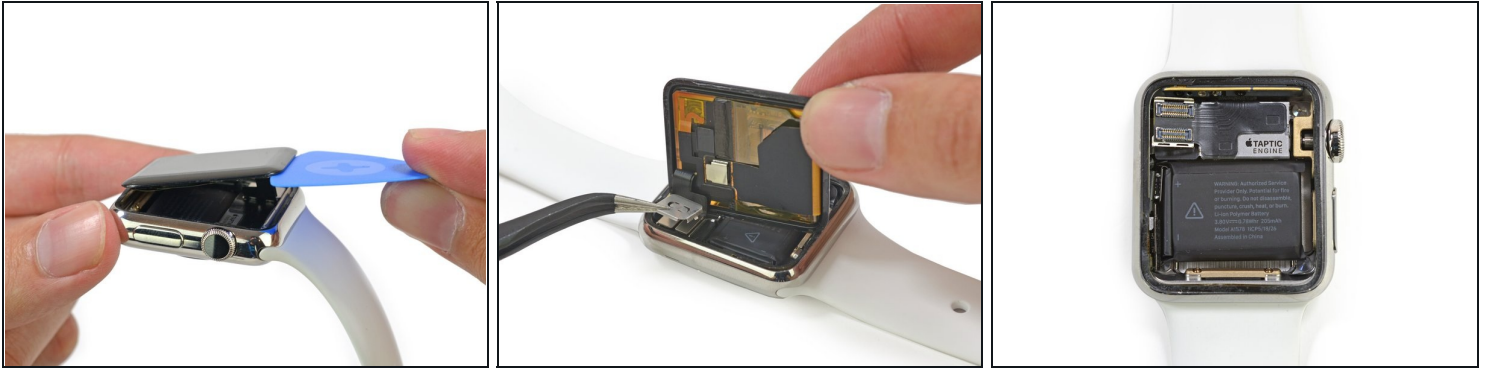


## Step 27



- But wait, there's more! For a limited time only, view one teardown, and get a second one free. You heard us, 100% absolutely free!
- Meet the true Apple Watch: the Stainless Steel model.
- Curiously enough, the standard Apple Watch has an entirely different box than the Watch Sport. This may be to accommodate the [various bands](#) that can't be laid out flat like the Sport Band.

## Step 28



- Having perfected our pick procedure, we pop the hood on the Apple Watch Stainless Steel.
  - No surprises here. The same clips and connectors greet us inside.
  - It looks like not too much has changed. The mounting bracket for the Digital Crown looks significantly more substantial, and the bottom features *gold* tri-point screws.
  - ① That's all for now—but we're not done yet. With several mysteries left, iFixit will be back soon with more analysis.
    - For a few mysteries revealed, check out our [X-ray Teardown!](#)
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