



# iPhone XS and XS Max Teardown

Teardown of iPhone XS and XS Max on September 21st, 2018.

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## INTRODUCTION

Last year's [iPhone X](#) had a weird name and the most advanced internals we'd ever seen in a teardown. This year Apple turns it up to eleven with the bafflingly-named iPhone XS and XS Max. In a teardown first, we're taking apart both phones simultaneously—so grab ahold of your Roman numerals and let's get started.

*Huge thanks to our friends at [Circuitwise](#) for hosting us in Sydney, Australia, where iPhones launch early and all the Apple Stores are upside-down—and to our pals at [Creative Electron](#), for their incredible imagery and appropriate use of the letter X.*

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### TOOLS:

- [iOpener](#) (1)
  - [Halberd Spudger](#) (1)
  - [Tweezers](#) (1)
  - [Phillips #00 Screwdriver](#) (1)
  - [Tri-point Y000 Screwdriver](#) (1)
  - [Suction Handle](#) (1)
  - [P2 Pentalobe Screwdriver iPhone](#) (1)
  - [Spudger](#) (1)
  - [Nylon Tipped Tweezers](#) (1)
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## Step 1 — iPhone XS and XS Max Teardown



- After its complete makeover last year, the new iPhone looks very familiar—looks like we're back on a *tick/tock* upgrade cycle for now. Here's what we know:
  - Hexa-core A12 Bionic SoC with a "next-generation" Neural Engine
  - 5.8" (2436 × 1125) and 6.5" (2688 × 1242) 458 ppi Super Retina OLED displays with True Tone, wide color gamut, and 3D Touch
  - 12 MP rear cameras (wide-angle and telephoto) with  $f/1.8$  and  $f/2.4$  apertures and OIS, and 7 MP selfie cam paired with TrueDepth FaceID hardware
  - 64 GB of onboard storage (256 and 512 GB optional configs)
  - Gigabit-class LTE (not 5G) as well as 802.11a/b/g/n/ac Wi-Fi w/MIMO + Bluetooth 5.0 + NFC
  - Improved dust and water resistance with an IP68 rating

## Step 2



- We aren't one to judge a book by its Gorilla Glass cover, but these covers don't suggest that much has changed since the [last X](#) we saw on this table.
- ... Besides the luxurious gold color and the new XL size option, that is.
- Thankfully, [Creative Electron](#) gives us a sneak peek at any hidden plot twists we might be in for. (Their high-tech technique still uses X-rays, which is still pronounced "ex-rays.")

## Step 3



- Here we have all our ~~exes~~ erm, *tens* lined up.
- We notice an extra antenna band has moved in where our left-side mic-hole friends used to live. Rumor has it this is for "Gigabit LTE," and it [seems to make a difference](#).
- Our teardown engineer doubles up on the drivers, demonstrating excellent dual-driver discipline as the teardown-ing commences.
- ❗ Not pictured: our teardown engineer's extra right hand.

## Step 4



- Apple may be changing up their naming scheme, but we're glad they left the opening procedure alone.
- Our [iOpener](#) pulls double duty to soften the hidden adhesive, and then a [suction handle](#) and a [halberd spudger](#) come in to free the display.
- Though we feared Apple might pile on more adhesive to achieve that new IP68 rating, we fared no worse opening these phones than we did with ye olde IP67-rated [predecessors](#).

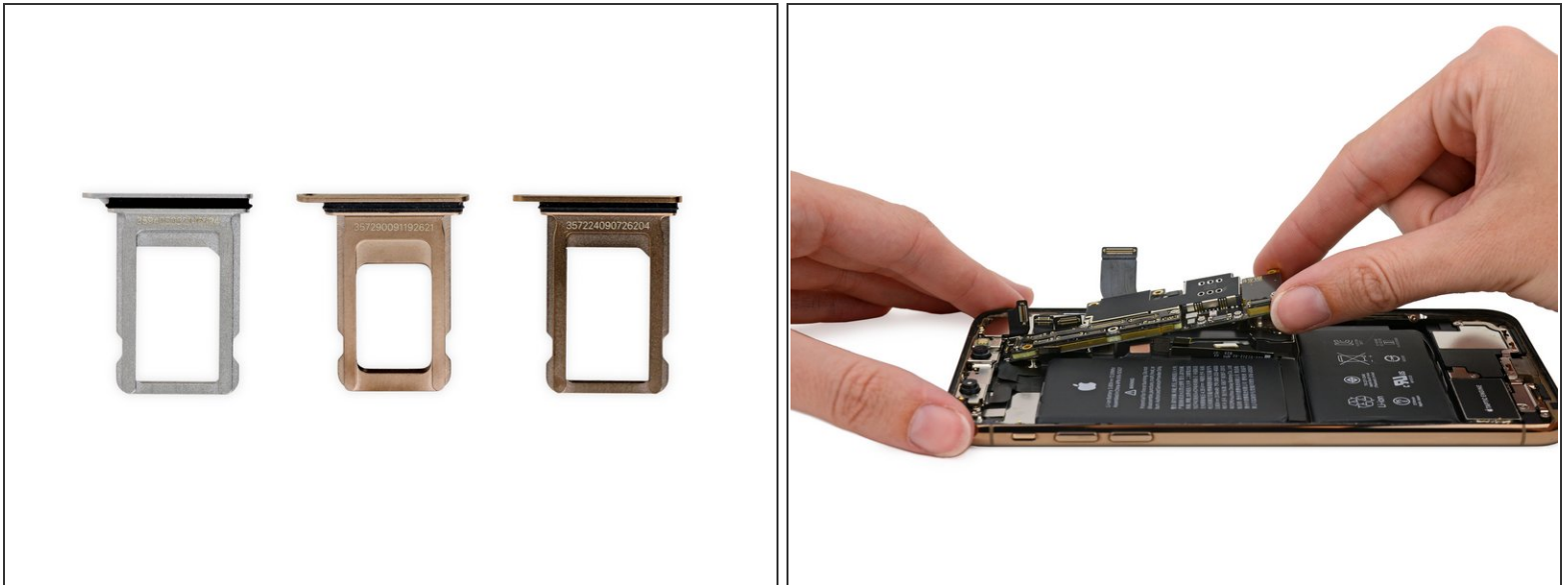
## Step 5



- We're a little short-handed in this 2-for-1 teardown, so we called in some local muscle to help kick things off.
  - It turns out lack of opposable thumbs slows things down a little, but our drivers make it so easy even a [kangaroo](#) can do it.
- With the displays out of the way, we start to notice a few differences between the XS and XS Max.
  - The Taptic Engine inside the XS Max has been resized—big phone, bigger vibrations?
  - The XS Max also gets an extended logic board, with one of the display connectors moved to the bottom.
  - The XS battery looks weird, and new, while the XS Max battery sticks to a [familiar design](#).



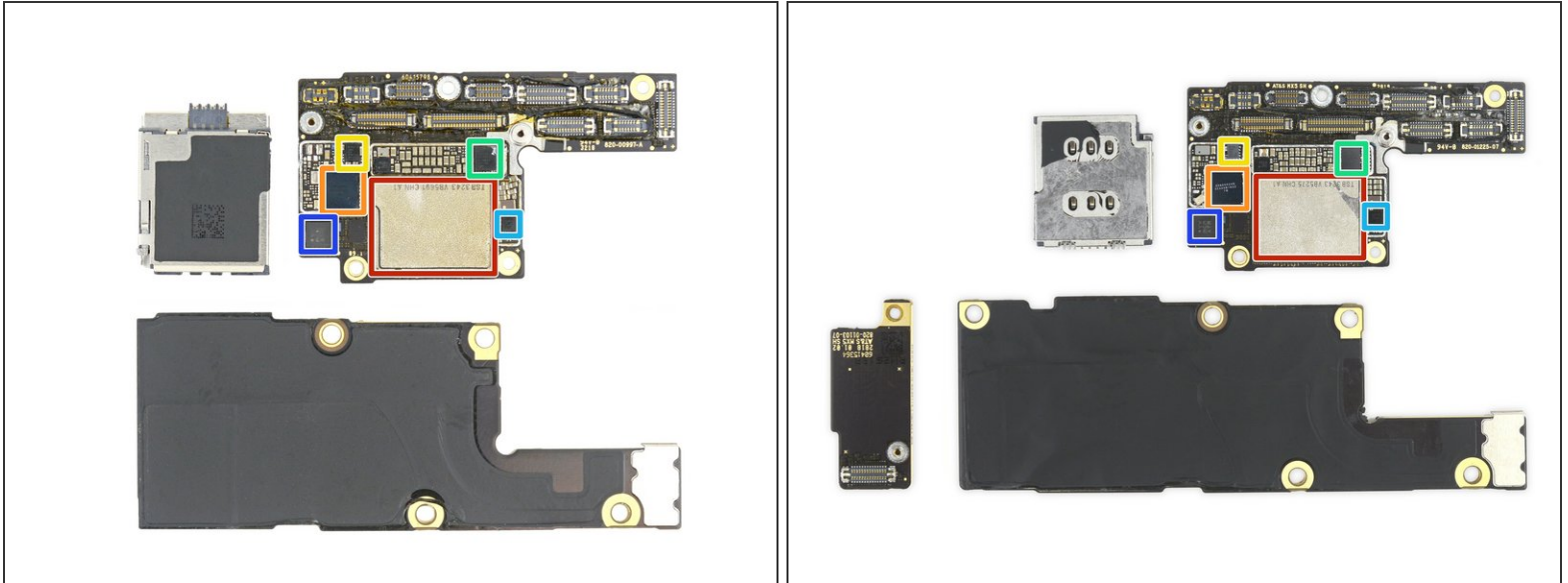
## Step 6



- On the hunt for signs of improved ingress proofing, we turn our attention to the largest unsealed gap in the device—the SIM card slot.
  - ⓘ Although shaped a little differently, upon closer inspection the gaskets (the important bits) look largely unchanged from last year's iteration. That said, if we were in [China](#) there would be a whole other side to this SIM story.
- With the topside set of peripherals dispatched, we can finally turn our attention to the most important part of every S-series iPhone—the logic board!

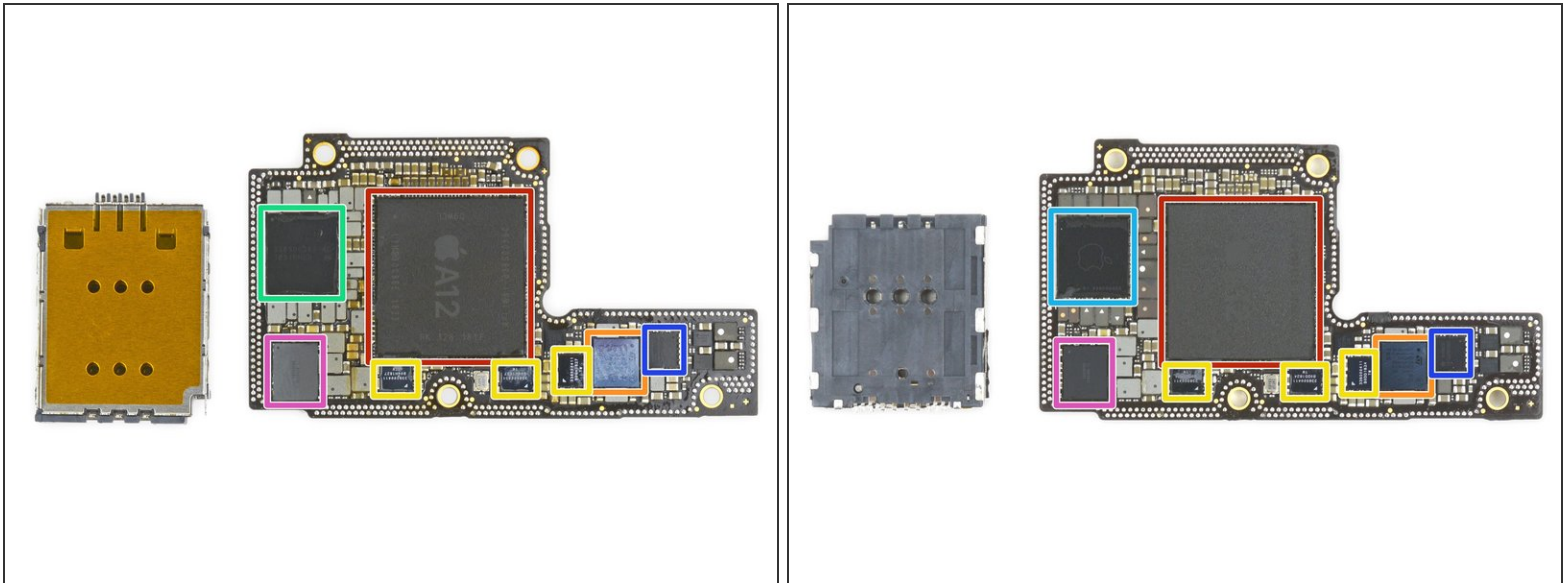


## Step 7



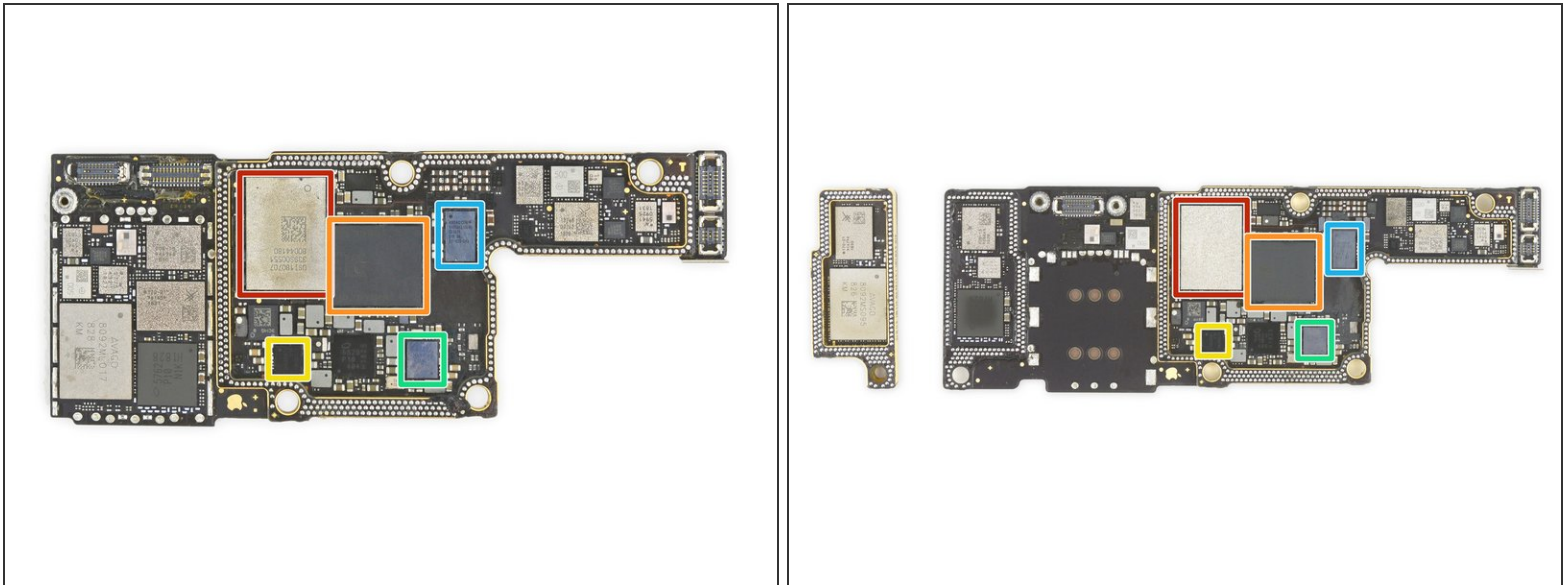
- Having seen this kind of logic board [once already](#), we've gotten pretty good at pulling this PCB sandwich apart. Let's see what's on top of the top layer (XS on left, XS Max on right):
  - Toshiba TSB3243VB5275 64 GB NAND flash storage
  - Apple/Cirrus Logic 338S00248 audio codec
  - Cypress CPD2104 USB-C port controller
  - NXP Semiconductor CBTL1612 display port multiplexer
  - Texas Instruments SN61280E battery boost converter
  - Bosch Sensortec accelerometer/gyroscope

## Step 8



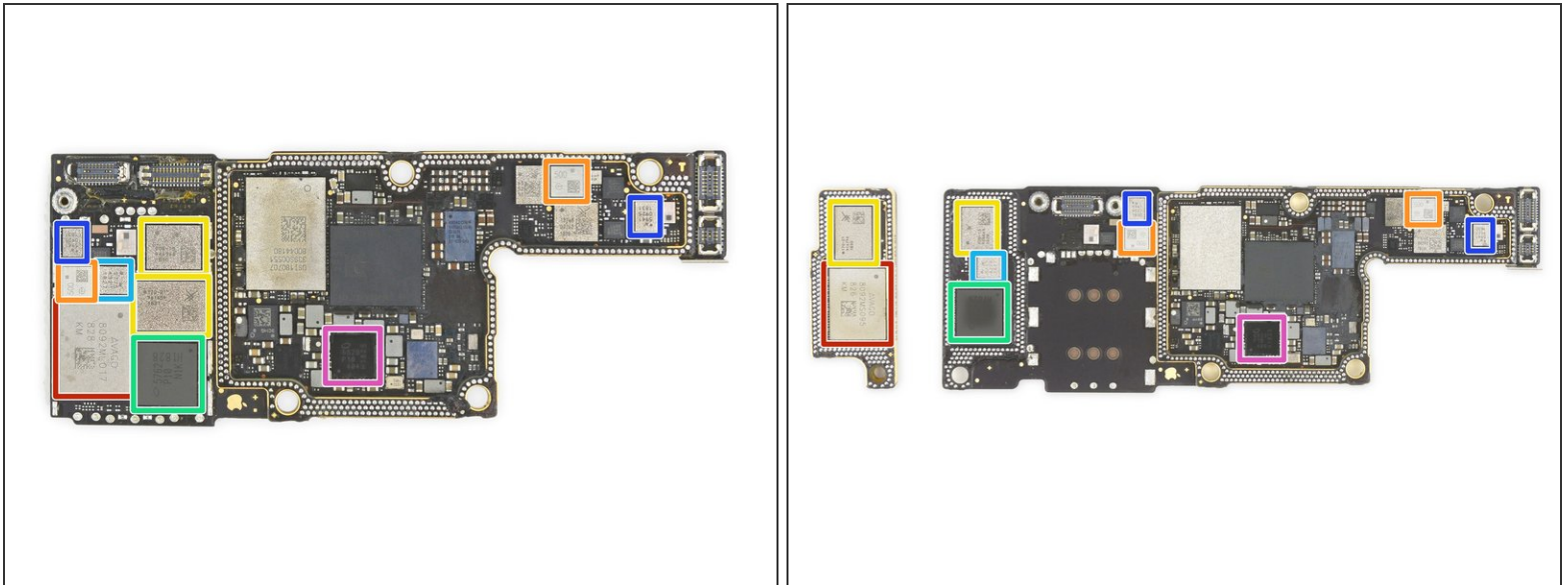
- Computer, zoom in and enhance the under-side of the top board:
  - Apple [APL1W81](#) A12 Bionic SoC layered over Micron MT53D512M64D4SB-046 4 GB LPDDR4X SDRAM
  - STMicroelectronics STB601A0 power management IC (possibly for Face ID)
  - 3x Apple/Cirrus Logic 338S00411 audio amplifiers, two for stereo and one for haptics
  - Apple/Dialog Semiconductor 338S00383-A0 power management IC
  - Apple 338S00456 power management IC
  - Apple/Dialog Semiconductor 338S00375 system power management IC
  - Texas Instruments SN2600B1 battery charger IC

## Step 9



- Digging a little deeper, we find the RF board (XS on left, XS Max on right):
  - Apple/USI 339S00551 (XS) and 338S00540 (XS Max) WiFi/Bluetooth SoC
  - Intel PMB9955 (likely XMM7560) baseband processor/modems
    - ⓘ Sorry, Qualcomm fans.
  - ST Microelectronics [ST33G1M2](#) 32 bit MCU with ARM [SecurCore SC300](#)
    - ⓘ This is the same [embedded SIM](#) (eSIM) that we found in the [Apple Watch Series 3](#) and the [Google Pixel 2 XL](#).
  - NXP 100VB27 (SN100V) NFC controller
  - Broadcom BCM59355A wireless charging module

## Step 10



- RF board part two:
  - Avago AFEM-8092M high/mid band power amplifier duplexer (PAD)
  - Murata 500 4x4 MIMO duplexer
  - Skyworks 206-15 and 170-21 power amplification modules
  - Intel PMB5762 RF transceiver
  - Skyworks S775 RF switch
  - Skyworks 5941 GPS low-noise amplifiers
  - Intel PMB6829 power management IC

## Step 11



- Time to talk cameras! The S-year often comes with a camera upgrade, and Apple had a lot to say about these new sensors.
  - The wide-angle sensor size has been increased by 32%.
  - Pixel size has also been bumped, bringing better low-light performance and contributing to the new "Smart HDR" feature.
    - ⓘ Only time will tell if bigger pixels can help beat last year's impressive [Pixel 2 camera](#).
- There was one thing Apple forgot to mention about the new camera: all that 32% had to go somewhere, and it turns out [the camera bump had to grow a little](#)—your iPhone X case [may not fit your iPhone XS](#).
- **Teardown Update:** We did a little testing, and the XS and XS Max camera modules appear to be identical—meaning you can swap the same camera between models with no problem.

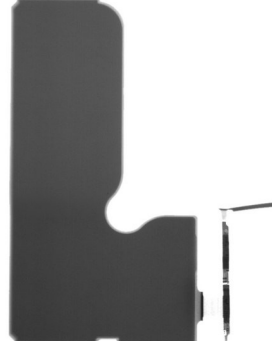
## Step 12



- After dissecting the brains and the eyes, we take a look at the brawn powering these phones.
- The XS packs a 10.13 Wh battery (2,659 mAh at 3.81 V), weighing 39.5 g—slightly downgraded from [last year's X](#).
  - But this decrease in capacity comes with a wild new battery configuration. Rather than using two cells to fill this L-shaped recess, Apple has constructed an all-new single-cell battery.
- The XS Max battery unsurprisingly comes out on top capacity-wise, with 12.08 Wh (3,179 mAh at 3.80 V), and weighing 46.6 g. No single-cell here, though!
- ❗ These are both in the ballpark of the [S9](#) and [S9+](#) batteries, but far smaller than that of the [Note9](#).



## Step 13



- Let's take a deep dive into Apple's battery origami:
- Since 2015 when the [12" MacBook](#) was announced with a terraced battery, Apple has increasingly sought to take advantage of every bit of space in the chassis of their devices using contoured batteries.
- [These patents](#) show solutions they have found to get around tricky problems like thermal expansion, using different layer sizes and precisely folding electrode sheets cut into complex shapes to fit those contours.
- ⓘ What's interesting is that this single-cell does a better job of utilizing space, but [packs less punch](#).
- The extra corners and edges of the single-cell battery in the XS will be prone to extra stress—it will be interesting to see how this new battery performs as it ages.

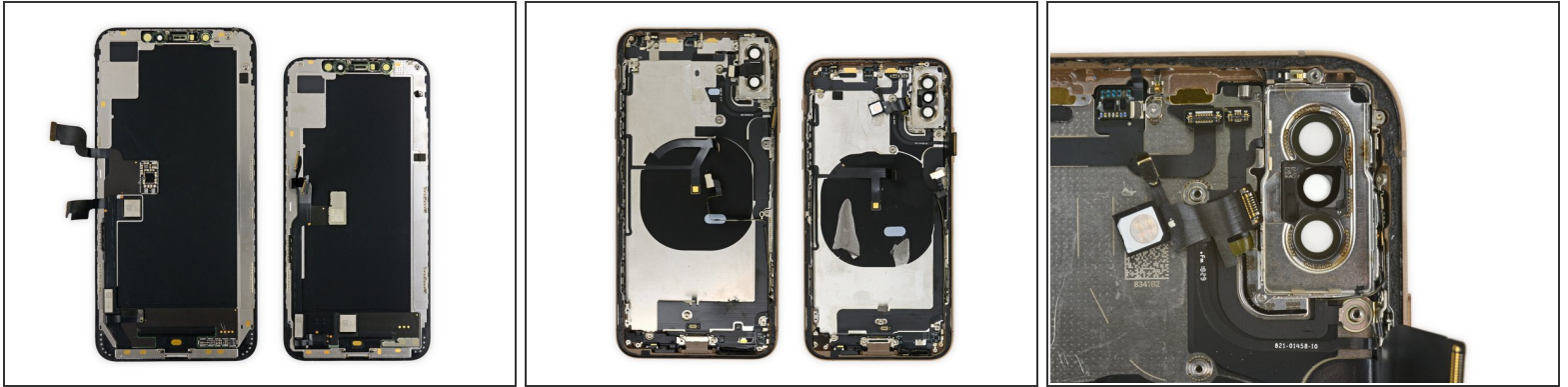


## Step 14



- What was revolutionary [last year](#) is quickly becoming standard equipment—both the XS and the XS Max come equipped with a sensor array for Apple's [fancy Face ID](#) technology.
- Time to fish out the noisemakers! The Taptic engine and loudspeaker come out in an assembly, but easily separate for modular replacement.
  - ❗ The XS Max features a slightly beefier set of feedback units, but both Taptic engines follow the [same designs of yore](#).
- Speaking of same, the earpiece speaker assemblies match *almost* identically across the XS and XS Max, with just a bit of extra speaker volume for Max.

## Step 15



- As we scrape the bottom of the phone we find some tasty display chips, and a barrel of tiny cables in the body.
- It looks like the rear glass is still sandwiched between the camera bump and the frame with dozens of tiny welds.
- ❗ Despite the many improvements this phone received, it's got the same iPhone 8/iPhone X back glass construction, meaning one tiny crack calls for a whole chassis replacement.

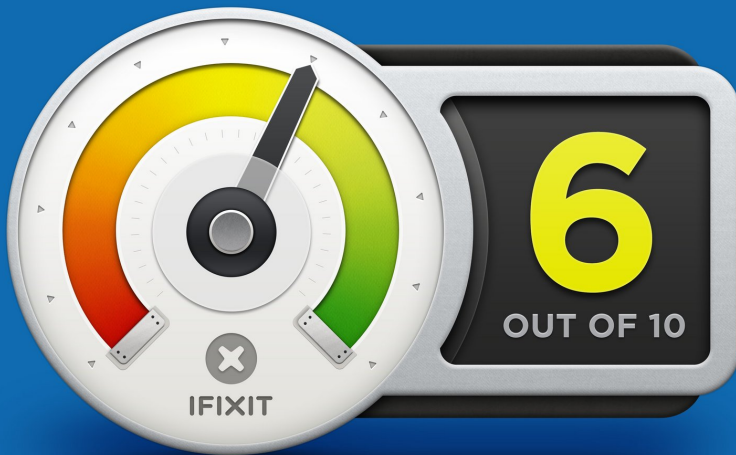
## Step 16



- Our [synchronized](#) two-phone teardown has come to a tidy conclusion.
- We suspect this marks the beginning of a new era in iPhone battery design—the carefully contoured single-cell concept is limited to the smaller XS for now, but we expect to see it again soon. iPhone XR, perhaps?
- Huge thanks again to our gracious hosts at [Circuitwise](#) in Sydney, Australia, and to our best buds over at [Creative Electron](#) for their stunning X-ray photography.
- Oh, and one more thing: it's time to assign an overall repairability score.

## Step 17 — Final Thoughts

### REPAIRABILITY SCORE:



- The iPhone XS and XS Max both earn a **6 out of 10** on our repairability scale (10 is the easiest to repair):
  - Critical display and battery repairs remain a priority in the iPhone's design.
  - A broken display can be replaced without removing the biometric Face ID hardware.
  - Liberal use of screws is preferable to glue—but you'll have to bring your Apple-specific drivers (Pentalobe and tri-point) in addition to a standard Phillips.
  - Waterproofing measures complicate some repairs, but make difficult water damage repairs less likely.
  - Glass on front and back doubles the likelihood of drop damage—and if the back glass breaks, you'll be removing *every* component and replacing the entire chassis.