

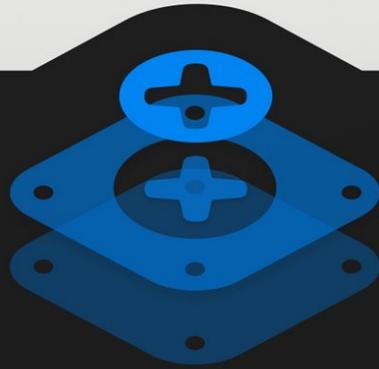


# Retina MacBook 2015 Teardown

Retina Macbook 2015 Teardown on Tuesday April 14, 2015.

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# Retina MacBook 2015



# TEARDOWN

## INTRODUCTION

Apple describes its new Retina MacBook as "the future of the notebook." Its all-new design certainly has us intrigued. The whiff of aluminum in the air and the whisper of screws unwinding to reveal the mysteries within can only mean one thing: The teardown has begun. Join us as we expertly dismantle the Retina MacBook 2015.

Want to watch repair history unfold? Follow us on [Instagram](#), [Twitter](#), and [Facebook](#)!

[video: <https://www.youtube.com/watch?v=7aHL2hcF624>]

## TOOLS:

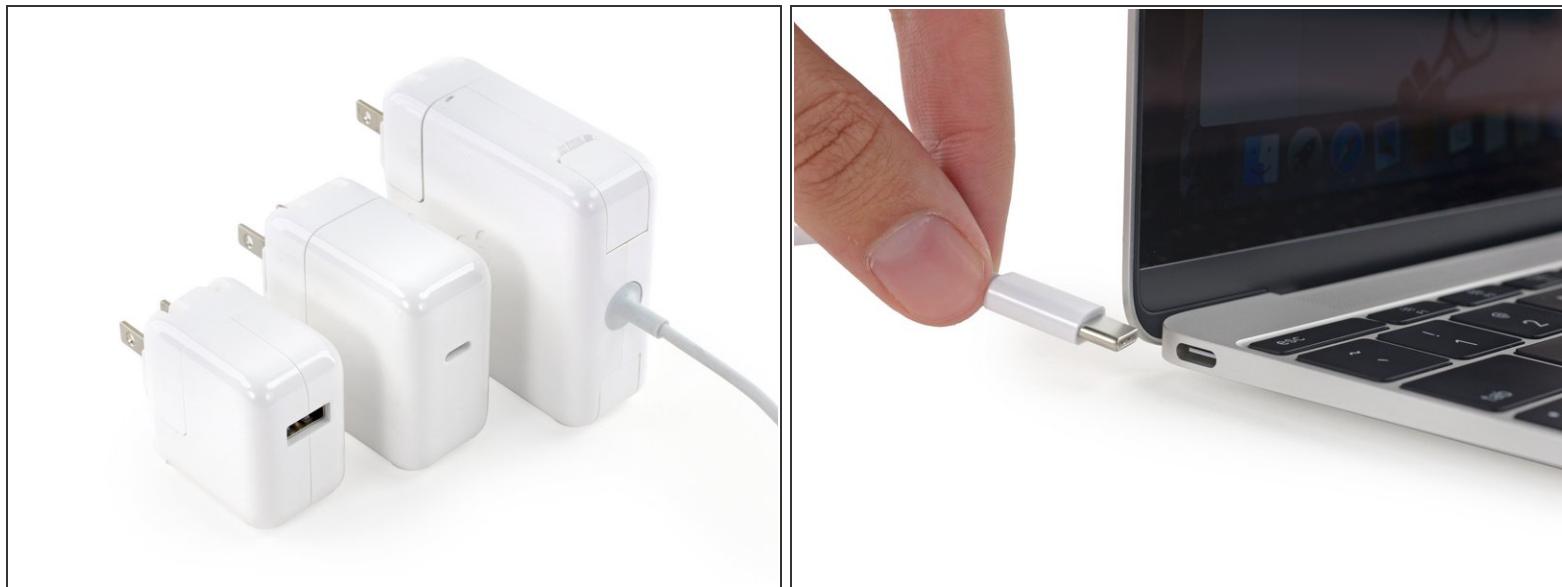
- [P5 Pentalobe Screwdriver Retina MacBook Pro and Air \(1\)](#)
- [T5 Torx Screwdriver \(1\)](#)
- [Tri-point Y0 Screwdriver \(1\)](#)
- [T3 Torx Screwdriver \(1\)](#)
- [Spudger \(1\)](#)
- [Tweezers \(1\)](#)
- [iPad Battery Isolation Pick \(1\)](#)
- [Plastic Cards \(1\)](#)
- [Phillips #000 Screwdriver \(1\)](#)
- [iOpener \(1\)](#)
- [P2 Pentalobe Screwdriver iPhone \(1\)](#)
- [T8 Torx Screwdriver \(1\)](#)

## Step 1 — Retina MacBook 2015 Teardown



- Since it was announced on March 9th, we've been eager to get our hands on the sleek new MacBook. Before we tear inside this beauty, we take a glance at its specs:
  - 12-inch, 2304-by-1440 pixel (~226 ppi) IPS "Retina" display
  - 1.1 GHz or 1.2 GHz dual-core Intel Core M processor (optional 1.3 GHz processor available)
  - 8 GB of 1600 MHz LPDDR3 memory
  - 256 GB or 512 GB flash storage
  - Intel HD Graphics 5300
  - Single USB-C port

## Step 2



- While we want to commend Apple for adopting the new USB Type-C standard, they've done so in a way that makes it impossible to use old adapters on new devices. The MagSafe and Thunderbolt ports of old are gone. The new MacBook has one USB-C [to rule them all.](#)
- For comparison's sake:
  - 10-watt iPad USB adapter (left)
  - 29-watt USB-C power adapter included with the MacBook (middle)
  - 60-watt MacBook Air Magsafe 2 (right)

ⓘ This is the first MacBook in memory to ship without some form of MagSafe adapter. The breakaway nature of MagSafe made it less likely to damage ports and plugs when yanked.

- Hopefully users will benefit from the standardization, and not trip over their cables *too often.*

## Step 3



- The new MacBook is less than half the thickness of its 2009 ancestor, measuring 0.52 inches at its thickest point.
- At 1.08" thick, the 5 pounds of polycarbonate-swathed 2009 MacBook dwarfs our 2.03 pound Retina MacBook.
- Apple probably shaved off a lot of that weight in removing ports. Back in 2009 we had MagSafe, ethernet, Mini DisplayPort, 2x USB, audio, and a security slot.
- We'd also remind you to say goodbye to your optical drive, but that ship has [pretty much sailed](#).

## Step 4



- Those are pretty short keys. Bursting from its cocoon is Apple's newly-designed keyboard, equipped with a [butterfly mechanism](#). Let's see if this keyboard will go [twice as high](#) as the traditional scissor-switch mechanism.
- We zoom in on the Retina display, described by Apple as [the thinnest, most energy-efficient Retina display ever on a Mac](#). The pixels themselves have a larger aperture, enabling more light to come through, resulting in greater energy efficiency without compromising brightness.

## Step 5



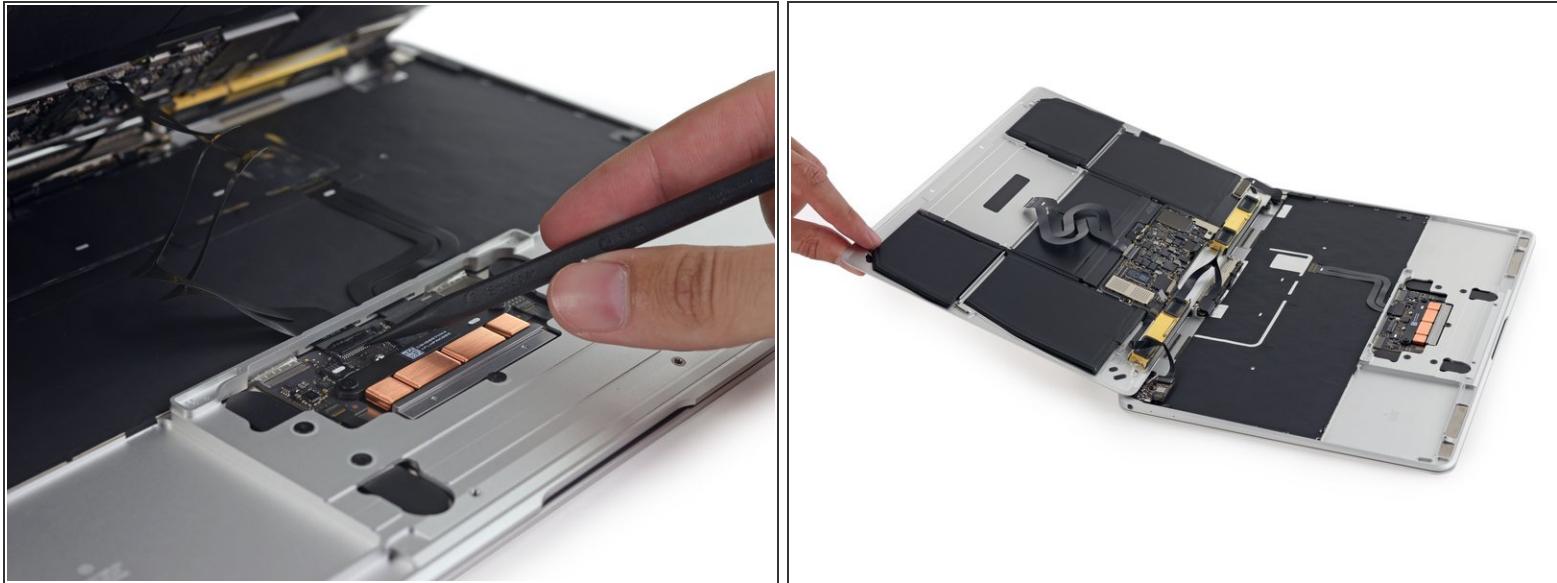
- We make a quick note of the newly-minted model number—A1534—before moving forward.
- This may be the future of laptops, but Apple has stuck to their tradition of using tamperproof 5-point [pentablob](#) screws for the new MacBook. *Le sigh.*

## Step 6



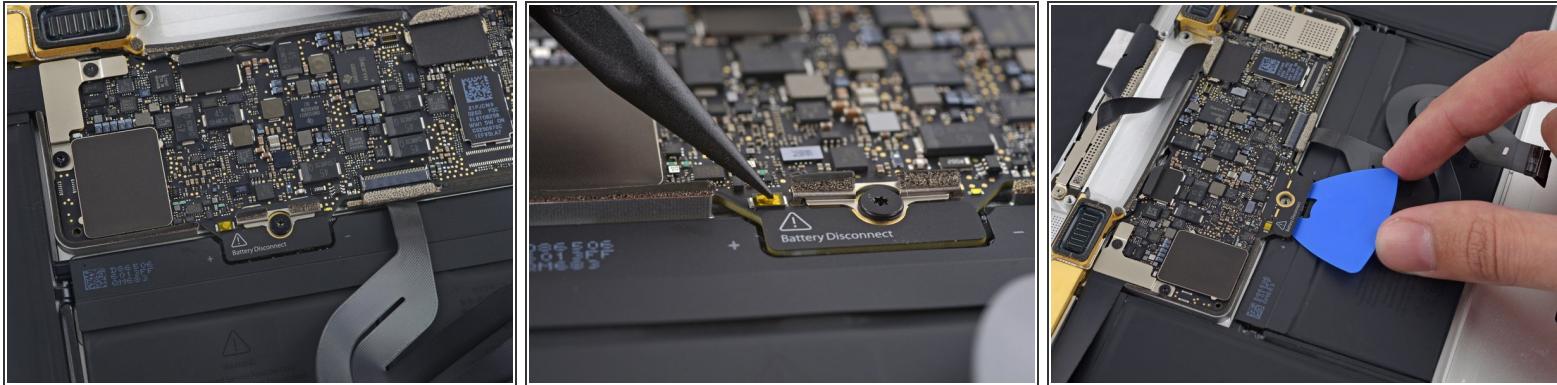
- Time to rip off that boring, plain ol' aluminum lower case, and get to the good—
- What is this new devilry? Cables!? A battery and logic board in the lower case?
- The standard pop-open-at-the-hinge practice still holds, but then the cables go taut. Then you have to hinge the case back *forward* to access the connectors and open the case.
- What is this, a [mid-gen iPhone](#)?
- The [standard plastic clips](#) of old are replaced with futuristic pegs and weird spring clips.  
*(i)* "If it ain't broke, make it out of, like, three more metal pieces in funky shapes." — Some [Apple designer](#), we assume.

## Step 7



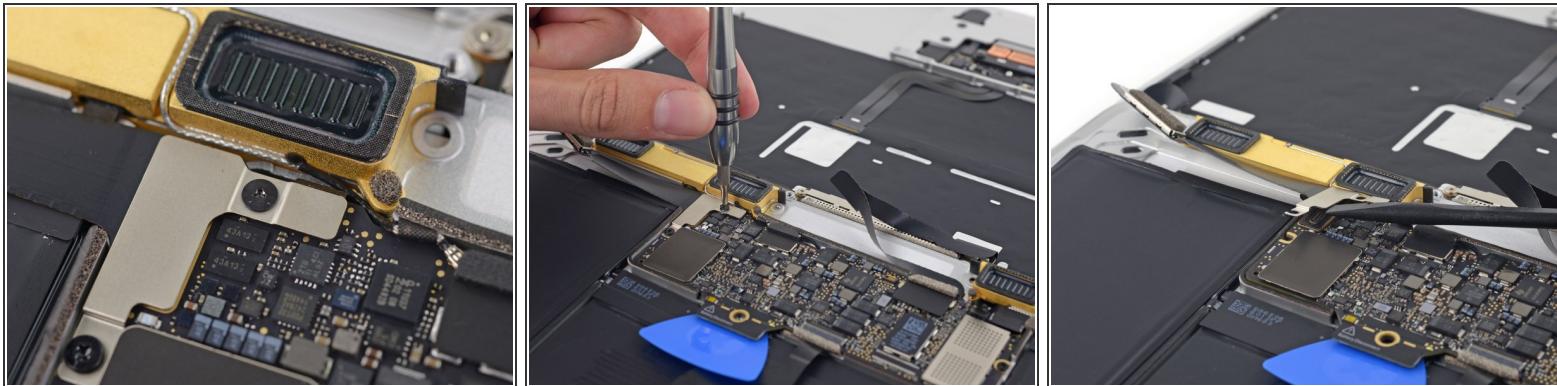
- Reminiscent of the [Macbook Pro 13" Retina](#) released in March, this MacBook comes equipped with the fancy Force Touch trackpad. We disconnect the trackpad/keyboard cable for a little more maneuvering room.
- With the springy trackpad/keyboard cable disconnected, we can fold the whole enchilada flat on the table. Time to survey the field and see what we're up against this time.

## Step 8



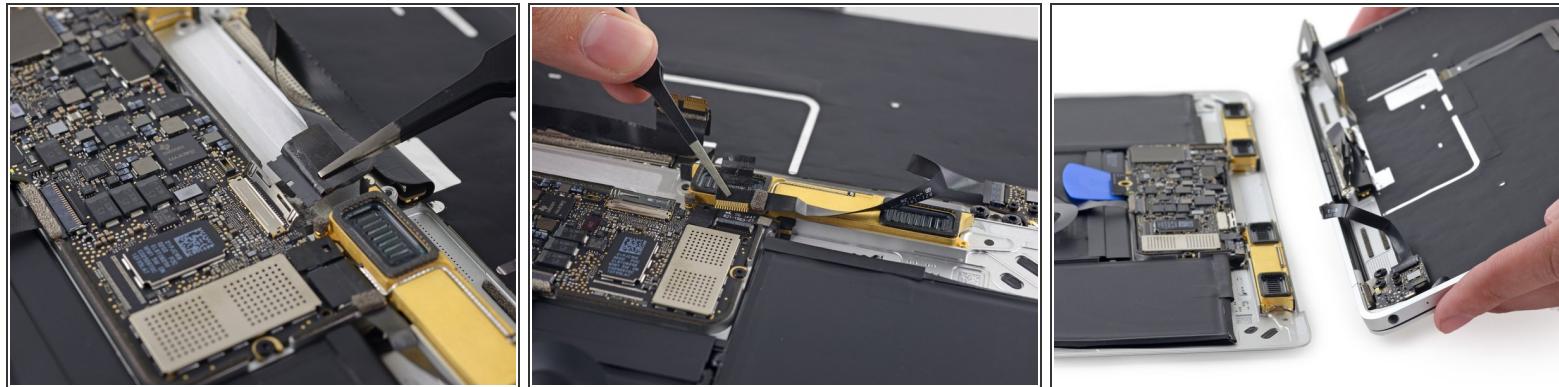
- Wait, this is a notebook, right? Where's the battery connector?
- At a loss, we play with this little yellow button for a bit. [Boop](#).
- We've seen something like this before—in the iPad, Apple loves to hide the battery connector under the logic board. This is the first time we've seen it in a laptop, so it looks like it's time for...
- Our newly-minted [battery isolation pick](#) turns out to be just the trick we need to keep the juice away from the logic board's spring contacts.

## Step 9



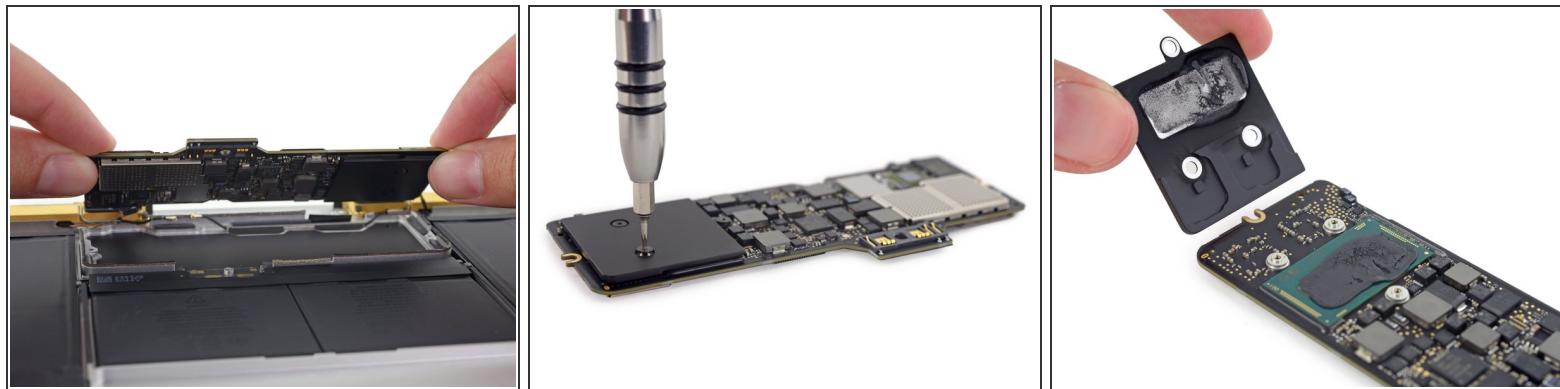
- In our quest to begin the Great Cable Disconnect of 2015, we find a [tri-wing screw!](#)
- [\*i\*](#) Lucky for us, that's something we can [handle](#).
- We finally disconnect the 3-in-1 display/power/I/O port cable that runs to the MacBook's lone USB-C port.
- It's funny because while there are three functions, there's only one port, and no I/O board.

## Step 10



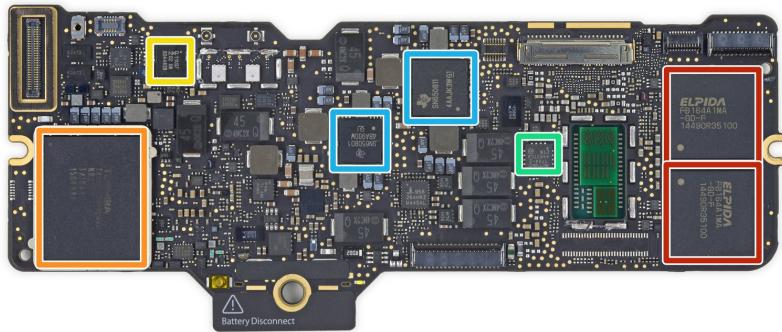
- We guessed that the [thinnest Retina display ever](#) would come with some other changes—but this is one weird display connector!
- We tweeze away the "audio board" connector that ties in the headphone jack and dual microphones.
- Finally, the two halves are free to fly. Now it's time to get to that logic board!

## Step 11



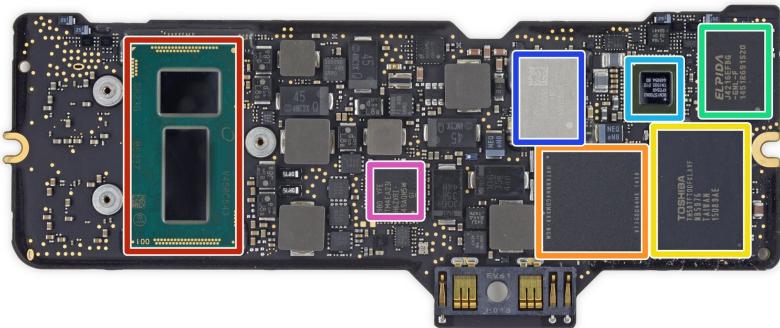
- We carefully lift the lovely logic board from its aluminum nest.
- *(i)* Apple points out that the logic board in the Retina MacBook is [67% smaller](#) than the logic board in the 11-inch MacBook Air.
- Apple's use of the new [Intel Core M](#) processors allows for smaller form factors and fun little heat sink covers.
- *(i)* More impressive than the updates is the [conflict-free](#) production of the Core M processors. Thanks, [Dodd—Frank!](#)
- The heat sink is nicely machined to provide multiple points of contact on the logic board—perhaps even to cool the reverse side of the logic board a bit.

## Step 12



- It's time to put the chips on the table! Let's see what this logic board has to offer:
  - Elpida/Micron [FB164A1MA-GD-F](#) 8 GB LPDDR3 Mobile RAM
  - Toshiba TH58TFT0DFKLAVF NB2953 128 GB MLC NAND Flash memory (+ 128 GB on the reverse side for a total of 256 GB)
  - NXP [11U37](#) microcontroller; 128 kB flash, 10kB SRAM
  - SMSC [1704-2](#) Temperature Sensor
  - Texas Instruments SN650811 (probably power converter related to [SN6501](#))

## Step 13



- Humming a [logical tune](#), we peruse the back side of the most logical of boards:
  - Intel [SR23G](#) Core M-5Y31 CPU (Dual-Core, 1.1 GHz, Turbo Boost up to 2.4 GHz) with Intel HD Graphics 5300
  - SK Hynix H9TKNNN4GDMRRR-NGM 4 Gb (512 MB) LPDDR2-SDRAM
  - Toshiba [TH58TFT0DFKLA VF](#) 128 GB MLC NAND Flash
  - Elpida/Micron [J4216EFBG-GNL-F](#) DDR3 SDRAM
  - Broadcom BCM15700A2, [appears to be](#) a wireless networking chipset
  - Murata 339S0250 (Likely an iteration of the 339S02541 Wi-Fi module found in the [iPad Air 2](#))
  - Texas Instruments/Stellaris [LM4FS1EH SMC Controller](#) (Replacement codename for TM4EA231)

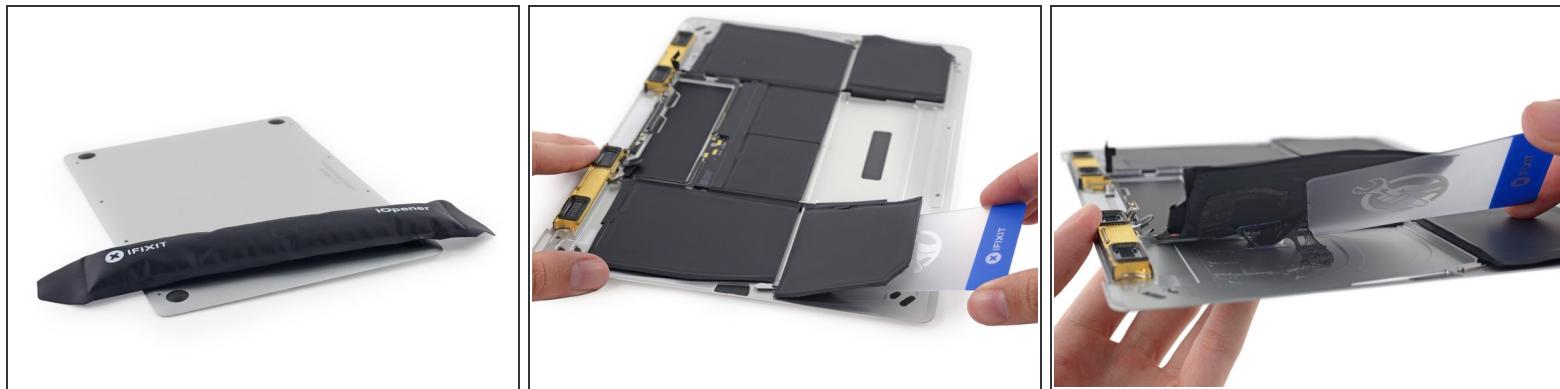
## Step 14



- In 2011, Apple acquired [Anobit](#), an Israeli flash memory controller designer.
- Four years later, it looks like they might now have something to show for it—thanks to [Anandtech's](#) report that the MacBook's SSD looked a little unusual in the system profiler, we took our heat gun to the SK Hynix SDRAM to see what was hiding underneath.
- Where we expected to see something by Samsung or Toshiba, we found an unbranded chip with a very Apple-esque part number: [338S00055](#).

*(i)* Our friends at [ChipWorks](#) took a peek, and have confirmed this is definitely an Apple custom device, fabricated at [TSMC](#). We'll have more details soon!

## Step 15



- It was too much to hope that the battery would be secured with a few screws, [MacBook Air-style](#). Time to break out the heat and the cards.
- **i** Apple's new [terraced battery](#) technology is supposed to provide 35% more battery cell capacity than would have been possible before.
  - We had hoped this would have provided room for a few screws, or some of those fancy little clips we saw on the case. Apparently not.
  - iOpener on a lower case? This just feels weird...
  - Scrape, peel, scrape, peel. Look at all that nasty adhesive.

## Step 16



- Ugh! Even the center cell of the battery is glued down, and we had hoped the [sticky cells](#) we found in the new [13" MacBook Pro](#) wouldn't be a trend...
- To complicate the procedure, the battery sits down in a well; the only safe place to pry is over this aluminum wall.
- *(i)* Apple says that they use photos from high-speed cameras to help align these batteries in their cases, [accounting for variations at the microscopic level](#).
- *(i)* This level of precision works well for fitting the largest battery possible, but it doesn't bode well for the idea of battery replacement.
- Well, it's finally out—in all its [multi-segmented glory](#).

## Step 17



- In order to power this slender gadget, Apple produced this form-fitting 7.55 V, 39.71 Wh, and 5263 mAh battery.
- According to the specs, this is just a hair more than you get from this year's almost-pudgy-by-comparison, 5100 mAh [MacBook Air 11"](#)—though Apple touts [equal battery performance](#) of up to nine hours surfing the net, or ten hours of iTunes video playback.
- For comparison's sake: With its slightly larger 7.6 V, 5380 mAh (42.4 Whr) battery, Microsoft's [Surface Pro 3](#) also promises "9 hours of web browsing."

## Step 18



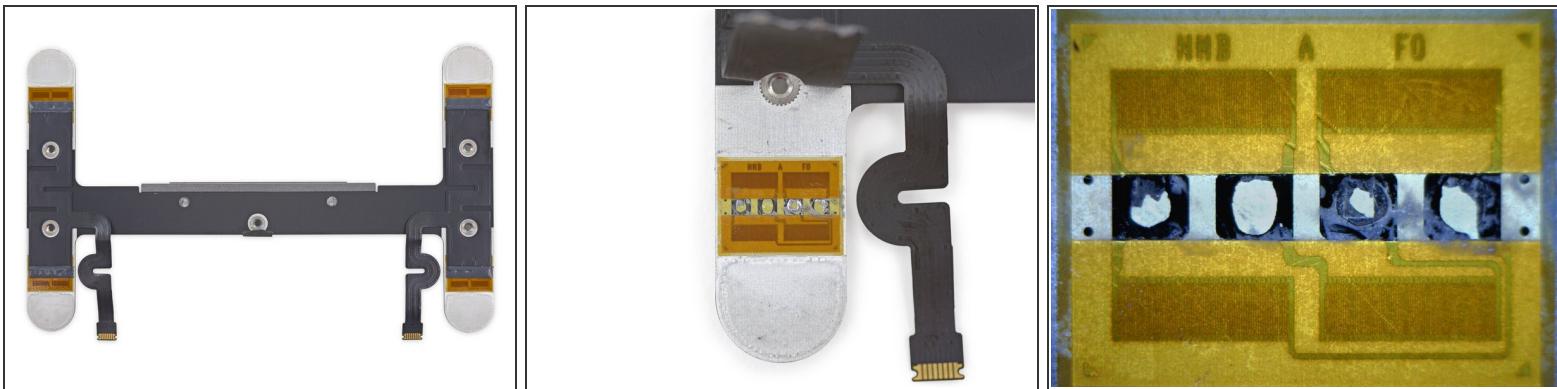
- We've struck gold! ...Or maybe just a dielectric coating on aluminum.
- The treasure antennas sit in channels routed into each speaker assembly.
- i If this is a dielectric coating, some of Apple's recent patents could suggest that Apple is using the speaker assemblies to form a compound antenna, helping maximize power efficiency in this smaller form factor.

## Step 19



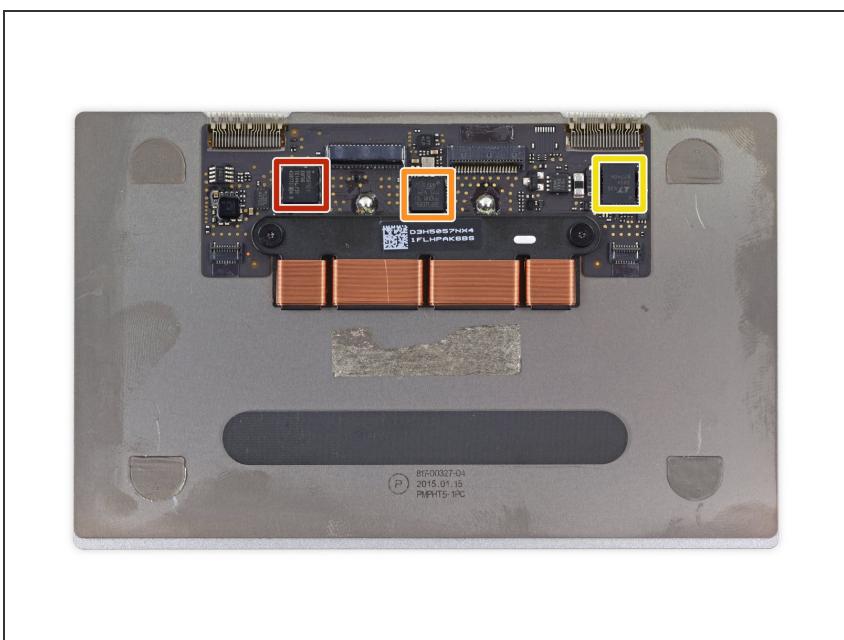
- Finally, we reach one of the most talked-about trackpads in town. As we could expect, the Force Touch trackpad in the Retina MacBook looks like a slimmer, daintier version of the one we found in the 13" MacBook Pro.
- Once we cut away the bracket, we get a clear view of the Taptic Engine.

## Step 20



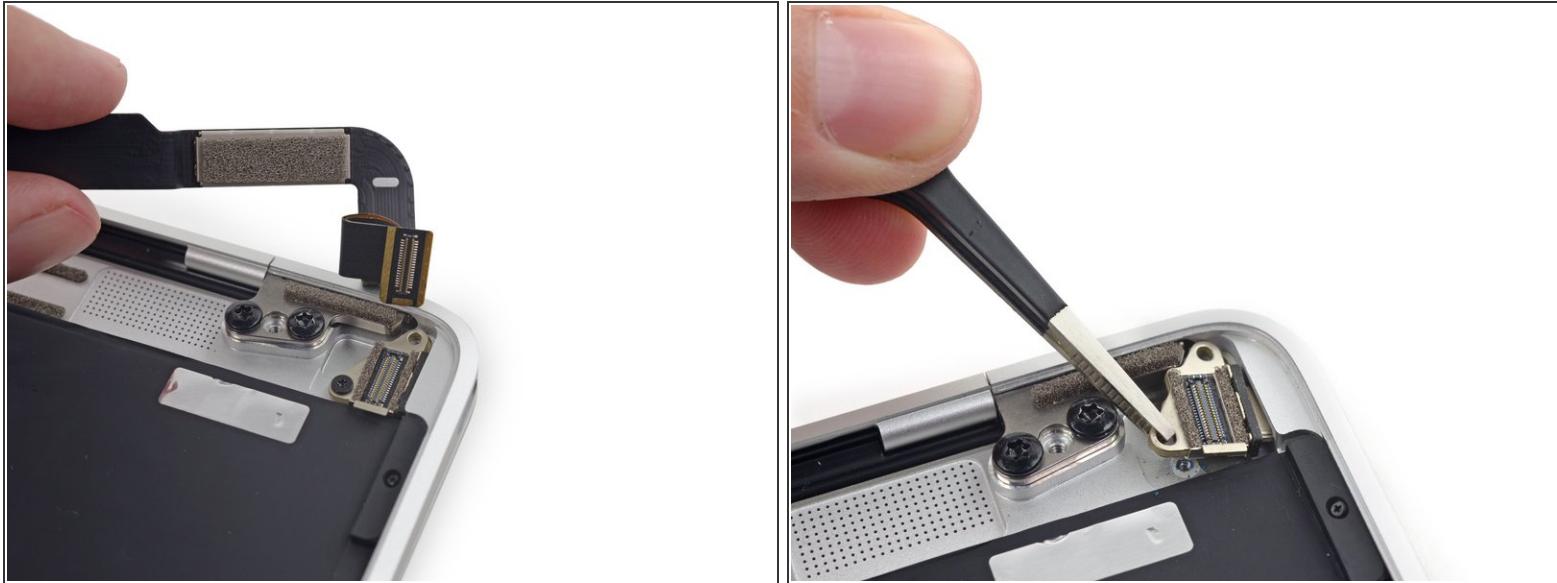
- Only four strain gauges? Seems unlikely... Time to hunt around.
- Ahah! Some strange rubbery glue was holding a cable over the second half of each strain gauge pair.
- As we found [previously](#) in Apple's Force Touch, the strain gauges on this trackpad sense pressure from your fingers without really moving.
- (i)* With the virtual feedback of the Taptic Engine, the new trackpad has essentially no moving parts, which usually makes for a more durable component.

## Step 21



- With the strain gauge bracket removed, we take a closer look at the chips powering this newfangled trackpad:
  - Broadcom [BCM5976](#) touchscreen controller
  - STMicroelectronics [32F103](#) ARM Cortex-M based microcontroller
  - Linear Technology [LT3954](#) LED Converter with Internal PWM Generator

## Step 22



- Another tri-wing bites the dust, and the USB-C port cable turns out to be an *interconnect cable*.
- And the dang port is trapped by the display hinge! [How rude](#).
-  Someone really doesn't want us to replace our sole everything-in-one port...
- We'll come back for you later, USB-C.
-  Dang it! We should have said "*USB-C you later*."

## Step 23



- Well at least the audio assembly is modular, allowing easy removal of the audio jack board. But that means the dual microphones are left behind.
- Behind the keyboard that is—curses!
- Wait, are those screws? No rivets? We can actually get in? Nice!
- To be fair, that screw you see in the corner is a pentalobe—a [P2](#). That's an iPhone-sized screw. Apple doesn't *really* want to let us in.

## Step 24



- Three pentalobes later...
- ...and 10 Phillips screws with weird sloping spacers, allowing them to secure the keyboard at an angle...
- ...and finally two screws that fit into the case clips (throwback to [step 6](#)).
- We can't complain too much, I mean screws are better than adhesive—[oh my goodness](#).
- The adhesive backing (a kind of layered tape) is stuck to the keyboard, and barely holds together upon peeling.
- Under the blanket of tape is a [field of disheartening stars](#). Two pentalobes per key, plus a row at the top and bottom, for a total of **83**, plus the three from before.

*(i)* "Look on my Macs, ye Mighty, and despair." — Jony Ive, probably.

## Step 25



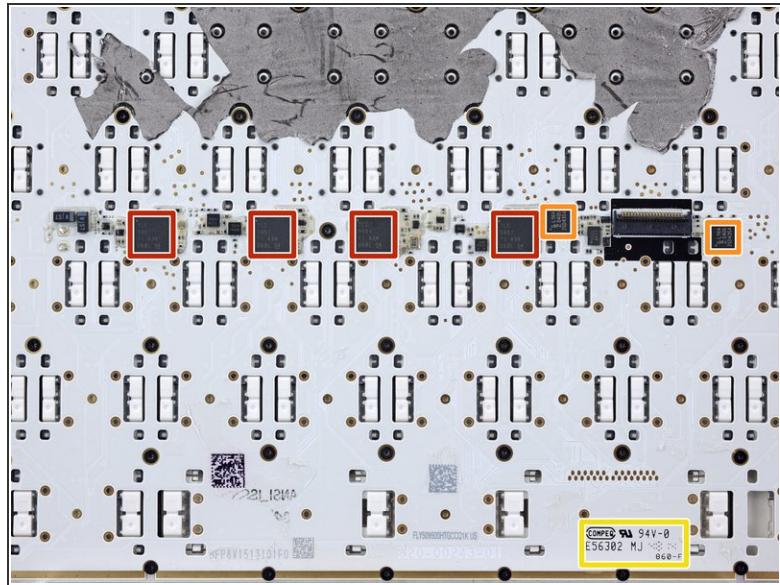
- Daunted by the pentalobe-packed rear panel, we opt for frontal access. The keys pop off easily enough and seem to simply snap in place.
- With very few moving parts inside, is it possible that this plastic butterfly mechanism might actually be a repair win?
- *i* Although we're a tiny bit worried about the plastic hinge fatiguing and breaking at its flex-point, we'll give Apple the benefit of the doubt and assume they've thought of that and designed for it.
- The bracket is held in with tiny little clips; [so cute](#).

## Step 26



- Now to remove the display and get to that pesky multipurpose port!
- Ahh, USB-C! This lil' guy combines charging, data transfer, and video output into a single port.
  - ⓘ We can't help but wonder why Apple chose to only include a single USB-C port. This means that if you want to charge your MacBook and use a USB device at the same time, you'll need a [\\$69 adapter](#). We're all for change Apple, but [come on](#).
  - ⓘ Some critics have also argued that while the single USB-C port helps to maintain the MacBook's sleek profile, it could leave the new notebook open to some serious [security problems](#).
- USB-C supports a top speed of 10 Gbps (this port maxes out at 5 Gbps), bi-directional 20V/5A power, and a reversible design aimed to solve all of your [USB woes](#).

## Step 27



- Apple has opted to transition from using a row of LEDs with a light guide panel, to installing individual LEDs beneath each key.
- And behind those keys, we find:
  - An array of four Texas Instruments [TLC5951](#) PWM LED Drivers
  - A pair of NXP [PCAL6416A](#) I/O Expanders

ⓘ They claim that this new keyboard [design](#) provides even lighting across the whole keyboard, while maintaining a higher level of power efficiency than previous designs.

- PCB maker Compeq [reports increased revenues for March](#).

## Step 28



- The MacBook 2015 Repairability Score: **1 out of 10** (10 is easiest to repair)
  - Proprietary pentalobe screws continue to make opening the device unnecessarily difficult, and new cable routing makes the procedure even trickier.
  - The USB-C port is secured by tri-wing screws, and buried under the display brackets, complicating replacement. Also, being the only port, it will experience more use and wear than a typical single-purpose port.
  - The battery assembly is entirely, and very solidly, glued into the lower case.
  - The Retina display is still a fused unit with no separate, protective glass. If the display needs replacing, it'll cost a pretty penny.
  - The processor, RAM, **and** flash memory are soldered to the logic board.