

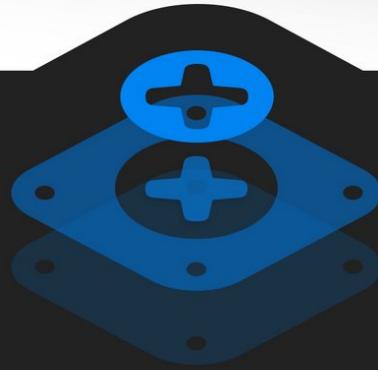


# MacBook Pro 13" Retina Display Early 2015 Teardown

Teardown of the early 2015 13" MacBook Pro Retina, performed on March 11, 2015.

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## MacBook Pro 13" Retina



## TEARDOWN

## INTRODUCTION

At their March 9 [keynote](#), Apple sprung four new MacBooks on us. As always, we had to get our paws on the revised MacBook Pro.

On the outside, the MacBook Pro 13" Retina Display Early 2015 looks a lot like its [older sibling](#); it includes the same Retina display and aluminum unibody construction. But with a newfangled Force Touch trackpad and Intel's latest Broadwell-U processors, this MacBook promises to be a whole new animal. Join us as we dive into the belly of this beast!

Can't get enough of our jibber-jabber? Follow us on [Instagram](#), [Twitter](#), and [Facebook](#)!

**Be sure to check out our in-depth video analysis of the [Force Touch trackpad](#)!**

[video: <https://www.youtube.com/watch?v=6a4dceudZEI>]

## TOOLS:

- [iOpener](#) (1)
- [T5 Torx Screwdriver](#) (1)
- [T3 Torx Screwdriver](#) (1)
- [P5 Pentalobe Screwdriver Retina MacBook Pro and Air](#) (1)
- [iFixit Tech Knife](#) (1)
- [Spudger](#) (1)
- [Tweezers](#) (1)
- [iFixit Opening Tools](#) (1)
- [Plastic Cards](#) (1)
- [T8 Torx Screwdriver](#) (1)

## Step 1 — MacBook Pro 13" Retina Display Early 2015 Teardown

### MacBook Pro 13" Retina



### TEARDOWN



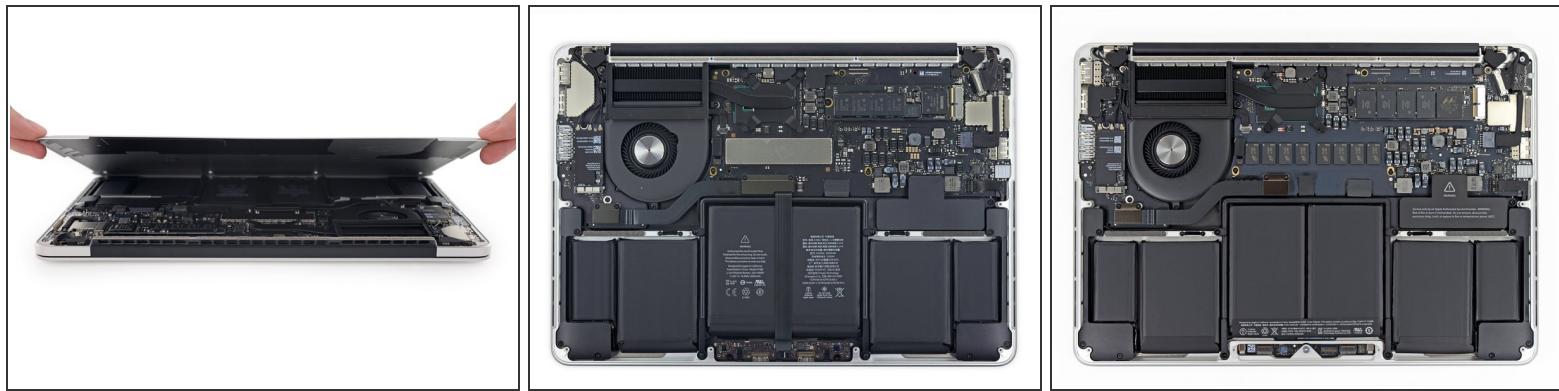
- Behold, the new Retina! We've done this dance before with [Apple's 13-inch professional laptop](#), but something's changed. Oooh that trackpad!
- Let's see what technical marvels this magic box has to offer:
  - 13.3-inch, 2560-by-1600 pixel (227 ppi) Retina display
  - 2.7 or 2.9 GHz dual-core Intel Core i5 processor (Optional 3.1 GHz dual-core Intel Core i7 processor available)
  - 8 GB or 16 GB of 1866 MHz LPDDR3 onboard memory
  - 128 GB, 256 GB, 512 GB, or 1 TB flash storage
  - Intel Iris Graphics 6100
  - Thunderbolt 2, USB 3.0, and full size HDMI I/O

## Step 2



- A quick look at the bottom panel reveals no surprises—this machine shares the A1502 designation with the [late 2013 Macbook Pro](#).
- Let's take a peek at the ports:
  - On the right side, this MacBook is equipped with an SDXC card slot, HDMI port, and a USB 3 port.
  - To the left ([to the left](#)), we have a MagSafe 2 port, two Thunderbolt 2 ports, another USB 3.0 port, a headphone jack, and dual microphones (plus everything we own, in a box).

## Step 3

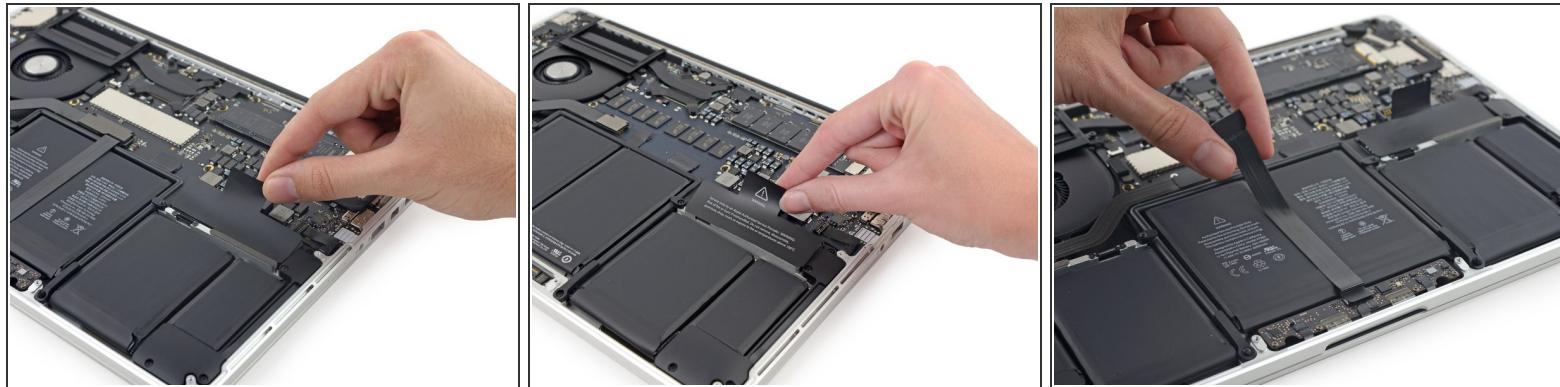


- Let the reveal commence. [Drumroll, please!](#)
- It looks like this MacBook Pro inherited the single fan gene from its [predecessor](#)... among other things.

*i* Actually, the only immediate difference we note is the trackpad cable, newly slung over the top of the battery. Other than that, it's very similar to the Late 2013 version (last image).

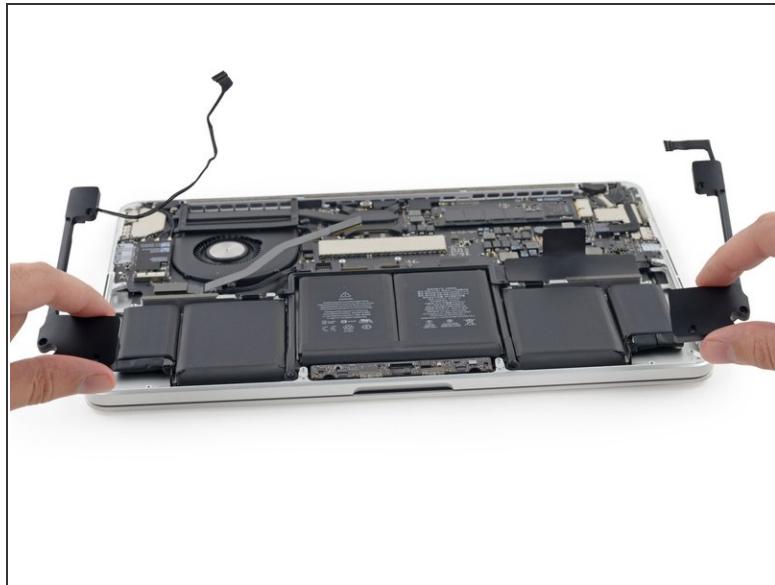
- We'll have to cut a bit deeper to get to the good stuff.

## Step 4



- Is Apple actually beckoning us in? The warning text on the battery that we've seen in the [MacBook Pro 13" Retina Display Late 2013 Teardown](#) (center) has disappeared. Well then, let's dig in!  
 *ⓘ Okay, maybe just relocated... But spoilers! We're not removing the battery just yet.*
- The mystery of the Force Touch trackpad unfolds layer by layer as we first remove its cable.
- Apple leaves us with [enticing instructions](#) for this trackpad: "Press a little deeper, do a lot more." Okay, Apple, [if you insist!](#)

## Step 5



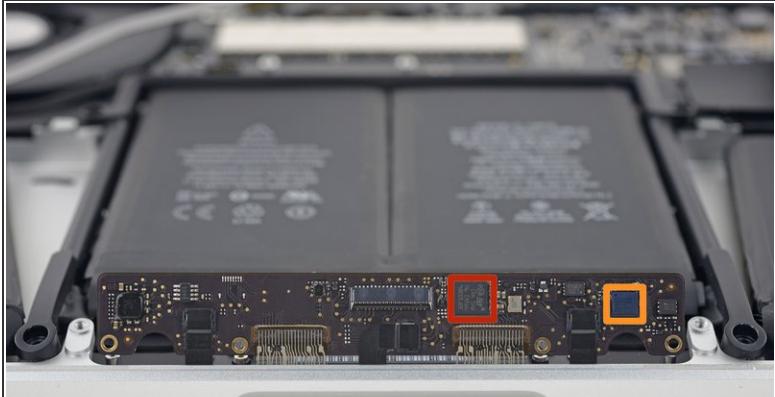
- Operation: Battery Extraction is underway! Since we've seen [retinas before](#), we've got a bit of an eye-dea how to proceed, but you aren't going to hear it since the speakers are out next.
- Where once there were four screws holding the battery frame in place (perhaps superfluously, with all of the adhesive used), there are now four rubber stoppers.
- *(i)* The previous gen's adhesive seemed plenty strong—so, is Apple poofing away these screws because they weren't ever needed, or because they aren't needed *now*? Perhaps a *stronger* adhesive made these screws unnecessary? We shudder at the thought.

## Step 6



- If it's a battle you want, Apple, it's a battle you'll get. As the old Klingon proverb says, today is a good day to die trying to unseat a battery.
- Armed with our trusted tools, [iOpener](#) and [plastic card](#), we begin heating and prying the battery, taking care not to puncture anything with "potential for fire or burning."

## Step 7



- These components are putting up an orchestrated effort to avoid our eyes. We use our plastic opening tool to nudge the trackpad control board out of our way, but not remove it...
- Apple decided to solder the largest cables onto the trackpad board, meaning we'll have to just flip it out of the way for now. [Y U NO ZIF](#), Apple?
- The new trackpad board has some interesting ICs:
  - ST Microelectronics [32F103](#) ARM Cortex-M based microcontroller
  - Broadcom [BCM5976](#) touch screen controller
-  This is the same lil' guy found in the [iPhone 5s](#) as well as the [iPad Air](#).

## Step 8



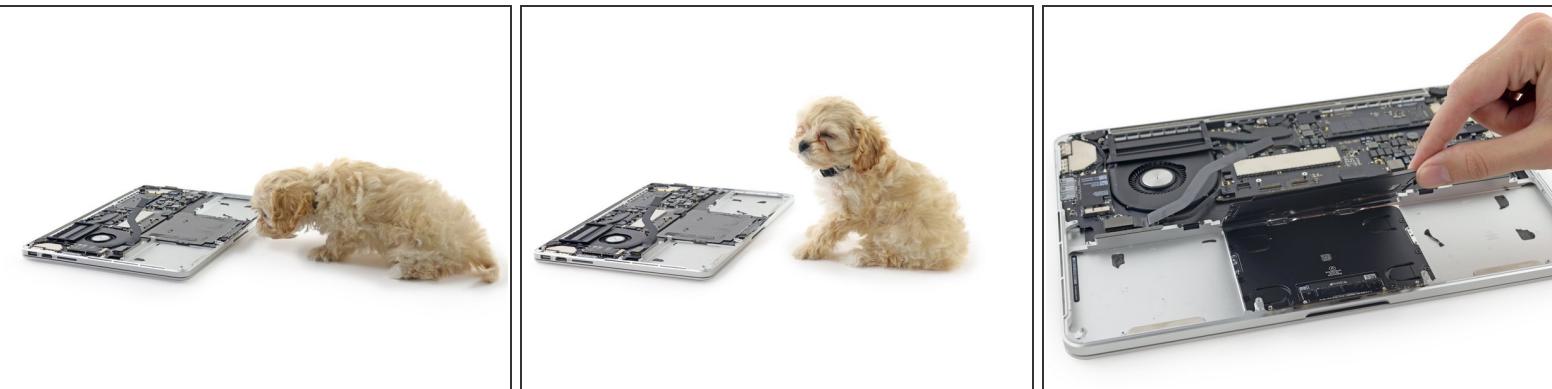
- Arrrgh. We begin the arduous process of carding this underaged battery for substance abuse. In our view, adhesive should be a controlled substance, and only used responsibly.  
*(i)* We know Apple can do better, since [we've seen it](#), like, [yesterday](#).
- The central cells seem tougher to remove than in in years gone by. Maybe we're just weaker.
- Peeling back the battery reveals... gunk. Either Apple doesn't think you need to replace this battery, or someone accidentally dipped it in [tar](#).

## Step 9



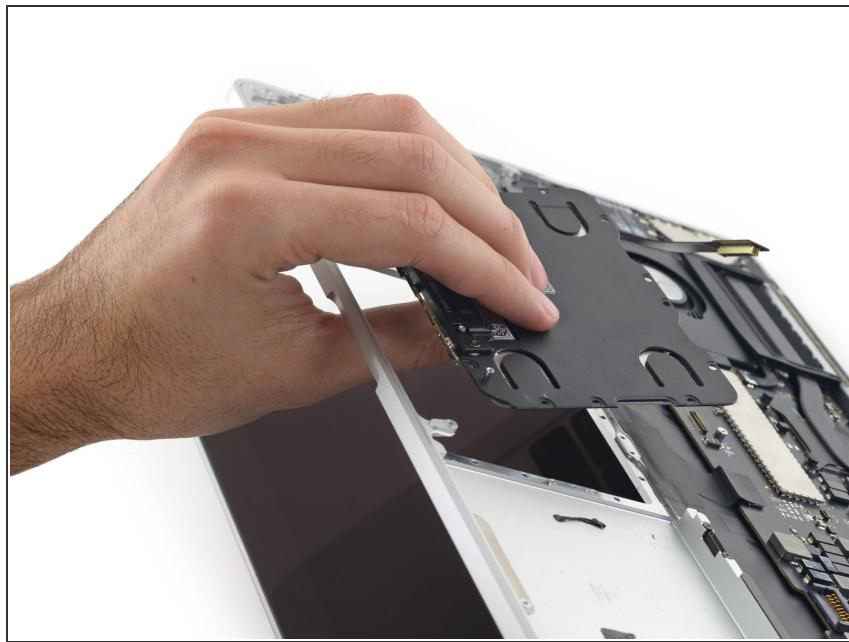
- We performed a battery of procedures in order to remove this 74.9-watt-hour array of lithium-polymer cells.
- *(i)* Apple claims that this new 11.42 V, 74.9 Whr battery provides up to 10 hours of web browsing and up to 12 hours of video playback.
- For the [Late 2013](#) model, we got 71.8 Whr—so we're up a whole 4% capacity, for an extra 11% runtime. We're gonna chalk the rest of the boost up to the Broadwell architecture's efficiency gains.
- The [Dell XPS 13](#), however, manages an HD screen and an (alleged) 11 hours of run time on a 52 Wh battery.
- This [familiar Retina denizen](#), the Texas Instruments BQ20Z451 Gas Gauge IC, measures battery life.
- This IC should be similar to the older [BQ20Z45](#), or its replacement, the [BQ20Z45-R1](#).

## Step 10



- Here it is, folks—the all-new Force Touch trackpad. To put it to the test, we bring in our littlest employee, Gus the Ewok Cavapoo, to investigate.  
 Thusfar, Gus is unimpressed. (Maybe he's not pressing hard enough?)
- You can't judge a trackpad by its cover, so we remove the 10 screws securing it.
- We're *trying* not to judge it; at least it's not adhesive. But the sight of 10 *more* screws in the trackpad underneath the cover makes us groan. Just how much force is in this trackpad?

## Step 11



- The Force is with us. Well, the Force Touch trackpad that is.
- [Hinted at as far back as 2007](#), we finally have our hands on the Taptic Engine, which provides the haptic feedback for the Force Touch.
-  Confused? Let's break these ridiculous rhymes down. [Haptic](#) feedback is just a fancy way of saying that the trackpad will use vibration and pressure to let you know what's happening. "Taptic Engine" is Apple's term for the underlying electromagnet that makes it shake, rattle, and roll.
- Tl;dr: [Rumble Pak](#).

## Step 12



- At their event on Monday, Apple showed us some incredible renders of the new MacBook's [cutting-edge Force Touch trackpad](#).
- We were expecting the MacBook Pro to receive the same trackpad—but this looks somewhat different, with a full lower panel and four springy mounts.

**i** Not that we're criticizing—there's certainly a big difference between retrofitting technology into an existing laptop like the MacBook Pro, and a ground-up design like the MacBook. But we'll be excitedly looking for the differences when we get our hands on the MacBook.

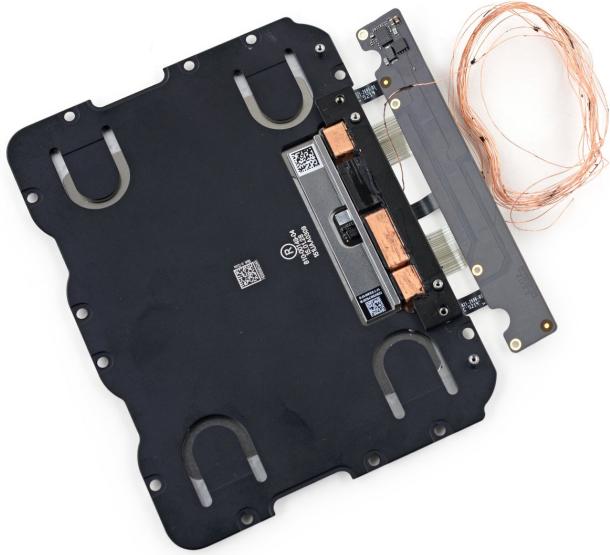
## Step 13



- Let's take a gander under the hood of the Taptic Engine, shall we?
- The rubber we hoped to simply cut open needed to be cut away chunk by chunk.
- Finally, the coils are free! Well, bare at least.
- Force Touch looks to be a clever application of a technology that dates back a ways—the year 1824, to be exact.
- Made of wire coils surrounding a ferromagnetic core, the electromagnet in the Force Touch Trackpad is used to create the vibrational feedback you feel.

ⓘ We're guessing that the four separate coils here are used to vary the feedback given to the user. Turning different sets of the four coils on and off varies the strength and direction of the vibration, and how it feels to your finger.

## Step 14

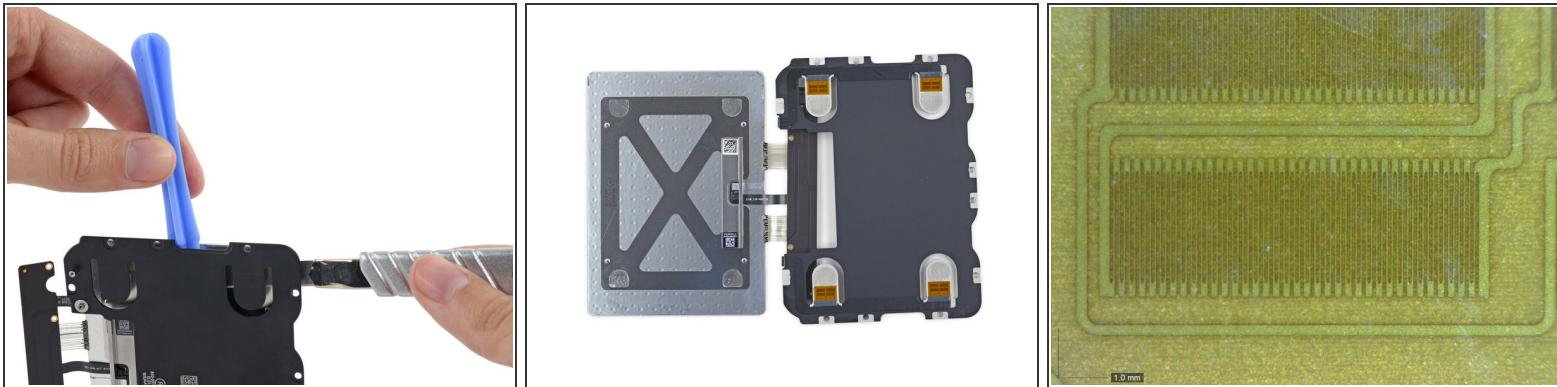


- Let's continue unraveling the secrets of the trackpad, starting with the coils—we were hoping to find some evidence of linear oscillators in the taptic engine, but it looks like it's just a series of electromagnets.
- The magnets rapidly push and pull against a metal rail mounted beneath the trackpad, to create a tiny "buzz" of feedback with each click (and a second buzz for a "force click").
- So that explains the buzzing, but what about the sensing?

**i** A patent issued [last year](#) hints that the Force Touch might utilize strain gauges to measure pressure on its surface.

- We're going to just have to crack this bad boy the rest of the way open to see if that's the case.

## Step 15



- Removing the trackpad from the bracket requires slicing through four pads of glue.
- With the pad splayed open, we get our first look at the pressure sensors.
- And popping the sensor bracket under a microscope, we get a second, closer look.

ⓘ Based on the wiggly pattern of traces stuck to the metal tabs, we're pretty sure the magic pressure sensors in the new Force Touch trackpad are tiny [strain gauges](#). Mounted on flexing metal supports, they detect the amount of flex on each—and based on that, the force from above.

- This works in conjunction with the traditional capacitive touchpad up top, to pinpoint where you're applying force.

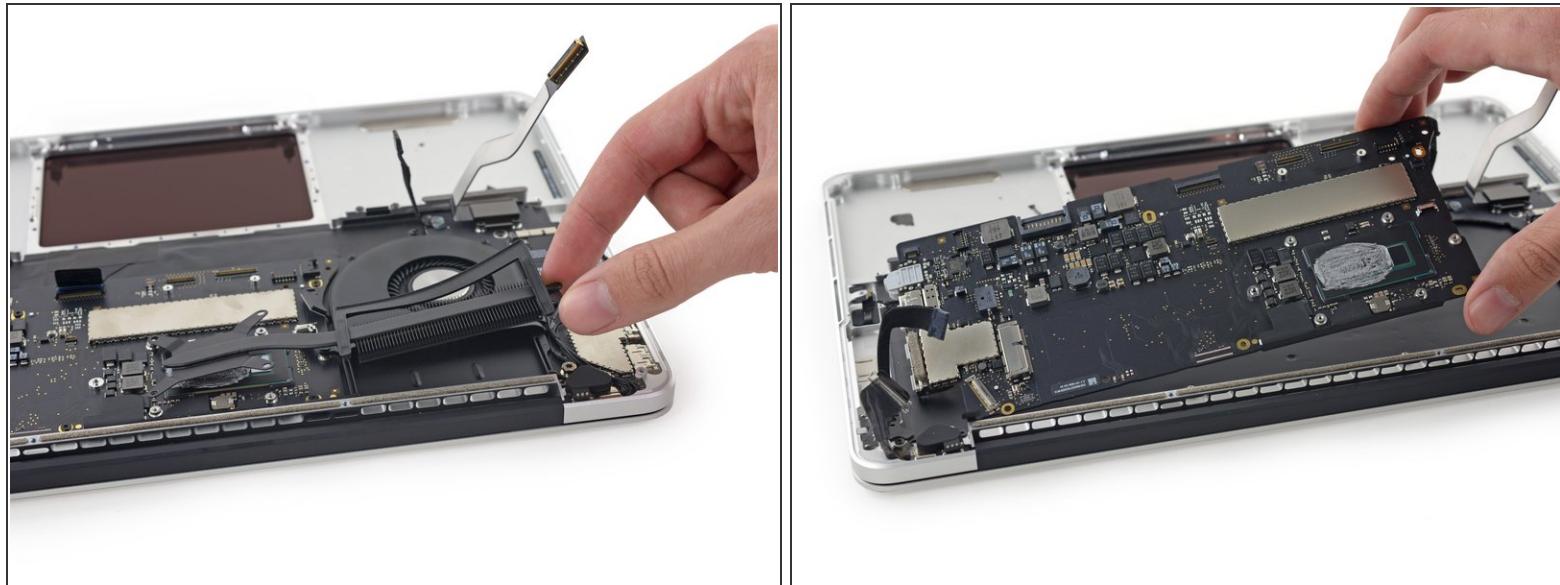
ⓘ **Be sure to check out our in-depth video analysis of the [Force Touch trackpad](#)!**

## Step 16



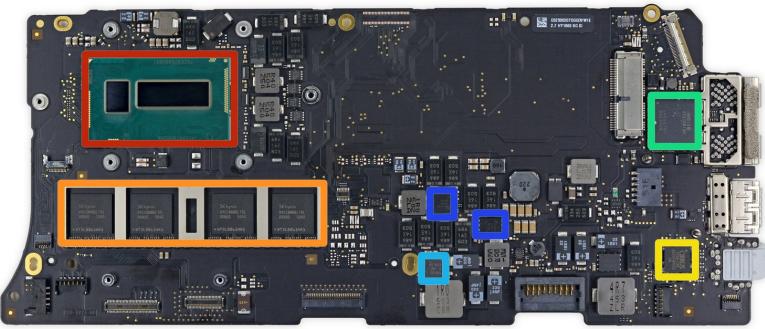
- This looks familiar... The all-new and twice-as-fast flash memory has the exact same ICs as the one found in our recent teardown of the [MacBook Air 13"](#):
  - Samsung S4LN058A01 PCIe 3.0 x4 AHCI flash controller
  - Samsung [K4E4E324ED](#) 512 MB LPDDR3 DRAM
  - 8 x Samsung [K9LDGY8S1D-XCK0](#) 16 GB flash storage (128 GB total)
- Just like its MacBook Air brother, this SSD [benchmarks](#) at significantly faster speeds than the previous generation.

## Step 17



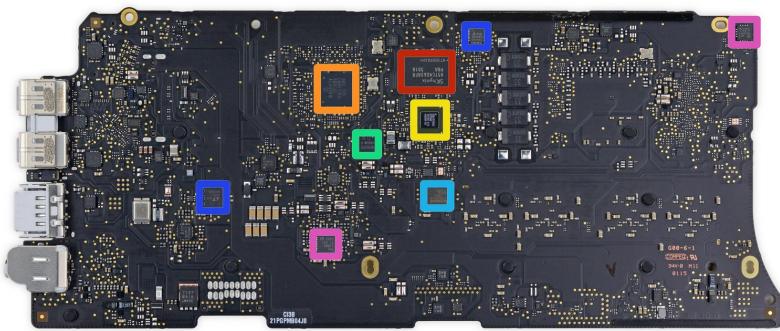
- This MacBook loses its cool, and moments later the logic board flips out.
- Not to worry—we've got this under control. Apart from that metastasizing blob of thermal paste, this looks like our old friend from teardowns of yore: same form factor, same removal procedure.

## Step 18



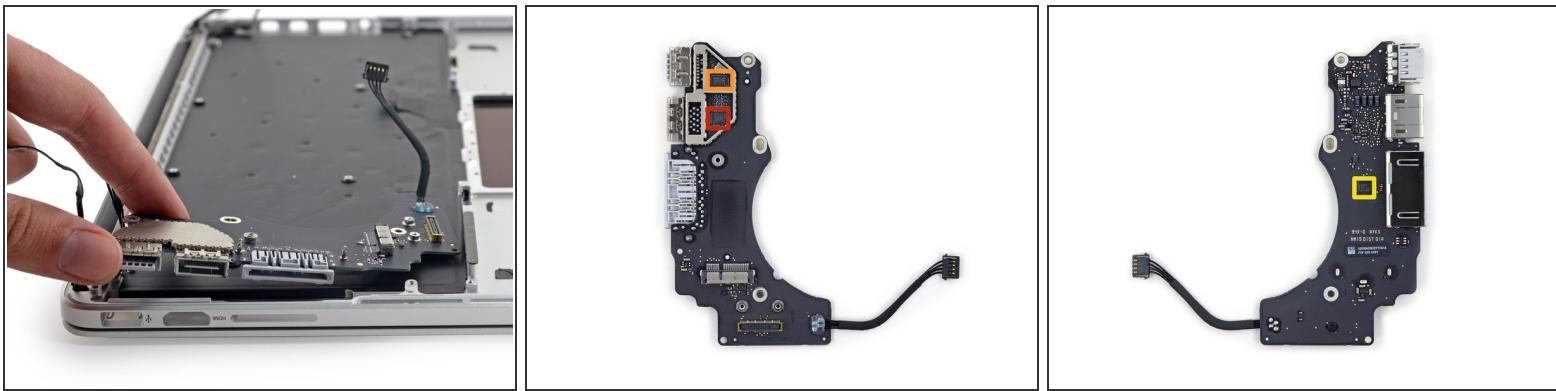
- We forgot our IC decoder ring, but no matter—a lot of these chips look very familiar:
  - Intel [SR26K](#) Dual-Core i5-5257U Processor with Intel Iris Graphics 6100
  - SK Hynix [H9CCNNNBLTALAR](#) LPDDR-SDRAM
  - Cirrus 4208-CRZ Two-Channel Low Power HD Audio Codec
  - Intel [DSL5520](#) Thunderbolt 2 Controller
  - Texas Instruments TI 58872D
  - 2 x Fairchild Semiconductor DE46SY

## Step 19



- More familiar friends! These are the ICs that bespangle the back of the lobo:
  - SK Hynix [H5TC4G63AFR](#) 4 Gb (512 MB) DDR3 SDRAM
  - Texas Instruments/Stellaris [LM4FS1EH](#) SMC controller
  - Broadcom BCM15700A2, [appears to be](#) a wireless networking chipset
  - Texas Instruments [HD3SS213](#) DisplayPort Differential Switch
  - Windbond 25064FVIQ
  - Linear Technology [LT3957](#) and Intersil 958 26AHRZ
  - Texas Instruments TPS51980 and SMSC [EMC1704-2](#)

## Step 20



- The I/O board [looks unchanged](#), but what about the onboard chips? Looks like some of them have swapped sides:
  - Parade Technology [PS8401A](#) HDMI Jitter Cleaning Repeater
  - Genesys Logic GL3219 SDXC Card Reader Controller
  - NXP Semiconductors [PCA9501](#) 8-bit I/O Expander with an On-Board 2-kbit EEPROM

## Step 21



- MacBook Pro with Retina Display 13" Early 2015 Repairability Score: **1 out of 10** (10 is easiest to repair)
- Proprietary pentalobe screws continue to make opening the device unnecessarily difficult.
- The battery assembly is entirely, and very solidly, glued into the case, thus complicating replacement. Additionally, the battery covers the screws holding the trackpad in place, meaning it's impossible to replace the trackpad without first removing the battery.
- The Retina display is a fused unit with no separate, protective glass. If anything ever fails inside the display, the entire (\$\$\$) assembly will need to be replaced.
- The RAM is soldered to the logic board. Pay for the upgrade now, or be stuck with 8 GB forever. There is no chance of upgrade.
- The proprietary PCIe SSD still isn't a standard drive. Cross your fingers for future compatible drives; for now, you're stuck with what you've got.