MacBook Pro 13" Touch Bar Teardown

Teardown of the MacBook Pro 13-inch Late 2016, with four Thunderbolt 3 ports and Touch Bar performed on November 15, 2016.

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This document was generated on 2019-09-17 07:55:14 AM (MST).

INTRODUCTION

Two weeks ago, we tore down the new entry-level 13" MacBook Pro to discover it was thinner, lighter, faster, and (sad face) less repairable than most any other pro-level laptop. Today, we turn our tools on its Touch Bar-equipped launch mate. Will this machine surprise us with some upgrade-friendly features, or will it be as disposable as the box it comes in? There's only one way to find out: it's teardown time!

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[video: https://www.youtube.com/watch?v=lBzDGjRge1A]

TOOLS:

- 64 Bit Driver Kit (1)
- iOpener (1)
- Nylon Tipped Tweezers (1)
- Plastic Cards (1)
- iFixit Opening Picks set of 6 (1)
- Spudger (1)

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Step 1 — MacBook Pro 13" Touch Bar Teardown
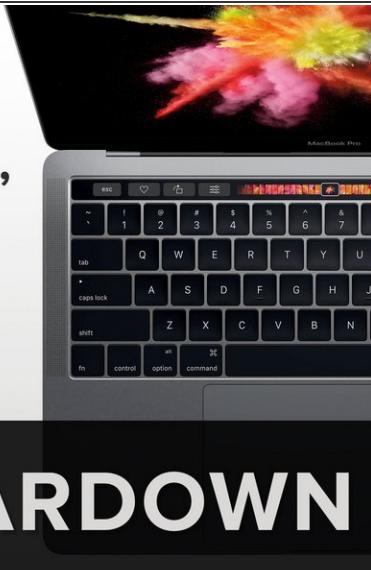
- Today's million-dollar question: Is this a scaled-up version of the 13-inch "Escape Edition," or a scaled-down version of the 15-inch Touch Bar unit? Here's what the tech specs tell us:
  - 13.3" LED-backlit IPS Retina display with 2560 × 1600 resolution (227 dpi), P3 color gamut
  - 2.9 GHz Skylake dual-core Intel Core i5 (Turbo Boost up to 3.3 GHz) with integrated Intel Iris Graphics 550
  - 8 GB of 2133 MHz LPDDR3 onboard memory (16 GB configuration available)
  - 256 GB, 512 GB, or 1 TB PCIe-based SSD
  - Four Thunderbolt 3 (USB-C) ports supporting charging, DisplayPort, Thunderbolt, USB 3.1 Gen 2
  - Touch Bar with integrated Touch ID sensor
 - Force Touch trackpad

Step 2
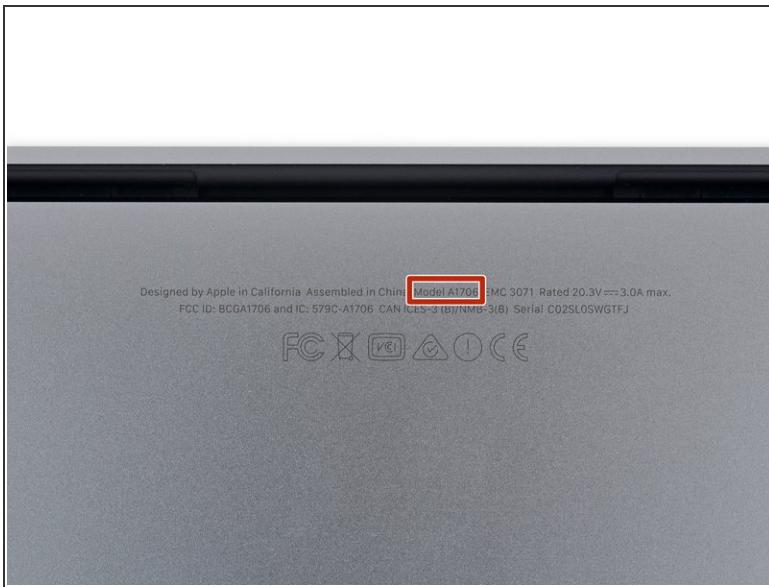
- A rudimentary inspection of the outer case reveals the expected FCC certifications, and a new model number: **A1706**.

- The Touch Bar is pretty, but it's missing ... something.
  - We won't tell Apple if you won't.

- We're itching to grab our screwdrivers and get to work—but first, let's whip out the *other* Late 2016 13" Retina MacBook Pro for some quick comparisons ...

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Page 4 of 22

Step 3

- According to Apple, this MacBook Pro's dimensions match *exactly* with those of the "Escape Edition" machine we tore down a couple weeks ago. Do we believe it even for a second? Yes we do.

- Do you miss your function keys? Hold down the Function key to see your missing function keys. Chameleon Mode, engage.

- One thing that *is* noticeably different is, of course, the port situation on the starboard side. This Touch Bar-equipped machine packs two extra Thunderbolt ports, so you have twice as many places to plug in your dongles.

- ⓘ Throwing both machines onto the scale, we find the Touch Bar version weighs about 20 grams less than its counterpart. We're chalking the difference up to this laptop's smaller battery.

- Finally, we note a pair of side vents on the underside of the Touch Bar version, similar to the ones we've spotted in previous Retina MacBook Pros—but absent from the Function Key model.

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Step 4
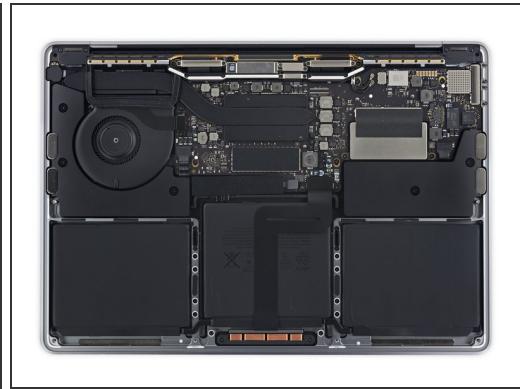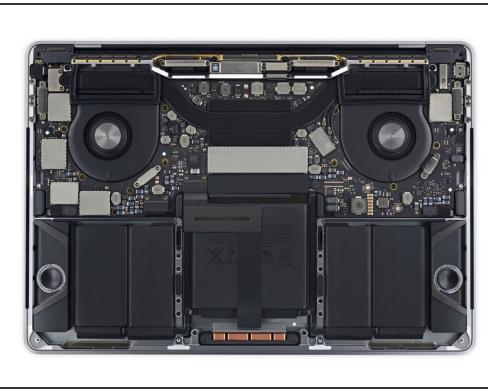
- Blasting through the pentalobe-and-suction-cup-dance normally reserved for iPhones, we beast the lid off with a [familiar sliding maneuver](#).

- Let's play "Spot the Differences!" On the left we have the Touch Bar MBP, and on the right is the Escape Edition MBP.

  - ⓘ Touch Bar features: a smaller battery, two fans, double-ended heat sink, no SSD card, and lower speakers (that don't actually line up with their grilles).

  - ⓘ Function Key features: way more components that you can actually remove right off the bat—namely the SSD, speakers, and battery (well ... [sort of](#)).

- On the Touch Bar model, it looks like we can *only* remove the trackpad and headphone jack before hitting a logic board barrier.

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Step 5

- It appears 2016 is the year of the new connector, as this is the second time we've seen the new approach to the battery bridge.
  - These copper pads are for the positive and negative terminals of the battery.

- Apple also seems to have included a connector that goes ... *nowhere*?
  - Could it be a diagnostic port? Circuits and firmware do need testing—although we have seen a fair amount of test points, which usually cut it.

- We also find the modular headphone jack this time without microphone hangers-on. Here we thought these were a thing of the past.

- Nearby we spot a water damage indicator sticker, waiting patiently for the day you spill iced tea on your Touch Bar and it can fulfill its purpose in life by turning pink.

Step 6

- Much like the [Function Keys model](#), the trackpad in the Touch Bar unit slides out easily after dispatching ten T5 Torx screws.

- We can also happily report that the trackpads from these respective models are identical, and likely cross-compatible.

  - (i) The cable routing, however, is different to accomodate the modified logic board design. So, if you're planning on replacing a busted trackpad, be sure to hold on to the original flex.

- In case you missed it, here are the ICs we identified the first time around:

  - STMicroelectronics [STM32F103VB](#) ARM Cortex-M3 MCU

  - Broadcom BCM5976C1KUFBG Touch Controller

  - Maxim Integrated MAX11291ENX 24-Bit, 6-Channel Delta-Sigma ADC

Step 7
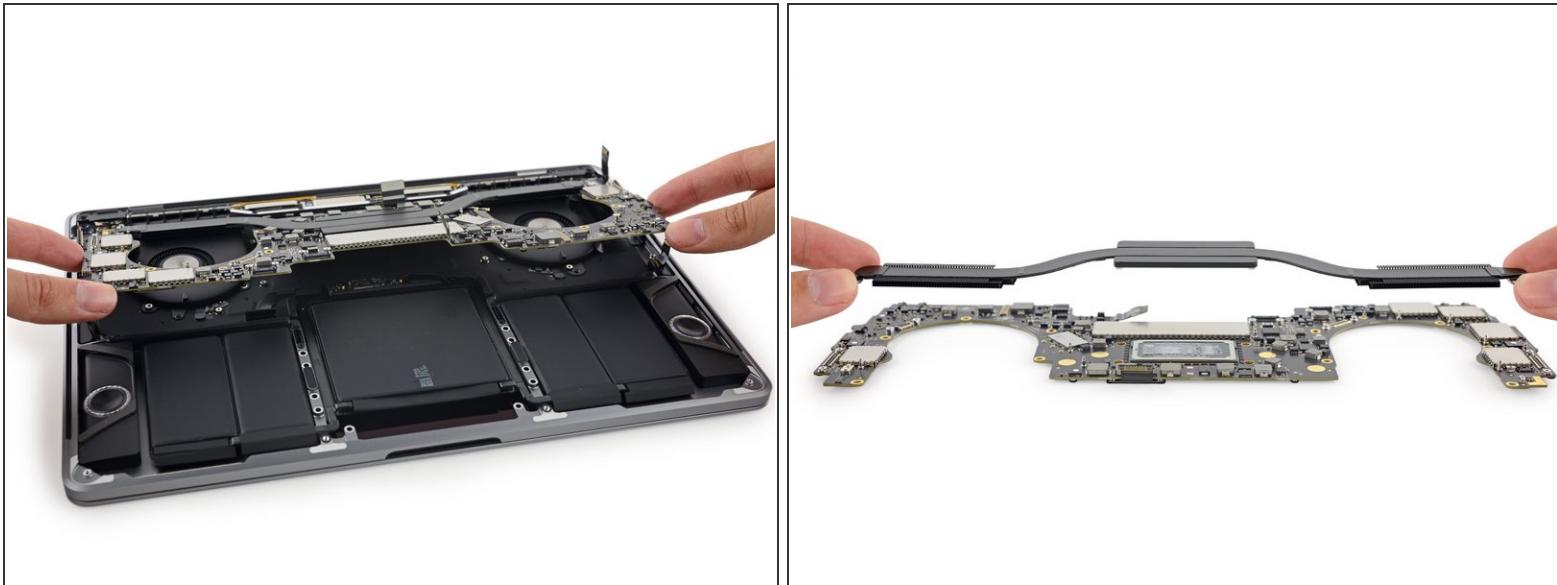
- We're ready to remove the rest of the peripherals. It'd be great to get a look at the battery, fans, heat sink, and speakers. Except we can't.

- The symmetrical logic board keeps guard over the remaining components, so we spudger off its connecting cables and wrest it free from the case.

- The heat sink is attached to the logic board with screws on the bottom. With the board out of the case, we're able to remove the heat sink for inspection—with a heat pipe running in each direction, it's got twice the pipe of the entry-level model.


Step 8
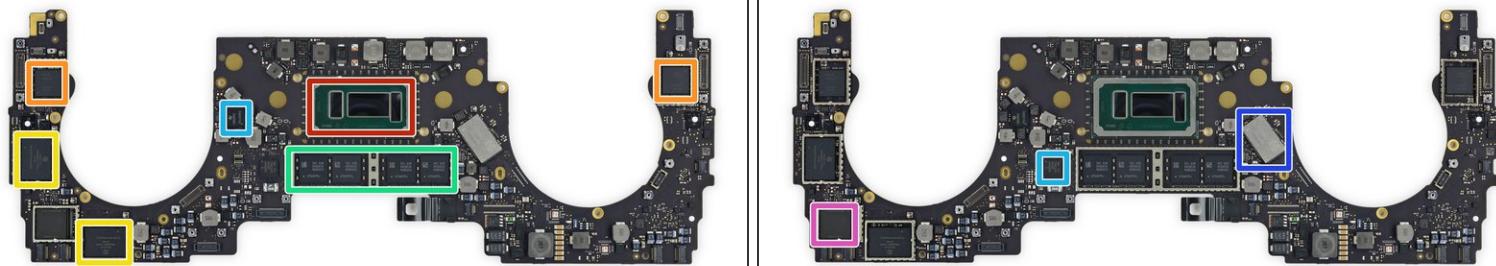
- We now look at the ~~moustache~~ logic board to see what chips make this MacBook a Pro:

  - Intel Core i5-6267U processor with Intel Iris Graphics 550

  - Intel JHL6540 Thunderbolt 3 controller

  - SanDisk SDRQKBDC4 064G 64 GB NAND flash memory (x2 for a total of 128 GB)

  - Samsung K4E6E304EB-EGCE DDR3 DRAM (4 x 2 GB for 8 GB total)

  - Texas Instruments SN650839 66AL7XWGI, and TI/Stellaris LM4FS1EH SMC Controller (Replacement codename for TM4EA231)

  - Murata/Apple 339S00056 Wi-Fi Module

  - R4432ACPE-GD-F

Step 9
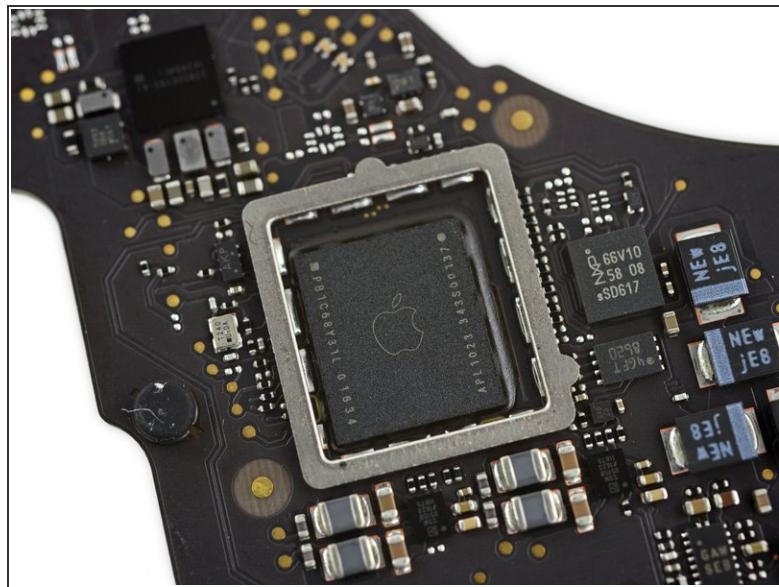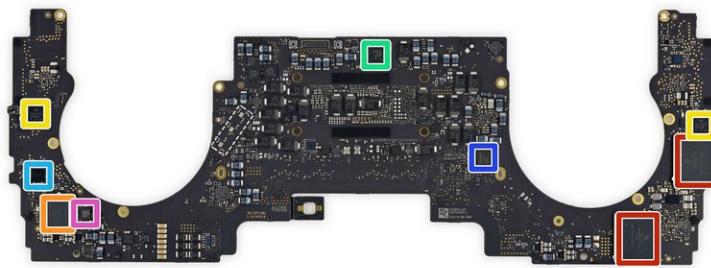
- Flipping the logic board over, we find no shortage of components, including:

  - SanDisk SDRQKBDC4 64 GB NAND flash storage (as seen in the Escape Edition's removable SSD)—bringing the total to 256 GB

  - APL1023 343S00137 (likely the custom Apple T1 chip that pairs with the Touch Bar)

  - 2x Texas Instruments TI CD3215C00 68C7QKW G1

  - Intersil 95828 HRTZ X630MRD

  - (Apple?) 338S00193-A1 16348HCI

  - WinBond SpiFlash W25Q64FVZPIQ 64 Mb serial flash memory

  - NXP 66V10 NFC controller, containing Secure Element 008 and NXP PN549 (as seen in the iPhone 6s)

Step 10
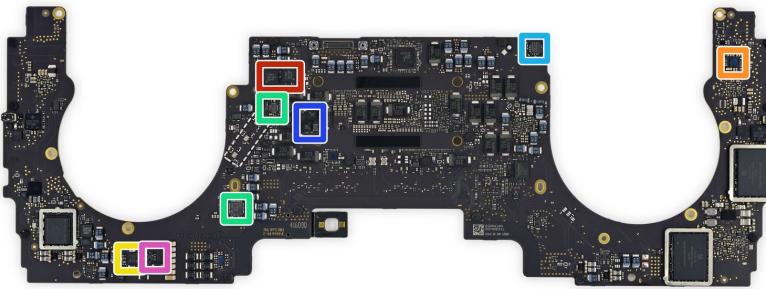
- More chips on the flip:
  - 2x Pericom PI3WVR12612 HDMI 2.0, DisplayPort 1.2 Video Switch
  - Cirrus Logic CS42L83A Audio Codec
  - National Semiconductor 66A82NU 48B1-004
  - Texas Instruments TPS51916 memory power synchronous buck controller, and TPS51980A synchronous buck controller
  - Texas Instruments TMP513A PMIC
  - 2x Fairchild Semiconductor FDMC7570S PMIC
 - Fairchild Semiconductor FDMC86106LZ PMIC

Step 11

- Another new feature of the MacBook Pro with Touch Bar is the addition of Touch ID.
  - (i) While this is the first *Mac* computer to feature a fingerprint reader, the tech has been around since at least 2004.

  - (i) Welcome to the family.

- The hardware helping drive this nifty feature contains a button coupled with capacitive sensors that can distinguish fingers. Yay for biometrics.
  - (i) That button also doubles as the power button, so fixing a power button may be a more costly affair than it once was.

- The Touch ID button is topped by sapphire crystal, which should protect the fingerprint scanner from scratches.

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Step 12

- Hanging off each end of the logic board, we find a small, modular USB-C board.

  ⚠️ Now that our beloved MagSafe connector has been retired, a wayward step on the power cord is much more likely to damage your ports—so, it's heartening to see the USB-C hardware can be replaced separately (although you'll have to remove the logic board to get to it).

- ⓘ While both USB-C modules look identical to our eyes, Apple notes that only the left-side ports offer full-bandwidth Thunderbolt 3 performance.

- With that, we can finally extract the fans. These highly-touted blowers measure 43 mm in diameter —a shade less than the 45 mm fan we found in the entry-level MacBook Pro (but hey, you get two of them).

Step 13
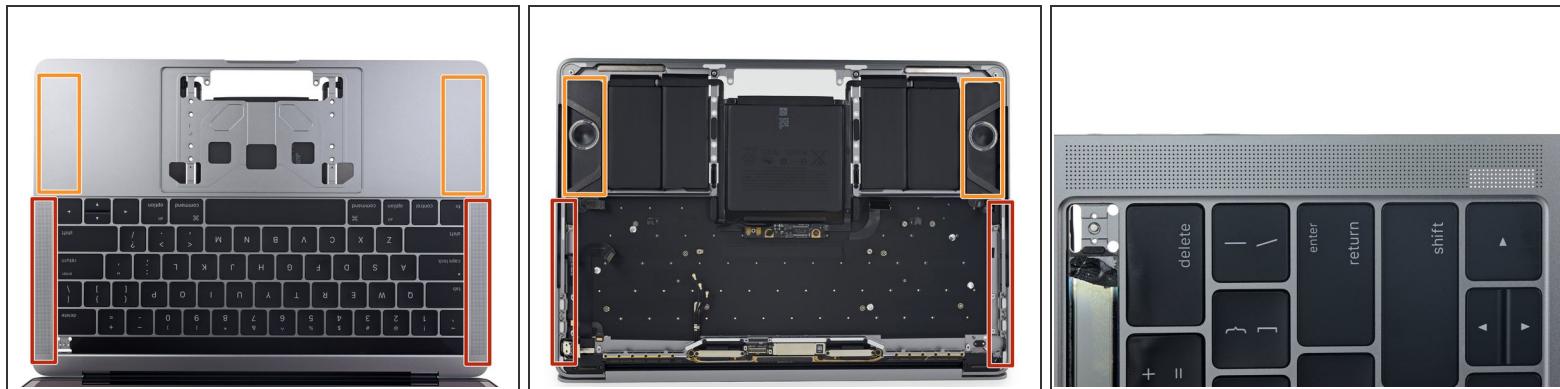
- Gently nestled between MacBook's edge and the keyboard are two speaker grilles—carefully crafted vents that channel sound waves out of the MacBook Pro straight to ... Wait.

  - The speakers are *not* located under the speaker grilles. The speaker grille doesn't even go clear through the case.

  - These speakers likely blast their impressive sound through the side air vents.

- *(i)* The "grilles" are seemingly cosmetic, maybe to unify the product line. Curiously, the [Function Key edition](#) also suffers from some fake holes, albeit different ones.

- *(i)* **Teardown Update**: Alright, *most* of these holes are cosmetic, but after yanking out the tweeters in the following step, it's clear that some of these are through-holes that carry sound out of the Mac's enclosure.

Step 14

- Met with resistance from heavy adhesive, we employ a combination of an opening pick and a spudger to pry the right speaker off the upper case.

- We spy with our little eyes what might be a teeny speaker, wedged in the corner above the "true" speaker.

  - ⓘ Judging from the through-holes under the smaller speaker, we assume this is a tweeter designed to produce high frequency audio.

- We loved the cute rubber-bumper sound-isolating screws holding down the speakers in the Function Keys MBP. Looks like the Touch Bar opted to use extra gooey glue instead.

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Step 15
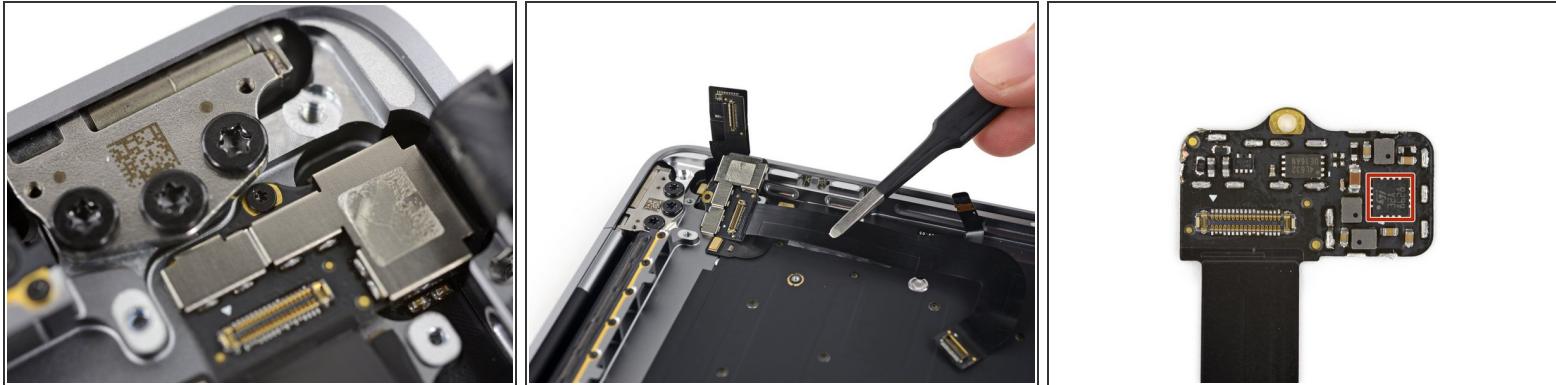
- We're so close to the Touch Bar we can almost, well, touch it.

- Apple seems to be staking its claim on the cool tech, by slapping a P2 pentalobe screw over the Touch Bar entry point.

  - (i) Good thing we always come prepared.

- We pluck an interconnect cable from the lower enclosure—this links the logic board to the Touch Bar display and likely hosts some display silicon. We find:

  - STMicroelectronics 32A 8628

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Step 16

- Things are about to get heated. We call upon our friend the [iOpener](#) to assist us in removing the Touch Bar.

- Kids, gather 'round! Today we'll learn how to accidentally break the Touch Bar. Our efforts to separate the OLED panel from the upper case resulted in the digitizer separating from the display. You live and you learn.

- Adding insult to injury, the Touch Bar flex cable is routed underneath the upper case, making removal just a tad bit more annoying than we expected.

Step 17

- Human touch needs to be processed by a brain. Touch Bar needs to be processed by a chip. With some surgery we find the Touch Bar brain:
  - Broadcom BCM5976TC1KUB60G touch controller

- Removing the OLED strip is difficult enough, but our efforts will not be in vain! Maybe a little in vain. Okay, our efforts were crushed (along with our hopes and dreams). The Touch Bar is fragile.

- To add to the fragile mystery that is the Touch Bar, we stumble across an unmarked chip. Given the location, it is likely a display driver of sorts.

- After scraping out all that business we uncover a three-microphone array. What is the leftmost one even listening to? The fan? The keyboard? Who knows!

Step 18
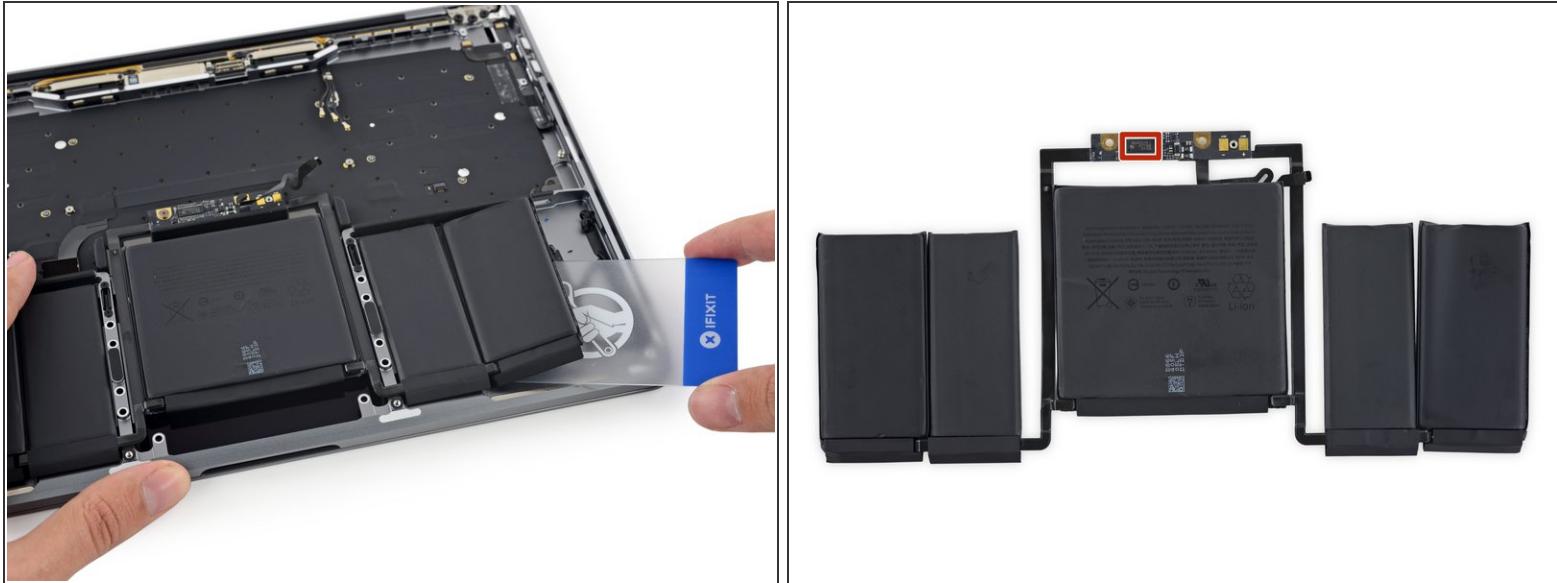
- At last we carve out the (mightily adhered) 5-cell battery.

  - (i) Well, five-ish cells. With a nominal voltage of 11.41 V, the two outer pairs are wired in parallel and together have the same charge capacity as the center one, to yield three ~3.8 V cells in series.

  - You'd better hope your "Pro" career is short; this battery replacement is a doozy.

- The battery board hosts a TI BQ20Z451 (a possible variant of the BQ20Z45-R1 line, seen in MacBook Pros forever)

- Listing a 49.2 Wh capacity, this battery seems a little piddly compared to the Function Key edition's 54.5 Wh—especially considering it's driving a lot more functionality (pun intended).

- Dotting our i's, we slap these batteries on a scale: the Function Key-equipped MacBook Pro battery weighed in at 235 grams, while this battery weighs just 197 grams.

  - (i) The weight disparity probably helps account for a lighter Touch Bar edition, but the battery seems to rate more watt-hours than the decrease in weight would suggest.

Step 19

- Here's the Late 2016 13" MacBook Pro with all its Touch Bar glory!

- Disappointed that we didn't get around to the display? It's the same procedure we found in the [13" Function Key teardown](#)—antenna bar, springy ribbons, the works.

Step 20 — Final Thoughts

- The MacBook Pro 13" with Touch Bar earns a **1 out of 10** on our repairability scale (10 is the easiest to repair):

  - The trackpad can be removed without first removing the battery.

  - Proprietary pentalobe screws continue to make working on the device unnecessarily difficult.

  - The battery assembly is entirely, and very solidly, glued into the case, thus complicating replacement.

  - The processor, RAM, *and* flash memory are soldered to the logic board.

  - The Touch Bar adds a second, difficult to replace, screen to damage.

  - The Touch ID sensor doubles as the power switch, and is paired with the T1 chip on the logic board. Fixing a broken power switch may require help from Apple, or a new logic board.

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