

EXHIBIT 19





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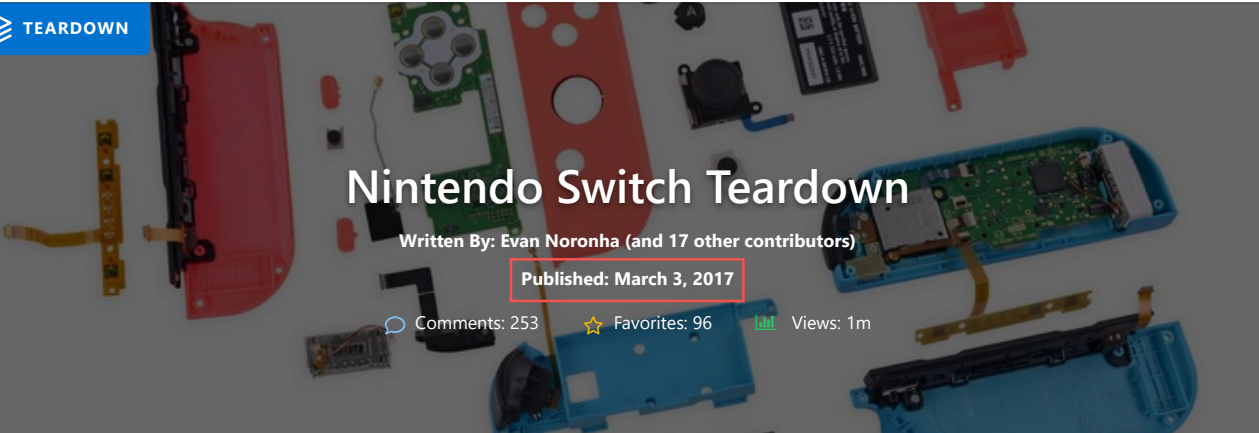
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Nintendo Switch Teardown



 TEARDOWN



Nintendo Switch Teardown

Written By: Evan Noronha (and 17 other contributors)

Published: March 3, 2017

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What you need

Tools



Nintendo Switch Toolkit

\$12.95

★★★★★ 4.8

Optional

Add to cart



Phillips #00 Screwdriver

\$5.49 iFixit

★★★★★ 4.8

Show more...

Video Overview

It's the Nintendo Switch Teardown!



This teardown is **not** a repair guide. To repair your Nintendo Switch, use our [service manual](#).

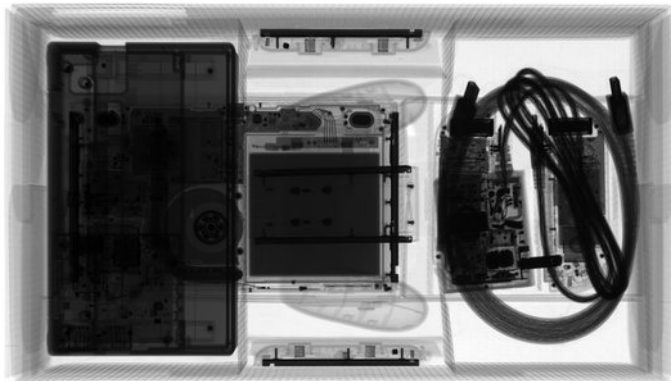
Step 1 Nintendo Switch Teardown



- Merry Switchmas everyone! Here's what Nintendo's new handheld/console hybrid holds hardware-wise:
 - NVIDIA customized Tegra processor
 - Built-in 6.2" multi-touch LCD screen with 1280 × 720 resolution (capable of 1920 × 1080 output on an external display via HDMI)
 - 32 GB of internal storage (up to 2 TB additional storage via microSDHC or microSDXC card)
 - 802.11 a/b/g/n/ac Wi-Fi, Bluetooth 4.1, USB Type-C charge port, and 3.5 mm audio jack on the console—plus three standard USB ports on the Switch Dock
 - Stereo speakers
 - Rechargeable lithium-ion battery capable of 2.5 - 6.5 hours play time
 - Detachable wireless Joy-Cons

 Add a comment

Step 2



- Teardowns are *really* hard, so our friends at [Creative Electron](#) thought they might save us time by X-raying the entire box.
- But that just got us more excited for a thorough hardware tour. We popped the console out of its box, and dock, and got another X-ray image just for funsies.
 - ① Is that a beefy battery we spy?
- Time to switch off the X-rays and break out the tools!

3 comments

Step 3



- Before we get too far, we take stock of Nintendo's offerings. We've got the console itself, two Joy-Cons, a dock, and the Joy-Con Grip.
- With the Joy-Cons attached, the Switch console measures approximately 9.4" wide, 4" tall, and only half an inch in depth.
- Despite added functionality, the Joy-Con'd console only weighs 0.88 pounds— less than the 1.1 pound [Wii U GamePad](#).

Add a comment

Step 4



- Let's *switch* this teardown into gear!
- The first thing we note is the weird Domino's logo the model number—HAC-001.
- Doing a quick turnaround, ports include:
 - MicroSD located underneath the (surprisingly stiff) kickstand
 - USB-C (for the dock)
 - Standard 3.5 mm headphone jack
 - Proprietary Nintendo game card slot
- The fan vents through the top of the device, and initial reports say the Switch makes heavy use of that cooling channel while docked and pushing 1080p graphics.

3 comments

Step 5



TOOL USED ON THIS STEP:
Mako Driver Kit - 64 Precision Bits
\$39.95

Add To Cart



- Disappointingly, tri-point screws guard the entrance to Hyrule the Switch, but we only have to flex 1/64th of our muscle.
- Tri-points are Nintendo's version of a "Keep out" sign, but once you're past them the back cover lifts off easily—no clips or adhesive.
- Our first peek inside reveals—nothing much. Just a metal shield.
- However, once un-cased the modular microSD card board is readily replaceable. Good news for future storage!

13 comments

Step 6



- And now for the moment we've all been waiting for...the internal reveal. It's **finally happening!**
- It... looks like a computer! Battery, heatpipe, thermal paste, fan. It's all there.
- ① The Switch's priorities are pretty clearly battery and cooling.
- By the looks of that purple blob, this metal plate is more than structural support. It's also a heat sink that channels heat from the heat pipe to the rear case.
- ① This should diffuse the heat, preventing hot spots that could melt plastic or burn your fingers.

4 comments

Step 7



- Safety first—we dispatch the battery connector before prying this sucker off its adhesive.
- ① **Most consoles** have a power supply, rather than a battery, but the Switch's portability demands wireless power. And that usually means a limited lifespan.
- ① Unlike the **3DS**, the Switch battery isn't meant to be user-replaceable. Instead Nintendo **"plans to"** offer a paid replacement program.
- The Switch packs a 16 Wh battery—bigger than the 5.6 Wh replaceable battery in the **Wii U GamePad**. Then again, this is powering a console, not just a display.

10 comments

Step 8



- With battery bestd, we turn to the next hardware priority: the cooling system.
 - The heatpipe is secured by simple Phillips screws, meaning thermal paste reapplication should be a breeze.
 - We aim for the fan, but looks like you can only clean it from here—it's trapped under the I/O board.
 - So we pop out the game card reader, and attached headphone jack.
- ☑ And no, we didn't [lick any cartridges](#).
- ⓘ STMicroelectronics [FingerTip](#) touchscreen controller on the opposite side of the game card reader

4 comments

Step 9



- With I/O board free, we can focus on the fan.
- This Delta electronics fan is held in place by three screws with rubber vibration damping mounts, and is rated for 5 V and 0.33 A.
- A fan can be a death sentence for battery life in any portable device, so it makes sense that [rumors](#) have it that the graphics are drastically underclocked when you're undocked.
- In addition to saving power by pushing fewer pixels, this ought to also let the Switch save juice by running the fan quite a bit less.

1 comment

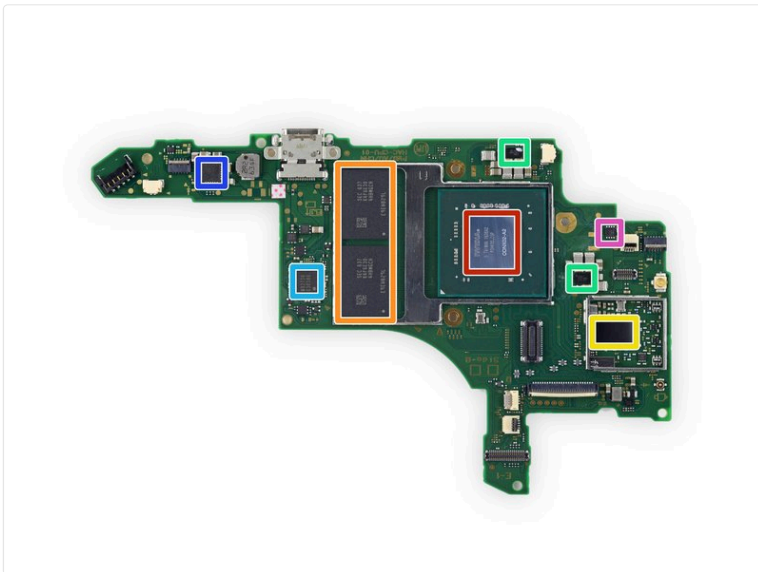
Step 10



- This is a well-connected motherboard; to get it free, we pop off the digitizer, backlight, and speaker connectors, two antennas, *and* the two Joy-Con rails. And then remove six Phillips screws.
- But hey, that's some awesome modularity. Even the eMMC storage pops off with an independent PCB!
 - Nintendo made a 6.2" tablet with removable flash storage, so don't say it can't be done.
 - The storage board contains a single Toshiba [THGBMHG8C2LBAIL](#) 32 GB eMMC NAND Flash IC.
- Sadly, the modularity ends at the USB-C port. This high-wear component will require some intense soldering skills to replace.

10 comments

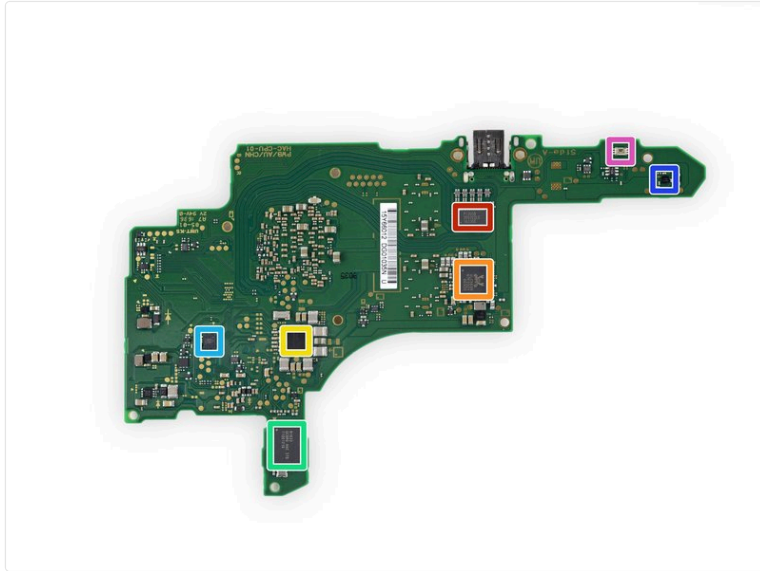
Step 11



- A small gathering of ~~mis~~ ICs populates the front side of the motherboard:
 - NVIDIA ODNX02-A2 (presumably the Tegra X1-based SoC)
 - Samsung [K4F6E304HB-MGCH](#) 2 GB LPDDR4 DRAM (x2 for a total of 4 GB)
 - Broadcom/Cypress [BCM4356](#) 802.11ac 2x2 + Bluetooth 4.1 SoC
 - Maxim Integrated [MAX77621AEWI+T](#) three phase buck regulator (x2)
 - Rohm BM92T36 USB-C controller
 - Texas Instruments [BQ24193](#) single cell battery charger (possibly)
 - Texas Instruments [TMP451](#) remote/local temperature sensor

11 comments

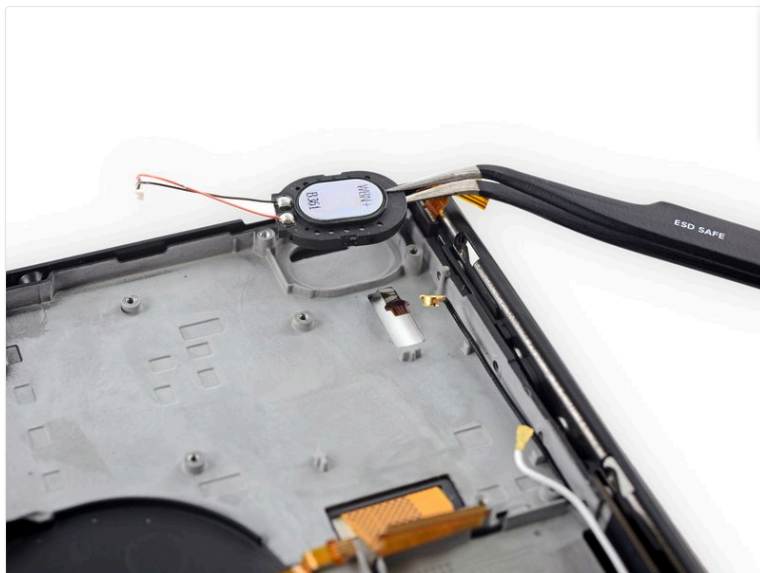
Step 12



- And on the back of the motherboard:
 - Pericom Semiconductor [PI3USB30532](#) USB 3.0/DP1.2 matrix switch
 - Realtek ALC5639 audio codec
 - Maxim Integrated [MAX77620AEWJ+T](#) PMIC
 - B1633 GCBRG HAC STD T1001216 (probably a Nintendo secure MCU)
 - STMicroelectronics [LSM6DS3H](#) 3-axis accelerometer/gyroscope (likely)
 - Maxim Integrated [MAX17050](#) battery fuel gauge
 - Rohm [BH1603FVC](#) ambient light sensor

2 comments

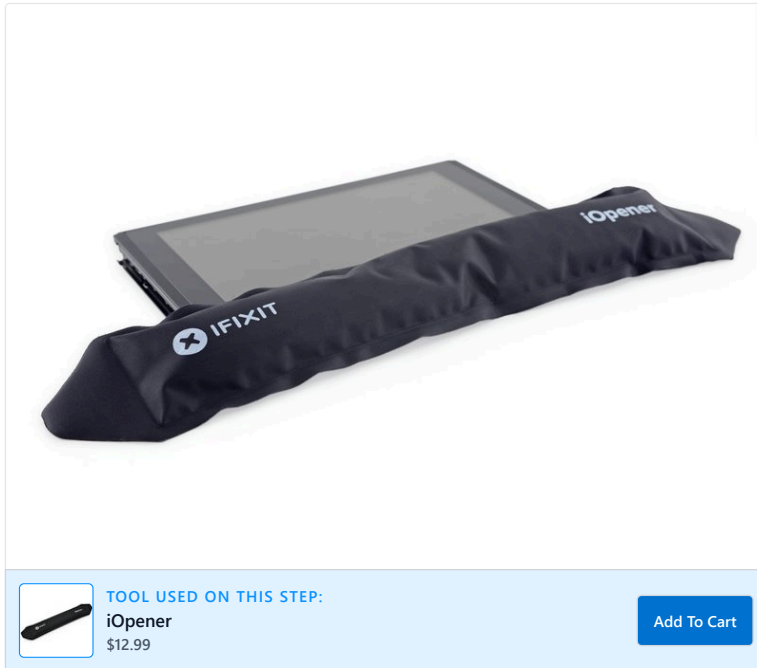
Step 13



- The stereo speakers are lightly adhered to the rear case, but don't put up much of a fight.
- These speakers are trying hard to pump that bass. The larger diaphragms will displace more air, and a [ported back](#) allows for booming bass. But initial reports say they still "[favor treble](#)."
- Phillips screws secure a Joy-Con rail to either end of the console.
 - Each rail has a set of pin contacts that interlock with contacts on the Joy-Cons to pass charge, and button presses to the motherboard via ribbon cable.

5 comments

Step 14



- Unlike a lot of modern touchscreen devices, the digitizer on the Switch is **not** fused to the display, meaning you can replace the two parts independently. Thanks for keeping repairability in mind Nintendo!
- The digitizer is adhered by a double-sided adhesive strip that runs around the perimeter of the display. With a bit of **heating** and **prying**, we manage to coax the digitizer off.

⚠ But in all our excitement, our hasty teardowner severed the digitizer data cable. Fixers be warned, this book opens longways.

7 comments

Step 15



- And for the cherry on this sundae? The LCD display is easily removable!
- Increasing a device's portability usually means increasing its likelihood of getting dropped. So way to go Nintendo for making a more breakable device more fixable.
- With that, the console is dispatched—but we're not done yet.
- Now where did we put those controllers...

3 comments

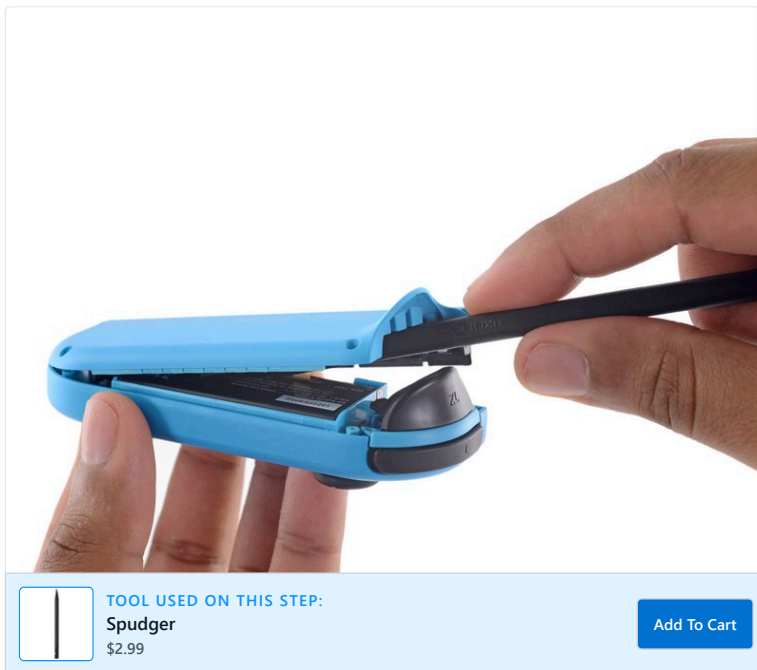
Step 16



- Nintendo provided some color coding to remind us that these seemingly identical Joy-Cons actually house different hardware.
- With different contents come different model numbers: The neon blue controller is designated HAC-015, while the neon red is HAC-016.
- [Neon](#) not your thing? If you're good at stickers, you [can mask their true colors](#) with a skin.
- The Joy-Cons aren't waterproof, and Nintendo even [recommends](#) that you [don't use them near your fish tank](#).
- ... or a laptop, wireless headset, wireless printer, microwave, wireless speakers, smart watch, cordless phone—basically, this is best used in a cave.

5 comments

Step 17



- Although we aren't geneticists, we bust out the [scalpel spudger](#) to compare these fraternal twins.
- Each controller is fitted with a 1.9 Wh lithium-ion battery, Bluetooth, accelerometer/gyroscope, and a [haptic](#) "HD Rumble" motor.
- Battery replacements certainly aren't as easy as in the [original Wii Remotes](#), but it can be done.
- Nintendo claims that the Joy-Con controllers offer up to 20 hours of game time, but it'll take a whole 3.5 hours to charge 'em back up.
- If that doesn't cut it, the [Joy-Con charging grip](#) adds a battery boost as well as a (more ergonomic) grip.

3 comments

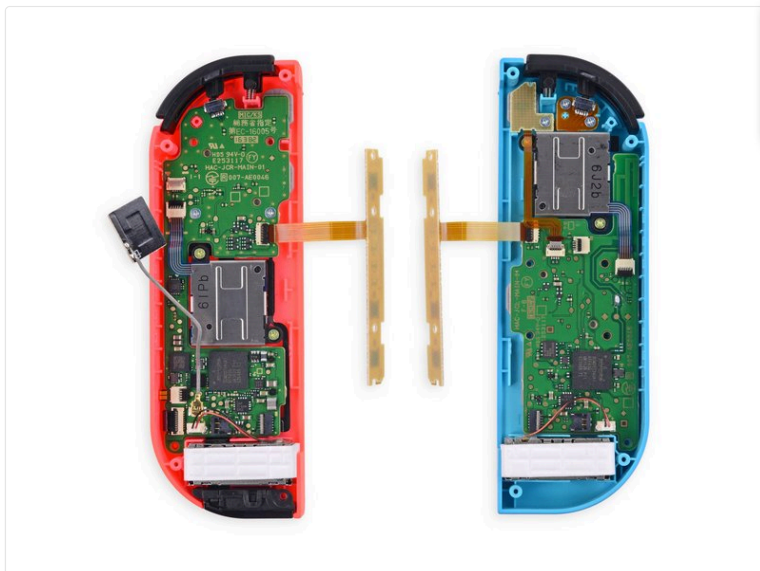
Step 18



- There have been early [rumors](#) of durability problems with the rail mechanism for the Joy-Con units, so we pause for a closer look.
- ① The rail itself, on the edge of the Switch Console, is metal and seems like it should hold up pretty well.
- Its mate on the Joy-Con side is plastic, which is probably exactly what you want—any failure will most likely be in the detachable controller, which should be cheaper to repair or replace if necessary.

3 comments

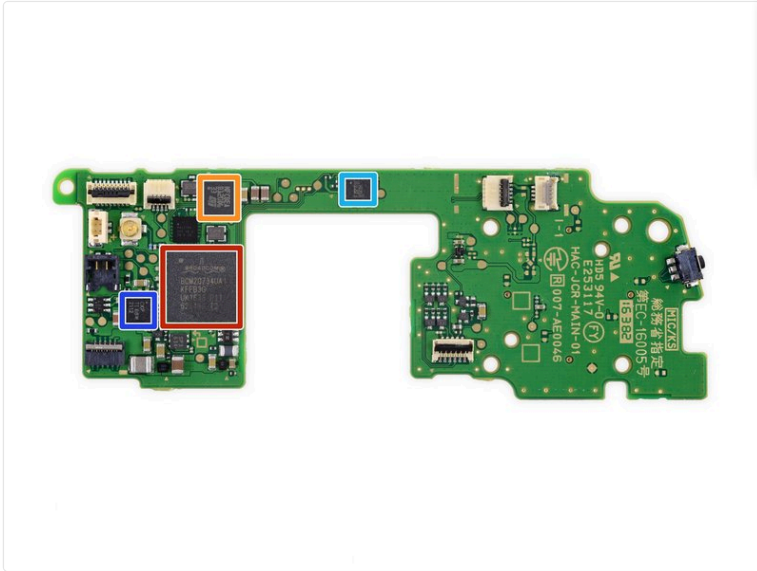
Step 19



- The controllers shed their skin for a close-up comparison. We bring you, [Red vs. Blue](#).
- We aren't shallow—it's what's inside that counts. The red Joy-Con comes out ahead with IR hardware and an NFC antenna.
- ① The [IR hardware](#) consists of an IR camera and four IR LEDs. Nintendo [says](#) that the camera can detect different hand shapes, distance, and in the future will be able to record video. As for the LEDs, our bet is that they cast IR light onto nearby objects to make them easier to identify.
- You know what both have though? Two Phillips screws holding the joystick and two Phillips screws holding the board. That's what.
 - Blue, you are there for us repair folk when it counts.
- On the bottom of each rests a hefty HD Rumble motor weighing in at 5.5 grams.

5 comments

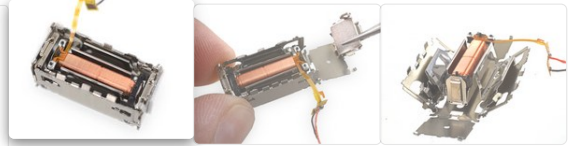
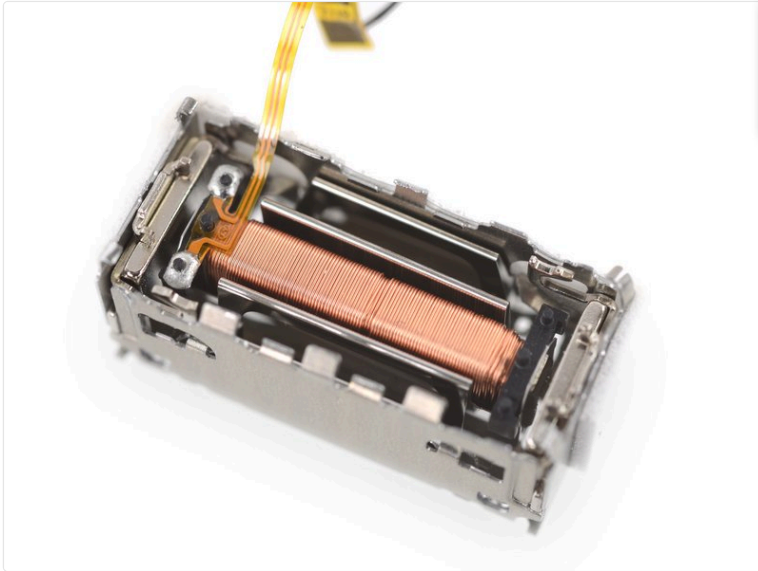
Step 20



- We lay out the controller boards in search of more silicon. Here's the feature-rich red board in all its glory (the blue board is shaped a bit differently, but has most of the same bits):
 - Broadcom [BCM20734](#) Bluetooth 4.1/2.4 GHz Transceiver
 - STMicroelectronics [ST21NFCB](#) NFC controller
 - Macronix International [MX25U4033E](#) 4 Mb CMOS Flash
 - STMicroelectronics [STM32P411](#) 32-bit microcontroller
 - STMicroelectronics [LSM6DS3H](#) 3-axis accelerometer/gyroscope (likely)
 - Texas Instruments [BQ24072](#) linear battery charger w/ power path management
 - Rohm [BD27400GUL](#) mono class-D audio amplifier

7 comments

Step 21



- **Teardown Update:** Just to make sure we were getting our fill of secret sauce, we popped the top off the haptic feedback motor, a [linear resonant actuator](#) (LRA) that powers Switch's HD Rumble.
- ① These LRAs look very similar to the ones we pulled out of the [Oculus Touch controllers](#), [HTC Vive](#), and the [Steam Controller](#).
- We took a second to pop open a Oculus Touch haptic motor and it seems to be internally identical to this one.
- On the inside, this vibration motor seems [fairly standard](#). It's essentially a voicecoil installed in a moving mass assembly, flanked by a pair of powerful magnets.
- ✦ However, it's interesting that this LRA seems to vibrate along its [short axis](#), while many haptic feedback motors that we've seen vibrate along their long axis.

4 comments

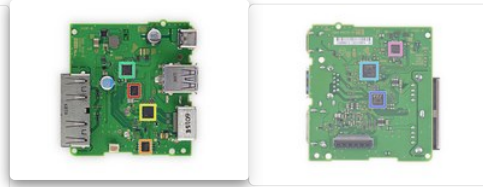
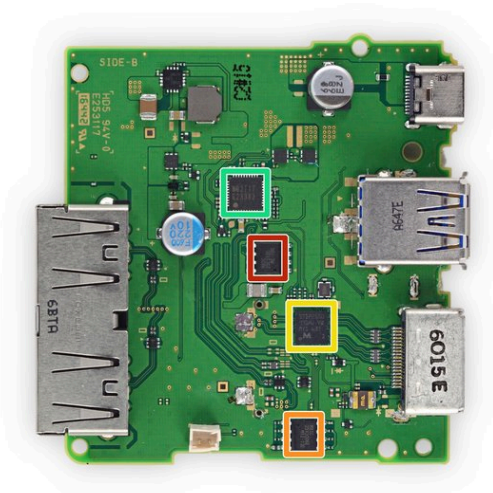
Step 22



- Before breaking into the Switch's home, we had our friends at Creative Electron perform some recon. We didn't want to hit any booby traps.
 - Let's be honest: that X-ray image is cooler than our findings. For all intents and purposes, the dock consists of a board in a box with [a handful of ports](#) including:
 - Two USB 2.0 Ports
 - AC Adapter Port
 - HDMI Port
 - One USB 3.0 Port
- ⓘ According to Nintendo, the rear USB port will only have USB 2.0 support at launch. A future update will bring USB 3.0 support.

[3 comments](#)

Step 23



- Dockside fish and chips:
 - Macronix International [MX25L512E](#) 512 Kb CMOS flash
 - Macronix International [MX25V2006E](#) 2 Mb CMOS flash
 - Megachips [STDP2550](#) Mobility DisplayPort (MyDP) to HDMI Converter
 - Rohm [BM92T17](#) USB-C power delivery controller
 - STMicroelectronics [STM32P048](#) 32-bit microcontroller
 - VIA Labs [VL210](#) USB 3.0 Hub Controller
 - Rohm [BM92T55](#) USB-C power delivery controller

9 comments

Step 24



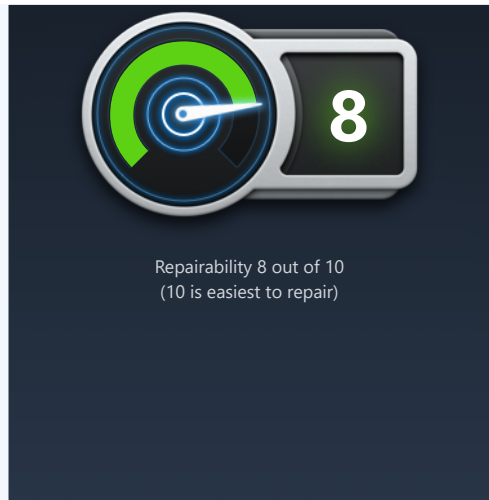
- It's time to hit you with our best shot some layout shots! Here are the Nintendo Switch's delicately laid out internals.
- ✦ Thanks again to our super-vision-having heroes over at [Creative Electron](#)!
- ⓘ Now we're gonna reassemble this thing as quick as we can—it's game time.

Add a comment

Final Thoughts

Repairability Score

- ✓ Aside from the digitizer, screws are used instead of adhesive to hold components in place.
- ✓ Most components, including the analog sticks, game cartridge reader, and headphone jack are modular and can be replaced.
- ✓ Batteries, while adhered to their housing, are modular and can be replaced by end users.
- The digitizer and display are not fused, reducing the cost of repair but increasing complexity.
- ✗ Proprietary tri-point screws restrict users from opening the Switch.
- ✗ Replacing a display or digitizer requires heating and prying against strong adhesive.



Author

with 17 other contributors



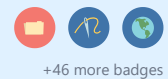
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137 GUIDE COMMENTS

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So there's 4GB RAM?

[Christopher Meyer](#) - Mar 4, 2017

Yes it has 4GB of RAM in the form of 2x 16Gb (or 2 gigabyte each) Samsung LPDDR4 RAM chips.

[acaew](#) - Mar 4, 2017



Does the HD Rumble operate the same way Apple's Taptic Engine works?

[Dimitri Bouniol](#) - Mar 4, 2017

Probably not. The Taptic Engine is a linear oscillator, but the Switch probably uses a 3-D oscillator: That means the weight can move freely in all three directions.

[Ethan Z](#) - Mar 4, 2017

Single pair of wires means single axis of movement.

[Lemming](#) - Mar 12, 2017

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