Amazon Echo Teardown

Teardown of the Amazon Echo on December 11, 2014.

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INTRODUCTION

The Amazon Echo aims to be your in-home personal assistant, in the form of a Wi-Fi connected tower speaker. Are smart speakers the next big thing? Follow us inside this new device for the inside scoop. Hey Alexa, it's teardown time.

Follow us on Instagram, like us on Facebook, or get the tl;dr on Twitter.

🔧 TOOLS:

- T9 Torx Screwdriver (1)
- T10 Torx Screwdriver (1)
- Spudger (1)
- Tweezers (1)
- X-ACTO Knife (1)

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Step 1 — Amazon Echo Teardown

- Amazon Echo: World's smartest speaker, or world's tallest Siri? Tech specs include:
  - 2.5" woofer, with a reflex port to drop a little extra bass
  - 2.0" tweeter
  - 7-microphone array
  - Light ring volume adjustment
  - Remote control

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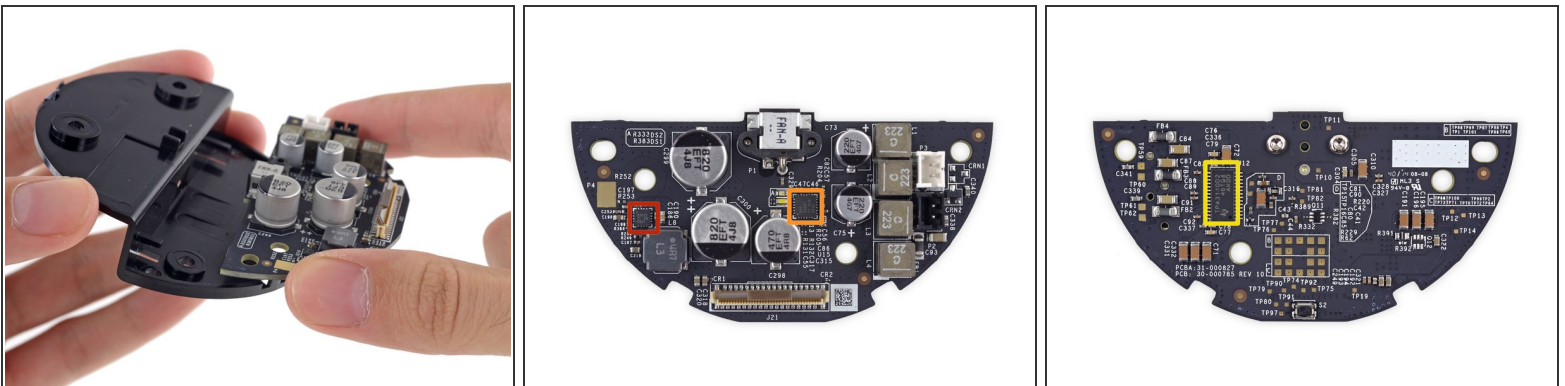
Step 2

- At 9.75" x 3.27", the Amazon Echo stands just a bit bigger than a couple cans of soup. (And significantly smaller than the last black cylinder we tore down, the Mac Pro).

- (i) Lifehack: While you're waiting for Amazon to decide to let you buy an Echo of your own, use soup cans to test out where you might put it in your home. Then ask it to do your homework. Have fun!

- Echo's model number lives in its rubber foot: SK705DI.

Step 3

- Amazon sealed the Echo up tight, with nary a fastener in sight. Time to peel up the foot and take a look.

  - (i) Just a little stick, peeling does the trick.

- Four impressively long T10 screws hold the bottom stage of the Echo rocket in place. Thanks, Amazon, for a standard fastener that we're really good at removing.

- The plate flips over, held in place by a data cable and speaker lines.
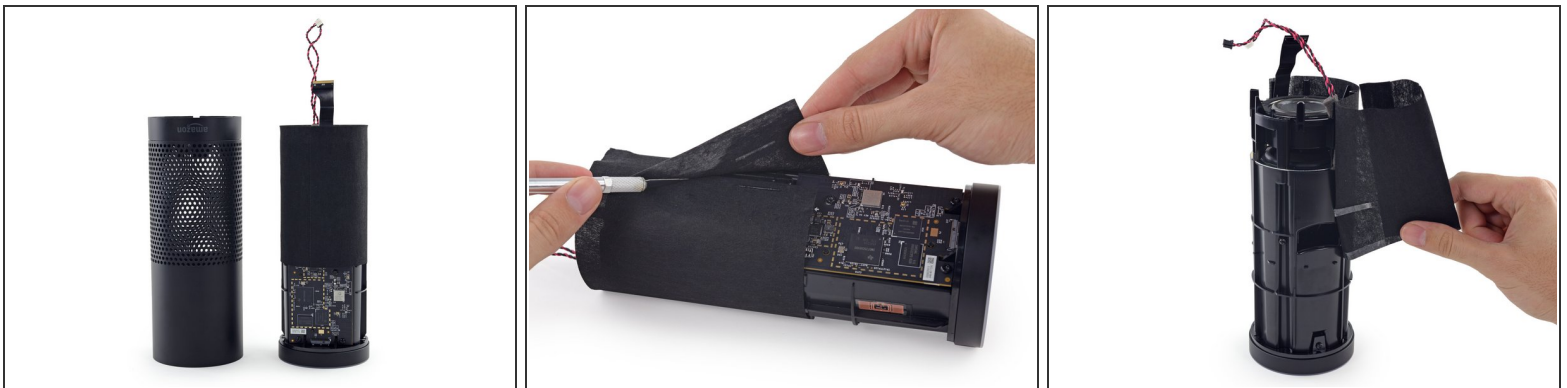
Step 4

- The power and speaker driver board lives on the bottom of the stack.

  - Texas Instruments TPS53312, likely an updated version of the TPS53311 3A Step-Down Regulator with Integrated Switcher

  - Texas Instruments TLV320DAC3203 Ultra Low Power Stereo Audio Codec

  - Texas Instruments TPA3110D2 15W Filter-Free Class D Stereo Amplifier

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Step 5

- [Echo have layer](#)

- Echo's design continues to remind us of a rocket, with several [stages](#) stacked within an outer shroud.

- (i) We'll have to keep peeling off stages to get to the brains of this operation.

Step 6

- With the outer housing removed, we find some vibration-dampening fabric swaddling the speakers.

- It takes a skillful combination of knifery and peeling double-stick tape, but we eventually get the fabric off, exposing a [sad-looking mouth](#) and the start of our path to a free motherboard.

Step 7

- The tower of components that remains is starting to remind us of a certain dark fortress. We'll keep an *eye* out for anything suspicious.

- *Stage separation in 3..2..1..*
  - Tweeter separated, and removed from its housing. Check out that magnet.

Step 8

- Final stage, ejecting the woofer from the ~~spacecraft~~ main body.

- This heavy duty woofer has an even heftier magnet than its tweeting twin.
  - ⓘ Amazon promises "deep bass response," thanks to this woofer and some funneling by the reflex port; more on that part later.

- The internals seem to feature a complex woven spider. Also known as a damper.

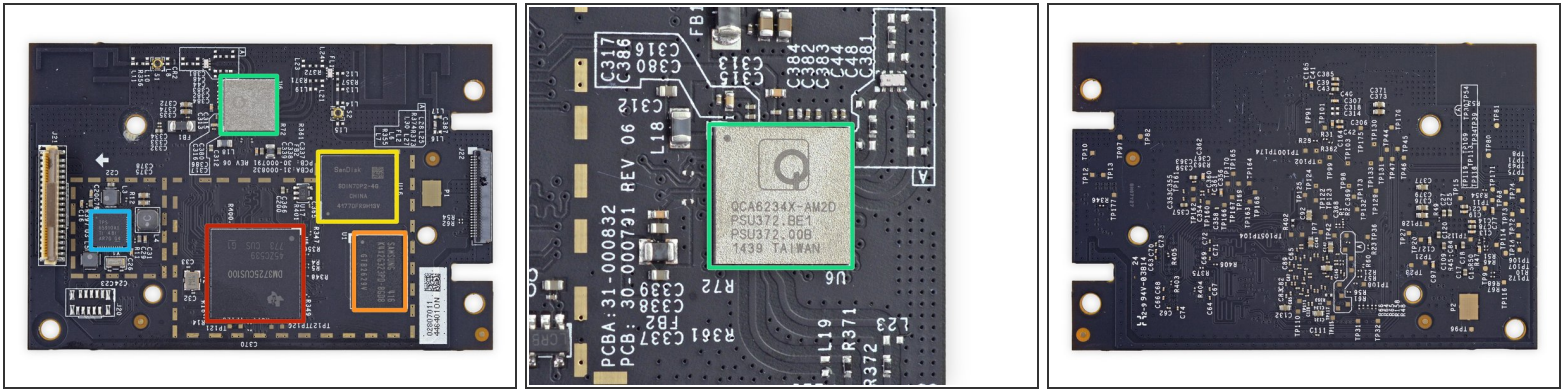This document was generated on 2019-09-19 02:34:09 AM (MST).

Step 9

- The Echo has made it into orbit, and is ready to launch its payload. Our handy T10 screwdriver is again put to the test to free the motherboard.

- This feels familiar.

  (i) But honestly, there are only so many places you can put a large rectangle in a tube, right?

- Time to excavate the board and check out its tasty chips!

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Step 10

- Here's what's powering the Echo:

  - Texas Instruments [DM3725CUS100](#) Digital Media Processor

  - Samsung [K4X2G323PD-8GD8](#) 256 MB LPDDR1 RAM

  - SanDisk [SDIN7DP2-4G](#) 4 GB iNAND Ultra Flash Memory

  - Qualcomm Atheros QCA6234X-AM2D Wi-Fi and Bluetooth Module

  - Texas Instruments [TPS65910A1](#) Integrated Power Management IC

Step 11

- Now for the fun part!

  - (i) Speakers are all well and good, but Alexa's true mouthpiece is the swivel-top volume control and light ring. Alexa acknowledges a voice command by changing the LEDs pointing toward you from blue to...lighter blue.

- The volume dial contains the user-interactive bits: the top portion spins freely, using a greased-up gear to turn an encoder...

  - (★) ...which you can also control via voice command!

    - Pro tip: take the Echo out of its protective plastic covering before attempting volume level 10.

Step 12

- Popping off the final guard, the greased gear is free to go. The Echo's spinning input wheel is similar to that of the Nest Thermostat, but is implemented completely differently.

  - (i) The Echo uses a gearing system and encoder to track movement of the outer wheel, whereas the Nest uses an optical sensor to watch the outer ring spin by.

- Around the edge of the wheel, we find the microphones responsible for hearing your commands (six on the perimeter, plus one in the center of the board), and LEDs used to indicate Alexa's acknowledgement.

Step 13

- We gently separate the LED/microphone board from the topmost plastic button cover.

- Only a thin layer of precision-cut foam, complete with microphone mesh and plastic window covers, stands between us and daughterboard freedom.

  - Texas Instruments LP55231 Programmable 9-Output LED Driver (x4)

  - Texas Instruments TLV320ADC3101 92dB SNR Low-Power Stereo ADC (x4)

  - Texas Instruments SN74LVC74A Dual Positive-Edge-Triggered D-Type Flip-Flops

  - S1053 0090 V6 Microphone (x7)

Step 14

- And here we remove the ~~saxophone~~reflex port.

  - [Cantina song](#), anyone?

- (i) The reflex port, also known as a [bass reflex system](#), boosts the bass while minimizing distortion.

- The strange shape takes full advantage of the limited space inside the Echo, while allowing Alexa to yell at you from across the room.
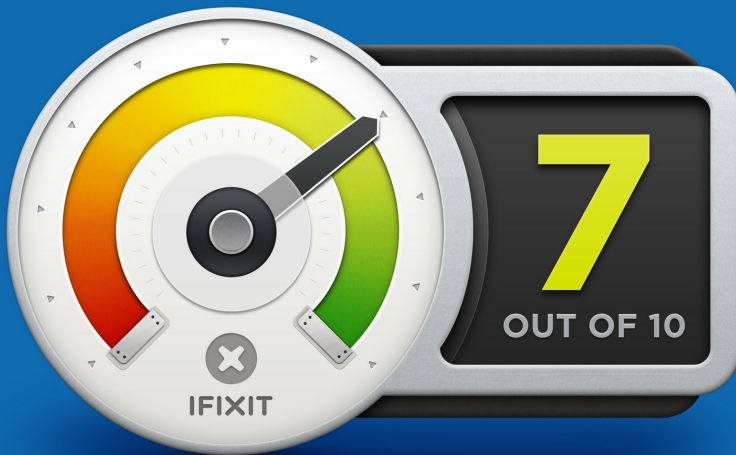
Step 15

- What a lovely layout! Here are all those Echo parts you've just now come to know and love.

- With that, it's time for a repairability score.

Step 16 — Final Thoughts

- Amazon Echo Repairability Score: 7 out of 10 (10 is the easiest to repair):
  - The speakers (the components most likely to fail) are replaceable.
  - Separating components across three circuit boards improves modularity.
  - Adhesive is used in two places— the rubber foot, and the fabric shroud. Removing the shroud requires a knife, and you'll need to tape it back together.
  - This is a fairly complex device— and with no repair documentation available, reassembly is especially difficult.

To reassemble your device, follow these instructions in reverse order.