



# Razer OSVR HDK 2 Teardown

Teardown of the Razer OSVR HDK 2 on August 9, 2016.

Written By: Scott Havard



## INTRODUCTION

The VR world is packed with serious contenders. The newest hardware and software solution comes from a dynamic duo: Razer, gaming peripherals giant, and Sensics, virtual reality maven. Their offering: the OSVR HDK 2. Can it hang with the platform heavyweights? We'll find out soon enough!

The future is now—find us on [Facebook](#), [Instagram](#), or [Twitter](#) and be the first to see it from the inside.



### TOOLS:

- [iFixit Opening Picks set of 6](#) (1)
  - [Phillips #000 Screwdriver](#) (1)
  - [Phillips #00 Screwdriver](#) (1)
  - [Phillips #1 Screwdriver](#) (1)
  - [Spudger](#) (1)
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## Step 1 — Razer OSVR HDK 2 Teardown



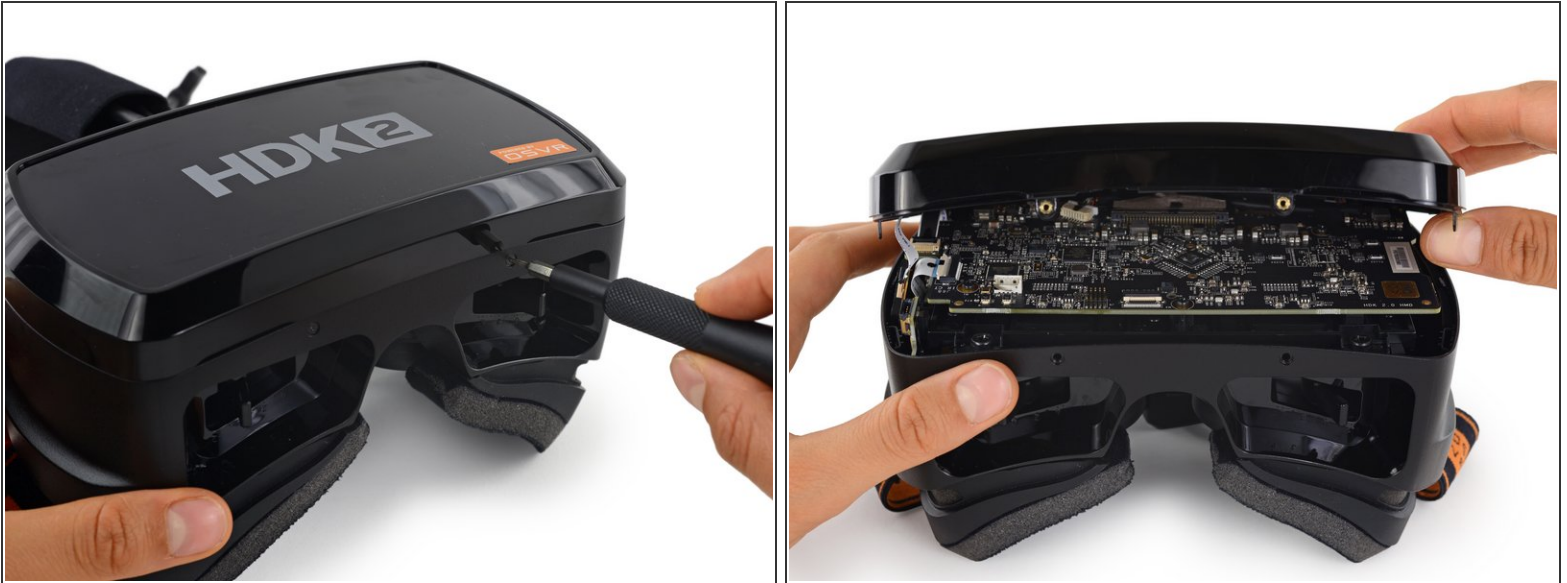
- Let's take a quick look at the OSVR HDK 2's specs and peripherals:
    - **Head-mounted display** (HMD) with dual OLED displays, 2160 x 1200 combined resolution (441 ppi), 90 Hz refresh rate
    - **IR camera** for 360° tracking, operating at 100 Hz
    - **Belt box** with surround sound audio codec and "signal boosters"
- 🔍 Decoding that name real quick, OSVR HDK 2 = Open Source Virtual Reality Hacker Development Kit version 2.

## Step 2



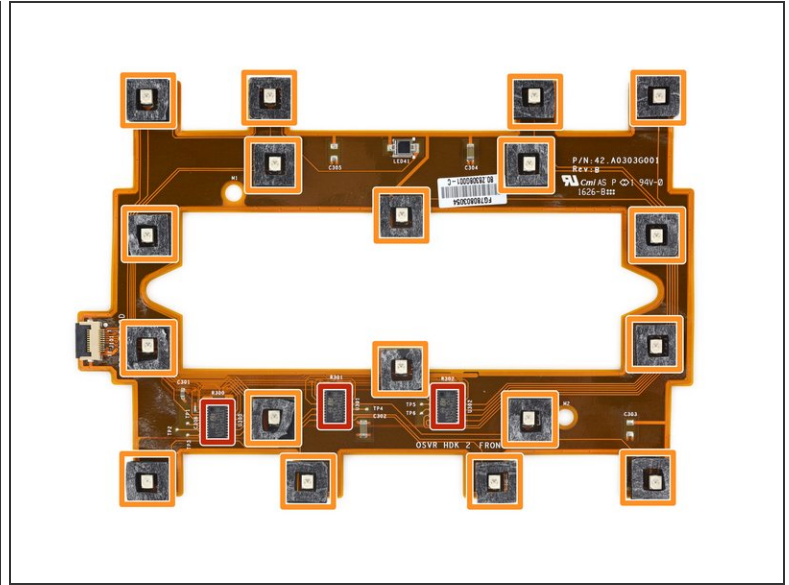
- Normally we can't wait to open our new toys and expose their inner workings... but we also [love](#) any [excuse](#) to pull out our handy dandy infrared camera.
- Dots everywhere! The HDK 2's stand-mounted sensor tracks this constellation of infrared (IR) LEDs from one instant to the next, in order to compute the wearer's motion and position.
- ⓘ This is similar to the tracking system employed by the [Oculus Rift](#), and the virtual opposite of that used in [HTC's Vive](#).
- The lone USB 3.0 port, nestled onto the side of this headset, can be used to attach accessories as they are developed.
- ✦ When wearing the HDK, two cables pass over your head—the large one feeds data to the HMD, while the skinny one is responsible for a few IR LEDs hidden in the box behind your head (allowing for 360° tracking).

### Step 3



- Time to hunt for those hidden IR LEDs. Since the HDK 2 is built to be [accessible to developers](#), we aren't surprised to learn the headset's gatekeepers are friendly Phillips screws.
  - But with the screws removed, the faceplate seems to be held in place by some mystical energy field. We suspect either wizardry or more likely, the Force.
  - The HDK 1.x models had some issues with [cables ripping apart](#). The HDK 2 seems to have remedied this with a beefier cable and a ZIF connector.
- 📌 With repair on our minds, we give this modular design two thumbs way up.

## Step 4



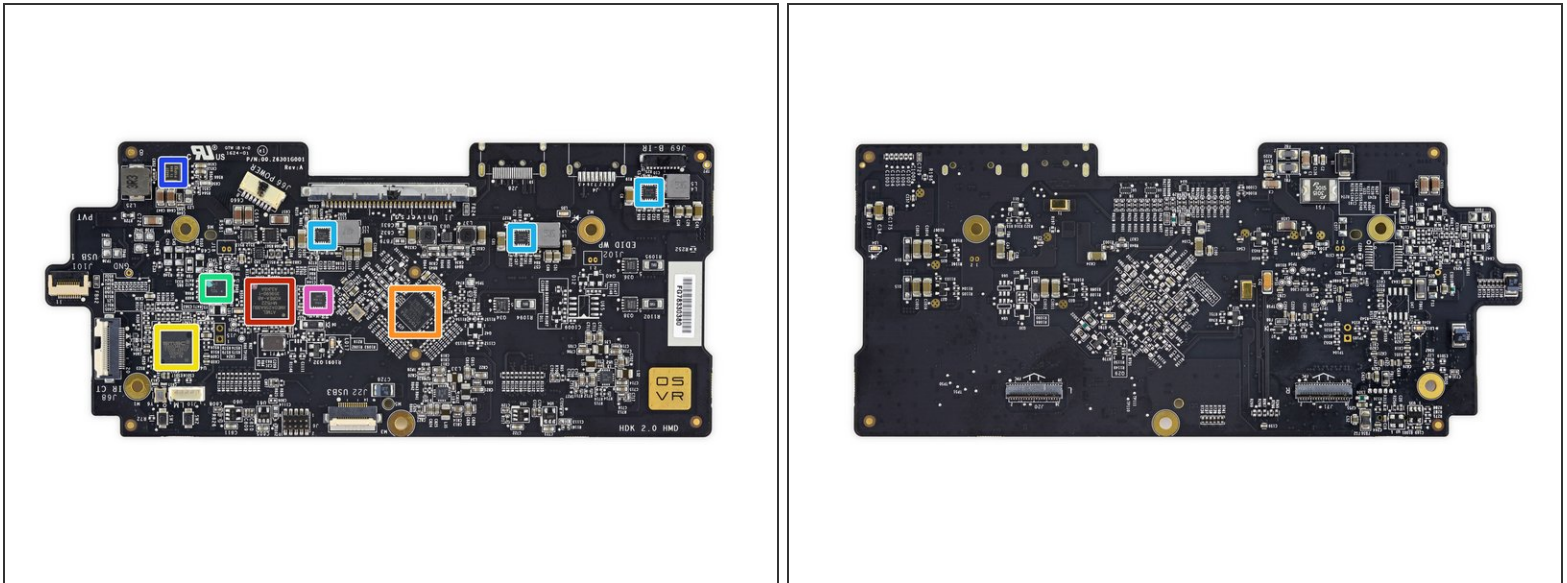
- We discover that magnets are the source of our [magical bind](#). By wizardry we totally meant magnets... Magnets are neat, especially with [interchangeable faceplates](#) on the horizon.
- On the inside of the faceplate we find the source of (some of) those invisible lights: the IR LED array!
- The hefty cable peels out quite easily, way less scary than some of the [LED arrays we've seen](#).
- Successfully removed, we take a closer look at this ring of light:
  - Three STMicroelectronics [STP16CPC26](#) low voltage 16-bit constant current LED sink driver
  - 18 LEDs, each attached to the (IR-transparent) faceplate with some sticky, black foam tape

## Step 5



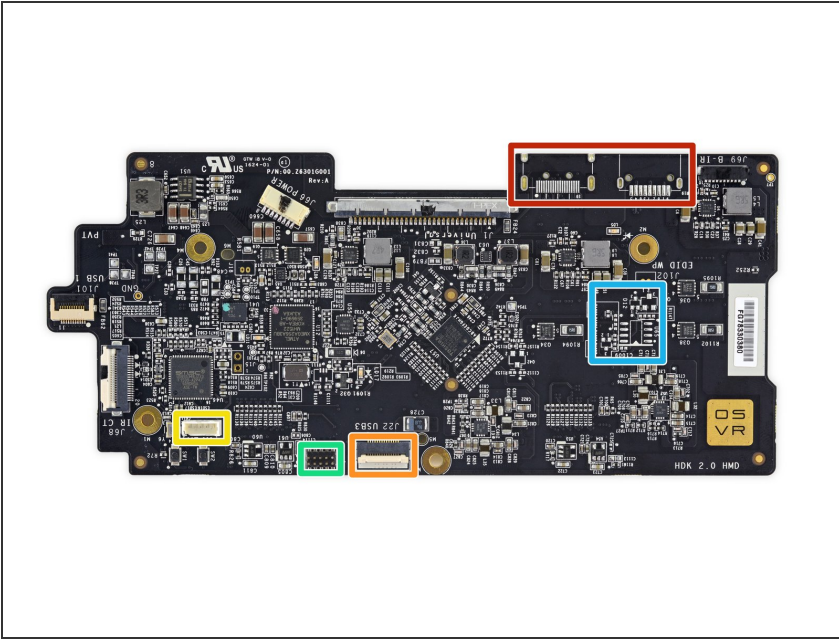
- We start to think this motherboard's easy access is a teardown engineer's dream...until we realize it's held hostage by two sneaky flex cables snaking down to the displays.
  - ① Many components are accessible without having to remove the motherboard, so hopefully most users won't need to go this far.
- With the cables disconnected, we're able to free the motherboard for a closer look.
  - ① Do you think motherboards nag their daughterboards the same way human [mothers](#) nag their human daughters? Just wondering.

## Step 6



- Open-source hardware means labels are a must. We're so busy admiring the organization we nearly forget about the silicon:
  - Atmel [XMEGA256A3BU](#) MCU
  - Toshiba [TC358870XBG](#) 4K HDMI to MIPI dual-DSI converter (also seen in the [Rift CV1](#) and the [Vive](#))
  - SMSC [USB5534](#) 4-port USB 3.0 hub controller
  - Bosch Sensortec/Hillcrest Labs [BNO070](#) 9-axis orientation sensor and sensor hub
  - Texas Instruments [TPS54478](#) buck converters
  - Texas Instruments [TPS54427](#) buck converter
  - Texas Instruments [TXS0104E](#) bi-directional level shifter

## Step 7



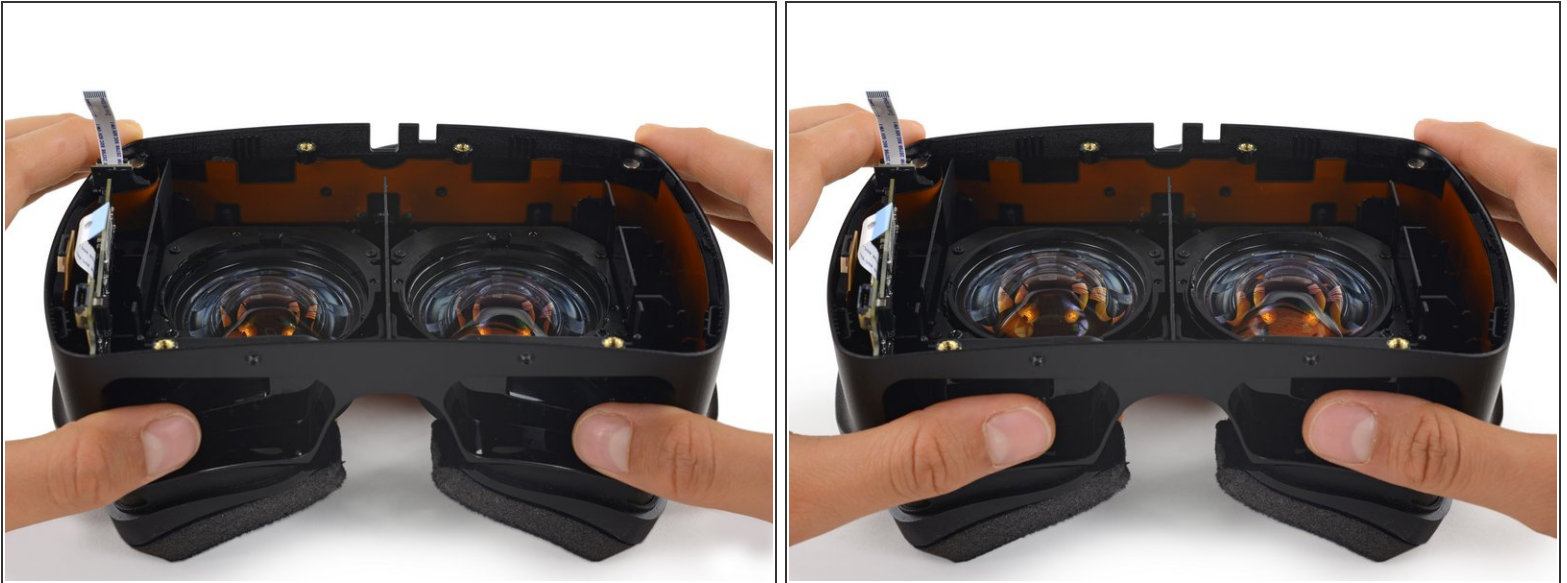
- Speaking of labels, we found a few goodies for enterprising devs:
  - These empty pads look like they're ready to accept some ZIFs, possibly for extra USB devices.
  - Unused USB 3.0 connector
  - Cute li'l empty 5-pin socket (possibly a header for another USB 2.0 port)
  - Similarly empty 10-pin header (possibly a JTAG port for the XMEGA MCU)
  - More empty solder pads!
- ❗ Hardware doesn't have the same open source licensing guidelines that software has. In order to follow a framework that promotes development beyond the code, Razer modeled their [Module Development Kit](#) platform after Google's [Project Ara](#).

## Step 8



- After removing four friendly Phillips screws, the display assembly lifts out of the headset with ease.
- ⓘ A smear of light adhesive attaches each of the screens to the plastic casing—we've certainly had an easier time here than getting to the [CV1's](#) displays.
- Improved visuals on the HDK 2 make it a contender with the big names in VR: The two 1080p OLED displays, made by AU Optronics, look similar to the [Samsung displays on the HTC Vive](#), and boast the same 2160 x 1200 combined resolution and 90 Hz refresh rate.
- ⓘ The display is one of the HDK 2's biggest [improvements from its predecessor](#). Conveniently, anyone with an older HDK can simply [upgrade their screen](#) to match the HDK 2.

## Step 9



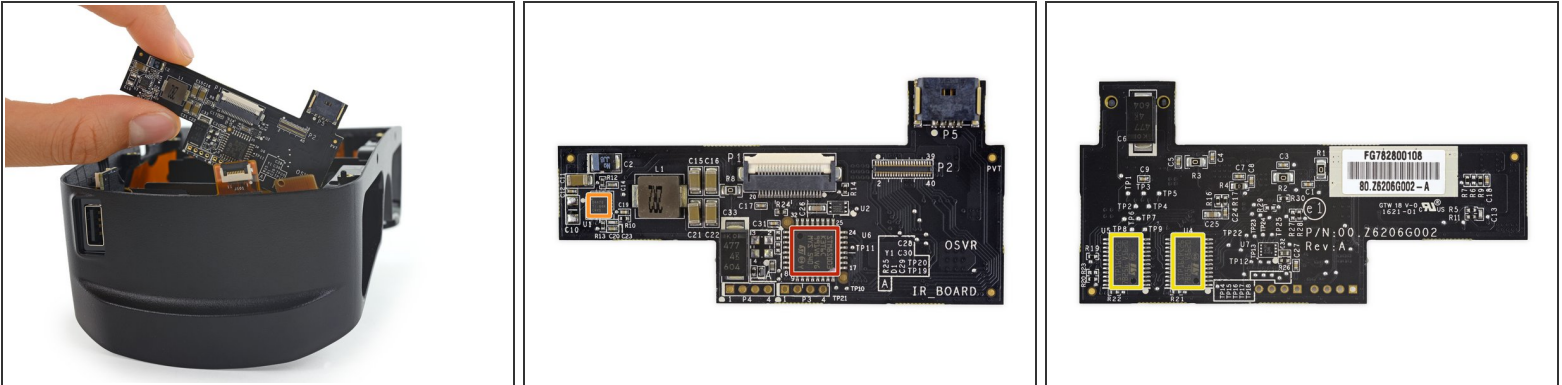
- We love watching lenses move. Like we did [here](#). Oh and [here](#) too.
- ❗ Not all lenses are created equal. While the HTC Vive and Oculus Rift both offer adjustments for IPD (inter-pupillary distance), the OSVR does not.
  - While the OSVR lacks IPD adjustment, it does boast one claim over the competition—those knobs allow independent eye relief adjustment. [Anisometropia](#) sufferers rejoice!
  - Focus adjustments range from [+4.5 to -2 diopters](#), which should allow most (but [not all](#)) regular optical-enhancers to ditch their spectacles while using the OSVR.

## Step 10



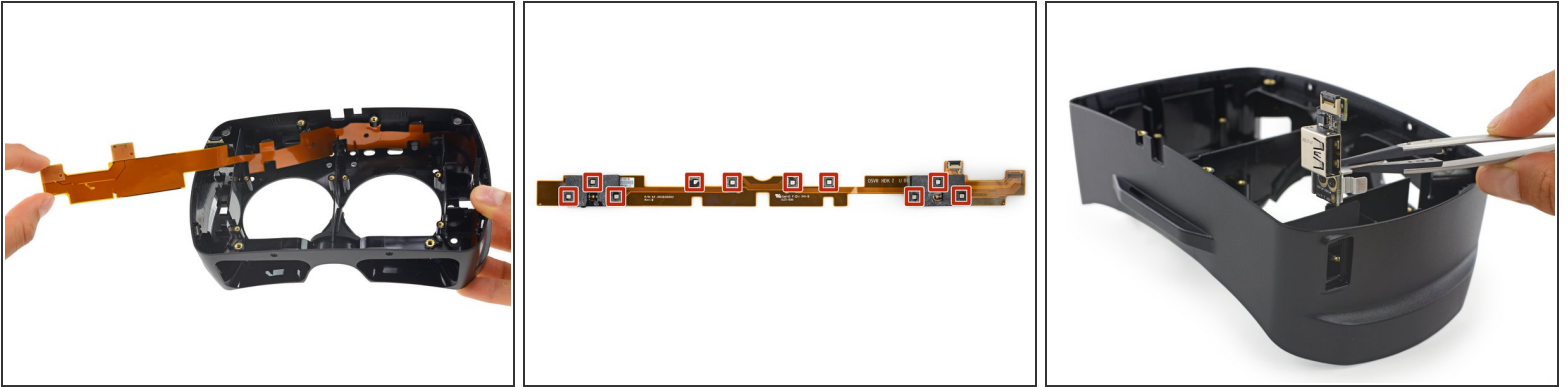
- The flexible foam face mask can be removed at any time, thanks to squishy pegs that pop out of the HMD with a simple tug.
- This is especially nice if you suffer from SFS ([Sweaty Face Syndrome](#)).
- ❗ The HDK 2 spec sheet boasts a "bamboo charcoal microfibre foam layer" on the face mask, which sounds like a mashup of beauty buzz words to us, but supposedly provides "additional comfort" to your VR experience.
- We also take the opportunity to snag the HDK's circular peepers. While they may look reminiscent of those in [ye olde Oculus](#), rather than the [Fresnel lenses](#) we've [been seeing](#) in [devices lately](#), these are actually dual-element lenses, with lower chromatic aberration and no Fresnel "God rays." They are related to [this earlier \(HDK pre-1.3\) design](#).

## Step 11



- Tucked ever-so-gently along the side of the headset, we find the IR Board. We knew something had to keep all those IR LEDs under control.
- Populating the board are a few more silicon-flavored morsels:
  - STMicroelectronics [STM8S003K3](#) 8-bit MCU
  - Texas Instruments [TPS54478](#) buck converter
  - STMicroelectronics [STP16CPC26](#) low voltage 16-bit constant current LED sink driver

## Step 12



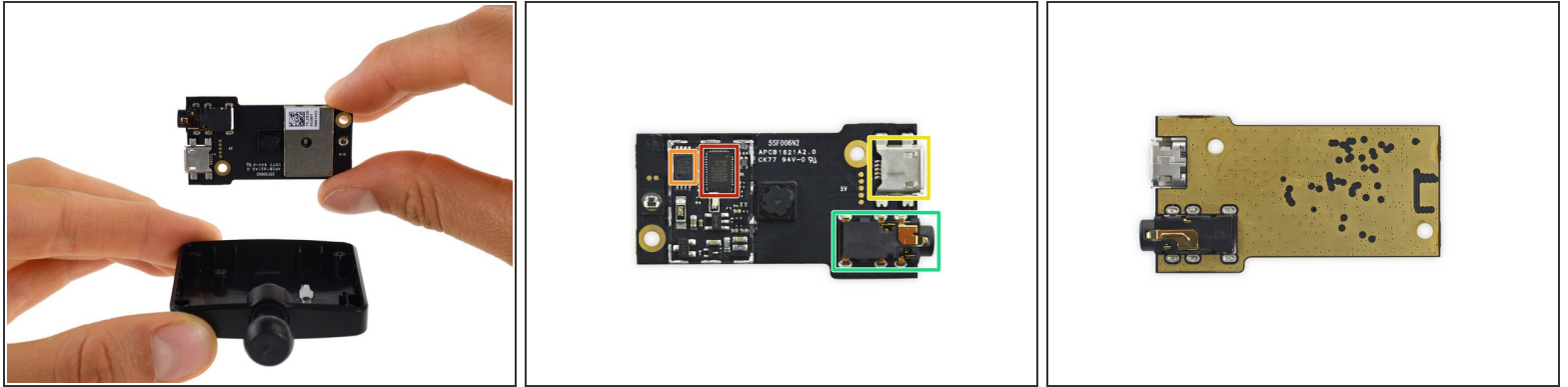
- The second LED array is looooong—see the [invisible measuring tape](#) in the photo for reference—wrapping around the top and both sides of the faceplate.
  - The ribbon itself is well adhered and a bit tricky to extricate, but we managed to free the 10-LED cable sans-incident.
- With the LED array out of the way, only two Phillips screws remain between us and the USB port.
- This board is just an interconnect, without any active circuitry of its own, hopefully some accessory will give its life purpose one day.

## Step 13



- Now on to the watchful spider (or maybe the watchful [complex virus?](#))—it's the IR-sensing camera!
  - ❗ This lil' guy tracks your movement via the infrared emitters on the headset while you're ~~stuck in the matrix~~ experiencing virtual reality.
- Though the OSVR HDK 2 uses similar technology to the Oculus Rift, its camera is tiny when compared to the Rift's [Constellation](#).
- The camera module also features a 3.5 mm stereo jack, used for synchronizing the camera with the LEDs on the HMD.

## Step 14



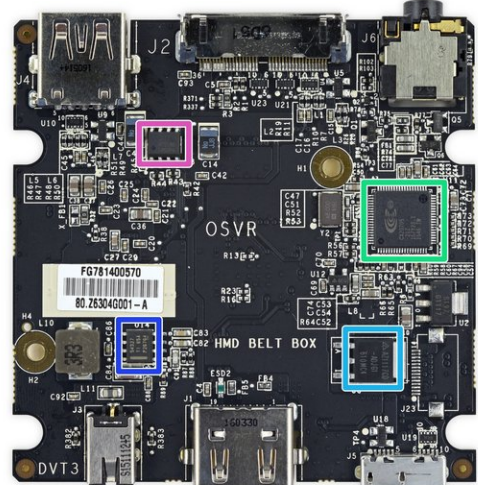
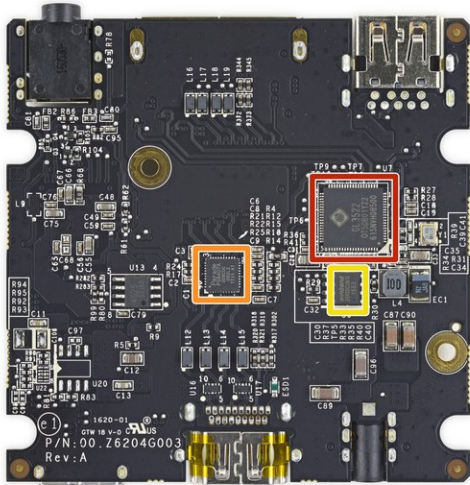
- Inside the camera module we find a wee little mobo, complete with two ICs:
  - Realtek RTS5838 camera controller (likely similar to the [RTS5822](#))
  - Elm Technology [GD25D05B](#) uniform dual serial flash
- And it's even more complete with two ports:
  - Micro USB port
  - Sync port

## Step 15



- Our newest fashion accessory, the clip-on belt box, offers improved "cable management" that looks a lot like cable hoarding. Six ports populate this sucker:
  - Out the bottom we have a barrel jack for the power/camera sync split cable, as well as HDMI-in and USB 3.0, for the computer connection.
  - The top sports a headphone jack, the proprietary HMD cable port, and a spare USB 3.0 port (for accessories, or maybe sweet hacks).
- After our quick port survey, we say adios to four Phillips screws and then lay hands on the board itself. Let's see if we can find those "signal boosters" we heard about.

## Step 16



- What makes our new hip accessory tick? We took a peek at the board to find out:
  - Genesys Logic Inc [GL3522](#) USB 3.0 hub controller
  - Parade [PS8407A](#) jitter cleaning repeater ("Signal boosters"? Is that you?)
  - Winbond [W25X05CL](#) serial flash memory
  - Conexant [CX20705](#) audio codec and DSP
  - BCD Semiconductors [AZ1117CD](#) low dropout linear regulator
  - TI [TPS54327](#) buck converter
  - Diodes Incorporated [AP2186](#) USB power switch

## Step 17



- OSVR HDK 2 Repairability Score: **9 out of 10** (10 is easiest to repair)
  - Standard Phillips screws hold the headset and its components together.
  - The motherboard is easily accessible after removing the cover.
  - The cables and foam facepad are sturdy and detach easily.
  - Reconnecting the motherboard to the two display data cables underneath is tricky.
  - The two OLED screens are attached to the case with adhesive that required some prying to detach.