Vaisala RS41 Radiosonde Teardown

Teardown of a Vaisala RS41-SGP Radiosonde

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🔧 TOOLS:

- 64 Bit Driver Kit (1)
- Large Needle Nose Pliers (1)

Step 1 — Remove EPS Housing

(i) Radiosondes are devices who are launched across the globe two times a day (sometimes more often) with the help of wheather ballons by meteorological organisations. Vaisala is one of the leading manufacturer and even the inventor of modern radiosondes. Check out sondehunt.de or radiosonde.eu for more details.

(i) The RS41 to be thorn down is of the newer variety with an EPS (Styropor) housing, weighing only 84 g, which helps saving in helium and reduces the amount of waste in the landscape if no sonde hunter comes picking it up - pretty cool.

(i) The -SGP suffix means the sonde is equipped with a barometric pressure sensor. The more common -SG version calculates the pressure based on GPS data. There is also an -SGM version for military applications featuring a 'radio silence' mode activating the radio transmitter at a certain altitude so no enemy can determine the launch site.

- First let's start by unclipping the removing the unwinder stick.

- That out of the way we proceed by removing two platic clips on the top and bottom using a pair of long-nosed pliers.

  - The top one may be behind a label, depending on the organization who launched the sonde.

  - The bottom one in partially covered by the serial number label.

- We can now separate the two EPS shells.

Step 2 — Remove Batteries

- You can now lift out the PCB and remove the two Energizer Ultimate Lithium AA lithium primary batteries. We're more or less finished now. But who would we be not to take a look at the PCB?

Step 3 — PCB investigations - front side

- The STM32F100 is the workhorse microcontroller in this sonde, featuring an ARM-Cortex M0 core. It is running at 24 MHZ

- Above it we can take a look at an TPS61200 boost converter, two TLV70030 LDOs (one additional LDO being on the rear side) and a P-Channel MOSFET who turns on the sonde, triggered either by a pushbutton or via NFC.

- Speaking of NFC, the NFC coil is visible on the bottom of the sonde quite prominently, featuring 12 turns over all 4 layers of this 1 mm thick PCB. There is no NFC interface chip, only one DC-coupled and one AC-coupled path. the return channel is formed by an N-Channel MOSFET who shorts the coil through an resistor

Step 4 — PCB investigations - rear side

- On the top of the PCB is the UBX-6010 GPS module which gets its data from a ceramic chip antenna on the edge of the pcb. No quadrifilar helical antennas and manual almanac downloads - this is one integrated puppy which just has an UART interface.

- Besides the GPS ist the Frontend. Not an analog frontend, mind you. Vaisala is using two ring oscillators with the temperature and humidity sensors in there feedback paths, varying there frequency - clever!

- On the lower half is all the magic for an VHF Telemetry Radio you need in 2014. Just a SI4032 Radio Chip and a few support components, no HF p*rn, unfortunately. That said, making the sonde transmit in the 70cm-HAM-Band or even the 433-MHz-ISM-Band is just a question of sending the right bytes over the SPI Interface.

- On the bottom there is the XDATA-Expansion Port which is mainly jused for connecting ozone and othe peripheral sensors. Physically, it's just a 2 mm 2x5 pin header. Vaisala official pinout lists just GND and an UART, but there is more to discover: various power rails and, more importantly, a SWD interface for interfacing with the STM32.

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Step 5 — Sensor Boom

- You might thought we were finished, but wait - there the sensor boom, this high-tech futuristic looking piece of proprietary Vaisala measurement know how.

- Below the silver coating, which is to prevent light from warming up the boom is an ordinary flex PCB - how boring. That almost makes it feel like a movie prop - just shiny on the outside.

- But our mood gets better when taking a look at the ceramic hybrid, which contains not only a capacitive type thin-film humidity sensor, but also a PT1000 temperature sensor and a heating element to keep the sensor at 5 K above ambient to prevent moisture condensing.

- what looks like a hook is another PT1000, this time made out of platinum wire, who is as thin as possible to minimize its thermal mass. You better won't hang your sonde on this hook...

Step 6 — Final Thoughts
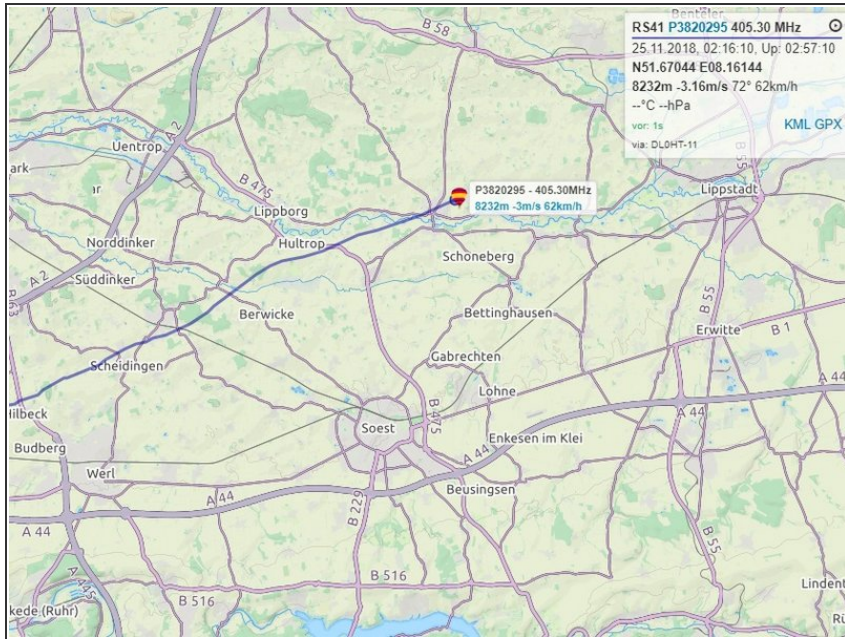
- If you are wondering what to do with your sonde, take a look at RS41-HUP or RS41-FOX, two alternative firmwares. Or check out the RS41-ReverseEngineering GitHub for more in-depth information and schematics of the sonde.