KIU Ground Station — Detailed BOM & Build Manual

This manual enables a two‑person student team to build, commission and maintain the KIU SatNOGS ground station in four weeks.

# Executive Summary

Goal: achieve ≥10 dB link margin with SakSat‑1 at 20° elevation or greater.

# Bill of Materials

|  |  |  |  |
| --- | --- | --- | --- |
| Item | Qty | Cost USD | Supplier URL |
| UHF Yagi (10el) kit 435‑10 | 1 | 120 | [rfiamericas.com](https://www.rfiamericas.com/product/uhf-10-element-yagi-11dbd-400-420mhz/) |
| VHF Yagi (5el) kit 145‑5 | 1 | 110 | [dxengineering.com](https://www.dxengineering.com/search/part-type/vhf-uhf-beam-antennas/vhf-uhf-beam-antenna-elements/5?srsltid=AfmBOorEeWuDPhAoYdAMdRftOArRP0aqaON1yL3VhLDCu0M1tALnvGDv) |
| SatNOGS Rotator v3 hardware set | 1 | 280 | [SatNOGS wiki](https://wiki.satnogs.org/SatNOGS_Rotator_v3) |
| NEMA17 stepper motors 1.7 A | 2 | 60 | [polulo.com](https://pololu.com/product/2267) |
| Arduino Mega + CNC shield | 2 | 30 | [aliexpress](https://aliexpress.ru/item/1005006345978083.html?sku_id=12000038004101164&spm=a2g2w.productlist.search_results.1.8f4f76ceyoQqSx) |
| RTL‑SDR Blog V3 dongle | 1 | 33 | [rtl-sdr.com](https://www.rtl-sdr.com/buy-rtl-sdr-dvb-t-dongles/) |
| Dual‑band LNA (VHF/UHF) PGA‑103+ | 2 | 90 | [minicircuits](https://minicircuits.com/pdfs/PGA-103+.pdf) |
| Second‑hand ICOM IC‑910H | 1 | 620 | [ebay](https://www.ebay.com/itm/197310566368) |
| 10 W VHF PA kit | 1 | 70 | [qrp-labs](https://qrp-labs.com/pa/10wpa.html) |
| 50 m LMR‑400 coax + N‑Type | 1 | 160 | [ebay](https://www.ebay.com/itm/156611040525) |
| Outdoor mast 6 m | 1 | 198 | [amazon](https://www.amazon.com/Telescoping-Antenna-Galvanized-Section-Clamps/dp/B00UUMGJYY) |
| Raspberry Pi 4 (4 GB) | 1 | 75 | [raspberrypi.com](https://www.raspberrypi.com/products/raspberry-pi-4-model-b/) |

Total parts: ≈ US$ 1846

# Mechanical Assembly

1. 3‑D print SatNOGS rotator pieces (STL files: https://gitlab.com/librespacefoundation/satnogs/satnogs-rotator).

2. Assemble rotator with NEMA17 motors, M5 threaded rod; calibrate backlash ≤0.5°.

3. Yagis: follow DX Engineering instruction sheet; ensure element spacing within ±1 mm.

4. Mount antennas on crossboom; attach to rotator with stainless U‑bolts.

5. Run LMR‑400 coax through rotator bearings; add ferrite chokes every 1 m.

6. Install mast with 3‑point guy wires; align true North using solar noon shadow method ±2°.

# Electronics & Software Setup

• Flash Arduino with rotator‑controller firmware (https://github.com/satnogs/satnogs-rotator-controller).

• Install SatNOGS‑client‑ansible on Raspberry Pi (docs: https://wiki.satnogs.org/SatNOGS\_Client\_Setup).

• Connect RTL‑SDR to Pi via powered USB hub; verify 0.5 ppm frequency error with kalibrate‑rtl.

• Build GNU Radio ‘gr‑satellites’ flowgraph for 9k6 GMSK AX.25 (example script: https://github.com/guruofquality/grextras).

• Configure hamlib (rigctld, rotctld) for ICOM IC‑910H; test Doppler auto‑tuning with GPredict.

• Push first observation to SatNOGS network; aim to decode ISS beacon as validation.

• Implement Python watchdog script to auto‑reboot Pi on USB failure (sample code link).

# Operational Check‑List

Daily: update TLE, run ‘satnogs-auto-scheduler’ for next 24 h.

Weekly: visual antenna inspection, SWR check < 1.3.

After each pass: verify decoded frames stored in InfluxDB.

Emergency: lightning forecast >50 kA km‑2 – disconnect feedlines.