**Title:** 30THz experiment over 100m distance

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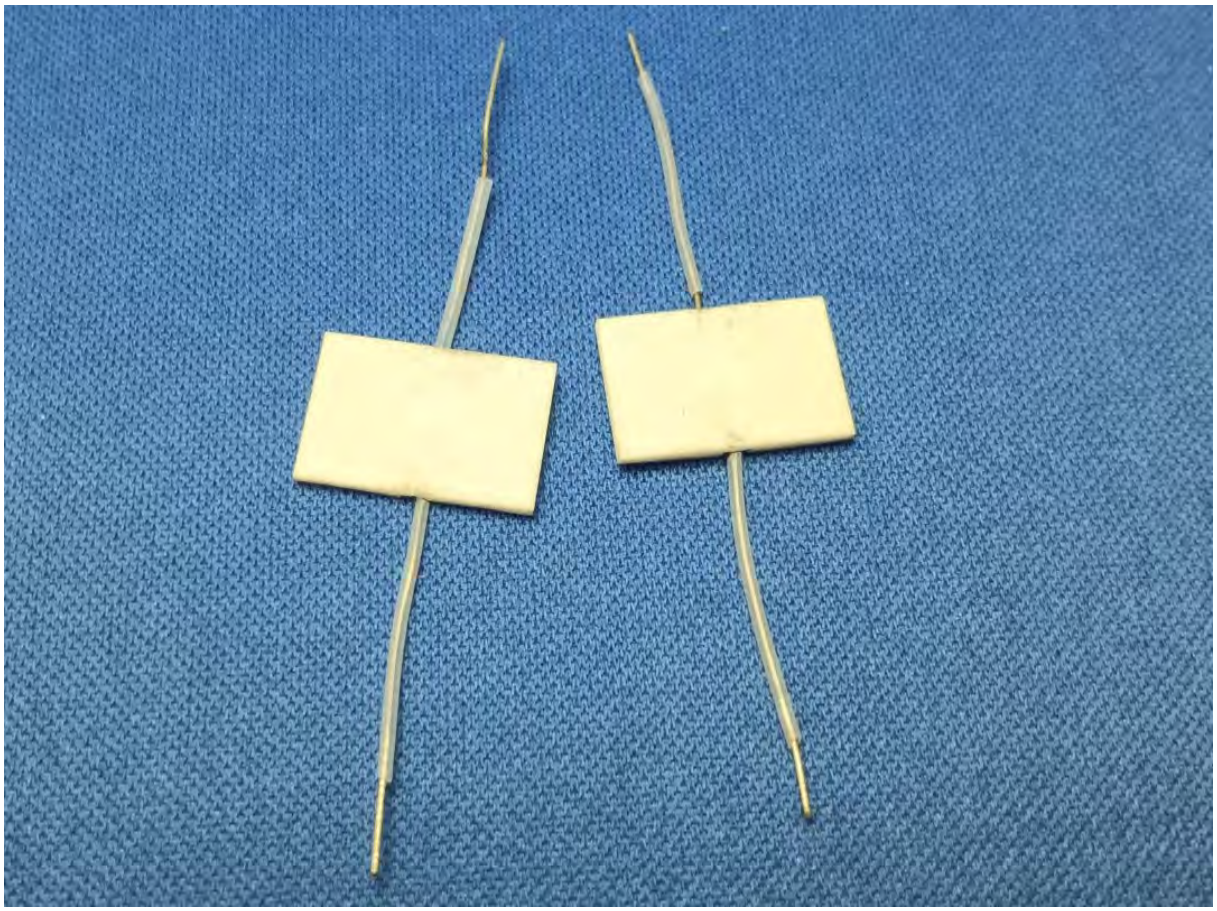

Figure 1. Resistive ceramic heaters

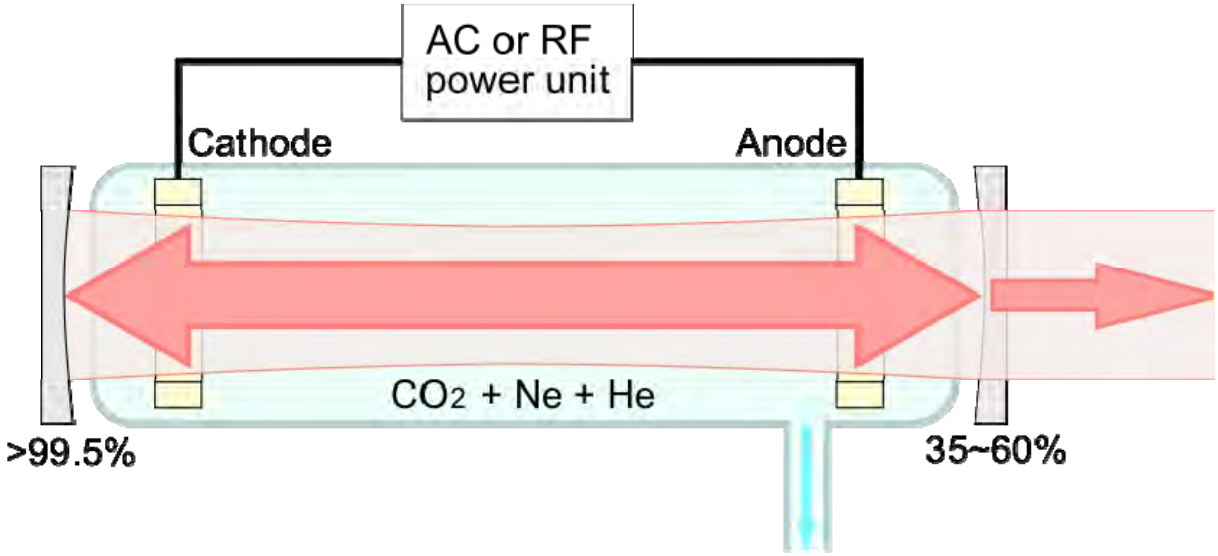


Figure 2. CO2 laser tube (Creative Commons Attribution-Share Alike 4.0 International; Source: Shigeru23; Author: רונאלדיניו המלך

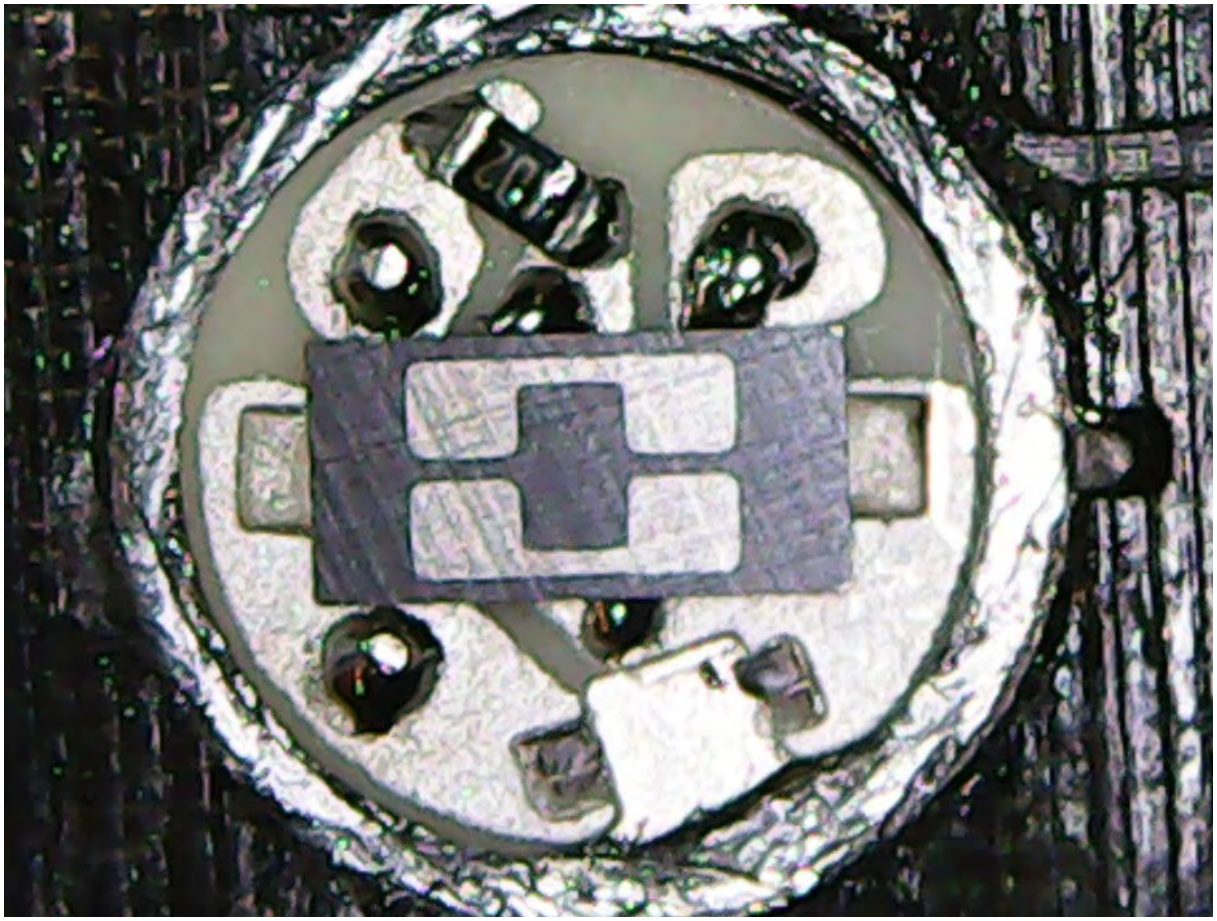

Figure 3. Pyroelectric sensor ( NICERA RE03R129)

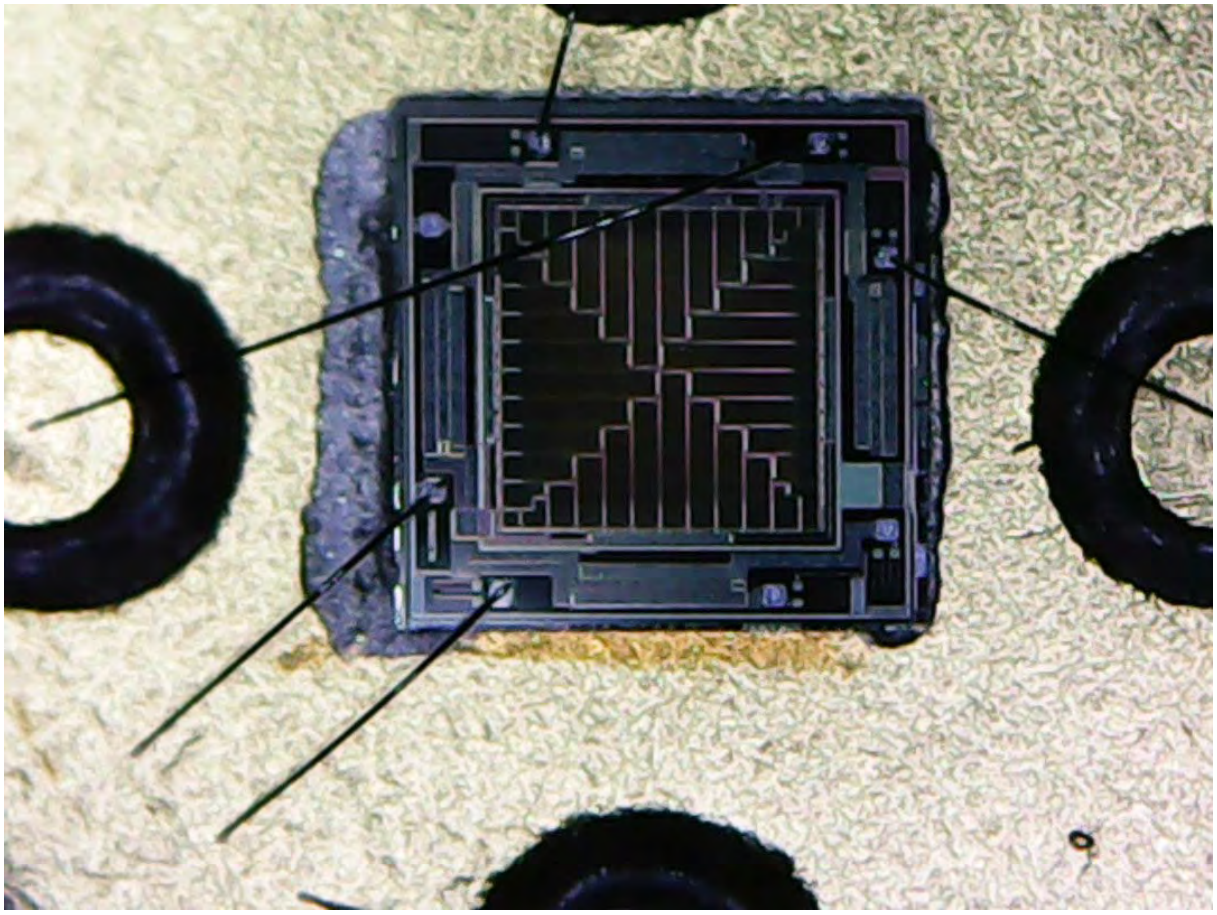

Figure 4. Thermopile sensor (Melexis MLX 90247)

Figure 5. First surface parabolic mirrors

Figure 6. Lenses for the 30THz band. From left Germanium, Zinc selenide, High-density polyethylene (HDPE)

Figure 7. Visible light Fresnel lenses (PMMA), opaque for 30THz (left), and Thermal Fresnel lenses (HDPE), transparent for 30THz (right)

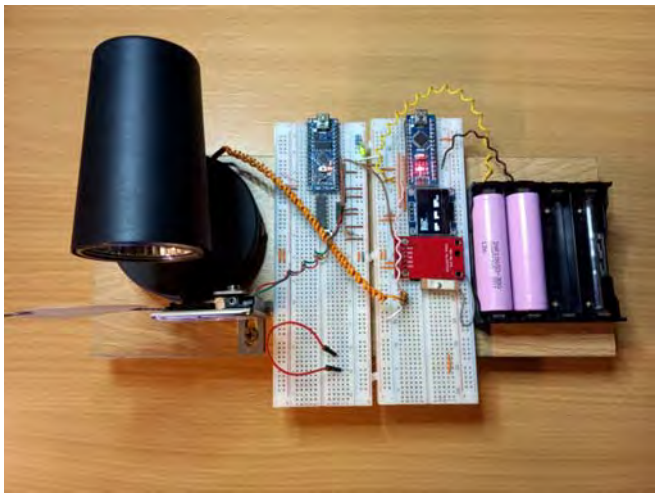

Figure 8. Transmitter

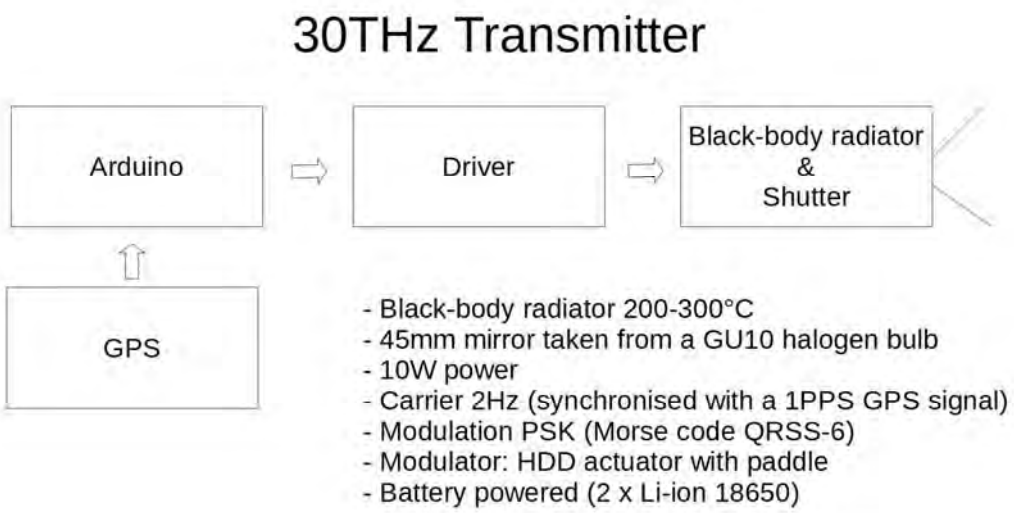


Figure 9. Block diagram of transmitter

Figure 10. Heater inside the mirror from a halogen spot lamp GU10

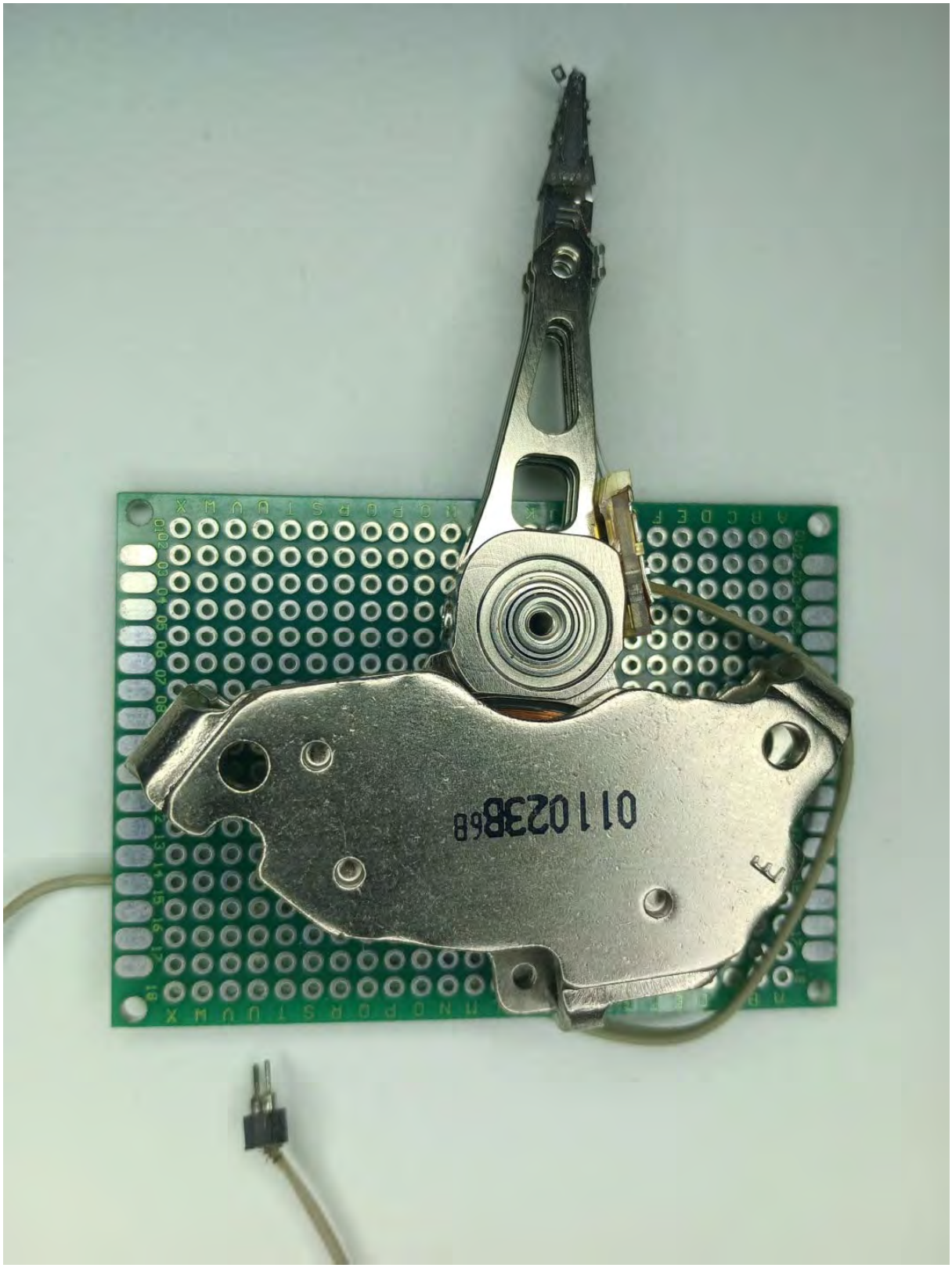


Figure 11. HDD actuator


Figure 12. Heater assembly with paddle mechanical modulator

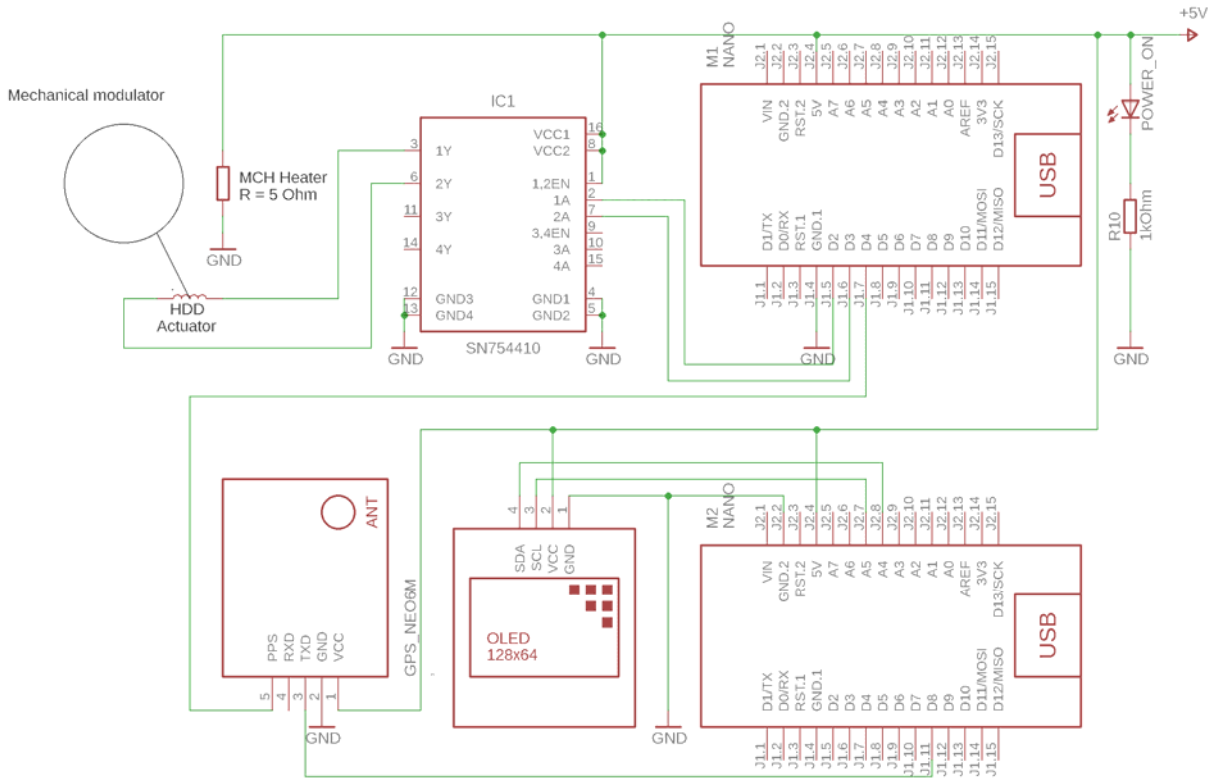


Figure 13. Electric scheme of the transmitter

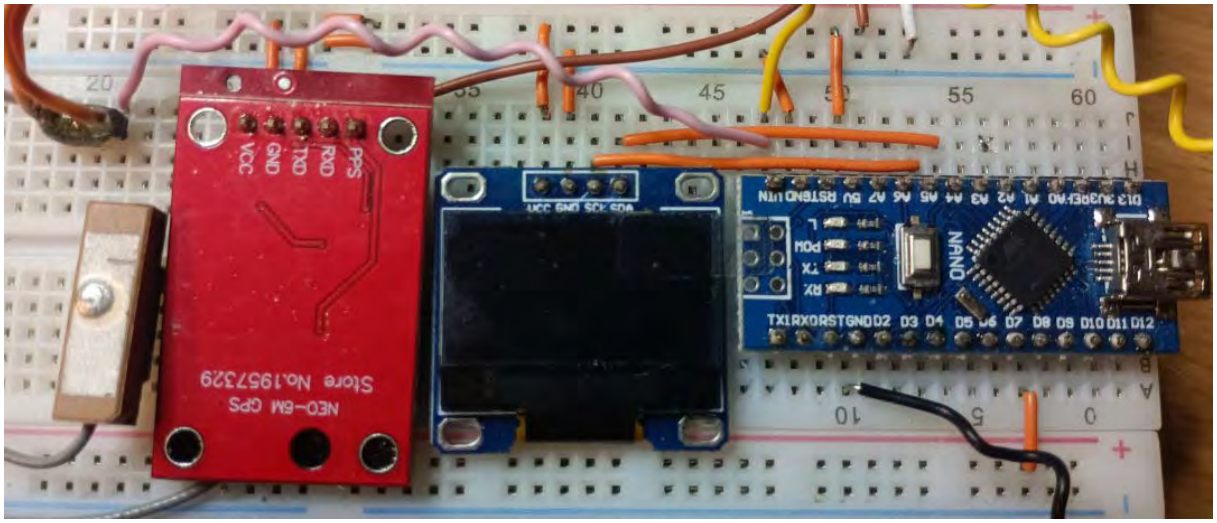


Figure 14. GPS module

Figure 15. Transmitter operating outdoors

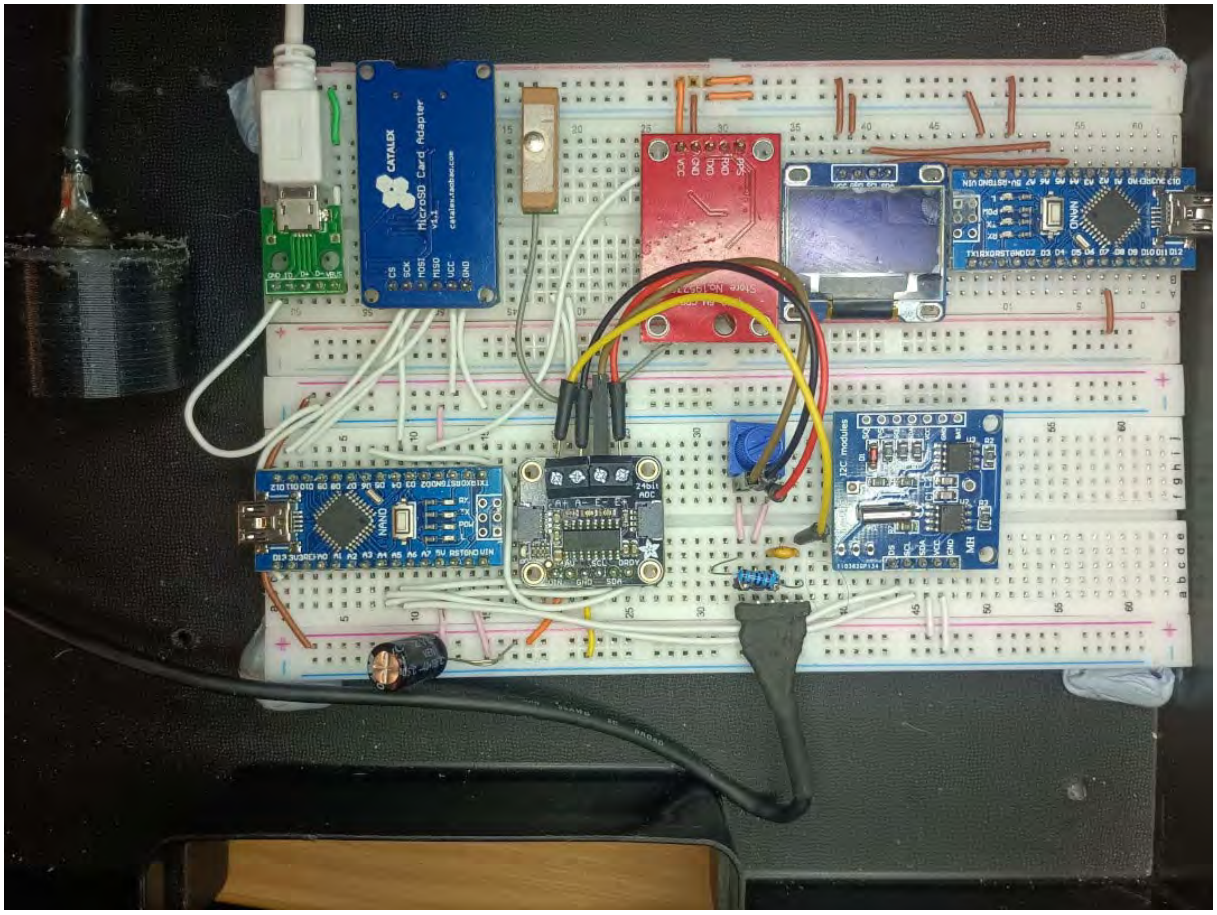


Figure 16. Receiver

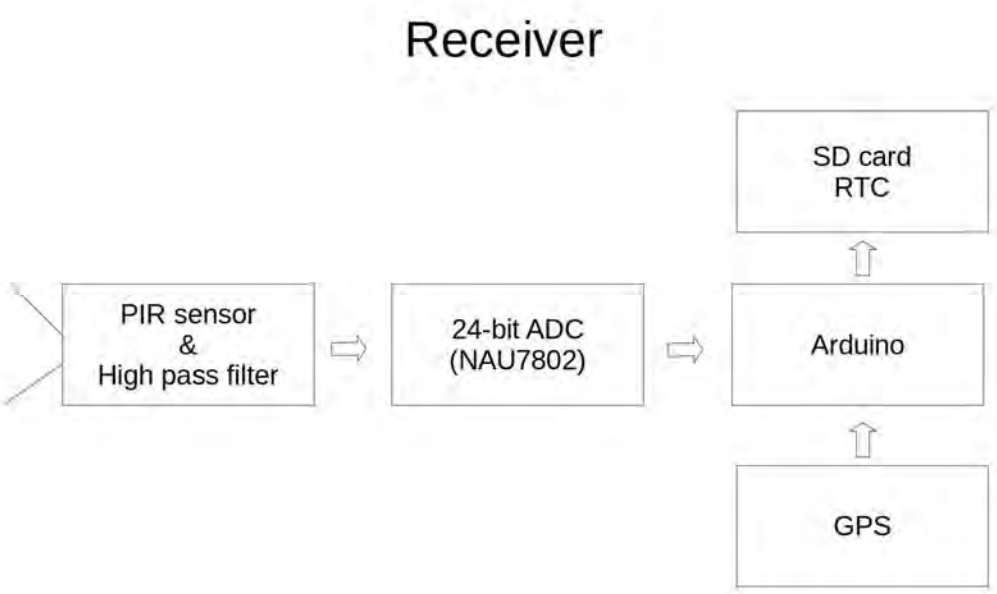


Figure 17. Block diagram of receiver


Figure 18. Celestron FirstScope: Newtonian reflector, mirror diameter 76mm, FL 300mm

Figure 19. The Moon observed by Celestron First Scope

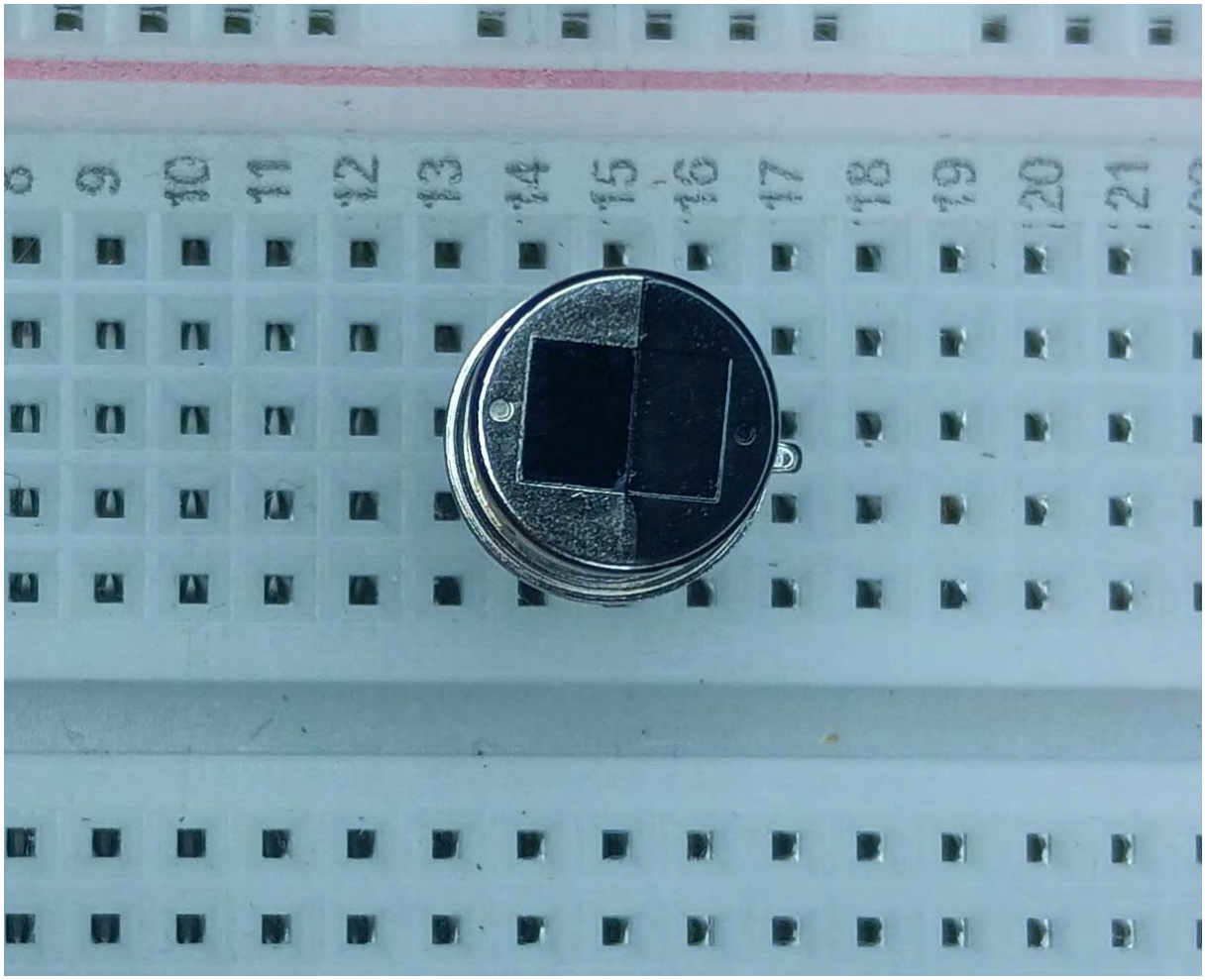

Figure 20. PIR sensor with one pyroelectric crystal blinded using black nail varnish

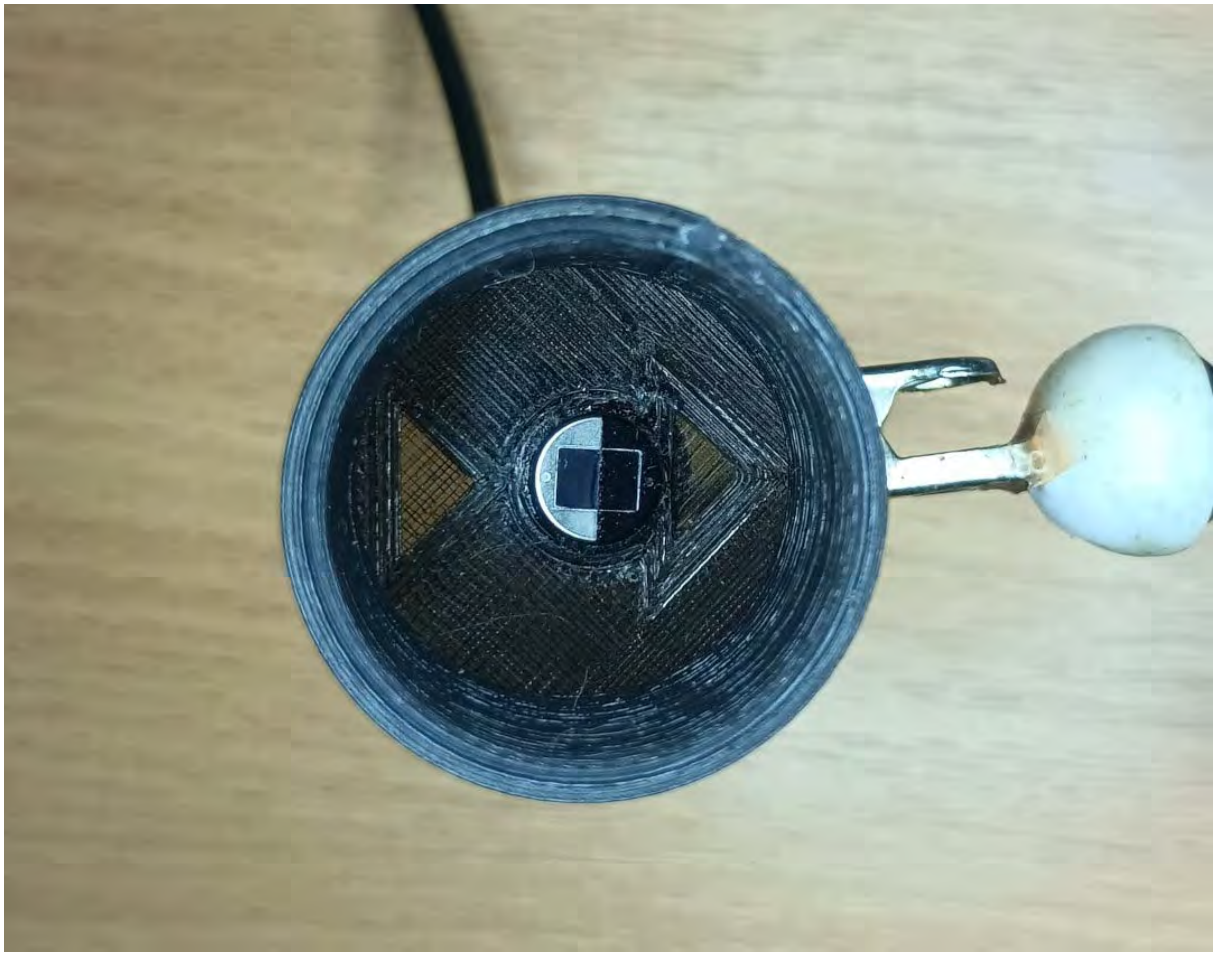

Figure 21. 3D printed "eyepiece" with PIR sensor

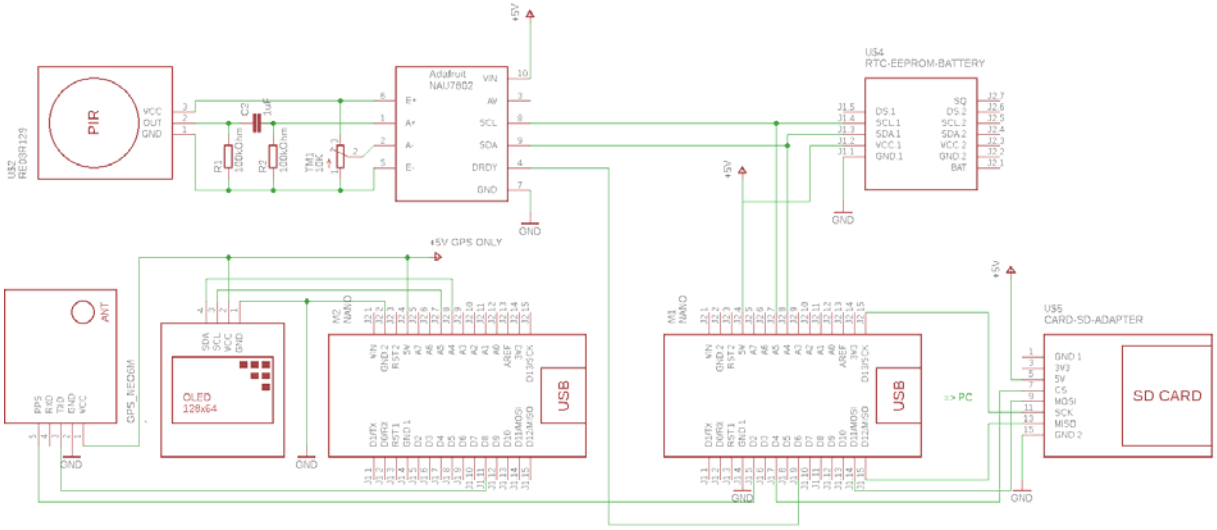


Figure 22. Electric Scheme of receiver

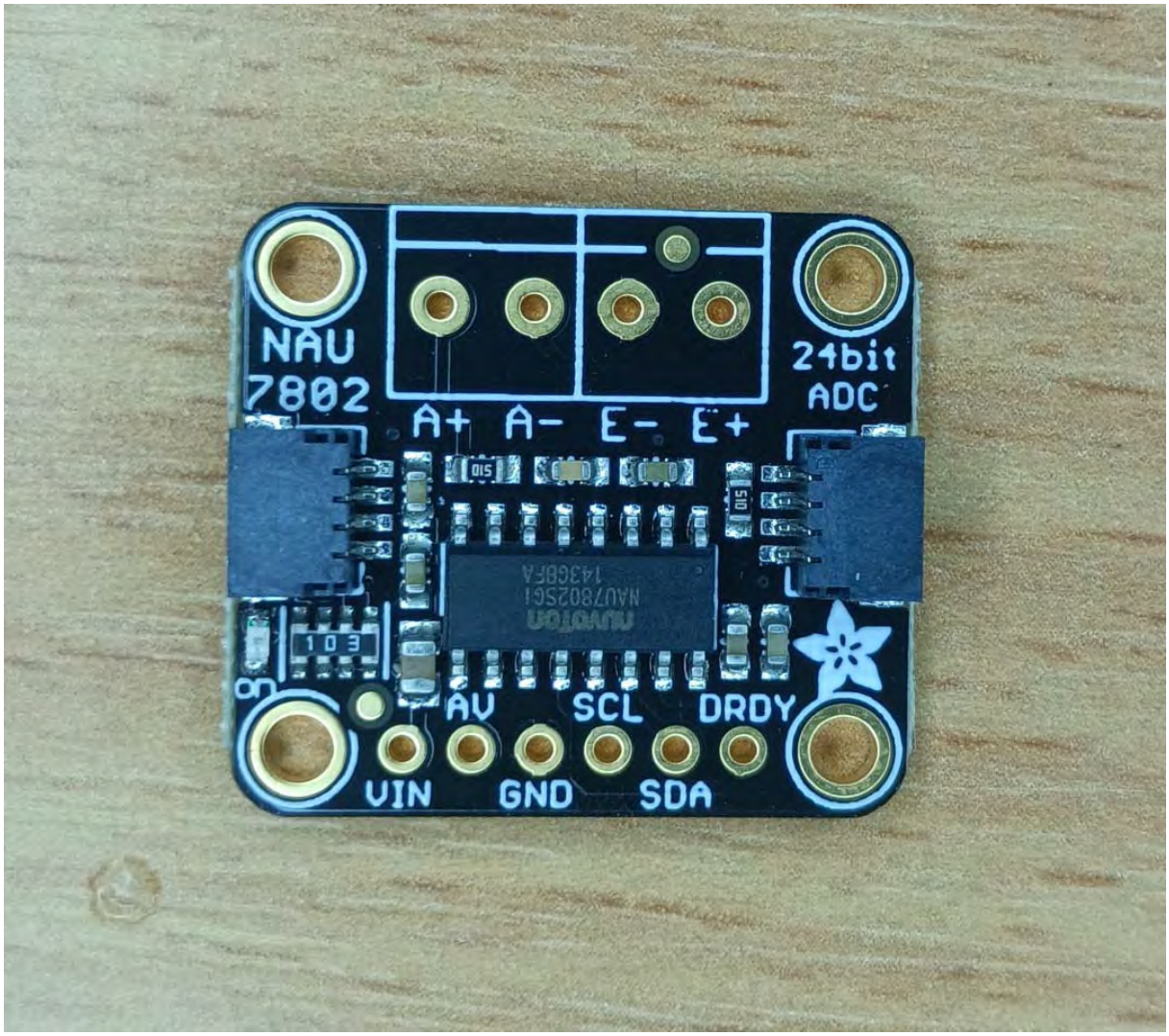


Figure 23. NAU7802 24-bit ADC Adafruit module

Figure 24. Geodesic Tripod with receiver


Figure 25. GPS Map 62ST


Figure 26. Celestron FirstScope with video camera

Figure 27. The transmitter observed through Celestron FirstScope with a video camera - distance 109m


Figure 28. Geodesic tripod levelling screws


Figure 29. Transmitter and Receiver on Google map

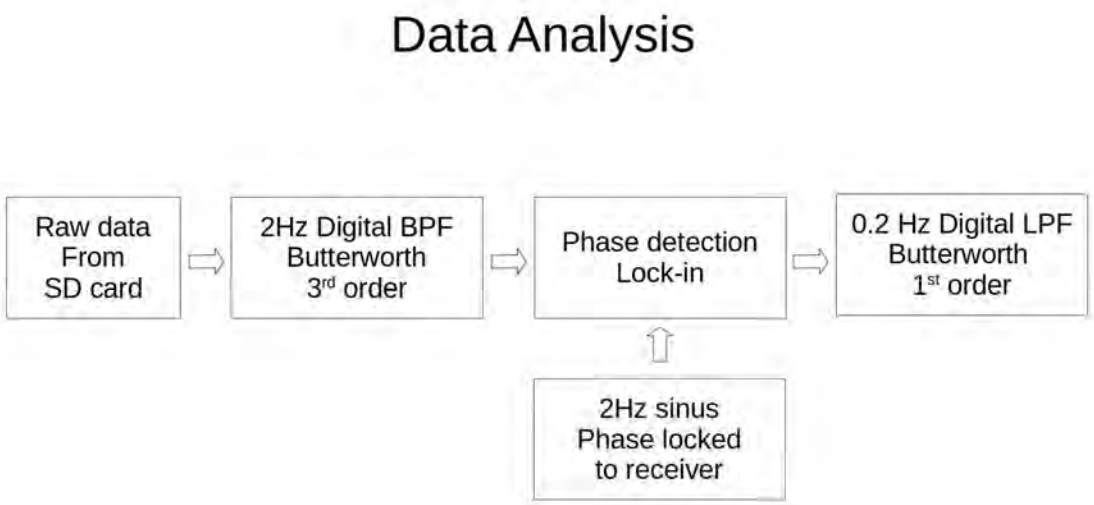


Figure 30. Block diagram of signal analysis

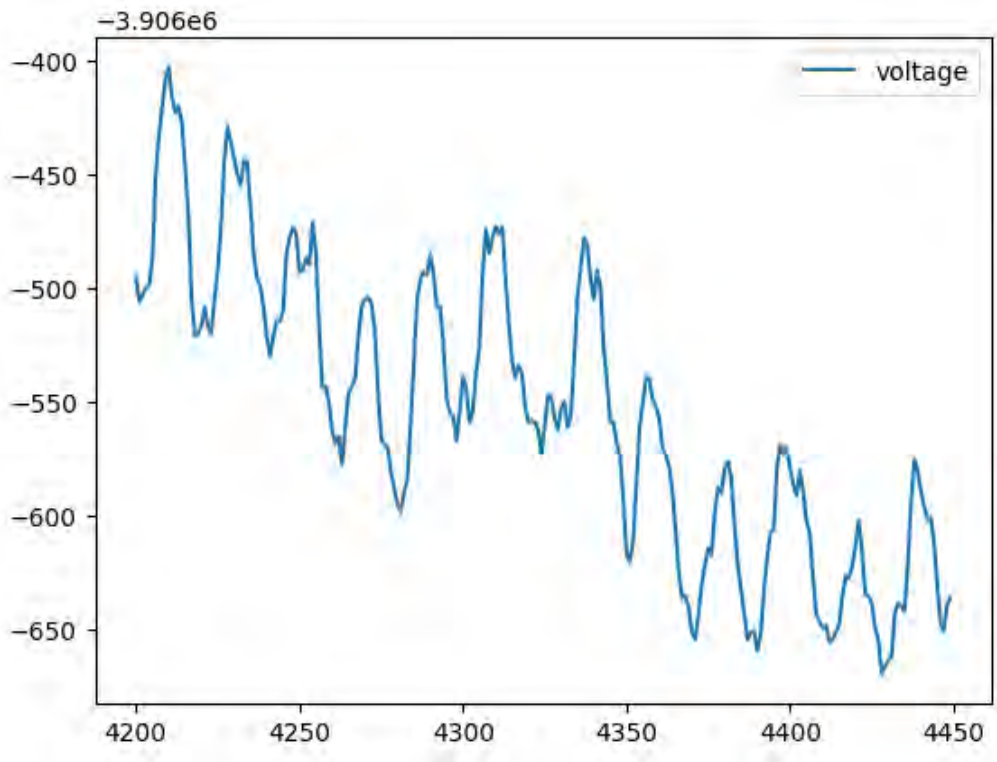


Figure 31. Sample of the raw recorded signal – distance 109 metres

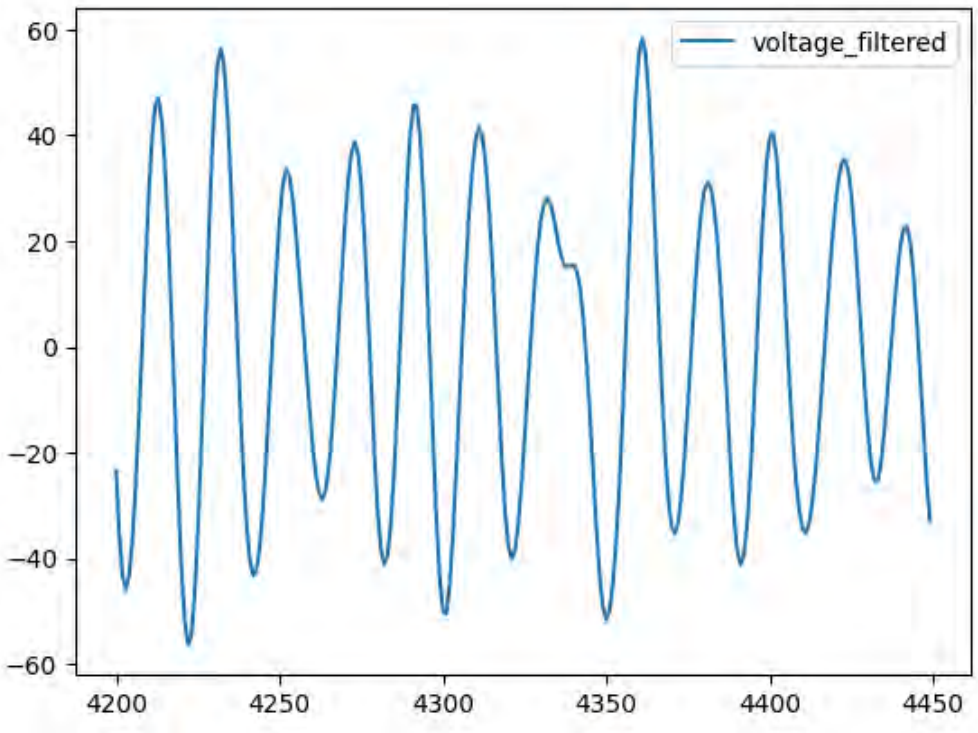


Figure 32. Signal after digital Butterworth bandpass filter (3rd order, 2Hz centre) – distance 109 metres

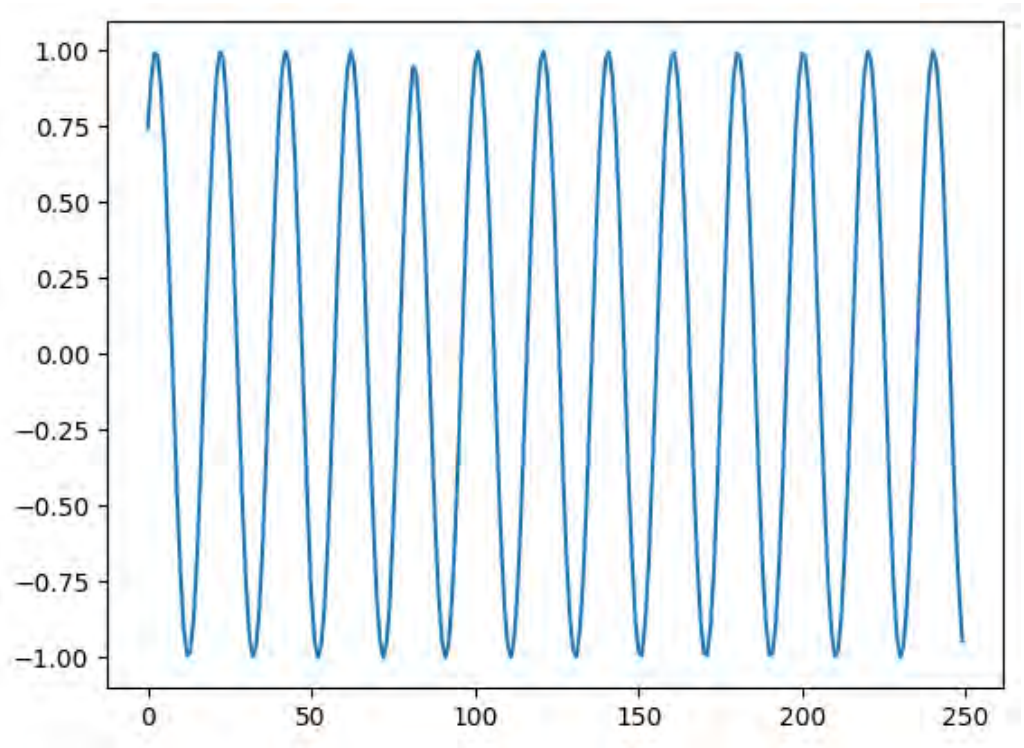


Figure 33. 2Hz sinusoidal signal

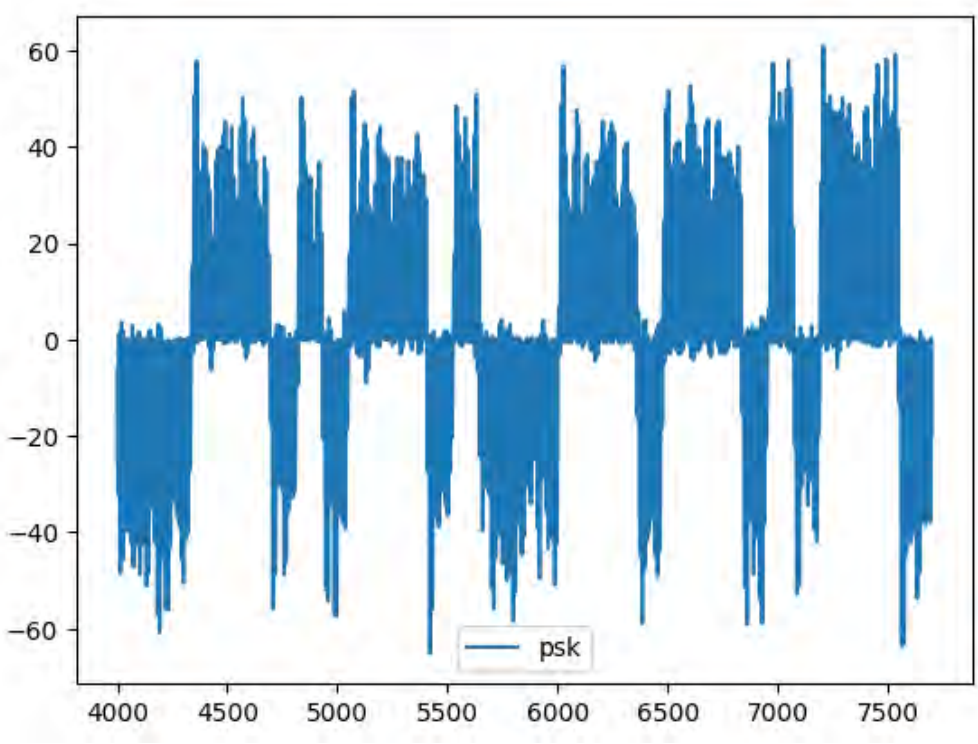


Figure 34. Phase locked detection; Signal from Fig. 32 multiplied by 2Hz signal from Fig . 33 – distance 109 metres

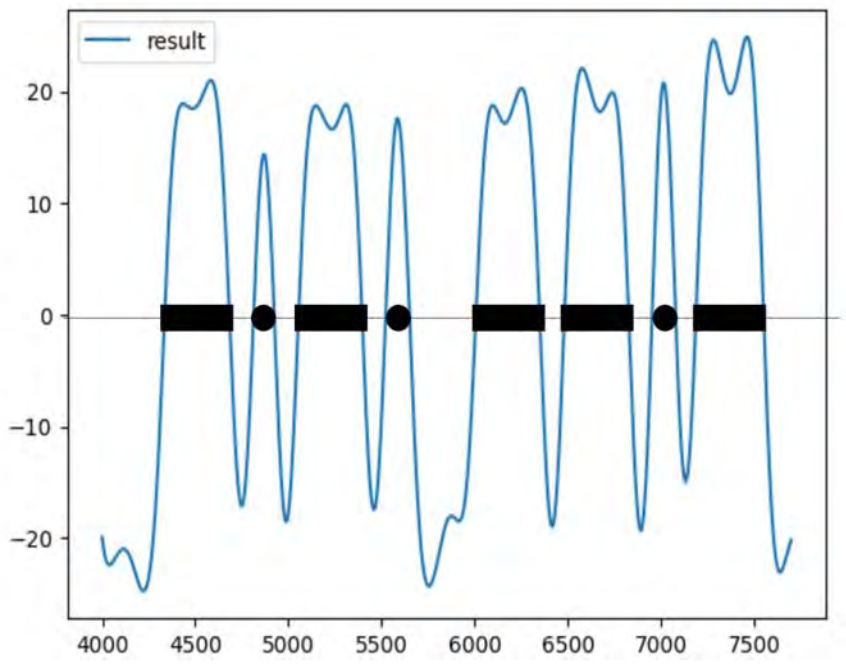


Figure 35. Decoded message: "CQ" (-.-. --.-) – distance 109 metres

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***Companion online document***

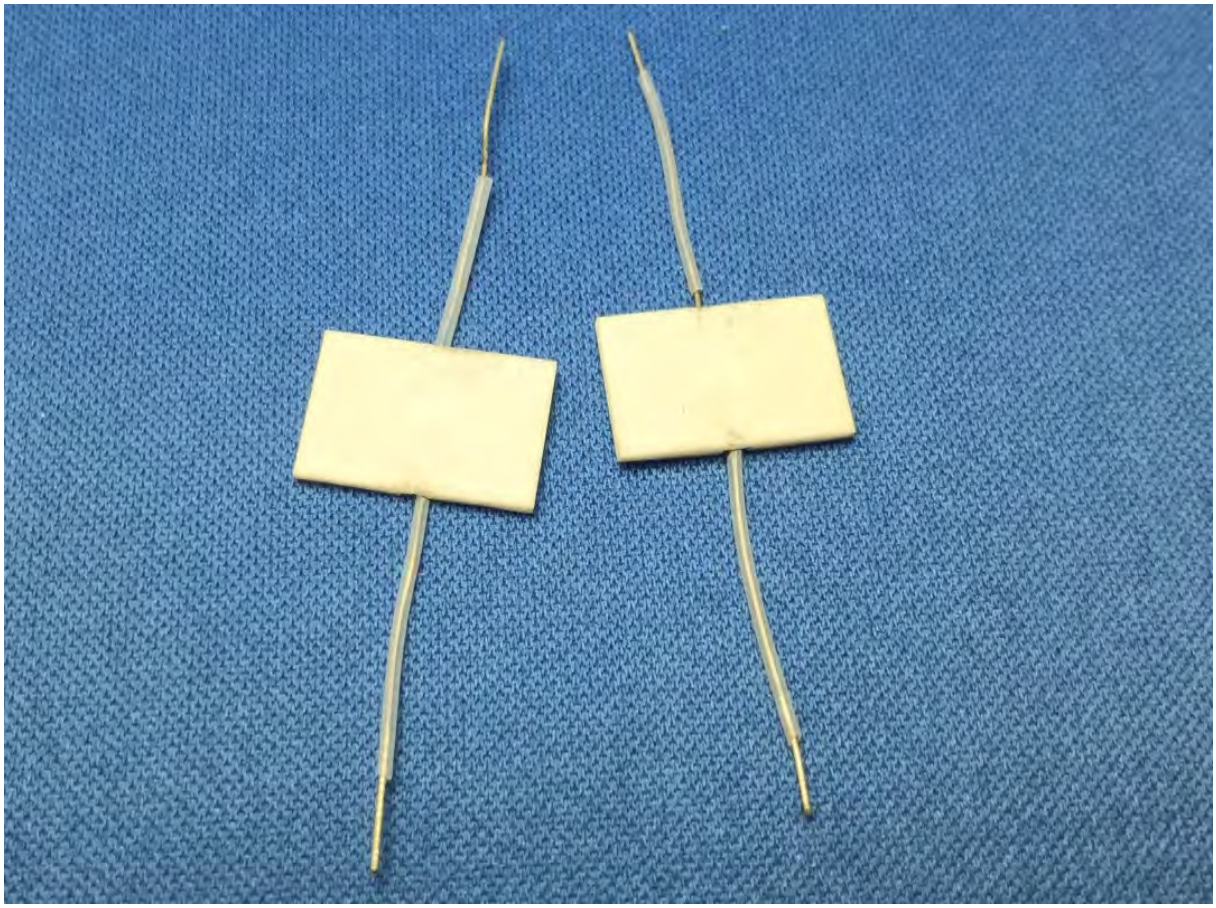

Figure 1. Resistive ceramic heaters

**Abbreviations:**

THz - Terahertz
GPS – Global Positioning System
OFCOM – Office of Communication (UK)
LWIR – Long Wavelength Infrared
CO2 – Carbon Dioxide
HDPE – Hard-Density Polyethylene
DIY - Do-It-Yourself
PMMA – Poly(methyl methacrylate)
MCH – Metal Ceramic Heater
SiO2 – Silicon Dioxide (silica)
HDD – Hard Disk Drive
QRSS-6 – Ultra Slow Speed Continuos Wave Modulation
PSK-31 – Phase Shift Keying 31 baud
FT8 – Frank-Taylor 8 modulation
OLED – Organic Light-Emitting Diode
PIR – Passive Infrared (sensor)
ADC – Analogue-to-Digital Converter
RTC – Real Time Clock
SD – Secure Digital (memory card)
PC – Personal Computer
HPF – High Pass Filter
LPF – Low Pass Filter
BPF – Band Pass Filter
CW – Continuous wave (modulation)
FLIR – Forward Looking Infrared (thermal camera)
MCT – Mercury Cadmium Telluride (sensor, known also as HgCdTe)