From Si4732 Mini-Radio to ARDF Champion!

ORA (Opwijkse Radio Amateurs)

11 September 2026

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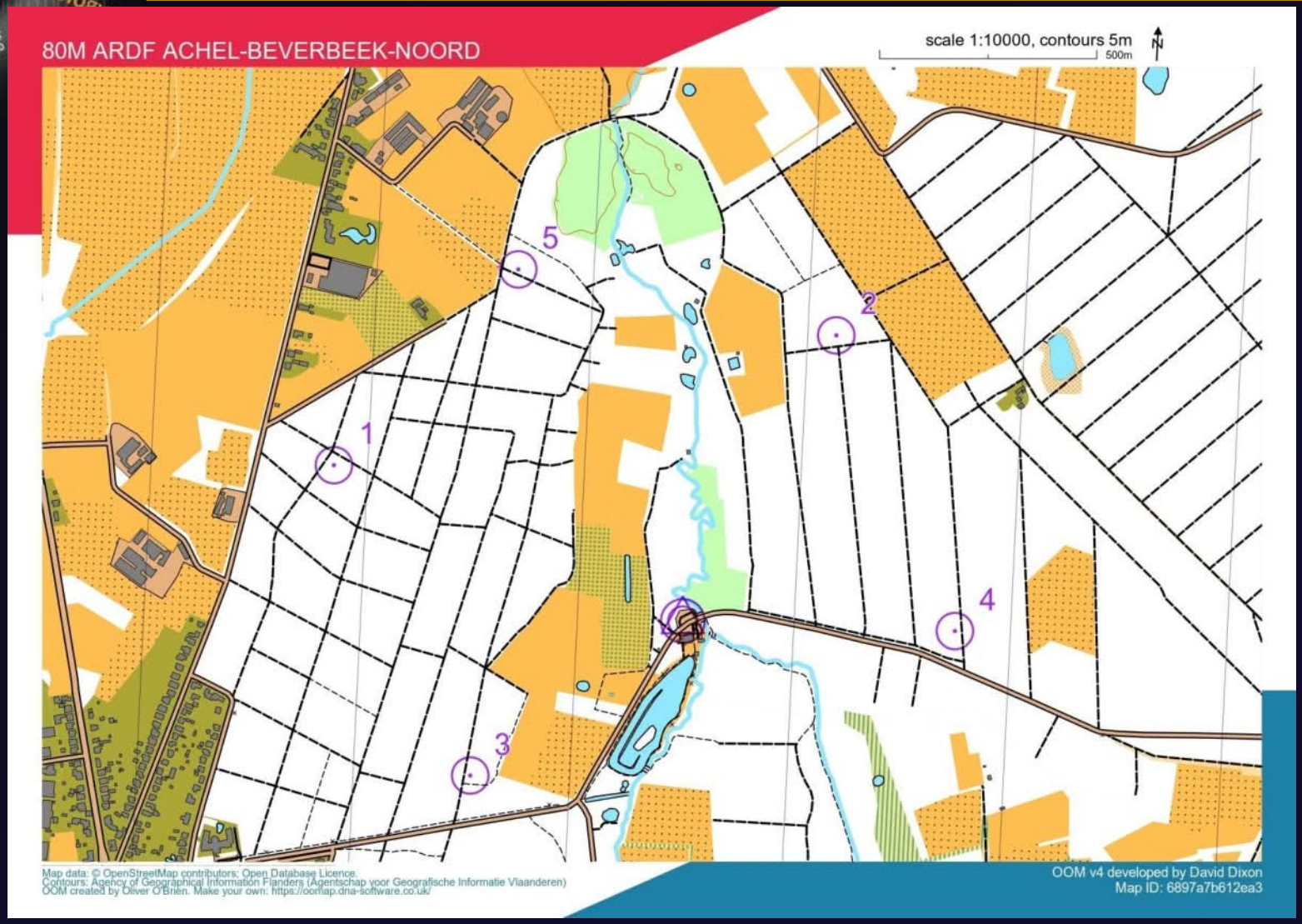
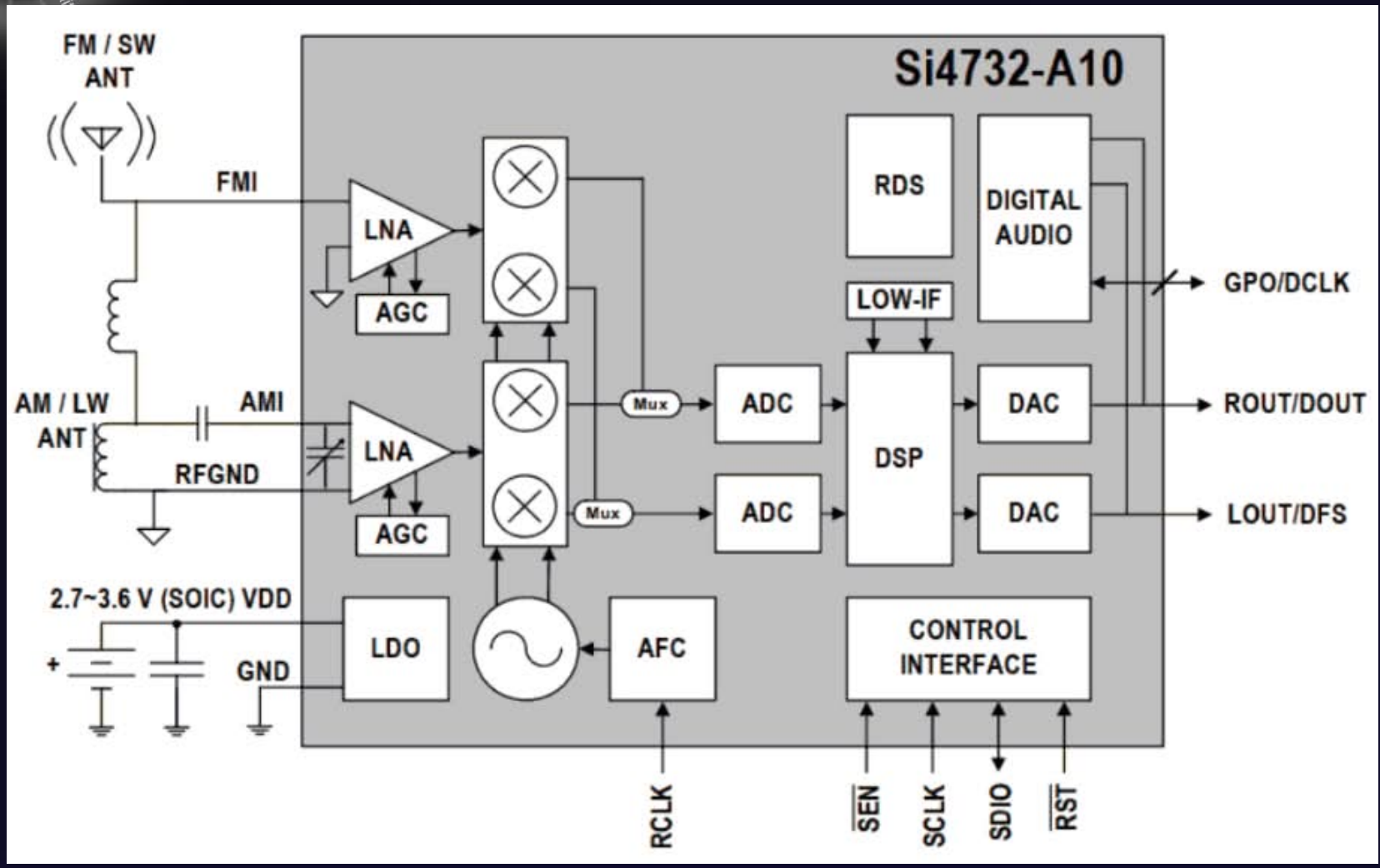
ON4CHE

What is ARDF?
5 foxes, 5-minute cycles



Si4732 mini-radio

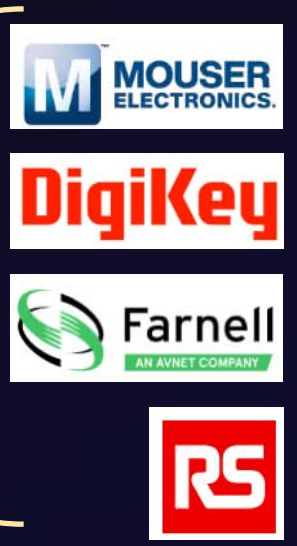
Si4732


Si4732-A10
FM / SW ANT
FMI
AM / LW ANT
AMI
RFGND
LNA
AGC
LNA
AGC
Mux
Mux
ADC
ADC
DSP
RDS
DIGITAL AUDIO
LOW-IF
DAC
DAC
GPO/DCLK
ROUT/DOUT
LOUT/DFS
2.7~3.6 V (SOIC) VDD
+
GND
LDO
AFC
CONTROL INTERFACE
RCLK
SEN
SCLK
SDIO
RST

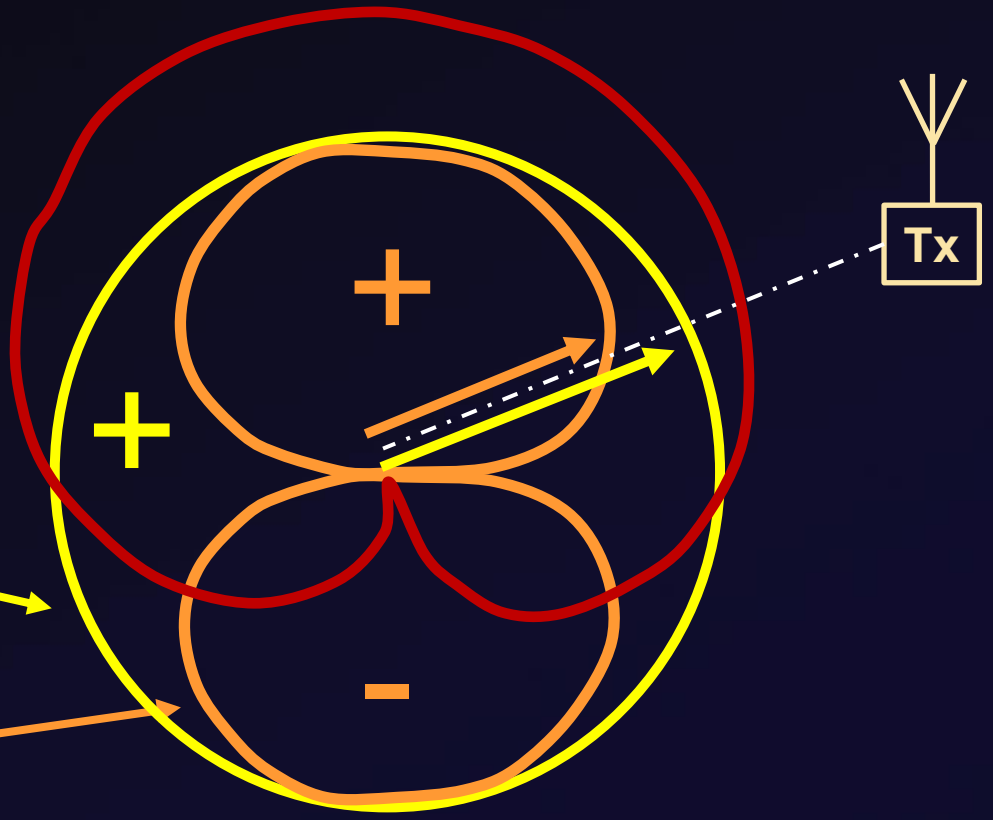
ARDF
(Amateur Radio Direction Finding)

From Si4732 Mini-Radio to ARDF Champion!

- Easy to replicate
- Uses active components
- Hand-solderable
- Low-cost (entry model)
- Sensitive
- Excellent direction-finding characteristics
- Lightweight and battery-powered



80m band (3,5MHz)
E and H - field



- E-field and H-field
- Received signal (polar diagram) of the
  - Sense antenna (yellow) – E-field
  - Loop antenna (green) – H-field

ARDF Receiver – Principle

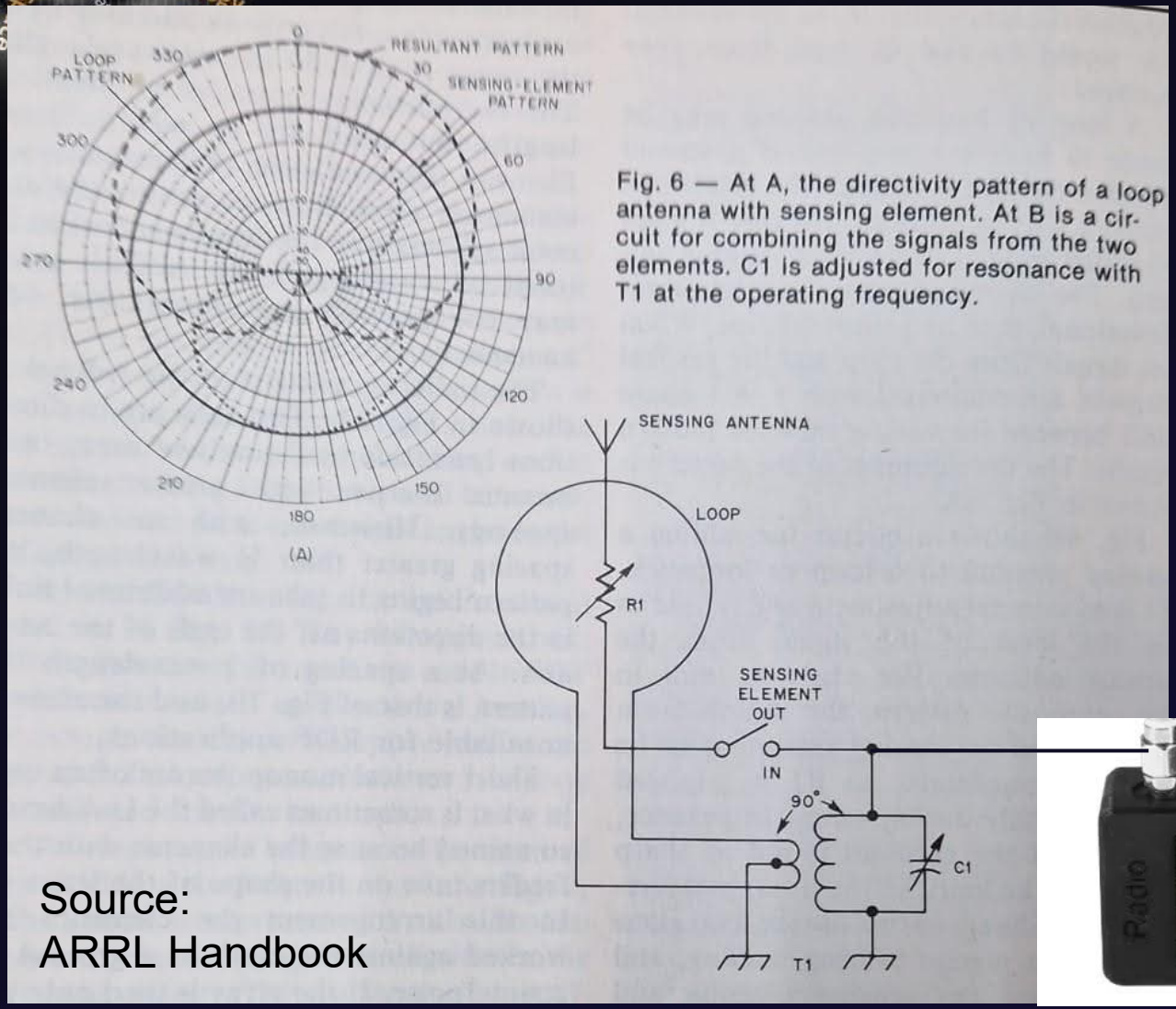


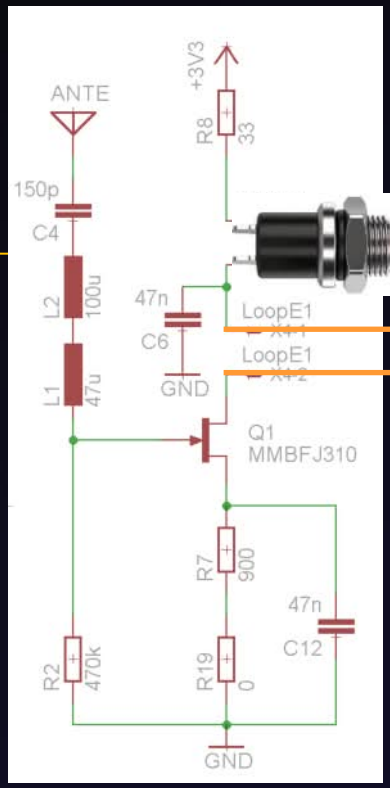
Fig. 6 — At A, the directivity pattern of a loop antenna with sensing element. At B is a circuit for combining the signals from the two elements. C1 is adjusted for resonance with T1 at the operating frequency.

Source:
ARRL Handbook

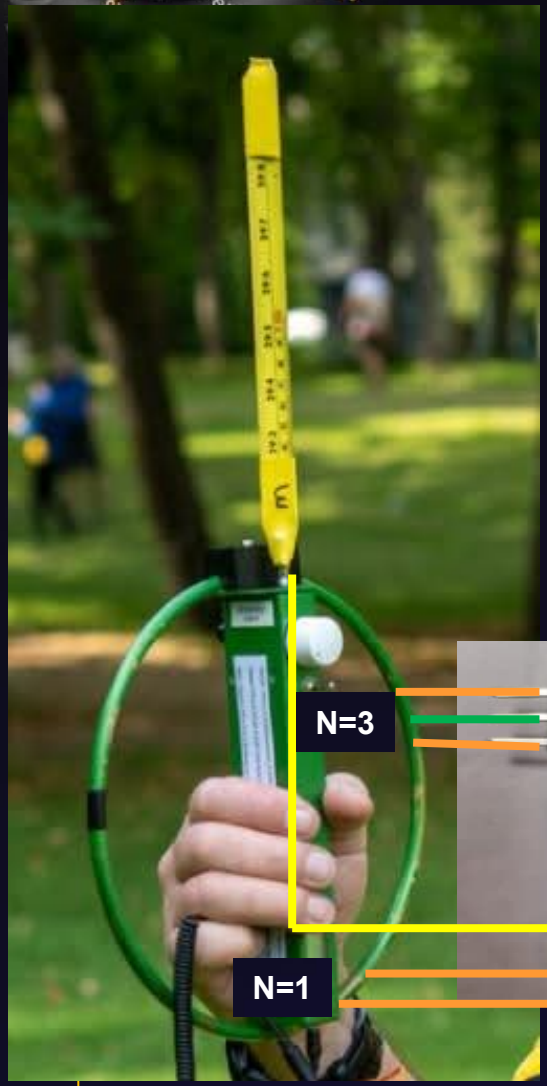
- Loop is coupled symmetrically
- Sense is coupled asymmetrically

ARDF Receiver

Minimal Implementation



N=1



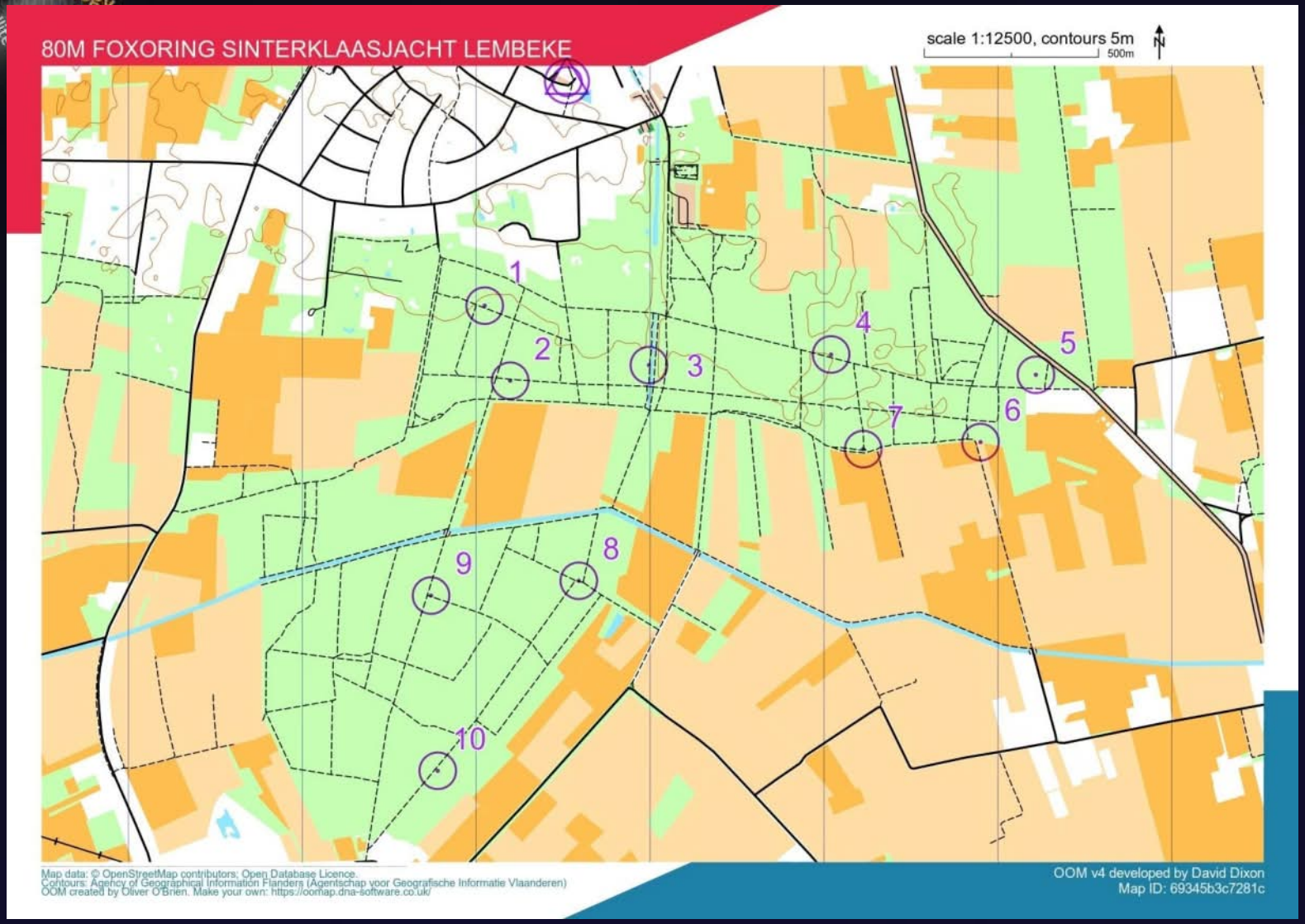
ARDF receiver

Construction

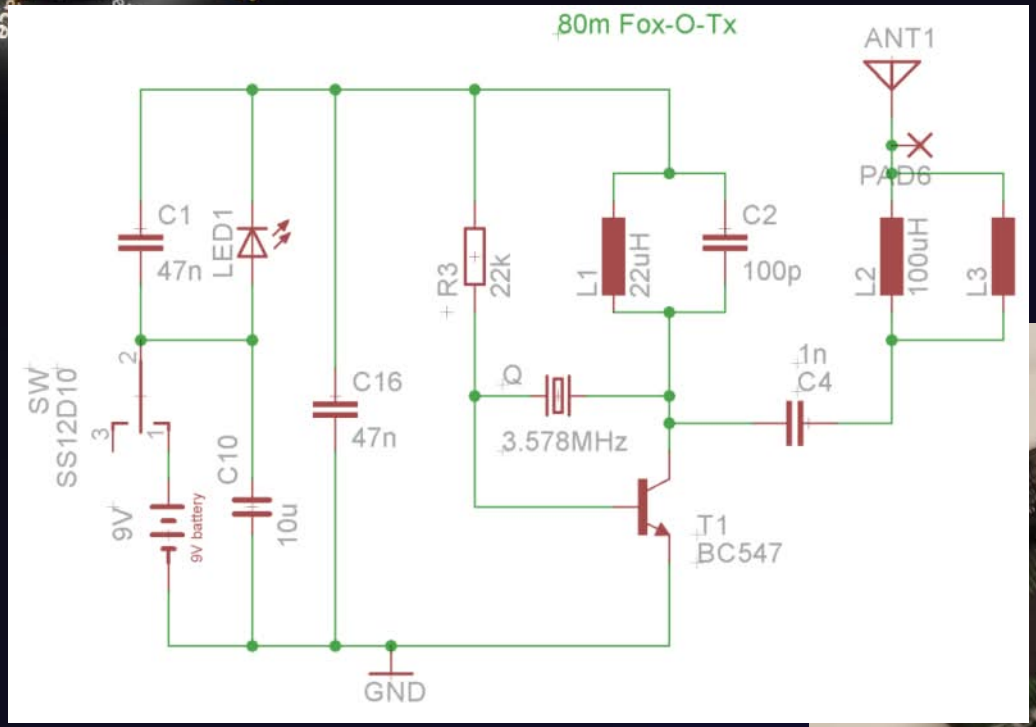
80m Fox-o-Ring

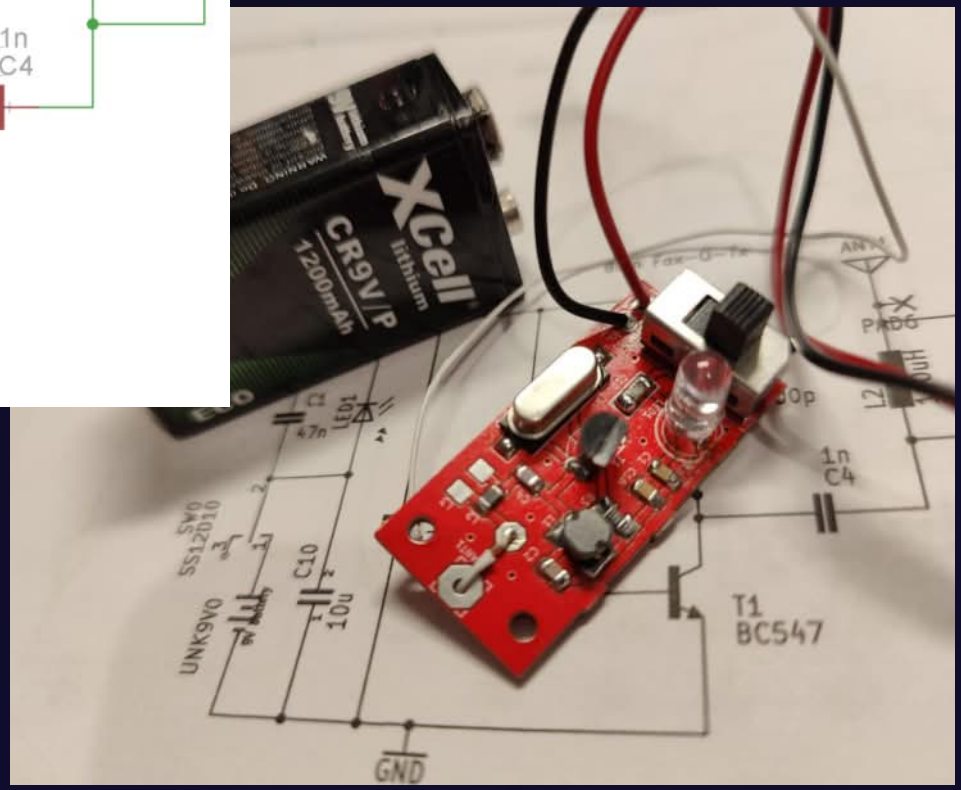
Continuous signal within a radius of <100 m

, Power of tens of milliwatts



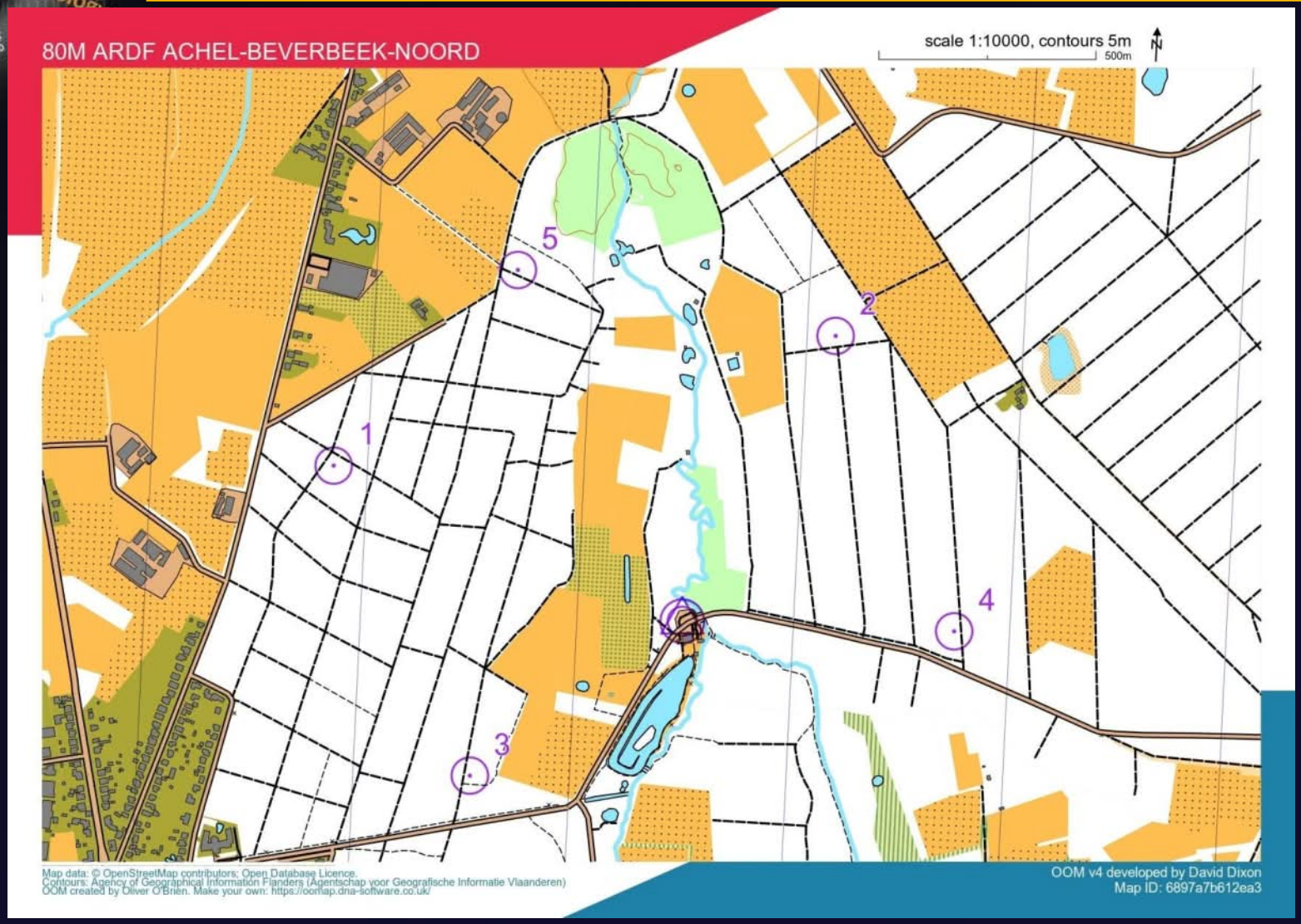
ARDF zender (Fox-o-ring, low power)





80m ARDF Classic

Distances up to 4 km, Transmitters 1 W to 5 W



Minimal Implementation

Tx = 1,5W

Usable range:

- 75 m – 2500 m
  Very clear minimum and very sharp null

Not Usable:

- < 75 m → signal too strong,
  min/max hard to hear
- 2500 m → no signal with 19 cm loop, balun ¼, Ali balun and wire wrap wire.

First Challenge (>2500 m): Increase Sensitivity

$$V_{\text{loop}} = N \cdot A \cdot 2\pi f \cdot B$$

Passive option:

- Increasing **turns** → more signal
- Increasing **area** → more signal
- Higher **frequency** → more signal, but frequency is fixed
- Stronger **magnetic field** → more signal, means closer to the fox

Active option:

- Preamplifier

Sensitivity Measurement

- Helmholtz Coil.

$$H = 0{,}72 * I * N / R$$

U	0,1 µV	0,2 µV	0,5 µV	1 µV	2 µV	5 µV	10 µV
H	3,3 nA/m	6,6 nA/m	16 nA/m	33 nA/m	66 nA/m	165 nA/m	330 nA/m
E	1,2 µV/m	2,5 µV/m	6,2 µV/m	12,5 µV/m	25 µV/m	62,5 µV/m	125 µV/m

https://df1fo.darc.de/DOC/80mEmpfindlichkeit.doc

Gevoeligheids meting: $B_{ron} = 11{,}5$ dBm

Balun = 1/4

n = 4 D = 24 cm $v_L = -15{,}8$ dBm

D = 25 cm

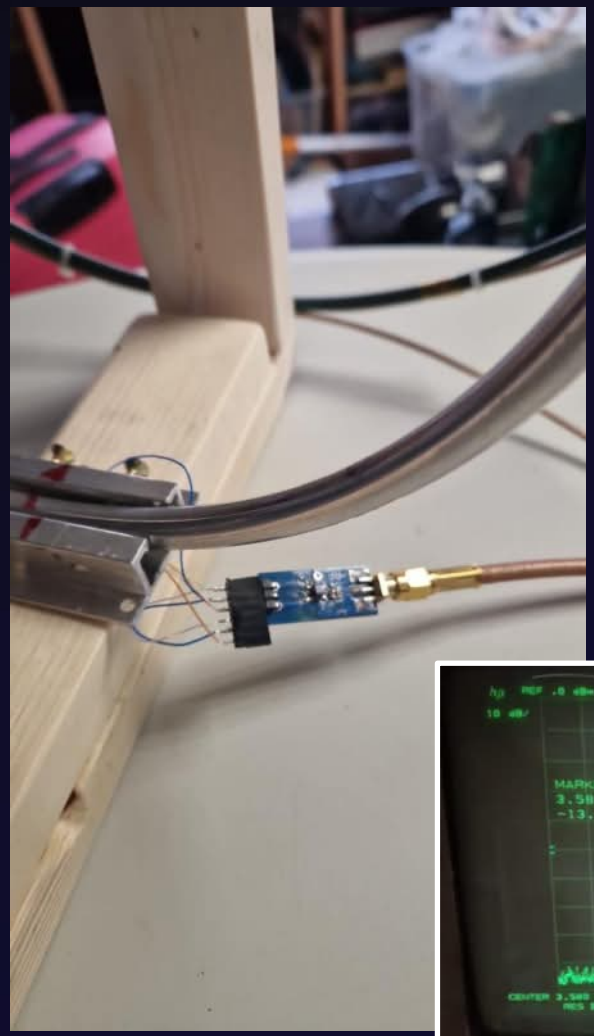
n	v
1	− 16,7 dBm
2	− 13,5 dBm
3	− 13,2 dBm
4	− 14,5 dBm
5	− 16,2 dBm

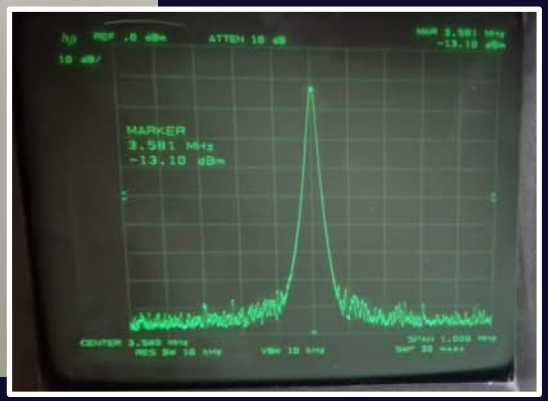
n = 4 D = 27 cm − 16,5 dBm

n = 4 D = 19 cm − 18,6 dBm

n = 4 D = 26 cm

n	v_L
1	− 20,9 dBm
2	− 15,9 dBm
3	− 14,5 dBm
4	− 14,9 dBm

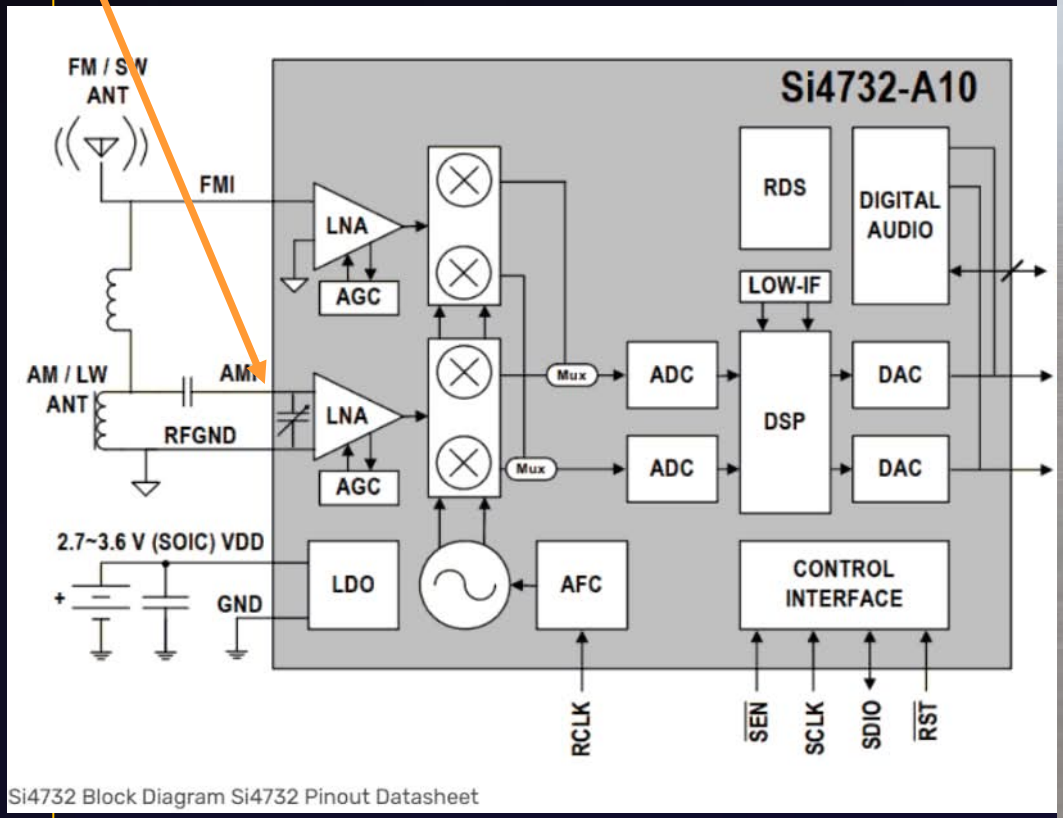




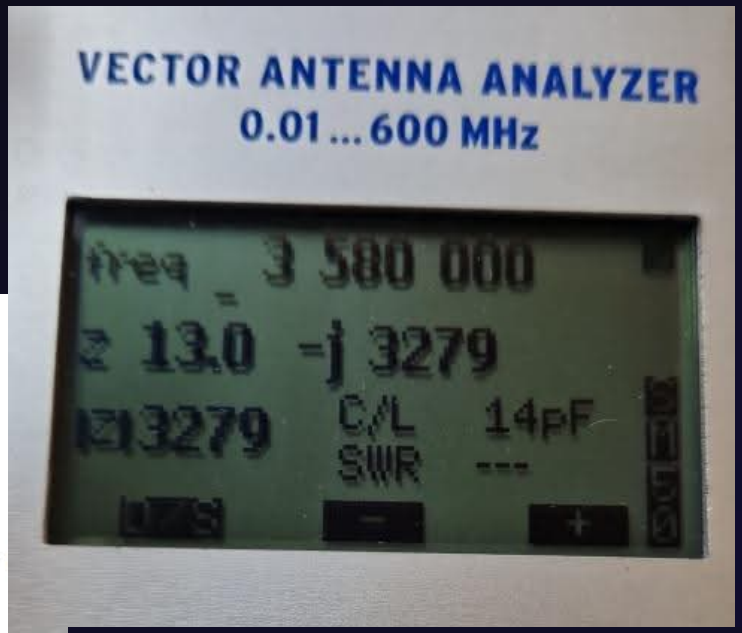
Input Impedance Si4732

(14pF)

$$Z_{AMI} = \frac{1}{2\pi f * 14pF}$$



Si4732 Block Diagram Si4732 Pinout Datasheet



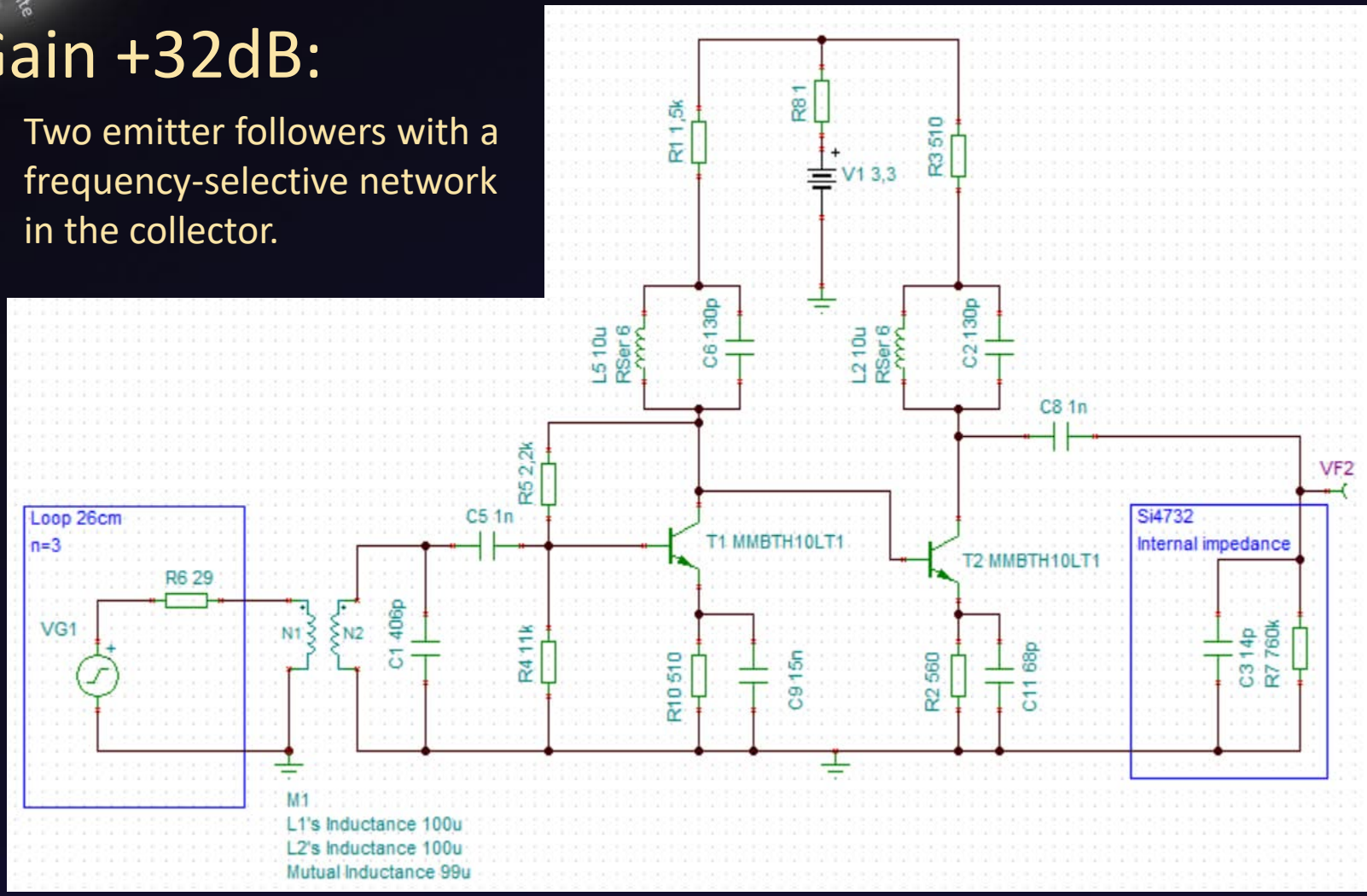
> 2700m

Geen signaal meer.

Active Preamplifier

Gain +32dB:

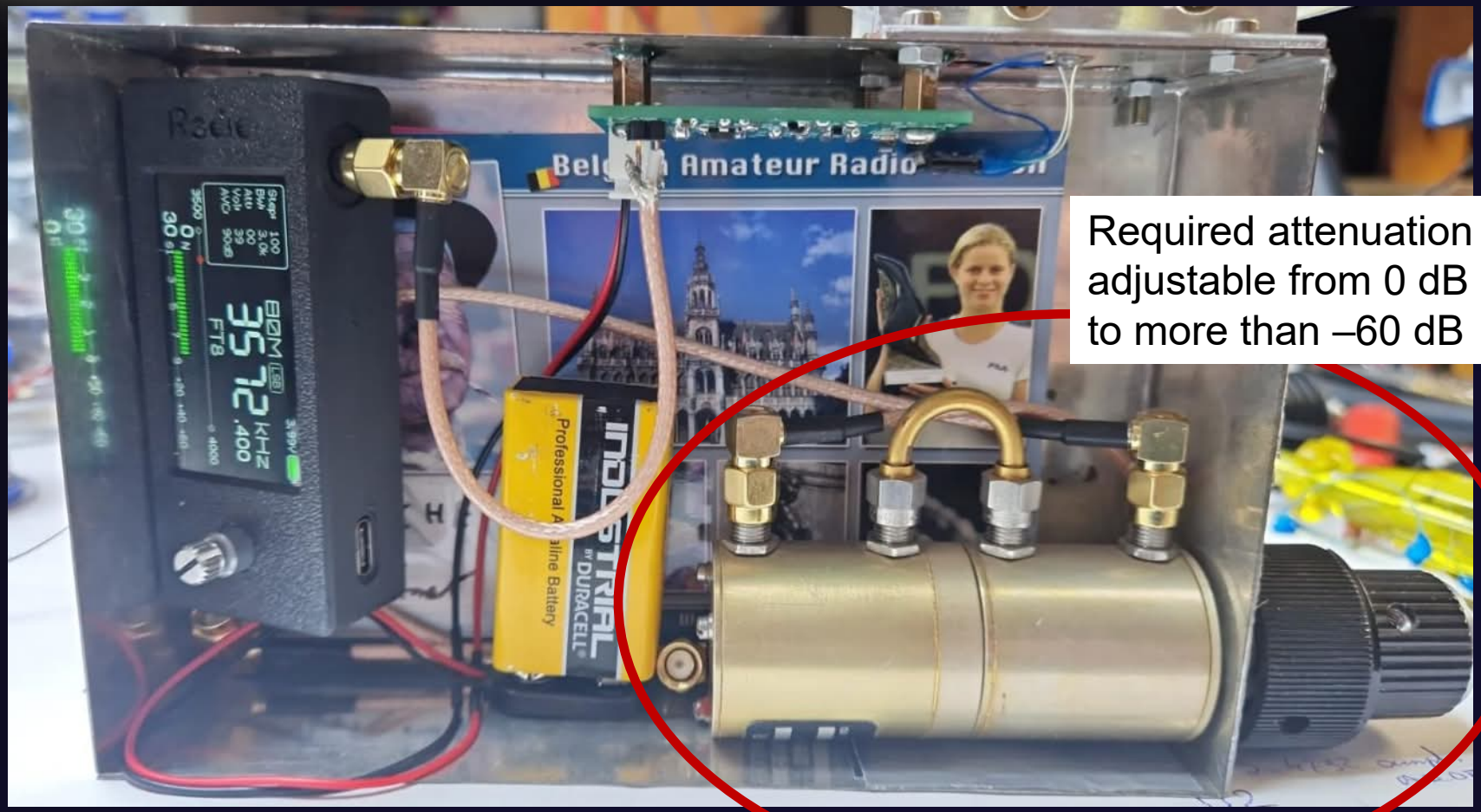
- Two emitter followers with a frequency-selective network in the collector.



Comparative Measurement

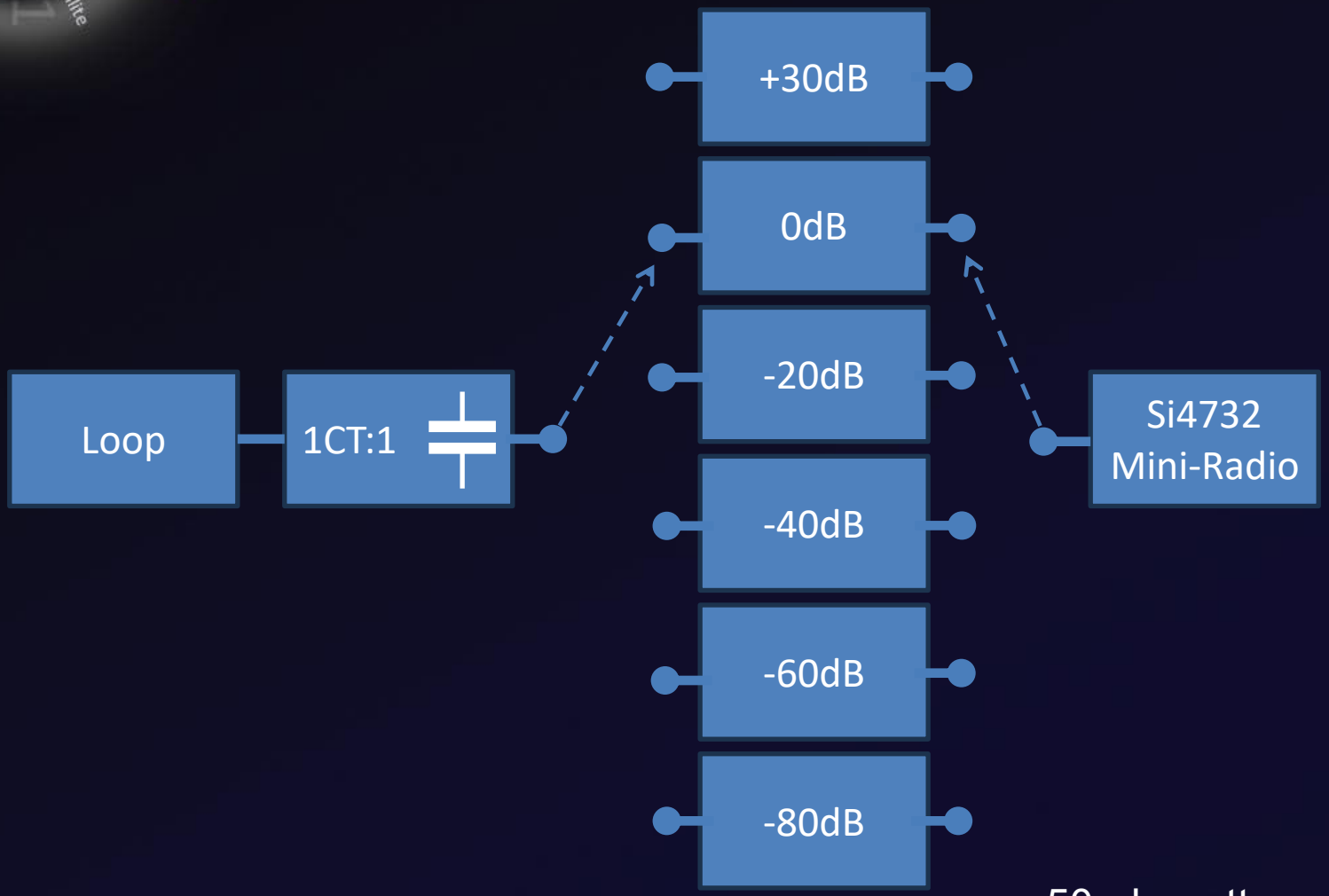
- Tests with preamplifier: > 4,1km

Second Challenge (<75m): Attenuate the Signal



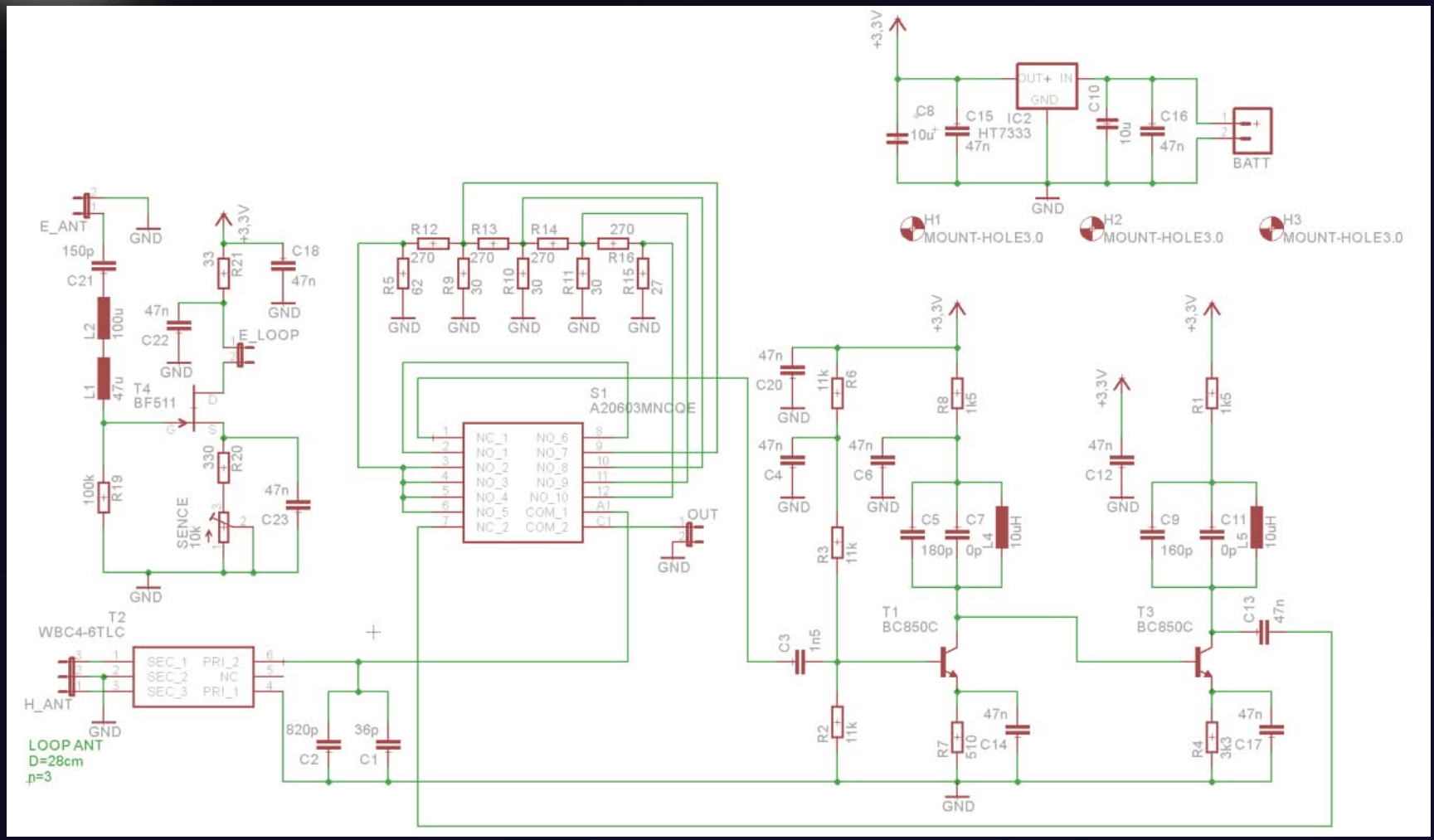
Required attenuation adjustable from 0 dB to more than –60 dB

Block diagram Prototype



50-ohm attenuator

Prototype Circuit



First Milestone Achieved: Successful Prototype

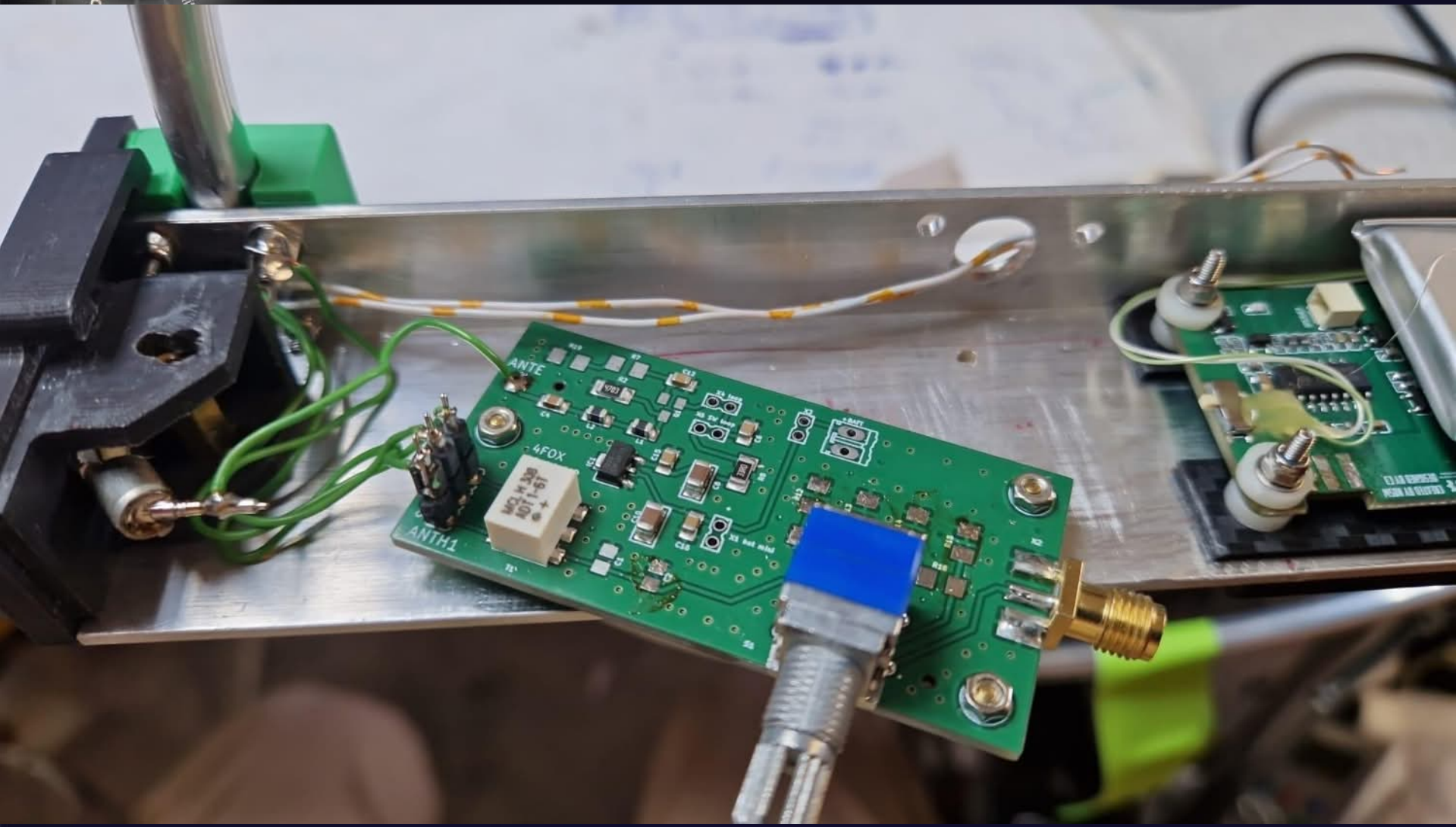
We succeeded in building an ARDF prototype receiver that is:

- Sensitive
- Accurate
- Battery-powered
- Lightweight
- Built with readily available active components
- Hand-solderable

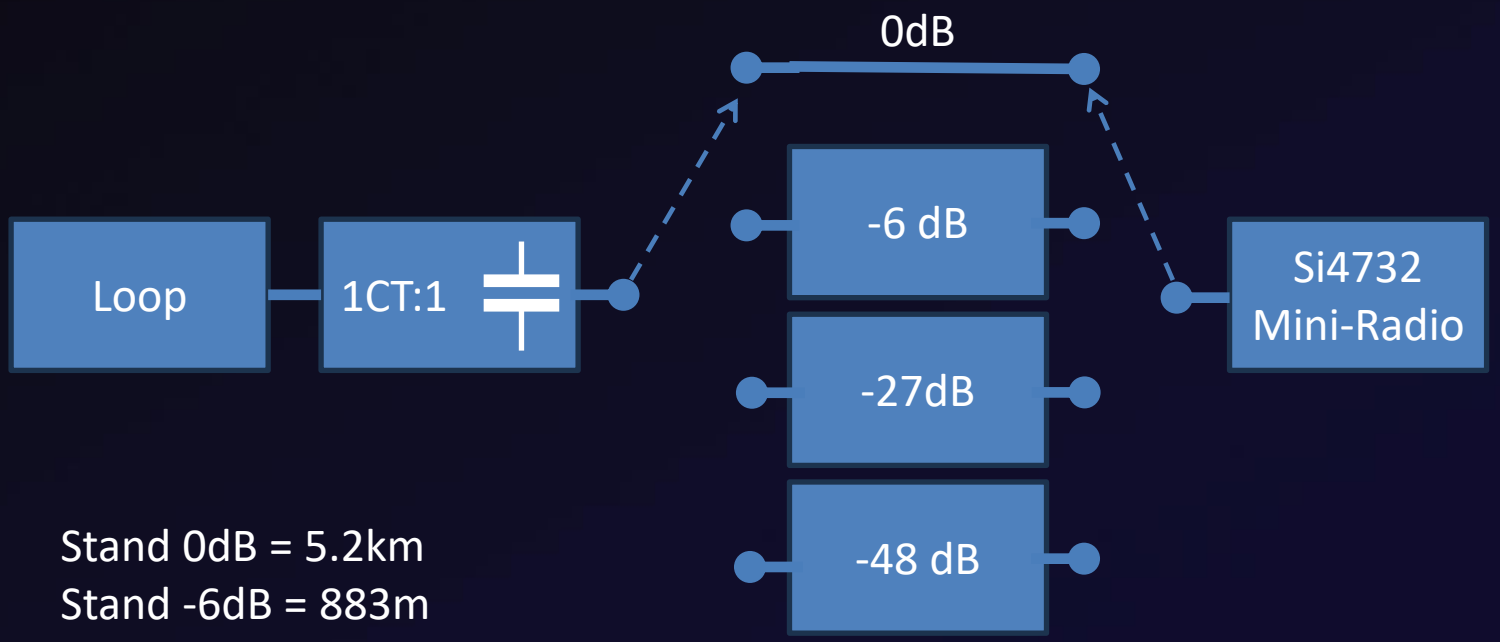
With a PCB & starting from the
low-cost mini-radio with the Si4732.

The “4FOX”

The “4FOX”



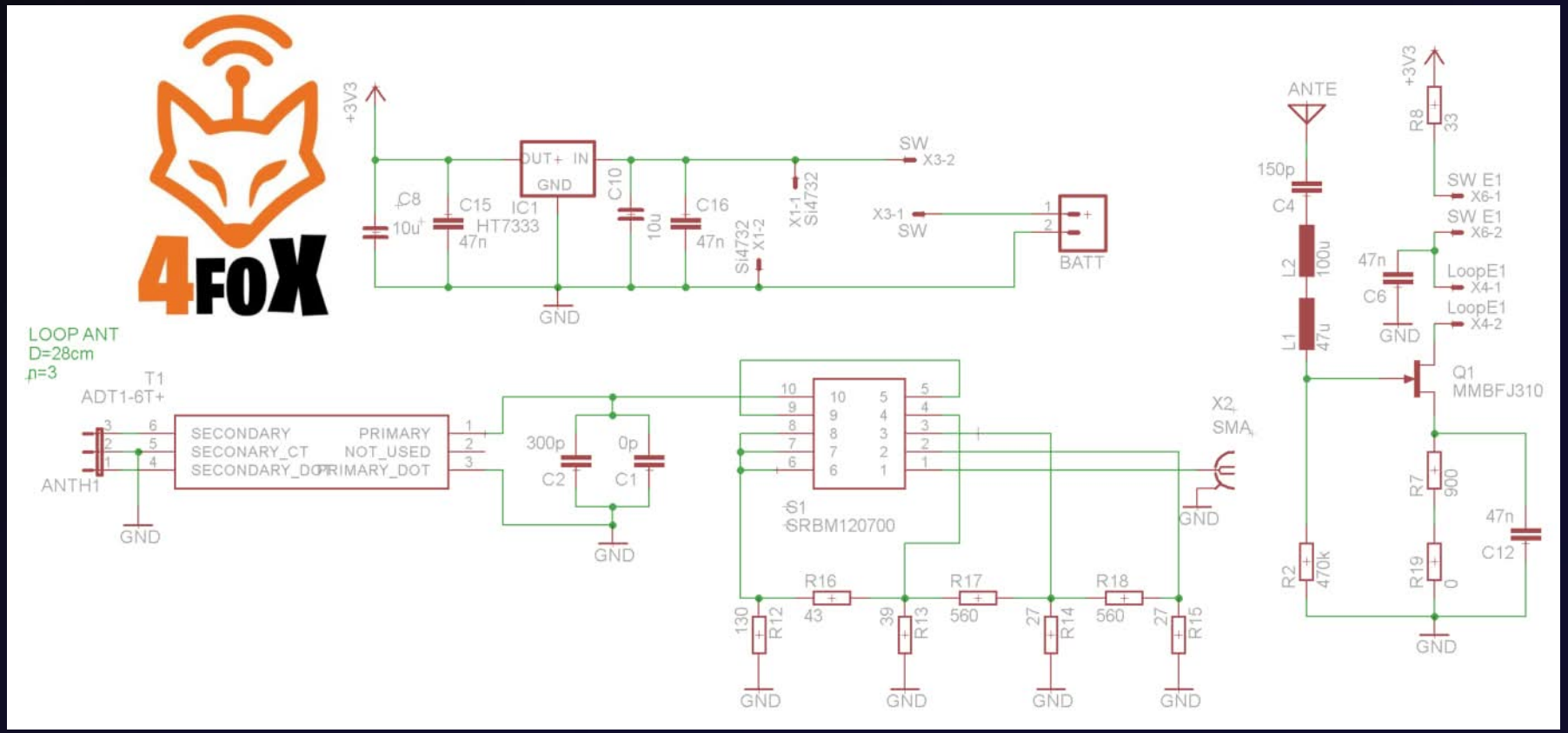
Block diagram - Final version "4FOX"



Stand 0dB = 5.2km
Stand -6dB = 883m
Stand -6dB-21dB = 265m
Stand -6db-21dB-21dB = 33m

50-ohm attenuator

Circuit - Final Version "4FOX"



The “4FOX” Kits are available

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