

Day 2 - Antenna Subsystem Construction & Architecture Initiation

RTL-SDR Signal Processing & Antenna Systems Project

Engineer: Luke Waszyn

12/20/2025

Objective

Design and construct a baseline receive antenna for VHF signal reception, document antenna geometry and assumptions, update the project Bill of Materials to reflect actual hardware status, and initiate the system architecture definition.

Activities Performed

1. Antenna Subsystem Design

1.1 Antenna Selection

- Selected a half-wave dipole antenna as the baseline receive antenna
- Rationale:
 - Well-understood reference design
 - Predictable radiation pattern
 - Appropriate for initial system validation
 - Simple construction using available materials (18 AWG speaker wire)

1.2 Design Inputs

- Target frequency: FM broadcast band (~ 100 MHz)
- Speed of light: $c = 3 \times 10^8$ m/s
- End-effect correction factor: $K \approx 0.95$

Calculated total length: $L = \frac{c}{2f} \cdot K \approx 1.425$ m

Calculated leg length: $l = 0.7125$ m

2. Antenna Construction

2.1 Materials Used

- 18 AWG two-conductor speaker wire
- Dowel rod (non-conductive support)
- Electrical tape
- Wire cutters/strippers
- Retractor (for future geometry variation)

2.2 Construction procedure

- Split speaker wire into two identical conductors
- Cut two antenna legs to planned length (slightly longer than calculated to allow for trimming)
- Stripped insulation at the feedpoint of each leg
- Mounted feedpoint at the center of the dowel rod.
- Arranged antenna legs symmetrically in a straight (180°) dipole configuration
- Secured geometry using electrical tape to maintain alignment.

2.3 Initial Geometry

- Configuration: Straight half wave dipole
- Orientation: Horizontal
- Mounting Environment: on top of grill on porch

3. Antenna Documentation

- Recorded Calculated and actual leg lengths:
- Documented construction method and materials.
- Noted Assumptions
 - No coax feedline attached yet
 - No balun implemented (Phase 1 prototype)

- Feedpoint connections provisional (non-soldered)

These limitations are acknowledged and planned for future refinement.

4. Bill of Materials (BOM) update

- Updated BOM to reflect:
 - Antenna materials acquired and used
 - RTL-SDR v4 status: ordered, pending arrival
 - Missing items identified
 - Coaxial feedline (SMA male)
 - SMA pigtail or terminal adapter
 - Identified phase 2 items:
 - choke balun
 - Soldering equipment (for finalized feedpoint)

5. System Architecture Initiation

- Identified core subsystems:
 - RF Environment
 - Antenna Subsystem
 - SDR Receiver Subsystem (RTL-SDR v4)
 - Host Computer & DSP Subsystem
 - Output & Visualization Subsystem
 - Verification & Measurement Subsystem (NI myDAQ)
- Initiated System Architecture v0.1 as a high-level representation of signal flow and subsystem boundaries.
- Noted planned but deferred subsystems:
 - Analog audio processing / tone control / Karaoke circuit
 - Telemetry reception extensions (ground-station role)

Architecture development prioritized clarity of interfaces over implementation detail

Observations

- Antenna geometry is mechanically stable and repeatable
- Construction tolerances are acceptable for initial RF validation
- Speaker wire stiffness provides adequate structural integrity for indoor testing.
- Clear separation between prototype hardware and future refinements established.

Open Items/Risks

- Coax feedline and connector implementation pending
- RF performance validation deferred until JDR arrival
- Architecture requires refinement as hardware and DSP mature

Day 2 Exit Criteria

- Baseline antenna constructed and documented
- BOM updated to reflect actual hardware status
- Architecture v0.1 initiated
- Clear path defined for RF validation and system integration

Day 2 Objectives met.

End of Day 2 Log