

NanoVNA Antenna Testing

Overview

A **NanoVNA** (Vector Network Analyzer) is the essential tool for verifying antenna performance before deployment. It measures SWR (Standing Wave Ratio) and impedance - telling you how well your antenna is matched to the 50 Ω system and whether it is resonant at 915 MHz. A 10-minute NanoVNA check before mounting an antenna can save hours of troubleshooting range problems later.

Models

Model	Screen	Frequency Range	Price
NanoVNA-H	2.8"	50 kHz - 1.5 GHz	~\$30 - 50
NanoVNA-H4	4.0"	10 kHz - 1.5 GHz	~\$50 - 70
NanoVNA-F	4.3" (metal case)	10 kHz - 1.5 GHz	~\$50 - 70

Frequency note: Common NanoVNA models (H / H4 / F) top out near **1.5 GHz**, not 3 GHz - 915 MHz sits comfortably within range. On the basic NanoVNA-H, operation above ~900 MHz uses harmonic mode with reduced dynamic range, so 915 MHz measurements are valid but recalibrate carefully; the H4 and F perform better here. Prices above are approximate as of 2026-06-08 and vary by vendor.

Kit includes: NanoVNA unit, calibration standards (Open/Short/Load), two SMA cables, USB-C charging cable.

Five-Step Testing Procedure

Step 1 - Initial Setup

1. Charge the NanoVNA via USB-C before first use.

2. Power on.
3. Set the frequency range: **START = 850 MHz, STOP = 950 MHz.**

Step 2 - Calibration (Most Critical)

Calibrate every session or any time you change the frequency range. Calibration compensates for cable and connector losses - skipping it invalidates all measurements.

1. Navigate to **Menu → CAL → CALIBRATE.**
2. Connect the **OPEN** standard → select OPEN → wait for measurement.
3. Connect the **SHORT** standard → select SHORT → wait.
4. Connect the **LOAD** (50 Ω) standard → select LOAD → wait.
5. Save calibration to a slot (0 - 4).
6. Verify: reconnect LOAD → SWR should read **~1.0**, impedance **~50+j0 Ω**. This check confirms the calibration math, not absolute accuracy; the supplied standards are adequate for hobby antenna work.

Recalibrate when: changing frequency range; moving to a significantly different temperature environment; switching to different cables.

Step 3 - Configure Display

- Set **Trace 1** to **SWR**.
- Optionally set **Trace 2** to Smith Chart or R+jX for impedance detail.
- Add a **marker at 915 MHz**.

Step 4 - Connect Antenna

Caution: Disconnect or power down the LoRa radio before connecting a NanoVNA to its antenna line. A NanoVNA is a low-power test source; applying transmit power to a NanoVNA port will damage the instrument.

- Connect antenna cable to **CH0 (Port 1)**.
- Use the shortest possible cable between the NanoVNA and antenna.
- Tighten connectors finger-tight only - do not over-torque SMA.
- **Check connector type:** LoRa antennas commonly use SMA or RP-SMA. These look identical but are not compatible - verify before connecting.

Step 5 - Interpret Results

SWR Ratings

SWR	Rating	Action
1.0 - 1.5	Excellent	Deploy with confidence
1.5 - 2.0	Good - acceptable	Fine for most deployments
2.0 - 3.0	Marginal - some power loss	Investigate connector quality
3.0+	Poor - significant loss	Replace antenna or diagnose connector

Resonant Frequency

The **lowest SWR dip** on the sweep is the antenna's resonant frequency.

- Dip **at 915 MHz** - optimal
- Dip **below 915 MHz** - antenna is slightly long (resonates lower)
- Dip **above 915 MHz** - antenna is slightly short (resonates higher)

Common Problems & Diagnosis

Symptom	Likely Cause
High SWR across entire 850 - 950 MHz band	Antenna tuned for 868 MHz (European band); damaged or loose connector; missing ground plane on whip antenna
SWR varies wildly / unstable reading	Loose connector; damaged cable - wiggle connections while watching display
Excellent SWR but poor range	SWR measures <i>impedance match only</i> , not gain. SWR and gain are independent - evaluate both. A 6 dBi antenna with moderate mismatch (2:1, ~0.5 dB loss) still beats a 0 dBi matched antenna at both short and long range; only a severe mismatch (loss exceeding the gain advantage) erases the gain benefit. Evaluate antenna gain separately.

PC Software: NanoVNA-Saver

NanoVNA-Saver is free, open-source software (Windows/Mac/Linux - search GitHub for "NanoVNA-Saver") that connects to your NanoVNA via USB and provides:

- Larger, higher-resolution graphs
- Data export (CSV)
- Smith chart display
- Touchstone (.s1p) file export for import into antenna modeling software
- Multi-antenna comparison - overlay sweeps from different antennas

Recommended for antenna selection decisions and documentation of deployed infrastructure antennas.

Common Mistakes to Avoid

- **Skipping calibration** - all measurements are invalid without calibration
- **Calibrating at the wrong frequency range** - calibration is only valid for the range it was performed at; recalibrate if you change START/STOP
- **Testing indoors near metal objects** - nearby metal detuning antennas; test in the open or simulate the actual mounting environment
- **Using adapters without accounting for electrical length** - SMA adapters add a small but measurable electrical length; minimize adapter use
- **Confusing SMA and RP-SMA** - SMA has center pin on plug; RP-SMA has center pin on jack. Forcing mismatched connectors damages both.

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