Understanding RF

URF VNA Emulator Beta User Manual

SCPI Automation • Simulated S-Parameters • VNA Learning

Support & Feedback
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This manual documents the controls and behavior of the supplied URF VNA Emulator Beta Python build.

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1. Quick Start

OVERVIEW

URF VNA Emulator is a standalone virtual vector network analyzer intended for learning, automation development, and software testing. It displays simulated S-parameter data and provides vendor-selectable SCPI command behavior.

GET STARTED

1. Launch the emulator and continue past the welcome screen.
2. Choose a vendor command profile.
3. Optionally enable Learning Mode.
4. Configure stimulus, traces, and a simulated DUT.
5. Run a sweep and inspect the traces.
6. Optionally connect a MATLAB or Python script to the local SCPI endpoint and save Touchstone data.

IMPORTANT

The displayed traces are simulations, not calibrated measurements. Verify scripts on actual hardware before relying on them in production.

2. Vendor Selection

SELECT A COMMAND PROFILE

Choose CMT, LibreVNA, Keysight, R&S, NanoVNA, Anritsu, or Signal Hound. The selection determines the SCPI command profile; the simulated DUT and measurement engine remain shared.

NAVIGATION

Select the desired vendor button to open the analyzer. Use Back to return to the welcome page, Help / How to Use to view startup guidance, or Quit to close the application.

CHANGING VENDORS

Use Back to Vendor Selection from the emulator interface to return to the vendor page. Reconnect any external automation scripts to the endpoint for the newly selected profile.

3. Learning Mode

ENABLE LEARNING MODE

Select Learning Mode on the vendor page before entering the analyzer. Explanatory pop-ups describe controls as you use them.

WHILE USING THE ANALYZER

Learning Mode can also be changed from the analyzer Options menu. It is intended as an instructional overlay, not a separate measurement mode.

BEST PRACTICE

Explore Stimulus, Trigger, Windows, DUT, Scale, Markers, and Save/Recall while Learning Mode is enabled.

4. Analyzer Interface

MAIN MENU

The soft-button menu includes Stimulus, Trigger, Windows, DUT, Scale, Average, Markers, Save/Recall, and System. Select a menu to open its controls; use Main Menu to return.

DISPLAY

The analyzer display shows simulated S-parameter responses in Log Magnitude (dB). Depending on the selected DUT, available traces include S11, S21, S12, and S22.

PRESET

Preset resets the emulator configuration. Save a state first if you want to restore the current setup.

5. Stimulus and Sweep Setup

FREQUENCY SETTINGS

Open Stimulus to configure Start Frequency, Stop Frequency, Center Frequency, and Span. The start frequency must be below the stop frequency.

OTHER SETTINGS

Set Points, IF Bandwidth, and Power from the Stimulus menu. The frequency range and number of points define the simulated frequency samples.

EXAMPLE WORKFLOW

1. Open Stimulus.
2. Enter the start and stop frequencies.
3. Set the number of sweep points.
4. Return to Main Menu and choose Trigger to run the sweep.

6. Trigger and Sweep Control

SINGLE

Select Single to initiate one simulated sweep.

HOLD

Select Hold to stop continuous sweeping and retain the current display.

CONTINUOUS

Toggle Continuous ON/OFF to control repeated simulated sweeps. The analyzer updates the displayed trace as the simulated sweep progresses.

7. DUT Models and S-Parameters

SIMULATED DEVICES

The DUT menu includes Band-Pass Filter and Antenna models. Use Operating Frequency to change the simulated device response.

S-PARAMETER SELECTION

For the two-port model, select S11, S21, S12, or S22. The Antenna model exposes S11 in the GUI.

DISPLAY ALL

The two-port DUT supports a Display All S-Parameters option. Use the Windows controls for additional trace assignments.

LIMITATION

These models are illustrative and do not replace characterization of real RF hardware.

8. Trace Windows and Display

WINDOW LAYOUT

Use Windows → Window Layout / Assign Traces to select a layout and assign one or more S-parameters to each window. The GUI supports up to four trace windows.

WINDOW CONTROLS

Add Window, Remove Selected Window, and Maximize / Restore Window let you customize the display. Select the active window before changing its traces.

SCALE

Open Scale to adjust Scale / Div and Reference Level, or choose Autoscale. The display uses Log Magnitude; additional format choices are not presented as supported plot modes in this build.

9. Markers

ADDING MARKERS

Open Markers and select Add S11 Marker, Add S21 Marker, Add S12 Marker, or Add S22 Marker as applicable. Multiple markers can be assigned to a trace.

POSITIONING

Drag a marker on the display, or use Set Marker Frequency to enter its desired frequency. Marker readouts identify the trace, marker number, and measured simulated value.

REMOVING

Use Remove Marker for the active marker or Clear All Markers to reset the display.

10. SCPI Connection and Automation

LOCAL SCPI SERVER

The emulator exposes a local SCPI TCP socket for external scripts. Open System to view the selected profile and socket endpoint; the displayed host is 127.0.0.1, with a vendor-dependent port.

CONNECTION PROCEDURE

1. Select the desired vendor profile.
2. Open System and note the SCPI socket address.
3. Configure your automation script to use that address and port.
4. Query *IDN? to confirm the endpoint responds.
5. Run the sweep and acquisition commands for the selected vendor.

COMPATIBILITY

SCPI dialects differ across manufacturers. Some vendor flows have not been verified against physical instruments. NanoVNA serial-device compatibility is not established by the local TCP SCPI workflow.

11. MATLAB and Python Examples

GENERATE EXAMPLES

Open System → Generate MATLAB Code or Generate Python Code to create a vendor-specific acquisition example.

TYPICAL SEQUENCE

The educational scripts demonstrate connecting to the selected endpoint, identifying the instrument, recalling a supported emulator state if needed, requesting sweep frequencies and complex S-parameters, and saving a Touchstone file.

SCRIPT USAGE

Run the example with the matching vendor selected in the emulator. Use the correct local port and review any vendor-specific prerequisites. These examples are for training and automation development.

12. Save and Recall

SAVE TOUCHSTONE

Open Save/Recall → Save Touchstone. Choose the filename and destination. The emulator exports simulated complex S-parameters in real/imaginary format with a 50-ohm reference impedance.

FILE TYPES

The Antenna model saves .s1p; the two-port model saves .s2p. The file header identifies the data as simulated.

SAVE STATE

Save State writes the emulator setup, trace windows, and markers using a vendor-specific filename extension. The contents are URF emulator JSON, not native manufacturer state data.

RECALL STATE

Recall State loads a compatible URF emulator state for the same selected vendor. Genuine manufacturer state files are not supported by this loader.

13. Troubleshooting

SCRIPT CANNOT CONNECT

Verify the emulator is running, the correct vendor is selected, and the script uses the local host and port shown under System. Confirm that another application is not using the same socket.

UNEXPECTED S-PARAMETERS

Confirm the selected DUT, frequency sweep, number of points, active trace windows, and requested S-parameters. Remember the data is simulated.

STATE FILE WILL NOT LOAD

Confirm the state was created by URF VNA Emulator and saved for the current vendor. A manufacturer state file with the same extension will not load as an emulator state.

MARKER NOT VISIBLE

Confirm the relevant S-parameter is displayed and that the marker frequency is inside the sweep.

GUI LAYOUT

If controls are difficult to see, enlarge the window or restore the display layout before continuing.

14. Limitations and Good Practice

SIMULATION ONLY

URF VNA Emulator does not measure a connected RF DUT. It cannot verify physical calibration, cable losses, hardware timing, measurement uncertainty, or actual vendor firmware behavior.

AUTOMATION VALIDATION

Use the emulator to prototype command sequences and parsing. Then validate instrument identification, SCPI command support, state handling, returned data formats, and sweep behavior on the actual target VNA.

DATA INTEGRITY

Do not present emulator-generated Touchstone files as physical test results. Maintain separate folders for simulated and measured data.

15. Contact

SUPPORT & FEEDBACK

For questions, bug reports, and feature feedback about URF VNA Emulator Beta, contact understandingrfllc@gmail.com.

SHARING DIAGNOSTICS

Describe the selected vendor, relevant steps, error message, and emulator version. Do not send customer-confidential information, passwords, proprietary measurements, or export-controlled material unless authorized.