Having Fun with Software Defined RF Test Tools

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Framework

- Software Defined Test Equipment
- Signal Hound Spectrum Analyzer
- miniVNA Pro Vector Network Analyzer
- Demonstrations
What is a Spectrum Analyzer?

- Visual display of the radio spectrum and the amplitude of radio signals and other characteristics
Traditional Spectrum Analyzers
Signal Hound USB SA44B
Software Defined 4.4 GHz Spectrum Analyzer

www.signalhound.com

$919
Features

RF Frequency Range: 1 Hz to 4.4 GHz
  Low noise amplifier available above 500 KHz
Wide dynamic range: -151 dBm to +10 dBm
Resolution bandwidths (RBW) of 0.1 Hz to 250 KHz and 5 MHz
Includes a High Dynamic Range Measuring Receiver
  0.25 dB relative accuracy
  0 dBm to -125 dBm, 150 KHz to 1 GHz; 0 dBm to -115 dBm, 1 GHz to 4.4 GHz
  Adjustable digital audio filters
No external power supply needed - draws power from USB
Digital Signal Processing happens on the PC
Additional Third-Party Software Packages are available
Free Application Programming Interface (API)
  I/Q Data up to a 240 KHz bandwidth
  Frequency Sweeps up to 140 MHz per second
  Windows XP, Windows 7 or 8 required
AM and FM Demodulation Measurements
USB 2.0 communications at 480 MBPS
Demodulates AM/FM/SSB/CW audio in real-time
Measures 8 inches long
Weighs 10 ounces
Tracking Generator Option

*Upgrade your USB-SA44B to a Scalar Network Analyzer*

**$599**

- RF Frequency Range: 10 Hz to 4.4 GHz
- Amplitude range: -30 dBm to -10 dBm
- Step sizes from 10 Hz to 10 MHz
- Sweep up to 700 frequency points per second with the USB-SA44(B)
- No external power supply needed - draws power from USB
- Software and hardware included for one low price
- Write your own software with the free Application Programming Interface (API)
- Compatible with Windows XP, 7, or 8 operating systems
- Measures 8 inches long
- Weighs 10 ounces
Caveats

The Signal Hound is not intended for use with spread spectrum signals. If the modulated signal is wider than 20 MHz, amplitude accuracy is not guaranteed.

Frequency-hopping and pulsed signal measurements may require special settings.

Higher models (and price) are better.

Rigol DSA815 1.5 GHz may be better? $1,295

http://www.rigolna.com
What’s Inside?

Requires External DC Isolation

- RF IN
- 0-15 dB
- RF Preamplifier
- MIXERS
- DIVIDER IC
- DUAL IFs
- IF-to-bits
- 5MHz RFV Detector
- USB 2.0

Display

Computer

Software Control

Analog

Analog to Digital
User Interface
Measuring Channel Power
Band Limit Lines
Measuring Receiver Utility

RF Carrier Freq: 27 MHz
IF Bandwidth: 60 KHz
Audio Filter: Low Pass 3 KHz

Synchronous Level Detector
Show FM (Frequency Modulation)
Show AM (Amplitude Modulation)
Amplitude Range Select
- High Power Range
- Low Power Range

EXIT

RF COUNTER: 27000000.05 Hz
FM RMS: 357.67 Hz
RMS(RT2): 505.82 Hz
PEAK+: 525.4 Hz
PEAK-: -523.3 Hz
Audio Freq: 1002.604 Hz
Relative Power: -0.001 dBc
Averaged: -0.000 dBc

Audio Listening Controls
Frequency (MHz): 27
IF Bandwidth: 120 KHz
Modulation Mode: FM
FM De-emphasis (usec): 75
Apply Changes
Questions?

Answers?
Demonstration
What’s a VNA?

A Vector Network Analyzer (VNA) is used for measuring amplitude and phase characteristics of an electrical network. These characteristics include:

S-parameters*, magnitude and phase, standing wave ratios (SWRs), insertion loss or gain, attenuation, group delay, return loss, reflection coefficient, and gain compression.

High priced VNAs can measure frequencies from 5 Hz to 110 GHz.

VNA hardware consists of a sweeping signal source (usually internal), a test set to separate forward and reverse test signals, and a multichannel, phase coherent, highly sensitive receiver, making a VNA a two port device, out and in.

* Scattering parameters or S-parameters (the elements of a scattering matrix or S-matrix) describe the electrical behavior of linear electrical networks when undergoing various steady state stimuli by electrical signals.
Traditional VNA
What’s an SNA?

A scalar network analyzer (SNA) measures only the amplitude portion of the S-parameters, and so obtains measurements such as:

Transmission gain and loss, return loss, and SWR.

The VNA has more extensive measurement capability, but an SNA may be a more cost effective measurement tool for revealing simpler out-of-specification measurements. Example: MFJ-259 series.

Like VNAs, SNAs require an external or internal sweeping signal source and signal-separation hardware, but they just need simple amplitude-only detectors, rather than complex (and more expensive) phase coherent detectors.
Traditional SNAs

MFJ-259B does not sweep the RF. It’s manual.
miniVNA Pro
http://www.w4rt.com/Misc/miniVNAPro.htm

$549.99
Software Defined!
Software-Defined
HF/VHF Network & Antenna Analyzer

- Measurements for VSWR, RL, Rs, Z +/- jx, Phase, Cable, R/L/C, Filters, Cavities, Traps
- Frequency range 0.1 to 200MHz, up to 1.5 GHz with Extender
- Extended dynamic range: up to 90dB for transmission, up to 50dB for reflection
- Calibration using open/short-load for accurate results
- Range of impedance Z from 1 to 1000 Ohms
- Two ports VNA with S11 and S12 display and data can be saved to a file
- I/Q DDS Generator with 0 dBm output power
- Two separate RF outputs for I/Q supporting SDR experiments and IMD measurements with independent attenuator from 0 to 55dB, phase angle adjustable to 1° precision
- Built in Bluetooth® Adaptor (Class 1) for wireless remote measurements
- Built in Lithium-Ion 1000mAh battery, (4 hours full-scan operation)
- Built in battery charger (up to 400mA)
- Low power consumption, < 220mA @3.6V, (analyzer mode using USB port)
- Power save mode
- SMA connectors for better isolation
- Boot loader for future firmware upgrades
- User friendly interfaces for PC Windows, Linux, Apple and Android; 3rd Party Software
- Integrated Smith Chart in software
- Export data in several formats: JPG, Excel, ZPLOT, S2P, PDF
What’s Inside?
miniVNA Pro with Laptop
miniVNA Pro with Android

By Dan Toma (YO3GGX)  http://www.yo3ggx.ro/
miniVNA Pro with Android

By Dan Toma (YO3GGX)  http://www.yo3ggx.ro/
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Can Your Analyzer do this?
miniVNA Pro Extender
miniVNA Pro Extender

Frequency Range: 200 — 1500 MHz
Dynamic Range: 60dB @ 1GHz
Operation modes: Reflection and Transmission, S11 and S21
Harmonics suppression: -35dB
Directional Coupler: Internal
Connectors: Two, SMA female
Output Power: -10dBm
Power Consumption: approx. 150 mA
3rd Party Software

http://ac6la.com/zplots.html
Reflection, Transmission and Smith Chart Measurements
Problem at KE7SA
Exported PDF Plots from miniVNA

Normal SWR and RL

“Double Dip” SWR and RL

Measurement on the Ground

Measurement on the Tower

Note 75 KHz Frequency Shift
Testing a Tri-Band Radiator Element

Mosley MP-33-N

The World Famous N7OYY Antenna Test Range
miniVNA Pro

Blue Masking Tape
20 Meter Band Sweep
Three Band Sweep
So, what was the problem?

60 feet of zinc strip on roof peaks for roof moss control, acting like an artificial ground relative to the antenna. Zinc strips removed and “double-dip” gone.
Questions?

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