Spectrum Analyzer Presentation

What is a spectrum Analyzer?

An instrument which displays the power, usually in dBm, of an applied signal in a visual representation with **power** (usually in dBm) on the Y axis and **frequency** on the X axis. The display is quite similar to that of an oscilloscope except that the o'scope displays **voltage** on the Y axis and **time** on the X axis.

Oscilloscope Display

Spectrum Analyzer Display
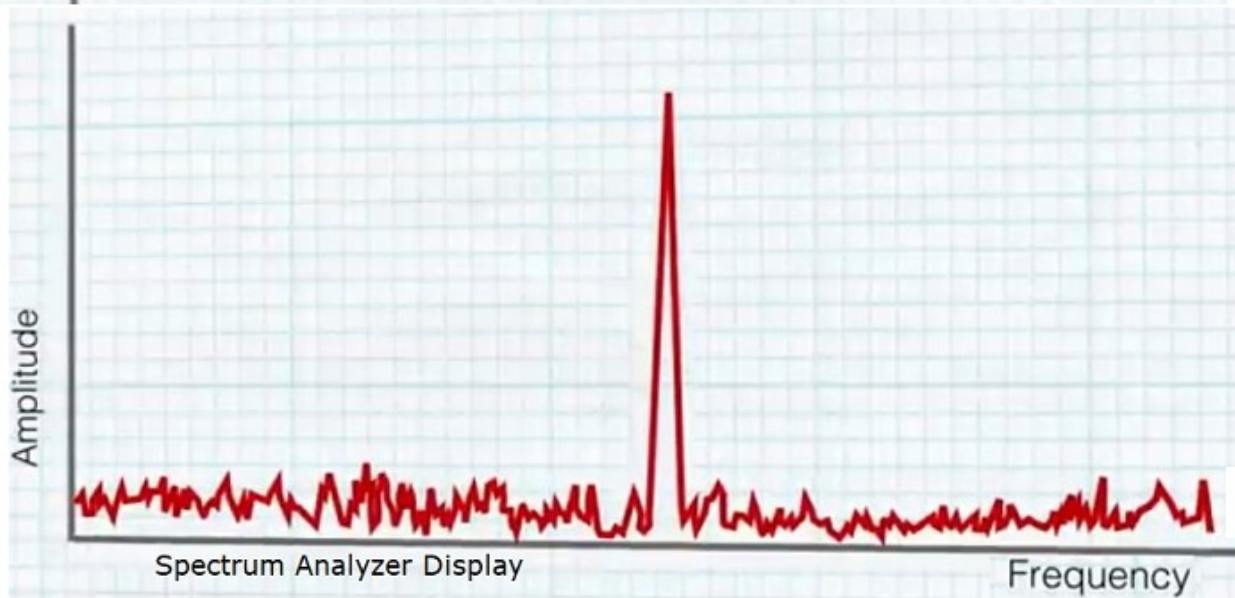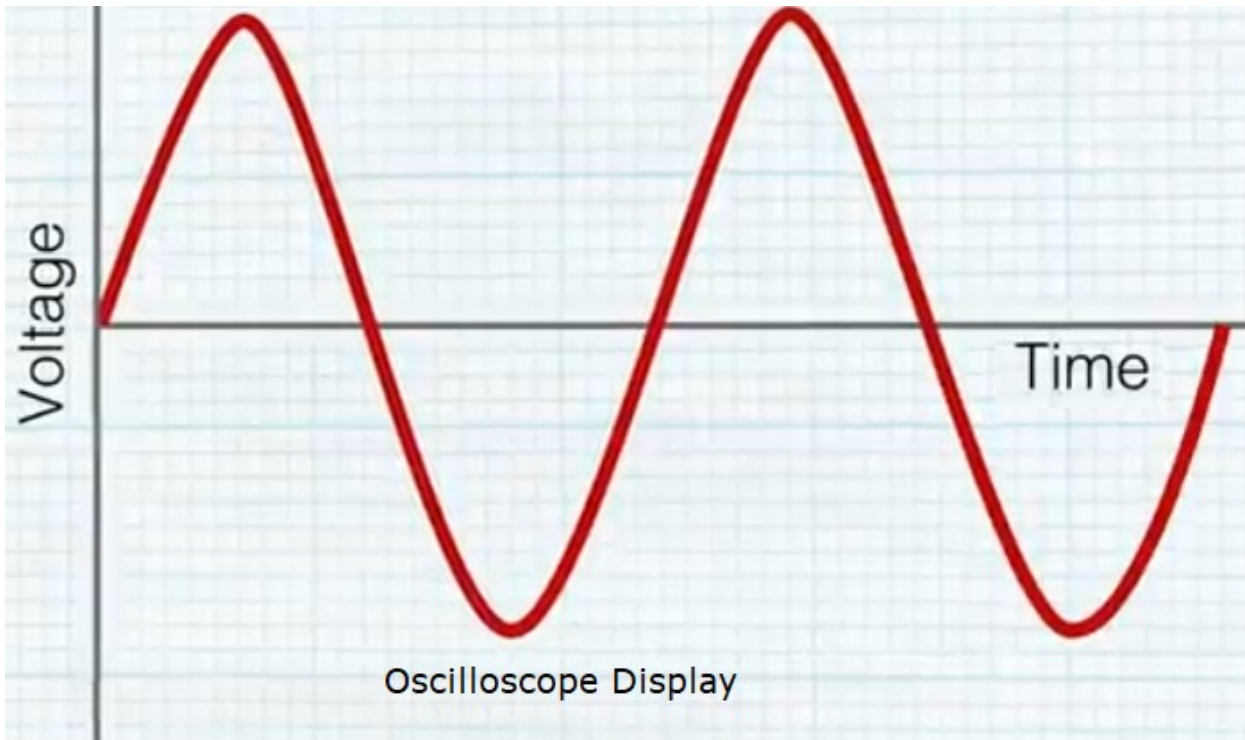
EVALUATING MIXERS
SEEING BEHIND THE WAVE FORM

- Double balance mixer combines two frequencies and produces a sum and a difference

- 40 meter SimpleSSB
  - IF = 9MHz
  - RF = 7MHz
  - LO = 16MHz
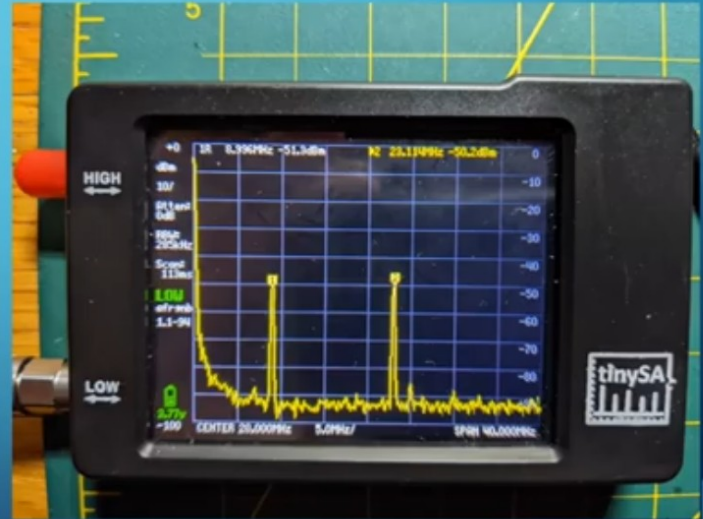
Note that for the double balanced mixer only the sum (16+7=23MHz) and difference (16-7=9MHz) frequencies are present. Neither of the original frequencies (16MHz, 7MHz) show any power in the display.

There are three main parameters that determine what the screen is displaying:
1. Frequency range - this can be entered in two ways
   1. Center Frequency and span
   2. Start and Stop frequencies
2. Resolution Bandwidth
   1. Auto – allow the instrument to decide
   2. set it manually
      Note that better resolution yields more detail but longer screen refresh time
3. Amplitude settings & Reference Level
   1. Internal – most SAs will adjust their internal attenuators automatically based on the level of the signal being measured. However, you do have the ability to set the value manually.
   2. External – the SA will typically allow you to enter the value of whatever attenuator or amplifier you have applied to the signal before it enters the unit. This is to enable the SA to display the actual power level.
   3. Reference Level is the level value at the top of the screen.

Some tutorials also include Video Bandwidth. This parameter does not affect any of the calculations. It is essentially a low pass filter affecting only the display. For instance, it can be used to reduce, or average out, what may be noise.

Misc. Notes
- The input of a spectrum analyzer **cannot** tolerate large signals. Before you connect a signal to the input, be sure you know that the signal will not exceed the maximum allowable input rating of the spectrum analyzer. It is important to realize that the input rating is for the entire spectrum – not just the spectrum you are viewing!
- Users have designed high impedance contact probes and buffers which also limit the output to be within the safe operating range of the SA input.

- The whip antenna that comes with the TinySA has a high impedance at low frequencies (AM broadcast). Some users have designed impedance buffers for it to transform the high impedance to 50 ohms which yields better sensitivity at lower frequencies.

Analog Spectrum Analyzer

tinySA Ultra block diagram
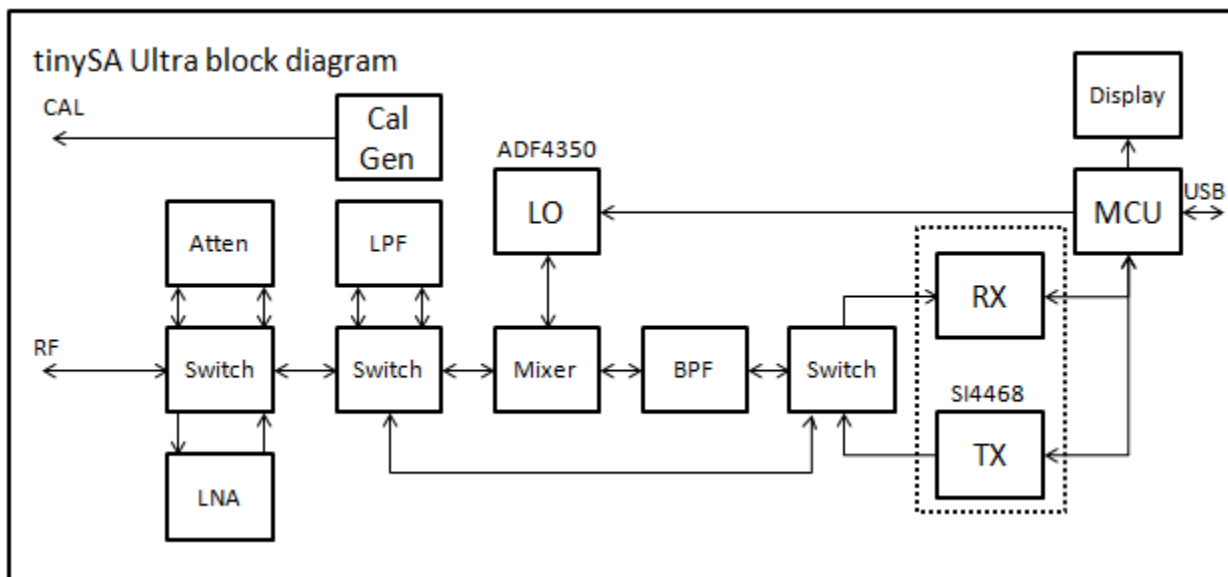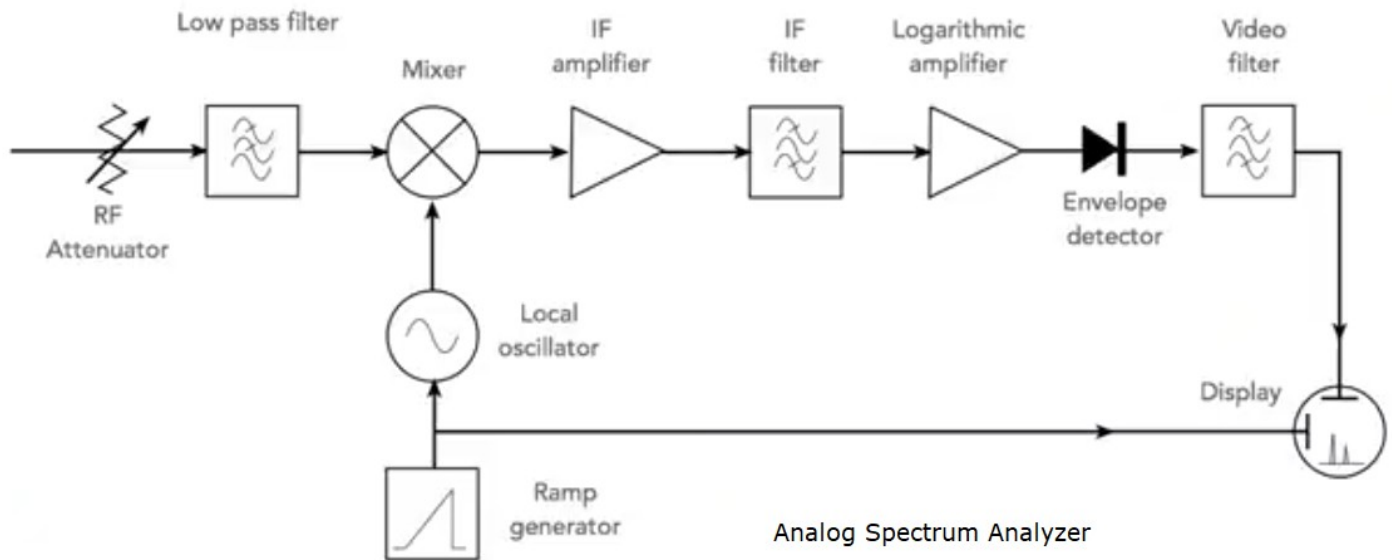
RX contains
- Second LO and mixer to down convert the high IF to a low IF at 870kHz.
- Selectable resolution filters between 200Hz and 800kHz.
- Power detector with 120dB dynamic range after the resolution filter.

Demos: use TinySA-App
- 10MHz from TinySA3: set SA4 3MHz-50MHz, RBW=100KHz & 10KHz
- 250MHz from Hi Out: Set SA4 200MHZ-2GHz, RBW=300KHz
- GT-3TP

Spectrum Analyzer Tutorials

What is a Spectrum Analyzer https://www.youtube.com/watch?v=nLIKaszlaiw

Understanding Basic Spectrum Analyzer Operation
                            https://www.youtube.com/watch?v=P5gxNGckjLc

Spectrum Analyzer Essentials https://nuwaves.com/spectrum-analyzer-essentials/

#22 Spectrum Analyzer Basics Tutorial, and the Tektronix 1401A
                            https://www.youtube.com/watch?v=4Y6ji0QBsww

#119 Spectrum Analyzer Basics RBW & VBW https://www.youtube.com/watch?v=Ffhs9Ny03lM

_spec_analyzer   https://web.ece.ucsb.edu/~long/ece145a/spec_analyzer.pdf

_ten_minute_tutorial_spectrum_analyzer
                            https://www.teledynelecroy.com/doc/tutorial-spectrum-analyzer

Fundamentals_of_RealTime_Spectrum_Analysis
                            https://d347awuzx0kdse.cloudfront.net/vicomnewzealand/content-file/
                            37w_17249_6_fundamentals_of_realtime_spectrum_analysis_0_vicom.pdf

an_150-10   https://www.scribd.com/document/352060907/an-150-10

Fundamentals_of_Spectrum_Analysis
                            https://www.rohde-schwarz.com/us/products/test-and-measurement/
                            analyzers/signal-spectrum-analyzers/educational-note-fundamentals-of-
                            spectrum-analysis-register_252824.html

How to use a Spectrum Analyzer https://www.youtube.com/watch?v=WnKK11UEvVE

Spectrum Analyzer Basics AN150
                            https://www.keysight.com/us/en/assets/7018-06714/application-notes/
                            5952-0292.pdf

Spectrum Analyzer Basics   https://www.youtube.com/watch?v=d3G86gp61D0

Understanding Spectrum Analyzers - Dynamic Range
                            https://www.youtube.com/watch?v=nQGhqCDkL_A

TinySA $10,000 in capability for under $60 https://www.youtube.com/watch?v=ixcWerQ-Trg

TinySA first use   https://www.youtube.com/watch?v=NFqxdGcWSdw

TinySA Measure Noise Figure https://www.youtube.com/watch?v=kUV1nJIAxQk

TinySA Ultra Spectrum Analyzer and RF Signal Generator
                            https://www.youtube.com/watch?v=miHa-gul4nE

TinySA Ultra_UK   ttps://www.youtube.com/watch?v=i8CYCua8vqQ