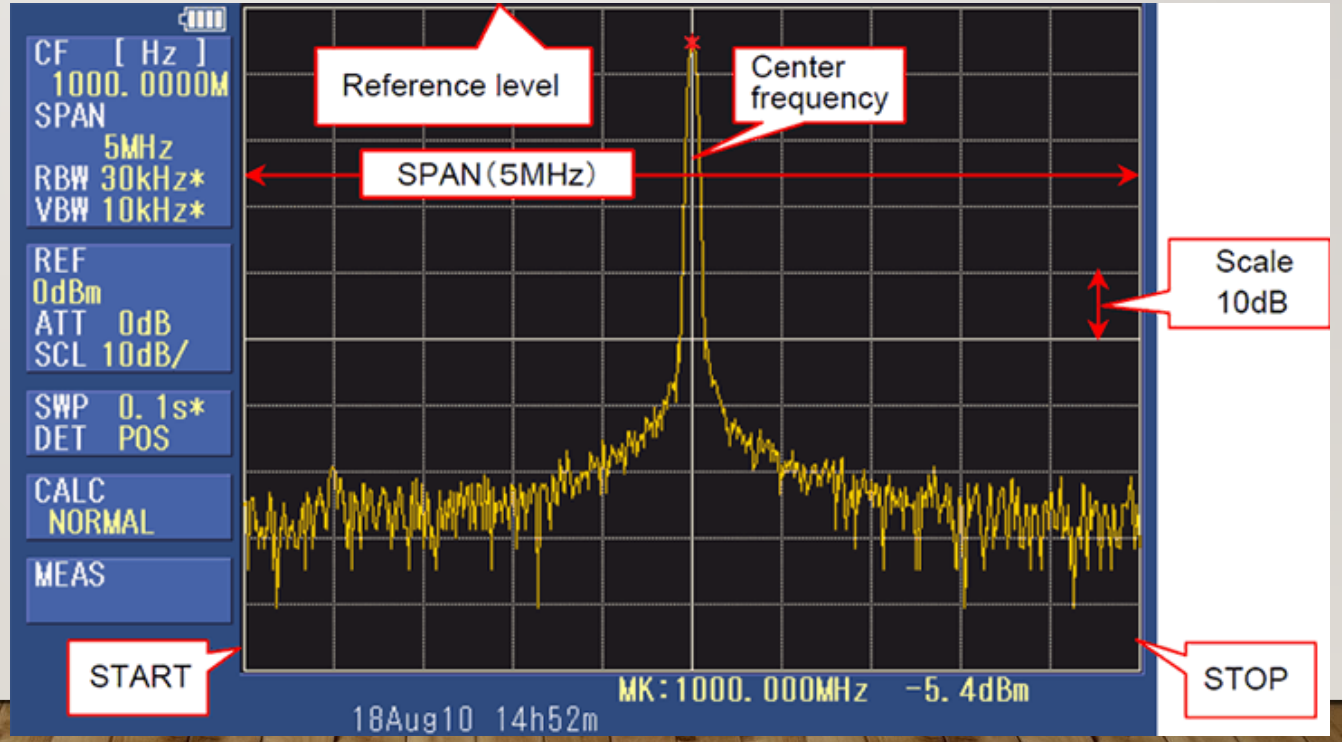
THE TINYSA

CALVERT AMATEUR RADIO ASSOCIATION

WHAT IS A SPECTRUM ANALYZER

- A spectrum analyzer measures the magnitude of an input signal against frequency, allowing for the analysis of power, distortion, and noise in RF signals.



TYPES OF SPECTRUM ANALYZERS

- Swept-Tuned (Superheterodyne): Excellent for general-purpose, high-frequency measurements.
  - TinySA fits in this category

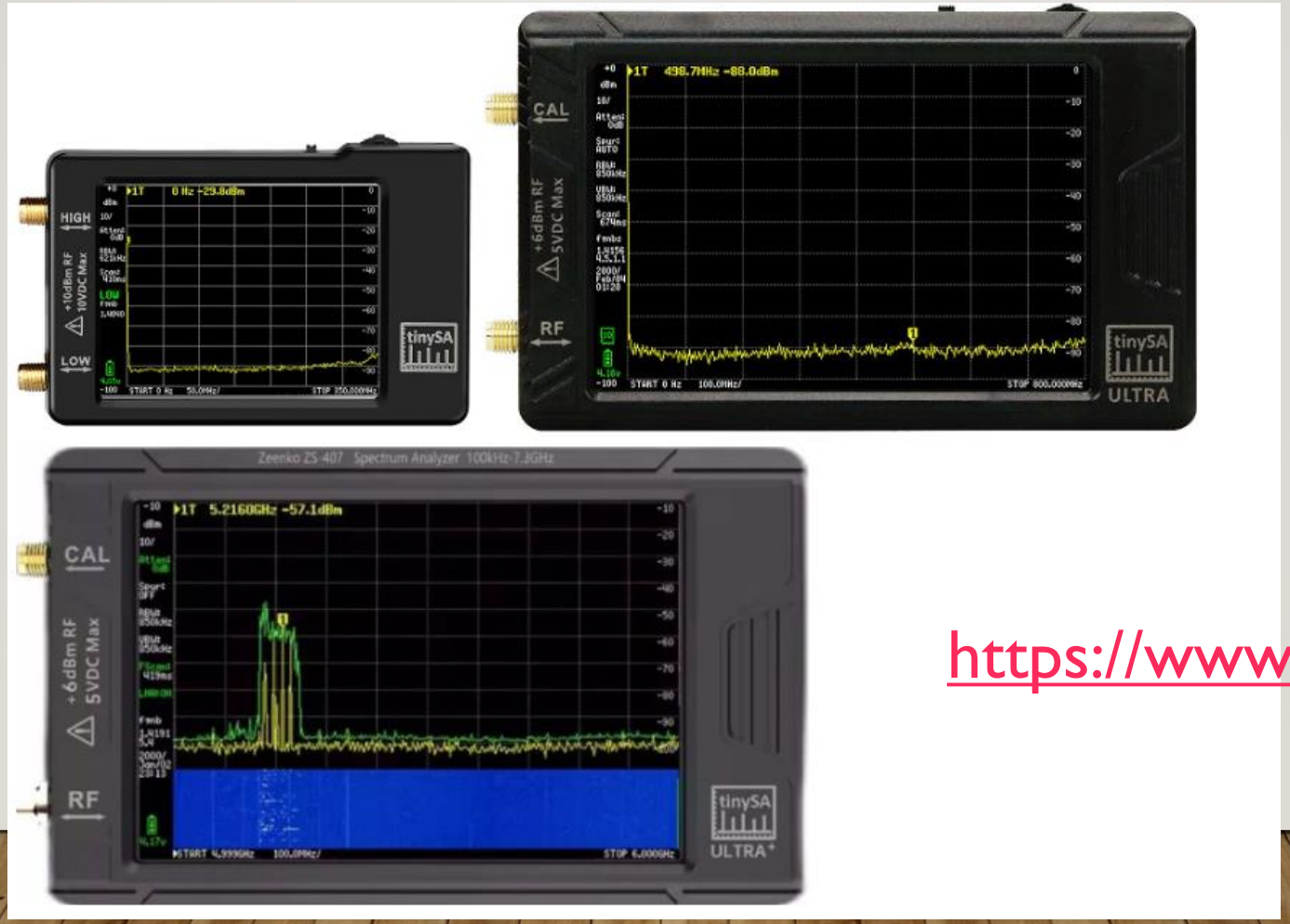
- Real-Time (RTSA): Uses FFT to analyze fast, transient, or intermittent signals.

COST

- High End Professional
  - Example: Rohde & Schwarz
  - $50,000-$100,000 depending on options

- Amateur/Hobbyist
  - Example: TinySA Ultra+
  - $89.95 - $219.95

THE TINYSA LINE



https://www.tinysa.org/wiki/

TINYSA CREATOR

- Designed by Erik Kaashoek in the Netherlands
- Manufactured in China by Wuyi Zeenko Industrial And Trading Co., Ltd (often listed as Zeenko on AliExpress) and others
- But typical of all electronics from China, BEAWARE OF CLONES
  - Chinese companies rip off the designs of other Chinese companies and try to undercut by taking shortcuts (different parts, no shielding, etc).
- By only from recommended vendor
  - See https://www.tinysa.org/wiki/

TINY SA SPECIFICATIONS

tinySA Basic

- Screen size 2.8 inch
- Spectrum Analyzer with two inputs, high quality MF/HF/VHF input for 0.1MHZ-350MHz, lesser quality UHF input for 240MHz-960MHz or
- Signal Generator with two output, sine wave output for 0.1MHz - 350MHz and square wave output for 240MHz-960MHz when not used as Spectrum Analyzer.
- Switchable resolution bandpass filters for both ranges between 2.6kHz and 640kHz
- Color display showing max 290 scan points providing gapless covering up to the full low or high frequency range.

TINY SA SPECIFICATIONS, CONT.

tinySA Ultra ZS405

- Screen size 4 inch
- Spectrum Analyzer for 0.1-800MHz or, with Ultra mode enabled up to 5.3 GHz, level calibrated up to 6GHz. Can observe signals up to 12GHz
- Signal Generator with sine wave output between 0.1-800MHz or square wave up to 4.4GHz or rf test signal output up to 5.3GHz when not used as Spectrum Analyzer.
- Switchable resolution bandpass filters from 200Hz to 850kHz
- Built-in 20dB optional LNA
- Color display showing max 450 points providing gapless covering up to the full frequency range.
- MicroSD card slot for storing measurements, settings and screen captures.

TINY SA SPECIFICATIONS, CONT.

tinySA Ultra+ ZS406

- Spectrum Analyzer for 0.1-900MHz or, with Ultra mode enabled up to 5.3 GHz, level calibrated up to 6GHz. Can observe signals up to 12GHz
- Signal Generator with sine wave output between 0.1-900MHz or square wave up to 4.4GHz or rf test signal output up to 5.4GHz when not used as Spectrum Analyzer.
- Other spec same specs as ZS405

TINY SA SPECIFICATIONS, CONT.

- **tinySA Ultra+ ZS407**
  - Spectrum Analyzer for 0.1-900MHz or, with Ultra mode enabled up to 7.3 GHz, level calibrated up to 7.3GHz. Can observe signals up to 12GHz
  - Signal Generator with sine wave output between 0.1-900MHz or square wave up to 6.3GHz or rf test signal output up to 7.3GHz when not used as Spectrum Analyzer.
  - Other spec same specs as ZS406

TINY SA SPECIFICATIONS COMMON TO ALL

- Input Step attenuator from 0dB to 31dB (can not be used in combination with LNA).
- A built-in calibration signal generator that is used for automatic self test and (low) input calibration.
- Connected to a PC via USB it becomes a PC controlled Spectrum Analyzer or Signal Generator
- Rechargeable battery allowing a minimum of 2 hours of portable use
- **Max input level +10dBm (0.01 watts). Do not destroy your tinySA**
- The generator function can not be used as a tracking generator as you can not use the spectrum analyzer and generator functions at the same time.
- Due to the low cost and very small form factor there are certain relevant tinySA limitations and tinySA Ultra limitations

ON-LINE VIDEO TUTORIALS AVAILABLE

- tinySA

#01 General introduction video
#16 Basic introduction
#02 First Use
#17 Touch Calibration
#03 Calibrating the HIGH input
#27 Calibrating the Frequency

tinySA Ultra

#43 Unboxing of and short intro to the tinySA Ultra
#44 tinySA Ultra and its LNA
#44 tinySA Ultra mode performance and limitations
#46 tinySA Ultra Low Frequency performance
#47 tinySA Ultra Signal Generator functionality
#48 tinySA Ultra observing WiFi and other networks
#49 tinySA Ultra measuring the NF of an amplifier
#50 Using a tinySA Ultra to tune FM deviation

ON-LINE VIDEO TUTORIALS AVAILABLE

- Menu Videos
  - #04 Exploring the Display Menu
  - #11 Preset Menu
  - #07 Frequency Menu
  - #08 Level Menu
  - #09 Marker Menuand Marker positioning
  - #10 Measure Menu
  - #11 Config and Expert Config Menu
  - #24 Quick menu's since firmware v1.1-52
  - #26 Frequency slider demo since firmware v1.1-65

Applications

- #05 Signal Identification
- #06 Observing modulation
- #13 tinySA and NanoVNA measuring each other
- #18 Strong Signal Test
- #14 Testing a Transceiver
- #15 doing AM and FM generation and analysis
- #22 Settings impacting Scanning Speed
- #25 Trigger features
- MORE - NOT SHOWN HERE

RECOMMENDED OPERATING CONDITIONS

- For the best accuracy, try to limit input power to -30 dbm (1.0 microwatts)
- When measuring harmonics, view how many db the harmonic is down from the fundamental. Then change the setting of the TinySA's input attenuator and observe if the harmonic to fundamental remains the same. If not, the TinySA may be overloaded and creating false harmonic indications. Reduce the input power with the TinySA's attenuator or an external attenuator.

WHAT'S WITH DBM

- dBm is a measure of power relative to one milliwatt

$dBm = 10*\log_{10}(P2/P1)$ where P1 = 0.001 watts

- 0 dBm = 1 milliwatt into a 50Ω Load = 223,607 microvolts into a 50Ω Load
- An S-9 signal (by definition) is 50 microvolts into a 50Ω load
  - **50 microvolts = -73dBm**
- Why use dB
  - Easer math when other attenuation or gain in system.
  - Example: 20db attenuator on input connector to spectrum analyzer.

    Signal on spectrum analyzer measures +5dBm

    Actual signal strength is -20 + 5 = -15dBm

$$\log(x*y) = \log(x) + \log(y)$$

SKIP THE MATH

- On-Line Calculators
  - https://coretechgroup.com/dbm-calculator/
- Charts
  - http://wa8lmf.net/miscinfo/dBm-to-Microvolts.pdf
  - https://www.minicircuits.com/pages/pdfs/dg03-110.pdf
  - https://awt-global.com/wp3/library/dbm-watt-conversion-tables.pdf
- Interesting factoid
  - **When you're receiving a very weak CW signal (around 0.1 microvolts) you're copying a signal that is 0.0000000000000002 watts (-127dBm)**
  - **Very good radio telescope RX 0.00000000000000001 watts (-150dBm)**

TINYSA DEMO