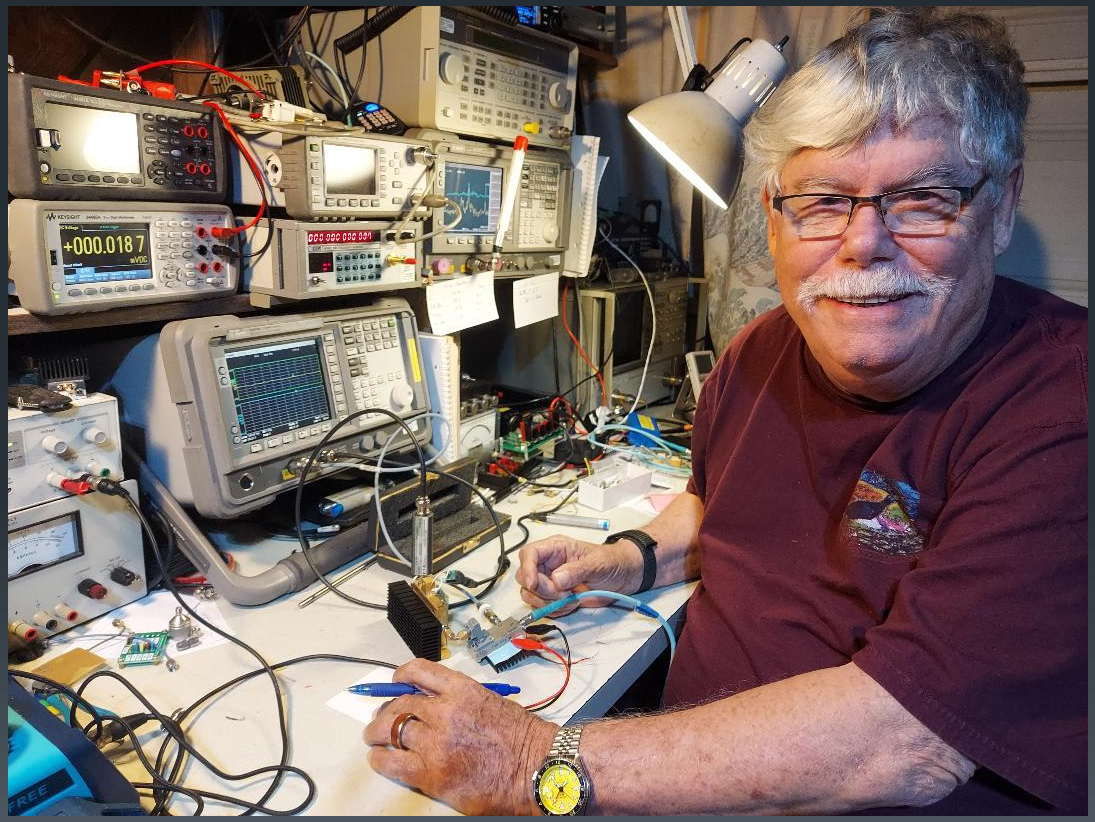
JEY Labs Presents

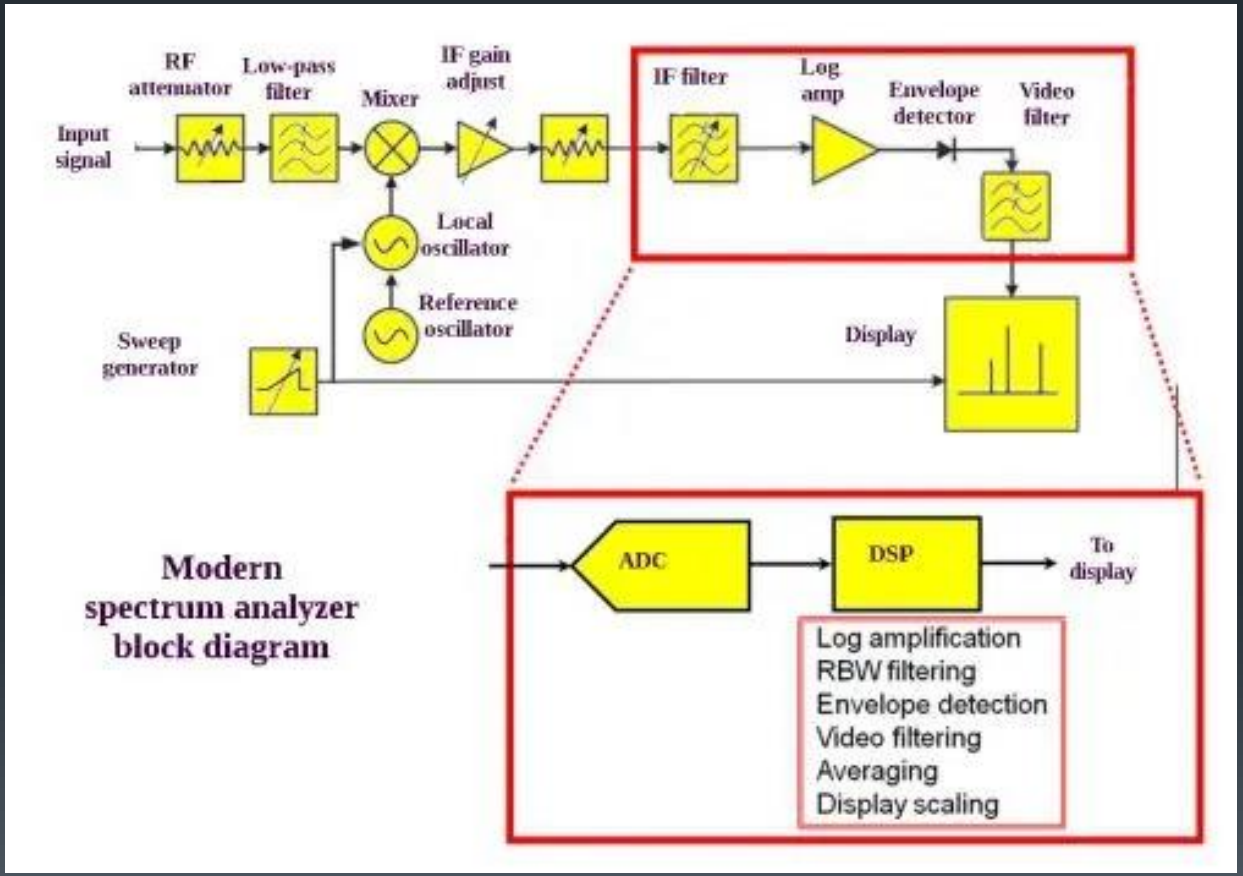


Spectrum Analyzer Technical History

Doug Millar
K6JEY

A history of major technical innovations in Microwave Spectrum Analyzers

What is it ? A bock diagram



Panadapters- The first analyzers

- Panadapters

as early as the 1940's.

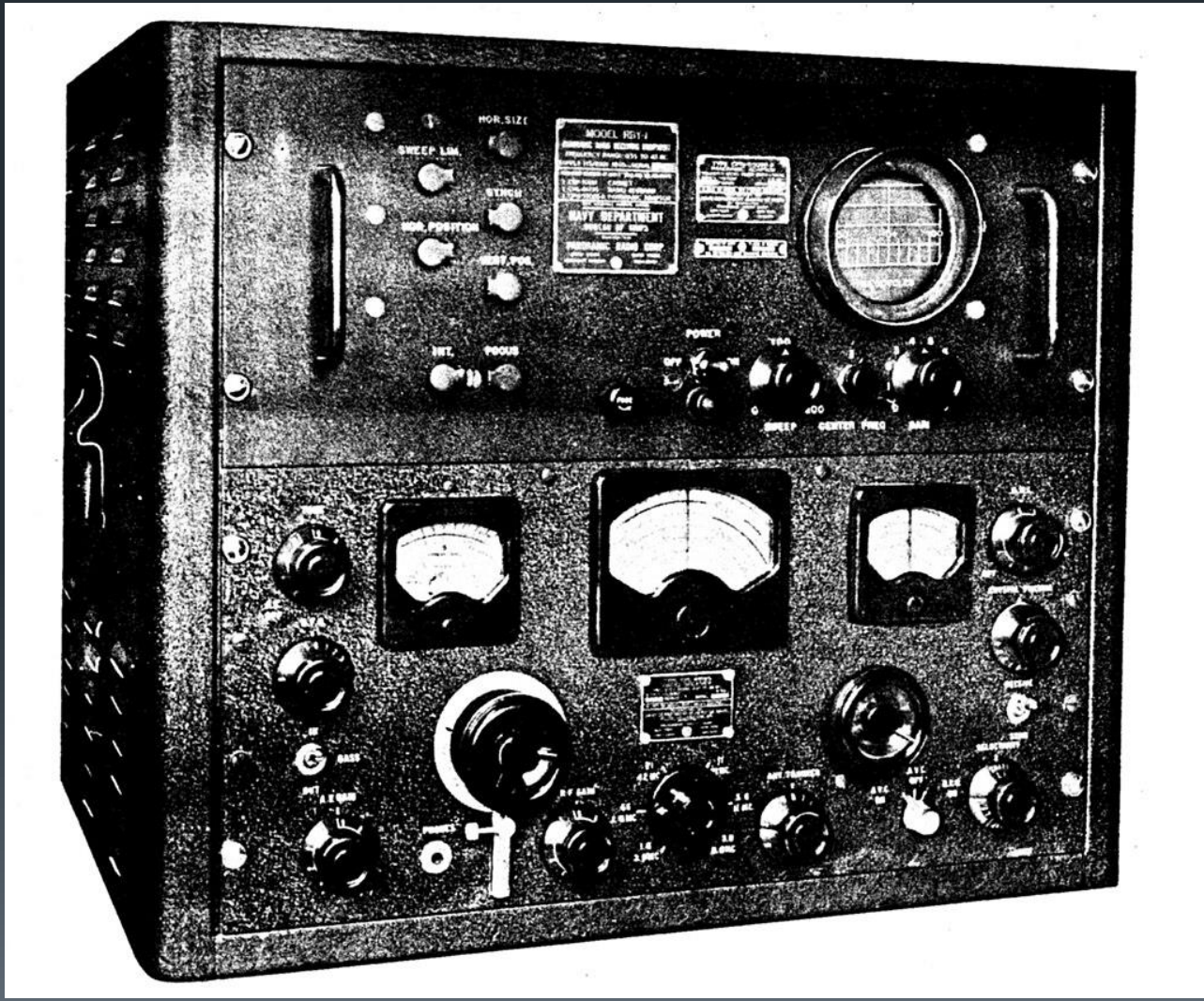
Used for surveillance.

Tapped in the RX IF chain.

Tunes with the RX.

100kc wide max sweep.

Amplitude relative.



Modern Panadapters

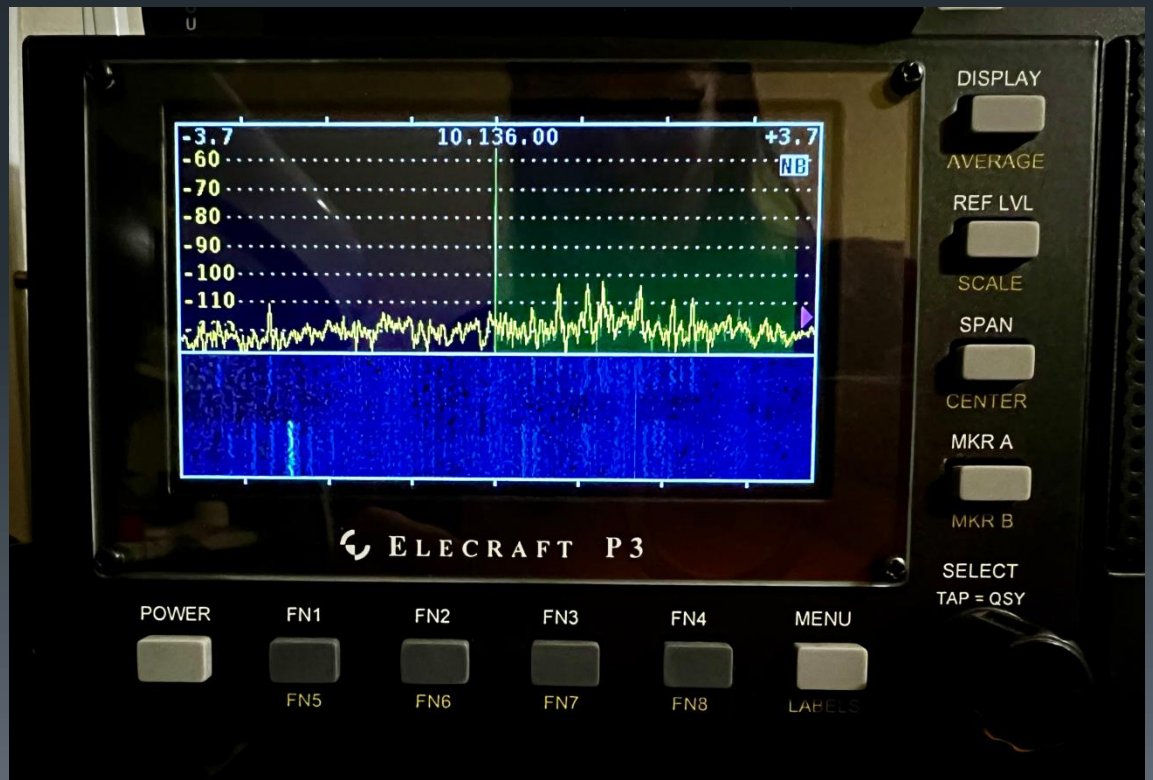
The Yaesu FTdx10.
It has been 80 years!

SDR-IQ

- Direct Sampling
- Computer does the heavy lifting
- Typical of many SDR receivers.

Elecraft P3

- Tracks both receivers
- External display has more detail
- Display can be used for other functions
- Input from .4-21MHz useful for many receivers



The Difference

- Panadapter-
  - Who and Where
  - Has demodulation as a goal
- Spectrum Analyzer-
  - What and Where
  - Has analysis as a goal

The First Analyzes
Early 60's

- Like the Polarad SA84W with only an attenuator and diode mixer in the front end.
- LO had limited sweep range
- Image problems at higher frequencies.
- 180lbs

Polarad SA84w
1955-62

Huge and Heavy

Went to 40GHz

Poor freq. resolution

Limited span

RfF image rejection is poor

Amplitude is not well calibrated.

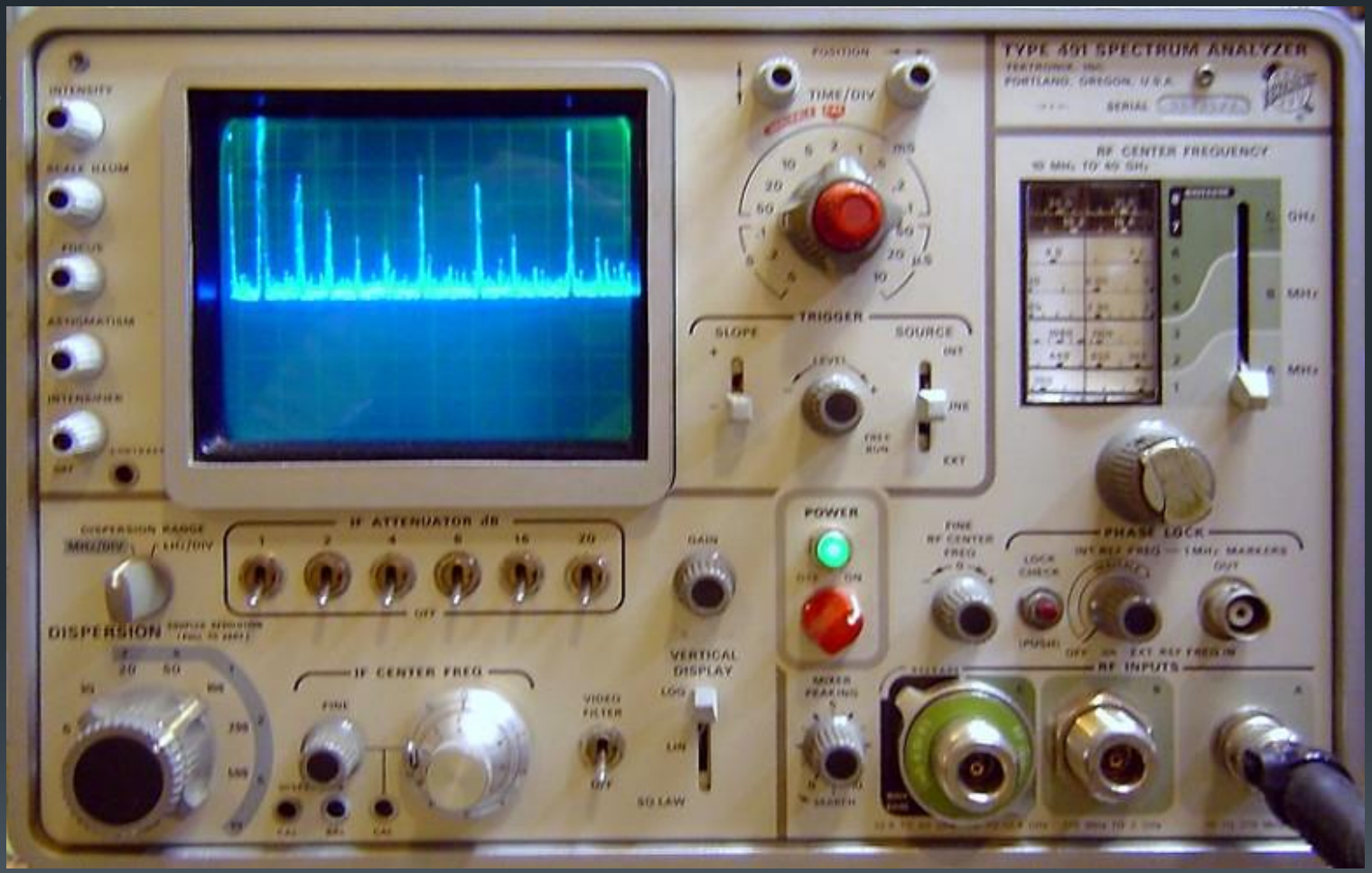
HP 8551 1965

Much Better

- BWO oscillator
- Good Attenuator
- Heavy but two boxes
- Swept 2GHz bandwidth
- 2GHz IF gave few images
- YIG osc. Modification
- Input was an attenuator and single diode mixer.

Tektronix 491 1967

Small
Very image prone
Limited sweep
width
Difficult to use.



HP 141T (8555) 1968

Yig oscillator
Good Amplitude cal
Microwave IF
Preamplifier,
Tracking filter available
The industry standard
For years.

A “full dresser”

Two choices on displays
4 tuning units
2 IF sections
Frequency counter
Tracking filter
Preamp
A huge number of cables

- Front end Still only
  an attenuator
  and Mixer

Pretty much what the
Tiny SA does.

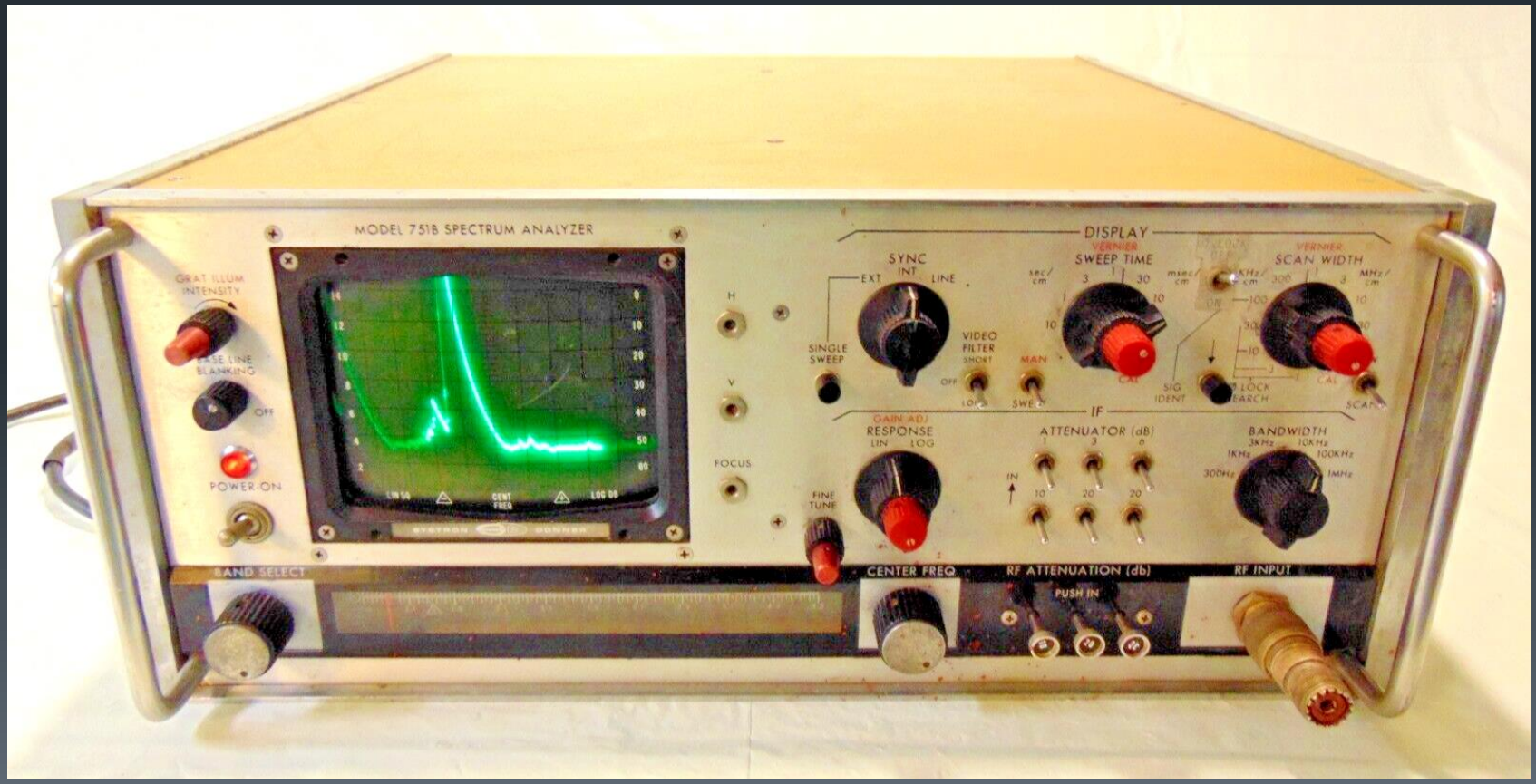
Crowded Field

Most analyzers up into the 90's were attenuator and single diode front ends.
Here are some of them-

Systron Donner
Rhode and Schwarz
Anritsu
Polarad 630 Series**VHP202ZT**

HP 141

Systron Donner

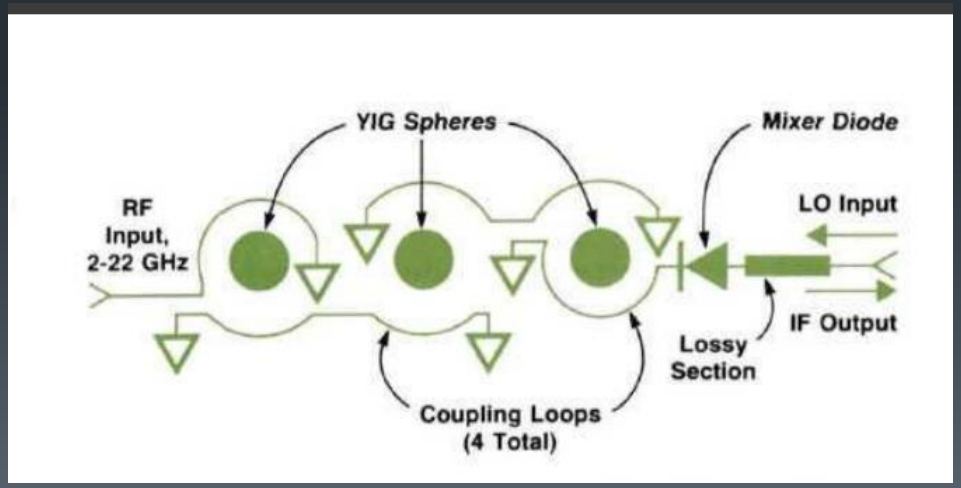


YIG Tracking Filter
A new day

Small
Easy to power
Multi stage
Electronically
steered.
High Q
YIG= Yttrium Iron Garnet

Put between an attenuator
And the mixer gives
Single signal reception

YIG Preselector and
Detector from the
HP8566 series.



AIL 707 1972

One of the first
Very expensive
Poor IC sockets
Big and heavy
Made for Govt

HP 8568A 1978

8568B 1980 better CPU

HP takes the market
by storm
Ultimate analyzer
for years
All the modern features
With low integration IC's
made it huge and heavy
Self calibrating
3 CPUs
Yig tuned first mixer
First GPIB analyzer
On screen annotation

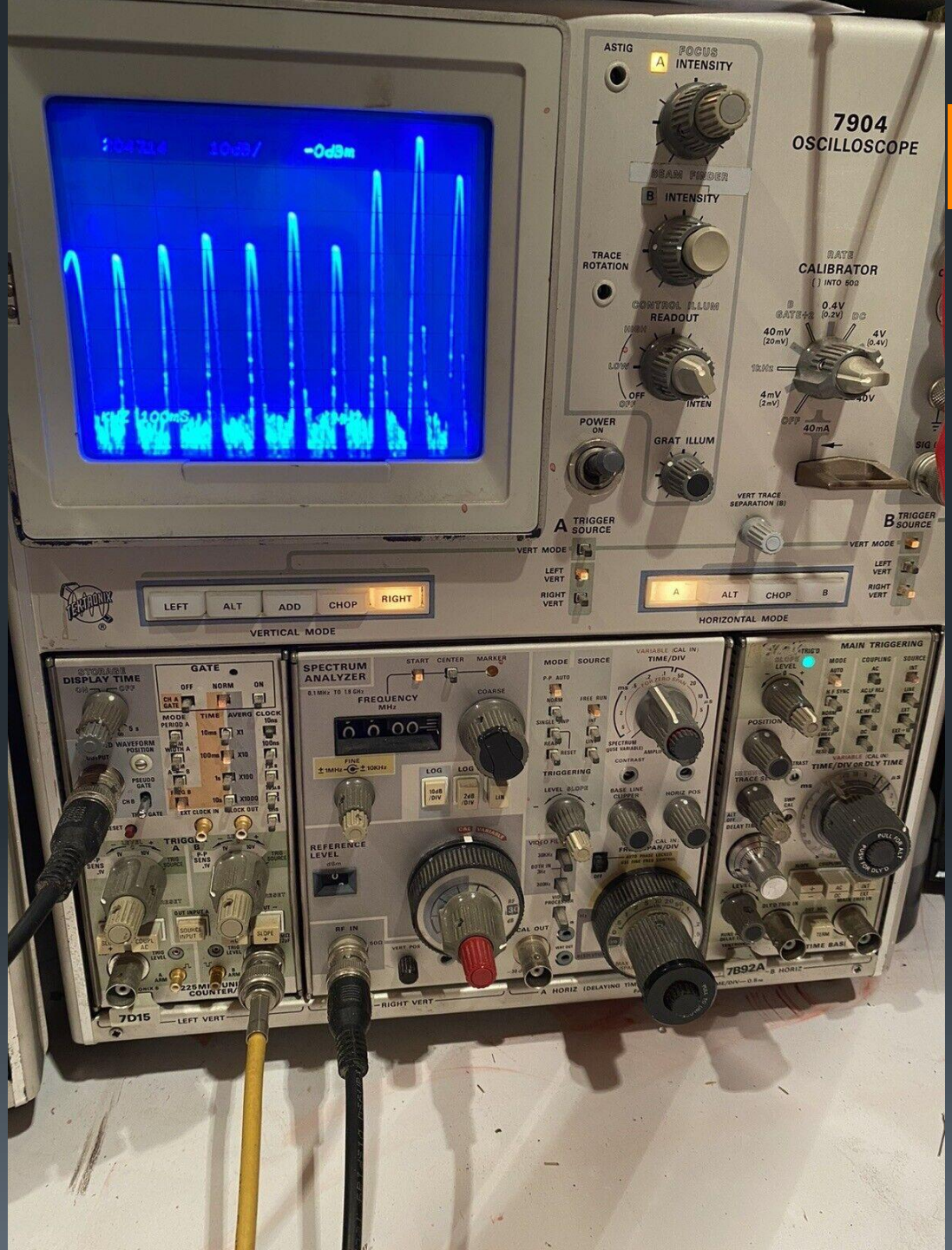
Still used

HP 8569B

A good step forward. Digital display. Very wide frequency range and good screen Annotation. Very bad switch design.

Tek 7L12 Analyzer

Lots of controls
But generally
Vague results.



Last of the CRT's

Advances in CPUs made them smaller

Tek 494AP 1987
Frequency counter
Accurate Amplitude Markers

Hp 8560 series 1991
Frequency counter
Excellent Amplitude markers

Agilent E4407B 2004
LCD, Windows CE, RF Box, FPGA

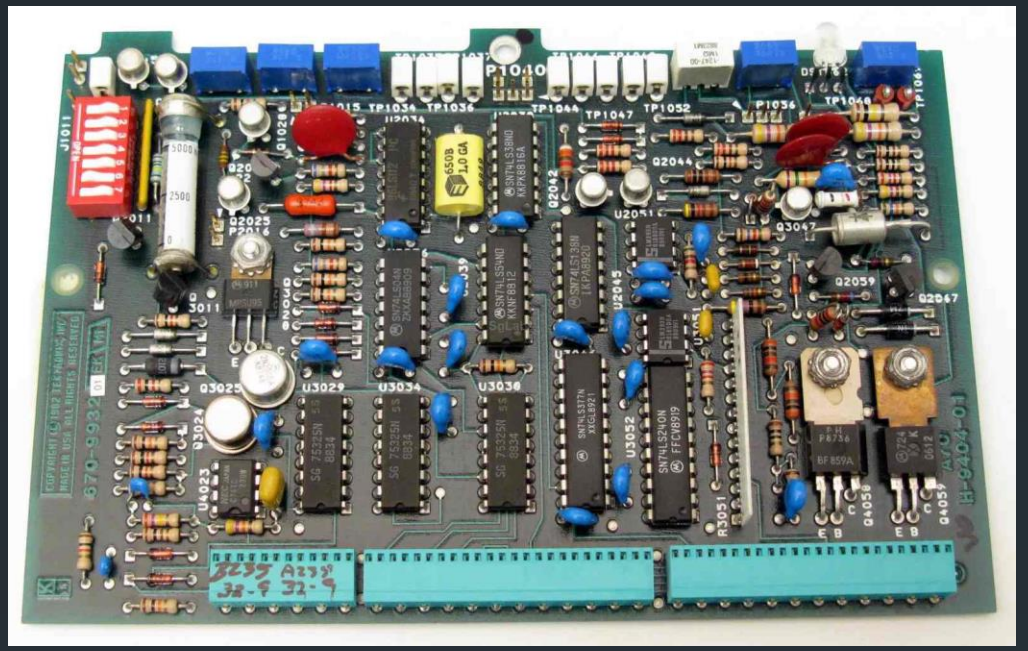
Advances

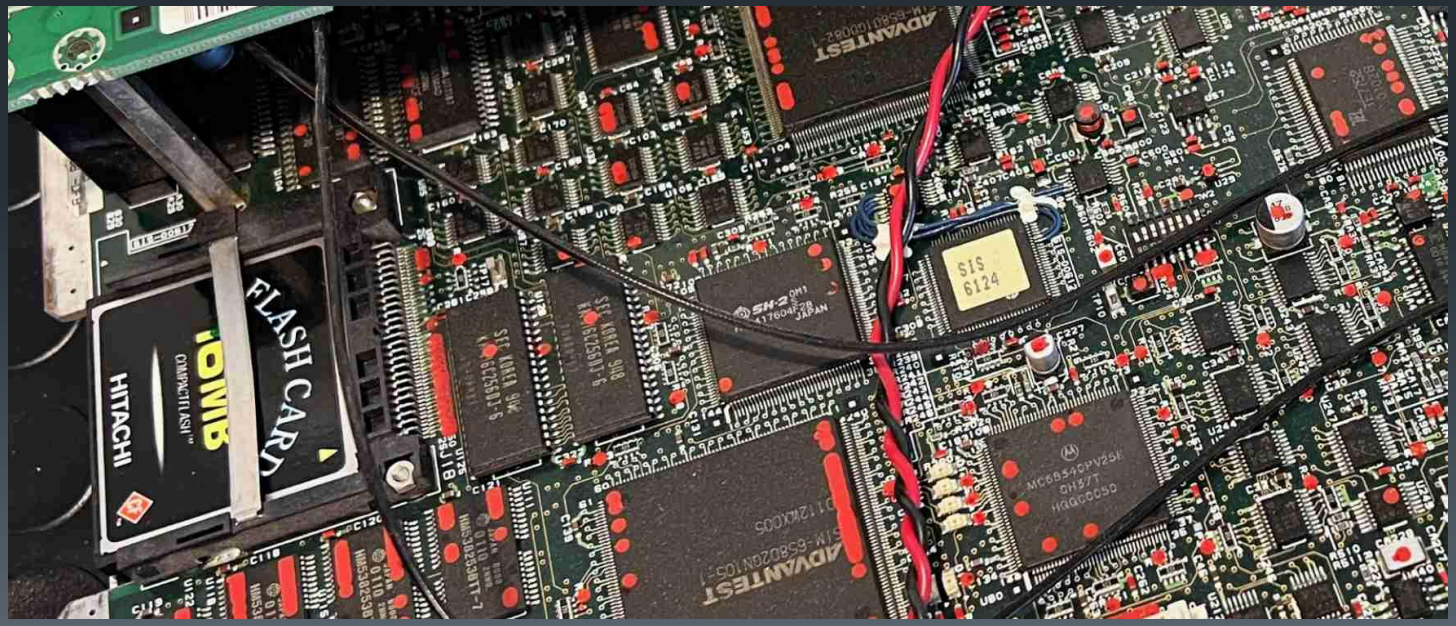
Simpler, better shielding and lower power
Easier to work on
Follows computer developments 1991-2004
Surface mount parts and higher density
FPGA and DSP do the heavy lifting
Most features in software
    Much more complex with new programs
      Noise figure, power measurement, digital modes
       east to measure
LCD gives better display and lighter, more trouble free
VGA output
External programs limited

How Dense?

1990-

2004





Lone Pine ↑

←New York City

Hand Held

Full Featured, 50GHz models, Portable

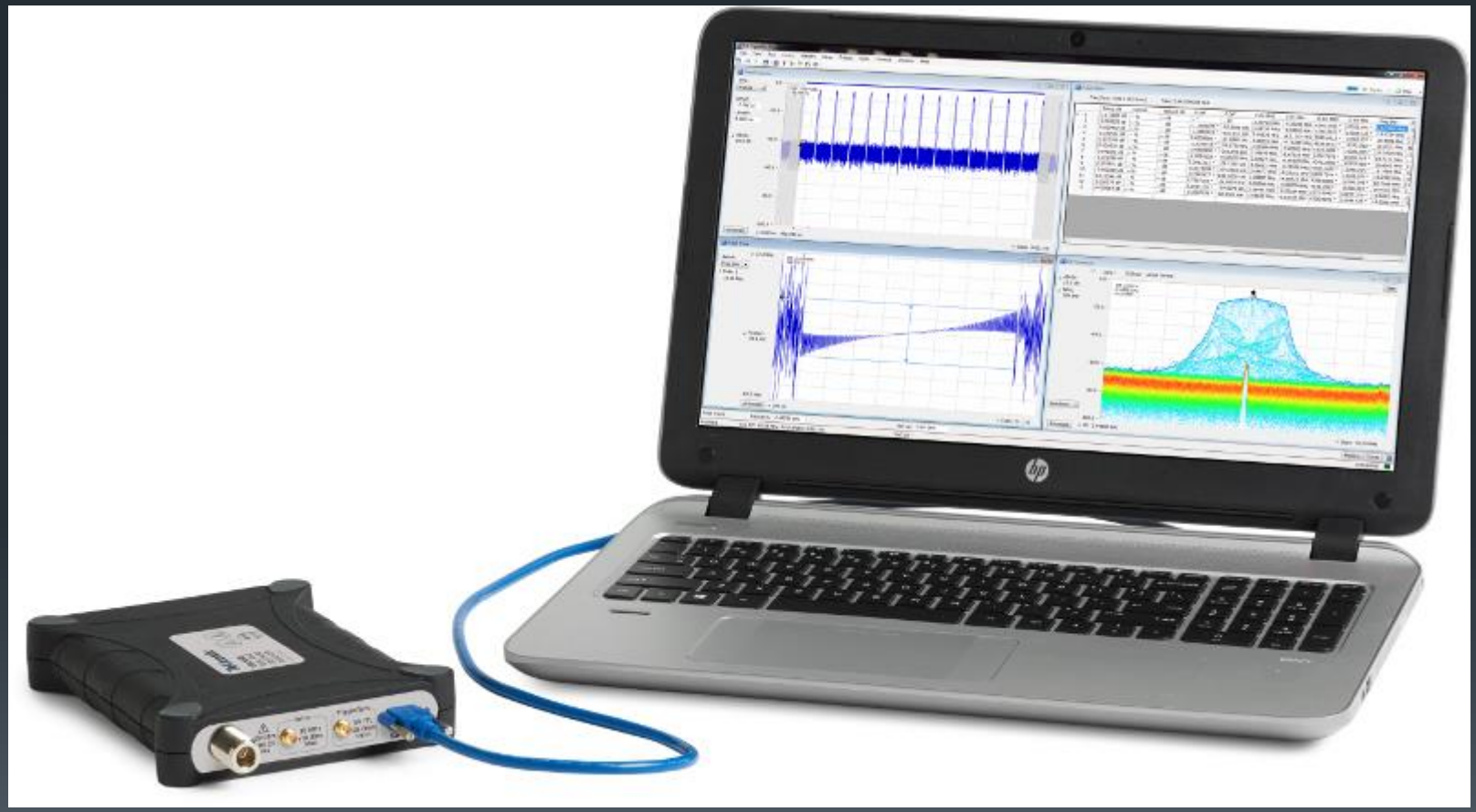
Agilent FieldFox
2014

Field Fox

Anritsu MS2712e
2023

Real Time Spec. An. Via USB

Tektronix RSA308B



How Does it Work?

Two Main Techniques
- FFT transform from time domain to frequency
- Wide bandwidth direct sampling A/D conversion

Both techniques eliminate the blank spots caused by displaying the signals using a swept display.

Current High End
UXA N9041b

2hz to 110GHz
Extensive and complex networking
Large Screen 14”
Real time SA

$200,000

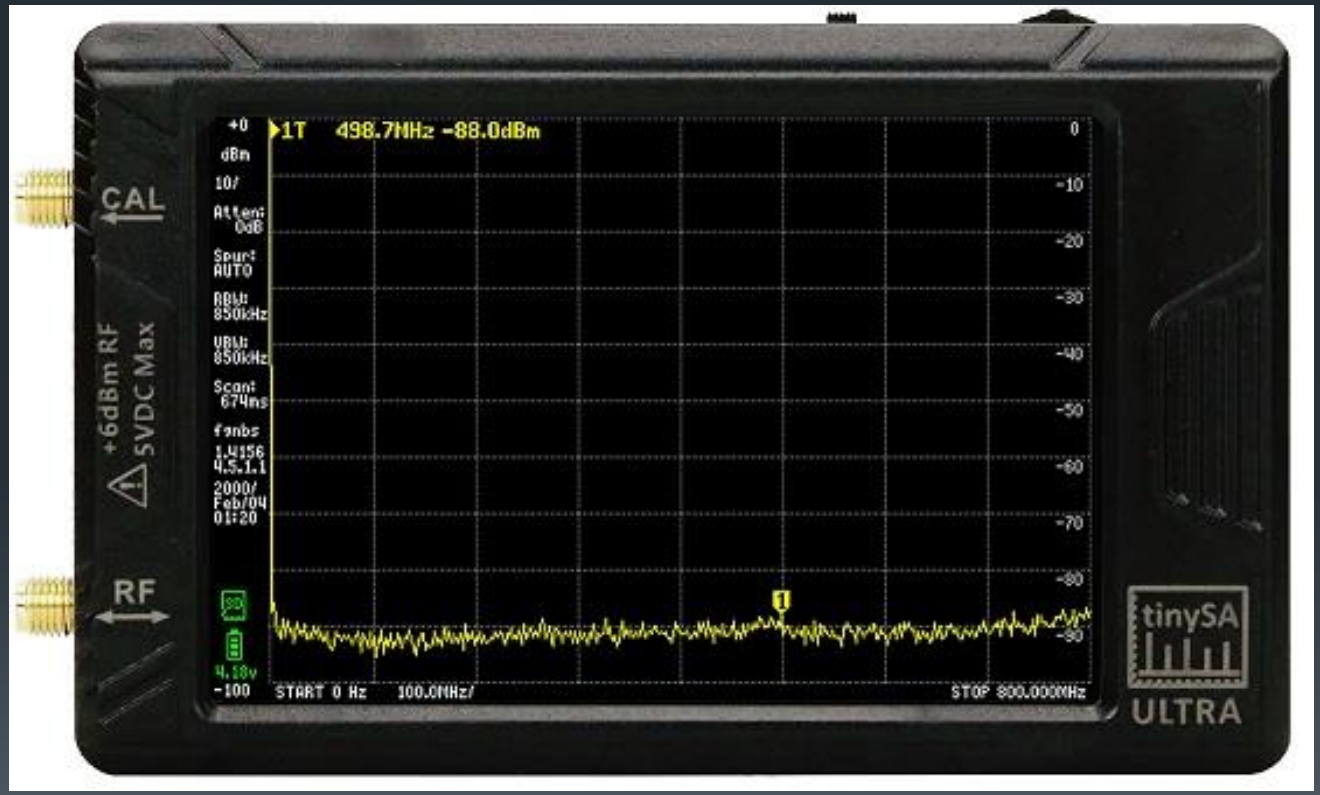
Tiny SA Ultra
Poor Man's "FieldFox"

100KHz- 10GHz

Attenuator
LNA

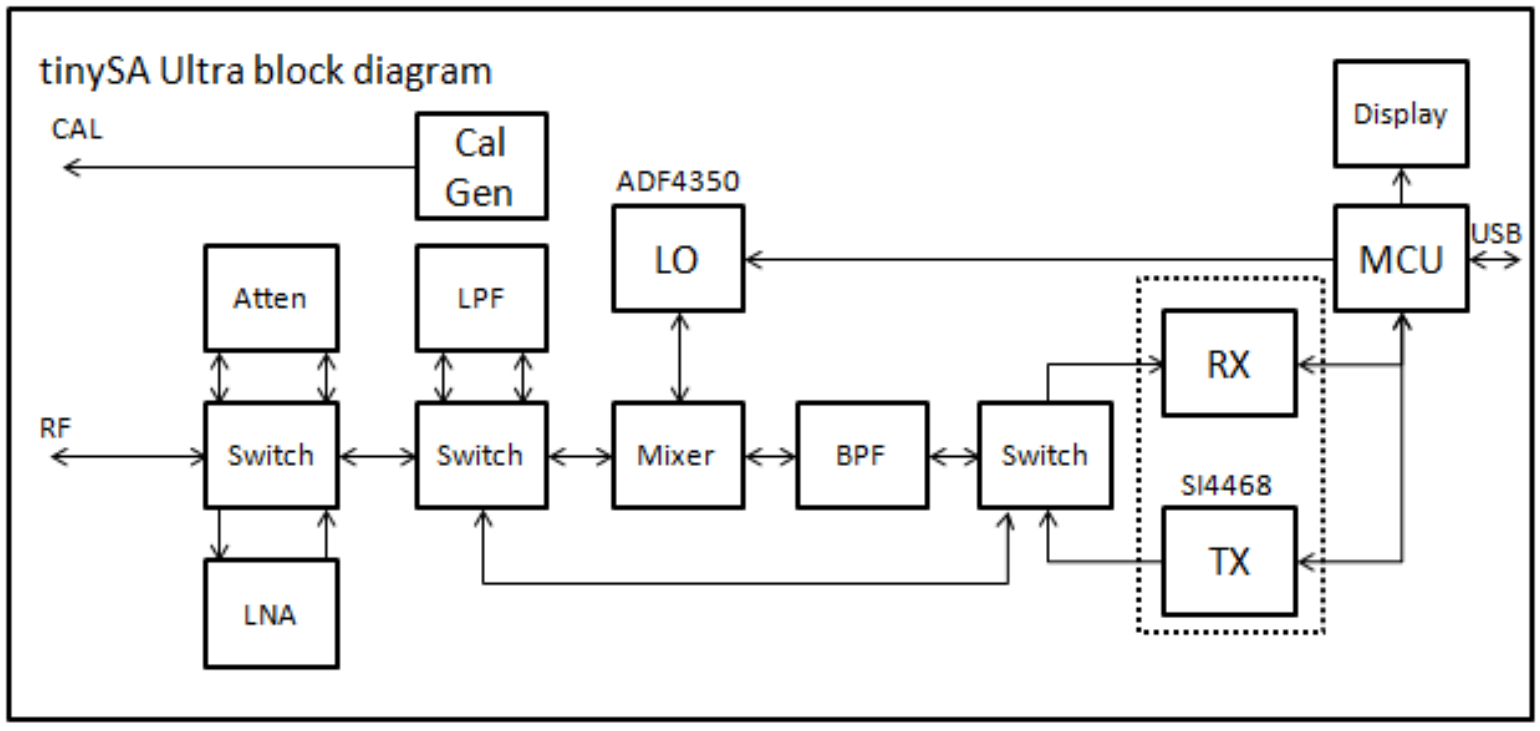
Dual conversion with
980MHz 1st IF.
Triple balanced Mixer
Front end

Good calibration in
Frequency
Amplitude

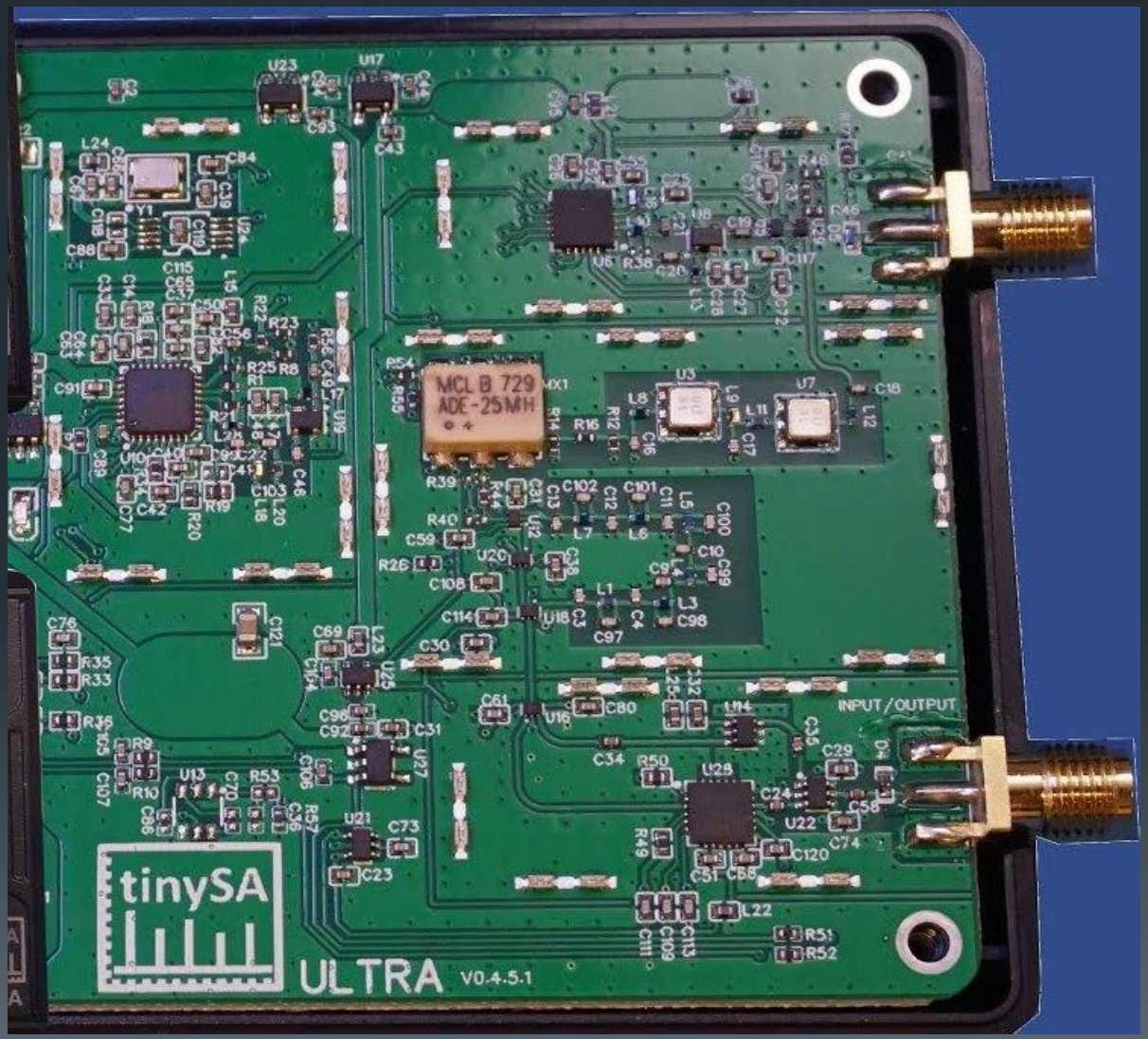


Block Diagram

1ST IF is 980MHz
2nd IF is 870KHz/SDR



Tiny SA Ultra Inside



SDR

Generator output

Mixer, filters

Switched filter

Attenuator, LNA, Input

So much for history
Which one of these beauties should you get?

So you want to get an analyzer-

- Get one with low hours
- Get the best one you can, you will keep it longer
- Set your sights and watch the prices.
- Set your price range. <$2,000 is good
- Check with friends. If they upgraded, you might get their older one.
- Stay away from HP 8559a plug in types
- HP EXA analyzers (e4407b) are less problem prone and there are lots of spares.

GET A DC BLOCK for the input.

Resources

Technical Paper on HP 8566

https://hpmemoryproject.org/an/pdf/hpj_aug79_ocr.pdf

Questions?