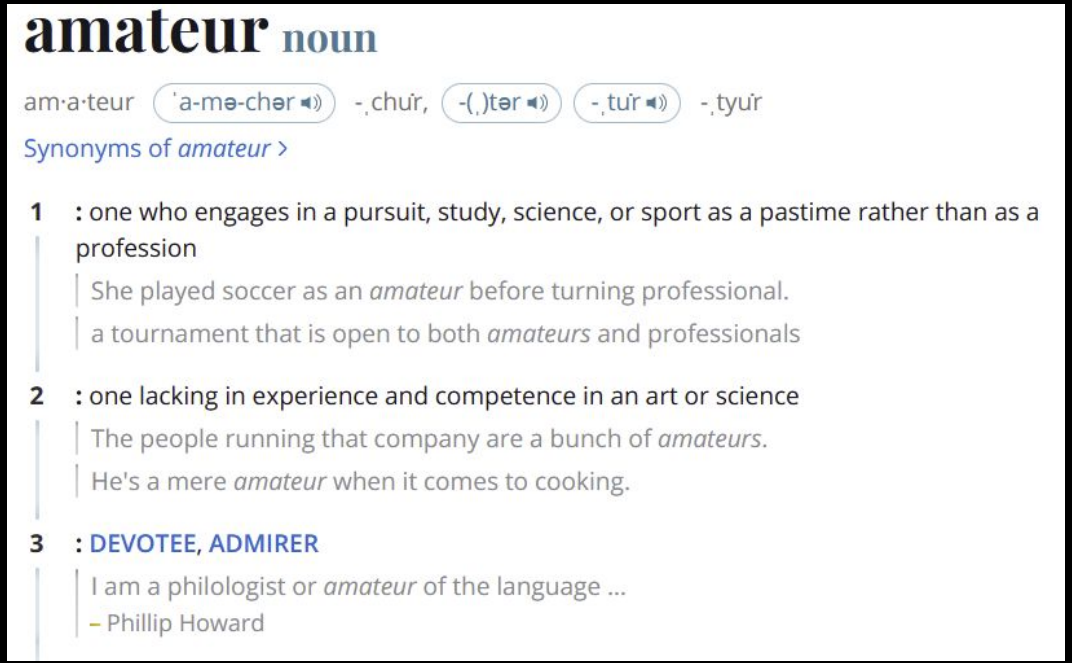
SPURRIOUS EMISSIONS

by Claus Niesen (AE0S)

February 1st, 2024
Story County Amateur Radio Club

Disclaimer

I’m a licensed **amateur** radio operator!



amateur noun

am·a·teur ˈa-mə-chər -ˌchu̇r, -(ˌ)tər -ˌtu̇r -ˌtyu̇r

Synonyms of *amateur* ›

1 : one who engages in a pursuit, study, science, or sport as a pastime rather than as a profession

- She played soccer as an *amateur* before turning professional.
- a tournament that is open to both *amateurs* and professionals

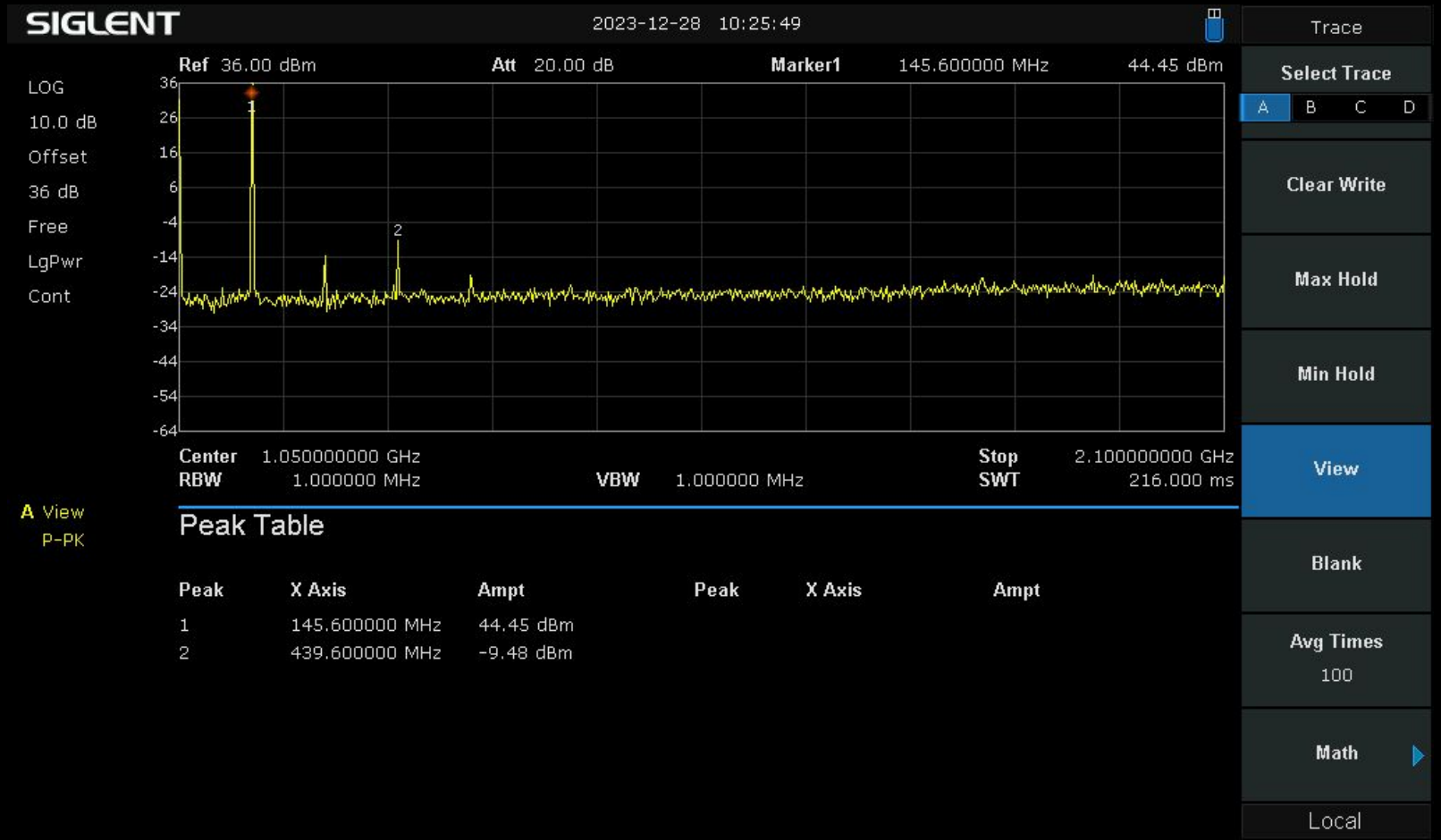
2 : one lacking in experience and competence in an art or science

- The people running that company are a bunch of *amateurs*.
- He's a mere *amateur* when it comes to cooking.

3 : DEVOTEE, ADMIRER

- I am a philologist or *amateur* of the language ...
  – Phillip Howard

What are Spurious Emissions?



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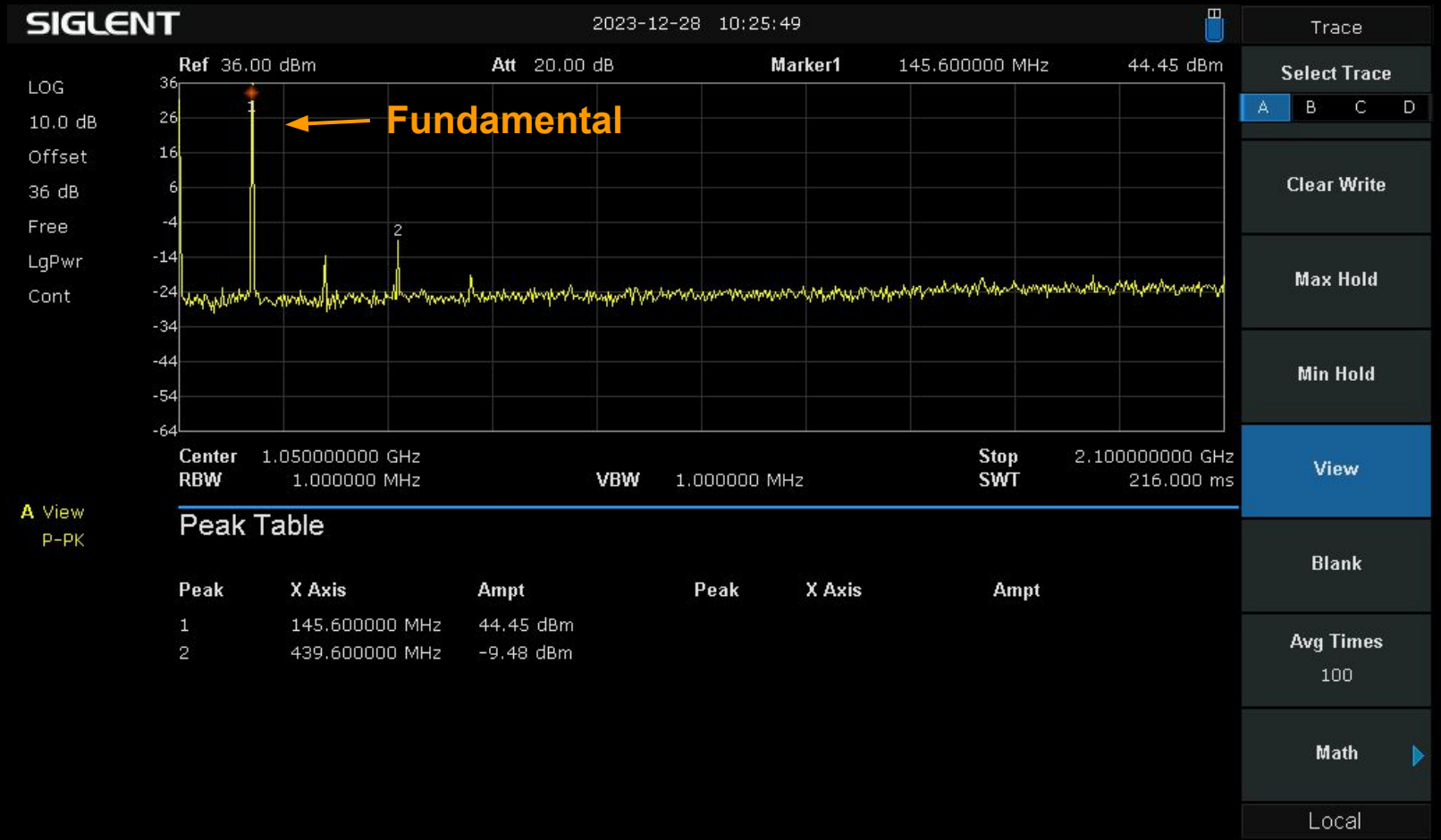

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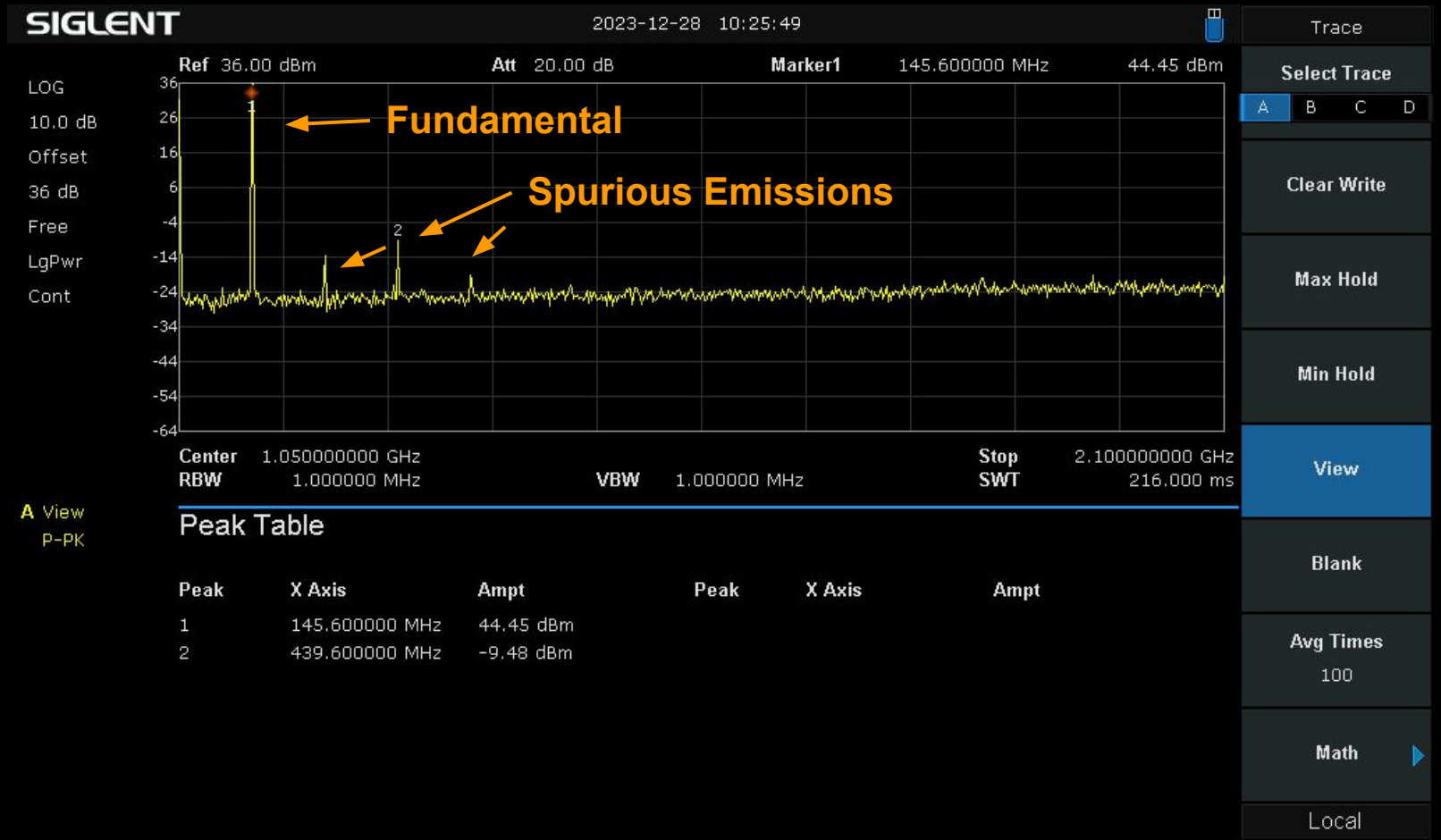

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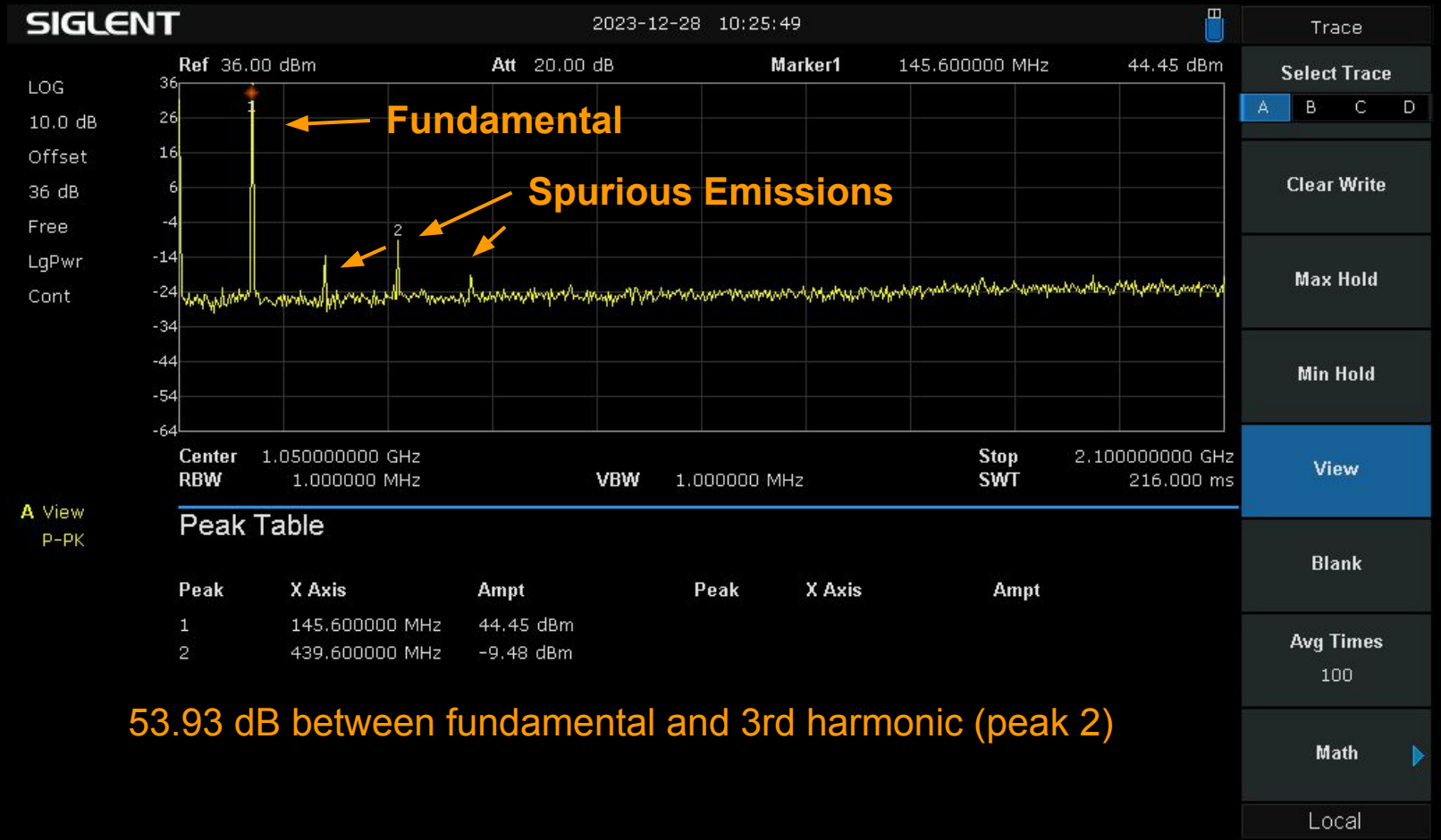


53.93 dB between fundamental and 3rd harmonic (peak 2)

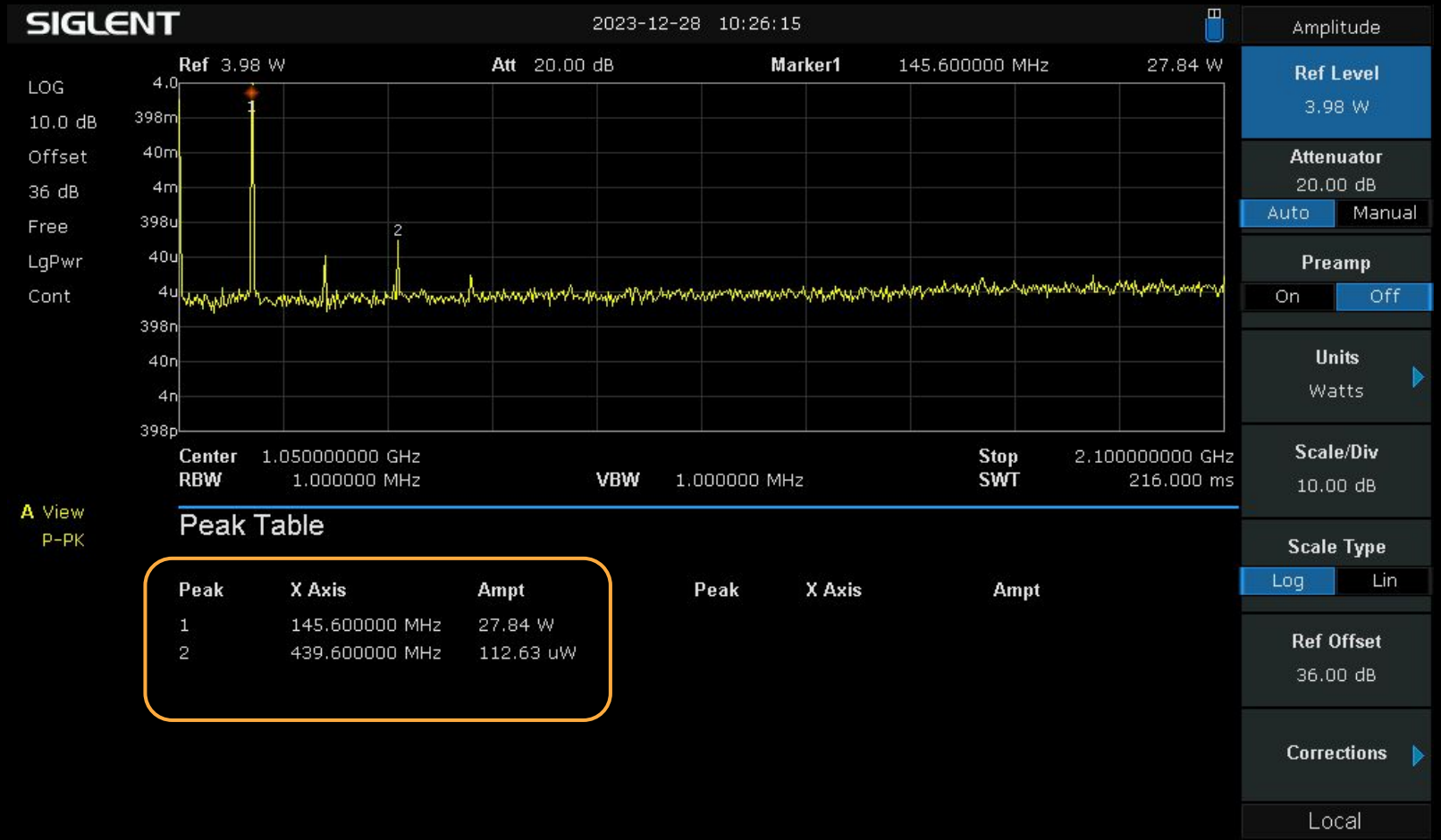
What are Spurious Emissions?

50 dBm	100 W
40 dBm	10 W
30 dBm	1 W
20 dBm	100 mW
10 dBm	10 mW
0 dBm	1 mw

-50 dBm	10 nW
-40 dBm	100 nW
-30 dBm	1 µW
-20 dBm	10 µW
-10 dBm	100 µW
0 dBm	1 mw

Nice online calculator: https://www.lasercalculator.com/gain-loss-calculator/

What are Spurious Emissions?



FCC Rule 47 CFR 97.307(c)

All spurious emissions from a station transmitter must be reduced to the greatest extent practicable. If any spurious emission, including chassis or power line radiation, causes harmful interference to the reception of another radio station, the licensee of the interfering amateur station is required to take steps to eliminate the interference, in accordance with good engineering practice.

FCC Rule 47 CFR 97.307(d)

For transmitters installed after January 1, 2003, the mean power of any spurious emission from a station transmitter or external RF power amplifier transmitting on a frequency below 30 MHz must be at least 43 dB below the mean power of the fundamental emission. For transmitters installed on or before January 1, 2003, the mean power of any spurious emission from a station transmitter or external RF power amplifier transmitting on a frequency below 30 MHz must not exceed 50 mW and must be at least 40 dB below the mean power of the fundamental emission. For a transmitter of mean power less than 5 W installed on or before January 1, 2003, the attenuation must be at least 30 dB. A transmitter built before April 15, 1977, or first marketed before January 1, 1978, is exempt from this requirement.

Spurious Emissions must be

Below 30 MHz and installed after January 1, 2003

- 43dB below fundamental
  - At 1500W this would be 75 mW
  - At 100W this would be 5 mW
  - At 5W this would be 251 µW
  - At 1W this would be 50 µW

Below 30 MHz and installed on or before January 1, 2003

- For any fundamental 500 W or more: not more than 500 mW
- For any fundamental 5 W or more: 40 dB below fundamental
  - At 5 W this would be 50 µW
- For any fundamental less than 5 W: 30 dB below fundamental
  - At 1 W this would be 1 mW

FCC Rule 47 CFR 97.307(e)

The mean power of any spurious emission from a station transmitter or external RF power amplifier transmitting on a frequency between 30–225 MHz must be at least 60 dB below the mean power of the fundamental. **For a transmitter having a mean power of 25 W or less, the mean power of any spurious emission supplied to the antenna transmission line must not exceed 25 µW and must be at least 40 dB below the mean power of the fundamental emission, but need not be reduced below the power of 10 µW.** A transmitter built before April 15, 1977, or first marketed before January 1, 1978, is exempt from this requirement.

Spurious Emissions must be

Between 30–225 MHz and more than 25 Watts

- 60dB below fundamental
  - At 100W this would be 100 µW
  - At 50W this would be 50 µW

Between 30–225 MHz and 25 Watts or less

- For any fundamental 250 mW or more: not more than 25 µW
- For any fundamental less than 250 mW: 40dB below fundamental or 10 µW

Ham Bands and Harmonics

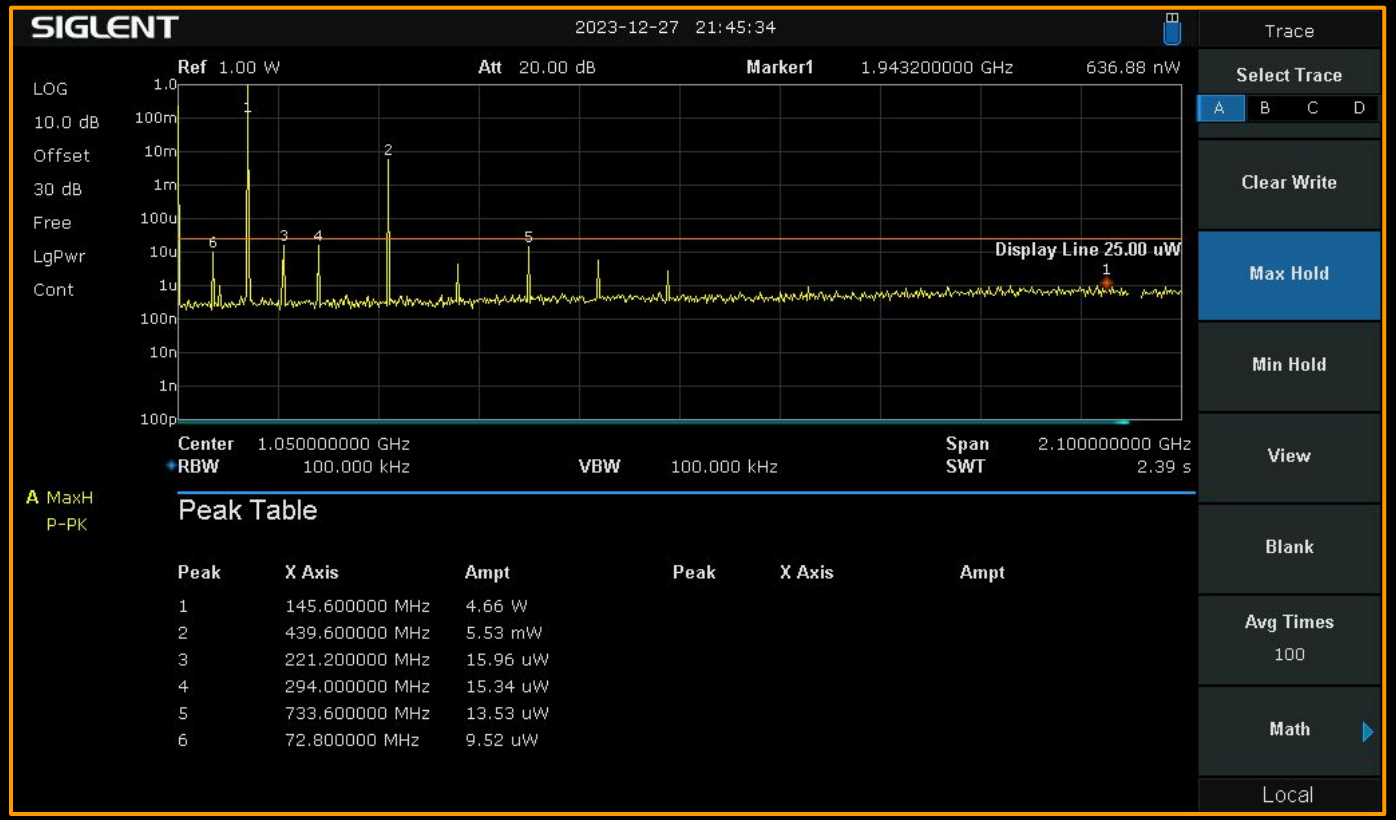
160m: 1.8 - 2.0 MHz
Harmonics: 3.6-4 MHz (80m), 5.4-6 MHz, 7.2 - 8 Mhz (40m)
80m: 3.5 - 4 MHz
Harmonics: 7 - 8 MHz (40m), 10.5 - 12 MHz, 14 - 16 Mhz (20m)
40m: 7 - 7.3 MHz
Harmonics: 14 - 14.6 Mhz (20m), 21 - 21.9 Mhz (15m), 28 - 29.2 MHz (10m)
20m: 14 - 14.35 MHz
Harmonics: 28 - 28.7 MHz (10m)

2m: 144 - 148 MHz
Harmonics: 288 - 296 MHz, 432 - 444 Mhz (70 cm)

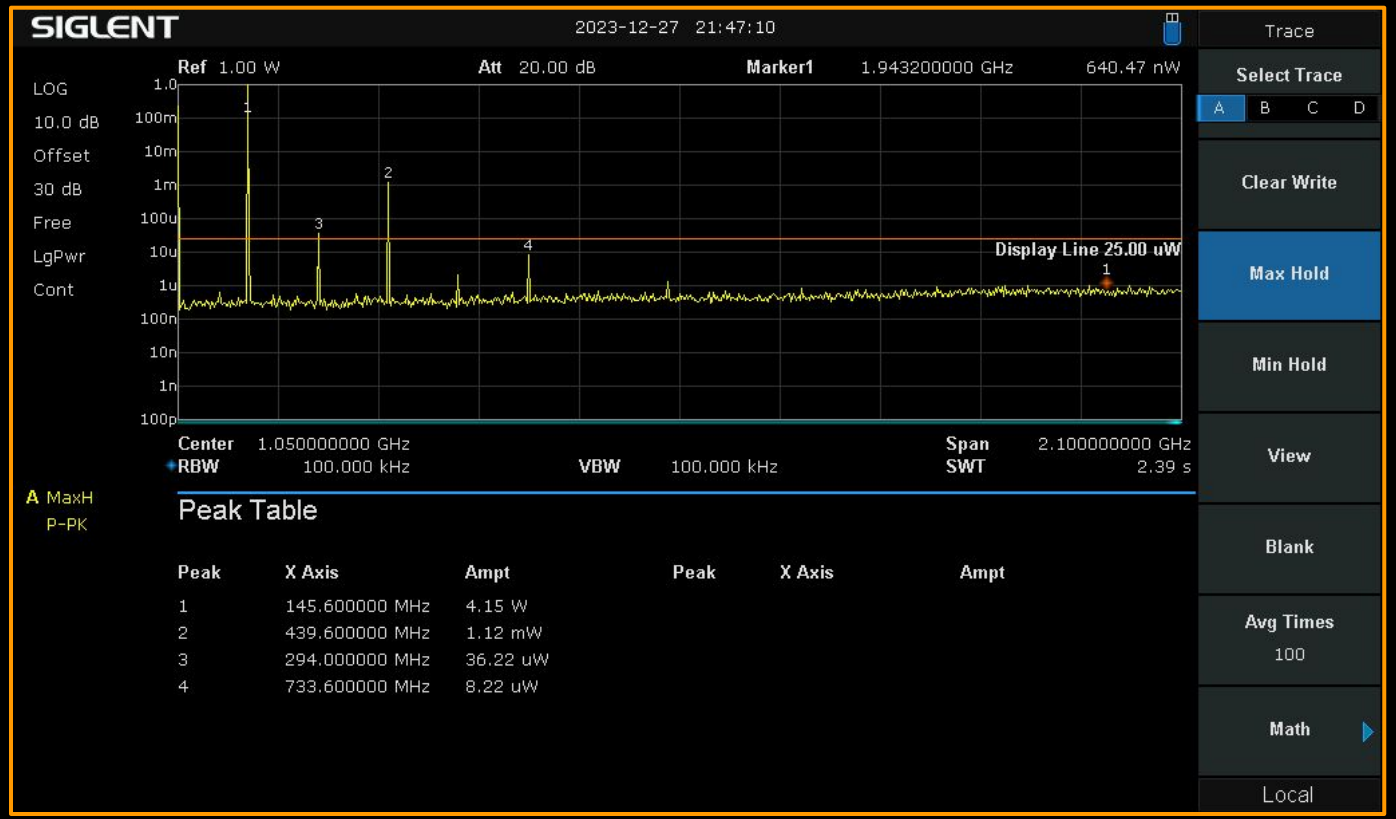
Test Candidates

Test Candidates

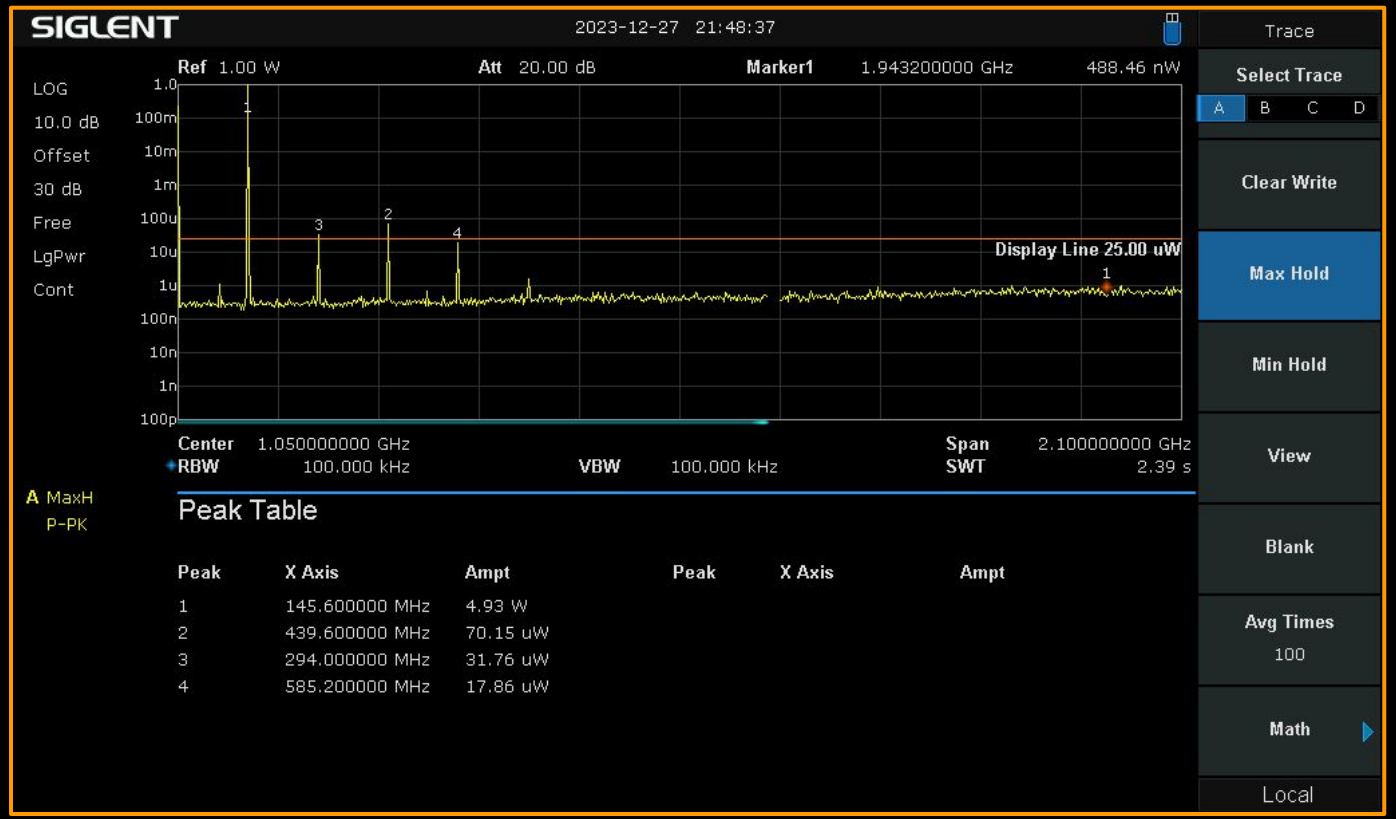
1 Baofeng UV-82



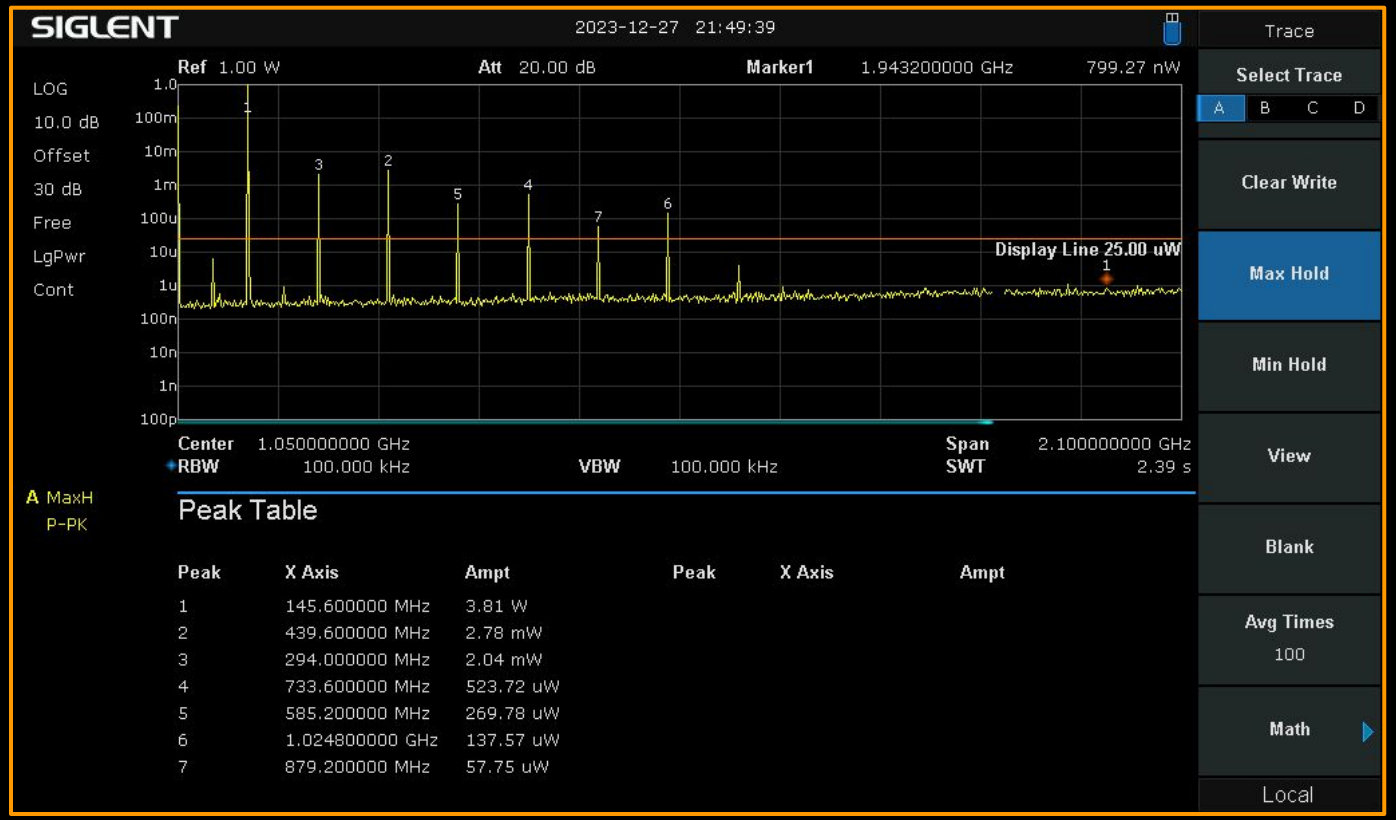
2 Baofeng UV-82



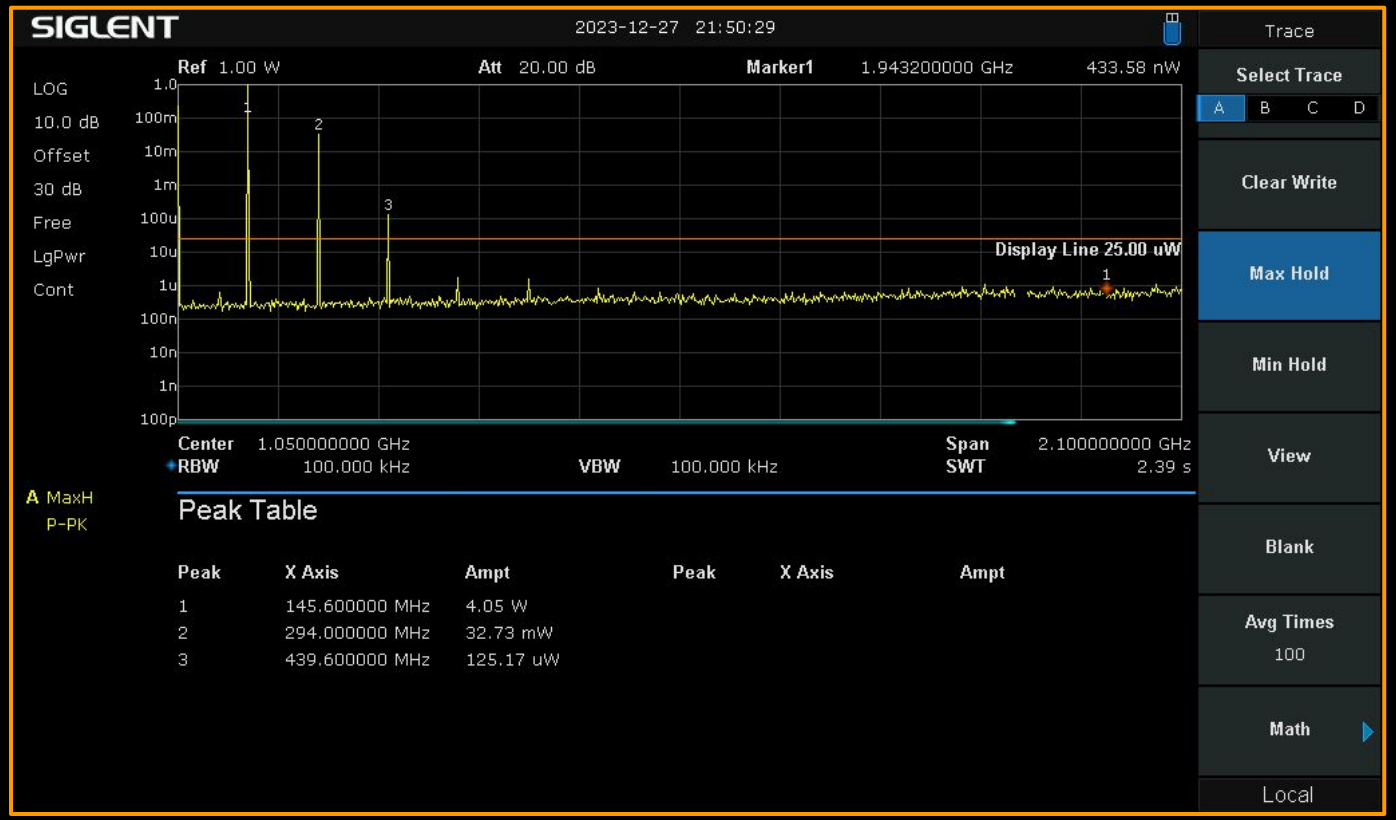
3 Baofeng UV-82



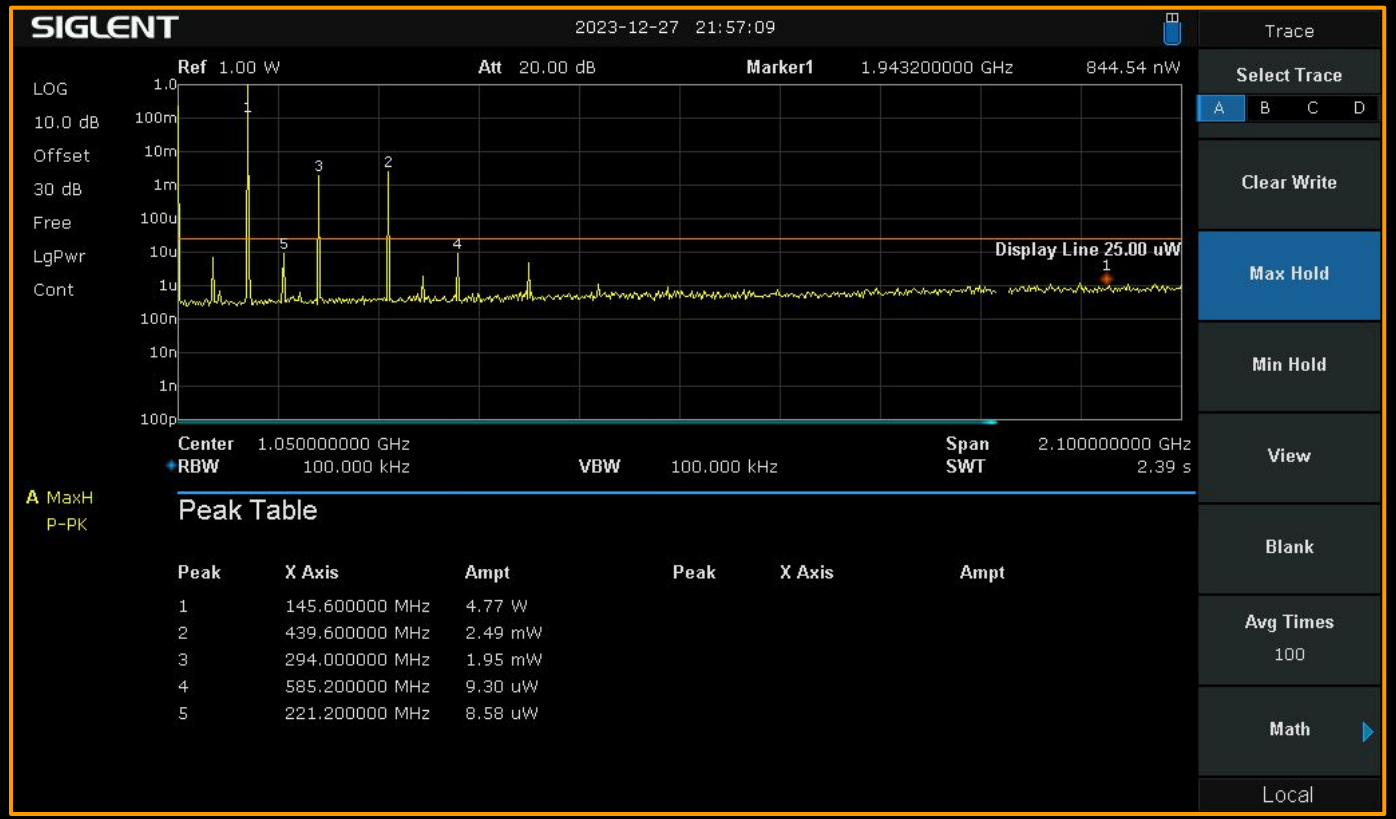
4 Baofeng UV-82



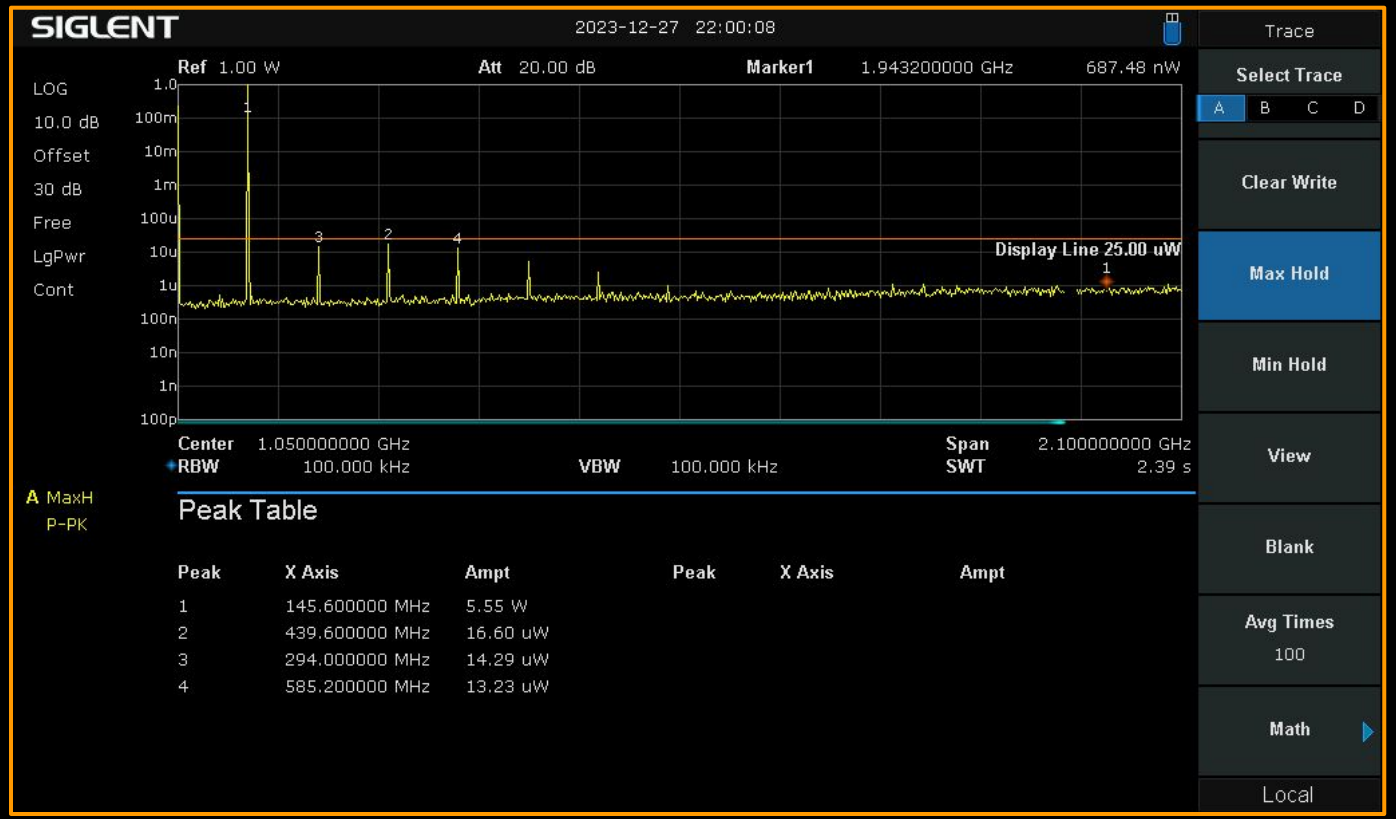
5 Baofeng UV-S9 Plus



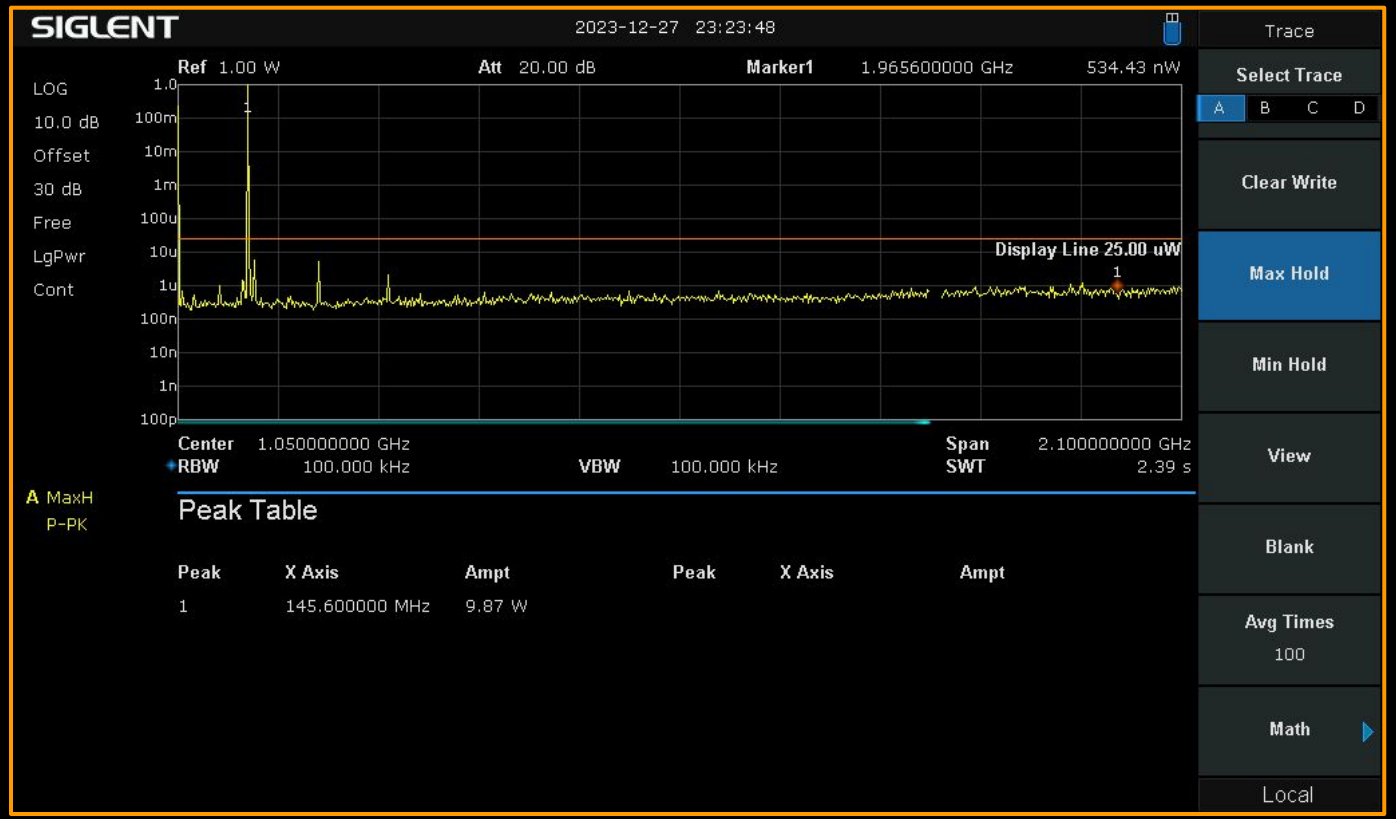
6 Baofeng UV-82T



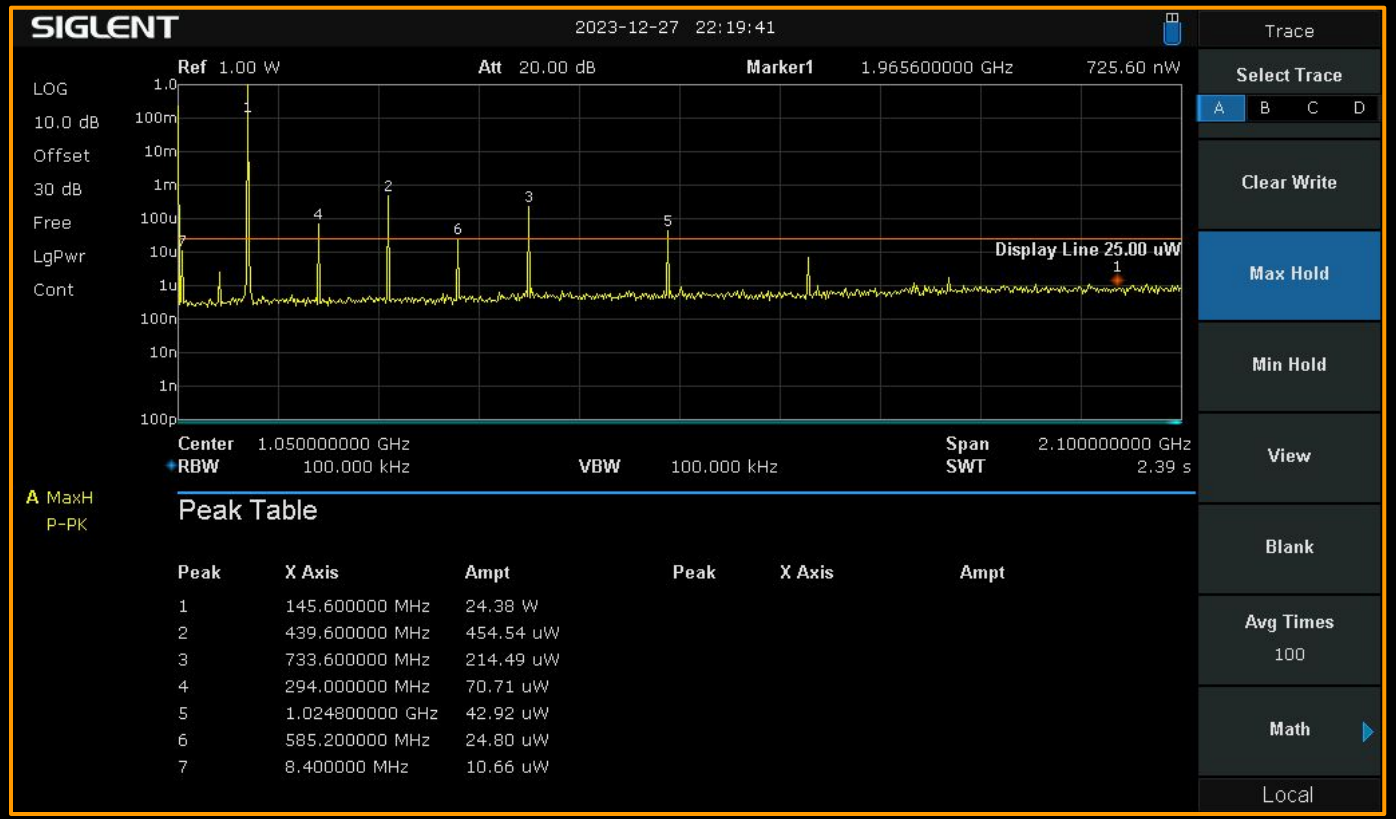
7 Yaesu VX-6R


SIGLENT
2023-12-27 22:00:08
Ref 1.00 W
Att 20.00 dB
Marker1 1.943200000 GHz 687.48 nW
LOG
10.0 dB
Offset
30 dB
Free
LgPwr
Cont
1.0
100m
10m
1m
100u
10u
1u
100n
10n
1n
100p
Display Line 25.00 uW
Center 1.050000000 GHz
RBW 100.000 kHz
VBW 100.000 kHz
Span 2.100000000 GHz
SWT 2.39 s
A MaxH
P-PK
Peak Table
Peak X Axis Ampt Peak X Axis Ampt
1 145.600000 MHz 5.55 W
2 439.600000 MHz 16.60 uW
3 294.000000 MHz 14.29 uW
4 585.200000 MHz 13.23 uW
Trace
Select Trace
A B C D
Clear Write
Max Hold
Min Hold
View
Blank
Avg Times
100
Math
Local

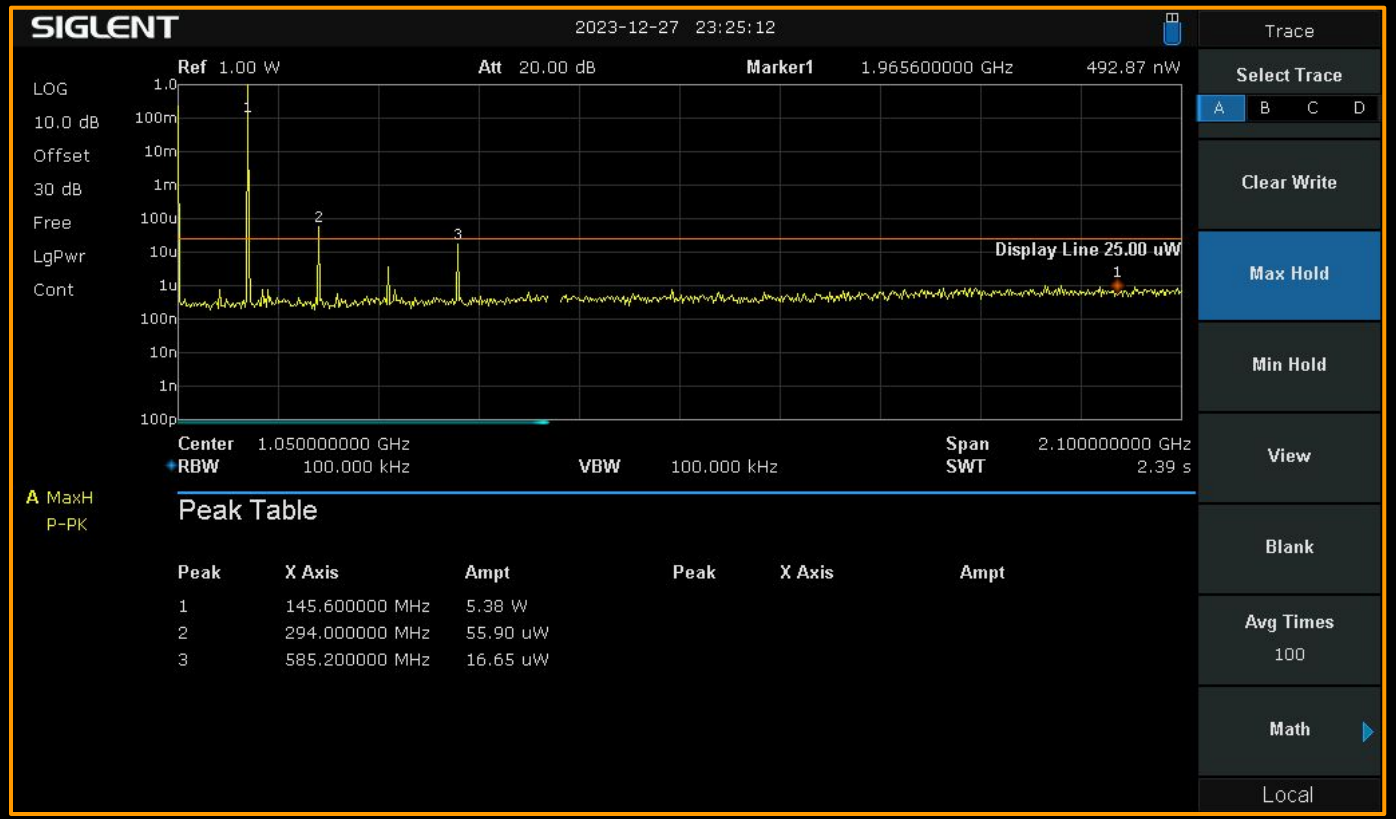
8 Yaesu FT-857



9 TYT TH-8600


SIGLENT
2023-12-27 22:19:41
Trace
Ref 1.00 W
Att 20.00 dB
Marker1 1.965600000 GHz
725.60 nW
LOG
10.0 dB
Offset
30 dB
Free
LgPwr
Cont
1.0
100m
10m
1m
100u
10u
1u
100n
10n
1n
100p
Display Line 25.00 uW
Select Trace
A B C D
Clear Write
Max Hold
Min Hold
View
Blank
Avg Times
100
Math
Local
Center 1.050000000 GHz
Span 2.100000000 GHz
RBW 100.000 kHz
VBW 100.000 kHz
SWT 2.39 s
A MaxH
P-PK
Peak Table
Peak X Axis Ampt Peak X Axis Ampt
1 145.600000 MHz 24.38 W
2 439.600000 MHz 454.54 uW
3 733.600000 MHz 214.49 uW
4 294.000000 MHz 70.71 uW
5 1.024800000 GHz 42.92 uW
6 585.200000 MHz 24.80 uW
7 8.400000 MHz 10.66 uW

9 TYT TH-8600 low power



Test Candidates

Test Candidates

The Realization!

6 Baofeng @ $30 = $180

Brand Name

- Yaesu FT-4XR $90
- Yaesu FT-65R $110
- Yaesu FT-60R $155

- Yaesu VX-6R $250

What’s next for me?

- Buying new transceivers
- Exploring filters (low pass / band pass)
- Modifying the internal LPF of the Baofeng
  https://wa5znu.org/2011/06/uv3r-lpf/

What about you?

Q&A / Discussions

- Are spurious emissions a concern to you?
- Should there be more education about spurious emissions?
- Should organized events be limited to compliant transceivers? (Baofengs => must have been tested)
- Should there be events / opportunities to get your transceiver tested?